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CNC

MELDAS 60/60S Series

PLC PROGRAMMING MANUAL
(LADDER SECTION)

BNP-B2212*(ENG)

Introduction

These specifications are the programming manual used when creating the sequence program 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.

This Instruction Manual does not explain the operation procedures for programming the sequence program with onboard or PLC development software. Refer to the related material listed below for details.

(1) M64 Series

MELDAS 64 PLC Onboard Instruction Manual BNP-B2213

MELDAS 64 PLC Program Development Manual (Personal Computer Section) BNP-B2215

MELDAS 64 PLC Interface Manual BNP-B2211

(2) MELDASMAGIC 64 Series

MELDASMAGIC 64 PLC Onboard Instruction Manual BNP-B2213

MELDASMAGIC 64 PLC Program Development Manual (Personal Computer Section) BNP-B2215

MELDASMAGIC 64 PLC Interface Manual BNP-B2211

The "Controller" and "Control Unit" in this Instruction Manual are equivalent to the "NC Card" in the MELDASMAGIC 64 Series.

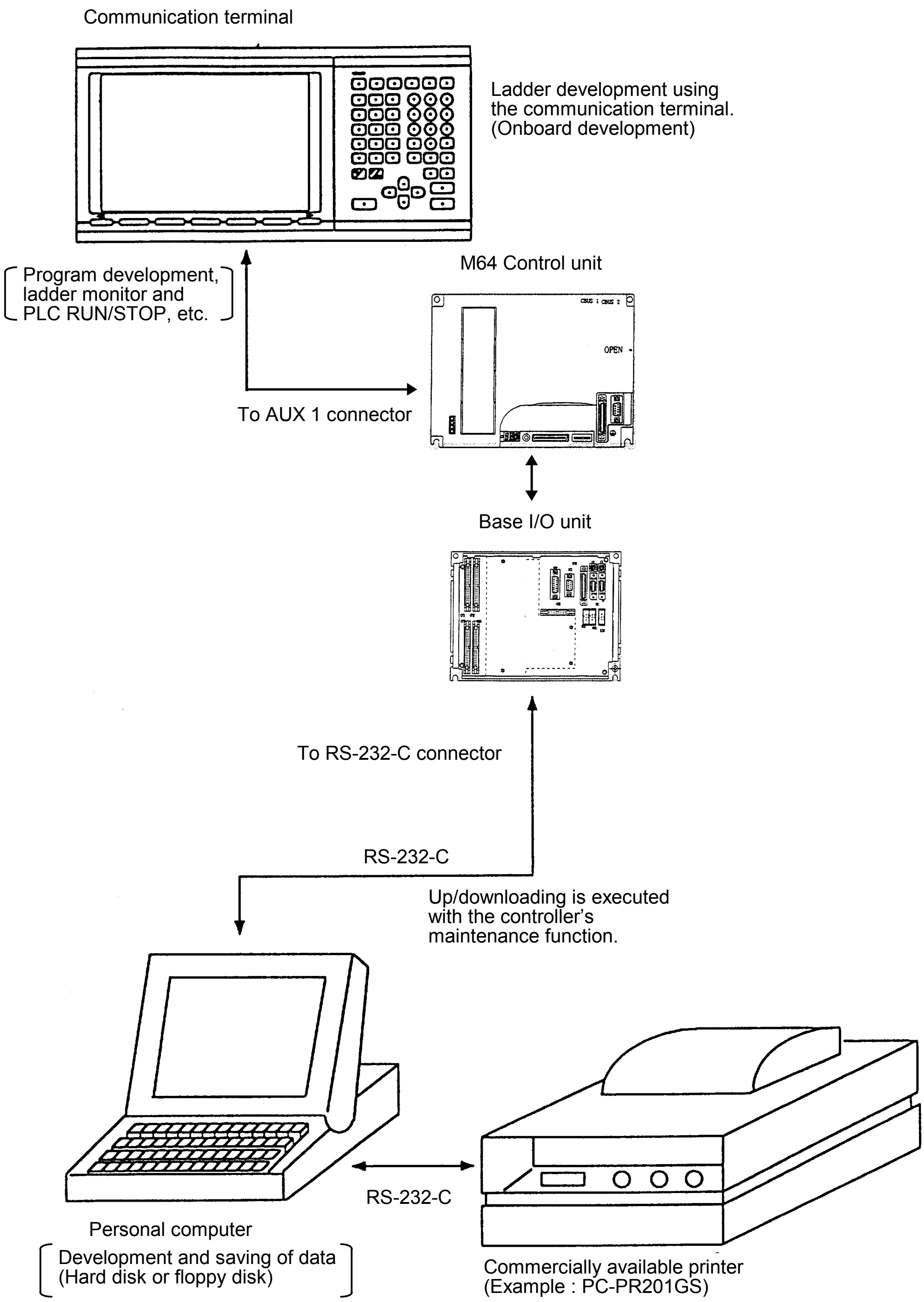
CONTENTS

1. System Configuration

1.1 System Configuration for PLC Development

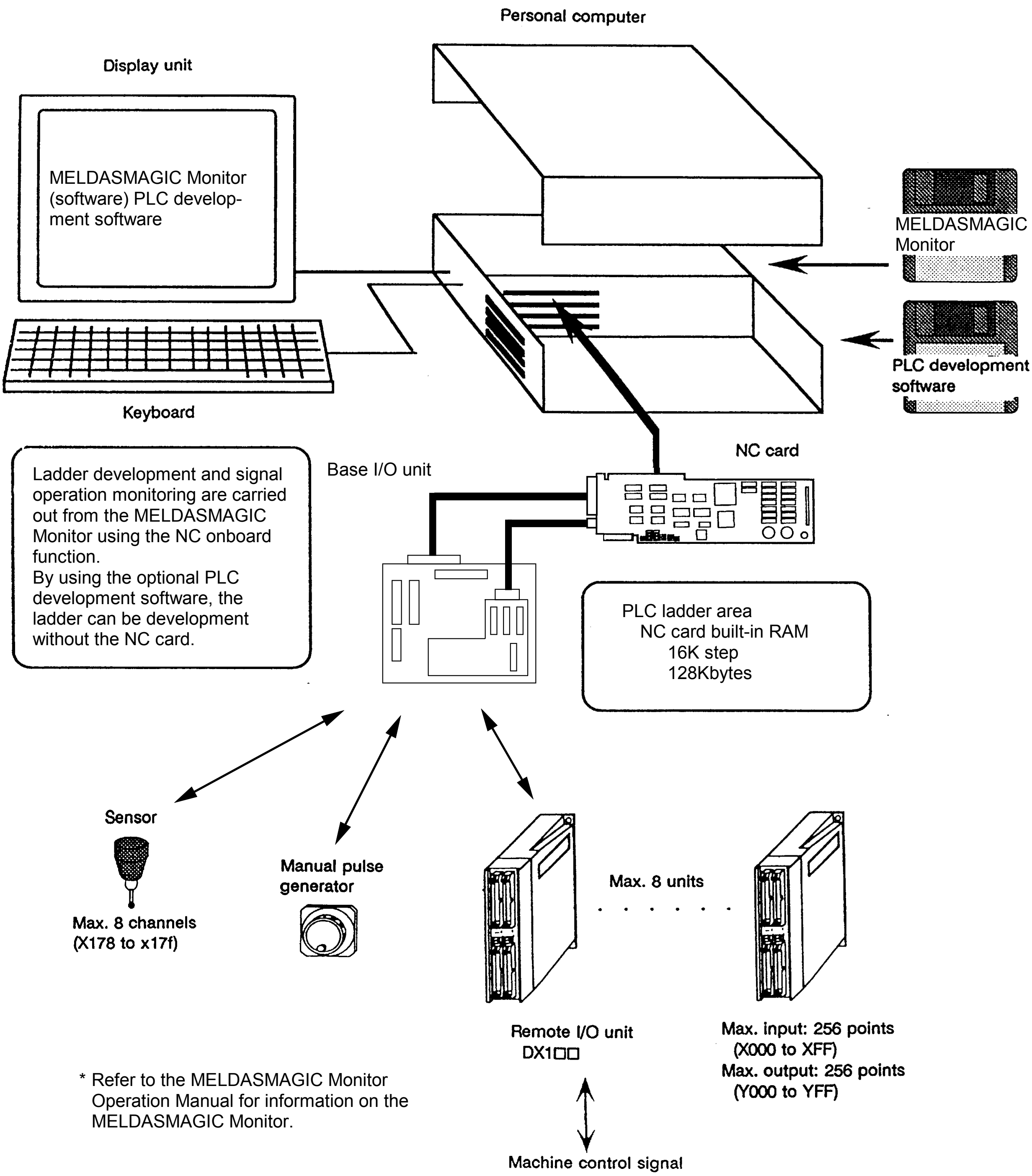
(1) M64 Series

The system configuration for PLC development is shown below.



Note) Refer to the "PLC Onboard Instruction Manual" for development using the communication terminal (onboard development), and the "PLC Program Development Manual (Personal Computer Section)" for development using the personal computer.

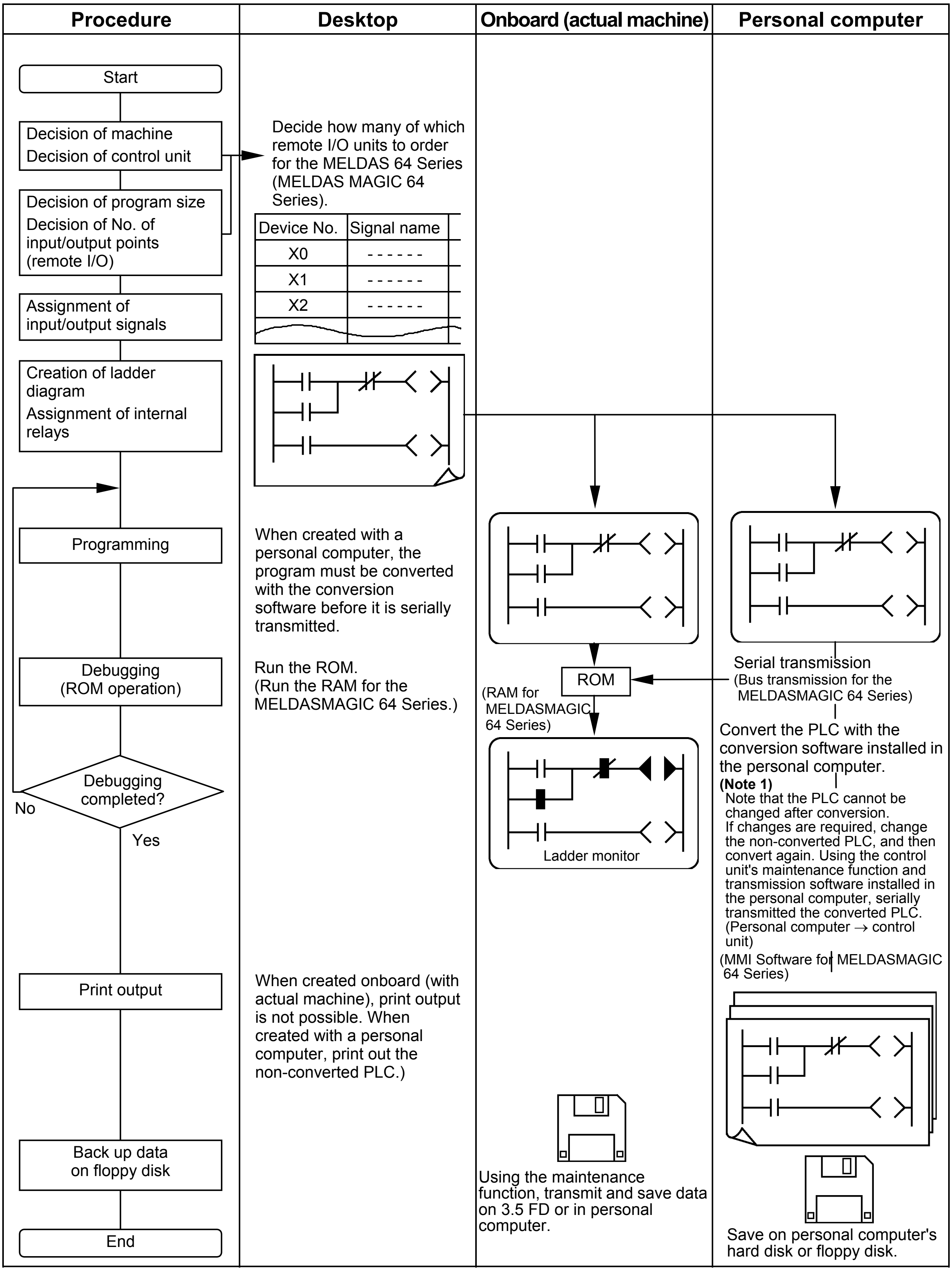
(2) MELDASMAGIC 64 Series



Note) Refer to the "PLC Onboard Instruction Manual (BNP-B2130)" for development using the onboard PLC development tool, and the "PLC Programming Manual (Personal Computer Section) (BN-B2132)" for development using the PLC development software.

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.



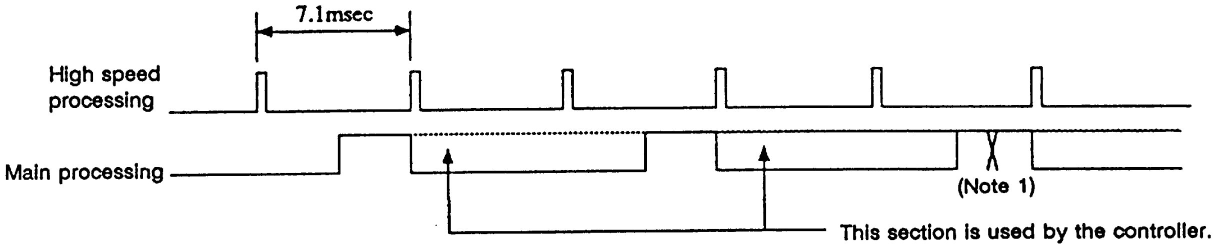
2. PLC Processing Program

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.

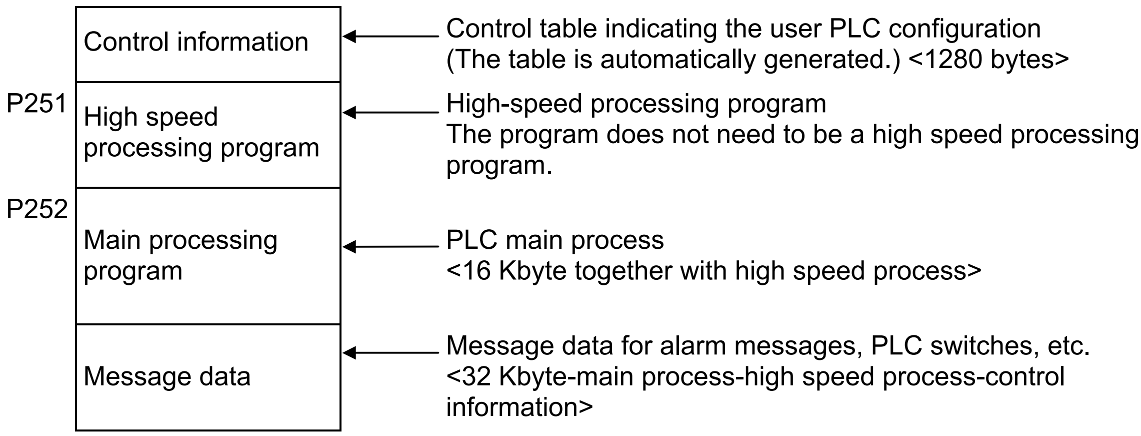


(Note 1) The section from the END command to the next scan is done immediately as shown with the X section. Note that the min. scan time will be 14.2msec.

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.

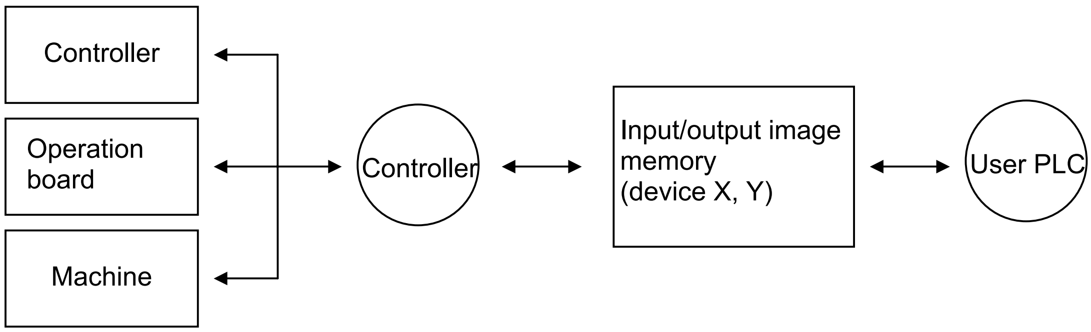


Max. 32 Kbyte from control information to messages.

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 is installed on the communication terminal. (This cannot be used with the MELDASMAGIC 64 Series.)

Fig. 3.1-1 Concept of input/output processing

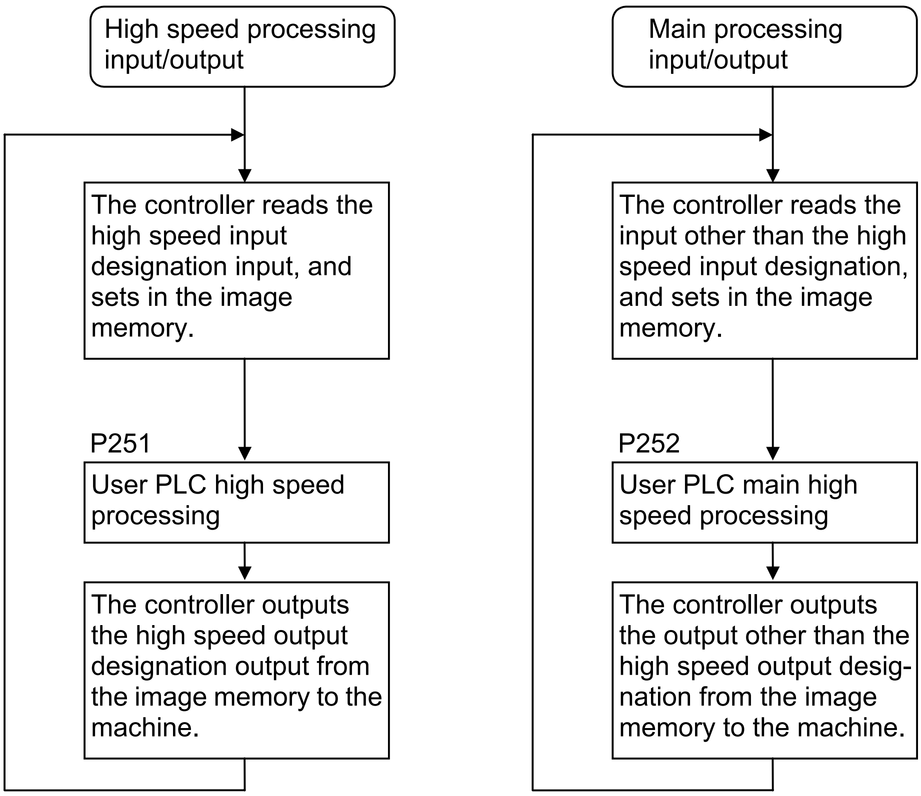


Fig. 3.1-2 Input/output processing conforming to program level

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

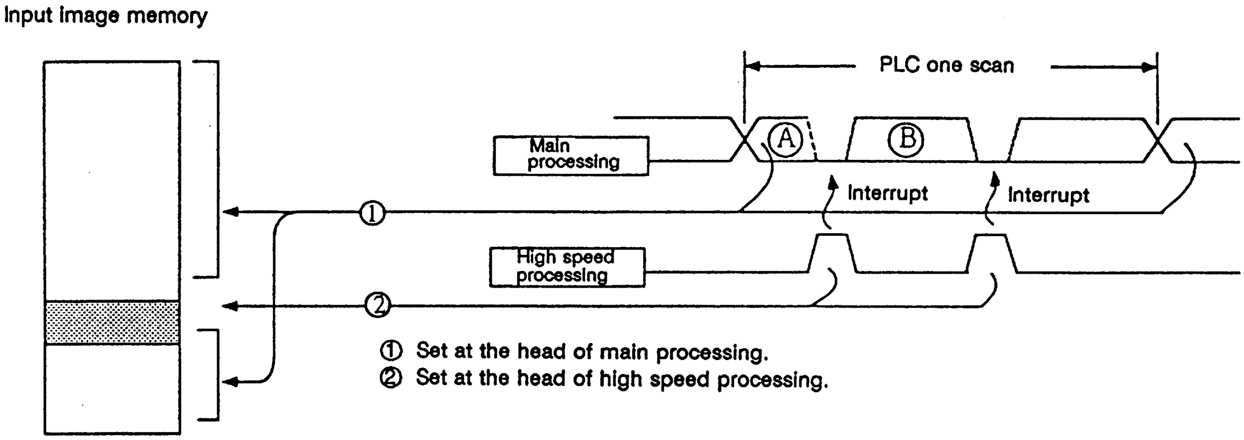
	High speed input specification	High speed output specification
Input signal from control unit	x	x
Output signal to control unit	x	x
Input signal from machine	◯ (2-byte units)	x
Output signal to machine	x	◯ (2-byte units)
Input signal from operation board (Cannot be used with the MELDASMAGIC 64 Series)	x	x
Output signal to operation board (Cannot be used with the MELDASMAGIC 64 Series)	x	x
Input signal from MELSEC when connected to MELSEC (Cannot be used with the MELDASMAGIC 64 Series)	x	x
Output signal to MELSEC when connected to MELSEC (Cannot be used with the MELDASMAGIC 64 Series)	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 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

Bit selection parameter	7	6	5	4	3	2	1	0	← Bit
#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

Bit selection parameter	7	6	5	4	3	2	1	0	← Bit
#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
└ Bits 0 and 1

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.

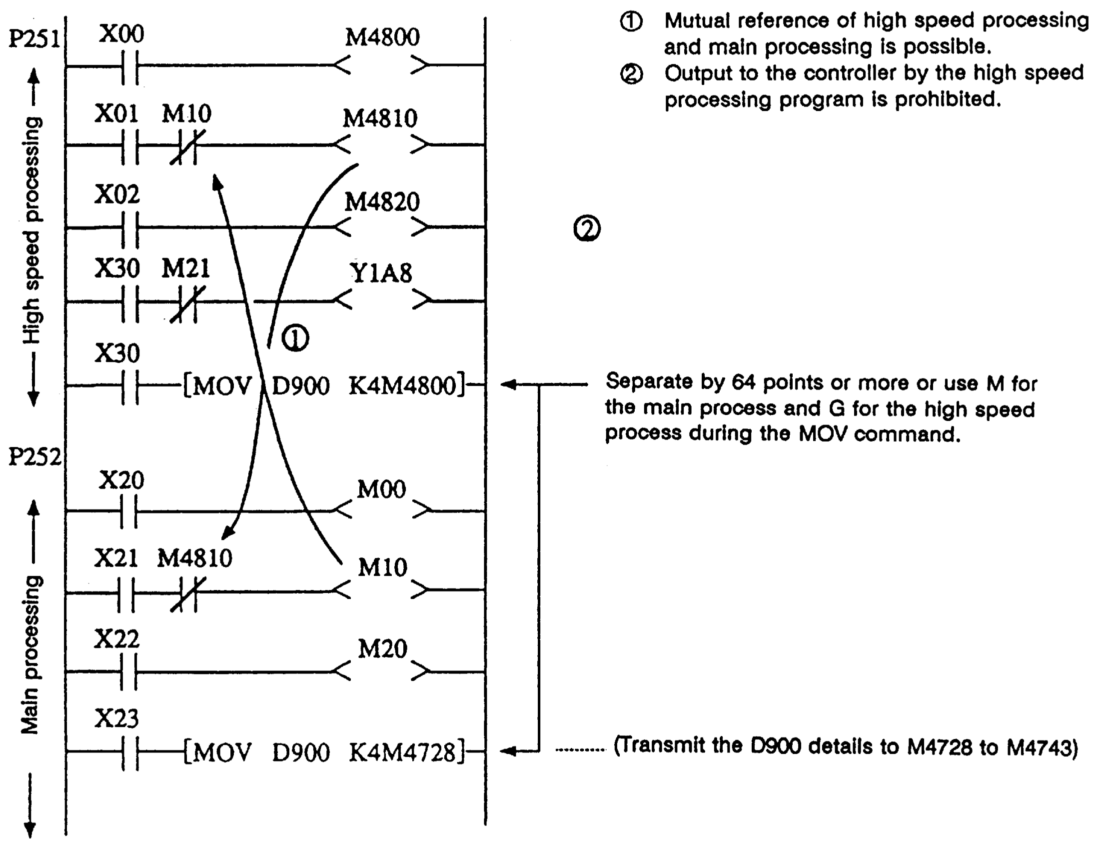
(Method 1) When using the same M or G code, the bit operation area for high speed processing and the bit operation area for main processing are separated by 64 points or more and used.

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 G, 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, G, F, E, T and Q.
(Note 3) Bit device G cannot be used for ladder program development using GPP.

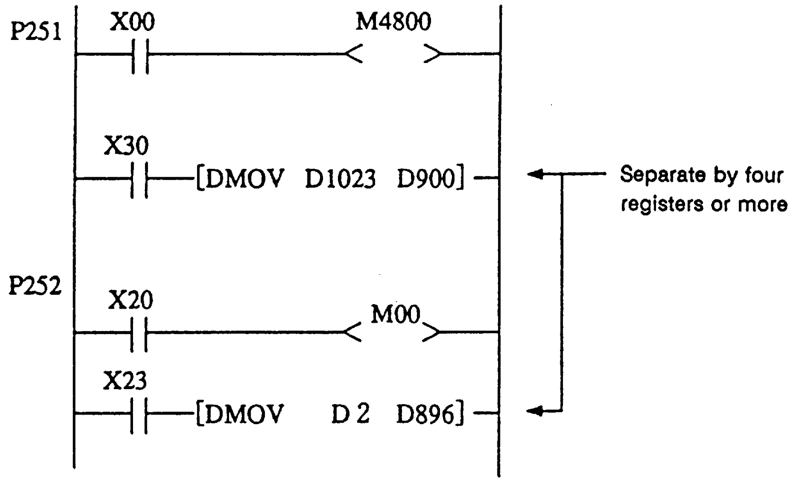
(Example)



(2) Data area

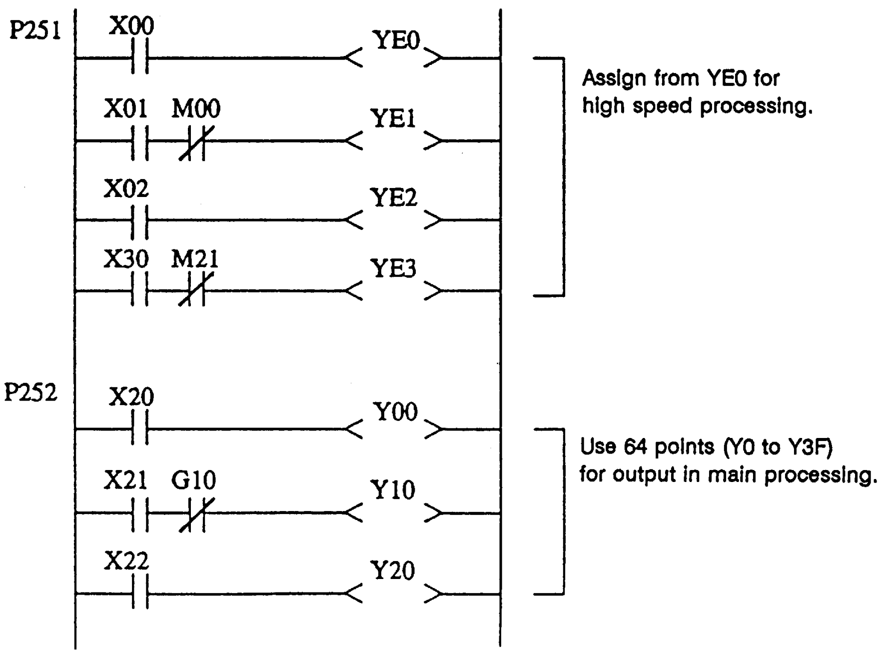
Even with commands that handle data (numerical values) during the MOV command, etc., the bit area must be separated by 64 points or more and the data register (D) and file register (R) separated by four registers or more.

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 raised 1 or more.

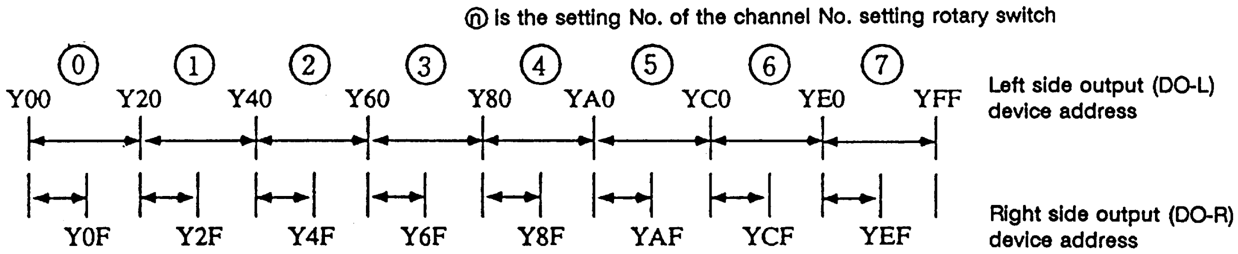


(Usage example 1) Avoid interference with the main process by assigning 7 (last channel) for the channel No. rotary switch for high speed processing output.
For example, use YE0 to YFF (for 32-point DO-L) or YE0 to YEF (for 16-point DO-R) as the high speed processing output.
(Refer to <Usage examples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

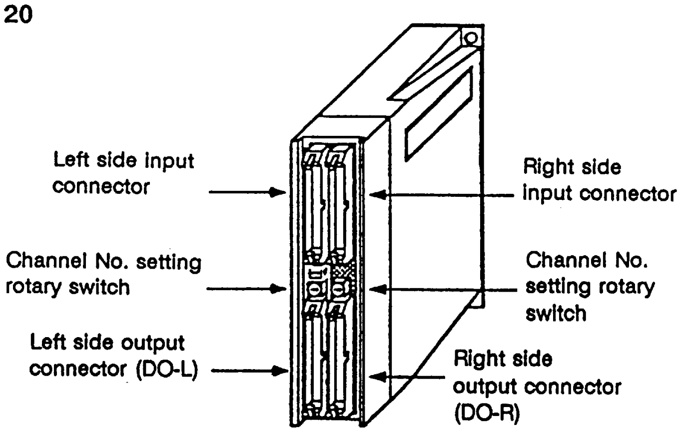
(Usage example 2) Assign Y0 to Y1F (32-point) for high speed processing, and use Y20 and following for the main process.
(Refer to <Usage example 2> below.)

(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.)

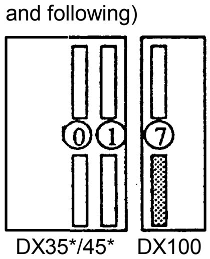
Relation of channel No. setting switch and device No.



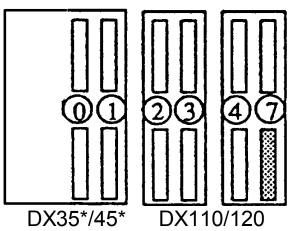
Appearance of remote I/O unit DX110/DX120
(DX100 only has the left side connector)



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

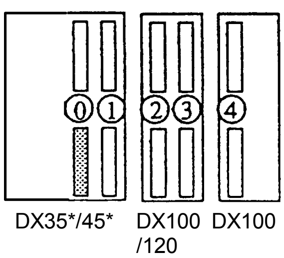


<Usage example 1-2>

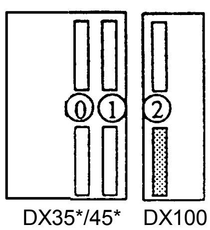


Usage examples 1-2 show the assignment for the 16-point unit as the No. of high speed output points is relatively low.

<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		#	Corresponding file registers		#	Corresponding file registers	
	High order	Low order		High order	Low order		High order	Low order
6301	R2801	R2800	6321	R2841	R2840	6341	R2881	R2880
6302	R2803	R2802	6322	R2843	R2842	6342	R2883	R2882
6303	R2805	R2804	6323	R2845	R2844	6343	R2885	R2884
6304	R2807	R2806	6324	R2847	R2846	6344	R2887	R2886
6305	R2809	R2808	6325	R2849	R2848	6345	R2889	R2888
6306	R2811	R2810	6326	R2851	R2850	6346	R2891	R2890
6307	R2813	R2812	6327	R2853	R2852	6347	R2893	R2892
6308	R2815	R1814	6328	R2855	R2854	6348	R2895	R2894
6309	R2817	R2816	6329	R2857	R2856			
6310	R2819	R2818	6330	R2859	R2858			
6311	R2821	R2820	6331	R2861	R2860			
6312	R2823	R2822	6322	R2863	R2862			
6313	R2825	R2824	6333	R2865	R2864			
6314	R2827	R2826	6334	R2867	R2866			
6315	R2829	R2828	6335	R2869	R2868			
6316	R2831	R2830	6336	R2871	R2870			
6317	R2833	R2832	6337	R2873	R2872			
6318	R2835	R2834	6338	R2875	R2874			
6319	R2837	R2836	6339	R2877	R2876			
6320	R2839	R2838	6340	R2879	R2878			

PLC constant screen

[PLC DATA] SETUP PARAM 6. 4/ 6

#		#		#		#	
6301	0	6313	0	6325	0	6337	0
6302	0	6314	0	6326	0	6338	0
6303	0	6315	0	6327	0	6339	0
6304	0	6316	0	6328	0	6340	0
6305	0	6317	0	6329	0	6341	0
6306	0	6318	0	6330	0	6342	0
6307	0	6319	0	6331	0	6343	0
6308	0	6320	0	6332	0	6344	0
6309	0	6321	0	6333	0	6345	0
6310	0	6322	0	6334	0	6346	0
6311	0	6323	0	6335	0	6347	0
6312	0	6324	0	6336	0	6348	0

#(   ) DATA(   )

MC-ERR PLC MACRO PSW MENU

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, G) 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	#	Corresponding file register	#	Corresponding file register	#	Corresponding file register
6401	R2900-LOW	6433	R2916-LOW	6449	R2924-LOW	6481	R2940-LOW
6402	R2900-HIGH	6434	R2916-HIGH	6450	R2924-HIGH	6482	R2940-HIGH
6403	R2901-L	6435	R2917-L	6451	R2925-L	6483	R2941-L
6404	R2901-H	6436	R2917-H	6452	R2925-H	6484	R2941-H
6405	R2902-L	6437	R2918-L	6453	R2926-L	6485	R2942-L
6406	R2902-H	6438	R2918-H	6454	R2926-H	6486	R2942-H
6407	R2903-L	6439	R2919-L	6455	R2927-L	6487	R2943-L
6408	R2903-H	6440	R2919-H	6456	R2927-H	6488	R2943-H
6409	R2904-L	6441	R2920-L	6457	R2928-L	6489	R2944-L
6410	R2904-H	6442	R2920-H	6458	R2928-H	6490	R2944-H
6411	R2905-L	6443	R2921-L	6459	R2929-L	6491	R2945-L
6412	R2905-H	6444	R2921-H	6460	R2929-H	6492	R2945-H
6413	R2906-L	6445	R2922-L	6461	R2930-L	6493	R2946-L
6414	R2906-H	6446	R2922-H	6462	R2930-H	6494	R2946-H
6415	R2907-L	6447	R2923-L	6463	R2931-L	6495	R2947-L
6416	R2907-H	6448	R2923-H	6464	R2931-H	6496	R2947-H
6417	R2908-L	Use bit selection parameters #6401~#6448 freely.		6465	R2932-L	Bit selection parameter #6449~#6496 are PLC operation selection parameters used by the machine manufacturer and MITSUBISHI. The contents are fixed.	
6418	R2908-H			6466	R2932-H		
6419	R2909-L			6467	R2933-L		
6420	R2909-H			6468	R2933-H		
6421	R2910-L			6469	R2934-L		
6422	R2910-H			6470	R2934-H		
6423	R2911-L			6471	R2935-L		
6424	R2911-H			6472	R2935-H		
6425	R2912-L			6473	R2936-L		
6426	R2912-H			6474	R2936-H		
6427	R2913-L			6475	R2937-L		
6428	R2913-H			6476	R2937-H		
6429	R2914-L			6477	R2938-L		
6430	R2914-H			6478	R2938-H		
6431	R2915-L			6479	R2939-L		
6432	R2915-H			6480	R2939-H		

Bit selection screen

```
[BIT SELECT]                                                  SETUP PARAM 6. 5/ 6
#    76543210   #    76543210   #    76543210   #    76543210   #    76543210
6401 00000000   6413 00000000   6425 00000000   6437 00000000   6449 00000000
6402 00000000   6414 00000000   6426 00000000   6438 00000000   6450 00000000
6403 00000000   6415 00000000   6427 00000000   6439 00000000   6451 00000000
6404 00000000   6416 00000000   6428 00000000   6440 00000000   6452 00000000
6405 00000000   6417 00000000   6429 00000000   6441 00000000   6453 00000000
6406 00000000   6418 00000000   6430 00000000   6442 00000000   6454 00000000
6407 00000000   6419 00000000   6431 00000000   6443 00000000   6455 00000000
6408 00000000   6420 00000000   6432 00000000   6444 00000000   6456 00000000
6409 00000000   6421 00000000   6433 00000000   6445 00000000   6457 00000000
6410 00000000   6422 00000000   6434 00000000   6446 00000000   6458 00000000
6411 00000000   6423 00000000   6435 00000000   6447 00000000   6459 00000000
6412 00000000   6424 00000000   6436 00000000   6448 00000000   6460 00000000
                  76543210
#(     ) DATA(         )

     MC-ERR          PLC          MACRO          PSW          MENU
```

Contents of bit selection parameters #6449~#6496

	Symbol name	7	6	5	4	3	2	1	0
0	Bit selection #6449 R2924L	Control unit thermal alarm valid	CRT thermal alarm valid (Note 4)	—		Counter C hold	Integrating timer T hold	PLC counter program valid	PLC timer program valid
1	#6450 R2924H			Alarm/ operator changeover	Message full screen display	—	Operator message	1: R mode / 0: L mode	Alarm message valid
2	#6451 R2925L	—	—					—	Onboard valid
3	#6452 R2925H	—				Counter B hold (V)	Integrating timer Q hold (V)		—
4	#6453 R2926L	—	—	—	—	—	Message Language change code		
5	#6454 R2926H								
6	#6455 R2927L	—	—	—	—	—	—	—	—
7	#6456 R2927H	—	—	—	—	—	—	—	—
8	#6457 R2928L			High speed input designation 1					
9	#6458 R2928H			High speed input designation 2					
A	#6459 R2929L	(Reserved)		High speed input designation 3					
B	#6460 R2929H	(Reserved)		High speed input designation 4					
C	#6461 R2930L			High speed output designation 1					
D	#6462 R2930H			High speed output designation 2					
E	#6463 R2931L	(Reserved)		High speed output designation 3					
F	#6464 R2931H	(Reserved)		High speed output designation 4					

	Symbol name	7	6	5	4	3	2	1	0
0	#6465 R2932L	—	—	—	—	—	—	—	—
1	#6466 R2932H	—	—	—	—	—	—	—	—
2	#6467 R2933L	—	—	—	—	—	—	—	—
3	#6468 R2933H	—	—	—	—	—	—	—	—
4	#6469 R2934L				Standard PLC parameter			—	NC alarm 4 output disabled
5	#6470 R2934H								
6	#6471 R2935L	—	—	—	—	—	—	—	—
7	#6472 R2935H	—	—	—	—	—	—	—	—
8	#6473 R2936L	—							—
9	#6474 R2936H								
A	#6475 R2937L								
B	#6476 R2937H								
C	#6477 R2938L								
D	#6478 R2938H								
E	#6479 R2939L								
F	#6480 R2939H								

(Note 1) The bits marked — are used by the system. Be sure to set to 0.
(Note 2) Parameters #6481~#6496 are not used. They are for debugging at MITSUBISHI.
(Note 3) For the parameter meanings, refer to the PLC Onboard Manual.
(Note 4) These cannot be used with the MELDASMAGIC 64 Series.

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, U, W, 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~X4BF (1216 points)	1 bit	Input signal to PLC. Machine input, etc.
Y*	Y0~Y53F (1344 points)	1 bit	Output signal from PLC. Machine output, etc.
U*	U0~U178 (384 points)	1 bit	Input signal to PLC for second system. Signal for No.2 system.
W*	W0~W1FF (512 points)	1 bit	Output signal from PLC for second system. Signal for No.2 system.
M	M0~M5119 (5120 points)	1 bit	Temporary memory
G	G0~G3071 (3072 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)
E*	E0~E127 (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
Q	Q0~Q39 (40 points)	1 bit or 16 bits	10ms unit timer (fixed)
	Q40~Q135 (96 points)	1 bit or 16 bits	100ms unit timer (fixed)
	Q136~Q151 (16 points)	1 bit or 16 bits	100ms unit integrating timer (fixed)
C	C0~C23 (24 points)	1 bit or 16 bits	Counter
B	B0~B103 (104 points)	1 bit or 16 bits	Counter (Fixed 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.
A	A0, A1 (2 points)	16 bits or 32 bits	Accumulator
Z	— (1 point)	16 bits	Index of D or R address (±n)
V	— (1 point)	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 commands
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) Devices I, J and S are available besides the above devices, but must not be used.

5.3 Detailed Explanation of Devices

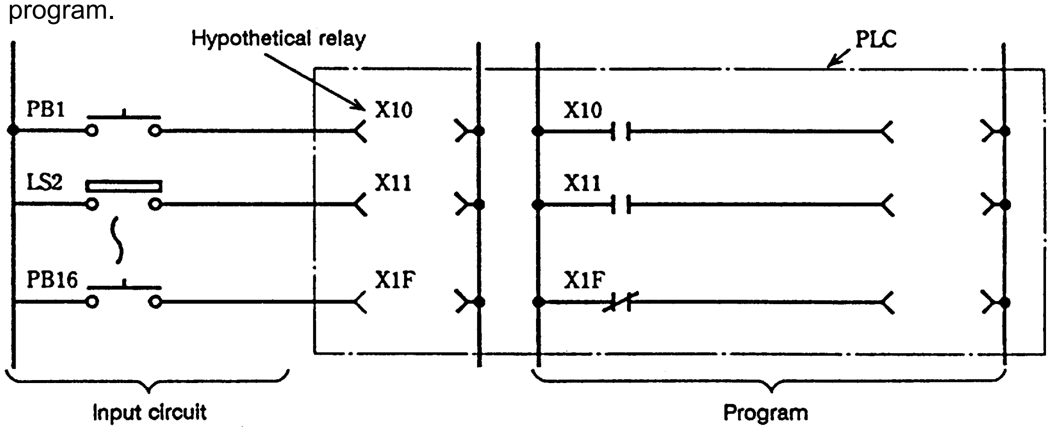
The devices used with the PLC are described below.

5.3.1 Input/output X, Y, U, W

Input/output X, Y, U and W are a window for executing communication with the PLC and external device or controller.

Input X, U

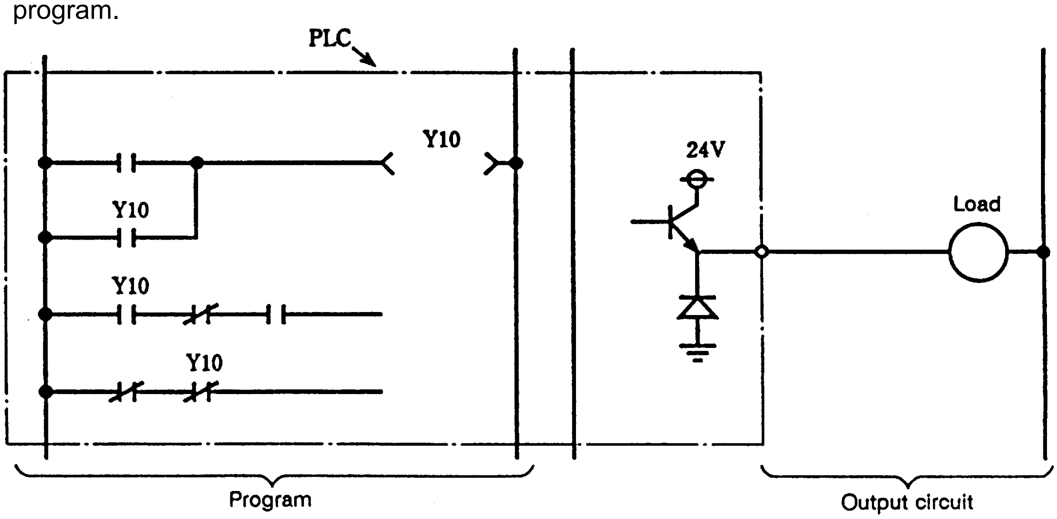
(1) This issued commands or data from an external device such as a push-button, changeover switch, limit switch or digital switch to the PLC.
(2) Assuming that there is a hypothetical relay Xn built-in the PLC per input point, the program uses the a contact and b contact of that Xn.
(3) There is no limit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



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

Output Y, W

(1) This outputs the results of the program control to the solenoid, magnetic switch, signal lamp or digital indicator, etc.
(2) The output (Y) can be retrieved with the equivalent of 1a contact.
(3) There is no limit to the No. of a contacts and b contacts of the output Yn that can be used in the program.



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

5.3.2 Internal Relays M , G 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 and G

(1) These relays are cleared when the power is turned OFF.
(2) There is no limit to the No. of a contacts and b contacts of the input relays that can be used in the program.
(3) 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

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

5.3.3 Special Relays E

The special relays are relays having fixed applications such as the carrier flag for operation results and the display request signal to the CRT setting and display unit. Even the relays of E0 to E127 that are not currently used must not be used as temporary memory.

Special relays E

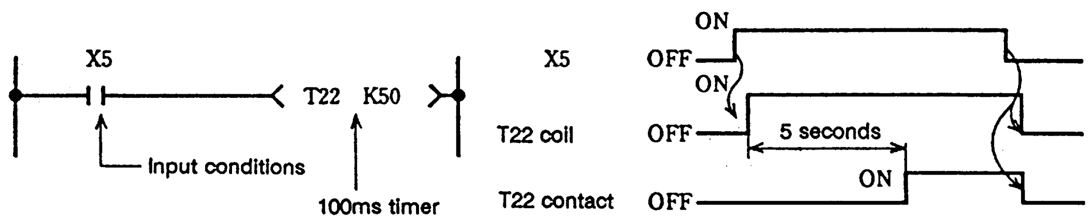
(1) These relays are cleared when the power is turned OFF.
(2) There is no limit to the No. of a contacts and b contacts of the special relays that can be used in the program.
(3) The special relay No. is expressed with a decimal.

5.3.4 Timer T, Q

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

100ms Timer T, Q

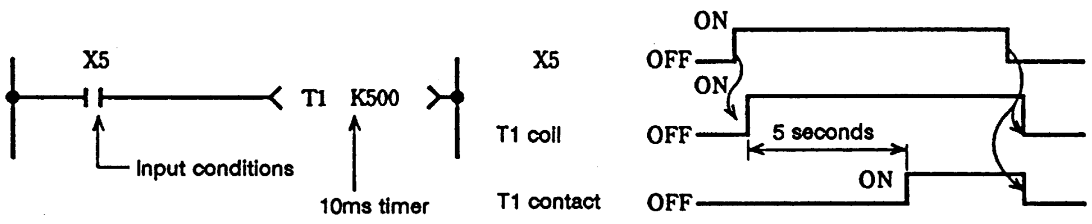
(1) When the input conditions are set, the count starts. When the set value is counted, that timer contact will turn ON.
(2) If the input conditions are turned OFF, the 100ms timer count value will be set to 0, and the contact will turn OFF.



(3) The value is set with a decimal, and can be designated from 1 to 32767 (0.1 to 3276.7 sec.). The data register (D) data can also be used as the setting value. File register (R) cannot be used.

10ms Timer T, Q

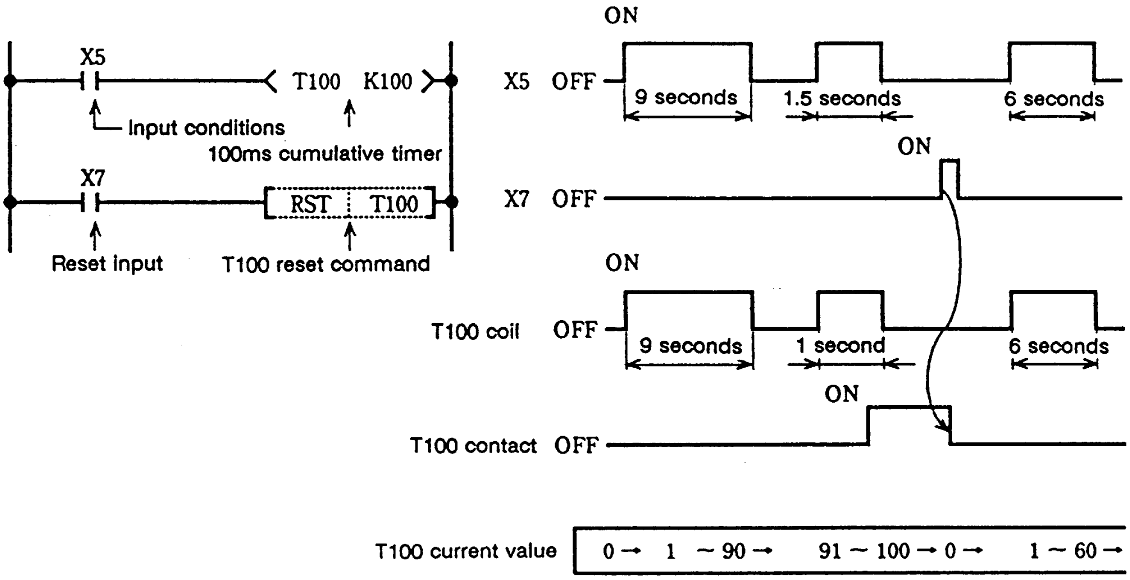
(1) When the input conditions are set, the count starts. When the set value is counted, that timer contact will turn ON.
(2) If the input conditions are turned OFF, the 10ms timer count value will be set to 0, and the contact will turn OFF.



(3) The value is set with a decimal, and can be designated from 1 to 32767 (0.01 to 327.67 sec.). The data register (D) data can also be used as the setting value. File register (R) cannot be used.

100ms Cumulative timer T, Q

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



(4) The value is set with a decimal, and can be designated from 1 to 32767 (0.1 to 3267.7 sec.). The data register (D) data can also be used as the setting value. File register (R) cannot be used.
(5) When the bit selection parameter is set, the 100ms cumulative timer current value (count value) will be held even when the power is turned OFF.

(2) Setting of timer setting value from CRT setting and display unit
The timer setting value can be set with the CRT setting and display unit using device T. (Variable timer)
Whether the setting value (Kn) programmed with the sequence program or the setting value set from the CRT setting and display unit is valid is selected with the bit selection parameters. The changeover is made in a group for T0 to T103. Even when set from the CRT 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 Q of the timer T, Q cannot be set from the CRT setting and display unit.

5.3.5 Counter C, B

(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, B

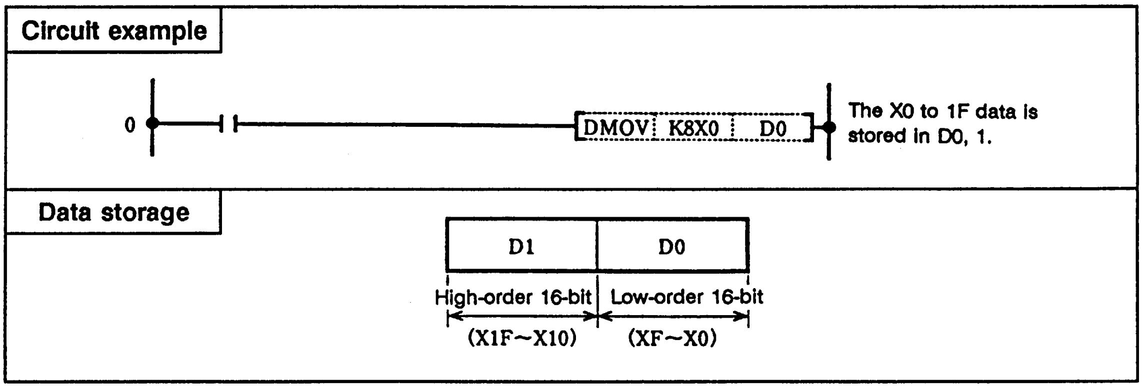
(1) The value is set with a decimal, and can be designated from 1 to 32767. The data register (D) data can also be used as the setting value. File register (R) cannot be used.
(2) The counter count value will not be cleared even if the input conditions turn OFF. The counter count value must be cleared with the RST command.
(3) When the bit selection parameter is set, the counter current value (count value) will be held even when the power is turned OFF.

(2) Setting of counter setting value from CRT setting and display unit
The counter setting value can be set with the CRT 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 CRT 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 CRT 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 B of counter C, B cannot be set from the CRT 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.
(Example) Use of the DMOV command is shown below.

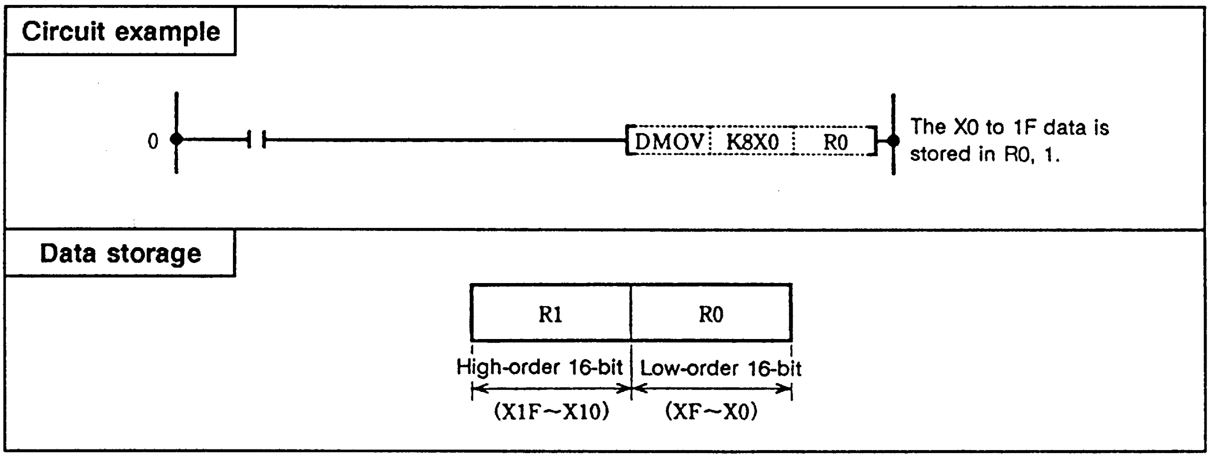


(3) The data that is stored once in the sequence program is held until other data is stored.
(4) The data stored in the data register is cleared when the power is turned OFF.
(5) Values that can be stored: Decimal -32768 to 32767 / Hexadecimal 0 to FFFF } For 16-bit command (Using Dn)
Decimal -2147483648 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) The data stored in the file registers R500 to R549 and R1900 to R2799 and the user release registers R1900 to R2799 is not cleared when the power is turned OFF.
The other file registers have fixed applications such as interface of the PLC and controller, parameter interface, etc.
(5) Values that can be stored: Decimal -32768 to 32767, Hexadecimal 0 to FFFF } For 16-bit command (Using Rn)
Decimal -2147483648 to 2147483647, Hexadecimal 0 to FFFFFFFF } For 32-bit command (Using Rn+1, Rn)

5.3.8 Accumulator A

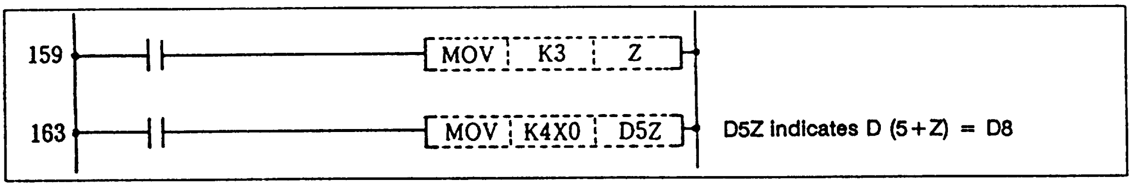
(1) The accumulator is a data register that stores the results of the function command operation and the function commands where the operation results are stored are as follow.

Commands
SER, SUM, ROR, DROR, RCR, DRCR, ROL, DROL, RCL, DRCL

(2) When using commands other than those above, the accumulator can be used in the sequence program with the equivalent registers as the data registers.
(3) The accumulator has a 1-point 16-bit configuration, and can be read and written in 16-bit units.
(4) The accumulator has two points (A0, A1). With the 32-bit command, A0 will be the low-order 16-bit, and A1 will be the high-order 16-bit. Thus, A1 cannot be designated with a 32-bit command.
(5) The data stored in the accumulator is cleared when the power is turned OFF.
(6) Values that can be stored: Decimal -32768 to 32767 } For 16-bit command (Using A1 or A0)
Hexadecimal 0 to FFFF
Decimal -2147483648 to 2147483647 } For 32-bit command
Hexadecimal 0 to FFFFFFFF (Using A1 or A0)

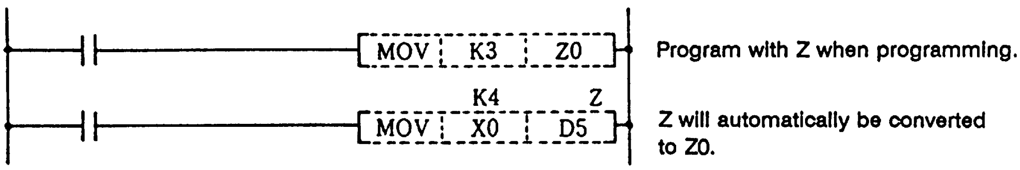
5.3.9 Index Registers Z and V

(1) Z and V index registers are available.
(2) The index registers are used as ornaments for the device (T, C, D, R).



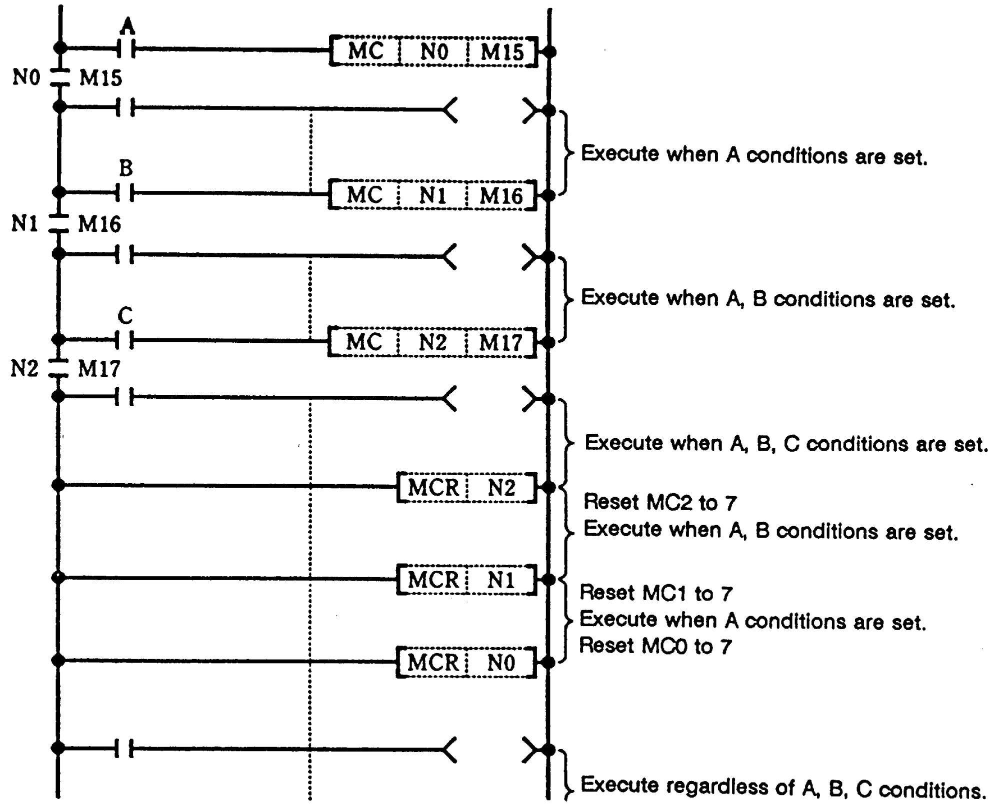
(3) The index register has a 1-point 16-bit configuration, and can be read and written in 16-bit units.
(4) The data stored in the index register is cleared when the power is turned OFF.
(5) Values that can be stored: Decimal -32768 to 32767
Hexadecimal 0 to FFFF

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



5.3.10 Nesting N

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



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

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

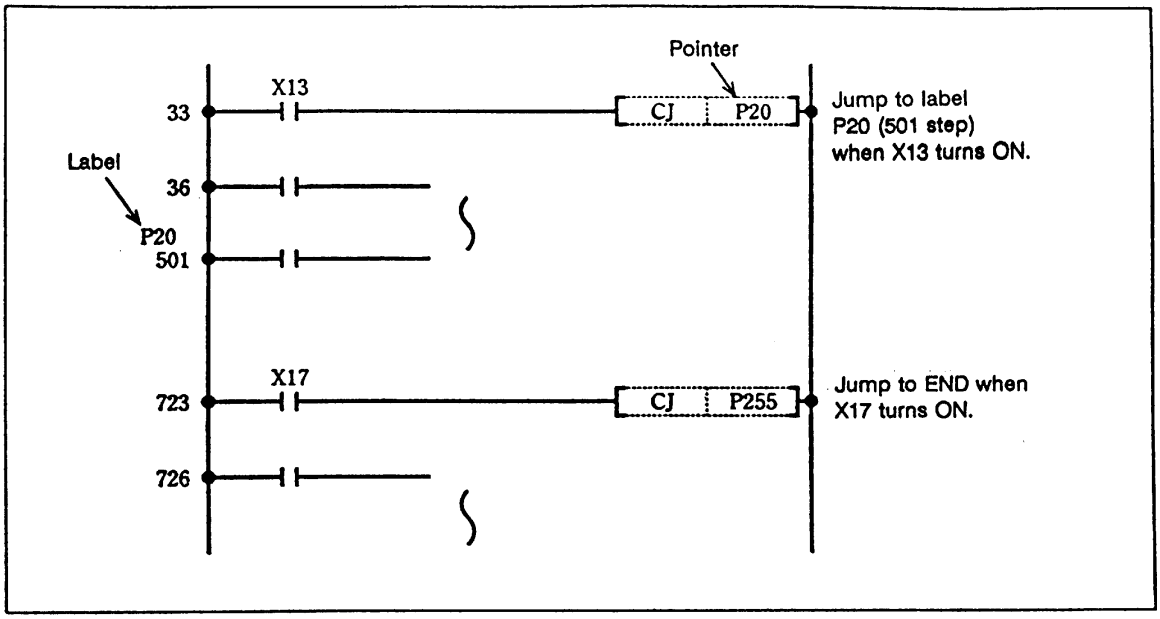
MC N2 M16 .... ON when conditions A, B are ON

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

(2) 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 cumulative timer : The current count value is retained.
- Counter: The current counter value is retained.
- OUT command: All turn OFF.

5.3.11 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 and P255 are user release pointers.
(3) P255 always indicates END.
(P255 can be used as a device such as a CJ command, 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.
This can be omitted when there is only a PLC main (ladder) processing program.
P128 to P159: Label for page return when printing out ladder diagram.
P128 to P159 are the head label of the return page. These can also be used as the normal CJ and CALL commands.

(Note 1) P251 and P252 cannot be used as CJ or CALL command devices.
(Note 2) 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 3) The P** used as a CJ or CALL command device must also be programmed as a label.

The PLC will not operate correctly if Notes 1 to 3 are not observed.

5.3.12 Decimal Constant K

(1) The decimal constant can be used in the following ways.
1) Timer counter setting value: Designate in the range of 1 to 32767.
2) Pointer No.: 0 to 159
3) Bit device digit designation: 1 to 8
4) 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 BIN value (binary) in the PLC.

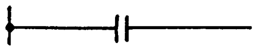
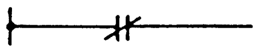
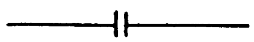
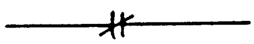
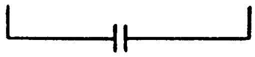
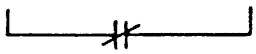
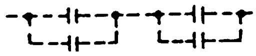
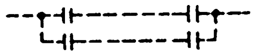
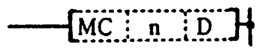
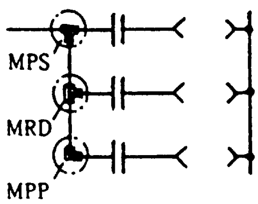
5.3.13 Hexadecimal Constant H

(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	L D		Start of logic operation (A contact operation start)	1	39
		LDI		Start of logic denial operation (B contact operation start)	1	39
		AND		Logical AND (A contact serial connection)	1	41
		ANI		Logical AND denial (B contact serial connection)	1	41
		O R		Logical OR (A contact parallel connection)	1	43
		ORI		Logical OR denial (B contact parallel connection)	1	43
		ANB		AND between logical blocks (Serial connection between blocks)	1	45
		ORB		OR between logical blocks (Parallel connection between blocks)	1	47
		OUT		Device output	1~2	49
		SET		Device set	2	55
		RST		Device reset	2	57
		M C		Master control start	3	59
		MCR		Master control release	2	59
		PLS		Generate one cycle worth of pulses at rising edge of input signal	2	61
		PLF		Generate one cycle worth of pulses at falling edge of input signal	2	61
		SFT		Device 1-bit shift	2	63
		MPS		Registration of logical operation	1	65
		MRD		Read of operation results registered in MPS	1	65
		MPP		Reading and resetting of operation results registered in MPS	1	65
		DEFR		Generate one cycle worth of pulses to oper-ation results at rising edge of input signal	1	67

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	70
		AND =	[= S1 S2]		3	70
		OR =	[= S1 S2]		3	70
	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	72
		ANDD=	[D= S1 S2]		3~4	72
		ORD =	[D= S1 S2]		3~4	72
>	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

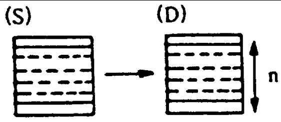
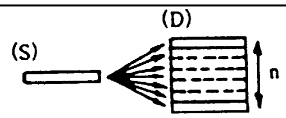
(2) Arithmetic operation commands

Class	Process unit	Command sign	Symbol	Process details	No. of steps	Page
+	16-bit	+	[+ S1 S2 D]	(S1) + (S2) → (D)	4	82
	32-bit	D+	[D+ S1 S2 D]	(S1+1, S1) + (S2+1, S2) → (D+1, D)	4~5	84
–	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) x (S2) → (D+1, D)	4	90
	32-bit	D*	[D∗ S1 S2 D]	(S1+1, S1) x (S2+1, S2) → (D+3, D+2, D+1, D)	4~5	92
/	16-bit	/	[/ S1 S2 D]	(S1) ≒ (S2) → (D) Quotient (D) Remainder (D+1)	4	94
	32-bit	D/	[D/ S1 S2 D]	(S1+1, S1) ≒ (S2+1, S2) → Quotient (D+1,D) Remainder (D+3, D+2)	4~5	96
+1	16-bit	INC	[INC D]	(D) + 1 → (D)	2	98
	32-bit	DINC	[DINC D]	(D+1, D) + 1 → (D + 1, D)	2	100
–1	16-bit	DEC	[DEC D]	(D) – 1 → (D)	2	102
	32-bit	DDEC	[DDEC D]	(D + 1, D) – 1 → (D + 1, D)	2	104

(3) BCD ↔ BIN conversion commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
BCD	16-bit	BCD	[BCD S D]	(S) BIN (0~9999) → BCD conversion → (D)	3	106
	32-bit	DBCD	[DBCD S D]	(S1+1, S1) BIN (0~99999999) → BCD conversion → (D+1, D)	3	108
BIN	16-bit	BIN	[BIN S D]	(S) BCD (0~9999) → BIN conversion → (D)	3	110
	32-bit	DBIN	[DBIN S D]	(S1+1, S1) BCD (0~99999999) → BIN conversion → (D+1, D)	3	112

(4) Data transmission commands

Class	Pro-cess unit	Command sign	Symbol	Process details	No. of step	Page
Transmission	16-bit	MOV	[MOV S D]	(S) → (D)	3	114
	32-bit	DMOV	[DMOV S D]	(S+1, S) → (D+1, D)	3~4	116
Con-ver-sion	16-bit	XCH	[XCH D1 D2]	(D1) ↔ (D2)	3	118
	32-bit	DXCH	[DXCH D1 D2]	(D1 + 1, D1) ↔ (D2 + 1, D2)	3	120
Batch trans-mis-si on	16-bit	BMOV	[BMOV S D n]		4	122
Batch trans-mission of same data	16-bit	FMOV	[FMOV S D n]		4	124

(5) Program branch commands

Class	Pro-cess unit	Command sign	Symbol	Process details	No. of step	Page
Jump	—	CJ	[CJ P**]	Jump to P** after input conditions are set	2	126
Pro-gr am end	—	FEND	[FEND]	End process during sequence program	1	128
Sub-r ou-tin e call	—	CALL	[CALL P**]	Execute P** sub-routine program after input conditions are set	2	130
Re-tur n	—	RET	[RET]	Return to main program from subroutine program	1	130

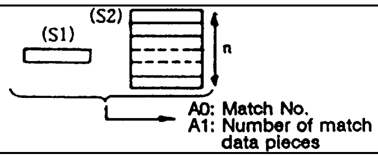
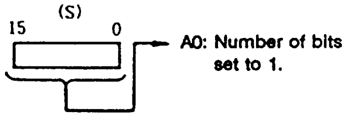
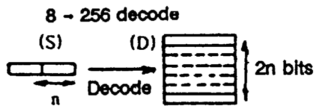
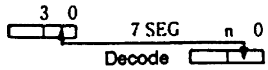
(6) Logical operation commands

Class	Pro-cess unit	Command sign	Symbol	Process details	No. of step	Page
Logical AND	16-bit	WAND	[WAND S1 S2 D]	(S1) ^ (S2) → (D)	4	132
	32-bit	DAND	[DAND S D]	(D + 1, D) ^ (S + 1, S) → (D + 1, D)	3~4	134
Logical OR	16-bit	WOR	[WOR S1 S2 D]	(S1) V (S2) → (D)	4	136
	32-bit	DOR	[DOR S D]	(D + 1, D) V (S + 1, S) → (D + 1, D)	3~4	138
Exclu-sive OR	16-bit	WXOR	[WXOR S1 S2 D]	(S1) V– (S2) → (D)	4	140
	32-bit	DXOR	[DXOR S D]	(D + 1, D) (S + 1, S) → (D + 1, D)	3~4	142
Com-plement of 2	16-bit	NEG	[NEG D]	(D) + 1 → (D)	2	144

(7) Rotation commands

Class	Pro-cess unit	Command sign	Symbol	Process details	No. of step	Page
Right rotation	16-bit	ROR	[ROR n]	Rotate n bits right.	2	146
		RCR	[RCR n]	Rotate n bits right.	2	148
	32-bit	DROR	[DROR n]	Rotate n bits right.	2	150
		DRCR	[DRCR n]	Rotate n bits right.	2	152
Left rotation	16-bit	ROL	[ROL n]	Rotate n bits left.	2	154
		RCL	[RCL n]	Rotate n bits left.	2	156
	32-bit	DROL	[DROL n]	Rotate n bits left.	2	158
		DRCL	[DRCL n]	Rotate n bits left.	2	160
Right shift	16-bit	SFR	[SFR D n]		3	162
	Devic unit	DSFR	[DSFR D n]		3	164
Left shift	16-bit	SFL	[SFL D n]		3	166
	Devic unit	DSFL	[DSFL D n]		3	168

(8) Data processing commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Search	16-bit	SER	[SER : S1 : S2 : n]		4	170
Number of bits set to 1	16-bit	SUM	[SUM : S]		2	172
Decode	2n-bit	DECO	[DECO : S : D : n]		4	174
	16-bit	SEG	[SEG : S : D]		3	176
Average value	16-bit	AVE	[AVE : S : D : n]	16-bit data average value $\frac{1}{n}\sum_{i=1}^{a}(S+i)\rightarrow(D)$	4	178

(9) Other function commands

Class	Process unit	Command sign	Symbol	Process details	No. of step	Page
Carry flag set	—	STC	[STC]	Carry flag contact (E12) is turned on.	1	180
Carry flag reset	—	CLC	[CLC]	Carry flag contact (E12) is turned off.	1	180
BIT	1-bit	LDBIT	[BIT : S1 : n]	Bit test (a contact operation start handling)	3	182
		ANDBIT	[BIT : S1 : n]	Bit test (a contact series connection handling)	3	182
		ORBIT	[BIT : S1 : n]	Bit test (a contact parallel connection handling)	3	182
		LDBII	[BII : S1 : n]	Bit test (b contact operation start handling)	3	184
		ANDBII	[BII : S1 : n]	Bit test (b contact series connection handling)	3	184
		ORBII	[BII : S1 : n]	Bit test (b contact parallel connection handling)	3	184

6.1.3 Exclusive commands

Class	Pro-cess unit	Command sign	Symbol	Process details	No. of step	Page
ATC	—	ATC	ATC : Kn : Rn : Rm	K1: Tool number search	4	194
				K2: Tool number AND search		195
				K3: Tool change		196
				K4: Random position tool change		197
				K5: Forward rotation of pointer		198
				K6: Reverse rotation of pointer		198
				K7: Normal rotation of tool table		199
				K8: Reverse rotation of tool table		199
				K9: Tool data read		200
				K10: Tool data write		201
				K11: Automatic write of tool data		202
ROT	—	ROT	ROT : Kn : Rn : Rm	K1: Rotary body index	4	207
				K3: Ring counter		210
TSRH	—	TSRH	TSRH : Rm : Rn	Spare tool selection in tool life management	3	211
DDB	—	DDBA (Asynchro-nous)	DDBA : Rn	Data designated after Rn is read/written.	2	222
		DDBS (Synchro-nous)	DDBS : Rn	Data designated after Rn is read/written.	2	225

6.2 Command Formats

6.2.1 How to Read the Command Table

The basic command and function command explanations are as follow.

