

PROGRAMMABLE CONTROLLERS

MELSEC iQ-F
series

MELSEC iQ-F FX5 Series

Programming Manual

[Instructions, Standard Functions/Function Blocks]

SAFETY PRECAUTIONS

(Read these precautions before use.)

Before using the FX5 series PLCs, please read the manual supplied with each product and the relevant manuals introduced in that manual carefully and pay full attention to safety to handle the product correctly.

Store this manual in a safe place so that it can be taken out and read whenever necessary. Always forward it to the end user.

INTRODUCTION

This manual describes the instructions and functions required for programming FX5 series systems. This manual and the related manuals should be read and the functions and performance of the FX5 series PLC should be understood before attempting to use the unit.

However, before using a program example introduced in this manual to the actual system, always confirm that it poses no problem for control of the target system.

Regarding use of this product

- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult with Mitsubishi Electric.
- This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions in the system.

Note

- If in doubt at any stage during the installation of the product, always consult a professional electrical engineer who is qualified and trained in the local and national standards. If in doubt about the operation or use, please consult the nearest Mitsubishi Electric representative.
- Since the examples indicated by this manual, technical bulletin, catalog, etc. are used as a reference, please use it after confirming the function and safety of the equipment and system. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples.
- This manual content, specification etc. may be changed without a notice for improvement.
- The information in this manual has been carefully checked and is believed to be accurate; however, if you have noticed a doubtful point, an error, etc., please contact the nearest Mitsubishi Electric representative. When doing so, please provide the manual number given at the end of this manual.

CONTENTS

SAFETY PRECAUTIONS	1
INTRODUCTION	1
RELEVANT MANUALS	14
TERMS	14
HOW TO READ THIS MANUAL	16

PART 1 OVERVIEW

CHAPTER 1 OVERVIEW	20
1.1 Instruction Configuration	20
1.2 Data Specification Method	21
Bit data	24
16-bit data (word data)	25
32-bit data (double word data)	27
Real number data (floating-point data)	30
Character string data	32
1.3 Execution Condition	33
1.4 Precautions on Programming	34
Errors common to instructions	34
Checking the ranges of instruction runtime devices and labels	34
Operations arising when the OUT, SET/RST, and PLS/PLF instructions of the same device are used	35

PART 2 INSTRUCTION/FUNCTION LIST

CHAPTER 2 CPU MODULE INSTRUCTION	42
2.1 Sequence Instruction	42
2.2 Basic instruction	46
2.3 Application instruction	60
2.4 Built-in Ethernet Function Instruction	78
CHAPTER 3 MODULE SPECIFIC INSTRUCTION	79
3.1 High-speed Counter Instruction	79
3.2 External Device I/O Instruction	79
3.3 Positioning Instruction	80
3.4 Inverter Communication Instruction	81
3.5 MODBUS Communication Instruction	81
3.6 BFM Device Read/ Write Instruction	82
CHAPTER 4 STANDARD FUNCTIONS/FUNCTION BLOCKS	83
4.1 Standard Functions	83
Type conversion functions	83
Standard functions of one numeric variable	89
Standard arithmetic functions	90
Standard bit shift functions	91
Standard bitwise boolean functions	91
Standard selection functions	91

	Standard comparison functions	92
	Standard character string functions	92
	Time data functions	93
4.2	Standard Function Blocks	94
	Bistable function blocks	94
	Edge detection function blocks	94
	Counter function blocks	94
	Timer function blocks	95

PART 3 CPU MODULE INSTRUCTIONS

CHAPTER 5	SEQUENCE INSTRUCTIONS	98
5.1	Contact Instructions	98
	Operation start, series connection, parallel connection	98
	Pulse operation start, pulse series connection, pulse parallel connection	100
	Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection	102
5.2	Association Instruction	104
	Ladder block series/parallel connection	104
	Storing/reading/clearing the operation result	105
	Inverting the operation result	106
	Converting the operation result into a pulse	107
5.3	Output Instructions	108
	Out (excluding the timer, counter and annunciator)	108
	Timer	109
	Counter	111
	Long counter	112
	Annunciator	113
	Setting devices (excluding annunciator)	114
	Resetting devices (excluding annunciator)	115
	Setting annunciator	116
	Resetting annunciator	117
	Setting annunciator (with check time)	118
	Resetting annunciator (smallest number reset)	119
	Rising edge output	120
	Falling edge output	122
	Inverting the bit device output	123
	Inverting the bit device output	124
5.4	Shift Instructions	125
	Shifting bit devices	125
	Shifting 16-bit data to the right by n bit(s)	127
	Shifting 16-bit data to the left by n bit(s)	128
	Shifting n-bit data to the right by 1 bit	129
	Shifting n-bit data to the left by 1 bit	130
	Shifting n-word data to the right by 1 word	131
	Shifting n-word data to the left by 1 word	132
	Shifting n-bit(s) data to the right by (n) bit(s)	133
	Shifting n-bit data to the left by n bit(s)	134
	Shifting n-word data to the right by n word(s)	135
	Shifting n-word data to the left by n word(s)	136
5.5	Master Control Instruction	137

	Setting/resetting the master control	137
5.6	Termination Instructions	141
	Ending the main routine program	141
	Ending the sequence program	142
5.7	Stop Instruction	143
	Stopping the sequence program	143
5.8	No Processing Instruction	144
	No operation	144

CHAPTER 6	BASIC INSTRUCTIONS	145
------------------	---------------------------	------------

6.1	Comparison Operation Instructions	145
	Comparing 16-bit binary data	145
	Comparing 32-bit binary data	147
	Comparison output 16-bit binary data	149
	Comparison output 32-bit binary data	151
	Comparing 16-bit binary data band	153
	Comparing 32-bit binary data band	155
	Comparing 16-bit binary block data	157
	Comparing 32-bit binary block data	159
6.2	Arithmetic Operation Instructions	161
	Adding 16-bit binary data	161
	Subtracting 16-bit binary data	165
	Adding 32-bit binary data	169
	Subtracting 32-bit binary data	173
	Multiplying 16-bit binary data	177
	Dividing 16-bit binary data	180
	Multiplying 32-bit binary data	183
	Dividing 32-bit binary data	187
	Adding BCD 4-digit data	190
	Subtracting BCD 4-digit data	192
	Adding BCD 8-digit data	194
	Subtracting BCD 8-digit data	196
	Multiplying BCD 4-digit data	198
	Dividing BCD 4-digit data	199
	Multiplying BCD 8-digit data	200
	Dividing BCD 8-digit data	201
	Adding 16-bit binary block data	202
	Subtracting 16-bit binary block data	204
	Adding 32-bit binary block data	206
	Subtracting 32-bit binary block data	209
	Incrementing 16-bit binary data	211
	Decrementing 16-bit binary data	212
	Incrementing 32-bit binary data	213
	Decrementing 32-bit binary data	214
6.3	Logical Operation Instructions	215
	Performing an AND operation on 16-bit data	215
	Performing an AND operation on 32-bit data	217
	Performing an AND operation on 16-bit block data	219
	Performing an OR operation on 16-bit data	220
	Performing an OR operation on 32-bit data	222

Performing an OR operation on 16-bit block data	224
Performing an XOR operation on 16-bit data	225
Performing an XOR operation on 32-bit data	227
Performing an XOR operation on 16-bit block data	229
Performing an XNOR operation on 16-bit data	230
Performing an XNOR operation on 32-bit data	232
Performing an XNOR operation on 16-bit block data	234
6.4 Bit Processing Instructions	235
Setting a bit in the word device	235
Resetting a bit in the word device	236
Performing a 16-bit test	237
Performing a 32-bit test	238
Batch-resetting bit devices	239
Batch-resetting devices	240
6.5 Data Conversion Instructions	242
Converting binary data to BCD 4-digit data	242
Converting binary data to BCD 8-digit data	244
Converting BCD 4-digit data to binary data	246
Converting BCD 8-digit data to binary data	248
Converting single-precision real number to 16-bit signed binary data	250
Converting single-precision real number to 16-bit unsigned binary data	251
Converting single-precision real number to 32-bit signed binary data	252
Converting single-precision real number to 32-bit unsigned binary data	253
Converting 16-bit signed binary data to 16-bit unsigned binary data	254
Converting 16-bit signed binary data to 32-bit signed binary data	255
Converting 16-bit signed binary data to 32-bit unsigned binary data	256
Converting 16-bit unsigned binary data to 16-bit signed binary data	257
Converting 16-bit unsigned binary data to 32-bit signed binary data	258
Converting 16-bit unsigned binary data to 32-bit unsigned binary data	259
Converting 32-bit signed binary data to 16-bit signed binary data	260
Converting 32-bit signed binary data to 16-bit unsigned binary data	261
Converting 32-bit signed binary data to 32-bit unsigned binary data	262
Converting 32-bit unsigned binary data to 16-bit signed binary data	263
Converting 32-bit unsigned binary data to 16-bit unsigned binary data	264
Converting 32-bit unsigned binary data to 32-bit signed binary data	265
Converting 16-bit binary data to Gray code	266
Converting 32-bit binary data to Gray code	267
Converting Gray code to 16-bit binary data	268
Converting Gray code to 32-bit binary data	269
Converting decimal ASCII to 16-bit binary data	270
Converting decimal ASCII to 32-bit binary data	272
Converting ASCII to HEX	274
Converting character string to 16-bit binary data	277
Converting character string to 32-bit binary data	279
Two's complement of 16-bit binary data (sign inversion)	282
Two's complement of 32-bit binary data (sign inversion)	283
Decoding from 8 to 256 bits	284
Encoding from 256 to 8 bits	285
Separating 4 bits from 16-bit data	286
Connecting 4 bits to 16-bit data	287
Separating the specified number of bits	288

	Connecting the specified number of bits	290
	Separating data in byte units	292
	Connecting data in byte units	294
6.6	Data Transfer Instructions	296
	Transferring 16-bit data	296
	Transferring 32-bit data	297
	Inverting and transferring 16-bit data	298
	Inverting and transferring 32-bit data	299
	Digit move	300
	Inverting and transferring 1-bit data	302
	Transferring 16-bit block data (65535 points maximum)	303
	Transferring identical 16-bit block data (65535 points maximum)	305
	Transferring identical 32-bit block data (65535 points maximum)	306
	Exchanging 16-bit data	307
	Exchanging 32-bit data	308
	Exchanging the upper and lower bytes of 16-bit data	309
	Exchanging the upper and lower bytes of 32-bit data	310
	Transferring 1-bit data	311
	Transferring octal bits (16-bit data)	312
	Transferring octal bits (32-bit data)	314
	Transferring n-bit data	316
	 CHAPTER 7 APPLICATION INSTRUCTION	 317
7.1	Rotation Instruction	317
	Rotating 16-bit data to the right	317
	Rotating 16-bit data to the left	320
	Rotating 32-bit data to the right	322
	Rotating 32-bit data to the left	324
7.2	Program branch instruction	326
	Pointer branch	326
	Jump to END	329
7.3	Program execution control instruction	330
	Disabling/enabling interrupt programs	330
	Disabling the interrupt program with specified priority or lower	332
	Interrupt program mask	335
	Disabling/enabling the specified interrupt pointer	337
	Returning from the interrupt program	338
	Resetting the watchdog timer	339
7.4	Structuring instruction	340
	FOR to NEXT	340
	Forcibly terminating the FOR to NEXT instruction loop	342
	Calling a subroutine program	344
	Returning from the subroutine program	348
	Calling a subroutine program	349
7.5	Data table operation instruction	351
	Reading the oldest data from the data table	351
	Reading the newest data from the data table	353
	Writing data to the data table	355
	Inserting data to the data table	357
	Deleting data from the data table	359

7.6	Character string operation instruction	361
	Comparing character strings	361
	Concatenating character strings	364
	Transferring character strings	368
	Converting 16-bit binary data to decimal ASCII	370
	Converting 32-bit binary data to decimal ASCII	372
	Converting HEX code data to ASCII	374
	Converting 16-bit binary data to character string	378
	Converting 32-bit binary data to character string	380
	Converting single-precision real number to character string	383
	Detecting a character string length	388
	Extracting character string data from the right	390
	Extracting character string data from the left	392
	Storing the specified number of character strings	394
	Replacing the specified number of character strings	396
	Searching character string	398
	Inserting character string	400
	Deleting character string	402
7.7	Real Number Instruction	404
	Comparing single-precision real numbers	404
	Single-precision real number comparison	406
	Single-precision real number data band comparison	408
	Adding single-precision real numbers	410
	Subtracting single-precision real numbers	412
	Adding single-precision real numbers	414
	Subtracting single-precision real numbers	416
	Multiplying single-precision real numbers	418
	Dividing single-precision real numbers	420
	Multiplying single-precision real numbers	422
	Dividing single-precision real numbers	424
	Converting 16-bit signed binary data to single-precision real number	426
	Converting 16-bit unsigned binary data to single-precision real number	427
	Converting 32-bit signed binary data to single-precision real number	428
	Converting 32-bit unsigned binary data to single-precision real number	429
	Converting character string to single-precision real number	430
	Converting binary floating point to decimal floating point	433
	Converting decimal floating point to binary floating point	435
	Inverting the sign of single-precision real number	437
	Transferring single-precision real number data	438
	Calculating the sine of single-precision real number	439
	Calculating the cosine of single-precision real number	441
	Calculating the tangent of single-precision real number	443
	Calculating the arc sine of single-precision real number	445
	Calculating the arc cosine of single-precision real number	447
	Calculating the arc tangent of single-precision real number	449
	Converting single-precision real number angle to radian	451
	Converting single-precision real number radian to angle	452
	Calculating the square root of single-precision real number	453
	Calculating the exponent of single-precision real number	454
	Calculating the natural logarithm of single-precision real number	456
	Calculating the exponentiation of single-precision real number	458

	Calculating the common logarithm of single-precision real number	460
	Searching the maximum value of single-precision real number	461
	Searching the minimum value of single-precision real number	463
7.8	Random Number Instruction	465
	Generating random number	465
7.9	Index register operation instruction	466
	Saving all data of the index register	466
	Returning all data of the index register	468
	Saving the selected data of the index register and long index register	469
	Returning the selected data of the index register and long index register.	471
7.10	Data control instruction	472
	Upper and lower limit control of 16-bit binary data	472
	Upper and lower limit control of 32-bit binary data	474
	Dead band control of 16-bit binary data	476
	Dead band control of 32-bit binary data	478
	Zone control of 16-bit binary data	480
	Zone control of 32-bit binary data	482
	Scaling 16-bit binary data (point coordinates)	484
	Scaling 32-bit binary data (point coordinates)	487
	Scaling 16-bit binary data (XY coordinates)	490
	Scaling 32-bit binary data (XY coordinates)	493
7.11	Special timer instruction.	496
	Teaching timer	496
	Special function timer	498
7.12	Shortcut control instruction.	500
	Rotary table shortest direction control	500
7.13	Ramp signal instruction	503
	Ramp signal	503
7.14	Pulse related instruction.	505
	Measuring the density of 16 bit binary pulses	505
	Measuring the density of 32 bit binary pulses	509
	16 bit binary pulse output	513
	32 bit binary pulse output	521
	16 bit binary pulse width modulation	529
	32 bit binary pulse width modulation	533
7.15	Drum sequence	538
	16-bit binary data absolute method	538
	32-bit binary data absolute method	540
	Relative method.	542
7.16	Check code	544
	Check code	544
7.17	Data operation instruction	547
	Searching 16-bit data	547
	Searching 32-bit data	549
	Bit check of 16-bit data	551
	Bit check of 32-bit data	552
	Bit judgment of 16-bit data.	553
	Bit judgment of 32-bit data.	554
	Searching the maximum value of 16-bit data	555
	Searching the maximum value of 32-bit data	556
	Searching the minimum value of 16-bit data	557

Searching the minimum value of 32-bit data	558
Sorting 16-bit data	559
16-bit data alignment 2	562
32-bit data alignment 2	565
Adding 16-bit data	568
Adding 32-bit data	569
Calculating the mean value of 16-bit data	570
Calculating the mean value of 32-bit data	571
Calculating the square root of 16-bit data	572
Calculating the square root of 32-bit data	573
CRC calculation	574
7.18 Indirect address read instruction	577
Reading the indirect address	577
7.19 Clock instruction	579
Reading clock data	579
Writing clock data	581
Adding clock data	583
Subtracting clock data	585
Converting time data from hour/minute/second to seconds in 16 bits	587
Converting time data from hour/minute/second to seconds in 32 bits	588
Converting time data from seconds to hour/minute/second in 16 bits	589
Converting time data from seconds to hour/minute/second in 32 bits	590
Comparing date data	591
Comparing time data	594
Comparing clock data	597
Comparing clock data zones	599
7.20 Timing check instruction	601
Generating timing pulses	601
Hour meter	603
7.21 Module access instruction	605
I/O refresh	605
Reading 1-word/2-word data from another module	607
Writing 1-word/2-word data to another module	610
Reading 1-word/2-word data from another module	613
Writing 1-word/2-word data to another module (32-bit specification)	616
CHAPTER 8 BUILT-IN ETHERNET FUNCTION INSTRUCTIONS	619
8.1 Open/Close Processing Instructions	619
Opening a connection	619
Closing a connection	622
8.2 Socket Communications Function Instructions	624
Reading receive data during the END processing	624
Sending data	627
Reading connection information	629
Reading socket communications receive data	631

PART 4 MODULE DEDICATED INSTRUCTION

CHAPTER 9 HIGH-SPEED COUNTER INSTRUCTION	634
9.1 High-speed Processing Instruction	634

Setting 32-bit data comparison	634
Reset 32-bit data comparison	636
Comparison of 32-bit data band	638
Start/stop of the 16-bit data high-speed I/O function	640
Start/stop of the 32-bit data high-speed I/O function	642
9.2 High-speed Current Value Transfer Instruction	644
High-speed current value transfer of 16-bit data	644
High-speed current value transfer of 32-bit data	646

CHAPTER 10 EXTERNAL DEVICE I/O INSTRUCTION 648

10.1 Serial Communication 2	648
--	------------

CHAPTER 11 POSITIONING INSTRUCTION 650

11.1 Positioning Instruction	650
Zero return(OPR) with 16-bit data DOG search	650
Zero return(OPR) with 32-bit data DOG search	652
16-bit data interrupt positioning	653
32-bit data interrupt positioning	655
Positioning by one table operation	657
Positioning by multiple table operation	659
Multiple axes concurrent drive positioning.	660
32-bit data ABS current value read	662
16-bit data variable speed pulse	663
32-bit data variable speed pulse	665
16-bit data relative positioning.	667
32-bit data relative positioning.	669
16-bit data absolute positioning.	671
32-bit data absolute positioning.	673

CHAPTER 12 INVERTER COMMUNICATION INSTRUCTION 675

12.1 Inverter operation monitoring(Status check)	675
12.2 Inverter operations control(Drive)	676
12.3 Inverter parameter read	677
12.4 Inverter parameter write	678
12.5 Inverter parameter block write	679
12.6 Inverter multi command	680

CHAPTER 13 MODBUS COMMUNICATION INSTRUCTION 682

13.1 MODBUS Read/Write.	682
--	------------

CHAPTER 14 DIVIDED DATA READ/WRITE FROM/TO BFM INSTRUCTION 684

14.1 Divided BFM Read.	684
14.2 Divided BFM write	687

PART 5 STANDARD FUNCTIONS

CHAPTER 15 TYPE CONVERSION FUNCTIONS 690

15.1 Converting BOOL to WORD	690
15.2 Converting BOOL to DWORD.	691

15.3	Converting BOOL to INT	692
15.4	Converting BOOL to DINT	693
15.5	Converting BOOL to TIME	694
15.6	Converting BOOL to STRING	695
15.7	Converting WORD to BOOL	696
15.8	Converting WORD to DWORD	697
15.9	Converting WORD to INT	698
15.10	Converting WORD to DINT	699
15.11	Converting WORD to TIME	700
15.12	Converting DWORD to BOOL	701
15.13	Converting DWORD to WORD	702
15.14	Converting DWORD to INT	704
15.15	Converting DWORD to DINT	706
15.16	Converting DWORD to TIME	707
15.17	Converting INT to BOOL	708
15.18	Converting INT to WORD	709
15.19	Converting INT to DWORD	710
15.20	Converting INT to DINT	711
15.21	Converting INT to BCD	712
15.22	Converting INT to REAL	714
15.23	Converting INT to TIME	715
15.24	Converting INT to STRING	716
15.25	Converting DINT to BOOL	718
15.26	Converting DINT to WORD	719
15.27	Converting DINT to DWORD	721
15.28	Converting DINT to INT	722
15.29	Converting DINT to BCD	723
15.30	Converting DINT to REAL	725
15.31	Converting DINT to TIME	726
15.32	Converting DINT to STRING	727
15.33	Converting BCD to INT	729
15.34	Converting BCD to DINT	731
15.35	Converting REAL to INT	733
15.36	Converting REAL to DINT	735
15.37	Converting REAL to STRING	737
15.38	Converting TIME to BOOL	740
15.39	Converting TIME to WORD	741
15.40	Converting TIME to DWORD	742
15.41	Converting TIME to INT	743
15.42	Converting TIME to DINT	744
15.43	Converting TIME to STRING	745
15.44	Converting STRING to BOOL	746
15.45	Converting STRING to INT	747
15.46	Converting STRING to DINT	749
15.47	Converting STRING to REAL	751
15.48	Converting STRING to TIME	754
15.49	Converting Bit Array to INT	755
15.50	Converting Bit Array to DINT	756
15.51	Converting INT to Bit Array	757
15.52	Converting DINT to Bit Array	758
15.53	Bit Array Copy	759

15.54	Reading the Specified Bit of Word Label	760
15.55	Writing the Specified Bit of Word Label	761
15.56	Copying the Specified Bit of Word Label	762
15.57	Unnecessary of Type Conversion	763
CHAPTER 16 SINGLE NUMBER VARIABLE FUNCTIONS		764
16.1	Absolute Value.....	764
16.2	Square Root.....	766
16.3	Natural Logarithm Operation	767
16.4	Calculating the Common Logarithm	768
16.5	Exponential Operation	770
16.6	Sine Operation.....	771
16.7	Cosine Operation.....	772
16.8	Tangent Operation.....	773
16.9	Arc Sine Operation	774
16.10	Arc Cosine Operation	775
16.11	Arc Tangent Operation	776
CHAPTER 17 ARITHMETIC OPERATION FUNCTIONS		777
17.1	Addition	777
17.2	Multiplication	779
17.3	Subtraction.....	781
17.4	Division.....	783
17.5	Remainder	785
17.6	Exponentiation.....	787
17.7	Move Operation	789
CHAPTER 18 BIT SHIFT FUNCTIONS		791
18.1	n-bit Left Shift	791
18.2	n-bit Right Shift	793
18.3	n-bit Left Rotation	795
18.4	n-bit Right Rotation.....	797
CHAPTER 19 STANDARD BITWISE BOOLEAN FUNCTIONS		799
19.1	AND Operation, OR Operation, XOR Operation	799
19.2	Logical Negation	801
CHAPTER 20 SELECTION FUNCTIONS		802
20.1	Selection.....	802
20.2	Selecting Maximum/Minimum Value	804
20.3	Limit Control	806
20.4	Multiplexer	808
CHAPTER 21 COMPARISON FUNCTIONS		810
21.1	Compare.....	810
21.2	Compare.....	812
CHAPTER 22 CHARACTER STRING FUNCTIONS		814
22.1	Character String Length Detection	814
22.2	Extracting Character String Data from the Left/Right	815

22.3	Extract Mid String	817
22.4	Link Character Strings	819
22.5	Inserting Character String	821
22.6	Deleting Character String	823
22.7	Replacing Character String	825
22.8	Searching Character String	828

CHAPTER 23 TIME DATA FUNCTIONS **830**

23.1	Addition	830
23.2	Subtraction	832
23.3	Multiplication	834
23.4	Division	836

PART 6 FUNCTION BLOCKS

CHAPTER 24 BISTABLE FUNCTION BLOCKS **840**

24.1	Bistable Function Blocks (Set Priority)	840
24.2	Bistable Function Blocks (Reset Priority)	842

CHAPTER 25 EDGE DETECTION FUNCTION BLOCKS **844**

25.1	Rising Edge Detector	844
25.2	Falling Edge Detector	846

CHAPTER 26 COUNTER FUNCTION BLOCKS **848**

26.1	Up Counter	848
26.2	Down Counter	850
26.3	Counter Function Block	852

CHAPTER 27 TIMER FUNCTION BLOCKS **854**

27.1	Timer Function Blocks	854
------	-----------------------------	-----

APPENDICES **857**

Appendix 1	Number of Instruction Steps	857
------------	-----------------------------------	-----

INSTRUCTION INDEX **876**

REVISIONS	882
WARRANTY	883
TRADEMARKS	884

RELEVANT MANUALS

User's manuals for the applicable modules


Manual name <manual number>	Description
MELSEC iQ-F FX5 Series User's Manual [Startup] <JY997D58201>	Performance specifications, procedures before operation, and troubleshooting of the CPU module.
MELSEC iQ-F FX5U Series User's Manual [Hardware] <JY997D55301>	Describes the details of hardware of the FX5U series CPU module, including input/output specifications, wiring, installation, and maintenance.
MELSEC iQ-F FX5 Series User's Manual [Application] <JY997D55401>	Describes basic knowledge required for program design, functions of the CPU module, devices/labels, and parameters.
MELSEC iQ-F FX5 Series Programming Manual [Program Design] <JY997D55701>	Describes specifications of ladders, ST, and other programs and labels.
MELSEC iQ-F FX5 Series Programming Manual [Instructions, Standard Functions/Function Blocks] <JY997D55801> (This manual)	Describes specifications of instructions and functions that can be used in programs.
MELSEC iQ-F FX5 Series User's Manual [Serial Communication] <JY997D55901>	Describes inverter communication and non-protocol communication.
MELSEC iQ-F FX5 Series User's Manual [MODBUS Communication] <JY997D56101>	Describes MODBUS serial communication.
MELSEC iQ-F FX5 Series User's Manual [Ethernet Communication] <JY997D56201>	Describes the functions of the built-in Ethernet port communication function.
MELSEC iQ-F FX5 Series User's Manual [SLMP] <JY997D56001>	Explains methods for the device that is communicating with the CPU module by SLMP to read and write the data of the CPU module.
MELSEC iQ-F FX5 Series User's Manual [Positioning Control] <JY997D56301>	Describes the built-in positioning function.
GX Works3 Operating Manual <SH-081215ENG>	System configuration, parameter settings, and online operations of GX Works3.

TERMS

Unless otherwise specified, this manual uses the following terms.

- indicates a variable portion used to collectively call multiple models or versions.

(Example) FX5U-32MR/ES, FX5U-32MT/ES ⇔ FX5U-32M□/ES

- For details of the FX3 series devices that can be connected with the FX5U series, refer to  MELSEC iQ-F FX5U Series User's Manual [Hardware].

Terms	Description
■Series name	
FX5 series	Abbreviation of FX5 series PLCs
FX3 series	Generic term for FX3S, FX3G, FX3GC, FX3U, and FX3UC series PLCs
■Devices	
CPU module	Generic term for FX5U-32MR/ES, FX5U-32MT/ES, FX5U-32MT/ESS, FX5U-64MR/ES, FX5U-64MT/ES, FX5U-64MT/ESS, FX5U-80MR/ES, FX5U-80MT/ES, and FX5U-80MT/ESS
Extension module	Generic term for FX5 series extension modules and FX3 series extension modules
• FX5 series extension module	Generic term for I/O modules, extension power supply modules, and FX5 series intelligent function modules
• FX3 series extension module	Generic term for FX3 series extension power supply modules and special extension blocks
I/O module	Generic term for input modules, output modules, and powered input/output modules
• Input module	Generic term for FX5-8EX/ES and FX5-16EX/ES
• Output module	Generic term for FX5-8EYR/ES, FX5-8EYT/ES, FX5-8EYT/ESS, FX5-16EYR/ES, FX5-16EYT/ES, and FX5-16EYT/ESS
• Powered input/output module	Generic term for FX5-32ER/ES, FX5-32ET/ES, and FX5-32ET/ESS
Extension power supply module	Generic term for FX5-1PSU-5V and FX3U-1PSU-5V
Intelligent module	The abbreviation for intelligent function modules
Intelligent function module	Generic term for FX5 series intelligent function modules and FX3 series intelligent function modules
• FX5 series intelligent function module	Generic term for FX5 series intelligent function modules
• FX3 series intelligent function module	Generic term for FX3 series special extension blocks

Terms	Description
Simple motion module	Different name for FX5-40SSC-S
Expansion board	Generic term for boards for FX5 series
• Communication board	Generic term for FX5-232-BD, FX5-485-BD and FX5-422-BD-GOT
Expansion adapter	Generic term for adapters for FX5 series
• Communication adapter	Generic term for FX5-232ADP and FX5-485ADP
Bus conversion module	Different name for FX5-CNV-BUS
Battery	Different name for FX3U-32BL
Peripheral device	Generic term for engineering tools and GOTs
GOT	Generic term for Mitsubishi Graphic Operation Terminal GOT1000 and GOT2000 series
■Software package	
Engineering tool	Different name for GX Works3
GX Works3	Product name of MELSEC PLC software package for the MELSEC programmable controllers
■Manuals	
User's manual	Generic term for separate manuals
User's manual [Startup]	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [Startup]
User's manual [Hardware]	Abbreviation of MELSEC iQ-F FX5U Series User's Manual [Hardware]
User's manual [Application]	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [Application]
Programming manual	Generic term for MELSEC iQ-F FX5 Series Programming Manual [Program Design] and MELSEC iQ-F FX5 Series Programming Manual [Instructions, Standard Functions/Function Blocks]
Programming manual [Program Design]	Abbreviation of MELSEC iQ-F FX5 Series Programming Manual [Program Design]
Programming manual [Instructions, Standard Functions/Function Blocks]	Abbreviation of MELSEC iQ-F FX5 Series Programming Manual [Instructions, Standard Functions/Function Blocks]
Communication manual	Generic term for MELSEC iQ-F FX5 Series User's Manual [Serial Communication], MELSEC iQ-F FX5 Series User's Manual [MODBUS Communication], and MELSEC iQ-F FX5 Series User's Manual [Ethernet Communication], MELSEC iQ-F FX5 Series User's Manual [SLMP]
• Serial communication manual	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [Serial Communication]
• MODBUS communication manual	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [MODBUS Communication]
• Ethernet communication manual	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [Ethernet Communication]
• SLMP manual	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [SLMP]
Positioning control manual	Abbreviation of MELSEC iQ-F FX5 Series User's Manual [Positioning Control]

HOW TO READ THIS MANUAL

The following describes the page layout and symbols used in this manual.

How to read PART 3 and PART 4

The contents described in this section are provided only for explaining how to read this manual. Thus, the actual description may differ.

1

2

3

4

5

6


7

8

Special function timer

STMR

This instruction uses the four devices from the device specified by (d) to perform four types of timer output.

Ladder diagram	Structured text
	ENO->STMR(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Used timer number (operates as a 100 ms timer)	—	Device name	ANY16
(s2)	Timer set value	1 to 32767	16-bit unsigned binary	ANY16
(d)	Start bit number to be output	—	Bit	Bit

■Applicable devices

Operand	Bit	Word				Double word		Indirect specification	Constant				Others
		X, Y, M, L, SM, F, B, SB	U□IG□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□IG□	Z		LC	LZ	K	H	
(s1)	—	—	—	—	○*1	—	—	—	○	—	—	—	—
(s2)	○	—	—	—	○	○	○	—	○	—	—	—	—
(d)	○	—	—	○	—	—	—	—	—	—	—	—	—

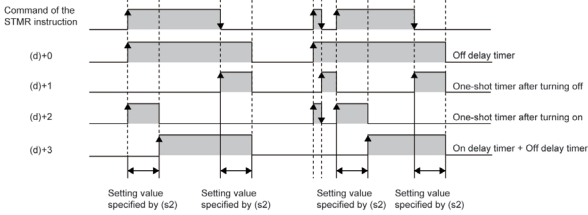
*1 Only T can be used.

■Control data

Operand: (d)		Setting range	Set by
Device	Description		
+0	Off delay timer output: Turns on at the rising edge of the command of the STMR instruction and turns off when the time specified by (s2) elapses after the falling edge.	—	System
+1	One-shot timer output after turning off: Turns on at the falling edge of the command of the STMR instruction and turns off when the time specified by (s2) elapses.	—	System
+2	One-shot timer output after turning on: Turns on at the rising edge of the command of the STMR instruction and turns off when the command of the STMR instruction is turned off or when the time specified by (s2) elapses.	—	System
+3	On delay timer + Off delay timer output: Turns on at the falling edge of the timer coil and turns off when the time specified by (s2) elapsed after the falling edge of the command of the STMR instruction.	—	System

Processing details

• This instruction uses the four devices from the device specified by (d) to perform four types of timer output.



Precautions

- The timer number specified in this instruction cannot be used in other general circuits (such as OUT instruction). If the timer number is used in other general circuits, the timer malfunctions.
- The timer specified by (s1) starts counting as a 100 ms timer on the rising edge of the command contact.
- Four devices are occupied from a device specified in (d). Make sure that such devices are not used in other controls for the machine.
- If the command contact is turned off, (d), (d)+1, and (d)+3 turn off when the set time elapses. (d)+2 and the timer (s1) are immediately reset.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (s2) is outside the following range. 1 to 32767

① Indicates the instruction symbol.

- The instruction symbol with brackets means multiple instructions. For example, "GRY(P)(_U)" means the GRY, GRYP, GRY_U, and GRYP_U instructions.

Instruction symbol	Description of symbol
Instruction symbol with "(P)"	The instruction is executed on the rising edge.
Instruction symbol with "(_U)"	The instruction handles 16-bit or 32-bit unsigned binary data.

- The instruction symbol with "□" means multiple instructions. For example, "LDDT□" means the LDDT=, LDDT<>, LDDT>, LDDT<=, LDDT<, and LDDT>= instructions.

② Indicates the description format of the ladder language and ST (structured text) language.

Instruction symbols are input in each corresponding place surrounded in a square in the ladder diagram.

③ Indicates the description, setting range, data type, and data type (label) of each operand.

- For the data type, refer to the following.

📖 MELSEC iQ-F FX5 Series Programming Manual [Program Design]

④ Indicates the applicable devices for each operand. The following table describes the usage classification.

Operand	Bit			Word			Double word		Indirect specification	Constant				Others ^{*5}
	X ^{*2} , Y ^{*2} , M ^{*2} , L ^{*2} , SM ^{*2} , F ^{*2} , B ^{*2} , SB ^{*2}	U□¥G□	T, ST, C, LC	T, ST, C, D ^{*3} , W ^{*3} , SD ^{*3} , SW ^{*3} , R ^{*3}	U□¥G□	Z	LC	LZ		K, H	E	\$		
Applicable devices ^{*1}	X, Y, M, L, SM, F, B, SB	U□¥G□	T ^{*4} , ST ^{*4} , C ^{*4} , LC ^{*4}	T, ST, C, D, W, SD, SW, R	U□¥G□	Z	LC	LZ	@□ @□.□	K, H	E	\$		P, I, U, N

*1 For the description of each device, refer to the following.

📖 MELSEC iQ-F FX5 Series User's Manual [Application]

*2 "○" is described in positions where bit devices or nibble specification of bit devices is available.

*3 "○" is described in positions where word device or bit specification of word device is available.

*4 When T, ST, C, and LC are used with an instruction other than the following instructions, they can be used only as word data. They cannot be used as bit data.

[Instruction which can be used as bit data]

LD, LDI, AND, ANI, OR, ORI, LDP, LDF, ANDP, ANDF, ORP, ORF, LDPI, LDFI, ANDPI, ANDFI, ORPI, ORFI, OUT, RST, BKRST, MOVB(P), CMLB(P)

*5 Devices which can be set are described in the "Others" column.

⑤ Depending on the instruction, the control data to set the operation of the instruction exists. When the "Set by" column is "User", the value must be specified according to the setting range.

⑥ Indicates the function details of the instruction. When no details are described, the following programs correspond to "Interrupt program".

- Interrupt program using the interrupt pointer (I)
- Event execution type program which is triggered by an interrupt by the interrupt pointer (I)

⑦ Indicates the cautions.

⑧ Indicates an error code (hexadecimal) which occurs at the execution and the error description when the instruction has a specific operation error.

- A device in which an error code is stored is described in the error code column. When an error code is stored in SD0/SD8067, the error flag (SM0, SM1, SM56, SM8067) turns on.

How to read PART 5 and PART 6

The contents described in this section are provided only for explaining how to read this manual. Thus, the actual description may differ.

①

②

③


④

⑤

15.28 Converting DINT to INT

DINT_TO_INT(_E)

These functions convert DINT type data to INT type data.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=DINT_TO_INT(s);</p> <p>[With EN/ENO] d:=DINT_TO_INT_E(EN,ENO,s);</p>

Setting data

■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■ Operation processing

- These functions convert the DINT type data input to (s) to INT type data and output from (d).

(s)

1234

DINT

→

(d)

1234

INT

- A value input to (s) is the DINT type data value.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred) ^{*1}	Indefinite value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD067)	Description
3401	The 32-bit signed binary data in the device specified by (s) is out of the valid range (-32768 to 32767).

722 15 TYPE CONVERSION FUNCTIONS

15.28 Converting DINT to INT

① Indicates function symbols.

When character strings in brackets are added to the end of the function symbol for standard functions and function blocks, the function symbol indicates multiple functions. For example, "DINT_TO_INT(_E)" means "DINT_TO_INT" and "DINT_TO_INT_E".

Function symbol	Description of symbol
Function symbol to which "(_E)" is added.	Indicates that the description format with EN/ENO can be used in the standard function and function block.

② Indicates the description format of the ladder language and ST (structured text) language.

Function symbols are input in each corresponding place surrounded in a square in the ladder diagram.

③ Indicates the description, type and data type of each argument.

④ Indicates the functions of each standard function or function block.

⑤ Indicates an error code which occurs at the execution and the error description when the standard function or the function block has a specific operation error.

A device in which an error code is stored is described in the error code column. When an error code is stored in SD0, the error flag SM0 turns on.

PART 1 OVERVIEW

Part 1 consists of the following chapter.

1 OVERVIEW

1 OVERVIEW

1.1 Instruction Configuration

Many instructions available for CPU module are each divided into the instruction part and device part.

The instruction part and device part are used as follows.

- Instruction part: Indicates the function of the relevant instruction.
- Device part: Indicates the data used for the instruction.

The device part is further classified to source data, destination data, and numerical data.

Source (s)

Source is the data used in the operation.

Depending on the label or device specified in each instruction, the source becomes as follows.

Type	Description
Constant	The constant specifies a numerical value used in the operation. It is set during program creation and cannot be changed during program execution.
Bit device Word device	The user specifies the device where the data to be used in the operation is stored. Necessary data must be thus stored in the specified device before operation execution. By changing the data to be stored in the specified device during program execution, the data to be used by the instruction can be changed.

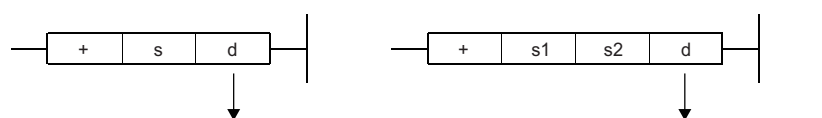
Destination (d)

Data after operation is stored in the destination area.

However, some instructions require the data to be used in the operation to be stored before the operation.

Ex.

Binary 16-bit data addition instruction



The data required for operation is stored before the operation. Only the operation result is stored.

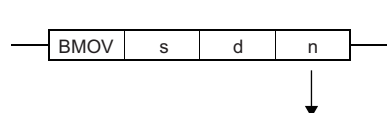
A label or device to store data must be set for the destination.

Numerical values (n)

In an instruction which uses multiple devices or an instruction which specifies the number of repetitions, data to be processed, and character strings, use numerical values to specify the number of devices, transfers, data, and character strings.

Ex.

Block transfer instruction



The number of transfers executed by the BMOV instruction is specified.

A numerical value from 0 to 65535 or 0 to 4294967295 can be set for the size such as the number of devices, transfers, or characters.*1

Note, however, that when the size specification such as the number of devices, transfers, or characters is 0, the relevant instruction results in non-processing.

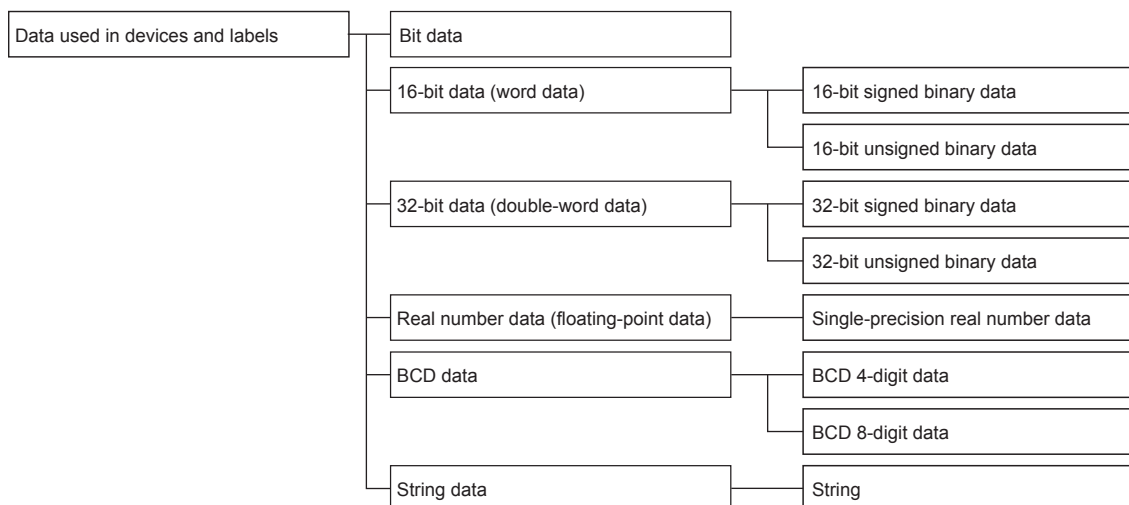
*1 The setting range varies depending on the instruction. For details, refer to the description of each instruction.



Be careful when a large numerical value is used such as for the number of transfers. It delays the scan time.

1.2 Data Specification Method

The following table lists the types of data that can be used for instructions in CPU modules.



Device data

Data type	Description	Specifiable device/constant ^{*1}
Bit	Bit data can be handled. ☞ Page 24 Bit data	<ul style="list-style-type: none"> • Bit device • Bit specification of word device
Word	Word data can be handled. ☞ Page 25 16-bit data (word data)	<ul style="list-style-type: none"> • Word device • Nibble specification of bit devices (K1 to K4)^{*2}
16-bit signed binary	16-bit data can be handled.	<ul style="list-style-type: none"> • Decimal constant • Hexadecimal constant
16-bit unsigned binary	The value range varies depending on whether the value is signed or unsigned. ☞ Page 25 16-bit data (word data)	
Double word	Double-word data can be handled. ☞ Page 27 32-bit data (double word data)	<ul style="list-style-type: none"> • Word device • Double-word device
32-bit signed binary	Two consecutive sets of 32-bit data or 16-bit data can be handled.	<ul style="list-style-type: none"> • Nibble specification of bit devices (K1 to K8)^{*2} • Decimal constant • Hexadecimal constant
32-bit unsigned binary	The value range varies depending on whether the value is signed or unsigned. ☞ Page 27 32-bit data (double word data)	
BCD 4-digit	BCD 4-digit data can be handled. 16-bit data is divided by 4 digits and each digit is specified in 0 to 9.	<ul style="list-style-type: none"> • Word device • Nibble specification of bit devices (K1 to K4)^{*2} • Decimal constant • Hexadecimal constant
BCD 8-digit	BCD 8-digit data can be handled. 32-bit data is divided by 8 digits and each digit is specified in 0 to 9.	<ul style="list-style-type: none"> • Word device • Double-word device • Nibble specification of bit devices (K1 to K8)^{*2} • Decimal constant • Hexadecimal constant
Single-precision real number	Single-precision real number data (single-precision floating-point data) can be handled. ☞ Page 30 Configuration of single-precision real number data	<ul style="list-style-type: none"> • Word device • Double-word device • Real constant
Character string	ASCII code and Shift JIS code character string data can be handled. ☞ Page 32 Character string data	<ul style="list-style-type: none"> • Word device • Character string constant

^{*1} A constant can be used in the data specified for the source (s) or numerical data (n) by an instruction.

^{*2} For the specification method, refer to the detail page of each data type.

Label data

■ Primitive data type

Data type (label)	Specifiable label
Bit (BOOL)	<ul style="list-style-type: none"> • Bit type label • Bit-specified word [unsigned]/bit string [16 bits] type label • Bit-specified word [signed] type label • Timer/retentive timer/long timer/long retentive timer type label contact/coil • Counter/ long counter type label contact/coil
Word [unsigned]/bit string [16 bits] (WORD)	<ul style="list-style-type: none"> • Word [unsigned]/bit string [16 bits] type label • Nibble specified bit type label (K1 to K4) • Current value of timer/retentive timer type label • Current value of counter type label
Double word [unsigned]/bit string [32 bits] (DWORD)	<ul style="list-style-type: none"> • Double word [unsigned]/bit string [32 bits] type label • Nibble specified bit type label (K1 to K8) • Current value of long timer/long retentive timer type label • Current value of long counter type label
Word [signed] (INT)	<ul style="list-style-type: none"> • Word [signed] type label • Nibble specified bit type label (K1 to K4) • Current value of timer/retentive timer type label • Current value of counter type label
Double word [signed] (DINT)	<ul style="list-style-type: none"> • Double word [signed] type label • Nibble specified bit type label (K1 to K8) • Current value of long timer/long retentive timer type label • Current value of long counter type label
Single-precision real number (REAL)	<ul style="list-style-type: none"> • Single-precision real data type label
Time (TIME)	<ul style="list-style-type: none"> • Time type label
Character string (STRING)	<ul style="list-style-type: none"> • Character string type label
Timer (TIMER)	<ul style="list-style-type: none"> • Timer type label
Retentive timer (RETENTIVETIMER)	<ul style="list-style-type: none"> • Retentive timer type label
Counter (COUNTER)	<ul style="list-style-type: none"> • Counter type label
Long counter (LCOUNTER)	<ul style="list-style-type: none"> • Long counter type label
Pointer (POINTER)	<ul style="list-style-type: none"> • Pointer type label

■Generic data type

Data type (label)	Specifiable label
ANY* ¹	Bit, word [signed], double word [signed], word [unsigned]/bit string [16 bits], double word [unsigned]/bit string[32 bits], single-precision real number, hour, character string, structure
ANY_BITADDR* ¹	Bit
ANY_BOOL	Bit
ANY_ELEMENTARY	Bit, word [signed], double word [signed], word [unsigned]/bit string [16 bits], double word [unsigned]/bit string[32 bits], single-precision real number, hour, character string
ANY_WORDADDR	Word [signed], double word [signed], word [unsigned]/bit string [16 bits], double word [unsigned]/bit string[32 bits], single-precision real number, hour, character string
Any 16-bit data (ANY16)	Word [signed], word [unsigned]/bit string [16 bits]
ANY16_S	Word [signed]
ANY16_U	Word [unsigned]/bit string [16 bits]
Any 32-bit data (ANY32)	Double word [signed], double word [unsigned]/bit string [32 bits], hour
ANY32_S	Double word [signed], hour
ANY32_U	Double word [unsigned]/bit string [32 bits]
ANY_REAL	Single-precision real number
ANYREAL_32	Single-precision real number
ANY_STRING	Character string
ANYSTRING_SINGLE	Character string
ANY_STRUCT* ¹	Structures
ANY_DT	Word [signed], word [unsigned]/bit string [16 bits]
ANY_TM	Word [signed], word [unsigned]/bit string [16 bits]
STRUCT	Structures
ANY16_OR_STRING_SINGLE	Word [signed], word [unsigned]/bit string [16 bits], character string

*1 Can also be used as an array.

■Generic data type (array)

For the following generic data type, define the number of array elements.

Data type (label)	Specifiable label
ANYBIT_ARRAY	Bit
ANYWORD_ARRAY	Word [signed], double word [signed], word [unsigned]/bit string [16 bits], double word [unsigned]/bit string[32 bits], single-precision real number, hour, character string
ANY16_ARRAY	Word [signed], word [unsigned]/bit string [16 bits]
ANY16_S_ARRAY	Word [signed]
ANY16_U_ARRAY	Word [unsigned]/bit string [16 bits]
ANY32_ARRAY	Double word [signed], double word [unsigned]/bit string [32 bits]
ANY32_S_ARRAY	Double word [signed]
ANY32_U_ARRAY	Double word [unsigned]/bit string [32 bits]
ANY_REAL_ARRAY	Single-precision real number
ANY_REAL_32_ARRAY	Single-precision real number
ANY_STRING_ARRAY	Character string
ANY_STRING_SINGLE_ARRAY	Character string
STRUCT_ARRAY	Structures

Bit data

Data size and data range

Bit data is handled in increments of bits such as contacts and coils.

Data name	Data size	Value range
Bit data	1 bit	0, 1

Handling bit data with bit devices and labels

Bit data of one point per point can be handled.

Handling bit data with bit word devices

By specifying a bit number for a word device, bit data of the specified bit number can be handled.

The notation for bit number specification is as follows.

Word device number	.	Bit number
--------------------	---	------------

A bit number can be specified in hexadecimal in the range from 0 to F.

For example, bit 5 (b5) of D0 is specified as D0.5, and bit 10 (b10) of D0 is specified as D0.A.

The following word devices support bit specification.

Item	Device
Word devices which support bit specification	<ul style="list-style-type: none">• Data register (D)• Link register (W)• Link special register (SW)• Special register (SD)• Module access device (U□\G)• File register (R)

Handling bit data with word type labels

By specifying a bit number for a word [unsigned]/bit string [16 bits] type label or word [signed] type label, bit data of the specified bit number can be handled.

The notation for bit number specification is as follows.

Label name	.	Bit number
------------	---	------------

16-bit data (word data)

Data size and data range

16-bit data includes signed and unsigned 16-bit data.

In signed 16-bit data, a negative number is represented in two's complement.

Data name	Data size	Value range	
		Decimal notation	Hexadecimal notation
Signed 16-bit data	16 bits (1 word)	-32768 to 32767	0000H to FFFFH
Unsigned 16-bit data		0 to 65535	

Handling 16-bit data with bit devices

A bit device can be handled as 16-bit data by performing nibble specification.

Item	Notation	Example
Bit device	<p>Number of digits: Specify the number within the range from 1 to 4.</p>	K4X10 K2M113

Handling 16-bit data with bit type array labels

A bit type array label can be handled as 16-bit data by performing nibble specification.

The following table shows the notation for handling a bit type array label as 16-bit data by nibble specification.

Item	Notation	Example
Bit type array label	<p>Number of digits: Specify a number within the range of 1 to 4.</p>	K1L_BOOL

Nibble specification range

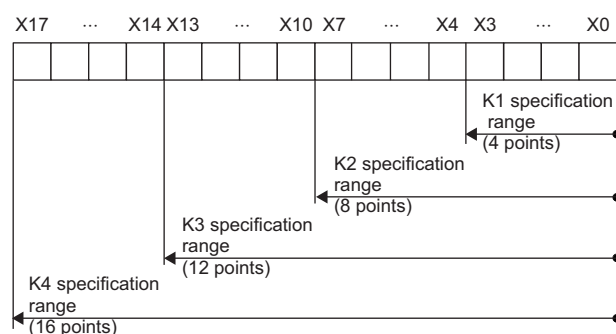
The following table lists the range of 16-bit data for each nibble specification.

Nibble specification	Decimal notation	Hexadecimal notation
K1	0 to 15	0H to FH
K2	0 to 255	00H to FFH
K3	0 to 4095	000H to FFFH
K4	Signed 16-bit data: -32768 to 32767 Unsigned 16-bit data: 0 to 65535	0000H to FFFFH

Ex.

When nibble specification is made for X0, the applicable number of points is as follows.

- K1X0→4 points from X0 to X3
- K2X0→8 points from X0 to X7
- K3X0→12 points from X0 to X13
- K4X0→16 points from X0 to X17



■Specifying a bit device with nibble specification in the source (s)

When a bit device with nibble specification is specified in the source of an instruction, 0 is stored in the bits, which follow the bit for which nibble specification is made in the source, in the word device of the destination.

Ladder example	Processing
<ul style="list-style-type: none"> • 16-bit data instruction 	

■Specifying a bit device with nibble specification in the destination (d)

When a nibble specification is made in the destination of an instruction, the number of points by the nibble specification is applicable in the destination.

The bit devices after the number of points specified by nibble remain unchanged.

Ladder example	Processing
<ul style="list-style-type: none"> • When the source data is a word device 	

Handling 16-bit data with word devices/labels

■Word device

One point of word device can handle 16-bit data.

■Word type label

One point of word type label can handle 16-bit data.

32-bit data (double word data)

Data size and data range

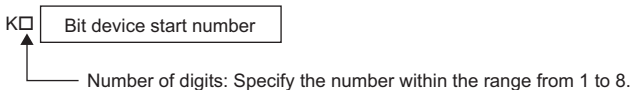
32-bit data includes signed and unsigned 32-bit data.

In signed 32-bit data, a negative number is represented in two's complement.

Data name	Data size	Value range	
		Decimal notation	Hexadecimal notation
Signed 32-bit data	32 bits (2 word)	-2147483648 to 2147483647	00000000H to FFFFFFFFH
Unsigned 32-bit data		0 to 4294967295	

Handling 32-bit data with bit devices

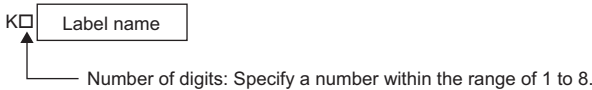
A bit device can be handled as 32-bit data by performing nibble specification.

Item	Notation	Example
Bit device		K8X80 K6B018

Handling 32-bit data with bit type array labels

A bit type array label can be handled as 32-bit data by performing nibble specification.

The following table shows the notation for handling a bit type array label as 32-bit data by nibble specification.

Item	Notation	Example
Bit type array label		K8L_BOOL

Nibble specification range

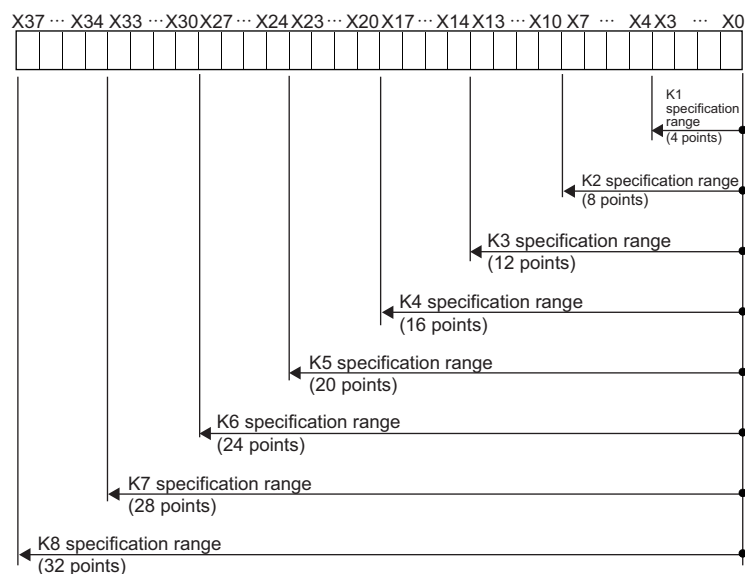
The following table lists the range of 32-bit data for each nibble specification.

Nibble specification	Decimal notation	Hexadecimal notation
K1	0 to 15	0H to FH
K2	0 to 255	00H to FFH
K3	0 to 4095	000H to FFFH
K4	0 to 65535	0000H to FFFFH
K5	0 to 1048575	00000H to FFFFFH
K6	0 to 16777215	000000H to FFFFFFFH
K7	0 to 268435455	0000000H to FFFFFFFFH
K8	Signed 32-bit data: -2147483648 to 2147483647 Unsigned 32-bit data: 0 to 4294967295	00000000H to FFFFFFFFH

Ex.

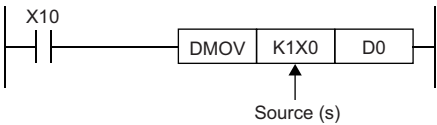
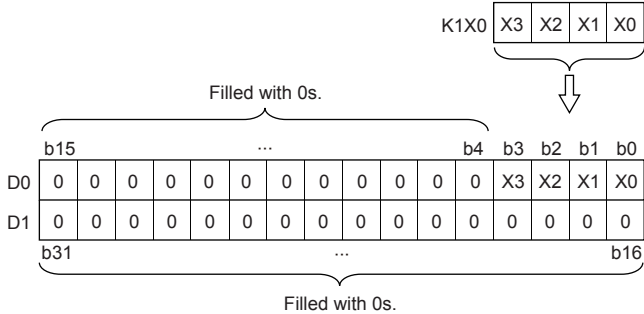
When nibble specification is made for X0, the applicable number of points is as follows.

- K1X0→4 points from X0 to X3
- K2X0→8 points from X0 to X7
- K3X0→12 points from X0 to X13
- K4X0→16 points from X0 to X17
- K5X0→20 points from X0 to X23
- K6X0→24 points from X0 to X27
- K7X0→28 points from X0 to X33
- K8X0→32 points from X0 to X37



■Specifying a bit device with nibble specification in the source (s)

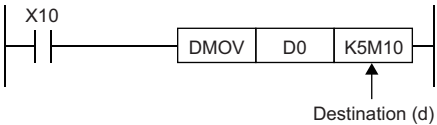
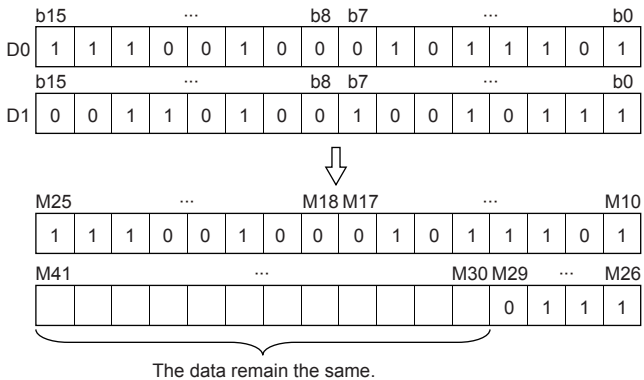
When a bit device with nibble specification is specified in the source of an instruction, 0 is stored in the bits, which follow the bit for which nibble specification is made in the source, in the word device of the destination.

Ladder example	Processing
<ul style="list-style-type: none"> 32-bit data instruction 	

■Specifying a bit device with nibble specification in the destination (d)

When a nibble specification is made in the destination of an instruction, the number of points by the nibble specification is applicable in the destination.

The bit devices after the number of points specified by nibble remain unchanged.

Ladder example	Processing
<ul style="list-style-type: none"> When the source data is a word device 	 <p>The data remain the same.</p>

Handling 32-bit data with word devices/labels

■Word device

Two points of word device can handle 32-bit data.

Note, however, that one point of the following devices can handle 32-bit data.

- Long counter (LC)
- Long index register (LZ)

■Double word type label

One point of double word device can handle 32-bit data.

Real number data (floating-point data)

Data size and data range

Real number data includes single-precision 32-bit real number data.

Real number data can be stored only in devices other than bit devices or in single-precision real data type labels.

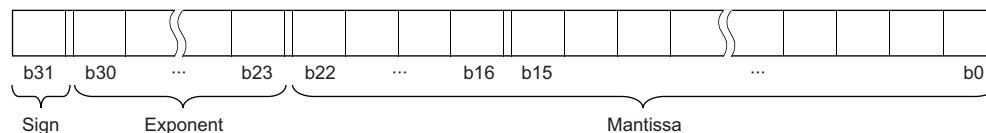
Data name		Data size	Value range
Single-precision real number data (single-precision floating-point data)	Positive number	32 bits (2 word)	$2^{-126} \leq \text{real number} < 2^{128}$
	Zero		0
	Negative number		$-2^{128} < \text{real number} \leq -2^{-126}$

Configuration of single-precision real number data

Single-precision real number data consists of a sign, mantissa, and exponent, and is expressed as shown below.

$$\boxed{\text{Sign}} \cdot 1. \boxed{\text{Mantissa}} \times 2^{\boxed{\text{Exponent}}}$$

The following figure shows the bit configuration of the internal expression of single-precision real number data and the meaning of each part.



■Sign (1 bit)

This bit represents the positive or negative sign of a numerical value. "0" indicates a positive number or 0. "1" Indicates a negative number.

■Mantissa (23 bits)

A mantissa means XXXXX... of $1.XXXXX \times 2^N$ representing a single-precision real number in binary.

■Exponent (8 bits)

An exponent means N of $1.XXXXX \times 2^N$ representing a single-precision real number in binary. The following table shows the relationships between the exponent value and N of a single-precision real number.

Exponent (b24 to b30)	FFH	FEH	FDH	...	81H	80H	7FH	7EH	...	02H	01H	00H
N	Not used	127	126	...	2	1	0	-1	...	-125	-126	Not used

Precautions

■When setting an input value of single-precision real number from the engineering tool

The number of significant digits is about 7 because the engineering tool processes single precision real number data in 32-bit single precision.

When the input value of single-precision real number data exceeds 7 digits, the 8th digit is rounded off.

Therefore, if the rounded-off value goes out of the range from -2147483648 to 2147483647, it will not be an intended value.

Ex.

When "2147483647" is set as an input value, it is handled as "2147484000" because 8th digit "6" is rounded off.

Ex.

When "E1.1754943562" is set as an input value, it is handled as "E1.175494" because 8th digit "3" is rounded off.

The monitor function of the engineering tool can monitor real number data of CPU modules.

To represent "0" in real number data, set all numbers in each of the following range to 0.

- Single-precision real number data: b0 to b31

The setting range of real number data is as follows.

- Single precision real number data: $-2^{128} < \text{single precision real number data} \leq -2^{-126}$, $0, 2^{-126} \leq [\text{single precision real number data}] < 2^{128}$

Do not specify "-0" (only the most significant bit is 1) in real number data. Performing a real number operation using -0 results in an operation error.

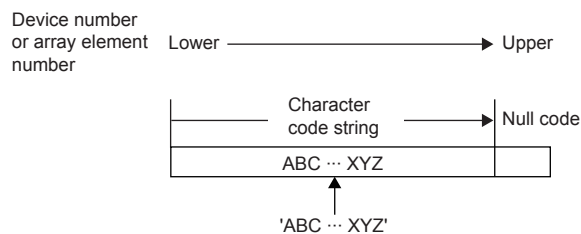
Character string data

Format of character string data

The following table lists the types of character string data, each of which ends with a NULL code to be handled as a character string.

Type	Character code	Last character
Character string	ASCII code	NULL(00H)

Character string data is stored in devices or an array in ascending order of device numbers or array element numbers.



Data range

The following table summarizes the ranges of character string data.

Type	Maximum number of character strings ^{*1}	Maximum number of character strings that can be handled in the program
Character string	255 single-byte characters (excluding the last NULL character)	16383 characters (excluding the last NULL character)

^{*1} When specifying a character string in the program, enclose it in single quotes (').

Number of words required for storing data

Character string data can be stored in word devices.

The following table lists the numbers of words required for storing character string data.

Number of character string bytes	Number of words required for storing character strings
0 byte	1 [word]
Odd number of bytes	(Number of character string bytes+1)÷ 2 [words]
Even number of bytes	(Number of character string bytes÷2) +1 [words]

Character string data storage location

An image of the character string data storage location is shown below.

■Character strings

In each character string storage image, "NULL" indicates a NULL code (00H).

Character string to be stored	Image of storing character string data from D0	Image of storing character string data from word type label array arrayA[0]												
' ' (null character string)	D0 <table><tr><td>NULL</td><td>NULL</td></tr></table>	NULL	NULL	arrayA[0] <table><tr><td>NULL</td><td>NULL</td></tr></table>	NULL	NULL								
NULL	NULL													
NULL	NULL													
'ABC'	D0 <table><tr><td>B</td><td>A</td></tr></table> D1 <table><tr><td>NULL</td><td>C</td></tr></table>	B	A	NULL	C	arrayA[0] <table><tr><td>B</td><td>A</td></tr></table> arrayA[1] <table><tr><td>NULL</td><td>C</td></tr></table>	B	A	NULL	C				
B	A													
NULL	C													
B	A													
NULL	C													
'ABCD'	D0 <table><tr><td>B</td><td>A</td></tr></table> D1 <table><tr><td>D</td><td>C</td></tr></table> D2 <table><tr><td>NULL</td><td>NULL</td></tr></table>	B	A	D	C	NULL	NULL	arrayA[0] <table><tr><td>B</td><td>A</td></tr></table> arrayA[1] <table><tr><td>D</td><td>C</td></tr></table> arrayA[2] <table><tr><td>NULL</td><td>NULL</td></tr></table>	B	A	D	C	NULL	NULL
B	A													
D	C													
NULL	NULL													
B	A													
D	C													
NULL	NULL													

1.3 Execution Condition

Types of execution conditions

The following are the five types of execution conditions of the instructions and functions of CPU module.

■On

An instruction is executed during on. It is executed only while the precondition of the instruction is on. When the precondition is off, the instruction is not executed.

■Rising edge

An instruction is executed one time when turned on. It is executed only once on the rising edge (off to on) of the precondition of the instruction and is no longer executed later even when the condition turns on.

■Off

An instruction is executed during off. It is executed only while the precondition of the instruction is off. When the precondition is on, the instruction is not executed.

■Falling edge

An instruction is executed one time when turned off. It is executed only once on the falling edge (on to off) of the precondition of the instruction and is no longer executed later even when the condition turns off.

■Always

An instruction is always executed regardless of whether the precondition of the instruction is on or off. When the precondition is off, the instruction performs off processing.

Execution condition of each instruction

The execution condition varies depending on the instruction. The following table lists the execution conditions of individual instructions.

Execution condition	Applicable instruction
On	All instructions except for the following
Rising edge	<ul style="list-style-type: none"> • Instruction followed by symbol (P) • PLS
Off	-
Falling edge	PLF
Always	LD, LDI, AND, ANI, OR, ORI, LDP, LDF, ANDP, ANDF, ORP, ORF, LDPI, LDFI, ANDPI, ANDFI, ORPI, ORFI, ANB, ORB, MPS, MRD, MPP, INV, MEP, MEF, OUT, OUT T, OUTH T, OUTHS T, OUT ST, OUTH ST, OUTHS ST, OUT C, OUT LC, MC, MCR, FEND, END, NOP, LD□, AND□, OR□, LD□_U, AND□_U, OR□_U, LDD□, ANDD□, ORD□, LDD□_U, ANDD□_U, ORD□_U, JMP, DI, EI, IMASK, SIMASK, IRET, FOR, NEXT, RET, LD\$□, AND\$□, OR\$□, LDE□, ANDE□, ORE□, STMR, LDDT□, ANDDT□, ORDT□, LDTM□, ANDTM□, ORTM□

1.4 Precautions on Programming

Errors common to instructions

The following table lists the conditions under which an error occurs when the instruction is executed.

Error content*1	Error code
An I/O number which corresponds to no module is specified.	2801
<ul style="list-style-type: none">An I/O number which is out of range (0 to 1777(Octal number)) is specified.The device or label specified by the instruction exceeds the available range.	2820
The range of the buffer memory of the module specified by the instruction is exceeded.	2823

*1 For a contact instruction, an error is not detected but the operation result becomes no continuity.

Checking the ranges of instruction runtime devices and labels

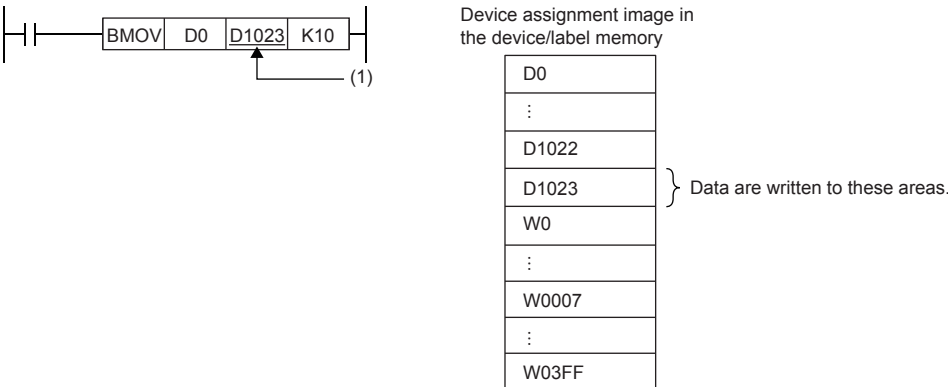
Checking the ranges of devices and labels

When a device or label is specified in an instruction, range check is performed. If a range exceeding that of the relevant device or label is specified, an error occurs.

The same applies when a label assigned to a device is specified in an instruction in the program.
Create such a program that the operation result falls within the range of the relevant device or label.

Ex.

When a global device is specified



(1) The transfer destination is in the range corresponding to D1023 to D1032. Because D1024 to D1032 do not exist, the data are written only to D1023.

Operations arising when the OUT, SET/RST, and PLS/PLF instructions of the same device are used

If two or more OUT, SET/RST, and PLS/PLF instructions are executed using the same device during one scan, they operate as described in this section.

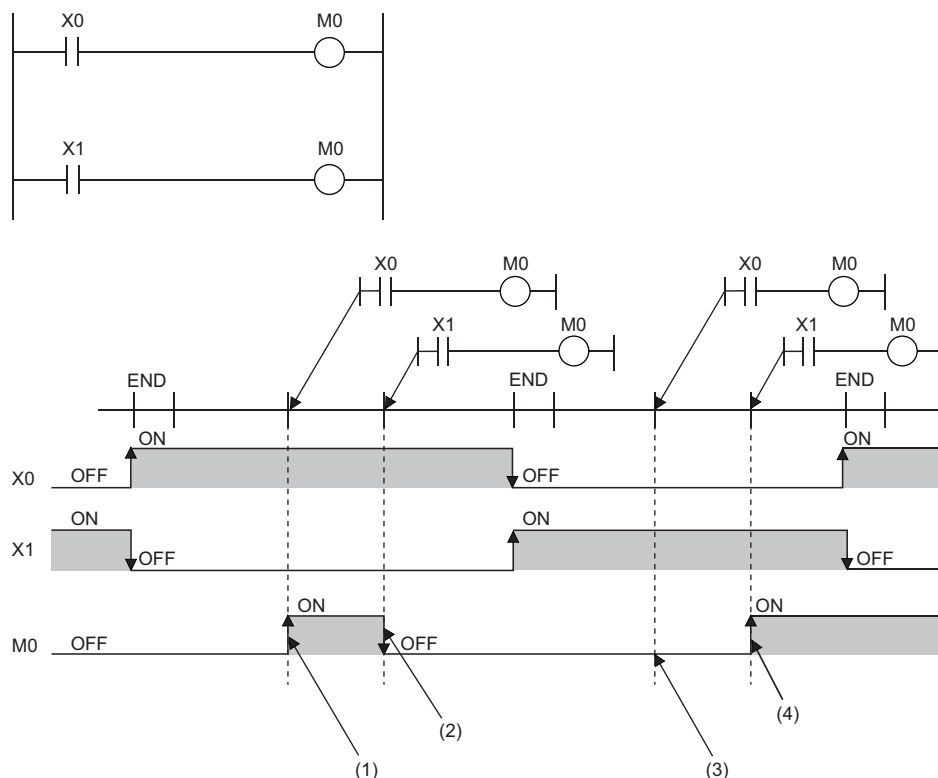
For OUT instructions of the same device

More than one OUT instruction of the same device must not be issued during one scan.

Otherwise, the specified device turns on or off, depending on the operation result up to each OUT instruction while it is in execution.

In this case, the device may turn on/off during one scan because the on/off state of the specified device is determined during execution of each OUT instruction.

The following figure shows the behavior arising when a circuit turning on/off the same internal relay (M0) is created with input X0 and X1.



- (1) Since X0 is on, M0 turns on.
- (2) Since X1 is off, M0 turns off.
- (3) Since X1 is off, M0 remains off.
- (4) Since X1 is on, M0 turns on.

If output (Y) is specified using an OUT instruction, the on/off state of the last OUT instruction executed during the one scan will be output.

If SET/RST instructions of the same device are used

■For SET instructions

The SET instruction turns on the specified device if the execution command is on, and causes no operation if it is off.

Thus, if two or more SET instructions of the same device are executed during one scan, the specified device turns on even if one execution command is on.

■For RST instructions

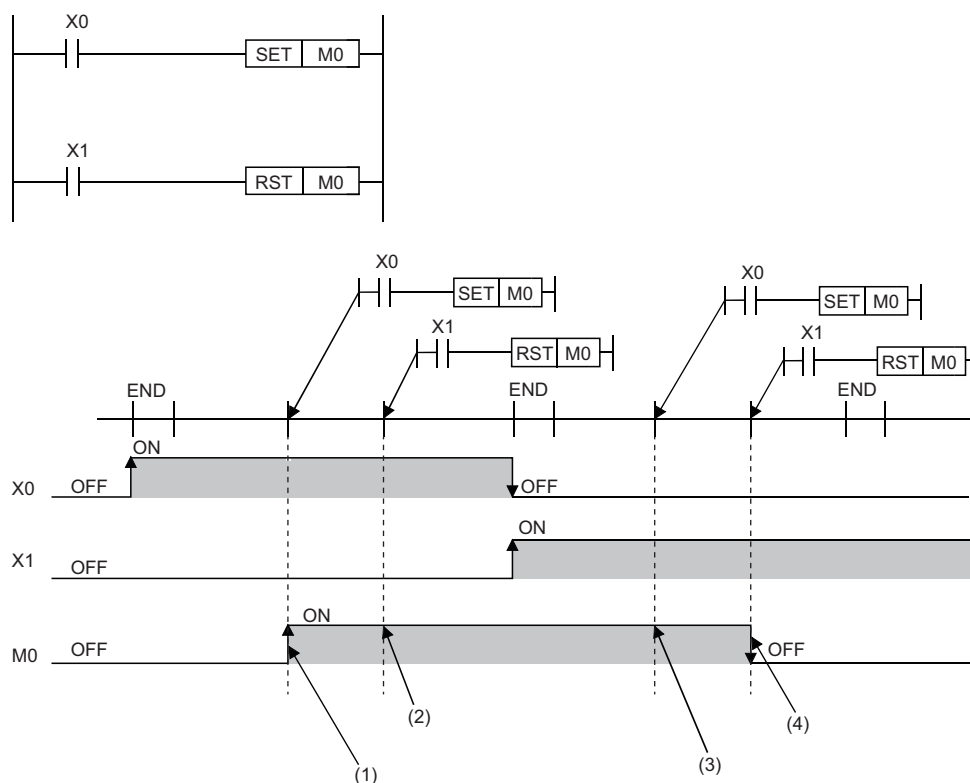
The RST instruction turns on the specified device if the execution command is off, and causes no operation if it is off.

Thus, if two or more RST instructions of the same device are executed during one scan, the specified device turns on even if one execution command is off.

■If the SET and RST instructions of the same device exist in one scan

If the SET and RST instructions of the same device exist in one scan, the SET instruction turns on the specified device if the execution command is on, and turns off the specified device if it is on.

If both the SET and RST instructions are off, the on/off state of the specified device will be unchanged.



(1) Since X0 is on, M0 turns on.

(2) Since X1 is off, M0 remains on. (The RST instruction results in non-processing.)

(3) Since X0 is off, M0 remains on. (The SET instruction results in non-processing.)

(4) Since X1 is on, M0 turns off.

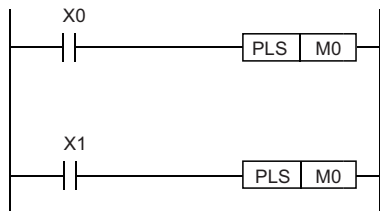
If output (Y) is specified using a SET/RST instruction, the on/off state of the last SET/RST instruction executed during the one scan will be output.

If PLS instructions of the same device are used

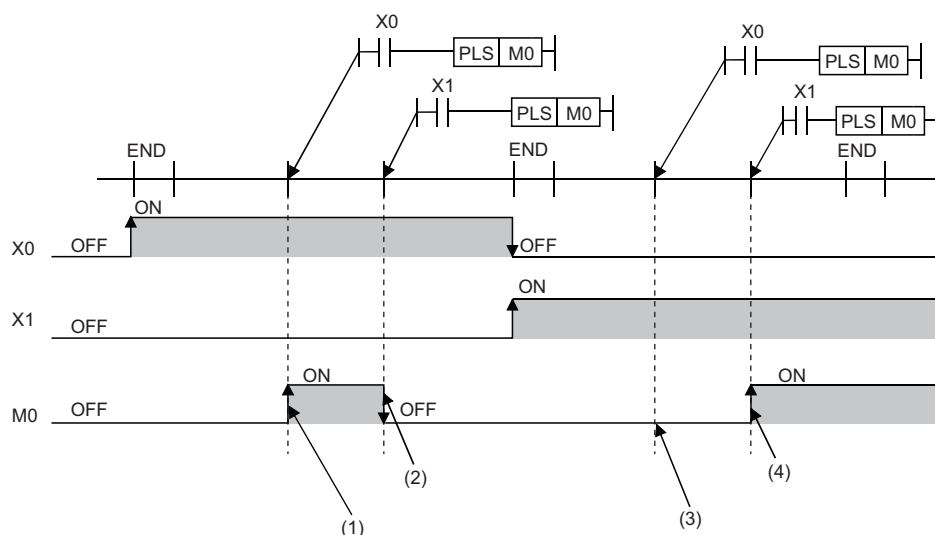
The PLS instruction turns on the specified device when the execution command specifies an off-to-on change. The specified device is turned off unless the execution command specifies an off-to-on change (i.e. off to off, on to on, on to off).

Thus, if two or more PLS instructions of the same device are issued during one scan, the specified device is turned on when the execution command of each PLS instruction specifies an off-to-on change. The specified device is turned off unless the execution command specifies an off-to-on change.

Thus, if two or more PLS instructions are issued during one scan, the device turned on by a PLS instruction may not turn on for one scan.

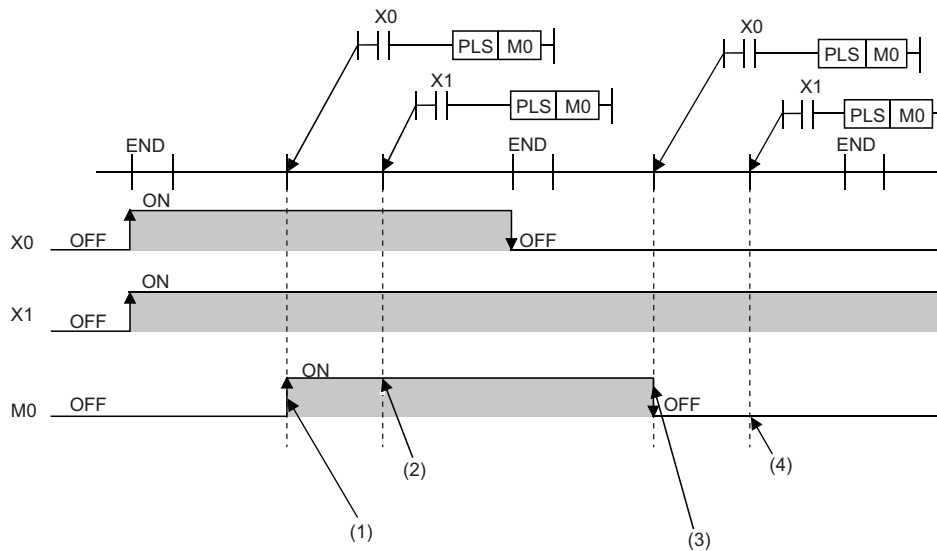


- If X0 and X1 differs in the on/off timing (i.e. the specified device does not turn on for one scan)



- (1) Since X0 turns on, M0 turns on.
- (2) Since X1 is other than turning on, M0 turns off.
- (3) Since X0 is other than turning on, M0 remains off.
- (4) Since X1 turns on, M0 turns on.

- If the off-to-on changes of X0 and X1 are at the same timing



- (1) Since X0 turns on, M0 turns on.
- (2) Since X1 turns on, M0 remains on.
- (3) Since X0 is other than turning on, M0 turns off.
- (4) Since X1 is other than turning on, M0 remains off.

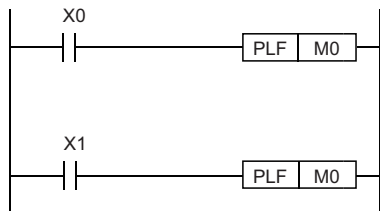
If output (Y) is specified using a PLS instruction, the on/off state of the last PLS instruction executed during the one scan will be output.

If PLF instructions of the same device are used

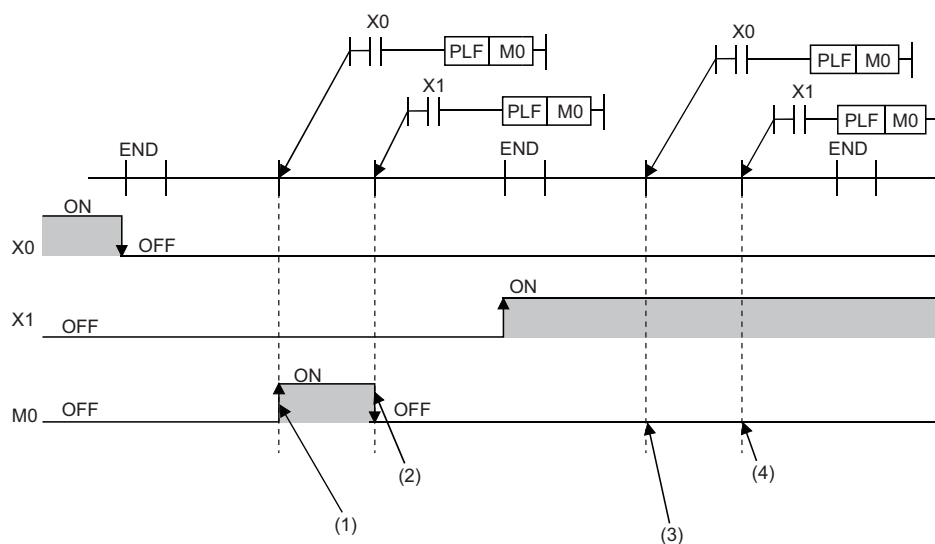
The PLF instruction turns on the specified device when the execution command specifies an off-to-on change. The specified device is turned off unless the execution command specifies an on-to-off change (i.e. off to off, off to on, on to on).

Thus, if two or more PLS instructions of the same device are issued during one scan, the specified device is turned on when the execution command of each PLS instruction specifies an on-to-off change. The specified device is turned off unless the execution command specifies an on-to-off change.

Thus, if two or more PLF instructions are issued during one scan, the device turned on by a PLF instruction may not turn on for one scan.

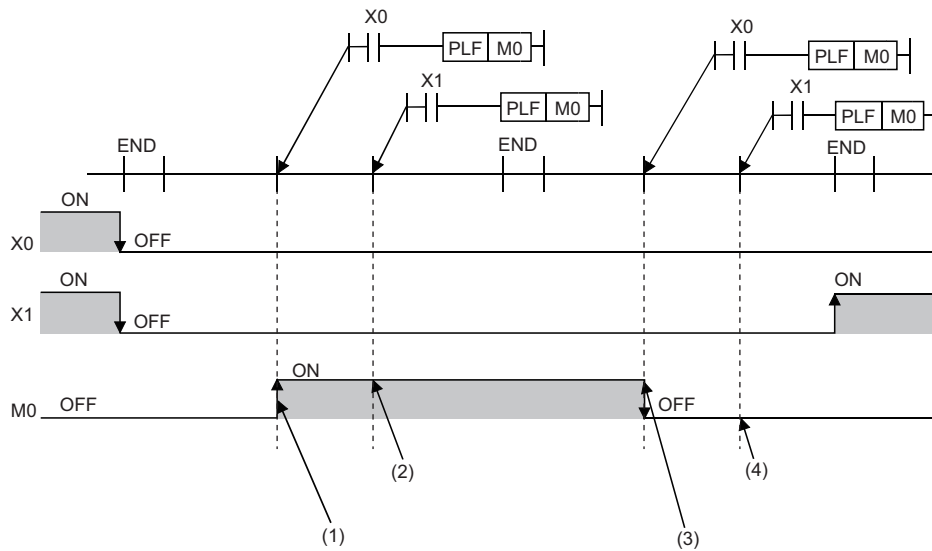


- If X0 and X1 differs in the on/off timing (i.e. the specified device does not turn on for one scan)



- (1) Since X0 turns off, M0 turns on.
- (2) Since X1 is other than turning off, M0 turns off.
- (3) Since X0 is other than turning off, M0 remains off.
- (4) Since X1 is other than turning off, M0 remains off.

- If the on-to-off changes of X0 and X1 are at the same timing



- (1) Since X0 turns off, M0 turns on.
- (2) Since X1 turns off, M0 remains on.
- (3) Since X0 is other than turning off, M0 turns off.
- (4) Since X1 is other than turning off, M0 remains off.

If output (Y) is specified using a PLF instruction, the on/off state of the last PLF instruction executed during the one scan will be output.

This part consists of the following chapters.

2 CPU MODULE INSTRUCTION

3 MODULE SPECIFIC INSTRUCTION

4 STANDARD FUNCTIONS/FUNCTION BLOCKS

2 CPU MODULE INSTRUCTION

2.1 Sequence Instruction

Contact instruction

■Operation start, series connection, parallel connection

Instruction symbol	Description	Reference
LD	Starts logical operation (Starts NO contact logical operation)	Page 98
LDI	Starts logical NOT operation (Starts NC contact logical operation)	
AND	Logical AND (NO contact series connection)	
ANI	Logical NAND (NC contact series connection)	
OR	Logical OR (NO contact parallel connection)	
ORI	Logical NOR (NC contact parallel connection)	

■Pulse operation start, pulse series connection, pulse parallel connection

Instruction symbol	Description	Reference
LDP	Starts rising edge pulse operation	Page 100
LDF	Starts falling edge pulse operation	
ANDP	Rising edge pulse series connection	
ANDF	Falling edge pulse series connection	
ORP	Rising edge pulse parallel connection	
ORF	Falling edge pulse parallel connection	

■Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection

Instruction symbol	Description	Reference
LDPI	Starts rising edge pulse NOT operation	Page 102
LDFI	Starts falling edge pulse NOT operation	
ANDPI	Rising edge pulse NOT series connection	
ANDFI	Falling edge pulse NOT series connection	
ORPI	Rising edge pulse NOT parallel connection	
ORFI	Falling edge pulse NOT parallel connection	

Association instruction

■Ladder block series/parallel connection

Instruction symbol	Description	Reference
ANB	AND between logical blocks (series connection between logical blocks)	Page 104
ORB	OR between logical blocks (parallel connection between logical blocks)	

■Storing/reading/clearing the operation result

Instruction symbol	Description	Reference
MPS	Stores the operation result	Page 105
MRD	Reads the operation result stored by MPS	
MPP	Reads and resets of the operation result stored by MPS	

■Inverting the operation result

Instruction symbol	Description	Reference
INV	Inversion of the operation result	Page 106

■Converting the operation result into a pulse

Instruction symbol	Description	Reference
MEP	Conversion of operation result to rising edge pulse	Page 107
MEF	Conversion of operation result to falling edge pulse	

Output instruction

■Out (excluding the timer, counter and annunciator)

Instruction symbol	Description	Reference
OUT	Device output	Page 108

■Timer (low-speed, high-speed, low-speed retentive, high-speed retentive)

Instruction symbol	Description	Reference
OUT T	Low-speed timer	Page 109
OUTH T	Timer	
OUTHS T	High-speed timer	
OUT ST	Low-speed retentive timer	
OUTH ST	Retentive timer	
OUTHS ST	High-speed retentive timer	

■Counter, long counter

Instruction symbol	Description	Reference
OUT C	Counter	Page 111
OUT LC	Long counter	Page 112

■Annunciator

Instruction symbol	Description	Reference
OUT F	Annunciator	Page 113

■Setting devices (excluding annunciator)

Instruction symbol	Description	Reference
SET	Sets devices	Page 114

■Resetting devices (excluding annunciator)

Instruction symbol	Description	Reference
RST	Resets devices	Page 115

■Setting/resetting annunciator

Instruction symbol	Description	Reference
SET F	Sets annunciator	Page 116
RST F	Resets annunciator	Page 117
ANS	Sets annunciator (with evaluation time)	Page 118
ANR	Resets annunciator (smallest number reset)	Page 119
ANRP		

■Rising/falling edge output

Instruction symbol	Description	Reference
PLS	Generates a pulse for 1 cycle of a program at the rising edge of the input signal.	Page 120
PLF	Generates a pulse for 1 cycle of a program at the falling edge of the input signal.	Page 122

■Inverting the bit device output

Instruction symbol	Description	Reference
FF	Inversion of device output	Page 123
ALT		Page 124
ALTP		

Shift instruction

■Shifting bit devices

Instruction symbol	Description	Reference
SFT	1 bit shift of the device	Page 125
SFTP		

■Shifting 16-bit data to the right/left by n bit (s)

Instruction symbol	Description	Reference
SFR		Page 127
SFRP		
SFL		Page 128
SFLP		

■Shifting n-bit data to the right/left by 1 bit

Instruction symbol	Description	Reference
BSFR		Page 129
BSFRP		
BSFL		Page 130
BSFLP		

■Shifting n-word data to the right/left by 1 word

Instruction symbol	Description	Reference
DSFR		Page 131
DSFRP		
DSFL		Page 132
DSFLP		

■Shifting n-bit data to the right/left by n bit (s)

Instruction symbol	Description	Reference
SFTR		Page 133
SFTRP		
SFTL		Page 134
SFTLP		

■Shifting n-word data to the right/left by n word (s)

Instruction symbol	Description	Reference
WSFR		Page 135
WSFRP		
WSFL		Page 136
WSFLP		

Master control instruction

■Setting/resetting the master control

Instruction symbol	Description	Reference
MC	Starts master control	Page 137
MCR	Releases master control	

Termination instruction

■Ending the main routine program

Instruction symbol	Description	Reference
FEND	Ends the main routine program	Page 141

■Ending the sequence program

Instruction symbol	Description	Reference
END	Ends the sequence program	Page 142

Stop instruction

■Stopping the sequence program

Instruction symbol	Description	Reference
STOP	Stops the sequence operation after input conditions are met. Executes the sequence program, upon setting the RUN/STOP/RESET switch to RUN again.	Page 143

No operation instruction

■No operation

Instruction symbol	Description	Reference
NOP	No processing (for deletion of instruction or for space)	Page 144

2.2 Basic instruction

Comparison operation instruction

■Comparing 16-bit binary data

Instruction symbol	Description	Reference
LD=, AND=, OR=	(s1)=(s2): Conductive	Page 145
LD=_U, AND=_U, OR=_U	(s1)≠(s2): Non-Conductive	
LD<>, AND<>, OR<>	(s1)≠(s2): Conductive	
LD<>_U, AND<>_U, OR<>_U	(s1)=(s2): Non-Conductive	
LD>, AND>, OR>	(s1)>(s2): Conductive	
LD>_U, AND>_U, OR>_U	(s1)≤(s2): Non-Conductive	
LD≤, AND≤, OR≤	(s1)≤(s2): Conductive	
LD≤_U, AND≤_U, OR≤_U	(s1)>(s2): Non-Conductive	
LD<, AND<, OR<	(s1)<(s2): Conductive	
LD<_U, AND<_U, OR<_U	(s1)≥(s2): Non-Conductive	
LD≥, AND≥, OR≥	(s1)≥(s2): Conductive	
LD≥_U, AND≥_U, OR≥_U	(s1)<(s2): Non-Conductive	

■Comparing 32-bit binary data

Instruction symbol	Description	Reference
LDD=, ANDD=, ORD=	[(s1)+1, (s1)] = [(s2)+1, (s2)]: Conductive	Page 147
LDD=_U, ANDD=_U, ORD=_U	[(s1)+1, (s1)] ≠ [(s2)+1, (s2)]: Non-Conductive	
LDD<>, ANDD<>, ORD<>	[(s1)+1, (s1)] ≠ [(s2)+1, (s2)]: Conductive	
LDD<>_U, ANDD<>_U, ORD<>_U	[(s1)+1, (s1)] = [(s2)+1, (s2)]: Non-Conductive	
LDD>, ANDD>, ORD>	[(s1)+1, (s1)] > [(s2)+1, (s2)]: Conductive	
LDD>_U, ANDD>_U, ORD>_U	[(s1)+1, (s1)] ≤ [(s2)+1, (s2)]: Non-Conductive	
LDD≤, ANDD≤, ORD≤	[(s1)+1, (s1)] ≤ [(s2)+1, (s2)]: Conductive	
LDD≤_U, ANDD≤_U, ORD≤_U	[(s1)+1, (s1)] > [(s2)+1, (s2)]: Non-Conductive	
LDD<, ANDD<, ORD<	[(s1)+1, (s1)] < [(s2)+1, (s2)]: Conductive	
LDD<_U, ANDD<_U, ORD<_U	[(s1)+1, (s1)] ≥ [(s2)+1, (s2)]: Non-Conductive	
LDD≥, ANDD≥, ORD≥	[(s1)+1, (s1)] ≥ [(s2)+1, (s2)]: Conductive	
LDD≥_U, ANDD≥_U, ORD≥_U	[(s1)+1, (s1)] < [(s2)+1, (s2)]: Non-Conductive	

■Comparison output 16-bit binary data

Instruction symbol	Description	Reference
CMP	(s1)>(s2): (d) is on	Page 149
CMPP	(s1)=(s2): (d) +1 is on	
CMP_U	(s1)<(s2): (d) +2 is on	
CMPP_U		

■Comparison output 32-bit binary data

Instruction symbol	Description	Reference
DCMP	$[(s1)+1, (s1)] > [(s2)+1, (s2)]$: (d) is on $[(s1)+1, (s1)] = [(s2)+1, (s2)]$: (d) + 1 is on $[(s1)+1, (s1)] < [(s2)+1, (s2)]$: (d) + 2 is on	Page 151
DCMPP		
DCMP_U		
DCMPP_U		

■Comparing 16-bit binary data band

Instruction symbol	Description	Reference
ZCP	$(s1) > (s3)$: (d) is on $(s1) \leq (s3) \leq (s2)$: (d) + 1 is on $(s3) > (s2)$: (d) + 2 is on	Page 153
ZCPP		
ZCP_U		
ZCPP_U		

■Comparing 32-bit binary data band

Instruction symbol	Description	Reference
DZCP	$[(s1)+1, (s1)] > [(s3)+1, (s3)]$: (d) is on $[(s1)+1, (s1)] \leq [(s3)+1, (s3)] \leq [(s2)+1, (s2)]$: (d) + 1 is on $[(s3)+1, (s3)] > [(s2)+1, (s2)]$: (d) + 2 is on	Page 155
DZCPP		
DZCP_U		
DZCPP_U		

■Comparing 16-bit binary block data

Instruction symbol	Description	Reference
BKCMP=, BKCMP<>, BKCMP>, BKCMP<=, BKCMP<, BKCMP>=	Compares the 16-bit binary data in the device area ((n) points) from (s1) with the 16-bit binary data in the device area ((n) points) from (s2), and stores the result in the device area ((n) points) from (d).	Page 157
BKCMP=P, BKCMP<>P, BKCMP>P, BKCMP<=P, BKCMP<P, BKCMP>=P		
BKCMP=_U, BKCMP<>_U, BKCMP>_U, BKCMP<=_U, BKCMP<_U, BKCMP>=_U		
BKCMP=P_U, BKCMP<>P_U, BKCMP>P_U, BKCMP<=P_U, BKCMP<P_U, BKCMP>=P_U		

■Comparing 32-bit binary block data

Instruction symbol	Description	Reference
DBKCMP=, DBKCMP<>, DBKCMP>, DBKCMP<=, DBKCMP<, DBKCMP>=	Compares the 32-bit binary data in the device area ((n) points) from (s1) with the 32-bit binary data in the device area ((n) points) from (s2), and stores the result in the device area ((n) points) from (d).	Page 159
DBKCMP=P, DBKCMP<>P, DBKCMP>P, DBKCMP<=P, DBKCMP<P, DBKCMP>=P		
DBKCMP=_U, DBKCMP<>_U, DBKCMP>_U, DBKCMP<=_U, DBKCMP<_U, DBKCMP>=_U		
DBKCMP=P_U, DBKCMP<>P_U, DBKCMP>P_U, DBKCMP<=P_U, DBKCMP<P_U, DBKCMP>=P_U		

Arithmetic operation instruction

■ Adding/subtracting 16-bit binary data

Instruction symbol	Description	Reference
+	(d)+(s) → (d)	Page 161
+P		
+_U		
+P_U		
+	(s1)+(s2) → (d)	Page 162
+P		
+_U		
+P_U		
ADD	(s1)+(s2) → (d)	Page 163
ADDP		
ADD_U		
ADDP_U		
-	(d)-(s) → (d)	Page 165
-P		
-_U		
-P_U		
-	(s1)-(s2) → (d)	Page 166
-P		
-_U		
-P_U		
SUB	(s1)-(s2) → (d)	Page 167
SUBP		
SUB_U		
SUBP_U		

■Adding/subtracting 32-bit binary data

Instruction symbol	Description	Reference
D+	$[(d)+1, (d)] + [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 169
D+P		
D+_U		
D+P_U		
D+	$[(s1)+1, (s1)] + [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 170
D+P		
D+_U		
D+P_U		
DADD	$[(s1)+1, (s1)] + [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 171
DADDP		
DADD_U		
DADDP_U		
D-	$[(d)+1, (d)] - [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 173
D-P		
D-_U		
D-P_U		
D-	$[(s1)+1, (s1)] - [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 174
D-P		
D-_U		
D-P_U		
DSUB	$[(s1)+1, (s1)] - [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 175
DSUBP		
DSUB_U		
DSUBP_U		

■Multiplying/dividing 16-bit binary data

Instruction symbol	Description	Reference
*	$(s1) \times (s2) \rightarrow [(d)+1, (d)]$	Page 177
*P		
*_U		
*P_U		
MUL	$(s1) \times (s2) \rightarrow [(d)+1, (d)]$	Page 178
MULP		
MUL_U		
MULP_U		
/	$(s1) \div (s2) \rightarrow \text{quotient } (d), \text{ remainder } (d)+1$	Page 180
/P		
/_U		
/P_U		
DIV	$(s1) \div (s2) \rightarrow \text{quotient } (d), \text{ remainder } (d)+1$	Page 181
DIVP		
DIV_U		
DIVP_U		

■Multiplying/dividing 32-bit binary data

Instruction symbol	Description	Reference
D*	$[(s1)+1, (s1)] \times [(s2)+1, (s2)] \rightarrow [(d)+3, (d)+2, (d)+1, (d)]$	Page 183
D*P		
D*_U		
D*P_U		
DMUL	$[(s1)+1, (s1)] \times [(s2)+1, (s2)] \rightarrow [(d)+3, (d)+2, (d)+1, (d)]$	Page 185
DMULP		
DMUL_U		
DMULP_U		
D/	$[(s1)+1, (s1)] \div [(s2)+1, (s2)] \rightarrow \text{quotient } [(d)+1, (d)], \text{ remainder } [(d)+3, (d)+2]$	Page 187
D/P		
D/_U		
D/P_U		
DDIV	$[(s1)+1, (s1)] \div [(s2)+1, (s2)] \rightarrow \text{quotient } [(d)+1, (d)], \text{ remainder } [(d)+3, (d)+2]$	Page 188
DDIVP		
DDIV_U		
DDIVP_U		

■Adding/subtracting BCD 4-digit data

Instruction symbol	Description	Reference
B+	$(d) + (s) \rightarrow (d)$	Page 190
B+P		
B+	$(s1) + (s2) \rightarrow (d)$	Page 191
B+P		
B-	$(d) - (s) \rightarrow (d)$	Page 192
B-P		
B-	$(s1) - (s2) \rightarrow (d)$	Page 193
B-P		

■Adding/subtracting BCD 8-digit data

Instruction symbol	Description	Reference
DB+	$[(d)+1, (d)] + [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 194
DB+P		
DB+	$[(s1)+1, (s1)] + [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 195
DB+P		
DB-	$[(d)+1, (d)] - [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 196
DB-P		
DB-	$[(s1)+1, (s1)] - [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 197
DB-P		

■Multiplying/dividing BCD 4-digit data

Instruction symbol	Description	Reference
B*	$(s1) \times (s2) \rightarrow [(d)+1, (d)]$	Page 198
B*P		
B/	$(s1) \div (s2) \rightarrow \text{quotient } (d), \text{ remainder } (d)+1$	Page 199
B/P		

■Multiplying/dividing BCD 8-digit data

Instruction symbol	Description	Reference
DB*	$[(s1)+1, (s1)] \times [(s2)+1, (s2)] \rightarrow [(d)+3, (d)+2, (d)+1, (d)]$	Page 200
DB*P		
DB/	$[(s1)+1, (s1)] \div [(s2)+1, (s2)] \rightarrow \text{quotient } [(d)+1, (d)], \text{ remainder } [(d)+3, (d)+2]$	Page 201
DB/P		

■Adding/subtracting 16-bit binary block data

Instruction symbol	Description	Reference
BK+	Adds the 16-bit binary bit data in the device area ((n) points) from (s1) and the data or constants in the device area ((n) points) from (s2) at once, and stores the result in the device area ((n) points) from (d).	Page 202
BK+P		
BK+_U		
BK+P_U		
BK-	Subtracts the 16-bit binary bit data in the device area ((n) points) from (s1) and the data or constants in the device area ((n) points) from (s2) at once, and stores the result in the device area ((n) points) from (d).	Page 204
BK-P		
BK-_U		
BK-P_U		

■Adding/subtracting 32-bit binary block data

Instruction symbol	Description	Reference
DBK+	Adds the 32-bit binary bit data in the device area ((n) points) from (s1) and the 32-bit data or constants in the device area ((n) points) from (s2), and stores the result in the device area specified by (d) and later.	Page 206
DBK+P		
DBK+_U		
DBK+P_U		
DBK-	Subtracts the 32-bit binary bit data in the device area ((n) points) from (s1) and the 32-bit data or constants in the device area ((n) points) from (s2) and later, and stores the result in the device area specified by (d) and later.	Page 209
DBK-P		
DBK-_U		
DBK-P_U		

■Incrementing/decrementing 16-bit binary data

Instruction symbol	Description	Reference
INC	$(d) + 1 \rightarrow (d)$	Page 211
INCP		
INC_U		
INCP_U		
DEC	$(d) - 1 \rightarrow (d)$	Page 212
DECP		
DEC_U		
DECP_U		

■Incrementing/decrementing 32-bit binary data

Instruction symbol	Description	Reference
DINC	$[(d)+1, (d)] + 1 \rightarrow [(d)+1, (d)]$	Page 213
DINCP		
DINC_U		
DINCP_U		
DDEC	$[(d)+1, (d)] - 1 \rightarrow [(d)+1, (d)]$	Page 214
DDECP		
DDEC_U		
DDECP_U		

Logical operation instruction

■Performing an AND operation on 16-bit/32-bit data

Instruction symbol	Description	Reference
WAND	$(d) \wedge (s) \rightarrow (d)$	Page 215
WANDP		
WAND	$(s1) \wedge (s2) \rightarrow (d)$	Page 216
WANDP		
DAND	$[(d)+1, (d)] \wedge [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 217
DANDP		
DAND	$[(s1)+1, (s1)] \wedge [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 218
DANDP		

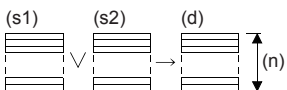
■Performing an AND operation on 16-bit block data

Instruction symbol	Description	Reference
BKAND		Page 219
BKANDP		

■Performing an OR operation on 16-bit/32-bit data

Instruction symbol	Description	Reference
WOR	$(d) \vee (s) \rightarrow (d)$	Page 220
WORP		
WOR	$(s1) \vee (s2) \rightarrow (d)$	Page 221
WORP		
DOR	$[(d)+1, (d)] \vee [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 222
DORP		
DOR	$[(s1)+1, (s1)] \vee [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 223
DORP		


■Performing an OR operation on 16-bit block data

Instruction symbol	Description	Reference
BKOR		Page 224
BKORP		

■Performing an XOR operation on 16-bit/32-bit data

Instruction symbol	Description	Reference
WXOR	$(d) \nabla (s) \rightarrow (d)$	Page 225
WXORP		
WXOR	$(s1) \nabla (s2) \rightarrow (d)$	Page 226
WXORP		
DXOR	$[(d)+1, (d)] \nabla [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 227
DXORP		
DXOR	$[(s1)+1, (s1)] \nabla [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 228
DXORP		


■Performing an XOR operation on 16-bit block data

Instruction symbol	Description	Reference
BKXOR		Page 229
BKXORP		

■Performing an XNOR operation on 16-bit/32-bit data

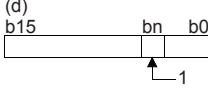
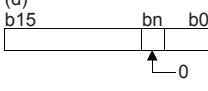
Instruction symbol	Description	Reference
WXNR	$\overline{(d) \vee (s)} \rightarrow (d)$	Page 230
WXNRP		
WXNR	$\overline{(s1) \vee (s2)} \rightarrow (d)$	Page 231
WXNRP		
DXNR	$\overline{[(d)+1, (d)] \vee [(s)+1, (s)]} \rightarrow [(d)+1, (d)]$	Page 232
DXNRP		
DXNR	$\overline{[(s1)+1, (s1)] \vee [(s2)+1, (s2)]} \rightarrow [(d)+1, (d)]$	Page 233
DXNRP		

■Performing an XNOR operation on 16-bit block data

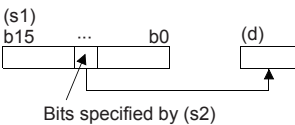

Instruction symbol	Description	Reference
BKXNR		Page 234
BKXNRP		

Bit processing instruction

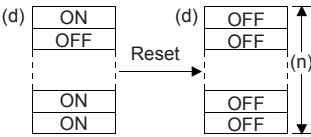
■Setting/resetting a bit in the word device

Instruction symbol	Description	Reference
BSET		Page 235
BSETP		
BRST		Page 236
BRSTP		

■Performing a bit test

Instruction symbol	Description	Reference
TEST		Page 237
TESTP		
DTEST		Page 238
DTESTP		

■Batch-resetting bit devices

Instruction symbol	Description	Reference
BKRST		Page 239
BKRSTP		

■Batch-resetting devices

Instruction symbol	Description	Reference
ZRST	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(d2)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d1)+2</div> <div style="border: 1px solid black; padding: 2px;">(d1)+1</div> <div style="border: 1px solid black; padding: 2px;">(d1)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↓ (d1), (d2) are bit devices: Writes off (reset) from (d1) to (d2) (d1), (d2) are word devices: Writes K0 from (d1) to (d2) </div> <div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(d2)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d1)+2</div> <div style="border: 1px solid black; padding: 2px;">(d1)+1</div> <div style="border: 1px solid black; padding: 2px;">(d1)</div> </div>	Page 240
ZRSTP		

Data conversion instruction

■Converting binary data to BCD 4-digit/8-digit data

Instruction symbol	Description	Reference
BCD	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ BIN (0 to 9999) </div>	Page 242
BCDP		
DBCD	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s+1, s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d+1, d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ BIN (0 to 99999999) </div>	Page 244
DBCDP		

■Converting BCD 4-digit/8-digit data to binary data

Instruction symbol	Description	Reference
BIN	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ BCD (0 to 9999) </div>	Page 246
BINP		
DBIN	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s+1, s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d+1, d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ BCD (0 to 99999999) </div>	Page 248
DBINP		

■Converting single-precision real number to 16-bit/32-bit signed binary data

Instruction symbol	Description	Reference
FLT2INT	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s+1, s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ Real number (-32768 to +32767) </div>	Page 250
FLT2INTP		
FLT2DINT	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s+1, s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d+1, d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ Real number (-2147483648 to +2147483647) </div>	Page 251
FLT2DINTP		

■Converting single-precision real number to 16-bit/32-bit unsigned binary data

Instruction symbol	Description	Reference
FLT2UINT	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s+1, s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ Real number (0 to 65535) </div>	Page 252
FLT2UINTP		
FLT2UDINT	<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">(s+1, s)</div> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 100px; border-left: 1px solid black; border-right: 1px solid black;"></div> <div style="border: 1px solid black; padding: 2px;">(d+1, d)</div> </div> <div style="text-align: center; margin: 10px 0;"> ↑ Real number (0 to 4294967295) </div>	Page 253
FLT2UDINTP		

■Converting 16-bit signed binary data to 16-bit/32-bit unsigned binary data

Instruction symbol	Description	Reference
INT2UINT	Converts 16-bit signed data in the device specified by (s) to 16-bit unsigned data, and stores the converted data in the device specified by (d).	Page 254
INT2UINTP		
INT2UDINT	Converts 16-bit signed data in the device specified by (s) to 32-bit unsigned data, and stores the converted data in the device specified by (d).	Page 255
INT2UDINTP		

■Converting 16-bit signed binary data to 32-bit signed binary data

Instruction symbol	Description	Reference
INT2DINT	Converts 16-bit signed data in the device specified by (s) to 32-bit signed data, and stores the converted data in the device specified by (d).	Page 256
INT2DINTP		

■Converting 16-bit unsigned binary data to 16-bit/32-bit signed binary data

Instruction symbol	Description	Reference
UINT2INT	Converts 16-bit unsigned data in the device specified by (s) to 16-bit signed data, and stores the converted data in the device specified by (d).	Page 257
UINT2INTP		
UINT2DINT	Converts 16-bit unsigned data in the device specified by (s) to 32-bit signed data, and stores the converted data in the device specified by (d).	Page 258
UINT2DINTP		

■Converting 16-bit unsigned binary data to 32-bit unsigned binary data

Instruction symbol	Description	Reference
UINT2UDINT	Converts 16-bit unsigned data in the device specified by (s) to 32-bit unsigned data, and stores the converted data in the device specified by (d).	Page 259
UINT2UDINTP		

■Converting 32-bit signed binary data to 16-bit signed binary data

Instruction symbol	Description	Reference
DINT2INT	Converts 32-bit signed data in the device specified by (s) to 16-bit signed data, and stores the converted data in the device specified by (d).	Page 260
DINT2INTP		

■Converting 32-bit signed binary data to 16-bit/32-bit unsigned binary data

Instruction symbol	Description	Reference
DINT2UINT	Converts 32-bit signed data in the device specified by (s) to 16-bit unsigned data, and stores the converted data in the device specified by (d).	Page 261
DINT2UINTP		
DINT2UDINT	Converts 32-bit signed data in the device specified by (s) to 32-bit unsigned data, and stores the converted data in the device specified by (d).	Page 262
DINT2UDINTP		

■Converting 32-bit unsigned binary data to 16-bit/32-bit signed binary data

Instruction symbol	Description	Reference
UDINT2INT	Converts 32-bit unsigned data in the device specified by (s) to 16-bit signed data, and stores the converted data in the device specified by (d).	Page 263
UDINT2INTP		
UDINT2DINT	Converts 32-bit unsigned data in the device specified by (s) to 32-bit signed data, and stores the converted data in the device specified by (d).	Page 264
UDINT2DINTP		

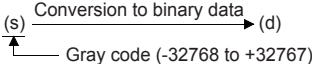
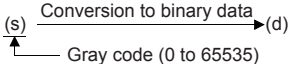
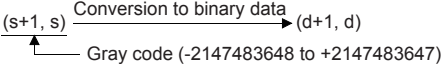
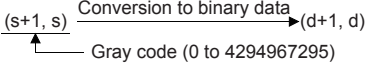
■Converting 32-bit unsigned binary data to 16-bit unsigned binary data

Instruction symbol	Description	Reference
UDINT2UINT	Converts 32-bit unsigned data in the device specified by (s) to 16-bit unsigned data, and stores the converted data in the device specified by (d).	Page 265
UDINT2UINTP		

■Converting 16-bit/32-bit binary data to Gray code

Instruction symbol	Description	Reference
GRY	<div><div>(s) $\xrightarrow{\text{Conversion to gray code}}$ (d)</div><div><div></div><div></div></div><div>BIN (-32768 to 32767)</div></div>	Page 266
GRYP		
GRY_U	<div><div>(s) $\xrightarrow{\text{Conversion to gray code}}$ (d)</div><div><div></div><div></div></div><div>BIN (0 to 65535)</div></div>	
GRYP_U		
DGRY	<div><div>(s+1, s) $\xrightarrow{\text{Conversion to gray code}}$ (d+1, d)</div><div><div></div><div></div></div><div>BIN (-2147483648 to 2147483647)</div></div>	Page 267
DGRYP		
DGRY_U	<div><div>(s+1, s) $\xrightarrow{\text{Conversion to gray code}}$ (d+1, d)</div><div><div></div><div></div></div><div>BIN (0 to 4294967295)</div></div>	
DGRYP_U		

■Converting Gray code to 16-bit/32-bit binary data

Instruction symbol	Description	Reference
GBIN		Page 268
GBINP		
GBIN_U		
GBINP_U		
DGBIN		Page 269
DGBINP		
DGBIN_U		
DGBINP_U		

■Converting decimal ASCII to 16-bit/32-bit binary data

Instruction symbol	Description	Reference
DABIN	Converts a 5-digit decimal ASCII value in the device specified by (s) to a 1 word binary value, and stores the converted data in the word device number specified by (d).	Page 270
DABINP		
DABIN_U		
DABINP_U		
DDABIN	Converts a 10-digit decimal ASCII value in the device specified by (s) to a 2 word binary value, and stores the converted data in the word device number specified by (d).	Page 272
DDABINP		
DDABIN_U		
DDABINP_U		


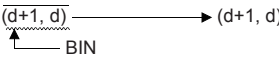
■Converting ASCII to HEX

Instruction symbol	Description	Reference
HEXA	Converts the ASCII data stored in the number of characters specified by (n) starting from device specified in (s), and stores the converted data in the device specified by (d) onwards.	Page 274
HEXAP		

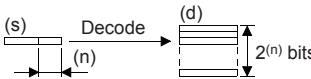
■Converting character string to 16-bit/32-bit binary data

Instruction symbol	Description	Reference
VAL	Converts a character string including decimal point in the device specified by (s) to a 1 word binary value and number of decimal fraction digits, and stores the converted data in the devices specified by (d1) and (d2).	Page 277
VALP		
VAL_U		
VALP_U		
DVAL	Converts a character string including decimal point in the device specified by (s) to a 2 words binary value and number of decimal fraction digits, and stores the converted data in the devices specified by (d1) and (d2).	Page 279
DVALP		
DVAL_U		
DVALP_U		

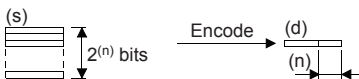
■Two's complement of 16-bit/32-bit binary data (sign inversion)

Instruction symbol	Description	Reference
NEG		Page 282
NEGP		
DNEG		Page 283
DNEGP		

■Decoding from 8 to 256 bits

Instruction symbol	Description	Reference
DECO		Page 284
DECOP		

■Encoding from 256 to 8 bits

Instruction symbol	Description	Reference
ENCO		Page 285
ENCOP		

■Separating 4 bits from 16-bit data

Instruction symbol	Description	Reference
DIS	Separates the 16-bit data specified by (s) into 4-bit units and stores in the lower 4 bits of (n) points from (d). (n < 4)	Page 286
DISP		

■Connecting 4 bits to 16-bit data

Instruction symbol	Description	Reference
UNI	Connects the lower 4 bits of (n) points from the device specified by (s), and stores the result in the device specified by (d). (n < 4)	Page 287
UNIP		

■Separating/connecting the specified number of bits

Instruction symbol	Description	Reference
NDIS	Separates the data in the devices starting from the one specified by (s1) into bits specified by the devices from (s2), and stores them to the devices starting from the one specified by (d).	Page 288
NDISP		
NUNI	Connects the data in the devices starting from the one specified by (s1) with bits specified by the devices from (s2), and stores them to the devices starting from the one specified by (d).	Page 290
NUNIP		

■Separating/connecting data in byte units

Instruction symbol	Description	Reference
WTOB	Breaks (n) points of 16 bit data from the device specified by (s) into 8-bit units, and stores in the devices starting from the one specified by (d).	Page 292
WTOBP		
BTOW	Connects the lower 8 bits of 16-bit data of (n) points from the device specified by (s) into 16-bit units, and stores in the devices starting from the one specified by (d).	Page 294
BTOWP		

Data transfer instruction

■Transferring 16-bit/32-bit data

Instruction symbol	Description	Reference
MOV	(s) \longrightarrow (d)	Page 296
MOVP		
DMOV	(s+1, s) \longrightarrow (d+1, d)	Page 297
DMOVP		

■Inverting and transferring 16-bit/32-bit data

Instruction symbol	Description	Reference
CML	$\overline{(s)}$ \longrightarrow (d)	Page 298
CMLP		
DCML	$\overline{(s+1, s)}$ \longrightarrow (d+1, d)	Page 299
DCMLP		

■Shift move

Instruction symbol	Description	Reference
SMOV	Shifts the specified no. of digits from the word device specified by (s), and store in (d).	Page 300
SMOVP		

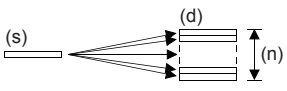
■Inverting and transferring 1-bit data

Instruction symbol	Description	Reference
CMLB	Inverts the bit data specified by (s), and store in (d).	Page 302
CMLBP		

■Transferring 16-bit block data (65535 points maximum)

Instruction symbol	Description	Reference
BMOV	 (n) = 1 to 65535	Page 303
BMOVP		

■Transferring identical 16-bit block data (65535 points maximum)

Instruction symbol	Description	Reference
FMOV	 (n) = 1 to 65535	Page 305
FMOVP		

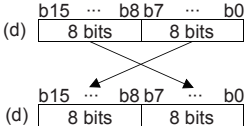
■Transferring identical 32-bit block data (65535 points maximum)

Instruction symbol	Description	Reference
DFMOV	 (n) = 1 to 65535	Page 306
DFMOVP		

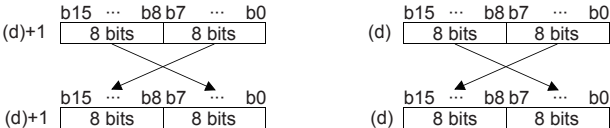
■Exchanging 16-bit/32-bit data

Instruction symbol	Description	Reference
XCH	(d1) \longleftrightarrow (d2)	Page 307
XCHP		
DXCH	(d1+1, d1) \longleftrightarrow (d2+1, d2)	Page 308
DXCHP		

■Exchanging the upper and lower bytes of 16-bit data

Instruction symbol	Description	Reference
SWAP		Page 309
SWAPP		

■Exchanging the upper and lower bytes of 32-bit data

Instruction symbol	Description	Reference
DSWAP		Page 310
DSWAPP		

■Transferring 1-bit data

Instruction symbol	Description	Reference
MOVB	Stores the bit data specified by (s) in (d).	Page 311
MOVBP		

■Parallel run (octal mode) (16-bit data)

Instruction symbol	Description	Reference
PRUN	Handles device number specified by (s) in nibble specification and (d) as octal, and stores into (d) from (s).	Page 312
PRUNP		

■Parallel run (octal mode) (32-bit data)

Instruction symbol	Description	Reference
DPRUN	Handles device number specified by (s) in nibble specification and (d) as octal, and stores into (d) from (s).	Page 314
DPRUNP		

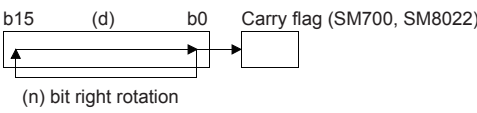
■Transferring n-bit data

Instruction symbol	Description	Reference
BLKMOVB	Block transfers bit data for (n) points from (s) to bit data for (n) points from (d).	Page 316
BLKMOVBP		

2.3 Application instruction

Rotation instruction

■Rotating 16-bit data to the right

Instruction symbol	Description	Reference
ROR		Page 317
RORP		
RCR		
RCRP		

■Rotating 16-bit data to the left

Instruction symbol	Description	Reference
ROL	<div>Carry flag (SM700, SM8022)</div> <div><div><div>b15</div><div>(d)</div><div>b0</div></div><div><div></div><div></div><div></div></div><div>(n) bit left rotation</div></div>	Page 320
ROLP		
RCL	<div>Carry flag (SM700, SM8022)</div> <div><div><div>b15</div><div>(d)</div><div>b0</div></div><div><div></div><div></div><div></div></div><div>(n) bit left rotation</div></div>	
RCLP		

■Rotating 32-bit data to the right

Instruction symbol	Description	Reference
DROR	<div><div><div>(d+1) b31 ... b16</div><div>(d) b15 ... b0</div></div><div>Carry flag (SM700, SM8022)</div><div>(n) bit right rotation</div></div>	Page 322
DRORP		
DRCR	<div><div><div>(d+1) b31 ... b16</div><div>(d) b15 ... b0</div></div><div>Carry flag (SM700, SM8022)</div><div>(n) bit right rotation</div></div>	
DRCRP		

■Rotating 32-bit data to the left

Instruction symbol	Description	Reference
DROL	<div>Carry flag (SM700, SM8022)</div> <div><div><div></div><div><div><div>(d+1)</div><div>b31 ... b16</div><div>b15</div></div><div><div>(d)</div><div>b15 ... b0</div><div>b0</div></div></div><div></div></div><div>(n) bit left rotation</div></div>	Page 324
DROLP		
DRCL	<div>Carry flag (SM700, SM8022)</div> <div><div><div></div><div><div><div>(d+1)</div><div>b31 ... b16</div><div>b15</div></div><div><div>(d)</div><div>b15 ... b0</div><div>b0</div></div></div><div></div></div><div>(n) bit left rotation</div></div>	
DRCLP		

Program branch instruction

■Pointer branch

Instruction symbol	Description	Reference
CJ	When the input condition is met, jump to pointer (P)	Page 326
CJP		

■Jumping to END

Instruction symbol	Description	Reference
GOEND	When the input condition is met, jump to END instruction	Page 329

Program execution control instruction

■Disabling/enabling interrupt programs

Instruction symbol	Description	Reference
DI	Disables the execution of interrupt programs.	Page 330
EI	Releases the execution disabled state of interrupt program.	

■Disabling the interrupt program with specified priority or lower

Instruction symbol	Description	Reference
DI	Disables the execution of the interrupt program with a priority specified by (s) or lower until the EI instruction is executed.	Page 332

■Interrupt program mask

Instruction symbol	Description	Reference
IMASK	Interrupt disable/enable settings	Page 335

■Disabling/enabling the specified interrupt pointer

Instruction symbol	Description	Reference
SIMASK	Disables/enables the interrupt pointer specified by (I)	Page 337

■Returning from the interrupt program

Instruction symbol	Description	Reference
IRET	Returns from the interrupt program to the sequence program	Page 338

■Resetting the watchdog timer

Instruction symbol	Description	Reference
WDT	Resets the watchdog timer (WDT) in the program	Page 339
WDTP		

Structuring instruction

■Performing the FOR to NEXT instruction loop

Instruction symbol	Description	Reference
FOR	Execute the instructions between FOR instruction and NEXT instruction (n) times	Page 340
NEXT		

■Forcibly terminating the FOR to NEXT instruction loop

Instruction symbol	Description	Reference
BREAK	Forcibly end execution between FOR instruction and NEXT instruction, and jump to pointer (P)	Page 342
BREAKP		

■Calling a subroutine program

Instruction symbol	Description	Reference
CALL	Executes a subroutine program specified by (P) when the input condition is met.	Page 344
CALLP		

■Returning from the subroutine program

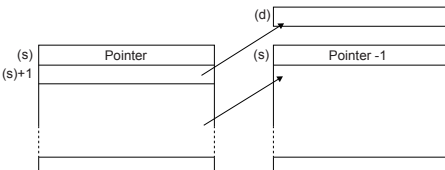
Instruction symbol	Description	Reference
RET	Returns from the subroutine program.	Page 348
SRET		

■Calling a subroutine program

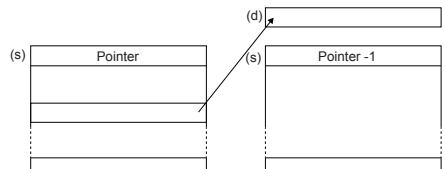
Instruction symbol	Description	Reference
XCALL	Executes a subroutine program specified by (P) when the input condition is met. Carry out non-execution processing for the subroutine program (P), when input conditions are not met.	Page 349

Data table operation instruction

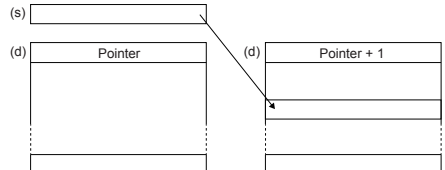
■Reading the oldest data from the data table

Instruction symbol	Description	Reference
SFRD		Page 351
SFRDP		

■Reading the newest data from the data table

Instruction symbol	Description	Reference
POP		Page 353
POPP		

■Writing data to the data table

Instruction symbol	Description	Reference
SFWR		Page 355
SFWRP		

■Deleting/inserting data from/to the data table

Instruction symbol	Description	Reference
FINS		Page 357
FINSP		
FDEL		Page 359
FDELP		

Character string operation instruction

■Comparing character strings

Instruction symbol	Description	Reference
LD\$=, AND\$=, OR\$=	Compares the character string (s1) with the character string (s2) one character at a time.*1 [Character string (s1)] = [Character string (s2)]: Conductive state [Character string (s1)] ≠ [Character string (s2)]: Non-Conductive state	Page 361
LD\$<>, AND\$<>, OR\$<>	Compares the character string (s1) with the character string (s2) one character at a time.*1 [Character string (s1)] ≠ [Character string (s2)]: Conductive state [Character string (s1)] = [Character string (s2)]: Non-Conductive state	
LD\$>, AND\$>, OR\$>	Compares the character string (s1) with the character string (s2) one character at a time.*1 [Character string (s1)] > [Character string (s2)]: Conductive state [Character string (s1)] ≤ [Character string (s2)]: Non-Conductive state	
LD\$≤, AND\$≤, OR\$≤	Compares the character string (s1) with the character string (s2) one character at a time.*1 [Character string (s1)] ≤ [Character string (s2)]: Conductive state [Character string (s1)] > [Character string (s2)]: Non-Conductive state	
LD\$<, AND\$<, OR\$<	Compares the character string (s1) with the character string (s2) one character at a time.*1 [Character string (s1)] < [Character string (s2)]: Conductive state [Character string (s1)] ≥ [Character string (s2)]: Non-Conductive state	
LD\$≥, AND\$≥, OR\$≥	Compares the character string (s1) with the character string (s2) one character at a time.*1 [Character string (s1)] ≥ [Character string (s2)]: Conductive state [Character string (s1)] < [Character string (s2)]: Non-Conductive state	

*1 The following shows comparison conditions for comparing character strings.

- Match: All characters in the strings must match
- Larger string: In case of different character strings, character string with the larger character code
(If character string lengths are different, the longer character string)
- Smaller string: In case of different character strings, character string with the smaller character code
(If character string lengths are different, the shorter character string)

■Concatenating character strings

Instruction symbol	Description	Reference
\$+	<ul style="list-style-type: none"> • In case of 2 operands Connect the character string specified by (s) to the end of the character string specified by (d), and store in (d).	Page 364
\$+P		
\$+	<ul style="list-style-type: none"> • In case of 3 operands Connect the character string specified by (s2) to the end of the character string specified by (s1), and store in (d).	Page 366
\$+P		

■Transferring character strings

Instruction symbol	Description	Reference
\$MOV	Transfer the character strings specified by (s) to the devices specified by (d) onwards.	Page 368
\$MOVP		

■Converting 16-bit/32-bit binary data to decimal ASCII

Instruction symbol	Description	Reference
BINDA	Converts the 1 word binary value specified by (s) to 5 digits decimal ASCII value, and stores in the word device specified by (d).	Page 370
BINDAP		
BINDA_U		
BINDAP_U		
DBINDA	Converts the 2 word binary value specified by (s) to 10 digits decimal ASCII value, and stores in the word device area specified by (d) onwards.	Page 372
DBINDAP		
DBINDA_U		
DBINDAP_U		

■Converting HEX code data to ASCII

Instruction symbol	Description	Reference
ASCI	Converts the (n) characters within the HEX code data specified by (s) to ASCII, and stores in the device area specified by (d) onwards.	Page 374
ASCIP		

■Converting 16-bit/32-bit binary data to character string

Instruction symbol	Description	Reference
STR	Converts the 1 word binary value specified by (s2) to the decimal character string with total number of digits and the number of digits in the decimal fraction part as specified in (s1), and stores this in the device specified by (d).	Page 378
STRP		
STR_U		
STRP_U		
DSTR	Convert the 2 word binary value specified by (s2) to the decimal character string with total number of digits and the number of digits in the decimal fraction part as specified in (s1), and stores this in the device specified by (d).	Page 380
DSTRP		
DSTR_U		
DSTRP_U		

■Converting single-precision real number to character string

Instruction symbol	Description	Reference
ESTR	Converts the single-precision real number data specified by (s1) to a character string, and store this in the device specified by (d).	Page 383
ESTRP		
DESTR		
DESTRP		

■Detecting a character string length

Instruction symbol	Description	Reference
LEN	Stores the length of the character string data stored in the device specified by (s) in the device specified by (d).	Page 388
LENP		

■Extracting character string data from the right/left

Instruction symbol	Description	Reference
RIGHT	Stores the (n) characters from the last character of the character string specified by (s) in the device specified by (d).	Page 390
RIGHTP		
LEFT	Stores the (n) characters from the first character of the character string specified by (s) in the device specified by (d).	Page 392
LEFTP		

■ Storing/replacing the specified number of character strings

Instruction symbol	Description	Reference
MIDR	Stores the specified number of characters from the position specified by (s2) of the character string (s1) into the device specified by (d).	Page 394
MIDRP		
MIDW	Stores the specified number of characters from the character string (s1) into the location specified by (s2) of the character string (d).	Page 396
MIDWP		

■ Searching character string

Instruction symbol	Description	Reference
INSTR	Searches the character string in the device specified by (s2), starting from the (s3)th character, for the character string in the device specified by (s1), and stores the matching location in the device specified by (d).	Page 398
INSTRP		

■ Inserting character string

Instruction symbol	Description	Reference
STRINS	Inserts the character string data specified in (s1) at the position (s2)(Insert position) from the beginning of the character string data specified by (d).	Page 400
STRINSP		

■ Deleting character string

Instruction symbol	Description	Reference
STRDEL	From the head of the character string data specified in (d), delete (n2) characters from the location specified as the character number (n1) (deletion start location).	Page 402
STRDELP		

Real number instruction

■ Comparing single-precision real numbers

Instruction symbol	Description	Reference
LDE=, ANDE=, ORE=	[[s1]+1, (s1)] = [(s2)+1, (s2)]: Conductive [[s1]+1, (s1)] ≠ [(s2)+1, (s2)]: Non-Conductive	Page 404
LDE<>, ANDE<>, ORE<>	[[s1]+1, (s1)] ≠ [(s2)+1, (s2)]: Conductive [[s1]+1, (s1)] = [(s2)+1, (s2)]: Non-Conductive	
LDE>, ANDE>, ORE>	[[s1]+1, (s1)] > [(s2)+1, (s2)]: Conductive [[s1]+1, (s1)] ≤ [(s2)+1, (s2)]: Non-Conductive	
LDE≤, ANDE≤, ORE≤	[[s1]+1, (s1)] ≤ [(s2)+1, (s2)]: Conductive [[s1]+1, (s1)] > [(s2)+1, (s2)]: Non-Conductive	
LDE<, ANDE<, ORE<	[[s1]+1, (s1)] < [(s2)+1, (s2)]: Conductive [[s1]+1, (s1)] ≥ [(s2)+1, (s2)]: Non-Conductive	
LDE≥, ANDE≥, ORE≥	[[s1]+1, (s1)] ≥ [(s2)+1, (s2)]: Conductive [[s1]+1, (s1)] < [(s2)+1, (s2)]: Non-Conductive	
DECMP	This instruction compares two data values (single-precision real numbers), and outputs the result (larger, smaller or equal) to three bit devices.	Page 406
DECMPP		
DEZCP	This instruction compares two data values (single-precision real numbers), and outputs the result (larger, smaller or data band) to three bit devices.	Page 408
DEZCPP		

■ Adding/subtracting single-precision real numbers

Instruction symbol	Description	Reference
E+	• In case of 2 operands [(d)+1, (d)] + [(s)+1, (s)] → [(d)+1, (d)]	Page 410
E+P		
E+	• In case of 3 operands [(s1)+1, (s1)] + [(s2)+1, (s2)] → [(d)+1, (d)]	Page 411
E+P		
DEADD		Page 414
DEADDP		
E-	• In case of 2 operands [(d)+1, (d)] - [(s)+1, (s)] → [(d)+1, (d)]	Page 412
E-P		

Instruction symbol	Description	Reference
E-	<ul style="list-style-type: none"> In case of 3 operands $[(s1)+1, (s1)] - [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 413
E-P		
DESUB		Page 416
DESUBP		

■ Multiplying/dividing single-precision real numbers

Instruction symbol	Description	Reference
E*	$[(s1)+1, (s1)] \times [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 418
E*P		
DEMUL		Page 422
DEMULP		
E/	$[(s1)+1, (s1)] \div [(s2)+1, (s2)] \rightarrow \text{quotient } [(d)+1, (d)]$	Page 420
E/P		
DEDIV		Page 424
DEDIVP		

■ Converting 16-bit/32-bit signed binary data to single-precision real number

Instruction symbol	Description	Reference
INT2FLT	Converts the 16-bit signed binary data in the device specified by (s) to single-precision real number, and stores the converted data in the device specified by (d).	Page 426
INT2FLTP		
DINT2FLT	Converts the 32-bit signed binary data in the device specified by (s) to single-precision real number, and stores the converted data in the device specified by (d).	Page 428
DINT2FLTP		

■ Converting 16-bit/32-bit unsigned binary data to single-precision real number

Instruction symbol	Description	Reference
UINT2FLT	Converts the 16-bit unsigned binary data in the device specified by (s) to single-precision real number, and stores the converted data in (d).	Page 427
UINT2FLTP		
UDINT2FLT	Converts the 32-bit unsigned binary data in the device specified by (s) to single-precision real number, and stores the converted data in (d).	Page 429
UDINT2FLTP		

■ Converting character string to single-precision real number

Instruction symbol	Description	Reference
EVAL	Converts the character string specified by (s) to a single-precision real number, and stores the converted data in (d).	Page 430
EVALP		
DEVAL		
DEVALP		

■ Converting binary floating point to decimal floating point

Instruction symbol	Description	Reference
DEBCD	Converts the binary floating point specified by (s) into decimal floating point, and stores in (d).	Page 433
DEBCDP		

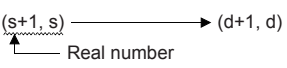
■ Converting decimal floating point to binary floating point

Instruction symbol	Description	Reference
DEBIN	Converts the decimal floating point specified by (s) into binary floating point, and stores in (d).	Page 435
DEBINP		

■ Inverting the sign of single-precision real number

Instruction symbol	Description	Reference
ENEG		Page 437
ENEGP		
DENEG		
DENEGP		

■Transferring single-precision real number data

Instruction symbol	Description	Reference
EMOV		Page 438
EMOVP		
DEMOV		
DEMOVP		

■Calculating the sine of single-precision real number

Instruction symbol	Description	Reference
SIN	Sin [(s)+1, (s)] → [(d)+1, (d)]	Page 439
SINP		
DSIN		
DSINP		

■Calculating the cosine of single-precision real number

Instruction symbol	Description	Reference
COS	Cos [(s)+1, (s)] → [(d)+1, (d)]	Page 441
COSP		
DCOS		
DCOSP		

■Calculating the tangent of single-precision real number

Instruction symbol	Description	Reference
TAN	Tan [(s)+1, (s)] → [(d)+1, (d)]	Page 443
TANP		
DTAN		
DTANP		

■Calculating the arc sine of single-precision real number

Instruction symbol	Description	Reference
ASIN	$\text{Sin}^{-1} [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 445
ASINP		
DASIN		
DASINP		

■Calculating the arc cosine of single-precision real number

Instruction symbol	Description	Reference
ACOS	$\text{Cos}^{-1} [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 447
ACOSP		
DACOS		
DACOSP		

■Calculating the arc tangent of single-precision real number

Instruction symbol	Description	Reference
ATAN	$\text{Tan}^{-1} [(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 449
ATANP		
DATAN		
DATANP		

■Converting single-precision real number angle to radian

Instruction symbol	Description	Reference
RAD	$(s+1, s) \longrightarrow (d+1, d)$ Converts from degrees to radians	Page 451
RADP		
DRAD		
DRADP		

■Converting single-precision real number radian to angle

Instruction symbol	Description	Reference
DEG	$(s+1, s) \longrightarrow (d+1, d)$ Converts from radians to degrees	Page 452
DEGP		
DDEG		
DDEGP		

■Calculating the square root of single-precision real number

Instruction symbol	Description	Reference
DESQR	$\sqrt{(s+1, s)} \longrightarrow (d+1, d)$	Page 453
DESQRP		

■Calculating the exponent of single-precision real number

Instruction symbol	Description	Reference
EXP	$e^{[(s)+1, (s)]} \rightarrow [(d)+1, (d)]$	Page 454
EXPP		
DEXP		
DEXPP		

■Calculating the natural logarithm of single-precision real number

Instruction symbol	Description	Reference
LOG	$\text{Loge}[(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 456
LOGP		
DLOGE		
DLOGEP		

■Calculating the exponentiation of single-precision real number

Instruction symbol	Description	Reference
POW	$[(s1)+1, (s1)]^{[(s2)+1, (s2)]} \rightarrow [(d)+1, (d)]$	Page 458
POWP		

■Calculating the common logarithm of single-precision real number

Instruction symbol	Description	Reference
LOG10	$\log_{10}[(s)+1, (s)] \rightarrow [(d)+1, (d)]$	Page 460
LOG10P		
DLOG10		
DLOG10P		

■Searching the maximum value of single-precision real number

Instruction symbol	Description	Reference
EMAX	These instructions search for the maximum value in the (n) points of single-precision real number block data specified by the device starting from the one specified by (s), and store the maximum value in the device area specified by (d).	Page 461
EMAXP		

■Searching the minimum value of single-precision real number

Instruction symbol	Description	Reference
EMIN	These instructions search for the minimum value in the (n) points of single-precision real number block data specified by the device starting from the one specified by (s), and store the minimum value in the device areas specified by (d).	Page 463
EMINP		

Random number instruction

■Generating random number

Instruction symbol	Description	Reference
RND	Generates a random number from 0 to 32767, and stores this in the device specified by (d).	Page 465
RNDP		

Index register operation instruction

■Saving/returning all data of the index register

Instruction symbol	Description	Reference
ZPUSH	Saves the contents of index registers to the devices specified by (d) onwards.	Page 466
ZPUSHP		
ZPOP	Reads the data in devices specified by (d) onwards to the index registers.	Page 468
ZPOPP		

■Saving/returning the selected data of the index register and long index register

Instruction symbol	Description	Reference
ZPUSH	Saves the contents of the index registers and long index registers in the range specified by (s) to devices specified by (d) onwards.	Page 469
ZPUSHP		
ZPOP	Reads data in the devices specified by (d) onwards to the index registers and long index registers.	Page 471
ZPOPP		

Data control instruction

■Upper and lower limit control of 16-bit/32-bit binary data

Instruction symbol	Description	Reference
LIMIT	(s3) < (s1): The (s1) value is stored in (d) (s1) ≤ (s3) ≤ (s2): The (s3) value is stored in (d) (s2) < (s3): The (s2) value is stored in (d)	Page 472
LIMITP		
LIMIT_U		
LIMITP_U		
DLIMIT	[(s3)+1, (s3)] < [(s1)+1, (s1)]: The [(s1)+1, (s1)] value is stored in [(d)+1, (d)] [(s1)+1, (s1)] ≤ [(s3)+1, (s3)] ≤ [(s2)+1, (s2)]: The [(s3)+1, (s3)] value is stored in [(d)+1, (d)] [(s2)+1, (s2)] < [(s3)+1, (s3)]: The [(s2)+1, (s2)] value is stored in [(d)+1, (d)]	Page 474
DLIMITP		
DLIMIT_U		
DLIMITP_U		

■Dead band control of 16-bit/32-bit binary data

Instruction symbol	Description	Reference
BAND	When $(s1) \leq (s3) \leq (s2)$: $0 \rightarrow (d)$ When $(s3) < (s1)$: $(s3) - (s1) \rightarrow (d)$ When $(s2) < (s3)$: $(s3) - (s2) \rightarrow (d)$	Page 476
BANDP		
BAND_U		
BANDP_U		
DBAND	When $[(s1)+1, (s1)] \leq [(s3)+1, (s3)] \leq [(s2)+1, (s2)]$: $0 \rightarrow (d+1, d)$ When $[(s3)+1, (s3)] < [(s1)+1, (s1)]$: $[(s3)+1, (s3)] - [(s1)+1, (s1)] \rightarrow [(d)+1, (d)]$ When $[(s2)+1, (s2)] < [(s3)+1, (s3)]$: $[(s3)+1, (s3)] - [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$	Page 478
DBANDP		
DBAND_U		
DBANDP_U		

■Zone control of 16-bit/32-bit binary data

Instruction symbol	Description	Reference
ZONE	When $(s3) = 0$: $0 \rightarrow (d)$ When $(s3) > 0$: $(s3) + (s2) \rightarrow (d)$ When $(s3) < 0$: $(s3) + (s1) \rightarrow (d)$	Page 480
ZONEP		
ZONE_U		
ZONEP_U		
DZONE	When $[(s3)+1, (s3)] = 0$: $0 \rightarrow [(d)+1, (d)]$ When $[(s3)+1, (s3)] > 0$: $[(s3)+1, (s3)] + [(s2)+1, (s2)] \rightarrow [(d)+1, (d)]$ When $[(s3)+1, (s3)] < 0$: $[(s3)+1, (s3)] + [(s1)+1, (s1)] \rightarrow [(d)+1, (d)]$	Page 482
DZONEP		
DZONE_U		
DZONEP_U		

■Scaling 16-bit/32-bit binary data (point coordinates)

Instruction symbol	Description	Reference
SCL	Executes scaling using the scaling conversion data (16-bit data units) specified by (s2) for the input value specified by (s1), and then stores the result in the device specified by (d). The scaling conversion is executed based on the scaling conversion data stored in the device specified by (s2) onwards.	Page 484
SCLP		
SCL_U		
SCLP_U		
DSCL	Executes scaling using the scaling conversion data (32-bit data units) specified by (s2) for the input value specified by (s1), and then stores the result in the device specified by (d). The scaling conversion is executed based on the scaling conversion data stored in the device specified by (s2) onwards.	Page 487
DSCLP		
DSCL_U		
DSCLP_U		

■Scaling 16-bit/32-bit binary data (XY coordinates)

Instruction symbol	Description	Reference
SCL2	Executes scaling using the scaling conversion data (16-bit data units) specified by (s2) for the input value specified by (s1), and then stores the result in the device specified by (d). The scaling conversion is executed based on the scaling conversion data stored in the device specified by (s2) onwards.	Page 490
SCL2P		
SCL2_U		
SCL2P_U		
DSCL2	Executes scaling using the scaling conversion data (32-bit data units) specified by (s2) for the input value specified by (s1), and then stores the result in the device specified by (d). The scaling conversion is executed based on the scaling conversion data stored in the device specified by (s2) onwards.	Page 493
DSCL2P		
DSCL2_U		
DSCL2P_U		

Special timer instruction

■Teaching timer

Instruction symbol	Description	Reference
TTMR	$(\text{On time of TTMR}) \times (s) \longrightarrow (d)$ <p style="text-align: center;">↑ (s)=0:1, (s)=1:10, (s)=2:100</p>	Page 496

■Special function timer

Instruction symbol	Description	Reference
STMR	<p>The 4 points from the bit device specified by (d) operate as shown below, depending on the ON/OFF status of the input conditions for the STMR instruction:</p> <p>(d)+0: Off delay timer output (d)+1: One shot after off timer output (d)+2: One shot after on timer output (d)+3: On delay and off delay timer output</p>	Page 498

Shortcut control instruction

■Rotary table shortest direction control

Instruction symbol	Description	Reference
ROTC	Rotates a rotary table with (n1) divisions from the stop position to the position specified by (s)+1 in the shortest direction.	Page 500

Ramp signal instruction

■Ramp signal

Instruction symbol	Description	Reference
RAMPF	Shifts the value from the one specified by (s1) to the one specified by (s2) in (n) scans. The current value is stored in the device specified by (d1)+0.	Page 503

Pulse related instruction

■Measuring the density of 16 bit binary/32 bit binary pulses

Instruction symbol	Description	Reference
SPD	Counts the pulse input from the device specified by (s1) for the duration of time specified by (s2), and stores the count in the device specified by (d).	Page 505
DSPD		Page 509

■16 bit binary/32 bit binary pulse output

Instruction symbol	Description	Reference
PLSY	<ul style="list-style-type: none"> When an FX3 series-compatible operand is specified <p>This instruction outputs a pulse at a frequency specified by (s) for the number of times specified by (n) from the output number (Y) specified by (d).</p> <ul style="list-style-type: none"> When an FX5 series-compatible operand is specified <p>This instruction outputs a pulse at a frequency specified by (s) for the number of times specified by (n), from the output number (axis number) specified by (d).</p>	Page 513
DPLSY		Page 521

■16 bit binary/32 bit binary pulse width modulation

Instruction symbol	Description	Reference
PWM	Outputs the pulse of the cycle specified by (s2), for the ON time on specified by (s1), to the output number specified by (d).	Page 529
DPWM		Page 533

Drum sequence

■16-bit binary data absolute method

Instruction symbol	Description	Reference
ABSD	Creates many output patterns corresponding to the current value of a counter.	Page 538

■32-bit binary data absolute method

Instruction symbol	Description	Reference
DABSD	Creates many output patterns corresponding to the current value of a counter.	Page 540

■Relative method

Instruction symbol	Description	Reference
INCD	This instruction compares the current value of a counter with the data table having (n) lines starting from (s1) (which occupies (n) lines × 1 device). If the counter value is equivalent to the table data, the current output is reset, and the ON/OFF status of the specified sequential outputs is controlled.	Page 542

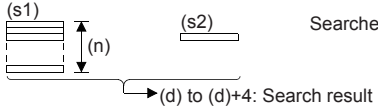
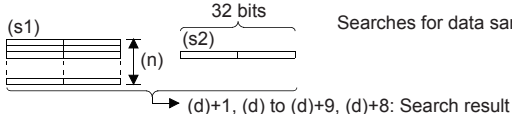
Check code

■Check code

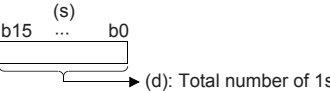
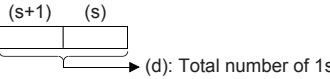
Instruction symbol	Description	Reference
CCD	This instruction calculates the sum data and horizontal parity value of data stored in (s) to (s)+(n)-1.	Page 544
CCDP	The sum data is stored in (d), and the horizontal parity value is stored in (d)+1.	

Data operation instruction

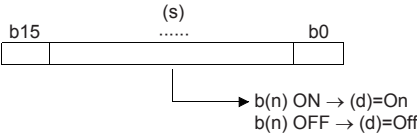
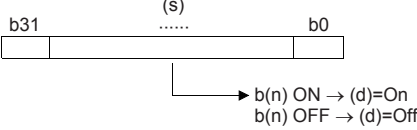
■Searching 16-bit/32-bit data

Instruction symbol	Description	Reference
SERMM	 <p>Searches for data same as (s2) in (s1).</p>	Page 547
SERMMP		
DSERMM	 <p>Searches for data same as (s2) in (s1).</p>	Page 549
DSERMMP		

■Bit check of 16-bit/32-bit data

Instruction symbol	Description	Reference
SUM		Page 551
SUMP		
DSUM		Page 552
DSUMP		

■Bit judgment of 16-bit data/32-bit data

Instruction symbol	Description	Reference
BON		Page 553
BONP		
DBON		Page 554
DBONP		

■Searching the maximum value of 16-bit/32-bit data

Instruction symbol	Description	Reference
MAX	This instruction searches the data of (n) points from the device specified by (s) in 16-bit units, and stores the maximum value in the device specified by (d).	Page 555
MAXP		
MAX_U		
MAXP_U		
DMAX	This instruction searches the data of (n) points from the device specified by (s) in 32-bit units, and stores the maximum value in the device specified by (d).	Page 556
DMAXP		
DMAX_U		
DMAXP_U		

■Searching the minimum value of 16-bit/32-bit data

Instruction symbol	Description	Reference
MIN	This instruction searches the data of (n) points from the device specified by (s) in 16-bit units, and stores the minimum value in the device specified by (d).	Page 557
MINP		
MIN_U		
MINP_U		
DMIN	This instruction searches the data of (n) points from the device specified by (s) in 32-bit units, and stores the minimum value in the device specified by (d).	Page 558
DMINP		
DMIN_U		
DMINP_U		

■Sorting 16-bit data

Instruction symbol	Description	Reference
SORTTBL	In the data table (sorting source) having ((m1)×(m2)) points specified by (s), sorts the data lines in the ascending order based on the group data in the column number (n), and stores the result in the data table (sorting result) having ((m1)×(m2)) points specified by (d).	Page 559
SORTTBL_U		

■16-bit/32-bit data alignment 2

Instruction symbol	Description	Reference
SORTTBL2	In the data table (sorting source) of 16-bit binary data having (m1×m2) points specified by (s), sorts the data lines in the ascending order based on the group data in the column number (n), and stores the result in the data table (sorting result) of 16-bit binary data having ((m1)×(m2)) points specified by (d).	Page 562
SORTTBL2_U		
DSORTTBL2	In the data table (sorting source) of 32-bit binary data having (m1×m2) points specified by (s), sorts the data lines in the ascending order based on the group data in the column number (n), and stores the result in the data table (sorting result) of 32-bit binary data having ((m1)×(m2)) points specified by (d).	Page 565
DSORTTBL2_U		

■Adding 16-bit data

Instruction symbol	Description	Reference
WSUM	These instructions add the (n) points of 16-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).	Page 568
WSUM_U		
WSUMP		
WSUMP_U		

■Adding 32-bit data

Instruction symbol	Description	Reference
DWSUM	These instructions add the (n) points of 32-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).	Page 569
DWSUM_U		
DWSUMP		
DWSUMP_U		

■Calculating the mean value of 16-bit/32-bit data

Instruction symbol	Description	Reference
MEAN	These instructions calculate the mean value of (n) points (16-bit binary data) in the devices starting from the one specified by (s), and store the result in the device specified by (d).	Page 570
MEANP		
MEAN_U		
MEANP_U		
DMEAN	These instructions calculate the mean value of (n) points (32-bit binary data) in the devices starting from the one specified by (s), and store the result in the device specified by (d).	Page 571
DMEANP		
DMEAN_U		
DMEANP_U		

■Calculating the square root of 16-bit/32-bit data

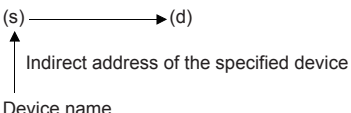
Instruction symbol	Description	Reference
SQRT	$\sqrt{(s)} \rightarrow (d)$	Page 572
SQRTP		
DSQRT	$\sqrt{(s)+1,(s)} \rightarrow (d)+1,(d)$	Page 573
DSQRTP		

■CRC calculation

Instruction symbol	Description	Reference
CRC	This instruction generates a CRC value for (n) 8-bit data (unit: byte) starting from the device specified by (s), and stores the CRC value to (d).	Page 574
CRCP		

File register operation instruction

■Reading the indirect address

Instruction symbol	Description	Reference
ADRSET	$(s) \longrightarrow (d)$ 	Page 577
ADRSETP		

Clock instruction

■Reading clock data

Instruction symbol	Description	Reference														
TRD	(Clock element) → (d)+0 <table><tr><td>+0</td><td>Year</td></tr><tr><td>+1</td><td>Month</td></tr><tr><td>+2</td><td>Day</td></tr><tr><td>+3</td><td>Hour</td></tr><tr><td>+4</td><td>Minute</td></tr><tr><td>+5</td><td>Seconds</td></tr><tr><td>+6</td><td>Day of week</td></tr></table>	+0	Year	+1	Month	+2	Day	+3	Hour	+4	Minute	+5	Seconds	+6	Day of week	Page 579
+0	Year															
+1	Month															
+2	Day															
+3	Hour															
+4	Minute															
+5	Seconds															
+6	Day of week															
TRDP																

■Writing clock data

Instruction symbol	Description	Reference						
TWR	(d)+0 <table><tr><td>Year</td></tr></table> → (Clock element)	Year	Page 581					
Year								
TWRP	+1 <table><tr><td>Month</td></tr></table> +2 <table><tr><td>Day</td></tr></table> +3 <table><tr><td>Hour</td></tr></table> +4 <table><tr><td>Minute</td></tr></table> +5 <table><tr><td>Seconds</td></tr></table> +6 <table><tr><td>Day of week</td></tr></table>	Month	Day	Hour	Minute	Seconds	Day of week	
Month								
Day								
Hour								
Minute								
Seconds								
Day of week								

■Adding clock data

Instruction symbol	Description	Reference
TADD	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} + \begin{array}{ c } \hline (s2) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} \rightarrow \begin{array}{ c } \hline (d) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} $	Page 583
TADDP		

■Subtracting clock data

Instruction symbol	Description	Reference
TSUB	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} - \begin{array}{ c } \hline (s2) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} \rightarrow \begin{array}{ c } \hline (d) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} $	Page 585
TSUBP		

■Converting time data from hour/minute/second to seconds in 16 bits/32 bits

Instruction symbol	Description	Reference
HTOS	$ \begin{array}{ c } \hline (s) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} \rightarrow \begin{array}{ c } \hline (d) \\ \hline \text{Seconds} \\ \hline \end{array} $	Page 587
HTOSP		
DHTOS	$ \begin{array}{ c } \hline (s) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} \rightarrow \begin{array}{ c } \hline (d)+1 \\ \hline \text{Seconds} \\ \hline \end{array} $	Page 588
DHTOSP		

■Converting time data from seconds to hour/minute/second in 16 bits/32 bits

Instruction symbol	Description	Reference
STOH	$ \begin{array}{ c } \hline (s) \\ \hline \text{Seconds} \\ \hline \end{array} \rightarrow \begin{array}{ c } \hline (d) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} $	Page 589
STOHP		
DSTOH	$ \begin{array}{ c } \hline (s)+1 \\ \hline \text{Seconds} \\ \hline \end{array} \rightarrow \begin{array}{ c } \hline (d) \\ \hline \text{Hour} \\ \hline \text{Minute} \\ \hline \text{Seconds} \\ \hline \end{array} $	Page 590
DSTOHP		

■Comparing date data

Instruction symbol	Description	Reference
LDDT=, ANDDT=, ORDT=	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Year} \\ \hline (s1)+1 \\ \hline \text{Month} \\ \hline (s1)+2 \\ \hline \text{Day} \\ \hline \end{array} = \begin{array}{ c } \hline (s2) \\ \hline \text{Year} \\ \hline (s2)+1 \\ \hline \text{Month} \\ \hline (s2)+2 \\ \hline \text{Day} \\ \hline \end{array} \rightarrow \text{Result} $	Page 591
LDDT<>, ANDDT<>, ORDT<>	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Year} \\ \hline (s1)+1 \\ \hline \text{Month} \\ \hline (s1)+2 \\ \hline \text{Day} \\ \hline \end{array} < > \begin{array}{ c } \hline (s2) \\ \hline \text{Year} \\ \hline (s2)+1 \\ \hline \text{Month} \\ \hline (s2)+2 \\ \hline \text{Day} \\ \hline \end{array} \rightarrow \text{Result} $	
LDDT>, ANDDT>, ORDT>	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Year} \\ \hline (s1)+1 \\ \hline \text{Month} \\ \hline (s1)+2 \\ \hline \text{Day} \\ \hline \end{array} > \begin{array}{ c } \hline (s2) \\ \hline \text{Year} \\ \hline (s2)+1 \\ \hline \text{Month} \\ \hline (s2)+2 \\ \hline \text{Day} \\ \hline \end{array} \rightarrow \text{Result} $	
LDDT<=, ANDDT<=, ORDT<=	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Year} \\ \hline (s1)+1 \\ \hline \text{Month} \\ \hline (s1)+2 \\ \hline \text{Day} \\ \hline \end{array} < = \begin{array}{ c } \hline (s2) \\ \hline \text{Year} \\ \hline (s2)+1 \\ \hline \text{Month} \\ \hline (s2)+2 \\ \hline \text{Day} \\ \hline \end{array} \rightarrow \text{Result} $	
LDDT<, ANDDT<, ORDT<	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Year} \\ \hline (s1)+1 \\ \hline \text{Month} \\ \hline (s1)+2 \\ \hline \text{Day} \\ \hline \end{array} < \begin{array}{ c } \hline (s2) \\ \hline \text{Year} \\ \hline (s2)+1 \\ \hline \text{Month} \\ \hline (s2)+2 \\ \hline \text{Day} \\ \hline \end{array} \rightarrow \text{Result} $	
LDDT>=, ANDDT>=, ORDT>=	$ \begin{array}{ c } \hline (s1) \\ \hline \text{Year} \\ \hline (s1)+1 \\ \hline \text{Month} \\ \hline (s1)+2 \\ \hline \text{Day} \\ \hline \end{array} > = \begin{array}{ c } \hline (s2) \\ \hline \text{Year} \\ \hline (s2)+1 \\ \hline \text{Month} \\ \hline (s2)+2 \\ \hline \text{Day} \\ \hline \end{array} \rightarrow \text{Result} $	

■Comparing time data

Instruction symbol	Description	Reference
LDTM=, ANDTM=, ORTM=	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} = \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \rightarrow \text{Result}$	Page 594
LDTM<>, ANDTM<>, ORTM<>	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} < > \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \rightarrow \text{Result}$	
LDTM>, ANDTM>, ORTM>	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} > \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \rightarrow \text{Result}$	
LDTM<=, ANDTM<=, ORTM<=	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} < = \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \rightarrow \text{Result}$	
LDTM<, ANDTM<, ORTM<	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} < \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \rightarrow \text{Result}$	
LDTM>=, ANDTM>=, ORTM>=	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} > = \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \rightarrow \text{Result}$	

■Comparing clock data

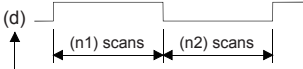
Instruction symbol	Description	Reference
TCMP	$\begin{matrix} (s1) & \text{Hour} \\ (s2) & \text{Minute} \\ (s3) & \text{Seconds} \end{matrix} > \begin{matrix} (s4) & \text{Hour} \\ (s4)+1 & \text{Minute} \\ (s4)+2 & \text{Seconds} \end{matrix} \Rightarrow (d) = \text{ON}$ $\begin{matrix} (s1) & \text{Hour} \\ (s2) & \text{Minute} \\ (s3) & \text{Seconds} \end{matrix} = \begin{matrix} (s4) & \text{Hour} \\ (s4)+1 & \text{Minute} \\ (s4)+2 & \text{Seconds} \end{matrix} \Rightarrow (d)+1 = \text{ON}$ $\begin{matrix} (s1) & \text{Hour} \\ (s2) & \text{Minute} \\ (s3) & \text{Seconds} \end{matrix} < \begin{matrix} (s4) & \text{Hour} \\ (s4)+1 & \text{Minute} \\ (s4)+2 & \text{Seconds} \end{matrix} \Rightarrow (d)+2 = \text{ON}$	Page 597
TCMP		
TCMP		

■Comparing clock data zones

Instruction symbol	Description	Reference
TZCP	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} > \begin{matrix} (s3) & \text{Hour} \\ (s3)+1 & \text{Minute} \\ (s3)+2 & \text{Seconds} \end{matrix} \Rightarrow (d) = \text{ON}$	Page 599
TZCPP	$\begin{matrix} (s1) & \text{Hour} \\ (s1)+1 & \text{Minute} \\ (s1)+2 & \text{Seconds} \end{matrix} \leq \begin{matrix} (s3) & \text{Hour} \\ (s3)+1 & \text{Minute} \\ (s3)+2 & \text{Seconds} \end{matrix} \leq \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \Rightarrow (d)+1 = \text{ON}$ $\begin{matrix} (s3) & \text{Hour} \\ (s3)+1 & \text{Minute} \\ (s3)+2 & \text{Seconds} \end{matrix} > \begin{matrix} (s2) & \text{Hour} \\ (s2)+1 & \text{Minute} \\ (s2)+2 & \text{Seconds} \end{matrix} \Rightarrow (d)+2 = \text{ON}$	

Timing check instruction

■Generating timing pulses

Instruction symbol	Description	Reference
DUTY	 <p>SM420 to SM424, SM2330 to SM2334</p>	Page 601

■Hour meter

Instruction symbol	Description	Reference
HOURM	This instruction adds the time during which the input contact is ON in units of 1 hour, turns ON the device specified by (d2) when the total ON time exceeds the time specified by (s) (16-bit binary data), and stores the current value in units of 1 hour (16-bit binary data) to (d1), and the current value that is less than one hour (16-bit binary data) to (d1)+1 in units of seconds.	Page 603
DHOURM	This instruction adds the time during which the input contact is ON in units of 1 hour, turns ON the device specified by (d2) when the total ON time exceeds the time specified by (s) (32-bit binary data), and stores the current value in units of 1 hour (32-bit binary data) to (d1), and the current value that is less than one hour (16-bit binary data) to (d1)+2 in units of seconds.	Page 604

Module access instruction

■Performing I/O refresh

Instruction symbol	Description	Reference
REF	This instruction refreshes the relevant I/O area during a scan.	Page 605
REFP		
RFS		
RFSP		

■Reading 1-word/2-word data from another module (16-bit specification)

Instruction symbol	Description	Reference
FROM	These instructions read the (n) word data from the buffer memory of the intelligent function module.	Page 607
FROMP		
DFROM	These instructions read the (n)×2 word data from the buffer memory of the intelligent function module.	
DFROMP		

■Writing 1-word/2-word data to another module (16-bit specification)

Instruction symbol	Description	Reference
TO	These instructions write the (n) word data to the buffer memory of the intelligent function module.	Page 610
TOP		
DTO	These instructions write the (n)×2 word data to the buffer memory of the intelligent function module.	
DTOP		

■Reading 1-word/2-word data from another module (32-bit specification)

Instruction symbol	Description	Reference
FROMD	These instructions read the (n) word data from the buffer memory of the intelligent function module.	Page 613
FROMDP		
DFROD	These instructions read the (n)×2 word data from the buffer memory of the intelligent function module.	
DFRODP		

■Writing 1-word/2-word data to another module (32-bit specification)

Instruction symbol	Description	Reference
TOD	These instructions write the (n) word data to the buffer memory of the intelligent function module.	Page 616
TODP		
DTOD	These instructions write the (n)×2 word data to the buffer memory of the intelligent function module.	
DTODP		

2.4 Built-in Ethernet Function Instruction

Socket communication function instruction

■Opening a connection

Instruction symbol	Description	Reference
SP.SOCOPEN	This instruction opens the connection specified by (s1).	Page 619

■Closing a connection

Instruction symbol	Description	Reference
SP.SOCCLOSE	This instruction closes the connection specified by (s1). (Closing a connection)	Page 622

■Reading receive data during the END processing

Instruction symbol	Description	Reference
SP.SOCRCV	This instruction reads the received data of the connection specified by (s1) from the socket communication receive data area, during the END processing.	Page 624

■Sending data

Instruction symbol	Description	Reference
SP.SOCSND	This instruction sends the data set in (s3) to the target device of the connection specified by (s1).	Page 627

■Reading connection information

Instruction symbol	Description	Reference
SP.SOCCINF	This instruction reads the connection information of the connection specified by (s1).	Page 629

■Reading socket communication receive data

Instruction symbol	Description	Reference
S.SOCDATA	This instruction reads the data of the number of words specified in (n) from the socket communication receive data area of the connection specified by (s1), and stores it to the device specified by (d) onwards.	Page 631
SP.SOCDATA		

3 MODULE SPECIFIC INSTRUCTION

3.1 High-speed Counter Instruction

High-speed processing instruction

■Setting 32-bit data comparison

Instruction symbol	Description	Reference
DHSCS	Turns ON the bit device of (d) when the current value of the high-speed counter of CH specified by (s2) is changed to the value specified by (s1).	Page 634

■Reset 32-bit data comparison

Instruction symbol	Description	Reference
DHSCR	Turns OFF the bit device of (d) when the current value of the high-speed counter of CH specified by (s2) is changed to the value specified by (s1).	Page 636

■Comparison of 32-bit data band

Instruction symbol	Description	Reference
DHSZ	Compares whether the current value of the high-speed counter is within or outside the value range specified by (s1) or (s2).	Page 638

■Start/stop of the 16-bit/32-bit data high-speed I/O function

Instruction symbol	Description	Reference
HIOEN	Start or stop high-speed I/O for the specified CH.	Page 640
HIOENP		
DHIOEN		Page 642
DHIOENP		

High-speed current value transfer instruction

■High-speed current value transfer of 16-bit/32-bit data

Instruction symbol	Description	Reference
HCMOV	Transfers the current value of the high-speed I/O.	Page 644
HCMOVP		
DHCMOV		Page 646
DHCMOVP		

3.2 External Device I/O Instruction

Serial communication 2

Instruction symbol	Description	Reference
RS2	Sends/receives data by non-protocol communication.	Page 648

3.3 Positioning Instruction

Positioning instruction

■Zero return(OPR) with 16-bit/32- bit data DOG search

Instruction symbol	Description	Reference
DSZR	• When FX3 series-compatible operand is specified	Page 650
DDSZR	Specifies the proximity dog signal, zero signal and device (Y). Outputs a pulse with the specified device (Y) to perform the zero return operation. • When FX5 series operand is specified Specifies the original position return speed, creep speed and axis number. Outputs a pulse with the specified axis to perform the zero return operation.	Page 652

■16-bit/32-bit data interrupt positioning

Instruction symbol	Description	Reference
DVIT	• When FX3 series-compatible operand is specified	Page 653
DDVIT	Performs interrupt positioning with the specified travel distance, speed, and device (Y). • When FX5 series operand is specified Performs interrupt positioning with the specified travel distance, speed, and axis number.	Page 655

■Positioning by one table operation

Instruction symbol	Description	Reference
TBL	• When FX3 series-compatible operand is specified Outputs 1 table operation from the table set by the parameter as pulse with specified device (Y). • When FX5 series operand is specified Outputs 1 table operation from the table set by the parameter as pulse with specified axis number.	Page 657

■Positioning by multiple table operation

Instruction symbol	Description	Reference
DRVTL	Outputs continuous multiple table operations from the table set by the parameter as pulse with specified axis number.	Page 659

■Multiple axes concurrent drive positioning

Instruction symbol	Description	Reference
DRVMUL	Outputs the table set by the parameter as pulse with specified multiple axes.	Page 660

■32-bit data ABS current value read

Instruction symbol	Description	Reference
DABS	Reads the absolute position data of the servo amplifier.	Page 662

■16-bit/32-bit data variable speed pulse

Instruction symbol	Description	Reference
PLSV	• When FX3 series-compatible operand is specified	Page 663
DPLSV	Specifies the command speed and output device (Y) and uses the specified device (Y) to perform pulse output. • When FX5 series operand is specified Specifies the command speed and performs pulse output with the specified axis number.	Page 665

■16-bit/32-bit data relative positioning

Instruction symbol	Description	Reference
DRVI	• When FX3 series-compatible operand is specified	Page 667
DDRVI	Specifies the travel distance from the current position, speed and performs pulse output with the specified device (Y). • When FX5 series operand is specified Specifies the travel distance from the current position, speed and performs pulse output with the specified axis number.	Page 669

■16-bit/32-bit data absolute positioning

Instruction symbol	Description	Reference
DRVA	<ul style="list-style-type: none">When FX3 series-compatible operand is specified Specifies the travel distance from the reference position, speed and performs pulse output with the specified device (Y).	Page 671
DDRVA		Page 673
	<ul style="list-style-type: none">When FX5 series operand is specified Specifies the travel distance from the reference position, speed and performs pulse output with the specified axis number.	

