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MITSUBISHI CNC

EZMotion-NC E60/E68 Series

PLC PROGRAMMING MANUAL
(Ladder Section with MELSEC Tool)

IB-1500178(ENG)-A

Introduction

These specifications are the programming manual used when creating the sequence program for the EZMotion-NC E60/E68 with the onboard PLC development tool or PLC development software.
The PLC (Programmable Logic Controller) is largely divided into the basic commands, function commands and exclusive commands, and ample command types are available. The commands can be used according to the purpose and application such as the PLC support function used when supporting the user PLCs.

Details described in this manual

⚠ CAUTION

⚠ For items described in "Restrictions" or "Usable State", the instruction manual issued by the machine maker takes precedence over this manual.
⚠ Items not described in this manual must be interpreted as "not possible".
⚠ This manual is written on the assumption that all option functions are added. Refer to the specifications issued by the machine maker before starting use.
⚠ Refer to the Instruction Manual issued by each machine maker for details in each machine tool.
⚠ Some screens and functions may differ or may not be usable depending on the NC version.

General precautions

(1) This Instruction Manual does not explain the operation procedures for programming the sequence program with onboard or personal computer. Refer to the related material listed below for details.

EZMotion-NC E60/E68	PLC Onboard Instruction Manual	.....	IB-1500179(ENG)
EZMotion-NC E60/E68	PLC Interface Manual	.....	IB-1500176(ENG)
EZMotion-NC E60/E68	PLC Development Software Manual (MELSEC Tool Section)	.....	IB-1500177(ENG)

Precautions for Safety

Always read the specifications issued by the machine maker, this manual, related manuals and attached documents before installation, operation, programming, maintenance or inspection to ensure correct use.
Understand this numerical controller, safety items and cautions before using the unit.
This manual ranks the safety precautions into "DANGER", "WARNING" and "CAUTION".

⚠ **DANGER**	When there is a great risk that the user could be subject to fatalities or serious injuries if handling is mistaken.
⚠ **WARNING**	When the user could be subject to fatalities or serious injuries if handling is mistaken.
⚠ **CAUTION**	When the user could be subject to injuries or when physical damage could occur if handling is mistaken.

Note that even items ranked as " ⚠ **CAUTION**", may lead to major results depending on the situation. In any case, important information that must always be observed is described.

⚠ DANGER

Not applicable in this manual.

⚠ WARNING

Not applicable in this manual.

⚠ CAUTION

1. Items related to product and manual

- ⚠ For items described as "Restrictions" or "Usable State" in this manual, the instruction manual issued by the machine maker takes precedence over this manual.
- ⚠ An effort has been made to describe special handling of this machine, but items that are not described must be interpreted as "not possible".
- ⚠ This manual is written on the assumption that all option functions are added. Refer to the specifications issued by the machine maker before starting use.
- ⚠ Refer to the Instruction Manual issued by each machine maker for details on each machine tool.
- ⚠ Some screens and functions may differ or some functions may not be usable depending on the NC version.

2. Items related to start up and maintenance

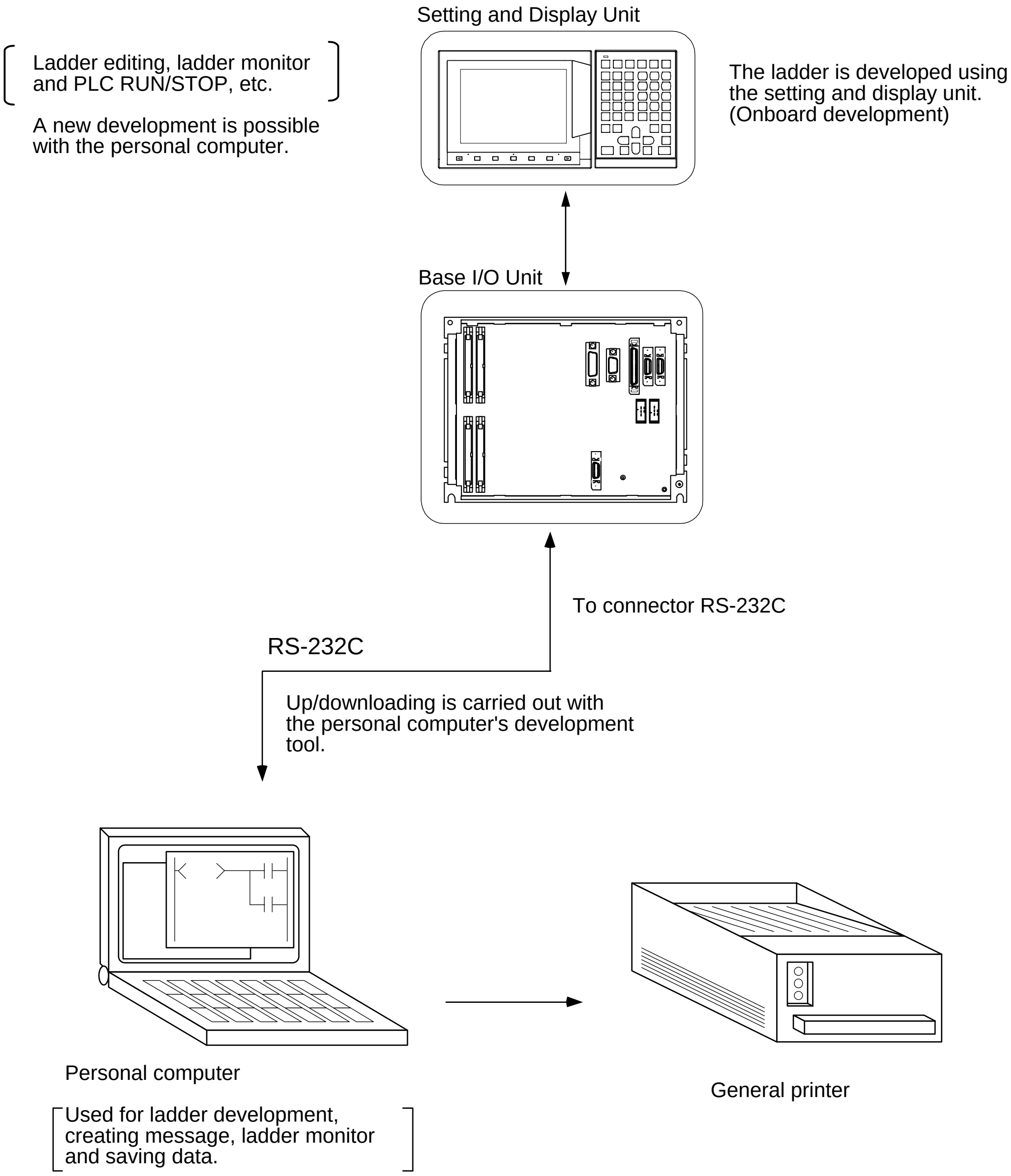
- ⚠ Read this manual carefully and confirm the safety enough before executing the operation of the program change, forced output, RUN, STOP, etc. during operation. Operation mistakes may cause damage of the machine and accidents.

CONTENTS

1. System Configuration

1.1 System Configuration for PLC Development

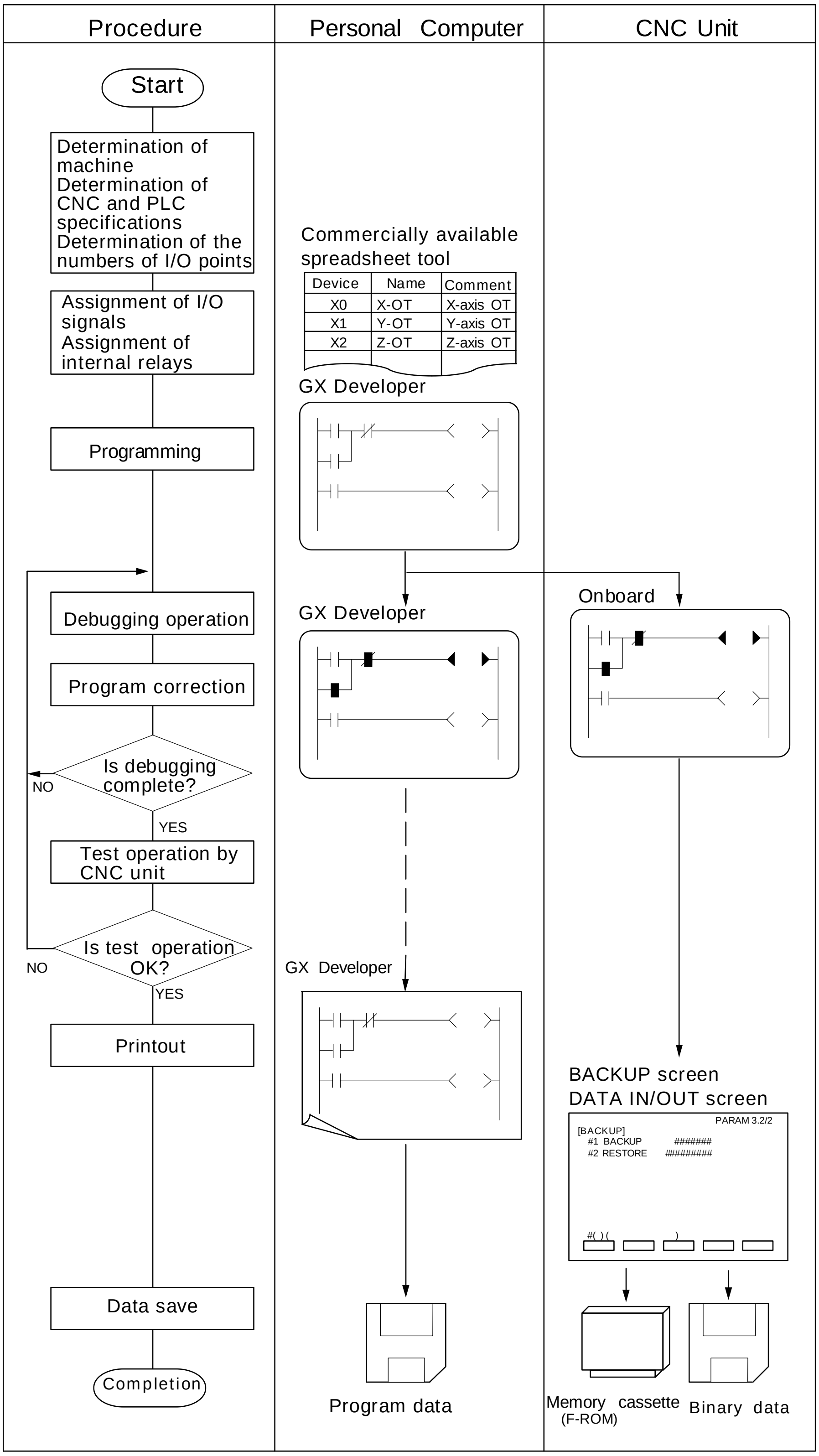
The system configuration for PLC development is shown below.



(Note) Refer to the "PLC Onboard Instruction Manual" (IB-1500179) for edition using the setting and display unit (onboard edition), and the "PLC Development Software Manual (MELSEC Tool Section)" (IB-1500177) for development using the personal computer.

1.2 User PLC (Ladder) Development Procedure

The procedure for creating the user PLC, used to control the control target (machine) built into the control unit, is shown below.



The data created with the commercially available spreadsheet tool can be used as ladder comment data.

Use GX Developer for programming.
After completion, download the data through RS-232C.

Perform monitoring/correction with GX Developer's online function or onboard function.

Printout to a commercial printer connected with the personal computer from GX Developer.

Excute the ROM backup operation on the BACKUP screen.
Excute the binary data output on the DATA IN/OUT screen.

Program data:
Saved using GX Developer

Binary data:
Saved using DATA IN/OUT screen

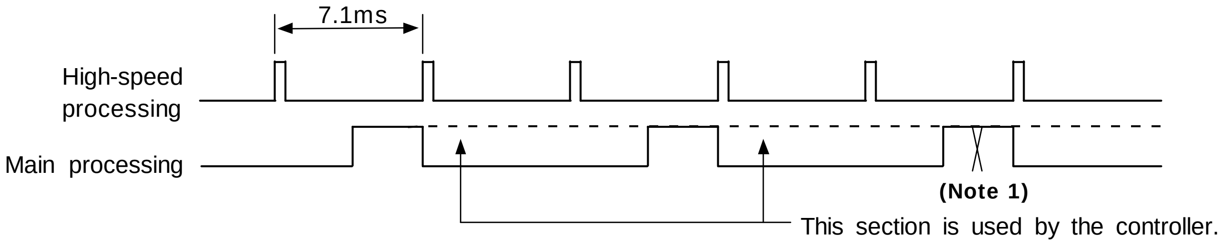
2. PLC Processing Program

2.1 PLC Processing Program Level and Operation

Table 2.1-1 explains the contents of users PLC processing level and Fig. 2.1-1 shows the timing chart.

Table 2.1-1 PLC processing level

Program name	Description (frequency, level, etc.)
High-speed processing program	This program starts periodically with a time interval of 7.1ms. This program has the highest level as a program that starts periodically. It is used in signal processing where high-speed processing is required. Processing time of this program shall not exceed 0.5ms. Application example: Position count control of turret and ATC magazine
Main processing program (ladder)	This program runs constantly. When one ladder has been executed from the head to END, the cycle starts again at the head.

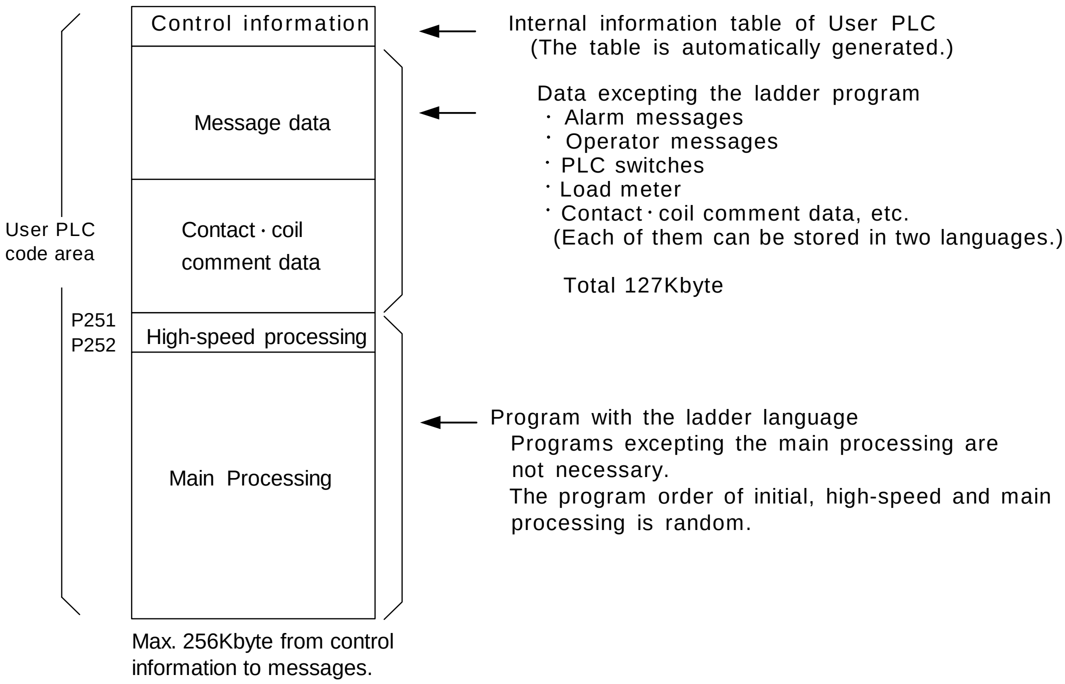


(Note 1) The section from the END command to the next scan is done immediately as shown with the X section. Note that the min. scan time will be 14.2ms.

Fig. 2.1-1 PLC processing program operation timing chart

2.2 User Memory Area Configuration

The user memory area approximate configuration and size are shown below.

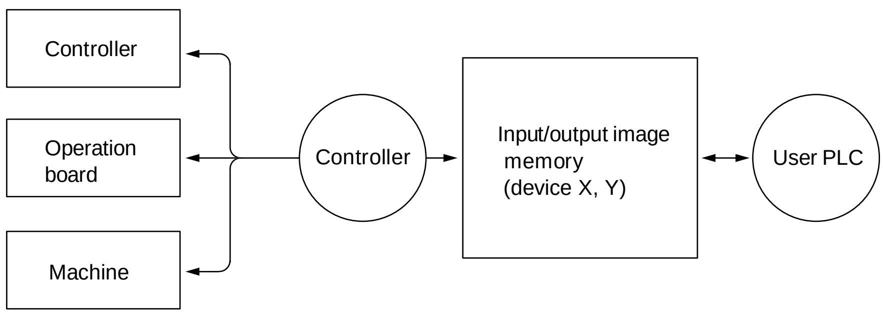


3. Input/Output Signals

3.1 Input/Output Signal Types and Processing

The input/output signals handled in user PLC are as follows:
(1) Input/output from/to controller
(2) Input/output from/to operation board **(Note 1)**
(3) Input/output from/to machine

The user PLC does not directly input or output these signals from or to hardware or controller; it inputs or outputs the signals from or to input/output image memory. For the reading and writing with the hardware or controller, the controller will perform the input/output according to the level of the main process or high-speed process.



(Note 1) The operation board here refers to when the remote I/O unit is installed on the communication terminal.

Fig. 3.1-1 Concept of input/output processing

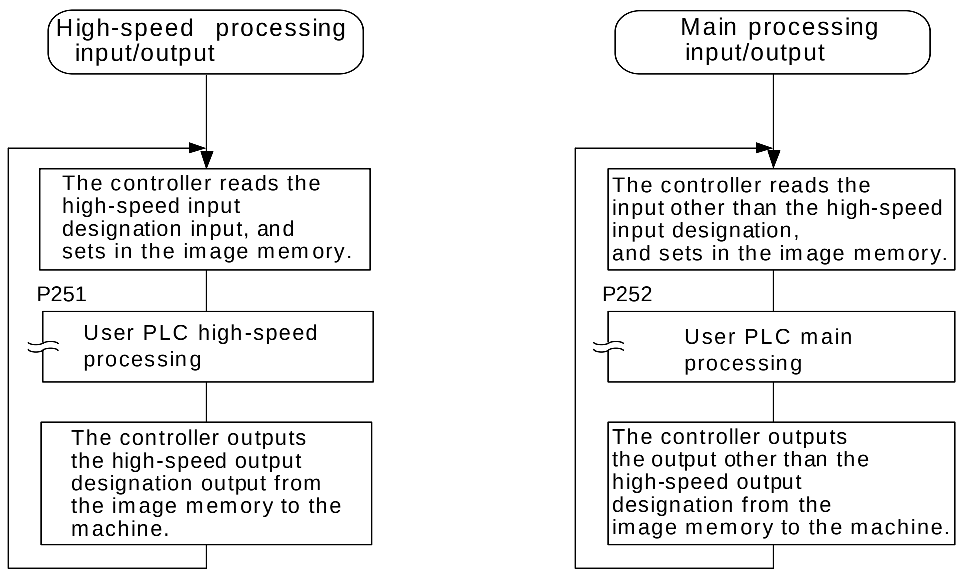


Fig. 3.1-2 Input/output processing conforming to program level

Table 3.1-1 lists whether or not high-speed input/output, interrupt input and initial processing can be performed.

Table 3.1-1 Whether or not high-speed input/output, interrupt input and initial can be performed

	High-speed input specification	High-speed output specification
Input signal from control unit	x	x
Output signal to control unit	x	x
Input signal from machine	◯ (2-byte units)	x
Output signal to machine	x	◯ (2-byte units)
Input signal from operation board	x	x
Output signal to operation board	x	x

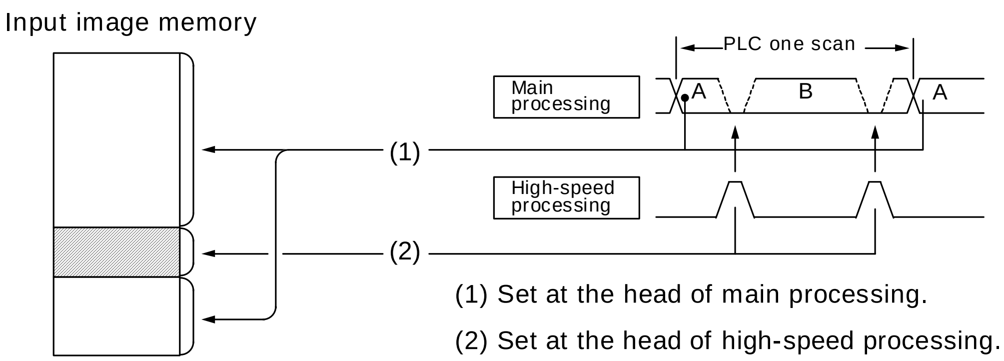
◯ : Possible x : Not possible

The operation board in Table 3.1-1 is applied when control is performed by operation board input/output card that can be added as NC option.

3.2 Handling of Input Signals Designated for High-Speed Input

The input/output signals used in user PLC are input/output for each program level as shown in Fig. 3.1-2.
In high-speed processing, input/output signal for which high-speed input or output designation (parameter) is made is input or output each time the high-speed processing program runs. In main processing, signals other than interrupt input signals or high-speed input/output designation are input/output.

When high-speed input designation signal is used in main processing, the input signal may change within one scan because high-speed processing whose level is higher than main processing interrupts. Input signal which must not change within one scan should be saved in temporary memory (M), etc., at the head of main processing and the temporary memory should be used in the main program, for example.



The hatched area is high-speed input designation part. Whenever the high-speed processing program runs, data is reset in the hatched area. Thus, the signal in the hatched area may change in main processing (A) and (B) because the high-speed process interrupts between (A) and (B) and re-reads the input signal in the hatched area.

3.3 High-Speed Input/output Designation Method

High-speed input/output is designated by setting the corresponding bit of the bit selection parameter as shown below.

(1) High-speed input designation

	7	6	5	4	3	2	1	0	← Bit
Bit selection parameter #6457	X70 ~ X7F	X60 ~ X6F	X50 ~ X5F	X40 ~ X4F	X30 ~ X3F	X20 ~ X2F	X10 ~ X1F	X00 ~ X0F	These bits correspond to the low-order byte (bits 0~7) of file register R2928.
#6458	XF0 ~ XFF	XE0 ~ XEF	XD0 ~ XDF	XC0 ~ XCF	XB0 ~ XBF	XA0 ~ XAF	X90 ~ X9F	X80 ~ X8F	These bits correspond to the high-order byte (bits 8~F) of file register R2928.

(2) High-speed output designation

	7	6	5	4	3	2	1	0	← Bit
Bit selection parameter #6461	Y70 ~ Y7F	Y60 ~ Y6F	Y50 ~ Y5F	Y40 ~ Y4F	Y30 ~ Y3F	Y20 ~ Y2F	Y10 ~ Y1F	Y00 ~ Y0F	These bits correspond to the low-order byte (bits 0~7) of file register R2930.
#6462	YF0 ~ YFF	YE0 ~ YEF	YD0 ~ YDF	YC0 ~ YCF	YB0 ~ YBF	YA0 ~ YAF	Y90 ~ Y9F	Y80 ~ Y8F	These bits correspond to the high-order byte (bits 8~F) of file register R2930.

- As listed above, one bit corresponds to two bytes (16 points).
- Input or output in which 1 is set in the table is not performed at the main processing program level.
- Although the number of bits set to 1 is not limited, set only necessary ones from viewpoint of overhead.
- High-speed input/output designation corresponds to the bit selection parameter and can be set in the parameter. However, it is recommended to set in a sequence program to prevent a parameter setting error, etc.

  Example: —[MOV H3 R2928]— ..... To designate X00~X0F, X10~X1F (bit 0 and 1 for H3)

3.4 Limits for Using High Speed Processing Program

3.4.1 Separation of Main Processing and High Speed Processing Bit Operation Areas

(1) Bit operation area

When using high speed processing, the bit operation range such as the temporary memory is separated from the main process.

(Method 1) When using the same M or G code, the bit operation area for high speed processing and the bit operation area for main processing are separated by 64 points or more and used.

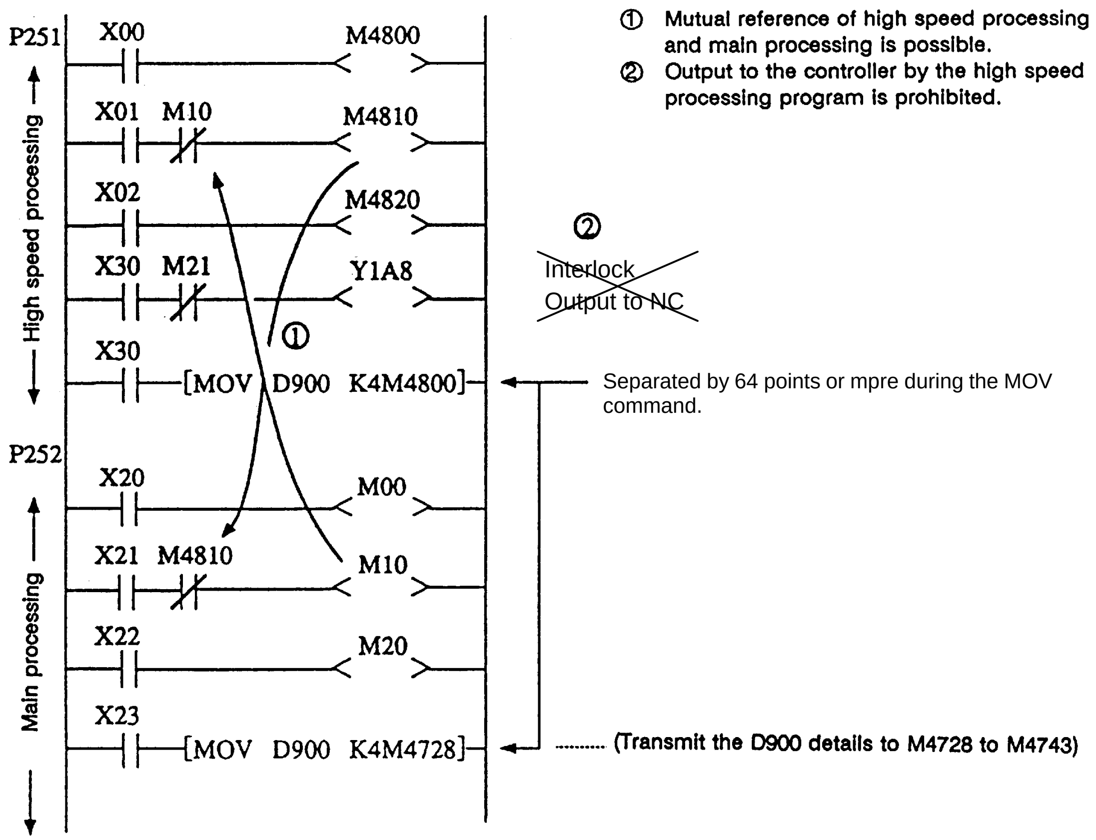
For example, the following is used
M0 to M4735 for main processing
M4800 to M5120 for high speed processing
Separate by 64 points or more
(M4736 to M4799 are not used)

(Method 2) M is used for the main processing temporary memory and G is used for the high speed processing temporary memory.

(Note 1) The output devices handled with high speed processing must be limited to M or Y, D and R.

(Note 2) These limits apply not only to the OUT command, but also to the PLF, PLS, SET, RST and MOV command, etc., outputs. The devices apply to all devices including M, F, L, SM, T and C.

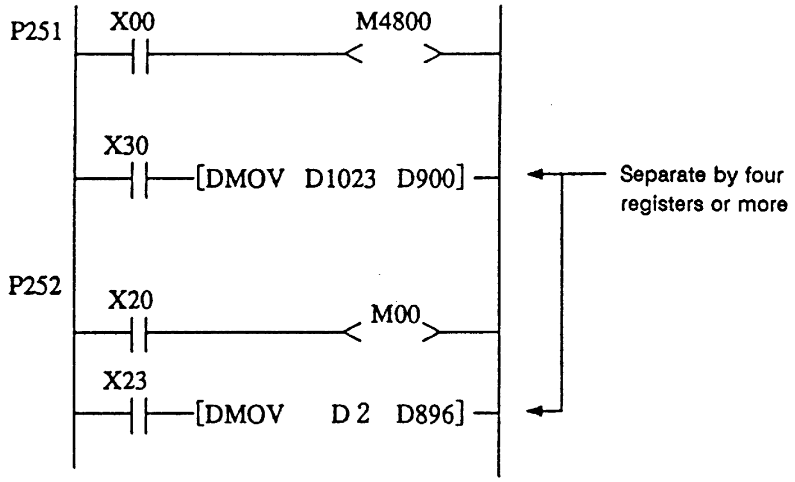
(Example)



(2) Data area

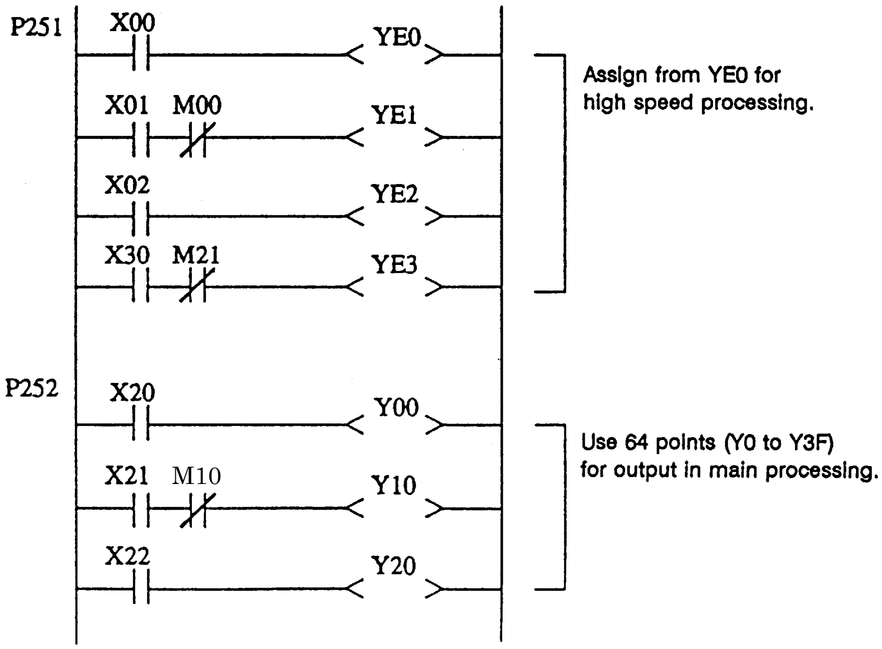
Even with commands that handle data (numerical values) during the MOV command, etc., the bit area must be separated by 64 points or more and the data register (D) and file register (R) separated by four registers or more.

Example) Use D0 to D896 for main processing
Use D900 to D1023 for high speed processing —Separate by four registers or more



3.4.2 Separation of Remote I/O Output

When handling high speed output during the high speed process, the main processing output and high speed processing output cannot be used together in the same remote I/O unit (32 points in channel No. setting rotary switch). A separate 32 points for high speed processing output or a 16-point remote I/O unit will be required.
MOV commands, etc., that extend over differing remote I/O units must not be enforced during either main processing or high speed processing. If these must be enforced, the channel No. setting rotary switch for the output unit used in the main processing and the output unit used for the high speed processing must be set 1 or more apart.



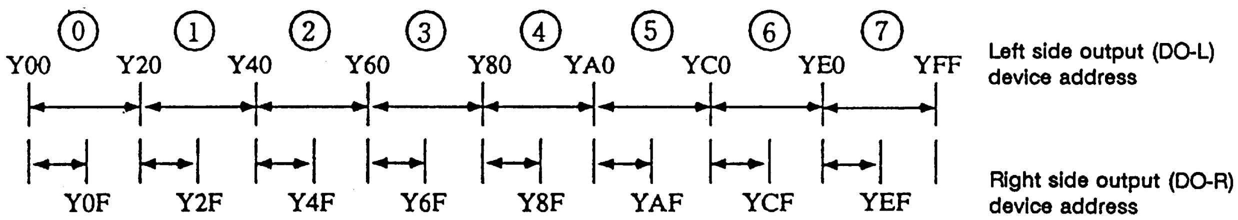
(Usage example 1) Avoid interference with the main process by assigning 7 (last channel) for the channel No. rotary switch for high speed processing output.
For example, use YE0 to YFF (for 32-point DO-L) or YE0 to YEF (for 16-point DO-R) as the high speed processing output.
(Refer to <Usage examples 1-1, 1-2 and 1-3> below.)

(Usage example 2) Assign Y0 to Y1F (32-point) for high speed processing, and use Y20 and following for the main process.
(Refer to <Usage example 2> below.)

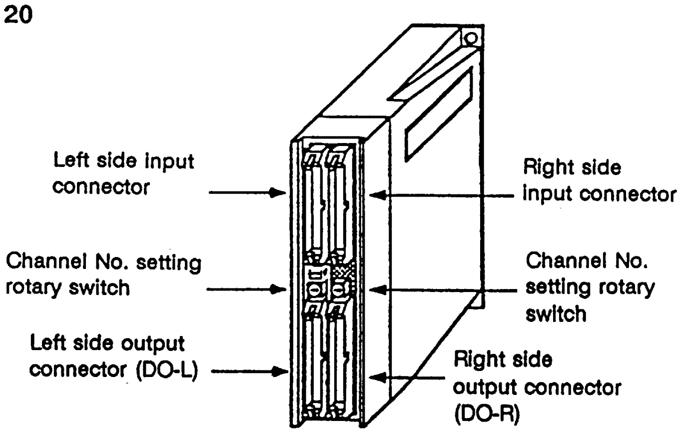
(Usage example 3) Assign the device after the device used for main processing for the high speed process.
For example, if the devices up to Y2D are used for the main process, use Y40 to Y5F (channel No. setting rotary switch No.: 2) for the high speed process.
(Refer to <Usage example 3> below.)

Relation of channel No. setting switch and device No.

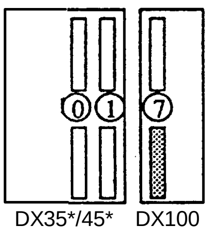
ⓝ is the setting No. of the channel No. setting rotary switch



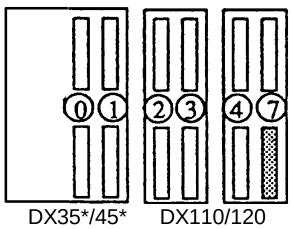
Appearance of remote I/O unit DX110/DX120
(DX100 only has the left side connector)



<Usage example 1-1>
(Devices are YE0 and following)

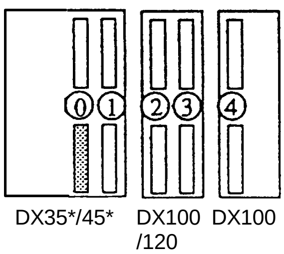


<Usage example 1-2>

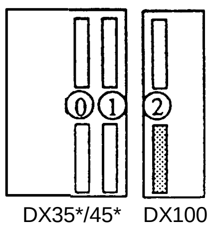


Usage examples 1-2 show the assignment for the 16-point unit as the No. of high speed output points is relatively low.

<Usage example 2>



<Usage example 3>



This is an outline drawing looking at the remote I/O unit from the front, in which the shaded portion is for high speed output.

4. Parameters

4.1 PLC Constants

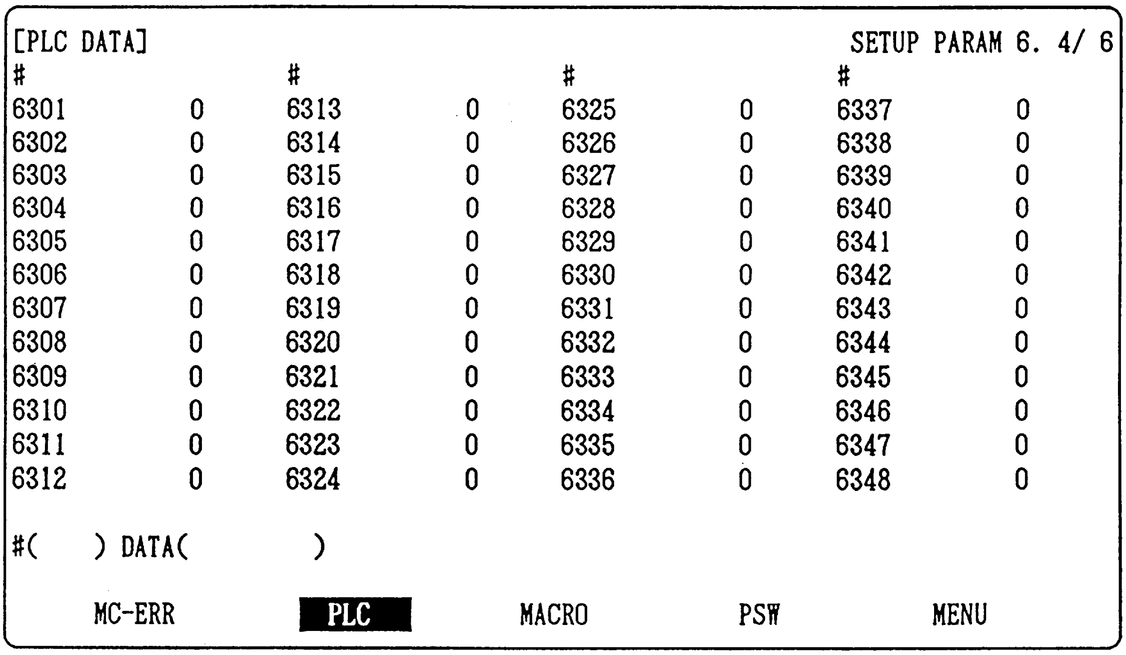
The parameters that can be used in user PLC include PLC constants set in the data type.
Set up data is stored in a file register and is backed up. In contrast, if data is stored in the file register corresponding to PLC constant by using sequence program MOV instruction, etc., it is backed up. However, display remains unchanged. Display another screen once and then select the screen again.
48 PLC constants are set (the setting range is ±8 digits). (Signed 4-byte binary data)
The correspondence between the PLC constants and file registers is listed below. The setting and display screens are also shown.

#	Corresponding file registers	
	High order	Low order
6301	R2801	R2800
6302	R2803	R2802
6303	R2805	R2804
6304	R2807	R2806
6305	R2809	R2808
6306	R2811	R2810
6307	R2813	R2812
6308	R2815	R1814
6309	R2817	R2816
6310	R2819	R2818
6311	R2821	R2820
6312	R2823	R2822
6313	R2825	R2824
6314	R2827	R2826
6315	R2829	R2828
6316	R2831	R2830
6317	R2833	R2832
6318	R2835	R2834
6319	R2837	R2836
6320	R2839	R2838

#	Corresponding file registers	
	High order	Low order
6321	R2841	R2840
6322	R2843	R2842
6323	R2845	R2844
6324	R2847	R2846
6325	R2849	R2848
6326	R2851	R2850
6327	R2853	R2852
6328	R2855	R2854
6329	R2857	R2856
6330	R2859	R2858
6331	R2861	R2860
6322	R2863	R2862
6333	R2865	R2864
6334	R2867	R2866
6335	R2869	R2868
6336	R2871	R2870
6337	R2873	R2872
6338	R2875	R2874
6339	R2877	R2876
6340	R2879	R2878

#	Corresponding file registers	
	High order	Low order
6341	R2881	R2880
6342	R2883	R2882
6343	R2885	R2884
6344	R2887	R2886
6345	R2889	R2888
6346	R2891	R2890
6347	R2893	R2892
6348	R2895	R2894

PLC constant screen



4.2 Bit Selection Parameters

The parameters that can be used in user PLC include bit selection parameters set in the bit type. Set up data is stored in a file register and is backed up.
For use in bit operation in a sequence program, the file register contents are transferred to temporary memory (M) using the MOV command. In contrast, if data is stored in the file register corresponding to bit selection by using the MOV command etc., it is backed up. However, display remains unchanged. Once display another screen and again select screen.
The corresponding between the bit selection parameters and file registers is listed below. The setting and display screens are also shown.

#	Corresponding file register
6401	R2900-LOW
6402	R2900-HIGH
6403	R2901-L
6404	R2901-H
6405	R2902-L
6406	R2902-H
6407	R2903-L
6408	R2903-H
6409	R2904-L
6410	R2904-H
6411	R2905-L
6412	R2905-H
6413	R2906-L
6414	R2906-H
6415	R2907-L
6416	R2907-H
6417	R2908-L
6418	R2908-H
6419	R2909-L
6420	R2909-H
6421	R2910-L
6422	R2910-H
6423	R2911-L
6424	R2911-H
6425	R2912-L
6426	R2912-H
6427	R2913-L
6428	R2913-H
6429	R2914-L
6430	R2914-H
6431	R2915-L
6432	R2915-H

#	Corresponding file register
6433	R2916-LOW
6434	R2916-HIGH
6435	R2917-L
6436	R2917-H
6437	R2918-L
6438	R2918-H
6439	R2919-L
6440	R2919-H
6441	R2920-L
6442	R2920-H
6443	R2921-L
6444	R2921-H
6445	R2922-L
6446	R2922-H
6447	R2923-L
6448	R2923-H

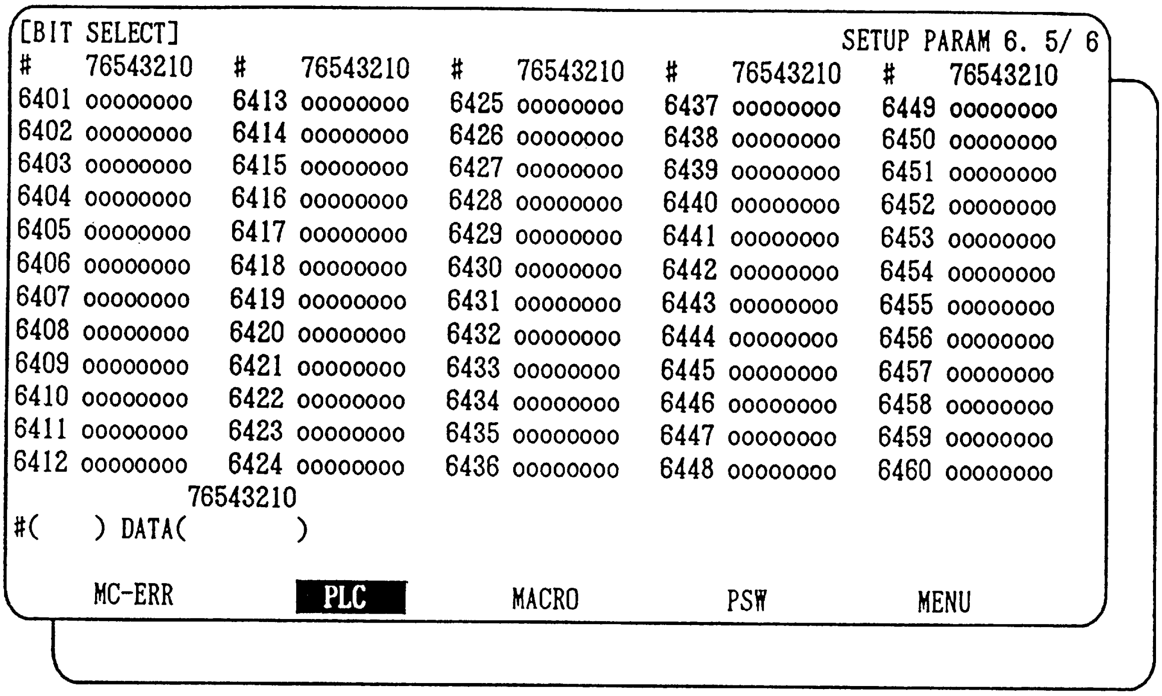
Use bit selection parameters #6401~#6448 freely.

#	Corresponding file register
6449	R2924-LOW
6450	R2924-HIGH
6451	R2925-L
6452	R2925-H
6453	R2926-L
6454	R2926-H
6455	R2927-L
6456	R2927-H
6457	R2928-L
6458	R2928-H
6459	R2929-L
6460	R2929-H
6461	R2930-L
6462	R2930-H
6463	R2931-L
6464	R2931-H
6465	R2932-L
6466	R2932-H
6467	R2933-L
6468	R2933-H
6469	R2934-L
6470	R2934-H
6471	R2935-L
6472	R2935-H
6473	R2936-L
6474	R2936-H
6475	R2937-L
6476	R2937-H
6477	R2938-L
6478	R2938-H
6479	R2939-L
6480	R2939-H

#	Corresponding file register
6481	R2940-LOW
6482	R2940-HIGH
6483	R2941-L
6484	R2941-H
6485	R2942-L
6486	R2942-H
6487	R2943-L
6488	R2943-H
6489	R2944-L
6490	R2944-H
6491	R2945-L
6492	R2945-H
6493	R2946-L
6494	R2946-H
6495	R2947-L
6496	R2947-H

Bit selection parameter #6449~#6496 are PLC operation selection parameters used by the machine manufacturer and MITSUBISHI. The contents are fixed.

Bit selection screen



Contents of bit selection parameters #6449~#6496

	Symbol name	7	6	5	4	3	2	1	0
0	#6449 R2924 L	NC card Controller thermal alarm on	Setting display unit thermal alarm on	-		Counter C retention	Integrating timer T retention	PLC counter program on	PLC timer program on
1	#6450 R2924 H		External alarm message display	Alarm/ operator change	Full screen display of message	-	Operator message on	1 / 0 R system / F system	Alarm message on
2	#6451 R2925 L	-	-	GX-Developer communi-cation on	PLC development environment selection		Onboard editing not possible	-	Onboard on
3	#6452 R2925 H	-		GOT communi-cation connection		Counter (fixed) retention	Integrating timer (fixed) retention		-
4	#6453 R2926 L	-	-	-	-	-		Message language change code	
5	#6454 R2926 H							Equivalent of remote I/O 2ch	
6	#6455 R2927 L	-	-	-	-	-	-	-	-
7	#6456 R2927 H	-	-	-	-	-	-	-	-
8	#6457 R2928 L	High-speed input specification 1							
9	#6458 R2928 H	High-speed input specification 2							
A	#6459 R2929 L	High-speed input specification 3 (Spare)							
B	#6460 R2929 H	High-speed input specification 4 (Spare)							
C	#6461 R2930 L	High-speed output specification 1							
D	#6462 R2930 H	High-speed output specification 2							
E	#6463 R2931 L	High-speed output specification 3 (Spare)							
F	#6464 R2931 H	High-speed output specification 4 (Spare)							

	Symbol name	7	6	5	4	3	2	1	0
0	#6465 R2932 L	-	-	-	-	-	-	-	-
1	#6466 R2932 H	-	-	-	-	-	-	-	-
2	#6467 R2933 L	-	-	-	-	-	-	-	-
3	#6468 R2933 H								
4	#6469 R2934 L	Standard PLC parameter						-	MC alarm 4 output off
5	#6470 R2934 H								
6	#6471 R2935 L	-	-	-	-	-	-	-	-
7	#6472 R2935 H	-	-	-	-	-	-	-	-
8	#6473 R2936 L	-							-
9	#6474 R2936 H								
A	#6475 R2937 L								
B	#6476 R2937 H								
C	#6477 R2938 L								
D	#6478 R2938 H								
E	#6479 R2939 L								
F	#6480 R2939 H								

(Note 1) Be sure to set the bits indicated - and blanks to 0.
(Note 2) Parameters #6481 to #6496 are reserved for debugging by Mitsubishi.

5. Explanation of Devices

5.1 Devices and Device Numbers

The devices are address symbols to identify signals handled in PLC. The device numbers are serial numbers assigned to the devices. The device numbers of devices X, Y and H are represented in hexadecimal notation. The device numbers of other devices are represented in decimal notation.

5.2 Device List

Device	Device No.	Unit	Details
X*	X0~XABF (2752 points)	1 bit	Input signal to PLC. Machine input, etc.
Y*	Y0~YDEF (3584 points)	1 bit	Output signal from PLC. Machine output, etc.
M	M0~M8191 (8192 points)	1 bit	Temporary memory
F	F0~F127 (128 points)	1 bit	Temporary memory, alarm message interface
L	L0~L255 (256 points)	1 bit	Latch relay (backup memory)
SM*	SM0~SM127 (128 points)	1 bit	Special relay
T	T0~T15 (16 points)	1 bit or 16 bits	10ms unit timer
	T16~T95 (80 points)	1 bit or 16 bits	100ms unit timer
	T96~T103 (8 points)	1 bit or 16 bits	100ms unit integrating timer
C	C0~C23 (24 points)	1 bit or 16 bits	Counter
D	D0~D1023 (1024 points)	16 bits or 32 bits	Data register for arithmetic operation
R*	R0~R8191 (8192 points)	16 bits or 32 bits	File register. R500 to R549 and R1900 to R2799 are released to the user for interface between the PLC and controller. R1900 to R2799 are backed up by the battery.
Z	Z0~Z1 (2 points)	16 bits	Index of D or R address (±n)
N	N0~N7 (8 points)	—	Master control nesting level
P*	P0~P255 (256 points)	—	Label for conditional jump and subroutine call
K	K-32768~K32767	—	Decimal constant for 16-bit command
	K-2147483648~ K2147483647	—	Decimal constant for 32-bit command
H	H0~HFFFF	—	Hexadecimal constant for 16-bit command
	H0~HFFFFFFFF	—	Hexadecimal constant for 32-bit command

(Note 1) The applications of the devices having a * in the device column are separately determined. Do not use the undefined device Nos., even if they are open.
(Note 2) When using temporary memory such as M device, separate READ and WRITE every 8bits.

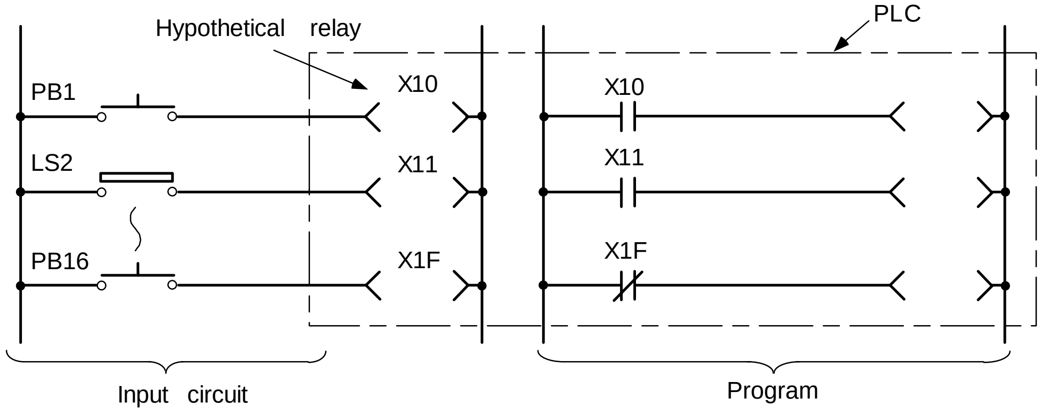
5.3 Detailed Explanation of Devices

5.3.1 Input/output X, Y

Input/output X and Y are a window for executing communication with the PLC and external device or CNC.

Input X

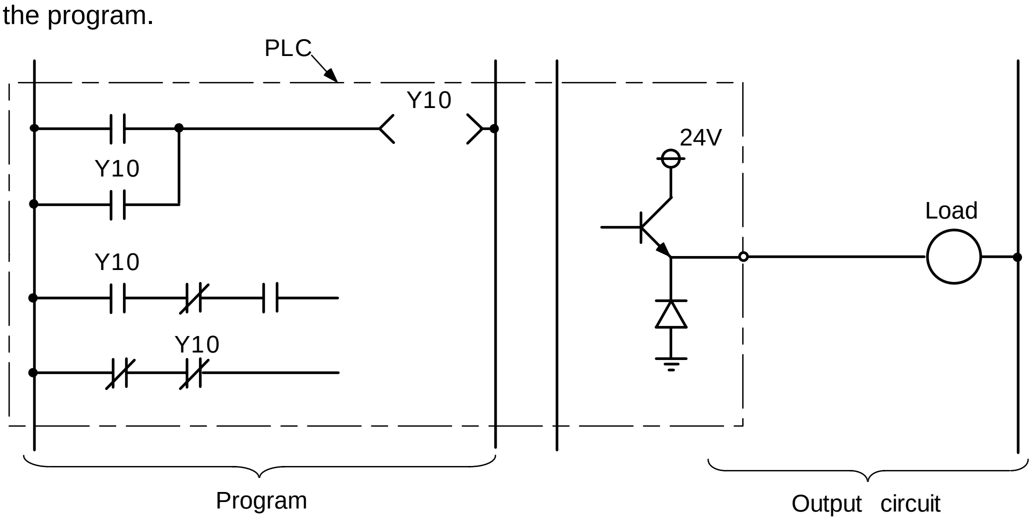
(a) This issued commands or data from an external device such as a push-button, changeover switch, limit switch or digital switch to the PLC.
(b) Assuming that there is a hypothetical relay Xn built-in the PLC per input point, the program uses the "A" contact and "B" contact of that Xn.
(c) There is no limit to the No. of "A" contacts and "B" contacts of the input Xn that can be used in the program.



(d) The input No. is expressed with a hexadecimal.

Output Y

(a) This outputs the results of the program control to the solenoid, magnetic switch, signal lamp or digital indicator, etc.
(b) The output can be retrieved with the equivalent of one "A" contact.
(c) There is no limit to the No. of "A" contacts and "B" contacts of the output Yn that can be used in the program.



(d) The output No. is expressed with a hexadecimal.

5.3.2 Internal Relays M and F, Latch Relay L

The internal relay and latch relay are auxiliary relays in the PLC that cannot directly output to an external source.

Internal relays M

(a) These relays are cleared when the power is turned OFF.
(b) There is no limit to the No. of "A" contacts and "B" contacts of the internal relays that can be used in the program.
(c) The internal relay No. is expressed with a decimal.

Internal relay F

Internal relay F is an interface for the alarm message display.
Use the bit selection parameter to determine whether to use this relay for the alarm message interface. The target will be F0 to F127. This internal relay can be used in the same manner as the internal relay M when not used as the alarm message interface.

Latch relay L

(a) The original state is held even when the power is turned OFF.
(b) There is no limit to the No. of "A" contacts and "B" contacts of the latch relay that can be used in the program.
(c) The latch No. is expressed with a decimal.

5.3.3 Special Relays SM

The special relays are relays having fixed applications such as the carrier flag for operation results and the display request signal to the setting and display unit. Even the relays of SM0 to SM127 that are not currently used must not be used as temporary memory.

Special relays SM

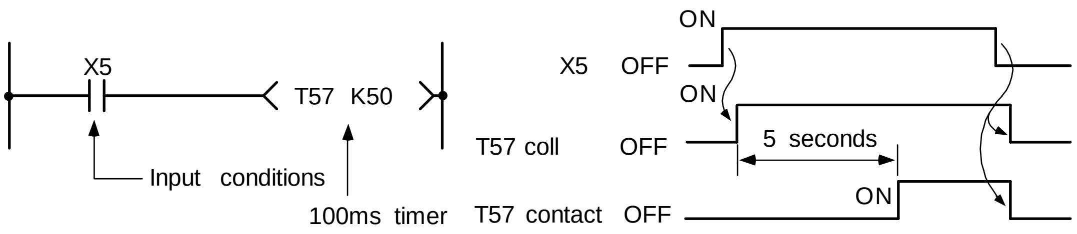
(a) This relay is cleared when the power is turned OFF.
(b) There is no limit to the No. of "A" contacts and "B" contacts of the special relays that can be used in the program.
(c) The special relay No. is expressed with a decimal.

5.3.4 Timer T

(1) The 100ms timer, 10ms timer and 100ms integrated timer are available for this count-up type timer.

100ms Timer T

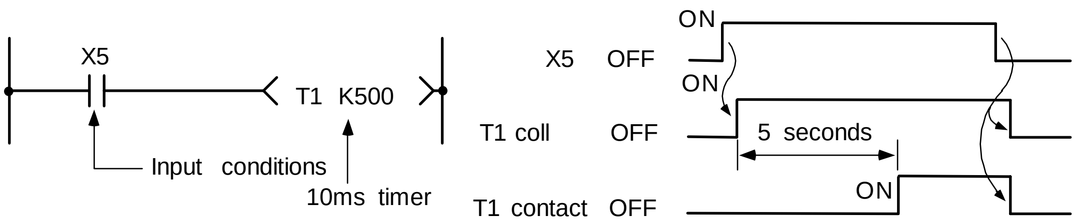
(a) When the input conditions are set, the count starts. When the set value is counted, that timer contact will turn ON.
(b) If the input conditions are turned OFF, the 100ms timer count value will be set to 0, and the contact will turn OFF.



(c) When #6449 bit0=1, the value is set with a decimal (Kn), and can be designated from 1 to 32767 (0.1 to 3276.7 s). The data register (D) data can also be used as the setting value. File register (R) cannot be used.

10ms Timer T

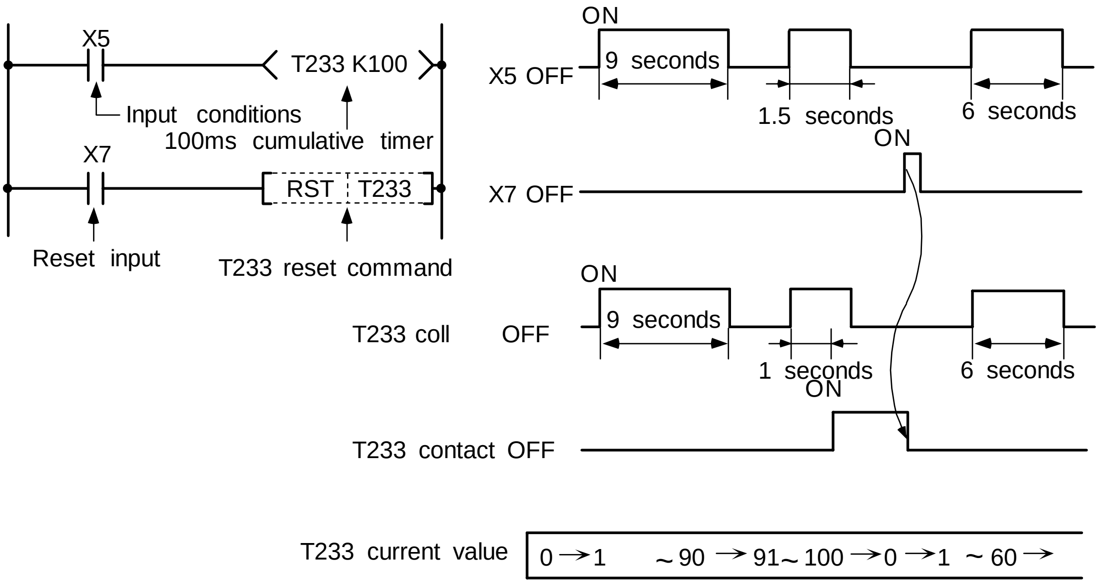
(a) When the input conditions are set, the count starts. When the set value is counted, that timer contact will turn ON.
(b) If the input conditions are turned OFF, the 10ms timer count value will be set to 0, and the contact will turn OFF.



(c) When #6449 bit0=1, the value is set with a decimal (Kn), and can be designated from 1 to 32767 (0.01 to 327.67 s). The data register (D) data can also be used as the setting value. File register (R) cannot be used.

100ms integrated timer T

(a) When the input conditions are set, the count starts. When the set value is counted, that timer contact will turn ON.
(b) Even the input conditions are turned OFF, the 100ms integrated timer current value (count value) will be held, and the contact state will not change.
(c) The 100ms integrated timer count value will be set to 0 and the contact will turn OFF when the RST command is executed.



(d) When #6449 bit0=1, the value is set with a decimal (Kn), and can be designated from 1 to 32767 (0.1 to 3267.7 s). The data register (D) data can also be used as the setting value. File register (R) cannot be used.
(e) When the bit selection parameter (#6449 bit2=1) is set, the 100ms integrated timer current value (count value) will be held even when the power is turned OFF.

(2) With the device T, the contact • coil is handled as bit device, and the current value is handled as word device. In the function commands described after, the word device T indicates the current value even if there is no description about it.

(3) When #6449 bit0=0 is set, timer value can be specified with the parameter set in the setting and display unit. At this time, the relationship between timer device and parameter is as shown below.

Device	Parameter
T0 to T15	#6000 to #6015
T56 to T135	#6016 to #6095
T232 to T239	#6096 to #6103

(Note 1) T16 to T55, T136 to T231, and T240 to T255 are specified with a program (Kn) regardless of #6449 bit0.
(Note2) Even when #6449 bit0=0, Kn is required for a sequence program. Note that, however, the Kn value is invalid.
(Note 3) When the data register (D) is used as setting value, the data register (D) details will be the setting value regardless of #6449 bit0.

5.3.5 Counter C

(1) The counter counts up and detects the rising edge of the input conditions. Thus, the count will not take place when the input conditions are ON.

Counter C	
(a) The value is set with a decimal, and can be designated from 1 to 32767. The data register (D) data can also be used as the setting value. File register (R) cannot be used. (b) The counter count value will not be cleared even if the input conditions turn OFF. The counter count value must be cleared with the RST command. (c) When the bit selection parameter is set, the counter current value (count value) will be held even when the power is turned OFF. Note that some can not be held depending on the version of CNC.	

(2) With the device C, the contact • coil is handled as bit device, and the current value (counter value) is handled as word device. In the function commands described after, the word device C indicates the current value (counter value) even if there is no description about it.

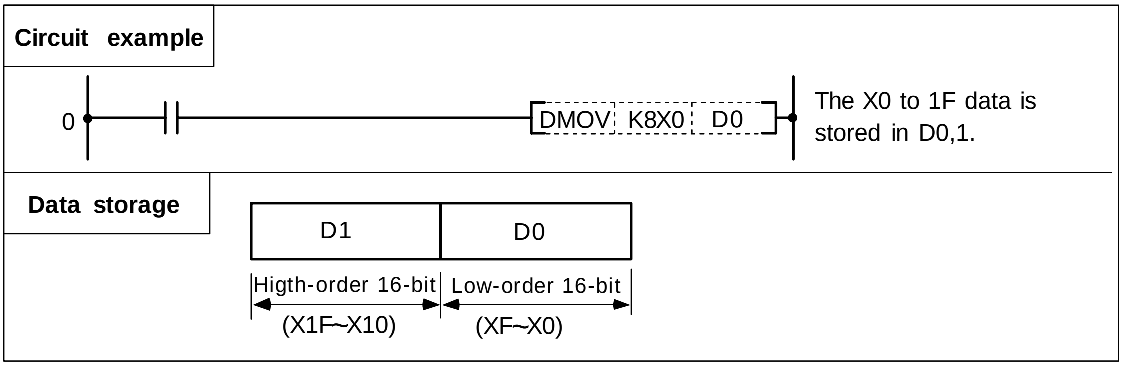
(3) The counter setting value can be set with the setting and display unit using device C. (Variable counter)
Whether the setting value (Kn) programmed with the sequence program or the setting value set from the setting and display unit is valid is selected with the bit selection parameters. The changeover is made in a group for C0 to C23. Even when set from the setting and display unit, the setting value (Kn) program will be required in the sequence program. However, the Kn value will be ignored. When the data register (D) is used for the setting value, the data register (D) details will be used as the setting value regardless of the parameter.

(Note) The setting value for device C24 to C127 of counter C cannot be set from the setting and display unit.

5.3.6 Data Register D

(1) The data register is the memory that stores the data in the PLC.

(2) The data register has a 1-point 16-bit configuration, and can be read and written in 16-bit units. To handle 32-bit data, two points must be used. The data register No. designated with the 32-bit command will be the low-order 16-bit, and the designated data register No. +1 will be the high-order 16-bit.



(3) The data that is stored once in the sequence program is held until other data is stored.

(4) The data stored in the data register is cleared when the power is turned OFF.

(5) Values that can be stored: Decimal -32768 to 32767, Hexadecimal 0 to FFFF — For 16-bit command (Using Dn)
Decimal -2147483648 to 2147483647, Hexadecimal 0 to FFFFFFFF — For 32-bit command (Using Dn+1, Dn)

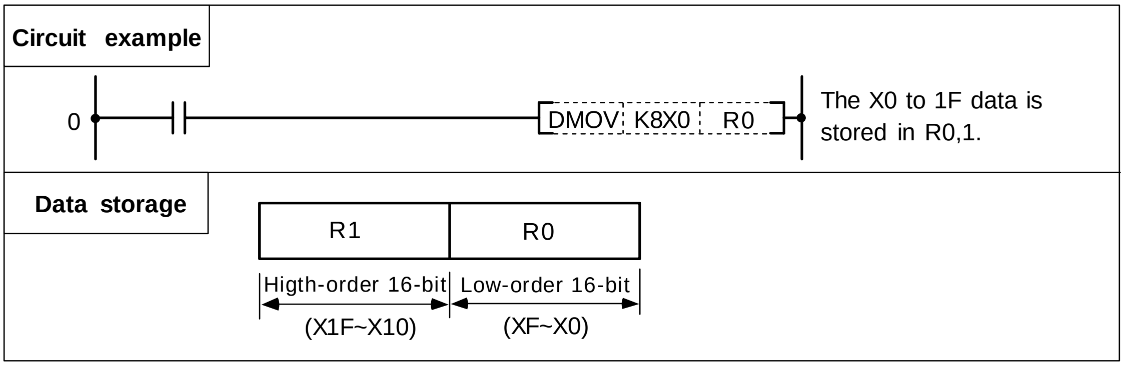
(6) Data registers D0 to D1023 are all user release data registers.

5.3.7 File Register R

(1) As with the data registers, the file registers are memories used to store data. However, there are some that have fixed applications, and those that are released.

(2) The file register has a 1-point 16-bit configuration, and can be read and written in 16-bit units. To handle 32-bit data, two points must be used. The file register No. designated with the 32-bit command will be the low-order 16-bit, and the designated file register No. +1 will be the high-order 16-bit.

(Example) Use of the DMOV command is shown below.



(3) The data that is stored once in the sequence program is held until other data is stored.

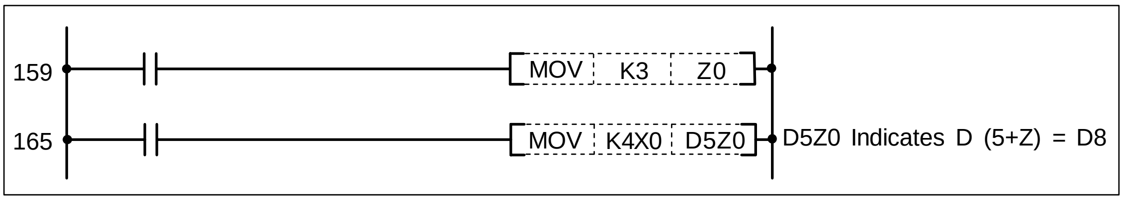
(4) With the file registers, the following registers are the user release.
R500 to R549, R1900 to R2799
The following registers of the registers above are not cleared when the power is turned OFF.
R1900 to R2799
The other file registers have fixed applications such as interface of the PLC and CNC, parameter interface, etc.

(5) Values that can be stored:

Decimal -32768 to 32767 Hexadecimal 0 to FFFF	For 16-bit command (Using Dn)
Decimal -2147483648 to 2147483647 Hexadecimal 0 to FFFFFFFF	For 32-bit command (Using Dn+1, Dn)

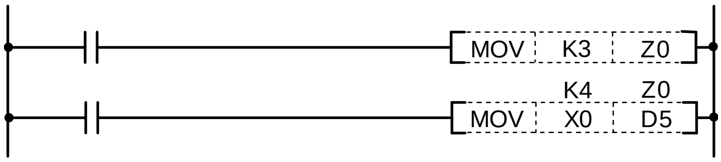
5.3.8 Index Registers Z

(1) The index registers are used as ornaments for the device (T, C, D, R).



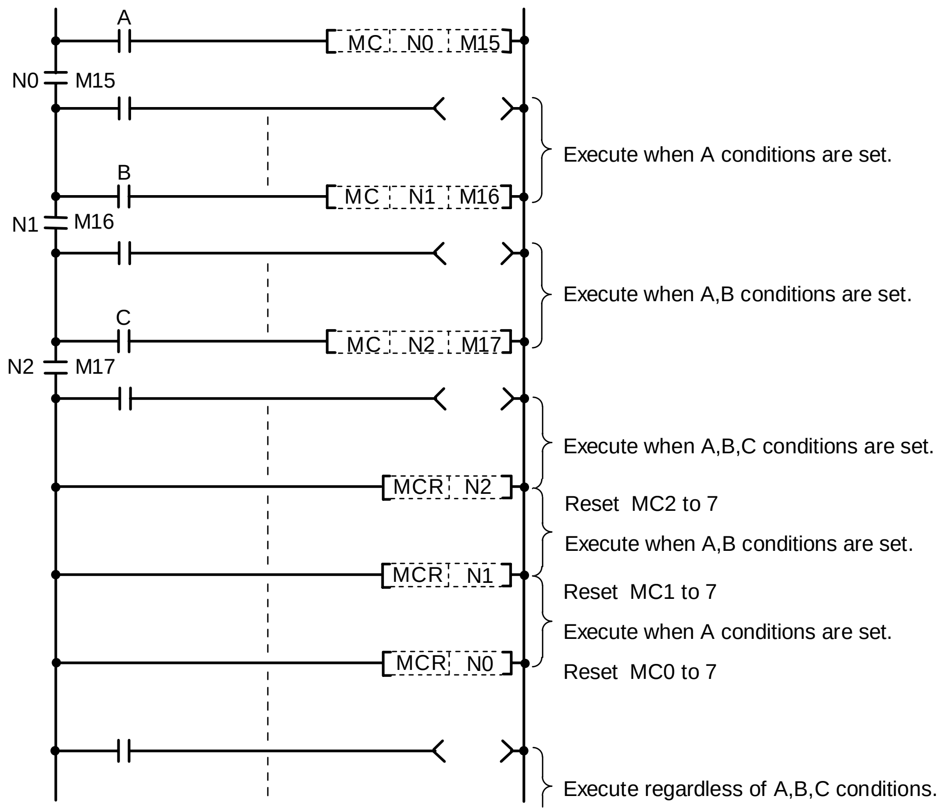
(2) The index register has a 1-point 16-bit configuration, and can be read and written in 16-bit units.
(3) The data stored in the index register is cleared when the power is turned OFF.
(4) Values that can be stored: Decimal -32768 to 32767
Hexadecimal 0 to FFFF

(Note) The CRT display of the index registers Z is as shown below.



5.3.9 Nesting N

(1) This indicates the master control nesting structure.
(2) The master control nesting (N) is used in order from smallest number.



(a) The conditions for each master control to turn ON are as follow.

MC N0 M15 .... ON when condition A is ON

MC N1 M16 .... ON when conditions A, B are ON

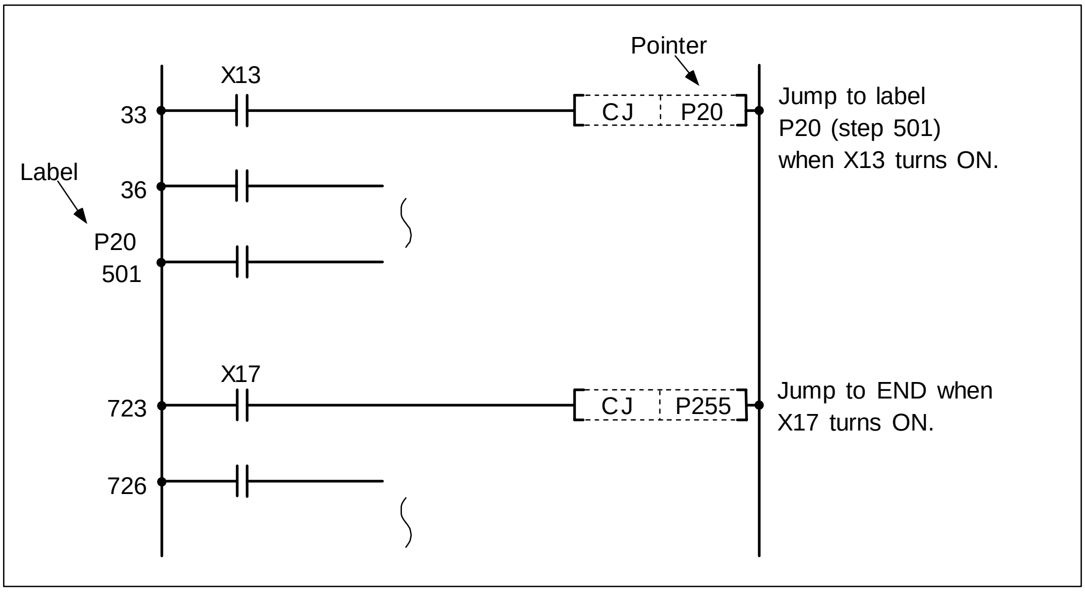
MC N2 M17 .... ON when conditions A, B, C are ON

(b) The timer and counter when the master control is OFF is as follows.

· 100ms timer, 10ms timer	: The count value is set to 0.
· 100ms integrated timer	: The current count value is retained.
· Counter	: The current counter value is retained.
· OUT command	: All turn OFF.

5.3.10 Pointer P

(1) The pointer indicates the branch command (CJ, CALL) jump destination. The pointer No. assigned at the jump destination head is called the label.
(2) Pointers P0 to P159, P251, P252, P255 are user release pointers.
(3) P255 always indicates END.
(P255 can be used as a device for CJ command, etc, but cannot be used as a label. This cannot be used for the CALL command device.)



(4) The special usages of the pointers other than P255 are shown below.
P251: Label for starting PLC high-speed processing program.
P252: Label for starting PLC main (ladder) processing program.

⚠ CAUTION

⚠ The PLC will not operate correctly if Notes 1 to 4 are not observed.

(Note 1) Do not omit P252 label even when there is only a PLC main processing program.
(Note 2) P251 and P252 cannot be used as CJ or CALL command devices.
(Note 3) Do not create a program in which the P** in the PLC high-speed processing program is jumped to from the PLC main processing program.
(Note 4) The P** used as a CJ or CALL command device must also be programmed as a label.

5.3.11 Decimal Constant K

(1) The decimal constant can be used in the following ways.
  (a) Timer counter setting value: Designate in the range of 1 to 32767.
  (b) Pointer No.: 0 to 159
  (c) Bit device digit designation: 1 to 8
  (d) Basic command, function command, exclusive command value setting
    · 16-bit command: -32768 to 32767
    · 32-bit command: -2147483648 to 2147483647
(2) The decimal constant is stored in the binary value (binary) in the PLC.

5.3.12 Hexadecimal Constant H

(1) The hexadecimal constant is used to designate the basic command, function command and exclusive command values.
  · 16-bit command: 0 to FFFF
  · 32-bit command: 0 to FFFFFFFF

6. Explanation of Commands

6.1 Command List

6.1.1 Basic Commands

Class	Process unit	Command sign	Symbol	Process details	No. of steps	Page
Basic command	Bit	LD		Start of logic operation (A contact operation start)	1	42
		LDI		Start of logic denial operation (B contact operation start)	1	42
		AND		Logical AND (A contact serial connection)	1	44
		ANI		Logical AND denial (B contact serial connection)	1	44
		OR		Logical OR (A contact parallel connection)	1	46
		ORI		Logical OR denial (B contact parallel connection)	1	46
		ANB		AND between logical blocks (Serial connection between blocks)	1	48
		ORB		OR between logical blocks (Parallel connection between blocks)	1	50
		OUT		Device output	1~3	52
		SET	SET D	Device set	1	58
		RST	RST D	Device reset	1~2	60
		MC	M n D	Master control start	2	62
		MCR	MCR n	Master control release	1	62
		PLS	PLS D	Generate one cycle worth of pulses at rising edge of input signal	2	64
		PLF	PLF D	Generate one cycle worth of pulses at falling edge of input signal	2	64
		SFT	SFT D	Device 1-bit shift	4	66
		MPS	MPS	Registration of logical operation result	1	68
		MRD	MRD	Read of operation results registered in MPS	1	68
		MPP	MPP	Reading and resetting of operation results registered in MPS	1	68
		DEFR (ANDP)		Generate one cycle worth of pulses to oper-ation results at rising edge of input signal **(Note)**	1	70

(Note) The "ANDP" command is alternatively used for the MELSEC PLC development tool (GX Developer).

6.1.2 Function Commands

(1) Comparison commands

Class	Process unit	Command sign	Symbol	Process details	No. of steps	Page
=	16-bit	LD=	[= S1 S2]	Continuity state when (S1) = (S2) Non-continuity state when (S1) =/ (S2)	3	74
		AND=	[= S1 S2]		3	74
		OR=	[= S1 S2]		3	74
	32-bit	LDD=	[D= S1 S2]	Continuity state when (S1+1, S1)=(S2+1, S2) Non-continuity state when (S1+1, S1) = (S2+1, S2)	3~4	76
		ANDD=	[D= S1 S2]		3~4	76
		ORD=	[D= S1 S2]		3~4	76
>	16-bit	LD>	[> S1 S2]	Continuity state when (S1) > (S2) Non-continuity state when (S1) <= (S2)	3	78
		AND>	[> S1 S2]		3	78
		OR>	[> S1 S2]		3	78
	32-bit	LDD>	[D> S1 S2]	Continuity state when (S1+1, S1) > (S2+1, S2) Non-continuity state when (S1+1, S1) <= (S2+1, S2)	3~4	80
		ANDD>	[D> S1 S2]		3~4	80
		ORD>	[D> S1 S2]		3~4	80
<	16-bit	LD<	[< S1 S2]	Continuity state when (S1) < (S2) Non-continuity state when (S1) >= (S2)	3	82
		AND<	[< S1 S2]		3	82
		OR<	[< S1 S2]		3	82
	32-bit	LDD<	[D< S1 S2]	Continuity state when (S1+1, S1) < (S2+1, S2) Non-continuity state when (S1+1, S1) >= (S2+1, S2)	3~4	84
		ANDD<	[D< S1 S2]		3~4	84
		ORD<	[D< S1 S2]		3~4	84

(2) Arithmetic operation commands

Class	Process unit	Command sign	Symbol	Process details	No. of steps	Page
+	16-bit	+	[+ S1 S2 D]	(S1) + (S2) → (D)	4	86
	32-bit	D+	[D+ S1 S2 D]	(S1+1, S1) + (S2+1, S2) → (D+1, D)	4~5	88
–	16-bit	-	[- S1 S2 D]	(S1) – (S2) → (D)	4	90
	32-bit	D-	[D- S1 S2 D]	(S1+1, S1) – (S2+1, S2) → (D+1, D)	4~5	92
*	16-bit	*	[* S1 S2 D]	(S1) x (S2) → (D+1, D)	4	94
	32-bit	D*	[D* S1 S2 D]	(S1+1, S1) x (S2+1, S2) → (D+3, D+2, D+1, D)	5~6	96
/	16-bit	/	[/ S1 S2 D]	(S1) ÷ (S2) → (D) Quotient (D) Remainder (D+1)	5	98
	32-bit	D/	[D/ S1 S2 D]	(S1+1, S1) ÷ (S2+1, S2) → Quotient (D+1,D) Remainder (D+3, D+2)	5~6	100
+1	16-bit	INC	[INC D]	(D) + 1 → (D)	2	102
	32-bit	DINC	[DINC D]	(D+1, D) + 1 → (D + 1, D)	2	104
–1	16-bit	DEC	[DEC D]	(D) – 1 → (D)	2	106
	32-bit	DDEC	[DDEC D]	(D + 1, D) – 1 → (D + 1, D)	2	108

(3) BCD ↔ BIN conversion commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
BCD	16-bit	BCD	[BCD S D]	BCD conversion (S) → (D) BIN (0 to 9999)	3	110
	32-bit	DBCD	[DBCD S D]	BCD conversion (S1+1,S1) → (D+1,D) BIN (0 to 99999999)	4	112
BIN	16-bit	BIN	[BIN S D]	BIN conversion (S) → (D) BIN (0 to 9999)	3	114
	32-bit	DBIN	[DBIN S D]	BIN conversion (S1+1,S1) → (D+1,D) BIN (0 to 99999999)	4	116

(4) Data transmission commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Trans-mission	16-bit	MOV	[MOV S D]	· (S) → (D)	3	118
	32-bit	DMOV	[DMOV S D]	· (S+1,S) → (D+1,D)	3~4	120
Conversion	16-bit	XCH	[XCH D1 D2]	· (D1) ↔ (D2)	4	122
	32-bit	DXCH	[DXCH D1 D2]	· (D1+1,D1) ↔ (D2+1,D2)	4	124
Batch trans-mission	16-bit	BMOV	[BMOV S D n]	(S) → (D) n	5	126
Batch trans-mission of same data	16-bit	FMOV	[FMOV S D n]	(S) → (D) n	5	128

(5) Program branch commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Jump	—	CJ	[CJ P**]	Jump to P** after input conditions are met	2	130
Program end	—	FEND	[FEND]	End process during sequence program	1	132
Subroutine call	—	CALL	[CALL P**]	Execute P** sub-routine program after input conditions are met	2	134
Return	—	RET	[RET]	Return to main program from subroutine program	1	134

(6) Logical operation commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Logical AND	16-bit	WAND	WAND S1 S2 D	(S1) ^ (S2) → (D)	4	136
	32-bit	DAND	DAND S D	(D + 1, D) ^ (S + 1, S) → (D + 1, D)	3~4	138
Logical OR	16-bit	WOR	WOR S1 S2 D	(S1) V (S2) → (D)	4	140
	32-bit	DOR	DOR S D	(D + 1, D) V (S + 1, S) → (D + 1, D)	3~4	142
Exclusive OR	16-bit	WXOR	WXOR S1 S2 D	(S1) V– (S2) → (D)	4	144
	32-bit	DXOR	DXOR S D	(D + 1, D) (S + 1, S) → (D + 1, D)	3~4	146
Complement of 2	16-bit	NEG	NEG D	$\overline{(D)}$ + 1 → (D)	2	148

(7) Rotation commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Right rotation	16-bit	ROR	ROR D n	b15 (D) b0 SM12 Rotate n bits right.	3	150
		RCR	RCR D n	b15 (D) b0 SM12 Rotate n bits right.	3	152
	32-bit	DROR	DROR D n	(D+1) (D) b31 ∼ b16 b15 ∼ b0 SM12 Rotate n bits right.	3	154
		DRCR	DRCR D n	(D+1) (D) b31 ∼ b16 b15 ∼ b0 SM12 Rotate n bits right.	3	156
Left rotation	16-bit	ROL	ROL D n	SM12 b15 (D) b0 Rotate n bits left.	3	158
		RCL	RCL D n	SM12 b15 (D) b0 Rotate n bits left.	3	160
	32-bit	DROL	DROL D n	(D+1) (D) SM12 b31 ∼ b16 b15 ∼ b0 Rotate n bits left.	3	162
		DRCL	DRCL D n	(D+1) (D) SM12 b31 ∼ b16 b15 ∼ b0 Rotate n bits left.	3	164
Right shift	16-bit	SFR	SFR D n	b15 bn b0 b15 b0 SM12 0∼0	3	166
	Device unit	DSFR	DSFR D n	n (D) 0	4	168
Left shift	16-bit	SFL	SFL D n	b15 bn b0 SM12 b15 b0 0∼0	3	170
	Device unit	DSFL	DSFL D n	n (D) 0	4	172

(8) Data processing commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Search	16-bit	SER	[SER S1 S2 D]	(S1) (S2) n → (D) :Match No. (D+1) :Number of match data pieces	6	174
Number of bits set to 1	16-bit	SUM	[SUM S D]	(S) b15 b0 → Number of bits set to 1.	4	176
Decode	2^n-bit	DECO	[DECO S D n]	8→256 decode (S) Decode → (D) n 2^n bits	5	178
	16-bit	SEG	[SEG S D]	b3～b0 (S) 7SEG → (D)	3	180
Average value	16-bit	S.AVE	[S.AVE S D n]	16-bit data average value $\frac{1}{n}\sum_{i=1}^{n}(S+i) \rightarrow (D)$	5	182

(9) Other function commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Carry flag set	—	S.STC	[S.STC]	Carry flag contact (SM12) is turned on.	1	184
Carry flag reset	—	S.CLC	[S.CLC]	Carry flag contact (SM12) is turned off.	1	184
BIT	1-bit	LDBIT (<=)	[BIT S1 n]	Bit test (A contact operation start handling) **(Note)**	2	186
		ANDBIT (<=)	[BIT S1 n]	Bit test (A contact series connection handling) **(Note)**	2	186
		ORBIT (<=)	[BIT S1 n]	Bit test (A contact parallel connection handling) **(Note)**	2	186
		LDBII (< >)	[BII S1 n]	Bit test (B contact operation start handling) **(Note)**	2	188
		ANDBII (< >)	[BII S1 n]	Bit test (B contact series connection handling) **(Note)**	2	188
		ORBII (< >)	[BII S1 n]	Bit test (B contact parallel connection handling) **(Note)**	2	188

(Note) The comparison operation commands are alternatively used for the MELSEC PLC development tool (GX Developer).

6.1.3 Exclusive commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
ATC	—	S.ATC	S.ATC Kn Rn Rm Mn	K1: Tool number search	5	198
				K2: Tool number AND search		199
				K3: Tool change		200
				K4: Random position tool change		201
				K5: Forward rotation of pointer		202
				K6: Reverse rotation of pointer		202
				K7: Normal rotation of tool table		203
				K8: Reverse rotation of tool table		203
				K9: Tool data read		204
				K10: Tool data write		205
				K11: Automatic write of tool data		206
ROT	—	S.ROT	S.ROT Kn Rn Rm Mn	K1: Rotary body index	5	211
				K3: Ring counter		215
TSRH	—	S.TSRH	S.TSRH Rn Rm Mn	Spare tool selection in tool life management	4	216
DDB	—	S.DDBA (Asynchro-nous)	S.DDBA Rn/Dn	Data designated after Rn/Dn is read/written.	2	227
		S.DDBS (Synchro-nous)	S.DDBS Rn	Data designated after Rn is read/written.	2	230

6.2 Command Formats

6.2.1 How to Read the Command Table

The basic command and function command explanations are shown below.

Example of D+ command

The command signal is indicated.

D+······BIN 32-bit addition

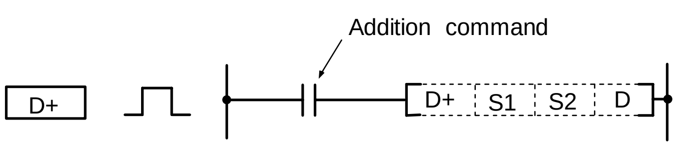
	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									4/5		
S2							○	○	○	○				○	○						
D							○	○	○	○											

The devices that can be used with the D+ command are circled.

A circle is indicated if digit designation of the bit device is possible.

The No. of steps of the D+ command is indicated.
This is a No. of steps required for the store in the controller.
In programming with MELSEC PLC development tool (GX Developer), the displayed No. of steps may be different from this No. of steps.
Description such as "4/5" indicates that the No. of steps is different depending on the designation device. For the 32-bit command, two steps are required for the constant. In the example for the D+ command, if S2 is the word device, the No. of steps will be 4 steps, and if S2 is the constant, the No. of steps will be 5 steps.

