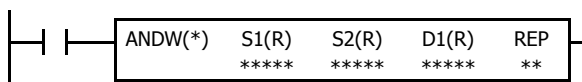


# 9: BOOLEAN COMPUTATION INSTRUCTIONS

## Introduction

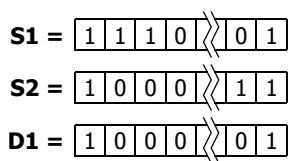
Boolean computations use the AND, OR, and exclusive OR statements as carried out by the ANDW, ORW, and XORW instructions in the word or double-word data, respectively.

## ANDW (AND Word)



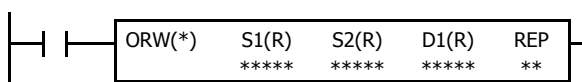
$$S1 \cdot S2 \rightarrow D1$$

When input is on, 16- or 32-bit data assigned by source devices S1 and S2 are ANDed, bit by bit. The result is set to destination device D1.



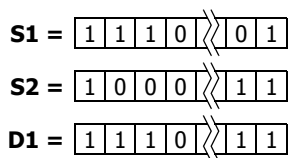
S1	S2	D1
0	0	0
0	1	0
1	0	0
1	1	1

## ORW (OR Word)



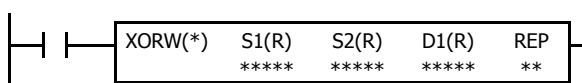
$$S1 + S2 \rightarrow D1$$

When input is on, 16- or 32-bit data assigned by source devices S1 and S2 are ORed, bit by bit. The result is set to destination device D1.



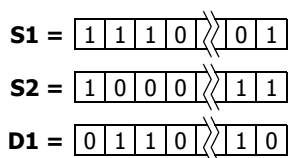
S1	S2	D1
0	0	0
0	1	1
1	0	1
1	1	1

## XORW (Exclusive OR Word)



$$S1 \oplus S2 \rightarrow D1$$

When input is on, 16- or 32-bit data assigned by source devices S1 and S2 are exclusive ORed, bit by bit. The result is set to destination device D1.



S1	S2	D1
0	0	0
0	1	1
1	0	1
1	1	1

## Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

9: BOOLEAN COMPUTATION INSTRUCTIONS

Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Data for computation	X	X	X	X	X	X	X	X	1-99
S2 (Source 2)	Data for computation	X	X	X	X	X	X	X	X	1-99
D1 (Destination 1)	Destination to store results	—	X	▲	X	X	X	X	—	1-99

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be assigned as D1. Special internal relays cannot be assigned as D1.

When T (timer) or C (counter) is used as S1 or S2, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

Since the Boolean computation instructions are executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

Valid Data Types

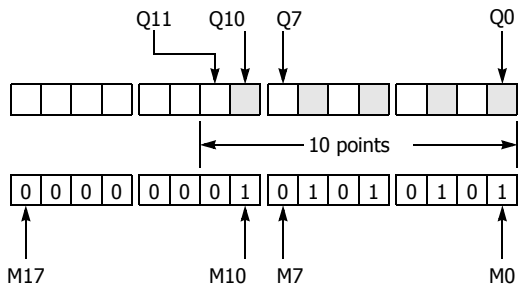
W (word)	X
I (integer)	—
D (double word)	X
L (long)	—
F (float)	—

When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source or destination, 16 points (word data) or 32 points (double-word data) are used. When repeat is assigned for a bit device, the quantity of device bits increases in 16- or 32-point increments.

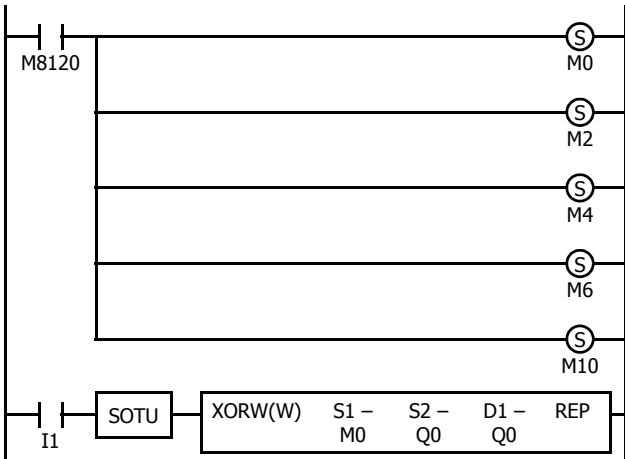
When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) or 2 points (double-word data) are used. When repeat is assigned for a word device, the quantity of device words increases in 1- or 2-point increments.

Example: XORW

To convert optional output status among a series of 10 output points, use the XORW instruction in combination with 10 internal relay points.



This program will invert the status of the shaded outputs on the left from on to off, and those not shaded from off to on.



Ten outputs Q0 through Q11 are assigned to 10 internal relays M0 through M11.

Five internal relays M0, M2, M4, M6, and M10 are set by initialize pulse special internal relay M8120.

When input I1 is turned on, the XORW instruction is executed to invert the status of outputs Q0, Q2, Q4, Q6, and Q10.

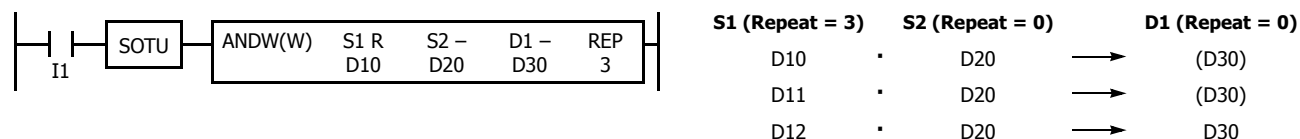
### Repeat Operation in the ANDW, ORW, and XORW Instructions

Source devices S1 and S2 and destination device D1 can be assigned to repeat individually or in combination. When destination device D1 is not designated set to repeat, the final result is set to destination device D1. When repeat is assigned, consecutive devices as many as the repeat cycles starting with the designated device are used. Since the repeat operation works similarly on the ANDW (AND word), ORW (OR word), and XORW (exclusive OR word) instructions, the following examples use the ANDW instruction.

#### Repeat One Source Device

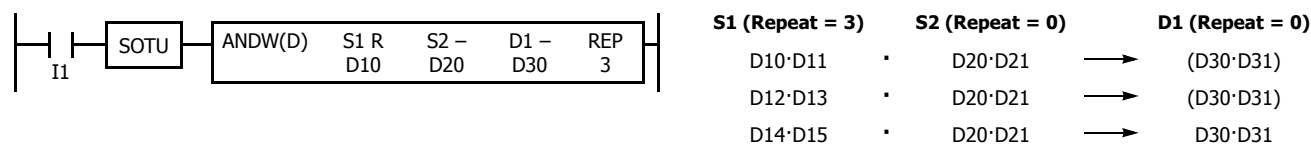
##### • Data Type: Word

When only S1 (source) is assigned to repeat, the final result is set to destination device D1.



##### • Data Type: Double Word

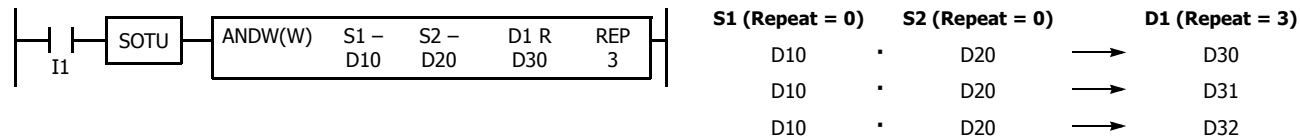
When only S1 (source) is assigned to repeat, the final result is set to destination device D1·D1+1.



#### Repeat Destination Device Only

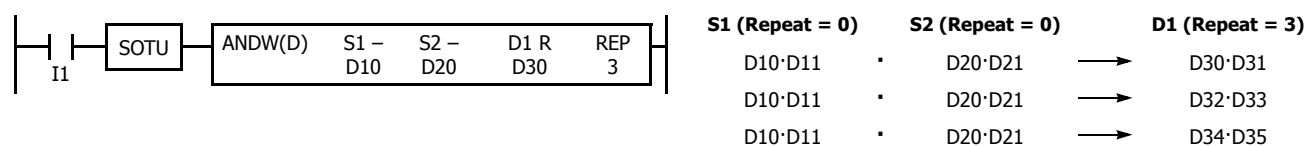
##### • Data Type: Word

When only D1 (destination) is assigned to repeat, the same result is set to 3 devices starting with D1.



##### • Data Type: Double Word

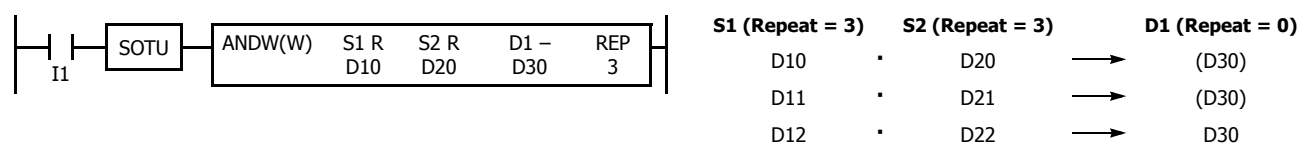
When only D1 (destination) is assigned to repeat, the same result is set to 3 devices starting with D1·D1+1.



#### Repeat Two Source Devices

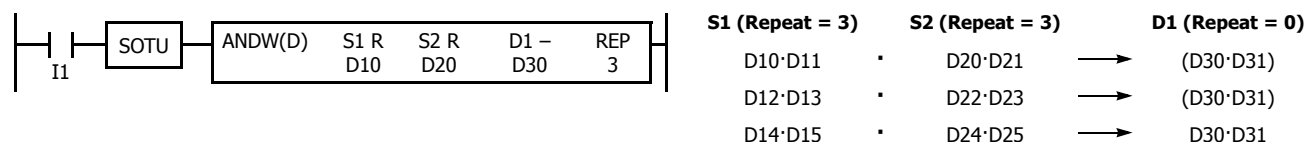
##### • Data Type: Word

When S1 and S2 (source) are assigned to repeat, the final result is set to destination device D1.



##### • Data Type: Double Word

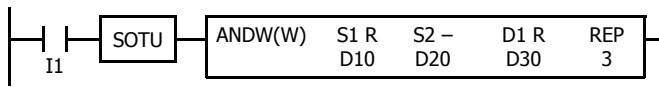
When S1 and S2 (source) are assigned to repeat, the final result is set to destination device D1·D1+1.



Repeat Source and Destination Devices

• Data Type: Word

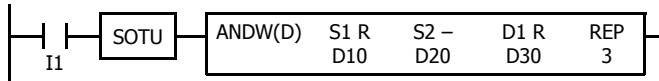
When S1 (source) and D1 (destination) are assigned to repeat, different results are set to 3 devices starting with D1.



S1 (Repeat = 3)	S2 (Repeat = 0)	D1 (Repeat = 3)
D10	• D20	→ D30
D11	• D20	→ D31
D12	• D20	→ D32

• Data Type: Double Word

When S1 (source) and D1 (destination) are assigned to repeat, different results are set to 3 devices starting with D1·D1+1.

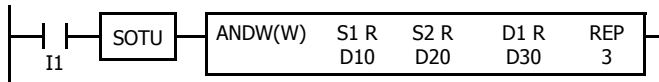


S1 (Repeat = 3)	S2 (Repeat = 0)	D1 (Repeat = 3)
D10·D11	• D20·D21	→ D30·D31
D12·D13	• D20·D21	→ D32·D33
D14·D15	• D20·D21	→ D34·D35

Repeat All Source and Destination Devices

• Data Type: Word

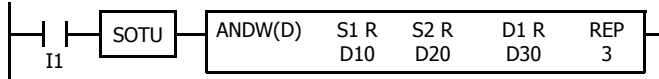
When all devices are assigned to repeat, different results are set to 3 devices starting with D1.



S1 (Repeat = 3)	S2 (Repeat = 3)	D1 (Repeat = 3)
D10	• D20	→ D30
D11	• D21	→ D31
D12	• D22	→ D32

• Data Type: Double Word

When all devices are assigned to repeat, different results are set to 3 devices starting with D1·D1+1.



S1 (Repeat = 3)	S2 (Repeat = 3)	D1 (Repeat = 3)
D10·D11	• D20·D21	→ D30·D31
D12·D13	• D22·D23	→ D32·D33
D14·D15	• D24·D25	→ D34·D35

**Note:** When a user program error occurs in any repeat operation, special internal relay M8004 (user program execution error) and the ERROR LED are turned on and maintained while operations for other instructions continues. For an advanced instruction that has caused a user program execution error due to an error in the source devices, results are not set to any destination.

# 10: SHIFT / ROTATE INSTRUCTIONS

## Introduction

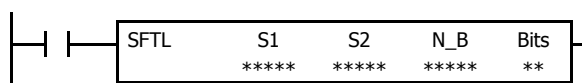
Bit shift instructions are used to shift the data string starting with source device S1 to the left or right by 1 to 15 bits as designated. The data string can be 1 to 65535 bits. The result is set to the source device S1 and special internal relay M8003 (carry or borrow). The LSB or MSB is filled with 0 or 1 as designated.

Bit shift and rotate instructions are used to shift the 16- or 32-bit data string in the designated source device S1 to the left or right by the quantity of bits designated. The result is set to the source device S1 and special internal relay M8003 (carry or borrow).

The BCD left shift instruction shifts the BCD digits in two consecutive data registers to the left.

The word shift instruction is used to move 16-bit data to a destination data register and shifts down the data of subsequent data registers as many as designated.

## SFTL (Shift Left)

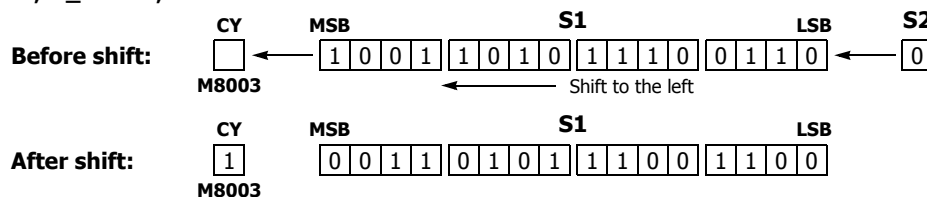


CY ← S1

When input is on, N\_B-bit data string starting with source device S1 is shifted to the left by the quantity of bits assigned by device Bits.

The result is set to source device S1, and the last bit status shifted out is set to special internal relay M8003 (carry or borrow). Zero or 1 assigned by source device S2 is set to the LSB.

- S2 = 0, N\_B = 16, Bits = 1



## Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

## Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	First data for bit shift	—	X	▲	X	—	—	X	—	—
S2 (Source 2)	Data to shift into the LSB	X	X	X	X	—	—	—	0 or 1	—
N_B	Number of bits in the data string	—	—	—	—	—	—	X	1-65535	—
Bits	Quantity of bits to shift	—	—	—	—	—	—	X	1-15	—

For valid device address ranges, see Chapter 5 "Special Functions" - "Device Addresses" in the SmartAXIS Touch User's Manual.

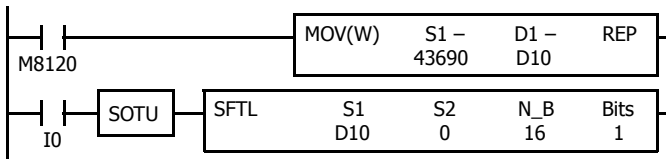
▲ Internal relays M0 through M1277 can be designated as S1. Special internal relays cannot be designated as S1.

Since the SFTL instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

## 10: SHIFT / ROTATE INSTRUCTIONS

### Examples: SFTL

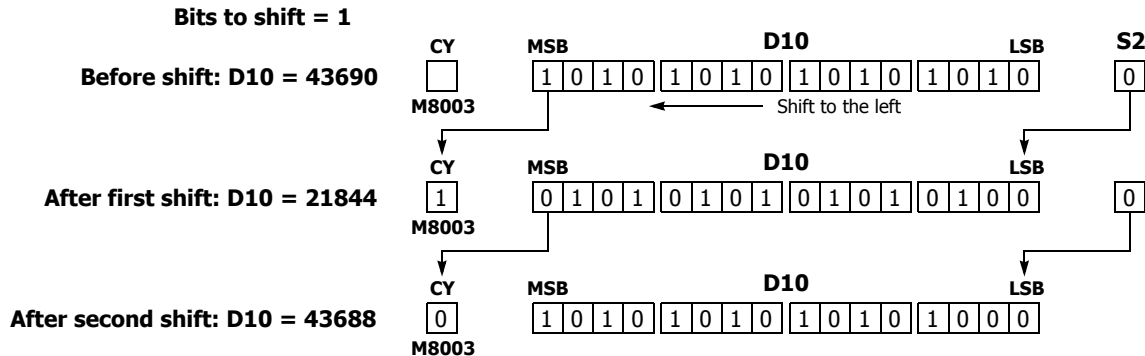
- N\_B = 16 bits



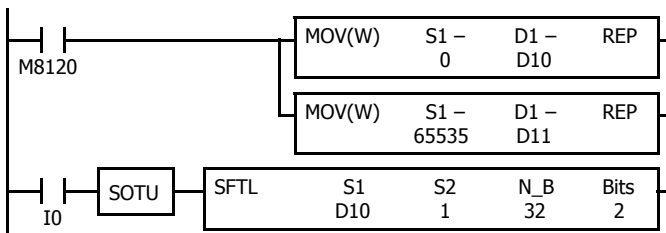
M8120 is the initialize pulse special internal relay.

When the CPU starts operation, the MOV (move) instruction sets 43690 to data register D10.

Each time input I0 is turned on, 16-bit data of data register D10 is shifted to the left by 1 bit as assigned by device Bits. The last bit status shifted out is set to special internal relay M8003 (carry or borrow). Zeros are set to the LSB.



- N\_B = 32 bits

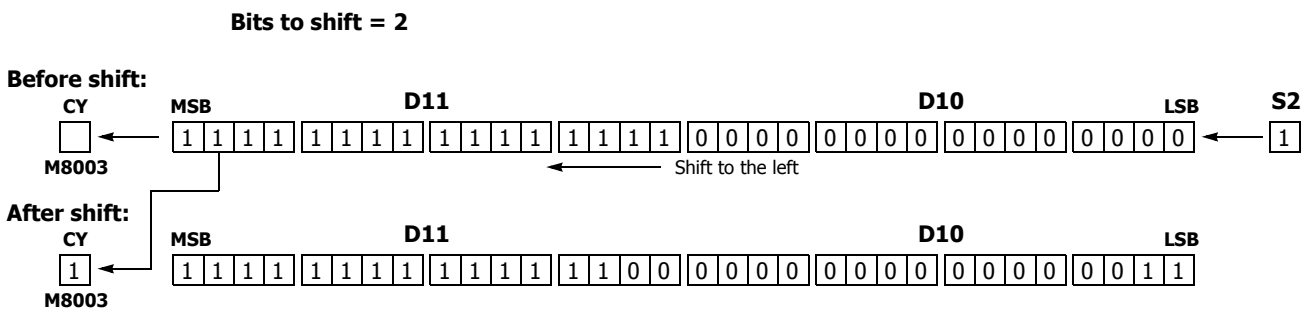


M8120 is the initialize pulse special internal relay.

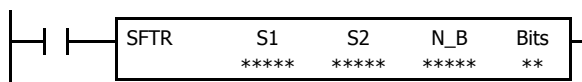
When the CPU starts operation, the MOV (move) instructions set 0 and 65535 to data registers D10 and D11, respectively.

Each time input I0 is turned on, 32-bit data of data registers D10 and D11 is shifted to the left by 2 bits as assigned by device Bits. D10 is the low word, and D11 is the high word.

The last bit status shifted out is set to a carry (special internal relay M8003). Ones are set to the LSBs.



## SFTR (Shift Right)

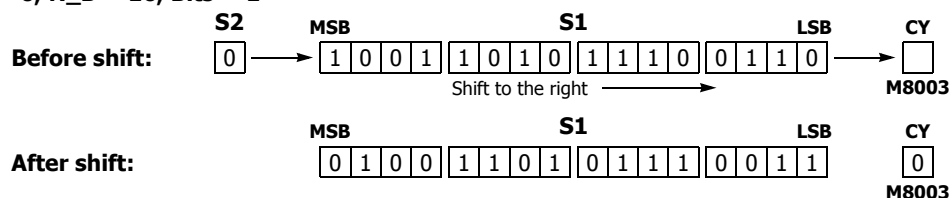


S1 → CY

When input is on, N\_B-bit data string starting with source device S1 is shifted to the right by the quantity of bits assigned by device Bits.

The result is set to source device S1, and the last bit status shifted out is set to a carry (special internal relay M8003). Zero or 1 assigned by source device S2 is set to the MSB.

- S2 = 0, N\_B = 16, Bits = 1



## Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

## Valid Devices

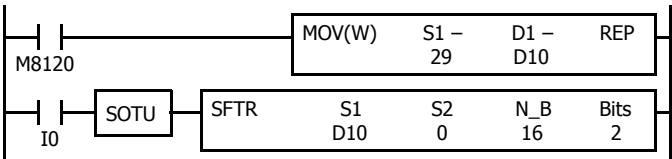
Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	First data for bit shift	—	X	▲	X	—	—	X	—	—
S2 (Source 2)	Data to shift into the MSB	X	X	X	X	—	—	—	0 or 1	—
N_B	Number of bits in the data string	—	—	—	—	—	—	X	1-65535	—
Bits	Quantity of bits to shift	—	—	—	—	—	—	X	1-15	—

For valid device address ranges, see Chapter 5 "Special Functions" - "Device Addresses" in the SmartAXIS Touch User's Manual.

Since the SFTR instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

Example: SFTR

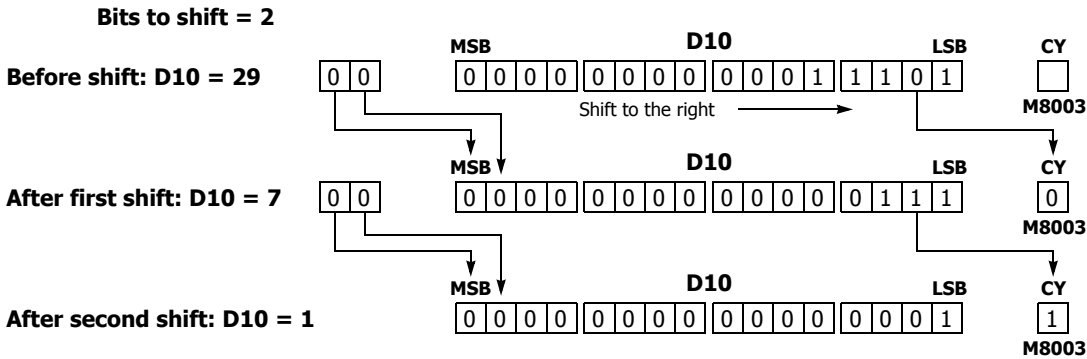
- Data Type: Word



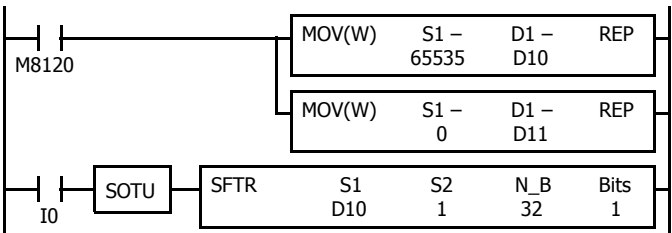
M8120 is the initialize pulse special internal relay.

When the CPU starts operation, the MOV (move) instruction sets 29 to data register D10.

Each time input I0 is turned on, 16-bit data of data register D10 is shifted to the right by 2 bits as assigned by device Bits. The last bit status shifted out is set to special internal relay M8003 (carry or borrow). Zeros are set to the MSB.



- Data Type: Double Word

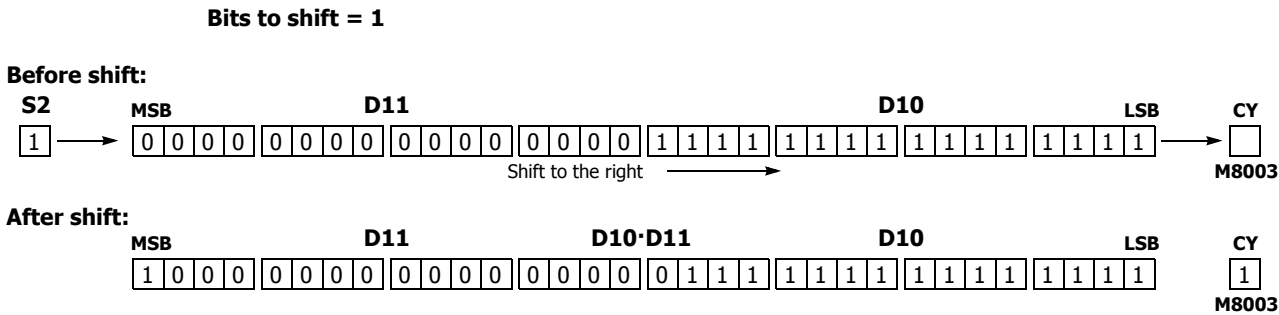


M8120 is the initialize pulse special internal relay.

When the CPU starts operation, the MOV (move) instructions set 65535 and 0 to data registers D10 and D11, respectively.

Each time input I0 is turned on, 32-bit data of data registers D10 and D11 is shifted to the right by 1 bit as assigned by device Bit. D10 is the low word, and D11 is the high word.

The last bit status shifted out is set to special internal relay M8003 (carry or borrow). Ones are set to the MSB.





## BCDLS (BCD Left Shift)



When input is on, the 32-bit binary data assigned by S1 is converted into 8 BCD digits, shifted to the left by the quantity of digits assigned by S2, and converted back to 32-bit binary data.

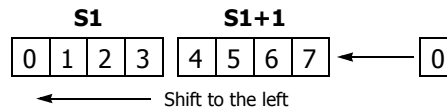
Valid values for each of S1 and S1+1 are 0 through 9999.

The number of digits that can be shifted is 1 through 7.

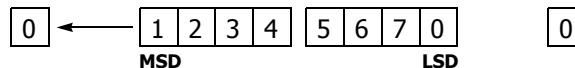
Zero is set to the lowest digit after each shift.

### When S2 = 1 (digits to shift)

Before shift:



After shift:



### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Data for BCD shift	—	—	—	—	—	—	X	—	—
S2 (Source 2)	Quantity of digits to shift	X	X	X	X	X	X	X	1-7	—

For valid device address ranges, see "Device Addresses" on page 3-1.

When T (timer) or C (counter) is used as S2, the timer/counter current value (TC or CC) is displayed.

The number of digits that can be shifted as S2 are 1 through 7.

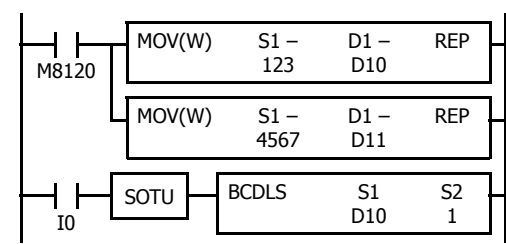
Make sure that the source data determined by S1 and S1+1 is between 0 and 9999 for each data register. If either source data is over 9999, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS. When S2 is higher than 7, a user program execution error will also result.

When a user program execution error occurs, the execution of the instruction is canceled. The data in S1 and S1+1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

### Valid Data Types

<b>W (word)</b>	—	When a word device such as D (data register) is assigned as source S1, 2 points (double-word data) are used.
<b>I (integer)</b>	—	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as source S2, 16 points are used.
<b>D (double word)</b>	X	
<b>L (long)</b>	—	When a word device such as T (timer), C (counter), or D (data register) is assigned as source S2, 1 point is used.
<b>F (float)</b>	—	

Example: BCDLS



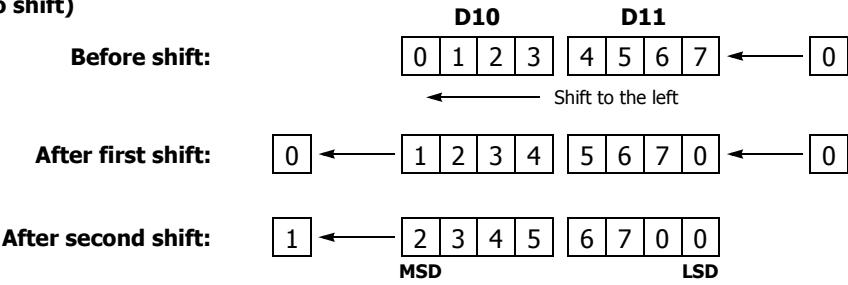
M8120 is the initialize pulse special internal relay.

When the CPU starts operation, the MOV (move) instructions set 123 and 4567 to data registers D10 and D11, respectively.

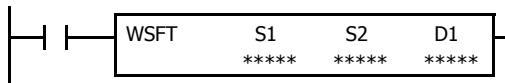
Each time input I0 is turned on, the 32-bit binary data of data registers D10 and D11 assigned by S1 is converted into 8 BCD digits, shifted to the left by 1 digit as assigned by device S2, and converted back to 32-bit binary data.

Zero is set to the lowest digit after each shift.

When S2 = 1 (digits to shift)

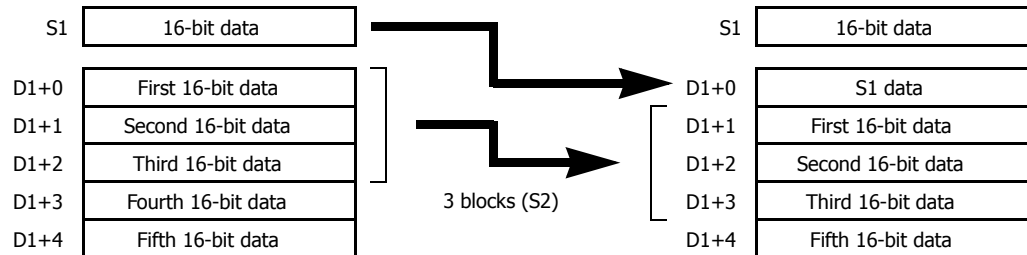


## WSFT (Word Shift)



When input is on, N blocks of 16-bit word data, starting with device assigned by D1, are shifted up to the next 16-bit positions. At the same time, the data assigned by device S1 is moved to the device assigned by D1. S2 specifies the quantity of blocks to move.

### When S2 = 3 (quantity of blocks to shift)



### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Source data for word shift	X	X	X	X	X	X	X	X	—
S2 (Source 2)	Quantity of blocks to shift	X	X	X	X	X	X	X	X	—
D1 (Destination 1)	First device address to shift	—	—	—	—	—	—	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

When T (timer) or C (counter) is used as S1 or S2, the timer/counter current value (TC or CC) is displayed.