Example) Explanation of D+ command

D+ ... BIN 32-bit addition ← The command sign is indicated.

	Usable device																				Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer						
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P						
S1							○	○	○	○		○										4/5		
S2							○	○	○	○		○				○	○							
D							○	○	○	○		○												

Expressed with T. Same applies for Q.

Same applies for B.

Same applies for G.

Same applies for W, J and S.

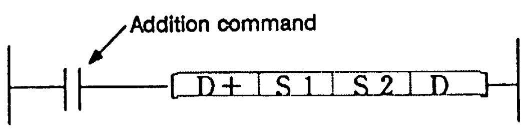
Same applies for U, I and S.

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

The No. of steps of the D+ command is indicated. 4/5 steps indicate that for the 32-bit command, two steps are required for the constant.
In the example for the D+ com-mand, if S2 is the word device and step 4 is the constant, the No. of steps will

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

The commands that can use an index (Z, V) are circled.



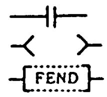
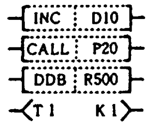
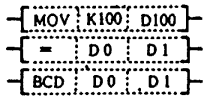
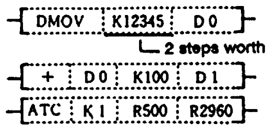
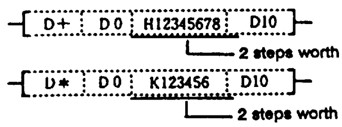
	Setting data
S1	Head No. data to be added or device where data to be added is stored.
S2	Head No. data to be added or device where data to be added is stored.
D	Head No. of device where addition results are stored.

The D+ command circuit display format is indicated.

The functions, execution conditions and program examples of each command are explained on the following pages.

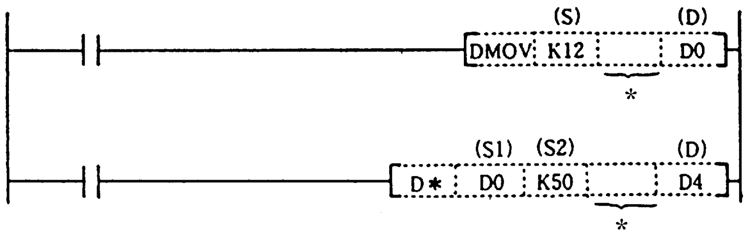
6.2.2 No. of Steps

The basic No. of steps in the sequence command includes step 1 to step 5.
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**	
Step 2	INC, DEC, SET, RST, OUT T, CJ, CALL, DDB	
Step 3	MOV, =, BCD, XCH	
Step 4	DMOV, +, -, ATC	
Step 5	D+, D-, D*, D/	

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

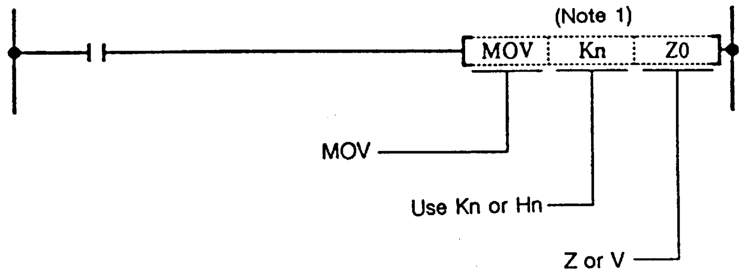


6.2.3 END Command

When programming a sequence program with a circuit mode, the END command is automatically created.

6.2.4 Index Ornament

(1) The index ornament is used to add an index (Z, V) to a device, add the details of the directly designated device No. and index register, and designate the device No.
(2) The index (Z, V) 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.
   1) Transmission of data to Z, V



(Note 1) After circuit conversion, the display will change to Z0 and V0. However, this must be input as "Z" and "V".

   2) Possible device combinations of MOV command with index ornament

	S (source)	D (destination)	Program example
MOV	Constant Kn or Hn	(Word device) · Z Example) D0Z, R500V	MOV K100 D0Z
	Word device Example) D0, R1900	(Word device) · Z Example) D0Z, R500V	MOV D0 D100V
	(Word device) · Z Example) D0Z, D1V	(Word device) · Z Example) D0V, D1Z	MOV D0Z D20Z
	(Word device) · Z Example) D0Z, D1V	Bit designation Example) K2Y20	MOV D0Z K2M10
	Bit designation Example) K2M00	(Word device) · Z Example) D0Z, R1900V	MOV K2M10 D0Z

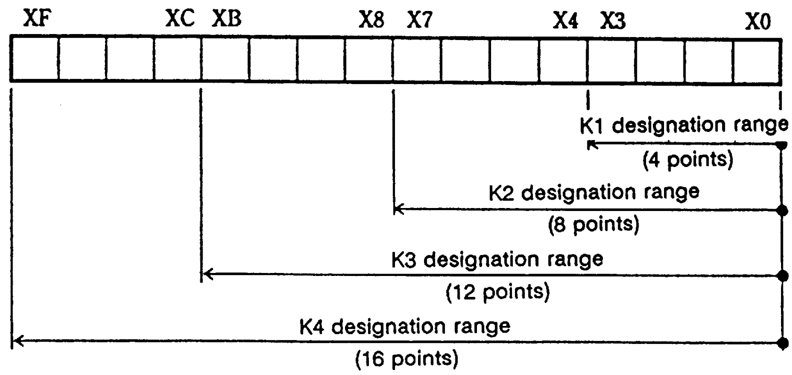
(Note 2) The word device refers to T, C, D, R, A0 and A1.
(Note 3) The CRT display of the circuit with index ornament is as shown below.

6.2.5 Digit Designation

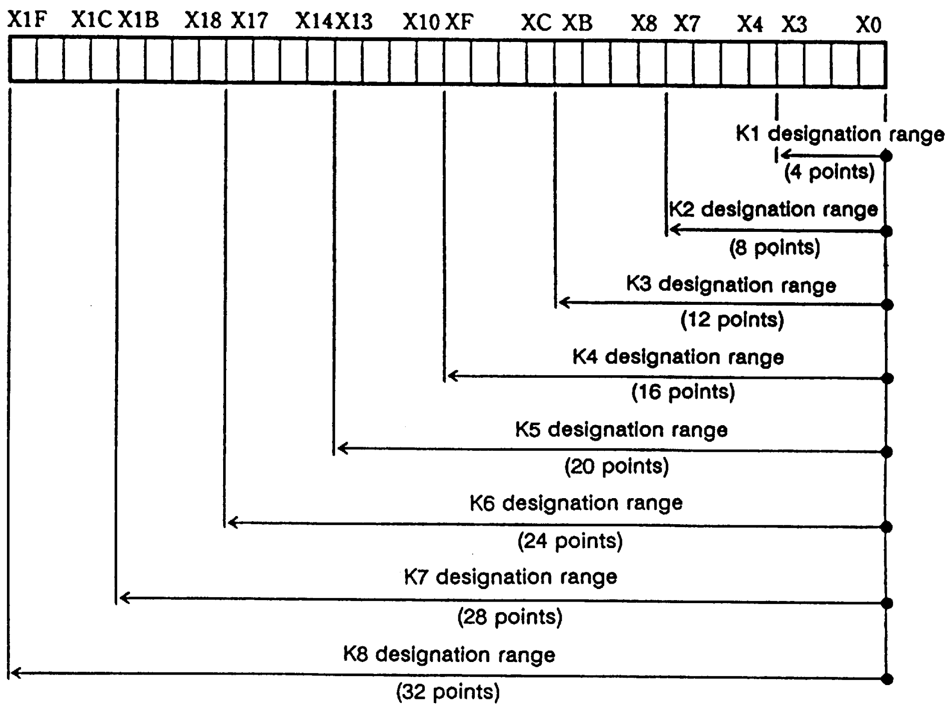
A digit may need to be designated for the bit device (X, Y, M, L, E, F) when using the function command. How many points of 4-point unit bit devices are to be used with the 16-bit or 32-bit command is selected with this digit designation.
Use device K when designating the digit. The designation range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



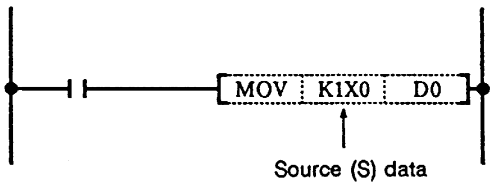
(1) When a digit is designated on the source (S) side, the values that can be handled as source data will be as shown below.

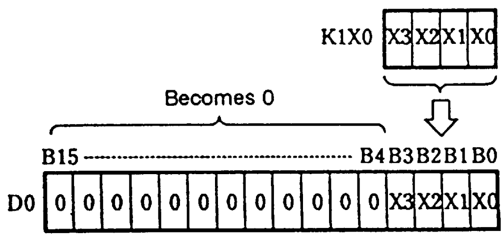
Table of digit designations and values that can be handled

	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

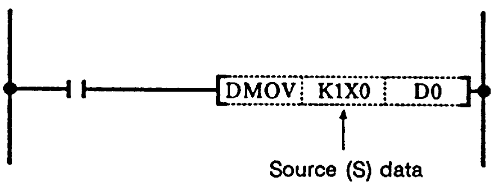
Program example / **Process**

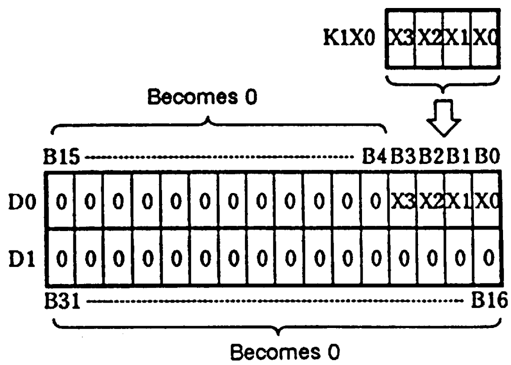
For 16-bit command



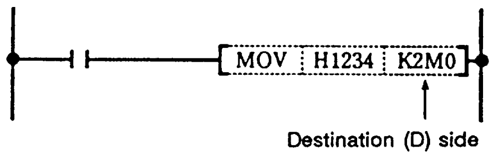
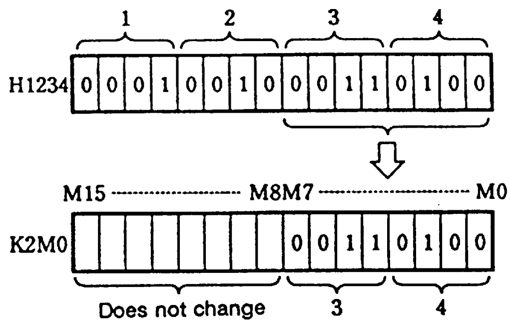
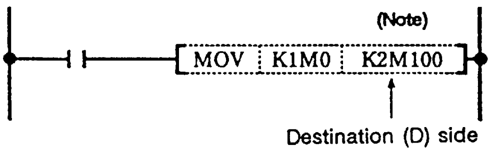
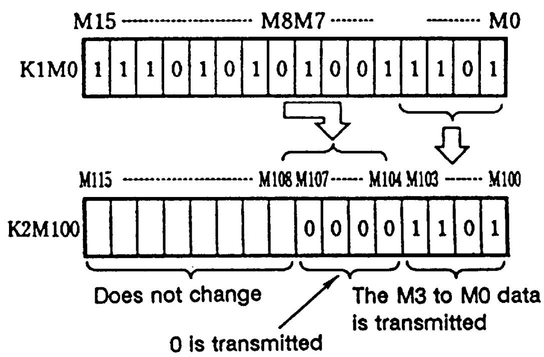
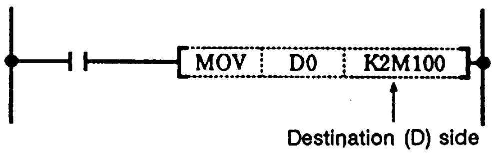
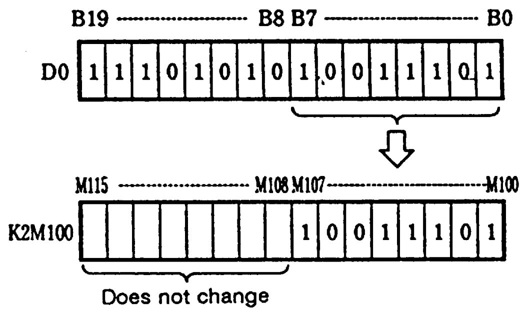


For 32-bit command

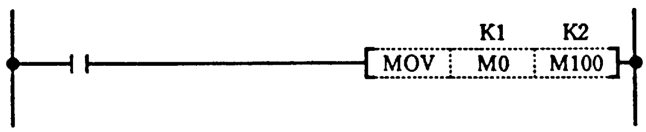




(2) When a digit is designated on the destination (D) side, the No. of points designated by the digit will be the target of the destination side.

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

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

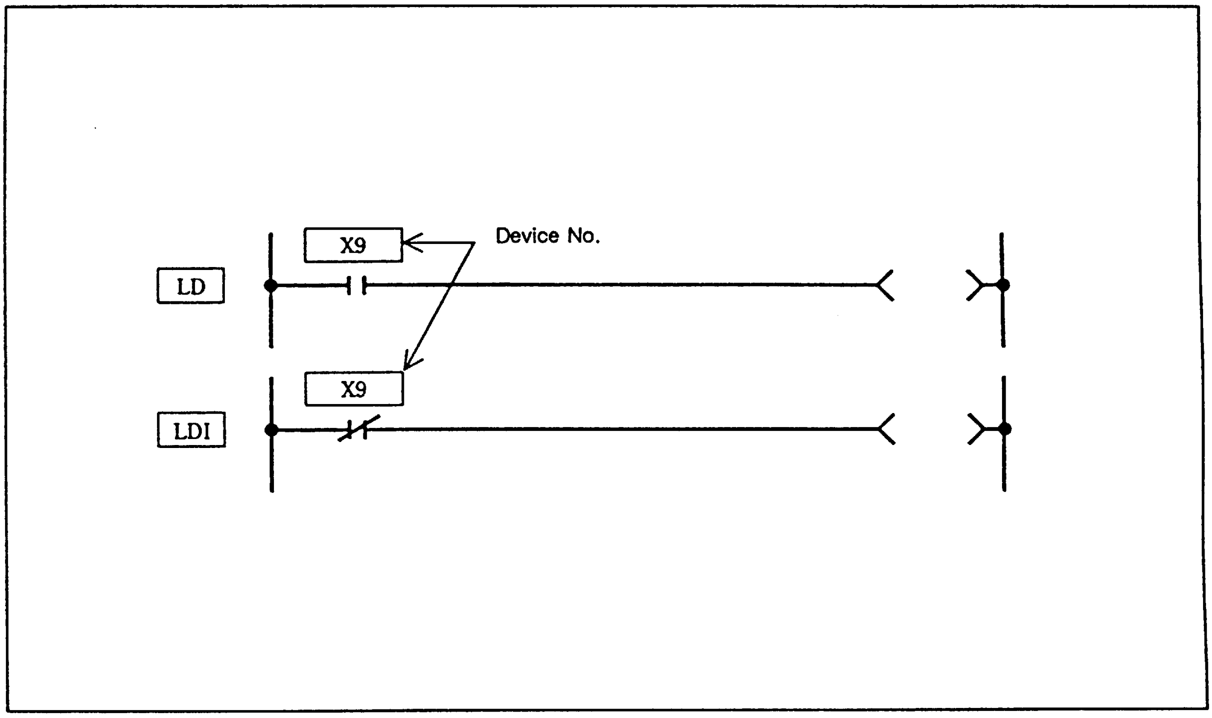


7. Basic Commands

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 (16-bit) device							Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
○	○	○	○	○	○	○	○													1		



Function

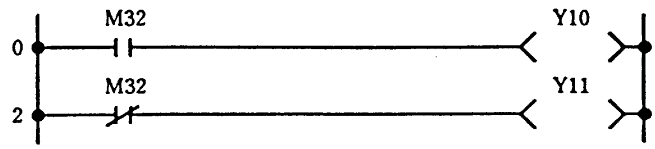
LD is the a contact operation start command and LDI is the b contact operation start command. The ON/OFF information of the designated device is read in as the operation results.

Execution conditions

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

Program example

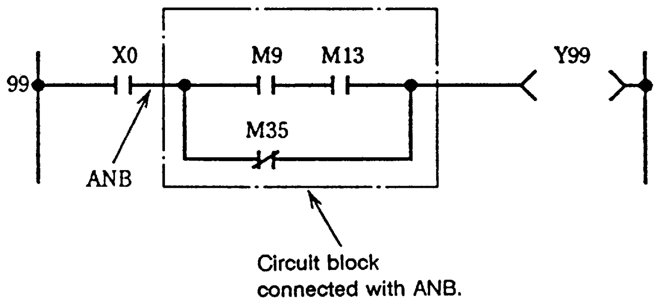
(1) Program used at head of circuit block.



Coding

No. of steps	Com-mand	Device			
0	LD	M32			
1	OUT	Y10			
2	LDI	M32			
3	OUT	Y11			

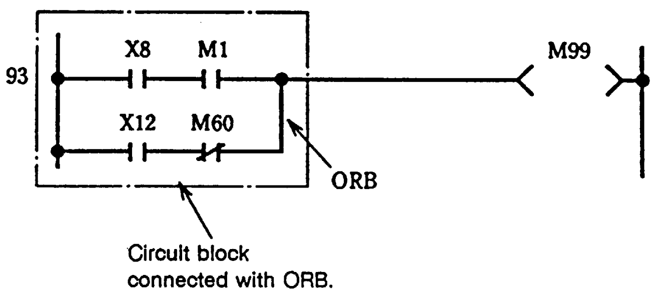
(2) Program used at head of circuit block connected with ANB.



Coding

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

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

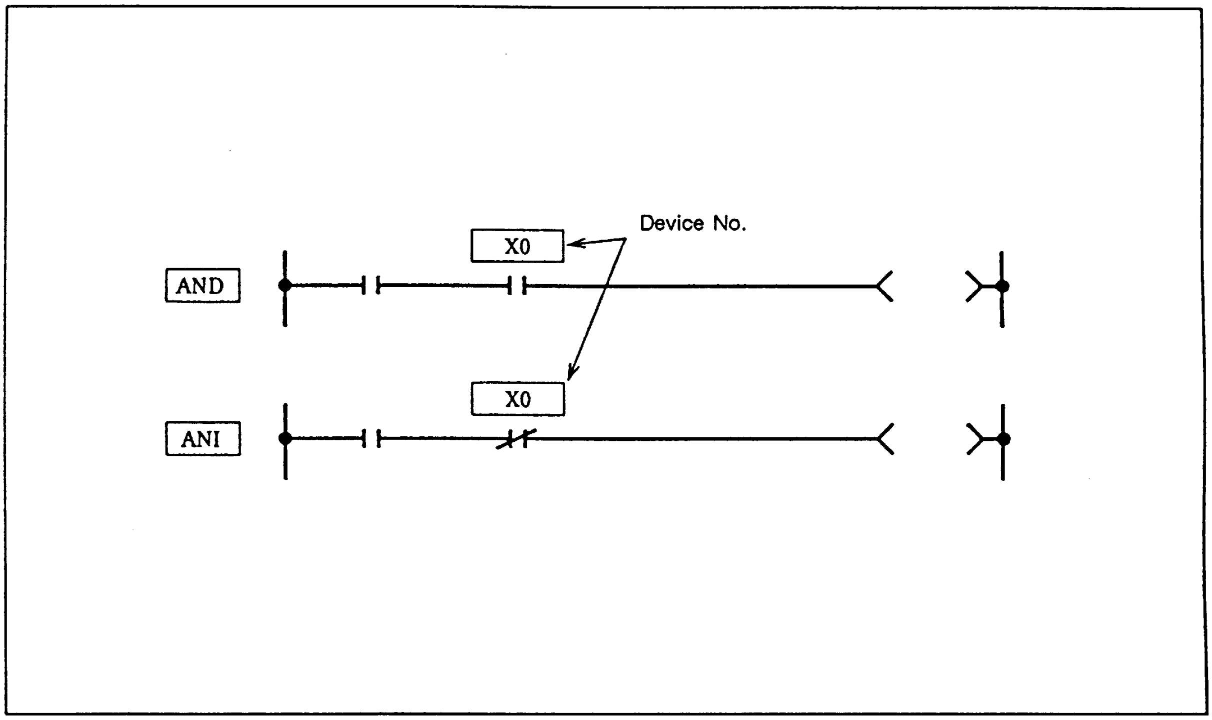


Coding

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

○ AND, ANI ... Serial connection of contact

Usable device																			Digit designation	No. of steps	Index	
Bit device								Word (16-bit) device							Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
○	○	○	○	○	○	○	○													1		



Function

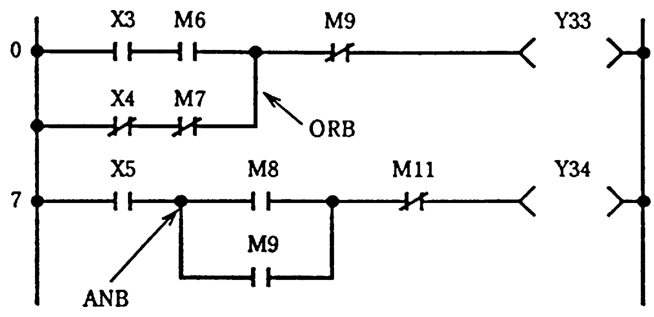
AND is the a contact serial connection command, and ANI is the b contact serial connection command. The ON/OFF information of the designated device is read in, and the AND operation with the operation results up to that point is executed. The result is the operation result.

Execution conditions

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

Program example

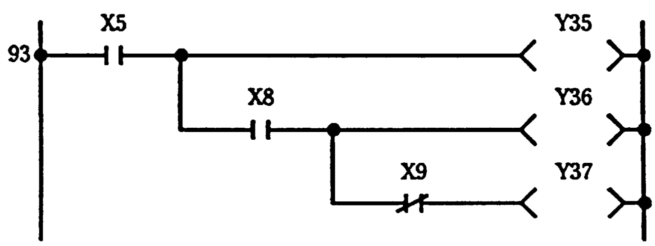
(1) Program used after LD, LDI, AND or ANI, etc.



Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	AND	M6			
2	LDI	X4			
3	ANI	M7			
4	ORB				
5	ANI	M9			
6	OUT	Y33			
7	LD	X5			
8	LD	M8			
9	OR	M9			
10	ANB				
11	ANI	M11			
12	OUT	Y34			

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

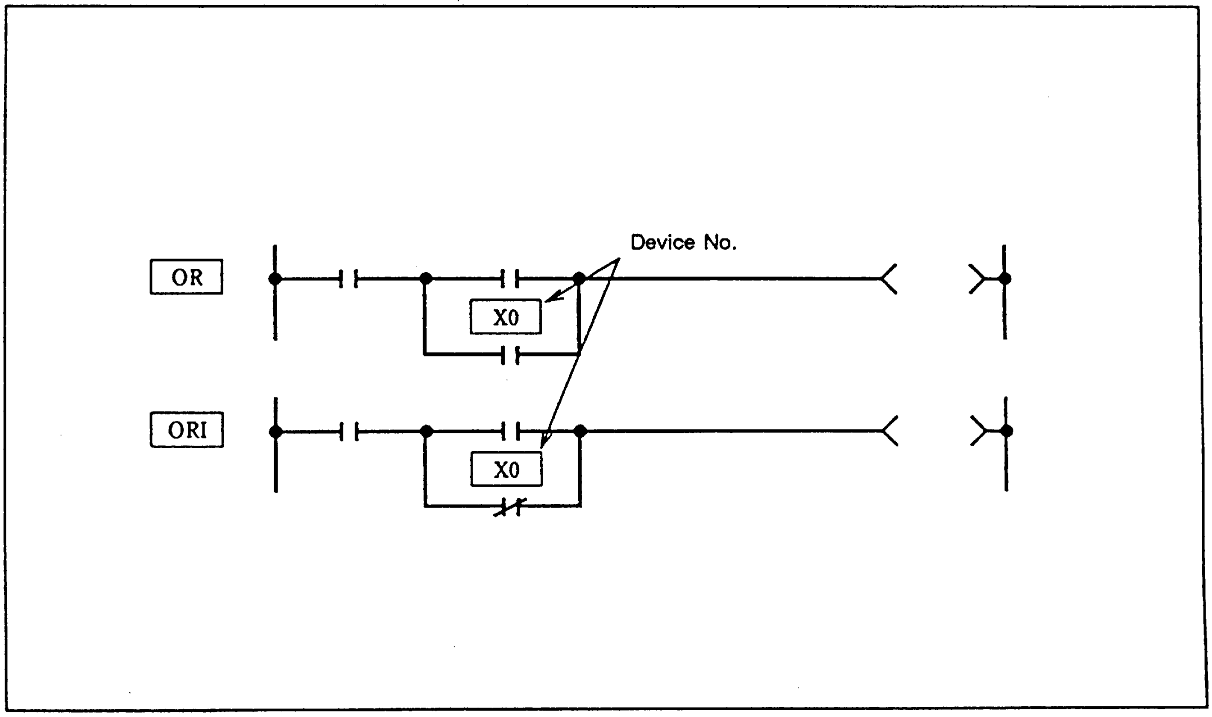


Coding

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

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

Usable device																					Digit designation	No. of steps	Index	
Bit device								Word (16-bit) device									Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N						
○	○	○	○	○	○	○	○															1		



Function

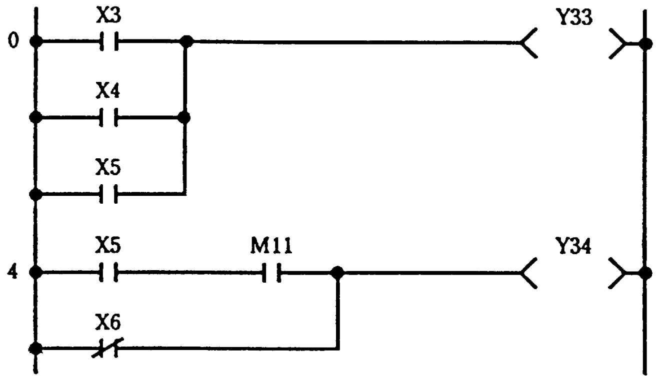
OR is the one a contact parallel connection command, and ORI is the one b contact parallel connection operation command. The ON/OFF information of the designated device is read in, and the OR operation with the operation results up to that point is executed. The result is the operation result.

Execution conditions

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

Program example

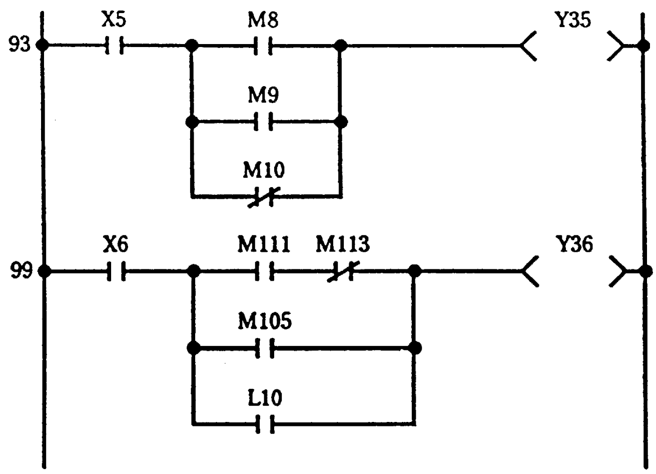
(1) Program used at head of circuit block.



Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	OR	X4			
2	OR	X5			
3	OUT	Y33			
4	LD	X5			
5	AND	M11			
6	ORI	X6			
7	OUT	Y34			

(2) Program used in circuit.

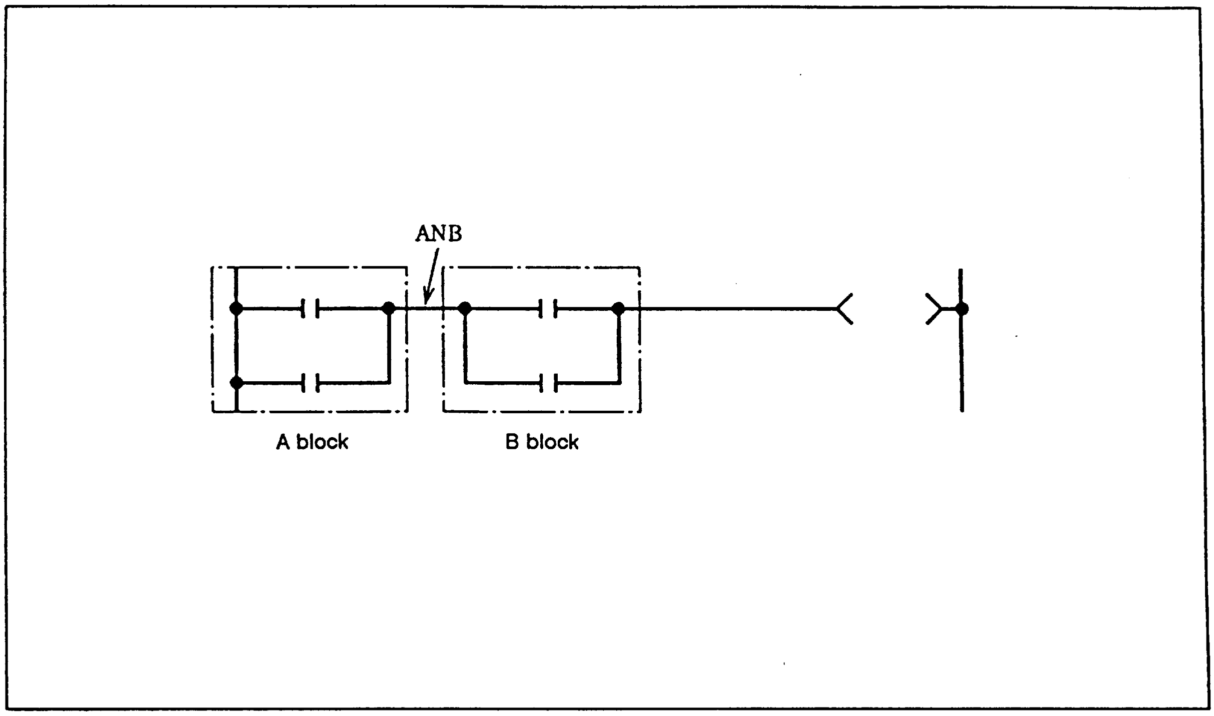


Coding

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			

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

Usable device																			Digit designation	No. of steps	Index	
Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
																				1		

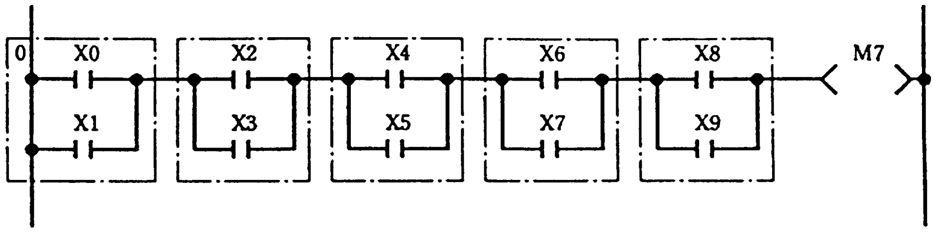


Function

(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.

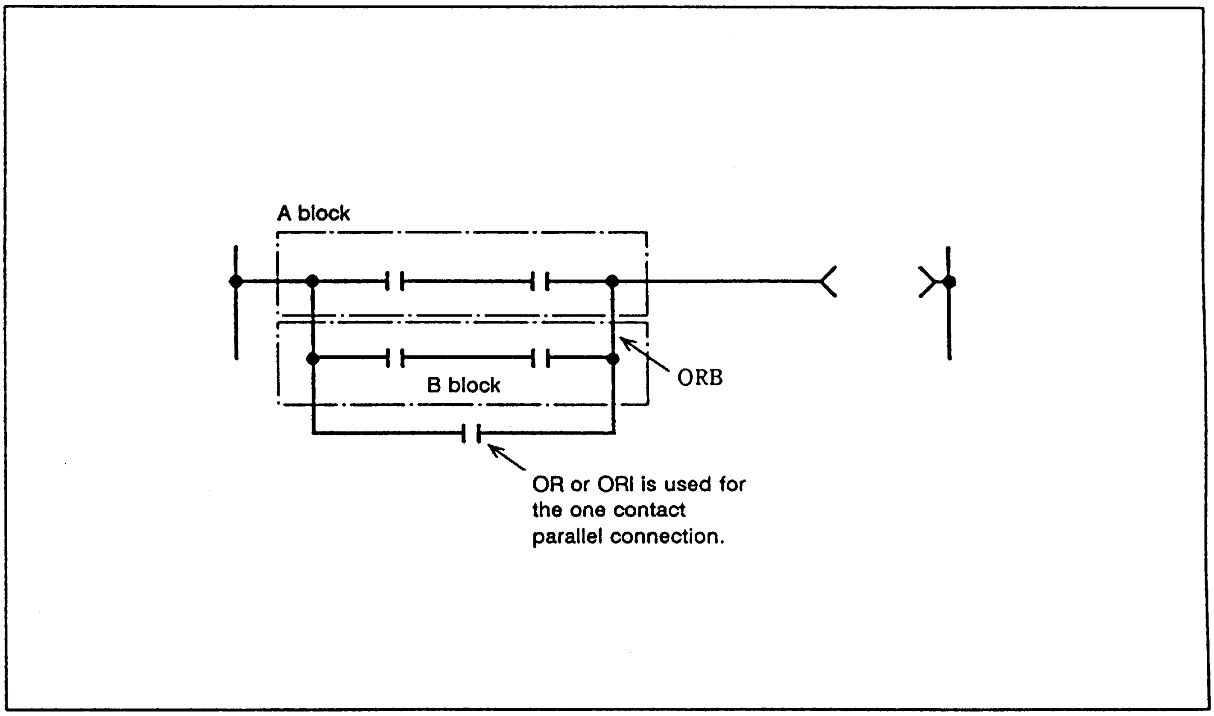


Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	OR	X1			
2	LD	X2			
3	OR	X3			
4	ANB				
5	LD	X4			
6	OR	X5			
7	ANB				
8	LD	X6			
9	OR	X7			
10	ANB				
11	LD	X8			
12	OR	X9			
13	ANB				
14	OUT	M7			

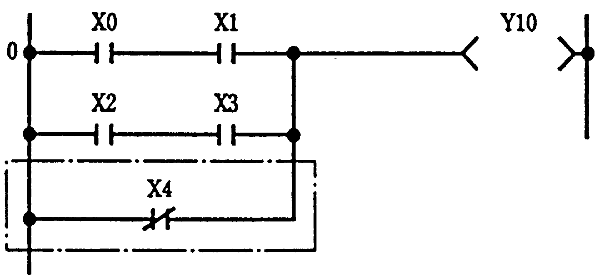
○ ORB ... Parallel connection of blocks

Usable device																			Digit designation	No. of steps	Index	
Bit device								Word (16-bit) device							Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	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.



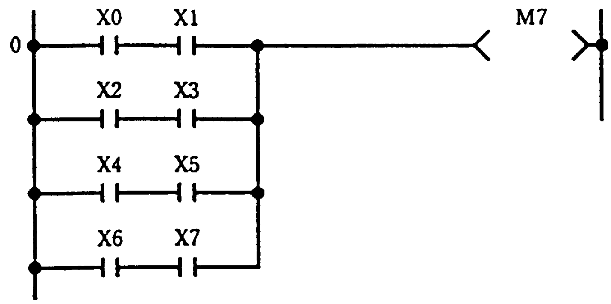
Coding

No. of steps	Command	Device			
0	LD	X0			
1	AND	X1			
2	LD	X2			
3	AND	X3			
4	ORB				
5	ORI	X4			
6	OUT	Y10			

(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.

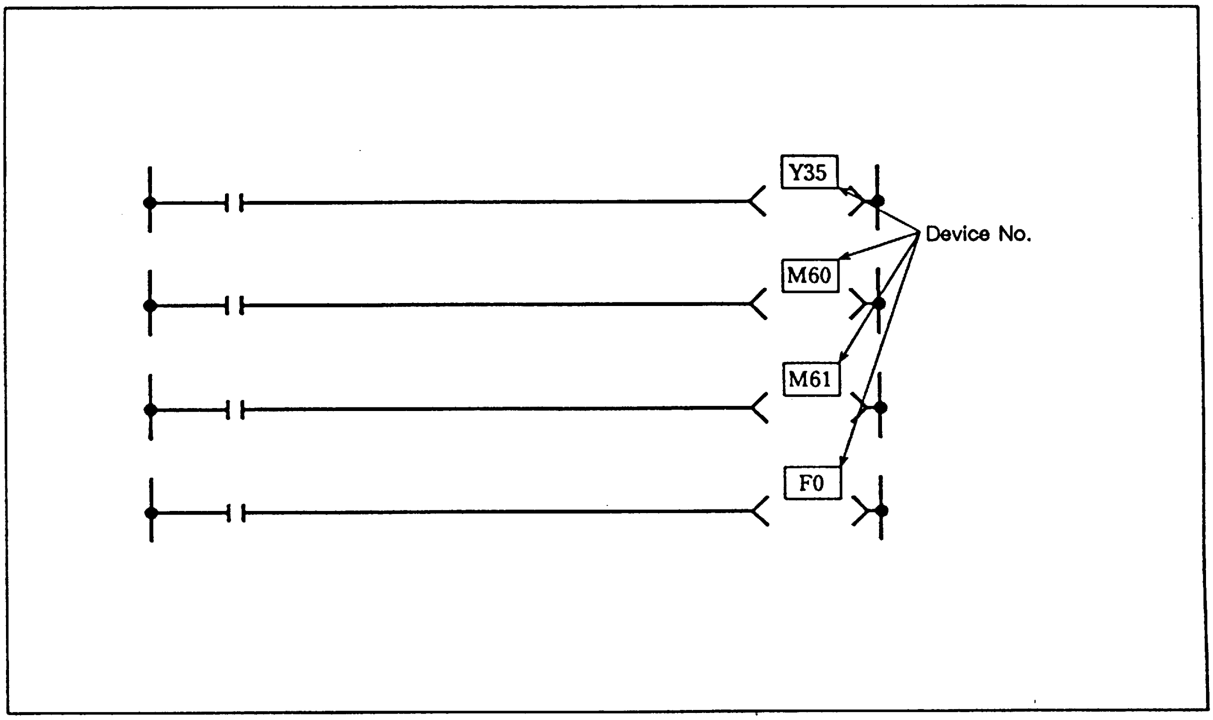


Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	AND	X1			
2	LD	X2			
3	AND	X3			
4	ORB				
5	LD	X4			
6	AND	X5			
7	ORB				
8	LD	X6			
9	AND	X7			
10	ORB				
11	OUT	M7			

○ OUT (Y, M, G, L, E, F) ... Output (Y, M, G, L, E, F)

Usable device																			Digit designation	No. of steps	Index	
Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
○	○	○	○	○	○															1		



Function

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

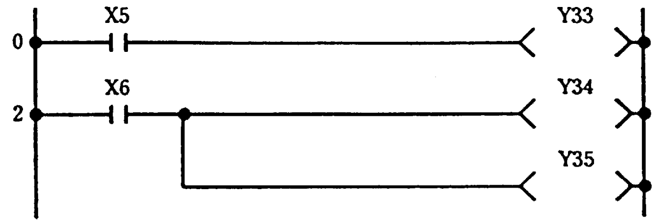
Operation results	OUT command		
	Coil	Contact	
		a contact	b contact
OFF	OFF	Non-continuity	Continuity
ON	ON	Continuity	Non-continuity

Execution condition

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

Program example

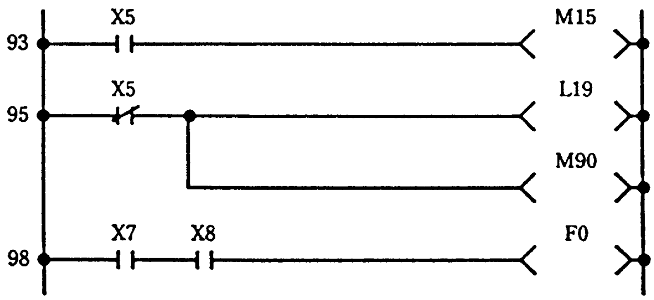
(1) Program output to output unit.



Coding

No. of steps	Com-mand	Device			
0	LD	X5			
1	OUT	Y33			
2	LD	X6			
3	OUT	Y34			
4	OUT	Y35			

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

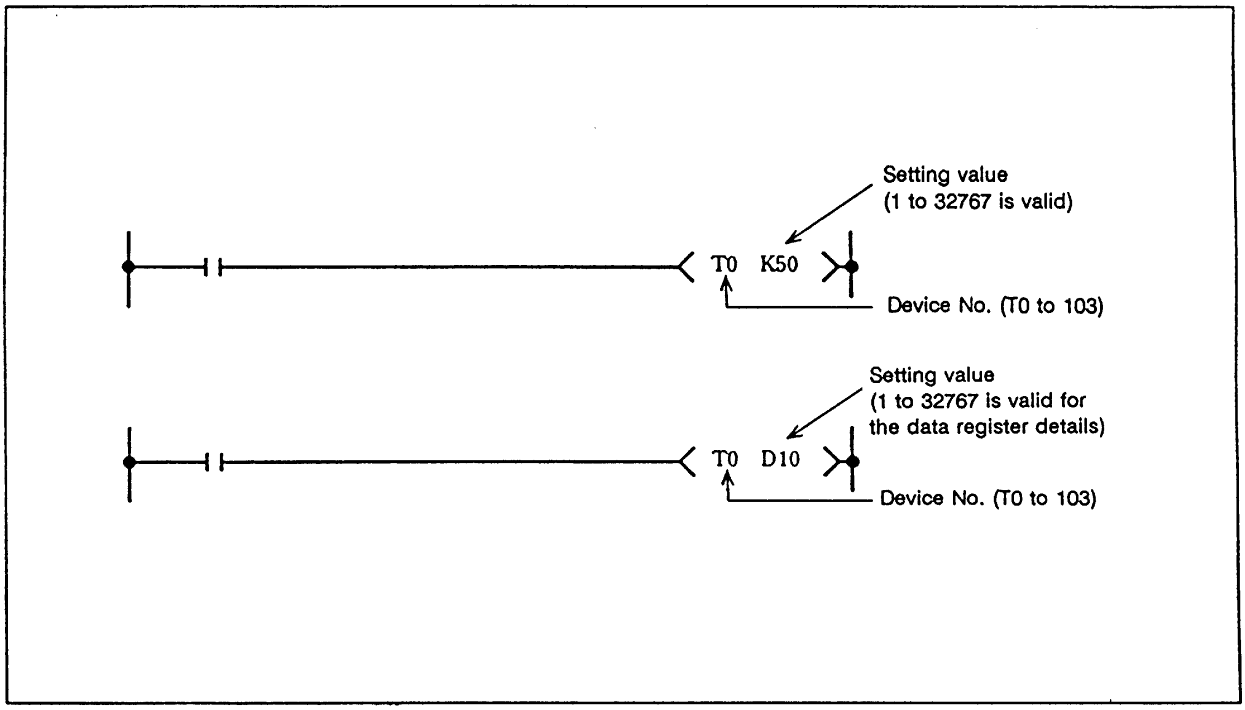


Coding

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

○ **OUT T, Q ... Timer output**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device								Word (16-bit) device							Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
Device							○														2		
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 ³ 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 10ms timer	OFF	0	Non-continuity	Continuity	Continuity	Non-continuity
100ms cumulative timer	OFF	Hold current value	Non-continuity	Continuity	Continuity	Non-continuity

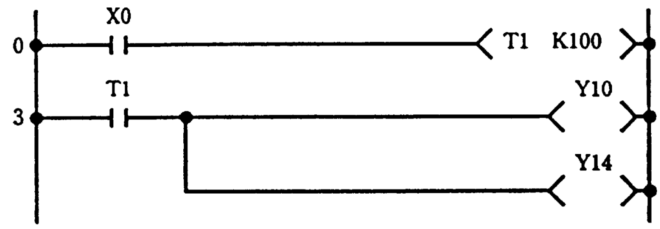
(3) The state of the cumulative timer contact after time up will not change until the RST command is executed.

Execution condition

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

Program example

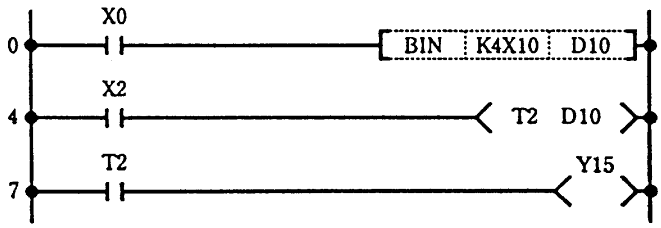
(1) Program to turn ON Y10 and Y14 ten seconds after X0 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	OUT	T1	K100		
3	LD	T1			
4	OUT	Y10			
5	OUT	Y14			

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



The X10 to 1F data is BIN converted and stored in D10.

If X2 turns ON, the data stored in D10 will be counted as the setting value.

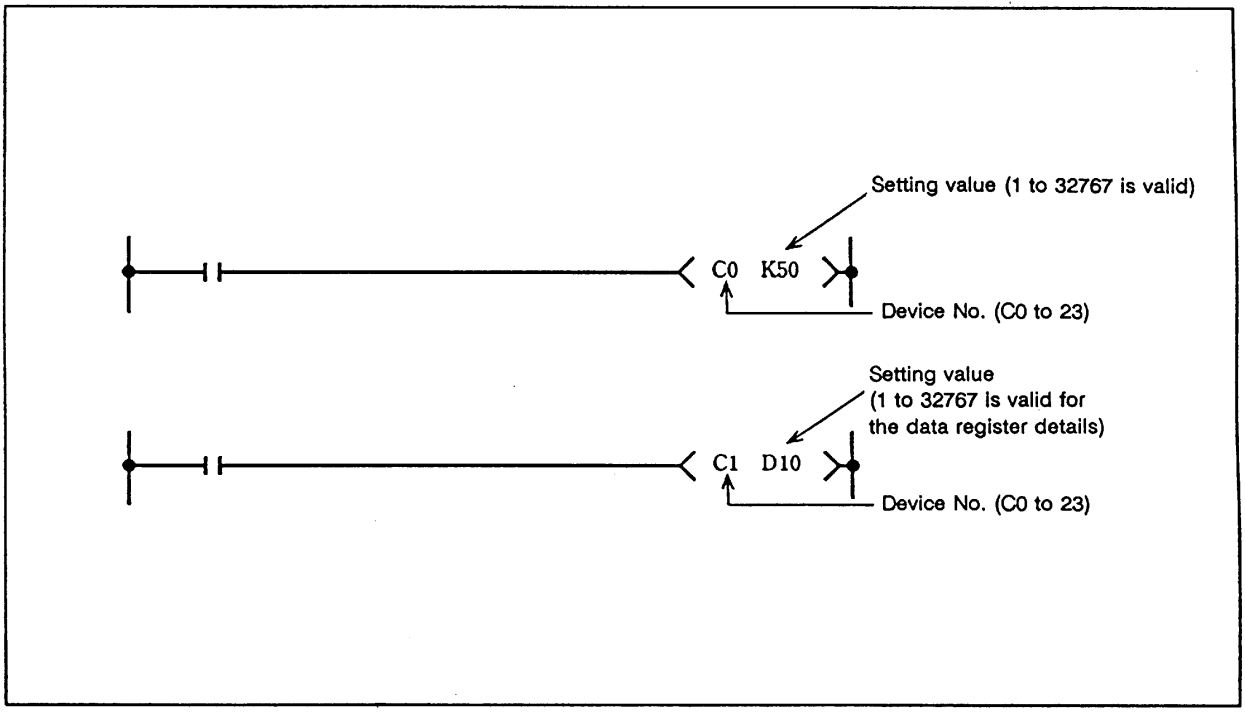
When T2 counts up, Y15 will turn ON.

Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	BIN	K4X10	D10		
4	LD	X2			
5	OUT	T2	D10		
7	LD	T2			
8	OUT	Y15			

○ **OUT C, B ... Counter output**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device								Word (16-bit) device							Con-st ant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
Device								○													2		
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 ^{3} 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.)

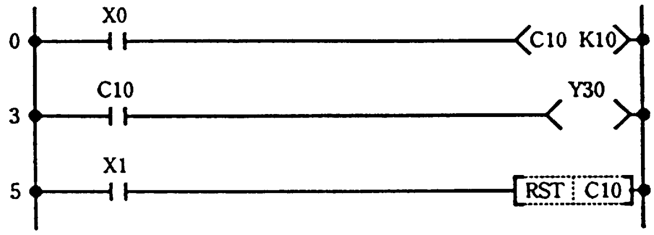
(3) If the operation results change from OFF to ON after the current value >= setting value is established, the contact state will remain the same and the current value will not be counted up.

Execution condition

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

Program example

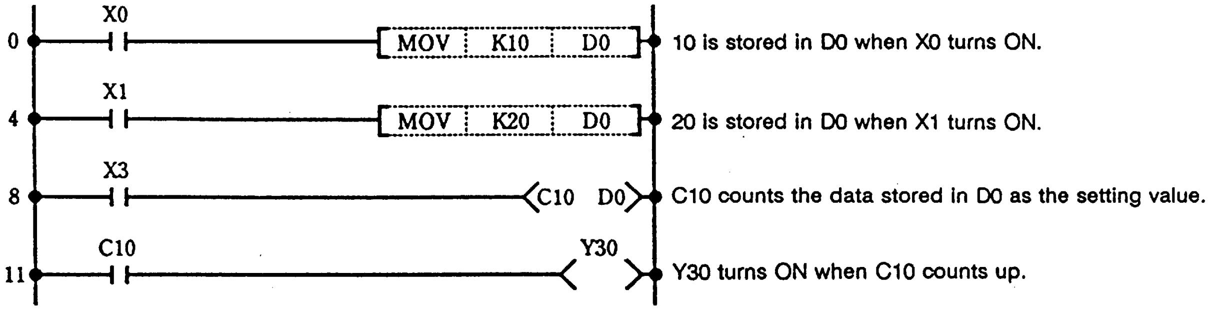
(1) Program to turn Y30 ON when X0 turns ON ten times, and to turn Y30 OFF when X1 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	OUT	C10	K10		
3	LD	C10			
4	OUT	Y30			
5	LD	X1			
6	RST	C10			

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

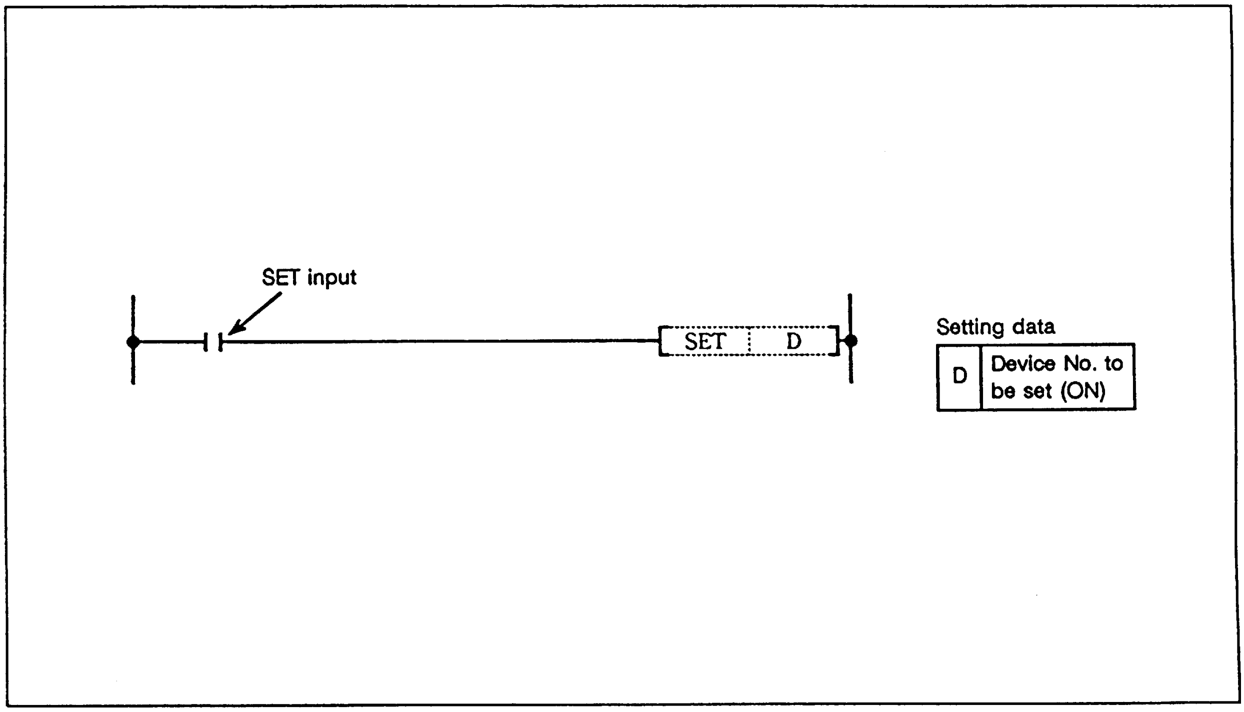


Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	MOV	K10	D0		
4	LD	X1			
5	MOV	K20	D0		
8	LD	X3			
9	OUT	C10	D0		
11	LD	C10			
12	OUT	Y30			

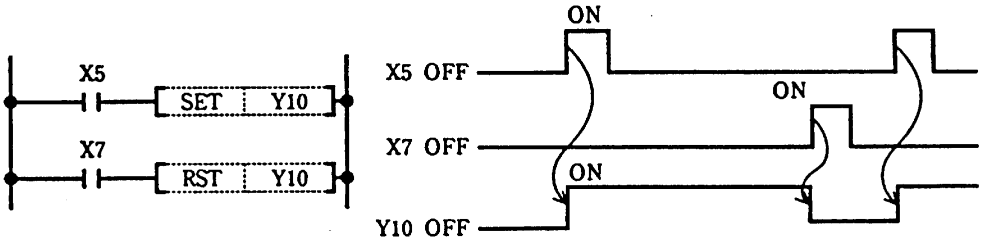
○ SET ... Device setting (ON)

	Usable device																			Digit desig-nation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D		○	○	○	○	○															2		



Function

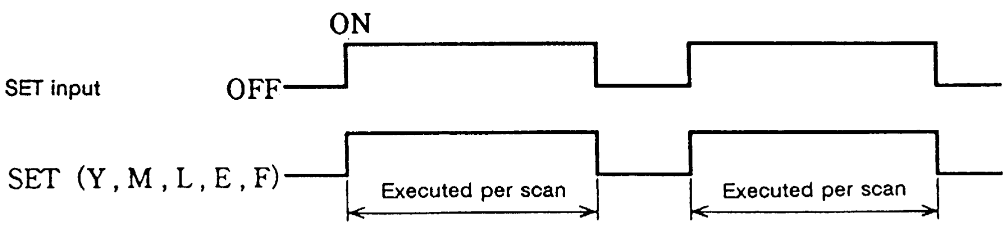
(1) The designated device turns ON when the SET input turns ON.
(2) The device turned ON remains ON even if the SET input turns OFF. The device can be turned OFF with the RST command.



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

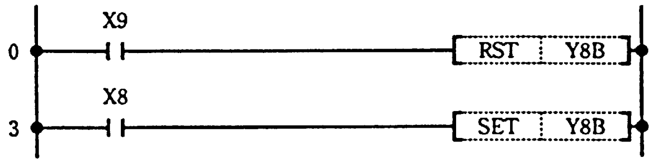
Execution condition

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



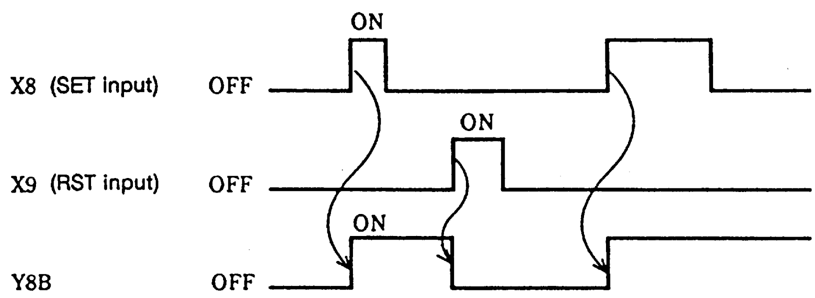
Program example

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



Coding

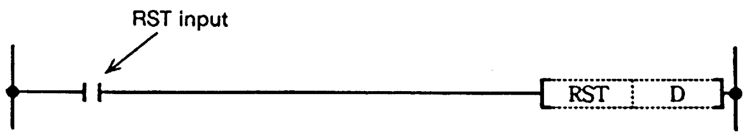
No. of steps	Com-mand	Device			
0	LD	X9			
1	RST	Y8B			
3	LD	X8			
4	SET	Y8B			



Operation of SET and RST commands

○ RST ... Device resetting

	Usable device																		Digit designation	No. of steps	Index	
	Bit device								Word (16-bit) device							Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D		○	○	○	○	○	○	○													2		



Setting data

D	Device No. to be reset

Function

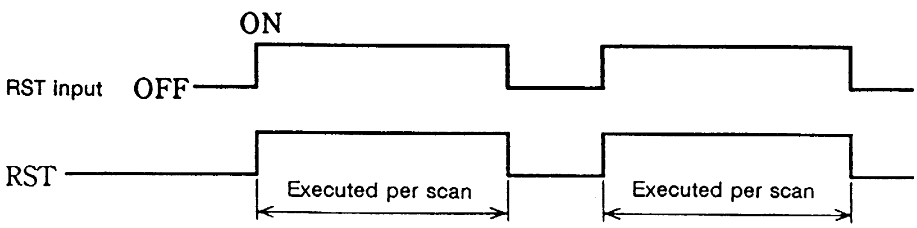
(1) The designated device will change as explained below when the RST input turns ON.

Device	Status
Y, M, E, F, L W, J, S, G	The coil and contact are turned OFF.
T, C, Q, B	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.

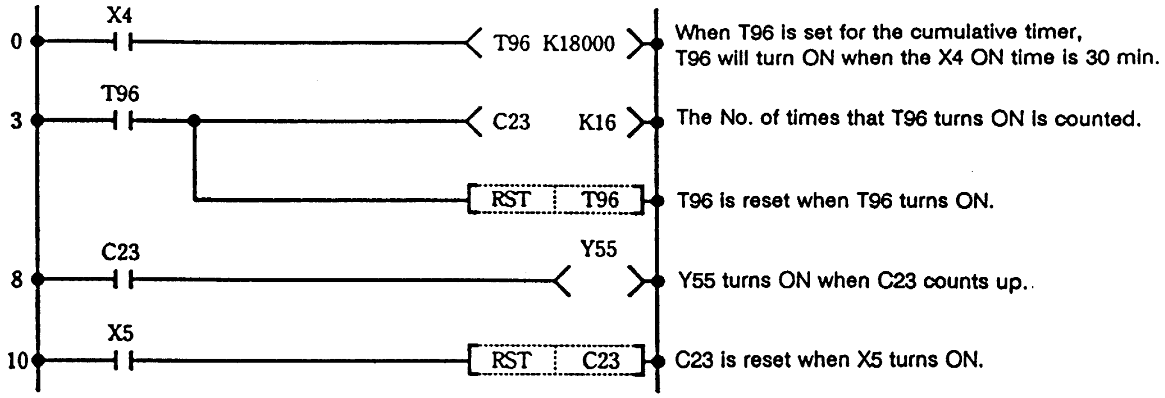
Execution condition

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



Program example

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

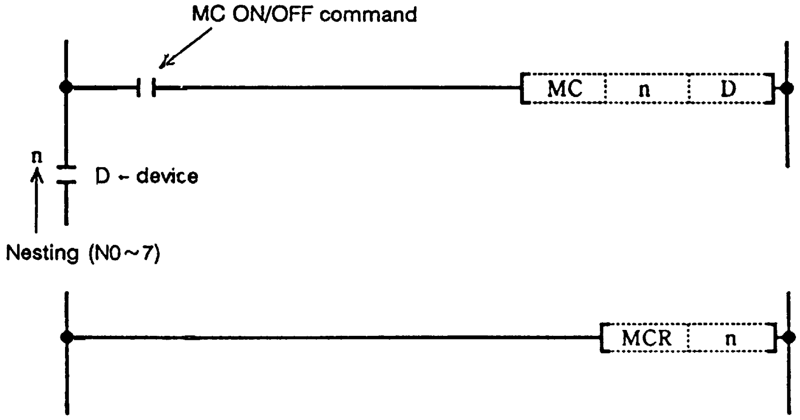


Coding

No. of steps	Com-mand	Device			
0	LD	X4			
1	OUT	T96	K18000		
3	LD	T96			
4	OUT	C23	K16		
6	RST	T96			
8	LD	C23			
9	OUT	Y55			
10	LD	X5			
11	RST	C23			

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Constant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																			○		2/3		
D		○	○	○	○	○																	



Setting data

n	Nesting (N0~7)
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 cumulative 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.

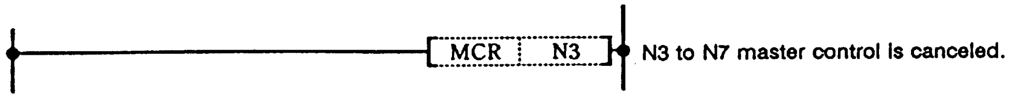
(4) The program between the MC command and MCR command will be scanned regardless of the MC command ON/OFF state.

(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.

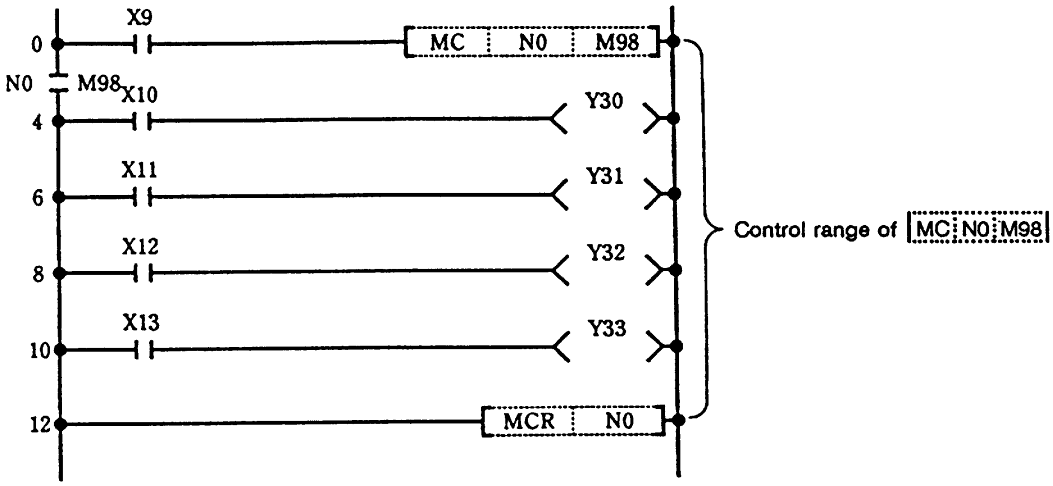
MCR

(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.

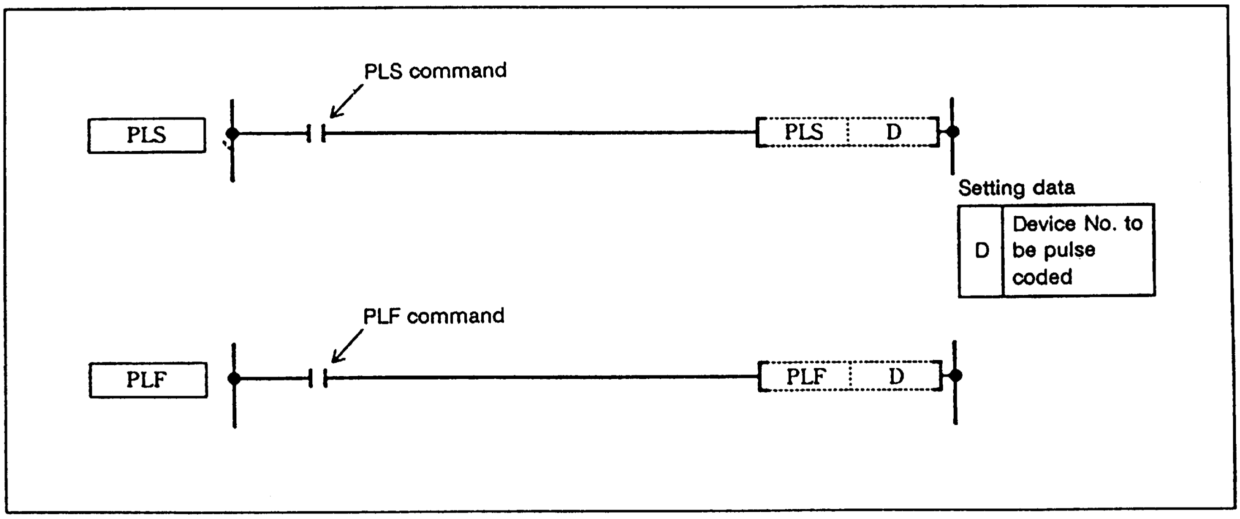


Coding

No. of steps	Com-mand	Device			
0	LD	X9			
1	MC	N0	M98		
4	LD	X10			
5	OUT	Y30			
6	LD	X11			
7	OUT	Y31			
8	LD	X12			
9	OUT	Y32			
10	LD	X13			
11	OUT	Y33			
12	MCR	N0			

○ PLS, PLF ... Pulse (1 scan ON)

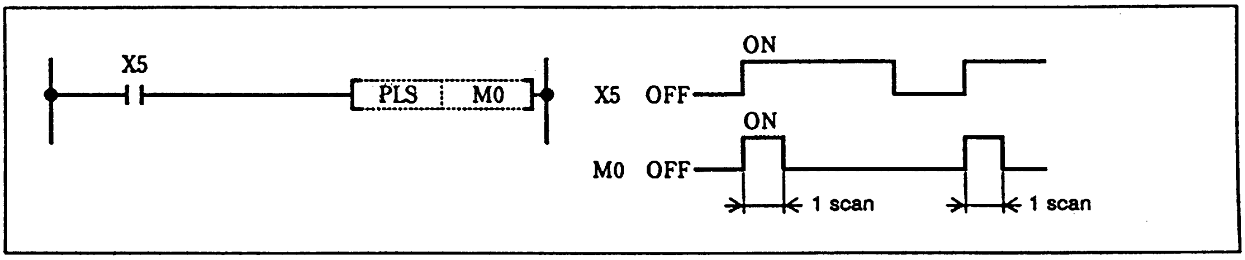
	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D		○	○	○		○															2		



Function

PLS

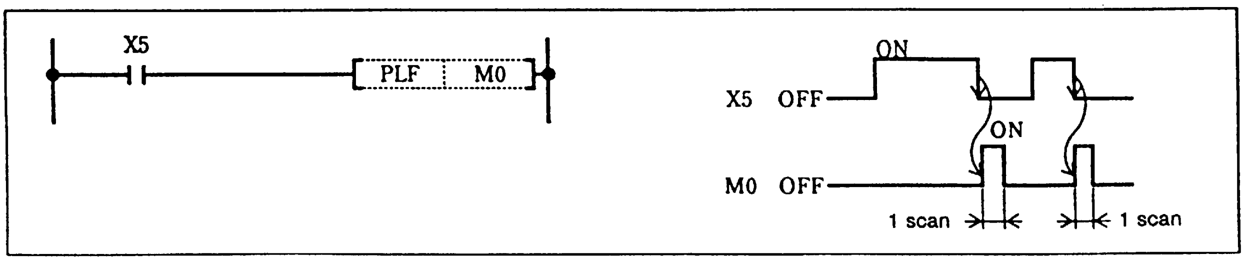
(1) The designated device is turned ON for one scan when the PLS command changes from OFF to ON and is turned OFF in all other cases.



(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

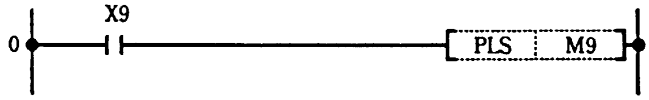
(1) The designated device is turned ON for one scan when the PLF command changes from ON to OFF and is turned OFF in all other cases.



(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.

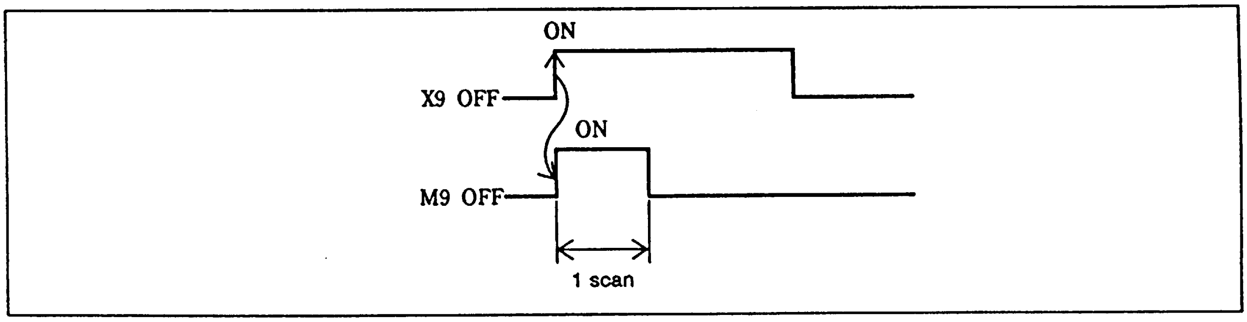
Program example

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



Coding

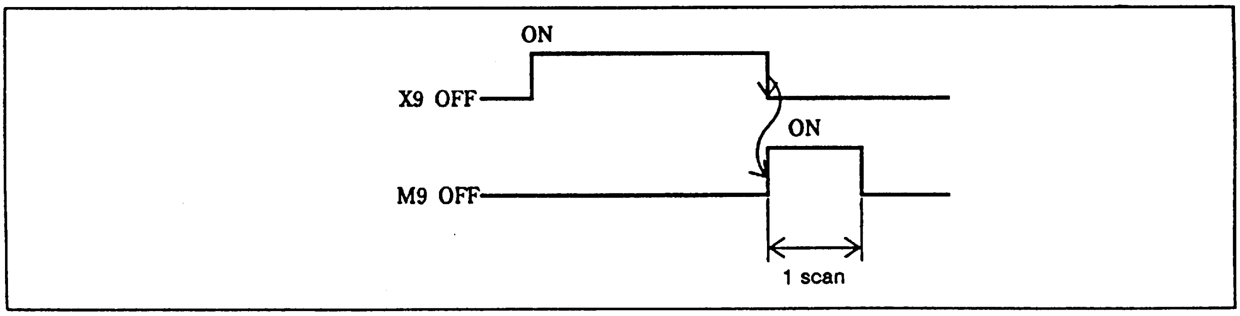
No. of steps	Com-mand	Device			
0	LD	X9			
1	PLS	M9			



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

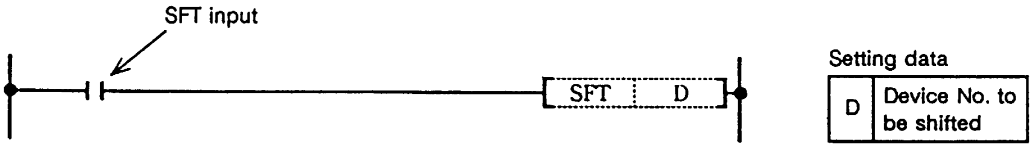
Coding

No. of steps	Com-mand	Device			
0	LD	X9			
1	PLF	M9			



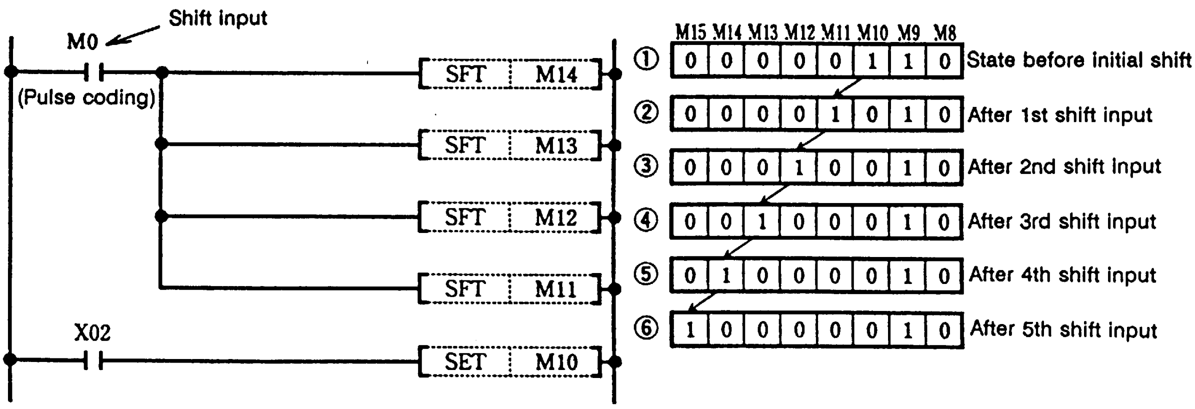
○ **SFT ... Device shift**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device							Word (16-bit) device							Con-stant		Pointer	Level					
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D		○	○	○	○	○															2		



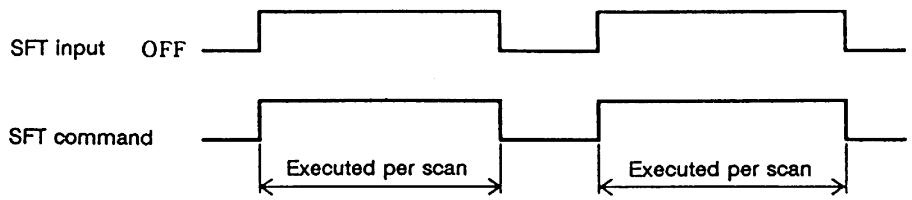
Function

(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.



