CONTENTS

SAFETY PRECAUTIONS 1
INTRODUCTION 1
RELEVANT MANUALS 16
TERMS 16
GENERIC TERMS AND ABBREVIATIONS 16
HOW TO READ THIS MANUAL 17

PART 1 OVERVIEW

CHAPTER 1 OVERVIEW 22

1.1 Instruction Configuration 22
1.2 Data Specification Method 23
Bit data 26
16-bit data (word data) 27
32-bit data (double word data) 29
Real number data (floating-point data) 32
Character string data 33
1.3 Execution Condition 35
1.4 Acceleration of Instruction Processing Time 36

CHAPTER 2 PRECAUTIONS ON PROGRAMMING 39

2.1 Errors Common to Instructions 39
2.2 Checking the Ranges of Instruction Runtime Devices and Labels 39
2.3 Operations Arising when the OUT, SET/RST, and PLS/PLF Instructions of the Same Device are Used . . . 40
2.4 Handling general flags 45
2.5 Standard Function/Function Block Return Values 47

PART 2 INSTRUCTION/FUNCTION LIST

CHAPTER 3 CPU MODULE INSTRUCTION 50

3.1 Sequence Instruction 50
3.2 Basic Instruction 54
3.3 Application Instruction 69
3.4 Step Ladder Instructions 90
3.5 PID Control Instruction 90
3.6 SFC Program Instructions 91

CHAPTER 4 MODULE SPECIFIC INSTRUCTION 93

4.1 Network Common Instruction 93
4.2 Ethernet Instruction 93
4.3 CC-Link IE TSN Instructions 95
4.4 CC-Link IE Field Network Instruction 95
4.5 High-speed Counter Instruction 96
4.6 External Device Communication Instruction 97
4.7 Positioning Instruction 98
4.8 BFM Device Read/ Write Instruction 99

CHAPTER 5 STANDARD FUNCTIONS/FUNCTION BLOCKS 100

5.1 **Standard Functions** 100
Type conversion functions 100
Standard functions of one numeric variable 105
Standard arithmetic functions 106
Standard bit shift functions 107
Standard bitwise boolean functions 107
Standard selection functions 108
Standard comparison functions 108
Standard character string functions 109
Time data functions 110

5.2 **Standard Function Blocks** 111
Bistable function blocks 111
Edge detection function blocks 111
Counter function blocks 111
Timer function blocks 112

PART 3 CPU MODULE INSTRUCTIONS

CHAPTER 6 SEQUENCE INSTRUCTIONS 114

6.1 **Contact Instructions** 114
Operation start, series connection, parallel connection 114
Pulse operation start, pulse series connection, pulse parallel connection 117
Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection 121

6.2 **Association Instruction** 123
Ladder block series/parallel connection 123
Storing/reading/clearing the operation result 125
Inverting the operation result 128
Converting the operation result into a pulse 129

6.3 **Output Instructions** 130
Out (excluding the timer, counter and annunciator) 130
Timer 132
Counter 135
Long counter 137
Annunciator 139
Setting devices (excluding annunciator) 141
Resetting devices (excluding annunciator) 143
Setting annunciator 145
Resetting annunciator 147
Setting annunciator (with check time) 149
Resetting annunciator (smallest number reset) 151
Rising edge output 152
Falling edge output 154
Inverting the bit device output 156
Inverting the bit device output 157

6.4 **Shift Instructions** 159
Shifting bit devices 159
Shifting 16-bit data to the right by n bit(s) 161
Shifting 16-bit data to the left by n bit(s) 163

Shifting n-bit data to the right by 1 bit . . . 165
Shifting n-bit data to the left by 1 bit . . . 167
Shifting n-word data to the right by 1 word . . . 169
Shifting n-word data to the left by 1 word . . . 170
Shifting n-bit(s) data to the right by (n) bit(s) . . . 171
Shifting n-bit data to the left by n bit(s) . . . 173
Shifting n-word data to the right by n word(s) . . . 175
Shifting n-word data to the left by n word(s) . . . 177
6.5 Master Control Instruction . . . 179
Setting/resetting the master control . . . 179
6.6 Termination Instructions . . . 183
Ending the main routine program . . . 183
Ending the sequence program . . . 186
6.7 Stop Instruction . . . 188
Stopping the sequence program . . . 188