### Valid Data Types

<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as source S1 or S2, 16 points are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	—	When a word device such as T (timer), C (counter), or D (data register) is assigned as source S1 or S2, 1 point is used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

### Special Internal Relay M8024: BMOV/WSFT Executing Flag

While the BMOV or WSFT is executed, M8024 turns on. When completed, M8024 turns off. If the CPU is powered down while executing BMOV or WSFT, M8024 remains on when the CPU is powered up again.

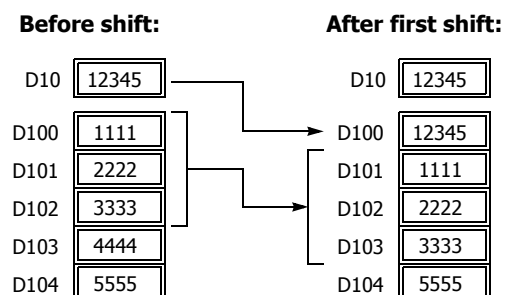
### Example: WSFT



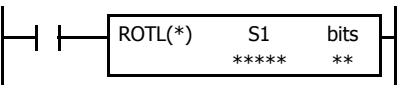
D100 through D102 → D101 through D103

D10 → D100

When input I0 is turned on, data of 3 data registers, starting with D100 assigned by destination device D1, is shifted to the next data registers. Data of data register D10, assigned by source device S1, is moved to D100 assigned by destination device D1.

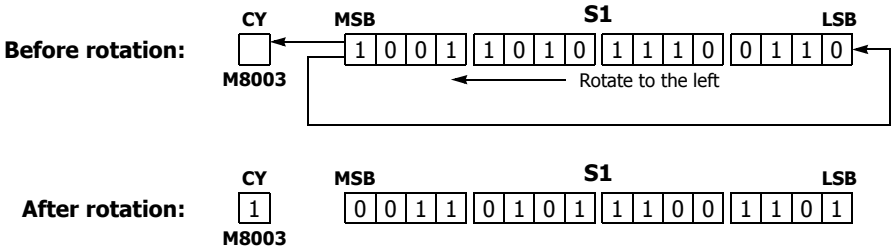


ROTL (Rotate Left)

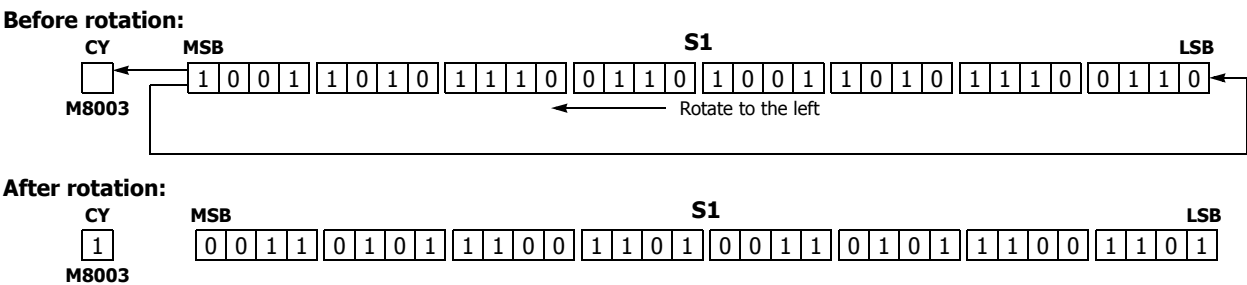


When input is on, 16- or 32-bit data of the assigned source device S1 is rotated to the left by the quantity of bits assigned by device bits.  
The result is set to the source device S1, and the last bit status rotated out is set to a carry (special internal relay M8003).

• Data Type: Word (bits to rotate = 1)



• Data Type: Double Word (bits to rotate = 1)



Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Data for bit rotation	—	X	▲	X	—	—	X	—	—
bits	Quantity of bits to rotate	—	—	—	—	—	—	—	1-15, 1-31	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as S1. Special internal relays cannot be designated as S1.

The quantity of bits to rotate can be 1 through 15 for word data, or 1 through 31 for double-word data.

Since the ROTL instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

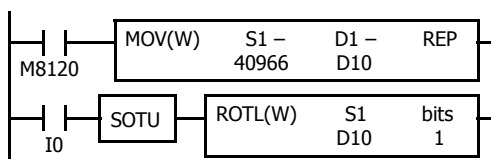
Valid Data Types

W (word)	X
I (integer)	—
D (double word)	X
L (long)	—
F (float)	—

When a bit device such as Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) or 32 points (double-word data) are used.  
When a word device such as D (data register) is assigned as the source, 1 point (word data) or 2 points (double-word data) are used.

**Example: ROTL**

- Data Type: Word



M8120 is the initialize pulse special internal relay.

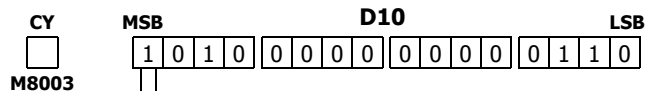
When the CPU starts operation, the MOV (move) instruction sets 40966 to data register D10.

Each time input I0 is turned on, 16-bit data of data register D10 is rotated to the left by 1 bit as assigned by device bits.

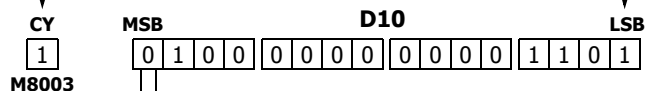
The status of the MSB is set to special internal relay M8003 (carry or borrow).

**Bits to rotate = 1**

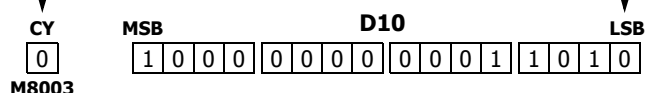
**Before rotation: D10 = 40966**



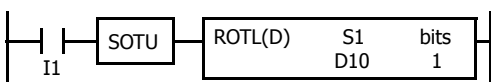
**After first rotation: D10 = 16397**



**After second rotation: D10 = 32794**



- Data Type: Double Word

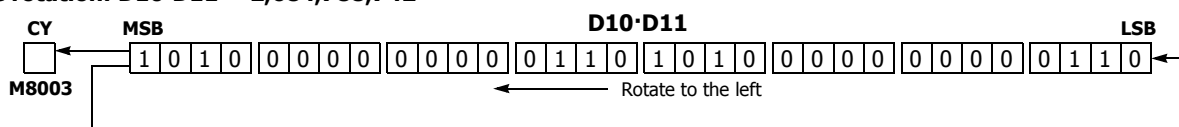


Each time input I1 is turned on, 32-bit data of data registers D10 and D11 is rotated to the left by 1 bit as assigned by device bits.

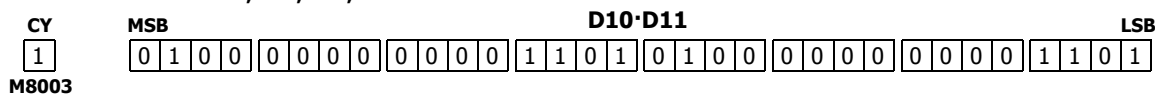
The status of the MSB is set to special internal relay M8003 (carry or borrow).

**Bits to rotate = 1**

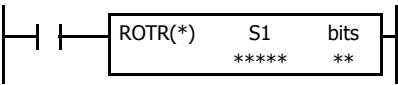
**Before rotation: D10·D11 = 2,684,788,742**



**After rotation: D10·D11 = 1,074,610,189**



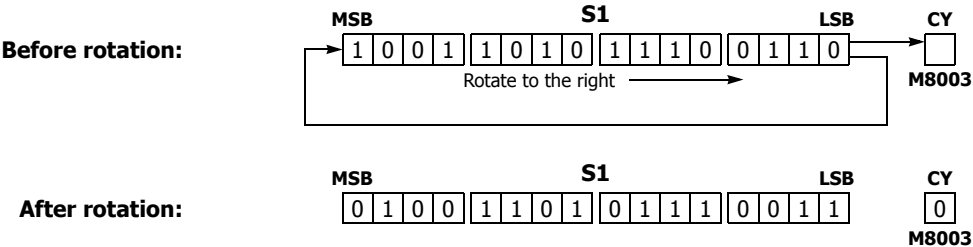
ROTR (Rotate Right)



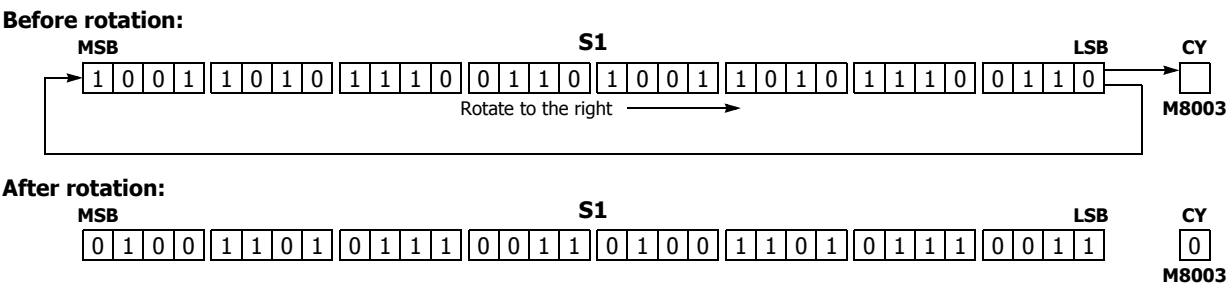
When input is on, 16- or 32-bit data of the assigned source device S1 is rotated to the right by the quantity of bits assigned by device bits.

The result is set to the source device S1, and the last bit status rotated out is set to special internal relay M8003 (carry or borrow).

• Data Type: Word (bits to rotate = 1)



• Data Type: Double Word (bits to rotate = 1)



Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Data for bit rotation	—	X	▲	X	—	—	X	—	—
bits	Quantity of bits to rotate	—	—	—	—	—	—	—	1-15, 1-31	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as S1. Special internal relays cannot be designated as S1.

The number of bits that can be rotated is 1 through 15 for word data, or 1 through 31 for double-word data.

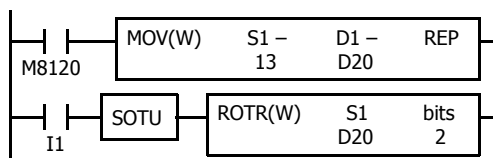
Since the ROTR instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

Valid Data Types

<b>W (word)</b>	X	When a bit device such as Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) or 32 points (double-word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	X	When a word device such as D (data register) is assigned as the source, 1 point (word data) or 2 points (double-word data) are used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

**Example: ROTR**

- Data Type: Word



M8120 is the initialize pulse special internal relay.

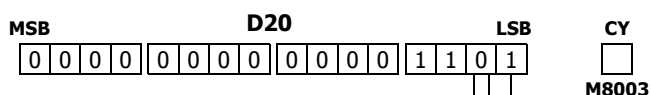
When the CPU starts operation, the MOV (move) instruction sets 13 to data register D20.

Each time input I1 is turned on, 16-bit data of data register D20 is rotated to the right by 2 bits as assigned by device bits.

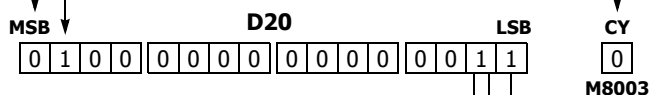
The last bit status rotated out is set to special internal relay M8003 (carry or borrow).

**Bits to rotate = 2**

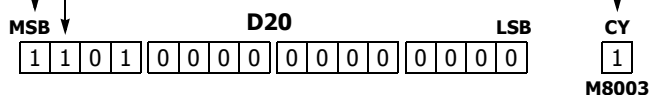
**Before rotation: D20 = 13**



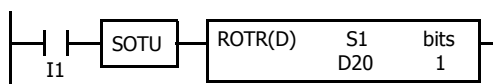
**After first rotation: D20 = 16387**



**After second rotation: D20 = 53248**



- Data Type: Double Word

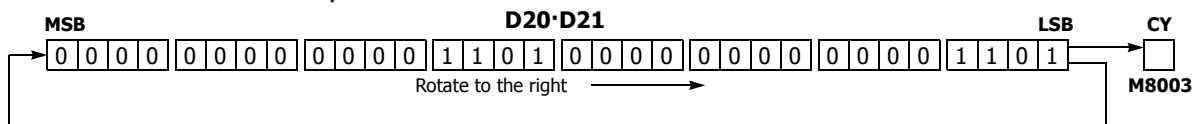


Each time input I1 is turned on, 32-bit data of data registers D20 and D21 is rotated to the right by 1 bit as assigned by device bits.

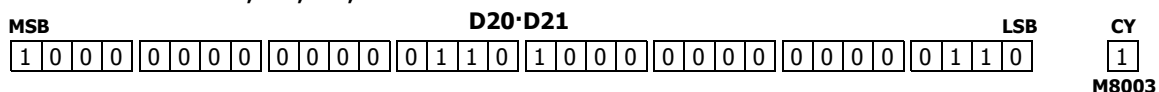
The last bit status rotated out is set to special internal relay M8003 (carry or borrow).

**Bits to rotate = 1**

**Before rotation: D20·D21 = 851,981**



**After rotation: D20·D21 = 2,147,909,638**







# 11: DATA CONVERSION INSTRUCTIONS

## Introduction

Data conversion instructions convert data to binary, BCD, and ASCII format.

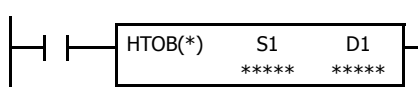
The ENCO (encode), DECO (decode), and BCNT (bit count) instructions processes bit device data.

The ALT (alternate output) instruction turns an output on and off each time an input button is pressed.

The CVDT (convert data) instruction converts data types among W (word), I (integer), D (double word), L (long), and F (float).

The DTDV and DTCB instructions convert data between two one-byte data and one word data. The SWAP exchanges upper and lower byte- or word-data for word- or double-word-data respectively.

## HTOB (Hex to BCD)



S1 → D1

When input is on, the 16- or 32-bit data assigned by S1 is converted into BCD and stored to the destination assigned by device D1.

Valid values for the source device are 0 through 9999 for word data, and 0 through 9999 9999 for double-word data.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Binary data to convert	X	X	X	X	X	X	X	X	—
D1 (Destination 1)	Destination to store conversion results	—	X	▲	X	X	X	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

When T (timer) or C (counter) is used as S1, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

Valid values for the source device are 0 through 9999 (270Fh) for word data, and 0 through 9999 9999 (5F5 E0FFh) for double-word data. Make sure that the source designated by S1 is within the valid value range. If the source data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

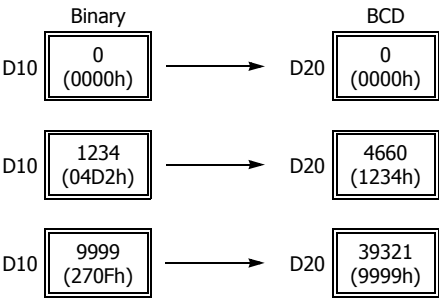
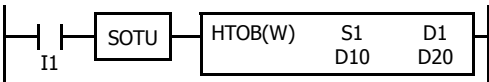
Since the HTOB instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

### Valid Data Types

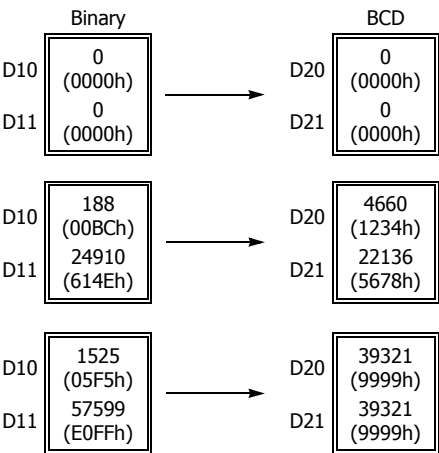
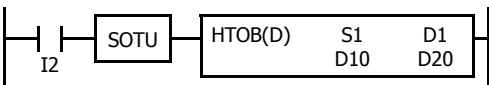
<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) or 32 points (double-word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	X	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source, 1 point (word data) or 2 points (double-word data) are used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

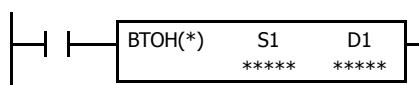
Examples: HTOB

• Data Type: Word



• Data Type: Double Word



**BTOH (BCD to Hex)**

S1 → D1

When input is on, the BCD data assigned by S1 is converted into 16- or 32-bit binary data and stored to the destination assigned by device D1.

Valid values for the source device are 0 through 9999 (BCD) for word data, and 0 through 9999 9999 (BCD) for double-word data.

**Applicable SmartAXIS**

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

**Valid Devices**

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	BCD data to convert	X	X	X	X	X	X	X	X	—
D1 (Destination 1)	Destination to store conversion results	—	X	▲	X	X	X	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

When T (timer) or C (counter) is used as S1, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

Valid values for the source device are 0 through 9999 (BCD) for word data, and 0 through 9999 9999 (BCD) for double-word data. Make sure that each digit of the source designated by S1 is 0 through 9. If the source data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

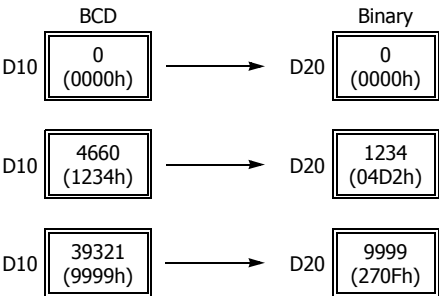
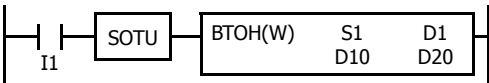
Since the BTOH instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

**Valid Data Types**

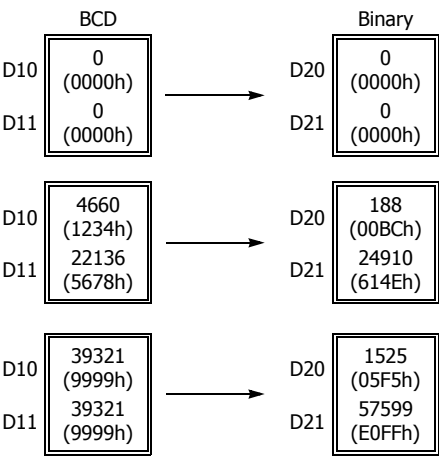
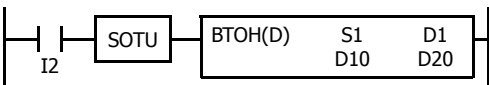
<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) or 32 points (double-word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	X	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source, 1 point (word data) or 2 points (double-word data) are used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

Examples: BTOH

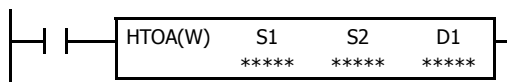
- Data Type: Word



- Data Type: Double Word



## HTOA (Hex to ASCII)



S1 → D1, D1+1, D1+2, D1+3

When input is on, the 16-bit binary data assigned by S1 is read from the lowest digit as many times as the quantity of digits assigned by S2, converted into ASCII data, and stored to the destination starting with the device assigned by D1.

The quantity of digits to convert can be 1 through 4.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Binary data to convert	X	X	X	X	X	X	X	X	—
S2 (Source 2)	Quantity of digits to convert	X	X	X	X	X	X	X	1-4	—
D1 (Destination 1)	Destination to store conversion results	—	—	—	—	—	—	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

When T (timer) or C (counter) is used as S1 or S2, the timer/counter current value (TC or CC) is displayed.

The quantity of digits to convert can be 1 through 4. Make sure that the quantity of digits designated by S2 is within the valid range. If the S2 data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

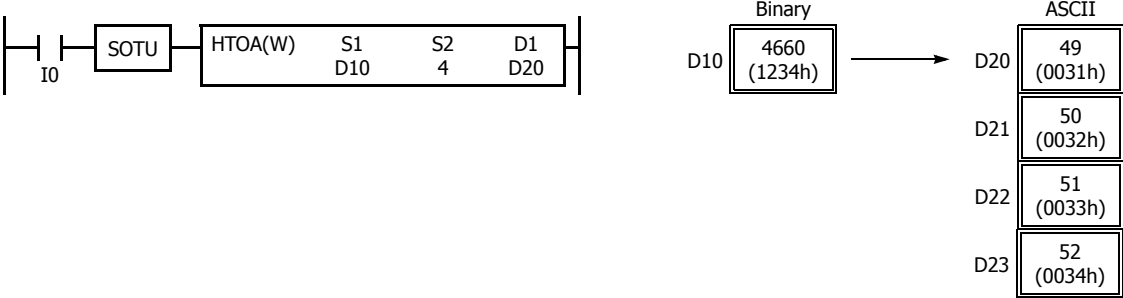
Since the HTOA instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

### Valid Data Types

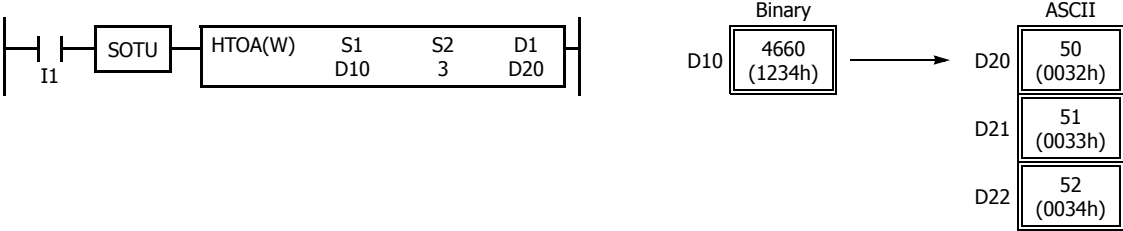
<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	—	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) is used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

Examples: HTOA

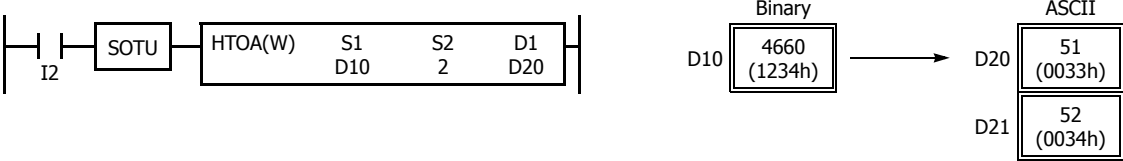
- Quantity of Digits: 4



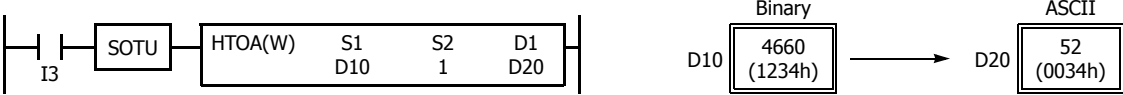
- Quantity of Digits: 3



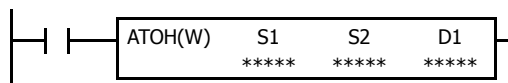
- Quantity of Digits: 2



- Quantity of Digits: 1



## ATOH (ASCII to Hex)



S1, S1+1, S1+2, S1+3 → D1

When input is on, the ASCII data, assigned by S1, is converted into 16-bit binary data. The number of times is determined by the quantity of digits assigned by S2. The data is then stored to the destination assigned by device D1.

Valid values for source data to convert are 30h to 39h and 41h to 46h.

The quantity of digits to convert can be 1 through 4.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	ASCII data to convert	—	—	—	—	—	—	X	—	—
S2 (Source 2)	Quantity of digits to convert	X	X	X	X	X	X	X	1-4	—
D1 (Destination 1)	Destination to store conversion results	—	X	▲	X	X	X	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

When T (timer) or C (counter) is used as S2, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

Valid values for source S1 data to convert are 30h to 39h and 41h to 46h. Make sure that the values for each source designated by S1 and the quantity of digits designated by S2 are within the valid range. If the S1 or S2 data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

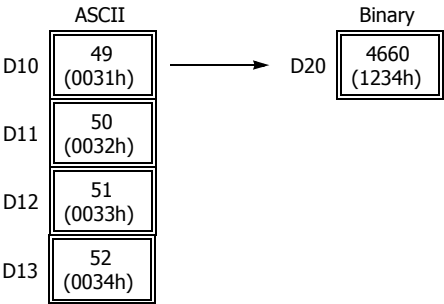
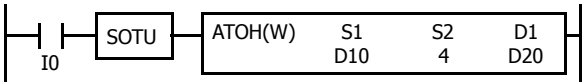
Since the ATOH instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

### Valid Data Types

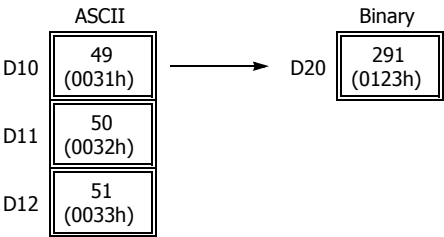
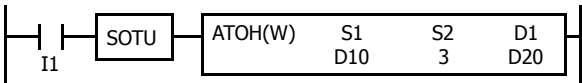
<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source or destination, 16 points (word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	—	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) is used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

Examples: ATOH

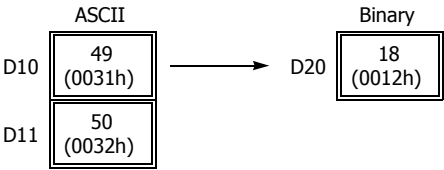
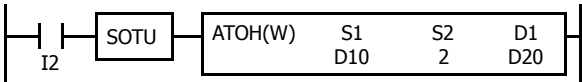
- Quantity of Digits: 4



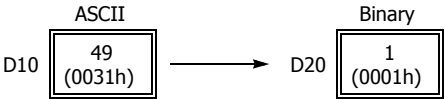
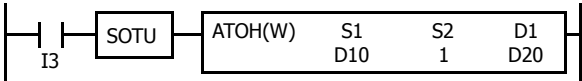
- Quantity of Digits: 3



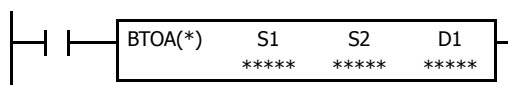
- Quantity of Digits: 2



- Quantity of Digits: 1





**BTOA (BCD to ASCII)**

Word data: S1 → D1, D1+1, D1+2, D1+3, D1+4  
 Double-word data: S1·S1+1 → D1, D1+1, D1+2, ..., D1+9  
 When input is on, the 16- or 32-bit binary data assigned by S1 is converted into BCD, and converted into ASCII data. The data is read from the lowest digit as many times as the quantity of digits assigned by S2. The result is stored to the destination starting with the device assigned by D1.

The number of digits that can be converted is 1 through 5 for word data, and 1 through 10 for double-word data.

**Applicable SmartAXIS**

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

**Valid Devices**

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Binary data to convert	X	X	X	X	X	X	X	X	—
S2 (Source 2)	Quantity of digits to convert	X	X	X	X	X	X	X	1-5, 1-10	—
D1 (Destination 1)	Destination to store conversion results	—	—	—	—	—	—	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

When T (timer) or C (counter) is used as S1 or S2, the timer/counter current value (TC or CC) is displayed.