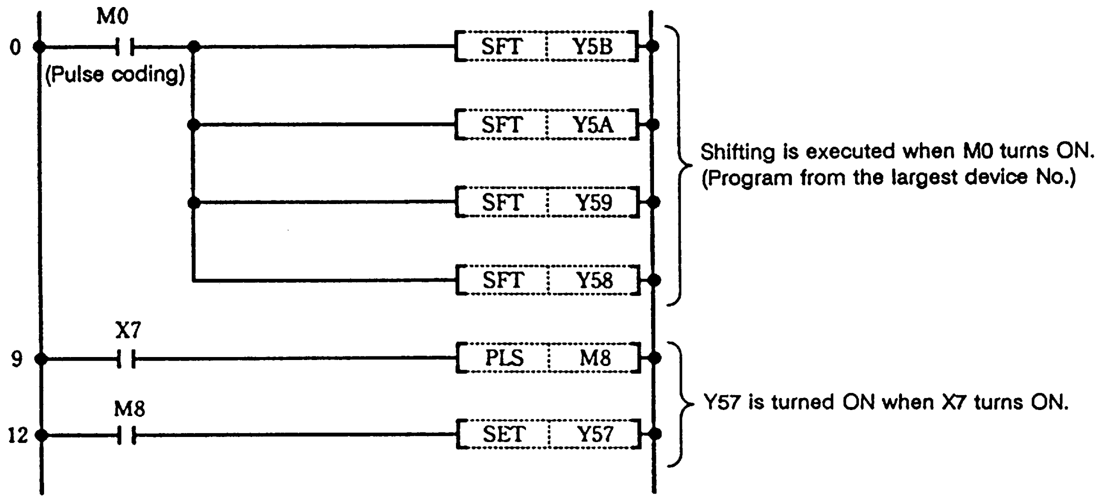
* In M8 to 15, 1 indicates ON and 0 indicates OFF.

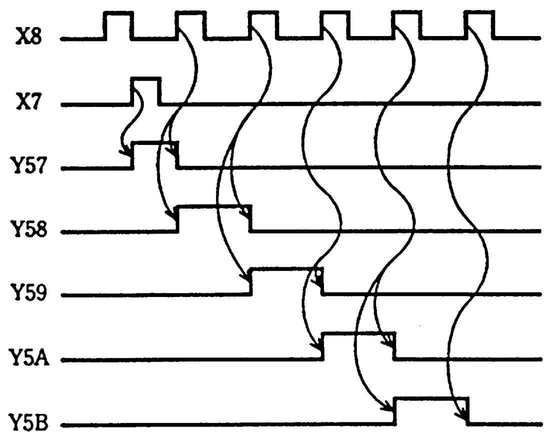
Operation of shift command



Program example

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



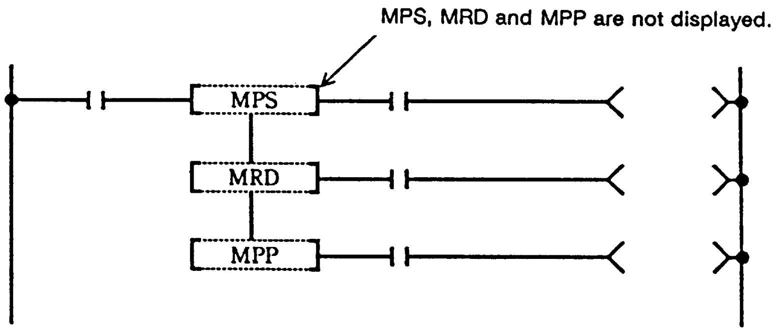


Coding

No. of steps	Com-mand	Device			
0	LD	X8			
1	SFT	Y5B			
3	SFT	Y5A			
5	SFT	Y59			
7	SFT	Y58			
9	LD	X7			
10	PLS	M8			
12	LD	M8			
13	SET	Y57			

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

Usable device																			Digit designation	No. of steps	Index	
Bit device								Word (16-bit) device							Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	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.

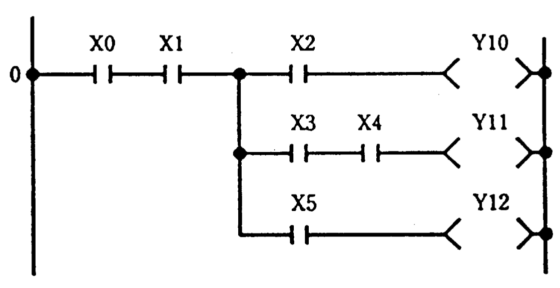
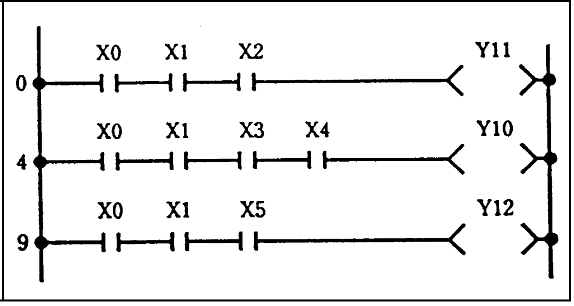
MPP

(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.

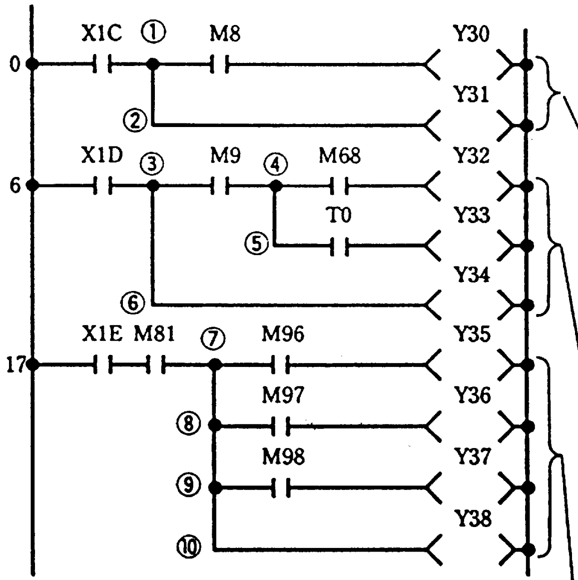
Point

(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
	

Program example

(1) Program using MPS, MRD and MPP.

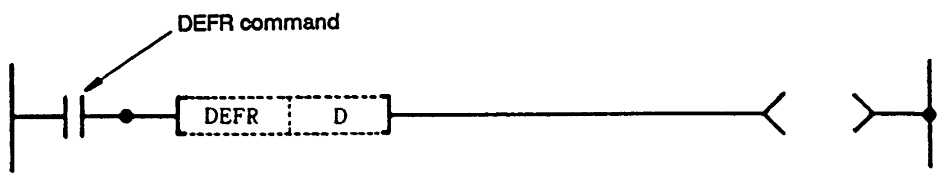


Coding

	No. of steps	Com-mand	Device			
	0	LD	X1C			
(1)	1	MPS				
	2	AND	M8			
	3	OUT	Y30			
(2)	4	MPP				
	5	OUT	Y31			
	6	LD	X1D			
(3)	7	MPS				
	8	ANI	M9			
(4)	9	MPS				
	10	AND	M68			
	11	OUT	Y32			
(5)	12	MPP				
	13	AND	T0			
	14	OUT	Y33			
(6)	15	MPP				
	16	OUT	Y34			
	17	LD	X1E			
	18	AND	M81			
(7)	19	MPS				
	20	AND	M96			
	21	OUT	Y35			
(8)	22	MRD				
	23	AND	M97			
	24	OUT	Y36			
(9)	25	MRD				
	26	AND	M98			
	27	OUT	Y37			
(10)	28	MPP				
	29	OUT	Y38			

○ DEFR ... Pulses in regard to operation results

Usable device																			Digit designation	No. of steps	Index	
Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
	○	○	○	○	○															1		

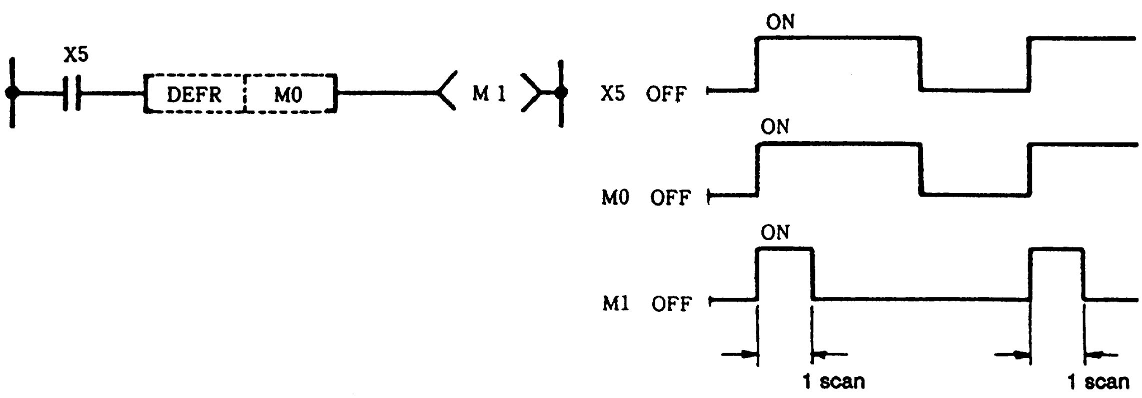


Setting data

D	Operation memory for generating one scan worth of pulses.

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.

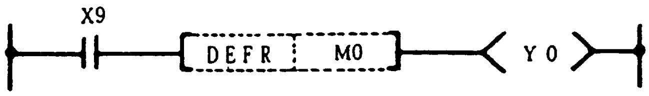


Execution conditions

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

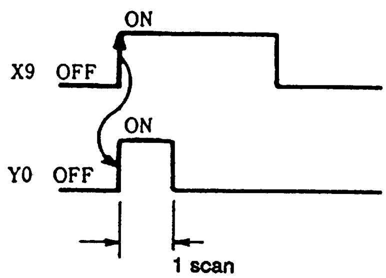
Program example

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

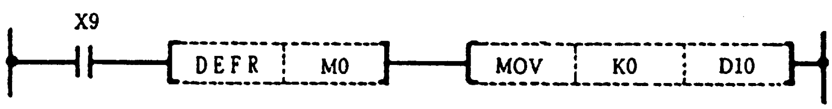


Coding

No. of steps	Com-mand	Device			
0	LD	X9			
1	DEFR	M0			
2	OUT	Y0			
3					



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



Coding

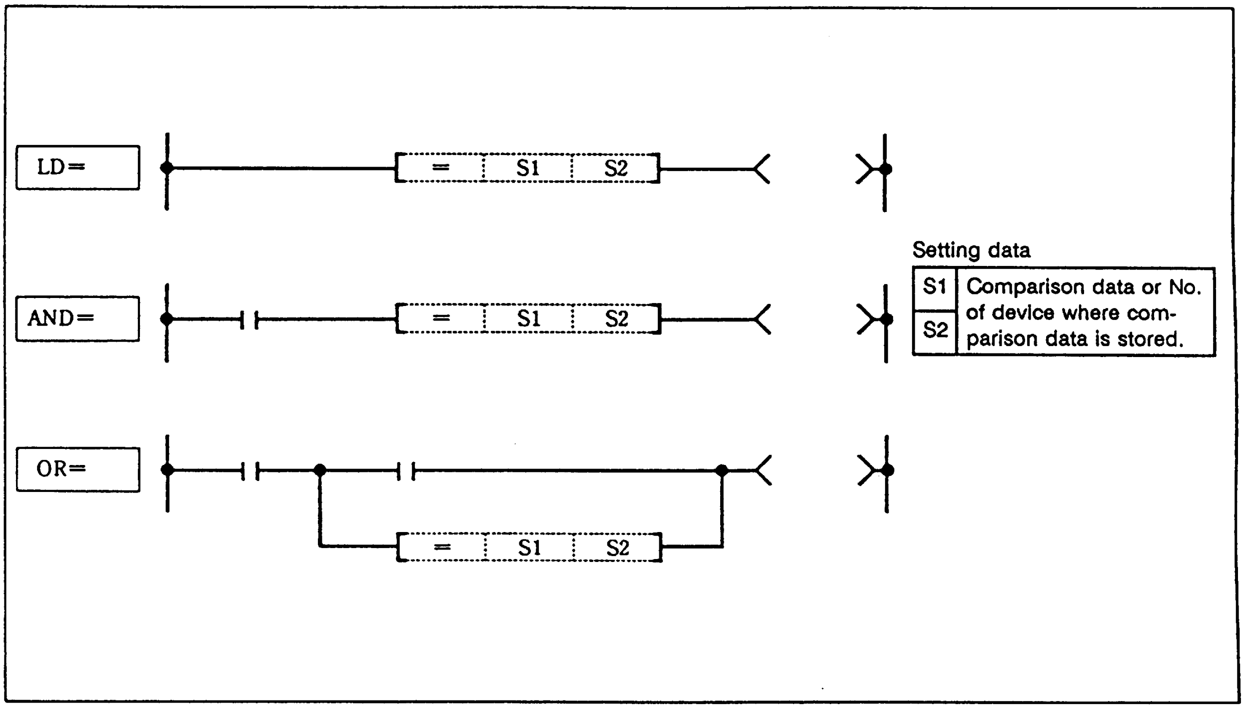
No. of steps	Com-mand	Device			
0	LD	X9			
1	DEFR	M0			
2	MOV	K0	D10		
5					

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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○		○	○			○	○			○	3		
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

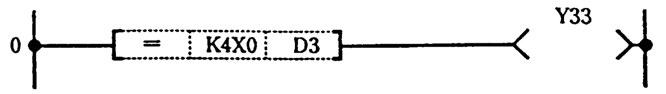
Execution conditions

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

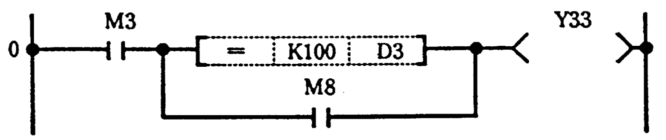
No. of steps	Com-mand	Device			
0	LD=	K4X0	D3		
3	OUT	Y33			
4					

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

Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND=	H100	D3		
4	OUT	Y33			
5					

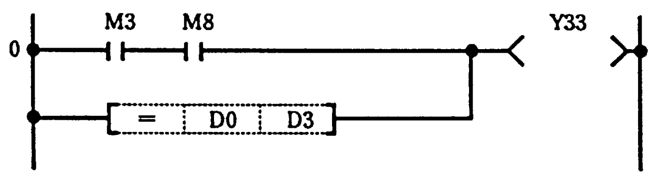
(3) Program to compare the BIN value 100 and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LD=	K100	D3		
4	OR	M8			
5	ANB				
6	OUT	Y33			
7					

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

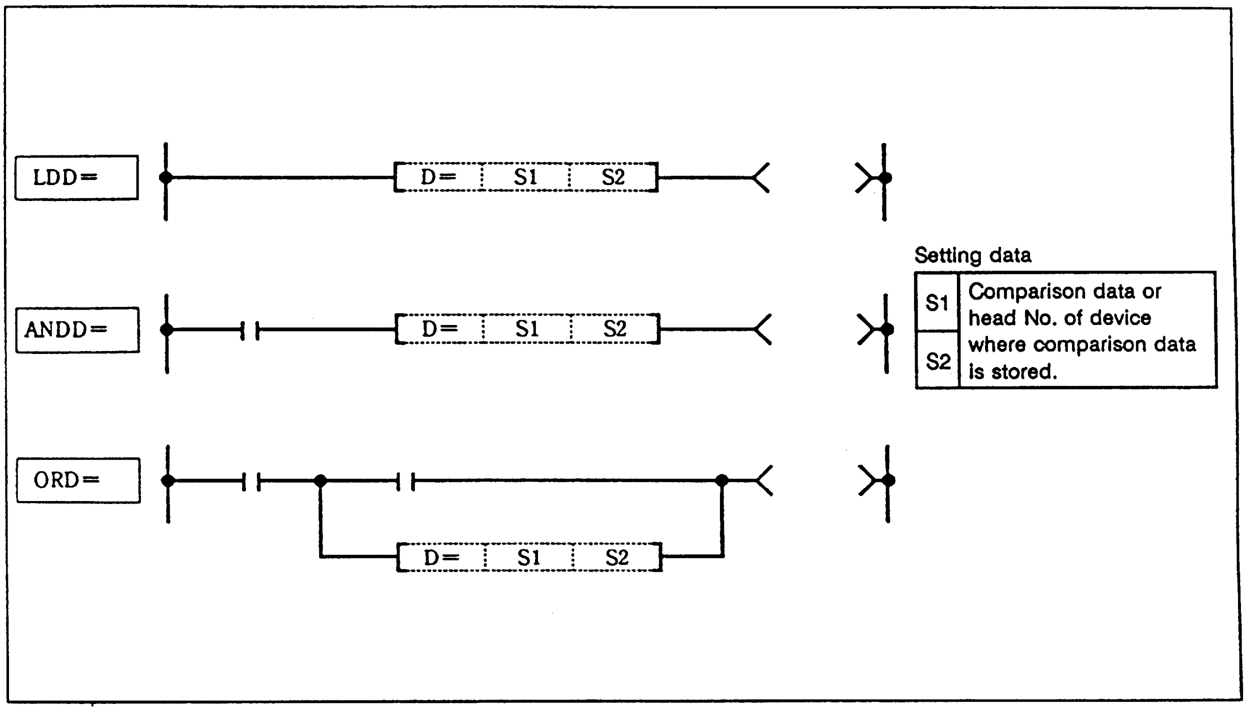


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	OR=	D0	D3		
5	OUT	Y33			
6					

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	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

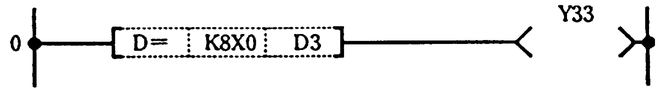
Execution conditions

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

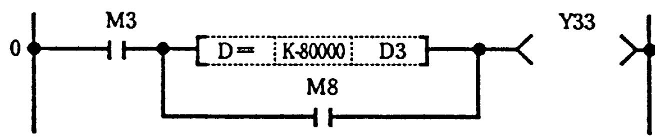
No. of steps	Com-mand	Device			
0	LDD=	K8X0	D3		
3	OUT	Y33			
4					

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

Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	ANDD=	H18000	D3		
5	OUT	Y33			
6					

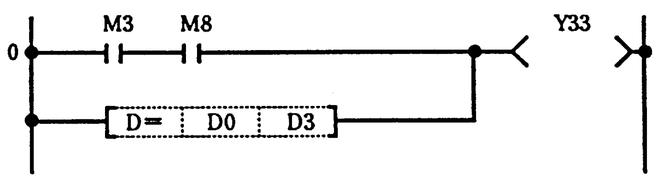
(3) Program to compare the BIN value -80000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LDD=	K-80000	D3		
5	OR	M8			
6	ANB				
7	OUT	Y33			
8					

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

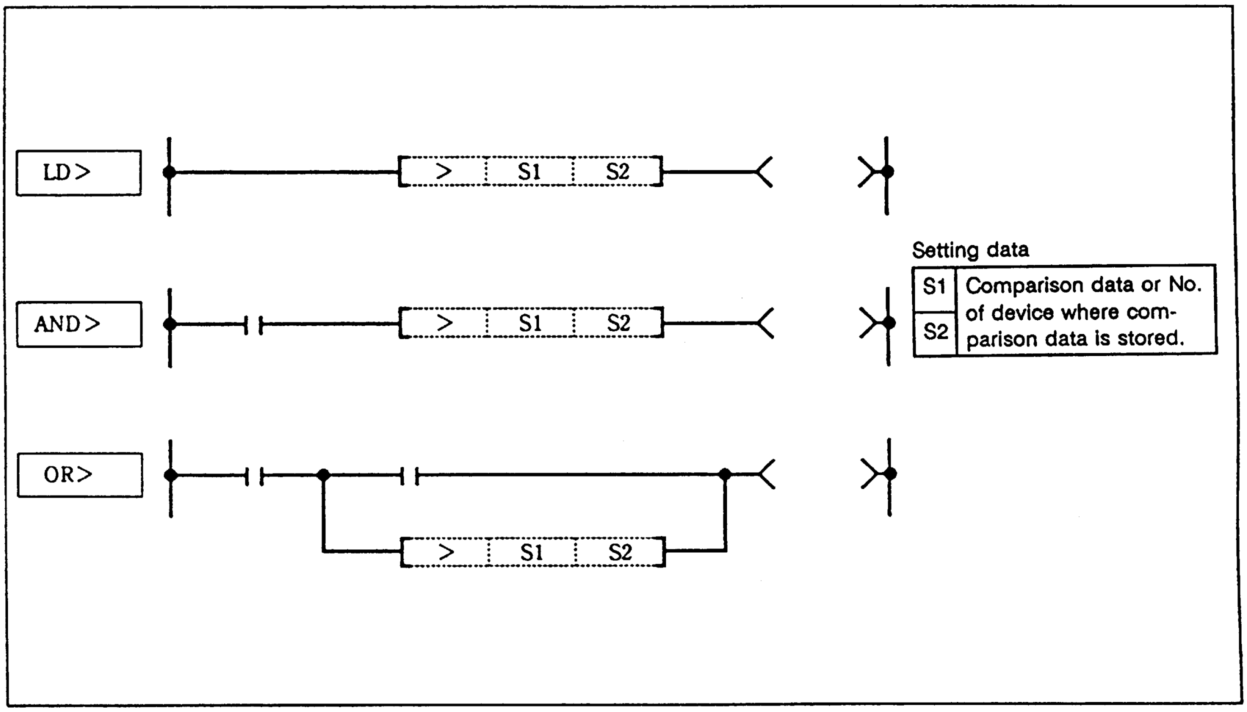


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	ORD=	D0	D3		
5	OUT	Y33			
6					

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

	Usable device																		Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○		○	○			○	○			○	3		
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

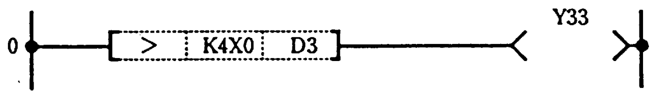
Execution conditions

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

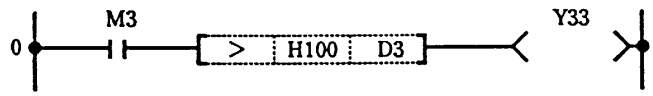
(1) Program to compare the X0 to F data and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD>	K4X0	D3		
3	OUT	Y33			
4					

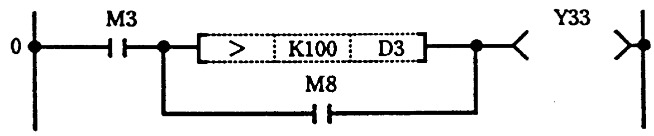
(2) Program to compare the BCD value 100 and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND>	H100	D3		
4	OUT	Y33			
5					

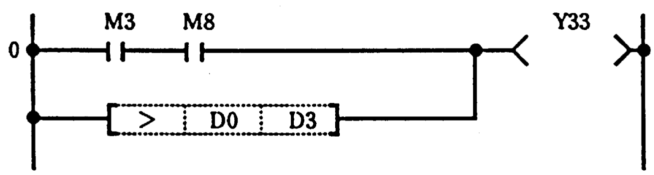
(3) Program to compare the BIN value 100 and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LD>	K100	D3		
4	OR	M8			
5	ANB				
6	OUT	Y33			
7					

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

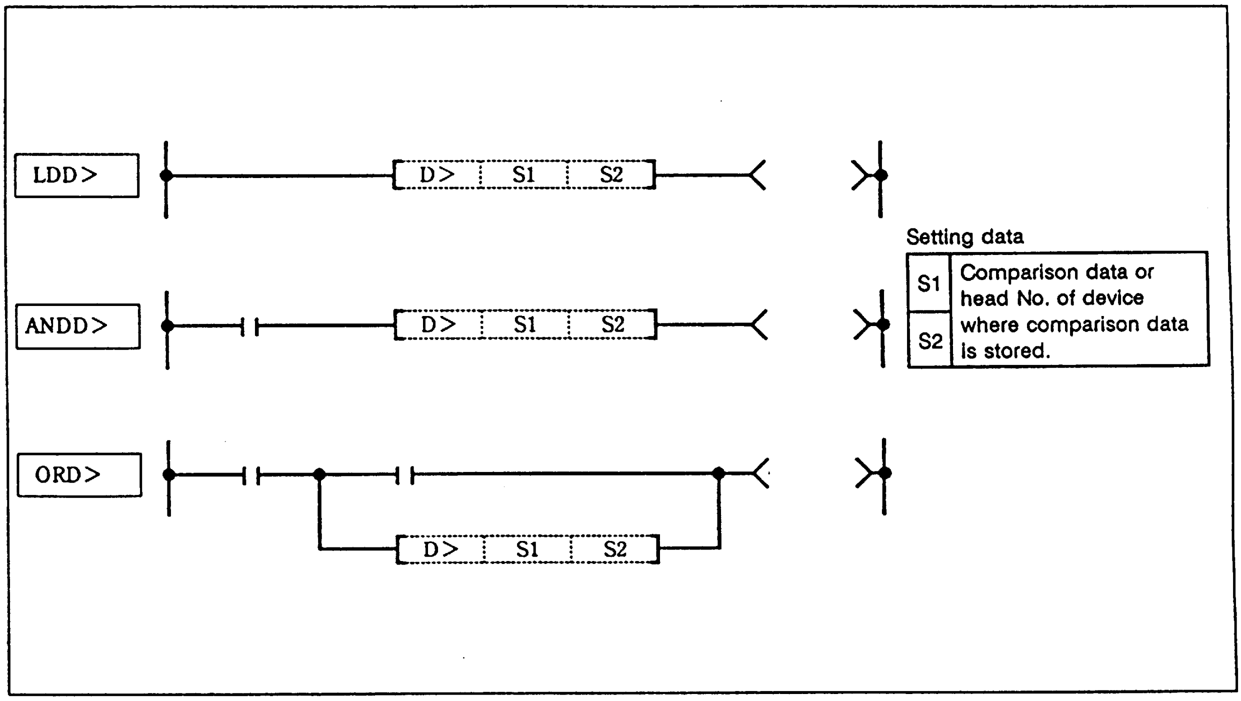


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	OR>	D0	D3		
5	OUT	Y33			
6					

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	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

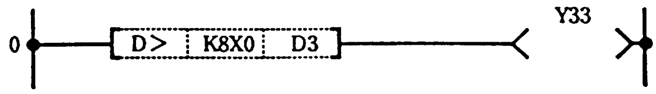
Execution conditions

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

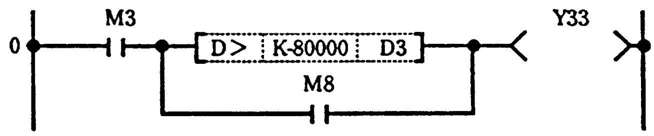
No. of steps	Com-mand	Device			
0	LDD>	K8X0	D3		
3	OUT	Y33			
4					

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

Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	ANDD>	H18000	D3		
5	OUT	Y33			
6					

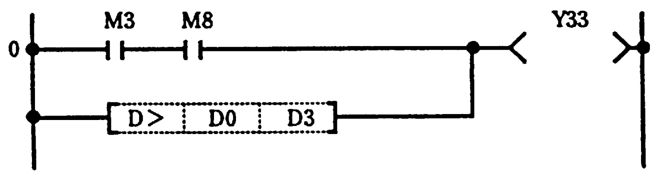
(3) Program to compare the BIN value -80000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LDD>	K-80000	D3		
5	OR	M8			
6	ANB				
7	OUT	Y33			
8					

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

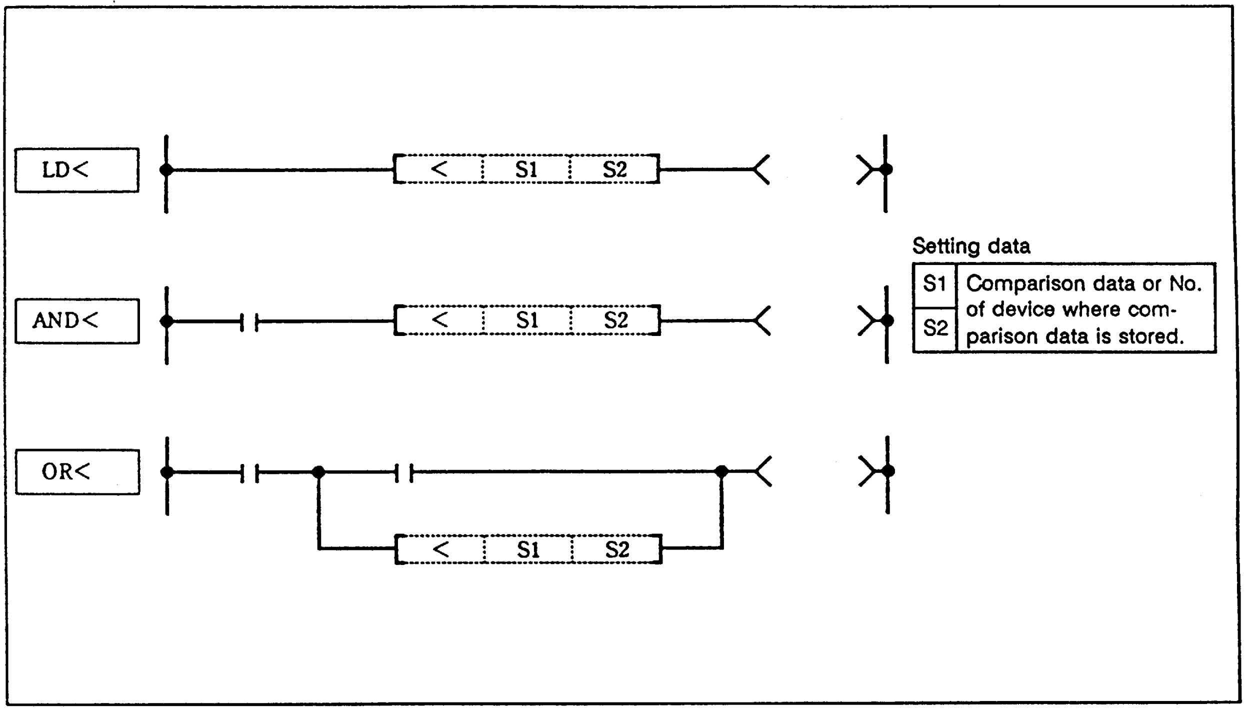


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	ORD>	D0	D3		
5	OUT	Y33			
6					

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

	Usable device																		Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○		○	○			○	○			○	3		
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

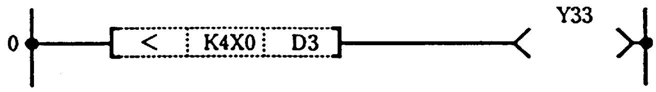
Execution conditions

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

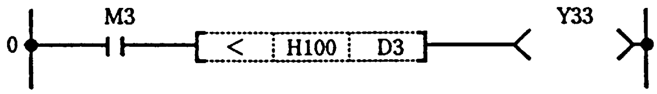
(1) Program to compare the X0 to F data and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD<	K4X0	D3		
3	OUT	Y33			
4					

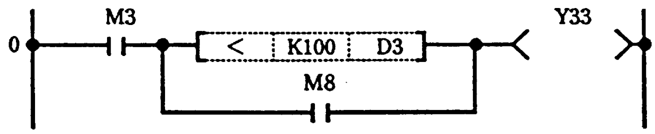
(2) Program to compare the BCD value 100 and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND<	H100	D3		
4	OUT	Y33			
5					

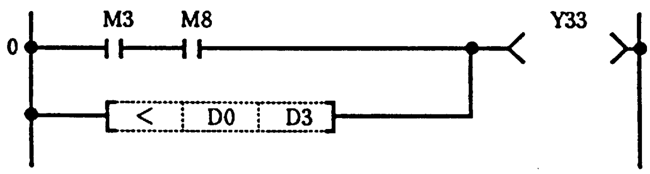
(3) Program to compare the BIN value 100 and D3 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LD<	K100	D3		
4	OR	M8			
5	ANB				
6	OUT	Y33			
7					

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

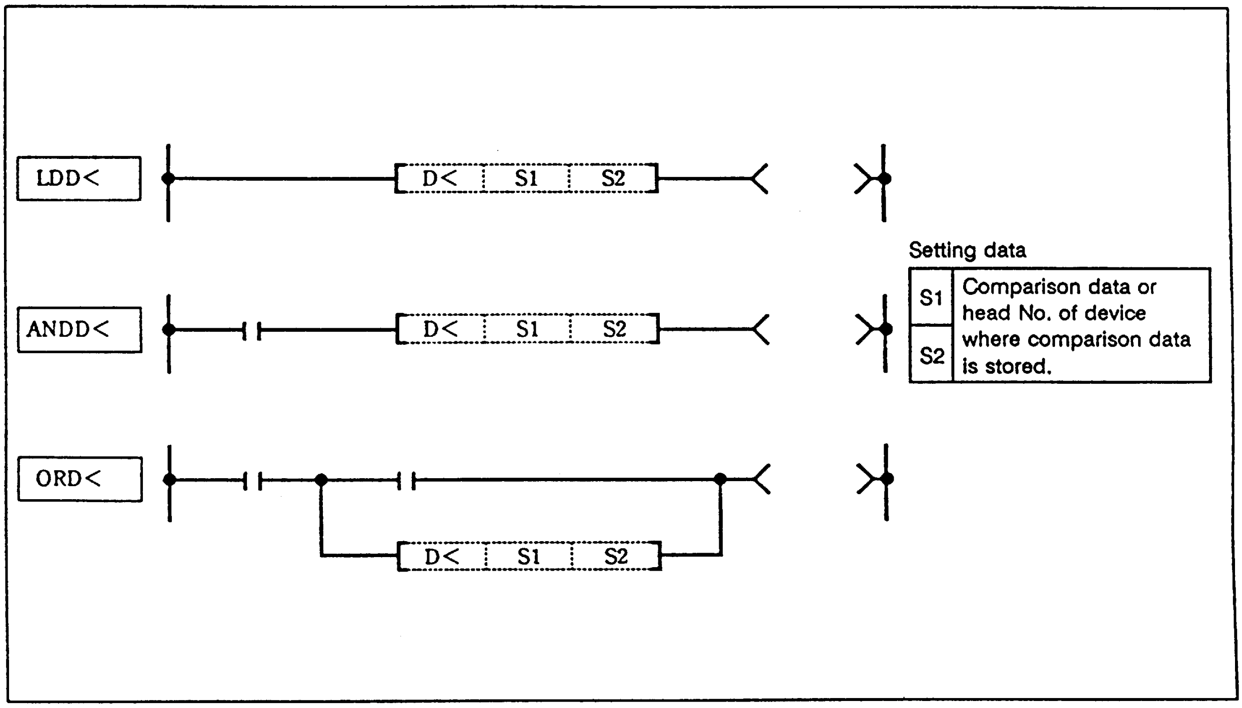


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	OR<	D0	D3		
5	OUT	Y33			
6					

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	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

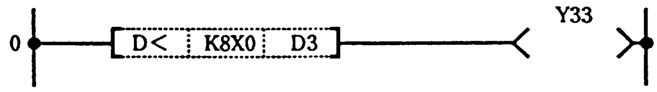
Execution conditions

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

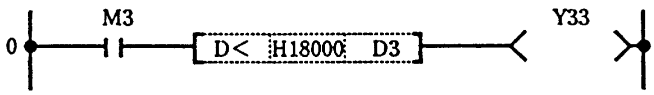
(1) Program to compare the X0 to 1F data, D3 and D4 data.



Coding

No. of steps	Com-mand	Device			
0	LDD<	K8X0	D3		
3	OUT	Y33			
4					

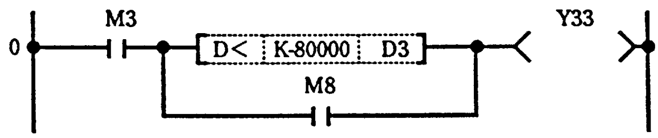
(2) Program to compare the BCD value 18000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	ANDD<	H18000	D3		
5	OUT	Y33			
6					

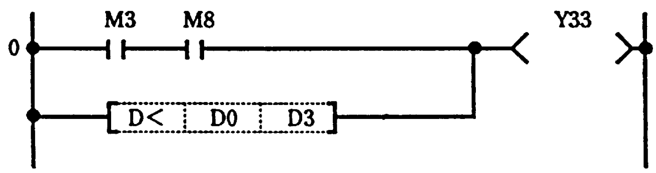
(3) Program to compare the BIN value -80000, D3 and D4 data.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LDD<	K-80000	D3		
5	OR	M8			
6	ANB				
7	OUT	Y33			
8					

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

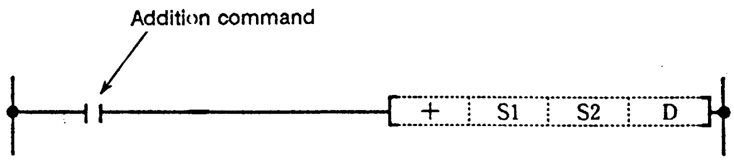


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	ORD<	D0	D3		
5	OUT	Y33			
6					

○ + ... BIN 16-bit addition

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○										
S2							○	○	○	○		○	○			○	○				4		
D							○	○	○	○		○	○										

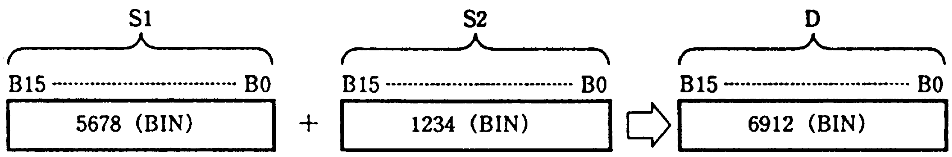


Setting data

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.

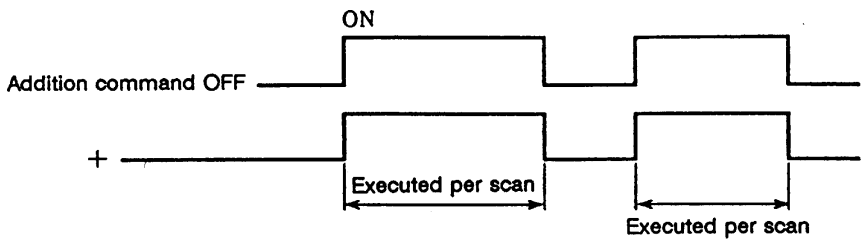
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B15).

B15	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON if the 15th bit overflows.

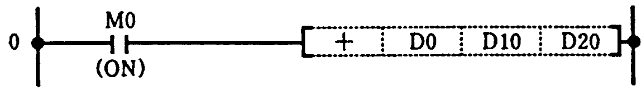
Execution conditions

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.

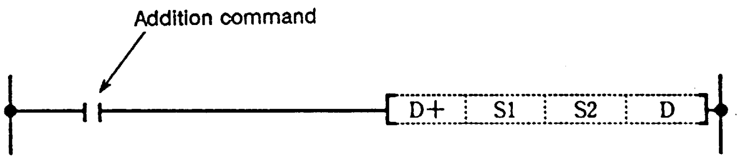


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	+	D0	D10	D20	

○ D+ ... BIN 32-bit addition

	Usable device																			Digit desig-nation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○											
S2							○	○	○	○		○				○	○				4/5		
D							○	○	○	○		○											

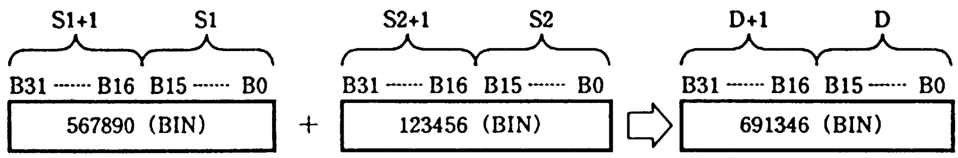


Setting data

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	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.

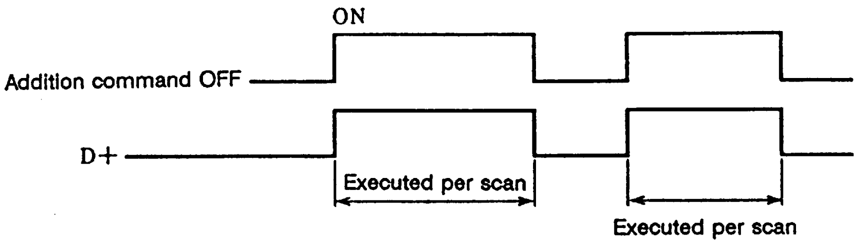
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B31).

B31	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON if the 31st bit overflows.

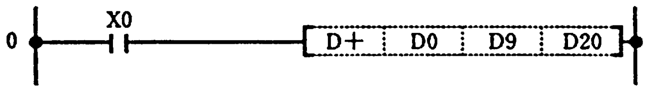
Execution conditions

The execution conditions for D+ are as shown below.



Program example

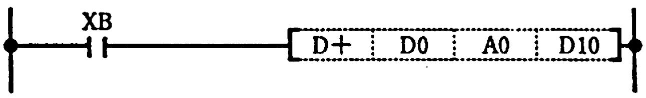
(1) Program to add the D0, 1 data and D9, 10 data when X0 turns ON, and output the results to D20, 21.



Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	D+	D0	D9	D20	
5					

(2) Program to add the A0, A1 data and D0, D1 data when XB turns ON, and output the results to D10, D11.

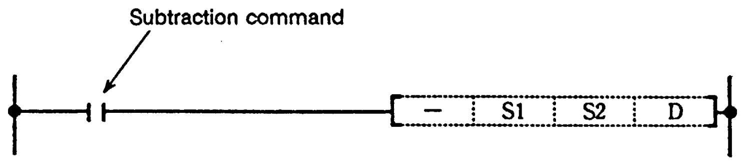


Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	D+	D0	A0	D10	
5					

○ − ... BIN 16-bit subtraction

	Usable device																			Digit desig-nation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○										
S2							○	○	○	○		○	○			○	○				4		
D							○	○	○	○		○	○										

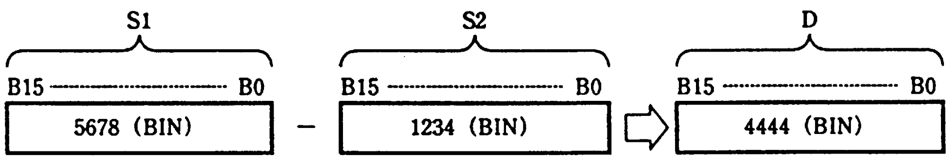


Setting data

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 S1 and the device designated with S2 are subtracted, and the subtracted results are stored in the device designated with D.



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

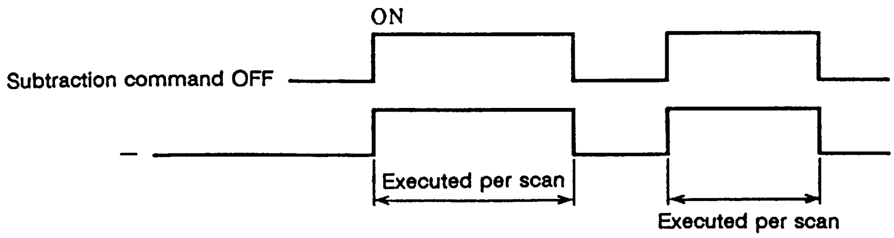
(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B15).

B15	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON if the 0 bit underflows.

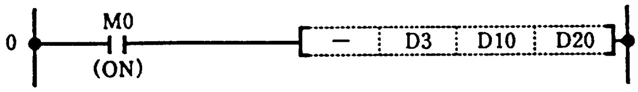
Execution conditions

The execution conditions for - are as shown below.



Program example

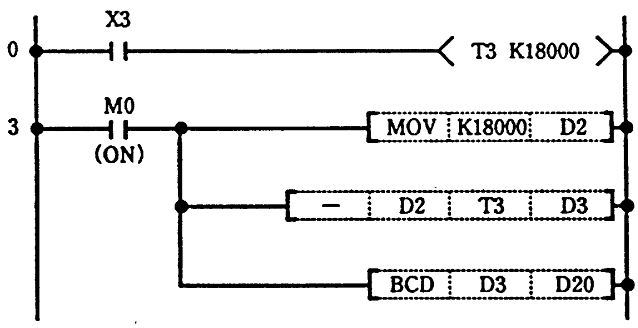
(1) Program to subtract the BIN data from D3 to D10 and output to D20.



Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	-	D3	D10	D20	
5					

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

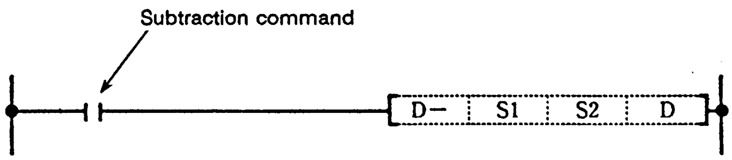


Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	OUT	T3	K18000		
3	LD	M0			
4	MOV	K18000	D2		
7	-	D2	T3	D3	
11	BCD	D3	D20		
14					

○ D– ... BIN 32-bit subtraction

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○									4/5		
S2							○	○	○	○		○				○	○						
D							○	○	○	○		○											

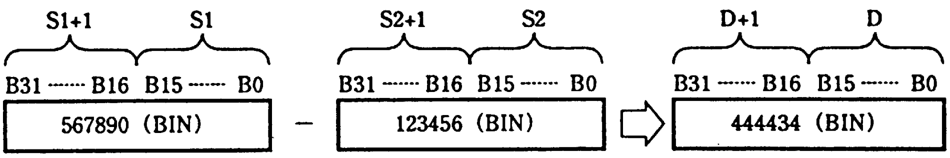


Setting data

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	No. of device to store subtraction results

Function

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



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

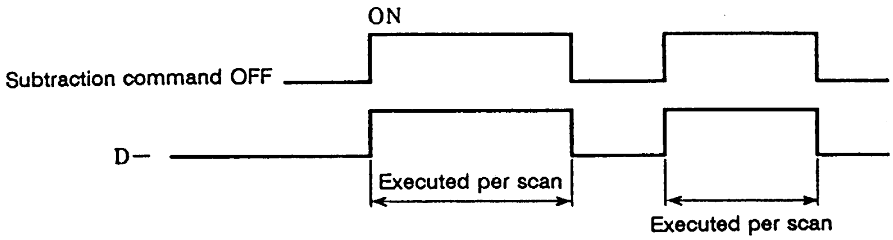
(3) The positive/negative of the data in S and D is determined with the highest-order bit (B31).

B31	Judgment of positive/negative
0	Positive
1	Negative

(4) The carry flag will not turn ON if the 0 bit underflows.

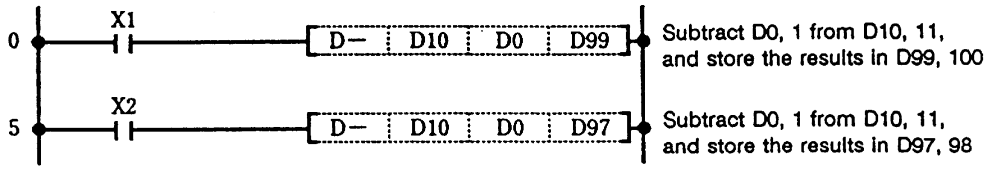
Execution conditions

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.

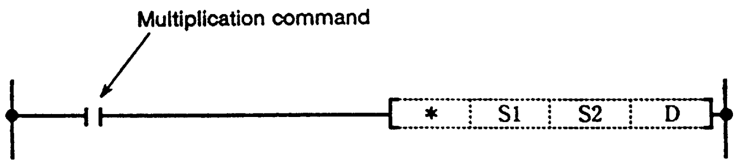


Coding

No. of steps	Com-mand	Device			
0	LD	X1			
1	D-	D10	D0	D99	
5	LD	X2			
6	D-	D10	D0	D97	
10					

○ * ... BIN 16-bit multiplication

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○								4		
S2							○	○	○	○		○	○			○	○						
D							○	○	○	○		○											

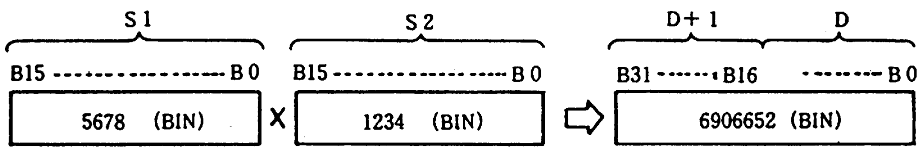


Setting data

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 and the BIN data designated with S2 are multiplied, and the multiplication results are stored in the device designated with D.



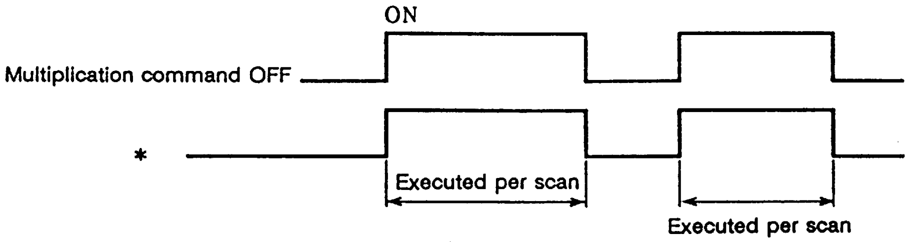
(2) -32768 to 32767 (BIN 16-bit) can be designated in S1 and S2.

(3) The positive/negative of the data in S1, S2 and D is determined with the highest-order bit (B15, D is B31).

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

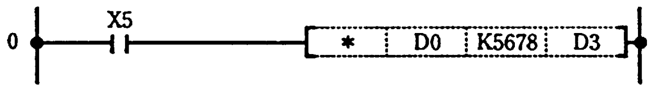
Execution conditions

The execution conditions for * are as shown below.



Program example

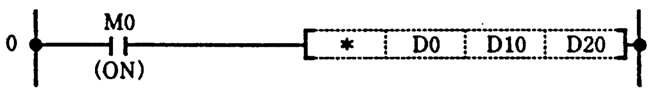
(1) Program to multiply the D0 data and BIN 5678 when X5 turns ON and output the results to D3, 4.



Coding

No. of steps	Com-mand	Device			
0	LD	X5			
1	*	D0	K5678	D3	
5					

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

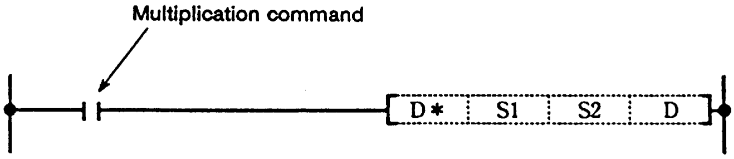


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	*	D0	D10	D20	
5					

○ D* ... BIN 32-bit multiplication

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○									4/5		
S2							○	○	○	○		○				○	○						
D							○	○	○	○													

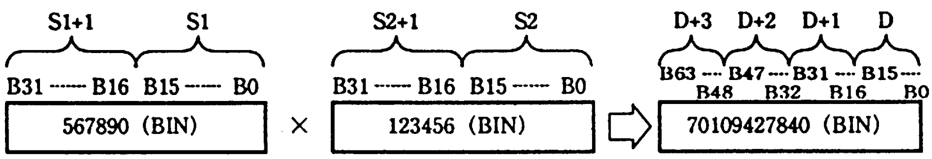


Setting data

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 and the BIN data designated with S2 are multiplied, and the multiplication results are stored in the device designated with D.



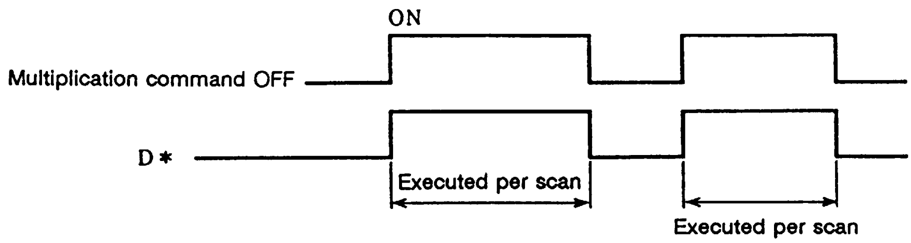
(2) -2147483648 to 2147483647 (BIN 32-bit) can be designated in S1 and S2.

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

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

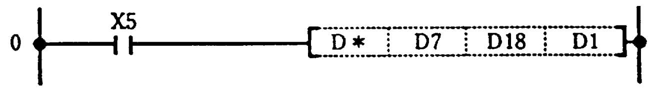
Execution conditions

The execution conditions for D* are as shown below.



Program example

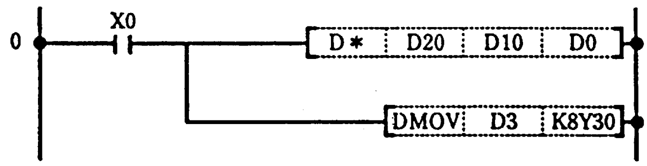
(1) Program to multiply the D7, 8 BIN data and D18, 19 BIN data when X5 turns ON, and output the results to D1 to 4.



Coding

No. of steps	Com-mand	Device			
0	LD	X5			
1	D*	D7	D18	D1	
5					

(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.

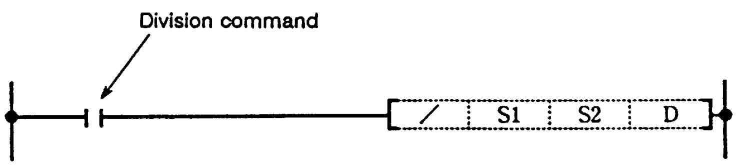


Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	D*	D20	D10	D0	
5	DMOV	D3	K8Y30		
8					

○ / ... **BIN 16-bit division**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○								4		
S2							○	○	○	○		○	○			○	○						
D							○	○	○	○		○											

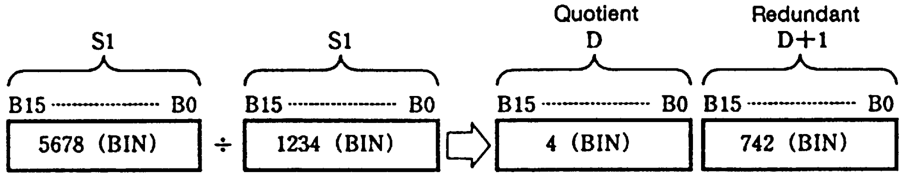


Setting data

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 and the BIN data designated with S2 are divided, 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.

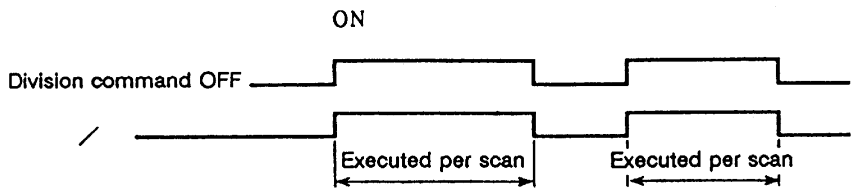
Quotient ... Stored in low-order 16-bit.

Redundant... Stored in high-order 16-bit.

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

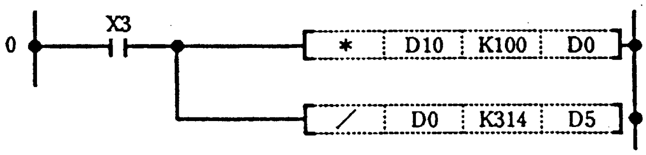
Execution conditions

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.

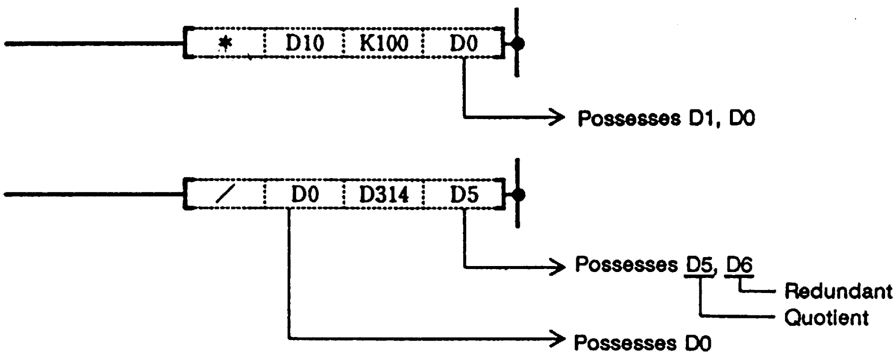


Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	*	D10	K100	D0	
5	/	D0	K314	D5	
9					

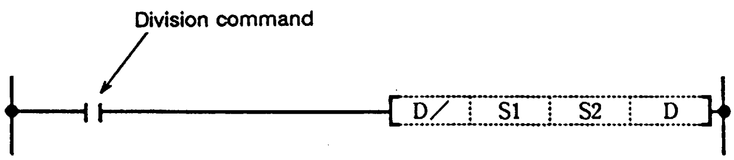
Point

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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○									4/5		
S2							○	○	○	○		○				○	○						
D							○	○	○	○													

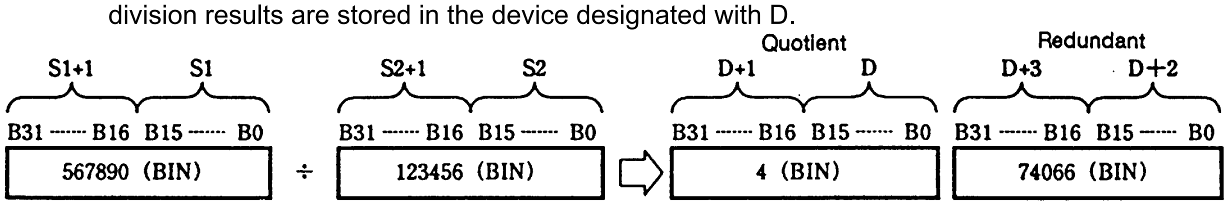


Setting data

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 and the BIN data designated with S2 are divided, 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 S 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.

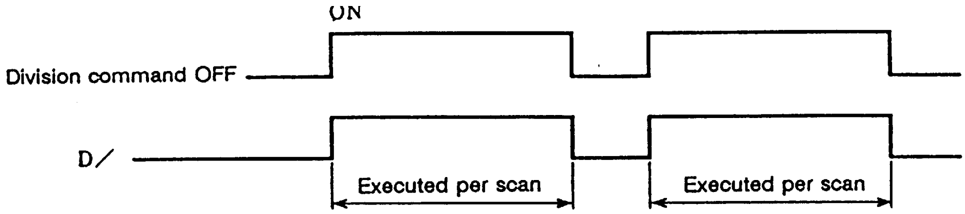
Quotient ... Stored in low-order 32-bit.

Redundant... Stored in high-order 32-bit.

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

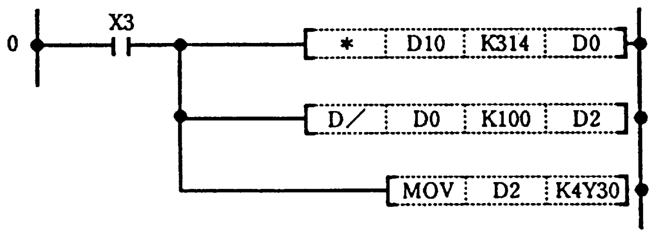
Execution conditions

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 results to Y30 to 3F.

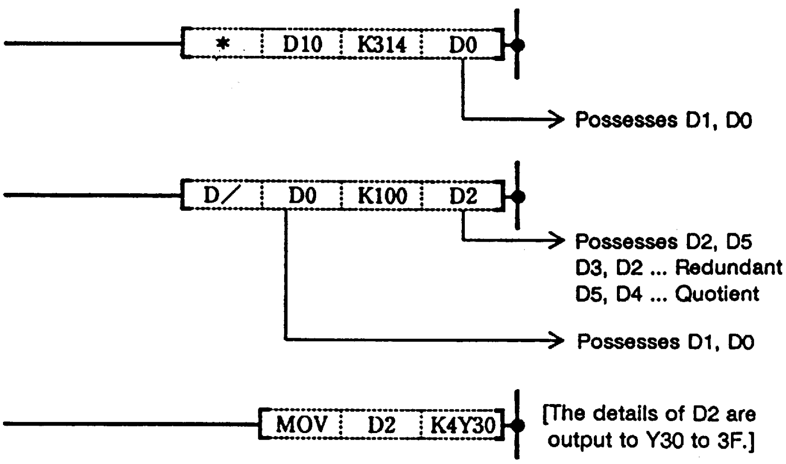


Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	*	D10	K314	D0	
5	D/	D0	K100	D2	
10	MOV	D2	K4Y30		

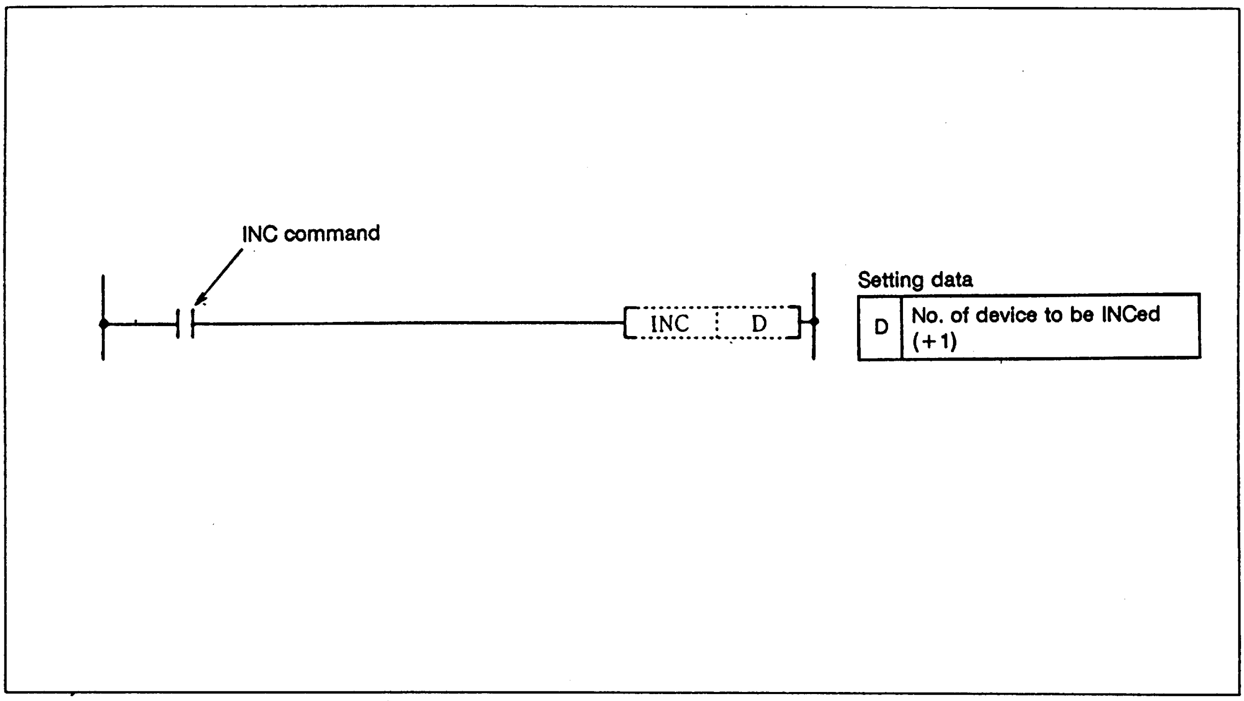
Point

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



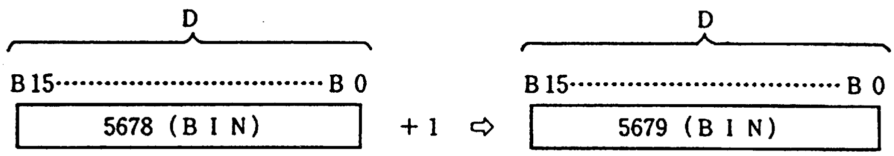
○ INC ... (16-bit BIN data) +1

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○	○								2		



Function

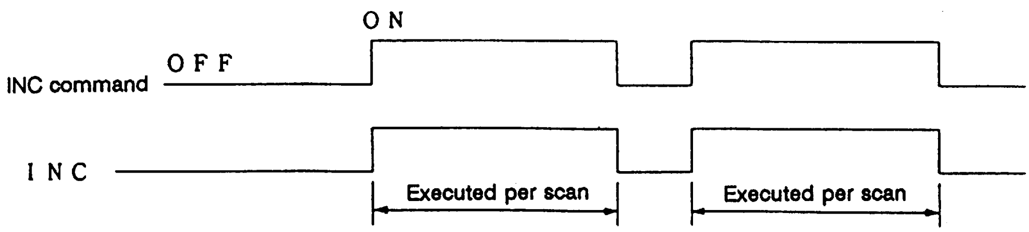
(1) The device (16-bit data) designated with D is incremented by one.



(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.

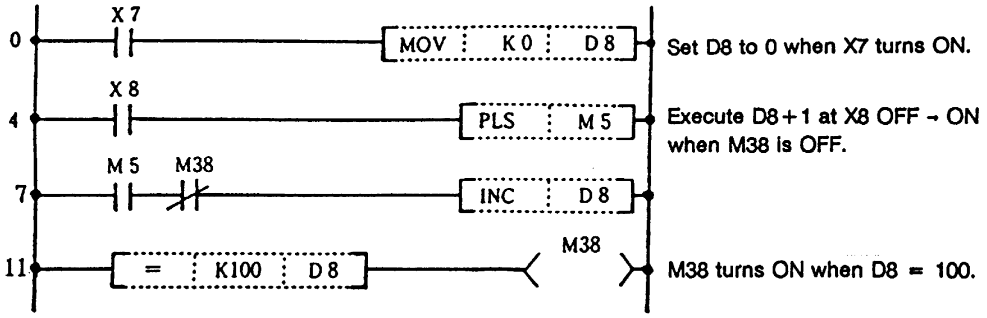
Execution conditions

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



Program example

(1) Example of addition counter program

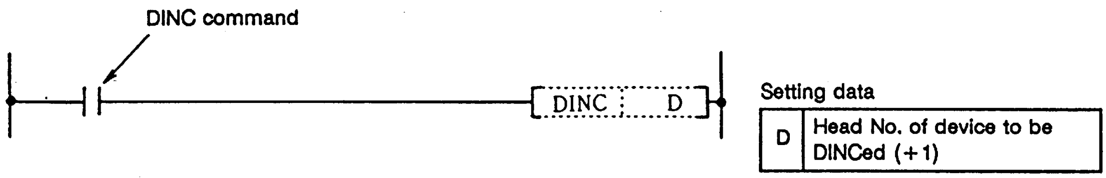


Coding

No. of steps	Com-mand	Device			
0	LD	X7			
1	MOV	K0	D8		
4	LD	X8			
5	PLS	M5			
7	LD	M5			
8	ANI	M38			
9	INC	D8			
11	LD=	K100	D8		
14	OUT	M38			
15					

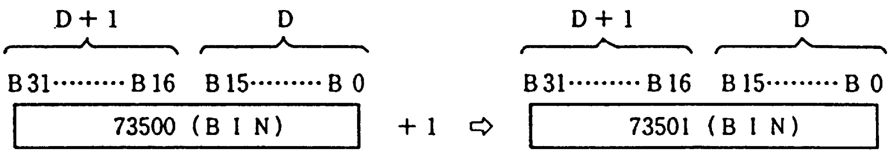
○ DINC ... (32-bit BIN data) +1

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○									2		



Function

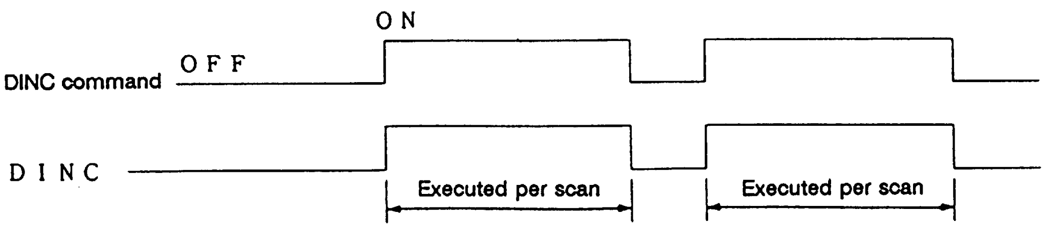
(1) The device (32-bit data) designated with D is incremented by one.



(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.

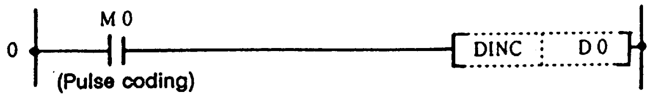
Execution conditions

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



Program example

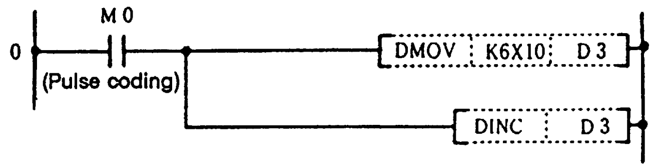
(1) Program to increment the D0, 1 data by one when M0 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	DINC	D0			

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

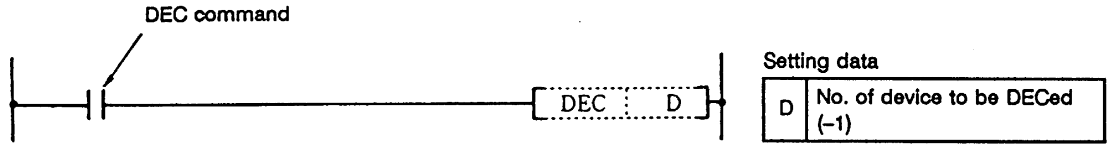


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	DMOV	K6X10	D3		
4	DINC	D3			

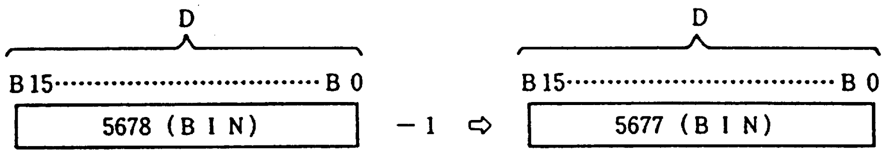
○ DEC ... (16-bit BIN data) –1

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○	○								2		



Function

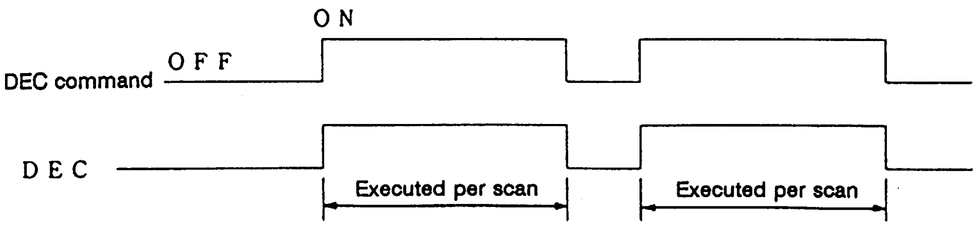
(1) The device (16-bit data) designated with D is decremented by one.



(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.

