YASKAWA ELECTRIC

TOE-C843-9.1B

YASNAC® LX3/MX3 PC SYSTEM

INSTRUCTION MANUAL

Before initial operation read these instructions thoroughly, and retain for future reference.

The programmable controller system (called PC hereafter) for YASNAC LX3/MX3 is to execute the sequence control required by the machine tool efficiently.

This manual mainly consists of "PC programming method" (Sections 1 to 8) and "Sequence program editing unit and the operating method" (Section 9). Functions with asterisks are optional.

YASNAC LX3

YASNAC MX3

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1. OUTLINE

1. The programmable controller (called PC hereafter) for YASNAC LX3/MX3 stands between the standard YASNAC NC unit and the machine tool. It facilitates the compact and efficient utilization of the sequence control required by the machine tool through the software.
2. Sequence program editing of PC can be performed efficiently with CRT; NC and SD modes are easily changed and selected.
3. The PC is optional and it is installed in the NC unit, if selected.
4. In this manual, "PC programming method" (Selections 1 to 8) and "Sequence program editing unit and the operating method" (Section 9) have been explained so that the users to facilitate the use of the above described PC.

2. BLOCK DIAGRAM

The block diagram of the PC system for YASNAC LX3/MX3 is shown in Fig. 2.1.

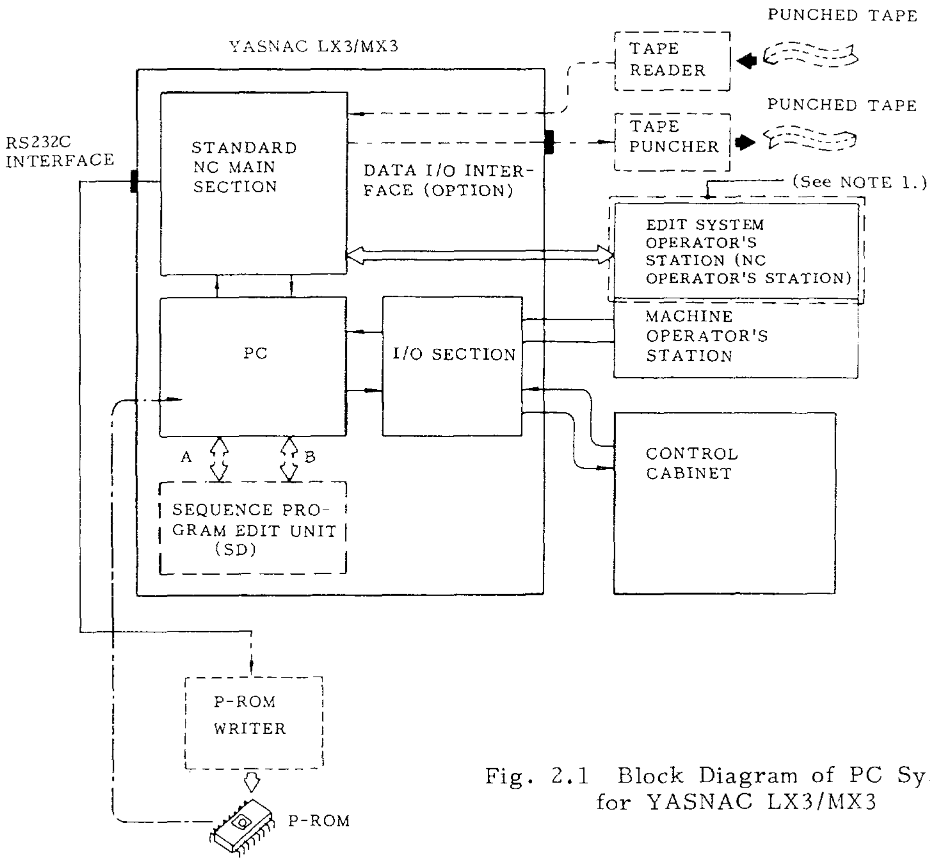


Fig. 2.1 Block Diagram of PC System for YASNAC LX3/MX3

- Solid line shows the YASNAC CNC unit provided with P.C.
- Broken line shows the sequence program edit system temporarily used by incorporating the sequence program edit system (SD20) in YASNAC.

Note:

1. When the control is used as sequence program edit system, the operator's panel with CRT display changes to the sequence program edit panel.
2. Sequence program edit system (SD20) can be mounted on the CPU rack.
3. P-ROM writer which is commercially available may be used. It is used to write the completed sequence edited and checked into P-ROM.
4. Tape reader is used to load List Tape in which sequence ladder is coded or P-ROM Format Tape consisting of machine language into sequence edit system.
5. Tape puncher punches out the completed sequence edited and checked in the form of List Tape or P-ROM Format Tape.

3. SPECIFICATIONS

3.1 FUNDAMENTAL SPECIFICATIONS

(1) Control method: Scanning method

(2) Processing time:
Approx. 2.7 μ sec/step
High speed scanning time - 8 msec
Low speed scanning time - 8 msec × n (n is determined by the capacity of the total program.)