The number of digits that can be converted is 1 through 5 for word data, and 1 through 10 for double-word data. Make sure that the quantity of digits designated by S2 is within the valid range. If the S2 data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

Make sure that the last destination data determined by D1+S2-1 is within the valid device range. If the derived destination device exceeds the valid device range, a user program execution error will result, turning on special internal relay M8004 and ERROR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

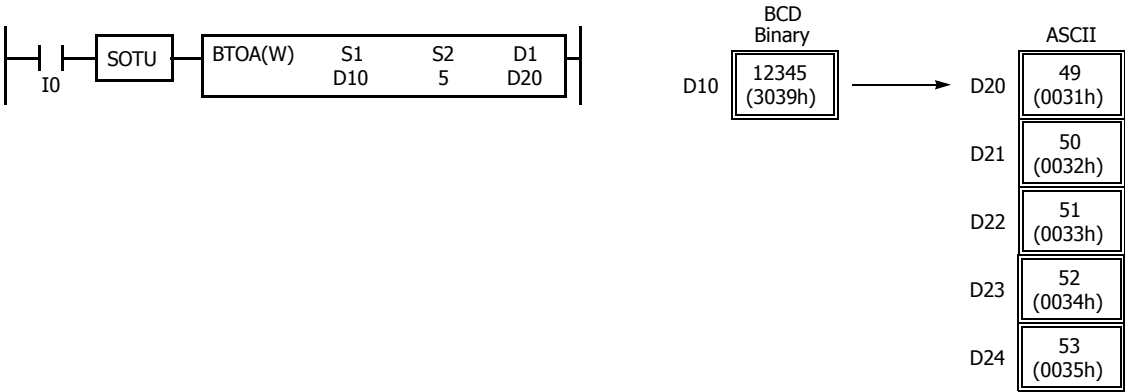
Since the BTOA instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

**Valid Data Types**

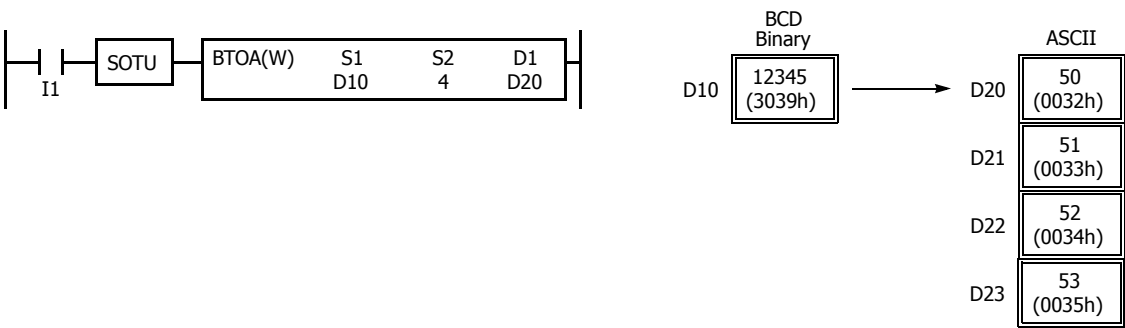
<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) or 32 points (double-word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	X	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) or 2 points (double-word data) are used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

Examples: BTOA(W)

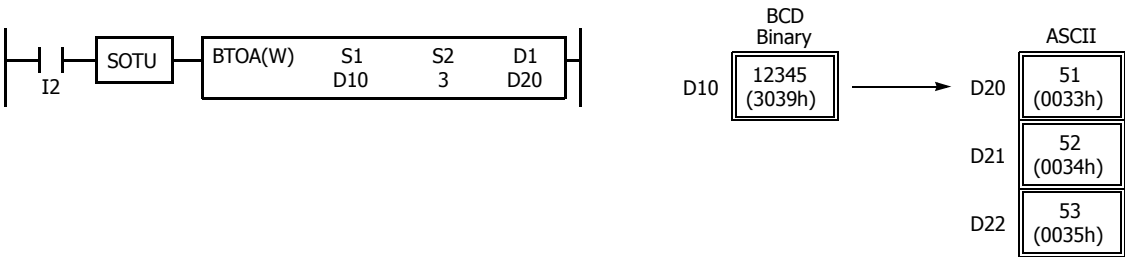
- Quantity of Digits: 5



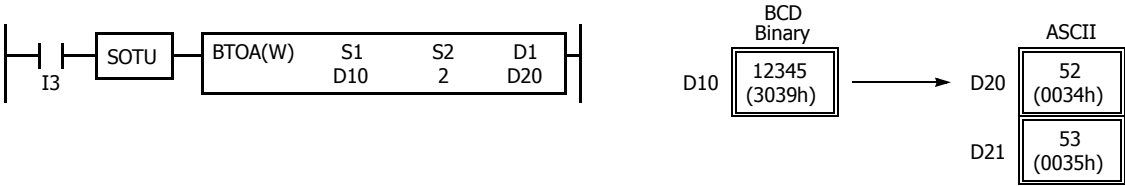
- Quantity of Digits: 4



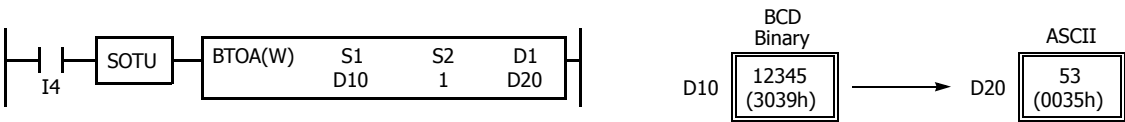
- Quantity of Digits: 3



- Quantity of Digits: 2

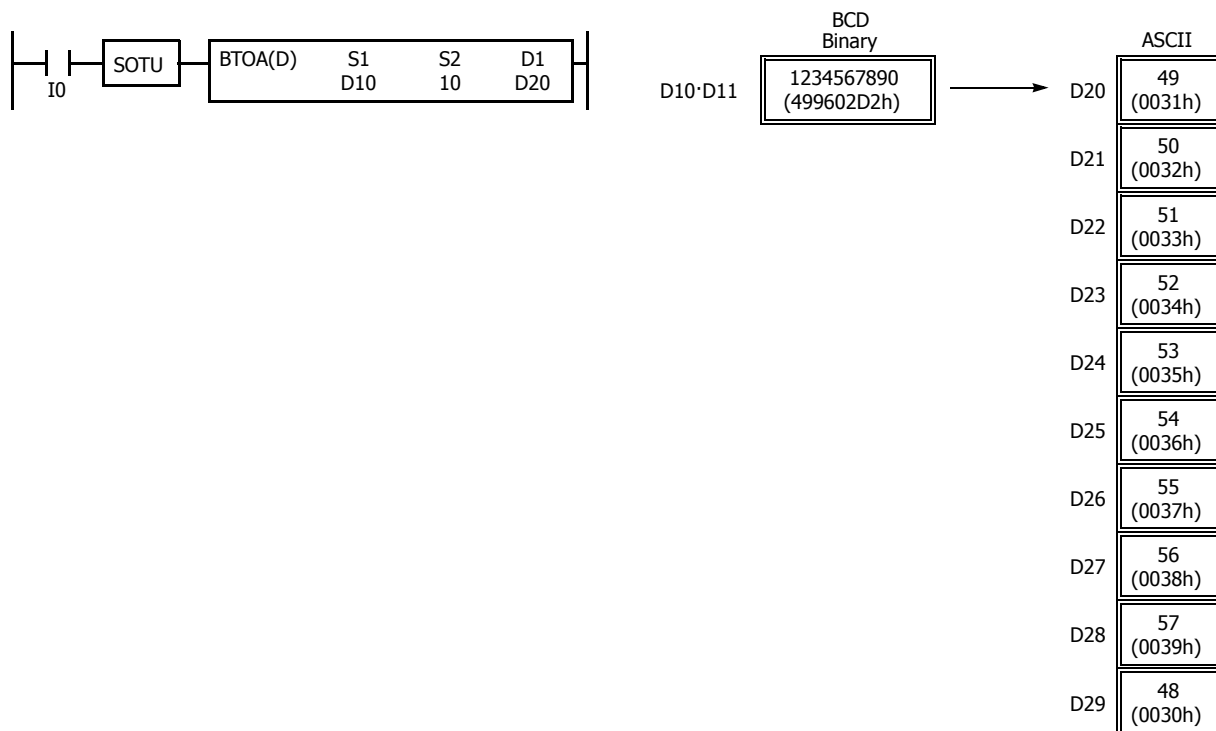


- Quantity of Digits: 1

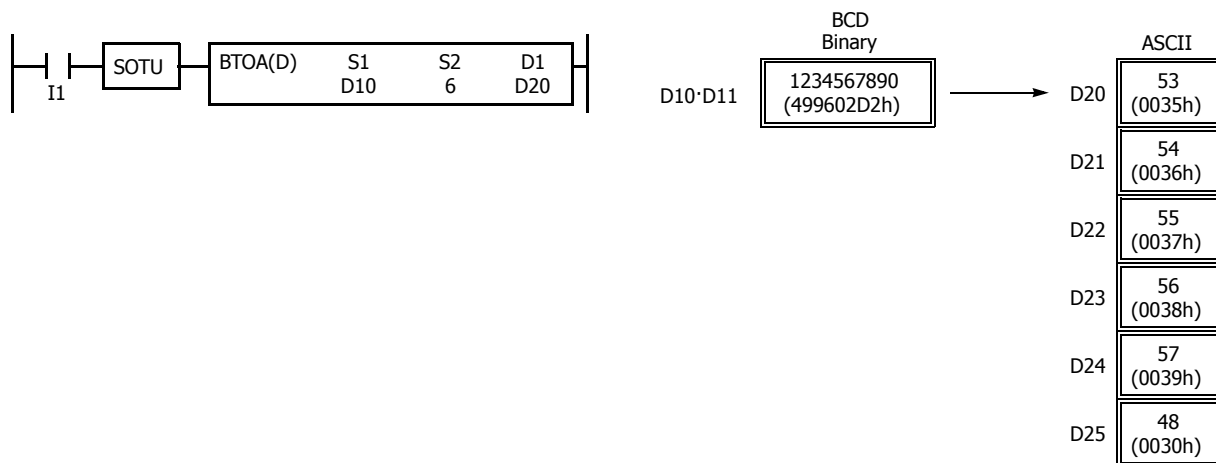


### Examples: BTOA(D)

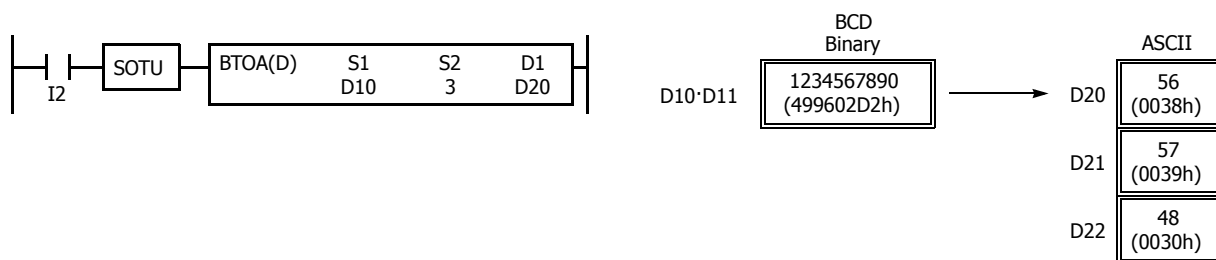
- Quantity of Digits: 10



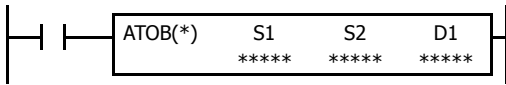
- Quantity of Digits: 6



- Quantity of Digits: 3



### ATOB (ASCII to BCD)



Word data: S1, S1+1, S1+2, S1+3, S1+4 → D1  
 Double-word data: S1, S1+1, S1+2, ... , S1+9 → D1·D1+1

When input is on, the ASCII data assigned by S1 as many times as the quantity of digits assigned by S2 is converted into BCD, and converted into 16- or 32-bit binary data. The result is stored to the destination assigned by device D1.

Valid values for source data to convert are 30h through 39h.

The number of digits that can be converted is through 5 for word data, and 1 through 10 for double-word data.

#### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

#### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	ASCII data to convert	—	—	—	—	—	—	X	—	—
S2 (Source 2)	Quantity of digits to convert	X	X	X	X	X	X	X	1-5, 1-10	—
D1 (Destination 1)	Destination to store conversion results	—	X	▲	X	X	X	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1.

When T (timer) or C (counter) is used as S2, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP).

Valid values for source S1 data to convert are 30h through 39h. The number of digits that can be converted is be 1 through 5 for word data, and 1 through 10 for double-word data. Make sure that the values for each source designated by S1 and the quantity of digits designated by S2 are within the valid range. If the S1 or S2 data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

Make sure that the last source data determined by S1+S2-1 is within the valid device range. If the derived source device exceeds the valid device range, a user program execution error will result, turning on special internal relay M8004 and ERROR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

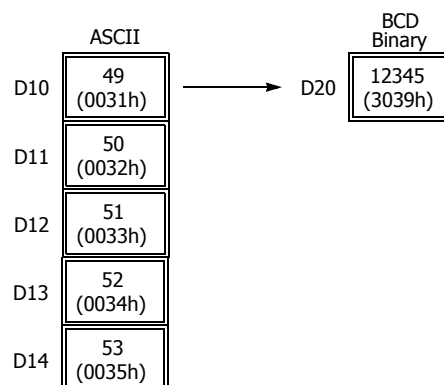
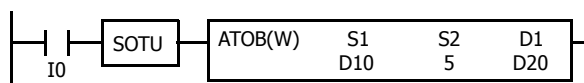
Since the ATOB instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

#### Valid Data Types

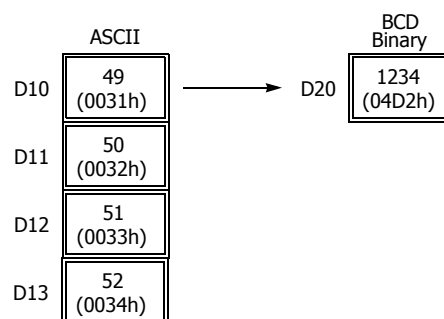
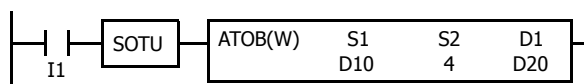
<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source or destination, 16 points (word data) or 32 points (double-word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	X	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) or 2 points (double-word data) are used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

**Examples: ATOB(W)**

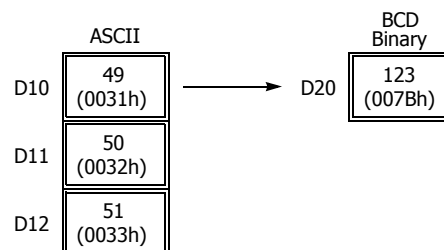
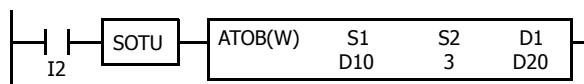
- Quantity of Digits: 5



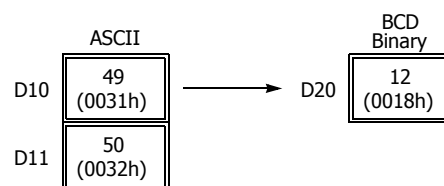
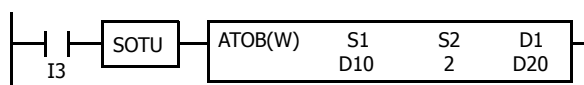
- Quantity of Digits: 4



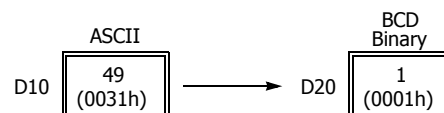
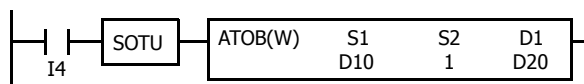
- Quantity of Digits: 3



- Quantity of Digits: 2



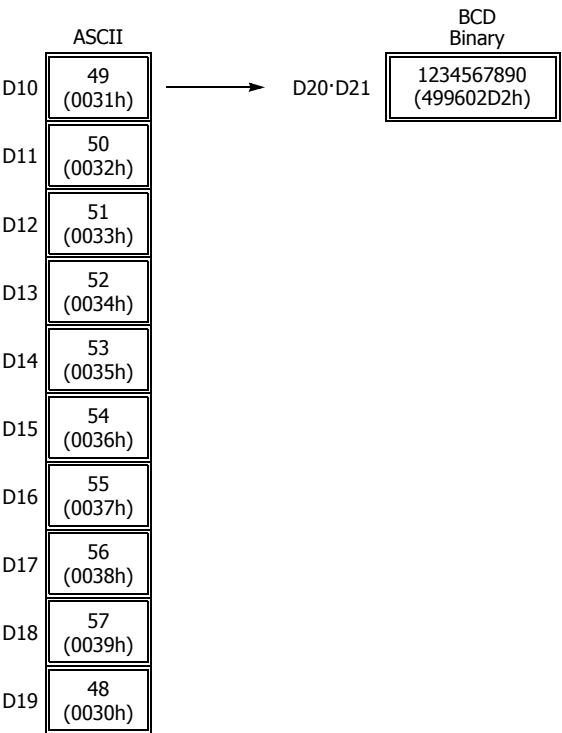
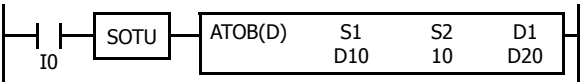
- Quantity of Digits: 1



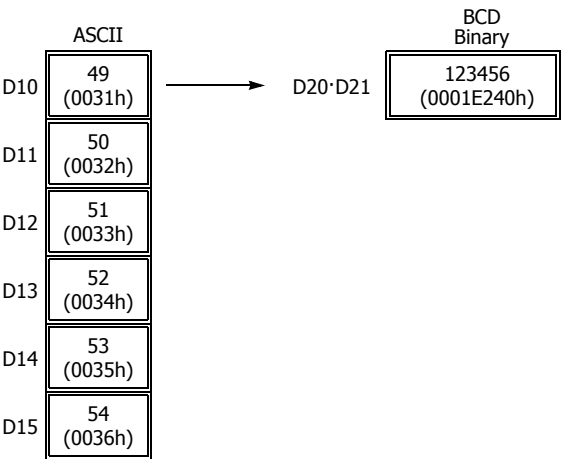
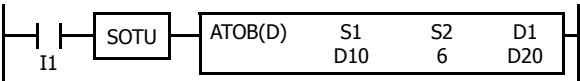
11: DATA CONVERSION INSTRUCTIONS

Examples: ATOB(D)

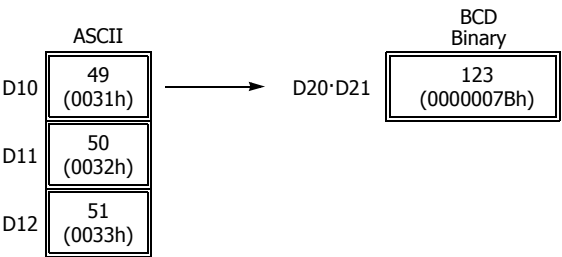
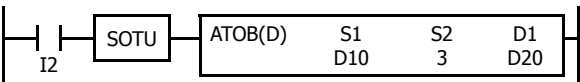
- Quantity of Digits: 10



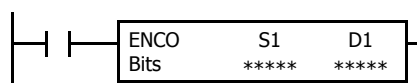
- Quantity of Digits: 6



- Quantity of Digits: 3



## ENCO (Encode)



When input is on, a search begins for the first bit that is set to on. The search begins at S1 until the first set (on) point is located. The number of points from S1 to the first set point (offset) is stored to the destination assigned by device D1.

If no point is on in the searched area, 65535 is stored to D1.

## Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

## Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	First bit to start search	X	X	X	X	—	—	X	—	—
D1 (Destination 1)	Destination to store search results	—	X	▲	X	—	—	X	—	—
Bits	Quantity of bits searched	—	—	—	—	—	—	—	1-256	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

Valid values for Bits to designate the quantity of bits searched are 1 through 256. Make sure that the search area designated by S1 plus Bits is within the valid value range. If the source data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

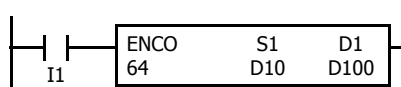
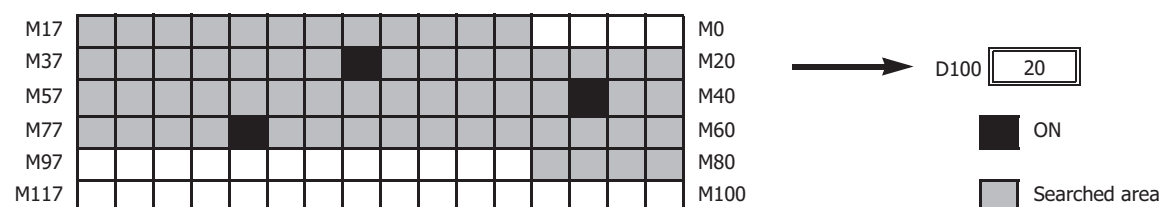
Since the ENCO instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

## Examples: ENCO



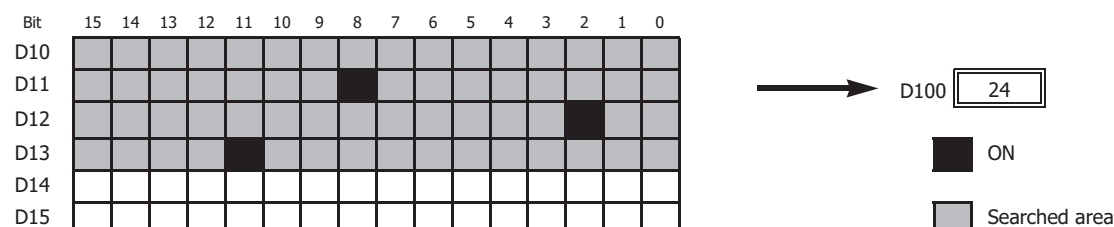
When input I0 is on, a search begins for a bit that is set on in an array of 64 bits starting at internal relay M4 assigned by device S1.

Since internal relay M30 is the first point that is on, the offset from the first search point is 20, and 20 is stored to data register D100 assigned by device D1.

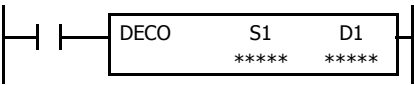


When input I1 is on, a search begins for a bit that is set on in an array of 64 bits starting at bit 0 of data register D10 assigned by device S1.

Since bit 8 of data register D11 is the first point that is on, the offset from the first search point is 24, and 24 is stored to data register D100 assigned by device D1.



DECO (Decode)



When input is on, the values contained in devices assigned by S1 and D1 are added together to determine the destination, and the bit is then turned on.

Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Offset	X	X	X	X	—	—	X	0-255	—
D1 (Destination 1)	First bit to count offset	—	X	▲	X	—	—	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

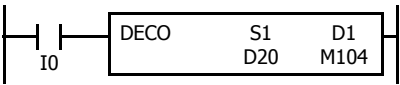
▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

Valid values for the offset designated by source device S1 are 0 through 255. Make sure that the offset designated by S1 and the last bit of destination data determined by the sum of S1 and D1 are within the valid value range. If the offset or destination data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

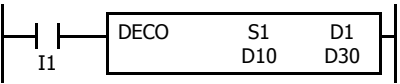
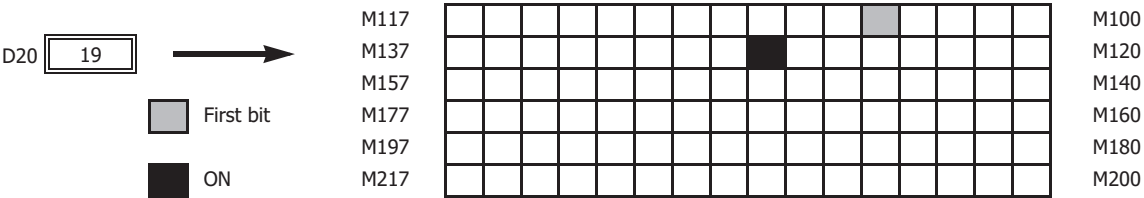
When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

Since the DECO instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

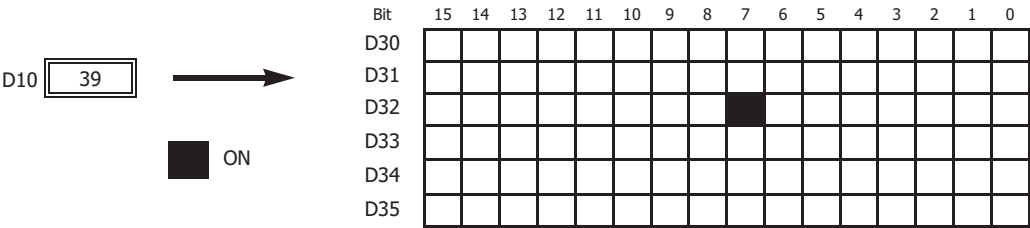
Examples: DECO



When input I0 is on, the destination bit is determined by adding the value contained in data register D20 assigned by device S1 to internal relay M104 assigned by destination device D1. Since the 19th bit from internal relay M104 is internal relay M127, the bit is then turned on.

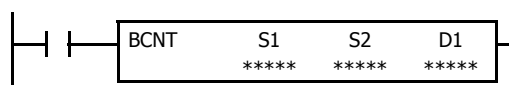


When input I1 is on, the destination bit is determined by adding the value contained in data register D10 assigned by device S1 to data register D30 assigned by destination device D1. Since the 39th bit from data register D30 bit 0 is data register D32 bit 7, the bit is then turned on.





## BCNT (Bit Count)



When input is on, a search begins for the total number of bits that are on an array of consecutive bits starting at the point assigned by source device S1. Source device S2 assigns the quantity of bits searched. The quantity of bits which are on is stored to the destination assigned by device D1.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	First bit to start search	X	X	X	X	—	—	X	—	—
S2 (Source 2)	Quantity of bits searched	X	X	X	X	X	X	X	1-256	—
D1 (Destination 1)	Destination to store quantity of ON bits	—	X	▲	X	X	X	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

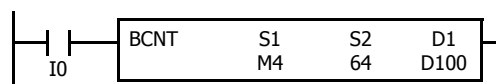
When T (timer) or C (counter) is used as S2, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

Valid values for S2 to designate as the number of bits that can be searched is 1 through 256. Make sure that the search area designated by S1 plus S2 is within the valid value range. If the source data exceeds the valid range, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

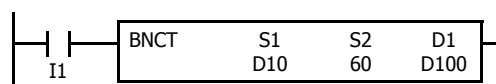
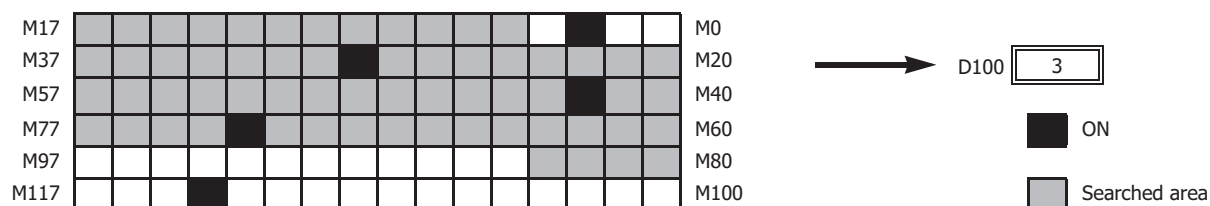
Since the BCNT instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

### Examples: BCNT



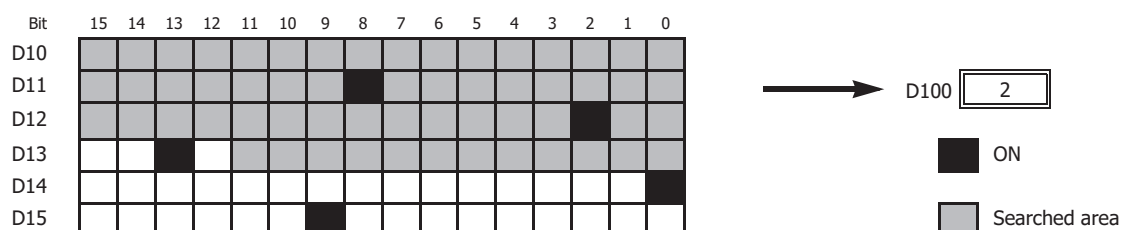
When input is on, a search begins for the total number of bits that are on in an array of 64 bits starting at internal relay M4 assigned by source device S1.

Since 3 bits are on in the searched area, the quantity is stored to data register D100 assigned by destination device D1.

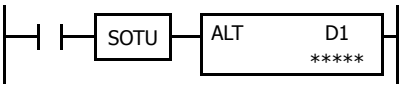


When input I0 is on, a search begins for the total number of bits that are on in an array of 60 bits starting at bit 0 of data register D10 assigned by device S1.

Since 2 bits are on among the 60 bits, 2 is stored to data register D100 assigned by device D1.



ALT (Alternate Output)



When input is turned on, output, internal relay, or shift register bit assigned by D1 is turned on and remains on after the input is turned off.

When input is turned on again, the assigned output, internal relay, or shift register bit is turned off.

The ALT instruction must be used with a SOTU or SOTD instruction, otherwise the assigned output, internal relay, or shift register bit repeats to turn on and off in each scan.

Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

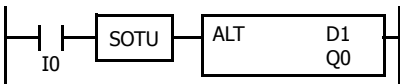
Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
D1 (Destination 1)	Bit to turn on and off	—	X	X	X	—	—	—	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

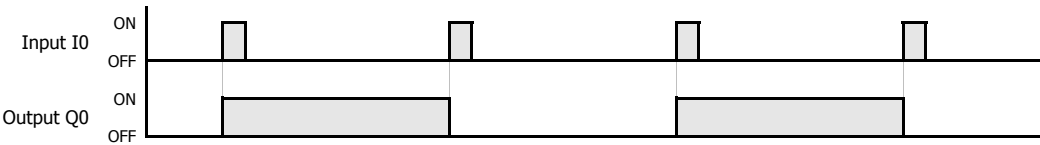
Since the ALT instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction must be used. For the SOTU instruction and the SOTD instruction, see "SOTU and SOTD (Single Output Up and Down)" on page 5-26.

Example: ALT

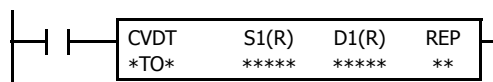


When input I0 is turned on, output Q0 assigned by device D1 is turned on and remains after input I0 is turned off.

When input I0 is turned on again, output Q0 is turned off.



## CVDT (Convert Data Type)



S1 → D1

When input is on, the data type of the 16- or 32-bit data assigned by S1 is converted and stored to the destination assigned by device D1.

Data types can be assigned for the source and destination, separately

Data Type	W, I	D, L, F
Source	S1	S1·S1+1
Destination	D1	D1·D1+1

When the same data type is assigned for both source and destination, the CVDT instruction has the same function as the MOV instruction.

Unless F (float) data is selected for both source and destination, only the integral number is moved, omitting the fraction.

When the source data exceeds the range of destination data, the destination stores a value closest to the source data within the destination data.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	First device address to convert data type	X	X	X	X	X	X	X	X	1-99
D1 (Destination 1)	First device address to store converted data	—	X	▲	X	X	X	X	—	1-99

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

When T (timer) or C (counter) is used as S1, the timer/counter current value (TC or CC) is displayed. When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

When F (float) data is selected, only data register and constant can be designated as S1 and only data register can be designated as D1.

When F (float) data is selected and S1 or D1 does not comply with the normal floating-point format, a user program execution error will result, turning on special internal relay M8004 and ERR LED on the SmartAXIS.

When a user program execution error occurs, the execution of the instruction is canceled. The value of D1 is left unchanged and the next instruction is executed. For user program execution errors, see "User Program Execution Errors" on page 4-13.

### Valid Data Types

<b>W (word)</b>	X
<b>I (integer)</b>	X
<b>D (double word)</b>	X
<b>L (long)</b>	X
<b>F (float)</b>	X

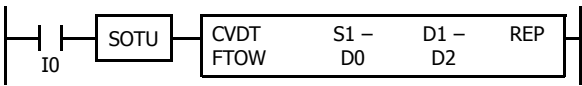
When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source or destination, 16 points (word or integer data) or 32 points (double-word, long, or float data) are used. When repeat is assigned for a bit device, the quantity of device bits increases in 16- or 32-point increments.

When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word or integer data) or 2 points (double-word, long, or float data) are used. When repeat is assigned for a word device, the quantity of device words increases in 1- or 2-point increments.

Examples: CVDT

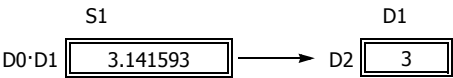
- **Data Type: Either S1 or D1 is not F (float)**

Unless F (float) data is selected for both source and destination, only the integral number is moved, omitting the fraction.



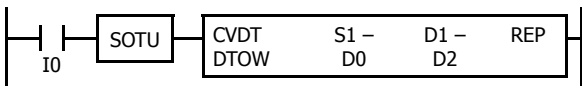
Device	Data Type	Value
Source	F	3.141593
Destination	W	3

When input I0 is turned on, 3 is stored to data register D2.



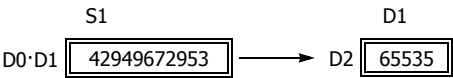
- **Data Type: S1 has a larger data range than D1**

When the source data exceeds the range of destination data type, the destination stores a value closest to the source data within the destination data type.

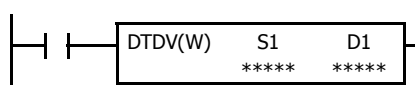


Device	Data Type	Value
Source	D	4294967295
Destination	W	65535

When input I0 is turned on, 65535 is stored to data register D2.



## DTDV (Data Divide)



S1 → D1, D1+1

When input is on, the 16-bit binary data assigned by S1 is divided into upper and lower bytes. The upper byte data is stored to the destination assigned by device D1. The lower byte data is stored to the device next to D1.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Binary data to divide	X	X	X	X	X	X	X	X	—
D1 (Destination 1)	Destination to store results	—	—	—	—	—	—	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

When T (timer) or C (counter) is used as S1, the timer/counter current value (TC or CC) is displayed.

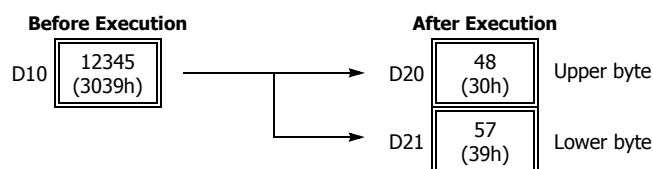
Destination device D1 uses 2 data registers starting with the device assigned by D1.