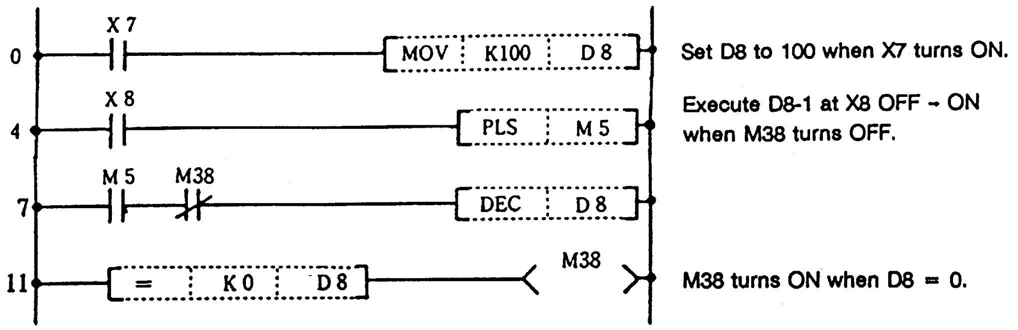
Execution conditions

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



Program example

(1) Example of subtraction counter program

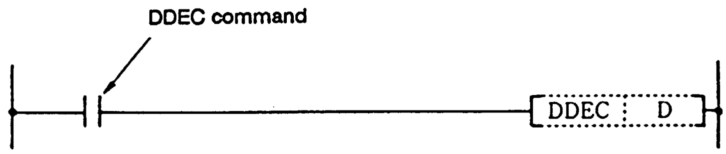


Coding

No. of steps	Com-mand	Device			
0	LD	X7			
1	MOV	K100	D8		
4	LD	X8			
5	PLS	M5			
7	LD	M5			
8	ANI	M38			
9	DEC	D8			
11	LD=	K0	D8		
14	OUT	M38			

○ **DDEC ... (32-bit BIN data) –1**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○									2		

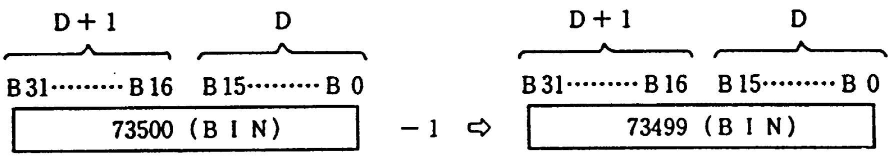


Setting data

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

Function

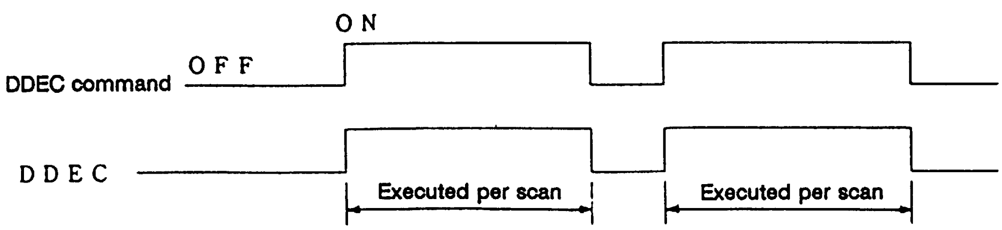
(1) The device (32-bit data) designated with D is decremented by one.



(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.



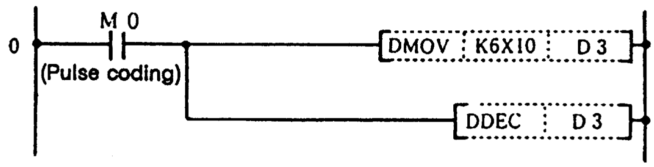
Program example

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

Coding

No. of steps	Com- mand	Device			
0	LD	M0			
1	DDEC	D0			
4 (3)					

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

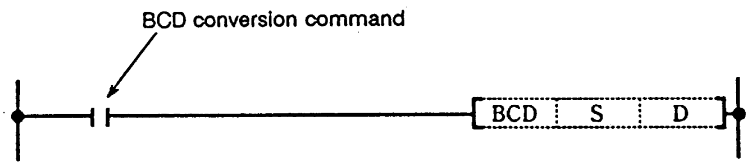


Coding

No. of steps	Com- mand	Device			
0	LD	M0			
1	DMOV	K6X10	D3		
4	DDEC	D3			
7 (6)					

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○	○							○	3		
D							○	○	○	○		○	○										

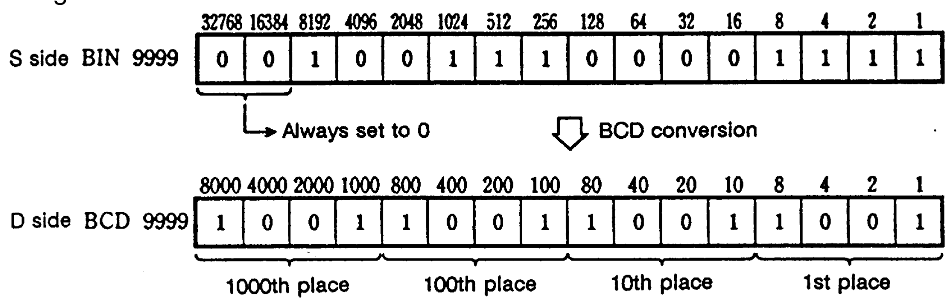


Setting data

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

Function

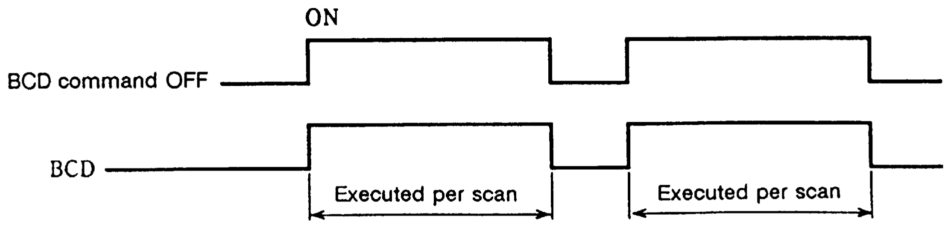
The BIN data (0 to 9999) of the device designated with S is BCD converted and transmitted to the device designated with D.



(Note 1) If the device BIN data designated by S is not within 0 to 9999, it will not be converted correctly.

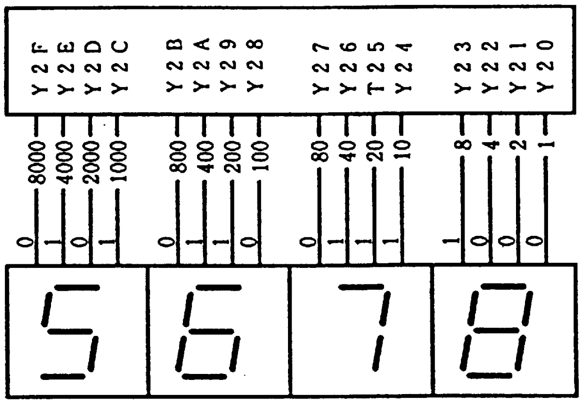
Execution conditions

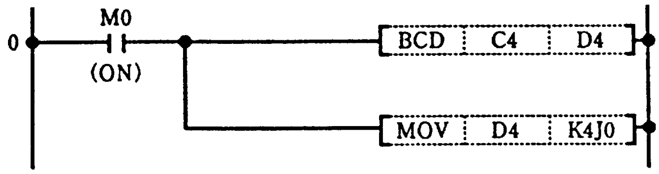
The execution conditions for BCD are as follow.



Program example

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



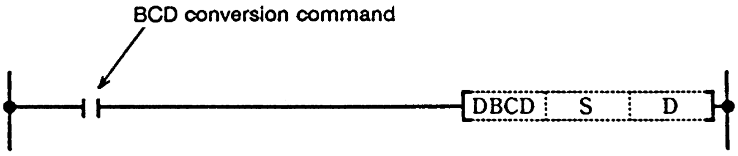


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	BCD	C4	D4		
4	MOV	D4	K4Y20		

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○								○	3		
D							○	○	○	○		○											

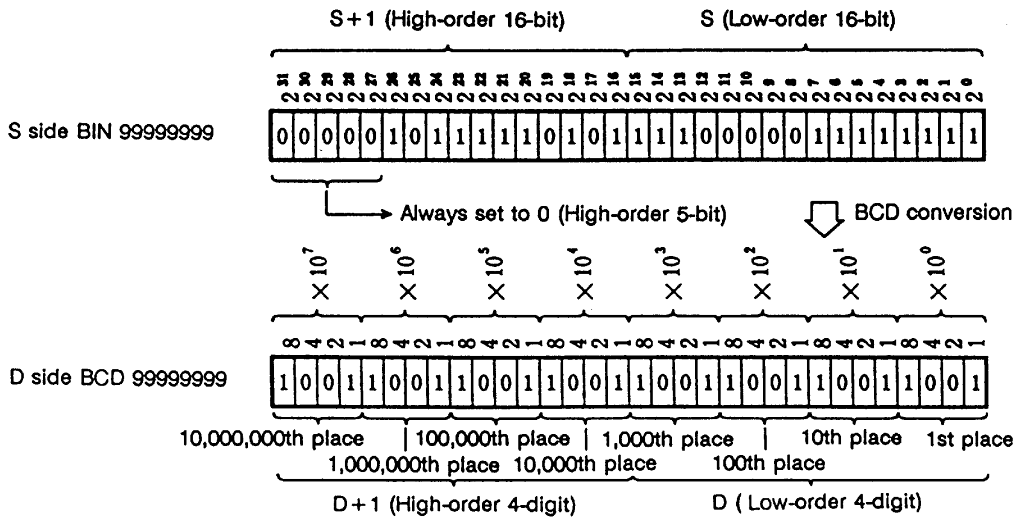


Setting data

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

Function

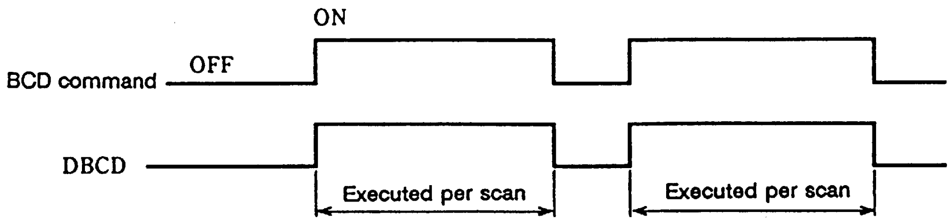
The BIN data (0 to 99999999) of the device designated with S is BCD converted and transmitted to the device designated with D.



(Note 1) If the device BIN data designated by S is not within 0 to 99999999, it will not be converted correctly.

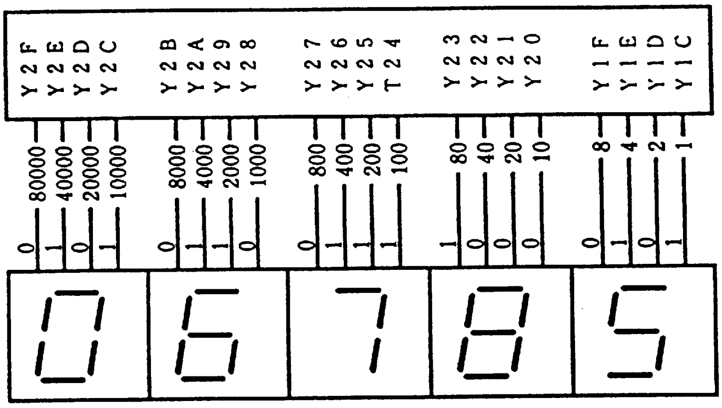
Execution conditions

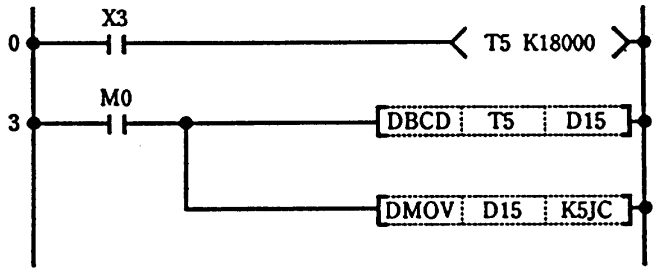
The execution conditions for DBCD are as follow.



Program example

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



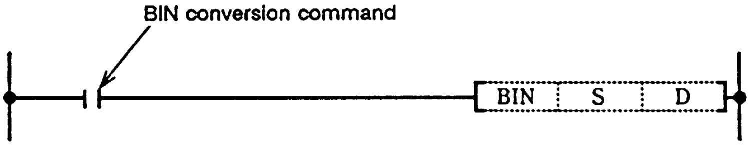


Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	OUT	T5	K18000		
3	LD	M0			
4	DBCD	T5	D15		
7	DMOV	D15	K5Y1C		

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Constant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○	○							○	3		
D							○	○	○	○		○	○										

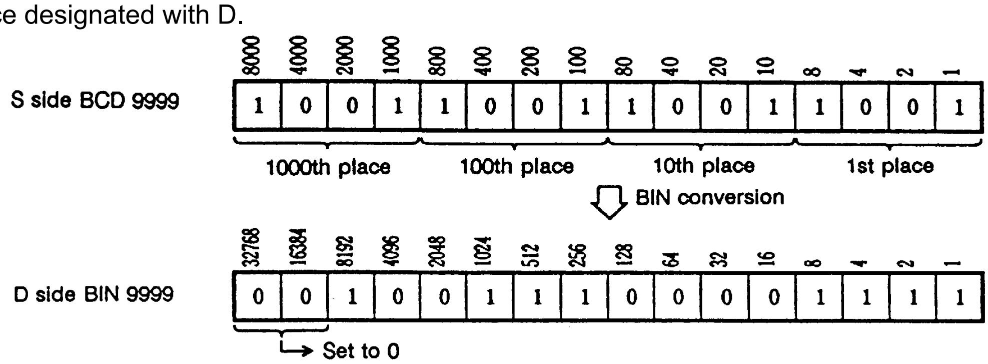


Setting data

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

Function

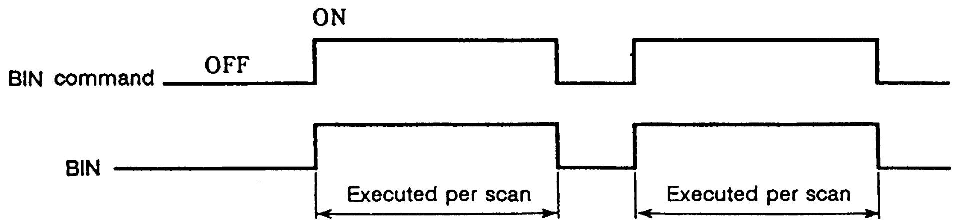
The BCD data (0 to 9999) of the device designated with S is BIN converted and transmitted to the device designated with D.



(Note 1) If the device digit data designated by S is not within 0 to 9, it will not be converted correctly.

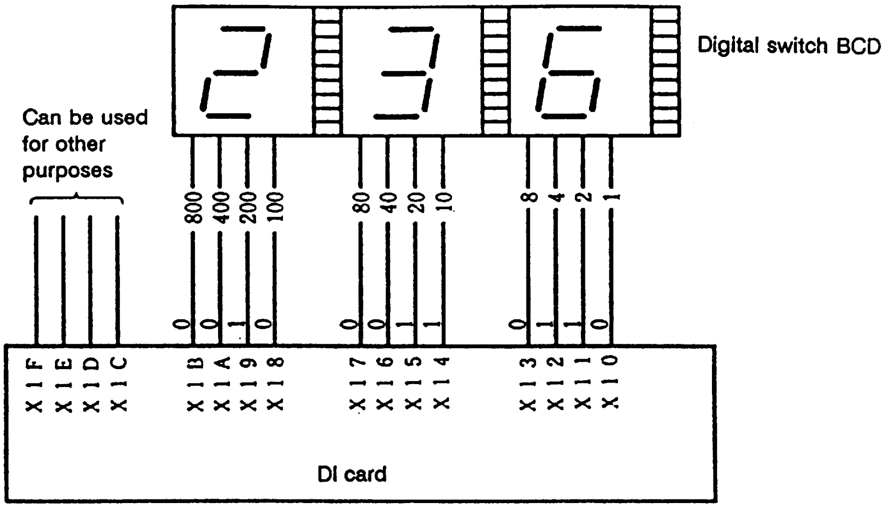
Execution conditions

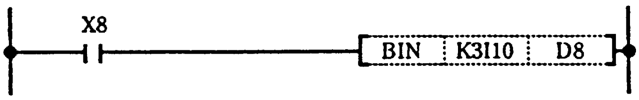
The execution conditions for BIN are as follow.



Program example

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



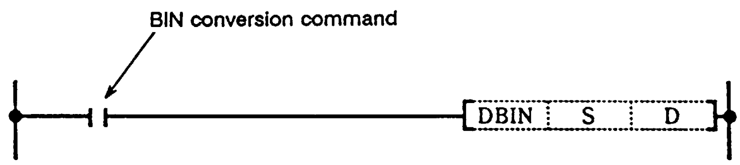


Coding

No. of steps	Com-mand	Device			
0	LD	X8			
1	BIN	K3X10	D8		
4					

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○								○	3		
D							○	○	○	○		○											

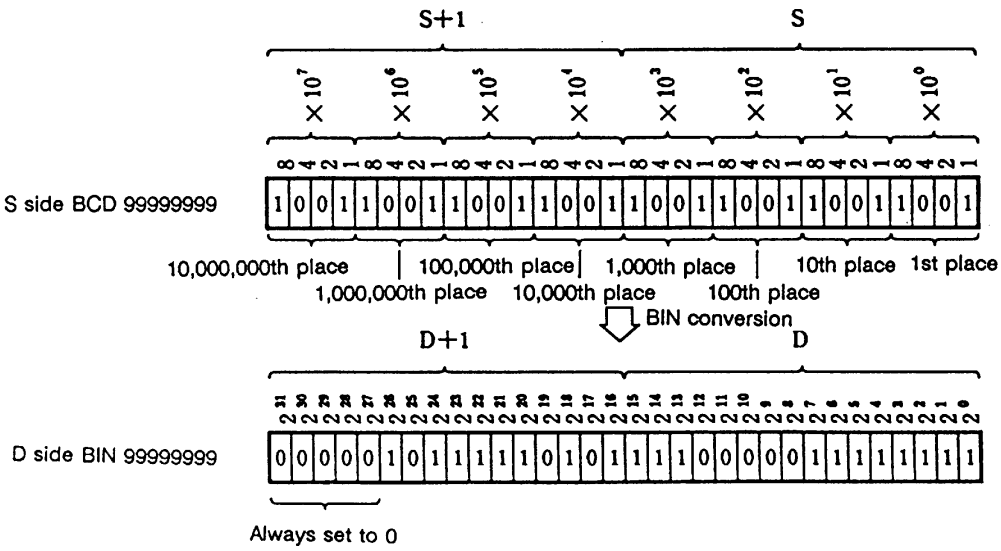


Setting data

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

Function

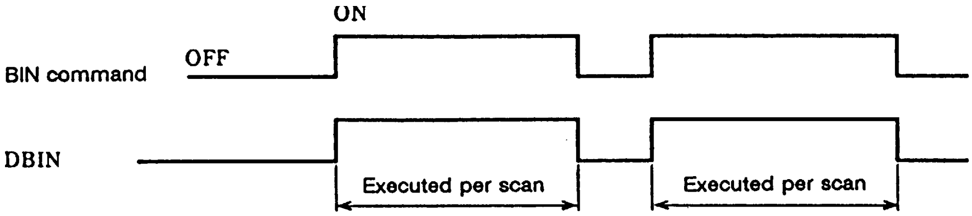
The BCD data (0 to 99999999) of the device designated with S is BIN converted and transmitted to the device designated with D.



(Note 1) If the device digit data designated by S is not within 0 to 9, it will not 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	Command	Device			
0	LD	X0			
1	DBIN	K5X10	D14		
4					

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

Coding

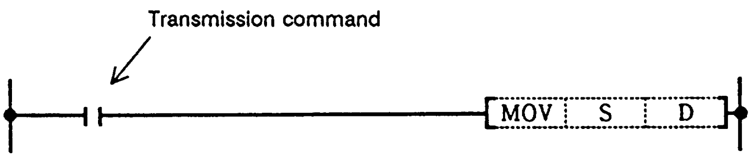
No. of steps	Command	Device			
0	LD	X0			
1	DBIN	D0	D18		
4					

○ MOV ... 16-bit data transmission

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○	○	△	△	○	○			○	3	○	
D	Note1	○	○	○	○	○	○	○	○	○		○	○	△	△								

△: MOV from a bit device (word device) to Z or V is not possible.
Z and V cannot be independently placed on the source side, but can be used on the source side as ornaments for D and R.
Refer to "6.2.4 Index Ornaments" for details.

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

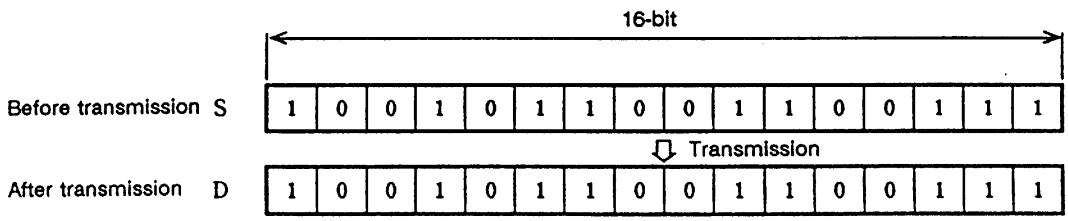


Setting data

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

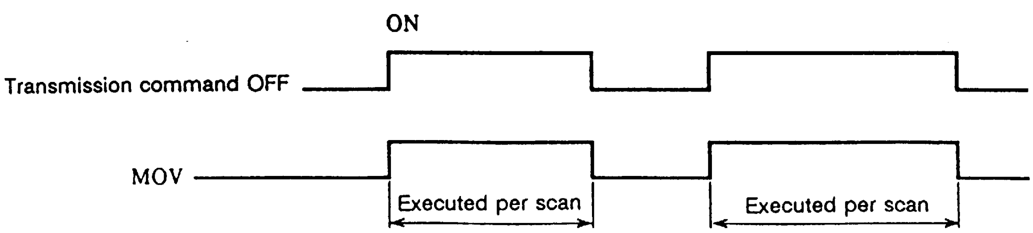
Function

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.



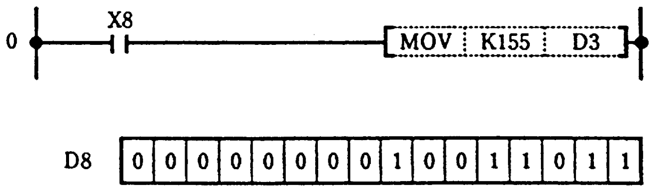
Program example

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

Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	MOV	K3X0	D8		
4					

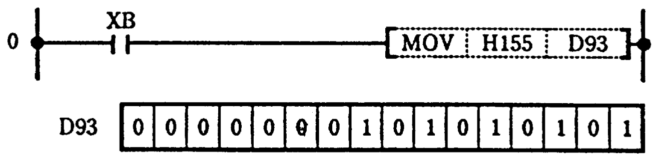
(2) Program to store 155 in D8 as binary value when X8 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	X8			
1	MOV	K155	D8		
4					

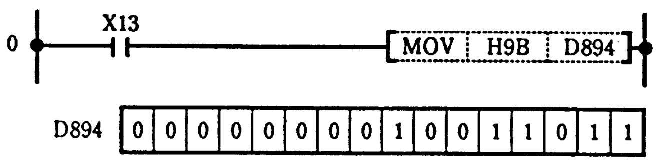
(3) Program to store 155 in D93 as BCD value in when XB turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	XB			
1	MOV	H155	D93		
4					

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



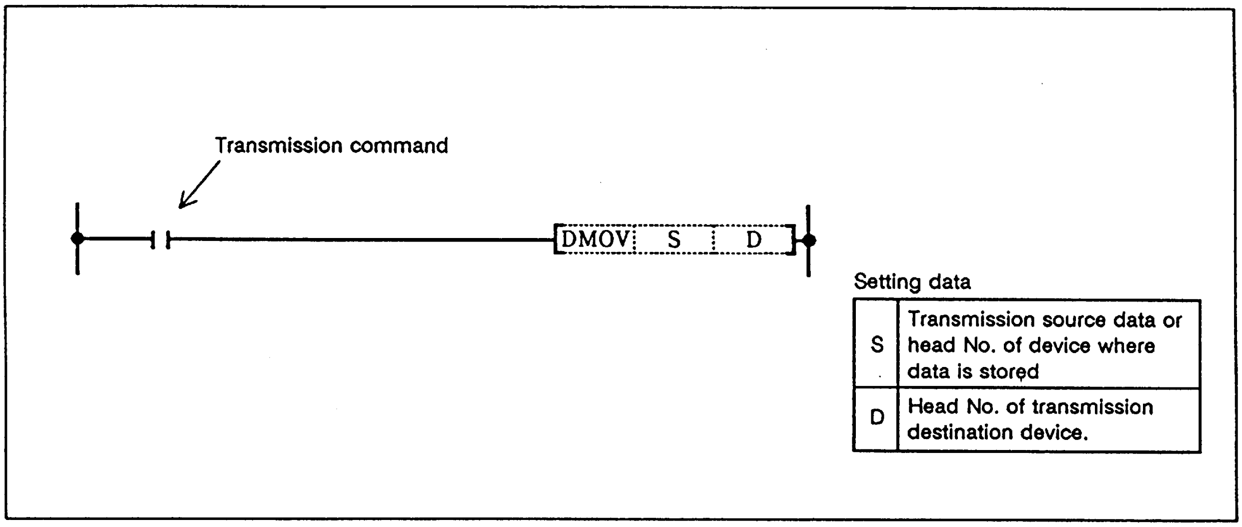
Coding

No. of steps	Com-mand	Device			
0	LD	X13			
1	MOV	H9B	D894		
4					

○ DMOV ... 32-bit data transmission

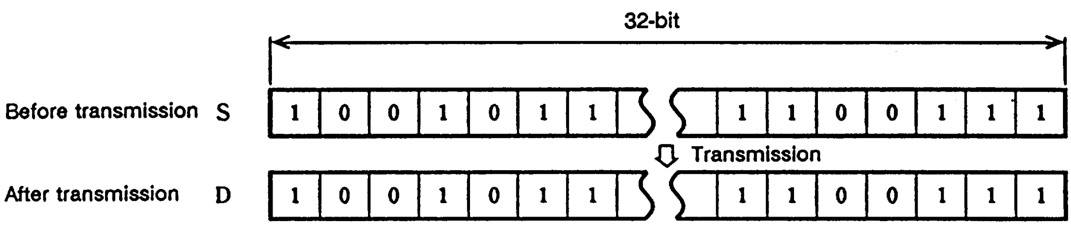
	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○				○	○			○	3/4		
D	Note2	○	○	○	○	○	○	○	○	○		○											

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



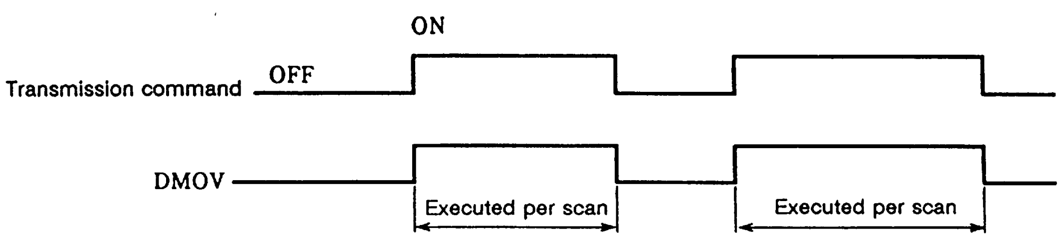
Function

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 A0, A1 data in D0, D1.

Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	DMOV	A0	D0		
4					

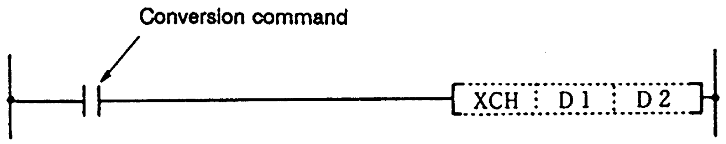
(2) Program to store X0 to 1F data in D0, D1.

Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	DMOV	K8X0	D0		

○ XCH ... 16-bit data exchange

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D1		○	○	○	○	○	○	○	○	○		○	○							○	3		
D2							○	○	○	○		○	○										

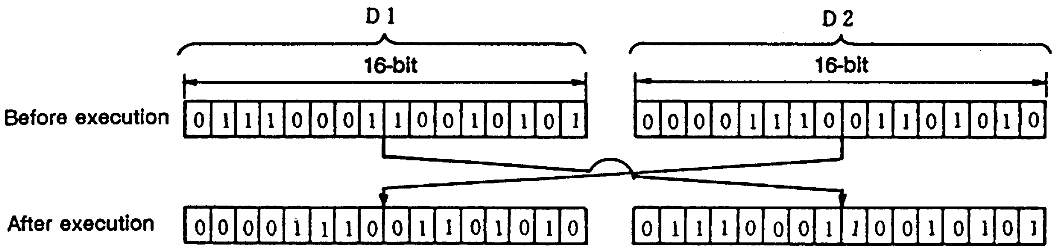


Setting data

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

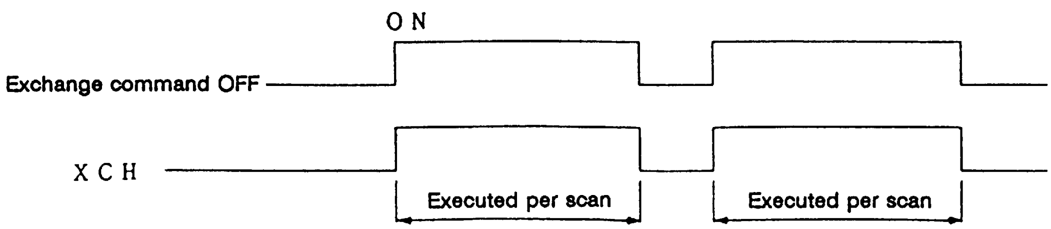
Function

The D1 and D2 16-bit data are exchanged.



Execution conditions

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



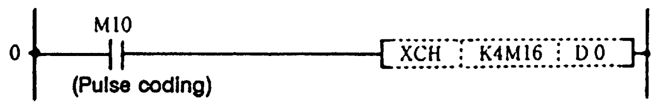
Program example

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

Coding

No. of steps	Com-mand	Device			
0	LD	M8			
1	XCH	T0	D0		

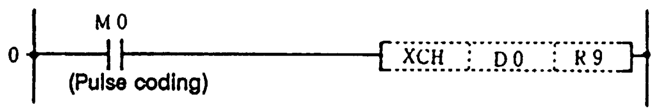
(2) Program to exchange D0 details with M16 to M31 data when M10 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	M10			
1	XCH	K4M16	D0		

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

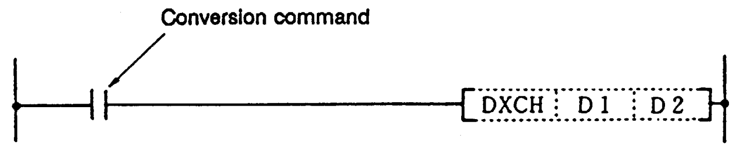


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	XCH	D0	R9		

○ DXCH ... 32-bit data exchange

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D1		○	○	○	○	○	○	○	○	○		○								○	3		
D2							○	○	○	○		○											

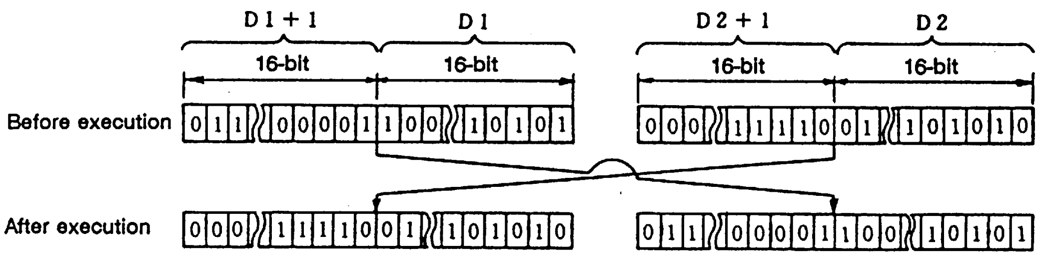


Setting data

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

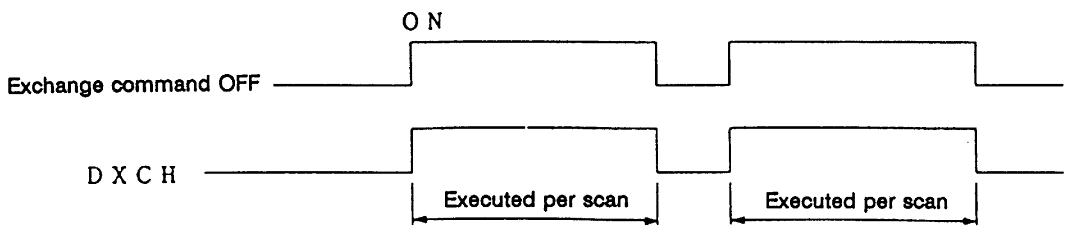
Function

The D1 and D2 32-bit data are exchanged.



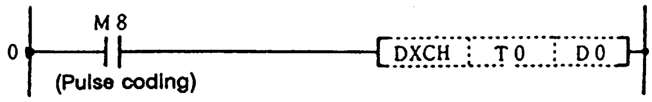
Execution conditions

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



Program example

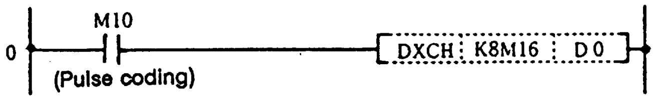
(1) Program to exchange T0 and T1 current values with D0, 1 details when M8 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	M8			
1	DXCH	T0	D0		

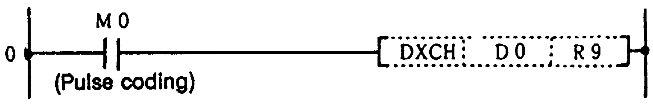
(2) Program to exchange D0, 1 details with M16 to M47 data when M10 turns ON.



Coding

No. of steps	Com-mand	Device			
0	LD	X10			
1	DXCH	K8M16	D0		

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

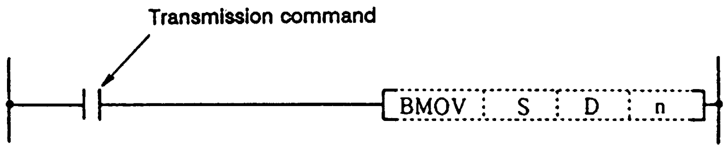


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	DXCH	D0	R9		

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S							○	○	○	○											4		
D							○	○	○	○													
n																○	○						

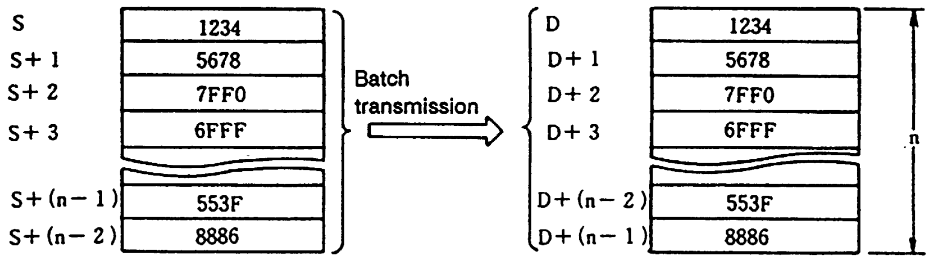


Setting data

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

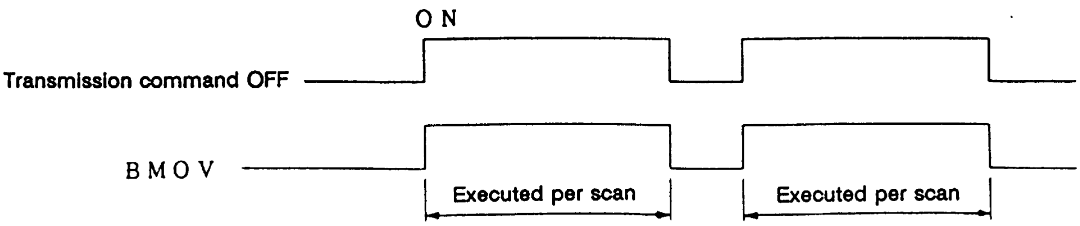
Function

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



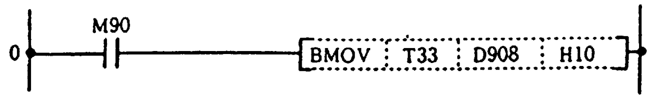
Execution conditions

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



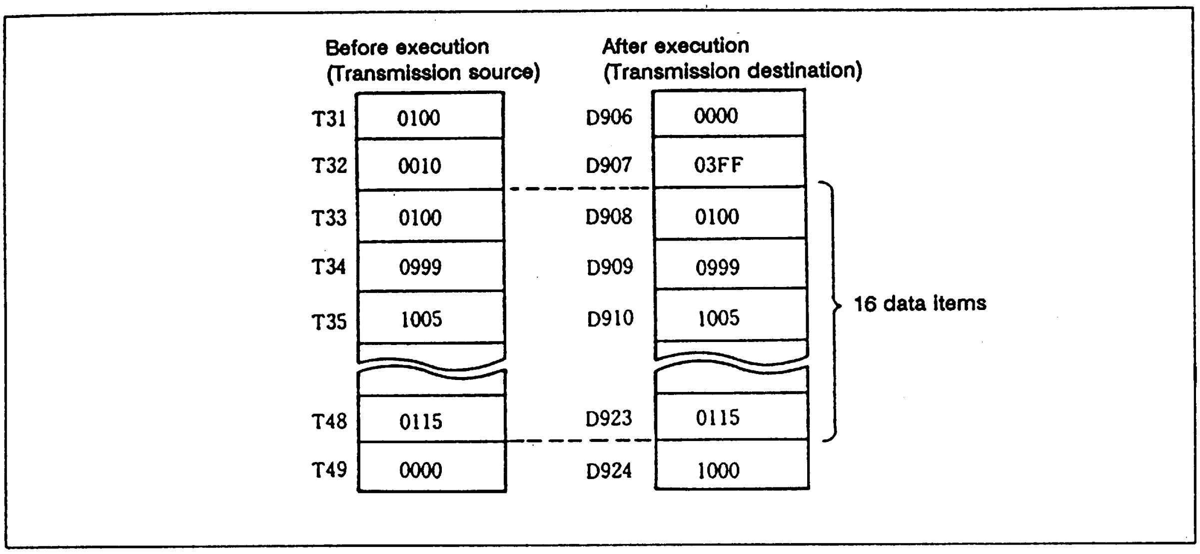
Program example

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



Coding

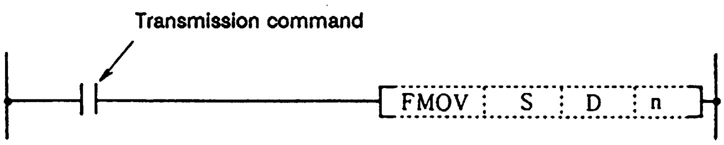
No. of steps	Com- mand	Device			
0	LD	M90			
1	BMOV	T33	D908	H10	



Block transmission with BMOV command

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S							○	○	○	○		○	○			○	○				3		
D							○	○	○	○													
n																○	○						

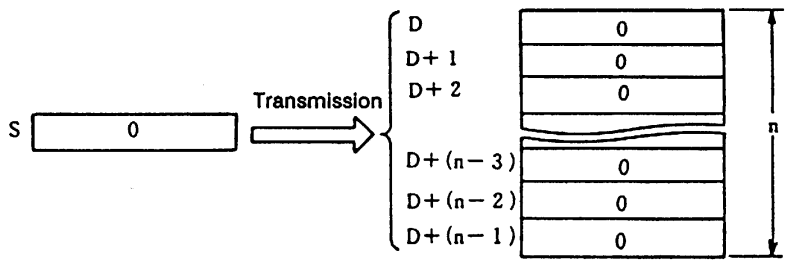


Setting data

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

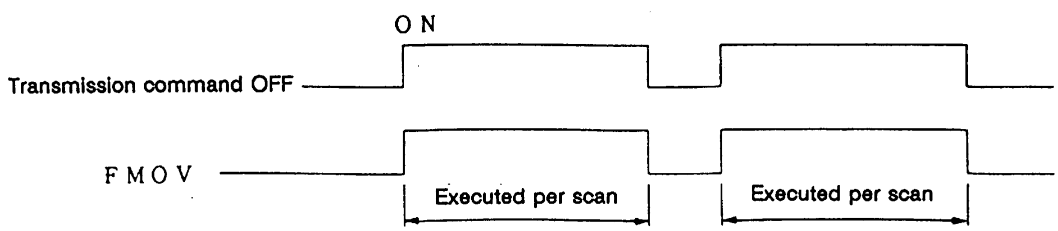
Function

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



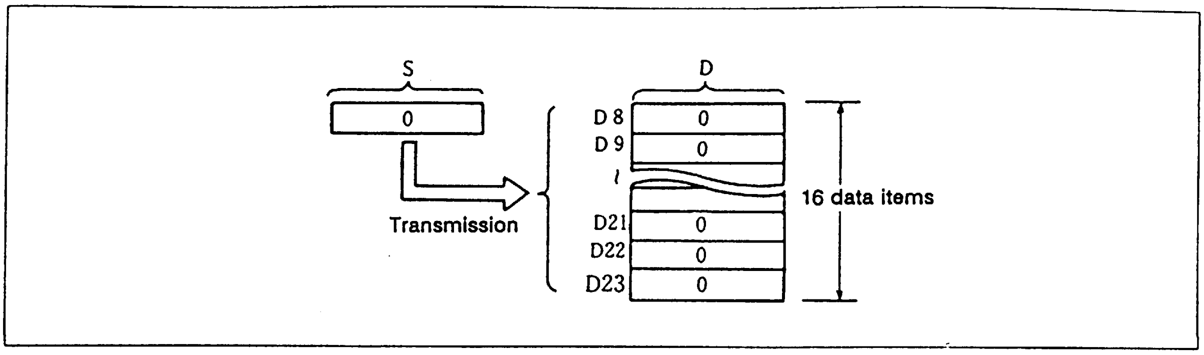
Execution conditions

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

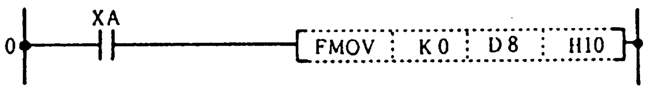


Program example

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



Resetting of data registers with FMOV command

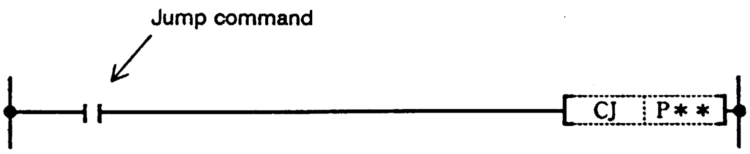


Coding

No. of steps	Command	Device			
0	LD	XA			
1	FMOV	K0	D8	H10	
5					

○ CJ ... Conditional jump

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
P																		○			2		



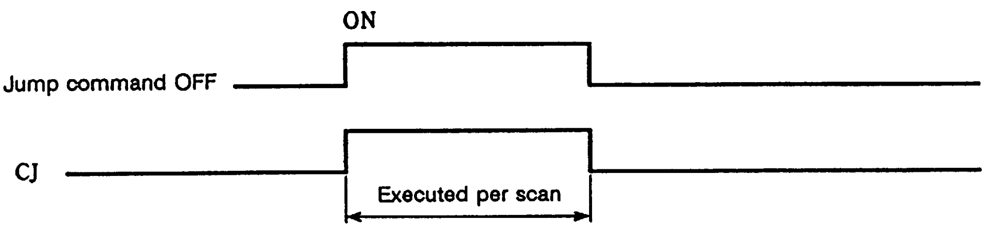
Setting data

P**	Jump designation pointer No. (P0 to 159)

Function

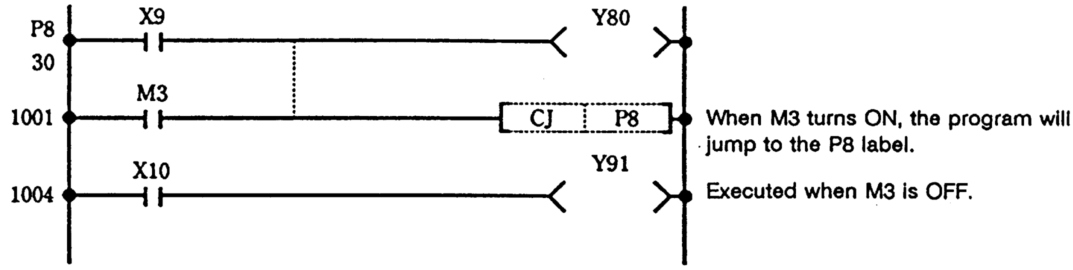
CJ

(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.

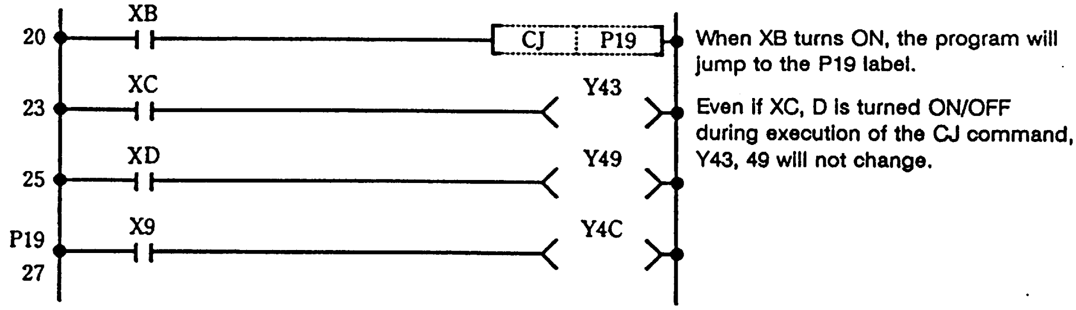


Point

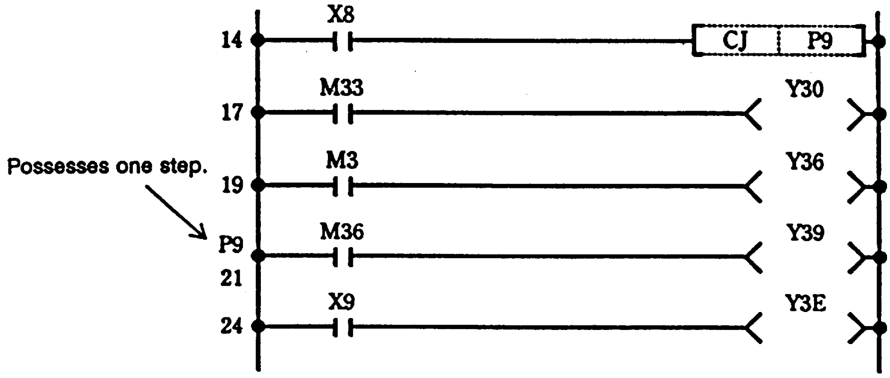
(1) After the timer coil is turned ON, if the timer that is turning the coil ON with the CJ command is jumped, the timer count will continue.
(2) The scan time will be shortened if jumping is done after the CJ command.
(3) The CJ command can be used to jump to a smaller step.



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

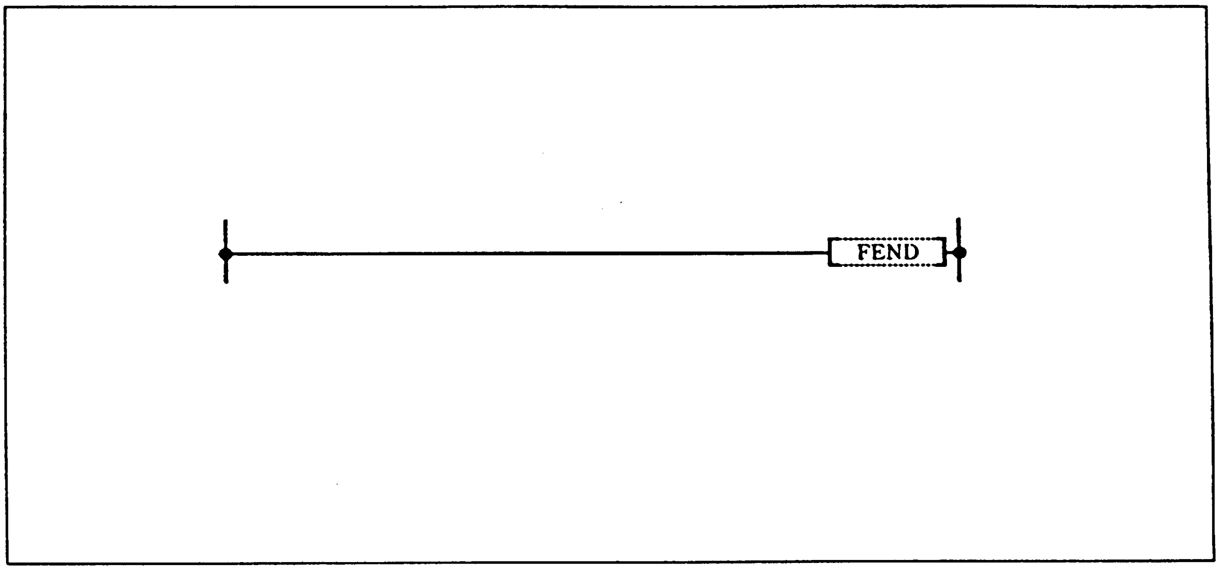


(5) Label (P**) possesses one step.



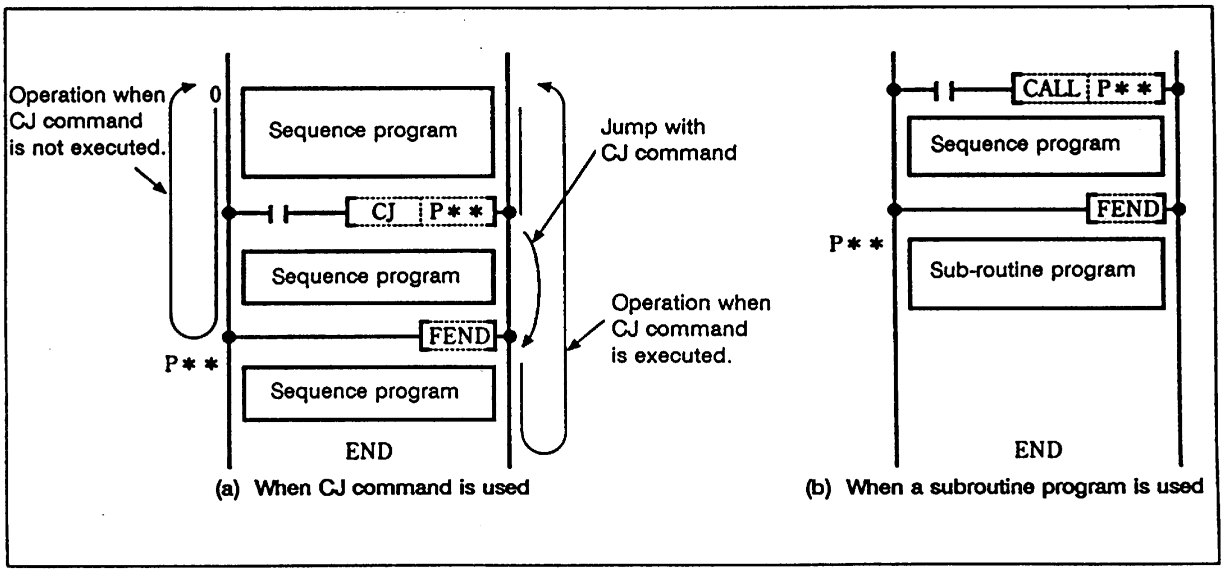
○ FEND ... Program end

Usable device																			Digit desig- nation	No. of steps	Index	
Bit device						Word (16-bit) device									Con-sta nt		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
																				1		



Function

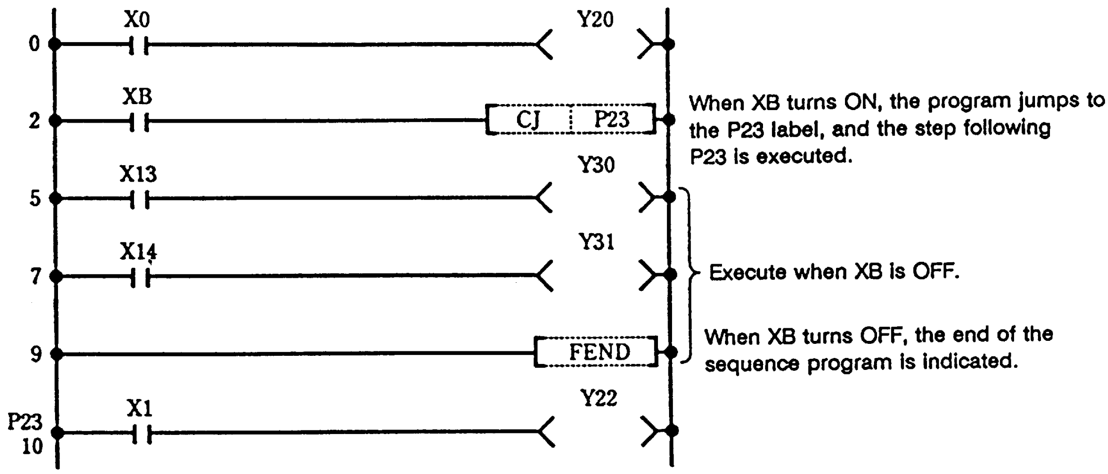
The sequence program is ended.



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

Program example

Program when using CJ command

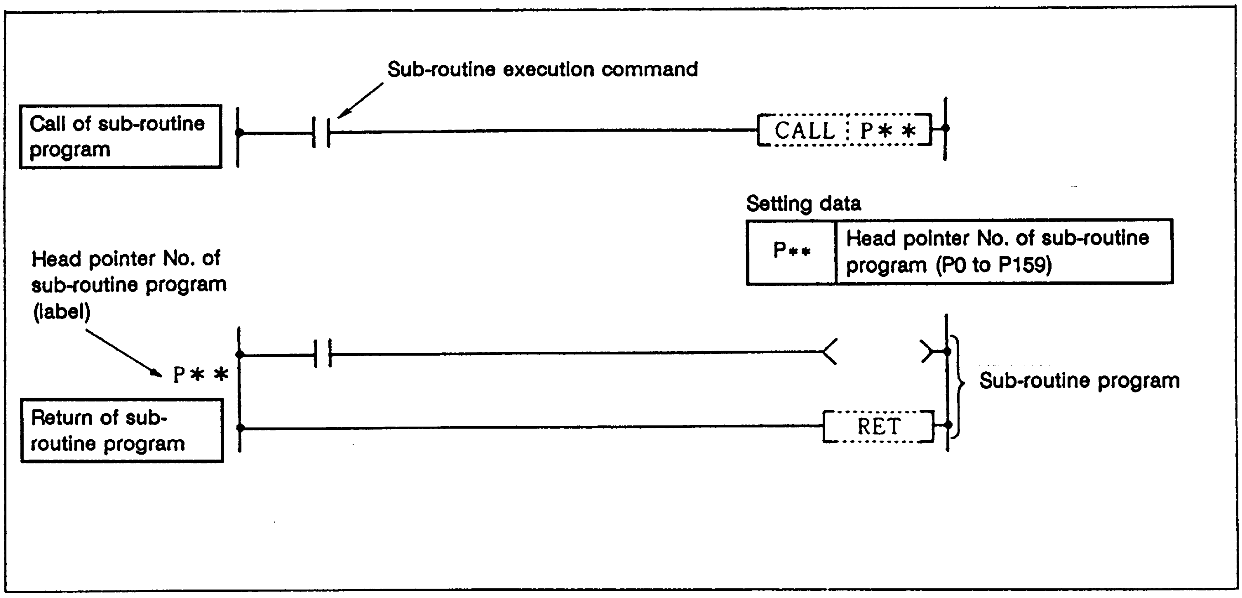


Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	OUT	Y20			
2	LD	XB			
3	CJ	P23			
5	LD	X13			
6	OUT	Y30			
7	LD	X14			
8	OUT	Y31			
9	FEND				
10	P23				
11	LD	X1			
12	OUT	Y22			
13					

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

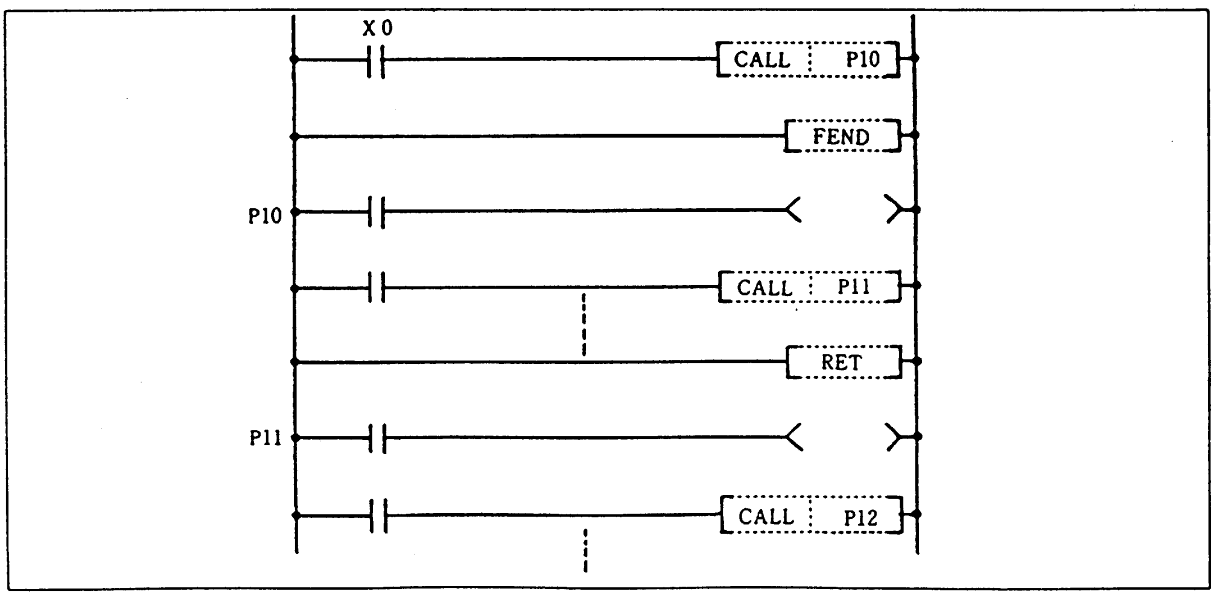
	Usable device																			Digit desig-nation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-st ant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
P																		○			2		



Function

CALL

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

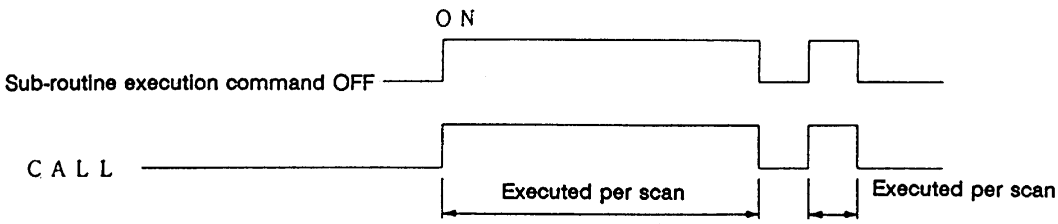


RET

(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.

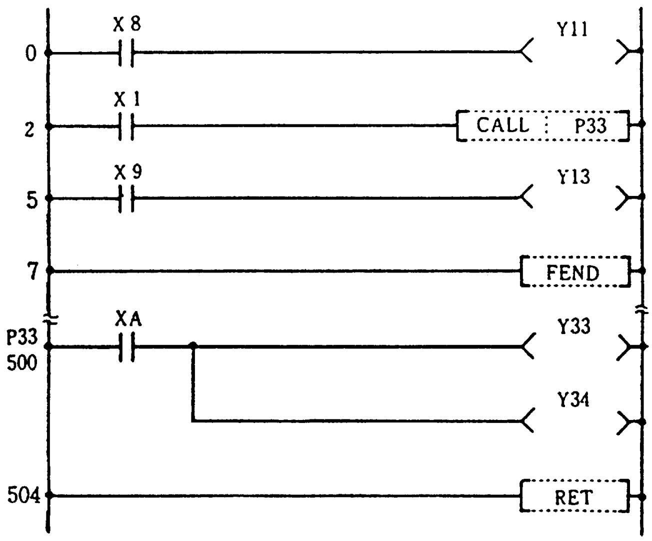
Execution conditions

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.

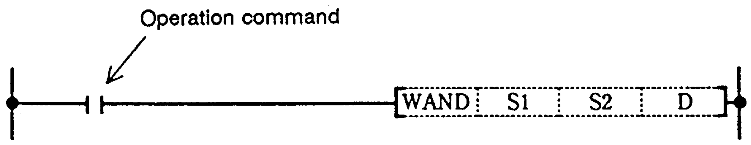


Coding

No. of steps	Com-mand	Device			
0	LD	X8			
1	OUT	Y11			
2	LD	X1			
3	CALL	P33			
5	LD	X9			
6	OUT	Y13			
7	FEND				
8					
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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	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.

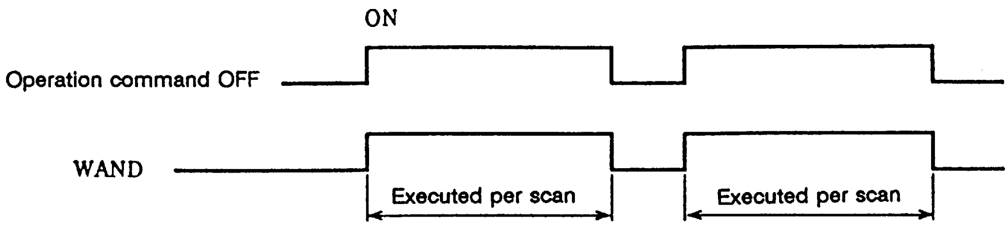
16-bit

Before execution	S1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1
		AND															
Before execution	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) Above the bit device digit designation is operated as 0.
(Refer to program example (2) on the next page.)

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.

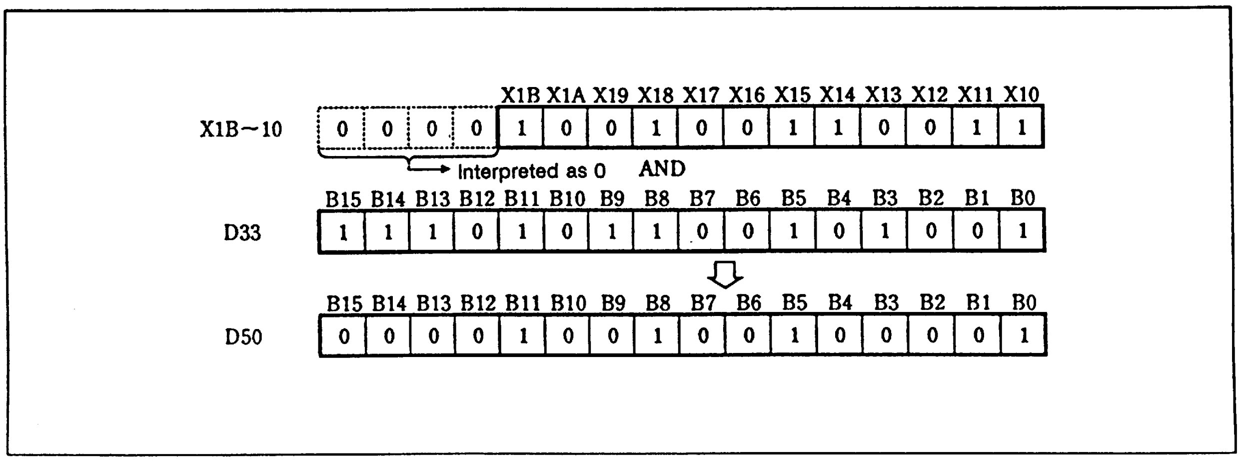
Coding

No. of steps	Com-mand	Device			
0	LD	XA			
1	WAND	D10	D20	D33	

(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.

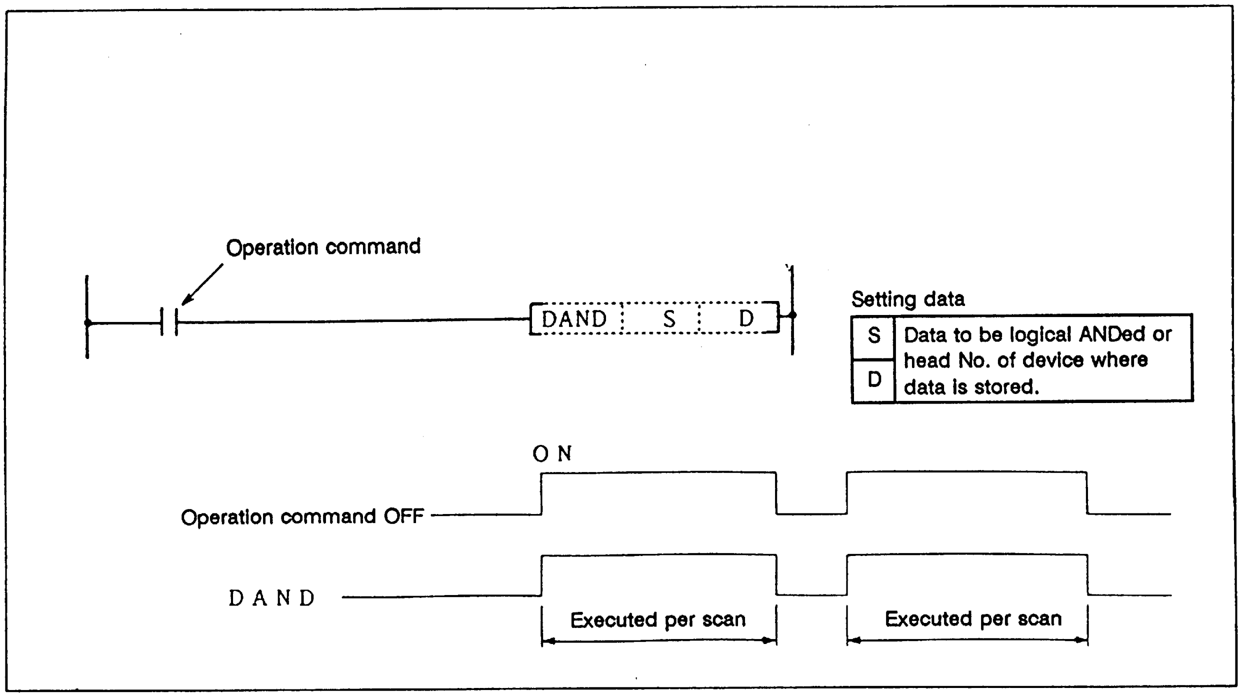
Coding

No. of steps	Com-mand	Device			
0	LD	XA			
1	WAND	K3X10	D33	D50	



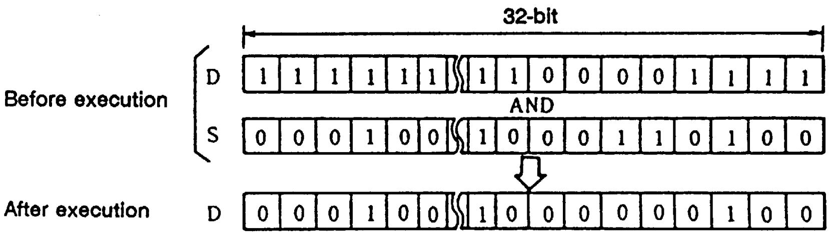
○ DAND ... Logical AND of 32-bit data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○				○	○			○	3/4		
D							○	○	○	○		○											



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.



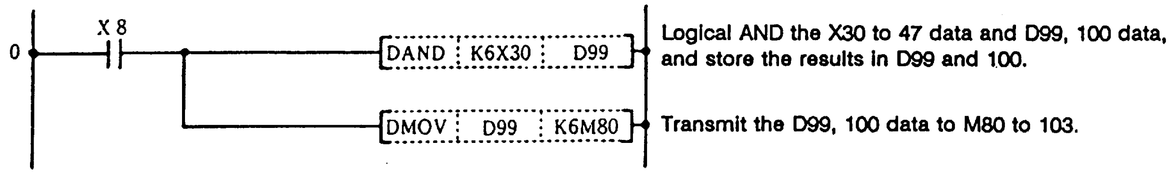
(2) Above the bit device digit designation is operated as 0.
(Refer to program example (1) on the next page.)

Execution conditions

The execution conditions for the DAND command are as follow.

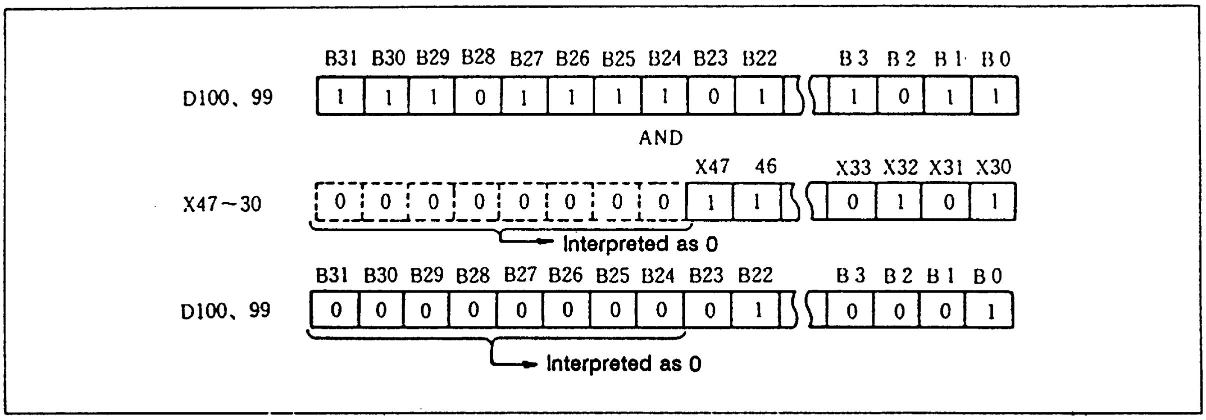
Program example

(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.

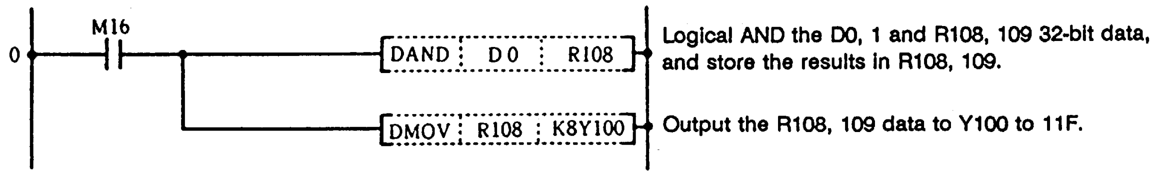


Coding

No. of steps	Com-mand	Device			
0	LD	X3			
1	DAND	K6X30	D99		
10	DMOV	D99	K6M80		



(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.