(3) Program memory capacity:
Memory element: EPROM (256 bits/one)
Basic - 16K bytes
Option - 32K bytes or 64K bytes

(64K bytes corresponds to approximately 16000 steps in basic instruction.)

(4) Types of instruction language:
Basic instruction - 61 types
Macro instruction - 11 types

3.2 PROGRAM FUNCTIONS

(1) Internal relay: 4000 points

(2) Register: 500 (8 bits/one)

(3) Timer: 94 (5 types)

- 8 msec - 2.4 sec, 20 ea.
- 50 msec - 12.75 sec, 30 ea.
- 100 msec - 25.5 sec, 30 ea.
- 1 sec - 255 sec , 10 ea.
- 1 min - 255 min, 4 ea.

(4) Sequencer parameter: 100

(5) Keep relay: 7200

(6) Keep memory: 900 (8 bits/memory)

3.3 MACRO INSTRUCTIONS

Following 11 types of macro instructions can be used.

	Instruction word
(1) Rise signal detection:	SUBP 003
(2) Fall signal detection:	SUBP 004
(3) Counter:	SUBP 005

Functions--Ring counter or preset counter or up-down counter.

Counting range--0 - 9999

(4) Rotation	SUBP 006
(5) Code conversion	SUBP 007
(6) Pattern clear	SUBP 009
(7) Parity check	SUBP 011
(8) Data conversion:	SUBP 014
(9) Data search	SUBP 017
(10) Index data transfer	SUBP 018
(11) Message display	SUBP 023 -- Optional function

3.4 INPUT/OUTPUT SPECIFICATIONS

(1) CPU built-in I/O boards (IO boards)*

DC input: 112 points (Max.)

Noncontact output: 64 points (Max.)

* CPU built-in I/O boards cannot be mounted to MX3.

(2) Optional standard I/O boards

DC input: 112 points

Noncontact output: 64 points

Reed relay output: 4 points

(3) CRT panel built-in I/O boards (SP20 board)

DC input: 64 points

Noncontact output: 32 points

$m + k \leqq 4$

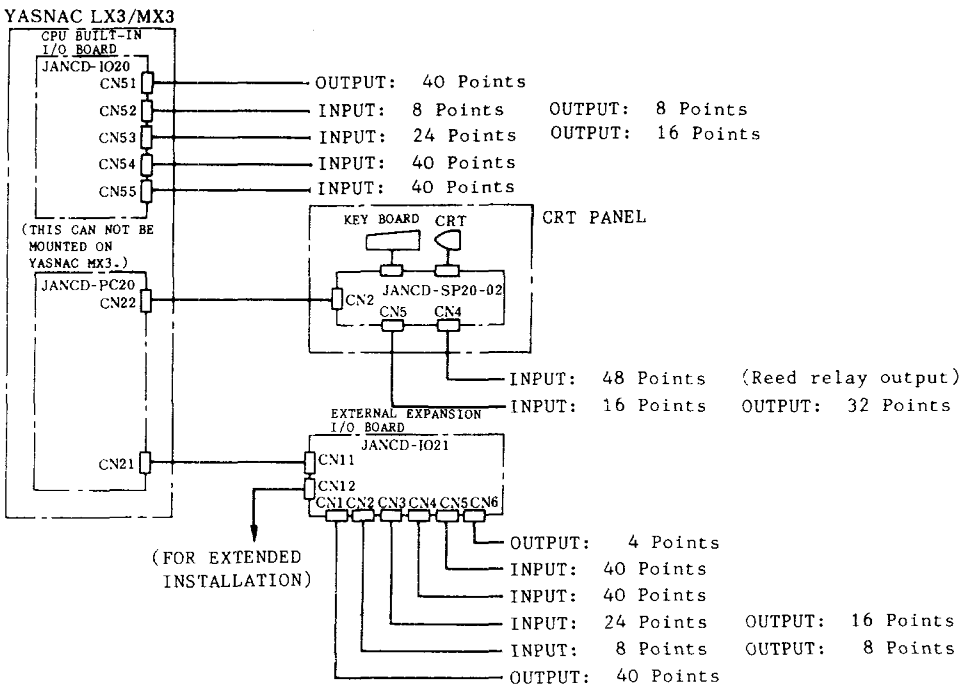
Note:
1. The detail of basic instructions are given in the following table.

Type of Instruction	No. of Instructions
1. Relay instruction	13
2. Register instruction	37
3. Timer instruction	2
4. Control instruction	9
Total	61

2. Internal relays and registers are the same. Addresses used as internal relays cannot be used as internal relays.
3. Keep relays and keep memories are the same. Addresses used as keep relays cannot be used as keep memories. Addresses used as keep memories cannot be used as keep relays.