3.4 Inverter Communication Instruction

3

Inverter operation monitoring (Status check)

Instruction symbol	Description	Reference
IVCK	Reads the contents of the corresponding instruction code from the specified inverter station number.	Page 675

Inverter operations control (Drive)

Instruction symbol	Description	Reference
IVDR	Writes the contents of the corresponding instruction code to the specified inverter station number.	Page 676

Inverter parameter read

Instruction symbol	Description	Reference
IVRD	Reads a parameter from the specified inverter station number.	Page 677

Inverter parameter write

Instruction symbol	Description	Reference
IVWR	Writes a parameter to the specified inverter station number.	Page 678

Inverter parameter block write

Instruction symbol	Description	Reference
IVBWR	Writes the range of the specified data tables to the specified inverter station number in batch.	Page 679

Inverter multi command

Instruction symbol	Description	Reference
IVMC	Sends/receives data corresponding to the send/receive data type to/from the specified inverter station number.	Page 680

3.5 MODBUS Communication Instruction

MODBUS read/write

Instruction symbol	Description	Reference
ADPRW	Sends the function code from the master to the slave of the MODBUS serial communication and reads or writes the data.	Page 682

3.6 BFM Device Read/ Write Instruction

Divided BFM Read

Instruction symbol	Description	Reference
RBFM	Divides and reads data from the continuous buffer memory in the intelligent module. (This instruction cannot be used with the FX5 series intelligent module.)	Page 684

Divided BFM Write

Instruction symbol	Description	Reference
WBFM	Divides and writes data to the continuous buffer memory in the intelligent module. (This instruction cannot be used with the FX5 series intelligent module.)	Page 687

4 STANDARD FUNCTIONS/FUNCTION BLOCKS

4.1 Standard Functions

Type conversion functions

Converting BOOL to WORD/DWORD

Function symbol	Description	Reference
BOOL_TO_WORD	Converts BOOL type data to WORD type data.	Page 690
BOOL_TO_WORD_E		
BOOL_TO_DWORD	Converts BOOL type data to DWORD type data.	Page 691
BOOL_TO_DWORD_E		

Converting BOOL to INT/DINT

Function symbol	Description	Reference
BOOL_TO_INT	Converts BOOL type data to INT type data.	Page 692
BOOL_TO_INT_E		
BOOL_TO_DINT	Converts BOOL type data to DINT type data.	Page 693
BOOL_TO_DINT_E		

Converting BOOL to TIME

Function symbol	Description	Reference
BOOL_TO_TIME	Converts BOOL type data to TIME type data.	Page 694
BOOL_TO_TIME_E		

Converting BOOL to STRING

Function symbol	Description	Reference
BOOL_TO_STRING	Converts BOOL type data to STRING type data.	Page 695
BOOL_TO_STRING_E		

Converting WORD to BOOL

Function symbol	Description	Reference
WORD_TO_BOOL	Converts WORD type data to BOOL type data.	Page 696
WORD_TO_BOOL_E		

Converting WORD to DWORD

Function symbol	Description	Reference
WORD_TO_DWORD	Converts WORD type data to DWORD type data.	Page 697
WORD_TO_DWORD_E		

Converting WORD to INT/DINT

Function symbol	Description	Reference
WORD_TO_INT	Converts WORD type data to INT type data.	Page 698
WORD_TO_INT_E		
WORD_TO_DINT	Converts WORD type data to DINT type data.	Page 699
WORD_TO_DINT_E		

Converting WORD to TIME

Function symbol	Description	Reference
WORD_TO_TIME	Converts WORD type data to TIME type data.	Page 700
WORD_TO_TIME_E		

Converting DWORD to BOOL

Function symbol	Description	Reference
DWORD_TO_BOOL	Converts DWORD type data to BOOL type data.	Page 701
DWORD_TO_BOOL_E		

Converting DWORD to WORD

Function symbol	Description	Reference
DWORD_TO_WORD	Converts DWORD type data to WORD type data.	Page 702
DWORD_TO_WORD_E		

Converting DWORD to INT/DINT

Function symbol	Description	Reference
DWORD_TO_INT	Converts DWORD type data to INT type data.	Page 704
DWORD_TO_INT_E		
DWORD_TO_DINT	Converts DWORD type data to DINT type data.	Page 706
DWORD_TO_DINT_E		

Converting DWORD to TIME

Function symbol	Description	Reference
DWORD_TO_TIME	Converts DWORD type data to TIME type data.	Page 707
DWORD_TO_TIME_E		

Converting INT to BOOL

Function symbol	Description	Reference
INT_TO_BOOL	Converts INT type data to BOOL type data.	Page 708
INT_TO_BOOL_E		

Converting INT to WORD/DWORD

Function symbol	Description	Reference
INT_TO_WORD	Converts INT type data to WORD type data.	Page 709
INT_TO_WORD_E		
INT_TO_DWORD	Converts INT type data to DWORD type data.	Page 710
INT_TO_DWORD_E		

Converting INT to DINT

Function symbol	Description	Reference
INT_TO_DINT	Converts INT type data to DINT type data.	Page 711
INT_TO_DINT_E		

Converting INT to BCD

Function symbol	Description	Reference
INT_TO_BCD	Converts INT type data to BCD type data.	Page 712
INT_TO_BCD_E		

Converting INT to REAL

Function symbol	Description	Reference
INT_TO_REAL	Converts INT type data to REAL type data.	Page 714
INT_TO_REAL_E		

Converting INT to TIME

Function symbol	Description	Reference
INT_TO_TIME	Converts INT type data to TIME type data.	Page 715
INT_TO_TIME_E		

Converting INT to STRING

Function symbol	Description	Reference
INT_TO_STRING	Converts INT type data to STRING type data.	Page 716
INT_TO_STRING_E		

Converting DINT to BOOL

Function symbol	Description	Reference
DINT_TO_BOOL	Converts DINT type data to BOOL type data.	Page 718
DINT_TO_BOOL_E		

Converting DINT to WORD/DWORD

Function symbol	Description	Reference
DINT_TO_WORD	Converts DINT type data to WORD type data.	Page 719
DINT_TO_WORD_E		
DINT_TO_DWORD	Converts DINT type data to DWORD type data.	Page 721
DINT_TO_DWORD_E		

Converting DINT to INT

Function symbol	Description	Reference
DINT_TO_INT	Converts DINT type data to INT type data.	Page 722
DINT_TO_INT_E		

Converting DINT to BCD

Function symbol	Description	Reference
DINT_TO_BCD	Converts DINT type data to BCD type data.	Page 723
DINT_TO_BCD_E		

Converting DINT to REAL

Function symbol	Description	Reference
DINT_TO_REAL	Converts DINT type data to REAL type data.	Page 725
DINT_TO_REAL_E		

Converting DINT to TIME

Function symbol	Description	Reference
DINT_TO_TIME	Converts DINT type data to TIME type data.	Page 726
DINT_TO_TIME_E		

Converting DINT to STRING

Function symbol	Description	Reference
DINT_TO_STRING	Converts DINT type data to STRING type data.	Page 727
DINT_TO_STRING_E		

Converting BCD to INT/DINT

Function symbol	Description	Reference
BCD_TO_INT	Converts BCD type data to INT type data.	Page 729
BCD_TO_INT_E		
BCD_TO_DINT	Converts BCD type data to DINT type data.	Page 731
BCD_TO_DINT_E		

Converting REAL to INT/DINT

Function symbol	Description	Reference
REAL_TO_INT	Converts REAL type data to INT type data.	Page 733
REAL_TO_INT_E		
REAL_TO_DINT	Converts REAL type data to DINT type data.	Page 735
REAL_TO_DINT_E		

Converting REAL to STRING

Function symbol	Description	Reference
REAL_TO_STRING	Converts REAL type data to STRING type data (exponent format).	Page 737
REAL_TO_STRING_E		

Converting TIME to BOOL

Function symbol	Description	Reference
TIME_TO_BOOL	Converts TIME type data to BOOL type data.	Page 740
TIME_TO_BOOL_E		

Converting TIME to WORD/DWORD

Function symbol	Description	Reference
TIME_TO_WORD	Converts TIME type data to WORD type data.	Page 741
TIME_TO_WORD_E		
TIME_TO_DWORD	Converts TIME type data to DWORD type data.	Page 742
TIME_TO_DWORD_E		

Converting TIME to INT/DINT

Function symbol	Description	Reference
TIME_TO_INT	Converts TIME type data to INT type data.	Page 743
TIME_TO_INT_E		
TIME_TO_DINT	Converts TIME type data to DINT type data.	Page 744
TIME_TO_DINT_E		

Converting TIME to STRING

Function symbol	Description	Reference
TIME_TO_STRING	Converts TIME type data to STRING type data.	Page 745
TIME_TO_STRING_E		

Converting STRING to BOOL

Function symbol	Description	Reference
STRING_TO_BOOL	Converts STRING type data to BOOL type data.	Page 746
STRING_TO_BOOL_E		

Converting STRING to INT/DINT

Function symbol	Description	Reference
STRING_TO_INT	Converts STRING type data to INT type data.	Page 747
STRING_TO_INT_E		
STRING_TO_DINT	Converts STRING type data to DINT type data.	Page 749
STRING_TO_DINT_E		

Converting STRING to REAL

Function symbol	Description	Reference
STRING_TO_REAL	Converts STRING type data to REAL type data.	Page 751
STRING_TO_REAL_E		

Converting STRING to TIME

Function symbol	Description	Reference
STRING_TO_TIME	Converts STRING type data to TIME type data.	Page 754
STRING_TO_TIME_E		

Converting bit array to INT/DINT

Function symbol	Description	Reference
BITARR_TO_INT	Converts a bit array to INT type data for a specified number of bits.	Page 755
BITARR_TO_INT_E		
BITARR_TO_DINT	Converts a bit array to DINT type data for a specified number of bits.	Page 756
BITARR_TO_DINT_E		

Converting INT/DINT to bit array

Function symbol	Description	Reference
INT_TO_BITARR	Outputs low-order (n) bits of INT type data to a bit array.	Page 757
INT_TO_BITARR_E		
DINT_TO_BITARR	Outputs low-order (n) bits of DINT type data to a bit array.	Page 758
DINT_TO_BITARR_E		

Bit array copy

Function symbol	Description	Reference
CPY_BITARR	Copies specified number of bits of a bit array.	Page 759
CPY_BITARR_E		

Reading the specified bit of word label

Function symbol	Description	Reference
GET_BIT_OF_INT	Reads a value of a specified bit of INT type data.	Page 760
GET_BIT_OF_INT_E		

Writing the specified bit of word label

Function symbol	Description	Reference
SET_BIT_OF_INT	Writes a value to a specified bit of INT type data.	Page 761
SET_BIT_OF_INT_E		

Copying the specified bit of word label

Function symbol	Description	Reference
CPY_BIT_OF_INT	Copies a specified bit of INT type data to a specified bit of another INT type data.	Page 762
CPY_BIT_OF_INT_E		

Unnecessary of type conversion

Function symbol	Description	Reference
GET_BOOL_ADDR	Converts a data type to the BOOL type.	Page 763
GET_INT_ADDR	Converts a data type to the INT type.	
GET_WORD_ADDR	Converts a data type to the WORD type.	

Standard functions of one numeric variable

Absolute value

Function symbol	Description	Reference
ABS	Outputs the absolute value of an input value.	Page 764
ABS_E		

Square root

Function symbol	Description	Reference
SQRT	Outputs the square root of an input value.	Page 766
SQRT_E		

Natural logarithm operation

Function symbol	Description	Reference
LN	Outputs the natural logarithm operation result of an input value.	Page 767
LN_E		

Calculating the common logarithm

Function symbol	Description	Reference
LOG	Outputs the operation result of the common logarithm (the logarithm whose base is 10) of an input value.	Page 768
LOG_E		

Exponential operation

Function symbol	Description	Reference
EXP	Outputs the exponential operation result of an input value.	Page 770
EXP_E		

Sine operation

Function symbol	Description	Reference
SIN	Outputs the sine of the angle of an input value.	Page 771
SIN_E		

Cosine operation

Function symbol	Description	Reference
COS	Outputs the cosine of the angle of an input value.	Page 772
COS_E		

Tangent operation

Function symbol	Description	Reference
TAN	Outputs the tangent of the angle value of an input value.	Page 773
TAN_E		

Arc sine operation

Function symbol	Description	Reference
ASIN	Outputs the arc sine value of an input value.	Page 774
ASIN_E		

Arc cosine operation

Function symbol	Description	Reference
ACOS	Outputs the arc cosine value of an input value.	Page 775
ACOS_E		

Arc tangent operation

Function symbol	Description	Reference
ATAN	Outputs the arc tangent value of an input value.	Page 776
ATAN_E		

Standard arithmetic functions

Addition

Function symbol	Description	Reference
ADD	Outputs the sum of input values $((s1) + (s2) + \dots + (s28))$.	Page 777
ADD_E		

Multiplication

Function symbol	Description	Reference
MUL	Outputs the product of input values $((s1) \times (s2) \times \dots \times (s28))$.	Page 779
MUL_E		

Subtraction

Function symbol	Description	Reference
SUB	Outputs the difference of input values $((s1) - (s2))$.	Page 781
SUB_E		

Division

Function symbol	Description	Reference
DIV	Outputs the quotient of input values $((s1) \div (s2))$.	Page 783
DIV_E		

Remainder

Function symbol	Description	Reference
MOD	Outputs the remainder of input values $((s1) \div (s2))$.	Page 785
MOD_E		

Exponentiation

Function symbol	Description	Reference
EXPT	Outputs the exponentiation of an input value.	Page 787
EXPT_E		

Move operation

Function symbol	Description	Reference
MOVE	Assigns an input value to (d).	Page 789
MOVE_E		

Standard bit shift functions

Shifting n-bit data to left/right

Function symbol	Description	Reference
SHL	Shifts an input value leftward by (n) bits and outputs the result.	Page 791
SHL_E		
SHR	Shifts an input value rightward by (n) bits and outputs the result.	Page 793
SHR_E		

Rotating n-bit data to left/right

Function symbol	Description	Reference
ROL	Rotates an input value leftward by (n) bits and outputs the result.	Page 795
ROL_E		
ROR	Rotates an input value rightward by (n) bits and outputs the result.	Page 797
ROR_E		

Standard bitwise boolean functions

AND operation, OR operation, XOR operation, NOT operation

Function symbol	Description	Reference
AND	Outputs the logical product of input values.	Page 799
AND_E		
OR	Outputs the logical sum of input values.	
OR_E		
XOR	Outputs the exclusive logical sum of input values.	
XOR_E		
NOT	Outputs the logical negation of input values.	Page 801
NOT_E		

Standard selection functions

Selection

Function symbol	Description	Reference
SEL	Outputs a selected input value.	Page 802
SEL_E		

Selecting Maximum/Minimum Value

Function symbol	Description	Reference
MAX	Outputs the maximum value of an input value.	Page 804
MAX_E		
MIN	Outputs the minimum value of an input value.	
MIN_E		

Limit Control

Function symbol	Description	Reference
LIMIT	Outputs an input value controlled with the upper and lower limits.	Page 806
LIMIT_E		

Multiplexer

Function symbol	Description	Reference
MUX	Outputs one of multiple input values.	Page 808
MUX_E		

Standard comparison functions

Compare

Function symbol	Description	Reference
GT	Outputs the data comparison result of input values.	Page 810
GT_E		
GE		
GE_E		
EQ		
EQ_E		
LE		
LE_E		
LT		
LT_E		
NE		Page 812
NE_E		

Standard character string functions

Character string length detection

Function symbol	Description	Reference
LEN	Detects the length of an input character string and outputs the result.	Page 814
LEN_E		

Extracting character string data from the left/right

Function symbol	Description	Reference
LEFT	Outputs specified number of characters from the left of input character string data.	Page 815
LEFT_E		
RIGHT	Outputs specified number of characters from the right of input character string data.	
RIGHT_E		

Extract mid string

Function symbol	Description	Reference
MID	Outputs specified number of characters from an arbitrary position of an input character string.	Page 817
MID_E		

String concatenation

Function symbol	Description	Reference
CONCAT	Concatenates character strings and output the result.	Page 819
CONCAT_E		

Inserting character string

Function symbol	Description	Reference
INSERT	Inserts a character string into another character string and output the result.	Page 821
INSERT_E		

Deleting character string

Function symbol	Description	Reference
DELETE	Deletes an arbitrary range of a character string and outputs the result.	Page 823
DELETE_E		

Replacing character string

Function symbol	Description	Reference
REPLACE	Replaces an arbitrary range of a character string and outputs the result.	Page 825
REPLACE_E		

Searching character string

Function symbol	Description	Reference
FIND	Searches for a character string and outputs the result.	Page 828
FIND_E		

Time data functions

Addition

Function symbol	Description	Reference
ADD_TIME	Outputs the sum of input values (time data) $((s1) + (s2))$.	Page 830
ADD_TIME_E		

Subtraction

Function symbol	Description	Reference
SUB_TIME	Outputs the difference of input values (time data) $((s1) - (s2))$.	Page 832
SUB_TIME_E		

Multiplication

Function symbol	Description	Reference
MUL_TIME	Outputs the product of input values (time data) $((s1) \times (s2))$.	Page 834
MUL_TIME_E		

Division

Function symbol	Description	Reference
DIV_TIME	Outputs the quotient of input values (time data) $((s1) \div (s2))$.	Page 836
DIV_TIME_E		

4.2 Standard Function Blocks

Bistable function blocks

Bistable function blocks (set priority)

Function block symbol	Description	Reference
SR	Judges two input values and outputs 1 (TRUE) or 0 (FALSE). (Set priority)	Page 840
SR_E		

Bistable function blocks (reset priority)

Function block symbol	Description	Reference
RS	Judges two input values and outputs 1 (TRUE) or 0 (FALSE). (Reset priority)	Page 842
RS_E		

Edge detection function blocks

Rising edge detector

Function block symbol	Description	Reference
R_TRIG	Detects the rising edge of a signal, and outputs a pulse signal.	Page 844
R_TRIG_E		

Falling edge detector

Function block symbol	Description	Reference
F_TRIG	Detects the falling edge of a signal, and outputs a pulse signal.	Page 846
F_TRIG_E		

Counter function blocks

Up counter

Function block symbol	Description	Reference
CTU	Counts up the number of times of rising of a signal.	Page 848
CTU_E		

Down counter

Function block symbol	Description	Reference
CTD	Counts down the number of times of rising of a signal.	Page 850
CTD_E		

Counter function block

Function block symbol	Description	Reference
COUNTER_FB_M	Counts up the number of times of rising of a signal from (s3) to (s2).	Page 852

Timer function blocks

Timer function blocks		
Function block symbol	Description	Reference
TIMER_1_FB_M	When the execution condition is established, these function blocks start the timer count to the set time.	Page 854
TIMER_10_FB_M		
TIMER_100_FB_M		
TIMER_CONT_FB_M		
TIMER_CONTHS_FB_M		

PART 3

CPU MODULE INSTRUCTIONS

This part consists of the following chapters.

5 SEQUENCE INSTRUCTIONS

6 BASIC INSTRUCTIONS

7 APPLICATION INSTRUCTION

8 BUILT-IN ETHERNET FUNCTION INSTRUCTIONS

5 SEQUENCE INSTRUCTIONS

5.1 Contact Instructions

Operation start, series connection, parallel connection

LD, LDI, AND, ANI, OR, ORI

- LD: NO contact operation start instruction/LDI: NC contact operation start instruction

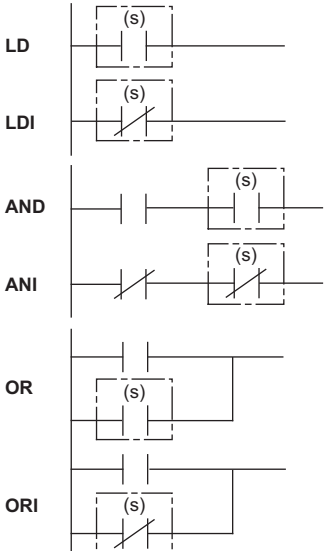
These instructions capture the ON/OFF information of the device specified by (s), and use that as the operation result.

- AND: NO contact series connection instruction/ANI: NC contact series connection instruction

These instructions capture the ON/OFF information of the device specified by (s), AND with the operation result so far, and use the result as the operation result.

- OR: NO contact parallel connection instruction/ORI: NC contact parallel instruction

These instructions capture the ON/OFF information of the device specified by (s), OR with the operation result so far, and use the result as the operation result.

Ladder diagram	Structured text
	<p>This becomes a assignment statement, operator, control syntax, etc.</p> <p>In the ST language, there are sometimes no instructions (symbols) that directly correspond to contacts such as LD, AND, and OR.</p> <p>When programming using assignment statements, express as shown in the following example.</p> <p>Example</p> <p>Y1:=(X0 OR X1) AND X2 AND NOT X3; Y2:=NOT X4 OR NOT X5;</p>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Device used as contact	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others (DX)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	○	○	○*1	—	—	—	—	—	—	—	—	○

*1 T, ST, C cannot be used.

Processing details

■LD, LDI

- The LD instruction is the NO contact operation start instruction, and the LDI instruction is the NC contact operation start instruction. These instructions capture the ON/OFF information^{*1} of the specified device, and use the result as the operation result.

^{*1} When bits of word devices are specified, devices turn ON/OFF by the 1/0 status of the specified bit.

■AND, ANI

- The AND instruction is NO contact series connection instruction and the ANI instruction is NC contact series connection instruction. These instructions capture the ON/OFF information^{*1} of the specified bit device, AND with the operation result so far, and use the result as the operation result.

^{*1} When bits of word devices are specified, devices turn ON/OFF by the 1/0 status of the specified bit.

- There is no limitation to the number of series contacts. Any number of contacts can use this instructions consecutively.
- Output to other coils through contacts after the OUT instruction is called cascade output, and these outputs can be repeated any number of times as long as their order is correct.

■OR, ORI

- The OR instruction is NO contact parallel connection and the ORI instruction is NC contact parallel connection. These instructions capture the ON/OFF information^{*1} of the specified device, OR with the operation result so far, and use the result as the operation result.

^{*1} When bits of word devices are specified, devices turn ON/OFF by the 1/0 status of the specified bit.

- These instructions are connected in parallel from the step with this instruction to the previous step with the LD and LDI instruction.
- There is no limitation in the number of parallel connections.

Point

- When bits of word devices are specified, bits are specified in hexadecimal. (For example, b11 of D0 is specified by "D0.B".)

Operation error

There is no operation error.

Pulse operation start, pulse series connection, pulse parallel connection

LDP, LDF, ANDP, ANDF, ORP, ORF

- LDP: Rising edge pulse operation start instruction

This becomes conductive (ON) only at the rising edge (OFF to ON) of the bit device specified by (s).

- LDF: Falling edge pulse operation start instruction

This becomes conductive (ON) only at the falling edge (ON to OFF) of the bit device specified by (s).

- ANDP: Rising edge pulse series connection instruction/ANDF: Falling edge pulse series connection instruction

This instruction ANDs the bit device specified by (s) with the operation result so far, and uses the result as the operation result.

- ORP: Rising edge pulse parallel connection/ORF: Falling edge pulse parallel connection

This instruction ORs the bit device specified by (s) with the operation result so far, and uses the result as the operation result.

Ladder diagram	Structured text
	<pre> ENO:=LDP(EN,s); ENO:=LDF(EN,s); ENO:=ANDP(EN,s); ENO:=ANDF(EN,s); ENO:=ORP(EN,s); ENO:=ORF(EN,s); </pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Device used as contact	—	Bit	ANY_BOOL

■Applicable devices

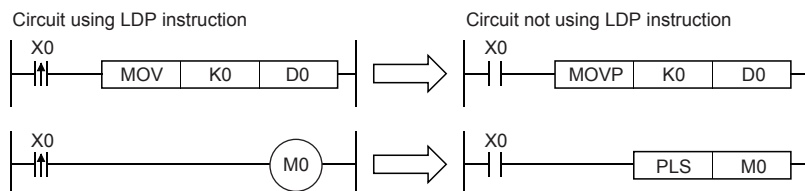
Operand	Bit			Word			Double word		Indirect specification	Constant				Others (DX)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	○	○	○	○*1	—	—	—	—	—	—	—	—	—	○

*1 T, ST, C cannot be used.

Processing details

■LDP, LDF

- The LDP instruction is the rising edge pulse operation start instruction, and becomes conductive (ON) only at the rising edge (OFF to ON) of the specified bit device. When word devices are specified by bits, this instruction becomes conductive (ON) only when the status of the specified bit changes to 0→1. When only the LDP instruction is programmed, operation is the same as the conversion of the instruction under execution to pulse instruction (□P).



- The LDF instruction is the falling edge pulse operation start instruction, and becomes conductive (ON) at the falling edge (ON to OFF) of the specified bit device. When word devices are specified by bits, this instruction becomes conductive only when the status of the specified bit changes to 1→0.

■ANDP, ANDF

- The ANDP instruction is the rising edge pulse series connection instruction, and the ANDF instruction is the falling edge pulse series connection. These instructions AND with the operation result so far, and uses the result as the operation result. The table below shows the ON/OFF information used by these instructions.

Device specified by ANDP, ANDF		ANDP status	ANDF status
Bit device	Bit specification of word device		
OFF to ON	0→1	ON	OFF
OFF	0	OFF	OFF
ON	1	OFF	OFF
ON to OFF	1→0	OFF	ON

■ORP, ORF

- The ORP instruction is the rising edge pulse parallel connection instruction, and the ORF instruction is the falling edge pulse parallel connection instruction. These instructions OR with the operation result so far, and use the result as the operation result. The table below shows the ON/OFF information used by these instructions.

Device specified by ORP, ORF		ORP status	ORF status
Bit device	Bit specification of word device		
OFF to ON	0→1	ON	OFF
OFF	0	OFF	OFF
ON	1	OFF	OFF
ON to OFF	1→0	OFF	ON

Operation error

There is no operation error.

Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection

LDPI, LDFI, ANDPI, ANDFI, ORPI, ORFI

- LDPI: Rising edge pulse NOT operation start instruction

This instruction becomes conductive (ON) at OFF, ON and the falling edge (ON to OFF) of the bit device specified by (s).

- LDFI: Falling edge pulse NOT operation start instruction

This instruction becomes conductive (ON) at the rising edge (OFF to ON), OFF and ON of the bit device specified by (s).

- ANDPI: Rising edge pulse NOT series connection instruction/ANDFI: Falling edge pulse NOT series connection instruction

This instruction ANDs the bit devices specified by (s) with the operation result so far, and uses the result as the operation result.

- ORPI: Rising edge pulse NOT parallel connection instruction/ORFI: Falling edge pulse NOT parallel connection instruction

This instruction ORs the bit devices specified by (s) with the operation result so far, and uses the result as the operation result.

Ladder diagram	Structured text
	<pre> ENO:=LDPI(EN,s); ENO:=LDFI(EN,s); ENO:=ANDPI(EN,s); ENO:=ANDFI(EN,s); ENO:=ORPI(EN,s); ENO:=ORFI(EN,s); </pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Device used as contact	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others (DX)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	○	○	○*1	—	—	—	—	—	—	—	—	○

*1 T, ST, C cannot be used.

Processing details

■LDPI, LDFI

- The LDPI instruction is the rising edge pulse NOT operation start instruction, and becomes conductive (ON) at OFF, ON and the falling edge (ON to OFF) of the specified bit device. When word devices are specified by bits, this instruction becomes conductive when the status of the specified bit is 0, 1, and when it changes 1→0.
- The LDFI instruction is the falling edge pulse NOT operation start instruction, and becomes conductive (ON) at the rising edge (OFF to ON), OFF and ON of the specified bit device. When word devices are specified by bits, this instruction becomes conductive (ON) when the status of the specified bit is 0, 1, and when it changes 0→1. The table below shows the ON/OFF information used by these instructions.

Device specified by LDPI, LDFI		LDPI status	LDFI status
Bit device	Bit specification of word device		
OFF to ON	0→1	OFF	ON
OFF	0	ON	ON
ON	1	ON	ON
ON to OFF	1→0	ON	OFF

■ANDPI, ANDFI

- The ANDPI instruction is the rising edge pulse NOT series connection instruction, and the ANDFI instruction is the falling edge pulse NOT series connection instruction. These instructions AND with the operation result so far, and use the result as the operation result. The table below shows the ON/OFF information used by these instructions.

Device specified by ANDPI, ANDFI		ANDPI status	ANDFI status
Bit device	Bit specification of word device		
OFF to ON	0→1	OFF	ON
OFF	0	ON	ON
ON	1	ON	ON
ON to OFF	1→0	ON	OFF

■ORPI, ORFI

- The ORPI instruction is the rising edge pulse NOT parallel connection instruction, and the ORFI instruction is the falling edge pulse NOT parallel connection instruction. These instructions OR with the operation result so far, and use the result as the operation result. The table below shows the ON/OFF information used by these instructions.

Device specified by ORPI, ORFI		ORPI status	ORFI status
Bit device	Bit specification of word device		
OFF to ON	0→1	OFF	ON
OFF	0	ON	ON
ON	1	ON	ON
ON to OFF	1→0	ON	OFF

Operation error

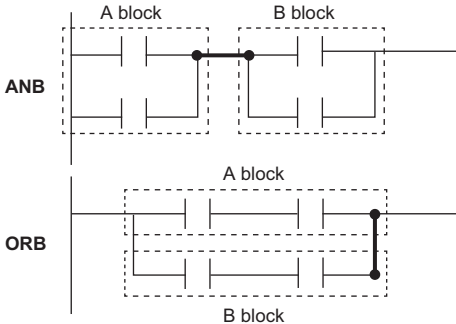
There is no operation error.

5.2 Association Instruction

Ladder block series/parallel connection

ANB, ORB

These instructions AND or OR the A and B blocks, and use the result as the operation result.

Ladder diagram	Structured text
 <p>The ANB diagram shows two blocks, A and B, connected in series. Block A is on the left and Block B is on the right. A connection symbol (a dot) is placed between the output of Block A and the input of Block B. The ORB diagram shows two blocks, A and B, connected in parallel. Block A is on the left and Block B is on the right. A connection symbol (a dot) is placed at the output of each block, and the lines from these dots are connected to a single output line.</p>	Not supported.

Processing details

■ANB

- This instruction ANDs the A and B blocks, and uses the result as the operation result.
- The symbol of this instruction is not NO contact symbol but a connection symbol.

■ORB

- This instruction ORs the A and B blocks, and uses the result as the operation result.
- This instruction connects the ladder blocks of two contacts or more in parallel. For parallel connection of only one contact, use the OR and ORI instructions; there is no need to use this instruction.
- The symbol of this instruction is not NO contact symbol but a connection symbol.

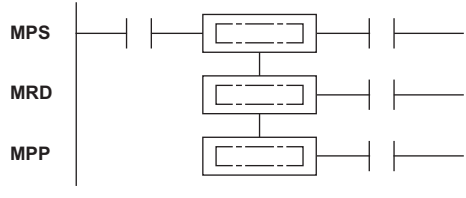
Operation error

There is no operation error.

Storing/reading/clearing the operation result

MPS, MRD, MPP

- MPS: This instruction stores the preceding operation result (ON/OFF) to memory.
- MRD, MPP: These instructions read the operation result stored by the MPS instruction, and executes operations from the next step using that operation result.

Ladder diagram	Structured text
	<pre>ENO:=MPS(EN); ENO:=MRD(EN); ENO:=MPP(EN);</pre>

Processing details

■MPS

- This instruction stores the preceding operation result (ON/OFF) to memory.
- This instruction can be used up to 16 times consecutively. When MPP instruction is used in between, the number of uses of MPS instruction is decremented by 1.

■MRD

- This instruction reads the operation result stored by the MPS instruction to memory, and executes operations from the next step using that operation result.

■MPP

- This instruction reads the operation result stored by the MPS instruction to memory, and executes operations from the next step using that operation result.
- This instruction clears the operation result stored by the MPS instruction from memory.
- The number of uses of MPS instruction is decremented by 1.

Operation error

There is no operation error.

Inverting the operation result

INV

This instruction inverts the operation result up to this instruction.

Ladder diagram	Structured text
	ENO:=INV(EN);

Processing details

- This instruction inverts the operation result up to this instruction.

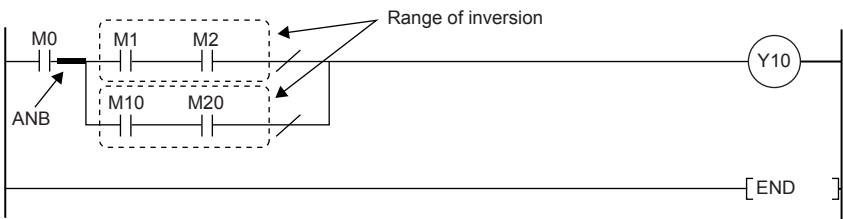
Operation result up to the INV instruction	Operation result after execution of INV instruction
OFF	ON
ON	OFF

Operation error

There is no operation error.

Point

- This instruction operates using the operation result so far. Hence, use it at the same position as the AND instruction. This instruction cannot be used at positions where the LD and OR instructions are programmed.
- If a ladder block is used, the operation result is inverted within the range of the ladder block. When operating a ladder with this instruction and the ANB instruction, pay attention to the inversion range.



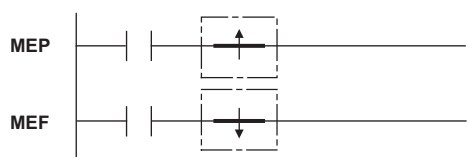
For details ANB instruction, refer to the following.

➡ Page 104 ANB, ORB

Converting the operation result into a pulse

MEP, MEF

- MEP: This instruction turns ON at the rising edge of the operation result up to the MEP instruction and turns OFF in other instances.
- MEF: This instruction turns ON at the falling edge of the operation result up to the MEF instruction and turns OFF in other instances.

Ladder diagram	Structured text
	<pre>ENO:=MEP(EN); ENO:=MEF(EN);</pre>

Processing details

■MEP

- This instruction turns ON (conductive state) at the rising edge (OFF to ON) of the operation result up to this instruction. This instruction turns OFF (non-conductive state) in instances other than the rising edge of the operation result up to this instruction.
- Use of this instruction makes conversion to pulse easier when multiple contacts are connected in series.

■MEF

- This instruction turns ON (conductive state) at the falling edge (ON to OFF) of the operation result up to this instruction. This instruction turns OFF (non-conductive state) in instances other than the falling edge of the operation result up to this instruction.
- Use of this instruction makes conversion to pulse easier when multiple contacts are connected in series.

Operation error

There is no operation error.

Point

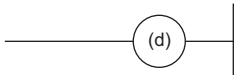
- If an indexed contact is converted to pulse by the subroutine program and the FOR to NEXT instructions, etc., these instructions may not function properly.
- These instructions operate using the operation result so far. Hence, use them at the same position as the AND instruction. These instructions cannot be used at positions where the LD and OR instructions are programmed.

5.3 Output Instructions

Out (excluding the timer, counter and annunciator)

OUT

This instruction outputs the operation result up to this instruction to the specified device.

Ladder diagram	Structured text
	ENO:=OUT(EN,d);


Setting data

■Descriptions, ranges, and data types


Operand	Remarks	Range	Data type	Data type (label)
(d)	Number of the device that turns ON/OFF	—	Bit	ANY_BOOL


■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○*1	○*2	—*3	○*4	—	—	—	—	—	—	—	—	○

*1 When using F, refer to  Page 113 OUT F.

*2 Only the FX5 series intelligent function module can be specified.

*3 When using T, ST, refer to  Page 109 OUT T, OUTH T, OUTHS T, OUT ST, OUTH ST, OUTHS ST.

When using C, refer to  Page 111 OUT C.

When using LC, refer to  Page 112 OUT LC.

*4 T, ST, C cannot be used.

Processing details

- This instruction outputs the operation result up to this instruction to the specified device.

Condition	Operation result	Coil/specified bit
When bit device is used	OFF	OFF
	ON	ON
When bit of word device is specified	OFF	0
	ON	1

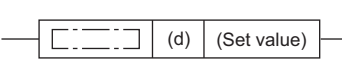
Operation error

There is no operation error.

Timer

OUT T, OUTH T, OUTHS T, OUT ST, OUTH ST, OUTHS ST

The timer counts up to the set value when the operation result up to the OUT instruction is ON and the coil of the timer/retentive timer specified by (d) turns ON. When the timer times up, NO contact becomes conductive and NC contact becomes non conductive.

Ladder diagram	Structured text
	<pre>ENO:=OUT_T(EN,d,set value); ENO:=OUTH(EN,d,set value); ENO:=OUTHs(EN,d,set value);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Timer Number	—	Bit	ANY_BOOL
(Set value)	Timer set value	0 to 32767	16-bit unsigned binary	ANY16

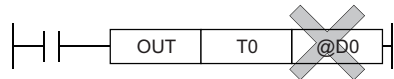
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	○*1	—	—	—	—	—	—	—	—	—	—
(Set value)	—	—	—	○*2	○	—	—	—	—*3	○*4	—	—	—

*1 Only T and ST can be used.

*2 T, ST, C cannot be used.

*3 Indirect specification cannot be entered for the timer set value.



*4 Only decimal constant (K) can be used.

Processing details

- These instructions count up to the set value when the operation result up to the OUT instruction is ON and the coil of the timer/retentive timer specified by (d) turns ON. When the timer reaches the end of its count (current value ≥ set value), NO contact becomes conductive and NC contact becomes non-conductive.
- Operation is as follows when the operation result up to the OUT instruction changes from ON to OFF.

Timer type	Timer coil	Current timer value	Before time-out		After time-out	
			NO contact	NC contact	NO contact	NC contact
Timer	off	0	Non-Conductive state	Conductive state	Non-Conductive state	Conductive state
Retentive timer	off	Holds current value	Non-Conductive state	Conductive state	Conductive state	Non-Conductive state

- After the timer times up, clear the current value of the retentive timer and turn the contact off by the RST instruction.
- When the set value is 0, the timer times up when the OUT instruction is executed.
- The following processing is executed when the OUT instruction is executed:
 - The coil in the OUT T, OUTH T, OUTHS T, OUT ST, OUTH ST and OUTHS ST instructions turns ON/OFF
 - The contact in the OUT T, OUTH T, OUTHS T, OUT ST, OUTH ST and OUTHS ST instructions turns ON/OFF
 - The current value in the OUT T, OUTH T, OUTHS T, OUT ST, OUTH ST and OUTHS ST instructions changes
- When the OUT T instruction is skipped using the CJ instruction, etc. while the OUT T and OUT ST instructions are ON, these instructions do not update the current value or turn ON/OFF the contacts.
- When the same OUT T and OUT ST instructions are executed in the same scan twice or more, these instructions update the current value for the same number of times of execution.

Values used for timers can be set in the range 1 to 32767. Actual timer constants are as follows since the OUT, OUTH, and OUTHS instructions operate as 100 ms, 10 ms, and 1 ms timers, respectively.

- OUT instruction: 0.1 to 3276.7 seconds
- OUTH instruction: 0.01 to 327.67 seconds
- OUTHS instruction: 0.001 to 32.767 seconds

For the counting method, refer to the following.

MELSEC iQ-F FX5 Series User's Manual [Application]

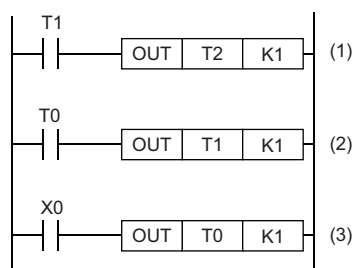
Precautions

When creating a program for measuring another timer at a timer contact, program in order starting with the timer to be measured later on. In the following instance, all timers turn on in the same scan when the program is created in the measurement order.

- When the set value is shorter than the scan time
- When the set value is 1

Ex.

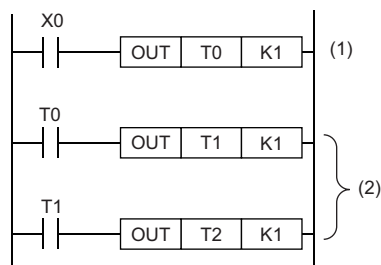
When the T0 to T2 timers are programmed in order from the timer that is measured later



- (1) The T2 timer starts measurement from the scan following the scan where the T1 contact turns ON.
- (2) The T1 timer starts measurement from the scan following the scan where the T0 contact turns ON.
- (3) The T0 timer starts measurement when X0 turns ON.

Ex.

When the T0 to T2 timers are programmed in measurement order



- (1) The T0 timer starts measurement when X0 turns ON.
- (2) The contacts of the T1 and T2 timers also turn on when the contact of T0 turns ON.

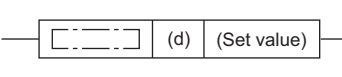
Operation error

Error code (SD0/SD8067)	Remarks
3405	A negative value is specified for the timer value.

Counter

OUT C

This instruction increments the current value of the counter specified by (d) by 1 when the operation result up to OUT instruction changes from OFF to ON, and when the counter reaches the end of its count, NO contact becomes conductive and NC contact becomes non-conductive.

Ladder diagram	Structured text
	<pre>ENO:=OUT_C(EN,d,set value);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Counter Number	—	Bit	ANY_BOOL
(Set value)	Counter set value	0 to 65535	16-bit unsigned binary	ANY16

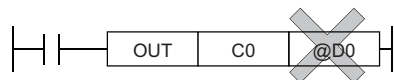
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	○*1	—	—	—	—	—	—	—	—	—	—
(Set value)	—	—	—	○*2	○	—	—	—	—*3	○*4	—	—	—

*1 Only C can be used.

*2 T, ST, C cannot be used.

*3 Indirect specification cannot be entered for the counter set value.



*4 Only decimal constant (K) can be used.

Processing details

- This instruction increments the current value of the counter specified by (d) by 1 when the operation result up to OUT instruction changes from OFF to ON, and when the counter reaches the end of its count (current value \geq set value), NO contact becomes conductive and NC contact becomes non-conductive.
- The counter does not count while the operation result remains on. (Count input does not need to be converted to pulses.)
- After a count up, the count value and contact status do not change until the RST instruction is executed.
- When the set value is 0, the same processing as for set value 1 is performed.

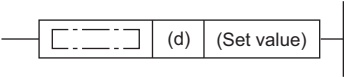
Operation error

Error code (SD0/SD8067)	Remarks
3405	A negative value is specified for the set value.

Long counter

OUT LC

This instruction increments the current value of the long counter specified by (d) by 1 when the operation result up to the OUT instruction changes from OFF to ON, and when the counter reaches the end of its count, NO contact becomes conductive and NC contact becomes non-conductive.

Ladder diagram	Structured text
	ENO:=OUT_C(EN,d,set value);

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Long counter number	—	Bit	ANY_BOOL
(Set value)	Long counter set value	0 to 4294967295	32-bit unsigned binary	ANY32

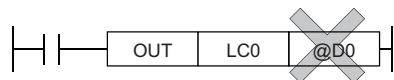
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	○*1	—	—	—	—	—	—	—	—	—	—
(Set value)	—	—	—	○*2	○	—	—	—	—*3	○*4	—	—	—

*1 Only LC can be used.

*2 T, ST, C cannot be used.

*3 Indirect specification cannot be entered for the long counter set value.



*4 Only decimal constant (K) can be used.

Processing details

- This instruction increments the current value of the long counter specified by (d) by 1 when the operation result up to the OUT instruction changes from OFF to ON, and when the counter reaches the end of its count (current value \geq set value), NO contact becomes conductive and NC contact becomes non-conductive.
- The counter does not count while the operation result remains on. (Count input does not need to be converted to pulses.)
- After a count up, the count value and contact status do not change until the RST instruction is executed.
- When the set value is 0, the same processing as for set value 1 is performed.

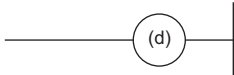
Operation error

There is no operation error.

Annunciator

OUT F

This instruction outputs the operation result up to the OUT F instruction to the specified annunciator.

Ladder diagram	Structured text
	ENO:=OUT(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Annunciator number that turns ON	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○*1	—	—	—	—	—	—	—	—	—	—	—	—	—

*1 Only F can be used.

Processing details

- This instruction outputs the operation result up to the OUT F instruction to the specified annunciator.
- Operation is as follows when annunciator (F) is turned ON by the OUT F instruction.
 - The annunciator number (F number) that turns ON is stored in special registers (SD64 to SD79).
 - The content of SD63 is incremented by 1.
- When the content of SD63 is 16 (16 annunciators are already on), the annunciator number that turns ON is not stored in SD64 to SD79 even if a new annunciator turns ON.
- Operation is as follows when annunciator (F) is turned OFF by the OUT F instruction:
 - The coil turns OFF, but the contents of SD64 to SD79 do not change.
 - To delete an annunciator that has turned OFF by the OUT F instruction from SD64 to SD79, use the RST F instruction.

Operation error

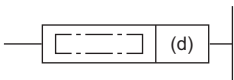
There is no operation error.

Setting devices (excluding annunciator)

SET

The status of the device specified by (d) changes as follows when the execution command turns ON.

- Bit device: Turns the coils and contacts ON.
- Bit specification of word device: Set the specified bit to 1.

Ladder diagram	Structured text
	ENO:=SET(EN,d);


Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Bit device number/ Bit specification of word device to be set (turns ON)	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○*1	○*2	—	○*3	—	—	—	—	—	—	—	—	—	○

*1 When using F, refer to  Page 116.

*2 Only the FX5 series intelligent function module can be used.

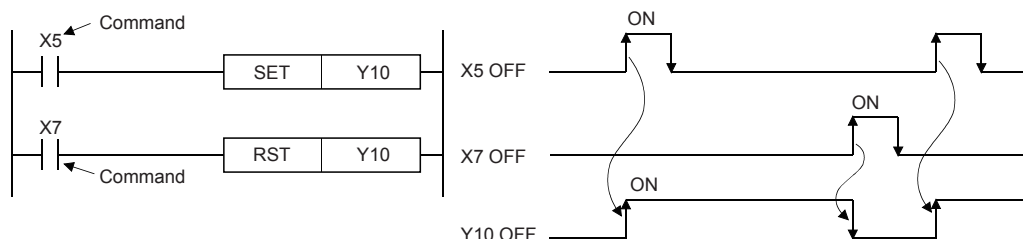
*3 T, ST, C cannot be used.

Processing details

- The status of the specified device changes as follows when the execution command turns ON.

Device	Device status
Bit devices	Turns coils and contacts ON.
Bit specification of word device	Sets the specified bit to 1.

- A device that is turned ON is held on even if the execution command turns OFF. Devices that are turned ON by the SET instruction can be turned OFF by the RST instruction.



- When the execution command is OFF, the device status does not change.

Precautions

When the SET and RST instructions are executed on the same output relay (Y), the result of the instruction nearer the END instruction (end of program) is output.

Operation error

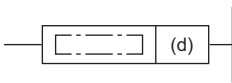
There is no operation error.

Resetting devices (excluding annunciator)

RST

The status of the device specified by (d) changes as follows when the RST input turns ON.

- Bit devices: Turns the coils and contacts OFF.
- Timers, counters: Sets the current value to 0, and turns coils and contacts OFF.
- Bit specification of word device: Sets the specified bit to 0.
- Word devices, module access devices, index registers: Sets content to 0.

Ladder diagram	Structured text
	ENO:=RST(EN,d);

5


Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Bit device number/ bit specification of word device to be reset, or word device number to be reset	—	Bit/word/double word	ANY_ELEMENTARY

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○*1	○*2	○	○*3	○	○	—	○	○	—	—	—	—	○

*1 When using F, refer to  Page 117.

*2 Only the FX5 series intelligent function module can be used.

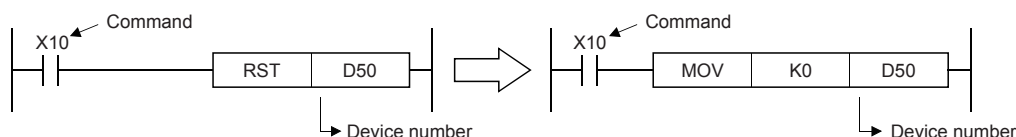
*3 T, ST, C cannot be used.

Processing details

- The status of the specified device changes as follows when the execution command turns ON.

Device	Device status
Bit devices	Turns coils and contacts OFF.
Timers, counters	Sets the current value to 0, and turns coils and contacts OFF.
Bit specification of word device	Set the specified bit to 0.
Word devices, module access device, index registers	Sets content to 0.

- When the execution command is OFF, the device status does not change.
- Function when a word device is specified by the RST instruction is the same as the following circuit.



Precautions

When the RST instruction for a timer or counter is executed by a program containing a jump or by a subroutine program or interrupt program, the timer or counter is held in a reset state, and the timer or counter may not work normally.

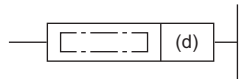
Operation error

There is no operation error.

Setting annunciator

SET F

This instruction turns ON the specified annunciator.

Ladder diagram	Structured text
	ENO:=SET(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Annunciator number (F number) that is set	—	Bit	ANY_BOOL

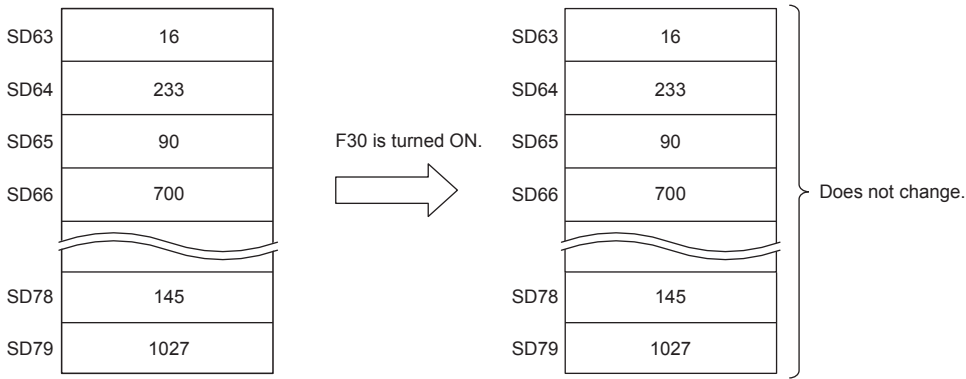
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○*1	—	—	—	—	—	—	—	—	—	—	—	—	—

*1 Only F can be used.

Processing details

- This instruction turns ON the annunciator specified by (d) when the execution command turns ON.
- Operation is as follows when annunciator (F) is turned ON.
 - The annunciator number (F number) that turns ON is stored in special registers (SD64 to SD79).
 - The content of SD63 is incremented by 1.
- When the content of SD63 is 16 (16 annunciators are already ON), the annunciator number that turns ON is not stored in SD64 to SD79 even if a new annunciator turns ON.



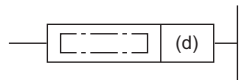
Operation error

There is no operation error.

Resetting annunciator

RST F

This instruction turns OFF the specified annunciator.

Ladder diagram	Structured text
	ENO:=RST(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Annunciator number (F number) that is reset	—	Bit	ANY_ELEMENTARY

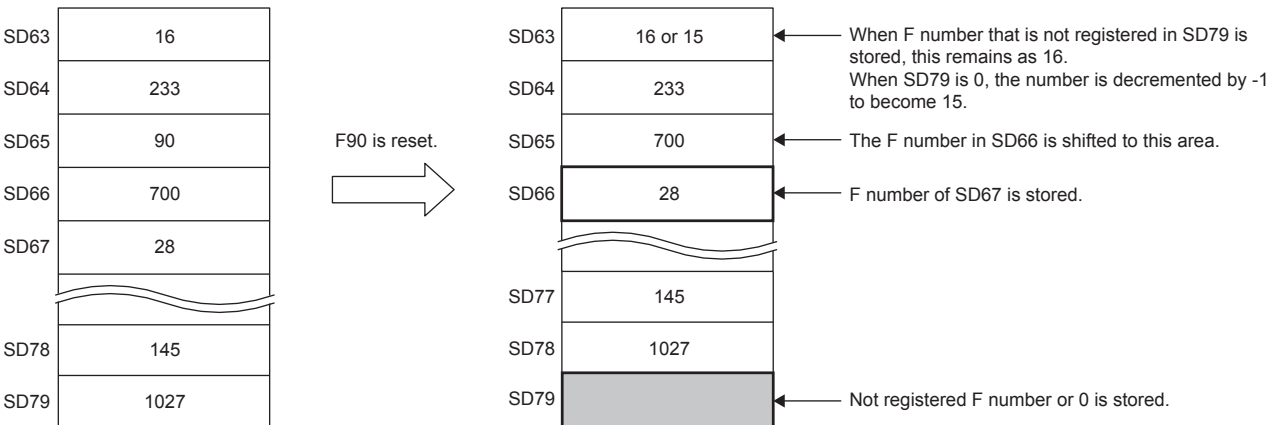
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○ ^{*1}	—	—	—	—	—	—	—	—	—	—	—	—

*1 Only F can be used.

Processing details

- This instruction turns OFF the annunciator specified by (d) when the execution command turns ON.
- An annunciator number (F number) that turns OFF is deleted from special registers (SD64 to SD79) and the content of SD63 is decremented by 1.
- When the content of SD63 is 16, annunciator numbers are deleted from SD64 to SD79 by the RST instruction. Also, if an annunciator not registered in SD64 to SD79 turns ON, its number is registered. When there are two or more unregistered numbers, this instruction adds the numbers starting from the smallest annunciator number. SD63 is not decremented by 1 when the numbers not registered in SD64 to SD79 are turned OFF.



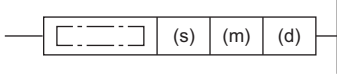
Operation error

There is no operation error.

Setting annunciator (with check time)

ANS

This instruction sets the annunciator (F device).

Ladder diagram	Structured text
	<pre>ENO:=ANS(EN,s,m,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Timer number for evaluation time	—	16-bit signed binary	ANY16
(m)	Evaluation time data	1 to 32767	16-bit unsigned binary	ANY16_U
(d)	Annunciator device to be set	—	Bit	ANY_BOOL

■Applicable devices

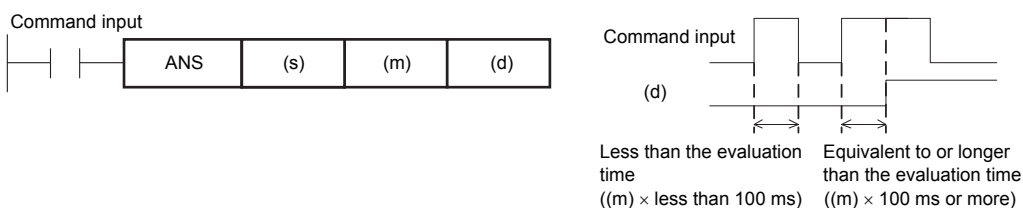
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(m)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○*2	—	—	—	—	—	—	—	—	—	—	—	—

*1 Only T can be used.

*2 Only F can be used.

Processing details

- This instruction sets (d) when the command input remains ON continuously for the evaluation time [(m)×100 ms, (s)] or more. This instruction resets the current value of (s) evaluation timer and does not set (d) when the command time is less than the evaluation time [(m)×100 ms]. Also, this instruction resets the evaluation timer when the command input turns OFF.



■Related devices

Device	Name	Remarks
SM8049	ON status annunciator smallest number enabled	When SM8049 is turned ON, SM8048 and SD8049 are enabled.
SM8048	Annunciator operation	When one of the F devices is operating, SM8048 turns ON.
SD8049	ON status annunciator smallest number	The smallest number of the F devices that are operating is stored.


Operation error

There is no operation error.

Resetting annunciator (smallest number reset)

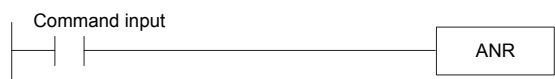
ANR(P)

This instruction resets the lowest number annunciator (F device) in the ON status.

Ladder diagram	Structured text
	ENO:=ANR(EN); ENO:=ANRP(EN);

Processing details

• Annunciator (F device) that is operating (in ON status) is reset when the command input turns ON.
This instruction resets the annunciator with the smallest number when multiple annunciators are ON. If the command input is turned ON again, this instruction resets the annunciator with the next smallest number among annunciators (F devices) that are operating.



Related devices

Device	Name	Remarks
SM8049	On status annunciator smallest number enabled	When SM8049 is turned ON, SM8048 and SD8049 are enabled.
SM8048	Annunciator operation	When one of the F devices is operating, SM8048 turns ON.
SD8049	On status annunciator smallest number	The smallest number of the F devices that are operating is stored.

Precautions

- When ANR instruction is used, annunciators in the ON status are reset in turn in each operation cycle.
- This is executed for only 1 operation cycle (only once) when the ANRP instruction is used.

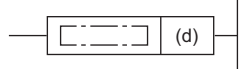
Operation error

There is no error.

Rising edge output

PLS

This instruction turns ON the device specified by (d) for one scan when the PLS command turns from OFF to ON, and turns OFF in other cases.

Ladder diagram	Structured text
	ENO:=PLS(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Device to be converted to pulse	—	Bit	ANY_BOOL

■Applicable devices

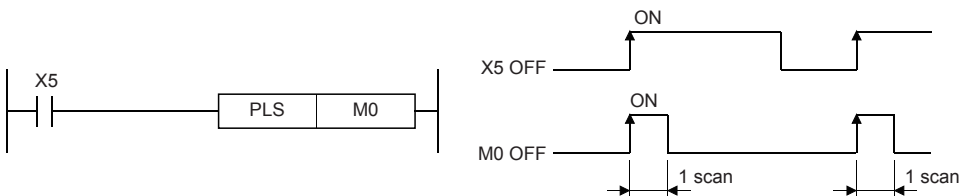
Operand	Bit			Word			Double word		Indirect specification	Constant				Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	○*1	—	○*2	—	—	—	—	—	—	—	—	—	○

*1 Only the FX5 series intelligent function module can be used.

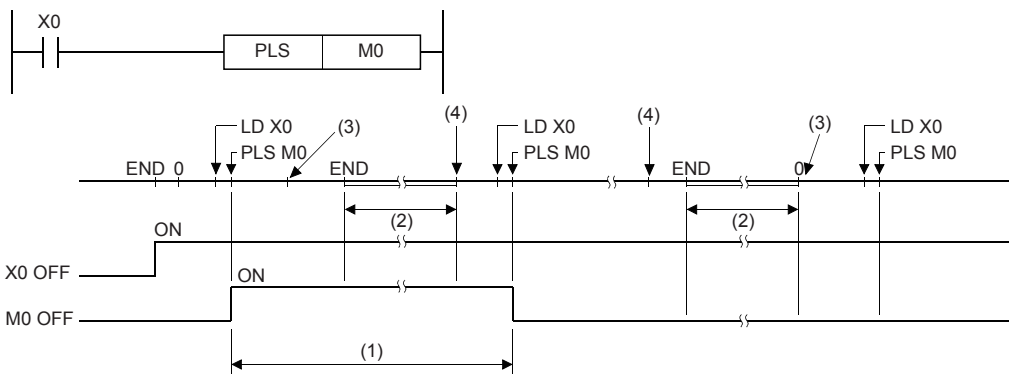
*2 T, ST, C cannot be used.

Processing details

- This instruction turns ON the specified device for one scan when the PLS command turns from OFF to ON, and turns OFF in other cases. When there is one PLS instruction programmed for the device specified by (d) during a scan, the specified device turns ON for one scan.



- If the RUN/STOP/RESET switch is changed from RUN to STOP after execution of the PLS instruction, the PLS instruction will not be executed even if the switch is set to RUN again.



- (1) 1 scan of PLS M0
- (2) CPU module operation stop time
- (3) Set the RUN/STOP/RESET switch on the CPU module to RUN→STOP.
- (4) Set the RUN/STOP/RESET switch on the CPU module to STOP→RUN.

Precautions

- When write during RUN is completed for a circuit including a rising edge instruction (LDP/ANDP/ORP instruction), the instruction is not executed regardless of the ON/OFF status of the target device of the rising edge instruction. Also, in the case of a rising edge instruction (PLS instruction), the instruction is not executed regardless of the ON/OFF status of the device that is set as the operation condition. The instruction is executed when the target device and the device in the operation conditions is set from OFF to ON again.
- Note that the device specified by (d) sometimes turns ON for one scan or more when the PLS instruction is made to jump by the CJ instruction or the executed subroutine program was not called by the CALL(P) instruction.

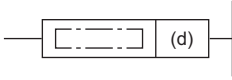
Operation error

There is no operation error.

Falling edge output

PLF

This instruction turns ON the device specified by (d) for one scan when the PLF command turns from ON to OFF, and turns OFF in other cases.

Ladder diagram	Structured text
	<pre>ENO:=PLF(EN,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Device to be converted to pulse	—	Bit	ANY_BOOL

■Applicable devices

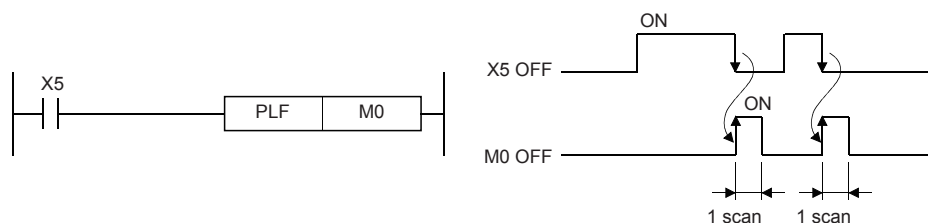
Operand	Bit			Word			Double word		Indirect specification	Constant				Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	○*1	—	○*2	—	—	—	—	—	—	—	—	—	○

*1 Only the FX5 series intelligent function module can be used.

*2 T, ST, C cannot be used.

Processing details

- This instruction turns ON the specified device for one scan when the PLF command turns OFF from ON, and turns OFF in other cases. When there is one PLF instruction programmed for the device specified by (d) during a scan, the specified device turns ON for one scan.



- If the RUN/STOP/RESET switch is changed from RUN to STOP after execution of the PLF instruction, the PLF instruction will not be executed even if the switch is set to RUN again.

Precautions

- When write during RUN is completed for a circuit including a falling edge instruction (LDF/ANDF/ORF instruction), the instruction is not executed regardless of the ON/OFF status of the target device of the falling edge instruction. Also, in the case of a falling edge instruction (PLF instruction), the instruction is not executed regardless of the ON/OFF status of the device that is set as the operation condition. The instruction is executed when the target device and the device in the operation conditions is set from ON to OFF again.
- Note that the device specified by (d) sometimes turns ON for one scan or more when the PLF instruction is made to jump by the CJ instruction or the executed subroutine program was not called by the CALL(P) instruction.

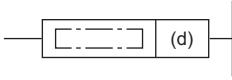
Operation error

There is no operation error.

Inverting the bit device output

FF

This instruction reverses the output status of the device specified by (d) when the execution command changes from OFF to ON.

Ladder diagram	Structured text
	ENO:=FF(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Device number to be reversed	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	○ ^{*1}	—	○ ^{*2}	—	—	—	—	—	—	—	—	○

*1 Only the FX5 series intelligent function module can be used.

*2 T, ST, C cannot be used.

Processing details

- This instruction reverses the state of the device specified by (d) when the execution command changes from OFF to ON.

Device	Device status	
	Before execution of FF instruction	After execution of FF instruction
Bit devices	OFF	ON
	ON	OFF
Bit specification of word device	0	1
	1	0


Operation error

There is no operation error.

Inverting the bit device output

ALT(P)

These instructions reverse (ON ↔ OFF) bit devices when input turns ON.

Ladder diagram	Structured text
	<pre>ENO:=ALT(EN,d); ENO:=ALTP(EN,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Bit device number whose output is alternated	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	○*1	—	○*2	—	—	—	—	—	—	—	—	—	—

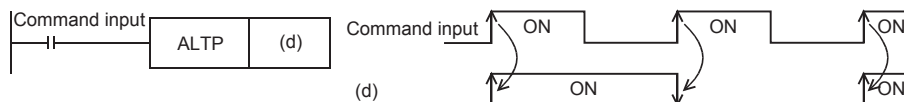
*1 Only the FX5 series intelligent function module can be used.

*2 T, ST, C cannot be used.

Processing details

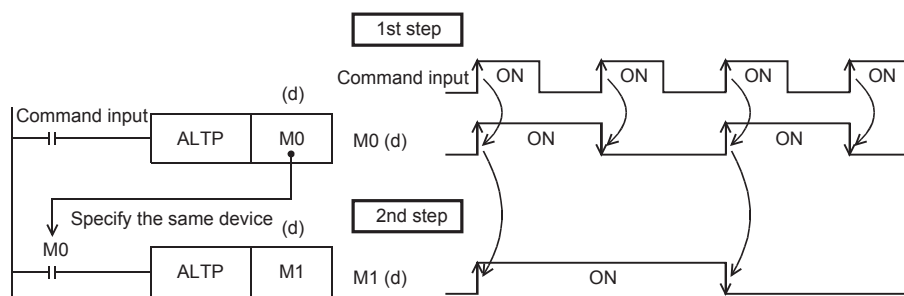
■Alternating output (1-step)

The bit device specified by (d) is reversed ON ↔ OFF each time the command input changes from OFF to ON.



■Division output (according to alternating output (2-step))

The ALTP instruction can be used in multiple combinations to perform division output.



Precautions

When the CPU module is programmed with the ALT instruction, reversal operation is performed at every operation cycle. To perform reversal operation by command ON/OFF, either use the ALTP instruction (pulse execution type) or set a command contact as LDP etc. (pulse execution type).

Operation error

There is no operation error.

5.4 Shift Instructions

Shifting bit devices

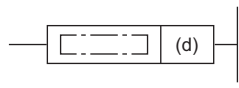
SFT(P)

- In case of bit device:

These instructions shift the ON/OFF status of the device before the device specified by (d) to the device specified by (d).

- When bit of word device is specified:

These instructions shift the 1/0 status of the bit before the bit specified by (d) to the bit specified by (d).

Ladder diagram	Structured text
	ENO:=SFT(EN,d); ENO:=SFTP(EN,d);

5

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Device number to receive shift	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—	○

*1 T, ST, C cannot be used.

Processing details

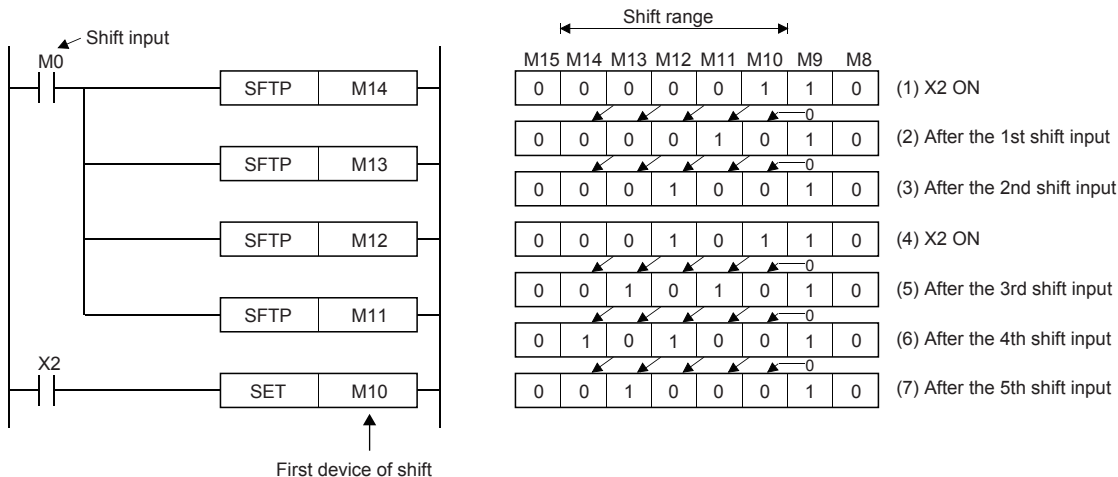
■In case of bit device

- This instruction shifts the ON/OFF status of the device before the device specified by (d) to the device specified by (d). The device before the device specified by (d) turns OFF.

Ex.

When M11 is specified by the SFTP instruction and the SFTP instruction is executed, the ON/OFF status of M10 is shifted to M11 and M10 is turned OFF.

- Turn ON the first device to be shifted by the SET instruction.
- When the SFT(P) instruction is used consecutively, create the program to start from the device with the largest number.

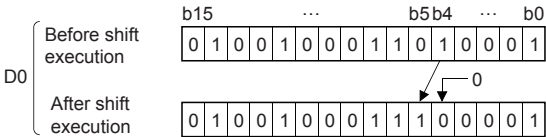


■When bit of word device is specified:

- This instruction shifts the 1/0 status of the bit before the bit specified by (d) to the bit specified by (d). The bit before the bit specified by (d) becomes 0.

Ex.

When D0.5 (bit 5 (b5) of D0) is specified by the SFT(P) instruction and the SFT(P) instruction is executed, the 1/0 status of b4 of the D0 is shifted to b5 and b4 is set to 0.



Operation error

Error code (SD0/SD8067)	Remarks
2820	The device specified by (d) exceeds the corresponding device range.

Shifting 16-bit data to the right by n bit(s)

SFR(P)

These instructions shift the 16-bit data in the device specified by (d) to the right by (n) bit(s).

Ladder diagram	Structured text
	<pre>ENO:=SFR(EN,n,d); ENO:=SFRP(EN,n,d);</pre>

Setting data

■ Descriptions, ranges, and data types

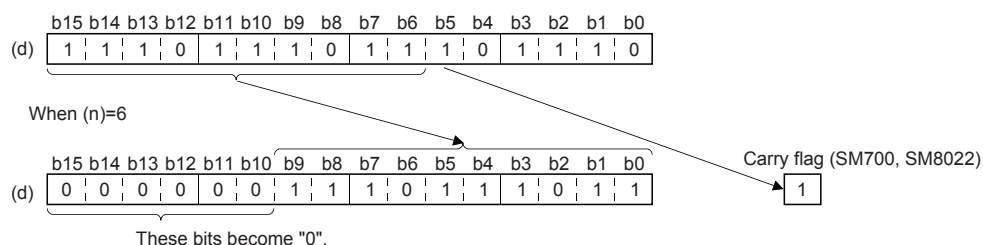
Operand	Remarks	Range	Data type	Data type (label)
(d)	Head device number where the shift-target data is stored	—	16-bit signed binary	ANY16
(n)	Number of shifts	0 to 15	16-bit unsigned binary	ANY16

■ Applicable devices

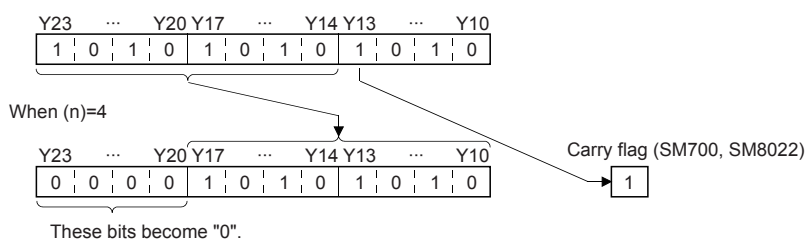
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- This instruction shifts the 16-bit data in the device specified by (d) to the right by (n) bit(s) from the most significant bit. The (n) bit(s) from the most significant bit is/are filled with 0(s).



- When (d) is a bit device, bits are shifted to the right within the device range specified by nibble specification.



- Specify any value between 0 and 15 for (n). If a value 16 or larger is specified for (n), bits are shifted to the right by the remainder value of (n)÷16. For example, when (n) is 18, data is shifted by 2 bits to the right because 18 divided by 16 equals 1 with a remainder of 2.

■ Related devices

Device	Name	Remarks
SM700	Carry	ON/OFF according to the status (1/0) of the (n-1)th bit.
SM8022		

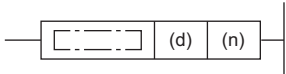
Operation error

There is no operation error.

Shifting 16-bit data to the left by n bit(s)

SFL(P)

These instructions shift the 16-bit data in the device specified by (d) to the left by (n) bit(s).

Ladder diagram	Structured text
	<pre>ENO:=SFL(EN,n,d); ENO:=SFLP(EN,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

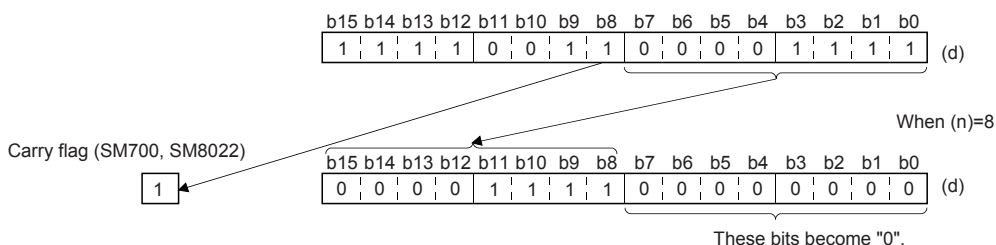
Operand	Remarks	Range	Data type	Data type (label)
(d)	Head device number where the shift-target data is stored	—	16-bit signed binary	ANY16
(n)	Number of shifts	0 to 15	16-bit unsigned binary	ANY16

■Applicable devices

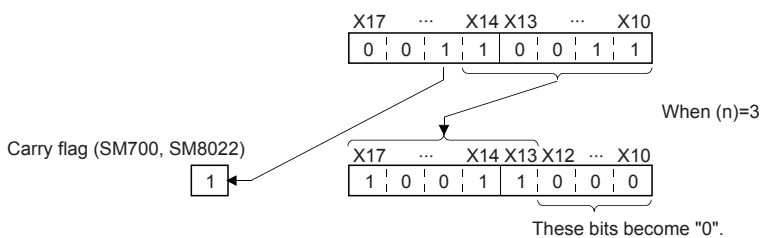
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions shift the 16-bit data in the device specified by (d) to the left by (n) bit(s) from the least significant bit. (n) bits from the least significant bit are filled with "0".



- When (d) is a bit device, bit(s) are shifted to the left within the device range specified by nibble specification.



- Specify any value between 0 and 15 for (n). If a value 16 or larger is specified for (n), bit(s) are shifted to the left by the remainder value of (n)÷16. For example, when (n) is 18, data is shifted by 2 bits to the left because 18 divided by 16 equals 1 with a remainder of 2.

■Related devices

Device	Name	Remarks
SM700	Carry	ON/OFF according to the status (1/0) of the (n-1)th bit.
SM8022		

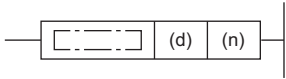
Operation error

There is no operation error.

Shifting n-bit data to the right by 1 bit

BSFR(P)

These instructions shift (n) point(s) of data to the right by 1 bit from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=BSFR(EN,n,d); ENO:=BSFRP(EN,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Head device number to be shifted	—	Bit	ANY_BOOL
(n)	Number of devices to be shifted	0 to 65535	16-bit unsigned binary	ANY16

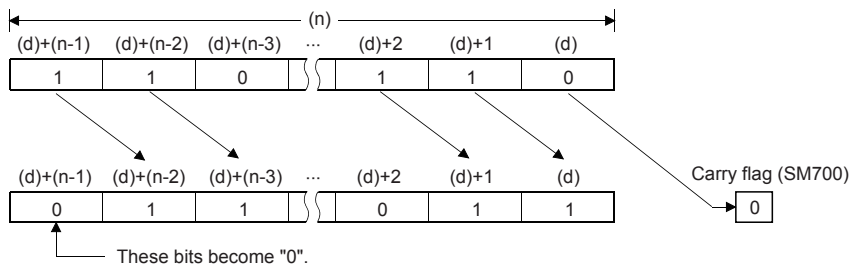
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions shift (n) point(s) of data to the right by 1 bit from the device specified by (d).



- The value of the device specified by (d) + (n-1) becomes 0.

■Related devices

Device	Name	Remarks
SM700	Carry	ON/OFF according to the status (1/0) of the (d) bit.

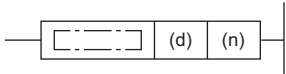
Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n) points of data starting from the device specified by (d) exceed in the corresponding device.

Shifting n-bit data to the left by 1 bit

BSFL(P)

These instructions shift (n) point(s) of data to the left by 1 bit from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=BSFL(EN,n,d); ENO:=BSFLP(EN,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(d)	Head device number to be shifted	—	Bit	ANY_BOOL
(n)	Number of devices to be shifted	0 to 65535	16-bit unsigned binary	ANY16

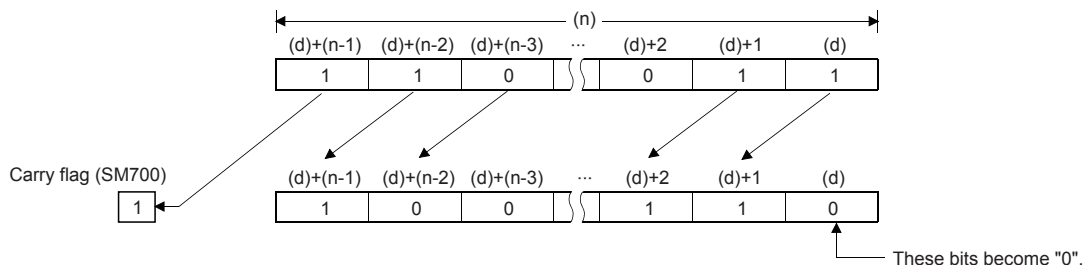
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions shift (n) point(s) of data to the left by 1 bit from the device specified by (d).



- The value of the device specified by (d) becomes 0.

■Related devices

Device	Name	Remarks
SM700	Carry	ON/OFF according to the status (1/0) of the (d) bit.

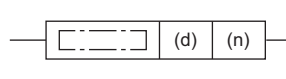
Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n) points of data starting from the device specified by (d) exceed in the corresponding device.

Shifting n-word data to the right by 1 word

DSFR(P)

These instructions shift (n) point(s) of data to the right by 1 word from the device specified by (d).

Ladder diagram	Structured text
	ENO:=DSFR(EN,n,d); ENO:=DSFRP(EN,n,d);

Setting data

■Descriptions, ranges, and data types

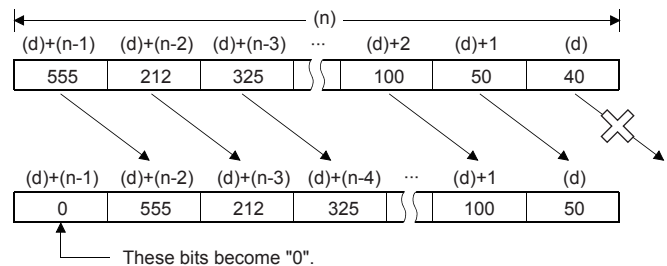
Operand	Remarks	Range	Data type	Data type (label)
(d)	Head device number to be shifted	—	Word	ANY16
(n)	Number of devices to be shifted	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions shift (n) point(s) of data to the right by 1 word from the device specified by (d).



- The value of the device specified by (d) + (n-1) becomes 0.

Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n) points of data starting from the device specified by (d) exceed in the corresponding device.

Shifting n-word data to the left by 1 word

DSFL(P)

These instructions shift (n) point(s) of data to the left by 1 word from the device specified by (d).

Ladder diagram	Structured text
	ENO:=DSFL(EN,n,d); ENO:=DSFLP(EN,n,d);

Setting data

■Descriptions, ranges, and data types

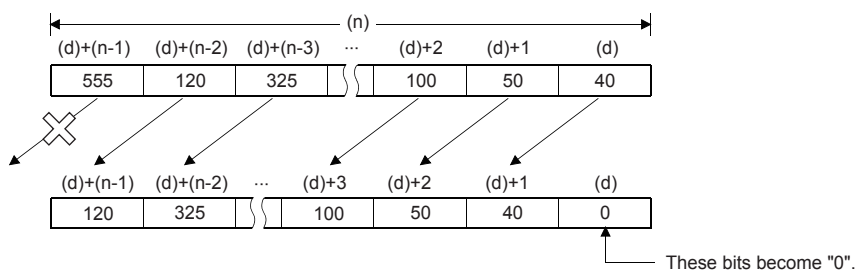
Operand	Remarks	Range	Data type	Data type (label)
(d)	Head device number to be shifted	—	Word	ANY16
(n)	Number of devices to be shifted	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—	—

Processing details

- These instructions shift (n) point(s) of data to the left by 1 word from the device specified by (d).



- The value of the device specified by (d) becomes 0.

Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n) points of data starting from the device specified by (d) exceed in the corresponding device.

Shifting n-bit(s) data to the right by (n) bit(s)

SFTR(P)

These instructions shift (n1) bits of data to the right by (n2) bit(s) from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=SFTR(EN,s,n1,n2,d); ENO:=SFTRP(EN,s,n1,n2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Head device number stored to the shift data after the shift	—	Bit	ANY_BOOL
(d)	Head device number to be shifted	—	Bit	ANY_BOOL
(n1)*1	Data length of shift data	0 to 65535	16-bit unsigned binary	ANY16_U
(n2)*1	Number of shifts	0 to 65535	16-bit unsigned binary	ANY16_U

*1 Set so that $n2 \leq n1$.

■Applicable devices

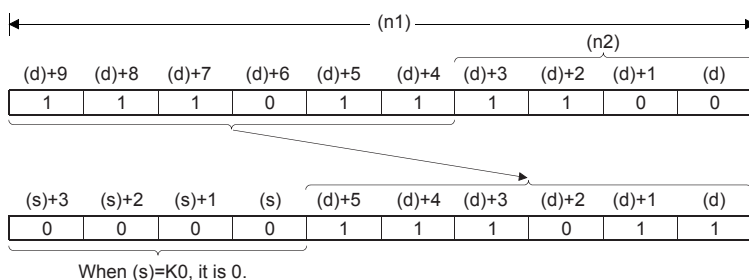
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	—	—	—	—	—	○*2	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

*2 Only 0 or 1 can be used.

Processing details

- These instructions shift (n1) bits of data to the right by (n2) bit(s) from the device specified by (d). After the shift, (n2) points from (s) are set into (n2) points from (d)+(n1-n2).
- When K0 is specified for (s), set 0s for (n2) points of bits from (d)+(n1-n2) after the shift.
- When K1 is specified for (s), set 1s for (n2) points of bits from (d)+(n1-n2) after the shift.



Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n2) points of data starting from the device specified by (s) exceed in the corresponding device. The (n1) points of data starting from the device specified by (d) exceed in the corresponding device.
2821	The transfer source data (s) overlaps with shift device (d).
3405	A constant other than K0 or K1 is specified when the constant (s) is specified. The values specified in (n1) and (n2) are such that $(n1) < (n2)$.

Shifting n-bit data to the left by n bit(s)

SFTL(P)

These instructions shift (n1) bits of data to the left by (n2) bit(s) from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=SFTL(EN,s,n1,n2,d); ENO:=SFTLP(EN,s,n1,n2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Head device number stored to the shift data after the shift	—	Bit	ANY_BOOL
(d)	Head device number to be shifted	—	Bit	ANY_BOOL
(n1)*1	Data length of shift data	0 to 65535	16-bit unsigned binary	ANY16_U
(n2)*1	Number of shifts	0 to 65535	16-bit unsigned binary	ANY16_U

*1 Set so that $n2 \leq n1$.

■Applicable devices

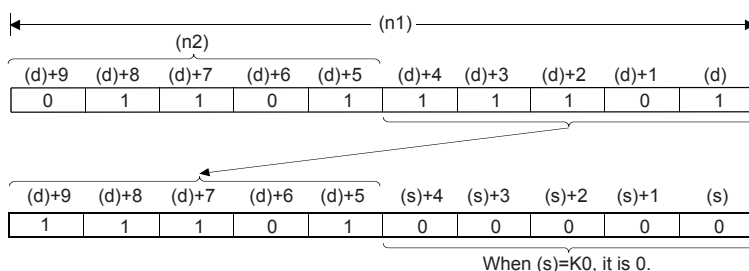
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	—	—	—	—	—	○*2	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

*2 Only 0 or 1 can be used.

Processing details

- These instructions shift (n1) bits of data to the left by (n2) bit(s) from the device specified by (d). After the shift, (n2) points from (s) are set into (n2) points from (d).
- When K0 is specified for (s), set 0s for (n2) points of bits from (d) after the shift.
- When K1 is specified for (s), set 1s for (n2) points of bits from (d) after the shift.



Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n2) points of data starting from the device specified by (s) exceed in the corresponding device. The (n1) points of data starting from the device specified by (d) exceed in the corresponding device.
2821	The transfer source data (s) overlaps with shift device (d).
3405	A constant other than K0 or K1 is specified when the constant (s) is specified. The values specified in (n1) and (n2) are such that $(n1) < (n2)$.

Shifting n-word data to the right by n word(s)

WSFR(P)

This instruction shifts (n1) words of data to the right by (n2) word(s) from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=WSFR(EN,s,n1,n2,d); ENO:=WSFRP(EN,s,n1,n2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Head device number stored to the shift data after the shift	—	Word	ANY16
(d)	Head device number to be shifted	—	Word	ANY16
(n1)*1	Data length of shift data	0 to 65535	16-bit unsigned binary	ANY16_U
(n2)*1	Number of shifts	0 to 65535	16-bit unsigned binary	ANY16_U

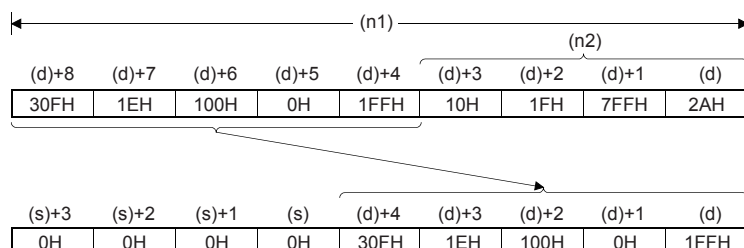
*1 Set so that $n2 \leq n1$.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- This instruction shifts (n1) words of data to the right by (n2) word(s) from the device specified by (d). After the shift, (n2) points from (s) are set into (n2) points from (d)+(n1-n2).
- This instruction sets the specified value for (n2) points of devices from (d) + (n1-n2) after the shift when K is specified for (s).



- When the value specified for (n1) or (n2) is 0, the processing is not performed.

Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n2) points of data starting from the device specified by (s) exceed in the corresponding device.
	The (n1) points of data starting from the device specified by (d) exceed in the corresponding device.
2821	The transfer source data (s) overlaps with shift device (d).
3405	A constant other than K0 or K1 is specified when the constant (s) is specified.
	The values specified in (n1) and (n2) are such that $(n1) < (n2)$.

Shifting n-word data to the left by n word(s)

WSFL(P)

This instruction shifts (n1) words of data to the left by (n2) word(s) from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=WSFL(EN,s,n1,n2,d); ENO:=WSFLP(EN,s,n1,n2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(s)	Head device number stored to the shift data after the shift	—	Word	ANY16
(d)	Head device number to be shifted	—	Word	ANY16
(n1)*1	Data length of shift data	0 to 65535	16-bit unsigned binary	ANY16_U
(n2)*1	Number of shifts	0 to 65535	16-bit unsigned binary	ANY16_U

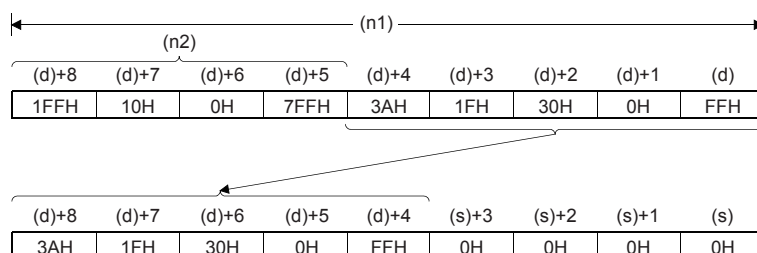
*1 Set so that $n2 \leq n1$.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- This instruction shifts (n1) words of data to the left by (n2) word(s) from the device specified by (d). After the shift, (n2) points from (s) are set into (n2) points from (d).
- This instruction sets the specified value for (n2) points of devices from (d) + (n1-n2) after the shift when K is specified for (s).



- When the value specified for (n1) or (n2) is 0, the processing is not performed.

Operation error

Error code (SD0/SD8067)	Remarks
2820	The (n2) points of data starting from the device specified by (s) exceed in the corresponding device.
	The (n1) points of data starting from the device specified by (d) exceed in the corresponding device.
2821	The transfer source data (s) overlaps with shift device (d).
3405	A constant other than K0 or K1 is specified when the constant (s) is specified.
	The values specified in (n1) and (n2) are such that $(n1) < (n2)$.

5.5 Master Control Instruction

Setting/resetting the master control

MC, MCR

- MC: This instruction starts master control.
- MCR: This instruction ends master control.

Ladder diagram	Structured text
<p>The diagram shows a ladder logic circuit. The top line contains an MC instruction, represented by a normally open contact with (N) and a coil with (d). Below this, a dashed box labeled 'Master control ladder' is connected between the MC and MCR instructions. The bottom line contains an MCR instruction, represented by a normally open contact with (N).</p>	<pre>ENO:=MC(EN,N,d); ENO:=MCR(EN,N);</pre>

5

Setting data

■ Descriptions, ranges, and data types

Operand	Remarks	Range	Data type	Data type (label)
(N)	Nesting	0 to 14	Device name	ANY16_S
(d)	Number of device to be turned ON	—	Bit	ANY_BOOL

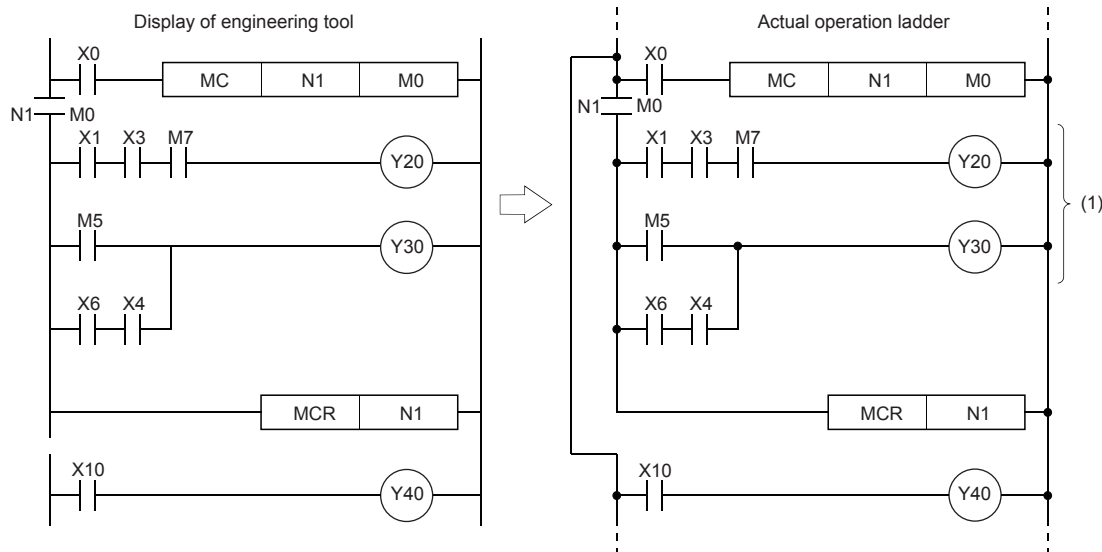
■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	N
(N)	—	—	—	—	—	—	—	—	—	—	—	—	○
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

These instructions create program with efficient ladder switching by opening/closing common buses in ladders. Ladder using master control is illustrated below.



■MC

- When the execution command of the MC instruction turns ON at the start of master control, the operation result between the MC and MCR instructions is as per the instructions (according to ladder). When the execution command of MC instruction turns OFF, the operation result between the MC and MCR instructions becomes as follows.

Device	Device status
Timer	The count value becomes 0, and both coils and contacts turn OFF.
Counters, retentive timers	Coils turn OFF but the current status of both count values and contacts is maintained.
Devices in OUT instruction	Forcibly turned OFF.
Devices in SET and RST instructions Devices in SFT(P) instruction Devices in basic instructions and applied instructions	Current status is maintained.

Point

When an instruction (e.g. FOR to NEXT instructions etc.) not requiring NO contact instruction is programmed in a ladder using master control, the CPU module executes that instruction regardless of the execution command of this instruction.

- With this instruction, the same nesting (N) number can be used as many times as necessary by changing the device specified by (d).
- When this instruction is ON, the coil of the device specified by (d) turns ON. Also, the coil becomes a double coil when the same device is used by the OUT instruction, for example. So, do not use the device specified by (d) in other instructions.

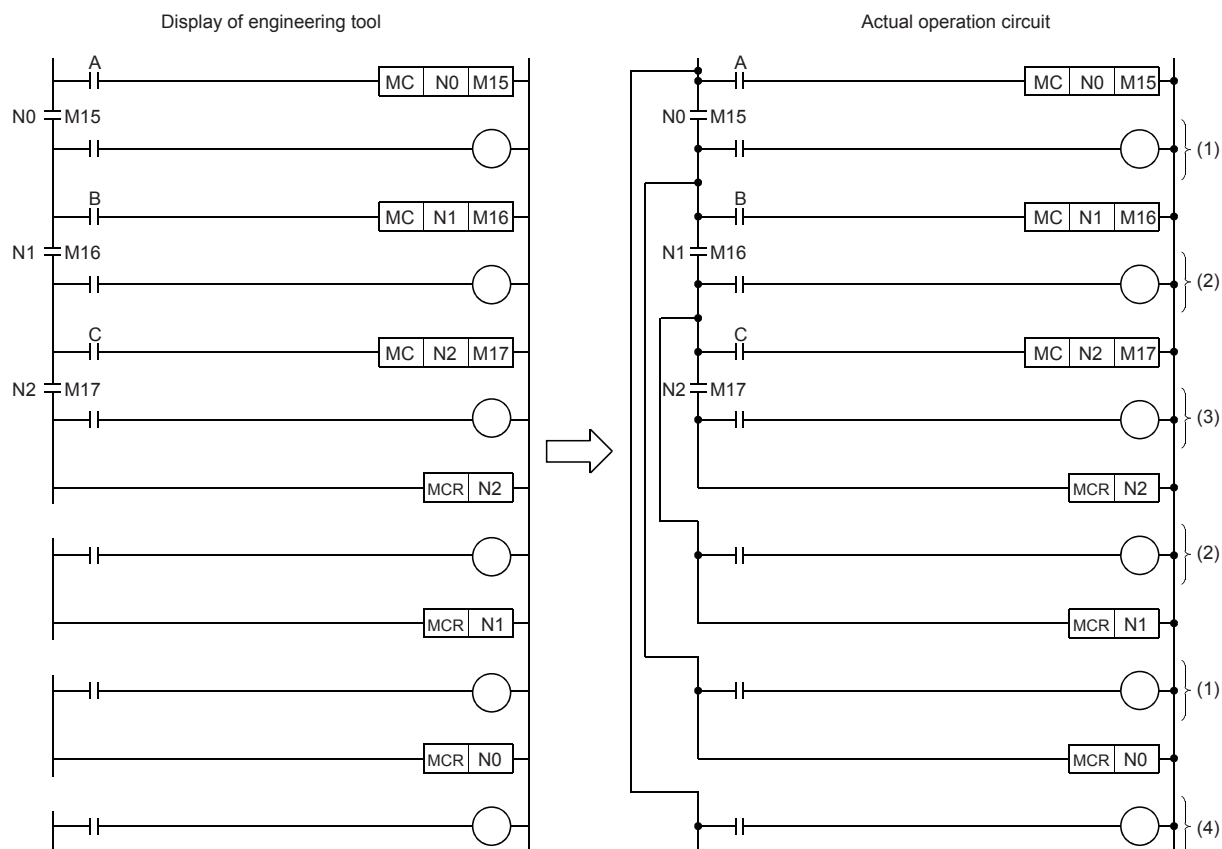
■MCR

- This instruction indicates the end of the master control range by the master control release instruction.
- Do not prefix this instruction with NO contact instruction.
- Use these (MC and MCR) instructions with same nesting number as a pair. Note, however, that when this instruction is nested at a single location, all master controls can be ended by just one (N) number, the smallest number. (Refer to Caution.)

Master control instructions can be used in a nested fashion. Each master control section is distinguished by nesting (N). Nesting is available within the range N0 to N14.

A nested structure allows you to create a ladder for successively restricting program execution conditions.

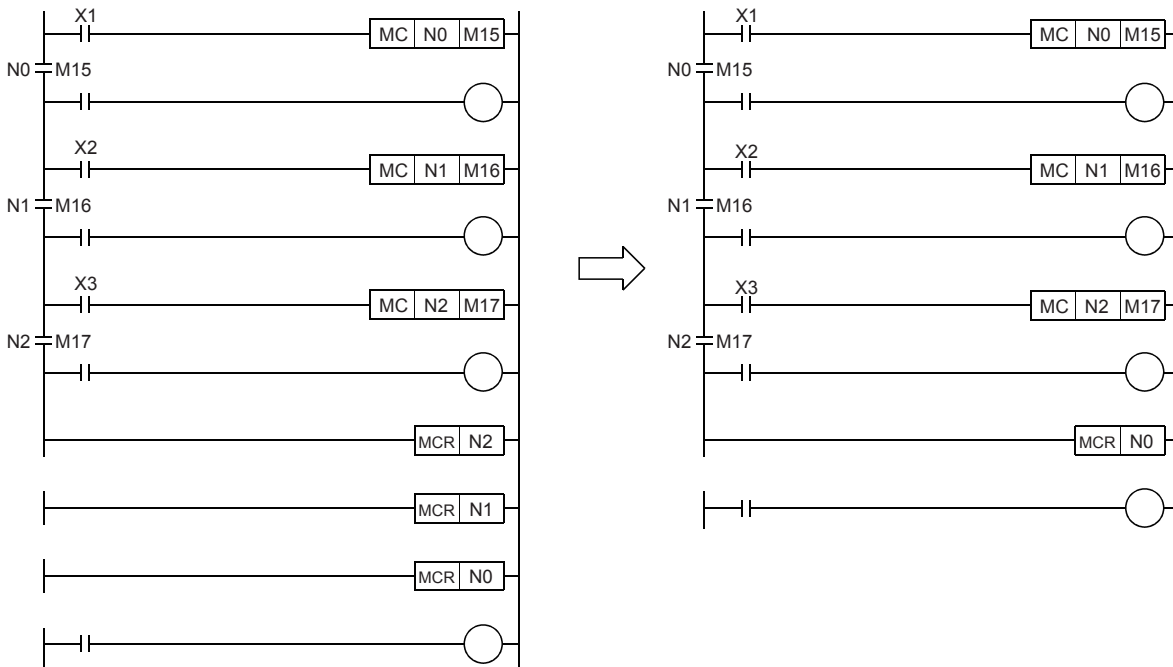
A nested structure ladder is illustrated as follows:



- (1) Executed when A is ON
- (2) Executed when A and B are ON
- (3) Executed when A, B, and C are ON
- (4) Regardless of A, B, and C

Precautions

- If an instruction (e.g. LD, LDI) to be connected to the bus is not programmed following the MC instruction, a ladder error (error code: 33E0) occurs.
- These instructions cannot be used in FOR to NEXT, P to RET (SRET), and I to IRET. Also, do not block by I, IRET, FEND, END, RET (SRET), etc. Addition by write during RUN mode results in an error.
- Nesting up to 15 levels (N0 to N14) is possible. When nesting instructions, the MC instruction is used starting from the smallest (N) number and the MCR instruction is started starting from the biggest number. Programming in reverse order does not produce a nested structure and hence the CPU module cannot execute operations properly.
- When the MCR instruction is nested at a single location, all master controls can be ended by just one nesting (N) number, the smallest number.



Operation error


There is no operation error.

5.6 Termination Instructions

Ending the main routine program

FEND

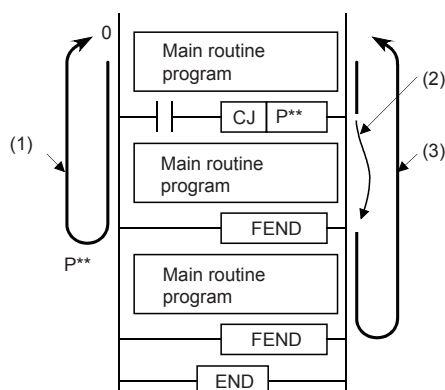
This instruction is used to branch operation of the sequence program by the CJ instruction or to divide the main routine program into a subroutine program or an interrupt program.

Ladder diagram	Structured text
	ENO:=FEND(EN);

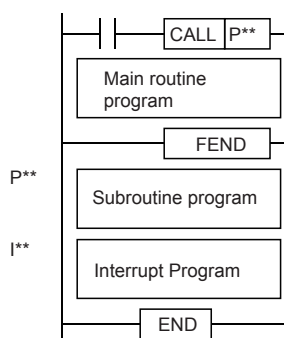
5

Processing details

- This instruction branches operation of the sequence program by the CJ instruction or dividing the main routine program into subroutine programs and interrupt programs.
- When this instruction is executed, program execution returns to the program at step 0 after output processing, input processing and refreshing of the watchdog timer.
- The sequence program from this instruction onwards can also be displayed as ladder by the engineering tool.



(a) When the CJ instruction is used



(b) When there are subroutine programs and interrupt programs

- (1) Operation when the CJ instruction is not executed
 (2) Jump by the CJ instruction
 (3) Operation when the CJ instruction has been executed


Operation error

Error code (SD0/SD8067)	Remarks
3340	The FEND instruction is executed before the NEXT instruction after the FOR instruction is executed.
3381	The FEND instruction is executed before the RET instruction after the CALL(P) instruction is executed.
33E3	The FEND instruction is programmed between FOR-NEXT.
33E4	The FEND instruction is programmed between MC-MCR.
33E7	The FEND instruction is programmed between I-IRET.
3100	The FEND instruction is programmed in standby type program. The FEND instruction is programmed in FB file.

Ending the sequence program

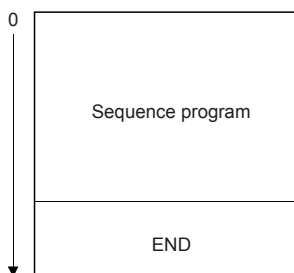
END

This instruction indicates the end of a program.

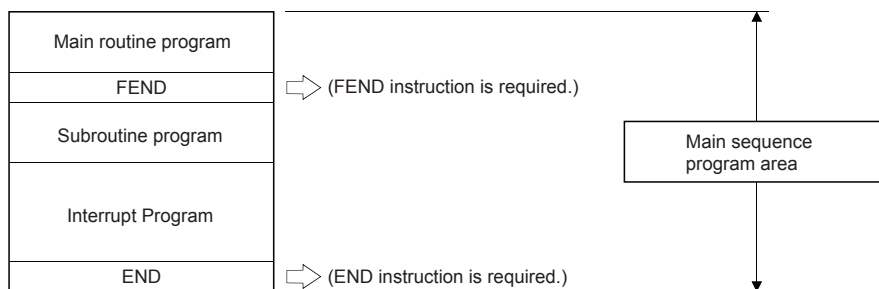
Ladder diagram	Structured text
	Not supported.

Processing details

- This instruction indicates the end of all programs including the main routine program, subroutine program, and interrupt program. When this instruction is executed, the CPU module ends execution of the currently executing program.



- The first time the RUN is started, execution begins from this instruction.
- This instruction cannot be programmed midway during the main sequence program. When this processing is required midway during the program, use the FEND instruction.
- When programming is performed using the engineering tool in ladder edit mode, the END instruction is automatically input and cannot be edited.
- The following illustrates how the END and FEND instructions are used properly when a program contains a main routine program, subroutine program, and interrupt program.



Point

The END instruction executed while a program is divided into multiple program blocks indicates the end of a program block.

The END instruction executed for END processing is executed at the end of the last executed program registered in the program settings.

Operation error

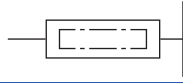
Error code (SD0/SD8067)	Remarks
3340	The END instruction is executed before the NEXT instruction after the FOR instruction is executed.
3381	The END instruction is executed before the RET instruction after the CALL(P) instruction is executed.
33E3	The END instruction is programmed between FOR-NEXT.
33E4	The END instruction is programmed between MC-MCR.
33E7	The END instruction is programmed between I-IRET.

5.7 Stop Instruction

Stopping the sequence program

STOP

This instruction resets outputs (Y) and stops operation of the CPU module when the execution command turns ON. (This operation is the same as setting the switch to STOP.)

Ladder diagram	Structured text
	ENO:=STOP(EN);

Processing details

- This instruction resets outputs (Y) and stops operation of the CPU module when the execution command turns ON. (This operation is the same as setting the switch to STOP.)
- To restart operation of the CPU module after this instruction is executed, return the switch from RUN→STOP and set it to RUN again.

Operation error

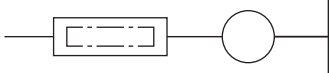
Error code (SD0/SD8067)	Remarks
3340	The STOP instruction is executed before the NEXT instruction is executed after the FOR instruction is executed.
3381	The STOP instruction is executed before the RET instruction is executed after the CALL(P) or XCALL(P) instruction is executed.
3582	The STOP instruction is executed before the IRET instruction is executed in the interruption program.

5.8 No Processing Instruction

No operation

NOP

This instruction is used, for example, to insert a space for debugging the program.

Ladder diagram	Structured text
	Not supported.

Processing details

■NOP

- Execution of the no processing instruction does not affect operation.
- This instruction is used in the following instances:
 - To insert a space for debugging the program.
 - To delete an instruction without altering the number of steps. (The instruction is overwritten with this instruction.)
 - To temporarily delete an instruction.

Operation error

There is no operation error.

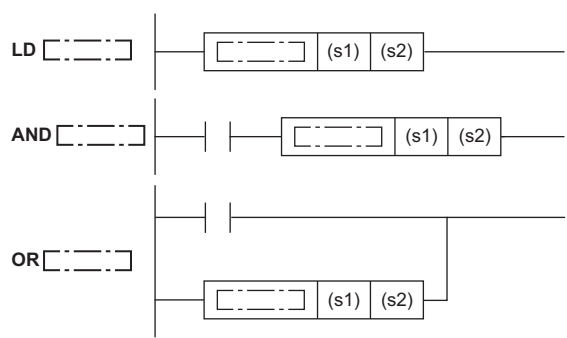
6 BASIC INSTRUCTIONS

6.1 Comparison Operation Instructions

Comparing 16-bit binary data

LD□(_U), AND□(_U), OR□(_U)

These instructions perform a comparison operation between the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2). (Devices are used as NO contacts.)

Ladder diagram	Structured text
 <p>(□ is to be replaced by any of the following: =(_U), <>(_U), >(_U), <=(_U), <(_U), >=(_U).)</p>	Not supported

6

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	LD□, AND□, OR□	-32768 to +32767	16-bit signed binary	ANY16
	LD□_U, AND□_U, OR□_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	LD□, AND□, OR□	-32768 to +32767	16-bit signed binary	ANY16
	LD□_U, AND□_U, OR□_U	0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions perform a comparison operation between the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2). (Devices are used as NO contacts.)
- The following table lists the comparison operation result of each instruction.

Instruction symbol	Condition	Result
=(_U)	(s1) = (s2)	Conductive state
<>(_U)	(s1) ≠ (s2)	
>(_U)	(s1) > (s2)	
<=(_U)	(s1) ≤ (s2)	
<(_U)	(s1) < (s2)	
>=(_U)	(s1) ≥ (s2)	
=(_U)	(s1) ≠ (s2)	Non-conductive state
<>(_U)	(s1) = (s2)	
>(_U)	(s1) ≤ (s2)	
<=(_U)	(s1) > (s2)	
<(_U)	(s1) ≥ (s2)	
>=(_U)	(s1) < (s2)	

Precautions

- When the most significant bit is "1" in the data stored in (s1) or (s2), it is regarded as a negative binary value for comparison. (Excluding unsigned operation)

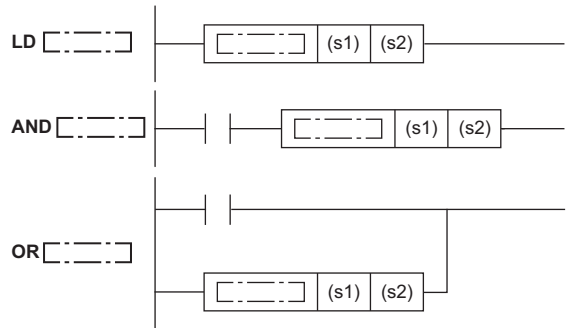
Operation error

There is no operation error.

Comparing 32-bit binary data

LDD□(_U), ANDDD□(_U), ORDD□(_U)

These instructions perform a comparison operation between the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2). (Devices are used as NO contacts.)

Ladder diagram	Structured text
 <p>(□ is to be replaced by any of the following: D=(_U), D<>(_U), D>(_U), D<=(_U), D<(_U), D>=(_U).)</p>	Not supported

6

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	LDD□, ANDDD□, ORDD□	-2147483648 to +2147483647	32-bit signed binary	ANY32
	LDD□_U, ANDDD□_U, ORDD□_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	LDD□, ANDDD□, ORDD□	-2147483648 to +2147483647	32-bit signed binary	ANY32
	LDD□_U, ANDDD□_U, ORDD□_U	0 to 4294967295	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—

Processing details

- These instructions perform a comparison operation between the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2). (Devices are used as NO contacts)
- The following table lists the comparison operation results of each instruction.

Instruction symbol	Condition	Result
D=(_U)	(s1) = (s2)	Conductive state
D<>(_U)	(s1) ≠ (s2)	
D>(_U)	(s1) > (s2)	
D<=(_U)	(s1) ≤ (s2)	
D<(_U)	(s1) < (s2)	
D>=(_U)	(s1) ≥ (s2)	
D=(_U)	(s1) ≠ (s2)	Non-conductive state
D<>(_U)	(s1) = (s2)	
D>(_U)	(s1) ≤ (s2)	
D<=(_U)	(s1) > (s2)	
D<(_U)	(s1) ≥ (s2)	
D>=(_U)	(s1) < (s2)	

Precautions

- When the most significant bit is "1" in the data stored in (s1) or (s2), it is regarded as a negative binary value for comparison. (Excluding unsigned operation)
- For comparison of 32-bit counter (LC), specify an instruction (LDD=, etc.) that handles 32-bit data. If an instruction (LD=, etc.) that handles 16-bit data is specified, a program error or operation error occurs. (Same applies for index device (LZ) as well.)

Operation error

There is no operation error.

Comparison output 16-bit binary data

CMP(P)(_U)

These instructions perform a comparison operation between the 16-bit binary data in the devices specified by (s1) and (s2).

Ladder diagram	Structured text	
	ENO:=CMP(EN,s1,s2,d); ENO:=CMPP(EN,s1,s2,d);	ENO:=CMP_U(EN,s1,s2,d); ENO:=CMPP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	CMP(P)	-32768 to +32767	16-bit signed binary	ANY16
	CMP(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	CMP(P)	-32768 to +32767	16-bit signed binary	ANY16
	CMP(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	The starting bit device to which the comparison result is output	—	Bit	ANY_BOOL

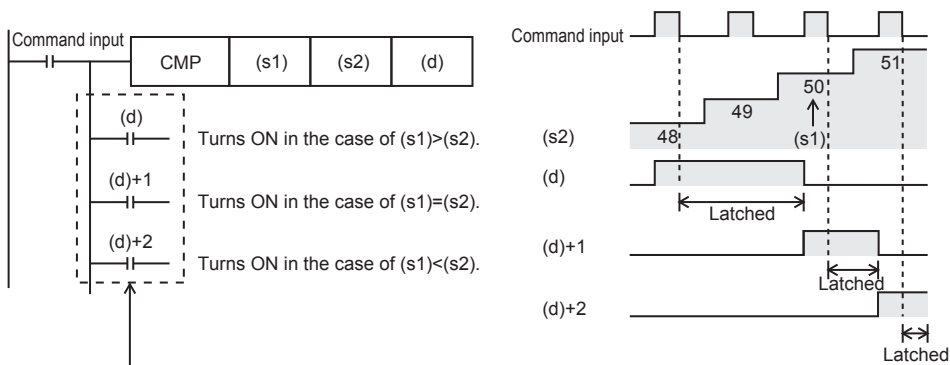
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions perform a comparison operation between the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2) and according to the result (small, equal, large), (d), (d) + 1, or (d) + 2 is turned ON.
- (s1) and (s2) are handled as binary values within the range of above data setting.
- Large and small comparison is executed algebraically.
 - With sign... -10 (FFF6H) < 2 (0002H)
 - Without sign... 32767 (7FFFH) < 65280 (FF00H)



Even if the command input turns OFF and the CMP instruction is not executed, (d) to (d)+2 latches the status just before the command input turns from ON to OFF.

Precautions

Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of 3 points of data starting from the device specified by (d) exceeds said device.

Comparison output 32-bit binary data

DCMP(P)(_U)

These instructions perform a comparison operation between the 32-bit binary data in the devices specified by (s1) and (s2).

Ladder diagram	Structured text	
	ENO:=DCMP(EN,s1,s2,d); ENO:=DCMPP(EN,s1,s2,d);	ENO:=DCMP_U(EN,s1,s2,d); ENO:=DCMPP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DCMP(P)	-2147483647 to +2147483647	32-bit signed binary	ANY32
	DCMP(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	DCMP(P)	-2147483647 to +2147483647	32-bit signed binary	ANY32
	DCMP(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	The starting bit device to which the comparison result is output	—	Bit	ANY_BOOL

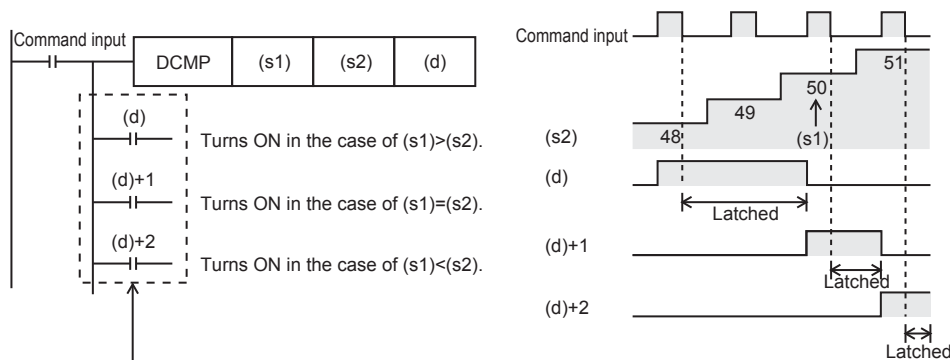
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions perform a comparison operation between the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2) and according to the result (small, equal, large), (d), (d) + 1, or (d) + 2 is turned ON.
- (s1) and (s2) are handled as binary values within the range of above data setting.
- Large and small comparison is executed algebraically.
 - With sign... -125400 (FFFE1628H) < 224566 (00036D36H)
 - Without sign... 16776690 (00FFDF2H) < 4294967176 (FFFFFF88H)



Precautions

Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

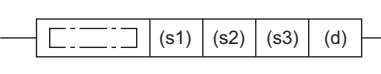
Operation error

Error code (SD0/SD8067)	Description
2820	The range of 3 points of data starting from the device specified by (d) exceeds said device.

Comparing 16-bit binary data band

ZCP(P)(_U)

These instructions perform a comparison operation on the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2) with the 16-bit binary data in the device specified by comparison source (s3), and output the comparison result (below, within zone, above) to the device specified by (d) onwards.

Ladder diagram	Structured text	
	ENO:=ZCP(EN,s1,s2,s3,d); ENO:=ZCPP(EN,s1,s2,s3,d);	ENO:=ZCP_U(EN,s1,s2,s3,d); ENO:=ZCPP_U(EN,s1,s2,s3,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	ZCP(P)	-32768 to +32767	16-bit signed binary	ANY16
	ZCP(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	ZCP(P)	-32768 to +32767	16-bit signed binary	ANY16
	ZCP(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s3)	ZCP(P)	-32768 to +32767	16-bit signed binary	ANY16
	ZCP(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	The starting bit device to which the comparison result is output	—	Bit	ANY_BOOL

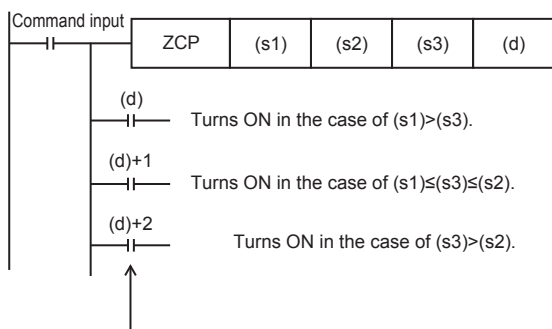
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions perform a comparison operation on the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2) with the 16-bit binary data in the device specified by comparison source (s3), and according to the comparison result (below, within zone, above), (d), (d) + 1, or (d) + 2 is turned ON. (s1), (s2), and (s3) are handled as binary values within the range of above data setting. Large and small comparison is executed algebraically.
- Large and small comparison is executed algebraically.
 - With sign... $-10 \text{ (FFF6H)} < 2 \text{ (0002H)} < 10 \text{ (000AH)}$
 - Without sign... $0 \text{ (0000H)} < 32767 \text{ (7FFFH)} < 40000 \text{ (9C40H)}$



Even if the command input turns OFF and the ZCP instruction is not executed, (d) to (d)+2 latches the status just before the command input turns from ON to OFF.

Precautions

- Set (s1) to a value less than (s2).
- Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the 3 points of data starting from the device specified by (d) exceeds said device.

Comparing 32-bit binary data band

DZCP(P)(_U)

These instructions perform a comparison operation on the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2) with the 32-bit binary data in the device specified by comparison source (s3), and output the comparison result (below, within zone, above) to the device specified by (d) onwards.

Ladder diagram	Structured text	
	ENO:=DZCP(EN,s1,s2,s3,d); ENO:=DZCPP(EN,s1,s2,s3,d);	ENO:=DZCP_U(EN,s1,s2,s3,d); ENO:=DZCPP_U(EN,s1,s2,s3,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DZCP(P)	-2147483647 to +2147483647	32-bit signed binary	ANY32
	DZCP(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	DZCP(P)	-2147483647 to +2147483647	32-bit signed binary	ANY32
	DZCP(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s3)	DZCP(P)	-2147483647 to +2147483647	32-bit signed binary	ANY32
	DZCP(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	The starting bit device to which the comparison result is output	—	Bit	ANY_BOOL

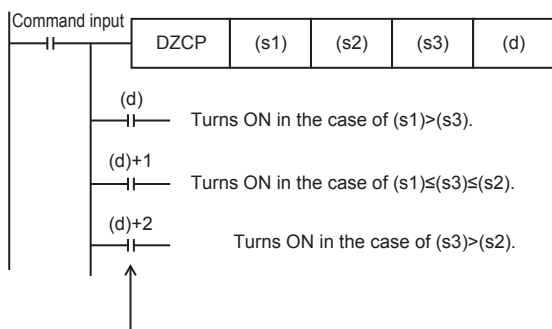
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s3)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions perform a comparison operation on the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2) with the 32-bit binary data in the device specified by comparison source (s3), and according to the comparison result (below, within zone, above), (d), (d) + 1, or (d) + 2 is turned ON. (s1), (s2), and (s3) are handled as binary values within the range of above data setting.
- Large and small comparison is executed algebraically.
 - With sign... -125400 (FFFE1628H) < 22466 (000057C2H) < 1015444 (000F7E94H)
 - Without sign... 0 (00000000H) < 2147483647 (7FFFFFFFH) < 4026531840 (F0000000H)



Even if the command input turns OFF and the DZCP instruction is not executed, (d) to (d)+2 latches the status just before the command input turns from ON to OFF.

Precautions

- Set (s1) to a value less than (s2).
- Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the 3 points of data starting from the device specified by (d) exceeds said device.

Comparing 16-bit binary block data

BKCMPO(P)(_U)

These instructions perform a comparison operation between (n) point(s) of 16-bit binary data in the device starting from the one specified by (s1) and (n) point(s) of 16-bit binary data in the device starting from the one specified by (s2), and store the operation result in the device specified by (d).

Ladder diagram	Structured text
<p>(□ is to be replaced by any of the following: BKCMPO(P)(_U), BKCMPO<>(P)(_U), BKCMPO>(P)(_U)< BKCMPO<=(P)(_U), BKCMPO<(P)(_U), BKCMPO>=(P)(_U).)</p>	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	BKCMPO(P)	-32768 to +32767	16-bit signed binary	ANY16
	BKCMPO(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	BKCMPO(P)	—	16-bit signed binary	ANY16
	BKCMPO(P)_U	—	16-bit unsigned binary	ANY16_U
(d)	Head device storing comparison result	—	Bit	ANY_BOOL
(n)	Number of data to be compared	0 to 65535	16-bit unsigned binary	ANY16_U

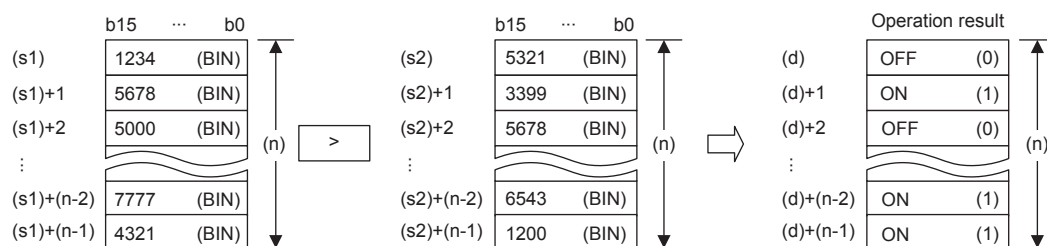
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

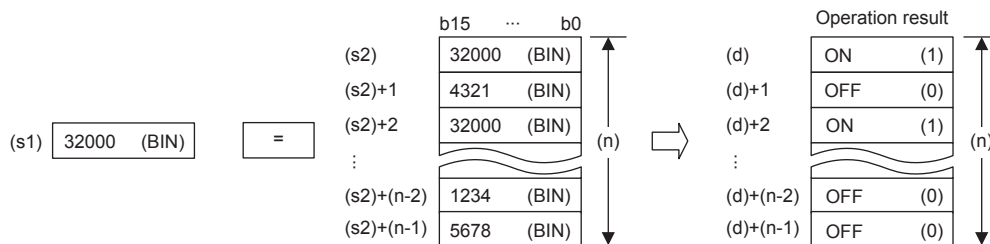
Processing details

- These instructions perform a comparison operation between (n) point(s) of 16-bit binary data in the device starting from the one specified by (s1) and (n) point(s) of 16-bit binary data in the device starting from the one specified by (s2), and store the comparison result in (n) point(s) of data starting from the device specified by (d).
- The relevant devices of (n) point(s) of data starting from the device specified by (d) are turned ON when the comparison conditions are met and turned OFF when the comparison conditions are not met.



- Comparison operation is performed in units of 16 bits.

- A constant can be directly specified in (s1).



- The following table lists the comparison operation result of each instruction.

Instruction symbol	Condition	Result
BKCMP=(P)(_U)	$(s1) = (s2)$	On(1)
BKCMP<>(P)(_U)	$(s1) \neq (s2)$	
BKCMP>(P)(_U)	$(s1) > (s2)$	
BKCMP<=(P)(_U)	$(s1) \leq (s2)$	
BKCMP<(P)(_U)	$(s1) < (s2)$	
BKCMP>=(P)(_U)	$(s1) \geq (s2)$	
BKCMP=(P)(_U)	$(s1) \neq (s2)$	Off(0)
BKCMP<>(P)(_U)	$(s1) = (s2)$	
BKCMP>(P)(_U)	$(s1) \leq (s2)$	
BKCMP<=(P)(_U)	$(s1) > (s2)$	
BKCMP<(P)(_U)	$(s1) \geq (s2)$	
BKCMP>=(P)(_U)	$(s1) < (s2)$	

- When the comparison operation result is all ON (1) in all (n) point(s) starting from (d), SM704 and SM8090 (block comparison signal) turns ON.

Operation error

Error code (SD0/SD8067)	Description
2820	The (n) point(s) starting from the device specified by (s1), (s2), and (d) exceeds said device.
2821	When (d) specifies "D□.b", the data register of (d) and the (n) point(s) of data starting from the device specified by (s1) overlap.
	When (d) specifies "D□.b", the data register of (d) and the (n) point(s) of data starting from the device specified by (s2) overlap.

Comparing 32-bit binary block data

DBKCMPO(P)(_U)

These instructions perform a comparison operation between the (n) point(s) of 32-bit binary data starting from the device specified by (s1) and the (n) point(s) of 32-bit binary data starting from the device specified by (s2), and store the operation result in the device specified by (d).

Ladder diagram	Structured text
<p>(□ is to be replaced by any of the following: DBKCMPO(P)(_U), DBKCMPO<>(P)(_U), DBKCMPO>(P)(_U), DBKCMPO<=(P)(_U), DBKCMPO<(P)(_U), DBKCMPO>=(P)(_U).)</p>	Not supported

Setting data

■ Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DBKCMPO(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DBKCMPO(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	DBKCMPO(P)	—	32-bit signed binary	ANY32
	DBKCMPO(P)_U	—	32-bit unsigned binary	ANY32_U
(d)	Head device storing comparison result	—	Bit	ANY_BOOL
(n)	Number of data to be compared	0 to 65535	16-bit unsigned binary	ANY16_U

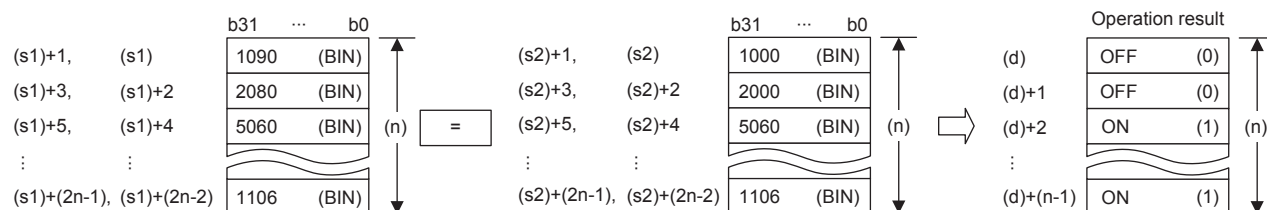
■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	○	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	○	—	○	—	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

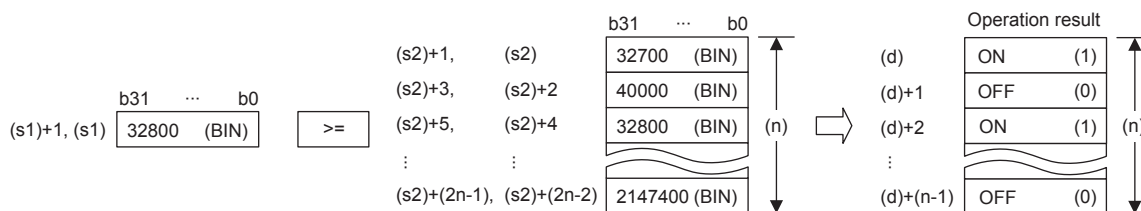
Processing details

- These instructions perform a comparison operation between (n) point(s) of 32-bit binary data starting from the device specified by (s1) and (n) point(s) of 32-bit binary data starting from the device specified by (s2), and store the comparison result in (n) point(s) of data starting from the device specified by (d).
- The relevant (n) point(s) of data starting from the device specified by (d) are turned ON when the comparison conditions are met and turned OFF when the comparison conditions are not met.



- Comparison operation is performed in units of 32 bits.

- A constant can be directly specified in (s1).



- (d) is specified outside the device range of (n) point(s) of data starting from the one specified by (s1) and outside the device range of (n) point(s) of data starting from the one specified by (s2).
- The following table lists the comparison operation result of each instruction.

Instruction symbol	Condition	Result
DBKCMP=(P)(_U)	(s1) = (s2)	On(1)
DBKCMP<>(P)(_U)	(s1) ≠ (s2)	
DBKCMP>(P)(_U)	(s1) > (s2)	
DBKCMP<=(P)(_U)	(s1) ≤ (s2)	
DBKCMP<(P)(_U)	(s1) < (s2)	
DBKCMP>=(P)(_U)	(s1) ≥ (s2)	
DBKCMP=(P)(_U)	(s1) ≠ (s2)	Off(0)
DBKCMP<>(P)(_U)	(s1) = (s2)	
DBKCMP>(P)(_U)	(s1) ≤ (s2)	
DBKCMP<=(P)(_U)	(s1) > (s2)	
DBKCMP<(P)(_U)	(s1) ≥ (s2)	
DBKCMP>=(P)(_U)	(s1) < (s2)	

- When the comparison operation result is all ON (1) in all (n) point(s) starting from (d), SM704 and SM8090 (block comparison signal) turns ON.

Precautions

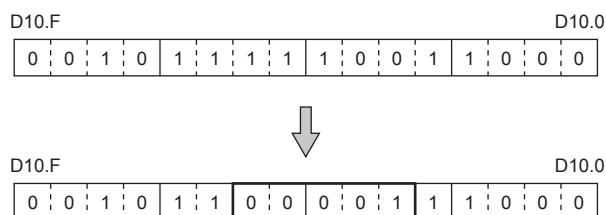
If a 32-bit counter (high-speed counter included) is used, make sure to compare using the 32-bit operation (DBKCMP=, DBKCMP>, DBKCMP<, etc.).

Operation error

Error code (SD0/SD8067)	Description
2820	The (n) × 2 points of data starting from the device specified by (s1) and (s2) or the (n) point(s) of data starting from the device specified by (d) exceeds said device.
2821	When (d) specifies "D□.b", the (n) point(s) of data starting from the device specified by (d) and the device range of the (n) × 2 points of data starting from the device specified by (s1) overlap. When (d) specifies "D□.b", the (n) point(s) of data starting from the device specified by (d) and the device range of the (n) × 2 points of data starting from the device specified by (s2) overlap.

Point

When bit is specified for word device, devices other than the bit-specified word devices where operation result is stored will not change.



6.2 Arithmetic Operation Instructions

Adding 16-bit binary data

+(P)(U) instruction and ADD(P)(U) instruction can be used for addition of 16-bit binary data.

+(P)(U) [using two operands]

These instructions add the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	+(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	+(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	+(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	+(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions add the 16-bit binary data in the device specified by (s) to the 16-bit binary data in the device specified by (d), and store the addition result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of +(P)

K32767 + K2 → K-32767 Because the highest bit is 1, the value is negative.
 (7FFFH) (0002H) (8001H)
 K-32768 + K-2 → K32766 Because the highest bit is 0, the value is positive.
 (8000H) (FFFEH) (7FFEh)

In case of +(P)(U)

K65535 + K2 → K1
 (FFFFH) (0002H) (0001H)

Operation error

There is no operation error.

+ (P) (U) [using three operands]

These instructions add the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=PLUS(EN,s1,s2,d); ENO:=PLUSP(EN,s1,s2,d);	ENO:=PLUS_U(EN,s1,s2,d); ENO:=PLUSP_U(EN,s1,s2,d);

Setting data

■ Descriptions, ranges, and data types

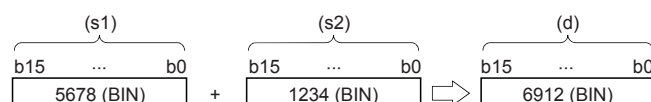
Operand	Description	Range	Data type	Data type (label)
(s1)	+(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	+(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	+(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	+(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	+(P)	—	16-bit signed binary	ANY16_S
	+(P)_U	—	16-bit unsigned binary	ANY16_U

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions add the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the addition result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of +(P)

K32767 + K2 → K-32767 Because the highest bit is 1, the value is negative.
(7FFFH) (0002H) (8001H)
K-32768 + K-2 → K32766 Because the highest bit is 0, the value is positive.
(8000H) (FFFEH) (7FFEH)

In case of +(P)_U

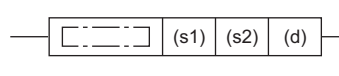
K65535 + K2 → K1
(FFFFH) (0002H) (0001H)

Operation error

There is no operation error.

ADD(P)(_U)

These instructions add the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=ADDP(EN,s1,s2,d);	ENO:=ADD_U(EN,s1,s2,d); ENO:=ADDP_U(EN,s1,s2,d);

*1 The ADD instruction is not supported by the ST language. Use ADD of the standard function.

☞ Page 777 ADD(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	ADD(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	ADD(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	ADD(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	ADD(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	ADD(P)	—	16-bit signed binary	ANY16_S
	ADD(P)_U	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

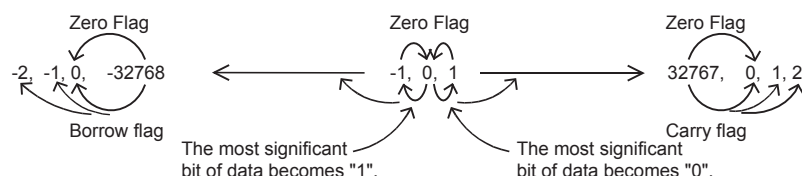
Processing details

- These instructions add the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the addition result in the device specified by (d).



■Relationship between the flag operation and the sign (positive or negative) of a numeric value

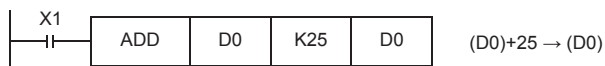
Device	Name	Description
SM700, SM8022	Carry	When the operation result exceeds the upper limit of the data setting range, the carry flag is turned ON.
SM8020	Zero	When the operation result is 0, the zero flag is turned ON.
SM8021	Borrow	When the operation result is less than the lower limit of the data setting range, the borrow flag is turned ON.



Precautions

■When specifying the same device in the source and destination

The same device number can be specified for both the source and the destination. In this case, note that the addition result changes in every operation cycle if a continuous operation type ADD instruction is used.



■Difference between ADD(P) instruction, +(P) instruction, and INC(P) instruction in a program for adding "+1"

When ADD(P) instruction is used to add 1 to the contents of D0 every time X1 turns from OFF to ON, ADD(P) instruction is similar to +(P) instruction and INC(P) instruction described later except for the contents shown in the table below

	ADD(P) instruction	+(P) instruction, INC(P) instruction
Flag (zero, borrow or carry)	Operates	Does not operate
Operation result	(s)+1=(d) +32767 → 0 → +1 → +2 →...	+32767 → -32768 → -32767 →...

Operation error

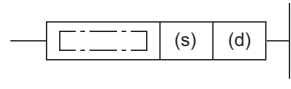
There is no operation error.

Subtracting 16-bit binary data

-(P)(_U) instruction and SUB(P)(_U) instruction can be used for subtraction of 16-bit binary data.

-(P)(_U) [using two operands]

These instructions subtract the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■ Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	-(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	-(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	-(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	-(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions subtract the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the subtraction result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of -(P)

K32768 - K2 → K32766 Because the highest bit is 0, the value is positive.
 (8000H) (0002H) (7FFE H)
 K32767 - K-2 → K-32767 Because the highest bit is 1, the value is negative.
 (7FFFH) (FFFEH) (8001H)

In case of -(P)(_U)

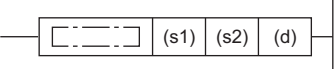
K0 - K1 → K65535
 (0000H) (0001H) (FFFFH)
 K0 - K65535 → K1
 (0000H) (FFFFH) (0001H)

Operation error

There is no operation error.

-(P)(U) [using three operands]

These instructions subtract the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=MINUS(EN,s1,s2,d); ENO:=MINUSP(EN,s1,s2,d);	ENO:=MINUS_U(EN,s1,s2,d); ENO:=MINUSP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

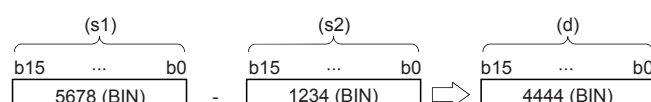
Operand	Description	Range	Data type	Data type (label)
(s1)	-(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	-(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	-(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	-(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	-(P)	—	16-bit signed binary	ANY16_S
	-(P)_U	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions subtract the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the subtraction result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of -(P)

K-32768 - K2 → K32766 Because the highest bit is 0, the value is positive.
(8000H) (0002H) (7FFEh)
K32767 - K-2 → K-32767 Because the highest bit is 1, the value is negative.
(7FFFh) (FFFEh) (8001H)

In case of -(P)(U)

K0 - K1 → K65535
(0000H) (0001H) (FFFFh)
K0 - K65535 → K1
(0000H) (FFFFh) (0001H)

Operation error

There is no operation error.

SUB(P)(_U)

These instructions subtract the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=SUBP(EN,s1,s2,d);	ENO:=SUB_U(EN,s1,s2,d); ENO:=SUBP_U(EN,s1,s2,d);

*1 The SUB instruction is not supported by the ST language. Use SUB of the standard function.

☞ Page 781 SUB(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	SUB(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	SUB(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	SUB(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	SUB(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	SUB(P)	—	16-bit signed binary	ANY16_S
	SUB(P)_U	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

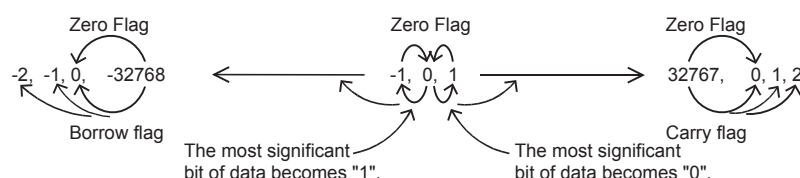
Processing details

- These instructions subtract the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the subtraction result in the device specified by (d).



■Relationship between the flag operation and the sign (positive or negative) of a numeric value

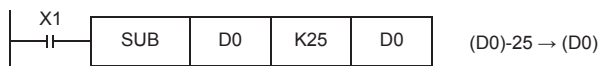
Device	Name	Description
SM700, SM8022	Carry	When the operation result exceeds the upper limit of the data setting range, the carry flag is turned ON.
SM8020	Zero	When the operation result is 0, the zero flag is turned ON.
SM8021	Borrow	When the operation result is less than the lower limit of the data setting range, the borrow flag is turned ON.



Precautions

■When specifying the same device in the source and destination

The same device number can be specified for both the source and the destination. In this case, note that the subtraction result changes in every operation cycle if a continuous operation type SUB instruction is used.



■Difference between SUB(P) instruction, -(P) instruction, and DEC(P) instruction in a program for subtracting "-1"

When SUB(P) instruction is used to subtract 1 from the contents of D0 every time X1 turns from OFF to ON, SUB(P) instruction is similar to -(P) instruction and DEC(P) instruction described later except for the contents shown in the table below

	SUB(P) instruction	-(P) instruction, DEC(P) instruction
Flag (zero, borrow or carry)	Operates	Does not operate
Operation result	(s)-1=(d) -32768 → 0 → -1 → -2 → ...	-32768 → +32767 → +32766 → ...

Operation error

There is no operation error.

Adding 32-bit binary data

D+(P)(_U) instruction and DADD(P)(_U) instruction can be used for addition of 32-bit binary data.

D+(P)(_U) [using two operands]

These instructions add the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■ Descriptions, ranges, and data types

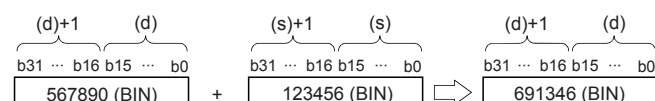
Operand	Description	Range	Data type	Data type (label)
(s)	D+(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D+(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	D+(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D+(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions add the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the addition result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of D+(P)

K2147483647 + K2 → K-2147483647 Because the highest bit is 1, the value is negative.
 (7FFFFFFFH) (00000002H) (80000001H)
 K-2147483648 + K-2 → K2147483646 Because the highest bit is 0, the value is positive.
 (80000000H) (FFFFFFFEH) (7FFFFFFEH)

In case of D+(P)(_U)

K4294967295 + K2 → K1
 (FFFFFFFFH) (00000002H) (00000001H)

Operation error

There is no operation error.

D+(P)(_U) [using three operands]

These instructions add the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DPLUS(EN,s1,s2,d); ENO:=DPLUSP(EN,s1,s2,d);	ENO:=DPLUS_U(EN,s1,s2,d); ENO:=DPLUSP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

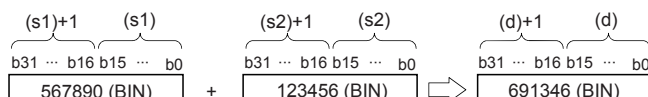
Operand	Description	Range	Data type	Data type (label)
(s1)	D+(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D+(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	D+(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D+(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	D+(P)	—	32-bit signed binary	ANY32_S
	D+(P)_U	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions add the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the addition result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of D+(P)

K2147483647 + K2 → K-2147483647 Because the highest bit is 1, the value is negative.
(7FFFFFFFH) (00000002H) (80000001H)

K-2147483648 + K-2 → K2147483646 Because the highest bit is 0, the value is positive.
(80000000H) (FFFFFFFEH) (7FFFFFFEH)

In case of D+(P)_U

K4294967295 + K2 → K1
(FFFFFFFFH) (00000002H) (00000001H)

Operation error

There is no operation error.

DADD(P)(_U)

These instructions add the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DADD(EN,s1,s2,d); ENO:=DADDP(EN,s1,s2,d);	ENO:=DADD_U(EN,s1,s2,d); ENO:=DADDP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

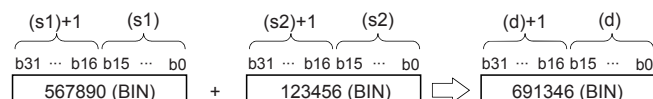
Operand	Description	Range	Data type	Data type (label)
(s1)	DADD(P) DADD(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32_S ANY32_U
(s2)	DADD(P) DADD(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32_S ANY32_U
(d)	DADD(P) DADD(P)_U	— —	32-bit signed binary 32-bit unsigned binary	ANY32_S ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

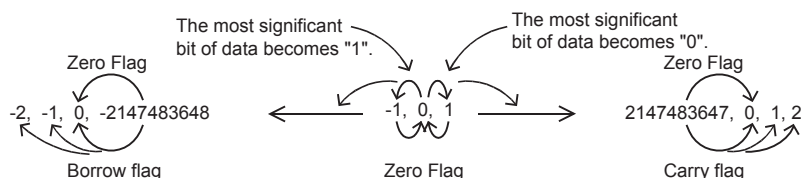
Processing details

- These instructions add the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the addition result in the device specified by (d).



■Relationship between the flag operation and the sign (positive or negative) of a numeric value

Device	Name	Description
SM700, SM8022	Carry	When the operation result exceeds the upper limit of the data setting range, the carry flag is turned ON.
SM8020	Zero	When the operation result is 0, the zero flag is turned ON.
SM8021	Borrow	When the operation result is less than the lower limit of the data setting range, the borrow flag is turned ON.



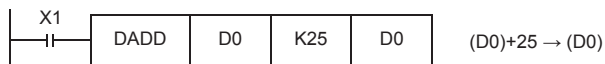
Precautions

■When DADD instruction is used

When specifying word devices, a device for the lower-order 16-bits is specified first, and then a word device with the next device number is set for the higher-order 16 bits. To prevent number overlap, it is recommended to always specify an even number.

■When specifying the same device in the source and destination

The same device number can be specified for both the source and the destination. In this case, note that the addition result changes in every operation cycle if a continuous operation type ADD instruction is used.



■Difference between DADD(P) instruction, D+(P) instruction, and DINC(P) instruction in a program for adding "+1"

When DADD(P) instruction is used to add 1 to the contents of D0 every time X1 turns from OFF to ON, DADD(P) instruction is similar to D+(P) instruction and DINC(P) instruction described later except for the contents shown in the table below.

		DADD(P) instruction	D+(P) instruction, DINC(P) instruction
Flag (zero, borrow or carry)		Operates	Does not operate
Operation result	(s)+1=(d)	+2147483647 → 0 → +1 → +2 →...	+2147483647 → -2147483648 → -2147483647 →...

Operation error

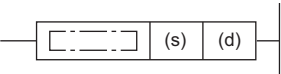
There is no operation error.

Subtracting 32-bit binary data

D-(P)(_U) instruction and DSUB(P)(_U) instruction can be used for subtraction of 32-bit binary data.

D-(P)(_U) [using two operands]

These instructions subtract the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■ Descriptions, ranges, and data types

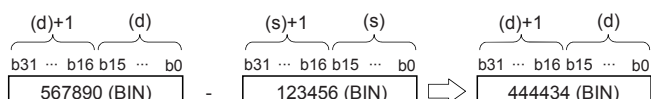
Operand	Description	Range	Data type	Data type (label)
(s)	D-(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D-(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	D-(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D-(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions subtract the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the subtraction result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of D-(P)

K-2147483648 - K2 → K2147483646 Because the highest bit is 0, the value is positive.
(80000000H) (00000002H) (7FFFFFFEH)
K2147483647 - K-2 → K-2147483647 Because the highest bit is 1, the value is negative.
(7FFFFFFFH) (FFFFFFFEH) (80000001H)

In case of D-(P)(_U)

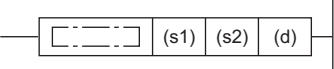
K0 - K1 → K4294967295
(00000000H) (00000001H) (FFFFFFFFH)
K0 - K4294967295 → K1
(00000000H) (FFFFFFFFH) (00000001H)

Operation error

There is no operation error.

D-(P)(U) [using three operands]

These instructions subtract the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DMINUS(EN,s1,s2,d); ENO:=DMINUSP(EN,s1,s2,d);	ENO:=DMINUS_U(EN,s1,s2,d); ENO:=DMINUSP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

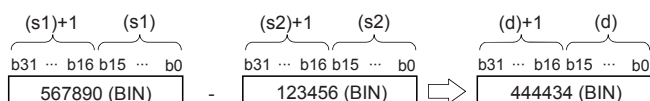
Operand	Description	Range	Data type	Data type (label)
(s1)	D-(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D-(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	D-(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	D-(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	D-(P)	—	32-bit signed binary	ANY32_S
	D-(P)_U	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions subtract the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the subtraction result in the device specified by (d).



- When underflow or overflow occurs in the operation result, the following processing is executed. In this case, the carry flag (SM700, SM8022) does not turn ON.

In case of D-(P)

K-2147483648 - K2 → K2147483646 Because the highest bit is 0, the value is positive.
(80000000H) (00000002H) (7FFFFFFEH)
K2147483647 - K-2 → K-2147483647 Because the highest bit is 1, the value is negative.
(7FFFFFFFH) (FFFFFFFEH) (80000001H)

In case of D-(P)(U)

K0 - K1 → K4294967295
(00000000H) (00000001H) (FFFFFFFFH)
K0 - K4294967295 → K1
(00000000H) (FFFFFFFFH) (00000001H)

Operation error

There is no operation error.

DSUB(P)(_U)

These instructions subtract the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DSUB(EN,s1,s2,d); ENO:=DSUBP(EN,s1,s2,d);	ENO:=DSUB_U(EN,s1,s2,d); ENO:=DSUBP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

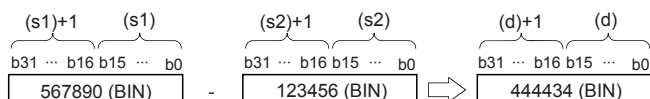
Operand		Description	Range	Data type	Data type (label)
(s1)	DSUB(P)	Subtrahend data or the head device where the data to be subtracted from another is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	DSUB(P)_U		0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	DSUB(P)	Subtrahend data or the head device where the data to be subtracted from another is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	DSUB(P)_U		0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	DSUB(P)	Head device for storing the operation result	—	32-bit signed binary	ANY32_S
	DSUB(P)_U		—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

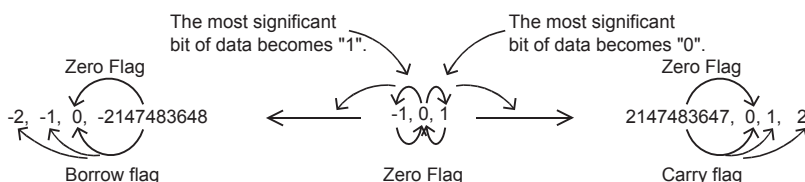
Processing details

- These instructions subtract the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the subtraction result in the device specified by (d).



■Relationship between the flag operation and the sign (positive or negative) of a numeric value

Device	Name	Description
SM700, SM8022	Carry	When the operation result exceeds the upper limit of the data setting range, the carry flag is turned ON.
SM8020	Zero	When the operation result is 0, the zero flag is turned ON.
SM8021	Borrow	When the operation result is less than the lower limit of the data setting range, the borrow flag is turned ON.



Precautions

■When the DSUB instruction is used

When specifying word devices, a device is specified for the lower-order 16-bits first, and then a word device with the next device number is set for the higher-order 16 bits. To prevent number overlap, it is recommended to always specify an even number.

■When specifying the same device in the source and destination

The same device number can be specified for both the source and the destination. In this case, note that the subtraction result changes in every operation cycle if a continuous operation type SUB instruction is used.



■Difference between DSUB(P) instruction, D-(P) instruction, and DDEC(P) instruction in a program for subtracting "-1"

When DSUB(P) instruction is used to subtract 1 from the contents of D0 every time X1 turns from OFF to ON, SUB(P) instruction is similar to D-(P) instruction and DDEC(P) instruction described later except for the contents shown in the table below:

		DSUB(P) instruction	D-(P) instruction, DDEC(P) instruction
Flag (zero, borrow or carry)		Operates	Does not operate
Operation result	(s)-1=(d)	-2147483648 → 0 → -1 → -2 →...	-2147483648 → +2147483647 → +2147483646 →...

Operation error

There is no operation error.

Multiplying 16-bit binary data

* $(P)_{(U)}$ instruction and $MUL(P)_{(U)}$ instruction can be used for multiplication of 16-bit binary data.

* $(P)_{(U)}$

These instructions multiply the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■ Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	* (P)	-32768 to +32767	16-bit signed binary	ANY16
	* $(P)_{(U)}$	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	* (P)	-32768 to +32767	16-bit signed binary	ANY16
	* $(P)_{(U)}$	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	* (P)	—	32-bit signed binary	ANY32
	* $(P)_{(U)}$	—	32-bit unsigned binary	ANY32_U

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions multiply the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the multiplication result in the device specified by (d).



- When (d) is a bit device, lower-order bit is specified first.

Ex.

Multiplication result when (d) is a bit device

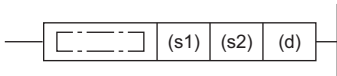
- K1 ... Lower 4 bits (b0 to b3)
- K4 ... Lower 16 bits (b0 to b15)
- K8 ... Lower 32 bits (b0 to b31)

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds said device range.

MUL(P)(_U)

These instructions multiply the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=MULP(EN,s1,s2,d);	ENO:=MUL_U(EN,s1,s2,d); ENO:=MULP_U(EN,s1,s2,d);

*1 The MUL instruction is not supported by the ST language. Use MUL of the standard function.

☞ Page 779 MUL(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	MUL(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	MUL(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	MUL(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	MUL(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	MUL(P)	—	32-bit signed binary	ANY32_S
	MUL(P)_U	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

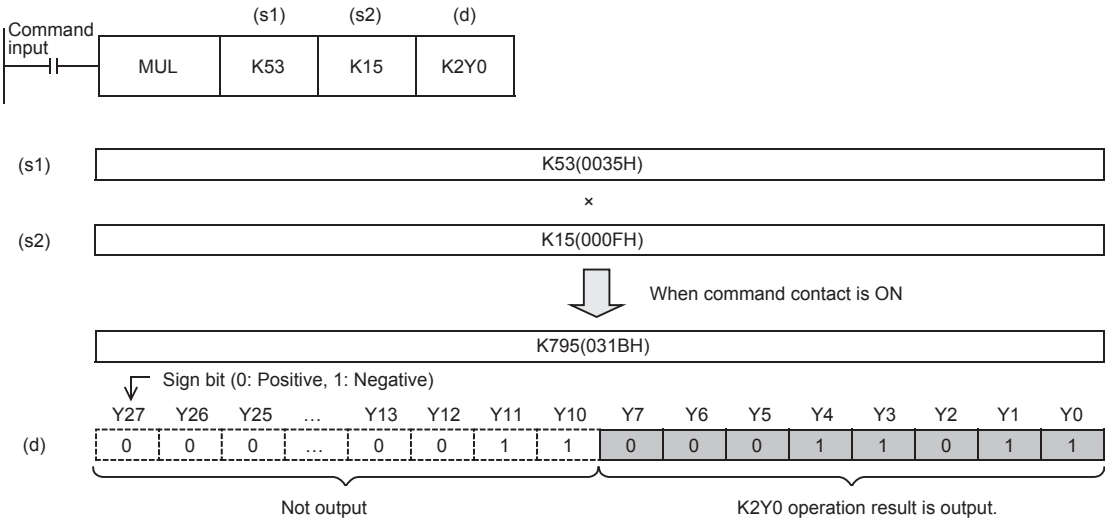
- These instructions multiply the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the multiplication result in the device specified by (d).



- Nibble can be specified ranging from K1 to K8 for (d).

Ex.

For example, when K2 is specified, only the lower-order 8 bits can be obtained out of the product (32 bits).



■Related flag

Device	Name	Description
SM8304	Zero	When the operation result is 0, the zero flag is turned ON.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds said device range.

Dividing 16-bit binary data

/ (P) (_ U) instruction and DIV (P) (_ U) instruction can be used for division of 16-bit binary data.

/ (P) (_ U)

These instructions divide the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

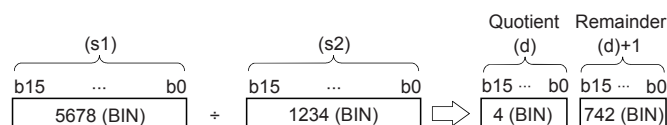
Operand	Description	Range	Data type	Data type (label)
(s1)	/ (P)	-32768 to +32767	16-bit signed binary	ANY16
	/ (P) _ U	0 to 65535	16-bit unsigned binary	ANY16 _ U
(s2)	/ (P)	-32768 to +32767	16-bit signed binary	ANY16
	/ (P) _ U	0 to 65535	16-bit unsigned binary	ANY16 _ U
(d)	/ (P)	—	32-bit signed binary	ANY16 _ S _ ARRAY (Number of elements: 2)
	/ (P) _ U	—	32-bit unsigned binary	ANY16 _ U _ ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions divide the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the division result in the device specified by (d).



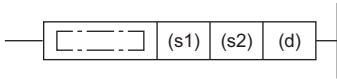
- For the division result, 32-bit is used for word device to store the quotient and remainder and 16-bit is used for bit device to store quotient only.
- Quotient..... Stored in the lower 16 bits.
- Remainder..... Stored in the upper 16 bits. (This data can be stored for word device only.)

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds the range of said device.
3400	0 is specified for (s2) value.
3403	The operation result exceeds 32767, in case of signed operation.

DIV(P)(_U)

These instructions divide the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text*1	
	ENO:=DIVP(EN,s1,s2,d);	ENO:=DIV_U(EN,s1,s2,d); ENO:=DIVP_U(EN,s1,s2,d);

*1 The DIV instruction is not supported by the ST language. Use DIV of the standard function.

☞ Page 783 DIV(_E)

Setting data

■Descriptions, ranges, and data types

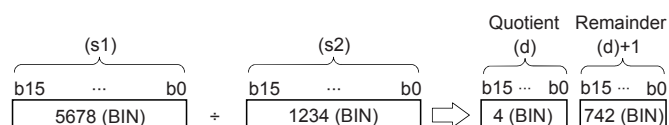
Operand	Description	Range	Data type	Data type (label)
(s1)	DIV(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	DIV(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	DIV(P)	-32768 to +32767	16-bit signed binary	ANY16_S
	DIV(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	DIV(P)	—	32-bit signed binary	ANY16_S_ARRAY (Number of elements: 2)
	DIV(P)_U		32-bit unsigned binary	ANY16_U_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions divide the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the division result in the device specified by (d).



- Two devices in total starting from the one specified by (d) are used to store the division result. Make sure that these two devices are not used for another control.
- Quotient..... Stored in the lower 16 bits.
- Remainder..... Stored in the upper 16 bits.

■Related flag

Device	Name	Description
SM700	Carry	When the operation result of the signed operation exceeds 32767, the carry flag is turned ON.
SM8304	Zero	When the operation result is 0, the zero flag is turned ON.
SM8306	Carry	When the operation result of the signed operation exceeds 32767, the carry flag is turned ON.

Precautions

■Operation result

- The most significant bit of the quotient and remainder indicates the sign (positive: 0, negative: 1), respectively.
- The quotient is negative when either (s1) or (s2) is negative. The remainder is negative when the (s1) is negative.

■Device specified by (d)

- The remainder is not obtained when a bit device is specified with nibble specification.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds the range of said device.
3400	0 is specified for (s2) value.
3403	The data type of the data setting is signed data and the operation result exceeds 32767.

Multiplying 32-bit binary data

D*(P)(U) instruction and DMUL(P)(U) instruction can be used for multiplication of 32-bit binary data.

D*(P)(U)

These instructions multiply the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	D*(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	D*(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	D*(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	D*(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	D*(P)	—	64-bit signed binary	ANY32_S_ARRAY (Number of elements: 2)
	D*(P)_U	—	64-bit unsigned binary	ANY32_U_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	—	—	○	—	○	—	—	—	—

Processing details

- These instructions multiply the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the multiplication result in the device specified by (d).



- When (d) is a bit device, only the lower 32 bits of the multiplication result are stored and the upper 32 bits cannot be specified. If the upper 32 bits data of the multiplication operation result are required, temporarily store the result in a word device, and transfer the data stored in word device ((d)+2) and ((d)+3) to the specified bit devices.

Ex.

Multiplication result when (d) is a bit device

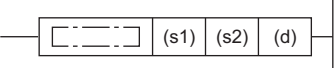
- K1 ... Lower 4 bits (b0 to b3)
- K4 ... Lower 16 bits (b0 to b15)
- K8 ... Lower 32 bits (b0 to b31)

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds the range of said device.

DMUL(P)(_U)

These instructions multiply the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DMUL(EN,s1,s2,d); ENO:=DMULP(EN,s1,s2,d);	ENO:=DMUL_U(EN,s1,s2,d); ENO:=DMULP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand		Description	Range	Data type	Data type (label)
(s1)	DMUL(P)	Multiplicand data or the head device where the data to be multiplied by another is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	DMUL(P)_U		0 to 4294967295	32-bit unsigned binary	ANY32_U
(s2)	DMUL(P)	Multiplier data or the head device where the data by which another is to be multiplied is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	DMUL(P)_U		0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	DMUL(P)	Head device for storing the operation result	—	64-bit signed binary	ANY32_S_ARRAY (Number of elements: 2)
	DMUL(P)_U			64-bit unsigned binary	ANY32_U_ARRAY (Number of elements: 2)

■Applicable devices

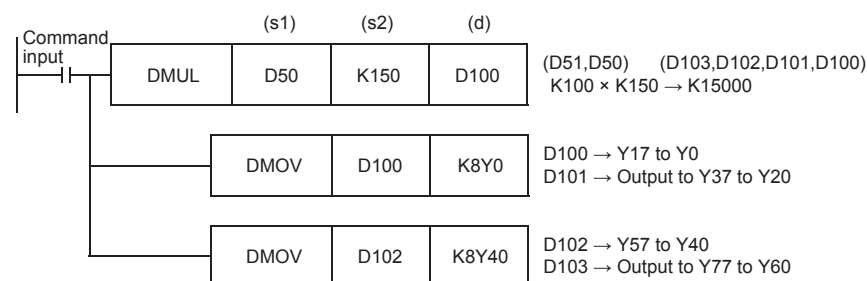
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions multiply the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the multiplication result in the device specified by (d).



- When nibble is specified ranging from K1 to K8 for (d), the result is obtained only for the lower-order 32 bits, and is not obtained for the higher-order 32 bits. Transfer the data to word devices once, then execute the operation.



■Related flag

Device	Name	Description
SM8304	Zero	When the operation result is 0, the zero flag is turned ON.

Precautions

- Even if word devices are used, the operation result (64 bits binary data) cannot be monitored at one time. In such a case, a floating point operation is recommended.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds the range of said device.

Dividing 32-bit binary data

D/(P)(_U) instruction and DDIV(P)(_U) instruction can be used for division of 32-bit binary data.

D/(P)(_U)

These instructions divide the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

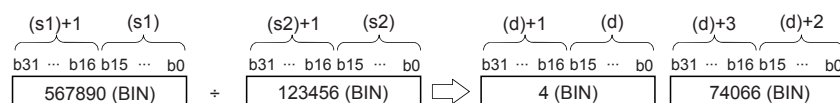
Operand	Description	Range	Data type	Data type (label)
(s1)	D/(P) D/(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(s2)	D/(P) D/(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(d)	D/(P) D/(P)_U	—	64-bit signed binary 64-bit unsigned binary	ANY32_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	—	—	○	—	○	—	—	—	—

Processing details

- These instructions divide the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the division result in the device specified by (d).



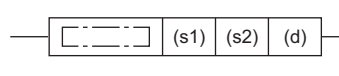
- For the division result of word device, 64-bit binary is used to store the quotient and remainder. For bit device, 32-bit binary is used to store quotient only.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds the range of said device.
3400	0 is specified for (s2) value.
3403	Signed operation is performed and the operation result exceeds 2147483647.

DDIV(P)(_U)

These instructions divide the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DDIV(EN,s1,s2,d); ENO:=DDIVP(EN,s1,s2,d);	ENO:=DDIV_U(EN,s1,s2,d); ENO:=DDIVP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DDIV(P) Dividend data or the head device where the data to be divided by another is stored	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32_S ANY32_U
(s2)	DDIV(P) Divisor data or the head device where the data by which another is to be divided is stored	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32_S ANY32_U
(d)	DDIV(P) Head device for storing the operation result	—	64-bit signed binary 64-bit unsigned binary	ANY32_S_ARRAY (Number of elements: 2) ANY32_U_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions divide the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the division result in the device specified by (d).



■Related flag

Device	Name	Description
SM700	Carry	When the operation result of the signed operation exceeds 32767, the carry flag is turned ON.
SM8304	Zero	When the operation result is 0, the zero flag is turned ON.
SM8306	Carry	When the operation result of the signed operation exceeds 32767, the carry flag is turned ON.

Precautions

■Operation result

- The most significant bit of the quotient and remainder indicates the sign (positive: 0, negative: 1), respectively.
- The quotient is negative when either (s1) or (s2) is negative. The remainder is negative when the (s1) is negative.

■Device specified by (d)

- The remainder is not obtained when a bit device is specified with nibble specification.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of the device specified by (d) exceeds the range of said device.
3400	0 is specified for (s2) value.
3403	Signed operation is performed and the operation result exceeds 2147483647.

Adding BCD 4-digit data

B+(P) [using two operands]

These instructions add the BCD 4-digit data in the device specified by (d) and the BCD 4-digit data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

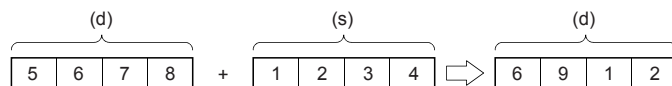
Operand	Description	Range	Data type	Data type (label)
(s)	Addend data or the device where the data that is added to another is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Device where the data to which another is added is stored	0 to 9999	BCD 4-digit	ANY16

■Applicable devices

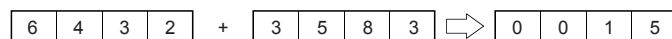
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions add the BCD 4-digit data in the device specified by (d) and the BCD 4-digit data in the device specified by (s), and store the addition result in the device specified by (d).



- If the addition result exceeds 9999, carry is ignored. In this case, the carry flag (SM700) does not turn ON.



Operation error

Error code (SD/SD8067)	Description
3405	BCD data in the device specified by (s) is outside of the valid range (0 to 9999).
	BCD data in the device specified by (d) is outside of the valid range (0 to 9999).

B+(P) [using three operands]

These instructions add the BCD 4-digit data in the device specified by (s1) and the BCD 4-digit data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=BPLUS(EN,s1,s2,d); ENO:=BPLUSP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

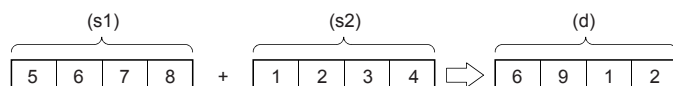
Operand	Description	Range	Data type	Data type (label)
(s1)	Augend data or the device where the data to which another is added is stored	0 to 9999	BCD 4-digit	ANY16
(s2)	Addend data or the device where the data that is added to another is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Device for storing the operation result	0 to 9999	BCD 4-digit	ANY16

■Applicable devices

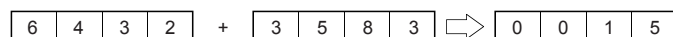
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions add the BCD 4-digit data in the device specified by (s1) and the BCD 4-digit data in the device specified by (s2), and store the addition result in the device specified by (d).



- If the addition result exceeds 9999, carry is ignored. In this case, the carry flag (SM700) does not turn ON.



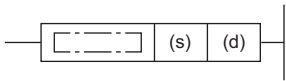
Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 9999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 9999).

Subtracting BCD 4-digit data

B-(P) [using two operands]

These instructions subtract the BCD 4-digit data in the device specified by (d) and the BCD 4-digit data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

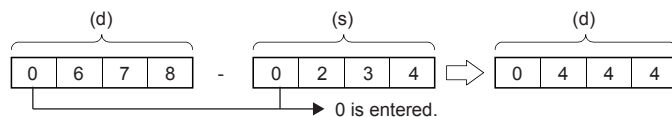
Operand	Description	Range	Data type	Data type (label)
(s)	Subtrahend data or the device where the data to be subtracted from another is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Device where the data from which another is to be subtracted is stored	0 to 9999	BCD 4-digit	ANY16

■Applicable devices

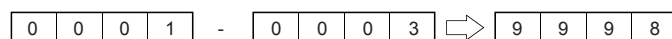
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions subtract the BCD 4-digit data in the device specified by (s) and the BCD 4-digit data in the device specified by (d), and store the subtraction result in the device specified by (d).



- If an underflow occurs, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.



Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s) is outside of the valid range (0 to 9999).
	BCD data in the device specified by (d) is outside of the valid range (0 to 9999).

B-(P) [using three operands]

These instructions subtract the BCD 4-digit data in the device specified by (s1) and the BCD 4-digit data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=BMINUS(EN,s1,s2,d); ENO:=BMINUSP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

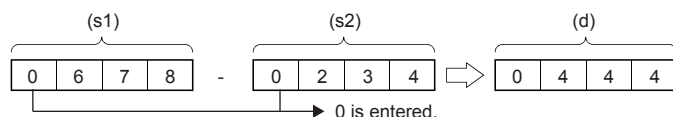
Operand	Description	Range	Data type	Data type (label)
(s1)	Minuend data or the device where the data from which another is to be subtracted is stored	0 to 9999	BCD 4-digit	ANY16
(s2)	Subtrahend data or the device where the data to be subtracted from another is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Device for storing the operation result	0 to 9999	BCD 4-digit	ANY16

■Applicable devices

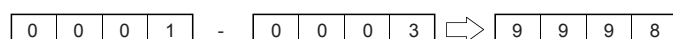
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions subtract the BCD 4-digit data in the device specified by (s1) and the BCD 4-digit data in the device specified by (s2), and store the subtraction result in the device specified by (d).



- If an underflow occurs, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.



Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 9999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 9999).