Since the DTDV instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

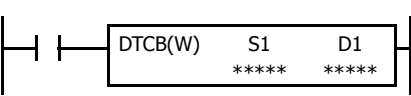
### Valid Data Types

<b>W (word)</b>	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the source, 16 points (word data) are used.
<b>I (integer)</b>	—	
<b>D (double word)</b>	—	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) is used.
<b>L (long)</b>	—	
<b>F (float)</b>	—	

### Example: DTDV



DTCB (Data Combine)



S1, S1+1 → D1

When input is on, the lower-byte data is displayed from 2 consecutive sources starting with device assigned by S1 and combined to make 16-bit data. The lower byte data from the first source device is moved to the upper byte of the destination assigned by device D1, and the lower byte data from the next source device is moved to the lower byte of the destination.

Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Binary data to combine	—	—	—	—	—	—	X	—	—
D1 (Destination 1)	Destination to store results	—	X	▲	X	X	X	X	—	—

For valid device address ranges, see "Device Addresses" on page 3-1.

▲ Special internal relays cannot be designated as D1.

When T (timer) or C (counter) is used as D1, the data is written in as a preset value (TP or CP) which can be 0 through 65535.

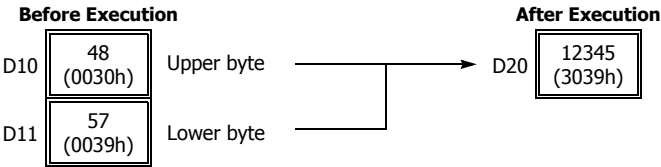
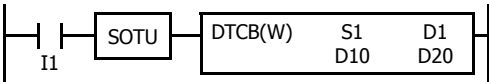
Source device S1 uses 2 data registers starting with the device assigned by S1.

Since the DTCB instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

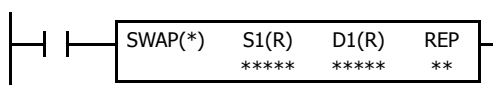
Valid Data Types

W (word)	X	When a bit device such as I (input), Q (output), M (internal relay), or R (shift register) is assigned as the destination, 16 points (word data) are used.
I (integer)	—	
D (double word)	—	When a word device such as T (timer), C (counter), or D (data register) is assigned as the source or destination, 1 point (word data) is used.
L (long)	—	
F (float)	—	

Example: DTCB



## SWAP (Data Swap)



S1 → D1

When input is on, upper and lower byte- or word-data of a word- or double-word-data assigned by S1 are exchanged, and the result is stored to destination assigned by D1.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Binary data to swap	—	—	—	—	—	—	X	—	1-99
D1 (Destination 1)	Destination to store conversion result	—	—	—	—	—	—	X	—	1-99

For valid device address ranges, see "Device Addresses" on page 3-1.

Since the SWAP instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

### Valid Data Types

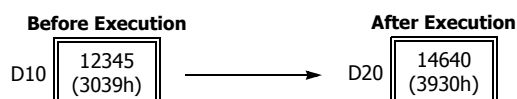
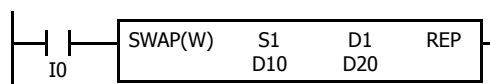
<b>W (word)</b>	X
<b>I (integer)</b>	—
<b>D (double word)</b>	X
<b>L (long)</b>	—
<b>F (float)</b>	—

When a D (data register) is assigned as the source or destination, 1 point (word data) or 2 points (double-word data) are used. When repeat is assigned, the quantity of device words increases in 1- or 2-point increments.

### Examples: SWAP

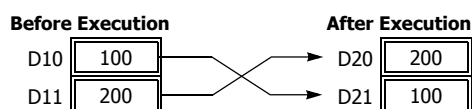
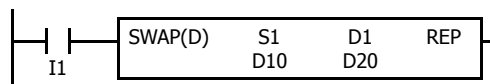
#### • Data Type: W (word)

When input I0 is turned on, upper- and lower-byte data of the 16-bit data in data register D10 assigned by source device S1 are exchanged, and the result is stored to data register D20 assigned by destination device D1.



#### • Data Type: D (double-word)

When input I1 is turned on, upper- and lower-word data of the 32-bit data in data registers D10 and D11 assigned by source device S1 are exchanged, and the result is stored to data registers D20 and D21 assigned by destination device D1.





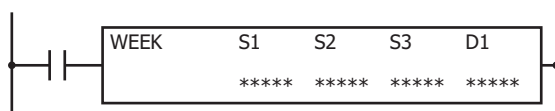


# 12: WEEK PROGRAMMER INSTRUCTIONS

## Introduction

The Week Programmer instructions turn output on or off at a specified interval.

## WEEK (Weekly Timer)

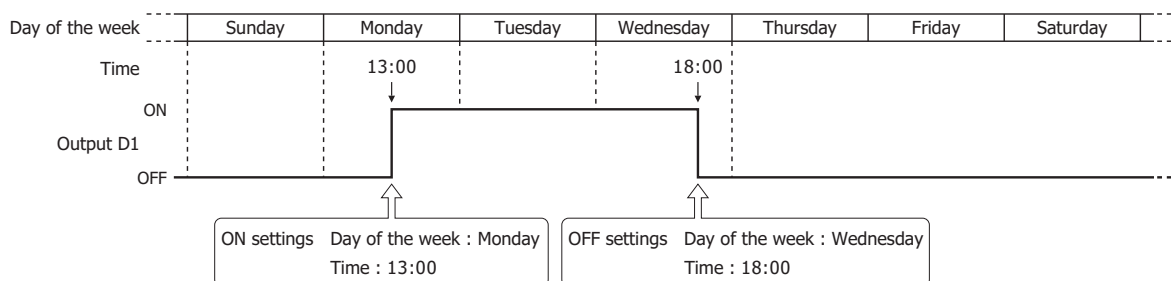


The WEEK instruction compares the specified day of the week, ON time, and OFF time with the current time and outputs that result.

When the input is on, the output specified by D1 is turned on when the day of the week and the time specified by the ON settings match the current day of the week and time.

The output is also turned off when the day of the week and the time specified by the OFF settings match the current day of the week and time.

For example, if the ON settings are Monday 13:00 and the OFF settings are Wednesday 18:00, output D1 turns on and off as follows.



### Notes:

- A maximum of 1 WEEK instruction can be used in a user program.
- Normally the output is only updated when the current time and the time for the ON/OFF settings matches, but when the WEEK instruction input changes from off to on, the output state at the current time is determined according to the ON/OFF settings and the output is turned on or off.
- When pulse output is enabled, output is turned on for one scan at the ON settings time. For pulse output, see "6. Pulse Output" on page 12-3 or "6. Pulse Output" on page 12-6.
- When the ON time is set to a value larger than 2359, the OFF time is set to a value larger than 2400, or the lower 2 digits of ON/OFF time is set to a value larger than 59, a user program execution error will occur.
- When the day of the week is not specified, a user program execution error will occur.
- The WEEK instruction cannot be used in an interrupt program. If used, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS. For details about the user program execution errors, see "User Program Execution Errors" on page 4-13.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Starting data register	—	—	—	—	—	—	▲	—	—
S2 (Source 2)	Initialization input	—	—	X	—	—	—	—	—	—
S3 (Source 3)	Number of parameter tabs	—	—	—	—	—	—	—	X	—
D1 (Destination 1)	Output port	—	X	▲	—	—	—	—	—	—

▲ Special data registers cannot be designated as S1. Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

### Settings

There are two methods to configure the day of the week and the time for the WEEK instruction. Specify the method on the **Device** tab with **Data register settings**.

- Configuring the day of the week and the time as fixed settings  
The day of the week and the time for the ON/OFF settings are uniquely determined. The day of the week and the time for the ON/OFF settings cannot be changed while the SmartAXIS is running. For details, see "To configure the day of the week and the time as fixed settings" on page 12-2.
- Configuring the day of the week and the time by specifying data registers  
The day of the week and the time for the ON/OFF settings are configured according to the values stored in the specified data registers. The day of the week and the time for the ON/OFF settings can be changed while the SmartAXIS is running. For details, see "To configure the days of the week and the time by specifying data registers" on page 12-5.

### To configure the day of the week and the time as fixed settings

The day of the week and the time for the ON/OFF settings are uniquely determined. The day of the week and the time for the ON/OFF settings cannot be changed while the SmartAXIS is running.

#### • Device tab

WEEK (Weekly Timer)

Devices | P1

1. Data register settings:

S1 (First DI) 2. S2 (Initialization Input) 3. D1 (Output) 5.

Tag Name: Device Address: Comment:

6. Pulse Output S3 (The number of parameter tabs): 4.

Preview: Week Day: ON OFF Sunday Monday Tuesday Wednesday Thursday Friday Saturday

Data Register Allocation OK Cancel

#### 1. Data register settings

This setting determines whether to configure the day of the week and the time as fixed settings or to indirectly specify them with data registers.

To configure the day of the week and the time as fixed settings, clear this check box.

##### ☐ Unselected check box

The day of the week and the time are fixed settings. The day of the week and the time are configured on the parameter tabs. The day of the week and the time cannot be changed while the SmartAXIS is running. For the settings, see "Parameter tab" on page 12-3.

**Note:** When this check box is selected, the settings for the day of the week and the time are indirectly specified with data registers.

Configure the day of the week and the time by using data registers. The day of the week and the time can be changed while the SmartAXIS is running. For directions specific to data registers, see "To configure the days of the week and the time by specifying data registers" on page 12-5.

#### 2. S1 (source 1): Starting data register

This setting is not configured when configuring the day of the week and the time as fixed settings.

#### 3. S2 (source 2): Initialization input

This setting is not configured when configuring the day of the week and the time as fixed settings.

#### 4. S3 (source 3): Number of parameter tabs

This setting configures the number of parameter tabs. When this value is increased or decreased, the number of parameter tabs displayed on the dialog box increases or decreases. 6 bytes of the user program region are used for each parameter tab. For the settings, see "Parameter tab" on page 12-3.

#### 5. D1 (destination 1): Output

This setting configures the output for the results when the configured day of the week and time and the current day of the week and time are compared.

Setting	Description
Tag Name	Specifies the tag name or the device address for each device.
Device Address	Shows the device address that corresponds to the tag name.
Comment	Shows the comment for the device address. This item can be edited.

#### 6. Pulse Output

This setting configures the operation for D1 (output). This setting is applied to all parameter tabs.

##### ☒ Selected check box

When the day of the week and the time configured in the ON settings matches the current day of the week and the time, the output is turned on for only one scan.

##### ☐ Unselected check box

The output is turned on and off according to the ON settings and the OFF settings.

#### • Parameter tab

This tab configures the ON/OFF settings for the output. A maximum of 20 parameter tabs can be configured for one WEEK instruction.

#### 1. ON settings

This section configures the day of the week and the time to turn on the output. The output is turned on at the specified time for the specified day of the week.

Setting	Description	Range
Day of the week	Specifies the days of the week.	—
ON time	Used to enter the time. Set the time in a range from 00:00 to 23:59.	Hour: 0 to 23 Minute: 0 to 59

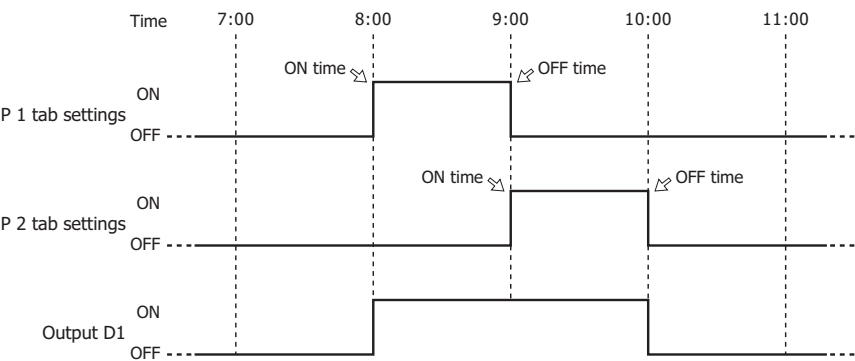
12: WEEK PROGRAMMER INSTRUCTIONS

2. OFF settings

This section configures the day of the week and the time to turn off the output. The output is turned off at the specified time for the specified day of the week.

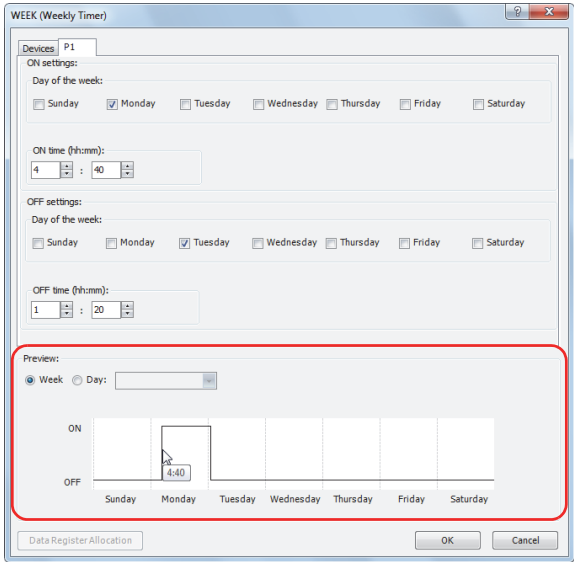
Setting	Description	Range
Day of the week	Specifies the days of the week.	—
OFF time	Used to enter the time. Set the time in a range from 00:00 to 24:00.	Hour: 0 to 24 Minute: 0 to 59

**Note:** When the time is duplicated in the settings on other tabs, the settings on the tab with the larger tab number are valid. For example, if **ON time** is 8:00 and **OFF time** is 9:00 on the **P 1** tab and **ON time** is 9:00 and **OFF time** is 10:00 on the **P 2** tab, the 9:00 setting is duplicated on the two tabs and **OFF time** for the **P 1** tab is disabled. In this situation, the output is on from 8:00 to 10:00.



If **ON time** is 9:00 and **OFF time** is 10:00 on the **P 1** tab and **ON time** is 8:00 and **OFF time** is 9:00 on the **P 2** tab, the 9:00 setting is duplicated on the two tabs and **ON time** for the **P 1** tab is disabled. In this situation, the output is on from 8:00 to 9:00.

• Preview



The preview shows the ON/OFF state for the output based on the settings configured on the parameter tabs as a time chart. The preview can be shown as a week or a day.

Setting	Description
Week	Select this radio button when showing the preview as a week.
Day	Select this radio button when showing the preview as a day.

### To configure the days of the week and the time by specifying data registers

The day of the week and the time for the ON/OFF settings are configured according to the values stored in the specified data registers. The day of the week and the time for the ON/OFF settings can be changed while the SmartAXIS is running.

When the day of the week or time in the ON/OFF settings is modified with the WEEK instruction input turned on, the modified data register values are reflected in the ladder program when the current date and time matches the day of the week or time in the ON/OFF settings.

#### • Device tab

#### 1. Data register settings

This setting selects whether to configure the day of the week and the time as fixed settings or to indirectly specify them with data registers. To configure the day of the week and the time by specifying data registers, select this check box.

##### ☒ Selected check box

The day of the week and the time settings are indirectly specified by data registers. Configure the day of the week and the time by using data registers. The day of the week and the time can be changed while the SmartAXIS is running. For allocating the data register region, see "Data Register Allocation" on page 12-7.

The data registers can be initialized with the days of the week and the times configured on the parameter tabs by turning on the initialization input. For initialization, see "3. S2 (source 2): Initialization input" on page 12-6.

**Note:** When this check box is not selected, the day of the week and the time are fixed settings. The day of the week and the time are configured on the parameter tabs. The day of the week and the time cannot be changed while the SmartAXIS is running. For fixed settings, see "To configure the day of the week and the time as fixed settings" on page 12-2.

#### 2. S1 (source 1): Starting data register

This setting specifies the start of the data register region to store the days of the week and time settings for the WEEK instruction.

This setting is only used when indirectly specifying the settings for the WEEK instruction with data registers.

Setting	Description
Tag Name	Specifies the tag name or the device address for the device.
Device Address	Shows the device address that corresponds to the tag name.
Used Data Registers	Shows the range of data registers used to store the settings. This item changes when the device address or the number of parameter tabs changes.
Comment	Shows the comment for the device address. This item can be edited.

For allocating the data register region, see "Parameter tab" on page 12-6.

### 3. S2 (source 2): Initialization input

This setting specifies the device to initialize the days of the week and the times stored in the data register region that starts from S1 (source 1).

The values configured on the parameter tabs are stored in the data registers by turning on the initialization input.

This setting is only used when indirectly specifying the settings for the WEEK instruction with data registers.

### 4. S3 (source 3): Number of parameter tabs

This setting configures the number of parameter tabs.

This setting is shared in common with "To configure the day of the week and the time as fixed settings". See "4. S3 (source 3): Number of parameter tabs" on page 12-3.

### 5. D1 (destination 1): Output

This setting configures the output for the results when the configured day of the week and time and the current day of the week and time are compared.

This setting is shared in common with "To configure the day of the week and the time as fixed settings". See "5. D1 (destination 1): Output" on page 12-3.

### 6. Pulse Output

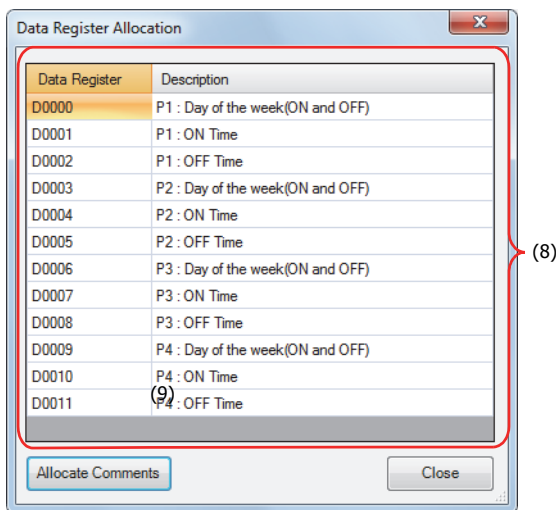
This setting configures the operation for D1 (output). This setting is applied to all parameter tabs and is shared in common with "To configure the day of the week and the time as fixed settings". See "6. Pulse Output" on page 12-3.

### 7. Data Register Allocation

Click this button to display the Data Register Allocation dialog box. As shown below, a table showing the data registers and their corresponding WEEK instruction settings is displayed on the dialog box (8). Click **Allocate Comments** (9) and you can configure the comments for the data registers that correspond to the names of the settings.

This button is only used when indirectly specifying the settings for the WEEK instruction with data registers.

#### • Data Register Allocation dialog box



#### • Parameter tab

This tab configures the ON/OFF settings for the output. A maximum of 20 parameter tabs can be configured for 1 WEEK instruction.

If indirectly specifying the settings for the WEEK instruction with data registers, the settings configured on the parameter tabs are stored in the data registers when the initialization input is turned on.

This setting is shared in common with "To configure the day of the week and the time as fixed settings". See "Parameter tab" on page 12-3.

#### • Preview

The preview shows the ON/OFF state for the output based on the settings configured on the parameter tabs as a time chart.

This function is shared in common with "To configure the day of the week and the time as fixed settings". See "Preview" on page 12-4.

## Data Register Allocation

If indirectly specifying the settings for the WEEK instruction with data registers, the settings are allocated to the data registers as follows.

Storage destination	Data size (word)	R (Read)/W (Write)	Setting	
Start address+0	1	R/W	P 1 tab	Day of the week
Start address+1	1	R/W		ON time
Start address+2	1	R/W		OFF time
Start address+3	1	R/W	P 2 tab	Day of the week
Start address+4	1	R/W		ON time
Start address+5	1	R/W		OFF time
•	•	•		•
•	•	•		•
•	•	•		•
Start address+57	1	R/W	P 20 tab	Day of the week
Start address+58	1	R/W		ON time
Start address+59	1	R/W		OFF time

### • Day of the week data register allocation

The day of the week for the ON settings and the day of the week for the OFF settings are allocated as bits in 1 data register as follows.

ON settings day of the week								OFF settings day of the week							
Bit 15	14	13	12	11	10	9	8	Bit 7	6	5	4	3	2	1	Bit 0
Reserved	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday	Sunday	Reserved	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday	Sunday

0: Disabled (check box not selected)  
1: Enabled (check box selected)

Data register (1 word)

### Example day of the week settings

[To configure the output to turn on Monday and to turn off Friday]

Monday is enabled in the ON settings, Friday is enabled in the OFF settings

ON settings								OFF settings							
Bit 15	14	13	12	11	10	9	8	Bit 7	6	5	4	3	2	1	Bit 0
	0	0	0	0	0	1	0		0	1	0	0	0	0	0
Reserved	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday	Sunday	Reserved	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday	Sunday

Day of the week setting (ON): 0000010

Day of the week setting (OFF): 0100000

The value of the data register is 1000100000 (binary) = 544 (decimal).

[To configure the output to turn on Monday and Thursday and to turn off Tuesday and Saturday]

Monday and Thursday are enabled in the ON settings, Tuesday and Saturday are enabled in the OFF settings

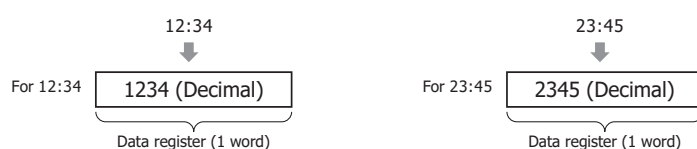
ON settings								OFF settings							
Bit 15	14	13	12	11	10	9	8	Bit 7	6	5	4	3	2	1	Bit 0
	0	0	1	0	0	1	0		1	0	0	0	1	0	0
Reserved	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday	Sunday	Reserved	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday	Sunday

Day of the week setting (ON): 0010010

Day of the week setting (OFF): 1000100

The value of the data register is 1001001000100 (binary) = 4676 (decimal).

The ON time and the OFF time are stored in the data register as follows.

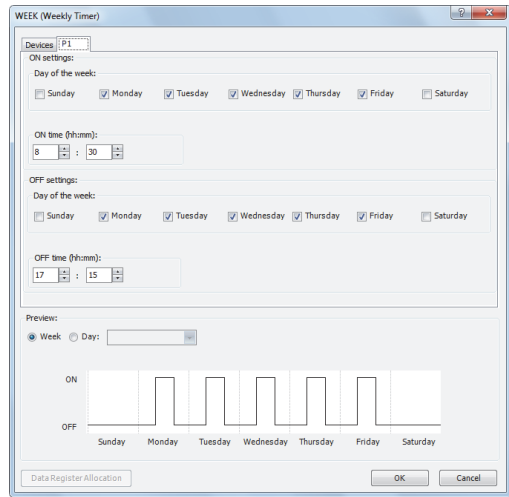


12: WEEK PROGRAMMER INSTRUCTIONS

Examples: WEEK

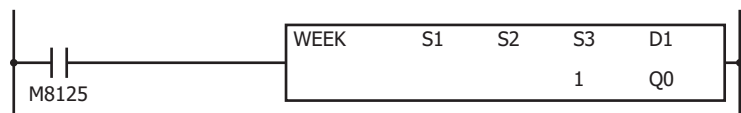
[To turn on output Q0 Monday to Friday each week from 8:30 to 17:15]

Parameter tab



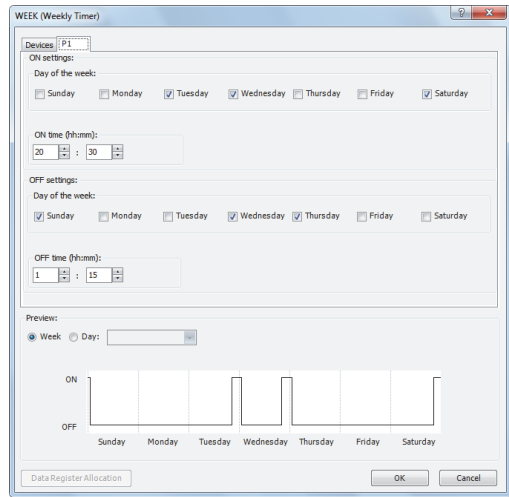
Configure the tab as shown above and set **D1** to Q0.

Ladder program



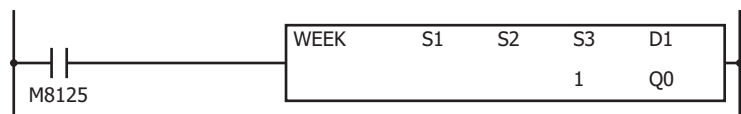
[To turn on output Q0 Tuesday, Wednesday, and Saturday each week from 20:30 to 1:15 the next day]

Parameter tab



Configure the tab as shown above and set **D1** to Q0.

Ladder program



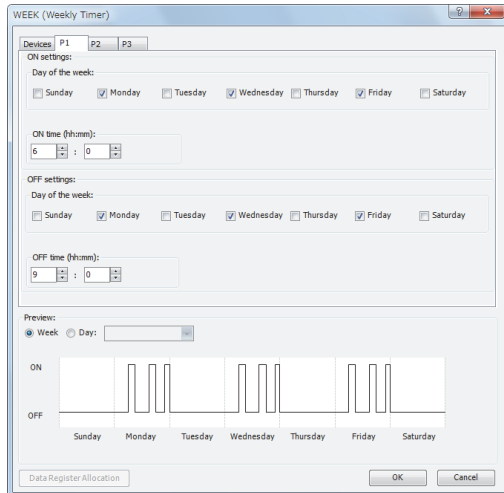


[To turn on output Q0 Monday, Wednesday, and Friday each week from 6:00 to 9:00, 15:00 to 18:00, and 22:00 to 0:00 the next day]

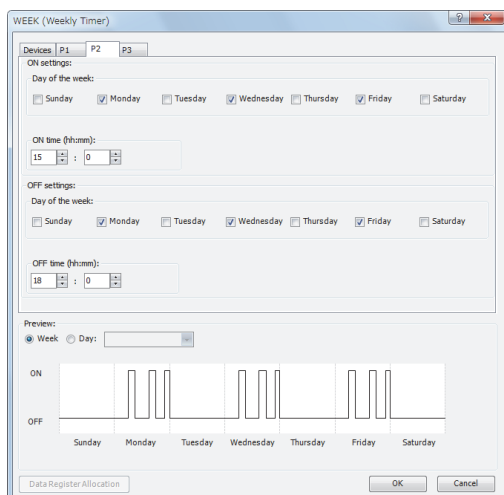
### Parameter tab

Configure the settings using three tabs.

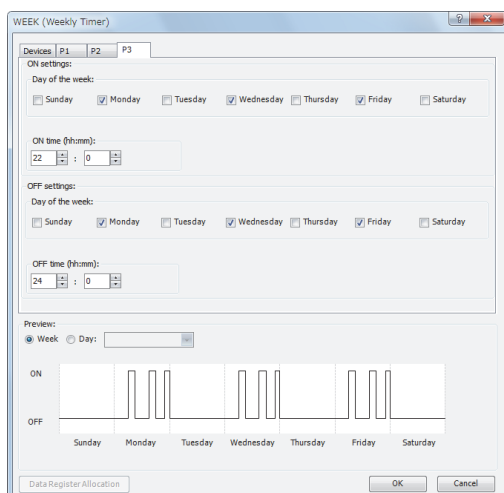
On P 1 tab, configure the output to turn on Monday, Wednesday, and Friday from 6:00 to 9:00.



On P 2 tab, configure the output to turn on Monday, Wednesday, and Friday from 15:00 to 18:00.



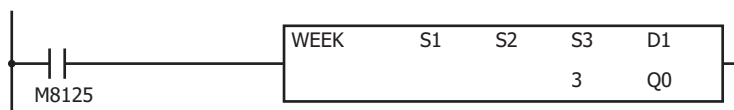
On P 3 tab, configure the output to turn on Monday, Wednesday, and Friday from 22:00 to 0:00 the next day.



Configure the tabs as shown above and set **D1** to Q0.

## 12: WEEK PROGRAMMER INSTRUCTIONS

## Ladder program



**[To indirectly specify the settings with data registers]**

This example describes turning on output Q0 Monday to Friday each week from 8:30 to 17:15 as an example.

Select the **Data register settings** check box and set S1 to D0 and S2 to M0.

### Parameter tab

WEEK (Weekly Timer)

Devices: **D1**

☒ Data register settings:

S1 (First DR): **D0000**

S2 (Initialization Input): **M0000**

D1 (Output): **M0100**

Tag Name:

Device Address: **D0000**

**D0000 - D0002**

Comment:

☐ Pulse Output

S3 (The number of parameter tabs): **1**

Preview:

☒ Week ☐ Day: **Sunday**

ON OFF

Sunday Monday Tuesday Wednesday Thursday Friday Saturday

Data Register Allocation

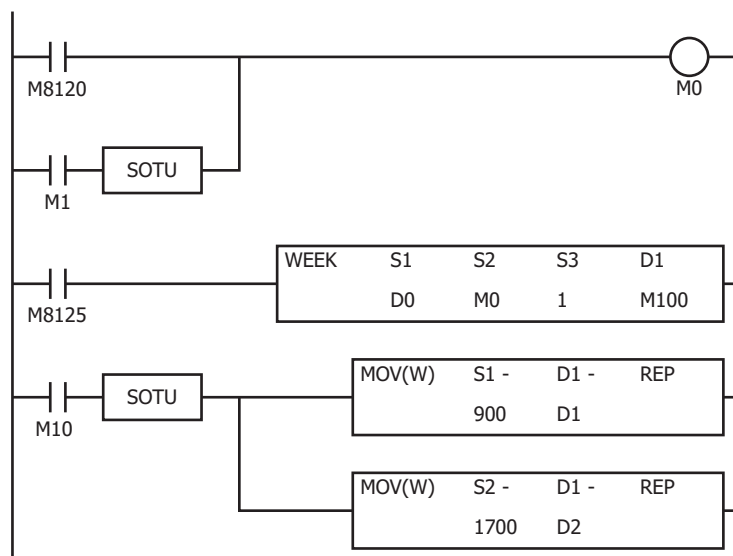
OK Cancel

### Data register allocation

The settings on the **P 1** tab are allocated to data registers D0 to D2 as shown in the table below. The settings configured on the parameter tab are stored in D0 to D2 by turning on initialization input S2.

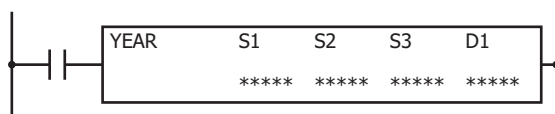
Data register	Setting	Initial setting
D0	P 1 tab	Day of the week setting 15934 (Monday to Friday, both ON settings and OFF settings)
D1		ON time 830
D2		OFF time 1715

## Ladder program



- The initialization input (M1) turns on with the first scan and the initial settings configured on the **P 1** tab are stored in D0 to D2.
- The WEEK instruction starts operating according to the values of data registers D0 to D2.
- When M10 turns on, the ON time (D1) changes to 9:00 and the OFF time (D2) changes to 17:00.
- When M1 turns on, all of the WEEK instruction settings (D0 to D2) return to the initial settings.