(4) I/O board location

3 I/O boards are shown below.



(5) Maximum number of I/O boards

- CPU built-in I/O boards Max. number 1
  - input: 112 points (Max.)
  - output: 64 points (Max.) *2
- External expansion I/O boards Max. number 4 *1
  - input: 448 points
  - output: 272 points
- CRT panel built-in I/O boards Max. number 1
  - input: 62 points
  - output: 32 points

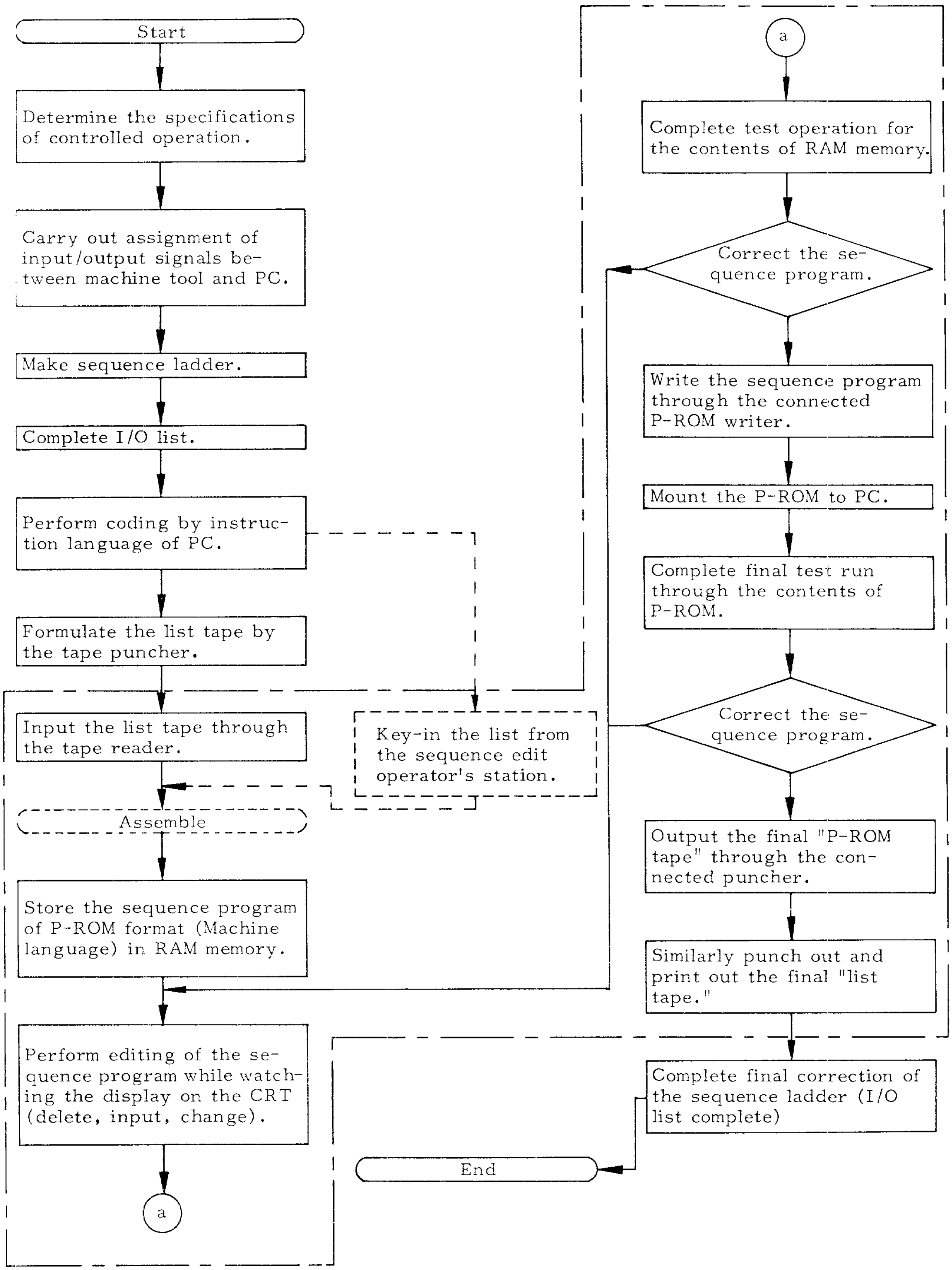
*1 When other I/O boards are additionally mounted, the max. number of external expansion I/O boards becomes as follows:

CPU built-in I/O boards	without	with	without	with
CRT panel built-in I/O boards	without	without	with	with
Max. external expansion I/O boards	Max.4	Max.3	Max.3	Max.2

*2 I/O points of CPU built-in I/O boards are as follows;

I/O 20 boards (JANCD-IO20-1)	input:	48 points
	output:	48 points
I/O 20 boards (JANCD-IO20-2)	input:	88 points
	output:	48 points
I/O 20 boards (JANCD-IO20-3)	input:	112 points
	output:	64 points

4. PROCEDURES FOR SEQUENCE PROGRAM PREPARATION



Note: The sections surrounded by [dashed box] require the "sequence program editing device (SD20)."