Adding BCD 8-digit data

DB+(P) [using two operands]

These instructions add the BCD 8-digit data in the device specified by (d) and the BCD 8-digit data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

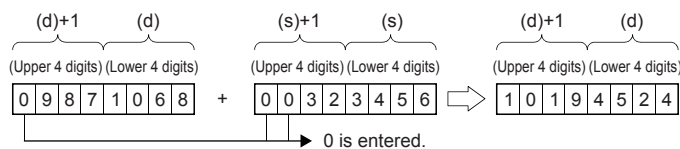
Operand	Description	Range	Data type	Data type (label)
(s)	Addend data or the head device where the data that is added to another is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Head device where the data to which another is added is stored	0 to 99999999	BCD 8-digit	ANY32

■Applicable devices

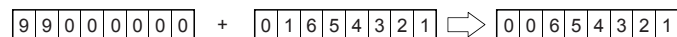
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	○	—	—	—

Processing details

- These instructions add the BCD 8-digit data in the device specified by (d) and the BCD 8-digit data in the device specified by (s), and store the addition result in the device specified by (d).



- If the addition result exceeds 99999999, carry is ignored. In this case, the carry flag (SM700) does not turn ON.



Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s) is outside of the valid range (0 to 99999999).
	BCD data in the device specified by (d) is outside of the valid range (0 to 99999999).

DB+(P) [using three operands]

These instructions add the BCD 8-digit data in the device specified by (s1) and the BCD 8-digit data in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DBPLUS(EN,s1,s2,d); ENO:=DBPLUSP(EN,s1,s2,d);</pre>

Setting data

■ Descriptions, ranges, and data types

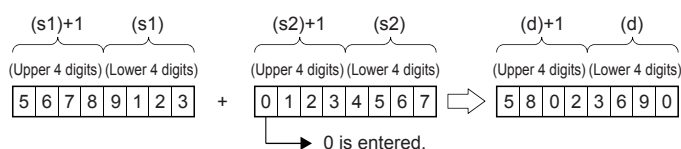
Operand	Description	Range	Data type	Data type (label)
(s1)	Augend data or the head device where the data to which another is added is stored	0 to 99999999	BCD 8-digit	ANY32
(s2)	Addend data or the head device where the data that is added to another is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Head device for storing the operation result	0 to 99999999	BCD 8-digit	ANY32

■ Applicable devices

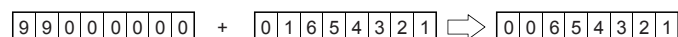
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions add the BCD 8-digit data in the device specified by (s1) and the BCD 8-digit data in the device specified by (s2), and store the addition result in the device specified by (d).



- If the addition result exceeds 99999999, carry is ignored. In this case, the carry flag (SM700) does not turn ON.



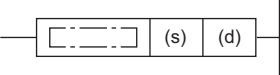
Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 99999999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 99999999).

Subtracting BCD 8-digit data

DB-(P) [using two operands]

These instructions subtract the BCD 8-digit data in the device specified by (d) and the BCD 8-digit data in the device specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

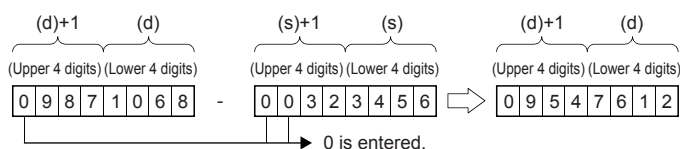
Operand	Description	Range	Data type	Data type (label)
(s)	Subtrahend data or the device where the data to be subtracted from another is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Minuend data or the device where the data from which another is to be subtracted is stored	0 to 99999999	BCD 8-digit	ANY32

■Applicable devices

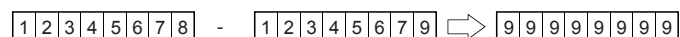
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions subtract the BCD 8-digit data specified by (d) and the BCD 8-digit data specified by (s), and store the results in the device specified by (d).



- If an underflow occurs, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.



Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s) is outside of the valid range (0 to 99999999).
	BCD data in the device specified by (d) is outside of the valid range (0 to 99999999).

DB-(P) [using three operands]

These instructions subtract the BCD 8-digit data specified by (s1) and the BCD 8-digit data specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DBMINUSP(EN,s1,s2,d); ENO:=DBMINUS(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

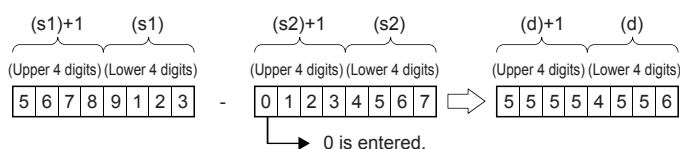
Operand	Description	Range	Data type	Data type (label)
(s1)	Minuend data or the head device where the data from which another is to be subtracted is stored	0 to 99999999	BCD 8-digit	ANY32
(s2)	Subtrahend data or the head device where the data to be subtracted from another is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Head device for storing the operation result	0 to 99999999	BCD 8-digit	ANY32

■Applicable devices

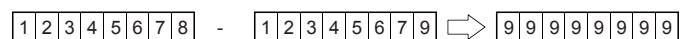
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions subtract the BCD 8-digit data specified by (s1) and the BCD 8-digit data specified by (s2), and store the results in the device specified by (d).



- If an underflow occurs, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.



Operation error

Error code (SD0/SD8067)	Description
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 99999999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 99999999).

Multiplying BCD 4-digit data

B*(P)

These instructions multiply the BCD 4-digit data specified by (s1) and the BCD 4-digit data specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

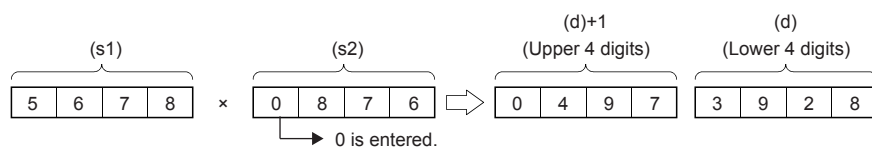
Operand	Description	Range	Data type	Data type (label)
(s1)	Multiplicand data or the device where the data to be multiplied by another is stored	0 to 9999	BCD 4-digit	ANY16
(s2)	Multiplier data or the device where the data by which another is to be multiplied is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Head device for storing the operation result	—	BCD 8-digit	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions multiply the BCD 4-digit data specified by (s1) and the BCD 4-digit data specified by (s2), and store the multiplication results in the device specified by (d).



Operation error

Error code (SD0/SD8067)	Description
2820	Device specified by (d) exceeds the allowable device range
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 9999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 9999).

Dividing BCD 4-digit data

B/(P)

These instructions divide the BCD 4-digit data specified by (s1) by the BCD 4-digit data specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

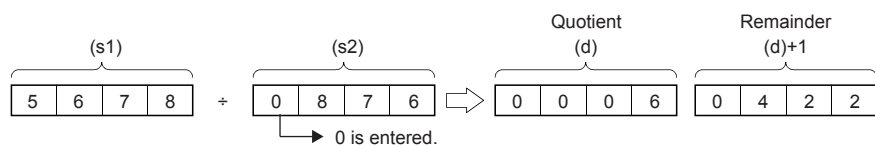
Operand	Description	Range	Data type	Data type (label)
(s1)	Dividend data or the device where the data to be divided by another is stored	0 to 9999	BCD 4-digit	ANY16
(s2)	Divisor data or the device where the data by which another is to be divided is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Head device for storing the operation result	—	BCD 8-digit	ANY16_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions divide the BCD 4-digit data specified by (s1) by the BCD 4-digit data specified by (s2), and store the results of division in the device specified by (d).



- The results of division are stored as quotient and remainder using 32 bit(s).
 - Quotient (BCD 4-digit): Stored in lower 16 bit(s).
 - Remainder (BCD 4-digit): Stored in upper 16 bit(s).
- If (d) is specified by bit device, remainder of division results is not stored.

Operation error

Error code (SD0/SD8067)	Description
2820	Device specified by (d) exceeds the allowable device range
3400	0 is specified for (s2) value.
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 9999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 9999).

Multiplying BCD 8-digit data

DB*(P)

These instructions multiply the BCD 8-digit data specified by (s1) and the BCD 8-digit data specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

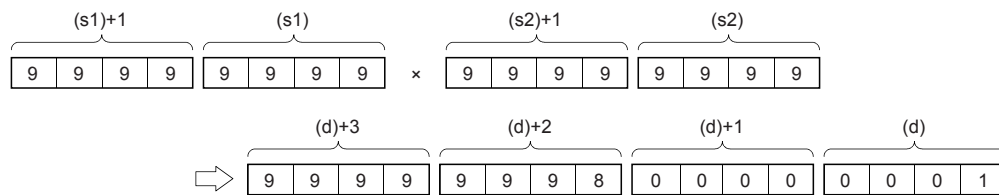
Operand	Description	Range	Data type	Data type (label)
(s1)	Multiplicand data or the head device where the data to be multiplied by another is stored	0 to 99999999	BCD 8-digit	ANY32
(s2)	Multiplier data or the head device where the data by which another is to be multiplied is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Head device for storing the operation result	—	BCD 16-digit	ANY32_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	—	—	○	—	○	—	—	—	—

Processing details

- These instructions multiply the BCD 8-digit data specified by (s1) and the BCD 8-digit data specified by (s2), and store the multiplication results in the device specified by (d).



- When (d) is a bit device, only the lower 8 nibbles (32 bits) of the multiplication result are stored, and the higher 8 nibbles (32 bits) cannot be specified.

Ex.

Multiplication result when (d) is a bit device

- K1 ... Lower 1 nibble (b0 to b3)
- K4 ... Lower 4 nibbles (b0 to b15)
- K8 ... Lower 8 nibbles (b0 to b31)

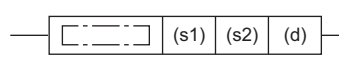
Operation error

Error code (SD0/SD8067)	Description
2820	Device specified by (d) exceeds the allowable device range
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 99999999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 99999999).

Dividing BCD 8-digit data

DB/(P)

These instructions divide the BCD 8-digit data specified by (s1) by the BCD 8-digit data specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

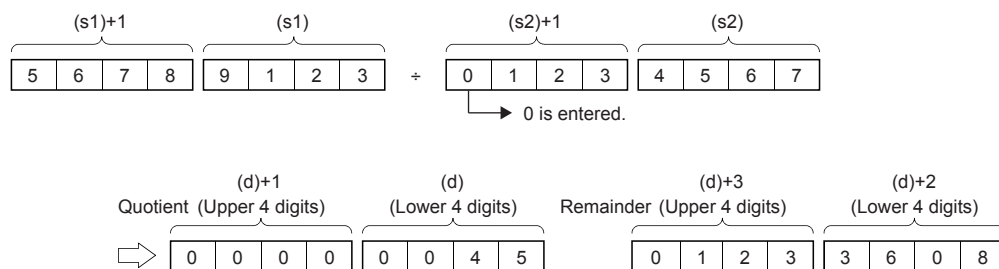
Operand	Description	Range	Data type	Data type (label)
(s1)	Dividend data or the head device where the data to be divided by another is stored	0 to 99999999	BCD 8-digit	ANY32
(s2)	Divisor data or the head device where the data by which another is to be divided is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Head device for storing the operation result	—	BCD 16-digit	ANY32_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	—	—	○	—	○	—	—	—	—

Processing details

- These instructions divide the BCD 8-digit data specified by (s1) by the BCD 8-digit data specified by (s2), and store the results of division in the device specified by (d).



- The results of division are stored as quotient and remainder using 64 bit(s) binary.
- Quotient (BCD 8-digit): Stored in lower 32 bit(s).
- Remainder (BCD 8-digit): Stored in upper 32 bit(s).
- If (d) is specified by bit device, remainder of division results is not stored.

Operation error

Error code (SD0/SD8067)	Description
2820	Device specified by (d) exceeds the allowable device range
3400	0 is specified for (s2) value.
3405	BCD data in the device specified by (s1) is outside of the valid range (0 to 99999999).
	BCD data in the device specified by (s2) is outside of the valid range (0 to 99999999).

Adding 16-bit binary block data

BK+(P)(_U)

These instructions add (n) point(s) of 16-bit binary data from the device specified by (s1) and the (n) point(s) of 16-bit binary data from the device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	BK+(P)	-32768 to +32767	16-bit signed binary	ANY16
	BK+(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	BK+(P)	-32768 to +32767	16-bit signed binary	ANY16
	BK+(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	BK+(P)	—	16-bit signed binary	ANY16
	BK+(P)_U	—	16-bit unsigned binary	ANY16_U
(n)	Number of addition data	0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

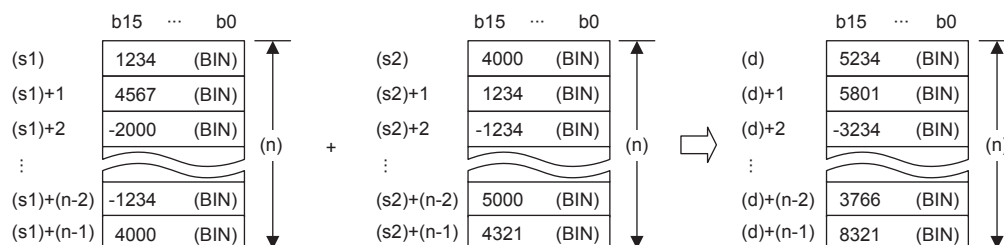
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

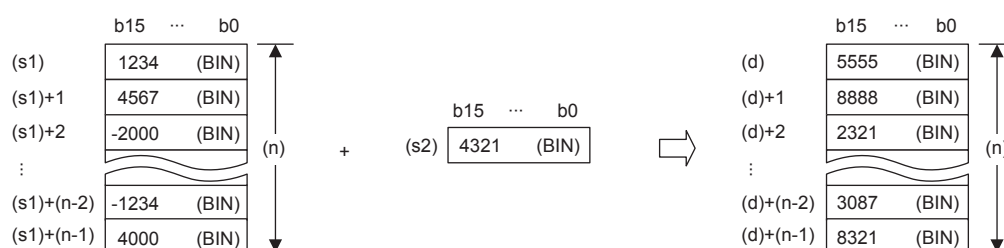
- These instructions add (n) point(s) of 16-bit binary data from the device specified by (s1) and the (n) point(s) of 16-bit binary data from the device specified by (s2), and store the results of addition in the device specified by (d).
- Block addition is performed in units of 16-bits.

Ex.

If device is specified for (s2) (signed)



If constant is specified for (s2) (signed)



- If an underflow or overflow occurs for operation result, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.

If signed is specified			If unsigned is specified		
K32767 (7FFFH)	+	K2 (0002H)	⇒	K-32767 (8001H)	
K-32767 (8001H)	+	K-2 (FFFEH)	⇒	K32767 (7FFFH)	
K65535 (FFFFH)	+	K1 (0001H)	⇒	K0 (0000H)	

Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	The device range for (n) point(s) beginning from (s1) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s1) and (d).)
	The device range for (n) point(s) beginning from (s2) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s2) and (d).)

Subtracting 16-bit binary block data

BK-(P)(_U)

These instructions subtract (n) point(s) of 16-bit binary data from the device specified by (s1) and the (n) point(s) of 16-bit binary data from the device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	BK-(P)	-32768 to +32767	16-bit signed binary	ANY16
	BK-(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(s2)	BK-(P)	-32768 to +32767	16-bit signed binary	ANY16
	BK-(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	BK-(P)	—	16-bit signed binary	ANY16
	BK-(P)_U	—	16-bit unsigned binary	ANY16_U
(n)	Number of subtraction data	0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

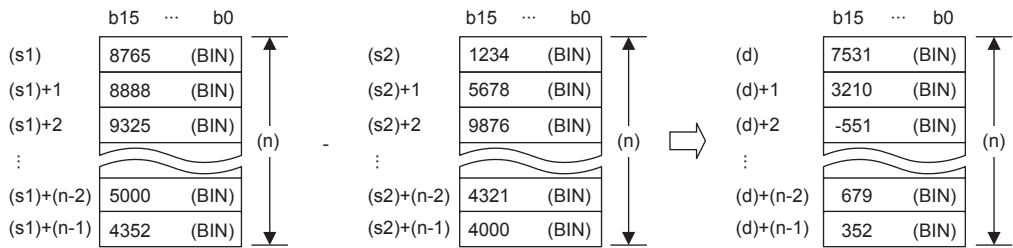
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

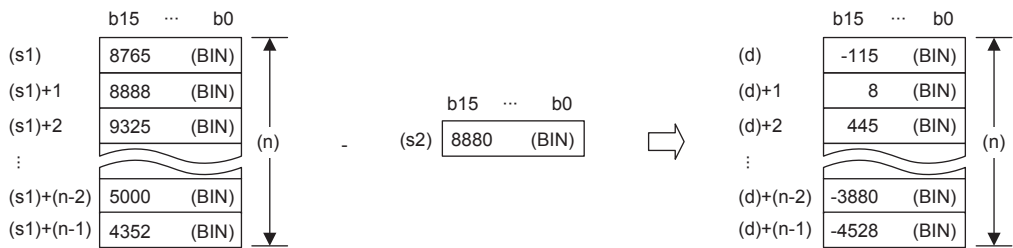
- These instructions subtract (n) point(s) of 16-bit binary data from the device specified by (s1) and the (n) point(s) of 16-bit binary data from the device specified by (s2), and store the subtraction results in the device specified by (d).
- Block subtraction is performed in 16-bit units.

Ex.

If device has been specified for (s2)



If constant is specified for (s2)



- If an underflow or overflow occurs for operation result, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.

If signed is specified			If unsigned is specified		
K-32767 (8001H)	-	K2 (0002H)	➡	K32766 (7FFE H)	
K32767 (7FFFH)	-	K-2 (FFFEH)	➡	K-32767 (8001H)	
				K0 (0000H)	- K1 (0001H) ➡ K65535 (FFFFH)

Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	The device range for (n) point(s) beginning from (s1) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s1) and (d).)
	The device range for (n) point(s) beginning from (s2) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s2) and (d).)

Adding 32-bit binary block data

DBK+(P)(_U)

These instructions add (n) point(s) of 32-bit binary data from the device specified by (s1) and the (n) point(s) of 32-bit binary data from the device specified by (s2), and store the results of addition in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DBK+(P) DBK+(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(s2)	DBK+(P) DBK+(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(d)	DBK+(P) DBK+(P)_U	— —	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(n)	Number of addition data	0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

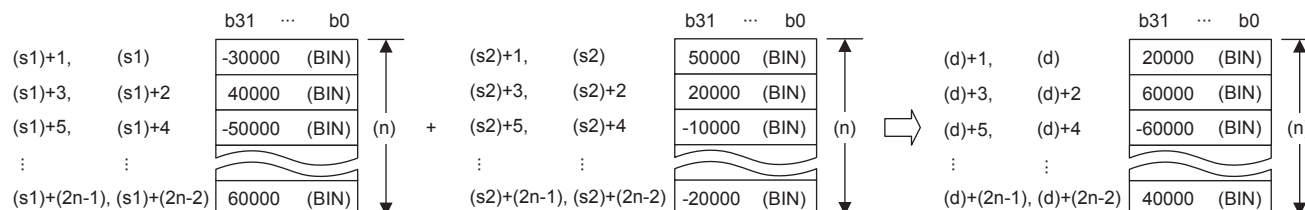
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	○	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	○	—	○	○	—	—	—
(d)	—	—	—	○	—	—	○	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

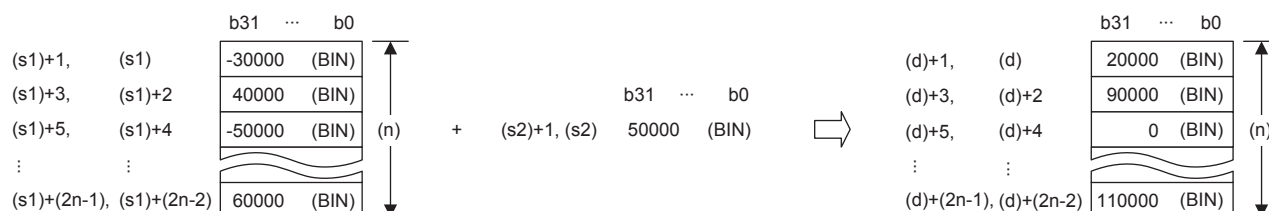
- These instructions add (n) point(s) of 32-bit binary data from the device specified by (s1) and the (n) point(s) of 32-bit binary data from the device specified by (s2), and store the results of addition in the device specified by (d).
- Block addition is performed in 32-bit units.

Ex.

If device is specified for (s2) (signed)



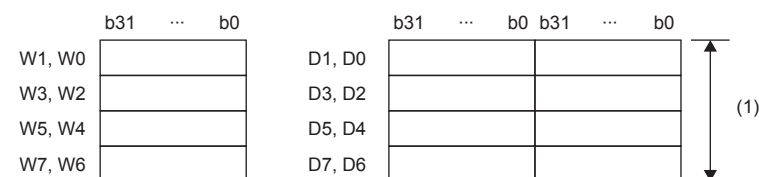
If constant is specified for (s2) (signed)



- Operation is enabled when (s1) or (s2) have been specified by same device as (d) (perfect match). An error occurs if the device range of (n) point(s) from (s1) or (s2) partially matches (overlaps) the device range of (n) point(s) from (d).

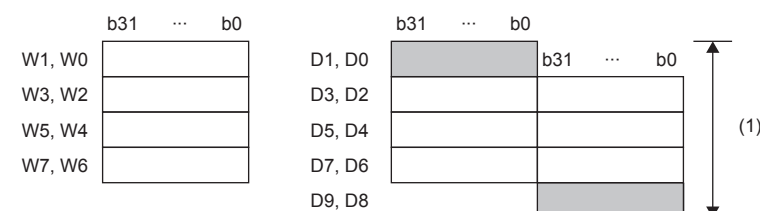
Ex.

If 4 points of the device from (s2) and (d) match



(1) Because it is a perfect match, operation is possible.

If 4 points of the device from (s2), (d) match partially



(1) An operation error occurs if they partially match.

- If the value specified for (n) is 0, processing is not performed.
- If an underflow or overflow occurs for operation result, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.

If signed is specified				If unsigned is specified			
K2147483647 (7FFFFFFFH) + K2 (00000002H) ➡ K-2147483647 (80000001H)				K4294967295 (FFFFFFFFFH) + K1 (00000001H) ➡ K0 (00000000H)			
K-2147483647 (80000001H) + K-2 (FFFFFFFEH) ➡ K2147483647 (7FFFFFFFH)							

Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	The device range for (n) point(s) beginning from (s1) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s1) and (d).)
	The device range for (n) point(s) beginning from (s2) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s2) and (d).)

Subtracting 32-bit binary block data

DBK-(P)(_U)

These instructions subtract (n) point(s) of 32-bit binary data from the device specified by (s1) and the (n) point(s) of 32-bit binary data from the device specified by (s2), and store the results of subtraction in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DBK-(P) DBK-(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(s2)	DBK-(P) DBK-(P)_U	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(d)	DBK-(P) DBK-(P)_U	— —	32-bit signed binary 32-bit unsigned binary	ANY32 ANY32_U
(n)	Number of subtraction data	0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

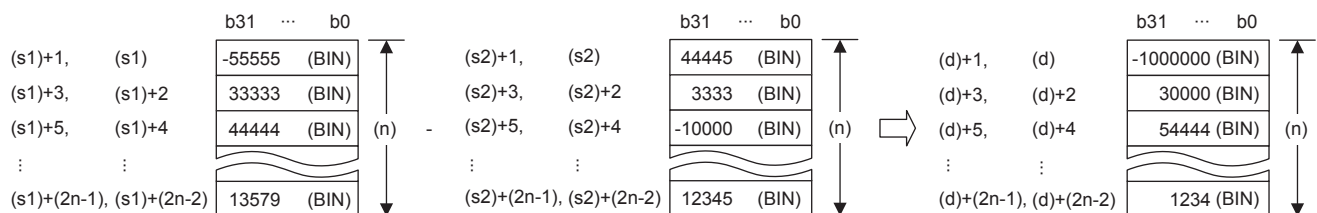
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	○	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	○	—	○	○	—	—	—
(d)	—	—	—	○	—	—	○	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

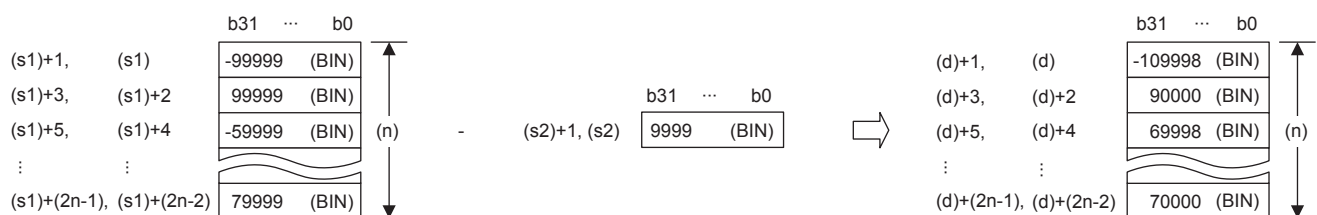
- These instructions subtract (n) point(s) of 32-bit binary data from the device specified by (s1) and the (n) point(s) of 32-bit binary data from the device specified by (s2), and store the results of subtraction in the device specified by (d).
- Block subtraction is performed in 32-bit units.

Ex.

If device is specified for (s2) (signed)



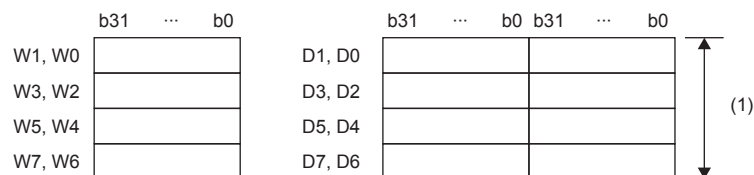
If constant is specified for (s2) (signed)



- Operation is enabled when (s1) or (s2) have been specified by same device as (d) (perfect match). An error occurs if the device range of (n) point(s) from (s1) or (s2) partially matches (overlaps) the device range of (n) point(s) from (d).

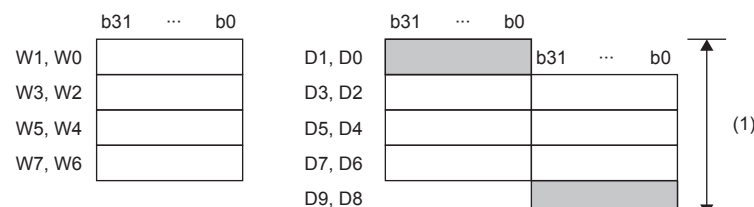
Ex.

If 4 points of the device from (s2) and (d) match



(1) Because it is a perfect match, operation is possible.

If 4 points of the device from (s2), (d) match partially



(1) An operation error occurs if they partially match.

- If the value specified for (n) is 0, processing is not performed.
- If an underflow or overflow occurs for operation result, the result will be as follows. In this case, the carry flag (SM700) does not turn ON.

If signed is specified			If unsigned is specified		
K2147483647 (7FFFFFFFH)	-	K-2 (FFFFFFFEH) →	K-2147483647 (80000001H)	K0 (00000000H)	-
K-2147483647 (80000001H)	-	K2 (00000002H) →	K2147483647 (7FFFFFFFH)	K1 (00000001H) →	K4294967295 (FFFFFFFHH)

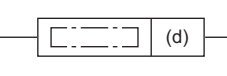
Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	The device range for (n) point(s) beginning from (s1) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s1) and (d).) The device range for (n) point(s) beginning from (s2) overlaps with that of (n) point(s) starting from (d). (Does not apply when same device has been specified for (s2) and (d).)

Incrementing 16-bit binary data

INC(P)(_U)

These instructions add +1 to the device (16-bit binary data) specified by (d).

Ladder diagram	Structured text	
	ENO:=INC(EN,d); ENO:=INCP(EN,d);	ENO:=INC_U(EN,d); ENO:=INCP_U(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d) INC(P)	Device to be incremented by +1	-32768 to +32767	16-bit signed binary	ANY16_S
INC(P)_U		0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions add +1 to the device (16-bit binary data) specified by (d).



- If INC(P) instruction is executed when contents of device specified by (d) is 32767, -32768 is stored in the device specified by (d). (If signed is specified)
- If INC(P)_U instruction is executed when contents of device specified by (d) is 65535, 0 is stored in the device specified by (d). (If unsigned is specified)
- Flags (zero, carry and borrow) are not activated at this time.

Precautions

Note that data is incremented in every operation cycle in a continuous operation type (INC) instruction.

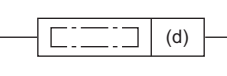
Operation error

There is no operation error.

Decrementing 16-bit binary data

DEC(P)(_U)

These instructions subtract 1 from the device (16-bit binary data) specified by (d).

Ladder diagram	Structured text	
	ENO:=DEC(EN,d); ENO:=DECP(EN,d);	ENO:=DEC_U(EN,d); ENO:=DECP_U(EN,d);

Setting data

■Descriptions, ranges, and data types

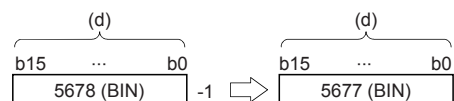
Operand	Description	Range	Data type	Data type (label)
(d) DEC(P)	Device to be decremented by -1	-32768 to +32767	16-bit signed binary	ANY16_S
DEC(P)_U		0 to 65535	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions decrement device (16-bit binary data) specified by (d) by 1.



- If DEC(P) instruction is executed when contents of device specified by (d) is -32768, 32767 is stored in the device specified by (d). (If signed is specified)
- If DEC(P)_U instruction is executed when contents of device specified by (d) is 0, 65535 is stored in the device specified by (d). (If unsigned is specified)
- Flags (zero, carry and borrow) are not activated at this time.

Precautions

Note that data is decremented in every operation cycle in a continuous operation type (DEC) instruction.

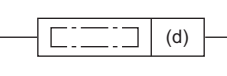
Operation error

There is no operation error.

Incrementing 32-bit binary data

DINC(P)(_U)

These instructions add +1 to the device (32-bit binary data) specified by (d).

Ladder diagram	Structured text	
	ENO:=DINC(EN,d); ENO:=DINCP(EN,d);	ENO:=DINC_U(EN,d); ENO:=DINCP_U(EN,d);

Setting data

■Descriptions, ranges, and data types

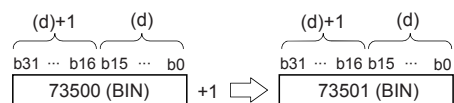
Operand	Description	Range	Data type	Data type (label)
(d)	DINC(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	DINC(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—	—

Processing details

- These instructions add +1 to the contents of device (32-bit binary data) specified by (d).



- If DINC(P) instruction is executed when contents of device specified by (d) is 2147483647, -2147483648 is stored in the device specified by (d). (If signed is specified)
- If DINC(P)_U instruction is executed when contents of device specified by (d) is 4294967295, 0 is stored in the device specified by (d). (If unsigned is specified)
- Flags (zero, carry and borrow) are not activated at this time.

Precautions

Note that data is incremented in every operation cycle in a continuous operation type instruction.

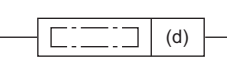
Operation error

There is no operation error.

Decrementing 32-bit binary data

DDEC(P)(_U)

These instructions subtract 1 from the device (32-bit binary data) specified by (d).

Ladder diagram	Structured text	
	ENO:=DDEC(EN,d); ENO:=DDECP(EN,d);	ENO:=DDEC_U(EN,d); ENO:=DDECP_U(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	DDEC(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32_S
	DDEC(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions decrement contents of device (32-bit binary data) specified by (d) by 1.



- If DDEC(P) instruction is executed when contents of device specified by (d) is 0, -1 is stored in the device specified by (d). (If signed is specified)
- If DDEC(P)_U instruction is executed when contents of device specified by (d) is 0, 4294967295 is stored in the device specified by (d). (If unsigned is specified)
- Flags (zero, carry and borrow) are not activated at this time.

Precautions

Note that data is decremented in every operation cycle in a continuous operation type (DDEC) instruction.

Operation error

There is no operation error.

6.3 Logical Operation Instructions

Performing an AND operation on 16-bit data

WAND(P) [using two operands]

These instructions AND each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■ Descriptions, ranges, and data types

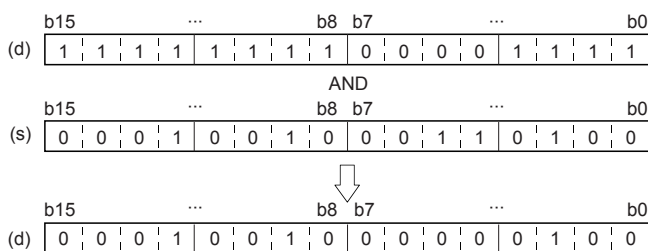
Operand	Description	Range	Data type	Data type (label)
(s)	Data for AND or device where the data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Device for storing AND results	-32768 to +32767	16-bit signed binary	ANY16

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions AND each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).



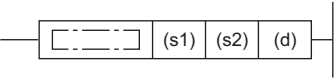
- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

WAND(P) [using three operands]

These instructions AND each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=WAND(EN,s1,s2,d); ENO:=WANDP(EN,s1,s2,d);</pre>

Setting data

■ Descriptions, ranges, and data types

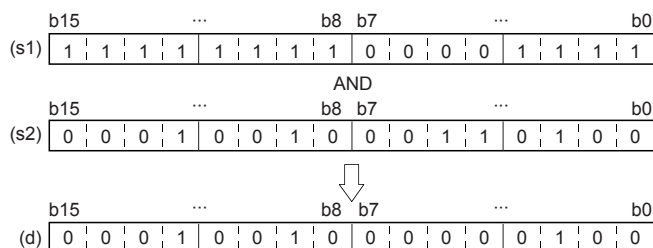
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for AND or device where the data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Data for AND or device where the data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Device for storing AND results	—	16-bit signed binary	ANY16

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions AND each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

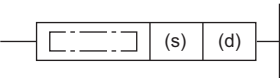
Operation error

There is no operation error.

Performing an AND operation on 32-bit data

DAND(P) [using two operands]

These instructions AND each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■ Descriptions, ranges, and data types

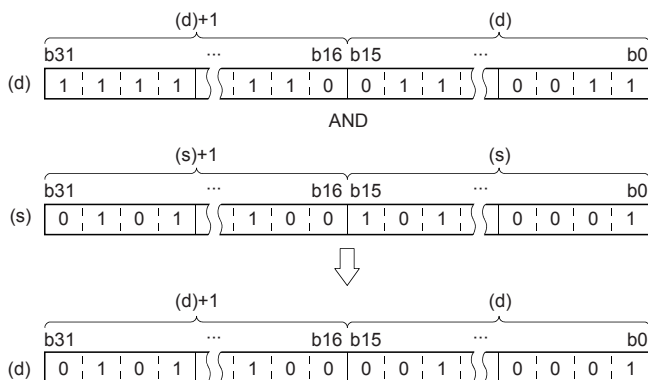
Operand	Description	Range	Data type	Data type (label)
(s)	Data for AND or head device where the data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing AND results	-2147483648 to +2147483647	32-bit signed binary	ANY32

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions AND each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).



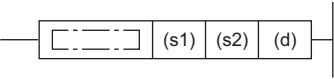
- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

DAND(P) [using three operands]

These instructions AND each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DAND(EN,s1,s2,d); ENO:=DANDP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

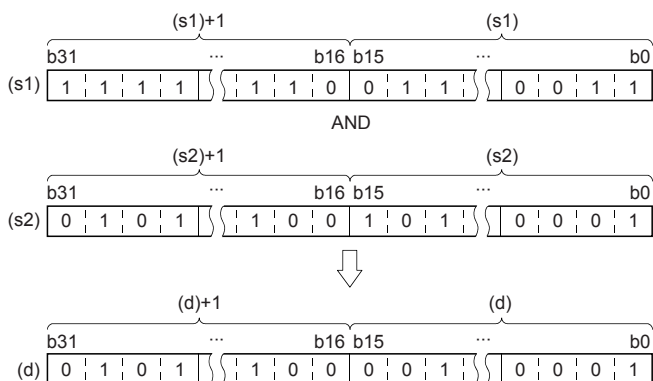
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for AND or head device where the data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Data for AND or head device where the data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing AND results	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions AND each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

Performing an AND operation on 16-bit block data

BKAND(P)

These instructions AND contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=BKAND(EN,s1,s2,n,d); ENO:=BKANDP(EN,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device that stores data for AND	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Data for AND or head device where the data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing AND results	—	16-bit signed binary	ANY16
(n)	Number of data	0 to 65535	16-bit unsigned binary	ANY16

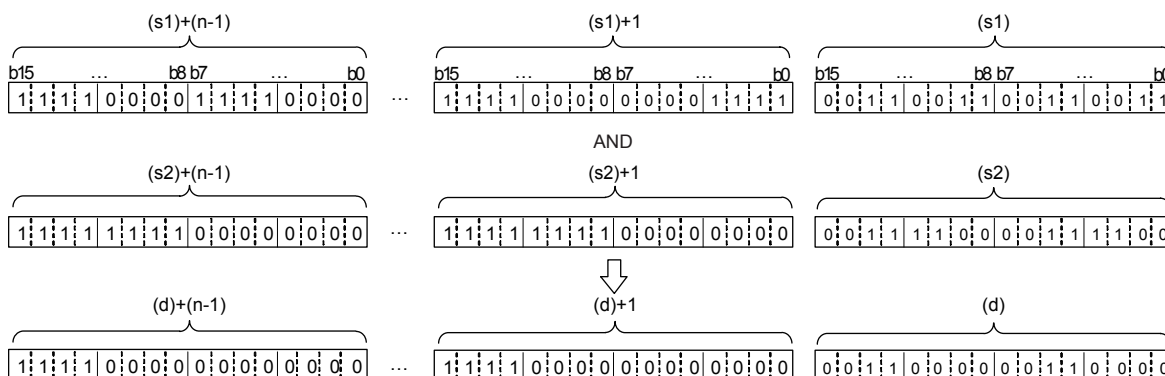
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)*1	—	—	—	○	—	—	—	—	○	○	—	—	—
(d)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

Processing details

- These instructions AND contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.



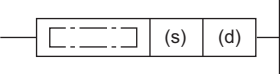
Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	Device range of (n) point(s) from (s1) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s1) and (d).)
	Device range of (n) point(s) from (s2) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s2) and (d).)

Performing an OR operation on 16-bit data

WOR(P) [using two operands]

These instructions OR each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types


Operand	Description	Range	Data type	Data type (label)
(s)	Data for OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing the OR results	-32768 to +32767	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions OR each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).

	b15	...				b8	b7	...				b0				
(d)	0	1	0	1	1	1	1	1	0	0	0	0	0	0	1	1
	OR															
	b15	...				b8	b7	...				b0				
(s)	1	0	0	1	1	1	0	0	1	1	0	0	1	1	0	0
																
	b15	...				b8	b7	...				b0				
(d)	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1

- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

WOR(P) [using three operands]

These instructions OR each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=WOR(EN,s1,s2,d); ENO:=WORP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

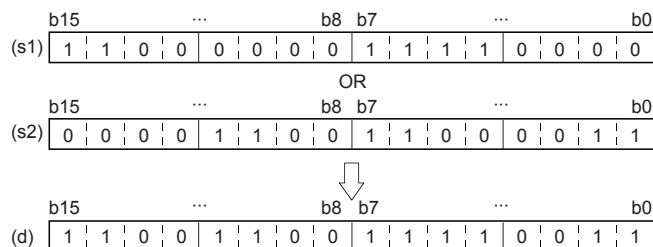
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Data for OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing the OR results	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions OR each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

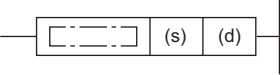
Operation error

There is no operation error.

Performing an OR operation on 32-bit data

DOR(P) [using two operands]

These instructions OR each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

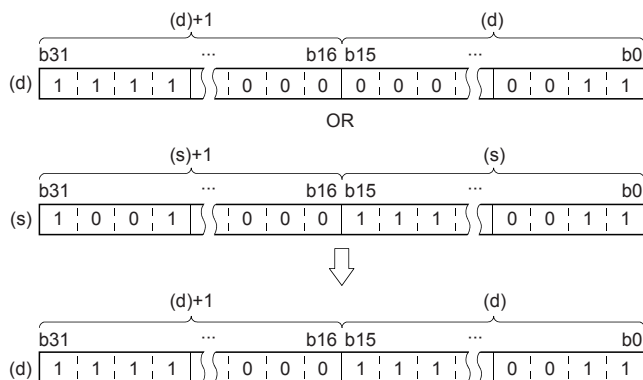
Operand	Description	Range	Data type	Data type (label)
(s)	Data for OR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing the OR results	-2147483648 to +2147483647	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions OR each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

DOR(P) [using three operands]

These instructions OR each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DOR(EN,s1,s2,d); ENO:=DORP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

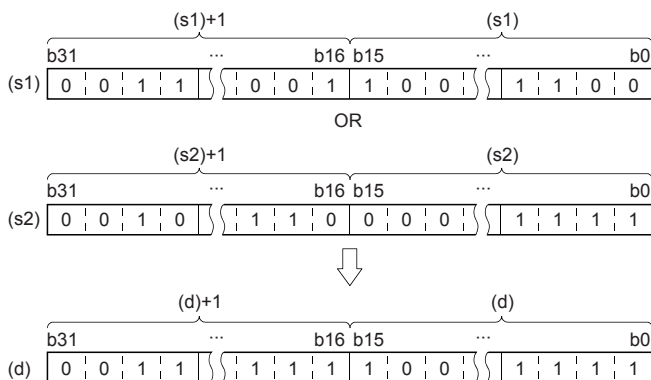
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for OR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Data for OR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing the OR results	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions OR each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

Performing an OR operation on 16-bit block data

BKOR(P)

These instructions OR contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=BKOR(EN,s1,s2,n,d); ENO:=BKORP(EN,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device where the logical operation data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Logical operation data or the head device where the logical operation data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing the operation result	—	16-bit signed binary	ANY16
(n)	Number of data	0 to 65535	16-bit unsigned binary	ANY16

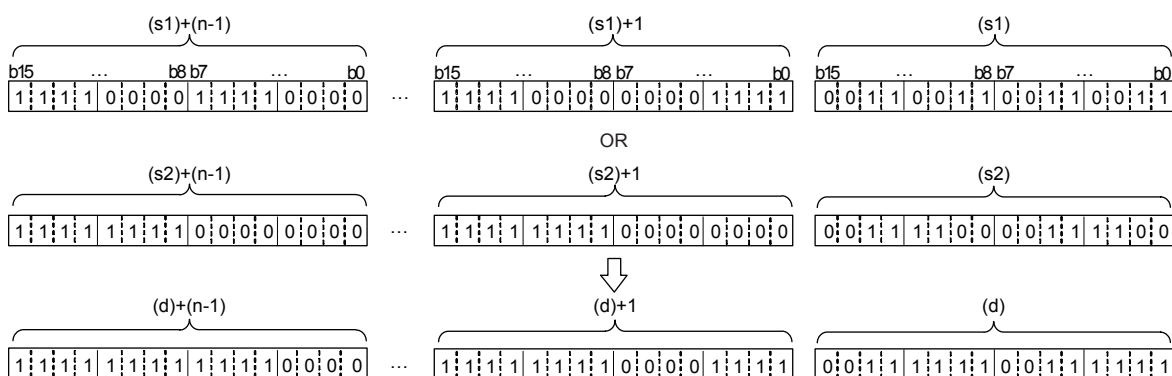
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)*1	—	—	—	○	—	—	—	—	○	○	—	—	—
(d)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

Processing details

- These instructions seek OR of contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.



Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	Device range of (n) point(s) from (s1) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s1) and (d).)
	Device range of (n) point(s) from (s2) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s2) and (d).)

Performing an XOR operation on 16-bit data

WXOR(P) [using two operands]

These instructions exclusive OR each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

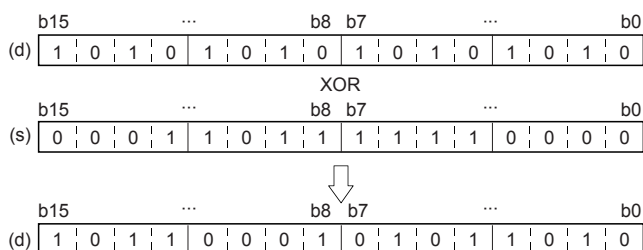
Operand	Description	Range	Data type	Data type (label)
(s)	Data for exclusive OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing exclusive OR results	-32768 to +32767	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions exclusive OR each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).



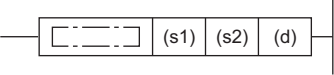
- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

WXOR(P) [using three operands]

These instructions exclusive OR each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=WXOR(EN,s1,s2,d); ENO:=WXORP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

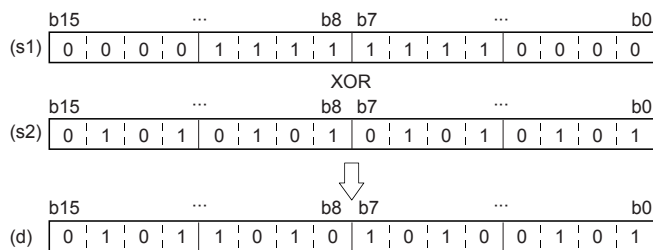
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for exclusive OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Data for exclusive OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing exclusive OR results	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions exclusive OR each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

Performing an XOR operation on 32-bit data

DXOR(P) [using two operands]

These instructions exclusive OR each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

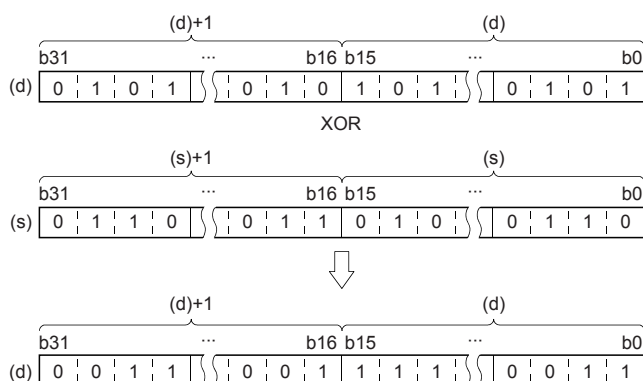
Operand	Description	Range	Data type	Data type (label)
(s)	Data for exclusive OR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing exclusive OR results	-2147483648 to +2147483647	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions exclusive OR each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

DXOR(P) [using three operands]

These instructions exclusive OR each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DXOR(EN,s1,s2,d); ENO:=DXORP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

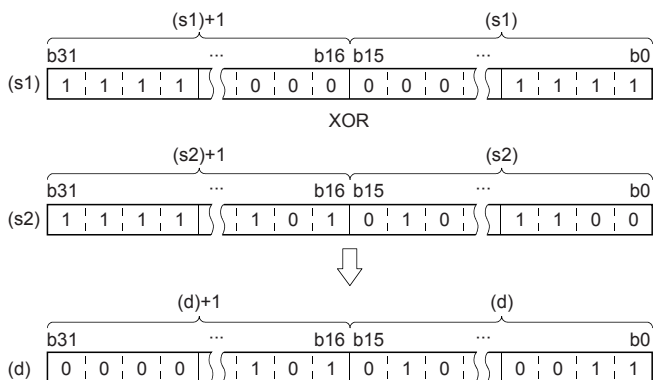
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for exclusive OR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Data for exclusive OR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing exclusive OR results	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions exclusive OR each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

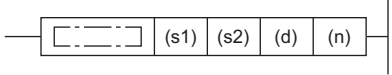
Operation error

There is no operation error.

Performing an XOR operation on 16-bit block data

BKXOR(P)

These instructions seek exclusive OR of contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=BKXOR(EN,s1,s2,n,d); ENO:=BKXORP(EN,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Data for exclusive OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Data for exclusive OR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing the operation result	—	16-bit signed binary	ANY16
(n)	Number of data	0 to 65535	16-bit unsigned binary	ANY16

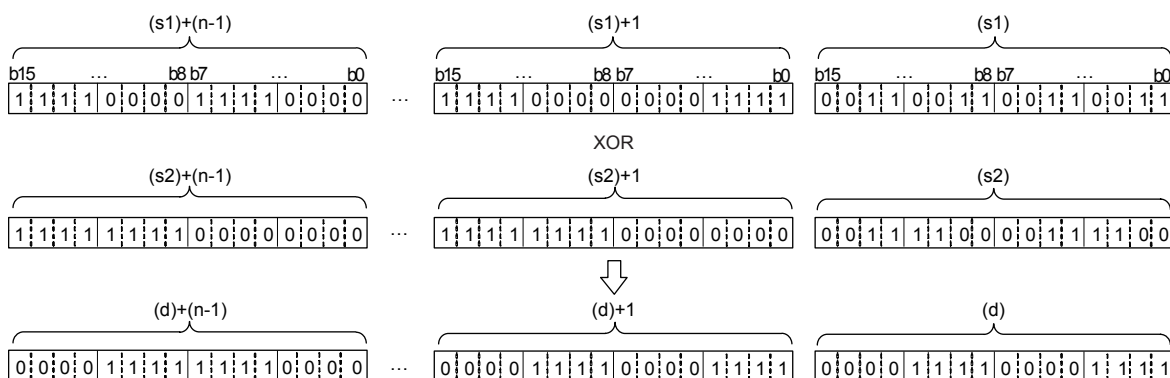
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)*1	—	—	—	○	—	—	—	—	○	○	—	—	—
(d)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

Processing details

- These instructions exclusive OR contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.



Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	Device range of (n) point(s) from (s1) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s1) and (d).)
	Device range of (n) point(s) from (s2) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s2) and (d).)

Performing an XNOR operation on 16-bit data

WXNR(P) [using two operands]

These instructions exclusive NOR each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

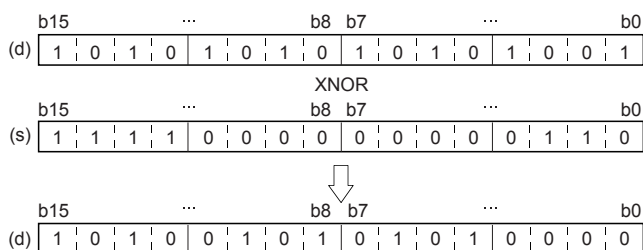
Operand	Description	Range	Data type	Data type (label)
(s)	Data for exclusive NOR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing exclusive NOR results	-32768 to +32767	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions exclusive NOR each bit of 16-bit binary data from the device specified by (d) and each bit of 16-bit binary data from device specified by (s), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

WXNR(P) [using three operands]

These instructions exclusive NOR each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	ENO:=WXNR(EN,s1,s2,d); ENO:=WXNRP(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

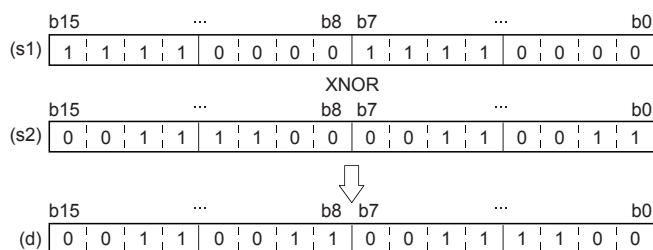
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for exclusive NOR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Data for exclusive NOR or head device where data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing exclusive NOR results	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions exclusive NOR each bit of 16-bit binary data from the device specified by (s1) and each bit of 16-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

Performing an XNOR operation on 32-bit data

DXNR(P) [using two operands]

These instructions exclusive NOR each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

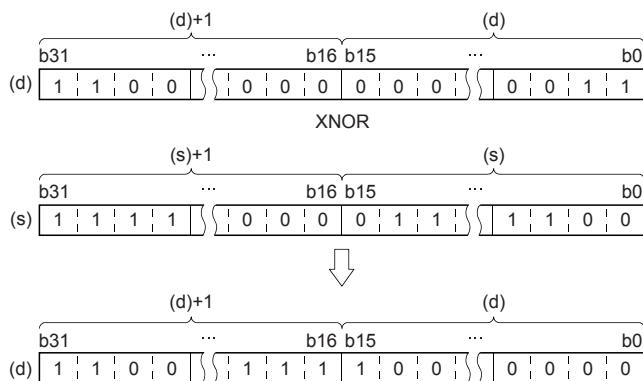
Operand	Description	Range	Data type	Data type (label)
(s)	Data for exclusive NOR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing exclusive NOR results	-2147483648 to +2147483647	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions exclusive NOR each bit of 32-bit binary data from the device specified by (d) and each bit of 32-bit binary data from device specified by (s), and store the results in the device specified by (d).



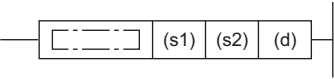
- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

DXNR(P) [using three operands]

These instructions exclusive NOR each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DXNR(EN,s1,s2,d); ENO:=DXNRP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

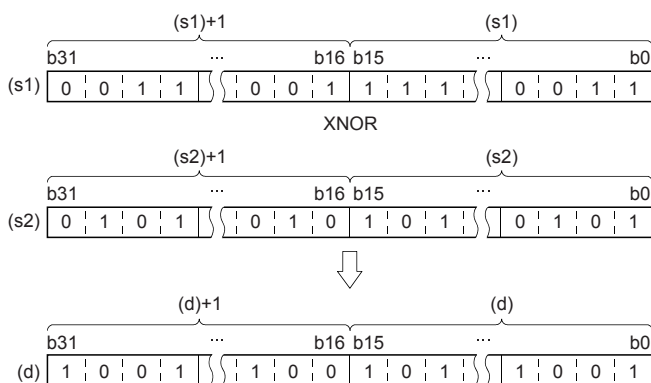
Operand	Description	Range	Data type	Data type (label)
(s1)	Data for exclusive NOR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Data for exclusive NOR or head device where data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device for storing exclusive NOR results	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions exclusive NOR each bit of 32-bit binary data from the device specified by (s1) and each bit of 32-bit binary data from device specified by (s2), and store the results in the device specified by (d).



- Bit devices subsequent to number of points by nibble specification are calculated as 0.

Operation error

There is no operation error.

Performing an XNOR operation on 16-bit block data

BKXNR(P)

These instructions exclusive NOR contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=BKXNR(EN,s1,s2,n,d); ENO:=BKXNRP(EN,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device where the logical operation data is stored	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Logical operation data or the head device where the logical operation data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device for storing the operation result	—	16-bit signed binary	ANY16
(n)	Number of data	0 to 65535	16-bit unsigned binary	ANY16

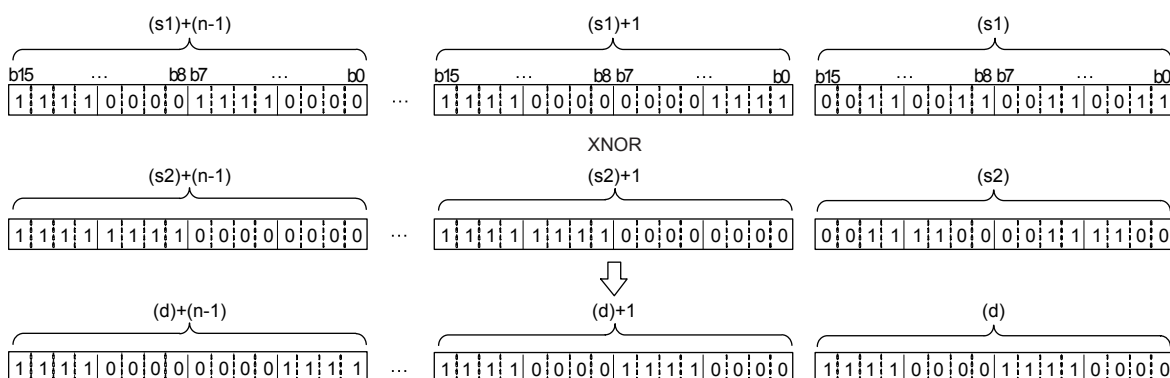
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)*1	—	—	—	○	—	—	—	—	○	○	—	—	—
(d)*1	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

Processing details

- These instructions exclusive NOR contents of (n) point(s) from the device specified by (s1) and (n) point(s) from the device specified by (s2), and store the results in the devices specified by (d) onward.



Operation error

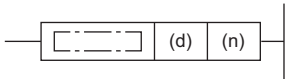
Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s1), (s2), or (d) exceed the corresponding device range.
2821	Device range of (n) point(s) from (s1) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s1) and (d).)
	Device range of (n) point(s) from (s2) partially overlaps with device range of (n) point(s) from (d). (Does not apply when same device has been specified for (s2) and (d).)

6.4 Bit Processing Instructions

Setting a bit in the word device

BSET(P)

These instructions set (to 1) (n)th bit of word device specified by (d).

Ladder diagram	Structured text
	ENO:=BSET(EN,n,d); ENO:=BSETP(EN,n,d);

Setting data

■Descriptions, ranges, and data types

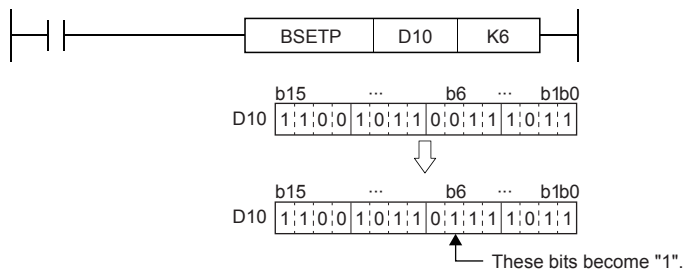
Operand	Description	Range	Data type	Data type (label)
(d)	Head device for which bit is to be set	—	16-bit signed binary	ANY16
(n)	Number of bit(s) to be set	0 to 15	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions set (to 1) (n)th bit of word device specified by (d).
- If (n) exceeds 15, the processing will be done based on the lower 4 bits of (n).



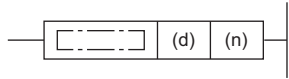
Operation error

There is no operation error.

Resetting a bit in the word device

BRST(P)

These instructions reset (to 0) (n)th bit of word device specified by (d).

Ladder diagram	Structured text
	ENO:=BRST(EN,n,d); ENO:=BRSTP(EN,n,d);

Setting data

■Descriptions, ranges, and data types

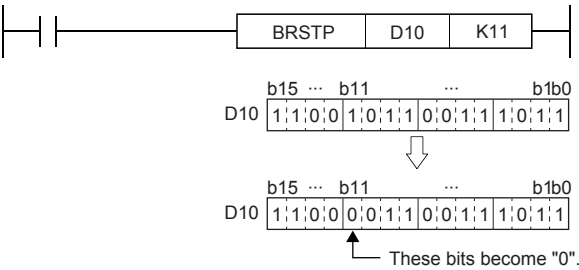
Operand	Description	Range	Data type	Data type (label)
(d)	Head device for which bit is to be reset	—	16-bit signed binary	ANY16
(n)	Number of bit(s) to be reset	0 to 15	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions reset (to 0) (n)th bit of word device specified by (d).
- If (n) exceeds 15, the processing will be done based on the lower 4 bits of (n).



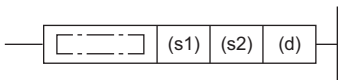
Operation error

There is no operation error.

Performing a 16-bit test

TEST(P)

These instructions take bit data at position specified by (s2) from device specified by (s1) and write to bit device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=TEST(EN,s1,s2,d); ENO:=TESTP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

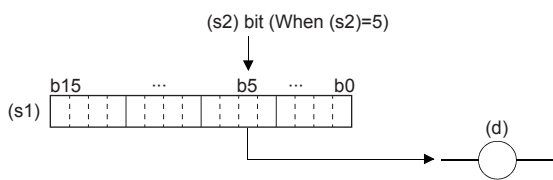
Operand	Description	Range	Data type	Data type (label)
(s1)	Device number where bit data to be extracted is stored	—	16-bit signed binary	ANY16
(s2)	Position of bit data to be extracted	0 to 15	16-bit unsigned binary	ANY16
(d)	Bit device number where extracted bit data is to be stored	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	○	—	○	—	—	—	—	—	—	—	—	—

Processing details

- These instructions take bit data at position specified by (s2) from device specified by (s1) and write to bit device specified by (d).



- If relevant bit is "0", device specified by (d) is turned OFF, and if it is "1", device is turned ON.
- For (s2) specify the bit position (0 to 15) of word data. If 16 or more is specified for (s2), the value of the remainder of $(s2) \div 16$ is the bit position.

Ex.

For (s2) = 18, the remainder for $18 \div 16$ is "2", so it becomes data of b2.

Operation error

There is no operation error.

Performing a 32-bit test

DTEST(P)

These instructions take bit data at position specified by (s2) from device specified by (s1) and write to bit device specified by (d).

Ladder diagram	Structured text
	ENO:=DTEST(EN,s1,s2,d); ENO:=DTESTP(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

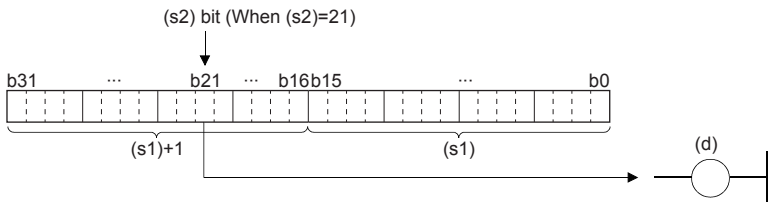
Operand	Description	Range	Data type	Data type (label)
(s1)	Device number where bit data to be extracted is stored	—	32-bit signed binary	ANY32
(s2)	Position of bit data to be extracted	0 to 31	16-bit unsigned binary	ANY16
(d)	Bit device number where extracted bit data is to be stored	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	○	—	○	—	—	—	—	—	—	—	—	—

Processing details

- These instructions take bit data at position specified by (s2) from device specified by (s1), (s1) +1 and write to bit device specified by (d).



- If relevant bit is "0", device specified by (d) is turned OFF, and if it is "1", device is turned ON.
- For (s2) specify the bit position (0 to 31) of double word data. If 32 or more is specified for (s2), the value of the remainder of (s2)÷32 is the bit position.

Ex.

For (s2) = 34, the remainder for 34÷32 is "2", so it becomes data of b2.

Operation error

There is no operation error.

Batch-resetting bit devices

BKRST(P)

These instructions reset (n) point(s) bit devices from the bit device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=BKRST(EN,n,d); ENO:=BKRSTP(EN,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device to be reset	—	Bit	ANY_BOOL
(n)	Number of devices to be reset	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	○	○	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions reset (n) point(s) bit devices from the bit device specified by (d).
- Reset status of bit device is as follows.

Device	Status
Annunciator (F)	<ul style="list-style-type: none"> • (n) point(s) from annunciator (F) number specified by (d) are turned OFF. • Annunciator numbers from SD64 to SD79 that were turned OFF are deleted and the subsequent numbers are shifted forward. • The number of annunciators stored in SD64 to SD79 is stored in SD67.
Timer (T), Counter (C)	<ul style="list-style-type: none"> • Current value of (n) point(s) from timer (T) or counter (C) number specified by (d) is set to 0, and coil contact is turned OFF.
Bit devices other than given above	<ul style="list-style-type: none"> • Coils and contacts of (n) point(s) from the device specified by (d) are turned OFF.

- If specified devices are OFF, device status remains unchanged.

Operation error

Error code (SD0/SD8067)	Description
2820	(n) point(s) of data starting from the device specified by (d) exceed the corresponding device range.

Batch-resetting devices

ZRST(P)

These instructions reset all data among devices of same type specified by (d1) and (d2). Use these instructions for restarting operation from the beginning after pause or after resetting control data.

Ladder diagram	Structured text
	<pre>ENO:=ZRST(EN, d1, d2); ENO:=ZRSTP(EN, d1, d2);</pre>

Setting data

■Descriptions, ranges, and data types

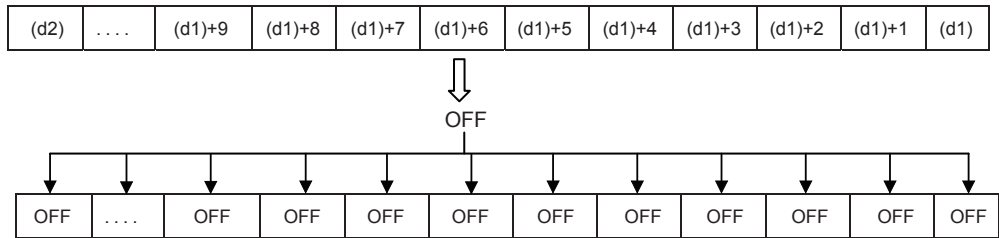
Operand	Description	Range	Data type	Data type (label)
(d1)	Head bit or word device number to be reset	—	16-bit signed binary	ANY_ELEMENTARY
(d2)	Last bit or word device number to be reset	—	16-bit signed binary	ANY_ELEMENTARY

■Applicable devices

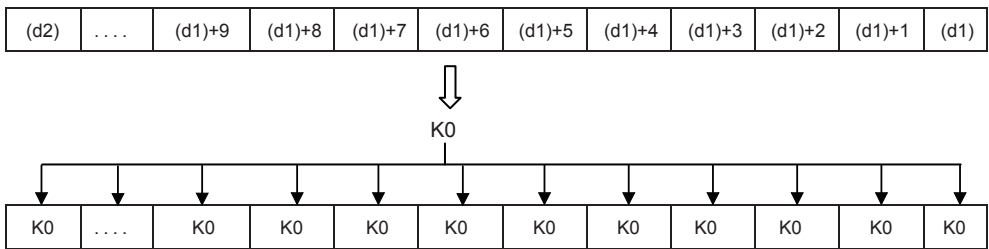
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d1)	○	—	—	○	○	○	○	○	○	—	—	—	—
(d2)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

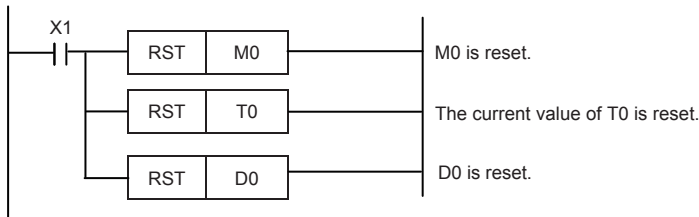
- These instructions reset all data among devices of same type specified by (d1) and (d2).
- OFF (reset) is written to the entire range of devices from (d1) to (d2) all at once if (d1) and/or (d2) are bit devices.



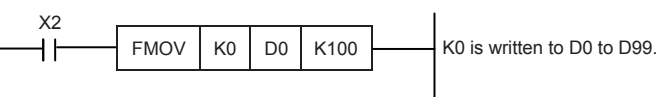
- K0 is written to the entire range of devices from (d1) to (d2) all at once if (d1) and/or (d2) are word devices.



- As a reset instruction for individual devices, the RST instruction can be used for bit devices and word devices.

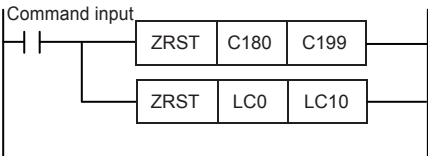


- The FMOV(P) instruction is a batch write instruction for a constant (K0 for example) that can write "0" for word devices (including nibble specification of bit devices).



Precautions

- Specify the same type of device for (d1) and (d2) so that (d1) number is less than (d2) number. If the (d1) number \geq (d2) number, only the device specified by (d1) is reset.
- The ZRST(P) instruction is a 16-bit instruction, but long counter (LC) and long index register (LZ) can be specified for (d1) and (d2).



Operation error

Error code (SD0/SD8067)	Description
2820	The number of devices to be reset is 32768 or more when module access device has been specified for (d1) and/or (d2).
3405	Device type specified by (d1) differs from type specified by (d2).
	Module number for (d1) and (d2) differ when module access device is specified.

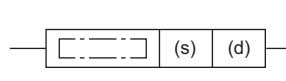
6.5 Data Conversion Instructions

Converting binary data to BCD 4-digit data

BCD(P)

These instructions convert the binary data in the device specified by (s) to BCD data, and store the converted data in the device specified by (d).

Binary data is used in operations in CPU module. Use this instruction to display numeric values on seven-segment display unit equipped with BCD decoder.

Ladder diagram	Structured text
	ENO:=BCD(EN,s,d); ENO:=BCDP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

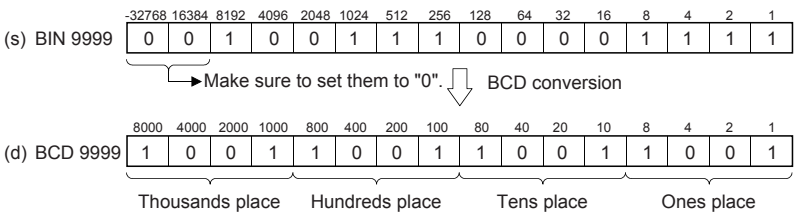
Operand	Description	Range	Data type	Data type (label)
(s)	Binary data or the head device where the binary data is stored	0 to 9999	16-bit signed binary	ANY16
(d)	Head device for storing the BCD data	—	BCD 4-digit	ANY16

■Applicable devices

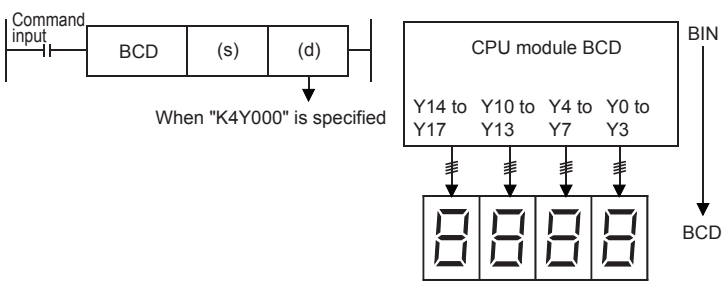
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit binary data (0 to 9999) in the device specified by (s) to BCD 4-digit data, and store the converted data in the device specified by (d).



- Data specified by (s) can be converted if it is within the range from K0 to K9999 BCD (decimal).
- The table below shows nibble specification for the data in the device specified by (s) and (d).



(d)	Number of digits	Data range
K1Y0	1-digit	0 to 9
K2Y0	2-digit	00 to 99
K3Y0	3-digit	000 to 999
K4Y0	4-digit	0000 to 9999

Precautions

- Binary data is used in all operations in CPU module including arithmetic operations (+-×÷), increment and decrement instructions. When receiving digital switch information in binary-coded decimal (BCD) format into a CPU module, use the BIN(P) instructions (for converting BCD data into binary data). Furthermore, to output data to seven-segment display unit handling binary-coded decimal (BCD) data, use the BCD(P) instructions (for converting binary data into BCD data).

Operation error

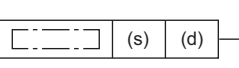
Error code (SD0/SD8067)	Description
3401	Data in the device specified by (s) is out of the valid range (0 to 9999).

Converting binary data to BCD 8-digit data

DBCD(P)

These instructions convert the binary data in the device specified by (s) to BCD data, and store the converted data in the device specified by (d).

Binary data is used in operations in CPU module. Use this instruction to display numeric values on seven-segment display unit equipped with BCD decoder.

Ladder diagram	Structured text
	ENO:=DBCD(EN,s,d); ENO:=DBCDP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

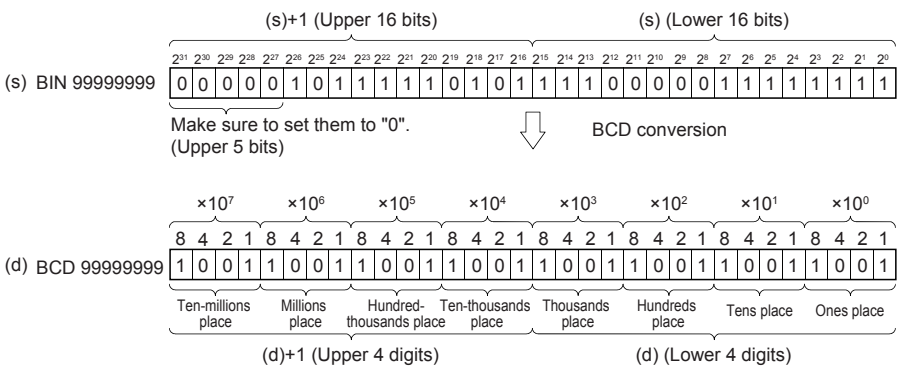
Operand	Description	Range	Data type	Data type (label)
(s)	Binary data or the head device where the binary data is stored	0 to 99999999	32-bit signed binary	ANY32
(d)	Head device for storing the BCD data	—	BCD 8-digit	ANY32

■Applicable devices

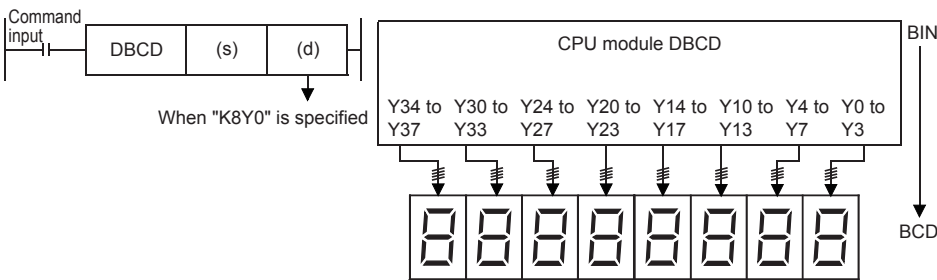
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert 32-bit binary data (0 to 99999999) in device specified by (s) to BCD 8-digit data, and store the converted data in the device specified by (d).



- Data specified by (s) can be converted if it is within the range from K0 to K99999999 BDC (decimal).
- The table below shows nibble specification for the data in the device specified by (s) and (d).



(d)+1, (d)	Number of digits	Data range
K1Y0	1-digit	0 to 9
K2Y0	2-digit	00 to 99
K3Y0	3-digit	000 to 999
K4Y0	4-digit	0000 to 9999
K5Y0	5-digit	00000 to 99999
K6Y0	6-digit	000000 to 999999
K7Y0	7-digit	0000000 to 9999999
K8Y0	8-digit	00000000 to 99999999

Precautions

- When using the SEGL instruction, because BCD \leftrightarrow binary conversion is automatically executed, the BCD(P) instruction do not have to be used.
- Binary data is used in all operations in CPU module including arithmetic operations (+- \times \div), increment and decrement instructions. When receiving digital switch information in binary-coded decimal (BCD) format into a CPU module, use the BIN(P) instructions (for converting BCD data into binary data). Furthermore, to output data to seven-segment display unit handling binary-coded decimal (BCD) data, use the BCD(P) instructions (for converting binary data into BCD data).

Operation error

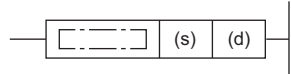
Error code (SD0/SD8067)	Description
3401	Data in the device specified by (s) is out of the valid range (0 to 99999999).

Converting BCD 4-digit data to binary data

BIN(P)

These instructions convert the binary-coded decimal data in the device specified by (s) to binary data, and store the converted data in the device specified by (d).

Use this instruction to convert a binary-coded decimal (BCD) value such as a value set by a digital switch into binary (BIN) data and to receive the converted binary data so that the data can be handled in operations in CPU module.

Ladder diagram	Structured text
	ENO:=BIN(EN,s,d); ENO:=BINP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

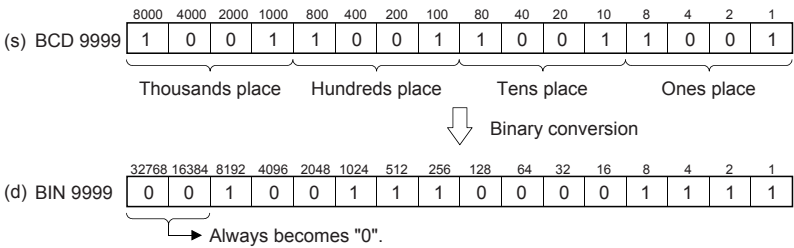
Operand	Description	Range	Data type	Data type (label)
(s)	Binary-coded decimal data or the head device where the binary-coded decimal data is stored	0 to 9999	BCD 4-digit	ANY16
(d)	Head device for storing the binary data	—	16-bit signed binary	ANY16

■Applicable devices

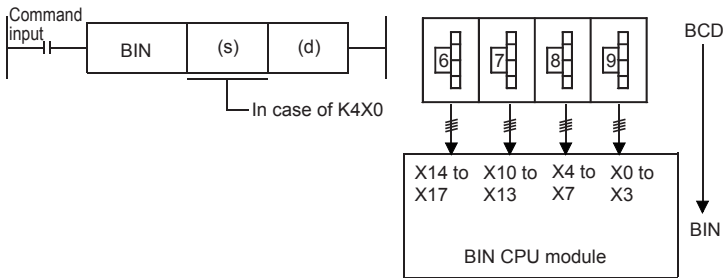
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the BCD 4-digit data (0 to 9999) in the device specified by (s) to 16-bit binary data, and store the converted data in the device specified by (d).



- The data in the device specified by (s) can be converted if it is in the range from 0 to 9999 (BCD).
- The table below shows nibble specification for the data in the device specified by (s) and (d).



(d)	Number of digits	Data range
K1X0	1-digit	0 to 9
K2X0	2-digit	00 to 99
K3X0	3-digit	000 to 999
K4X0	4-digit	0000 to 9999

Precautions

- Binary data is used in all operations in CPU module including arithmetic operations (+-×÷), increment and decrement instructions. When receiving digital switch information in binary-coded decimal (BCD) format into a CPU module, use the BIN(P) instructions (for converting BCD data into binary data). Furthermore, to output data to seven-segment display unit handling binary-coded decimal (BCD) data, use the BCD(P) instructions (for converting binary data into BCD data).

Operation error

Error code (SD0/SD8067)	Description
3401	The value of each digit of the device specified by (s) is other than 0 to 9. (The data is not binary-coded decimal data.)

Converting BCD 8-digit data to binary data

DBIN(P)

These instructions convert the binary-coded decimal data in the device specified by (s) to binary data, and store the converted data in the device specified by (d).

Use this instruction to convert a binary-coded decimal (BCD) value such as a value set by a digital switch into binary (BIN) data and to receive the converted binary data so that the data can be handled in operations in CPU module.

Ladder diagram	Structured text
	<pre>ENO:=DBIN(EN,s,d); ENO:=DBINP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

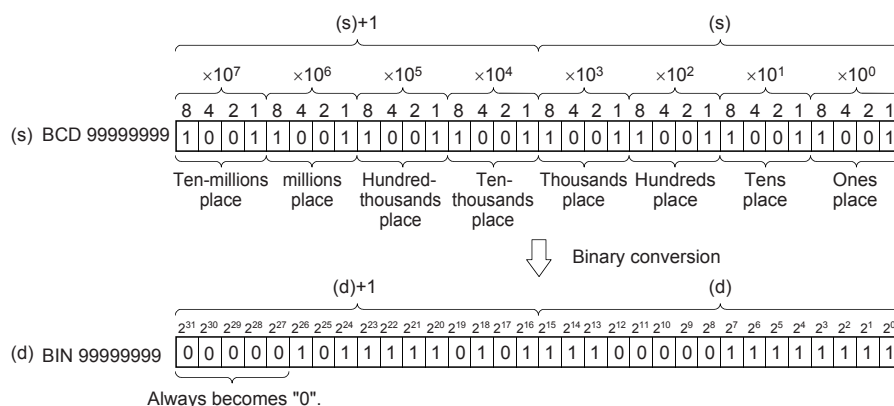
Operand	Description	Range	Data type	Data type (label)
(s)	Binary-coded decimal data or the head device where the binary-coded decimal data is stored	0 to 99999999	BCD 8-digit	ANY32
(d)	Head device for storing the binary data	—	32-bit signed binary	ANY32

■Applicable devices

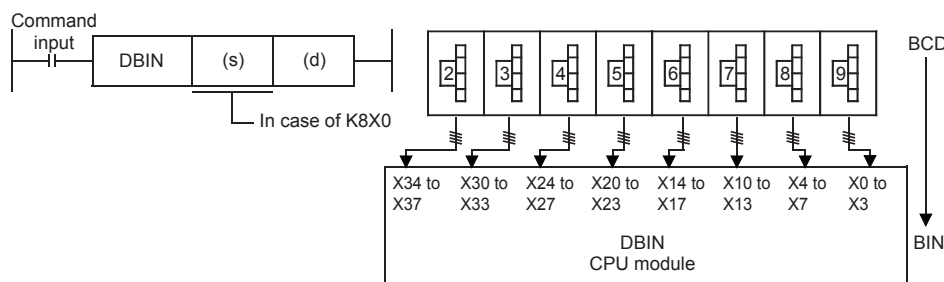
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the BCD 8-digit data (0 to 99999999) in the device specified by (s) to 32-bit binary data, and store the converted data in the device specified by (d).



- The data in the device specified by (s) can be converted if it is in the range from 0 to 99999999 (BCD).
- The table below shows nibble specification for the data in the device specified by (s) and (d).



(s)+1, (s)	Number of digits	Data range
K1X0	1-digit	0 to 9
K2X0	2-digit	00 to 99
K3X0	3-digit	000 to 999
K4X0	4-digit	0000 to 9999
K5X0	5-digit	00000 to 99999
K6X0	6-digit	000000 to 999999
K7X0	7-digit	0000000 to 9999999
K8X0	8-digit	00000000 to 99999999

Precautions

- Binary data is used in all operations in CPU module including arithmetic operations (+-×÷), increment and decrement instructions. When receiving digital switch information in binary-coded decimal (BCD) format into a CPU module, use the BIN instruction (for converting BCD data into binary data). Furthermore, to output data to seven-segment display unit handling binary-coded decimal (BCD) data, use the BCD instruction (for converting binary data into BCD data).

Operation error

Error code (SD0/SD8067)	Description
3401	The value of each digit of the device specified by (s) is other than 0 to 9. (The data is not binary-coded decimal data.)

Converting single-precision real number to 16-bit signed binary data

FLT2INT(P)

These instructions convert the single-precision real number in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

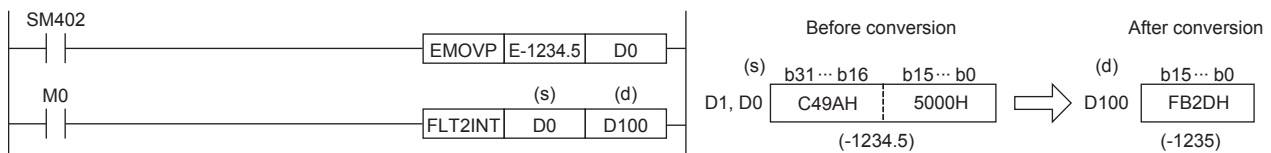
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	-32768 to +32767	Single-precision real number	ANYREAL_32
(d)	Data after conversion	—	16-bit signed binary	ANY16_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.



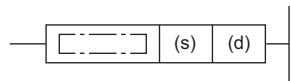
Operation error

Error code (SD0/SD8067)	Description
3401	The single-precision real number in the device specified by (s) is out of the valid range (-32768 to +32767).
3402	When the contents of the specified device are outside the following range: $0, 2^{-126} \leq \text{specified value (stored value)} < 2^{128}$ The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Converting single-precision real number to 16-bit unsigned binary data

FLT2UINT(P)

These instructions convert the single-precision real number in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

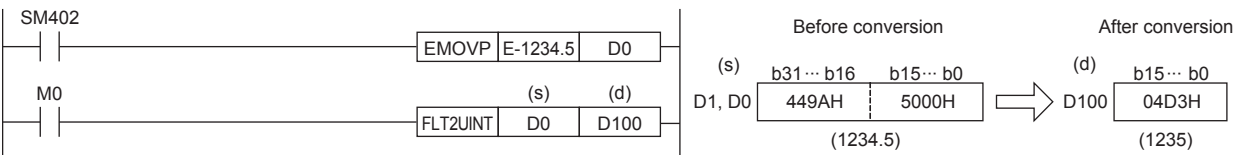
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	0 to 65535	Single-precision real number	ANYREAL_32
(d)	Data after conversion	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.



Operation error

Error code (SD0/SD8067)	Description
3401	The single-precision real number in the device specified by (s) is out of the valid range (0 to 65535).
3402	When the contents of the specified device are outside the following range: $0, 2^{-126} \leq \text{specified value (stored value)} < 2^{128}$ The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Converting single-precision real number to 32-bit signed binary data

FLT2DINT(P)

These instructions convert the single-precision real number in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

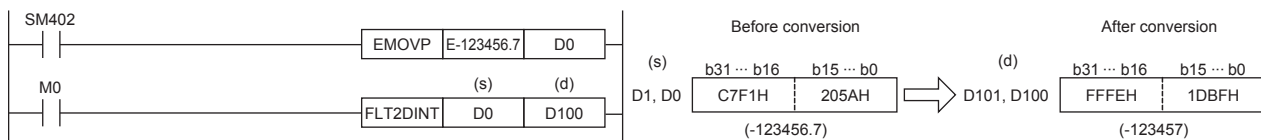
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	-2147483648 to +2147483647	Single-precision real number	ANYREAL_32
(d)	Data after conversion	—	32-bit signed binary	ANY32_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.



Operation error

Error code (SD0/SD8067)	Description
3401	The single-precision real number in the device specified by (s) is out of the valid range (-2147483648 to +2147483647).
3402	When the contents of the specified device are outside the following range: $0, 2^{-126} \leq \text{specified value (stored value)} < 2^{128}$ The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Converting single-precision real number to 32-bit unsigned binary data

FLT2UDINT(P)

These instructions convert the single-precision real number in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

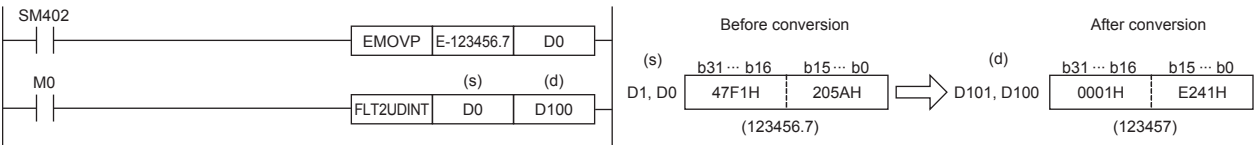
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	0 to 4294967295	Single-precision real number	ANYREAL_32
(d)	Data after conversion	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d). After conversion, the first digit after the decimal point of the single-precision real number is rounded off.



Operation error

Error code (SD0/SD8067)	Description
3401	The single-precision real number in the device specified by (s) is out of the valid range (0 to 4294967295).
3402	When the contents of the specified device are outside the following range: $0, 2^{-126} \leq \text{specified value (stored value)} < 2^{128}$ The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Converting 16-bit signed binary data to 16-bit unsigned binary data

INT2UINT(P)

These instructions convert the 16-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

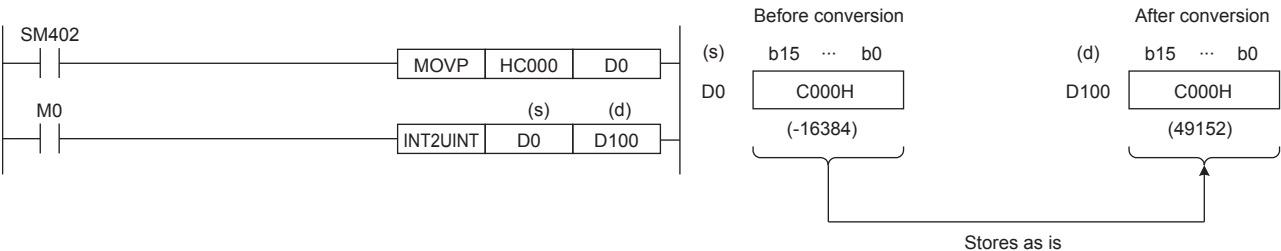
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	16-bit signed binary	ANY16_S
(d)	Data after conversion	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and store the result in the device specified by (d).



Operation error

There is no operation error.

Converting 16-bit signed binary data to 32-bit signed binary data

INT2DINT(P)

These instructions convert the 16-bit signed binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

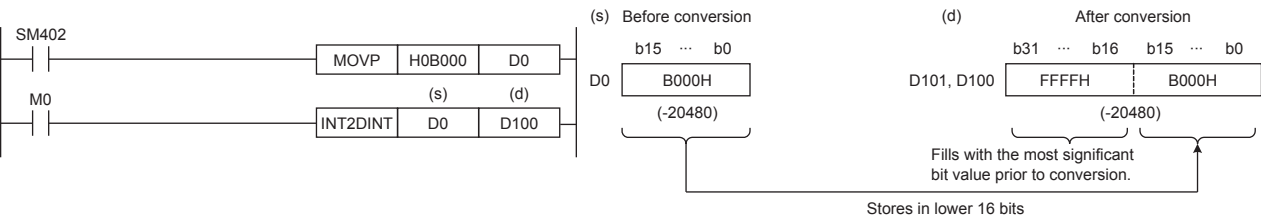
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	16-bit signed binary	ANY16_S
(d)	Data after conversion	—	32-bit signed binary	ANY32_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 16-bit signed binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 16-bit signed binary data to 32-bit unsigned binary data

INT2UDINT(P)

These instructions convert the 16-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

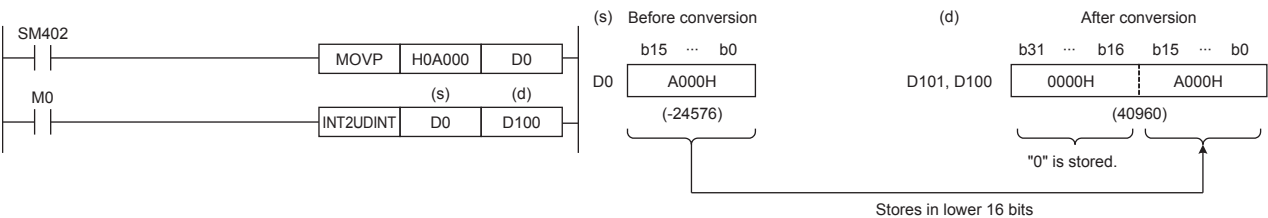
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	16-bit signed binary	ANY16_S
(d)	Data after conversion	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 16-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 16-bit unsigned binary data to 16-bit signed binary data

UINT2INT(P)

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

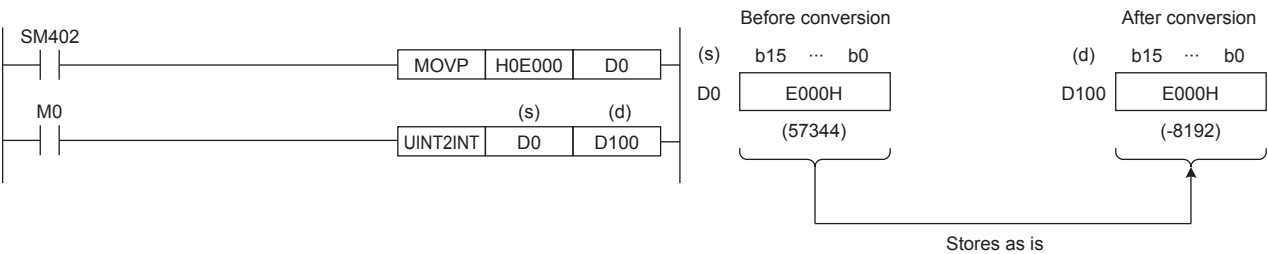
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	16-bit unsigned binary	ANY16_U
(d)	Data after conversion	—	16-bit signed binary	ANY16_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).



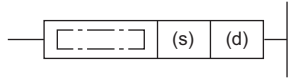
Operation error

There is no operation error.

Converting 16-bit unsigned binary data to 32-bit signed binary data

UINT2DINT(P)

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

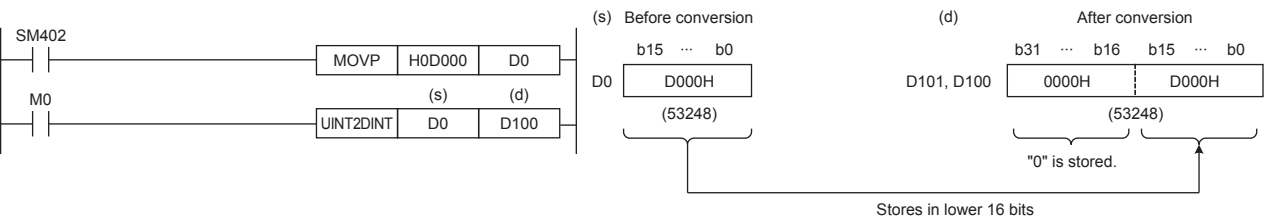
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	16-bit unsigned binary	ANY16_U
(d)	Data after conversion	—	32-bit signed binary	ANY32_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 16-bit unsigned binary data to 32-bit unsigned binary data

UINT2UDINT(P)

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

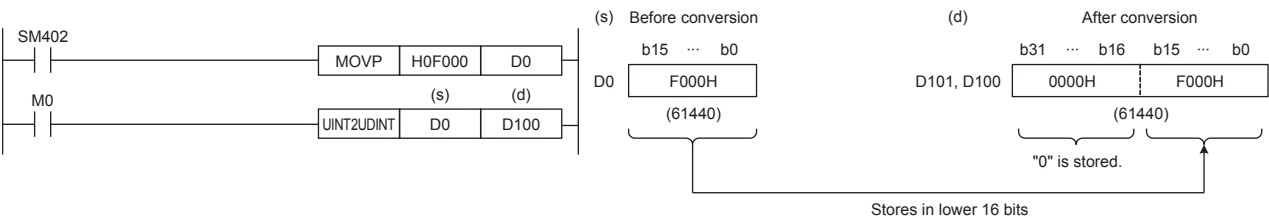
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	16-bit unsigned binary	ANY16_U
(d)	Data after conversion	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit signed binary data to 16-bit signed binary data

DINT2INT(P)

These instructions convert the 32-bit signed binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

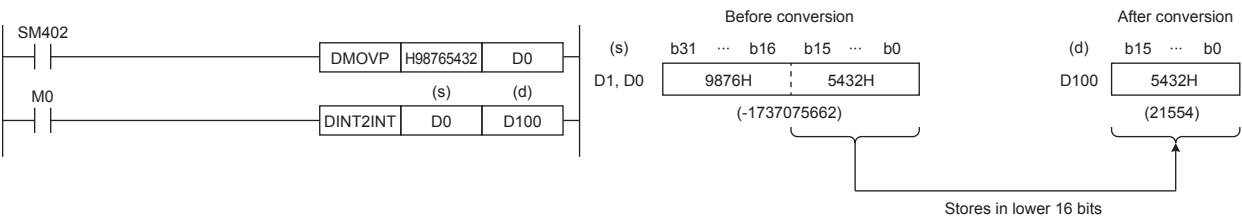
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	32-bit signed binary	ANY32_S
(d)	Data after conversion	—	16-bit signed binary	ANY16_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 32-bit signed binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit signed binary data to 16-bit unsigned binary data

DINT2UINT(P)

These instructions convert the 32-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

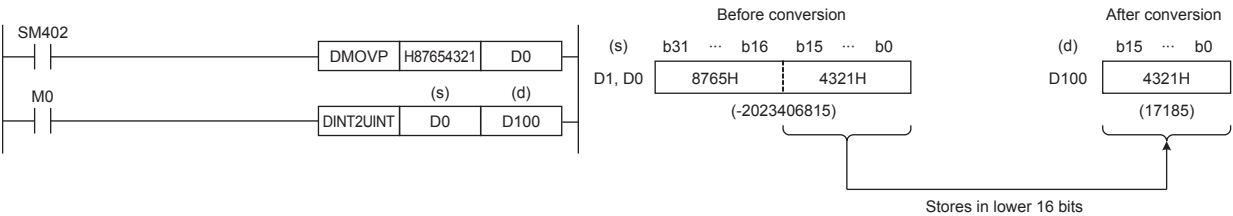
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	32-bit signed binary	ANY32_S
(d)	Data after conversion	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 32-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).



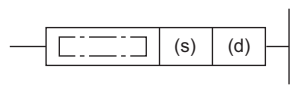
Operation error

There is no operation error.

Converting 32-bit signed binary data to 32-bit unsigned binary data

DINT2UDINT(P)

These instructions convert the 32-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

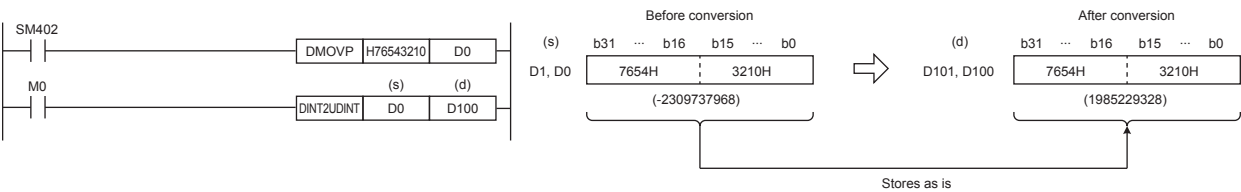
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	32-bit signed binary	ANY32_S
(d)	Data after conversion	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 32-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit unsigned binary data to 16-bit signed binary data

UDINT2INT(P)

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

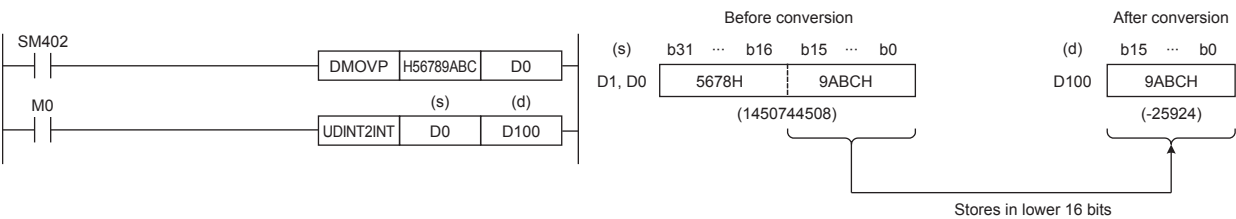
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	32-bit unsigned binary	ANY32_U
(d)	Data after conversion	—	16-bit signed binary	ANY16_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit unsigned binary data to 16-bit unsigned binary data

UDINT2UINT(P)

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

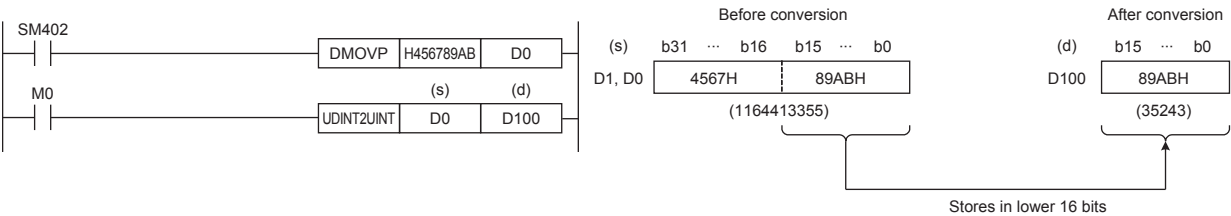
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	32-bit unsigned binary	ANY32_U
(d)	Data after conversion	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit unsigned binary data to 32-bit signed binary data

UDINT2DINT(P)

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

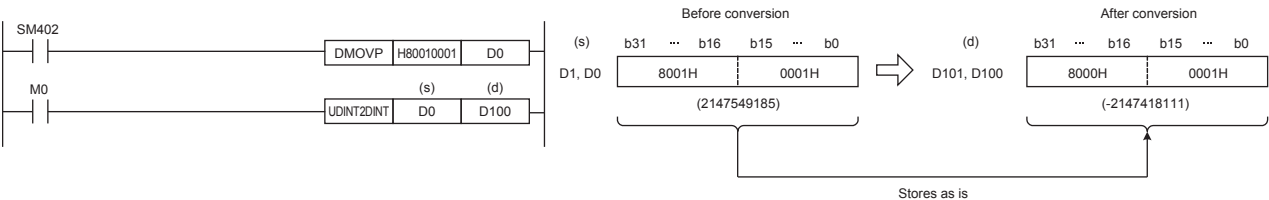
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	—	32-bit unsigned binary	ANY32_U
(d)	Data after conversion	—	32-bit signed binary	ANY32_S

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	<input type="radio"/>	—	—	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	—	—	—
(d)	<input type="radio"/>	—	—	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	—	—	—

Processing details

- These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).



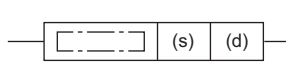
Operation error

There is no operation error.

Converting 16-bit binary data to Gray code

GRY(P)(_U)

These instructions convert the 16-bit binary data in the device specified by (s) to 16-bit binary gray code data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=GRY(EN,s,d); ENO:=GRYP(EN,s,d);	ENO:=GRY_U(EN,s,d); ENO:=GRYP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

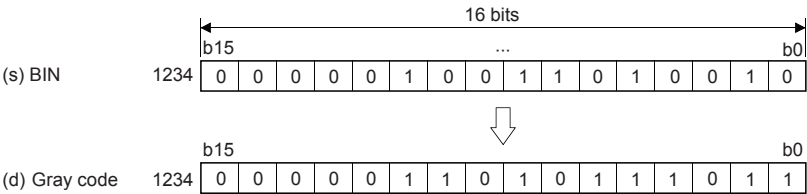
Operand	Description	Range	Data type	Data type (label)
(s)	GRY(P)	0 to 32767	16-bit signed binary	ANY16_S
	GRY(P)_U	0 to 65535	16-bit unsigned binary	ANY16_U
(d)	GRY(P)	—	16-bit signed binary	ANY16_S
	GRY(P)_U		16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit binary data in the device specified by (s) to 16-bit binary gray code data, and store the converted data in the device specified by (d).



Precautions

The data conversion speed depends on the scan time of the CPU module.

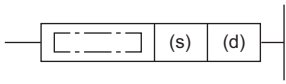
Operation error

There is no operation error.

Converting 32-bit binary data to Gray code

DGRY(P)(_U)

These instructions convert the 32-bit binary data in the device specified by (s) to 32-bit binary gray code data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DGRY(EN,s,d); ENO:=DGRYP(EN,s,d);	ENO:=DGRY_U(EN,s,d); ENO:=DGRYP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

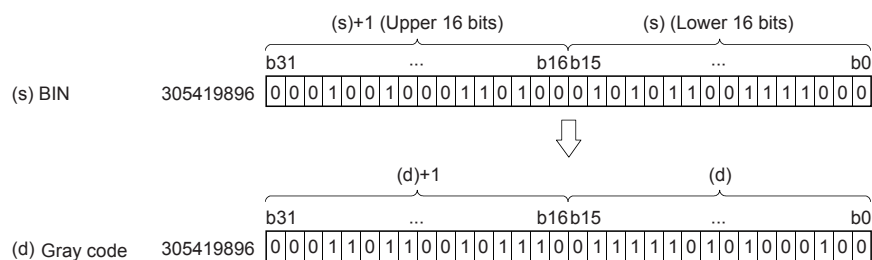
Operand	Description	Range	Data type	Data type (label)
(s)	DGRY(P)	0 to 2147483647	32-bit signed binary	ANY32_S
	DGRY(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	DGRY(P)	—	32-bit signed binary	ANY32_S
	DGRY(P)_U	—	32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 32-bit binary data in the device specified by (s) to 32-bit binary gray code data, and store the converted data in the device specified by (d).



Precautions

The data conversion speed depends on the scan time of the CPU module.

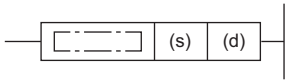
Operation error

There is no operation error.

Converting Gray code to 16-bit binary data

GBIN(P)(_U)

These instructions convert the 16-bit binary gray code data in the device specified by (s) to 16-bit binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=GBIN(EN,s,d); ENO:=GBINP(EN,s,d);	ENO:=GBIN_U(EN,s,d); ENO:=GBINP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

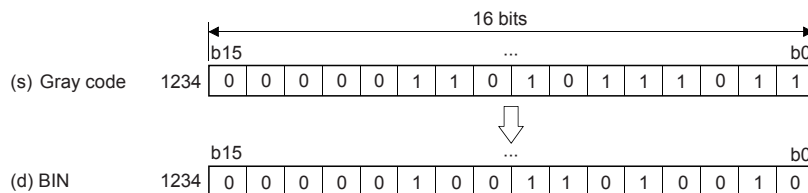
Operand		Description	Range	Data type	Data type (label)
(s)	GBIN(P)	Gray code data or head device storing the gray code data	0 to 32767	16-bit signed binary	ANY16_S
	GBIN(P)_U		0 to 65535	16-bit unsigned binary	ANY16_U
(d)	GBIN(P)	Head device for storing the binary data after conversion	—	16-bit signed binary	ANY16_S
	GBIN(P)_U			16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit binary gray code data in the device specified by (s) to 16-bit binary data, and store the converted data in the device specified by (d).



Precautions

When an input relay (X) is specified as (s), the response delay will be "Scan time of CPU module + Input filter constant".

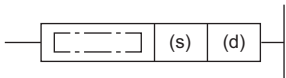
Operation error

There is no operation error.

Converting Gray code to 32-bit binary data

DGBIN(P)(_U)

These instructions convert the 32-bit binary gray code data in the device specified by (s) to 32-bit binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DGBIN(EN,s,d); ENO:=DGBINP(EN,s,d);	ENO:=DGBIN_U(EN,s,d); ENO:=DGBINP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

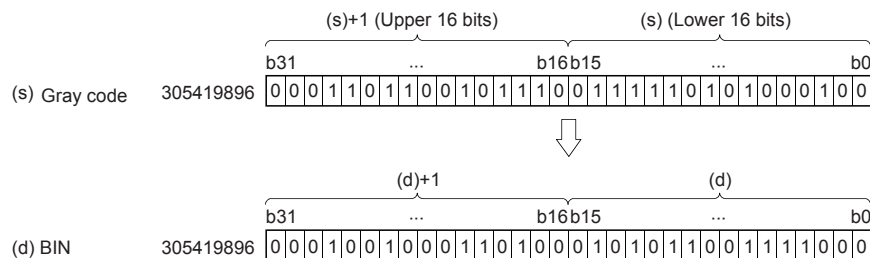
Operand		Description	Range	Data type	Data type (label)
(s)	DGBIN(P)	Gray code data or head device storing the gray code data	0 to 2147483647	32-bit signed binary	ANY32_S
	DGBIN(P)_U		0 to 4294967295	32-bit unsigned binary	ANY32_U
(d)	DGBIN(P)	Head device for storing the binary data after conversion	—	32-bit signed binary	ANY32_S
	DGBIN(P)_U			32-bit unsigned binary	ANY32_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions convert the 32-bit binary gray code data in the device specified by (s) to 32-bit binary data, and store the converted data in the device specified by (d).



Precautions

When an input relay (X) is specified as (s), the response delay will be "Scan time of CPU module + Input filter constant".

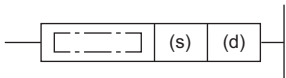
Operation error

There is no operation error.

Converting decimal ASCII to 16-bit binary data

DABIN(P)(_U)

These instructions convert the decimal ASCII data in the device areas specified by (s) and later to 16-bit binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DABIN(EN,s,d); ENO:=DABINP(EN,s,d);	ENO:=DABIN_U(EN,s,d); ENO:=DABINP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	ASCII data or the head device where the ASCII data is stored	—	Character string	ANYSTRING_SINGLE
(d)	DABIN(P)	—	16-bit signed binary	ANY16_S
	DABIN(P)_U		16-bit unsigned binary	ANY16_U

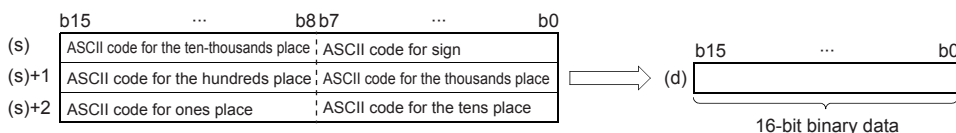
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	○	—
(d)	○	—	—	○*1	○	○	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

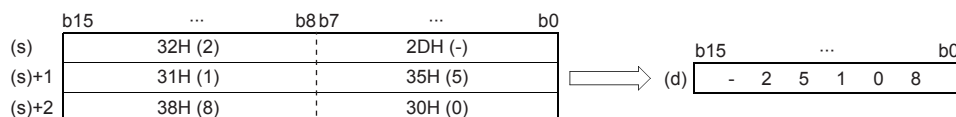
Processing details

- These instructions convert the decimal ASCII data in the device areas specified by (s) and later to 16-bit binary data, and store the converted data in the device specified by (d).



Ex.

When the ASCII data, -25108 (signed), is specified by (s)



- The ASCII data that can be specified by (s) to (s)+2 is -32768 to +32767 for signed data, and 0 to 65535 for unsigned data.
- As signed data, "20H" is stored if the ASCII data is positive, and "2DH" is stored if the data is negative. (If a value other than "20H" and "2DH" is set, the data will be processed as positive data.) (DABIN(P))
- A value "30H" to "39H" can be set in the each place of the ASCII code.
- If a value "20H" or "00H" is set, the value will be processed as "30H".

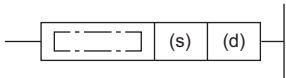
Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (s) exceeds the corresponding device range.
3401	The signed data is other than 20H, 2DH.
	A value specified by (s) to (s)+2 for each place of the ASCII code is other than "30H" to "39H", "20H", and "00H".
	The ASCII data in the device specified by (s) to (s)+2 is out of the valid range (-32768 to +32767) (when a signed data is specified).
	The ASCII data in the device specified by (s) to (s)+2 is out of the valid range (0 to 65535) (when unsigned data is specified).

Converting decimal ASCII to 32-bit binary data

DDABIN(P)(_U)

These instructions convert the decimal ASCII data in the device numbers specified by (s) and later to 32-bit binary data, and store the converted data in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DDABIN(EN,s,d); ENO:=DDABINP(EN,s,d);	ENO:=DDABIN_U(EN,s,d); ENO:=DDABINP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	ASCII data or the head device where the ASCII data is stored	—	Character string	ANYSTRING_SINGLE
(d)	DDABIN(P)	—	32-bit signed binary	ANY32_S
	DDABIN(P)_U		32-bit unsigned binary	ANY32_U

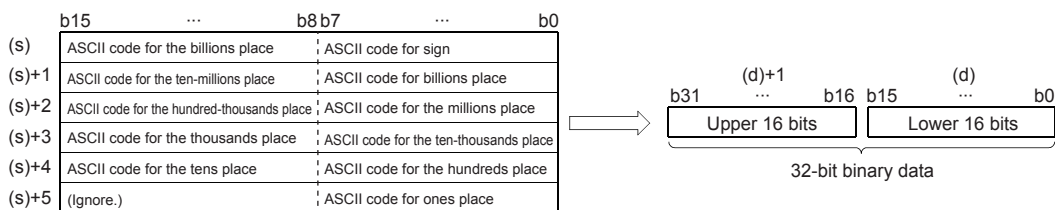
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	○	—
(d)	○	—	—	○*1	○	○	○	○	○	—	—	—	—

*1 T, ST, C cannot be used.

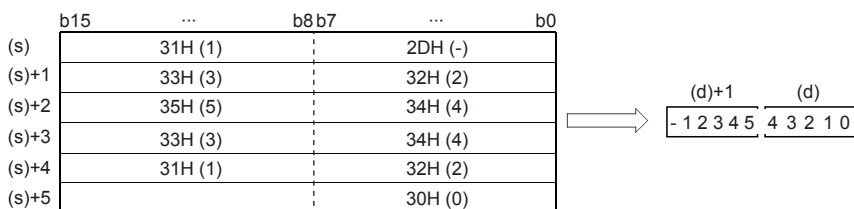
Processing details

- These instructions convert the decimal ASCII data in the device numbers specified by (s) and later to 32-bit binary data, and store the converted data in the device specified by (d).



Ex.

When the ASCII data, -1234543210 (signed), is specified by (s)



- The ASCII data that can be specified by (s) to (s)+5 is -2147483648 to +2147483647 for signed data, and 0 to 429496729 for unsigned data. The data stored in the high-order byte of (s)+5 is ignored.
- As signed data, "20H" is stored if the ASCII data is positive, and "2DH" is stored if the data is negative. (If a value other than "20H" and "2DH" is set, the data will be processed as positive data.) (DABIN(P))
- A value "30H" to "39H" can be set in the each place of the ASCII code.
- If a value "20H" or "00H" is set, the value will be processed as "30H".

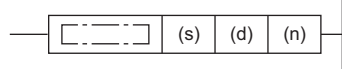
Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (s) exceeds the corresponding device range.
3401	The signed data is other than 20H, 2DH. A value specified by (s) to (s)+2 for each place of the ASCII code is other than "30H" to "39H", "20H", and "00H". The ASCII data in the device specified by (s) to (s)+5 is out of the valid range (-2147483648 to +2147483647) (when a signed data is specified). The ASCII data in the device specified by (s) to (s)+5 is out of the valid range (0 to 4294967295) (when unsigned data is specified).

Converting ASCII to HEX

HEXA(P)

These instructions convert the ASCII data stored in the number of characters specified by (n) in the device numbers specified by (s) and later to HEX code data, and store the converted data in the device numbers specified by (d) and later.

Ladder diagram	Structured text
	ENO:=HEXA(EN,s,n,d); ENO:=HEXAP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the ASCII data to be converted to hexadecimal code	—	Character string	ANYSTRING_SINGLE
(d)	Head device for storing the hexadecimal code after conversion	—	16-bit signed binary	ANY16
(n)	Number of characters (number of bytes) of ASCII data to be converted	1 to 16383	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

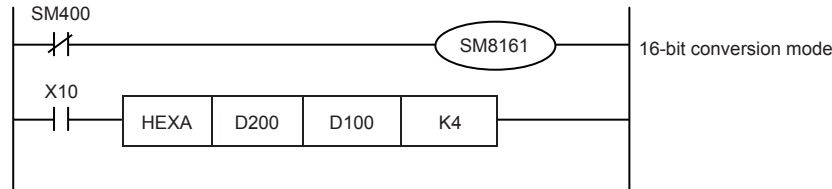
*1 T, ST, C cannot be used.

Processing details

- These instructions convert the ASCII data stored in the number of characters specified by (n) in the device numbers specified by (s) and later to HEX code data, and store the converted data in the device numbers specified by (d) and later. 16-bit conversion mode and 8-bit conversion mode options are available for these instructions. For operation in each mode, refer to the succeeding pages.

- 16-bit conversion mode (while SM8161 is OFF)

The ASCII data stored in high-order 8 bits and low-order 8 bits (byte) of the device specified by (s) is converted to hexadecimal code, and transferred to the device specified by (d) in units of 4 digits. The number of characters to be converted is specified by (n). SM8161 is also used for the RS2, ASCI(P), CCD(P), and CRC(P) instructions. When using the 16-bit conversion mode, set SM8161 to normally OFF. SM8161 is cleared when the CPU module mode is changed from RUN to STOP. Moreover, when using the 16-bit conversion mode, the ASCII data must also be stored in high-order 8 bits of the device specified by (s). In the following program, conversion is executed as follows:



Conversion source data

(s)	ASCII data	Hexadecimal code
D200 low-order	30H	0
D200 high-order	41H	A
D201 low-order	42H	B
D201 high-order	43H	C
D202 low-order	31H	1
D202 high-order	32H	2
D203 low-order	33H	3
D203 high-order	34H	4
D204 low-order	35H	5

Number of specified characters and conversion result "." indicates "0".

(n)	(d)		
	D102	D101	D100
1	Does not change		... 0H
2			.. 0AH
3			.0ABH
4			0ABCH
5		... 0H	ABC1H
6		.. 0AH	BC12H
7		.0ABH	C123H
8		0ABCH	1234H
9	... 0H	ABC1H	2345H

When (n)=K4

D200	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
	41H to "A"								30H to "0"							
D201	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0
	43H to "C"								42H to "B"							
D100	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0
	0				A				B				C			

• 8-bit conversion mode (while SM8161 is on)

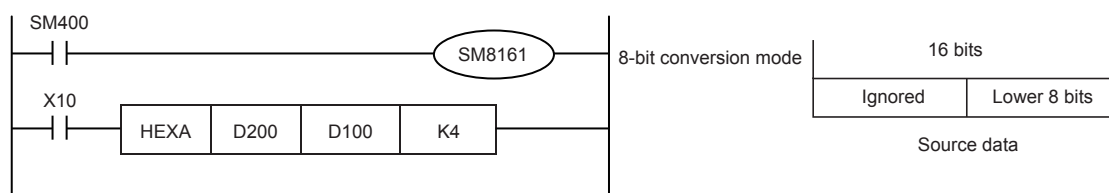
The ASCII data stored in low-order 8 bits of the device specified by (s) is converted to hexadecimal code, and transferred to the device specified by (d) in units of 4 digits.

The number of characters to be converted is specified by (n).

SM8161 is also used for the RS2, ASCI(P), CCD(P), and CRC(P) instructions. When using the 8-bit conversion mode, set SM8161 to normally on.

SM8161 is cleared when the CPU module mode is changed from RUN to STOP.

In the following program, conversion is executed as follows:



Conversion source data

(s)	ASCII data	Hexadecimal code
D200	30H	0
D201	41H	A
D202	42H	B
D203	43H	C
D204	31H	1
D205	32H	2
D206	33H	3
D207	34H	4
D208	35H	5

Number of specified characters and conversion result "." indicates "0".

(n)	(d)		
	D102	D101	D100
1	Does not change		... 0H
2			.. 0AH
3			· 0ABH
4			0ABCH
5		... 0H	ABC1H
6		.. 0AH	BC12H
7		· 0ABH	C123H
8		0ABCH	1234H
9	... 0H	ABC1H	2345H

When (n)=K2

D200										0	0	1	1	0	0	0	0
	30H to "0"																
D201										0	1	0	0	0	0	0	1
	41H to "A"																
D100	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
	0								A								

Precautions

- Make sure that only ASCII codes "0" to "9" and "A" to "F" are stored in the device specified by (s).
- If ASCII data is not stored in the device specified for (s) by the HEXA(P) instructions, an operation error occurs and conversion into hexadecimal code is disabled. Especially, note that when SM8161 is OFF (16-bit conversion mode), ASCII code should be stored in high-order 8 bits of the device specified by (s).
- The number of points occupied by the device specified by (d) varies depending on the ON/OFF status of SM8161. When SM8161 is on (8-bit conversion mode), as many points as the number of characters are occupied, and when SM8161 is OFF (16-bit conversion mode) as many points as the (number of characters ÷ 2) are occupied.
- The SM8161 flag is also used for the RS2, ASCI(P), CCD(P) and CRC(P) instructions. When using these instructions and the HEXA(P) instructions in the same program, make sure to set SM8161 to ON or OFF just before each instruction so that SM3161 does not affect another instruction.

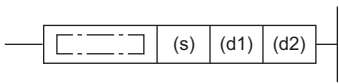
Operation error

Error code (SD0/SD8067)	Description
2820	The (n) number of devices specified by (s) and (d) exceeds the corresponding device range.
2821	The range specified by (s) and (d) overlaps.
3401	An ASCII code other than 30H to 39H, and 41H to 46H is set in the device specified by (s).
3405	The value specified in (n) is outside the range specified below. 1 to 16383

Converting character string to 16-bit binary data

VAL(P)(_U)

These instructions convert the character string in the device numbers specified by (s) and later to 16-bit binary data, and store the number of digits in the device specified by (d1) and the binary data in the device specified by (d2).

Ladder diagram	Structured text	
	ENO:=VAL(EN,s,d1,d2); ENO:=VALP(EN,s,d1,d2);	ENO:=VAL_U(EN,s,d1,d2); ENO:=VALP_U(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string to be converted to binary data, or head device for storing the character string.	—	Character string	ANYSTRING_SINGLE
(d1)	VAL(P)	—	16-bit signed binary	ANY16_S_ARRAY
	VAL(P)_U		16-bit unsigned binary	ANY16_U_ARRAY
(d2)	VAL(P)	—	16-bit signed binary	ANY16_S
	VAL(P)_U		16-bit unsigned binary	ANY16_U

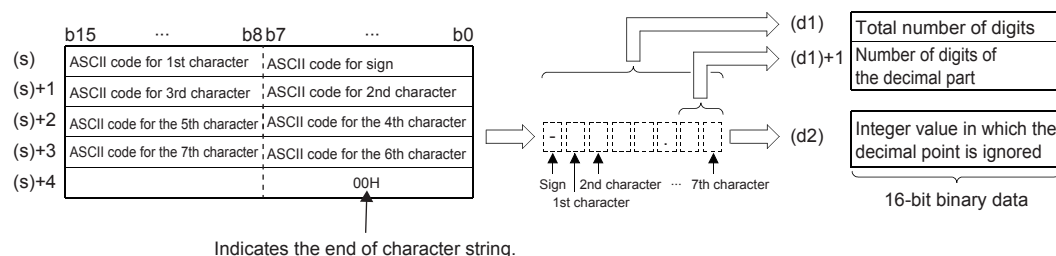
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d1)	○	—	—	○	—	—	—	—	○	—	—	—	—
(d2)	○	—	—	○	○	○	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

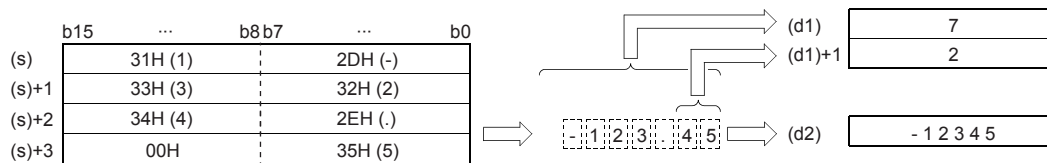
Processing details

- These instructions convert the character string in the device numbers specified by (s) and later to 16-bit binary data, and store the number of digits in the device specified by (d1) and the binary data in the device specified by (d2). When converting a character string into binary data, the data from the device number specified by (s) to a device number storing "00H" is handled as a character string.
- The total number of digits stored in (d1) is the total number of characters (including the sign and decimal point) representing the numeric value. The number of digits in the decimal part stored in (d1)+1 is the number of characters representing the decimal part after 2EH (.). The 16-bit binary data stored in (d2) is binary value converted from a character string with the decimal point ignored.



Ex.

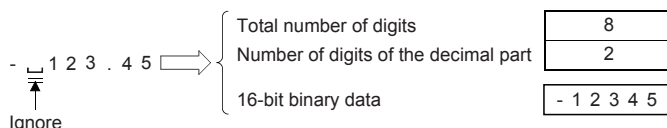
When the character string "-123.45" (signed) is specified by (s) and later



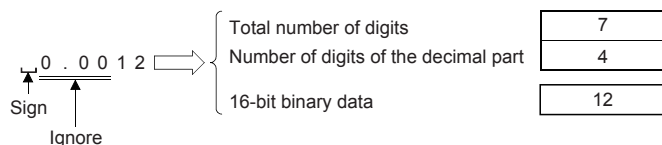
- The total number of characters of the character string specified by (s) is 2 to 8 characters.
- In the character string specified by (s), the number of characters that form the decimal part is 0 to 5 characters. However, be sure to specify "Total number of digits - 3" or below.
- The range of the character string of the numeric value that can be converted to a binary value is -32768 to +32767 for a signed value with the decimal point ignored, and 0 to 65535 for an unsigned value. A character string of a numeric value excluding the sign and decimal point can be specified only within the range of 30H to 39H. (Value with the decimal point ignored ... "-12345.6" becomes "-123456".)
- When representing a positive numeric value, 20H is set in the sign, and when representing a negative numeric value, 2DH is set.
- 2EH is set in the decimal point.
- When "20H (space)" or "30H (0)" exists between the sign and the first non-zero number in a character string specified by (s), "20H" or "30H" is ignored during conversion to a binary value.

Ex.

When "20H" exists between the sign and the first non-zero number (a signed value is specified)

**Ex.**

When "30H" exists between the sign and the first non-zero number



Precautions

- Store signed data, "space (20H)" or "-" (2DH)" only in the 1st byte (low-order 8 bits of the head device set in (s)). Only the ASCII data "0 (30H)" to "9 (39H)", "space (20H)" and "decimal point (2EH)" can be stored from the 2nd byte to the "00H" at the end of the character string in (s). If "-" (2DH)" is stored in the 2nd byte or later, an operation error occurs.

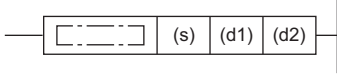
Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (d1) exceeds the corresponding device range. When "00H" is not set in the corresponding device range after the device specified in (s).
3401	The number of characters of the character string specified by (s) is other than 2 to 8 characters. The number of characters of the decimal part of the character string specified by (s) is other than 0 to 5 characters. The relationship between the total number of characters specified by (s) and the number of characters of the decimal part is other than that described below. Total number of characters - 3 ≥ Number of characters in the decimal part An ASCII code other than 20H, 2DH is set in the sign. (a signed value is specified) An ASCII code other than 30H to 39H, and 2EH (decimal point) is set in the digits of each number Two or more decimal points are set. The converted binary value exceeds the range that can be converted by each instruction. Signed operation: -32768 to +32767, unsigned operation: 0 to 65535

Converting character string to 32-bit binary data

DVAL(P)(_U)

These instructions convert the character string in the device numbers specified by (s) and later to 32-bit binary data, and store the number of digits in the device specified by (d1) and the binary data in the device specified by (d2).

Ladder diagram	Structured text	
	ENO:=DVAL(EN,s,d1,d2); ENO:=DVALP(EN,s,d1,d2);	ENO:=DVAL_U(EN,s,d1,d2); ENO:=DVALP_U(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string to be converted to binary data, or head device for storing the character string.	—	Character string	ANYSTRING_SINGLE
(d1)	DVAL(P)	—	16-bit signed binary	ANY16_S_ARRAY
	DVAL(P)_U		16-bit unsigned binary	ANY16_U_ARRAY
(d2)	DVAL(P)	—	32-bit signed binary	ANY32_S
	DVAL(P)_U		32-bit unsigned binary	ANY32_U

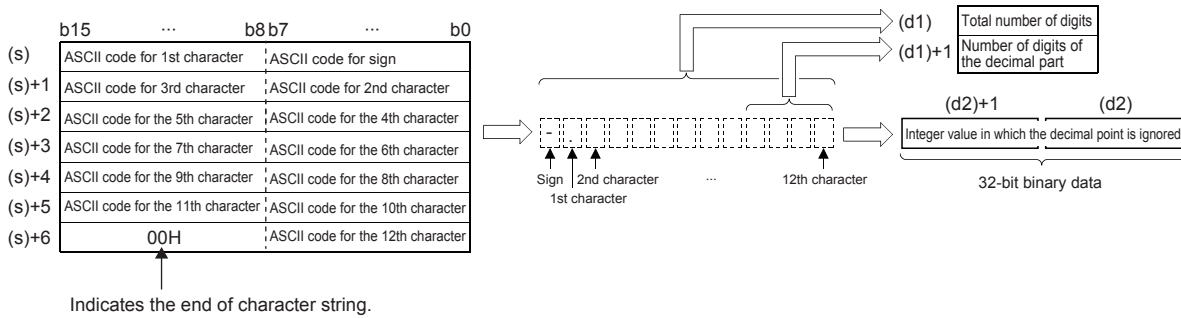
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	—	—	—	○*1	—	—	—	—	○	—	—	○	—	
(d1)	○	—	—	○	—	—	—	—	○	—	—	—	—	
(d2)	○	—	—	○	○	○	○	○	○	—	—	—	—	

*1 T, ST, C cannot be used.

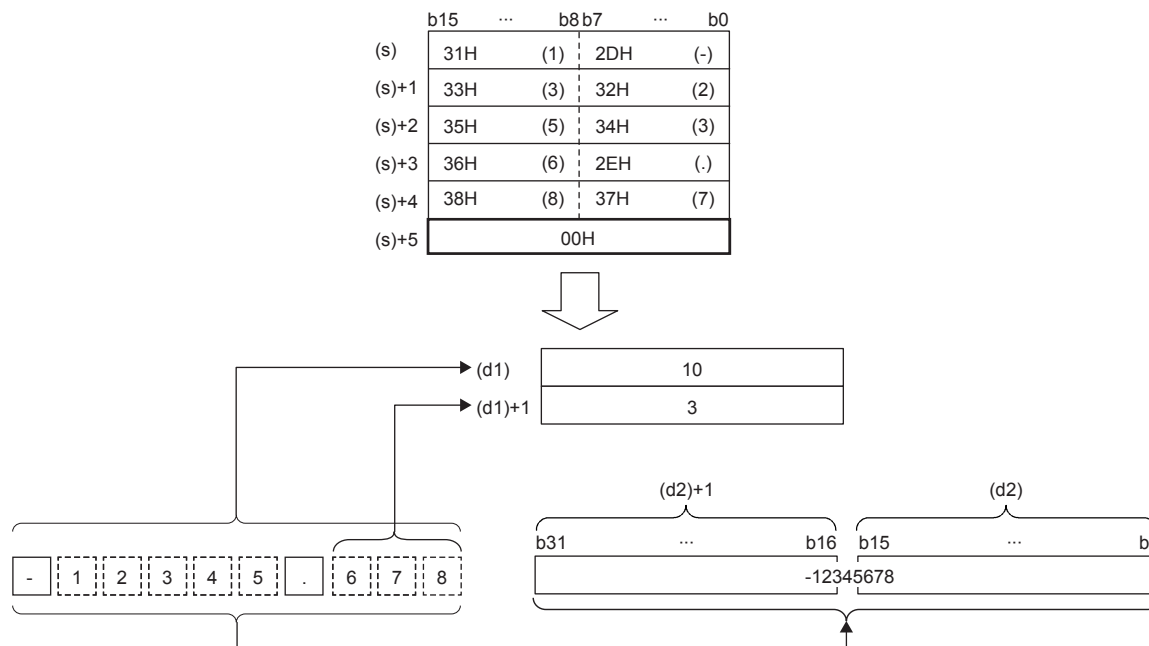
Processing details

- These instructions convert the character string in the device numbers specified by (s) and later to 32-bit binary data, and store the number of digits in the device specified by (d1) and the binary data in the device specified by (d2). When converting a character string into binary data, the data from the device number specified by (s) to a device number storing "00H" is handled as a character string.
- The total number of digits stored in (d1) is the total number of characters (including the sign and decimal point) representing the numeric value. The number of digits in the decimal part stored in (d1)+1 is the number of characters representing the decimal part after 2EH (.). The 32-bit binary data stored in (d2) is binary value converted from a character string with the decimal point ignored.



Ex.

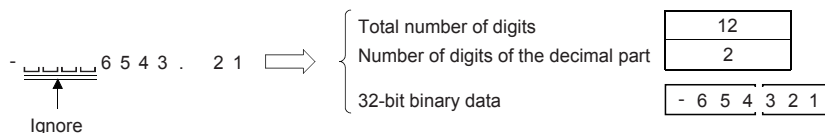
When the character string "-12345.678" (signed) is specified by (s) and later



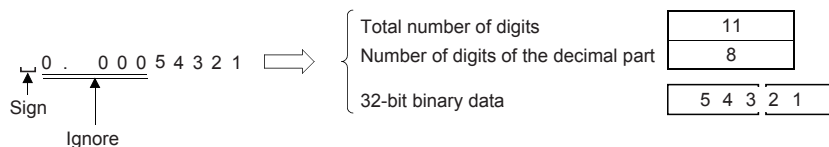
- The total number of characters of the character string specified by (s) is 2 to 13 characters.
- In the character string specified by (s), the number of characters that form the decimal part is 0 to 10 characters. However, be sure to specify "Total number of digits - 3" or below.
- The range of the character string of the numeric value that can be converted to a binary value is -2147483648 to 2147483647 for a signed value with the decimal point ignored, and 0 to 4294967295 for an unsigned value. A character string of a numeric value excluding the sign and decimal point can be specified only within the range of 30H to 39H. (Value with the decimal point ignored ... "-12345.6" becomes "-123456".)
- When representing a positive numeric value, 20H is set in the sign, and when representing a negative numeric value, 2DH is set.
- Set 2EH in the decimal point.
- When "20H (space)" or "30H (0)" exists between the sign and the first non-zero number in a character string specified by (s), "20H" or "30H" is ignored during conversion to a binary value.

Ex.

When "20H" exists between the sign and the first non-zero number (a signed value is specified)

**Ex.**

When "30H" exists between the sign and the first non-zero number



Precautions

- Store sign data, "space (20H)" or "-" (2DH)" in the 1st byte (low-order 8 bits of the head device set in (s)). Only the ASCII data "0 (30H)" to "9 (39H)", "space (20H)" and "decimal point (2EH)" can be stored from the 2nd byte to the "00H" at the end of the character string in (s). If "-" (2DH)" is stored in the 2nd byte or later, an operation error occurs.

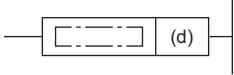
Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (d1) exceeds the corresponding device range. When "00H" is not set in the corresponding device range after the device specified in (s).
3401	The number of characters of the character string specified by (s) is other than 2 to 13 characters. The number of characters of the decimal part of the character string specified by (s) is other than 0 to 10 characters. The relationship between the total number of characters specified by (s) and the number of characters of the decimal part is other than that described below. Total number of characters - 3 ≥ Number of characters in the decimal part An ASCII code other than 20H, 2DH is set in the sign. Two or more decimal points are set. The converted binary value exceeds the range that can be converted by each instruction. Signed operation: -2147483648 to +2147483647, unsigned operation: 0 to 4294967295

Two's complement of 16-bit binary data (sign inversion)

NEG(P)

These instructions invert the sign of the 16-bit binary data in the device specified by (d), and store the resultant data in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=NEG(EN,d); ENO:=NEGP(EN,d);</pre>

Setting data

■Descriptions, ranges, and data types

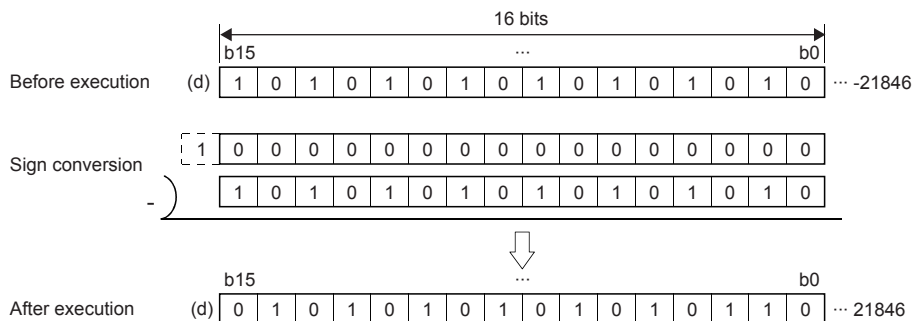
Operand	Description	Range	Data type	Data type (label)
(d)	Head device for storing the data that performs two's complement	-32768 to +32767	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions invert the sign of the 16-bit binary data in the device specified by (d), and store the resultant data in the device specified by (d).
- They are used when a positive or negative sign is to be inverted.



Precautions

Note that data is inverted in every operation cycle in a continuous operation type (NEG) instruction.

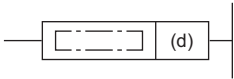
Operation error

There is no operation error.

Two's complement of 32-bit binary data (sign inversion)

DNEG(P)

These instructions invert the sign of the 32-bit binary data in the device specified by (d), and store the resultant data in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DNEG(EN,d); ENO:=DNEGP(EN,d);</pre>

Setting data

■ Descriptions, ranges, and data types

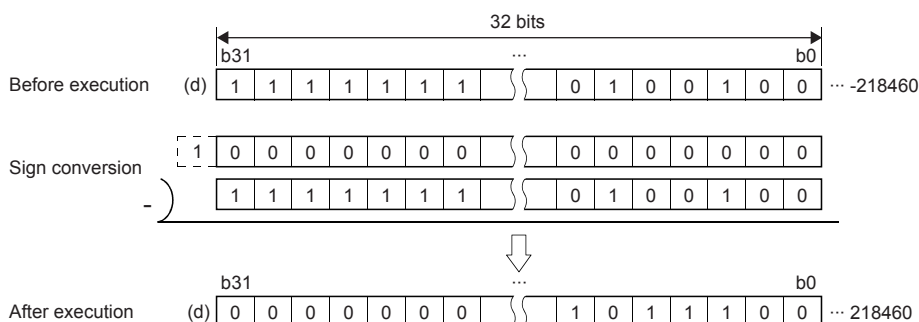
Operand	Description	Range	Data type	Data type (label)
(d)	Head device for storing the data that performs two's complement	-2147483648 to +2147483647	32-bit signed binary	ANY32

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—	—

Processing details

- These instructions invert the sign of the 32-bit binary data in the device specified by (d), and store the resultant data in the device specified by (d).
- They are used when a positive or negative sign is to be inverted.



Precautions

Note that data is inverted in every operation cycle in a continuous operation type (DNEG) instruction.

Operation error

There is no operation error.

Decoding from 8 to 256 bits

DECO(P)

These instructions decode the lower-order (n) bits of the device specified by (s), and store the result in the 2 (to the power (n)) bit from the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DECO(EN,s,n,d); ENO:=DECOP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

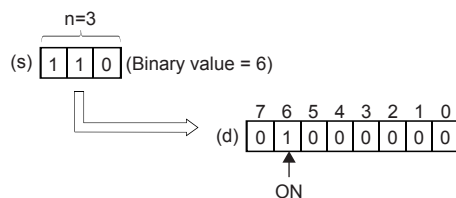
Operand	Description	Range	Data type	Data type (label)
(s)	Decode data or device number for storing the decode data	—	Bit/16-bit signed binary	ANY_ELEMENTARY
(d)	Head device for storing the decode result	—	Bit/word	ANY_ELEMENTARY
(n)	Valid bit length	1 to 8	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions turn ON the bit position of the device specified by (d) in correspondence to the BIN value specified by the lower-order (n) bits of (s).



- When (n) is 0, no processing is performed, and the contents of the device specified by (d) do not change.
- The bit device is handled as a device storing one-bit data and the word device is handled as a device storing 16-bit data.

Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (s) exceeds the corresponding device range.
	The device specified by (d) exceeds the corresponding device range.
3401	(d) is specified as a bit device and (n) is other than 0 to 8.
	(d) is specified as a word device and (n) is other than 0 to 4.

Encoding from 256 to 8 bits

ENCO(P)

These instructions encode the $2^{(n)}$ bits of data from the device specified by (s), and store it in (d).

Ladder diagram	Structured text
	<pre>ENO:=ENCO(EN,s,n,d); ENO:=ENCOP(EN,s,n,d);</pre>

Setting data

■ Descriptions, ranges, and data types

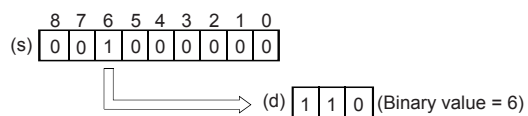
Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the encode data	—	Bit/word	ANY_ELEMENTARY
(d)	Device number for storing the encoding result	—	16-bit signed binary	ANY16
(n)	Valid bit length	1 to 8	16-bit unsigned binary	ANY16

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions store into (d) the binary value corresponding to the bit whose value is 1 in the data with $2^{(n)}$ bits.



- When (n) is 0, no processing is performed, and the contents of the device specified by (d) do not change.
- The bit device is handled as a device storing one-bit data and the word device is handled as a device storing 16-bit data.
- If two or more bits are 1, the higher bit position is processed.

Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (s) exceeds the corresponding device range.
3401	The entire data from (s) to $2^{(n)}$ number of bits is 0.
	(s) is specified as a bit device and (n) is other than 0 to 8.
	(s) is specified as a word device and (n) is other than 0 to 4.

Separating 4 bits from 16-bit data

DIS(P)

These instructions store the data equivalent of the (n) nibbles (1-nibble/ 4-bits) of the 16-bit binary data specified by (s) in to the lower-order 4 bits of (n) number of devices starting from the one specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DIS(EN,s,n,d); ENO:=DISP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

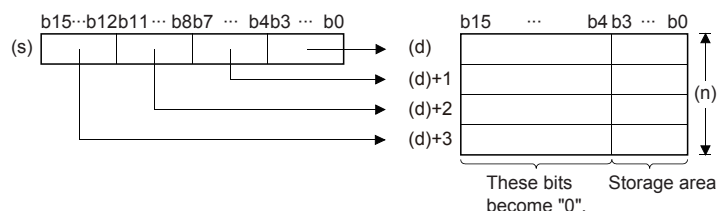
Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the data to be separated	—	16-bit signed binary	ANY16
(d)	Head device storing separated data	—	16-bit signed binary	ANY16
(n)	Number of separations (0 indicates no processing is performed)	1 to 4	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions store the data equivalent of the (n) nibbles (1-nibble/ 4-bits) of the 16-bit binary data specified by (s) in to the lower-order 4 bits of (n) number of devices starting from the one specified by (d).



- The higher-order 12 bits of (n) number of devices starting from the one specified by (s) becomes 0.
- When (n) is 0, no processing is performed, and the contents of the (n) number of devices starting from the one specified by (d) do not change.

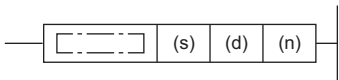
Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) number of points from (d) exceed the corresponding device range.
3401	(n) is other than 0 to 4.

Connecting 4 bits to 16-bit data

UNI(P)

These instructions link the lower-order 4 bits of the 16-bit binary data of the (n) number of devices starting from the one specified by (s) to the device storing 16-bit binary data specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=UNI(EN,s,n,d); ENO:=UNIP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

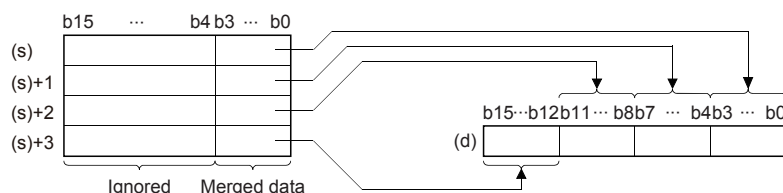
Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the data to be linked	—	16-bit signed binary	ANY16
(d)	Head device for storing the linked data	—	16-bit signed binary	ANY16
(n)	Number of links	1 to 4	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions link the lower-order 4 bits of the 16-bit binary data of the (n) number of devices starting from the one specified by (s) to the device storing 16-bit binary data specified by (d).



- The higher-order (4-n) nibble bits of the device specified by (d) becomes 0.
- When (n) is 0, no processing is performed, and the contents of the device specified by (d) do not change.

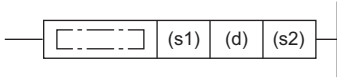
Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) number of points from (d) exceed the corresponding device range.
3401	(n) is other than 0 to 4.

Separating the specified number of bits

NDIS(P)

These instructions separate each bit of the data in the device numbers specified by (s1) onwards into bit units specified by (s2), and store the separated data in the device number specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=NDIS(EN,s1,s2,d); ENO:=NDISP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

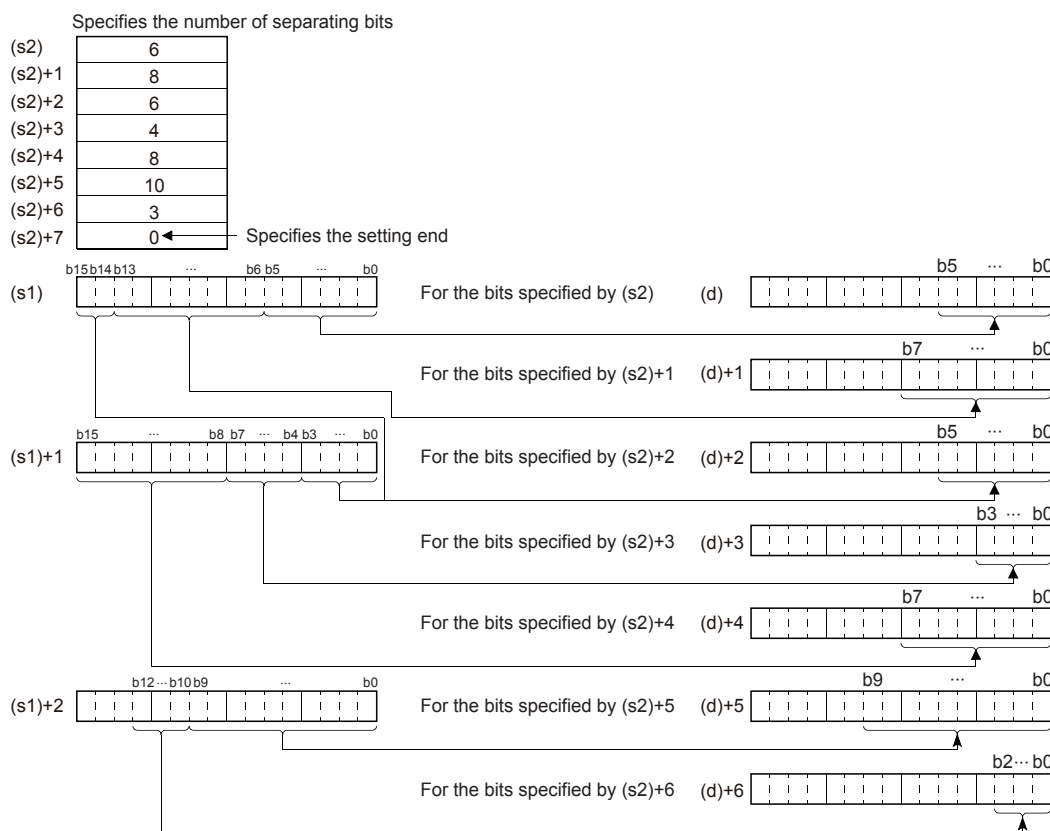
Operand	Description	Range	Data type	Data type (label)
(s1)	Head device for storing the data to be separated	—	16-bit signed binary	ANY16
(d)	Head device for storing the separated data	—	16-bit signed binary	ANY16
(s2)	Head device for storing the separation unit	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—

Processing details

- These instructions separate each bit of the data in the device numbers specified by (s1) and later into bit units specified by (s2), and store the separated data in the device numbers starting from the one specified by (d).



- The number of separation bits specified by (s2) can be specified within the range of 1 to 16 bits.
- The number of bits specified in devices from the device number specified by (s2) up to the device number in which "0" is stored are processed as the number of separation bits.
- If the device numbers specified by (s1), (s2), (d) are partially overlapping, an operation error occurs.

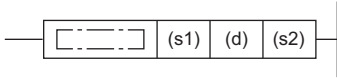
Operation error

Error code (SD0/SD8067)	Description
2820	The usage range of the device specified by (s1) or (d) exceeds the corresponding device range due to the specification of the number of separation bits specified by (s2).
2821	The (s1), (s2) devices are overlapping.
	The (s1), (d) devices are overlapping.
	The (s2), (d) devices are overlapping.
3401	The specification of the number of separation bits specified by (s2) is not set within the range of 1 to 16 bits.
	0 is not set in the range between the device specified by (s2) up to the corresponding device range.

Connecting the specified number of bits

NUNI(P)

These instructions link each bit of the data in the device numbers specified by (s1) onwards into bit units specified by (s2), and store the connected data in the device number specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=NUNI(EN,s1,s2,d); ENO:=NUNIP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

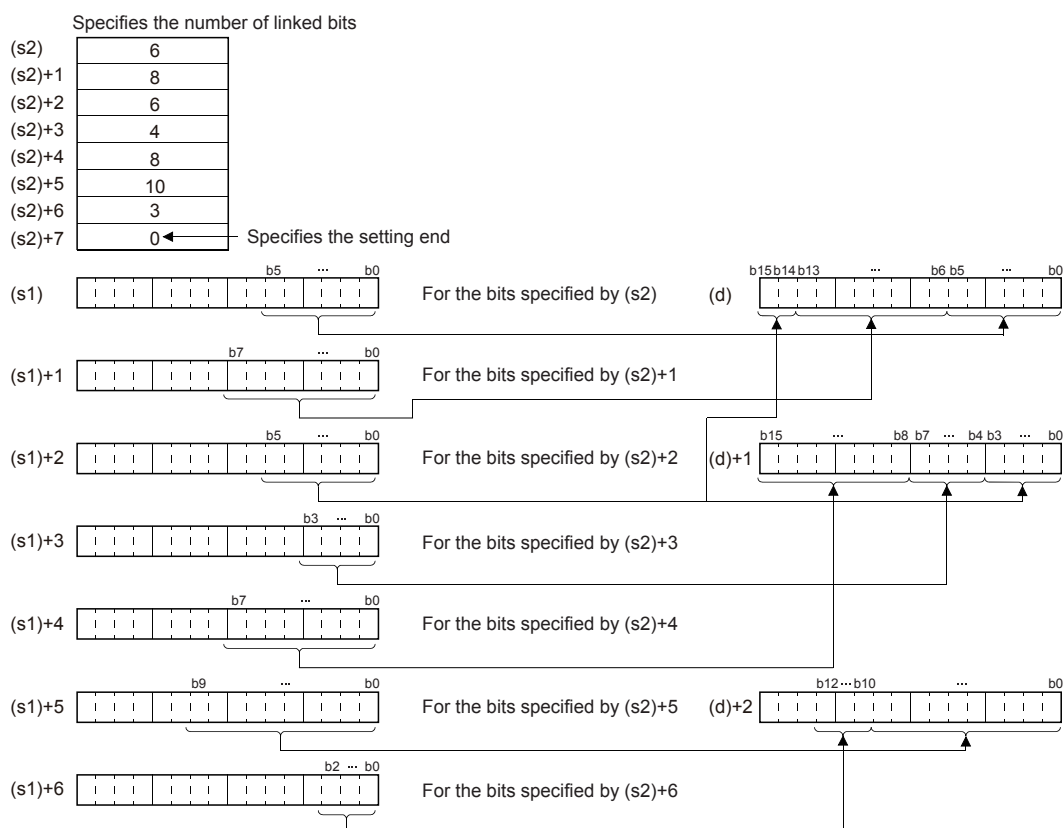
Operand	Description	Range	Data type	Data type (label)
(s1)	Head device for storing the data to be linked	—	16-bit signed binary	ANY16
(d)	Head device for storing the linked data	—	16-bit signed binary	ANY16
(s2)	Head device for storing the link unit size	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—

Processing details

- These instructions link each bit of the data in the device numbers specified by (s1) onwards into bit units specified by (s2), and store the linked data in the device number specified by (d).



- The number of link bits specified by (s2) can be specified within the range of 1 to 16 bits.
- The number of bits specified in devices from the device number specified by (s2) up to the device number in which "0" is stored are processed as the number of connection bits.
- If the device numbers specified by (s1), (s2), (d) are partially overlapping, an operation error occurs.

Operation error

Error code (SD0/SD8067)	Description
2820	The usage range of the device specified by (s1) or (d) exceeds the corresponding device range due to the specification of the number of link bits specified by (s2).
2821	The (s1), (s2) devices are overlapping.
	The (s1), (d) devices are overlapping.
	The (s2), (d) devices are overlapping.
3401	The specification of the number of link bits specified by (s2) is not set within the range of 1 to 16 bits.
	0 is not set in the range between the device specified by (s2) up to the corresponding device range.

Separating data in byte units

WTOB(P)

These instructions separate the 16-bit binary data in the device numbers starting from the one specified by (s) onwards into (n) byte units, and store the separated data in the device number specified by (d) onwards.

Ladder diagram	Structured text
	<pre>ENO:=WTOB(EN,s,n,d); ENO:=WTOBP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

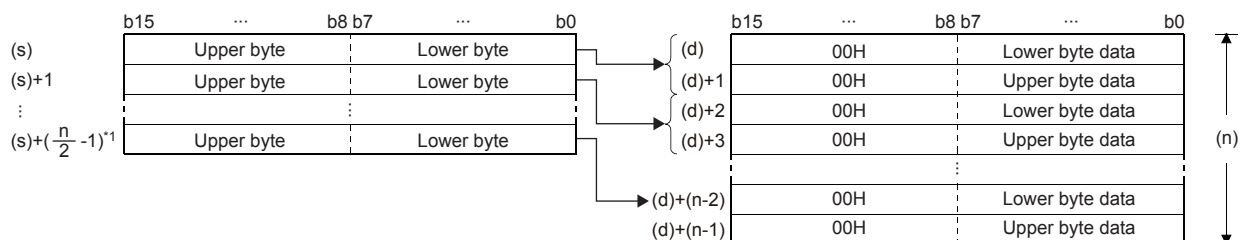
Operand	Description	Range	Data type	Data type (label)
(s)	Head device where the separation target data is stored	—	16-bit signed binary	ANY16
(d)	Head device for storing the result of separation in byte unit	—	16-bit signed binary	ANY16
(n)	Number of byte units	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

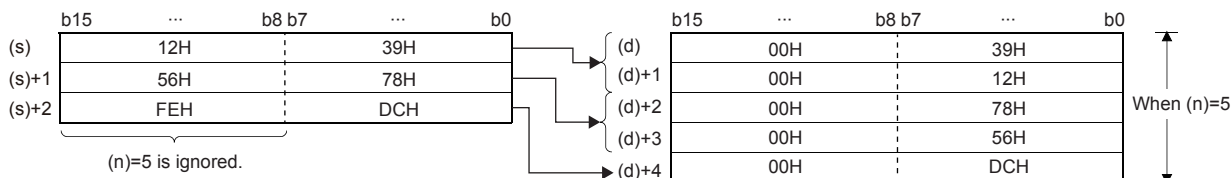
- These instructions separate the 16-bit binary data in the device numbers starting from the one specified by (s) onwards into (n) byte units, and store the separated data in the device number specified by (d) onwards.



*1 Values after the decimal point are rounded up.

Ex.

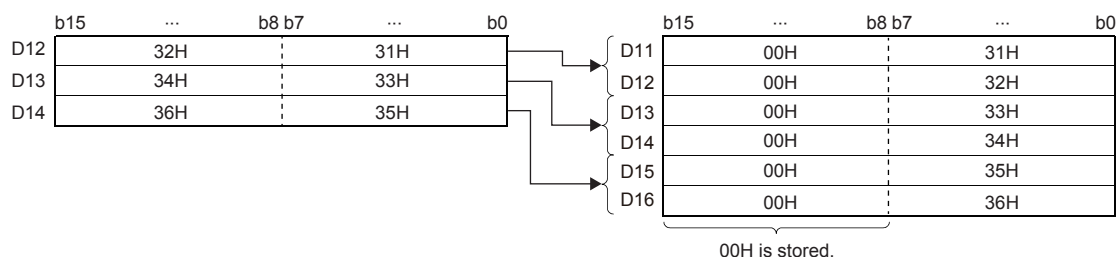
For example, when (n) is 5, data starting from (s) to the lower 8 bits of (s)+2 is stored into (d) through (d)+4.



- Setting the number of bytes by (n) automatically determines the 16-bit binary data range specified by (s) and the device range specified by (d) for storing the separated byte data.
- If (n) is 0, no processing is performed.
- In the upper byte of the devices specified by (d) to hold byte data, 00Hs are automatically stored.

Ex.

To store data in D12 to D14 into the lower 8 bits of D11 to D16



- Even if the device range of the data to be separated and the device range for storing the separated data overlap, the processing is performed normally.

Device range where the data to be separated is stored	Device range for storing the separated data
(s) to (s)+($\frac{n}{2}$ -1)	(d)+0 to (d)+(n)-1

Operation error

Error code (SD0/SD8067)	Description
2820	The range of no. of bytes specified in (n) from the device number specified in (s) onwards exceed the corresponding device range.
	The range of (n) points of devices from the device number specified in (d) onwards exceed the corresponding device range.

Connecting data in byte units

BTOW(P)

These instructions link the lower-order 8 bits of the 16-bit binary data of (n) number of bytes stored in the device numbers starting from the one specified by (s) onwards into word units, and store the linked data in the device numbers starting from the one specified by (d) onwards.

Ladder diagram	Structured text
	ENO:=BTOW(EN,s,n,d); ENO:=BTOWP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

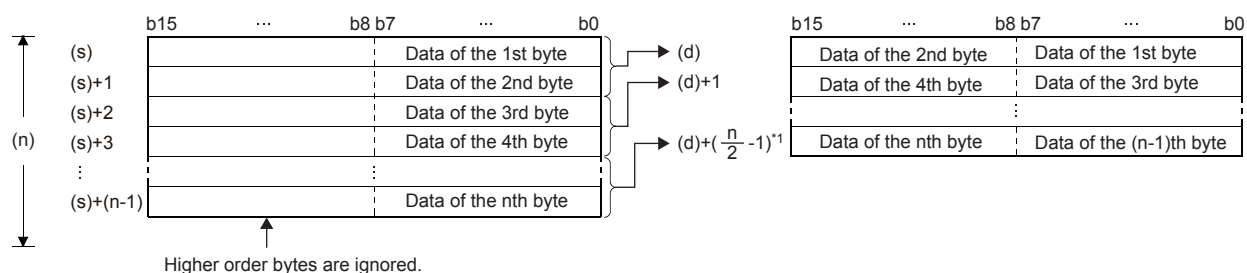
Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the data to be linked in byte units	—	16-bit signed binary	ANY16
(d)	Head device storing data acquired by combination in byte units	—	16-bit signed binary	ANY16
(n)	Number of byte data to be linked	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

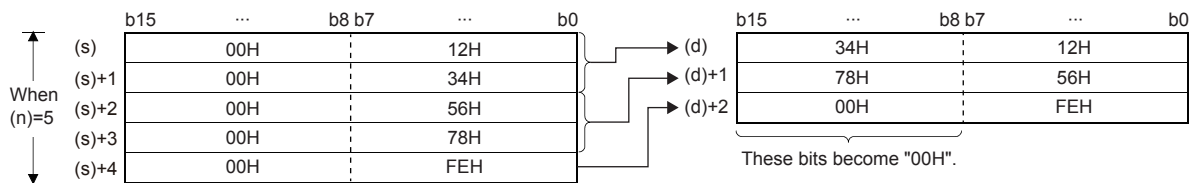
- These instructions link the lower-order 8 bits of the 16-bit binary data of (n) number of bytes stored in the device numbers starting from the one specified by (s) onwards, and store the linked data in the device numbers starting from the one specified by (d) onwards.
- The higher-order 8 bits of the data of (n) words stored in device numbers starting from the one specified by (s) are ignored. If (n) is an odd number, 0 is stored in the higher-order 8 bits of the device for storing the data of the (n)th byte.



*1 Values after the decimal point are rounded up.

Ex.

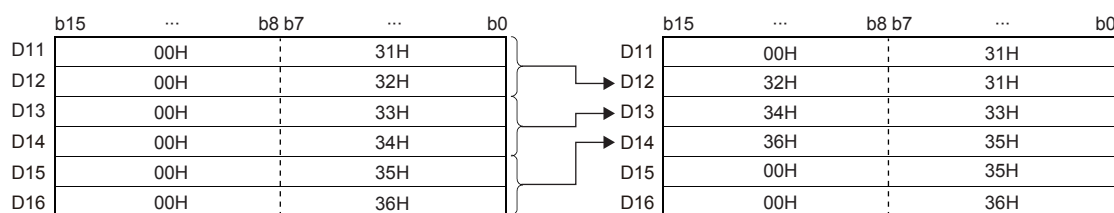
For example, when (n) is 5, lower 8 bits of data from (s) through (s)+4 is stored into (d) through (d)+2.



- Setting the number of bytes by (n) automatically determines the byte data range specified by (s) and the device range specified by (d) for storing the linked data.
- If (n) is 0, no processing is performed.
- The higher-order 8 bits of the device specified by (s) for storing byte data are ignored, and only the lower-order 8 bits are applicable.

Ex.

To store data in lower 8 bits of D11 to D16 into D12 to D14



- Even if the device range of the data to be linked and the device range for storing the linked data overlap, the processing is performed normally.

Device range where the data to be linked is stored	Device range for storing the linked data
(s)+0 to (s)+(n)-1	(d) to (d)+($\frac{n}{2}$)-1)

Operation error

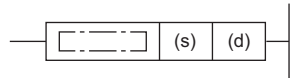
Error code (SD0/SD8067)	Description
2820	The range of (n) points of devices from the device number specified in (s) onwards exceed the corresponding device range.
	The range of no. of bytes specified in (n) from the device number specified in (d) onwards exceed the corresponding device range.

6.6 Data Transfer Instructions

Transferring 16-bit data

MOV(P)

These instructions transfer the 16-bit binary data in the device specified by (s) to the device specified by (d).

Ladder diagram	Structured text
	ENO:=MOV(EN,s,d); ENO:=MOV(P)(EN,s,d);

Setting data

■Descriptions, ranges, and data types

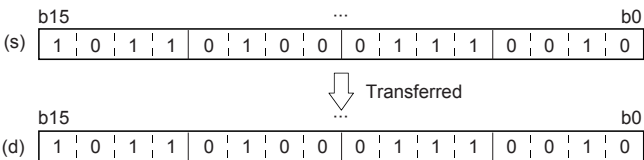
Operand	Description	Range	Data type	Data type (label)
(s)	Transfer source data or device number for storing data	-32768 to +32767	16-bit signed binary	ANY16
(d)	Transfer destination device number	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions transfer the 16-bit binary data in the device specified by (s) to the device specified by (d).



Operation error

There is no operation error.

Transferring 32-bit data

DMOV(P)

These instructions transfer the 32-bit binary data in the device specified by (s) to the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DMOV(EN,s,d); ENO:=DMOVP(EN,s,d)</pre>

Setting data

■Descriptions, ranges, and data types

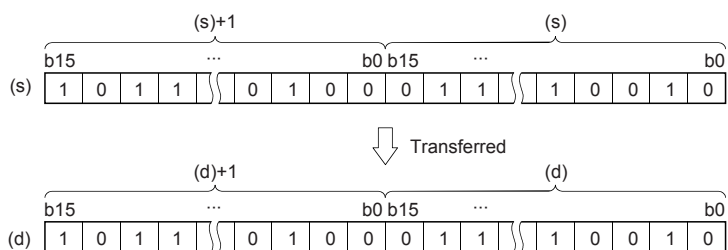
Operand	Description	Range	Data type	Data type (label)
(s)	Transfer source data or device number for storing data	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Transfer destination device number	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—	—

Processing details

- These instructions transfer the 32-bit binary data in the device specified by (s) to the device specified by (d).



Operation error

There is no operation error.

Inverting and transferring 16-bit data

CML(P)

These instructions invert each bit of the 16-bit binary data in the device specified by (s), and transfer the result to the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=CML(EN,s,d); ENO:=CMLP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

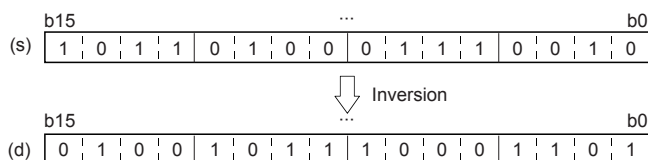
Operand	Description	Range	Data type	Data type (label)
(s)	Data to be inverted or device number in which data is stored	-32768 to +32767	16-bit signed binary	ANY16
(d)	Device number for storing the inversion result	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions invert each bit of the 16-bit binary data in the device specified by (s), and transfer the result to the device specified by (d).



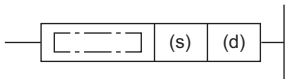
Operation error

There is no operation error.

Inverting and transferring 32-bit data

DCML(P)

These instructions invert each bit of the 32-bit binary data in the device specified by (s), and transfer the result to the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DCML(EN,s,d); ENO:=DCMLP(EN,s,d);</pre>

Setting data

■ Descriptions, ranges, and data types

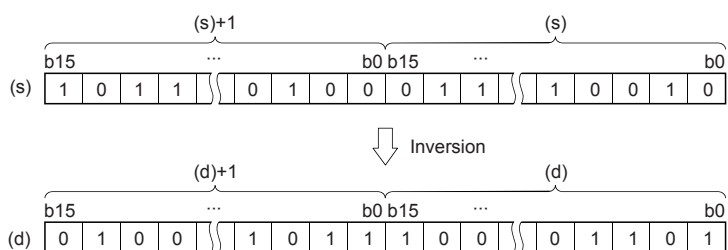
Operand	Description	Range	Data type	Data type (label)
(s)	Data to be inverted or device number in which data is stored	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Device number for storing the inversion result	—	32-bit signed binary	ANY32

■ Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions invert each bit of the 32-bit binary data in the device specified by (s), and store the result in the device specified by (d).



Operation error

There is no operation error.

Digit move

SMOV(P)

These instructions distribute and compose data in units of nibble (4 bits).

Ladder diagram	Structured text
	<pre>ENO:=SMOV(EN,s,m1,m2,n,d); ENO:=SMOVP(EN,s,m1,m2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Word device number storing data whose nibbles will be moved	—	16-bit signed binary	ANY16
(m1)*1	Head nibble position to be moved	1 to 4	16-bit unsigned binary	ANY16_U
(m2)*1	Number of nibbles to be moved	1 to 4	16-bit unsigned binary	ANY16_U
(d)	Word device number storing data whose nibbles are moved	—	16-bit signed binary	ANY16
(n)*1	Head digit position of movement destination	1 to 4	16-bit unsigned binary	ANY16_U

*1 Set so that $m2 \leq m1$, $m2 \leq n$.

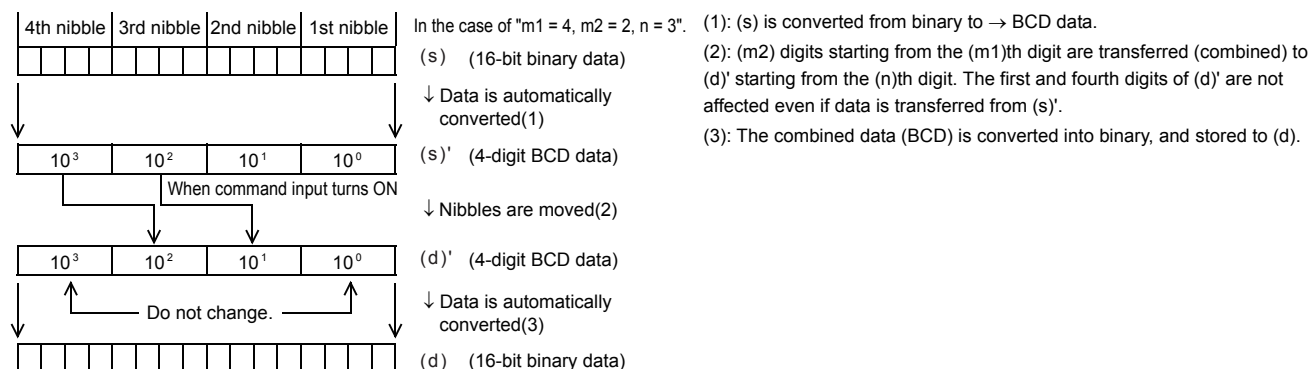
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	—	—	—	—
(m1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(m2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

These instructions distribute and compose data in units of nibble (4 bits). The contents of the transfer source (s) and transfer destination (d) are converted into 4-digit BCD (0000 to 9999). (m2) nibbles starting from the (m1)th nibble are transferred to the transfer destination (d) starting from the (n)th nibble, converted into binary, and then stored to the transfer destination (d).

- While the command input is OFF, the transfer destination (d) does not change.
- When the command input turns ON, only the specified digits in the transfer destination (d) are changed. The transfer source (s) and unspecified digits in the transfer destination (d) do not change.



■Extension function

When SM8168 is set to ON first and then SMOV instruction is executed, conversion from binary to BCD is not executed. Data is moved in units of 4 bits.

Operation error

Error code (SD0/SD8067)	Description
3405	Any one of (m1), (m2), (n) is 0.
	Either (s) or (d) is other than 0 to 9999 when SM8168 is OFF.
	Either (m1) or (n) is larger than 4.
	(m2) is larger than (m1) or (n).

Inverting and transferring 1-bit data

CMLB(P)

These instructions invert the bit data in the device specified by (s), and transfer the result into the device specified by (d).

Ladder diagram	Structured text
	ENO:=CMLB(EN,s,d); ENO:=CMLBP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Transfer-source data	—	Bit	ANY_BOOL
(d)	Transfer-destination data	—	Bit	ANY_BOOL

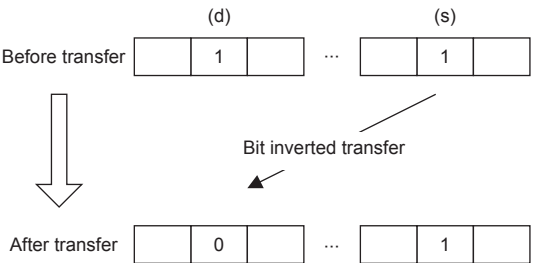
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	○	○	○*1	—	—	—	—	—	—	—	—	—
(d)	○	○	○	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

These instructions invert the bit data in the device specified by (s), and transfer the result in the device specified by (d).