The commands that can use an index (Z) are circled.
Such a command is only the MOV command in this manual.



setting data

S1	Addition data or head No. of device where addition data is stored.
S2	Addition data or head No. of device where addition data is stored.
D	Head No. of device to store addition results.

The D+ command circuit display format is indicated.

The functions first, then execution conditions, then program examples are described on the following pages.

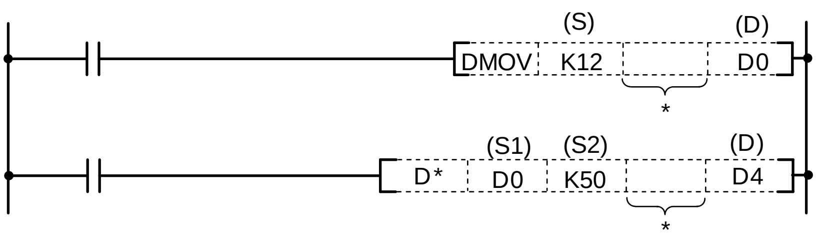
6.2.2 No. of Steps

The basic No. of steps in the sequence command includes step 1 to step 6.
Main examples of each step are shown below.

Basic No. of steps	Command (mnemonic)	Circuit display
Step 1	LD, ANI, ANB, ORB, STC, CLC, FEND, RET, P**	FEND
Step 2	INC, DEC, PLS, PLF, CJ, CALL	INC D10 CALL P20
Step 3	MOV, =, BCD, OUT T	MOV K100 D100 = D0 D1 BCD D0 D1 T1 K1
Step 4	DMOV, +, -, XCH	DMOV K12345 D0 2 steps worth + D0 K100 D1 XCH D0 D10 2 steps worth
Step 5	D+, D-	D+ D0 H12345678 D10 2 steps worth
Step 6	D*, D/	D* D0 K123456 D10 2 steps worth

As shown above, the command code, source and destination in basic No. of steps for the command are equivalent to one step each. Only some of the command codes and the 32-bit command constant K or H use two steps.

(Note) If the constant value in the DMOV or D* command, etc., is small, a display in which there is a space equivalent to one step will occur between the source (S) and destination (D) or between the source (S2) and destination (D). (Section marked with * in diagram.

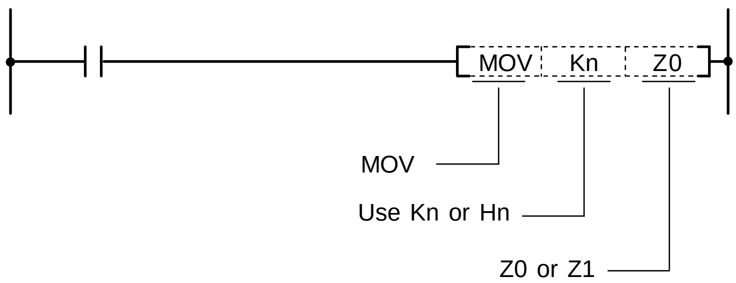


6.2.3 END Command

With the END command, both the circuit mode and the list mode are automatically created, so programming is not necessary.

6.2.4 Index Ornament

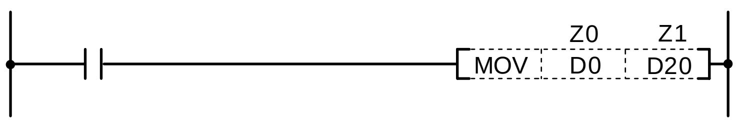
(1) The index ornament is used to add an index (Z0, Z1) to a device, add the details of the directly designated device No. and index register, and designate the device No.
(2) The index (Z0, Z1) can be set between -32768 to 32767 with a sign added.
(3) The index ornament is used only for the MOV command. (It cannot be used for DMOV.)
(4) The usable command format is shown below.
(a) Transmission of data to Z0, Z1



(b) Possible device combinations of MOV command with index ornament

	S (source)	D (destination)	Program example
MOV	Constant Kn or Hn	(Word device) · Z Example) D0Z0, R500Z1	MOV K100 D0Z0
	Word device Example) D0, R1900	(Word device) · Z Example) D0Z0, R500Z1	MOV D0 D100Z1
	(Word device) · Z Example) D0Z0	(Word device) · Z Example) D1Z0, D0Z1	MOV D0Z0 D20Z0
	(Word device) · Z Example) D0Z0	Bit designation Example) K2Y20	MOV D0Z0 K2M10
	Bit designation Example) K2M00	(Word device) · Z Example) D0Z0, R1900Z1	MOV K2M10 D0Z0

(Note 1) The word device refers to T, C, D and R.
(Note 2) The display of the circuit with index ornament is as shown below.

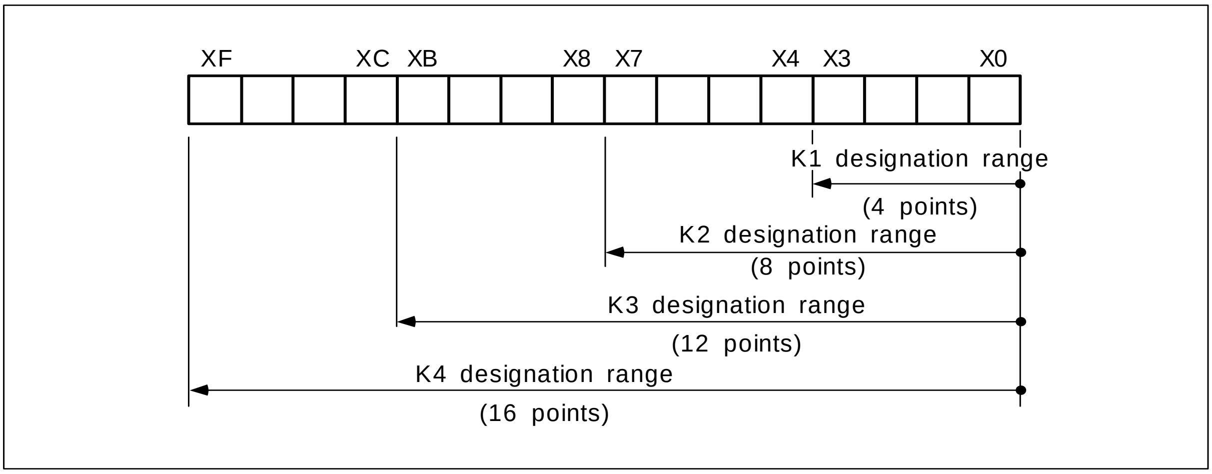


6.2.5 Digit Designation

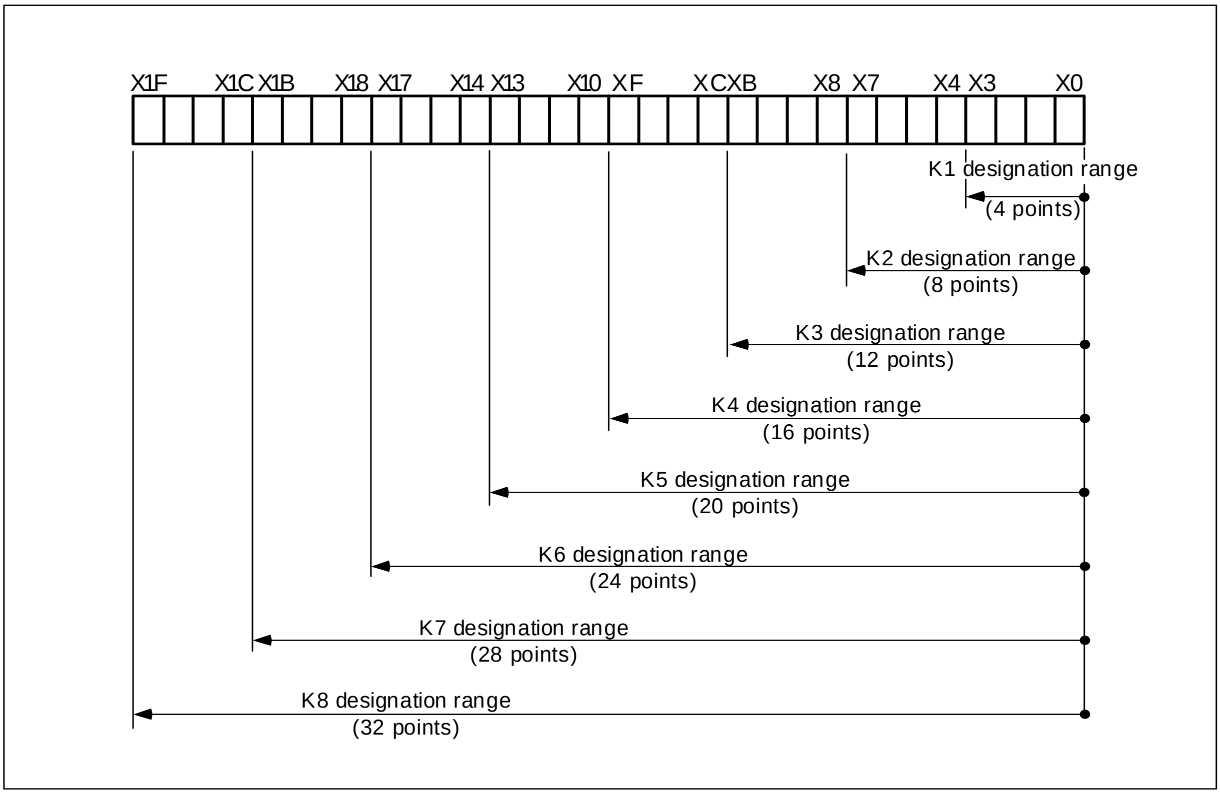
A digit may need to be designated for the bit device (X, Y, M, L, SM, F) when using the function command. How many points of 4-point unit bit devices are to be used with the 16-bit or 32-bit command is selected with this digit designation.
Use device K when designating the digit. The designation range is as shown below. A random bit device can be set for the bit device.

(a) 16-bit command: K1 to 4 (4 to 16 points)

(Example) Setting range with digit designation of X0 to F 16-bit data



(b) 32-bit command: K1 to 8 (4 to 32 points)
(Example) Setting range with digit designation of X0 to 1F 32-bit data.



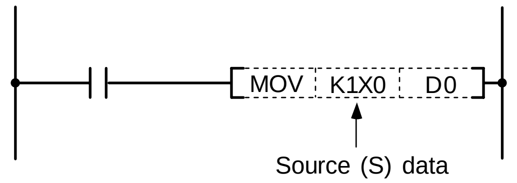
(1) When a digit is designated on the source (S) side, the values that can be handled as source data will be as shown below.

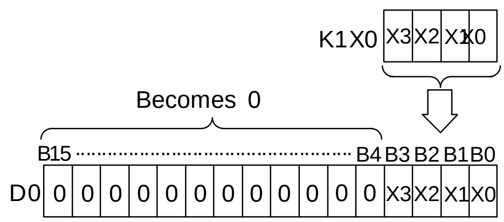
Table of digit designations and values that can be handled

	For 16-bit command	For 32-bit command
K1 (4 points)	0~15	0~15
K2 (8 points)	0~255	0~255
K3 (12 points)	0~4095	0~4095
K4 (16 points)	-32768~32767	0~65535
K5 (20 points)	—	0~1048575
K6 (24 points)	—	0~167772165
K7 (28 points)	—	0~268435455
K8 (32 points)	—	-2147483648~2147483647

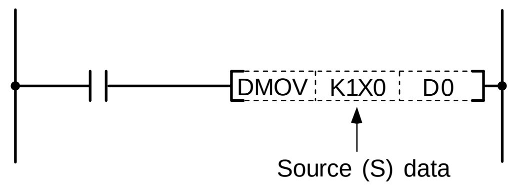
Program example | **Process**

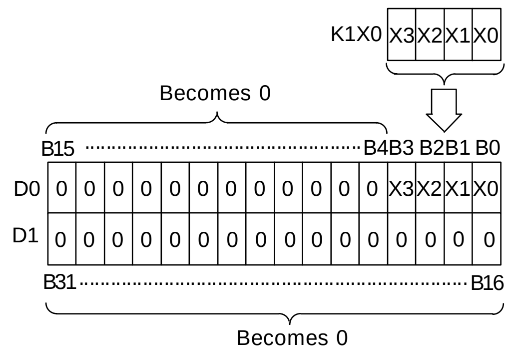
For 16-bit command



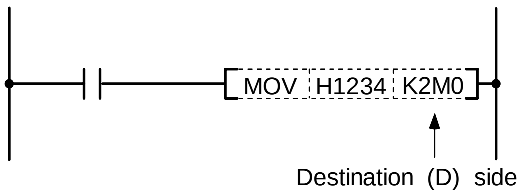
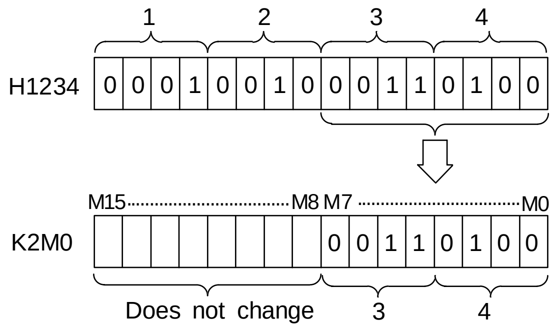
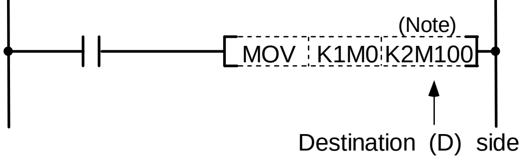
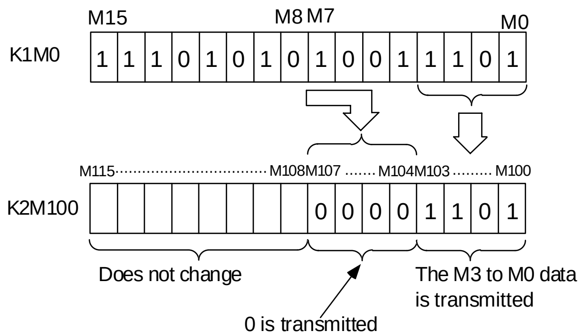
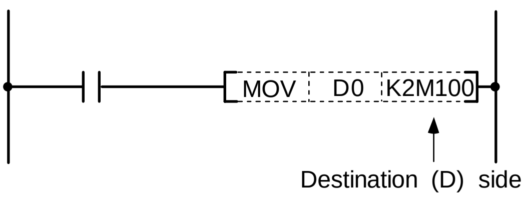
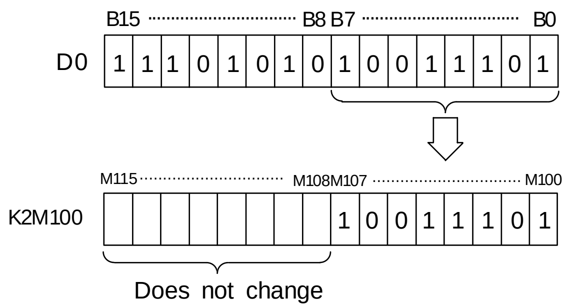


For 32-bit command

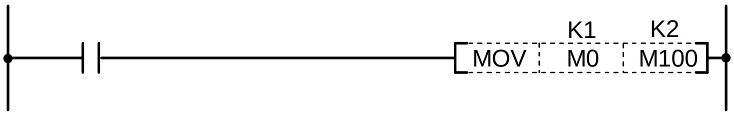




(2) When a digit is designated on the destination (D) side, the No. of points designated by the digit will be the target of the destination side.

Circuit side	Process
When source data (S) is a value 	
When source data (S) is a bit device 	
When source data (S) is a word device 	

(Note) The display of the circuit having a digit designation will be as follows.

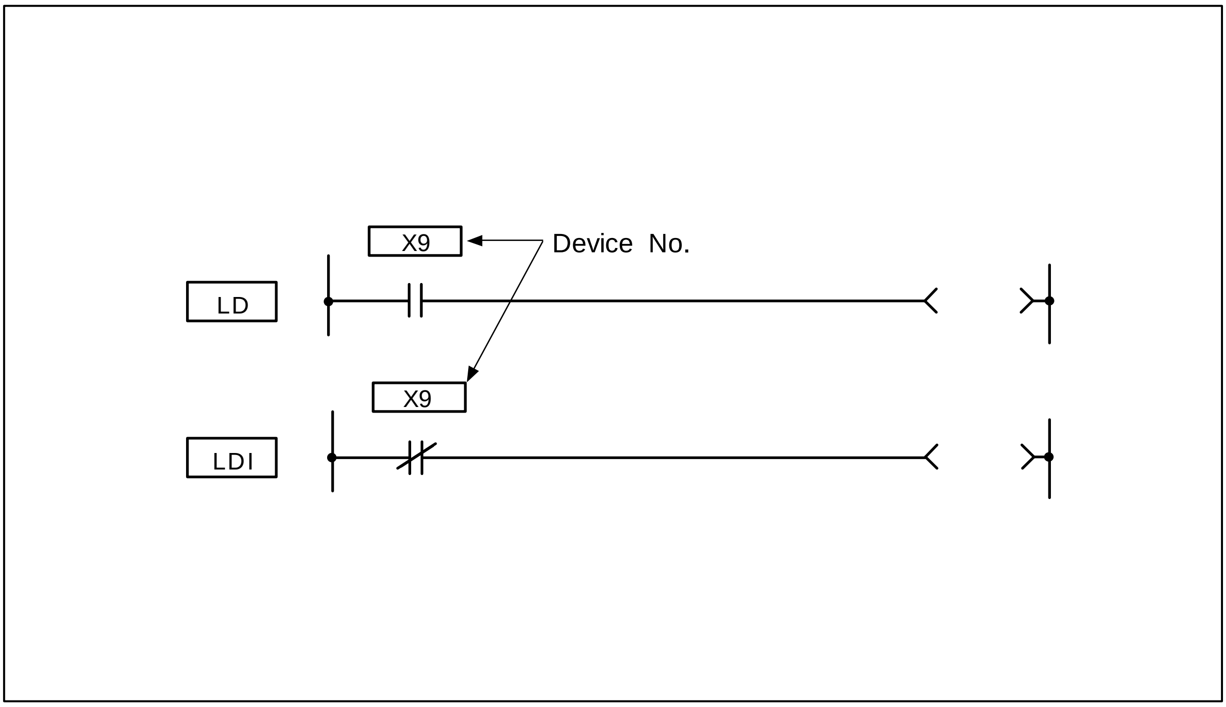


7. Basic Commands

These commands are the basis for the sequence programs. The sequence program cannot be created without these commands.
The circuit can be created (programmed) with the same image as creating a circuit by combining the actual relay A contacts and B contacts as done conventionally.

○ **LD, LDI ... Operation start**

Usable device																	Digit desig-nation	No. of steps	Index	
Bit device								Word device					Con-stant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
○	○	○	○	○	○	○	○											1		



Function

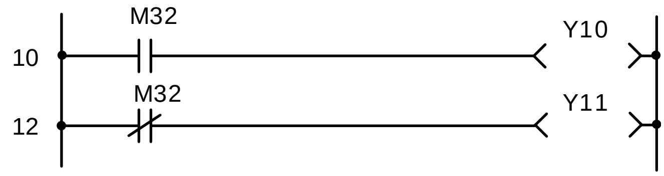
LD is the A contact operation start command and LDI is the B contact operation start command. The ON/OFF information of the designated device is read in as the operation results.

Execution conditions

This is executed per scan regardless of the device ON/OFF setting.

Program example

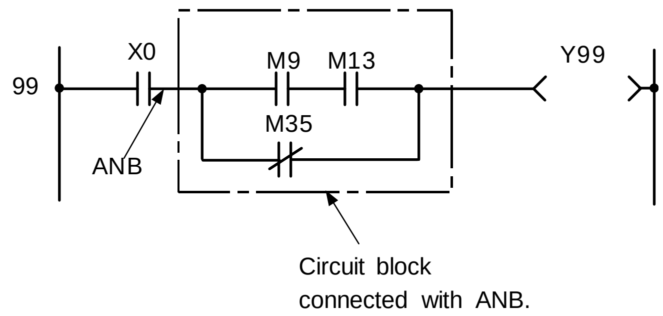
(1) Program used at head of circuit block.



Coding

No. of steps	Com- mand	Device		
10	LD	M32		
11	OUT	Y10		
12	LDI	M32		
13	OUT	Y11		
14				

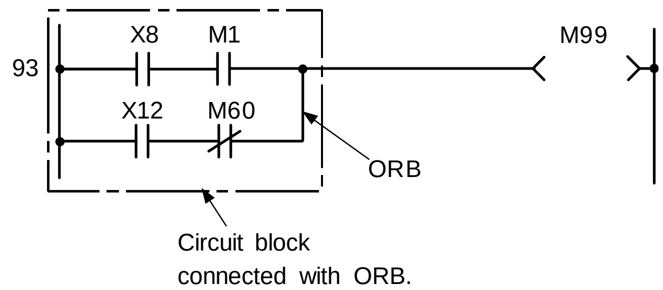
(2) Program used at head of circuit block connected with ANB.



Coding

No. of steps	Com- mand	Device		
99	LD	X0		
100	LD	M9		
101	AND	M13		
102	ORI	M35		
103	ANB			
104	OUT	Y99		
105				

(3) Program used at head of circuit block connected with ORB.

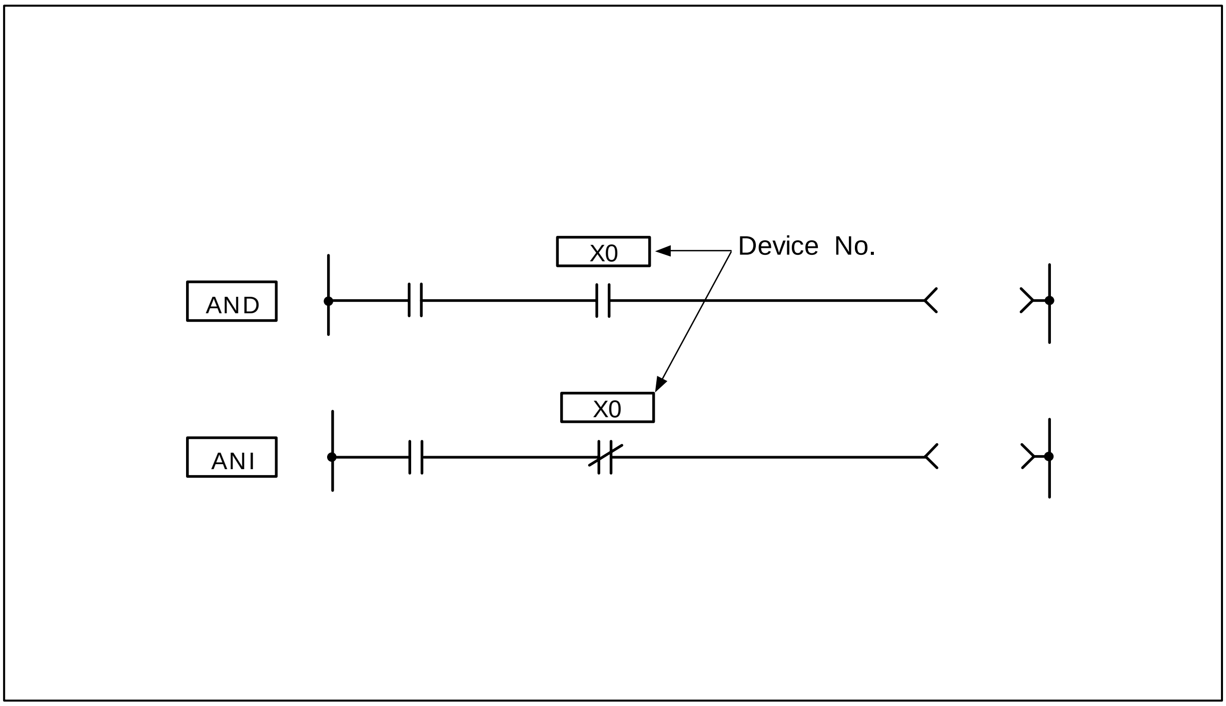


Coding

No. of steps	Com- mand	Device		
93	LD	X8		
94	AND	M1		
95	LD	X12		
96	ANI	M60		
97	ORB			
98	OUT	M99		
99				

○ AND, ANI ... Serial connection of contact

Usable device																	Digit designation	No. of steps	Index	
Bit device								Word device					Constant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
○	○	○	○	○	○	○	○											1		



Function

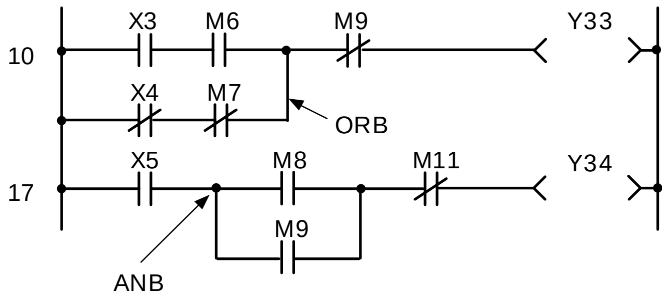
AND is the A contact serial connection command, and ANI is the B contact serial connection command. The ON/OFF information of the designated device is read in, and the AND operation with the operation results up to that point is executed. The result is the operation result.

Execution conditions

This is executed per scan regardless of the operation results before the AND, ANI commands.

Program example

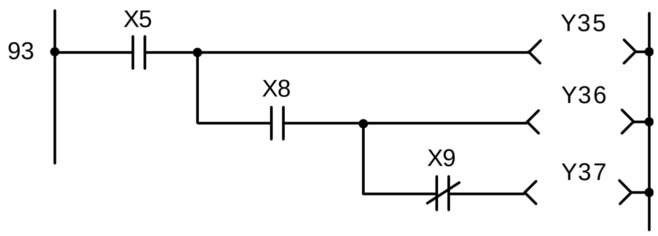
(1) Program used after LD, LDI, AND or ANI, etc.



Coding

No. of steps	Com-mand	Device		
10	LD	X3		
11	AND	M6		
12	LDI	X4		
13	ANI	M7		
14	ORB			
15	ANI	M9		
16	OUT	Y33		
17	LD	X5		
18	LD	M8		
19	OR	M9		
20	ANB			
21	ANI	M11		
22	OUT	Y34		
23				

(2) Program used to connect contact in parallel with coil.

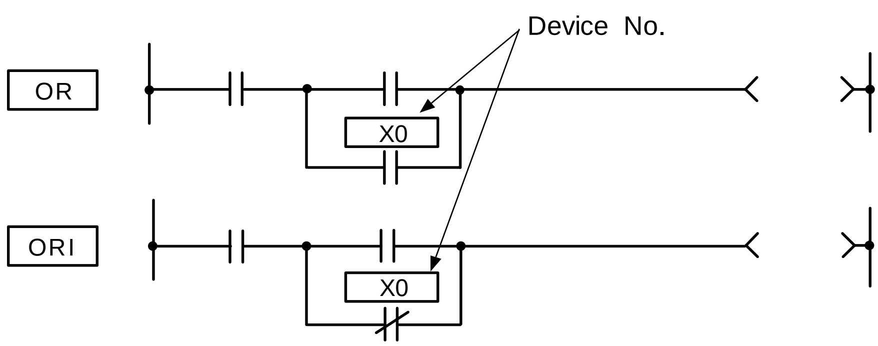


Coding

No. of steps	Com-mand	Device		
93	LD	X5		
94	OUT	Y35		
95	AND	X8		
96	OUT	Y36		
97	ANI	X9		
98	OUT	Y37		
99				

○ OR, ORI ... Parallel connection of one contact

Usable device																	Digit designation	No. of steps	Index	
Bit device								Word device					Constant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
○	○	○	○	○	○	○	○											1		



Function

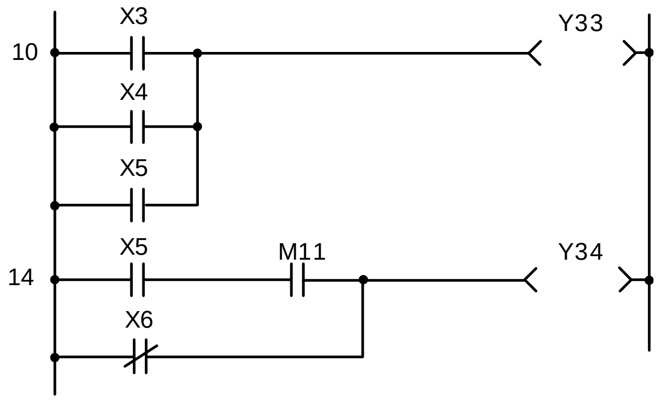
OR is the one A contact parallel connection command, and ORI is the one B contact parallel connection operation command. The ON/OFF information of the designated device is read in, and the OR operation with the operation results up to that point is executed. The result is the operation result.

Execution conditions

This is executed per scan regardless of the operation results before the OR, ORI commands.

Program example

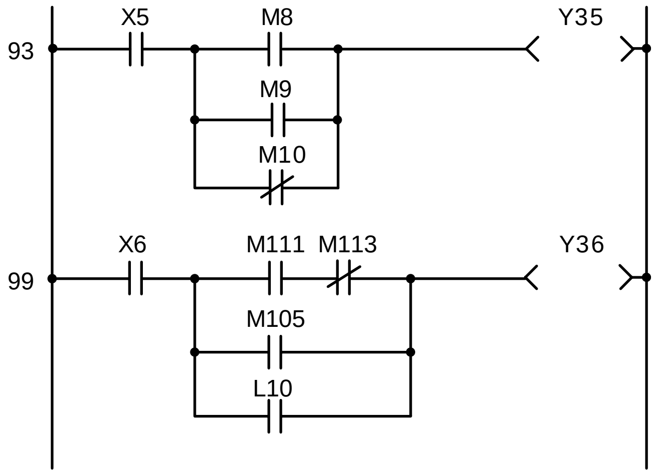
(1) Program used at head of circuit block.



Coding

No. of steps	Com-mand	Device		
10	LD	X3		
11	OR	X4		
12	OR	X5		
13	OUT	Y33		
14	LD	X5		
15	AND	M11		
16	ORI	X6		
17	OUT	Y34		
18				

(2) Program used in circuit.

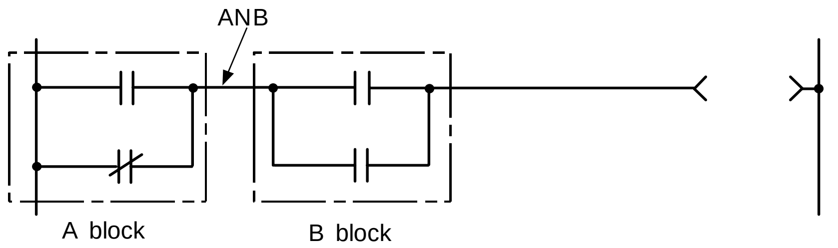


Coding

No. of steps	Com-mand	Device		
93	LD	X5		
94	LD	M8		
95	OR	M9		
96	ORI	M10		
97	ANB			
98	OUT	Y35		
99	LD	X6		
100	LD	M111		
101	ANI	M113		
102	OR	M105		
103	OR	L10		
104	ANB			
105	OUT	Y36		
106				

○ **ANB ... Serial connection of circuit block**

Usable device																	Digit designation	No. of steps	Index	
Bit device								Word device					Constant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
																		1		

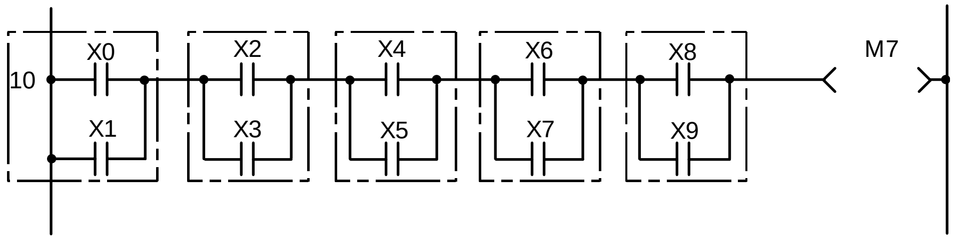


Function

(1) AND operation of the A block and B block is executed, and the operation results are obtained.
(2) The ANB symbol is a connection symbol instead of a contact symbol.
(3) When consecutively writing ANB, a max. of 7 commands (8 blocks) can be written. The PC cannot execute a correct operation if 8 or more commands are written consecutively.

Program example

Program that serially connects continuous circuit blocks.

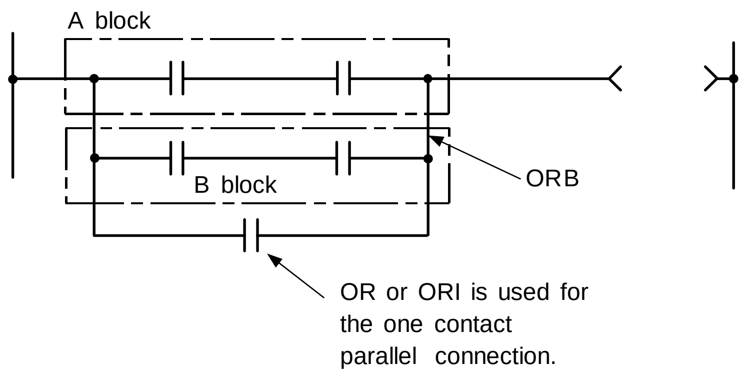


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	OR	X1		
12	LD	X2		
13	OR	X3		
14	ANB			
15	LD	X4		
16	OR	X5		
17	ANB			
18	LD	X6		
19	OR	X7		
20	ANB			
21	LD	X8		
22	OR	X9		
23	ANB			
24	OUT	M7		
25				

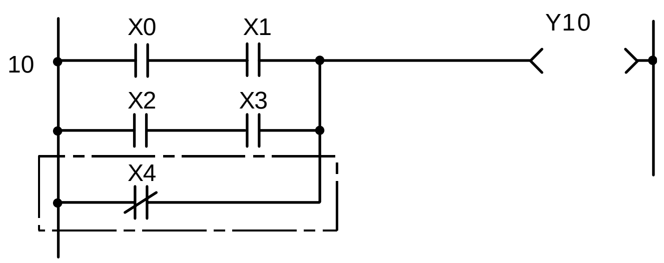
○ ORB ... Parallel connection of blocks

Usable device																	Digit designation	No. of steps	Index	
Bit device								Word device					Constant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
																		1		



Function

(1) OR operation of the A block and B block is executed, and the operation results are obtained.
(2) ORB connects circuit blocks with two or more contacts in parallel. Use OR or ORI to connect circuit blocks with only one contact in parallel.



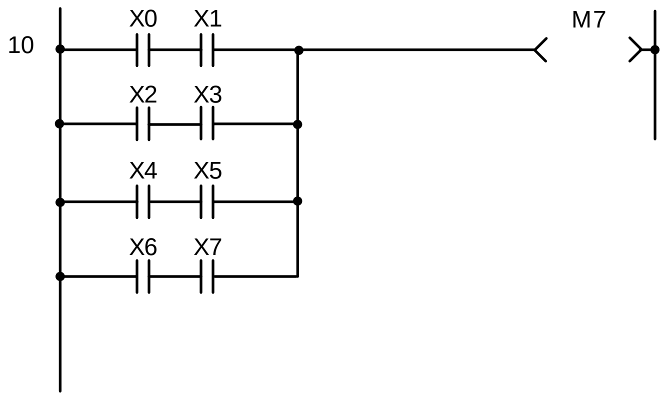
Coding

No. of steps	Command	Device		
10	LD	X0		
11	AND	X1		
12	LD	X2		
13	AND	X3		
14	ORB			
15	ORI	X4		
16	OUT	Y10		
17				

(3) The ORB symbol is a connection symbol instead of a contact symbol.
(4) When consecutively writing ORB, a max. of 7 commands (8 blocks) can be written. The PC cannot execute a correct operation if 8 or more commands are written consecutively.

Program example

Program that connects continuous circuit blocks in parallel.

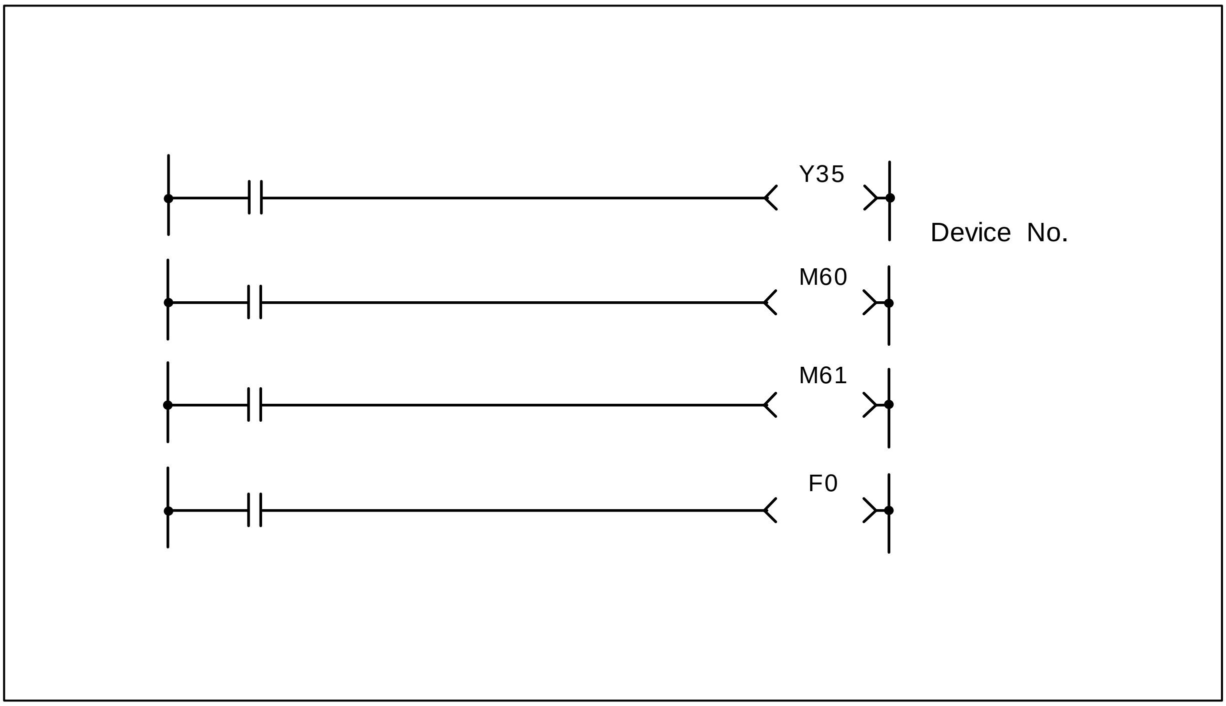


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	AND	X1		
12	LD	X2		
13	AND	X3		
14	ORB			
15	LD	X4		
16	AND	X5		
17	ORB			
18	LD	X6		
19	AND	X7		
20	ORB			
21	OUT	M7		
22				

○ OUT (Y, M, L, SM, F) ... Output (Y, M, L, SM, F)

Usable device																	Digit designation	No. of steps	Index	
Bit device						Word device							Con-stant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
	○	○	○	○	○													1		



Function

The operation results before the OUT command are output to the designated device.

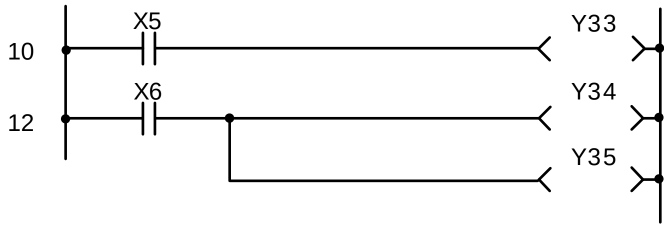
Operation results	OUT command		
	Coil	Contact	
		A contact	B contact
OFF	OFF	Non-continuity	Continuity
ON	ON	Continuity	Non-continuity

Execution condition

This is executed per scan regardless of the operation results before the OUT command.

Program example

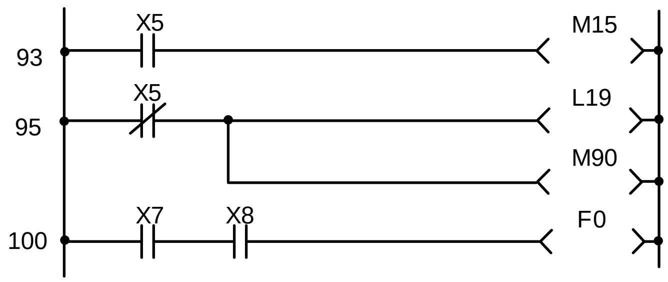
(1) Program output to output unit.



Coding

No. of steps	Com-mand	Device		
10	LD	X5		
11	OUT	Y33		
12	LD	X6		
13	OUT	Y34		
14	OUT	Y35		
15				

(2) Program that turns internal relay or latch relay ON/OFF.

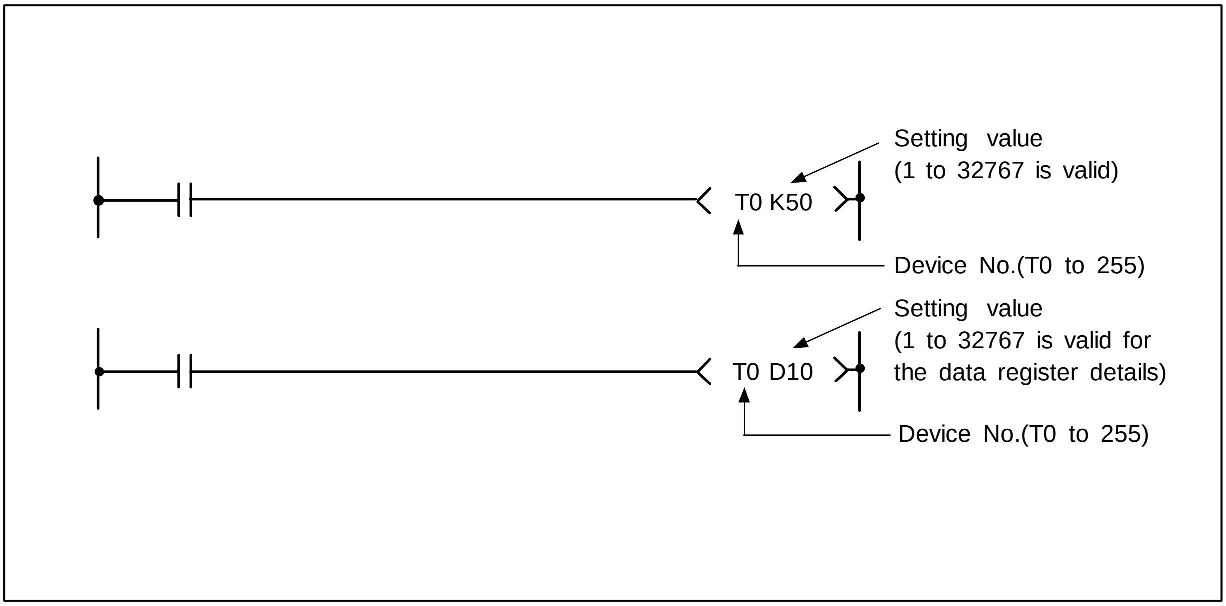


Coding

No. of steps	Com-mand	Device		
93	LD	X5		
94	OUT	M15		
95	LDI	X5		
96	OUT	L19		
97	OUT	M90		
100	LD	X7		
101	AND	X8		
102	OUT	F0		
103				

○ OUT T ... Timer output

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
Device							○												3		
Setting value									○					○							



Function

(1) When the operation results before the OUT command are ON, the timer coil will turn ON and count to the set value. When the time is counted up (count value >= set value), the contacts will change as shown below.

A contact	Continuity
B contact	Non-continuity

(2) If the operation results before the OUT command turn ON to OFF, the following will occur.

Timer type	Timer coil	Timer current value	Before time up		After time up	
			A contact	B contact	A contact	B contact
100ms timer	OFF	0	Non-continuity	Continuity	Continuity	Non-continuity
10ms timer						
100ms integrated timer	OFF	Hold current value	Non-continuity	Continuity	Continuity	Non-continuity

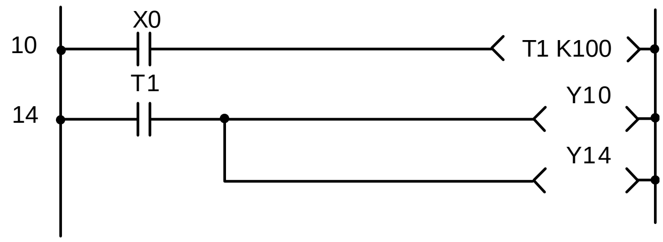
(3) The state of the integrated timer contact after time up will not change until the RST command is executed.

Execution condition

This is executed per scan regardless of the operation results before the OUT command.

Program example

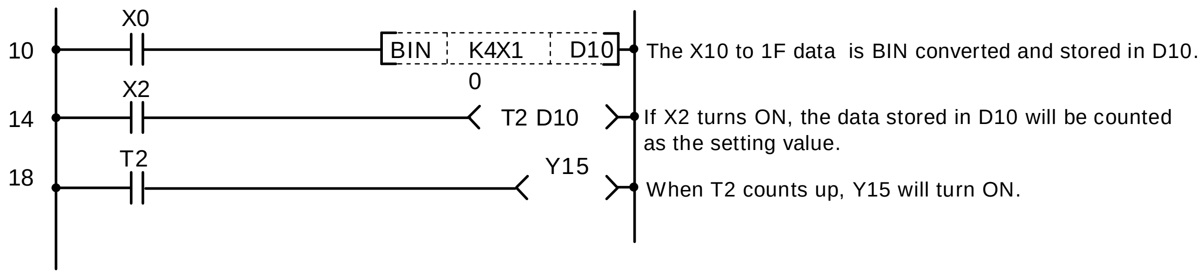
(1) Program to turn ON Y10 and Y14 ten seconds after X0 turns ON.



Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	OUT	T1	K100	
14	LD	T1		
15	OUT	Y10		
16	OUT	Y14		
17				

(2) Program to use X10 to 1F BCD data as timer setting value.

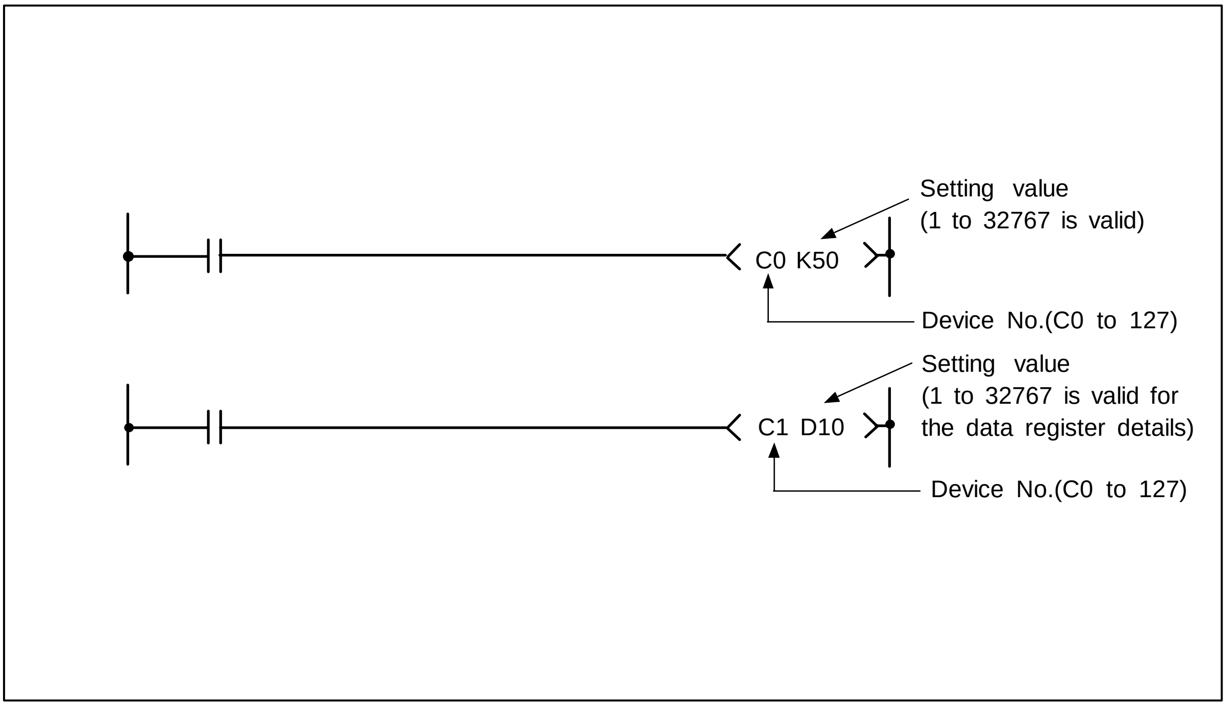


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	BIN	K4X10	D10	
14	LD	X2		
15	OUT	T2	D10	
18	LD	T2		
19	OUT	Y15		
20				

○ **OUT C ... Counter output**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device								Word device					Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
Device								○											3		
Setting value									○					○							



Function

(1) If the operation results before the OUT command change from OFF to ON, the current value (count value) will be incremented by one. When the value is counted up (current value >= setting value), the contacts will change as shown below.

A contact	Continuity
B contact	Non-continuity

(2) The value will not be counted when the operation results are ON. (A pulse change is not required to input the count.)

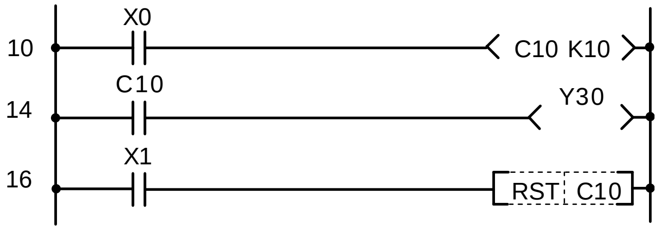
(3) If the operation results change from OFF to ON after the "current value >= setting value" is established, the contact state will remain the same, however the current value will be incremented by 1.

Execution condition

This is executed per scan regardless of the operation results before the OUT command.

Program example

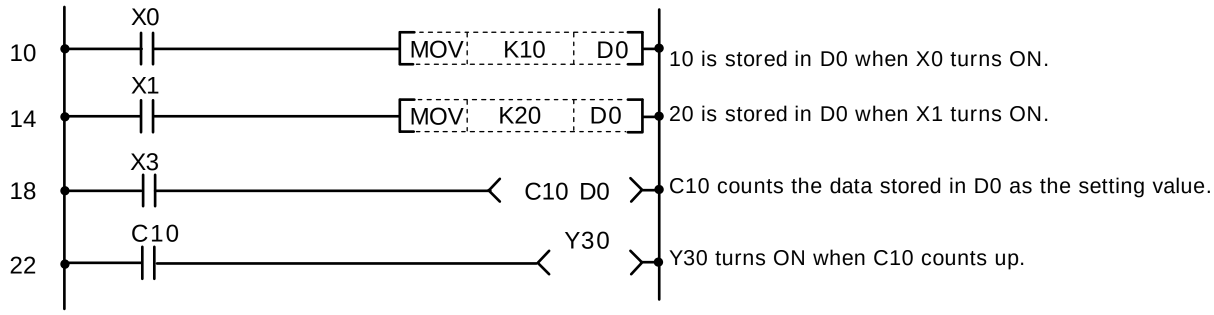
(1) Program to turn Y30 ON when X0 turns ON ten times, and to turn Y30 OFF when X1 turns ON.



Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	OUT	C10	K10	
14	LD	C10		
15	OUT	Y30		
16	LD	X1		
17	RST	C10		
19				

(2) Program to set C10 setting value to 10 when X0 turns ON, and to 20 when X1 turns ON.

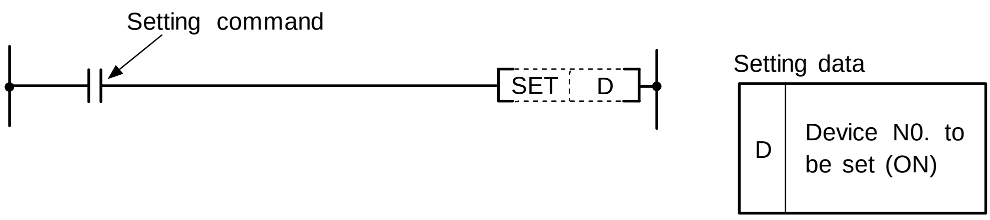


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	MOV	K10	D0	
14	LD	X1		
15	MOV	K20	D0	
18	LD	X3		
19	OUT	C10	D0	
22	LD	C10		
23	OUT	Y30		
24				

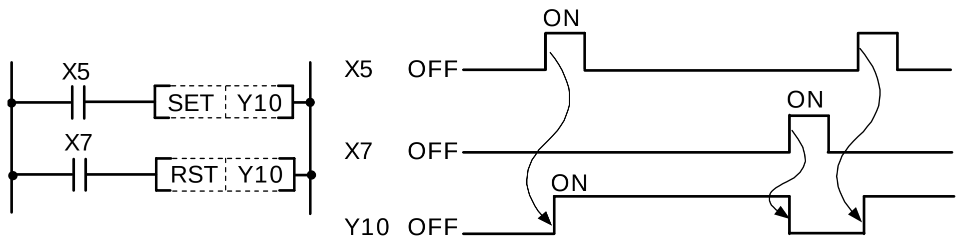
○ SET ... Device setting (ON)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device							Word device					Constant		Pointer	Level					
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D		○	○	○	○	○													1		



Function

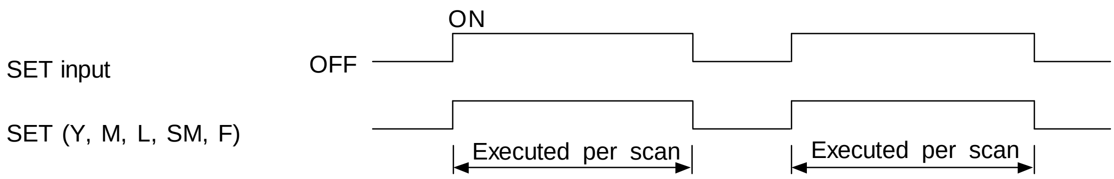
(1) The designated device turns ON when the SET input turns ON.
(2) The device turned ON remains ON even if the SET input turns OFF. The device can be turned OFF with the RST command.



(3) If the SET input is OFF, the state of the device will not change.

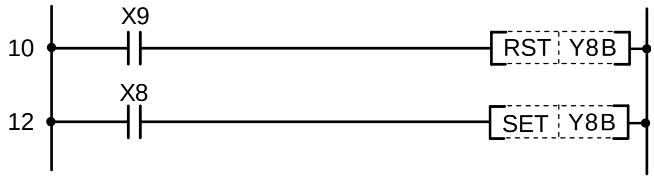
Execution condition

The execution conditions for the SET command are as shown below.



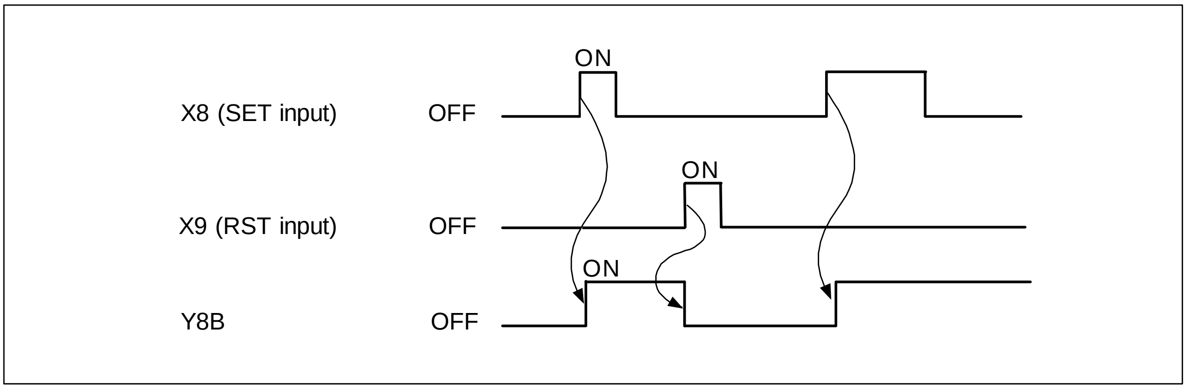
Program example

(1) Program to set Y8B (ON) when X8 turns ON, and reset Y8B (OFF) when X9 turns ON.



Coding

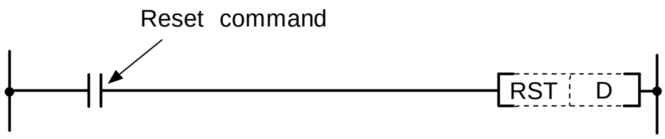
No. of steps	Com-mand	Device		
10	LD	X9		
11	RST	Y8B		
12	LD	X8		
13	SET	Y8B		
14				



Operation of SET and RST commands

○ RST ... Device resetting

	Usable device																	Digit designation	No. of steps	Index	
	Bit device								Word device					Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D		○	○	○	○	○	○	○											1/2		



Setting data

D	Device No. to be reset

Function

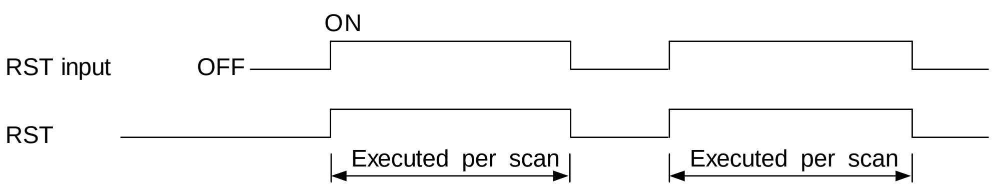
(1) The designated device will change as explained below when the RST input turns ON.

Device	Status
Y, M, L, SM, F	The coil and contact are turned OFF.
T, C	0 is set for the current value, and the coil and contact are turned OFF.

(2) If the RST input is OFF, the state of the device will not change.

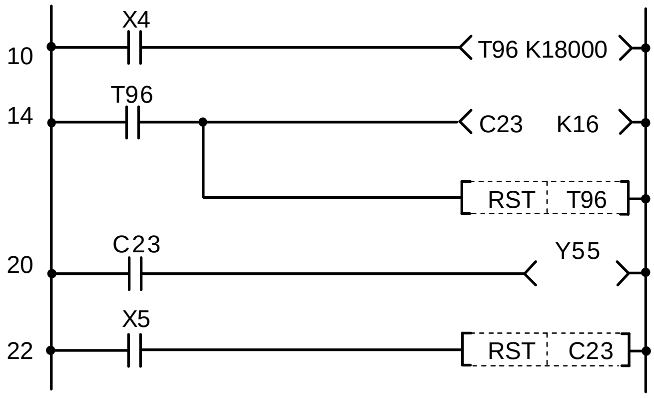
Execution condition

The execution conditions for the RST command are as shown below.



Program example

(1) Program to reset 100ms integrated timer and counter.



When T96 is set for the integrated timer, T96 will turn ON when the X4 ON time is 30 min.

The No. of times that T96 turns ON is counted.

T96 is reset when T96 turns ON.

Y55 turns ON when C23 counts up.

C23 is reset when X5 turns ON.

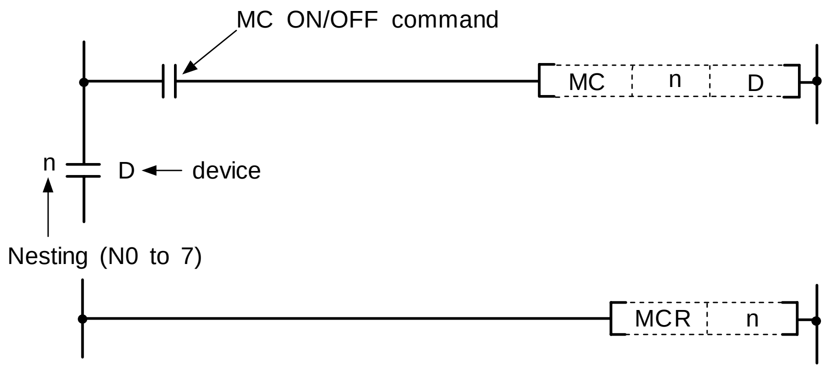
2 steps are used for T or C device.
1 step is used for the other devices.

Coding

No. of steps	Com-mand	Device		
10	LD	X4		
11	OUT	T96	K18000	
14	LD	T96		
15	OUT	C23	K16	
18	RST	T96		
20	LD	C23		
21	OUT	Y55		
22	LD	X5		
23	RST	C23		
25				

○ **MC, MCR ... Master control set/reset**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device							Word device						Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
n																	○		2/1		
D		○	○	○	○	○															



Setting data

n	Nesting (N0 to 7)
D	Device No. to be turned ON

Function

MC

(1) If the MC ON/OFF command is ON when the master control starts, the operation results between MC and MCR will remain the same.

(2) If the MC ON/OFF command is OFF, the operation results between MC and MCR will be as follows.

100ms, 10ms timer	100ms integrated timer counter	OUT command	SET/RST	SFT
Count value is set to 0	Current count value is held	All become OFF	The state is retained	

(3) Up to eight (N0 to 7) nests can be used. When using nests, the MC will use the nesting (N) from the smallest No., and MCR will use from the largest No.

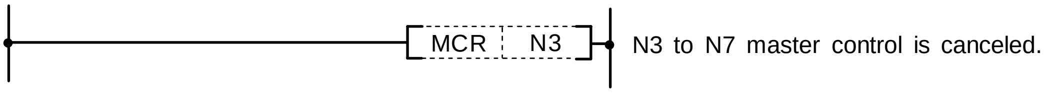
(4) The program between the MC command and MCR command will be scanned regardless of the MC command ON/OFF state.

(5) By changing the destination D device, the MC command can be used as often as necessary in one scan.

(6) When the MC command is ON, the coil for the device designated for the destination will turn ON.

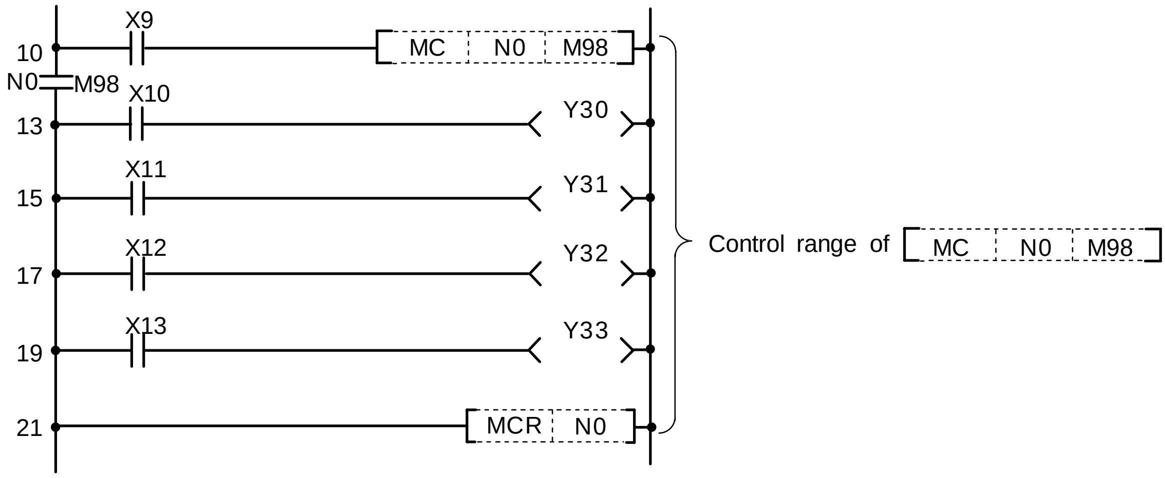
MCR

(1) This is the master control cancel command, and indicates the end of the master control range.
(2) The designated nesting (N) No. and following nests will be canceled.



Program example

(1) Program to turn MC ON when X9 is ON and turn MC OFF when OFF.

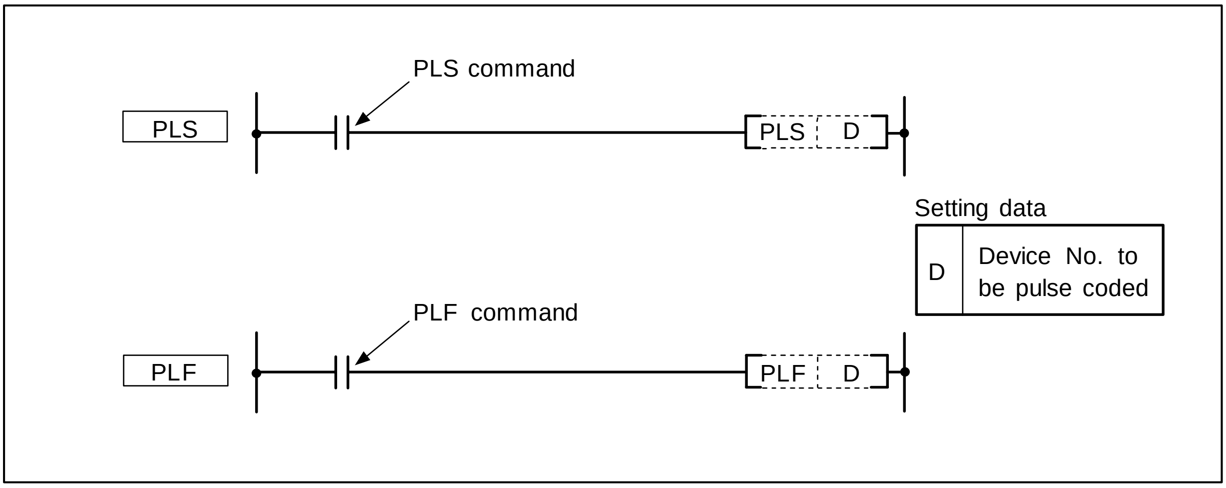


Coding

No. of steps	Com-mand	Device		
10	LD	X9		
11	MC	N0	M98	
13	LD	X10		
14	OUT	Y30		
15	LD	X11		
16	OUT	Y31		
17	LD	X12		
18	OUT	Y32		
19	LD	X13		
20	OUT	Y33		
21	MCR	N0		
22				

○ PLS, PLF ... Pulse (1 scan ON)

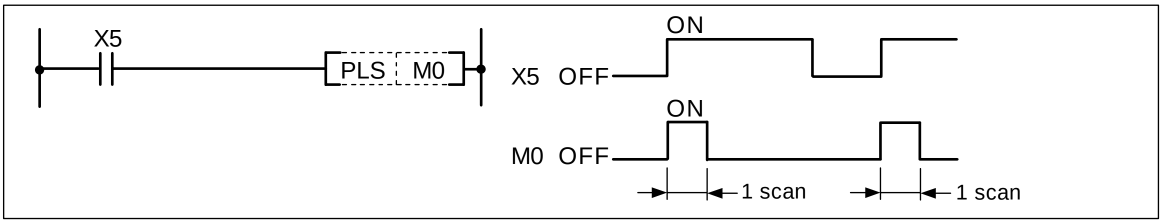
	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D		○	○	○		○													2		



Function

PLS

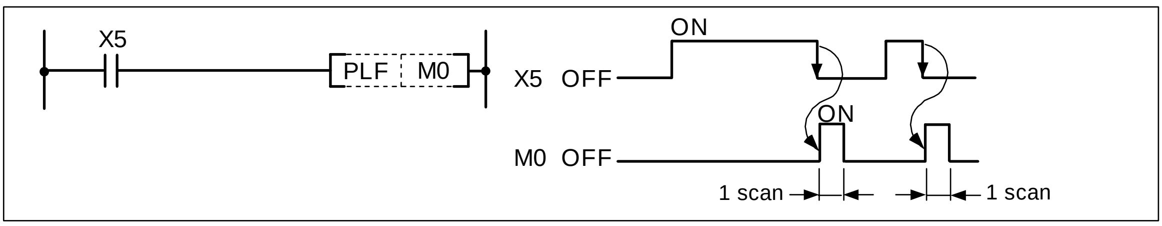
(1) The designated device is turned ON for one scan when the PLS command changes from OFF to ON and is turned OFF in all other cases.



(2) Even if the sequence program is changed from RUN to STOP and then RUN after the PLS command is executed, the PLS command will not be executed. If the PLS command is ON when the power is turned ON, the PLS command will be executed.

PLF

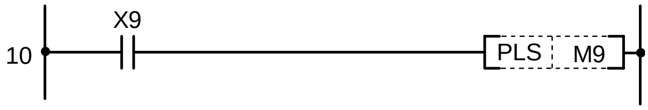
(1) The designated device is turned ON for one scan when the PLF command changes from ON to OFF and is turned OFF in all other cases.



(2) Even if the sequence program RUN switch is changed from RUN to STOP and then RUN after the PLF command is executed, the PLF command will not be executed.

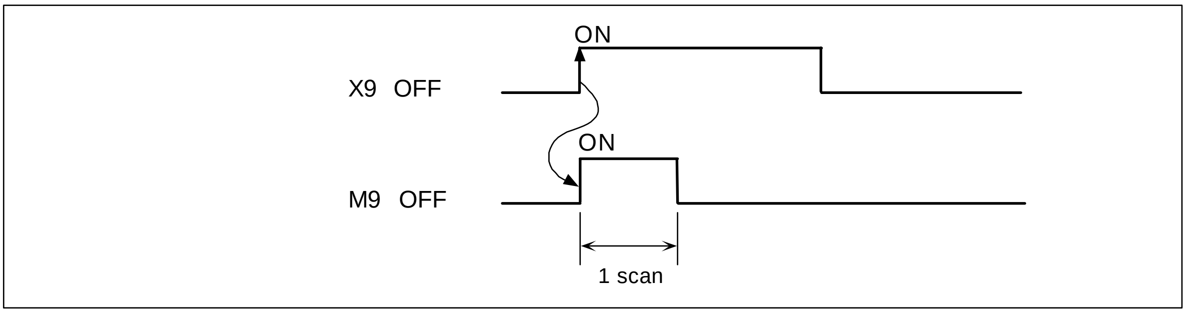
Program example

(1) Program to execute PLS command when X9 turns ON.

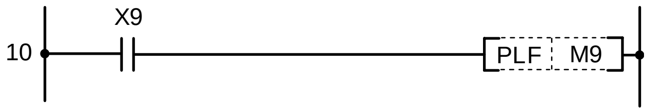


Coding

No. of steps	Com-mand	Device		
10	LD	X9		
11	PLS	M9		
13				

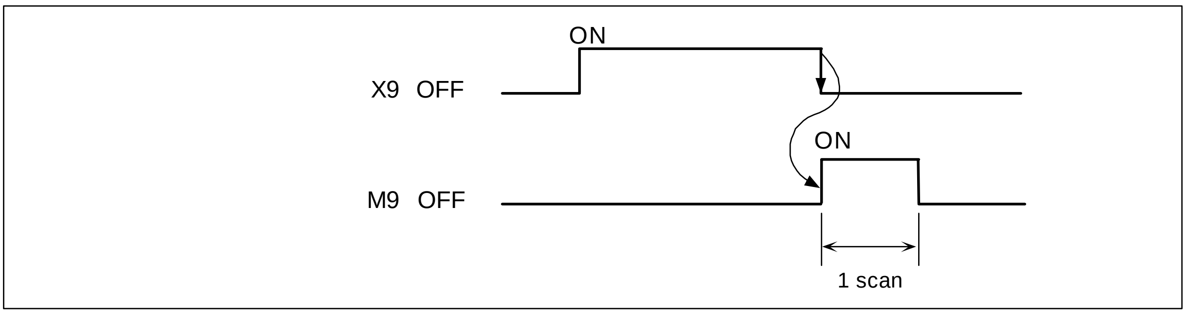


(2) Program to execute PLF command when X9 turns OFF.



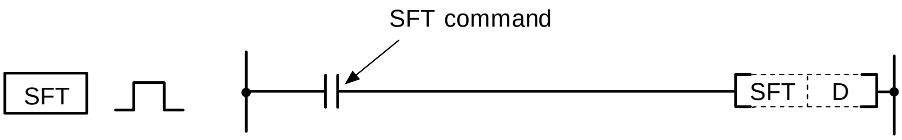
Coding

No. of steps	Com-mand	Device		
10	LD	X9		
11	PLF	M9		
13				



○ SFT ... Device shift

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device						Constant		Pointer	Level					
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D		○	○	○	○	○													4		

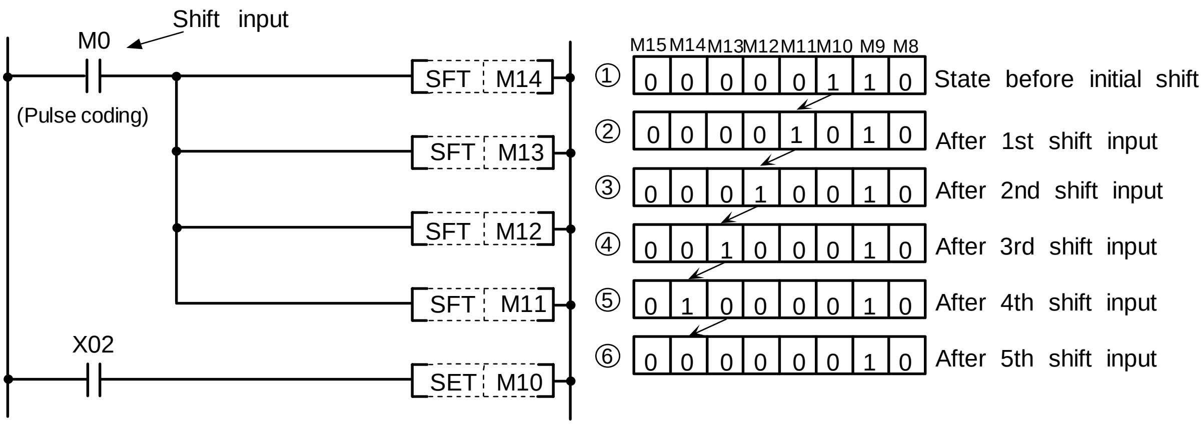


Setting data

D	Device No. to be shifted

Function

(1) The device that designates the ON/OFF state of the device that is one number smaller than the device designated with D (destination) is shifted, and the device that is one number smaller is turned OFF.
(2) Turn the head device to be shifted ON with the SET command.
(3) When using SFT in succession, program from the largest device No.

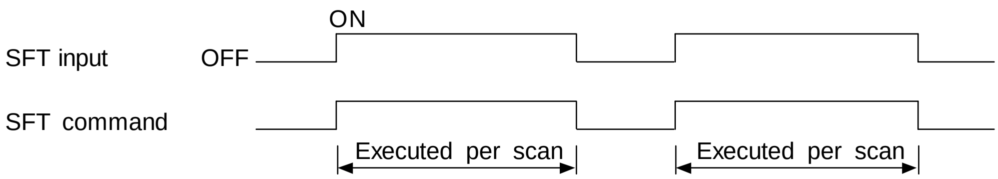


* In M8 to 15, "1" indicates ON and "0" indicates OFF.

Operation of shift command

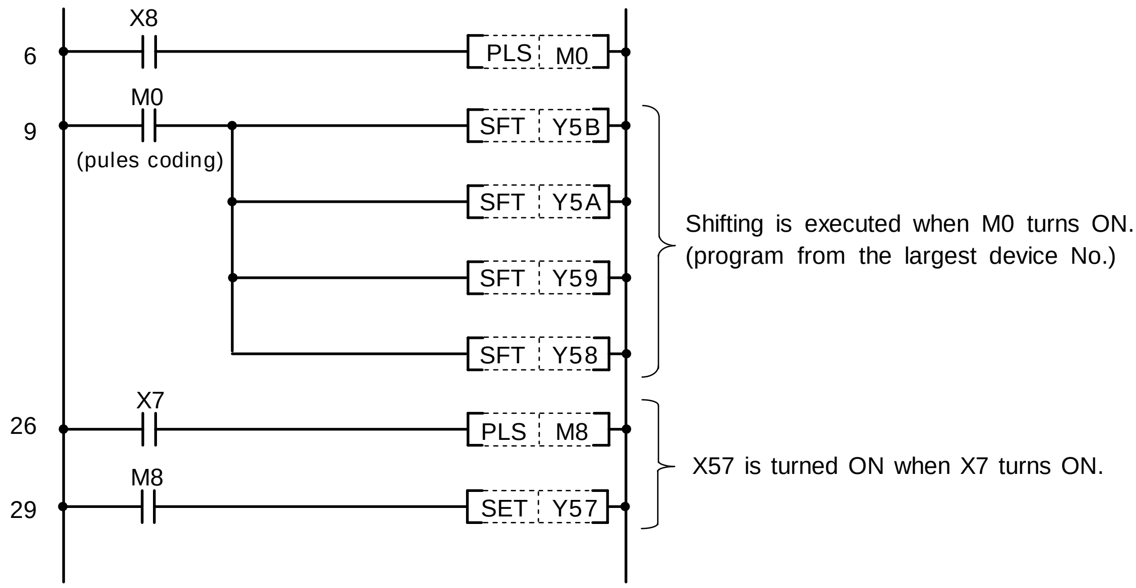
Execution condition

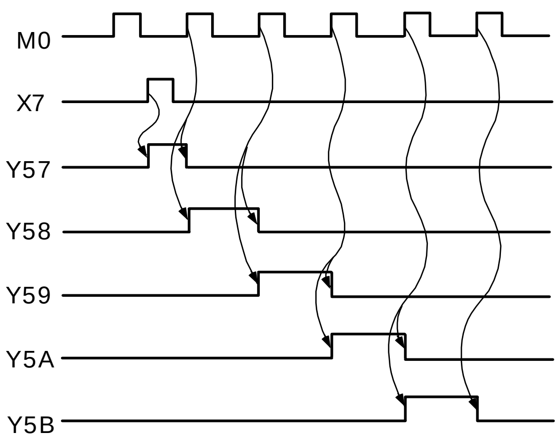
The execution conditions for the SFT command are as shown below.



Program example

(1) Program to shift Y57 to 5B when X8 turns ON.



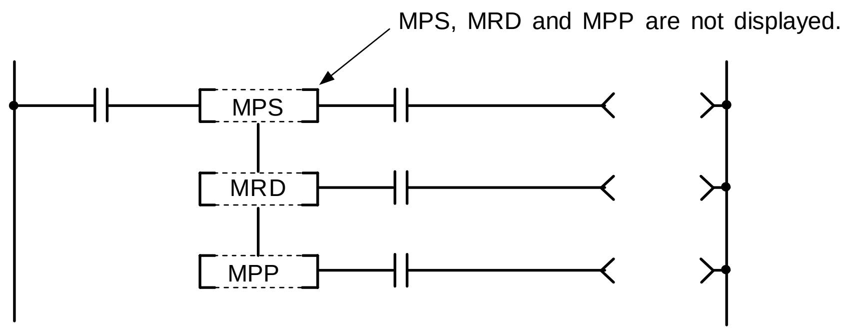


Coding

No. of steps	Com-mand	Device		
6	LD	X8		
7	PLS	M0		
9	LD	M0		
10	SFT	Y5B		
14	SFT	Y5A		
18	SFT	Y59		
22	SFT	Y58		
26	LD	X7		
27	PLS	M8		
29	LD	M8		
30	SET	Y57		
31				

○ MPS, MRD, MPP ... Registering, reading and clearing of operation results

Usable device																	Digit designation	No. of steps	Index	
Bit device								Word device					Constant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
																		1		



Function

MPS

(1) The operation results (ON/OFF) just before the MPS command are registered.
(2) The MPS command can be used consecutively up to four times. If the MPP command is used in between, the No. of MPS usages will be decremented by one.

MRD

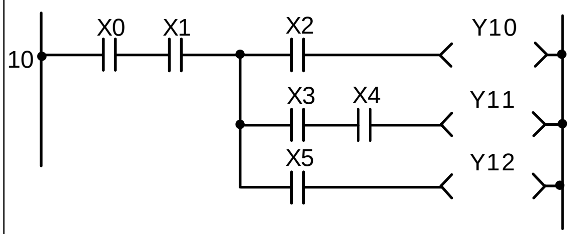
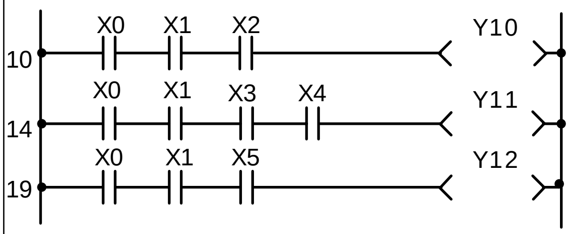
(1) The operation results registered with the MPS command are read, and the operation is continued from the next step using those operation results.

MPP

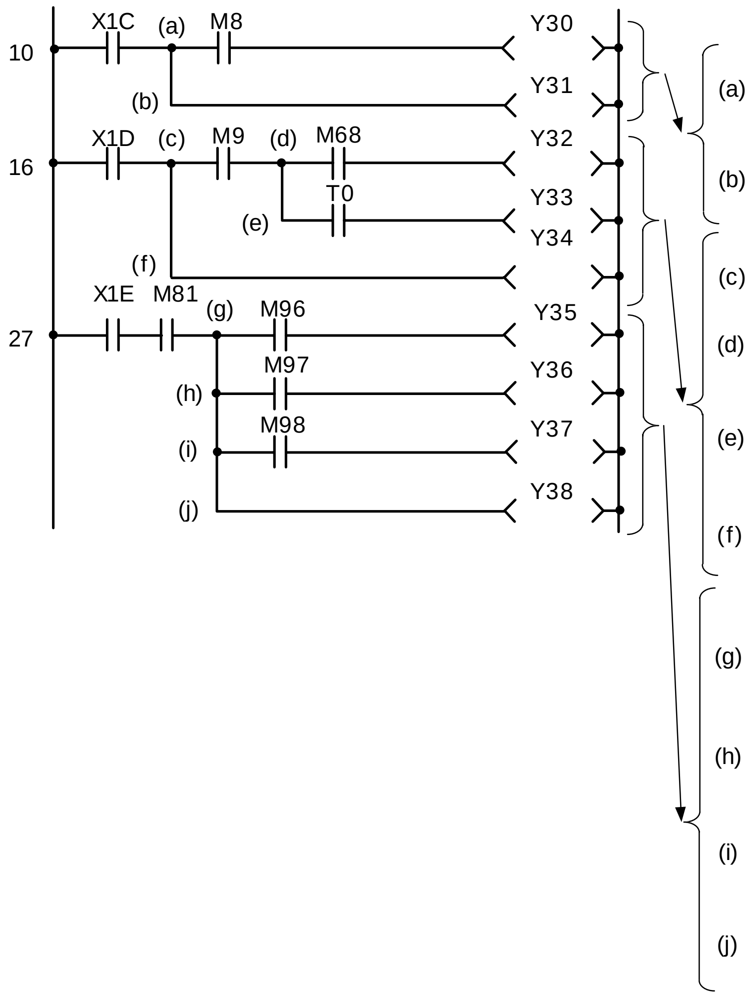
(1) The operation results registered with the MPS command are read, and the operation is continued from the next step using those operation results.
(2) The operation results registered with the MPS command are cleared.

Point

(1) The circuits when MPS, MRD and MPP are used and not used are as follow.

Circuit using MPS, MRD and MPP	Circuit not using MPS, MRD and MPP
	

(1) Program using MPS, MRD and MPP.

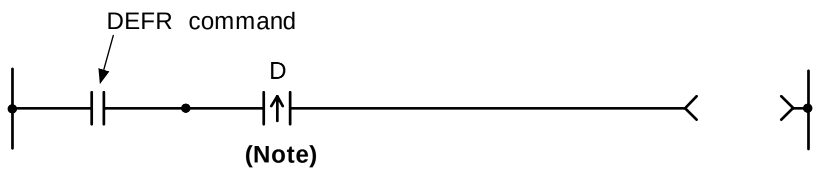


Coding

No. of steps	Com-mand	Device		
10	LD	X1C		
11	MPS			
12	AND	M8		
13	OUT	Y30		
14	MPP			
15	OUT	Y31		
16	LD	X1D		
17	MPS			
18	ANI	M9		
19	MPS			
20	AND	M68		
21	OUT	Y32		
22	MPP			
23	AND	T0		
24	OUT	Y33		
25	MPP			
26	OUT	Y34		
27	LD	X1E		
28	AND	M81		
29	MPS			
30	AND	M96		
31	OUT	Y35		
32	MRD			
33	AND	M97		
34	OUT	Y36		
35	MRD			
36	AND	M98		
37	OUT	Y37		
38	MPP			
39	OUT	Y38		
40				

○ DEFR ... Pulses in regard to operation results

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D		○	○	○	○	○													1		



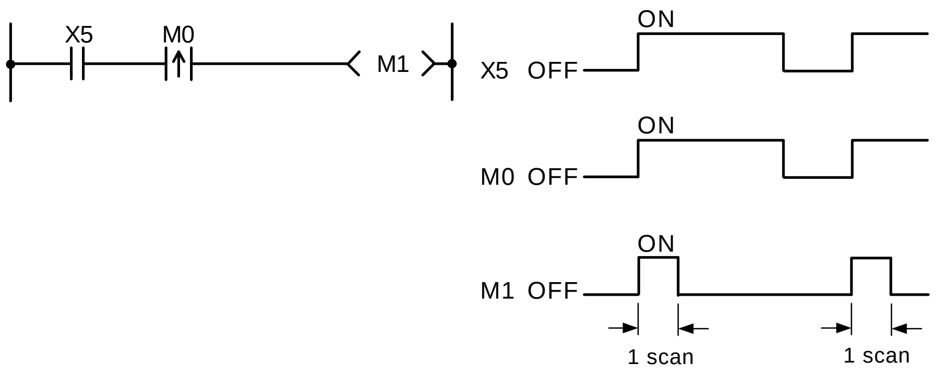
Setting data

D	Operation memory for generating one scan worth of pulses

(Note) In programming with the MELSEC PLC development tool (GX Developer), "AND" command is substituted and used.

Function

The operation results are turned ON for one scan when the DEFR command is turned from OFF to ON, and are turned OFF for all other cases.

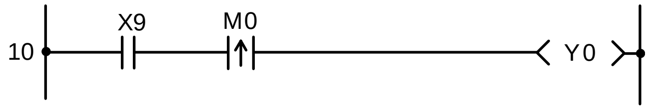


Execution conditions

This is executed per scan regardless of the operation results to the DEFR command.

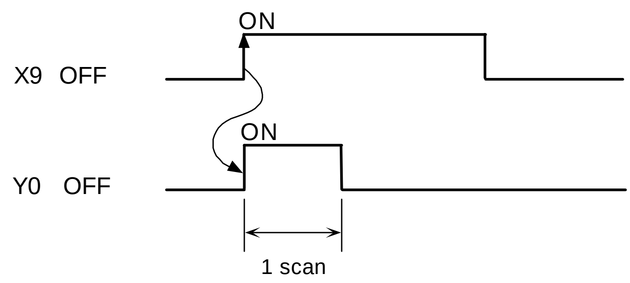
Program example

(1) Program to turn Y0 ON for one scan when X9 turns ON.

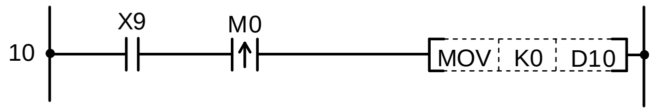


Coding

No. of steps	Com-mand	Device		
10	LD	X9		
11	ANDP	M0		
12	OUT	Y0		
13				



(2) Program to execute MOV command once when X9 turns ON.