CHAPTER 7 BASIC INSTRUCTIONS 189

7.1 Comparison Operation Instructions . . . 189
Comparing 16-bit binary data . . . 189
Comparing 32-bit binary data . . . 192
Comparison output 16-bit binary data . . . 194
Comparison output 32-bit binary data . . . 196
Comparing 16-bit binary data band . . . 198
Comparing 32-bit binary data band . . . 200
Comparing 16-bit binary block data . . . 202
Comparing 32-bit binary block data . . . 205
7.2 Arithmetic Operation Instructions . . . 208
Adding 16-bit binary data . . . 208
Subtracting 16-bit binary data . . . 214
Adding 32-bit binary data . . . 220
Subtracting 32-bit binary data . . . 226
Multiplying 16-bit binary data . . . 232
Dividing 16-bit binary data . . . 236
Multiplying 32-bit binary data . . . 240
Dividing 32-bit binary data . . . 244
Adding BCD 4-digit data . . . 248
Subtracting BCD 4-digit data . . . 250
Adding BCD 8-digit data . . . 253
Subtracting BCD 8-digit data . . . 256
Multiplying BCD 4-digit data . . . 259
Dividing BCD 4-digit data . . . 261
Multiplying BCD 8-digit data . . . 263
Dividing BCD 8-digit data . . . 265
Adding 16-bit binary block data . . . 267
Subtracting 16-bit binary block data . . . 269
Adding 32-bit binary block data . . . 271
Subtracting 32-bit binary block data . . . 273
Incrementing 16-bit binary data . . . 275
Decrementing 16-bit binary data . . . 277
Incrementing 32-bit binary data . . . 278

Decrementing 32-bit binary data . . . 279
7.3 Logical Operation Instructions . . . 280
Performing an AND operation on 16-bit data . . . 280
Performing an AND operation on 32-bit data . . . 282
Performing an AND operation on 16-bit block data . . . 285
Performing an OR operation on 16-bit data . . . 287
Performing an OR operation on 32-bit data . . . 289
Performing an OR operation on 16-bit block data . . . 292
Performing an XOR operation on 16-bit data . . . 294
Performing an XOR operation on 32-bit data . . . 296
Performing an XOR operation on 16-bit block data . . . 299
Performing an XNOR operation on 16-bit data . . . 301
Performing an XNOR operation on 32-bit data . . . 303
Performing an XNOR operation on 16-bit block data . . . 306
7.4 Bit Processing Instructions . . . 308
Setting a bit in the word device . . . 308
Resetting a bit in the word device . . . 309
Performing a 16-bit test . . . 310
Performing a 32-bit test . . . 312
Batch-resetting bit devices . . . 314
Batch-resetting devices . . . 315
7.5 Data Conversion Instructions . . . 318
Converting binary data to BCD 4-digit data . . . 318
Converting binary data to BCD 8-digit data . . . 320
Converting BCD 4-digit data to binary data . . . 322
Converting BCD 8-digit data to binary data . . . 324
Converting single-precision real number to 16-bit signed binary data . . . 326
Converting single-precision real number to 16-bit unsigned binary data . . . 328
Converting single-precision real number to 32-bit signed binary data . . . 330
Converting single-precision real number to 32-bit unsigned binary data . . . 332
Converting 16-bit signed binary data to 16-bit unsigned binary data . . . 334
Converting 16-bit signed binary data to 32-bit signed binary data . . . 335
Converting 16-bit signed binary data to 32-bit unsigned binary data . . . 336
Converting 16-bit unsigned binary data to 16-bit signed binary data . . . 337
Converting 16-bit unsigned binary data to 32-bit signed binary data . . . 338
Converting 16-bit unsigned binary data to 32-bit unsigned binary data . . . 339
Converting 32-bit signed binary data to 16-bit signed binary data . . . 340
Converting 32-bit signed binary data to 16-bit unsigned binary data . . . 341
Converting 32-bit signed binary data to 32-bit unsigned binary data . . . 342
Converting 32-bit unsigned binary data to 16-bit signed binary data . . . 343
Converting 32-bit unsigned binary data to 16-bit unsigned binary data . . . 344
Converting 32-bit unsigned binary data to 32-bit signed binary data . . . 345
Converting 16-bit binary data to Gray code . . . 346
Converting 32-bit binary data to Gray code . . . 347
Converting Gray code to 16-bit binary data . . . 349
Converting Gray code to 32-bit binary data . . . 350
Converting decimal ASCII to 16-bit binary data . . . 352
Converting decimal ASCII to 32-bit binary data . . . 356
Converting ASCII to HEX . . . 360
Converting character string to 16-bit binary data . . . 364
Converting character string to 32-bit binary data . . . 367