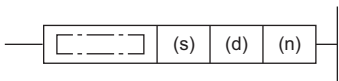
Operation error

There is no operation error.

Transferring 16-bit block data (65535 points maximum)

BMOV(P)

These instructions block transfer the 16-bit binary data of (n) number of devices starting from the one specified by (s) to the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=BMOV(EN,s,n,d); ENO:=BMOV(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

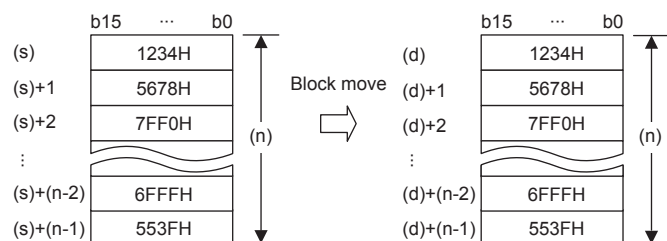
Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the data to be transferred	—	16-bit signed binary/ 32-bit signed binary	ANY16
(d)	Head number of the transfer-destination device	—	16-bit signed binary/ 32-bit signed binary	ANY16
(n)	Number of transfers	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	—	○	—	○	—	—	—	—
(d)	○	—	—	○	○	—	○	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions block transfer the 16-bit binary data of (n) number of devices starting from the one specified by (s) to the device specified by (d).



- If the device number range is exceeded, data is transferred within the possible range.
- Data can be transferred even when the device range of the transfer-source device and transfer-destination device is overlapping. To transfer data to a device having a smaller device number, transfer from (s), and to transfer data to a device having a larger device number, transfer from (s)+(n)-1.

Ex.

When transferring data to a device having a smaller device number



When transferring data to a device having a larger device number



Precautions

- To perform nibble specification of bit device for both (s) and (d), be sure to set the same number of nibbles for (s) and (d).
- To use a module access device for (s) and (d), specify either (s) or (d).

Operation error

Error code (SD0/SD8067)	Description
3405	The number of nibbles of the nibble specification of bit device of (s) and (d) is different.
3420	A module access device is specified for both (s) and (d).

Transferring identical 16-bit block data (65535 points maximum)

FMOV(P)

These instructions transfer (n) point(s) of data identical to the 16-bit binary data in the device specified by (s) to the devices specified by (d).

Ladder diagram	Structured text
	ENO:=FMOV(EN,s,n,d); ENO:=FMOV(P)(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

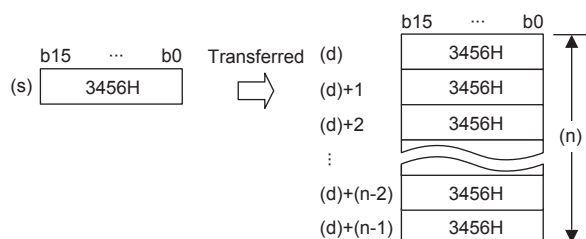
Operand	Description	Range	Data type	Data type (label)
(s)	Data to be transferred or the head device for storing the data to be transferred	-32748 to +32767	16-bit signed binary	ANY16
(d)	Head device of the transfer-destination	—	16-bit signed binary	ANY16
(n)	Number of transfers	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions transfer (n) point(s) of data identical to the 16-bit binary data in the device specified by (s) to the device specified by (d).



- If the number of points specified by (n) exceeds the device number range, data is transferred within the possible range.
- When a constant (K) is specified as the transfer source (s), it is automatically converted into binary.

Precautions

When the value specified in (n) is 0, an operation error does not occur, but no processing is performed,

Operation error

There is no operation error.

Transferring identical 32-bit block data (65535 points maximum)

DFMOV(P)

These instructions transfer (n) point(s) of data identical to the 32-bit binary data in the device specified by (s) to the devices specified by (d).

(65535 points maximum)

Ladder diagram	Structured text
	ENO:=DFMOV(EN,s,n,d); ENO:=DFMOV(P)(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

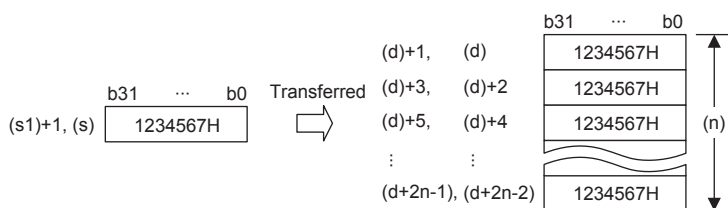
Operand	Description	Range	Data type	Data type (label)
(s)	Data to be transferred or the head device for storing the data to be transferred	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device of the transfer-destination	—	32-bit signed binary	ANY32
(n)	Number of transfers	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	—	○	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions transfer (n) point(s) of data identical to the 32-bit binary data in the device specified by (s) to the device specified by (d).



- If the number of points specified by (n) exceeds the device number range, data is transferred within the possible range.
- When a constant (K) is specified as the transfer source (s), it is automatically converted into binary.

Precautions

When the value specified in (n) is 0, an operation error does not occur, but no processing is performed,

Operation error

There is no operation error.

Exchanging 16-bit data

XCH(P)

These instructions exchange 16-bit binary data of (d1) and (d2).

Ladder diagram	Structured text
	<pre>ENO:=XCH(EN,d1,d2); ENO:=XCHP(EN,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

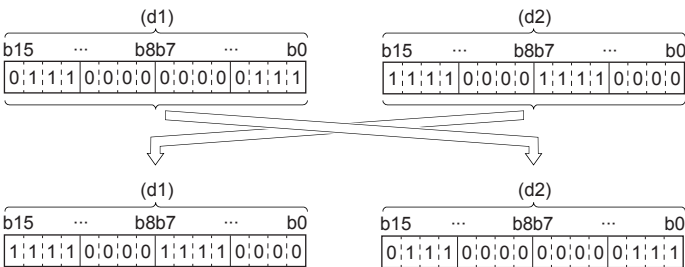
Operand	Description	Range	Data type	Data type (label)
(d1)	Head device for storing the data to be exchanged	—	16-bit signed binary	ANY16
(d2)	Head device for storing the data to be exchanged	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d1)	○	—	—	○	○	○	—	—	○	—	—	—	—
(d2)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

These instructions exchange 16-bit binary data of (d1) and (d2).



Operation error

There is no operation error.

Exchanging 32-bit data

DXCH(P)

These instructions exchange 32-bit binary data of (d1) and (d2).

Ladder diagram	Structured text
	ENO:=DXCH(EN,d1,d2); ENO:=DXCHP(EN,d1,d2);

Setting data

■Descriptions, ranges, and data types

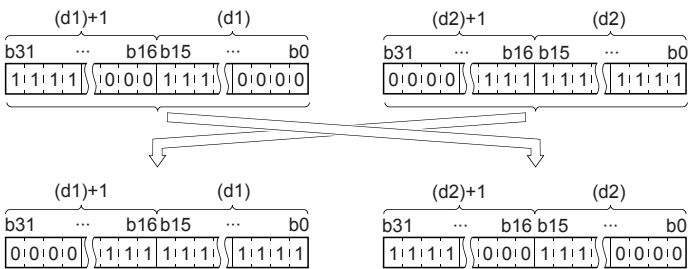
Operand	Description	Range	Data type	Data type (label)
(d1)	Head device for storing the data to be exchanged	—	32-bit signed binary	ANY32
(d2)	Head device for storing the data to be exchanged	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d1)	○	—	—	○	○	○	○	○	○	—	—	—	—
(d2)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

These instructions exchange 32-bit binary data of (d1), (d1)+1 and (d2), (d2)+1



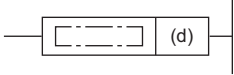
Operation error

There is no operation error.

Exchanging the upper and lower bytes of 16-bit data

SWAP(P)

These instructions swap the value of 8 bits of the upper and lower bytes of the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=SWAP(EN,d); ENO:=SWAPP(EN,d);</pre>

Setting data

■Descriptions, ranges, and data types

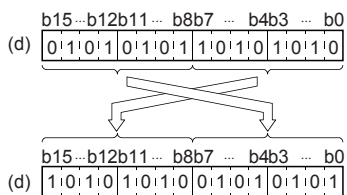
Operand	Description	Range	Data type	Data type (label)
(d)	Head device for storing the data to be swapped	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—	—

Processing details

These instructions swap the value of 8 bits of the upper and lower bytes of the device specified by (d).



Precautions

If a continuous operation type instruction is used, swap is done in each operation cycle.

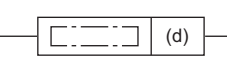
Operation error

There is no operation error.

Exchanging the upper and lower bytes of 32-bit data

DSWAP(P)

These instructions swap the value of 8 bits of the upper and lower bytes of the word devices specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DSWAP(EN,d); ENO:=DSWAPP(EN,d);</pre>

Setting data

■Descriptions, ranges, and data types

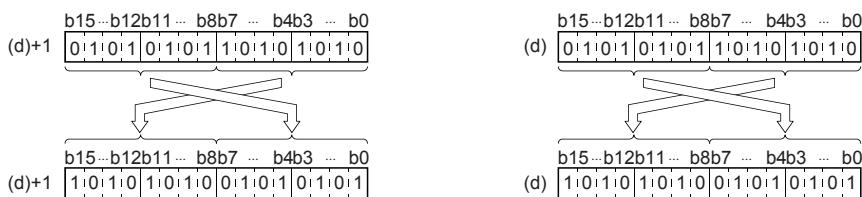
Operand	Description	Range	Data type	Data type (label)
(d)	Head device for storing the data to be swapped	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—	

Processing details

These instructions swap the value of each of the upper and lower 8 bits of the device specified by (d) and (d)+1.



Precautions

If a continuous operation type instruction is used, swap is done in each operation cycle.

Operation error

There is no operation error.

Transferring 1-bit data

MOVB(P)

These instructions store bit data specified by (s) to (d).

Ladder diagram	Structured text
	ENO:=MOVB(EN,s,d); ENO:=MOVBP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the transfer-source data	—	Bit	ANY_BOOL
(d)	Head device for storing the transfer-destination data	—	Bit	ANY_BOOL

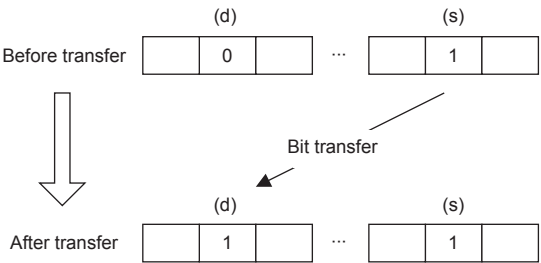
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	○	○	○*1	—	—	—	—	—	—	—	—	—
(d)	○	○	○	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions transfer bit data specified by (s) to (d).



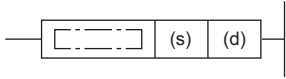
Operation error

There is no operation error.

Transferring octal bits (16-bit data)

PRUN(P)

These instructions handle the device number of (s) and (d) with nibble specification as octal numbers, and transfer data.

Ladder diagram	Structured text
	ENO:=PRUN(EN,s,d); ENO:=PRUNP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Nibble specification*1	—	16-bit signed binary	ANY16
(d)	Device number of transfer destination*1	—	16-bit signed binary	ANY16

*1 Make sure that the least significant digit of a specified device number is "0".

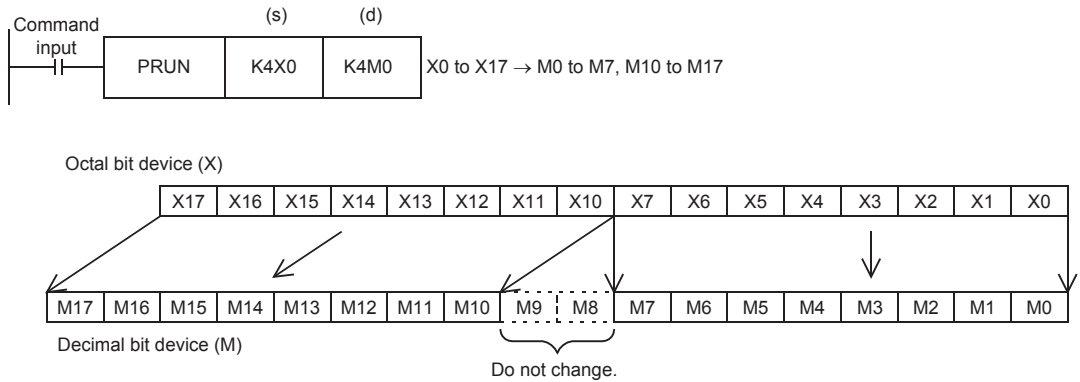
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○*1	—	—	—	—	—	—	—	○	—	—	—	—
(d)	○*1	—	—	—	—	—	—	—	○	—	—	—	—

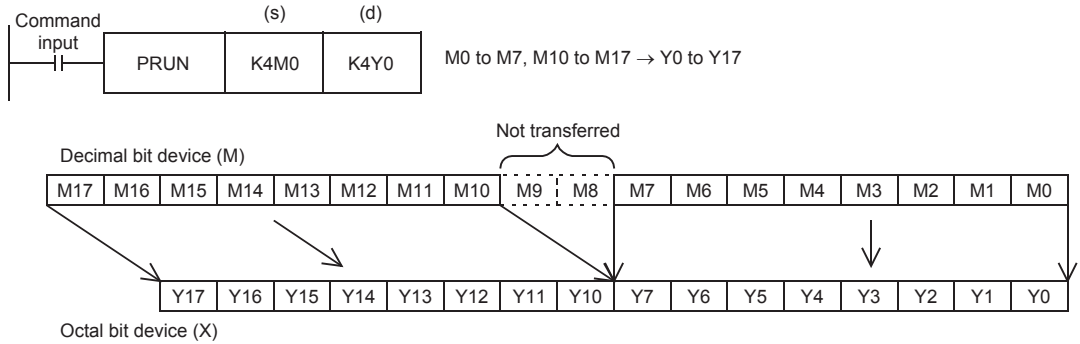
*1 B, SB cannot be used.

Processing details

- Octal bit device → Decimal bit device



- Decimal bit device → Octal bit device



Operation error

Error code (SD0/SD8067)	Description
2820	The devices specified by (s) and (d) exceed the range of the corresponding device.

Transferring octal bits (32-bit data)

DPRUN(P)

These instructions handle the device number of (s) and (d) with nibble specification as octal numbers, and transfer data.

Ladder diagram	Structured text
	<pre>ENO:=DPRUN(EN,s,d); ENO:=DPRUNP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Nibble specification*1	—	32-bit signed binary	ANY32
(d)	Device number of transfer destination*1	—	32-bit signed binary	ANY32

*1 Make sure that the least significant digit of a specified device number is "0".

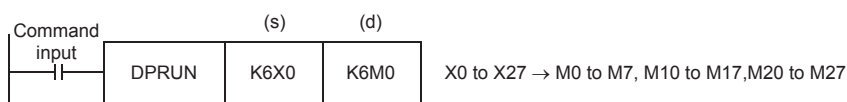
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○*1	—	—	—	—	—	—	—	○	—	—	—	—
(d)	○*1	—	—	—	—	—	—	—	○	—	—	—	—

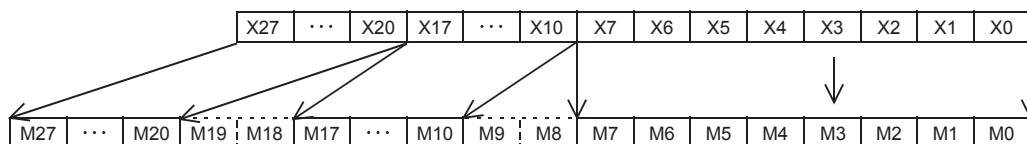
*1 B, SB cannot be used.

Processing details

- Octal bit device → Decimal bit device



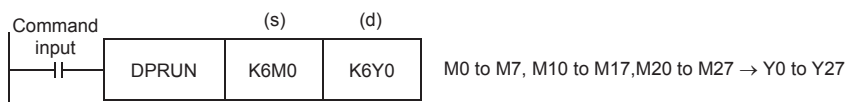
Octal bit device (X)



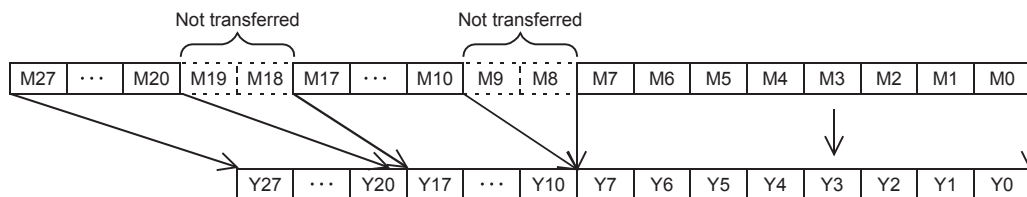
Do not change.

Decimal bit device (M)

- Decimal bit device → Octal bit device



Decimal bit device (M)



Octal bit device (Y)

Operation error

Error code (SD0/SD8067)	Description
2820	The devices specified by (s) and (d) exceed the range of the corresponding device.

Transferring n-bit data

BLKMOVB(P)

These instructions block transfer the bit data of (n) point(s) from the device specified by (s) to the bit data of (n) point(s) from (d).

Ladder diagram	Structured text
	<pre>ENO:=BLKMOVB(EN,s,n,d); ENO:=BLKMOVBP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device for storing the transfer-source bit data	—	Bit	ANY_BOOL
(d)	Head device for storing the transfer-destination bit data	—	Bit	ANY_BOOL
(n)	Number of transfers	0 to 65535	16-bit unsigned binary	ANY16

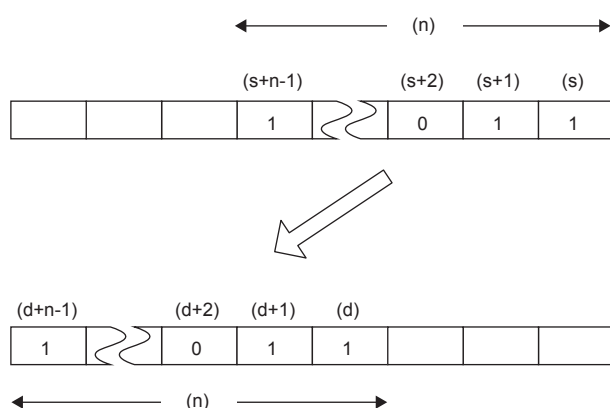
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions block transfer the bit data of (n) point(s) from the device specified by (s) to the bit data of (n) point(s) from the device specified by (d).
- Data can be transferred even when the device range of the transfer-source device and transfer-destination device is overlapping.



Operation error

Error code (SD0/SD8067)	Description
2820	The range of (n) point(s) of data starting from the device specified by (s) and (d) exceed the corresponding device range.

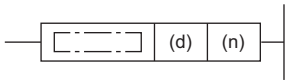
7 APPLICATION INSTRUCTION

7.1 Rotation Instruction


Rotating 16-bit data to the right

ROR(P), RCR(P)

- ROR(P): These instructions rotate the 16-bit binary data in the device specified by (d) to the right by (n) bit(s) (not including the carry flag).
- RCR(P): These instructions rotate the 16-bit binary data in the device specified by (d) to the right by (n) bit(s) (including the carry flag).

Ladder diagram	Structured text ^{*1}
	ENO:=RORP(EN,n,d); ENO:=RCR(EN,n,d); ENO:=RCRP(EN,n,d);

^{*1} The ROR instruction is not supported by the ST language. Use ROR of the standard function.

 Page 797 ROR(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number where the rotation target data is stored	—	16-bit signed binary	ANY16
(n)	Number of rotations	0 to 15	16-bit unsigned binary	ANY16

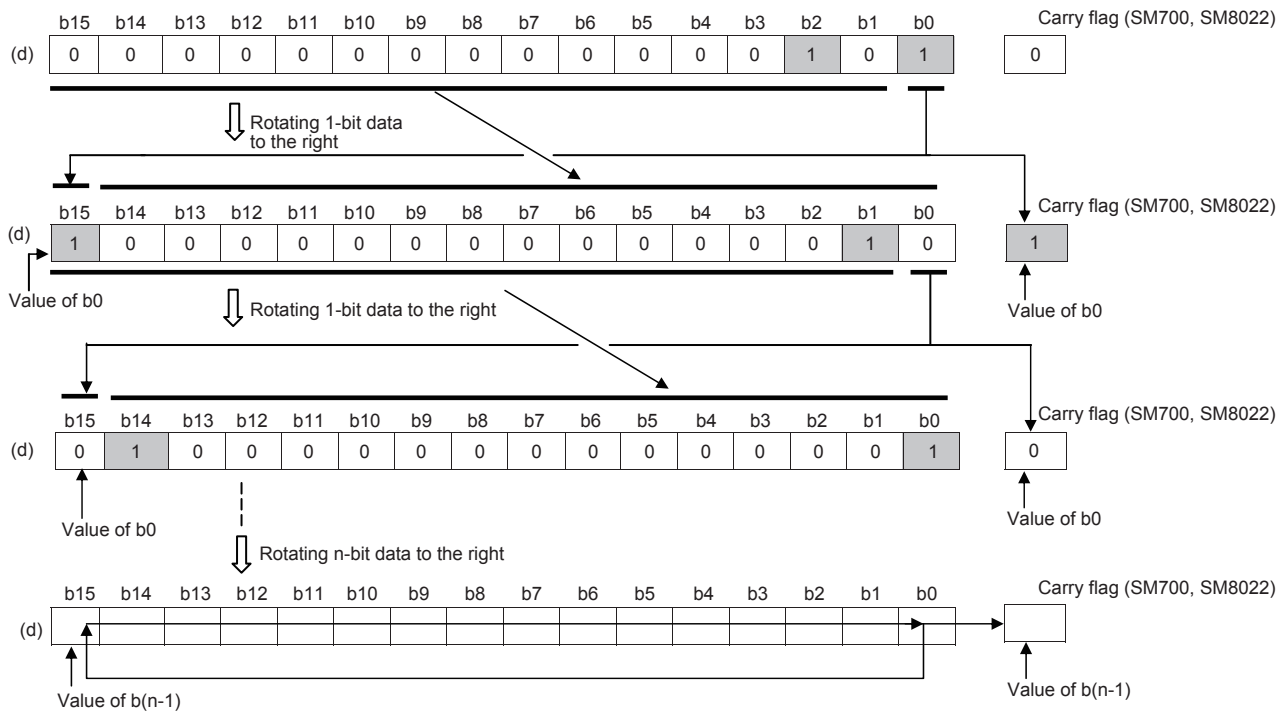
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K	H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—	—

Processing details

■ROR(P)

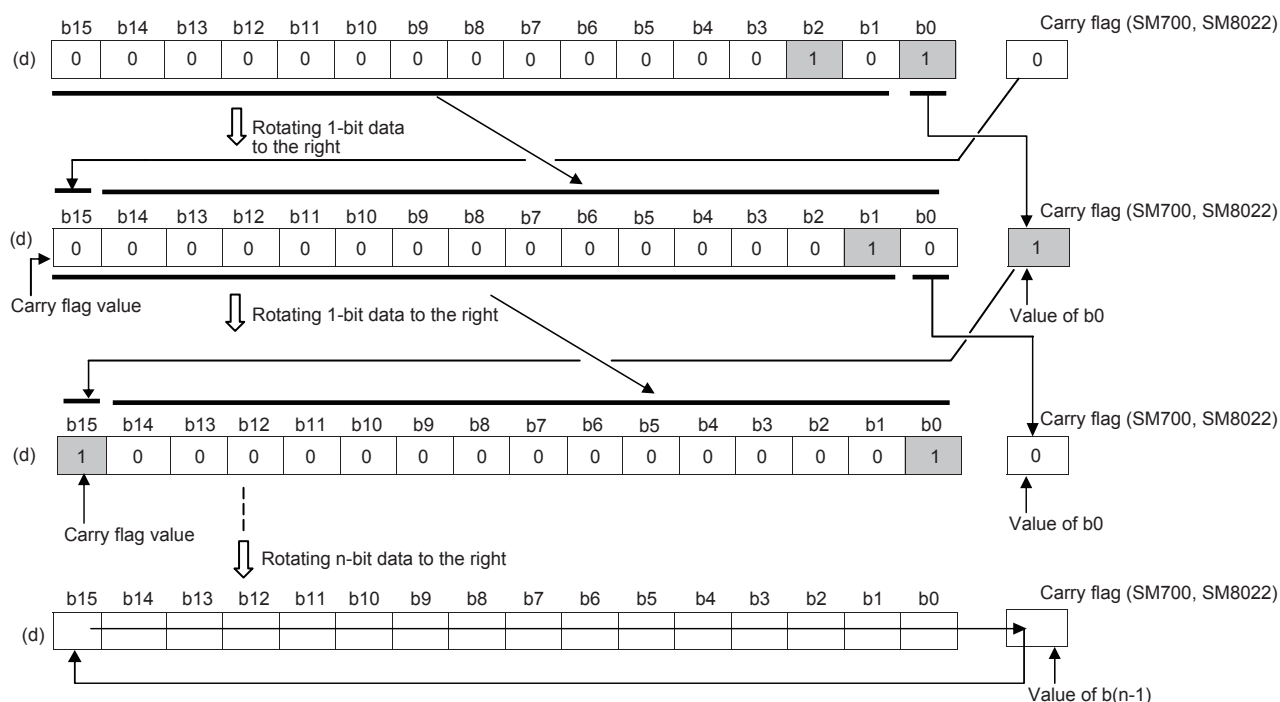
- These instructions rotate the 16-bit binary data in the device specified by (d) to the right by (n) bit(s) (not including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of $(n) \div (\text{specified number of bits})$. For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of $n \div 16$. For example, when (n) is 18, 2 bits are rotated because 18 divided by 16 equals 1 with a remainder of 2.

■RCR(P)

- These instructions rotate the 16-bit binary data in the device specified by (d) to the right by (n) bit(s) (including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of $(n) \div (\text{specified number of bits})$. For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of $n \div 16$. For example, when (n) is 18, 2 bits are rotated because 18 divided by 16 equals 1 with a remainder of 2.

Precautions

- Do not set a negative value to the number of bits to be rotated (n).
- In the case of continuous operation type instructions (ROR and RCR), note that shift and rotation are executed in every scan time (operation cycle).

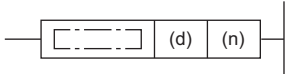
Operation error

There is no operation error.


Rotating 16-bit data to the left

ROL(P), RCL(P)

- ROL(P): These instructions rotate the 16-bit binary data in the device specified by (d) to the left by (n) bit(s) (not including the carry flag).
- RCL(P): These instructions rotate the 16-bit binary data in the device specified by (d) to the left by (n) bit(s) (including the carry flag).

Ladder diagram	Structured text ^{*1}
	ENO:=ROLP(EN,n,d); ENO:=RCL(EN,n,d); ENO:=RCLP(EN,n,d);

*1 The ROL instruction is not supported by the ST language. Use ROL of the standard function.

 Page 795 ROL(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number where the rotation target data is stored	—	16-bit signed binary	ANY16
(n)	Number of rotations	0 to 15	16-bit unsigned binary	ANY16

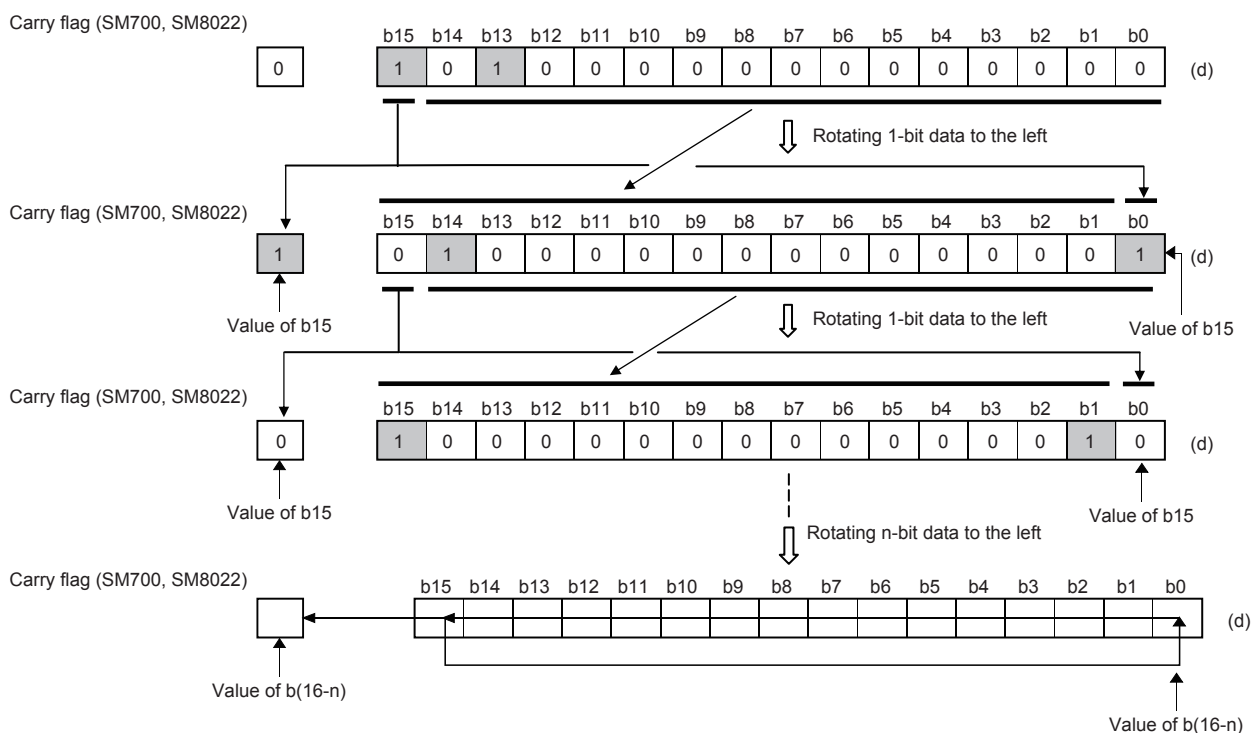
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

■ROL(P)

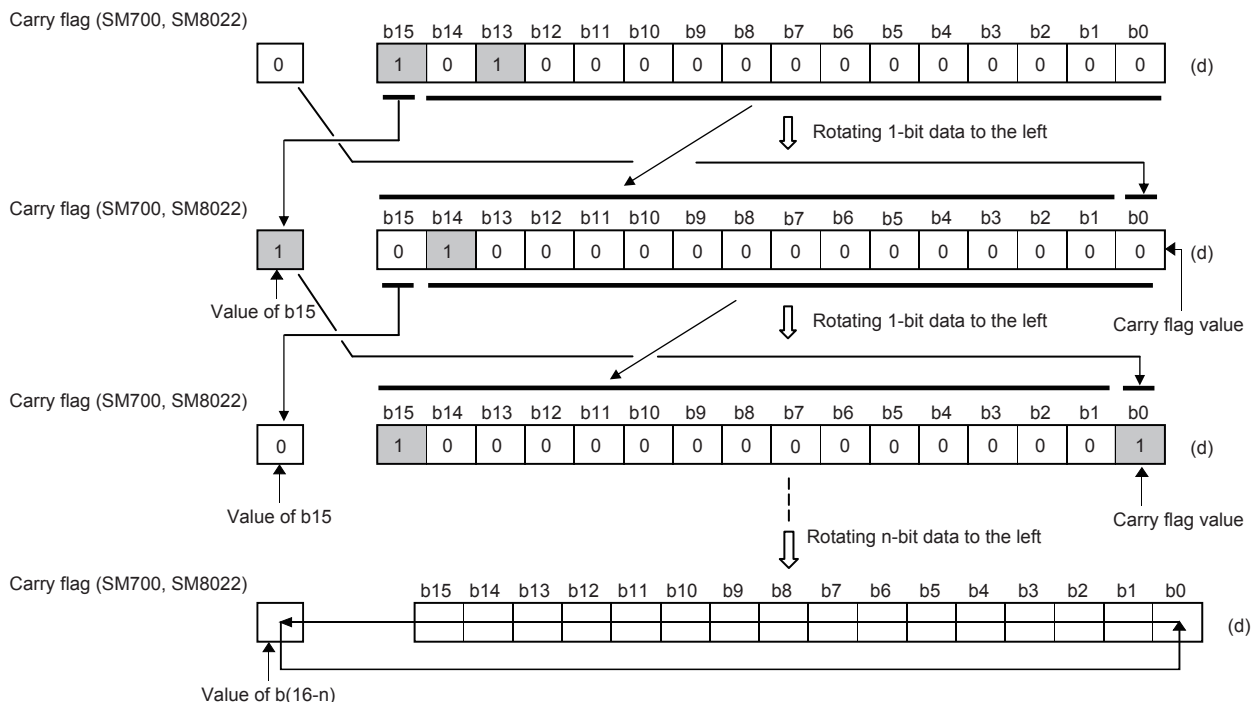
- These instructions rotate the 16-bit binary data in the device specified by (d) to the left by (n) bit(s) (not including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of $(n) \div (\text{specified number of bits})$. For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of $n \div 16$. For example, when (n) is 18, 2 bits are rotated because 18 divided by 16 equals 1 with a remainder of 2.

■ RCL(P)

- These instructions rotate the 16-bit binary data in the device specified by (d) to the left by (n) bit(s) (including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of $(n) \div (\text{specified number of bits})$. For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of $n \div 16$. For example, when (n) is 18, 2 bits are rotated because 18 divided by 16 equals 1 with a remainder of 2.

Precautions

- Do not set a negative value to the number of bits to be rotated (n).
- In the case of continuous operation type instructions (ROL and RCL), note that shift and rotation are executed in every scan time (operation cycle).

Operation error

There is no operation error.

Rotating 32-bit data to the right

DROR(P), DRCR(P)

- DROR(P): These instructions rotate the 32-bit binary data in the device specified by (d) to the right by (n) bit(s) (not including the carry flag).
- DRCR(P): These instructions rotate the 32-bit binary data in the device specified by (d) to the right by (n) bit(s) (including the carry flag).

Ladder diagram	Structured text ^{*1}
	<pre>ENO:=DRORP(EN,n,d); ENO:=DRCR(EN,n,d); ENO:=DRCRP(EN,n,d);</pre>

*1 The DROR instruction is not supported by the ST language. Use ROR of the standard function.

Page 797 ROR(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number where the rotation target data is stored	—	32-bit signed binary	ANY32
(n)	Number of rotations	0 to 31	16-bit unsigned binary	ANY16

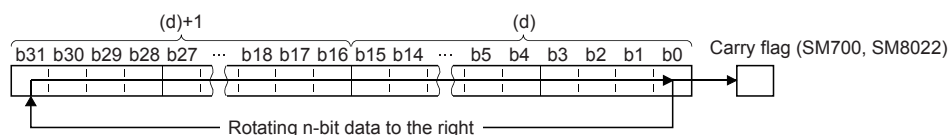
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

■DROR(P)

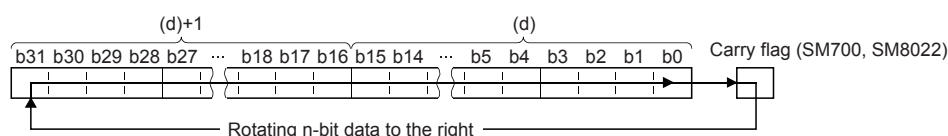
- These instructions rotate the 32-bit binary data in the device specified by (d) to the right by (n) bit(s) (not including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of (n)÷(specified number of bits). For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.
- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of n÷32. For example, when (n) is 34, 2 bits are rotated because 34 divided by 32 equals 1 with a remainder of 2.

■DRCR(P)

- These instructions rotate the 32-bit binary data in the device specified by (d) to the right by (n) bit(s) (including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of (n)÷(specified number of bits). For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.

- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of $n \div 32$. For example, when (n) is 34, 2 bits are rotated because 34 divided by 32 equals 1 with a remainder of 2.

Precautions

- Do not set a negative value to the number of bits to be rotated (n).
- In the case of continuous operation type instructions (DROR and DRCR), note that shift and rotation are executed in every scan time (operation cycle).

Operation error

There is no operation error.

Rotating 32-bit data to the left

DROL(P), DRCL(P)

- DROL(P): These instructions rotate the 32-bit binary data in the device specified by (d) to the left by (n) bit(s) (not including the carry flag).
- DRCL(P): These instructions rotate the 32-bit binary data in the device specified by (d) to the left by (n) bit(s) (including the carry flag).

Ladder diagram	Structured text ^{*1}
	ENO:=DROL(P,EN,n,d); ENO:=DRCL(P,EN,n,d); ENO:=DRCLP(P,EN,n,d);

^{*1} The DROL instruction is not supported by the ST language. Use ROL of the standard function.

Page 795 ROL(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number where the rotation target data is stored	—	32-bit signed binary	ANY32
(n)	Number of rotations	0 to 31	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□□□□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□□□□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

■DROL(P)

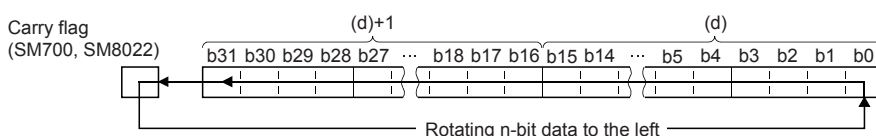
- These instructions rotate the 32-bit binary data in the device specified by (d) to the left by (n) bit(s) (not including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of (n)÷(specified number of bits). For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.
- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of n÷32. For example, when (n) is 34, 2 bits are rotated because 34 divided by 32 equals 1 with a remainder of 2.

■DRCL(P)

- These instructions rotate the 32-bit binary data in the device specified by (d) to the left by (n) bit(s) (including the carry flag). The carry flag is on or off depending on the status prior to the execution of the instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by nibble specification. The number of bits actually to be rotated is the remainder of (n)÷(specified number of bits). For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.

- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of $n \div 32$. For example, when (n) is 34, 2 bits are rotated because 34 divided by 32 equals 1 with a remainder of 2.

Precautions

- Do not set a negative value to the number of bits to be rotated (n).
- In the case of continuous operation type instructions (DROL and DRCL), note that shift and rotation are executed in every scan time (operation cycle).

Operation error

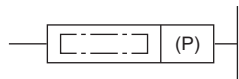
There is no operation error.

7.2 Program branch instruction

Pointer branch

CJ(P)

These instructions execute the program specified by the pointer number within the same program file when the jump command is on.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(P)	Pointer number of the jump destination	—	Device name	ANY16

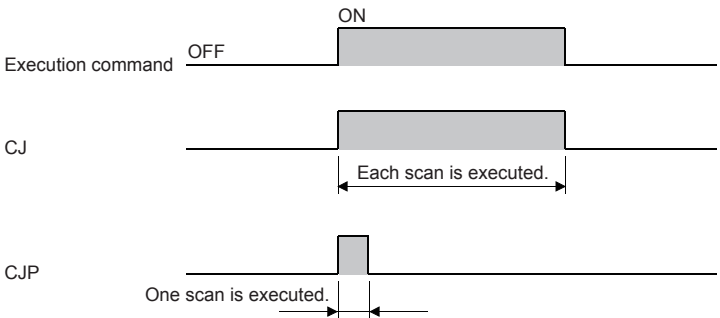
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(P)	—	—	—	—	—	—	—	—	—	—	—	—	○

Processing details

■CJ(P)

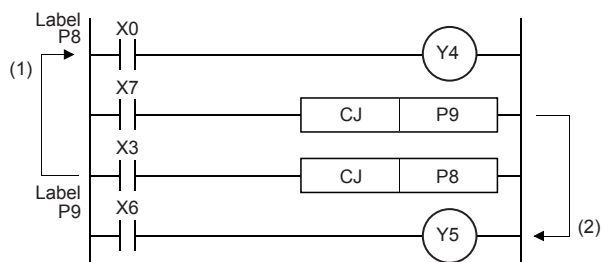
- These instructions execute the program specified by the pointer number when the execution command is on.
- When the execution command is off, the program in the next step is executed.



Precautions

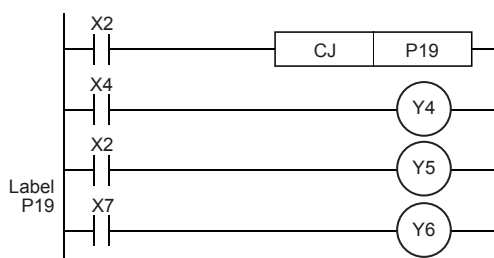
- If the timer with its coil on is skipped by these instructions, time cannot be measured correctly.
- If the OUT instruction is skipped by these instructions, the scan time will be shortened.
- If these instructions specify and jump to a later step, the scan time will be shortened.

- These instructions can specify and jump from the current step to a smaller step number. In this case, consider a method to exit a loop so that the watchdog timer does not time out.



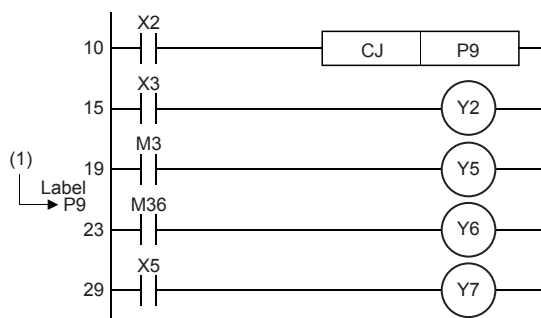
- (1) While X3 is on, the loop is repeated.
(2) To exit the loop, turn on X7.

- The value in the device skipped with these instructions remains the same.



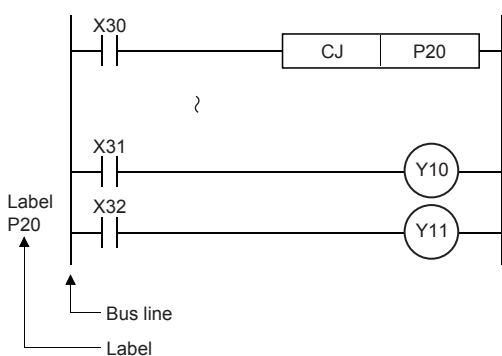
When X2 turns on, the program jumps to the label, P19.
Y4 and Y5 remain the same even if X2 and X4 turn on/off during the execution of the CJ instruction.

- A label (P□) occupies two steps.

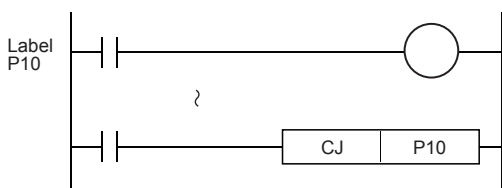


- (1) A label occupies two steps.

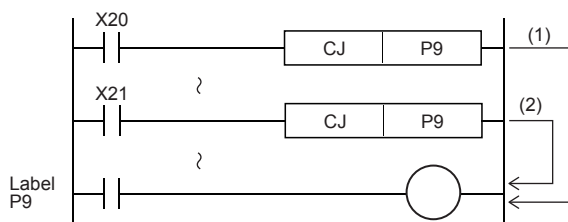
- Only the pointer numbers within the same program file can be specified.
- During skip operation, if the program jumps to the pointer number within the skip range, the programs of the jump destination pointer number and later are executed.
- The figure below shows programming of a label. When creating a circuit program, move the cursor to the left side of the bus line in the ladder diagram, and input a label (P) at the head of the circuit block.



- A label can be programmed in a smaller number step than CJ instruction. However, note that a watchdog timer error occurs when the scan time exceeds 200 ms (default setting).

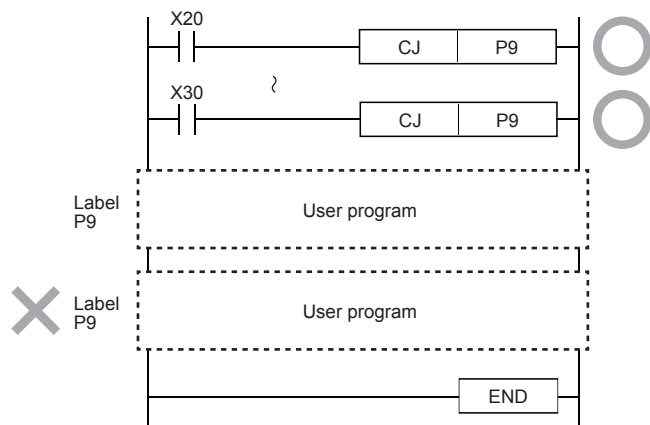


- When the pointer number in operands is same and there is one label, the following operation is caused:

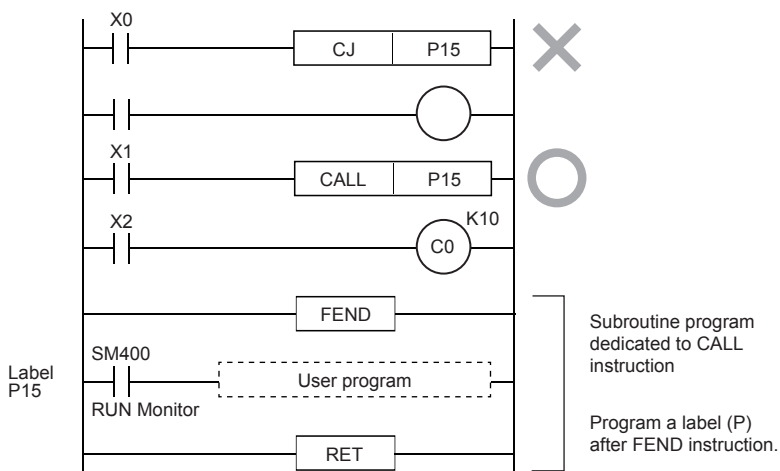


- (1) When X20 turns ON, the program execution jumps from CJ instruction corresponding to X20 to the label P9.
- (2) When X20 turns OFF and X21 turns ON, the program execution jumps from CJ instruction corresponding to X21 to the label P9.

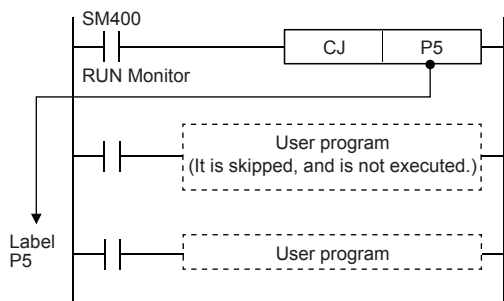
- When a label number (including labels for CALL instructions described later) is used two or more times, an error is caused.



- No label can be shared by CALL instruction and CJ instruction.



- Because SM400/SM8000 is normally ON while a PLC is operating, unconditional jump is applied when SM400 is used as shown in the following example:



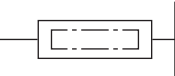
Operation error

Error code (SD0/SD8067)	Description
3380	A pointer number which is not used as a label in the same program file is specified.

Jump to END

GOEND

This instruction moves the program execution to the FEND or END instruction in the same program file.

Ladder diagram	Structured text
	ENO:=GOEND(EN);

Processing details

- This instruction moves the program execution to the FEND or END instruction in the same program file.

Precautions

- When a GOEND instruction is executed by invalid jump during interrupt program execution, it becomes the same operation as the IRET instruction.

Operation error

Error code (SD0/SD8067)	Description
3340	After the FOR instruction is executed, the GOEND instruction is executed before the NEXT instruction is executed.
3381	After the CALL(P) or XCALL instruction is executed, the GOEND instruction is executed before the RET instruction is executed.


7.3 Program execution control instruction

Disabling/enabling interrupt programs

DI, EI


Interrupts are usually disabled in CPU module. These instructions enable interrupts in CPU module (EI instruction) or disable interrupts again (DI instruction).

- DI: Disables the execution of the interrupt program.
- EI: Releases the execution disabled state of interrupt programs.


Ladder diagram	Structured text
	ENO:=DI(EN); ENO:=EI(EN);

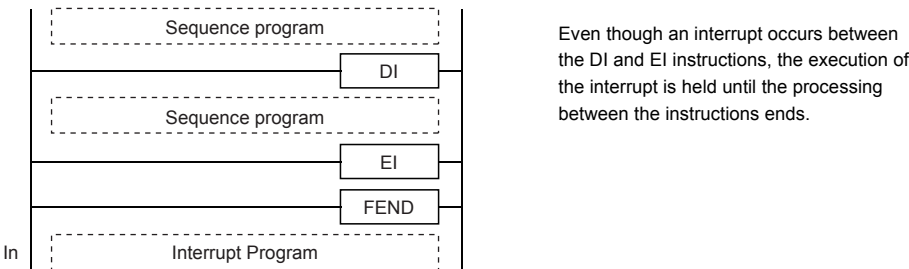
Processing details

DI

- This instruction disables the execution of the interrupt program until the EI instruction is executed, even if the interrupt cause occurs.
- When the power is turned on or the CPU module is reset, the state in which the DI instruction is executed is applied.
- For the operation of the DI instruction (DI instruction without an argument) when using the interrupt disable instruction with a specified priority or lower (DI instruction with an argument), refer to  Page 332 Disabling the interrupt program with specified priority or lower.

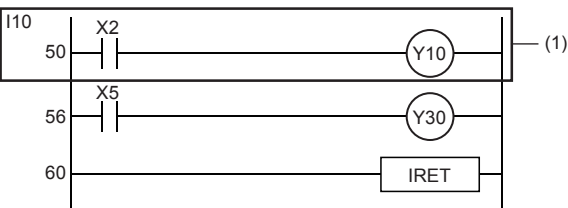
EI

- This instruction releases the execution disabled state of interrupt programs when the DI instruction is executed, and enables the execution of the interrupt program with the interrupt pointer number enabled by the IMASK instruction.
- For the operation of the EI instruction when using the interrupt disable instruction with a specified priority or lower (DI instruction with an argument), refer to  Page 332 Disabling the interrupt program with specified priority or lower.



Point

- An interrupt pointer occupies two steps. (In (1) below, I10 is the step 50, X2 is the step 52, and Y10 is the step 54.)



- If the master control contains the EI or DI instruction, such an instruction is executed regardless of the execution of the MC instruction.

Precautions

Interrupts (requests) that are generated after the DI instruction execution, are processed after the EI instruction is executed.

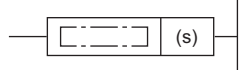
Operation error

Error code (SD0/SD8067)	Description
3362	Nesting of the DI instruction exceeds 16 levels.

Disabling the interrupt program with specified priority or lower

DI

This instruction disables the execution of the interrupt program with a priority specified by (s) or lower until the EI instruction is executed, even if the interrupt cause occurs.

Ladder diagram	Structured text
	ENO:=DI(EN,s);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Priority for disabling interrupts	1 to 3	16-bit unsigned binary	ANY16

■Applicable devices

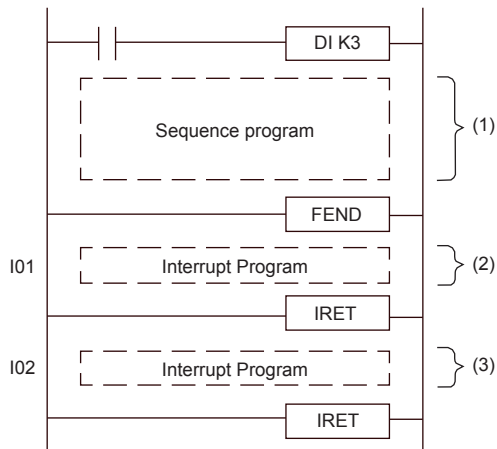
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- This instruction disables the execution of the interrupt program of the interrupt pointer number with an interrupt priority specified by (s) or lower.

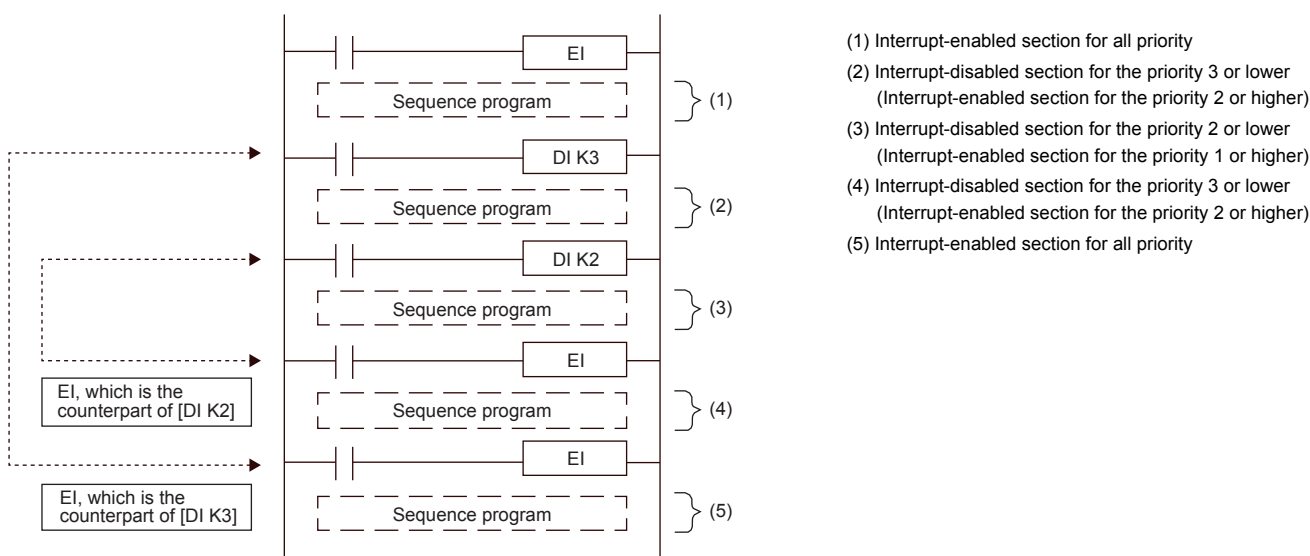
Interrupt priority setting

I No.	Priority
I01	2
I02	3



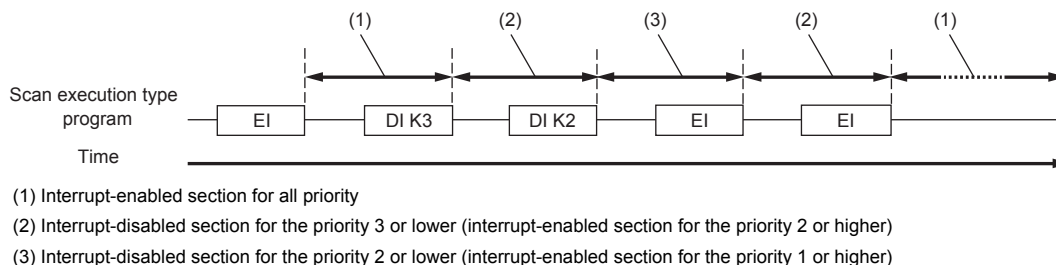
- (1) Interrupt-disabled section for the priority 3 or lower (Interrupt-enabled section for the priority 2 or higher)
- (2) Can be executed because of the priority 2.
- (3) Cannot be executed because of the priority 3.

- By executing the EI instruction, the interrupt with the priority disabled by the counterpart DI instruction is enabled. However, when interrupts are disabled only with the DI instruction without an argument, interrupts with all the priorities are enabled by executing the EI instruction once.

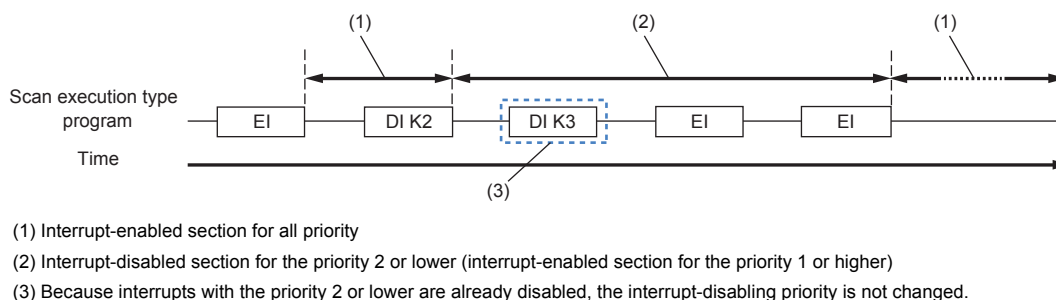


- Interrupts (requests) that are generated after the DI instruction are processed after the EI instruction is executed.
- When multiple DI instructions are executed and the argument has a priority higher than the currently disabled priority, interrupts with a priority lower than that of the argument are disabled.
- When multiple DI instructions are executed and the argument has a priority lower than the currently disabled priority, the interrupt disabled state is not changed.
- The DI instruction can be nested in up to 16 levels.
- The interrupt priority of the interrupt pointer can be set with parameters. (MELSEC iQ-F FX5 Series User's Manual [Application])
- The interrupt-disabled priority can be checked with SD758 (interrupt-disabling priority setting value).
- The following shows the interrupt-disabled section when the DI or EI instruction is executed.

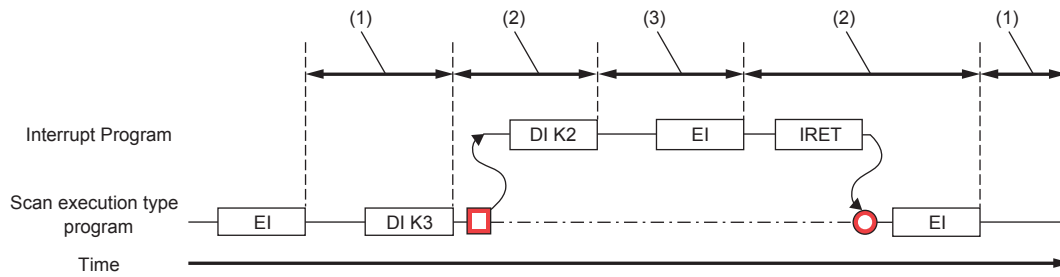
- When multiple DI instructions are executed (when interrupts with a priority higher than the currently disabled priority are specified and disabled)



- When multiple DI instructions are executed (when interrupts with a priority lower than the currently disabled priority are specified and disabled)

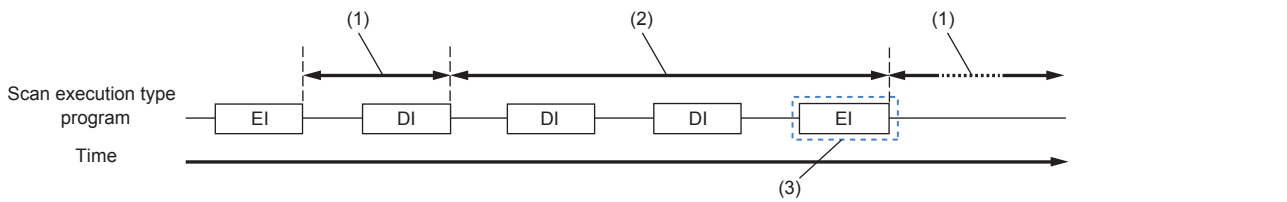


- When the DI instruction is executed in an interrupt program



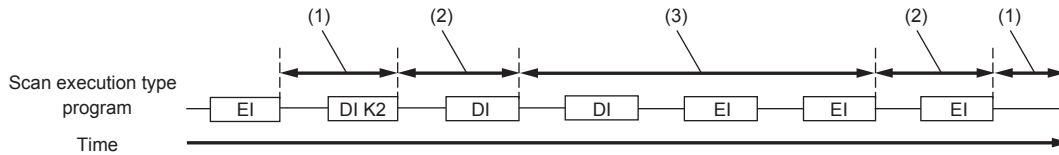
- (1) Interrupt-enabled section for all priority
- (2) Interrupt-disabled section for the priority 3 or lower (interrupt-enabled section for the priority 2 or higher)
- (3) Interrupt-disabled section for the priority 2 or lower (interrupt-enabled section for the priority 1 or higher)

- When the DI instruction without an argument is executed



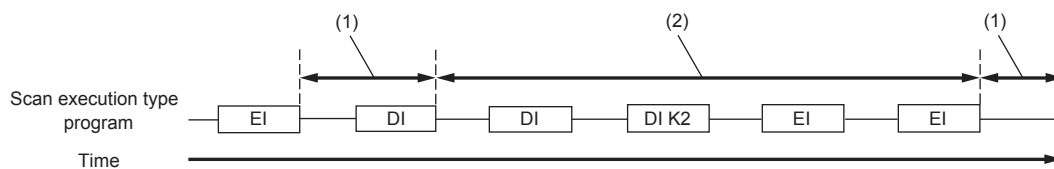
- (1) Interrupt-enabled section for all priority
- (2) Interrupt-disabled section for the priority 1 or lower (where all the interrupts are disabled)
- (3) Because interrupts are disabled with the DI instruction without an argument, interrupts with all the priorities are enabled by executing the EI instruction once.

- When the DI instructions with and without an argument are executed (Execution order is DI instruction with an argument → DI instruction without an argument)



- (1) Interrupt-enabled section for all priority
- (2) Interrupt-disabled section for the priority 2 or lower (interrupt-enabled section for the priority 1 or higher)
- (3) Interrupt-disabled section for the priority 1 or lower (where all the interrupts are disabled)

- When the DI instructions with and without an argument are executed (Execution order is DI instruction without an argument → DI instruction with an argument)



- (1) Interrupt-enabled section for all priority
- (2) Interrupt-disabled section for the priority 1 or lower (where all the interrupts are disabled)

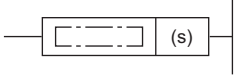
Operation error

Error code (SD0/SD8067)	Description
3405	The value specified by (s) is other than the following. 1 to 3
3362	Nesting of the DI instruction exceeds 16 levels.

Interrupt program mask

IMASK

This instruction enables or disables the execution of the interrupt program with the specified interrupt pointer number according to the 16-point bit pattern starting from the device specified in (s).

Ladder diagram	Structured text
	ENO:=IMASK(EN,s);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the interrupt mask data is stored The device specified in (s) and following 15 devices are used.	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—

7

Processing details

- This instruction enables or disables the execution of the interrupt program with the specified interrupt pointer number according to the 16-point bit pattern starting from the device specified in (s).
 - 1 (ON): The execution of interrupt programs is enabled.
 - 0 (OFF): The execution of interrupt programs is disabled.
- The following shows the assignment of the interrupt pointer numbers to each bit.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
(s)	I15	I14	I13	I12	I11	I10	I9	I8	I7	I6	I5	I4	I3	I2	I1	I0
(s)+1	I31	I30	I29	I28	-	-	-	-	I23	I22	I21	I20	I19	I18	I17	I16
(s)+2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(s)+3	I63	I62	I61	I60	I59	I58	I57	I56	I55	I54	I53	I52	I51	I50	-	-
(s)+4	I79	I78	I77	I76	I75	I74	I73	I72	I71	I70	I69	I68	I67	I66	I65	I64
(s)+5	I95	I94	I93	I92	I91	I90	I89	I88	I87	I86	I85	I84	I83	I82	I81	I80
(s)+6	I111	I110	I109	I108	I107	I106	I105	I104	I103	I102	I101	I100	I99	I98	I97	I96
(s)+7	I127	I126	I125	I124	I123	I122	I121	I120	I119	I118	I117	I116	I115	I114	I113	I112
(s)+8	I143	I142	I141	I140	I139	I138	I137	I136	I135	I134	I133	I132	I131	I130	I129	I128
(s)+9	I159	I158	I157	I156	I155	I154	I153	I152	I151	I150	I149	I148	I147	I146	I145	I144
(s)+10	I175	I174	I173	I172	I171	I170	I169	I168	I167	I166	I165	I164	I163	I162	I161	I160
(s)+11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I177	I176
(s)+12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(s)+13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(s)+14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(s)+15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- When the power is turned on or the CPU module is reset, execution status of the interrupt programs of I0 to I177 is applied.
- The states of the device (s) to (s)+15 are stored in SD1400 to SD1415 (IMASK instruction mask pattern).



The IMASK instruction can enable or disable the interrupt pointers I0 to I177 in a batch.

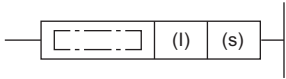
Operation error

Error code (SD0/SD8067)	Description
2820	The 16-point range starting from the device specified by (s) exceeds the corresponding device range.

Disabling/enabling the specified interrupt pointer

SIMASK

This instruction enables or disables the interrupt pointer number specified by (I) according to the value of (s).

Ladder diagram	Structured text
	ENO:=SIMASK(EN,I,s);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(I)	Interrupt pointer number for which interrupts are enabled or disabled	I0 to I177	Device name	ANY16
(s)	Enabled or disabled state of the specified interrupt pointer number	0: Disabled 1: Enabled	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(I)	—	—	—	—	—	—	—	—	—	—	—	—	—	○
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—	—

7

Processing details

- This instruction enables or disables the execution of the interrupt program with the interrupt pointer number specified by (I) according to the data specified by (s)
- When 1 is set in (s): The execution of the interrupt program is enabled.
- When 0 is set in (s): The execution of the interrupt program is disabled.
- When the power is turned on or the CPU module is reset, the execution status of the interrupt programs of I0 to I177 is applied.
- The execution-enabled/disabled states of interrupt pointers are stored in SD1400 to 1415 (IMASK instruction mask pattern).

Point

Indexing is available for (I). By using the SIMASK instruction with indexing, the execution of the interrupt pointers I0 to I177 can be enabled or disabled.


Operation error

Error code (SD0/SD8067)	Description
3405	The interrupt pointer number specified by (I) exceeds the range of the interrupt pointer number (I0 to I177). The value in (s) is other than the interrupt disabled (0) or interrupt enabled (1).

Returning from the interrupt program

IRET

This instruction indicates an end of the processing of an interrupt program.

Ladder diagram	Structured text
	Not supported

Processing details

When an interrupt (input or timer) is generated while the main program is executing, the program execution jumps to an interrupt (I) routine. The IRET instruction returns the program execution to the main routine.

The table below shows two types of jump to an interrupt routine.

Function	Interrupt No.	Description
Interrupt from inputs (including counter)	I0 to I23	Interrupt pointer used for the CPU built-in functions (such as input interrupt, high-speed comparison match interrupt)
Internal timer interrupt	I28 to I31	Interrupt pointer used for fixed-cycle interrupts of the internal timer


Operation error

Error code (SD0/SD8067)	Description
33E6	The IRET instruction is executed in the main program.

Resetting the watchdog timer

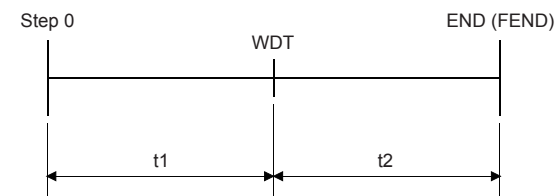
WDT(P)

These instructions reset the watchdog timer in a program.

Ladder diagram	Structured text
	<pre>ENO:=WDT(EN); ENO:=WDTP(EN);</pre>

Processing details

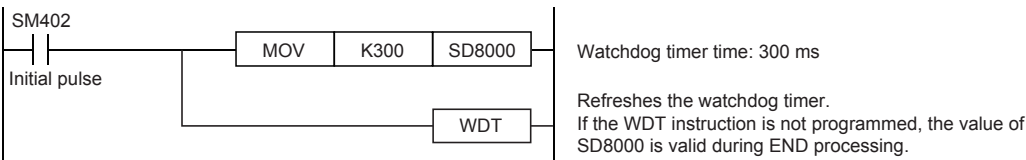
- These instructions reset the watchdog timer in a program.
- These instructions are used when the scan time exceeds the value set for the watchdog timer depending on the condition. If the scan time exceeds the value set for the watchdog timer every scan, change the setting of the watchdog timer in the parameter setting of the engineering tool.
- Design a program so that t1 from the step 0 to the WDT(P) instruction and t2 from the WDT(P) instruction to the END (FEND) instruction do not exceed the setting value of the watchdog timer.



- The WDT(P) instruction can be used more than once in one scan. However, note that turning off the output takes some time if an error occurs.

Precautions

- The time of the watchdog timer can be changed in the [RAS] tab of [CPU Parameter]. The default value is 200 ms.
- By overwriting the contents of SD8000 (watchdog timer time), the watchdog timer detection time can be changed using a program. When the program shown below is input, the sequence program will be monitored with the new watchdog timer time.



Operation error

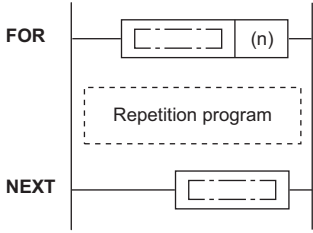
There is no operation error.

7.4 Structuring instruction

FOR to NEXT

FOR, NEXT

When the processing between the FOR and NEXT instructions is executed (n) times without any condition, the processing of the step following the NEXT instruction is executed.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(n)	Number of repetitions of the loop between FOR and NEXT instructions	1 to 32767	16-bit signed binary	ANY16

■Applicable devices

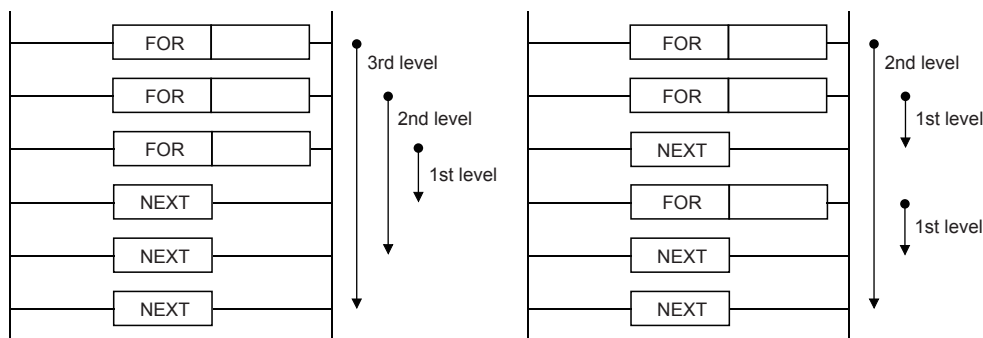
Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—	—

Processing details

- When the processing between the FOR and NEXT instructions is executed (n) times without any condition, the processing of the step following the NEXT instruction is executed.
- In (n), any of 1 to 32767 can be specified. If any of -32768 to 0 is specified, the processing of (n)=1 is applied.
- To skip the processing between the FOR and NEXT instructions, jump the program execution with the CJ instruction.
- Up to 16 FOR instructions can be nested.

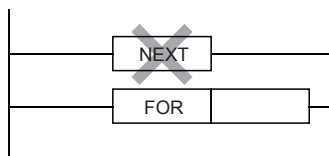
Precautions

- The FOR-NEXT loop can be nested up to 16 levels.

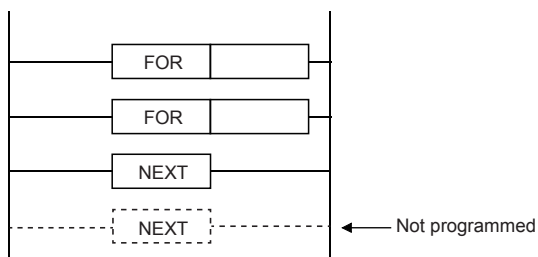


- The FOR-NEXT loop cannot be interrupted by the I, IRET, SRET, RET, FEND, or END instruction.
- When FOR-NEXT loop is repeated many times, the operation cycle is too long, and a watchdog timer error may occur. In such a case, change the watchdog timer time or reset the watchdog timer.
- The following programs are regarded as errors.

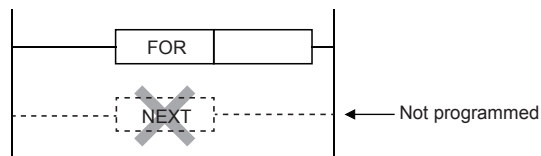
When the NEXT instruction is located before FOR



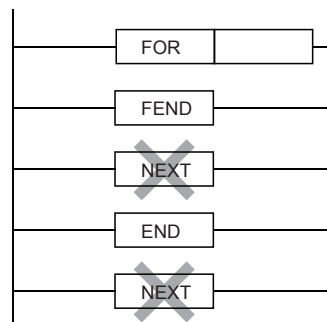
When the number of FOR instructions is not equivalent to the number of NEXT instructions



No NEXT instruction



When the NEXT instruction is located after the FEND or END instruction



Operation error

Error code (SD0/SD8067)	Description
3340	After the FOR instruction is executed, the END or GOEND instruction is executed before the NEXT instruction is executed.
3361	When the FOR instruction is nested, the 17th level is executed.

Point

- To terminate the FOR to NEXT instruction loop halfway, use the BREAK instruction. (Page 342 Forcibly terminating the FOR to NEXT instruction loop)

Forcibly terminating the FOR to NEXT instruction loop

BREAK(P)

This instruction forcibly terminates the FOR to NEXT instruction loop and shifts the program execution to the pointer specified by (P).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

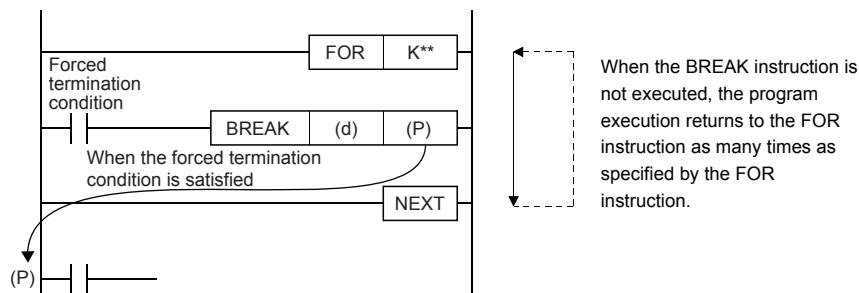
Operand	Description	Range	Data type	Data type (label)
(d)	Device number storing the number of remaining loops	—	16-bit signed binary	ANY16
(P)	Pointer number of the branch destination when the loop is forcibly terminated	—	Device name	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○	—	—	○	○	○	—	—	○	○	—	—	—
(P)	—	—	—	—	—	—	—	—	—	—	—	—	○

Processing details

- This instruction forcibly terminates the FOR to NEXT instruction loop and shifts the program execution to the pointer specified by (P). Only the pointer numbers within the same program file can be specified in (P). If a pointer in another program is specified in (P), an operation error occurs.



- In (d), the number of remaining FOR to NEXT instruction loops at the forced termination is stored. Note that the number includes the loop when the BREAK(P) instructions are executed.
- The BREAK(P) instructions can be used only between the FOR and NEXT instructions.
- The BREAK(P) instructions can be used for only one nesting level. To forcibly terminate multiple nesting levels, execute as many BREAK(P) instructions as the number of nesting levels.

Precautions

- If the branch pointer number of the BREAK instruction outside two nesting levels or more is specified, an operation error occurs and the program execution stops when the BREAK instruction is executed.

Operation error

Error code (SD0/SD8067)	Description
3340	The branch pointer number outside two nesting levels or more is specified.
3342	The BREAK(P) instructions are used other than between the FOR and NEXT instructions.
3380	The destination pointer specified by (P) does not exist.
	A pointer in other program file is specified in (P).

Calling a subroutine program

CALL(P)

This instruction executes the subroutine program specified by (P).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

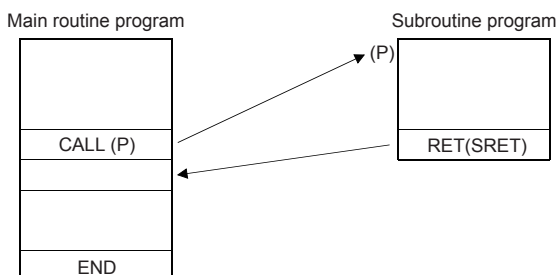
Operand	Description	Range	Data type	Data type (label)
(P)	Start pointer number of the subroutine program	—	Device name	ANY16

■Applicable devices

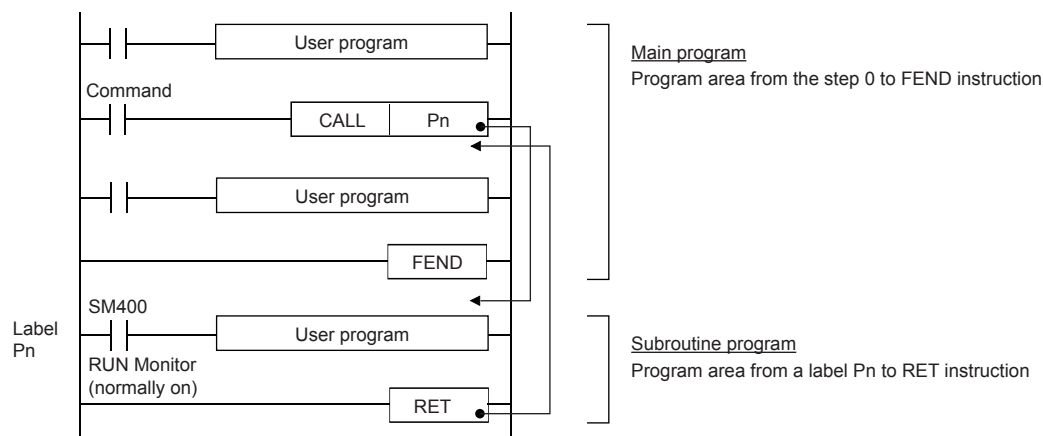
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(P)	—	—	—	—	—	—	—	—	—	—	—	—	○

Processing details

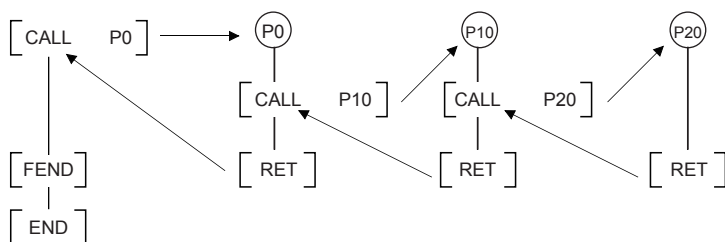
- When the CALL(P) instructions are executed, the subroutine program specified by the pointer (P) is executed. The CALL(P) instructions can execute a subroutine program specified by a pointer in the same program file or by a common pointer.



- While the command input is ON, the CALL instruction is executed and the program execution jumps to a step with a label (Pn). Then, a subroutine program with the label (Pn) is executed. When the RET (SRET) instruction is executed, the program execution returns to the step following the CALL instruction. At the end of the main program, put FEND instruction. Put a label (Pn) for the CALL instruction after the FEND instruction.

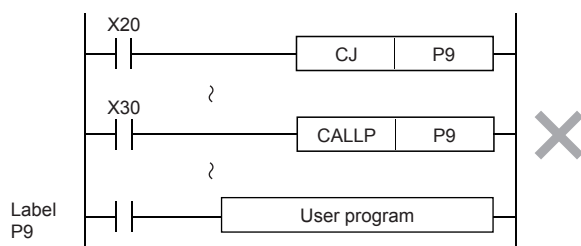


- The CALL(P) instructions can be nested up to 16 levels. However, the 16 levels are the total of the CALL(P) and XCALL instructions.



Precautions

- In the CALL instruction, the same number can be used two or more times in operands (P). However, do not use a label (P) and number used in another instruction (CJ instruction).

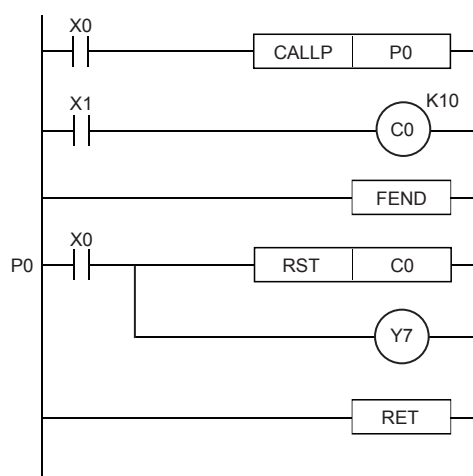


- In a subroutine (or interrupt routine), use timers for routine programs. These timers count when a coil instruction or END instruction is executed. After a timer reaches the set value, the output contact is activated when the coil instruction or END instruction is executed. Because general timers count only when the coil instruction is executed, they do not count if they are used in subroutines in which the coil instruction is executed only under some conditions.
- If a retentive type 1 ms timer is used in a subroutine (interrupt routine), note that the output contact is activated when the first coil instruction (or subroutine) is executed after the timer reaches its set value.
- Devices which were set to ON in a subroutine (or interrupt routine) are latched in the ON status even after the subroutine is finished. (Refer to the program example shown below). When the RST instruction for a timer or counter is executed, the reset status of the timer or counter is latched also. For turning OFF such a device latched in the ON status or for canceling such a timer or counter latched in the reset status, reset such a device in the main program after the subroutine is finished, or program a sequence for resetting such a device or for deactivating the RST instruction in the subroutine. (Refer to the program example shown below).

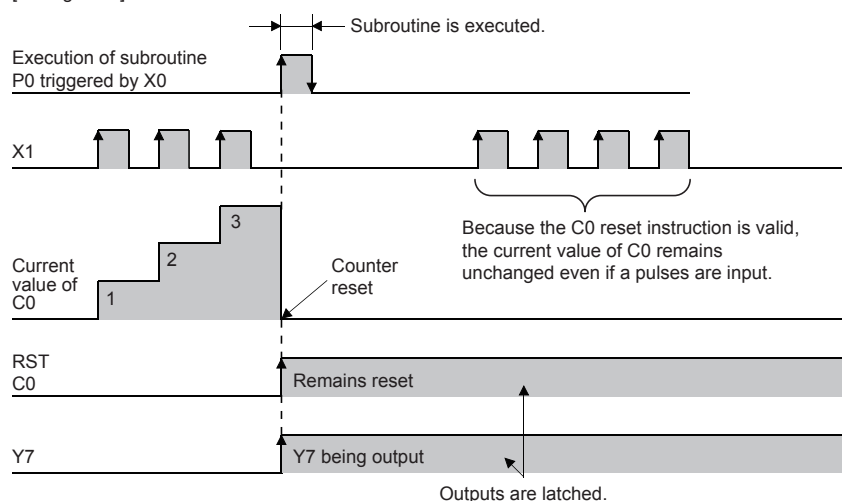
Example in which outputs are latched

In the following program example, the counter C0 is provided to count X1. When X0 is input, the subroutine P0 is executed only in one scan, and then the counter is reset and Y7 is output.

[Program example]

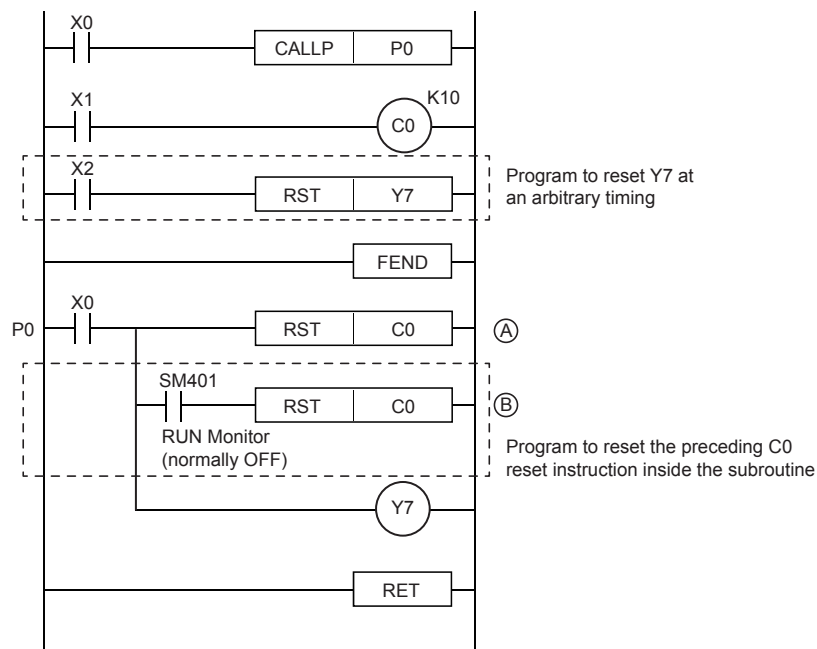


[Timing chart]

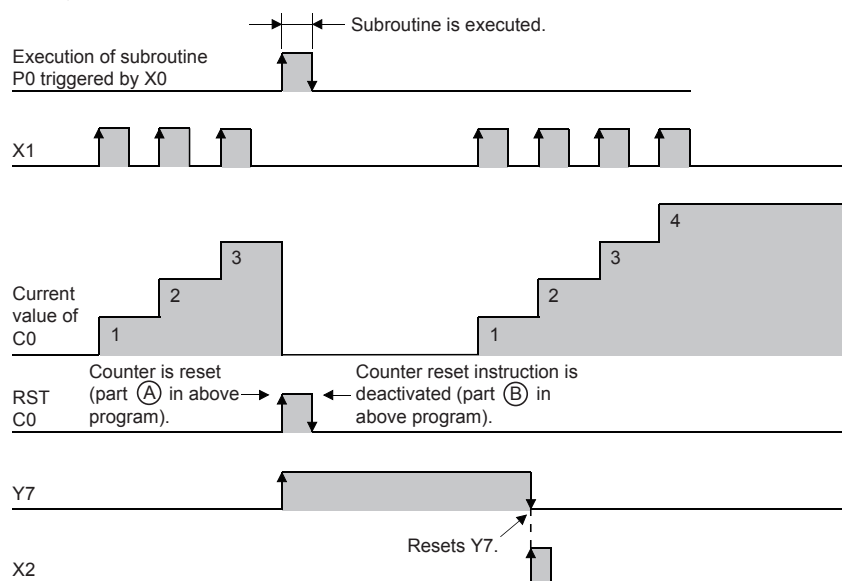


Example in which latched outputs are reset (countermeasures)

[Program example]



[Timing chart]



Operation error


Error code (SD0/SD8067)	Description
3360	The 17th level of the nesting is executed.
3380	The subroutine program specified by the pointer in the CALL(P) instructions do not exist.
3381	After the CALL(P) instructions are executed, the END, FEND, GOEND, or STOP instruction is executed before the RET (SRET) instruction is executed.
3382	The RET (SRET) instruction is executed before the CALL(P) instructions are executed.

Returning from the subroutine program

RET/SRET

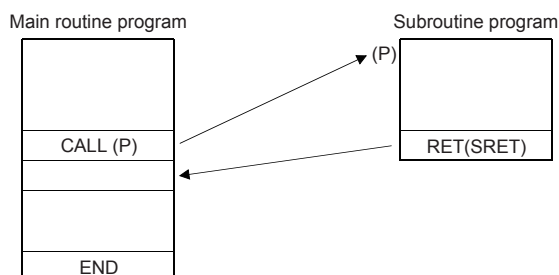
These instructions indicate an end of a subroutine program.

The RET instruction can be used as SRET.

Ladder diagram	Structured text
	Not supported

Processing details

- These instructions indicate an end of a subroutine program.
- When the RET instruction is executed, the program execution returns to the step following the CALL(P) or XCALL instruction that called the subroutine program.



Precautions

- If the RET (SRET) instruction is executed in a user interrupt program (I-IRET), a compiling error occurs.

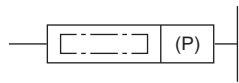
Operation error

Error code (SD0/SD8067)	Description
3381	The END, FEND, GOEND, or STOP instruction is executed before the RET instruction is executed.
3382	While the number of nesting levels is decreased by the return instruction, the result becomes negative. (The number of RET (SRET) instructions is larger than that of the CALL instructions.)

Calling a subroutine program

XCALL

This instruction executes CALL for (turns on and executes) the subroutine program specified by (P) when the execution condition is established. When the condition is turned off, this instruction executes FCALL for (turns off and terminates) the subroutine program.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(P)	Start pointer number of the subroutine program	—	Device name	ANY16

■Applicable devices

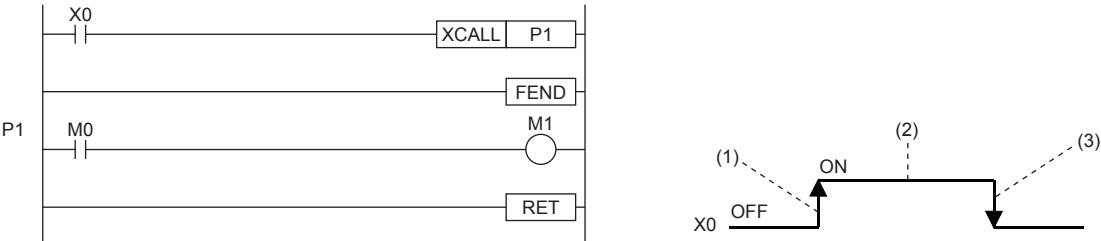
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(P)	—	—	—	—	—	—	—	—	—	—	—	—	○

Processing details

- The XCALL instruction controls the execution and non-execution processing of subroutine programs.
 - In the execution of subroutine programs, each coil instruction is operated according to the ON/OFF status of the condition contact.
 - In the non-execution processing of subroutine programs, each coil instruction is operated with the OFF status of the condition contact applied.
- The following table lists the operation result of each coil instruction after the non-execution processing. Regardless of the status of the condition contact, the following result is applied.

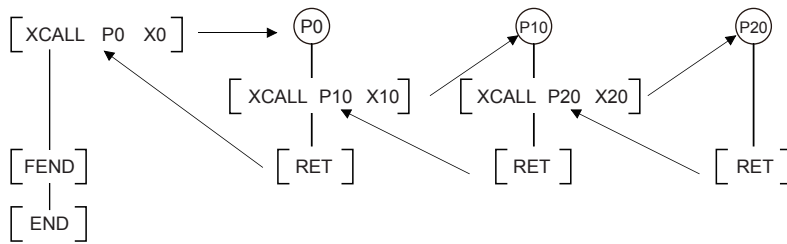
Device used for operation	Operation result (device status)
1 ms timer, 10 ms timer, 100 ms timer	0
1 ms retentive timer, 10 ms retentive timer, 100 ms retentive timer, counter	The current status is held.
Device in the OUT instruction	Forcibly turned off.
Device in the SET, RST, or SFT(P) instruction or basic/applied instruction	The current status is held.
PLS instruction, pulse instruction (□P)	Same as when the condition contact is off

- The following shows the operation of the XCALL instruction.



- (1) Rising edge of X0 (OFF → ON): The subroutine program of P1 is executed.
- (2) While X0 is on: The subroutine program of P1 is executed. (The rising edge of X0 is not included.)
- (3) Falling edge of X0 (ON → OFF): The non-execution processing of the subroutine program of P1 is executed.

- The XCALL instruction can be nested up to 16 levels. However, the 16 levels are the total of the CALL(P) and XCALL instructions.



Operation error

Error code (SD0/SD8067)	Description
3360	The 17th level of the nesting is executed.
3380	The subroutine program specified by the pointer in the XCALL instruction does not exist.
3381	After the XCALL instruction is executed, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction is executed.

7.5 Data table operation instruction

Reading the oldest data from the data table

SFRD(P)

These instructions read data for first-in first-out control.

Ladder diagram	Structured text
	ENO:=SFRD(EN,s,n,d); ENO:=SFRDP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

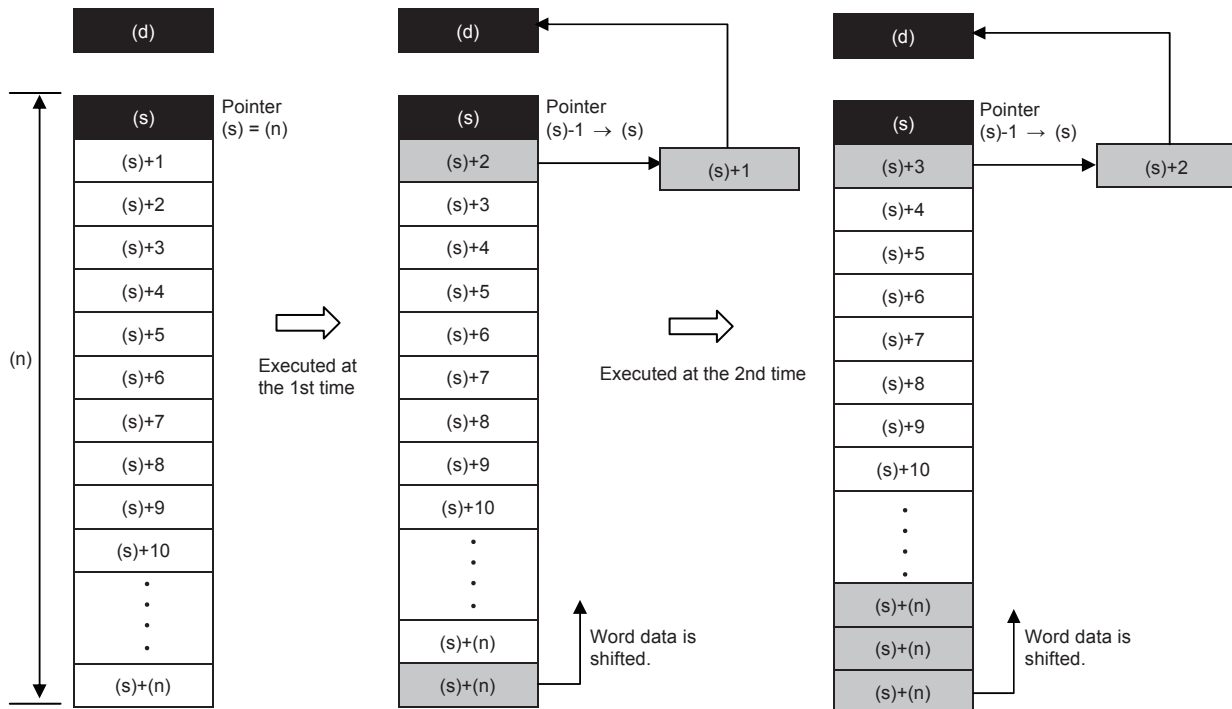
Operand	Description	Range	Data type	Data type (label)
(s)	Start number of the word device storing the data (The start is a pointer. The data is stored starting from (s)+1.)	—	16-bit signed binary	ANY16
(d)	Word device number storing data taken out first	—	16-bit signed binary	ANY16
(n)	Number of stored points plus "1". "+1" is required for the pointer.	2 to 32768	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions transfer (read) (s)+1, which was sequentially written by the SFWR instruction, to (d), and shift the word data of (n)-1 points starting from (s)+1 upward by 1 word. Then, these instructions decrease the number of data points stored in (s) by 1.



- The data of (s)+1 is transferred (read) to (d). Accompanied by this transfer, the contents of the pointer (s) decrease, and the data is shifted upward by 1 word. (When the continuous operation type SFRD instruction is used, the contents are stored in turn in each operation cycle. Use the pulse operation type SFRDP instruction in programming.)

Precautions

- The contents of (s)+(n) do not change by reading.
- When the continuous operation type (SFRD) instruction is used, data is read in turn in each scan time (operation cycle), but the contents of (s)+(n) do not change.
- When 0 is set in the pointer (s), no processing is executed and the contents of (d) do not change.

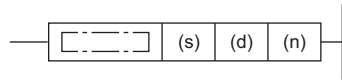
Operation error

Error code (SD0/SD8067)	Description
2820	The number of device points (n) from (s) exceed the device range.
3405	The value set in (n) is other than the following. $2 \leq (n) \leq 32768$
	In (s), a negative value is specified.

Reading the newest data from the data table

POP(P)

These instructions read the latest data written by a shift write (SFWR) instruction for FIFO/FILO control.

Ladder diagram	Structured text
	ENO:=POP(EN,s,n,d); ENO:=POPP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number storing the first-in data (including pointer data) (start number of the word device storing the data)	—	16-bit signed binary	ANY16
(d)	Device number storing last-out data	—	16-bit signed binary	ANY16
(n)	Length of data array (Add "1" because pointer data is also included.)	2 to 32768	16-bit unsigned binary	ANY16

■Applicable devices

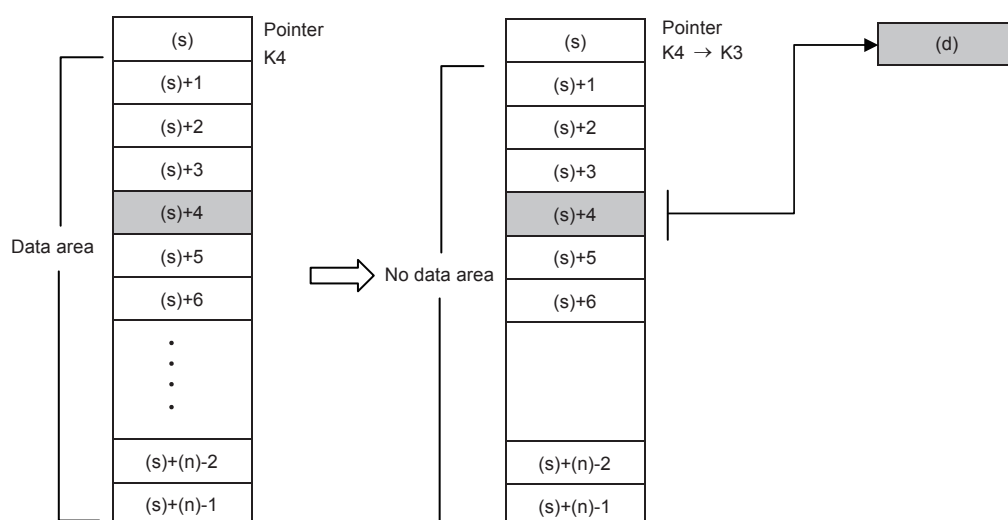
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- Every time the instruction is executed for the word devices (s) to (s)+(n)-1, a device "(s) + Pointer data (s)" is read to (d).
(The last data entry written by the shift write (SFWR) instruction for first-in first-out control is read to (d).) Specify any value between 2 and 32767 for (n).
- Subtract "1" from the value of the pointer data (s).

Data for FILO control

	Description
(s)	Pointer data (amount of data stored)
(s)+1	Data area (First-in data written by shift write (SFWR) instruction)
(s)+2	
(s)+3	
⋮	
(s)+(n)-3	
(s)+(n)-2	
(s)+(n)-1	



Precautions

- If programed in the continuous operation type, the POP(P) instructions are executed in every operation cycle. As a result, expected operation may not be achieved. Usually, program the POP(P) instructions in the "pulse operation type", or let them be executed by a "pulsed command contact".
- When the current value of the pointer (s) is "0", the zero flag SM8020 turns ON and the POP(P) instructions are not executed.
- When the current value of the pointer (s) is "1", "0" is written to (s) and the zero flag SM8020 turns ON.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range (s)+(n)-1 exceeds the device.
3405	(s) is larger than (n)-1.
	(s) is smaller than 0.
	The value set in (n) is other than the following. $2 \leq (n) \leq 32768$

Writing data to the data table

SFWR(P)

These instructions write data for first-in first-out (FIFO) and last-in first-out (LIFO) control.

Ladder diagram	Structured text
	<pre>ENO:=SFWR(EN,s,n,d); ENO:=SFWRP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

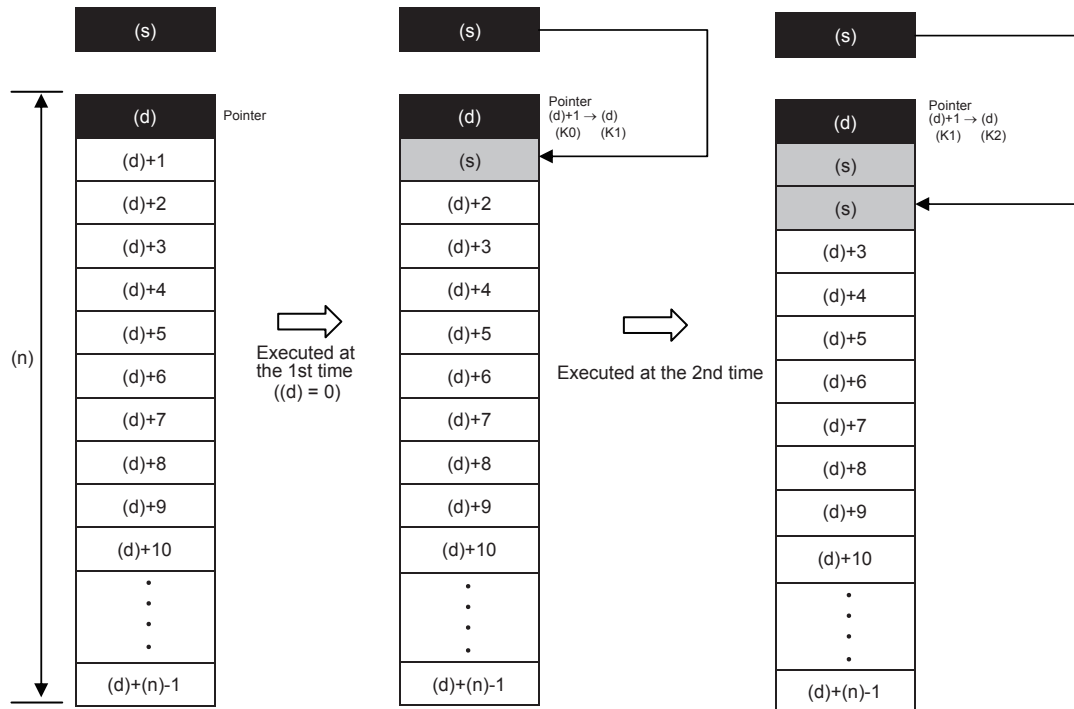
Operand	Description	Range	Data type	Data type (label)
(s)	Word device number storing data to be put in first	—	16-bit signed binary	ANY16
(d)	Start word device number storing and shifting data (The start is a pointer. The data is stored starting from (d)+1.)	—	16-bit signed binary	ANY16
(n)	Number of stored points plus "1".	2 to 32768	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- The contents of (s) are written to "(n)-1" devices from (d)+1, and "1" is added to the number of data stored in (d). For example, for (d)=0, the contents are written to (d)+1, and for (d)=1, to (d)+2.



- At the first execution, the contents of (s) are stored in (d)+1.
- When the contents of (s) are changed and then the instruction is executed again, the new contents of (s) are stored to (d)+2. So the contents of +2 become equivalent to (s). (When the continuous operation type SFWR instruction is used, the contents are stored in each operation cycle. Use the pulse operation type SFWRP instruction in programming.) Data is stored from the right end in the same way, and the number of stored data is specified by the contents of the pointer (d).

Precautions

- In the case of the continuous operation type instruction (SFWR), note that data is stored (overwritten) in every scan time (operation cycle).

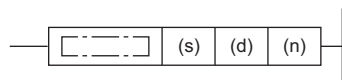
Operation error

Error code (SD0/SD8067)	Description
2820	The number of device points (n) from (d) exceeds the device range.
3405	The value set in (n) is other than the following. 2≤(n)≤32768
	In (d), a negative value is specified.

Inserting data to the data table

FINS(P)

These instructions insert 16-bit data specified by (s) to the data table specified by (d) as the (n)th data. After these instructions are executed, the data after the (n)th data in the data table is moved down by one data point.

Ladder diagram	Structured text
	ENO:=FINS(EN,s,n,d); ENO:=FINSP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

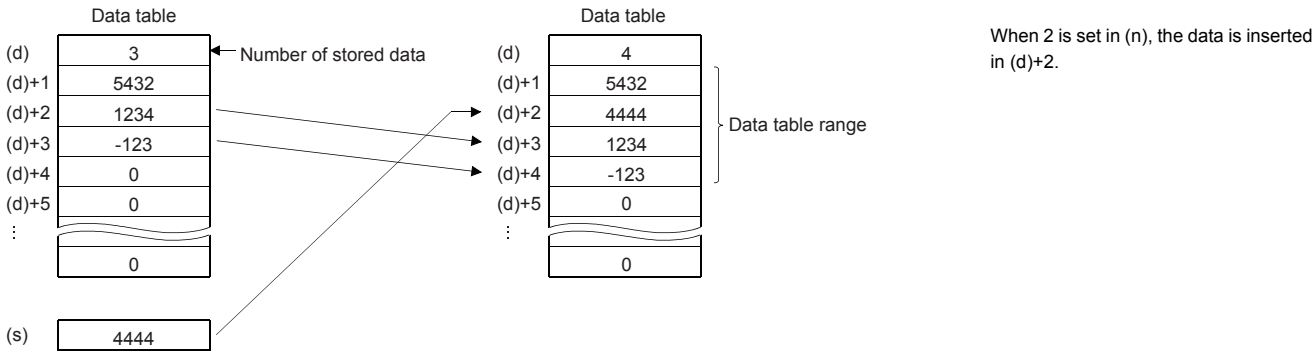
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the insertion-target data is stored	—	16-bit signed binary	ANY16
(d)	Start number of the table	—	Word	ANY16
(n)	Data insertion position in the table	1 to 32767	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions insert 16-bit binary data specified by (s) to the data table specified by (d) as the (n)th data. After these instructions are executed, the data after the (n)th data in the data table is moved down by one data point.



Precautions

- The device range used in a data table should be controlled by the user.
- The data table has (d) number of stored data starting from ((d)+1).

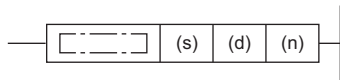
Operation error

Error code (SD0/SD8067)	Description
2820	When the FINS(P) instructions are executed, the data table range exceeds the corresponding device range.
3405	When the FINS(P) instructions are executed, the value (n) exceeds the corresponding device range of the table (d).
	When the FINS(P) instructions are executed, the table position (n) where the data is inserted exceeds "the number of stored data points + 1".
	The value set in (n) is other than the following. $2 \leq (n) \leq 32767$

Deleting data from the data table

FDEL(P)

These instructions remove the (n)th data in the data table specified by (d) and store the data in the device specified by (s). After these instructions are executed, the data after the (n)+1th data in the data table is moved up by one data point.

Ladder diagram	Structured text
	ENO:=FDEL(EN,s,n,d); ENO:=FDELP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

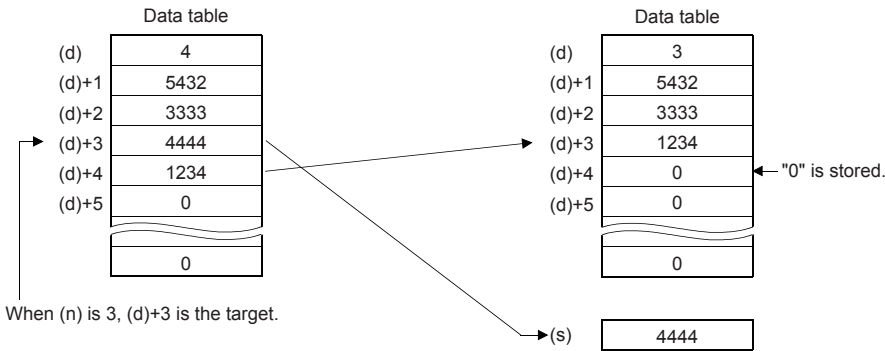
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number for storing the data to be deleted	—	16-bit signed binary	ANY16
(d)	Start number of the table	—	Word	ANY16
(n)	Position of the data to be deleted in the table	1 to 32767	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions remove the (n)th data in the data table specified by (d) and store the data in the device specified by (s). After these instructions are executed, the data after the (n)+1th data in the data table is moved up by one data point.



Precautions

- The device range used in a data table should be controlled by the user.
- The data table has (d) number of stored data starting from ((d)+1).

Operation error

Error code (SD0/SD8067)	Description
2820	When the FDEL(P) instructions are executed, the data table range exceeds the corresponding device range.
3405	When the FDEL(P) instructions are executed, the value (n) exceeds the corresponding device range of the table (d).
	When 0 is set in (d), and the FDEL(P) instructions are executed.
	When the FDEL(P) instructions are executed, the table position (n) where the data to be deleted is stored exceeds the number of stored data points.
	The value set in (n) is other than the following. $2 \leq (n) \leq 32767$

7.6 Character string operation instruction

Comparing character strings

LD\$, AND\$, OR\$

These instructions perform a comparison operation between the character string data in the device specified by (s1) and later and the character string data in the device specified by (s2) and later. (Devices are used as a normally open contact.)

Ladder diagram	Structured text
<p>(\$, \$<>, \$>, \$<=, \$<, or \$>= enters □.)</p>	Not supported

7

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Comparison data or head device number where the comparison data is stored	—	Character string	Character string
(s2)	Comparison data or head device number where the comparison data is stored	—	Character string	Character string

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(s2)	—	—	—	○*1	—	—	—	—	○	—	—	○	—

*1 T, ST, C cannot be used.

Processing details

- These instructions perform a comparison operation between the character string data specified by (s1) and the character string data specified by (s2). (Devices are used as a normally open contact.)
- In the comparison operation, the ASCII codes of the character strings are compared one by one from the start of the strings.
- Character strings in the devices specified by (s1) and (s2) to a device that stores 00H are compared.
 - When all the character strings match, the comparison is considered as matched.

	b15	...	b8	b7	...	b0		b15	...	b8	b7	...	b0	
(s1)	42H (B)			41H (A)			<div></div>	(s2)	42H (B)			41H (A)		
(s1)+1	44H (D)			43H (C)				(s2)+1	44H (D)			43H (C)		
(s1)+2	00H			45H (E)				(s2)+2	00H			45H (E)		
"ABCDE"								"ABCDE"						

Instruction symbol in □	Result	Instruction symbol in □	Result
\$=	Conductive state	\$<=	Conductive state
\$<>	Non-conductive state	\$<	Non-conductive state
\$>	Conductive state	\$>=	Conductive state

- When the character strings are different, the string with a large character code is considered as the large one.

	b15 ... b8 b7 ... b0		b15 ... b8 b7 ... b0
(s1)	42H (B) 41H (A)	(s2)	42H (B) 41H (A)
(s1)+1	44H (D) 43H (C)	(s2)+1	44H (D) 43H (C)
(s1)+2	00H 45H (F)	(s2)+2	00H 45H (E)
	"ABCDEF"		"ABCDE"

Instruction symbol in □	Result	Instruction symbol in □	Result
\$=	Non-conductive state	\$<=	Non-conductive state
\$<>	Conductive state	\$<	Non-conductive state
\$>	Conductive state	\$>=	Conductive state

- When the character strings are different, the magnitude relation between them is determined based on the size of the first different character code.

	b15 ... b8 b7 ... b0		b15 ... b8 b7 ... b0
(s1)	32H (2) 31H (1)	(s2)	32H (2) 31H (1)
(s1)+1	34H (4) 33H (3)	(s2)+1	33H (3) 33H (4)
(s1)+2	00H 35H (5)	(s2)+2	00H 35H (5)
	"12345"		"12435"

Instruction symbol in □	Result	Instruction symbol in □	Result
\$=	Non-conductive state	\$<=	Conductive state
\$<>	Conductive state	\$<	Conductive state
\$>	Non-conductive state	\$>=	Non-conductive state

- When the length of the character strings specified by (s1) and (s2) is different, the longer character string is considered as the large one.

	b15 ... b8 b7 ... b0		b15 ... b8 b7 ... b0
(s1)	32H (2) 31H (1)	(s2)	32H (2) 31H (1)
(s1)+1	34H (4) 33H (3)	(s2)+1	34H (4) 33H (3)
(s1)+2	36H (6) 35H (5)	(s2)+2	36H (6) 35H (5)
(s1)+3	00H 37H (7)	(s2)+3	00H 00H
	"1234567"		"123456"

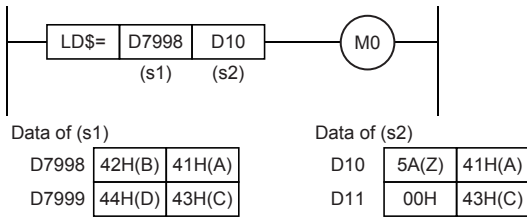
Instruction symbol in □	Result	Instruction symbol in □	Result
\$=	Non-conductive state	\$<=	Non-conductive state
\$<>	Conductive state	\$<	Non-conductive state
\$>	Conductive state	\$>=	Conductive state

- If the character string specified by (s1) or (s2) has more than 16383 characters, the operation result is the non-conductive state.

Precautions

- In character string comparison operation, if the target device range does not have "00H", the values until the last number of the device are retrieved. Thus, even if the target device range does not have "00H", a comparison operation result is output when a mismatch between the acquired character strings is detected.

[Example]



- For the data specified by (s1) and (s2) as shown above, the second character is different between them. Thus, the operation result is non-conductive.

Operation error

There is no operation error.

Concatenating character strings

\$+(P) [For 2 operands]

These instructions concatenate the character string data stored in the device specified by (s) and later to the end of the character string data stored in the device specified by (d) and later, and store the concatenated string in the device specified by (d) and later.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number storing data to be concatenated or data, or directly specified character string	—	Character string	Character string
(d)	Head device number storing data to which another data is concatenated	—	Character string	Character string

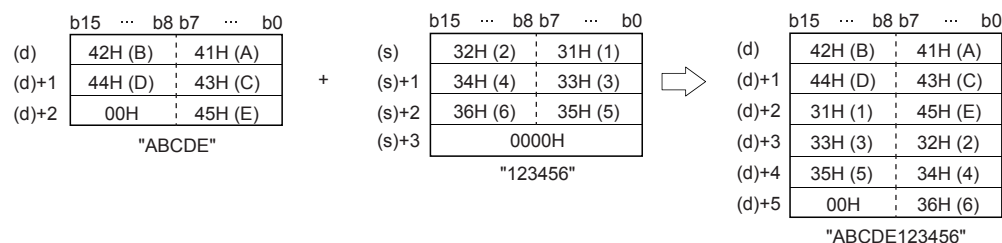
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions concatenate the character string data stored in the device specified by (s) and later to the end of the character string data stored in the device specified by (d) and later, and store the concatenated string in the device specified by (d) and later.



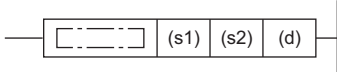
- Character strings in the devices specified by (s) and (d) up to a device that stores 00H are concatenated.
- When character strings are concatenated, 00H indicating an end of the character string specified by (d) is ignored and the character string specified by (s) is concatenated to the last character of (d).

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range after the device specified by (s), "00H" does not exist.
	In the corresponding device range after the device specified by (d), "00H" does not exist.
3406	The whole concatenated character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.
	The number of characters of the character string in the device specified by (s)+(d) exceeds 16383..
3405	The character string specified by (s) has more than 16383 characters.
	The character string specified by (d) has more than 16383 characters.

\$(P) [For 3 operands]

These instructions concatenate the character string data stored in the device specified by (s2) and later to the end of the character string data stored in the device specified by (s1) and later, and store the concatenated string in the device specified by (d) and later.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number storing data to which another data is concatenated or data, or directly specified character string	—	Character string	Character string
(s2)	Head device number storing data to be concatenated or data, or directly specified character string	—	Character string	Character string
(d)	Head device number for storing the concatenated data	—	Character string	Character string

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(s2)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions concatenate the character string data stored in the device specified by (s2) and later to the end of the character string data stored in the device specified by (s1) and later, and store the concatenated string in the device specified by (d) and later.
- Character strings in the devices specified by (s1) and (s2) up to a device that stores 00H are concatenated.

	b15 ... b8	b7 ... b0		b15 ... b8	b7 ... b0		b15 ... b8	b7 ... b0
(s1)	46H (F)	48H (H)		(s2)	35H (5) 31H (1)	⇒	(d)	46H (F) 48H (H)
(s1)+1	2DH (-)	41H (A)	+	(s2)+1	39H (9) 33H (3)		(d)+1	2DH (-) 41H (A)
(s1)+2	00H			(s2)+2	00H 41H (A)		(d)+2	35H (5) 31H (1)
							(d)+3	39H (9) 33H (3)
							(d)+4	00H 41H (A)

- When character strings are concatenated, 00H indicating an end of the character string specified by (s1) is ignored and the character string specified by (s2) is concatenated to the last character of (s1).
- After two character strings are connected, "00H" is automatically added at the end. When the number of characters after the concatenation is odd, 00H is stored in the upper byte of the device storing the last character. When the number is even, 0000H is stored in the device after the last character.

Precautions

- For direct specification, up to 32 characters can be specified (input). When word devices are specified in (s1) or (s2), this restriction (up to 32 characters) is not applicable.
- When the values in both (s1) and (s2) start from "00H" (that is, when the number of characters is "0"), "0000H" is stored in (d).

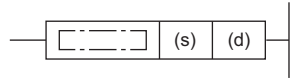
Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range after the device specified by (s1), "00H" does not exist.
	In the corresponding device range after the device specified by (s2), "00H" does not exist.
2821	The numbers of the character string-storing devices specified by (s1), (s2), and (d) overlap.
3405	The character string specified by (s1) has more than 16383 characters.
	The character string specified by (s2) has more than 16383 characters.
3406	The character string specified by (d) has more than 16383 characters.
	The whole concatenated character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

Transferring character strings

\$MOV(P)

These instructions transfer the character string data specified by (s) to the device specified by (d) and later.

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string to be transferred (up to 255 characters) or head device number storing a character string	—	Character string	Character string
(d)	Head device number storing transferred character string	—	Character string	Character string

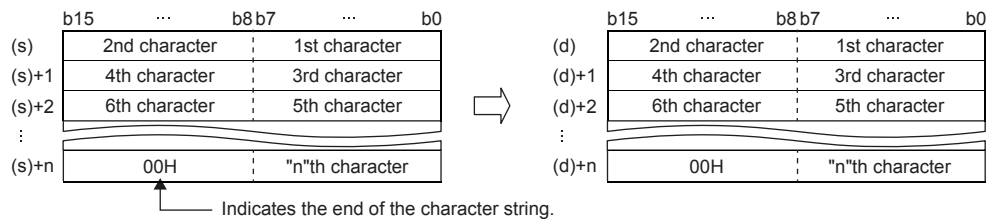
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—

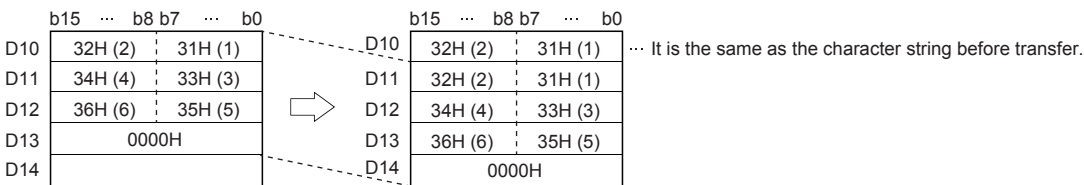
*1 T, ST, C cannot be used.

Processing details

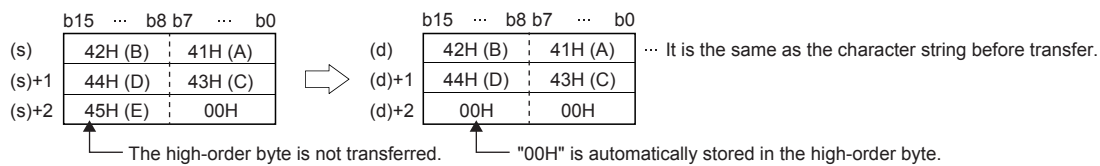
- These instructions transfer the character string data specified by (s) to the device specified by (d) and later. A character string enclosed with double quotation marks and specified by (s) or stored in the devices from the device specified by (s) to the device storing 00H is transferred in a batch.



- Even though the device range of the data to be transferred (s) to (s)+n and the device range for storing the transferred data (d) to (d)+n overlap, the processing is performed normally. For example, when a character string stored in D10 to D13 is transferred to D11 to D14, the transfer is executed as shown below:



- When "00H" is stored in the lower byte of (s)+n, "00H" is stored to both the upper byte and lower byte of (d)+n.




Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	The character string specified by (s) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

Converting 16-bit binary data to decimal ASCII

BINDA(P)(_U)

These instructions convert 16-bit binary data specified by (s) into decimal ASCII codes, and store the converted data in the device specified by (d) and later.

Ladder diagram	Structured text	
	ENO:=BINDA(EN,s,d); ENO:=BINDAP(EN,s,d)	ENO:=BINDA_U(EN,s,d); ENO:=BINDAP_U(EN,s,d)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	BINDA(P)	-32768 to +32767	16-bit signed binary	ANY16
	BINDA(P)_U		16-bit unsigned binary	ANY16
(d)	Head device number storing conversion result	—	Character string	Character string

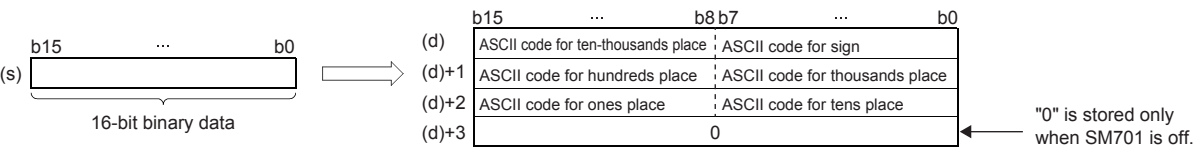
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

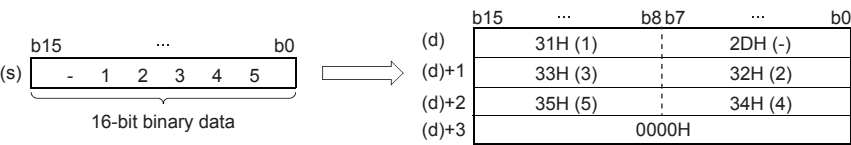
Processing details

- These instructions convert 16-bit binary data specified by (s) into decimal ASCII codes, and store the converted data in the device specified by (d) and later.



Ex.

When -12345 is specified in (s) (when signed data is specified)



- The following shows the operation result to be stored in (d).
 - As sign data, "20H" is stored if the 16-bit binary data is positive, and "2DH" is stored if the data is negative.
 - "20H" is stored for "0" on the left side of the valid digits (zero suppression). For "00325", 20H is stored for "00", and the number of digits is 3 based on "325".
 - In the device specified by (d)+3, 0 is stored when SM701 (output character number selector signal) is off, and the original data remains when SM701 is on.

Precautions

- The number of occupied points of (d) is 3 when SM701 is on, and 4 when SM701 is off.

Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (d) exceeds the corresponding device range.

Converting 32-bit binary data to decimal ASCII

DBINDA(P)(_U)

These instructions convert 32-bit binary data specified by (s) into decimal ASCII codes, and store the converted data in the device specified by (d) and later.

Ladder diagram	Structured text	
	ENO:=DBINDA(EN,s,d); ENO:=DBINDAP(EN,s,d);	ENO:=DBINDA_U(EN,s,d); ENO:=DBINDAP_U(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	DBINDA(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DBINDA(P)_U	0 to 4294967295	32-bit unsigned binary	ANY32
(d)	Head device number storing conversion result	—	Character string	Character string

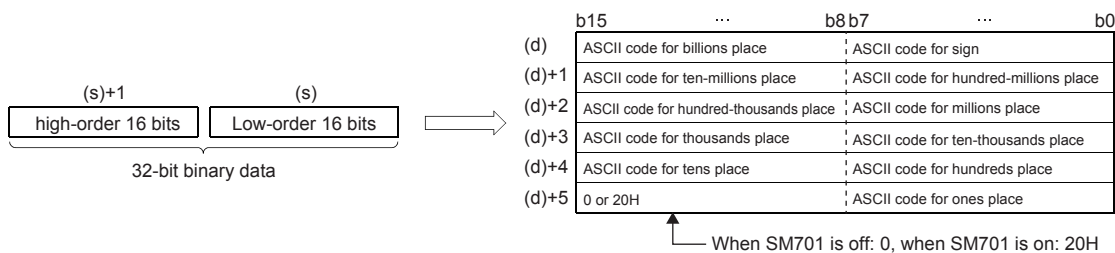
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

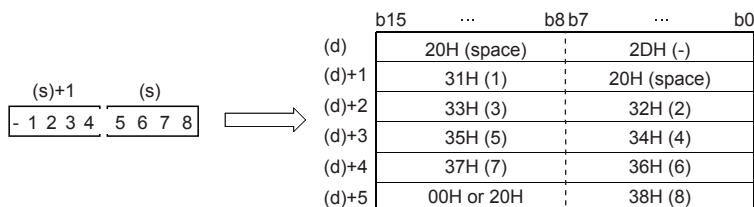
Processing details

- These instructions convert 32-bit binary data specified by (s) into decimal ASCII codes, and store the converted data in the device specified by (d) and later.



Ex.

When -12345678 is specified in (s) (when signed data is specified)



- The following shows the operation result to be stored in (d).
 - As sign data, "20H" is stored if the 16-bit binary data is positive, and "2DH" is stored if the data is negative.
 - "20H" is stored for "0" on the left side of the valid digits (zero suppression). For "0012034560", 20H is stored for "00", and the number of digits is 8 based on "12034560".
 - In the upper 8 bits of the device specified by (d)+5, 0 is stored when SM701 (output character number selector signal) is off, and 20H is stored when SM701 is on.

Precautions

- (d) occupies six points.

Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (d) exceeds the corresponding device range.

Converting HEX code data to ASCII

ASCI(P)

These instructions convert the (n) characters (digits) within the hexadecimal code data specified by (s) to ASCII, and store the converted data in the device specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=ASCI(EN,s,n,d); ENO:=ASCIP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number storing hexadecimal code to be converted	—	16-bit signed binary	ANY16
(d)	Head device number storing converted ASCII code	—	Character string	Character string
(n)	Number of characters (digits) of hexadecimal code to be converted	1 to 32767	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○ ^{*1}	○	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

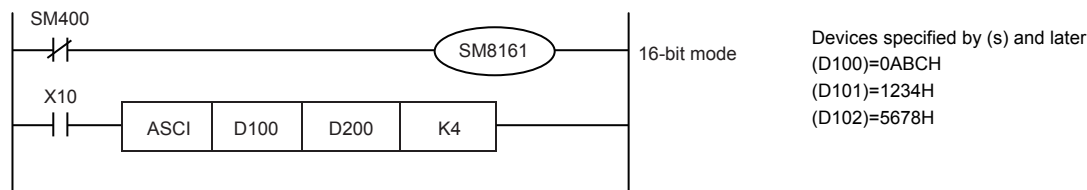
Processing details

- These instructions convert the (n) characters (digits) within the hexadecimal code data specified by (s) to ASCII, and store the converted data in the device specified by (d) and later.
- The 16-bit mode and 8-bit mode options are available for the ASCII(P) instructions. For the operation in each mode, refer to the proceeding pages.

- 16-bit conversion mode (while SM8161 is OFF)

Each digit of hexadecimal data stored in the device specified by (s) and later is converted into ASCII code, and transferred to the upper 8 bits and lower 8 bits of each device specified by (d) and later. SM8161 must always be off in the 16-bit conversion mode.

In the following program, conversion is executed as follows:



■ Number of specified digits (characters) and conversion result

(n)	K1	K2	K3	K4	K5	K6	K7	K8	K9
(d)									
D200 lowest-order byte	"C"	"B"	"A"	"0"	"4"	"3"	"2"	"1"	"8"
D200 highest-order byte		"C"	"B"	"A"	"0"	"4"	"3"	"2"	"1"
D201 lowest-order byte			"C"	"B"	"A"	"0"	"4"	"3"	"2"
D201 highest-order byte				"C"	"B"	"A"	"0"	"4"	"3"
D202 lowest-order byte					"C"	"B"	"A"	"0"	"4"
D202 highest-order byte						"C"	"B"	"A"	"0"
D203 lowest-order byte							"C"	"B"	"A"
D203 highest-order byte								"C"	"B"
D204 lowest-order byte									"C"

■ Bit configuration when (n) is K4

D100 = 0ABCH																ASCII code		
0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0			
0				A				B				C						
D200																		
0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0			
"A" → 41H								"0" → 30H										
D201																		
0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0			
"C" → 43H								"B" → 42H										

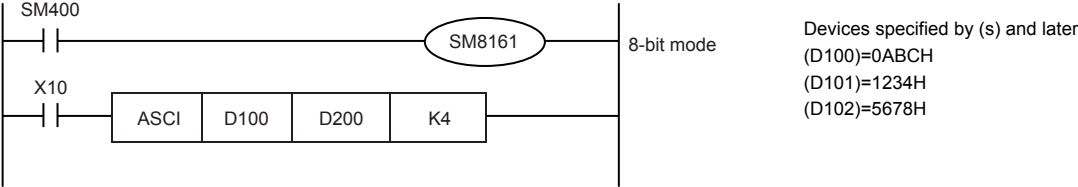
ASCII code

"0" = 30H	"1" = 31H	"5" = 35H
"A" = 41H	"2" = 32H	"6" = 36H
"B" = 42H	"3" = 33H	"7" = 37H
"C" = 43H	"4" = 34H	"8" = 38H

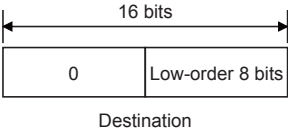
• 8-bit conversion mode (while SM8161 is ON)

Each digit of hexadecimal data stored in the device specified by (s) and later is converted into ASCII code, and transferred to the lower 8 bits of each device specified by (d) and later. SM8161 must always be on in the 8-bit conversion mode.

In the following program, conversion is executed as follows:



When SM8161 is set to on, the 8-bit mode is selected.
The conversion processing is executed as follows.



■ Number of specified digits (characters) and conversion result

(n)	K1	K2	K3	K4	K5	K6	K7	K8	K9
(d)									
D200	"C"	"B"	"A"	"0"	"4"	"3"	"2"	"1"	"8"
D201		"C"	"B"	"A"	"0"	"4"	"3"	"2"	"1"
D202			"C"	"B"	"A"	"0"	"4"	"3"	"2"
D203				"C"	"B"	"A"	"0"	"4"	"3"
D204					"C"	"B"	"A"	"0"	"4"
D205						"C"	"B"	"A"	"0"
D206							"C"	"B"	"A"
D207								"C"	"B"
D208									"C"

■ Bit configuration when (n) is K2

D100 = 0ABCH

0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0
0				A				B				C			

D200 = ASCII code of B = 42H

0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
								4				2			

D201 = ASCII code of C = 34H

0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
								4				3			

ASCII code

"0" = 30H	"1" = 31H	"5" = 35H
"A" = 41H	"2" = 32H	"6" = 36H
"B" = 42H	"3" = 33H	"7" = 37H
"C" = 43H	"4" = 34H	"8" = 38H

Precautions

- When outputting data in the BCD format for a printer, for example, it is necessary to convert binary data into BCD data before executing the ASCI(P) instructions.
- Whether NULL (00H) is stored after the last character or not depends on the ON/OFF status of the output character number selector signal SM701. When SM701 is off, NULL (00H) is stored. When SM701 is on, the original data remains.
- Depending on the ON/OFF status of SM701 and SM8161, the number of devices occupied by (d) differs.

SM701	SM8161	Number of devices occupied by (d)
ON	ON	Number of letters
ON	OFF	Number of letters ÷ 2
OFF	ON	Number of letters ÷ 1
OFF	OFF	(Number of letters ÷ 2) + 1

- When RS2, HEX, or CCD is used, the extension flag SM8161 is common to other instructions. When using an instruction described above and the ASCI(P) instructions in the same program, make sure to set SM8161 to ON or OFF just before each instruction so that SM8161 does not apply to another instruction.

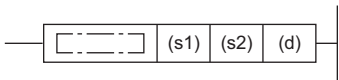
Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (s) or (d) exceeds the corresponding device range.
3405	The value specified by (s) is other than any of 1 to 32767.

Converting 16-bit binary data to character string

STR(P)(_U)

These instructions add a decimal point to the 16-bit binary data in the device specified by (s2) at the location specified by (s1), convert the data to character string data, and store the converted data in the device areas specified by (d) and later.

Ladder diagram	Structured text	
	ENO:=STR(EN,s1,s2,d); ENO:=STRP(EN,s1,s2,d);	ENO:=STR_U(EN,s1,s2,d); ENO:=STRP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	STR(P) STR(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(s2)	STR(P) STR(P)_U	-32768 to +32767 0 to 65535	16-bit signed binary 16-bit unsigned binary	ANY16
(d)	Head device number for storing the converted data	—	Character string	Character string

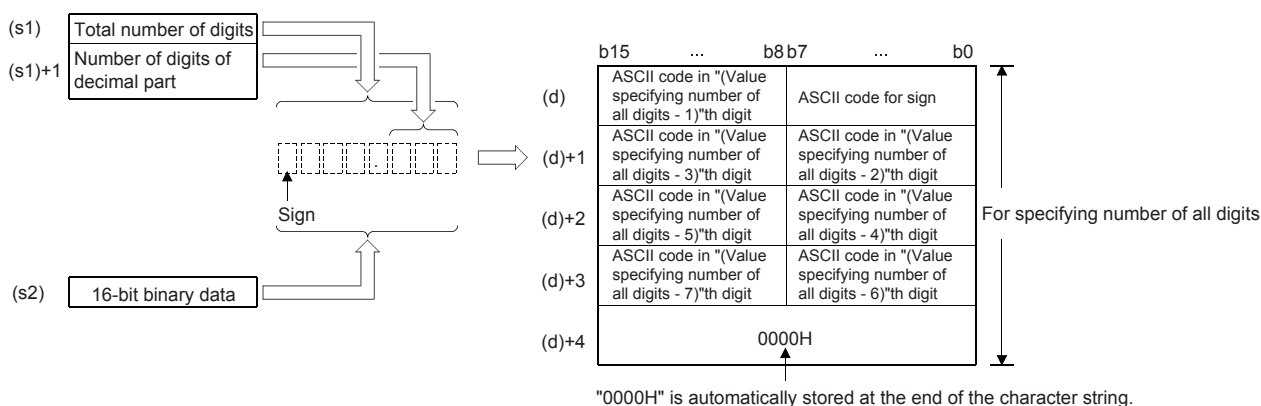
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

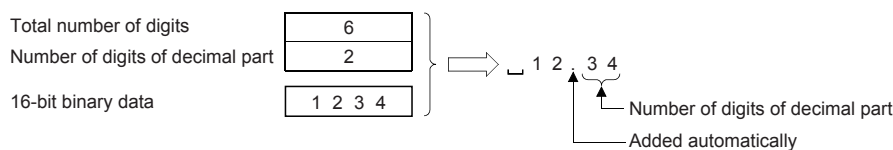
- These instructions add a decimal point to the 16-bit binary data in the device specified by (s2) at the location specified by (s1), convert the data to character string data, and store the converted data in the device areas specified by (d) and later.



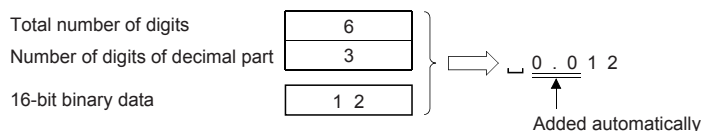
- The total number of digits that can be specified by (s1) is 2 to 8.
- The number of digits in the decimal part that can be specified by (s1)+1 is 0 to 5. Note that the number of digits in the decimal part must be smaller than or equal to the total number of digits minus 3.

- The converted character string data are stored in the device areas specified by (d) and later as shown below.

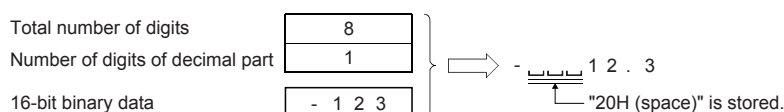
- As sign data, "20H" (space) is stored if the 16-bit binary data is positive, and "2DH" (-) is stored if the data is negative.
- If the number of digits in the decimal part is set to other than 0, "2EH" (.) is automatically stored at the position before the specified number of digits. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



- If the specified number of digits in the decimal part is greater than the number of digits of the 16-bit binary data, 0(s) is automatically added and the data is regarded as "0.□□□□".



- If the total number of digits excluding the sign and the decimal point is greater than the number of digits of the 16-bit binary data, "20H" (space) is stored between the sign and the numeric value. If the number of digits of the 16-bit binary data is greater, an error occurs.



- The value "00H" is automatically stored at the end of the converted character string.
- When the number of all digits is even, "0000H" is stored in the device after the last character. When the number of all digits is odd, "00H" is stored in the upper byte (8 bits) of the device storing the final character.

Operation error

Error code (SD0/SD8067)	Description
3401	<p>The number of digits specified by (s1) is smaller than the number of digits plus 2 of the 16-bit binary data in the device specified by (s2). (The additional 2 digits indicate the sign (+/-) and the decimal point.)</p> <p>The total number of digits specified by (s1) is out of the valid range (2 to 8).</p> <p>The number of digits in the decimal part specified by (s1)+1 is out of the valid range (0 to 5).</p> <p>The relationship between the total number of digits specified by (s1) and the number of digits in the decimal part specified by (s1)+1 does not satisfy the following. (Total number of digits)-3 ≥ Number of digits in the decimal part</p>
3406	The device areas storing the character string specified by (d) exceed the corresponding device range.
2820	The device range specified by (s1) exceeds the corresponding device range.

Converting 32-bit binary data to character string

DSTR(P)(_U)

These instructions add a decimal point to the 32-bit binary data in the device specified by (s2) at the location specified by (s1), convert the data to character string data, and store the converted data in the device areas specified by (d) and later.

Ladder diagram	Structured text	
	ENO:=DSTR(EN,s1,s2,d); ENO:=DSTRP(EN,s1,s2,d);	ENO:=DSTR_U(EN,s1,s2,d); ENO:=DSTRP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DSTR(P) DSTR(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(s2)	DSTR(P) DSTR(P)_U	-2147483648 to +2147483647 0 to 4294967295	16-bit signed binary 16-bit unsigned binary	ANY32
(d)	Head device number for storing the converted data	—	Character string	Character string

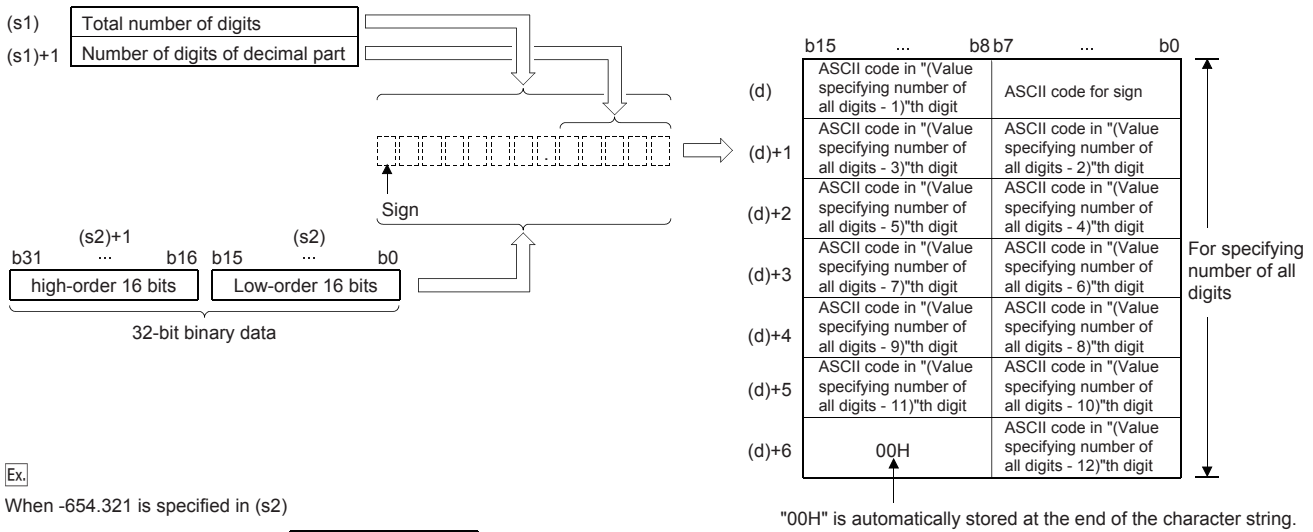
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

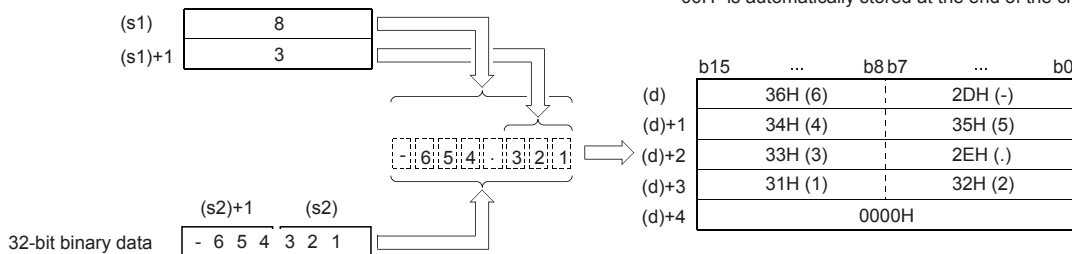
Processing details

- These instructions add a decimal point to the 32-bit binary data in the device specified by (s2) at the location specified by (s1), convert the data to character string data, and store the converted data in the device areas specified by (d) and later.

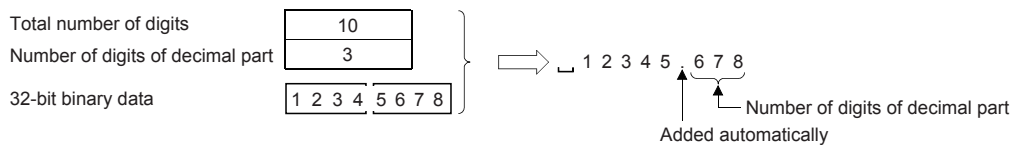


Ex.

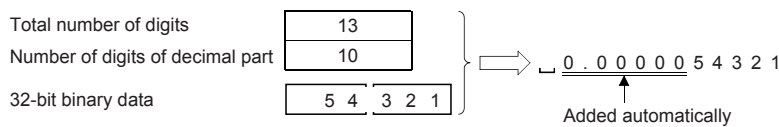
When -654.321 is specified in (s2)



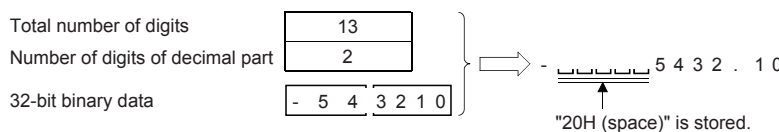
- The total number of digits that can be specified by (s1) is 2 to 13.
- The number of digits in the decimal part that can be specified by (s1)+1 is 0 to 10. Note that the number of digits in the decimal part must be smaller than or equal to the total number of digits minus 3.
- The converted character string data are stored in the device areas specified by (d) and later as shown below.
 - As sign data, "20H" (space) is stored if the 32-bit binary data is positive, and "2DH" (-) is stored if the data is negative.
 - If the number of digits in the decimal part is set to other than 0, "2EH" (.) is automatically stored at the position before the specified number of digits. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



- If the specified number of digits in the decimal part is greater than the number of digits of the 32-bit binary data, 0(s) is automatically added and the data is regarded as "0.□□□□".



- If the total number of digits excluding the sign and the decimal point is greater than the number of digits of the 32-bit binary data, "20H" (space) is stored between the sign and the numeric value. If the number of digits of the 32-bit binary data is greater, an error occurs.



- The value "00H" is automatically stored at the end of the converted character string.
- When the number of all digits is even, "0000H" is stored in the device after the last character. When the number of all digits is odd, "00H" is stored in the upper byte (8 bits) of the device storing the final character.

Operation error

Error code (SD0/SD8067)	Description
3401	The number of digits specified by (s1) is smaller than the number of digits plus 2 of the 16-bit binary data in the device specified by (s2). (The additional 2 digits indicate the sign (+/-) and the decimal point.)
	The total number of digits specified by (s1) is out of the valid range (2 to 13).
	The number of digits in the decimal part specified by (s1)+1 is out of the valid range (0 to 10).
	The relationship between the total number of digits specified by (s1) and the number of digits in the decimal part specified by (s1)+1 does not satisfy the following. (Total number of digits)-3 ≥ Number of digits in the decimal part
3406	The device areas storing the character string specified by (d) exceed the corresponding device range.
2820	The device range specified by (s1) exceeds the corresponding device range.

Converting single-precision real number to character string

ESTR(P)/DESTR(P)

These instructions convert the single-precision real number data stored in the device specified by (s1) into a character string according to the display specification stored in the device specified by (s2) and later, and store the string in the device specified by (d) and later.

The ESTR(P) instructions can also be used as DESTR(P).

Ladder diagram	Structured text
	ENO:=ESTR(EN,s1,s2,d); ENO:=ESTRP(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Single-precision real number data to be converted or the start number of the device where data is stored	$0, 2^{-126} < (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Head device number storing the display specification of a numeric value to be converted The device specified in (s2) and following 2 devices are used.	—	16-bit signed binary	ANY16
(d)	Head device number for storing the converted data	—	Character string	Character string

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—	—
(s2)	○	—	—	○	○	—	—	—	○	—	—	—	—	—
(d)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	—	—	—

*1 T, ST, C cannot be used.

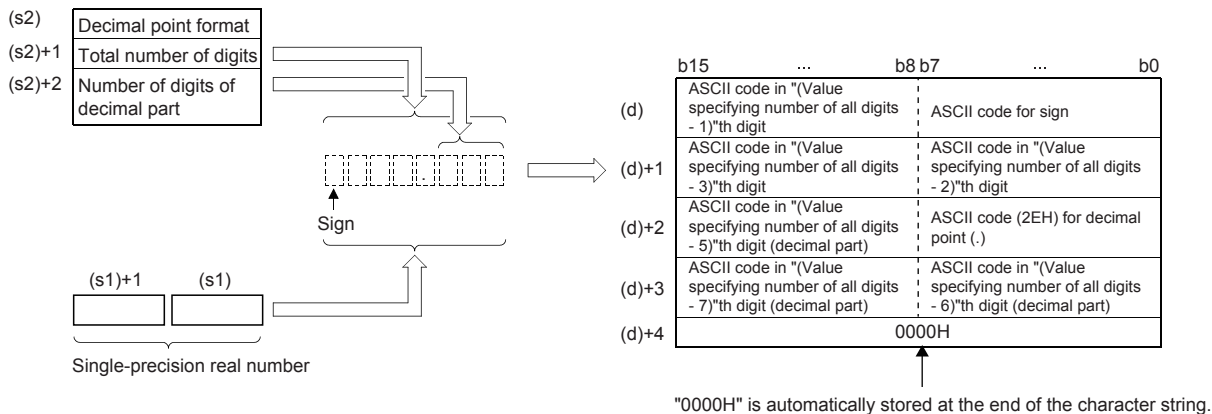
Processing details

- These instructions convert the single-precision real number data stored in the device specified by (s1) into a character string according to the display specification stored in the device specified by (s2) and later, and store the string in the device specified by (d) and later. A real number can be directly specified as (s1).
- The data after conversion varies depending on the display specification stored in (s2).

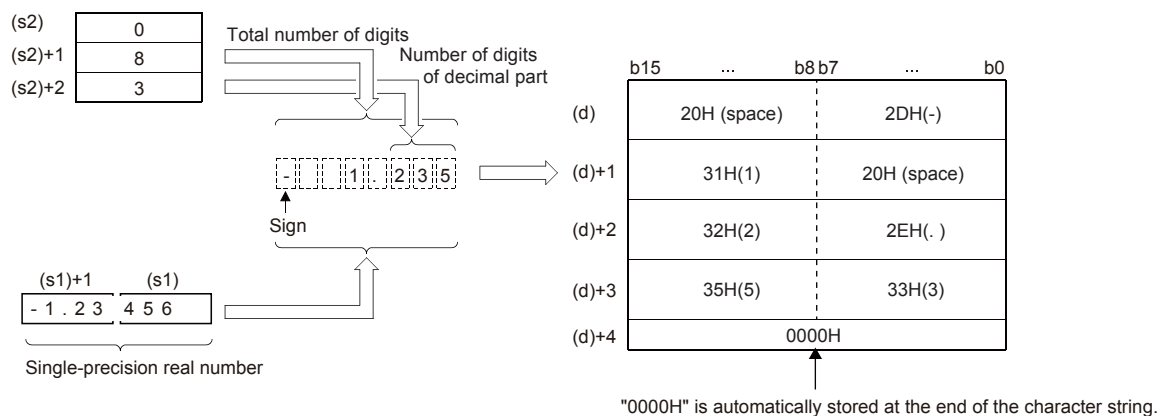
(s2)	0: Decimal part format 1: Exponent format	... 2 to 24 can be set.
(s2)+1	Total number of digits	
(s2)+2	Number of digits of decimal part	

■Decimal point format

- When 0 is specified in (s2), the decimal point format is applied.

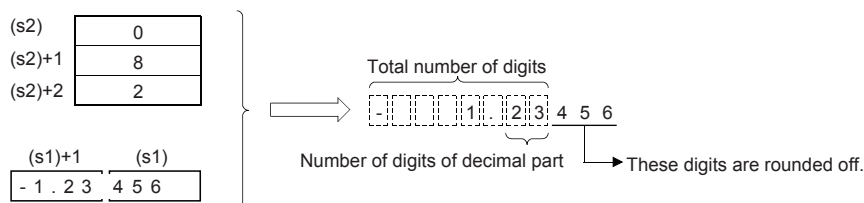


- When the number of decimal part digits is 0, the number of digits that can be specified by (s2)+1 is "the number of digits (24 at a maximum) \geq 2". For other than 0, the number of digits that can be specified by (s2)+1 is "the number of digits (24 at a maximum) \geq (the number of decimal point digits + 3)".
- The number of digits in the decimal part that can be specified by (s2)+2 is 0 to 7. Note that the number of digits in the decimal part must be smaller than the total number of digits minus 3.
- For example, when the total number of digits is "8", the number of digits of the decimal part is "3", and "-1.23456" is specified, data is stored in (d) and later as shown below:

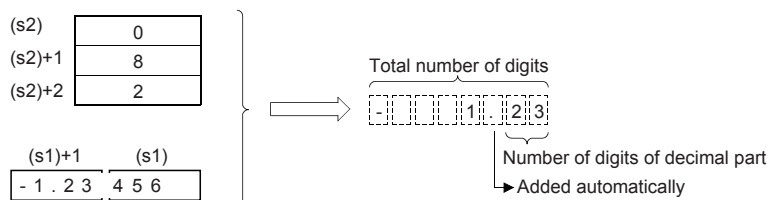


- The converted character string data are stored in the device areas specified by (d) and later as shown below.

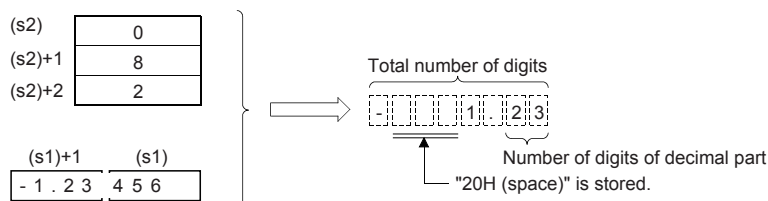
- As sign data, "20H" (space) is stored if the single-precision real number is positive, and "2DH" (-) is stored if the data is negative.
- If the decimal part of the single-precision real number data cannot be accommodated in the number of digits of the decimal part, lower digits of the decimal part are rounded off.



- If the number of digits in the decimal part is set to other than 0, "2EH" (.) is automatically stored at the position before the specified number of digits. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



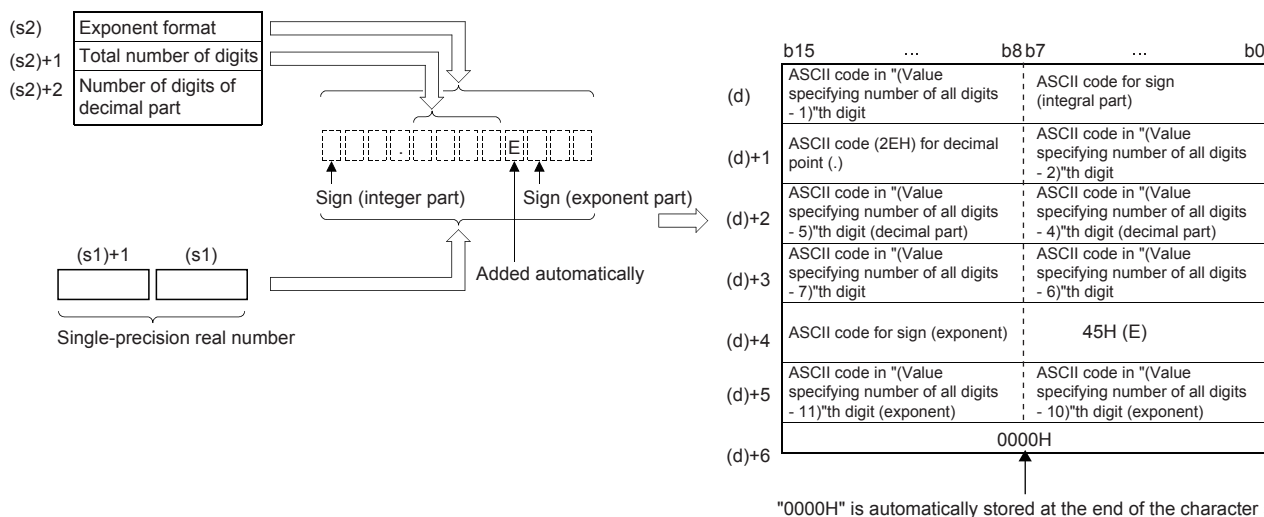
- When the total number of digits subtracted by the digits for sign, decimal point, and decimal part is larger than the integer part of the single-precision real number data, "20H" (space) is stored between the sign and the integer part.



- The value "00H" is automatically stored at the end of the converted character string.

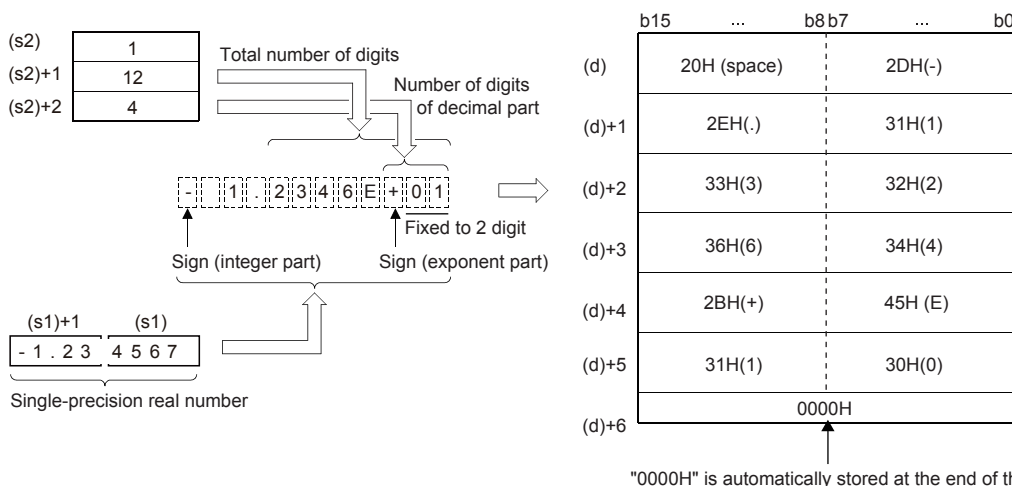
Exponent format

- When 1 is specified in (s2), the exponent format is applied.



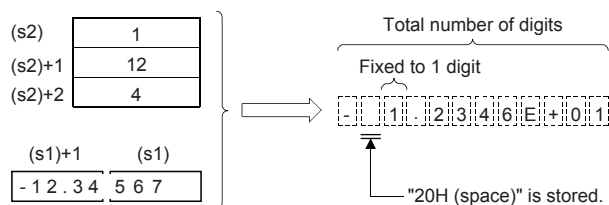
- When the number of decimal part digits is 0, the number of digits that can be specified by (s2)+1 is "the number of digits (24 at a maximum) \geq 6". For other than 0, the number of digits that can be specified by (s2)+1 is "the number of digits (24 at a maximum) $>$ (the number of decimal point digits + 7)".
- The number of digits in the decimal part that can be specified by (s2)+2 is 0 to 7. Note that the number of digits in the decimal part must be equal to or smaller than the total number of digits minus 7.

- For example, when the total number of digits is "12", the number of digits of the decimal part is "4", and "-12.34567" is specified, data is stored in (d) and later as shown below:

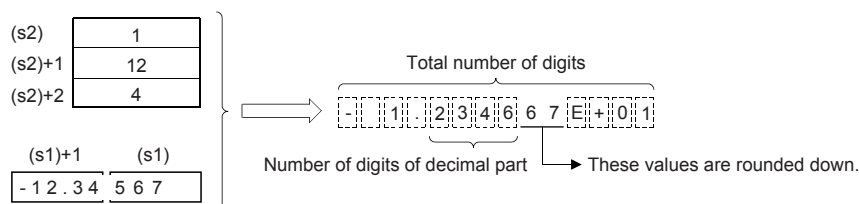


- The converted character string data are stored in the device areas specified by (d) and later as shown below.

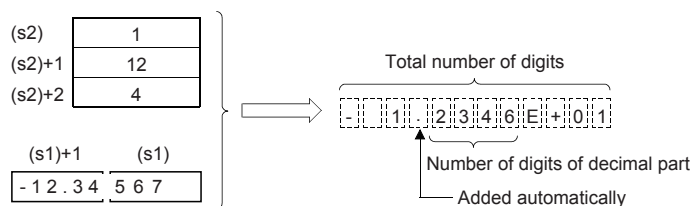
- As sign data of the integral part, "20H" (space) is stored if the single-precision real number is positive, and "2DH" (-) is stored if the data is negative.
- The integer part is fixed to 1 digit. "20H (space)" is stored between the integer part and the sign.



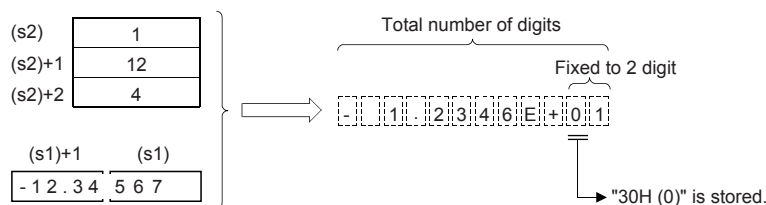
- If the decimal part of the single-precision real number data cannot be accommodated in the number of digits of the decimal part, lower digits of the decimal part are rounded.



- If the number of digits in the decimal part is set to other than 0, "2EH" (.) is automatically stored at the position before the specified number of digits. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



- For the sign of the exponent part, "2BH (+)" is stored when the exponent is positive, and "2DH (-)" is stored when the exponent is negative.
- The exponent part is fixed to 2 digits. When the exponent part is 1 digit, "30H (0)" is stored after the sign of the exponent part.



- The value "00H" is automatically stored at the end of the converted character string.

Operation error

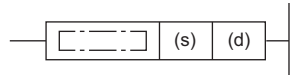
Error code (SD0/SD3067)	Description
2820	The device specified by (s2) exceeds the corresponding device range.
3401	<p>The number of total digits specified by (s1)+1 exceeds 24.</p> <p>The format specified by (s2) is any value other than "0" or "1".</p> <p>The total number of digits specified by (s2)+1 is not within the following range in the decimal point format. When the number of digits of the decimal part is "0": Total number of digits ≥ 2 When the number of digits of the decimal part is any value other than "0": Total number of digits $\geq (\text{Number of digits of decimal part} + 3)$</p> <p>The total number of digits specified by (s2)+1 is not within the following range in the exponent format. When the number of digits of the decimal part is "0": Total number of digits ≥ 6 When the number of digits of the decimal part is any value other than "0": Total number of digits $\geq (\text{Number of digits of decimal part} + 7)$</p> <p>The number of digits of the decimal part specified by (s2)+2 is not within the following range. In the decimal part format $\leq (\text{Total number of digits} - 3)$ In the exponent format $\leq (\text{Total number of digits} - 7)$</p> <p>When the conversion result exceeds the specified total number of digits</p>
3402	<p>(s1) is not within the following range $0, \pm 2^{-126} \leq (s1) < \pm 2^{128}$</p> <p>The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.</p>
3405	The number of digits of the decimal part specified by (s2)+2 is not within the following range. 0 to 7
3406	The device areas that store the character string specified by (d) exceed the corresponding device range.

Detecting a character string length


LEN(P)

These instructions detect the length of the character string specified by (s), and store the length in the device specified by (d) and later.

These instructions handle data stored in the device specified by (s) to the device storing 00H as a character string.

Ladder diagram	Structured text ^{*1}
	ENO:=LENP(EN,s,d);

^{*1} The LEN instruction is not supported by the ST language. Use LEN of the standard function.

 Page 814 LEN(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string or head device number storing a character string	—	Character string	Character string
(d)	Device number storing the detected character string length	—	16-bit signed binary	ANY16

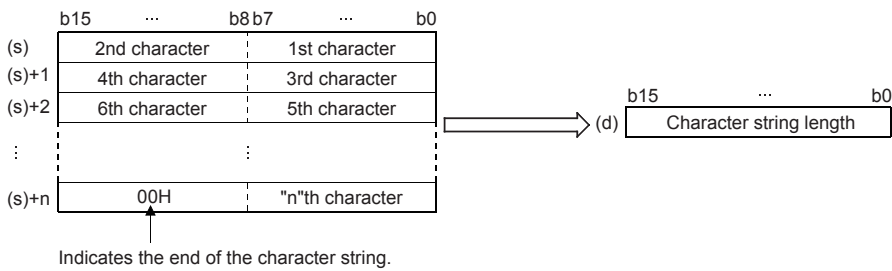
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	○	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

^{*1} T, ST, C cannot be used.

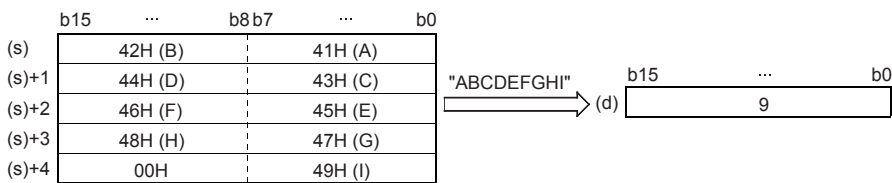
Processing details

- These instructions detect the length of the character string specified by (s), and store the length in the device specified by (d) and later.
- These instructions handle data stored in the device specified by (s) to the device storing 00H as a character string.



Ex.

When "ABCDEFGHI" is stored in (s) and later



Precautions

The LEN(P) instructions can handle character codes other than ASCII codes, but the character string length is handled in byte units (8 bits). Accordingly, in the case of character codes in which 2 bytes express 1 character such as shift JIS codes, the length of 1 character is detected as "2".

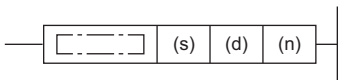
Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	The character string specified by (s) has more than 16383 characters.


Extracting character string data from the right

RIGHT(P)

These instructions extract "n" characters of the character string data stored in the device specified by (s) and later from the right end (from the end), and store the extracted characters in the device specified by (d) and later.

Ladder diagram	Structured text ^{*1}
	ENO:=RIGHTP(EN,s,n,d);

^{*1} The RIGHT instruction is not supported by the ST language. Use RIGHT of the standard function.

 Page 815 LEFT(_E), RIGHT(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string or head device number storing a character string	—	Character string	Character string
(d)	Head device number for storing "n" characters extracted from the right of the device specified by (s)	—	Character string	Character string
(n)	Number of characters to be extracted	1 to 16383	16-bit unsigned binary	ANY16

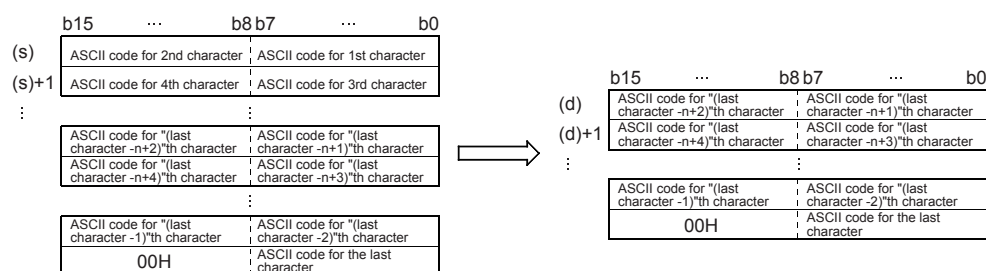
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

^{*1} T, ST, C cannot be used.

Processing details

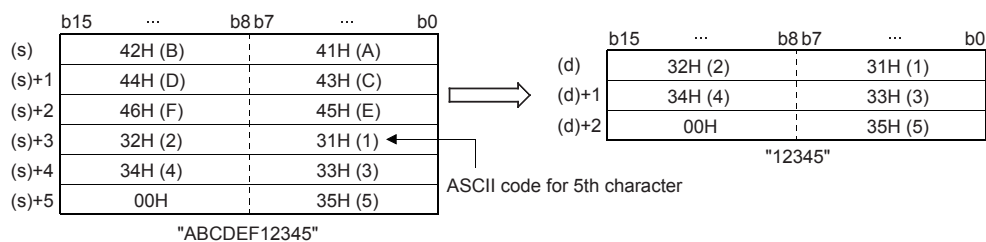
- These instructions extract "n" characters of the character string data stored in the device specified by (s) and later from the right end (from the end), and store the extracted characters in the device specified by (d) and later.



- A character string stored in (s) indicates data stored in devices from the specified device until "00H" is first detected in units of 1 byte.

Ex.

When 5 is specified in (n)



- A NULL code (00H), which indicates an end of a character string, is automatically added at the end of the character string data.
- When the number of extracted characters is odd, "00H" is stored in the upper byte of a device storing the last character. When the number of extracted characters is even, "0000H" is stored in the device after the last character.
- When the number of characters specified by (n) is 0, a NULL code (00H) is stored in (d).

Precautions

When handling character codes other than ASCII codes, note the following points:

- The number of characters is handled in byte units (8 bits). Accordingly, in the case of character codes in which 2 bytes express 1 character such as shift JIS codes, 1 character is detected as "2".
- When extracting characters from a character string including character codes in which 2 bytes express 1 character such as shift JIS codes, consider the number of characters to be extracted in units of character codes for 1 character. Note that the expected character code is not retrieved if only 1 byte is extracted out of a 2-byte character code.

7

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	(n) is not within the following range 0 to 16383
	The character string specified by (s) has more than 16383 characters.
	"n" exceeds the number of characters specified by (s)
3406	The (n) points of data in the device starting from the one specified by (d) exceed the corresponding device range.

Extracting character string data from the left

LEFT(P)

These instructions extract "n" characters of the character string data stored in the device specified by (s) and later from the left end (from the start), and store the extracted characters in the device specified by (d) and later.

Ladder diagram	Structured text ^{*1}
	ENO:=LEFTP(EN,s,n,d);

^{*1} The LEFT instruction is not supported by the ST language. Use LEFT of the standard function.
 Page 815 LEFT(_E), RIGHT(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string or head device number storing a character string	—	Character string	Character string
(d)	Head device number for storing "n" characters extracted from the left of the device specified by (s)	—	Character string	Character string
(n)	Number of characters to be extracted	1 to 16383	16-bit unsigned binary	ANY16

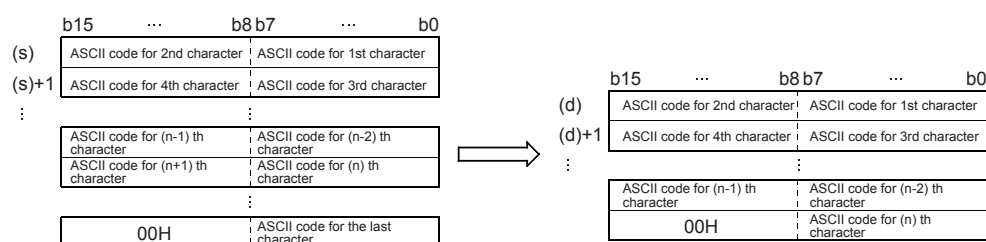
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

^{*1} T, ST, C cannot be used.