## YEAR (Yearly Timer)

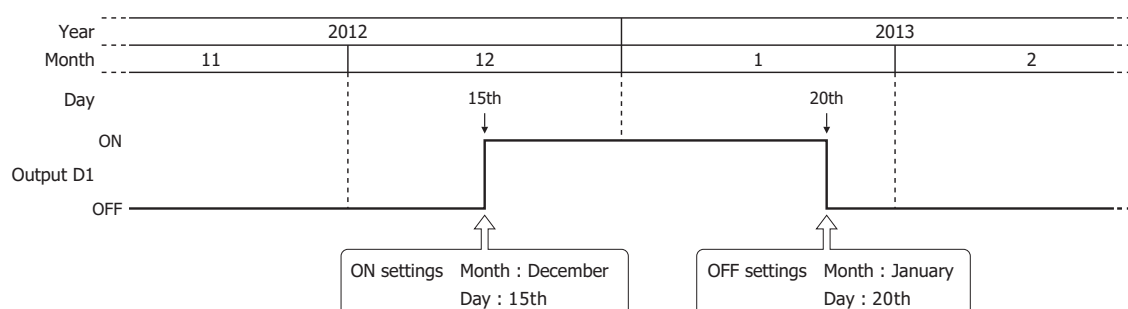


The YEAR instruction compares the specified date with the current date and outputs that result. With this instruction you can specify special dates within a one year period.

When the input is on, the output specified by D1 is turned on when the date specified by the ON settings matches the current date.

The output is turned off when the date specified by the OFF settings matches the current date.

When the ON settings are December 15, 2012 and the OFF settings are January 20, 2013, output D1 turns on and off as follows.



### Notes:

- A maximum of 1 YEAR instruction can be used in a user program.
- Normally the output is only updated when the current date and the date for the ON/OFF settings matches, but when the YEAR instruction input changes from off to on, the output state at the current date is determined according to the ON/OFF settings and the output is turned on or off.  
For details, see "Timing Chart when the Input Turns On during the Configured Interval" on page 12-20.
- When pulse output is enabled, output is turned on for one scan at the instant (0:00) the date changes to the ON date.  
When the YEAR instruction input changes from off to on, the output state at the current date is judged according to the ON/OFF settings, and the output is turned on for 1 scan only.  
For pulse output, see "6. Pulse Output" on page 12-13 or "6. Pulse Output" on page 12-17.
- When the year data is outside the range of 2000 to 2099, the month data is outside the range of 1 to 12, the day data is outside the range of 1 to 31, the week data is outside the range of 1 to 5, and the day of the week data is outside the range of 0 to 6, a user program execution error will occur.
- The YEAR instruction cannot be used in an interrupt program.  
If used, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS. For details about the user program execution errors, see "User Program Execution Errors" on page 4-13.
- When the yearly setting or monthly setting is enabled and a date that does not exist according to the month or year is set for the ON setting or the OFF setting, the output turns on or off on the first day of the next month.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Starting data register	—	—	—	—	—	—	▲	—	—
S2 (Source 2)	Initialization input	—	—	X	—	—	—	—	—	—
S3 (Source 3)	Number of parameter tabs	—	—	—	—	—	—	—	X	—
D1 (Destination 1)	Output port	—	X	▲	—	—	—	—	—	—

▲ Special data registers cannot be designated as S1. Internal relays M0 through M1277 can be designated as D1. Special internal relays cannot be designated as D1.

### Settings

There are two methods to configure dates for the YEAR instruction. Specify the method on the **Device** tab with **Data register settings**.

- Configure the dates as a fixed setting

The dates for the ON/OFF settings are uniquely determined. The dates for the ON/OFF settings cannot be changed while the SmartAXIS is running. For details, see "To configure the dates as a fixed setting" on page 12-12.

- Configuring the dates by specifying data registers

The dates for the ON/OFF settings are configured according to the values stored in the specified data registers. The dates for the ON/OFF settings can be changed while the SmartAXIS is running. For details, see "To configure the dates by specifying data registers" on page 12-16.

### To configure the dates as a fixed setting

The dates for the ON/OFF settings are uniquely determined. The dates for the ON/OFF settings cannot be changed while the SmartAXIS is running.

### • Device tab

The screenshot shows the 'YEAR (Yearly Timer)' configuration window with the 'Device' tab selected. The 'Data register settings' section is highlighted with numbered callouts: 1. 'Data register settings' checkbox, 2. 'S1 (First DR)' input field, 3. 'S2 (Initialization Input)' input field, 4. 'S3 (The number of parameter tabs)' dropdown menu, 5. 'D1 (Output)' input field, and 6. 'Pulse Output' checkbox. Below these is a 'Preview' section showing a calendar for the year 2012, with months January, February, and March visible. The calendar shows days of the week and dates. At the bottom are 'Data Register Allocation', 'OK', and 'Cancel' buttons.

### 1. Data register settings

This setting selects whether to configure YEAR instruction dates as fixed settings or to indirectly specify them with data registers.

To configure the dates as fixed settings, clear this check box.

#### ☐ Unselected check box

The dates are fixed settings.

The dates are configured on the parameter tabs. The dates cannot be changed while the SmartAXIS is running. For the settings, see "Parameter tab" on page 12-3.

**Note:** When this check box is selected, the settings for dates are indirectly specified with data registers. Configure the dates by using data registers. The dates can be changed while the SmartAXIS is running. For indirection specification with data registers, see "To configure the dates by specifying data registers" on page 12-16.

### 2. S1 (source 1): Starting data register

This setting is not configured when configuring the dates as fixed settings.

### 3. S2 (source 2): Initialization input

This setting is not configured when configuring the dates as fixed settings.

**4. S3 (source 3): Number of parameter tabs**

This setting configures the number of parameter tabs. When this value is increased or decreased, the number of parameter tabs displayed on the dialog box increases or decreases. 10 bytes of the user program region are used for each parameter tab. For the settings, see "Parameter tab" on page 12-13.

**5. D1 (destination 1): Output**

This setting configures the output for the results when the configured dates and the current date are compared.

Setting	Description
Tag Name	Specifies the tag name or the device address for each device.
Device Address	Shows the device address that corresponds to the tag name.
Comment	Shows the comment for the device address. This item can be edited.

**6. Pulse Output**

This setting configures the operation for D1 (output). This setting is applied to all parameter tabs.

☒ **Selected check box**

When the current date changes to the date in the ON settings, the output is turned on for only one scan.

☐ **Unselected check box**

The output is turned on and off according to the ON settings and the OFF settings.

**• Parameter tab**

This tab configures the settings for the output. A maximum of 20 parameter tabs can be configured for 1 YEAR instruction.

**1. Yearly**

When **Yearly** is selected, the **Month and Day settings** are valid every year.

At this time, you can configure whether or not to make the **Month and Day settings** valid yearly from a year until another year with **Year**.

**2. Monthly**

The settings for the selected tab are valid each month. At this time, **Month** is disabled.

## 12: WEEK PROGRAMMER INSTRUCTIONS

### 3. ON settings

This section configures the date to turn on the output. The output is turned on at 0:00 on the configured date.

Setting		Description	Range
Year		Specifies the year to turn on the output.	2000 to 2099
Month and Day setting	Month	Specifies the month to turn on the output.	1 to 12
	Day	Specifies the day to turn on the output.	1 to 31
	Day of the week	Specifies the day as the day of the week to turn on the output. Specify the week in the range of the 1st to the 5th (or the last) week and set the day of the week.	1 to 6

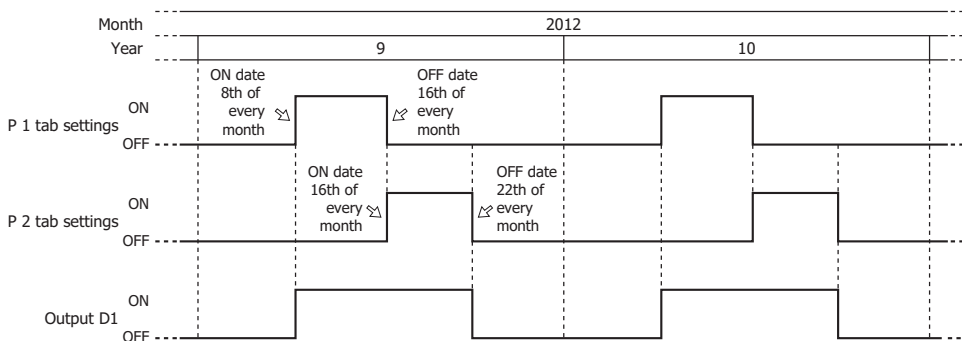
### 4. OFF settings

This section configures the date to turn off the output. The output is turned off at 0:00 on the configured date.

Setting		Description	Range
Year		Specifies the year to turn off the output.	2000 to 2099
Month and Day setting	Month	Specifies the month to turn off the output.	1 to 12
	Day	Specifies the day to turn off the output.	1 to 31
	Day of the week	Specifies the day as the day of the week to turn off the output. Select in the range of the 1st to the 5th (or the last) week and set the day of the week.	1 to 6
Specify ON duration		This item specifies whether or not to turn off the output after the number of specified days from when it was turned on. If this setting is enabled, the OFF settings are disabled. This setting can be set in a range from 1 day to 30 days.	1 to 30

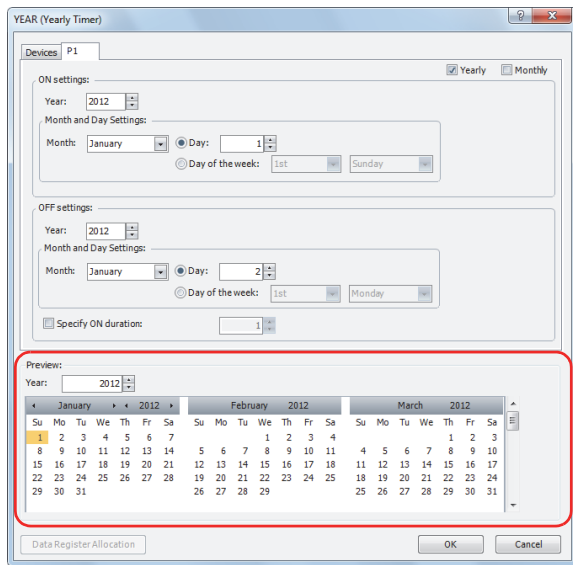
**Note:** When the date is duplicated in the settings on other tabs, the settings on the tab with the larger tab number are valid.

For example, if the ON date is the 8th of every month and the OFF date is the 16th of every month on the **P 1** tab and the ON date is the 16th of every month and the OFF date is the 22nd of every month on the **P 2** tab, the 16th of every month setting is duplicated on the two tabs and the ON settings for the **P 2** tab are valid. In this situation, the output is on from the 8th to the 22nd of every month.



If the ON date is the 16th of every month and the OFF date is the 22nd of every month on the **P 1** tab and the ON date is the 8th of every month and the OFF date is the 16th of every month on the **P 2** tab, the 16th of every month setting is duplicated on the two tabs and the ON settings for the **P 1** tab are disabled. In this situation, the output is on from the 8th to the 16th of every month.

## • Preview



The preview shows the ON/OFF state for the output based on the settings configured on the parameter tabs in a calendar. The dates that are set to ON are highlighted in orange. Three months are shown at one time.

Setting	Description
Year	Specifies the year to show in the preview.
Scrollbar	You can change the month shown in the preview by moving the scrollbar.

### To configure the dates by specifying data registers

The dates for the ON/OFF settings are configured according to the values stored in the specified data registers.

The dates for the ON/OFF settings can be changed while the SmartAXIS is running.

When the date in the ON/OFF settings is modified with the YEAR instruction input turned on, the modified data register values are reflected in the ladder program when the current date and time matches 0:00 on the date in the ON/OFF settings.

#### • Device tab

The screenshot shows the 'YEAR (Yearly Timer)' configuration window. It has a 'Devices' tab with 'P1' selected. The main area is divided into three sections: 'S1 (First DR)', 'S2 (Initialization Input)', and 'D1 (Output)'. Each section has a 'Tag Name' and 'Device Address' field. The 'Data register settings' checkbox is checked. Below these are three empty text boxes for comments. At the bottom, there is a 'Pulse Output' section with a 'S3 (The number of parameter tabs)' field. A 'Preview' section shows a calendar for 2012. At the very bottom, there is a 'Data Register Allocation' section and 'OK' and 'Cancel' buttons.

#### 1. Data register settings

This setting selects whether to configure YEAR instruction dates as fixed settings or to indirectly specify them with data registers.

To configure the dates by specifying data registers, select this check box.

##### ☒ Selected check box

The date settings are indirectly specified by data registers. Configure the dates by using data registers. The dates can be changed while the SmartAXIS is running. For allocating the data register region, see "Data Register Allocation" on page 12-18.

The data registers can be initialized with the days of the week and the times configured on the parameter tabs by turning on the initialization input. For initialization, see "3. S2 (source 2): Initialization input" on page 12-16.

**Note:** When this check box is not selected, the dates are fixed settings. The dates are configured on the parameter tabs. The dates cannot be changed while the SmartAXIS is running. For fixed settings, see "To configure the dates as a fixed setting" on page 12-12.

#### 2. S1 (source 1): Starting data register

This setting specifies the start of the data register region to store the dates for the YEAR instruction.

This setting is only used when indirectly specifying the dates with data registers.

Setting	Description
Tag Name	Specifies the tag name or the device address for the device.
Device Address	Shows the device address that corresponds to the tag name.
Used Data Registers	Shows the range of data registers used to store the settings. This item changes when the device address or the number of parameter tabs changes.
Comment	Shows the comment for the device address. This item can be edited.

For allocating the data register region, see "Data Register Allocation" on page 12-18.

#### 3. S2 (source 2): Initialization input

This setting specifies the device to initialize the dates stored in the data register region that starts from S1 (source 1).

The values configured on the parameter tabs are stored in the data registers by turning on the initialization input.

This setting is only used when indirectly specifying the settings for the YEAR instruction with data registers.



#### 4. S3 (source 3): Number of parameter tabs

This setting configures the number of parameter tabs.

This setting is shared in common with "To configure the dates as a fixed setting". See "4. S3 (source 3): Number of parameter tabs" on page 12-13.

#### 5. D1 (destination 1): Output

This setting configures the output for the results when the configured dates and the current date are compared.

This setting is shared in common with "To configure the dates as a fixed setting". See "5. D1 (destination 1): Output" on page 12-13.

#### 6. Pulse Output

This setting configures the operation for D1 (output). This setting is applied to all parameter tabs.

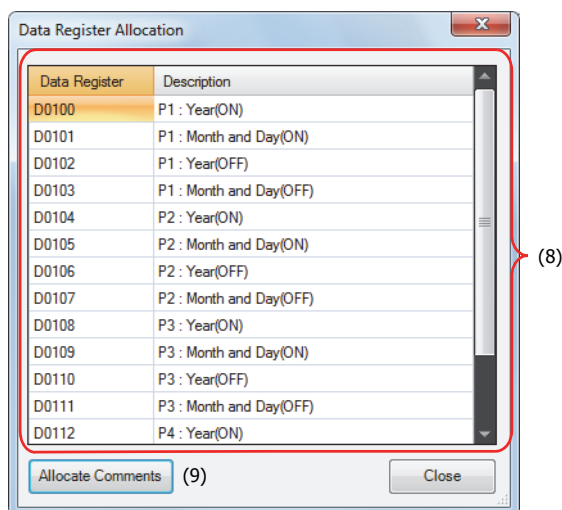
This setting is shared in common with "To configure the dates as a fixed setting". See "6. Pulse Output" on page 12-13.

#### 7. Data Register Allocation

Click this button to display the Data Register Allocation dialog box. As shown below, a table of the data registers and their corresponding YEAR instruction settings is displayed on the dialog box (8). Click **Allocate Comments** (9) and you can configure the comments for the data registers that correspond to the names of the settings.

This button is only used when indirectly specifying the settings for the YEAR instruction with data registers.

##### • Data Register Allocation dialog box



##### • Parameter tab

This tab configures the settings for the output. A maximum of 20 parameter tabs can be configured for 1 YEAR instruction.

If indirectly specifying the settings for the YEAR instruction with data registers, the settings configured on the parameter tabs are stored in the data registers when the initialization input is turned on.

This setting is shared in common with "To configure the dates as a fixed setting". See "Parameter tab" on page 12-13.

##### • Preview

The preview shows the ON/OFF state for the output based on the settings configured on the parameter tabs in a calendar.

This function is shared in common with "To configure the dates as a fixed setting". See "Preview" on page 12-15.

## 12: WEEK PROGRAMMER INSTRUCTIONS

### Data Register Allocation

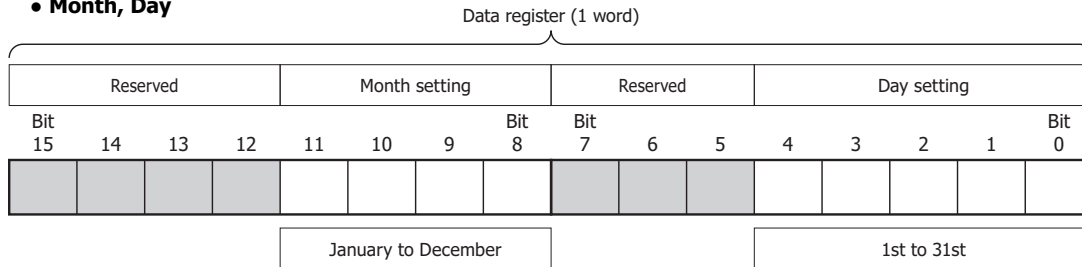
The settings configured on the parameter tabs are allocated to the data registers as follows.

Storage destination	Data size (word)	R (Read)/ W (Write)	Setting		
Start address+0	1	R/W	P 1 tab	ON setting	Year
Start address+1	1	R/W			Month, Day or Day of the week
Start address+2	1	R/W		OFF setting	Year
Start address+3	1	R/W			Month, Day or Day of the week (number of days when specified to remain on)
Start address+4	1	R/W	P 2 tab	ON setting	Year
Start address+5	1	R/W			Month, Day or Day of the week
Start address+6	1	R/W		OFF setting	Year
Start address+7	1	R/W			Month, Day or Day of the week (number of days when specified to remain on)
•	•	•			•
•	•	•			•
•	•	•			•
Start address+76	1	R/W	P 20 tab	ON setting	Year
Start address+77	1	R/W			Month, Day or Day of the week
Start address+78	1	R/W		OFF setting	Year
Start address+79	1	R/W			Month, Day or Day of the week (number of days when specified to remain on)

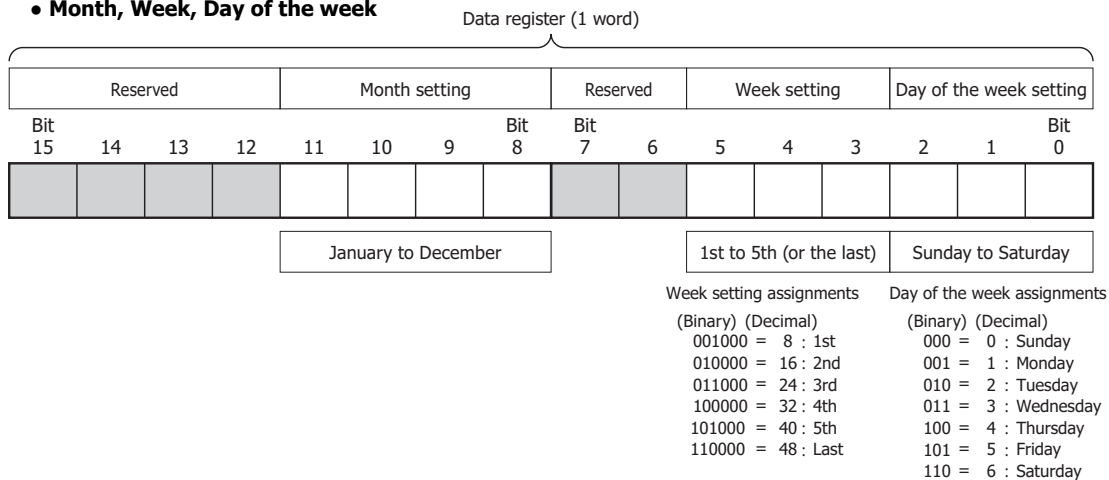
#### • Month, Day or Day of the week data register allocation

The Month, Day or Day of the week are allocated as bits in 1 data register as follows.

##### • Month, Day



##### • Month, Week, Day of the week



**Example day of the week settings****[When configured to turn on the output on January 1st]**

January 1st

Reserved				Month setting				Reserved				Day setting			
Bit 15	14	13	12	11	10	9	Bit 8	Bit 7	6	5	4	3	2	1	Bit 0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1

Month setting: 0001 = 1

Day setting: 00001 = 1

The value of the data register is 100000001 (binary) = 257 (decimal).

**[When configured to turn on the output on December 31st]**

December 31st

Reserved				Month setting				Reserved				Day setting			
Bit 15	14	13	12	11	10	9	Bit 8	Bit 7	6	5	4	3	2	1	Bit 0
0	0	0	0	1	1	0	0	0	0	0	1	1	1	1	1

Month setting: 1100 = 12

Day setting: 11111 = 31

The value of the data register is 110000011111 (binary) = 3103 (decimal).

**[When configured to turn on the output on the 1st Monday of January]**

1st Monday of January

Reserved				Month setting				Reserved	Week setting				Day of the week setting		
Bit 15	14	13	12	11	10	9	Bit 8	Bit 7	6	5	4	3	2	1	Bit 0
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1

Month setting: 0001 = 1 (January)

Week setting: 001 = 1 (1st)

Day of the week setting: 001 = 1 (Monday)

The value of the data register is 100001001 (binary) = 265 (decimal).

**[When configured to turn on the output on the 4th Thursday of June]**

4th Thursday of June

Reserved				Month setting				Reserved	Week setting				Day of the week setting		
Bit 15	14	13	12	11	10	9	Bit 8	Bit 7	6	5	4	3	2	1	Bit 0
0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0

Month setting: 0110 = 6 (June)

Week setting: 100 = 4 (4th)

Day of the week setting: 100 = 4 (Thursday)

The value of the data register is 11000100100 (binary) = 1572 (decimal).

Timing Chart when the Input Turns On during the Configured Interval

When the input turns on or off during the interval between the ON settings and the OFF settings, and when the input turns on or off after 0:00 on the date configured by the ON settings when pulse output is enabled, the timing chart is as follows.

• When pulse output is disabled

When the input is turned on, the current date and the ON and OFF settings are compared and the output turns on or off.

**Settings**

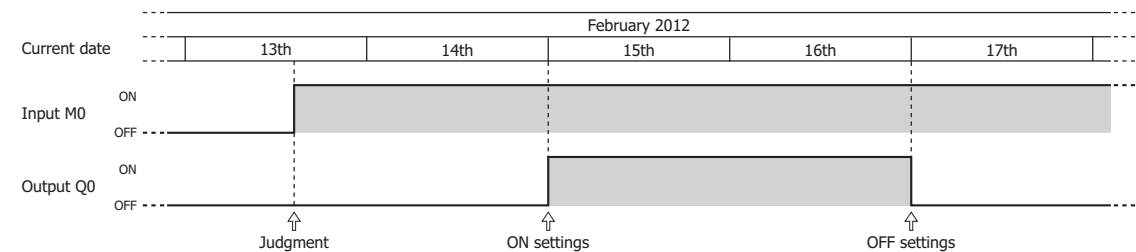
ON settings	February 15, 2012
OFF settings	February 17, 2012
Output port	Q0

**Ladder program**

```
graph LR
    M0[M0] --- Coil[Coil]
    subgraph CoilParameters [ ]
        direction TB
        YEAR[YEAR]
        S1[S1]
        S2[S2]
        S3[S3: 1]
        D1[D1]
        Q0[Q0]
    end
    Coil --- CoilParameters
```

[When the input is on before the day specified by the ON settings]

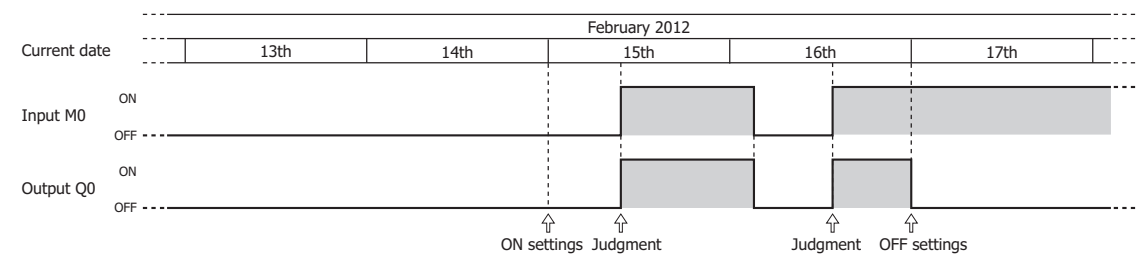
On February 13, 2012, when the input is turned on, the result of the current date compared with the ON and OFF settings is not within the ON and OFF settings (February 15 to February 17, 2012). Therefore, the output remains off.



[When the input is turned on or off during the interval between the ON and OFF settings]

On February 15, 2012, when the input is turned on, the result of the current date compared with the ON and OFF settings is within the ON and OFF settings (February 15 to February 17, 2012). Therefore, the output turns on. The output turns off when the input is turned off.

On February 16, 2012, when the input is turned on, the result of the current date compared with the ON and OFF settings is that the output is turned on.



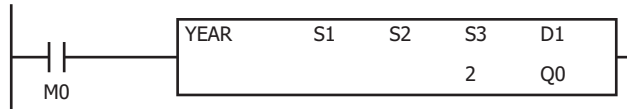
### • When pulse output is enabled

The input is determined to be on or off at 0:00 on the date of the ON settings and the output is turned on. The current date is not compared with the ON settings when the input is turned on.

#### Settings

P 1 tab ON settings	July 2, 2012
P 2 tab ON settings	July 4, 2012
Output port	Q0

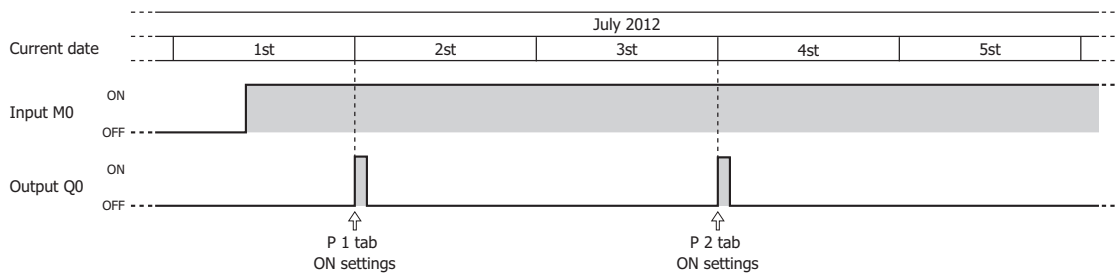
#### Ladder program



#### [When the input turns on before the day specified by the ON settings]

The result of the input being determined at 0:00 on July 2, 2012 is to turn on the output for one scan.

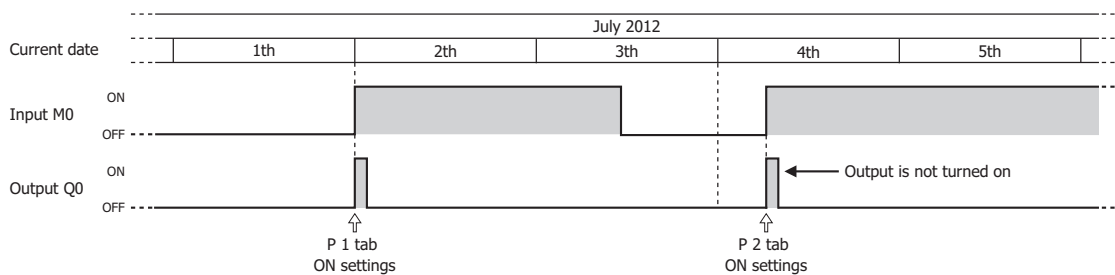
The result of the input being determined at 0:00 on July 4, 2012 is to turn on the output for one scan.



#### [When the input turns on exactly on the day specified by the ON settings]

When the input turns on at 0:00 on July 2, 2012, the output turns on for one scan.

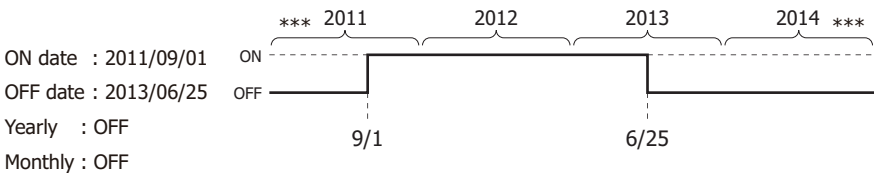
When the input turns on after 0:00 on July 4, 2012, the output turns on for one scan.



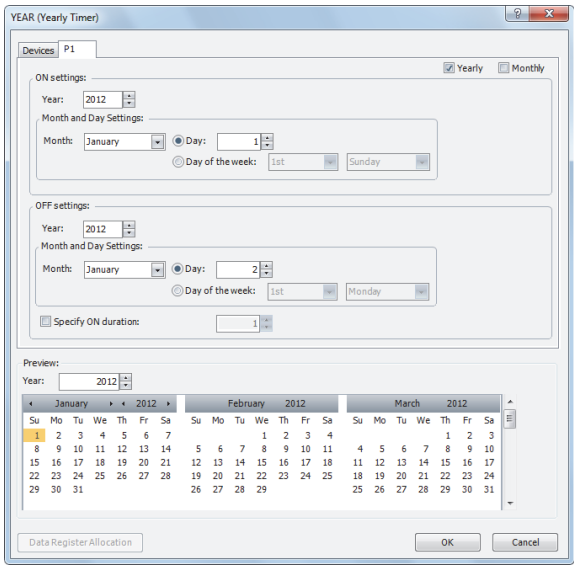
Examples: YEAR

- To configure the dates as fixed settings

[To turn on Q0 from 0:00 on September 1, 2011, to 0:00 on June 25, 2013]

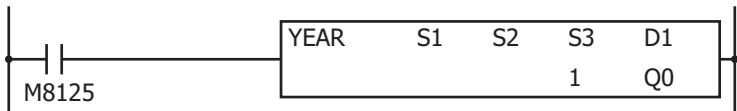


Parameter tab

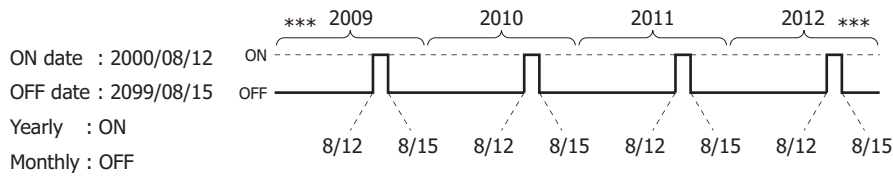


Configure the tab as shown above and set **D1** to Q0.