Two's complement of 16-bit binary data (sign inversion) . . . 370
Two's complement of 32-bit binary data (sign inversion) . . . 372
Decoding from 8 to 256 bits . . . 373
Encoding from 256 to 8 bits . . . 375
Seven-segment decoding . . . 377
Seven Segment With Latch . . . 379
Separating 4 bits from 16-bit data . . . 382
Connecting 4 bits to 16-bit data . . . 384
Separating the specified number of bits . . . 386
Connecting the specified number of bits . . . 388
Separating data in byte units . . . 390
Connecting data in byte units . . . 392
7.6 Digital Switch . . . 395
7.7 Data Transfer Instructions . . . 397
Transferring 16-bit data . . . 397
Transferring 32-bit data . . . 399
Inverting and transferring 16-bit data . . . 401
Inverting and transferring 32-bit data . . . 403
Digit move . . . 404
Inverting and transferring 1-bit data . . . 406
Transferring 16-bit block data (65535 points maximum) . . . 407
Transferring identical 16-bit block data (65535 points maximum) . . . 409
Transferring identical 32-bit block data (65535 points maximum) . . . 411
Exchanging 16-bit data . . . 413
Exchanging 32-bit data . . . 415
Exchanging the upper and lower bytes of 16-bit data . . . 417
Exchanging the upper and lower bytes of 32-bit data . . . 418
Transferring 1-bit data . . . 419
Transferring octal bits (16-bit data) . . . 420
Transferring octal bits (32-bit data) . . . 422
Transferring n-bit data . . . 424

CHAPTER 8 APPLICATION INSTRUCTION 426

8.1 Rotation Instruction . . . 426
Rotating 16-bit data to the right . . . 426
Rotating 16-bit data to the left . . . 429
Rotating 32-bit data to the right . . . 432
Rotating 32-bit data to the left . . . 434
8.2 Program Branch Instruction . . . 436
Pointer branch . . . 436
Jump to END . . . 440
8.3 Program Execution Control Instruction . . . 441
Disabling/enabling interrupt programs . . . 441
Disabling the interrupt program with specified priority or lower . . . 443
Interrupt program mask . . . 447
Disabling/enabling the specified interrupt pointer . . . 449
Returning from the interrupt program . . . 451
Resetting the watchdog timer . . . 454
8.4 Structuring Instruction . . . 455
FOR to NEXT . . . 455

Forcibly terminating the FOR to NEXT instruction loop . . . 458
Calling a subroutine program . . . 460
Returning from the subroutine program . . . 465
Calling a subroutine program . . . 466
8.5 Data Table Operation Instruction . . . 468
Reading the oldest data from the data table . . . 468
Reading the newest data from the data table . . . 471
Writing data to the data table . . . 474
Inserting data to the data table . . . 476
Deleting data from the data table . . . 478
8.6 Reading/writing Data Instructions . . . 480
Reading data from the data memory . . . 481
Writing data to the data memory . . . 483
8.7 File Operation Instructions . . . 486
Reading data from the specified file . . . 486
Writing data to the specified file . . . 512
Deleting the specified file . . . 535
Copying the specified file . . . 543
Moving the specified file . . . 553
Renaming the specified file . . . 563
Acquiring the status of the specified file . . . 571
Error codes generated for file operation instructions . . . 579
8.8 Extended File Register Operation Instruction . . . 580
Reading extended file register . . . 580
Writing extended file register . . . 583
Batch initialization function of extended file register . . . 586
8.9 Character String Operation Instruction . . . 589
Comparing character strings . . . 589
Concatenating character strings . . . 592
Transferring character strings . . . 596
Transferring Unicode string data . . . 598
Converting 16-bit binary data to decimal ASCII . . . 600
Converting 32-bit binary data to decimal ASCII . . . 605
Converting HEX code data to ASCII . . . 611
Converting 16-bit binary data to character string . . . 615
Converting 32-bit binary data to character string . . . 618
Converting single-precision real number to character string . . . 621
Converting Unicode character string to Shift JIS character string . . . 628
Converting shift JIS character string to Unicode character string (without byte order mark) . . . 631
Converting shift JIS character string to Unicode (with byte order mark) . . . 634
Detecting a character string length . . . 637
Extracting character string data from the right . . . 639
Extracting character string data from the left . . . 642
Storing the specified number of character strings . . . 645
Replacing the specified number of character strings . . . 648
Searching character string . . . 652
Inserting character string . . . 655
Deleting character string . . . 657
8.10 Real Number Instruction . . . 659
Comparing single-precision real numbers . . . 659
Single-precision real number comparison . . . 661