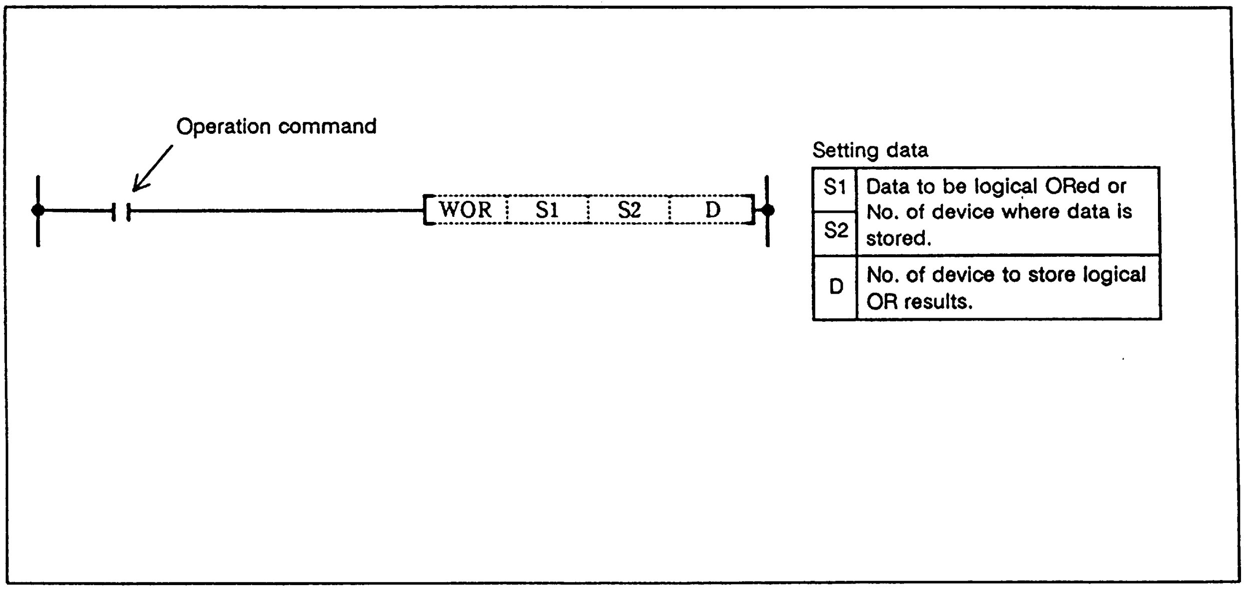


Coding

No. of steps	Com-mand	Device			
0	LD	M16			
1	DAND	D0	R108		
4	DMOV	R108	K8Y100		

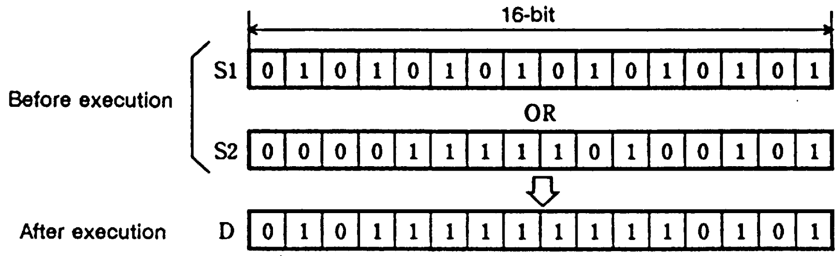
○ WOR ... Logical OR of 16-bit data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○		○	○										
S2							○	○	○	○		○	○			○	○			○	4		
D							○	○	○	○		○	○										



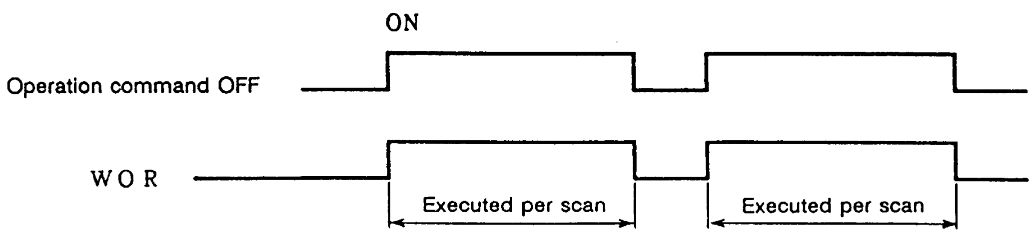
Function

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.



Execution conditions

The execution conditions for WOR are as follow.



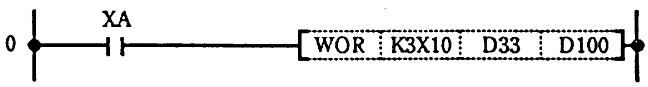
Program example

(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			
0	LD	XA			
1	WOR	D10	D20	D33	

(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.

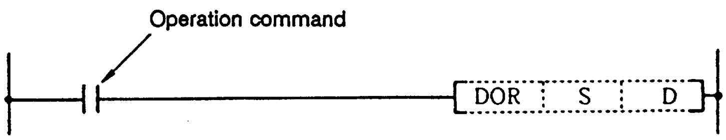


Coding

No. of steps	Com-mand	Device			
0	LD	XA			
1	WOR	K3X10	D33	D100	

○ DOR ... Logical OR of 32-bit data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○				○	○			○	3/4		
D							○	○	○	○		○											

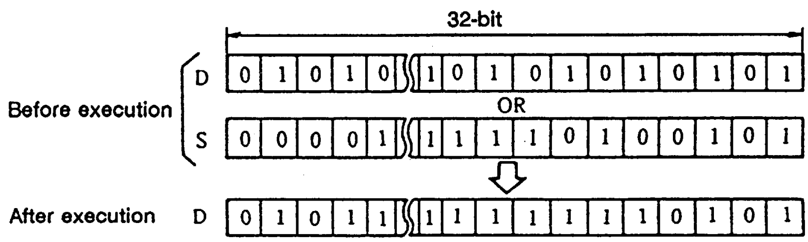


Setting data

S	Data to be logical ORed or head No. of device where data is stored.
D	

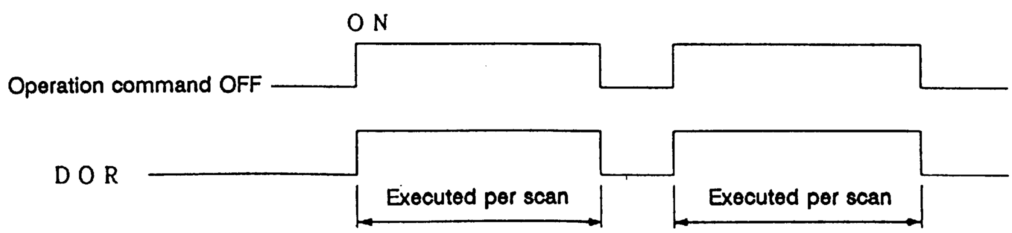
Function

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.



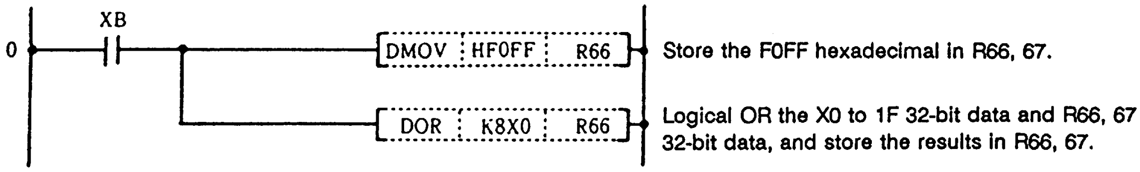
Execution conditions

The execution conditions for DOR are as follow.



Program example

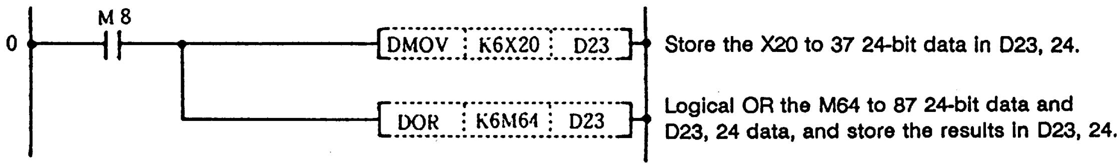
(1) Program that executes logical OR of the X0 to 1F 32-bit data and the F0FF hexadecimal when XB turns ON, and stores the results in R66, 67.



Coding

No. of steps	Com-mand	Device			
0	LD	XB			
1	DMOV	HFOFF	R66		
5	DOR	X8X0	R66		

(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.

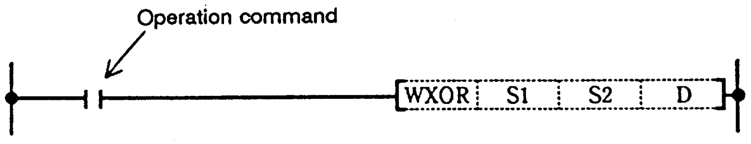


Coding

No. of steps	Com-mand	Device			
0	LD	M8			
1	DMOV	K6X20	D23		
4	DOR	K6M64	D23		

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1	○	○	○	○	○	○	○	○	○	○		○	○							○	4		
S2							○	○	○	○		○	○			○	○						
D							○	○	○	○		○	○										

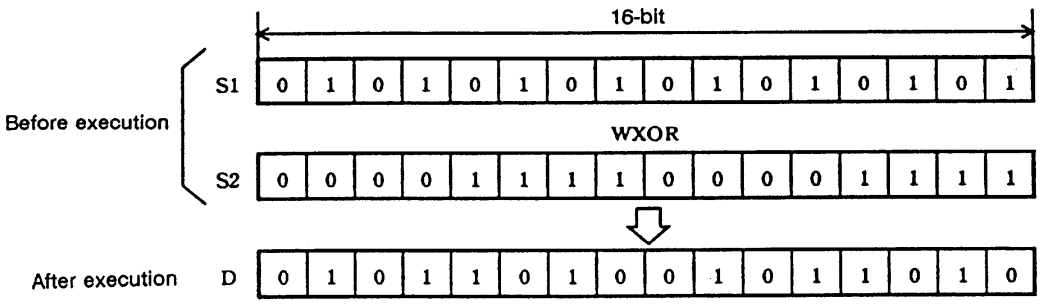


Setting data

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

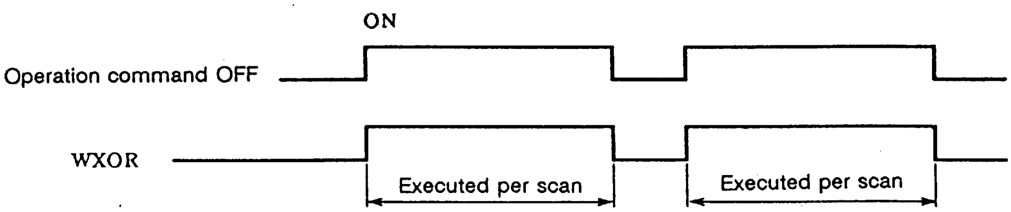
Function

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.



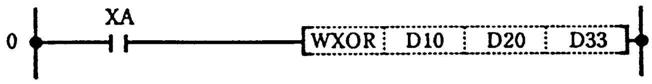
Execution conditions

The execution conditions for WXOR are as follow.



Program example

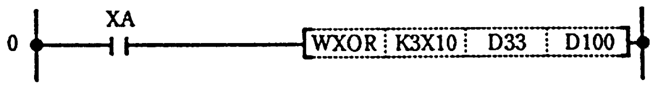
(1) Program that executes exclusive OR of the D10 data and D20 data when XA turns ON, and stores the results in D33.



Coding

No. of steps	Command	Device			
0	LD	XA			
1	WXOR	D10	D20	D33	

(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.

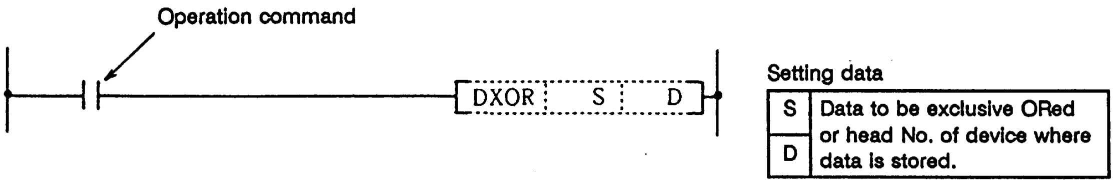


Coding

No. of steps	Command	Device			
0	LD	XA			
1	WXOR	K3X10	D33	D100	

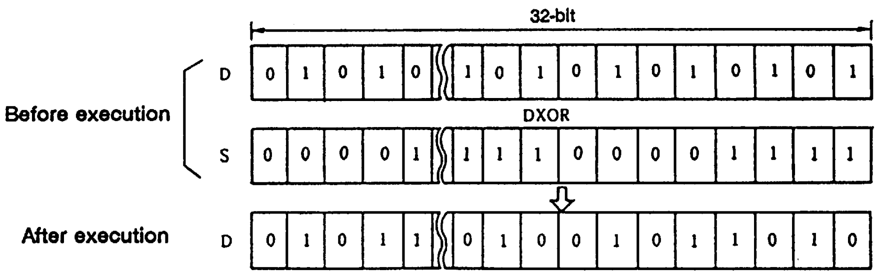
○ DXOR ... Exclusive OR of 32-bit data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S	○	○	○	○	○	○	○	○	○	○		○				○	○			○	3/4		
D							○	○	○	○		○											



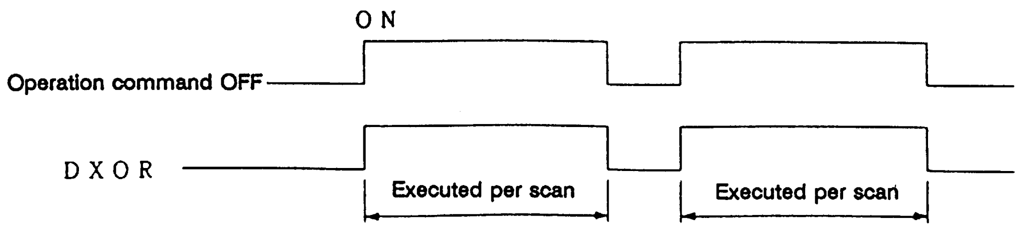
Function

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.



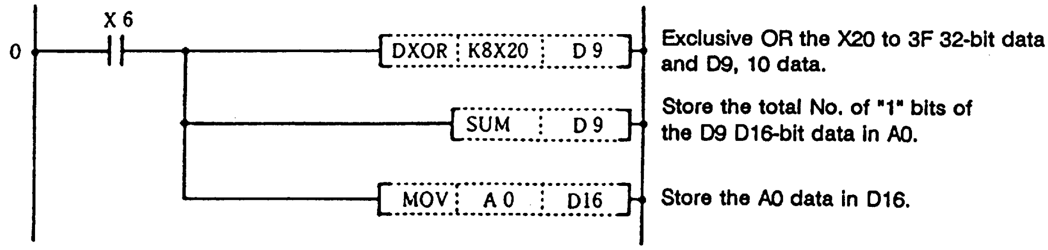
Execution conditions

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.

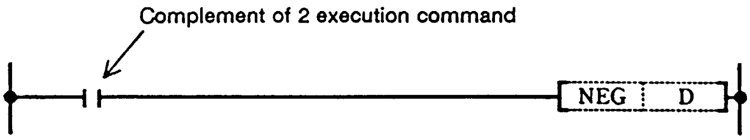


Coding

No. of steps	Command	Device			
0	LD	X6			
1	DXOR	K8X20	D9		
4	SUM	D9			
6	MOV	A0	D16		

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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○	○								2		

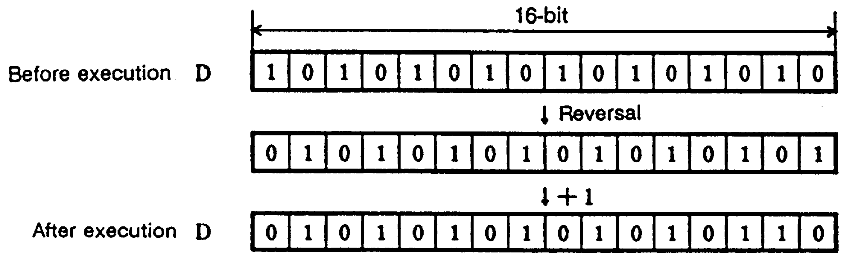


Setting data

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

Function

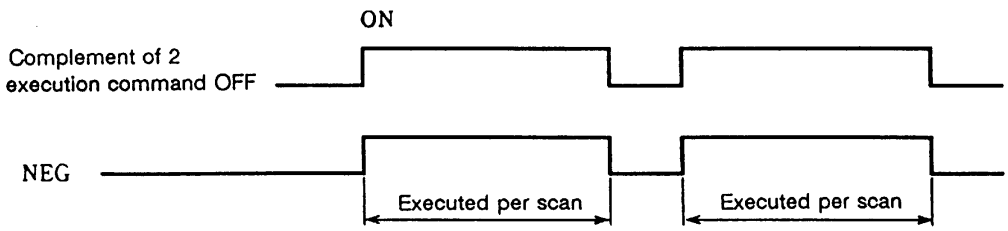
(1) The 16-bit data of the device designated with D is reversed and incremented by one, and then stored in the device designated with D.



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

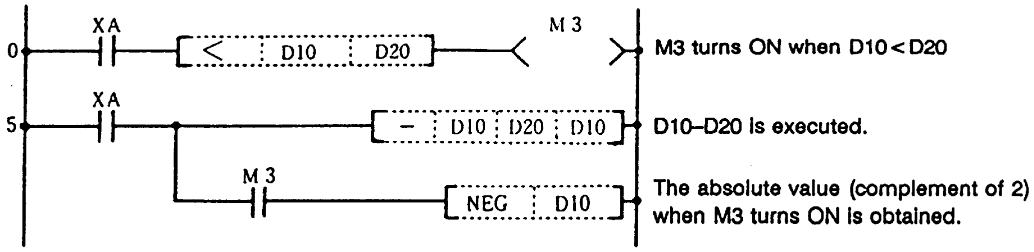
Execution conditions

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.

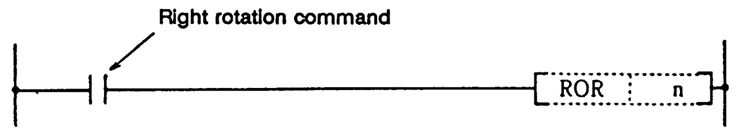


Coding

No. of steps	Com-mand	Device			
0	LD	XA			
1	AND<	D10	D20		
4	OUT	M3			
5	LD	XA			
6	-	D10	D20	D10	
10	AND	M3			
11	NEG	D10			
13					

○ ROR ... Right rotation of A0 data

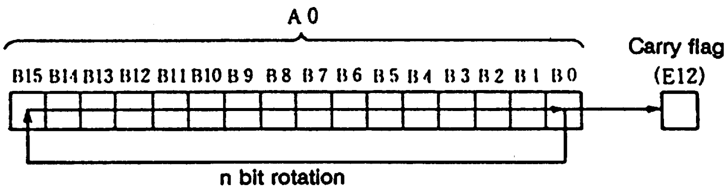
	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Constant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		



Setting data	
n	Times (0 to 15)

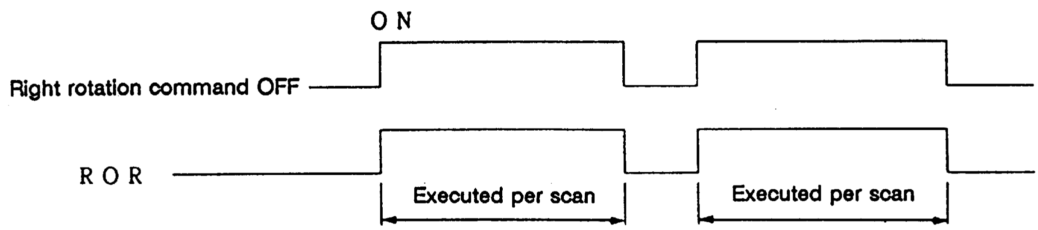
Function

The A0 data excluding the carry flag is rotated to the right n bits.



Execution conditions

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

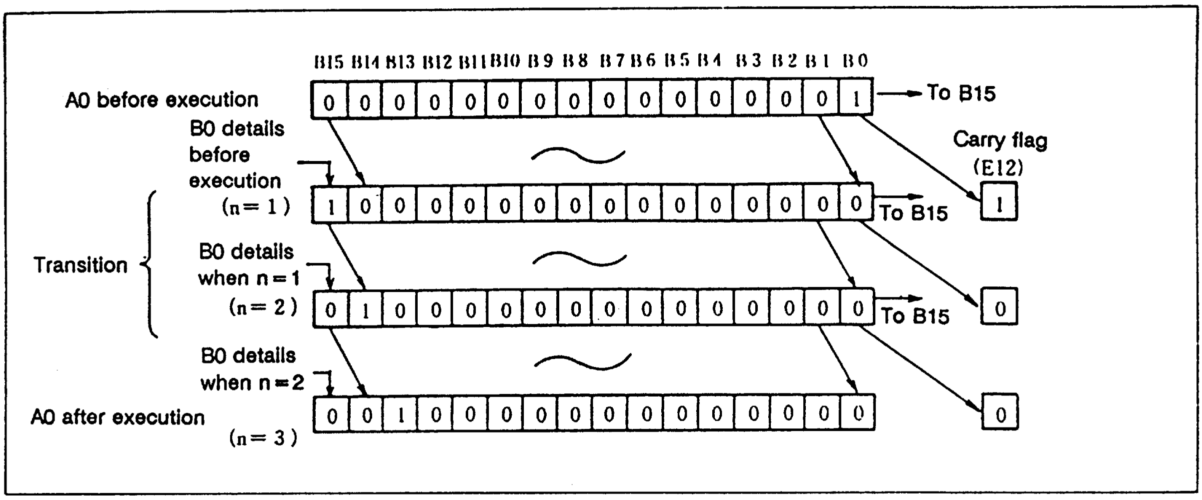


Program example

Program to rotate the A0 details 3 bits to the right when M0 turns ON.

Coding

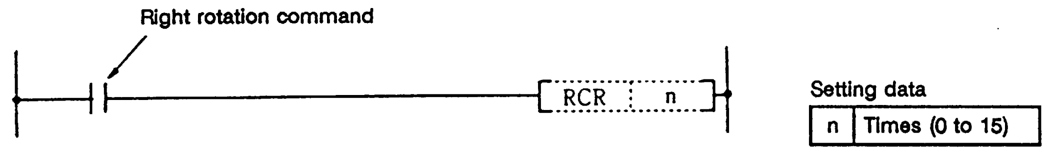
No. of steps	Com-mand	Device			
0	LD	M0			
1	ROR	K3			
3					



Right rotation of data using ROR command

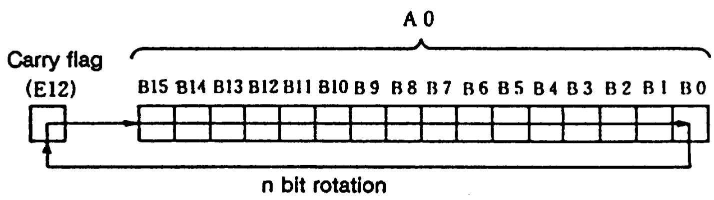
○ RCR ... Right rotation of A0 data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		



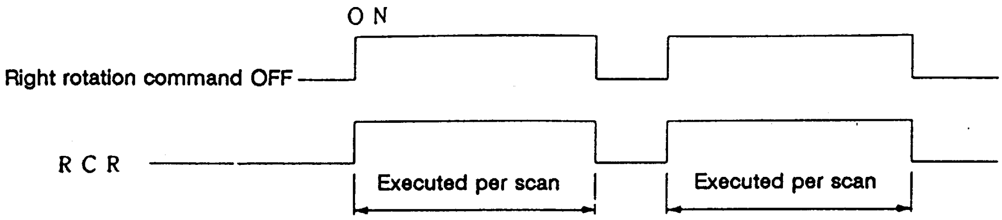
Function

The A0 data including the carry flag is rotated to the right n bits.
· The carry flag must be set to 1 or 0 before executing RCR.



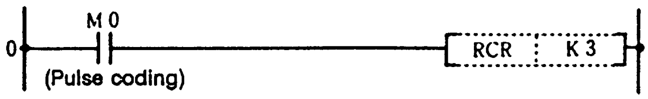
Execution conditions

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



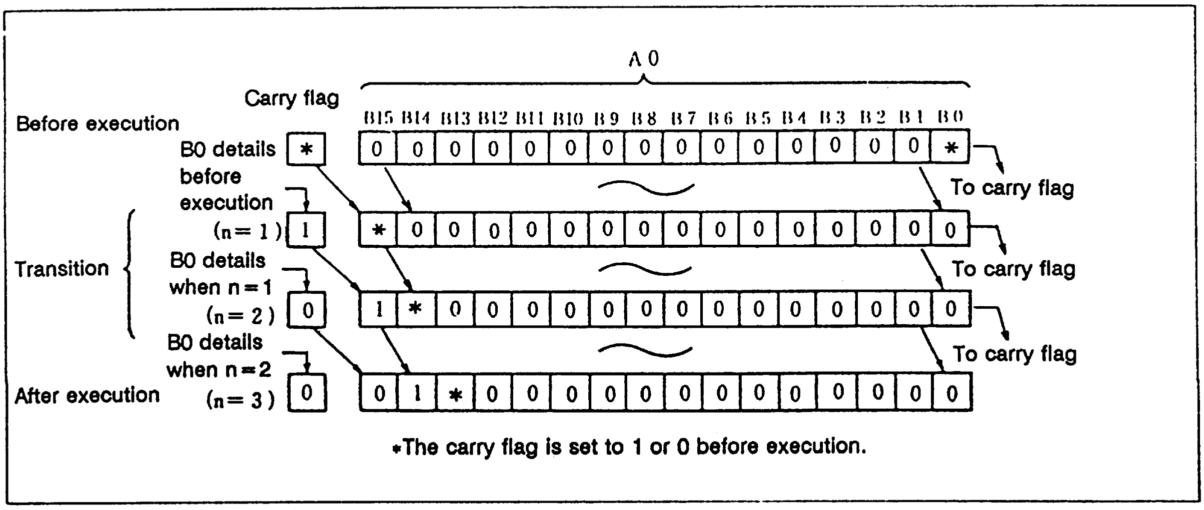
Program example

Program to rotate the A0 details 3 bits to the right when M0 turns ON.



Coding

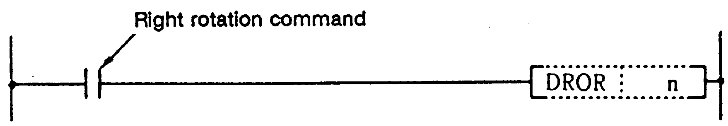
No. of steps	Com-mand	Device			
0	LD	M0			
1	RCR	K3			
3					



Right rotation of data using RCR command

○ DROR ... Right rotation of A0, 1 data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		

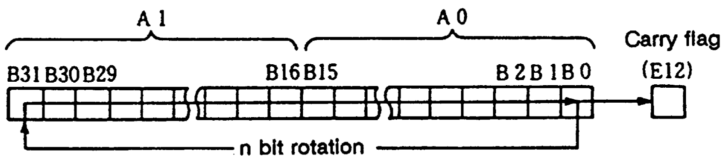


Setting data

n	Times (0 to 31)

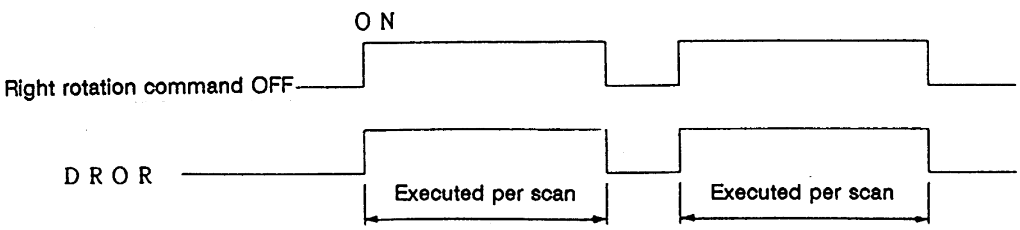
Function

The A0, 1 data excluding the carry flag is rotated to the right n bits.



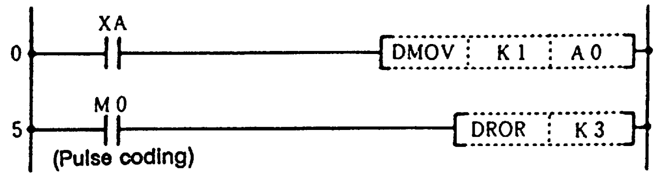
Execution conditions

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



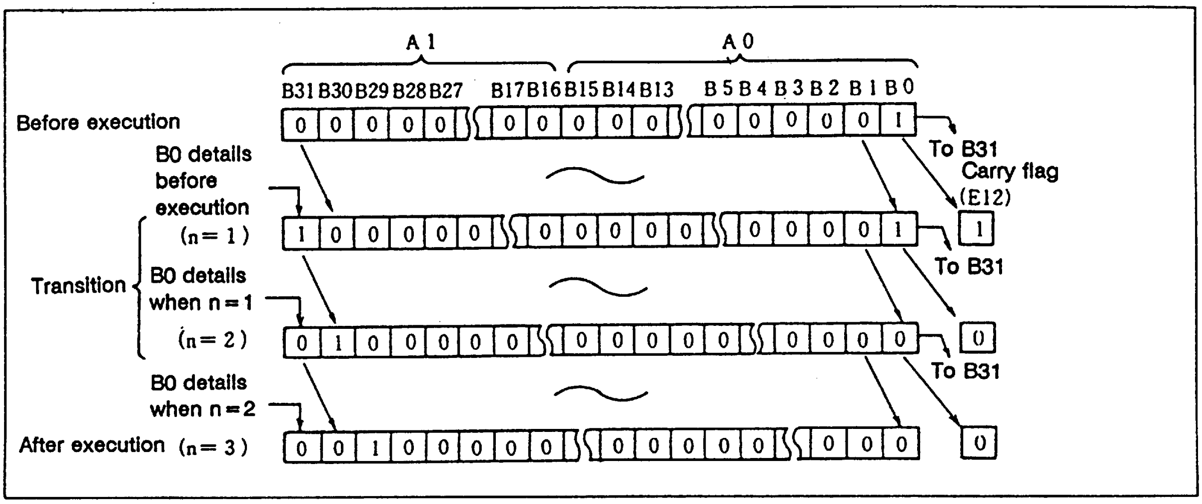
Program example

Program to rotate the A0, 1 details 3 bits to the right when M0 turns ON.



Coding

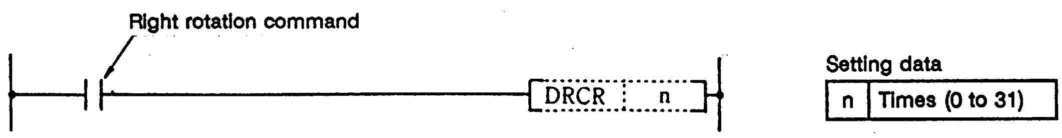
No. of steps	Com-mand	Device			
0	LD	XA			
1	DMOV	K1	A0		
5	LD	M0			
6	DROR	K3			
8					



Right rotation of data using DROR command

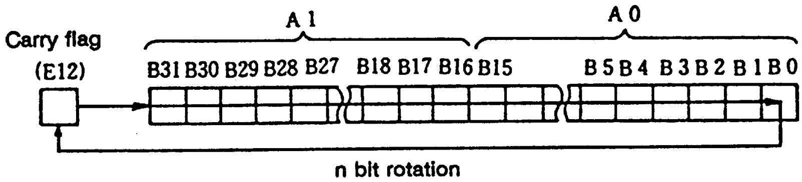
○ **DRCR ... Right rotation of A0, 1 data**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		



Function

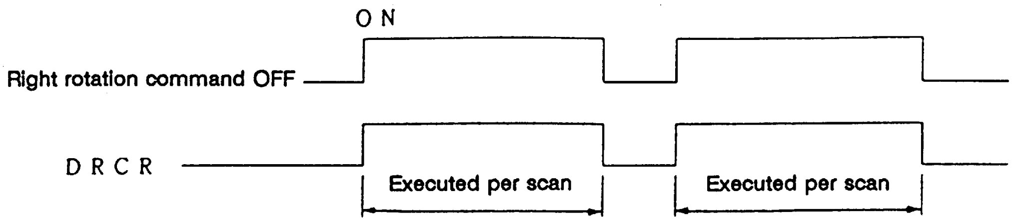
The A0, 1 data including the carry flag is rotated to the right n bits.



· The carry flag must be set to 1 or 0 before executing DRCR.

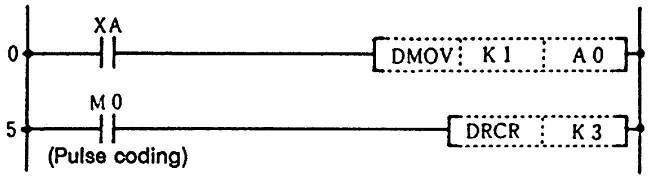
Execution conditions

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



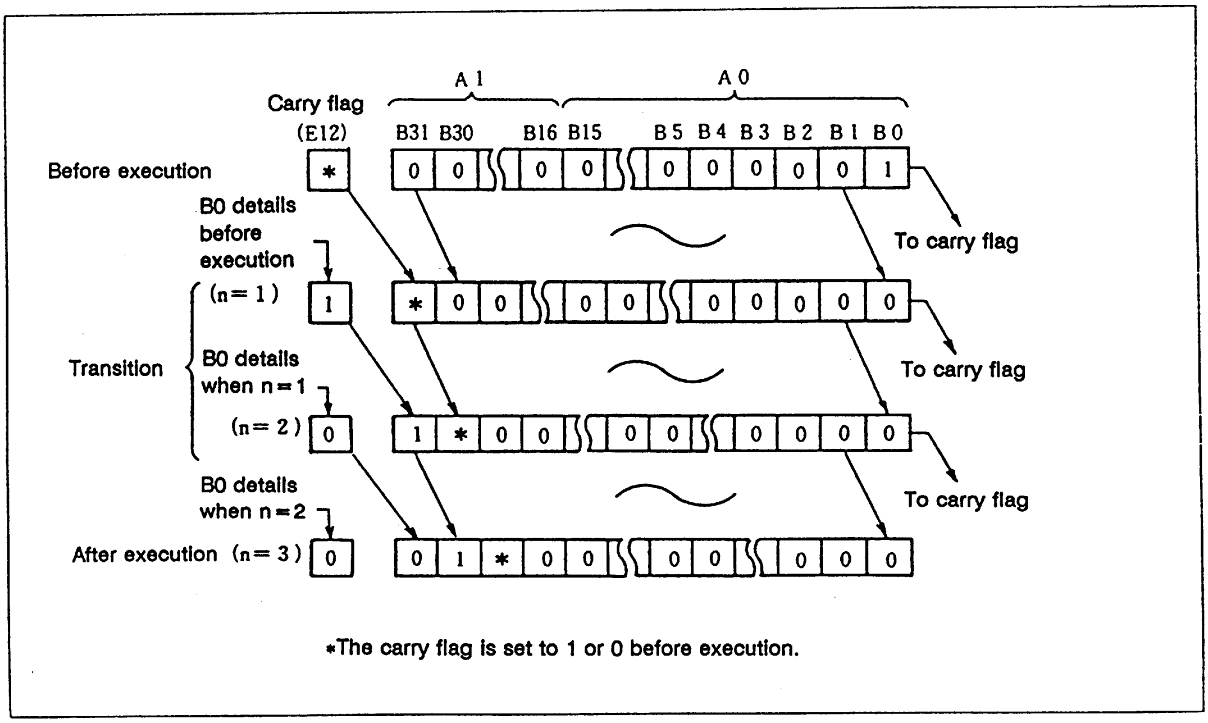
Program example

Program to rotate the A0, 1 details 3 bits to the right when M0 turns ON.



Coding

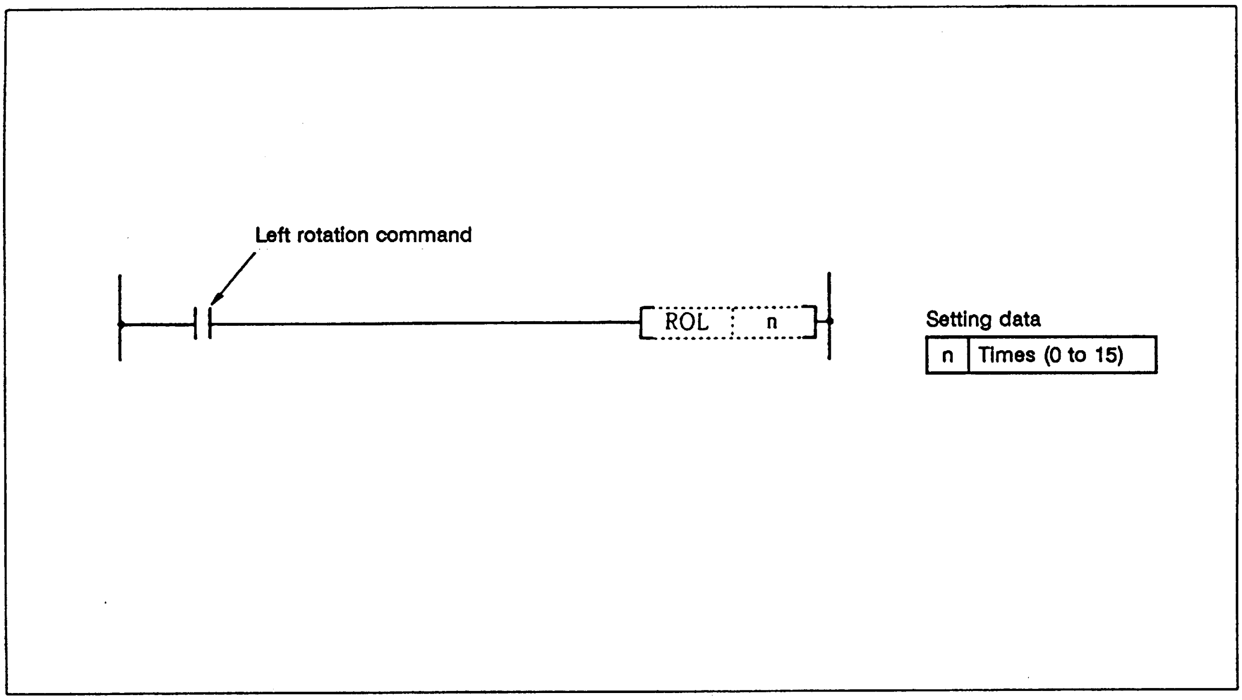
No. of steps	Command	Device			
0	LD	XA			
1	DMOV	K1	A0		
5	LD	M0			
6	DRCR	K3			
8					



Right rotation of data using DRCR command

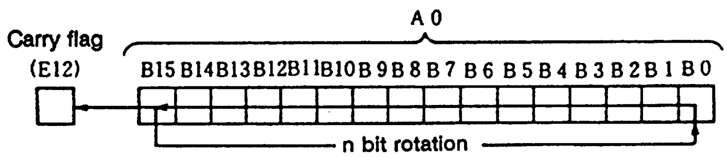
○ ROL ... Left rotation of A0 data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		



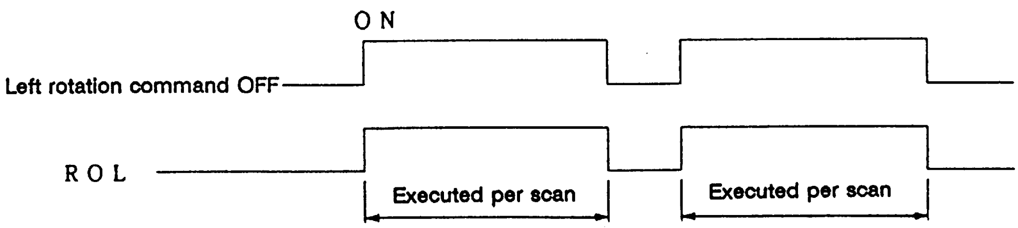
Function

The A0 data excluding the carry flag is rotated to the left n bits.
· 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.

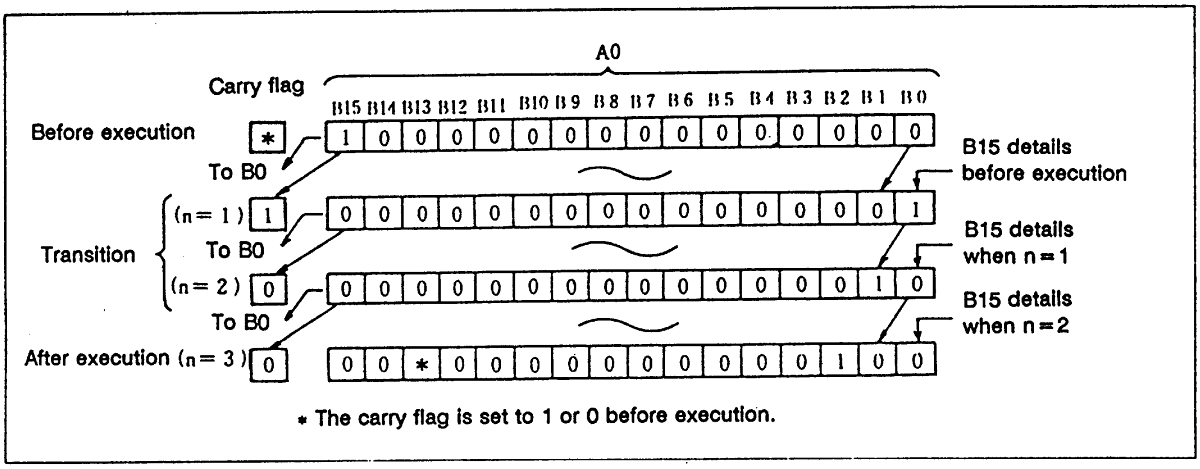


Program example

Program to rotate the A0 details 3 bits to the left when M0 turns ON.

Coding

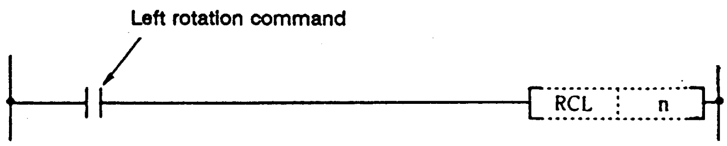
No. of steps	Com-mand	Device			
0	LD	M0			
1	ROL	K3			
3					



Left rotation of data using ROL command

○ RCL ... Left rotation of A0 data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		

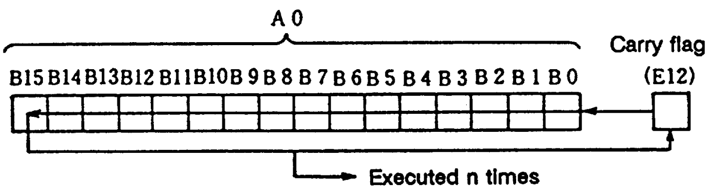


Setting data

n	Times (0 to 15)

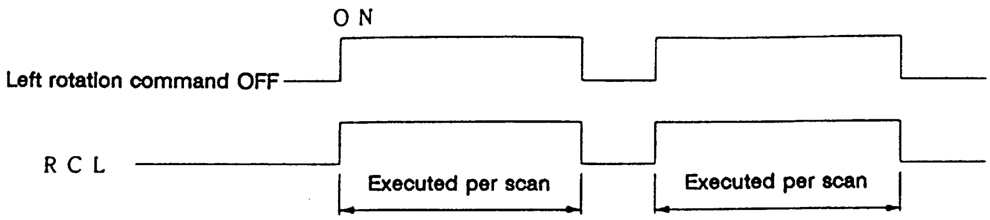
Function

The A0 data including the carry flag is rotated to the left n bits.
· 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.

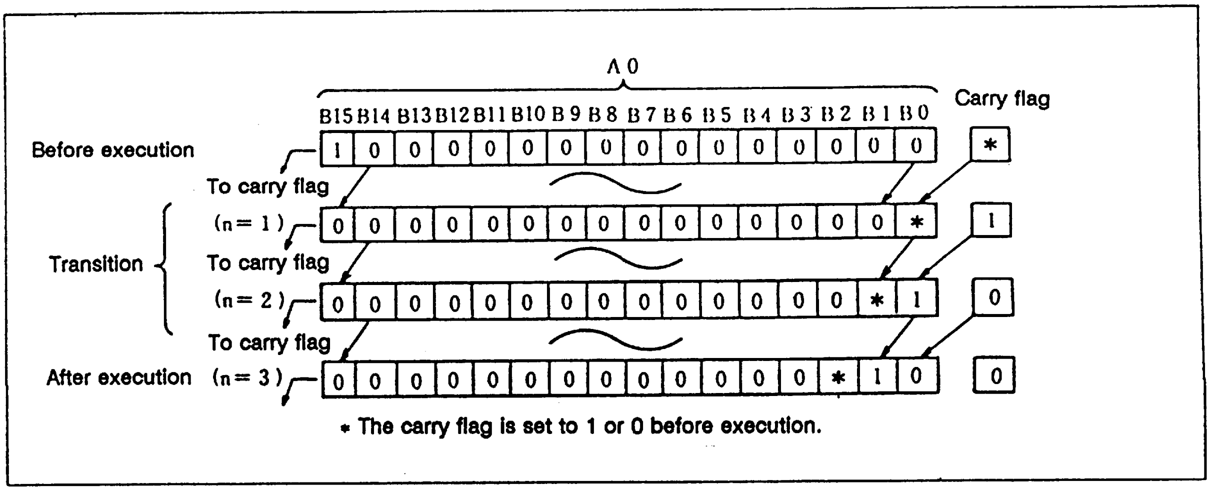


Program example

Program to rotate the A0 details 3 bits to the left when M0 turns ON.

Coding

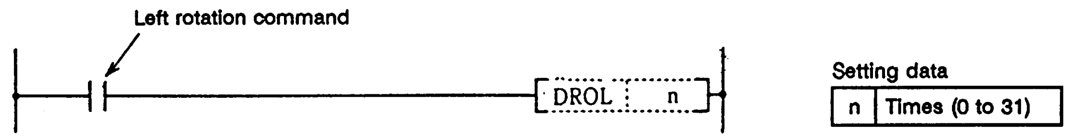
No. of steps	Com-mand	Device			
0	LD	M0			
1	RCL	K3			
3					



Left rotation of data using RCL command

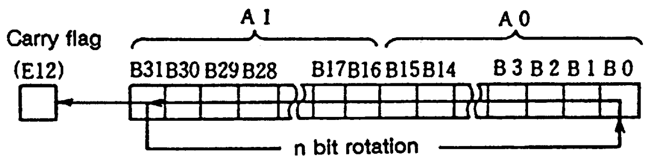
○ **DROL ... Left rotation of A0, 1 data**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		



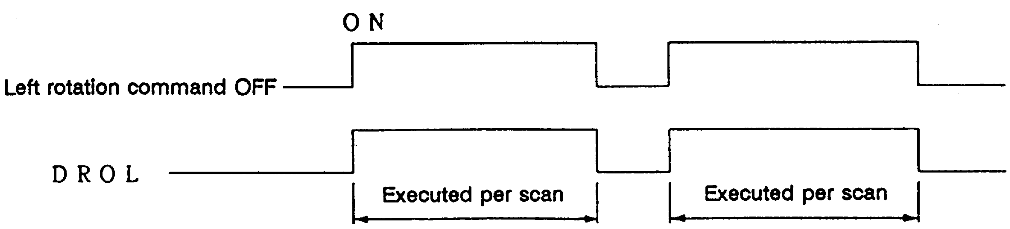
Function

The A0, 1 data excluding the carry flag is rotated to the left n bits.



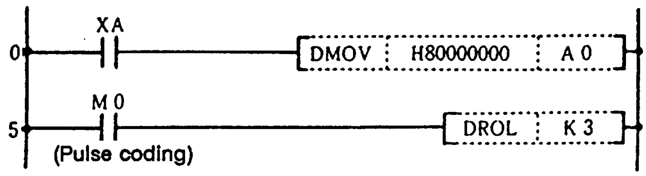
Execution conditions

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



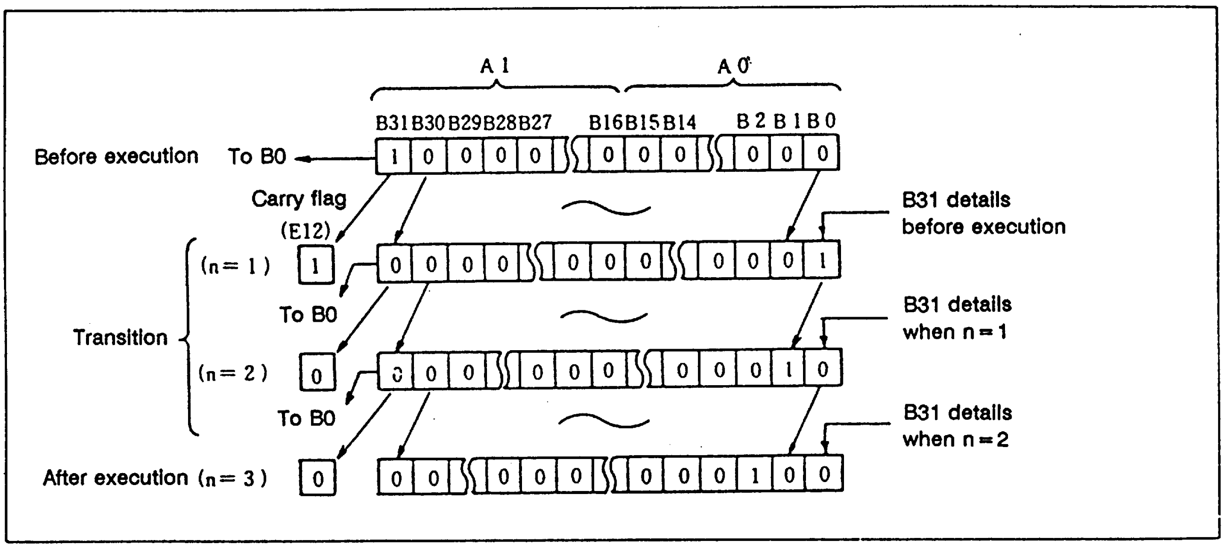
Program example

Program to rotate the A0, 1 details 3 bits to the left when M0 turns ON.



Coding

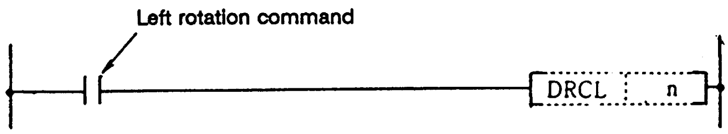
No. of steps	Com-mand	Device			
0	LD	XA			
1	DMOV	H80000000	A0		
5	LD	M0			
6	DROL	K3			
8					



Left rotation of data using DROL command

○ DRCL ... Left rotation of A0, 1 data

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
n																○	○				2		

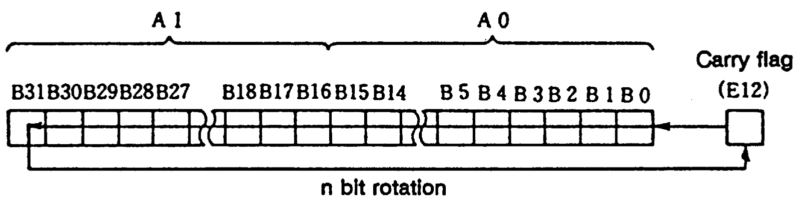


Setting data

n	Times (0 to 31)

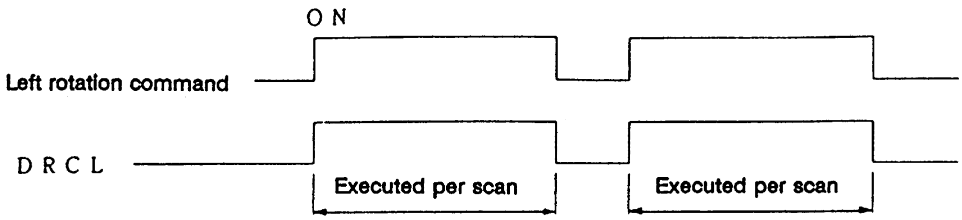
Function

The A0, 1 data including the carry flag is rotated to the left n bits.
· The carry flag must be set to 1 or 0 before executing DRCL.



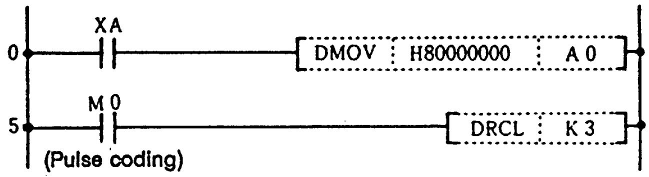
Execution conditions

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



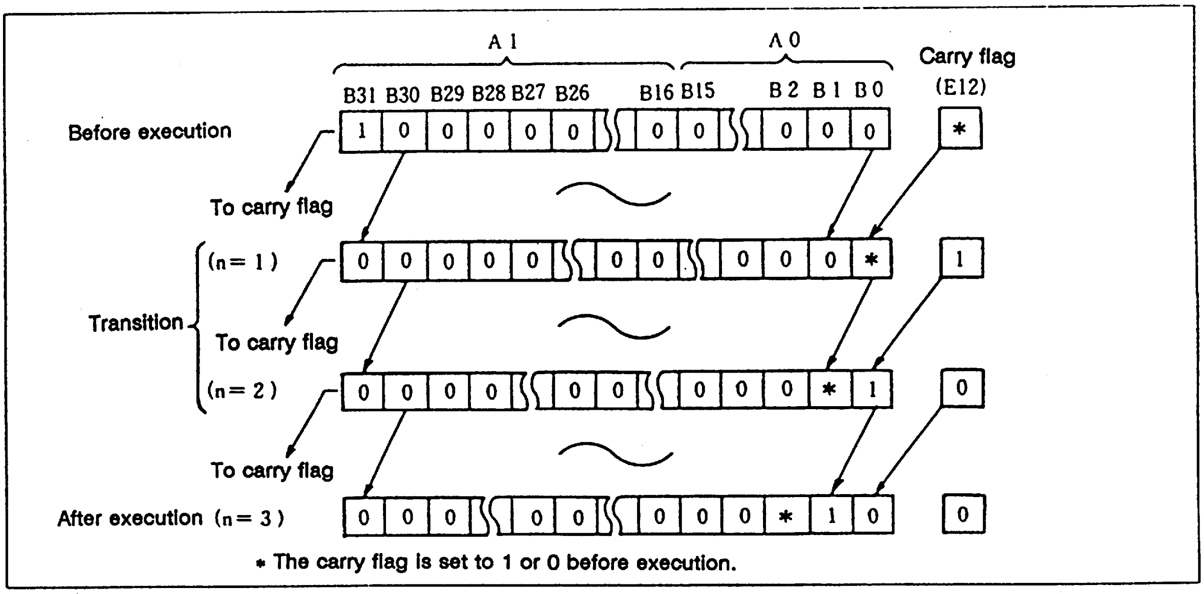
Program example

Program to rotate the A0, 1 details 3 bits to the left when M0 turns ON.



Coding

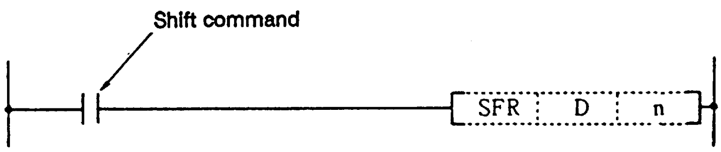
No. of steps	Com-mand	Device			
0	LD	XA			
1	DMOV	H80000000	A0		
5	LD	M0			
6	DRCL	K3			
8					



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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○	○								3		
n																○	○						

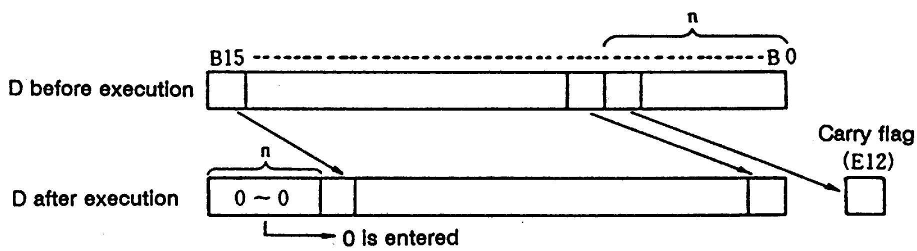


Setting data

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.

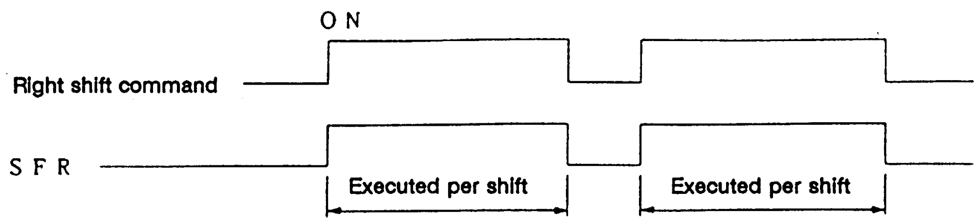


(2) n bits from the highest order are set to 0.

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

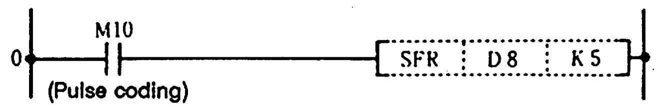
Execution conditions

The execution conditions for SFR are as shown below.



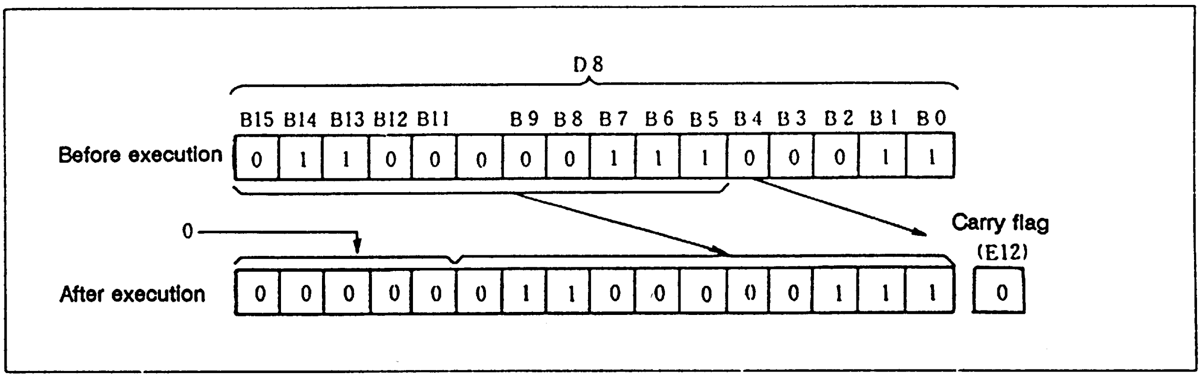
Program example

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



Coding

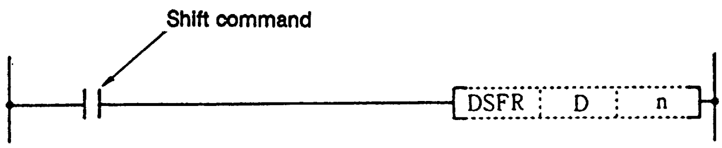
No. of steps	Com-mand	Device			
0	LD	M10			
1	SFR	D8	K5		



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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○											3		
n																○	○						

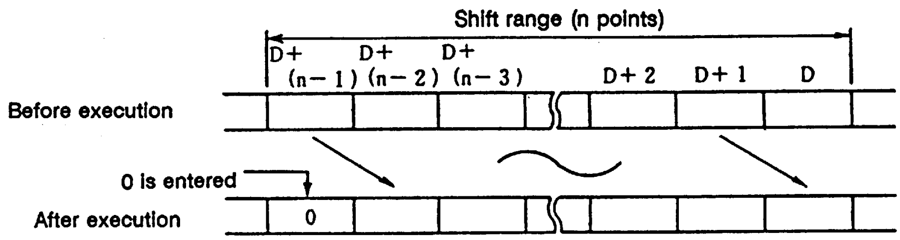


Setting data

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

Function

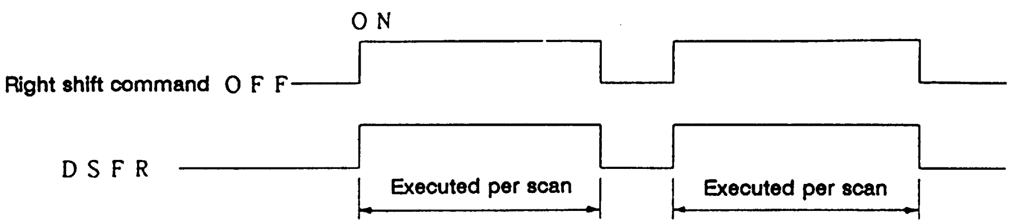
(1) n points starting at the head of the device designated with D are shifted one point to the right.



(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.)

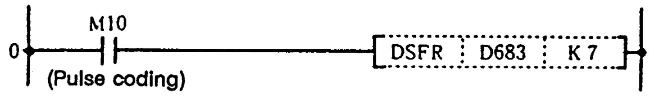
Execution conditions

The execution conditions of DSFR are as shown below.



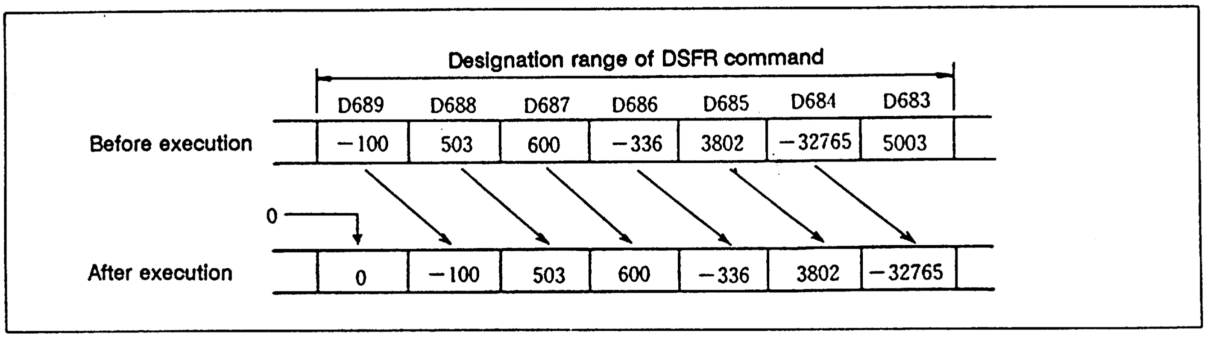
Program example

(1) Program to shift the details of D668 to 689 to the right when M10 turns ON.



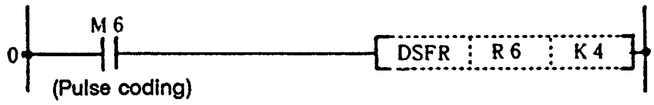
Coding

No. of steps	Com-mand	Device			
0	LD	M10			
1	DSFR	D683	K7		



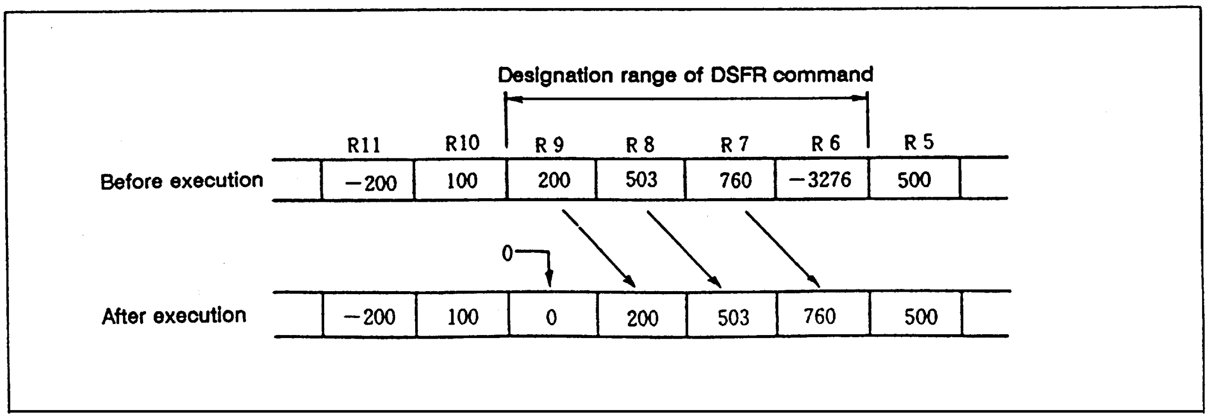
Right shift of data with DSFR command

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



Coding

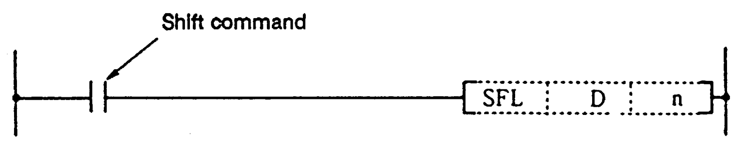
No. of steps	Com-mand	Device			
0	LD	M6			
1	DSFR	R6	K4		



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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○		○	○								3		
n																○	○						

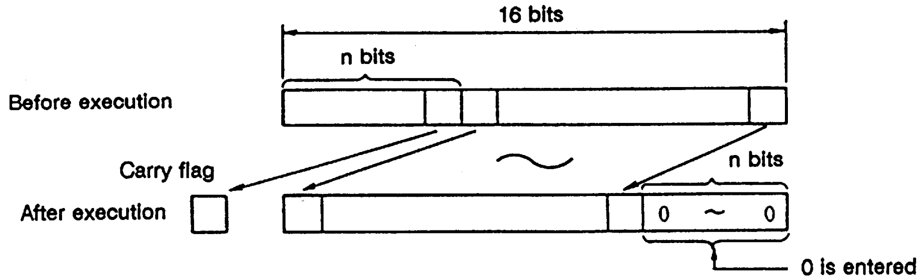


Setting data

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

Function

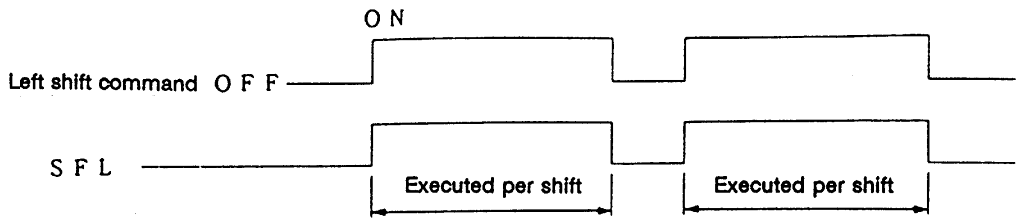
(1) The 16-bit data of the device designated with D is shifted n bits to the left.
(2) n bits from the lowest order are set to 0.



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

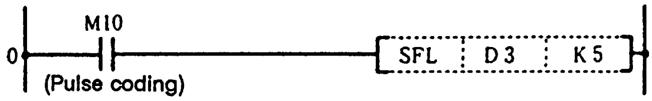
Execution conditions

The execution conditions for SFL are as shown below.



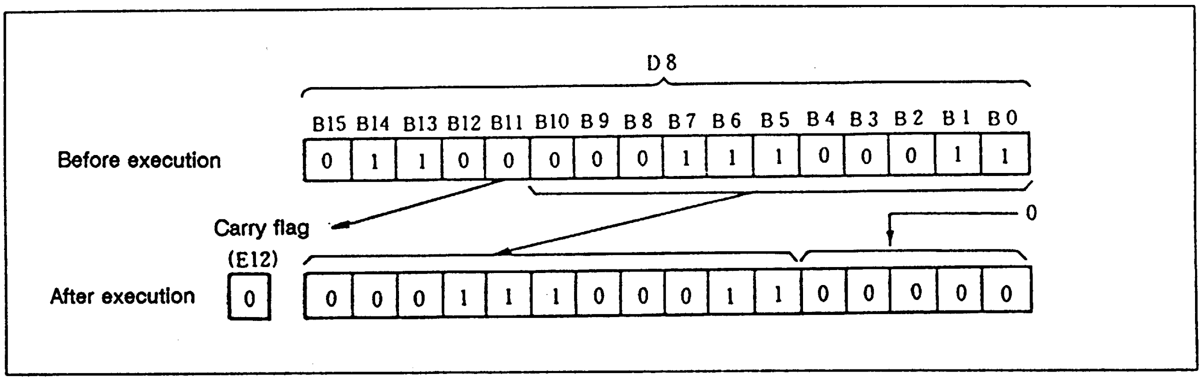
Program example

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



Coding

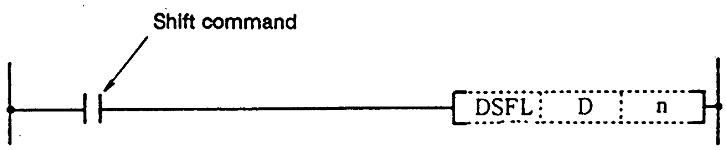
No. of steps	Com- mand	Device			
0	LD	M10			
1	SFL	D8	K5		



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 (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○											3		
n																○	○						

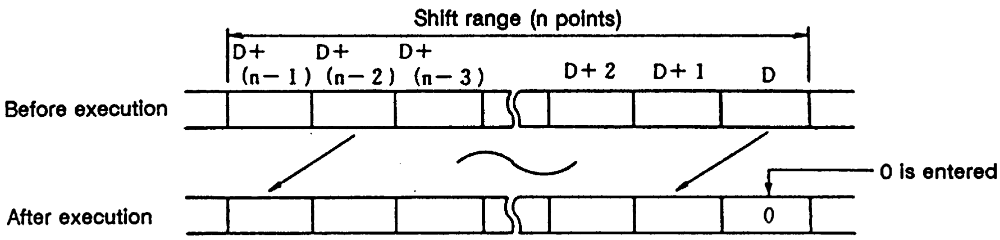


Setting data

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.

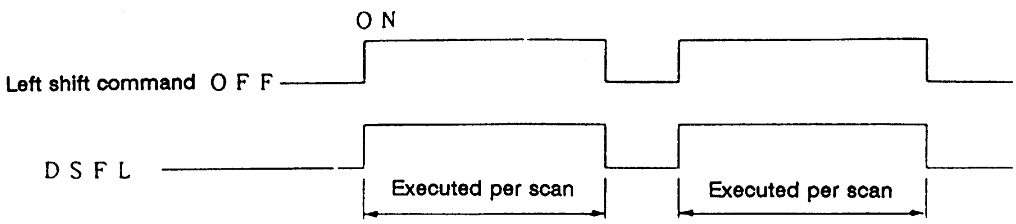


(2) The lowest order device is set to 0.

(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.

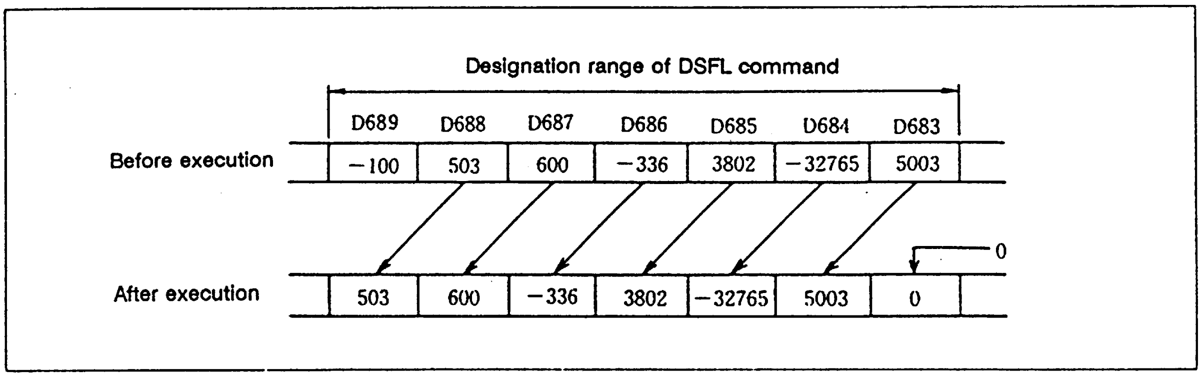


Program example

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

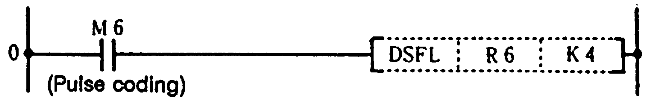
Coding

No. of steps	Com-mand	Device			
0	LD	M10			
1	DSFL	D683	K7		



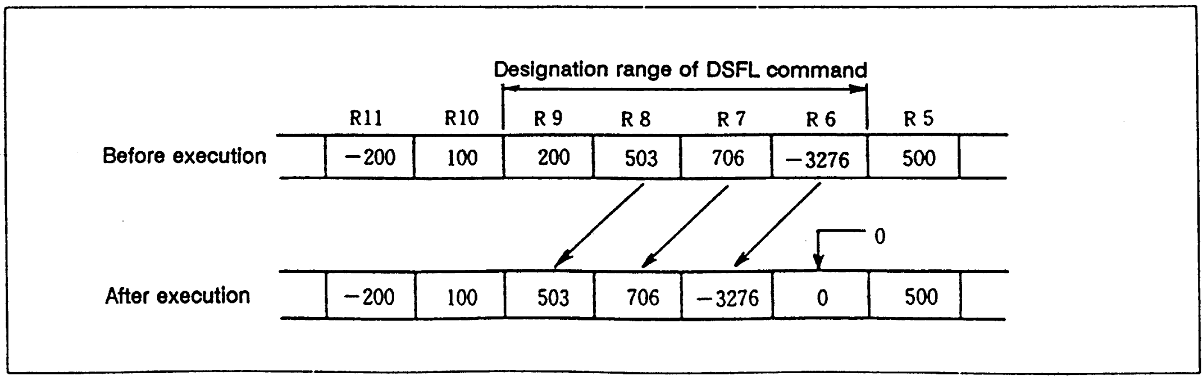
Left shift of data with DSFL command

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



Coding

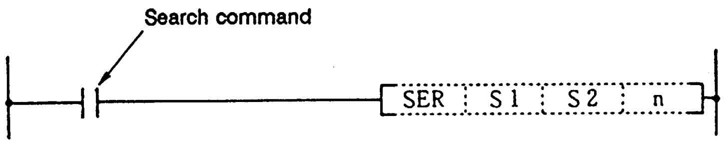
No. of steps	Com-mand	Device			
0	LD	M6			
1	DSFL	R6	K4		



Left shift of data with DSFL command

○ **SER ... Search of 16-bit data**

	Usable device																		Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○								4		
S2							○	○	○	○													
n																○	○						



Setting data

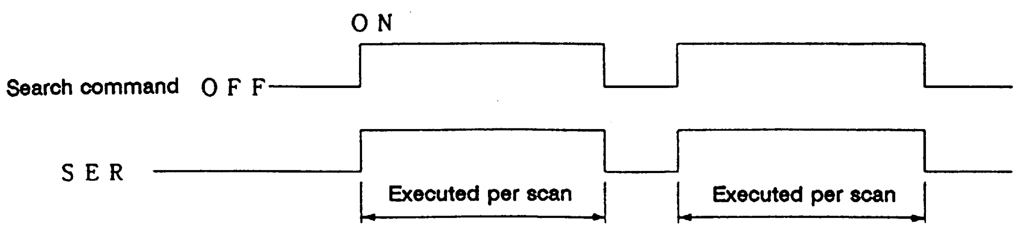
S1	No. of device where search data is stored
S2	Head No. of device to be searched
n	No. of devices to be searched

Function

(1) Using the 16-bit data of the device designated with S1 as the keyword, the n points from the 16-0bit data of the device designated with S2 are searched.
(2) The number of data items matching the keyword is stored in A1. The relative position of the device containing the first matched data counted from S2 is stored in A0.
(3) When n is a negative value, it is interpreted as 0.
(4) No process is executed when n = 0.