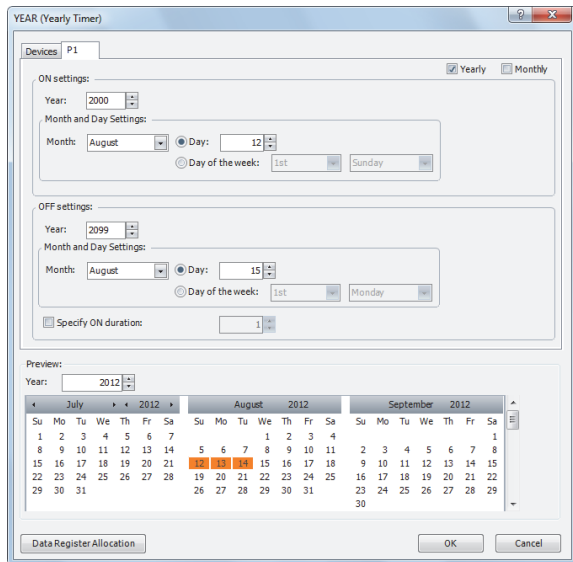
Ladder program



[To turn on output Q0 from 0:00 on August 12 to 0:00 on August 15 every year]

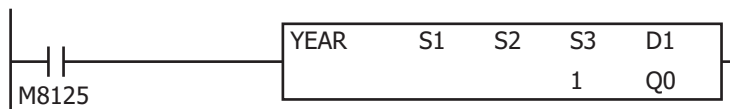


### Parameter tab



Configure the tab as shown above and set **D1** to Q0.

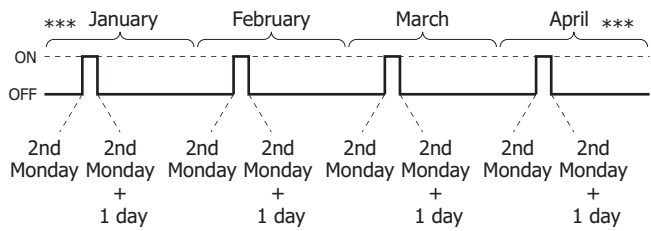
### Ladder program



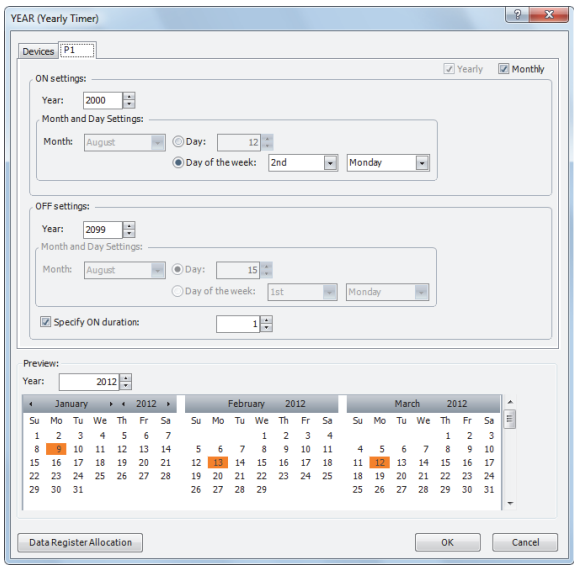
12: WEEK PROGRAMMER INSTRUCTIONS

[To turn on output Q0 only on the 2nd Monday of each month from 2000 to 2099]

ON date : 2000/\*\*/2nd Monday  
OFF date : 2099/\*\*/2nd Monday + 1 day  
Yearly : OFF  
Monthly : ON

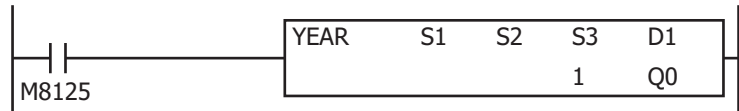


Parameter tab



Configure the tab as shown above and set **D1** to Q0.

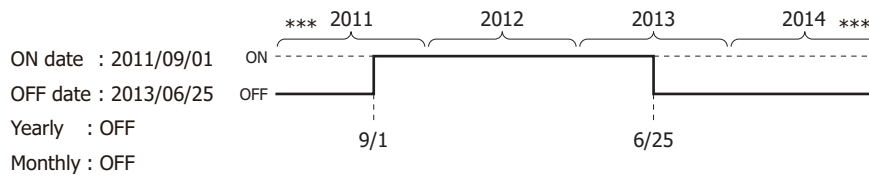
Ladder program





- To configure the dates by specifying data registers

[To turn on Q0 from 0:00 on September 1, 2011, to 0:00 on June 25, 2013]



Device tab

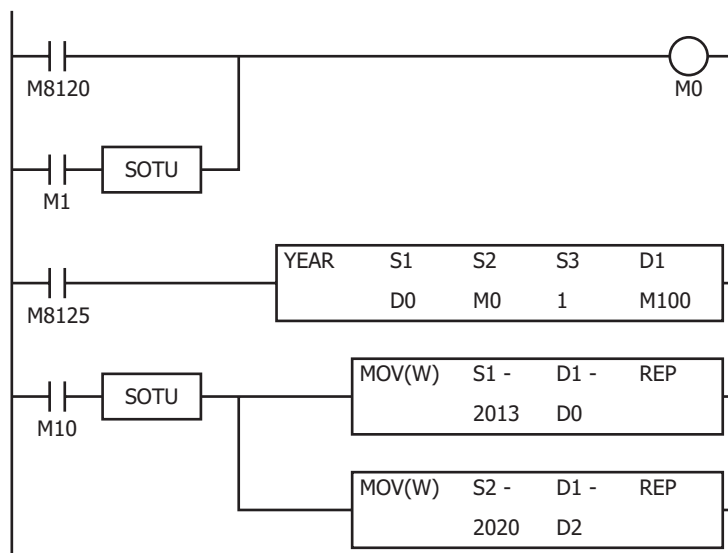
Parameter tab

### Data register allocation

The settings on the **P 1** tab are allocated to data registers D0 to D3 as shown in the table below. The settings configured on the **P 1** tab are stored in D0 to D3 by turning on initialization input S2.

Data register	Setting		Initial setting
D0	P 1 tab	ON settings	Year
D1			2011
D2	P 1 tab	OFF settings	Month, Day
D3			2305 (September 1st)
			Year
			2013
			Month, Day
			1561 (June 25th)

### Ladder program



- The initial settings configured on the **P 1** tab are stored in D0 to D3 at the first scan.
- The YEAR instruction starts operating according to the values of data registers D0 to D3.
- When M10 turns on, the ON settings year changes to 2013 (D0) and the OFF settings year changes to 2020 (D2).
- When M1 turns on, all of the YEAR instruction settings (D0 to D3) return to the initial settings.



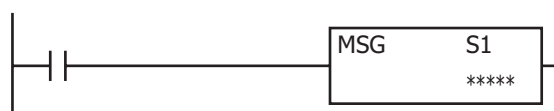
# 13: DISPLAY INSTRUCTIONS

## Introduction

The display instructions display the specified data such as text and device values on the SmartAXIS LCD.

## MSG (Message)

This instruction displays the specified data on the SmartAXIS LCD.



When the input turns on, a message is displayed on the LCD according to the content configured in the MSG instruction dialog box. The following types of data can be displayed.

### Device values can be displayed.

- Word device values can be displayed as numeric values according to the specified data type.  
For details, see "Insert Word Device" on page 13-4.
- Word device values can be displayed as bar graphs.  
For details, see "Insert Bar Graph" on page 13-7.
- Text can be displayed and switched according to the value of a bit device (input/output, internal relay, shift register, timer contact, or counter contact).  
For details, see "Insert Bit Device" on page 13-5.

### Arbitrary text can be displayed.

- The specified text can be displayed.  
For details, see "Edit MSG (Message) dialog box" on page 13-2.

### The text display effects can be configured.

- Text can be scrolled, blinked, or inverted.  
For details, see "Insert Text with Effect" on page 13-6.

### Date/time data can be displayed.

- The current date/time and the date/time when the input to the MSG instruction is turned on can be displayed on the LCD.  
For details, see "7. Special Data" on page 13-3.

### The language for displayed text can be selected from 9 languages.

- Text can be displayed in 9 languages using 4 types of character sets.  
For details, see "MSG Instruction Common Settings" on page 13-8.

### The text display settings can be configured.

- The scroll unit, scroll speed, and blinking speed can be configured.  
For details, see "MSG Instruction Common Settings" on page 13-8.

### Device values can be modified.

- Device values displayed with the MSG instruction can be modified on the SmartAXIS.  
For details, see "Modifying Device Values on the SmartAXIS" on page 13-16.

### Notes:

- A maximum of 50 MSG instructions can be entered in a user program. Only one MSG instruction message can be displayed on the LCD. S1 for the MSG instruction stores the MSG instruction priority. When the display conditions for multiple MSG instructions are satisfied, the messages are displayed according to the priority set for the MSG instruction.  
For MSG instruction priority, see "10. Priority" on page 13-3.
- The MSG instruction cannot be used during an interrupt program. If it is used during an interrupt program, a user program execution error occurs, the execution of the instruction is canceled, and the next instruction is executed.  
For user program execution errors, see "User Program Execution Errors" on page 4-13.

## Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
▲	▲	▲	▲	—

▲ For Pro only (The display instructions cannot be used on Lite.)

## Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Priority	—	—	—	—	—	—	—	X	—

\*1 Special internal relays cannot be used.

### Settings

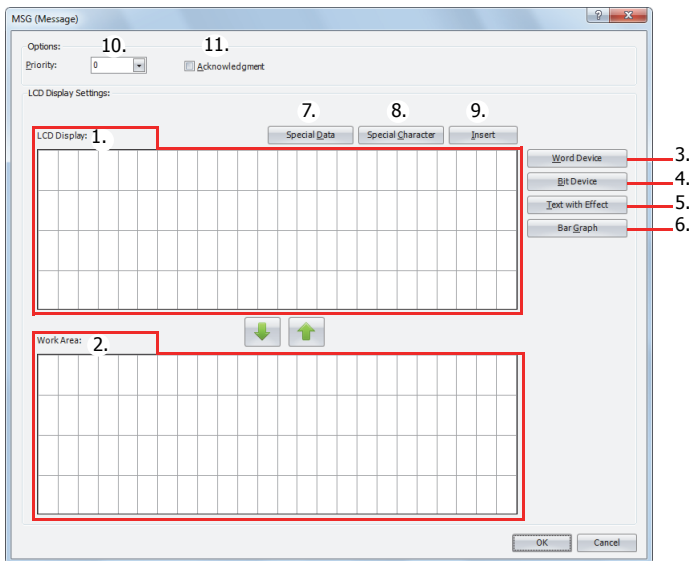
For the MSG instruction settings, there are settings for the individual MSG instruction and settings that are common to all the MSG instructions.

**Note:** Settings that are common to all the MSG instructions are modified in the Function Area Settings dialog box of WindLDR. For details, see "MSG Instruction Common Settings" on page 13-8.

#### ■MSG Instruction Individual Settings

The settings for the individual MSG instruction, such as texts and devices to display and the priority, can be configured in the Edit MSG instruction dialog box.

#### Edit MSG (Message) dialog box





##### 1. LCD Screen

The screen displayed on the SmartAXIS LCD when the MSG instruction is executed can be configured in this area. Enter characters at the cursor position using the keyboard. The character input method (insert/overwrite) is changed by clicking **Insert** (9).

**Note:** Text entered on the LCD Screen (1) with the keyboard cannot be set to scroll, blink, or invert. To scroll, blink, or invert the text, enter the text with **Text with Effects** (5) and configure the display options. For details on inserting text with effects, see "Insert Text with Effect" on page 13-6.

##### 2. Work Area

This area is used when editing the LCD screen. This area is for temporarily relocating text and device data.

Text and device data be moved between the LCD Screen and the Work Area with  or .

When the dialog is closed, the work area data is discarded.

##### 3. Word Device

Inserts a word device at the cursor position. The value of the specified word device is displayed on the SmartAXIS LCD. For details, see "Insert Word Device" on page 13-4.

##### 4. Bit Device

Inserts a bit device in the area specified by the cursor. Two different items of text can be switched between and displayed on the SmartAXIS LCD according to the value of the specified bit device. For details, see "Insert Bit Device" on page 13-5.

##### 5. Text with Effects

Inserts text in the area specified by the cursor. The specified text is displayed on the SmartAXIS LCD. For details, see "Insert Text with Effect" on page 13-6.

##### 6. Bar Graph

Inserts a bar graph in the area specified by the cursor. The value of the specified device is displayed as a bar graph on the SmartAXIS LCD. For details, see "Insert Bar Graph" on page 13-7.

## 7. Special Data

Special data such as the current date and time can be entered at the cursor position. Select the data to enter on the special data list window popped up when **Special Data** is pressed. Size of the area used on the LCD screen varies based on the selected special data.

Special data	Display		Occupied Area (Lines x columns)
	Display type	Display example (January 1, 2012, 13:30)	
Current date	YYYY/MM/DD	2012/01/01	1 x 10
Current time	HH:MM	13:30	1 x 5
Date the input to the MSG instruction is turned on	YYYY/MM/DD	2012/01/01	1 x 10
Time the input to the MSG instruction is turned on	HH:MM	13:30	1 x 5

## 8. Special Character

A special character can be entered at the cursor position. Select the character to enter on the special characters list window popped up when **Special Character** is pressed. The special characters that can be used are as follows.


Special characters list							
▼	▲	◀	▶	°C	°F	°	±



## 9. Insert/Overwrite

Selects insert or overwrite as the character input mode. Click this button to switch the input mode.

## 10. Priority

The priority of the MSG instruction can be configured between 0 to 49. 0 is the highest priority and 49 is the lowest priority.

- The same priority cannot be set for multiple MSG instructions.
- When inputs to two or more MSG instructions turns on, the message of the MSG instruction with the highest priority is displayed, out of all the MSG instructions with inputs that are on.
- When the MSG instruction input with the highest priority changes from on to off, the message for the MSG instruction with the next highest priority is displayed (the priority is checked when the input changes).
- If **Acknowledgement** (11) is enabled for the MSG instruction with the highest priority, even after the input changes from on to off, the same message is kept displayed. The message for the MSG instruction with the next highest priority is displayed when the SmartAXIS module  (OK) button is pressed.

**Note:** When you press the  (up) or  (down) button on the SmartAXIS, the messages are switched between the MSG instructions that have inputs that are on. Messages are also switched when the acknowledgement for the MSG instruction is enabled.

```
Motor 5
STOP AT
10:12
!! ACTION !!
```

Example: Message output  
in Priority 30



```
Motor 2
3000
hours
!! MAINTENANCE !!
```

Example: Message output  
in Priority 10

```
Running
2012/OCT/01/MON
09:00:12
```

Date and current time

## 11. Acknowledgment

When acknowledgement is enabled, the message is kept displayed even after the input to the MSG instruction is turned off. The message is closed when  (OK) button on the SmartAXIS is pressed, and then the message for the MSG instruction with the next highest priority is displayed, out of all the MSG instructions with inputs that are on at that time. If the input to the MSG instruction is on, the message is not closed even when the  (OK) button is pressed.

## 13: DISPLAY INSTRUCTIONS

### Insert Word Device

The value of the specified word device can be displayed on the SmartAXIS LCD.

1. Device: [Text Input] [Browse]

2. Data Type: [Word (W)]

Conversion Type: [Decimal]

3. Display Option: ☐ Blinking ☐ Invert

4. Occupied Area (Row x Column): 1 x 5

[OK] [Cancel]

#### 1. Device

Enter the device to display.

##### Valid Devices

<b>W (word)</b>	TC, TP, CC, CP, D
<b>I (integer)</b>	D
<b>D (double word)</b>	CC, CP, D
<b>L (long)</b>	D
<b>F (float)</b>	D

#### 2. Data Type and Conversion Type

Select the display type for the specified device. The size of the area used on the LCD screen varies based on the specified data type and conversion type.

Data Type	Conversion Type	Occupied Area	Example on LCD
W (word)	Decimal	5	65535
	Hexadecimal	4	FFFF
I (integer)	Decimal	6	-32768
D (double word)	Decimal	10	4294967295
	Hexadecimal	8	FFFFFFFF
L (long)	Decimal	11	-2147483648
F (float)	Decimal	13	-3.402823E+38

#### 3. Display Options

Configure the options to blink or invert the value of the specified device. For the blinking speed, see "MSG Instruction Common Settings" on page 13-8.

Display Options	Description
Blinking	Blinks the value of the specified device.
Invert	Inverts the display of the specified value.

#### 4. Occupied Area

Shows the size of the area to be used on the LCD screen (Lines: 1, columns: 4 to 13). The area is determined by the selected data type and conversion type.

### Insert Bit Device

Two different items of text can be switched between and displayed on the SmartAXIS LCD according to the value of the specified bit device (when on/when off).

#### 1. Device

Enter the device to display.

##### Valid Devices

I	Q	M	R	T	C	D
X	X	X	X	X	X	—

#### 2. Display Options

Configure the options to blink or invert the text. For the blinking speed, see "MSG Instruction Common Settings" on page 13-8.

Display Options	Description
Blinking	Blinks the specified text.
Invert	Inverts the display of the specified text.

#### 3. Occupied Area

Shows the size of the area to be used on the LCD screen (Lines: 1, columns: 1 to 24). The display size is determined by the selected range on the LCD screen area (or work area). If multiple lines are selected, the area at the top line in the selected range is used.

#### 4. ON Text

Enter the text to display when the specified device is on. Up to 24 single-byte characters can be entered. A space is also counted as one character.

#### 5. OFF Text

Enter the text to display when the specified device is off. Up to 24 single-byte characters can be entered. A space is also counted as one character.

#### 6. Special Character

Enters a special character at the cursor position. Select the character to enter on the special characters list window popped up when **Special Character** is pressed. For the special characters, see "8. Special Character" on page 13-3.

#### 7. Insert/Overwrite

Selects whether to insert or overwrite characters when entering new characters.

## 13: DISPLAY INSTRUCTIONS

### Insert Text with Effect

The specified text can be displayed on the SmartAXIS LCD.

[When scrolling is disabled]

The dialog box 'Insert Text with Effect' has the following settings: 'Display Option' with 'Scroll' unchecked, 'Blinking' unchecked, and 'Invert' unchecked; 'Occupied Area (Row x Column): 1 x 24'; 'Input Text Directly' selected; a 'Text' input field with a cursor at the first position; 'Special Character' and 'Insert' buttons; 'Select from Text Table' with a dropdown menu showing 'Select a text...'; and 'OK' and 'Cancel' buttons at the bottom.

[When scrolling is enabled]

The dialog box 'Insert Text with Effect' has the following settings: 'Display Option' with 'Scroll' checked, 'Blinking' unchecked, and 'Invert' unchecked; 'Occupied Area (Row x Column): 1 x 24'; 'Input Text Directly' selected; a 'Text' input field with a cursor at the first position; 'Special Character' and 'Insert' buttons; 'Select from Text Table' with a dropdown menu showing 'Select a text...'; and 'OK' and 'Cancel' buttons at the bottom.

#### 1. Display Options

Configure the options to scroll, blink, or invert the specified text. For the scroll unit, scroll speed, and blinking speed, see "MSG Instruction Common Settings" on page 13-8.

Display Options	Description
Scroll	Scrolls the specified text.
Blinking	Blinks the specified text.
Invert	Invert the display of the specified text.

#### 2. Occupied Area

Shows the size of the area to be used on the LCD screen (Lines: 1, columns: 1 to 24). The occupied area is determined by the selected range on the LCD screen area (or work area). If multiple lines are selected, the area at the top line in the selected range is used.

#### 3. Input Text Directly

Directly enter the characters to display. A space is also counted as one character. If scrolling is disabled, the message can be entered up to 24 single-byte characters. However, you cannot enter a number of characters that exceeds the occupied area. If scrolling is enabled, the message can be entered up to 48 single-byte characters.

#### 4. Select from Text Manager

Select the text to display from the text manager. This can be selected only when the scroll is enabled.

#### 5. Special Character

Enters a special character at the cursor position. Select the character to enter on the special characters list window popped up when **Special Character** is pressed. For the special characters, see "8. Special Character" on page 13-3.

#### 6. Insert/Overwrite

Selects whether to insert or overwrite characters when entering new characters.



## Insert Bar Graph

The value of the specified device can be displayed as a bar graph on the SmartAXIS LCD.

### 1. Device

Enter the device to display as a bar graph.

#### Valid Devices

<b>W (word)</b>	TC, TP, CC, CP, D
<b>I (integer)</b>	D
<b>D (double word)</b>	CC, CP, D
<b>L (long)</b>	D
<b>F (float)</b>	—

### 2. Data Type

Selects the data type for the specified device.

#### Data Type

<b>W (word)</b>	X
<b>I (integer)</b>	X
<b>D (double word)</b>	X
<b>L (long)</b>	X
<b>F (float)</b>	—

For data types, see "Data Types for Advanced Instructions" on page 4-10.

### 3. Maximum

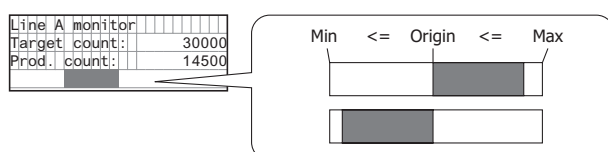
Enter the maximum value for the bar graph. If the device value is larger than the maximum value, the bar graph is displayed as the maximum value. The valid range varies based on the data type. See "Data Types for Advanced Instructions" on page 4-10.

### 4. Minimum

Enter the minimum value for the bar graph. If the device value is smaller than the minimum value, the bar graph is displayed as the minimum value. The valid range varies based on the data type. See "Data Types for Advanced Instructions" on page 4-10.

### 5. Origin

Enter the value to be the origin of the bar graph. If the device value is larger than the origin value, the bar graph is displayed on the right side of the origin value. If the device value is smaller than the origin value, the bar graph is displayed on the left side of the origin value. The valid range varies based on the data type. See "Data Types for Advanced Instructions" on page 4-10. The origin value must satisfy the condition of  $\text{Minimum} \leq \text{Origin} \leq \text{Maximum}$ .



### 6. Occupied Area

The occupied area is determined by the selected range on the LCD screen area (or work area). If multiple lines are selected, the area at the top line in the selected range is used (Lines: 1, columns: 1 to 24).

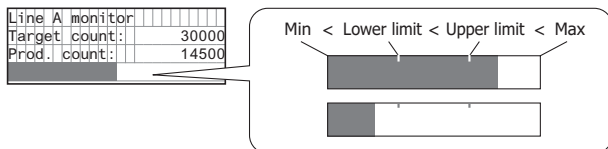
## 13: DISPLAY INSTRUCTIONS

### 7. Blinking Settings

Blink the bar graph when the value of the specified device exceeds the upper or lower limit.  
For the blinking speed, see "MSG Instruction Common Settings" on page 13-8.

Blinking Settings	Description
Upper limit	The bar graph is blinked when the value of the specified device is larger than the upper limit.
Lower limit	The bar graph is blinked when the value of the specified device is smaller than the lower limit.

Maximum, minimum, upper limit, and lower limit values must satisfy the following condition.

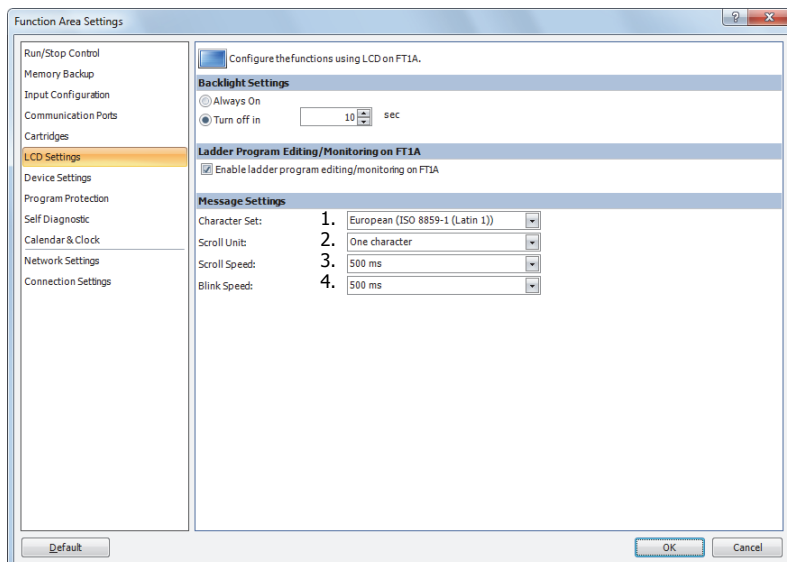


### ■MSG Instruction Common Settings

The common settings, character set, scroll unit, scroll speed, and blinking speed, for the message to display can be configured. The common settings are configured in the WindLDR Function Area Settings dialog box.

**Note:** The common settings for the MSG instructions are applicable for all MSG (message) instructions in the user program. For the MSG instruction individual settings, see "MSG Instruction Individual Settings" on page 13-2.

#### Function Area Settings dialog box



#### 1. Character Set

The character set used for the messages can be configured from the following.

Selection	Character Set	Languages usable in the MSG instruction
European	ISO-8859-1 (Latin 1)	Italian, English, Dutch, Spanish, German, French
Japanese	Shift-JIS	Japanese
Chinese	GB2312	Chinese (simplified)
Cyrillic	ANSI 1251	Russian

#### 2. Scroll Unit

The unit to scroll the texts can be configured.

1 character	Scrolls the text in 1 character units.
1 dot	Scrolls the text in 1 dot units.

#### 3. Scroll Speed

The speed to scroll the texts can be configured. The setting range is 500 to 1000 ms.

#### 4. Blinking Speed

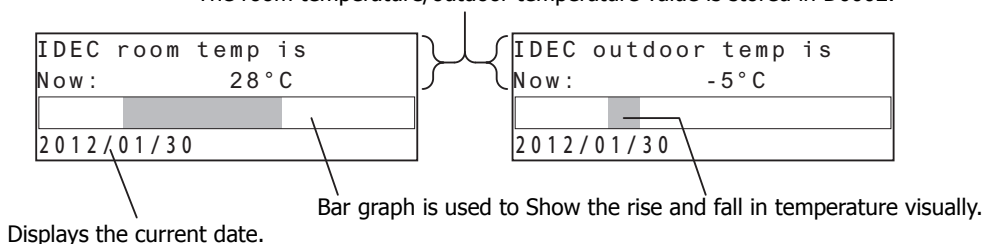
The speed to blink the texts can be configured. The setting range is 500 to 1000 ms.

**Note:** The MSG instruction character set can be configured irrespective of the SmartAXIS system menu language.

**MSG Instruction Configuration Example**

[Display the room temperature when M0000 is on and the outdoor temperature when M0000 is off]

The room temperature/outdoor temperature value is stored in D0002.

**■Settings**

Configure the following items.

1. Bit Device
2. Text with Effects
3. Word Device
4. Special Character
5. Bar Graph
6. Special Data

Setting items		Setting details
1. Bit Device	Device	M0000
	Display Options	All disabled (scroll, blink, invert)
	ON Text	IDEC room temp is:
	OFF Text	IDEC outdoor temp is:
2. Text with Effects	Text	Now:
	Display Options	All disabled (scroll, blink, invert)
3. Word Device	Device	D0002
	Data Type	I (integer)
	Conversion Type	Decimal
4. Special Character		°C
5. Bar Graph	Device	D0002
	Data Type	I (integer)
	Max	50
	Min	-20
	Origin	0
	Blinking Settings	Disabled
6. Special Data		Current date

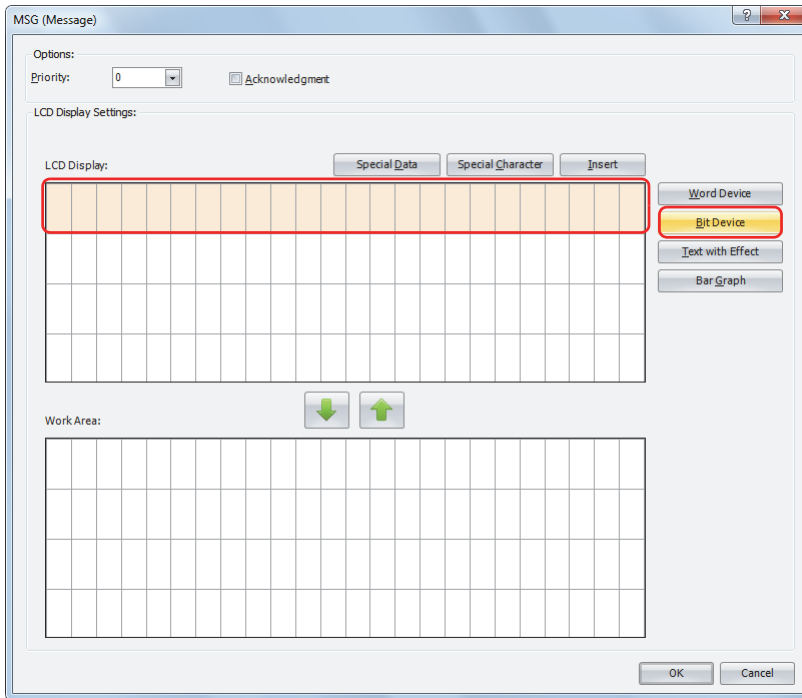
## 13: DISPLAY INSTRUCTIONS

### ■ Operation Procedure

1. On the WindLDR right-click menu, click **Advanced Instructions > Display > MSG (Message)**.
2. The MSG (Message) dialog box opens.

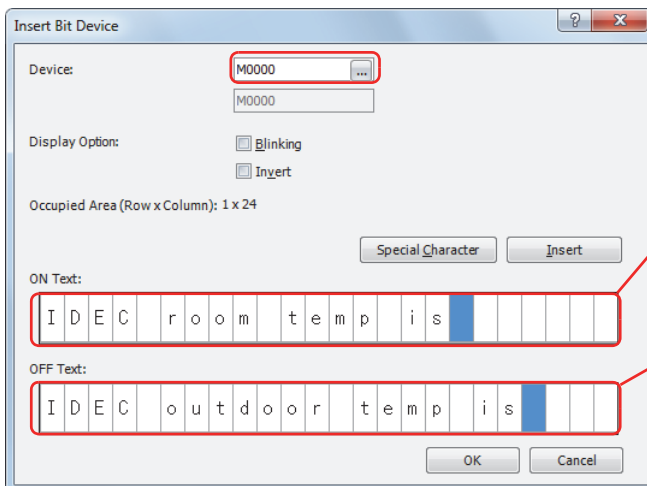
### Configuring the bit device

3. Select the area to insert the parameter and click **Bit Device**.

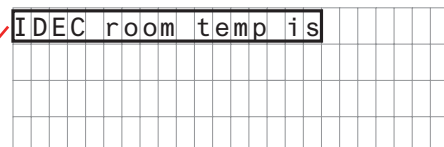


The Insert Bit Device dialog box opens.