Single-precision real number data band comparison . . . 663
Adding single-precision real numbers . . . 665
Subtracting single-precision real numbers . . . 669
Adding single-precision real numbers . . . 673
Subtracting single-precision real numbers . . . 675
Multiplying single-precision real numbers . . . 677
Dividing single-precision real numbers . . . 679
Multiplying single-precision real numbers . . . 681
Dividing single-precision real numbers . . . 683
Converting 16-bit signed binary data to single-precision real number . . . 685
Converting 16-bit unsigned binary data to single-precision real number . . . 686
Converting 32-bit signed binary data to single-precision real number . . . 687
Converting 32-bit unsigned binary data to single-precision real number . . . 688
Converting character string to single-precision real number . . . 689
Converting binary floating point to decimal floating point . . . 694
Converting decimal floating point to binary floating point . . . 696
Inverting the sign of single-precision real number . . . 698
Transferring single-precision real number data . . . 700
Calculating the sine of single-precision real number . . . 702
Calculating the cosine of single-precision real number . . . 704
Calculating the tangent of single-precision real number . . . 706
Calculating the arc sine of single-precision real number . . . 708
Calculating the arc cosine of single-precision real number . . . 711
Calculating the arc tangent of single-precision real number . . . 714
Converting single-precision real number angle to radian . . . 716
Converting single-precision real number radian to angle . . . 718
Calculating the square root of single-precision real number . . . 720
Calculating the exponent of single-precision real number . . . 722
Calculating the natural logarithm of single-precision real number . . . 724
Calculating the exponentiation of single-precision real number . . . 726
Calculating the common logarithm of single-precision real number . . . 728
Searching the maximum value of single-precision real number . . . 730
Searching the minimum value of single-precision real number . . . 732
8.11 Random Number Instruction . . . 734
Generating random number . . . 734
8.12 Index Register Operation Instruction . . . 736
Saving all data of the index register . . . 736
Returning all data of the index register . . . 739
Saving the selected data of the index register and long index register . . . 740
Returning the selected data of the index register and long index register . . . 742
8.13 Data Control Instruction . . . 743
Upper and lower limit control of 16-bit binary data . . . 743
Upper and lower limit control of 32-bit binary data . . . 745
Dead band control of 16-bit binary data . . . 747
Dead band control of 32-bit binary data . . . 749
Zone control of 16-bit binary data . . . 752
Zone control of 32-bit binary data . . . 754
Scaling 16-bit binary data (point coordinates) . . . 756
Scaling 32-bit binary data (point coordinates) . . . 759
Scaling 16-bit binary data (XY coordinates) . . . 762
Scaling 32-bit binary data (XY coordinates) . . . 766

8.14 Special Timer Instruction . . . 769
Teaching timer . . . 769
Special function timer . . . 772
8.15 Special Counter Instruction . . . 774
Signed 32-bit bi-directional counters . . . 774
8.16 Shortcut Control Instruction . . . 776
Rotary table shortest direction control . . . 776
8.17 Ramp Signal Instruction . . . 779
Ramp signal . . . 779
8.18 Pulse Related Instruction . . . 782
Measuring the density of 16 bit binary pulses . . . 782
Measuring the density of 32 bit binary pulses . . . 788
16 bit binary pulse output . . . 793
32 bit binary pulse output . . . 801
16 bit binary pulse width modulation . . . 809
32 bit binary pulse width modulation . . . 816
8.19 Input Matrix Instruction . . . 823
Input matrix . . . 823
8.20 Initial State . . . 827
Initial State . . . 827
8.21 Drum Sequence . . . 838
16-bit binary data absolute method . . . 838
32-bit binary data absolute method . . . 840
Relative method . . . 842
8.22 Check Code . . . 845
Check code . . . 845
8.23 Data Operation Instruction . . . 848
Searching 16-bit data . . . 848
Searching 32-bit data . . . 850
Bit check of 16-bit data . . . 852
Bit check of 32-bit data . . . 854
Bit judgment of 16-bit data . . . 855
Bit judgment of 32-bit data . . . 857
Searching the maximum value of 16-bit data . . . 859
Searching the maximum value of 32-bit data . . . 861
Searching the minimum value of 16-bit data . . . 863
Searching the minimum value of 32-bit data . . . 865
Sorting 16-bit data . . . 867
Sorting 16-bit data 2 . . . 870
Sorting 32-bit data 2 . . . 873
Adding 16-bit data . . . 876
Adding 32-bit data . . . 878
Calculating the mean value of 16-bit data . . . 880
Calculating the mean value of 32-bit data . . . 882
Calculating the square root of 16-bit data . . . 884
Calculating the square root of 32-bit data . . . 886
CRC calculation . . . 887
8.24 Indirect Address Read Instruction . . . 890
Reading the indirect address . . . 890
8.25 Clock Instruction . . . 892
Reading clock data . . . 892