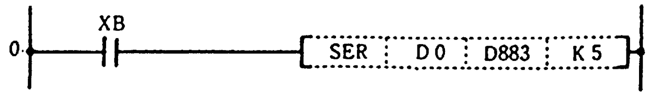
Execution conditions

The execution conditions for SER are as shown below.



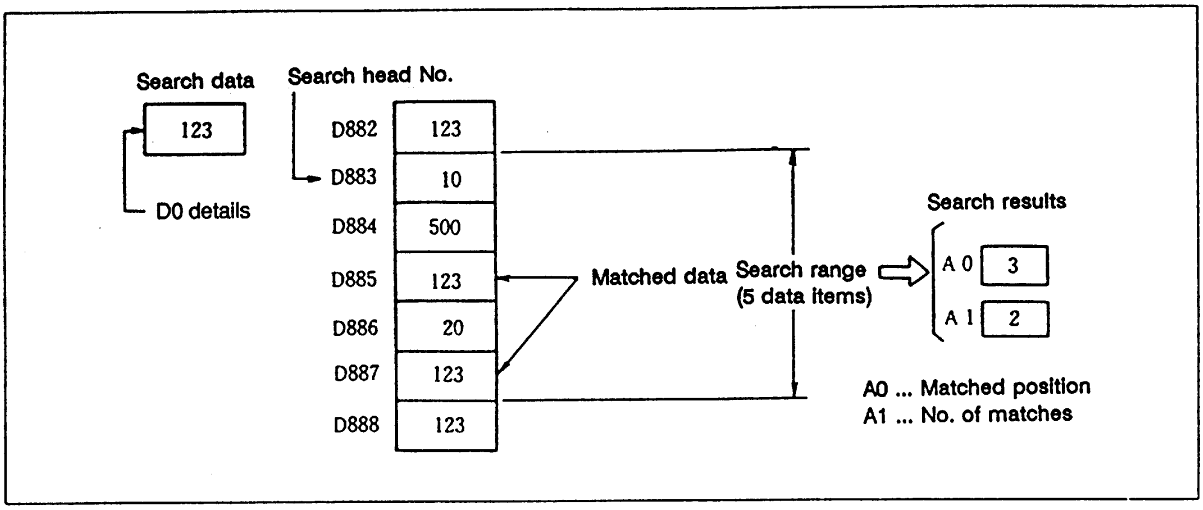
Program example

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



Coding

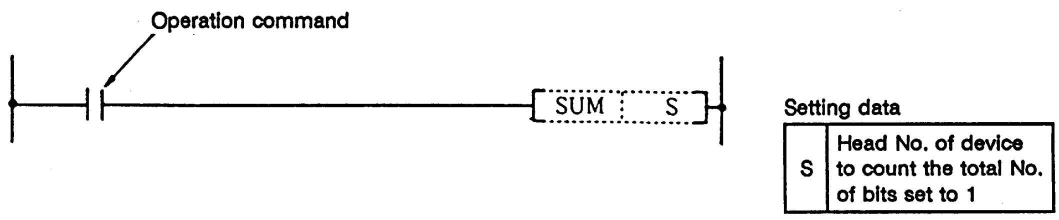
No. of steps	Com-mand	Device			
0	LD	XB			
1	SER	D0	D883	K5	



Search of data using SER command

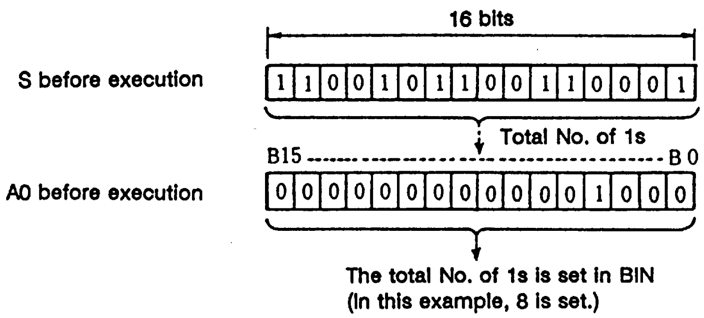
○ SUM ... Count of No. of 16-bit data items set to 1

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
D							○	○	○	○											2		



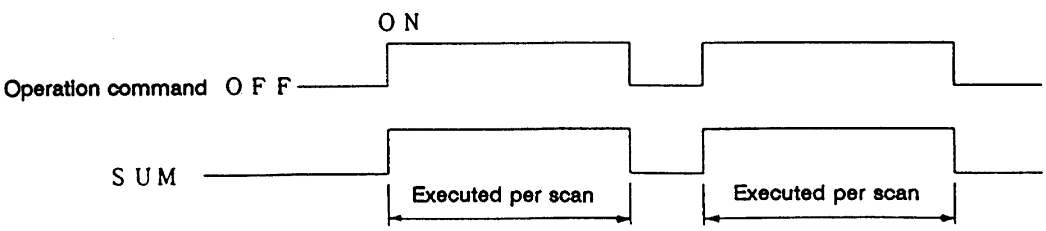
Function

The total No. of bits in the 16-bit data of the device designated with S that are set to 1 is stored in A0.



Execution conditions

The execution conditions for SUM are as shown below.

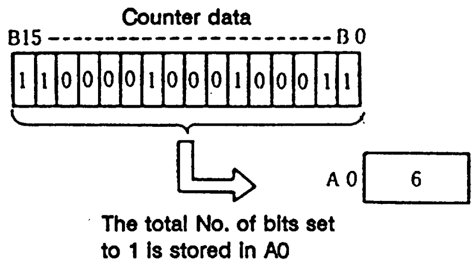


Program example

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

Coding

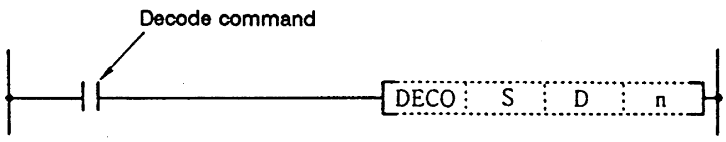
No. of steps	Com-mand	Device				
0	LD	XB				
1	SUM	D10				
3						



Counting with SUM command

○ DECO ... 8 → 256 bit decoding

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S							○	○	○	○		○	○								4		
D							○	○	○	○													
n																○	○						



Setting data

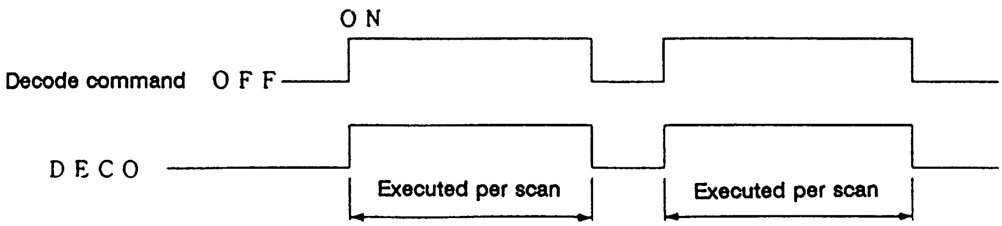
S	No. of device where data to be decoded is set
D	Head No. of device to store the decoding results
n	Valid bit length (1 to 8)

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.

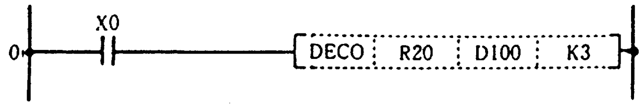
Execution conditions

The execution conditions for DECO are as shown below.



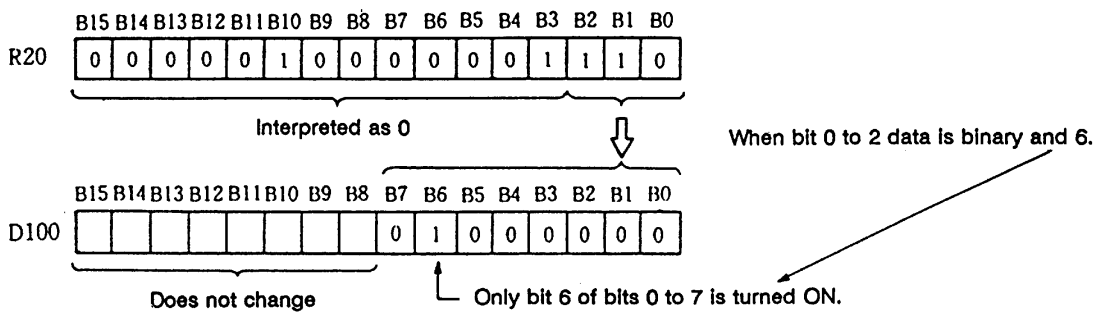
Program example

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



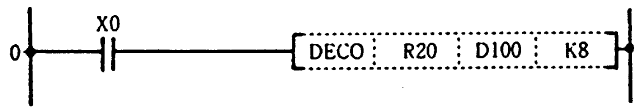
Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	DECO	R20	D100	K3	
5					



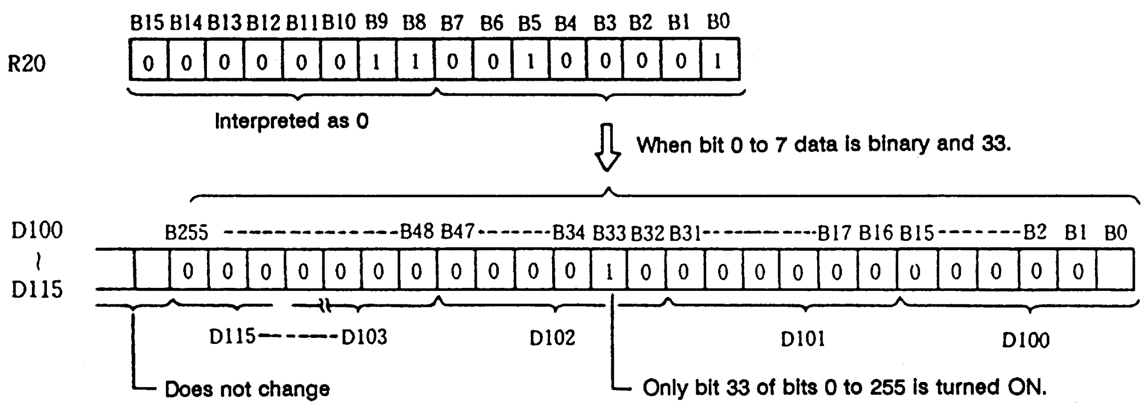
(Note 1) The D100 bit 0 turns ON when the R20 B0 to B2 is 0.
(Note 2) The D100 details remain the same even if X0 turns OFF.

(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.



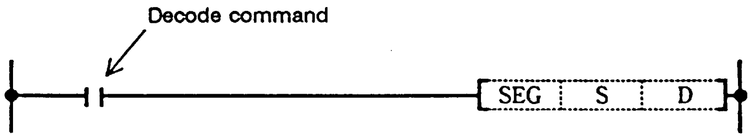
Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	DECO	R20	D100	K8	
5					



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

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S							○	○	○	○		○	○								3		
D							○	○	○	○		○	○										

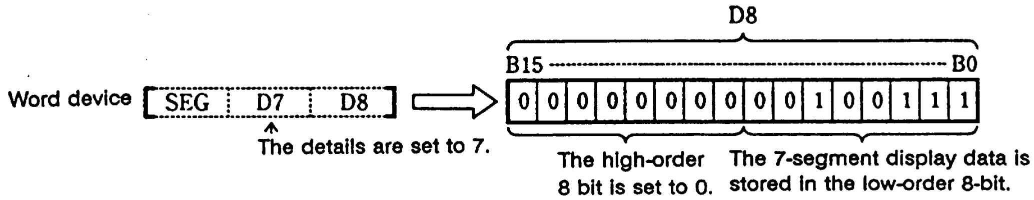


Setting data

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

Function

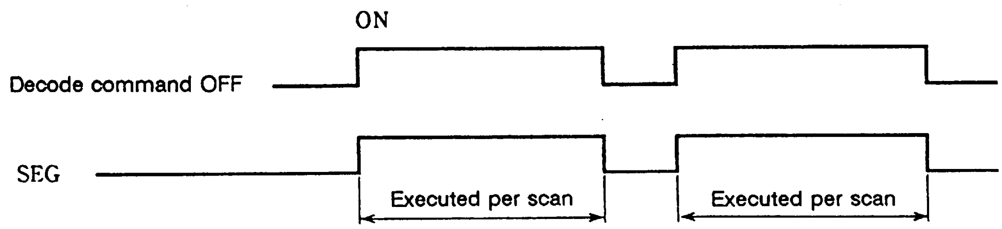
(1) The 0 to F data designated with the low-order 4-bit in S is decoded in the 7-segment display data and stored in D.



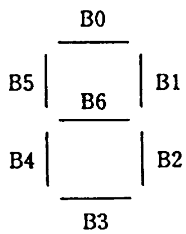
(2) Refer to the following page for the 7-segment display.

Execution conditions

The execution conditions for SEG are as follow.



7-segment decode table

S		Configuration of 7-segment	D								Display data
Hexa-decimal	Bit pattern		B7	B6	B5	B4	B3	B2	B1	B0	
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	1	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 (B0)

Program example

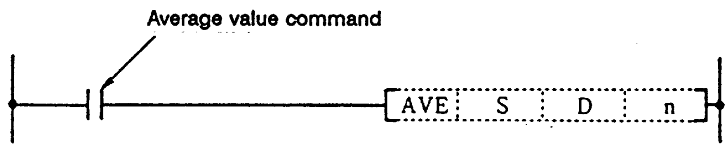
Program to convert D7 data into 7-segment display data when X0 turns ON, and output to D8.

Coding

No. of steps	Com-mand	Device			
0	LD	X0			
1	SEG	D7	D8		

○ **AVE ... Calculation of average value**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S							○	○	○	○													
D							○	○	○	○											4		
n																○	○						

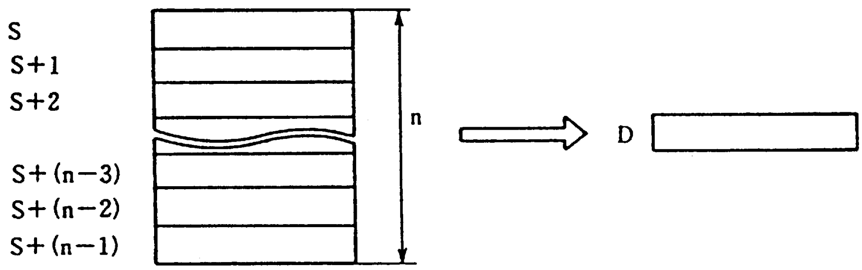


Setting data

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

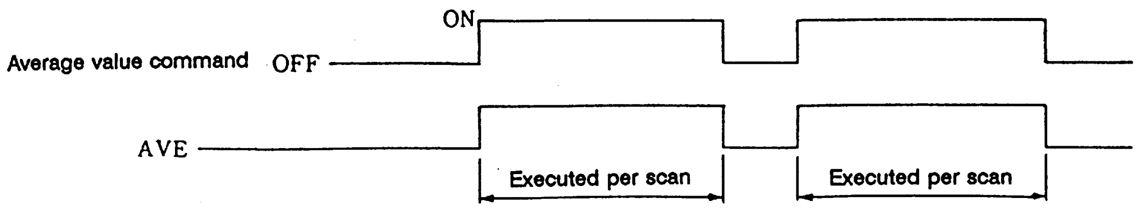
Function

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.



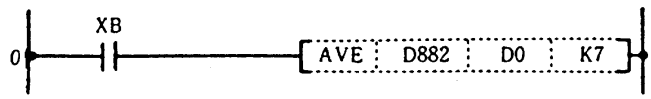
Execution conditions

The execution conditions for AVE are as shown below.



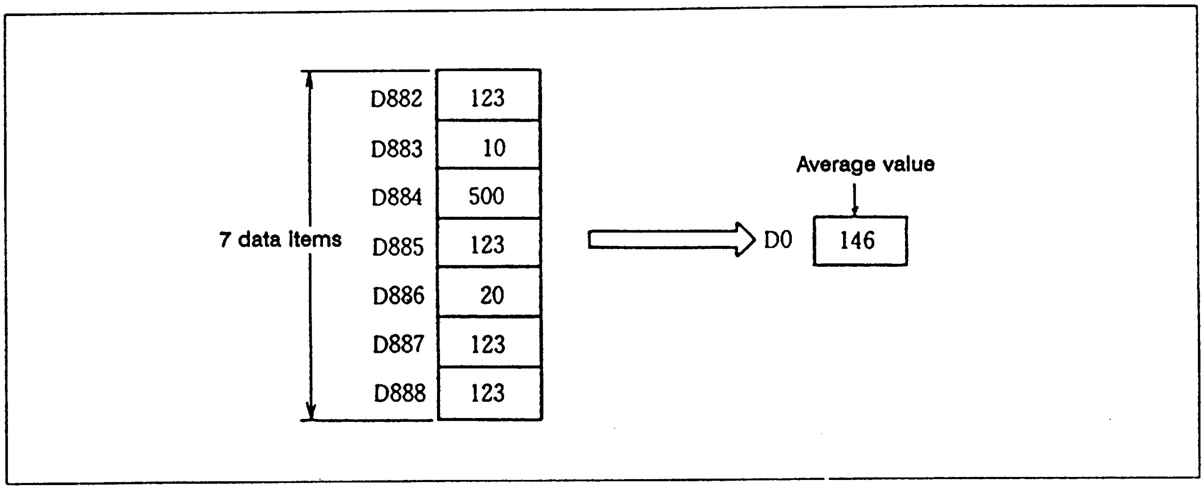
Program example

(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			
0	LD	XB			
1	AVE	D882	D0	K7	

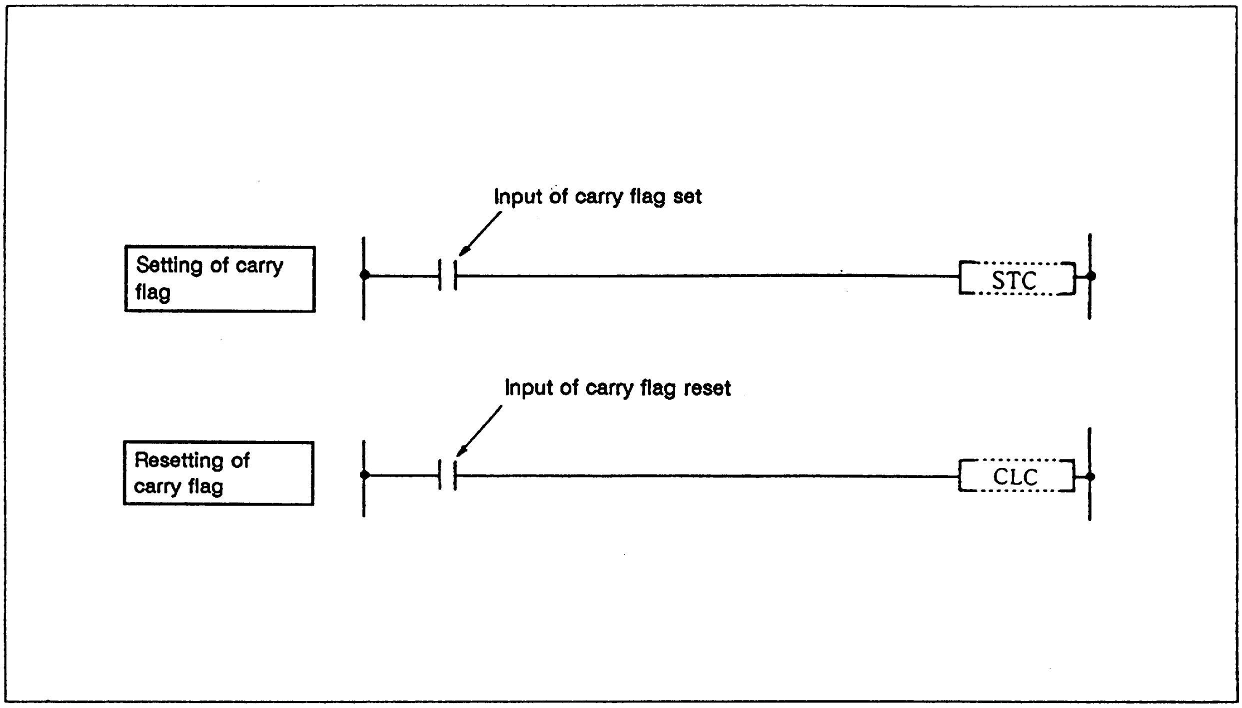


Averaging of data with AVE command

(Note) Fractional values are omitted.

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

Usable device																			Digit designation	No. of steps	Index	
Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
																				1		



Function

STC

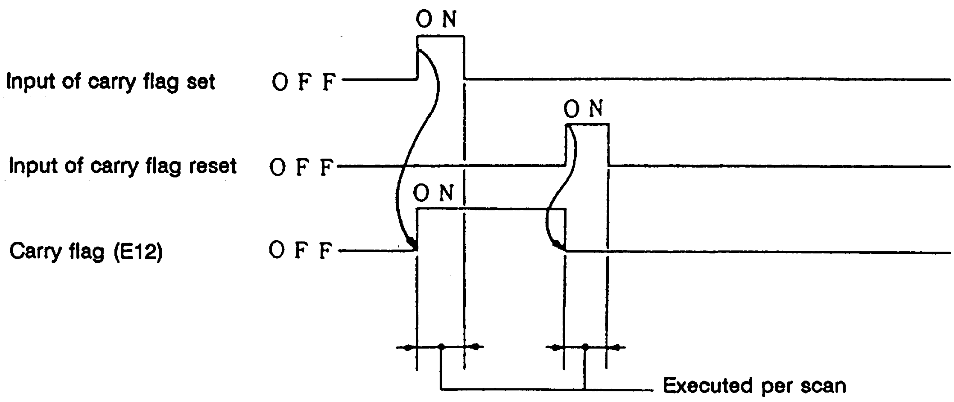
(1) The carry flag contact (E12) is set (ON).

CLC

(2) The carry flag contact (E12) is reset (OFF).

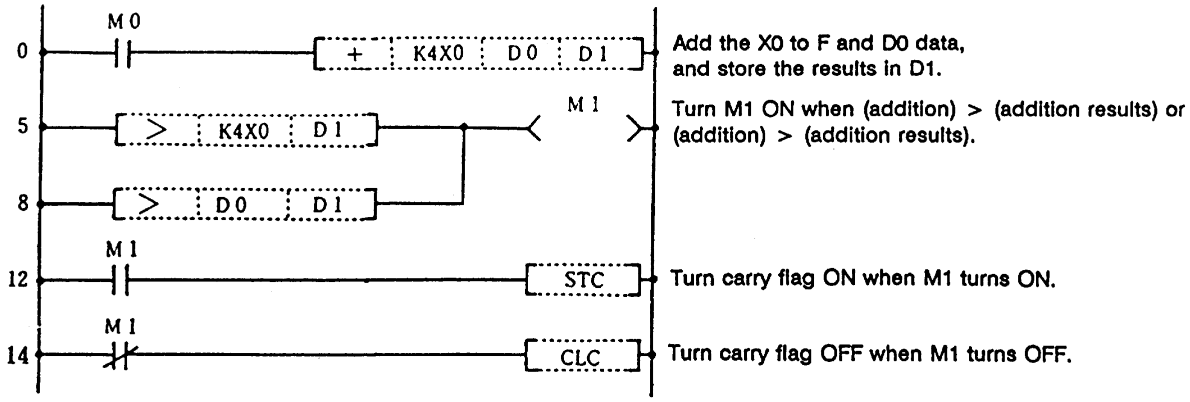
Execution conditions

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



Program example

Program to add the X0 to F data and D0 data when M0 turns ON and to turn the carry flag (E12) ON if the results exceed 9999. If the results are 9999 or less, the carry flag is turned OFF.

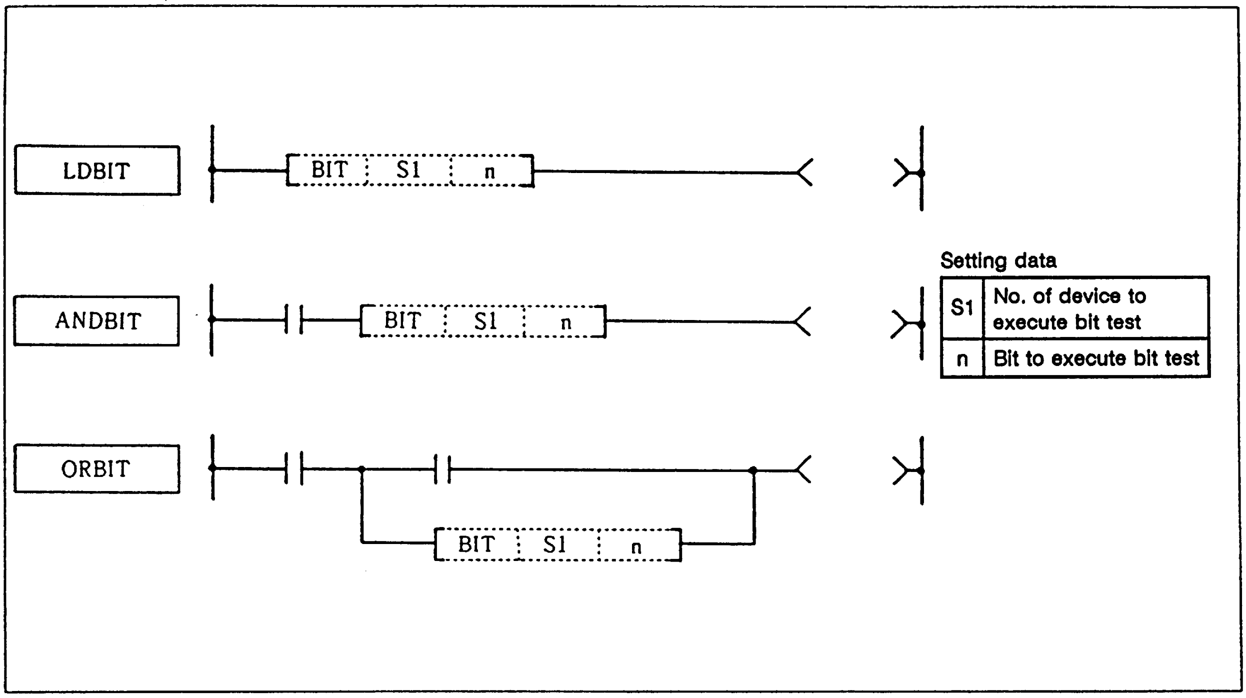


Coding

No. of steps	Com-mand	Device			
0	LD	M0			
1	+	K4X0	D0	D1	
5	LD>	K4X0	D1		
8	OR>	D0	D1		
11	OUT	M1			
12	LD	M1			
13	STC				
14	LD1	M1			
15	CLC				
16					

○ LDBIT, ANDBIT, ORBIT ... Bit test of a contact handling

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-st ant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○								3		
n																○	○						



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

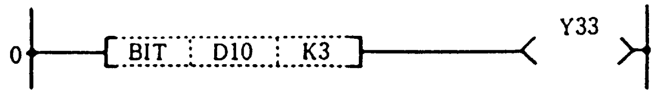
Execution conditions

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

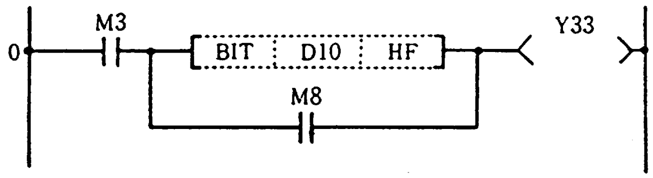
No. of steps	Com-mand	Device			
0	LDBIT	D10	K3		
3	OUT	Y33			
4					

(2) Program to test bit 15 of D10.

Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	ANDBIT	D10	K15		
4	OUT	Y33			
5					

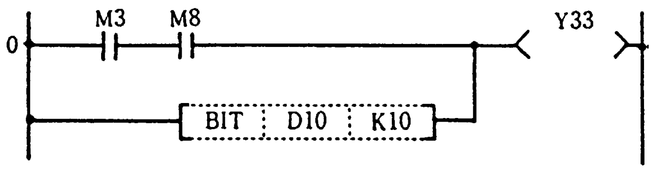
(3) Program to test bit 15 of D10.



Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	LDBIT	D10	HF		
4	OR	M8			
5	ANB				
6	OUT	Y33			
7					

(4) Program to test bit 10 of D10.

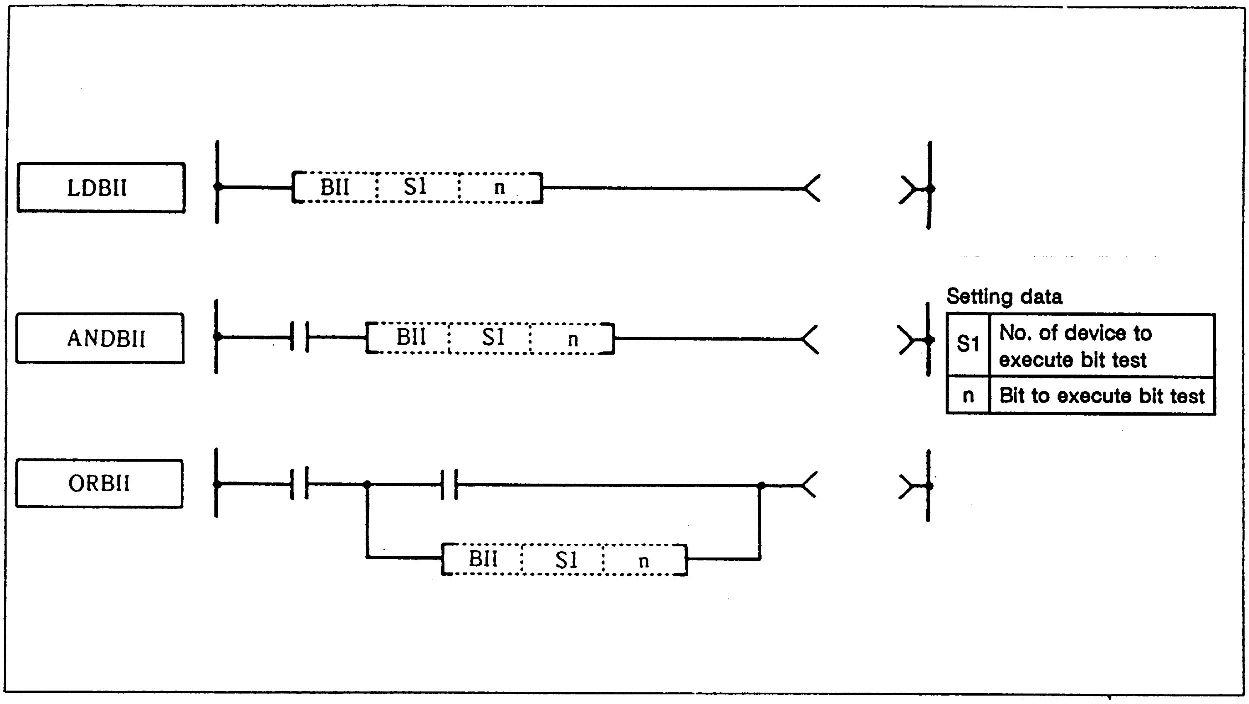


Coding

No. of steps	Com-mand	Device			
0	LD	M3			
1	AND	M8			
2	ORBIT	D10	K10		
5	OUT	Y33			
6					

○ **LDBII, ANDBII, ORBII ... Bit test of b contact handling**

	Usable device																			Digit designation	No. of steps	Index	
	Bit device						Word (16-bit) device									Con-stant		Pointer	Level				
	X	Y	M	L	E	F	T	C	D	R		A0	A1	Z	V	K	H	P	N				
S1							○	○	○	○		○	○								3		
n																○	○						



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

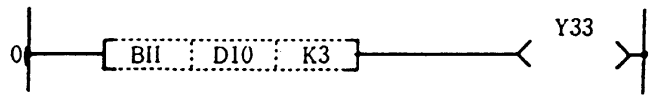
Execution conditions

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

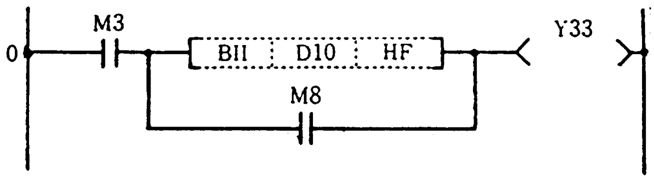
No. of steps	Com-mand	Device				
0	LDBII	D10	K3			
3	OUT	Y33				
4						

(2) Program to test bit 15 of D10.

Coding

No. of steps	Com-mand	Device				
0	LD	M3				
1	ANDBII	D10	K15			
4	OUT	Y33				
5						

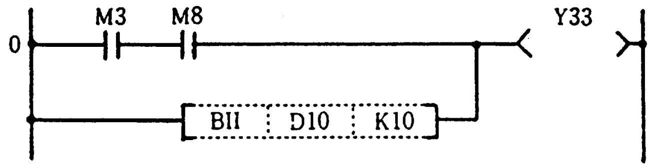
(3) Program to test bit 15 of D10.



Coding

No. of steps	Com-mand	Device				
0	LD	M3				
1	LDBII	D10	HF			
4	OR	M8				
5	ANB					
6	OUT	Y33				
7						

(4) Program to test bit 10 of D10.



Coding

No. of steps	Com-mand	Device				
0	LD	M3				
1	AND	M8				
2	ORBII	D10	K10			
5	OUT	Y33				
6						

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:

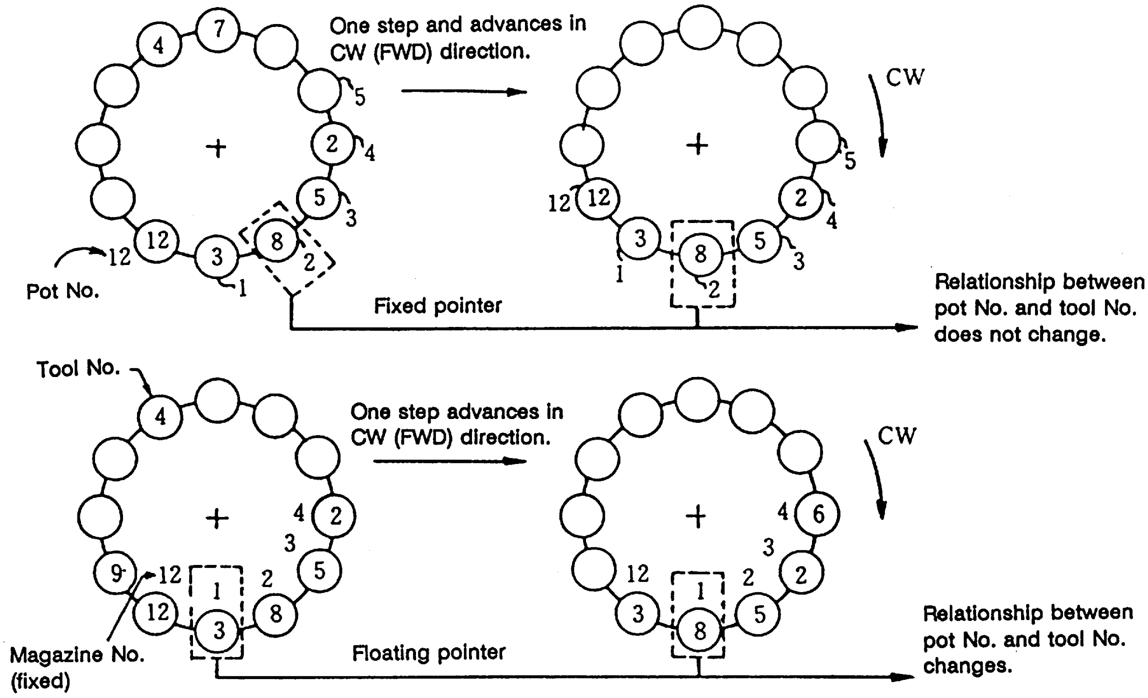
(1) Index of magazine ..... (ATC-K1, K2, K5, K6, K7, K8)
(2) Tool change (arm, or the like is used) ..... (ATC-K3, K4)
(3) Transfer of tool to intermediate pot or arm ..... (Normal function commands such as MOV, XCH are used.)
(4) Others ..... (ATC-K9, K10, K11)

9.1.3 Explanation of Terminology

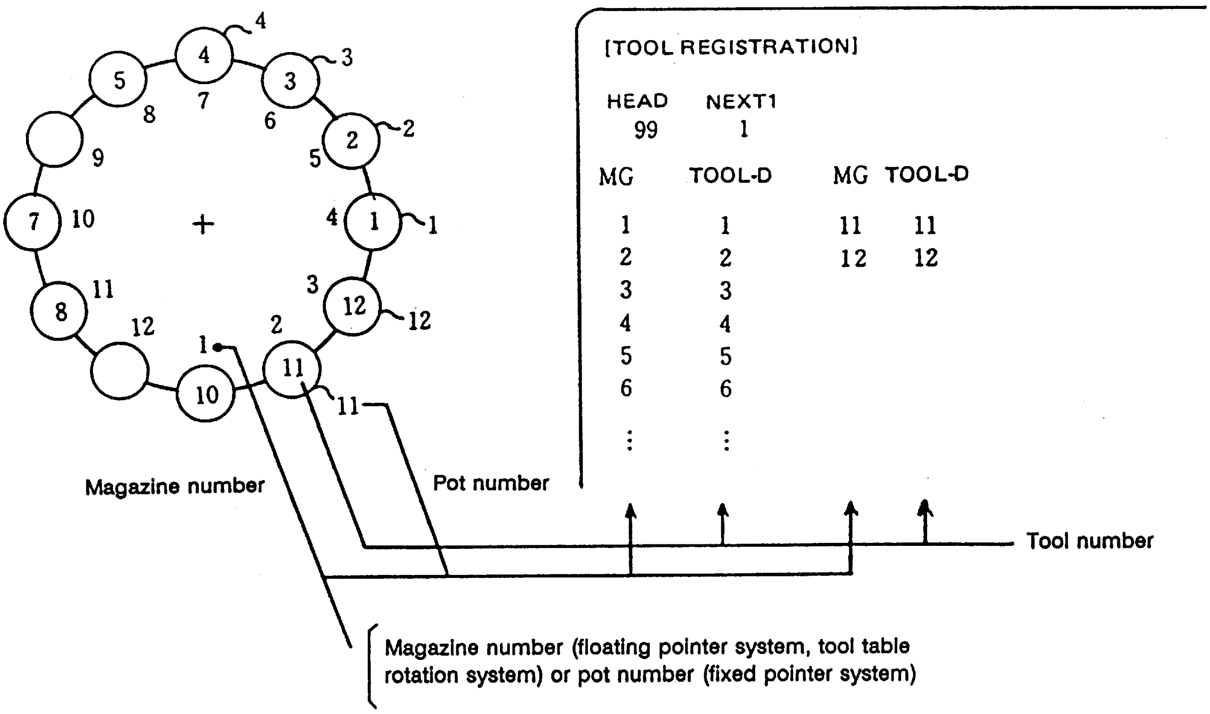
(1) Pointer
This points out the position where the magazine is indexed. When a tool table in which tool No. are previously recorded is used, the tool table does not rotate with rotation of the magazine and the pointer serves as "ring counter" for control of magazine position.

(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.



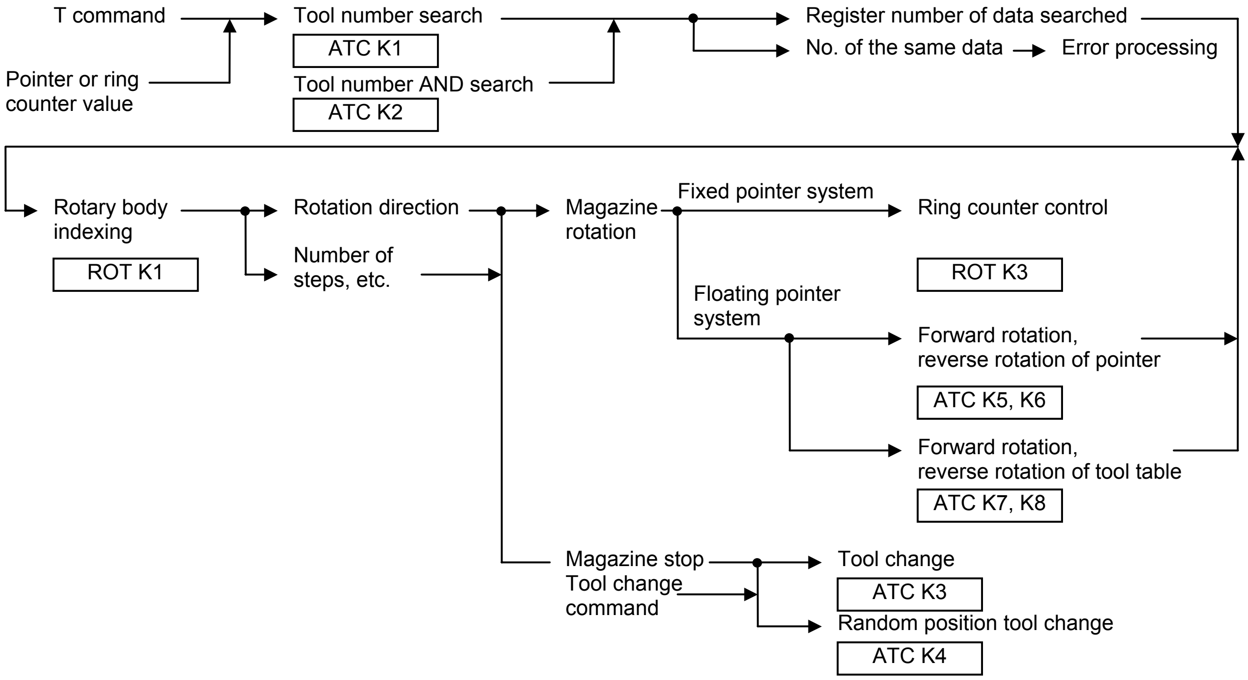
9.1.4 Relationship between Tool Registration Screen and Magazines



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.

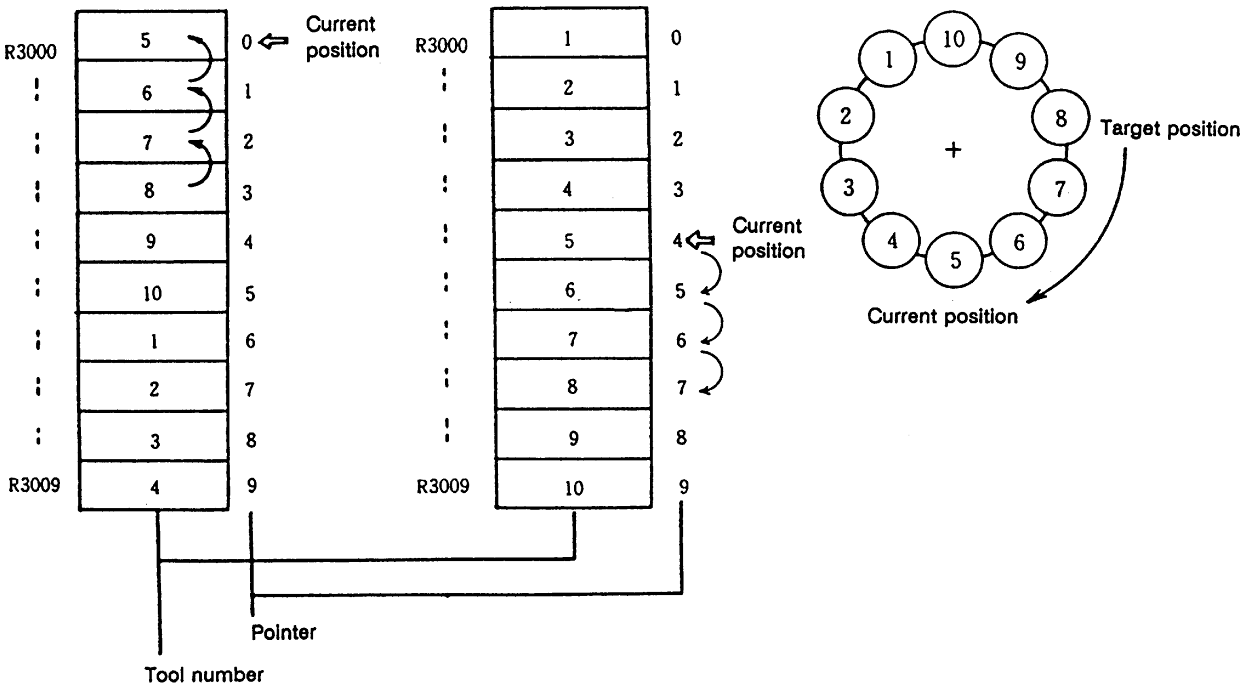
9.1.5 Use of ATC and ROT Commands

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.

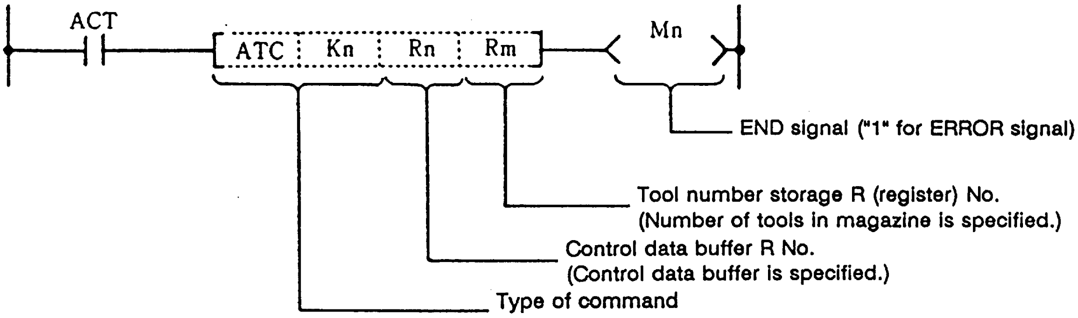
Tool table rotation system **Floating pointer system**

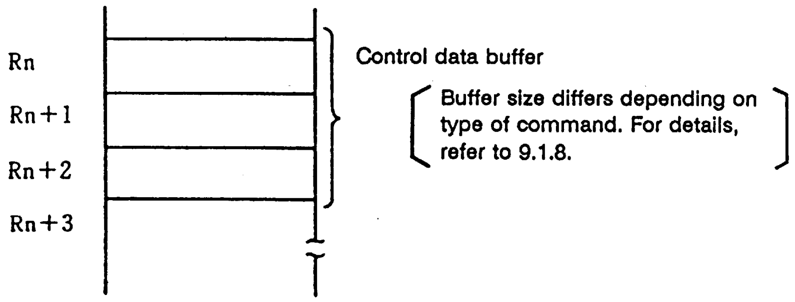


(1) Index tool number 8 in the situation shown above
  (a) In the tool table rotation system, the tool number search command outputs 3.
  (b) In the floating pointer system, the tool number search command outputs 7.
(2) The tool number search command output result is used by the rotary body indexing 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
ATC K1 Rn Rm	Tool No. search
ATC K2 Rn Rm	Tool No. logical product search
ATC K3 Rn Rm	Tool change
ATC K4 Rn Rm	Random position tool change
ATC K5 Rn Rm	Pointer "FWD" rotation
ATC K6 Rn Rm	Pointer "REV" rotation
ATC K7 Rn Rm	Tool table "FWD" rotation
ATC K8 Rn Rm	Tool table "REV" rotation
ATC K9 Rn Rm	Tool data read
ATC K10 Rn Rm	Tool data write
ATC K11 Rn Rm	Automatic tool data write

9.1.8 Control Data Buffer Contents

	Command	Rn	Rn+1	Rn+2
1	Tool No. search	No. of register to store search data	No. of register to which data output	—
2	Tool No. logical product search	No. of register to store search data	No. of register to which data output	Mask data position R No.
3	Tool change (Ex.: Spindle↔Index position)	No. of register to specify the position of tool change	—	—
4	Random position tool change	No. of register to specify the position of tool change	No. of register to specify the tool to be changed	—
5	Pointer "FWD" rotation	—	—	—
6	Pointer "REV" rotation	—	—	—
7	Tool table "FWD" rotation	—	—	—
8	Tool table "REV" rotation	—	—	—
9	Tool data read	Magazine position (to be read) R No.	No. of register to which data output	—
10	Tool data write	Magazine position (to be written) R No.	Written data position R No.	—
11	Automatic tool data write	Initial data storage R No.	—	—

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

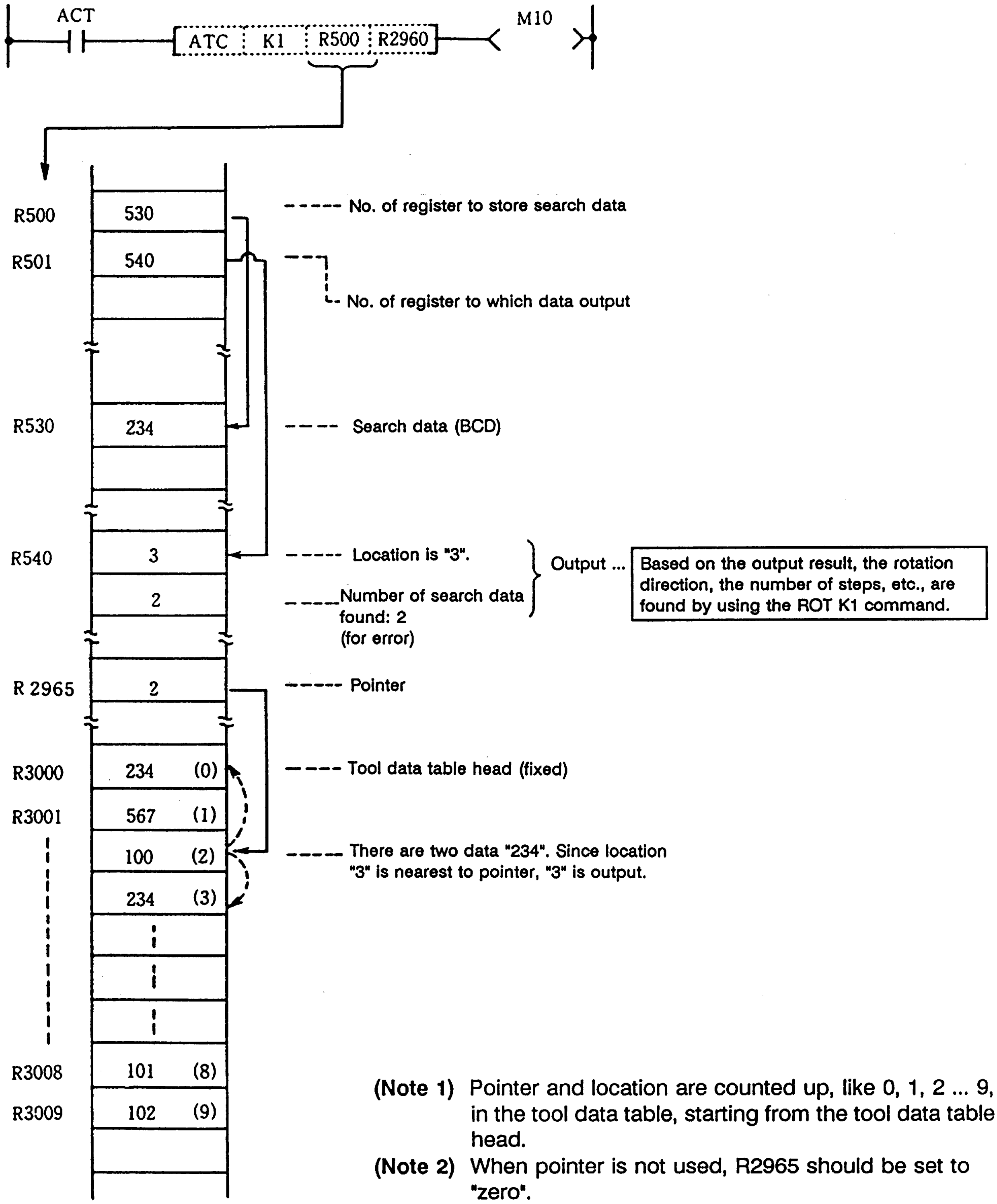
- Bits F to 8: Max. number of standby displayed: 4
- Bit 1:
  - 0: Magazine starts from "1".
  - 1: Magazine starts from "0".
- Bit 0:
  - 0: T 4-digit
  - 1: T 8-digit

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)

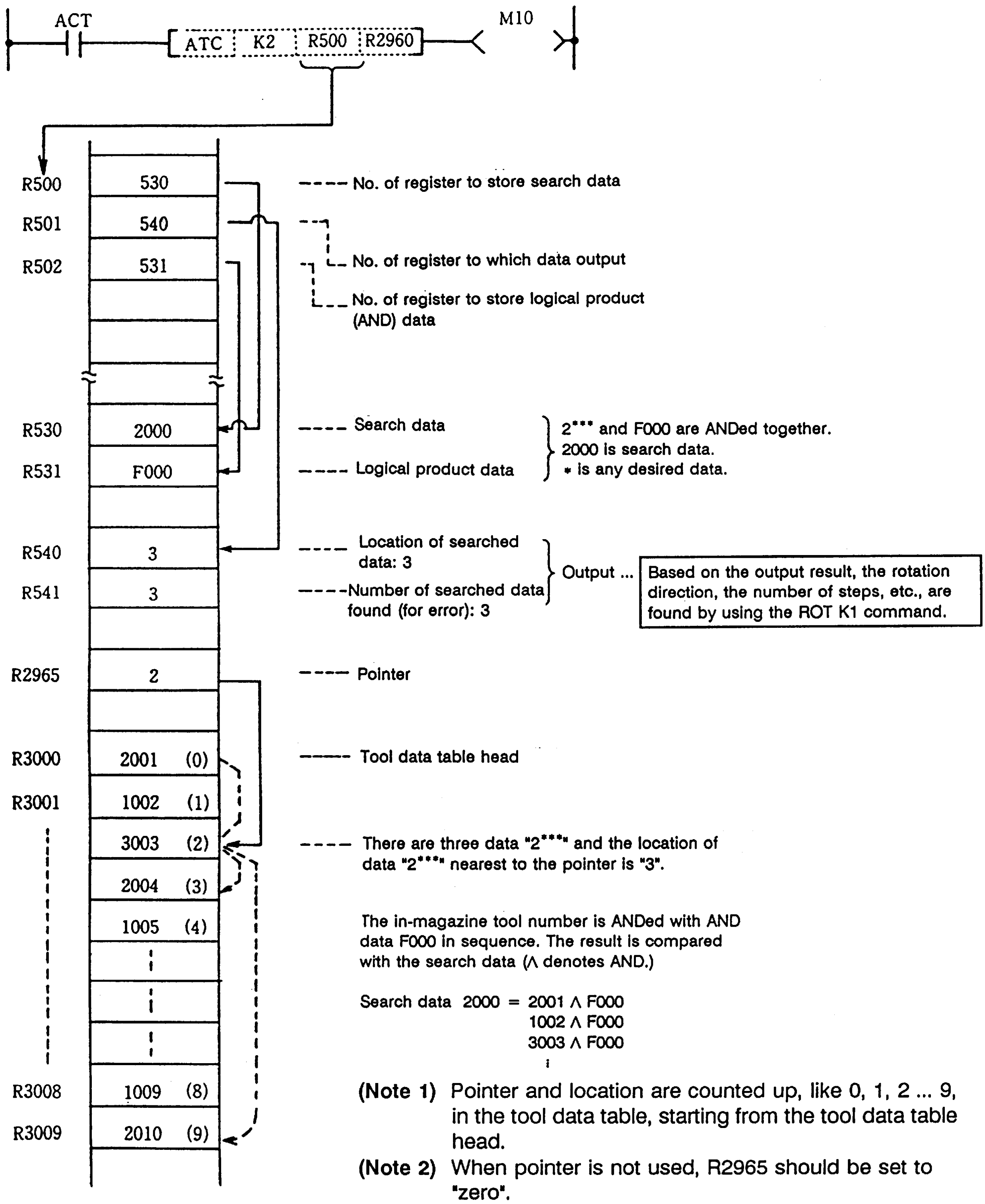
(Note 1) Pointer and location are counted up, like 0, 1, 2 ... 9, in the tool data table, starting from the tool data table head.

(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.



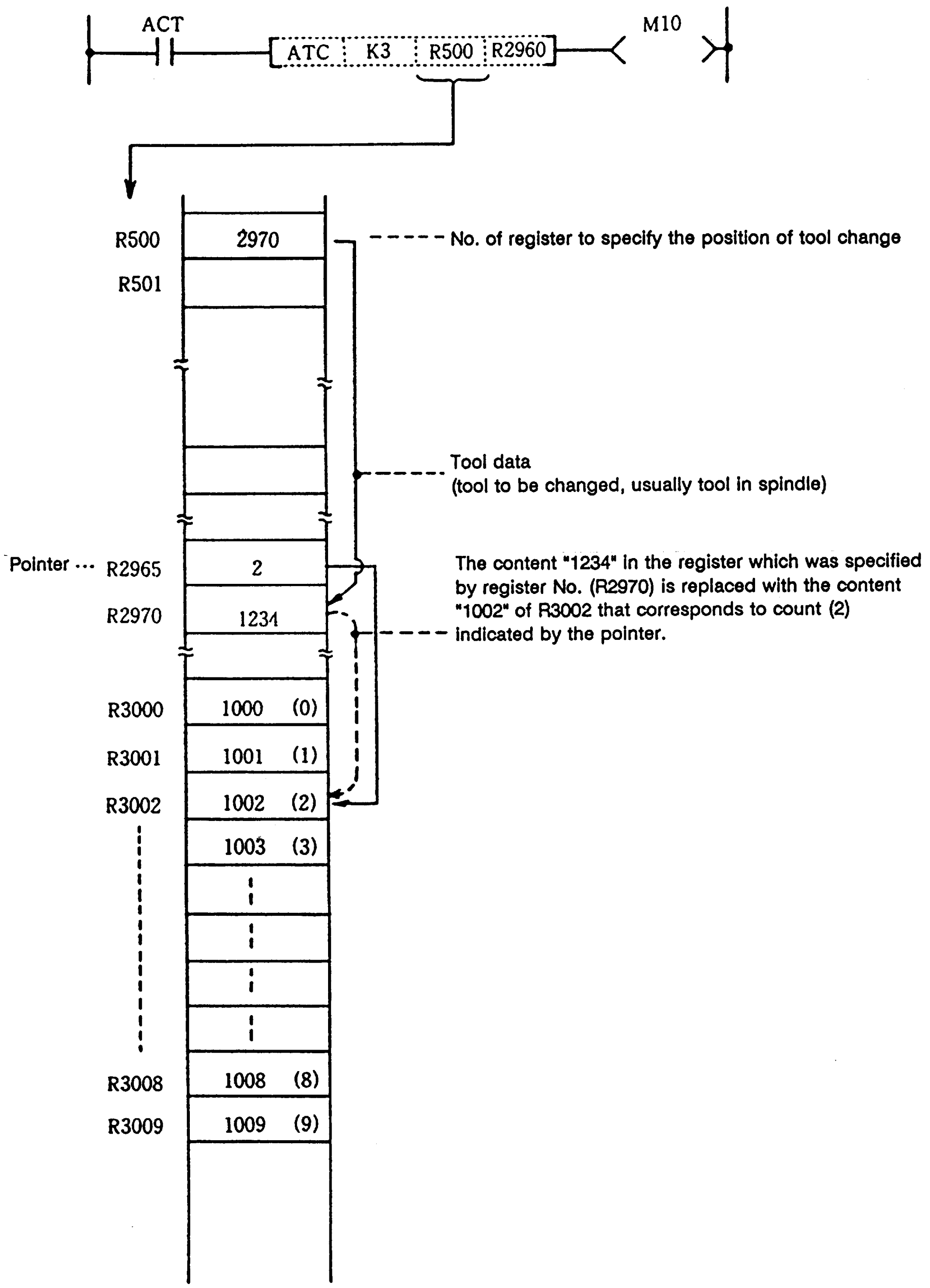
(Note 1) Pointer and location are counted up, like 0, 1, 2 ... 9, in the tool data table, starting from the tool data table head.

(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.

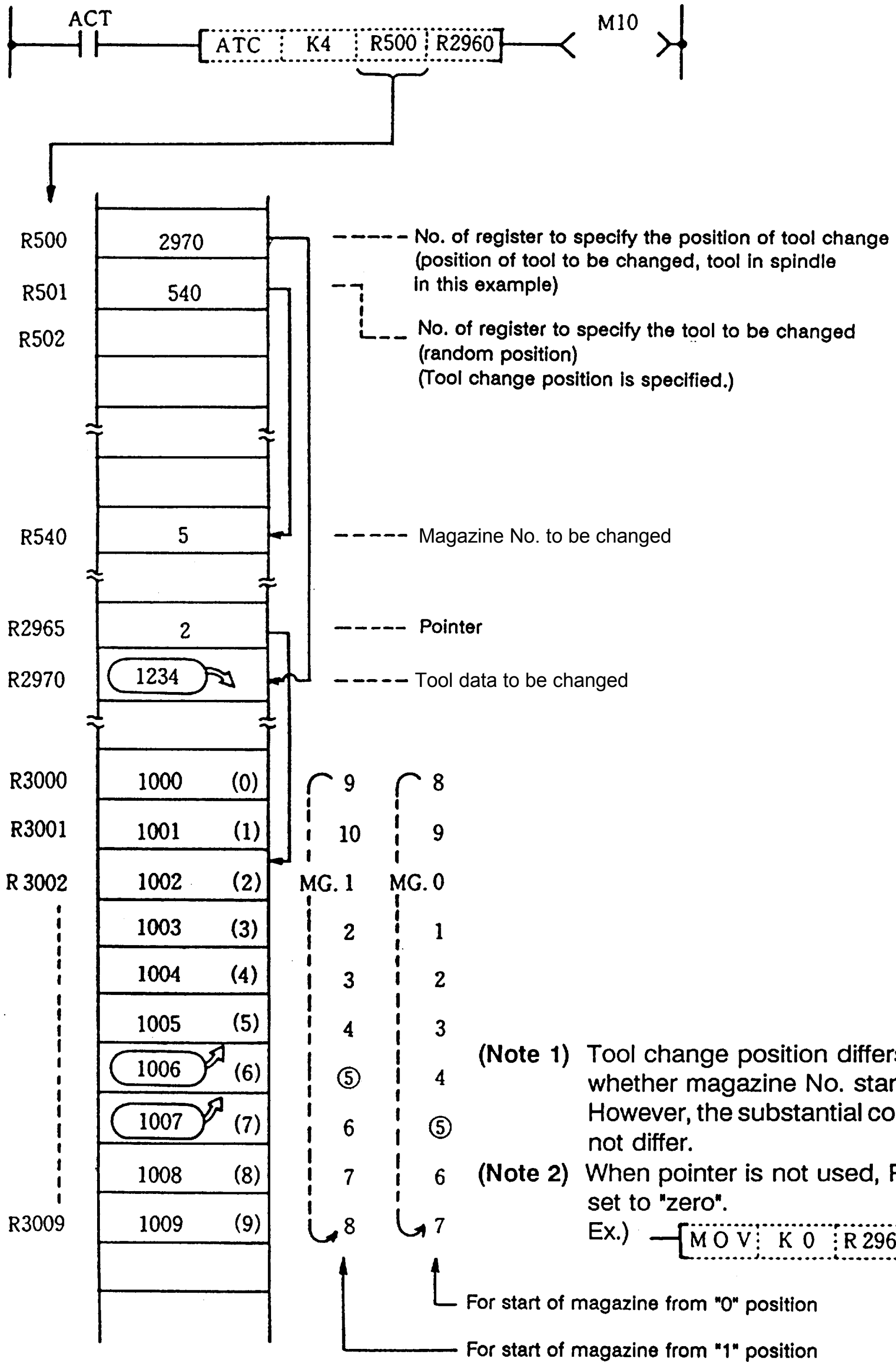


(Note 1) When pointer is not used, R2965 should be set to "zero".

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.



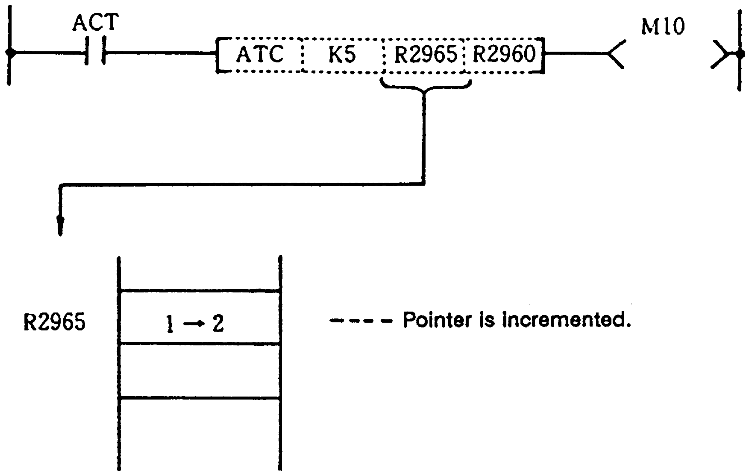
(Note 1) Tool change position differs depending on whether magazine No. starts with "0" or "1". However, the substantial consequence does not differ.

(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.

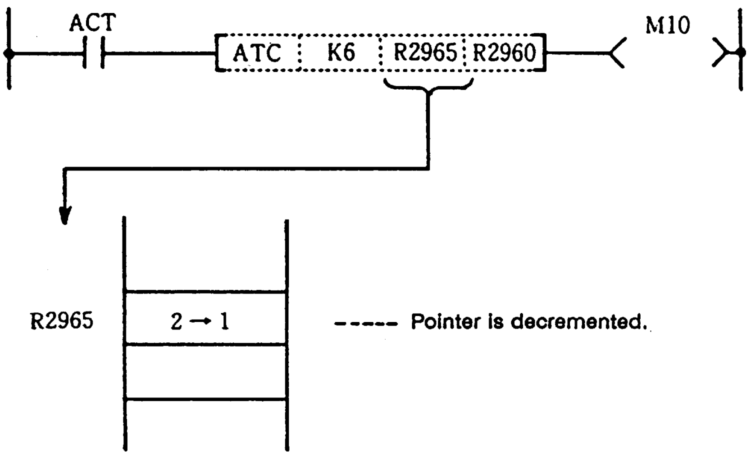


When a magazine with 10 tools is used, the control sequence is as follows:
0, 1, 2, 3 .... 9, 0, 1, 2, ... 8, 9, 0, 1 ...

(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.

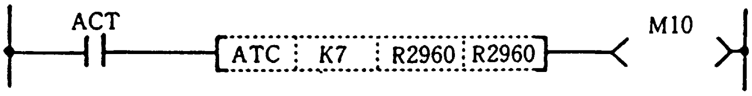


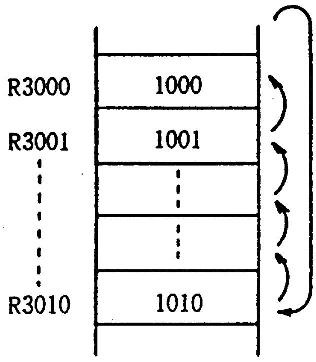
When a magazine with 10 tools is used, for example, the control sequence is as follows:
2, 1, 0, 9, 8 .... 2, 1, 0, 9, 8 .... 1, 0, 9, 8 ...

(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.



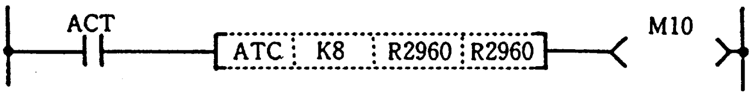


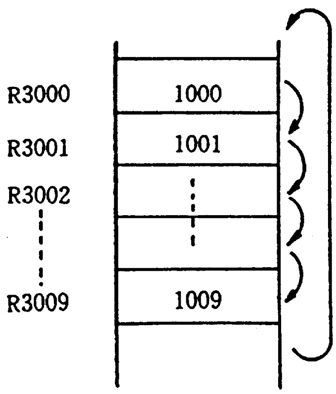
(Note 1) In this control mode, pointer always indicates "0" (tool table head).

(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.



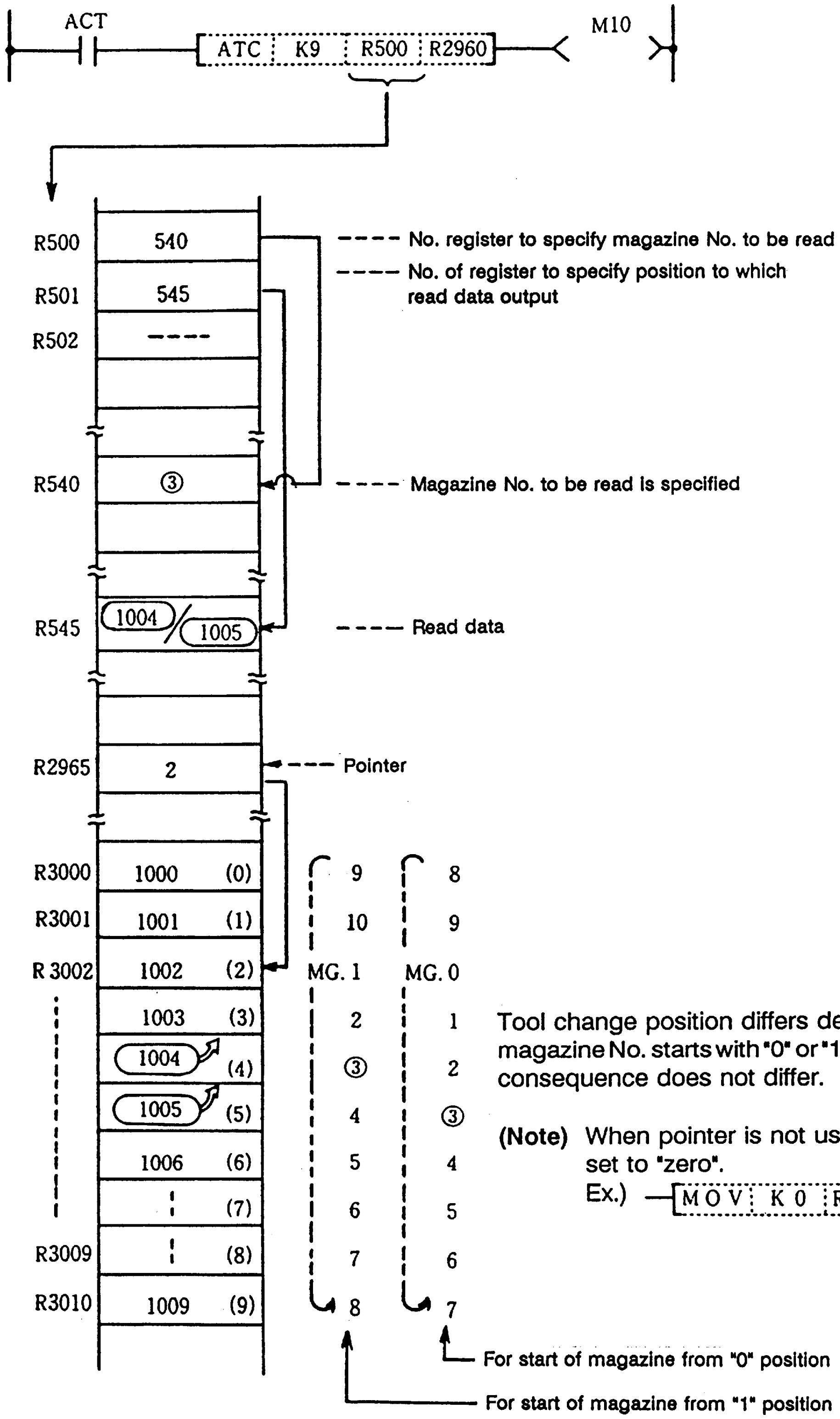


(Note 1) In this control mode, pointer always indicates "0" (tool table head).

(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.