5. ADDRESS NUMBER AND ADDRESS MAP

5.1 ADDRESS NUMBER

In the preparation of the sequence program, the I/O signals of PC, internal relay, timer, battery backed-up memory, etc. of PC are all designated by address No. (4-digit number following mark #) and bit number (0 - 7 bit).

□□□□ □

Bit No. (0 - 7)

Address No.

(A) Name of 8 points of signal or

(B) Name of 1 byte (= 8 bits) of data

(1) Designation of I/O Signals, Internal Relays, etc. (1 Bit Element)

As shown below, the elements which can be indicated by 1 bit information are designated by 5 digits (address no. and bit no.) preceded by the mark #.

Element	Name
1. I/O signal 2. Internal relay 3. Keep relay	# □□□□ □ Bit No. Address No.

In the case, the address No. takes the meaning of above (A) and it can be taken as the name given with respect to the 8 points of the signal.

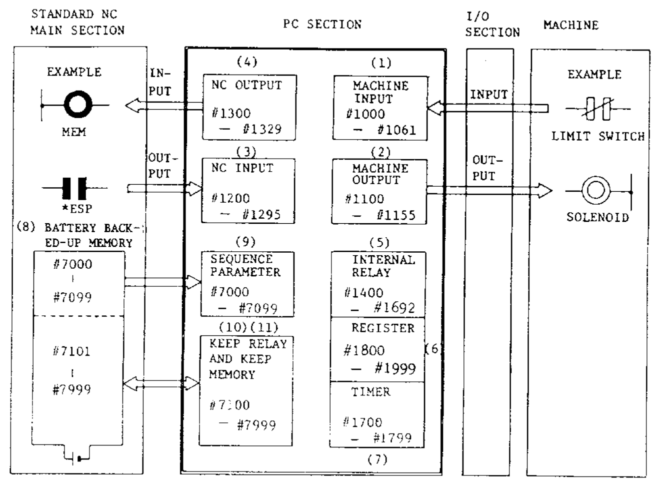
(2) Designation of Register, Timer, etc. (1 Byte Element)

The elements having 1 byte (= 8 bits) information, as shown below, are designated only by address number. In this case, the address number takes the meaning of above (B) and it can be taken as the name given with respect to 1 byte data.

Element	Name
4. Register 5. Timer 6. Sequencer parameter 7. Keep memory	# □□□□ Address No.

Note: Depending on the instruction, naming of 2 bytes #1500 and #1501 can be carried out through the address name #1500. Example: PUSH #1500

5.2 ADDRESS MAP AND DISPLAY SYMBOL



(1) Addresses of Input Signals from Machine (#1000 - #1061)

These are the address numbers + bit numbers (# □□□□□) for input signals like, push buttons, limit switch, etc. from the machine operation panel, machine controller, etc. This section should be determined by the machine tool builder.

(a) 1 bit of the address #1000 corresponds to 1 point of the input signal.

(b) The address number and the bit number are determined depending on the number of the pin and the number of the connector of the I/O board to which the input signal is connected.

Example:

Bit No	7	6	5	4	3	2	1	0
#1000								
	54-36	54-21	54-5	54-35	54-20	54-34	54-19	54-33

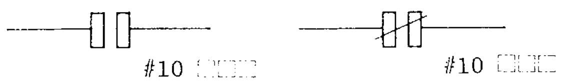
Pin No. 10

Connector No. 01

Input signal name (arbitrary) is registered

Refer to the I/O lists shown in Appendix 1, 2 for details.

(c) The input signals in the order of #1000-1999 are expressed by the following symbols.



(NO Contact) (NC Contact)

(2) Addresses of Output Signals to Machine (#1100 - #1155)

These are the address numbers + bit numbers (#) of output signals like, lamp, solenoid, etc. from the machine operation panel, machine controller, etc. This section should also be decided through the machine tool builder.

(a) 1 bit of the address #1100 corresponds to 1 point of the output signal.

(b) The address number and the bit number are determined, depending on the number of the pin and the number of the connector of the I/O board to which the input signal is connected.

Example:

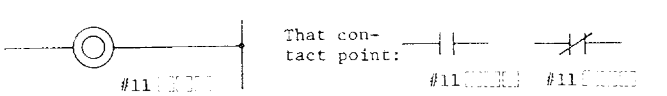
Bit No.

	7	6	5	4	3	2	1	0
#1100								
	51-5	51-6	51-7	51-8	51-41	51-27	51-26	51-25

Pin No. 10
Connector No. 08
Output signal name (arbitrary) is registered

Refer to the I/O Lists shown in Appendix 1, 2 for details.

(c) The output signals in the order of #1100-#1199 are expressed by the following symbols.