Writing clock data . . . 894
Adding clock data . . . 897
Subtracting clock data . . . 900
Converting time data from hour/minute/second to seconds in 16 bits . . . 903
Converting time data from hour/minute/second to seconds in 32 bits . . . 905
Converting time data from seconds to hour/minute/second in 16 bits . . . 907
Converting time data from seconds to hour/minute/second in 32 bits . . . 909
Comparing date data . . . 911
Comparing time data . . . 914
Comparing clock data . . . 917
Comparing clock data zones . . . 920
8.26 Timing Check Instruction . . . 923
Generating timing pulses . . . 923
Hour meter . . . 926
8.27 Module Access Instruction . . . 930
I/O refresh . . . 930
Reading 1-word/2-word data from another module . . . 932
Writing 1-word/2-word data to another module . . . 936
Reading 1-word/2-word data from another module . . . 939
Writing 1-word/2-word data to another module (32-bit specification) . . . 942
8.28 Logging Instructions . . . 945
Setting trigger logging . . . 945
Resetting trigger logging . . . 946
8.29 Real-time Monitor Function Instruction . . . 947

CHAPTER 9 STEP LADDER INSTRUCTIONS 949

9.1 Starts/Ends Step Ladder . . . 949

CHAPTER 10 PID CONTROL INSTRUCTION 953

10.1 PID Control Loop . . . 953

CHAPTER 11 SFC PROGRAM INSTRUCTIONS 956

11.1 SFC Control Instructions . . . 956
Checking the status of a step . . . 956
Checking the status of a block . . . 958
Batch-reading the status of steps . . . 960
Starting a block . . . 970
Ending a block . . . 971
Pausing a block . . . 972
Restarting a block . . . 974
Activating a step . . . 976
Deactivating a step . . . 978
Activating/deactivating a step . . . 980
Batch-deactivating a step . . . 982
11.2 SFC Dedicated Instruction . . . 984
Creating a dummy transition condition . . . 984

PART 4 MODULE DEDICATED INSTRUCTION

CHAPTER 12 NETWORK COMMON INSTRUCTION 986

12.1 **Link Dedicated Instructions** **988**
Reading data from another station programmable controller 988
Reading data from another station programmable controller (with notification) 994
Writing data to another station programmable controller. 1000
Writing data to another station programmable controller (with notification). 1008
Sending data to another station programmable controller. 1016
Receiving data from another station programmable controller 1024

CHAPTER 13 ETHERNET INSTRUCTION 1030

13.1 **Built-in Ethernet Function Instruction** **1030**
Opening a connection 1030
Closing a connection 1033
13.2 **Socket Communications Function Instruction** **1035**
Reading receive data during the END processing. 1035
Sending data 1038
Reading connection information 1041
Reading socket communications receive data 1043
13.3 **Predefined Protocol Support Function Instruction** **1045**
Executing the registered protocols 1045
13.4 **SLMP Frame Send Instruction** **1049**
Sending the SLMP frame 1049
13.5 **File Transfer Function Instruction** **1054**
Sending FTP client files. 1054
Retrieving FTP client files 1059
13.6 **Ethernet Module** **1064**
Opening a connection 1064
Closing a connection 1067
Reading receive data. 1069
Sending data 1071