Coding

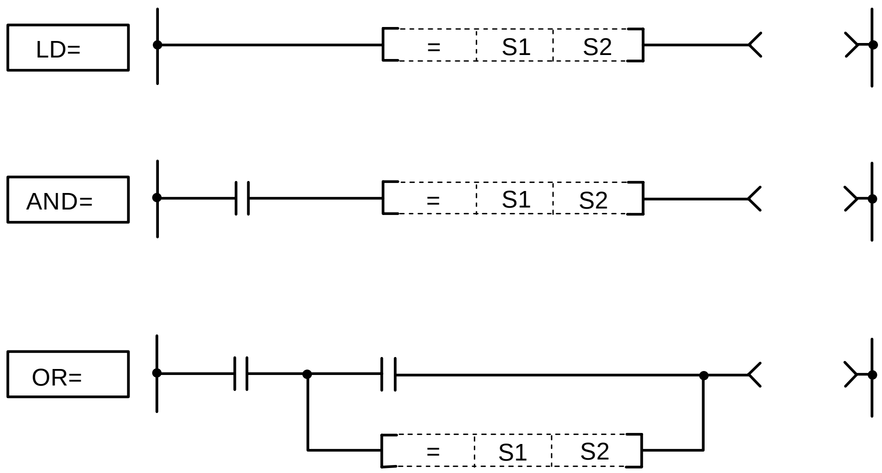
No. of steps	Com-mand	Device		
10	LD	X9		
11	ANDP	M0		
12	MOV	K0	D10	
15				

8. Function Commands

Recent sequence programs that require more advanced control cannot provide sufficient control only with basic commands and thus need four-rule operation and comparison, etc.
Many function commands have been prepared for this. There are approx. 76 types of function commands.
Each command is explained in the following section.

○ LD=, AND=, OR= .... Comparison of 16-bit data (=)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○				○	○			○	3		
S2							○	○	○	○											



Setting data

S1	Comparison data or No. of device where comparison data is stored.
S2	

Function

(1) 16-bit comparison operation is executed with "A" contact handling.
(2) The comparison operation results will be as follow.

Conditions	Comparison operation results
S1=S2	Continuity state
S1≠S2	Non-continuity state

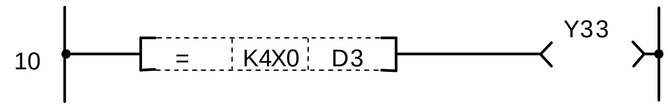
Execution conditions

The execution conditions for LD=, AND= and OR= are as follow.

Command	Execution conditions
LD=	Executed per scan
AND=	Executed only when previous contact command is ON
OR=	Executed per scan

Program example

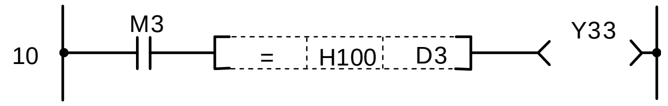
(1) Program to compare the X0 to F data and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD=	K4X0	D3	
13	OUT	Y33		
14				

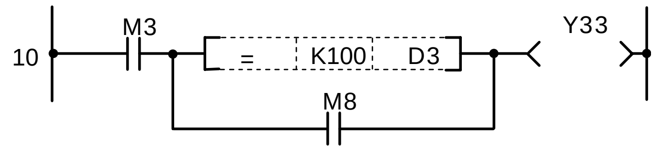
(2) Program to compare the BCD value 100 and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND=	H100	D3	
14	OUT	Y33		
15				

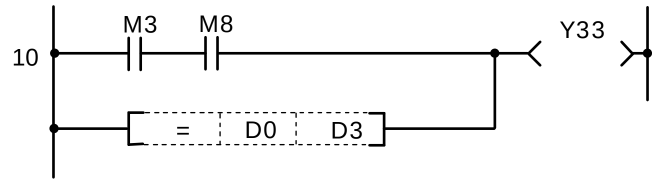
(3) Program to compare the BIN value 100 and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LD=	K100	D3	
14	OR	M8		
15	ANB			
16	OUT	Y33		
17				

(4) Program to compare the D0 and D3 data.

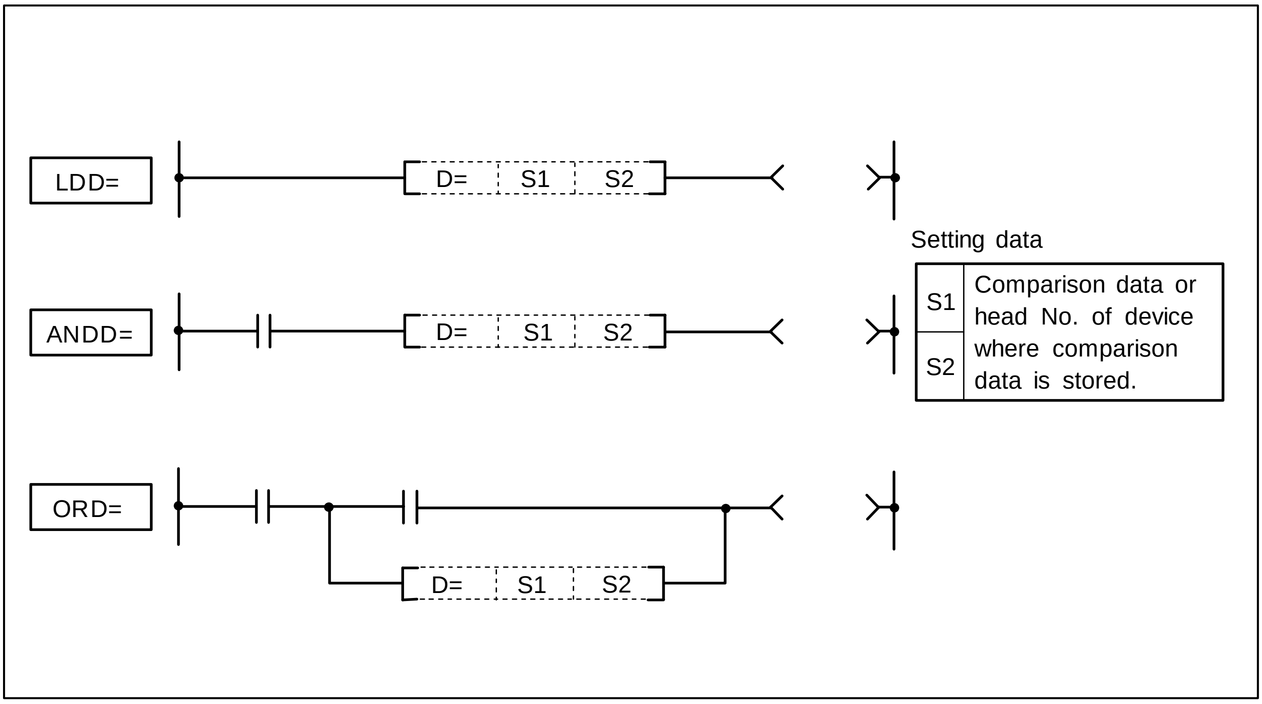


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	OR=	D0	D3	
15	OUT	Y33		
16				

○ LDD=, ANDD=, ORD= ... Comparison of 32-bit data (=)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
S2							○	○	○	○											



Function

(1) 32-bit comparison operation is executed with "A" contact handling.
(2) The comparison operation results will be as follow.

Conditions	Comparison operation results
S1=S2	Continuity state
S1≠S2	Non-continuity state

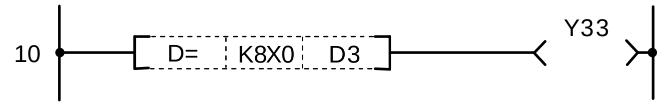
Execution conditions

The execution conditions for LDD=, ANDD= and ORD= are as follow.

Command	Execution conditions
LDD=	Executed per scan
ANDD=	Executed only when previous contact command is ON
ORD=	Executed per scan

Program example

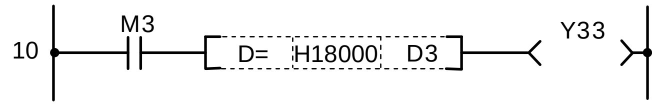
(1) Program to compare the X0 to 1F data, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LDD=	K8X0	D3	
13	OUT	Y33		
14				

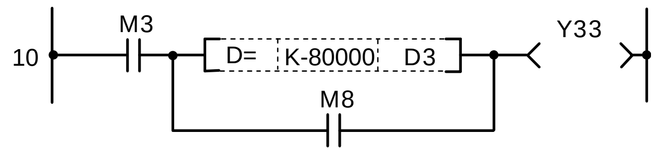
(2) Program to compare the BCD value 18000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	ANDD=	H18000	D3	
15	OUT	Y33		
16				

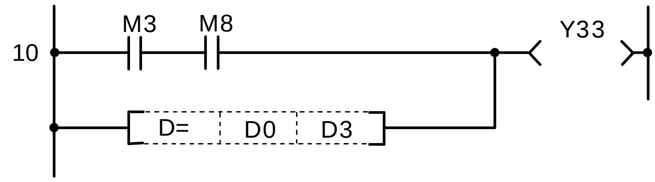
(3) Program to compare the BIN value -80000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LDD=	K-80000	D3	
15	OR	M8		
16	ANB			
17	OUT	Y33		
18				

(4) Program to compare the D0, D1, D3 and D4 data.

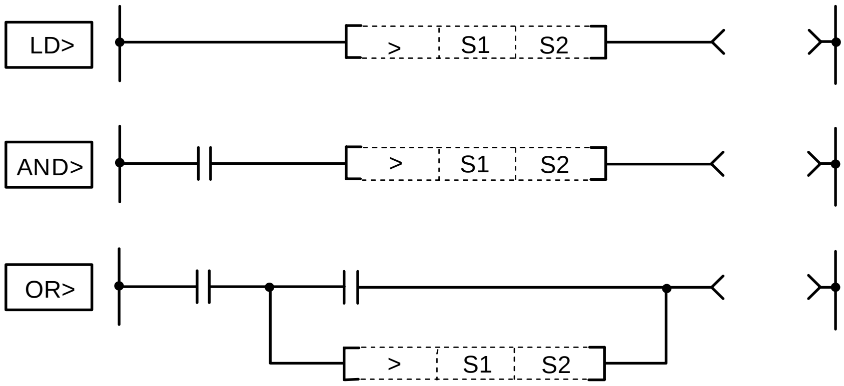


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	ORD=	D0	D3	
15	OUT	Y33		
16				

○ LD>, AND>, OR> .... Comparison of 16-bit data (>)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○				○	○			○	3		
S2							○	○	○	○											



Setting data

S1 S2	Comparison data or No. of device where comparison data is stored.

Function

(1) 16-bit comparison operation is executed with "A" contact handling.
(2) The comparison operation results will be as follow.

Conditions	Comparison operation results
S1>S2	Continuity state
S1<=S2	Non-continuity state

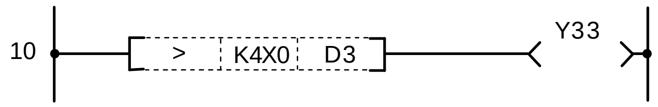
Execution conditions

The execution conditions for LD>, AND> and OR> are as follow.

Command	Execution conditions
LD>	Executed per scan
AND>	Executed only when previous contact command is ON
OR>	Executed per scan

Program example

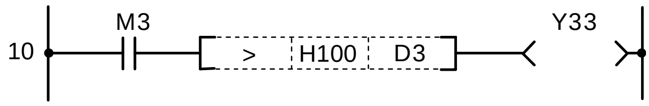
(1) Program to compare the X0 to F data and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD>	K4X0	D3	
13	OUT	Y33		
14				

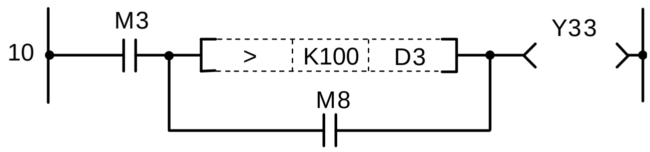
(2) Program to compare the BCD value 100 and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND>	H100	D3	
14	OUT	Y33		
15				

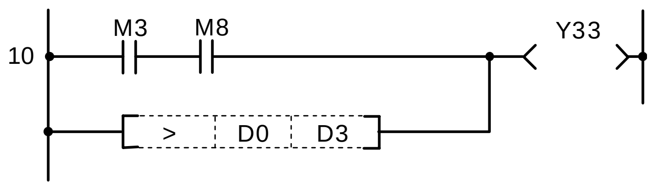
(3) Program to compare the BIN value 100 and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LD>	K100	D3	
14	OR	M8		
15	ANB			
16	OUT	Y33		
17				

(4) Program to compare the D0 and D3 data.

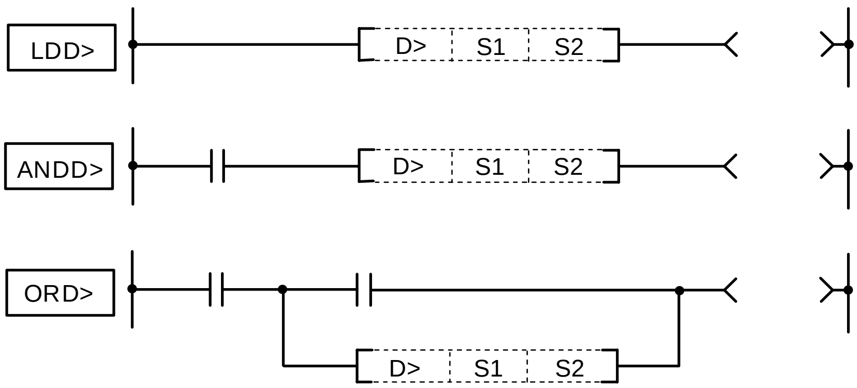


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	OR>	D0	D3	
15	OUT	Y33		
16				

○ LDD>, ANDD>, ORD> ... Comparison of 32-bit data (>)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
S2							○	○	○	○											



Setting data

S1	Comparison data or head No. of device where comparison data is stored.
S2	

Function

(1) 32-bit comparison operation is executed with "A" contact handling.
(2) The comparison operation results will be as follow.

Conditions	Comparison operation results
S1>S2	Continuity state
S1<=S2	Non-continuity state

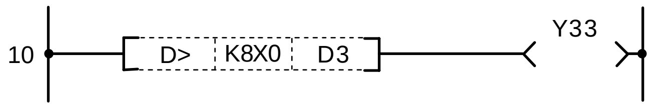
Execution conditions

The execution conditions for LDD>, ANDD> and ORD> are as follow.

Command	Execution conditions
LDD>	Executed per scan
ANDD>	Executed only when previous contact command is ON
ORD>	Executed per scan

Program example

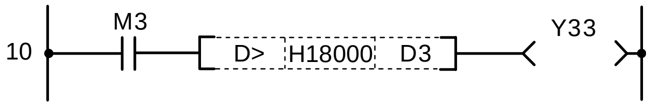
(1) Program to compare the X0 to 1F data, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LDD>	K8X0	D3	
13	OUT	Y33		
14				

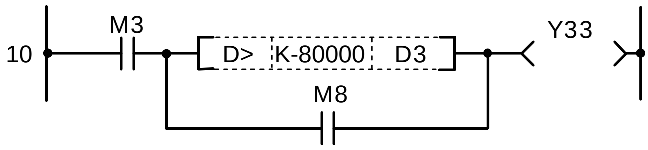
(2) Program to compare the BCD value 18000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	ANDD>	H18000	D3	
15	OUT	Y33		
16				

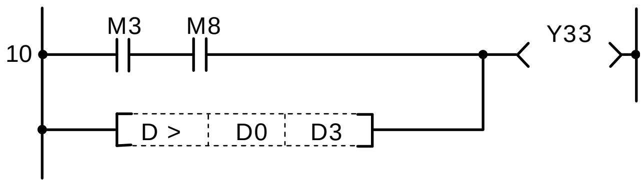
(3) Program to compare the BIN value -80000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LDD>	K-80000	D3	
15	OR	M8		
16	ANB			
17	OUT	Y33		
18				

(4) Program to compare the D0, D1, D3 and D4 data.

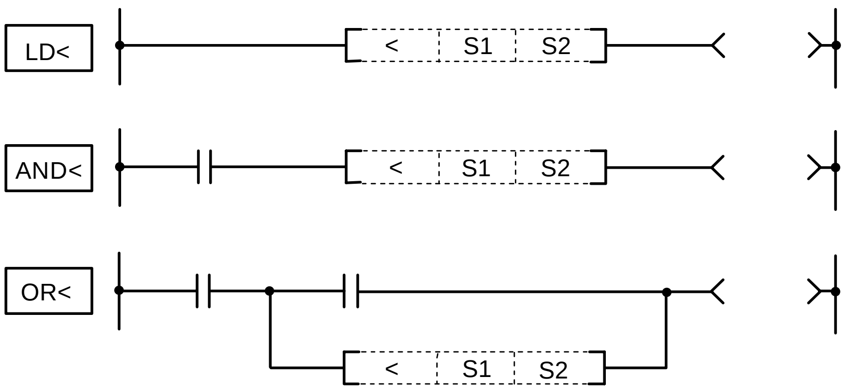


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	ORD>	D0	D3	
15	OUT	Y33		
16				

○ LD<, AND<, OR< .... Comparison of 16-bit data (<)

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○				○	○			○	3		
S2							○	○	○	○											



Setting data

S1	Comparison data or No. of device where comparison data is stored.
S2	

Function

(1) 16-bit comparison operation is executed with "A" contact handling.
(2) The comparison operation results will be as follow.

Conditions	Comparison operation results
S1<S2	Continuity state
S1>=S2	Non-continuity state

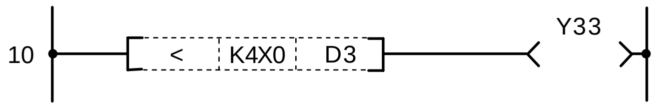
Execution conditions

The execution conditions for LD<, AND< and OR< are as follow.

Command	Execution conditions
LD<	Executed per scan
AND<	Executed only when previous contact command is ON
OR<	Executed per scan

Program example

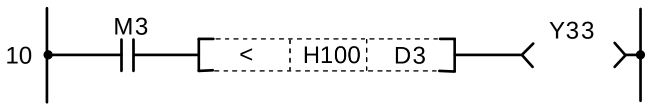
(1) Program to compare the X0 to F data and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD<	K4X0	D3	
13	OUT	Y33		
14				

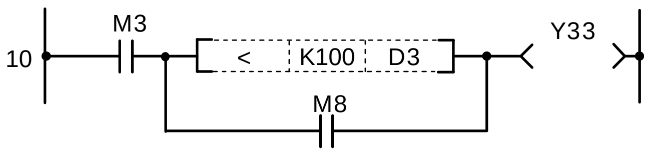
(2) Program to compare the BCD value 100 and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND<	H100	D3	
14	OUT	Y33		
15				

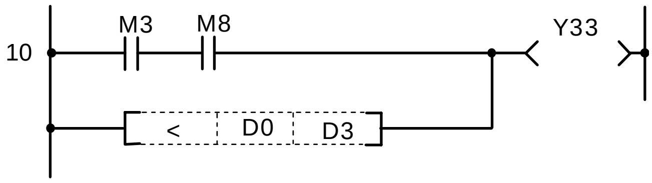
(3) Program to compare the BIN value 100 and D3 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LD<	K100	D3	
14	OR	M8		
15	ANB			
16	OUT	Y33		
17				

(4) Program to compare the D0 and D3 data.

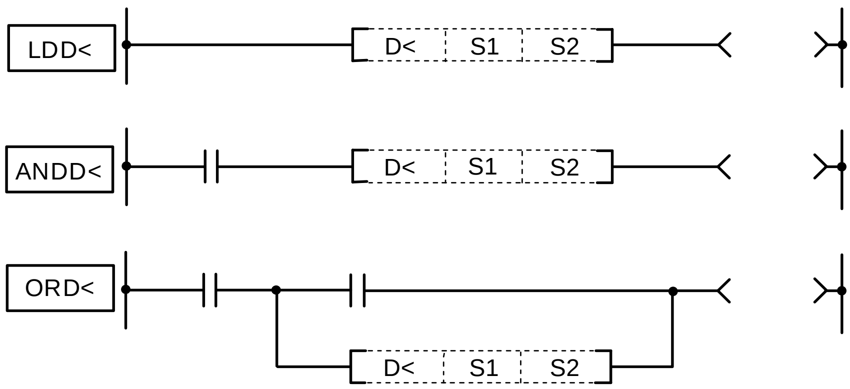


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	OR<	D0	D3	
15	OUT	Y33		
16				

○ LDD<, ANDD<, ORD< ... Comparison of 32-bit data (<)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
S2							○	○	○	○											



Setting data

S1	Comparison data or head No. of device where comparison data is stored.
S2	

Function

(1) 32-bit comparison operation is executed with "A" contact handling.
(2) The comparison operation results will be as follow.

Conditions	Comparison operation results
S1<S2	Continuity state
S1>=S2	Non-continuity state

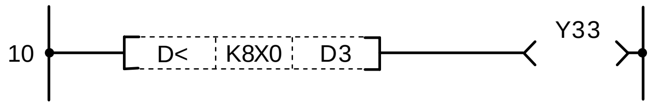
Execution conditions

The execution conditions for LDD<, ANDD< and ORD< are as follow.

Command	Execution conditions
LDD<	Executed per scan
ANDD<	Executed only when previous contact command is ON
ORD<	Executed per scan

Program example

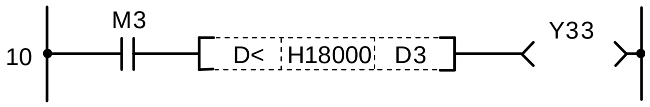
(1) Program to compare the X0 to 1F data, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LDD<	K8X0	D3	
13	OUT	Y33		
14				

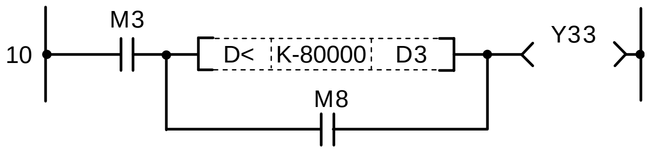
(2) Program to compare the BCD value 18000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	ANDD<	H18000	D3	
15	OUT	Y33		
16				

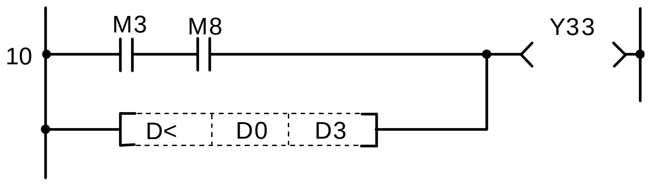
(3) Program to compare the BIN value -80000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LDD<	K-80000	D3	
15	OR	M8		
16	ANB			
17	OUT	Y33		
18				

(4) Program to compare the D0, D1, D3 and D4 data.

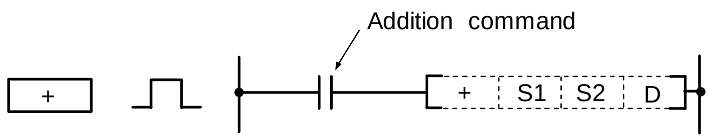


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	ORD<	D0	D3	
15	OUT	Y33		
16				

○+ ... BIN 16-bit addition

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○											
S2							○	○	○	○				○	○				4		
D							○	○	○	○											

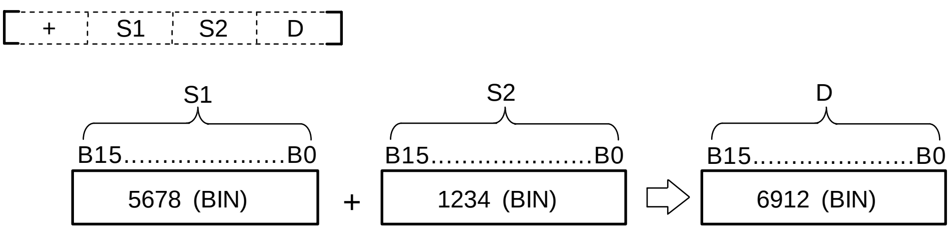


Setting data

S1	Addition data or No. of device where addition data is stored.
S2	Addition data or No. of device where addition data is stored.
D	No. of device to store addition results.

Function

(1) The BIN data designated with S1 and the BIN data designated with S2 are added, and the addition results are stored in the device designated with D.



(2) -32768 to 32767 (BIN 16-bit) can be designated in S1 and S2.

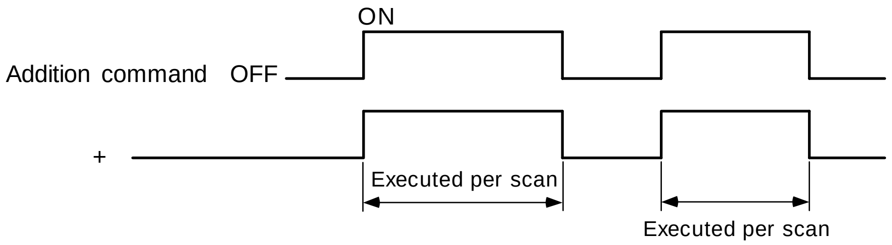
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B15).

B15	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON even if an overflow results.

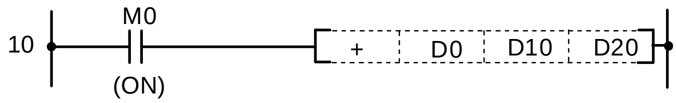
Execution conditions

The execution conditions for + are as shown below.



Program example

(1) Program to add the D0 BIN data and D10 BIN data and output to D20.

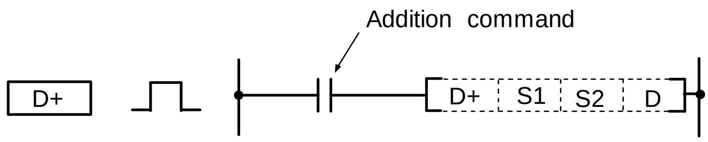


Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	+	D0	D10	D20
15				

○ D+ ... BIN 32-bit addition

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									4/5		
S2							○	○	○	○				○	○						
D							○	○	○	○											

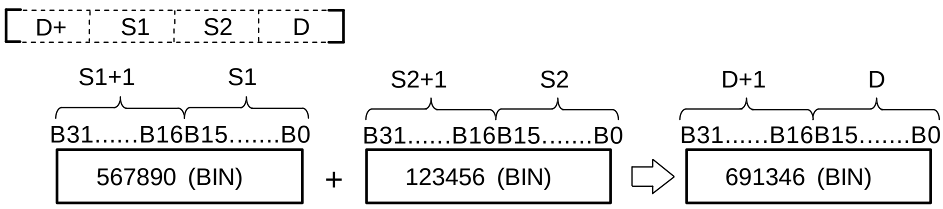


Setting data

S1	Addition data or head No. of device where addition data is stored.
S2	Addition data or head No. of device where addition data is stored.
D	Head No. of device to store addition results.

Function

(1) The BIN data designated with S1 and the BIN data designated with S2 are added, and the addition results are stored in the device designated with D.



(2) -2147483648 to 2147483647 (BIN 32-bit) can be designated in S1 and S2.

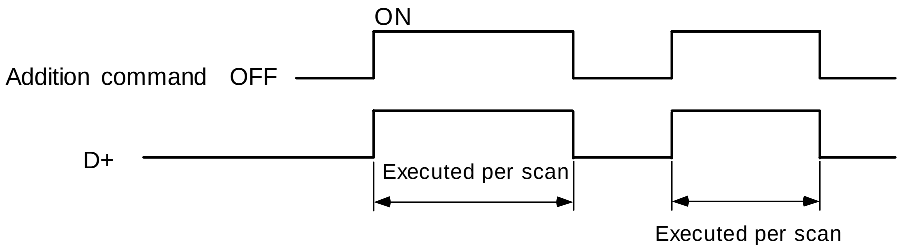
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B31).

B31	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON even if an overflow results.

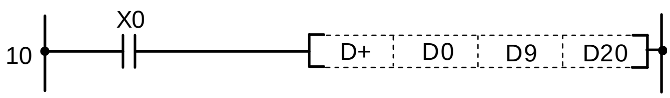
Execution conditions

The execution conditions for D+ are as shown below.



Program example

(1) Program to add the D0, 1 data and D9, 10 data when X0 turns ON, and output the results to D20, 21.

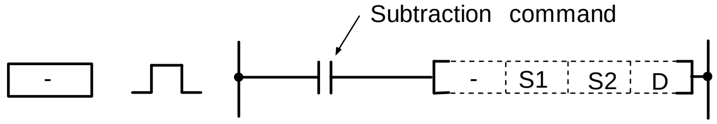


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	D+	D0	D9	D20
15				

○ **– ... BIN 16-bit subtraction**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○											
S2							○	○	○	○				○	○				4		
D							○	○	○	○											

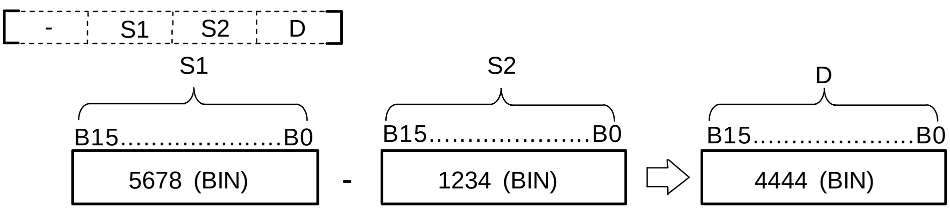


Setting data

S1	Subtraction data or No. of device where subtraction data is stored.
S2	Subtraction data or No. of device where subtraction data is stored.
D	No. of device to store subtraction results.

Function

(1) The device designated with S2 is subtracted From the device designated with S1, and the subtraction results are stored in the device designated with D.



(2) -32768 to 32767 (BIN 16-bit) can be designated in S1 and S2.

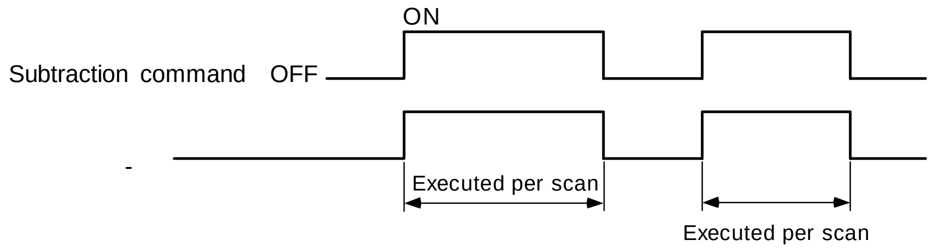
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B15).

B15	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON even if an underflow results.

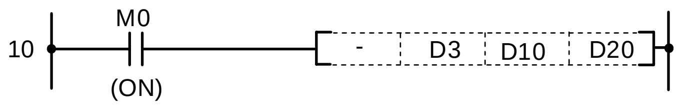
Execution conditions

The execution conditions for - are as shown below.



Program example

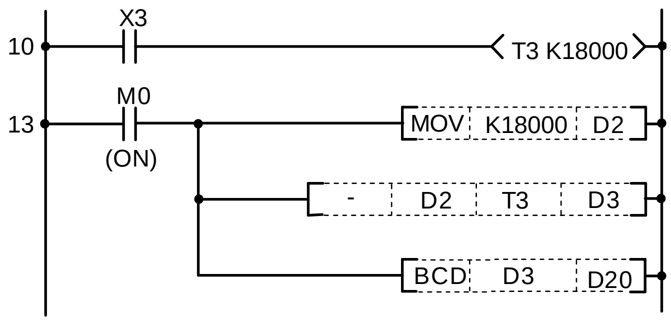
(1) Program to subtract the BIN data D10 from D3 and output to D20.



Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	-	D3	D10	D20
15				

(2) Program to BCD output the difference of the timer T3 setting value and current value to D20.

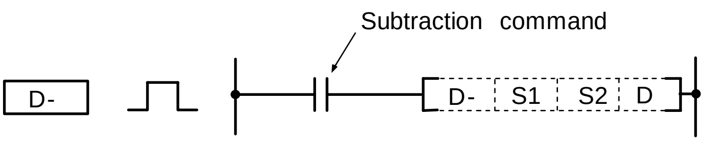


Coding

No. of steps	Com-mand	Device		
10	LD	X3		
11	OUT	T3	K18000	
13	LD	M0		
14	MOV	K18000	D2	
17	-	D2	T3	D3
21	BCD	D3	D20	
24				

○ D– ... BIN 32-bit subtraction

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N			
S1							○	○	○	○											
S2							○	○	○	○				○	○				4/5		
D							○	○	○	○											

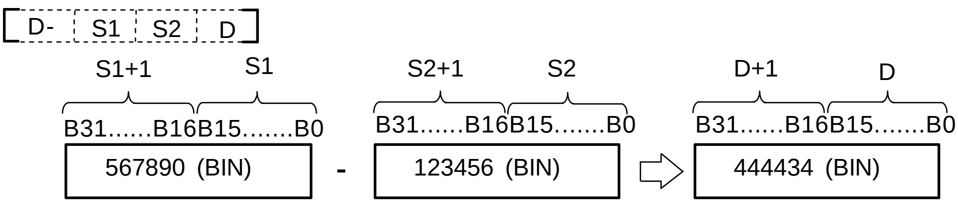


Setting data

S1	Subtraction data or head No. of device where subtraction data is stored.
S2	Subtraction data or head No. of device where subtraction data is stored.
D	Head No. of device to store subtraction results.

Function

(1) The device designated with S2 is subtracted from the device designated with S1, and the subtraction results are stored in the device designated with D.



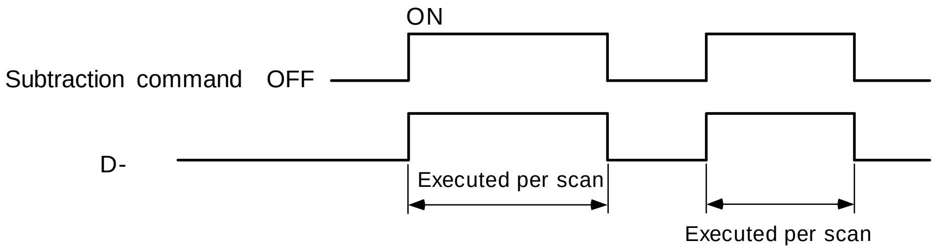
(2) -2147483648 to 2147483647 (BIN 32-bit) can be designated in S1 and S2.
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B31).

B31	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON even if an underflow results.

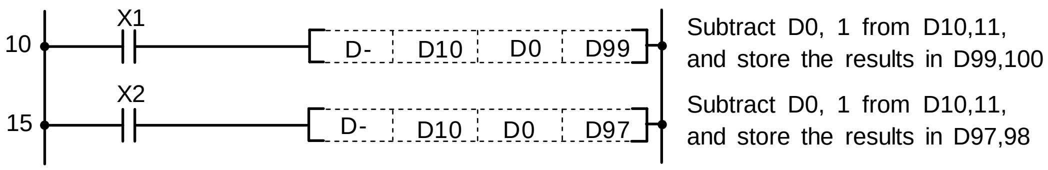
Execution conditions

The execution conditions for D- are as shown below.



Program example

(1) Program to subtract the D0, 1 data from the D10, 11 data when X1 turns ON, and output the results to D99, 100. Program to subtract the D0, 1 data from D10, 11 data when X2 turns ON, and output the results to D97, 98.

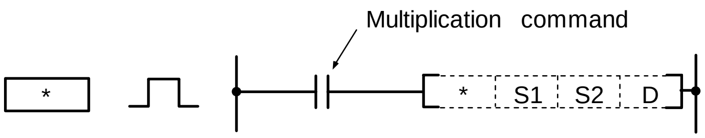


Coding

No. of steps	Com-mand	Device		
10	LD	X1		
11	D-	D10	D0	D99
15	LD	X2		
16	D-	D10	D0	D97
20				

○ *** ... BIN 16-bit multiplication**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									4		
S2							○	○	○	○				○	○						
D							○	○	○	○											

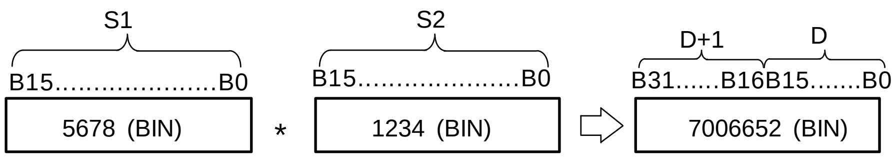


Setting data

S1	Multiplication data or No. of device where multiplication data is stored.
S2	Multiplication data or No. of device where multiplication data is stored.
D	Head No. of device to store multiplication results.

Function

(1) The BIN data designated with S1 is multiplied by the BIN data designated with S2, and the multiplication results are stored in the device designated with D.

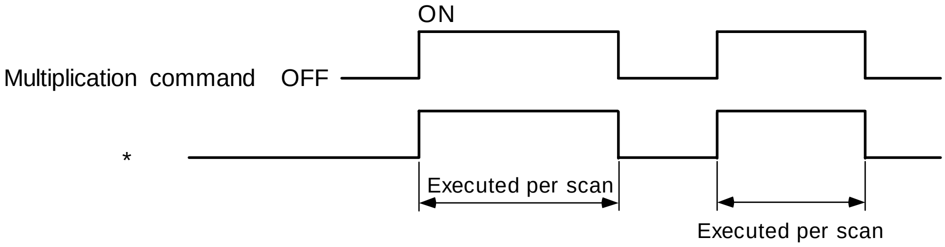


(2) -32768 to 32767 (BIN 16-bit) can be designated in S1 and S2.
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (S1 and S2 is by B15, D is by B31).

B15/B31	Judgment of positive/negative
0	Positive
1	Negative

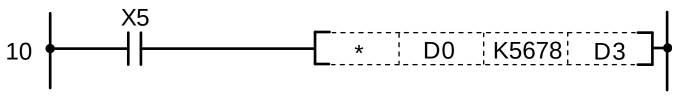
Execution conditions

The execution conditions for * are as shown below.



Program example

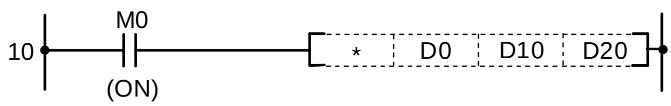
(1) Program to multiply the D0 data and BIN 5678 when X5 turns ON and output the results to D3, 4.



Coding

No. of steps	Com-mand	Device		
10	LD	X5		
11	*	D0	K5678	D3
15				

(2) Program to multiple the D0 BIN data and D10 BIN data, and output the results to D20.

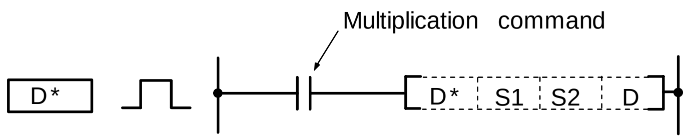


Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	*	D0	D10	D20
15				

○ **D* ... BIN 32-bit multiplication**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○											
S2							○	○	○	○				○	○				5/6		
D							○	○	○	○											

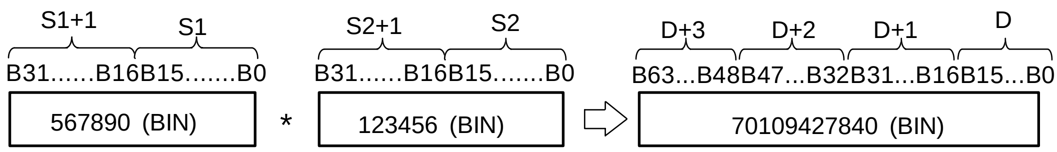


Setting data

S1	Multiplication data or head No. of device where multiplication data is stored.
S2	Multiplication data or head No. of device where multiplication data is stored.
D	Head No. of device to store multiplication results.

Function

(1) The BIN data designated with S1 is multiplied by the BIN data designated with S2, and the multiplication results are stored in the device designated with D.



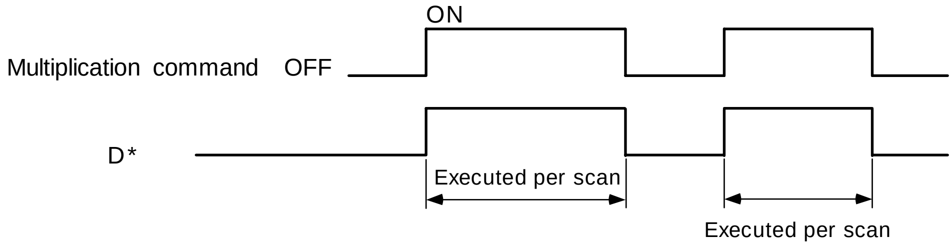
(2) -2147483648 to 2147483647 (BIN 32-bit) can be designated in S1 and S2.

(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (S1 and S2 is by B31, D is by B63).

B31/B63	Judgment of positive/negative
0	Positive
1	Negative

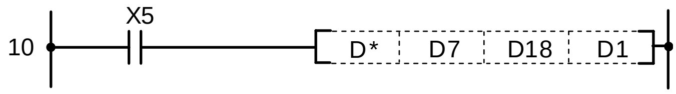
Execution conditions

The execution conditions for D* are as shown below.



Program example

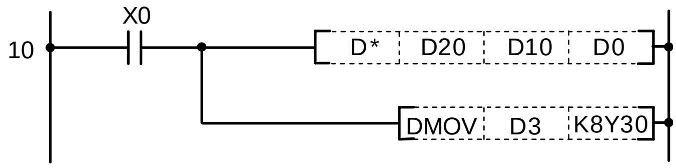
(1) Program to multiply the D7, 8 BIN data and D18, 19 BIN data when X5 turns ON, and output the results to D1 to 4.



Coding

No. of steps	Com-mand	Device		
10	LD	X5		
11	D*	D7	D18	D1
16				

(2) Program to multiply the D20 BIN data and D10 BIN data when X0 turns ON, and output the high-order 16-bit to Y30 to 4F.

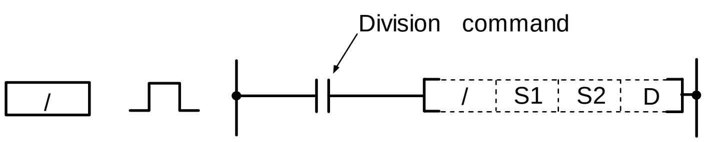


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	D*	D20	D10	D0
16	DMOV	D3	K8Y30	
20				

○ / ... BIN 16-bit division

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									5		
S2							○	○	○	○				○	○						
D							○	○	○	○											

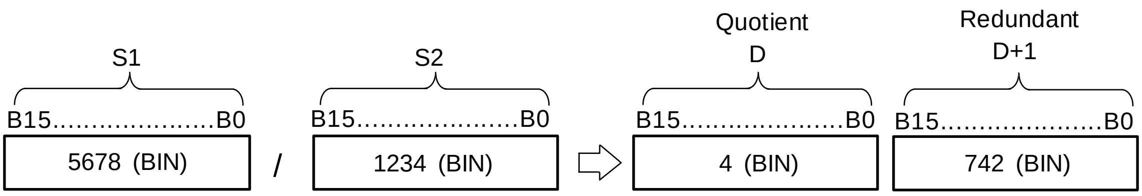


Setting data

S1	Division data or No. of device where division data is stored.
S2	Division data or No. of device where division data is stored.
D	Head No. of device to store division results.

Function

(1) The BIN data designated with S1 is divided by BIN data designated with S2, and the division results are stored in the device designated with D.



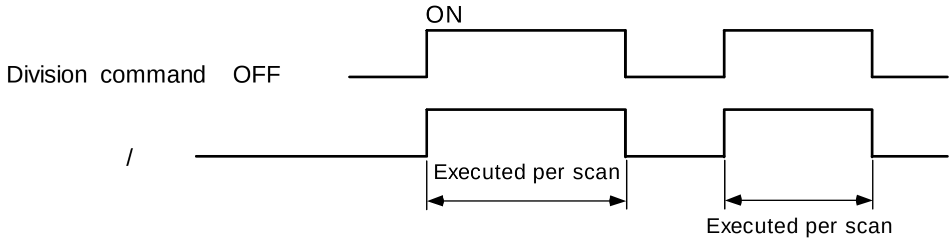
(2) -32768 to 32767 (BIN 16-bit) can be designated in S1 and S2.
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B15).

B15	Judgment of positive/negative
0	Positive
1	Negative

(4) For the word device, the operation results will be stored as quotient and redundant using the 32-bit.
Quotient ... Stored in low-order 16-bit.
Redundant... Stored in high-order 16-bit.
(5) The S1 and S2 data will not change even after operation is executed.

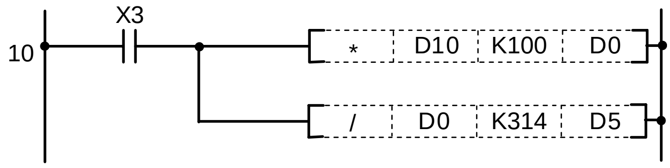
Execution conditions

The execution conditions for / are as shown below.



Program example

(1) Program to divide the D10 data by 3.14 when X3 turns ON, and output the value (quotient) to D5.

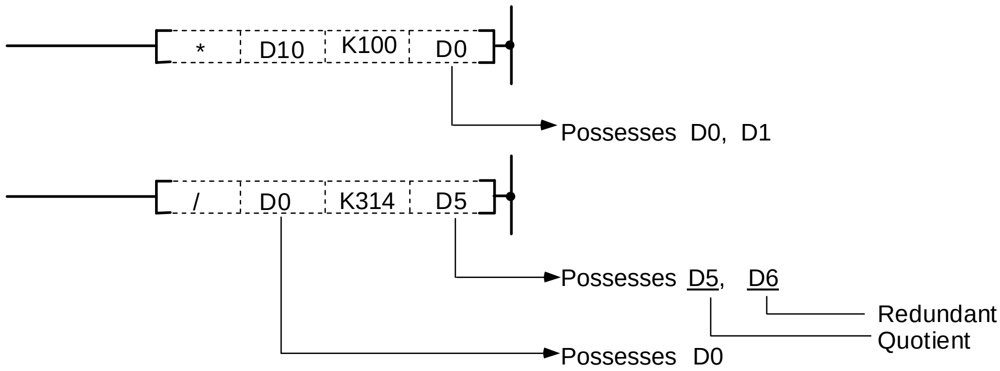


Coding

No. of steps	Com-mand	Device		
10	LD	X3		
11	*	D10	K100	D0
15	/	D0	K314	D5
20				

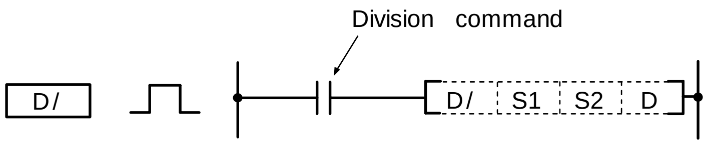
Point

The source and destination sides of the above program are as follow.



○ D/ ... BIN 32-bit division

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									5/6		
S2							○	○	○	○				○	○						
D							○	○	○	○											

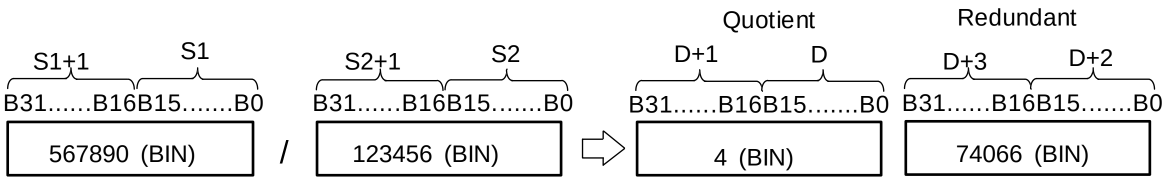


Setting data

S1	Division data or head No. of device where division data is stored.
S2	Division data or head No. of device where division data is stored.
D	Head No. of device to store division results.

Function

(1) The BIN data designated with S1 is divided by the BIN data designated with S2, and the division results are stored in the device designated with D.



(2) -2147483648 to 2147483647 (BIN 32-bit) can be designated in S1 and S2.

(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B31).

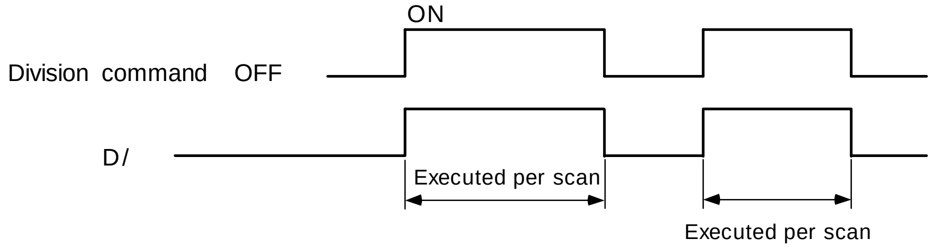
B31	Judgment of positive/negative
0	Positive
1	Negative

(4) For the word device, the operation results will be stored as quotient and redundant using the 64-bit.
Quotient ... Stored in low-order 32-bit.
Redundant... Stored in high-order 32-bit.

(5) The S1 and S2 data will not change even after operation is executed.

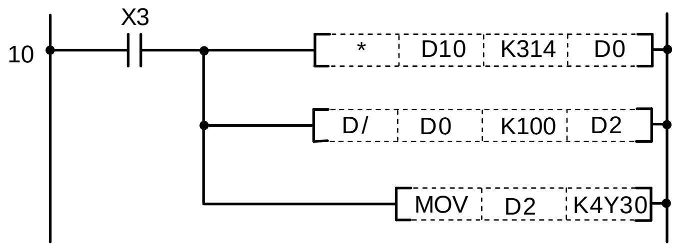
Execution conditions

The execution conditions for D/ are as shown below.



Program example

(1) Program to multiply the D10 data by 3.14 when X3 turns ON, and output the worth of low-order 16-bit of the results to Y30 to 3F.

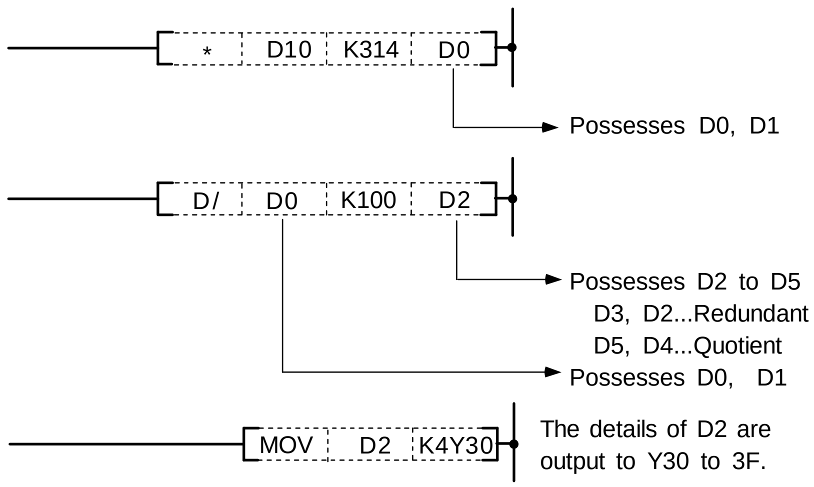


Coding

No. of steps	Com-mand	Device		
10	LD	X3		
11	*	D10	K314	D0
15	D/	D0	K100	D2
21	MOV	D2	K4Y30	
24				

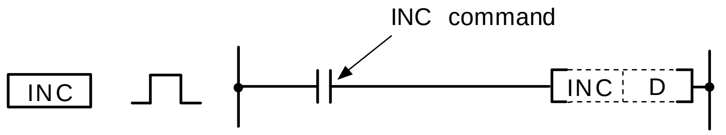
Point

The source and destination sides of the above program are as follow.



○ INC ... (16-bit BIN data) +1

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									2		

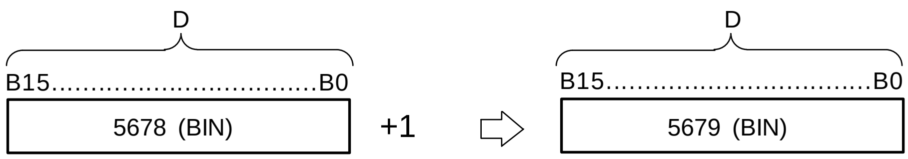


Setting data

D	No. of device to be INCed (+1)

Function

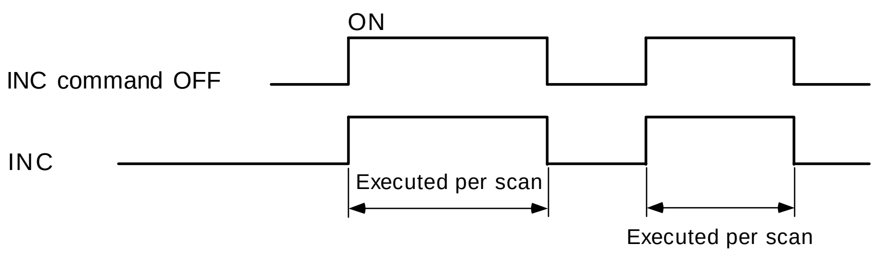
(1) The device (16-bit data) designated with D is incremented by one.



(2) If INC is executed when the details of the device designated with D are 32767, -32768 will be stored in the device designated with D.

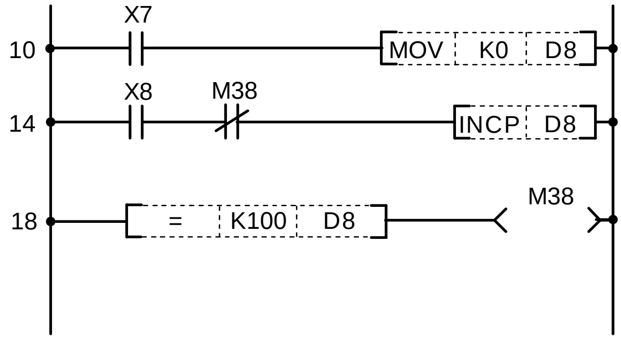
Execution conditions

The execution conditions for the INC command are as shown below.



Program example

(1) Example of addition counter program



Set D8 to 0 when X7 turns ON.

Execute D8+1 at X8 OFF to ON when M38 is OFF.

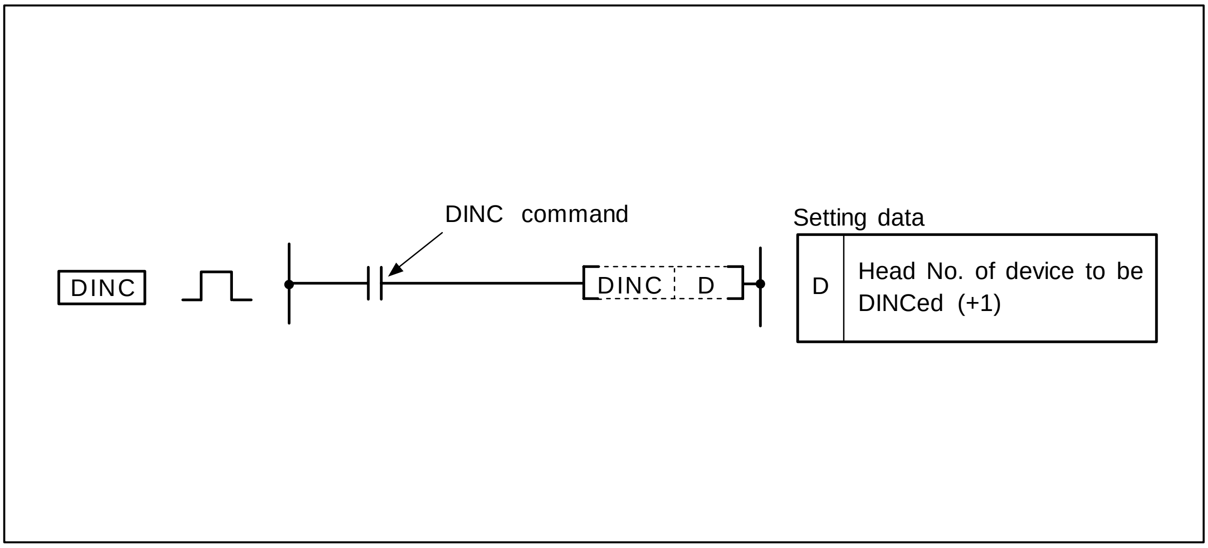
M38 turns ON when D8 = 100.

Coding

No. of steps	Com-mand	Device		
10	LD	X7		
11	MOV	K0	D8	
14	LD	X8		
15	PLS	M5		
17	LD	M5		
18	ANI	M38		
19	INC	D8		
21	LD=	K100	D8	
24	OUT	M38		
25				

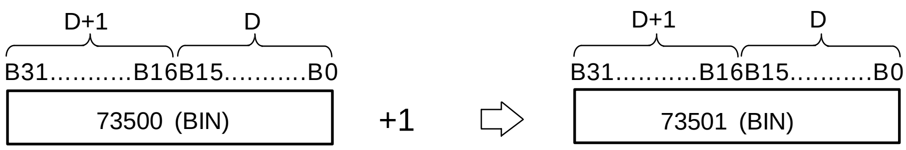
○ **DINC ... (32-bit BIN data) +1**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									2		



Function

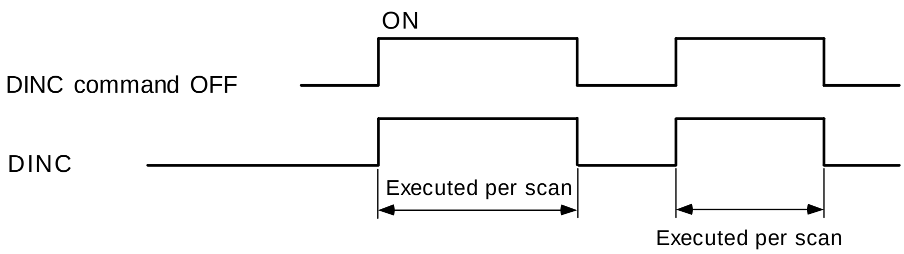
(1) The device (32-bit data) designated with D is incremented by one.



(2) If DINC is executed when the details of the device designated with D are 2147483647, -2147483648 will be stored in the device designated with D.

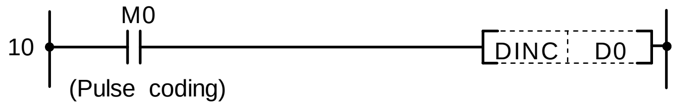
Execution conditions

The execution conditions for the DINC command are as shown below.



Program example

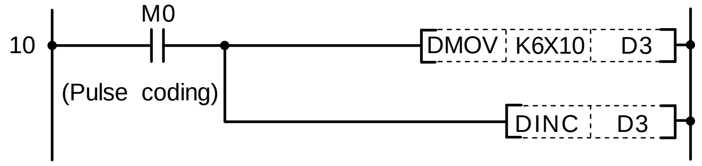
(1) Program to increment the D0, 1 data by one when M0 turns ON.



Coding

No. of steps	Command	Device		
10	LD	M0		
11	DINC	D0		
13				

(2) Program to increment X10 to 27 data by one when M0 turns ON, and to store the results in D3, 4.

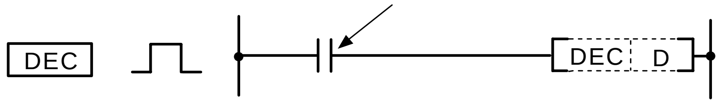


Coding

No. of steps	Command	Device		
10	LD	M0		
11	DMOV	K6X10	D3	
14	DINC	D3		
16				

○ **DEC ... (16-bit BIN data) –1**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									2		

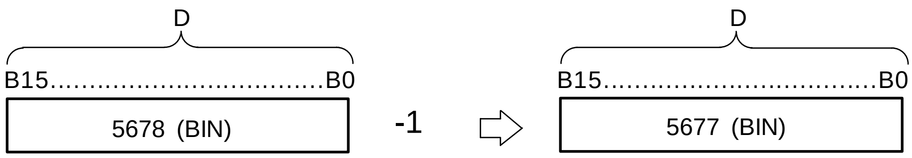


Setting data

D	No. of device to be DECed (-1)

Function

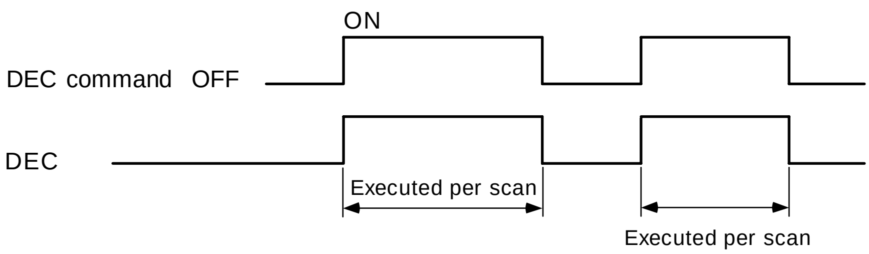
(1) The device (16-bit data) designated with D is decremented by one.



(2) If DEC is executed when the details of the device designated with D are 0, -1 will be stored in the device designated with D.

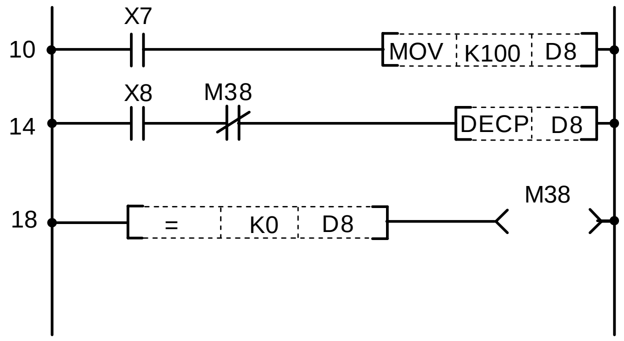
Execution conditions

The execution conditions for the DEC command are as shown below.



Program example

(1) Example of subtraction counter program



Set D8 to 100 when X7 turns ON.

Execute D8-1 at X8 OFF to ON when M38 turns OFF.

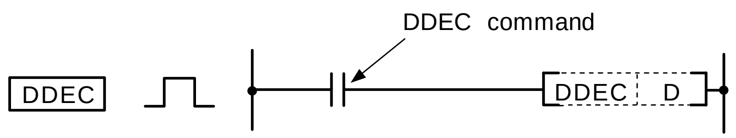
M38 turns ON when D8 = 0.

Coding

No. of steps	Com-mand	Device		
10	LD	X7		
11	MOV	K100	D8	
14	LD	X8		
15	PLS	M5		
17	LD	M5		
18	ANI	M38		
19	DEC	D8		
21	LD=	K0	D8	
24	OUT	M38		
25				

○ DDEC ... (32-bit BIN data) –1

	Usable device																				
	Bit device						Word device							Con-stant		Pointer	Level	Digit desig-nation	No. of steps	Index	
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									2		

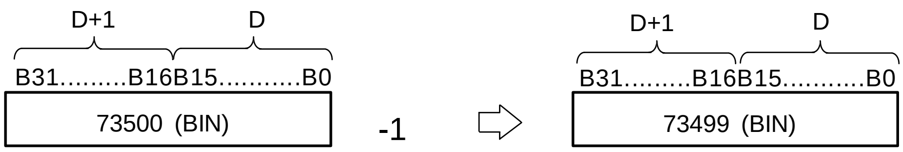


Setting data

D	Head No. of device to be DDECed (-1)

Function

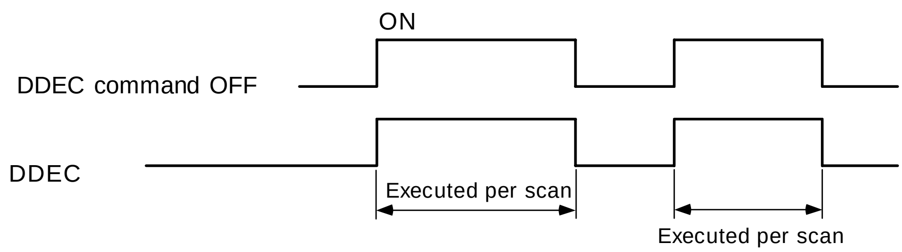
(1) The device (32-bit data) designated with D is decremented by one.



(2) If DDEC is executed when the details of the device designated with D are 0, -1 will be stored in the device designated with D.

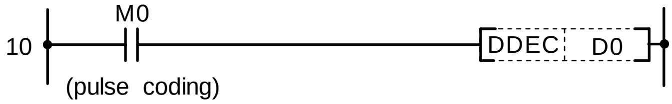
Execution conditions

The execution conditions for the DDEC command are as shown below.



Program example

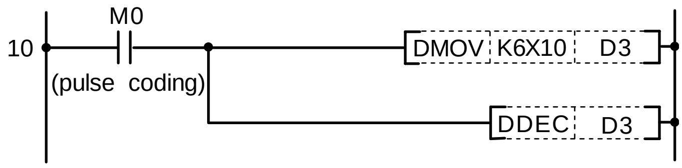
(1) Program to decrement the D0, 1 data by one when M0 turns ON.



Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	DDEC	D0		
13				

(2) Program to decrement X10 to 27 data by one when M0 turns ON, and to store the results in D3, 4.

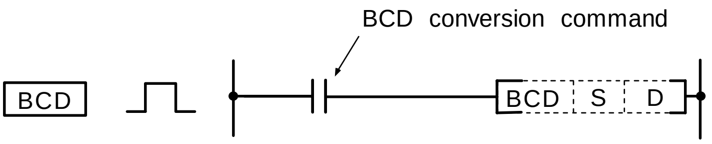


Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	DMOV	K6X10	D3	
14	DDEC	D3		
16				

○ BCD ... BIN → BCD conversion (16-bit)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○								○	3		
D							○	○	○	○											



Setting data

S	BIN data or No. of device where BIN data is stored.
D	No. of device to store BCD data.

Function

The BIN data (0 to 9999) of the device designated with S is BCD converted and transmitted to the device designated with D.

S side BIN 9999

32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1

Always set to 0 (upper 2 bits)

⇩ BCD conversion

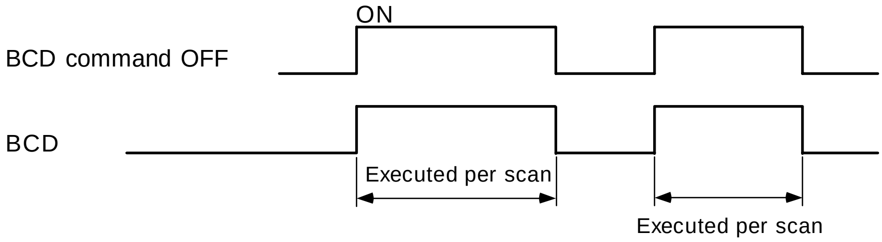
D side BCD 9999

8000	4000	2000	1000	800	400	200	100	80	40	20	10	8	4	2	1
1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
1000th place				100th place				10th place				1st place			

(Note 1) A minus value cannot be converted correctly.

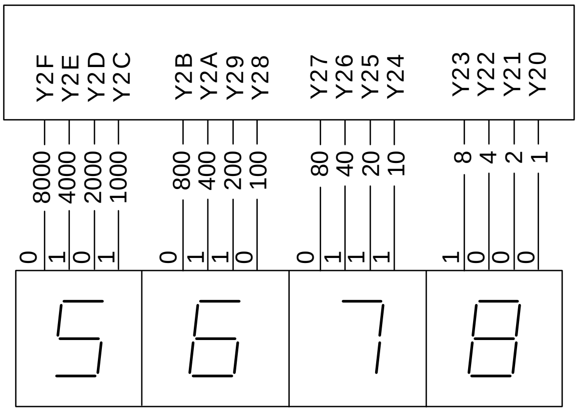
Execution conditions

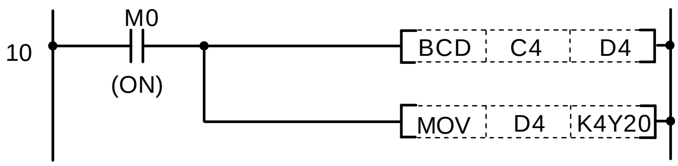
The execution conditions for BCD are as follow.



Program example

(1) Program to output C4 current value from Y20 to 2F to BCD display.



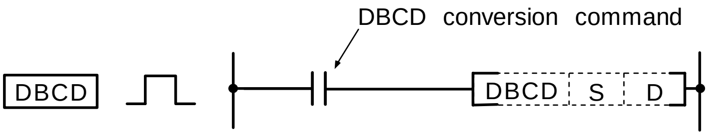


Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	BCD	C4	D4	
14	MOV	D4	K4Y20	
17				

○ DBCD ... BIN → BCD conversion (32-bit)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○								○	4		
D							○	○	○	○											

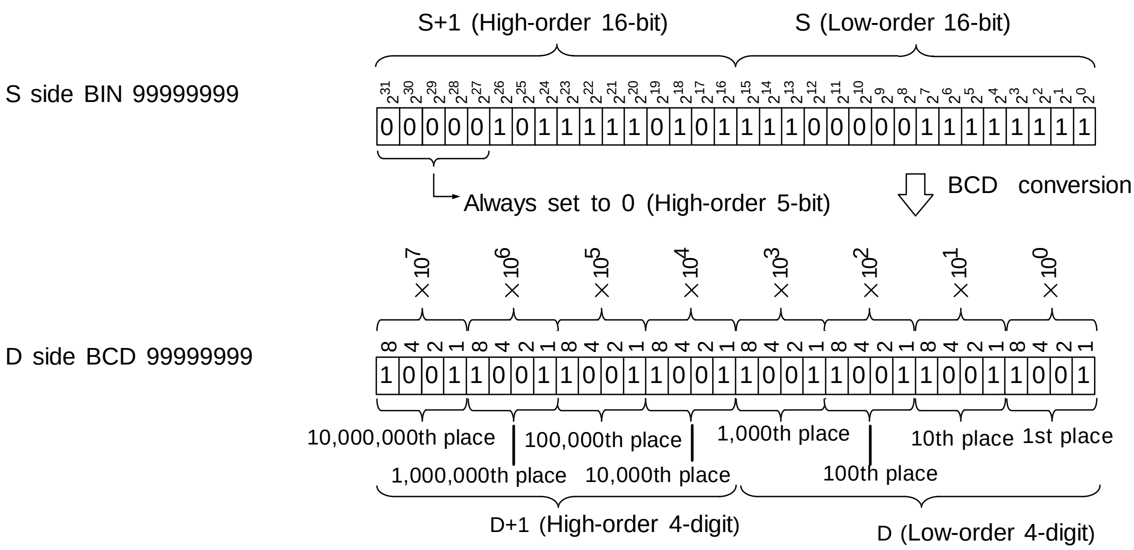


Setting data

S	BIN data or head No. of device where BIN data is stored.
D	Head No. of device to store BCD data.

Function

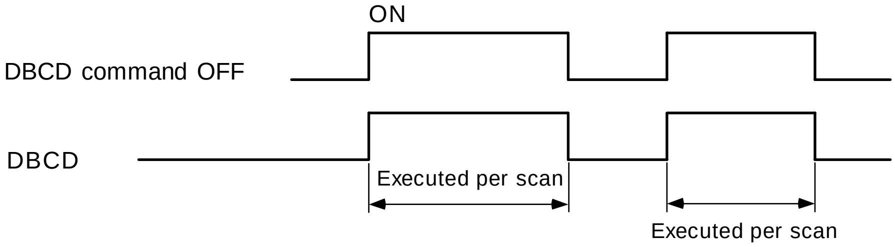
The BIN data (0 to 99999999) of the device designated with S is BCD converted and transmitted to the device designated with D.



(Note 1) A minus value cannot be converted correctly.

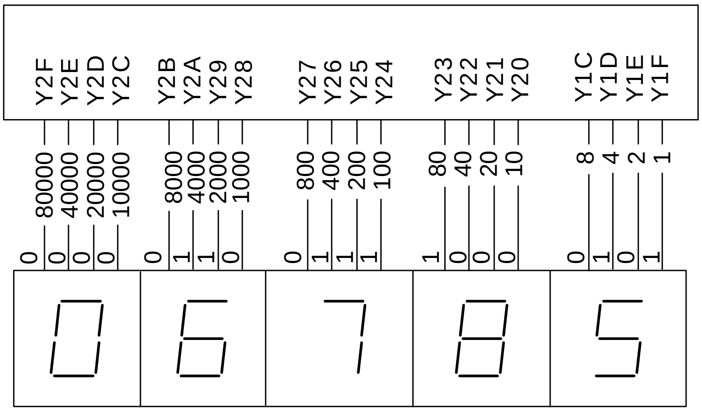
Execution conditions

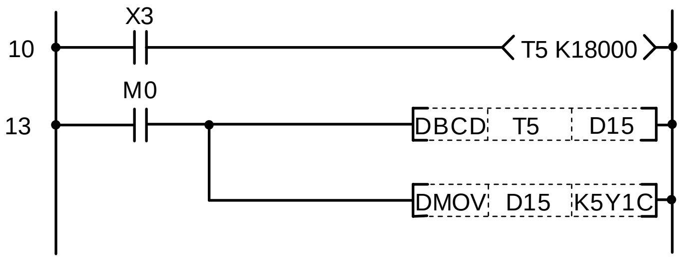
The execution conditions for DBCD are as follow.



Program example

(1) Program to output the current timer value of which the setting value exceeds 9999 to Y1C to 2F.



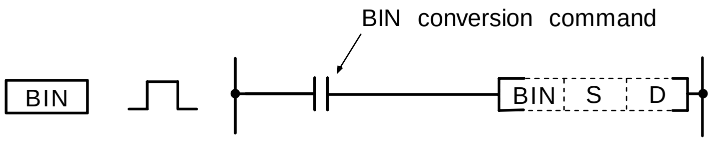


Coding

No. of steps	Com-mand	Device		
10	LD	X3		
11	OUT	T5	K18000	
13	LD	M0		
14	DBCD	T5	D15	
18	DMOV	D15	K5Y1C	
22				

○ BIN ... BCD → BIN conversion (16-bit)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○								○	3		
D							○	○	○	○											



Setting data

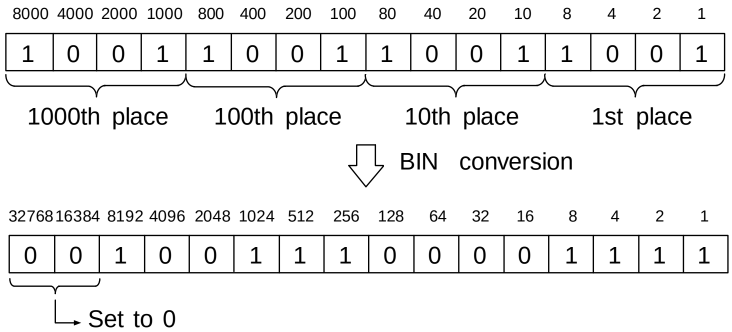
S	BCD data or No. of device where BCD data is stored.
D	No. of device to store BIN data

Function

The BCD data (0 to 9999) of the device designated with S is BIN converted and transmitted to the device designated with D.

S side BCD 9999

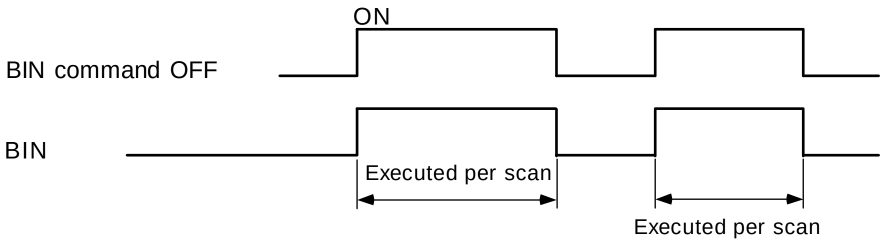
D side BIN 9999



(Note 1) A minus value cannot be converted correctly.

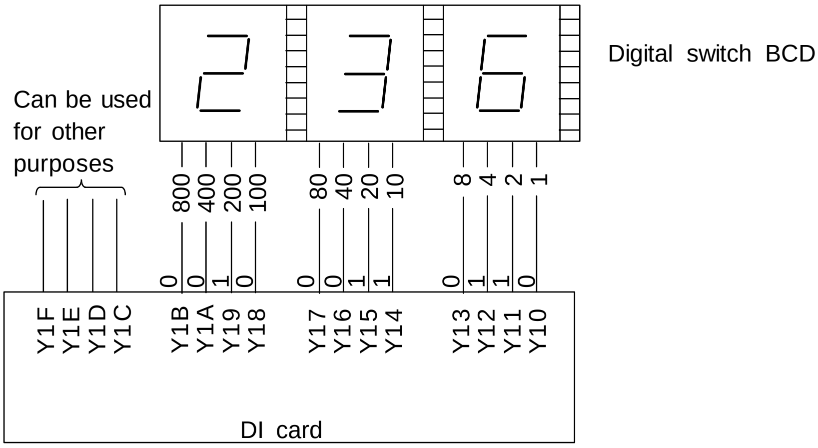
Execution conditions

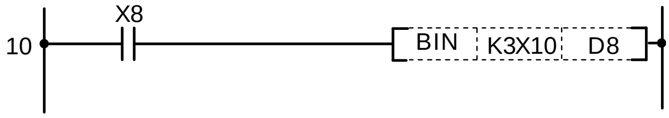
The execution conditions for BIN are as follow.



Program example

(1) Program to BIN convert the X10 to 1B BCD data when X8 turns On, and store in D8.



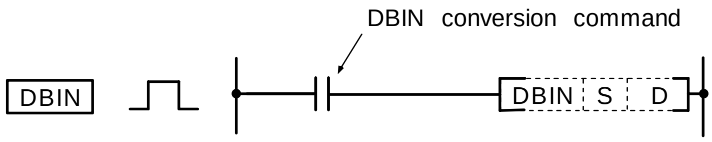


Coding

No. of steps	Com-mand	Device		
10	LD	X8		
11	BIN	K3X10	D8	
14				

○ DBIN ... BCD → BIN conversion (32-bit)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○								○	4		
D							○	○	○	○											



Setting data

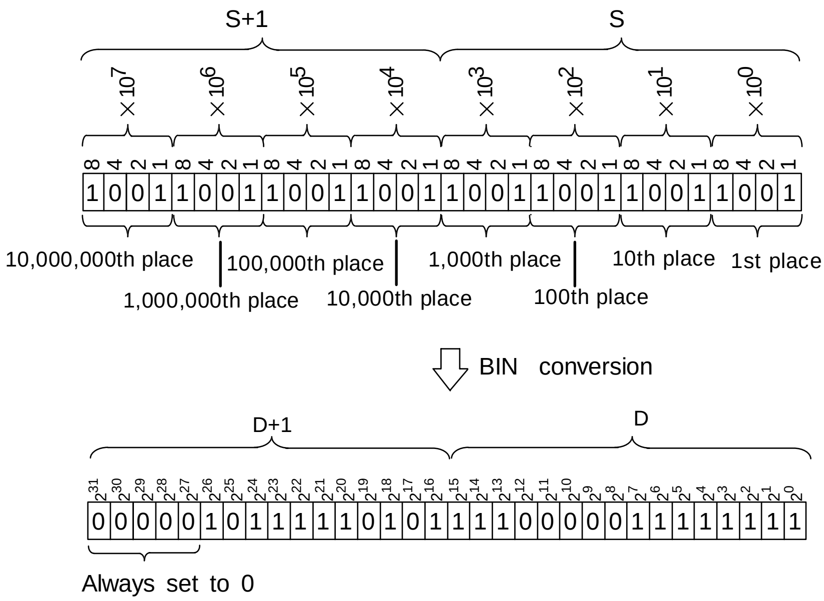
S	BCD data or head No. of device where BCD data is stored.
D	Head No. of device to store BIN data

Function

The BCD data (0 to 99999999) of the device designated with S is BIN converted and transmitted to the device designated with D.

S side BCD 99999999

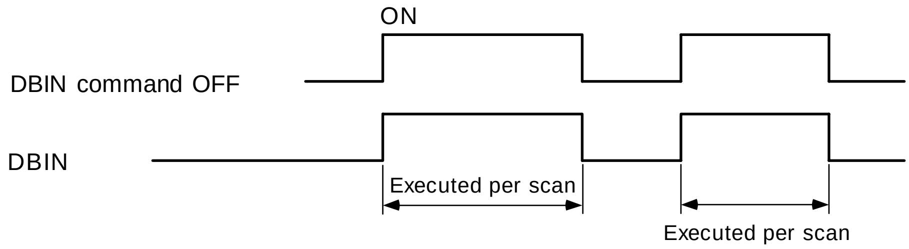
D side BIN 99999999



(Note 1) A minus value cannot be converted correctly.

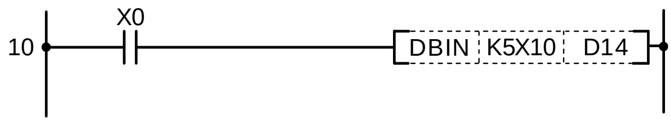
Execution conditions

The execution conditions for DBIN are as follow.



Program example

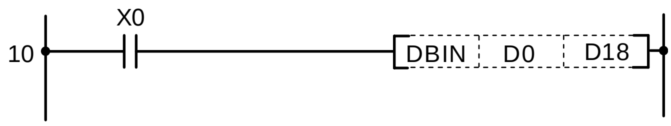
(1) Program to BIN convert the X10 to 23 BCD data when X0 turns ON, and to store in D14, 15.



Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	DBIN	K5X10	D14	
15				

(2) Program to BIN convert the D0, 1 data when X0 turns ON, and store in D18, 19.



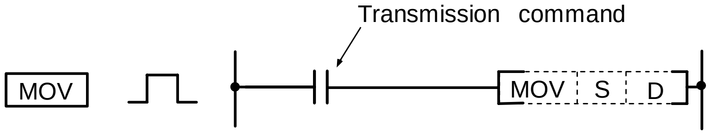
No. of steps	Com-mand	Device		
10	LD	X0		
11	DBIN	D0	D18	
15				

○ MOV ... 16-bit data transmission

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○	△			○	○			○	3	○	
D	*1	○	○	○	○	○	○	○	○	○	△										

△ : MOV from a bit device (word device) to Z is not possible. (MOV to Z is possible only for a constant.)
Z cannot be independently placed on the source side, but can be used on the source side as ornaments for D and R.
Refer to "Index Ornament" for details.

***1** MOV to device X can be programmed, but this is a command for testing by Mitsubishi. Do not use it.

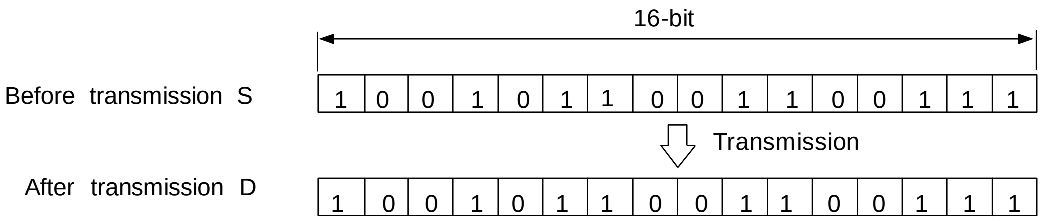


Setting data

S	Transmission source data or No. of device where data is stored.
D	No. of transmission destination device.

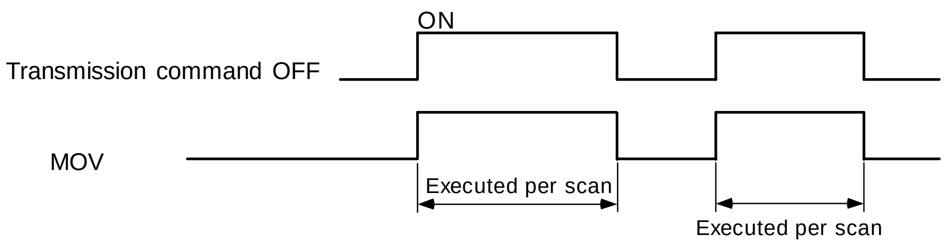
Function

The 16-bit data of the device designated with S is transmitted to the device designated with D.



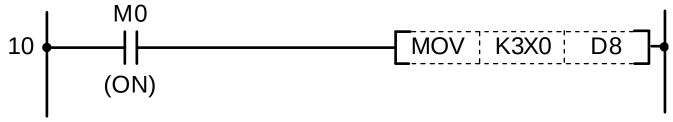
Execution conditions

The execution conditions for MOV are as shown below.



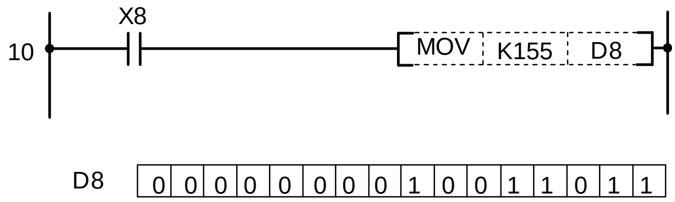
Program example

(1) Program to store input X0 to B data in D8.



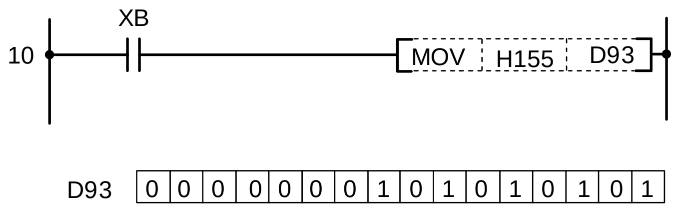
No. of steps	Com-mand	Device		
10	LD	M0		
11	MOV	K3X0	D8	
14				

(2) Program to store 155 in D8 as binary value when X8 turns ON.



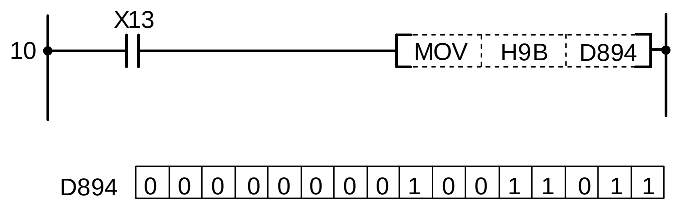
No. of steps	Com-mand	Device		
10	LD	X8		
11	MOV	K155	D8	
14				

(3) Program to store 155 in D93 as BCD value in when XB turns ON.



No. of steps	Com-mand	Device		
10	LD	XB		
11	MOV	H155	D93	
14				

(4) Program to store 155 in D894 as hexadecimal (HEX) when X13 turns ON.

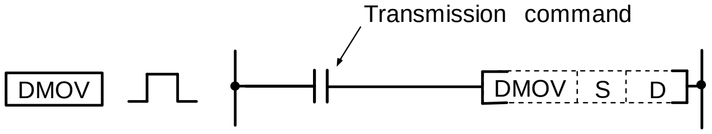


No. of steps	Com-mand	Device		
10	LD	X13		
11	MOV	H9B	D894	
14				

○ **DMOV ... 32-bit data transmission**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
D	*2	○	○	○	○	○	○	○	○	○											

***1** DMOV from a bit device to a bit device is not possible.
***2** DMOV to device X can be programmed, but this is a command for testing by Mitsubishi. Do not use it.