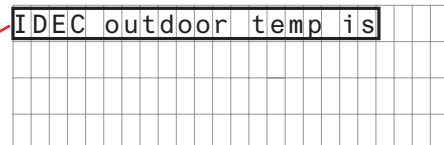
4. Configure the parameters so that the room temperature is displayed when M0000 is on and the outdoor temperature is displayed when M0000 is off. Set **Device** to "M0000". Using the keyboard, enter "IDEC room temp is:" as the ON Text and "IDEC outdoor temp is:" as the OFF Text. Under **Display Options**, disable all of the options.



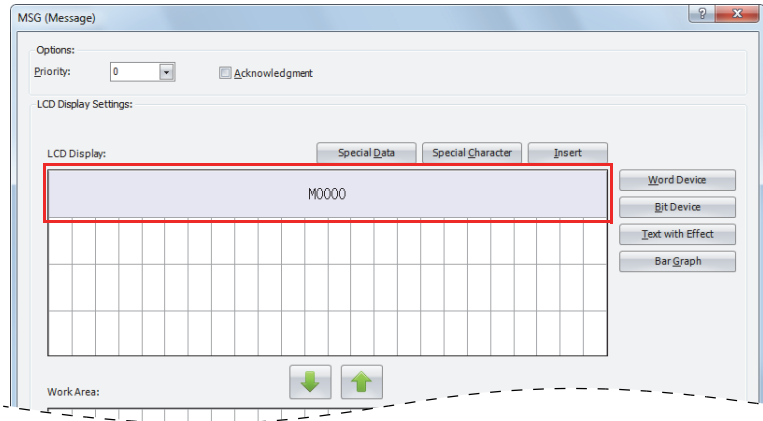
Displayed when M0000 is on



Displayed when M0000 is off

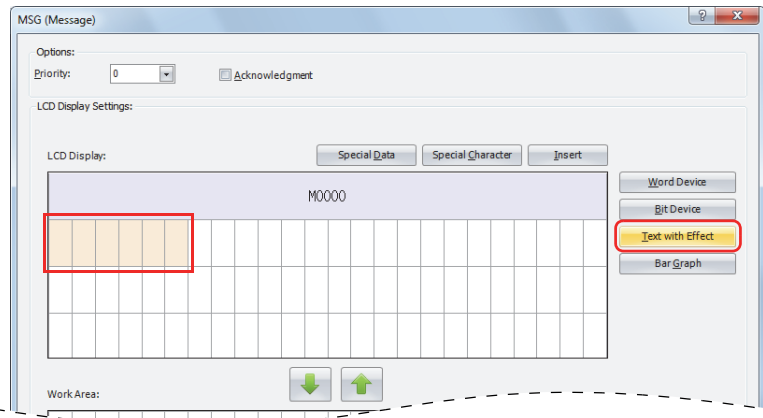


5. After the settings are configured, click **OK**.  
The configured content is displayed on the LCD screen area.



### Configuring the text with effect

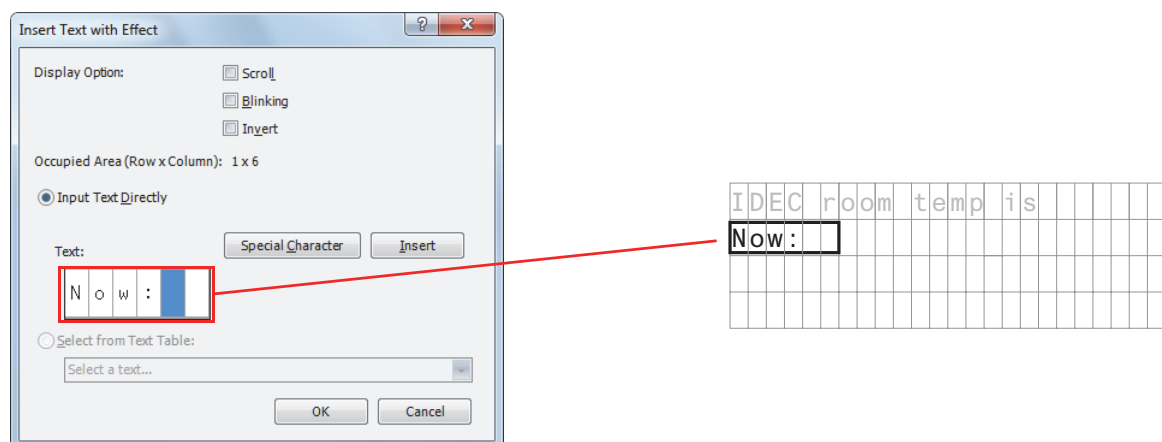
6. Select the six-column area from the start of the second line and click **Text with Effect**.



**Note:** The text can also be entered directly on the LCD screen area. In the sample above, move the cursor to the start of the second line and enter "Now:" with the keyboard. When you directly enter the text, proceed to "Configuring the word device" on page 13-12, step 9.

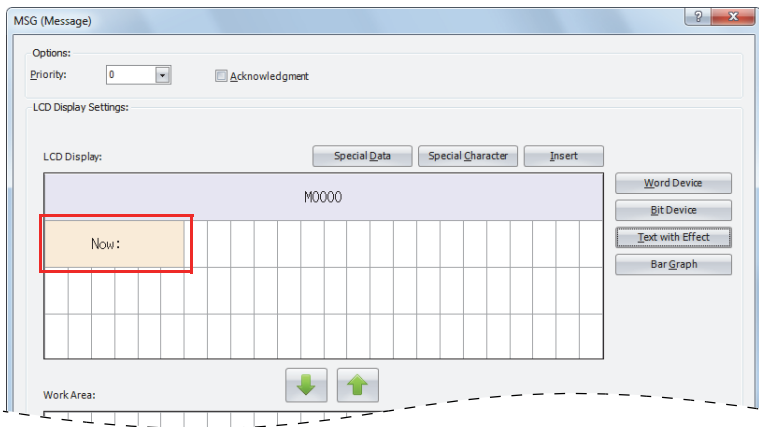
The Insert Text with Effect dialog box opens.

7. In Text, enter "Now:" with the keyboard. Under **Display Options**, disable all of the options.



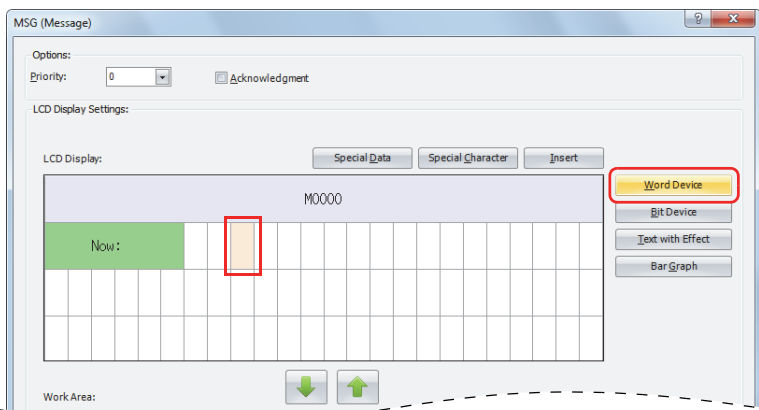
## 13: DISPLAY INSTRUCTIONS

8. After the settings are configured, click **OK**.  
The configured content is displayed on the LCD screen area.



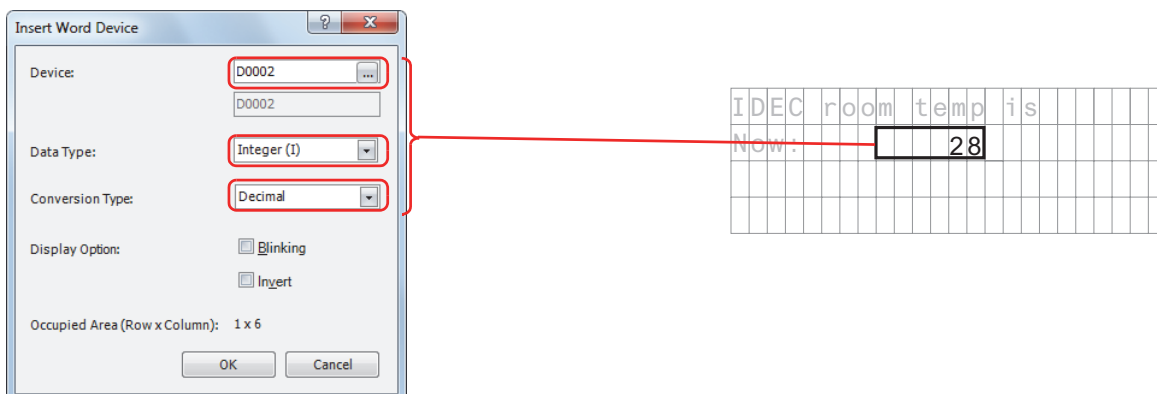
### Configuring the word device

9. Select the area at the ninth column on the second line and click **Word Device**.

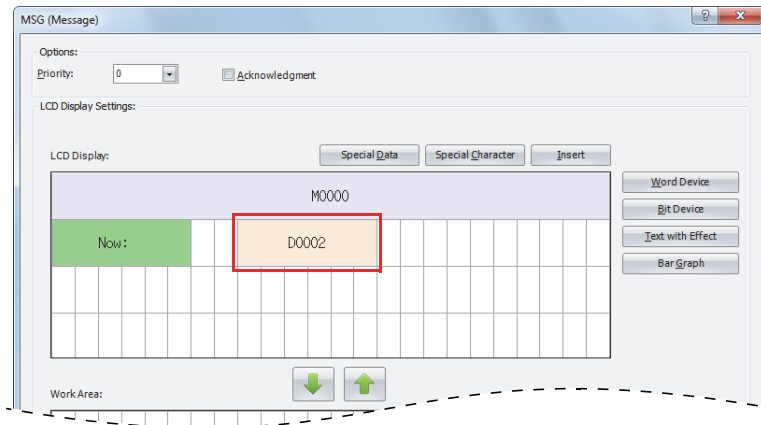


The Insert Word Device dialog box opens.

10. Set **Device** to "D0002", **Data Type** to **I (Integer)**, and **Conversion Type** to **Decimal**.  
Under **Display Options**, disable all of the options.

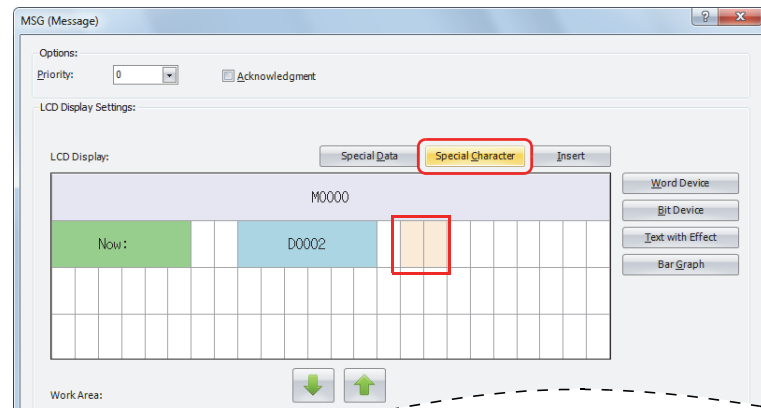


11. After the settings are configured, click **OK**.  
The configured content is displayed on the LCD screen area.



### Configuring the special character

12. Select the area at the 15th column on the second line and click **Special Character**.

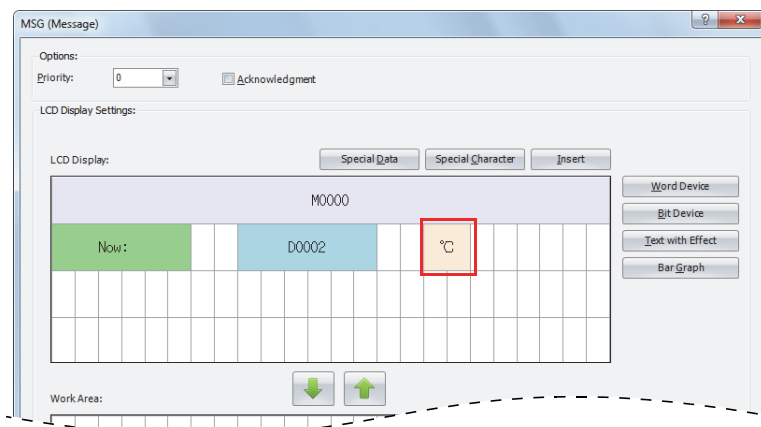


The **Special Characters List** window is popped up.

13. Double-click on **°C**.



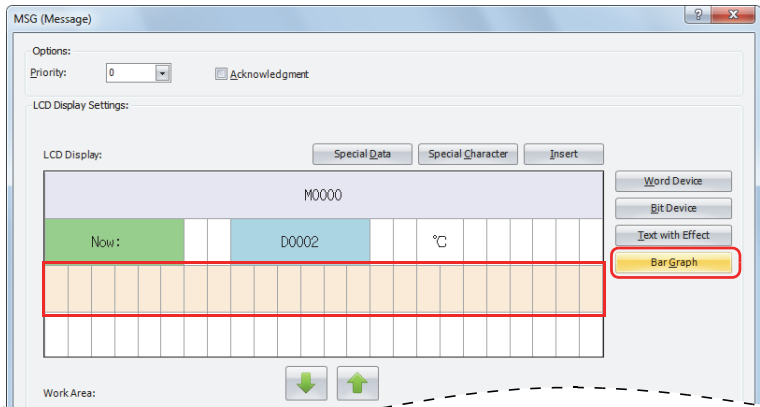
The configured content is displayed on the LCD screen area.



## 13: DISPLAY INSTRUCTIONS

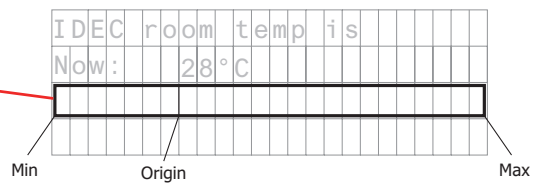
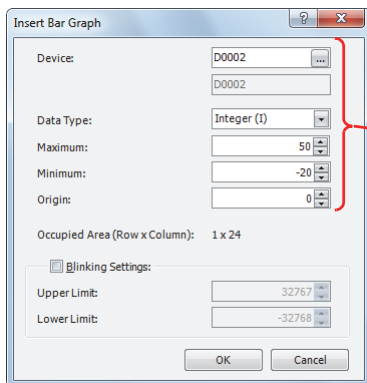
### Configuring the bar graph

14. Select the entire area on the third line and click **Bar Graph**.

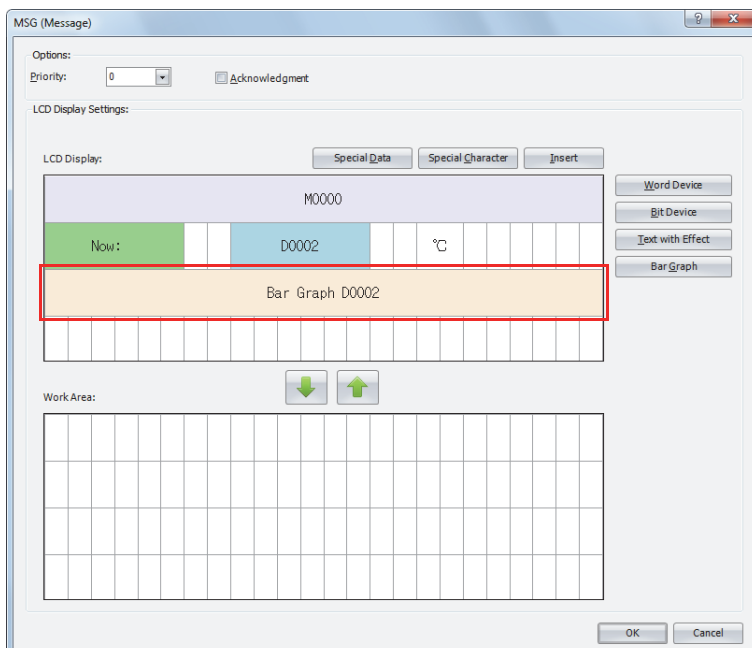


The Insert Bar Graph dialog box opens.

15. Set **Device** to "D0002", **Max** to "50", **Min** to "-20", and **Origin** to "0".  
Disable the blinking settings.



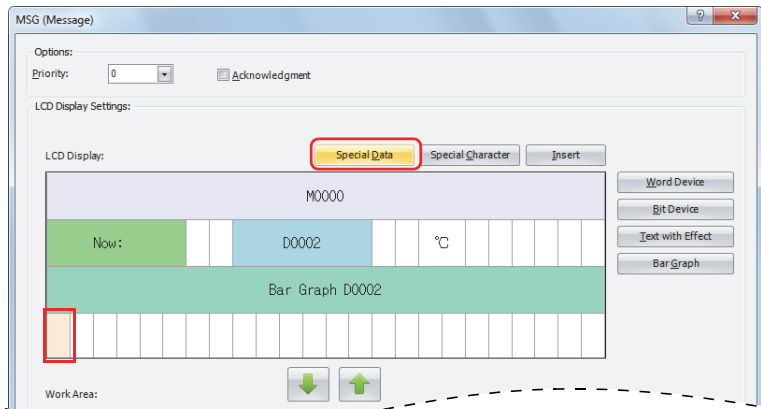
16. After the settings are configured, click **OK**.  
The configured content is displayed on the LCD screen area.





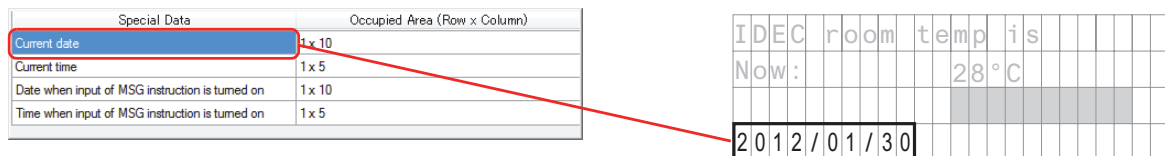
### Configuring the special data

17. Select the left edge of the fourth line and click **Special Data**.



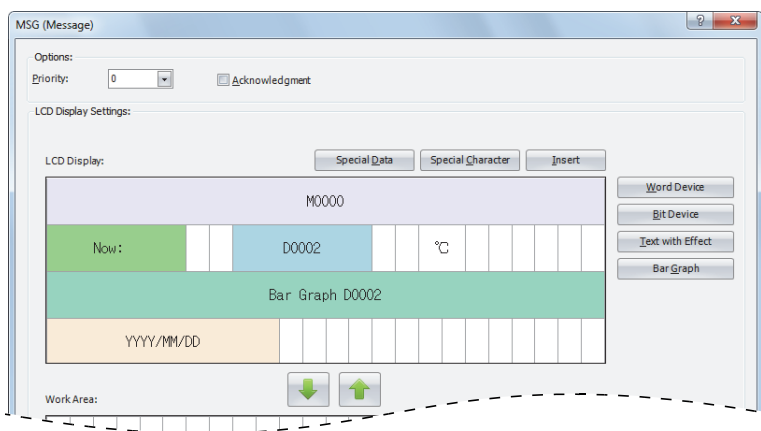
The **Special Data List** window is popped up.

18. Double-click on the **Current date**.



19. After the settings are configured, click **OK**.

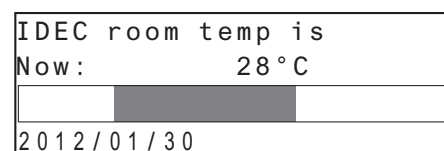
The configured content is displayed on the LCD screen area.



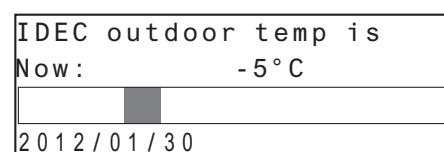
This concludes configuring the settings.

### LCD display

When M0000 is on, the room temperature stored in D0002 is displayed as the numeric value (°C) and bar graph.



When M0000 is off, the outdoor temperature stored in D0002 is displayed as the numeric value (°C) and bar graph.



### 13: DISPLAY INSTRUCTIONS

#### Modifying Device Values on the SmartAXIS


The values of the word devices displayed on the SmartAXIS LCD can be modified using the SmartAXIS operation buttons. The values cannot be modified when the SmartAXIS is stopped.

[To modify the value of word device CP0]

Line A monitor																
Plan:	CP0				Actual:	CC0										
Diff:	D0															
Bar Graph CC0																

When the SmartAXIS is running and the input to the MSG instruction is turned on, the following screen will be displayed on the LCD.



Line A monitor																
Plan:	60000				Actual:	20000										
Diff:	40000															

While the above message is displayed, press and hold the  (OK) button and the cursor is displayed on the devices that can be modified.


Line A monitor																
Plan:	60000				Actual:	20000										
Diff:	40000															

Move the cursor to the device you wish to edit using the  (up)  (down)  (left)  (right) buttons and press and hold the  (OK) button to change the device in the editable state.

Line A monitor																
Plan:	60000				Actual:	20000										
Diff:	40000															

Press the  (right) button to move the cursor to the fourth digit, and then use the  (up) button to modify the target value to "65000".

Line A monitor																
Plan:	65000				Actual:	20000										
Diff:	40000															

Press the  (OK) button to confirm the modifications.

Line A monitor																
Plan:	65000				Actual:	20000										
Diff:	40000															

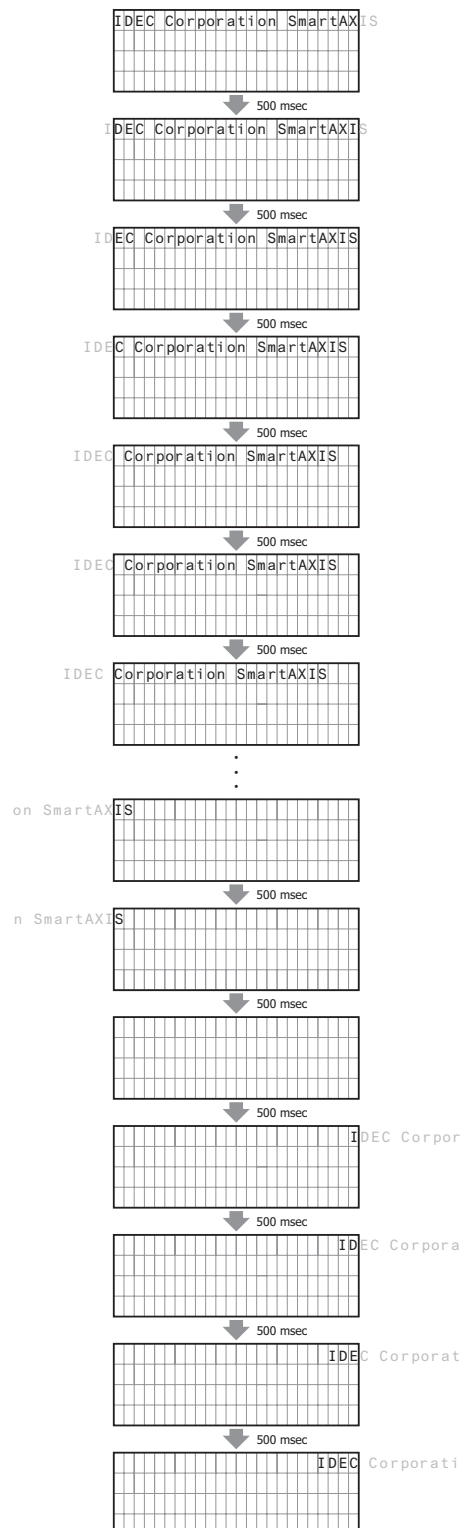
### Scrolling text example

[Character Set: European scroll speed: 500 ms]

When a text with effect is set to scroll, the text is displayed on the SmartAXIS LCD as follows.

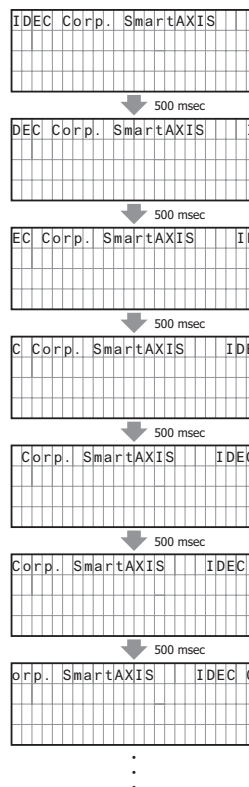
**When scrolling a text longer than the specified area on the LCD**

Text: "IDEC Corporation SmartAXIS"



**When scrolling a text shorter than or equal to the specified area on the LCD**

Text: "IDEC Corp. SmartAXIS"

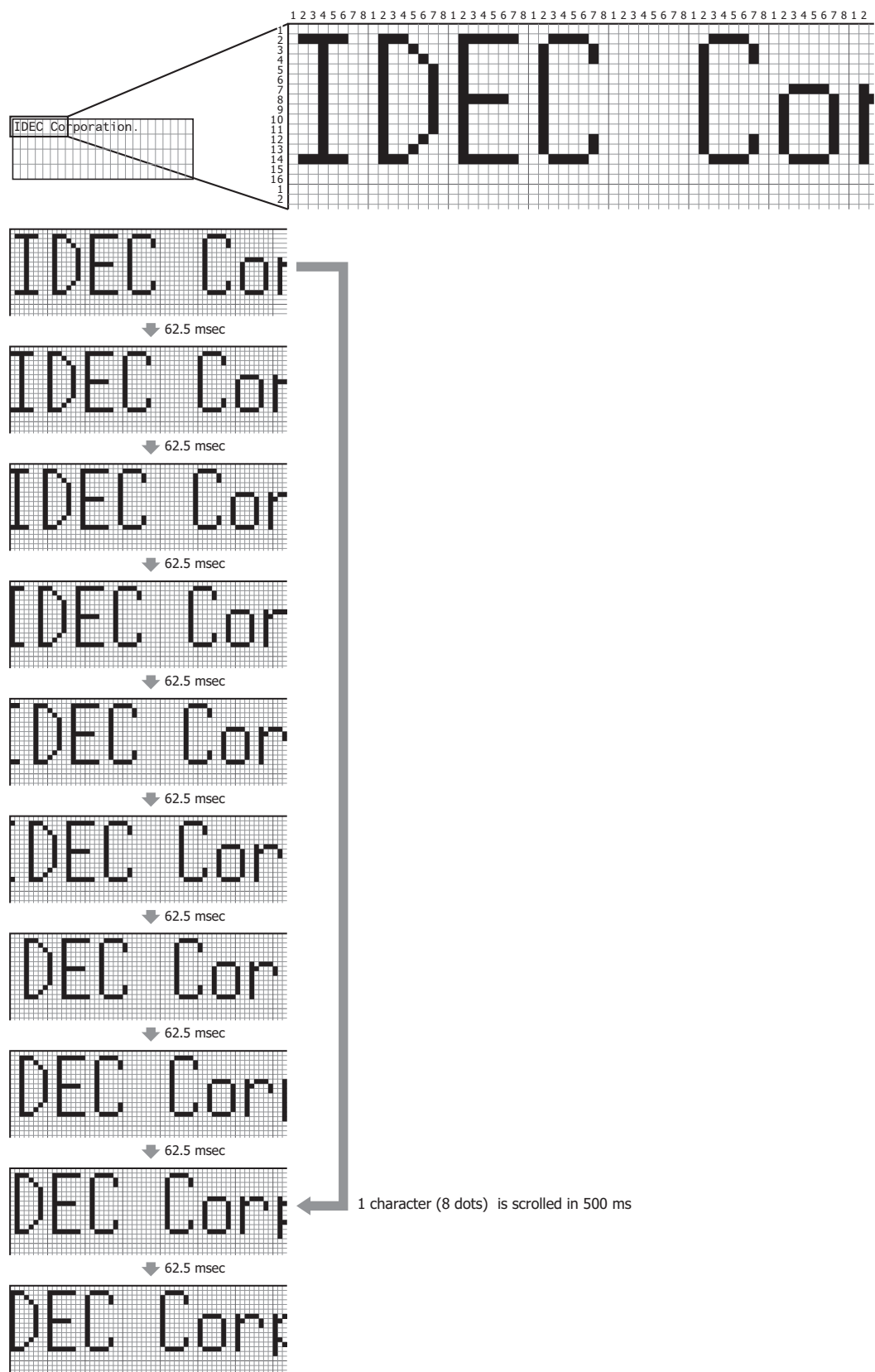


**13: DISPLAY INSTRUCTIONS**

[Character Set: European, Scroll speed: 500 ms, Scroll unit: 1-dot]

When a text with effect is set to scroll, the text is displayed on the LCD of the SmartAXIS as follows.

Text: "IDEC Corporation SmartAXIS"



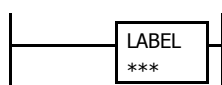
# 14: PROGRAM BRANCHING INSTRUCTIONS

## Introduction

The program branching instructions reduce execution time by making it possible to bypass portions of the program whenever certain conditions are not satisfied.

The basic program branching instructions are LABEL and L JMP, which are used to tag an address and jump to the address which has been tagged. Programming tools include "either/or" options between numerous portions of a program and the ability to call one of several subroutines which return execution to where the normal program stopped.

## LABEL (Label)



This is the label number, from 0 to 255, used at the program address where the execution of program instructions begins for a program branch.

An END instruction may be used to separate a tagged portion of the program from the main program. In this way, scan time is minimized by *not* executing the program branch unless input conditions are satisfied.

**Note:** A single label number cannot be used more than once.

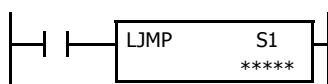
### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-40	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
Label number	Tag for L JMP and LCAL	—	—	—	—	—	—	—	0-255	—

## L JMP (Label Jump)



When input is on, jump to the address with label 0 through 255 assigned by S1.

When input is off, no jump takes place, and program execution proceeds with the next instruction.

The L JMP instruction is used as an "either/or" choice between two portions of a program. Program execution does *not* return to the instruction following the L JMP instruction, after the program branch.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Label number	—	—	—	—	—	—	X	0-255	—

For valid device address ranges, see "Device Addresses" on page 3-1.