(NO Contact) (NC Contact)

(3) Addresses (#1200 - #1295) of Input Signals from NC Main Section

In other words, these can be termed as output signals to the PC from the NC main section. For example, the address numbers + bit numbers with respect to the M-BCD signals. These numbers in the order of #1200 are determined as standard signals and they can not be changed.

(a) 1 bit of addresses between #1200 and #1295 corresponds to 1 point of the input signal.

Example:

Bit No.

	7	6	5	4	3	2	1	0
#1200	M28	M24	M22	M21	M18	M14	M12	M11

M function BCD output

Refer to "Appendix: I/O list" for details. However, they differ for YASNAC LX3 (for lathes) and YASNAC MX3 (for machining centers). So, refer to the corresponding list.

(b) The input signals in the order of #1200 - #1295 are expressed by the following symbols.

(4) Addresses (#1300 - #1329) of Output Signals from NC Main Section

In other words, these can be termed as input signals to NC main section from the PC. For example, the address numbers and the bit numbers with respect to the EDIT and MEM (memory operation) selection.

The numbers between 1300 and 1329 are determined as standard signals and they can not be changed.

(a) 1 bit of the addresses between #1300-#1329 corresponds to 1 point of the input signal.

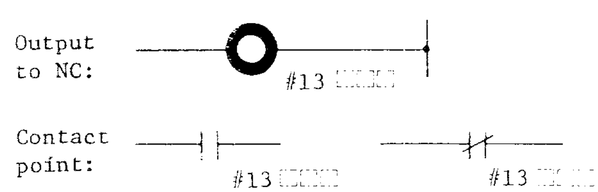
Example:

Bit No.

	7	6	5	4	3	2	1	0
#1300	EDT	MEM	D	T		H/S	J	RT
	EDIT	MEMORY	MANUAL	TAPE		HANDLE/ STEP	JOG	RAPID

Refer to "Appendix: I/O list" for details. However, they differ for YASNAC LX3 and YASNAC MX3. So, refer to the corresponding list.

(b) The output signals between #1300 and #1329 are expressed by the following symbols.

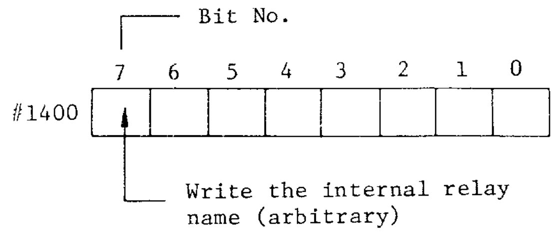


(5) Addresses (#1400 - #1999 except for #1700 - #1799) for Internal Relays

These are the address numbers and bit numbers with respect to the internal relays which can only be used inside the PC while preparing the sequence program.

(a) 1 bit of the addresses between #1400 - #1492 corresponds to 1 internal relay, for example.

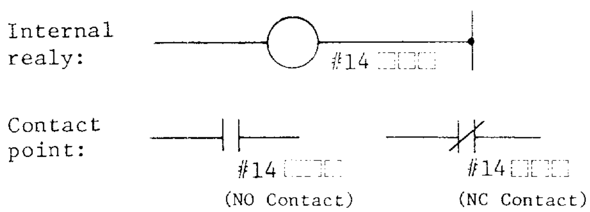
I/O list example:



(b) The number of usable internal relays are as follows.

500 bytes × 8 bits = 4000 relays

(c) The internal relay and its contact point are expressed by the following symbol.



There is no limit for NO and NC contact points until the program memory capacity is exceeded.

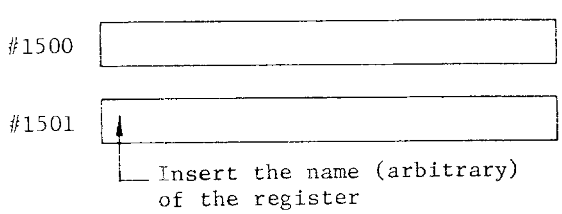
(d) Adressed used in register cannot be used as internal relay.

(6) Addresses (#1400 - #1999 except for #1700 - #1799) of Register

These are the address numbers with respect to the 1 byte (= 8 bits) register for general purpose use. These registers are used for register instruction or for the working addresses of macro instructions.

(a) 1 address number corresponds to 1 register of 1 byte.

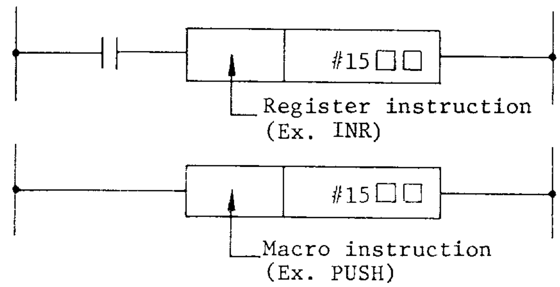
I/O list example:



(b) Number of usable registers are as follows:

500 registers from #1400 to #1999 except for #1700 to #1799.