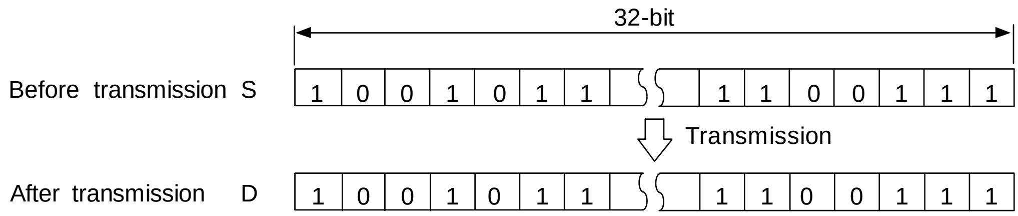


Setting data

S	Transmission source data or head No. of device where data is stored.
D	Head No. of transmission destination device.

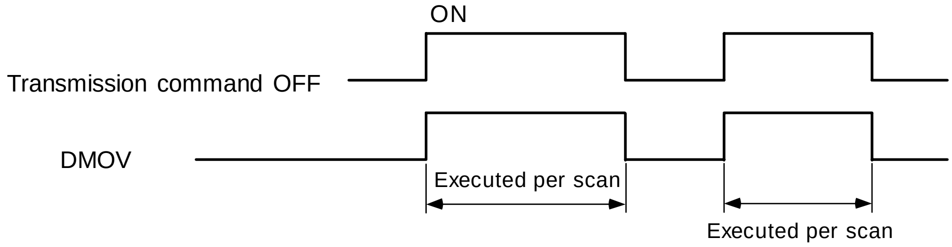
Function

The 32-bit data of the device designated with S is transmitted to the device designated with D.



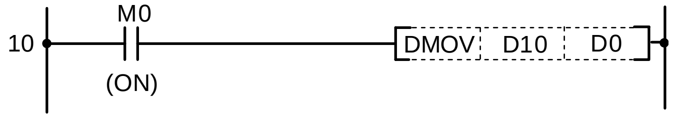
Execution conditions

The execution conditions for DMOV are as shown below.



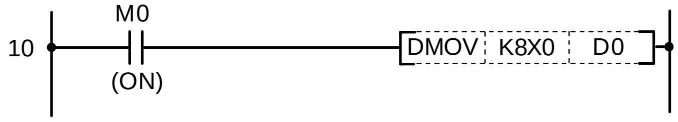
Program example

(1) Program to store D10, D11 data in D0, D1.



No. of steps	Com-mand	Device		
10	LD	M0		
11	DMOV	D10	D0	
14				

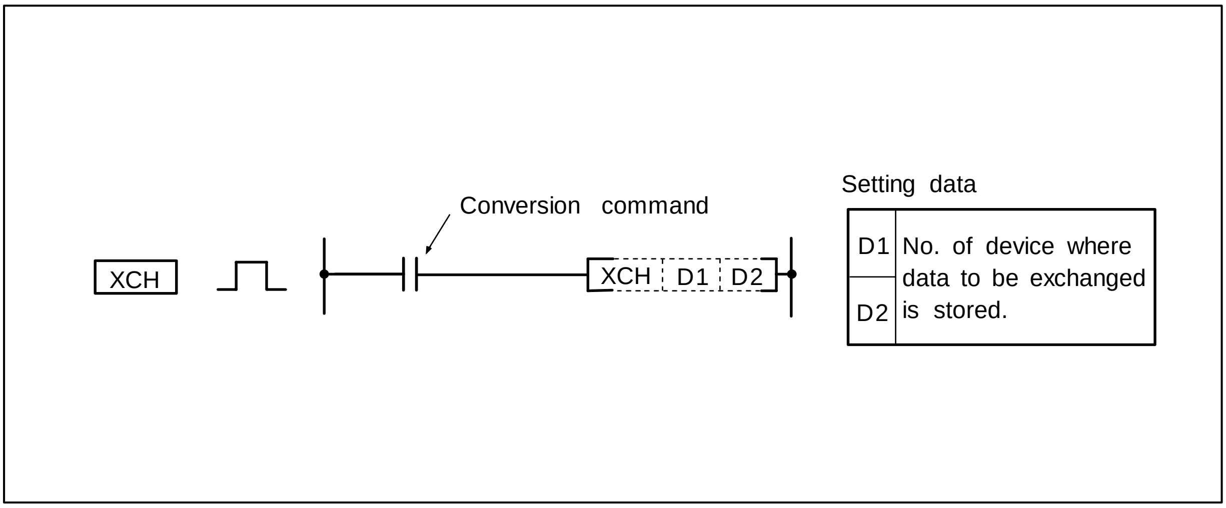
(2) Program to store X0 to 1F data in D0, D1.



No. of steps	Com-mand	Device		
10	LD	M0		
11	DMOV	K8X0	D0	
15				

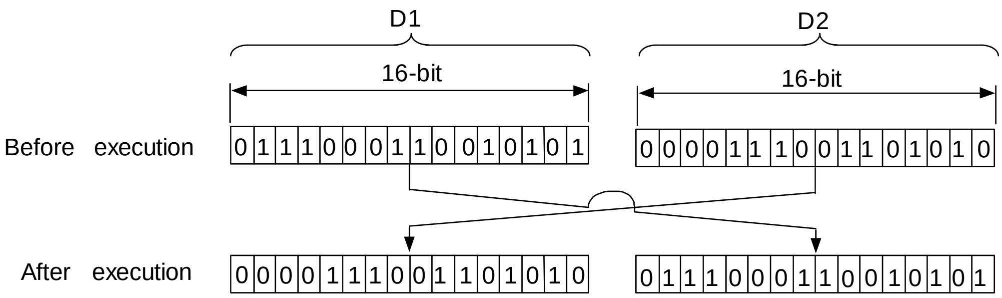
○ XCH ... 16-bit data exchange

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D1		○	○	○	○	○	○	○	○	○								○	4		
D2							○	○	○	○											



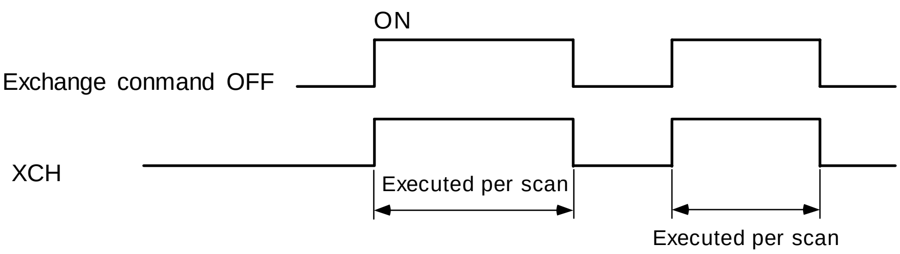
Function

The D1 and D2 16-bit data are exchanged.



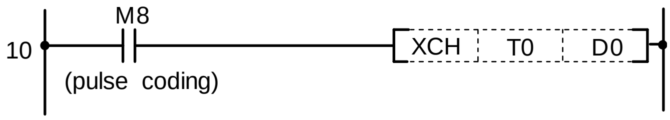
Execution conditions

The execution conditions for the XCH command are as shown below.



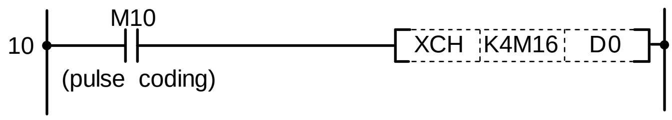
Program example

(1) Program to exchange T0 current value with D0 details when M8 turns ON.



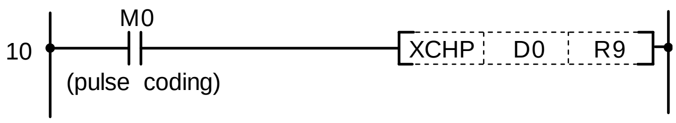
No. of steps	Com-mand	Device		
10	LD	M8		
11	XCH	T0	D0	
15				

(2) Program to exchange D0 details with M16 to M31 data when M10 turns ON.



No. of steps	Com-mand	Device		
10	LD	M10		
11	XCH	K4M16	D0	
15				

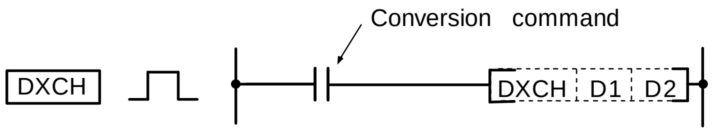
(3) Program to exchange D0 details with R9 details when M0 turns ON.



No. of steps	Com-mand	Device		
10	LD	M0		
11	XCH	D0	R9	
15				

○ DXCH ... 32-bit data exchange

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D1		○	○	○	○	○	○	○	○	○								○	4		
D2							○	○	○	○											

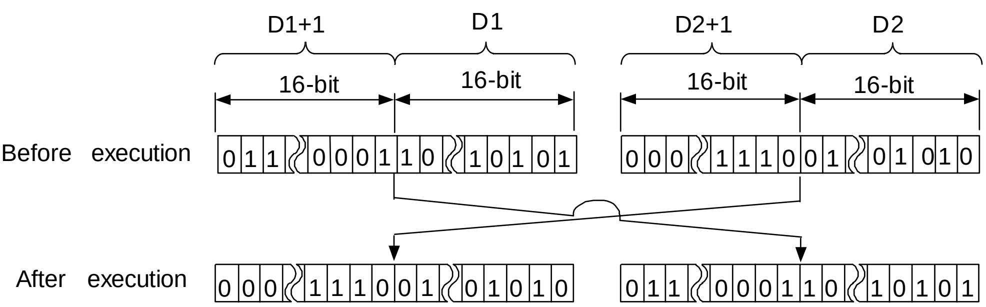


Setting data

D1	Head No. of device where data to be exchanged is stored.
D2	

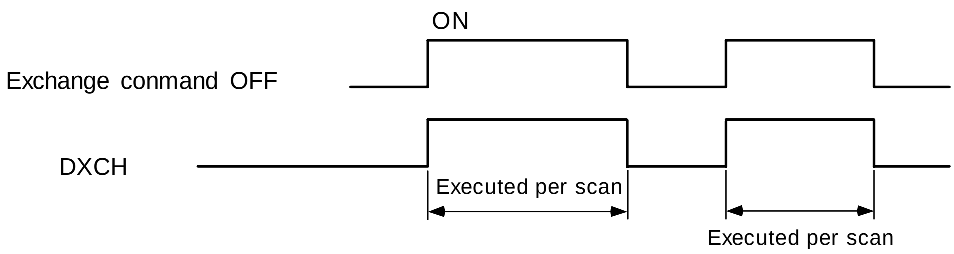
Function

The D1 and D2 32-bit data are exchanged.



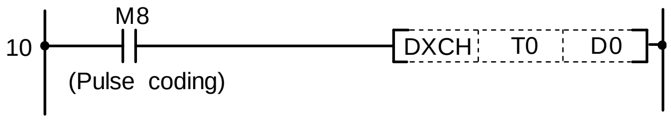
Execution conditions

The execution conditions for the DXCH command are as shown below.



Program example

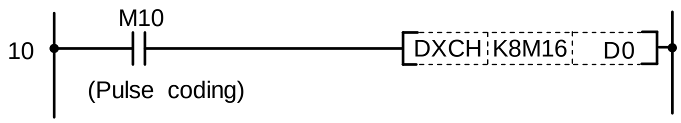
(1) Program to exchange T0 and T1 current values with D0, 1 details when M8 turns ON.



Coding

No. of steps	Com-mand	Device		
10	LD	M8		
11	DXCH	T0	D0	
15				

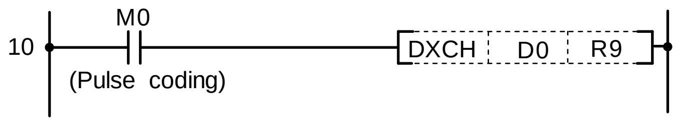
(2) Program to exchange D0, 1 details with M16 to M47 data when M10 turns ON.



Coding

No. of steps	Com-mand	Device		
10	LD	X10		
11	DXCH	K8M16	D0	
15				

(3) Program to exchange D0, 1 details with R9, 10 details when M0 turns ON.

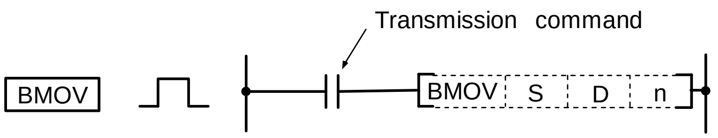


Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	DXCH	D0	R9	
15				

○ BMOV ... Block transmission of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S							○	○	○	○									5		
D							○	○	○	○											
n														○	○						

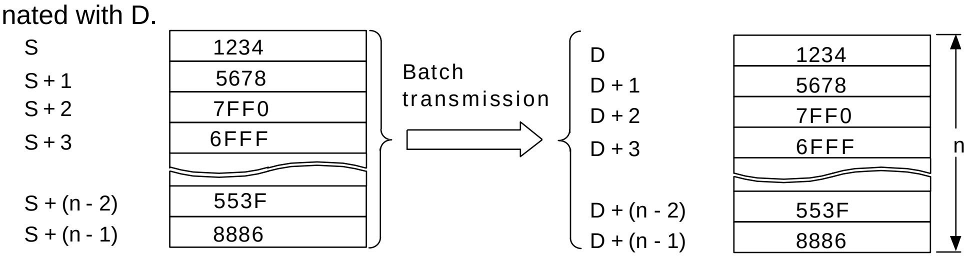


Setting data

S	Head No. of device where data to be transmitted is stored.
D	Head No. of device to store transmitted data
n	No. of transmissions

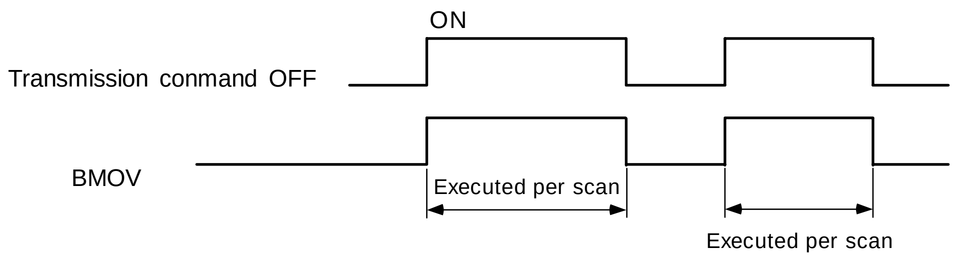
Function

The details of n points from the device designated with S are batch transmitted to the n point designated with D.



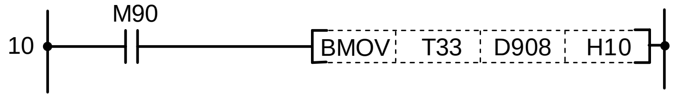
Execution conditions

The execution conditions of the BMOV command are as shown below.



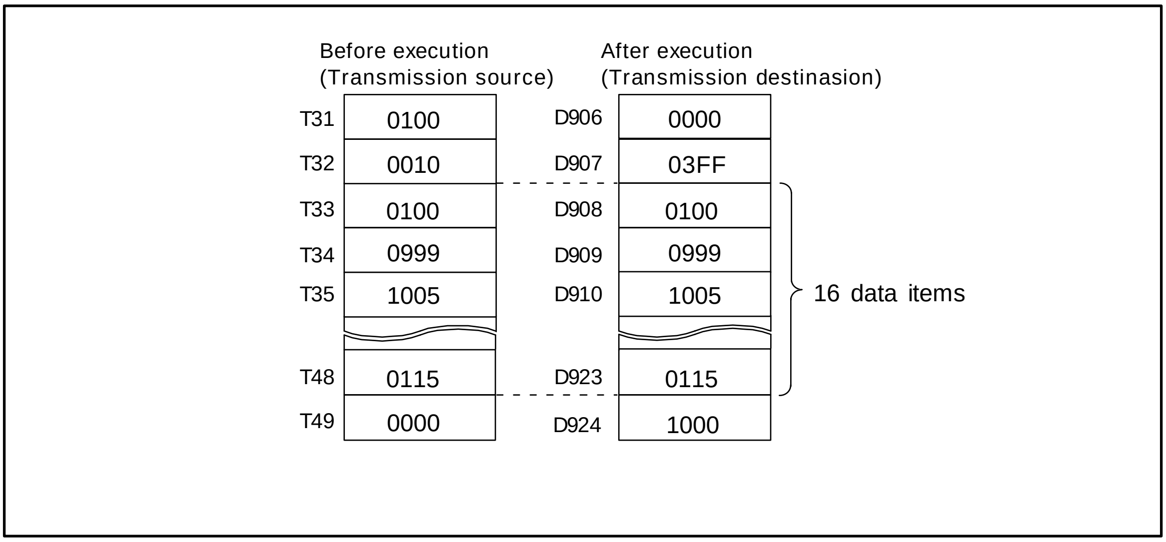
Program example

(1) Program to transmit the current values of T33 to 48 to D908 to 923.



Coding

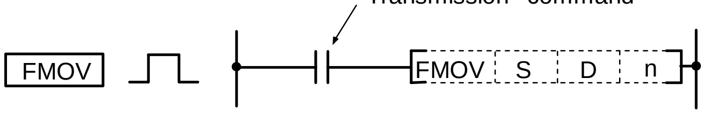
No. of steps	Com-mand	Device		
10	LD	M90		
11	BMOV	T33	D908	H10
16				



Block transmission with BMOV command

○ FMOV ... Batch transmission of same 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S							○	○	○	○				○	○						
D							○	○	○	○									5		
n														○	○						

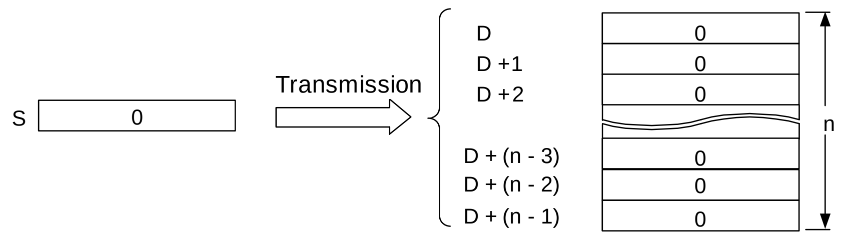


Setting data

S	No. of device where data to be transmitted is stored.
D	Head No. of device to store transmitted data
n	No. of transmissions

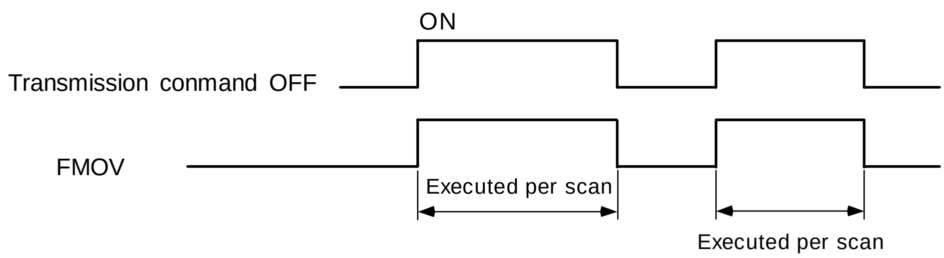
Function

The details of the device designated with S are transmitted to the area by n points designated with D in batch.



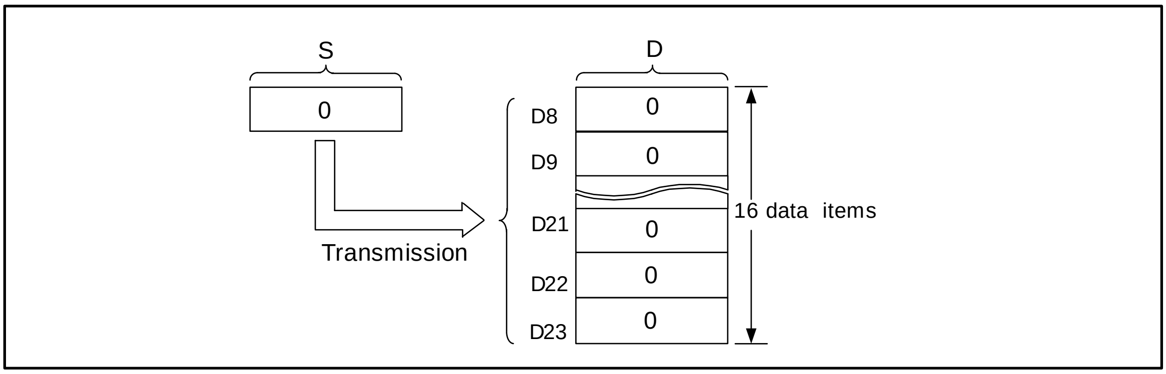
Execution conditions

The execution conditions of the FMOV command are as shown below.

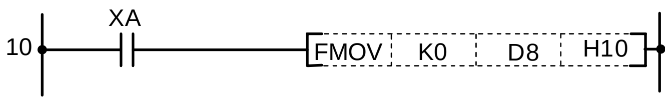


Program example

(1) Program to reset (clear) D8 to 23 when XA turns ON.



Resetting of data registers with FMOV command

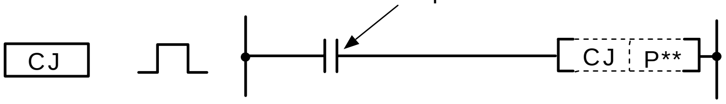


Coding

No. of steps	Com-mand	Device		
10	LD	XA		
11	FMOV	K0	D8	H10
16				

○ **CJ ... Conditional jump**

	Usable device																	Digit desig-nation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
P																○			2		



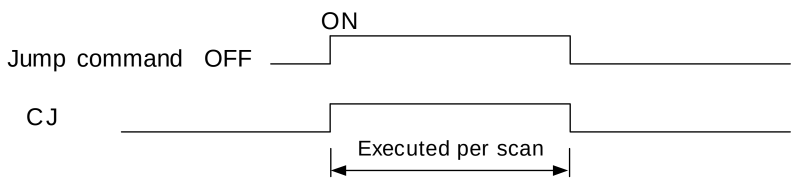
Setting data

P**	Jump designation pointer No. (P0 to P159)

Function

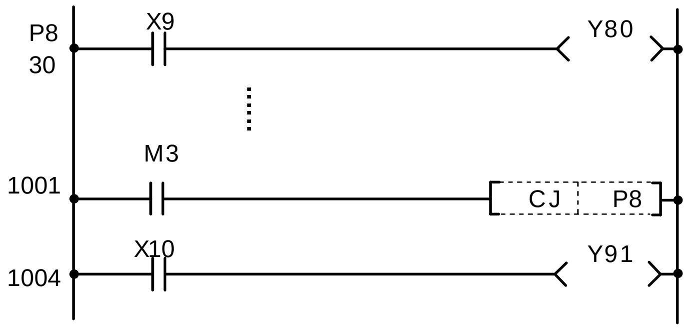
CJ

(1) The program of the designated pointer No. is executed when the jump command turns ON.
(2) The program of the next step is executed when the jump command is OFF.



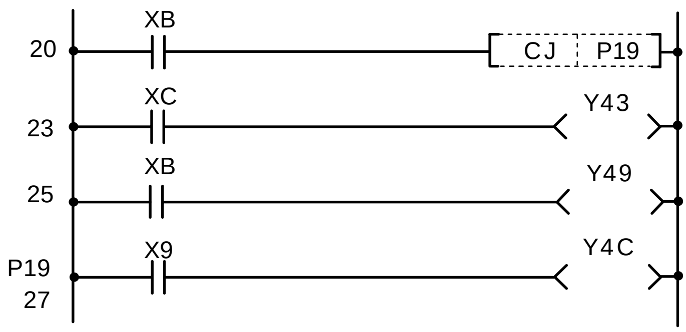
Point

(a) After the timer coil is turned ON, even if the timer that is turning the coil ON with the CJ command is jumped, the timer count will continue.
(b) The scan time will be shortened if jumping is done after the CJ command.
(c) The CJ command can be used to jump to a previous step.



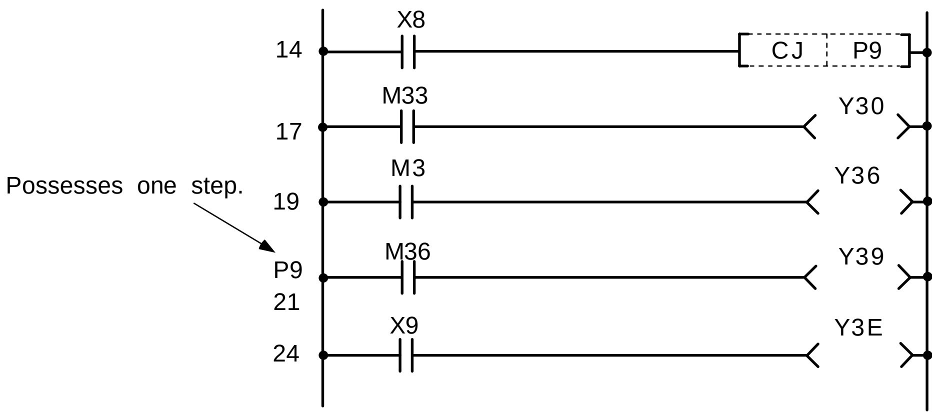
When M3 turns ON, the program will jump to the P8 label.
Executed when M3 is OFF.

(d) The devices skipped with CJ will not change.



When XB turns ON, the program will jump to the P19 label.
Even if XB, C is turned ON/OFF during execution of the CJ command, Y43, 49 will not change.

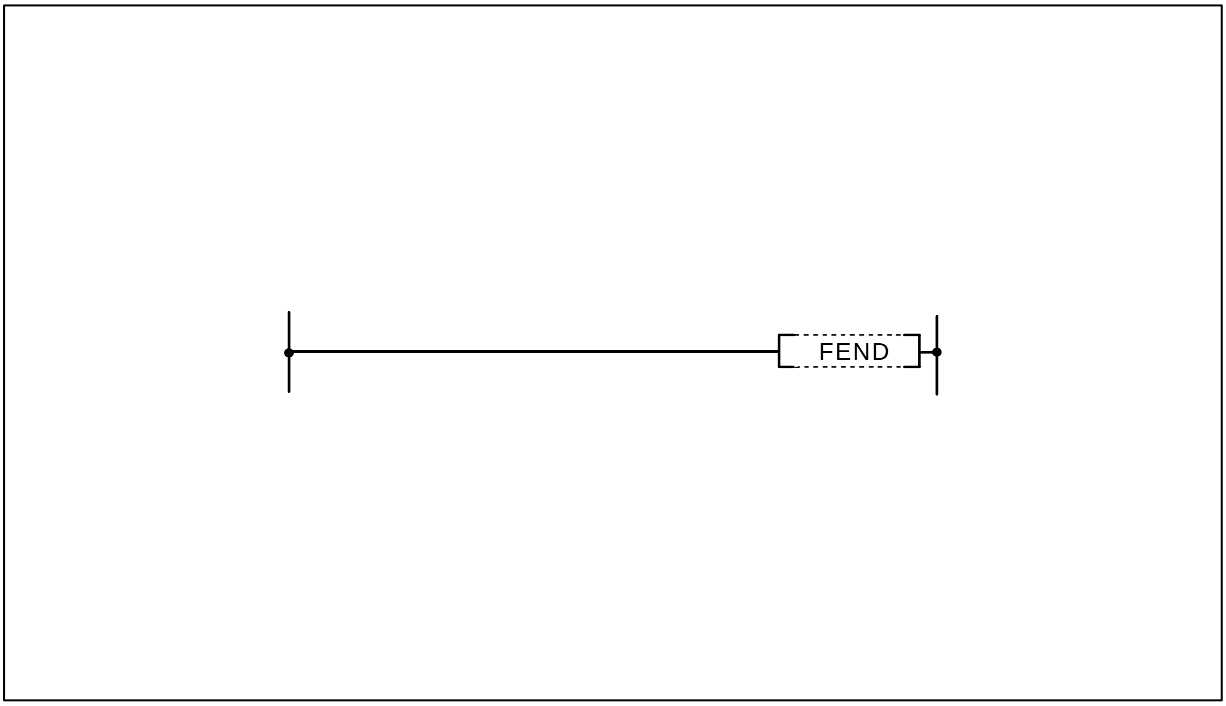
(e) Label (P**) possesses one step.



(Notes)
(1) Designate the pointer No. so that it comes prior to the END command.
(2) Designate the lavel No. which exists in the program file as the pointer No.

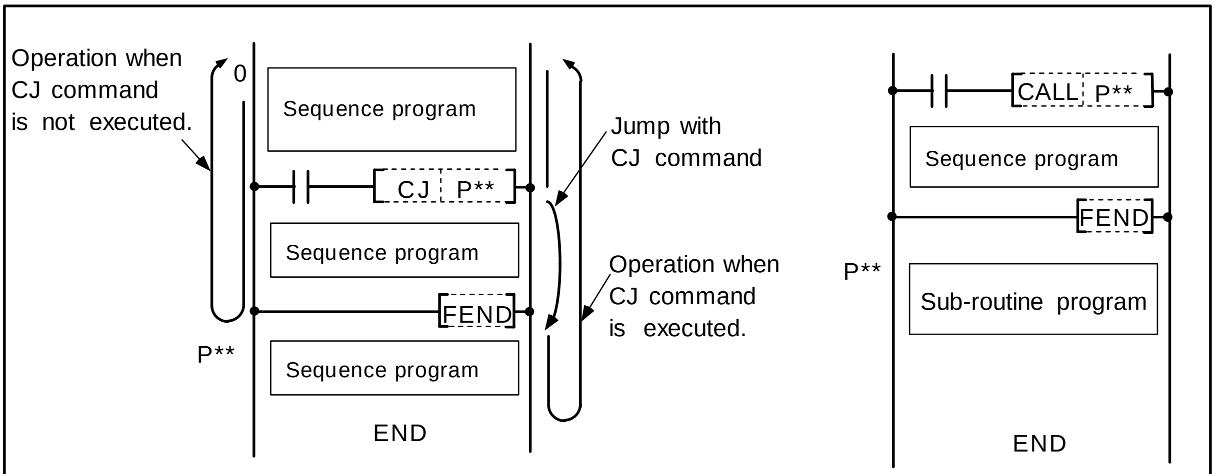
○ **FEND ... Program end**

Usable device																	Digit designation	No. of steps	Index	
Bit device						Word device							Constant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
																		1		



Function

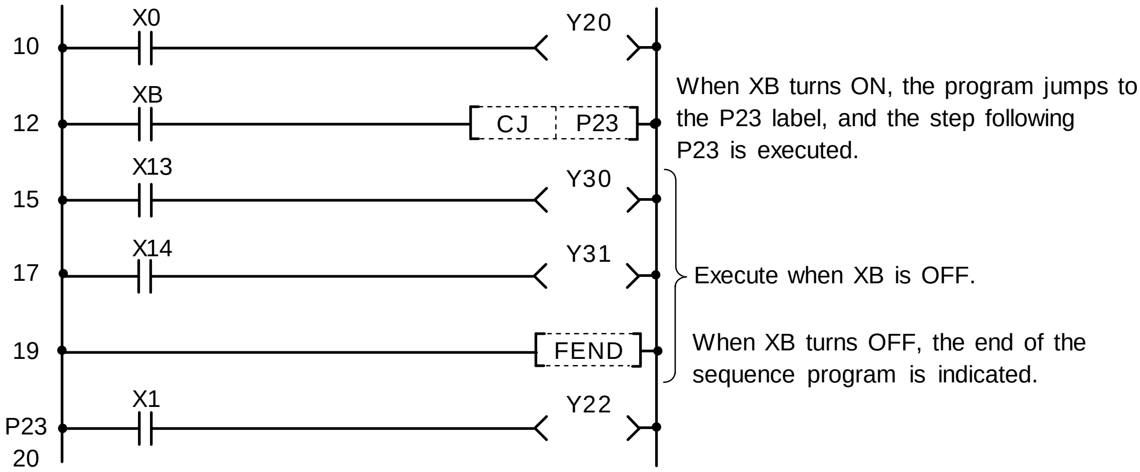
The sequence program is ended.



(a) When CJ command is used (b) When a subroutine program is used

Program example

Program when using CJ command

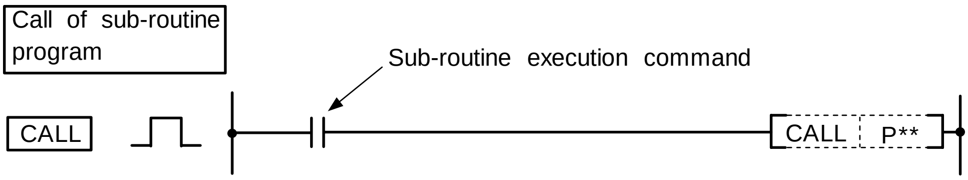


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	OUT	Y20		
12	LD	XB		
13	CJ	P23		
15	LD	X13		
16	OUT	Y30		
17	LD	X14		
18	OUT	Y31		
19	FEND			
20		P23		
21	LD	X1		
22	OUT	Y22		
23				

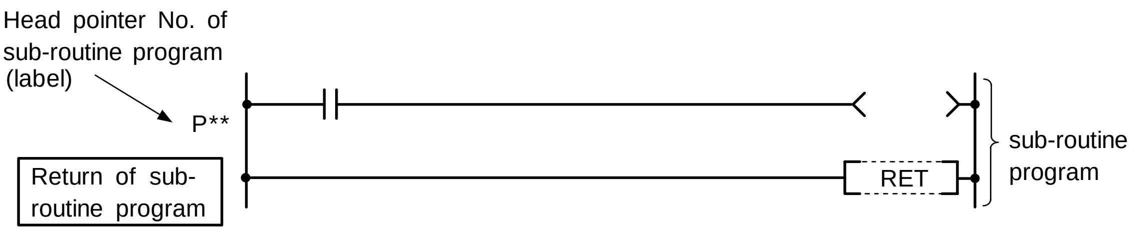
○ CALL, RET ... Call/return of sub-routine program

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
P																○			2/1		



Setting data

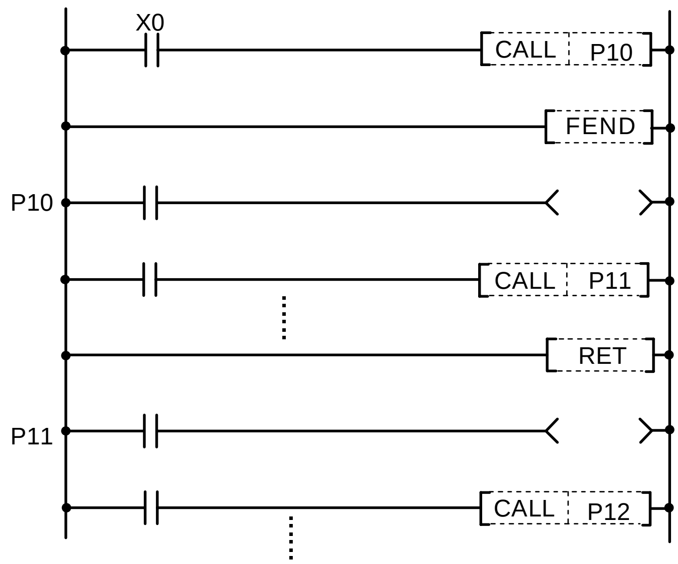
P**	Head pointer No. of sub-routine program (P0 to P159)



Function

CALL

(1) The sub-routine program designated with the point (P**) is executed.

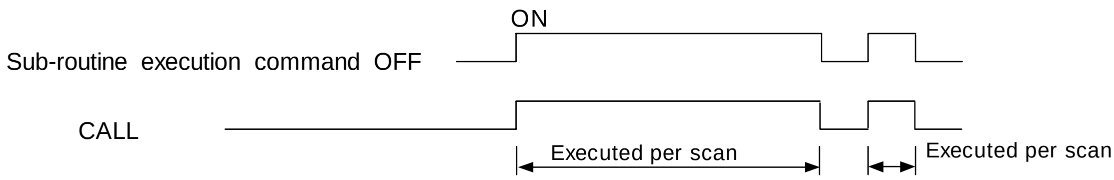


RET

(1) The end of the sub-routine program is indicated.
(2) When the RET command is executed, the sequence program in the step after the CALL command will be executed.

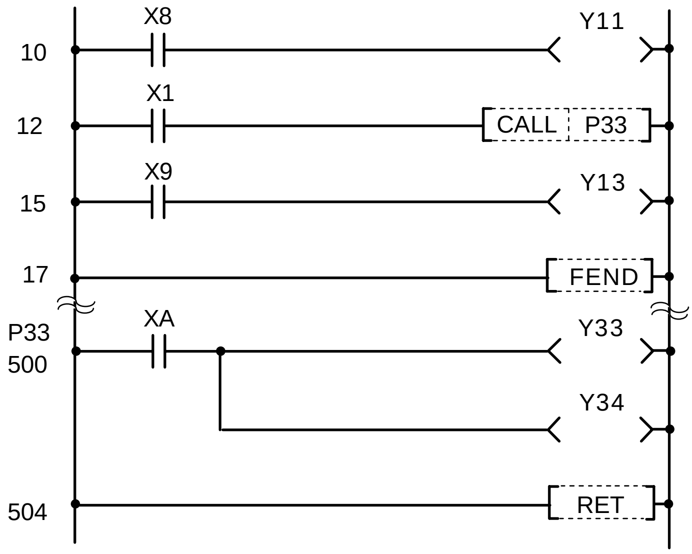
Execution conditions

The execution conditions of the CALL command are as shown below.



Program example

Program to execute sub-routine program when X1 changes from OFF to ON.

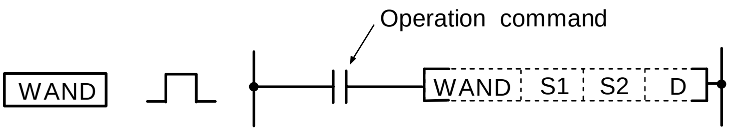


Coding

No. of steps	Com-mand	Device		
10	LD	X8		
11	OUT	Y11		
12	LD	X1		
13	CALL	P33		
15	LD	X9		
16	OUT	Y13		
17	FEND			
18				
:				
500		P33		
501	LD	XA		
502	OUT	Y33		
503	OUT	Y34		
504	RET			
505				

○ WAND ... Logical AND of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○								○	4		
S2							○	○	○	○				○	○						
D							○	○	○	○											



Setting data

S1 / S2	Data to be logical ANDed or No. of device where data is stored.
D	No. of device to store logical AND results.

Function

(1) Logical AND is executed for each bit of the 16-bit data in the device designated with S1 and the device designated with S2, and the results are stored in the device designated with D.

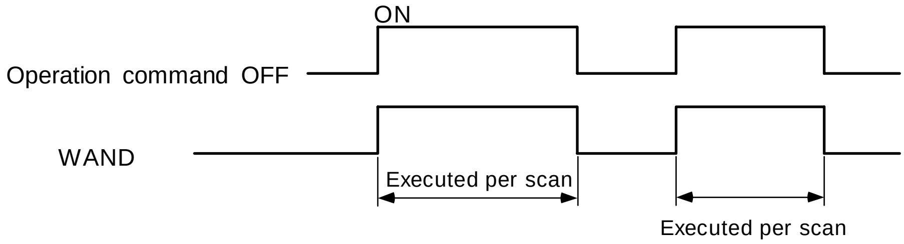
16-bit

Before execution	S1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1
		WAND															
	S2	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0
After execution	D	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0

(2) The bit device other than the designated digits are operated as 0.
(Refer to program example (2).)

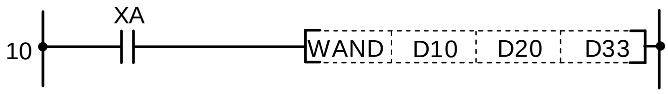
Execution conditions

The execution conditions for WAND are as follow.



Program example

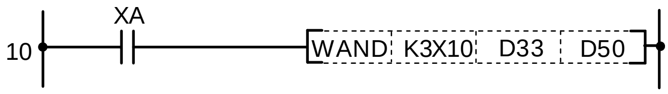
(1) Program that executes logical AND of the D10 data and D20 data when XA turns ON, and stores the results in D33.



Coding

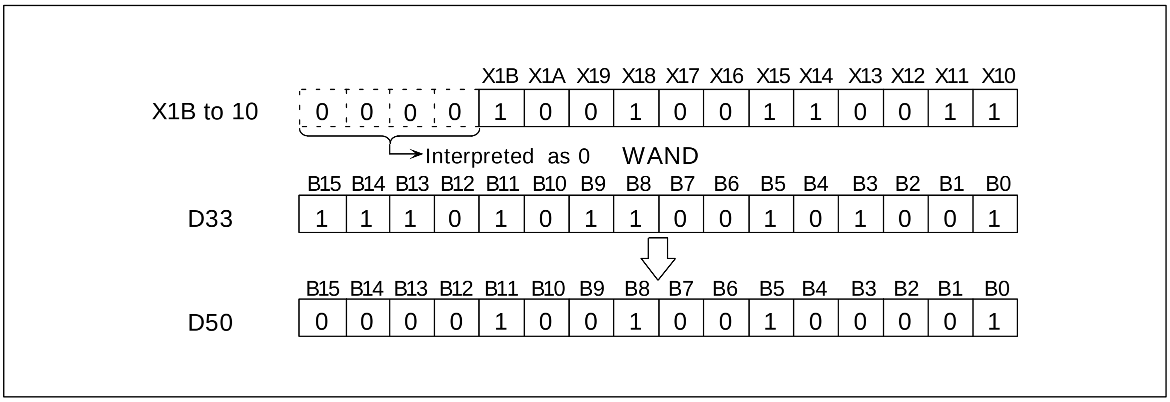
No. of steps	Com-mand	Device		
10	LD	XA		
11	WAND	D10	D20	D33
15				

(2) Program that executes logical AND of the X10 to 1B data and D33 data when XA turns ON, and outputs the results to D50.



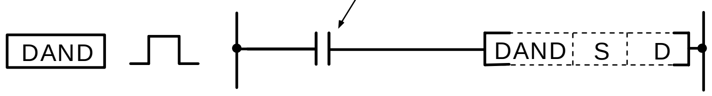
Coding

No. of steps	Com-mand	Device		
10	LD	XA		
11	WAND	K3X10	D33	D50
15				



○ DAND ... Logical AND of 32-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
D							○	○	○	○											

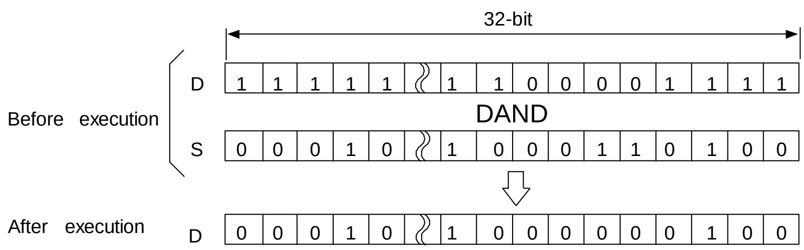


Setting data

S	Data to be logical ANDed or head No. of device where data is stored.
D	The logical AND results are stored in D device.

Function

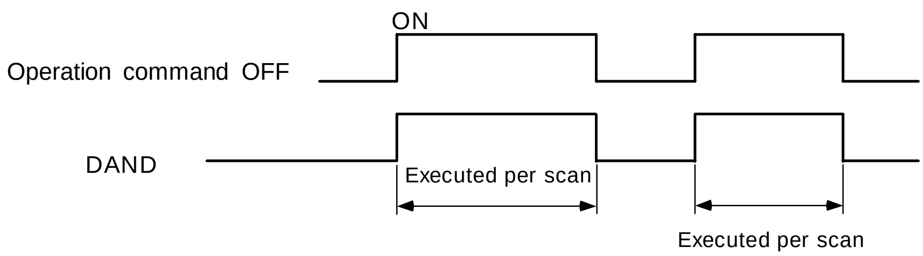
(1) Logical AND is executed for each bit of the 32-bit data in the device designated with D and the device designated in S, and the results are stored in the device designated with D.



(2) The bit device other than the designated digits are operated as 0.
(Refer to program example (1).)

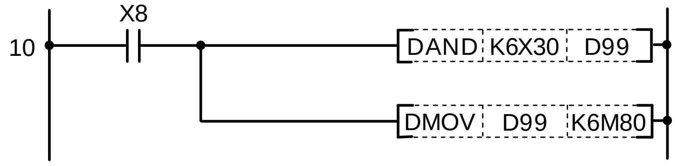
Execution conditions

The execution conditions for the DAND command are as follow.



Program example

(1) Program that executes logical AND of the X30 to 47 24-bit data and D99, 100 data when X8 turns ON, and transmit the results to M80 to 103.

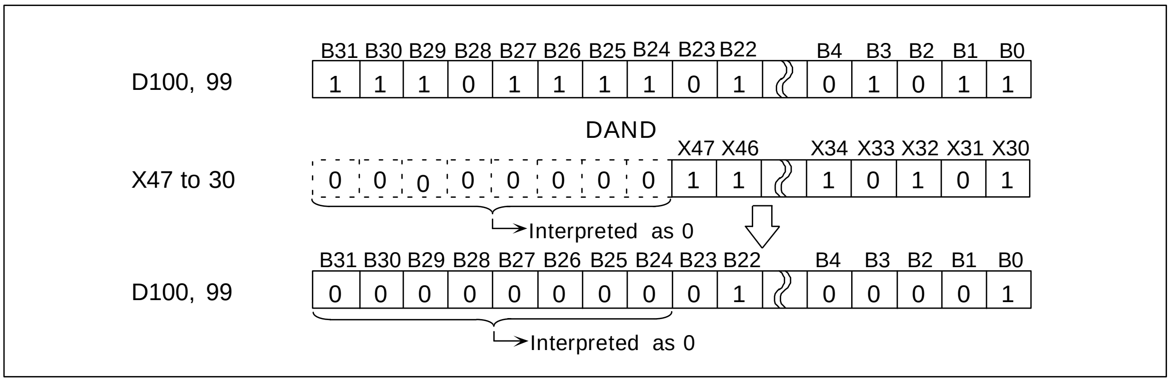


Logical AND the X30 to 47 data and D99, 100 data, and store the results in D99 to 100.

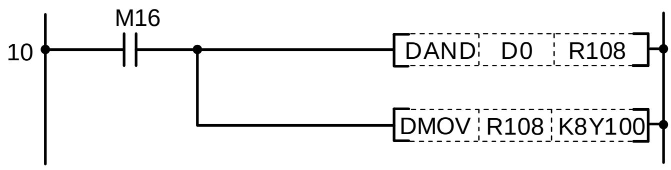
Transmit the D99, 100 data to M80 to 103.

Coding

No. of steps	Com-mand	Device		
10	LD	X8		
11	DAND	K6X30	D99	
14	DMOV	D99	K6M80	
18				



(2) Program that executes logical AND of the D0, 1 32-bit data and R108, 109 when M16 turns ON, and outputs the results to Y100 to 11F.



Logical AND the D0, 1 and R108, 109 32-bit data, and store the results in R108, 109.

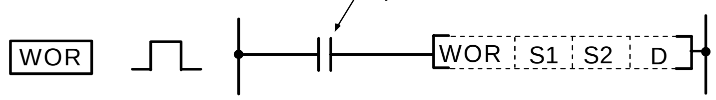
Output the R108, 109 data to Y100 to 11F.

Coding

No. of steps	Com-mand	Device		
10	LD	M16		
11	DAND	D0	R108	
14	DMOV	R108	K8Y100	
18				

○ WOR ... Logical OR of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○								○	4		
S2							○	○	○	○				○	○						
D							○	○	○	○											



Setting data

S1, S2	Data to be logical ORed or No. of device where data is stored.
D	No. of device to store logical OR results.

Function

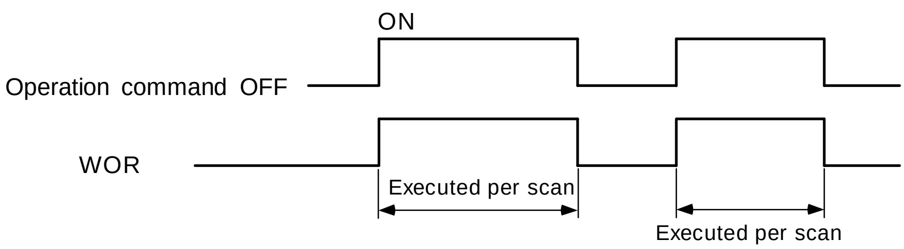
Logical OR is executed for each bit of the 16-bit data in the device designated with S1 and the device designated with S2, and the results are stored in the device designated with D.

16-bit

Before execution	S1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
		WOR															
	S2	0	0	0	0	1	1	1	1	1	0	1	0	0	1	0	1
After execution	D	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1

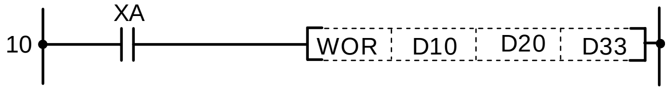
Execution conditions

The execution conditions for WOR are as follow.



Program example

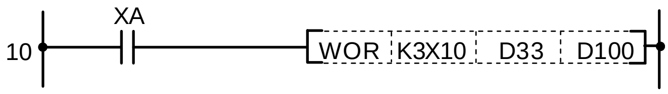
(1) Program that executes logical OR of the D10 data and D20 data when XA turns ON, and stores the results in D33.



Coding

No. of steps	Com-mand	Device		
10	LD	XA		
11	WOR	D10	D20	D33
15				

(2) Program that executes logical OR of the X10 to 1B data and D33 data when XA turns ON, and outputs the results in D100.

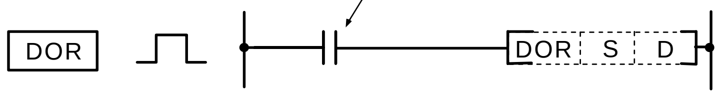


Coding

No. of steps	Com-mand	Device		
10	LD	XA		
11	WOR	K3X10	D33	D100
15				

○ DOR ... Logical OR of 32-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
D							○	○	○	○											

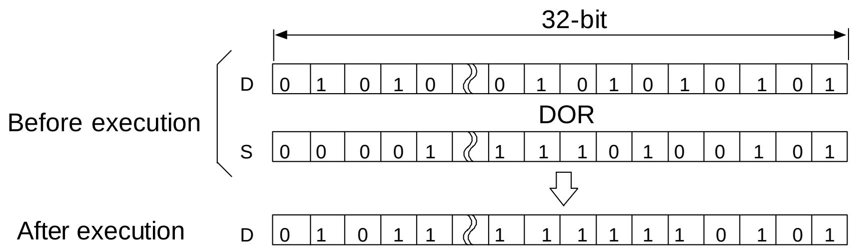


Setting data

S	Data to be logical ORed or head No. of device where data is stored.
D	The logical OR results are stored in D device.

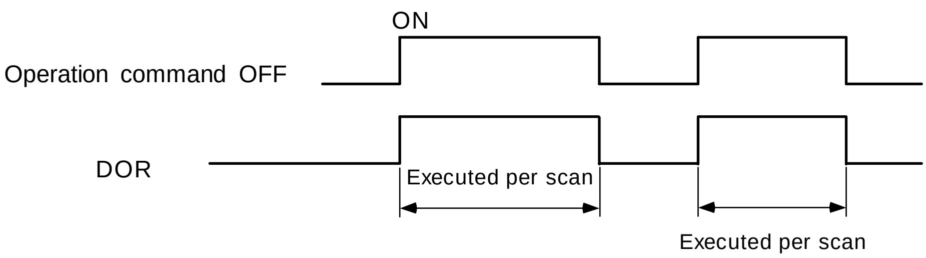
Function

Logical OR is executed for each bit of the 32-bit data in the device designated with D and the device designated with S, and the results are stored in the device designated with D.



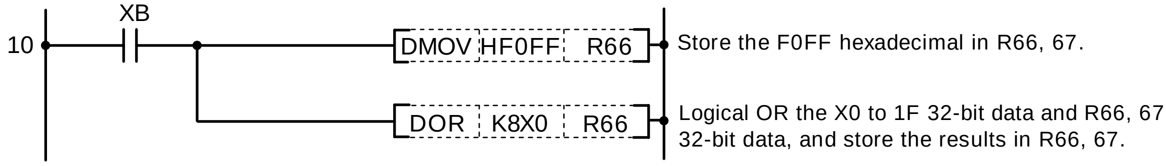
Execution conditions

The execution conditions for DOR are as follow.



Program example

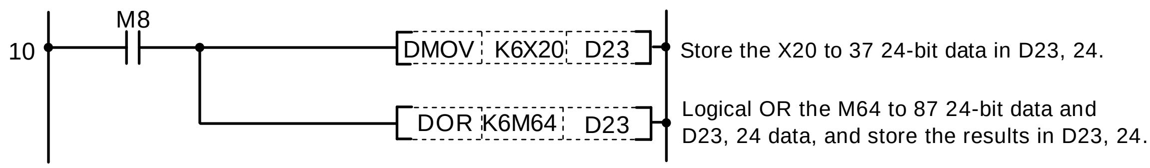
(1) Program that executes logical OR of the X0 to 1F 32-bit data and the F0FF hexadecimal when XB turns ON, and stores the results in R66, 67.



Coding

No. of steps	Com-mand	Device		
10	LD	XB		
11	DMOV	HFOFF	R66	
14	DOR	K8X0	R66	
18				

(2) Program that executes logical OR of the M64 to 87 24-bit data and X20 to 37 24-bit data when M8 turns ON, and stores the results in D23, 24.

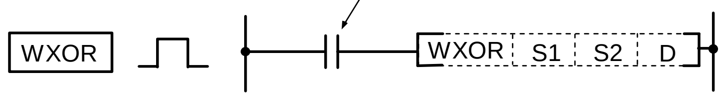


Coding

No. of steps	Com-mand	Device			
10	LD	M8			
11	DMOV	K6X20	D23		
14	DOR	K6M64	D23		
18					

○ WXOR ... Exclusive OR of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○								○	4		
S2							○	○	○	○				○	○						
D							○	○	○	○											

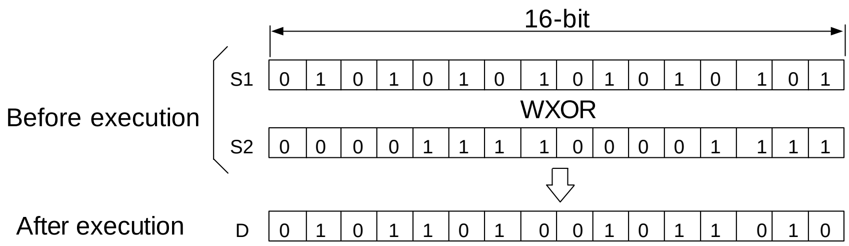


Setting data

S1	Data to be exclusive ORed or No. of device where data is stored.
S2	
D	No. of device to store exclusive OR results.

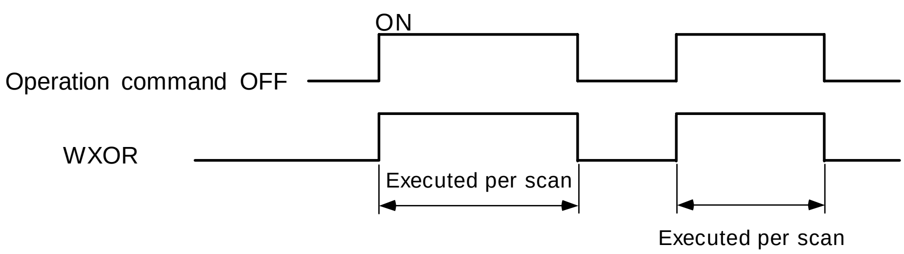
Function

Exclusive OR is executed for each bit of the 16-bit data designated with S1 and designated with S2, and the results are stored in the device designated with D.



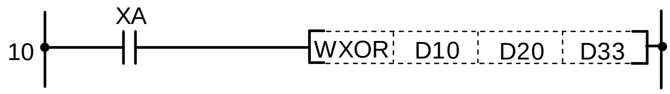
Execution conditions

The execution conditions for WXOR are as follow.



Program example

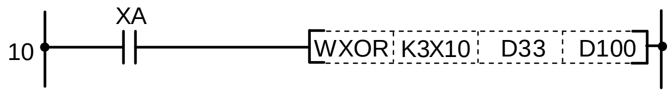
(1) Program that executes exclusive OR of the D10 data and D20 data when XA turns ON, and stores the results in D33.



Coding

No. of steps	Com- mand	Device		
10	LD	XA		
11	WXOR	D10	D20	D33
15				

(2) Program that executes exclusive OR of the X10 to 1B data and D33 data when XA turns ON, and outputs the results to D100.

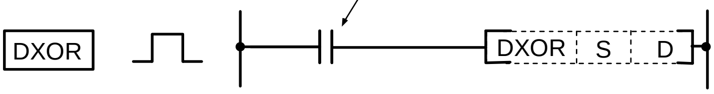


Coding

No. of steps	Com- mand	Device		
10	LD	XA		
11	WXOR	K3X10	D33	D100
15				

○ **DXOR ... Exclusive OR of 32-bit data**

	Usable device																Digit desig-nation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○				○	○			○	3/4		
D							○	○	○	○											

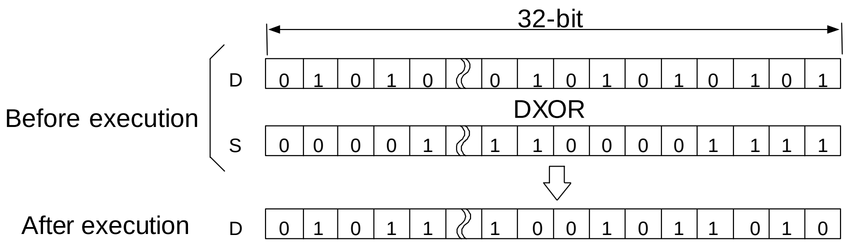


Setting data

S	Data to be exclusive ORed or head No. of device where data is stored.
D	The exclusive OR results are stored in D device.

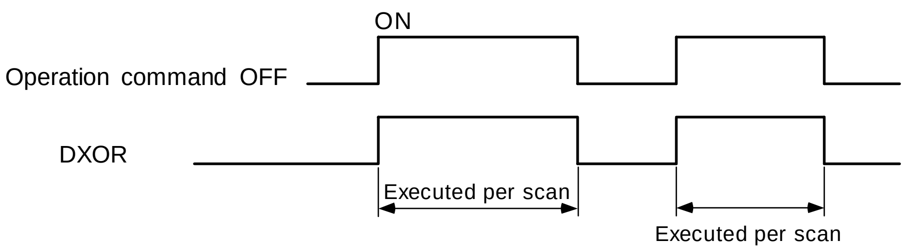
Function

Exclusive OR is executed for each bit of the 32-bit data designated with D and designated with S, and the results are stored in the device designated with D.



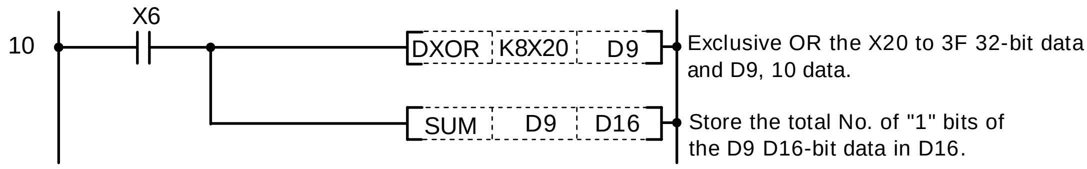
Execution conditions

The execution conditions for DXOR are as follow.



Program example

(1) Program that compares the X20 to 3F 32-bit data and the D9, 10 data when X6 turns ON, and stores the differing No. of bits in D16.

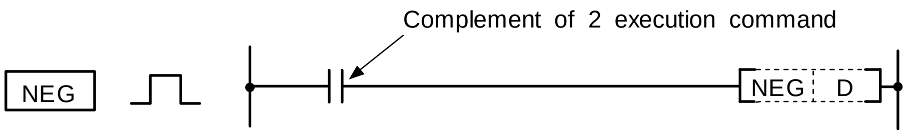


Coding

No. of steps	Com-mand	Device		
10	LD	X6		
11	DXOR	K8X20	D9	
14	SUM	D9	D16	
18				

○ NEG ... Complement of 2 (BIN 16-bit data)

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									2		

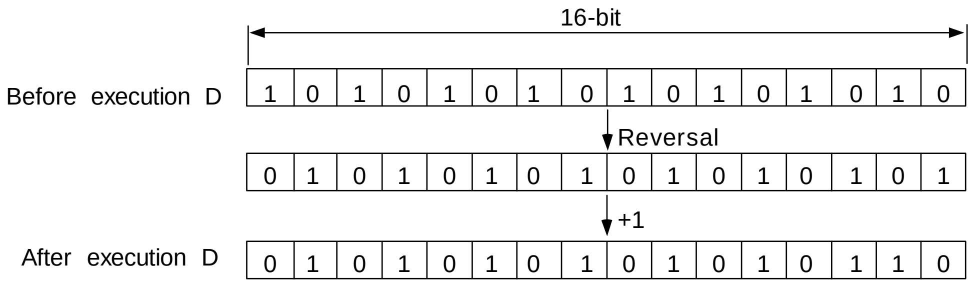


Setting data

D	No. of device where data to be complemented by 2 is stored.

Function

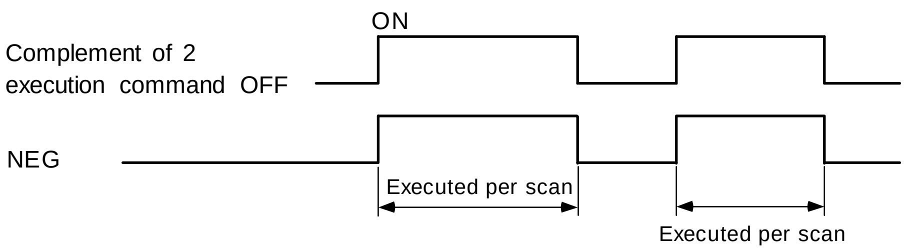
(1) The 16-bit data of the device designated with D is reversed and incremented by one, and then stored in the device designated with D.



(2) This is used to use a negative BIN value as an absolute value.

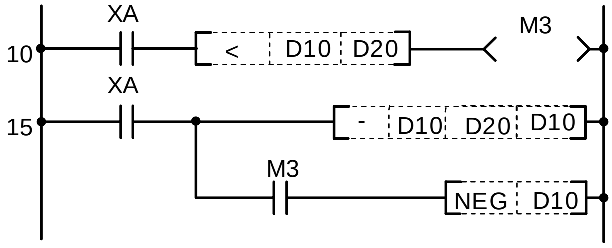
Execution conditions

The execution conditions for NEG are as follow.



Program example

(1) Program to calculate D10 - D20 when XA turns ON and obtain an absolute value when the results are negative.



M3 turns ON when D10 < D20

D10-D20 is executed.

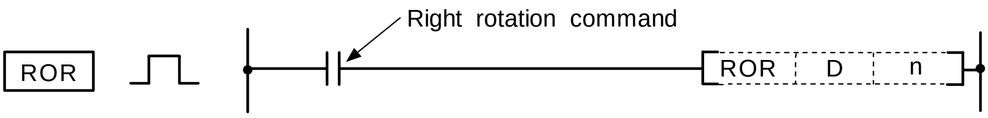
The absolute value (complement of 2) when M3 turns ON is obtalned.

Coding

No. of steps	Com-mand	Device		
10	LD	XA		
11	AND<	D10	D20	
14	OUT	M3		
15	LD	XA		
16	-	D10	D20	D10
20	AND	M3		
21	NEG	D10		
23				

○ ROR ... Right rotation of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

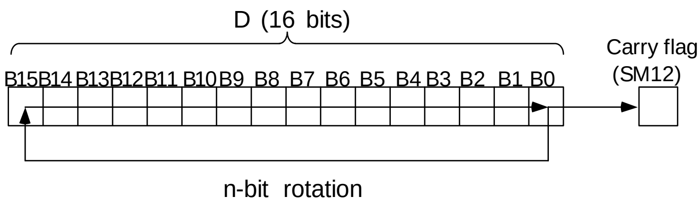


Setting data

D	No. of device where right ratation data is stored.
n	Times (0 to 15)

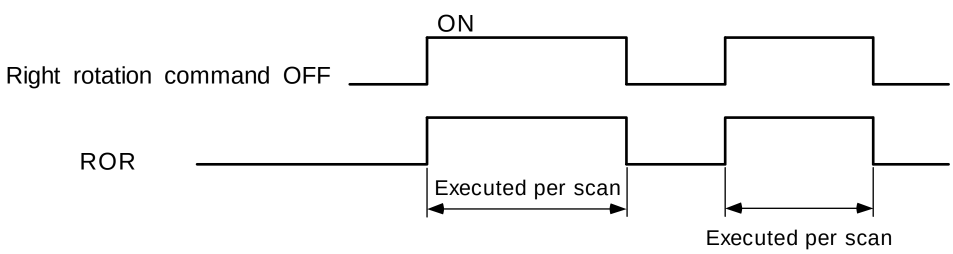
Function

The 16-bit data designated with D is rotated n bits to the right excluding the carry flag.



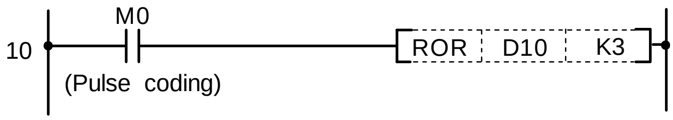
Execution conditions

The execution conditions for the ROR command are as shown below.



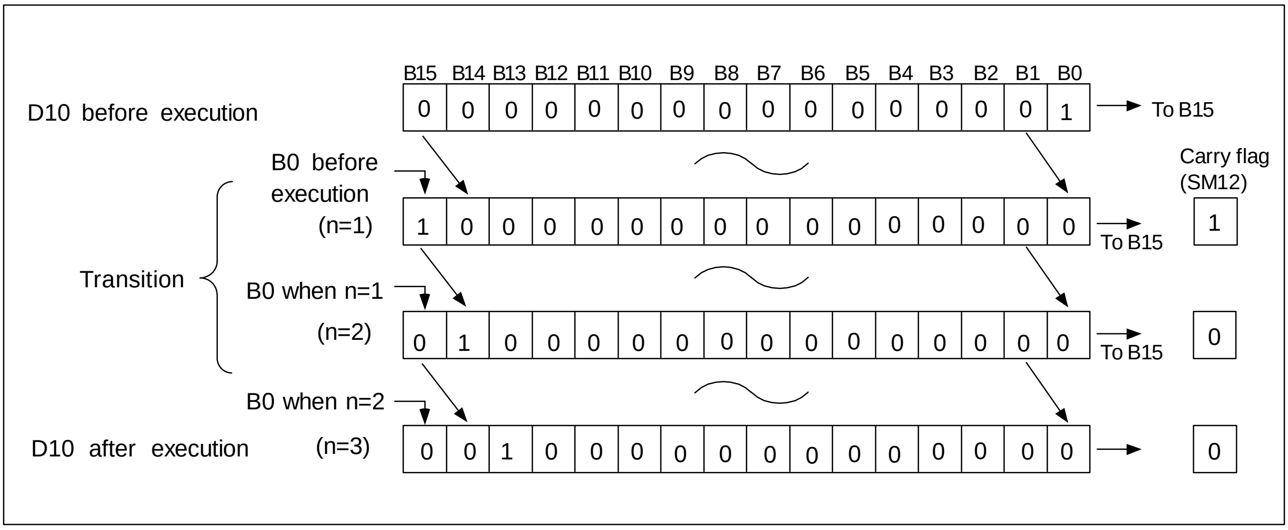
Program example

Program to rotate the D10 details 3 bits to the right when M0 turns ON.



Coding

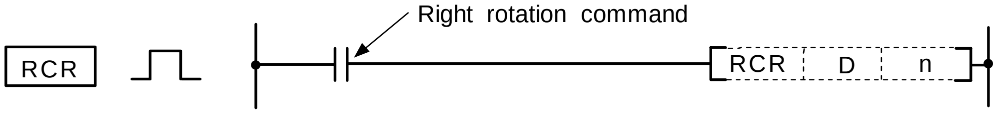
No. of steps	Com-mand	Device		
10	LD	M0		
11	ROR	D10	K3	
14				



Right rotation of data using ROR command

○ RCR ... Right rotation of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

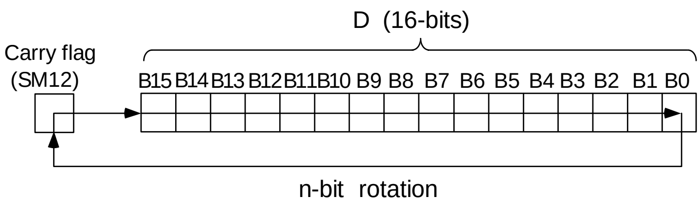


Setting data

D	No. of device where right rotation data is stored.
n	Times (0 to 15)

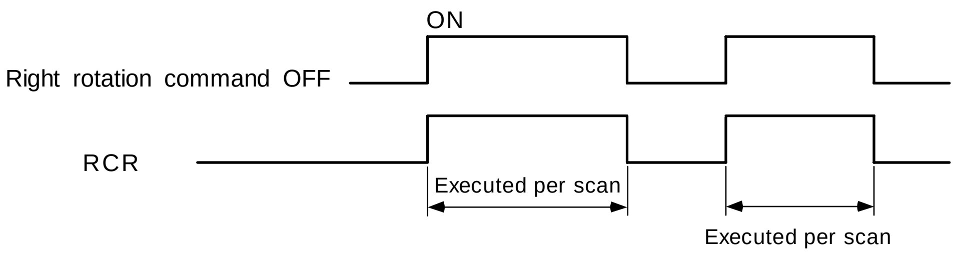
Function

The 16-bit data designated with D is rotated n bits to the right including the carry flag.
The carry flag must be set to 1 or 0 before executing RCR.



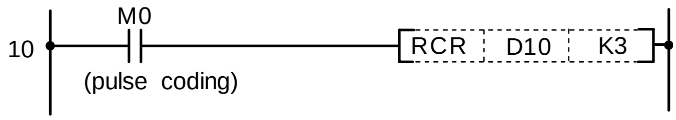
Execution conditions

The execution conditions for the RCR command are as shown below.



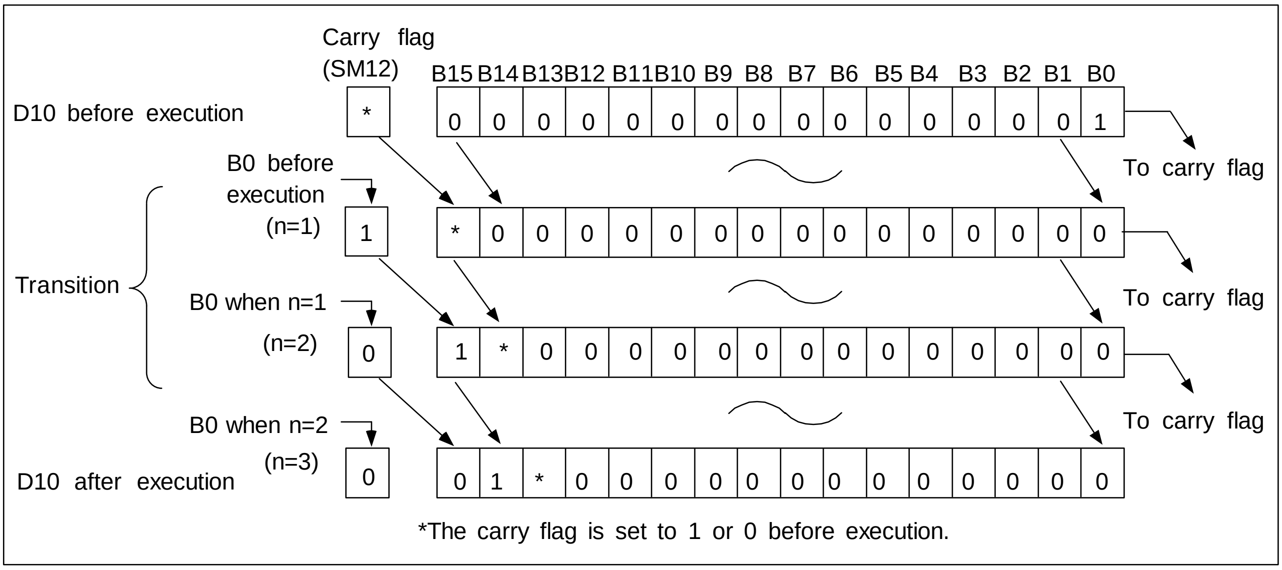
Program example

Program to rotate the D10 details 3 bits to the right when M0 turns ON.



Coding

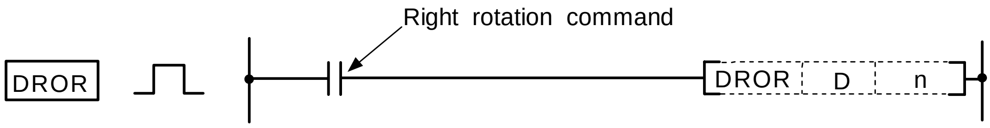
No. of steps	Com-mand	Device		
10	LD	M0		
11	RCR	D10	K3	
14				



Right rotation of data using RCR command

○ DROR ... Right rotation of 32-bit data

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

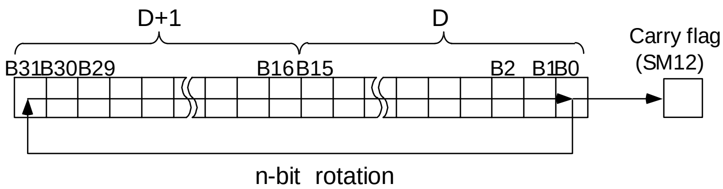


Setting data

D	Head No. of device where right rotation data is stored.
n	Times (0 to 31)

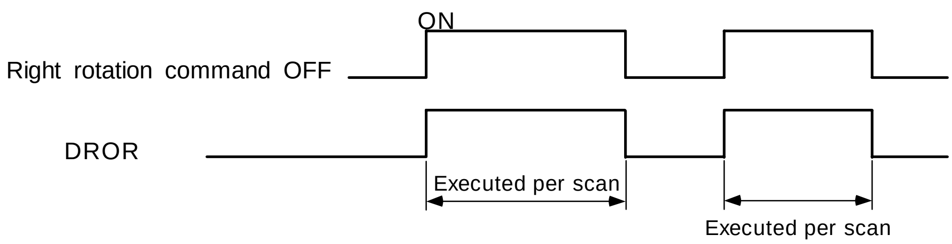
Function

The 32-bit data designated with D is rotated n bits to the right excluding the carry flag.



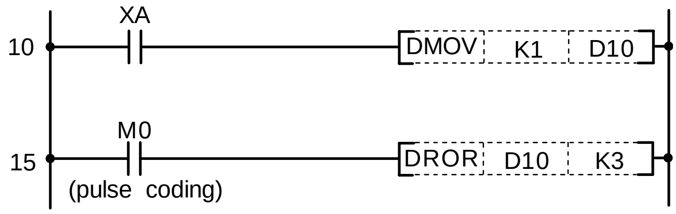
Execution conditions

The execution conditions for the DROR command are as shown below.



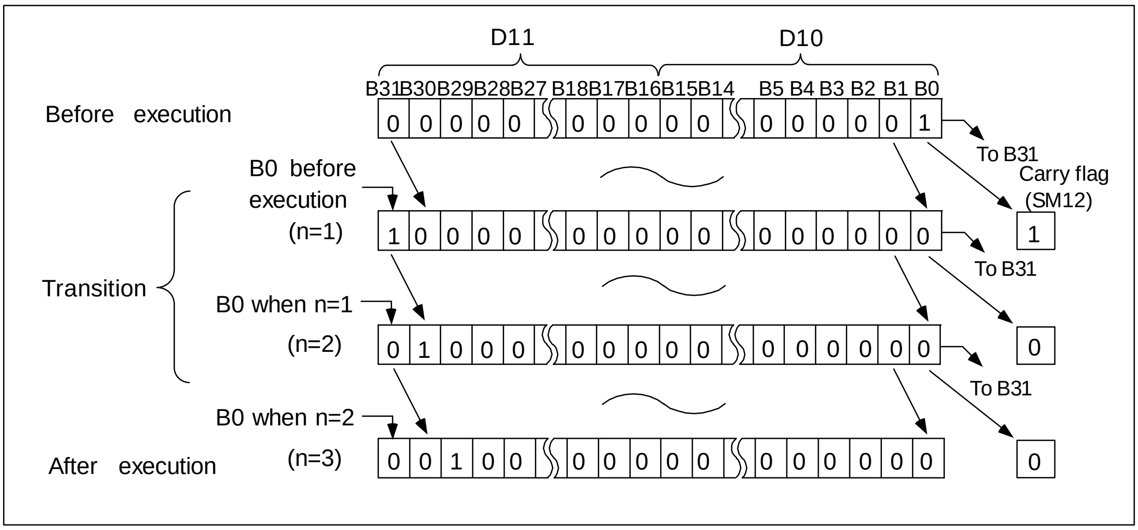
Program example

Program to rotate the D10, 11 details 3 bits to the right when M0 turns ON.



Coding

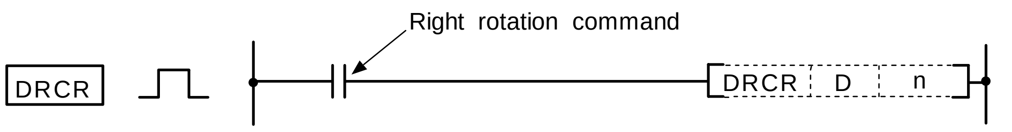
No. of steps	Com-mand	Device		
10	LD	XA		
11	DMOV	K1	D10	
15	LD	M0		
16	DROR	D10	K3	
19				



Right rotation of data using DROR command

○ DRCR ... Right rotation of 32-bit data

	Usable device																	Digit desig-nation	No. of steps	Index	
	Bit device						Word device							Con-stant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

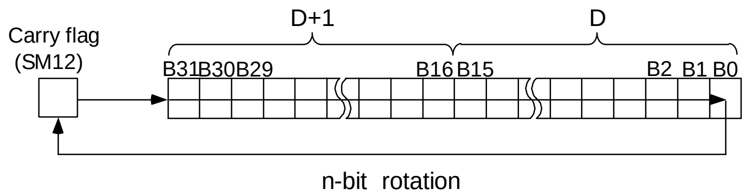


Setting data

D	Head No. of device where right rotation data is stored.
n	Times (0 to 31)

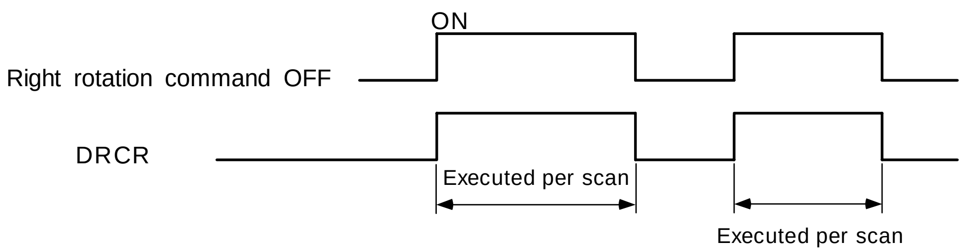
Function

The 32-bit data designated with D is rotated n bits to the right including the carry flag.
The carry flag must be set to 1 or 0 before executing DRCR.



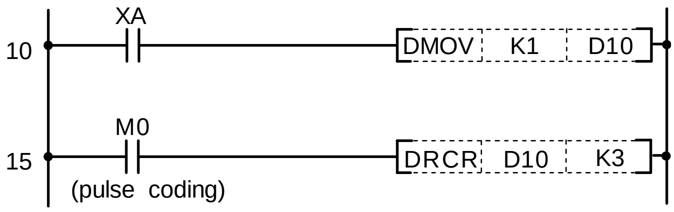
Execution conditions

The execution conditions for the DRCR command are as shown below.



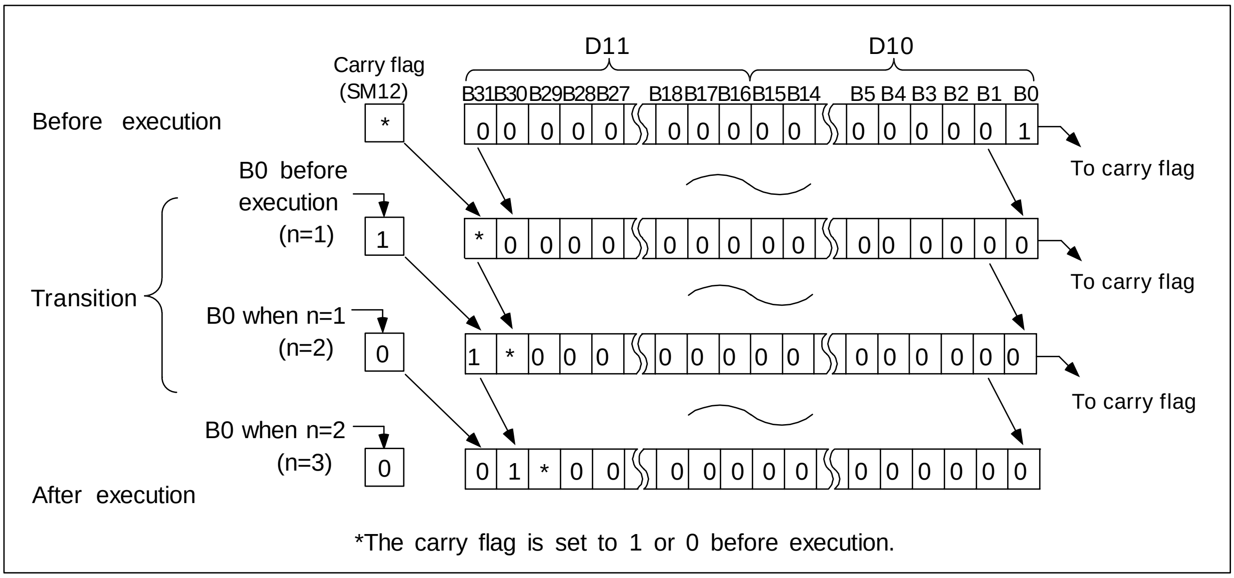
Program example

Program to rotate the D10, 11 details 3 bits to the right when M0 turns ON.



Coding

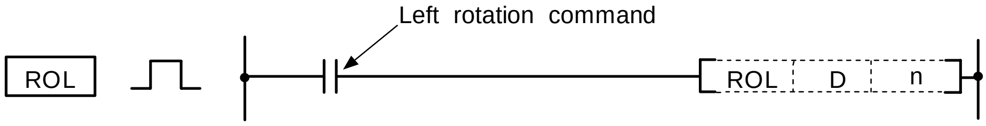
No. of steps	Com-mand	Device		
10	LD	XA		
11	DMOV	K1	D10	
15	LD	M0		
16	DRCR	D10	K3	
19				



Right rotation of data using DRCR command

○ **ROL ... Left rotation of 16-bit data**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

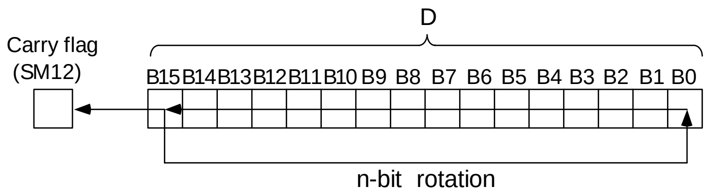


Setting data

D	No.of device where left rotation data is stored.
n	Times (0 to 15)

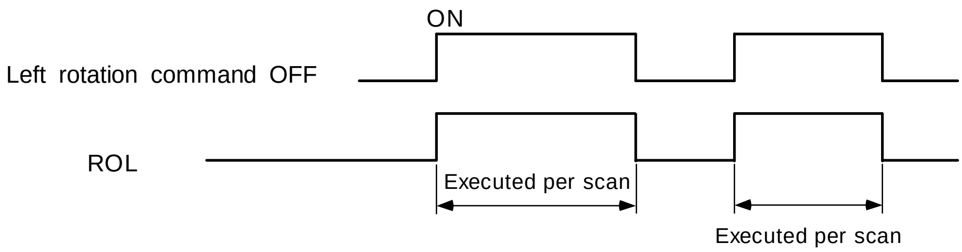
Function

The 16-bit data designated with D is rotated n bits to the left excluding the carry flag.
The carry flag must be set to 1 or 0 after executing ROL.



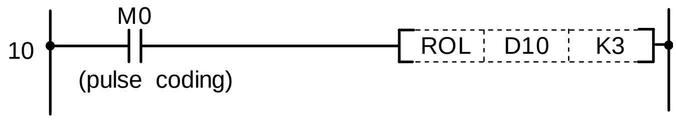
Execution conditions

The execution conditions for the ROL command are as shown below.



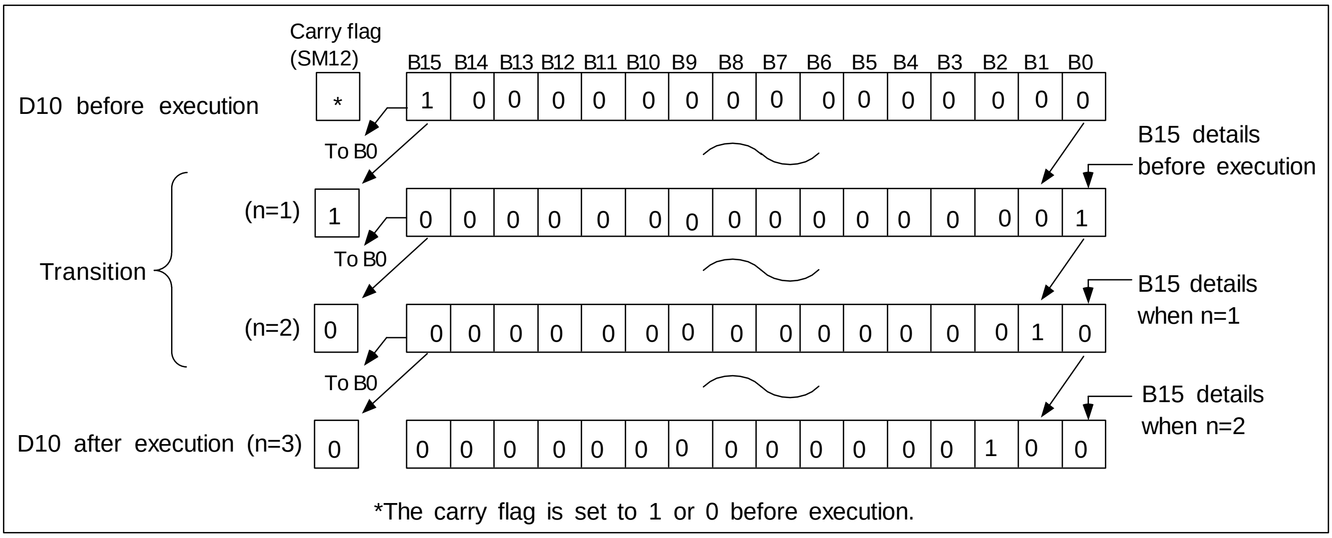
Program example

Program to rotate the D10 details 3 bits to the left when M0 turns ON.