CHAPTER 14 CC-LINK IE TSN INSTRUCTION 1073

14.1 **Own Station Number/IP Address Setting** **1073**
14.2 **Sending an SLMP Frame** **1076**

CHAPTER 15 CC-LINK IE FIELD NETWORK INSTRUCTION 1085

15.1 **Setting parameters** **1085**
15.2 **Setting the station number to own station** **1088**

CHAPTER 16 HIGH-SPEED COUNTER INSTRUCTION 1091

16.1 **High-speed Processing Instruction** **1091**
Setting 32-bit data comparison 1091
Reset 32-bit data comparison 1094
Comparison of 32-bit data band 1097
Start/stop of the 16-bit data high-speed I/O function 1100
Start/stop of the 32-bit data high-speed I/O function 1104

16.2 High-speed Current Value Transfer Instruction 1108
High-speed current value transfer of 16-bit data 1108
High-speed current value transfer of 32-bit data 1110

CHAPTER 17 EXTERNAL DEVICE COMMUNICATION INSTRUCTION 1113

17.1 Serial Communication 2 1113
17.2 Inverter Communication Instruction 1115
Inverter operation monitoring (Status check) 1115
Inverter operations control (Drive) 1117
Inverter parameter read 1119
Inverter parameter write 1121
Inverter parameter block write 1123
Inverter multi command 1125
17.3 MODBUS Communication Instruction 1127
17.4 Predefined Protocol Support Function Instruction 1129

CHAPTER 18 POSITIONING INSTRUCTION 1133

18.1 Dedicated Instruction (Positioning Function) 1133
Zero return(OPR) with 16-bit data DOG search 1134
Zero return(OPR) with 32-bit data DOG search 1138
16-bit data interrupt positioning 1140
32-bit data interrupt positioning 1144
Positioning by one table operation 1148
Positioning by multiple table operation 1150
Multiple axes concurrent drive positioning 1152
32-bit data ABS current value read 1154
16-bit data variable speed pulse 1156
32-bit data variable speed pulse 1160
16-bit data relative positioning 1164
32-bit data relative positioning 1168
16-bit data absolute positioning 1172
32-bit data absolute positioning 1176
18.2 Positioning Module 1180
Restoring the absolute position 1180
Starting the positioning 1184
Teaching 1187
Backing up module data (writing data to the flash ROM) 1190
Initializing the Module 1193

CHAPTER 19 DIVIDED DATA READ/WRITE FROM/TO BFM INSTRUCTION 1196

19.1 Divided BFM Read 1196
19.2 Divided BFM Write 1200

PART 5 STANDARD FUNCTIONS

CHAPTER 20 TYPE CONVERSION FUNCTIONS 1204

20.1 Converting BOOL to WORD 1204
20.2 Converting BOOL to DWORD 1206
20.3 Converting BOOL to INT 1207

20.4 Converting BOOL to DINT 1208
20.5 Converting BOOL to TIME 1209
20.6 Converting BOOL to STRING 1210
20.7 Converting WORD to BOOL 1211
20.8 Converting WORD to DWORD 1212
20.9 Converting WORD to INT 1213
20.10 Converting WORD to DINT 1214
20.11 Converting WORD to TIME 1216
20.12 Converting DWORD to BOOL 1217
20.13 Converting DWORD to WORD 1218
20.14 Converting DWORD to INT 1220
20.15 Converting DWORD to DINT 1222
20.16 Converting DWORD to TIME 1223
20.17 Converting INT to BOOL 1224
20.18 Converting INT to WORD 1225
20.19 Converting INT to DWORD 1226
20.20 Converting INT to DINT 1228
20.21 Converting INT to BCD 1229
20.22 Converting INT to REAL 1231
20.23 Converting INT to TIME 1232
20.24 Converting INT to STRING 1233
20.25 Converting DINT to BOOL 1235
20.26 Converting DINT to WORD 1236
20.27 Converting DINT to DWORD 1238
20.28 Converting DINT to INT 1239
20.29 Converting DINT to BCD 1241
20.30 Converting DINT to REAL 1243
20.31 Converting DINT to TIME 1244
20.32 Converting DINT to STRING 1245
20.33 Converting BCD to INT 1247
20.34 Converting BCD to DINT 1249
20.35 Converting REAL to INT 1251
20.36 Converting REAL to DINT 1253
20.37 Converting REAL to STRING 1255
20.38 Converting TIME to BOOL 1258
20.39 Converting TIME to WORD 1259
20.40 Converting TIME to DWORD 1260
20.41 Converting TIME to INT 1261
20.42 Converting TIME to DINT 1262
20.43 Converting TIME to STRING 1263
20.44 Converting STRING to BOOL 1265
20.45 Converting STRING to INT 1266
20.46 Converting STRING to DINT 1268
20.47 Converting STRING to REAL 1270
20.48 Converting STRING to TIME 1273
20.49 Converting Bit Array to INT 1274
20.50 Converting Bit Array to DINT 1275
20.51 Converting INT to Bit Array 1276
20.52 Converting DINT to Bit Array 1277
20.53 Bit Array Copy 1278
20.54 Reading the Specified Bit of Word Label 1279