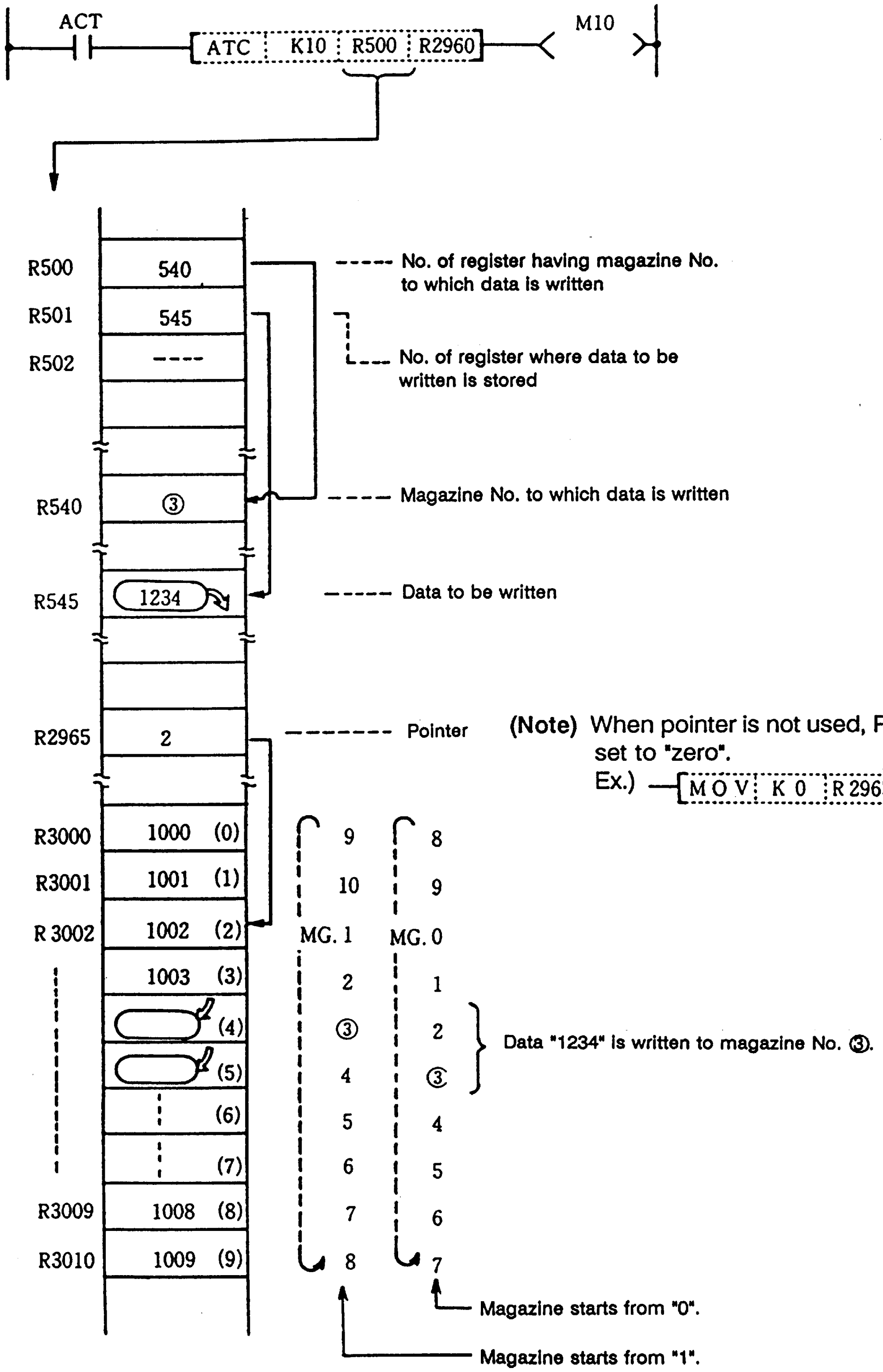
Tool change position differs depending on whether magazine No. starts with "0" or "1". However, the substantial consequence does not differ.

(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 CRT console, the tool No. is entered to each magazine No. set through PLC program.

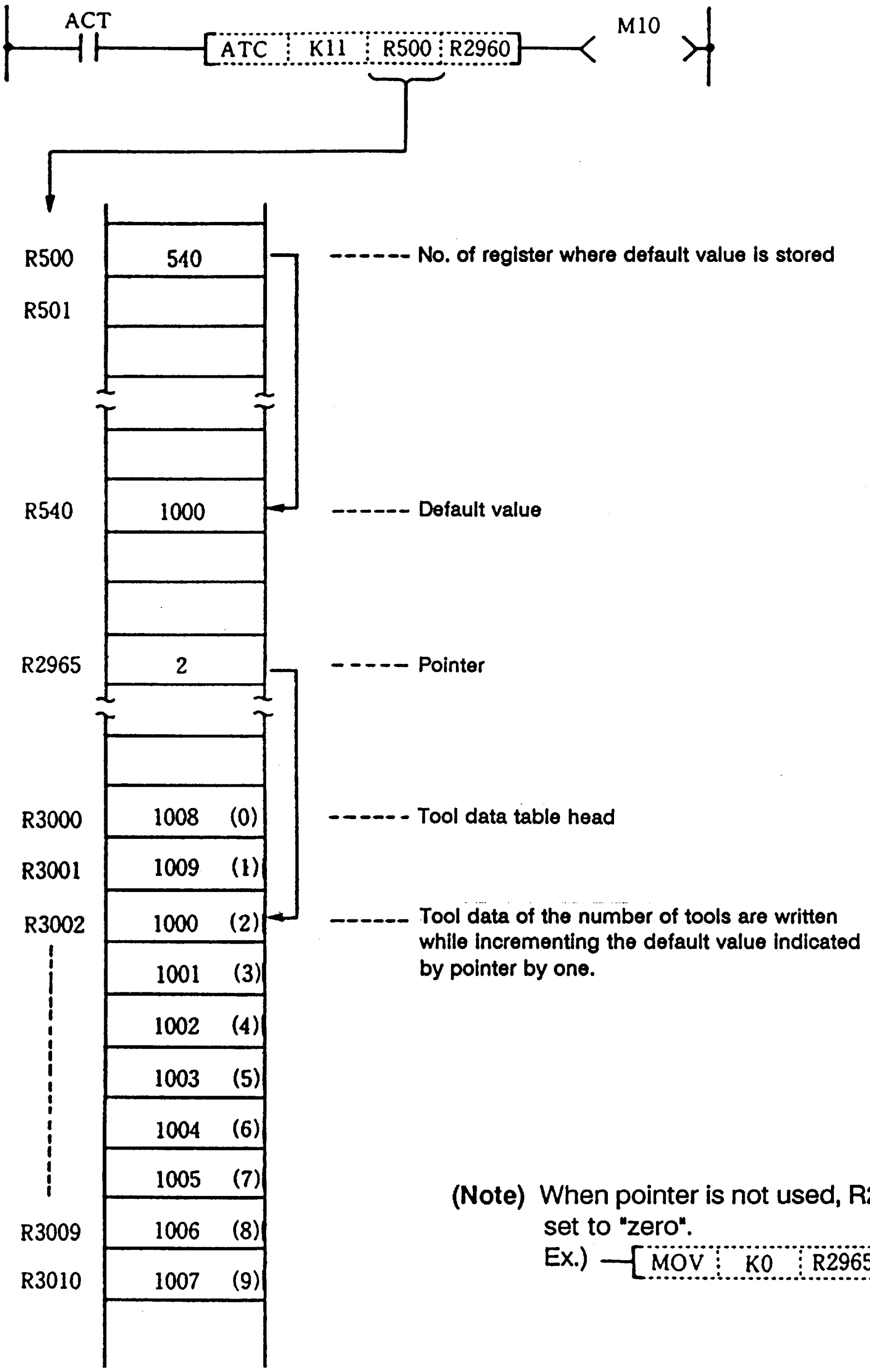


(Note) When pointer is not used, R2965 should be set to "zero".

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.

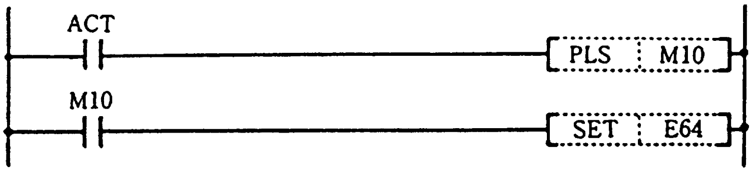


(Note) When pointer is not used, R2965 should be set to "zero".
Ex.) MOV K0 R2965

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 E64 by using the SET command.

Program example)



· E64 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).
· E64 is set through the use of the user PLC and reset by controller.

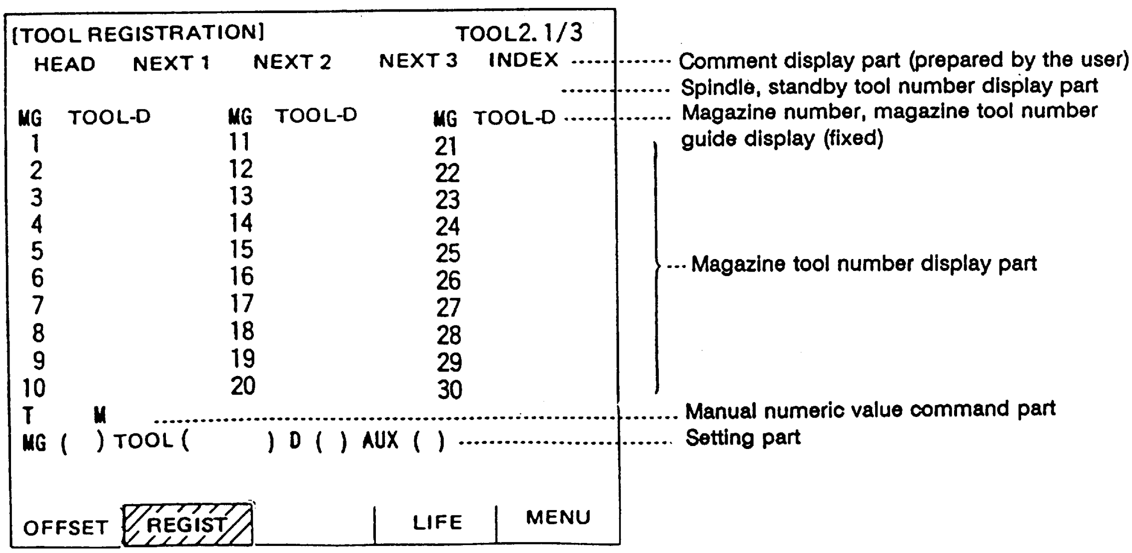
(2) Method of tool registration prohibiting during magazine rotation
If tool data is set on the tool registration screen during magazine rotation, data may be set in erroneous position. To prevent this error, a signal called special relay E71 is provided.
· Turn on E71 during magazine rotation.

Program example)

· Setting of AUX data (R2998) is valid while E71 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 Manual (Personal Computer Section) and PLC Onboard Instruction Manual.

(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	7	6	5	4	3	2	1	0

(Bits F to 8:)

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.

1) 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.

2) Magazine number start value
Control parameter (R2950)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

(Bit 1:)
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.

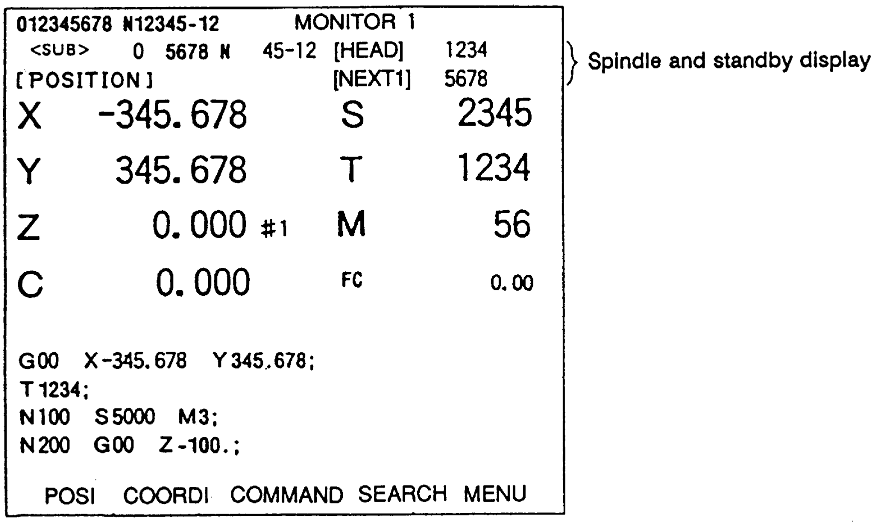
MG	TOOL-D	MG	TOOL-D
0		⁓	
1		10	
⁓		11	

The magazine number starts at 0.

9.1.13 Display of Spindle Tool and Standby Tool

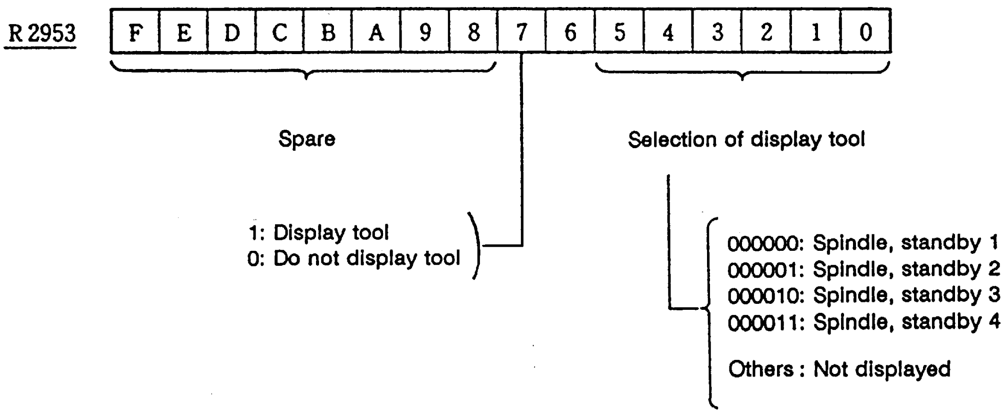
The tool mounted on the spindle or the tool to be mounted next on the spindle (standby tool) and tool No. in the magazine are set and displayed on the tool registration screen. However, the spindle and standby tool Nos. can also be displayed on the position display screen and tool length measurement 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 for 9-inch CRT



(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 current value screen and tool length measurement screen, etc., are selected.



9.2 Rot Commands

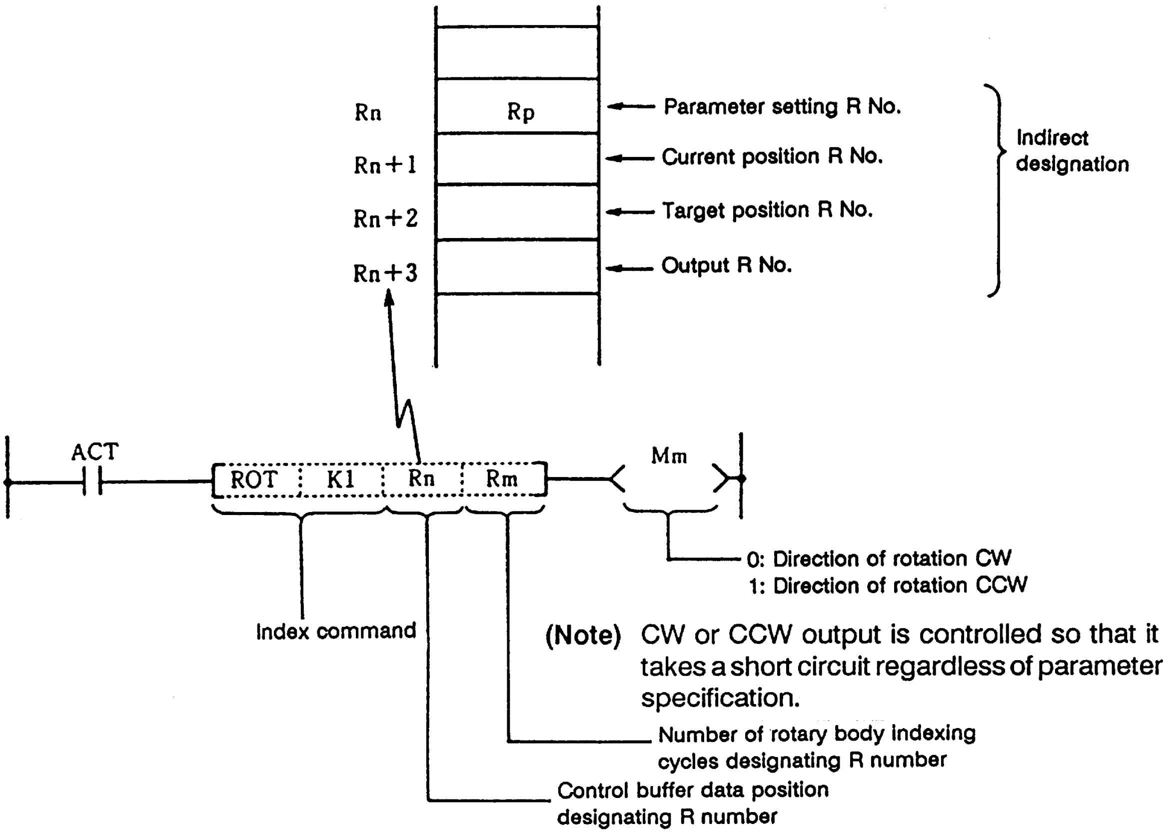
Rot commands are prepared as functions such as rotary body target position, rotation direction and ring counter. The commands can be used to determine the direction of rotation and number of steps with the data resulting from ATC exclusive command tool No. search processing.

9.2.1 Command List

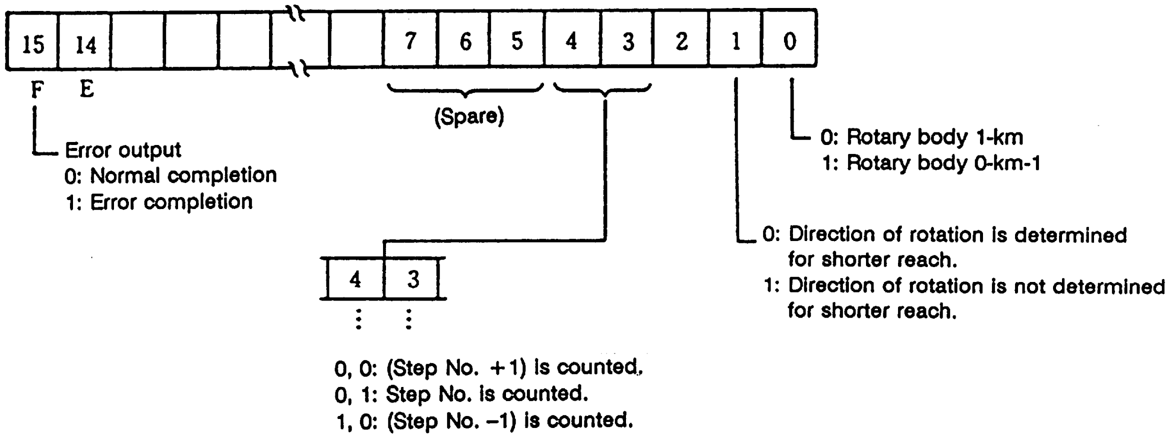
Command	Description
ROT K1 Rn Rm	Rotary body indexing
ROT K3 Rn Rm	Ring counter

(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 (Rs) 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.

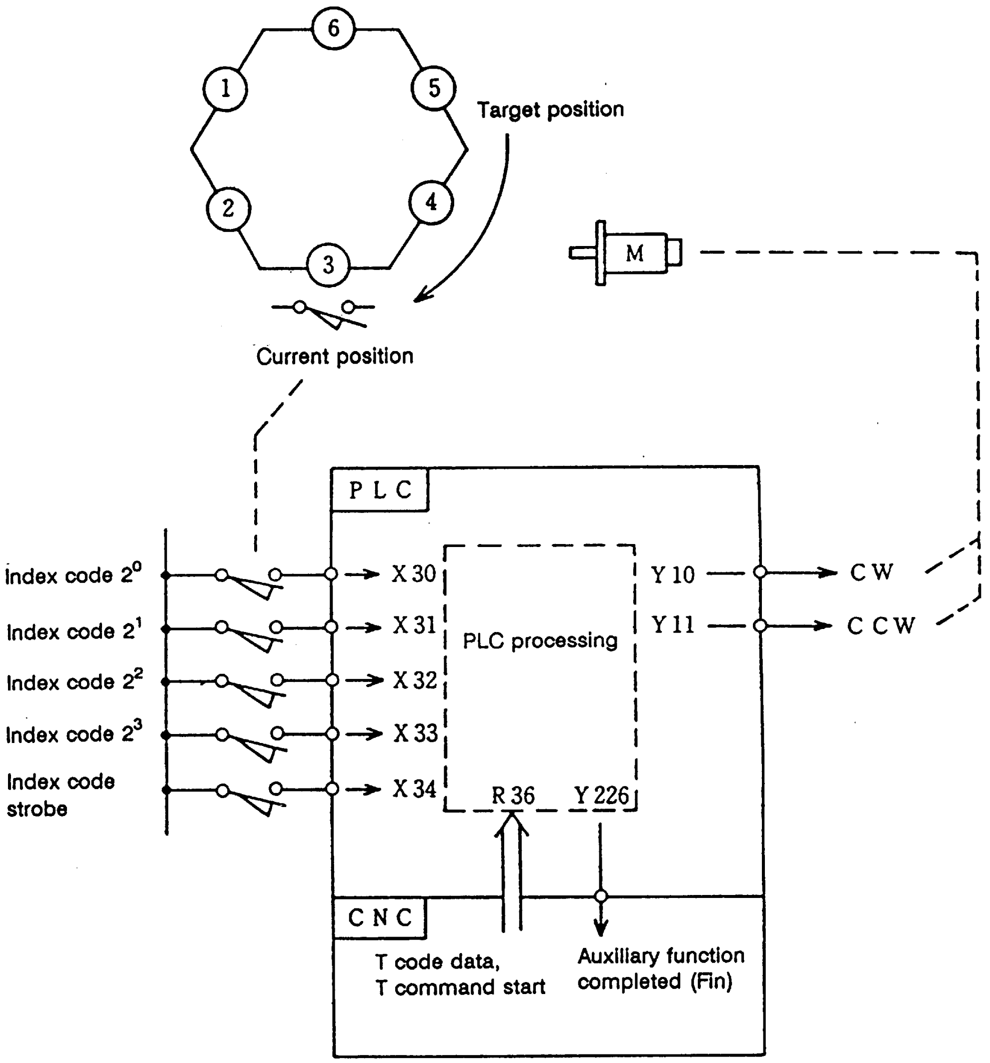
(Note 2) The error code stored in bit F of the parameter (Rp) is cleared when the Index command activating signal (ACT) goes off.

1) Example of rotary body index by ROT K1 instruction

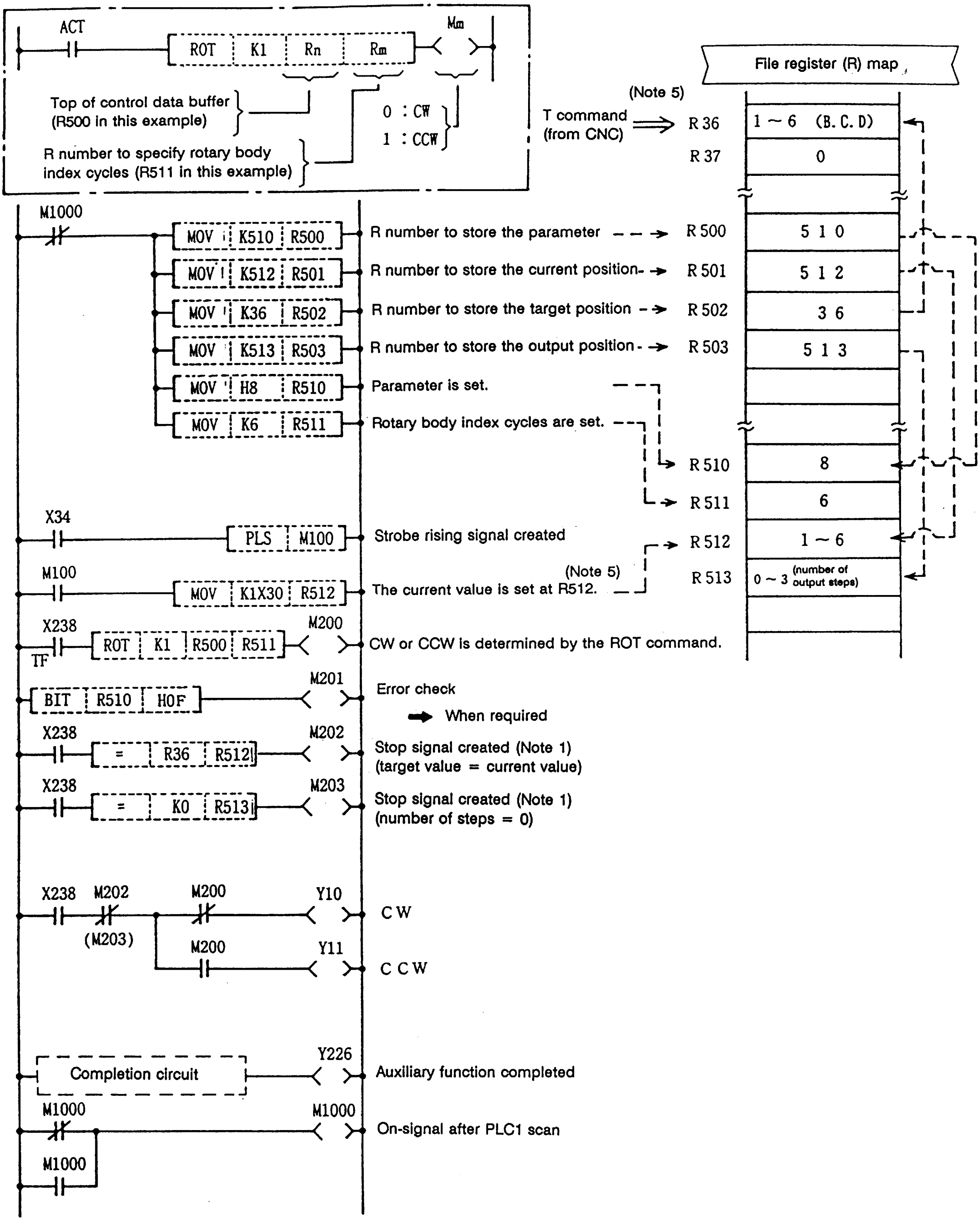
Conditions: (i) The number of rotary body index cycles is 6.

(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
ROT K1 Rn Rm
Mm
Top of control data buffer (R500 in this example)
R number to specify rotary body index cycles (R511 in this example)
0 : CW
1 : CCW
File register (R) map
(Note 5)
T command (from CNC)
R 36
1 ~ 6 (B.C.D)
R 37
0
M1000
MOV K510 R500
MOV K512 R501
MOV K36 R502
MOV K513 R503
MOV H8 R510
MOV K6 R511
R number to store the parameter
R number to store the current position
R number to store the target position
R number to store the output position
Parameter is set.
Rotary body index cycles are set.
R 500
5 1 0
R 501
5 1 2
R 502
3 6
R 503
5 1 3
R 510
8
R 511
6
X34
PLS M100
Strobe rising signal created
R 512
1 ~ 6
M100
MOV K1X30 R512
(Note 5)
The current value is set at R512.
R 513
0 ~ 3 (number of output steps)
X238
ROT K1 R500 R511
M200
TF
CW or CCW is determined by the ROT command.
BIT R510 H0F
M201
Error check
When required
X238
= R36 R512
M202
Stop signal created (Note 1) (target value = current value)
X238
= K0 R513
M203
Stop signal created (Note 1) (number of steps = 0)
X238 M202 M200 Y10
(M203)
M200 Y11
C W
C C W
Completion circuit
Y226
Auxiliary function completed
M1000
M1000
M1000
On-signal after PLC1 scan

(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.

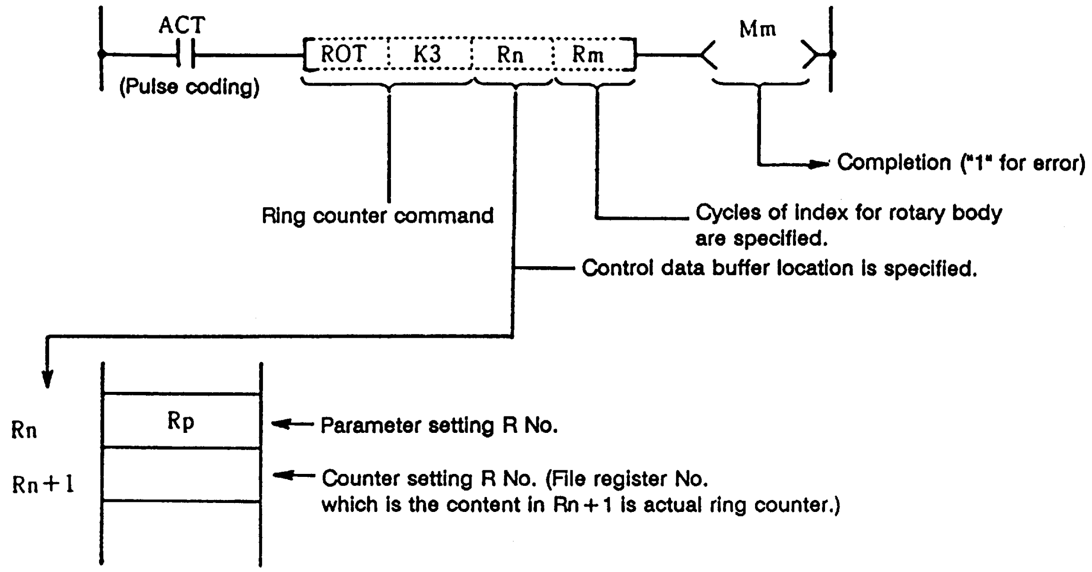
(Note 3) If a number from 1 to 6 has not been specified for current position data (R512) before the ROT command is activated, an error results.

(Note 4) The control parameters (R510) are specified as follows:
1) Magazine 1~km
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 ROT K1 command must be binaries. (In actual use, the contents of R36 are binary converted.)

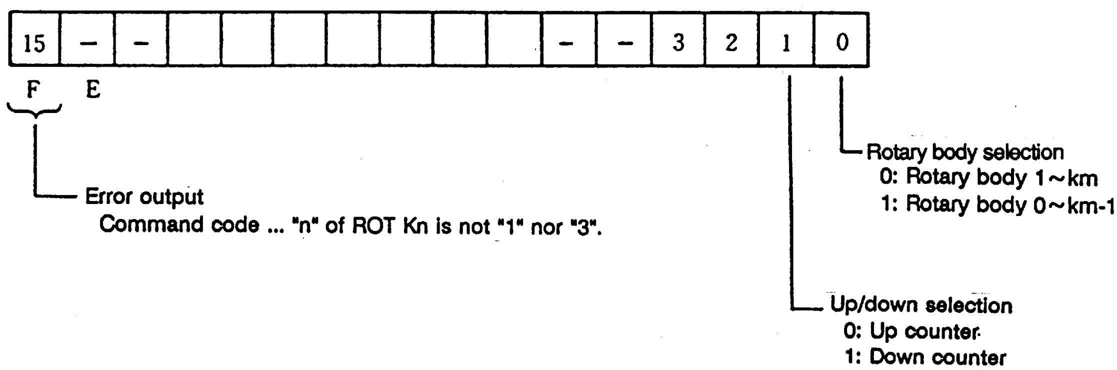
(2) Ring counter (Up/down counter)

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 0 to Km-1 or 1 to Km 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.

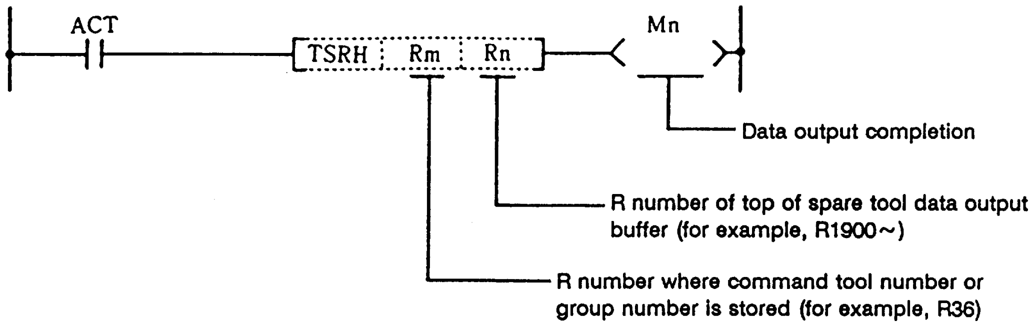
(Note 2) The error code (Mm) of the ring counter command and the error code in bit F of the parameter (Rp) are cleared when the activating signal (ACT) goes off. The activating signal (ACT) of the ring counter command is generally pulsed. This makes it hard for the interface diagnostic and ladder monitor 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

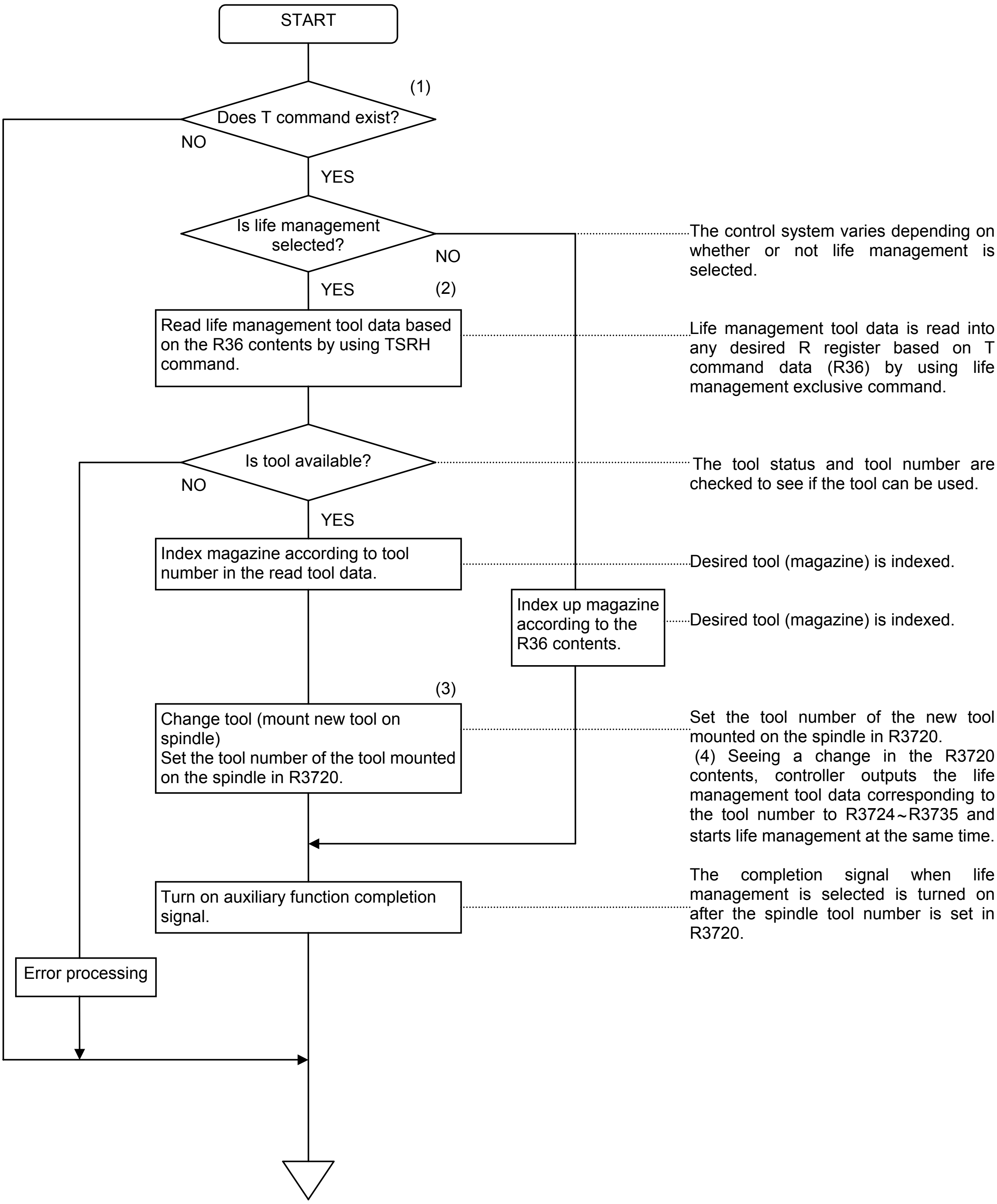
Device name	Signal name	Explanation
Y29A	Auxiliary function locking signal	While this signal is input, tool life management is not made.
Y2C8	Tool error 1 signal	This signal indicates tool error state 1. When controller inputs the signal it changes the status in spindle tool data to 3. (Unused tools 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

(1) 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.

(2) 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.

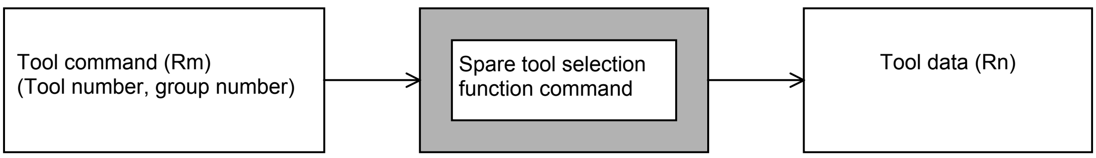
(Note) If -1 is set in the group number in the output tool data, the tool data is invalid. At the time, the specified tool number is output to the tool number in the output tool data as it is.

(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.

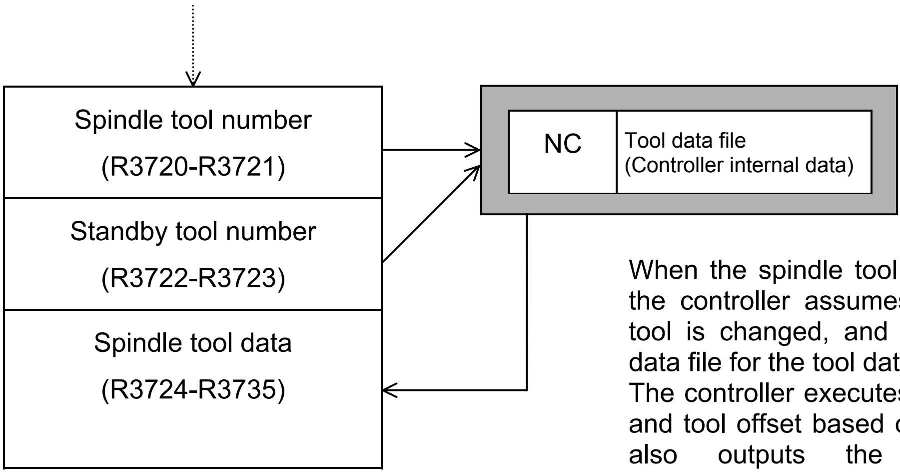
<When tool command is executed>



In tool life management I, tool number is only specified and spare tool is selected.

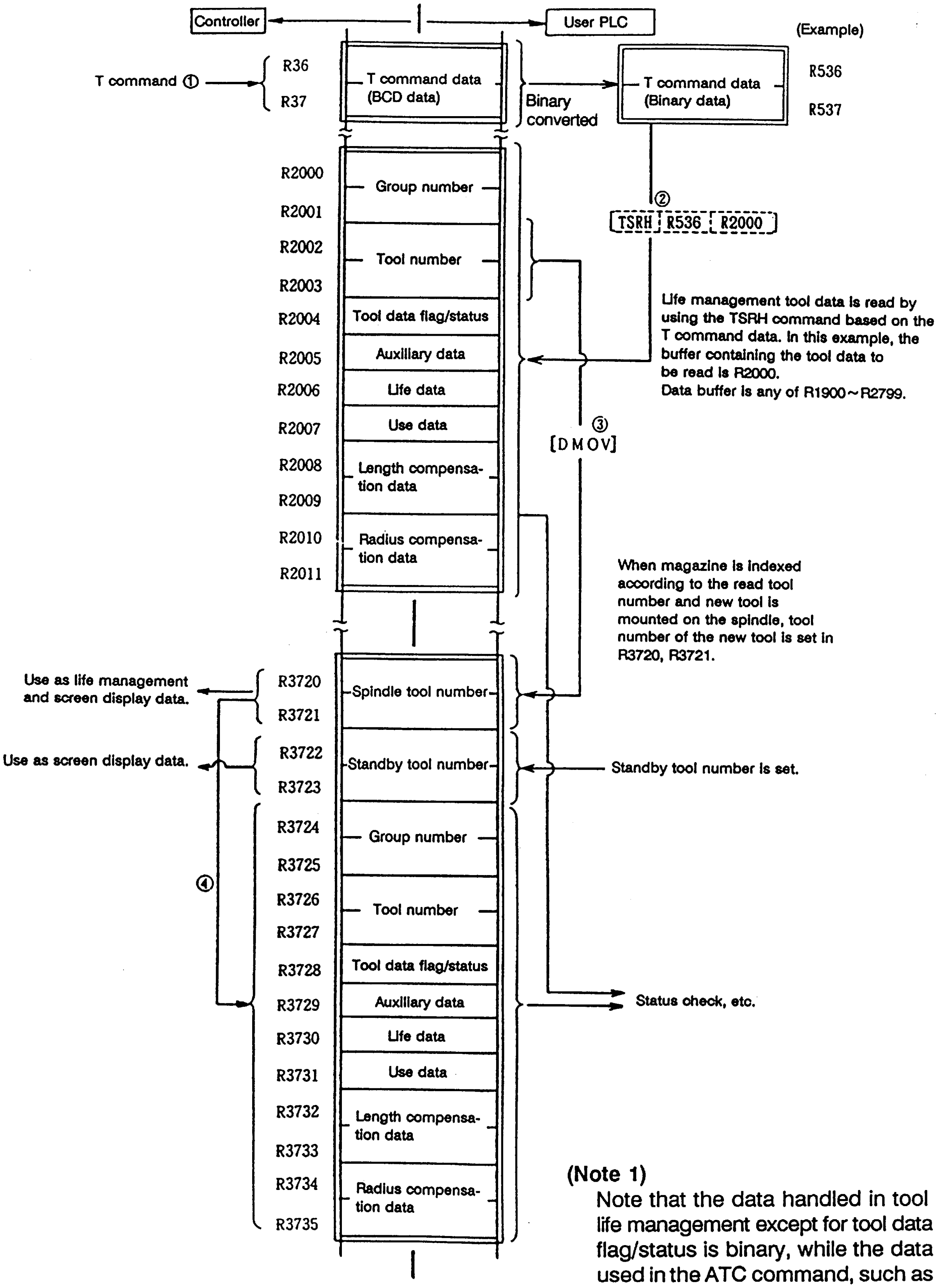
Tool is selected according to tool number in tool data. (User PLC)

<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

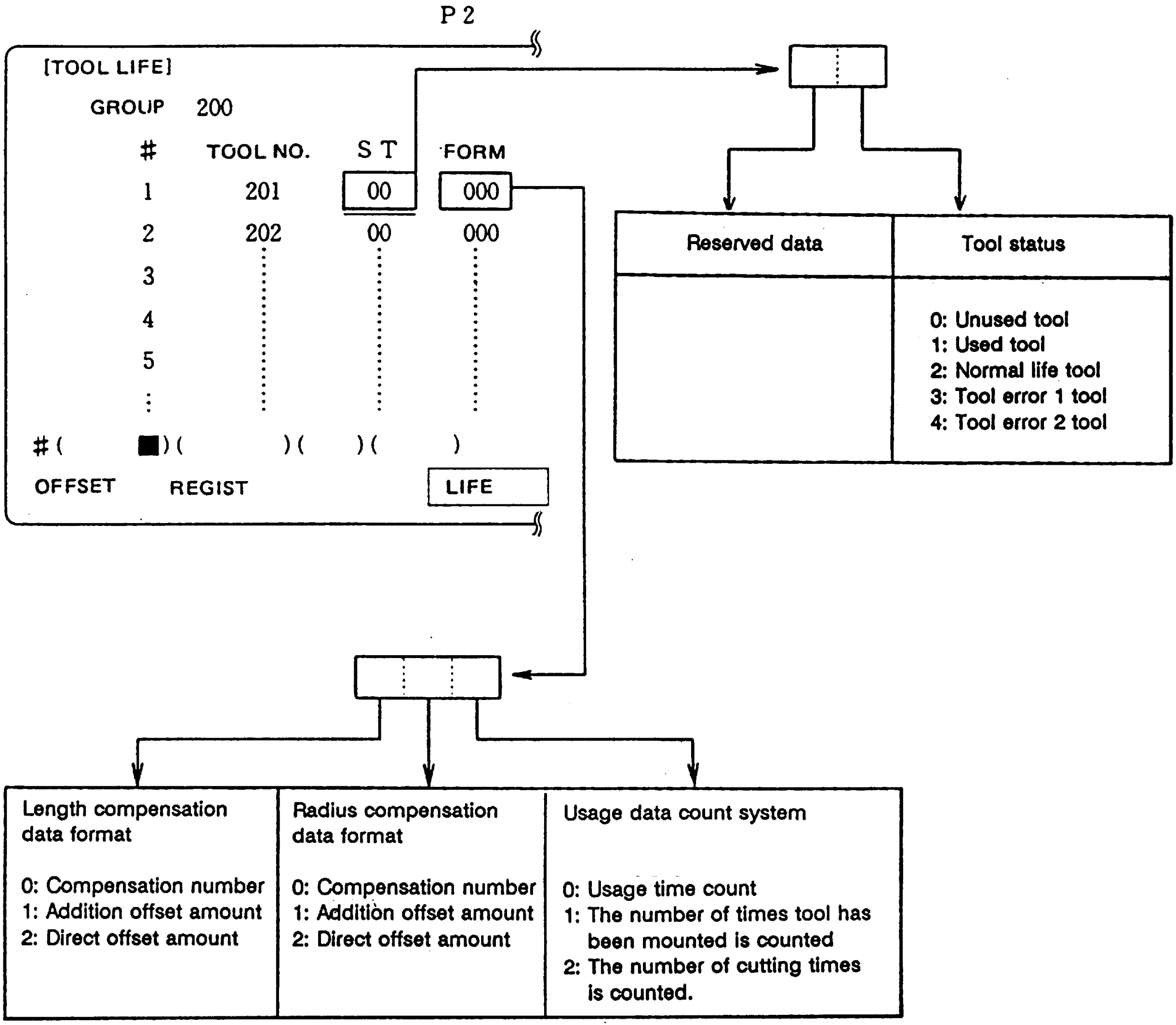
The tool data is tool management data such as the group number, tool number, and tool status. The details are given below:

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 - 9999 (times)
Tool use data	Use time or use count for each tool.	0 - 4000 (minutes) 0 - 9999 (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:

1) Correspondence with tool life management data screen



2) Tool data flag ..... Bits 0~7 of file register Rn (such as R3728)

bit	Explanation	
bit 0	Length compensation data format (spare tool compensation system)	0: Compensation number 1: Addition offset 2: Direct offset amount
bit 1		
bit 2	Radius compensation data format (spare tool compensation system)	0: Compensation number 1: Addition offset 2: Direct offset amount
bit 3		
bit 4	Usage data count system	0: Usage time (minutes) 1: Number of times tool has been mounted 2: Number of cutting times
bit 5		
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:

a) 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.

b) 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.

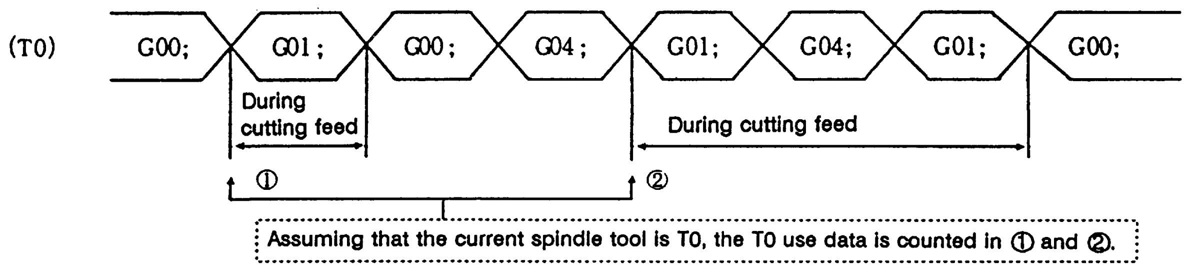
c) Direct compensation system (2 is set on the tool data registration screen.)
Compensation data in tool data is handled as direct offset amount. It is replaced with the offset amount indicated by the compensation number given in a work program and compensation is executed.

2) Usage data count system

a) 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.

b) 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.

c) 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).

3) 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	(Reserved)
bit D	
bit E	
bit F	

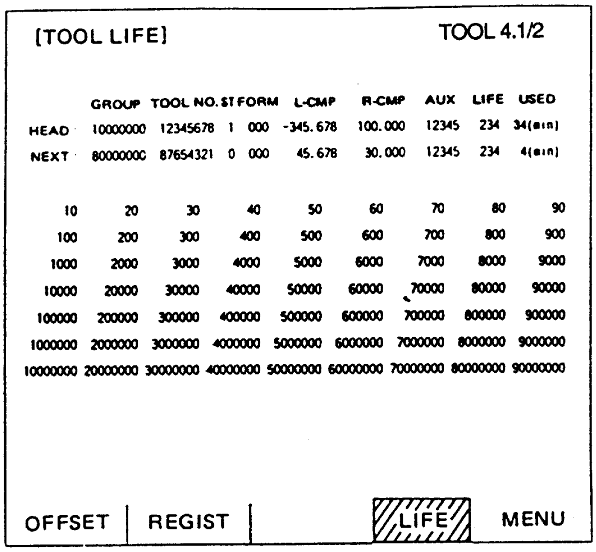
4) Tool status contents

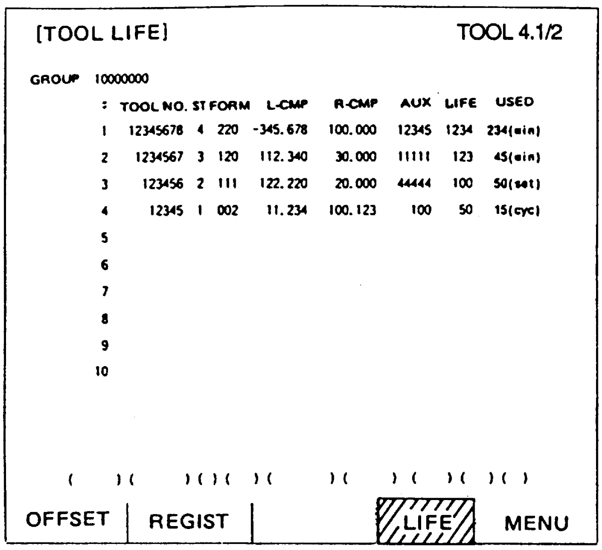
When the tool status number is 0 or 1, NC assumes the tool to be available.

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.



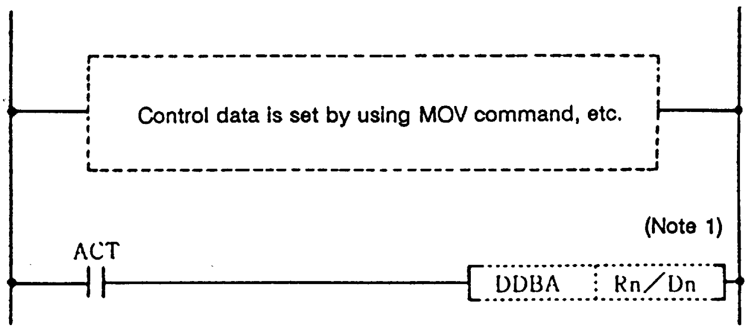


Tool life management screen example on 9-inch CRT setting and display unit

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



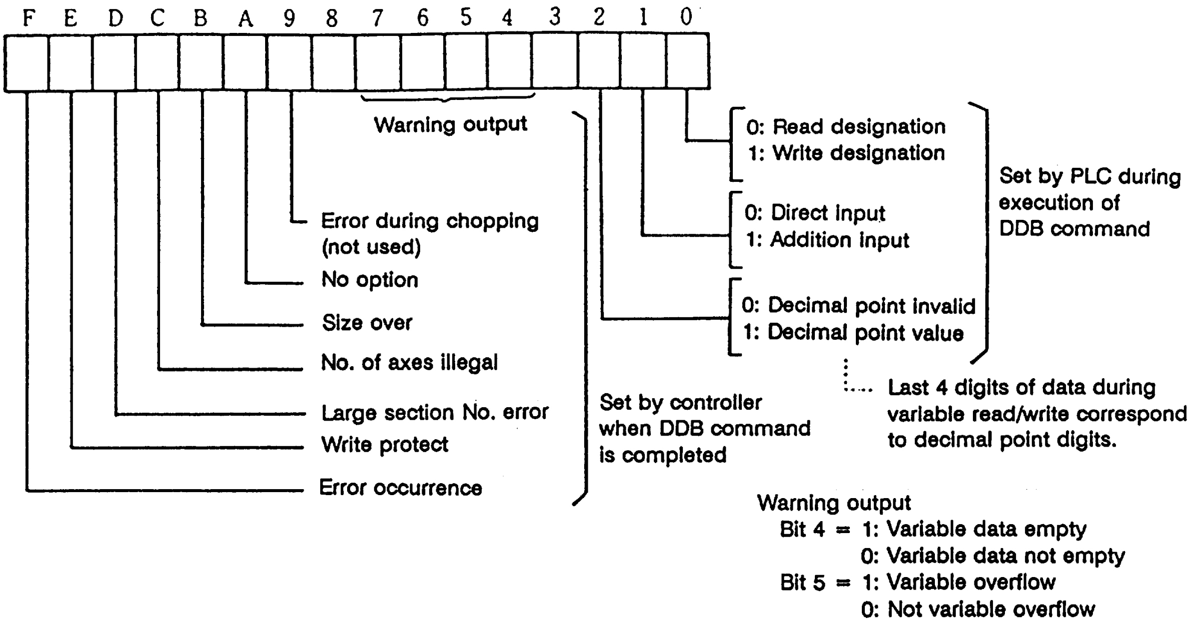
(Note 1) File registers (Rn) and data registers (Dn) to which the user is accessible can be used as the asynchronous DDB control data buffer. The file registers (R) to which the user is accessible are R500 through R549 (not backed up) and R1900 through R2799 (backed up).

9.4.2 Basic Format of Control Data

Rn (Dn)	Control signal
Rn+1 (Dn+1)	Large section No.
Rn+2 (Dn+2)	Sub-section No.
Rn+4 (Dn+4)	Data size
Rn+5 (Dn+5)	Read/write designated axis, system specification
Rn+6 (Dn+6)	Read/write data (For 1st axis)
Rn+8 (Dn+8)	(For 2nd axis)
Rn+10 (Dn+10)	(For 3rd axis)
Rn+12 (Dn+12)	(For 4th axis)

(Note) 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)

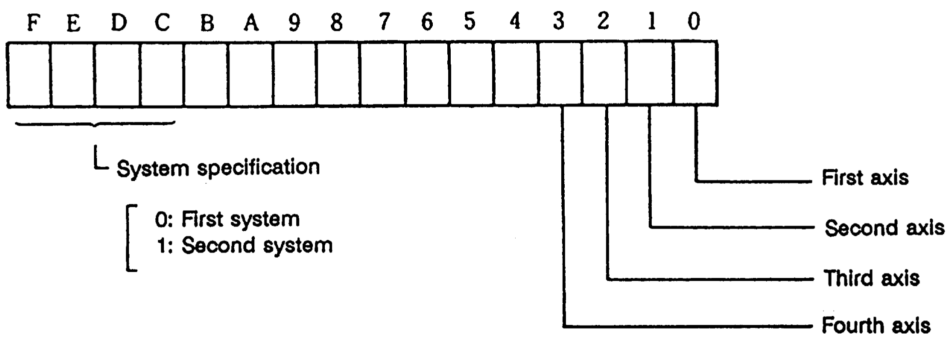


(2) Large section number (Rn+1), (Dn+1)
Specify the large section number of the data to be read/written in binary form.

(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.

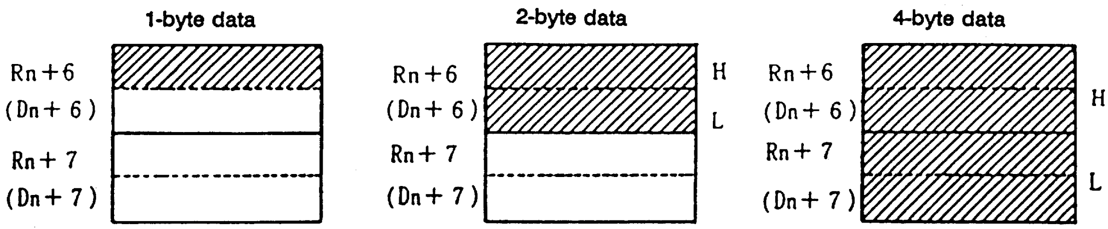
(5) Read/write specifications axis (Rn+5), (Dn+5)
Specify the axis to read or write data for each axis classified by major classification numbers.



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, stroke stored 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

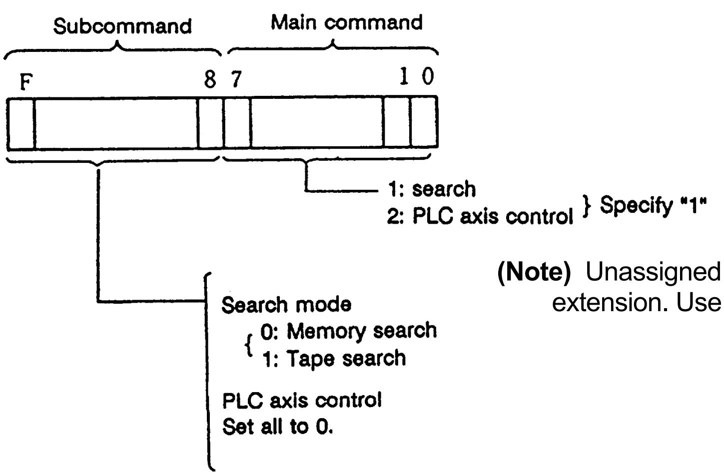
PLC sets data except the status.

Rn + 0	Two bytes	Command
1	Two bytes	Status
2		Program No.
3	Four bytes	
4		Sequence No.
5	Four bytes	
6		Block No.
7	Four bytes	
8	Two bytes	System specification

(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 used for 2-system specifications.

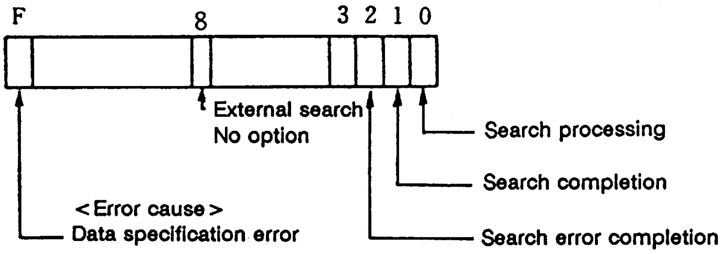
(1) Command



(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.

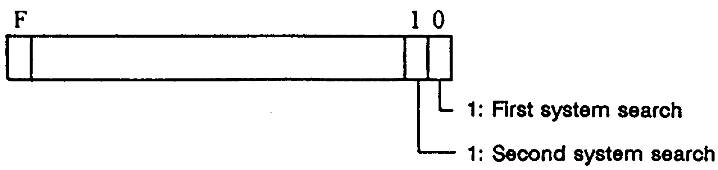
(5) Block number

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)

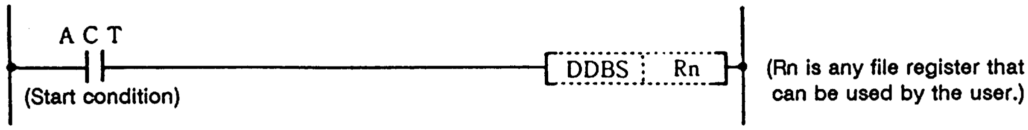
(6) System specification

Specify the system to be searched. If no system specification is made, only the first system is searched.



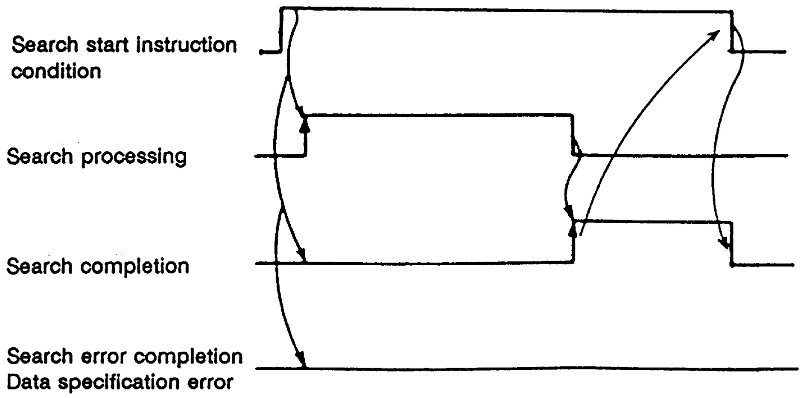
9.5.3 Search Start Instruction

After interface data between the controller and PLC is prepared, search is started by using the following instruction:

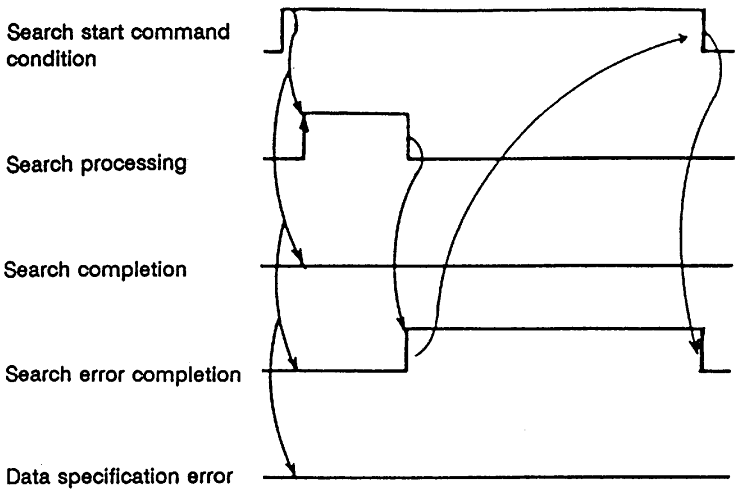


9.5.4 Timing Charts and Error Causes

(1) Normal completion



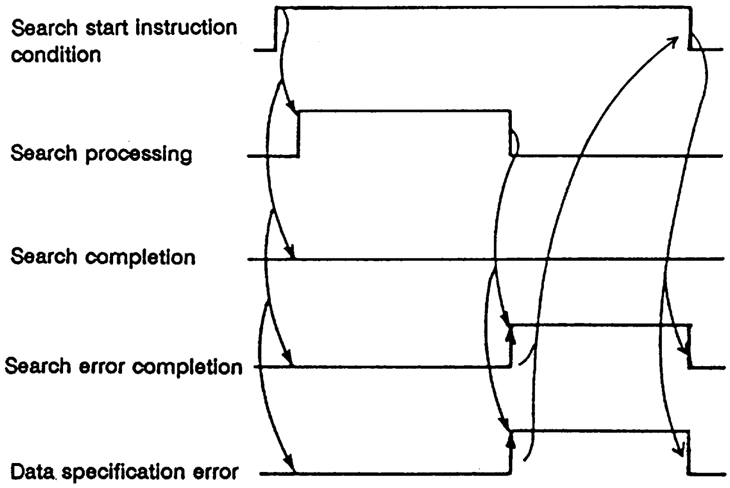
(2) Search error completion



<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.

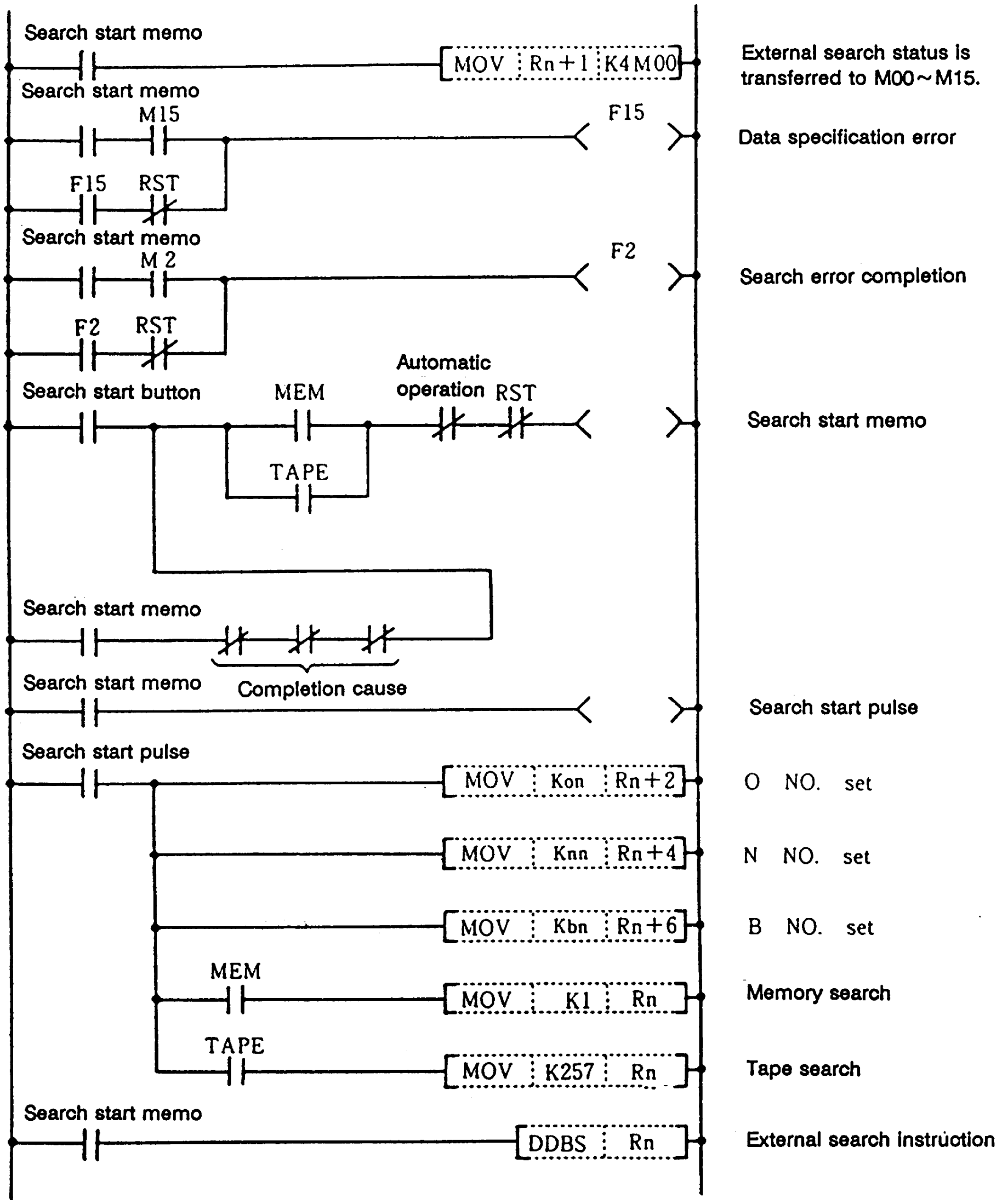
(3) Search error completion (Data specification error)



< 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.)

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

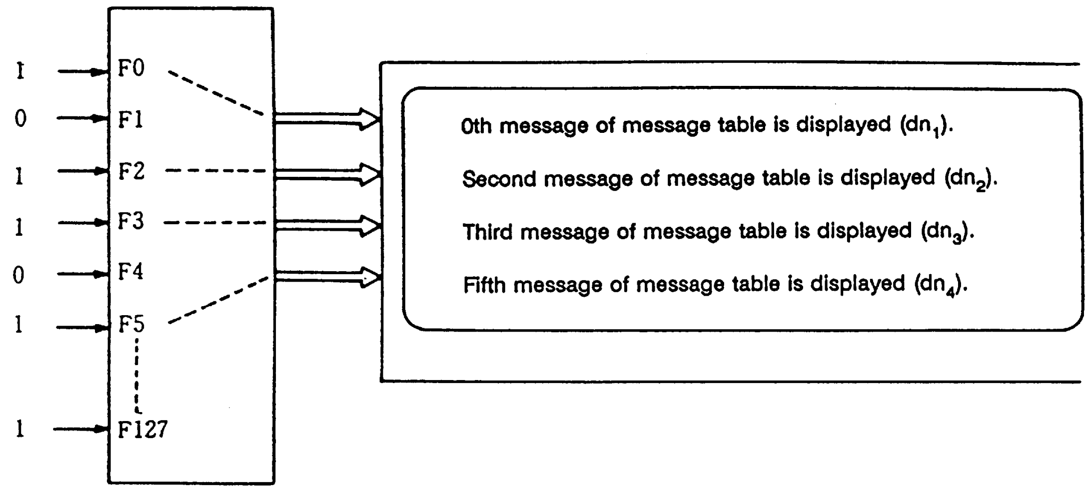
The contents of an alarm that occurred during sequence (user PLC) processing can be displayed on the CRT setting and display unit.
Up to four alarm messages can be displayed at a time on the alarm diagnosis screen. The maximum length of a message is 32 characters.

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

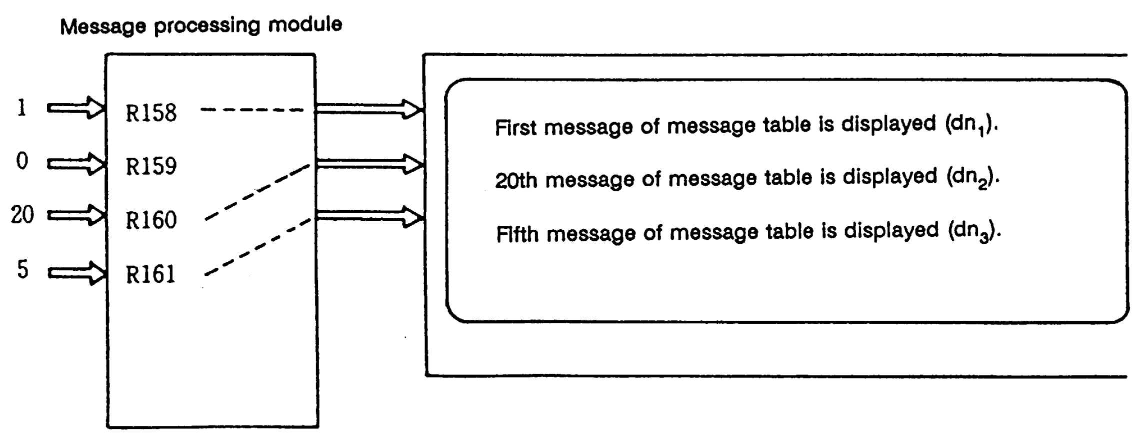
This interface applies to 128 points of temporary memory F0~F127.
If temporary memory F is used as the alarm interface, do not use it for another purpose.



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.

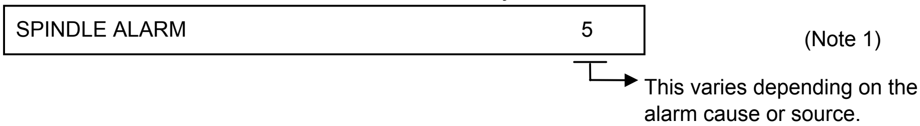


The messages are displayed starting at the message corresponding to R158 from top to bottom.
Since message display is cleared by setting the R register to 0, number 0 in the table message cannot be used in the R mode.
If greater value than the number of prepared messages, m is set in the R register, the message "USER PC ERROR m" is displayed.

(3) Alarm classification display

Classification number 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 number can be used to indicate the alarm source or cause.

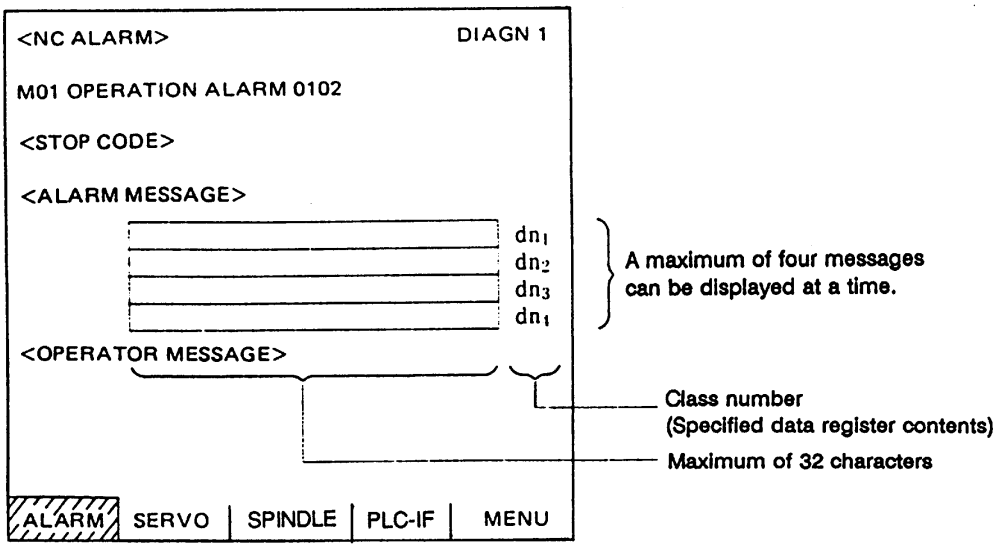
Example) When spindle alarm occurs, the message "SPINDLE ALARM" is displayed and the alarm source or cause is indicated by the classification number.