(c) In a register, the address itself is the expression symbol. The following shows two examples of the symbols.



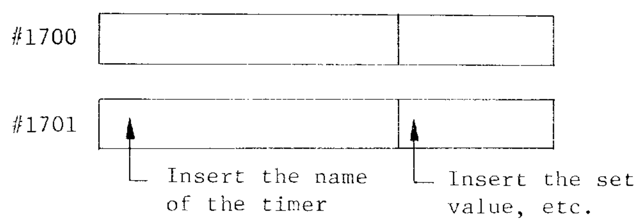
(d) Addresses used in internal relay cannot be used as register.

(7) Addresses of Timer (#1700 - #1799)

These are the addresses with respect to the timers. They are used in the instruction of timers.

(a) 1 address number corresponds to 1 timer.

I/O list example:



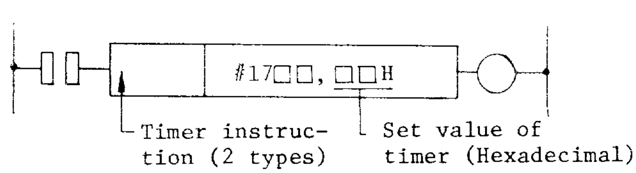
(b) The time unit and the number of usable timers are shown in the following table.

Address No.	No. of timers	Time unit
#1700-#1709, #1760-#1769	20	1 = 8 msec
#1710-#1729, #1790-#1799	30	1 = 100 msec
#1730-#1749, #1780-#1789	30	1 = 50 msec
#1750-#1759	10	1 = 1 sec
#1770-#1773	4	1 = 1 min

The range of set values is 0 - 255.
(0 - 127 for variable timer.)

(c) The symbol example of timers is given below.

Example:



5.2 ADDRESS MAP AND DISPLAY SYMBOL (Cont'd)

(8) Battery Backed-up Memory (#7000 - #7999)

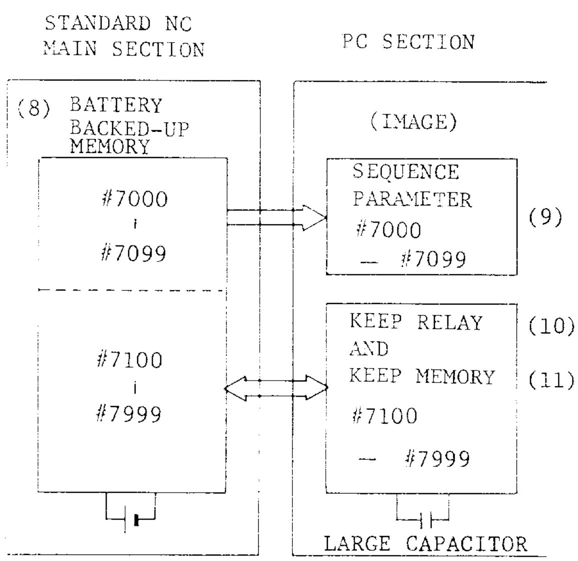
(a) The above addresses of #7000 to #7295 are differentiated from others by the name "battery backed-up memory." That means, the data of #7000 to #7295 are preserved in the battery back-up memory in the standard NC main section. So, even if the power supply is turned off, the data are not erased.

(b) The sequence program of PC unit can only handle image data of the PC unit. The original data from NC main section can not be handled (reading or writing).

(c) Following 3 types of battery backed-up memory data are available.

Sequencer parameter: #7000 - #7099

Keep relay: } #7100 - #7999
Keep memory:



(d) Transfer to sequencer parameter data to PC

In addition to the power supply turning on, the sequencer parameter data is transferred to PC from the NC main unit under the following conditions. Through the parameter writing operation, even if a single sequencer parameter data is modified, then all the sequencer parameter data are transferred. Consequently, all the image data of the PC are always latest data. The sequencer parameter data can only be read in the sequence program and they must not be modified.

(e) Transfer of keep relay and keep memory data to NC.

The image data of the PC unit keep relay and keep memory are sometimes read and written, so they are changed in the sequence program. Consequently, it becomes necessary to preserve the latest image data of the PC unit by transferring them to the battery backed-up memory as latest original data. And this procedure is explained below.

Automatic data transfer

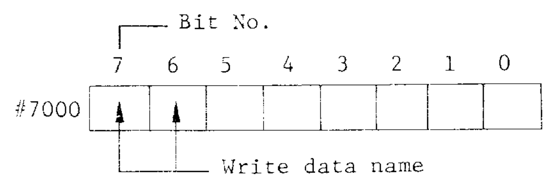
When the power supply of the unit is kept turned on, the data of #7100 - #7999 get transferred from PC to NC unit.

(9) Addresses (#7000 - #7099) of Sequencer Parameter

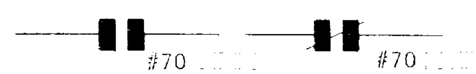
These are the address numbers corresponding to the parameter of the sequencer. The data of #7000 - #7099 can be changed through the normal writing operation. These data can be used in a sequence program in the following two procedures: a Using as 1 bit data and b Using as 1 byte data.