Coding

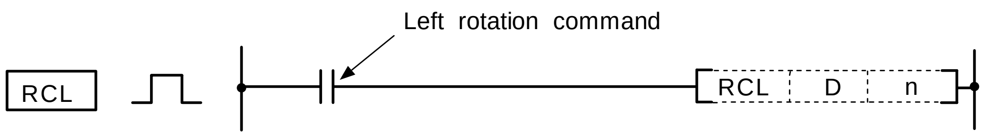
No. of steps	Com-mand	Device		
10	LD	M0		
11	ROL	D10	K3	
14				



Left rotation of data using ROL command

○ **RCL ... Left rotation of 16-bit data**

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

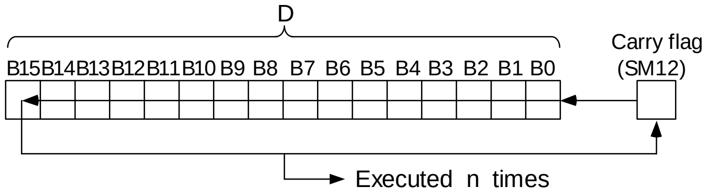


Setting data

D	No. of device where left rotation datais stored.
n	Times (0 to 15)

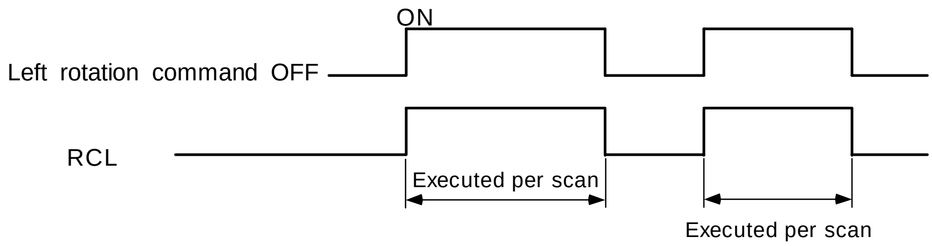
Function

The 16-bit data designated with D is rotated n bits to the left including the carry flag.
The carry flag must be set to 1 or 0 before executing RCL.



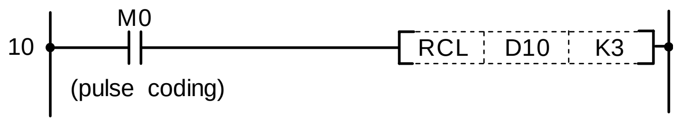
Execution conditions

The execution conditions for the RCL command are as shown below.



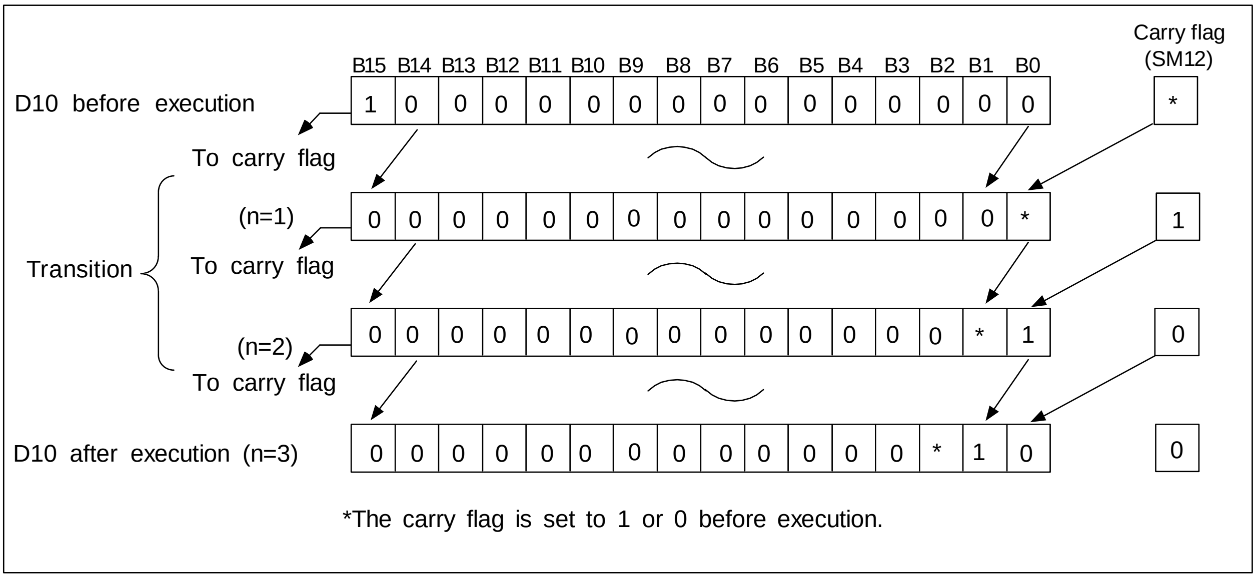
Program example

Program to rotate the D10 details 3 bits to the left when M0 turns ON.



Coding

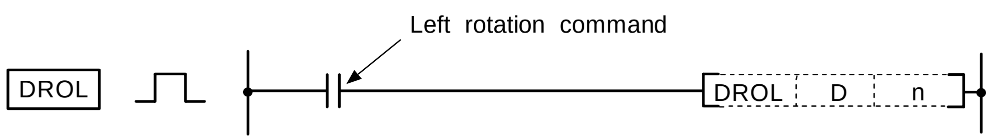
No. of steps	Com-mand	Device		
10	LD	M0		
11	RCL	D10	K3	
14				



Left rotation of data using RCL command

○ DROL ... Left rotation of 32-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

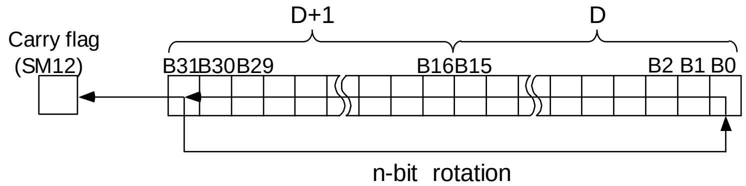


Setting data

D	Head No. of device where left rotation data is stored
n	Times (0 to 31)

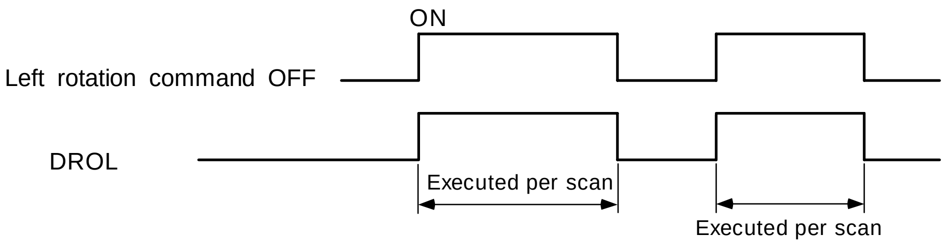
Function

The 32-bit data designated with D is rotated n bits to the left excluding the carry flag.



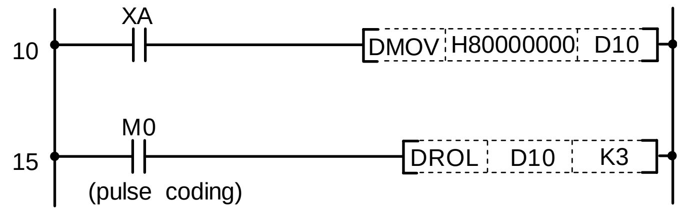
Execution conditions

The execution conditions for the DROL command are as shown below.



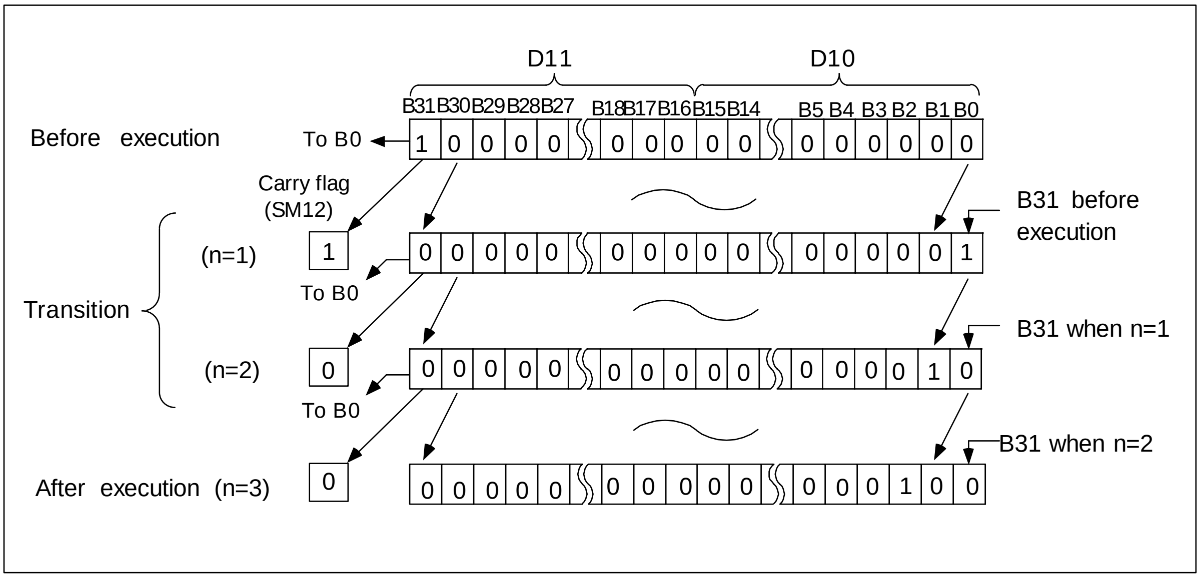
Program example

Program to rotate the D10, 11 details 3 bits to the left when M0 turns ON.



Coding

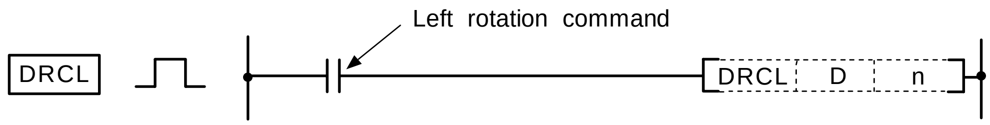
No. of steps	Com-mand	Device		
10	LD	XA		
11	DMOV	H80000000	D10	
15	LD	M0		
16	DROL	D10	K3	
19				



Left rotation of data using DROL command

○ DRCL ... Left rotation of 32-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

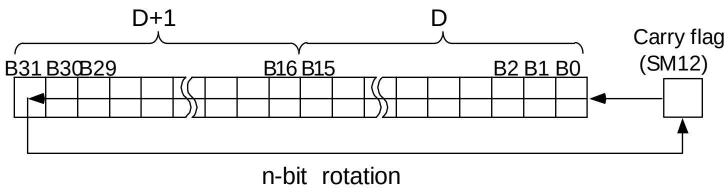


Setting data

D	Head No. of device where left rotation data is stored
n	Times (0 to 31)

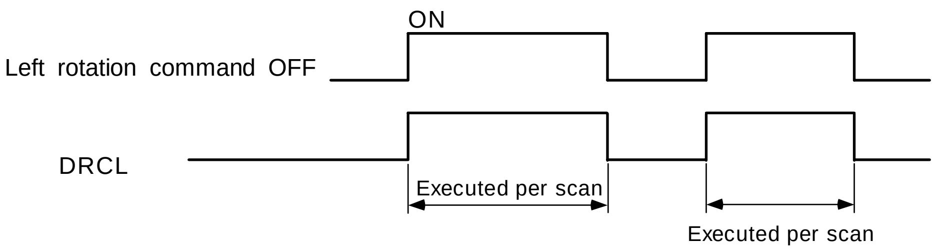
Function

The 32-bit data designated with D is rotated n bits to the left including the carry flag.
The carry flag must be set to 1 or 0 before executing DRCL.



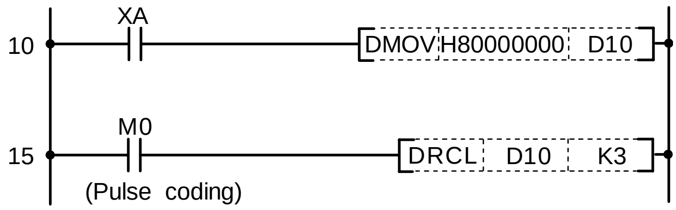
Execution conditions

The execution conditions for the DRCL command are as shown below.



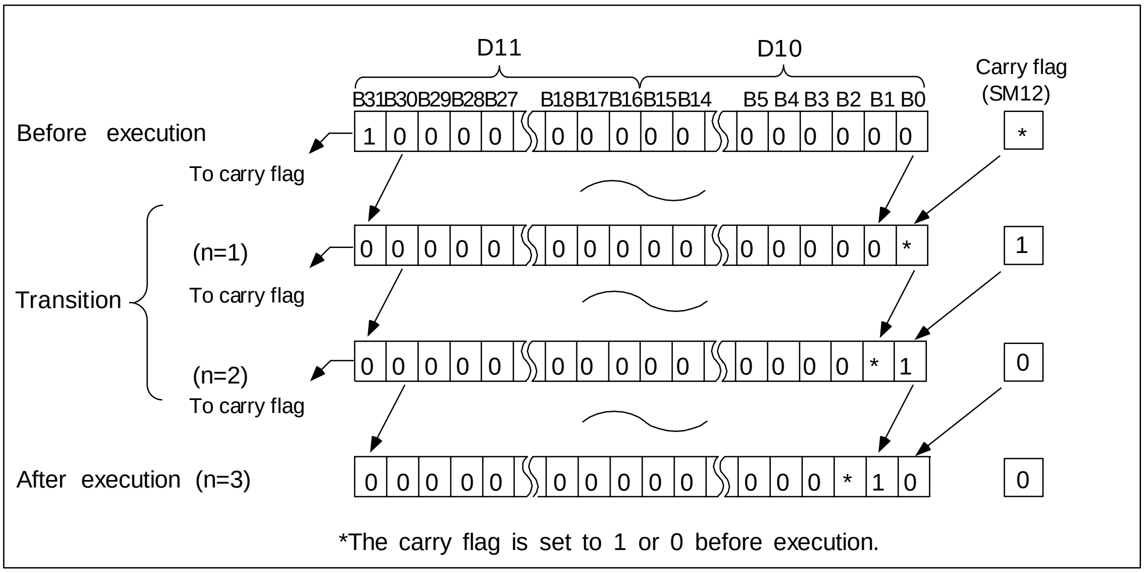
Program example

Program to rotate the D10, 11 details 3 bits to the left when M0 turns ON.



Coding

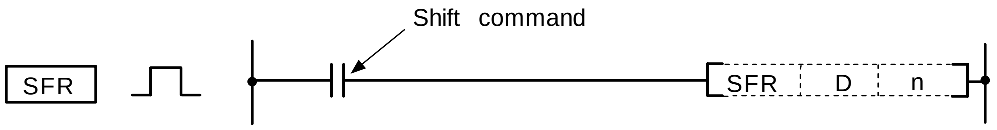
No. of steps	Com-mand	Device		
10	LD	XA		
11	DMOV	H80000000	D10	
15	LD	M0		
16	DRCL	D10	K3	
19				



Left rotation of data using DRCL command

○ SFR ... Right shift of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

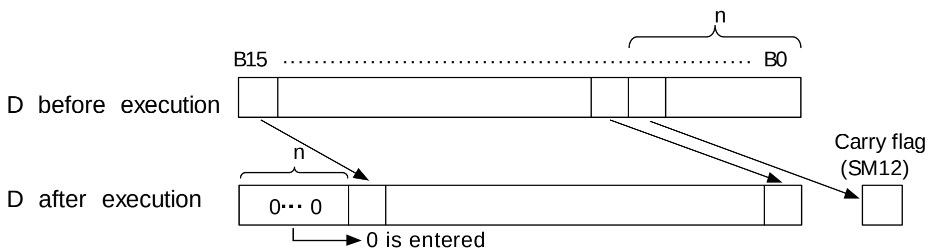


Setting data

D	No. of device where shift data is stored.
n	No. of shifts

Function

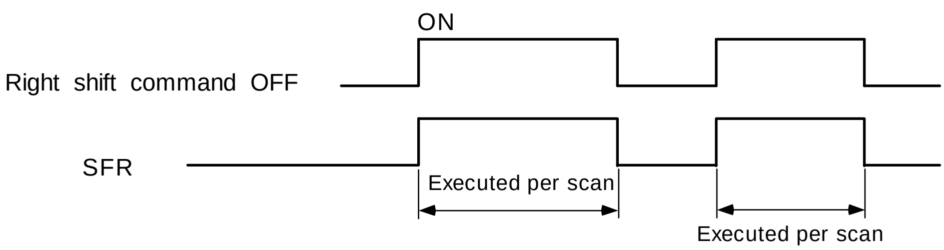
(1) The 16-bit data of the device designated with D is shifted n bits to the right.



(2) n bits from the highest order are set to 0.
(3) The T, C shift will be a current value (attribute value or count value) shift. (Shifting with the setting value is not possible.)

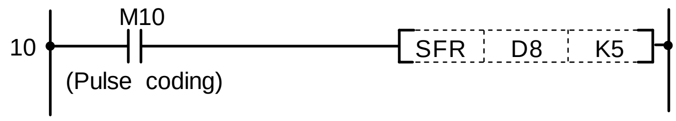
Execution conditions

The execution conditions for SFR are as shown below.



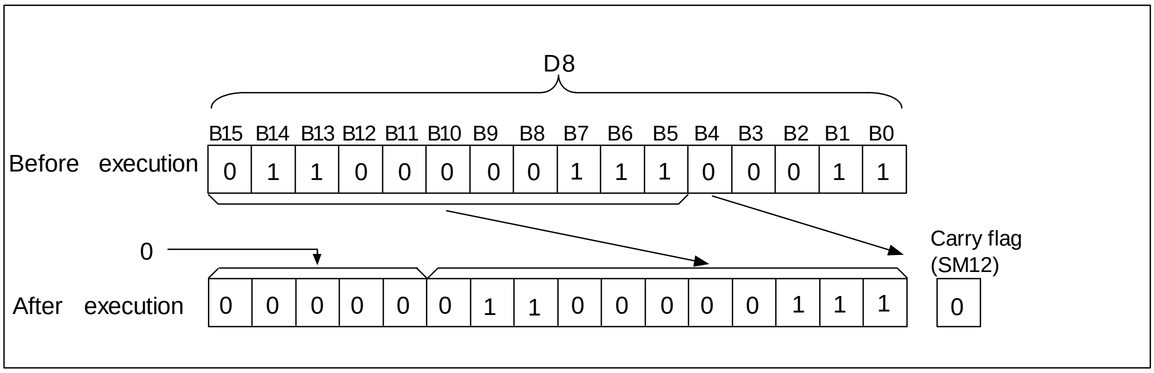
Program example

Program that shifts the details of D8 5 bits to the right when M10 turns ON.



Coding

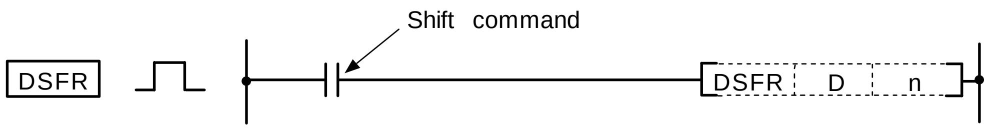
No. of steps	Com-mand	Device		
10	LD	M10		
11	SFR	D8	K5	
14				



Right shift of data with SFR command (word device)

○ DSFR ... Right shift of word device in batch

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									4		
n														○	○						

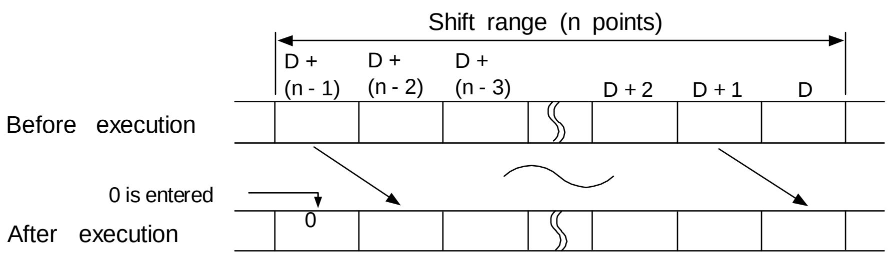


Setting data

D	Head No. of device to be shifted
n	Shift range

Function

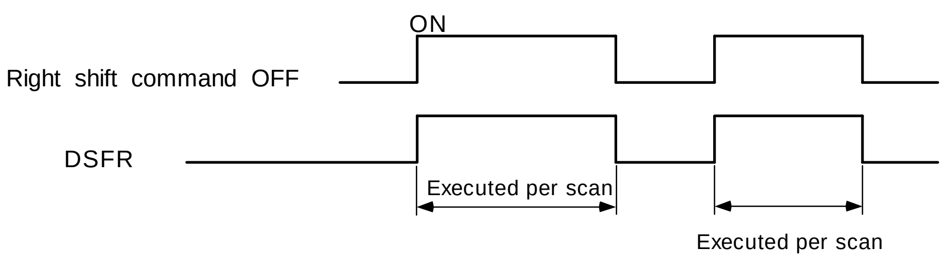
(1) n points starting at the head of the device designated with D are shifted one point to the right.



(2) The highest order device is set to 0.
(3) The T, C shift will be a current value (attribute value or count value) shift. (Shifting with the setting value is not possible.)

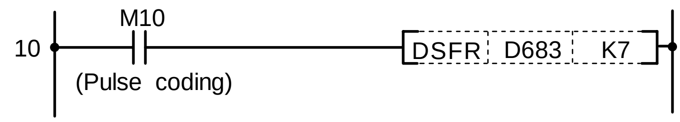
Execution conditions

The execution conditions of DSFR are as shown below.



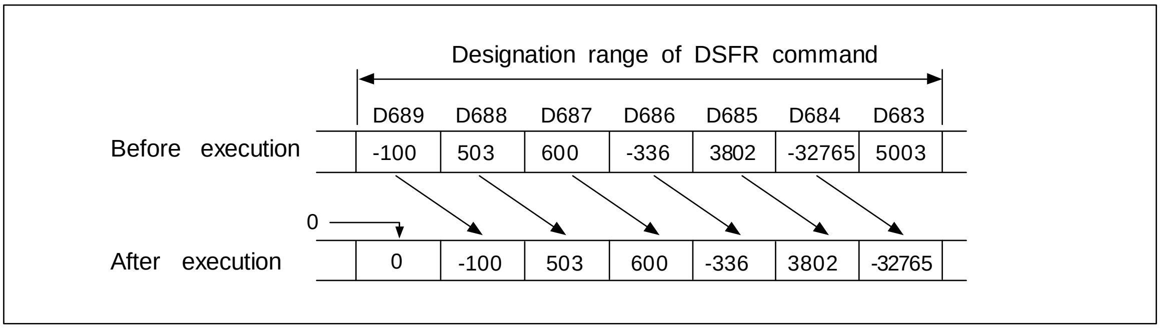
Program example

(1) Program to shift the details of D683 to 689 to the right when M10 turns ON.



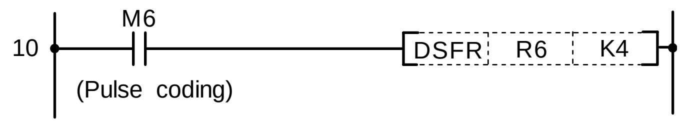
Coding

No. of steps	Com-mand	Device		
10	LD	M10		
11	DSFR	D683	K7	
15				



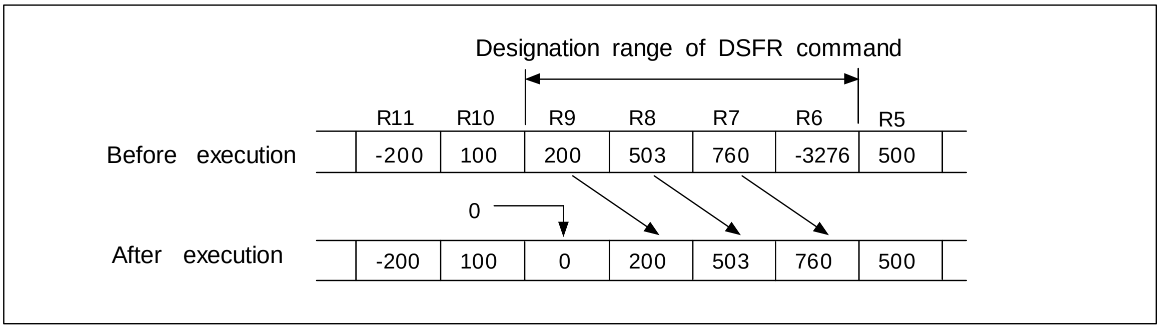
Right shift of data with DSFR command

(2) Program to shift the details of R6 to 9 to the right when M6 turns ON.



Coding

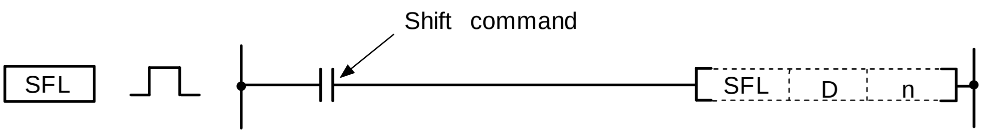
No. of steps	Com-mand	Device		
10	LD	M6		
11	DSFR	R6	K4	
15				



Right shift of data with DSFR command

○ SFL ... Left shift of 16-bit data

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									3		
n														○	○						

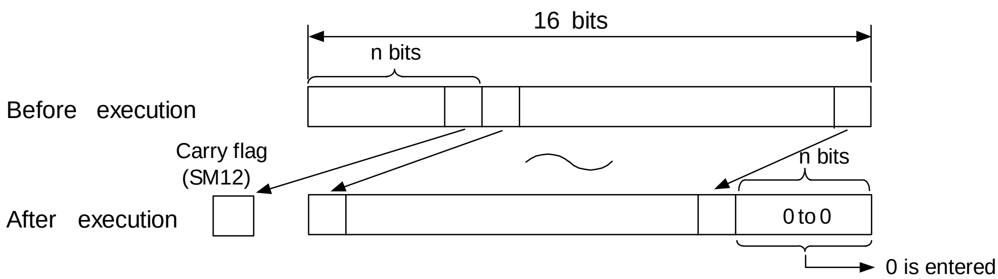


Setting data

D	No. of device where shift data is stored.
n	No. of shifts

Function

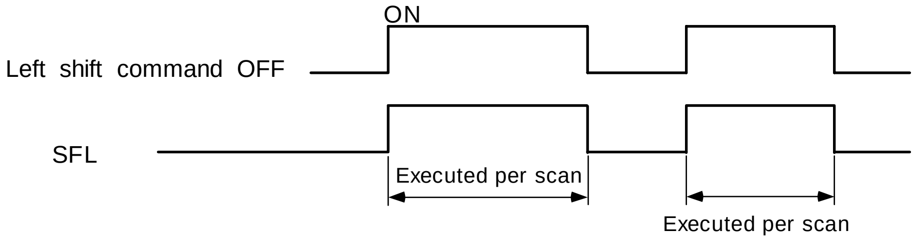
(1) The 16-bit data of the device designated with D is shifted n bits to the left.
(2) n bits from the lowest order are set to 0.



(3) The T, C shift will be a current value (attribute value or count value) shift. (Shifting with the setting value is not possible.)

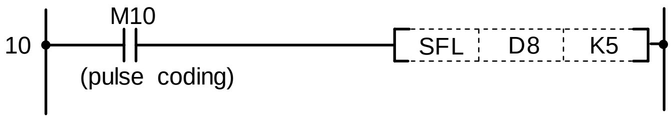
Execution conditions

The execution conditions for SFL are as shown below.



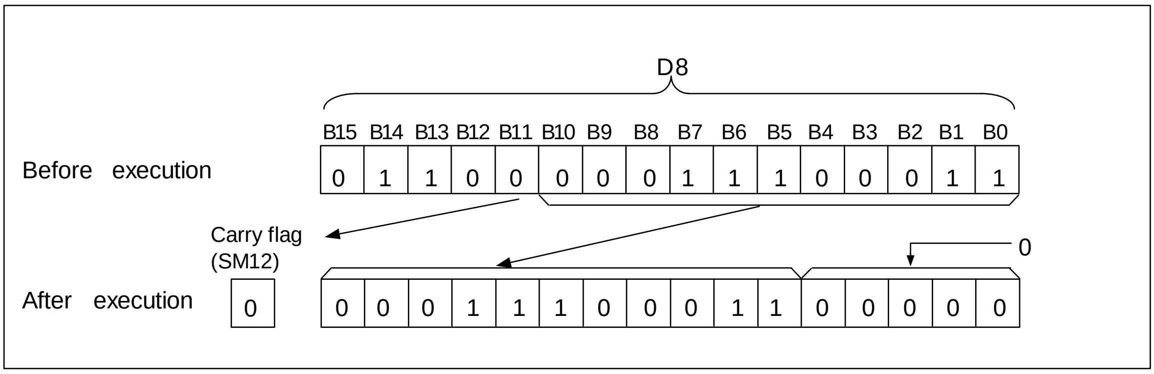
Program example

(1) Program that shifts the details of D8 5 bits to the left when M10 turns ON.



Coding

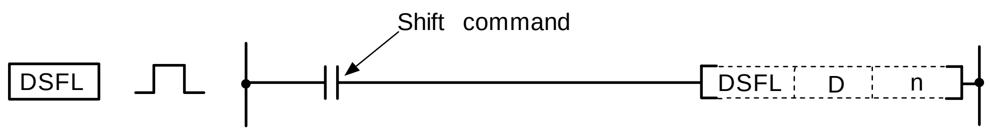
No. of steps	Com-mand	Device		
10	LD	M10		
11	SFL	D8	K5	
14				



Left shift of data with SFL command (word device)

○ DSFL ... Left shift of word device in batch

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
D							○	○	○	○									4		
n														○	○						

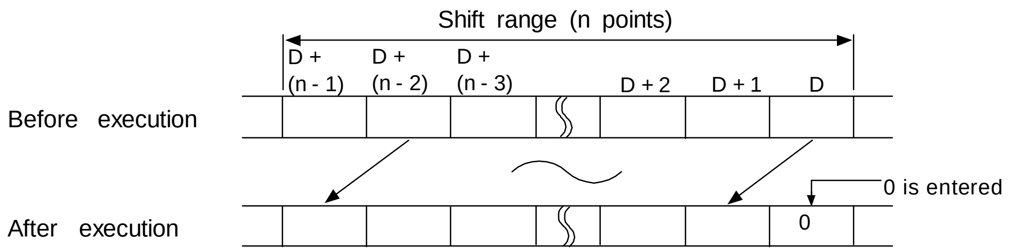


Setting data

D	Head No. of device to be shifted
n	Shift range

Function

(1) n points starting at the head of the device designated with D are shifted one point to the left.

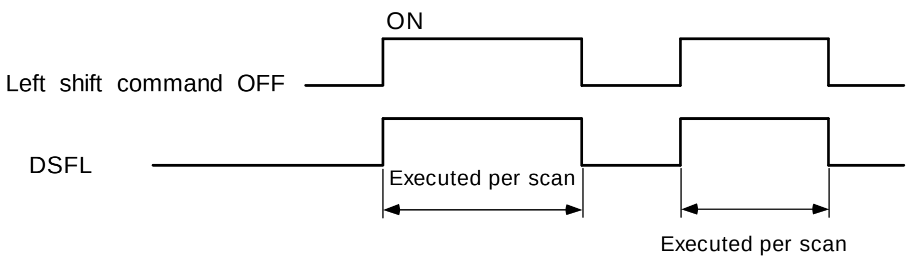


(2) The lowest order device is set to 0.

(3) The T, C shift will be a current value (attribute value or count value) shift. (Shifting with the setting value is not possible.)

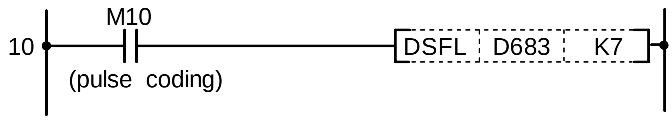
Execution conditions

The execution conditions of DSFL are as shown below.



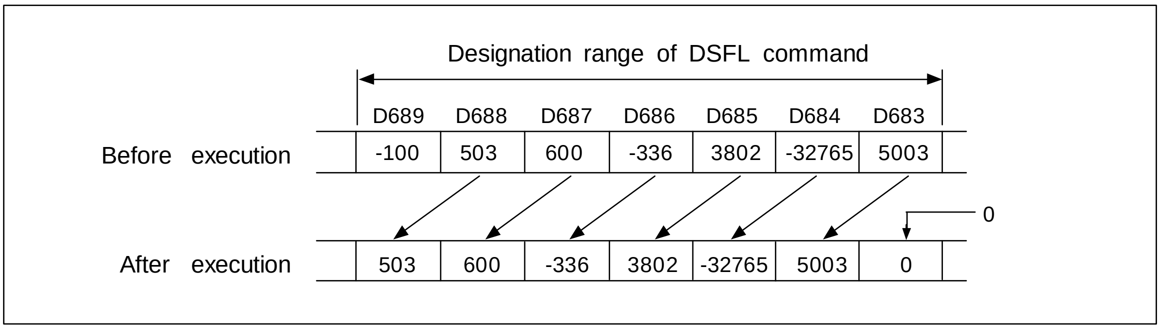
Program example

(1) Program to shift the details of D683 to 689 to the left when M10 turns ON.



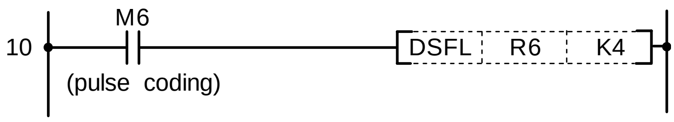
Coding

No. of steps	Com-mand	Device		
10	LD	M10		
11	DSFL	D683	K7	
15				



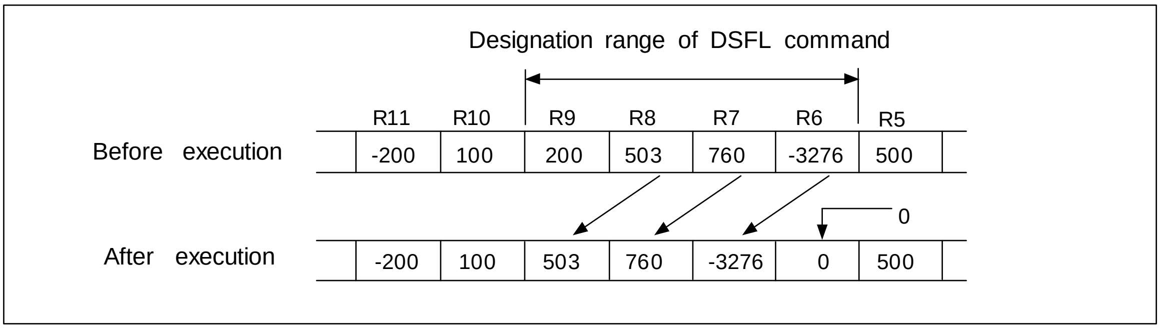
Left shift of data with DSFL command

(2) Program to shift the details of R6 to 9 to the left when M6 turns ON.



Coding

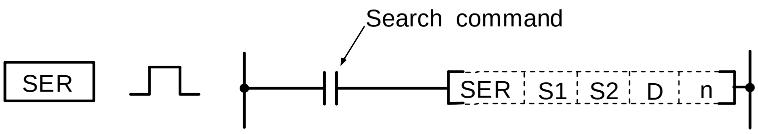
No. of steps	Com-mand	Device		
10	LD	M6		
11	DSFL	R6	K4	
15				



Left shift of data with DSFL command

○ **SER ... Search of 16-bit data**

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									6		
S2							○	○	○	○											
D							○	○	○	○											
n														○	○						



Setting data

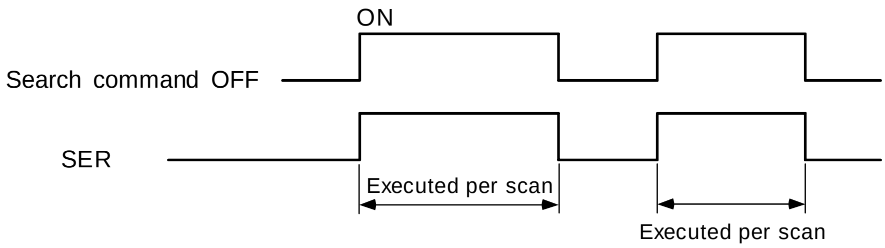
S1	No. of device where search data is stored.
S2	Head No. of device to be searched
D	Head No. of device where search results are stored
n	No. of devices to be searched

Function

(1) Using the 16-bit data of the device designated with S1 as the keyword, the n points from the 16-bit data of the device designated with S2 are searched.
(2) The number of data items matching the keyword is stored in D+1. The relative position of the device containing the first matched data counted from S2 is stored in D.
(3) When n is a negative value, it is interpreted as 0.
(4) No process is executed when n = 0.

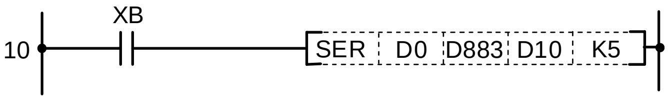
Execution conditions

The execution conditions for SER are as shown below.



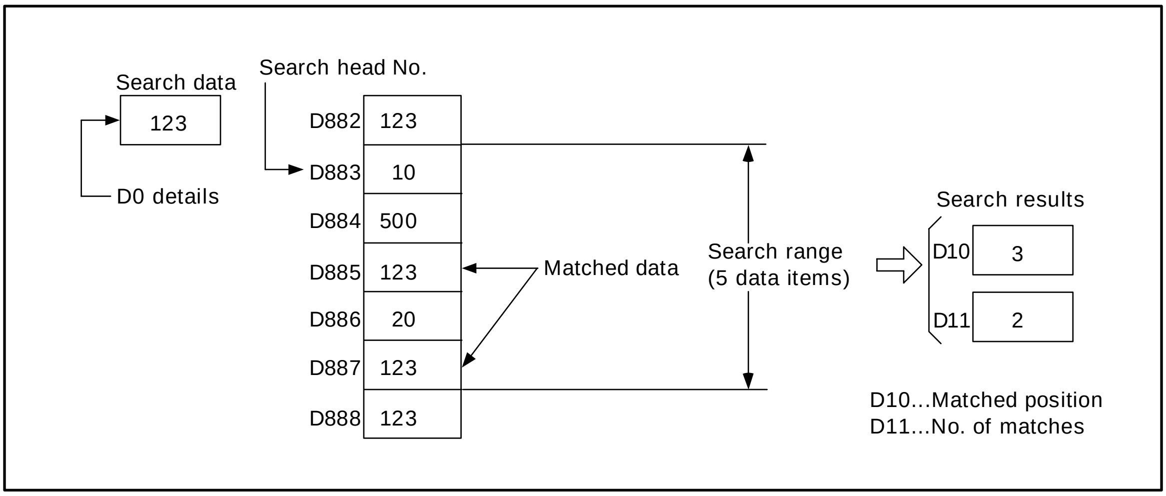
Program example

Program to compare the data in D883 to D887 with 123 when XB turns ON.



Coding

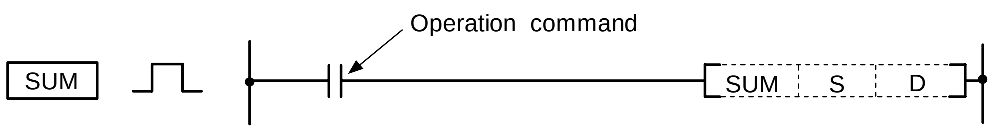
No. of steps	Com-mand	Device			
10	LD	XB			
11	SER	D0	D883	D10	K5
17					



Search of data using SER command

○ SUM ... Count of No. of 16-bit data items set to 1

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S							○	○	○	○									4		
D							○	○	○	○											

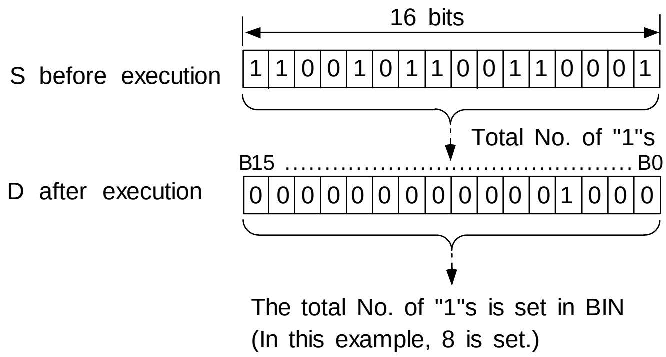


Setting data

S	No. of device to count the total No. of bits set to 1
D	No. of device where the total No. of bits is stored

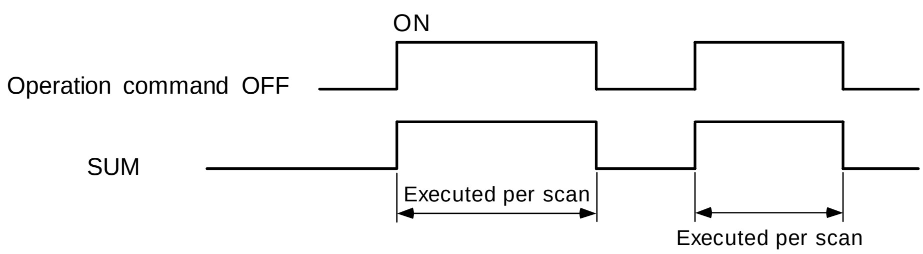
Function

The total No. of bits in the 16-bit data of the device designated with S that are set to "1" is stored in D.



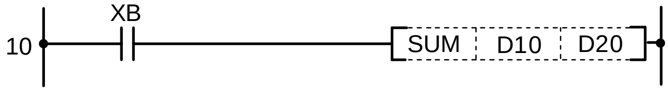
Execution conditions

The execution conditions for SUM are as shown below.



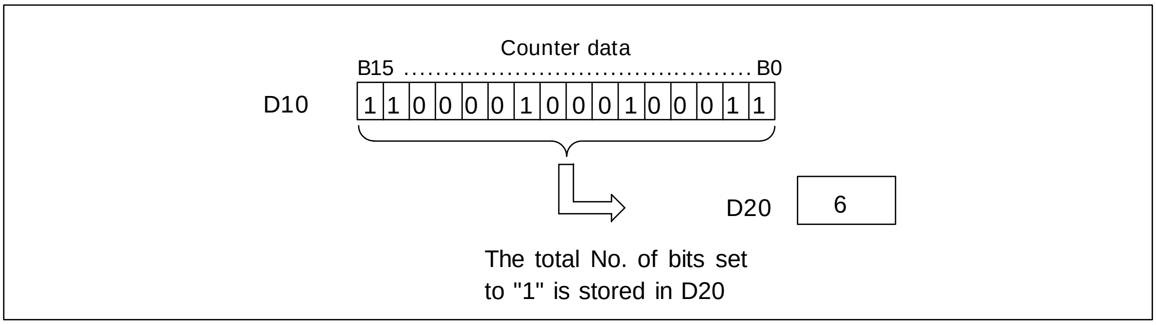
Program example

Program to obtain the No. of D10 data bits that are set to ON (1) when XB turns ON.



Coding

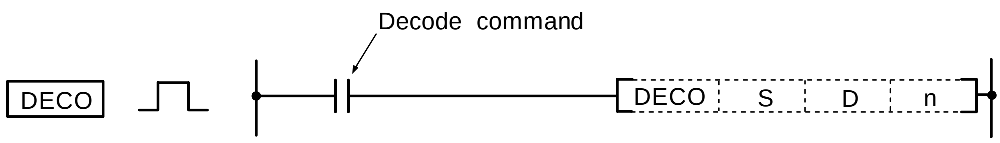
No. of steps	Com-mand	Device		
10	LD	XB		
11	SUM	D10	D20	
15				



Counting with SUM command

○ DECO ... 8 → 256 bit decoding

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S							○	○	○	○											
D							○	○	○	○									5		
n														○	○						



Setting data

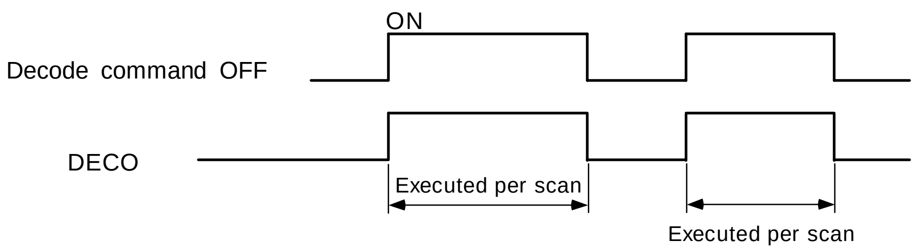
S	No. of device where data to be decoded is set.
D	Head No. of device to store the decoding results.
n	Valid bit length (1 to 8)

Function

(1) The low-order n bits of the device designated with S are decoded, and the results are stored in the 2^n bit from the device designated with D.
(2) 1 to 8 can be designated for n.
(3) No process is executed when n = 0, and the details of the device designated with D will not change.
(4) The word device is handled as 16 bits.

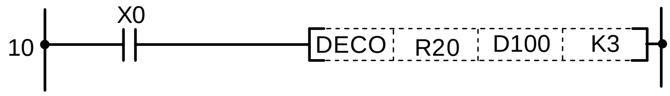
Execution conditions

The execution conditions for DECO are as shown below.



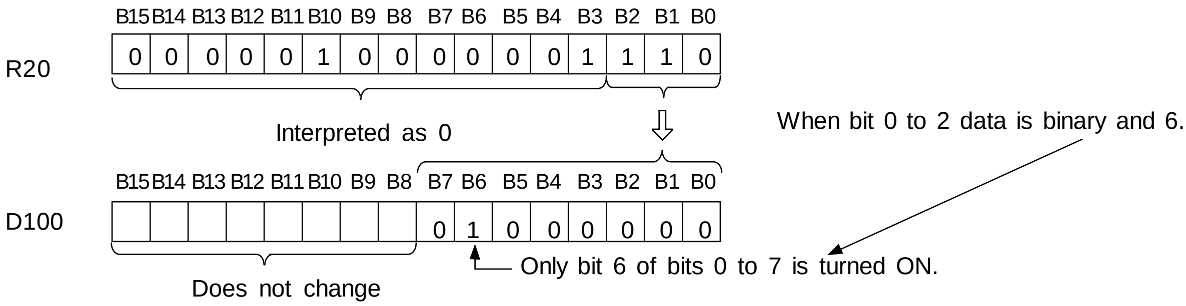
Program example

(1) Program to decode the three bits 0 to 2 of R20, and turn the bits corresponding in D100 ON.



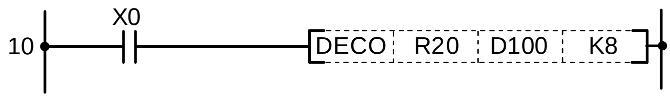
Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	DECO	R20	D100	K3
16				



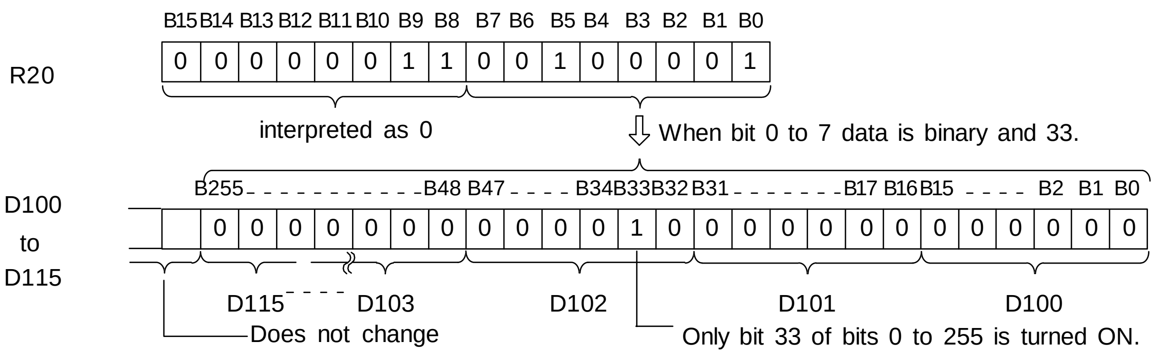
(Note 1) The D100 bit 0 turns ON when the B0 to B2 of R20 are 0.
(Note 2) The D100 details remain the same even if X0 turns OFF.

(2) Program to decode the eight bits 0 to 7 of R20, and turn the bits corresponding in D100 to D115 (2^8 = 256 bits) ON.



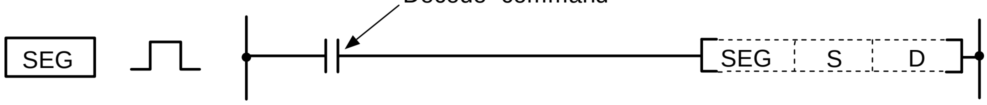
Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	DECO	R20	D100	K8
16				



○ SEG ... Decoding to 7-segment display data

	Usable device																Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S							○	○	○	○									3		
D							○	○	○	○											

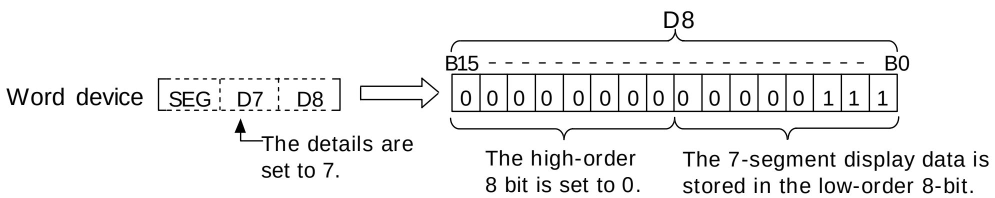


Setting data

S	Decode data or No. of device where decode data is stored.
D	No. of device to store the decoding results.

Function

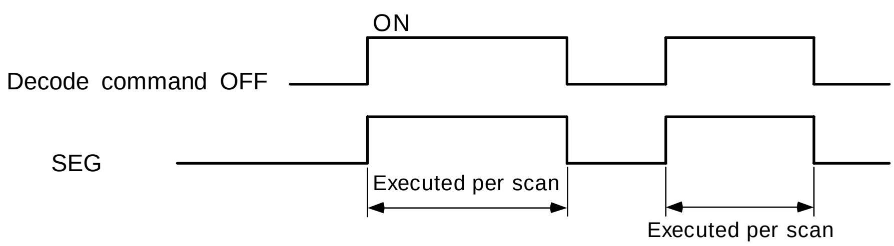
(1) The 0 to F data designated with the low-order 4-bit in S is decoded in the 7-segment display data and stored in D.



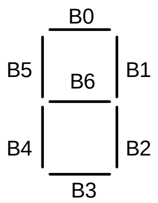
(2) Refer to the following page for the 7-segment display.

Execution conditions

The execution conditions for SEG are as follow.



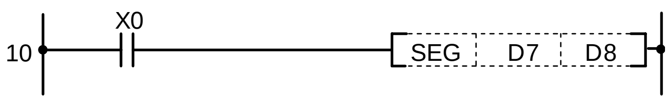
7-segment decode table

S: Hexa-decimal	S: Bit pattern	Configuration of 7-segment	D: B7	D: B6	D: B5	D: B4	D: B3	D: B2	D: B1	D: B0	Display data
0	0000		0	0	1	1	1	1	1	1	0
1	0001		0	0	0	0	0	1	1	0	1
2	0010		0	1	0	1	1	0	1	1	2
3	0011		0	1	0	0	1	1	1	1	3
4	0100		0	1	1	0	0	1	1	0	4
5	0101		0	1	1	0	1	1	0	1	5
6	0110		0	1	1	1	1	1	0	1	6
7	0111		0	0	0	0	0	1	1	1	7
8	1000		0	1	1	1	1	1	1	1	8
9	1001		0	1	1	0	0	1	1	1	9
A	1010		0	1	1	1	0	1	1	1	A
B	1011		0	1	1	1	1	1	0	0	b
C	1100		0	0	1	1	1	0	0	1	C
D	1101		0	1	0	1	1	1	1	0	d
E	1110		0	1	1	1	1	0	0	1	E
F	1111		0	1	1	1	0	0	0	1	F

Lowest-order bit of word device

Program example

Program to convert D7 data into 7-segment display data when X0 turns ON, and output to D8.

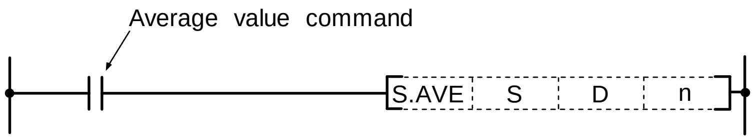


Coding

No. of steps	Com-mand	Device		
10	LD	X0		
11	SEG	D7	D8	
14				

○ S.AVE ... Calculation of average value

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S							○	○	○	○									5		
D							○	○	○	○											
n														○	○						

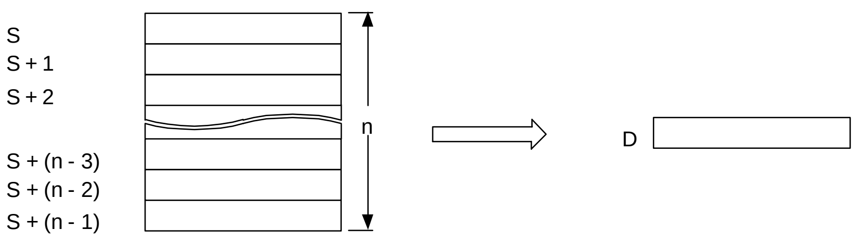


Setting data

S	Head No. of device where data to be averaged is stored.
D	Device No. of output destination
n	No. of averages

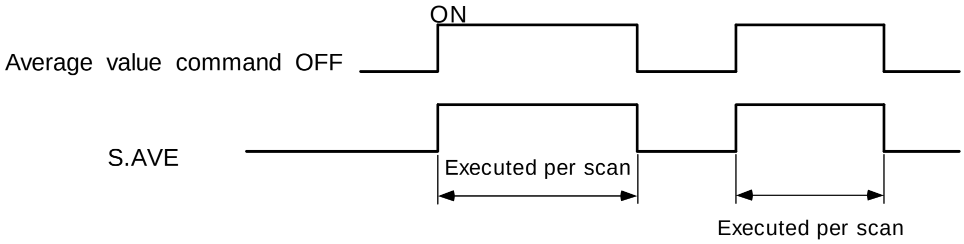
Function

The details of the n point devices from the device designated with S are averaged, and the results are output to the device designated with D.



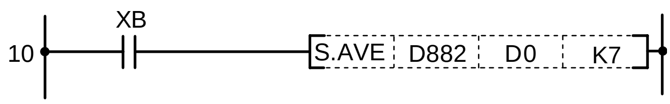
Execution conditions

The execution conditions for S.AVE are as shown below.



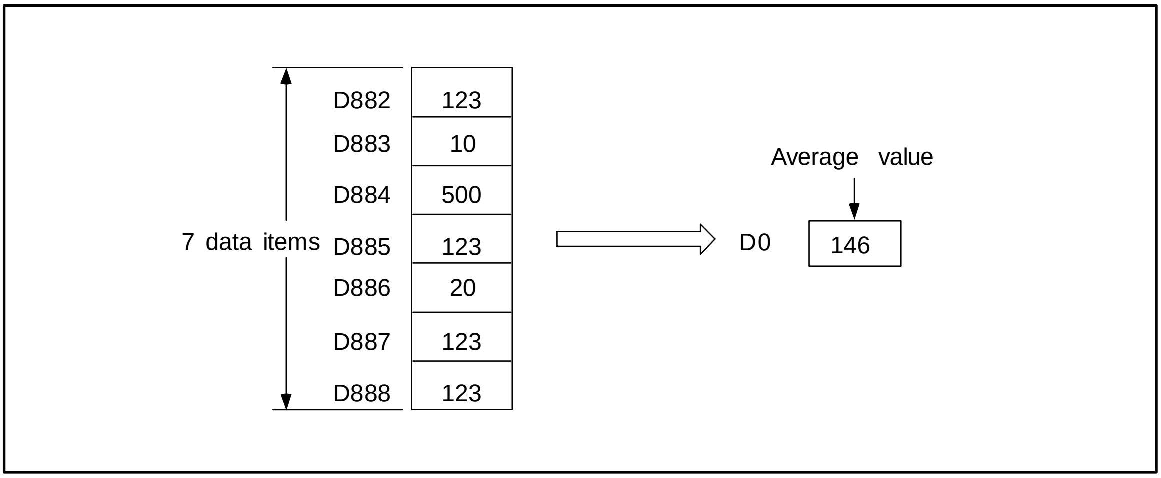
Program example

(1) Program to average the details of D882 to D888 when XB turns ON, and to output the results to D0.



Coding

No. of steps	Com-mand	Device		
10	LD	XB		
11	S.AVE	D882	D0	K7
16				

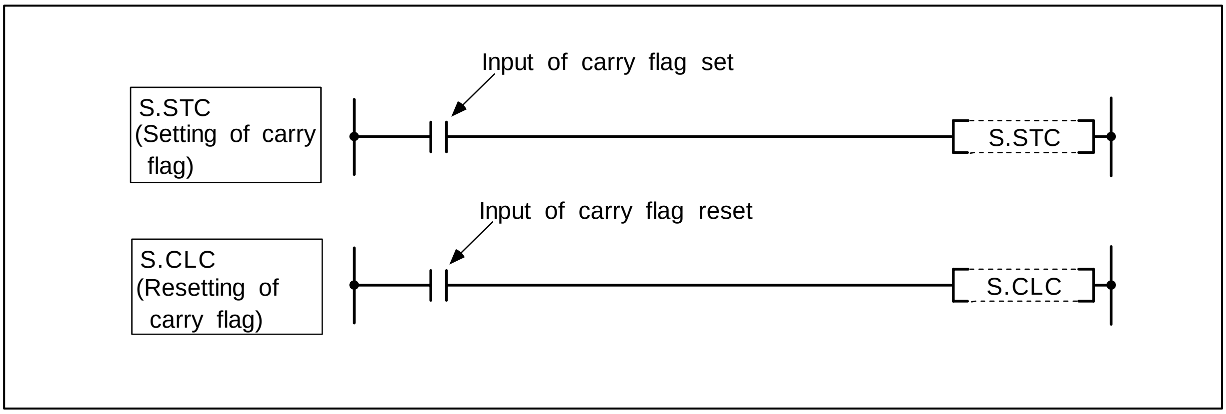


Averaging of data with S.AVE command

(Note) Fractional values are omitted.

○ S.STC, S.CLC ... Setting/resetting of carry flag

Usable device																	Digit designation	No. of steps	Index	
Bit device						Word device							Con-stant		Pointer	Level				
X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
																		1		



Function

S.STC

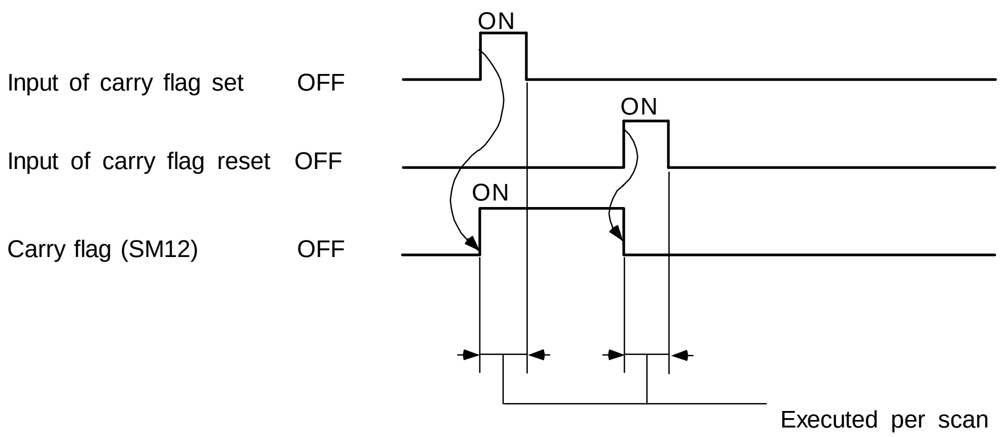
(1) The carry flag contact (SM12) is set (ON).

S.CLC

(1) The carry flag contact (SM12) is reset (OFF).

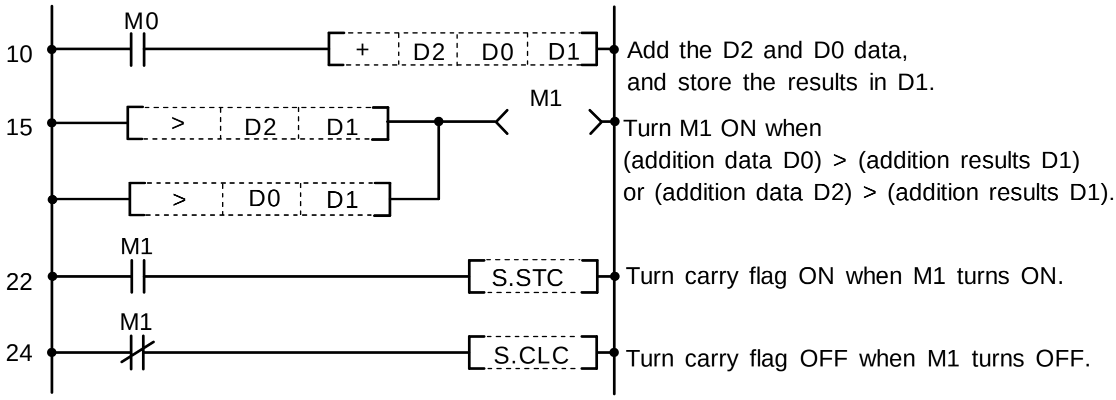
Execution conditions

The execution conditions for S.STC and S.CLC are as shown below.



Program example

Program to add the D2 data and D0 data, both D0 and D2 are plus data, when M0 turns ON and to turn the carry flag (SM12) ON if the results exceed 32767. If the results are 32767 or less, the carry flag is turned OFF.

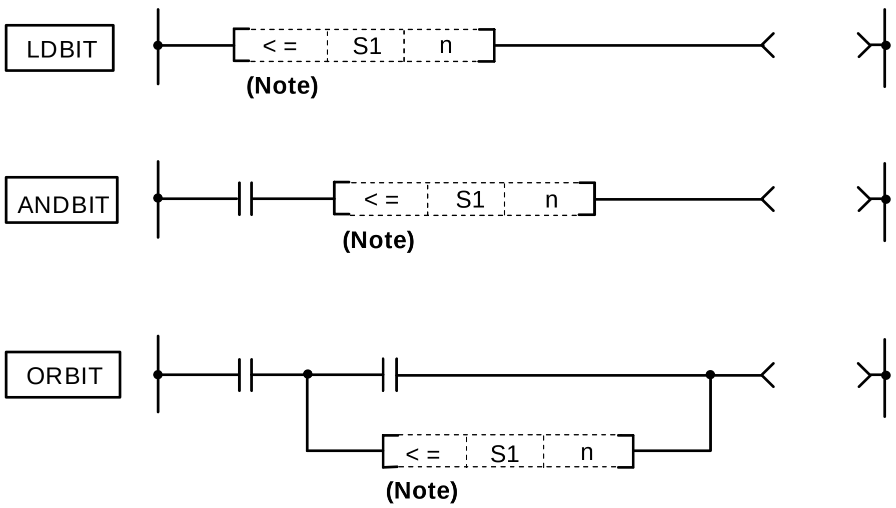


Coding

No. of steps	Com-mand	Device		
10	LD	M0		
11	+	D2	D0	D1
15	LD>	D2	D1	
18	OR>	D0	D1	
21	OUT	M1		
22	LD	M1		
23	S.STC			
24	LD1	M1		
25	S.CLC			
26				

○ LDBIT, ANDBIT, ORBIT ... Bit test of "A" contact handling

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									2		
n														○	○						



Setting data

S1	No. of device to execute bit test
n	Bit to execute bit test

(Note) In programming with the MELSEC PLC development tool (GX Developer), the comparison operation command mentioned above is subsututited and used.

Function

(1) A bit test of the 16-bit device is executed with "A" contact handling.
(2) The bit test results are as shown below.

Condition	Bit test results
When test bit is 1	Continuity
When test bit is 0	Non-continuity

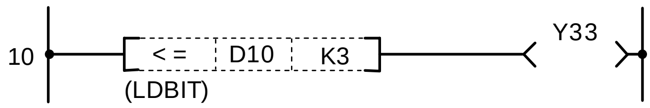
Execution conditions

The execution conditions for LDBIT, ANDBIT and ORBIT are as shown below.

Condition	Execution conditions
LDBIT	Executed per scan
ANDBIT	Executed only when previous contact command is ON
ORBIT	Executed per scan

Program example

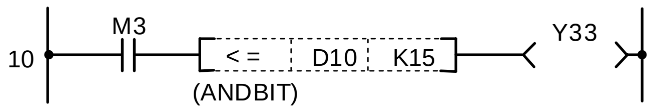
(1) Program to test bit 3 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD<=	D10	K3	
12	OUT	Y33		
13				

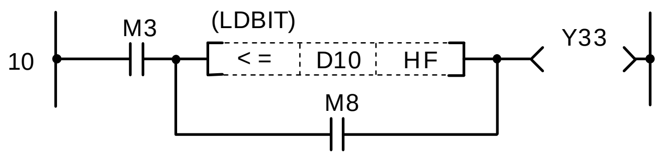
(2) Program to test bit 15 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND<=	D10	K15	
13	OUT	Y33		
14				

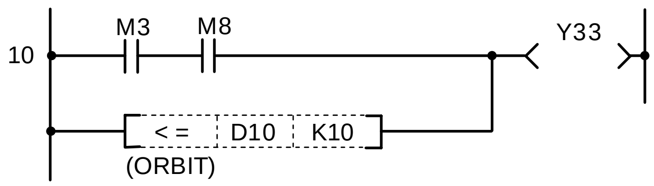
(3) Program to test bit 15 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LD<=	D10	HF	
13	OR	M8		
14	ANB			
15	OUT	Y33		
16				

(4) Program to test bit 10 of D10.

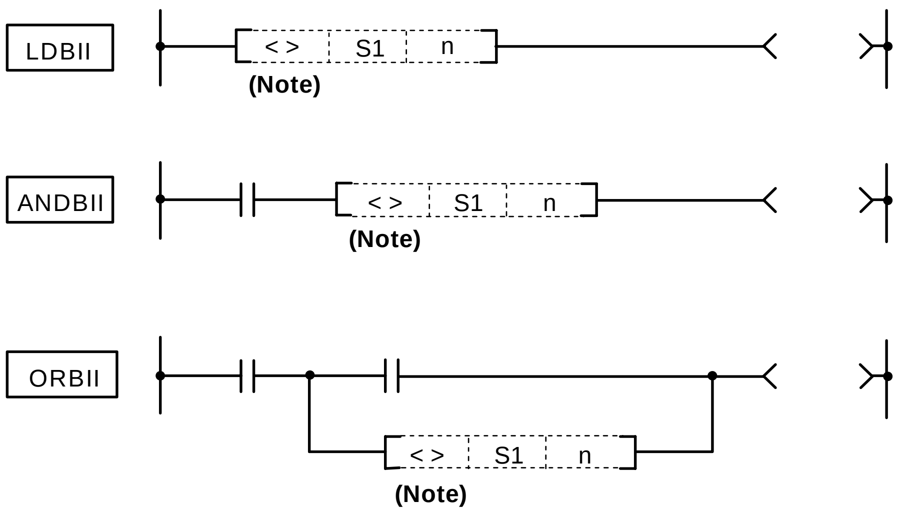


Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	OR<=	D10	K10	
14	OUT	Y33		
15				

○ LDBII, ANDBII, ORBII ... Bit test of "B" contact handling

	Usable device																	Digit designation	No. of steps	Index	
	Bit device						Word device							Constant		Pointer	Level				
	X	Y	M	L	SM	F	T	C	D	R	Z			K	H	P	N				
S1							○	○	○	○									2		
n														○	○						



Setting data

S1	No. of device to execute bit test
n	Bit to execute bit test

(Note) In programming with the MELSEC PLC development tool (GX Developer), the comparison operation command mentioned above is subsutituted and used.

Function

(1) A bit test of the 16-bit device is executed with "B" contact handling.
(2) The bit test results are as shown below.

Condition	Bit test results
When test bit is 0	Continuity
When test bit is 1	Non-continuity

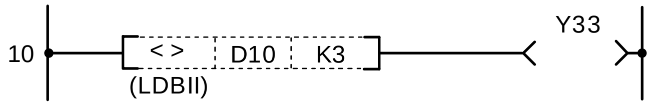
Execution conditions

The execution conditions for LDBII, ANDBII and ORBII are as shown below.

Condition	Execution conditions
LDBII	Executed per scan
ANDBII	Executed only when previous contact command is ON
ORBII	Executed per scan

Program example

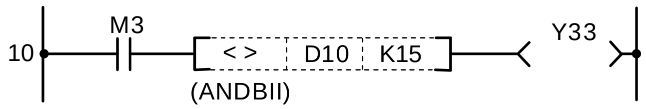
(1) Program to test bit 3 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD<>	D10	K3	
12	OUT	Y33		
13				

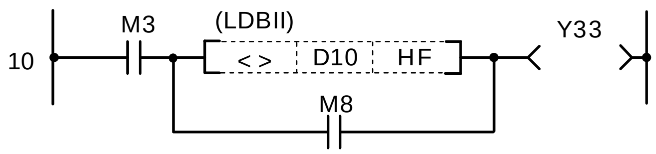
(2) Program to test bit 15 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND<>	D10	K15	
13	OUT	Y33		
14				

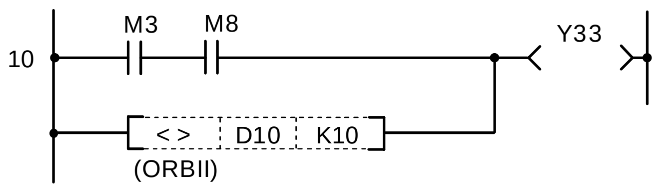
(3) Program to test bit 15 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	LD<>	D10	HF	
13	OR	M8		
14	ANB			
15	OUT	Y33		
16				

(4) Program to test bit 10 of D10.



Coding

No. of steps	Com-mand	Device		
10	LD	M3		
11	AND	M8		
12	OR<>	D10	K10	
14	OUT	Y33		
15				

9. Exclusive Commands

Although the basic and functional commands are not used only for specific purposes, some commands may be efficient if command applications such as data transfer between under PLC and controller and controller display screen are limited.
Then, the M300 series provides a number of exclusive commands which are explained below.

Examples of exclusive commands:
· ATC dedicated command (ATC)
· Rotary body control command (ROT)
· Tool life management exclusive command (TSRH)
· DDB (direct data bus) ..... asynchronous
· External search .... synchronous

9.1 ATC Exclusive Command

9.1.1 Outline of ATC Control

The ATC (Automatic Tool Change) can be controlled in the following two ways:

(1) Mechanical random control
With the information of magazine position from the machine, and T command, the control system determines the direction of magazine rotation, number of steps required, etc. for index of the magazine, according to the given command.
Each tool and magazine tool pot (socket) have a one-on-one corresponding relation.
Usually, the "intermediate pot" that supports the transfer of the tool is provided between the spindle and the magazine.
This control is possible by not using ATC command, but ROT command only.

(2) Memory random control
With the information of magazine rotation, or magazine position from the machine, the control system refers to tool No. stored in the memory. For index of the magazine, the direction of magazine rotation and number of steps are determined by the given T command and tool No. stored in the memory.
Each tool and magazine tool pot (socket) does not always have a one-on-one corresponding relation.
Usually, the "intermediate pot" is not provided.

9.1.2 ATC Operation

The motions related to ATC operation can be largely divided into the following four motions:

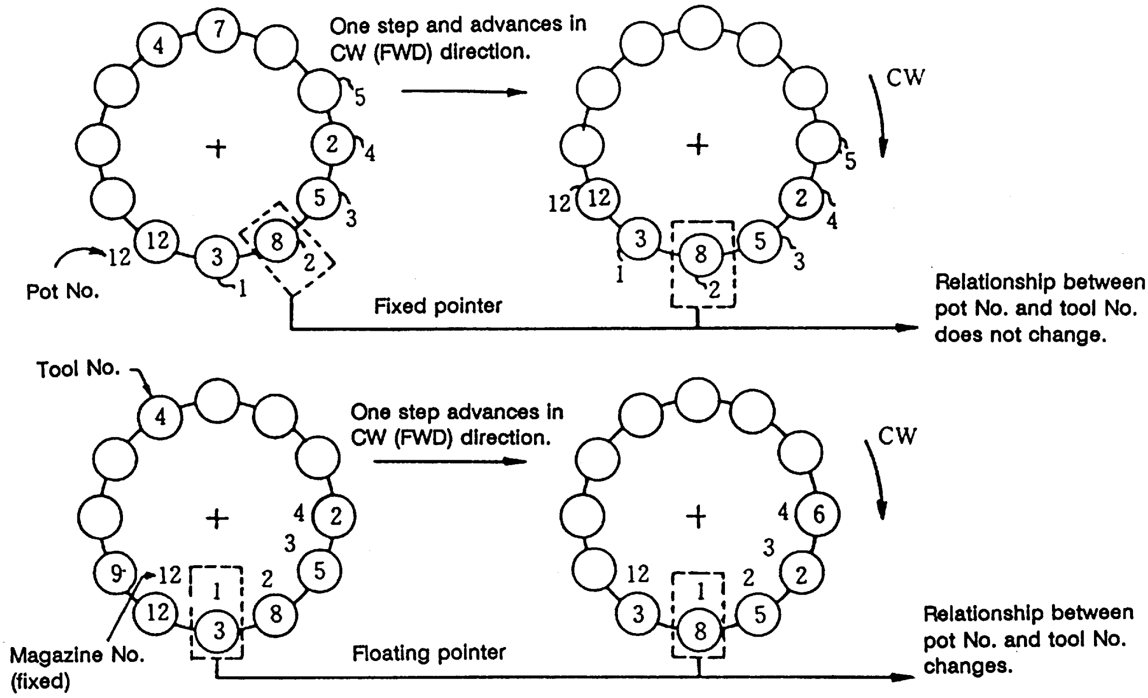
(1) Index of magazine ………………………..………. (ATC-K1, K2, K5, K6, K7, K8)
(2) Tool change (arm, or the like is used) ………..... (ATC-K3, K4)
(3) Transfer of tool to intermediate pot or arm ..... (Normal function commands such as MOV, XCH are used.)
(4) Others ..…………………………………………….. (ATC-K9, K10, K11)

9.1.3 Explanation of Terminology

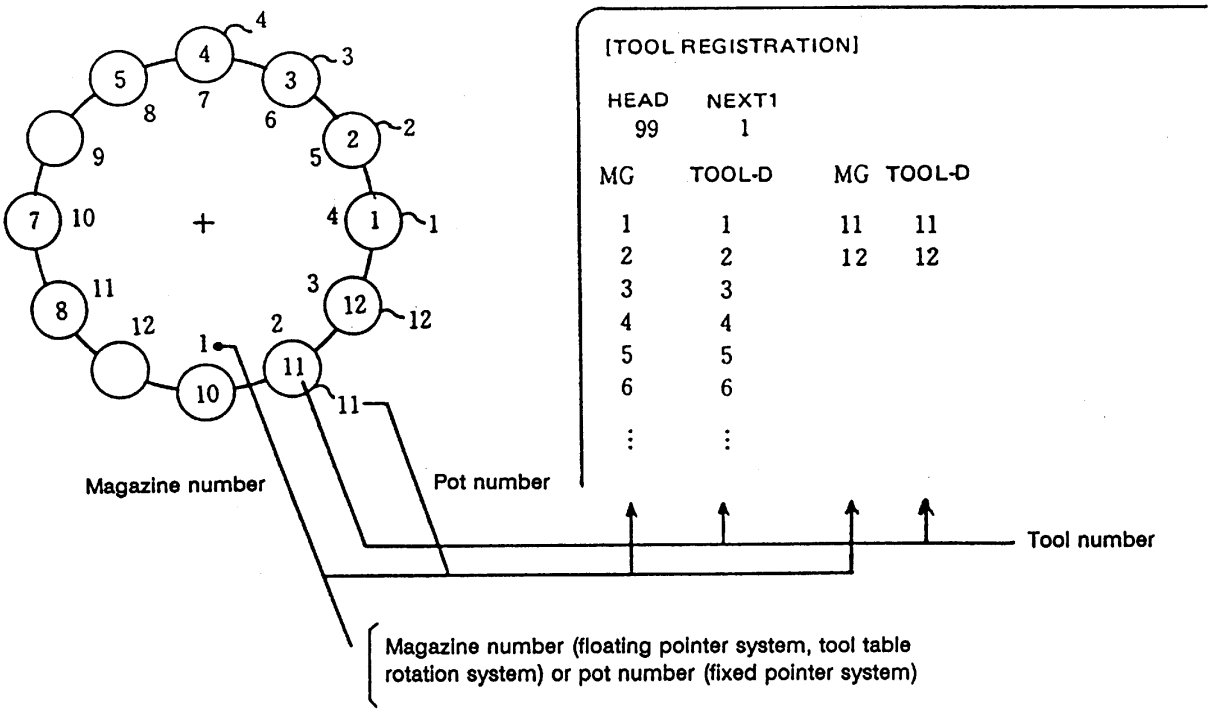
(1) Pointer
This points out the position where the magazine is indexed. When a tool table in which tool No. are previously recorded is used, the tool table does not rotate with rotation of the magazine and the pointer serves as "ring counter" for control of magazine position.

(2) Fixed pointer
This is the type with tool pots numbered and the relationship between tool pot and tool No. is fixed if the magazine is rotated. When the tool table is rotated, fixed pointer does not functionally differ from "floating pointer".

(3) Floating pointer
This is the type with numbered fixed position on magazine and the relationship between magazine No. and tool No. changes when the magazine rotates.



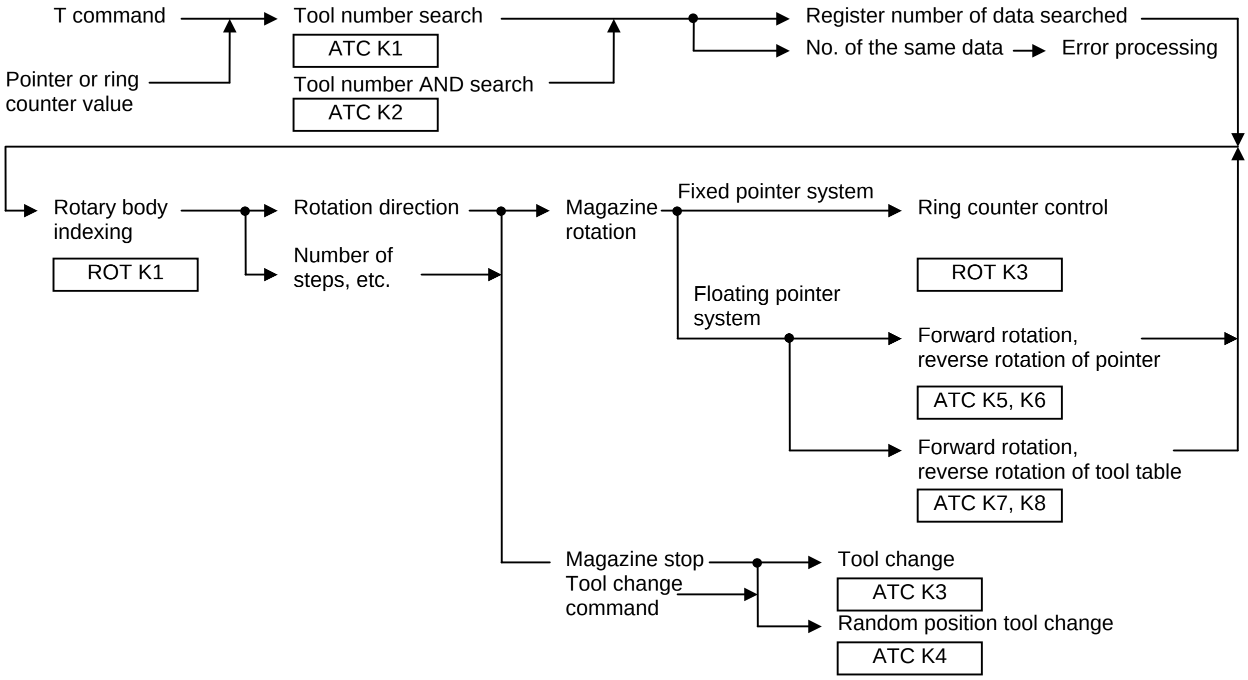
9.1.4 Relationship between Tool Registration Screen and Magazines



When the floating pointer system or tool table rotation system is selected on the tool registration screen, correspondence display between the magazines and tools changes each time the magazine rotates; when the fixed pointer system is selected, it does not change.

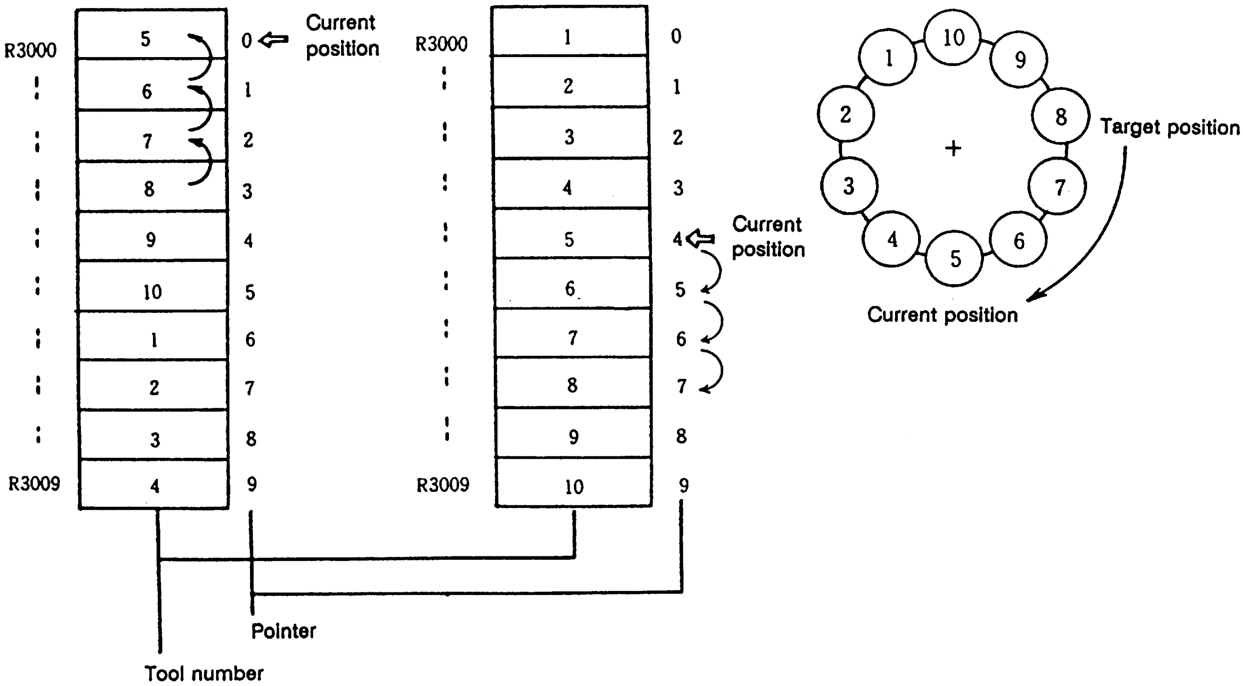
9.1.5 Use of ATC and ROT Commands

The use order of the ATC and ROT commands during the T command or tool change command is shown below:



The relationship between the tool number search command and rotary body indexing command when the tool table rotation system or floating pointer system is used is explained below.

Tool table rotation system **Floating pointer system**

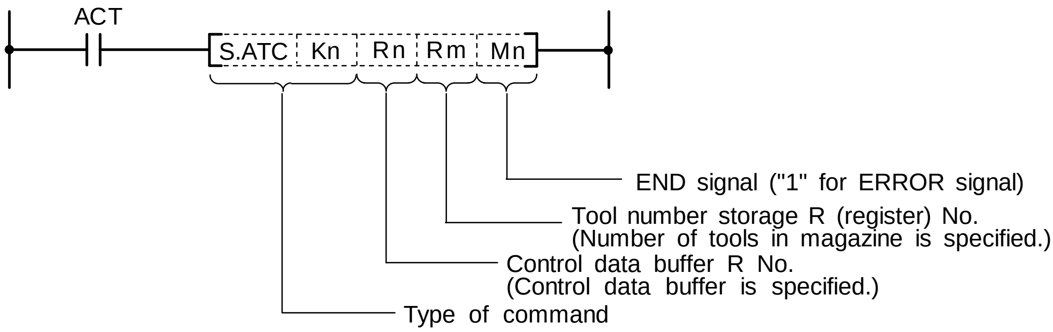


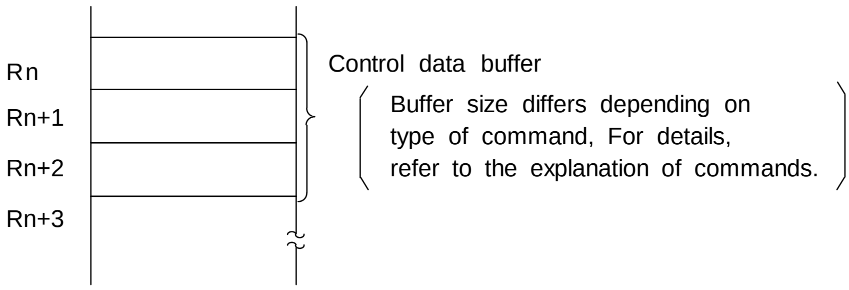
(1) Index tool number 8 in the situation such as the figure
 (a) In the tool table rotation system, the tool number search command outputs 3.
 (b) In the floating pointer system, the tool number search command outputs 7.

(2) The tool number search command output result is used by the rotary body indexing command to find the rotation direction, the number of steps, etc.
 (a) In the tool table rotation system, rotation direction CW and number of steps 3 are found from the relationship between current value 0 (pointer 0) and tool number search output result 3.
 (b) In the floating pointer system, rotation direction CW and number of steps 3 are found from the relationship between current value 4 (pointer 4) and tool number search output result 7, as in (a) above.

In the fixed pointer system, the pointer is fixed to 0 and the ring counter of 0 to n-1 (n is the number of magazines) separate from the pointer is controlled. The counter value is used as the current position.

9.1.6 Basic Format of ATC Exclusive Command





9.1.7 Command List

Command	Description
S.ATC K1 Rn Rm Mn	Tool No. search
S.ATC K2 Rn Rm Mn	Tool No. logical product search
S.ATC K3 Rn Rm Mn	Tool change
S.ATC K4 Rn Rm Mn	Random position tool change
S.ATC K5 Rn Rm Mn	Pointer forward rotation
S.ATC K6 Rn Rm Mn	Pointer reverse rotation
S.ATC K7 Rn Rm Mn	Tool table forward rotation
S.ATC K8 Rn Rm Mn	Tool table reverse rotation
S.ATC K9 Rn Rm Mn	Tool data read
S.ATC K10 Rn Rm Mn	Tool data write
S.ATC K11 Rn Rm Mn	Automatic tool data write

9.1.8 Control Data Buffer Contents

	Command	Rn	Rn+1	Rn+2
1	Tool No. search	R No. to store search data	R No. to which data output	—
2	Tool No. logical product search	R No. to store search data	R No. to which data output	Logical product data position R No.
3	Tool change (Ex.: Spindle↔Index position)	R No. to specify the position of tool change	—	—
4	Random position tool change	R No. to specify the position of tool change	R No. to specify the tool to be changed	—
5	Pointer forward rotation	—	—	—
6	Pointer reverse rotation	—	—	—
7	Tool table forward rotation	—	—	—
8	Tool table reverse rotation	—	—	—
9	Tool data read	R No. for magazine position (to be read)	R No. to which data read	—
10	Tool data write	R No. for magazine position (to be written)	R No. to which data written	—
11	Automatic tool data write	R No. to store Initial data	—	—

9.1.9 File Register (R Register) Assignment and Parameters

(1) File registers for ATC control

The file registers used with the ATC are as shown below.