Processing details

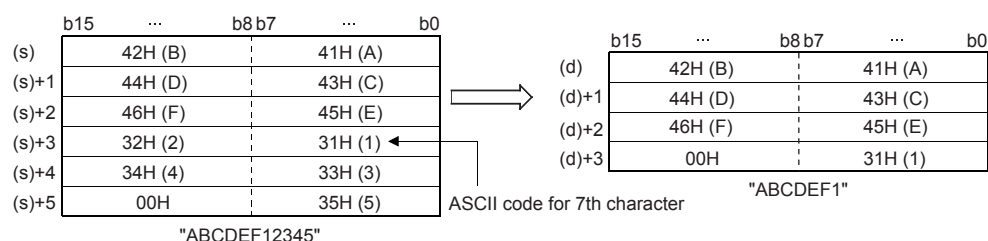
- These instructions extract "n" characters of the character string data stored in the device specified by (s) and later from the left end (from the start), and store the extracted characters in the device specified by (d) and later.



- A character string stored in (s) indicates data stored in devices from the specified device until "00H" is first detected in units of 1 byte.

Ex.

When 7 is specified in (n)



- A NULL code (00H), which indicates an end of a character string, is automatically added at the end of the character string data.
- When the number of extracted characters is odd, "00H" is stored in the upper byte of a device storing the last character. When the number of extracted characters is even, "0000H" is stored in the device after the last character.
- When the number of characters specified by (n) is 0, a NULL code (00H) is stored in (d).

Precautions

When handling character codes other than ASCII codes, note the following points:

- The number of characters is handled in byte units (8 bits). Accordingly, in the case of character codes in which 2 bytes express 1 character such as shift JIS codes, 1 character is detected as "2".
- When extracting characters from a character string including character codes in which 2 bytes express 1 character such as shift JIS codes, consider the number of characters to be extracted in units of character codes for 1 character. Note that the expected character code is not retrieved if only 1 byte is extracted out of a 2-byte character code.

7

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	(n) is not within the following range 0 to 16383 The character string specified by (s) has more than 16383 characters. "n" exceeds the number of characters specified by (s)
3406	The (n) points of data in the device starting from the one specified by (d) exceed the corresponding device range.

Storing the specified number of character strings

MIDR(P)

These instructions extract the number of characters specified by (s2)+1 of the character string data stored in the device specified by (s1) and later from the position specified by (s2), and store the extracted characters in the device specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=MIDR(EN,s1,s2,d); ENO:=MIDRP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Character string or head device number storing a character string	—	Character string	Character string
(d)	Head device number for storing the character string data of the operation result	—	Character string	Character string
(s2)	Head device number for storing the number of characters and position of the start character (s2)+0: Position of the start character, (s2)+1: Number of characters	—	16-bit signed binary	ANY16

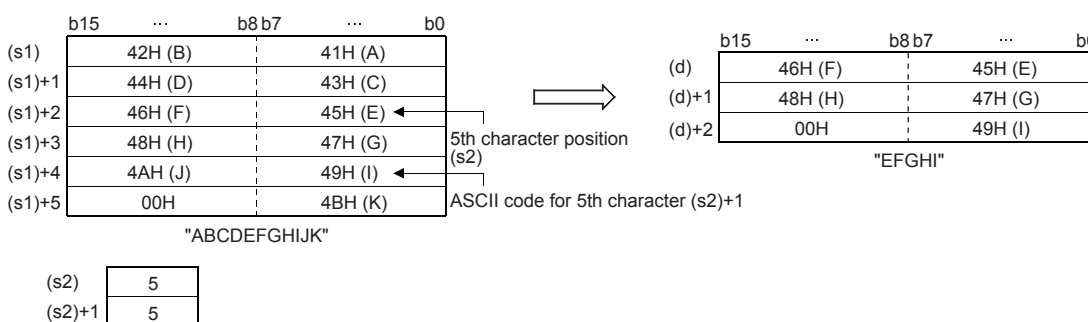
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

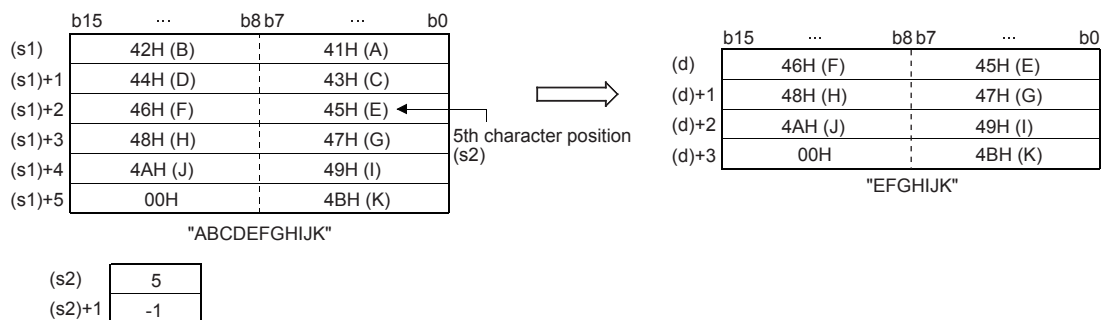
Processing details

- These instructions extract the number of characters specified by (s2)+1 of the character string data stored in the device specified by (s1) and later from the position specified by (s2), and store the extracted characters in the device specified by (d) and later.



- A character string stored in (s1) indicates data stored in devices from the specified device until "00H" is first detected in units of byte.
- A NULL code (00H), which indicates an end of a character string, is automatically added at the end of the character string data.
- When the number of extracted characters "(s2)+1" is odd, "00H" is stored in the upper byte of a device storing the last character. When the number of extracted characters "(s2)+1" is even, "0000H" is stored in the device after the last character.
- If the number of characters specified by (s2)+1 is 0, no processing is performed.

- When (s2)+1 (the number of characters to be extracted) is "-1", the entire character string stored in (s1) and later is stored to (d) and later.



Precautions

When handling character codes other than ASCII codes, note the following points:

- The number of characters is handled in byte units (8 bits). Accordingly, in the case of character codes in which 2 bytes express 1 character such as shift JIS codes, 1 character is detected as "2".
- When extracting characters from a character string including character codes in which 2 bytes express 1 character such as shift JIS codes, consider the number of characters to be extracted in units of character codes for 1 character. Note that the expected character code is not retrieved if only 1 byte is extracted out of a 2-byte character code.

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) and later, "00H" does not exist.
3405	The value stored in a device specified in (s2)+1 is -2 or lower.
	The value stored in a device specified in (s2) exceeds the number of characters of (s1).
	A negative value is specified in (s2).
	The value stored in a device specified in (s2)+1 exceeds the number of characters of (s1).
	The character string specified by (s1) has more than 16383 characters.
	The total of the values stored in devices specified in (s2) and (s2)+1 exceeds the number of characters of (s1).
3406	The number of characters from the position specified by (d) to (s2)+1 exceeds the corresponding device range.

Replacing the specified number of character strings

MIDW(P)

These instructions extract the number of characters specified by (s2)+1 from the character string data stored in the device specified by (s1) and later, and store the extracted data in the position specified by (s2) and later of the character string data stored in the device specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=MIDW(EN,s1,s2,d); ENO:=MIDWP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Character string or head device number storing a character string	—	Character string	Character string
(d)	Head device number for storing the character string data of the operation result	—	Character string	Character string
(s2)	Head device number for storing the number of characters and position of the start character (s2)+0: Position of the start character, (s2)+1: Number of characters	—	16-bit signed binary	ANY16

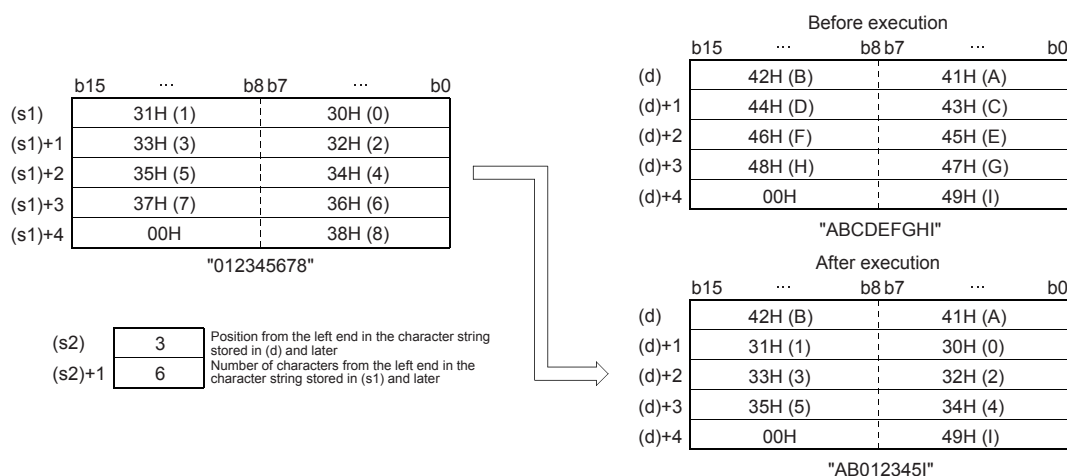
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	—	—	—	—

*1 T, ST, C cannot be used.

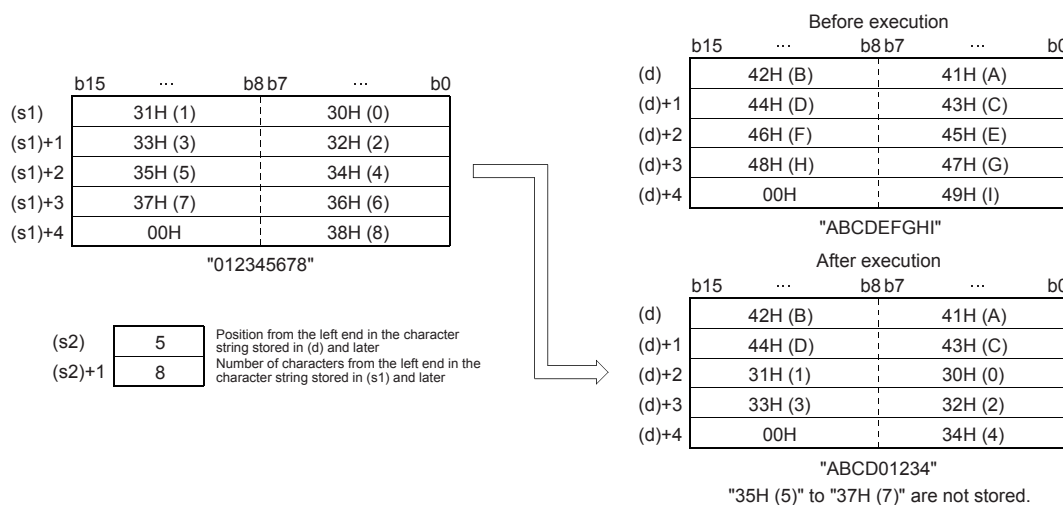
Processing details

- These instructions extract the number of characters specified by (s2)+1 from the character string data stored in the device specified by (s1) and later, and store the extracted data in the position specified by (s2) and later of the character string data stored in the device specified by (d) and later.

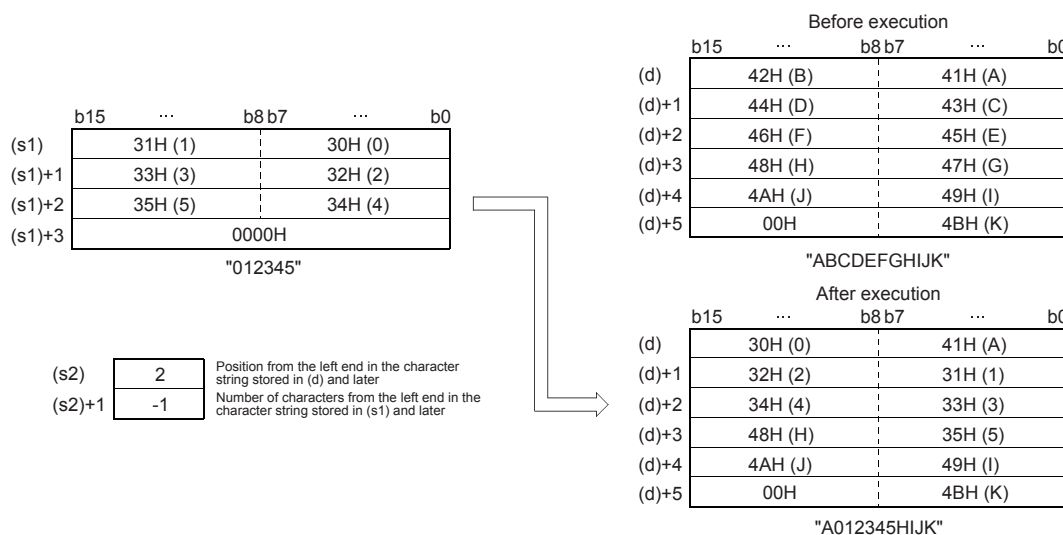


- A character string stored in (s1) or (d) indicates data stored in devices from the specified device until "00H" is first detected in units of 1 byte.
- A NULL code (00H), which indicates an end of a character string, is automatically added at the end of the character string data.

- If the number of characters specified by (s2)+1 is 0, no processing is performed.
- When the number of characters specified by (s2)+1 exceeds the last character of the character string specified by (d), data is stored up to the last character of (d).



- When (s2)+1 (the number of characters to be extracted) is "-1", the entire character string stored in (s1) and later is stored to (d) and later.



Precautions

When handling character codes other than ASCII codes, note the following points:

- The number of characters is handled in byte units (8 bits). Accordingly, in the case of character codes in which 2 bytes express 1 character such as shift JIS codes, 1 character is detected as "2".
- When extracting characters from a character string including character codes in which 2 bytes express 1 character such as shift JIS codes, consider the number of characters to be extracted in units of character codes for 1 character. Note that the expected character code is not retrieved if only 1 byte is extracted out of a 2-byte character code.

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) and later, "00H" does not exist.
	The device specified by (d) exceeds the corresponding device range.
3405	The value stored in a device specified in (s2)+1 is -2 or lower.
	The value stored in a device specified in (s2) exceeds the number of characters of (d).
	The value stored in a device specified in (s2)+1 exceeds the number of characters of (s1).
	The character string specified by (s1) has more than 16383 characters.
	The character string specified by (d) has more than 16383 characters.

Searching character string

INSTR(P)

These instructions search the character string data stored in the device specified by (s2) and later starting from the (s3)th character from the left, for the character string data stored in the device specified by (s1) and later and store the search result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=INSTR(EN,s1,s2,s3,d); ENO:=INSTRP(EN,s1,s2,s3,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Character string to be searched for or head device number storing a character string to be searched for	—	Character string	Character string
(s2)	Character string to be searched or head device number storing a character string to be searched	—	Character string	Character string
(d)	Head device number storing search result	—	16-bit signed binary	ANY16
(s3)	Search start position	1 to 16383	16-bit unsigned binary	ANY16

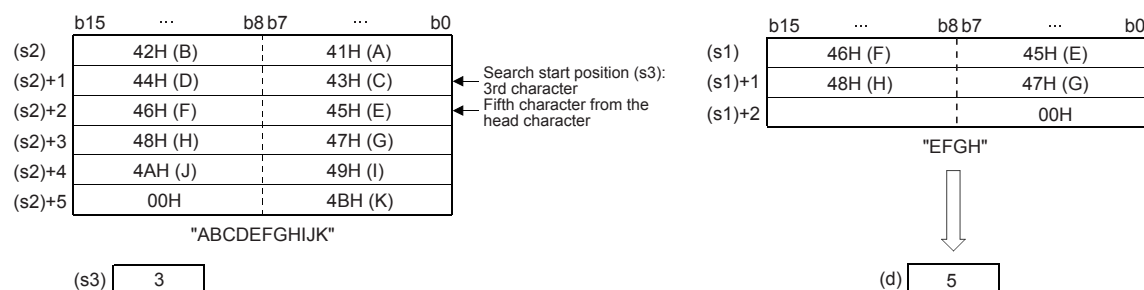
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(s2)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

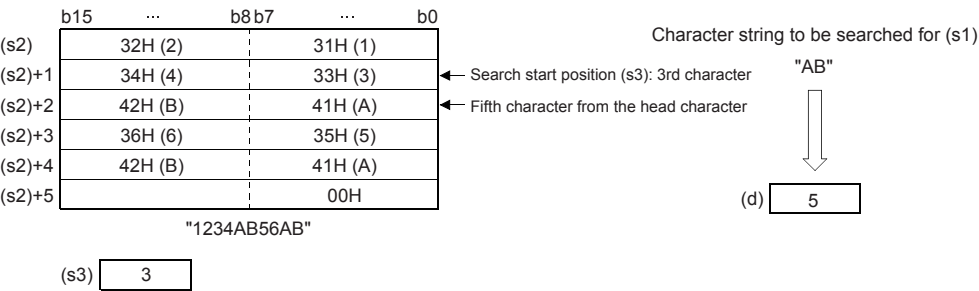
Processing details

- These instructions search the character string data stored in the device specified by (s2) and later starting from the (s3)th character from the left, for the character string data stored in the device specified by (s1) and later and store the search result in the device specified by (d). The search result stores the position where the first detected character is located from the start character in the character string data stored in (s2).



- If no matched character string data is found, 0 is stored in (d).
- When the search start position "s3" is a negative number or "0", search processing is not executed.

- A character string can be directly specified in the character string (s1).



Operation error

Error code (SD0/SD8067)	Description
2820	No NULL code (00H) exists in the corresponding device range of the device specified by (s1) and later.
	No NULL code (00H) exists in the corresponding device range of the device specified by (s2) and later.
3405	The value stored in a device specified in (s3) exceeds the number of characters of (s2).
	The character string specified by (s1) has more than 16383 characters.
	The character string specified by (s2) has more than 16383 characters.

Inserting character string

STRINS(P)

These instructions insert the character string specified by (s1) at the (s2)th character from the start of the character string specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=STRINS(EN,s1,s2,d); ENO:=STRINSP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Character string to be inserted or head device number storing the character string to be inserted	—	Character string	Character string
(d)	Head device number storing a character string to which another character string is inserted	—	Character string	Character string
(s2)	Insertion position (in units of bytes)	1 to 16383	16-bit unsigned binary	ANY16

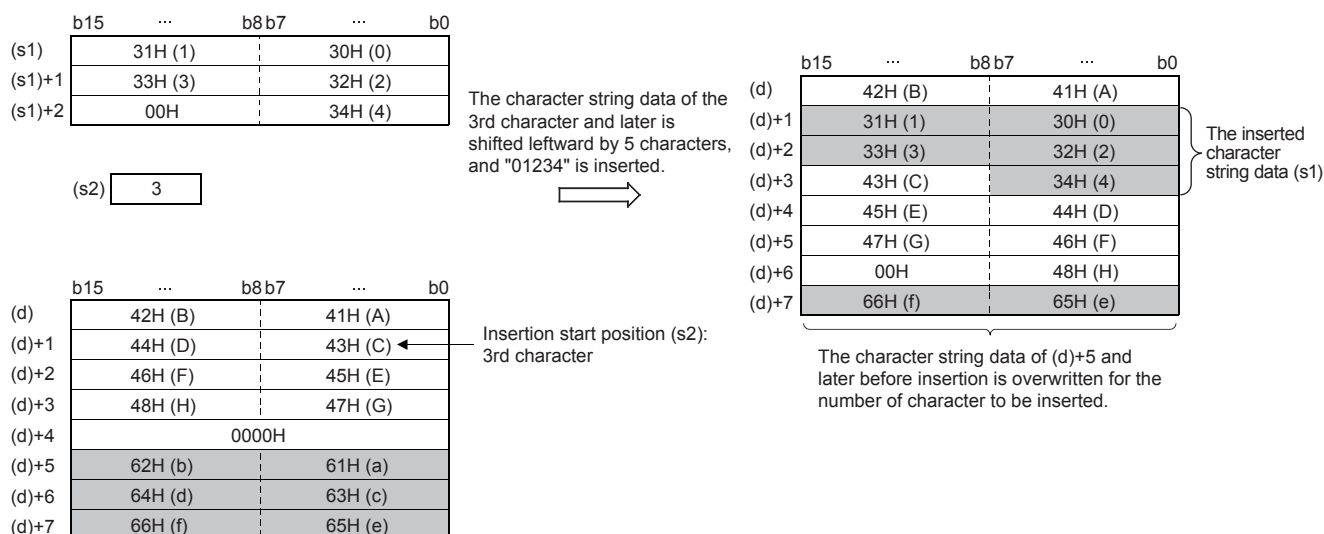
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	○	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions insert the character string specified by (s1) at the (s2)th character from the start of the character string specified by (d).



- When the number of characters after insertion, (s1)+(d), is even, a NULL code (00H) is stored in the device (1 word) after the last device storing the character string.
- When the number of characters after insertion, (s1)+(d), is odd, a NULL code (00H) is stored in the last device (upper 8 bits) of the character string.
- If the number of characters exceeding (d) by one character is specified in (s2), the character string in (s1) is added to the end of the character string in (d).

Operation error

Error code (SD0/SD8067)	Description
2820	No NULL code (00H) exists in the corresponding device range of the device specified by (s1) and later. No NULL code (00H) exists in the corresponding device range of the device specified by (d) and later.
2821	A device of the character strings (s1) and (d) overlaps. The device storing the character string after insertion, (s1)+(d), overlaps with the character string-storing device of (s1).
3405	The character string specified by (s1) has more than 16383 characters. The character string specified by (d) has more than 16383 characters. (s2) is not within the range (1≤(s2)≤16383) The value specified by (s2) exceeds "the number of characters of the character string (d) + 1".
3406	The character string after insertion, (s1)+(d), has more than 16383 characters. The character string after insertion, (s1)+(d), exceeds the corresponding device range.

Deleting character string

STRDEL(P)

These instructions delete (n) characters starting from the (s)th character (deletion start position) from the start of the character string data specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=STRDEL(EN,s,n,d); ENO:=STRDELP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number storing a character string having characters to be deleted	—	Character string	Character string
(s)	Deletion start position	1 to 16383	16-bit unsigned binary	ANY16
(n)	Number of characters to be deleted	0 to 16384 - (n1)	16-bit unsigned binary	ANY16

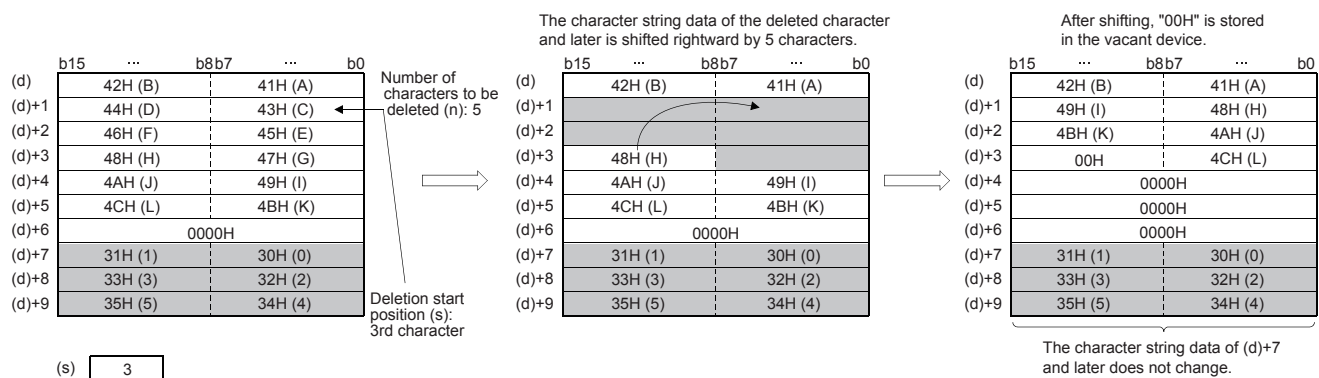
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(s)	—	—	—	○	○	○	—	—	○	○	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions delete (n) characters starting from the (s)th character (deletion start position) from the start of the character string data specified by (d).



- When the number of characters after deletion, (d), is even, a NULL code (00H) is stored in the device after the last device storing the character string.
- When the number of characters after deletion, (d), is odd, a NULL code (00H) is stored in the last device (upper 8 bits) of the character string.
- The character string after the deleted character string is shifted by (n) characters, a NULL code (00H) is stored in vacant devices.

Operation error

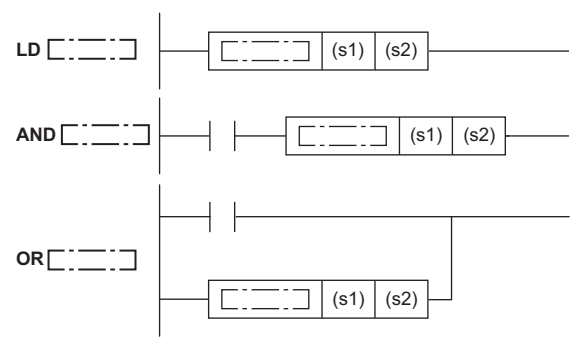
Error code (SD0/SD8067)	Description
2820	No NULL code (00H) exists in the corresponding device range of the device specified by (d) and later.
3405	The character string specified by (d) has more than 16383 characters.
	(s) is not within the range ($1 \leq (s) \leq 16383$)
	The value specified by (s) exceeds the number of characters of the character string (d).
	The value specified by (n) exceeds the number of characters from (s) to the last of the character string (d).

7.7 Real Number Instruction

Comparing single-precision real numbers

LDE□, ANDE□, ORE□

These instructions perform a comparison operation between the single-precision real number in the device specified by (s1) and the single-precision real number in the device specified by (s2). (Devices are used as a normally open contact.)

Ladder diagram	Structured text
 <p>(E=, E<>, E>, E<=, E<, or E>= enters □.)</p>	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Comparison data or the head device number where the comparison data is stored	$0, 2^{-126} < (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Comparison data or the head device number where the comparison data is stored	$0, 2^{-126} < (s2) < 2^{128}$	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	—	○	—	—

Processing details

- These instructions perform a comparison operation between the single-precision real number in the device specified by (s1) and the single-precision real number in the device specified by (s2). (Devices are used as a normally open contact.)
- The following table lists the comparison operation results of each instruction.

Instruction symbol	Condition	Result	Instruction symbol	Condition	Result
E=	(s1)=(s2)	Conductive state	E=	(s1)≠(s2)	Non-conductive state
E<>	(s1)≠(s2)		E<>	(s1)=(s2)	
E>	(s1)>(s2)		E>	(s1)<(s2)	
E<=	(s1)<(s2)		E<=	(s1)>(s2)	
E<	(s1)<(s2)		E<	(s1)>(s2)	
E>=	(s1)>(s2)		E>=	(s1)<(s2)	

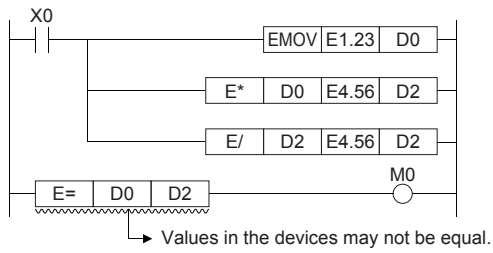
- When an input value is set from the engineering tool, a rounding error may occur.

Operation error

There is no operation error.

Point

When the E= instruction is used, note that values in the devices may not be equal.



Single-precision real number comparison

DECMP(P)

These instructions compare two data values (single-precision real number), and output the result (larger, same or smaller) to three consecutive bit devices.

Ladder diagram	Structured text
	<pre>ENO:=DECMP(EN,s1,s2,d); ENO:=DECMP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

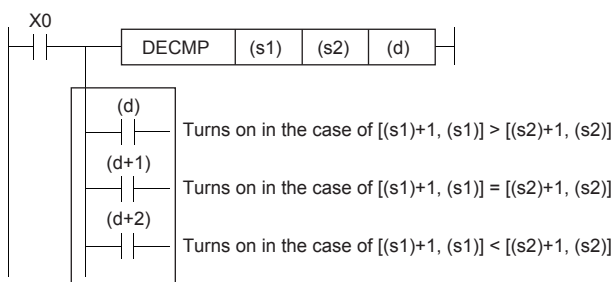
Operand	Description	Range	Data type	Data type (label)
(s1)	Comparison data or the number of the device where the comparison data is stored	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Comparison data or the number of the device where the comparison data is stored	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Start bit device number to which comparison result is output (Three devices are occupied).	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	○	○	—	—
(d)	○	—	—	○	—	—	—	—	—	—	—	—	—

Processing details

- These instructions compare the comparison value (s1) with the comparison source (s2) as floating point data, and one of the bits among (d), (d)+1, and (d)+2 turns on according to the result (smaller, same or larger).



Even if the command input X0 turns off before the DECMP instruction is fully executed, (d) to (d)+2 hold the status.

- When the constant (K or H) is specified the device specified by (s1) and (s2), these instructions convert the binary value into single-precision real number automatically.

Precautions

- Three devices ((d), (d)+1, and (d)+2) specified by (d) are occupied. Note that these devices are not used for any other purpose.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.

Single-precision real number data band comparison

DEZCP(P)

These instructions compare the comparison range of two points, upper and lower, with the binary floating point, and output the result to three consecutive bit devices in accordance with the larger, smaller, and band.

Ladder diagram	Structured text
	<pre>ENO:= DEZCP (EN, s1, s2, s3, d); ENO:= DEZCPP(EN, s1, s2, s3, d);</pre>

Setting data

■Descriptions, ranges, and data types

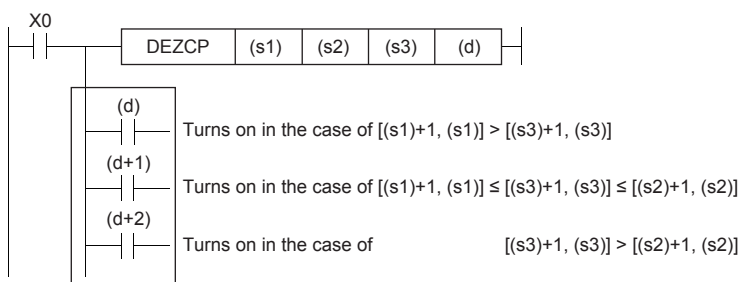
Operand	Description	Range	Data type	Data type (label)
(s1)	Comparison data or the number of the device where the comparison data is stored	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Comparison data or the number of the device where the comparison data is stored	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(s3)	Comparison data or the number of the device where the comparison data is stored	$0, 2^{-126} \leq (s3) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Start bit device number to which comparison result is output (Three devices are occupied).	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s3)	—	—	—	○	○	—	○	—	○	○	○	—	—
(d)	○	—	—	○	—	—	—	—	—	—	—	—	—

Processing details

- These instructions compare the comparison values (s1) and (s2) with the comparison source (s3) as floating point data, and one of the bits among (d), (d)+1, and (d)+2 turns on according to the result (smaller, within the range or larger).



Even if the command input X0 turns off before the DEZCP instruction is fully executed, (d) to (d)+2 hold the status.

- When the constant (K or H) is specified the device specified by (s1), (s2) and (s3), these instructions convert the binary value into single-precision real number automatically.

Precautions

- Three devices ((d), (d)+1, and (d)+2) specified by (d) are occupied. Note that these devices are not used for any other purpose.
- The size relationship of the comparison data should be $[(s1)+1, (s1)] \leq [(s2)+1, (s2)]$. If the relationship is $[(s1)+1, (s1)] > [(s2)+1, (s2)]$, the value of $[(s2)+1, (s2)]$ is regarded as the same as that of $[(s1)+1, (s1)]$, and is compared.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.

Adding single-precision real numbers

E+(P) [For 2 operands]

These instructions add the single-precision real number in the device specified by (s) to the single-precision real number in the device specified by (d), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

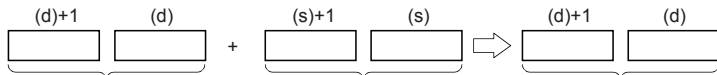
Operand	Description	Range	Data type	Data type (label)
(s)	Addend data or the head device number where the data that is added to another is stored	$0, 2^{-126} \leq (s) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number where the data to which another is added is stored	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions add the single-precision real number in the device specified by (s) to the single-precision real number in the device specified by (d), and store the result in the device specified by (d).



Single-precision real number Single-precision real number Single-precision real number

- Values in the devices specified (stored) by (s) and (d) should be $0, 2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$.
- When an input value is set from the engineering tool, a rounding error may occur.
- The table below shows the related devices.

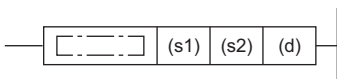
Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{Specified device value} < 2^{128}$

E+(P) [For 3 operands]

These instructions add the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

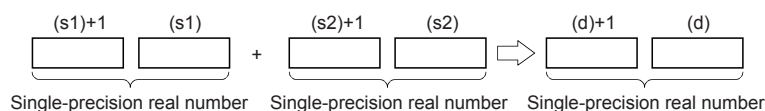
Operand	Description	Range	Data type	Data type (label)
(s1)	Augend data or the head device number where the data to which another is added is stored	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Addend data or the head device number where the data that is added to another is stored	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions add the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- Values in the devices specified (stored) by (s1), (s2), and (d) should be 0 or $2^{-126} \leq |\text{specified value (stored value)}| \leq 2^{128}$.
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

Subtracting single-precision real numbers

E-(P) [For 2 operands]

These instructions subtract the single-precision real number in the device specified by (s) from the single-precision real number in the device specified by (d), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

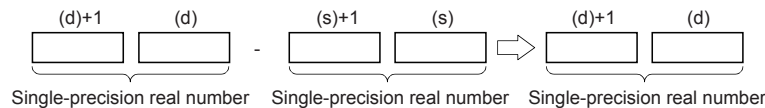
Operand	Description	Range	Data type	Data type (label)
(s)	Subtrahend data or the head device number where the data to be subtracted from another is stored	$0, 2^{-126} \leq (s) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number where the data from which another is to be subtracted is stored	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions subtract the single-precision real number in the device specified by (s) from the single-precision real number in the device specified by (d), and store the result in the device specified by (d).



- Values in the devices specified (stored) by (s) and (d) should be 0 or $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$.
- When an input value is set from the engineering tool, a rounding error may occur.
- The table below shows the related devices.

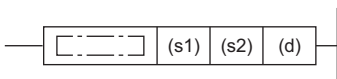
Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

E-(P) [For 3 operands]

These instructions subtract the single-precision real number in the device specified by (s2) from the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

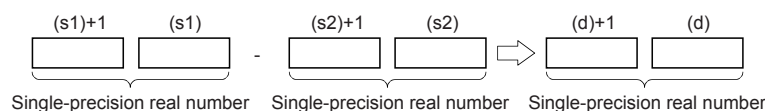
Operand	Description	Range	Data type	Data type (label)
(s1)	Minuend data or head device number where the data from which another is to be subtracted is stored	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Subtrahend data or head device number where the data to be subtracted from another is stored	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions subtract the single-precision real number in the device specified by (s2) from the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- Values in the devices specified (stored) by (s1), (s2), and (d) should be 0 or $2^{-126} | \text{specified value (stored value)} | \leq 2^{128}$.
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

Adding single-precision real numbers

DEADD(P)

These instructions add the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DEADD(EN,s1,s2,d); ENO:=DEADDP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

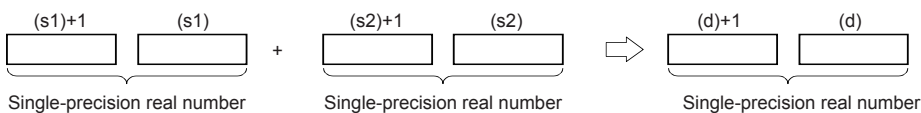
Operand	Description	Range	Data type	Data type (label)
(s1)	Augend data or head device number where the data to which another is added is stored	$0, 2^{-126} \leq (s1) \leq 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Addend data or head device number where the data that is added to another is stored	$0, 2^{-126} \leq (s2) \leq 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

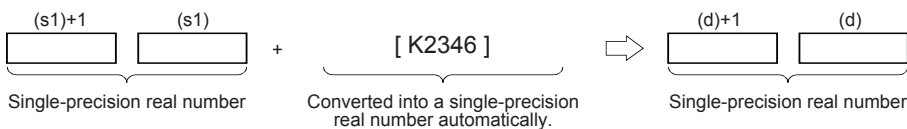
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	○	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions add the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- When the constant (K or H) is specified in (s1) and (s2), these instructions convert values into single-precision real number automatically.



- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Precautions

The same device number can be specified for (s1), (s2), and (d). In this case, note that the addition result changes in every operation cycle when the continuous operation type instruction (DEADD) is used.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.

Subtracting single-precision real numbers

DESUB(P)

These instructions subtract the single-precision real number in the device specified by (s2) from the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DSUB(EN,s1,s2,d); ENO:=DSUBP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

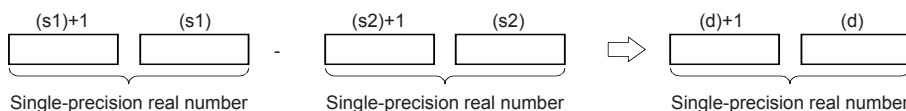
Operand	Description	Range	Data type	Data type (label)
(s1)	Minuend data or head device number where the data from which another is subtracted is stored	$0, 2^{-126} \leq (s1) \leq 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Minuend data or head device number where the data that is subtracted another is stored	$0, 2^{-126} \leq (s2) \leq 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

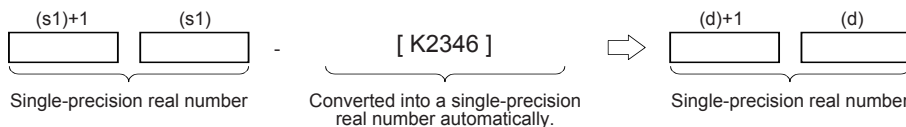
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	○	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions subtract the single-precision real number in the device specified by (s2) from the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- When the constant (K or H) is specified in (s1) and (s2), these instructions convert values into single-precision real number automatically.



- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Precautions

The same device number can be specified for (s1), (s2), and (d). In this case, note that the subtraction result changes in every operation cycle when the continuous operation type instruction (DESUB) is used.

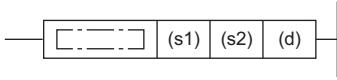
Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.

Multiplying single-precision real numbers

E*(P)

These instructions multiply the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

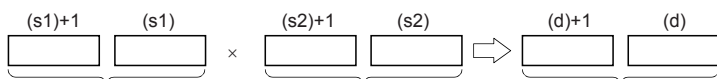
Operand	Description	Range	Data type	Data type (label)
(s1)	Multiplicand data or head device number where the data to be multiplied by another is stored	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Multiplier data or head device number where the data by which another is to be multiplied is stored	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions multiply the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



Single-precision real number Single-precision real number Single-precision real number

- Values in the devices specified (stored) by (s1), (s2), and (d) should be 0 or $2^{-126} | \text{specified value (stored value)} | \leq 2^{128}$.
- When an input value is set from the engineering tool, a rounding error may occur.
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

Dividing single-precision real numbers

E/(P)

These instructions divide the single-precision real number in the device specified by (s1) by the single-precision real number in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

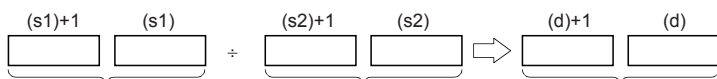
Operand	Description	Range	Data type	Data type (label)
(s1)	Dividend data or head device number where the data which is divided by another is stored.	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Divisor data or head device number where the data that divides another is stored.	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions divide the single-precision real number in the device specified by (s1) by the single-precision real number in the device specified by (s2), and store the result in the device specified by (d).



Single-precision real number Single-precision real number Single-precision real number

- Values in the devices specified (stored) by (s1), (s2), and (d) should be 0 or $2^{-126} < |\text{specified value (stored value)}| \leq 2^{128}$.
- When an input value is set from the engineering tool, a rounding error may occur.
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3400	The divisor is 0.
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$. The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

Multiplying single-precision real numbers

DEMUL(P)

These instructions multiply the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DEMUL(EN,s1,s2,d); ENO:=DEMULP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

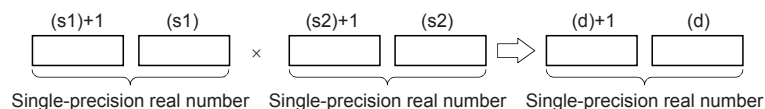
Operand	Description	Range	Data type	Data type (label)
(s1)	Multiplicand data or head device number where the data to be multiplied by another is stored	$0, 2^{-126} \leq (s1) \leq 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Multiplier data or head device number where the data by which another is to be multiplied is stored	$0, 2^{-126} \leq (s2) \leq 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

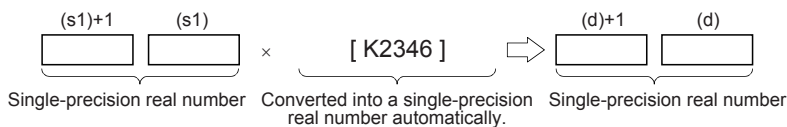
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	○	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions multiply the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- When the constant (K or H) is specified in (s1) and (s2), these instructions convert values into single-precision real number automatically.



- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

Dividing single-precision real numbers

DEDIV(P)

These instructions divide the single-precision real number in the device specified by (s1) by the single-precision real number in the device specified by (s2), and store the result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DEDIV(EN,s1,s2,d); ENO:=DEDIVP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

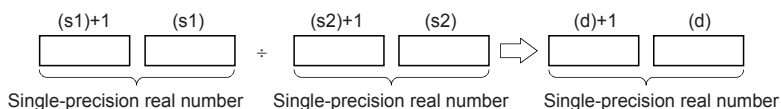
Operand	Description	Range	Data type	Data type (label)
(s1)	Dividend data or head device number where the data which is divided by another is stored.	—	Single-precision real number	Single-precision real number
(s2)	Divisor data or head device number where the data that divides another is stored.	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

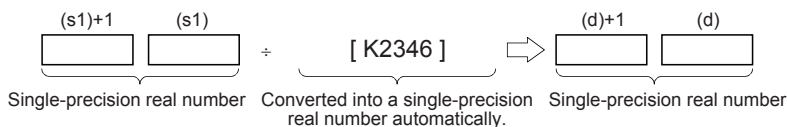
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	○	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	○	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions divide the single-precision real number in the device specified by (s1) by the single-precision real number in the device specified by (s2), and store the result in the device specified by (d).



- When the constant (K or H) is specified in (s1) and (s2), these instructions convert values into single-precision real number automatically.



- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3400	The divisor is 0.
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value stored in specified device is outside the following range $0, 2^{-126} \leq \text{specified device value} < 2^{128}$

Converting 16-bit signed binary data to single-precision real number

INT2FLT(P)

These instructions convert the 16-bit signed binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

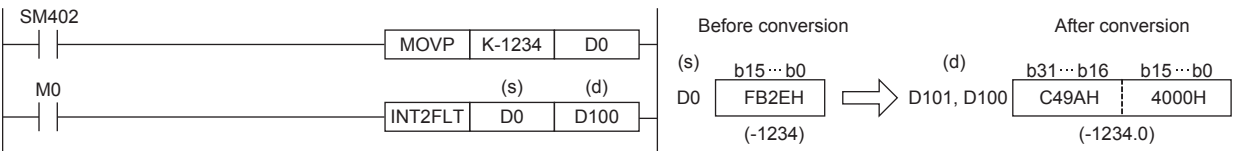
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	-32768 to +32767	16-bit signed binary	ANY16
(d)	Data after conversion	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit signed binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 16-bit unsigned binary data to single-precision real number

UINT2FLT(P)

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

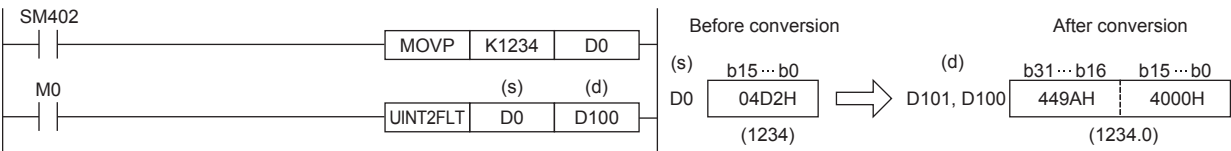
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	0 to 65535	16-bit unsigned binary	ANY16
(d)	Data after conversion	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions convert the 16-bit unsigned binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit signed binary data to single-precision real number

DINT2FLT(P)

These instructions convert the 32-bit signed binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

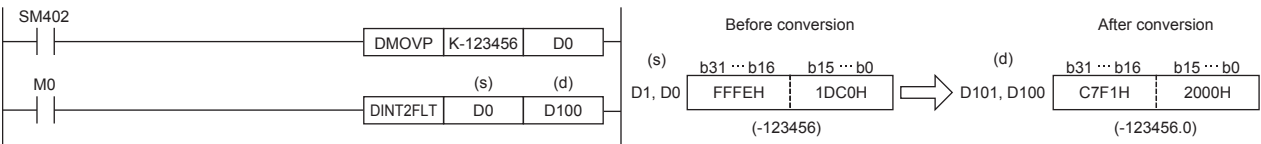
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Data after conversion	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions convert the 32-bit signed binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting 32-bit unsigned binary data to single-precision real number

UDINT2FLT(P)

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

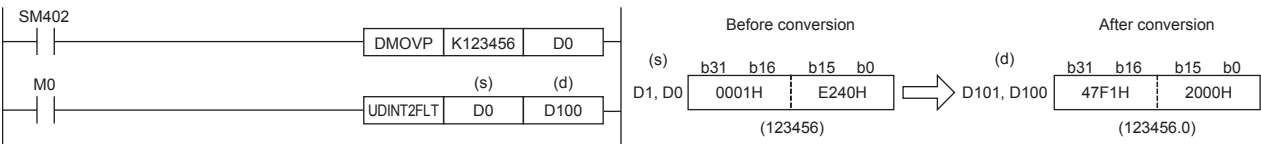
Operand	Description	Range	Data type	Data type (label)
(s)	Data before conversion	0 to 4294967295	32-bit unsigned binary	ANY32
(d)	Data after conversion	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions convert the 32-bit unsigned binary data in the device specified by (s) to single-precision real number, and store the converted data in the device specified by (d).



Operation error

There is no operation error.

Converting character string to single-precision real number

EVAL(P)/DEVAL(P)

These instructions convert the character strings in the device areas specified by (s) and later to single-precision real number, and store the converted data in the device specified by (d).

The EVAL(P) instructions can also be used as DEVAL(P).

Ladder diagram	Structured text
	<pre>ENO:=EVAL(EN,s,d); ENO:=EVALP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Character string data to be converted to single-precision real number or head device number where the character string data is stored	—	Character string	Character string
(d)	Head device number storing converted single-precision real number	—	Single-precision real number	Single-precision real number

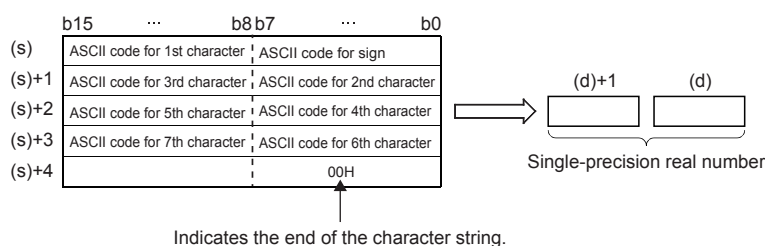
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	○	—	—	—	○	—	—	○	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

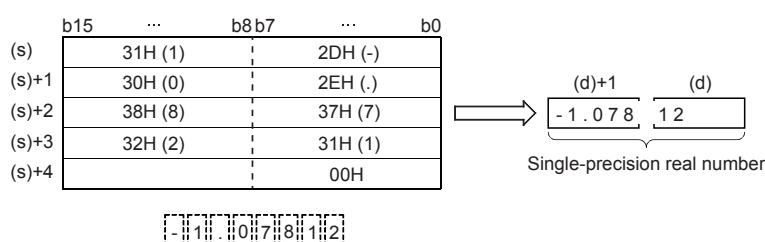
- These instructions convert the character strings in the device areas specified by (s) and later to single-precision real number, and store the converted data in the device specified by (d).
- A specified character string may be in the decimal point format or exponent format. A character string in either format can be converted into single-precision real number.



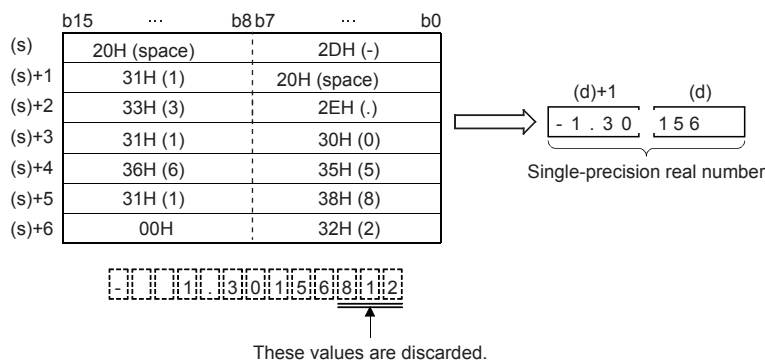
- A character string can consist of up to 24 characters. 20H (space) and 30H (0) in a character string are counted as one character each.

■Decimal point format

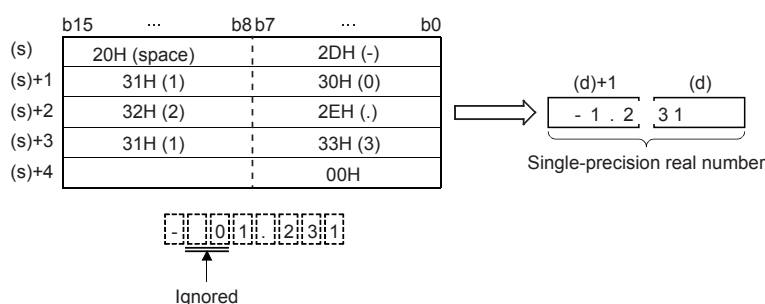
- When the character string specified by (s) is decimal point format, the operation is executed as follows.



- With regard to character string, six digits excluding the sign, decimal point and exponent part are valid, and the 7th and later digits are discarded during conversion.

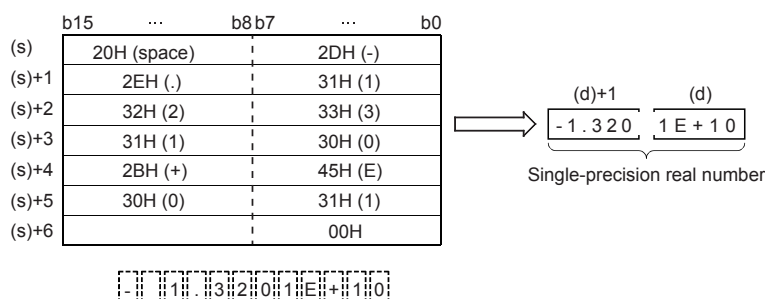


- When 2BH (+) is specified as the sign in the floating point format or when the sign is omitted, a character string is converted into a positive value. It is handled as negative value during conversion when the sign is set to 2DH (-).
- When 20H (space) or 30H (0) exists between numbers except the first 0 in a character string specified by (s), 20H or 30H is ignored during conversion.

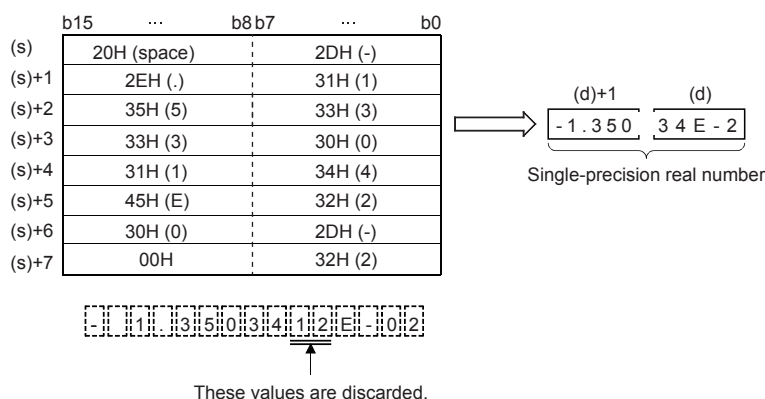


Exponent format

- When the character string specified by (s) is in exponent format, the operation is executed as follows.



- With regard to character string, six digits excluding the sign, decimal point and exponent part are valid, and the 7th and later digits are discarded during conversion.



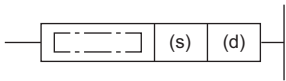
- String data in the exponent format is handled as positive value during conversion when the sign of the exponent part is set to 2BH (+) or when the sign is omitted. When 2DH (-) is specified as the sign, a character string is converted into a negative value.
- When 20H (space) or 30H (0) exists between numbers except the first 0 in a character string specified by (s), 20H or 30H is ignored during conversion.
- When 30H (0) exists between a number and "E" in a character string in the exponent format, 30H is ignored during conversion.

Operation error

Converting binary floating point to decimal floating point

DEBCD(P)

These instructions convert the binary floating point specified by (s) to decimal floating point, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DEBCD(EN,s,d); ENO:= DEBCDP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number storing binary floating point data	—	Single-precision real number (binary)	Single-precision real number (binary)
(d)	Device number storing converted decimal floating point	—	Single-precision real number (decimal)	Single-precision real number (decimal)

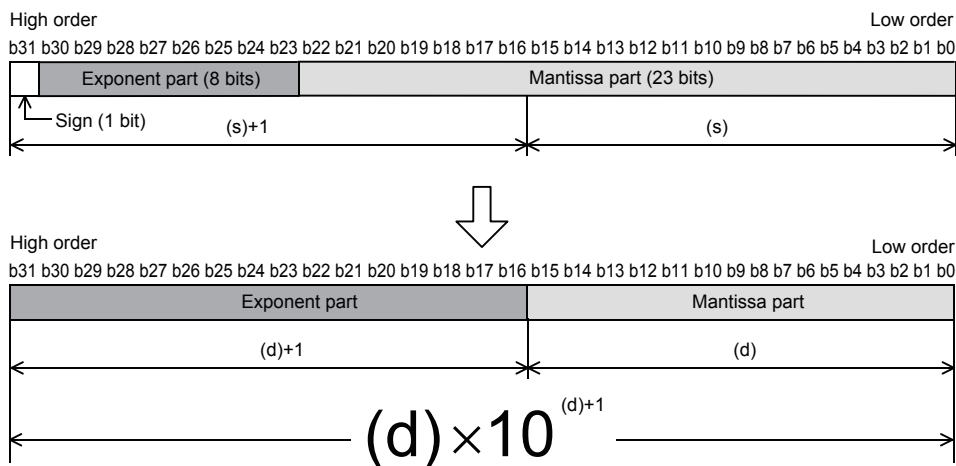
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

7

Processing details

- These instructions convert the binary floating point specified by (s) to decimal floating point, and store the converted data in the device specified by (d).



Precautions

In floating point operations, all data is handled in binary floating point. Because binary floating point is difficult to understand (requiring a dedicated monitoring method), it is converted into scientific notation (decimal floating point) so that monitoring can be easily executed by peripheral equipment.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.

Converting decimal floating point to binary floating point

DEBIN(P)

These instructions convert the decimal floating point specified by (s) to the binary floating point, and store the converted data in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DEBIN(EN,s,d); ENO:= DEBINP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number storing decimal floating-point data	—	Single-precision real number (decimal)	Single-precision real number (decimal)
(d)	Device number storing converted binary floating-point data	—	Single-precision real number (binary)	Single-precision real number (binary)

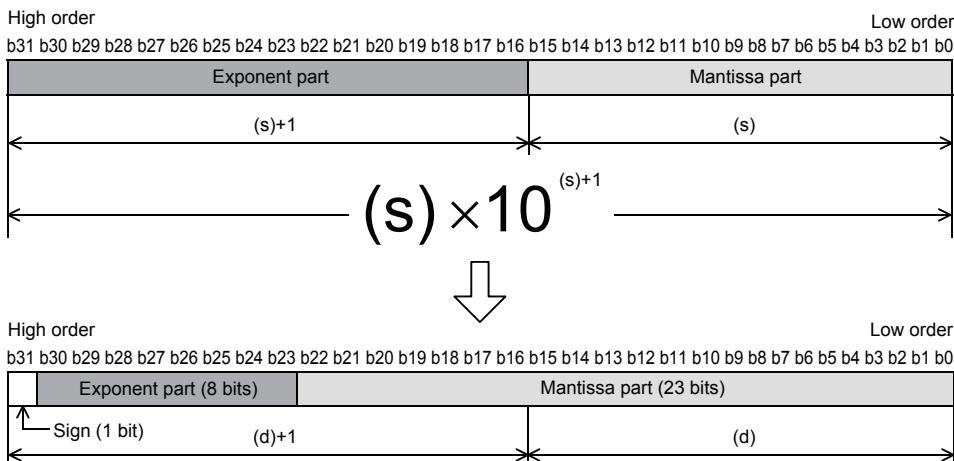
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

7

Processing details

- These instructions convert the decimal floating point specified by (s) to the binary floating point, and store the converted data in the device specified by (d).



- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

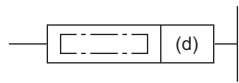
There is no operation error.

Inverting the sign of single-precision real number

ENEG(P)/DENEG(P)

These instructions invert the sign of the single-precision real number specified by (d), and store the data of the device specified by (d).

The ENEG(P) instructions can also be used as DENEG(P).

Ladder diagram	Structured text
	ENO:=ENEG(EN,d); ENO:=ENEGP(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number storing single-precision real number whose sign is to be inverted	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

7

Processing details

- These instructions invert the sign of the single-precision real number specified by (d), and store the data in the device specified by (d).



- Use these instructions for inverting the positive and negative sign.

Operation error

There is no operation error.

Transferring single-precision real number data

EMOV(P)/DEMOV(P)

These instructions transfer the single-precision real number data stored in the device specified by (s) to the device specified by (d).

The EMOV(P) instructions can also be used as DEMOV(P).

Ladder diagram	Structured text
	ENO:=EMOV(EN,s,d); ENO:=EMOVP(EN,s,d)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Data to be transferred or head device number where the data to be transferred is stored	$0, 2^{-126} < (s) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Device number storing the data in transfer destination	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions transfer the single-precision real number data stored in the device specified by (s) to the device specified by (d).



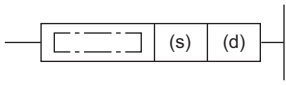
Operation error

There is no operation error.


Calculating the sine of single-precision real number

SIN(P)/DSIN(P)

These instructions calculate the sine of the angle specified by (s), and store the operation result in the device specified by (d). The SIN(P) instructions can also be used as DSIN(P).

Ladder diagram	Structured text ^{*1}
	ENO:=SINP(EN,s,d);

*1 The SIN instruction is not supported by the ST language. Use SIN of the standard function.

 Page 771 SIN(_E)

Setting data

■Descriptions, ranges, and data types

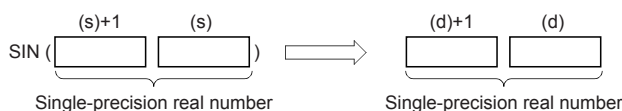
Operand	Description	Range	Data type	Data type (label)
(s)	Angle data or head device number where the angle data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—	—

Processing details

- These instructions calculate the sine of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians (angle $\times\pi\div180$).
- The table below shows the related devices.


Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.



For the angle \leftrightarrow radian conversion, refer to the DRAD(P) and DDEG(P) instructions.

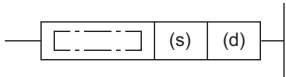
( Page 451 Converting single-precision real number angle to radian, Page 452 Converting single-precision real number radian to angle)

Calculating the cosine of single-precision real number


COS(P)/DCOS(P)

These instructions calculate the cosine of the angle specified by (s), and store the operation result in the device specified by (d).

The COS(P) instructions can also be used as DCOS(P).

Ladder diagram	Structured text ^{*1}
	ENO:=COSP(EN,s,d);

*1 The COS instruction is not supported by the ST language. Use COS of the standard function.

 Page 772 COS(_E)

Setting data

■Descriptions, ranges, and data types

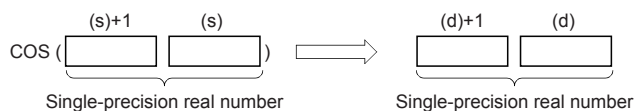
Operand	Description	Range	Data type	Data type (label)
(s)	Angle data or head device number where the angle data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the cosine of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians (angle $\times\pi\div180$).
- The table below shows the related devices.


Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.



For the angle \leftrightarrow radian conversion, refer to the DRAD(P) and DDEG(P) instructions.

( Page 451 Converting single-precision real number angle to radian, Page 452 Converting single-precision real number radian to angle)

Calculating the tangent of single-precision real number

TAN(P)/DTAN(P)

These instructions calculate the tangent of the angle specified by (s), and store the operation result in the device specified by (d).

The TAN(P) instructions can also be used as DTAN(P).

Ladder diagram	Structured text ^{*1}
	ENO:=TANP(EN,s,d);

^{*1} The TAN instruction is not supported by the ST language. Use TAN of the standard function.

Page 773 TAN(_E)

Setting data

■Descriptions, ranges, and data types

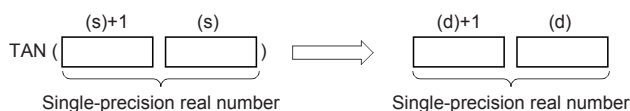
Operand	Description	Range	Data type	Data type (label)
(s)	Angle data or head device number where the angle data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the tangent of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians (angle $\times\pi\div180$).
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Precautions


When the angle specified by (s) is $\pi/2$ radian or $(3/2)\pi$ radian, no error occurs because an operation error occurs in a radian value.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Point

For the angle↔radian conversion, refer to the DRAD(P) and DDEG(P) instructions.

( Page 451 Converting single-precision real number angle to radian, Page 452 Converting single-precision real number radian to angle)

Calculating the arc sine of single-precision real number

ASIN(P)/DASIN(P)

These instructions calculate the angle from the sine of the angle specified by (s), and store the operation result in the word device specified by (d).

The ASIN(P) instructions can also be used as DASIN(P).

Ladder diagram	Structured text ^{*1}
	ENO:=ASINP(EN,s,d);

*1 The ASIN instruction is not supported by the ST language. Use ASIN of the standard function.

Page 774 ASIN(_E)

Setting data

■Descriptions, ranges, and data types

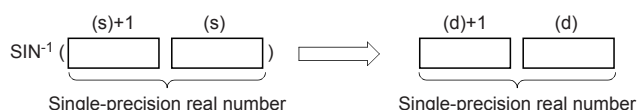
Operand	Description	Range	Data type	Data type (label)
(s)	A sine value used in SIN^{-1} (arc sine) operation or head device number storing the sine value	-1.0 to +1.0	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	$-\pi/2$ to $+\pi/2$	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the angle from the sine of the angle specified by (s), and store the operation result in the device specified by (d).



- The sine value specified by (s) can be set ranging from -1.0 to 1.0.
- The angle (operation result) stored in (d) is expressed in radians (from $(-\pi/2)$ to $(\pi/2)$).
- The table below shows the related devices.


Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3405	A value specified in (s) is outside the range from -1.0 to 1.0.

Point

For the radian↔angle conversion, refer to the DRAD(P) and DDEG(P) instructions.

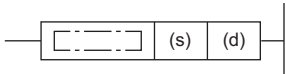
( Page 451 Converting single-precision real number angle to radian, Page 452 Converting single-precision real number radian to angle)

Calculating the arc cosine of single-precision real number


ACOS(P)/DACOS(P)

These instructions calculate the angle from the cosine of the angle specified by (s), and store the operation result in the word device specified by (d).

The ACOS(P) instructions can also be used as DACOS(P).

Ladder diagram	Structured text ^{*1}
	ENO:=ACOSP(EN,s,d)

^{*1} The ACOS instruction is not supported by the ST language. Use ACOS of the standard function.

 Page 775 ACOS(_E)

Setting data

■Descriptions, ranges, and data types

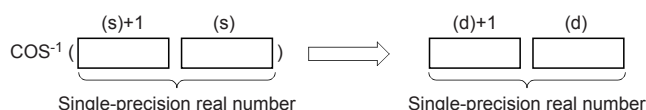
Operand	Description	Range	Data type	Data type (label)
(s)	A cosine value used in COS^{-1} (arc cosine) operation or head device number storing the cosine value	-1.0 to +1.0	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	0 to π	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the angle from the cosine of the angle specified by (s), and store the operation result in the device specified by (d).



- The cosine value specified by (s) can be set ranging from -1.0 to 1.0
- The angle (operation result) stored in (d) is expressed in radians (0 to π).
- The table below shows the related devices.


Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3405	A value specified in (s) is outside the range from -1.0 to 1.0.

Point

For the radian↔angle conversion, refer to the DRAD(P) and DDEG(P) instructions.

( Page 451 Converting single-precision real number angle to radian, Page 452 Converting single-precision real number radian to angle)

Calculating the arc tangent of single-precision real number

ATAN(P)/DATAN(P)

These instructions calculate the angle from the tangent of the angle specified by (s), and store the operation result in the word device specified by (d).

The ATAN(P) instructions can also be used as DATAN(P).

Ladder diagram	Structured text ^{*1}
	ENO:=ATANP(EN,s,d);

*1 The ATAN instruction is not supported by the ST language. Use ATAN of the standard function.

Page 776 ATAN(_E)

Setting data

■Descriptions, ranges, and data types

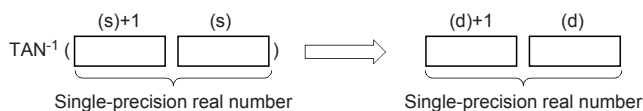
Operand	Description	Range	Data type	Data type (label)
(s)	A tangent value used in the TAN^{-1} (arc tangent) operation or head device number storing the tangent value	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	$-\pi/2$ to $+\pi/2$	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the angle from the tangent of the angle specified by (s), and store the operation result in the device specified by (d).



- The angle (operation result) stored in (d) is expressed in radians (from $-\pi/2$ to $\pi/2$).
- The table below shows the related devices.


Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.



For the radian \leftrightarrow angle conversion, refer to the DRAD(P) and DDEG(P) instructions.

( Page 451 Converting single-precision real number angle to radian, Page 452 Converting single-precision real number radian to angle)

Converting single-precision real number angle to radian

RAD(P)/DRAD(P)

These instructions convert a unit of angle from degrees (DEG.) specified by (s) into radians, and store the converted angle in the device specified by (d).

The RAD(P) instructions can also be used as DRAD(P).

Ladder diagram	Structured text
	<pre>ENO:=RAD(EN,s,d); ENO:=RADP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

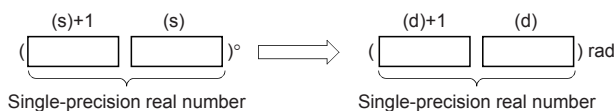
Operand	Description	Range	Data type	Data type (label)
(s)	A value in degrees to be converted into a value in radians or the start number storing the value in degrees	—	Single-precision real number	Single-precision real number
(d)	Head device number storing a value in radians acquired by conversion	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—	—

Processing details

- These instructions convert a unit of angle from degrees (DEG.) specified by (s) into radians, and store the converted angle in the device specified by (d).



- The conversion from degrees into radians is executed as follows:

$$\text{Radians} = \text{Degrees} \times \frac{\pi}{180}$$

- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Converting single-precision real number radian to angle

DEG(P)/DDEG(P)

These instructions convert a unit of angle from radians specified by (s) into degrees (DEG.), and store the converted angle in the device specified by (d). The DEG(P) instructions can also be used as DDEG(P).

Ladder diagram	Structured text
	<pre>ENO:=DEG(EN,s,d); ENO:=DEGP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

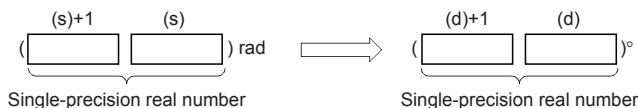
Operand	Description	Range	Data type	Data type (label)
(s)	A value in radians to be converted into a value in degrees or the head device number storing a value in radians	—	Single-precision real number	Single-precision real number
(d)	Head device number storing a value in degrees acquired by conversion	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions convert a unit of angle from radians specified by (s) into degrees (DEG.), and store the converted angle in the device specified by (d).



- The conversion from radians into degrees is executed as follows:

$$\text{Degrees} = \text{Radians} \times \frac{180}{\pi}$$

- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

Calculating the square root of single-precision real number

DESQR(P)

These instructions calculate the square root of a value specified by (s), and store the operation result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DESQR(EN,s,d); ENO:=DESQRP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Data whose square root is calculated or head device number where the data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

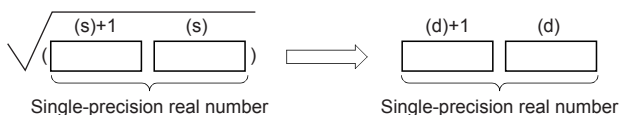
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	—	—	—	○	○	—	○	—	○	○	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—	—

7

Processing details

- These instructions calculate the square root of a value specified by (s), and store the operation result in the device specified by (d).



- Only a positive value can be set in (s). (The square root operation cannot be executed for a negative value).
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.

Operation error

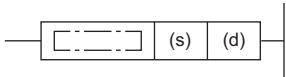
Error code (SD0/SD8067)	Description
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.
3405	The value stored in a device specified in (s) is negative.

Calculating the exponent of single-precision real number


EXP(P)/DEXP(P)

These instructions calculate the exponent of a value specified by (s), and store the operation result in the device specified by (d).

The EXP(P) instructions can also be used as DEXP(P).

Ladder diagram	Structured text ^{*1}
	ENO:=EXPP(EN,s,d);

*1 The EXP instruction is not supported by the ST language. Use EXP of the standard function.

 Page 770 EXP(_E)

Setting data

■Descriptions, ranges, and data types

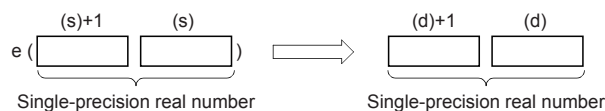
Operand	Description	Range	Data type	Data type (label)
(s)	Data whose exponent is calculated or head device number where the data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the exponent of a value specified by (s), and store the operation result in the device specified by (d).



- In the exponential operation, the base (e) is set to "2.71828".
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

- The EXP(P) instructions execute operations in natural logarithm. For obtaining a value in common logarithm, specify a common logarithm value divided by 0.4342945 in (s).

$$10^X = e^{\frac{X}{0.4342945}}$$

Calculating the natural logarithm of single-precision real number

LOG(P)/DLOGE(P)

These instructions calculate the logarithm whose base is natural logarithm e of a value specified by (s), and store the operation result in the device specified by (d).

The LOG(P) instructions can also be used as DLOGE(P).

Ladder diagram	Structured text ^{*1}
	<pre>ENO:=LOGP(EN,s,d);</pre>

*1 The LOG instruction is not supported by the ST language. Use LOG of the standard function.

Page 768 LOG(_E)

Setting data

■Descriptions, ranges, and data types

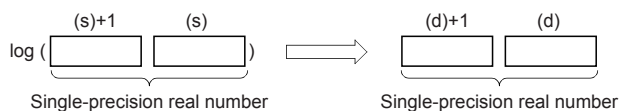
Operand	Description	Range	Data type	Data type (label)
(s)	Data whose natural logarithm is calculated or head device number where the data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions calculate the logarithm whose base is natural logarithm e of a value specified by (s), and store the operation result in the device specified by (d).



- Only a positive value can be set in (s). (The natural logarithm operation cannot be executed for a negative value).
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.
3405	The value stored in a device specified in (s) is negative.
	The value stored in a device specified in (s) is 0.

Calculating the exponentiation of single-precision real number

POW(P)

These instructions raise float (single precision) data stored in a device specified by (s1) by the single-precision real number specified by (s2), and store the operation result in a device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=POW(EN,s1,s2,d); ENO:=POWP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

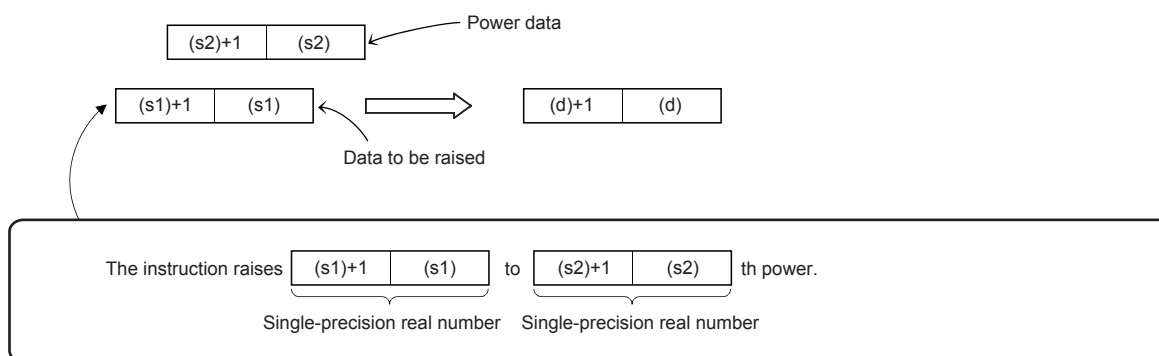
Operand	Description	Range	Data type	Data type (label)
(s1)	Data to be raised, or head device number which stores such data	$0, 2^{-126} \leq (s1) < 2^{128}$	Single-precision real number	Single-precision real number
(s2)	Power data, or head device number which stores such data	$0, 2^{-126} \leq (s2) < 2^{128}$	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	○	—	○	—	○	—	—
(s2)	—	—	—	○	○	—	○	—	○	—	○	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—

Processing details

- These instructions raise float (single precision) data stored in a device specified by (s1) by the single-precision real number specified by (s2), and store the operation result in a device specified by (d).



- Values in the devices specified (stored) by (s1) and (s2) should be 0 or $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$.
- When the operation result is -0 or underflow occurs, the operation result is regarded as 0 .
- When the operation result is within the following range, the operation result is regarded as 2^{128} , and the carry flag SM716 turns on.
 $2^{128} \leq |\text{operation result}|$
- When an input value is set from the engineering tool, a rounding error may occur.

Operation error

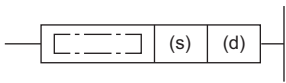
Error code (SD0/SD8067)	Description
3402	The value specified by (s1) or (s2) is outside the following range. $0, 2^{-126} \leq \text{specified value (stored value)} < 2^{128}$
	The specified device value is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	The operation result is within the following range. (An overflow has occurred.) $2^{128} \leq \text{operation result} $

Calculating the common logarithm of single-precision real number

LOG10(P)/DLOG10(P)

These instructions calculate the common logarithm (the logarithm whose base is 10) of a value specified by (s), and store the operation result in the device specified by (d).

The LOG10(P) instructions can also be used as DLOG10(P).

Ladder diagram	Structured text
	<pre>ENO:=LOG10(EN,s,d); ENO:=LOG10P(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Data whose common logarithm is calculated or head device number where the data is stored	—	Single-precision real number	Single-precision real number
(d)	Head device number for storing the operation result	—	Single-precision real number	Single-precision real number

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	—	—	—	○	○	—	○	—	○	—	○	—	—	—
(d)	—	—	—	○	○	—	○	—	○	—	—	—	—	—

Processing details

- These instructions calculate the common logarithm (the logarithm whose base is 10) of a value specified by (s), and store the operation result in the device specified by (d).



- Only a positive value can be set in (s). (The common logarithm operation cannot be executed for a negative value).
- The table below shows the related devices.

Device	Name	Description	
		Condition	Operation
SM700	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM700 turns on.
SM8020	Zero	The operation result is true "0". (The mantissa part is "0").	The zero flag SM8020 turns on.
SM8021	Borrow	The absolute value of the operation result $< 2^{-126}$	The value of (d) is the minimum value (2^{-126}) of 32-bit real numbers and the borrow flag SM8021 turns on.
SM8022	Carry	The absolute value of the operation result $\geq 2^{128}$	The value of (d) is the maximum value (2^{128}) of 32-bit real numbers and the carry flag SM8022 turns on.

Operation error

Error code (SD0/SD8067)	Description
3402	The specified device value is denormalized number, NaN (not a number), or $\pm\infty$.
3405	The value stored in a device specified in (s) is negative.
	The value stored in a device specified in (s) is 0.

Searching the maximum value of single-precision real number

EMAX(P)

These instructions search for the maximum value in the (n) point(s) of single-precision real number block data in the device starting from the one specified by (s), and store the maximum value in the device areas specified by (d) and (d)+1. These instructions also store the location of the first maximum value from (s) in the device specified by (d)+2 and the number of maximum values in the device specified by (d)+3.

Ladder diagram	Structured text ^{*1}
	ENO:=EMAXP(EN,s,n,d);

*1 The EMAX instruction is not supported by the ST language. Use MAX of the standard function.

Page 804 MAX(_E), MIN(_E)

Setting data

■Descriptions, ranges, and data types

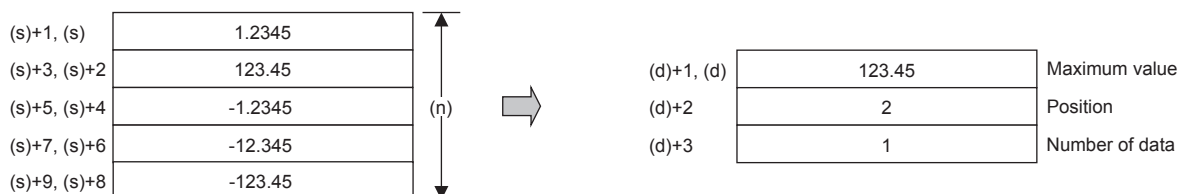
Operand	Description	Range	Data type	Data type (label)
(s)	Search target data	—	Single-precision real number	Single-precision real number
(d)	Search result	—	Single-precision real number	Single-precision real number
(n)	Number of search target data points	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search for the maximum value in the (n) point(s) of single-precision real number block data in the device starting from the one specified by (s), and store the maximum value in the device areas specified by (d). These instructions also store the location of the first maximum value from (s) in the device specified by (d)+2 and the number of maximum values in the device specified by (d)+3.
- The start of the block data in the device specified by (s) is counted as 1st point when the location is counted.



- The following values are stored in (d).

	Data type	Description
(d)	Single-precision real number	Maximum value
(d)+1		
(d)+2	16-bit data	Maximum value position
(d)+3	16-bit data	Number of maximum values

- When (n) is 0, the processing is not performed.

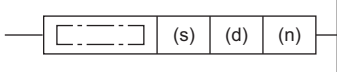
Operation error

Error code (SD0/SD8067)	Description
2820	The device areas specified by (s) exceed the corresponding device range.
	The device areas specified by (d) exceed the corresponding device range.
3402	The block data in the device areas specified by (s) includes a value other than single-precision real number.


Searching the minimum value of single-precision real number

EMIN(P)

These instructions search for the minimum value in the (n) point(s) of single-precision real number block data in the device starting from the one specified by (s), and store the minimum value in the device areas specified by (d) and (d)+1. These instructions also store the location of the first minimum value from (s) in the device specified by (d)+2 and the number of minimum values in the device specified by (d)+3.

Ladder diagram	Structured text ^{*1}
	ENO:=EMINP(EN,s,n,d);

*1 The EMIN instruction is not supported by the ST language. Use MIN of the standard function.

 Page 804 MAX(_E), MIN(_E)

Setting data

■Descriptions, ranges, and data types

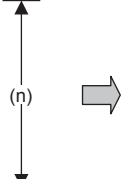
Operand	Description	Range	Data type	Data type (label)
(s)	Search target data	—	Single-precision real number	Single-precision real number
(d)	Search result	—	Single-precision real number	Single-precision real number
(n)	Number of search target data points	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search for the minimum value in the (n) point(s) of single-precision real number block data in the device starting from the one specified by (s), and store the minimum value in the device areas specified by (d) and (d)+1. These instructions also store the location of the first minimum value from (s) in the device specified by (d)+2 and the number of minimum values in the device specified by (d)+3.
- The start of the block data in the device specified by (s) is counted as 1st point when the location is counted.

(s)+1, (s)	1.2345	
(s)+3, (s)+2	123.45	
(s)+5, (s)+4	-1.2345	
(s)+7, (s)+6	-12.345	
(s)+9, (s)+8	-123.45	
(d)+1, (d)	-123.45	Minimum value
(d)+2	2	Position
(d)+3	1	Number of data

- The following values are stored in (d).

	Data type	Description
(d)	Single-precision real number	Minimum value
(d)+1		
(d)+2	16-bit data	Minimum value position
(d)+3	16-bit data	Number of minimum values

- When (n) is 0, the processing is not performed.

Operation error


Error code (SD0/SD8067)	Description
2820	The device areas specified by (s) exceed the corresponding device range.
	The device areas specified by (d) exceed the corresponding device range.
3402	The block data in the device areas specified by (s) includes a value other than single-precision real number.

7.8 Random Number Instruction

Generating random number

RND(P)

These instructions generate a pseudo-random number ranging from 0 to 32767, and store it as a random number to a device specified by (d).

Ladder diagram	Structured text
	ENO:=RND(EN,d); ENO:=RNDP(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number storing a random number	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—	

Processing details

- These instructions generate a pseudo-random number ranging from 0 to 32767, and store it as a random number to a device specified by (d).
- In the pseudo-random number sequence, the source value of a random number is calculated every time, and this instruction calculates a pseudo-random number using the source value.

Pseudo-random number calculation equation:

$(SD8311, SD8310) = (SD8311, SD8310)^{*1} \times 1103515245 + 12345$

$(d) = "([SD8311, SD8310] > 16) \& \text{logical product} > 00007FFFh"$

- *1 To (SD8311, SD8310), write a non-negative value (0 to 2,147,483,647) only once when the CPU module mode switches from STOP to RUN. (K1 is written to (SD8311, SD8310) as the initial value when the power is restored.)

Operation error

There is no operation error.

7.9 Index register operation instruction

Saving all data of the index register

ZPUSH(P)

These instructions save the contents of index registers and long index registers in the devices specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=ZPUSH(EN,d); ENO:=ZPUSH(EN,d);</pre>

Setting data

■Descriptions, ranges, and data types

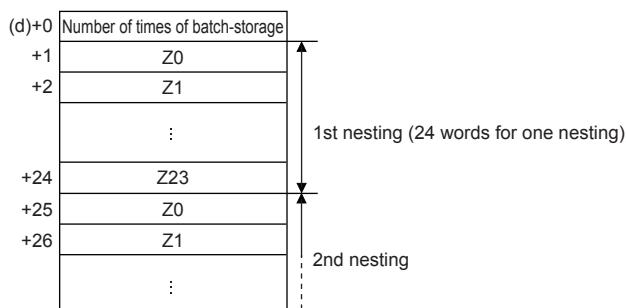
Operand	Description	Range	Data type	Data type (label)
(d)	Head device number for saving the data of index registers and long index registers	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—	—

Processing details

- These instructions save the contents of index registers and long index registers in the devices specified by (d) and later.
- When the contents of index registers are saved, "1" is added to (d).
- These instructions save the contents of index registers and long index registers for 24 words regardless of the assignment of the number of the registers. Thus, when the number of index registers is 0, the contents of long index registers are saved for 12 points.
- The ZPOP(P) instructions are used to return the data. The ZPUSH(P) and ZPOP(P) instructions are used in pairs, and by using the same device in (d) a nesting structure can be adopted. (Page 468 Returning all data of the index register)
- When a nesting structure is adopted, the areas to be used are added to (d) and later every time the ZPUSH(P) instructions are used. Check the number of index registers and long index registers by SD300 and SD302, and secure the areas for the number of instructions to be used in advance.
- The following shows the areas of (d) and later to be used.



Precautions

- When a nesting structure is not adopted, clear (d) before executing the ZPUSH(P) instructions.
- When a nesting structure is adopted, clear (d) before executing the first ZPUSH(P) instructions.
- When the ZPOP(P) instructions are used to return the data of index registers, use the ZPOP(P) instructions corresponding to the ZPUSH(P) instructions that were used for saving the data.
ZPUSH(P) (One setting data) → ZPOP(P) (One setting data)
ZPUSH(P) (Two setting data) → ZPOP(P) (Two setting data)
- Secure the areas so that the save destination specified by (d) do not exceed the device range.

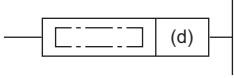
Operation error

Error code (SD0/SD8067)	Description
2820	The range of points used in (d) or later exceeds the range of the target device/label area.
3405	(d) is negative.

Returning all data of the index register

ZPOP(P)

These instructions read the data saved in the devices specified by (d) and later to index registers and long index registers.

Ladder diagram	Structured text
	ENO:=ZPOP(EN,d); ENO:=ZPOPP(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number for returning the data of index registers	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—

Processing details

- These instructions read the data saved in the devices specified by (d) and later to index registers and long index registers.
- When the saved contents of the index registers and long index registers are read, "1" is subtracted from (d).
- The ZPUSH(P) instructions are used to temporarily save the data. The ZPUSH(P) and ZPOP(P) instructions are used in pairs.

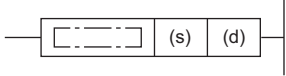
Operation error

Error code (SD0/SD8067)	Description
2820	The range of points used in (d) or later exceeds the range of the target device/label area.
3405	(d) is 0 or negative.

Saving the selected data of the index register and long index register

ZPUSH(P)

These instructions save the contents of index registers and long index registers within the range specified by (s) in the devices specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=ZPUSH_2(EN,s,d); ENO:=ZPUSHP_2(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Type of the index register or long index register to be saved	0 to 2	16-bit unsigned binary	ANY16
(d)	Head device number for saving the data of index registers	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	○	—	—	○	—	—	—	—	○	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—	—

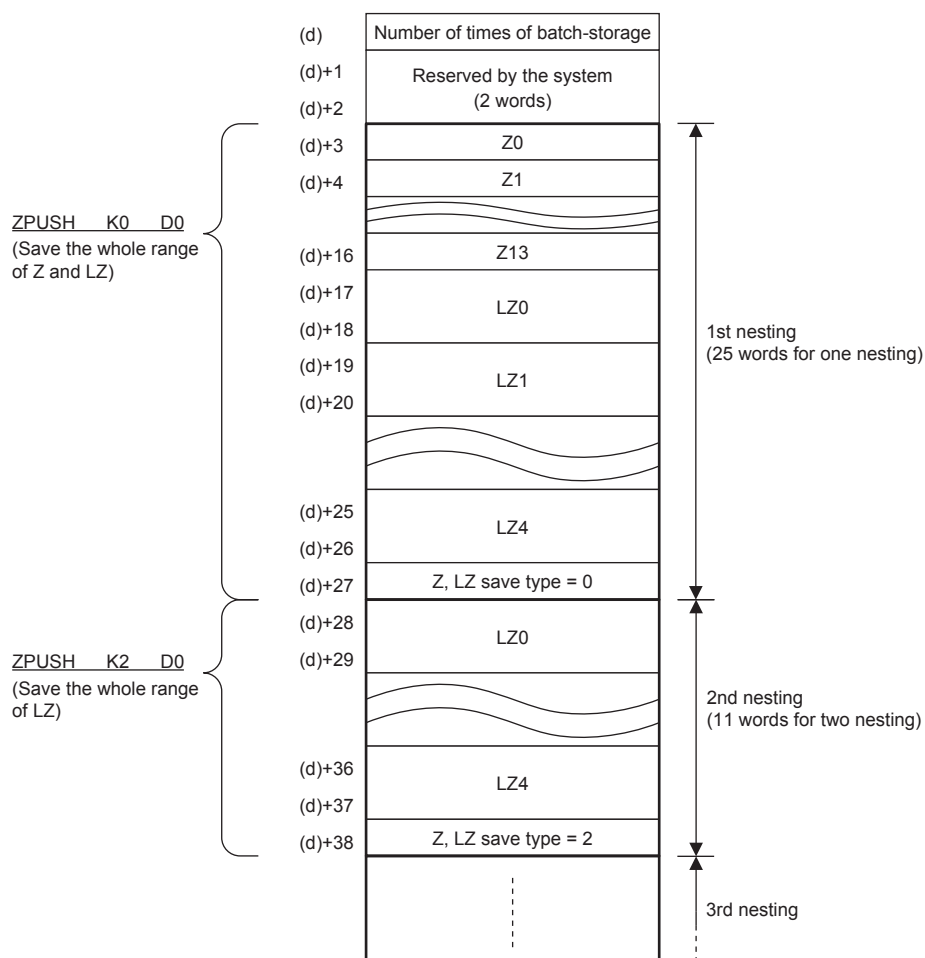
Processing details

- These instructions save the contents of index registers and long index registers within the range specified by (s) in the devices specified by (d) and later. The type of the index register or long index register saved is stored in the end of the saved data.
- When the contents of the index registers and long index registers are saved, "1" is added to (d).
- The following shows values specified by (s) and the index register or long index register to be saved.

(s) value	Z or LZ to be saved
0	Z, LZ (whole range)
1	Z (whole range)
2	LZ (whole range)

- The selected data of index register/long index register return instructions (ZPOP(P) instructions) are used to return the data. The selected data of index register/long index register save instructions (ZPUSH(P) instructions) and the selected data of index register/long index register return instructions (ZPOP(P) instructions) can be used in pairs and to adopt a nesting structure. (Page 471 Returning the selected data of the index register and long index register)
- When a nesting structure is adopted, the areas to be used are added to (d) and later every time the selected data of index register/long index register save instructions (ZPUSH(P) instructions) are executed. Check the number of index registers and long index registers by SD300 and SD302, and secure the areas for the number of instructions to be used in advance.

- The following shows the areas of (d) and later used for the instructions (when Z0 to 13 and LZ0 to 4 are used).



Precautions

- When a nesting structure is not adopted, clear (d) before executing the ZPUSH(P) instructions.
- When a nesting structure is adopted, clear (d) before executing the first ZPUSH(P) instructions.
- When the ZPOP(P) instructions are used to return the data of index registers, use the ZPOP(P) instructions corresponding to the ZPUSH(P) instructions that were used for saving the data.
 ZPUSH(P) (One setting data) → ZPOP(P) (One setting data)
 ZPUSH(P) (Two setting data) → ZPOP(P) (Two setting data)
- Do not change the values of (d)+1 and (d)+2 because they are used by the system. Do not change the values of the Z and LZ save types stored in the devices specified by (d) and later because they are used by the system.
- Secure the areas so that the save destination specified by (d) does not exceed the device range.

Operation error

Error code (SD0/SD8067)	Description
2820	The range of points used in (d) or later exceeds the range of the target device/label area.
3405	A value other than 0 to 2 is specified in (s).
	When the number of index registers is 0, "1" is specified in (s).
	When the number of long index registers is 0, "2" is specified in (s).

Returning the selected data of the index register and long index register

ZPOP(P)

These instructions read the data saved in the devices specified by (d) and later to index registers and long index registers.

Ladder diagram	Structured text
	ENO:=ZPOP_2(EN,s,d); ENO:=ZPOPP_2(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Dummy	—	16-bit unsigned binary	ANY16
(d)	Head device number for returning the data of index registers	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	—	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—

Processing details

- These instructions read the data saved in the devices specified by (d) and later to index registers and long index registers.
- When the saved contents of the index registers and long index registers are read, "1" is subtracted from (d).
- The data specified by (s) is regarded as dummy data and ignored.

Operation error

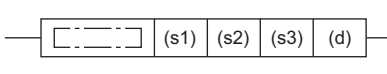
Error code (SD0/SD8067)	Description
2820	The range of points used in (d) or later exceeds the range of the target device/label area.
3405	(d) is 0 or negative.

7.10 Data control instruction


Upper and lower limit control of 16-bit binary data

LIMIT(P)(_U)

These instructions control the output value to be stored in the device specified by (d) by checking the input value (16-bit binary data) in the device specified by (s3) with the upper and lower limit values specified by (s1) and (s2).

Ladder diagram	Structured text*1	
	ENO:=LIMIT(EN,s1,s2,s3,d); ENO:=LIMITP(EN,s1,s2,s3,d);	ENO:=LIMITP_U(EN,s1,s2,s3,d);

*1 The LIMIT_U instruction is not supported by the ST language. Use LIMIT of the standard function.

 Page 806 LIMIT(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	LIMIT(P)	-32768 to 32767	16-bit signed binary	ANY16
	LIMIT(P)_U	0 to 65535	16-bit unsigned binary	
(s2)	LIMIT(P)	-32768 to 32767	16-bit signed binary	ANY16
	LIMIT(P)_U	0 to 65535	16-bit unsigned binary	
(s3)	LIMIT(P)	-32768 to 32767	16-bit signed binary	ANY16
	LIMIT(P)_U	0 to 65535	16-bit unsigned binary	
(d)	LIMIT(P)	—	16-bit signed binary	ANY16
	LIMIT(P)_U	—	16-bit unsigned binary	

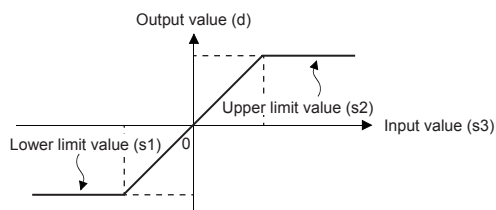
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking the input value (16-bit binary data) in the device specified by (s3) with the upper and lower limit values specified by (s1) and (s2). The output value is controlled as follows.

Condition	Output value
Lower limit value (s1) > Input value (s3)	Lower limit value (s1)
Upper limit value (s2) < Input value (s3)	Upper limit value (s2)
Lower limit value (s1) ≤ Input value (s3) ≤ Upper limit value (s2)	Input value (s3)



- To control the input value only with the upper limit, set the minimum value within the setting range in (s1).
- To control the input value only with the lower limit, set the maximum value within the setting range in (s2).

Operation error

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s2).

Upper and lower limit control of 32-bit binary data

DLIMIT(P)(_U)

These instructions control the output value to be stored in the device specified by (d) by checking the input value (32-bit binary data) in the device specified by (s3) with the upper and lower limit values specified by (s1) and (s2).

Ladder diagram	Structured text ^{*1}	
	ENO:=DLIMITP(EN,s1,s2,s3,d);	ENO:=DLIMITP_U(EN,s1,s2,s3,d);

*1 The DLIMIT(_U) instructions are not supported by the ST language. Use LIMIT of the standard function.

Page 806 LIMIT(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DLIMIT(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DLIMIT(P)_U	0 to 4294967295	32-bit unsigned binary	
(s2)	DLIMIT(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DLIMIT(P)_U	0 to 4294967295	32-bit unsigned binary	
(s3)	DLIMIT(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DLIMIT(P)_U	0 to 4294967295	32-bit unsigned binary	
(d)	DLIMIT(P)	—	32-bit signed binary	ANY32
	DLIMIT(P)_U	—	32-bit unsigned binary	

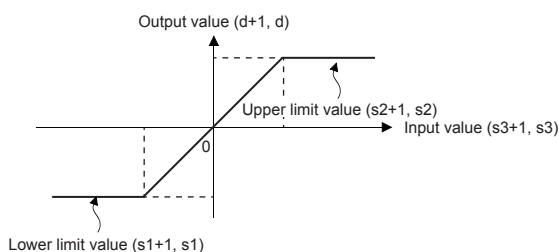
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s3)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking the input value (32-bit binary data) in the device specified by (s3) with the upper and lower limit values specified by (s1) and (s2). The output value is controlled as follows.

Condition	Output value
Lower limit value ((s1), (s1)+1) > Input value ((s3), (s3)+1)	Lower limit value ((s1), (s1)+1)
Upper limit value ((s2), (s2)+1) < Input value ((s3), (s3)+1)	Upper limit value ((s2), (s2)+1)
Lower limit value ((s1), (s1)+1) ≤ Input value ((s3), (s3)+1) ≤ Upper limit value ((s2), (s2)+1)	Input value ((s3), (s3)+1)



- To control the input value only with the upper limit, set the minimum value within the setting range in (s1).
- To control the input value only with the lower limit, set the maximum value within the setting range in (s2).

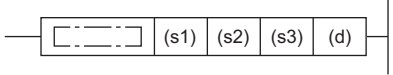
Operation error

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s2).

Dead band control of 16-bit binary data

BAND(P)(_U)

These instructions control the output value to be stored in the device specified by (d) by checking the input value (16-bit binary data) in the device specified by (s3) with the upper and lower limit values of the dead band specified by (s1) and (s2).

Ladder diagram	Structured text	
	ENO:=BAND(EN,s1,s2,s3,d); ENO:=BANDP(EN,s1,s2,s3,d);	ENO:=BAND_U(EN,s1,s2,s3,d); ENO:=BANDP_U(EN,s1,s2,s3,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	BAND(P)	-32768 to +32767	16-bit signed binary	ANY16
	BAND(P)_U	0 to 65535	16-bit unsigned binary	
(s2)	BAND(P)	-32768 to +32767	16-bit signed binary	ANY16
	BAND(P)_U	0 to 65535	16-bit unsigned binary	
(s3)	BAND(P)	-32768 to +32767	16-bit signed binary	ANY16
	BAND(P)_U	0 to 65535	16-bit unsigned binary	
(d)	BAND(P)	—	16-bit signed binary	ANY16
	BAND(P)_U		16-bit unsigned binary	

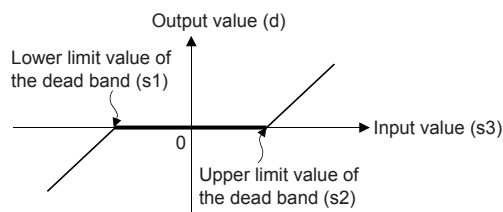
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking the input value (16-bit binary data) in the device specified by (s3) with the upper and lower limit values of the dead band specified by (s1) and (s2). The output value is controlled as follows.

Condition	Output value
Lower limit value of the dead band (s1) > Input value (s3)	Input value (s3) - Lower limit value of the dead band (s1)
Upper limit value of the dead band (s2) < Input value (s3)	Input value (s3) - Upper limit value of the dead band (s2)
Lower limit value of the dead band (s1) ≤ Input value (s3) ≤ Upper limit value of the dead band (s2)	0



- When the output value to be stored in the device specified by (d) is a 16-bit signed binary value and the operation result exceeds the range of -32768 to 32767, the output value is calculated as follows.

Ex.

When (s1) is 10 and (s3) is -32768: Output value = $-32768 - 10 = 8000\text{H} - 000\text{AH} = 7\text{FFFH} = 32758$

- When the output value to be stored in the device specified by (d) is a 16-bit unsigned binary value and the operation result exceeds the range of 0 to 65535, the output value is calculated as follows.

Ex.

When (s1) is 100 and (s3) is 50: Output value = $50 - 100 = 0032\text{H} - 0064\text{H} = \text{FFCEH} = 65486$

Operation error

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s2).

Dead band control of 32-bit binary data

DBAND(P)(_U)

These instructions control the output value to be stored in the device specified by (d) by checking the input value (32-bit binary data) in the device specified by (s3) with the upper and lower limit values of the dead band specified by (s1) and (s2).

Ladder diagram	Structured text	
	ENO:=DBAND(EN,s1,s2,s3,d); ENO:=DBANDP(EN,s1,s2,s3,d);	ENO:=DBAND_U(EN,s1,s2,s3,d); ENO:=DBANDP_U(EN,s1,s2,s3,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DBAND(P) Lower limit value of the dead band (no-output band)	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32
(s2)	DBAND(P) Upper limit value of the dead band (no-output band)	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32
(s3)	DBAND(P) Input value controlled by the dead band	-2147483648 to +2147483647 0 to 4294967295	32-bit signed binary 32-bit unsigned binary	ANY32
(d)	DBAND(P) Head device number for storing the output value controlled by the dead band	—	32-bit signed binary 32-bit unsigned binary	ANY32

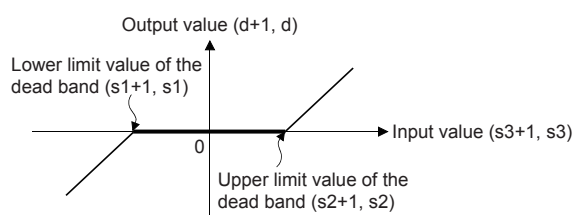
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s3)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking the input value (32-bit binary data) in the device specified by (s3) with the upper and lower limit values of the dead band specified by (s1) and (s2). The output value is controlled as follows.

Condition	Output value
Lower limit value of the dead band ((s1), (s1)+1) > Input value ((s3), (s3)+1)	Input value ((s3), (s3)+1) - Lower limit value of the dead band ((s1), (s1)+1)
Upper limit value of the dead band ((s2), (s2)+1) < Input value ((s3), (s3)+1)	Input value ((s3), (s3)+1) - Upper limit value of the dead band ((s2), (s2)+1)
Lower limit value of the dead band ((s1), (s1)+1) ≤ Input value ((s3), (s3)+1) ≤ Upper limit value of the dead band ((s2), (s2)+1)	0



- When the output value to be stored in the device specified by (d) is a 32-bit signed binary value and the operation result exceeds the range of -2147483648 to 2147483647, the output value is calculated as follows.

Ex.

When (s1) and (s1)+1 are 1000, and (s3) and (s3)+1 are -2147483648: Output value = -2147483648-1000 = 80000000H-000003E8H = 7FFFC18H = 2147482648

- When the output values to be stored in the devices specified by (d) and (d)+1 are 32-bit unsigned binary values and the operation result exceeds the range of 0 to 4294967295, the output value is calculated as follows.

Ex.

When (s1) and (s1)+1 are 100, and (s3) and (s3)+1 are 50: Output value = 50-100 = 00000032H-00000064H = FFFFFFFCEH = 4294967246

Operation error

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s2).

Zone control of 16-bit binary data

ZONE(P)(_U)

These instructions add the bias value specified by (s1) or (s2) to the input value specified by (s3), and store the operation result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=ZONE(EN,s1,s2,s3,d); ENO:=ZONEP(EN,s1,s2,s3,d);	ENO:=ZONE_U(EN,s1,s2,s3,d); ENO:=ZONEP_U(EN,s1,s2,s3,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	ZONE(P) ZONE(P)_U	-32768 to +32767 0 to 65535	16-bit signed binary 16-bit unsigned binary	ANY16
(s2)	ZONE(P) ZONE(P)_U	-32768 to +32767 0 to 65535	16-bit signed binary 16-bit unsigned binary	ANY16
(s3)	ZONE(P) ZONE(P)_U	-32768 to +32767 0 to 65535	16-bit signed binary 16-bit unsigned binary	ANY16
(d)	ZONE(P) ZONE(P)_U	—	16-bit signed binary 16-bit unsigned binary	ANY16

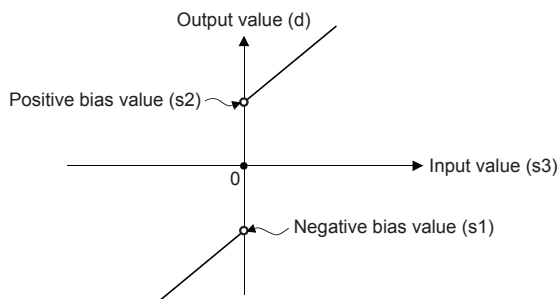
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions add the bias value specified by (s1) or (s2) to the input value (16-bit binary data) specified by (s3), and store the operation result in the device specified by (d). The bias value is controlled as follows.

Condition	Output value
Input value (s3) < 0	Input value (s3) + Negative bias value (s1)
Input value (s3) = 0	0
Input value (s3) > 0	Input value (s3) + Positive bias value (s2)



- When the output value to be stored in the device specified by (d) is a 16-bit signed binary value and the operation result exceeds the range of -32768 to 32767, the output value is calculated as follows.

Ex.

When (s1) is -100 and (s3) is -32768: Output value = $-32768 + (-100) = 8000\text{H} - \text{FF}9\text{CH} = 7\text{F}9\text{CH} = 32668$

- When the output value to be stored in the device specified by (d) is a 16-bit unsigned binary value and the operation result exceeds the range of 0 to 65535, the output value is calculated as follows.

Ex.

When (s2) is 100 and (s3) is 65535: Output value = $65535 + 100 = \text{FFFFH} - 0064\text{H} = 0063\text{H} = 99$

- When the ZONE(P)_U instructions are used, (s1) is regarded as dummy data and ignored.

Operation error

There is no operation error.

Zone control of 32-bit binary data

DZONE(P)(_U)

These instructions add the bias value specified by (s1) or (s2) to the input value specified by (s3), and store the operation result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DZONE(EN,s1,s2,s3,d); ENO:=DZONEP(EN,s1,s2,s3,d);	ENO:=DZONE_U(EN,s1,s2,s3,d); ENO:=DZONEP_U(EN,s1,s2,s3,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DZONE(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DZONE(P)_U	0 to 4294967295	32-bit unsigned binary	
(s2)	DZONE(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DZONE(P)_U	0 to 4294967295	32-bit unsigned binary	
(s3)	DZONE(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DZONE(P)_U	0 to 4294967295	32-bit unsigned binary	
(d)	DZONE(P)	—	32-bit signed binary	ANY32
	DZONE(P)_U	—	32-bit unsigned binary	

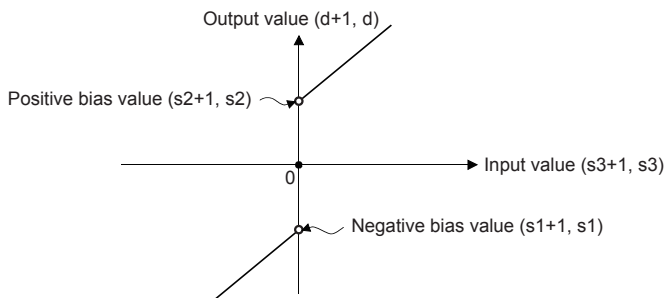
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s3)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions add the bias value specified by (s1) or (s2) to the input value (32-bit binary data) specified by (s3), and store the operation result in the device specified by (d). The bias value is controlled as follows.

Condition	Output value
Input value ((s3), (s3)+1) < 0	Input value ((s3), (s3)+1) + Negative bias value (s1), (s1)+1
Input value ((s3), (s3)+1) = 0	0
Input value ((s3), (s3)+1) > 0	Input value ((s3), (s3)+1) + Positive bias value (s2), (s2)+1



- When the output values to be stored in the devices specified by (d) and (d)+1 are 32-bit signed binary values and the operation result exceeds the range of -2147483648 to 2147483647, the output value is calculated as follows.

Ex.

When (s1) and (s1)+1 are -1000, and (s3) and (s3)+1 are -2147483648: Output value = -2147483648+(-1000) = 80000000H-FFFFFC18H = 7FFFFC18H = 2147482648

- When the output values to be stored in the devices specified by (d) and (d)+1 are 32-bit unsigned binary values and the operation result exceeds the range of 0 to 4294967295, the output value is calculated as follows.

Ex.

When (s2) and (s2)+1 are 1000, and (s3) and (s3)+1 are 4294967295: Output value = 4294967295+1000 = FFFFFFFFH-00003E8H = 000003E7H = 999

- When the DZONE(P)_U instructions are used, (s1) and (s1)+1 are regarded as dummy data and ignored.

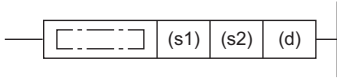
Operation error

There is no operation error.

Scaling 16-bit binary data (point coordinates)

SCL(P)(_U)

These instructions process the scaling conversion data (in 16-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=SCL(EN,s1,s2,d); ENO:=SCLP(EN,s1,s2,d);	ENO:=SCL_U(EN,s1,s2,d); ENO:=SCLP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	SCL(P)	-32768 to +32767	16-bit signed binary	ANY16
	SCL(P)_U	0 to 65535	16-bit unsigned binary	
(s2)	SCL(P)	—	16-bit signed binary ^{*1}	ANY16
	SCL(P)_U		16-bit unsigned binary ^{*1}	
(d)	SCL(P)	—	16-bit signed binary	ANY16
	SCL(P)_U		16-bit unsigned binary	

*1 The number of coordinate points of (s2) is 16-bit unsigned binary data.

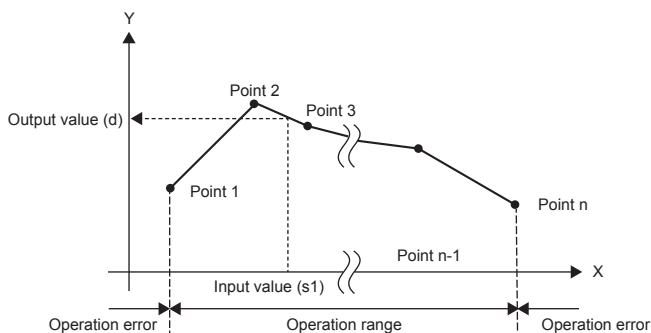
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

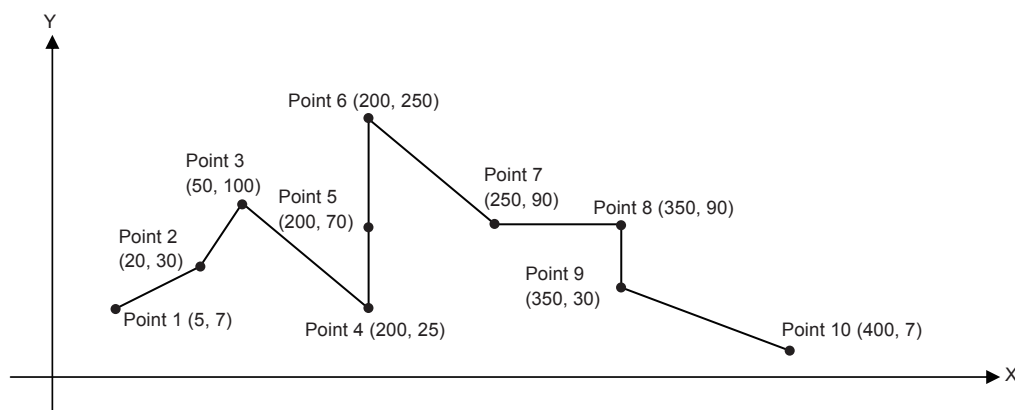
- These instructions process the scaling conversion data (in 16-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device number specified by (d). The scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

Setting item ("n" indicates the number of coordinate points specified by (s2).)		Device assignment	
Number of coordinate points		(s2)	
Point 1	X coordinate	(s2)+1	
	Y coordinate	(s2)+2	
Point 2	X coordinate	(s2)+3	
	Y coordinate	(s2)+4	
⋮			
Point n	X coordinate	(s2)+2n-1	
	Y coordinate	(s2)+2n	



- If the operation result is not an integer, the number in the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in the ascending order.
- Set (s1) within the scaling conversion data range (device value of (s2)).
- If the same X coordinate is specified by multiple points, the Y coordinate value of the point whose number is the largest is output.
- Set the number of coordinate points for the scaling conversion data within the range of 1 to 65535.
- Setting example of the conversion table for scaling

In the case of the conversion characteristics for scaling shown in the figure below, set each value as shown in the following data table.



Setting item		Setting device and setting contents			Remarks
		When R0 is specified in (s2)		Setting details	
Number of coordinate points		(s2)	R0	K10	
Point 1	X coordinate	(s2)+1	R1	K5	
	Y coordinate	(s2)+2	R2	K7	
Point 2	X coordinate	(s2)+3	R3	K20	
	Y coordinate	(s2)+4	R4	K30	
Point 3	X coordinate	(s2)+5	R5	K50	
	Y coordinate	(s2)+6	R6	K100	
Point 4	X coordinate	(s2)+7	R7	K200	When coordinates are specified using three points in this way, the output value can be set to an intermediate value. In this example, the output value (intermediate value) is specified by the Y coordinate of the point 5. Even if the X coordinate is the same at three points or more, the value at the second point is output.
	Y coordinate	(s2)+8	R8	K25	
Point 5	X coordinate	(s2)+9	R9	K200	
	Y coordinate	(s2)+10	R10	K70	
Point 6	X coordinate	(s2)+11	R11	K200	
	Y coordinate	(s2)+12	R12	K250	
Point 7	X coordinate	(s2)+13	R13	K250	
	Y coordinate	(s2)+14	R14	K90	
Point 8	X coordinate	(s2)+15	R15	K350	When coordinates are specified using two points in this way, the output value is the Y coordinate at the next point. In this example, the output value is specified by the Y coordinate of the point 9.
	Y coordinate	(s2)+16	R16	K90	
Point 9	X coordinate	(s2)+17	R17	K350	
	Y coordinate	(s2)+18	R18	K30	
Point 10	X coordinate	(s2)+19	R19	K400	
	Y coordinate	(s2)+20	R20	K7	

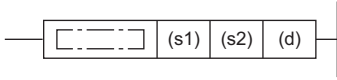
Operation error

Error code (SD0/SD8067)	Description
3405	The Xn data is not set in the ascending order in the data table. However, the instructions before the occurrence of an error are executed.
	The input value specified by (s1) is out of the range for the set scaling conversion data.
	The value in the middle of operation exceeds the 32-bit data range. In this case, verify that the distance between points is not "65535" or more. If the distance is "65535" or more, reduce the distance between points.
	The number of coordinate points from the device specified by (s2) is 0 or less.

Scaling 32-bit binary data (point coordinates)

DSCL(P)(_U)

These instructions process the scaling conversion data (in 32-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DSCL(EN,s1,s2,d); ENO:=DSCLP(EN,s1,s2,d);	ENO:=DSCL_U(EN,s1,s2,d); ENO:=DSCLP_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DSCL(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DSCL(P)_U	0 to 4294967295	32-bit unsigned binary	
(s2)	DSCL(P)	—	32-bit signed binary ^{*1}	ANY32
	DSCL(P)_U		32-bit unsigned binary ^{*1}	
(d)	DSCL(P)	—	32-bit signed binary	ANY32
	DSCL(P)_U		32-bit unsigned binary	

*1 The numbers of coordinate points of (s2)+1 and (s2) are 32-bit unsigned binary data.

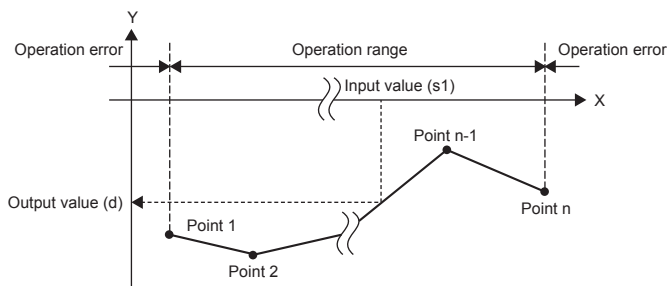
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

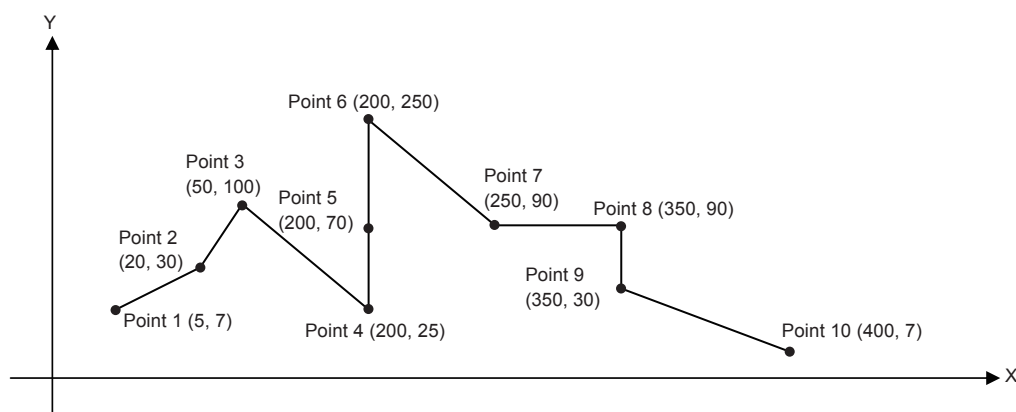
- These instructions process the scaling conversion data (in 32-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device number specified by (d). The scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

Setting item ("n" indicates the number of coordinate points specified by (s2).)		Device assignment	
Number of coordinate points		(s2)+1, (s2)	
Point 1	X coordinate	(s2)+3, (s2)+2	
	Y coordinate	(s2)+5, (s2)+4	
Point 2	X coordinate	(s2)+7, (s2)+6	
	Y coordinate	(s2)+9, (s2)+8	
⋮			
Point n	X coordinate	(s2)+4n-1, (s2)+4n-2	
	Y coordinate	(s2)+4n+1, (s2)+4n	



- If the operation result is not an integer, the number in the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in the ascending order.
- Set (s1) within the scaling conversion data range (device values of (s2) and (s2)+1).
- If the same X coordinate is specified by multiple points, the Y coordinate value of the point whose number is the largest is output.
- Set the number of coordinate points for the scaling conversion data within the range of 1 to 4294967295.
- Setting example of the conversion table for scaling

In the case of the conversion characteristics for scaling shown in the figure below, set each value as shown in the following data table.



Setting item		Setting device and setting contents			Remarks
		When R0 is specified in (s2)		Setting details	
Number of coordinate points		(s2)+1, (s2)	R1, R0	K10	
Point 1	X coordinate	(s2)+3, (s2)+2	R3, R2	K5	
	Y coordinate	(s2)+5, (s2)+4	R5, R4	K7	
Point 2	X coordinate	(s2)+7, (s2)+6	R7, R6	K20	
	Y coordinate	(s2)+9, (s2)+8	R9, R8	K30	
Point 3	X coordinate	(s2)+11, (s2)+10	R11, R10	K50	
	Y coordinate	(s2)+13, (s2)+12	R13, R12	K100	
Point 4	X coordinate	(s2)+15, (s2)+14	R15, R14	K200	When coordinates are specified using three points in this way, the output value can be set to an intermediate value. In this example, the output value (intermediate value) is specified by the Y coordinate of the point 5. Even if the X coordinate is the same at three points or more, the value at the second point is output.
	Y coordinate	(s2)+17, (s2)+16	R17, R16	K25	
Point 5	X coordinate	(s2)+19, (s2)+18	R19, R18	K200	
	Y coordinate	(s2)+21, (s2)+20	R21, R20	K70	
Point 6	X coordinate	(s2)+23, (s2)+22	R23, R22	K200	
	Y coordinate	(s2)+25, (s2)+24	R25, R24	K250	
Point 7	X coordinate	(s2)+27, (s2)+26	R27, R26	K250	
	Y coordinate	(s2)+29, (s2)+28	R29, R28	K90	
Point 8	X coordinate	(s2)+31, (s2)+30	R31, R30	K350	When coordinates are specified using two points in this way, the output value is the Y coordinate at the next point. In this example, the output value is specified by the Y coordinate of the point 9.
	Y coordinate	(s2)+33, (s2)+32	R33, R32	K90	
Point 9	X coordinate	(s2)+35, (s2)+34	R35, R34	K350	
	Y coordinate	(s2)+37, (s2)+36	R37, R36	K30	
Point 10	X coordinate	(s2)+39, (s2)+38	R39, R38	K400	
	Y coordinate	(s2)+41, (s2)+40	R41, R40	K7	

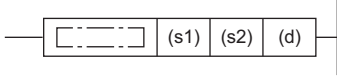
Operation error

Error code (SD0/SD8067)	Description
3405	The Xn data is not set in the ascending order in the data table. However, the instructions before the occurrence of an error are executed.
	The input value specified by (s1) is out of the range for the set scaling conversion data.
	The value in the middle of operation exceeds the 32-bit data range. In this case, verify that the distance between points is not "65535" or more. If the distance is "65535" or more, reduce the distance between points.
	The number of coordinate points from the device specified by (s2) is 0 or less.

Scaling 16-bit binary data (XY coordinates)

SCL2(P)(_U)

These instructions process the scaling conversion data (in 16-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=SCL2(EN,s1,s2,d); ENO:=SCL2P(EN,s1,s2,d);	ENO:=SCL2_U(EN,s1,s2,d); ENO:=SCL2P_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	SCL2(P)	-32768 to +32767	16-bit signed binary	ANY16
	SCL2(P)_U	0 to 65535	16-bit unsigned binary	
(s2)	SCL2(P)	—	16-bit signed binary ^{*1}	ANY16
	SCL2(P)_U		16-bit unsigned binary ^{*1}	
(d)	SCL2(P)	—	16-bit signed binary	ANY16
	SCL2(P)_U		16-bit unsigned binary	

*1 The number of coordinate points of (s2) is 16-bit unsigned binary data.

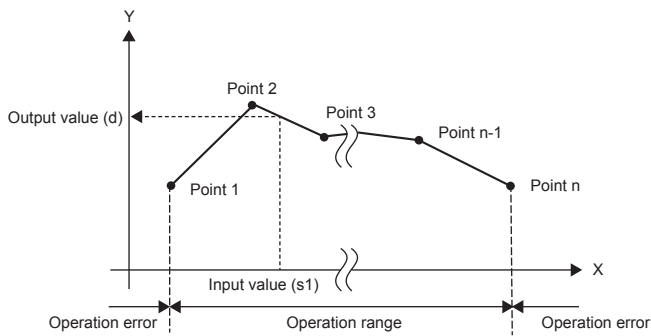
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

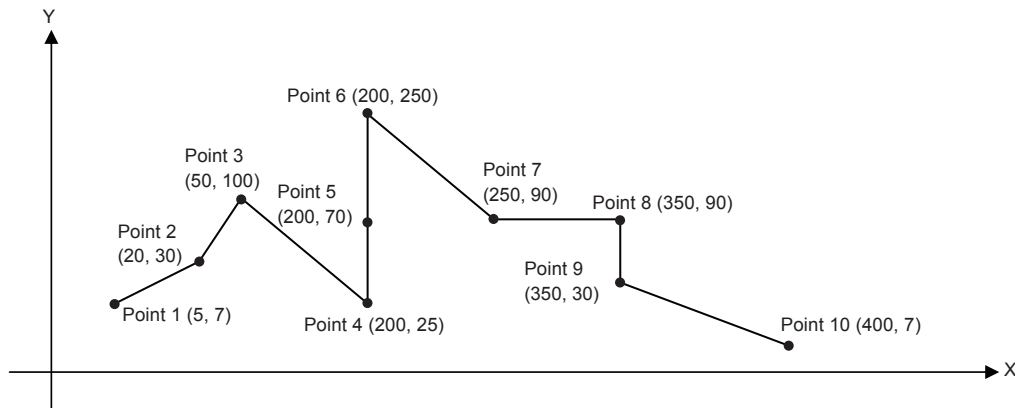
- These instructions process the scaling conversion data (in 16-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device number specified by (d). The scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

Setting item ("n" indicates the number of coordinate points specified by (s2).)			Device assignment
Number of coordinate points			(s2)
X coordinate	Point 1		(s2)+1
	Point 2		(s2)+2
	⋮		⋮
	Point n		(s2)+n
Y coordinate	Point 1		(s2)+n+1
	Point 2		(s2)+n+2
	⋮		⋮
	Point n		(s2)+2n



- If the operation result is not an integer, the number in the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in the ascending order.
- Set (s1) within the scaling conversion data range (device value of (s2)).
- If the same X coordinate is specified by multiple points, the Y coordinate value of the point whose number is the largest is output.
- Set the number of coordinate points for the scaling conversion data within the range of 1 to 65535.
- Setting example of the conversion table for scaling

In the case of the conversion characteristics for scaling shown in the figure below, set each value as shown in the following data table.



Setting item		Setting device and setting contents			Remarks
		When R0 is specified in (s2)	Setting details		
Number of coordinate points		(s2)	R0	K10	
X coordinate	Point 1	(s2)+1	R1	K5	
	Point 2	(s2)+2	R2	K20	
	Point 3	(s2)+3	R3	K50	
	Point 4	(s2)+4	R4	K200	Refer to *1.
	Point 5	(s2)+5	R5	K200	
	Point 6	(s2)+6	R6	K200	
	Point 7	(s2)+7	R7	K250	
	Point 8	(s2)+8	R8	K350	Refer to *2.
	Point 9	(s2)+9	R9	K350	
	Point 10	(s2)+10	R10	K400	
Y coordinate	Point 1	(s2)+11	R11	K7	
	Point 2	(s2)+12	R12	K30	
	Point 3	(s2)+13	R13	K100	
	Point 4	(s2)+14	R14	K25	Refer to *1.
	Point 5	(s2)+15	R15	K70	
	Point 6	(s2)+16	R16	K250	
	Point 7	(s2)+17	R17	K90	
	Point 8	(s2)+18	R18	K90	Refer to *2.
	Point 9	(s2)+19	R19	K30	
	Point 10	(s2)+20	R20	K7	

- *1 When coordinates are specified using three points as shown in the points 4, 5 and 6, the output value can be set to an intermediate value.
In this example, the output value (intermediate value) is specified by the Y coordinate of the point 5.
Even if the X coordinate is the same at three points or more, the value at the second point is output.
- *2 When coordinates are specified using two points as shown in the points 8 and 9, the output value is the Y coordinate at the next point.
In this example, the output value is specified by the Y coordinate of the point 9.

Operation error

Error code (SD0/SD8067)	Description
3405	The Xn data is not set in the ascending order in the data table. However, the instructions before the occurrence of an error are executed.
	The input value specified by (s1) is out of the range for the set scaling conversion data.
	The value in the middle of operation exceeds the 32-bit data range. In this case, verify that the distance between points is not "65535" or more. If the distance is "65535" or more, reduce the distance between points.
	The number of coordinate points from the device specified by (s2) is 0 or less.

Scaling 32-bit binary data (XY coordinates)

DSCL2(P)(_U)

These instructions process the scaling conversion data (in 32-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=DSCL2(EN,s1,s2,d); ENO:=DSCL2P(EN,s1,s2,d);	ENO:=DSCL2_U(EN,s1,s2,d); ENO:=DSCL2P_U(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	DSCL2(P)	-2147483648 to +2147483647	32-bit signed binary	ANY32
	DSCL2(P)_U	0 to 4294967295	32-bit unsigned binary	
(s2)	DSCL2(P)	—	32-bit signed binary ^{*1}	ANY32
	DSCL2(P)_U		32-bit unsigned binary ^{*1}	
(d)	DSCL2(P)	—	32-bit signed binary	ANY32
	DSCL2(P)_U		32-bit unsigned binary	

*1 The numbers of coordinate points of (s2)+1 and (s2) are 32-bit unsigned binary data.

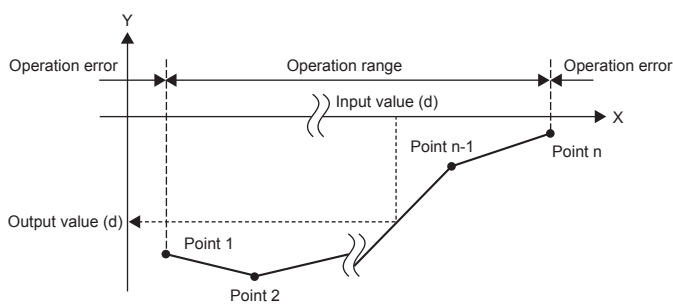
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions process the scaling conversion data (in 32-bit data units) specified by (s2) by scaling it based on the input value specified by (s1), and store the operation result in the device number specified by (d). The scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

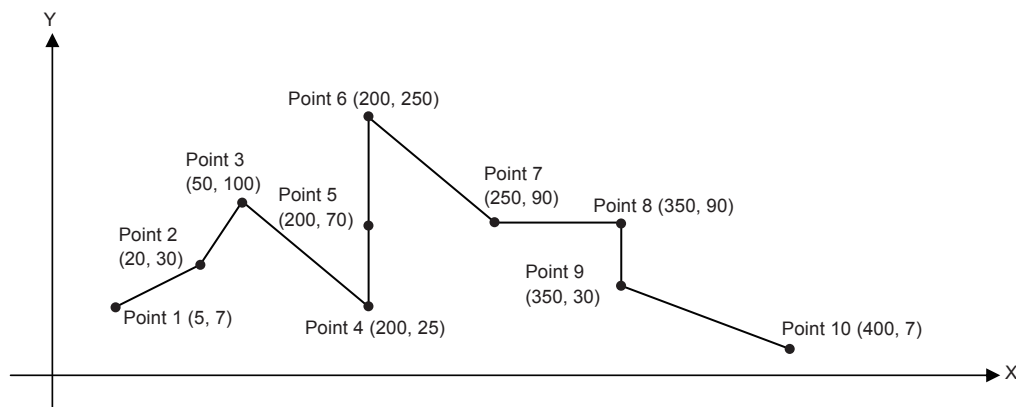
Setting item ("n" indicates the number of coordinate points specified by (s2).)		Device assignment
Number of coordinate points		(s2)+1, (s2)
X coordinate	Point 1	(s2)+3, (s2)+2
	Point 2	(s2)+5, (s2)+4
	⋮	⋮
	Point n	(s2)+2n+1, (s2)+2n
Y coordinate	Point 1	(s2)+2n+3, (s2)+2n+2
	Point 2	(s2)+2n+5, (s2)+2n+4
	⋮	⋮
	Point n	(s2)+4n+1, (s2)+4n



- If the operation result is not an integer, the number in the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in the ascending order.
- Set (s1) within the scaling conversion data range (device values of (s2) and (s2)+1).
- If the same X coordinate is specified by multiple points, the Y coordinate value of the point whose number is the largest is output.
- Set the number of coordinate points for the scaling conversion data within the range of 1 to 4294967295.

- Setting example of the conversion table for scaling

In the case of the conversion characteristics for scaling shown in the figure below, set each value as shown in the following data table.



Setting item		Setting device and setting contents			Remarks
		When R0 is specified in (s2)		Setting details	
Number of coordinate points		(s2)+1, (s2)	R1, R0	K10	
X coordinate	Point 1	(s2)+3, (s2)+2	R3, R2	K5	
	Point 2	(s2)+5, (s2)+4	R5, R4	K20	
	Point 3	(s2)+7, (s2)+6	R7, R6	K50	
	Point 4	(s2)+9, (s2)+8	R9, R8	K200	Refer to *1.
	Point 5	(s2)+11, (s2)+10	R11, R10	K200	
	Point 6	(s2)+13, (s2)+12	R13, R12	K200	
	Point 7	(s2)+15, (s2)+14	R15, R14	K250	
	Point 8	(s2)+17, (s2)+16	R17, R16	K350	Refer to *2.
	Point 9	(s2)+19, (s2)+18	R19, R18	K350	
	Point 10	(s2)+21, (s2)+20	R21, R20	K400	
Y coordinate	Point 1	(s2)+23, (s2)+22	R23, R22	K7	
	Point 2	(s2)+25, (s2)+24	R25, R24	K30	
	Point 3	(s2)+27, (s2)+26	R27, R26	K100	
	Point 4	(s2)+29, (s2)+28	R29, R28	K25	Refer to *1.
	Point 5	(s2)+31, (s2)+30	R31, R30	K70	
	Point 6	(s2)+33, (s2)+32	R33, R32	K250	
	Point 7	(s2)+35, (s2)+34	R35, R34	K90	
	Point 8	(s2)+37, (s2)+36	R37, R36	K90	Refer to *2.
	Point 9	(s2)+39, (s2)+38	R39, R38	K30	
	Point 10	(s2)+41, (s2)+40	R41, R40	K7	

*1 When coordinates are specified using three points as shown in the points 4, 5 and 6, the output value can be set to an intermediate value.

In this example, the output value (intermediate value) is specified by the Y coordinate of the point 5.

Even if the X coordinate is the same at three points or more, the value at the second point is output.

*2 When coordinates are specified using two points as shown in the points 8 and 9, the output value is the Y coordinate at the next point.

In this example, the output value is specified by the Y coordinate of the point 9.

Operation error

Error code (SD0/SD8067)	Description
3405	The Xn data is not set in the ascending order in the data table. However, the instructions before the occurrence of an error are executed.
	The input value specified by (s1) is out of the range for the set scaling conversion data.
	The value in the middle of operation exceeds the 32-bit data range. In this case, verify that the distance between points is not "65535" or more. If the distance is "65535" or more, reduce the distance between points.
	The number of coordinate points from the device specified by (s2) is 0 or less.

7.11 Special timer instruction

Teaching timer

TTMR

This instruction measures the period of time in which TTMR instruction is ON.

Use this instruction to adjust the set value of a timer by a pushbutton switch.

Ladder diagram	Structured text
	ENO:=TTMR(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Device storing the teaching data	—	16-bit signed binary	ANY16
(s)	Magnification applied to the teaching data	0 to 2	16-bit signed binary	ANY16

■Applicable devices

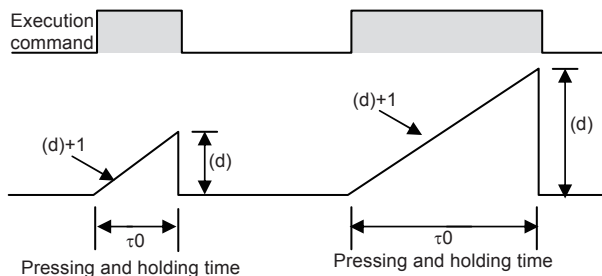
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—

■Control data

Operand: (d)			
Device	Description	Setting range	Set by
+0	Teaching time	—	System
+1	Current value of the pressing and holding time	—	System

Processing details

- This instruction measures the period of time to press and hold the command input (pushbutton switch) in 1-second units, multiplies the measured value by the magnification (10^s) which is specified by (s), and stores it in the device specified by (d).



- The table below shows the actual value indicated by (d) depending on the magnification specified by (s) and the pressing and holding time τ_0 .

(s)	Magnification	(d)
K0	τ_0	$(d) \times 1$
K1	$10\tau_0$	$(d) \times 10$
K2	$100\tau_0$	$(d) \times 100$

Precautions

- When the command contact turns from on to off, the current value (d)+1 of the pressing and holding time is cleared, and the teaching time (d) will not change any more.
- Two devices are occupied from a device specified as the teaching time (d). Make sure that such devices are not used in other controls for the machine.

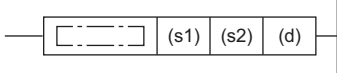
Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (s) is outside the following range. 0 to 2

Special function timer

STMR

This instruction uses the four devices from the device specified by (d) to perform four types of timer output.

Ladder diagram	Structured text
	ENO:=STMR(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Used timer number (operates as a 100 ms timer)	—	Device name	ANY16
(s2)	Timer set value	1 to 32767	16-bit unsigned binary	ANY16
(d)	Start bit number to be output	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	—	—	—	—	—	—	—	—	—

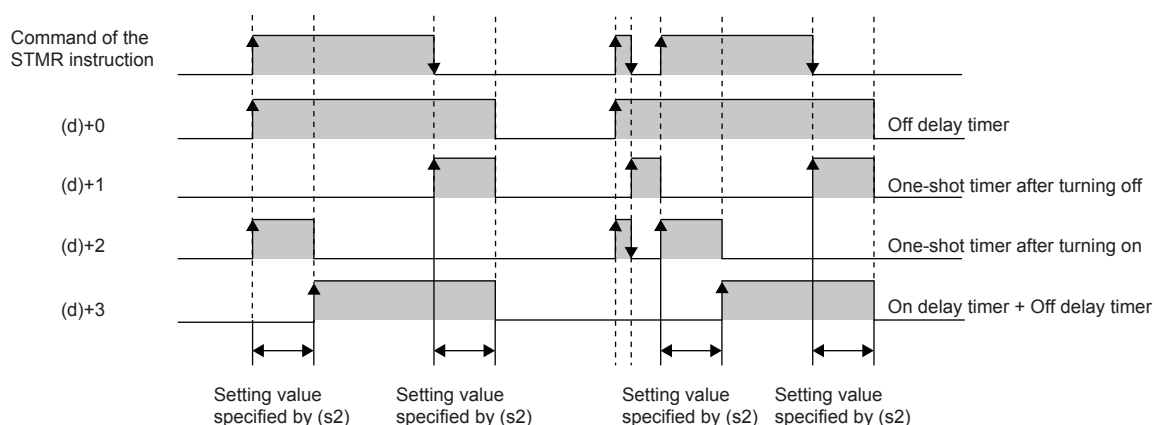
*1 Only T can be used.

■Control data

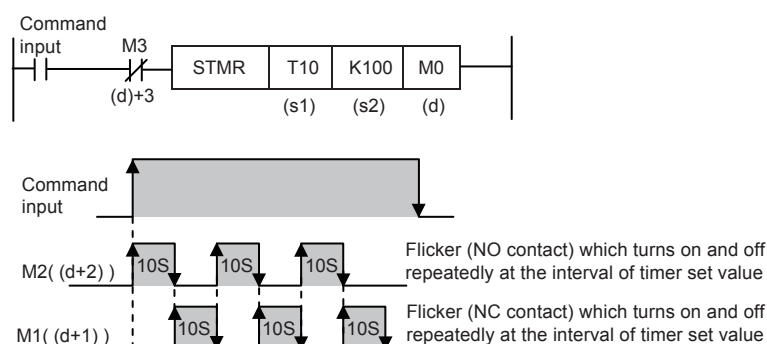
Operand: (d)				
Device	Description	Setting range	Set by	
+0	Off delay timer output: Turns on at the rising edge of the command of the STMR instruction and turns off when the time specified by (s2) elapses after the falling edge.	—	System	
+1	One-shot timer output after turning off: Turns on at the falling edge of the command of the STMR instruction and turns off when the time specified by (s2) elapses.	—	System	
+2	One-shot timer output after turning on Turns on at the rising edge of the command of the STMR instruction and turns off when the command of the STMR instruction is turned off or when the time specified by (s2) elapses.	—	System	
+3	On delay timer + Off delay timer output: Turns on at the falling edge of the timer coil and turns off when the time specified by (s2) elapsed after the falling edge of the command of the STMR instruction.	—	System	

Processing details

- This instruction uses the four devices from the device specified by (d) to perform four types of timer output.



- The flickering effect is produced using (d)+1 and (d)+2 with the following program, which turns on/off at the normally closed contact of (d)+3 (T10 is assigned to (s1), K100 is assigned to (s2), and M0 is assigned to (d)).



- A value in the range of 0 to 32767 (0 to 3276.7 seconds) can be specified in (s2).

Precautions

- The timer number specified in this instruction cannot be used in other general circuits (such as OUT instruction). If the timer number is used in other general circuits, the timer malfunctions.
- The timer specified by (s1) starts counting as a 100 ms timer on the rising edge of the command contact.
- Four devices are occupied from a device specified in (d). Make sure that such devices are not used in other controls for the machine.
- If the command contact is turned off, (d), (d)+1, and (d)+3 turn off when the set time elapses. (d)+2 and the timer (s1) are immediately reset.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (s2) is outside the following range. 1 to 32767

7.12 Shortcut control instruction

Rotary table shortest direction control

ROTC

This instruction is suitable for efficient control of the rotary table for putting/taking a product on/off the rotary table.

Ladder diagram	Structured text
	ENO:=ROTC(EN,s,n1,n2,d);

Setting data

■Descriptions, ranges, and data types

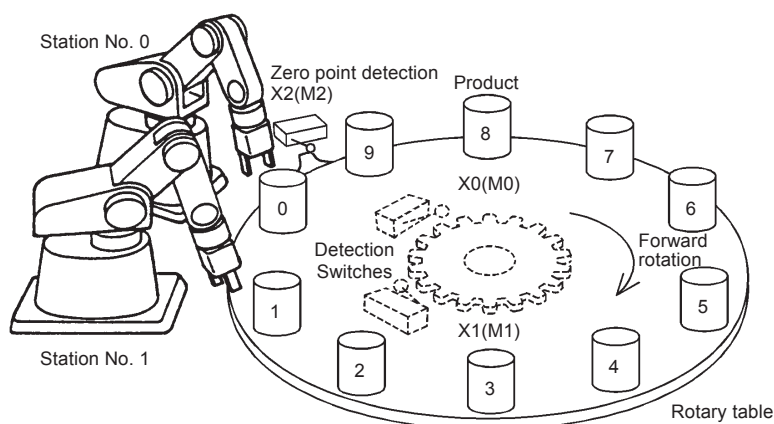
Operand	Description	Range	Data type	Data type (label)
(s)	Registers specifying the calling condition (Set them in advance using the transfer instruction.)	(s)+0: Works as a register for counting. (s)+1: Sets the station No. to be called. (s)+2: Sets the product No. to be called.	16-bit signed binary	ANY16
(n1)	Number of divisions	2 to 32767	16-bit signed binary	ANY16
(n2)	Number of low-speed sections	0 to 32767	16-bit signed binary	ANY16
(d)	Registers (bit devices) specifying the calling condition (Construct an internal contact circuit in advance which is driven by the input signal (X).)	(d): A phase signal (d)+1: B phase signal (d)+2: Zero point detection signal (d)+3: Forward rotation at high-speed (d)+4: Forward rotation at low-speed (d)+5: Stop (d)+6: Backward rotation at low-speed (d)+7: Backward rotation at high-speed	Bit	Bit

■Applicable devices

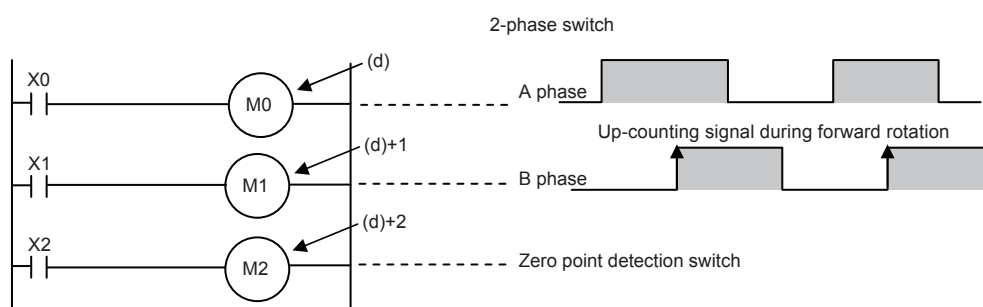
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	—	—	—	—	—	—	—	—	—	—

Processing details

- The table rotation is controlled by conditions of "n2", (s), and (d) so that a product can be efficiently put on or taken off the rotary table divided into "n1" (=10) sections as shown in the figure below. When the following conditions are specified, forward/backward rotation and high-speed/low-speed/stop are output to (d)+3 to (d)+7.



- Provide a 2-phase switch (X0 and X1) for detecting the rotation direction (forward or backward) of the table and the switch X2 which turns ON when the product No. 0 reaches the station No. 0. X0 to X2 are replaced with internal contacts of (d) to (d)+2. Any head device number can be specified by X or (d).



- The counter (s) detects which product number is located at the station No. 0.
- Set the station No. to be called in (s)+1.
- Set the product No. to be called in (s)+2.
- Specify the number of divisions (n1) of the table, and number of low-speed sections (n2).

Precautions

- When the command input is set to ON and this instruction is executed, the result will be automatically output to (d)+3 to (d)+7. When the command input is set to OFF, (d)+3 to (d)+7 are set to OFF accordingly.
- For example, when the rotation detection signal ((d) to (d)+2) is activated 10 times in one division, set a value multiplied by "10" to each division, station No. to be called and product No. to be called. As a result, an intermediate value of the division number can be set to a low-speed section.
- When the zero point detection signal (M2) turns ON while the command input is ON, the contents of the register for counting (s) are cleared to "0". This clear operation should be executed before starting the operation.
- Up to four ROTC instructions can be used simultaneously.

Operation error

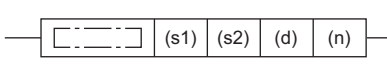
Error code (SD0/SD8067)	Description
1811	The number of the ROTC instructions which are used simultaneously exceeds four.
2820	The device range specified by (s) exceeds the corresponding device range. The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (n1) is outside the following range. 2 to 32767 The value specified by (n2) is outside the following range. 0 to 32767 The value specified by (n1) or (n2) is in the following condition. (n1) < (n2) Either (s), (s)+1, or (s)+2 is negative. Either (s), (s)+1, or (s)+2 is equal to (n1) or larger.

7.13 Ramp signal instruction

Ramp signal

RAMPF

This instruction obtains the data which changes between the start value (initial value) and the end value (target value) over the specified "n" times.

Ladder diagram	Structured text
	ENO:=RAMPF(EN,s1,s2,n,d);

Setting data

■Descriptions, ranges, and data types

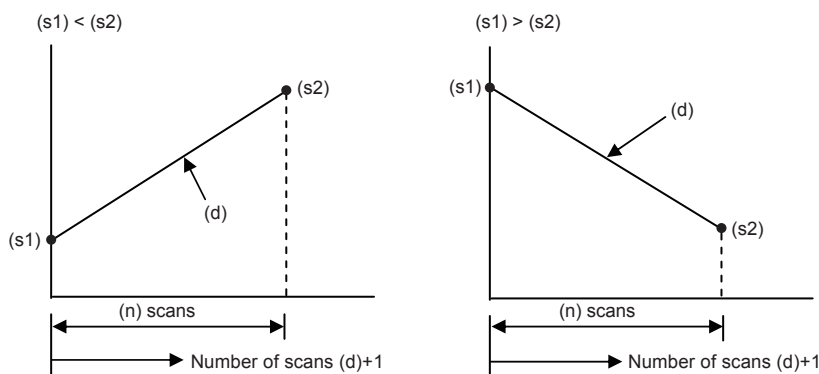
Operand	Description	Range	Data type	Data type (label)
(s1)	Initial value of ramp	—	16-bit signed binary	ANY16
(s2)	Target value of ramp	—	16-bit signed binary	ANY16
(d)	(d)+0: Current value (d)+1: Number of scans	—	16-bit signed binary	ANY16
(n)	Ramp transfer time (scan)	1 to 32767	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

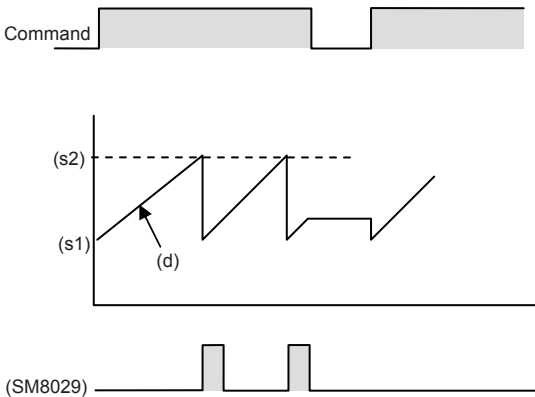
Processing details

- When the start value (s1) and the end value (s2) have been specified and the command input is set to ON, the value obtained by adding a value divided equally by "n" times to (s1) in the next operation cycle is stored to (d). By combining this instruction and an analog output, the cushion start/stop command can be output.



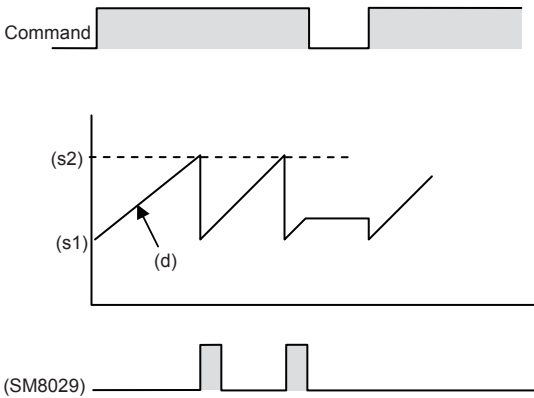
- The number of scans ("0" to "n") is stored in $(d)+1$.
- The time from start to the end value is the operation cycle multiplied by "n" times.
- If the command input is set to OFF in the middle of operation, execution is paused. (The current value stored in (d) is held, and the number of scans stored in $(d)+1$ is cleared.) When the command input is set to ON again, (d) is cleared, and the operation is started from $(s1)$.

- After transfer is completed, the instruction execution complete flag SM8029 turns ON, and the (d) value is returned to the (s1) value.

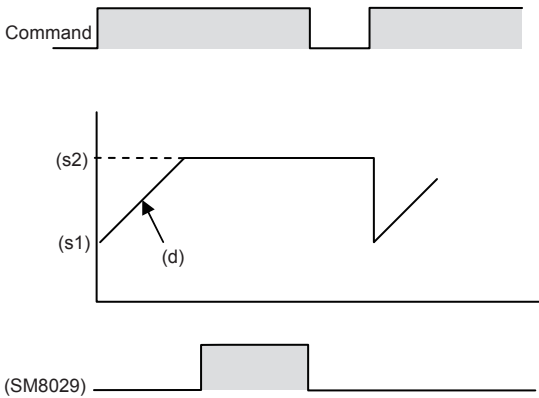


- When the operation result is acquired at a constant time interval (constant scan mode), write a prescribed scan time (which is longer than the actual scan time) to SD8039 and set SM8039 to ON. For example, when "20 ms" is written to SD8039 and "n" is set to 100, the (d) value will change from (s1) to (s2) in 2 seconds.
- The value used in the constant scan mode can be set in the parameter setting of an engineering tool (constant scan execution interval setting of CPU parameter).
For details on the constant scan, refer to [MELSEC iQ-F FX5 Series User's Manual \[Application\]](#).
For details on the engineering tool, refer to [GX Works3 Operating Manual](#).
- The contents of (d) are changed as follows depending on the ON/OFF status of the mode flag SM8026.

When SM8026 is off



When SM8026 is on



Precautions

To specify a latched (battery backed) type device as (d) when setting the CPU module to the RUN mode while the command input is ON, clear (d) in advance.

Operation error

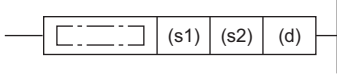
Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (n) is outside the following range. 1 to 32767

7.14 Pulse related instruction

Measuring the density of 16 bit binary pulses

SPD

This instruction counts the number of times the device input specified by (s1) turns off → on only for the time (in 16-bit data units) specified by (s2) × 1ms and stores the operation result in the device specified by (d).

Ladder diagram	Structured text
	ENO:=SPD(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Pulse input	—	Bit/16-bit unsigned binary	Bit/ANY16
(s2)	Measurement time (Unit: ms)	-32768 to +32767	16-bit signed binary	ANY16
(d)	Head device number for storing the measurement result	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○*1	—	—	○*2	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	○	—	—	○	—	—	—	—

*1 When a bit device is specified, specify one of X0 to X17.

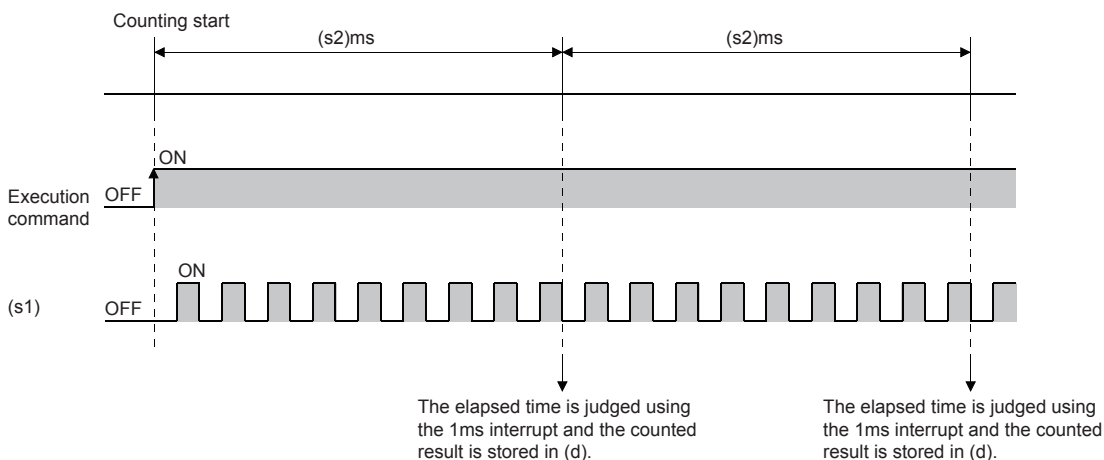
Only X can be used for a bit device.

The nibble of a bit device cannot be specified.

*2 When a word device is specified, specify one of the channel numbers (CH1 to CH8).

Processing details

- This instruction counts the number of times the device input specified by (s1) turns off → on only for the time (in 16-bit data units) specified by (s2) × 1ms and stores the operation result in the device specified by (d).



- The channel number of the high-speed counter specified by (s1) interlocks with the channel number in which parameters are set.

- When a word device is specified by (s1), this instruction counts the number of pulses by the high-speed counter setting of the channel number corresponding to each word device.
- When a bit device is specified by (s1), the following input assignment devices (shaded area) are valid.

General-purpose input assignment of the 1-phase 1-input counter (switching S/W up or down)

U/D: UP/DOWN pulse input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	U/D(A)								P	E						
CH2		U/D(A)									P	E				
CH3			U/D(A)										P	E		
CH4				U/D(A)											P	E
CH5					U/D(A)				P	E						
CH6						U/D(A)					P	E				
CH7							U/D(A)						P	E		
CH8								U/D(A)							P	E

If one of X10 to X17 is specified as a device, an error occurs.

General-purpose input assignment of the 1-phase 1-input counter (switching H/W up or down)

C: Pulse input, D: Direction input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	C(A)	D(B)							P	E						
CH2			C(A)	D(B)							P	E				
CH3					C(A)	D(B)							P	E		
CH4							C(A)	D(B)							P	E
CH5									C(A)	D(B)	P	E				
CH6											C(A)	D(B)	P	E		
CH7													C(A)	D(B)	P	E
CH8															C(A)	D(B)

If one of X1, X3, X5, X7, X11, X13, X15, X17 is specified as a device, an error occurs.

General-purpose input assignment of the 1-phase 2-input counter

U: UP pulse input, D: DOWN pulse input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	U(A)	D(B)							P	E						
CH2			U(A)	D(B)							P	E				
CH3					U(A)	D(B)							P	E		
CH4							U(A)	D(B)							P	E
CH5									U(A)	D(B)	P	E				
CH6											U(A)	D(B)	P	E		
CH7													U(A)	D(B)	P	E
CH8															U(A)	D(B)

If one of X1, X3, X5, X7, X11, X13, X15, X17 is specified as a device, an error occurs.

General-purpose input assignment of the 2-phase 2-input counter

A: A phase pulse input, B: B phase pulse input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	A	B							P	E						
CH2			A	B							P	E				
CH3					A	B							P	E		
CH4							A	B							P	E
CH5									A	B	P	E				
CH6											A	B	P	E		
CH7													A	B	P	E
CH8															A	B

If one of X1, X3, X5, X7, X11, X13, X15, X17 is specified as a device, an error occurs.

- The table below shows the related devices.

Function	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Monitor in operation	SM4500	SM4501	SM4502	SM4503	SM4504	SM4505	SM4506	SM4507
High-speed counter pulse density	SD4507, SD4506	SD4537, SD4536	SD4567, SD4566	SD4597, SD4596	SD4627, SD4626	SD4657, SD4656	SD4687, SD4686	SD4717, SD4716
Measurement unit time	SD4517, SD4516	SD4547, SD4546	SD4577, SD4576	SD4607, SD4606	SD4637, SD4636	SD4667, SD4666	SD4697, SD4696	SD4727, SD4726

- The table below shows the related device update timing.

Function	R/W	Update timing	Clear
Monitor in operation	R	<ul style="list-style-type: none"> When the SPD instruction is executed When the HIOEN instruction is executed 	<ul style="list-style-type: none"> Power-on Reset
High-speed counter pulse density	R	<ul style="list-style-type: none"> When the measurement time is finished 	<ul style="list-style-type: none"> Power-on Reset
Measurement unit time	R/W	<ul style="list-style-type: none"> When the SPD instruction is executed 	<ul style="list-style-type: none"> Power-on Reset

Precautions

- The maximum input frequency of turning the inputs ON and OFF is shown below:

FX5U-32M□ CPU module

Used input number	Maximum input frequency
X0 to X5	200 kHz
X6, X7	10 kHz

FX5U-64M□/FX5U-80M□ CPU module

Used input number	Maximum input frequency
X0 to X7	200 kHz
X10 to X17	10 kHz

- When the SPD instruction is used, the UP/DOWN pulse input, preset input and enable input operate in accordance with the contents set by the parameters of the high-speed counter.
- When the measurement time is changed while the SPD instruction is executed, the changed time is applied every time the measurement time ends.
- When the SPD instruction is started, the high-speed counter and pulse density measurement are started simultaneously. When the SPD instruction is stopped, only the pulse density measurement is stopped and the high-speed counter is not stopped.
- When the current value of the high-speed counter is overwritten, a preset input is executed, or the high-speed counter is reset by the DHCMOV instruction while the SPD instruction is executed, the operation continues, but the pulse density cannot be measured normally.
- When the SPD instruction is used, pulses per unit time which exceeds the ring length of the high-speed counter cannot be input.

- The measurement time specified by (S2) overwrites the value stored in the SD device specified for the measurement unit time.
- When the measurement time specified by (S2) is outside the range from 1 to 2,147,483,647, the specified measurement time is rounded into “1” with the sign.

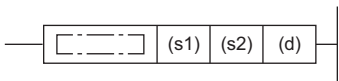
Operation error

Error code (SD0/SD8067)	Description
3600	The channel number or device number in which parameters are not set in (s1) is specified.
3405	An unavailable bit device is set in (s1).
	A channel number other than 1 to 8 is specified in (s1).
1810	The input specified in (s1) is already used by another instruction.

Measuring the density of 32 bit binary pulses

DSPD

This instruction counts the number of times the device input specified by (s1) turns off → on only for the time (in 32-bit data units) specified by (s2) × 1ms and stores the operation result in the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DSPD(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Pulse input	—	Bit/32-bit unsigned binary	Bit/ANY32
(s2)	Measurement time (Unit: ms)	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d)	Head device number for storing the measurement result	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○*1	—	—	○*2	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	—	—	—	○	—	○	○	○	○	—	—	—	—

*1 When a bit device is specified, specify one of X0 to X17.

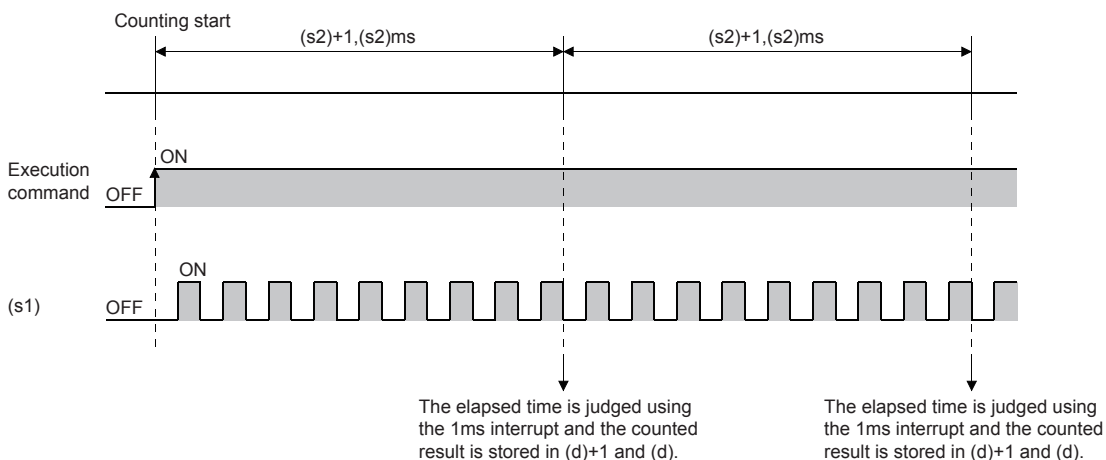
Only X can be used for a bit device.

The nibble of a bit device cannot be specified.

*2 When a word device is specified, specify one of the channel numbers (CH1 to CH8).

Processing details

- This instruction counts the number of times the device input specified by (s1) turns off → on only for the time (in 32-bit data units) specified by (s2) × 1ms and stores the operation result in the device specified by (d).



- The channel number of the high-speed counter specified by (s1) interlocks with the channel number in which parameters are set.
- When a word device is specified by (s1), this instruction counts the number of pulses by the high-speed counter setting of the channel number corresponding to each word device.

- When a bit device is specified by (s1), the following input assignment devices (shaded area) are valid.

General-purpose input assignment of the 1-phase 1-input counter (switching S/W up or down)

U/D: UP/DOWN pulse input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	U/D(A)								P	E						
CH2		U/D(A)									P	E				
CH3			U/D(A)										P	E		
CH4				U/D(A)											P	E
CH5					U/D(A)				P	E						
CH6						U/D(A)					P	E				
CH7							U/D(A)						P	E		
CH8								U/D(A)							P	E

If one of X10 to X17 is specified as a device, an error occurs.

General-purpose input assignment of the 1-phase 1-input counter (switching H/W up or down)

C: Pulse input, D: Direction input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	C(A)	D(B)							P	E						
CH2			C(A)	D(B)							P	E				
CH3					C(A)	D(B)							P	E		
CH4							C(A)	D(B)							P	E
CH5									C(A)	D(B)	P	E				
CH6											C(A)	D(B)	P	E		
CH7													C(A)	D(B)	P	E
CH8															C(A)	D(B)

If one of X1, X3, X5, X7, X11, X13, X15, X17 is specified as a device, an error occurs.

General-purpose input assignment of the 1-phase 2-input counter

U: UP pulse input, D: DOWN pulse input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	U(A)	D(B)							P	E						
CH2			U(A)	D(B)							P	E				
CH3					U(A)	D(B)							P	E		
CH4							U(A)	D(B)							P	E
CH5									U(A)	D(B)	P	E				
CH6											U(A)	D(B)	P	E		
CH7													U(A)	D(B)	P	E
CH8															U(A)	D(B)

If one of X1, X3, X5, X7, X11, X13, X15, X17 is specified as a device, an error occurs.

General-purpose input assignment of the 2-phase 2-input counter

A: A phase pulse input, B: B phase pulse input, P: Preset input (reset), E: Enable input (start)

	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
CH1	A	B							P	E						
CH2			A	B							P	E				
CH3					A	B							P	E		
CH4							A	B							P	E
CH5									A	B	P	E				
CH6											A	B	P	E		
CH7													A	B	P	E
CH8															A	B

If one of X1, X3, X5, X7, X11, X13, X15, X17 is specified as a device, an error occurs.

- The table below shows the related devices.

Function	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Monitor in operation	SM4500	SM4501	SM4502	SM4503	SM4504	SM4505	SM4506	SM4507
High-speed counter pulse density	SD4507, SD4506	SD4537, SD4536	SD4567, SD4566	SD4597, SD4596	SD4627, SD4626	SD4657, SD4656	SD4687, SD4686	SD4717, SD4716
Measurement unit time	SD4517, SD4516	SD4547, SD4546	SD4577, SD4576	SD4607, SD4606	SD4637, SD4636	SD4667, SD4666	SD4697, SD4696	SD4727, SD4726

- The table below shows the related device update timing.

Function	R/W	Update timing	Clear
Monitor in operation	R	<ul style="list-style-type: none"> When the DSPD instruction is executed When the DHIOEN instruction is executed 	<ul style="list-style-type: none"> Power-on Reset
High-speed counter pulse density	R	<ul style="list-style-type: none"> When the measurement time is finished 	<ul style="list-style-type: none"> Power-on Reset
Measurement unit time	R/W	<ul style="list-style-type: none"> When the DSPD instruction is executed 	<ul style="list-style-type: none"> Power-on Reset

Precautions

- The maximum input frequency of turning the inputs ON and OFF is shown below:

FX5U-32M□ CPU module

Used input number	Maximum input frequency
X0 to X5	200 kHz
X6, X7	10 kHz

FX5U-64M□/FX5U-80M□ CPU module

Used input number	Maximum input frequency
X0 to X7	200 kHz
X10 to X17	10 kHz

- When the DSPD instruction is used, the UP/DOWN pulse input, preset input and enable input operate in accordance with the contents set by the parameters of the high-speed counter.
- When the measurement time is changed while the DSPD instruction is executed, the changed time is applied every time the measurement time ends.
- When the DSPD instruction is started, the high-speed counter and pulse density measurement are started simultaneously. When the DSPD instruction is stopped, only the pulse density measurement is stopped and the high-speed counter is not stopped.
- When the current value of the high-speed counter is overwritten, a preset input is executed, or the high-speed counter is reset by the DHCMOV instruction while the SPD instruction is executed, the operation continues, but the pulse density cannot be measured normally.
- When the DSPD instruction is used, pulses per unit time which exceeds the ring length of the high-speed counter cannot be input.

- The measurement time specified by (S2) overwrites the value stored in the SD device specified for the measurement unit time.
- When the measurement time specified by (S2) is outside the range from 1 to 2,147,483,647, the specified measurement time is rounded into “1” with the sign.

Operation error

Error code (SD0/SD8067)	Description
3600	The channel number or device number in which parameters are not set in (s1) is specified.
3405	An unavailable bit device is set in (s1).
	A channel number other than 1 to 8 is specified in (s1).
1810	The input specified in (s1) is already used by another instruction.

16 bit binary pulse output

PLSY [For the FX3 Series-compatible operand specification]

This instruction outputs 16-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 16-bit pulses specified by the positioning address (n).

Ladder diagram	Structured text
	<pre>ENO:=PLSY(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed or word device number storing data	0 to 65535	16-bit unsigned binary	ANY16
(n)	Positioning address or word device number storing data	0 to 65535	16-bit unsigned binary	ANY16
(d)	Bit device number from which pulses are to be output	0 to 3	bit	ANY_BOOL

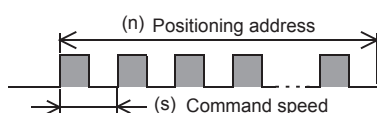
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○*1	—	—	—	—	—	—	—	—	—	—	—	—

*1 Y0 to Y3 can be used.

Processing details

- This instruction outputs 16-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 16-bit pulses specified by the positioning address (n).



- Set the value from 0 to 65535 (in user unit) to the command speed (s), so that the command speed is 200 kpps or less when the command speed is converted to frequency.
- Set the value from 0 to 65535 (in user unit) to the positioning address (n), so that the positioning address is within the range from 0 to 2147483647 when the positioning address is converted to number of pulses.
- Specify the Y device number (Y0 to Y3) in (d).

- The following tables show the special relays and special registers related to the PLSY instruction.

[Special relays]

Axis number				Name	Descriptions
1	2	3	4		
SM5500	SM5501	SM5502	SM5503	Positioning instruction activation	ON: During activation, OFF: Not activated
SM5516	SM5517	SM5518	SM5519	Pulse output monitor	ON: During output, OFF: During stop
SM5532	SM5533	SM5534	SM5535	Positioning error occurrence	On: Error occurred, OFF: Error not occurred
SM5628	SM5629	SM5630	SM5631	Pulse output stop command	ON: Stop command is on, OFF: Stop command is off
SM5644	SM5645	SM5646	SM5647	Pulse deceleration stop command ^{*1}	ON: Deceleration stop command is on, OFF: Deceleration stop command is off
SM5660	SM5661	SM5662	SM5663	Forward limit	ON: Forward limit is on, OFF: Forward limit is off
SM5676	SM5677	SM5678	SM5679	Reverse limit	ON: Reverse limit is on, OFF: Reverse limit is off

*1 Because the PLSY instruction does not have the acceleration/deceleration function, the operation is stopped immediately even though the pulse deceleration stop command is turned on.

[Special registers]

Axis number				Name
1	2	3	4	
SD5500 SD5501	SD5540 SD5541	SD5580 SD5581	SD5620 SD5621	Current address (in user unit)
SD5502 SD5503	SD5542 SD5543	SD5582 SD5583	SD5622 SD5623	Current address (in pulse unit)
SD5504 SD5505	SD5544 SD5545	SD5584 SD5585	SD5624 SD5625	Current speed (in user unit)
SD5510	SD5550	SD5590	SD5630	Positioning error error code

[Special relays (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SM8029				Instruction execution complete flag
SM8329				Instruction execution abnormal end flag
SM8340	SM8350	SM8360	SM8370	Pulse output monitoring
SM8348	SM8358	SM8368	SM8378	Positioning instruction activation

[Special registers (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SD8136 SD8137		—	—	Total number of outputs for axis 1 and 2 of PLSY instruction
SD8140 SD8141	SD8142 SD8143	—	—	Total number of output pulses of PLSY instruction
SD8340 SD8341	SD8350 SD8351	SD8360 SD8361	SD8370 SD8371	Current address (in user unit)

Precautions

- The operation cannot be performed normally in an environment such as user program where the instruction cannot be executed at each scan or if the instruction is jumped by the CJ(P) instruction. However, the pulse output is continued.
- The same devices as the ones of position instruction, PMW output or general-purpose output cannot be used for the output in the PLSY instruction.
- The following table shows how to stop the pulse output. The operation is stopped immediately in any stopping method by the PLSY instruction. Note that the motor is stopped without deceleration and this may damage the system.