(a) Using as 1 bit data

I/O list example:



Symbol expression is carried out in the following way.

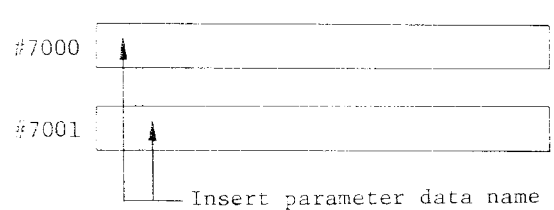


Data "1" = Closed   Data "1" = Open
Data "0" = Open   Data "0" = Closed

Bits cannot be set to "0" or "1" from the keyboard. Set the bit desired to "1" or "0" using the key-in operation of decimal (0 - 127).

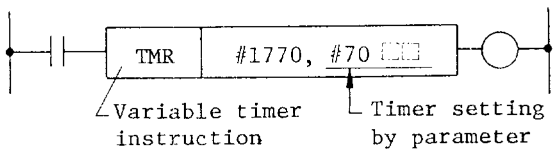
(b) Using as 1 byte data

I/O list example:



The symbol expression is the address number. The example of using in timer is shown in the following figure.

Example:

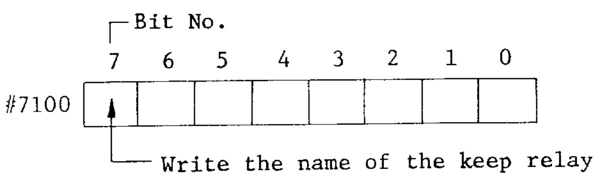


(10) Addresses (#7100 - #7999) of Keep Relay

These are the address numbers and bit numbers of the keep relays used in the PC.

(a) 1 bit of #7100 - #7999 corresponds to 1 keep relay.

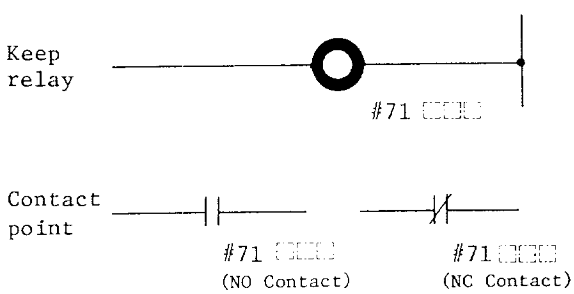
I/O list example:



(b) The number of usable keep relays is as follows.

900 bytes × 8 bits = 7200

(c) The keep relays and their contact points are
expressed by the following symbols.

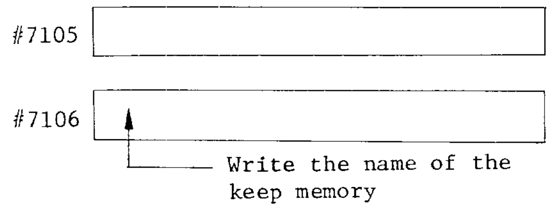


(11) Addresses (#7100 - #7999)

These are the addresses corresponding to the 1 byte memory which can be preserved even after turning off the power supply. If the performance is limited only to the preservation of data, the keep memory can be used in the same way as that of a register. Consequently, the keep memory can also be used as an object of register instruction or as supplementary data of macro instruction. Especially, when preparing a sequence program for memory random type ATC, this keep memory becomes necessary.

(a) 1 address number beyond #7100 corresponds to one keep memory of 1 byte (8 bits).

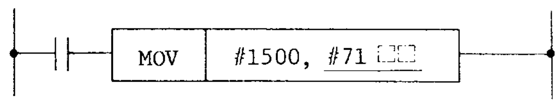
I/O list example:



(b) The number of usable keep memory is as follows:

900 memories from #7100 to #7999

(c) The address number itself stands for the symbol of the keep memory.



MOV: Transfer the contents of register #1500 to keep memory #71□□

(12) Writing Initial Values of Keep Relays and Keep Memories

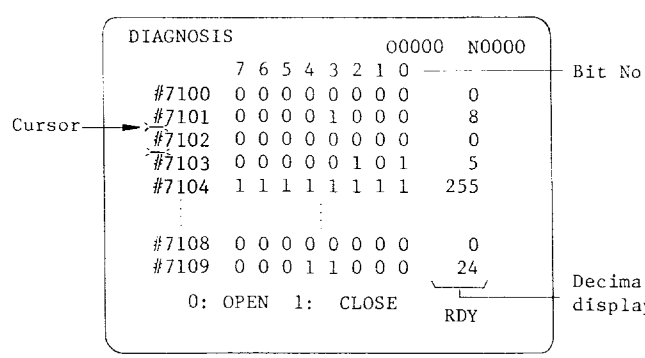
When preparing a sequence program by using the keep relays and keep memories, it becomes necessary to set the initial values prior to the execution.