		Corresponding file (R) register						Remarks (data type)
Magazine		No. 1 magazine		No. 2 magazine		No. 3 magazine		
T4-digit/T8-digit specifications		T4-digit	T8-digit	T4-digit	T8-digit	T4-digit	T8-digit	
ATC control parameters		R2950	←	←	←	←	←	—
No. of magazine designation		R2960	←	R2961	←	R2962	←	Binary
Pointer designation		R2965	←	R2966	←	R2967		Binary
Spindle tool		R2970	R2970 R2971	R2980	R2980 R2981	—	—	BCD
Standby 1 tool		R2971	R2972 R2973	R2981	R2982 R2983	—	—	BCD
Standby 2 tool		R2972	R2974 R2975	R2982	R2984 R2985	—	—	BCD
Standby 3 tool		R2973	R2976 R2977	R2983	R2986 R2987	—	—	BCD
Standby 4 tool		R2974	R2978 R2979	R2984	R2988 R2989	—	—	BCD
AUX data		R2998	←	←	←	←	←	Binary (0~99)
Magazine tool data	MG1	R3000	R3000 R3001	R3240	R3240 R3241	R3480	R3480 R3481	BCD
	MG2	R3001	R3002 R3003	R3241	R3242 R3243	R3481	R3482 R3483	BCD
	MG3	R3002	R3004 R3005	R3242	R3244 R3245	R3482	R3484 R3485	BCD
	≈	≈	≈	≈	≈	≈	≈	≈
	MG79	R3078	R3156 R3157	R3318	R3396 R3397	R3558	R3636 R3637	BCD
	MG80	R3079	R3158 R3159	R3319	R3398 R3399	R3559	R3638 R3639	BCD

(Note 1) A maximum of 80 tools per magazine can be used.
(Note 2) The tool registration screen has been prepared only for the No. 1 magazine.

(2) Control parameter contents

R2950

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

Bits F–8: Max. number of standby displayed: 4

Bit 0:
0:T 4-digit
1:T 8-digit

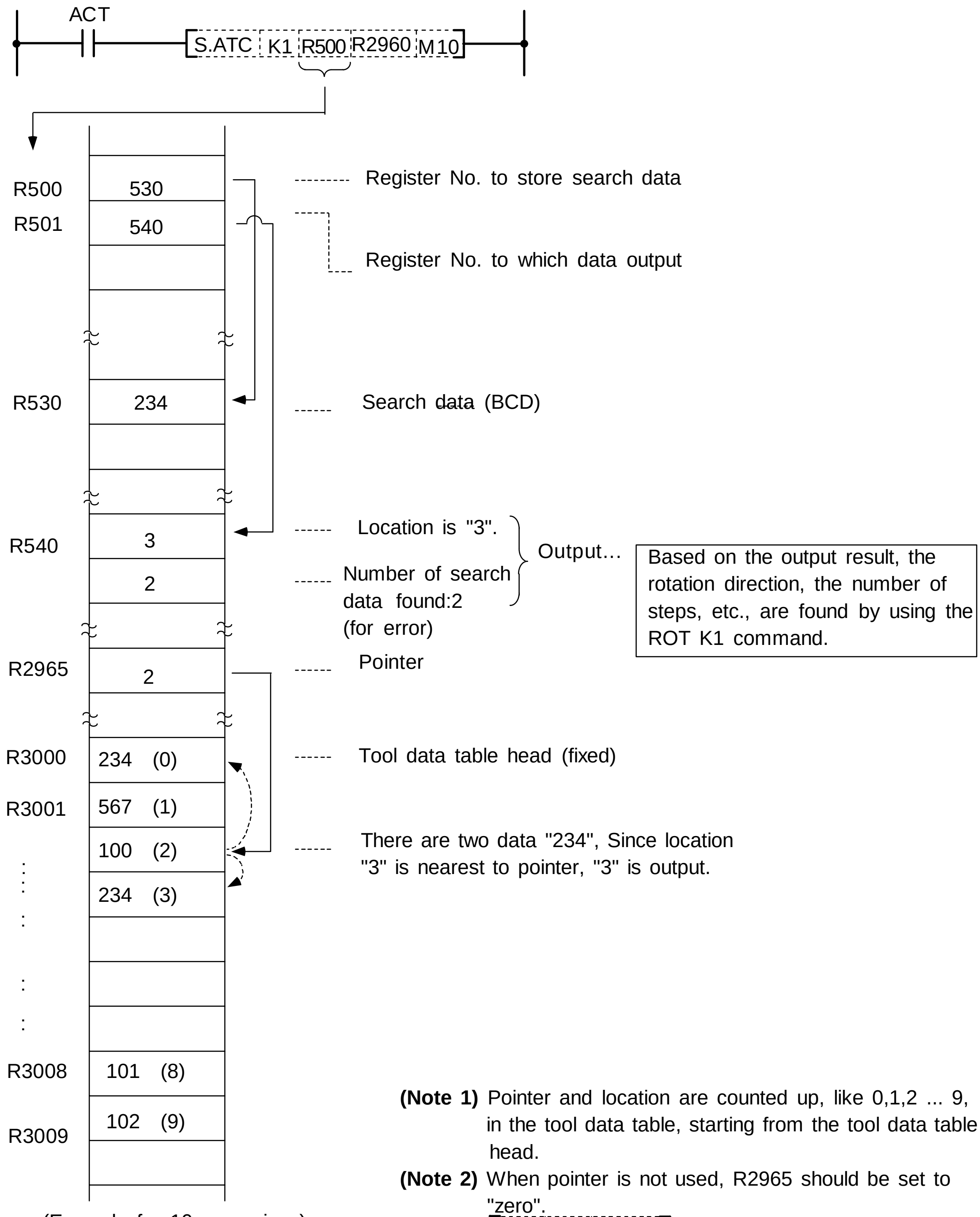
Bit 1:
0:Magazine starts from "1".
1:Magazine starts from "0".

For details on the control parameters, refer to 9.1.12 Examples of Tool Registration Screen.

9.1.10 Details of Each Command

(1) Tool No. search

This command is used to search for tool No. stored in the tool data table.
When the command tool No. is found, number of searched data and its location are output. If two or more tool No. are found, the location of tool No. nearest to the pointer is output.



(Example for 10 magazines)

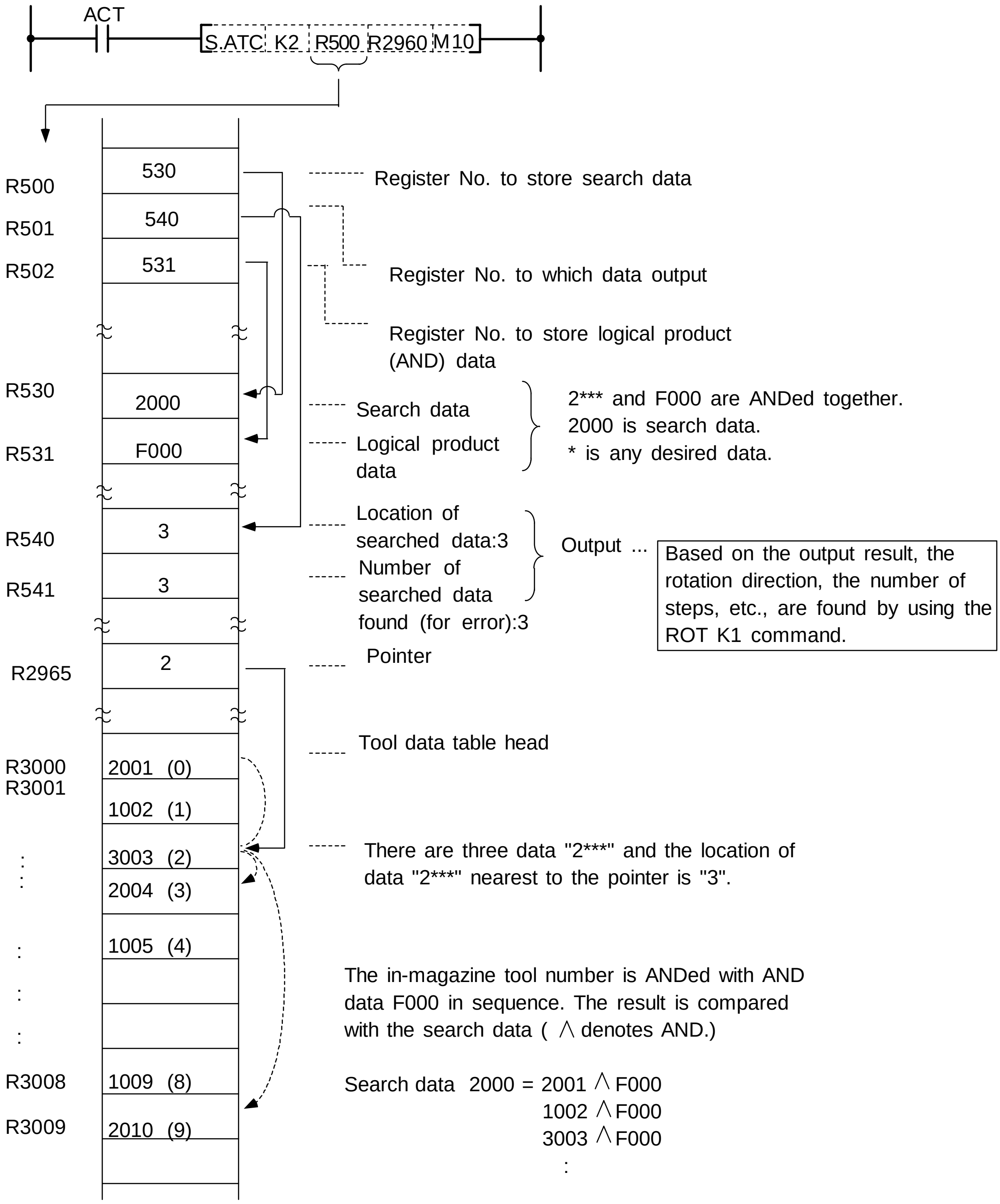
(Note 1) Pointer and location are counted up, like 0,1,2 ... 9, in the tool data table, starting from the tool data table head.

(Note 2) When pointer is not used, R2965 should be set to "zero".

Ex.) MOV K0 R2965

(2) Tool No. logical product (AND) search

Tool number AND search is the same as the tool number search command (ATC K1) in function: search data and in-magazine tool number and AND data are ANDed together for a search.



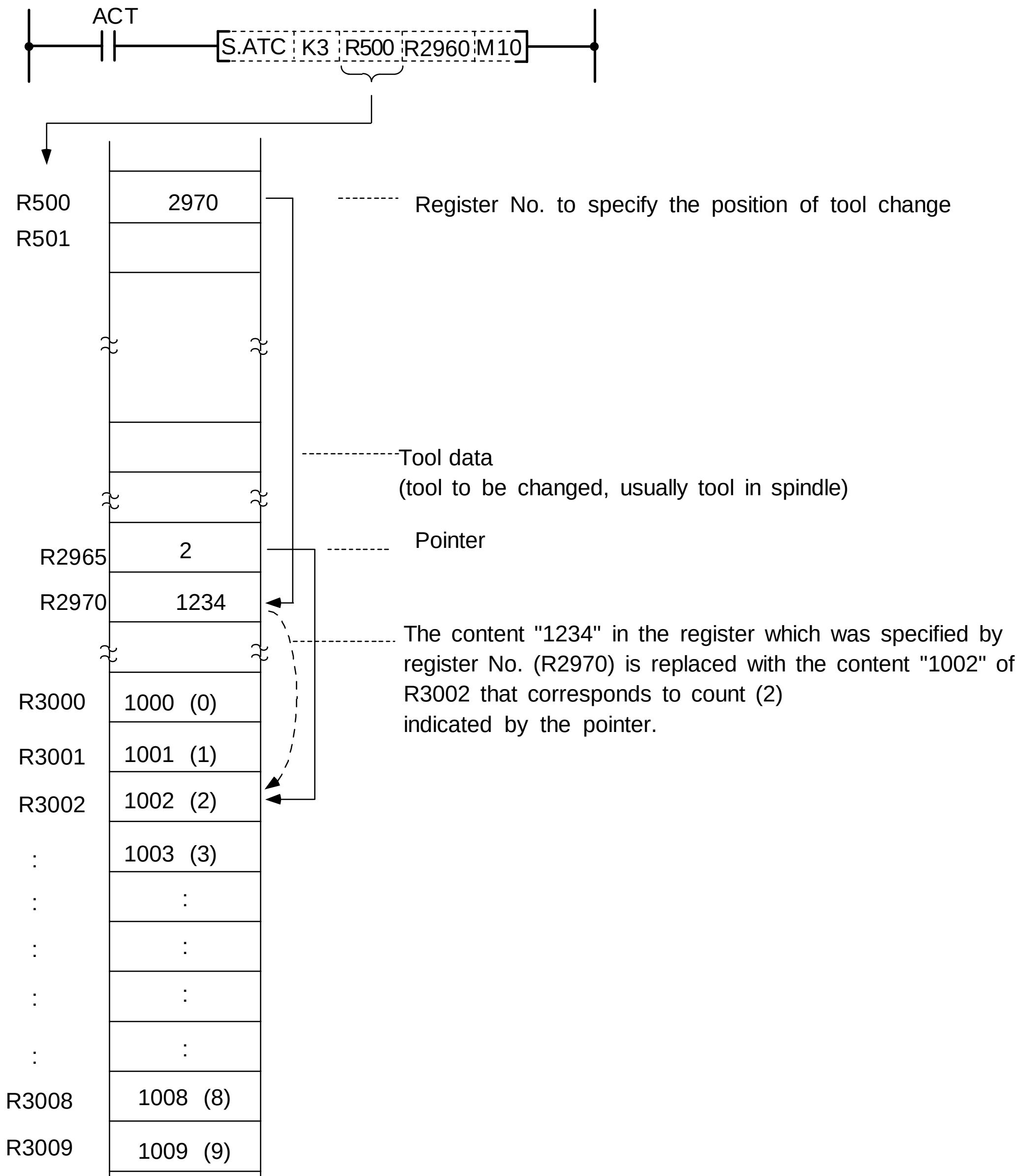
(Note 1) Pointer and location are counted up, like 0,1,2 ... 9, in the tool data table, starting from the tool data table head.

(Note 2) When pointer is not used, R2965 should be set to "zero".

Ex.) MOV K0 R2965

(3) Tool change

When a spindle tool and a magazine index tool are exchanged by the ATC arm, etc., the contents in the memory (R register) must be updated correspondingly.

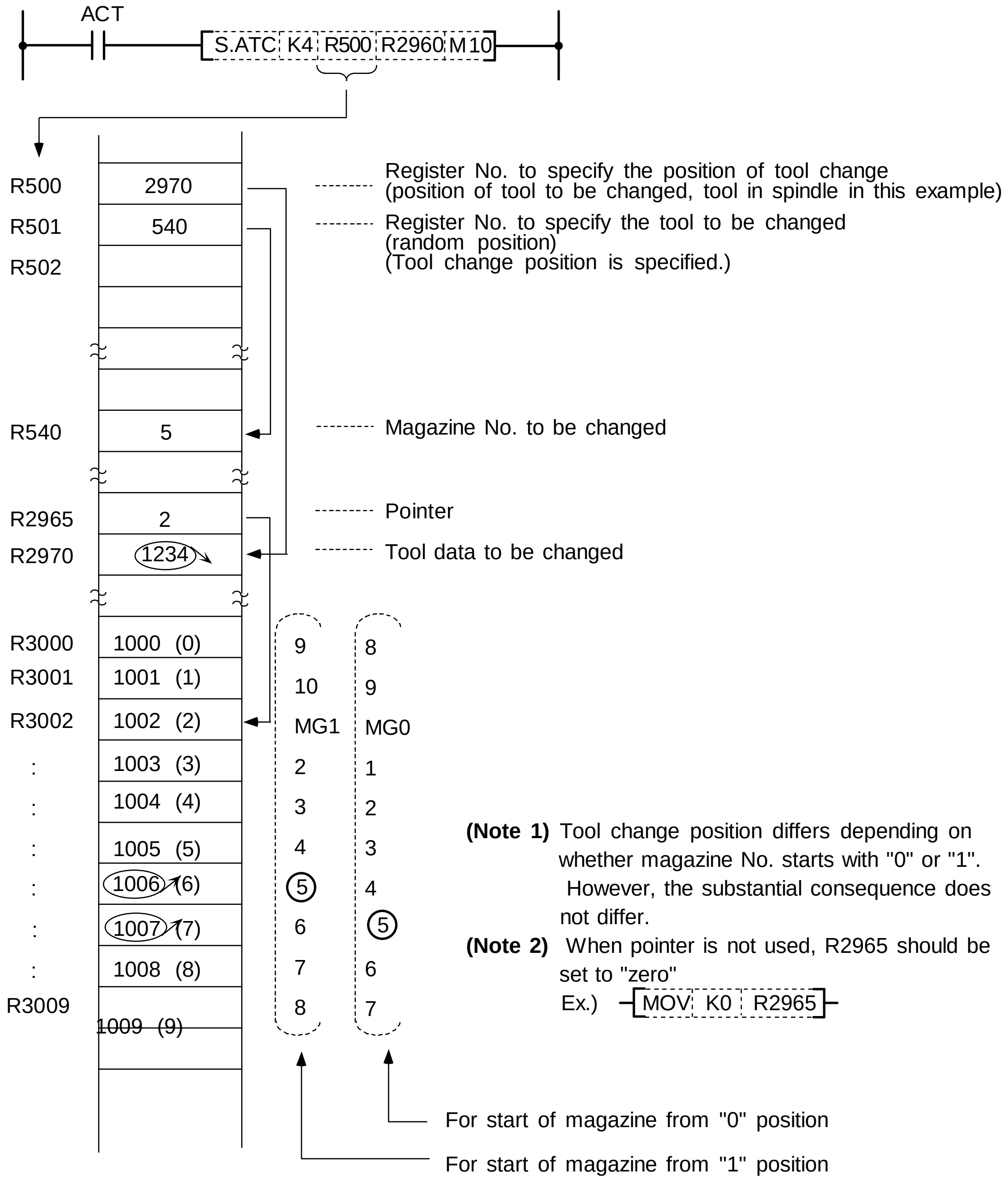


(Note) When pointer is not used, R2965 should be set to "zero".

Ex.) MOV K0 R2965

(4) Random position tool change

In tool change, a spindle tool is usually exchanged with a magazine index tool. It may often occur, however, that tool change must be performed at a station other than the usual tool change position (tool change at auxiliary tool change position, for example). This command is used in such cases.



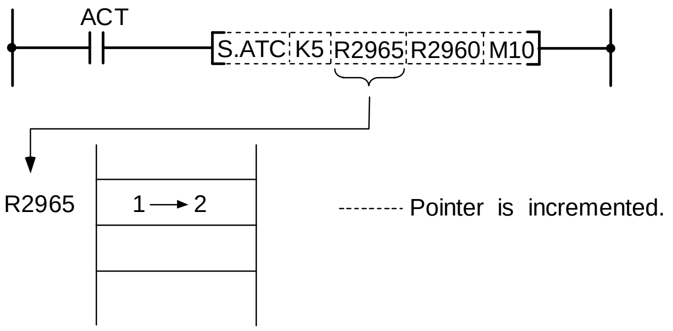
(Note 1) Tool change position differs depending on whether magazine No. starts with "0" or "1". However, the substantial consequence does not differ.

(Note 2) When pointer is not used, R2965 should be set to "zero"

Ex.) MOV K0 R2965

(5) Pointer "FWD" rotation

In the ATC control with floating pointer, pointer count is controlled so that it coincides with the actually indexed magazine position when the magazine rotates in "FWD" direction for index.

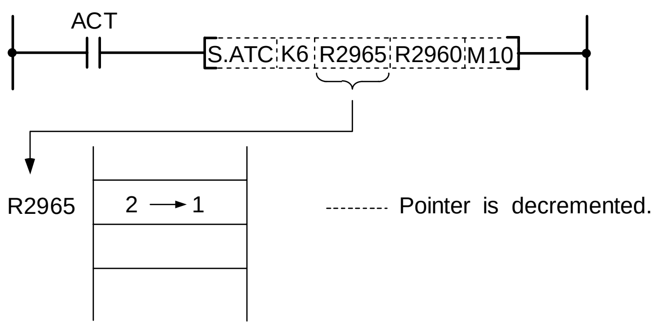


When a magazine with 10 tools is used, the control sequence is as follows:
0, 1, 2, 3 .... 9, 0, 1, 2, ... 8, 9, 0, 1 ...

(Note 1) When this command is executed, the relationship between magazine No. and tool No., appearing on the tool entry display, changes accordingly.

(6) Pointer "REV" rotation

In the ATC control with floating pointer, pointer count is controlled so that it coincides with actually indexed magazine position when the magazine rotates in "REV" direction for index.

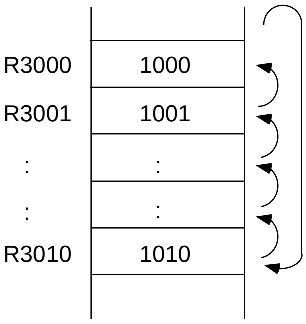


When a magazine with 10 tools is used, for example, the control sequence is as follows:
2, 1, 0, 9, 8 .... 2, 1, 0, 9, 8 .... 1, 0, 9, 8 ...

(Note 1) When this command is executed, the relationship between magazine No. and tool No., appearing on the tool entry display, changes accordingly.

(7) Tool table "FWD" rotation

The tool table rotates in "FWD" direction in accordance with the magazine rotation.

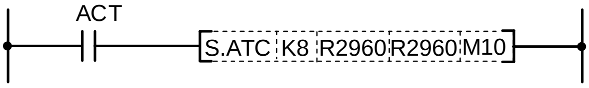


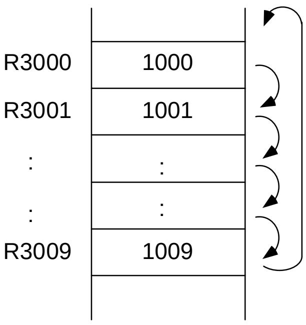
(Note 1) In this control mode, pointer always indicates "0" (tool table head).

(Note 2) When this command is executed, the relationship between magazine No. and tool No., appearing on the tool entry display, changes accordingly.

(8) Tool table "REV" rotation

The tool table rotates in "REV" direction in accordance with the magazine rotation.



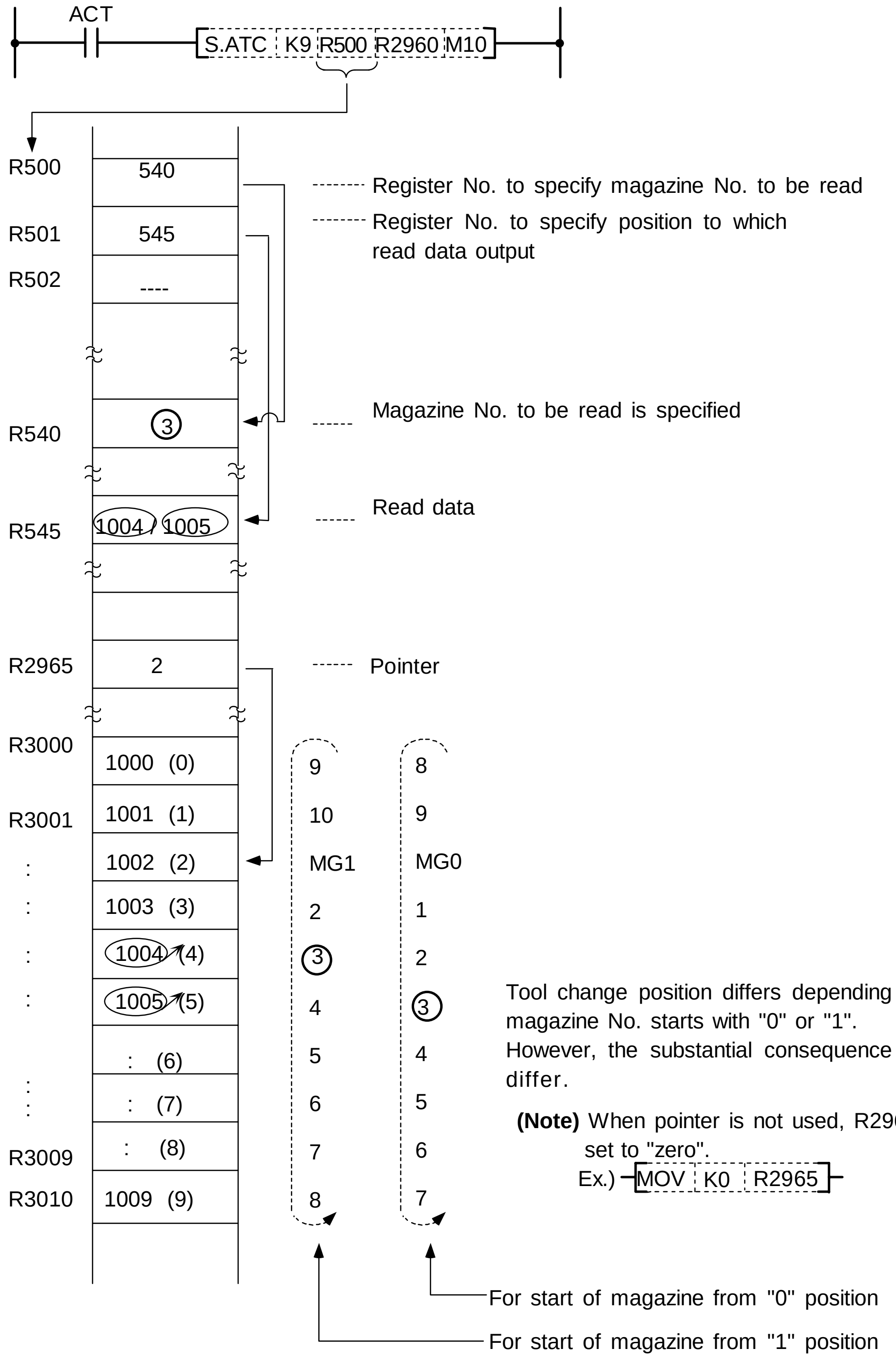


(Note 1) In this control mode, pointer always indicates "0" (tool table head).

(Note 2) When this command is executed, the relationship between magazine No. and tool No., appearing on the tool entry display, changes accordingly.

(9) Tool data read

This command is used to call a specific tool No. in the magazine.



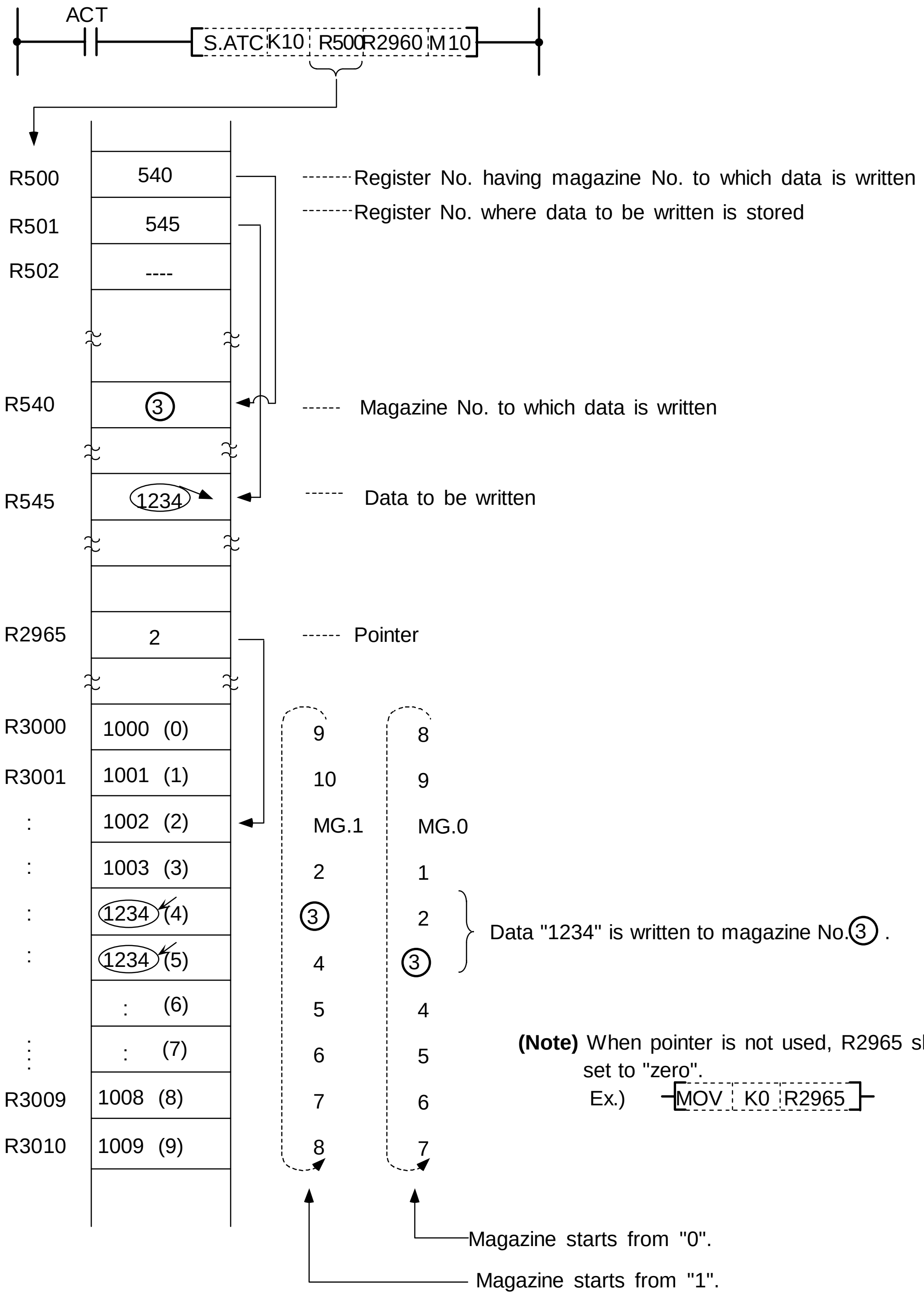
Tool change position differs depending on whether magazine No. starts with "0" or "1".
However, the substantial consequence does not differ.

(Note) When pointer is not used, R2965 should be set to "zero".

Ex.) MOV K0 R2965

(10) Tool data write

Instead of setting tool No. through the setting and display unit, the tool No. is entered to each magazine No. set through PLC program.

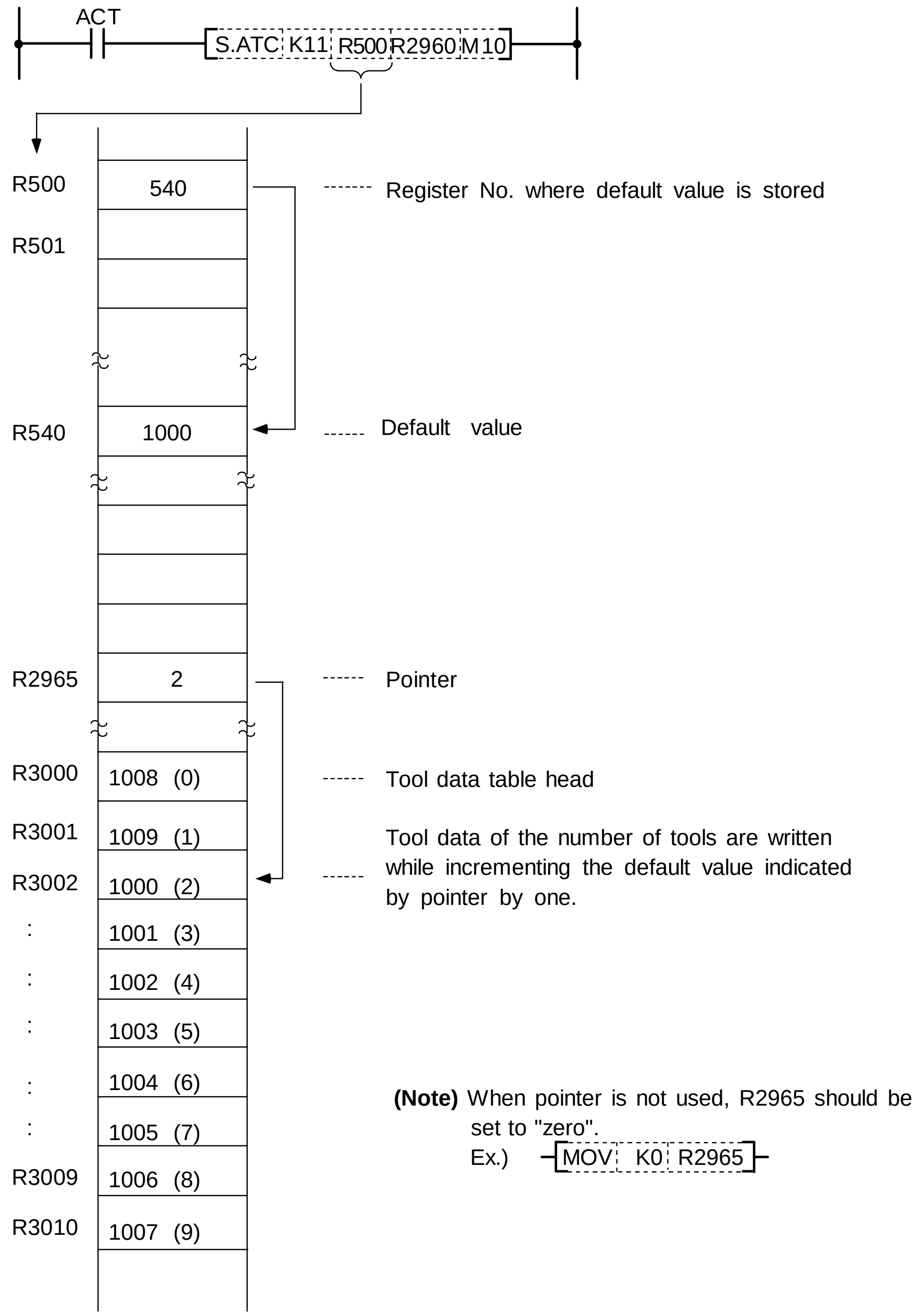


(Note) When pointer is not used, R2965 should be set to "zero".

Ex.) MOV K0 R2965

(11) Automatic tool data write

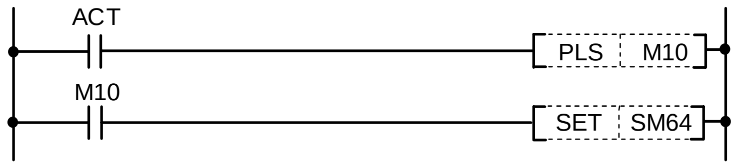
All tool Nos. are written (entered) in batch. This command is used for initialization, etc.
The data are written one after another for each tool, starting from the default value.



9.1.11 Precautions for Using ATC Exclusive Instructions

(1) When tool data is rewritten by ATC or other than ATC command, tool registration screen display is not updated. The following processing is required:
- Turn on special relay SM64 by using the SET command.

Program example)



- SM64 processing is not required for ATC commands ATC K5, K6 (forward rotation, reverse rotation of pointer), ATC K7, K8 (forward rotation, reverse rotation of tool table).
- SM64 is set through the use of the user PLC and reset by controller.

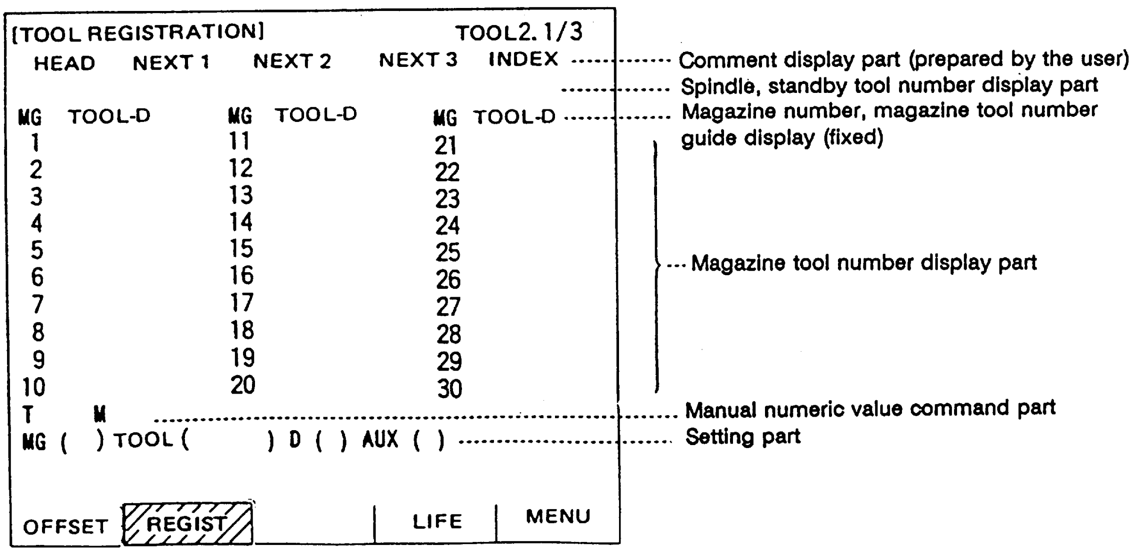
(2) Method of tool registration prohibiting during magazine rotation
If tool data is set on the tool registration screen during magazine rotation, data may be set in erroneous position. To prevent this error, a signal called special relay SM71 is provided.
- Turn on SM71 during magazine rotation.

Program example)

- Setting of AUX data (R2998) is valid while SM71 is being ON.

9.1.12 Examples of Tool Registration Screen

Tool registration screen examples are given below.
For operation, refer to the Operation Manual.



(1) Comment display part

Comment in the comment display part is prepared by the user who uses the comment display function described in the PLC Development Software Manual (IB-1500177).

(2) Spindle tool, standby tool display part

The number of display items can be changed according to the control parameter value.

Control parameter (R2950)

F	E	D	C	B	A	9	8	≀≀	4	3	2	1	0

00: Only spindle tool is displayed.
01: Spindle tool and standby 1 are displayed.
02: Spindle tool and standby 1 and 2 are displayed.
03: Spindle tool and standby 1~3 are displayed.
04: Spindle tool and standby 1~4 are displayed.
05 or more: No spindle tool or standby tool is displayed.

Hexadecimal expression

(3) Magazine tool number display part

The number of displayed magazine tools and the magazine number start value can be changed according to the number-of-magazine parameter and control parameter values.

(a) Number of magazines

Number-of-magazine parameter (R2960): The value can be set in the range of 0 to 80.

(Note) If 0 is set, the magazine number is not displayed. However, the magazine number and magazine tool number guide part is displayed.

(b) Magazine number start value

Control parameter (R2950)

F	E	D			≀≀		7	6	5	4	3	2	1	0

0: The magazine number starts at 1.
1: The magazine number starts at 0.

Example) Magazine number display when the number of magazines is 12.

MG	TOOL-D	MG	TOOL-D
1		≀	
2		11	
≀		12	

The magazine number starts at 1.

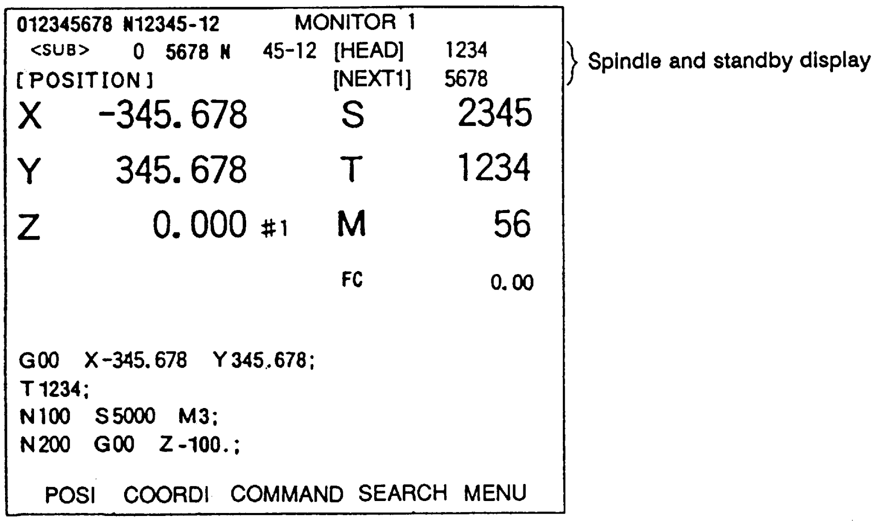
MG	TOOL-D	MG	TOOL-D
0		≀	
1		10	
≀		11	

The magazine number starts at 0.

9.1.13 Display of Spindle Tool and Standby Tool

The tool mounted on the spindle or the tool to be mounted next on the spindle (standby tool) and tool No. in the magazine are set and displayed on the tool registration screen. However, the spindle and standby tool Nos. can also be displayed on the position display screen and tool length measurement screen that are often used. With this, the changes in the magazine pot and spindle tool No. according to the tool selection command or tool change command can be confirmed.

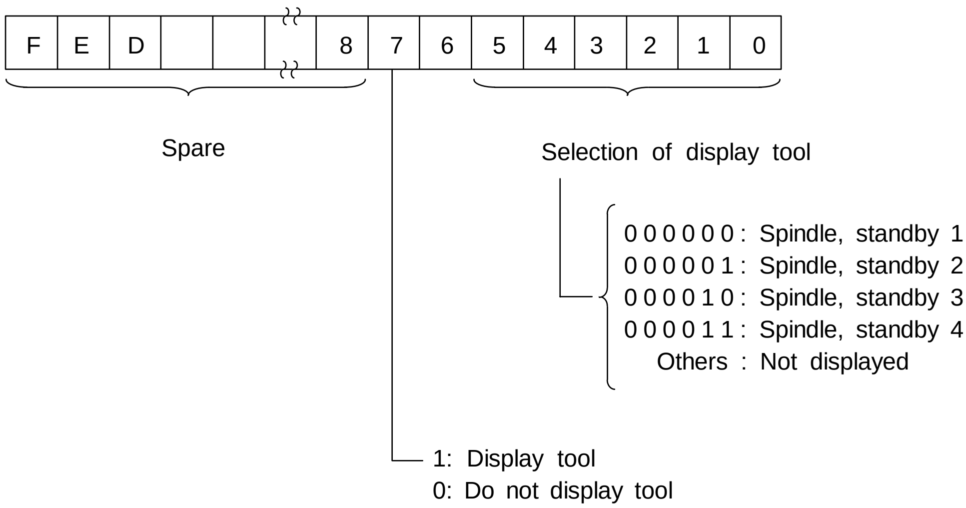
(1) Position display screen



(2) Display tool selection parameter

A maximum of four standby tools can be displayed on the tool registration screen. The No. of the standby tool and the title to be displayed on the POSITION screen and TOOL DATA screen, etc., are selected.

Display tool selection parameter (R2953)



9.2 S.ROT Commands

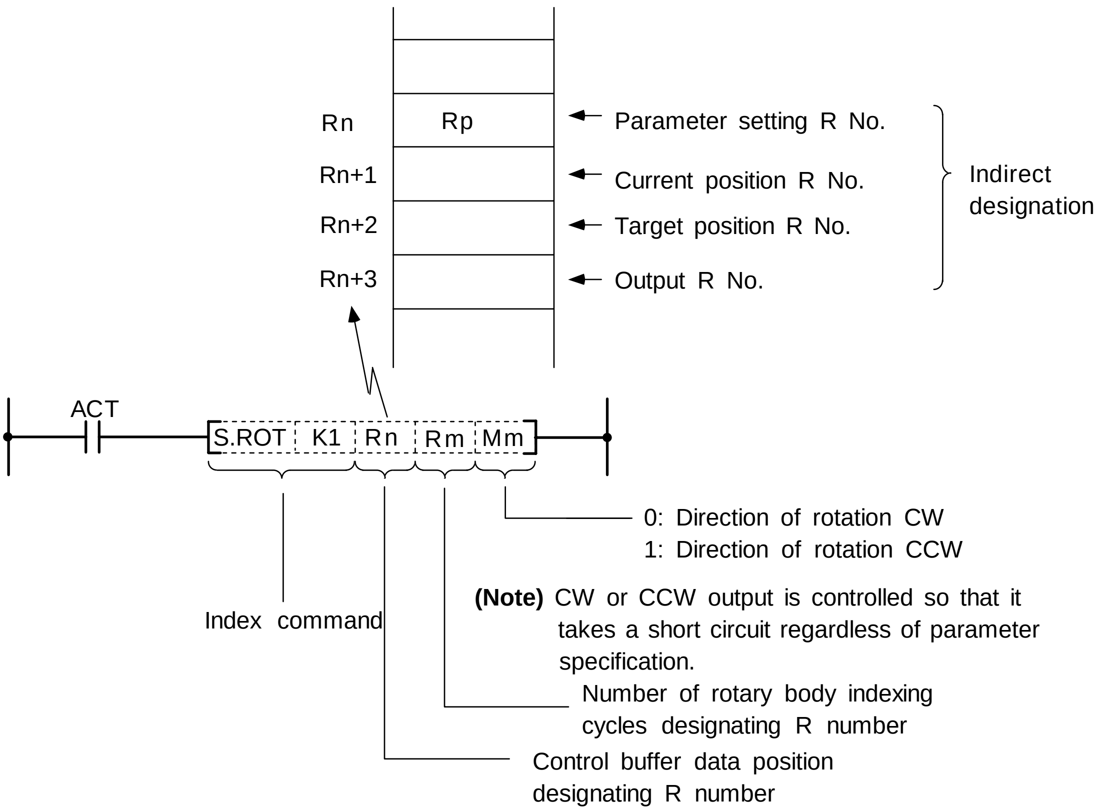
ROT commands are prepared as functions such as rotary body target position, rotation direction and ring counter. The commands can be used to determine the direction of rotation and number of steps with the data resulting from ATC exclusive command tool No. search processing.

9.2.1 Command List

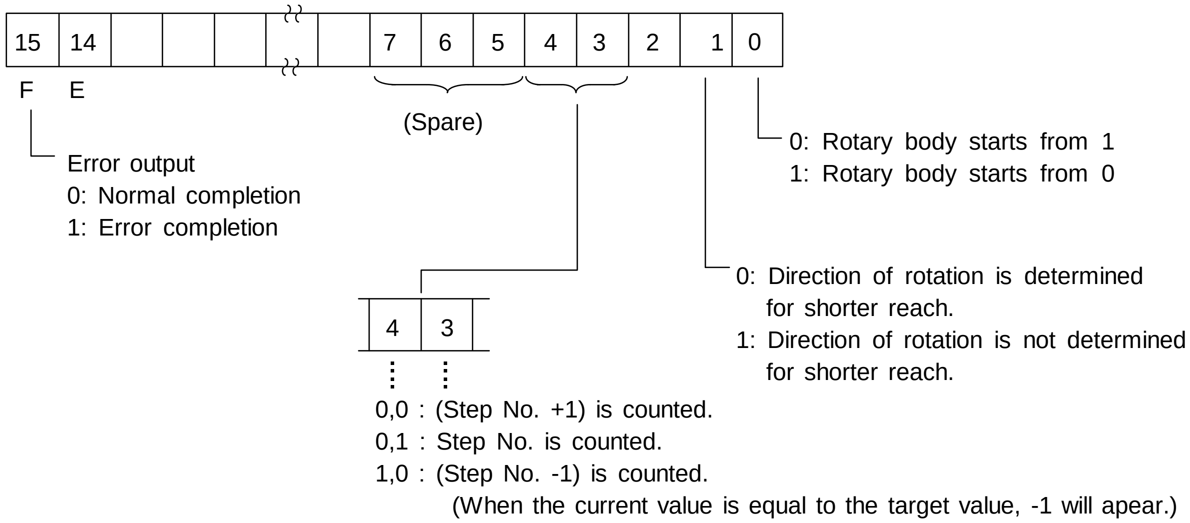
Command	Description
S.ROT K1 Rn Rm Mn	Rotary body indexing
S.ROT K3 Rn Rm Mn	Ring counter

(1) Rotary body indexing

Direction of rotation and number of steps of ATC magazine (or turret) are determined automatically.



Rp (parameter) contents



(Note 1) The Index command is executed after setting R numbers to Rn to Rn+3 and writing data in the file registers (R) each corresponding to the R numbers. However, data setting to the parameter (Rp) is done once before execution of the Index command; this is to prevent the error code from being cleared.

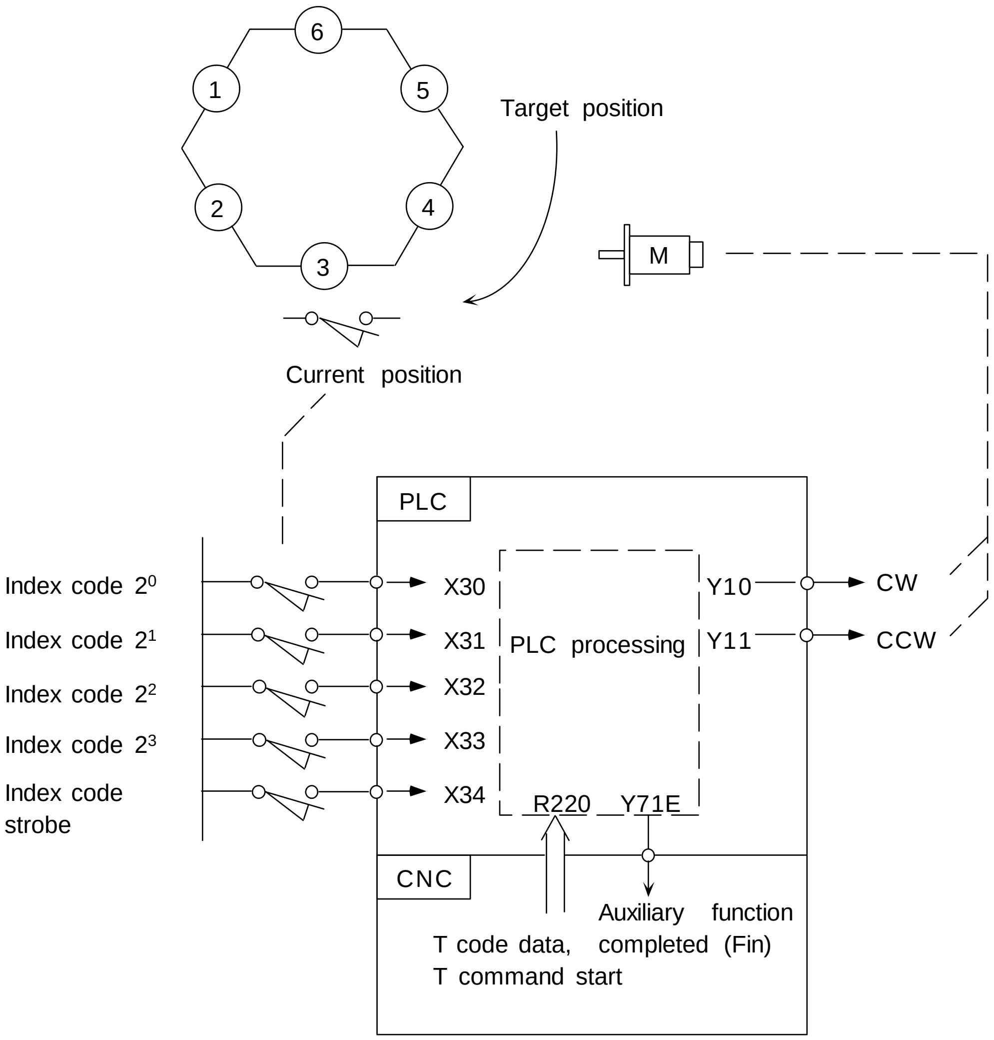
(Note 2) The error code stored in bit F of the parameter (Rp) is not cleared even if the Index command activating signal (ACT) goes off.

(a) Example of rotary body index by ROT K1 instruction

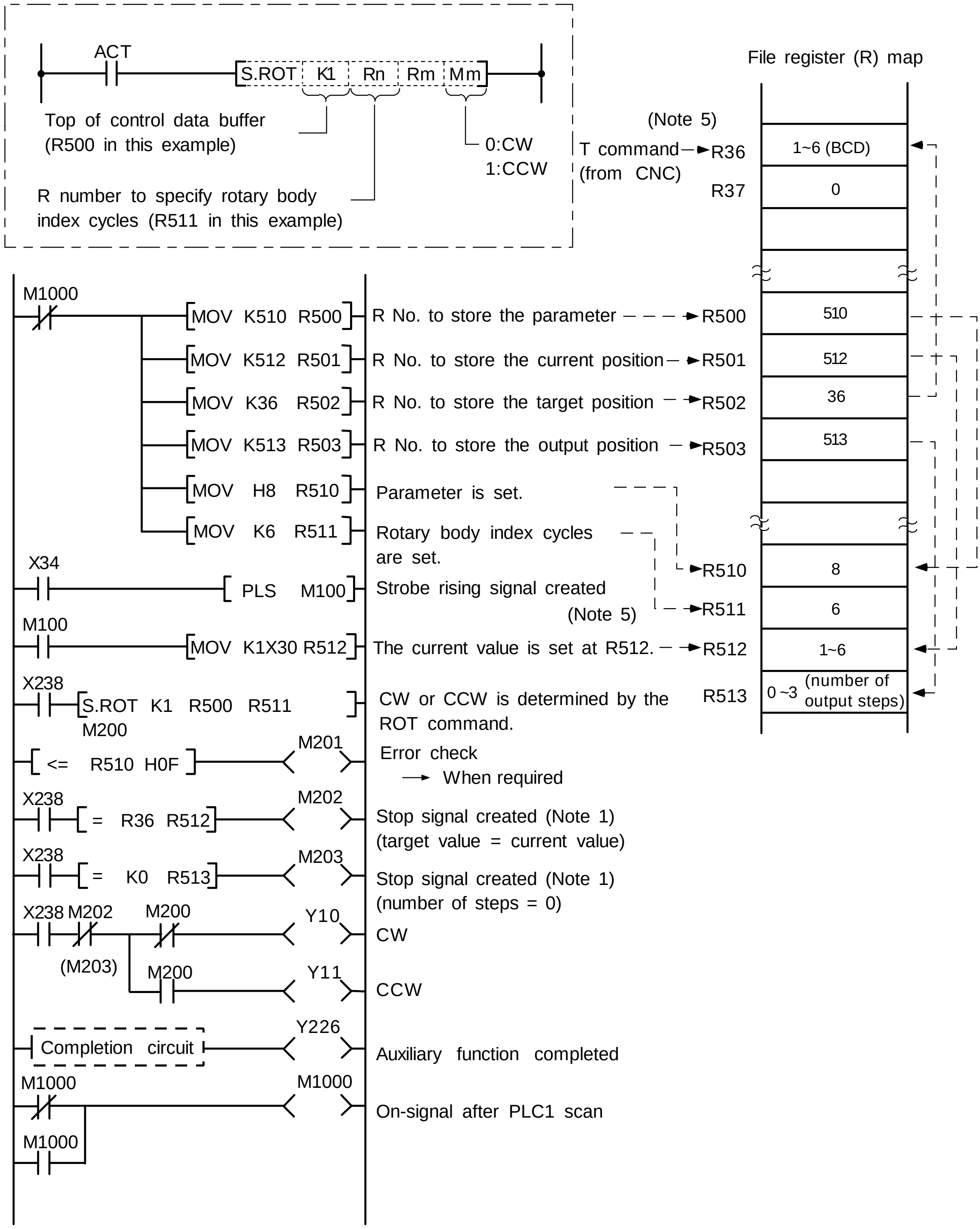
Conditions: (i) The number of rotary body index cycles is 6.

(ii) The target position is specified by a T command.

(Note) Normally the target position must be a binary, but in this example, the number of rotary body index cycles is 1 to 6, and there is no difference between the binary and BCD. Thus, the direct T command output file register R36 (B C D) is used.



In the example of ladder circuit shown below, the rotation direction is determined by the T command and current position data given by the machine, and the rotary body is rotated in that direction until the target position reaches the current position. When indexing is completed, the auxiliary command completion signal is turned on.


ACT
S.ROT K1 Rn Rm Mm
Top of control data buffer
(R500 in this example)
0:CW
1:CCW
R number to specify rotary body
index cycles (R511 in this example)
File register (R) map
(Note 5)
T command
(from CNC)
R36
1~6 (BCD)
R37
0
M1000
MOV K510 R500
R No. to store the parameter
R500
510
MOV K512 R501
R No. to store the current position
R501
512
MOV K36 R502
R No. to store the target position
R502
36
MOV K513 R503
R No. to store the output position
R503
513
MOV H8 R510
Parameter is set.
MOV K6 R511
Rotary body index cycles
are set.
X34
PLS M100
Strobe rising signal created
(Note 5)
R510
8
R511
6
M100
MOV K1X30 R512
The current value is set at R512.
R512
1~6
X238
S.ROT K1 R500 R511
M200
CW or CCW is determined by the
ROT command.
R513
0 ~3
(number of
output steps)
M201
<= R510 H0F
Error check
When required
X238
M202
= R36 R512
Stop signal created (Note 1)
(target value = current value)
X238
M203
= K0 R513
Stop signal created (Note 1)
(number of steps = 0)
X238 M202
M200
Y10
CW
(M203)
M200
Y11
CCW
Y226
Completion circuit
Auxiliary function completed
M1000
M1000
On-signal after PLC1 scan
M1000

(Note 1) Either M202 or M203 can be used for a stop signal.

(Note 2) The devices (X, Y, and R) are used in this example for no special purpose. Use any device within the available range.

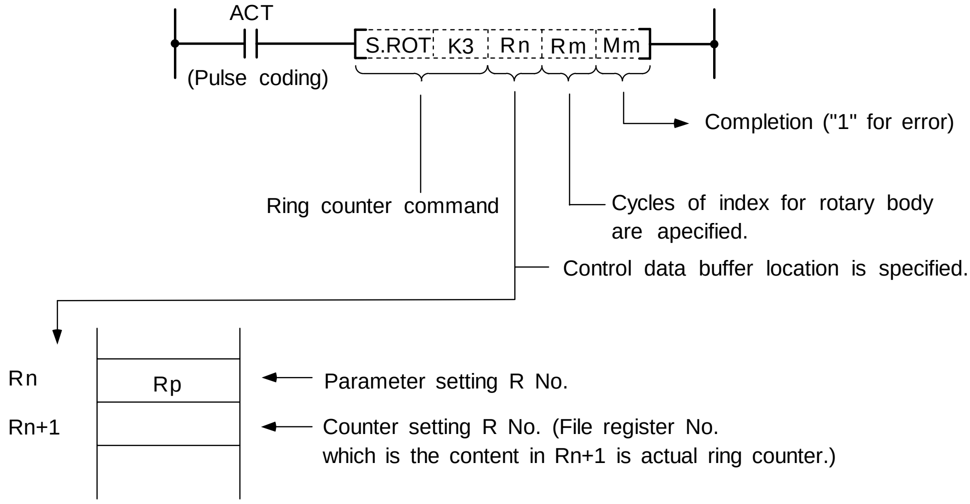
(Note 3) If a number from 1 to 6 has not been specified for current position data (R512) before the ROT command is activated, an error results.

(Note 4) The control parameters (R510) are specified as follows:
1) Rotary body starts from 1
2) Take a short cut.
3) Calculate the number of steps.

(Note 5) The T command (R36) is output with a BCD code. In this example, the number of rotary body index cycles is 1 to 6, and there is no difference between the binary and BCD. Thus, the contents of R36 are used as they are.
The target position and current value (R36 and R512 in this example), which are the data to be compared in the S.ROT K1 command must be binaries. (In actual use, the contents of R36 are binary converted.)

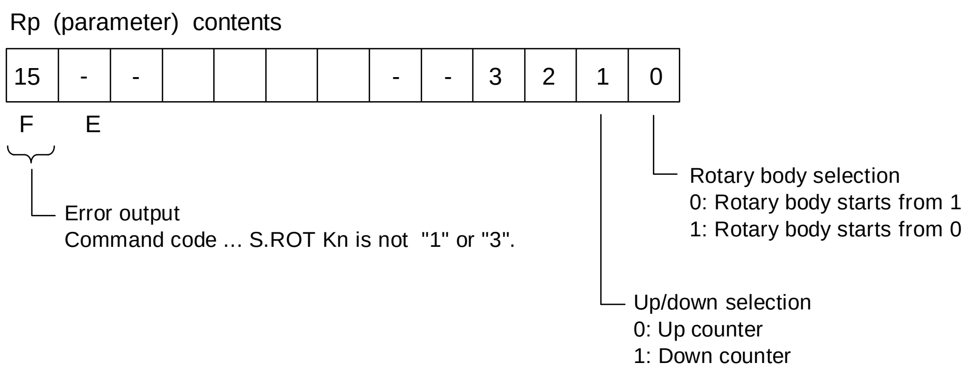
(2) Ring counter (Up/down counter)

This command is used to control position of rotary body (or turret).



The ring counter is a binary counter; it is used as an up/down counter of "start from 0" or "start from 1" according to the parameter rotary body command.

Rp (parameter) contents



(Note 1) The ring counter command is executed after setting R numbers to Rn to Rn+1 and specifying data for the parameter.

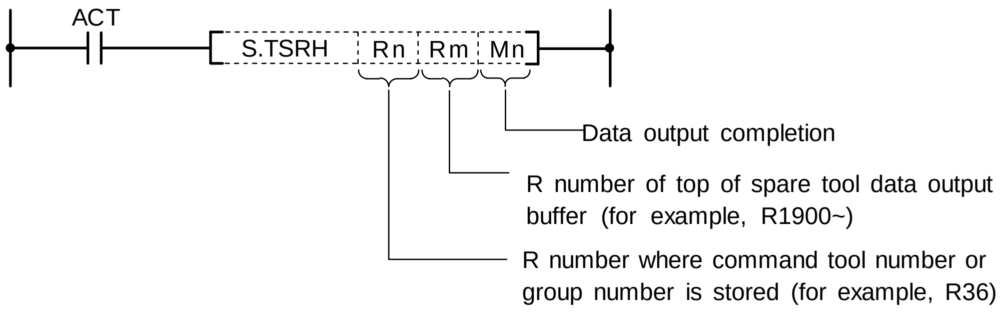
(Note 2) The error code (Mm) of the ring counter command and the error code in bit F of the parameter (Rp) are cleared when the activating signal (ACT) goes off. The activating signal (ACT) of the ring counter command is generally pulsed. This makes it hard for the interface diagnostic and ladder monitor programs to detect an error signal. For debugging, therefore, an error hold circuit is provided after the ring count command to ease error detection.

9.3 Tool Life Management Exclusive Command

(When BASE SPEC parameter #1037 cmdtype is set to 1 or 2.)

The following command is provided only for tool life management. (It is used for the machining centers.)

1. Spare tool selection ... TSRH



9.3.1 Tool Life Management System

(1) Tool life management I (When BASE SPEC parameter #1096 T-Ltyp is set to 1.)
The use time or use count of the spindle tool specified from user PLC (R3720, R3721) is integrated and the tool use state is monitored. Tool data corresponding to the spindle tool is also output. (R3724~R3735)

(2) Tool life management II (When BASE SPEC parameter #1096 T-Ltyp is set to 2.)
Tool life management II is provided by adding the spare tool selection function to tool life management I. Spare tool is selected among group by the spare tool selection command executed by user PLC during tool command, etc., and the tool data of the spare tool is output.
Tool data corresponding to the spindle tool specified from user PLC is output (R3724~R3735) and tool offset corresponding to the spindle tool is made.

9.3.2 Tool Command System

One of the following two can be selected by using a parameter for command tool number (Rm contents) input to the spare tool selection command in tool life management II:

(1) Group number command system (When BASE SPEC parameter #1104 T-Com2 is set to 0.)
The command tool number (Rm contents) input to the spare tool selection command is handled as group number. Spare tool is selected among the tools corresponding to the group number in tool data.

(2) Tool number command system (When BASE SPEC parameter #1104 T-Com2 is set to 1.)
The command tool number (Rm contents) input to the spare tool selection command is handled as a tool number. The group number containing the command tool number is found and spare tool is selected among the group.

9.3.3 Spare Tool Selection System

One of the following two can be selected by using a parameter for the spare tool selection system of the spare tool selection command in tool life management II:

(1) Selection in tool registration order (When BASE SPEC parameter #1105 T-Sel2 is set to 0.)
Spare tool is selected among the used tools of a single group in the registration number order. If used tools do not exist, spare tool is selected among unused tools in the registration number order. If none of used and unused tools exist, spare tool is selected among normal life tools and abnormal tools (the former is assigned higher priority) in the registration number order.

(2) Life equality selection (When BASE SPEC parameter #1105 T-Sel2 is set to 1.)
Tool whose remaining life is the longest is selected among the used and unused tools of a single group. If more than one tool has the same remaining life, it is selected in the registration number order. If none of used and unused tools exist, spare tool is selected among normal life tools and abnormal tools (the former is assigned higher priority) in the registration number order.

9.3.4 Interface

(1) User PLC → Controller

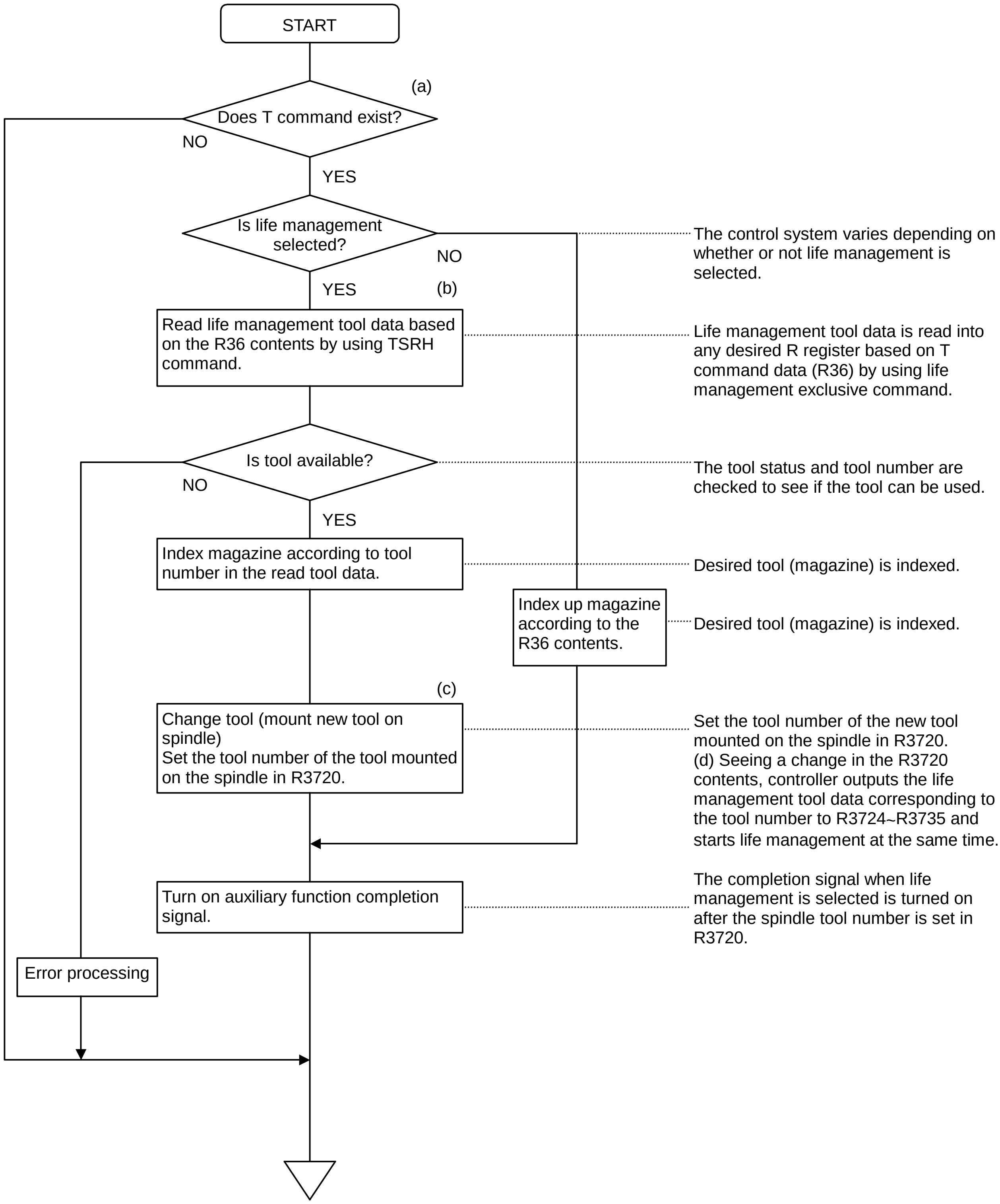
Device name	Signal name	Explanation
Y29A	Auxiliary function locking signal	While this signal is input, tool life management is not made.
Y2C8	Tool error 1 signal	This signal indicates tool error state 1. When controller inputs the signal it changes the status in spindle tool data to 3. (Unused tools or used tools are changed to toll error state 1.)
Y2C9	Tool error 2 signal	This signal indicates tool error state 2. When controller inputs the signal, it changes the status in spindle tool data to 4. (Unused tools or used tools are changed to toll error state 2.)
Y2CA	Usage data counter validity signal	If this signal is not input, the usage data is not counted.
Y2CB	Tool life management input signal	If this signal is input to controller and the tool life management output signal is output to PLC, tool life management is made.

(2) Controller → User PLC

Device name	Signal name	Explanation
X20B	Tool life management output signal	The controller outputs this signal to PLC while the tool life management function is selected. (When BASE SPEC parameter #1103 T-Life is set to 1.)

9.3.5 User PLC Processing When the Tool Life Management Function Is Selected

A PLC processing example when tool change is made by the T command is given below:



(1) Procedure when tool command is executed

(a) Tool life management I

1) When tool command (T command) is given, the controller outputs T code data and start signal (TF). **(Note)** The T code data (BCD) is binary converted and then used.
2) The user PLC checks the tool command. If life management is required, the user PLC executes the spare tool selection command.
3) The spare tool selection command outputs the tool data of the tool corresponding to the specified tool number.
4) The user PLC decides whether or not the tool can be used according to the status in the output tool data, and selects command tool or performs alarm processing.

(Note) If -1 is set in the group number in the output tool data, the tool data is invalid. At the time, the specified tool number is output to the tool number in the output tool data as it is.

(b) Tool life management II

1) When tool command (T command) is given, the controller outputs T code data and start signal (TF). **(Note)** The T code data (BCD) is binary converted and then used.
2) The user PLC checks the tool command. If life management is required, the user PLC executes the spare tool selection command.
3) The spare tool selection command selects the spare tool corresponding to the specified number (group number, tool number) and outputs the tool data of the spare tool.
4) The user PLC decides whether or not the tool can be used according to the status in the output tool data, and selects command tool or performs alarm processing.

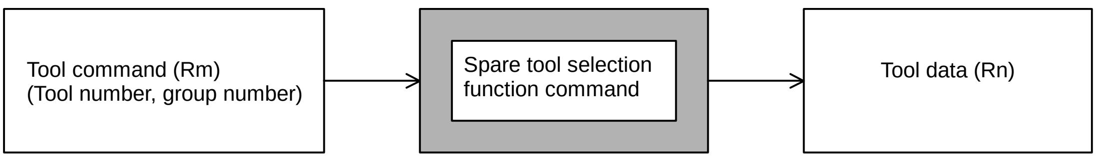
(Note) If -1 is set in the group number in the output tool data, the tool data is invalid. At the time, the specified tool number is output to the tool number in the output tool data as it is.

(2) Procedure when spindle tool is changed

1) When spindle tool is changed during the spindle tool change command (M06), etc., the user PLC specifies the tool number of the spindle tool (R3720~R3721).
The controller outputs the spindle tool data corresponding to the tool number of the spindle tool every user PLC main cycle (R3724~R3735).
2) The controller integrates the use time or use count of the spindle tool based on the spindle tool data in the tool data file.
In tool life management II, it also executes tool offset corresponding to the spindle tool.

(Note) If -1 is set in the group number in the output spindle tool data, the spindle tool data is invalid. At the time, the specified tool number (R3720~R3721) is output to the tool number in the output spindle tool data as it is. The controller does not integrate the usage time or usage count of the spindle tool or make tool offset.

<When tool command is executed>

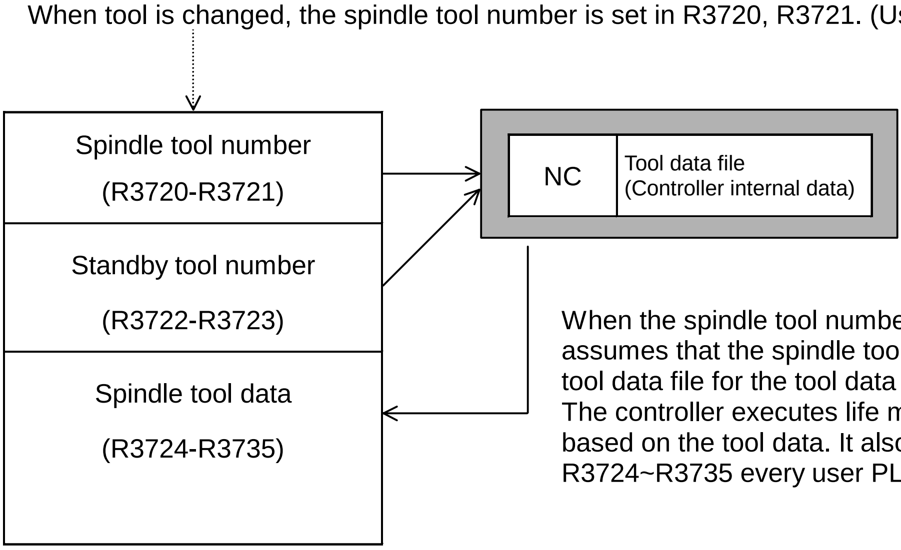


In tool life management I, tool number is only specified and spare tool is selected.

Tool is selected according to tool number in tool data. (User PLC)

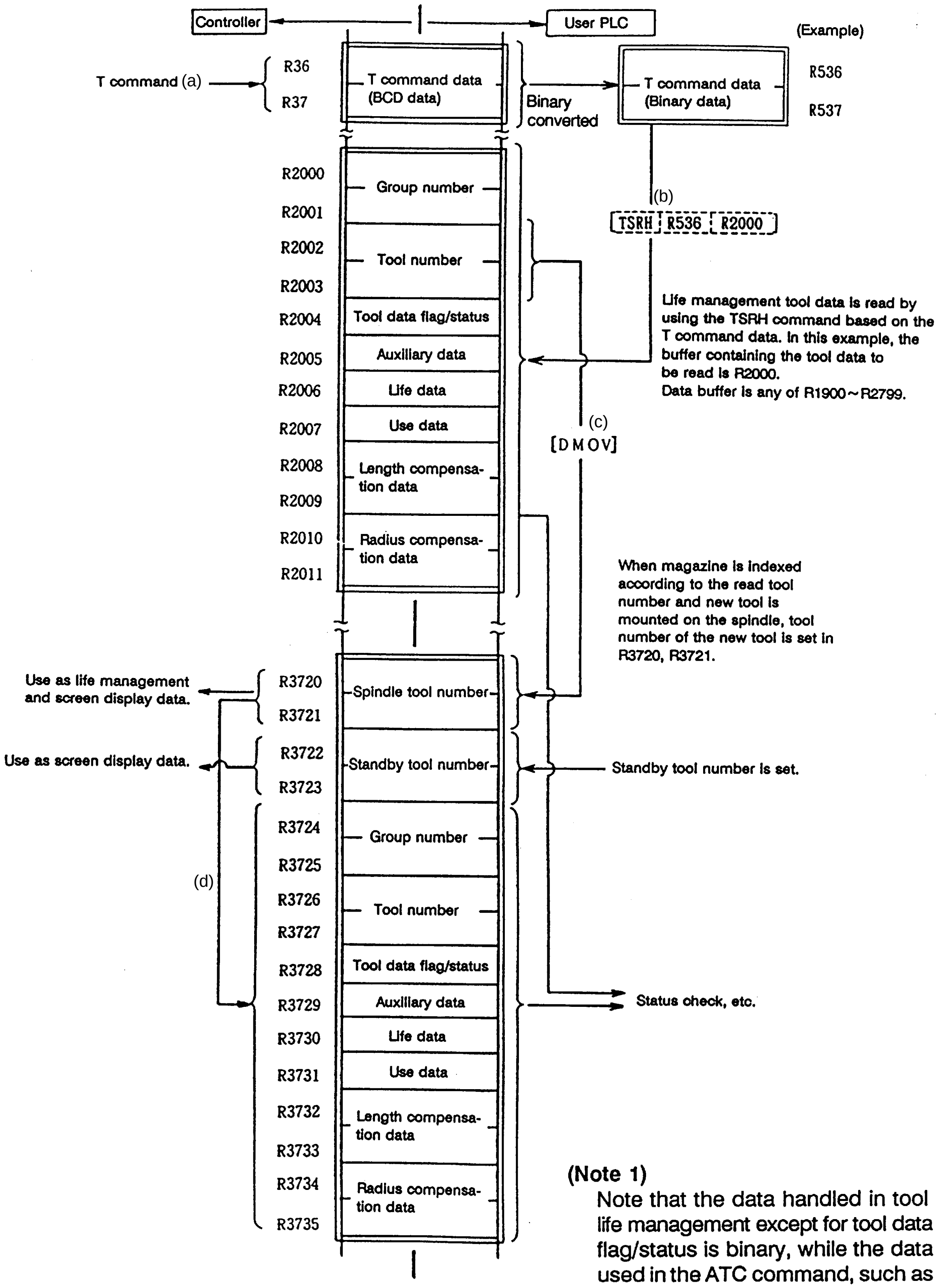
<When tool is changed>

When tool is changed, the spindle tool number is set in R3720, R3721. (User PLC)



When the spindle tool number changes, the controller assumes that the spindle tool is changed, and searches the tool data file for the tool data of the new tool.
The controller executes life management and tool offset based on the tool data. It also outputs the tool data to R3724~R3735 every user PLC main cycle.

(3) Tool data flow



(Note 1)
Note that the data handled in tool life management except for tool data flag/status is binary, while the data used in the ATC command, such as search data and magazine tool number, is BCD.

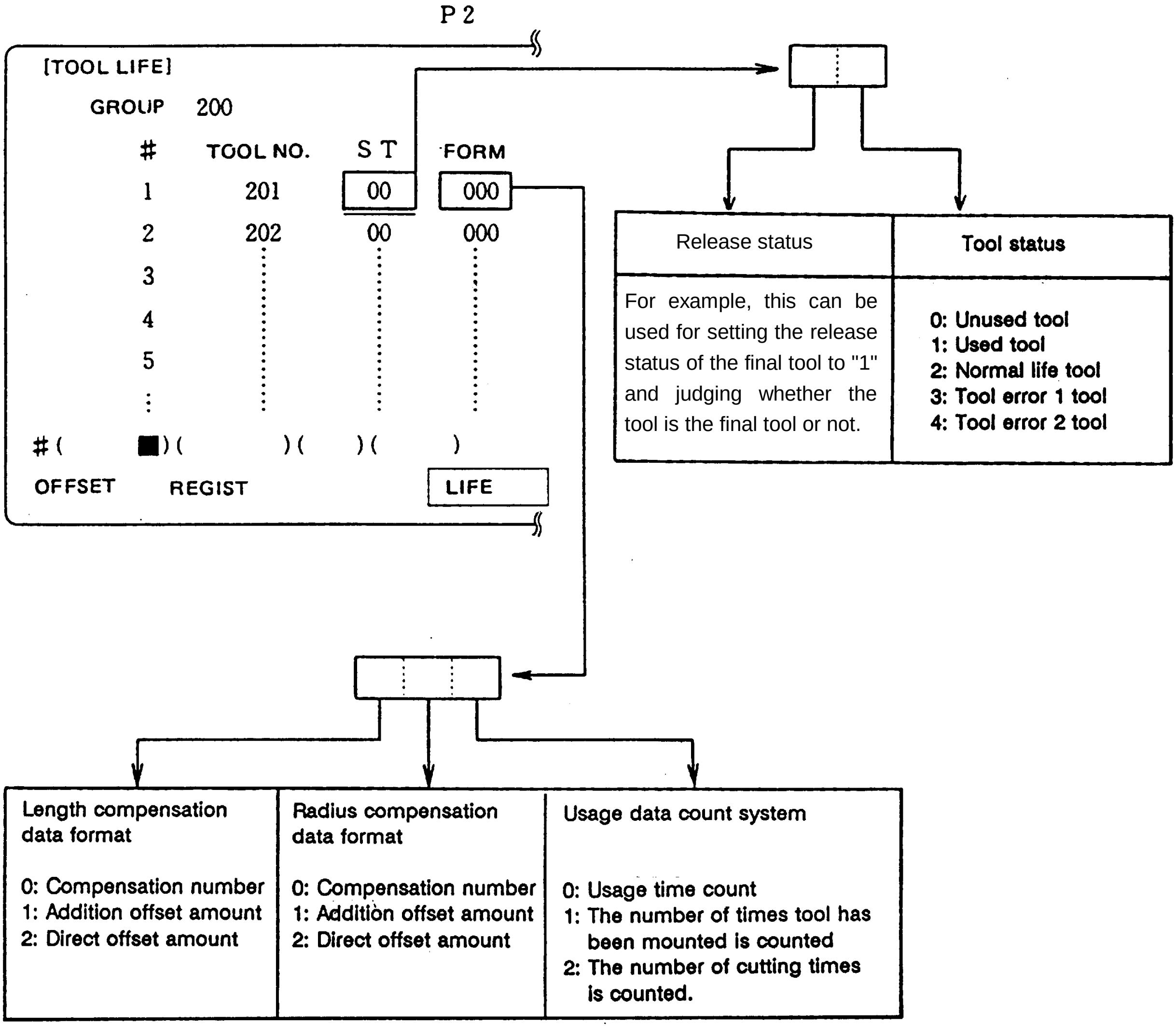
(4) Tool data

The tool data is tool management data such as the group number, tool number, and tool status. The details are given below:

Tool data name	Explanation	Data range
Group number	Number to manage tools of the same type (form and dimensions) in a group. The tools assigned the same group number are assumed to be spare tools.	1 - 99999999
Tool number	Number unique to each tool actually output during tool command execution	1 - 99999999
Tool data flag	Parameter of use data count system, length compensation system, radius compensation system, etc.	
Tool status	The tool state is indicated.	0 - FF (H)
Auxiliary data	Reserved data	0 - 65535
Tool life data	Life time or life count for each tool. (If 0 is set, infinity is assumed to be specified.)	0 - 4000 (minutes) 0 - 65000 (times)
Tool use data	Use time or use count for each tool.	0 - 4000 (minutes) 0 - 65000 (times)
Tool length compensation data	Length compensation data set in any format of compensation number, direct offset amount, and addition offset amount.	Compensation numbers 1 - 400 Direct offset amount ±99999.999 Addition offset amount ±99999.999
Tool radius compensation data	Radius compensation data set in any format of compensation number, direct offset amount, and addition offset amount.	Compensation numbers 1 - 400 Direct offset amount ±99999.999 Addition offset amount ±99999.999

(5) Tool data flag and tool status
The tool data flag and tool status contents are shown below:

(a) Correspondence with tool life management data screen



(b) Tool data flag ..... Bits 0~7 of file register Rn (such as R3728)

bit	Explanation	
bit 0 bit 1	Length compensation data format (spare tool compensation system)	0: Compensation number 1: Addition offset amount 2: Direct offset amount
bit 2 bit 3	Radius compensation data format (spare tool compensation system)	0: Compensation number 1: Addition offset amount 2: Direct offset amount
bit 4 bit 5	Usage data count system	0: Usage time (minutes) 1: Number of times tool has been mounted 2: Number of cutting times
bit 6		
bit 7		

1) Spare tool compensation system

Tool compensation corresponding to the spindle tool can be made in tool life management II.

One of the following three types of length and compensation can be selected by setting tool data:

i) Compensation umber system (0 is set on the tool data registration screen.)
Compensation data in tool data is handled as the compensation number. It is replaced with the compensation number given in a work program and compensation is executed.

ii) Addition compensation system (1 is set on the tool data registration screen.)
Compensation data in tool data is handled as addition offset amount. It is added to the offset amount indicated by the compensation number given in a work program and compensation is executed.

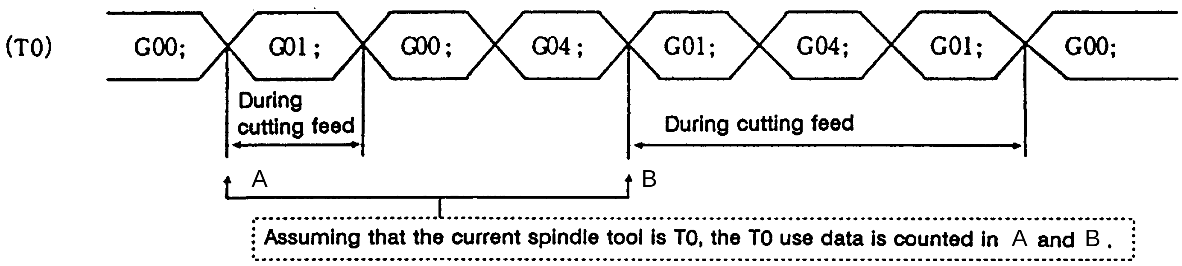
iii) Direct compensation system (2 is set on the tool data registration screen.)
Compensation data in tool data is handled as direct offset amount. It is replaced with the offset amount indicated by the compensation number given in a work program and compensation is executed.

2) Usage data count system

i) Usage time count
For usage data, the execution time of cutting feed (such as G01, G02, or G03) is counted in 3.75-s units. However, the life data and usage data are displayed in minute units on the tool data registration screen.

ii) Number of times tool has been mounted is counted
When tool is used as spindle tool in tool change, etc., usage data is counted. However, if cutting feed (G01, G02, or G03) is not executed after tool is used as spindle tool, usage data is not counted.

iii) Number of cutting times is counted
Usage data is counted when a change is made from rapid traverse feed (such as G00) command to cutting feed (such as G01, G02, or G03) command as shown below. However rapid traverse or cutting feed command with no movement becomes invalid.
Even if a command other than the rapid traverse command appears between cutting feed commands, usage data is not counted.



Caution:

When none of the tool life management input signal and use data count validity signal are input or during machine lock, auxiliary function lock, dry run, or single block, usage data is not counted.

· The usage data is not counted when the life data is 0.
· Life management is executed even in the MDI operation mode.
· The usage data is not counted even when the status is 2 or more (normal life, error tool 1, error tool 2).