Operation	Whether to decelerate or not	Abnormal end flag
Turn off the drive contact.	Stops immediately.	OFF
All outputs disable (Turn on the special relay.)		ON
Pulse output stop command (Turn on the special relay.)		ON
Pulse deceleration stop command (Turn on the special relay.)		ON
Forward limit (Turn on the special relay.)		ON
Reverse limit (Turn on the special relay.)		ON
Set 0 for the command speed specified by (s2).		OFF

- If the positioning address is 0 when the PLSY instruction is activated, pulses are output without limitation.
- Overwrite the positioning address during the pulse output to change the positioning address in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten. The positioning address becomes invalid if it is changed from 0 to a value other than 0 or from a value other than 0 to 0 during positioning operation.
- When the positioning address is changed during the pulse output, the operation is stopped immediately if the changed value is the number of pulses which have already been output or less.
- Overwrite the command speed during the pulse output to change the command speed in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten.
- When the numbers of pulses (by the pulses conversion) of the command speed and positioning address exceed the 32-bit range, an error occurs and the operation cannot be performed.
- The PLSY instruction always increases the current address because the setting of rotation direction is disabled due to the absence of direction.
- When the output mode is CW/CCW mode, output is always performed from the device set to CW.
- If reverse limit is used, it operates as forward limit.
- Do not set the value of 200 kpps or more by the frequency conversion when changing the command speed during the pulse output.
- If the command speed is set to 0 when the PLSY instruction is activated, the operation ends with an error and stops pulse output.
- If the command speed is changed to 0 during operation, the operation does not end with errors but is immediate stop.
- The command speed is changed to negative value during operation, it is the operation ends with an error.
- The following table shows the operation timing of the complete flag and abnormal end flag of the PLSY instruction.

	Complete flag (SM8029)* ¹	Abnormal end flag (SM8329)
ON condition	From when the output of the specified positioning address is completed until the drive contact is turned off	From the following stops until the drive contact is turned off <ul style="list-style-type: none"> • The specified axis is already used*² • Pulse output stop command • Pulse deceleration stop command • Forward limit • Reverse limit • All outputs disabled • Positioning address error • Command speed 0 (when the PLSY instruction is activated)
ON→OFF condition	• When the drive contact is turned off	• When the drive contact is turned off

*1 When pulses are being output without limitation, instruction execution complete flag is not turned on.

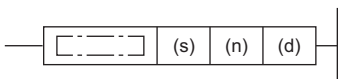
*2 The flag turns on only during one scan time when the activation contact of the instruction turns off and on.

Operation error

Error code (SD0/SD8067)				Description
Axis 1	Axis 2	Axis 3	Axis 4	
SD5510	SD5550	SD5590	SD5630	
1810				The axis number specified by (d) is used by another instruction.
2820				The value specified by (s) is outside the following range. 0 to 65535
				The value specified by (n) is outside the following range. 0 to 65535
				The value specified by (d) is outside the following range. 0 to 3
3600				The axis number specified by (d) is not set by parameters. A function which is set to be not used by parameters (such as interrupt input signal 1 and zero return relations) is used.
3631	3632	3633	3634	The numbers of pulses (by the pulses conversion) of the positioning address specified by (n) exceed the 32-bit range.
3641	3642	3643	3644	The numbers of pulses (by the pulses conversion) of the command speed specified by (s) exceed the 32-bit range.
3651	3652	3653	3654	The operation decelerates and stops by the forward limit or reverse limit during the pulse output or at the activating of the positioning.
3661	3662	3663	3664	The operation decelerates and stops by the pulse output stop command or special relay whose all outputs are disabled during the pulse output or at the activating of the positioning.

PLSY [For the FX5 Series operand specification]

This instruction outputs 16-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 16-bit pulses specified by the positioning address (n).

Ladder diagram	Structured text
	ENO:=PLSY(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed or word device number storing data	0 to 65535	16-bit unsigned binary	ANY16
(n)	Positioning address or word device number storing data	0 to 65535	16-bit unsigned binary	ANY16
(d)	Axis number from which pulses are to be output	1 to 4	16-bit unsigned binary	ANY16

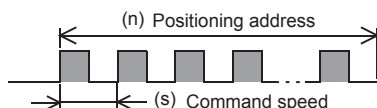
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	○	○	—	—	○	○	—	—	—

7

Processing details

- This instruction outputs 16-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 16-bit pulses specified by the positioning address (n).



- Set the value from 0 to 65535 (in user unit) in the command speed (s), so that the command speed is 200 kpps or less when the command speed is converted to frequency.
- Set the value from 0 to 65535 (in user unit) in the positioning address (n), so that the positioning address is within the range from 0 to 2147483647 when the positioning address is converted to number of pulses.
- Specify the axis number (K1 to K4) in which positioning parameters exist in (d).

- The following tables show the special relays and special registers related to the PLSY instruction.

[Special relays]

Axis number				Name	Descriptions
1	2	3	4		
SM5500	SM5501	SM5502	SM5503	Positioning instruction activation	ON: During activation, OFF: Not activated
SM5516	SM5517	SM5518	SM5519	Pulse output monitor	ON: During output, OFF: During stop
SM5532	SM5533	SM5534	SM5535	Positioning error occurrence	On: Error occurred, OFF: Error not occurred
SM5628	SM5629	SM5630	SM5631	Pulse output stop command	ON: Stop command is on, OFF: Stop command is off
SM5644	SM5645	SM5646	SM5647	Pulse deceleration stop command ^{*1}	ON: Deceleration stop command is on, OFF: Deceleration stop command is off
SM5660	SM5661	SM5662	SM5663	Forward limit	ON: Forward limit is on, OFF: Forward limit is off
SM5676	SM5677	SM5678	SM5679	Reverse limit	ON: Reverse limit is on, OFF: Reverse limit is off

*1 Because the PLSY instruction does not have the acceleration/deceleration function, the operation is stopped immediately even though the pulse deceleration stop command is turned on.

[Special registers]

Axis number				Name
1	2	3	4	
SD5500 SD5501	SD5540 SD5541	SD5580 SD5581	SD5620 SD5621	Current address (in user unit)
SD5502 SD5503	SD5542 SD5543	SD5582 SD5583	SD5622 SD5623	Current address (in pulse unit)
SD5504 SD5505	SD5544 SD5545	SD5584 SD5585	SD5624 SD5625	Current speed (in user unit)
SD5510	SD5550	SD5590	SD5630	Positioning error error code

[Special relays (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SM8029				Instruction execution complete flag
SM8329				Instruction execution abnormal end flag
SM8340	SM8350	SM8360	SM8370	Pulse output monitoring
SM8348	SM8358	SM8368	SM8378	Positioning instruction activation

[Special registers (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SD8136 SD8137		—	—	Total number of outputs for axis 1 and 2 of PLSY instruction
SD8140 SD8141	SD8142 SD8143	—	—	Total number of output pulses of PLSY instruction
SD8340 SD8341	SD8350 SD8351	SD8360 SD8361	SD8370 SD8371	Current address (in user unit)

Precautions

- The operation cannot be performed normally in an environment such as user program where the instruction cannot be executed at each scan or if the instruction is jumped by the CJ(P) instruction. However, the pulse output is continued.
- The same devices as the ones of position instruction, PMW output or general-purpose output cannot be used for the output in the PLSY instruction.
- The following table shows how to stop the pulse output. The operation is stopped immediately in any stopping method by the PLSY instruction. Note that the motor is stopped without deceleration and this may damage the system.

Operation	Whether to decelerate or not	Abnormal end flag
Turn off the drive contact.	Stops immediately.	OFF
All outputs disable (Turn on the special relay.)		ON
Pulse output stop command (Turn on the special relay.)		ON
Pulse deceleration stop command (Turn on the special relay.)		ON
Forward limit (Turn on the special relay.)		ON
Reverse limit (Turn on the special relay.)		ON
Set 0 for the command speed specified by (s2).		OFF

- If the positioning address is 0 when the PLSY instruction is activated, pulses are output without limitation.
- Overwrite the positioning address during the pulse output to change the positioning address in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten. The positioning address becomes invalid if it is changed from 0 to a value other than 0 or from a value other than 0 to 0 during positioning operation.
- When the positioning address is changed during the pulse output, the operation is stopped immediately if the changed value is the number of pulses which have already been output or less.
- Overwrite the command speed during the pulse output to change the command speed in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten.
- When the numbers of pulses (by the pulses conversion) of the command speed and positioning address exceed the 32-bit range, an error occurs and the operation cannot be performed.
- The PLSY instruction always increases the current address because the setting of rotation direction is disabled due to the absence of direction.
- When the output mode is CW/CCW mode, output is always performed from the device set to CW.
- If reverse limit is used, it operates as forward limit.
- Do not set the value of 200 kpps or more by the frequency conversion when changing the command speed during the pulse output.
- If the command speed is set to 0 when the PLSY instruction is activated, the operation ends with an error and stops pulse output.
- If the command speed is changed to 0 during operation, the operation does not end with errors but is immediate stop.
- The command speed is changed to negative value during operation, it is the operation ends with an error.
- The following table shows the operation timing of the complete flag and abnormal end flag of the PLSY instruction.

	Complete flag (SM8029)*1	Abnormal end flag (SM8329)
ON condition	From when the output of the specified positioning address is completed until the drive contact is turned off	From the following stops until the drive contact is turned off <ul style="list-style-type: none"> • The specified axis is already used*2 • Pulse output stop command • Pulse deceleration stop command • Forward limit • Reverse limit • All outputs disabled • Positioning address error • Command speed 0 (when the PLSY instruction is activated)
ON→OFF condition	• When the drive contact is turned off	• When the drive contact is turned off

*1 When pulses are being output without limitation, instruction execution complete flag is not turned on.

*2 The flag turns on only during one scan time when the activation contact of the instruction turns off and on.

Operation error

Error code (SD0/SD8067)				Description
Axis 1	Axis 2	Axis 3	Axis 4	
SD5510	SD5550	SD5590	SD5630	
1810				The axis number specified by (d) is used by another instruction.
2820				The value specified by (s) is outside the following range. 0 to 65535
				The value specified by (n) is outside the following range. 0 to 65535
				The value specified by (d) is outside the following range. 0 to 3
3600				The axis number specified by (d) is not set by parameters. A function which is set to be not used by parameters (such as interrupt input signal 1 and zero return relations) is used.
3631	3632	3633	3634	The numbers of pulses (by the pulses conversion) of the positioning address specified by (n) exceed the 32-bit range.
3641	3642	3643	3644	The numbers of pulses (by the pulses conversion) of the command speed specified by (s) exceed the 32-bit range.
3651	3652	3653	3654	The operation decelerates and stops by the forward limit or reverse limit during the pulse output or at the activating of the positioning.
3661	3662	3663	3664	The operation decelerates and stops by the pulse output stop command or special relay whose all outputs are disabled during the pulse output or at the activating of the positioning.

32 bit binary pulse output

DPLSY [For the FX3 Series-compatible operand specification]

This instruction outputs 32-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 32-bit pulses specified by the positioning address (n).

Ladder diagram	Structured text
	<pre>ENO:=DPLSY(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed or word device number storing data	0 to 2147483647	32-bit unsigned binary	ANY32
(n)	Positioning address or word device number storing data	0 to 2147483647	32-bit unsigned binary	ANY32
(d)	Bit device number from which pulses are to be output	0 to 3	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(n)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○*1	—	—	—	—	—	—	—	—	—	—	—	—

*1 Y0 to Y3 can be used.

Processing details

- This instruction outputs 32-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 32-bit pulses specified by the positioning address (n).



- Set the value from 0 to 2147483647 (in user unit) to the command speed (s), so that the command speed is 200 kpps or less when the command speed is converted to frequency.
- Set the value from 0 to 2147483647 (in user unit) to the positioning address (n), so that the positioning address is within the range from 0 to 2147483647 when the positioning address is converted to number of pulses.
- Specify the Y device number (Y0 to Y3) in (d).

- The following tables show the special relays and special registers related to the DPLSY instruction.

[Special relays]

Axis number				Name	Descriptions
1	2	3	4		
SM5500	SM5501	SM5502	SM5503	Positioning instruction activation	ON: During activation, OFF: Not activated
SM5516	SM5517	SM5518	SM5519	Pulse output monitor	ON: During output, OFF: During stop
SM5532	SM5533	SM5534	SM5535	Positioning error occurrence	On: Error occurred, OFF: Error not occurred
SM5628	SM5629	SM5630	SM5631	Pulse output stop command	ON: Stop command is on, OFF: Stop command is off
SM5644	SM5645	SM5646	SM5647	Pulse deceleration stop command ^{*1}	ON: Deceleration stop command is on, OFF: Deceleration stop command is off
SM5660	SM5661	SM5662	SM5663	Forward limit	ON: Forward limit is on, OFF: Forward limit is off
SM5676	SM5677	SM5678	SM5679	Reverse limit	ON: Reverse limit is on, OFF: Reverse limit is off

*1 Because the DPLSY instruction does not have the acceleration/deceleration function, the operation is stopped immediately even though the pulse deceleration stop command is turned on.

[Special registers]

Axis number				Name
1	2	3	4	
SD5500 SD5501	SD5540 SD5541	SD5580 SD5581	SD5620 SD5621	Current address (in user unit)
SD5502 SD5503	SD5542 SD5543	SD5582 SD5583	SD5622 SD5623	Current address (in pulse unit)
SD5504 SD5505	SD5544 SD5545	SD5584 SD5585	SD5624 SD5625	Current speed (in user unit)
SD5510	SD5550	SD5590	SD5630	Positioning error error code

[Special relays (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SM8029				Instruction execution complete flag
SM8329				Instruction execution abnormal end flag
SM8340	SM8350	SM8360	SM8370	Pulse output monitoring
SM8348	SM8358	SM8368	SM8378	Positioning instruction activation

[Special registers (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SD8136 SD8137		—	—	Total number of outputs for axis 1 and 2 of PLSY instruction
SD8140 SD8141	SD8142 SD8143	—	—	Total number of output pulses of PLSY instruction
SD8340 SD8341	SD8350 SD8351	SD8360 SD8361	SD8370 SD8371	Current address (in user unit)

Precautions

- The operation cannot be performed normally in an environment such as user program where the instruction cannot be executed at each scan or if the instruction is jumped by the CJ(P) instruction. However, the pulse output is continued.
- The same devices as the ones of position instruction, PMW output or general-purpose output cannot be used for the output in the DPLSY instruction.
- The following table shows how to stop the pulse output. The operation is stopped immediately in any stopping method by the DPLSY instruction. Note that the motor is stopped without deceleration and this may damage the system.

Operation	Whether to decelerate or not	Abnormal end flag
Turn off the drive contact.	Stops immediately.	OFF
All outputs disable (Turn on the special relay.)		ON
Pulse output stop command (Turn on the special relay.)		ON
Pulse deceleration stop command (Turn on the special relay.)		ON
Forward limit (Turn on the special relay.)		ON
Reverse limit (Turn on the special relay.)		ON
Set 0 for the command speed specified by (s2).		OFF

- If the positioning address is 0 when the DPLSY instruction is activated, pulses are output without limitation.
- Overwrite the positioning address during the pulse output to change the positioning address in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten. The positioning address becomes invalid if it is changed from 0 to a value other than 0 or from a value other than 0 to 0 during positioning operation.
- When the positioning address is changed during the pulse output, the operation is stopped immediately if the changed value is the number of pulses which have already been output or less.
- Overwrite the command speed during the pulse output to change the command speed in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten.
- When the numbers of pulses (by the pulses conversion) of the command speed and positioning address exceed the 32-bit range, an error occurs and the operation cannot be performed.
- The DPLSY instruction always increases the current address because the setting of rotation direction is disabled due to the absence of direction.
- When the output mode is CW/CCW mode, output is always performed from the device set to CW.
- If reverse limit is used, it operates as forward limit.
- Do not set the value of 200 kpps or more by the frequency conversion when changing the command speed during the pulse output.
- If the command speed is set to 0 when the DPLSY instruction is activated, the operation ends with an error and stops pulse output.
- If the command speed is changed to 0 during operation, the operation does not end with errors but is immediate stop.
- The command speed is changed to negative value during operation, it is the operation ends with an error.
- The following table shows the operation timing of the complete flag and abnormal end flag of the DPLSY instruction.

	Complete flag (SM8029)*1	Abnormal end flag (SM8329)
ON condition	From when the output of the specified positioning address is completed until the drive contact is turned off	From the following stops until the drive contact is turned off <ul style="list-style-type: none"> • The specified axis is already used*2 • Pulse output stop command • Pulse deceleration stop command • Forward limit • Reverse limit • All outputs disabled • Positioning address error • Command speed 0 (when the DPLSY instruction is activated)
ON→OFF condition	• When the drive contact is turned off	• When the drive contact is turned off

*1 When pulses are being output without limitation, instruction execution complete flag is not turned on.

*2 The flag turns on only during one scan time when the activation contact of the instruction turns off and on.

Operation error

Error code (SD0/SD8067)				Description
Axis 1	Axis 2	Axis 3	Axis 4	
SD5510	SD5550	SD5590	SD5630	
1810				The axis number specified by (d) is used by another instruction.
2820				The value specified by (s) is outside the following range. 0 to 65535
				The value specified by (n) is outside the following range. 0 to 65535
				The value specified by (d) is outside the following range. 0 to 3
3600				The axis number specified by (d) is not set by parameters. A function which is set to be not used by parameters (such as interrupt input signal 1 and zero return relations) is used.
3631	3632	3633	3634	The numbers of pulses (by the pulses conversion) of the positioning address specified by (n) exceed the 32-bit range.
3641	3642	3643	3644	The numbers of pulses (by the pulses conversion) of the command speed specified by (s) exceed the 32-bit range.
3651	3652	3653	3654	The operation decelerates and stops by the forward limit or reverse limit during the pulse output or at the activating of the positioning.
3661	3662	3663	3664	The operation decelerates and stops by the pulse output stop command or special relay whose all outputs are disabled during the pulse output or at the activating of the positioning.

DPLSY [For the FX5 Series operand specification]

This instruction outputs 32-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 32-bit pulses specified by the positioning address (n).

Ladder diagram	Structured text
	ENO:=DPLSY(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed or word device number storing data	0 to 2147483647	32-bit unsigned binary	ANY32
(n)	Positioning address or word device number storing data	0 to 2147483647	32-bit unsigned binary	ANY32
(d)	Axis number from which pulses are to be output	1 to 4	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	○	○	○	○	—	—	—	—
(d)	—	—	—	○	○	○	—	—	○	○	—	—	—	—

Processing details

- This instruction outputs 32-bit pulse trains specified by the command speed (s) from the device specified by the output (d) for the amount of 32-bit pulses specified by the positioning address (n).



- Set the value from 0 to 2147483647 (in user unit) to the command speed (s), so that the command speed is 200 kpps or less when the command speed is converted to frequency.
- Set the value from 0 to 2147483647 (in user unit) to the positioning address (n), so that the positioning address is within the range from 0 to 2147483647 when the positioning address is converted to number of pulses.
- Specify the axis number (K1 to K4) in which positioning parameters exist in (d).

- The following tables show the special relays and special registers related to the DPLSY instruction.

[Special relays]

Axis number				Name	Descriptions
1	2	3	4		
SM5500	SM5501	SM5502	SM5503	Positioning instruction activation	ON: During activation, OFF: Not activated
SM5516	SM5517	SM5518	SM5519	Pulse output monitor	ON: During output, OFF: During stop
SM5532	SM5533	SM5534	SM5535	Positioning error occurrence	On: Error occurred, OFF: Error not occurred
SM5628	SM5629	SM5630	SM5631	Pulse output stop command	ON: Stop command is on, OFF: Stop command is off
SM5644	SM5645	SM5646	SM5647	Pulse deceleration stop command ^{*1}	ON: Deceleration stop command is on, OFF: Deceleration stop command is off
SM5660	SM5661	SM5662	SM5663	Forward limit	ON: Forward limit is on, OFF: Forward limit is off
SM5676	SM5677	SM5678	SM5679	Reverse limit	ON: Reverse limit is on, OFF: Reverse limit is off

*1 Because the DPLSY instruction does not have the acceleration/deceleration function, the operation is stopped immediately even though the pulse deceleration stop command is turned on.

[Special registers]

Axis number				Name
1	2	3	4	
SD5500 SD5501	SD5540 SD5541	SD5580 SD5581	SD5620 SD5621	Current address (in user unit)
SD5502 SD5503	SD5542 SD5543	SD5582 SD5583	SD5622 SD5623	Current address (in pulse unit)
SD5504 SD5505	SD5544 SD5545	SD5584 SD5585	SD5624 SD5625	Current speed (in user unit)
SD5510	SD5550	SD5590	SD5630	Positioning error error code

[Special relays (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SM8029				Instruction execution complete flag
SM8329				Instruction execution abnormal end flag
SM8340	SM8350	SM8360	SM8370	Pulse output monitoring
SM8348	SM8358	SM8368	SM8378	Positioning instruction activation

[Special registers (FX3 compatible area)]

Axis number				Name
1	2	3	4	
SD8136 SD8137		—	—	Total number of outputs for axis 1 and 2 of DPLSY instruction
SD8140 SD8141	SD8142 SD8143	—	—	Total number of output pulses of DPLSY instruction
SD8340 SD8341	SD8350 SD8351	SD8360 SD8361	SD8370 SD8371	Current address (in user unit)

Precautions

- The operation cannot be performed normally in an environment such as user program where the instruction cannot be executed at each scan or if the instruction is jumped by the CJ(P) instruction. However, the pulse output is continued.
- The same devices as the ones of position instruction, PMW output or general-purpose output cannot be used for the output in the DPLSY instruction.
- The following table shows how to stop the pulse output. The operation is stopped immediately in any stopping method by the DPLSY instruction. Note that the motor is stopped without deceleration and this may damage the system.

Operation	Whether to decelerate or not	Abnormal end flag
Turn off the drive contact.	Stops immediately.	OFF
All outputs disable (Turn on the special relay.)		ON
Pulse output stop command (Turn on the special relay.)		ON
Pulse deceleration stop command (Turn on the special relay.)		ON
Forward limit (Turn on the special relay.)		ON
Reverse limit (Turn on the special relay.)		ON
Set 0 for the command speed specified by (s2).		OFF

- If the positioning address is 0 when the DPLSY instruction is activated, pulses are output without limitation.
- Overwrite the positioning address during the pulse output to change the positioning address in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten. The positioning address becomes invalid if it is changed from 0 to a value other than 0 or from a value other than 0 to 0 during positioning operation.
- When the positioning address is changed during the pulse output, the operation is stopped immediately if the changed value is the number of pulses which have already been output or less.
- Overwrite the command speed during the pulse output to change the command speed in operation. The written value is reflected at the first time that the instruction is executed after the device is overwritten.
- When the numbers of pulses (by the pulses conversion) of the command speed and positioning address exceed the 32-bit range, an error occurs and the operation cannot be performed.
- The PLSY instruction always increases the current address because the setting of rotation direction is disabled due to the absence of direction.
- When the output mode is CW/CCW mode, output is always performed from the device set to CW.
- If reverse limit is used, it operates as forward limit.
- Do not set the value of 200 kpps or more by the frequency conversion when changing the command speed during the pulse output.
- If the command speed is set to 0 when the PLSY instruction is activated, the operation ends with an error and stops pulse output.
- If the command speed is changed to 0 during operation, the operation does not end with errors but is immediate stop.
- The command speed is changed to negative value during operation, it is the operation ends with an error.
- The following table shows the operation timing of the complete flag and abnormal end flag of the DPLSY instruction.

	Complete flag (SM8029)*1	Abnormal end flag (SM8329)
ON condition	From when the output of the specified positioning address is completed until the drive contact is turned off	From the following stops until the drive contact is turned off <ul style="list-style-type: none"> • The specified axis is already used*2 • Pulse output stop command • Pulse deceleration stop command • Forward limit • Reverse limit • All outputs disabled • Positioning address error • Command speed 0 (when the DPLSY instruction is activated)
ON→OFF condition	• When the drive contact is turned off	• When the drive contact is turned off

*1 When pulses are being output without limitation, instruction execution complete flag is not turned on.

*2 The flag turns on only during one scan time when the activation contact of the instruction turns off and on.

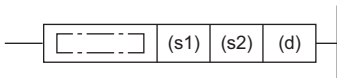
Operation error

Error code (SD0/SD8067)				Description
Axis 1	Axis 2	Axis 3	Axis 4	
SD5510	SD5550	SD5590	SD5630	
1810				The axis number specified by (d) is used by another instruction.
2820				The value specified by (s) is outside the following range. 0 to 65535
				The value specified by (n) is outside the following range. 0 to 65535
				The value specified by (d) is outside the following range. 0 to 3
3600				The axis number specified by (d) is not set by parameters. A function which is set to be not used by parameters (such as interrupt input signal 1 and zero return relations) is used.
3631	3632	3633	3634	The numbers of pulses (by the pulses conversion) of the positioning address specified by (n) exceed the 32-bit range.
3641	3642	3643	3644	The numbers of pulses (by the pulses conversion) of the command speed specified by (s) exceed the 32-bit range.
3651	3652	3653	3654	The operation decelerates and stops by the forward limit or reverse limit during the pulse output or at the activating of the positioning.
3661	3662	3663	3664	The operation decelerates and stops by the pulse output stop command or special relay whose all outputs are disabled during the pulse output or at the activating of the positioning.

16 bit binary pulse width modulation

PWM

This instruction outputs the pulse (in 16-bit data units) of the ON time (in 16-bit data units) specified by (s1) and the period specified by (s2) to the output destination specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=PWM(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	ON time or the device number storing the ON time	1 to 65535	16-bit unsigned binary	ANY16
(s2)	Period or the device number storing the period	1 to 65535	16-bit unsigned binary	ANY16
(d)	Channel number or device number from which pulses are to be output	—	Bit/16-bit unsigned binary	Bit/ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○*1	—	—	○*2	○*2	○*2	—	—	○	○*2	—	—	—

*1 When a bit device is specified, specify one of Y0 to Y7.

Only Y can be used for a bit device.

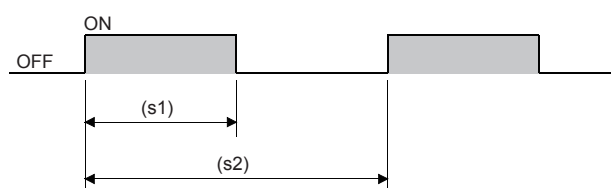
If Y is specified, outputs are enabled when there is an unused channel number in the parameter setting and the specified Y number is not used.

The nibble of a bit device cannot be specified.

*2 When a word device or constant is specified, specify one of the channel numbers.

Processing details

- This instruction outputs the pulse of the ON time specified by (s1) and the period specified by (s2) to the output destination specified by (d).



- Time with a unit selected on the parameter setting screen (μs or ms) can be specified by (s1) and (s2).
- The pulse output destination channel number selected on the parameter setting screen can be specified by (d).
- This instruction store the number of pulses, pulse width, and period output from each channel to an SD device. The pulse width and period are stored in the units set by the parameters. When 0 is specified in the pulse output, pulses are output without any limitation.

Pulse output destination channel	Number of output pulses	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5301, SD5300	R/W	0	<ul style="list-style-type: none"> When the DHCMOV instruction is executed*1 When the PWM instruction is executed END processing 	STOP/PAUSE→RUN
CH2	SD5317, SD5316				
CH3	SD5333, SD5332				
CH4	SD5349, SD5348				

Pulse output destination channel	ON time	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5303, SD5302	R/W	0 ^{*2}	<ul style="list-style-type: none"> When the DHCMOV instruction is executed^{*1} When this instruction is executed^{*3} END processing 	STOP/PAUSE→RUN
CH2	SD5319, SD5318				
CH3	SD5335, SD5334				
CH4	SD5351, SD5350				

Pulse output destination channel	Period	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5305, SD5304	R/W	0 ^{*2}	<ul style="list-style-type: none"> When the DHCMOV instruction is executed^{*1} When this instruction is executed^{*3} END processing 	STOP/PAUSE→RUN
CH2	SD5321, SD5320				
CH3	SD5337, SD5336				
CH4	SD5353, SD5352				

*1 When the DHCMOV instruction is used, the latest value can be read. A writable device can be updated immediately.

*2 Parameter setting values are set to an SD device at STOP to RUN.

*3 When this instruction is executed, the pulse width and period specified (s1) and (s2) are set to an SD device.

• After the pulse output is started from each channel, the pulse output monitor turns on.

Pulse output destination channel	Pulse output monitor	R/W	Initial value	ON timing	OFF timing
CH1	SM5300	R	OFF	<ul style="list-style-type: none"> When the HIOEN instruction is executed When this instruction is executed 	<ul style="list-style-type: none"> Power on Reset RUN→STOP/PAUSE When the specified number of pulses are output. The drive contact is turned off
CH2	SM5301				
CH3	SM5302				
CH4	SM5303				

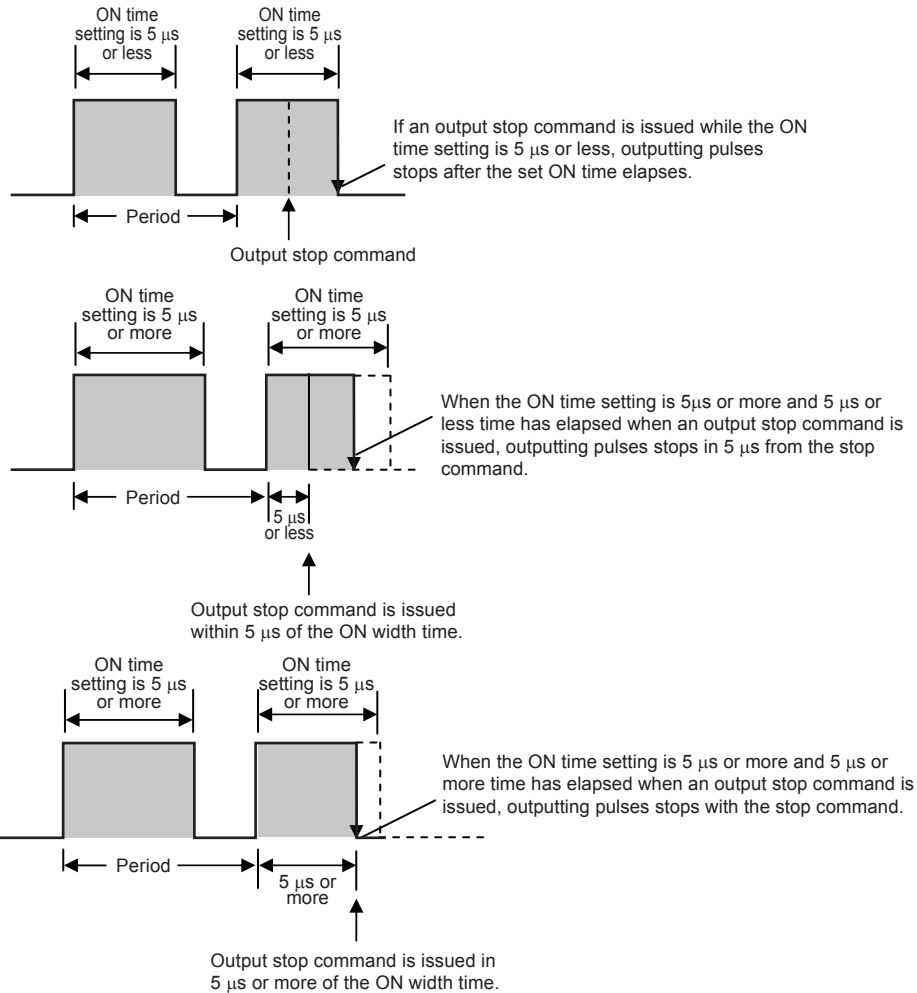
• This instruction stores the number of pulses output from each channel.

Pulse output destination channel	Monitoring the current number of output pulses	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5307, SD5306	R/W	0	<ul style="list-style-type: none"> When the DHCMOV instruction is executed → An SD device is updated When the PWM instruction is executed END processing 	<ul style="list-style-type: none"> Power-on Reset STOP/PAUSE→RUN
CH2	SD5323, SD5322				
CH3	SD5339, SD5338				
CH4	SD5355, SD5354				

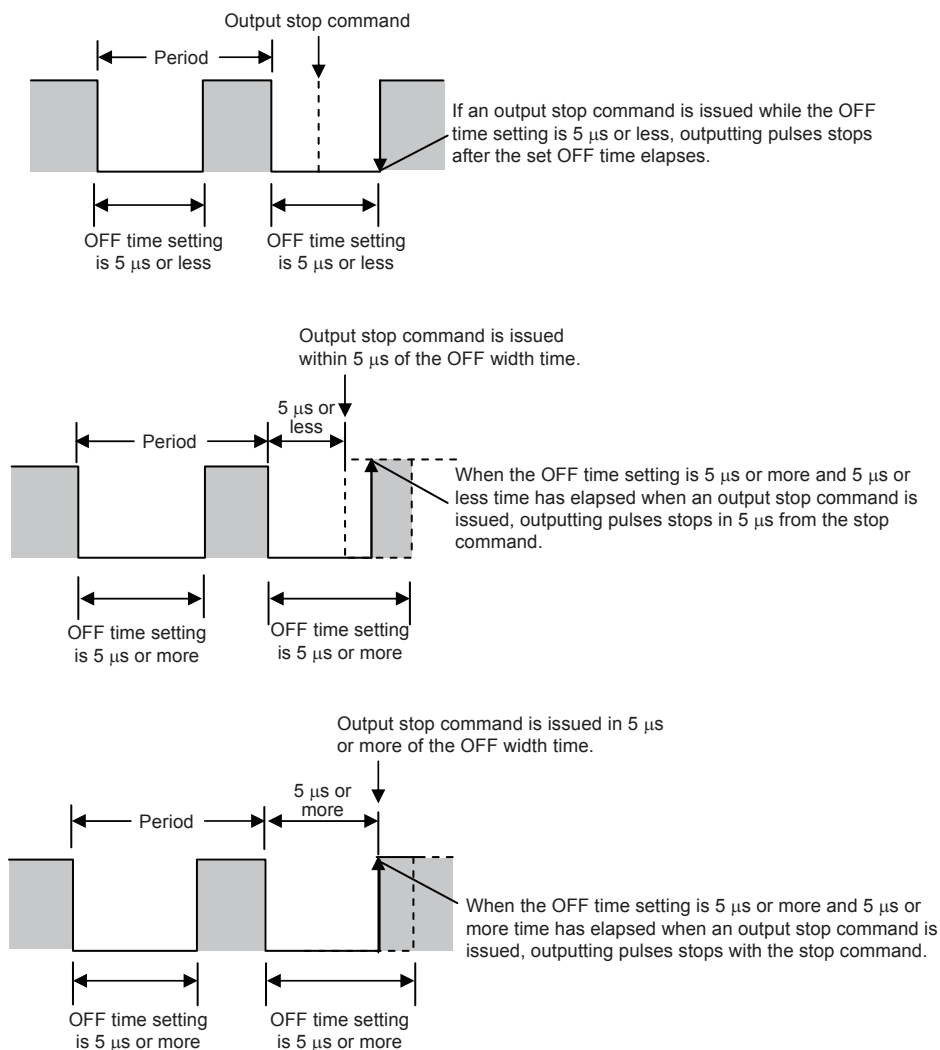
- The number of output pulses set to an SD device is valid for this instruction as well. The setting values are always read and updated.
- When the specified number of output pulses is equal to or less than the number of pulses which have already been output, pulse output stops after outputting pulses which are being output.
- When the specified number of output pulses is larger than the number of pulses which have already been output, pulse output stops after outputting set number of pulses.
- When the number of output pulses is set from the no limitation output setting (number of output pulses is 0), the number of output pulses is not updated (because outputting pulses continues or stops in the no limitation output).
- The maximum number of output pulses which can be output when the PWM instruction is executed once (= maximum value which can be set to an SD device) is "2,147,483,647".
- The ON time and period can be set during the pulse output. Setting values are always read and updated.
- When the number of output pulses is 0 (no limitation output setting), the monitor of the current number of output pulses is set to 0.
- When the number of output pulses is specified, the output pulses are monitored. When the PWM output is executed several times, the monitor of the number of output pulses is an integrated value.
- The monitor of the current number of output pulses can be changed during the pulse output.
- The monitor of the current number of output pulses is updated when the number of pulses is counted at the falling edge of pulses in the positive logic and at the rising edge of pulses in the negative logic.
- When the output always remains ON or OFF, the monitor of the current number of output pulses does not change.
- The maximum value of the monitor of the current number of output pulses is "FFFFFFFFH". After the current number of output pulses reaches the maximum value, the monitor of the current number of output pulses starts to count again from "0".

Precautions

- Specify the ON time by (s1) and the period by (s2) so that $[(s2)-(s1)]$ is equal to or larger than $3\ \mu\text{s}$.
- Specify $2\ \mu\text{s}$ or more in Y0 to Y3 and $200\ \mu\text{s}$ or more in Y4 to Y7 for the ON time specified by (s1), and specify $5\ \mu\text{s}$ or more in Y0 to Y3 and $400\ \mu\text{s}$ or more in Y4 to Y7 for the period specified by (s2).
- When a channel number that is not selected for the PMW output in the parameter setting is specified for (d), this instruction is not executed. An operation error occurs.
- Operations when the PMW output is stopped (while the output pulse is on)



- Operations when the PMW output is stopped (while the output pulse is off)



- The PMW output stops when SM8034 is on, and starts when SM8034 is off.
- When the pulse output for positioning is driven, the PMW output does not stop.
- When specifying the number of output pulses, executing the PWM instruction, and then outputting pulses again after the pulse output stops due to the completion of output of the specified number of pulses, turn OFF the contact which drove the PWM instruction. If the PWM instruction was driven by the HIOEN instruction, stop the HIOEN instruction.
- When the period setting is equivalent to the ON time setting, the output always remains ON. The output ON state continues even after "Period x Number of output pulses" is finished in this condition.

Operation error

Error code (SD0/SD8067)	Description
1810	The output destination specified by (d) is already used by another instruction (positioning instruction). (The PMW output is not executed.)
	A Y device is specified as the output destination specified by (d), and there is no unused channel number in the parameter setting.
3405	Y10 or later is specified as the output destination specified by (d). (The PMW output stops.)
3600	A channel number that is not selected in the parameter setting are specified for the output destination specified by (d). (The PMW output is not executed.)
3611(CH1) 3612(CH2) 3613(CH3) 3614(CH4)	The ON time specified by (s1) is larger than the period specified by (s2). (The PMW output stops.)
	The ON time or period is less than "1".
	The SD device specified for the number of output pulses stores a value outside the available range (0 to 2,147,483,647).

32 bit binary pulse width modulation

DPWM

This instruction outputs the pulse (in 32-bit data units) of the ON time (in 32-bit data units) specified by (s1) and the period specified by (s2) to the output destination specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DPWM(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	ON time or the device number storing the ON time	1 to 2147483647	32-bit unsigned binary	ANY32
(s2)	Period or the device number storing the period	1 to 2147483647	32-bit unsigned binary	ANY32
(d)	Channel number or device number from which pulses are to be output	—	Bit/16-bit unsigned binary	Bit/ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○*1	—	—	○*2	○*2	○*2	—	—	○	○*2	—	—	—

*1 When a bit device is specified, specify one of Y0 to Y7.

Only Y can be used for a bit device.

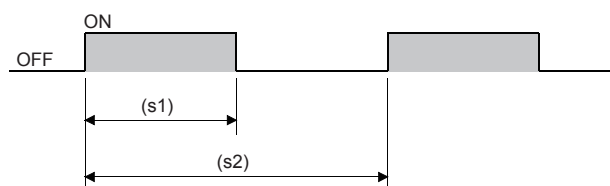
If Y is specified, outputs are enabled when there is an unused channel number in the parameter setting and the specified Y number is not used.

The nibble of a bit device cannot be specified.

*2 When a word device or constant is specified, specify one of the CH numbers.

Processing details

- This instruction outputs the pulse of the ON time specified by (s1) and the period specified by (s2) to the output destination specified by (d).



- Time with a unit selected on the parameter setting screen (μs or ms) can be specified by (s1) and (s2).
- The pulse output destination channel number selected on the parameter setting screen can be specified by (d).
- This instruction stores the number of pulses, pulse width, and period output from each channel to an SD device. The pulse width and period are stored in the units set by the parameters. When 0 is specified in the pulse output, pulses are output without any limitation.

Pulse output destination channel	Number of output pulses	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5301, SD5300	R/W	0	<ul style="list-style-type: none"> When the DHCMOV instruction is executed*1 When the DPWM instruction is executed END processing 	STOP/PAUSE→RUN
CH2	SD5317, SD5316				
CH3	SD5333, SD5332				
CH4	SD5349, SD5348				

Pulse output destination channel	ON time	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5303, SD5302	R/W	0 ^{*2}	<ul style="list-style-type: none"> When the DHCMOV instruction is executed^{*1} When the DPWM instruction is executed^{*3} END processing 	STOP/PAUSE→RUN
CH2	SD5319, SD5318				
CH3	SD5335, SD5334				
CH4	SD5351, SD5350				

Pulse output destination channel	Period	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5305, SD5304	R/W	0 ^{*2}	<ul style="list-style-type: none"> When the DHCMOV instruction is executed^{*1} When the DPWM instruction is executed^{*3} END processing 	STOP/PAUSE→RUN
CH2	SD5321, SD5320				
CH3	SD5337, SD5336				
CH4	SD5353, SD5352				

*1 When the DHCMOV instruction is used, the latest value can be read. A writable device can be updated immediately.

*2 Parameter setting values are set to an SD device at STOP to RUN.

*3 When this instruction is executed, the pulse width and period specified (s1) and (s2) are set to an SD device.

• After the pulse output is started from each channel, the pulse output monitor turns on.

Pulse output destination channel	Pulse output monitor	R/W	Initial value	ON timing	OFF timing
CH1	SM5300	R	OFF	<ul style="list-style-type: none"> When the HIOEN instruction is executed When the DPWM instruction is executed 	<ul style="list-style-type: none"> Power on Reset RUN→STOP/PAUSE When the specified pulse number output is terminated The drive contact is turned off
CH2	SM5301				
CH3	SM5302				
CH4	SM5303				

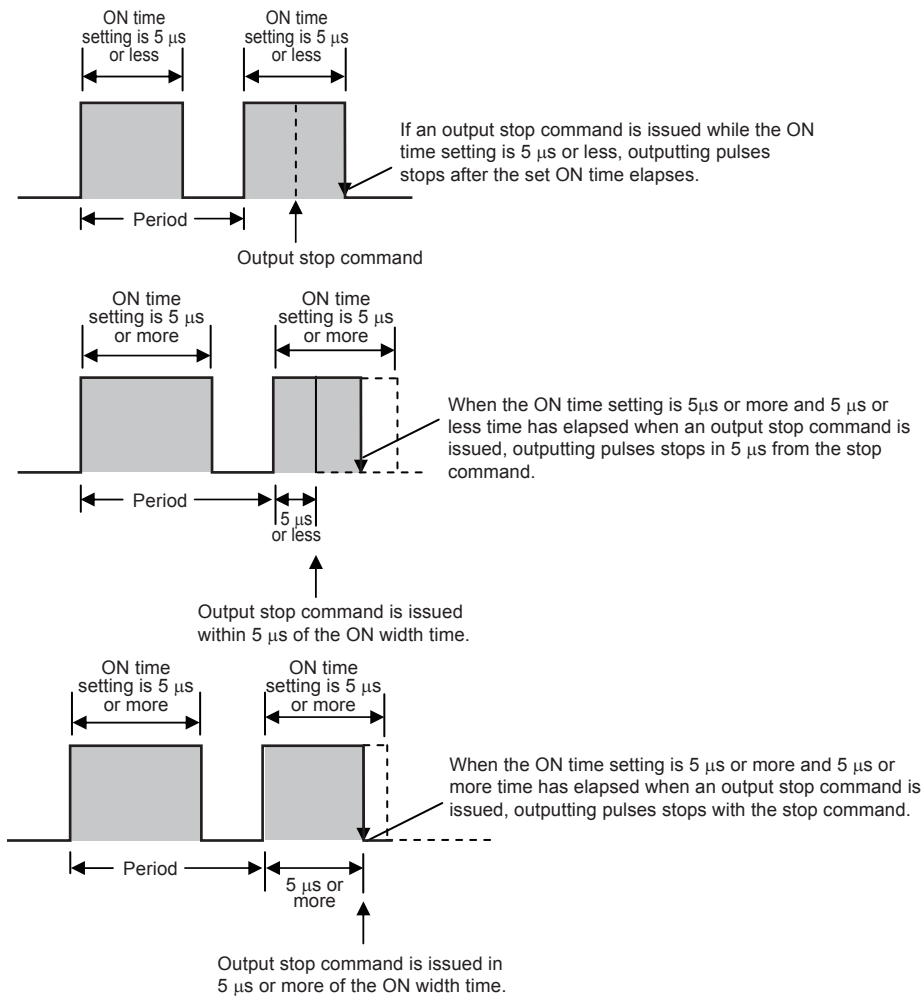
• This instruction stores the number of pulses output from each channel.

Pulse output destination channel	Monitoring the current number of output pulses	R/W	Initial value	Timing of reflection on operation	Timing of clearing to initial value
CH1	SD5307, SD5306	R/W	0	<ul style="list-style-type: none"> When the DHCMOV instruction is executed → An SD device is updated When the DPWM instruction is executed END processing 	<ul style="list-style-type: none"> Power-on Reset STOP/PAUSE→RUN
CH2	SD5323, SD5322				
CH3	SD5339, SD5338				
CH4	SD5355, SD5354				

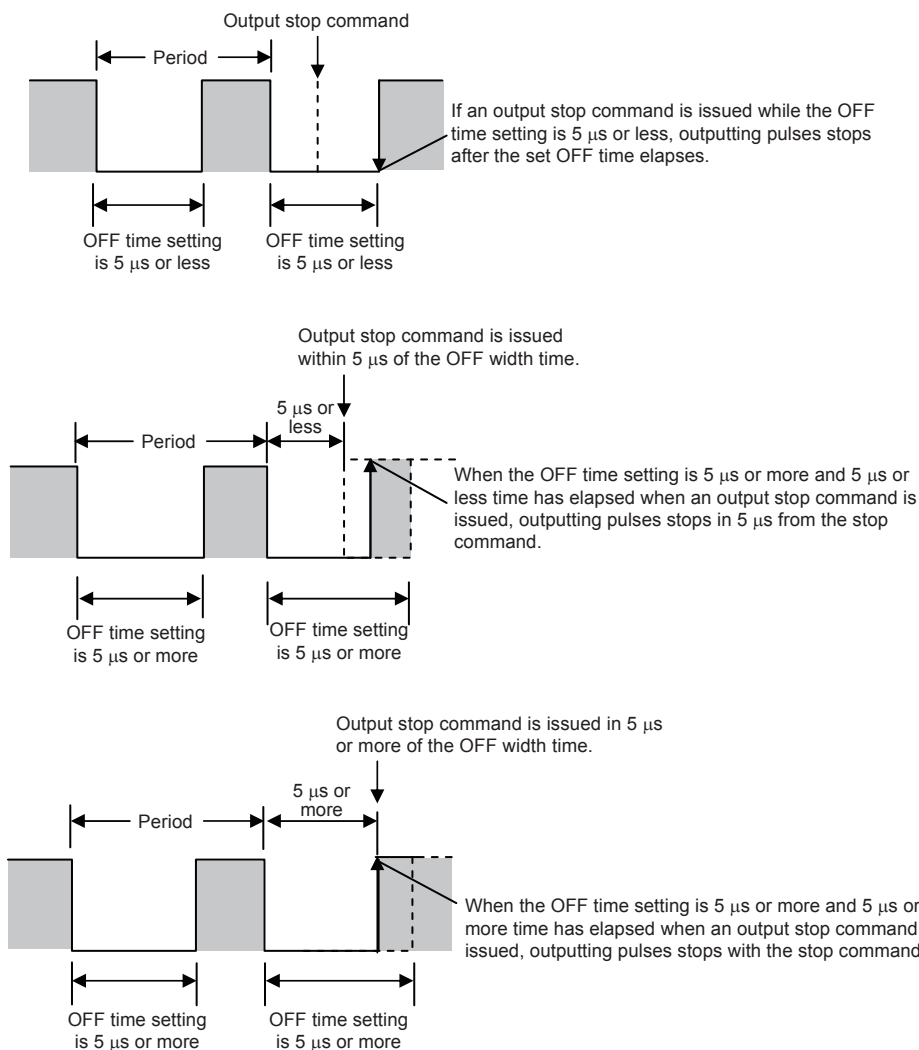
- The number of output pulses set to an SD device is valid for this instruction as well. The setting values are always read and updated.
- When the specified number of output pulses is equal to or less than the number of pulses which have already been output, pulse output stops after outputting pulses which are being output.
- When the specified number of output pulses is larger than the number of pulses which have already been output, pulse output stops after outputting set number of pulses.
- When the number of output pulses is set from the no limitation output setting (number of output pulses is 0), the number of output pulses is not updated (because outputting pulses continues or stops in the no limitation output).
- The maximum number of output pulses which can be output when the DPWM instruction is executed once (= maximum value which can be set to an SD device) is "2,147,483,647"
- The ON time and period can be set during the pulse output. Setting values are always read and updated.
- When the number of output pulses is 0 (no limitation output setting), the monitor of the current number of output pulses is set to 0.
- When the number of output pulses is specified, the output pulses are monitored. When the DPWM output is executed several times, the monitor of the number of output pulses is an integrated value.
- The monitor of the current number of output pulses can be changed during the pulse output.
- The monitor of the current number of output pulses is updated when the number of pulses is counted at the falling edge of pulses in the positive logic and at the rising edge of pulses in the negative logic.
- When the output always remains ON or OFF, the monitor of the current number of output pulses does not change.
- The maximum value of the monitor of the current number of output pulses is "FFFFFFFFH". After the current number of output pulses reaches the maximum value, the monitor of the current number of output pulses starts to count again from "0".

Precautions

- Specify the ON time by (s1) and the period by (s2) so that $[(s2)-(s1)]$ is equal to or larger than 3 μs .
- When a negative value is specified for the ON time by (s1) and the period by (s2), an operation error occurs. (In 16-bit instruction PWM, no error occurs.)
- Specify 2 μs or more in Y0 to Y3 and 200 μs or more in Y4 to Y7 for the ON time specified by (s1), and specify 5 μs or more in Y0 to Y3 and 400 μs or more in Y4 to Y7 for the period specified by (s2).
- When a channel number that is not selected for the PMW output in the parameter setting is specified for (d), this instruction is not executed. An operation error occurs.
- Operations when the PMW output is stopped (while the output pulse is on)



- Operations when the PMW output is stopped (while the output pulse is off)



- The PMW output stops when SM8034 is on, and starts when SM8034 is off.
- When the pulse output for positioning is driven, the PMW output does not stop.
- When specifying the number of output pulses, executing the PWM instruction, and then outputting pulses again after the pulse output stops due to the completion of output of the specified number of pulses, turn OFF the contact which drove the PWM instruction. If the PWM instruction was driven by the HIOEN instruction, stop the HIOEN instruction.
- When the period setting is equivalent to the ON time setting, the output always remains ON. The output ON state continues even after "Period x Number of output pulses" is finished in this condition.

Operation error

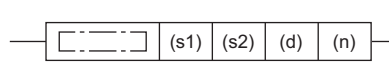
Error code (SD0/SD8067)	Description
1810	The output destination specified by (d) is already used by another instruction (positioning instruction). (The PMW output is not executed.)
	A Y device is specified as the output destination specified by (d), and there is no unused channel number in the parameter setting
3405	Y10 or later is specified as the output destination specified by (d). (The PMW output stops.)
3600	A channel number that is not selected in the parameter setting are specified for the output destination specified by (d). (The PMW output is not executed.)
3611(CH1) 3612(CH2) 3613(CH3) 3614(CH4)	The ON time specified by (s1) is larger than the period specified by (s2). (The PMW output stops.)
	In (s1) and (s2), a negative value is specified. (The PMW output stops.)
	Values of an SD device for setting pulse width and period of this instruction are incorrect. (The PMW output stops.)
	The ON time or period is less than "1".
	The SD device specified for the number of output pulses stores a value outside the available range (0 to 2,147,483,647).

7.15 Drum sequence

16-bit binary data absolute method

ABSD

This instruction creates many output patterns corresponding to the current value (16-bit binary data) of a counter.

Ladder diagram	Structured text
	ENO:=ABSD(EN,s1,s2,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number storing the data table (with rising and falling point data)	—	16-bit signed binary	ANY16
(s2)	Counter number for monitoring the current value compared with the data table	—	16-bit signed binary	ANY16
(d)	Head bit device number to be output	—	Bit	Bit
(n)	Number of lines in the table and the number of output bit devices	1 to 64	16-bit unsigned binary	ANY16

■Applicable devices

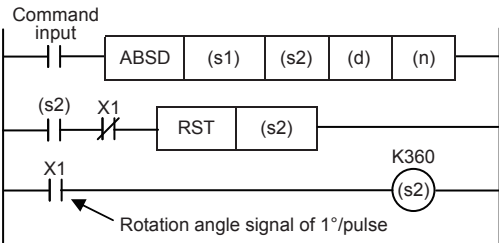
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	—	—	—	—
(s2)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○*2	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only C can be used.

*2 T, ST, C cannot be used.

Processing details

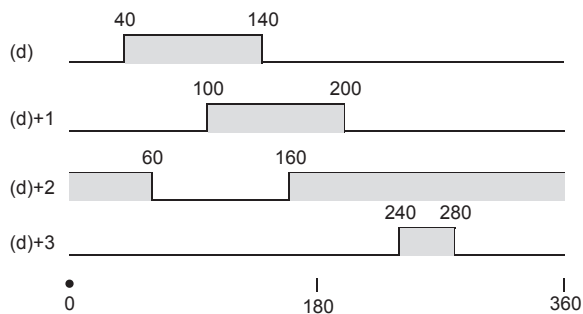
- In this example, outputs are controlled to on or off by one table rotation (0 to 360° using the rotation angle signal of 1°/pulse).
- The current value (s2) of the counter is compared with the data table with "n" lines starting from (s1) (which occupies "n" lines × 2 devices), and consecutive "n" outputs starting from (d) are controlled to on or off during one rotation.



- Write the following data to (s1) to (s1)+2(n)-1 in advance by a transfer instruction: For example, store 16-bit rising point data in even-numbered devices and 16-bit falling point data in odd-numbered devices.

Rising point		Falling point		Target output
—	Data value (example)	—	Data value (example)	
(s1)	40	(s1)+1	140	(d)
(s1)+2	100	(s1)+3	200	(d)+1
(s1)+4	160	(s1)+5	60	(d)+2
(s1)+6	240	(s1)+7	280	(d)+3
⋮	—	⋮	—	⋮
(s1)+2(n)-2		(s1)+2(n)-1		(d)+n-1

- The following figure shows the output patterns for device points (n) starting from (d) when the command input is set to on. Each rising point/falling point can be changed by overwriting the data in (s1) to (s1)+2(n)-1.



Precautions

- When specifying the nibble of a bit device to (s1), specify a multiple of 16 (0, 16, 32, 64 ...) as a device number and always specify K4 for the number of digits.
- The value of (n) determines the number of target outputs ($1 \leq (n) \leq 64$).
- Even if the command input is set to OFF, the ON/OFF status of outputs does not change.

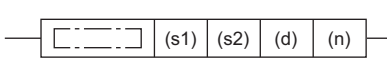
Operation error

Error code (SD0/SD8067)	Description
2820	The number of device points specified by (s1) or (d) is insufficient.
3405	The value specified by (n) is outside the following range. 1 to 64

32-bit binary data absolute method

DABSD

This instruction creates many output patterns corresponding to the current value (32-bit binary data) of a counter.

Ladder diagram	Structured text
	<pre>ENO:=DABSD(EN,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number storing the data table (with rising and falling point data)	—	32-bit signed binary	ANY32
(s2)	Counter number for monitoring the current value compared with the data table	—	32-bit signed binary	ANY32
(d)	Head bit device number to be output	—	Bit	Bit
(n)	Number of lines in the table and the number of output bit devices	1 to 64	16-bit unsigned binary	ANY16

■Applicable devices

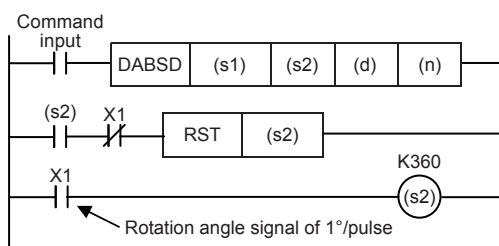
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	—	—	—	—
(s2)	—	—	—	○*1	—	—	○	—	○	—	—	—	—
(d)	○	—	—	○*2	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only C (32 bits) can be used.

*2 T, ST, C cannot be used.

Processing details

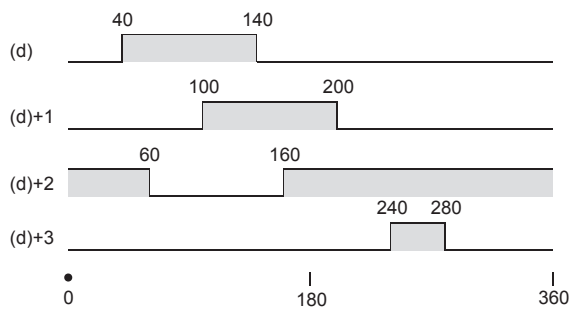
- In this example, outputs are controlled to on or off by one table rotation (0 to 360° using the rotation angle signal of 1°/pulse).
- The current value (s2) of the counter is compared with the data table with "n" lines starting from (s1) (which occupies "n" lines × 4 devices), and consecutive "n" outputs starting from (d) are controlled to on or off during one rotation.



- Write the following data to (s1), (s1)+1 to (s1)+4(n)-2, and (s1)+4(n)-1 in advance by a transfer instruction: For example, store 32-bit rising point data in even-numbered devices and 32-bit falling point data in odd-numbered devices.

Rising point		Falling point		Target output
—	Data value (example)	—	Data value (example)	
(s1)+1, (s1)	40	(s1)+3, (s1)+2	140	(d)
(s1)+5, (s1)+4	100	(s1)+7, (s1)+6	200	(d)+1
(s1)+9, (s1)+8	160	(s1)+11, (s1)+10	60	(d)+2
(s1)+13, (s1)+12	240	(s1)+15, (s1)+14	280	(d)+3
⋮	—	⋮	—	⋮
(s1)+4(n)-3, (s1)+4(n)-4		(s1)+4(n)-1, (s1)+4(n)-2		(d)+n-1

- The following figure shows the output patterns for device points (n) starting from (d) when the command input is set to on. Each rising point/falling point can be changed by overwriting the data in (s1) to (s1)+2(n)-1.



Precautions

- The DABSD instruction can specify a high-speed counter. When the high-speed counter is specified, the output pattern contains response delay caused by the scan cycle with regard to the current value of a counter.
- When specifying the nibble of a bit device to (s1), specify a multiple of 16 (0, 16, 32, 64 ...) as a device number and always specify K8 for the number of digits.
- The value of (n) determines the number of target outputs ($1 \leq (n) \leq 64$).
- Even if the command input is set to OFF, the ON/OFF status of outputs does not change.

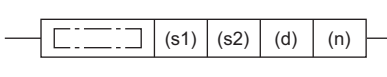
Operation error

Error code (SD0/SD8067)	Description
2820	The number of device points specified by (s1) or (d) is insufficient.
3405	The value specified by (n) is outside the following range. 1 to 64

Relative method

INCD

This instruction creates many output patterns using a pair of counters.

Ladder diagram	Structured text
	ENO:=INCD(EN,s1,s2,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head word device number storing the set value	—	32-bit signed binary	ANY32
(s2)	Head counter number for monitoring current value is monitored	—	32-bit signed binary	ANY32
(d)	Head bit device number to be output	—	Bit	Bit
(n)	Number of output bit devices	1 to 64	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	○	—	—	○	—	—	—	—
(s2)	—	—	—	○ ^{*1}	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○ ^{*2}	—	—	—	—	—	—	—	—	—
(n)	—	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only C can be used.

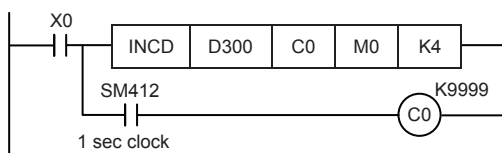
*2 T, ST, C cannot be used.

Processing details

- The current value of a counter is compared with the data table having "n" lines starting from (s1) (which occupies "n" lines × 1 device). When the value is equivalent to the table data, the current output is reset, and the next output is controlled. In this way, the ON/OFF status of specified outputs is controlled in turn.

■Operation example

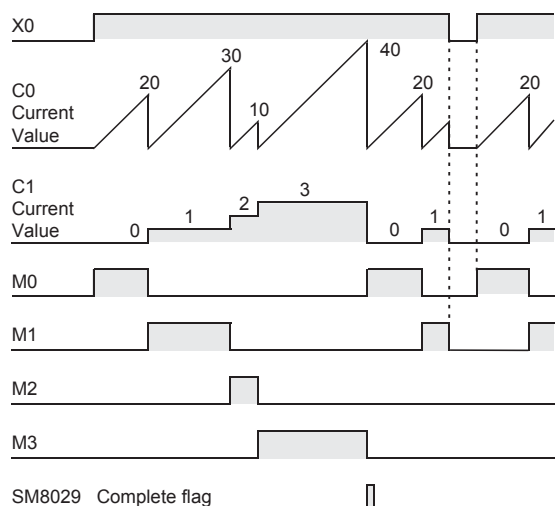
- The following ladder example shows the operation. (s2) occupies two points. In the following timing chart, C0 and C1 correspond to the two points.



- Suppose that the following data is written in advance by a transfer instruction:

Device storing data		Output	
—	Data value (example)	—	Example
(s1)	D300=20	(d)	M0
(s1)+1	D301=30	(d)+1	M1
(s1)+2	D302=10	(d)+2	M2
(s1)+3	D303=40	(d)+3	M3
⋮	⋮	⋮	⋮
(s1)+(n)-1	—	(d)+(n)-1	—

• Timing chart



- When the command contact turns on, the output M0 turns on.
- When the current value of C0 reaches the comparison value D300, the output M0 is reset, "1" is added to the count value of the process counter C1, and the current value of the counter C0 is reset.
- The next output M1 turns ON.
- When the current value of C0 reaches the comparison value D301, the output M1 is reset, "1" is added to the count value of the process counter C1, and the current value of the counter C0 is reset.
- The current value is compared for up to "n (K4)" outputs in the same way ($1 \leq (n) \leq 64$).
- When the final process specified by (n) is finished, the execution complete flag SM8029 turns on and remains on for one operation cycle. SM8029 is used for many instructions as the instruction execution complete flag. Use SM8029 as a contact just after a corresponding instruction.
- The program execution returns to the beginning, and outputs are repeated.

Precautions

When specifying the nibble of a bit device to (s1), specify a multiple of 16 (0, 16, 32, 64 ...) as a device number.

Operation error

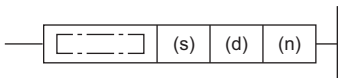
Error code (SD0/SD8067)	Description
2820	The number of device points specified by (s1), (s2), or (d) is insufficient.
3405	The value specified by (n) is outside the following range. 1 to 64

7.16 Check code

Check code

CCD(P)

These instructions calculate the horizontal parity value and sum check value in the error check methods used in communication. There is another check method, called CRC (cyclic redundancy check). For obtaining CRC value, use the CRC(P) instructions.

Ladder diagram	Structured text
	ENO:=CCD(EN,s,n,d); ENO:=CCDP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number of applicable device	—	16-bit signed binary	ANY16
(d)	Head device number storing the calculated data	—	16-bit signed binary	ANY16
(n)	Number of data	1 to 32767	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○*1	○	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions calculate the addition data and horizontal parity value of data stored in (s) to (s)+(n)-1. The addition data is stored to (d), and the horizontal parity value is stored to (d)+1. The 16-bit mode and 8-bit mode are available for these instructions. For the operation in each mode, refer to the proceeding pages.

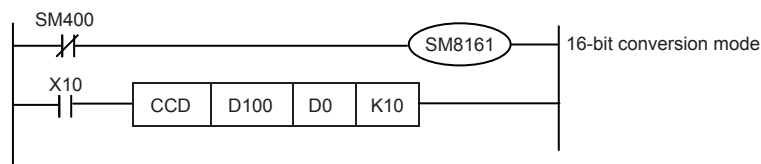
- 16-bit conversion mode (while SM8161 is OFF)

With regard to (n) data points starting from (s), the addition data and horizontal parity data of high-order 8 bits and low-order 8 bits are stored to (d) and (d)+1 respectively.

SM8161 is shared with the RS2, ASCI(P), HEX(P), and CRC(P) instructions. SM8161 must always be off in the 16-bit mode.

SM8161 is cleared when the CPU module mode is changed from RUN to STOP.

In the following program, conversion is executed as follows:



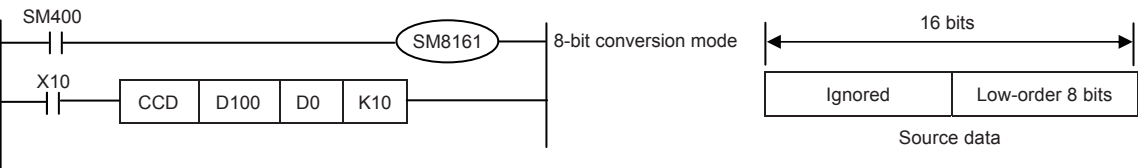
(s)	Example of data contents
D100 lowest-order byte	K100 = 0 1 1 0 0 1 0 0
D100 highest-order byte	K111 = 0 1 1 0 1 1 1 (1) ←
D101 lowest-order byte	K100 = 0 1 1 0 0 1 0 0
D101 highest-order byte	K 98 = 0 1 1 0 0 0 1 0
D102 lowest-order byte	K123 = 0 1 1 1 1 0 1 (1) ←
D102 highest-order byte	K 66 = 0 1 0 0 0 0 1 0
D103 lowest-order byte	K100 = 0 1 1 0 0 1 0 0
D103 highest-order byte	K 95 = 0 1 0 1 1 1 1 (1) ←
D104 lowest-order byte	K210 = 1 1 0 1 0 0 1 0
D104 highest-order byte	K 88 = 0 1 0 1 1 0 0 0
Total	K1091
Horizontal parity	1 0 0 0 0 1 0 (1)

← When the number of "1" is odd, the horizontal parity is "1".
When the number of "1" is even, the horizontal parity is "0".

D0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 1 1 ← 1091 in BCD.

D1 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 1 ← Horizontal parity

- 8-bit conversion mode (while SM8161 is ON)
- With regard to (n) data points starting from (s), the addition data and horizontal parity data of only low-order 8 bits are stored to (d) and (d)+1 respectively. SM8161 is shared with the RS2, ASCI(P), HEX(P), and CRC(P) instructions. SM8161 must always be on in the 8-bit mode.
- SM8161 is cleared when the CPU module mode is changed from RUN to STOP.
- In the following program, conversion is executed as follows:



(s)	Example of data contents
D100	K100 = 0 1 1 0 0 1 0 0
D101	K111 = 0 1 1 0 1 1 1 (1) ←
D102	K100 = 0 1 1 0 0 1 0 0
D103	K 98 = 0 1 1 0 0 0 1 0
D104	K123 = 0 1 1 1 1 0 1 (1) ←
D105	K 66 = 0 1 0 0 0 0 1 0
D106	K100 = 0 1 1 0 0 1 0 0
D107	K 95 = 0 1 0 1 1 1 1 (1) ←
D108	K210 = 1 1 0 1 0 0 1 0
D109	K 88 = 0 1 0 1 1 0 0 0
Total	K1091
Horizontal parity	1 0 0 0 0 1 0 (1)

← When the number of "1" is odd, the horizontal parity is "1".
 When the number of "1" is even, the horizontal parity is "0".

D0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	← 1091 in BCD.	
D1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	← Horizontal parity

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s) or (d) exceeds the corresponding device range.
3405	The value specified by (n) is outside the following range. 1 to 32767

7.17 Data operation instruction

Searching 16-bit data

SERMM(P)

These instructions search for the same data, maximum value and minimum value in a data table.

Ladder diagram	Structured text
	ENO:=SERMM(EN,s1,s2,n,d); ENO:=SERMMP(EN,s1,s2,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number in which same data, maximum value and minimum value are searched	—	16-bit signed binary	ANY16
(s2)	Data to be searched for or device number storing data	—	16-bit signed binary	ANY16
(d)	Head device number storing number of same data, maximum value and minimum value detected by search	—	16-bit signed binary	ANY16
(n)	Number of data in which same data, maximum value and minimum value are searched	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search the same data as the 16-bit binary data of (s2) in (n) data starting from (s1), and store the search result in (d) to (d)+4.
- When the same data exists, five devices starting from (d) store the number of same data, first position, last position, maximum value position and minimum value position.
- When the same data does not exist, five devices starting from (d) store the number of same data, first position, last position, maximum value position and minimum value position. In this case, however, 0 is stored in three devices starting from (d) (which store the number of same data, first position and last position).

- The following table shows example of search result table configuration and data. (n=10)

Searched device (s1)	Searched data (s1) value (example)	Comparison data (s2) value (example)	Data position	Search result		
				Maximum value (d)+4	Same (d)	Minimum value (d)+3
(s1)	K100	K100	0		○ (First time)	
(s1)+1	K111		1			
(s1)+2	K100		2		○	
(s1)+3	K98		3			
(s1)+4	K123		4			
(s1)+5	K66		5			○
(s1)+6	K100		6		○ (Last)	
(s1)+7	K95		7			
(s1)+8	K210		8	○		
(s1)+9	K88		9			

- The following table shows example of search result table.

Device number	Description	Search result item
(d)	3	Number of same data
(d)+1	0	Same data position (first position)
(d)+2	6	Same data position (last position)
(d)+3	5	Minimum value position (last position)
(d)+4	8	Maximum value position (last position)

Precautions

- Comparison is executed algebraically. ($-10 < 2$)
- When there are two or more maximum or minimum values in the searched data, the last position of the max/min is stored respectively.
- When these instructions are driven, five devices ((d), (d)+1, (d)+2, (d)+3, and (d)+4) are occupied for storing the search result (d). Make sure that these devices are not used in other controls for the machine.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s1) or (d) exceeds the corresponding device range.
3405	The value stored in a device specified by (n) is 0.

Searching 32-bit data

DSERMM(P)

These instructions search for the same data, maximum value and minimum value in a data table.

Ladder diagram	Structured text
	<pre>ENO:=DSERMM(EN,s1,s2,n,d); ENO:=DSERMMP(EN,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number in which same data, maximum value and minimum value are searched	—	32-bit signed binary	ANY32
(s2)	Data to be searched for or device number storing data	—	32-bit signed binary	ANY32
(d)	Head device number storing number of same data, maximum value and minimum value detected by search	—	32-bit signed binary	ANY32
(n)	Number of data in which same data, maximum value and minimum value are searched	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	—	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search the same data as the 32-bit binary data of (s2)+1 and (s2) in (n) data starting from (s1)+1 and (s1), and store the search result in (d)+1, (d) to (d)+9, and (d)+8.
- When the same data exists, five 32-bit binary data devices starting from (d)+1 and (d) store the number of same data, first position, last position, maximum value position and minimum value position.
- When the same data does not exist, five 32-bit binary data devices starting from (d)+1 and (d) store the number of same data, first position, last position, maximum value position and minimum value position. In this case, however, 0 is stored in three 32-bit devices starting from (d)+1 and (d) (which store the number of same data, first position and last position).
- The following table shows example of search result table configuration and data. (n=10)

Searched device (s1)	Searched data (s1) value (example)	Comparison data (s2) value (example)	Data position	Search result		
				Maximum value (d)+9, (d)+8	Same (d)	Minimum value (d)+7, (d)+6
(s1)+1, (s)	K100000	K100000	0		○ (First time)	
(s1)+3, (s1)+2	K110100		1			
(s1)+5, (s1)+4	K100000		2		○	
(s1)+7, (s1)+6	K98000		3			
(s1)+9, (s1)+8	K123000		4			
(s1)+11, (s1)+10	K66000		5			○
(s1)+13, (s1)+12	K100000		6		○ (Last)	
(s1)+15, (s1)+14	K95000		7			
(s1)+17, (s1)+16	K910000		8	○		
(s1)+19, (s1)+18	K910000		9	○		

- The following table shows example of search result table.

Device number	Description	Search result item
(d)+1, (d)	3	Number of same data
(d)+3, (d)+2	0	Same data position (first position)
(d)+5, (d)+4	6	Same data position (last position)
(d)+7, (d)+6	5	Minimum value position (last position)
(d)+9, (d)+8	9	Maximum value position (last position)

Precautions

- Comparison is executed algebraically. ($-10 < 2$)
- When there are two or more maximum or minimum values in the searched data, the last position of the max/min is stored respectively.
- When these instructions are driven, five devices [(d)+1, (d)], [(d)+3, (d)+2], [(d)+5, (d)+4], [(d)+7, (d)+6], and [(d)+9, (d)+8] are occupied for storing the these result (d). Make sure that these devices are not used in other controls for the machine.

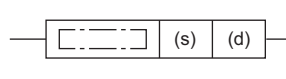
Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s1) or (d) exceeds the corresponding device range.
3405	The value stored in a device specified by (n) is 0.

Bit check of 16-bit data

SUM(P)

These instructions store the total bits of 1 in the binary 16-bit data of the device specified by (s) to the device specified by (d).

Ladder diagram	Structured text
	ENO:=SUM(EN,s,d); ENO:=SUMP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

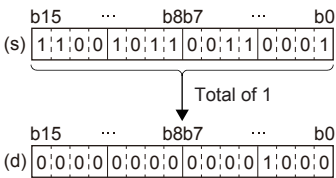
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number that counts the total bits of 1	—	16-bit signed binary	ANY16
(d)	Head device number storing the total bits	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions store the total bits of 1 in the binary 16-bit data of the device specified by (s) to the device specified by (d).



The total of 1 is stored in the binary data. (In the example shown on the left, the total is 8.)

- When all binary 16-bit data of the device specified by (s) are 0 (off), the zero flag M8020 turns on.

Precautions

While the command input is off, the instruction is not executed. The output of the number of bits in the on status is latched in the previous status.

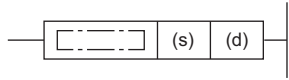
Operation error

There is no operation error.

Bit check of 32-bit data

DSUM(P)

These instructions store the total bits of 1 in the binary 32-bit data of the device specified by (s) to the device specified by (d).

Ladder diagram	Structured text
	ENO:=DSUM(EN,s,d); ENO:=DSUMP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

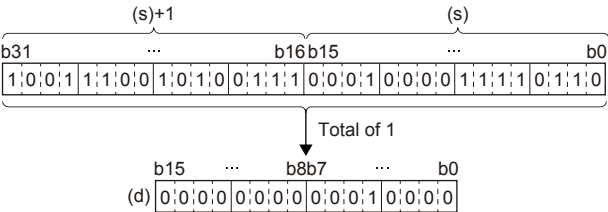
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number that counts the total bits of 1	—	32-bit signed binary	ANY32
(d)	Head device number storing the total bits	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions store the total bits of 1 in the binary 32-bit data of the device specified by (s) to the device specified by (d).



The total of 1 is stored in the binary data. (In the example shown on the left, the total is 16.)

- When all binary 32-bit data of the device specified by (s) are 0 (off), the zero flag M8020 turns on.

Precautions

While the command input is off, the instruction is not executed. The output of the number of bits in the on status is latched in the previous status.

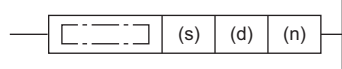
Operation error

There is no operation error.

Bit judgment of 16-bit data

BON(P)

These instructions check whether (n) bit(s) of binary 16-bit data of the device specified by (s) are on or off, and output the result to the device specified by (d).

Ladder diagram	Structured text
	ENO:=BON(EN,s,n,d); ENO:=BONP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Word device number storing the data	—	16-bit signed binary	ANY16
(d)	Bit device number to be driven	—	Bit	Bit
(n)	Bit position to be checked	0 to 15	16-bit signed binary	ANY16

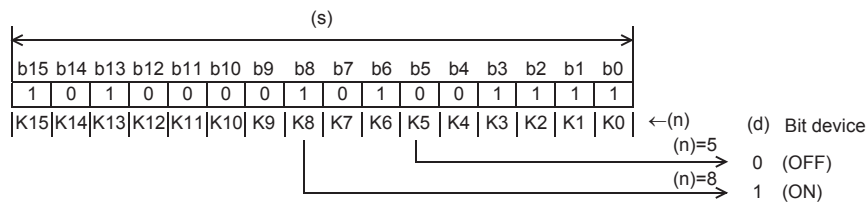
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	○	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions check whether (n) bit(s) of binary 16-bit data of the device specified by (s) are on or off, and output the result to the device specified by (d).
- When the result above is on, these instructions turn (d) on. When the result above is off, these instructions turn (d) off.
- When a constant (K) is specified in the device specified by (s), it is automatically converted into binary.



Operation error

Error code (SD0/SD8067)	Description
3405	The value specified by (n) is outside the following range. 0 to 15

Bit judgment of 32-bit data

DBON(P)

These instructions check whether (n) bit(s) of binary 32-bit data of the device specified by (s) are on or off, and output the result to the device specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DBON(EN,s,n,d); ENO:=DBONP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Word device number storing the data	—	32-bit signed binary	ANY32
(d)	Bit device number to be driven	—	Bit	Bit
(n)	Bit position to be checked	0 to 31	16-bit signed binary	ANY16

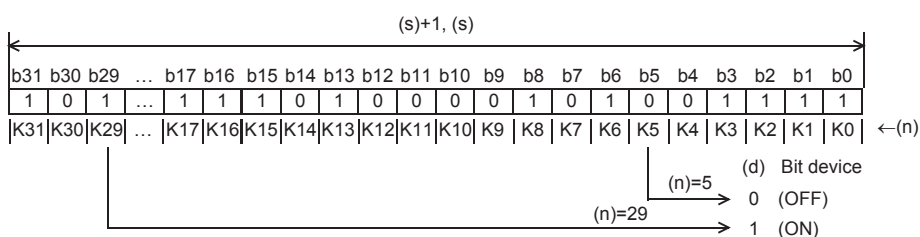
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	○	—	○*1	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

- These instructions check whether (n) bit(s) of binary 32-bit data of the device specified by (s) are on or off, and output the result to the device specified by (d).
- When the result above is on, these instructions turn (d) on. When the result above is off, these instructions turn (d) off.
- When a constant (K) is specified in the device specified by (s), it is automatically converted into binary.



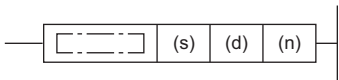
Operation error

Error code (SD0/SD8067)	Description
3405	The value specified by (n) is outside the following range. 0 to 31


Searching the maximum value of 16-bit data

MAX(P)(_U)

These instructions search the maximum value from the (n) point(s) of 16-bit binary data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=MAXP(EN,s,n,d);	ENO:=MAXP_U(EN,s,n,d);

*1 The MAX(_U) instructions are not supported by the ST language. Use MAX of the standard function.

 Page 804 MAX(_E), MIN(_E)

Setting data

■Descriptions, ranges, and data types

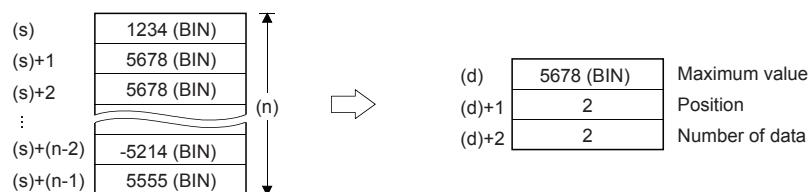
Operand	Description	Range	Data type	Data type (label)
(s)	MAX(P) MAX(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(d)	MAX(P) MAX(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(n)	Number of data to be searched	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search the maximum value from the (n) point(s) of 16-bit binary data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d). These instructions start searching from the device specified by (s), and store the location from (s) of the first maximum value in (d)+1 and the number of maximum values in (d)+2.



Operation error

Error code (SD0/SD8067)	Description
2820	The (n) point(s) of data in the device starting from the one specified by (s) exceed the corresponding device range.
	The device specified by (d) exceeds the corresponding device range.

Searching the maximum value of 32-bit data

DMAX(P)(_U)

These instructions search the maximum value from the (n) point(s) of 32-bit binary data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=DMAXP(EN,s,n,d);	ENO:=DMAXP_U(EN,s,n,d);

*1 The DMAX(_U) instructions are not supported by the ST language. Use MAX of the standard function.

Page 804 MAX(_E), MIN(_E)

Setting data

■Descriptions, ranges, and data types

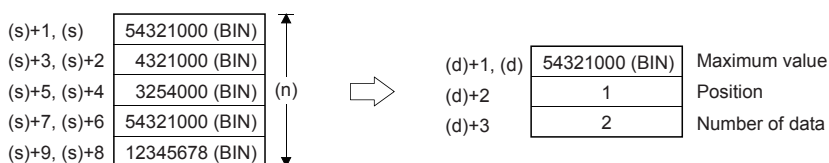
Operand	Description	Range	Data type	Data type (label)
(s)	DMAX(P) DMAX(P)_U	—	32-bit signed binary	ANY32
			32-bit unsigned binary	
(d)	DMAX(P) DMAX(P)_U	—	32-bit signed binary	ANY32
			32-bit unsigned binary	
(n)	Number of data to be searched	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search the maximum value from the (n) point(s) of 32-bit binary data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d) and (d)+1. These instructions start searching from the device specified by (s), and store the location from (s) of the first minimum value in (d)+2 and the number of maximum values in (d)+3.



Operation error

Error code (SD0/SD8067)	Description
2820	The (n) point(s) of data in the device starting from the one specified by (s) exceed the corresponding device range.
	The device specified by (d) exceeds the corresponding device range.

Searching the minimum value of 16-bit data

MIN(P)(_U)

These instructions search the minimum value from the (n) point(s) of 16-bit binary data in the device starting from the one specified by (s), and store the minimum value in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=MINP(EN,s,n,d);	ENO:=MINP_U(EN,s,n,d);

*1 The MIN(_U) instructions are not supported by the ST language. Use MIN of the standard function.

Page 804 MAX(_E), MIN(_E)

Setting data

■Descriptions, ranges, and data types

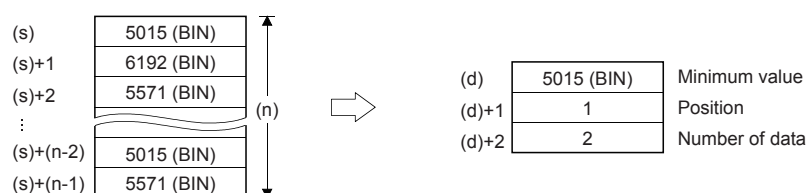
Operand	Description	Range	Data type	Data type (label)
(s)	MIN(P)	—	16-bit signed binary	ANY16
	MIN(P)_U		16-bit unsigned binary	
(d)	MIN(P)	—	16-bit signed binary	ANY16
	MIN(P)_U		16-bit unsigned binary	
(n)	Number of data to be searched	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search the minimum value from the (n) point(s) of 16-bit binary data in the device starting from the one specified by (s), and store the minimum value in the device specified by (d). These instructions start searching from the device specified by (s), and store the location from (s) of the first minimum value in (d)+1 and the number of minimum values in (d)+2.



Operation error

Error code (SD0/SD8067)	Description
2820	The (n) point(s) of data in the device starting from the one specified by (s) exceed the corresponding device range.
	The device specified by (d) exceeds the corresponding device range.

Searching the minimum value of 32-bit data

DMIN(P)(_U)

These instructions search the minimum value from the (n) point(s) of 32-bit binary data in the device starting from the one specified by (s), and store the minimum value in the device specified by (d).

Ladder diagram	Structured text ^{*1}	
	ENO:=DMINP(EN,s,n,d);	ENO:=DMINP_U(EN,s,n,d);

*1 The DMIN(_U) instructions are not supported by the ST language. Use MIN of the standard function.

Page 804 MAX(_E), MIN(_E)

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	DMIN(P)	—	32-bit signed binary	ANY32
	DMIN(P)_U		32-bit unsigned binary	
(d)	DMIN(P)	—	32-bit signed binary	ANY32
	DMIN(P)_U		32-bit unsigned binary	
(n)	Number of data to be searched	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions search the minimum value from the (n) point(s) of 32-bit binary data in the device starting from the one specified by (s), and store the minimum value in the device specified by (d) and (d)+1. These instructions start searching from the device specified by (s), and store the location from (s) of the first minimum value in (d)+2 and the number of minimum values in (d)+3.

(s)+1, (s)	22342001 (BIN)	↑ (n) ↓	⇒	(d)+1, (d)	22342001 (BIN)	Minimum value
(s)+3, (s)+2	37282010 (BIN)			(d)+2	1	Position
(s)+5, (s)+4	22342001 (BIN)			(d)+3	2	Number of data
(s)+7, (s)+6	59872019 (BIN)					

Operation error

Error code (SD0/SD8067)	Description
2820	The (n) point(s) of data in the device starting from the one specified by (s) exceed the corresponding device range.
	The device specified by (d) exceeds the setting area in the device/label memory.

Sorting 16-bit data

SORTTBL(_U)

These instructions sort data lines in the data table (sorting source) having ((m1)×(m2)) points specified by (s) in the ascending order based on the group data in the column number (n), and store the result in the data table (sorting result) having ((m1)×(m2)) points specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=SORTTBL(EN,s,m1,m2,n,d); ENO:= SORTTBL_U(EN,s,m1,m2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	SORTTBL SORTTBL_U	—	16-bit signed binary 16-bit unsigned binary	ANY16
(m1)	Number of data (lines)	1 to 32	16-bit unsigned binary	ANY16
(m2)	Number of group data (columns)	1 to 6	16-bit unsigned binary	ANY16
(d)	SORTTBL SORTTBL_U	—	16-bit signed binary 16-bit unsigned binary	ANY16
(n)	Column number of group data (column) used as the basis of sorting	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—	—
(m1)	○	—	—	○	○	○	—	—	○	○	—	—	—	—
(m2)	○	—	—	○	○	○	—	—	○	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—	—

Processing details

- These instructions sort data lines in the data table (sorting source) having ((m1)×(m2)) points specified by (s) in the ascending order based on the group data in the column number (n), and store the result in the data table (sorting result) having (m1×m2) points specified by (d).
- The data table configuration is explained in an example in which the sorting source data table has 3 lines and 4 columns (m1 = K3, m2 = K4). For the sorting result data table, understand (s) as (d).

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 3	Line No. 1	(s)	(s)+3	(s)+6	(s)+9
	Line No. 2	(s)+1	(s)+4	(s)+7	(s)+10
	Line No. 3	(s)+2	(s)+5	(s)+8	(s)+11

- When the command input turns on, data sorting is started. Data sorting is completed after (m1) scans, and the instruction execution complete flag SM8029 is set to on.

- The following table shows an operation example based on the sorting source data below. It is recommended to put a serial number such as a control number in the first column so that the original line number can be estimated based on the contents.

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(s)	(s)+5	(s)+10	(s)+15
		1	150	45	20
	Line No. 2	(s)+1	(s)+6	(s)+11	(s)+16
		2	180	50	40
	Line No. 3	(s)+2	(s)+7	(s)+12	(s)+17
		3	160	70	30
	Line No. 4	(s)+3	(s)+8	(s)+13	(s)+18
		4	100	20	8
	Line No. 5	(s)+4	(s)+9	(s)+14	(s)+19
		5	150	50	45

- Sorting result when the instructions are executed with (n) = K2 (column No. 2)

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(d)	(d)+5	(d)+11	(d)+15
		4	100	20	8
	Line No. 2	(d)+2	(d)+6	(d)+10	(d)+16
		1	150	45	20
	Line No. 3	(d)+1	(d)+7	(d)+12	(d)+17
		5	150	50	45
	Line No. 4	(d)+3	(d)+8	(d)+13	(d)+18
		3	160	70	30
	Line No. 5	(d)+4	(d)+9	(d)+14	(d)+19
		2	180	50	40

- Sorting result when the instructions are executed with (n) = K3 (column No. 3)

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(d)	(d)+5	(d)+10	(d)+15
		4	100	20	8
	Line No. 2	(d)+1	(d)+6	(d)+11	(d)+16
		1	150	45	20
	Line No. 3	(d)+2	(d)+7	(d)+12	(d)+17
		2	180	50	40
	Line No. 4	(d)+3	(d)+8	(d)+13	(d)+18
		5	150	50	45
	Line No. 5	(d)+4	(d)+9	(d)+14	(d)+19
		3	160	70	30

Precautions

- Do not change the contents of operands and data during operation.
- To execute these instructions again, set the command input to off once, then on again.
- These instructions can only be used once in any program.
- When specifying the same device in (s) and (d), the source data is overwritten by the data acquired by sorting. Take special care so that the contents of (s) are not changed until execution is completed.

Operation error

Error code (SD0/SD8067)	Description
1811	These instructions are used more than once.
2820	The device range specified by (s) exceeds the corresponding device range. The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (m1) is outside the following range. 1 to 32 The value specified by (m2) is outside the following range. 1 to 6 The value specified by (n) is outside the following range. 1 to (m2)

16-bit data alignment 2

SROTTBL2(_U)

These instructions sort data lines in the data table (sorting source) of 16-bit binary data having $(m1 \times m2)$ points specified by (s) in the ascending order or descending order based on the group data in the column number (n), and store the result in the data table (sorting result) of 16-bit binary data having $((m1) \times (m2))$ points specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=SROTTBL2(EN,s,m1,m2,n,d); ENO:=SROTTBL2_U(EN,s,m1,m2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	SROTTBL2	—	16-bit signed binary	ANY16
	SROTTBL2_U		16-bit unsigned binary	
(m1)	Number of data (lines)	1 to 32	16-bit unsigned binary	ANY16
(m2)	Number of group data (columns)	1 to 6	16-bit unsigned binary	ANY16
(d)	SROTTBL2	—	16-bit signed binary	ANY16
	SROTTBL2_U		16-bit unsigned binary	
(n)	Column number of group data (column) used as the basis of sorting	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	—	—	○	—	—	—	—
(m1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(m2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions sort data lines in the data table (sorting source) of 16-bit binary data having $(m1 \times m2)$ points specified by (s) in the ascending order or descending order based on the group data in the column number (n), and store the result in the data table (sorting result) of 16-bit binary data having $((m1) \times (m2))$ points specified by (d).
- The data table configuration is explained in an example in which the sorting source data table has 3 lines and 4 columns ($m1 = K3$, $m2 = K4$). For the sorting result data table, understand (s) as (d).

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 3	Line No. 1	(s)	(s)+1	(s)+2	(s)+3
	Line No. 2	(s)+4	(s)+5	(s)+6	(s)+7
	Line No. 3	(s)+8	(s)+9	(s)+10	(s)+11

- Set the sorting order by setting SM703 to on or off.

	Sorting order
SM703 = ON	Descending order
SM703 = OFF	Ascending order

- When the command input turns on, data sorting is started. Data sorting is completed after (m1) scans, and the instruction execution complete flag SM8029 is set to on.
- The following table shows an operation example based on the sorting source data below. It is recommended to put a serial number such as a control number in the first column so that the original line number can be estimated based on the contents.

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(s)	(s)+1	(s)+2	(s)+3
		1	150	45	20
	Line No. 2	(s)+4	(s)+5	(s)+6	(s)+7
		2	180	50	40
	Line No. 3	(s)+8	(s)+9	(s)+10	(s)+11
		3	160	70	30
	Line No. 4	(s)+12	(s)+13	(s)+14	(s)+15
		4	100	20	8
	Line No. 5	(s)+16	(s)+17	(s)+18	(s)+19
		5	150	50	45

- Sorting result when the instructions are executed with (n) = K2 (column No. 2) (in the case of ascending order SM703=OFF)

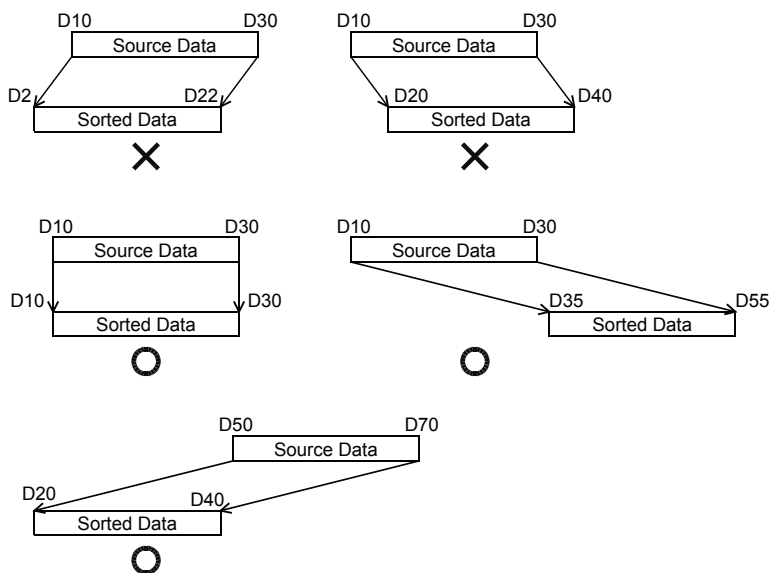
		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(d)	(d)+1	(d)+2	(d)+3
		4	100	20	8
	Line No. 2	(d)+4	(d)+5	(d)+6	(d)+7
		1	150	45	20
	Line No. 3	(d)+8	(d)+9	(d)+10	(d)+11
		5	150	50	45
	Line No. 4	(d)+12	(d)+13	(d)+14	(d)+15
		3	160	70	30
	Line No. 5	(d)+16	(d)+17	(d)+18	(d)+19
		2	180	50	40

- Sorting result when the instructions are executed with (n) = K3 (column No. 3) (in the case of descending order SM703=ON)

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(d)	(d)+1	(d)+2	(d)+3
		3	160	70	30
	Line No. 2	(d)+4	(d)+5	(d)+6	(d)+7
		2	180	50	40
	Line No. 3	(d)+8	(d)+9	(d)+10	(d)+11
		5	150	50	45
	Line No. 4	(d)+12	(d)+13	(d)+14	(d)+15
		1	150	45	20
	Line No. 5	(d)+16	(d)+17	(d)+18	(d)+19
		4	100	20	8

Precautions

- Do not change the contents of operands and data during operation.
- To execute these instructions again, set the command input to off once, then on again.
- These instructions can be used up to twice in any program.
- When specifying the same device in (s) and (d), the source data is overwritten by the data acquired by sorting. Take special care so that the contents of (s) are not changed until execution is completed.
- Ensure that the sorted data does not overlap with the source data.



Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s) exceeds the corresponding device range.
	The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (m1) is outside the following range. 1 to 32
	The value specified by (m2) is outside the following range. 1 to 6
	The value specified by (n) is outside the following range. 1 to (m2)

32-bit data alignment 2

DSORTTBL2(_U)

These instructions sort data lines in the data table (sorting source) of 32-bit binary data having $(m1 \times m2)$ points specified by (s) in the ascending order or descending order based on the group data in the column number (n), and store the result in the data table (sorting result) of 32-bit binary data having $((m1) \times (m2))$ points specified by (d).

Ladder diagram	Structured text
	<pre>ENO:=DSORTTBL2(EN,s,m1,m2,n,d); ENO:= DSORTTBL2_U(EN,s,m1,m2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	DSORTTBL2	—	32-bit signed binary	ANY32
	DSORTTBL2_U		32-bit unsigned binary	
(m1)	Number of data (lines)	1 to 32	16-bit unsigned binary	ANY16
(m2)	Number of group data (columns)	1 to 6	16-bit unsigned binary	ANY16
(d)	DSORTTBL2	—	32-bit signed binary	ANY32
	DSORTTBL2_U		32-bit unsigned binary	
(n)	Column number of group data (column) used as the basis of sorting	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	—	—	○	—	○	—	—	—	—
(m1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(m2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	—	○	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions sort data lines in the data table (sorting source) of 32-bit binary data having $(m1 \times m2)$ points specified by (s) in the ascending order or descending order based on the group data in the column number (n), and store the result in the data table (sorting result) of 32-bit binary data having $((m1) \times (m2))$ points specified by (d).
- The data table configuration is explained in an example in which the sorting source data table has 3 lines and 4 columns ($m1 = K3$, $m2 = K4$). For the sorting result data table, understand (s) as (d).

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 3	Line No. 1	(s)+1, (s)	(s)+3, (s)+2	(s)+5, (s)+4	(s)+7, (s)+6
	Line No. 2	(s)+9, (s)+8	(s)+11, (s)+10	(s)+13, (s)+12	(s)+15, (s)+14
	Line No. 3	(s)+17, (s)+16	(s)+19, (s)+18	(s)+21, (s)+20	(s)+23, (s)+22

- Set the sorting order by setting SM703 to on or off.

	Sorting order
SM703 = ON	Descending order
SM703 = OFF	Ascending order

- When the command input turns on, data sorting is started. Data sorting is completed after (m1) scans, and the instruction execution complete flag SM8029 is set to on.
- The following table shows an operation example based on the sorting source data below. It is recommended to put a serial number such as a control number in the first column so that the original line number can be estimated based on the contents.

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(s)+1, (s)	(s)+3, (s)+2	(s)+5, (s)+4	(s)+7, (s)+6
		1	150	45	20
	Line No. 2	(s)+9, (s)+8	(s)+11, (s)+10	(s)+13, (s)+12	(s)+15, (s)+14
		2	180	50	40
	Line No. 3	(s)+17, (s)+16	(s)+19, (s)+18	(s)+21, (s)+20	(s)+23, (s)+22
		3	160	70	30
	Line No. 4	(s)+25, (s)+24	(s)+27, (s)+26	(s)+29, (s)+28	(s)+31, (s)+30
		4	100	20	8
	Line No. 5	(s)+33, (s)+32	(s)+35, (s)+34	(s)+37, (s)+36	(s)+39, (s)+38
		5	150	50	45

- Sorting result when the instructions are executed with (n) = K2 (column No. 2) (in the case of ascending order SM703=OFF)

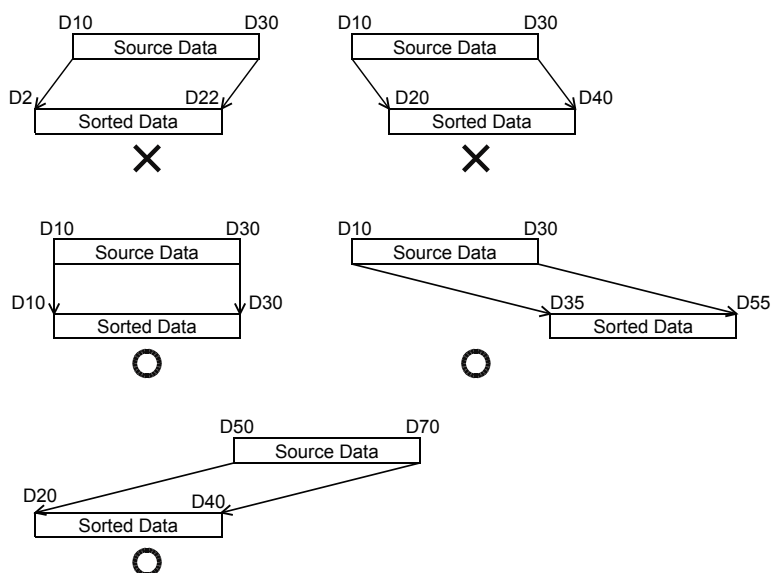
		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(d)+1, (d)	(d)+3, (d)+2	(d)+5, (d)+4	(d)+7, (d)+6
		4	100	20	8
	Line No. 2	(d)+9, (d)+8	(d)+11, (d)+10	(d)+13, (d)+12	(d)+15, (d)+14
		1	150	45	20
	Line No. 3	(d)+17, (d)+16	(d)+19, (d)+18	(d)+21, (d)+20	(d)+23, (d)+22
		5	150	50	45
	Line No. 4	(d)+25, (d)+24	(d)+27, (d)+26	(d)+29, (d)+28	(d)+31, (d)+30
		3	160	70	30
	Line No. 5	(d)+33, (d)+32	(d)+35, (d)+34	(d)+37, (d)+36	(d)+39, (d)+38
		2	180	50	40

- Sorting result when the instructions are executed with (n) = K3 (column No. 3) (in the case of descending order SM703=ON)

		Number of groups (m2 = K4)			
		Column No. 1	Column No. 2	Column No. 3	Column No. 4
		Control number	Height	Weight	Age
Number of data (m1) = 5	Line No. 1	(d)+1, (d)	(d)+3, (d)+2	(d)+5, (d)+4	(d)+7, (d)+6
		3	160	70	30
	Line No. 2	(d)+9, (d)+8	(d)+11, (d)+10	(d)+13, (d)+12	(d)+15, (d)+14
		2	180	50	40
	Line No. 3	(d)+17, (d)+16	(d)+19, (d)+18	(d)+21, (d)+20	(d)+23, (d)+22
		5	150	50	45
	Line No. 4	(d)+25, (d)+24	(d)+27, (d)+26	(d)+29, (d)+28	(d)+31, (d)+30
		1	150	45	20
	Line No. 5	(d)+33, (d)+32	(d)+35, (d)+34	(d)+37, (d)+36	(d)+39, (d)+38
		4	100	20	8

Precautions

- Do not change the contents of operands and data during operation.
- To execute these instructions again, set the command input to off once, then on again.
- These instructions can be used up to or twice in any program.
- When specifying the same device in (s) and (d), the source data is overwritten by the data acquired by sorting. Take special care so that the contents of (s) are not changed until execution is completed.
- Ensure that the sorted data does not overlap with the source data.



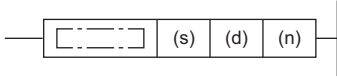
Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s) exceeds the corresponding device range.
	The device range specified by (d) exceeds the corresponding device range.
3405	The value specified by (m1) is outside the following range. 1 to 32
	The value specified by (m2) is outside the following range. 1 to 6
	The value specified by (n) is outside the following range. 1 to (m2)

Adding 16-bit data

WSUM(P)(_U)

These instructions add the (n) point(s) of 16-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text	
	ENO:=WSUM(EN,s,n,d); ENO:=WSUMP(EN,s,n,d);	ENO:=WSUM_U(EN,s,n,d); ENO:=WSUMP_U(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

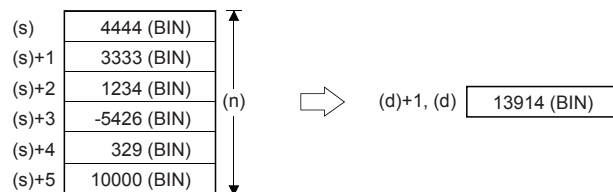
Operand	Description	Range	Data type	Data type (label)
(s)	WSUM(P) WSUM(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(d)	WSUM(P) WSUM(P)_U	—	32-bit signed binary	ANY32
			32-bit unsigned binary	
(n)	Number of data	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions add the (n) point(s) of 16-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).



Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.
	The (n) point(s) of data in the device starting from (s) exceed the corresponding device range.
3405	The data stored in a device specified by (n) is 0.

Adding 32-bit data

DWSUM(P)(_U)

These instructions add the (n) point(s) of 32-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).

Ladder diagram	Structured text	Structured text
	ENO:=DWSUM(EN,s,n,d); ENO:=DWSUMP(EN,s,n,d);	ENO:=DWSUM_U(EN,s,n,d); ENO:=DWSUMP_U(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

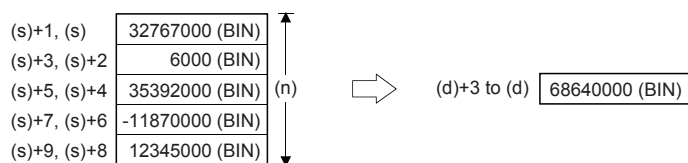
Operand	Description	Range	Data type	Data type (label)
(s)	DWSUM(P) DWSUM(P)_U	—	32-bit signed binary 32-bit unsigned binary	ANY32
(d)	DWSUM(P) DWSUM(P)_U	—	64-bit signed binary 64-bit unsigned binary	Array of any 32-bit data (0..1)
(n)	Number of data	—	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	○	—	○	—	—	—	—
(d)	—	—	—	○	○	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions add the (n) point(s) of 32-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).



Precautions

In the 32-bit operation, the acquired sum is 64-bit data. The FX5 series CPU module cannot handle 64-bit data. When the sum is within the numeric range of 32-bit data (K-2147483648 to K2147483647), however, the FX5 series CPU module can handle the low-order 32 bits of 32-bit data as the sum while ignoring the high-order 32 bits.

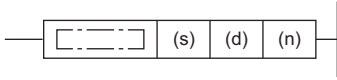
Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range. The (n) point(s) of data in the device starting from (s) exceed the corresponding device range.
3405	The data stored in a device specified by (n) is 0.

Calculating the mean value of 16-bit data

MEAN(P)(_U)

These instructions calculate the mean value of the (n) point(s) of 16-bit data units starting from the one specified by (s), and store the operation result in (d).

Ladder diagram	Structured text	
	ENO:=MEAN(EN,s,n,d); ENO:=MEANP(EN,s,n,d);	ENO:=MEAN_U(EN,s,n,d); ENO:=MEANP_U(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

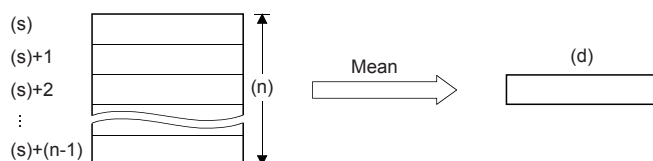
Operand	Description	Range	Data type	Data type (label)
(s)	MEAN(P) MEAN(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(d)	MEAN(P) MEAN(P)_U	—	16-bit signed binary	ANY16
			16-bit unsigned binary	
(n)	Number of data or the device number storing the number of data	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions calculate the mean value of the (n) point(s) of 16-bit data starting from the one specified by (s), and store the operation result in a device specified by (d).



- The sum is obtained as algebraic sum, and divided by (n).
- The remainder is ignored.

Precautions

When a device number is exceeded, (n) is handled as a smaller value in the possible range.

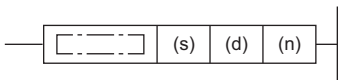
Operation error

Error code (SD0/SD8067)	Description
3405	The value stored in a device specified by (n) is 0.

Calculating the mean value of 32-bit data

DMEAN(P)(_U)

These instructions calculate the mean value of the (n) point(s) of 32-bit data units starting from the one specified by (s), and store the operation result in (d).

Ladder diagram	Structured text	
	ENO:=DMEAN(EN,s,n,d); ENO:=DMEANP(EN,s,n,d);	ENO:=DMEAN_U(EN,s,n,d); ENO:=DMEANP_U(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

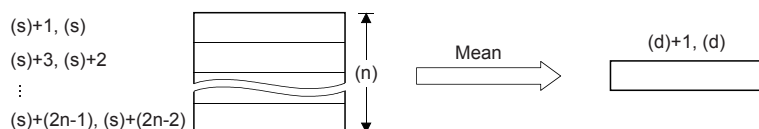
Operand	Description	Range	Data type	Data type (label)
(s)	DMEAN(P) DMEAN(P)_U	—	32-bit signed binary	ANY32
			32-bit unsigned binary	
(d)	DMEAN(P) DMEAN(P)_U	—	32-bit signed binary	ANY32
			32-bit unsigned binary	
(n)	Number of data or the device number storing the number of data	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	—	○	—	○	—	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions calculate the mean value of the (n) point(s) of 32-bit data starting from the one specified by (s), and store the operation result in a device specified by (d).



- The sum is obtained as algebraic sum, and divided by (n).
- The remainder is ignored.

Precautions

When a device number is exceeded, (n) is handled as a smaller value in the possible range.

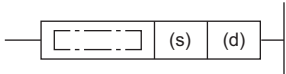
Operation error

Error code (SD0/SD8067)	Description
3405	The value stored in a device specified by (n) is 0.

Calculating the square root of 16-bit data

SQRT(P)

These instructions calculate the square root of binary 16-bit data specified by (s1), and store the operation result in (d).

Ladder diagram	Structured text
	<pre>ENO:=SQRT(EN,s,d); ENO:=SQRTP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Device where the data whose square root is operated is calculated	—	16-bit signed binary	ANY16
(d)	Device for storing the calculated square root	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	○	○	—	—	○	—	—	—	—

Processing details

- These instructions calculate the square root of binary 16-bit data specified by (s1), and store the operation result in (d).

$$\sqrt{(s)} \rightarrow (d)$$

Precautions

- The obtained square root is an integer because the decimal point is ignored. When the calculated decimal value is ignored, SM8021 (borrow flag) turns on.
- When the operation result is true 0, SM8020 (zero flag) turns on.

Operation error

Error code (SD0/SD8067)	Description
3405	In (s), a negative value is specified.

Calculating the square root of 32-bit data

DSQRT(P)

These instructions calculate the square root of binary 32-bit data specified by (s1), and store the operation result in (d).

Ladder diagram	Structured text
	ENO:=DSQRT(EN,s,d); ENO:=DSQRTP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Device where the data whose square root is operated is calculated	—	32-bit signed binary	ANY32
(d)	Device for storing the calculated square root	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	○	○	○	○	○	—	—	—
(d)	—	—	—	○	○	○	○	○	○	—	—	—	—

Processing details

- These instructions calculate the square root of binary 32-bit data specified by (s1), and store the operation result in (d).

$$\sqrt{(s)+1, (s)} \rightarrow (d)+1, (d)$$

Precautions

- The obtained square root is an integer because the decimal point is ignored. When the calculated decimal value is ignored, SM8021 (borrow flag) turns on.
- When the operation result is true 0, SM8020 (zero flag) turns on.

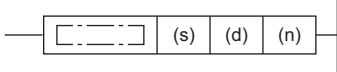
Operation error

Error code (SD0/SD8067)	Description
3405	In (s), a negative value is specified.

CRC calculation

CRC(P)

These instructions calculate the CRC (cyclic redundancy check) value which is an error check method used in communication. In addition to CRC value, parity check and sum check are available. For obtaining the horizontal parity value and sum check value, the CCD(P) instruction is available. For the generation of CRC value (CRC-16), these instructions use " $X^{16} + X^{15} + X^2 + 1$ " in a polynomial.

Ladder diagram	Structured text
	<pre>ENO:=CRC(EN,s,n,d); ENO:=CRCP(EN,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number storing data for which the CRC value is generated	—	16-bit unsigned binary	ANY16
(d)	Device number storing the generated CRC value	—	16-bit unsigned binary	ANY16
(n)	Number of 8-bit (1-byte) data for which the CRC value is generated or the device number storing the number of data	1 to 32767	16-bit unsigned binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	—	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

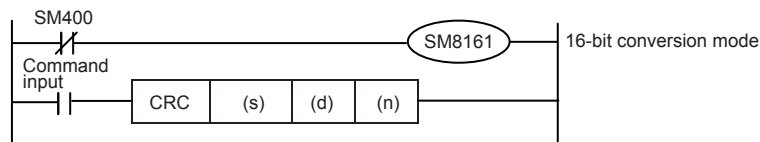
Processing details

- These instructions generate CRC value for (n) 8-bit data (unit: byte) starting from a device specified in (s), and store to (d). The 16-bit conversion mode and 8-bit conversion mode are available for these instructions. For the operation in each mode, refer to the proceeding pages.

- 16-bit conversion mode (while SM8161 is OFF)

In this mode, the operation is executed for high-order 8 bits (1 byte) and low-order 8 bits (1 byte) of a device specified in (s). The operation result is stored to one 16-bit device specified in (d).

In the following program, conversion is executed as follows:

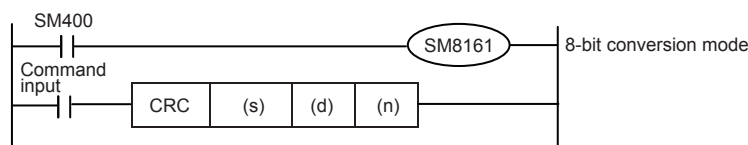


			Example) (s) = D100, (d) = D0, (n) = 6		
			Device	Contents of target data	
				8 bits	16 bits
Device storing data for which the CRC value is generated	(s)	Low-order byte	Low-order bits of D100	01H	0301H
		High-order byte	High-order bits of D100	03H	
	(s)+1	Low-order byte	Low-order bits of D101	03H	0203H
		High-order byte	High-order bits of D101	02H	
	(s)+2	Low-order byte	Low-order bits of D102	00H	1400H
		High-order byte	High-order bits of D102	14H	
	⋮	⋮	—		
	(s)+(n)/2-1	Low-order byte	—		
		High-order byte			
Device storing the generated CRC value	(d)	Low-order byte	Low-order bits of D0	E4H	41E4H
		High-order byte	High-order bits of D0	41H	

- 8-bit conversion mode (while SM8161 is ON)

In this mode, the operation is executed only for low-order 8 bits (low-order 1 byte) of a device specified by (s). With regard to the operation result, low-order 8 bits (1 byte) are stored to a device specified by (d), and high-order 8 bits (1 byte) are stored to a device specified by (d)+1.

In the following program, conversion is executed as follows:



			Example) (s) = D100, (d) = D0, (n) = 6	
			Device	Contents of target data
Device storing data for which the CRC value is generated	(s)	Low-order byte	Low-order bits of D100	01H
	(s)+1	Low-order byte	Low-order bits of D101	03H
	(s)+2	Low-order byte	Low-order bits of D102	03H
	(s)+3	Low-order byte	Low-order bits of D103	02H
	(s)+4	Low-order byte	Low-order bits of D104	00H
	(s)+5	Low-order byte	Low-order bits of D105	14H
	⋮		—	
	(s)+(n)-1	Low-order byte	—	
Device storing the generated CRC value	(d)	Low-order byte	Low-order bits of D0	E4H
	(d)+1	High-order byte	High-order bits of D0	41H

Precautions

- In these instructions, " $X^{16}+X^{15}+X^2+1$ " is used in a polynomial for generating the CRC value (CRC-16). There are many other standard polynomials for generating the CRC value. Note that the CRC value completely differs if an adopted polynomial is different. Major polynomials for generating the CRC value are shown below.

Name	Polynomial
CRC-12	$X^{12} + X^{11} + X^3 + X^2 + X + 1$
CRC-16	$X^{16} + X^{15} + X^2 + 1$
CRC-32	$X^{32} + X^{26} + X^{23} + X^{22} + X^{16} + X^{12} + X^{11} + X^{10} + X^8 + X^7 + X^5 + X^4 + X^2 + X + 1$
CRC-CCITT	$X^{16} + X^{12} + X^5 + 1$

Operation error

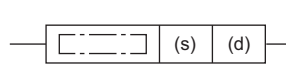
There is no operation error.

7.18 Indirect address read instruction

Reading the indirect address

ADRSET(P)

These instructions store the indirect address of the device specified by (s) to the device specified by (d).
The addresses stored in the device specified by (d)+0 and (d)+1 are used by the program to execute the indirect address of the device.

Ladder diagram	Structured text
	ENO:=ADRSET(EN,s,d); ENO:=ADRSETP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Device number for reading the indirect address	—	Device name	ANY16
(d)	Device number for storing the indirect address of the device specified by (s)	—	32-bit signed binary	ANY32

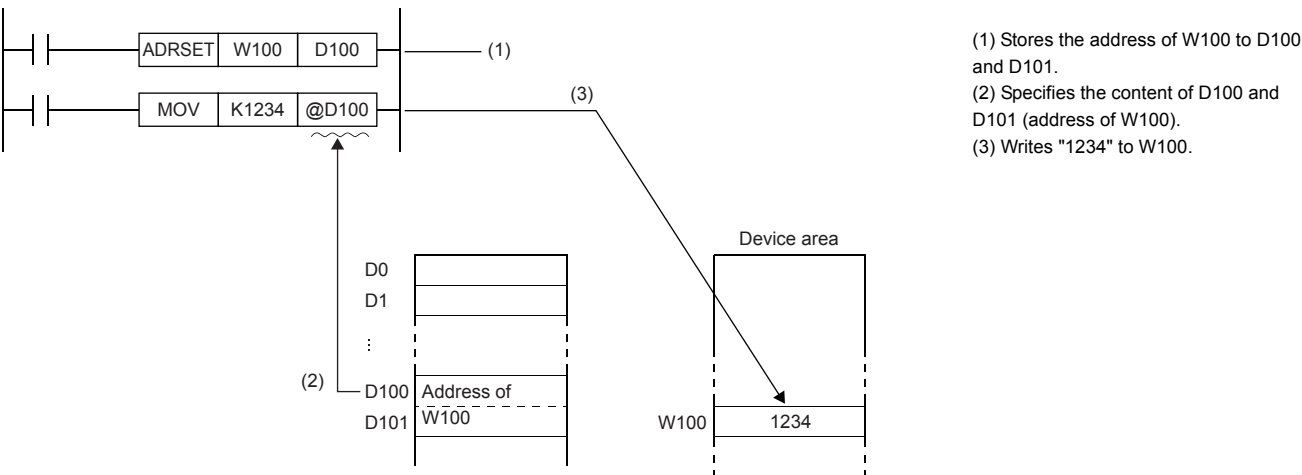
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	○	—	○	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

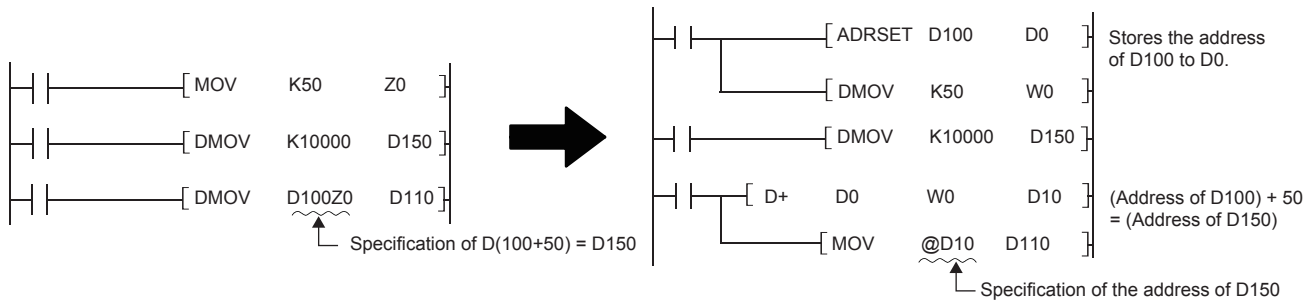
- These instructions store the indirect address of the device specified by (s) to the device specified by (d). The addresses stored in the device specified by (d)+0 and (d)+1 are used by the program to execute the indirect address of the device.



- The nibble of a bit device, and the bit of a word device cannot be specified in (s).

Precautions

- In the indirect specification, the device address used in sequence program is specified with a word device of 2 words (2-word devices). Use the indirect specification as an index when index register is insufficient.



- In the indirect specification, the device which specify the address of the specified device is specified by "@+(word device number)". For example, when "@D100" is specified, and the content of D101 and D100 becomes the device address.

Operation error

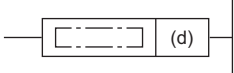
There is no operation error.

7.19 Clock instruction

Reading clock data

TRD(P)

These instructions read the clock data from the built-in real time clock in the CPU module.

Ladder diagram	Structured text
	ENO:=TRD(EN,d); ENO:=TRDP(EN,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Head device number where the read clock data is stored	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○	○	—	—	—	○	—	—	—	—

7

Processing details

- These instructions read the clock data (SD210 to SD216) from the built-in real time clock in the CPU module to the device numbers (d) to (d)+6 in the following format.

	Device	Item	Clock data		Device	Item
Special registers	SD210	Year	1980 to 2079 (year, four digits)	→	D0	Year
	SD211	Month	1 to 12	→	D1	Month
	SD212	Day	1 to 31	→	D2	Day
	SD213	Hour data	0 to 23	→	D3	Hour data
	SD214	Minute data	0 to 59	→	D4	Minute data
	SD215	Second data	0 to 59	→	D5	Second data
	SD216	Day-of-the-week data	0 (Sunday) to 6 (Saturday)	→	D6	Day-of-the-week data

- The table below shows the related devices. The clock data stored in these special registers is updated during the END processing.

Device	Name	Description
Binary code		
SD210	Binary clock data (year)	The year data in the clock data is stored as a four-digit binary code.
SD211	Binary clock data (month)	The month data in the clock data is stored as a binary code.
SD212	Binary clock data (day)	The day data in the clock data is stored as a binary code.
SD213	Binary clock data (hour)	The hour data in the clock data is stored as a binary code.
SD214	Binary clock data (minute)	The minute data in the clock data is stored as a binary code.
SD215	Binary clock data (second)	The second data in the clock data is stored as a binary code.
SD216	Binary clock data (day of the week)	The day-of-a-week data in the clock data (0: Sunday, 1: Monday, ..., 6: Saturday) is stored as a binary code.
Binary code (FX3 compatible area)		
SD8013	Binary clock data (second)	The second data in the clock data is stored as a binary code.
SD8014	Binary clock data (minute)	The minute data in the clock data is stored as a binary code.
SD8015	Binary clock data (hour)	The hour data in the clock data is stored as a binary code.
SD8016	Binary clock data (day)	The day data in the clock data is stored as a binary code.
SD8017	Binary clock data (month)	The month data in the clock data is stored as a binary code.

Device	Name	Description
SD8018	Binary clock data (year)	The year data in the clock data is stored as a four-digit binary code.
SD8019	Binary clock data (day of the week)	The day-of-a-week data in the clock data (0: Sunday, 1: Monday, ..., 6: Saturday) is stored as a binary code.

Precautions

- These instructions occupy seven points of device starting from device number specified by (d). Make sure that these devices are not used by other machine controls.


Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (d) exceeds the corresponding device range.

Writing clock data

TWR(P)

This instruction writes the clock data to the built-in CPU module real time clock.

Ladder diagram	Structured text
	<pre>ENO:=TWR(EN,s); ENO:=TWRP(EN,s);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the clock write source data is stored	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○	○	—	—	—	○	—	—	—	—

Processing details

- These instructions write the clock data stored in device numbers (s) to (s)+6 to the clock data area (SD210 to SD216 and SD8013 to SD8019) of the built-in real time clock in the CPU module.

Time setting data				Special registers	
Device	Item	Clock data		Device	Item
(s)	Year	1980 to 2079 (year, four digits)	→	SD210, SD8018	Year
(s)+1	Month	1 to 12	→	SD211, SD8017	Month
(s)+2	Day	1 to 31	→	SD212, SD8016	Day
(s)+3	Hour data	0 to 23	→	SD213, SD8015	Hour data
(s)+4	Minute data	0 to 59	→	SD214, SD8014	Minute data
(s)+5	Second data	0 to 59	→	SD215, SD8013	Second data
(s)+6	Day-of-the-week data	0 (Sunday) to 6 (Saturday)	→	SD216, SD8019	Day-of-the-week data

- Executing these instructions immediately changes the real time clock data. Therefore, transfer the clock data of a few minutes ahead the current time to the clock data area (s) to (s)+6 in advance. Execute the instruction when the actual time matches the clock data time.
- When using these instructions to set the clock data (i.e., performing time adjustment), control of special relay SM8015 (clock stop/adjustment) is not required.
- If incorrect values (i.e., values out of range) are set to the write source area, the clock data will not be updated. In this case, correct the clock data in the write source area and execute the instruction.
- Day of the week (SD216 and SD8019) is automatically corrected.

- The table below shows the related devices.

Device	Name	Description
SM8019	Real time clock error	This special data register turns on when the clock data value in the special register is exceeding the setting range.
Binary code		
SD210	Binary clock data (year)	The year data in the clock data is stored as a four-digit binary code.
SD211	Binary clock data (month)	The month data in the clock data is stored as a binary code.
SD212	Binary clock data (day)	The day data in the clock data is stored as a binary code.
SD213	Binary clock data (hour)	The hour data in the clock data is stored as a binary code.
SD214	Binary clock data (minute)	The minute data in the clock data is stored as a binary code.
SD215	Binary clock data (second)	The second data in the clock data is stored as a binary code.
SD216	Binary clock data (day of the week)	The day-of-a-week data in the clock data (0: Sunday, 1: Monday, ..., 6: Saturday) is stored as a binary code.
Binary code (FX3 compatible area)		
SD8013	Binary clock data (second)	The second data in the clock data is stored as a binary code.
SD8014	Binary clock data (minute)	The minute data in the clock data is stored as a binary code.
SD8015	Binary clock data (hour)	The hour data in the clock data is stored as a binary code.
SD8016	Binary clock data (day)	The day data in the clock data is stored as a binary code.
SD8017	Binary clock data (month)	The month data in the clock data is stored as a binary code.
SD8018	Binary clock data (year)	The year data in the clock data is stored as a four-digit binary code.
SD8019	Binary clock data (day of the week)	The day-of-a-week data in the clock data (0: Sunday, 1: Monday, ..., 6: Saturday) is stored as a binary code.

Precautions

- These instructions occupy seven points of device starting from device number specified by (s). Make sure that these devices are not used by other machine controls.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s) exceeds the corresponding device range.

Adding clock data

TADD(P)

These instructions add the time data stored in the device number specified by (s2) and later to the clock data stored in the device number specified by (s1) and later, and store the result to the device number specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=TADD(EN,s1,s2,d); ENO:=TADDP(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number where the clock data to be added is stored.	—	16-bit signed binary	ANY16
(s2)	Head device number where the adding time value (or clock data value) is stored.	—	16-bit signed binary	ANY16
(d)	Head device number where the resultant clock data (or time value) is stored.	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	○	—	—	—	○	—	—	—	—
(d)	—	—	—	○	○	—	—	—	○	—	—	—	—

Processing details

- These instructions add the time data stored in the device numbers starting from (s2) to the clock data stored in the device numbers starting from (s1), and store the result to the device numbers starting from (d).

(s1)	Hour	Data range (0 to 23)	(s2)	Hour	Data range (0 to 23)	(d)	Hour	Data range (0 to 23)
(s1)+1	Minute	(0 to 59)	(s2)+1	Minute	(0 to 59)	(d)+1	Minute	(0 to 59)
(s1)+2	Second	(0 to 59)	(s2)+2	Second	(0 to 59)	(d)+2	Second	(0 to 59)

Ex.

When adding 7:48:10 to 6:32:40

(s1)	6	(s2)	7	(d)	14
(s1)+1	32	(s2)+1	48	(d)+1	20
(s1)+2	40	(s2)+2	10	(d)+2	50

- If the sum of two values exceeds 24:00:00, the carry flag turns on, and the result will be the sum minus 24:00:00. For example, if a time value of 20:20:20 is added to another time value of 14:30:30, the sum is 34:40:50. However, the actual addition result will be 10:40:50.

(s1)	14	(s2)	20	(d)	10
(s1)+1	20	(s2)+1	20	(d)+1	40
(s1)+2	30	(s2)+2	20	(d)+2	50

- If the result is 0 (0:00:00), the zero flag turns on.
- If 1 second is added to 23:59:59, the result will be 0:00:00. This turns on both the carry flag and the zero flag.
- The table below shows the related devices.

Device	Name	Description
SM700	Carry	If the result exceeds the maximum value of the time data, 23:59:59, this special relay turns on.

Device	Name	Description
SM8020	Zero	If the result is 0:00:00, this special relay turns on.
SM8022	Carry	If the result exceeds the maximum value of the time data, 23:59:59, this special relay turns on.

Precautions

- These instructions occupy three points for each of three devices starting from device number specified by (s1), (s2), and (d) respectively. Make sure that these devices are not used by other machine controls.
- When using the time value (hour, minute, second) of the built-in real time clock in the CPU module for the operation, use the TRD(P) operation to read the special register values first. Then specify the word devices where the read values are stored to each operand.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s1), (s2), and (d) exceeds the corresponding device range.
3405	Any of values specified by (s1) and (s2) is outside the following range. 0 to 23
	Any of values specified by (s1)+1, (s2)+1, (s1)+2, and (s2)+2 is outside the following range. 0 to 59

Subtracting clock data

TSUB(P)

These instructions subtract the time data stored in the device numbers starting from (s2) from the clock data stored in the device numbers starting from (s1), and store the result to the device numbers starting from (d).

Ladder diagram	Structured text
	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number where the clock data that is subtracted is stored	—	16-bit signed binary	ANY16
(s2)	Head device number where the subtracting time value (or clock data value) is stored	—	16-bit signed binary	ANY16
(d)	Head device number where the resultant clock data (or time value) is stored	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	○	—	—	—	○	—	—	—	—
(d)	—	—	—	○	○	—	—	—	○	—	—	—	—

Processing details

- These instructions subtract the time data stored in the device numbers starting from (s2) from the clock data stored in the device numbers starting from (s1), and store the result to the device numbers starting from (d).

(s1)	Hour	Data range (0 to 23)	(s2)	Hour	Data range (0 to 23)	(d)	Hour	Data range (0 to 23)
(s1)+1	Minute	(0 to 59)	(s2)+1	Minute	(0 to 59)	(d)+1	Minute	(0 to 59)
(s1)+2	Second	(0 to 59)	(s2)+2	Second	(0 to 59)	(d)+2	Second	(0 to 59)

Ex.

When subtracting 3:50:10 from 10:40:20

(s1)	10	(s2)	3	(d)	6
(s1)+1	40	(s2)+1	50	(d)+1	50
(s1)+2	20	(s2)+2	10	(d)+2	10

- If the remainder is a negative time value, the borrow flag turns on. The actual result will be the remainder plus 24:00:00. For example, if a time value of 10:42:12 is subtracted from another time value of 4:50:32, the remainder is -6:08:20. However, the actual subtraction result will be 18:08:20.

(s1)	4	(s2)	10	(d)	18
(s1)+1	50	(s2)+1	42	(d)+1	8
(s1)+2	32	(s2)+2	12	(d)+2	20

- If the result is 0 (0:00:00), the zero flag turns on.
- The table below shows the related devices.

Device	Name	Description
SM8020	Zero	If the result is 0:00:00, this special relay turns on.
SM8021	Borrow	If the execution result of the TSUB(P) instruction is less than 0:00:00, this special relay turns on.

Precautions

- These instructions occupy three points for each of three devices starting from device number specified by (s1), (s2), and (d) respectively. Make sure that these devices are not used by other machine controls.
- When using the time value (hour, minute, second) of the built-in real time clock in the CPU module for the operation, use the TRD(P) operation to read the special register values first. Then specify the word devices where the read values are stored to each operand.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified by (s1), (s2), and (d) exceeds the corresponding device range.
3405	Any of values specified by (s1) and (s2) is outside the following range. 0 to 23
	Any of values specified by (s1)+1, (s2)+1, (s1)+2, and (s2)+2 is outside the following range. 0 to 59

Converting time data from hour/minute/second to seconds in 16 bits

HTOS(P)

These instructions convert the time data stored in the device numbers starting from (s) to the time value in seconds, and store the converted data in the device numbers starting from (d) as 16-bit binary.

Ladder diagram	Structured text
	<pre>ENO:=HTOS(EN,s,d); ENO:=HTOSP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

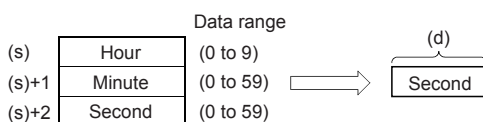
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the clock data before conversion is stored	—	16-bit signed binary	ANY16
(d)	Head device number where the clock data after conversion is stored	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—

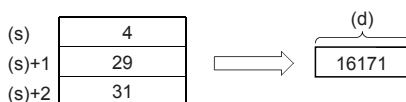
Processing details

- These instructions convert the time data stored in the device numbers starting from (s) to the time value in seconds, and store the converted data in the device numbers starting from (d).



Ex.

When specifying 4 hours 29 minutes 31 seconds in (s)



Operation error

Error code (SD0/SD8067)	Description
2820	Any of the device area ranges specified in (s) and (d) exceed the corresponding device range.
3403	The result is outside the following range. 0 to 32767
3405	A value specified by (s) is outside the following range. 0 to 9 Any of values specified by (s)+1 and (s)+2 is outside the following range. 0 to 59

Converting time data from hour/minute/second to seconds in 32 bits

DHTOS(P)

These instructions convert the time data stored in the device numbers starting from (s) to the time value in seconds, and store the converted data in the device numbers starting from (d) as 32-bit binary.

Ladder diagram	Structured text
	<pre>ENO:=DHTOS(EN,s,d); ENO:=DHTOSP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

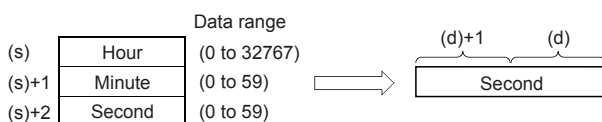
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the clock data before conversion is stored	—	16-bit signed binary	ANY16
(d)	Head device number where the clock data after conversion is stored	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—

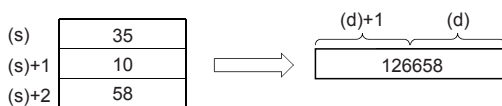
Processing details

- These instructions convert the time data stored in the device numbers starting from (s) to the time value in seconds, and store the converted data in the device numbers starting from (d).



Ex.

When specifying 35 hours 10 minutes 58 seconds in (s)



Operation error

Error code (SD0/SD8067)	Description
2820	Any of the device area ranges specified in (s) and (d) exceed the corresponding device range.
3405	A value specified by (s) is outside the following range. 0 to 32767
	Any of values specified by (s)+1 and (s)+2 is outside the following range. 0 to 59

Converting time data from seconds to hour/minute/second in 16 bits

STOH(P)

These instructions convert the 16-bit time value in seconds stored in the device numbers starting from (s) to the time value in the HHMMDD format, and store the converted data in the device numbers starting from (d).

Ladder diagram	Structured text
	<pre>ENO:=STOH(EN,s,d); ENO:=STOHP(EN,s,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the clock data before conversion is stored	—	16-bit signed binary	ANY16
(d)	Head device number where the clock data after conversion is stored	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	—	—	—	○	—	—	—	—

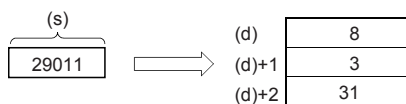
Processing details

- These instructions convert the time value in seconds stored in the device numbers starting from (s) to the time value in HHMMDD format, and store the converted data in the device numbers starting from (d).



Ex.

When specifying 29011 seconds in (s)



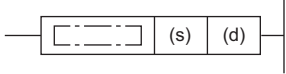
Operation error

Error code (SD0/SD8067)	Description
2820	The specified device area exceeds the corresponding device range.
3405	The value specified by (s) is outside the range.

Converting time data from seconds to hour/minute/second in 32 bits

DSTOH(P)

These instructions convert the 32-bit time value in seconds stored in the device numbers starting from (s) to the time value in the HHMMDD format, and store the converted data in the device numbers starting from (d).

Ladder diagram	Structured text
	ENO:=DSTOH(EN,s,d); ENO:=DSTOHP(EN,s,d);

Setting data

■Descriptions, ranges, and data types

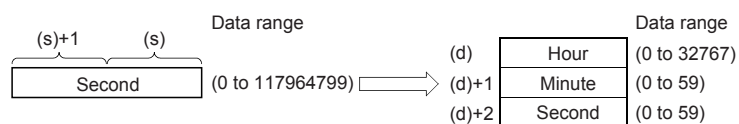
Operand	Description	Range	Data type	Data type (label)
(s)	Head device number where the clock data before conversion is stored	—	32-bit signed binary	ANY32
(d)	Head device number where the clock data after conversion is stored	—	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	—	—	—	○	—	—	—	—

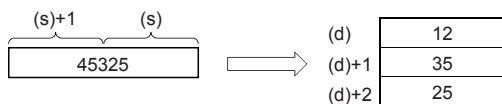
Processing details

- These instructions convert the time value in seconds stored in the device numbers starting from (s) to the time value in HHMMDD format, and store the converted data in the device numbers starting from (d).



Ex.

When specifying 45325 seconds in (s)



Operation error

Error code (SD0/SD8067)	Description
2820	The specified device area exceeds the corresponding device range.
3405	The value specified by (s) is outside the range.

Comparing date data

LDDT□, ANDDT□, ORDT□

These instructions compare the date data in the devices specified by (s1) and (s2). Or, these instructions compare the date data in the device specified by (s1) with the current date.

Set the comparison target by (s3).

Ladder diagram	Structured text
<p>(□ indicates T=, DT<>, DT>, DT<=, DT<, or DT>=.)</p>	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number where the comparison data is stored	—	16-bit signed binary	ANY16
(s2)	Head device number where the comparison data is stored	—	16-bit signed binary	ANY16
(s3)	Comparison target setting value or the number of comparison target data	0001H to 0007H, 8001H to 8007H	16-bit signed binary	ANY16

■Applicable devices

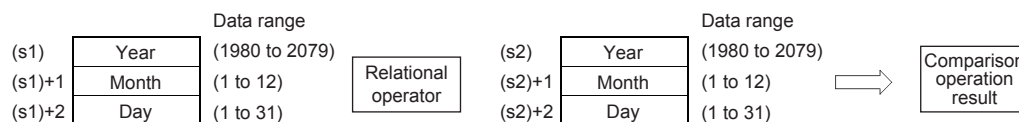
Operand	Bit	Word		Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ	K, H, E, \$	
(s1)	—	—	—	○	—	—	—	—	○	—
(s2)	—	—	—	○	—	—	—	—	○	—
(s3)	—	—	—	○	○	○	—	—	○	—

Processing details

- These instructions compare the date data in the devices specified by (s1) and (s2), or compare the date data in the device specified by (s1) with the current date. Set the comparison target by (s3).

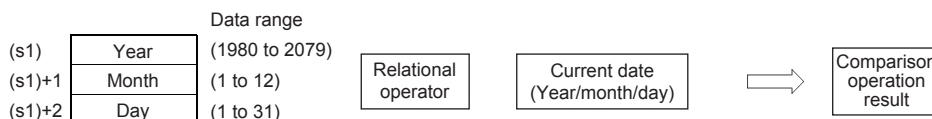
- Comparing two specified date data

These instructions compare the date data in the device specified by (s1) with the date data in the device specified by (s2) in accordance with the conditions set by (s3). (Devices are used as a normally open contact.)

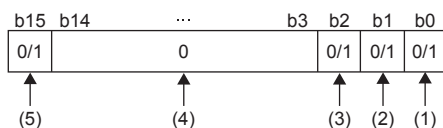


- Comparing the specified date data with the current date

These instructions compare the date data in the device specified by (s1) with the current date data in accordance with the conditions set by (s3). (Devices are used as a normally open contact.) The date data in the device specified by (s2) is regarded as dummy data and ignored.



- Set each data in binary.
- Set the 4 digit "year" data in the devices specified by (s1) and (s2) within the range 1980 to 2079.
- Set the "month" data in the devices specified by (s1)+1 and (s2)+1 within the range 1 to 12.
- Set the "date" data in the devices specified by (s1)+2 and (s2)+2 within the range 1 to 31.
- Set the following in (s3) as comparison target setting values. The following shows the bit configuration of (s3).



- (1) Set "day" as comparison target.
- (2) Set "month" as comparison target.
- (3) Set "year" as comparison target.
- (4) Set 0. If a value other than 0 is set, the operation result will be non-continuity.
- (5) When 1 is set to the 15 bit, the data in the device specified by (s1) is compared with the current date in accordance with the conditions set in the 0 to 2 bits.

- When 0 is set to the 0 to 2 bits, the date data are not compared. When 1 is set, the entire date data (year, month, and day) are compared.
- When 0 is set to the 15 bit, the data in the device specified by (s1) and the date data in the device specified by (s2) are compared. When 1 is set, the data in the device specified by (s1) is compared with the current date. The date data in the device specified by (s2) is ignored.
- The following table lists processing details of each bit.

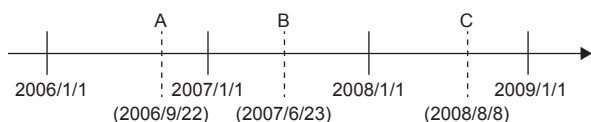
(s3) value when comparing two specified date data	(s3) value when comparing the specified date data with the current date	Comparison target	Contents of processing
0001H	8001H	Day	Only data in the device specified by (s1)+2 is compared.
0002H	8002H	Month	Only data in the device specified by (s1)+1 is compared.
0003H	8003H	Month, day	Data in the device areas specified by (s1)+2 and (s1)+2 are compared.
0004H	8004H	Year	Only data in the device specified by (s1) is compared.
0005H	8005H	Year, day	Data in the device areas specified by (s1) and (s1)+2 are compared.
0006H	8006H	Year, month	Data in the device areas specified by (s1) and (s1)+1 are compared.
0007H	8007H	Year, month, day	The entire date data in the device areas specified by (s1), (s1)+1, and (s1)+2 are compared.
Other than 0001H to 0007H, 8001H to 8007H		None	The entire date data in the device areas specified by (s1), (s1)+1, and (s1)+2 are not compared. (The operation result will be non-continuity.)

- If the comparison target data in the device are not recognized as date data, SM709 turns on after the instruction is executed and the operation result will be non-continuity. Even if the data are not recognized as date data, SM709 does not turn on if the data are within the setting range. If the device areas specified by (s1) to (s1)+2 or (s2) to (s2)+2 exceed the corresponding device range, SM709 turns on after the instruction is executed and the operation result will be non-continuity as well. Once SM709 turns on, the on state is held until the CPU module is powered off or reset. Turn off SM 709 as needed.
- The following table lists the comparison operation results of each instruction.

Instruction symbol	Condition	Result	Instruction symbol	Condition	Result
DT=	(s1)=(s2)	Conductive state	DT=	(s1)≠(s2)	Non-conductive state
DT<>	(s1)≠(s2)		DT<>	(s1)=(s2)	
DT>	(s1)>(s2)		DT>	(s1)≤(s2)	
DT<=	(s1)≤(s2)		DT<=	(s1)>(s2)	
DT<	(s1)<(s2)		DT<	(s1)≥(s2)	
DT>=	(s1)≥(s2)		DT>=	(s1)<(s2)	

Ex.

The date data A, B, and C are compared.



- The following table lists the comparison operation results between A, B, and C. Even when the data are compared under the same conditions, the results differ depending on the comparison target data.

○: Continuity, ×: Non-continuity

Comparison target data	Condition		
	A<B	B<C	A<C
Day	○	×	×
Month	×	○	×
Month, day	×	○	×
Year	○	○	○
Year, day	○	○	○
Year, month	○	○	○
Year, month, day	○	○	○
None	×	×	×

- Even though the specified date does not exist, the comparison operation is performed in accordance with the conditions in the following table as long as the date data are within the valid range.

- Date A: 2006/02/30 (Even though the date does not exist, this date can be set.)
- Date B: 2007/03/29
- Date A: 2008/02/31 (Even though the date does not exist, this date can be set.)

○: Continuity, ×: Non-continuity

Comparison target data	Condition		
	A<B	B<C	A<C
Day	×	×	○
Month	×	×	×
Month, day	○	×	○
Year	○	○	○
Year, day	○	○	○
Year, month	○	○	○
Year, month, day	○	○	○
None	×	×	×

Operation error

There is no operation error.

Comparing time data

LDTM□, ANDTM□, ORTM□

These instructions compare the time data in the devices specified by (s1) and (s2). Or, these instructions compare the time data in the device specified by (s1) with the current time.

Set the comparison target by (s3).

Ladder diagram	Structured text
<p>(□ indicates, TM=, TM<>, TM>, TM<=, TM<, TM>=.)</p>	Not supported

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Head device number where the comparison data is stored	—	16-bit signed binary	ANY16
(s2)	Head device number where the comparison data is stored	—	16-bit signed binary	ANY16
(s3)	Comparison target setting value or the number of comparison target data	0001H to 0007H, 8001H to 8007H	16-bit signed binary	ANY16

■Applicable devices

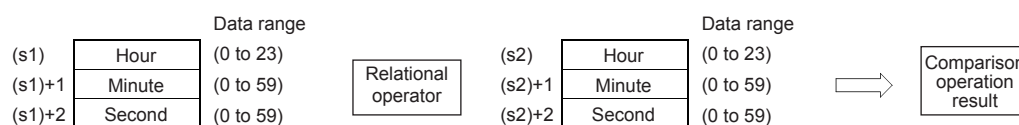
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s3)	—	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- These instructions compare the time data in the devices specified by (s1) and (s2), or compare the time data in the device specified by (s1) with the current time. Set the comparison target by (s3).

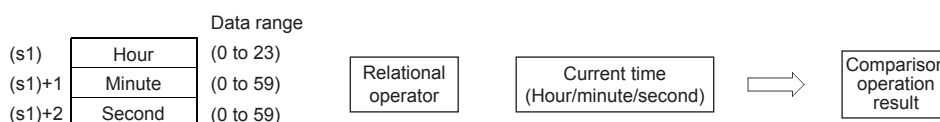
- Comparing two specified time data

These instructions compare the time data in the device specified by (s1) with the time data in the device specified by (s2) in accordance with the conditions set by (s3). (Devices are used as a normally open contact.)

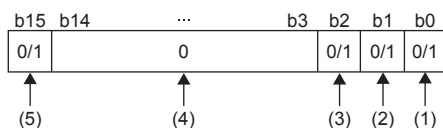


- Comparing specified time data with current time data

These instructions compare the time data in the device specified by (s1) with the current time data in accordance with the conditions set by (s3). (Devices are used as a normally open contact.) The time data in the device specified by (s2) is regarded as dummy data and ignored.



- Set each data in binary.
- Set the "hour" data as in the 24-hour clock in the devices specified by (s1) and (s2) within the range 0 to 23.
- Set the "minute" data in the devices specified by (s1)+1 and (s2)+1 within the range 0 to 59.
- Set the "second" data in the devices specified by (s1)+2 and (s2)+2 within the range 0 to 59.
- Set the following in (s3) as comparison target setting values. The following shows the bit configuration of (s3).



- (1) Set "second" as comparison target.
- (2) Set "minute" as comparison target.
- (3) Set "hour" as comparison target.
- (4) Set 0. If a value other than 0 is set, the operation result will be non-continuity.
- (5) When 1 is set to the 15 bit, the data in the device specified by (s1) is compared with the current time in accordance with the conditions set in the 0 to 2 bits.

- When 0 is set to the 0 to 2 bits, the time data (hour, minute, and second) are not compared. When 1 is set, the entire time data (hour, minute, and second) are compared.
- When 0 is set to the 15 bit, the data in the device specified by (s1) and the time data in the device specified by (s2) are compared. When 1 is set, the data in the device specified by (s1) is compared with the current time. The time data in the device specified by (s2) is ignored.
- The following table lists processing details of each bit.

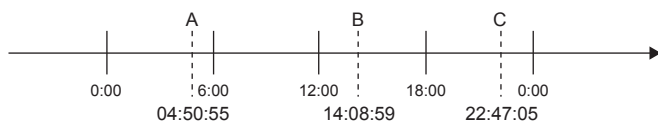
(s3) value when comparing two specified time data	(s3) value when comparing the specified time data with the current time	Comparison target	Contents of processing
0001H	8001H	Second data	Only data in the device specified by (s1)+2 is compared.
0002H	8002H	Minute data	Only data in the device specified by (s1)+1 is compared.
0003H	8003H	Minute and second data	Data in the device areas specified by (s1)+2 and (s1)+1 are compared.
0004H	8004H	Hour data	Only data in the device specified by (s1) is compared.
0005H	8005H	Hour and second data	Data in the device areas specified by (s1) and (s1)+2 are compared.
0006H	8006H	Hour and minute data	Data in the device areas specified by (s1) and (s1)+1 are compared.
0007H	8007H	Hour, minute, and second data	The entire time data in the device areas specified by (s1), (s1)+1, and (s1)+2 are compared.
Other than 0001H to 0007H, 8001H to 8007H		None	The entire time data in the device areas specified by (s1), (s1)+1, and (s1)+2 are not compared. (The operation result will be non-continuity.)

- If the comparison target data in the device are not recognized as time data, SM709 turns on after the instruction is executed and the operation result will be non-continuity. If the device areas specified by (s1) to (s1)+2 or (s2) to (s2)+2 exceed the corresponding device range, SM709 turns on after the instruction is executed and the operation result will be non-continuity as well. Once SM709 turns on, the on state is held until the CPU module is powered off or reset. Turn off SM709 as needed.
- The following table lists the comparison operation results of each instruction.

Instruction symbol	Condition	Result	Instruction symbol	Condition	Result
TM=	(s1)=(s2)	Conductive state	TM=	(s1)≠(s2)	Non-conductive state
TM<>	(s1)≠(s2)		TM<>	(s1)=(s2)	
TM>	(s1)>(s2)		TM>	(s1)≤(s2)	
TM<=	(s1)≤(s2)		TM<=	(s1)>(s2)	
TM<	(s1)<(s2)		TM<	(s1)≥(s2)	
TM>=	(s1)≥(s2)		TM>=	(s1)<(s2)	

Ex.

The time data A, B, and C are compared.



- The following table lists the comparison operation results between A, B, and C. Even when the data are compared under the same conditions, the results differ depending on the comparison target data.

○: Continuity, ×: Non-continuity

Comparison target data	Condition		
	A<B	B<C	A<C
Second data	○	×	×
Minute data	×	○	×
Minute and second data	×	○	×
Hour data	○	○	○
Hour and second data	○	○	○
Hour and minute data	○	○	○
Hour, minute, and second data	○	○	○
None	×	×	×

Operation error

There is no operation error.

Comparing clock data

TCMP(P)

These instructions compare the time specified by (s1), (s2), and (s3) with the time data specified by (s4), and turn on/off the bit device specified by (d) depending on the size match.

Ladder diagram	Structured text
	<pre>ENO:=TCMP(EN,s1,s2,s3,s4,d); ENO:=TCMPP(EN,s1,s2,s3,s4,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Specify the "hour" of the time comparison	0 to 23	16-bit signed binary	ANY16
(s2)	Specify the "minute" of the time comparison	0 to 59	16-bit signed binary	ANY16
(s3)	Specify the "second" of the time comparison	0 to 59	16-bit signed binary	ANY16
(s4)	Specify the time data (hour, minute, and second)	—	16-bit signed binary	ANY16
(d)	Specify the Bit device that turns on/off depending on the comparison result	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s4)	—	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	—	—	—	—	—	—	—	—	—

Processing details

- These instructions compare the time specified by (s1), (s2), and (s3) with the time data specified by (s4), and turn on/off the bit device specified by (d) depending on the size match.

Data range		>	Data range		⇒	(d) = ON
(s1)	Hour (0 to 23)		(s4)	Hour (0 to 23)		
(s2)	Minute (0 to 59)		(s4)+1	Minute (0 to 59)		
(s3)	Second (0 to 59)		(s4)+2	Second (0 to 59)		
Data range		=	Data range		⇒	(d) + 1 = ON
(s1)	Hour (0 to 23)		(s4)	Hour (0 to 23)		
(s2)	Minute (0 to 59)		(s4)+1	Minute (0 to 59)		
(s3)	Second (0 to 59)		(s4)+2	Second (0 to 59)		
Data range		<	Data range		⇒	(d) + 2 = ON
(s1)	Hour (0 to 23)		(s4)	Hour (0 to 23)		
(s2)	Minute (0 to 59)		(s4)+1	Minute (0 to 59)		
(s3)	Second (0 to 59)		(s4)+2	Second (0 to 59)		

- (d), (d)+1, and (d)+2 hold the state before the command contact is turned off even if, the TCMP instruction is not executed by switching on → off the command contact.

Precautions

- Three devices are occupied by (s4) and (d). Make sure that these devices are not used by other machine controls.
- Specify each operand of the word device after reading the value of the special register used in the TRD(P) instruction when the time (hour, minute, second) of the clock data of the built-in real time clock in the CPU module is used.

Operation error

Error code (SD0/SD8067)	Description
2820	The device range specified exceeds the corresponding device range.
3405	The value specified by (s1) and (s4) is outside the following range. 0 to 23
	The value specified by (s2), (s3), (s4)+1, and (s4)+2 is outside the following range. 0 to 59

Comparing clock data zones

TZCP(P)

This instruction compares two comparison time (comparison time zone) specified by (s1) and (s2) with the time data specified by (s3), and turns on or off the specified bit devices (d) according to the comparison results.

Ladder diagram	Structured text
	<pre>ENO:=TZCP(EN,s1,s2,s3,d); ENO:=TZCP(EN,s1,s2,s3,d);</pre>

Setting data

■Descriptions, ranges, and data types

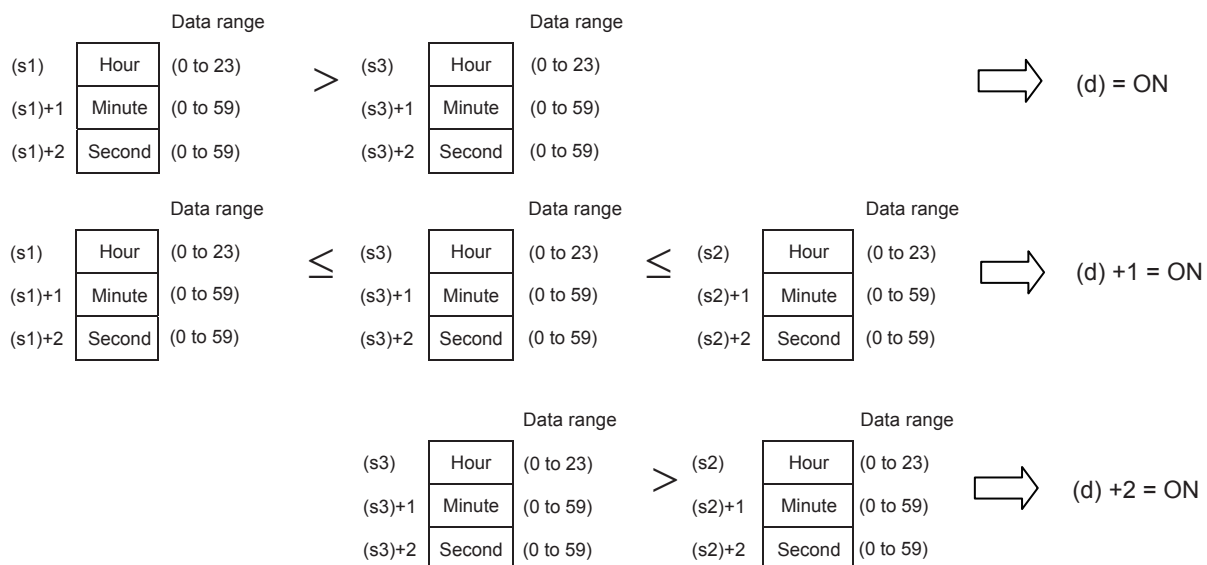
Operand	Description	Range	Data type	Data type (label)
(s1)	Specify the lower limit of time comparison (hour, minute, and second).	—	16-bit signed binary	ANY16
(s2)	Specify the upper limit of time comparison (hour, minute, and second).	—	16-bit signed binary	ANY16
(s3)	Specify the time data (hour, minute, and second).	—	16-bit signed binary	ANY16
(d)	Specify the Bit device that turns on/off depending on the comparison result	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○	○	—	—	—	○	—	—	—	—
(s2)	—	—	—	○	○	—	—	—	○	—	—	—	—
(s3)	—	—	—	○	○	—	—	—	○	—	—	—	—
(d)	○	—	—	○	—	—	—	—	—	—	—	—	—

Processing details

- This instruction compares two comparison time (comparison time zone) specified by (s1) and (s2) with the time data specified by (s3), and turns on or off the specified bit devices (d) according to the comparison results.



- Even if the command contact turns off from on and the TZCP instruction is not executed, (d), (d)+1, and (d)+2 hold the status before the command contact turned off.

Precautions

- Three devices are occupied by (s1), (s2), (s3), and (d). Make sure that these devices are not used by other machine controls.
- When the time (hour, minute, second) of the clock data of the real time clock built in the CPU module is used, read the values of special registers by the TRD instruction, and then specify those word devices as the operands.
- Make $(s1) \leq (s2)$.

Operation error

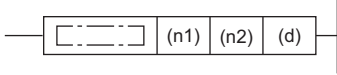
Error code (SD0/SD8067)	Description
2820	The device range specified exceeds the corresponding device range.
3405	The value specified by (s1), (s2), and (s3) is outside the following range. 0 to 23
	The value specified by (s1)+1, (s2)+1, (s3)+1, (s1)+2, (s2)+2, and (s3)+2 is outside the following range. 0 to 59

7.20 Timing check instruction

Generating timing pulses

DUTY

This instruction sets user timing clock output destinations (SM420 to SM424 and SM8330 to SM8334) specified by (d) to on for the number of scans specified by (n1) and to off for the number of scans specified by (n2).

Ladder diagram	Structured text
	ENO:=DUTY(EN,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(n1)	Number of scans to be turned on	0 to 65535	16-bit unsigned binary	ANY16
(n2)	Number of scans to be turned off	0 to 65535	16-bit unsigned binary	ANY16
(d)	Special relay of the timing clock output destination	(SM420 to SM424, SM8330 to SM8334)	Bit	Bit

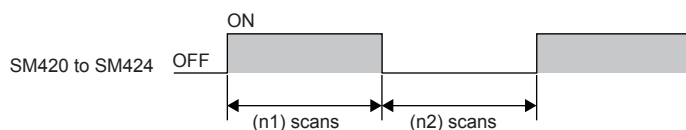
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○*1	—	—	—	—	—	—	—	—	—	—	—	—

*1 Only SM can be used.

Processing details

- This instruction sets user timing clock output destinations (SM420 to SM424 and SM8330 to SM8334) specified by (d) to on for the number of scans specified by (n1) and to off for the number of scans specified by (n2).



- Specify SM420 to SM424 (SM8330 to SM8334) in the special relay of the timing clock output destination specified by (d).
- In SM420 to SM424 (SM8330 to SM8334), when one device is turned on, another device is also turned on at the same time.
- The counted number of scans is stored among SD8330 to SD8334 in accordance with the special relay of the timing clock output destination specified by (d).
- The counted number of scans stored among SD8330 to SD8334 is reset when the counted value reaches "(n1)+(n2)" or when the command input (instruction) is set to on.

Special relay (d) for outputting the timing clock	Scan counting device
SM420(SM8330)	SD8330
SM421(SM8331)	SD8331
SM422(SM8332)	SD8332
SM423(SM8333)	SD8333
SM424(SM8334)	SD8334

- When the command input is set to ON, the operation is started. The special relay of the timing clock output destination is set to ON or OFF by the END instruction. Even if the command input is set to OFF, the operation is not stopped. In the STOP mode, the operation is stopped. When the power to the CPU module is turned OFF, the operation is stopped.
- When (n1) and (n2) are set to "0", the status is as shown below:

Status of (n1) and (n2)	ON/OFF status of (d)
(n1)=0, (n2)≥0	(d)= Fixed to OFF
(n1)>0, (n2)=0	(d)= Fixed to ON

- The table below shows the related devices.

Special relay	Name	Description
SM420(SM8330)	Timing clock output 1	Timing clock output in the DUTY instruction
SM421(SM8331)	Timing clock output 2	
SM422(SM8332)	Timing clock output 3	
SM423(SM8333)	Timing clock output 4	
SM424(SM8334)	Timing clock output 5	

Special register	Name	Description
SD8330	Counted number of scans for timing clock output 1	Counted number of scans for timing clock output 1 in the DUTY instruction
SD8331	Counted number of scans for timing clock output 2	Counted number of scans for timing clock output 2 in the DUTY instruction
SD8332	Counted number of scans for timing clock output 3	Counted number of scans for timing clock output 3 in the DUTY instruction
SD8333	Counted number of scans for timing clock output 4	Counted number of scans for timing clock output 4 in the DUTY instruction
SD8334	Counted number of scans for timing clock output 5	Counted number of scans for timing clock output 5 in the DUTY instruction

Precautions

- The DUTY instruction can be used up to 5 times (points). It is not permitted, however, to use the same timing clock output destination device for two or more DUTY instructions.

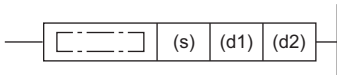
Operation error

Error code (SD0/SD8067)	Description
2820	The device specified by (d) is out of the range from SM420 to SM424 (SM8330 to SM8334).

Hour meter

HOURLM

This instruction measures the on time of the input contact in units of hour.

Ladder diagram	Structured text
	ENO:=HOURLM(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Time after which the alarm (d2) is set to on (unit: hour)	—	16-bit signed binary	ANY16
(d1)	Device for storing the measured current value (latched (battery backed) type data register)	—	16-bit signed binary	ANY16
(d2)	Device to be turned on when timeout occurs (alarm output)	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d2)	○	—	—	○	—	—	—	—	—	—	—	—	—

7

Processing details

- This instruction measures the period of time for which the input contact is on in units of hour, and turns on the device specified by (d2) when the accumulated ON time exceeds the time (16-bit binary data) specified in (s).
- In (s), specify the period of time until the device specified by (d2) is turned on in units of hour.
- The measured current value in units of hour is stored in (d1).
- The measured current value of less than one hour (in units of second) is stored in (d1)+1.
- (d2) is set to on when the current value in (d1) exceeds the time specified by (s).
- Specify a latched (battery backed) type data register as (d1) so that the current value data can be continuously used even after the power to CPU module turns off. If a general data type register is used, the current value data is cleared when the power to the CPU module is turned OFF or when the controller mode switches from STOP to RUN.
- Even after the alarm output specified by (d2) turns ON, the measurement is continued.
- When the current value reaches the maximum value of 16-bit data, the measurement is stopped. For continuing the measurement, clear the current value stored in (d1) to (d1)+1.

Precautions

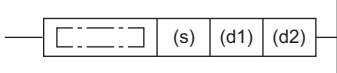
- Two devices are occupied by (d1). Make sure that these devices are not used by other machine controls.

Operation error

Error code (SD0/SD8067)	Description
2820	The device areas specified by (d1) exceed the corresponding device range.
3405	The value of (s) is negative.

DHOURM

This instruction measures the on time of the input contact in units of hour.

Ladder diagram	Structured text
	ENO:=DHOURM(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Time after which the alarm (d2) is set to on (unit: hour)	—	32-bit signed binary	ANY32
(d1)	Device for storing the measured current value (latched (battery backed) type data register)	—	32-bit signed binary	ANY32
(d2)	Device to be turned on when timeout occurs (alarm output)	—	Bit	Bit

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d2)	○	—	—	○	—	—	—	—	—	—	—	—	—

Processing details

- This instruction measures the period of time for which the input contact is on in units of hour, and turns on the device specified by (d2) when the accumulated ON time exceeds the time (32-bit binary data) specified in (s).
- In (s)+1 and (s), specify the period of time until the device specified by (d2) is turned on in units of hour.
- The measured current value in units of hour is stored in (d1)+1 and (d1). ((d1)+1: highest-order, (d1): lowest-order)
- The measured current value of less than one hour (in units of second) is stored in (d1)+2.
- (d2) is set to on when the current value in (d1)+1 and (d1) exceeds the time specified by (s).
- Specify a latched (battery backed) type data register as (d1) so that the current value data can be continuously used even after the power to CPU module turns off. If a general data type register is used, the current value data is cleared when the power to the CPU module is turned OFF or when the controller mode switches from STOP to RUN.
- Even after the alarm output specified by (d2) turns ON, the measurement is continued.
- When the current value reaches the maximum value of 32-bit data, the measurement is stopped. For continuing the measurement, clear the current value stored in (d1) to (d1)+2.

Precautions

- Three devices are occupied by (d1). Make sure that these devices are not used by other machine controls.

Operation error

Error code (SD0/SD8067)	Description
2820	The device areas specified by (d1) exceed the corresponding device range.
3405	The value of (s) is negative.

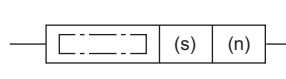
7.21 Module access instruction

I/O refresh

REF(P)/RFS(P)

These instructions refresh the (n) points of devices starting from the device specified by (s), and receive an external input or generate an output.

The REF(P) instructions can also be used as RFS(P).

Ladder diagram	Structured text
	<pre>ENO:=REF(EN,s,n); ENO:=REFP(EN,s,n);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number to be refreshed	—	Bit	Bit
(n)	Number of devices to be refreshed	0 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

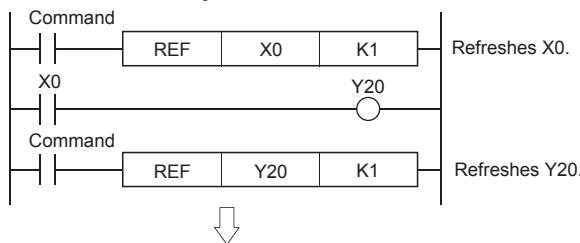
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○*1	—	—	—	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only X and Y can be used.

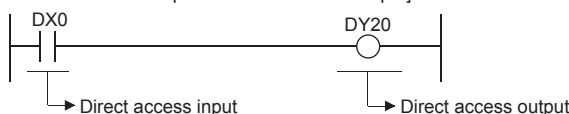
Processing details

- This function refreshes only the corresponding devices in the middle of a scan and receives an external input or generates an output.
- Since the input receptions and external outputs are performed at one time only after the END instruction is executed in the program, a pulse signal cannot be output externally in the middle of a scan. The execution of the I/O refresh instruction forcibly refreshes the corresponding input (X) or output (Y) in the middle of program execution, and then a pulse signal can be output externally in the middle of a scan.
- To refresh an input (X) or an output (Y) in 1 point units, use the direct access input (DX) or the direct access output (DY).

[Program based on the REF instruction]



[Program based on direct access input and direct access output]



Operation error

Error code (SD0/SD8067)	Description
2820	The (n) points of device range starting from the device specified by (s) exceed the range of proximal I/O.

Reading 1-word/2-word data from another module

FROM(P), DFROM(P)

- FROM(P)

These instructions read (n) words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later (d).

- DFROM(P)

These instructions read the (n) × 2 words of data from the buffer memory specified by (s) intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.

Ladder diagram	Structured text
	ENO:=FROM(EN,UnHn,s,n,d); ENO:=FROMP(EN,UnHn,s,n,d); ENO:=DFROM(EN,UnHn,s,n,d); ENO:=DFROMP(EN,UnHn,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U/H)	Unit number	H1 to H10	16-bit unsigned binary	ANY16
(s)	Start address of the buffer memory where the read-target data is stored	0 to 65535	16-bit unsigned binary	ANY16
(d)	FROM(P) DFROM(P)	—	16-bit signed binary	ANY16
			32-bit signed binary	ANY32
(n)	Number of read data	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

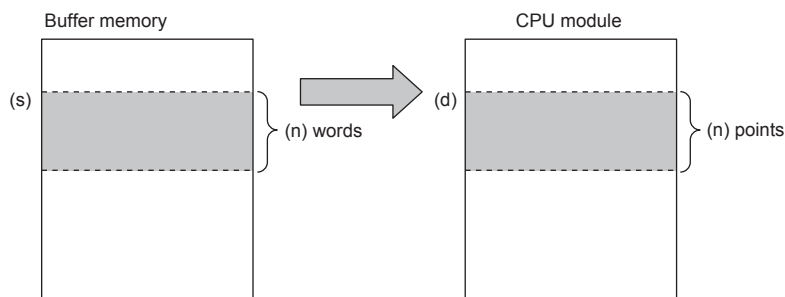
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U/H)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	—	○	○ ^{*1}	○ ^{*1}	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only the DFROM(P) instruction can be used.