For the classification number, 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 number 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 numbers are displayed.

Display example of 9-inch CRT setting and display unit



10.1.2 Message Creation

Create messages by using PLC development software.

Set the length of a 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 (even numbers).
A maximum of 256 alarm messages can be prepared. However, the number of alarm messages may be limited depending on the available memory capacity. For details, refer to the PLC Development Manual (Personal Computer Section).

10.1.3 F or R Type Selection Parameter

Set the parameter on the machine manufacturer parameter bit selection screen.

```
                      7   6   5   4   3   2   1   0
# (6450)   Data   ( 0   0   0   0   0   0   *   1 )
```

- # (6450): Use number 6450.
- Bit 1 (*): 0: F mode / 1: R mode
- Bit 0 (1): Alarm message valid.

(Reference) #6450 corresponds to the high-order byte of file register R2924.

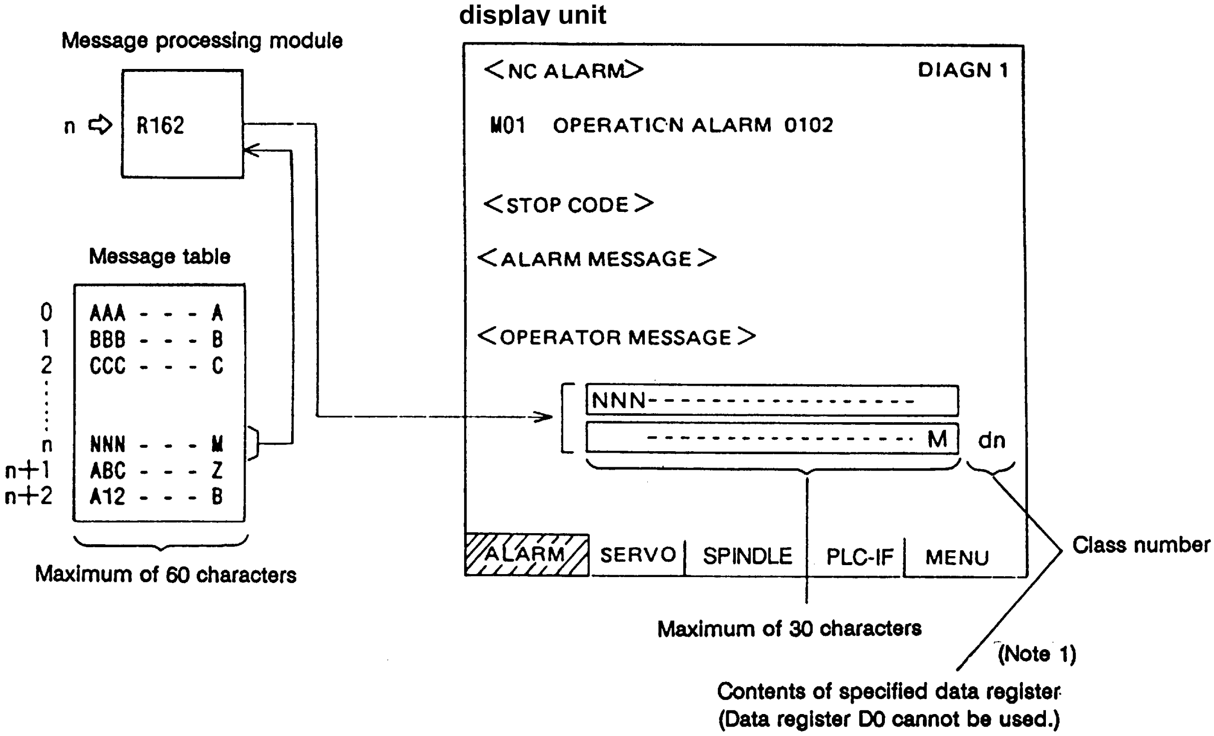
10.2 Operator Message Display

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 of 9-inch CRT setting and display unit



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.

On M-FAS, set the length of a message and the number of messages to be prepared, then prepare message data.
The maximum length of an operator message is 60 characters (even numbers). A maximum of 256 operator messages can be prepared. However, the number of operator messages may be limited depending on the available memory capacity. For details, refer to the PLC Development Manual (Personal Computer Section).

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
# (6450)	Data	(0	0	0	0	0	1	0	0)

Use number 6450.

Operator message display valid.

(Reference) #6450 corresponds to the high-order byte of file register R2924.

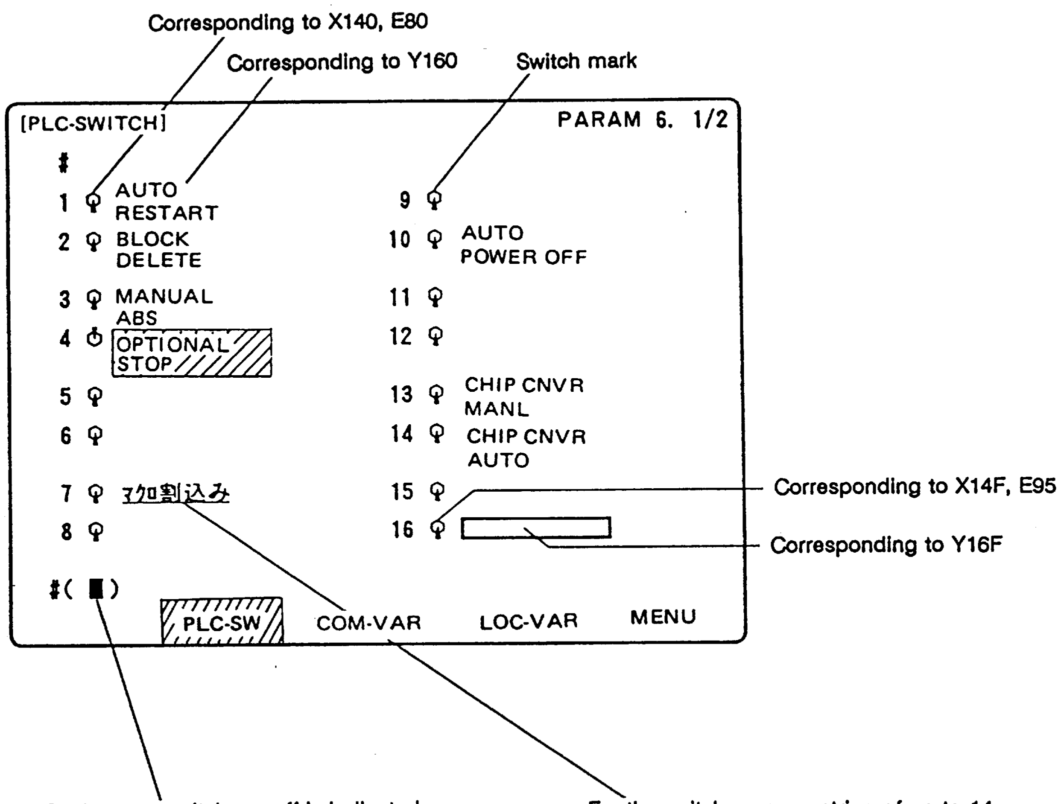
10.3 PLC Switches

Similar function to machine operation switches can be provided by using the controller CRT setting and display unit. The number of switch points is 32. The switch names can be given as desired.

10.3.1 Explanation of CRT Screen

The CRT screen is explained below.

PARAMETER SCREEN PLC SWITCH (MENU)



Setting part switch on, off is indicated.
For example, when 1 is set and [INPUT CALC] 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 E80 to E111 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: (on symbol)
Switch off state display : (off symbol)

10.3.2 Explanation of Operation

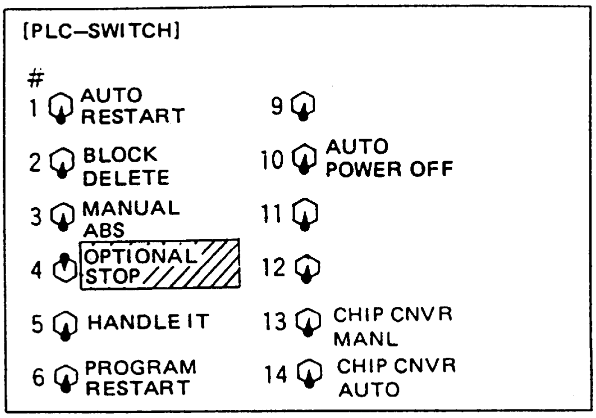
To turn on or off a switch, set the number of the switch to be turned on or off in the parentheses of setting part # (   ) and press the [INPUT CALC] key.

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.

When the optional stop is to be turned on:

Set 4 in # ( ).

Press the [INPUT CALC] key.



The switch can be turned off (on) the same way.

Special relay E can reverse the switch on/off states. When special relay E 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 E is listed below:

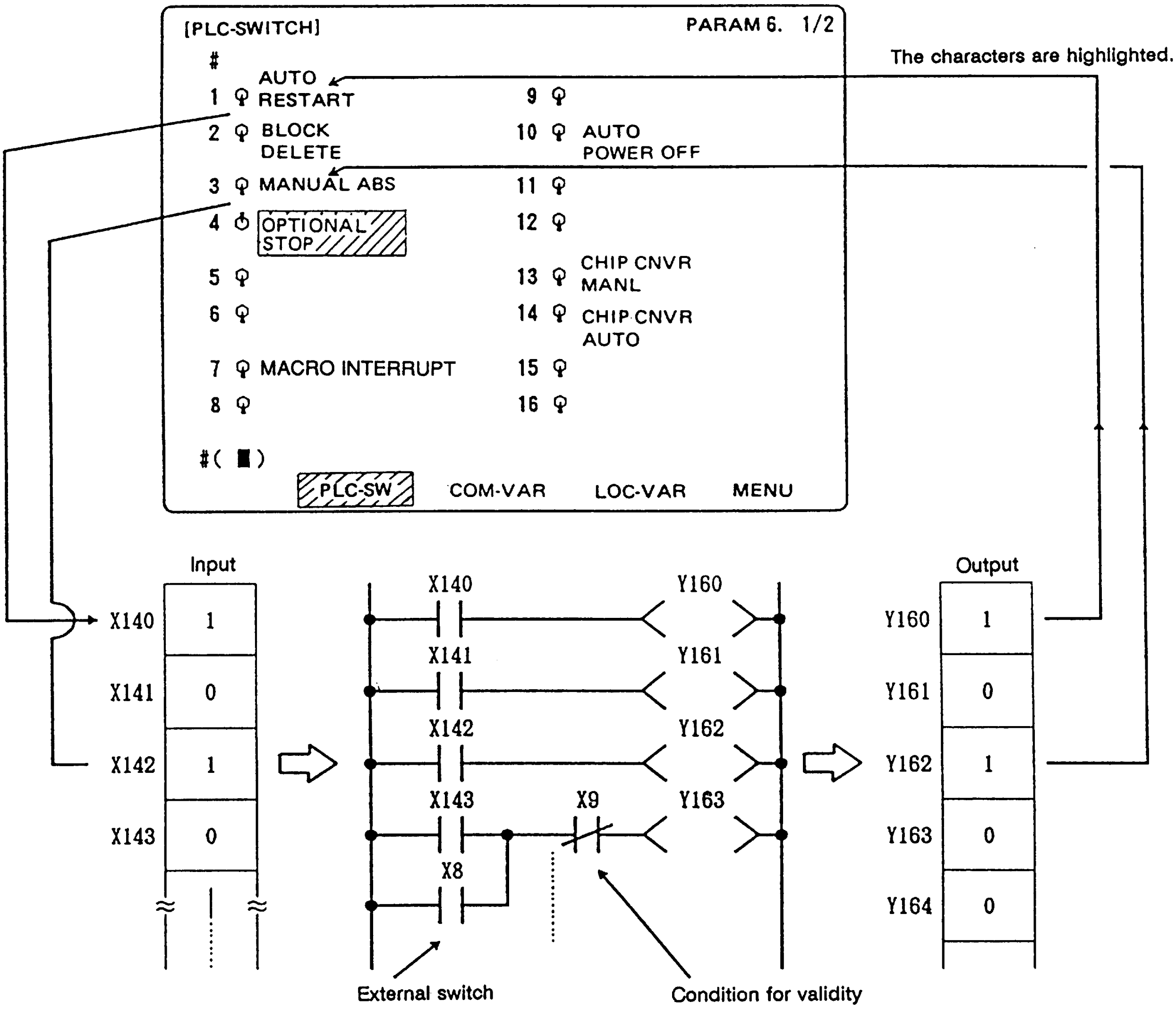
Switch No.	Corresponding device			Switch No.	Corresponding device		
	X	Y	E		E	Y	E
#1	X140	Y160	E80	#17	X150	Y170	E96
#2	X141	Y161	E81	#18	X151	Y171	E97
#3	X142	Y162	E82	#19	X152	Y172	E98
#4	X143	Y163	E83	#20	X153	Y173	E99
#5	X144	Y164	E84	#21	X154	Y174	E100
#6	X145	Y165	E85	#22	X155	Y175	E101
#7	X146	Y166	E86	#23	X156	Y176	E102
#8	X147	Y167	E87	#24	X157	Y177	E103
#9	X148	Y168	E88	#25	X158	Y178	E104
#10	X149	Y169	E89	#26	X159	Y179	E105
#11	X14A	Y16A	E90	#27	X15A	Y17A	E106
#12	X14B	Y16B	E91	#28	X15B	Y17B	E107
#13	X14C	Y16C	E92	#29	X15C	Y17C	E108
#14	X14D	Y16D	E93	#30	X15D	Y17D	E109
#15	X14E	Y16E	E94	#31	X15E	Y17E	E110
#16	X14F	Y16F	E95	#32	X15F	Y17F	E111

(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

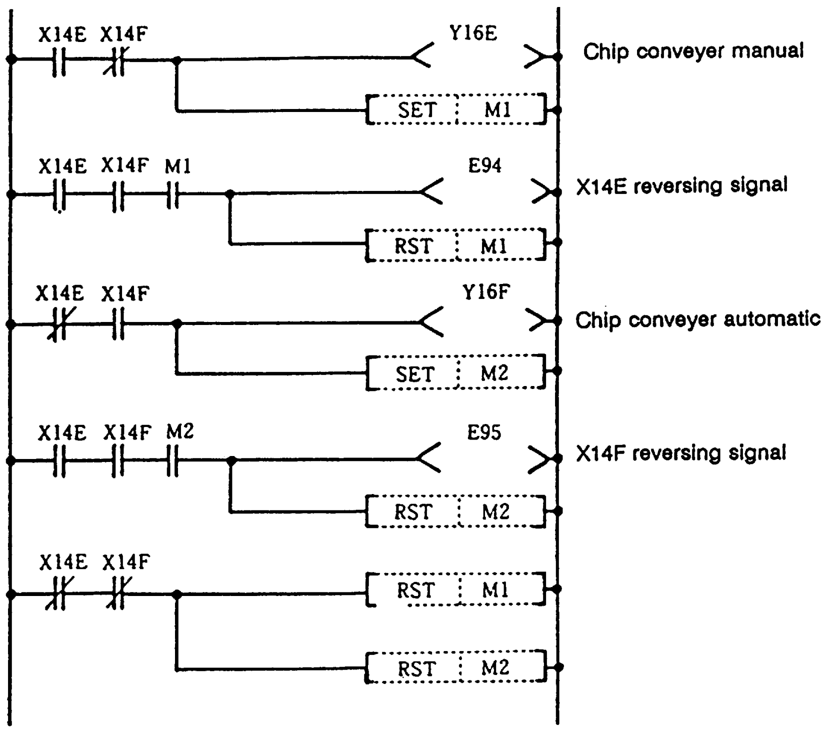


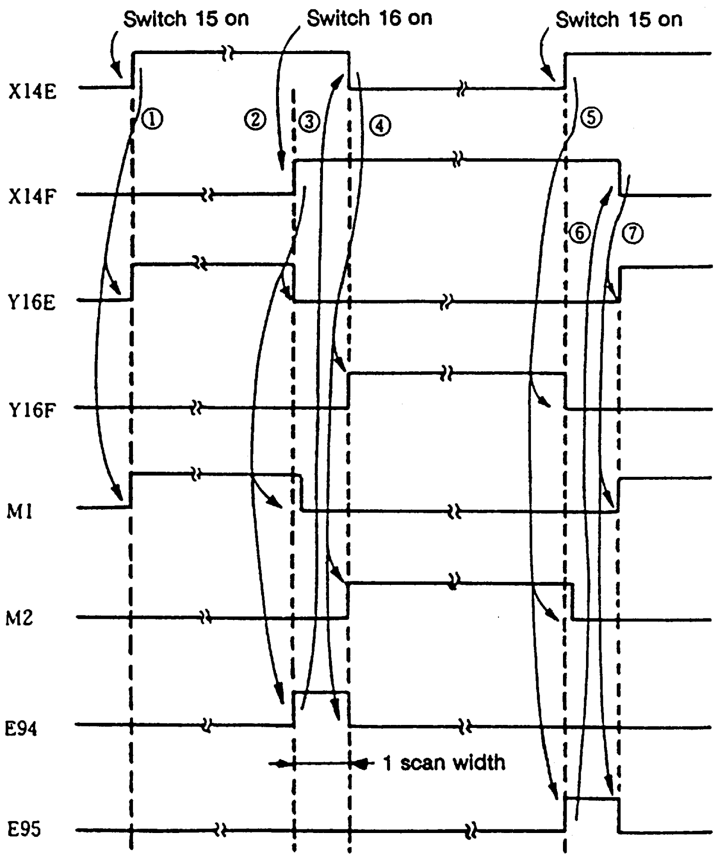
- When setting is done on the PLC switch screen, the input device X corresponding to the specified switch number is turned on or off to switch over the switch state.
- When special relay E is turned on from the user PLC, its corresponding input device X and the switch state are reversed. Special relay E 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 E from the user PLC.

(1) Two-point switch

(Example) When two opposite switches, chip conveyer manual and chip conveyer automatic, are provided;





1) When switch 15 (X14E) is on and switch 16 (X14F) is off, Y16E and M1 turn on. [Initial state]

2) When switch 16 (X14F) turns on while being in state 1), Y16E turns off, E94 turns on, and M1 turns off.

3) Turning E94 on reverses X14E (to off).

4) When X14E is off and X14F is on, E94 turns off and Y16F and M2 turn on.

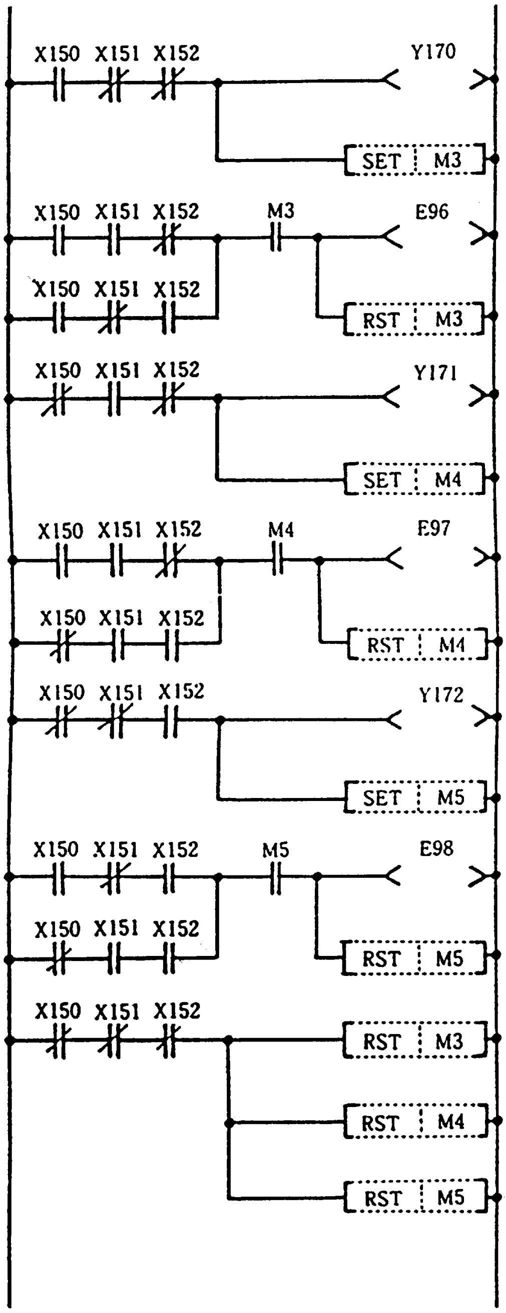
5) When switch 15 (X14E) turns on while being in state 4), Y16F turns off, E95 turns on, and M2 turns off.

6) Turning E95 on reverses X14F (to off).

7) When X14F is off and X14E is on, E95 turns off and Y16E and M1 turn on again.

(2) Three-point switch

(Example) When three opposite switches 17, 18, and 19 are provided;



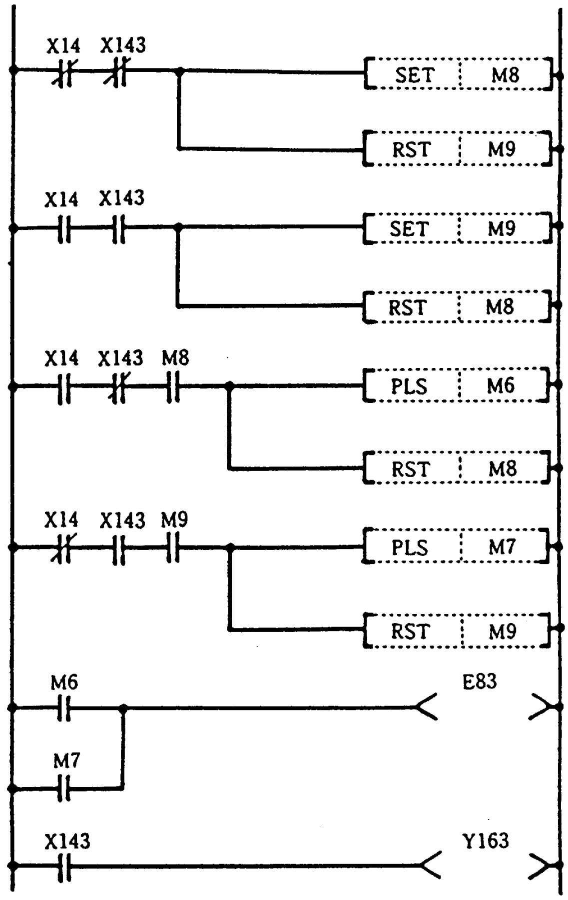
When E96 turns on, X150 turns off.

When E97 turns on, X151 turns off.

When E98 turns on, X152 turns off.

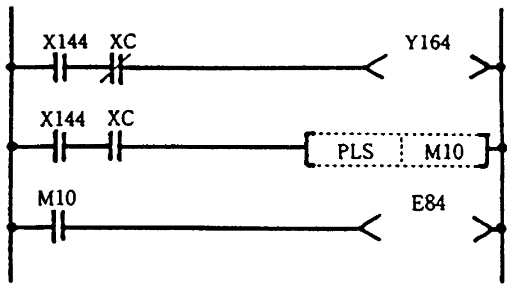
(3) External switch and PLC switch

(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.

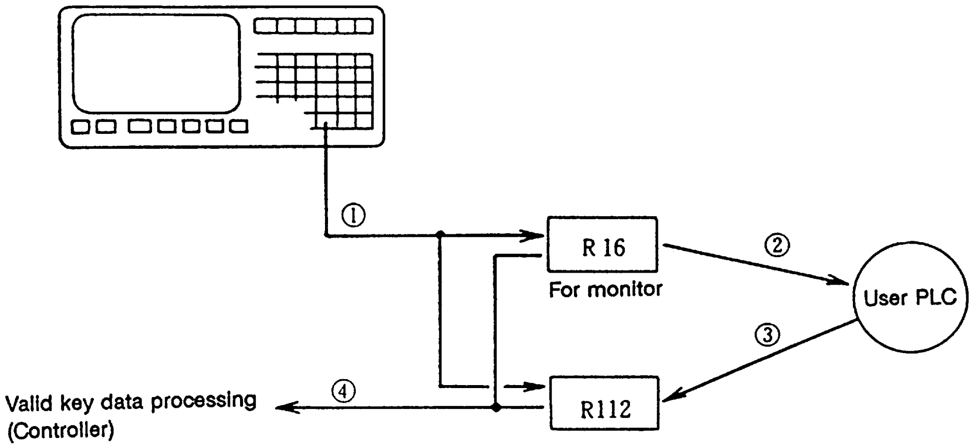
Alphanumeric, kana, katakana, and Kanji characters can be used for the switch name. For details, refer to the PLC Development Manual (Personal Computer Section).

10.4 Key Operation by User PLC

(This cannot be used with the MELDASMAGIC 64 Series.)

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



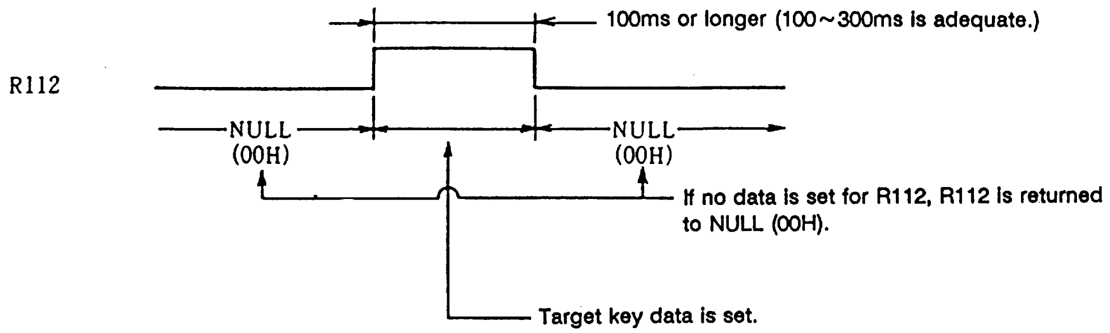
1) Key data is set in file registers R16 and R112 at the top of the user PLC main.
2) The user PLC refers to the key data and performs necessary processing.
3) The user PLC sets the key data matching the operation board being used in R112.
4) After user PLC main processing is performed, controller performs valid key data processing according to the R16 and R112 contents.

10.4.2 Key Operations That Can Be Performed

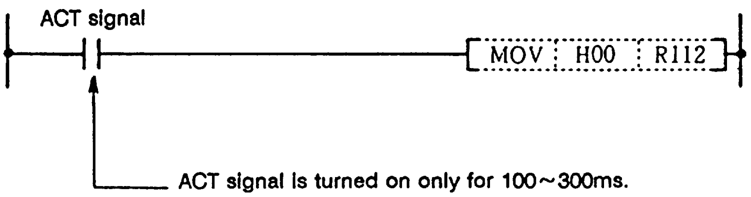
1) When a key is pressed, it is ignored.
   · The R16 contents are judged and NULL (00H) code is set in R112.
2) When R16 is NULL, that is, key operation is not performed, user PLC performs key operation conforming to the operator.
   · Key data matching the target operation is set in R112.

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.



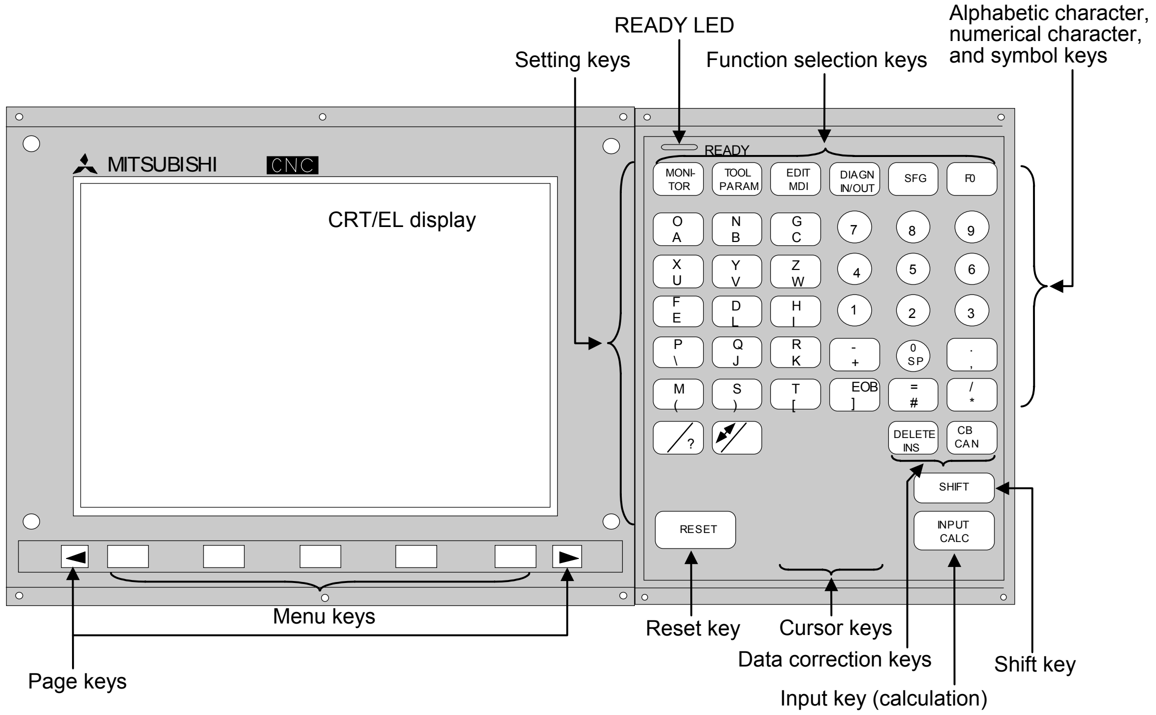
Example)



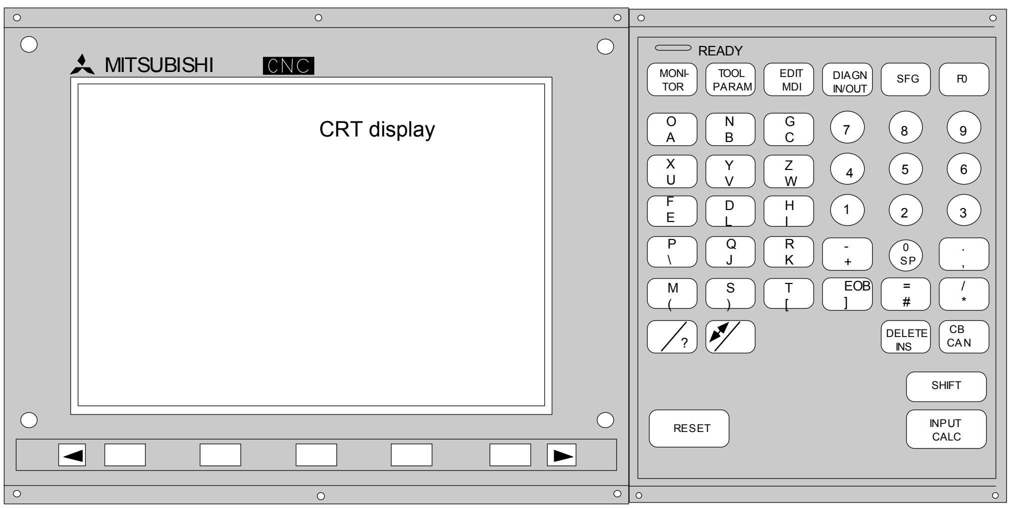
10.4.4 Layout of Keys on Communication Terminal

There are two types of layouts for the keys on the communication terminal used with this controller as shown below.
The layouts of the alphabetic keys differ.

(1) Key layout for communication terminal CT100
(This also applies to the separated type FCUA-CR10+KB10)



(2) Key layout for communication terminal CT120



(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

(1) For communication terminal CT100, KB10 (M series)

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

(2) For communication terminal CT120 (L series)

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(59)
SFG	86	DELETE (INS)	7F(8C)	/ (*)	2F(2A)	Z (H)	5A(48)
F0	87	C.B.(CAN)	8E(18)			F (E)	46(45)
		SHIFT	88	0 (SP)	30(20)	U (V)	55(56)
		INPUT(CALC)	0D(F4)	1	31	W (P)	57(50)
				2	32	M (Q)	4D(51)
				3	33	I (J)	49 (4A)
Previous page	90	Window key (?HELP)	89(F9)	4	34	K (L)	4B(4C)
Next page	9A	Activ Wind (CTRL)	8A(8B)	5	35	S (!)	53(21)
Menu 1	91			6	36	R (( )	52(28)
Menu 2	92			7	37	D ( ))	44(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

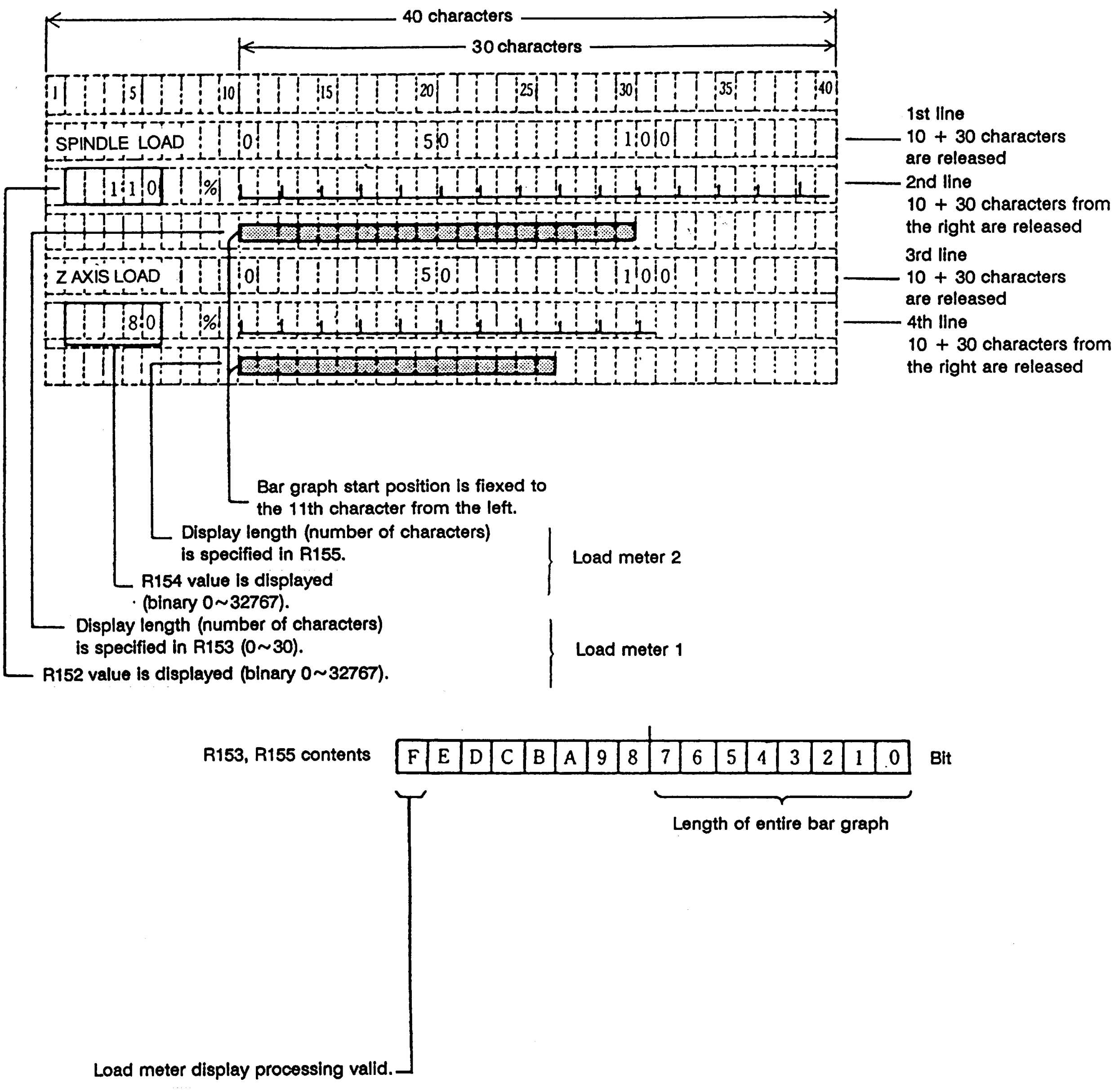
Example 2)

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 message function.

10.5.1 Interface

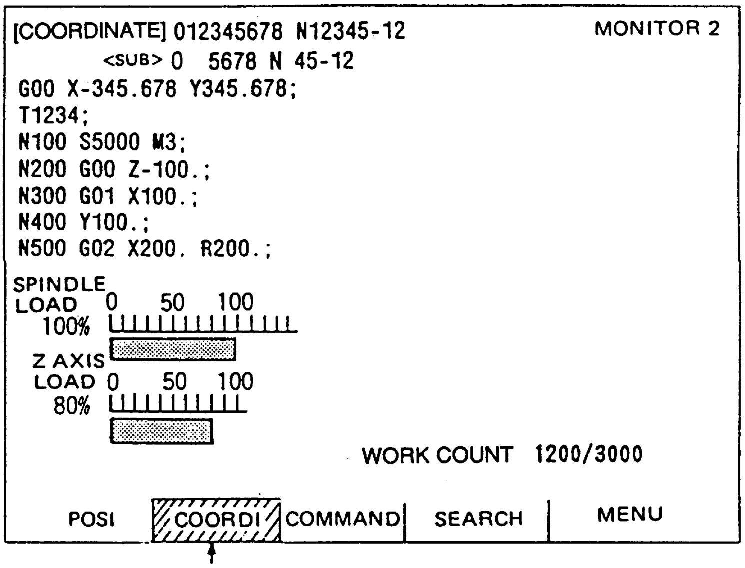


○ File register (R) for load meter display

		For $1	For $2
Load meter 1	Numerical display	R152	R352
	Bar graph display	R153	R353
Load meter 2	Numerical display	R154	R354
	Bar graph display	R155	R355

(Note 1) Use $1 for models not having a system.

Display example of 9-inch CRT setting and display unit
(**Note:** This screen consists of 80 characters wide x 18 lines long.)



Display on coordinate screen of position display second menu.

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	File register	Contents
R560	$1 Compensation data for the first axis	R568	$2 Compensation data for the first axis
R561	$1 Compensation data for the second axis	R569	$2 Compensation data for the second axis
R562	$1 Compensation data for the third axis	R570	—
R563	$1 Compensation data for the fourth axis	R571	—
R564	—	R572	—
R565	—	R573	—
R566	—	R574	—
R567	—	R575	—

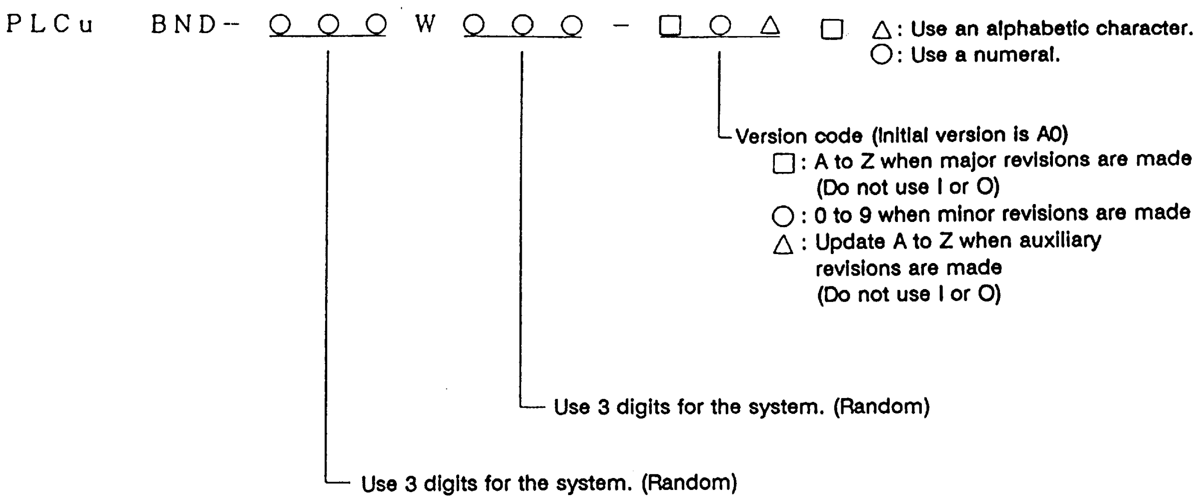
(Note 1) Use $1 for models not having a system.

Data in file registers R560~R575 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 (communication terminal).

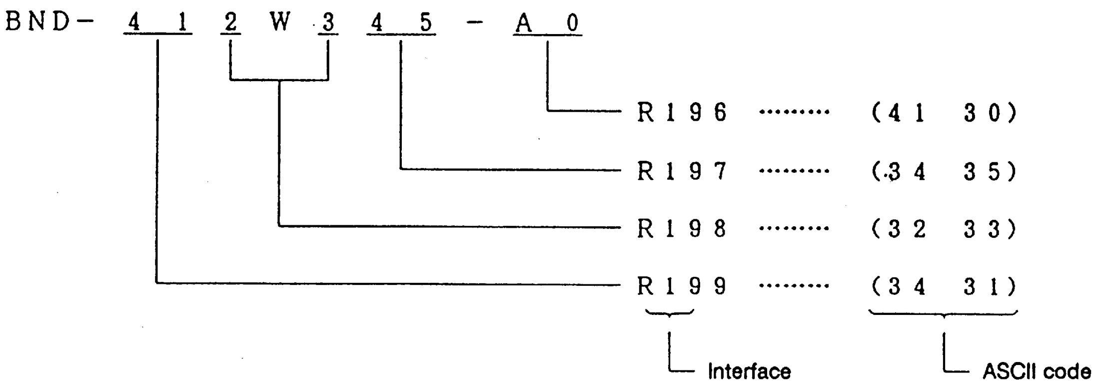


(Note) The user PLC must be controlled by the user.

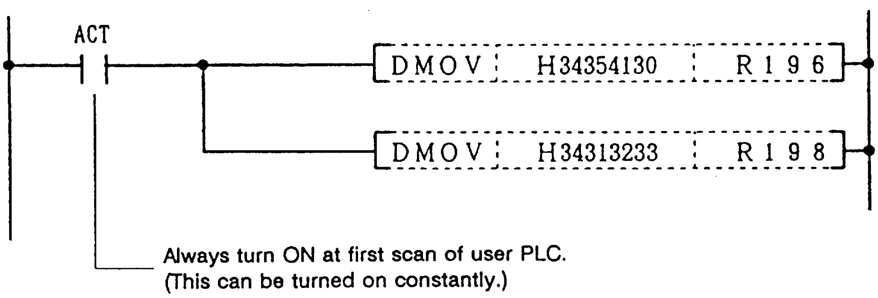
10.7.1 Interface

Data corresponding to the characters to be displayed on the corresponding file register (R) is set.

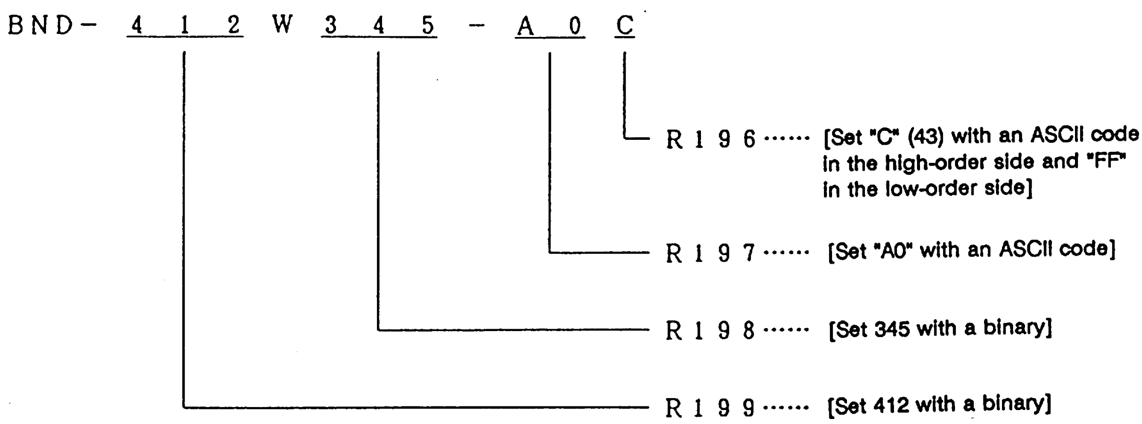
(1) To display a 2-digit version code



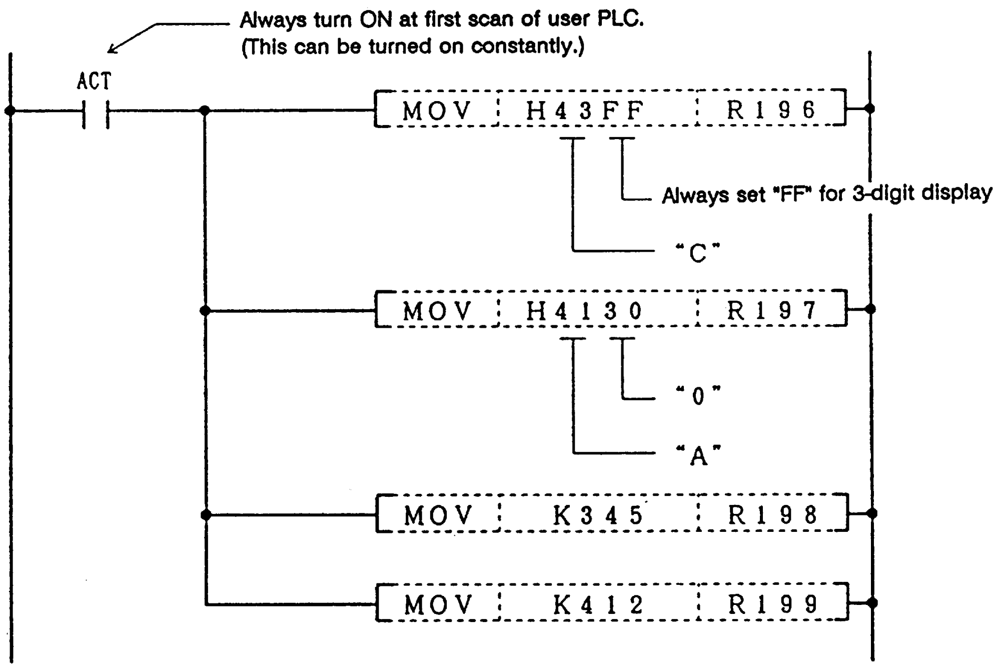
Program example)



(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 24000 inch/min.) Cutting feed 0 to 240000 mm/min. (0 to 24000 inch/min.) (Min. command unit 0.0001mm) Rapid traverse 0 to 24000 mm/min. (0 to 2400 inch/min.) Cutting feed 0 to 24000 mm/min. (0 to 2400 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 } Linear acceleration/linear deceleration Jog feed (+), (-) Reference point return feed (+), (-) Handle feed
Acceleration/ deceleration	Rapid traverse, Jog feed Reference point return feed 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)

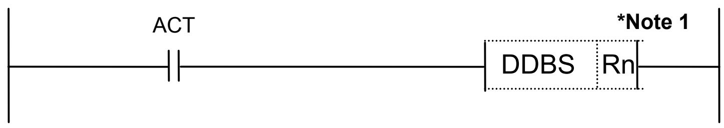
11.2.2 Other Restrictions

(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 DDBS Function Command

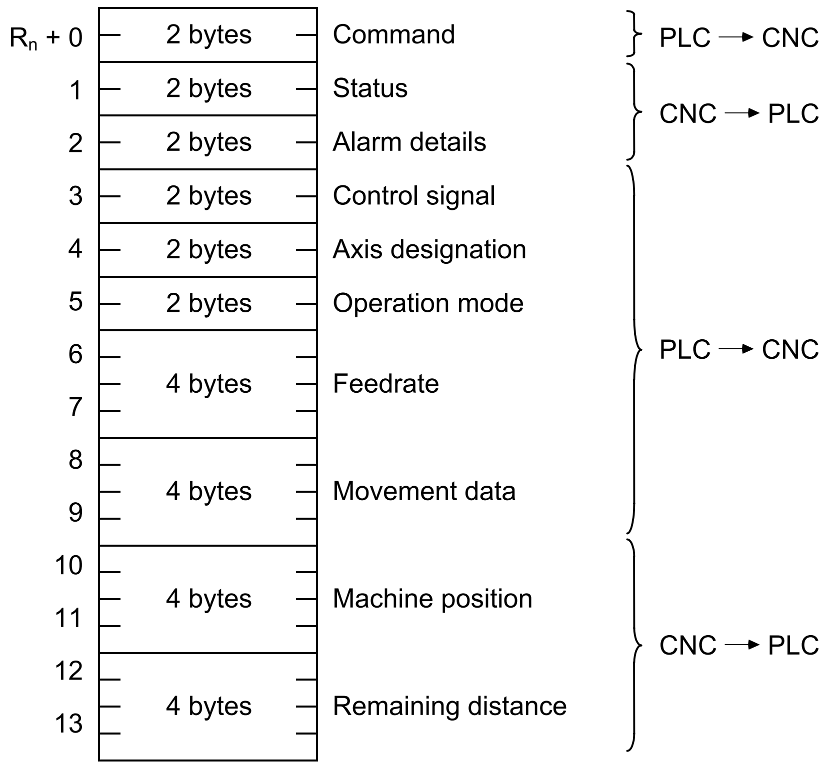


When ACT is set to 1, the PLC axis control process is carried out with the control information data contents. Thus, ACT should be set to 1 during PLC axis control.
Setting ACT to 0 causes a reset status.

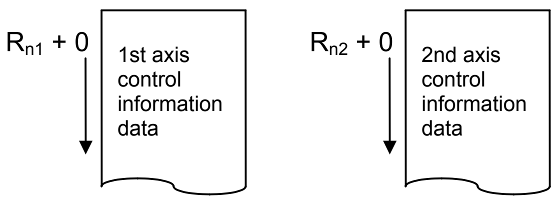
(Note 1) The following R-registers can be used.
R500 to R549 (No battery backup)
R1900 to R2799 (Battery backup)

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: WAIT	Axis movement wait	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.

bit7: WAIT   Axis movement wait

This bit turns ON in the buffering mode when the axis movement of the previous block has been completed, and the machine is in a WAIT 5 status. It turns OFF when the previous block movement is completed and the movement of the next block begins.

bit 8: oper   Option error

This bit turns ON when an attempt is made to execute PLC axis control when there is no PLC axis control option.

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 outputting a reset signal, 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 CRT 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

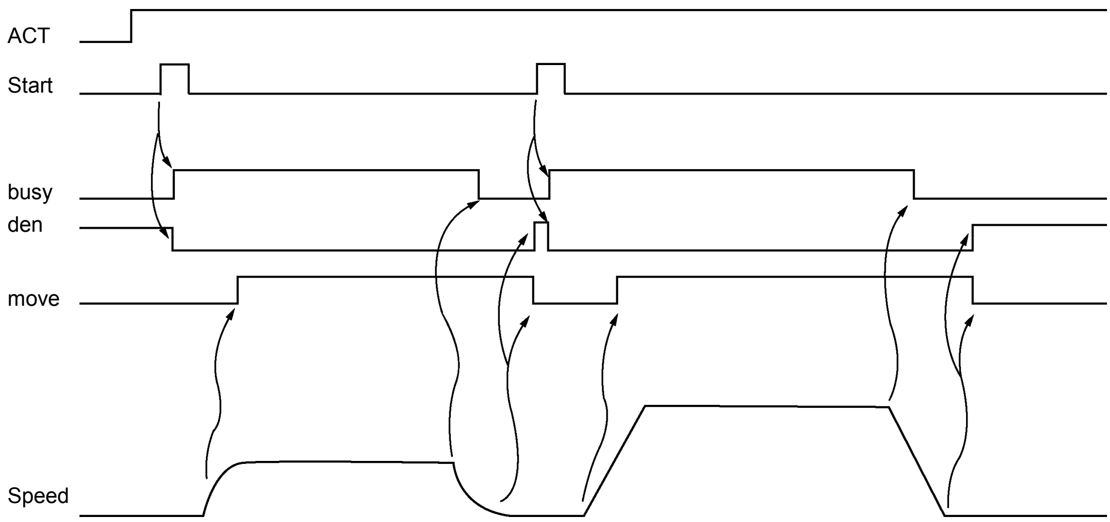
```
S03  Servo alarm   52    1
                         └ PLC axis
```

bit F: ALM:1   Control information data designation alarm

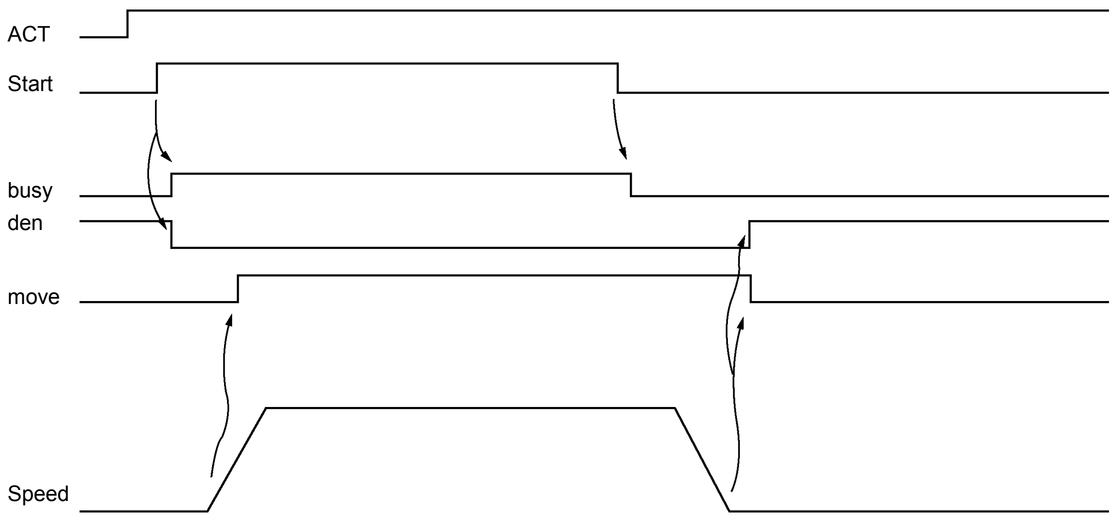
This bit turns ON when the designated details of the control information data are illegal. Thus, the PLC axis control process is not executed. Turn the bit OFF by correcting the data, outputting a reset signal, or setting ACT to 0.

Timing chart

(1) For rapid traverse and cutting feed mode



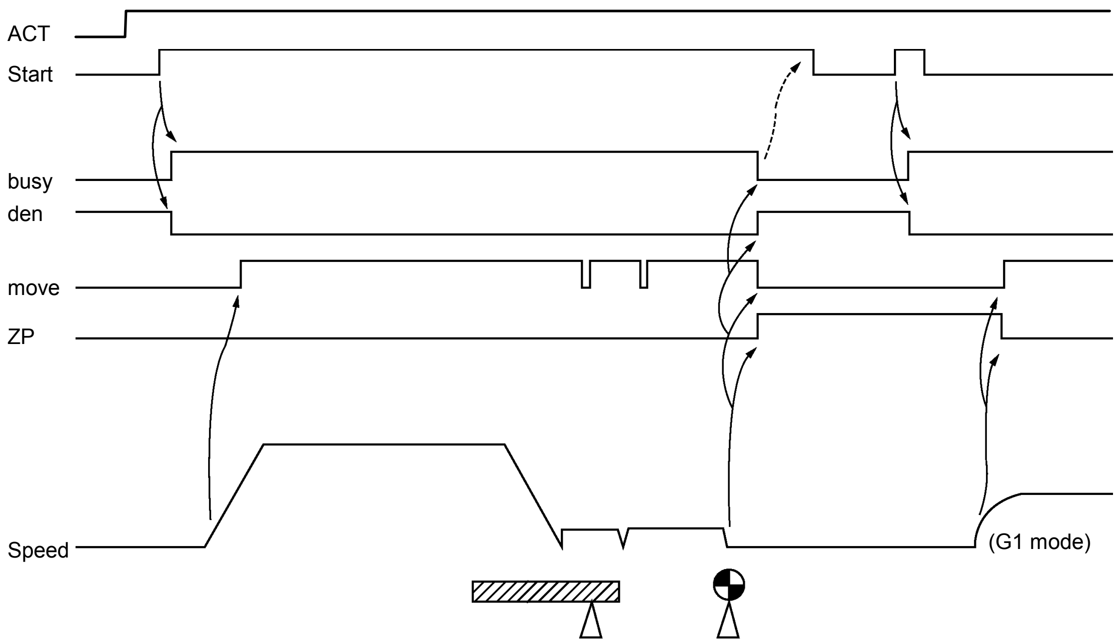
(2) For jog feed mode



(Note) The axis moves by jog feed only during start ON.

(3) For reference point return feed mode

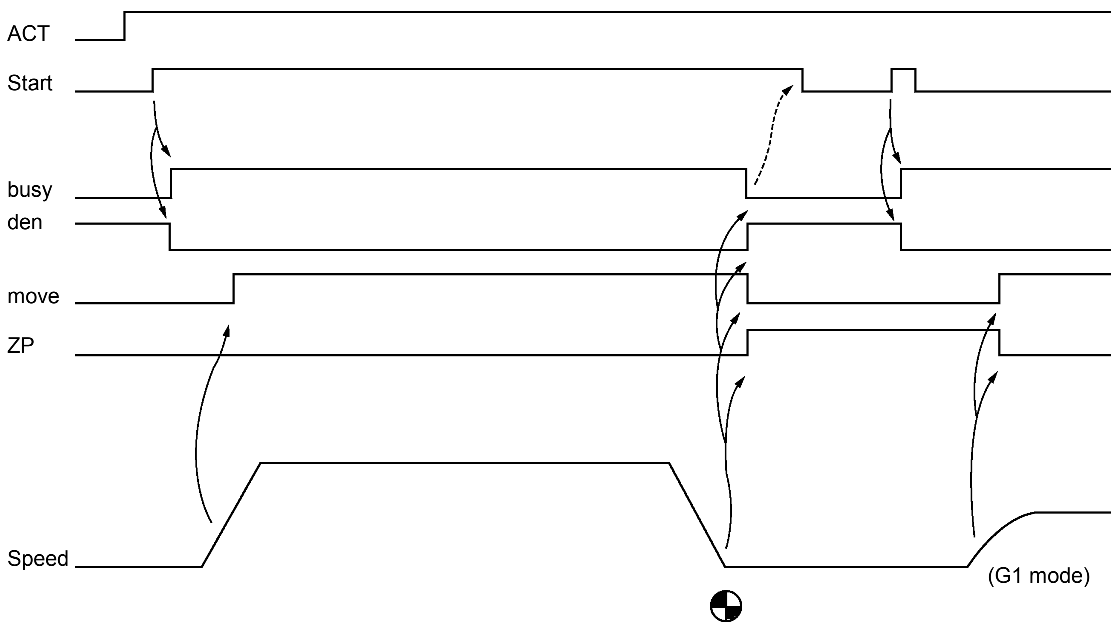
(3-1) Dog-type reference point return



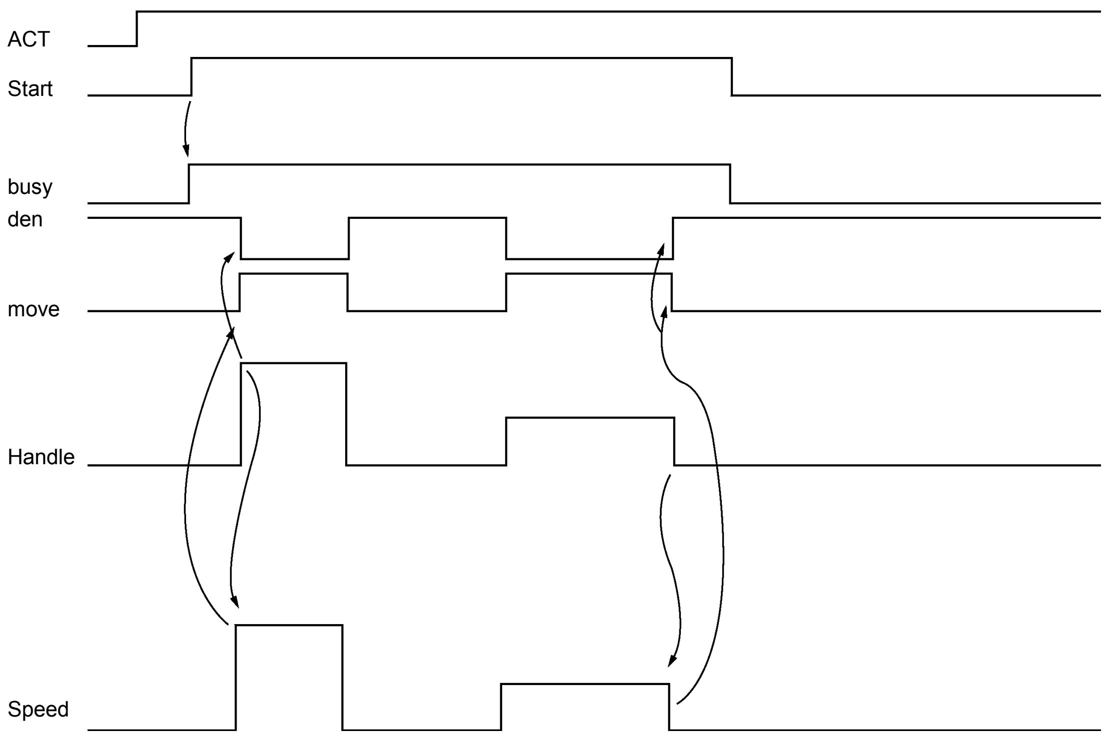
(Note 1) The axis moves by reference point return feed only during start ON. Turn the start OFF after confirming that the reference point has been reached.

(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

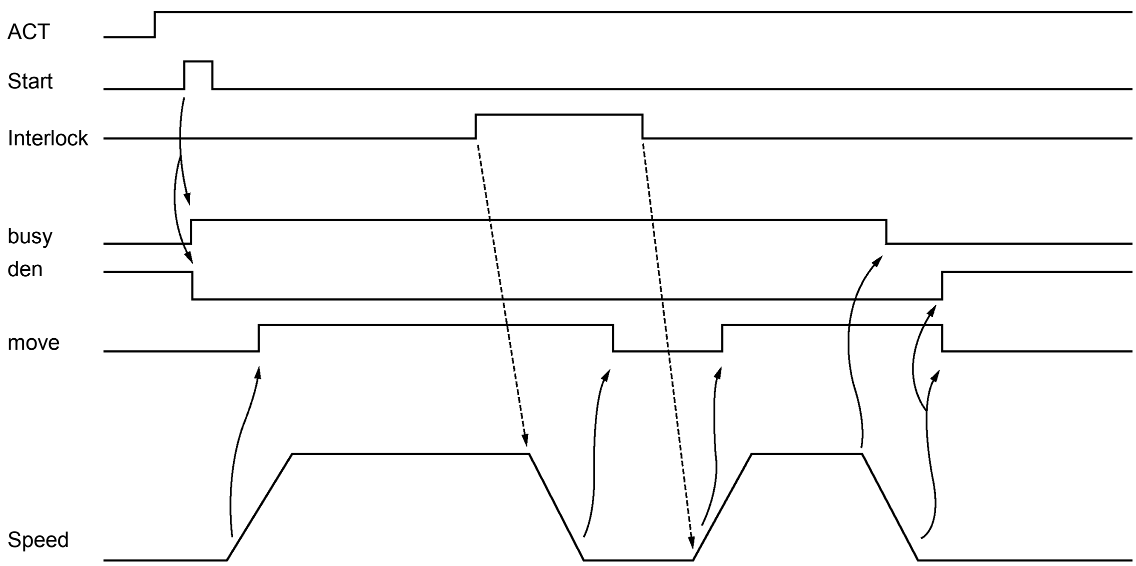


(4) For handle feed mode

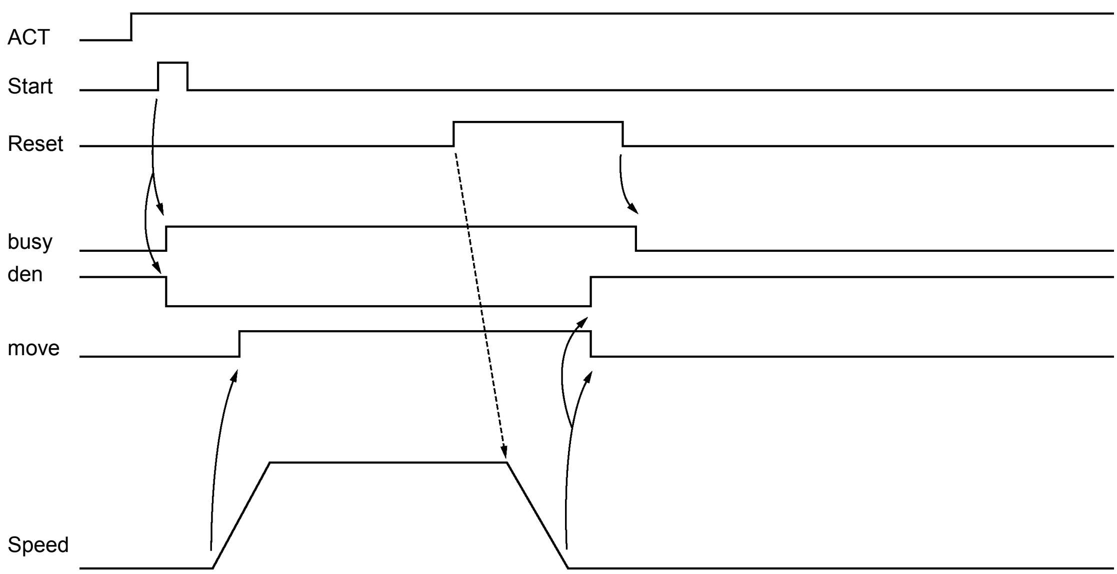


(Note) Handle feed is possible only during start ON.

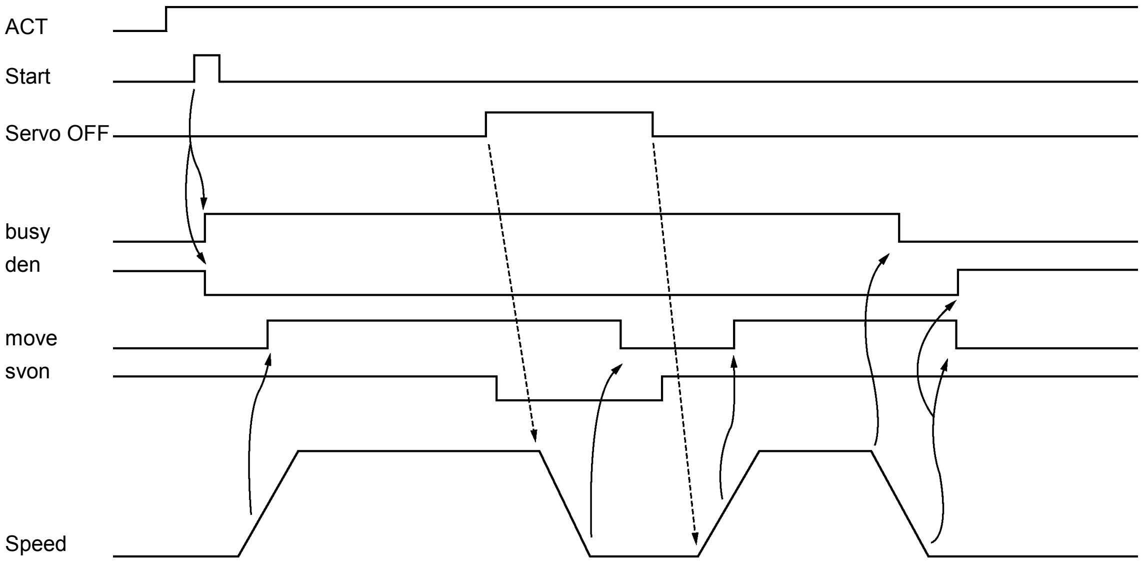
(5) When the interlock signal is ON (= 1)



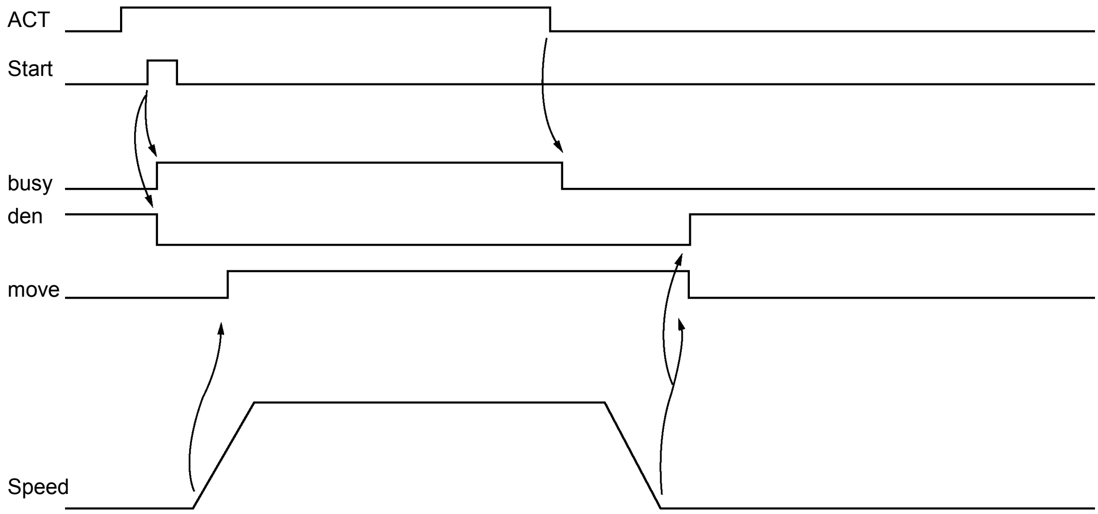
(6) When the reset signal is ON (= 1)



(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
1: Interlock
2: Reset
3: Servo OFF
4: Axis removal
5: Axis removal 2
6:
7:

bit 8 : Absolute value command
9:
A:
B:
C:
D:
E:
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.

$R_n + 5$	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 240000 mm/min. (0.1 inch/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 11	Machine position (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 13	Remaining distance (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	Reference point return near point detection 1
Y2E1	*PCD2	PLC axis	Reference point return near point detection 2
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	HS1P	1st handle PLC axis valid
Y2E5	HS2P	2nd handle PLC axis valid
Y2E6		
Y2E7		

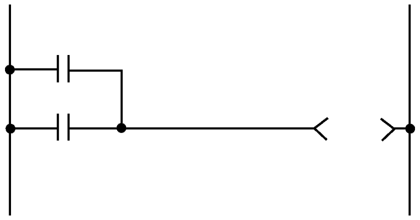
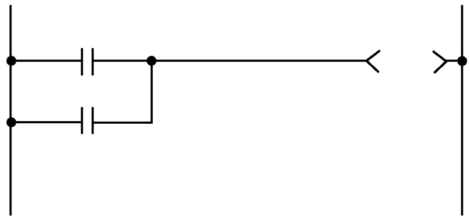
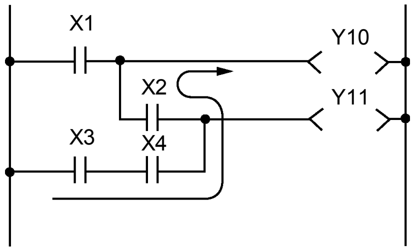
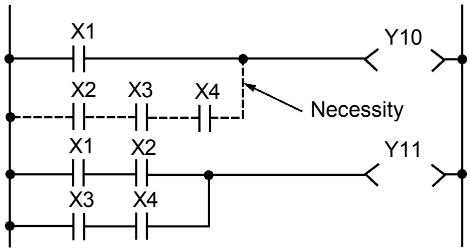
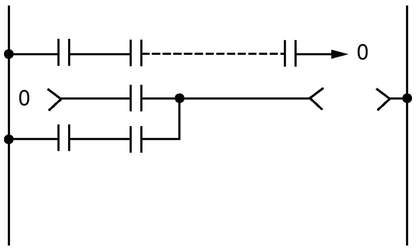
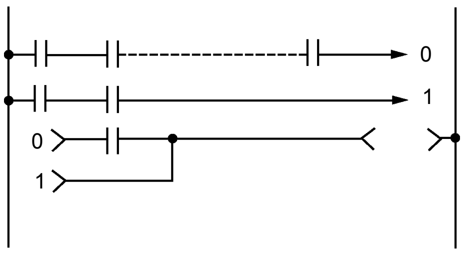
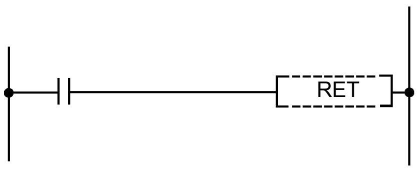
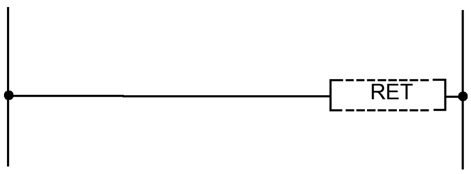
When Y2E4 and Y2E5 are ON, each handle is PLC axis dedicated and not valid for NC axes.
Y248 to Y24F and Y250 to Y257 are used for the axis selection of each handle.

(Note) 1. 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

Sub-No.	Date of revision	Revision details
*	February 1998	First edition created.

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