(c) Tool status ..... Bits 8~F of file register Rn (such as R3728)

bit	Explanation
bit 8	Tool status (numeric data 0~4) 0: Unused tool 1: Used tool 2: Normal life tool 3: Tool error 1 tool 4: Tool error 2 tool
bit 9	
bit A	
bit B	
bit C	Release status For example, this can be used for setting the release status of the final tool to "1" and judging whether the tool is the final tool or not.
bit D	
bit E	
bit F	

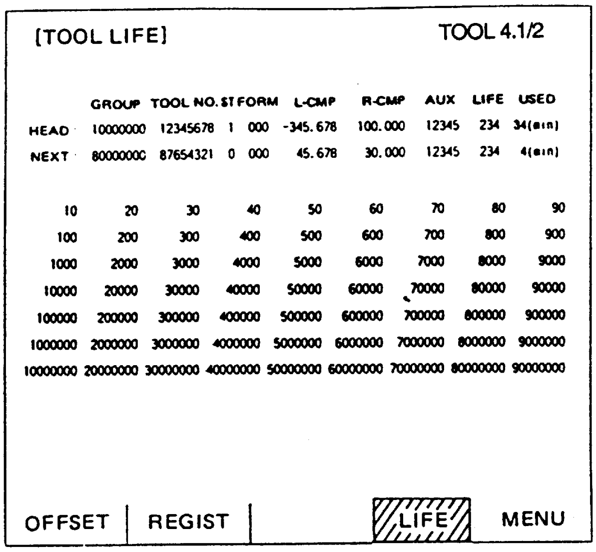
(d) Tool status contents

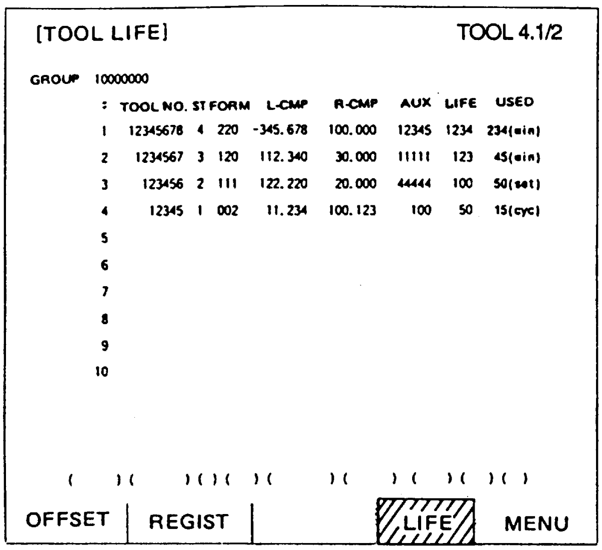
When the tool status number is 0 or 1, NC assumes the tool to be available.

Tool status number	Explanation
0	Indicates unused tool. Normally, this state is set when tool is replaced with a new tool.
1	Indicates used tool. When actual cutting is started, this state is set.
2	Indicates normal life tool. When use data exceeds life data, this state is set.
3	Indicates tool error 1 tool. When controller inputs the tool error 1 signal, this state is set.
4	Indicates tool error 2 tool. When controller inputs the tool error 2 signal, this state is set.

9.3.6 Examples of Tool Life Management Screen

Tool life management screen examples are given below.
For operation, refer to the Operation Manual.

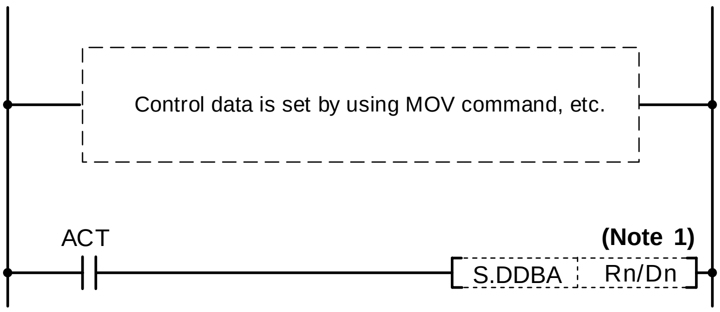




9.4 DDB (Direct Data Bus) ... Asynchronous DDB

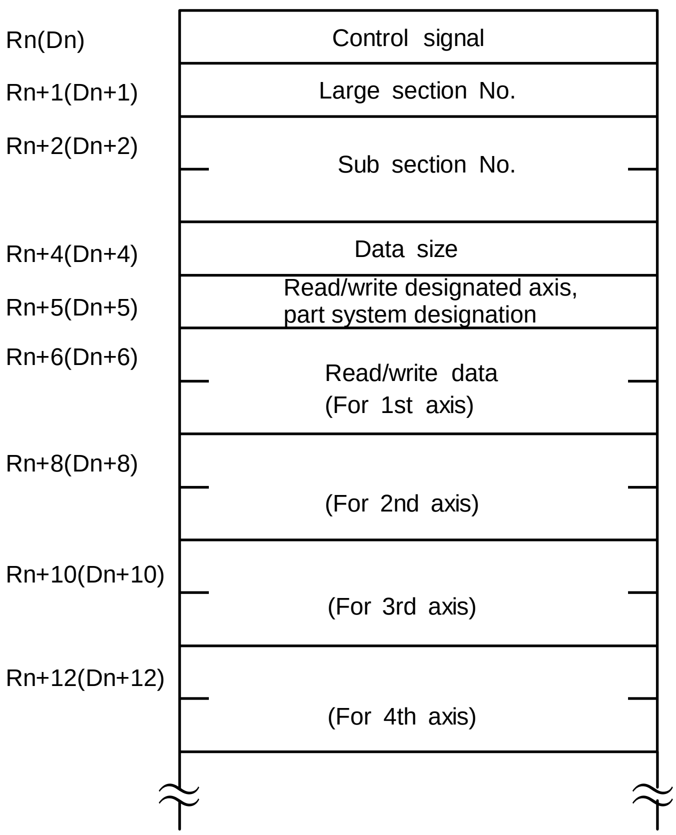
The DDB function is used for PLC to directly read/write various pieces of data that controller has. PLC can read specified data into buffer or write specified data into controller by storing necessary information for read/write and calling the DDB function. Generally, data is read or written for each data piece; data concerning the control axes is processed in batch as many as the specified number of axes.

9.4.1 Basic Format of Command



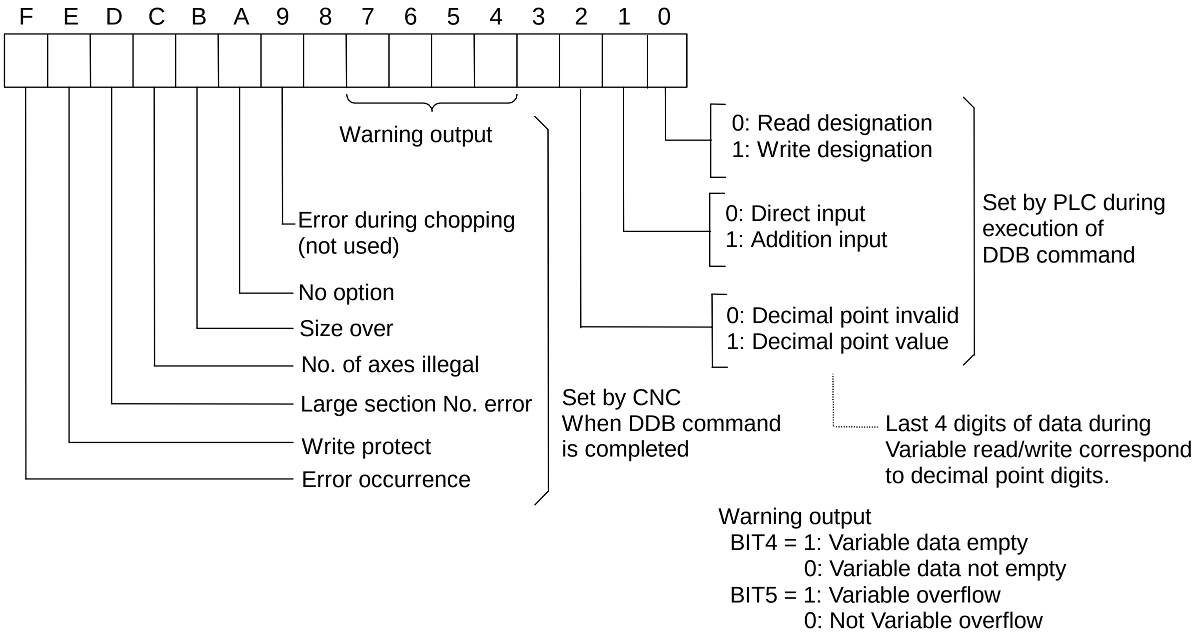
(Note 1) File registers (Rn) and data registers (Dn) to which the user is accessible can be used as the asynchronous DDB control data buffer. The file registers (R) to which the user is accessible are R500 through R549 (not backed up) and R1900 through R2799 (backed up).

9.4.2 Basic Format of Control Data



(Note 1) If only the 3rd axis is designated for example, the section for the 3rd axis will be read/write data.

(1) Control signals (Rn), (Dn)

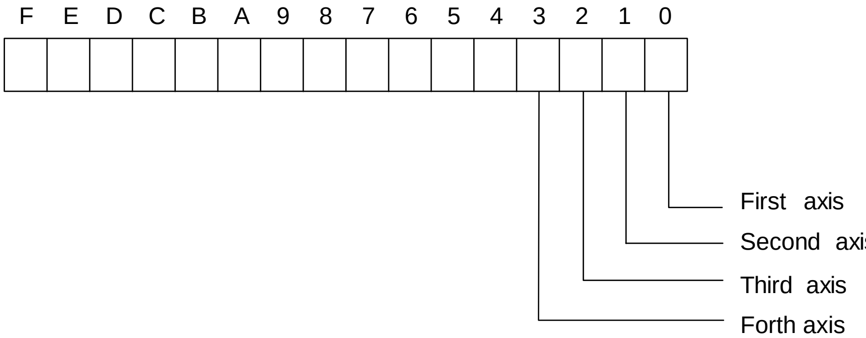


(2) Large section number (Rn+1), (Dn+1)
Specify the large section number of the data to be read/written in binary form.

(3) Sub-section number (Rn+2, Rn+3), (Dn+2, Dn+3)
(LOW) (HIGH) (LOW) (HIGH)
Specify the sub-section number of the data to be read/written in binary form.

(4) Data size (Rn+4), (Dn+4)
Specify the size of the data to be read/written in binary form.
1: One byte
2: Two bytes
4: Four bytes
If any value other than 1, 2, or 4 is specified, the invalid data size alarm will occur.

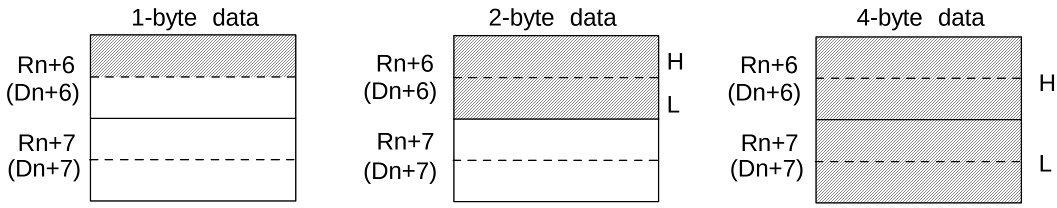
(5) Read/write specifications axis (Rn+5), (Dn+5)
Specify the axis to read or write data for each axis classified by major classification numbers.



If axis specification is not made or exceeds the maximum control axis when axis data is read or written, the invalid axis number alarm will occur.

(6) Read/write data (Rn+6, Rn+7), (Dn+6, Dn+7)
(LOW) (HIGH) (LOW) (HIGH)

When data is read, the controller outputs data specified by PLC. When data is written, PLC sets the data to be written.



The effective portion of data varies depending on the data size. (Hatched portion)
When read is specified the sign of 1-byte or 2-byte is extended to four bytes.

The main data that can be referenced by using the DDB function is listed below.

Specification item	Contents	Read	Write	Remarks
Asynchronous	Current position in work coordinate, machine coordinate	○	—	
	system, length, radius offset amount	○	○	
	Parameters (Maximum rotation speed of spindle, second, third, and fourth reference position coordinates, stored stroke limit, coordinate system offset, etc.)	○	○	
	User macro variables	○	○	
	Modal data of G code, etc.	○	—	
	Controller alarm number	○	—	
	Compensation function (External work coordinate system input, external tool compensation input)	—	○	
Synchronous	External search	—	—	
	PLC axis control, etc.	—	—	

Caution:

The DDBA command is issued after setting necessary data such as control signal and large and sub-classification numbers to the buffer (Rn or Dn). A read or write of the control signal is specified only once before execution of the DDBA command to prevent error codes stored in high-order bits by the CNC from being erased.

9.5 External Search

9.5.1 Function

When PLC specifies the program number, sequence number, and block number of a work program for the controller, the external search function searches memory or tape for the program number, sequence number, and block number.

9.5.2 Interface

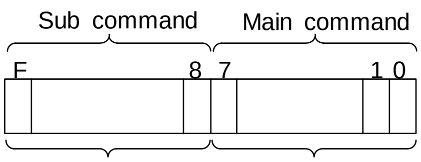
PLC sets data except the status.

Rn+0	Two bytes	command
1	Two bytes	Status
2, 3	Four bytes	Program No.
4, 5	Four bytes	Sequence No.
6, 7	Four bytes	Block No.
8	Two bytes	System designation

(Note 1) File register (Rn) that can be used by the user is used for the control data buffer.
Data register (Dn) cannot be used.

(Note 2) System designation is not used.

(1) Command



Main command:
1: search
2: PLC axis control
Specify "1"

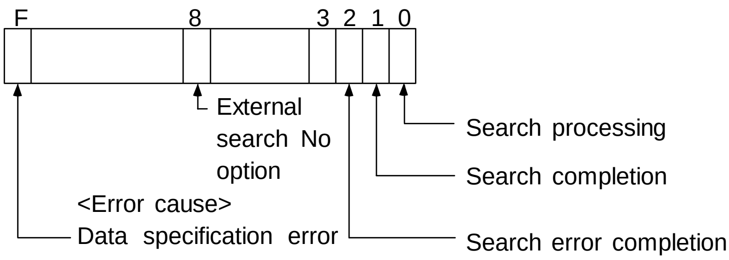
Sub command:
Search mode
0: Memory search
1: Tape search

PLC axis control
Set all to 0.

(Note) Unassigned bits will be used for later function extension. Use only bits shown here.

(2) Status

The search state is indicated.
The status is set by the controller and is used by PLC for completion check, etc.



The status is cleared by the controller when the search start instruction execution condition is off.

(3) Program number

Specify the program number to be searched in binary form in the range of 1 to 99999999 (eight digits).
Specify 0 to search for the sequence number of the current program selected.
If a number other than 0~99999999 is specified, a data specification error will occur.

(4) Sequence number

Specify the sequence number to be searched in binary form in the range of 1 to 99999 (five digits).
Specify 0 to search for the head of the specified program number.
If a number other than 0~99999 is specified, a data specification error will occur.

(5) Block number

Specify the block number to be searched in binary form in the range of 0 to 99 (two digits).
If a number other than 0~99 is specified, a data specified error will occur.

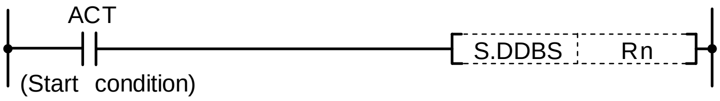
Program No.	Sequence No.	Search
Specified	Specified	Memory or tape is searched for the specified sequence number of the specified program.
Specified	Not specified (=0)	Memory or tape is searched for the top of the specified program.
Not specified (=0)	Specified	Memory or tape is searched for the specified sequence number of the current program selected.
Not specified (=0)	Not specified (=0)	Error (no specification)

(6) System specification

This is not used. "0" is set.

9.5.3 Search Start Instruction

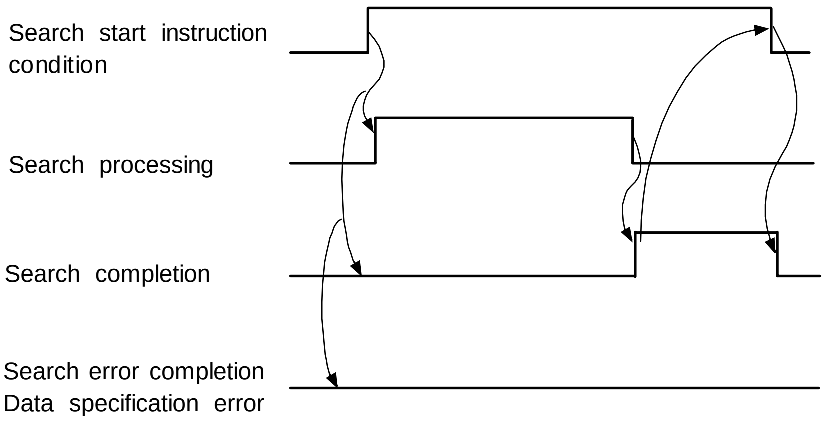
After interface data between the controller and PLC is prepared, search is started by using the following instruction:



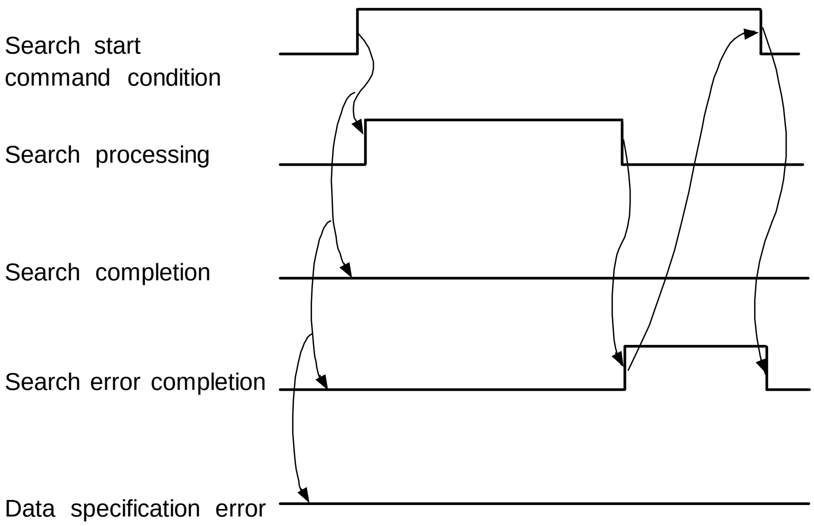
(Rn is any file register that can be used by the user.)

9.5.4 Timing Charts and Error Causes

(1) Normal completion



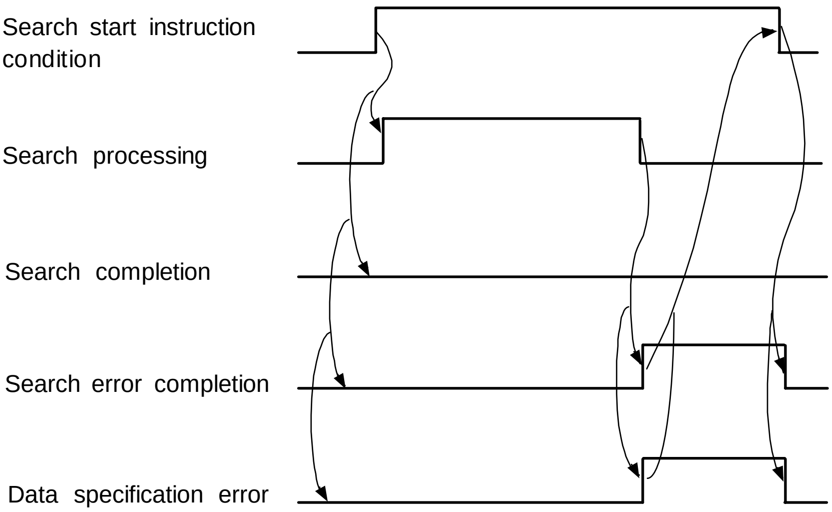
(2) Search error completion



<Error cause>

- The specified program number or sequence number is not found.
- In tape search, tape or I/O device does not exist.
- In tape search, an I/O error occurred.
- The NC operation state is not reset state Any other search-impossible state.

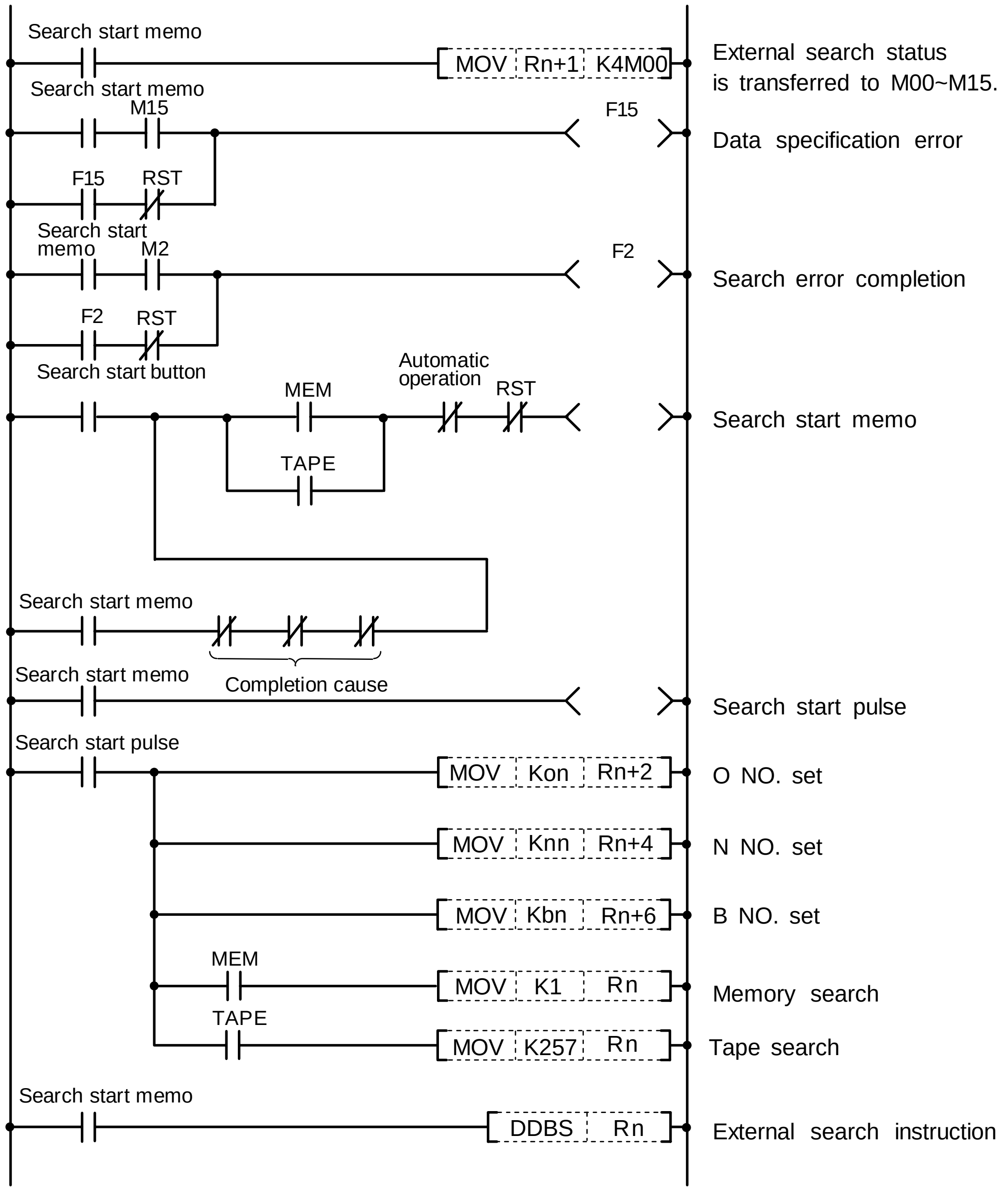
(3) Search error completion (Data specification error)



<Error cause>

- Program number and sequence number are not specified.
- Program number or sequence number is specified beyond the range.

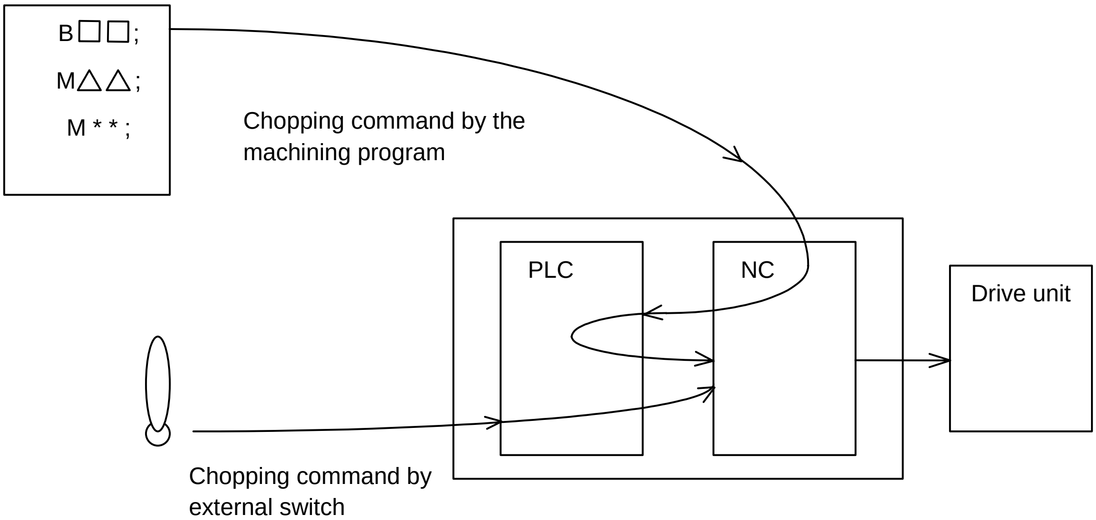
9.5.5 Sequence Program Example

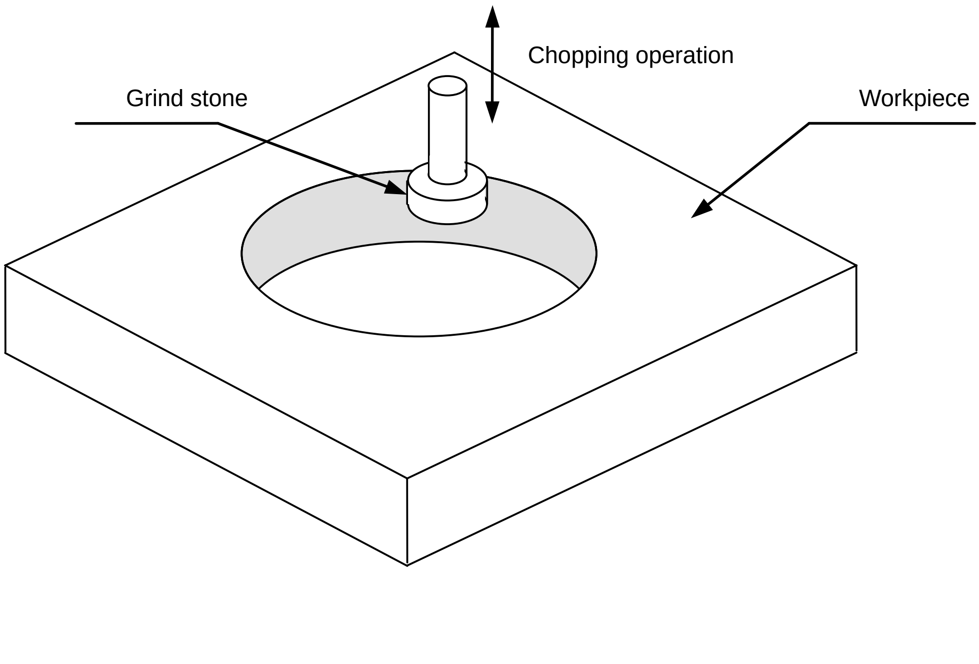


RST: Reset signal (reset button, output during reset, etc.)

9.6 Chopping

With this function, the chopping axis constantly moves back and forth independently of the program operation during executing the program.
By applying chopping, higher surface accuracy can be achieved than that of abrasive grain.
The chopping operation is started/stopped by the "Chopping" signal from the PLC.
When the chopping operation is commanded from the machining program, use the auxiliary instruction (M or B) codes.

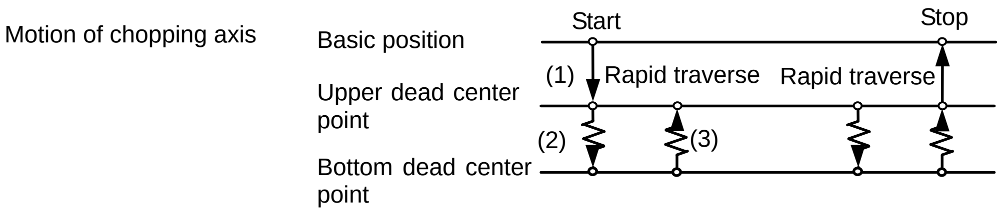




9.6.1 Chopping operation start

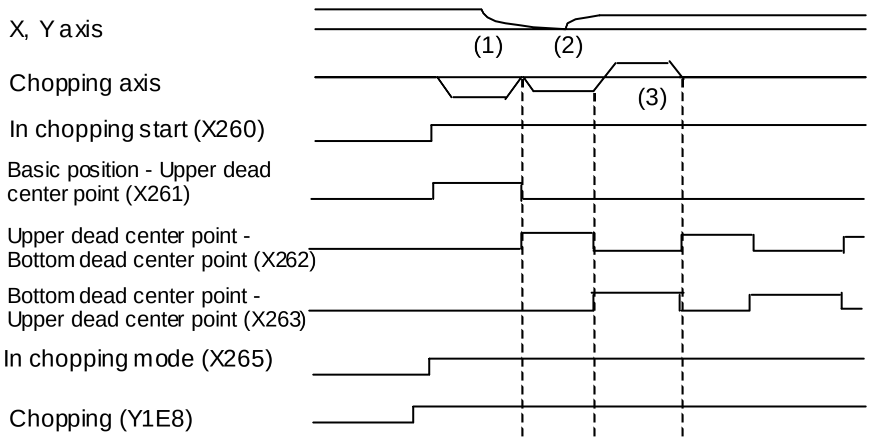
The chopping mode is entered at the rising edge of the "Chopping" signal (Y1E8), and the chopping operation is started based on the position determined with the program, etc.
The chopping control sequence is the following.

- When the chopping axis is not moving, chopping is started immediately.
- When the chopping axis is moving, chopping is valid from the next block in the automatic mode, and an operation alarm will occur in the manual mode.

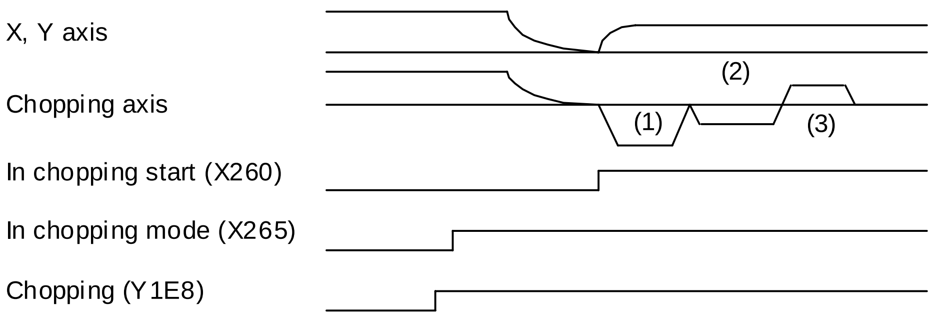


(1) In automatic mode

(a) When the chopping axis is not moving:



(b) When the chopping axis is moving:

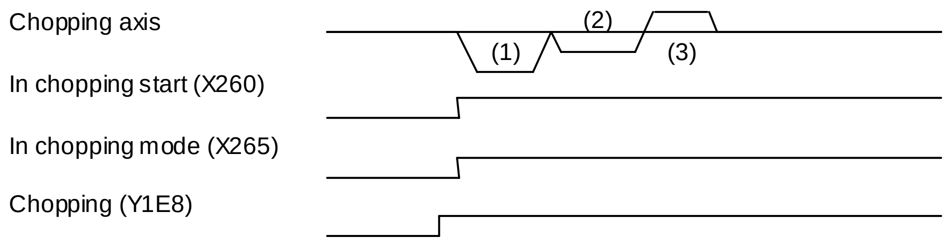


The "In chopping start" is entered after the chopping axis movement has been finished.

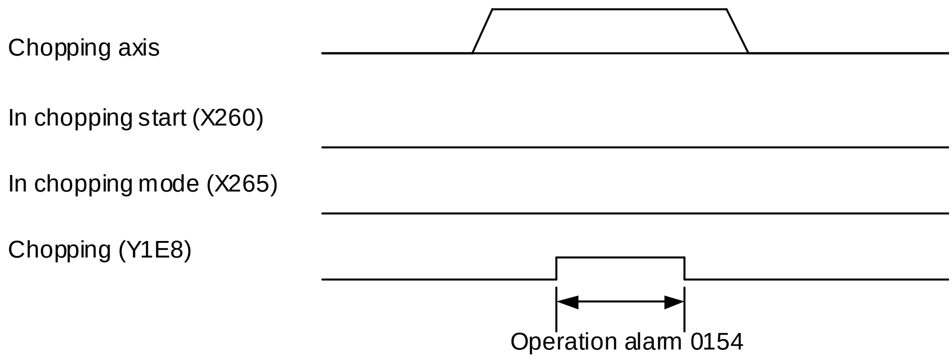
(2) In manual mode

In the jog and step mode, when the chopping axis is not moving, the chopping operation is started at the rising edge of the "Chopping" signal.
If the "Chopping" signal is turned ON when the chopping axis is moving, the OPERATION ALARM 0154 will occur, and the chopping will not be started.
(Rising edge of the "Chopping" signal is ignored.)

(a) When the chopping axis is not moving:



(b) When the chopping axis is moving:

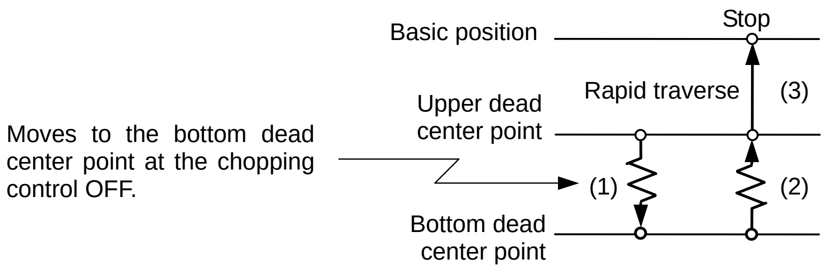


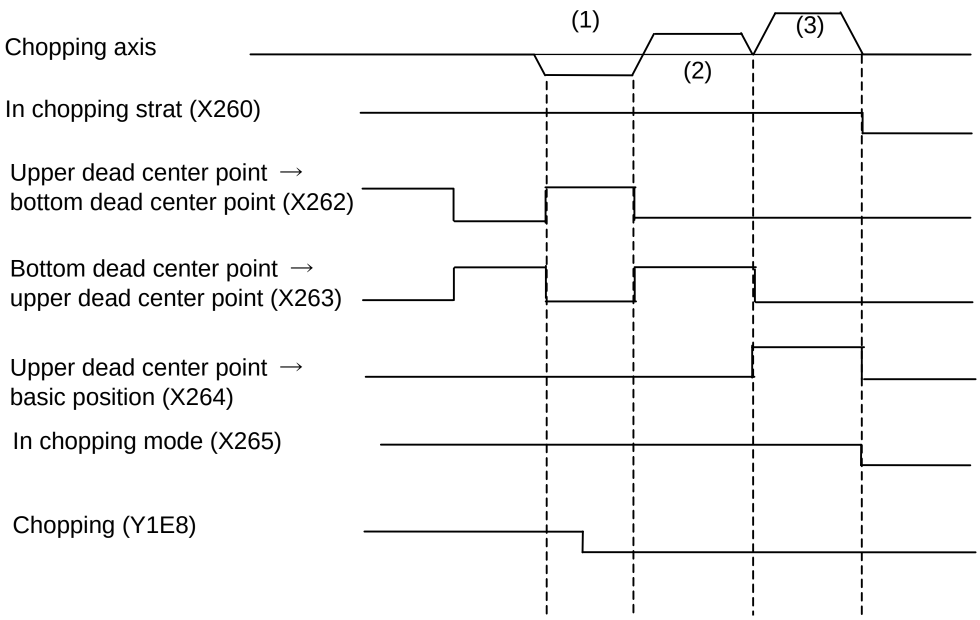
In the handle mode, when the chopping axis is not selected as the handle axis, the chopping operation is started at the rising edge of the "Chopping" signal.
If the "Chopping" signal is turned ON when the chopping axis is selected as the handle axis, the OPERATION ALARM 0154 will occur, and the chopping is not started.

9.6.2 Chopping operation stop

The chopping operation is stopped at the falling edge of the "Chopping" signal from the PLC.
The chopping axis moves to the basic position with the rapid traverse after executing the chopping operation to the upper dead center point.
The chopping axis once moves to the bottom dead center point even while moving from the upper dead center point to the bottom dead center point.

Stop operation of the chopping axis





The "In chopping start" and the "In chopping mode" signals are turned OFF upon completion of the basic position return.

9.6.3 Chopping compensation

Because this function involves high-speed repetitive motions, the positioning method allowing compensation based on the calculation from the machinery operation (feedback position of the motor end) is adopted, rather than the method using in-position check. Compensation amount used for positioning is calculated every 4 cycles from the start of chopping operation, based on the difference between the commanded position and feedback position. Then the compensation amount is added to the positioning command for the next cycle so that the difference between the commanded position and feedback position will disappear. (Compensation value sequential update method: Refer to Fig.1)
However, with this method, if the grindstone contacts with the workpiece, the chopping width before and after compensation may be differed, and which may affect the machining surface. In this case, the compensation value fixed method is appropriate.
With the compensation amount fixed method, compensation amount based on a dry run operation is recorded in advance so that, in the real operation, compensation is carried out from the first positioning to the bottom dead center point using the compensation amount recorded earlier. (Compensation value fixed method: Refer to Fig.2)

Fig.1 Chopping operation in compensation value sequential update method

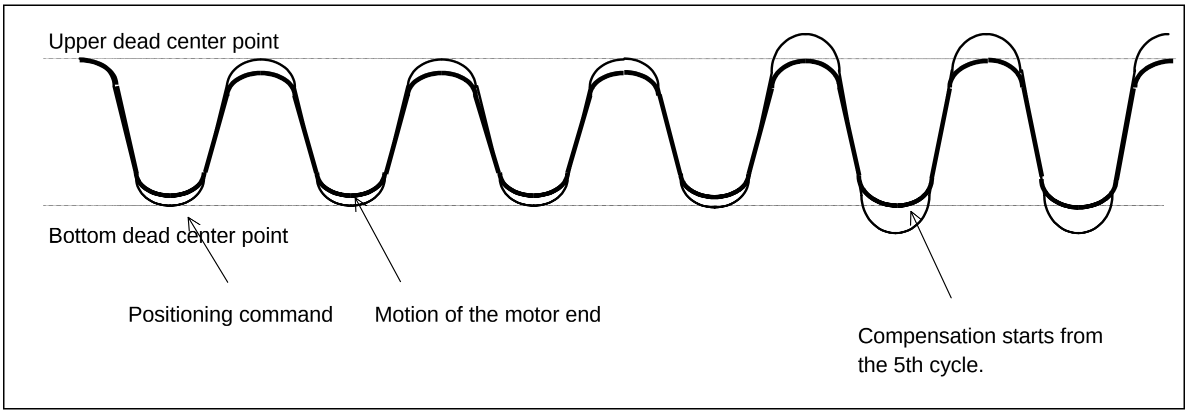
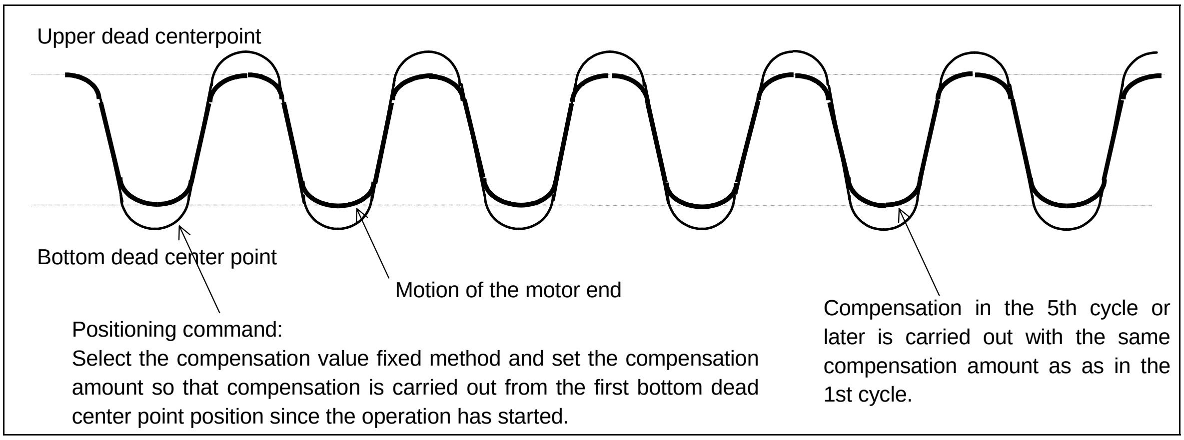


Fig.2 Chopping operation in compensation value fixed method



(1) Compensation value sequential update method

Every chopping command starts with "0" compensation amount. Compensation amount is calculated every 4-cycle chopping operation, and the compensation is carried out.

(2) Compensation value fixed method

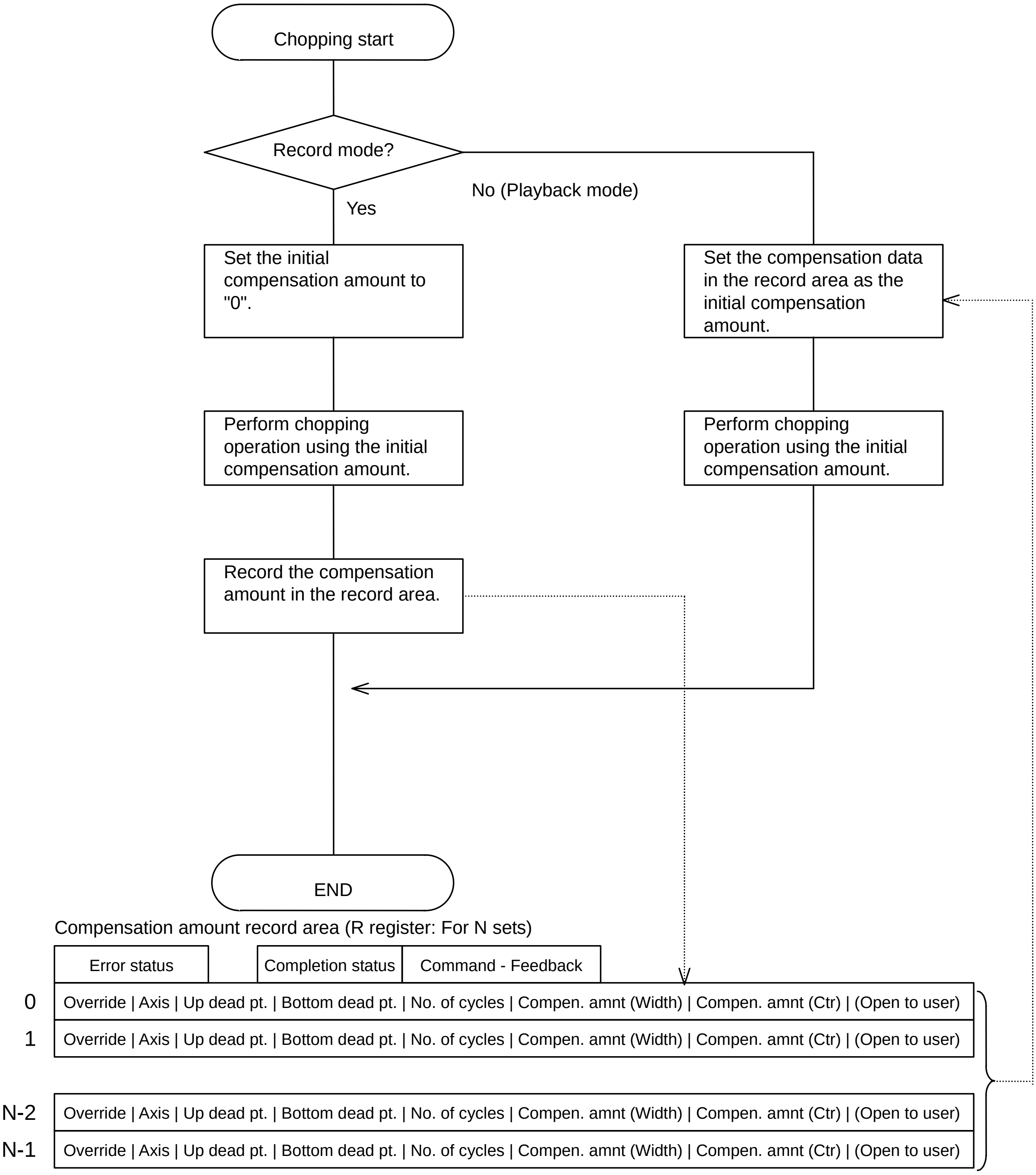
Compensation value fixed method includes the record mode and the playback mode.

<Record mode>

- Override, command axis, upper/bottom dead center point position, number of cycles, and compensation amount are recorded as the chopping control data.
- Compensation amount record area is specified with R register.
- Number of sets for compensation amount record area is determined by the number of R registers to be secured.
  14 consecutive R registers are required for 1 set of record.
- Compensation amount is always updated in the record mode.

<Playback mode>

- Chopping operation is started using the data (override, command axis, upper/bottom dead center point position, number of cycles, compensation amount) recorded in the record mode.
  Compensation amount is not calculated in the playback mode.



14 R registers are required per one set.

For N sets, the number of R registers required is 14*N+4.

9.6.4 Chopping interface

(1) PLC→NC

Device No.	Abbreviation	Signal name
Y1E8	CHPS	Chopping

(2) NC→PLC

In chopping start, intervals during chopping and chopping mode are output.

Device No.	Abbreviation	Signal name
X260	CHOP	In chopping start
X261	CHP1	Basic position→upper dead point
X262	CHP2	Upper dead point→bottom dead point
X263	CHP3	Bottom dead point→upper dead point
X264	CHP4	Upper dead point→basic position
X265	CHPMD	In chopping mode

(3) Chopping override (PLC→NC)

Set within the range of 0% to 100% by 1% increments.

Device No.	Abbreviation	Signal name
R135	CHPOV	Chopping override

9.6.5 Parameters (DDB function instructions from PLC)

Parameters for chopping functions (DDB function instructions from PLC) are as follows.

<Compensation value sequential update method>

- Rapid traverse override valid/invalid selection
- Chopping axis
- Upper dead center point position L1 (increment from the basic position)
- Bottom dead center point position L2 (increment from the upper dead center point)
- Number of cycles/min

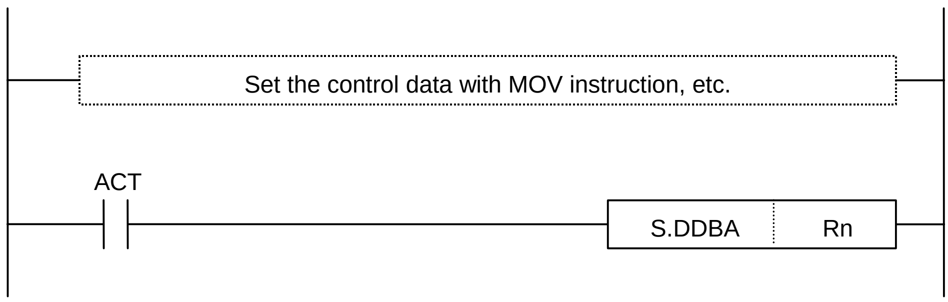
<Compensation value fixed method>

- Mode for the compensation value fixed method
- Data No.

Each parameter can be set from PLC using DDB function.

The master parameter is kept in R register, and when changing parameters, it is read into the current parameter area in the NC by the DDB function instruction.
Parameters can be changed during chopping.

(1) Program example



(Note) Writing parameters from PLC using DDB at every scan execution may cause a longer cycle time because the chopping axis stops once at the bottom dead center point and the upper dead center point even if the value is not to be changed. Thus, change the parameter (turn "ACT" ON) only when necessity of parameter change arose.)

(2) Control data

Data to be used differs depending on whether the compensation value sequential update method is applied or compensation amount fixed method is applied.

Update : Specify with the compensation value sequential update method

Fixed : Specify with the compensation value fixed method

Rn	a
Rn+1	b
Rn+2	c
Rn+4	d
Rn+5	e
Rn+6	f
Rn+8	g
Rn+10	h
Rn+12	i
Rn+13	j

a:	Control status	(Rn)	Update	Fixed
	bit0 : Set to "1". bit1 : Set to "0". bit2 to bit8 : Not used bitF : Error occurred This turns ON if an alarm occurrs when the chopping parameter valid signal is turned ON. The details of error is notified with bit9 to C. (Note) bit9 : Chopping error bitA : Chopping specifications is not available bitB : Compensation method is set to other than 0/1 bitC : Multiple chopping axes are specified			
b:	Section No.	(Rn+1)	Update	Fixed
	This sets 0100(HEX).			
c:	Sub-section No.	(Rn+2[low], Rn+3[high])	Update	Fixed
	0000(HEX) : Compensation value sequential update method 0001(HEX) : Compensation value fixed method			
d:	Rapid traverse override valid/invalid	(Rn+4)	Update	
	This sets the rapid traverse override valid/invalid in respect to the movement speed between the basic position and the upper dead center point. 0 : Invalid 1 : Valid			
e:	Chopping axis designation	(Rn+5)	Update	
	bit0 : 1st axis bit1 : 2nd axis bit2 : 3rd axis bit3 : 4th axis Select any one of the existing axes using bit. When no axis is specified, the axis whose base specification parameter "chop_ax" is "1" (the smallest No. of axis) is selected. bit4 F : Not used (Set to "0".)			
f:	Upper dead center point	(Rn+6[low], Rn+7[high])	Update	
	This sets the movement amount of basic position → upper dead center point with the code. Use the setting and display unit (#1003 iunit) for setting.			
g:	Bottom dead center point	(Rn+8[low], Rn+9[high])	Update	
	This sets the distance of upper dead center point → bottom dead center point with the code. Use the setting and display unit for setting.			
h:	Number of cycles	(Rn+10[low], Rn+11[high])	Update	
	This sets the number of cycles for chopping cycle. (Unit: Number of cycles/min)			
I:	Operation mode with the compensation value fixed method	(Rn+12)		Fixed
	0000(HEX) : Playback mode 0001(HEX) : Record mode			
j:	Data No.	(Rn+13)		Fixed
	This specifies what number data (n-th data) from the head of the record area (specified by the parameter) to be used. (Both the record mode and playback mode must be specified. 1st data area is specified with 0.)			

(Note) If an alarm occurs when the chopping parameter valid signal is turned ON, Rn bit is turned ON. Alarm details are output to the chopping error No. (R554), as well.

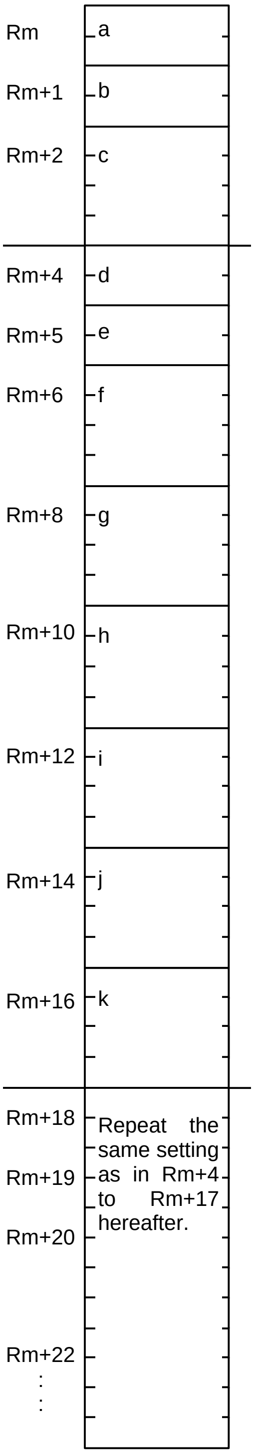
Rn bit	Error	Cause
BITA BITF	Option error	There is no specification for chopping.
BITB BITF	Compensation method error	Compensation method is set to other than 0(Compensation value sequential update type) or 1(Compensation value fixed type).
BITC BITF	Illegal number of axes error	Multiple chopping axes are specified by the PLC interface.
BIT9 BITF	Chopping error	Chopping axis is not specified by either PLC interface or parameter.
		Rotary axis is specified as the chopping axis.
		Rapid traverse override valid/invalid is set to other than 0(invalid) or 1(valid).
		Data No. of the control data is a negative value.
		Compensation amount record area exceeds R register backup area (R1900 to R2800). ((Rm+14xN sets+4) > 2800.)
		The mode for the compensation value fixed method is set to other than 0(playback mode) or 1(record mode).
		Number of cycles is 0 or less, or over 1056. (If 0 or less, 1 is applied. If exceeds 1056, 1056 is applied.)
		Acceleration determined by the parameter exceeds clamp/chtL. (The number of cycles is reduced.)
		The chopping axis is changed during chopping operation. (Chopping axis is not changed during chopping.)
		F(feedrate) exceeds the clamp speed. (The speed is clamped to the clamp speed (#2081 chclsp).)
		Chopping axis's #2081 chclsp (chopping clamp speed) and #2002 clamp (cutting clamp speed) are both set to "0".

The error bit shown above is not turned ON in the following cases. However, chopping error No. is output.

- Control data area exceeds the R register area designated for the control data.
- Control data area and compensation amount record area are overlapped.

(3) Compensation amount record area (Dedicated for compensation value fixed method)

Rm is specified with the parameter (#1324 chop_R).



a:	Error status (in playback mode)	(Rm)
	bit0 : This is turned ON when the difference between the commanded stroke and the actual stroke has exceeded the tolerance set with the parameter (#2080 chwid).	
b:	Chopping compensation amount record completion status (in record mode)	(Rm+1)
	bit0 : "1" at completion of recording bit1 : "1" when recording is not completed	
c:	Command - Feedback	(Rm+2[low], Rm+3[high])
	[In playback mode] Difference between the commanded stroke and the actual stroke is stored when the difference has exceeded the tolerance set with the parameter (#2080 chwid). [In record mode] Difference between command and feedback is stored every time the compensation amount is calculated.	
d:	Rapid traverse override valid/invalid	(Rm+4)
	Set the rapid traverse override valid/invalid in respect to the movement speed between the basic position and upper dead center point. 0 : Invalid 1 : Valid	
e:	Chopping axis designation	(Rm+5)
	bit0 : 1st axis bit1 : 2nd axis bit2 : 3rd axis bit3 : 4th axis bit4 F : Not used (Set to "0".)	Select any one of the existing axes using bit. When no axis is specified, the axis whose base specification parameter "chop_ax" is "1.
f:	Upper dead center point	(Rm+6[low], Rm+7[high])
	Set the movement amount of basic position → upper dead center point with the code. Use the setting and display unit (#1003 iunit) for setting.	
g:	Bottom dead center point	(Rm+8[low], Rm+9[high])
	Set the distance of upper dead center point → bottom dead center point with the code. Use the setting and display unit for setting.	
h:	Number of cycles	(Rm+10[low], Rm+11[high])
	Set the number of cycles for chopping cycle. (Unit: Number of cycles/min)	
i:	Compensation amount (Width)	(Rm+12[low], Rm+13[high])
	Compensation amount to be added to the chopping upper/bottom dead center point command. In the playback mode, this is used for amplitude compensation. When started with the record mode, this is automatically stored.	
j:	Compensation amount (Center)	(Rm+14[low], Rm+15[high])
	Compensation amount to be added to the chopping upper/bottom dead center point command. In the playback mode, this is used for compensating the center of amplitude. When started with the record mode, this is automatically stored.	
k	Data to be opened	(Rm+16[low], Rm+17[high])
	Use this for managing the compensation amount record area, etc. by using ladder of the user.	

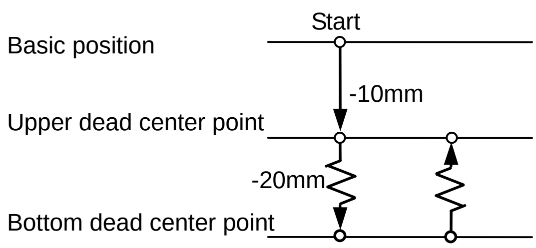
(4) Setting example for the compensation value sequential update method

The following parameters are set using R2000 to R2011 as DDB buffer.

Parameter	Decimal	HEX	Setting details
Rapid traverse override valid/invalid	1	0001	Valid
Chopping axis designation	4	0004	Z axis (3rd axis)
Upper dead center point (increment amount from the basic position)	-10000	FFFFD8F0	-10000 (Output unit)
Bottom dead center point (increment amount from the upper dead center point)	-20000	FFFFB1E0	-20000 (Output unit)
Number of cycles	50	00000032	50/min

R2000	0001	Control signal
R2001	0000	Section No.
R2002	0000 0000	Sub-section No.
R2004	0001	Rapid traverse override valid
R2005	0004	Chopping axis designation
R2006	D8F0 FFFF	Upper dead center point
R2008	B1E0 FFFF	Bottom dead center point
R2010	0032 0000	Number of cycles

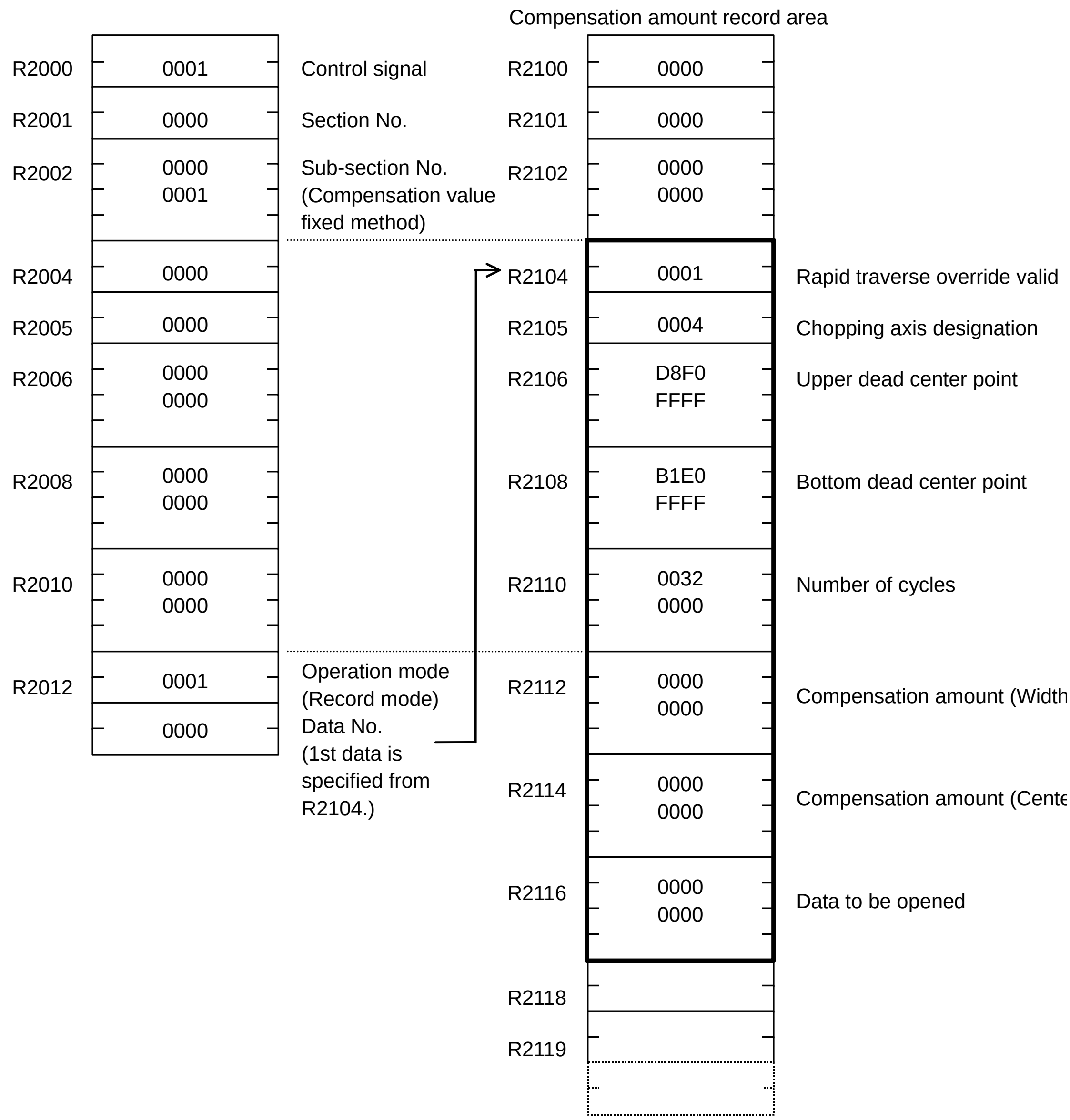
Chopping axis operation



(5) Setting example for the compensation value fixed method

The following parameters are set using R2000 to R2013 as DDB buffer.
R2100 (#1324 chop_R = 2100) is used for the compensation amount record area.

Parameter	Decimal	HEX	Setting details
Rapid traverse override valid/invalid	1	0001	Valid
Chopping axis designation	4	0004	Z axis (3rd axis)
Upper dead center point (increment amount from the basic position)	-10000	FFFFD8F0	-10000 (Output unit)
Bottom dead center point (increment amount from the upper dead center point)	-20000	FFFFB1E0	-20000 (Output unit)
Number of cycles	50	00000032	50/min



9.6.6 Example of chopping control by program command

In the example given below, the upper dead center point (increment from the basic position), bottom dead center point (increment from the upper dead center point), and number of cycles (times/min) are set using G code macro.
The above data is set to the local variables by G code macro. The local variable data is read by the ladder upon execution of M code (M10). Then, chopping is started upon DDB function instruction. The chopping is stopped by the ladder upon execution of M code (M11).

(1) G code macro execution

The following is an example in which O9000 is defined as the sub-program of G200 (G65 macro type).

Main program

```
 :
G200 Z-20. Q-10. R50. ;   ---------- Chopping start
 :
 :  }------------------------------- Shape
 :
M11 ;   ---------------------------- Chopping stop
```

Argument of G200
Z : Upper dead center point (Increment from the basic position)
Q : Bottom dead center point (Increment from the upper dead center point)
R : Number of cycles/min.

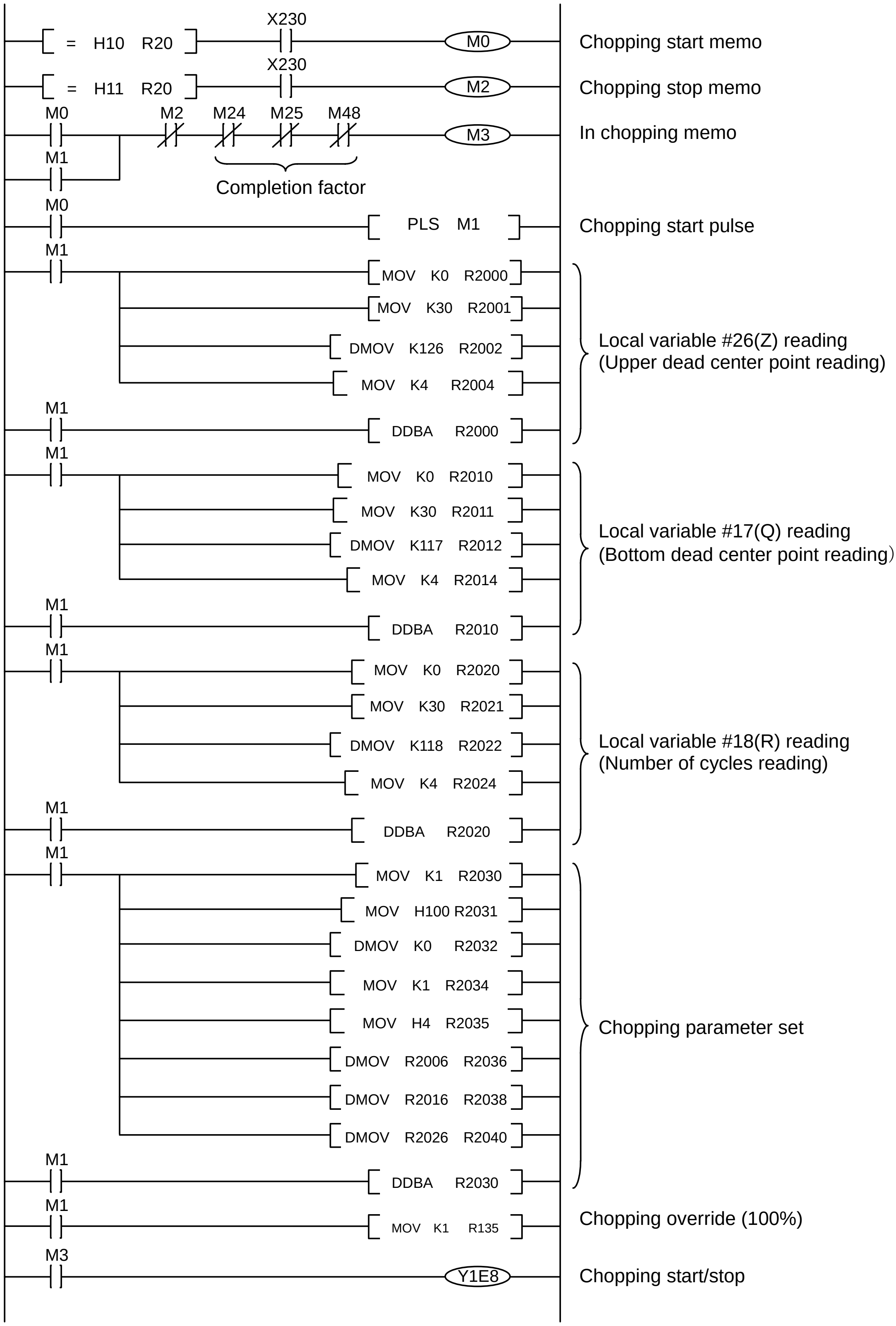
O9000

```
#26=#26*1000 ;  ----------------- Value of Z, Q, R: local
#17=#17*1000 ;  ----------------- variables set to #26, #17, #18
G04 ;
M10 ;   ------------------------- Chopping start
M99 ;
```

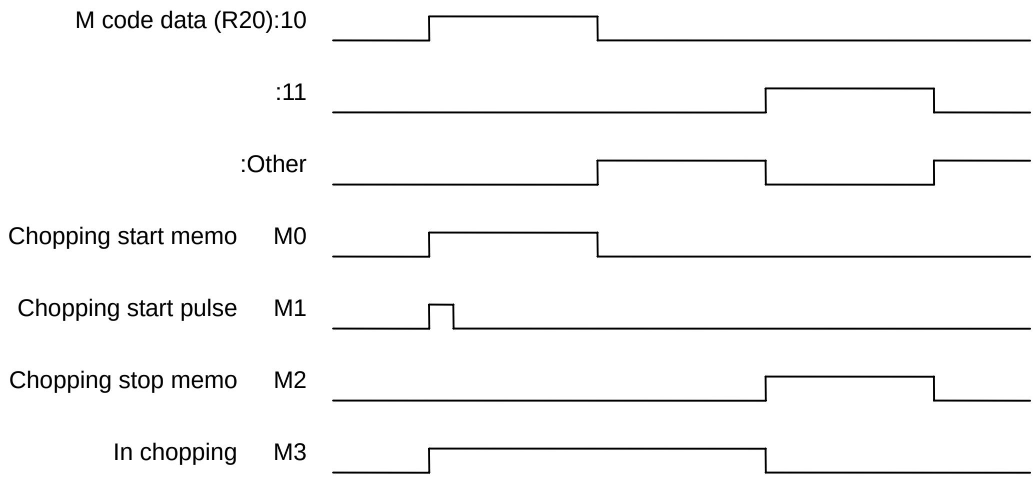
(Note 1) As for Z, Q commands, even if a decimal place is omitted (Ex. Z-20. → Z-20), the unit is remained mm.
(Note 2) With the submicron system, change the constant for macro operation from 1000-fold to 10000-fold.
(Note 3) When a macro call is executed, the nesting level of local variable will be 1, and the level of local variable will also be 1. So, the number of layers of nesting has to be kept to 4.

(2) Set the local variables of (1) for chopping parameters by using DDB function, and start the chopping operation.

The following is its sequence example. (Compensation value sequential update method)



Sequence example timing chart



(Note) Chopping axis cannot be specified as a synchronous control axis.

10. PLC Help Function

To help the user PLC, an exclusive interface is provided between the user PLC and controller or PLC basic. The function and interface are explained below.

PLC help function examples:
· Alarm message display
· Operator message display
· PLC switches
· Key operation by user PLC
· Load meter display
· External machine coordinate system compensation
· User PLC version display

10.1 Alarm Message Display

There are two types of alarm message, which can be selected with a parameter (described later)

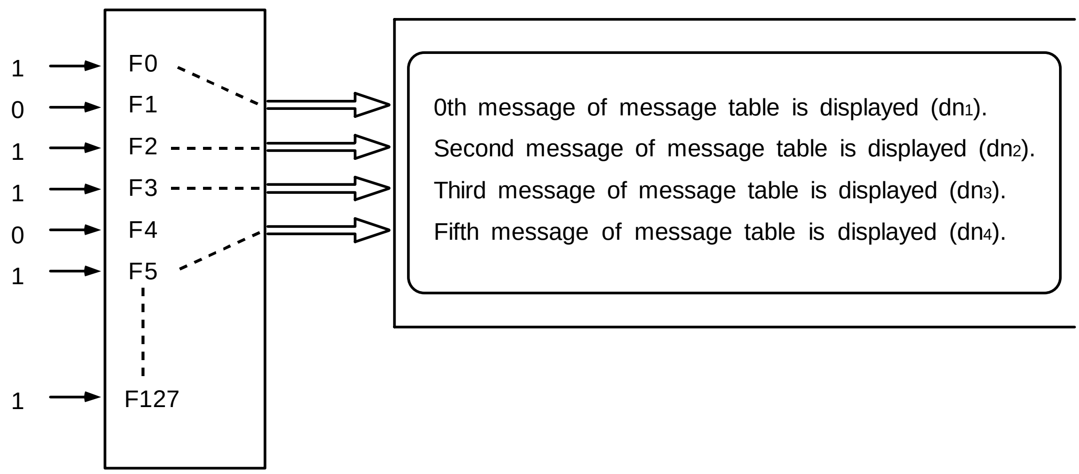
Format	Alarm message	External alarm message
Max. No. of messages	256 messages	256 messages
Max. data length	32 bytes per message	128 bytes per message
Number of Display messages	4 messages	1 to 4 messages (according to data length)
Interface	F type / R type (classification No. designated)	F type / R type (without classification No.)
Available language	2 languages	8 languages
Store method	User PLC attached data	Independent data (other area)

10.1.1 Interface

The alarm message display interface is available in the two types: F type in which temporary memory F is used for message display request and R type in which file register (R) is used for message display request. Either type is selected by using a parameter.

(1) F type interface

This interface applies to 128 points of temporary memory F0~F127.
If temporary memory F is used as the alarm interface, do not use it for another purpose.

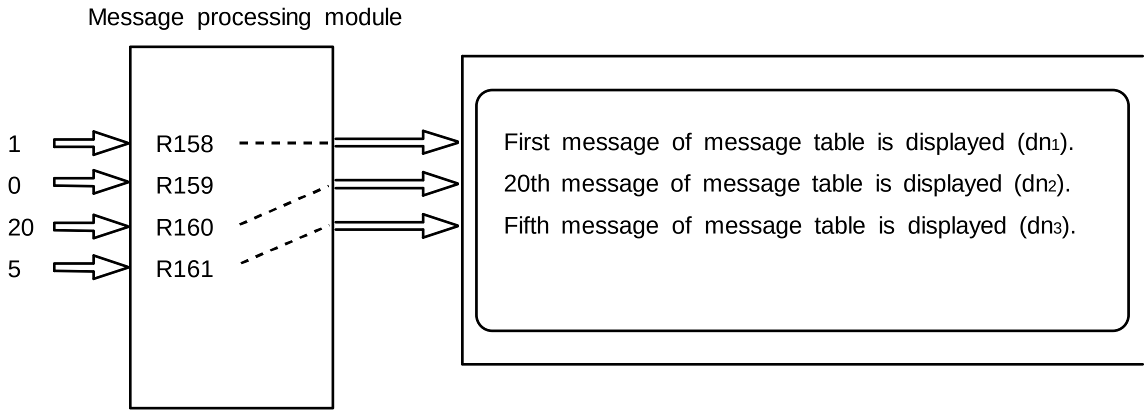


The highest priority is assigned to the F0 signal. The message corresponding to Fn set to 1 is fetched from the message table and displayed in order starting at F0. If no messages are prepared or Fm greater than the number of prepared messages is set to 1, the message "USER PC ERROR m" is displayed.

(2) R type interface

This interface applies to file registers R158~R161. The numeric value (binary) contained in each of the R registers indicates the position of the message to be displayed in the message table.

The message is cleared by setting the R register to 0.



The messages are displayed starting at the message corresponding to R158 from top to bottom.

Since message display is cleared by setting the R register to 0, number 0 in the table message cannot be used in the R mode.

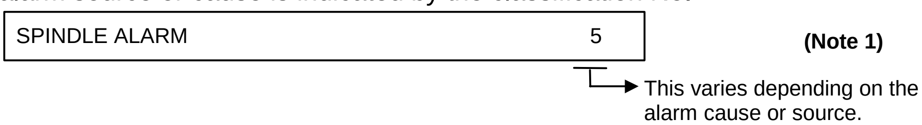
If greater value than the number of prepared messages, m is set in the R register, the message "USER PC ERROR m" is displayed.

(3) Alarm classification display (Only for Alarm message type)

Classification No. can be displayed following the message to be displayed regardless of the F or R type. (Dn1~Dn4 in the figure)

For example, one typical alarm message is prepared and classification No. can be used to indicate the alarm source or cause.

Example) When spindle alarm occurs, the message "SPINDLE ALARM" is displayed and the alarm source or cause is indicated by the classification No.



For the classification No., the contents of each data register specified in alarm message preparation are displayed. Data register D0 cannot be specified.

(Note 1) The display of the classification No. by cause is updated when an alarm message display changes. It is not updated if only the contents of the specified data register (Dn1 to Dn4) change. If the contents of the specified data register are 0, no classification Nos. are displayed.

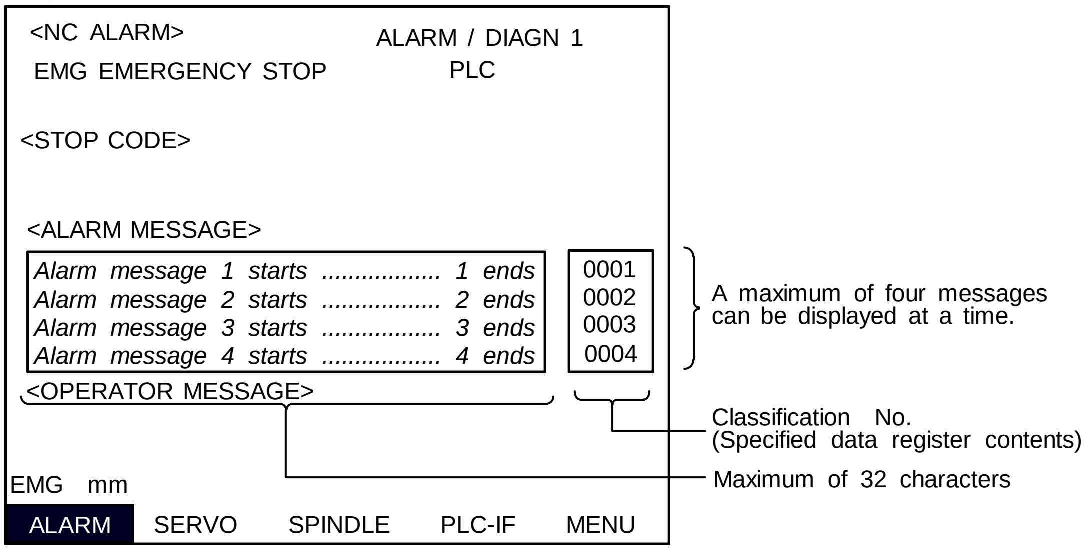
10.1.2 Screen Display

Screen Display depends on the message type as described below.

(1) Alarm message type

Message length is up to 32 characters.
Alarm messages corresponding to four classification Nos. can be displayed.

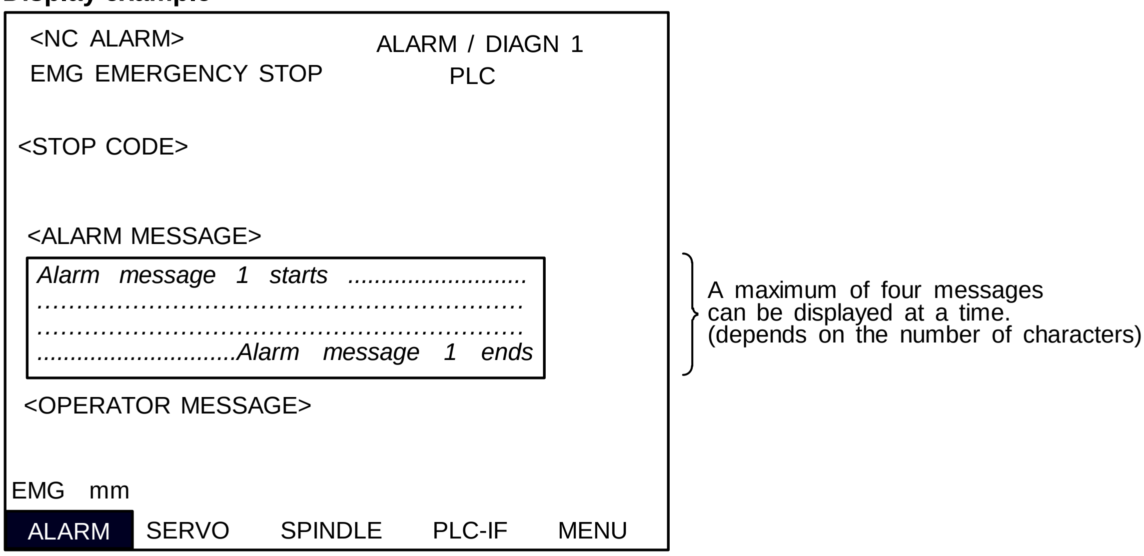
Display example



(2) External alarm message type

The contents of data register is not displayed for this type.
Display area is 32-character width and has 4 lines. (Total: 128 characters)
Up to 4 messages can be displayed in the area.

Display example



Note that the number of displayed external alarm messages depends on their number of characters.

Number of External alarm message characters	
0 to 32 characters	33 to 64 characters
4 messages displayed	2 messages displayed
Alarm message 1 starts............1 ends *Alarm message 2 starts............2 ends* *Alarm message 3 starts............3 ends* *Alarm message 4 starts............4 ends*	*Alarm message 1 starts.........................* *...................... Alarm message 1 ends* *Alarm message 2 starts......................* *...................... Alarm message 2 ends*
65 to 96 characters	97 to 128 characters
2 messages displayed (Note that the second message has up to 32 characters from the head)	1 message displayed
Alarm message 1 starts...................... *...* *....................... Alarm message 1 ends* *Alarm message 2 starts......................*	*Alarm message 1 starts......................* *...* *...* *...................... Alarm message 1 ends*

10.1.3 Message Creation

(1) Alarm message type

Create messages by using PLC development software (GX-Developer). **(Note 1)**

Set the number of characters for one message and the number of messages to be prepared, then enter message data through the keyboard.
The maximum length of an alarm message is 32 characters.
A maximum of 512 alarm messages can be prepared. For details, refer to “PLC Development Software Manual (IB-1500177)”.

(Note 1) PLC Onboard does not include the message creation function.

(2) External alarm message type

Text-form PLC alarm message can be input as the External alarm message.
Moreover, PLC alarm message can be input or output with a maintenance data format.
Details of the external alarm messages creation method are described below.

(a) Input with text data format

1) Format of the text file

Format of the message text is shown below.

JPN01 96-12-01 ↓	(i) Version data	Language No. : 0
256 * 16,0 ↓	(ii) Number of characters / messages and language designation	
alarm_message001alarm_message0 02alarm_message003............. .... alarm_message256 ↓	(iii) Character string of PLC alarm message	
ENG01 96-12-01 ↓	(i) Version data	Language No. : 1
256 * 16,1 ↓	(ii) Number of characters / messages and language designation	
alarm_message001alarm_message0 02alarm_message003............. .... alarm_message256 ↓	(iii) Character string of PLC alarm message	
• • • • •	(i) ~ (iii) Up to 8 sets	
%	(iv) End code	

(i) Version data

Up to 15 alphabetical / numerical characters are available.
(Version data of selected language is displayed on construction screen.)

(ii) Number of characters / messages and language designation

Designate the “number of message” and the “number of characters for one message” in decimal. Add “*” (0x2a) code between the numbers.
Always designate even number for the number of characters.
Maximum of messages is 256, and maximum of characters for one message is 128.
These numbers can be designated for each alarm message.
In other words, message size may vary from message to message.
To designate a language, add a comma “,” and parameter data.
When “,0” (number: 0) or nothing is designated, the language for number 0 is selected.

(iii) Character string of PLC alarm message

Set the message text.
It is not necessary to add some code to separate messages.
(The messages are recognized following to (ii) conditions.)
Maximum number of message character strings is 32768 (128 characters × 256 strings) for each language.

(iv) End code

Set “%” (0x25) code.

(Note 1) Always add a return code (CR + LF) in each
Even if version data is not necessary, return code is needed.
When a message text file without a return code is used, “E86 INPUT DATA ERR” error will occur.

(Note 2) Make sure so that the number of all characters designated in (ii) conditions (number of characters for one message × number of messages = number of all characters) is the same as the total number of message characters set in (iii).

2) Input PLC alarm messages
Select DATA IN screen and input PLC alarm message with text data format.

#(98) DATA( ) $\boxed{\text{INPUT}}$

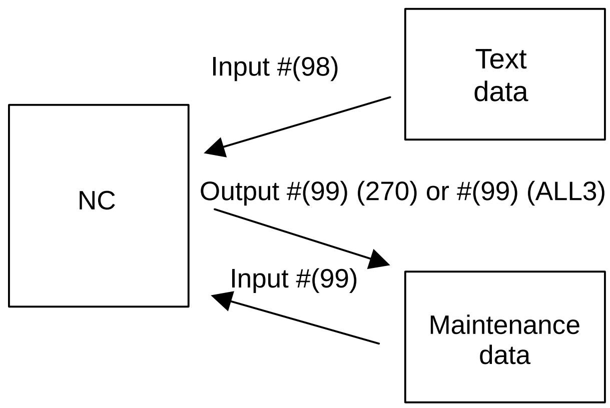
(b) Input/output with maintenance data format
1) Input PLC alarm message with maintenance data format
Select DATA IN screen and input PLC alarm message with maintenance data format .

#(99) DATA( ) $\boxed{\text{INPUT}}$

2) Output PLC alarm message with maintenance data format
Select DATA OUT screen and input PLC alarm message with maintenance data format .

#(99) DATA(270) $\boxed{\text{INPUT}}$

PLC alarm messages are also output when APLC program batch output (#(99) (ALL3)) is performed.



3) N-number assignment of maintenance data
The head N-number is assigned for each language.
(The last N-number depends on the data size of alarm message.)
If there is no message data for some language, the N number assigned for the language will be ignored when maintenance data is output.

Language	N number	Language	N number
Language No.1	0 to 2499	Language No.5	10000 to 12499
Language No.2	2500 to 4999	Language No.6	12500 to 14999
Language No.3	5000 to 7499	Language No.7	15000 to 17499
Language No.4	7500 to 9999	Language No.8	17500 to 19999

(c) Precautions at external alarm creation
2-byte character (kanji (Chinese character), kana, etc.) can be available for PLC alarm message.
However, make sure that 2-byte character starts from uneven byte position.
If 2-byte character is at an even byte position, it may cause overflow to the next line and illegal display.

10.1.4 Parameters

(1) PLC alarm message selection parameter

[Bit selection parameter screen]

```
                        7   6   5   4   3   2   1   0  ← Bit
# (6450)   Data   ( 0   1   0   0   0   0   0   0 )
   ↑                   |
Use number 6450.       └── 0: PLC alarm message display in user PLC
                           1: External alarm message display
```

The operation is as the following depending on the bit state of the bit selection #6450.

Bit 6 = 0
The PLC alarm message in the user PLC is displayed as usual.
Bit 6 = 1
The external alarm message input with the text format is displayed.

(2) Language selection parameter

[Bit selection parameter screen]

```
                        7   6   5   4   3   2   1   0  ← Bit
# (6453)   Data   ( 0   0   0   0   0   0   0   0 )
   ↑                                        |
Use number 6453.                            └── Message language selection code
```

No.	Bit			Notes
	2	1	0	
#6453	0	0	0	The language 1 is displayed.
	0	0	1	The language 2 is displayed.
	0	1	0	The language 3 is displayed.
	0	1	1	The language 4 is displayed.
	1	0	0	The language 5 is displayed.
	1	0	1	The language 6 is displayed.
	1	1	0	The language 7 is displayed.
	1	1	1	The language 8 is displayed.

(3) F or R Type Selection Parameter

Set the parameter on the bit selection screen of PLC parameter (setup para).

[Bit selection parameter screen]

```
                          7   6   5   4   3   2   1   0   <-- Bit
# (6450)   Data   ( 0   0   0   0   0   0   *   1 )
    ^
    |
Use number 6450.
```

Bit 0:
- 0: Alarm message invalid.
- 1: Alarm message valid.

Bit 1:
- 0: F type interface
- 1: R type interface

[Reference] #6450 corresponds to the high-order byte of the file register R2924.