Processing details

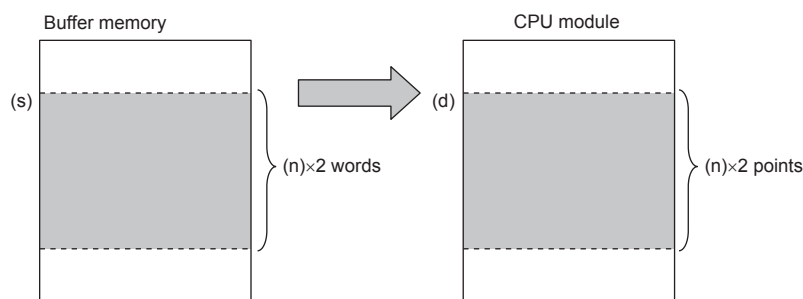
■FROM(P)

- These instructions read (n) words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.



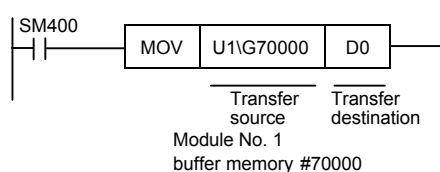
■DFROM(P)

- These instructions read the $(n) \times 2$ words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.



Precautions

- For the nibble of a bit device specified by (d), specify K1 to K4 in the FROM(P) instruction and K1 to K8 in the DFROM(P) instruction.
- When a number greater than 65535 is specified as the buffer memory specified by (s), use the FROMD(P) instruction or use $U\Box\backslash G\Box$ in the MOV(P) instruction. The following shows the program to transfer the buffer memory #70000 in the intelligent function module No. 1 to D0.



Operation error

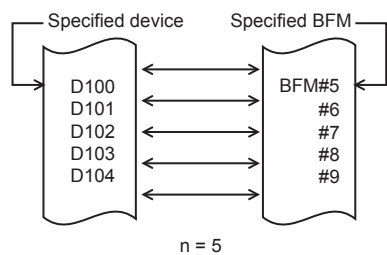
Error code (SD0/SD8067)	Description
2441	Updating procedure with the unit was not properly completed during the execution of the instruction.
2801	The unit number specified by (U/H) does not exist.
2823	The buffer memory number specified by (s) exceeds the buffer memory area. The buffer memory number specified by (s) + the number of transfer points specified by (n) exceeds the buffer memory area.
2820	The device number specified by (d) + the number of read data specified by (n) exceeds the corresponding device range.
3056	Timeout occurred while communicating with the connected units during the execution of the instruction.
3060	Signal error is detected while accessing the connected units during the execution of the instruction.
3580	The instruction that is disabled in the interrupt routine program is used.

Common items among the FROM(P), DFROM(P), TO(P), and DTO(P) (details)

- Use the module number to specify which Intelligent function module the instruction works for. The setting range is from H1 to H10 (K1 to K16).

		Module No. 1		Module No. 2		Module No. 3		Module No. 4	Module No. 5
CPU module	I/O module	Intelligent function module	Extension power supply unit	Intelligent function module	I/O module	Intelligent function module	Bus conversion module	Intelligent function module	

- A module number is automatically assigned to each intelligent function module connected to a CPU module. The module number is assigned in the way "No. 1 → No. 2 → No. 3 ..." starting from the equipment nearest the CPU module.
- 16-bit RAM memories are built in an intelligent function module, and they are called buffer memories. The contents of buffer memories vary depending on the purpose of control of each Intelligent function module, and the setting range is from K0 to K65535.
- The number of read data is specified by (n), and the setting range is from K1 to K65535.



Writing 1-word/2-word data to another module

TO(P), DTO(P)

• TO(P)

These instructions write the (n) points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).

• DTO(P)

These instructions write the (n) × 2 points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).

Ladder diagram	Structured text
	ENO:=TO(EN,m1,m2,s,n); ENO:=TOP(EN,m1,m2,s,n); ENO:=DTO(EN,m1,m2,s,n); ENO:=DTOP(EN,m1,m2,s,n);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U/H)	Unit number	H1 to H10	16-bit unsigned binary	ANY16
(s1)	Start address of the buffer memory for writing the data	0 to 65535	16-bit unsigned binary	ANY16
(s2)	Write data, or head device number which stores the write data	—	16-bit signed binary	ANY16
		—	32-bit signed binary	ANY32
(n)	Number of write data	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

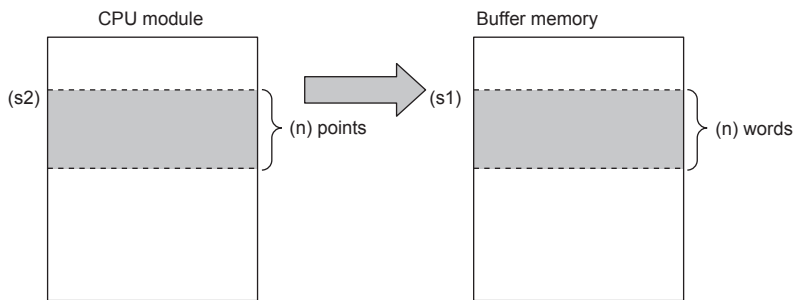
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U/H)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	—	○	○ ^{*1}	○ ^{*1}	○	○	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only the DTO(P) instruction can be used.

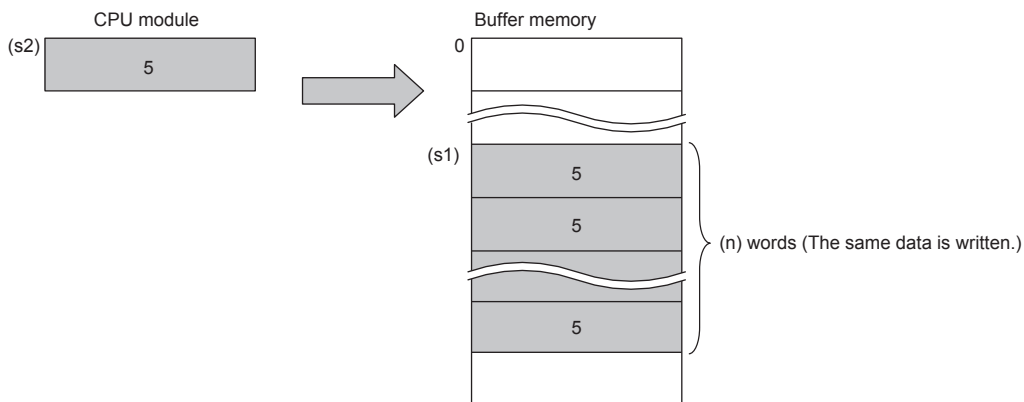
Processing details

■TO(P)

- These instructions write the (n) points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).

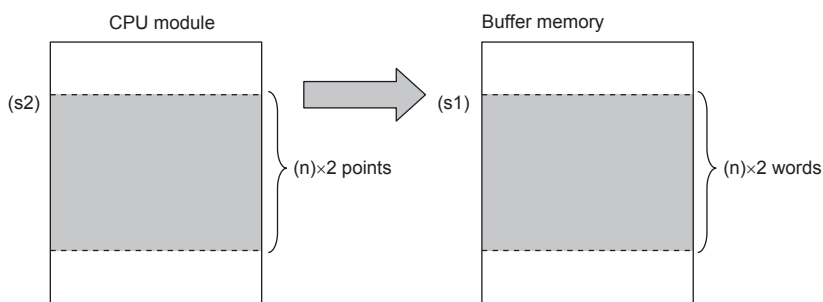


- When a constant is specified in (s2), (n) words of the same data (the value specified by (s2)) is written starting from the specified buffer memory address.

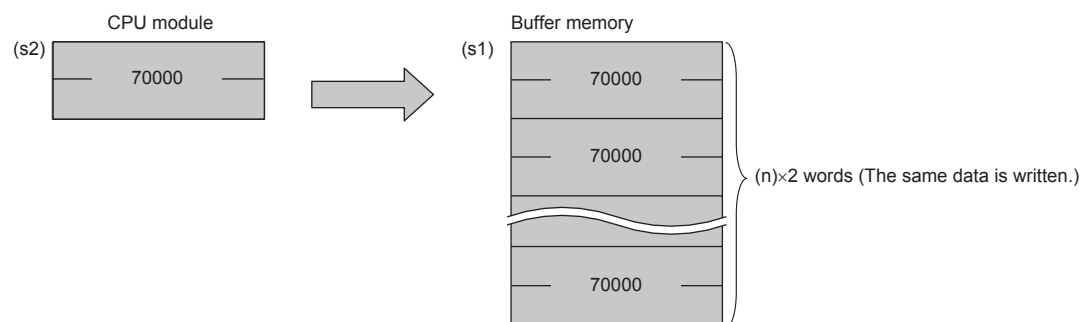


■ DTO(P)

- These instructions write the $(n) \times 2$ points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).



- When a constant is specified in (s2), $(n) \times 2$ words of the same data (the value specified by (s2)) is written starting from the specified buffer memory address.



Precautions

- For the nibble of a bit device specified by (s2), specify K1 to K4 in the TO(P) instruction and K1 to K8 in the DTO(P) instruction.
- When a number greater than 65535 is specified as the buffer memory specified by (s1), use the TOD(P) instruction or use U\G in the MOV(P) instruction.

Operation error

Error code (SD0/SD8067)	Description
2441	Updating procedure with the unit was not properly completed during the execution of the instruction.
2801	The unit number specified by (U/H) does not exist.
2823	The buffer memory number specified by (s1) exceeds the buffer memory area. The buffer memory number specified by (s1) + the number of transfer points specified by (n) exceeds the buffer memory area.
2820	The device number specified by (s2) + the number of write data specified by (n) exceeds the corresponding device range.
3056	Timeout occurred while communicating with the connected units during the execution of the instruction.
3060	Signal error is detected while accessing the connected units during the execution of the instruction.
3580	The instruction that is disabled in the interrupt routine program is used.

Reading 1-word/2-word data from another module

FROMD(P), DFROD(P)

- FROMD(P)

These instructions read (n) words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.

- DFROD(P)/DFROD(P)

These instructions read the (n) × 2 words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.

Ladder diagram	Structured text
	<pre>ENO:=FROMD(EN,UnHn,s,n,d); ENO:=FROMDP(EN,UnHn,s,n,d); ENO:=DFROD(EN,UnHn,s,n,d); ENO:=DFRODP(EN,UnHn,s,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U/H)	Unit number	H1 to H10	16-bit unsigned binary	ANY16
(s)	Start address of the buffer memory where the read-target data is stored	0 to 4294967295	32-bit unsigned binary	ANY32
(d)	Head device number for storing the read data	—	16-bit signed binary	ANY16
			32-bit signed binary	ANY32
(n)	Number of read data	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

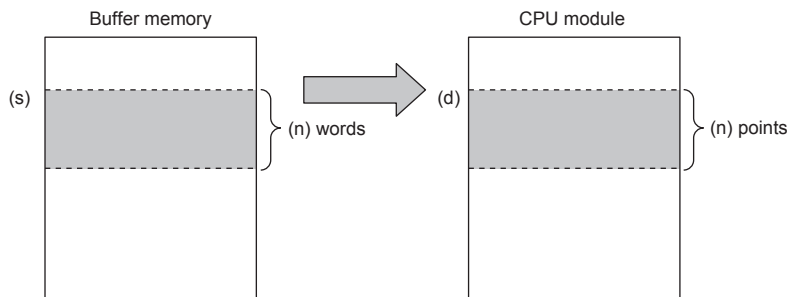
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U/H)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	—	○	○ ^{*1}	○ ^{*1}	○	—	—	—	—
(n)	○	—	—	○	○	○	○	○	○	○	—	—	—

*1 Only the DFROD(P) instruction can be used.

Processing details

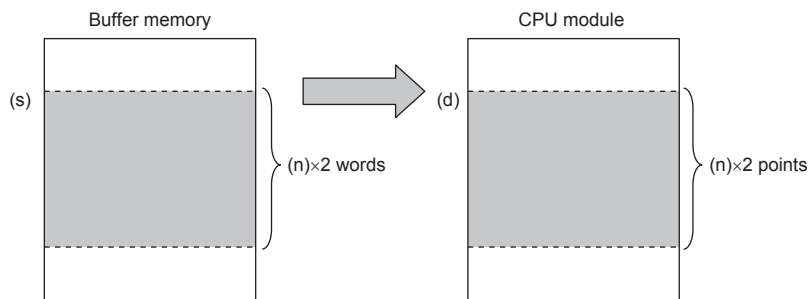
■FROMD(P)

- These instructions read (n) words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.



■DFROD(P)

- These instructions read the $(n) \times 2$ words of data from the buffer memory specified by (s) in intelligent function module specified by (U/H), and store the data to the device specified by (d) and later.



Precautions

- For the nibble of a bit device specified by (d), specify K1 to K4 in the FROMD(P) instruction and K1 to K8 in the DFROD(P) instruction.

Operation error

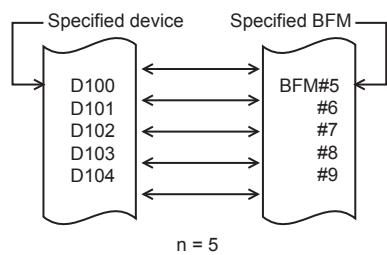
Error code (SD0/SD8067)	Description
2441	Updating procedure with the unit was not properly completed during the execution of the instruction.
2801	The unit number specified by (U/H) does not exist.
2823	The buffer memory number specified by (s) exceeds the buffer memory area. The buffer memory number specified by (s) + the number of transfer points specified by (n) exceeds the buffer memory area.
2820	The device number specified by (d) + the number of read data specified by (n) exceeds the corresponding device range.
3056	Timeout occurred while communicating with the connected units during the execution of the instruction.
3060	Signal error is detected while accessing the connected units during the execution of the instruction.
3580	The instruction that is disabled in the interrupt routine program is used.

Common items among the FROMD(P), DFROD(P), TOD(P), and DTOD(P) (details)

- Use the module number to specify which intelligent function module the instruction works for. The setting range is from H1 to H10 (K1 to K16).

		Module No. 1		Module No. 2		Module No. 3	Module No. 4	Module No. 5
CPU module	I/O module	Intelligent function module	Extension power supply unit	Intelligent function module	I/O module	Intelligent function module	Bus conversion module	Intelligent function module

- A module number is automatically assigned to each intelligent function module connected to a CPU module. The module number is assigned in the way "No. 1 → No. 2 → No. 3 ..." starting from the equipment nearest the CPU module.
- 16-bit RAM memories are built in an intelligent function module, and they are called buffer memories. The contents of buffer memories vary depending on the purpose of control of each intelligent function module, and the setting range is from K0 to K4294967295.
- The number of read data is specified by (n), and the setting range is from K1 to K65535.



Writing 1-word/2-word data to another module (32-bit specification)

TOD(P), DTOD(P)

• TOD(P)

These instructions write the (n) points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).

• DTOD(P)

These instructions write the (n) × 2 points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).

Ladder diagram	Structured text
	ENO:=TOD(EN,UnHn,s1,s2,n); ENO:=TODP(EN,UnHn,s1,s2,n); ENO:=DTOD(EN,UnHn,s1,s2,n); ENO:=DTODP(EN,UnHn,s1,s2,n);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U/H)	Unit number	H1 to H10	16-bit unsigned binary	ANY16
(s1)	Start address of the buffer memory for writing the data	0 to 4294967295	32-bit unsigned binary	ANY32
(s2)	TOD(P)	—	16-bit signed binary	ANY16
	DTOD(P)	—	32-bit signed binary	ANY32
(n)	Number of write data	1 to 65535	16-bit unsigned binary	ANY16

■Applicable devices

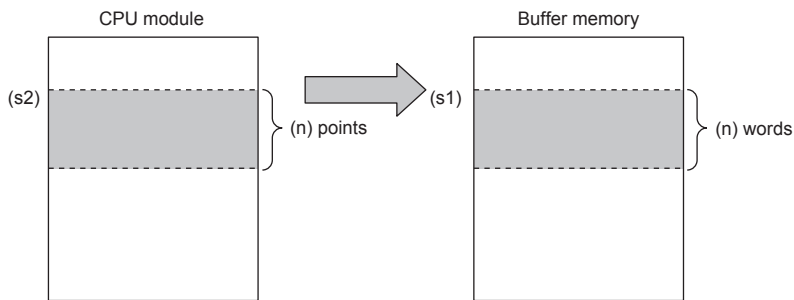
Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U/H)	○	—	—	○	○	○	—	—	○	○	—	—	○
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	—	○	○*1	○*1	○	○	—	—	—
(n)	○	—	—	○	○	○	○	○	○	○	—	—	—

*1 Only the DTOD(P) instruction can be used.

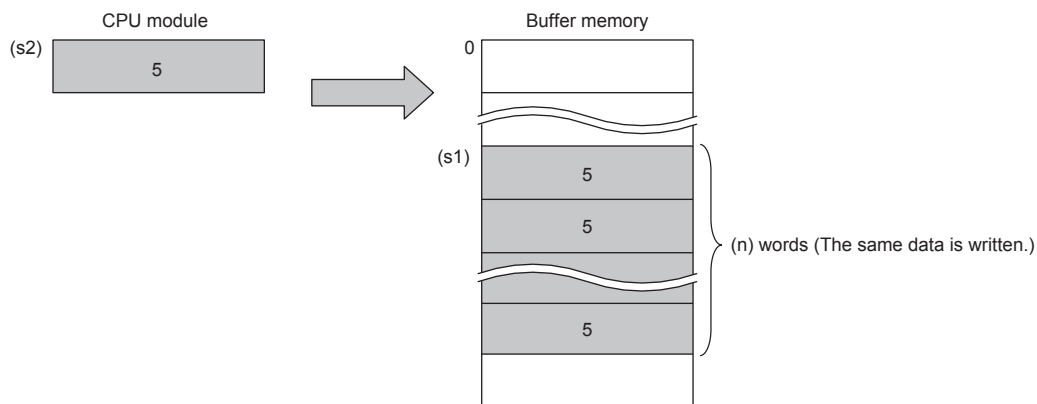
Processing details

■TOD(P)

- These instructions write the (n) points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).

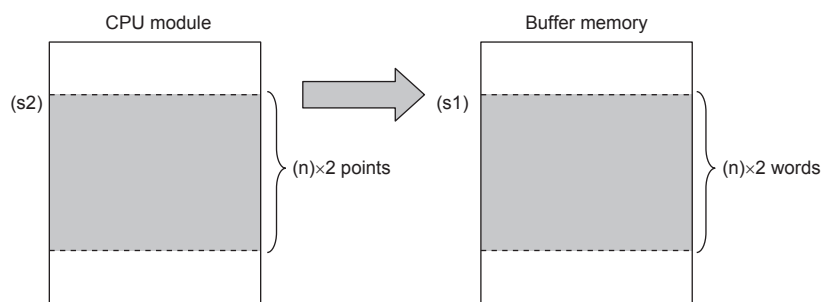


- When a constant is specified in (s2), (n) words of the same data (the value specified by (s2)) is written starting from the specified buffer memory address.

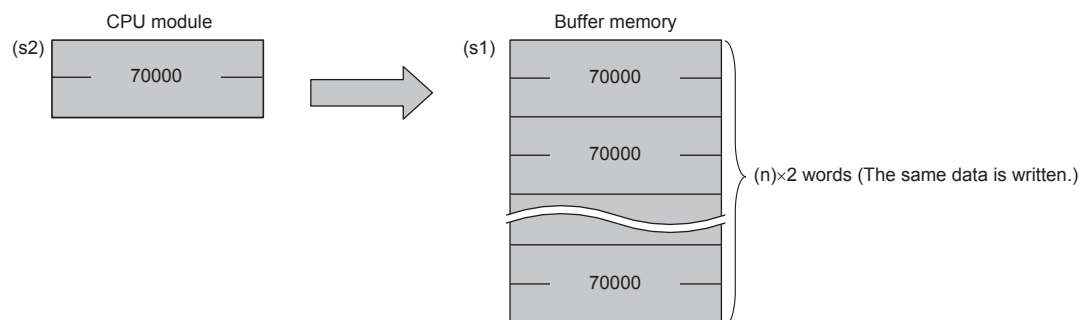


■DTOD(P)

- These instructions write the $(n) \times 2$ points of data in the device starting from the one specified by (s2) to the buffer memory address specified by (s1) in intelligent function module specified by (U/H).



- When a constant is specified in (s2), $(n) \times 2$ words of the same data (the value specified by (s2)) is written starting from the specified buffer memory address.



Precautions

- For the nibble of a bit device specified by (s2), specify K1 to K4 in the TOD(P) instruction and K1 to K8 in the DTOD(P) instruction.

Operation error

Error code (SD0/SD8067)	Description
2441	Updating procedure with the unit was not properly completed during the execution of the instruction.
2801	The unit number specified by (U/H) does not exist.
2823	The buffer memory number specified by (s1) exceeds the buffer memory area. The buffer memory number specified by (s1) + the number of transfer points specified by (n) exceeds the buffer memory area.
2820	The device number specified by (s2) + the number of write data specified by (n) exceeds the corresponding device range.
3056	Timeout occurred while communicating with the connected units during the execution of the instruction.
3060	Signal error is detected while accessing the connected units during the execution of the instruction.
3580	The instruction that is disabled in the interrupt routine program is used.

8 BUILT-IN ETHERNET FUNCTION INSTRUCTIONS

8.1 Open/Close Processing Instructions

Opening a connection

SP.SOCOPEN

This instruction opens a connection.

Ladder diagram	Structured text
	ENO:=SP_SOCOPEN(EN,U,s1,s2,d);

Setting data

■Descriptions, ranges, and data types


Operand	Description	Range	Data type	Data type (label)
(U)	Dummy	—	Character string	ANYSTRING_SINGLE
(s1)	Connection number	1 to 8	16-bit unsigned binary	ANY16
(s2)	Head device number for storing the control data	Refer to Control data (Page 620)	Word	ANY16_ARRAY (Number of elements: 10)
(d)	Head device number which turns ON when the execution of the instruction is completed and remains ON for 1 scan. If the instruction is completed with an error, (d)+1 is also turned on.	—	Bit	ANYBIT_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U)	—	—	—	—	—	—	—	—	—	—	—	○	—
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

■Control data

Device	Item	Description	Setting range	Set by ^{*1}						
(s2)+0	Execution type/ completion type	Specify whether to use the parameter value set using the engineering tool or to use the set values of the control data (s2)+2 to (s2)+9 during the open processing of the connection. 0000H: The open processing is performed with the settings configured using "External Device Configuration" of the engineering tool. 8000H: The open processing is performed with the set values of the control data (s2)+2 to (s2)+9.	0000H 8000H	User						
(s2)+1	Completion status	The status at the completion of the instruction is stored. 0000H: Completed successfully Other than 0000H: Completed with an error (error code) For error codes, refer to  Built-in Ethernet communication manual.	—	System						
(s2)+2	Application setting area	<div style="text-align: center;">b15b14 b13 to b11 b10 b9 b8 b7 to b0 (s2)+2 <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="width: 20px; text-align: center;">[4]</td><td style="width: 20px; text-align: center;">0</td><td style="width: 20px; text-align: center;">[3]</td><td style="width: 20px; text-align: center;">[2]</td><td style="width: 20px; text-align: center;">[1]</td><td style="width: 20px; text-align: center;">0</td></tr></table></div> [1] Communication method (protocol) 0: TCP/IP 1: UDP/IP [2] Means for communication 1: Use the socket communication function (fixed) [3] 0 (fixed) [4] Open method 00: Active open or UDP/IP 10: Unpassive open 11: Fullpassive open	[4]	0	[3]	[2]	[1]	0	As shown on the left	User
[4]	0	[3]	[2]	[1]	0					
(s2)+3	Host station port number	Specify the host station port number.	0001H to 15ACH, 15C2H to FFFE ^H *3							
(s2)+4 (s2)+5	Target device IP address*2	Specify the IP address of the target device.	00000001H to DFFFFFFEH (FFFFFFFH: Simultaneous broadcast)							
(s2)+6	Target device port number*2	Specify the port number of the target device.	0001H to FFFFH (FFFFH: Simultaneous broadcast)							
(s2)+7 to (s2)+9	—	Use prohibited	—	System						

*1 The contents in the "Set by" column mean as follows:

User: Data to be set before the execution of the SP.SOCOPEN instruction

System: The CPU module stores the execution result of the SP.SOCOPEN instruction.

*2 When Unpassive open is selected, the target device IP address and target device port number are ignored.

*3 Of the host station port numbers, 0001H to 03FFH are generally reserved port numbers and F000H to FFFE^H are used by other communication functions. Thus, using 0400H to 15ACH and 15C2H to EFFFH as the port numbers is recommended. Do not specify 15ADH to 15C1H since they are used by the system.

Processing details

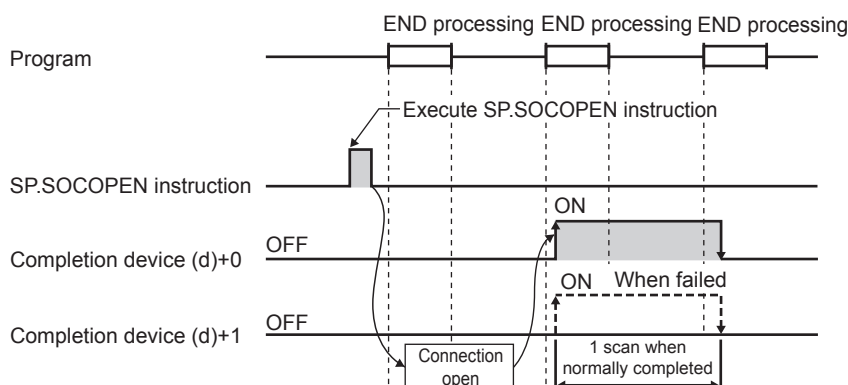
This instruction performs the open processing for the connection specified by (s1).

The setting value used by the open processing is selected by (s2)+0.

The completion of the SP.SOCOPEN instruction can be checked using the completion devices (d)+0 and (d)+1.

- Completion device (d)+0: Turns ON during the END processing for the scan in which the SP.SOCOPEN instruction is completed, and turns OFF during the next END processing.
- Completion device (d)+1: Turns ON or OFF depending on the status of when the SP.SOCOPEN instruction is completed.

Status	Description
When completed normally	The device does not change (remains OFF).
When completed with an error	The device turns ON during the END processing for the scan in which the SP.SOCOPEN instruction is completed, and turns OFF during the next END processing.



- The connection in which no protocol is set with the parameter can be opened and used. In this case, specify 8000H in (s2)+0 and the contents of the open processing in (s2)+2 to (s2)+9.

For details, refer to Built-in Ethernet communication manual.

Operation error

Error code (SD0/SD8067)	Description
3405	The connection number specified by (s1) is other than 1 to 8.
2820	The device number specified by (s2) or (d) is outside the range of the number of device points.
2822	Device that cannot be specified is specified.
3582	When an instruction which cannot be used in interruption routine program is used.

Closing a connection

SP.SOCCLOSE

This instruction closes a connection.

Ladder diagram	Structured text
	<pre>ENO:=SP_SOCCLOSE(EN,U,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U)	Dummy	—	Character string	ANYSTRING_SINGLE
(s1)	Connection number	1 to 8	16-bit unsigned binary	ANY16
(s2)	Head device number for storing the control data	Refer to Control data (Page 622)	Word	ANY16_ARRAY (Number of elements: 2)
(d)	Head device number which turns on when the execution of the instruction is completed and remains on for 1 scan. If the instruction is completed with an error, (d)+1 is also turned on.	—	Bit	ANYBIT_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U)	—	—	—	—	—	—	—	—	—	—	—	○	—
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

■Control data

Device	Item	Description	Setting range	Set by ^{*1}
(s2)+0	System area	—	—	—
(s2)+1	Completion status	The status at the completion of the instruction is stored. 0000H: Completed successfully Other than 0000H: Completed with an error (error code) For error codes, refer to Built-in Ethernet communication manual .	—	System

*1 The contents in the "Set by" column mean as follows:
System: The CPU module stores the execution result of the SP.SOCCLOSE instruction.

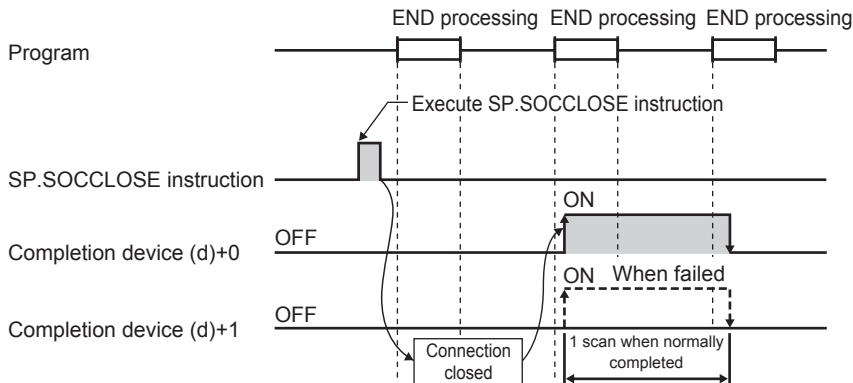
Processing details

This instruction performs the close processing for the connection specified by (s1). (Connection disconnection)

The completion of the SP.SOCCLOSE instruction can be checked using the completion devices (d)+0 and (d)+1.

- Completion device (d)+0: Turns ON during the END processing for the scan in which the SP.SOCCLOSE instruction is completed, and turns OFF during the next END processing.
- Completion device (d)+1: Turns ON or OFF depending on the status when the SP.SOCCLOSE instruction is completed.

Status	Description
When completed normally	The device does not change (remains OFF).
When completed with an error	The device turns ON during the END processing for the scan in which the SP.SOCCLOSE instruction is completed, and turns OFF during the next END processing.



For details, refer to Built-in Ethernet communication manual.

Operation error

Error code (SD0/SD8067)	Description
3405	The connection number specified by (s1) is other than 1 to 8.
2820	The device number specified by (s2) or (d) is outside the range of the number of device points.
2822	Device that cannot be specified is specified.
3582	When an instruction which cannot be used in interruption routine program is used.

Point

Do not execute the SP.SOCCLOSE instruction when Passive open is selected. Since the open completion signal and open request signal of the corresponding connection turn OFF and close processing is executed, the communication is disabled.

8.2 Socket Communications Function Instructions

Reading receive data during the END processing

SP.SOCRCV

This instruction reads the receive data. (Reading during END processing)

Ladder diagram	Structured text
	ENO:=SP_SOCRCV(EN,U,s1,s2,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U)	Dummy	—	Character string	ANYSTRING_SINGLE
(s1)	Connection number	1 to 8	16-bit unsigned binary	ANY16
(s2)	Head device number for specifying the control data	Refer to Control data (Page 624)	Word	ANY16_ARRAY (Number of elements: 2)
(d1)	Head device number for storing the receive data	—	Word	ANY16
(d2)	Head device number which turns ON when the execution of the instruction is completed and remains ON for 1 scan. If the instruction is completed with an error, (d2)+1 is also turned on.	—	Bit	ANYBIT_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U)	—	—	—	—	—	—	—	—	—	—	—	○	—
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d1)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

■Control data

Device	Item	Description	Setting range	Set by*1
(s2)+0	System area	—	—	—
(s2)+1	Completion status	The status at the completion of the instruction is stored. 0000H: Completed successfully Other than 0000H: Completed with an error (error code) For error codes, refer to Built-in Ethernet communication manual.	—	System
(d1)+0	Receive data length	The data length of the data read from the socket communication receive data area is stored. (Number of bytes)	0 to 2046	System
(d1)+1 to (d1)+n	Receive data	The data read from the socket communication receive data area is sequentially stored.	—	System

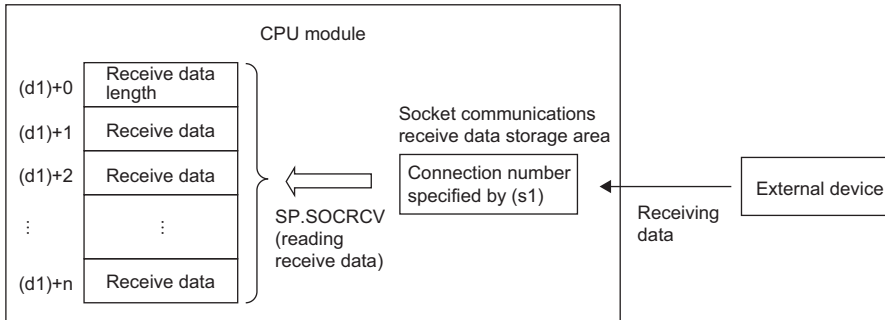
*1 The contents in the "Set by" column mean as follows:

System: The CPU module stores the execution result of the SP.SOCRCV instruction.

- When the SP.SOCRCV instruction is executed, reading data from the socket communication receive data area is executed with the END processing. Thus, executing the SP.SOCRCV instruction extends the scan time.
- When the data of odd-number of bytes is received, invalid data is stored in the higher byte of the device where the last receive data is stored.

Processing details

In the END processing after the execution of the SP.SOCRCV instruction, the receive data of the connection specified by (s1) is read from the socket communication receive data area.

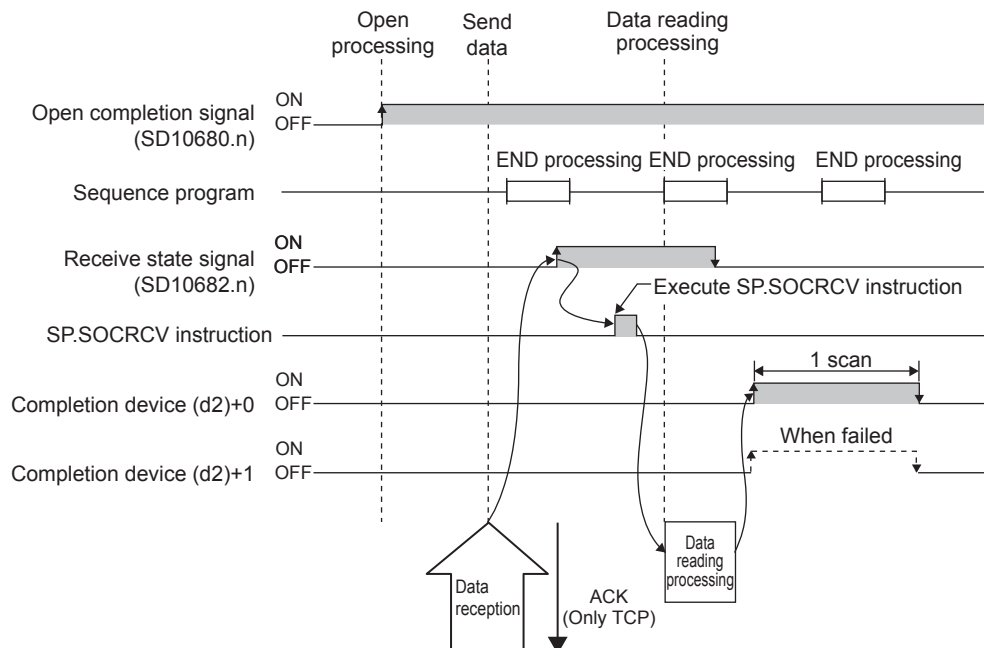


The completion of the SP.SOCRCV instruction can be checked using the completion devices (d2)+0 and (d2)+1.

- Completion device (d2)+0: Turns ON during the END processing for the scan in which the SP.SOCRCV instruction is completed, and turns OFF during the next END processing.
- Completion device (d2)+1: Turns ON or OFF depending on the status when the SP.SOCRCV instruction is completed.

Status	Description
When completed normally	The device does not change (remains OFF).
When completed with an error	The device turns ON during the END processing for the scan in which the SP.SOCRCV instruction is completed, and turns OFF during the next END processing.

The following figure shows the timing of the receive processing with the SP.SOCRCV instruction.



For details, refer to Built-in Ethernet communication manual.

Operation error

Error code (SD0/SD8067)	Description
3405	The connection number specified by (s1) is other than 1 to 8.
2820	The size of the receive data exceeds the size of the receive data storage device.
	The device number specified by (s2), (d1), or (d2) is outside the range of the number of device points.
2822	Device that cannot be specified is specified.
3582	When an instruction which cannot be used in interruption routine program is used.

Sending data

SP.SOCSND

This instruction sends data.

Ladder diagram	Structured text
	<pre>ENO:=SP_SOCSND(EN,U,s1,s2,s3,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U)	Dummy	—	Character string	ANYSTRING_SINGLE
(s1)	Connection number	1 to 8	16-bit unsigned binary	ANY16
(s2)	Head device number for specifying the control data	Refer to Control data (Page 627)	Word	ANY16_ARRAY (Number of elements: 2)
(s3)	Head device number for storing the send data	—	Word	ANY16
(d)	Head device number which turns ON when the execution of the instruction is completed and remains on for 1 scan. If the instruction is completed with an error, (d)+1 is also turned on.	—	Bit	ANYBIT_ARRAY (Number of elements: 2)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U)	—	—	—	—	—	—	—	—	—	—	—	○	—
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(s3)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

■Control data

Device	Item	Description	Setting range	Set by*1
(s2)+0	System area	—	—	—
(s2)+1	Completion status	The status at the completion of the instruction is stored. 0000H: Completed successfully Other than 0000H: Completed with an error (error code) For error codes, refer to Built-in Ethernet communication manual.	—	System
(s3)+0	Send data length	Specifies the send data length. (Number of bytes)	1 to 2046	User
(s3)+1 to (s3)+n	Send data	Specifies the send data.	—	User

*1 The contents in the "Set by" column mean as follows:

User: Data to be set before the execution of the SP.SOCSND instruction

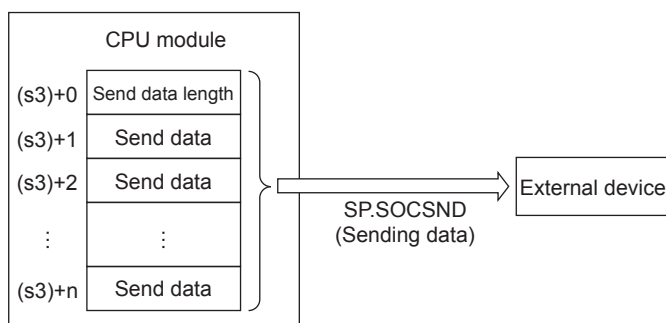
System: The CPU module stores the execution result of the SP.SOCSND instruction.

Point

When TCP is used, specify send data length that is smaller than the maximum window size of the target device (Receive data buffer of TCP). Data whose size exceeds the maximum window size of the target device cannot be sent.

Processing details

This instruction send the data set by (s3) to the target device of the connection specified by (s1).



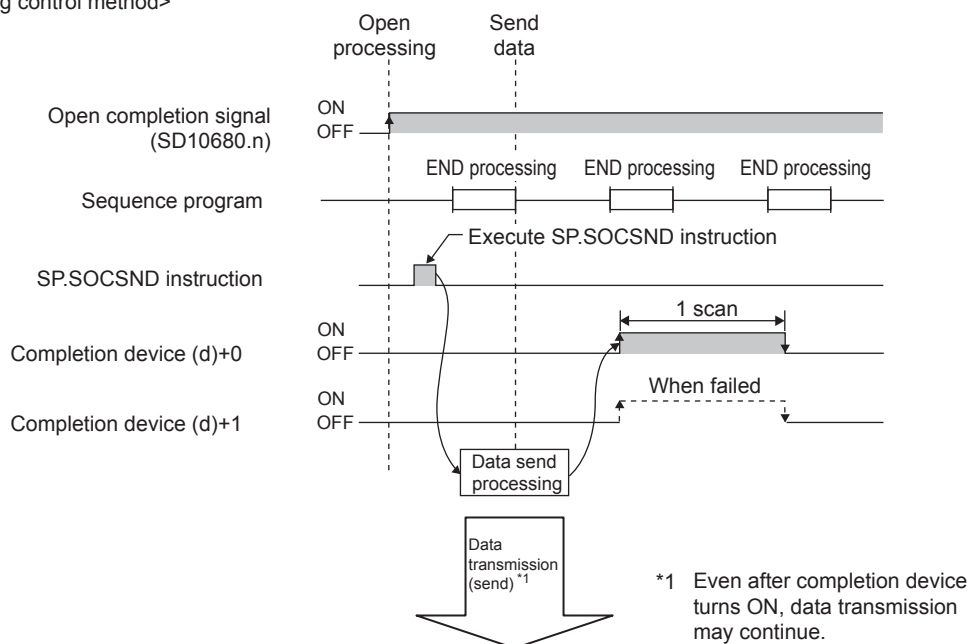
The completion of the SP.SOCSEND instruction can be checked using the completion devices (d)+0 and (d)+1.

- Completion device (d)+0: Turns ON during the END processing for the scan in which the SP.SOCSEND instruction is completed, and turns OFF during the next END processing.
- Completion device (d)+1: Turns ON or OFF depending on the status when the SP.SOCSEND instruction is completed.

Status	Description
When completed normally	The device does not change (remains OFF).
When completed with an error	The device turns ON during the END processing for the scan in which the SP.SOCSEND instruction is completed, and turns OFF during the next END processing.

The following figure shows the timing of the send processing with the SP.SOCSEND instruction.

<Sending control method>



For details, refer to Built-in Ethernet communication manual.

Operation error

Error code (SD0/SD8067)	Description
3405	The connection number specified by (s1) is other than 1 to 8.
2820	The device number specified by (s2), (s3), or (d) is outside the range of the number of device points.
2822	Device that cannot be specified is specified.
3582	When an instruction which cannot be used in interruption routine program is used.

Reading connection information

SP.SOCCINF

This instruction reads the connection information.

Ladder diagram	Structured text
	ENO:=SP_SOCCINF(EN,U,s1,s2,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U)	Dummy	—	Character string	ANYSTRING_SINGLE
(s1)	Connection number	1 to 8	16-bit unsigned binary	ANY16
(s2)	Head device number for storing the control data	Refer to Control data (Page 630)	Word	ANY16_ARRAY (Number of elements: 2)
(d)	Head device number for storing the connection information	—	Word	ANY16_ARRAY (Number of elements: 5)

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others (DY)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U)	—	—	—	—	—	—	—	—	—	—	—	○	—
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—

■Control data

Device	Item	Description	Setting range	Set by ^{*1}
(s2)+0	System area	—	—	—
(s2)+1	Completion status	The status at the completion of the instruction is stored. 0000H: Completed successfully Other than 0000H: Completed with an error (error code) For error codes, refer to Built-in Ethernet communication manual.	—	System
(d)+0 (d)+1	Target device IP address	The IP address of the target device is stored.	00000001H to DFFFFFFEH ^{*2}	System
(d)+2	Target device port number	The port number of the target device is stored.	0001H to FFFE ^{*2}	
(d)+3	Host station port number	The host station port number is stored.	0001H to 15ACH, 15C2H to FFFE ^{*2*3}	
(d)+4	Application setting area	<div style="text-align: center;"> b15b14b13 to b10 b9 b8 b7 to b0 (d)+4 [3] 0 [2][1] 0 </div> [1] Communication method (protocol) 0: TCP/IP 1: UDP/IP [2] Procedure of the socket communication function 1: Non-protocol method [3] Open method 00: Active open or UDP/IP 10: Unpassive open 11: Fullpassive open	As shown on the left ^{*2}	

*1 The contents in the "Set by" column mean as follows:

System: The CPU module stores the execution result of the SP.SOCCINF instruction.

*2 When the instruction is executed for a connection that is not open, 0H is returned.

*3 Of the host station port numbers, 0001H to 03FFH are generally reserved port numbers and F000H to FFFE^H are used by other communication functions. Thus, using 0400H to 15ACH and 15C2H to EFFF^H as the port numbers is recommended. Do not specify 15ADH to 15C1H since they are used by the system.

Processing details

This instruction reads the connection information of the connection specified by (s1).

For details, refer to Built-in Ethernet communication manual.

Operation error

Error code (SD0/SD8067)	Description
3405	The connection number specified by (s1) is other than 1 to 8.
2820	The device number specified by (s2) or (d) is outside the range of the number of device points.
2822	Device that cannot be specified is specified.

Reading socket communications receive data

S(P).SOCRDATA

This instruction reads the data in the socket communication receive data area.

Ladder diagram	Structured text
	<pre>ENO:=S_SOCRDATA(EN,U,s1,s2,n,d); ENO:=SP_SOCRDATA(EN,U,s1,s2,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(U)	Dummy	—	Character string	ANYSTRING_SINGLE
(s1)	Connection number	1 to 8	16-bit unsigned binary	ANY16
(s2)	Head device number for storing the control data	Refer to Control data (Page 631)	Word	ANY16_ARRAY (Number of elements: 2)
(d)	Head device number for storing the read data	—	Word	ANY16
(n)	Number of the read data (1 to 1024 words)	1 to 1024	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U)	—	—	—	—	—	—	—	—	—	—	—	○	—
(s1)	—	—	—	○	—	—	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	—	—	—	○	—	—	—	—
(d)	—	—	—	○	—	—	—	—	○	—	—	—	—
(n)	—	—	—	○	—	—	—	—	○	○	—	—	—

■Control data

Device	Item	Description	Setting range	Set by ^{*1}
(s2)+0	System area	—	—	—
(s2)+1	Completion status	The status at the completion of the instruction is stored. 0000H: Completed successfully Other than 0000H: Completed with an error (error code) For error codes, refer to Built-in Ethernet communication manual.	—	System

^{*1} The contents in the "Set by" column mean as follows:

System: The CPU module stores the execution results of the S(P).SOCRDATA instructions.

Processing details

These instructions read the data for the number of words specified by (n) from the socket communication receive data area of the connection specified by (s1) to the devices from the device specified by (d) onwards. No processing is performed when (n) is 0.

Point

- When (n) is 1, the receive data length can be read. By doing this, the device for storing the receive data can be changed when the SP.SOCRCV instruction is executed.

For details, refer to  Built-in Ethernet communication manual.

Precautions

- Even when the S(P).SOCRDATA instructions are executed, the socket communication receive data area is not cleared and the receiving status signal does not change. Therefore, the next receive data is not stored in the socket communication receive data area.
- To update receive data, use the SP.SOCRCV instruction to read the receive data.

Operation error

Error code (SD0/SD8067)	Description
3405	The connection number specified by (s1) is other than 1 to 8.
2820	The device number specified by (s2), (d), or (n) is outside the range of the number of device points.
2822	Device that cannot be specified is specified.

This part consists of the following chapters.

9 HIGH-SPEED COUNTER INSTRUCTION

10 EXTERNAL DEVICE I/O INSTRUCTION

11 POSITIONING INSTRUCTION

12 INVERTER COMMUNICATION INSTRUCTION

13 MODBUS COMMUNICATION INSTRUCTION

14 DIVIDED DATA READ/WRITE FROM/TO BFM INSTRUCTION

9 HIGH-SPEED COUNTER INSTRUCTION

9.1 High-speed Processing Instruction

Setting 32-bit data comparison

DHSCS

This instruction compares the value counted by a high-speed counter with a specified value, and immediately sets a bit device if the two values are equivalent to each other.

Ladder diagram	Structured text ^{*1}
	<pre>ENO:=DHSCS(EN,s1,s2,d); ENO:=DHSCS_I(EN,s1,s2,d);</pre>

^{*1} When the interrupt pointer (I) is specified in operand (d) by structured text, use the DHSCS_I instruction.

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Data to be compared with the current value of a high-speed counter or word device number storing the data to be compared	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Channel number of a high-speed counter	K1 to 8	32-bit signed binary	ANY32
(d)	DHSCS	—	Bit	ANY_BOOL
	DHSCS_I		—	POINTER

■Applicable devices

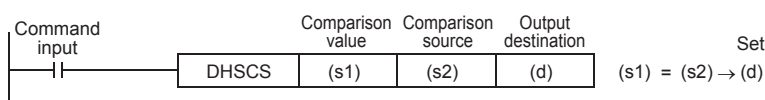
Operand	Bit			Word			Double word		Indirect specification	Constant				Others (I)
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—	—
(d)	○	○	—	○ ^{*1}	—	—	—	—	—	—	—	—	—	○ ^{*2}

^{*1} T, ST, C cannot be used.

^{*2} I16 to I23 can be used.

Processing details

- When the current value of a high-speed counter of the channel specified in (s2) becomes the comparison value (s1) (for example, when the current value changes from "199" to "200" or from "201" to "200" if the comparison value is K200), the bit device (d) is set to ON regardless of the scan time. In this instruction, the comparison processing is executed after the count processing in the high-speed counter. For details, refer to User's manual [Application].



Point

Use DHSCS if the output should be given when the counting result becomes equivalent to the comparison value regardless of the scan time of the CPU module.

When the number of instructions that can be simultaneously used is exceeded, use a general-purpose comparison instruction.

Precautions

The value specified in (s2) should only be the channel of high-speed counter number (1 to 8) set by the parameter. If a channel which is not set by the parameter or a value other than K1 to K8 is specified, an operation error occurs.

For other precautions, refer to  User's manual [Application].

Operation error

Error code (SD0/SD8067)	Description
3780	The DHSCS, DHSCR, and DHSZ instructions are used exceeding the maximum limit of the number of these instructions.
3405	A channel number outside the range or the device (I) number is specified.
3600	A channel number for which the channel setting is not set is specified in the operand for channel number specification of the high-speed counter.

Reset 32-bit data comparison

DHSCR

This instruction compares the value counted by a high-speed counter with a specified value, and immediately resets a bit device if the two values are equivalent to each other, or resets the high speed counter.

Ladder diagram	Structured text
	<pre>ENO:=DHSCR(EN,s1,s2,d);</pre>

Setting data

■Descriptions, ranges, and data types

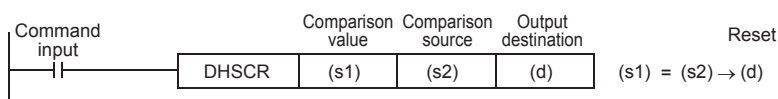
Operand	Description	Range	Data type	Data type (label)
(s1)	Data to be compared with the current value of a high-speed counter or word device number storing the data to be compared	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Channel number of a high-speed counter	K1 to 8	32-bit signed binary	ANY32
(d)	Bit device number to be reset (set to OFF) when both values become equivalent to each other, or channel number of self-reset high speed counter	—	Bit/32-bit signed binary	ANY_ELEMENTARY

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	○	—	○	○	○	○	—	○	○	—	—	—

Processing details

- When the current value of a high-speed counter of the channel specified in (s2) becomes the comparison value (s1) (for example, when the current value changes from "199" to "200" or from "201" to "200" if the comparison value is K200), the bit device (d) is reset to OFF regardless of the scan time. For details, refer to User's manual [Application].



Point

Use DHSCR if the output should be given when the counting result becomes equivalent to the comparison value regardless of the scan time of the CPU module.

When the number of instructions that can be simultaneously used is exceeded, use a general-purpose comparison instruction.

Precautions

The value specified in (s2) should only be the channel of high-speed counter number (1 to 8) set by the parameter. If a channel which is not set by the parameter or a value other than K1 to K8 is specified, an operation error occurs.

For other precautions, refer to  User's manual [Application].

Operation error

Error code (SD0/SD8067)	Description
3780	The DHSCS, DHSCR, and DHSZ instructions are used exceeding the maximum limit of the in number of these instructions.
3405	A channel number outside the range is specified.
3600	A channel number for which the channel setting is not set is specified in the operand in channel number specification of the high-speed counter.

Comparison of 32-bit data band

DHSZ

This instruction compares the current value of a high-speed counter with two values (one zone), and outputs the comparison result (refresh).

Ladder diagram	Structured text
	<pre>ENO:=DHSZ(EN,s1,s2,s3,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Data to be compared with the current value of a high-speed counter or word device number storing data to be compared (comparison value 1)	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Data to be compared with the current value of a high-speed counter or word device number storing data to be compared (comparison value 2)	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s3)	Channel number of a high-speed counter or the device number of the current value of a high-speed counter	K1 to 8	32-bit signed binary	ANY32
(d)	Head bit device number to which the comparison result is output based on the comparison value 1 and the comparison value 2	—	Bit	ANY_BOOL

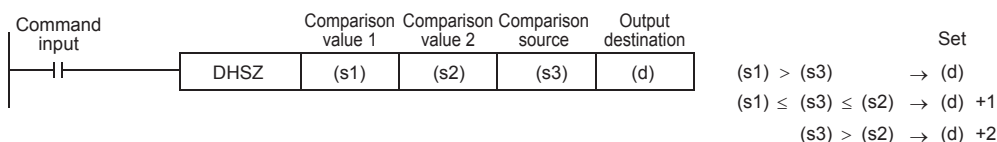
■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s3)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

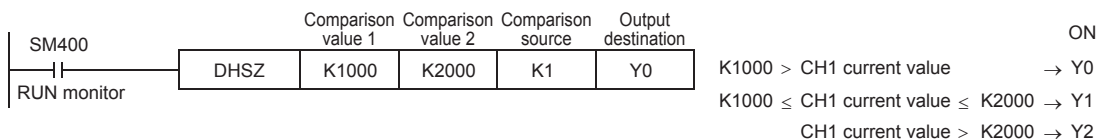
Processing details

- The current value of a high-speed counter specified in (s3) is compared with two comparison points (comparison value 1 and comparison value 2). Based on the zone comparison result, "smaller than the lower comparison value", "inside the comparison zone" or "larger than the upper comparison value", one among (d), (d)+1 and (d)+2 is set to ON regardless of the scan time. For details, refer to User's manual [Application].



- Make sure that the comparison value 1 and the comparison value 2 have the following relationship: [Comparison value 1] ≤ [Comparison value 2]. When the setting differs from the above, an operation error occurs and the DHSZ instruction will not perform any operation.

- When the current value of the high-speed counter CH1 changes (counts) as shown below, the comparison result is turn on to one of the outputs Y0, Y1 or Y2.



Comparison pattern	Current value of CH1 (s3)	Change of output contact (Y)		
		Y0	Y1	Y2
(s1) > (s3)	1000>(s3)	ON	OFF	OFF
	999→1000	ON→OFF	OFF→ON	OFF
	1000→999	OFF→ON	ON→OFF	OFF
(s1) ≤ (s3) ≤ (s2)	999→1000	ON→OFF	OFF→ON	OFF
	1000→999	OFF→ON	ON→OFF	OFF
	1000 ≤ (s3) ≤ 2000	OFF	ON	OFF
	2000→2001	OFF	ON→OFF	OFF→ON
	2001→2000	OFF	OFF→ON	ON→OFF
(s3) > (s2)	2000→2001	OFF	ON→OFF	OFF→ON
	2001→2000	OFF	OFF→ON	ON→OFF
	(s3) > 2000	OFF	OFF	ON

Point

It is used when the output should be given when the counting result becomes equivalent to the comparison value regardless of the scan time of the CPU module.

When the number of instructions that can be simultaneously used is exceeded, use a general-purpose comparison instruction.

Precautions

- If a channel which is not set to (s) by the parameter or a value other than K1 to 8 is specified, an operation error occurs.
- Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.
- For other precautions, refer to User's manual [Application].

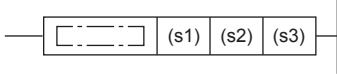
Operation error

Error code (SD0/SD8067)	Description
3780	The DHSCS, DHSCR, and DHSZ instructions are used exceeding the maximum limit of the number of these instructions.
3405	A channel number outside the range or the device (I) number is specified.
	The comparison value 1 is greater than the comparison value 2.
2820	The number of devices is insufficient.
3600	A channel number for which the channel setting is not set is specified in the operand for channel number specification of the high-speed counter.

Start/stop of the 16-bit data high-speed I/O function

HIOEN(P)

These instructions control the start and stop operations of a high-speed I/O function.

Ladder diagram	Structured text
	<pre>ENO:=HIOEN(EN,s1,s2,s3); ENO:=HIOENP(EN,s1,s2,s3);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Function number to be started or stopped	K0 to 50	16-bit signed binary	ANY16
(s2)	Set the bit of the channel number where the function is started.	-32768 to +32767	16-bit signed binary	ANY16
(s3)	Set the bit of the channel number where the function is stopped.	-32768 to +32767	16-bit signed binary	ANY16

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K	H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—	—
(s3)	○	—	—	○	○	○	—	—	○	○	—	—	—	—

Processing details

Specify the number of the function to be started or stopped in (s1), the bit of the channel to be started in (s2), and the bit of the channel to be stopped in (s3).

The following table shows the function numbers which can be specified in (s1).

Function number	Function name
0	High-speed counter
10*1	Pulse density/rotation speed measurement
30*1*2	Multi-output high-speed comparison table
40	Pulse width measurement
50	PWM

*1 When high-speed counter (function number: 0) is stopped during function operation, the function continues to operate, but nothing will be processed.

*2 When multi-output high-speed comparison table (function number: 30) is stopped, high-speed counter of the same ch is also stopped.

The following table shows the values which can be specified in (s2) and (s3) for each function number.

■Function number 0

The counting start and stop of a high-speed counter can be controlled for each channel of high-speed counter.

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—								CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1

Ex.

To start CH3, set 04H in (s2). To stop it, set 04H in (s3).

To start CH1, CH4, and CH5, set 19H in (s2). To stop them, set 19H in (s3).

To start CH1 and CH4 and to stop CH5, set 09H in (s2) and set 10H in (s3).

■Function number 10

The measuring start and stop of the pulse density (rotation speed measurement) can be controlled for each channel of the high-speed counter.

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—								CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1

■Function number 30

For the multi-output high-speed comparison table, specification of a channel is not required. To start the multi-output high-speed comparison table, set 01H in (s2). To stop it, set 01H in (s3).

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—															Valid

■Function numbers 40 and 50

The measuring start and stop of pulse width measurement and PWM can be controlled for each channel.

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—												CH4	CH3	CH2	CH1

Precautions

- When values that turn on the same channel are set for start and stop, the stop operation is prioritized.
- To start the multi-output high-speed comparison table (function number: 30), the high-speed counter must be started using the HIOEN instruction in advance.
- The high-speed input/output instructions operate according to the following parameters.

Function number	Function specified by the HIOEN instruction	Parameter setting
0	High-speed counter	Channel setting of the high-speed counter
10	Pulse density (rotation speed measurement)	Channel setting of the pulse density/rotation speed measurement High-speed counter
30	Multi-output high-speed comparison table	Output setting of the high-speed counter
40	Pulse width measurement	Channel setting of the pulse width measurement
50	PWM	Channel setting of PWM

Operation error

Error code (SD0/SD8067)	Description
1810	A channel number which is used in another instruction is specified.
3405	An invalid function number is specified in (s).
3600	A channel number which is not selected in the parameter setting is executed.

Start/stop of the 32-bit data high-speed I/O function

DHIOEN(P)

These instructions control the start and stop operations of a high-speed I/O function.

Ladder diagram	Structured text
	ENO:=DHIOEN(EN,s1,s2,s3); ENO:=DHIOENP(EN,s1,s2,s3);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Function number to be started or stopped	K0 to 50	16-bit signed binary	ANY16
(s2)	Set the bit of the channel number where the function is started.	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s3)	Set the bit of the channel number where the function is stopped.	-2147483648 to +2147483647	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s3)	○	—	—	○	○	○	○	○	○	○	—	—	—

Processing details

Specify the number of the function to be started or stopped in (s1), the bit of the channel to be started in (s2), and the bit of the channel to be stopped in (s3).

The following table shows the function numbers which can be specified in (s1).

Function number	Function name
0	High-speed counter
10*1	Pulse density/rotation speed measurement
20*1	High-speed comparison table
30*1*2	Multi-output high-speed comparison table
40	Pulse width measurement
50	PWM

*1 When high-speed counter (function number: 0) is stopped during function operation, the function continues to operate, but nothing will be processed.

*2 When multi-output high-speed comparison table (function number: 30) is stopped, high-speed counter of the same ch is also stopped.

The following table shows the values which can be specified in (s2) and (s3) for each function number.

■Function number 0

The counting start and stop of a high-speed counter can be controlled for each channel of the high-speed counter.

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—								CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1

Ex.

To start CH3, set 04H in (s2). To stop it, set 04H in (s3).

To start CH1, CH4, and CH5, set 19H in (s2). To stop them, set 19H in (s3).

To start CH1 and CH4 and to stop CH5, set 09H in (s2) and set 10H in (s3).

■Function number 10

The measuring start and stop of the pulse density (rotation speed measurement) can be controlled for each channel of the high-speed counter.

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—								CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1

■Function number 20

Set the value to turn on the bit of the high-speed comparison table number which is to be started or stopped.

Low-order bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—												4	3	2	1

High-order bit position															
b31	b30	b29	b28	b27	b26	b25	b24	b23	b22	b21	b20	b19	b18	b17	b16
—															

■Function number 30

For the multi-output high-speed comparison table, specification of a channel is not required. To start the multi-output high-speed comparison table, set 01H in (s2). To stop it, set 01H in (s3).

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—														Valid	

■Function numbers 40 and 50

The measuring start and stop of pulse width measurement and PWM can be controlled for each channel.

Bit position															
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
—												CH4	CH3	CH2	CH1

Precautions

- When the same channel is simultaneously turned on for start and stop, the stop operation is prioritized.
- When the high-speed comparison table is used with the DHIOEN instruction, the total number of high-speed comparisons, including the DHSCS instruction, DHSCR instruction, DHSZ instruction, and interrupt input of built-in positioning, must be 4 or less.
- To start the multi-output high-speed comparison table (function number: 30), start the high-speed counter using the (D)HIOEN instruction in advance.
- The high-speed input/output instructions operate according to the following parameters.

Function number	Function specified by the DHIOEN instruction	Parameter setting
0	High-speed counter	Channel setting of the high-speed counter
10	Pulse density (rotation speed measurement)	Channel setting of the pulse density/rotation speed measurement High-speed counter
20	High-speed comparison table	Output setting of the high-speed counter
30	Multi-output high-speed comparison table	Output setting of the high-speed counter
40	Pulse width measurement	Channel setting of the pulse width measurement
50	PWM	Channel setting of PWM

Operation error

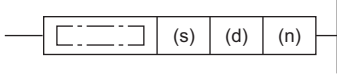
Error code (SD0/SD8067)	Description
1810	A channel number which is used in another instruction is specified.
3405	An invalid function number is specified in (s).
3600	A channel number which is not selected in the parameter setting is executed.

9.2 High-speed Current Value Transfer Instruction

High-speed current value transfer of 16-bit data

HCMOV(P)

These instructions read and write (updates) special register for high-speed counter, pulse width measurement, PWM, and positioning.

Ladder diagram	Structured text
	ENO:=HCMOV(EN,s,n,d); ENO:=HCMOV(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Transfer source device number	—	Bit/16-bit signed binary	ANY_ELEMENTARY
(d)	Transfer destination device number	—	Bit/16-bit signed binary	ANY_ELEMENTARY
(n)	Specification to clear the device value of the transfer source after the transfer	K0, K1	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	—	—	○	○	○	—	—	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

These instructions transfer the data in the device specified by (s) to the device specified by (d). At this time, if the value of (n) is K0, the value of (s) is not cleared. If the value of (n) is K1, the value of (s) is cleared to "0" after the transfer. The value is cleared only for special devices supporting high-speed transfer.

Point

When (s) is a device supporting high-speed transfer

- When the HCMOV instruction is executed, the latest value is acquired such as the current value of a high-speed counter and transferred to (d).

When (d) is a device supporting high-speed transfer

- When the HCMOV instruction is executed, value such as the current value of a high-speed counter is changed.

■Effect of HCMOV instruction

- By using both input interrupt and HCMOV instruction, the current value of a high-speed counter can be received at the rising edge or falling edge of an external input.
- When HCMOV instruction is used just before a comparison instruction (CMP, ZCP or comparison contact instruction), the latest value of the high-speed counter is used in comparison.

Precautions

- When it is necessary to execute comparison and outputting as soon as the current value of a high-speed counter changes, use the high-speed comparison table, multi-output high-speed comparison table, or one of the DHSCS, DHSCR, and DHSZ instructions.
- If 32-bit binary data special device which supports the high-speed transfer (such as the current value of a high-speed counter) is read using the HCMOV instruction, the operation is the same as that when the MOV instruction is used.
- Do not overwrite the current value of a high-speed counter using the HCMOV instruction while executing the pulse density (rotation speed measurement) or the SPD instruction.

Point

The HCMOV instruction is mainly used to read the current value of the high-speed counter/pulse width measurement and change the current address (in the user units) or the current address (in the pulse unit) of positioning.

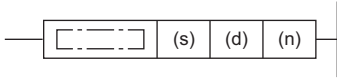
Operation error

Error code (SD0/SD8067)	Description
3405	A value outside the data range is set in (n).

High-speed current value transfer of 32-bit data

DHCMOV(P)

These instructions read and write (updates) special register for high-speed counter, pulse width measurement, PWM, and positioning.

Ladder diagram	Structured text
	ENO:=DHCMOV(EN,s,n,d); ENO:=DHCMOVP(EN,s,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Transfer source device number	—	Bit/32-bit signed binary	ANY_ELEMENTARY
(d)	Transfer source device number	—	Bit/32-bit signed binary	ANY_ELEMENTARY
(n)	Specification to clear the device value of the transfer source after the transfer	K0, K1	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d)	○	—	—	○	○	○	○	○	○	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

These instructions transfer the data in the device specified by (s) to the device specified by (d). At this time, if the value of (n) is K0, the value of (s) is not cleared. If the value of (n) is K1, the value of (s) is cleared to "0" after the transfer. The value is cleared only for special devices supporting high-speed transfer.

Point

When (s) is a device supporting high-speed transfer

- When the DHCMOV instruction is executed, the latest value is acquired such as the current value of a high-speed counter and transferred to (d).

When (d) is a device supporting high-speed transfer

- When the DHCMOV instruction is executed, value such as the current value of a high-speed counter is changed.

■Effect of DHCMOV instruction

- By using both input interrupt and DHCMOV instruction, the current value of a high-speed counter can be received at the rising edge or falling edge of an external input.
- When DHCMOV instruction is used just before a comparison instruction (DCMP, DZCP or comparison contact instruction), the latest value of the high-speed counter is used in comparison.

Precautions

- When it is necessary to execute comparison and outputting as soon as the current value of a high-speed counter changes, use the high-speed comparison table, multi-output high-speed comparison table, or one of the DHSCS, DHSCR, and DHSZ instructions.
- Do not overwrite the current value of a high-speed counter using the DHCMOV instruction while executing the pulse density (rotation speed measurement) or the DSPD instruction.

Point

The DHCMOV instruction is mainly used to read the current value of the high-speed counter/pulse width measurement and change the current address (in the user units) or the current address (in the pulse unit) of positioning.

Operation error

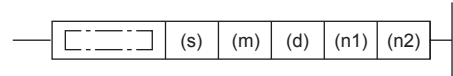
Error code (SD0/SD8067)	Description
3405	A value outside the data range is set in (n).

10 EXTERNAL DEVICE I/O INSTRUCTION

10.1 Serial Communication 2

RS2

This instruction sends or receives data by non-protocol communication via serial ports of RS-232C or RS-485.

Ladder diagram	Structured text
	ENO:=RS2(EN,s,m,n1,n2,d);

Setting data

■Descriptions, ranges, and data types


Operand	Description	Range	Data type	Data type (label)
(s)	Head device storing send data	—	16-bit signed binary/ character string	ANY16
(m)	Number of send data	0 to 4096	16-bit unsigned binary	ANY16_U
(d)	Head device storing receive data	—	16-bit signed binary/ character string	ANY16
(n1)	Amount of received data	0 to 4096	16-bit unsigned binary	ANY16_U
(n2)	Communication channel	K1 to 4	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(m)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○*1	—	—	—	—	○	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	—	—	—	—	—	—	—	—	—	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction sends or receives data by non-protocol communication via built-in RS-485 port or serial ports of RS-232C or RS-485 provided by add-on modules. This instruction specifies the head device storing the sent data from the CPU module, amount of data, head device storing the received data and the maximum allowable amount of received data. For details, refer to  Serial communication manual.

Precautions

- It is not permitted to use instructions for external device I/O, MODBUS communication, and inverter communication on the same port.
- While this instruction is being driven, the communication format cannot be changed. Set this instruction to OFF before changing the communication format.
- When using the header and terminator, set them before driving this instruction. Do not change the values of the header and terminator while this instruction is being driven.

Operation error

Error code (SD0/SD8067)	Description
2822	Device that cannot be specified by this instruction is specified.
3405	Data outside the allowable range was input.
2820	The device specified by (s) and (d) exceeds the corresponding device range.
1810	Channel number which is used in another instruction is specified.
3600	Channel number specified by (n2) is not set by parameters.

For communication errors, refer to  Serial communication manual.

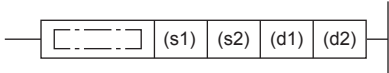
11 POSITIONING INSTRUCTION

11.1 Positioning Instruction

Zero return(OPR) with 16-bit data DOG search

DSZR [For the FX3 Series-compatible operand specification]

This instruction executes mechanical zero return.

Ladder diagram	Structured text
	ENO:=DSZR(EN,s1,s2,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Bit device number to which the near-point dog signal is input	—	Bit	ANY_ELEMENTARY
(s2)	Bit device number to which the zero-phase signal is input	—	Bit	ANY_ELEMENTARY
(d1)	Bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○*1	—	—	—	—	—	—	—	—	—	—	—	—
(s2)	○*1*2	—	—	—	—	—	—	—	—	—	—	—	—
(d1)	○*3	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○*4	—	—	—	—	—	—	—	—	—	—	—	—

*1 When using X, always specify a device that has been set by parameter.

*2 Specify the device set with a parameter or same as the one set in (s1).


*3 Only Y can be used.

*4 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

Processing details

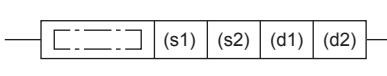
This instruction executes mechanical zero return. The values of special devices are applied as the zero return speed and creep speed. With the forward limit or reverse limit, zero return with the dog search function can be executed.

- For (s1), specify the near-point dog signal input device number.
 - When an X device is specified : The near-point dog signal functions follow the logic set by parameter.
 - When other than X device is specified : The device functions follow the positive logic.
- For (s2), specify the zero-phase signal input device number.
 - When an X device is specified : The zero-phase signal functions follow the logic set by parameter.
 - When other than X device is specified : The device functions follow the positive logic.
- For (d1), specify the device from which pulses are output. Only the output devices (Y) having positioning parameters can be specified.
- For (d2), specify the bit device from which the rotation direction signal is output. Only the device specified with a parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DSZR [For the FX5 Series operand specification]

This instruction executes mechanical zero return.

Ladder diagram	Structured text
	ENO:=DSZR(EN,s1,s2,d1,d2);

Setting data

■ Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Zero return speed	1 to 65535	16-bit unsigned binary	ANY_ELEMENTARY
(s2)	Creep speed	1 to 65535	16-bit unsigned binary	ANY_ELEMENTARY
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the zero return complete flag or abnormal end flag	—	Bit	ANY_BOOL

■ Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes mechanical zero return. The near-point dog signal and zero-phase signal function follow the device set with parameters. With the forward limit or reverse limit, zero return with the dog search function can be executed.

- For (s1), specify the zero return speed in the user units. (The speed must be 200 Kpps or lower in frequency.)
- For (s2), specify the creep speed in the user units. Set the creep speed equal to or slower than the zero return speed set in (s1). (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number for which zero return is performed.
- For (d2), specify the bit device of the zero return complete flag or abnormal end flag.

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

Zero return(OPR) with 32-bit data DOG search

DDSZR

This instruction executes mechanical zero return.

Ladder diagram	Structured text
	<pre>ENO:=DDSZR(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Zero return speed	1 to 2147483647	32-bit signed binary	ANY32
(s2)	Creep speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Axis number from which pulses are to be output	K1 to 4	32-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the zero return complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes mechanical zero return. The near-point dog signal and zero-phase signal function follow the device set with parameters. With the forward limit or reverse limit, zero return with the dog search function can be executed.

- For (s1), specify the zero return speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (s2), specify the creep speed in user units. Set the creep speed equal to or slower than the zero return speed set in (s1). (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number for which zero return is performed.
- For (d2), specify the bit device of the zero return complete flag or abnormal end flag.

For details on the function and error code, refer to Built-in positioning manual.

Precautions

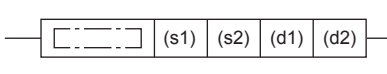
Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to Built-in positioning manual.

16-bit data interrupt positioning

DVIT [For the FX3 Series-compatible operand specification]

This instruction executes interrupt 1-speed constant quantity feed.

Ladder diagram	Structured text
	ENO:=DVIT(EN,s1,s2,d1,d2);

11

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address after an interrupt input	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Command speed	1 to 65535	16-bit unsigned binary	ANY16
(d1)	Bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	○ ^{*1}	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○ ^{*2}	—	—	○ ^{*3}	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

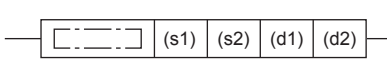
This instruction executes interrupt 1-speed constant quantity feed.

- For (s1), specify the transfer distance that is output after an interrupt, in user units. (The distance must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the output devices (Y) having positioning parameters can be specified.
- For (d2), specify the device from which the rotation direction signal is output. Only the device specified with a parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DVIT [For the FX5 Series operand specification]

This instruction executes interrupt 1-speed constant quantity feed.

Ladder diagram	Structured text
	<pre>ENO:=DVIT(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address after an interrupt input	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Command speed	1 to 65535	16-bit unsigned binary	ANY16
(d1)	Specify the axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes interrupt 1-speed constant quantity feed.

- For (s1), specify the transfer distance that is output after an interrupt, in user units. (The distance must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the normal complete flag or abnormal end flag for the DVIT instruction.

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

32-bit data interrupt positioning

DDVIT [For the FX3 Series-compatible operand specification]

This instruction executes interrupt 1-speed constant quantity feed.

Ladder diagram	Structured text
	<pre>ENO:=DDVIT(EN,s1,s2,d1,d2);</pre>

11

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address after an interrupt input	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Command speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—	—
(d1)	○ ^{*1}	—	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○ ^{*2}	—	—	○ ^{*3}	—	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

This instruction executes interrupt 1-speed constant quantity feed.

- For (s1), specify the transfer distance that is output after an interrupt, in user units. (The distance must be within the range of -2147483647 to +2147483647 in the number of pulses.)
- For (s2), specify the speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the output devices (Y) having positioning parameters can be specified.
- For (d2), specify the device from which the rotation direction signal is output. Only the device specified with a parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to Built-in positioning manual.

DDVIT [For the FX5 Series operand specification]

This instruction executes interrupt 1-speed constant quantity feed.

Ladder diagram	Structured text
	<pre>ENO:=DDVIT(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address after an interrupt input	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Command speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Specify the axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes interrupt 1-speed constant quantity feed.

- For (s1), specify the transfer distance that is output after an interrupt, in user units. (The distance must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the normal complete flag or abnormal end flag for the DDVIT instruction.

For details on the function and error code, refer to Built-in positioning manual.

Precautions

Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to Built-in positioning manual.

Positioning by one table operation

TBL [For the FX3 Series-compatible operand specification]

This instruction executes one specified table operation from the instructions set in the data table using the engineering tool etc.

Ladder diagram	Structured text
	<pre>ENO:=TBL(EN,n,d);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(n)	Table number to be executed	1 to 100	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	○*1	—	—	—	—	—	—	—	—	—	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

*1 Only Y can be used.

Processing details

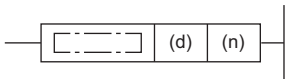
This instruction operates one table of the positioning table that is set with parameters in the engineering tool.

- For (d), specify the device from which pulses are output. Only the output devices (Y) having positioning parameters can be specified.
- For (n), specify the table number to be executed according to the output specified in (d).

For details on the function, precautions, and error code, refer to Built-in positioning manual.

TBL [For the FX5 Series operand specification]

This instruction executes one specified table operation from the instructions set in the data table using the engineering tool etc.

Ladder diagram	Structured text
	ENO:=TBL(EN,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(n)	Table number to be executed	1 to 100	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d)	—	—	—	○	○	○	—	—	○	○	—	—	—
(n)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

This instruction operates one table of the positioning table that is set with parameters in the engineering tool.

- For (d), specify the axis number from which pulses are output.
- For (n), specify the table number to be executed according to the output specified in (d).

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

Positioning by multiple table operation

DRVTL

This instruction executes positioning operation set in multiple data tables with the engineering tool in continuous operation or stepping operation. To execute such operation, this instruction needs to be executed only once.

Ladder diagram	Structured text
	ENO:=DRVTL(EN,n1,n2,n3,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY16
(n1)	Start table number to be executed	1 to 100	16-bit unsigned binary	ANY16_U
(n2)	Last table number to be executed	1 to 100	16-bit unsigned binary	ANY16_U
(n3)	Table execution method	K0, K1	16-bit unsigned binary	ANY16_U
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(d1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	○	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes positioning operation set in multiple data tables with the engineering tool in the continuous operation or stepping operation. To execute such operation, this instruction needs to be executed only once.

- For (d1), specify the axis number from which pulses are output.
- For (n1), specify the start table to be executed according to the output specified in (d1).
- For (n2), specify the last table. When (n1) and (n2) are the same, only one table is executed. The table operation keeps executing until the last table or a table that is not set with parameters is executed.
- For (n3), specify the table execution method. (K0 = Stepping operation, K1 = Continuous operation)
- For (d2), specify the bit device of the normal complete flag or abnormal end flag.

For details on the function and error code, refer to Built-in positioning manual.

Precautions

Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls. For other precautions, refer to Built-in positioning manual.

Multiple axes concurrent drive positioning

DRVMUL

This instruction executes tables of multiple axes of one module simultaneously.

Ladder diagram	Structured text
	ENO:=DRVMUL(EN,n1,n2,n3,n4,n5,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(n1)	Start axis number	K1	16-bit unsigned binary	ANY16_U
(n2)	Table number of the axis 1	K0 to 100	16-bit unsigned binary	ANY16_U
(n3)	Table number of the axis 2	K0 to 100	16-bit unsigned binary	ANY16_U
(n4)	Table number of the axis 3	K0 to 100	16-bit unsigned binary	ANY16_U
(n5)	Table number of the axis 4	K0 to 100	16-bit unsigned binary	ANY16_U
(d)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n3)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n4)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n5)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	○	○	—	○*1	—	—	—	—	—	—	—	—	—


*1 T, ST, C cannot be used.

Processing details

This instruction executes tables of multiple axes of one module simultaneously.

- For (n1), specify the start axis number. When the built-in positioning function of the CPU module is used, the start axis is the axis 1. Thus, specify K1.
- For (n2), specify the table number that is executed with the axis (n1). When not executing the axis (n1), specify K0.
- For (n3), specify the table number that is executed with the axis (n1)+1. When not executing the axis (n1)+1, specify K0.
- For (n4), specify the table number that is executed with the axis (n1)+2. When not executing the axis (n1)+2, specify K0.
- For (n5), specify the table number that is executed with the axis (n1)+3. When not executing the axis (n1)+3, specify K0.
- For (d), specify the device of the instruction execution complete flag for each axis. Eight devices are occupied from (d), and function as follows.

Device	Description
(d)	Instruction execution complete flag for the axis (n1)
(d)+1	Instruction execution abnormal end flag for the axis (n1)
(d)+2	Instruction execution complete flag for the axis (n1)+1
(d)+3	Instruction execution abnormal end flag for the axis (n1)+1
(d)+4	Instruction execution complete flag for the axis (n1)+2
(d)+5	Instruction execution abnormal end flag for the axis (n1)+2
(d)+6	Instruction execution complete flag for the axis (n1)+3
(d)+7	Instruction execution abnormal end flag for the axis (n1)+3

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

Eight devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

32-bit data ABS current value read

DABS

This instruction reads the absolute position (ABS) data when a servo amplifier (equipped with the absolute position detection function) is connected. The data is converted into pulse when read.

Ladder diagram	Structured text
	<pre>ENO:=DABS(EN,s,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Head device number that inputs the output signal for absolute position (ABS) data from the servo amplifier	—	Bit	ANY_BOOL
(d1)	Head device number that outputs the absolute position (ABS) data control signal to the servo amplifier	—	Bit	ANY_BOOL
(d2)	Absolute position (ABS) data (32-bit value)	—	32-bit signed binary	ANY32

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(d1)	○	—	—	○*1	—	—	—	—	—	—	—	—	—
(d2)	○	—	—	○	○	○	○	○	○	○	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction reads the absolute position (ABS) data when a servo amplifier (equipped with the absolute position detection function) is connected. The data is converted into pulse when being read.

- For (s), specify the head device number that inputs the output signal for absolute position (ABS) data from the servo amplifier.
- For (d1), specify the head device number that outputs the absolute position (ABS) data control signal to the servo amplifier. Be sure to use transistor outputs for the CPU module outputs.
- For (d2), specify the device that stores the absolute position (ABS) data read from the servo amplifier.

For details on the function and error code, refer to Built-in positioning manual.

Precautions

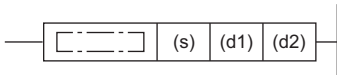
Three devices are occupied from the device specified in (s) and (d1). Make sure that these devices are not used in other controls.

For other precautions, refer to Built-in positioning manual.

16-bit data variable speed pulse

PLSV [For the FX3 Series-compatible operand specification]

This instruction outputs variable speed pulses with an assigned rotation direction output.

Ladder diagram	Structured text
	ENO:=PLSV(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed	-32768 to +32767	16-bit signed binary	ANY16
(d1)	Bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	○*1	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○*2	—	—	○*3	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

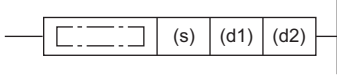
This instruction outputs variable speed pulses with an assigned rotation direction output.

- For (s), specify the command speed to be output. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the output devices (Y) having positioning parameters can be specified.
- For (d2), specify the device from which the rotation direction signal is output. Only the device specified with the parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

PLSV [For the FX5 Series operand specification]

This instruction outputs variable speed pulses with an assigned rotation direction output.

Ladder diagram	Structured text
	ENO:=PLSV(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed	-32768 to +32767	16-bit signed binary	ANY16
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction outputs variable speed pulses with an assigned rotation direction output.

- For (s), specify the command speed to be output. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the abnormal end flag for the PLSV instruction. (This device does not have the normal complete status, and only has the abnormal end status ((d2)+1).

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

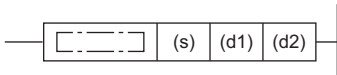
Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

32-bit data variable speed pulse

DPLSV [For the FX3 Series-compatible operand specification]

This instruction outputs variable speed pulses with an assigned rotation direction output.

Ladder diagram	Structured text
	ENO:=DPLSV(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d1)	Bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$		
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—	—
(d1)	○*1	—	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○*2	—	—	○*3	—	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

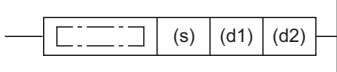
This instruction outputs variable speed pulses with an assigned rotation direction output.

- For (s), specify the command speed to be output. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the output devices (Y) having positioning parameters can be specified.
- For (d2), specify the device from which the rotation direction signal is output. Only the device specified with the parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DPLSV [For the FX5 Series operand specification]

This instruction outputs variable speed pulses with an assigned rotation direction output.

Ladder diagram	Structured text
	ENO:=DPLSV(EN,s,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s)	Command speed	-2147483648 to +2147483647	32-bit signed binary	ANY32
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction outputs variable speed pulses with an assigned rotation direction output.

- For (s), specify the command speed to be output. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the abnormal end flag for the DPLSV instruction. (This device does not have the normal complete status, and only has the abnormal end status ((d2)+1).

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

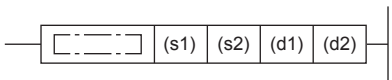
Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

16-bit data relative positioning

DRVI [For the FX3 Series-compatible operand specification]

This instruction executes one-speed positioning by incremental drive.

Ladder diagram	Structured text
	<pre>ENO:=DRVI(EN,s1,s2,d1,d2);</pre>

11

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Command speed	1 to 65535	16-bit unsigned binary	ANY16
(d1)	Output bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	○ ^{*1}	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○ ^{*2}	—	—	○ ^{*3}	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

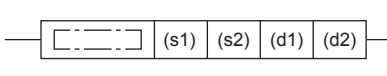
This instruction executes one-speed positioning by incremental drive. Specify the positioning address in the incremental system, in which the transfer direction and transfer distance from the current position (relative address) are specified for positioning.

- For (s1), specify the relative positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the Y devices having positioning parameters can be specified.
- For (d2), specify the bit device from which the rotation direction signal is output. Only the device specified with the parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DRVI [For the FX5 Series operand specification]

This instruction executes one-speed positioning by incremental drive.

Ladder diagram	Structured text
	ENO:=DRVI(EN,s1,s2,d1,d2);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Command speed	1 to 65535	16-bit unsigned binary	ANY16
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.


Processing details

This instruction executes one-speed positioning by incremental drive. Specify the positioning address in the incremental system, in which the transfer direction and transfer distance from the current position (relative address) are specified for positioning.

- For (s1), specify the relative positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the normal complete flag or abnormal end flag for the DRVI instruction.

For details on the function and error code, refer to  Built-in positioning manual.

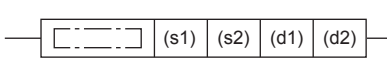
Precautions

Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls. For other precautions, refer to  Built-in positioning manual.

32-bit data relative positioning

DDRVI [For the FX3 Series-compatible operand specification]

This instruction executes one-speed positioning by incremental drive.

Ladder diagram	Structured text
	<pre>ENO:=DDRVI(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Command speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Output bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	○ ^{*1}	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○ ^{*2}	—	—	○ ^{*3}	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.


*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

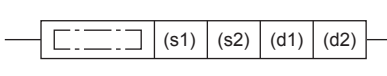
This instruction executes one-speed positioning by incremental drive. Specify the positioning address in the incremental system, in which the transfer direction and transfer distance from the current position (relative address) are specified for positioning.

- For (s1), specify the relative positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the Y devices having positioning parameters can be specified.
- For (d2), specify the device from which the rotation direction signal is output. Only the device specified with the parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DDRVI [For the FX5 Series operand specification]

This instruction executes one-speed positioning by incremental drive.

Ladder diagram	Structured text
	<pre>ENO:=DDRVI(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Command speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes one-speed positioning by incremental drive. Specify the positioning address in the incremental system, in which the transfer direction and transfer distance from the current position (relative address) are specified for positioning.

- For (s1), specify the relative positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the normal complete flag or abnormal end flag for the DDRVI instruction.

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

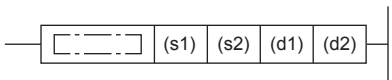
Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

16-bit data absolute positioning

DRVA [For the FX3 Series-compatible operand specification]

This instruction executes one-speed positioning by absolute drive.

Ladder diagram	Structured text
	<pre>ENO:=DRVA(EN,s1,s2,d1,d2);</pre>

11

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Command speed	1 to 65535	16-bit unsigned binary	ANY16
(d1)	Output bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	○*1	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○*2	—	—	○*3	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

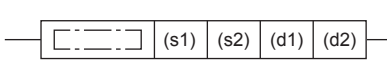
This instruction executes one-speed positioning by absolute drive. Specify the positioning address in the absolute system, in which the transfer distance from the origin (absolute address) is specified for positioning.

- For (s1), specify the absolute positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the Y devices having positioning parameters can be specified.
- For (d2), specify the bit device from which the rotation direction signal is output. Only the device specified with the parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DRVA [For the FX5 Series operand specification]

This instruction executes one-speed positioning by absolute drive.

Ladder diagram	Structured text
	<pre>ENO:=DRVA(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-32768 to +32767	16-bit signed binary	ANY16
(s2)	Command speed	1 to 65535	16-bit unsigned binary	ANY16
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes one-speed positioning by absolute drive. Specify the positioning address in the absolute system, in which the transfer distance from the origin (absolute address) is specified for positioning.

- For (s1), specify the absolute positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the normal complete flag or abnormal end flag for the DRVA instruction.

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

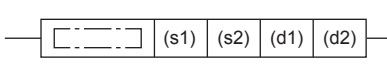
Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

For other precautions, refer to  Built-in positioning manual.

32-bit data absolute positioning

DDRVA [For the FX3 Series-compatible operand specification]

This instruction executes one-speed positioning by absolute drive.

Ladder diagram	Structured text
	<pre>ENO:=DDRVA(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Command speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Output bit device number (Y) from which pulses are output	0 to 3	Bit	ANY_ELEMENTARY
(d2)	Bit device number from which the rotation direction is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	○ ^{*1}	—	—	—	—	—	—	—	—	—	—	—	—
(d2)	○ ^{*2}	—	—	○ ^{*3}	—	—	—	—	—	—	—	—	—

*1 Only Y can be used.

*2 When the output mode is CW/CCW, specify the CCW axis. When the output mode is PULSE/SIGN and using Y, only the SIGN output or general-purpose output of the self-axis can be specified.

*3 T, ST, C cannot be used.

Processing details

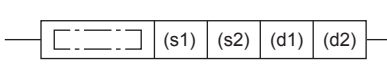
This instruction executes one-speed positioning by absolute drive. Specify the positioning address in the absolute system, in which the transfer distance from the origin (absolute address) is specified for positioning.

- For (s1), specify the absolute positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the device from which pulses are output. Only the Y devices having positioning parameters can be specified.
- For (d2), specify the bit device from which the rotation direction signal is output. Only the device specified with the parameter or general-purpose outputs can be specified. When the output devices (Y) is executed by another function (PWM, positioning PULSE axis, or CW/CCW axis etc.), the device does not function and causes an error.

For details on the function, precautions, and error code, refer to  Built-in positioning manual.

DDRVA [For the FX5 Series operand specification]

This instruction executes one-speed positioning by absolute drive.

Ladder diagram	Structured text
	<pre>ENO:=DDRVA(EN,s1,s2,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Positioning address	-2147483648 to +2147483647	32-bit signed binary	ANY32
(s2)	Command speed	1 to 2147483647	32-bit signed binary	ANY32
(d1)	Axis number from which pulses are to be output	K1 to 4	16-bit signed binary	ANY_ELEMENTARY
(d2)	Bit device number of the positioning complete flag or abnormal end flag	—	Bit	ANY_BOOL

■Applicable devices


Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	○	—	—	○	○	○	○	○	○	○	—	—	—
(s2)	○	—	—	○	○	○	○	○	○	○	—	—	—
(d1)	—	—	—	○	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○ ^{*1}	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes one-speed positioning by absolute drive. Specify the positioning address in the absolute system, in which the transfer distance from the origin (absolute address) is specified for positioning.

- For (s1), specify the absolute positioning address in user units. (The address must be within the range of -2147483647 to +2147483647 number of pulses.)
- For (s2), specify the command speed in user units. (The speed must be 200 Kpps or lower in frequency.)
- For (d1), specify the axis number from which pulses are output.
- For (d2), specify the bit device of the normal complete flag or abnormal end flag for the DDRVA instruction.

For details on the function and error code, refer to  Built-in positioning manual.

Precautions

Two devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

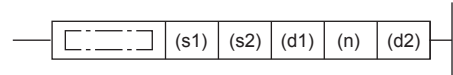
For other precautions, refer to  Built-in positioning manual.

12 INVERTER COMMUNICATION INSTRUCTION

12.1 Inverter operation monitoring(Status check)

IVCK

This instruction reads the operation status of an inverter to the CPU module.


Ladder diagram	Structured text
	ENO:=IVCK(EN,s1,s2,n,d1,d2);

12

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Inverter station number	K0 to 31	16-bit signed binary	ANY16
(s2)	Inverter instruction codes	*1	16-bit signed binary	ANY16
(d1)	Device number storing the read value	—	16-bit signed binary	ANY16
(n)	Channel to be used	K1 to 4	16-bit unsigned binary	ANY16_U
(d2)	Head bit device to which the execution status of the instruction is output	—	Bit	ANY_BOOL


*1  Refer to Serial communication manual or respective inverter manual.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(d1)	○	—	—	○	○	—	—	—	○	—	—	—	—
(n)	—	—	—	—	—	—	—	—	—	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

The operation status corresponding to the instruction code specified in (s2) of an inverter connected to the channel to be used (n) whose station number is specified in (s1) is read and transferred to (d1). For details, refer to  Serial communication manual. (For the instruction codes, refer to the each inverter manual.)

Precautions

Three devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

Operation error

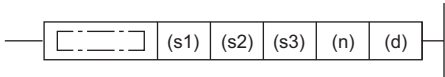
Error code (SD0/SD8067)	Description
1810	Channel number specified by (d) is used by another instruction.
2820	The specified device exceeds the range of the corresponding device.
3405	The value specified by (s1) is other than any of K0 to 31. The value specified by (n) is other than any of K1 to 4.
3600	Channel number specified by (d) is not set by parameters.

For communication errors, refer to  Serial communication manual.

12.2 Inverter operations control(Drive)

IVDR


This instruction writes a control value necessary for inverter operation to a CPU module using the computer link operation function of the inverter.

Ladder diagram	Structured text
	ENO:=IVDR(EN,s1,s2,s3,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Inverter station number	K0 to 31	16-bit signed binary	ANY16
(s2)	Inverter instruction codes	*1	16-bit signed binary	ANY16
(s3)	Set value to be written to the inverter parameter or device number storing the data to be set	—	16-bit signed binary	ANY16
(n)	Channel to be used	K1 to 4	16-bit unsigned binary	ANY16_U
(d)	Head bit device to which the execution status of the instruction is output	—	Bit	ANY_BOOL


*1  Refer to Serial communication manual or respective inverter manual.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	—	—	—	○	○	—	—	—
(n)	—	—	—	—	—	—	—	—	—	○	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

The control value specified in (s3) is written to the instruction code specified in (s2) of an inverter connected to the channel to be used (n) whose station number is specified in (s1). For details, refer to  Serial communication manual. (For the instruction codes, refer to the each inverter manual.)

Precautions

Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

Operation error

Error code (SD0/SD8067)	Description
1810	Channel number specified by (d) is used by another instruction.
2820	The specified device exceeds the range of the corresponding device.
3405	The value specified by (s1) is other than any of K0 to 31. The value specified by (n) is other than any of K1 to 4.
3600	Channel number specified by (d) is not set by parameters.

For communication errors, refer to  Serial communication manual.

12.3 Inverter parameter read

IVRD

This instruction reads a parameter of an inverter to the CPU module.

Ladder diagram	Structured text
	<pre>ENO:=IVRD(EN,s1,s2,n,d1,d2);</pre>

12

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Inverter station number	K0 to 31	16-bit signed binary	ANY16
(s2)	Inverter parameter number	*1	16-bit signed binary	ANY16
(d1)	Device number storing the read value	—	16-bit signed binary	ANY16
(n)	Channel to be used	K1 to 4	16-bit unsigned binary	ANY16_U
(d2)	Head bit device to which the execution status of the instruction is output	—	Bit	ANY_BOOL

*1 Refer to Serial communication manual or respective inverter manual.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant				Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K	H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—	—
(d1)	○	—	—	○	○	—	—	—	○	—	—	—	—	—
(n)	—	—	—	—	—	—	—	—	—	○	—	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

The value of the parameter (s2) is read from an inverter connected to the channel to be used (n) whose station number is (s1), and output to (d1). For details, refer to Serial communication manual. (For the parameter numbers, refer to the each inverter manual.)

Precautions

Three devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

Operation error

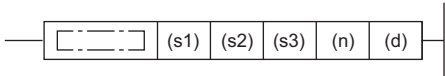
Error code (SD0/SD8067)	Description
1810	Channel number specified by (d) is used by another instruction.
2820	The specified device exceeds the range of the corresponding device.
3405	The value specified by (s1) is other than any of K0 to 31.
	The value specified by (s2) is outside the allowable range. (Less than K0, K3000 to 9999, or K13000 to 32767)
	The value specified by (n) is other than any of K1 to 4.
3600	Channel number specified by (d) is not set by parameters.

For communication errors, refer to Serial communication manual.

12.4 Inverter parameter write

IVWR


This instruction writes a parameter of an inverter from the CPU module.

Ladder diagram	Structured text
	ENO:=IVWR(EN,s1,s2,s3,n,d);

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Inverter station number	K0 to 31	16-bit signed binary	ANY16
(s2)	Inverter parameter number	*1	16-bit signed binary	ANY16
(s3)	Set value to be written to the inverter parameter or device number storing the data to be set	—	16-bit signed binary	ANY16
(n)	Channel to be used	K1 to 4	16-bit unsigned binary	ANY16_U
(d)	Head bit device to which the execution status of the instruction is output	—	Bit	ANY_BOOL


*1  Refer to Serial communication manual or respective inverter manual.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s3)	○	—	—	○	○	—	—	—	○	○	—	—	—
(n)	—	—	—	—	—	—	—	—	—	○	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

A value specified in (s3) is written to a parameter (s2) in an inverter connected to the channel to be used (n) whose station number is (s1). For details, refer to  Serial communication manual. (For the parameter numbers, refer to the each inverter manual.)

Precautions

Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

Operation error

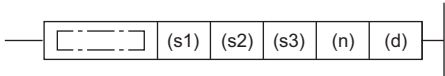
Error code (SD0/SD8067)	Description
1810	Channel number specified by (d) is used by another instruction.
2820	The specified device exceeds the range of the corresponding device.
3405	The value specified by (s1) is other than any of K0 to 31.
	The value specified by (s2) is outside the allowable range. (Less than K0, K3000 to 9999, or K13000 to 32767)
	The value specified by (n) is other than any of K1 to 4.
3600	Channel number specified by (d) is not set by parameters.

For communication errors, refer to  Serial communication manual.

12.5 Inverter parameter block write

IVBWR

This instruction writes parameters of an inverter from the CPU module in a batch.

Ladder diagram	Structured text
	<pre>ENO:=IVBWR(EN,s1,s2,s3,n,d);</pre>

12

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Inverter station number	K0 to 31	16-bit signed binary	ANY16
(s2)	Number of parameters in an inverter to be written at one time	*1	16-bit signed binary	ANY16
(s3)	Start device of a parameter table to be written to an inverter	—	16-bit signed binary	ANY16
(n)	Channel to be used	K1 to 4	16-bit unsigned binary	ANY16_U
(d)	Head bit device to which the execution status of the instruction is output	—	Bit	ANY_BOOL

*1 Refer to Serial communication manual or respective inverter manual.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s3)	—	—	—	○	○	—	—	—	○	—	—	—	—
(n)	—	—	—	—	—	—	—	—	—	○	—	—	—
(d)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

A data table specified in (s2) and (s3) is written to an inverter connected to the channel to be used (n) whose station number is (s1) in batch. For details, refer to Serial communication manual. (For the parameter numbers, refer to the each inverter manual.)

Precautions

Three devices are occupied from the device specified in (d). Make sure that these devices are not used in other controls.

Operation error

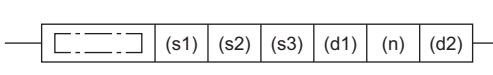
Error code (SD0/SD8067)	Description
1810	Channel number specified by (d) is used by another instruction.
2820	The specified device exceeds the range of the corresponding device.
3405	The value specified by (s1) is other than any of K0 to 31.
	The value specified by (s2) is K0 or less.
	The value specified by (s3) is outside the allowable range. (Less than K0, K3000 to 9999, or K13000 to 32767)
	The value specified by (n) is other than any of K1 to 4.
3600	Channel number specified by (d) is not set by parameters.

For communication errors, refer to Serial communication manual.

12.6 Inverter multi command

IVMC


This instruction writes 2 types of settings (operation command and set frequency) to the inverter, and reads 2 types of data (inverter status monitor, output frequency, etc.) from the inverter at the same time.

Ladder diagram	Structured text
	<pre>ENO:=IVMC(EN,s1,s2,s3,n,d1,d2);</pre>

Setting data

■Descriptions, ranges, and data types

Operand	Description	Range	Data type	Data type (label)
(s1)	Inverter station number	K0 to 31	16-bit signed binary	ANY16
(s2)	Multiple instructions for inverter: Send/receive data type specification	*1	16-bit signed binary	ANY16
(s3)	Head device which stores data to be written to the inverter	—	16-bit signed binary	ANY16
(d1)	Head device which stores values to be read from the inverter	—	16-bit signed binary	ANY16
(n)	Channel to be used	K1 to 4	16-bit unsigned binary	ANY16_U
(d2)	Head bit device to which the execution status of the instruction is output	—	Bit	ANY_BOOL


*1  Refer to Serial communication manual.

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s3)	—	—	—	○	○	—	—	—	○	—	—	—	—
(d1)	—	—	—	○	○	—	—	—	○	—	—	—	—
(n)	—	—	—	—	—	—	—	—	—	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

This instruction executes multiple commands of an inverter connected to the channel to be used (n) whose station number is specified in (s1). Specify the send/receive data type using (s2), the head device which stores data to be written to the inverter using (s3), and the head device which stores values to be read from the inverter using (d1). For details, refer to  Serial communication manual.

Precautions

- If a device number outside the range due to indexing, etc. is specified in (d1), the receive data from the inverter is not stored in (d1). However, values set in (s3) and (s3)+1 may be written to the inverter.
- If any unspecified value is set in (s2), unexpected data may be written to and read from the inverter, and values of (d1) and (d1)+1 may be updated.
- The IVMC instruction reads the inverter status at the time of communication with the inverter, and stores it in (d1). Accordingly, the inverter status written by the IVMC instruction can be read when the next reading instruction (IVCK, IVMC, etc.) is executed.
- Two devices are occupied from the device specified in (s3) and (d1). Make sure that these devices are not used in other controls.
- Three devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

Operation error

Error code (SD0/SD8067)	Description
1810	Channel number specified by (d) is used by another instruction.
2820	The specified device exceeds the range of the corresponding device.
3405	The value specified by (s1) is other than any of K0 to 31.
	The value specified by (n) is other than any of K1 to 4.
3600	Channel number specified by (d) is not set by parameters.

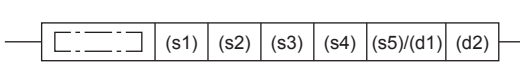
For communication errors, refer to  Serial communication manual.

13 MODBUS COMMUNICATION INSTRUCTION

13.1 MODBUS Read/Write

ADPRW

This instruction allows the MODBUS Master to communicate (read/write data) with the Slaves.

Ladder diagram	Structured text
	ENO:=ADPRW(EN,s1,s2,s3,s4,s5d1,d2);

Setting data

■Descriptions, ranges, and data types


Operand	Description	Range	Data type	Data type (label)
(s1)	Slave node address	0 to 20H	16-bit signed binary	ANY16
(s2)	Function code	01H to 06H, 0FH, 10H	16-bit signed binary	ANY16
(s3)	Function parameters depending on the function code	0 to FFFFH	16-bit signed binary	ANY16
(s4)	Function parameters depending on the function code	1 to 2000	16-bit signed binary	ANY16
(s5)/(d1)	Function parameters depending on the function code	—	Bit/16-bit signed binary	ANY_ELEMENTARY
(d2)	Head bit device number to which the execution status of the communication is output	—	Bit	ANY_BOOL

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(s1)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s3)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s4)	—	—	—	○*1	○	○	—	—	○	○	—	—	—
(s5)/(d1)	○	—	—	○*1	○	○	—	—	○	○	—	—	—
(d2)	○	—	—	○*1	—	—	—	—	—	—	—	—	—

*1 T, ST, C cannot be used.

Processing details

- Function code (s2) is operated on Slave node address (s1) according to Parameters (s3), (s4), and (s5)/(d1). Use 0 as the Slave Node Address for Broadcast commands. For details, refer to  MODBUS communication manual.
- The communication execution status (d2) is output according to the status of the ADPRW instruction such as communicating/completed normally/completed with an error.

Precautions

Three devices are occupied from the device specified in (d2). Make sure that these devices are not used in other controls.

Operation error

Error code (SD0/SD8067)	Description
1810	Channel used by the instruction is used by other instruction.
3600	Invalid parameter setup.
2822	Device that cannot be used by this instruction is specified.
3405	Data outside the allowable range was input.
2820	The specified device exceeds the range of the corresponding device.

For communication errors, refer to  MODBUS communication manual.

14 DIVIDED DATA READ/WRITE FROM/TO BFM INSTRUCTION

14.1 Divided BFM Read

RBFM

This instruction reads data from continuous buffer memory areas in an FX3 series intelligent function module

Ladder diagram	Structured text
	ENO:=RBFM(EN,UnHn,s,n1,n2,d);

Setting data

■Descriptions, ranges, and data types

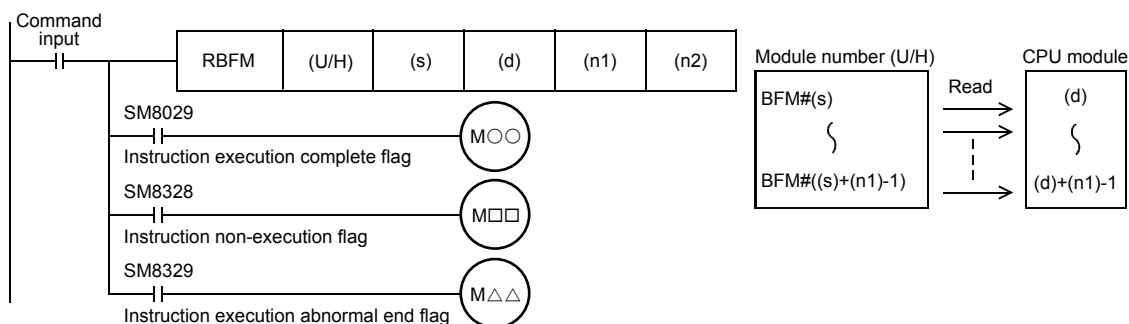
Operand	Description	Range	Data type	Data type (label)
(U/H)	Module number	K1 to 16	16-bit unsigned binary	ANY16_U
(s)	Head buffer memory number	0 to 32767	16-bit unsigned binary	ANY16_U
(d)	Head device number storing data to be read from buffer memory	—	16-bit signed binary	ANY16
(n1)	Number of all buffer memory areas to be read	1 to 32768	16-bit unsigned binary	ANY16_U
(n2)	Not used	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U/H)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s)	○	—	—	○	○	○	—	—	○	○	—	—	—
(d)	—	—	—	○	—	○	—	—	○	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- This instruction reads (n1) points of buffer memory starting from (s) inside the intelligent function module number (U/H) to (d) in the CPU module. When (n1) exceeds 64 points, it divides and reads by several scans. (64 points are read in one scan)



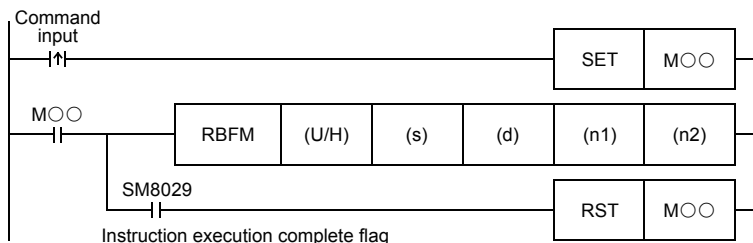
- When this instruction is finished normally, instruction execution complete flag (SM8029) turns on. When this instruction is finished abnormally, instruction execution abnormal end flag (SM8329) turns on.
- When this instruction or the WBFM instruction is executed in the same scan, instruction non-execution flag (SM8328) is set to on, and execution of such an instruction is paused. When execution of the other target instruction is complete, the paused instruction resumes.

■Related devices

Device	Name	Description
SM8029	Instruction execution complete	Turns ON when an instruction is finished normally.
SM8328	Instruction non-execution	Turns ON when the RBFM instruction or WBFM instruction in another step is executed for the same module number.
SM8329	Instruction execution abnormal end	Turns ON when an instruction is finished abnormally.

Precautions

- Do not stop the instruction while it is being executed. If driving is stopped, the buffer memory reading processing is suspended, but the data that is already read is stored in (d) onwards. Stop the instruction after execution completes as in the following program.




- When indexing is executed, the contents of index registers at the beginning of execution are used. Even if the contents of index registers are changed after the instruction, such changes do not affect the process of the instruction.
- The contents of (n1) points starting from (d) update (change) every scan while this instruction is executed. Use the data after the instruction is completed.
- Do not update (change) the contents of (n1) buffer memory areas starting from the buffer memory (s) while this instruction is executed. If the contents are updated, the intended data may not be read.
- This instruction cannot be used in FX5 series intelligent function modules.
- This instruction cannot be used while a interrupt routine program is being executed.

Operation error

Error code (SD0/SD8067)	Description
2441	Communication procedure with module is not completed correctly when this instruction is executed.
2801	Module with the module number specified by (U/H) does not exist.
2823	The number of transfer points specified by (n1) and the buffer memory number specified by (s) is beyond the buffer memory area range.
2820	The number of transfer points specified by (n1) and the device number specified by (d) is beyond the specified device range.
3580	Instructions that cannot be used in an interrupt routine program are being used.

Common items between RBFM instruction and WBFM instruction

■ Specification of module number of FX3 series intelligent function module and buffer memory

For FX3 series intelligent function module connection method, number of connectable FX3 series intelligent function modules and handling of I/O numbers, refer to  manuals of the CPU module and FX3 series intelligent function modules.

- Module number of FX3 series intelligent function module


Use the module number to specify for which equipment the RBFM/WBFM instruction is used. (Setting range: K1 to K16)

		Module No. 1	Module No. 2	Module No. 3
CPU module	I/O module	Bus conversion module	Intelligent function module	Intelligent function module

A module number is automatically assigned to each intelligent function module connected to the CPU module. The module number is assigned as No.1 → No.2 → No.3... starting from the equipment nearest the CPU module.

- Buffer memory number

The intelligent function module incorporates a RAM memory. The RAM memory is called buffer memory. Buffer memory numbers range from #0 to #32767 and their contents vary depending on the function of the extension equipment. (Setting range: K0 to K32767)

For the contents of buffer memory areas, refer to  manuals of intelligent function modules.

14.2 Divided BFM write

WBFM

This instruction writes data to continuous buffer memory areas in an FX3 series intelligent function module.

Ladder diagram	Structured text
	ENO:=WBFM(EN,UnHn,s1,s2,n1,n2);

Setting data

■Descriptions, ranges, and data types

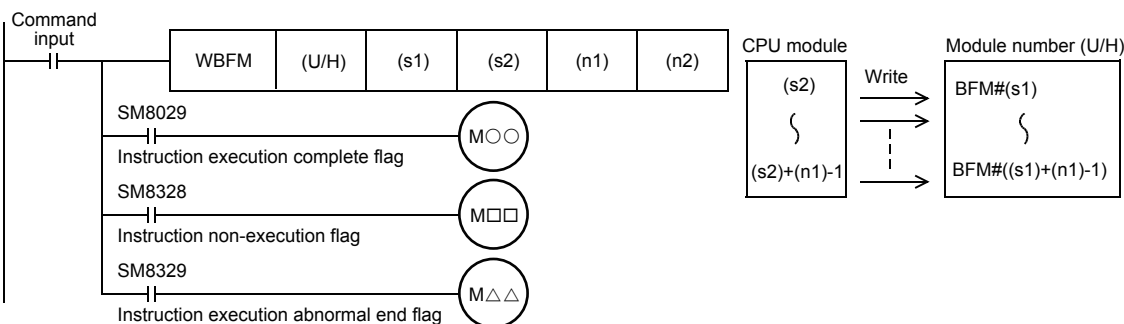
Operand	Description	Range	Data type	Data type (label)
(U/H)	Module number	K1 to 16	16-bit unsigned binary	ANY16_U
(s1)	Head buffer memory number	0 to 32767	16-bit unsigned binary	ANY16_U
(s2)	Head device number storing data to be written to buffer memory	—	16-bit signed binary	ANY16
(n1)	Number of all buffer memory areas to be written	1 to 32768	16-bit unsigned binary	ANY16_U
(n2)	Not used	—	16-bit unsigned binary	ANY16_U

■Applicable devices

Operand	Bit			Word			Double word		Indirect specification	Constant			Others
	X, Y, M, L, SM, F, B, SB	U□\G□	T, ST, C, LC	T, ST, C, D, W, SD, SW, R	U□\G□	Z	LC	LZ		K, H	E	\$	
(U/H)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(s2)	—	—	—	○	—	○	—	—	○	—	—	—	—
(n1)	○	—	—	○	○	○	—	—	○	○	—	—	—
(n2)	○	—	—	○	○	○	—	—	○	○	—	—	—

Processing details

- This instruction writes (n1) points of buffer memory starting from (s1) inside the intelligent function module number (U/H) to (s2) in the CPU module. When (n1) exceeds 64 points, it divides and writes by several scans. (64 points are read in one scan)



- When this instruction is finished normally, instruction execution complete flag (SM8029) turns on. When this instruction is finished abnormally, instruction execution abnormal end flag (SM8329) turns on.
- When this instruction or the RBFM instruction is executed in the same scan, instruction non-execution flag (SM8328) is set to on, and execution of such an instruction is paused. When execution of the other target instruction is complete, the paused instruction resumes.

■Related devices

Device	Name	Description
SM8029	Instruction execution complete	Turns ON when an instruction is finished normally.
SM8328	Instruction non-execution	Turns ON when the RBFM instruction or WBFM instruction in another step is executed for the same module number.
SM8329	Instruction execution abnormal end	Turns ON when an instruction is finished abnormally.

Precautions

- Do not stop the instruction while it is being executed. If driving is stopped, the buffer memory write processing is suspended, but the data that is already written is stored in (m2) onwards.
- When indexing is executed, the contents of index registers at the beginning of execution are used. Even if the contents of index registers are changed after the instruction, such changes do not affect the process of the instruction.
- Do not update (change) the contents of (n1) points starting from (s2) while this instruction is executed. If the contents are updated, the intended data may not be written to the buffer memory areas.
- This instruction cannot be used in FX5 series intelligent function modules.
- This instruction cannot be used while a interrupt routine program is being executed.

Operation error

Error code (SD0/SD8067)	Description
2441	Communication procedure with module is not completed correctly when this instruction is executed.
2801	Module with the module number specified by (U/H) does not exist or the specified module is not an FX series module.
2823	The number of transfer points specified by (n1) and the buffer memory number specified by (s1) is beyond the buffer memory range.
2820	The number of transfer points specified by (n1) and the device number specified by (s2) is beyond the specified device range.
3580	Instructions that cannot be used in an interrupt routine program are being used.

This part consists of the following chapters.

15 TYPE CONVERSION FUNCTIONS

16 SINGLE NUMBER VARIABLE FUNCTIONS

17 ARITHMETIC OPERATION FUNCTIONS

18 BIT SHIFT FUNCTIONS

19 STANDARD BITWISE BOOLEAN FUNCTIONS

20 SELECTION FUNCTIONS

21 COMPARISON FUNCTIONS

22 CHARACTER STRING FUNCTIONS

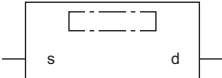
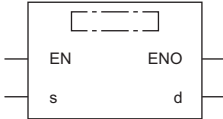
23 TIME DATA FUNCTIONS

15 TYPE CONVERSION FUNCTIONS

15.1 Converting BOOL to WORD

BOOL_TO_WORD(_E)

These functions convert BOOL type data to WORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=BOOL_TO_WORD(s); [With EN/ENO] d:=BOOL_TO_WORD_E(EN,ENO,s);
		

Setting data

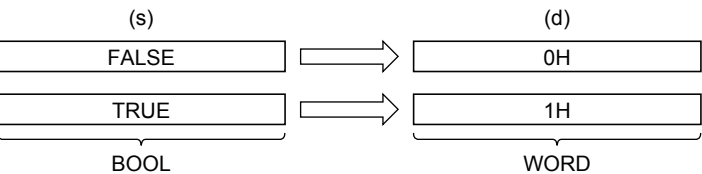
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	WORD

Processing details

■Operation processing

- These functions convert the BOOL type data input to (s) to WORD type data and output from (d).
- When the input value is "FALSE", these functions output 0H as the WORD type data value.
- When the input value is "TRUE", these functions output 1H as the WORD type data value.



- A value input to (s) is the BOOL type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.2 Converting BOOL to DWORD

BOOL_TO_DWORD(_E)

These functions convert BOOL type data to DWORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=BOOL_TO_DWORD(s); [With EN/ENO] d:=BOOL_TO_DWORD_E(EN,ENO,s);

Setting data

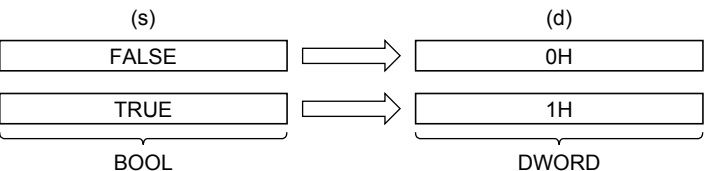
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DWORD

Processing details

■Operation processing

- These functions convert the BOOL type data input to (s) to DWORD type data and output from (d).
- When the input value is "FALSE", these functions output 0H as the DWORD type data value.
- When the input value is "TRUE", these functions output 1H as the DWORD type data value.



- A value input to (s) is the BOOL type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.3 Converting BOOL to INT

BOOL_TO_INT(_E)

These functions convert BOOL type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=BOOL_TO_INT(s); [With EN/ENO] d:=BOOL_TO_INT_E(EN,ENO,s);

Setting data

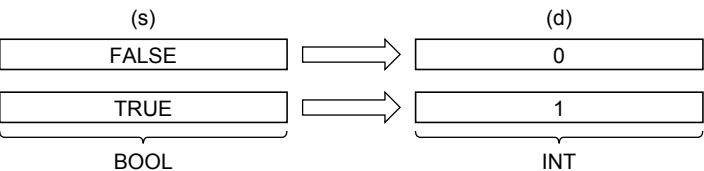
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the BOOL type data input to (s) to INT type data and output from (d).
- When the input value is "FALSE", these functions output 0 as the INT type data value.
- When the input value is "TRUE", these functions output 1 as the INT type data value.



- A value input to (s) is the BOOL type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

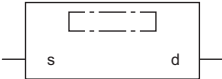
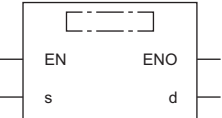
Operation error

There is no operation error.

15.4 Converting BOOL to DINT

BOOL_TO_DINT(_E)

These functions convert BOOL type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=BOOL_TO_DINT(s); [With EN/ENO] d:=BOOL_TO_DINT_E(EN,ENO,s);

Setting data

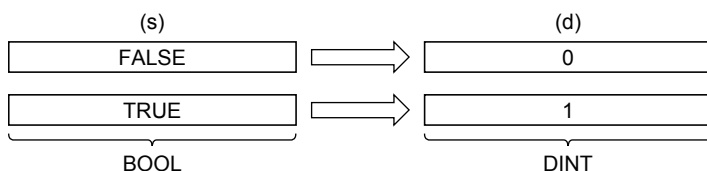
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the BOOL type data input to (s) to DINT type data and output from (d).
- When the input value is "FALSE", these functions output 0 as the DINT type data value.
- When the input value is "TRUE", these functions output 1 as the DINT type data value.



- A value input to (s) is the BOOL type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.5 Converting BOOL to TIME

BOOL_TO_TIME(_E)

These functions convert BOOL type data to TIME type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=BOOL_TO_TIME(s); [With EN/ENO] d:=BOOL_TO_TIME_E(EN,ENO,s);

Setting data

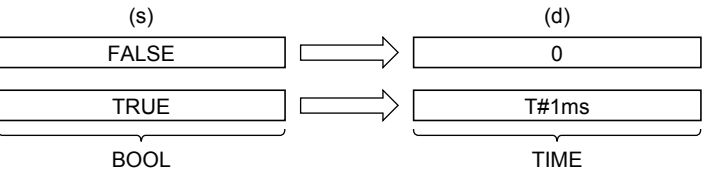
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions convert the BOOL type data input to (s) to TIME type data and output from (d).
- When the input value is "FALSE", these functions output 0 as the TIME type data value.
- When the input value is "TRUE", these functions output 1 as the TIME type data value.



- A value input to (s) is the BOOL type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.6 Converting BOOL to STRING

BOOL_TO_STRING(_E)

These functions convert BOOL type data to STRING type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=BOOL_TO_STRING(s); [With EN/ENO] d:=BOOL_TO_STRING_E(EN,ENO,s);

Setting data

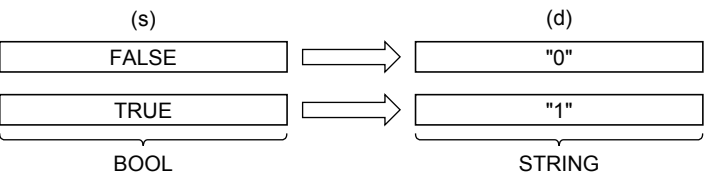
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING

Processing details

■Operation processing

- These functions convert the BOOL type data input to (s) to STRING type data and output from (d).
- When the input value is "FALSE", these functions output 0 as the STRING type data value.
- When the input value is "TRUE", these functions output 1 as the STRING type data value.



- A value input to (s) is the BOOL type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

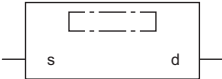
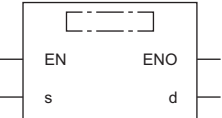
Operation error

There is no operation error.

15.7 Converting WORD to BOOL

WORD_TO_BOOL(_E)

These functions convert WORD type data to BOOL type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=WORD_TO_BOOL(s); [With EN/ENO] d:=WORD_TO_BOOL_E(EN,ENO,s);

Setting data

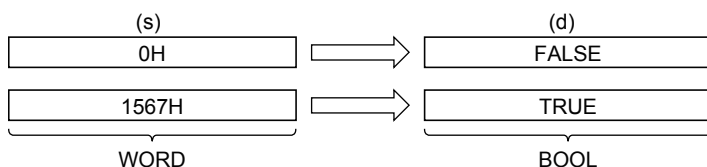
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	WORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions convert the WORD type data input to (s) to BOOL type data and output from (d).
- When the input value is 0H, these functions output "FALSE".
- When the input value is any value other than 0H, these functions output "TRUE".



- A value input to (s) is the WORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


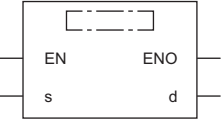
Operation error

There is no operation error.

15.8 Converting WORD to DWORD

WORD_TO_DWORD(_E)

These functions convert WORD type data to DWORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=WORD_TO_DWORD(s); [With EN/ENO] d:=WORD_TO_DWORD_E(EN,ENO,s);
		

Setting data

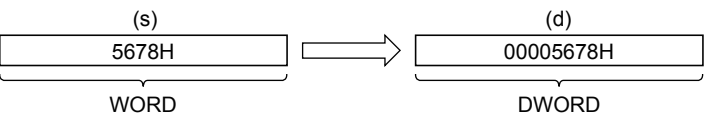
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	WORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DWORD

Processing details

■Operation processing

- These functions convert the WORD type data input to (s) to DWORD type data and output from (d).
- Each of high-order 16 bits becomes "0" after data conversion.



- A value input to (s) is the WORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


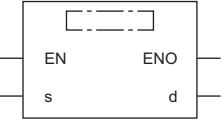
Operation error

There is no operation error.

15.9 Converting WORD to INT

WORD_TO_INT(_E)

These functions convert WORD type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=WORD_TO_INT(s); [With EN/ENO] d:=WORD_TO_INT_E(EN,ENO,s);
		

Setting data

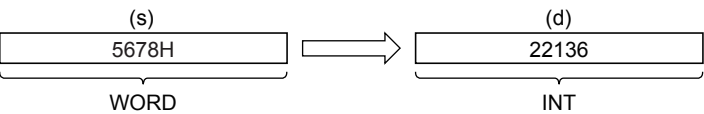
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	WORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the WORD type data input to (s) to INT type data and output from (d).



- A value input to (s) is the WORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.10 Converting WORD to DINT

WORD_TO_DINT(_E)

These functions convert WORD type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=WORD_TO_DINT(s); [With EN/ENO] d:=WORD_TO_DINT_E(EN,ENO,s);

Setting data

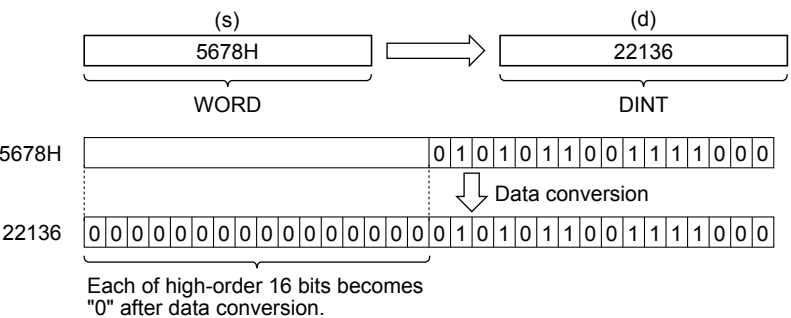
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	WORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the WORD type data input to (s) to DINT type data and output from (d).
- Each of high-order 16 bits becomes "0" after data conversion.



- A value input to (s) is the WORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


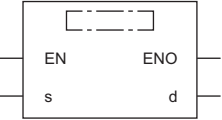
Operation error

There is no operation error.

15.11 Converting WORD to TIME

WORD_TO_TIME(_E)

These functions convert WORD type data to TIME type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=WORD_TO_TIME(s); [With EN/ENO] d:=WORD_TO_TIME_E(EN,ENO,s);

Setting data

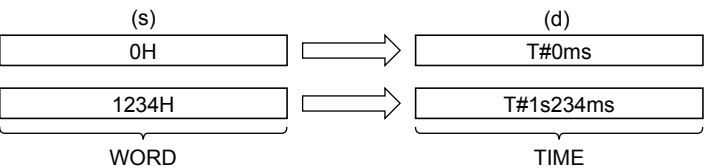
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	WORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions convert the WORD type data input to (s) to TIME type data and output from (d).



- A value input to (s) is the WORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

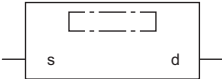
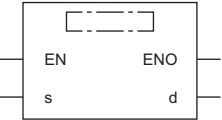
Operation error

There is no operation error.

15.12 Converting DWORD to BOOL

DWORD_TO_BOOL(_E)

These functions convert DWORD type data to BOOL type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=DWORD_TO_BOOL(s); [With EN/ENO] d:=DWORD_TO_BOOL_E(EN,ENO,s);

Setting data

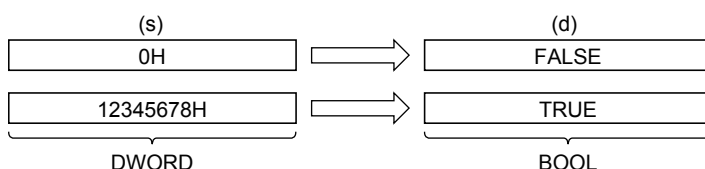
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DWORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions convert the DWORD type data input to (s) to BOOL type data and output from (d).
- When the input value is 0H, these functions output "FALSE".
- When the input value is any value other than 0H, these functions output "TRUE".



- A value input to (s) is the DWORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

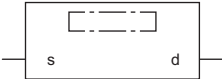
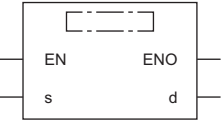
Operation error

There is no operation error.

15.13 Converting DWORD to WORD

DWORD_TO_WORD(_E)

These functions convert DWORD type data to WORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DWORD_TO_WORD(s); [With EN/ENO] d:=DWORD_TO_WORD_E(EN,ENO,s);
		

Setting data

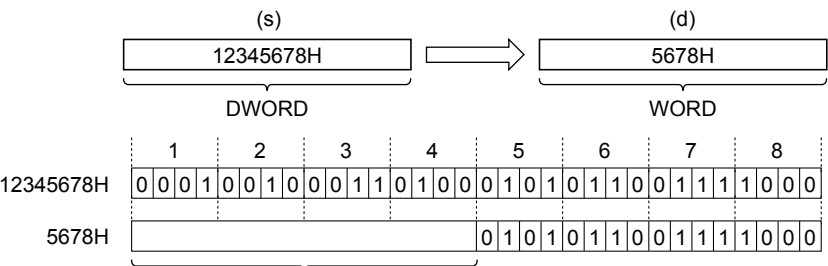
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DWORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	WORD

Processing details

■Operation processing

- These functions convert the DWORD type data input to (s) to WORD type data and output from (d).
- The information stored in high-order 16 bits of an input value is discarded.



The information stored in high-order 16 bits is discarded.

- A value input to (s) is the DWORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Point

When DWORD_TO_WORD(_E) is executed, the information stored in high-order 16 bits of the DWORD type data value input from (s) is discarded.

Operation error

There is no operation error.

15.14 Converting DWORD to INT

DWORD_TO_INT(_E)

These functions convert DWORD type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DWORD_TO_INT(s); [With EN/ENO] d:=DWORD_TO_INT_E(EN,ENO,s);

Setting data

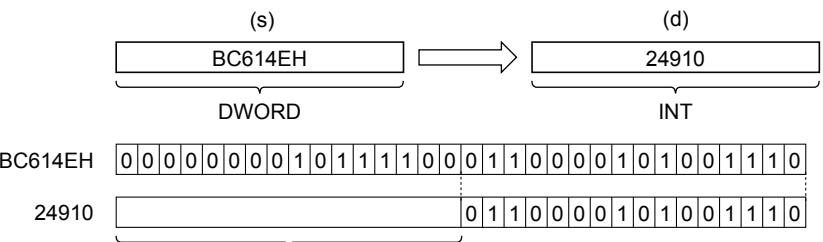
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DWORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the DWORD type data input to (s) to INT type data and output from (d).
- The information stored in high-order 16 bits of an input value is discarded.



The information stored in high-order 16 bits is discarded.

- A value input to (s) is the DWORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Point

When DWORD_TO_INT(_E) is executed, the information stored in high-order 16 bits of the DWORD type data value input from (s) is discarded.


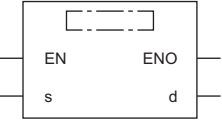
Operation error

There is no operation error.

15.15 Converting DWORD to DINT

DWORD_TO_DINT(_E)

These functions convert DWORD type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=DWORD_TO_DINT(s); [With EN/ENO] d:=DWORD_TO_DINT_E(EN,ENO,s);

Setting data

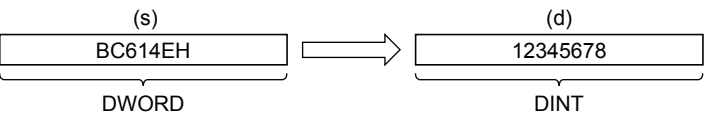
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DWORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the DWORD type data input to (s) to DINT type data and output from (d).



- A value input to (s) is the DWORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


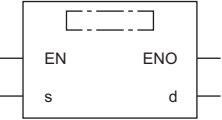
Operation error

There is no operation error.

15.16 Converting DWORD to TIME

DWORD_TO_TIME(_E)

These functions convert DWORD type data to TIME type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DWORD_TO_TIME(s); [With EN/ENO] d:=DWORD_TO_TIME_E(EN,ENO,s);
		

Setting data

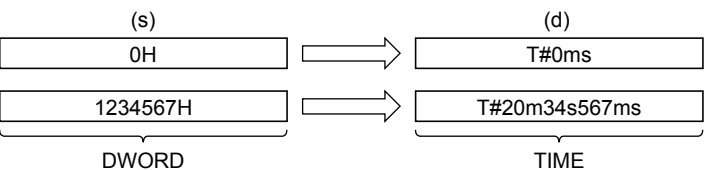
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DWORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions convert the DWORD type data input to (s) to TIME type data and output from (d).



- A value input to (s) is the DWORD type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

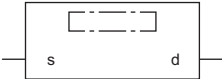
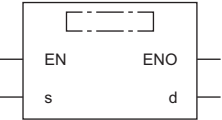
Operation error

There is no operation error.

15.17 Converting INT to BOOL

INT_TO_BOOL(_E)

These functions convert INT type data to BOOL type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=INT_TO_BOOL(s); [With EN/ENO] d:=INT_TO_BOOL_E(EN,ENO,s);
		

Setting data

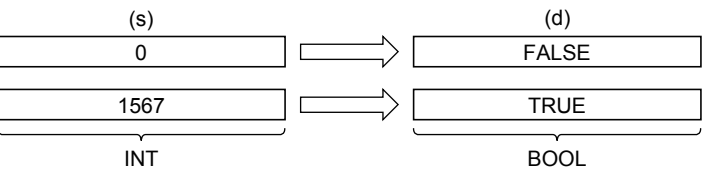
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to BOOL type data and output from (d).
- When the input value is 0, these functions output "FALSE".
- When the input value is any value other than 0, these functions output "TRUE".



- A value input to (s) is the INT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


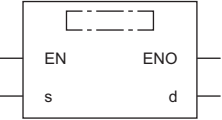
Operation error

There is no operation error.

15.18 Converting INT to WORD

INT_TO_WORD(_E)

These functions convert INT type data to WORD type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=INT_TO_WORD(s); [With EN/ENO] d:=INT_TO_WORD_E(EN,ENO,s);

Setting data

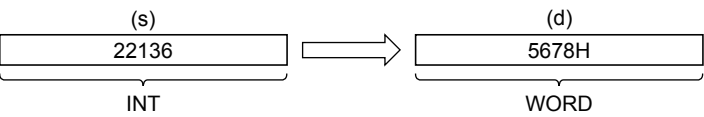
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	WORD

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to WORD type data and output from (d).



- A value input to (s) is the INT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

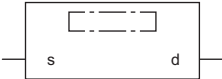
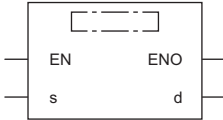
Operation error

There is no operation error.

15.19 Converting INT to DWORD

INT_TO_DWORD(_E)

These functions convert INT type data to DWORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=INT_TO_DWORD(s); [With EN/ENO] d:=INT_TO_DWORD_E(EN,ENO,s);
		

Setting data

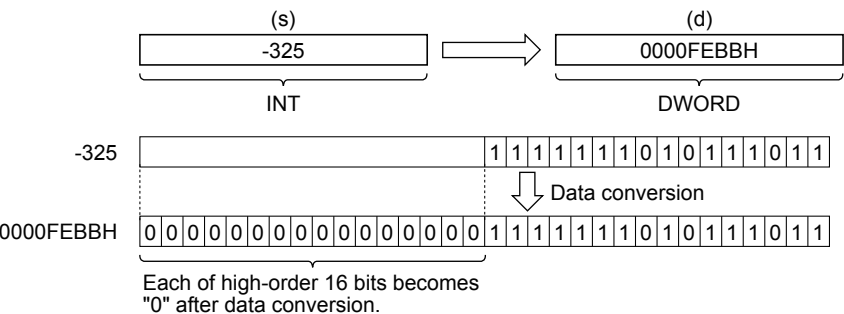
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DWORD

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to DWORD type data and output from (d).
- Each of high-order 16 bits becomes "0" after data conversion.



- A value input to (s) is the INT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


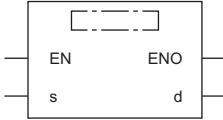
Operation error

There is no operation error.

15.20 Converting INT to DINT

INT_TO_DINT(_E)

These functions convert INT type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=INT_TO_DINT(s); [With EN/ENO] d:=INT_TO_DINT_E(EN,ENO,s);
		

Setting data

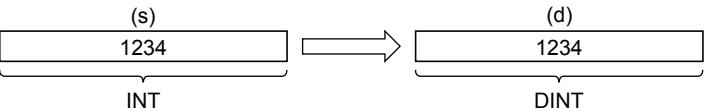
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to DINT type data and output from (d).



- A value input to (s) is the INT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.21 Converting INT to BCD

INT_TO_BCD(_E)

These functions convert INT type data to BCD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=INT_TO_BCD(s); [With EN/ENO] d:=INT_TO_BCD_E(EN,ENO,s);

Setting data

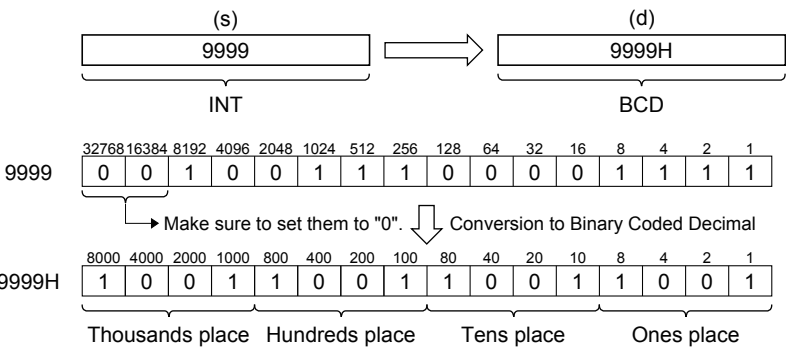
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	WORD

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to BCD type data and output from (d).



- A value input to (s) is the INT type data value and within the range from 0 to 9999.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


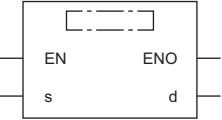
Operation error

Error code (SD0/SD8067)	Description
3401	Data in the device specified by (s) is out of the valid range (0 to 9999).

15.22 Converting INT to REAL

INT_TO_REAL(_E)

These functions convert INT type data to REAL type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=INT_TO_REAL(s); [With EN/ENO] d:=INT_TO_REAL_E(EN,ENO,s);</pre>
		

Setting data

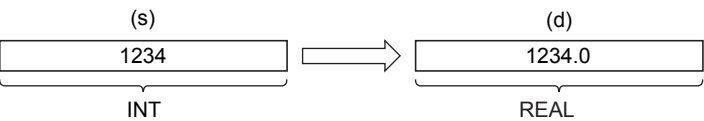
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to REAL type data and output from (d).



- A value input to (s) is the INT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


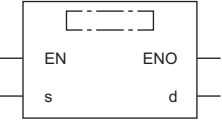
Operation error

There is no operation error.

15.23 Converting INT to TIME

INT_TO_TIME(_E)

These functions convert INT type data to TIME type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=INT_TO_TIME(s); [With EN/ENO] d:=INT_TO_TIME_E(EN,ENO,s);
		

Setting data

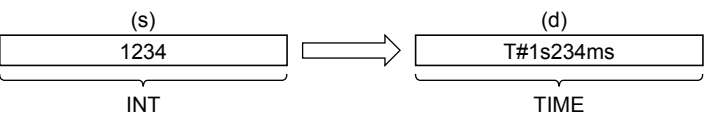
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions convert the INT type data input to (s) to TIME type data and output from (d).



- A value input to (s) is the INT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.24 Converting INT to STRING

INT_TO_STRING(_E)

These functions convert INT type data to STRING type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=INT_TO_STRING(s); [With EN/ENO] d:=INT_TO_STRING_E(EN,ENO,s);

Setting data

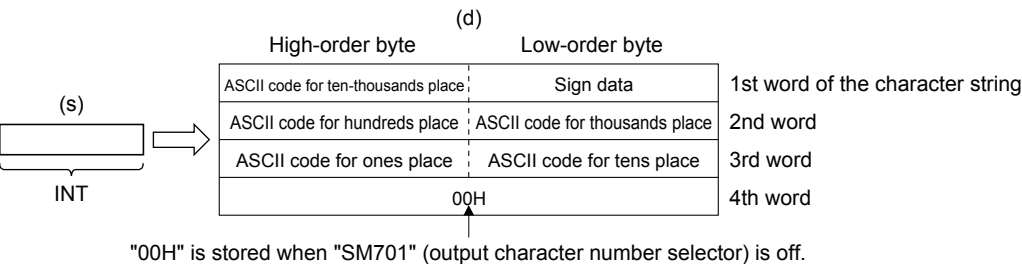
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(6)

Processing details

■Operation processing

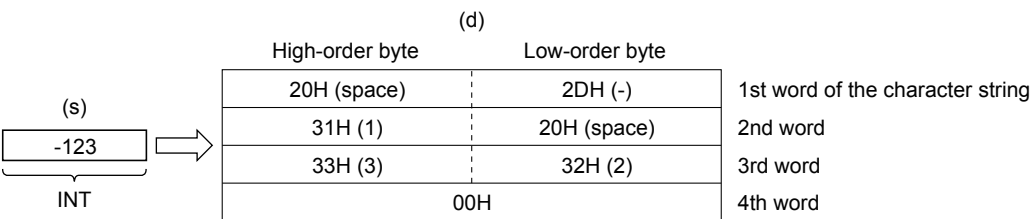
- These functions convert the INT type data input to (s) to STRING type data and output from (d).



- A value input to (s) is the INT type data value.
- In "Sign data", 20H (space) is stored when the input value is positive, and 2DH (-) is stored when the input value is negative.
- 20H (space) is stored in high-order digits when the number of significant figures is small.

Ex.

When "-123" is input



- 00H is stored at the end (4th word) of the character string when SM701 (output character number selector signal) is off.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

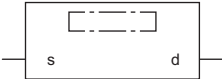
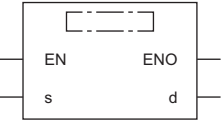
Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "0000H" does not exist.
3405	The character string specified by (s) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

15.25 Converting DINT to BOOL

DINT_TO_BOOL(_E)

These functions convert DINT type data to BOOL type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=DINT_TO_BOOL(s); [With EN/ENO] d:=DINT_TO_BOOL_E(EN,ENO,s);

Setting data

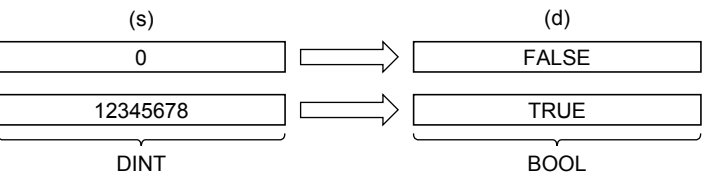
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions convert the DINT type data input to (s) to BOOL type data and output from (d).
- When the input value is 0, these functions output "FALSE".
- When the input value is any value other than 0, these functions output "TRUE".



- A value input to (s) is the DINT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition		Operation result
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


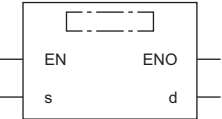
Operation error

There is no operation error.

15.26 Converting DINT to WORD

DINT_TO_WORD(_E)

These functions convert DINT type data to WORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] <code>d:=DINT_TO_WORD(s);</code> [With EN/ENO] <code>d:=DINT_TO_WORD_E(EN,ENO,s);</code>
		

Setting data

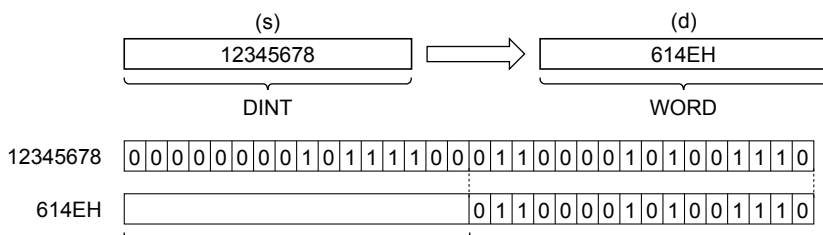
■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	WORD

Processing details

■ Operation processing

- These functions convert the DINT type data input to (s) to WORD type data and output from (d).
- The information stored in high-order 16 bits of an input value is discarded.



The information stored in high-order 16 bits is discarded.

- A value input to (s) is the DINT type data value.

■ Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Point

When DINT_TO_WORD(_E) is executed, the information stored in high-order 16 bits of the DINT type data value input from (s) is discarded.


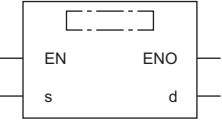
Operation error

There is no operation error.

15.27 Converting DINT to DWORD

DINT_TO_DWORD(_E)

These functions convert DINT type data to DWORD type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=DINT_TO_DWORD(s); [With EN/ENO] d:=DINT_TO_DWORD_E(EN,ENO,s);

Setting data

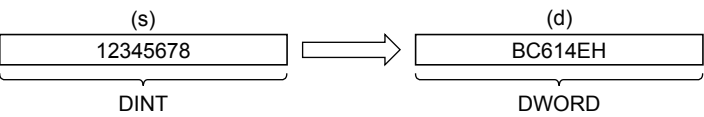
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DWORD

Processing details

■Operation processing

- These functions convert the DINT type data input to (s) to DWORD type data and output from (d).



- A value input to (s) is the DINT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


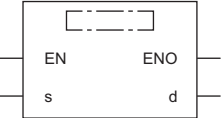
Operation error

There is no operation error.

15.28 Converting DINT to INT

DINT_TO_INT(_E)

These functions convert DINT type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DINT_TO_INT(s); [With EN/ENO] d:=DINT_TO_INT_E(EN,ENO,s);
		

Setting data

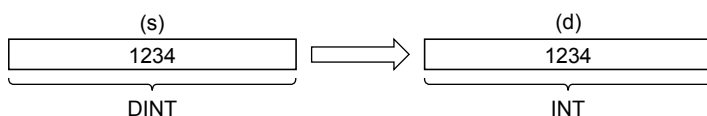
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the DINT type data input to (s) to INT type data and output from (d).



- A value input to (s) is the DINT type data value.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3401	The 32-bit signed binary data in the device specified by (s) is out of the valid range (-32768 to 32767).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- When (d) is WORD

Error code (SD0/SD8067)	Description
3401	The 32-bit signed binary data in the device specified by (s) is out of the valid range (-32768 to 32767).
	Data in the device specified by (s) is out of the valid range (0 to 9999).


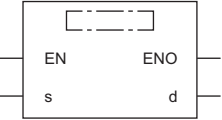
- When (d) is DWORD

Error code (SD0/SD8067)	Description
3401	Data in the device specified by (s) is out of the valid range (0 to 99999999).

15.30 Converting DINT to REAL

DINT_TO_REAL(_E)

These functions convert DINT type data to REAL type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DINT_TO_REAL(s); [With EN/ENO] d:=DINT_TO_REAL_E(EN,ENO,s);
		

Setting data

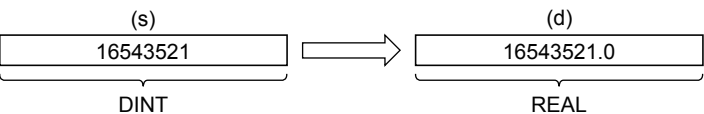
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions convert the DINT type data input to (s) to REAL type data and output from (d).



- A value input to (s) is the DINT type data value.
- The number of significant figures of the REAL type data is approximately 7 since the data is processed in 32-bit single precision.
- The converted data includes an error (rounding error) if an integer value is outside the range of -16777216 to 16777215.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


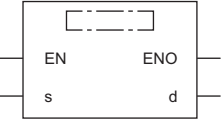
Operation error

There is no operation error.

15.31 Converting DINT to TIME

DINT_TO_TIME(_E)

These functions convert DINT type data to TIME type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=DINT_TO_TIME(s); [With EN/ENO] d:=DINT_TO_TIME_E(EN,ENO,s);

Setting data

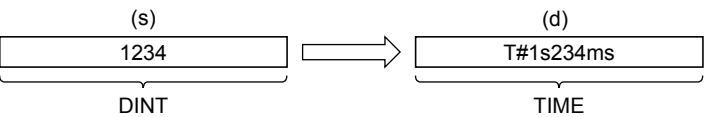
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions convert the DINT type data input to (s) to TIME type data and output from (d).



- A value input to (s) is the DINT type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

15.32 Converting DINT to STRING

DINT_TO_STRING(_E)

These functions convert DINT type data to STRING type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DINT_TO_STRING(s); [With EN/ENO] d:=DINT_TO_STRING_E(EN,ENO,s);

Setting data

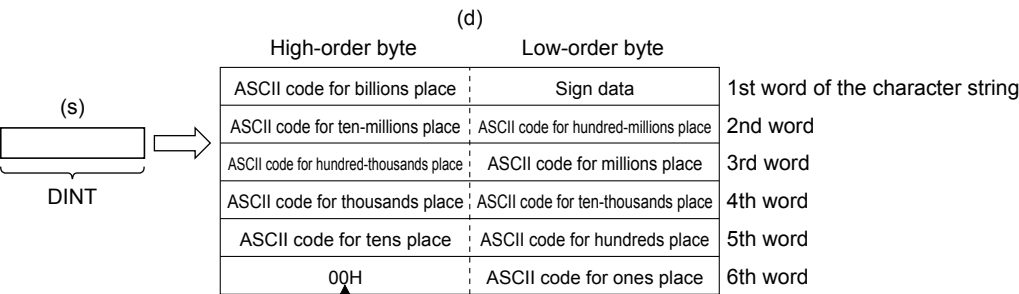
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	DINT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(11)

Processing details

■Operation processing

- These functions convert the DINT type data input to (s) to STRING type data and output from (d).

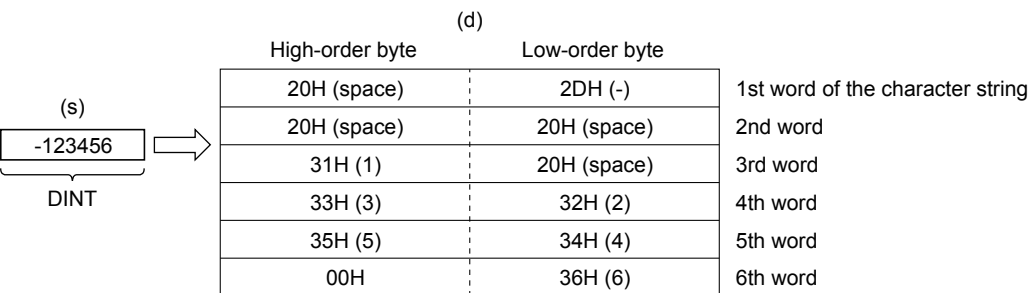


"00H" is stored when "SM701" (output character number selector) is off.

- A value input to (s) is the DINT type data value.
- In "Sign data", 20H (space) is stored when the input value is positive, and 2DH (-) is stored when the input value is negative.
- 20H (space) is stored in high-order digits when the number of significant figures is small.

Ex.

When "-123456" is input



- 00H is stored at the end (high-order byte of the 6th word) of the character string when SM701 (output character number selector signal) is off.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


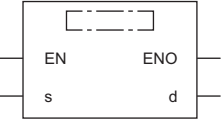
Operation error

There is no operation error.

15.33 Converting BCD to INT

BCD_TO_INT(_E)

These functions convert BCD type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=BCD_TO_INT(s); [With EN/ENO] d:=BCD_TO_INT_E(EN,ENO,s);
		

Setting data

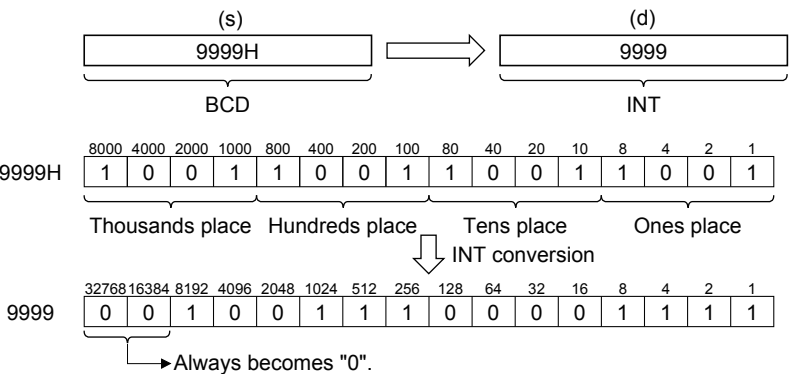
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	WORD
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the BCD type data input to (s) to INT type data and output from (d).



- A value input to (s) is the WORD type data value and within the range from 0H to 9999H (from 0 to 9 for each digit).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

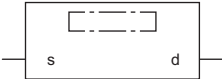
Operation error

Error code (SD0/SD8067)	Description
3401	A value other than 0 to 9 exists in each digit of (s).

15.34 Converting BCD to DINT

BCD_TO_DINT(_E)

These functions convert BCD type data to DINT type data.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=BCD_TO_DINT(s);</p> <p>[With EN/ENO] d:=BCD_TO_DINT_E(EN,ENO,s);</p>

Setting data

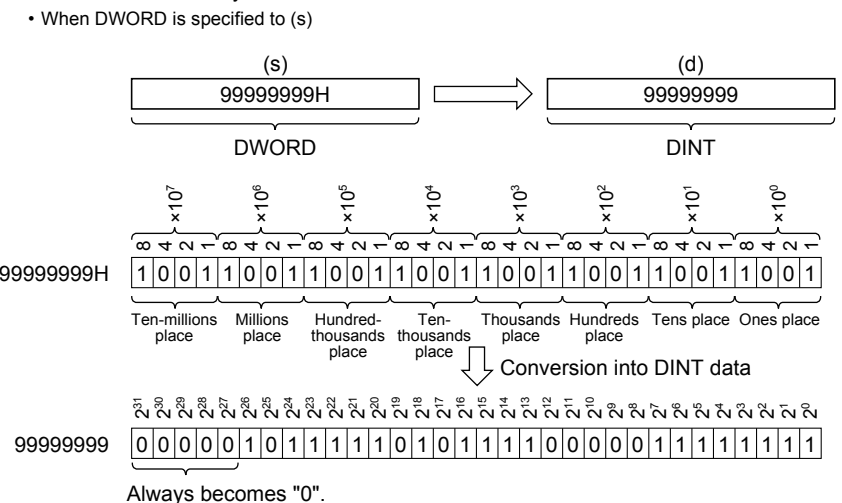
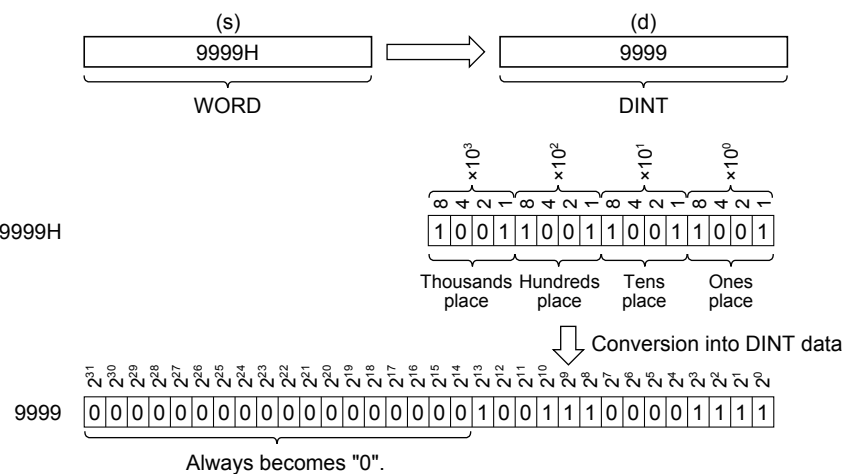
■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■ Operation processing

- These functions convert the BCD type data input to (s) to DINT type data and output from (d).
 - When WORD is specified to (s)



- A value input to (s) is within the range from 0H to 9999H (from 0 to 9 for each digit) for the WORD type data value and from 0H to 99999999H (from 0 to 9 for each digit) for the DWORD type data value.
- WORD or DWORD can be specified to (s). BOOL cannot be specified.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- When (s) is WORD

Error code (SD0/SD8067)	Description
3401	A value other than 0 to 9 exists in each digit of (s).


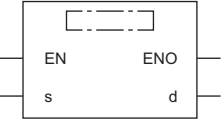
- When (s) is DWORD

Error code (SD0/SD8067)	Description
3401	A value other than 0 to 9 exists in each digit of (s).

15.35 Converting REAL to INT

REAL_TO_INT(_E)

These functions convert REAL type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=REAL_TO_INT(s); [With EN/ENO] d:=REAL_TO_INT_E(EN,ENO,s);
		

Setting data

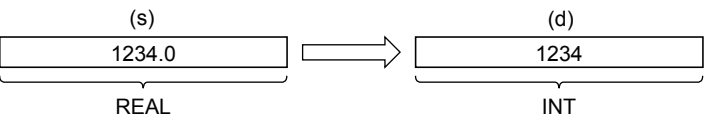
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the REAL type data input to (s) to INT type data and output from (d).



- A value input to (s) is the REAL type data value and within the range from -32768 to 32767.
- After conversion, the first digit after the decimal point of the REAL type data value is rounded off.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3401	The single-precision real number in the device specified by (s) is out of the valid range (-32768 to 32767).
3402	<ul style="list-style-type: none">• A special number is set to (s).• The set single-precision real number is not located within the following range. $0, 2^{-126} \leq (s) < 2^{128}$• The set device or label value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

15.36 Converting REAL to DINT

REAL_TO_DINT(_E)

These functions convert REAL type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=REAL_TO_DINT(s); [With EN/ENO] d:=REAL_TO_DINT_E(EN,ENO,s);

Setting data

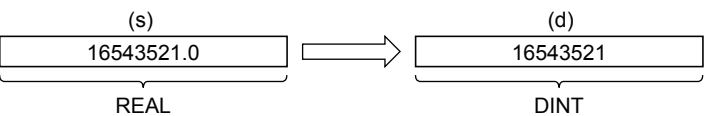
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the REAL type data input to (s) to DINT type data and output from (d).



- A value input to (s) is the REAL type data value and within the range from -2147483648 to 2147483647.
- After conversion, the first digit after the decimal point of the REAL type data value is rounded off.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


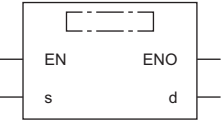
Operation error

Error code (SD0/SD8067)	Description
3401	The single-precision real number in the device specified by (s) is out of the valid range (-2147483648 to 2147483647).
3402	<p>A special number is set to (s).</p> <ul style="list-style-type: none">• The set single-precision real number is not located within the following range. $0, 2^{-126} \leq (s) < 2^{128}$• The set device or label value is -0, denormalized number, NaN (not a number), or $\pm\infty$.

15.37 Converting REAL to STRING

REAL_TO_STRING(_E)

These functions convert REAL type data to STRING type data (exponent format).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=REAL_TO_STRING(s); [With EN/ENO] d:=REAL_TO_STRING_E(EN,ENO,s);
		

Setting data

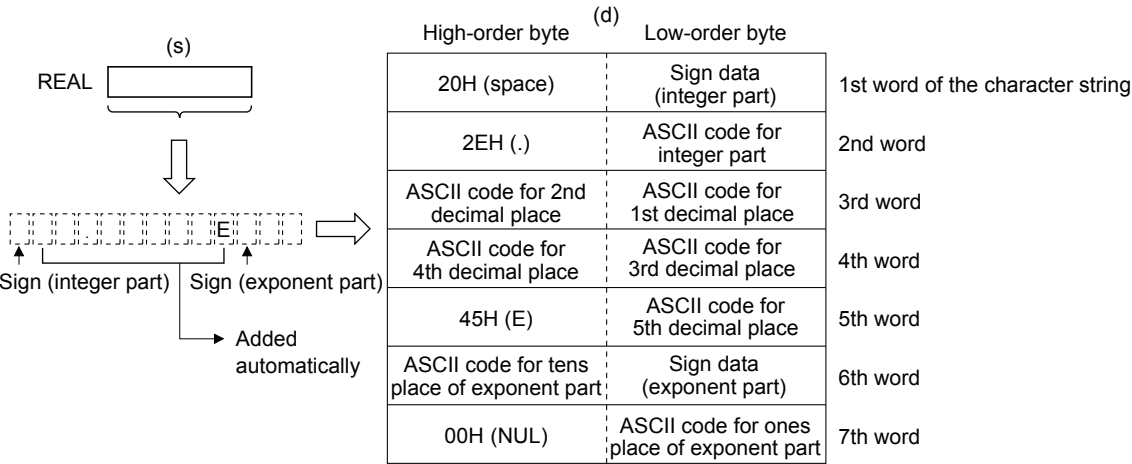
■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(13)

Processing details

■ Operation processing

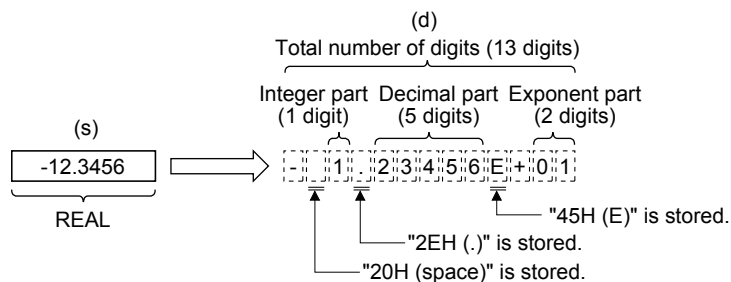
- These functions convert the REAL type data input to (s) to STRING type (exponent format) data and output from (d).



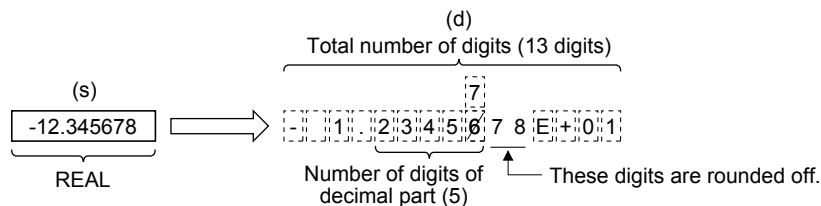
- A value input to (s) is the REAL type data value.

- The string data obtained by conversion is output from (d) as follows:

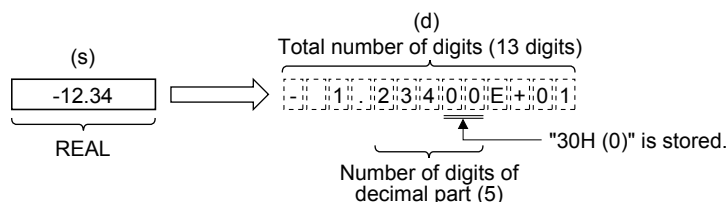
- The number of digits is fixed respectively for the integer part, decimal part and exponent part as follows: Integer part: 1, decimal part: 5, exponent part: 2
- "20H (space)" is stored in the 2nd byte, "2EH (.)" is stored in the 4th byte, and "45H (E)" is stored in the 10th byte automatically.



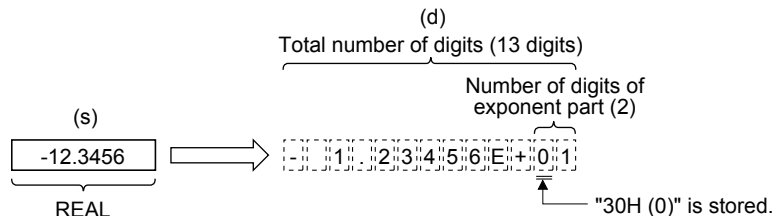
- In "Sign data (integer part)", "20H (space)" is stored when the input value is positive, and "2DH (-)" is stored when the input value is negative.
- The 6th and later digits of the decimal part are rounded.



- "30H (0)" is stored in the decimal part when the number of significant figures is small.



- In "Sign data (exponent part)", "2BH (+)" is stored when the input value is positive, and "2DH (-)" is stored when the input value is negative.
- "30H (0)" is stored in the tens place of the exponent part when the exponent part consists of 1 digit.



- "00H" is automatically stored at the end (7th word) of the character string.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


Operation error

Error code (SD0/SD8067)	Description
3402	(s) is not located within the following range <ul style="list-style-type: none">• $0, 2^{-126} \leq \text{specified device value} < 2^{128}$• (s) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3406	The whole converted character string cannot be stored in the devices from the device specified by (d) to the last device of the target device.

15.38 Converting TIME to BOOL

TIME_TO_BOOL(_E)

These functions convert TIME type data to BOOL type data.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=TIME_TO_BOOL(s);</p> <p>[With EN/ENO] d:=TIME_TO_BOOL_E(EN,ENO,s);</p>

Setting data

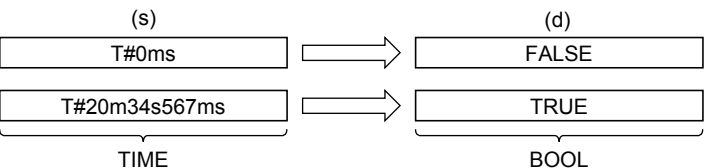
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions convert the TIME type data input to (s) to BOOL type data and output from (d).



■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


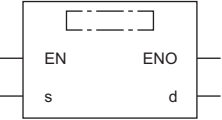
Operation error

There is no operation error.

15.39 Converting TIME to WORD

TIME_TO_WORD(_E)

These functions convert TIME type data to WORD type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=TIME_TO_WORD(s); [With EN/ENO] d:=TIME_TO_WORD_E(EN,ENO,s);
		

Setting data

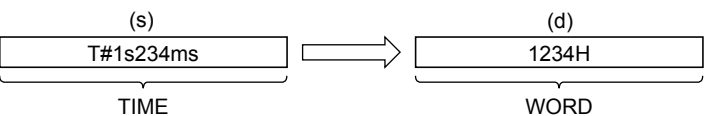
■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	WORD

Processing details

■ Operation processing

- These functions convert the TIME type data input to (s) to WORD type data and output from (d).



- A value input to (s) is the TIME type data value.

■ Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


Operation error

There is no operation error.

15.40 Converting TIME to DWORD

TIME_TO_DWORD(_E)

These functions convert TIME type data to DWORD type data.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=TIME_TO_DWORD(s);</p> <p>[With EN/ENO] d:=TIME_TO_DWORD_E(EN,ENO,s);</p>

Setting data

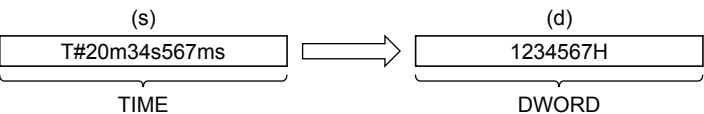
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DWORD

Processing details

■Operation processing

- These functions convert the TIME type data input to (s) to DWORD type data and output from (d).



- A value input to (s) is the TIME type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


Operation error

There is no operation error.

15.41 Converting TIME to INT

TIME_TO_INT(_E)

These functions convert TIME type data to INT type data.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=TIME_TO_INT(s);</p> <p>[With EN/ENO] d:=TIME_TO_INT_E(EN,ENO,s);</p>

Setting data

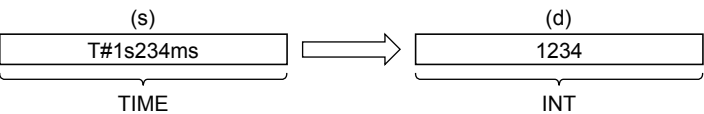
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the TIME type data input to (s) to INT type data and output from (d).



- A value input to (s) is the TIME type data value.
- When the data is converted to INT, the TIME type data stored in high-order 16 bits (1 word) are ignored.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


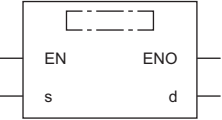
Operation error

There is no operation error.

15.42 Converting TIME to DINT

TIME_TO_DINT(_E)

These functions convert TIME type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=TIME_TO_DINT(s); [With EN/ENO] d:=TIME_TO_DINT_E(EN,ENO,s);

Setting data

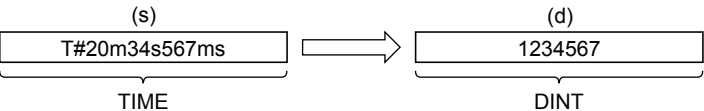
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the TIME type data input to (s) to DINT type data and output from (d).



- A value input to (s) is the TIME type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


Operation error

There is no operation error.

15.43 Converting TIME to STRING

TIME_TO_STRING(_E)

These functions convert TIME type data to STRING type data.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=TIME_TO_STRING(s);</p> <p>[With EN/ENO] d:=TIME_TO_STRING_E(EN,ENO,s);</p>

Setting data

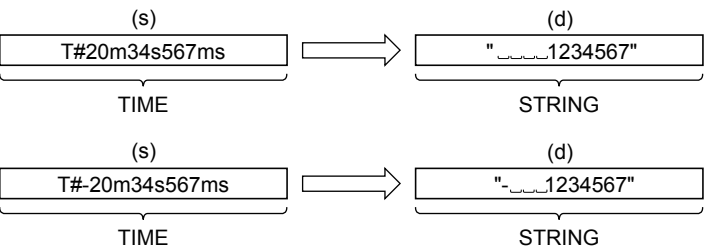
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(11)

Processing details

■Operation processing

- These functions convert the TIME type data input to (s) to STRING type data and output from (d).