20.55 Writing the Specified Bit of Word Label 1280
20.56 Copying the Specified Bit of Word Label 1281
20.57 Unnecessary of Type Conversion 1282

CHAPTER 21 SINGLE NUMBER VARIABLE FUNCTIONS 1283

21.1 Absolute Value 1283
21.2 Square Root 1285
21.3 Natural Logarithm Operation 1286
21.4 Calculating the Common Logarithm 1287
21.5 Exponential Operation 1289
21.6 Sine Operation 1290
21.7 Cosine Operation 1291
21.8 Tangent Operation 1292
21.9 Arc Sine Operation 1294
21.10 Arc Cosine Operation 1296
21.11 Arc Tangent Operation 1298

CHAPTER 22 ARITHMETIC OPERATION FUNCTIONS 1300

22.1 Addition 1300
22.2 Multiplication 1302
22.3 Subtraction 1304
22.4 Division 1306
22.5 Remainder 1308
22.6 Exponentiation 1310
22.7 Move Operation 1312

CHAPTER 23 BIT SHIFT FUNCTIONS 1314

23.1 n-bit Left Shift 1314
23.2 n-bit Right Shift 1316
23.3 n-bit Left Rotation 1318
23.4 n-bit Right Rotation 1320

CHAPTER 24 STANDARD BITWISE BOOLEAN FUNCTIONS 1322

24.1 AND Operation, OR Operation, XOR Operation 1322
24.2 Logical Negation 1324

CHAPTER 25 SELECTION FUNCTIONS 1325

25.1 Selection 1325
25.2 Selecting Maximum/Minimum Value 1327
25.3 Limit Control 1329
25.4 Multiplexer 1331

CHAPTER 26 COMPARISON FUNCTIONS 1333

26.1 Compare 1333
26.2 Compare 1335

CHAPTER 27 CHARACTER STRING FUNCTIONS 1337

27.1 Character String Length Detection 1337
27.2 Extracting Character String Data from the Left/Right 1339
27.3 Extract Mid String 1341

27.4 Link Character Strings 1343
27.5 Inserting Character String 1345
27.6 Deleting Character String 1347
27.7 Replacing Character String 1349
27.8 Searching Character String 1352

CHAPTER 28 TIME DATA FUNCTIONS 1354

28.1 Addition 1354
28.2 Subtraction 1356
28.3 Multiplication 1358
28.4 Division 1360

PART 6 FUNCTION BLOCKS

CHAPTER 29 BISTABLE FUNCTION BLOCKS 1364

29.1 Bistable Function Blocks (Set Priority) 1364
29.2 Bistable Function Blocks (Reset Priority) 1366

CHAPTER 30 EDGE DETECTION FUNCTION BLOCKS 1368

30.1 Rising Edge Detector 1368
30.2 Falling Edge Detector 1370

CHAPTER 31 COUNTER FUNCTION BLOCKS 1372

31.1 Up Counter 1372
31.2 Down Counter 1374
31.3 Up-down Counter 1376
31.4 Counter Function Block 1379

CHAPTER 32 TIMER FUNCTION BLOCKS 1381

32.1 Pulse Timer 1381
32.2 On-delay Timer 1383
32.3 Off-delay Timer 1385
32.4 Timer Function Blocks 1387

APPENDIX 1390

Appendix 1 Instruction Processing Time 1390
Instruction processing time (High-speed instruction) 1390
Instruction processing time 1395
Appendix 2 Number of Instruction Steps 1431
Appendix 3 Added and Changed Functions 1452

INSTRUCTION INDEX 1455

REVISIONS 1463
WARRANTY 1465
TRADEMARKS 1466