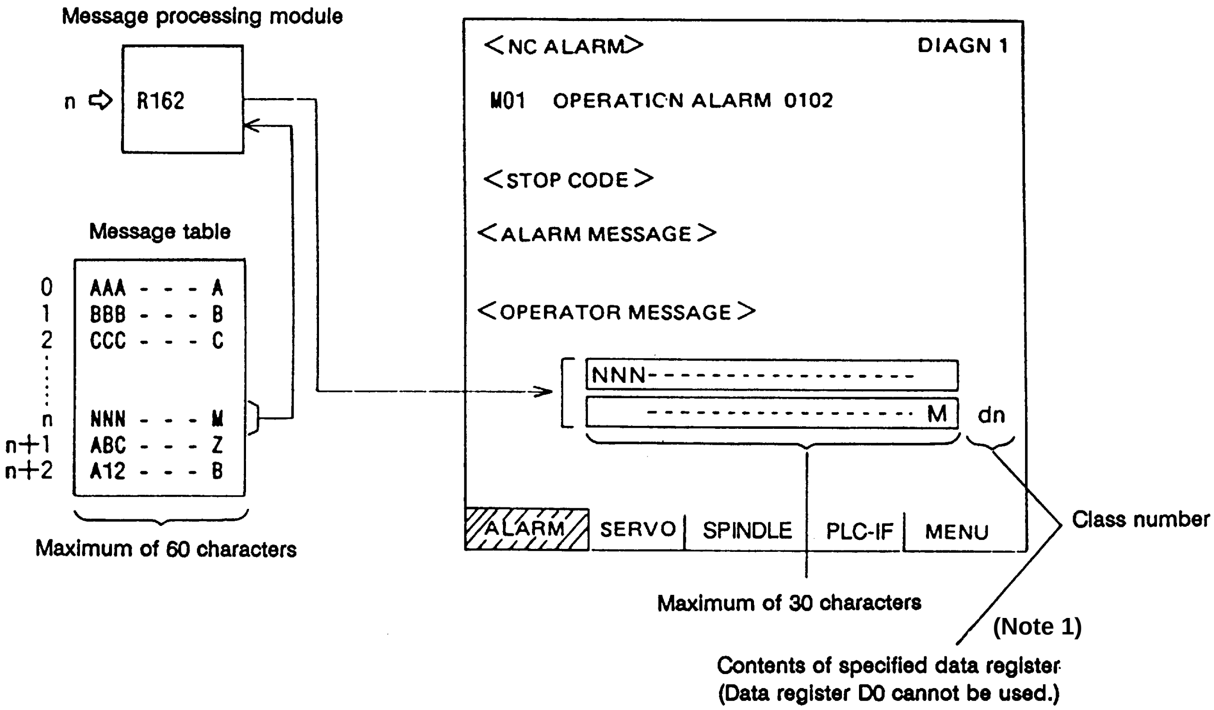
10.2 Operator Message Display

When a condition to inform the operator of a message occurs, an operator message can be displayed independently of an alarm message.
A maximum of 60 characters can be displayed for the operator message on the alarm diagnosis screen. One operator message can be displayed at a time.

10.2.1 Interface

An operator message is displayed by setting the number of the operator message table to be displayed in file register R162. It is cleared by setting R162 to 0. Thus, number 0 of the operator message table cannot be displayed.

Display example



As with alarm messages, the contents of the data register specified for the class number display in operator message preparation are also displayed.

(Note 1) The class number display is updated when the contents of file register R162 change. It is not updated if only the contents of the specified data register (Dn) change.
To change the class number display only, the contents of R162 must be cleared to 0. If the contents of the specified data register are 0, no class numbers are displayed.

10.2.2 Operator Message Preparation

Create messages by using PLC development software (GX Developer). **(Note1)**

According to the description format, set the number of characters for one message and the number of messages to be prepared, then prepare message data.
The maximum length of an operator message is 60 characters. A maximum of 512 operator messages can be prepared. For details, refer to "PLC Development Software Manual (IB-1500177)".
However, the number of operator messages may be limited depending on the available memory capacity. For details, refer to the PLC Development Software Manual.

(Note 1) PLC Onboard does not include the message creation function.

10.2.3 Operator Message Display Validity Parameter

The parameter is set on the machine manufacturer parameter bit selection screen.

```
                 7  6  5  4  3  2  1  0 ←bit
#(6450) Data  (  0  0  0  0  0  0  0  0  )
                                └── 0: Operator message display invalid.
                                    1: Operator message display valid.
   └ Use number 6450.
```

(Reference) #6450 corresponds to the high-order byte of file register R2924.

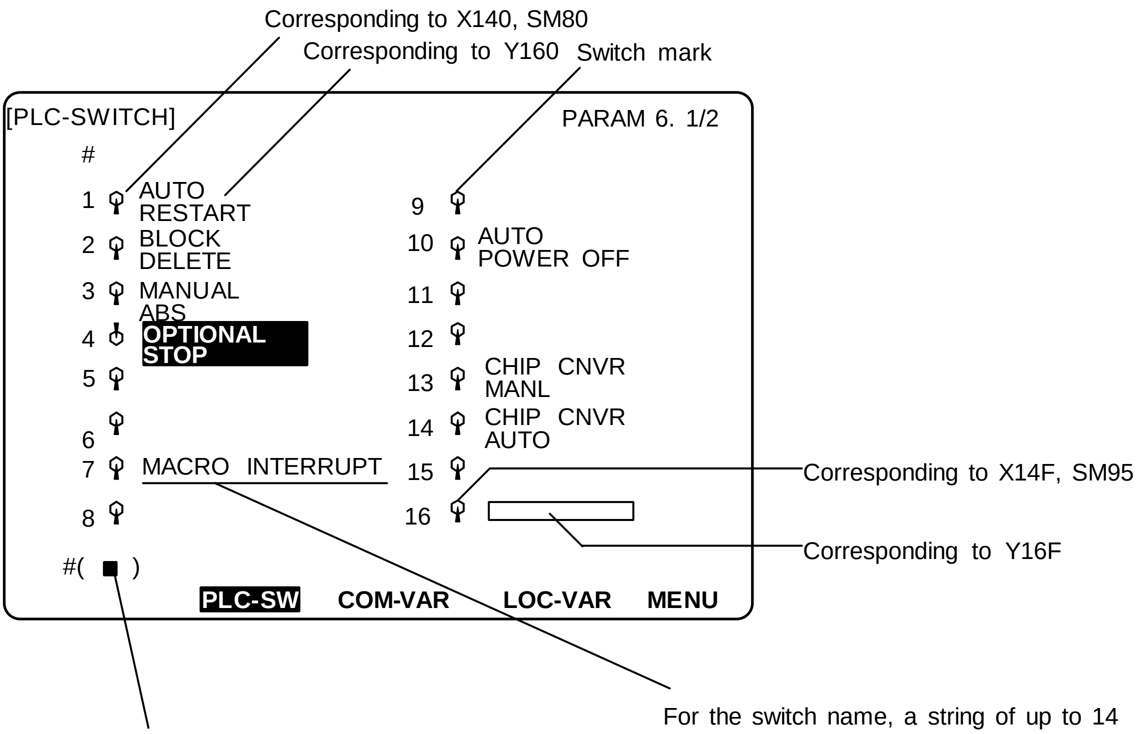
10.3 PLC Switches

Similar function to machine operation switches can be provided by using the controller setting and display unit. The number of switch points is 32. The switch names can be given as desired.

10.3.1 Explanation of Screen

The screen is explained below.

PARAMETER SCREEN PLC SWITCH (MENU)



Setting part switch on, off is indicated.
For example, when 1 is set and INPUT is pressed, #1 switch is turned on.
When the same operation is again performed, the switch is turned off.
However, on/off control of certain switches may trigger other switches to turn on or off (depending on the user PLC SM80 to SM111 operations).

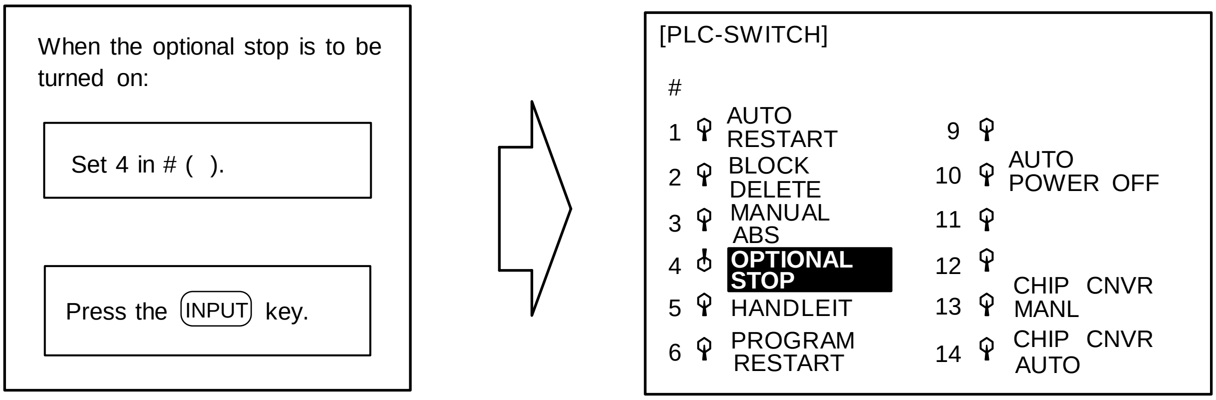
For the switch name, a string of up to 14 alphanumeric and kana characters (kanji requires 2-character space) can be displayed.

Switch on state display part :
Switch off state display :

10.3.2 Explanation of Operation

To turn on or off a switch, set the number of the switch to be turned on or off in the parentheses of setting part # ( ) and press the INPUT CALC key.

Depending on the state of the switch, its input device X is turned on (off) and accordingly the switch mark indicates the on (off) state.



The switch can be turned off (on) the same way.
Special relay SM can reverse the switch on/off states. When special relay SM is activated, the on/off state of the corresponding switch and device X is reversed.
To display the switch validity state, etc., the switch name can be highlighted. To do this, turn on or off output device Y corresponding to the switch name.
The corresponding table of the switch numbers, input device X, output device Y, and special relay SM is listed below:

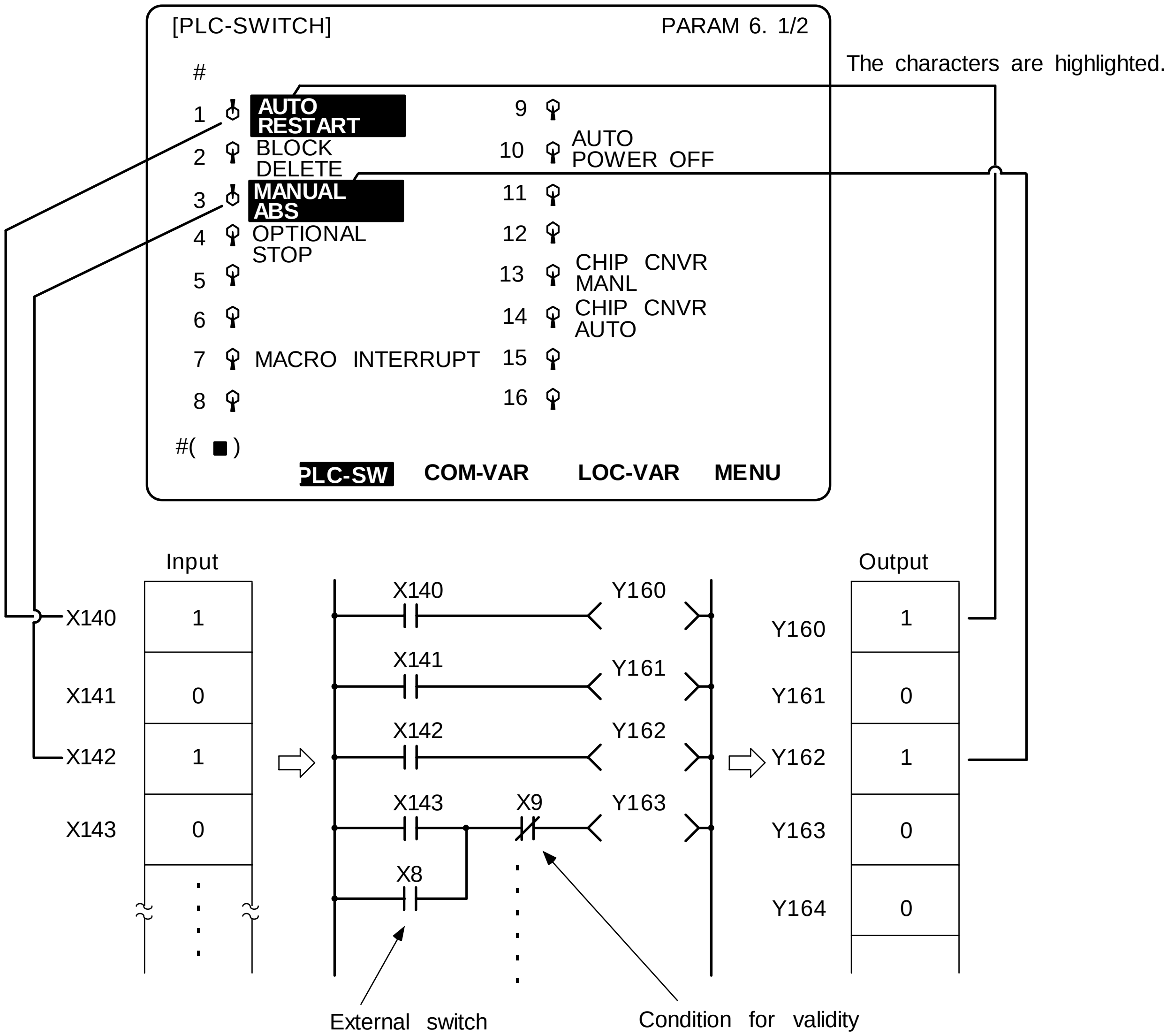
Switch No.	Corresponding device			Switch No.	Corresponding device		
	X	Y	E		E	Y	E
#1	X140	Y160	SM80	#17	X150	Y170	SM96
#2	X141	Y161	SM81	#18	X151	Y171	SM97
#3	X142	Y162	SM82	#19	X152	Y172	SM98
#4	X143	Y163	SM83	#20	X153	Y173	SM99
#5	X144	Y164	SM84	#21	X154	Y174	SM100
#6	X145	Y165	SM85	#22	X155	Y175	SM101
#7	X146	Y166	SM86	#23	X156	Y176	SM102
#8	X147	Y167	SM87	#24	X157	Y177	SM103
#9	X148	Y168	SM88	#25	X158	Y178	SM104
#10	X149	Y169	SM89	#26	X159	Y179	SM105
#11	X14A	Y16A	SM90	#27	X15A	Y17A	SM106
#12	X14B	Y16B	SM91	#28	X15B	Y17B	SM107
#13	X14C	Y16C	SM92	#29	X15C	Y17C	SM108
#14	X14D	Y16D	SM93	#30	X15D	Y17D	SM109
#15	X14E	Y16E	SM94	#31	X15E	Y17E	SM110
#16	X14F	Y16F	SM95	#32	X15F	Y17F	SM111

(Note 1) Input device X also holds the state if power is turned off.

○ The table below shows the message displayed during operation on the PLC switch screen.

No.	Message	Explanation	Remedy
E01	SETTING ERROR	A number outside the allowable setting range from 1 to 32 is specified in # ( ).	Specify a valid number within the range.

10.3.3 Signal Processing

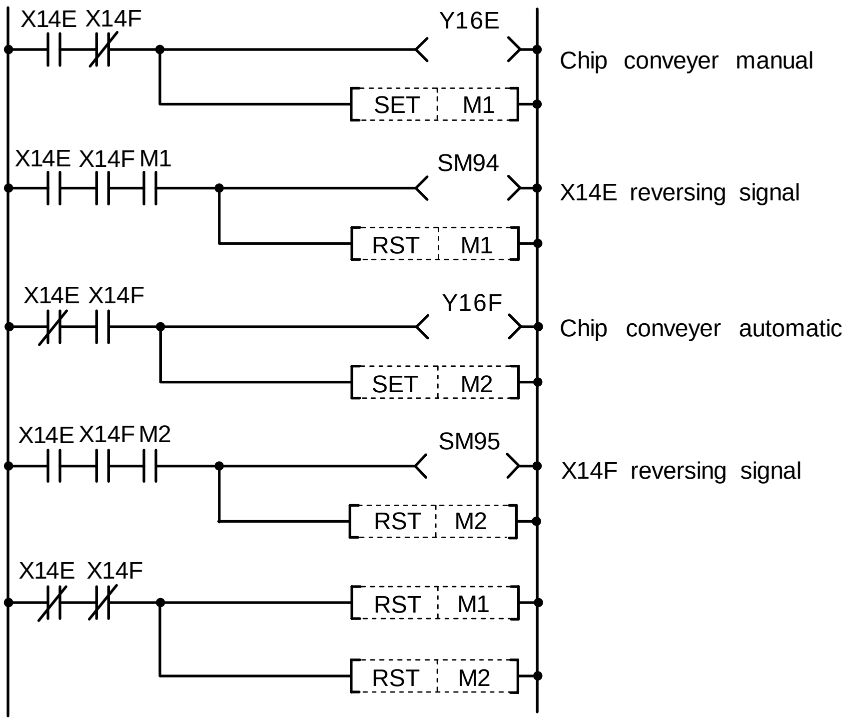


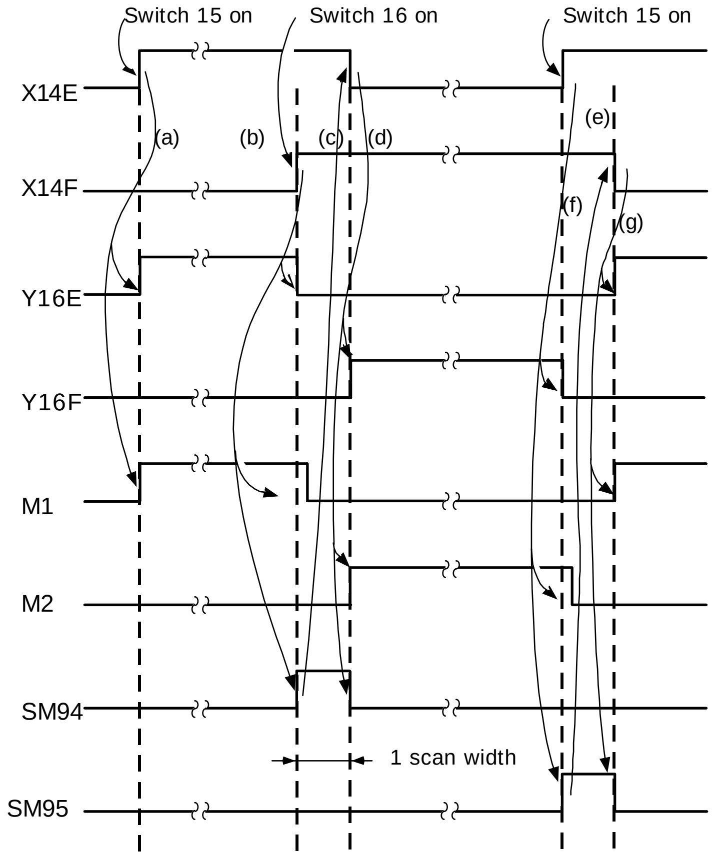
- When setting is done on the PLC switch screen, the input device X corresponding to the specified switch number is turned on or off to switch over the switch state.
- When special relay SM is turned on from the user PLC, its corresponding input device X and the switch state are reversed. Special relay SM is reset immediately after the CNC reverses the input device X and the switch state. It is turned on by one pulse (scan) only also in the user PLC. In either case, when output device Y is set to on based on the input device X state, the corresponding switch name is highlighted.

The following shows an example of operation of special relay SM from the user PLC.

(1) Two-point switch

(Example) When two opposite switches, chip conveyer manual and chip conveyer automatic, are provided;





(a) When switch 15 (X14E) is on and switch 16 (X14F) is off, Y16E and M1 turn on. [Initial state]

(b) When switch 16 (X14F) turns on while being in state (a), Y16E turns off, SM94 turns on, and M1 turns off.

(c) Turning SM94 on reverses X14E (to off).

(d) When X14E is off and X14F is on, SM94 turns off and Y16F and M2 turn on.

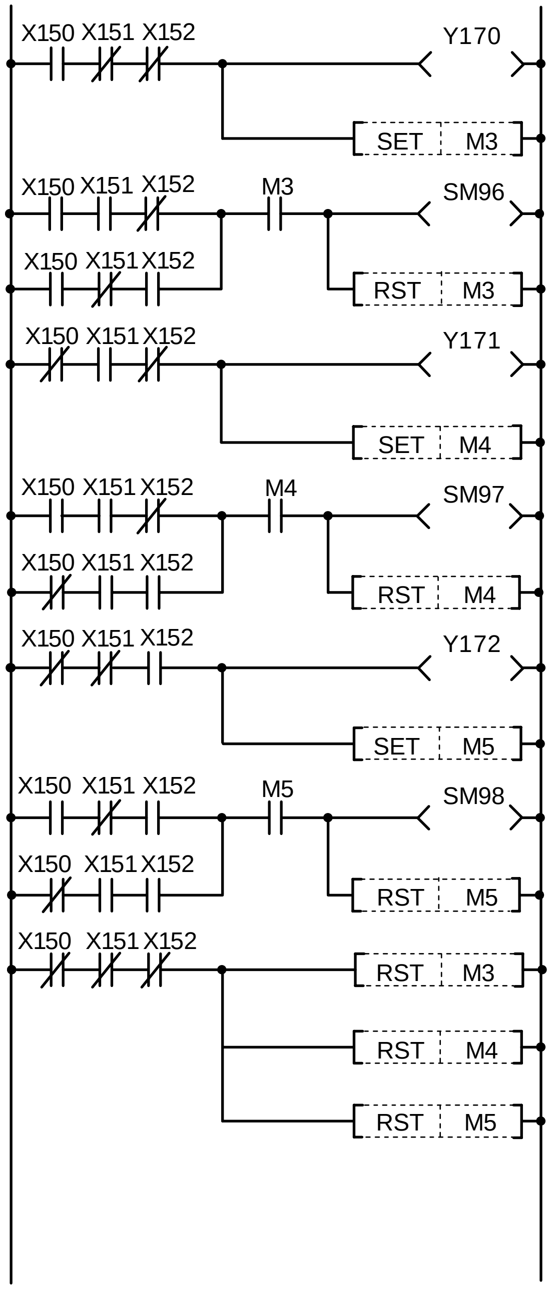
(e) When switch 15 (X14E) turns on while being in state (d), Y16F turns off, SM95 turns on, and M2 turns off.

(f) Turning SM95 on reverses X14F (to off).

(g) When X14F is off and X14E is on, SM95 turns off and Y16E and M1 turn on again.

(2) Three-point switch

(Example) When three opposite switches 17, 18, and 19 are provided;



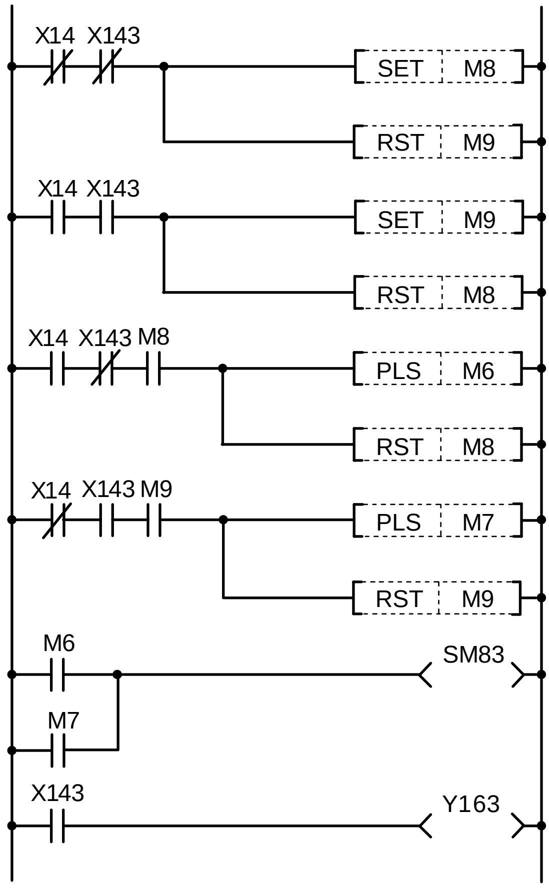
When SM96 turns on, X150 turns off.

When SM97 turns on, X151 turns off.

When SM98 turns on, X152 turns off.

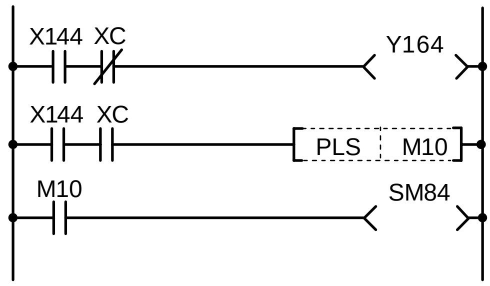
(3) External switch and PLC switch

(Example 1) When an external optional stop switch (X14) is provided;



Under sequence control in the above example, the switch marks on the PLC switch screen can be operated from both external and PLC switches.

(Example 2) When an external switch (XC) that inhibits a PLC switch handle interrupt is provided;



Under sequence control in the above example, when the external switch (XC) is on, the PLC switch for a handle interrupt cannot be turned on.

10.3.4 Switch Name Preparation

Prepare PLC switch names by using PLC development software (GX Developer). **(Note1)**

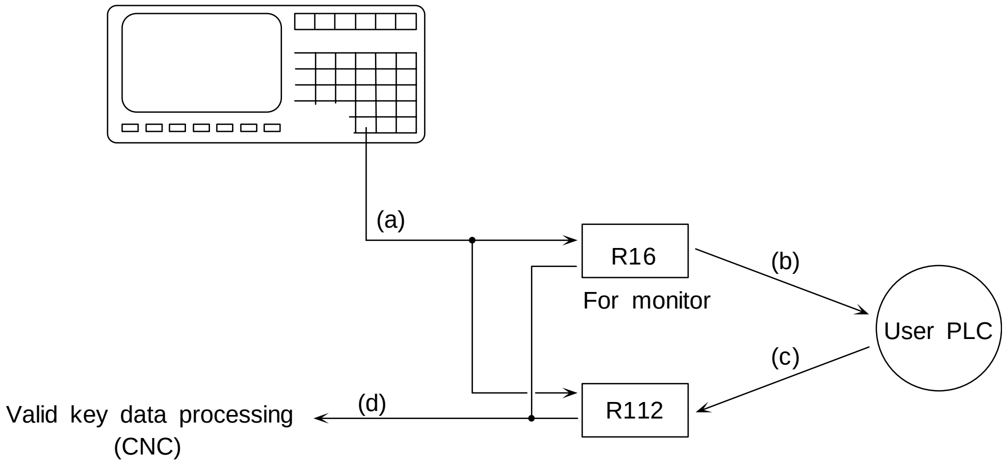
According to the description format, set the number of characters for one switch name and the number of switch names to be prepared, then prepare switch name data. The maximum length of a switch name is 14 characters. A maximum of 32 switch names can be prepared.
For details, refer to "PLC Development Software Manual (IB-1500177)".

(Note 1) PLC Onboard does not include the switch name creation function.

10.4 Key Operation by User PLC

The same operation as if the operator performed key operation can be performed by operating key data by user PLC.

10.4.1 Key Data Flow



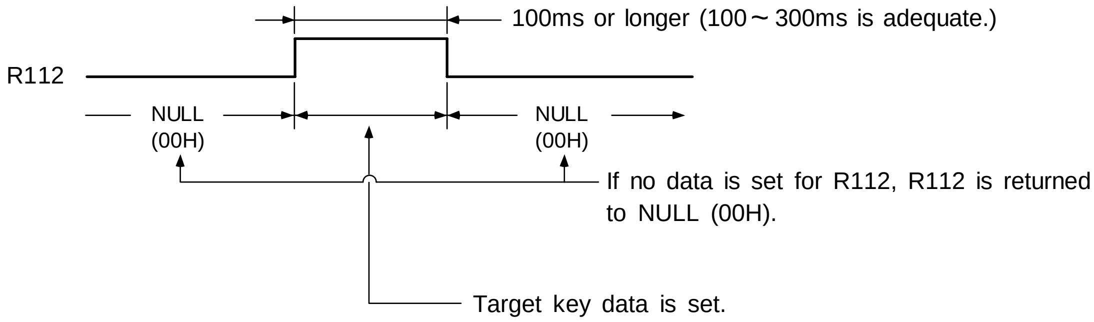
(a) Key data is set in file registers R16 and R112 at the top of the user PLC main.
(b) The user PLC refers to the key data and performs necessary processing.
(c)The user PLC sets the key data matching the operation board being used in R112.
(d) After user PLC main processing is performed, controller performs valid key data processing according to the R16 and R112 contents.

10.4.2 Key Operations That Can Be Performed

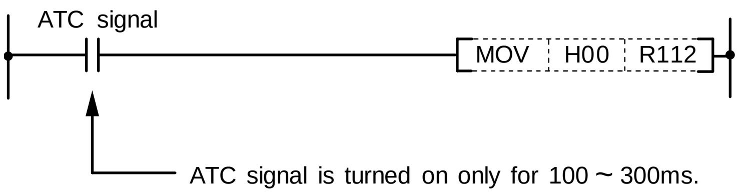
(1) When a key is pressed, it is ignored.
· The R16 contents are judged and NULL (00H) code is set in R112.
(2) When R16 is NULL, that is, key operation is not performed, user PLC performs key operation conforming to the operator.
· Key data matching the target operation is set in R112.

10.4.3 Key Data Processing Timing

Key data is processed at the timing shown below.
Set data in R112 only when it is necessary. Normal key operation by the operator is made impossible.

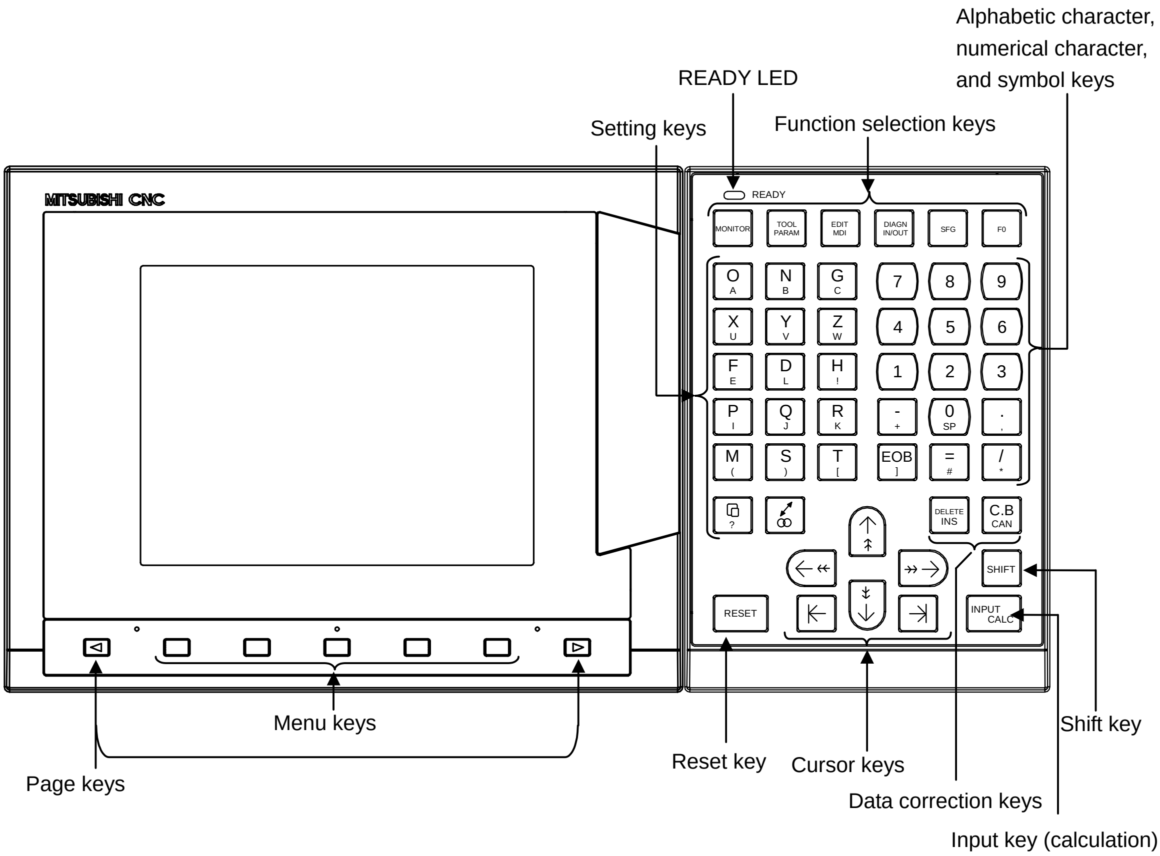


Example)



10.4.4 Layout of Keys on Setting and Display Unit

The layout for the keys on the setting and display unit (display unit + keyboard unit) used with this controller is shown below.



(Note 1) When inputting an alphabet or symbol on the lower right of the alphabet or symbol keys, press [SHIFT], and then press the corresponding key.

(Example) When [SHIFT] [O/A] are pressed, "A" will be input.

10.4.5 List of Key Codes

The code correspondences for the keys and R16, R112 are shown below.

Key symbol	Code (HEX)	Key symbol	Code (HEX)	Key symbol	Code (HEX)	Key symbol	Code (HEX)
MONITOR	80	↑ (↟)	0B(F8)	– (+)	2D(2B)	O (A)	4F(41)
TOOL/PARAM	81	↓ (↡)	0A(F7)	• (,)	2E(2C)	N (B)	4E(42)
EDIT/MDI	83	← (↞)	08 (F5)	EOB ( ])	3B (5D)	G (C)	47 (43)
DIAGN IN/OUT	85	→ (↠)	09(F6)	= (#)	3D(23)	X (U)	58(55)
SFG	86	DELETE (INS)	7F(8C)	/ (*)	2F(2A)	Y (V)	59(56)
F0	87	C.B.(CAN)	8E(18)			Z (W)	5A(57)
		SHIFT	88	0 (SP)	30(20)	F (E)	46(45)
		INPUT(CALC)	0D(F4)	1	31	D (L)	44(4C)
				2	32	H (!)	48(21)
				3	33	P (I)	50 (49)
Previous page	90	Window key (?HELP)	89(F9)	4	34	Q (J)	51(4A)
Next page	9A	Activ Wind (CTRL)	8A(8B)	5	35	R (K)	52(4B)
Menu 1	91			6	36	M (( )	4D(28)
Menu 2	92			7	37	S ( ))	53(29)
Menu 3	93			8	38	T ([ )	54(5B)
Menu 4	94			9 ($)	39(24)		
Menu 5	95						

* The key signals and codes shown in parentheses are the shift IN side key signals.

Shift is canceled by pressing another key after pressing the shift key, or by pressing the shift key again.

Example 1) SHIFT N(B) 0(SP) ← Key pressed

88 42 30 ← Code generated

Example 2) SHIFT SHIFT 0(SP) ← Key pressed

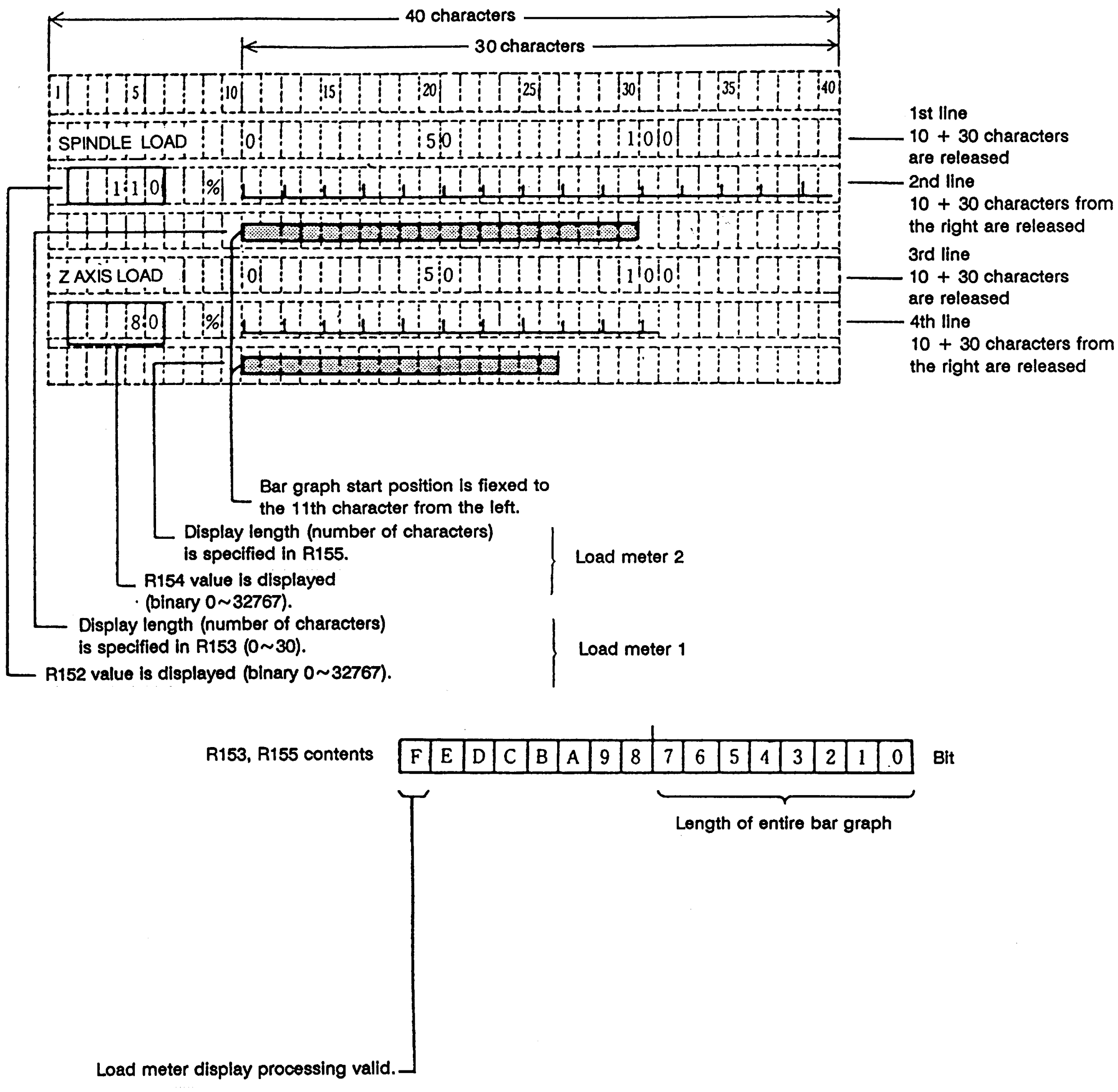
88 88 30 ← Code generated

10.5 Load Meter Display

The load meter can be displayed by setting a value in the designated file register (R) with the ladder program. The spindle load, Z axis load, etc. characters and scale are created with comments in the PLC development software (GX Developer) message function.
For details, refer to "PLC Development Software Manual (IB-1500177)".

(Note 1) PLC Onboard does not include the switch name creation function.

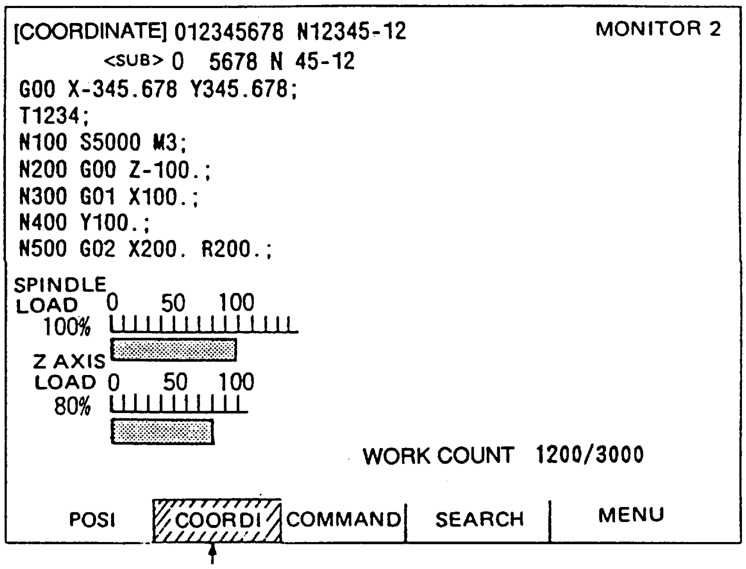
10.5.1 Interface



○ **File register (R) for load meter display**

Load meter 1	Numerical display	R152
	Bar graph display	R153
Load meter 2	Numerical display	R154
	Bar graph display	R155

Display example



Display on coordinate screen of position display second menu.

(Note) This screen consists of 80 characters wide x 18 lines long.

10.6 External Machine Coordinate System Compensation

External machine coordinate system compensation is executed by setting compensation data (absolute amount) in the PLC file register (R) for each axis.
Thus, the compensation timing is when PLC rewrites file register (R) compensation data. Necessary condition, timing, etc., are set by user PLC.
The interface between user PLC and CNC is shown below.

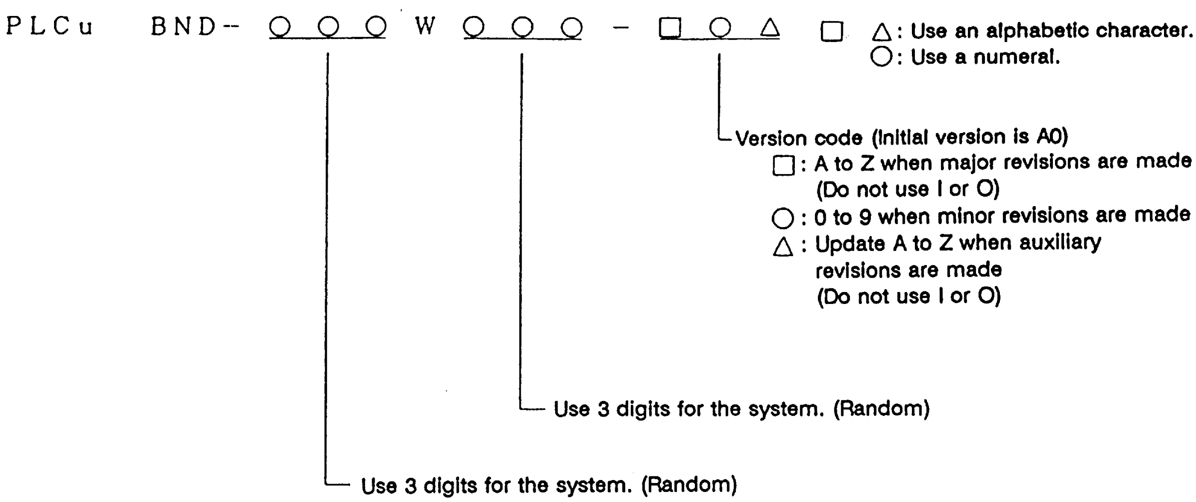
File register	Contents
R560	Compensation data for the first axis
R561	Compensation data for the second axis
R562	Compensation data for the third axis
R563	Compensation data for the forth axis
R564	—
R565	—
R566	—
R567	—

Data in file registers R560~R567 is not backed up. If it must be backed up, use back-up file registers (R1900~R2799).

(Note 1) The maximum delay to compensation is (one user PLC scan + 15ms). However, smoothing time constant and servo follow delay are not contained.

10.7 User PLC Version Display

The user PLC version can be displayed together with the controller software version on the DIAGN/IN/OUT → menu changeover → configuration (menu) screen of the setting and display unit.

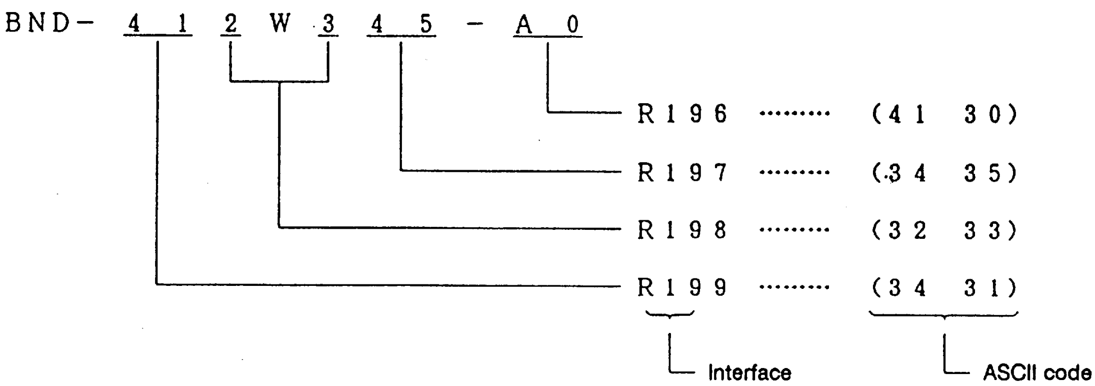


(Note) The user PLC must be controlled by the user.

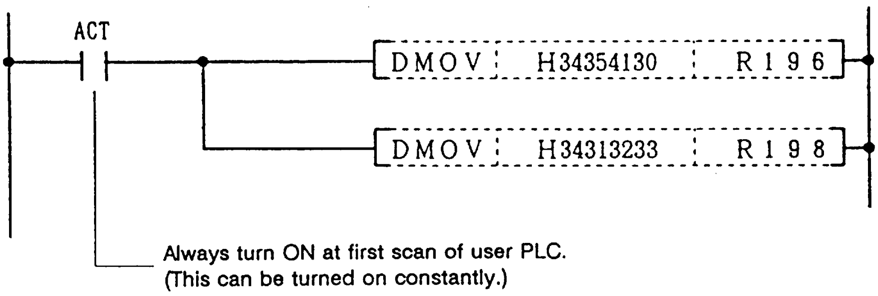
10.7.1 Interface

Data corresponding to the characters to be displayed on the corresponding file register (R) is set.

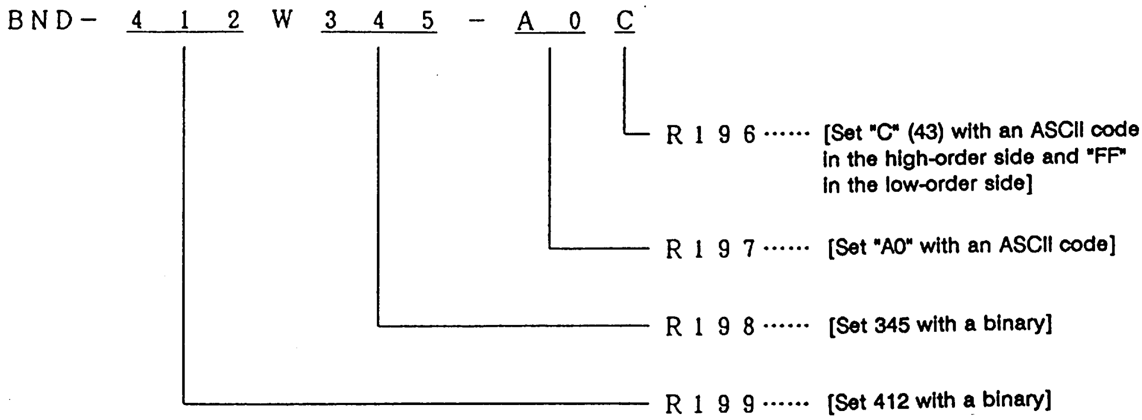
(1) To display a 2-digit version code



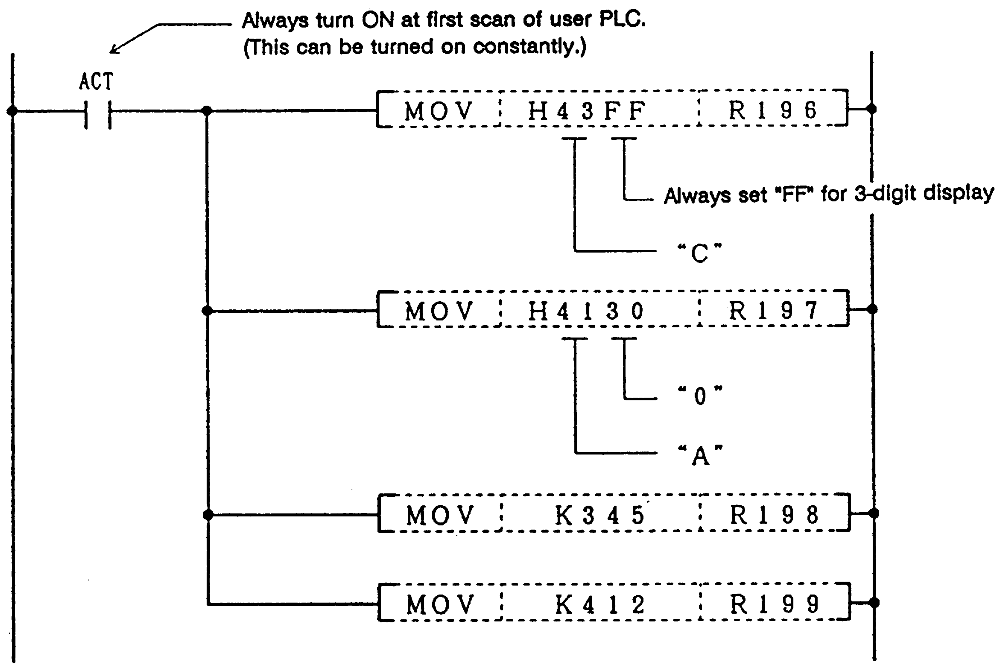
Program example)



(2) To display a 3-digit version code



Program example)



11. PLC Axis Control

11.1 Outline

This function allows an independent axis to be controlled with commands from the PLC, separately from the NC control axis.

11.2 Specifications

11.2.1 Basic Specifications

Item	Details
No. of control axes	Max. 2 axes
Simultaneous control axes	The PLC control axis is controlled independently of the NC control axis. Simultaneous start of multiple PLC axes is possible.
Command unit	Min. command unit 0.001mm (0.0001 inch) 0.0001mm (0.00001 inch) (Same command unit as the NC control axis.)
Feedrate	(Min. command unit 0.001mm) Rapid traverse 0 to 240000 mm/min. (0 to 9448.8 inch/min.) Cutting feed 0 to 240000 mm/min. (0 to 9448.8 inch/min.) (Min. command unit 0.0001mm) Rapid traverse 0 to 100000 mm/min. (0 to 10000 inch/min.) Cutting feed 0 to 100000 mm/min. (0 to 10000 inch/min.)
Movement commands	Incremental value commands from the current position. Absolute value commands of the machine coordinate system. 0~±99999999 (0.001mm/0.0001inch)
Operation modes	Rapid traverse, cutting feed Jog feed (+), (-) Reference point return feed (+), (-) Handle feed
Acceleration/ deceleration	Rapid traverse, Jog feed Reference point return feed } Linear acceleration/linear deceleration Cutting feed } Exponential function acceleration/ exponential function deceleration Handle feed } Step
Backlash compensation	Provided
Stroke end	Not provided
Soft limit	Provided
Rotation axis commands	Provided Absolute value commands........ Rotation amount within one rotation. (Rotates the remainder divided by 360°.) Incremental commands .... Rotates the commanded rotation amount.
Inch/mm changeover	Not provided Command to match the feedback unit.
Position detector	Encoder (absolute position detection also possible)

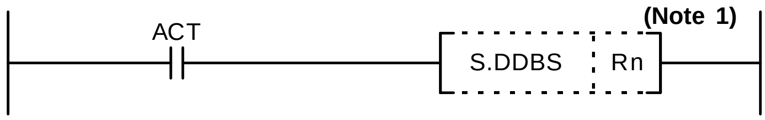
11.2.2 Other Restrictions

(1) There is no mirror image, external deceleration or machine lock function.
(2) Rapid feed override, cutting override and dry run control are not possible.
(3) Automatic operation start, automatic operation stop, reset and interlock NC controls are invalid for PLC control axes.
The same control can be realized using an interface dedicated for PLC control axes.
(4) There is no dedicated emergency switch. The emergency stop is valid in the same manner as the NC control axis.

11.3 PLC Interface

The interface between the PLC and NC is carried out by setting the control information data in the R-register [Note 1] with the PLC, and calling the DDBS function.

11.3.1 S.DDBS Function Command

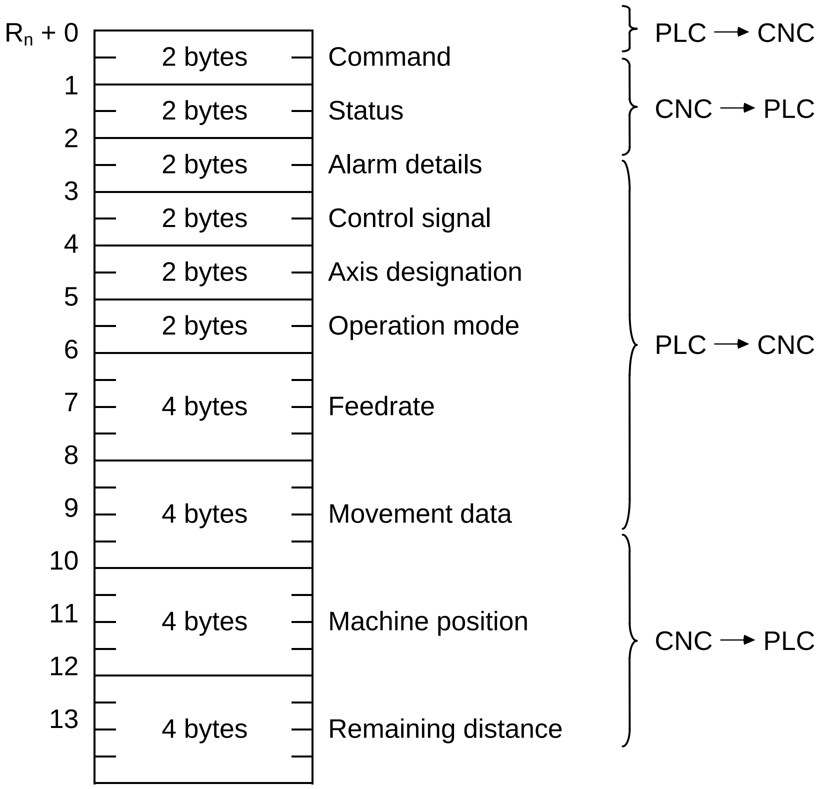


When ACT is set to 1, the PLC axis control process is carried out with the control information data contents. Thus, ACT should be set to 1 during PLC axis control.
Setting ACT to 0 causes a reset status.

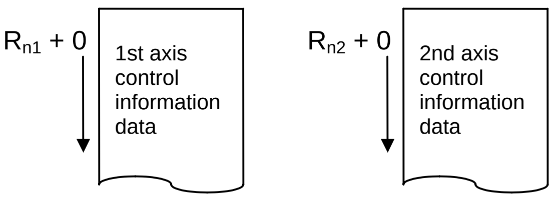
(Note 1) The following R-registers can be used.
R500 to R549 (No battery backup)
R1900 to R2799 (Battery backup)

11.3.2 Control Information Data

Set the control information data in the R-register before calling the DDBS function command. The following is a list of control information data.



A max. of 2 axes can be controlled by the PLC. Each axis should have its own control information data.



11.3.3 Control Information Data Details

11.3.3.1 Commands

Commands consist of main commands and sub-commands.

	F 8	7 0
R_n + 0	Sub-commands	Main commands

Main commands: The types of DBBS main commands are as follows.
1: Search
2: PLC axis control

Sub-commands: The PLC axis control sub-command is as follows.
0: Movement data output and control signal output

(Note 1) "Input" and "output" are the input/output looking from the PLC side.

11.3.3.2 Status

The status is set by the NC to indicate the execution status of this function command and the status of the axis being controlled.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
$R_n + 1$																

bit 0: busy	Command processing	bit 8 : oper	Option error
1: den	Axis movement completed	9:	
2: move	Axis moving	A:	
3: SA	Servo ready	B:	
4: svon	Servo ON	C:	
5: ZP	Reference point reached	D:	
6:		E: ALM2	Axis in control alarm
7:		F: ALM1	Control information data designation alarm

bit 0: busy   Command processing

This turns ON when the command is being processed.
The next command is not received while this bit is ON. The next command to be issued is received while this bit is OFF.

bit 1: den   Axis movement completed

This bit turns ON when the initialization and commanded movement are completed. This bit stays OFF during movement, even when an interlock is applied. This bit turns ON at reset or servo OFF, or when ACT = 0.

bit 2: move   Axis moving

This bit turns ON when the machine is moving, and turns OFF when the machine is stopped.

bit 3: SA   Servo ready

This bit turns ON when the servo is ready. It turns OFF during emergency stops and servo alarms.

bit 4: svon   Servo ON

This bit turns OFF when a servo OFF signal is output. It also turns OFF during emergency stops and servo alarms.
Machine movement is possible when this signal is ON.

bit5: ZP   Reference point reached

This bit turns ON when the reference point is reached after completion of a reference point return.
It turns OFF when the machine moves.

bit 8: oper   Option error (not used)

bit E: ALM2   Axis in control alarm

This bit turns ON when an alarm occurs (such as a servo alarm) during execution of axis control. Axis control cannot be executed while this bit is ON.
After the cause of the alarm has been removed, turn the bit OFF by turning a reset signal ON, setting ACT to 0, or turning the power OFF then ON again.

(Note) When alarms occur during axis control, the same alarms appear in the screen as for NC control axes. Set the PLC 1st axis to "1" and the PLC 2nd axis to "2".

Example: When a servo alarm occurs for the PLC 1st axis

S03 Servo alarm   52   1

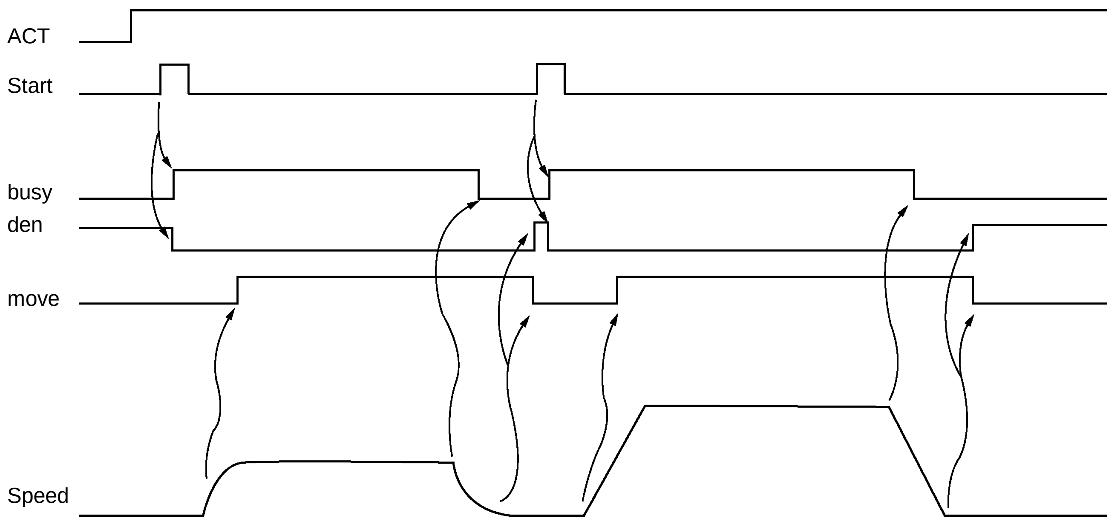
PLC axis

bit F: ALM:1   Control information data designation alarm

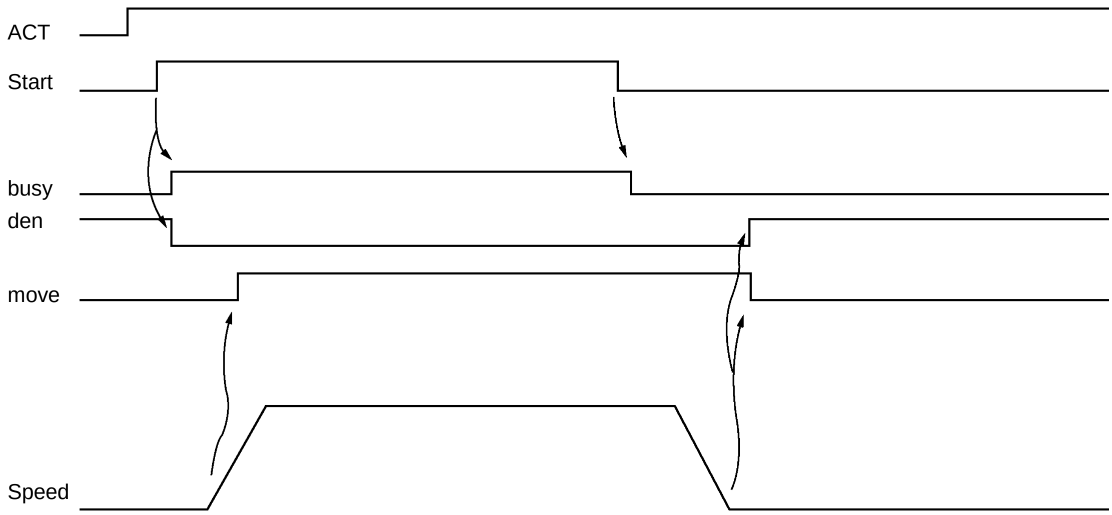
This bit turns ON when the designated details of the control information data are illegal. Thus, the PLC axis control process is not executed. Turn the bit OFF by correcting the data, turning a reset signal ON, or setting ACT to 0.

Timing chart

(1) For rapid traverse and cutting feed mode



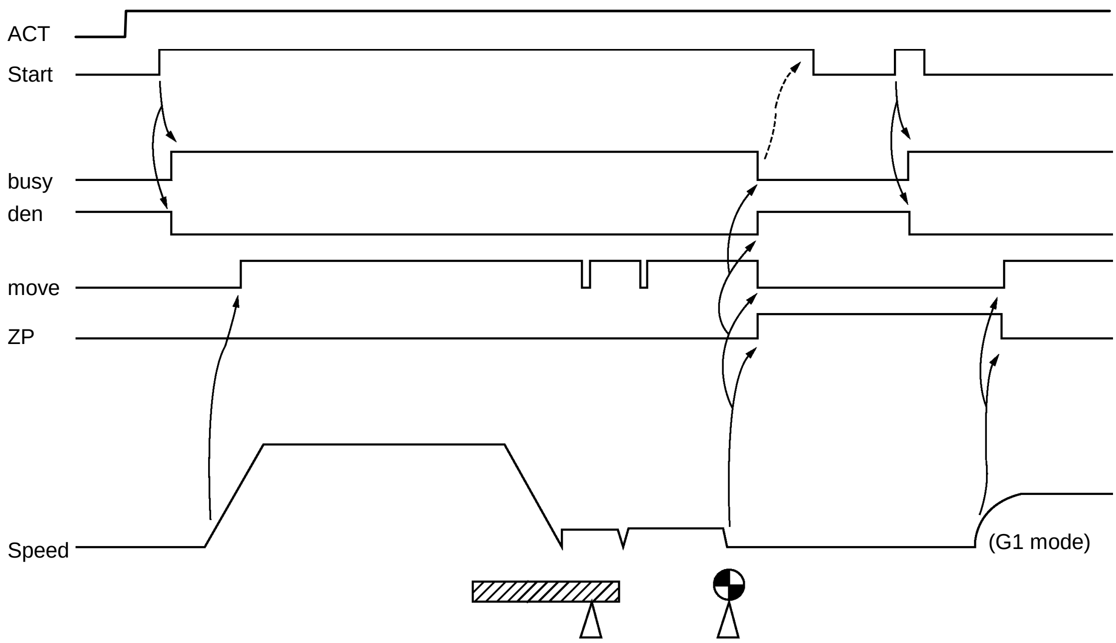
(2) For jog feed mode



(Note) The axis moves by jog feed only during start ON.

(3) For reference point return feed mode

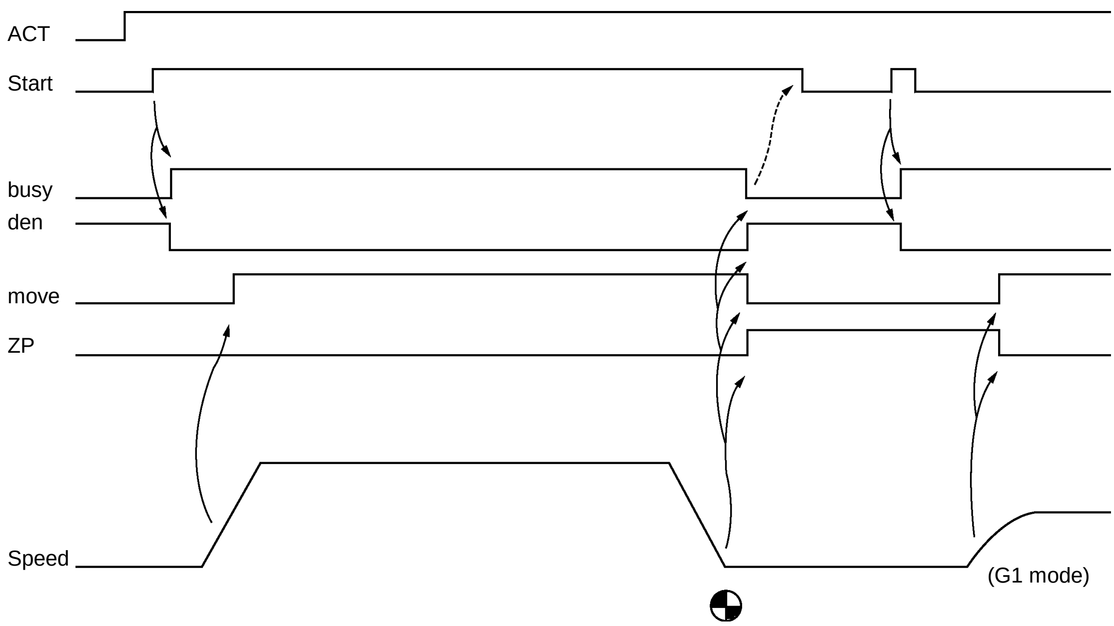
(3-1) Dog-type reference point return



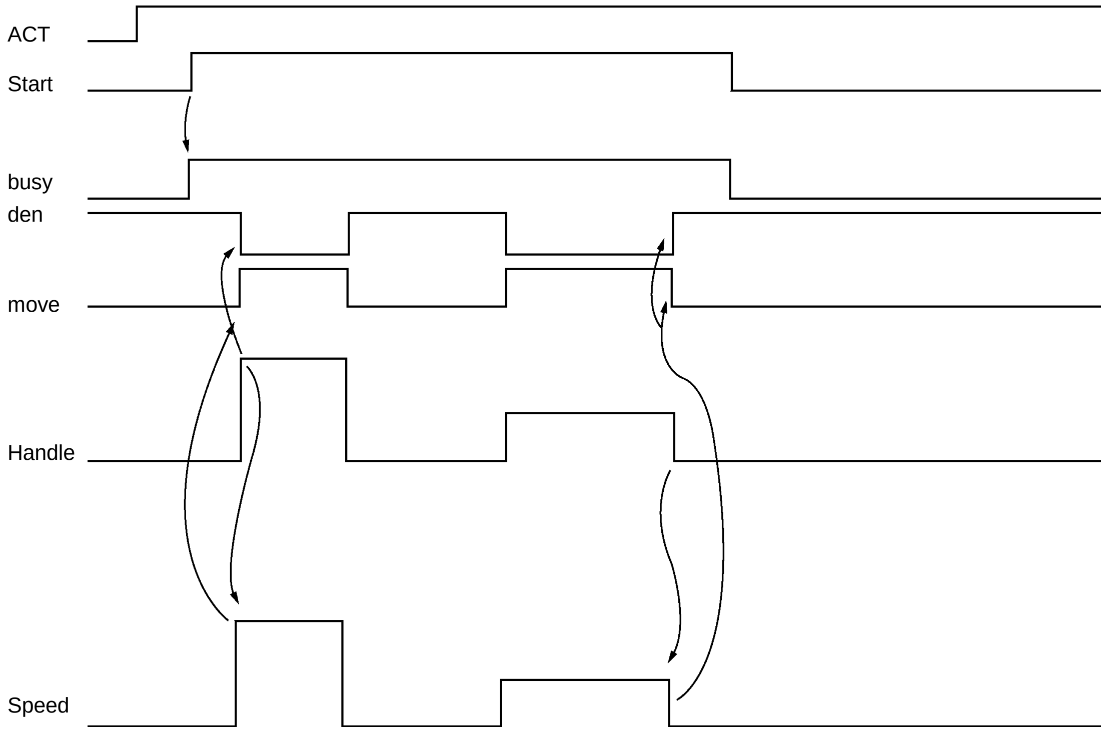
(Note 1) The axis moves by reference point return feed only during start ON. Turn the start OFF after confirming that the reference point has been reached.

(Note 2) The first reference point return after the power is turned ON is always dog-type. All returns after that are high-speed reference point returns.

(3-2) High-speed reference point return

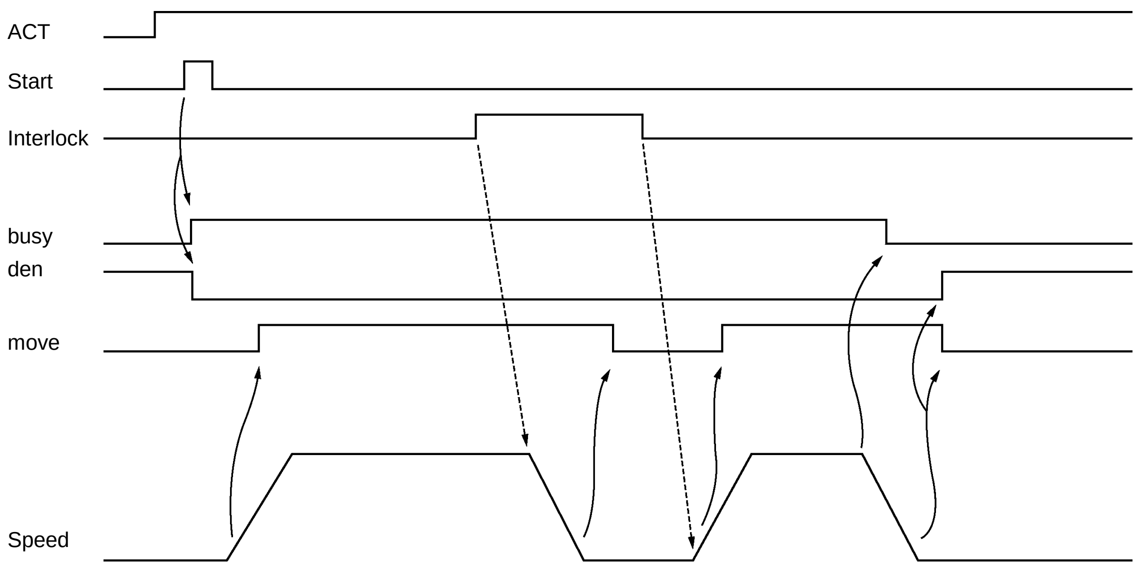


(4) For handle feed mode

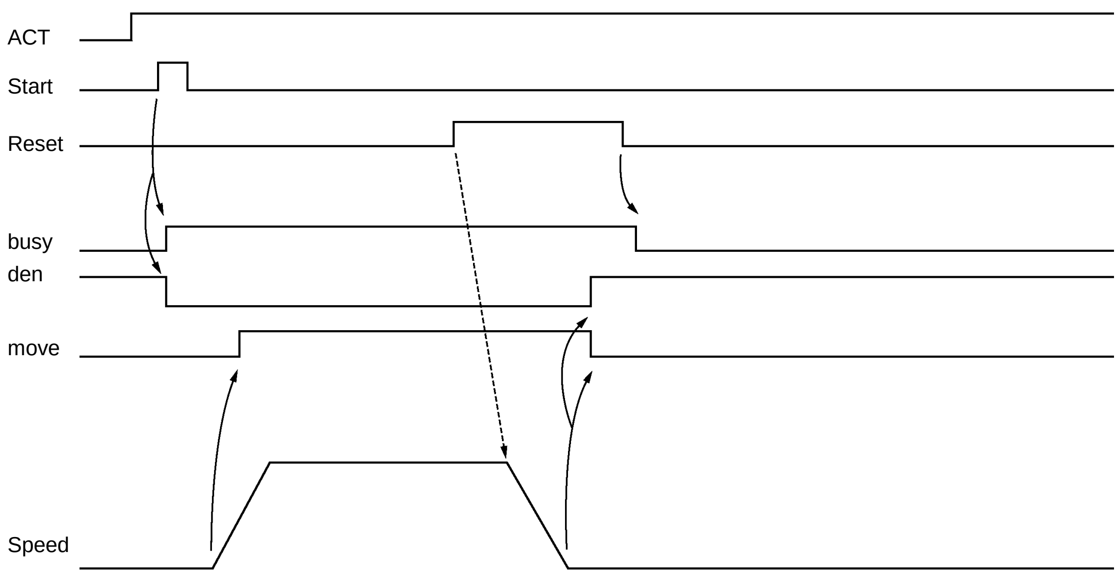


(Note) Handle feed is possible only during start ON.

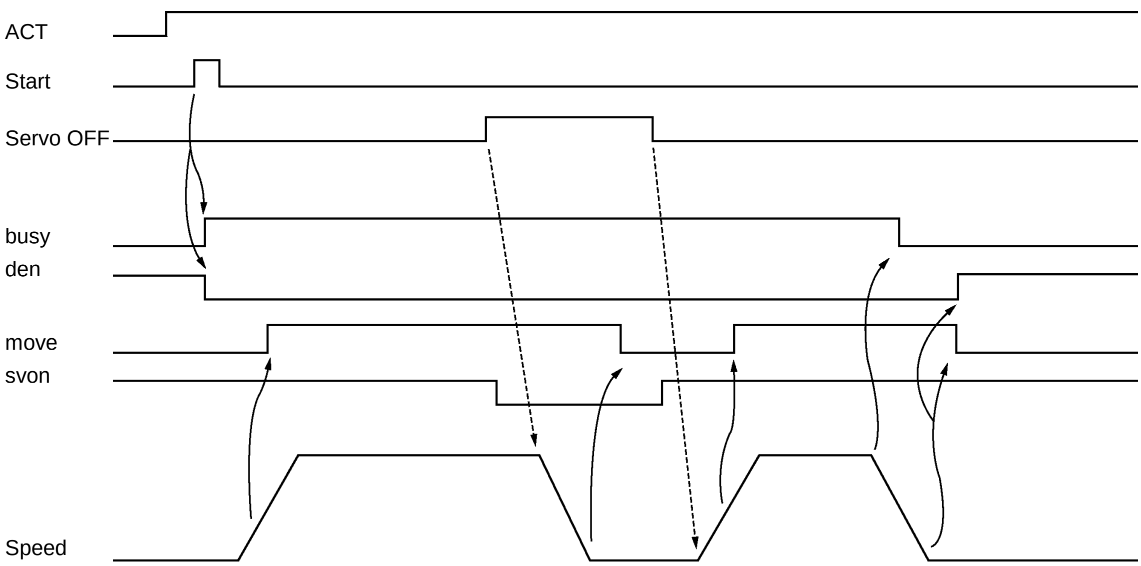
(5) When the interlock signal is ON (= 1)



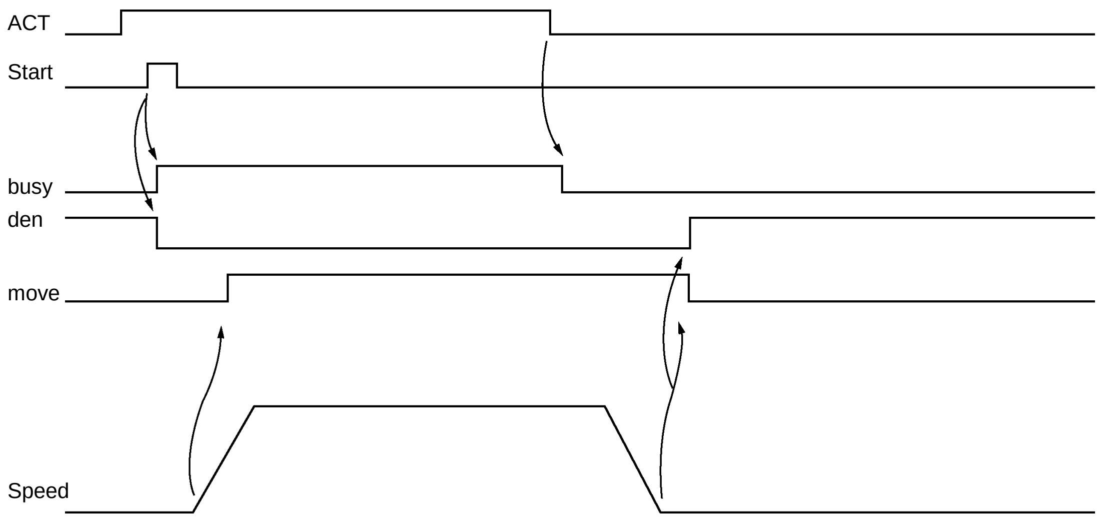
(6) When the reset signal is ON (= 1)



(7) When the servo OFF signal is ON (= 1)



(8) When the ACT signal is OFF (= 0)



11.3.3.3 Alarm No.

The alarm Nos. of status ALM1 and ALM2 are set.

F 8	7 0
ALM1 Alarm No.	ALM2 Alarm No.

The details of each alarm No. are shown below.

(1) ALM1 (Control information data designation alarm)

Alarm No.	Details
01	Control signal illegal (A signal other than a registered control signal has been commanded.)
02	Axis No. illegal
03	Operation mode illegal (0 to 6)
04	Movement data range exceeded -99999999 to +99999999
05	
06	
⋮	
10	Zero point return not complete (absolute value command not possible)
11	
12	

(2) ALM2 (Axis in control alarm)

Alarm No.	Details
0	Servo alarm (Alarm No. is displayed in the PLC axis monitor screen. Refer to the Drive Unit Maintenance Manual for details.)
1	Z-phase not passed
2	Soft limit (+)
3	Soft limit (-)

11.3.3.4 Control Signals (PLC axis control information data)

Control signals such as start, interlock, reset, axis removal and axis removal 2 are designated for the PLC axis.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
R_n + 3																

bit 0: Start	bit 8 : Absolute value command
1: Interlock	9:
2: Reset	A:
3: Servo OFF	B:
4: Axis removal	C:
5: Axis removal 2	D:
6:	E:
7:	F:

bit 0: Start

Starting begins at the at the rising edge (OFF -> ON) of the start signal, based on the control information data.
The axis does not move during interlock, servo OFF, axis removal and axis removal 2. Movement starts after interlock, servo OFF, axis removal and axis removal 2 are canceled.
Start is invalid during resetting.

bit 1: Interlock

The moving PLC axis executes a deceleration stop when the interlock signal turns ON. The stopped PLC axis will resume movement when the interlock signal turns OFF (is canceled).

bit 2: Reset

The PLC axis is reset when the reset signal turns ON. Moving PLC axes will execute a deceleration stop. Commands and controls are invalid during resetting.
If the reset signal turns ON during an alarm occurrence, the alarm will be cleared.

bit 3: Servo OFF

The PLC axis will execute a deceleration stop and its servo will turn OFF when the servo OFF signal turns ON. Whether the PLC axis movement is compensated during servo OFF can be selected in the basic specification parameter "#1064 svof".
A servo ON status will result when the power is turned ON.

bit4: Axis removal

The axis will execute a deceleration stop, and a servo OFF status will result, when the axis removal signal turns ON. A servo ON status will result and the stopped PLC axis will resume movement when the axis removal signal turns OFF (is canceled).
Axis removal is validated when either this signal or machining parameter and axis parameter "#8201 Axis Removal" is validated.
The zero point return will become incomplete when the axis is removed. Therefore, a dog-type reference point return must be completed again when starting with an absolute value command.

bit 5: Axis removal 2

The axis will execute a deceleration stop, and a servo OFF/ready OFF status will result, when the axis removal 2 signal turns ON. A servo ON/ready ON status will result for the stopped PLC axis when the axis removal 2 signal turns OFF (is canceled).
A restart must be executed to start the movement again.
Position control cannot be carried out while the axis removal 2 signal is ON. However, position detection is possible so the position will not be lost.

bit 8: Absolute value command

Turn this bit ON when the movement data is commanded in absolute values.
When this bit is OFF, the commands will be processed as incremental value commands.

11.3.3.5 Axis Designation

The axis No. of the PLC axis is designated.

$R_n + 4$	Axis designation

0: 1st axis
1: 2nd axis

11.3.3.6 Operation Mode

The operation mode for the PLC axis is designated.

For example, in the handle mode, Rn+5=6 (DATA) is set.

$R_n + 5$	Operation mode

0: Rapid traverse (G0)
1: Cutting feed (G1)
2: Jog feed (+)
3: Jog feed (-)
4: Reference point return (+)
5: Reference point return (-)
6: Handle feed

The axis movement will not be affected by changing the operation mode, even while the axis is moving. The new operation mode is validated at the next start.

11.3.3.7 Feedrate

When the operation mode is cutting feed or jog feed (Rn + 5 = 1 to 3), the PLC axis feedrate is designated with a binary code.

R_n + 6 7	Feedrate

Designation value
1 to 1000000mm/min (0.1inch/min)

(Note 1) The feedrate designated in the parameters is used for the rapid traverse mode and reference point return mode.
(Note 2) The feedrate can be changed during axis movement. In that case, change using a direct feedrate data (Rn + 6, 7) is possible.

11.3.3.8 Movement Data

When the operation mode is rapid traverse or cutting feed, the movement data is designated with a binary code.

R_n + 8 9	Movement data

Designation value
0 to ±99999999 (0.001mm/0.0001inch)

(Note 1) The movement data is classified as follows by the absolute value command flag (bit 8) of the command signal.
Absolute value command flag = 0: Incremental value from the current position
Absolute value command flag = 1: Absolute value of the machine coordinate system
(Note 2) If the movement amount is changed during axis movement, the new movement amount will be validated at the next start.

11.3.3.9 Machine Position

The machine position output to the machine system is expressed. The machine position becomes the rfp (reference point) when the reference point is reached.

R_n + 10	Machine position
11	(input unit)

11.3.3.10 Remaining Distance

The remaining distance of the movement data output to the machine system is expressed.

R_n + 12	Remaining distance
13	(input unit)

11.3.4 Reference Point Return Near Point Detection

Set the near point dog signal of the PLC axis reference point return for the following devices in the PLC.

Device No.		Signal name	
Y2E0	*PCD1	PLC axis	PLC axis near point detect 1st axis
Y2E1	*PCD2	PLC axis	PLC axis near point detect 2nd axis
Y2E2			
Y2E3			
Y2E4			
Y2E5			
Y2E6			
Y2E7			

(Note) The responsiveness when the dog signal is set in PLC middle-speed processing is worse than when set in PLC high-speed processing.

11.3.5 Handle Feed Axis Selection

The axis is designated for the following devices when handle feed is carried out with a PLC axis.

Device No.		Signal name
Y2E0		
Y2E1		
Y2E2		
Y2E3		
Y2E4	PCH1	PLC axis 1st handle valid
Y2E5	PCH2	PLC axis 2nd handle valid
Y2E6		
Y2E7		

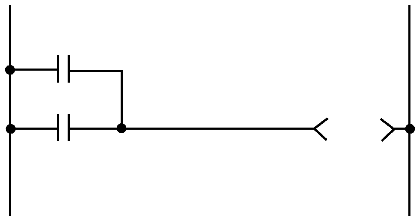
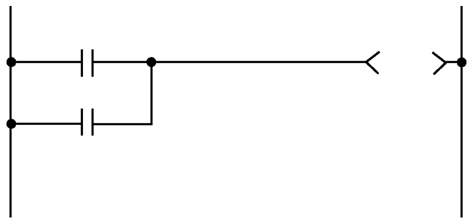
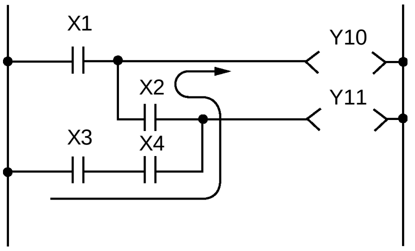
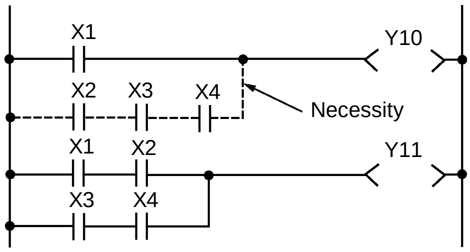
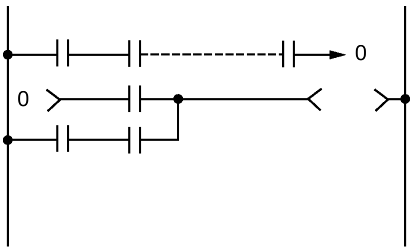
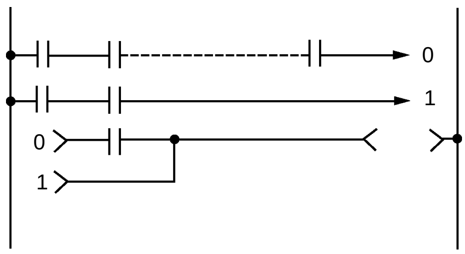
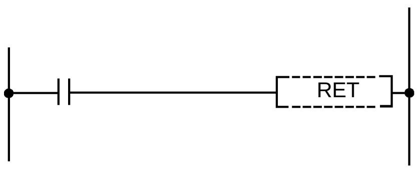
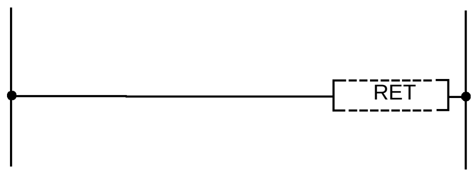
When Y2E4 and Y2E5 are ON, each handle changes to PLC axis dedication.
Y248 to Y24C, Y24F, Y250 to Y254 and Y257 usually used in the control device are used for the axis selection of each handle.
PLC axes are counted as PLC such as first axis and second axis. Therefore, if you will operate the first handle in the first axis of PLC, turn ON Y2E4, Y248 to Y24C and Y24F.

(Note) The handle feed magnification is also used for NC control axes.

12. Appendix

12.1 Example of Faulty Circuit

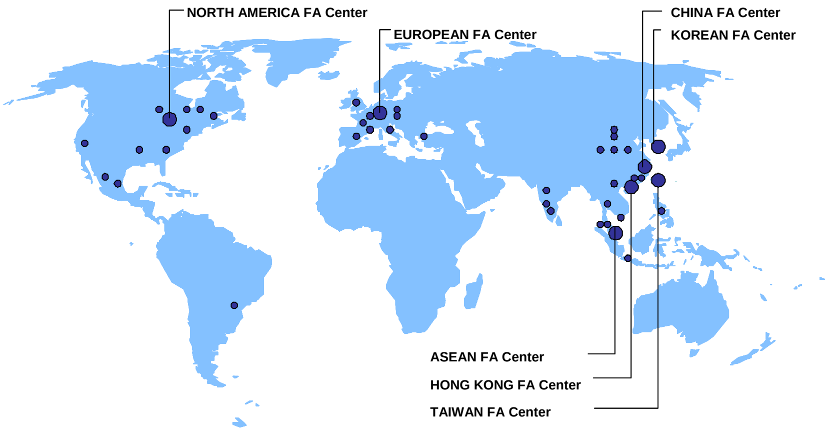
Wrong configurations of circuits are shown below. Correct the circuitry, if any.

Faulty circuit producing errors →	Correct circuit
(1) Circuit containing OR 	
(2) Rounding circuit  Whether or not the Y10 condition includes X3, X4 and X2 is unknown.	
(3) Modification of loopback circuit 	
(4) Presence of a contact before RET, FEND, or MCR circuit 	

Revision History

Date of revision	Manual No.	Revision details
April. 2006	IB(NA)1500178-A	First edition created.

Global service network



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Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible.

Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

Duplication Prohibited

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