- A value input to (s) is the TIME type data value.
- 00H is stored at the end of the character string when SM701 (output character number selector signal) is off.
- The following shows the operation result to be stored in the output.
 - As the 1st character, "20H" (space) is stored if the binary data is positive, and "2DH" (-) is stored if the data is negative.
 - "20H" (space) is stored on the left side of the effective digits.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


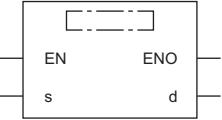
Operation error

There is no operation error.

15.44 Converting STRING to BOOL

STRING_TO_BOOL(_E)

These functions convert STRING type data to BOOL type data.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=STRING_TO_BOOL(s); [With EN/ENO] d:=STRING_TO_BOOL_E(EN,ENO,s);

Setting data

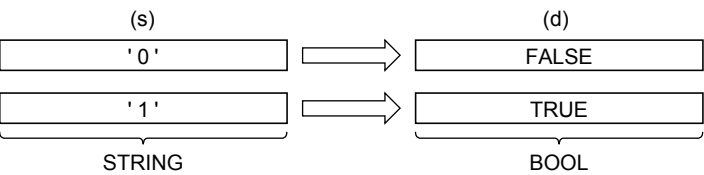
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(1)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions convert the STRING type (in the decimal format or exponent format) data input to (s) to BOOL type data and output from (d).



■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


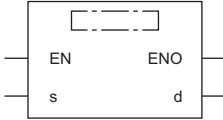
Operation error

There is no operation error.

15.45 Converting STRING to INT

STRING_TO_INT(_E)

These functions convert STRING type data to INT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=STRING_TO_INT(s); [With EN/ENO] d:=STRING_TO_INT_E(EN,ENO,s);
		

Setting data

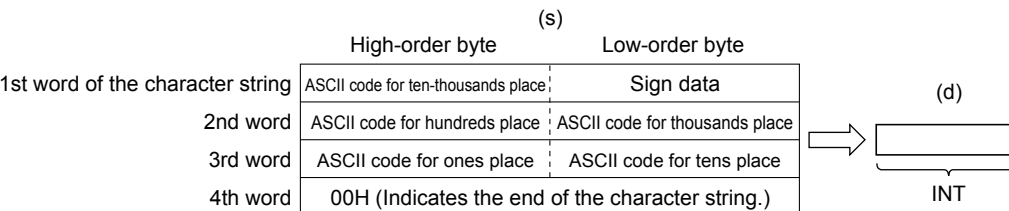
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(6)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions convert the STRING type data input to (s) to INT type data and output from (d).



- A value input to (s) is the STRING type data value and within the following range.
 - Within the range of "30H" to "39H", "20H", "2DH", and "00H" in ASCII code
 - Within the range of "-32768" to "32767" as the STRING type data value

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

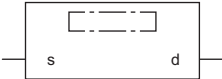
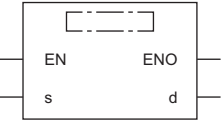
Operation error

Error code (SD0/SD8067)	Description
3401	Invalid data which cannot be converted to (s) are input. <ul style="list-style-type: none">• Values for each place of the ASCII code are other than "30H" to "39H", "20H", and "00H".• Values for the ASCII data are other than "-32768" to "32767" when STRING_TO_INT(_E) is used.

15.46 Converting STRING to DINT

STRING_TO_DINT(_E)

These functions convert STRING type data to DINT type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=STRING_TO_DINT(s); [With EN/ENO] d:=STRING_TO_DINT_E(EN,ENO,s);
		

Setting data

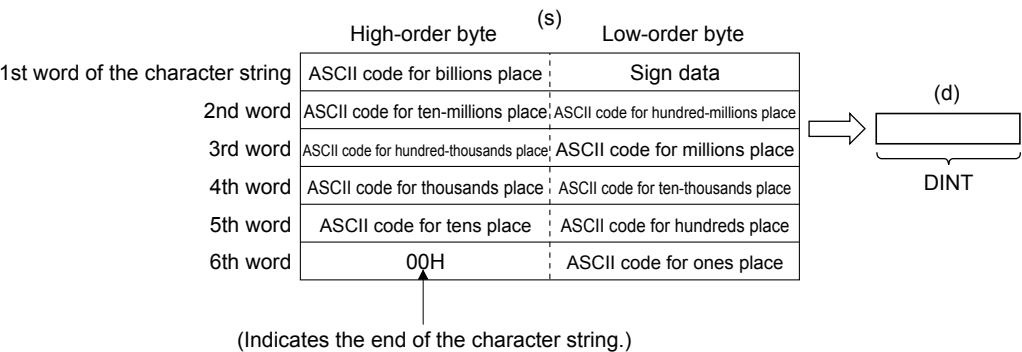
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(11)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	DINT

Processing details

■Operation processing

- These functions convert the STRING type data input to (s) to DINT type data and output from (d).



- A value input to (s) is the STRING type data value and within the following range.
 - Within the range of "30H" to "39H", "20H", "2DH", and "00H" in ASCII code
 - Within the range of "-2147483648" to "2147483647" as the STRING type data value

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

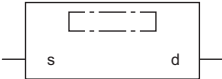
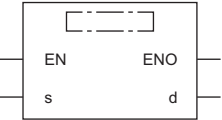
Operation error

Error code (SD0/SD8067)	Description
3401	Invalid data which cannot be converted to (s) are input. <ul style="list-style-type: none">• Values for each place of the ASCII code are other than "30H" to "39H", "20H", and "00H".• Values for the ASCII data are other than "-2147483648" to "2147483647" when STRING_TO_DINT(_E) is used.

15.47 Converting STRING to REAL

STRING_TO_REAL(_E)

These functions convert STRING type data to REAL type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=STRING_TO_REAL(s); [With EN/ENO] d:=STRING_TO_REAL_E(EN,ENO,s);
		

Setting data

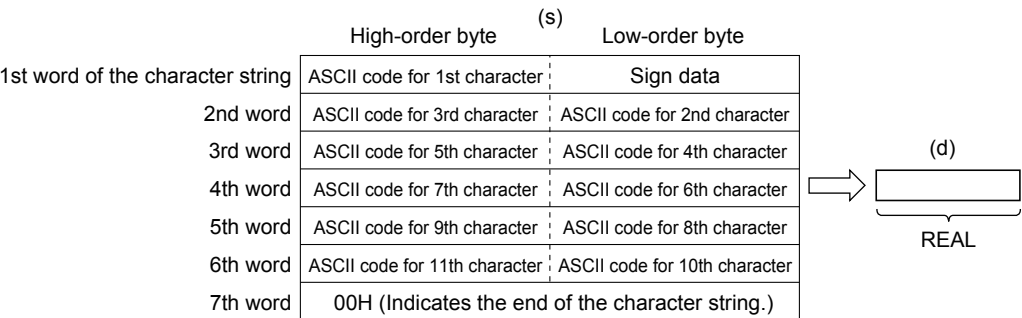
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(24)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

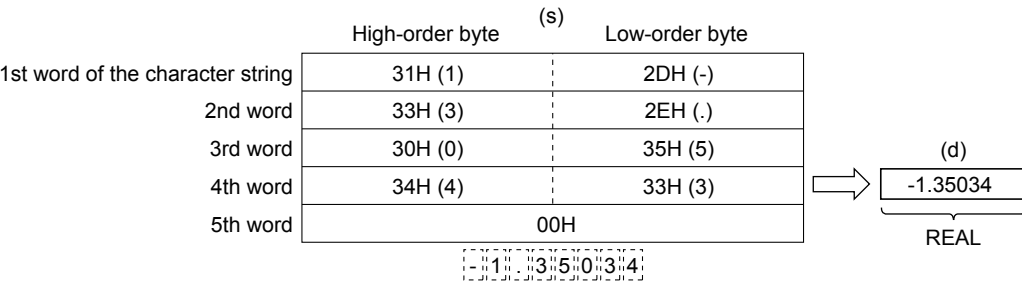
Processing details

■Operation processing

- These functions convert the STRING type (in the decimal format or exponent format) data input to (s) to REAL type data and output from (d).



- The conversion source STRING type data can be in the decimal format or exponent format.
 - Decimal point format

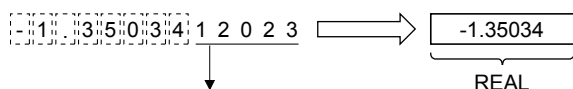


- Exponent format

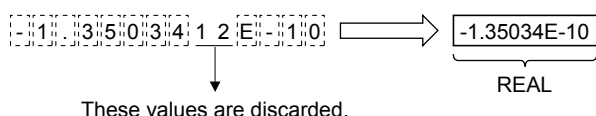
	(s)		
	High-order byte	Low-order byte	
1st word of the character string	31H (1)	2DH (-)	
2nd word	33H (3)	2EH (.)	
3rd word	30H (0)	35H (5)	
4th word	34H (4)	33H (3)	
5th word	2DH (-)	45H (E)	
6th word	30H (0)	31H (1)	
7th word	00H		

- With regard to STRING type data, six digits excluding the sign, decimal point and exponent part are valid, and the 7th and later digits are discarded during conversion.

- Decimal point format

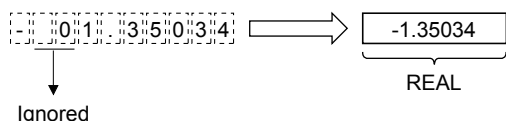


- Exponent format

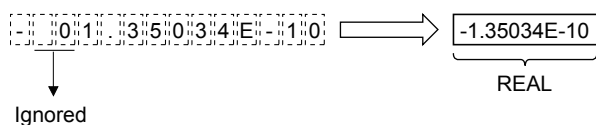


- When 2BH (+) is specified as the sign in the floating point format or when the sign is omitted, a character string is converted into a positive value. It is handled as negative value during conversion when the sign is set to 2DH (-).
- String data in the exponent format is handled as positive value during conversion when the sign of the exponent part is set to 2BH (+) or when the sign is omitted. When 2DH (-) is specified as the sign, a character string is converted into a negative value.
- When 20H (space) or 30H (0) exists between numbers except the first 0 in STRING type data, 20H or 30H is ignored during conversion.

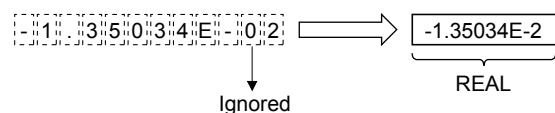
- Decimal point format



- Exponent format



- When 30H (0) exists between a number and "E" in STRING type data (exponent format), 30H is ignored during conversion.



- When 20H (space) is contained in character string, 20H is ignored during conversion.
- Up to 24 characters can be input as STRING type data. 20H (space) and 30H (0) in a character string are counted as one character respectively.
- A value input to (s) is the STRING type data value and within the following range.
 - Within the range of "30H" to "39H", "45H", "2BH", "2DH", "2EH", "20H" and "00H" in ASCII code

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


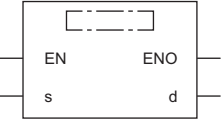
Operation error

Error code (SD0/SD8067)	Description
2820	00H does not exist in the corresponding device range starting from (s)
3401	Invalid data which cannot be converted to (s) are set. <ul style="list-style-type: none"> Any character other than "30(0)" to "39(9)" exists in the integer part or decimal part. 2EH (.) exists in two or more positions in the specified character string. Any character other than 45H (E), 65(e), 2B(+) , or 2D(-) exists in the specified exponent part. Two or more exponent parts of 45H (E) or 65(e) exist in the specified character string. Three or more digits of numerical values in the exponent parts are described in the specified character string. Two or more signs of exponent parts of 2B(+) or 2D(-) exist in the specified character string. Two or more signs of 2B(+) or 2D(-) exist in the integral part for the decimal point format and exist in the mantissa part for the exponent format in the specified character string. The number of characters after (s) is 0 or more than 24
3403	(d) exceeds the following range. (An overflow has occurred.) $ (d) < 2^{128}$

15.48 Converting STRING to TIME

STRING_TO_TIME(_E)

These functions convert STRING type data to TIME type data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=STRING_TO_TIME(s); [With EN/ENO] d:=STRING_TO_TIME_E(EN,ENO,s);
		

Setting data

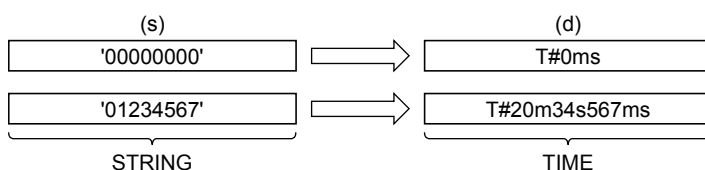
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(11)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions convert the STRING type data input to (s) to TIME type data and output from (d).



- A value input to (s) is the STRING type data value.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

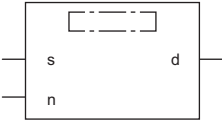
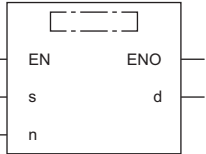
Operation error

Error code (SD0/SD8067)	Description
3401	Values for each place of the ASCII code for input are other than "30H" to "39H", "20H", and "00H". Value of the ASCII code for input are outside the following range. -2147483648 to 4147483647

15.49 Converting Bit Array to INT

BITARR_TO_INT(_E)

These functions convert a bit array to INT type data for a specified number of bits.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=BITARR_TO_INT(s,n); [With EN/ENO] d:=BITARR_TO_INT_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input (Variables are available for element specification.)	Input variable	BOOL array element
n	Only a constant 4, 8, 12 or 16 can be specified.	Input variable	INT
ENO	Output status (TRUE: Normal , FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY16

15

Processing details

■Operation processing

- These functions convert the data for bits specified by (n) starting from the bit array element input to (s) to ANY 16 type data and output from (d).
- "0" is set to output bits beyond the specified number of bits.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

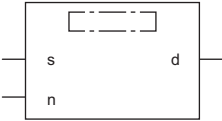
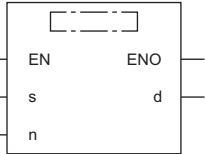
Operation error

There is no operation error.

15.50 Converting Bit Array to DINT

BITARR_TO_DINT(_E)

These functions convert a bit array to DINT type data for a specified number of bits.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=BITARR_TO_DINT(s,n) [With EN/ENO] d:=BITARR_TO_DINT_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input (Variables are available for element specification.)	Input variable	BOOL array element
n	Only a constant 4, 8, 12, 16, 20, 24, 28 or 32 can be specified.	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY32

Processing details

■Operation processing

- These functions convert the data for bits specified by (n) starting from the bit array element input to (s) to ANY 32 type data and output from (d).
- "0" is set to output bits beyond the specified number of bits.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

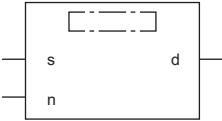
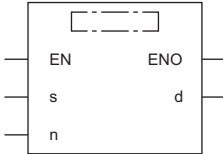
Operation error

There is no operation error.

15.51 Converting INT to Bit Array

INT_TO_BITARR(_E)

These functions output low-order (n) bits of INT type data to a bit array.

Ladder diagram		Structured text
<p>[Without EN/ENO]</p> 	<p>[With EN/ENO]</p> 	<p>[Without EN/ENO] d:=INT_TO_BITARR(s,n);</p> <p>[With EN/ENO] d:=INT_TO_BITARR_E(EN,ENO,s,n);</p>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY16
n	Only a constant 4, 8, 12 or 16 can be specified.	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output (Variables are available for element specification.)	Output variable	BOOL array element

Processing details

■Operation processing

- These functions output low-order (n) bits of ANY 16 type data specified to (s).
- Output bits beyond the specified number of bits are not changed.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

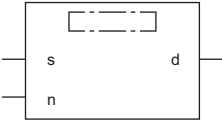
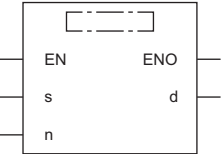
Operation error

There is no operation error.

15.52 Converting DINT to Bit Array

DINT_TO_BITARR(_E)

These functions output low-order (n) bits of DINT type data to a bit array.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=DINT_TO_BITARR(s,n); [With EN/ENO] d:=DINT_TO_BITARR_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY32
n	Only a constant 4, 8, 12, 16, 20, 24, 28 or 32 can be specified.	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output (Variables are available for element specification.)	Output variable	BOOL array element

Processing details

■Operation processing

- These functions output low-order (n) bits of ANY 32 type data specified to (s) to (d).
- Output bits beyond the specified number of bits are not changed.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

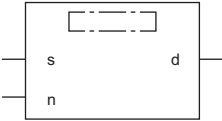
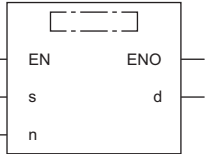
Operation error

There is no operation error.

15.53 Bit Array Copy

CPY_BITARR(_E)

These functions copy specified number of bits of a bit array.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=CPY_BITARR(s,n); [With EN/ENO] d:=CPY_BITARR_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL array element
n	Only a constant 4, 8, 12, 16, 20, 24, 28 or 32 can be specified.	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL array element

15

Processing details

■Operation processing

- These functions output (n) bits of a bit array specified to (s) to (d).

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

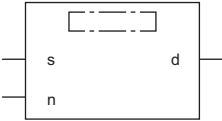
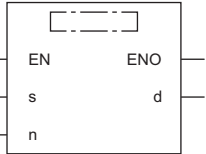
Operation error

There is no operation error.

15.54 Reading the Specified Bit of Word Label

GET_BIT_OF_INT(_E)

These functions reads the specified bit of the word label

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=GET_BIT_OF_INT(s,n); [With EN/ENO] d:=GET_BIT_OF_INT_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY16
n	Only a constant 0 to 15 can be specified.	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

- These functions output (n)th bit of (s).

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

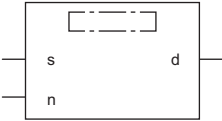
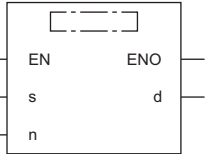
Operation error

There is no operation error.

15.55 Writing the Specified Bit of Word Label

SET_BIT_OF_INT(_E)

These functions writes the specified bit of the word label.

Ladder diagram		Structured text
[Without EN/ENO] 	[With EN/ENO] 	[Without EN/ENO] d:=SET_BIT_OF_INT(s,n); [With EN/ENO] d:=SET_BIT_OF_INT_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	BOOL
n	Only a constant 0 to 15 can be specified.	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY16

15

Processing details

■Operation processing

- These functions write the BOOL value specified by (s) in the (n)th bit of (d).

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

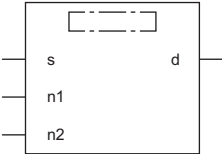
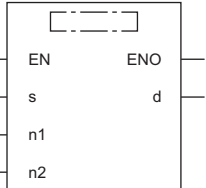
Operation error

There is no operation error.

15.56 Copying the Specified Bit of Word Label

CPY_BIT_OF_INT(_E)

These functions copy the specified bit of the word label to the one of another word label.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=CPY_BIT_OF_INT(s,n1,n2); [With EN/ENO] d:=CPY_BIT_OF_INT_E(EN,ENO,s,n1,n2);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY16
n1	Bit specification of input variable (Only a constant 0 to 15 can be specified.)	Input variable	INT
n2	Bit specification of output variable (Only a constant 0 to 15 can be specified.)	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY16

Processing details

■Operation processing

- These function copy the value of the (n1)th bit of the word specified by (s) to the (n2)th bit of (d).

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

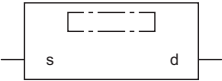
Operation error

There is no operation error.

15.57 Unnecessary of Type Conversion

GET_BOOL_ADDR, GET_INT_ADDR, GET_WORD_ADDR

These functions output the input variable as the output variable type.

Ladder diagram	Structured text
	<pre>d:=GET_BOOL_ADDR(s) d:=GET_INT_ADDR(s); d:=GET_WORD_ADDR(s);</pre>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
s	Input	Input variable	ANY
d	Output	Output variable	BOOL/INT/WORD

Processing details

■Operation processing

- These functions output the input data variable as the output variable type according to the following table.

General function	Input data type	Output data type
GET_BOOL_ADDR	BOOL ARRAY OF BOOL	BOOL
GET_INT_ADDR	INT	INT
GET_WORD_ADDR	DINT WORD REAL TIME STRING ARRAY OF INT ARRAY OF DINT ARRAY OF WORD ARRAY OF DWORD ARRAY OF REAL ARRAY OF TIME	WORD

■Operation result

The operation processing is executed. The operation output value is output from (d).

Operation error

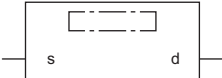
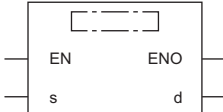
There is no operation error.

16 SINGLE NUMBER VARIABLE FUNCTIONS

16.1 Absolute Value

ABS(_E)

These functions output the absolute value of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=ABS(s); [With EN/ENO] d:=ABS_E(EN,ENO,s);
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_NUM

Processing details

■Operation processing

- These functions output the absolute value of the INT, DINT, or REAL type data input to (s) in the same data type as (s) from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".
 $B=|A|$
- A value input to (s) is the INT, DINT, or REAL type data value.
- When -32768 is input while the data type of (s) is INT, -32768 is output from (d).
- When -2147483648 is input while the data type of (s) is DINT, -2147483648 is output from (d). (An operation error does not occur. "ABS_E" outputs "TRUE" from output variable ENO.)

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- When (s) is REAL

Error code (SD0/SD8067)	Description
3402	The data specified by (s) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	(d) exceeds the following range. (An overflow has occurred.) $ (\text{d}) < 2^{128}$

16.2 Square Root

SQRT(_E)

These functions output the square root of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=SQRT(s); [With EN/ENO] d:=SQRT_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions output the square root of the REAL type data input to (s) from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".

$$B=\sqrt{A}$$

- A value input to (s) is the REAL type data value and within the positive value range.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3405	A negative value is input.

16.3 Natural Logarithm Operation

LN(_E)

These functions output the natural logarithm operation result of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=LN(s); [With EN/ENO] d:=LN_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the logarithm whose base is "e" of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".

$$B = \log_e A$$
- In the natural logarithm operation, the base "e" is set to "2.71828".

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3405	A negative value is input. The data after conversion is other than -3.40282^{+38} to -1.17549^{-38} , 0, or 1.17549^{-38} to 3.40282^{+38} .

16.4 Calculating the Common Logarithm

LOG(_E)

These functions output the operation result of the common logarithm (the logarithm whose base is 10) of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=LOG(s); [With EN/ENO] d:=LOG_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output condition (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the logarithm whose base is "10" of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".

$$B = \log_{10} A$$
- A value input to (s) is the REAL type data value.
- Only a positive value can be set in (s). (The logarithm operation cannot be executed for a negative value).
- When the operation result is -0 or underflow occurs, the operation result is regarded as 0.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- When (s) is REAL

Error code (SD0/SD8067)	Description
3402	The value specified in (s) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	The value of (d) exceeds the following range. (An overflow has occurred.) $ (d) < 2^{128}$
3405	Data outside the allowable range was set to (s). <ul style="list-style-type: none">• A negative value is specified.• "0" is specified.

16.5 Exponential Operation

EXP(_E)

These functions output the exponential operation result of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=EXP(s); [With EN/ENO] d:=EXP_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the exponent of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".

$$B=e^A$$
- In the exponential operation, the base "e" is set to "2.71828".
- A value input to (s) is the REAL type data value.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

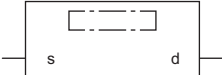
Operation error

Error code (SD0/SD8067)	Description
3403	The data after conversion is not -3.40282^{+38} to -1.17549^{-38} , or 1.17549^{-38} to 3.40282^{+38} .

16.6 Sine Operation

SIN(_E)

These functions output the sine of the angle of an input value.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=SIN(s);</p> <p>[With EN/ENO] d:=SIN_E(EN,ENO,s);</p>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the sine of the angle of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".
B=SIN A
- A value (angle) input to (s) is the REAL type data value. Input a value in radians (angle $\times\pi/180$).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3402	A negative value is input.

16.7 Cosine Operation

COS(_E)

These functions output the cosine of the angle of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=COS(s); [With EN/ENO] d:=COS_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the cosine of the angle of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".
 $B = \cos A$
- A value (angle) input to (s) is the REAL type data value. Input a value in radians ($\text{angle} \times \pi / 180$).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


Operation error

Error code (SD0/SD8067)	Description
3402	A negative value is input.

16.8 Tangent Operation

TAN(_E)

These functions output the tangent of the angle of an input value.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=TAN(s);</p> <p>[With EN/ENO] d:=TAN_E(EN,ENO,s);</p>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the tangent of the angle data of the REAL type data (angle) input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".
 $B = \tan A$
- Even when the input value is $\pi/2$ radian or $(3/2)\pi$ radian, no error occurs because an operation error occurs in a radian value.
- A value (angle) input to (s) is the REAL type data value. Input a value in radians (angle $\times\pi/180$).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3402	A negative value is input.

16.9 Arc Sine Operation

ASIN(_E)

These functions output the arc sine value of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=ASIN(s); [With EN/ENO] d:=ASIN_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the arc sine of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".
 $B = \sin^{-1} A$
- A value input to (s) is the REAL type data value and within the following range.
ASIN(_E): -1.0 to 1.0
- A value (angle) in radians ($\text{angle} \times \pi / 180$) is output from (d).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3402	A negative value is input.
3405	A value input by these functions is other than -1.0 to 1.0.

16.10 Arc Cosine Operation

ACOS(_E)

These functions output the arc cosine value of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=ACOS(s); [With EN/ENO] d:=ACOS_E(EN,ENO,s);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the arc cosine of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".

$$B = \cos^{-1} A$$
- A value input to (s) is the REAL type data value and within the following range.

$$\text{ACOS_E}: -1.0 \text{ to } 1.0$$
- A value (angle) in radians ($\text{angle} \times \pi / 180$) is output from (d).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


Operation error

Error code (SD0/SD8067)	Description
3402	A negative value is input.
3405	A value input by these functions is other than -1.0 to 1.0.

16.11 Arc Tangent Operation

ATAN(_E)

These functions output the arc tangent value of an input value.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=ATAN(s);</p> <p>[With EN/ENO] d:=ATAN_E(EN,ENO,s);</p>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	REAL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■Operation processing

- These functions calculate the arc tangent value of the REAL type data input to (s), and output from (d).
- These functions are expressed as follows when the input value is "A" and the output operation result is "B".

$$B = \tan^{-1} A$$
- A value input to (s) is the REAL type data value and within the following range.

$$\text{ATAN_E: } \pm 1.17549 \times 10^{-38} \text{ to } \pm 3.40282 \times 10^{38}$$
- A value (angle) in radians ($\text{angle} \times \pi / 180$) is output from (d).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3402	-0 is input.

17 ARITHMETIC OPERATION FUNCTIONS

17

17.1 Addition

ADD(_E)

These functions output the sum of input values ((s1) + (s2) + ... + (s28)).

Ladder diagram ^{*1}		Structured text ^{*1}
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=ADD(s1,s2); [With EN/ENO] d:=ADD_E(EN,ENO,s1,s2);

*1 The input variable "s" can be changed in the range of 2 to 28.

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1 to s28	Input	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_NUM

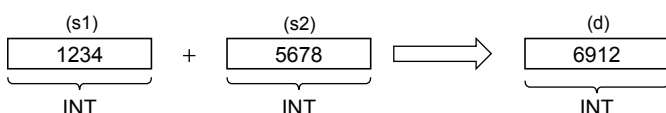
Processing details

■Operation processing

- These functions add the INT, DINT, or REAL type data ((s1) + (s2) + ... + (s28)) input to (s1) to (s28), and output from (d) in the same data type as (s).

Ex.

Data type is the INT type



- A value input to (s1) to (s28) is the INT, DINT, or REAL type data value.
- If an underflow and an overflow occur in the operation result, the result will be output as follows from (d).

Data type is INT	Data type is DINT	Data type is REAL
<ul style="list-style-type: none"> Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. "ADD_E" outputs "TRUE" from ENO. [Example 1] 32767+2=1 (7FFFH)+(0002H)=0001H The most significant bit becomes 0, and the carry flags (SM716 and SM8022) turn on. [Example 2] -32768+(-2)=-1 (8000H)+(FFFEH)=(FFFFH) The most significant bit becomes 1, and the borrow flag (SM8021) turns on.	<ul style="list-style-type: none"> Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. "ADD_E" outputs "TRUE" from ENO. [Example 1] 2147483647+2=1 (7FFFFFFFH)+(0002H)=(00000001H) The most significant bit becomes 1, and the carry flags (SM716 and SM8022) turn on. [Example 2] -2147483648+(-2)=-1 (80000000H)+(FFFEH)=(7FFFFFFFH) The most significant bit becomes 1, and the borrow flag (SM8021) turns on.	An operation error occurs and an undefined value is output.

- When the operation result is 0, the zero flag (SM8020) turns on.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred) ^{*1}	Indefinite value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) to (s28) are REAL

Error code (SD0/SD8067)	Description
3402	The data specified by (s1) to (s28) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	(d) exceeds the following range. (An overflow has occurred.) $ (d) < 2^{128}$

17.2 Multiplication

MUL(_E)

These functions output the product input values $((s1) \times (s2) \times \dots \times (s28))$.

Ladder diagram ^{*1}		Structured text ^{*1}
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=MUL(s1,s2); [With EN/ENO] d:=MUL_E(EN,ENO,s1,s2);

*1 The input variable "s" can be changed in the range of 2 to 28.

Setting data

■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1 to s28	Input	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_NUM

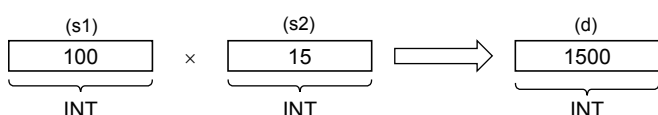
Processing details

■ Operation processing

- These functions multiply the INT, DINT, or REAL type data input to (s1) to (s28) $((s1) \times (s2) \times \dots \times (s28))$, and output the operation result from (d) in the same data type as (s).

Ex.

Data type is INT



- A value input to (s1) to (s28) is the INT, DINT, or REAL type data value.
- If an underflow occurs in the operation result, the result will be output as follows from (d).

Data type is INT	Data type is DINT	Data type is REAL
<ul style="list-style-type: none"> Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. "MUL_E" outputs "TRUE" from ENO. Even when the operation result exceeds the INT type data range, the INT type data is output. (The operation result is the DINT type, however, the output data is the INT type data with high-order 16 bits deleted.) When the operation result exceeds the INT type data, convert an input value into the DINT type data by INT_TO_DINT then perform the operation. 	<ul style="list-style-type: none"> Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. "MUL_E" outputs "TRUE" from ENO. Even when the operation result exceeds the DINT type data range, the DINT type data is output. (The operation result is the 64-bit data, however, the output data is the DINT type data with high-order 32 bits deleted.) When the operation result exceeds the DINT type data, convert an input value into the REAL type data by DINT_TO_REAL then perform the operation. 	An operation error occurs and an undefined value is output.

- When the operation result is 0, the zero flag (SM8020) turns on.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Point

When the operation result exceeds the data type range, convert the data type of an input value then perform the operation.

Operation error


- (s1) to (s28) are REAL

Error code (SD0/SD8067)	Description
3402	The data specified by (s1) to (s28) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	(d) exceeds the following range. (An overflow has occurred.) $ (d) < 2^{128}$

17.3 Subtraction

SUB(_E)

These functions output the difference of input values ((s1) - (s2)).

Ladder diagram	Structured text
<p>[Without EN/ENO]</p> 	<p>[Without EN/ENO] d:=SUB(s1,s2);</p> <p>[With EN/ENO] d:=SUB_E(EN,ENO,s1,s2);</p>

Setting data

■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_NUM

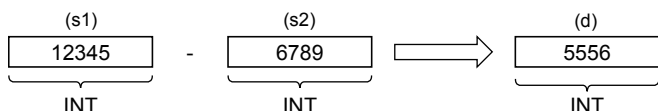
Processing details

■ Operation processing

- These functions subtract the INT, DINT, or REAL type data input to (s1) and (s2) ((s1)-(s2)), and output the operation result from (d) in the same data type as (s).

Ex.

Data type is INT



- A value input to (s1) and (s2) is the INT, DINT, or REAL type data value.
- If an underflow and an overflow occur in the operation result, the result will be output as follows from (d).

Data type is INT	Data type is DINT	Data type is REAL
<ul style="list-style-type: none"> Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. "SUB_E" outputs "TRUE" from ENO. <p>[Example 1] 32767-(-2)=1 (7FFFH)-(0002H)=(0001H) The most significant bit becomes 1, and the carry flags (SM716 and SM8022) turn on.</p> <p>[Example 2] -32768-2=-1 (8000H)-(0002H)=(FFFFH) The most significant bit becomes 0, and the borrow flag (SM8021) turns on.</p>	<ul style="list-style-type: none"> Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. "SUB_E" outputs "TRUE" from ENO. <p>[Example 1] 2147483647-(-2)=-2147483647 (7FFFFFFFH)-(FFFEH)=(80000001H) The most significant bit becomes 1, and a negative value is output.</p> <p>[Example 2] -2147483648-2=2147483646 (80000000H)-(0002H)=(7FFFFFFEH) The most significant bit becomes 0, and a positive value is output.</p>	<p>An operation error occurs and an undefined value is output.</p>

- When the operation result is 0, the zero flag (SM8020) turns on.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred) ^{*1}	Indefinite value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) and (s2) are REAL

Error code (SD0/SD8067)	Description
3402	The data specified by (s1) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The data specified by (s2) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	(d) exceeds the following range. (An overflow has occurred.) $ (d) < 2^{128}$

17.4 Division

DIV(_E)

These functions output the quotient of input values $((s1) \div (s2))$.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] <code>d:=DIV(s1,s2);</code> [With EN/ENO] <code>d:=DIV_E(EN,ENO,s1,s2);</code>

Setting data

■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Dividend	Input variable	ANY_NUM
s2	Divisor	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_NUM

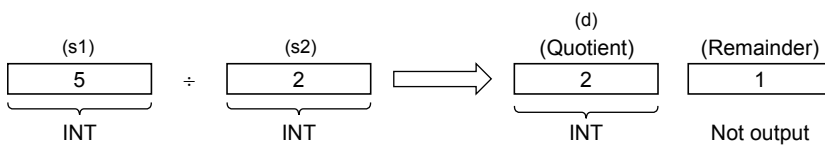
Processing details

■ Operation processing

- These functions divide the INT, DINT, or REAL type data input to (s1) and (s2) $((s1) \div (s2))$, and output the operation result from (d) in the same data type as (s).

Ex.

Data type is INT



- A value input to (s1) and (s2) is the INT, DINT, or REAL type data value. (However, input other than 0 to (s2).)
- When the operation result is 0, the zero flag (SM8020) turns on. When the operation result exceeds "32,767" (16-bit operation) or "2,147,483,647" (32-bit operation), the carry flag (SM8022) turns on.

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) and (s2) are INT

Error code (SD0/SD8067)	Description
3400	The value (divisor) specified by (s2) is 0.

- (s1) and (s2) are DINT

Error code (SD0/SD8067)	Description
3400	The value (divisor) specified by (s2) is 0.

- (s1) and (s2) are REAL

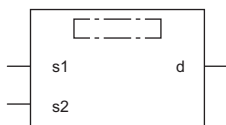
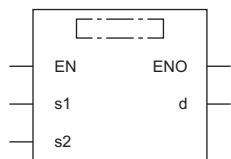
Error code (SD0/SD8067)	Description
3400	The value (divisor) specified by (s2) is 0.
3402	The data specified by (s1) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The data specified by (s2) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	(d) exceeds the following range. (An overflow has occurred.) $ (d) < 2^{128}$

17.5 Remainder

17

MOD(_E)

These functions output the remainder of input values ((s1) ÷ (s2)).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] <code>d:=MOD(s1,s2);</code> [With EN/ENO] <code>d:=MOD_E(EN,ENO,s1,s2);</code>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Dividend	Input variable	ANY_INT
s2	Divisor	Input variable	ANY_INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_INT

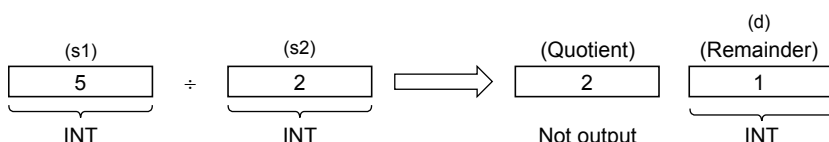
Processing details

■Operation processing

- These functions divide the INT or DINT type data input to (s1) and (s2) ((s1) ÷ (s2)), and output the remainder from (d) in the same data type as (s).

Ex.

Data type is INT



- A value input to (s1) and (s2) is the INT and DINT type data value. (However, input other than 0 to (s2).)

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) and (s2) are INT

Error code (SD0/SD8067)	Description
3400	The value (divisor) specified by (s2) is 0.

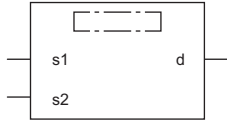
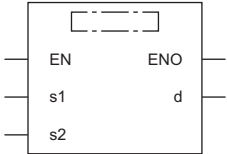
- (s1) and (s2) are DINT

Error code (SD0/SD8067)	Description
3400	The value (divisor) specified by (s2) is 0.

17.6 Exponentiation

EXPT(_E)

These functions output the exponentiation of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] <code>d:=EXPT(s1,s2);</code> [With EN/ENO] <code>d:=EXPT_E(EN,ENO,s1,s2);</code>
		

Setting data

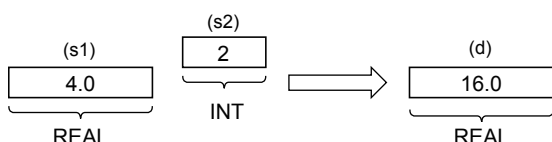
■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Cardinal number	Input variable	REAL
s2	Exponent	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	REAL

Processing details

■ Operation processing

- These functions raise the REAL type data input to (s1) by INT, DINT, or REAL specified by (s2), and output the operation result from (d).



■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) is the REAL type and (s2) is the INT type

Error code (SD0/SD8067)	Description
3402	The value of (s1) is outside the following range. $0, 2^{-126} \leq (s1) < 2^{128}$
	The data specified by (s1) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	The operation result is within the following range. $2^{128} \leq \text{operation result} $

- (s1) is the REAL type and (s2) is the DINT type

Error code (SD0/SD8067)	Description
3402	The value of (s1) is outside the following range. $0, 2^{-126} \leq (s1) < 2^{128}$
	The data specified by (s1) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	The operation result is within the following range. $2^{128} \leq \text{operation result} $

- (s1) and (s2) are REAL

Error code (SD0/SD8067)	Description
3402	The value of (s1) is outside the following range. $0, 2^{-126} \leq (s1) < 2^{128}$
	The data specified by (s1) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value of (s2) is outside the following range. $0, 2^{-126} \leq (s2) < 2^{128}$
	The data specified by (s2) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3403	The operation result is within the following range. $2^{128} \leq \text{operation result} $

17.7 Move Operation

MOVE(_E)

These functions output the assignment of input values.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=MOVE(s); [With EN/ENO] d:=MOVE_E(EN,ENO,s);

Setting data

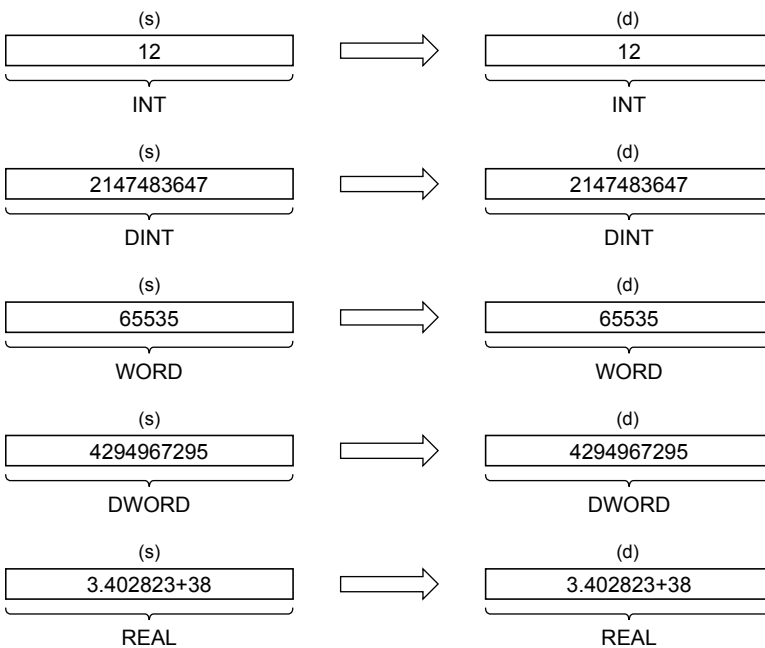
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY

Processing details

■Operation processing

- These functions assign the value of variable specified to (s) to the variable specified to (d).
- BOOL, INT, DINT, WORD, DWORD, REAL, STRING, TIME, structure, or array type can be specified for (s) and (d). Specify the same data type for (s) and (d).



■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	The character string specified by (s) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

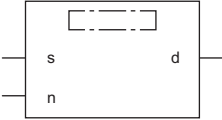
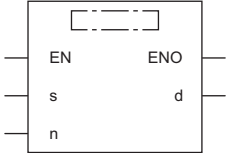
18 BIT SHIFT FUNCTIONS

18.1 n-bit Left Shift

18

SHL(_E)

These functions shift an input value leftward by (n) bits and output the result.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=SHL(s,n); [With EN/ENO] d:=SHL_E(EN,ENO,s,n);
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_BIT
n	Number of shift bits	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_BIT

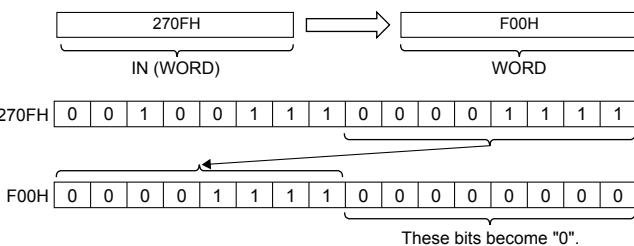
Processing details

■Operation processing

- These functions shift the WORD or DWORD type data input to (s) left by (n) bits and output the result in the same data type as (s) from (d).
- The number input in (n) is used as the number of left-shift bits.

Ex.

When the data type of (s) is WORD and 8 is input in (n)



- "0" is set to "n" bits from the least significant bit.
- A value input to (n) is the WORD or DWORD type data value.
- A value input to (n) (Number of shift bits) is the INT type data value and within the following range.

When the data type of (s) is WORD	When the data type of (s) is DWORD
A value in (n) is within 0 to 15. The lower 4-bit data of the value in (n) is used. [Example] When the input value is 6: 6 When the input value is 22: 6	A value in (n) is within 0 to 31. The lower 5-bit data of the value in (n) is used. [Example] When the input value is 6: 6 When the input value is 22: 22

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

18.2 n-bit Right Shift

SHR(_E)

These functions shift an input value rightward by (n) bits and output the result.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p>	<p>[Without EN/ENO] d:=SHR(s,n);</p> <p>[With EN/ENO] d:=SHR_E(EN,ENO,s,n);</p>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_BIT
n	Number of shift bits	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_BIT

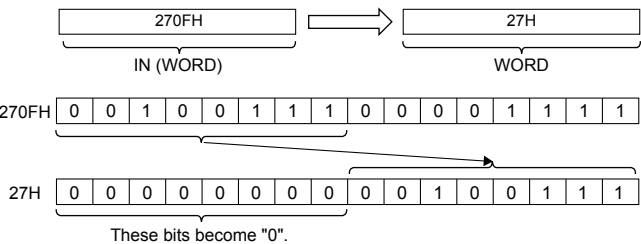
Processing details

■Operation processing

- These functions shift the WORD or DWORD type data input to (s) right by (n) bits and output the result in the same data type as (s) from (d).
- The number input in (n) is used as the number of right-shift bits.

Ex.

When the data type of (s) is WORD and 8 is input in (n)



- "0" is set to "n" bits from the most significant bit.
- A value input to (n) is the WORD or DWORD type data value.
- A value input to (n) (Number of shift bits) is the INT type data value and within the following range.

When the data type of (s) is WORD	When the data type of (s) is DWORD
<p>A value in (n) is within 0 to 15.</p> <p>The lower 4-bit data of the value in (n) is used.</p> <p>[Example]</p> <p>When the input value is 6: 6</p> <p>When the input value is 22: 6</p>	<p>A value in (n) is within 0 to 31.</p> <p>The lower 5-bit data of the value in (n) is used.</p> <p>[Example]</p> <p>When the input value is 6: 6</p> <p>When the input value is 22: 22</p>

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

18.3 n-bit Left Rotation

ROL(_E)

These functions rotate an input value leftward by (n) bits and output the result.

Ladder diagram	Structured text
<p>[Without EN/ENO]</p>	<p>[Without EN/ENO] d:=ROL(s,n);</p> <p>[With EN/ENO] d:=ROL_E(EN,ENO,s,n);</p>

Setting data

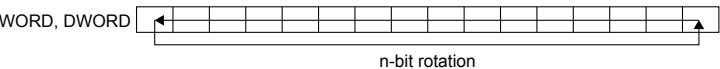
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_BIT
n	Number of shift bits	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_BIT

Processing details

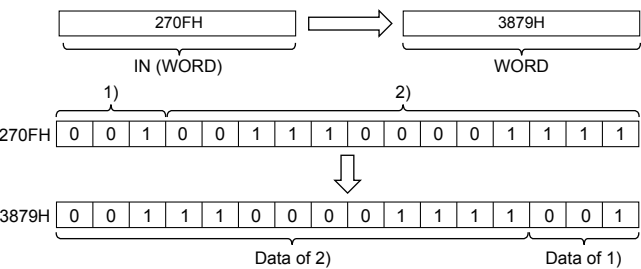
■Operation processing

- These functions rotate the WORD or DWORD type data input to (s) left by (n) bits and output the result in the same data type as (s) from (d).
- The number input in (n) is used as the number of left-rotation bits.



Ex.

When the data type of (s) is WORD and 3 is input in (n) (The bits are rotated left by 3 bits.)



- A value input to (n) is the WORD or DWORD type data value.
- A value input to (n) (Number of shift bits) is the INT type data value and within the following range.

When the data type of (s) is WORD	When the data type of (s) is DWORD
<p>A value in (n) is within 0 to 15.</p> <p>The lower 4-bit data of the value in (n) is used.</p> <p>[Example]</p> <p>When the input value is 6: 6</p> <p>When the input value is 22: 6</p>	<p>A value in (n) is within 0 to 31.</p> <p>The lower 5-bit data of the value in (n) is used.</p> <p>[Example]</p> <p>When the input value is 6: 6</p> <p>When the input value is 22: 22</p>

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

18.4 n-bit Right Rotation

ROR(_E)

These functions rotate an input value rightward by (n) bits and output the result.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=ROR(s,n); [With EN/ENO] d:=ROR_E(EN,ENO,s,n);

Setting data

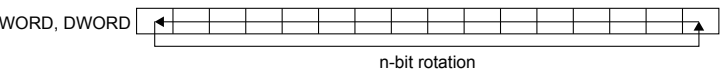
■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_BIT
n	Number of shift bits	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_BIT

Processing details

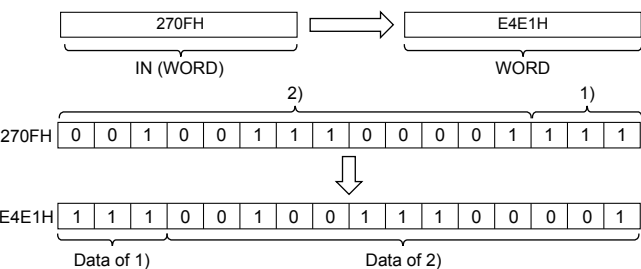
■ Operation processing

- These functions rotate the WORD or DWORD type data input to (s) right by (n) bits and output the result in the same data type as (s) from (d).
- The number input in (n) is used as the number of right-rotation bits.



Ex.

When the data type of (s) is WORD and 3 is input in (n) (The bits are rotated right by 3 bits.)



- A value input to (n) is the WORD or DWORD type data value.
- A value input to (n) (Number of shift bits) is the INT type data value and within the following range.

When the data type of (s) is WORD	When the data type of (s) is DWORD
A value in (n) is within 0 to 15. The lower 4-bit data of the value in (n) is used. [Example] When the input value is 6: 6 When the input value is 22: 6	A value in (n) is within 0 to 31. The lower 5-bit data of the value in (n) is used. [Example] When the input value is 6: 6 When the input value is 22: 22

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.


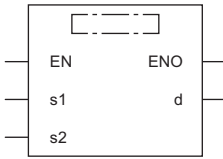
19 STANDARD BITWISE BOOLEAN FUNCTIONS

19.1 AND Operation, OR Operation, XOR Operation

19

AND(_E), OR(_E), XOR(_E)

- AND(_E): Outputs the logical product of input values.
- OR(_E): Outputs the logical sum of input values.
- XOR(_E): Outputs the exclusive logical sum of input values.

Ladder diagram ^{*1}		Structured text ^{*1}
<p>[Without EN/ENO]</p> 	<p>[With EN/ENO]</p> 	<p>[Without EN/ENO]</p> <pre>d:=AND(s1,s2); d:=OR(s1,s2); d:=XOR(s1,s2);</pre> <p>[With EN/ENO]</p> <pre>d:=AND_E(EN,ENO,s1,s2); d:=OR_E(EN,ENO,s1,s2); d:=XOR_E(EN,ENO,s1,s2);</pre>

*1 The input variable "s" can be changed in the range of 2 to 28.

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1 to s28	Input	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_BIT

Processing details

■Operation processing

1. AND(_E)

- These functions perform the logical AND on the BOOL, WORD, or DWORD type data input in (s1) to (s28) bit by bit, and output the operation result from (d) in the same data type as (s).

Ex.

When the data type is WORD

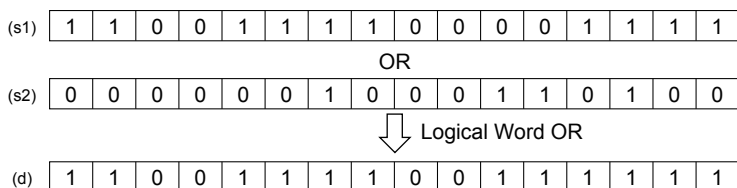
(s1)	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1
	AND															
(s2)	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0
	↓ Logical Word AND															
(d)	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0

2. OR(_E)

- These functions perform the logical OR on the BOOL, WORD, or DWORD type data input in (s1) to (s28) bit by bit, and output the operation result from (d) in the same data type as (s).

Ex.

When the data type is WORD

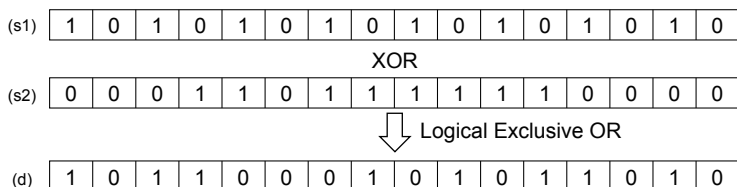


3. XOR(_E)

- These functions perform the exclusive logical OR on the BOOL, WORD, or DWORD type data input in (s1) to (s28) bit by bit, and output the operation result from (d) in the same data type as (s).

Ex.

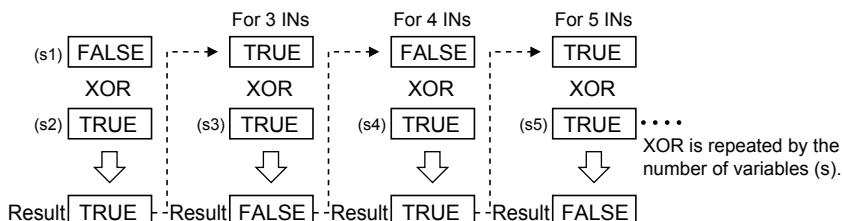
When the data type is WORD



- When three or more variables (s) exist, XOR is performed between (s1) and (s2) first, and XOR is successively performed between the result and (s3). When the expression includes (s4), XOR is performed between the result of XOR with (s3) and (s4). In this manner, XOR is repeated by the number of variables (s) in the order with (s5), (s6), and so on.

Ex.

When the data type is BOOL



■ Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


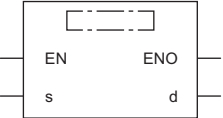
Operation error

There is no operation error.

19.2 Logical Negation

NOT(_E)

These functions output the logical negation of input values.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] <code>d:=NOT(s);</code> [With EN/ENO] <code>d:=NOT_E(EN,ENO,s);</code>
		

Setting data

■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	ANY_BIT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_BIT

Processing details

■ Operation processing

- These functions calculate the logical negation for each bit of the BOOL, WORD, or DWORD type data input in (s), and output the operation result from (d) in the same data type as (s).

Ex.

When the data type is WORD

(s)	0	1	1	0	1	0	1	1	0	0	0	0	1	1	1	1
	NOT															
(d)	1	0	0	1	0	1	0	0	1	1	1	1	0	0	0	0

- A value input to (s) is the BOOL, WORD, or DWORD type data value.

■ Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

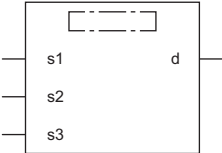
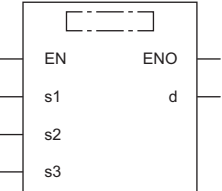
There is no operation error.

20 SELECTION FUNCTIONS

20.1 Selection

SEL(_E)

These functions output a selected input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=SEL(s1,s2,s3); [With EN/ENO] d:=SEL_E(EN,ENO,s1,s2,s3);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Output condition (TRUE: Output s3, FALSE: Output s2)	Input variable	BOOL
s2	Input	Input variable	ANY
s3			
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY

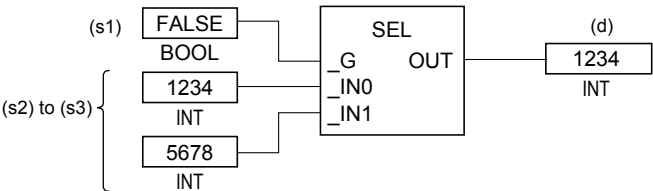
Processing details

■Operation processing

- These functions output a value input to (s2) and (s3) according to a value input to (s1) in the same data type as (s2) and (s3) from (d).
- When FALSE(=0) is input to (s1), these functions output an input value of (s2) from (d).
- When TRUE(=1) is input to (s1), these functions output an input value of (s3) from (d).

Ex.

The data type of (s2) and (s3) is the INT type ((s2) and (s3) of an argument correspond to the bit value of (s1) (0 or 1).)



- A value input to (s1) is the BOOL type data value.
- A data value of the BOOL, INT, DINT, WORD, DWORD, REAL, STRING, TIME, structure, or array type can be input to (s2) and (s3).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error


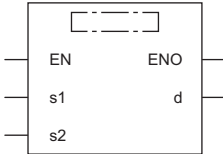
- (s2) and (s3) are the STRING type

Error code (SD0/SD8067)	Description
2820	"00H" is not set to a label specified by (s2) or devices from the device number to end device number of corresponding device.
	"00H" is not set to a label specified by (s3) or devices from the device number to the end device number of corresponding device.
3406	The specified character string cannot be stored in a label specified by (d) or devices from the device number to the end device number of corresponding device.

20.2 Selecting Maximum/Minimum Value

MAX(_E), MIN(_E)

- MAX(_E): These functions output the maximum value of an input value.
- MIN(_E): These functions output the minimum value of an input value.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=MAX(s1,s2); d:=MIN(s1,s2); [With EN/ENO] d:=MAX_E(EN,ENO,s1,s2); d:=MIN_E(EN,ENO,s1,s2);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1 to s28	Input	Input variable	ANY_SIMPLE
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_SIMPLE

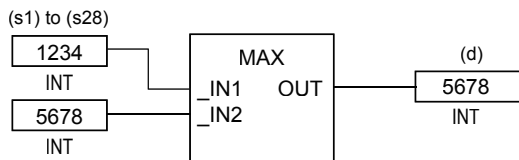
Processing details

■Operation processing

- MAX(_E)
These functions output the maximum value of the BOOL, INT, DINT, WORD, DWORD, DWORD, REAL, STRING, or TIME type data input to (s1) to (s28) in the same data type as (s) from (d).

Ex.

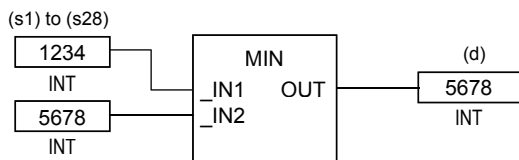
Data type is INT



- MIN(_E)
These functions output the minimum value of the BOOL, INT, DINT, WORD, DWORD, DWORD, REAL, STRING, or TIME type data input to (s1) to (s28) in the same data type as (s) from (d).

Ex.

Data type is INT



- A data value of the BOOL, INT, DINT, WORD, DWORD, REAL, STRING, or TIME type can be input to (s1) to (s28).
- The number of pins for (s) can be changed in the range of 2 to 28.

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) to (s28) are STRING

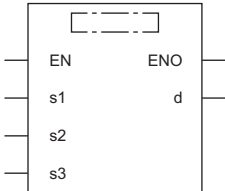
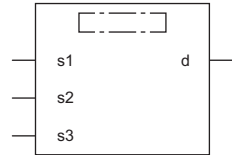
Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) to (s28) and later, "00H" does not exist.
3405	The character string specified by (s1) to (s28) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

20.3 Limit Control

LIMIT(_E)

These functions output an input value controlled with the upper and lower limits.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=LIMIT(s1,s2,s3); [With EN/ENO] d:=LIMIT_E(EN,ENO,s1,s2,s3);



Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Lower limit value (minimum output threshold value)	Input variable	ANY_SIMPLE
s2	Input value to be controlled with the upper and lower limits	Input variable	ANY_SIMPLE
s3	Upper limit value (maximum output threshold value)	Input variable	ANY_SIMPLE
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY_SIMPLE

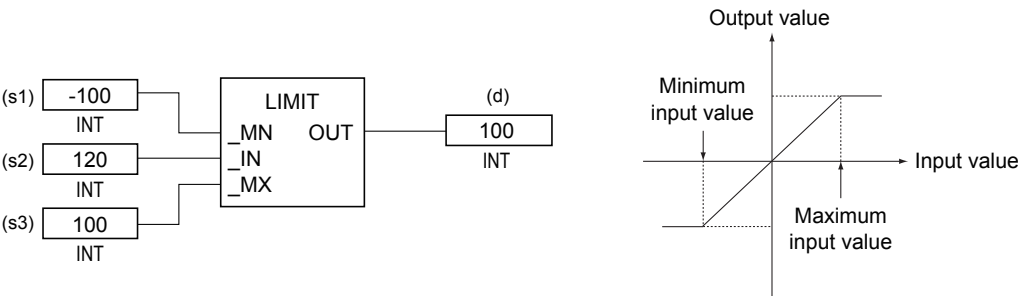
Processing details

■Operation processing

- These functions output an input value according to the BOOL, INT, DINT, WORD, DWORD, REAL, STRING, or TIME type data input to (s1), (s2), and (s3) in the same data type as (s1), (s2), and (s3) from (d).
 - When the input value of (s2) is larger than the one of (s3), these functions output the input value of (s3) from (d).
 - When the input value of (s2) is smaller than the one of (s1), these functions output the input value of (s1) from (d).
 - When the input value of (s1) ≤ the input value of (s2) ≤ the input value of (s3), these functions output the input value of (s2) from (d).

Ex.

Data type is INT



- A data value of the BOOL, INT, DINT, WORD, DWORD, REAL, STRING, or TIME type can be input to (s1), (s2), and (s3). (The input value of (s1) must be smaller than the one of (s3).)

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1), (s2), and (s3) are INT or WORD

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s2).

- (s1), (s2), and (s3) are DINT, DWORD, or TIME

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s2).

- (s1), (s2), and (s3) are BOOL

Error code (SD0/SD8067)	Description
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s3).

- (s1), (s2), and (s3) are the REAL type

Error code (SD0/SD8067)	Description
3402	The value of (s1) is outside the following range. $0, 2^{-126} \leq (s1) < 2^{128}$
	The data specified by (s1) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value of (s2) is outside the following range. $0, 2^{-126} \leq (s2) < 2^{128}$
	The data specified by (s2) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
	The value of (s3) is outside the following range. $0, 2^{-126} \leq (s3) < 2^{128}$
	The data specified by (s3) is -0, denormalized number, NaN (not a number), or $\pm\infty$.
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s3).

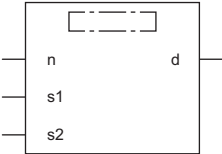
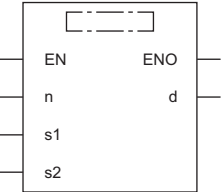
- (s1), (s2), and (s3) are STRING

Error code (SD0/SD8067)	Description
2820	"00H" is not set to a label specified by (s1), (s2), and (s3) or devices from specified device number to the end device number of corresponding device.
3405	The lower limit value specified by (s1) is greater than the upper limit value specified by (s3).
	The character strings specified by (s1), (s2), and (s3) have more than 16383 characters.
3406	The specified character string cannot be stored in a label specified by (d) or devices from specified device number to the end device number of corresponding device.

20.4 Multiplexer

MUX(_E)

These functions output one of multiple input values.

Ladder diagram*1		Structured text*1
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=MUX(n,s1,s2); [With EN/ENO] d:=MUX_E(EN,ENO,n,s1,s2);</pre>
		

*1 The input variable "s" can be changed in the range of 2 to 28.

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
n	Output value selection	Input variable	INT
s1 to s28	Input	Input variable	ANY
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	ANY

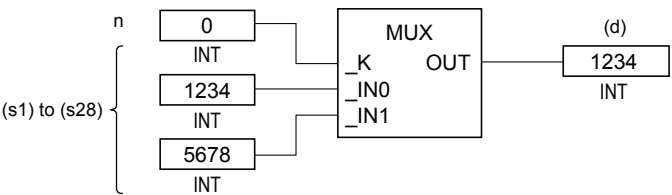
Processing details

■Operation processing

- These functions output one of values input to (s1) to (s28) according to the input value of (n) in the same data type as (s) from (d).
- When 0 is input to (n), these functions output a value input to (s1) from (d).
- When (n)-1 is input to (n), these functions output a value input to (sn) from (d).

Ex.

Data type is INT



- When a value input to (n) is outside the pin number range for (s), these functions output an indefinite value from (d). (An operation error does not occur. "MUX_E" outputs "FALSE" from ENO).
- A value input to (n) is the INT type data value and within the range from 0 to 27. (The value must be in the pin number range for (s).)
- A data value of the BOOL, INT, DINT, WORD, DWORD, REAL, STRING, TIME, structure, or array type can be input to (s).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) to (s28) are STRING



Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) to (s28) and later, "00H" does not exist.
3405	The character string specified by (s1) to (s28) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

21 COMPARISON FUNCTIONS

21.1 Compare

GT(_E), GE(_E), EQ(_E), LE(_E), LT(_E)

These functions output the data comparison result of input values.

Ladder diagram ^{*1}		Structured text ^{*1}
[Without EN/ENO]		[Without EN/ENO] d:=GT(s1,s2); d:=GE(s1,s2); d:=EQ(s1,s2); d:=LE(s1,s2); d:=LT(s1,s2); [With EN/ENO] d:=GT_E(EN,ENO,s1,s2); d:=GE_E(EN,ENO,s1,s2); d:=EQ_E(EN,ENO,s1,s2); d:=LE_E(EN,ENO,s1,s2); d:=LT_E(EN,ENO,s1,s2);
		

^{*1} The input variable "s" can be changed in the range of 2 to 28.

Setting data

■ Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1 to s28	Input	Input variable	ANY_SIMPLE
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output (TRUE: True value, FALSE: False value)	Output variable	BOOL

Processing details

■ Operation processing

- These functions perform a comparison operation of input values of (s) and output operation results from (d) in the BOOL type.
 - GT(_E): These functions compare $[(s1) > (s2)] \& [(s2) > (s3)] \& \dots \& [(s)_{(n-1)} > (s)_{(n)}]$.
 - When all the operation results are $(s)_{(n-1)} > (s)_{(n)}$, these functions output TRUE.
 - When any of the operation results is $(s)_{(n-1)} \leq (s)_{(n)}$, these functions output FALSE.
 - GE(_E): These functions compare $[(s1) \geq (s2)] \& [(s2) \geq (s3)] \& \dots \& [(s)_{(n-1)} \geq (s)_{(n)}]$.
 - When all the operation results are $(s)_{(n-1)} \geq (s)_{(n)}$, these functions output TRUE.
 - When any of the operation result is $(s)_{(n-1)} < (s)_{(n)}$, these functions output FALSE.
 - EQ(_E): These functions compare $[(s1) = (s2)] \& [(s2) = (s3)] \& \dots \& [(s)_{(n-1)} = (s)_{(n)}]$.
 - When all the operation results are $(s)_{(n-1)} = (s)_{(n)}$, these functions output TRUE.
 - When any of the operation results is $(s)_{(n-1)} \neq (s)_{(n)}$, these functions output FALSE.
 - LE(_E): These functions compare $[(s1) \leq (s2)] \& [(s2) \leq (s3)] \& \dots \& [(s)_{(n-1)} \leq (s)_{(n)}]$.
 - When all the operation results are $(s)_{(n-1)} \leq (s)_{(n)}$, these functions output TRUE.
 - When any of the operation result is $(s)_{(n-1)} > (s)_{(n)}$, these functions output FALSE.
 - LT(_E): These functions compare $[(s1) < (s2)] \& [(s2) < (s3)] \& \dots \& [(s)_{(n-1)} < (s)_{(n)}]$.
 - When all the operation results are $(s)_{(n-1)} < (s)_{(n)}$, these functions output TRUE.
 - When any of the operation results is $(s)_{(n-1)} \geq (s)_{(n)}$, these functions output FALSE.
- A data value of the INT, DINT, REAL, BOOL, WORD, DWORD, TIME, or STRING type can be input to (s).

■ Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) to (s28) are the STRING type

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) to (s28) and later, "00H" does not exist.
3405	The character string specified by (s1) to (s28) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

21.2 Compare

NE(_E)

These functions output the data comparison result of input values.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=NE(s1,s2); [With EN/ENO] d:=NE_E(EN,ENO,s1,s2);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	ANY_SIMPLE
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output (TRUE: True value, FALSE: False value)	Output variable	BOOL

Processing details

■Operation processing

- These functions perform a comparison operation of input values of (s) and output operation results from (d) in the BOOL type.
 - NE(_E): These functions compare [(s1)≠(s2)].
 - When (s1)≠(s2), these functions output TRUE.
 - These functions output FALSE when (s1)=(s2).
- A data value of the INT, DINT, REAL, BOOL, WORD, DWORD, TIME, or STRING type can be input to (s).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

- (s1) and (s2) are the STRING type

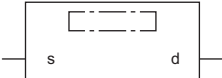
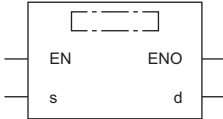
Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	The character string specified by (s) has more than 16383 characters.
3406	The whole specified character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

22 CHARACTER STRING FUNCTIONS

22.1 Character String Length Detection

LEN(_E)

These functions detect the length of an input character string and output the result.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=LEN(s); [With EN/ENO] d:=LEN_E(EN,ENO,s);
		

Setting data

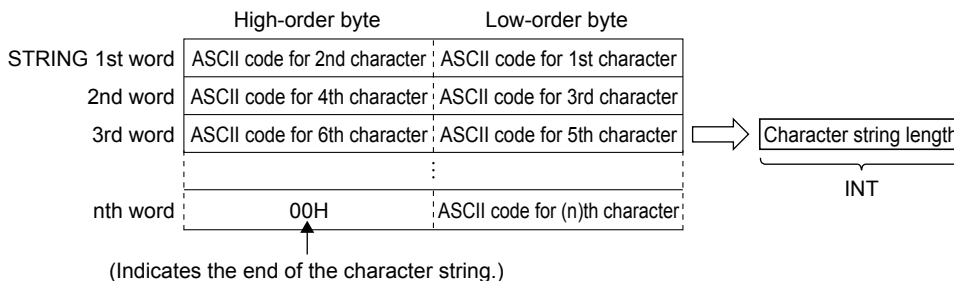
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(255)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions detect the length of a character string input to (s) and output the result from (d).



- A value input to (s) is the STRING type data value and within the range from 0 to 255 byte(s).

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

22.2 Extracting Character String Data from the Left/Right

LEFT(_E), RIGHT(_E)

- LEFT(_E): These functions output specified number of characters from the left of input character string data.
- RIGHT(_E): These functions output specified number of characters from the right of input character string data.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=LEFT(s,n); d:=RIGHT(s,n); [With EN/ENO] d:=LEFT_E(EN,ENO,s,n); d:=RIGHT_E(EN,ENO,s,n);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(255)
n	Specification of number of characters to be extracted	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(255)

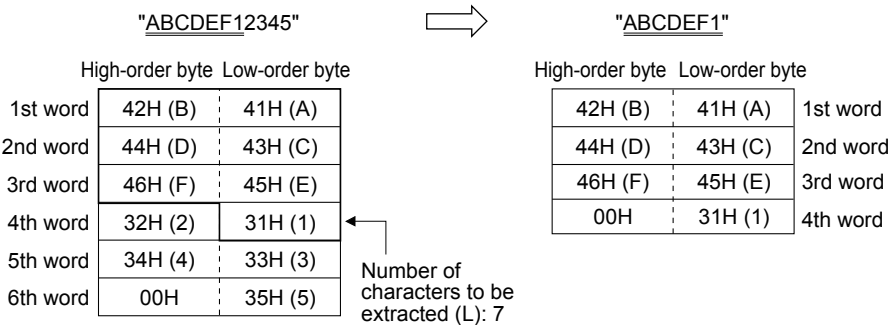
Processing details

■Operation processing

- LEFT(_E)
These functions output the data for the specified number of characters from the left of a character string input to (s) from (d).
The value input to (n) specifies the number of characters to be extracted.

Ex.

When the value input to (n) is 7

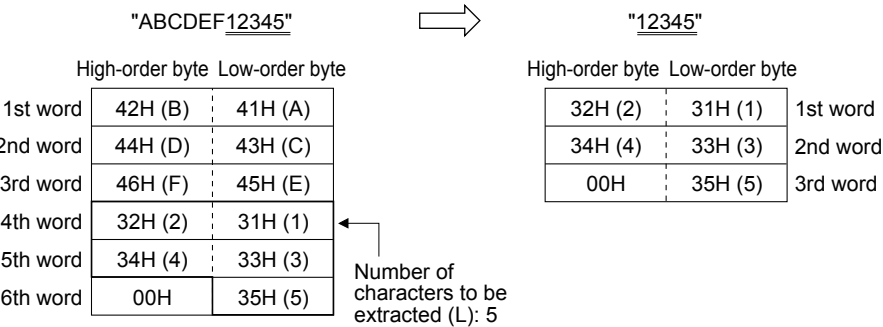


- RIGHT(_E)

These functions output the data for the specified number of characters from the right of a character string input to (s) from (d).
The value input to (n) specifies the number of characters to be extracted.

Ex.

When the value input to (n) is 5



- A value input to (s) is the STRING type data value and within the range from 0 to 255 byte(s).
- A value input to (n) is the INT type data value and within the range from 0 to 255. (However, the value must be within the number of characters of the character string to be input to (s).)

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

^{*1} When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

22.3 Extract Mid String

MID(_E)

These functions output the specified number of characters from an arbitrary position of an input character string.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=MID(s,n1,n2); [With EN/ENO] d:=MID_E(EN,ENO,s,n1,n2);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(255)
n1	Specification of number of characters to be extracted	Input variable	INT
n2	Specification of head character position of a character string to be extracted	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(255)

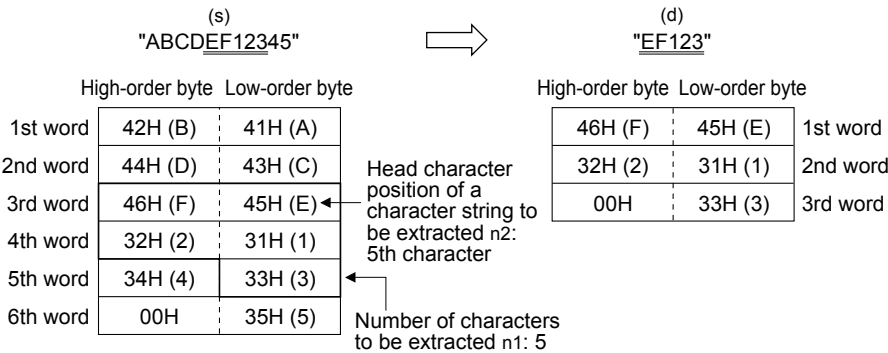
Processing details

■Operation processing

- These functions output the data for the specified number of characters from an arbitrary position of a character string input to (s).
- The value input to (n1) specifies the number of characters to be extracted.
- The value input to (n2) specifies the number of the head character position of a character string to be extracted.

Ex.

When the value input to (n1) and (n2) is 5



- A value input to (s) is the STRING type data value and within the range from 0 to 255 byte(s).
- A value input to (n1) is the INT type data value and within the range from 0 to 255. (However, the value must be within the number of characters of the character string to be input to (s).)
- A value input to (n2) is the INT type data value and within the range from 1 to 255. (However, the value must be within the number of characters of the character string to be input to (s).)

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s) and later, "00H" does not exist.
3405	The character string specified by (s) has more than 16383 characters. Data outside the allowable range was set to (n1) and (n2). <ul style="list-style-type: none">• The value stored in a device specified in (n1) and (n2) is 0 or less.• The value stored in a device specified in (n2) is any value other than an effective value (-1, 0, 1, or more).• The value stored in a device specified in (n1) exceeds the number of characters of (s).• The total of the values stored in devices specified in (n1) and (n2) exceeds the number of characters of (s).

22.4 Link Character Strings

CONCAT(_E)

These functions concatenate character strings and output the result.

Ladder diagram*1		Structured text*1
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=CONCAT(s1,s2); [With EN/ENO] d:=CONCAT_E(EN,ENO,s1,s2);

*1 The input variable "s" can be changed in the range of 2 to 28.

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1 to s28	Input	Input variable	STRING(255)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(255)

Processing details

■Operation processing

- These functions concatenate the character string input to the input variables (s2) to (s28) after the one input to (s1) and output the result from (d).
- When character strings are concatenated, 00H indicating an end of the character string specified by (s1) is ignored and the character string specified by (s2) to (s28) is concatenated.
- When the concatenated character string exceeds 255 bytes, these functions output a character string within 255 bytes.

(s1) "ABCDE"		+	(s2) "123456"		⇒	(d) "ABCDE123456"	
High-order byte	Low-order byte		High-order byte	Low-order byte		High-order byte	Low-order byte
1st word	42H (B) : 41H (A)		1st word	32H (2) : 31H (1)		1st word	42H (B) : 41H (A)
2nd word	44H (D) : 43H (C)		2nd word	34H (4) : 33H (3)		2nd word	44H (D) : 43H (C)
3rd word	00H : 45H (E)		3rd word	36H (6) : 35H (5)		3rd word	31H (1) : 45H (E)
			4th word	00H		4th word	33H (3) : 32H (2)
						5th word	35H (5) : 34H (4)
						6th word	00H : 36H (6)

- A value input to the input variables (s1) and (s2) to (s28) is the STRING type data value and within the range from 0 to 255 byte(s).

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) to (s28) and later, "00H" does not exist.
3406	The whole concatenated character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

22.5 Inserting Character String

INSERT(_E)

These functions insert a character string into another character string and output the result.

Ladder diagram	Structured text
<div>[Without EN/ENO] </div> <div>[With EN/ENO] </div>	<div>[Without EN/ENO] d:=INSERT(s1,s2,n);</div> <div>[With EN/ENO] d:=INSERT_E(EN,ENO,s1,s2,n);</div>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	STRING(255)
n	Specification of head character position of a character string to be inserted	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(255)

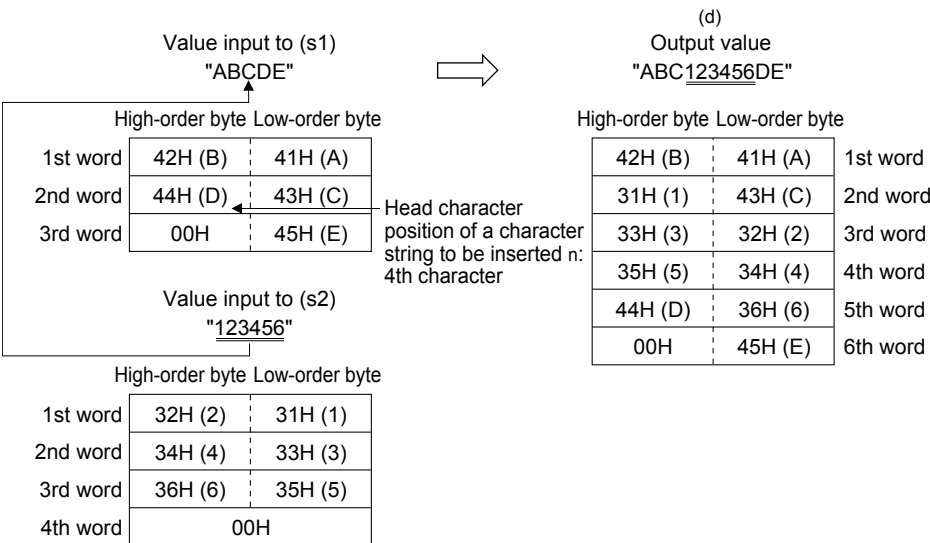
Processing details

■Operation processing

- These functions insert the character string input to (s2) at the (n)th character from the start of the character string input to (s1) (head position of the insertion) and output from (d).
- After the character string specified by (s2) is inserted to the one specified by (s1), 00H indicating an end of the character string specified by (s2) is ignored.
- When the inserted character string exceeds 255 bytes, these functions output a character string within 255 bytes.

Ex.

When the value input to (n) is 4



- A value input to (s1) and (s2) is the STRING type data value and within the range from 0 to 255 byte(s).
- A value input to (n) is the INT type data value and within the range from 1 to 255. (However, the value must be within the number of characters of the character string to be input to (s1).)

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
2820	In the corresponding device range of the device specified by (s1) to (s28) and later, "00H" does not exist.
3406	The whole concatenated character string cannot be stored in the devices from the device specified by (d) to the last device in the corresponding device range.

22.6 Deleting Character String

DELETE(_E)

These functions delete an arbitrary range of a character string and output the result.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=DELETE(s,n1,n2); [With EN/ENO] d:=DELETE_E(EN,ENO,s,n1,n2);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Input	Input variable	STRING(255)
n1	Specification of number of characters to be deleted	Input variable	INT
n2	Specification of head character position of a character string to be deleted	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(255)

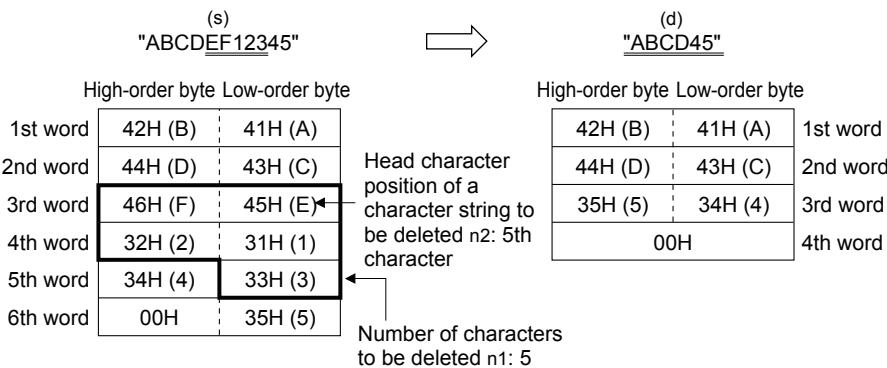
Processing details

■Operation processing

- These functions delete the data for the specified number of characters from an arbitrary position of a character string input to (s) and output the remaining character strings from (d).
- The value input to (n1) specifies the number of characters to be deleted.
- The value input to (n2) specifies the number of the head character position of a character string to be deleted.

Ex.

When the value input to (n1) and (n2) is 5



- A value input to (s) is the STRING type data value and within the range from 0 to 255 byte(s).
- A value input to (n1) is the INT type data value and within the range from 0 to 255. (However, the value must be within the number of characters of the character string to be input to (s).)
- A value input to (n2) is the INT type data value and within the range from 1 to 255. (However, the value must be within the number of characters of the character string to be input to (s).)

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

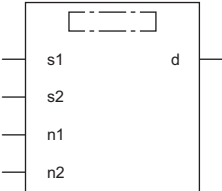
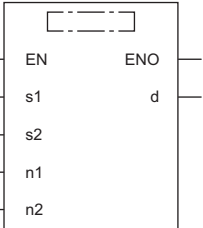
Operation error

Error code (SD0/SD8067)	Description
2820	"00H" is not set to devices from the device number specified by (s) to the end device number of corresponding device.
3405	The character strings specified by (s) have more than 255 characters.
	The device value specified by (n1) is out of the valid range (0 to 255).
	The device value specified by (n2) is out of the valid range (1 to 255).
	(n1) exceeds the number of characters of a character string specified by (s).
	(n2) exceeds the number of characters of a character string specified by (s).
3406	The whole deleted character string cannot be stored in the devices from the device specified by (d) to the last device of the target device.

22.7 Replacing Character String

REPLACE(_E)

These functions replace an arbitrary range of a character string and output the result.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=REPLACE(s1,s2,n1,n2); [With EN/ENO] d:=REPLACE_E(EN,ENO,s1,s2,n1,n2);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	STRING(255)
n1	Specification of number of characters to be replaced	Input variable	INT
n2	Specification of head character position of a character string to be replaced	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	STRING(255)

Processing details

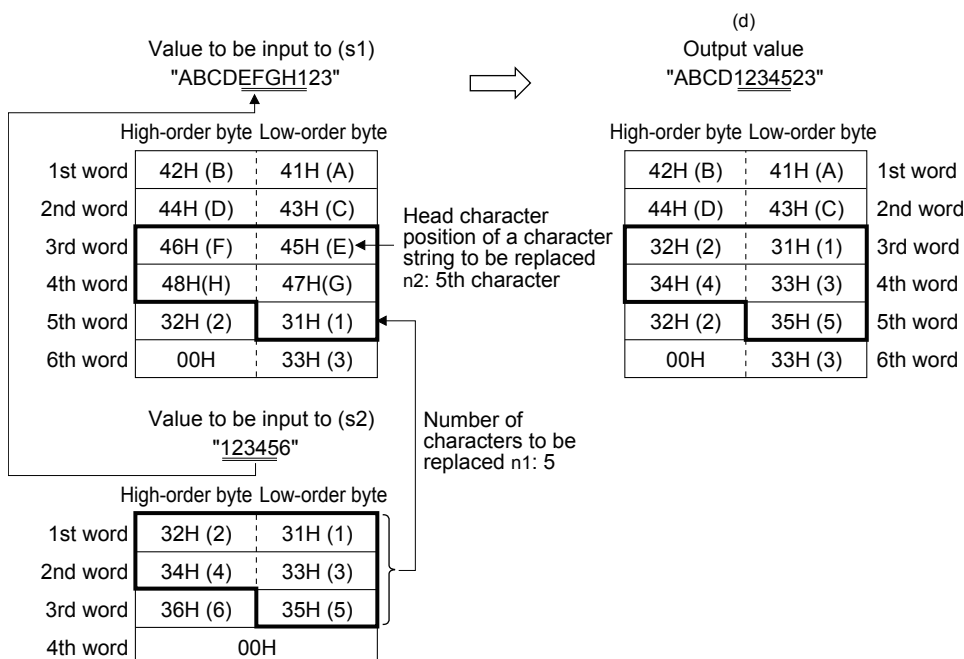
■Operation processing

- These functions replace the data for the specified number of characters from an arbitrary position of a character string input to (s1) with a character string input to (s2) and output from (d).
- The value input to (n1) specifies the number of characters to be replaced.

- The value input to (n2) specifies the number of the head character position of a character string to be replaced.

Ex.

When the value input to (n1) and (n2) is 5



- A value input to (s1) and (s2) is the STRING type data value and within the range from 0 to 255 byte(s).
- A value input to (n1) is the INT type data value and within the range from 0 to 255. (However, the value must be within the number of characters of the character string to be input to (s1).)
- A value input to (n2) is the INT type data value and within the range from 1 to 255. (However, the value must be within the number of characters of the character string to be input to (s1).)

■Operation result

1. Function without EN/ENO

The following table lists the operation results.

Operation result	(d)
No operation error occurred	Operation output value
An operation error occurred	Indefinite value

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE (Operation error did not occur)	Operation output value
	FALSE (Operation error occurred)*1	Indefinite value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
2820	"00H" is not set to devices from the device number specified by (s1) to the end device number of corresponding device.
	"00H" is not set to devices from the device number specified by (s2) to the end device number of corresponding device.
3405	The character strings specified by (s1) have more than 255 characters.
	The character strings specified by (s2) have more than 255 characters.
	The device value specified by (n1) is out of the valid range (0 to 255).
	The device value specified by (n2) is out of the valid range (1 to 255).
	(n1) exceeds the number of characters of a character string specified by (s2).
	(n2) exceeds the number of characters of a character string specified by (s1).
3406	The whole deleted character string cannot be stored in the devices from the device specified by (d) to the last device of the target device.

22.8 Searching Character String

FIND(_E)

These functions search for a character string and output the result.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=FIND(s1,s2); [With EN/ENO] d:=FIND_E(EN,ENO,s1,s2);

Setting data

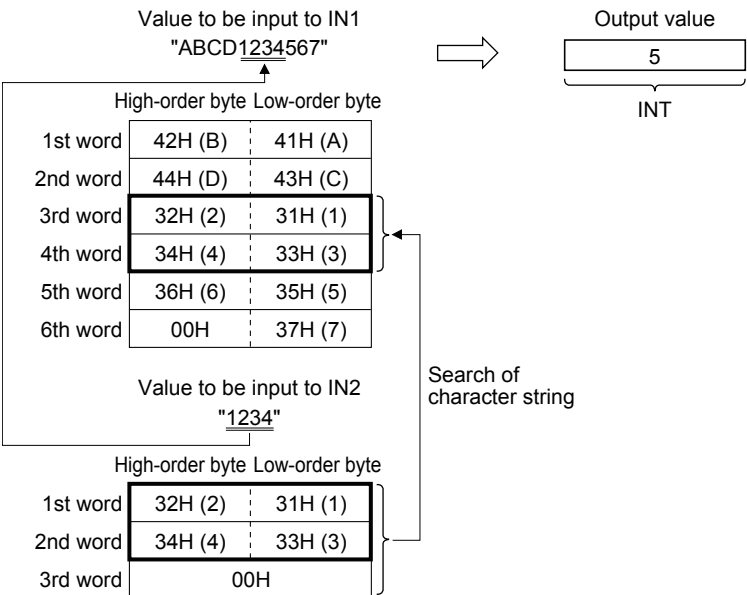
■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	STRING(255)
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	INT

Processing details

■Operation processing

- These functions search for a character string input to (s2) from the start of the character string input to (s1) and output the result from (d).
- This function outputs the head character position of the searched character string detected first as the search result.
- If a character string specified by (s2) cannot be searched from the one specified by (s1), these functions output "0".



- A value input to (s1) and (s2) is the STRING type data value and within the range from 0 to 255 byte(s).

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

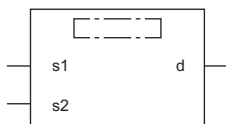
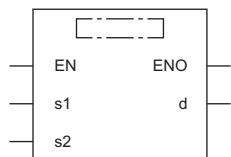
There is no operation error.

23 TIME DATA FUNCTIONS

23.1 Addition

ADD_TIME(_E)

These functions output the sum of input values (TIME data) ((s1) + (s2)).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] <code>d:=ADD_TIME(s1,s2);</code> [With EN/ENO] <code>d:=ADD_TIME_E(EN,ENO,s1,s2);</code>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

Processing details

■Operation processing

- These functions add the TIME type data input to (s1) and (s2) ((s1) + (s2)), and output the operation result from (d) as TIME type data.

Ex.

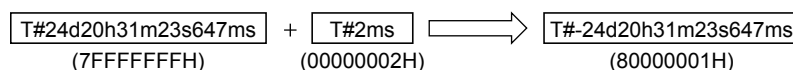
When a value input to (s1) and (s2) is T#1d2h33m44s55ms (1 day 2 hours 33 minutes 44 seconds 55 milliseconds) and T#2ms (2 milliseconds)



- A value input to (s1) and (s2) is the TIME type data value.
- Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. The data is output from (d) as follows: "ADD_TIME_E" outputs "TRUE" from the output variable ENO.

Ex.

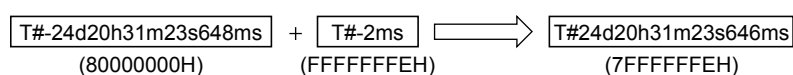
Overflow



The most significant bit becomes 1, and a negative time is output.

Ex.

Underflow



The most significant bit becomes 0, and a positive time is output.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE*1	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

23.2 Subtraction

SUB_TIME(_E)

These functions output the difference of input values (TIME data) ((s1) - (s2)).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=SUB_TIME(s1,s2); [With EN/ENO] d:=SUB_TIME_E(EN,ENO,s1,s2);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1, s2	Input	Input variable	TIME
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

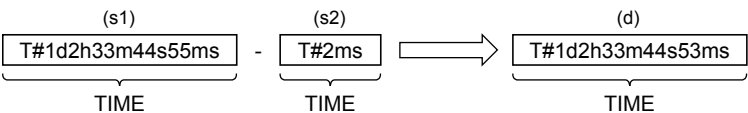
Processing details

■Operation processing

- These functions subtract the TIME type data input to (s1) and (s2) ((s1) - (s2)), and output the operation result from (d) as TIME type data.

Ex.

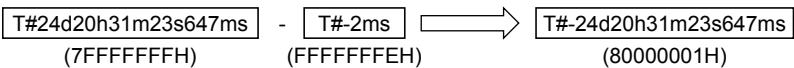
When a value input to (s1) and (s2) is T#1d2h33m44s55ms (1 day 2 hours 33 minutes 44 seconds 55 milliseconds) and T#2ms (2 milliseconds)



- A value input to (s1) and (s2) is the TIME type data value.
- Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. The data is output from (d) as follows: "SUB_TIME_E" outputs "TRUE" from the output variable ENO.

Ex.

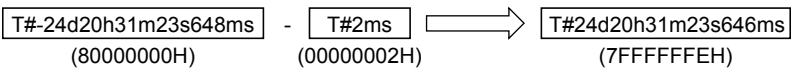
Overflow



The most significant bit becomes 1, and a negative time is output.

Ex.

Underflow



The most significant bit becomes 0, and a positive time is output.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

There is no operation error.

23.3 Multiplication

MUL_TIME(_E)

These functions output the multiplication of input values (TIME) ((s1) × (s2)).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	[Without EN/ENO] d:=MUL_TIME(s1,s2); [With EN/ENO] d:=MUL_TIME_E(EN,ENO,s1,s2);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Input	Input variable	TIME
s2	Input	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

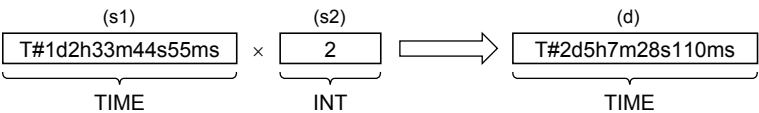
Processing details

■Operation processing

- These functions multiply the TIME type data input to (s1) and (s2) ((s1) × (s2)), and output the operation result from (d) as TIME type data.

Ex.

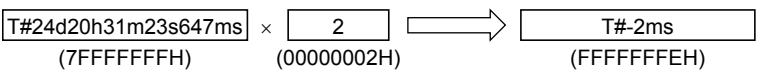
When a value input to (s1) and (s2) is T#1d2h33m44s55ms (1 day 2 hours 33 minutes 44 seconds 55 milliseconds) and 2



- A value input to (s1) is the TIME type data value.
- A value input to (s2) is the INT, DINT, or REAL type.
- Even if underflow or overflow occurs in the operation result, it is not regarded as an operation error. The data is output from (d) as follows: "MUL_TIME_E" outputs "TRUE" from the output variable ENO. (The operation result is the 64-bit data, however, the output data is the time type data with high-order 32 bits deleted.)

Ex.

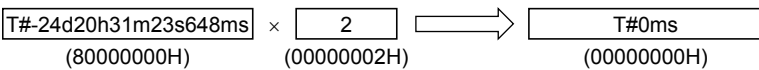
Overflow



The most significant bit becomes 1, and a negative time is output.

Ex.

Underflow



The most significant bit becomes 0, and a positive time is output.

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.


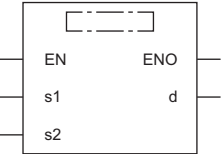
Operation error

There is no operation error.

23.4 Division

DIV_TIME(_E)

These functions output the quotient of input values (TIME data) ((s1) ÷ (s2)).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] d:=DIV_TIME(s1,s2); [With EN/ENO] d:=DIV_TIME_E(EN,ENO,s1,s2);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Input	Input variable	TIME
s2	Input	Input variable	ANY_NUM
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	TIME

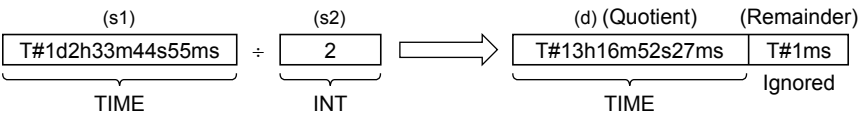
Processing details

■Operation processing

- These functions divide the TIME type data input to (s1) and (s2) ((s1) ÷ (s2)), and output the operation result from (d) as TIME type data. The remainder is ignored.

Ex.

When a value input to (s1) and (s2) is T#1d2h33m44s55ms (1 day 2 hours 33 minutes 44 seconds 55 milliseconds) and 2



- A value input to (s1) is the TIME type data value.
- A value input to (s2) is the INT, DINT, or REAL type. (However, input other than 0 to (s2).)

■Operation result

1. Function without EN/ENO

The operation processing is executed. The operation output value is output from (d).

2. Function with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE ^{*1}	Indefinite value

*1 When FALSE is output from ENO, data output from (d) is undefined. In that case, modify a program so that the data output from (d) is not used.

Operation error

Error code (SD0/SD8067)	Description
3400	A value input to (s2) is 0. (Zero division)

MEMO

PART 6

FUNCTION BLOCKS

This part consists of the following chapters.

24 BISTABLE FUNCTION BLOCKS

25 EDGE DETECTION FUNCTION BLOCKS

26 COUNTER FUNCTION BLOCKS

27 TIMER FUNCTION BLOCKS

24 BISTABLE FUNCTION BLOCKS

24.1 Bistable Function Blocks (Set Priority)

SR(_E)

These function blocks judge two input values and output 1 (TRUE) or 0 (FALSE).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] SR_1(S1:=s1,R:=s2,Q1:=d); [With EN/ENO] SR_E_1(EN:=EN,ENO:=ENO S1:=s1,R:=s2,Q1:=d);</pre>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Set instruction	Input variable	BOOL
s2	Reset instruction	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

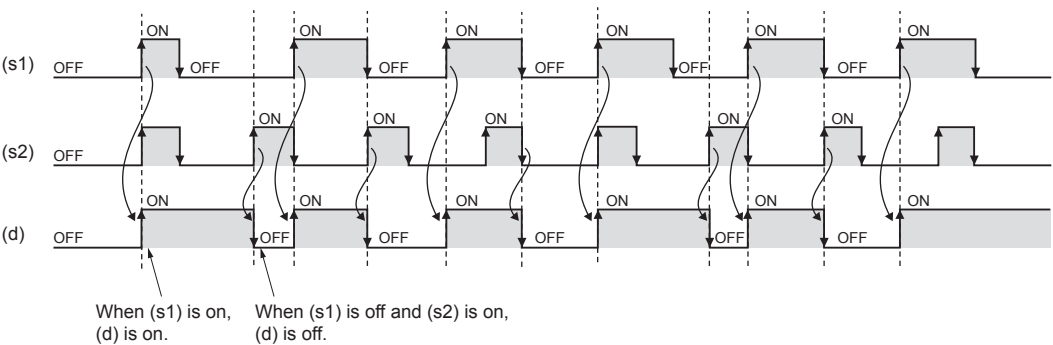
- When (s1) turns ON, (d) is set. If (s2) is turned ON when (s1) is OFF, (d) is reset.
- If (s2) is turned ON when (s1) is ON, (d) is not reset.

■Operation result

1. Function block without EN/ENO

The operation processing is executed. The operation output value is output from (d).

- Timing chart

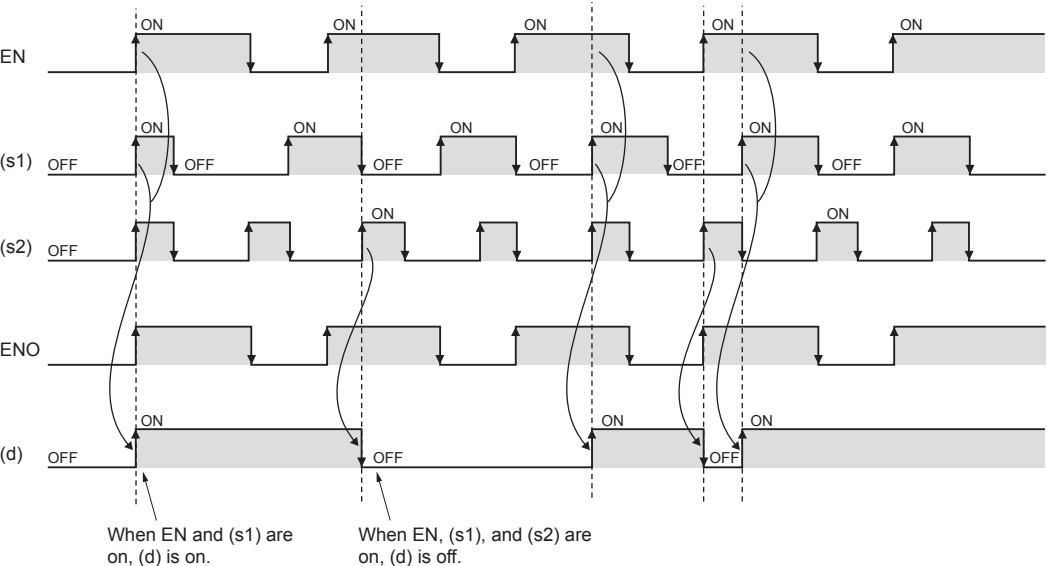


2. Function block with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE	Previous output value

• Timing chart




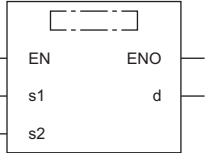
Operation error

There is no operation error.

24.2 Bistable Function Blocks (Reset Priority)

RS(_E)

These function blocks judge two input values and output 1 (TRUE) or 0 (FALSE).

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] RS_1(S:=s1,R1:=s2,Q1:=d); [With EN/ENO] RS_E_1(EN:=EN, ENO:=ENO S:=s1,R1:=s2,Q1:=d);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Set instruction	Input variable	BOOL
s2	Reset instruction	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

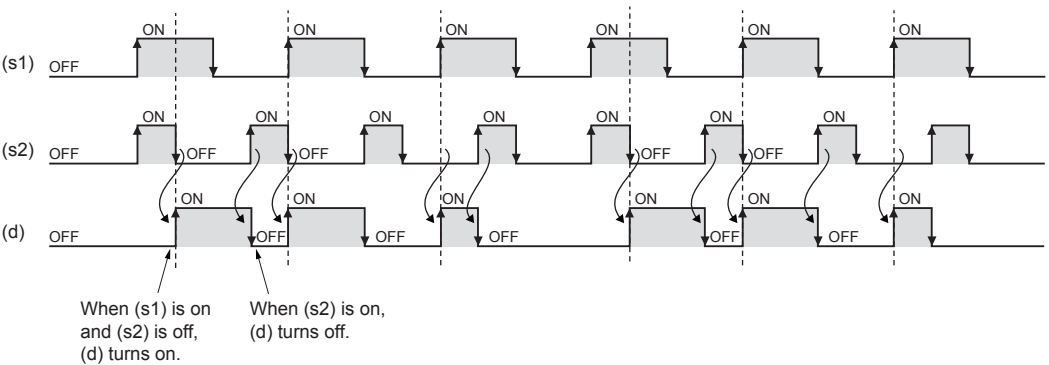
- When (s1) turns ON, (d) is set. When (s2) is turned ON, (d) is reset.
- If (s1) is turned ON when (s2) is ON, (d) is not reset.

■Operation result

1. Function block without EN/ENO

The operation processing is executed. The operation output value is output from (d).

- Timing chart

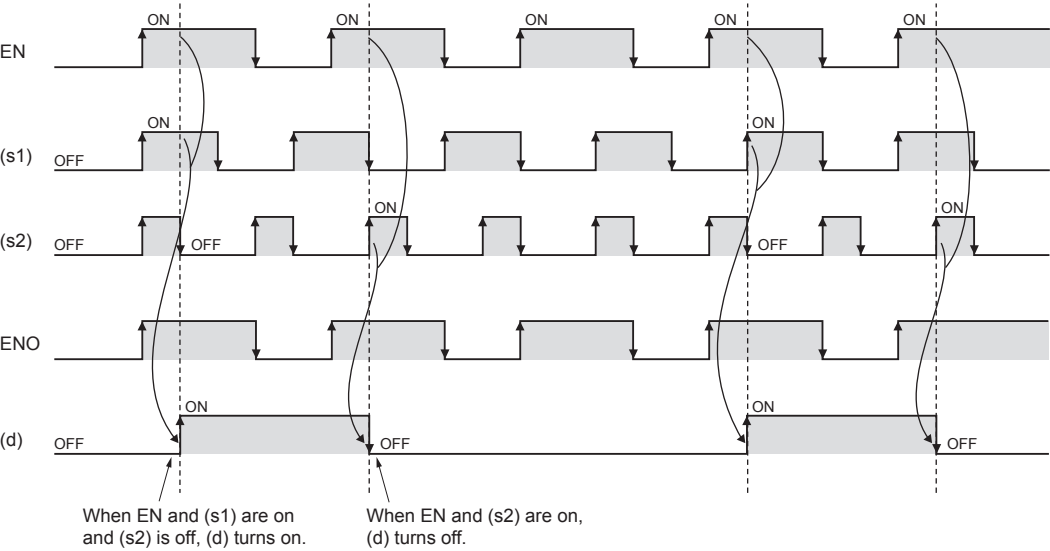


2. Function block with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE	Previous output value

• Timing chart



Operation error

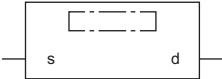
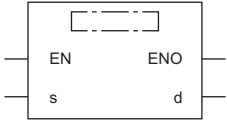
There is no operation error.

25 EDGE DETECTION FUNCTION BLOCKS

25.1 Rising Edge Detector

R_TRIG(_E)

These functions detect the rising edge of a signal, and output a pulse signal.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] R_TRIG_1(CLK:=s,Q:=d); [With EN/ENO] R_TRIG_E_1(EN:=EN, ENO:=ENO CLK:=s,Q:=d);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Rising edge detector input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

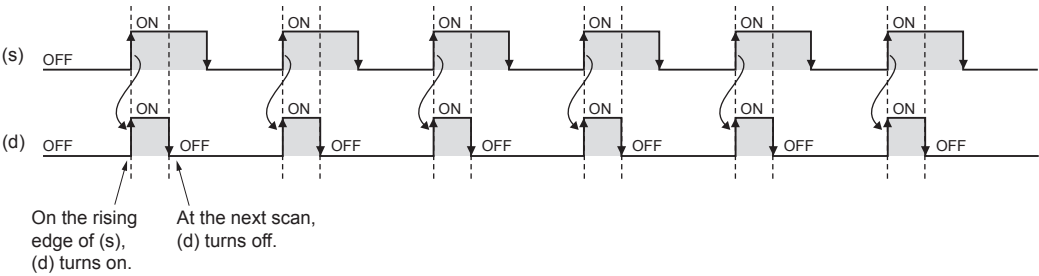
When (s) turns ON, (d) is turned ON only for one scan.

■Operation result

1. Function block without EN/ENO

The operation processing is executed. The operation output value is output from (d).

- Timing chart

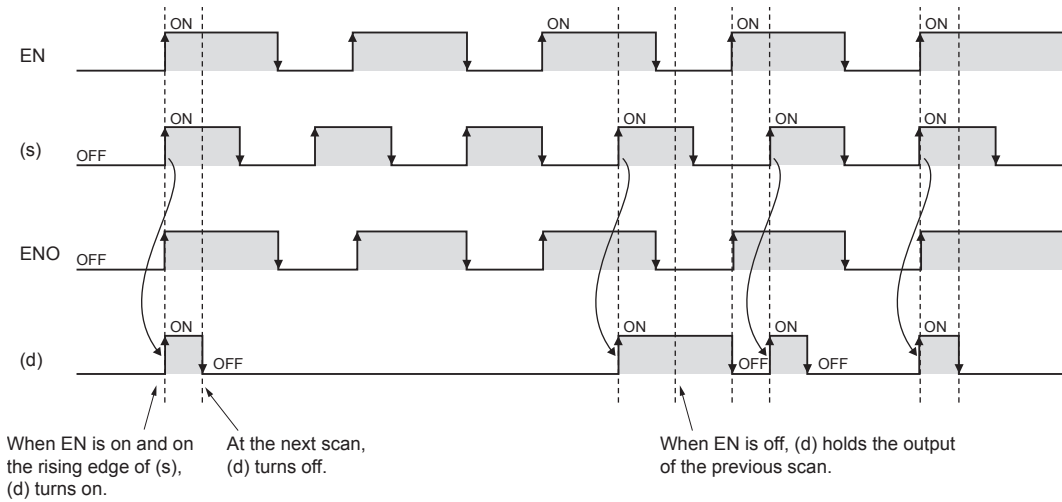


2. Function block with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE	Previous output value

• Timing chart



Operation error

There is no operation error.

25.2 Falling Edge Detector

F_TRIG(_E)

These function blocks detect the falling edge of a signal, and output a pulse signal.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] F_TRIG_1(CLK:=s,Q:=d); [With EN/ENO] F_TRIG_E_1(EN:=EN, ENO:=ENO CLK:=s,Q:=d);</pre>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s	Falling edge detector input	Input variable	BOOL
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d	Output	Output variable	BOOL

Processing details

■Operation processing

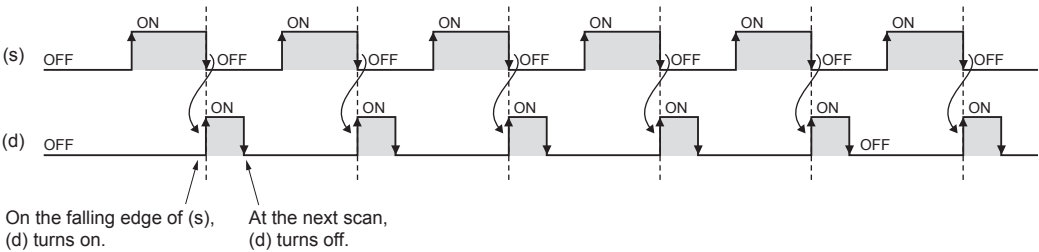
When (s) turns OFF, (d) is turned ON only for one scan.

■Operation result

1. Function block without EN/ENO

The operation processing is executed. The operation output value is output from (d).

- Timing chart

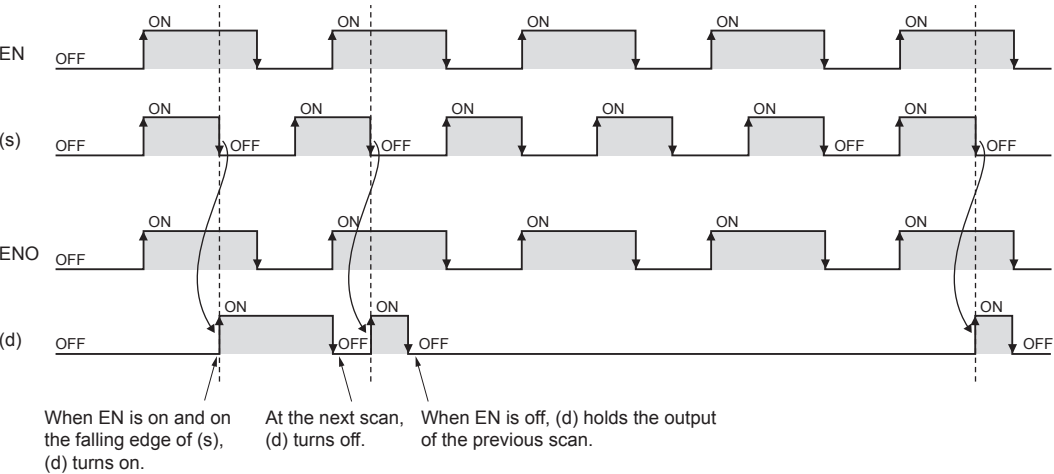


2. Function block with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE	Previous output value

• Timing chart



Operation error

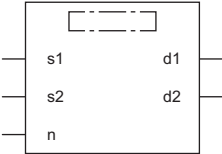
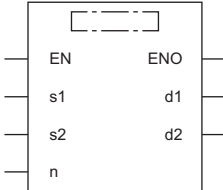
There is no operation error.

26 COUNTER FUNCTION BLOCKS

26.1 Up Counter

CTU(_E)

These function blocks count up the number of times of rising of a signal.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<pre>[Without EN/ENO] CTU_1(CU:=s1,R:=s2,PV:=n,Q:=d1,CV:=d2); [With EN/ENO] CTU_E_1(EN:=EN, ENO:=ENO CU:=s1,R:=s2,PV:=n,Q:=d1,CV:=d2);</pre>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Count signal input	Input variable	BOOL
s2	Count value reset	Input variable	BOOL
n	Count maximum value	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d1	Count end	Output variable	BOOL
d2	Count value	Output variable	INT

Processing details

■Operation processing

- Count up
 - These function blocks count up (add "1" to) the value of (d2) when (s1) turns ON from OFF.
 - When the value of (d2) reaches the value of (n) of the counter, (d1) turns ON and the function blocks stop counting up.
 - Set the maximum value of the counter for (n). When (s2) is turned ON, (d1) turns OFF and (d2) is set to 0.

2. Count maximum value

The effective setting range of (n) is from 0 to 32767.

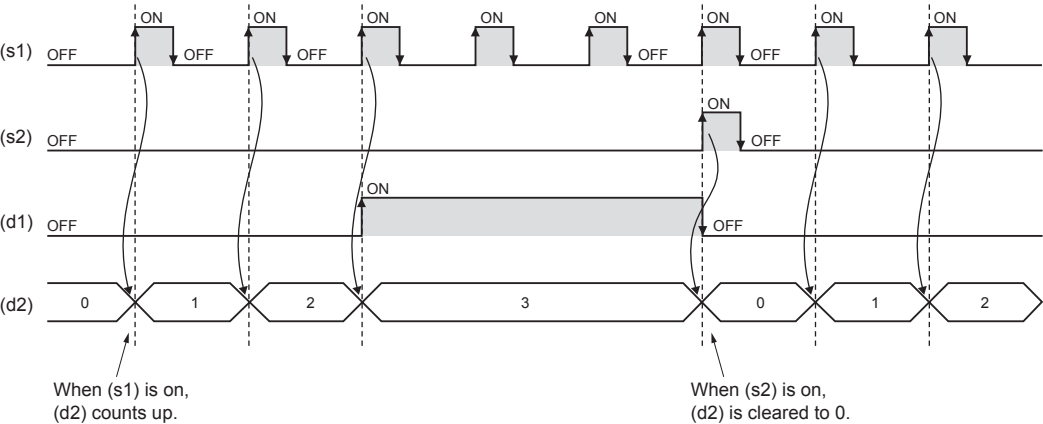
■Operation result

1. Function block without EN/ENO

The operation processing is executed. The operation output value is output from (d1) and (d2).

• Timing chart

When 3 is specified in n



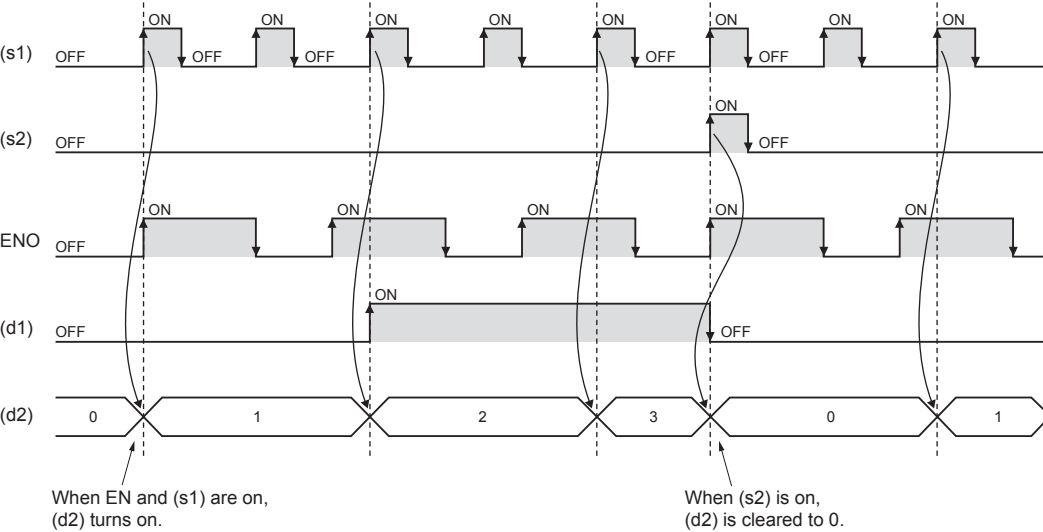
2. Function block with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d1), (d2)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE	Previous output value

• Timing chart

When 3 is specified in n



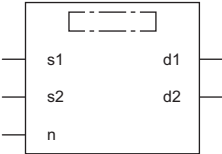
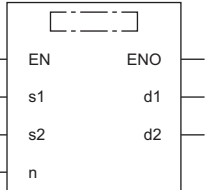
Operation error

There is no operation error.

26.2 Down Counter

CTD(_E)

These function blocks count down the number of times of rising of a signal.

Ladder diagram		Structured text
[Without EN/ENO]	[With EN/ENO]	<div>[Without EN/ENO] CTD_1(CD:=s1,LD:=s2,PV:=n,Q:=d1,CV:=d2);</div> <div>[With EN/ENO] CTD_E_1(EN:=EN, ENO:=ENO CD:=s1,LD:=s2,PV:=n,Q:=d1,CV:=d2);</div>
		

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
EN	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s1	Count signal input	Input variable	BOOL
s2	Count value set	Input variable	BOOL
n	Count start value	Input variable	INT
ENO	Output status (TRUE: Normal, FALSE: Abnormal)	Output variable	BOOL
d1	Count end	Output variable	BOOL
d2	Count value	Output variable	INT

Processing details

■Operation processing

1. Count down

- These function blocks count down (subtract "-1" from) the value of (d2) when (s1) turns ON from OFF.
- When the value of (d2) is 0, (d1) turns ON and the function blocks stop counting down.
- Set the count start value for (n). When (s2) is turned ON, (d1) turns OFF and (n) is set for (d2).

2. Count start value

The effective setting range of (n) is from 0 to 32767.

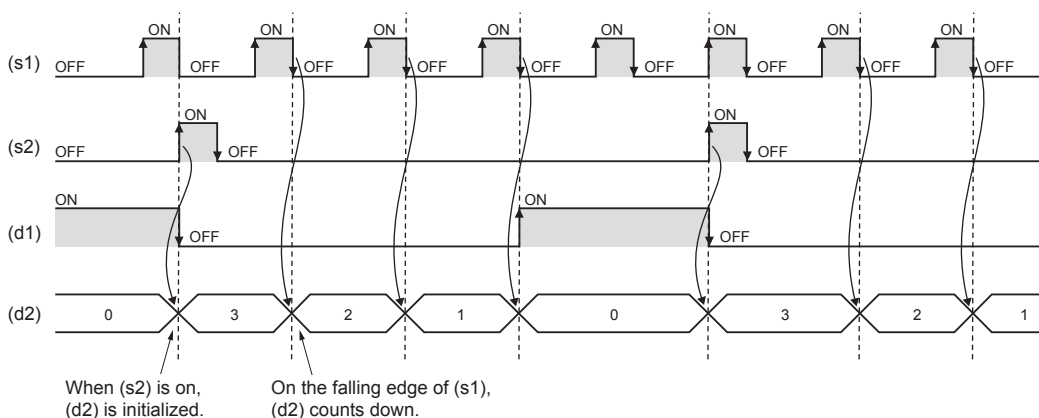
■ Operation result

1. Function block without EN/ENO

The operation processing is executed. The operation output value is output from (d1) and (d2).

• Timing chart

When 3 is specified in n



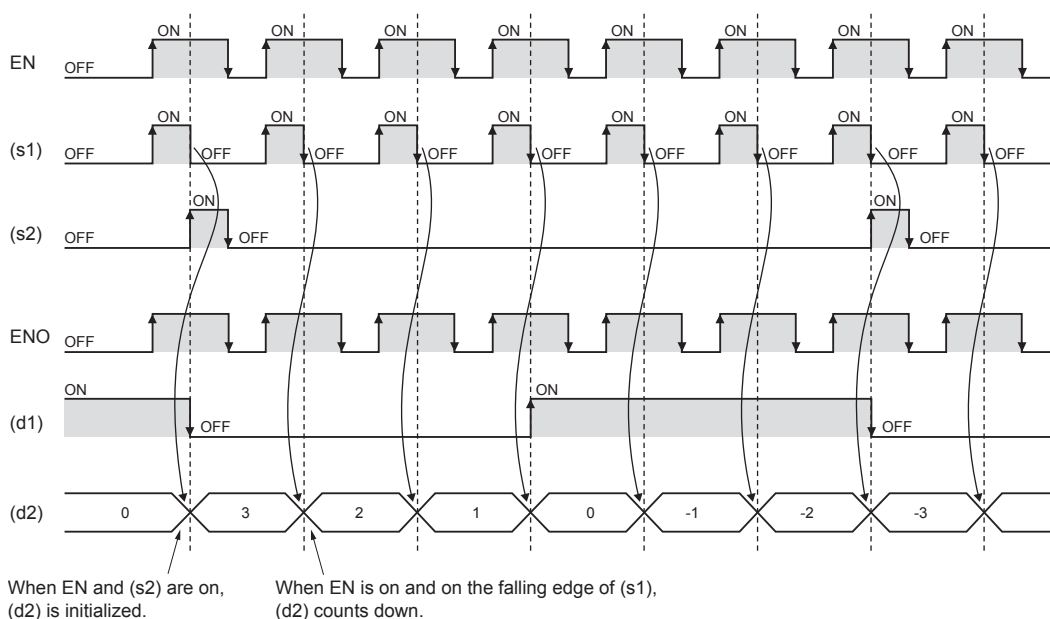
2. Function block with EN/ENO

The following table lists the execution conditions and operation results.

Execution condition	Operation result	
EN	ENO	(d1), (d2)
TRUE (Executes operation)	TRUE	Operation output value
FALSE (Stops operation)	FALSE	Previous output value

• Timing chart

When 3 is specified in n



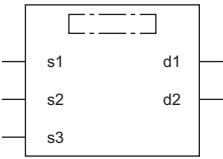
Operation error

There is no operation error.

26.3 Counter Function Block

COUNTER_FB_M

When the execution condition is established, this function block starts counting up.

Ladder diagram	Structured text
	COUNTER_FB_M_1(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2);

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
s1	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s2	Counter set value	Input variable	INT
s3	Counter initial value	Input variable	INT
d1	Counter current value	Output variable	ANY16
d2	Output	Output variable	BOOL

Processing details

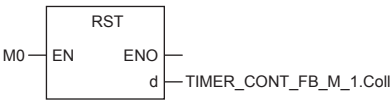
■Operation processing

- The counter starts counting when detecting the rising edge (from OFF to ON) of (s1). It does not start counting if (s1) remains ON. The counting is started from the value of (s3). When the count value reaches the value of (s2), (d2) turns ON. The current count value is stored in (d1).
- A value in the range of 0 to 32767 can be specified for (s2).
- A value in the range of -32768 to 32767 can be specified for (s3). However, when a negative value is specified, the initial value is set to 0.
- To reset the current value of the counter (d1), reset (s1) of FB directly.

Ex.

When the label name is TIMER_CONT_FB_M_1

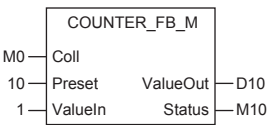
[Ladder]



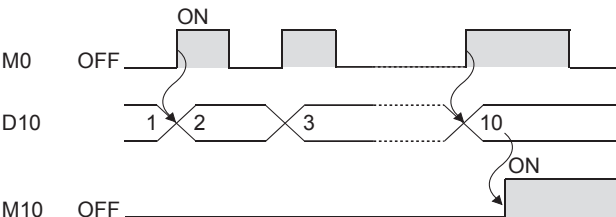
[ST]

RST(M0,TIMER_CONT_FB_M_1.Coil)

[Ladder example]



[Timing chart]



Operation error

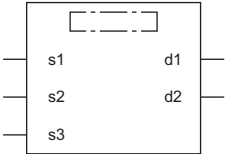
There is no error.

27 TIMER FUNCTION BLOCKS

27.1 Timer Function Blocks

TIMER_□_M

When the execution condition is established, these function blocks start the timer count to the set time.

Ladder diagram	Structured text
 <p>(□ indicates TIMER_1_FB_M, TIMER_10_FB_M, TIMER_100_FB_M, TIMER_CONT_FB_M, TIMER_CONTHS_FB_M.)</p>	<pre>TIMER_1_FB_M_1(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2); TIMER_10_FB_M_1(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2); TIMER_100_FB_M_1(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2); TIMER_CONT_FB_M_1(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2); TIMER_CONTHS_FB_M_1(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2);</pre>

Setting data

■Descriptions, types, and data types

Argument	Description	Type	Data type
s1	Execution condition (TRUE: Execution, FALSE: Stop)	Input variable	BOOL
s2	Timer set value	Input variable	INT
s3	Timer initial value	Input variable	INT
d1	Timer current value	Output variable	ANY16
d2	Output	Output variable	BOOL

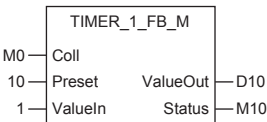
Processing details

■TIMER_1_FB_M

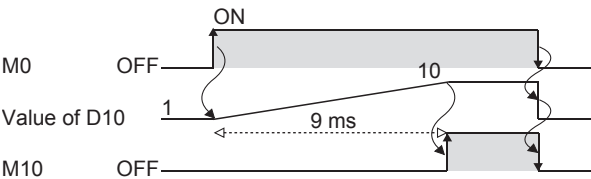
- When the execution condition of (s1) turns on, counting the current value starts. The timer starts counting from "(s3) × 1 ms". When it counts up to "(s2) × 1 ms", (d2) turns on. The current measurement value is output into (d1).
- When the execution condition of (s1) turns off, the current value is reset to (s3) and (d2) turns off.
- A value in the range of 0 to 32767 can be specified for (s2).
- A value in the range of -32768 to 32767 can be specified for (s3). However, when a negative value is specified, the initial value is set to 0.

Ex.

[Ladder example]



[Timing chart]

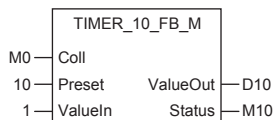


■TIMER_10_FB_M

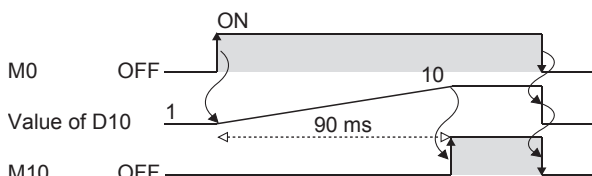
- When the execution condition of (s1) turns on, counting the current value starts. The timer starts counting from " $(s3) \times 10$ ms". When it counts up to " $(s2) \times 10$ ms", (d2) turns on. The current measurement value is output into (d1).
- When the execution condition of (s1) turns off, the current value is reset to (s3) and (d2) turns off.
- A value in the range of 0 to 32767 can be specified for (s2).
- A value in the range of -32768 to 32767 can be specified for (s3). However, when a negative value is specified, the initial value is set to 0.

Ex.

[Ladder example]



[Timing chart]

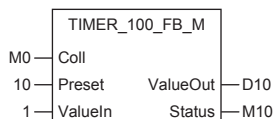


■TIMER_100_FB_M

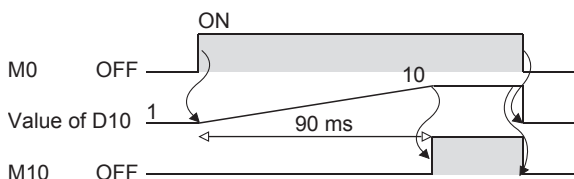
- When the execution condition of (s1) turns on, counting the current value starts. The timer starts counting from " $(s3) \times 100$ ms". When it counts up to " $(s2) \times 100$ ms", (d2) turns on. The current measurement value is output into (d1).
- When the execution condition of (s1) turns off, the current value is reset to (s3) and (d2) turns off.
- A value in the range of 0 to 32767 can be specified for (s2).
- A value in the range of -32768 to 32767 can be specified for (s3). However, when a negative value is specified, the initial value is set to 0.

Ex.

[Ladder example]



[Timing chart]

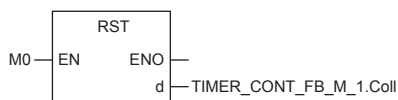


■TIMER_CONT_FB_M

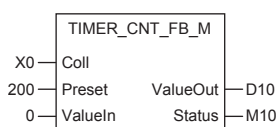
- This is a retentive timer that counts the time when the variable is on. When the execution condition of (s1) turns on, counting the current value starts. There are two retentive timers: low-speed (TIMER_CONT_FB_M) and highspeed (TIMER_CONTHS_FB_M) retentive timers.
- The timer starts counting from "(s3) × 100 ms"(or 1ms if the high-speed retentive timer is used). When it counts up to "(s2) × 100 ms"(or 1ms if the high-speed retentive timer is used), (d2) turns on. The current measurement value is output into (d1).
- The on/off status of (d1) and (d2) is maintained even if the execution condition of (s1) turns off. When the execution condition of (s1) turns on, the timer resume counting from the measurement it holds.
- A value in the range of 0 to 32767 can be specified for (s2).
- A value in the range of -32768 to 32767 can be specified for (s3). However, when a negative value is specified, the initial value is set to 0.
- To reset (d1) of the retentive timer, reset (s1) of FB directly.

Ex.

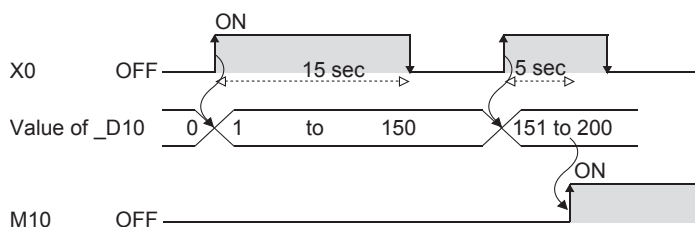
For label name TIMER_CONT_FB_M_1
[Ladder program]



[ST]
RST(M0,TIMER_CONT_FB_M_1.Coll)
[Ladder example]



[Timing chart]



Operation error

There is no error.

APPENDICES

Appendix 1 Number of Instruction Steps

The number of instruction steps are shown below.

The number of steps may increase depending on the contents of the source and destination (such as specification of BFM or character string), bit specification of word device, nibble specification of bit devices, indexing etc.

Instruction name	Number of minimum steps
LD	2
LDI	2
AND	2
ANI	2
OR	2
ORI	2
LDP	4
LDF	4
ANDP	4
ANDF	4
ORP	4
ORF	4
LDPI	4
LDFI	4
ANDPI	4
ANDFI	4
ORPI	4
ORFI	4
ANB	1
ORB	1
MPS	1
MRD	1
MPP	1
INV	1
MEP	3
MEF	3
OUT	2
OUT T/ST	5
OUTH T/ ST	5
OUTHS T/ST	5
OUT C	5
OUT LC	5
OUT F	3
SET	2
RST	2
SET F	3
RST F	3
ANS	7
ANR	1
ANRP	1
PLS	3
PLF	3
FF	3
ALT	3

Instruction name	Number of minimum steps
ALTP	3
SFT	3
SFTP	3
SFR	4
SFRP	4
SFL	4
SFLP	4
BSFR	4
BSFRP	4
BSFL	4
BSFLP	4
DSFR	4
DSFRP	4
DSFL	4
DSFLP	4
SFTR	6
SFTRP	6
SFTL	6
SFTLP	6
WSFR	6
WSFRP	6
WSFL	6
WSFLP	6
MC	5
MCR	3
FEND	1
END	1
STOP	1
NOP	1
LD=	4
LD<>	4
LD>	4
LD<=	4
LD<	4
LD>=	4
AND=	4
AND<>	4
AND>	4
AND<=	4
AND<	4
AND>=	4
OR=	4
OR<>	4
OR>	4
OR<=	4
OR<	4
OR>=	4
LD=_U	4
LD<>_U	4
LD>_U	4
LD<=_U	4
LD<_U	4
LD>=_U	4

Instruction name	Number of minimum steps
AND=_U	4
AND<>_U	4
AND>_U	4
AND<=_U	4
AND<_U	4
AND>=_U	4
OR=_U	4
OR<>_U	4
OR>_U	4
OR<=_U	4
OR<_U	4
OR>=_U	4
LDD=	4
LDD<>	4
LDD>	4
LDD<=	4
LDD<	4
LDD>=	4
ANDD=	4
ANDD<>	4
ANDD>	4
ANDD<=	4
ANDD<	4
ANDD>=	4
ORD=	4
ORD<>	4
ORD>	4
ORD<=	4
ORD<	4
ORD>=	4
LDD=_U	4
LDD<>_U	4
LDD>_U	4
LDD<=_U	4
LDD<_U	4
LDD>=_U	4
ANDD=_U	4
ANDD<>_U	4
ANDD>_U	4
ANDD<=_U	4
ANDD<_U	4
ANDD>=_U	4
ORD=_U	4
ORD<>_U	4
ORD>_U	4
ORD<=_U	4
ORD<_U	4
ORD>=_U	4
CMP	5
CMPP	5
CMP_U	5
CMPP_U	5
DCMP	5

Instruction name	Number of minimum steps
DCMPP	5
DCMP_U	5
DCMPP_U	5
ZCP	6
ZCPP	6
ZCP_U	6
ZCPP_U	6
DZCP	6
DZCPP	6
DZCP_U	6
DZCPP_U	6
BKCMP=	6
BKCMP<>	6
BKCMP>	6
BKCMP<=	6
BKCMP<	6
BKCMP>=	6
BKCMP=P	6
BKCMP<>P	6
BKCMP>P	6
BKCMP<=P	6
BKCMP<P	6
BKCMP>=P	6
BKCMP=_U	6
BKCMP<>_U	6
BKCMP>_U	6
BKCMP<=_U	6
BKCMP<_U	6
BKCMP>=_U	6
BKCMP=P_U	6
BKCMP<>P_U	6
BKCMP>P_U	6
BKCMP<=P_U	6
BKCMP<P_U	6
BKCMP>=P_U	6
DBKCMP=	6
DBKCMP<>	6
DBKCMP>	6
DBKCMP<=	6
DBKCMP<	6
DBKCMP>=	6
DBKCMP=P	6
DBKCMP<>P	6
DBKCMP>P	6
DBKCMP<=P	6
DBKCMP<P	6
DBKCMP>=P	6
DBKCMP=_U	6
DBKCMP<>_U	6
DBKCMP>_U	6
DBKCMP<=_U	6
DBKCMP<_U	6
DBKCMP>=_U	6

Instruction name	Number of minimum steps
DBKCOMP=P_U	6
DBKCOMP<>P_U	6
DBKCOMP>P_U	6
DBKCOMP<=P_U	6
DBKCOMP<P_U	6
DBKCOMP>=P_U	6
+ (s) (d)	5
+P (s) (d)	5
+ (s1) (s2) (d)	5
+P (s1) (s2) (d)	5
+_U (s) (d)	5
+P_U (s) (d)	5
+_U (s1) (s2) (d)	5
+P_U (s1) (s2) (d)	5
ADD	5
ADDP	5
ADD_U	5
ADDP_U	5
- (s) (d)	5
-P (s) (d)	5
- (s1) (s2) (d)	5
-P (s1) (s2) (d)	5
-_U (s) (d)	5
-P_U (s) (d)	5
-_U (s1) (s2) (d)	5
-P_U (s1) (s2) (d)	5
SUB	5
SUBP	5
SUB_U	5
SUBP_U	5
D+ (s) (d)	5
D+P (s) (d)	5
D+ (s1) (s2) (d)	5
D+P (s1) (s2) (d)	5
D+_U (s) (d)	5
D+P_U (s) (d)	5
D+_U (s1) (s2) (d)	5
D+P_U (s1) (s2) (d)	5
DADD	5
DADDP	5
DADD_U	5
DADDP_U	5
D- (s) (d)	5
D-P (s) (d)	5
D- (s1) (s2) (d)	5
D-P (s1) (s2) (d)	5
D-_U (s) (d)	5
D-P_U (s) (d)	5
D-_U (s1) (s2) (d)	5
D-P_U (s1) (s2) (d)	5
DSUB	5
DSUBP	5
DSUB_U	5

Instruction name	Number of minimum steps
DSUBP_U	5
*	7
*P	7
*_U	7
*P_U	7
MUL	7
MULP	7
MUL_U	7
MULP_U	7
/	7
/P	7
/_U	7
/P_U	7
DIV	7
DIVP	7
DIV_U	7
DIVP_U	7
D*	7
D*P	7
D*_U	7
D*P_U	7
DMUL	7
DMULP	7
DMUL_U	7
DMULP_U	7
D/	7
D/P	7
D/_U	7
D/P_U	7
DDIV	7
DDIVP	7
DDIV_U	7
DDIVP_U	7
B+ (s) (d)	4
B+P (s) (d)	4
B+ (s1) (s2) (d)	5
B+P (s1) (s2) (d)	5
B- (s) (d)	4
B-P (s) (d)	4
B- (s1) (s2) (d)	5
B-P (s1) (s2) (d)	5
DB+ (s) (d)	4
DB+P (s) (d)	4
DB+ (s1) (s2) (d)	5
DB+P (s1) (s2) (d)	5
DB- (s) (d)	4
DB-P (s) (d)	4
DB- (s1) (s2) (d)	5
DB-P (s1) (s2) (d)	5
B*	7
B*P	7
B/	7
B/P	7

Instruction name	Number of minimum steps
DB*	7
DB*P	7
DB/	7
DB/P	7
BK+	6
BK+P	6
BK+_U	6
BK+P_U	6
BK-	6
BK-P	6
BK-_U	6
BK-P_U	6
DBK+	6
DBK+P	6
DBK+_U	6
DBK+P_U	6
DBK-	6
DBK-P	6
DBK-_U	6
DBK-P_U	6
INC	3
INCP	3
INC_U	3
INCP_U	3
DEC	3
DECP	3
DEC_U	3
DECP_U	3
DINC	3
DINCP	3
DINC_U	3
DINCP_U	3
DDEC	3
DDECP	3
DDEC_U	3
DDECP_U	3
WAND (s) (d)	5
WANDP (s) (d)	5
WAND (s1) (s2) (d)	5
WANDP (s1) (s2) (d)	5
DAND (s) (d)	5
DANDP (s) (d)	5
DAND (s1) (s2) (d)	5
DANDP (s1) (s2) (d)	5
BKAND	6
BKANDP	6
WOR (s) (d)	5
WORP (s) (d)	5
WOR (s1) (s2) (d)	5
WORP (s1) (s2) (d)	5
DOR (s) (d)	5
DORP (s) (d)	5
DOR (s1) (s2) (d)	5

Instruction name	Number of minimum steps
DORP (s1) (s2) (d)	5
BKOR	6
BKORP	6
WXOR (s) (d)	5
WXORP (s) (d)	5
WXOR (s1) (s2) (d)	5
WXORP (s1) (s2) (d)	5
DXOR (s) (d)	5
DXORP (s) (d)	5
DXOR (s1) (s2) (d)	5
DXORP (s1) (s2) (d)	5
BKXOR	6
BKXORP	6
WXNR (s) (d)	5
WXNRP (s) (d)	5
WXNR (s1) (s2) (d)	5
WXNRP (s1) (s2) (d)	5
DXNR (s) (d)	5
DXNRP (s) (d)	5
DXNR (s1) (s2) (d)	5
DXNRP (s1) (s2) (d)	5
BKXNR	6
BKXNRP	6
BSET	4
BSETP	4
BRST	4
BRSTP	4
TEST	5
TESTP	5
DTEST	5
DTESTP	5
BKRST	4
BKRSTP	4
ZRST	4
ZRSTP	4
BCD	4
BCDP	4
DBCD	4
DBCDP	4
BIN	4
BINP	4
DBIN	4
DBINP	4
FLT2INT	4
FLT2INTP	4
FLT2UINT	4
FLT2UINTP	4
FLT2DINT	4
FLT2DINTP	4
FLT2UDINT	4
FLT2UDINTP	4
INT2UINT	4
INT2UINTP	4

Instruction name	Number of minimum steps
INT2DINT	4
INT2DINTP	4
INT2UDINT	4
INT2UDINTP	4
UINT2INT	4
UINT2INTP	4
UINT2DINT	4
UINT2DINTP	4
UINT2UDINT	4
UINT2UDINTP	4
DINT2INT	4
DINT2INTP	4
DINT2UINT	4
DINT2UINTP	4
DINT2UDINT	4
DINT2UDINTP	4
UDINT2INT	4
UDINT2INTP	4
UDINT2UINT	4
UDINT2UINTP	4
UDINT2DINT	4
UDINT2DINTP	4
GRY	4
GRYP	4
GRY_U	4
GRYP_U	4
DGRY	4
DGRYP	4
DGRY_U	4
DGRYP_U	4
GBIN	4
GBINP	4
GBIN_U	4
GBINP_U	4
DGBIN	4
DGBINP	4
DGBIN_U	4
DGBINP_U	4
DABIN	4
DABINP	4
DABIN_U	4
DABINP_U	4
DDABIN	4
DDABINP	4
DDABIN_U	4
DDABINP_U	4
HEXA	5
HEXAP	5
VAL	5
VALP	5
VAL_U	5
VALP_U	5
DVAL	5

Instruction name	Number of minimum steps
DVALP	5
DVAL_U	5
DVALP_U	5
NEG	3
NEGP	3
DNEG	3
DNEGP	3
DECO	5
DECOP	5
ENCO	5
ENCOP	5
DIS	5
DISP	5
UNI	5
UNIP	5
NDIS	5
NDISP	5
NUNI	5
NUNIP	5
WTOB	5
WTOBP	5
BTOW	5
BTOWP	5
MOV	4
MOVP	4
DMOV	4
DMOVP	4
CML	4
CMLP	4
DCML	4
DCMLP	4
SMOV	7
SMOVP	7
CMLB	4
CMLBP	4
BMOV	5
BMOVP	5
FMOV	5
FMOVP	5
DFMOV	5
DFMOVP	5
XCH	4
XCHP	4
DXCH	4
DXCHP	4
SWAP	3
SWAPP	3
DSWAP	3
DSWAPP	3
MOVB	4
MOVBP	4
PRUN	5
PRUNP	5

Instruction name	Number of minimum steps
DPRUN	5
DPRUNP	5
BLKMOVB	5
BLKMOVBP	5
ROR	4
RORP	4
RCR	4
RCRP	4
DROR	4
DRORP	4
DRCR	4
DRCRP	4
ROL	4
ROLP	4
RCL	4
RCLP	4
DROL	4
DROLP	4
DRCL	4
DRCLP	4
CJ	3
CJP	3
GOEND	1
DI	1
DI (s)	3
EI	1
IMASK	3
SIMASK	5
IRET	1
WDT	1
WDTP	1
FOR	3
NEXT	1
BREAK	5
BREAKP	5
CALL	3
CALLP	3
RET	1
SRET	1
XCALL	3
SFRD	5
SFRDP	5
POP	5
POPP	5
SFWR	5
SFWRP	5
FINS	5
FINSP	5
FDEL	5
FDELP	5
LD\$=	4
LD\$<>	4
LD\$>	4

Instruction name	Number of minimum steps
LD\$<=	4
LD\$<	4
LD\$>=	4
AND\$=	4
AND\$<>	4
AND\$>	4
AND\$<=	4
AND\$<	4
AND\$>=	4
OR\$=	4
OR\$<>	4
OR\$>	4
OR\$<=	4
OR\$<	4
OR\$>=	4
\$+ (s) (d)	4
\$+P (s) (d)	4
\$+ (s1) (s2) (d)	5
\$+P (s1) (s2) (d)	5
\$MOV	4
\$MOVP	4
BINDA	4
BINDAP	4
BINDA_U	4
BINDAP_U	4
DBINDA	4
DBINDAP	4
DBINDA_U	4
DBINDAP_U	4
ASCI	5
ASCIP	5
STR	5
STRP	5
STR_U	5
STRP_U	5
DSTR	5
DSTRP	5
DSTR_U	5
DSTRP_U	5
ESTR	5
ESTRP	5
DESTR	5
DESTRP	5
LEN	4
LENP	4
RIGHT	5
RIGHTP	5
LEFT	5
LEFTP	5
MIDR	5
MIDRP	5
MIDW	5
MIDWP	5

Instruction name	Number of minimum steps
INSTR	6
INSTRP	6
STRINS	5
STRINSP	5
STRDEL	5
STRDELP	5
LDE=	4
LDE<>	4
LDE>	4
LDE<=	4
LDE<	4
LDE>=	4
ANDE=	4
ANDE<>	4
ANDE>	4
ANDE<=	4
ANDE<	4
ANDE>=	4
ORE=	4
ORE<>	4
ORE>	4
ORE<=	4
ORE<	4
ORE>=	4
DECMP	5
DECMPP	5
DEZCP	6
DEZCPP	6
E+ (s) (d)	4
E+P (s) (d)	4
E+ (s1) (s2) (d)	5
E+P (s1) (s2) (d)	5
DEADD	5
DEADDP	5
E- (s) (d)	4
E-P (s) (d)	4
E- (s1) (s2) (d)	5
E-P (s1) (s2) (d)	5
DESUB	5
DESUBP	5
E*	5
E*P	5
DEMUL	5
DEMULP	5
E/	5
E/P	5
DEDIV	5
DEDIVP	5
INT2FLT	4
INT2FLTP	4
UINT2FLT	4
UINT2FLTP	4
DINT2FLT	4

Instruction name	Number of minimum steps
DINT2FLTP	4
UDINT2FLT	4
UDINT2FLTP	4
EVAL	4
EVALP	4
DEVAL	4
DEVALP	4
DEBCD	4
DEBCDP	4
DEBIN	4
DEBINP	4
ENEG	3
ENEGP	3
DENEG	3
DENEGP	3
EMOV	4
EMOVP	4
DEMOV	4
DEMOVP	4
SIN	4
SINP	4
DSIN	4
DSINP	4
COS	4
COSP	4
DCOS	4
DCOSP	4
TAN	4
TANP	4
DTAN	4
DTANP	4
ASIN	4
ASINP	4
DASIN	4
DASINP	4
ACOS	4
ACOSP	4
DACOS	4
DACOSP	4
ATAN	4
ATANP	4
DATAN	4
DATANP	4
RAD	4
RADP	4
DRAD	4
DRADP	4
DEG	4
DEGP	4
DDEG	4
DDEGP	4
DESQR	4
DESQRP	4

Instruction name	Number of minimum steps
EXP	4
EXPP	4
DEXP	4
DEXPP	4
LOG	4
LOGP	4
DLOGE	4
DLOGEP	4
POW	5
POWP	5
LOG10	4
LOG10P	4
DLOG10	4
DLOG10P	4
EMAX	5
EMAXP	5
EMIN	5
EMINP	5
RND	3
RNDP	3
ZPUSH (d)	3
ZPUSHP (d)	3
ZPUSH (s) (d)	4
ZPUSHP (s) (d)	4
ZPOP (d)	3
ZPOPP (d)	3
ZPOP (s) (d)	4
ZPOPP (s) (d)	4
LIMIT	6
LIMITP	6
LIMIT_U	6
LIMITP_U	6
DLIMIT	6
DLIMITP	6
DLIMIT_U	6
DLIMITP_U	6
BAND	6
BANDP	6
BAND_U	6
BANDP_U	6
DBAND	6
DBANDP	6
DBAND_U	6
DBANDP_U	6
ZONE	6
ZONEP	6
ZONE_U	6
ZONEP_U	6
DZONE	6
DZONEP	6
DZONE_U	6
DZONEP_U	6
SCL	5

Instruction name	Number of minimum steps
SCLP	5
SCL_U	5
SCLP_U	5
DSCL	5
DSCLP	5
DSCL_U	5
DSCLP_U	5
SCL2	5
SCL2P	5
SCL2_U	5
SCL2P_U	5
DSCL2	5
DSCL2P	5
DSCL2_U	5
DSCL2P_U	5
TTMR	4
STMR	7
ROTC	6
RAMPF	6
SPD	5
DSPD	5
PLSY	5
DPLSY	5
PWM	5
DPWM	5
ABSD	9
DABSD	9
INCD	9
CCD	5
CCDP	5
SERMM	6
SERMMP	6
DSERMM	6
DSERMMP	6
SUM	4
SUMP	4
DSUM	4
DSUMP	4
BON	5
BONP	5
DBON	5
DBONP	5
MAX	5
MAXP	5
MAX_U	5
MAXP_U	5
DMAX	5
DMAXP	5
DMAX_U	5
DMAXP_U	5
MIN	5
MINP	5
MIN_U	5

Instruction name	Number of minimum steps
MINP_U	5
DMIN	5
DMINP	5
DMIN_U	5
DMINP_U	5
SORTTBL	7
SORTTBL_U	7
SORTTBL2	7
SORTTBL2_U	7
DSORTTBL2	7
DSORTTBL2_U	7
WSUM	7
WSUMP	7
WSUM_U	7
WSUMP_U	7
DWSUM	7
DWSUMP	7
DWSUM_U	7
DWSUMP_U	7
MEAN	5
MEANP	5
MEAN_U	5
MEANP_U	5
DMEAN	5
DMEANP	5
DMEAN_U	5
DMEANP_U	5
SQRT	4
SQ RTP	4
DSQRT	4
DSQ RTP	4
CRC	5
CRCP	5
ADRSET	4
ADRSETP	4
TRD	3
TRDP	3
TWR	3
TWRP	3
TADD	5
TADDP	5
TSUB	5
TSUBP	5
HTOS	4
HTOSP	4
DHTOS	4
DHTOSP	4
STOH	4
STOHP	4
DSTOH	4
DSTOHP	4
LDDT=	5
LDDT<>	5

Instruction name	Number of minimum steps
LDDT>	5
LDDT<=	5
LDDT<	5
LDDT>=	5
ANDDT=	5
ANDDT<>	5
ANDDT>	5
ANDDT<=	5
ANDDT<	5
ANDDT>=	5
ORDT=	5
ORDT<>	5
ORDT>	5
ORDT<=	5
ORDT<	5
ORDT>=	5
LDTM=	5
LDTM<>	5
LDTM>	5
LDTM<=	5
LDTM<	5
LDTM>=	5
ANDTM=	5
ANDTM<>	5
ANDTM>	5
ANDTM<=	5
ANDTM<	5
ANDTM>=	5
ORTM=	5
ORTM<>	5
ORTM>	5
ORTM<=	5
ORTM<	5
ORTM>=	5
TCMP	7
TCMPP	7
TZCP	6
TZCPP	6
DUTY	5
HOURM	5
DHOURM	5
REF	4
REFP	4
RFS	4
RFSP	4
FROM	6
FROMP	6
DFROM	6
DFROMP	6
TO	6
TOP	6
DTO	6
DTOP	6

Instruction name	Number of minimum steps
FROMD	6
FROMDP	6
DFROD	6
DFRODP	6
TOD	6
TODP	6
DTOD	6
DTODP	6
SP.SOCOPEN	10
SP.SOCCLOSE	10
SP.SOCRRCV	12
SP.SOCSND	12
SP.SOCCINF	10
S.SOCRDATA	12
SP.SOCRDATA	12
DHSCS	5
DHSCR	5
DHSZ	6
HIOEN	5
HIOENP	5
DHIOEN	5
DHIOENP	5
HCMOV	5
HCMOVP	5
DHCMOV	5
DHCMOVP	5
RS2	7
DSZR	6
DDSZR	6
DVIT	6
DDVIT	6
TBL	4
DRV TBL	7
DRVMUL	13
DABS	5
PLSV	5
DPLSV	5
DRVI	6
DDRVI	6
DRVA	6
DDRVA	6
IVCK	7
IVDR	7
IVRD	7
IVWR	7
IVBWR	7
IVMC	13
ADPRW	13
RBFM	7
WBFM	7

INSTRUCTION INDEX

Symbols

-(P)(_U)	165,166
*(P)(_U)	177
/(P)(_U)	180
+(P)(_U)	161,162
\$+(P)	364,366
\$MOV(P)	368

A

ABS(_E)	764
ABSD	538
ACOS(_E)	775
ACOS(P)	447
ADD(_E)	777
ADD(P)(_U)	163
ADD_TIME(_E)	830
ADPRW	682
ADRSET(P)	577
ALT(P)	124
ANB	104
AND	98
AND(_E)	799
AND<(_U)	145
AND<=(_U)	145
AND<>(_U)	145
AND=(_U)	145
AND>(_U)	145
AND>=(_U)	145
AND\$<	361
AND\$<=	361
AND\$<>	361
AND\$=	361
AND\$>	361
AND\$>=	361
ANDD<(_U)	147
ANDD<=(_U)	147
ANDD<>(_U)	147
ANDD=(_U)	147
ANDD>(_U)	147
ANDD>=(_U)	147
ANDDT<	591
ANDDT<=	591
ANDDT<>	591
ANDDT=	591
ANDDT>	591
ANDDT>=	591
ANDE<	404
ANDE<=	404
ANDE<>	404
ANDE=	404
ANDE>	404
ANDE>=	404
ANDF	100
ANDFI	102
ANDP	100
ANDPI	102
ANDTM<	594
ANDTM<=	594
ANDTM<>	594
ANDTM=	594

ANDTM>	594
ANDTM>=	594
ANI	98
ANR(P)	119
ANS	118
ASCI(P)	374
ASIN(_E)	774
ASIN(P)	445
ATAN(_E)	776
ATAN(P)	449

B

B-(P)	192,193
B*(P)	198
B/(P)	199
B+(P)	190,191
BAND(P)(_U)	476
BCD(P)	242
BCD_TO_DINT(_E)	731
BCD_TO_INT(_E)	729
BIN(P)	246
BINDA(P)(_U)	370
BITARR_TO_DINT(_E)	756
BITARR_TO_INT(_E)	755
BK-(P)(_U)	204
BK+(P)(_U)	202
BKAND(P)	219
BKCMPL(P)(_U)	157
BKCMPL(P)(_U)	157
BKCMPL(P)(_U)	157
BKCMPL(P)(_U)	157
BKCMPL(P)(_U)	157
BKCMPL(P)(_U)	157
BKOR(P)	224
BKRST(P)	239
BKXNR(P)	234
BKXOR(P)	229
BLKMOVB(P)	316
BMOV(P)	303
BON(P)	553
BOOL_TO_DINT(_E)	693
BOOL_TO_DWORD(_E)	691
BOOL_TO_INT(_E)	692
BOOL_TO_STRING(_E)	695
BOOL_TO_TIME(_E)	694
BOOL_TO_WORD(_E)	690
BREAK(P)	342
BRST(P)	236
BSET(P)	235
BSFL(P)	130
BSFR(P)	129
BTOW(P)	294

C

CALL(P)	344
CCD(P)	544
CJ(P)	326
CML(P)	298
CMLB(P)	302
CMP(P)(_U)	149

CONCAT(_E)	819
COS(_E)	772
COS(P)	441
COUNTER_FB_M.	852
CPY_BITARR(_E).	759
CPY_BIT_OF_INT(_E)	762
CRC(P)	574
CTD(_E)	850
CTU(_E)	848

D

D-(P)(_U)	173,174
D*(P)(_U)	183
D/(P)(_U)	187
D+(P)(_U)	169,170
DABIN(P)(_U)	270
DABS	662
DABSD	540
DACOS(P)	447
DADD(P)(_U)	171
DAND(P)	217,218
DASIN(P)	445
DATAN(P)	449
DB-(P)	196,197
DB*(P)	200
DB/(P)	201
DB+(P)	194,195
DBAND(P)(_U)	478
DBCD(P)	244
DBIN(P)	248
DBINDA(P)(_U)	372
DBK-(P)(_U)	209
DBK+(P)(_U)	206
DBKCMPLT(P)(_U)	159
DBKCMPLT<=(P)(_U)	159
DBKCMPLT<>(P)(_U)	159
DBKCMPLT=(P)(_U)	159
DBKCMPLT>(P)(_U)	159
DBKCMPLT>=(P)(_U)	159
DBON(P)	554
DCML(P)	299
DCMP(P)(_U)	151
DCOS(P)	441
DDABIN(P)(_U)	272
DDEC(P)(_U)	214
DDEG(P)	452
DDIV(P)(_U)	188
DDRVA	673,674
DDRVI	669,670
DDSZR	652
DDVIT	655,656
DEADD(P)	414
DEBCD(P)	433
DEBIN(P)	435
DEC(P)(_U)	212
DECMPLT(P)	406
DECO(P)	284
DEDIV(P)	424
DEG(P)	452
DELETE(_E)	823
DEMOV(P)	438
DEMUL(P)	422
DENEG(P)	437
DESQR(P)	453
DESTR(P)	383

DESUB(P)	416
DEVAL(P)	430
DEXP(P)	454
DEZCP(P)	408
DFMOV(P)	306
DFROD(P)	613,615
DFROM(P)	607,609
DGBIN(P)(_U)	269
DGRY(P)(_U)	267
DHCMOV	646
DHIOEN(P)	642
DHOURL	604
DHSCR	636
DHSCS	634
DHSZ	638
DHTOS(P)	588
DI	330,332
DINC(P)(_U)	213
DINT2FLT(P)	428
DINT2INT(P)	260
DINT2UDINT(P)	262
DINT2UINT(P)	261
DINT_TO_BCD(_E)	723
DINT_TO_BITARR(_E)	758
DINT_TO_BOOL(_E)	718
DINT_TO_DWORD(_E)	721
DINT_TO_INT(_E)	722
DINT_TO_REAL(_E)	725
DINT_TO_STRING(_E)	727
DINT_TO_TIME(_E)	726
DINT_TO_WORD(_E)	719
DIS(P)	286
DIV(_E)	783
DIV(P)(_U)	181
DIV_TIME(_E)	836
DLIMIT(P)(_U)	474
DLOG10(P)	460
DLOGE(P)	456
DMAX(P)(_U)	556
DMEAN(P)(_U)	571
DMIN(P)(_U)	558
DMOV(P)	297
DMUL(P)(_U)	185
DNeg(P)	283
DOR(P)	222,223
DPLSV	665,666
DPLSY	521,525
DPRUN(P)	314
DPWM	533
DRAD(P)	451
DRCL(P)	324
DRCLR(P)	322
DROL(P)	324
DROR(P)	322
DRVA	671,672
DRVI	667,668
DRVMUL	660
DRVITBL	659
DSCL(P)(_U)	487
DSCL2(P)(_U)	493
DSERMM(P)	549
DSFL(P)	132
DSFR(P)	131
DSIN(P)	439
DSORTTBL2(_U)	565
DSPD	509

DSQRT(P)	573
DSTOH(P)	590
DSTR(P)(_U)	380
DSUB(P)(_U)	175
DSUM(P)	552
DSWAP(P)	310
DSZR	650,651
DTAN(P)	443
DTEST(P)	238
DTO(P)	609,610
DTOD(P)	615,616
DUTY	601
DVAL(P)(_U)	279
DVIT	653,654
DWORD_TO_BOOL(_E)	701
DWORD_TO_DINT(_E)	706
DWORD_TO_INT(_E)	704
DWORD_TO_TIME(_E)	707
DWORD_TO_WORD(_E)	702
DWSUM(P)(_U)	569
DXCH(P)	308
DXNR(P)	232,233
DXOR(P)	227,228
DZCP(P)(_U)	155
DZONE(P)(_U)	482

E

E-(P)	412,413
E*(P)	418
E/(P)	420
E+(P)	410,411
EI	330
EMAX(P)	461
EMIN(P)	463
EMOV(P)	438
ENCO(P)	285
END	142
ENEG(P)	437
EQ(_E)	810
ESTR(P)	383
EVAL(P)	430
EXP(_E)	770
EXP(P)	454
EXPT(_E)	787

F

FDEL(P)	359
FEND	141
FF	123
FIND(_E)	828
FINS(P)	357
FLT2DINT(P)	252
FLT2INT(P)	250
FLT2UDINT(P)	253
FLT2UINT(P)	251
FMOV(P)	305
FOR	340
FROM(P)	607,609
FROMD(P)	613
FROMD(P)	615
F_TRIG(_E)	846

G

GBIN(P)(_U)	268
GE(_E)	810
GET_BIT_OF_INT(_E)	760
GET_BOOL_ADDR	763
GET_INT_ADDR	763
GET_WORD_ADDR	763
GRY(P)(_U)	266
GT(_E)	810

H

HCMOV	644
HEXA(P)	274
HIOEN(P)	640
HOURM	603
HTOS(P)	587

I

IMASK	335
INC(P)(_U)	211
INCD	542
INSERT(_E)	821
INSTR(P)	398
INT2DINT(P)	255
INT2FLT(P)	426
INT2UDINT(P)	256
INT2UINT(P)	254
INT_TO_BCD(_E)	712
INT_TO_BITARR(_E)	757
INT_TO_BOOL(_E)	708
INT_TO_DINT(_E)	711
INT_TO_DWORD(_E)	710
INT_TO_REAL(_E)	714
INT_TO_STRING(_E)	716
INT_TO_TIME(_E)	715
INT_TO_WORD(_E)	709
INV	106
IRET	338
IVBWR	679
IVCK	675
IVDR	676
IVMC	680
IVRD	677
IVWR	678

L

LD	98
LD<(_U)	145
LD<=(_U)	145
LD<>(_U)	145
LD=(_U)	145
LD>(_U)	145
LD>=(_U)	145
LD\$<	361
LD\$<=	361
LD\$<>	361
LD\$=	361
LD\$>	361
LD\$>=	361
LDD<(_U)	147
LDD<=(_U)	147
LDD<>(_U)	147

LDD(_U)	147
LDD>(_U)	147
LDD>=(_U)	147
LDDT<	591
LDDT<=	591
LDDT<>	591
LDDT=	591
LDDT>	591
LDDT>=	591
LDE<	404
LDE<=	404
LDE<>	404
LDE=	404
LDE>	404
LDE>=	404
LDF	100
LDFI	102
LDI	98
LDP	100
LDPI	102
LDTM<	594
LDTM<=	594
LDTM<>	594
LDTM=	594
LDTM>	594
LDTM>=	594
LE(_E)	810
LEFT(_E)	815
LEFT(P)	392
LEN(_E)	814
LEN(P)	388
LIMIT(_E)	806
LIMIT(P)(_U)	472
LN(_E)	767
LOG(_E)	768
LOG(P)	456
LOG10(P)	460
LT(_E)	810

M

MAX(_E)	804
MAX(P)(_U)	555
MC	137
MCR	137
MEAN(P)(_U)	570
MEF	107
MEP	107
MID(_E)	817
MIDR(P)	394
MIDW(P)	396
MIN(_E)	804
MIN(P)(_U)	557
MOD(_E)	785
MOV(P)	296
MOVB(P)	311
MOVE(_E)	789
MPP	105
MPS	105
MRD	105
MUL(_E)	779
MUL(P)(_U)	178
MUL_TIME(_E)	834
MUX(_E)	808

N

NDIS(P)	288
NE(_E)	812
NEG(P)	282
NEXT	340
NOP	144
NOT(_E)	801
NUNI(P)	290

O

OR	98
OR(_E)	799
OR<(_U)	145
OR<=(_U)	145
OR<>(_U)	145
OR=(_U)	145
OR>(_U)	145
OR>=(_U)	145
OR\$<	361
OR\$<=	361
OR\$<>	361
OR\$=	361
OR\$>	361
OR\$>=	361
ORB	104
ORD<(_U)	147
ORD<=(_U)	147
ORD<>(_U)	147
ORD=(_U)	147
ORD>(_U)	147
ORD>=(_U)	147
ORDT<	591
ORDT<=	591
ORDT<>	591
ORDT=	591
ORDT>	591
ORDT>=	591
ORE<	404
ORE<=	404
ORE<>	404
ORE=	404
ORE>	404
ORE>=	404
ORF	100
ORFI	102
ORI	98
ORP	100
ORPI	102
ORTM<	594
ORTM<=	594
ORTM<>	594
ORTM=	594
ORTM>	594
ORTM>=	594
OUT	108
OUT C	111
OUT F	113
OUT LC	112
OUT ST	109
OUT T	109
OUTH ST	109
OUTH T	109
OUTHS ST	109
OUTHS T	109

P

PLF	122
PLS	120
PLSV	663,664
PLSY	513,517
POP(P)	353
POW(P)	458
PRUN(P)	312
PWM	529

R

RAD(P)	451
RAMPF	503
RBFM	684
RCL(P)	320
RCR(P)	317
REAL_TO_DINT(_E)	735
REAL_TO_INT(_E)	733
REAL_TO_STRING(_E)	737
REF(P)	605
REPLACE(_E)	825
RET	348
RFS(P)	605
RIGHT(_E)	815
RIGHT(P)	390
RND(P)	465
ROL(_E)	795
ROL(P)	320
ROR(_E)	797
ROR(P)	317
ROTC	500
RS(_E)	842
RS2	648
RST	115
RST F	117
R_TRIG(_E)	844

S

S(P).SOCRDATA	631
SCL(P)(_U)	484
SCL2(P)(_U)	490
SEL(_E)	802
SERMM(P)	547
SET	114
SET F	116
SET_BIT_OF_INT(_E)	761
SFL(P)	128
SFR(P)	127
SFRD(P)	351
SFT(P)	125
SFTL(P)	134
SFTR(P)	133
SFWR(P)	355
SHL(_E)	791
SHR(_E)	793
SIMASK	337
SIN(_E)	771
SIN(P)	439
SMOV(P)	300
SORTTBL(_U)	559
SP.SOCCINF	629
SP.SOCCLOSE	622
SP.SOCOPEN	619
SP.SOCRCV	624

SP.SOCSND	627
SPD	505
SQRT(_E)	766
SQRT(P)	572
SR(_E)	840
SRET	348
SROTTBL2(_U)	562
STMR	498
STOH(P)	589
STOP	143
STR(P)(_U)	378
STRDEL(P)	402
STRING_TO_BOOL(_E)	746
STRING_TO_DINT(_E)	749
STRING_TO_INT(_E)	747
STRING_TO_REAL(_E)	751
STRING_TO_TIME(_E)	754
STRINS(P)	400
SUB(_E)	781
SUB(P)(_U)	167
SUB_TIME(_E)	832
SUM(P)	551
SWAP(P)	309

T

TADD(P)	583
TAN(_E)	773
TAN(P)	443
TBL	657,658
TCMP(P)	597
TEST(P)	237
TIMER_100_FB_M	854
TIMER_10_FB_M	854
TIMER_1_FB_M	854
TIMER_CONT_FB_M	854
TIMER_CONTHS_FB_M	854
TIME_TO_BOOL(_E)	740
TIME_TO_DINT(_E)	744
TIME_TO_DWORD(_E)	742
TIME_TO_INT(_E)	743
TIME_TO_STRING(_E)	745
TIME_TO_WORD(_E)	741
TO(P)	609,610
TOD(P)	615,616
TRD(P)	579
TSUB(P)	585
TTMR	496
TWR(P)	581
TZCP(P)	599

U

UDINT2DINT(P)	265
UDINT2FLT(P)	429
UDINT2INT(P)	263
UDINT2UINT(P)	264
UINT2DINT(P)	258
UINT2FLT(P)	427
UINT2INT(P)	257
UINT2UDINT(P)	259
UNI(P)	287

V

VAL(P)(_U)	277
------------	-----

W

WAND(P).....	215,216
WBFM.....	687
WDT(P).....	339
WOR(P).....	220,221
WORD_TO_BOOL(_E).....	696
WORD_TO_DINT(_E).....	699
WORD_TO_DWORD(_E).....	697
WORD_TO_INT(_E).....	698
WORD_TO_TIME(_E).....	700
WSFL(P).....	136
WSFR(P).....	135
WSUM(P)(_U).....	568
WTOB(P).....	292
WXNR(P).....	230,231
WXOR(P).....	225,226

X

XCALL.....	349
XCH(P).....	307
XOR(_E).....	799

Z

ZCP(P)(_U).....	153
ZONE(P)(_U).....	480
ZPOP(P).....	468,471
ZPUSH(P).....	466,469
ZRST(P).....	240

REVISIONS

Revision date	Revision	Description
October, 2014	A	First Edition

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

© 2014 MITSUBISHI ELECTRIC CORPORATION

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company. However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place. Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

- 1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.
- 2) Even within the gratis warranty term, repairs shall be charged for in the following cases.
 - a) Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
 - b) Failure caused by unapproved modifications, etc., to the product by the user.
 - c) When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
 - d) Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
 - e) Relay failure or output contact failure caused by usage beyond the specified life of contact (cycles).
 - f) Failure caused by external irresistible forces such as fires or abnormal voltages, and failure caused by force majeure such as earthquakes, lightning, wind and water damage.
 - g) Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
 - h) Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

- 1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued.
Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.
- 2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation of damages caused by any cause found not to be the responsibility of Mitsubishi, loss in opportunity, lost profits incurred to the user or third person by failure of Mitsubishi products, special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products, replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

6. Product application

- 1) In using the Mitsubishi MELSEC programmable controller, the usage conditions shall be that the application will not lead to a major accident even if any problem or fault should occur in the programmable controller device, and that backup and fail-safe functions are systematically provided outside of the device for any problem or fault.
- 2) The Mitsubishi programmable controller has been designed and manufactured for applications in general industries, etc. Thus, applications in which the public could be affected such as in nuclear power plants and other power plants operated by respective power companies, and applications in which a special quality assurance system is required, such as for railway companies or public service purposes shall be excluded from the programmable controller applications.
In addition, applications in which human life or property that could be greatly affected, such as in aircraft, medical applications, incineration and fuel devices, manned transportation, equipment for recreation and amusement, and safety devices, shall also be excluded from the programmable controller range of applications.
However, in certain cases, some applications may be possible, providing the user consults their local Mitsubishi representative outlining the special requirements of the project, and providing that all parties concerned agree to the special circumstances, solely at the user's discretion.

TRADEMARKS

Microsoft® and Windows® are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Ethernet is a trademark of Xerox Corporation.

MODBUS® is a registered trademark of Schneider Electric SA.

The company name and the product name to be described in this manual are the registered trademarks or trademarks of each company.

Manual number: JY997D55801A

Model: FX5-P-MF-E

Model code: 09R539

When exported from Japan, this manual does not require application to the
Ministry of Economy, Trade and Industry for service transaction permission.

mitsubishi electric corporation

HEAD OFFICE: TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
HIMEJI WORKS: 840, CHIYODA MACHI, HIMEJI, JAPAN

Specifications are subject to change without notice.