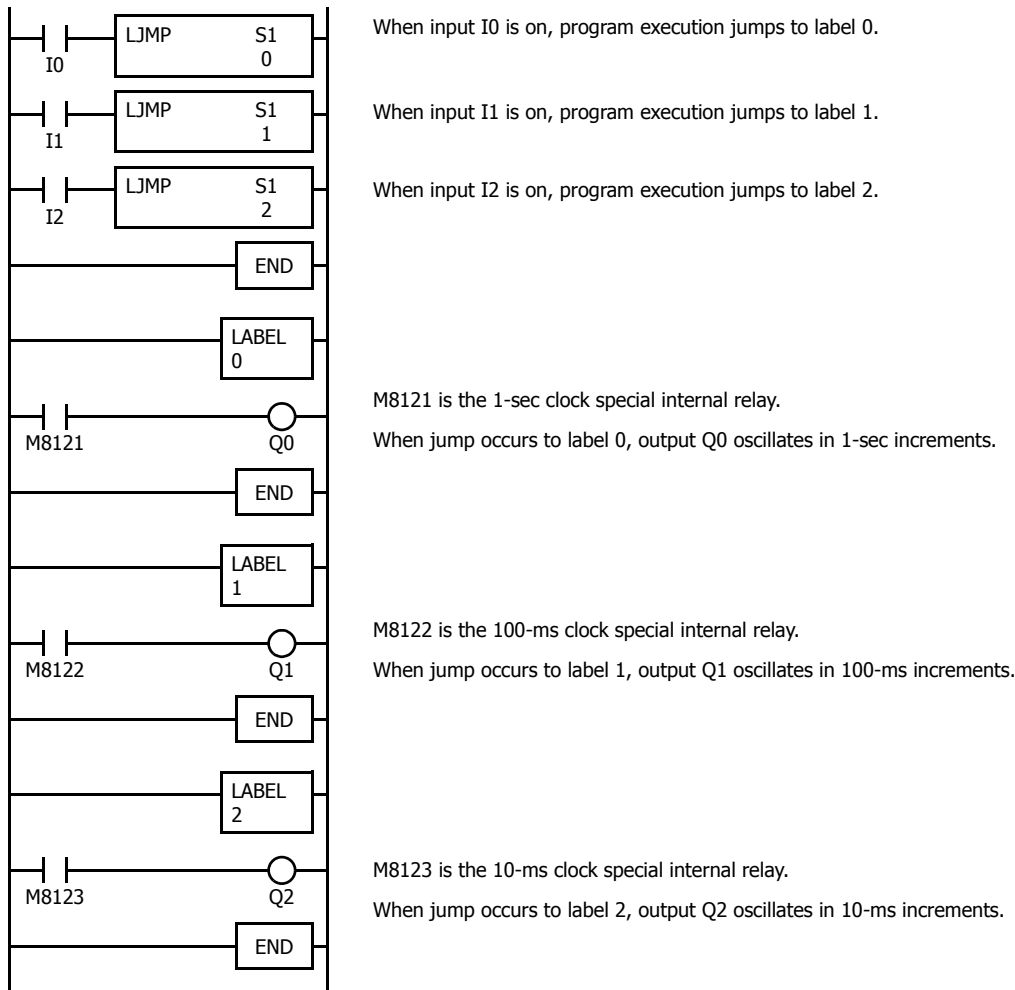
Since the L JMP instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

**Note:** Make sure that a LABEL instruction of the label number used for a L JMP instruction is programmed. When designating S1 using other than a constant, the value for the label is a variable. When using a variable for a label, make sure that all probable LABEL numbers are included in the user program. If a matching label does not exist, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS. For details about the user program execution errors, see "User Program Execution Errors" on page 4-13.

## 14: PROGRAM BRANCHING INSTRUCTIONS

### Example: Ljmp and LABEL

The following example demonstrates a program that jumps to three different portions of the program depending on the input.

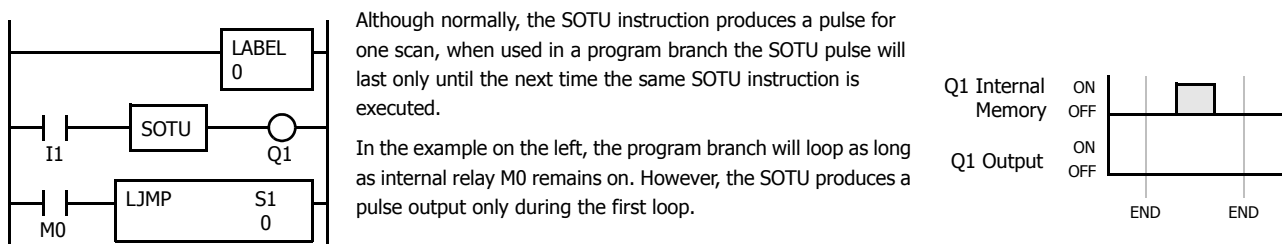


### Using the Timer Instruction with Program Branching

When the timer start input of the TML, TIM, TMH or TMS instruction is already on, countdown begins immediately at the location jumped to, starting with the timer current value. When using a program branch, it is important to make sure that timers are initialized when desired, after the jump. If it is necessary to initialize the timer instruction (set to the preset value) after the jump, the timer's start input should be kept off for one or more scan cycles before initialization. Otherwise, the timer input on will not be recognized.

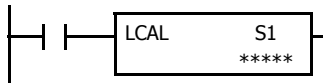
### Using the SOTU/SOTD Instructions with Program Branching

Check that pulse inputs of counters and shift registers, and inputs of single outputs (SOTU and SOTD) are maintained during the jump, if required. Hold the input off for one or more scan cycles after the jump for the rising or falling edge transition to be recognized.



Since the END instruction is not executed as long as M0 remains on, output Q1 is not turned on even if input I1 is on.

## LCAL (Label Call)



When input is on, the address with label 0 through 255 assigned by S1 is called. When input is off, no call takes place, and program execution proceeds with the next instruction.

The LCAL instruction calls a subroutine, and returns to the main program after the branch is executed. A LRET instruction (see below) must be placed at the end of a program branch which is called, so that normal program execution resumes by returning to the instruction following the LCAL instruction.

**Note:** The END instruction must be used to separate the main program from any subroutines called by the LCAL instruction.

A maximum of four LCAL instructions can be nested. When more than four LCAL instructions are nested, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

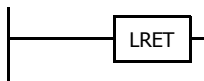
Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Label number to call	—	—	—	—	—	—	X	0-255	—

For valid device address ranges, see "Device Addresses" on page 3-1.

Since the LCAL instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

**Note:** Make sure that a LABEL instruction of the label number used for a LCAL instruction is programmed. When designating S1 using other than a constant, the value for the label is a variable. When using a variable for a label, make sure that all probable LABEL numbers are included in the user program. If a matching label does not exist, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

## LRET (Label Return)



This instruction is placed at the end of a subroutine called by the LCAL instruction. When the subroutine is completed, normal program execution resumes by returning to the instruction following the LCAL instruction.

The LRET must be placed at the end of the subroutine starting with a LABEL instruction. When the LRET is programmed at other places, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

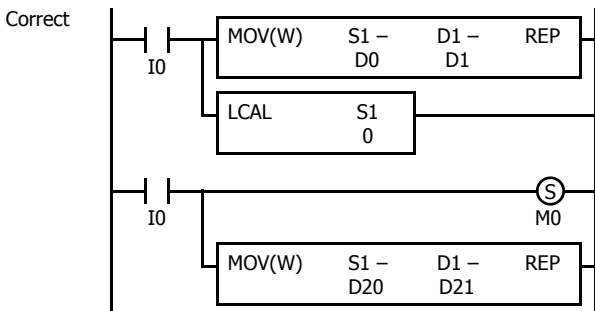
Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
—	—	—	—	—	—	—	—	—	—	—

## 14: PROGRAM BRANCHING INSTRUCTIONS

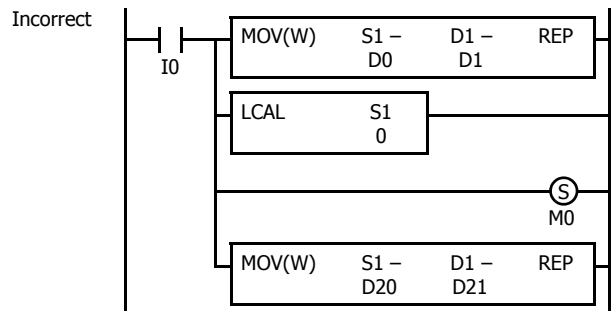
### Correct Structure for Calling Subroutine

When a LCAL instruction is executed, the remaining program instructions on the same rung may not be executed upon return, if input conditions are changed by the subroutine. After the LRET instruction of a subroutine, program execution begins with the instruction following the LCAL instruction, depending on current input condition.

When instructions following a LCAL instruction must be executed after the subroutine is called, make sure the subroutine does not change input conditions unfavorably. In addition, include subsequent instructions in a new ladder line, separated from the LCAL instruction.



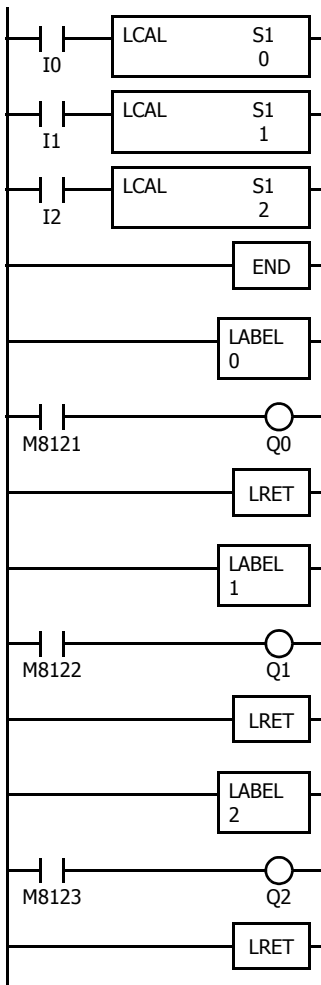
Separate the ladder line for each LCAL instruction.



I0 status may be changed by the subroutine upon return.

### Example: LCAL and LRET

The following example demonstrates a program that calls three different portions of program depending on the input. When the subroutine is complete, program execution returns to the instruction following the LCAL instruction.



When input I0 is on, program execution jumps to label 0.

When input I1 is on, program execution jumps to label 1.

When input I2 is on, program execution jumps to label 2.

M8121 is the 1-sec clock special internal relay.

When jump occurs to label 0, output Q0 oscillates in 1-sec increments.

Program execution returns to the address of input I1.

M8122 is the 100-ms clock special internal relay.

When jump occurs to label 1, output Q1 oscillates in 100-ms increments.

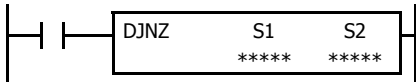
Program execution returns to the address of input I2.

M8123 is the 10-ms clock special internal relay.

When jump occurs to label 2, output Q2 oscillates in 10-ms increments.

Program execution returns to the address of END.



**DJNZ (Decrement Jump Non-zero)**

When input is on, the value stored in the data register assigned by S1 is decremented by one and is checked. If the resultant value is not 0, program execution jumps to address with label 0 through 255 assigned by S2. If the decrement results in 0, no jump takes place, and program execution proceeds with the next instruction.

**Applicable SmartAXIS**

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

**Valid Devices**

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Decrement value	—	—	—	—	—	—	X	—	—
S2 (Source 2)	Label number to jump to	—	—	—	—	—	—	X	0-255	—

For valid device address ranges, see "Device Addresses" on page 3-1.

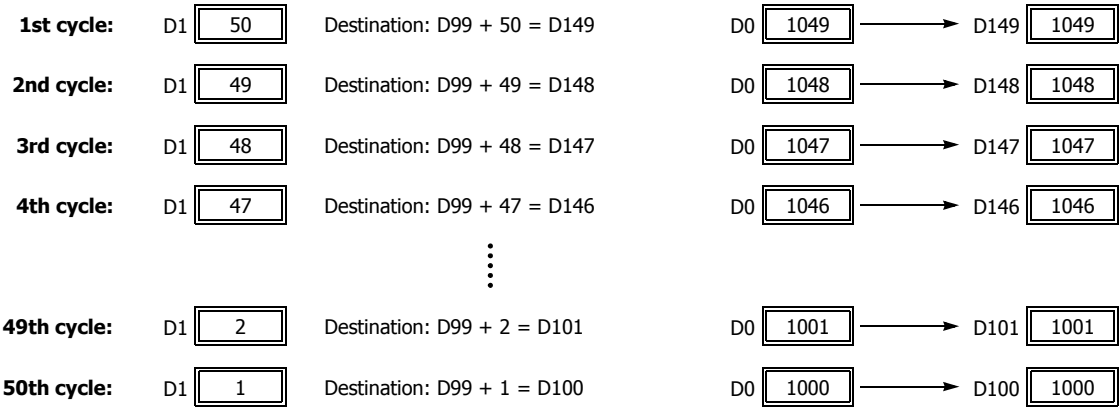
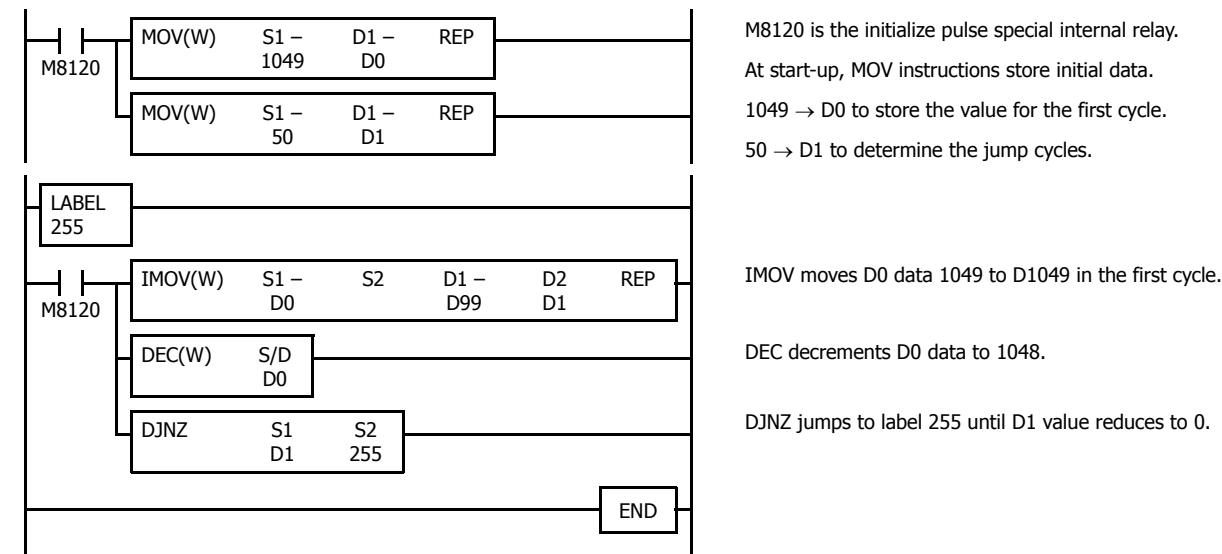
Since the DJNZ instruction is executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used.

The label number can be 0 through 255. Make sure that a LABEL instruction of the label number used for a DJNZ instruction is programmed. When designating S2 using a data register, the value for the label is a variable. When using a variable for a label, make sure that all probable LABEL numbers are included in the user program. If a matching label does not exist, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

14: PROGRAM BRANCHING INSTRUCTIONS

Example: DJNZ and LABEL

The following example demonstrates a program to store consecutive values 1000 through 1049 to data registers D100 through D149, respectively.



# 15: REFRESH INSTRUCTIONS

## Introduction

This chapter describes the refresh instructions that update the status of input contacts, external output, and the current value of the high-speed counter, to the latest value during a ladder scan.

## IOREF (I/O Refresh)



When input is on, 1-bit I/O data assigned by source device S1 is refreshed immediately regardless of the scan time.

When I (input) is used as S1, the actual input status is immediately read into an internal relay starting with M300 allocated to each input available on the SmartAXIS.

When Q (output) is used as S1, the output data in the RAM is immediately written to the actual output available on the SmartAXIS.

Refresh instructions are useful when a real-time response is required in a user program which has a long scan time. The refresh instruction is most effective when using the refresh instruction at a ladder step immediately before using the data.

The IOREF instruction can be used with an interrupt input or timer interrupt to refresh data.

## Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

## Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	I/O for refresh	X	X	—	—	—	—	—	—	—

Only input or output numbers available on the SmartAXIS can be designated as S1. Input and output numbers for remote I/O slaves cannot be designated as S1. For valid device address ranges, see "Device Addresses" on page 3-1.

## Input Device Addresses and Allocated Internal Relays

Internal relays are allocated to each input device as shown in the table below. For example, when I10 is designated as S1, the latest value of I10 is set to M310.

Input Device	Internal Relay	Input Device	Internal Relay	Input Device	Internal Relay	Input Device	Internal Relay
I0	M300	I10	M310	I20	M320	I30	M330
I1	M301	I11	M311	I21	M321	I31	M331
I2	M302	I12	M312	I22	M322	I32	M332
I3	M303	I13	M313	I23	M323	I33	M333
I4	M304	I14	M314	I24	M324	I34	M334
I5	M305	I15	M315	I25	M325	I35	M335
I6	M306	I16	M316	I26	M326		
I7	M307	I17	M317	I27	M327		

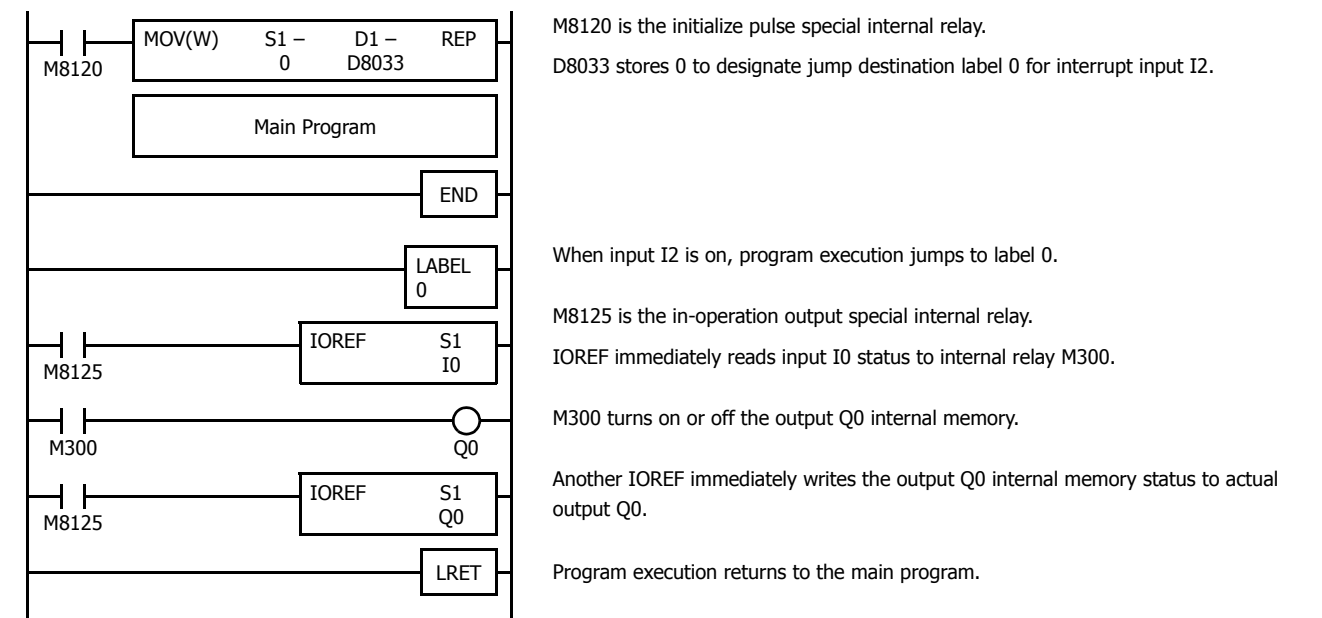
During normal execution of a user program, I/O statuses are refreshed simultaneously when the END instruction is executed at the end of a scan. When a real-time response is needed to execute an interrupt, the IOREF instruction can be used. When the input to the IOREF instruction is turned on, the status of the designated input or output is read or written immediately.

When the IOREF instruction is executed for an input, the filter does not take effect and the input status at the moment is read to a corresponding internal relay.

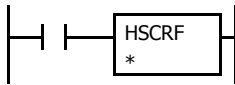
The actual input status of the same input number is read to the internal input memory when the END instruction is executed as in the normal scanning, then the filter value has effect as designated in the Function Area Settings. See Chapter 5 "Special Functions" - "Input Filter" in the SmartAXIS Pro/Lite User's Manual.

Example: IOREF

The following example demonstrates a program that transfers the input I0 status to output Q0 using the IOREF instruction. Input I2 is designated as an interrupt input. For the interrupt input function, see Chapter 5 "Special Functions" - "Interrupt Input" in the SmartAXIS Pro/Lite User's Manual.



## HSCRF (High-speed Counter Refresh)



When input is on, the HSCRF instruction refreshes the high-speed counter current values in special data registers in real time.

The current values of six high-speed counters HSC1 through HSC6 are usually updated in every scan. The HSCRF can be used in any place in the ladder diagram where you want to read the updated high-speed counter current value.

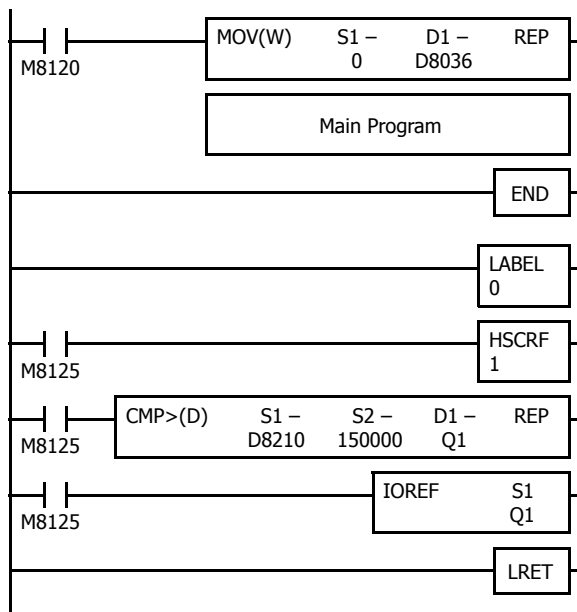
For the high-speed counter function, see Chapter 5 "Special Functions" - "High-Speed Counter" in the SmartAXIS Pro/Lite User's Manual.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Example: HSCRF

The following example demonstrates a program that updates the current value of high-speed counter HSC1 using the HSCRF instruction. For the timer interrupt, see Chapter 5 "Special Functions" - "Timer Interrupt" in the SmartAXIS Pro/Lite User's Manual.



M8120 is the initialize pulse special internal relay.

D8036 stores 0 to designate jump destination label 0 for timer interrupt.

The interrupt program is separated from the main program by the END instruction.

While the CPU is running, program execution jumps to label 0 repeatedly at intervals selected in the Function Area Settings.

M8125 is the in-operation output special internal relay.

HSCRF updates the HSC1 current value in data registers D8050 and D8051.

When D8050/D8051 exceeds 150000, Q1 is turned on.

IOREF immediately writes the output Q1 internal memory status to actual output Q1.

Each time the interrupt program is completed, program execution returns to the main program at the address where timer interrupt occurred.

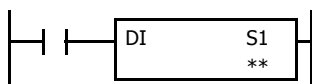


# 16: INTERRUPT CONTROL INSTRUCTIONS

## Introduction

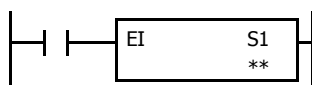
The DI or EI instruction disables or enables interrupt inputs and timer interrupt individually.

### DI (Disable Interrupt)



When input is on, interrupt inputs and timer interrupt assigned by source device S1 are disabled.

### EI (Enable Interrupt)



When input is on, interrupt inputs and timer interrupt assigned by source device S1 are enabled.

### Applicable SmartAXIS

FT1A-12	FT1A-24	FT1A-40	FT1A-48	FT1A-Touch
X	X	X	X	X

### Valid Devices

Device	Function	I	Q	M	R	T	C	D	Constant	Repeat
S1 (Source 1)	Interrupt inputs and timer interrupt	—	—	—	—	—	—	—	1-127	—

Interrupt inputs I0 through I7 and timer interrupt selected in the Function Area Settings are normally enabled when the CPU starts. When the DI instruction is executed, interrupt inputs and timer interrupt designated as source device S1 are disabled even if the interrupt condition is met in the user program area subsequent to the DI instruction. When the EI instruction is executed, disabled interrupt inputs and timer interrupt designated as source device S1 are enabled again in the user program area subsequent to the EI instruction. Different interrupts can be selected for the DI and EI instructions to disable and enable interrupt inputs selectively. For Interrupt Input and Timer Interrupt, see Chapter 5 "Special Functions" - "Interrupt Input" and "Timer Interrupt" in the SmartAXIS Pro/Lite User's Manual.

Make sure that interrupt inputs and timer interrupt designated as source device S1 are selected in the Function Area Settings. Otherwise, when the DI or EI instruction is executed, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS.

The DI and EI instructions cannot be used in an interrupt program. If used, a user program execution error will result, turning on special internal relay M8004 and the ERR LED on the SmartAXIS. For details about the user program execution errors, see "User Program Execution Errors" on page 4-13.

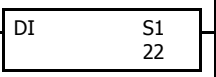
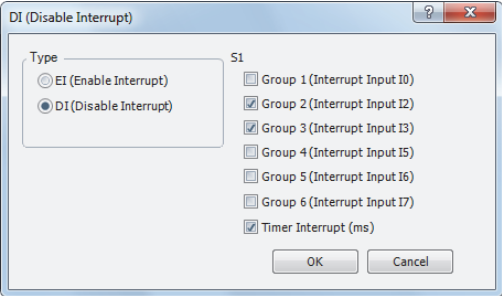
### Special Internal Relays M8070-M8075 and M8144: Interrupt Status

Special internal relays M8070 through M8075 and M8144 are provided to indicate whether interrupt inputs and timer interrupt are enabled or disabled.

Interrupt (Lite/Pro/Touch)	Interrupt Enabled	Interrupt Disabled
Group 1 (I0/-)	M8070 ON	M8070 OFF
Group 2 (I2/I2)	M8071 ON	M8071 OFF
Group 3 (I3/I3)	M8072 ON	M8072 OFF
Group 4 (I5/I4)	M8073 ON	M8073 OFF
Group 5 (I6/I5)	M8074 ON	M8074 OFF
Group 6 (I7/-)	M8075 ON	M8075 OFF
Timer Interrupt	M8144 ON	M8144 OFF

Programming WindLDR

In the Disable Interrupt (DI) or Enable Interrupt (EI) dialog box, select the check box on the left of Interrupt Groups 1 through 6 or Timer Interrupt to select source device S1. The example below selects interrupt groups 2, 3, and timer interrupt for the DI instruction, and a 22 will be shown as source device S1.



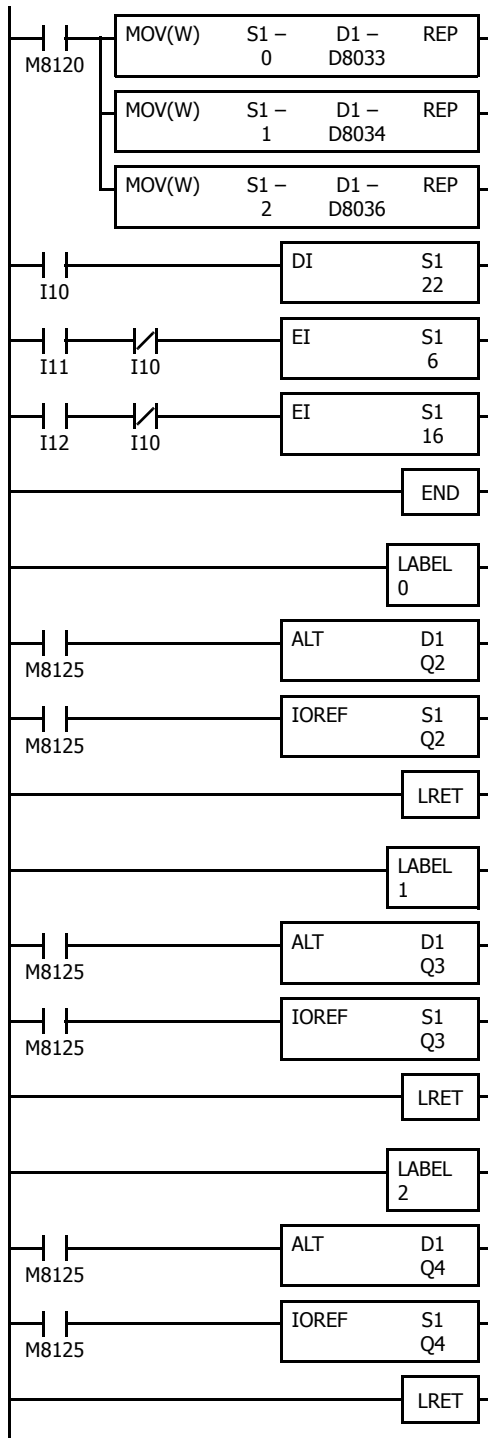
The total of selected interrupt inputs and timer interrupt is shown as source device S1.

Interrupt (Lite•Pro/Touch)	S1 Value
Group 1 (I0/-)	0
Group 2 (I2/I2)	2
Group 3 (I3/I3)	4
Group 4 (I5/I4)	8
Group 5 (I6/I5)	32
Group 6 (I7/-)	64
Timer Interrupt	16



### Example: DI and EI

The following example demonstrates a program that will disable and enable interrupt inputs and timer interrupt selectively. For the interrupt input and timer interrupt functions, see Chapter 5 "Special Functions" - "Interrupt Input" and "Timer Interrupt" in the SmartAXIS Pro/Lite User's Manual. In this example, inputs I2 and I3 are designated as interrupt inputs and timer interrupt is used with interrupt intervals of 100 ms.



M8120 is the initialize pulse special internal relay.

D8033 stores jump destination label number 0 for interrupt input I2.

D8034 stores jump destination label number 1 for interrupt input I3.

D8036 stores jump destination label number 2 for timer interrupt.

When input I10 is on, DI disables interrupt inputs I2, I3, and timer interrupt, then M8071, M8072, and M8144 turn off.

When input I11 is on and I10 is off, EI enables interrupt inputs I2 and I3, then M8071 and M8072 turn on.

When input I12 is on and I10 is off, EI enables timer interrupt, then M8144 turns on.

End of the main program.

When input I2 is on, program execution jumps to label 0.

M8125 is the in-operation output special internal relay.

ALT turns on or off the output Q2 internal memory.

IOREF immediately writes the output Q2 internal memory status to actual output Q2.

Program execution returns to the main program.

When input I3 is on, program execution jumps to label 1.

M8125 is the in-operation output special internal relay.

ALT turns on or off the output Q3 internal memory.

IOREF immediately writes the output Q3 internal memory status to actual output Q3.

Program execution returns to the main program.

Timer interrupt occurs every 100 ms, then program execution jumps to label 2.

M8125 is the in-operation output special internal relay.

ALT turns on or off the output Q4 internal memory.

IOREF immediately writes the output Q4 internal memory status to actual output Q4.

Program execution returns to the main program.