(a) Set the system number switch of NC unit at "1" and then turn on the power supply.

(b) Depress the [DGN] function key.

Input/output signal ON/OFF state will be displayed on the CRT screen.

(c) After keying-in in the order of [7] [1] [0] [1], if the cursor key is depressed, then the following display will be obtained.



(d) Adjust addresses #7105 to #7294 for initial condition setting by depressing the cursor.

(e) If the INSRT (insert) key is depressed, the cursor will move in the right hand direction, and will move to the 7th bit position of the address.

(f) Keep on pressing the cursor key until it becomes adjusted to the position of the decimal display.

(g) Key-in the desired values (0 - 255) for setting initial condition and then depress the WR key. The decimal display will get changed to the presently keyed in value.

(h) If the INSRT key is depressed, the cursor will move to the left hand position #. Thereby, the setting of one address number is completed.

(i) Repeat steps (d) to (h) to write all the desired initial values of the address numbers.

(j) Adjust the system number switch to "0."

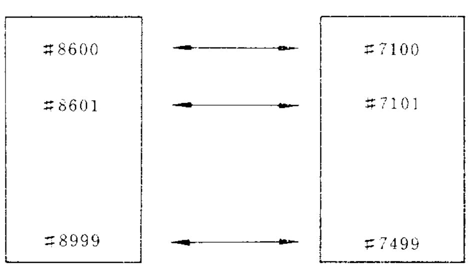
Note: If a particular bit is desired to be changed 0 ⇄ 1, carry out following operations after the operation of item 5). Depress the cursor key and adjust the cursor to the bit desired to be changed, then depress WR key.

0 ⇄ 1 change will be obtained.
1 ⇄ 0 change will be obtained if the WR key is depressed again.

(13) Writing of Keep Relay Numerical Input (Optional only for MX3)

Writing to keep memory (#7100 - #7999) can be normally executed from 0 to 255, however, 4-digit writing is also possible with numbers #8600 - #8999. #7100 - #7499 and #8600 - #8999 correspond to each other as shown in the figure below. #7101 is altered by writing and alteration of #8601.

Note: When keep memory is referred from sequence, use #7100 - #7499, not #8600 - #8999.



(a) Keep memory display

Following displays are added to existing #7100 - #7499 display:
Depress function key DGN .
Key-in 8 , 6 , 0 , 1 and depress cursor .
CRT screen has display as shown in either Fig. (i) or (ii).
[Hereafter Fig. (i) is to be called 2-digit display, while Fig. (ii) is to be called 4-digit display.]

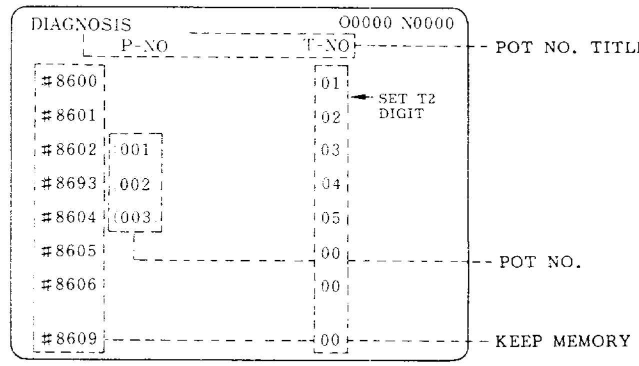


Fig. (i) #6022 D2=0 #6355=8602 #6356=8604

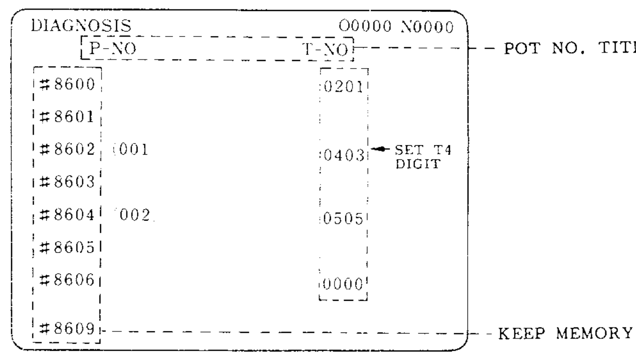


Fig. (ii) #6022 D2=1 #6355=8602 #6356=8604

For Fig. (ii), even and uneven number keep memories are used in pairs, 0 to 9999 are available by expressing the higher 2 digits of the decimal 4 digits with even No. keep memory, and lower 2 digits with uneven No. keep memory.

Pot No. display [Figs. (i), (ii)]
When the max. and min. keep memory numbers are set to parameters #6355 and #6356, Figs. (i) and (ii) show how #6355 and #6356 are set for #7402 and #8604, respectively.

(b) Writing to keep memory
Turn system No. switch to "1".
Use page cursor keys and to move the cursor to keep memory No. to be changed. Input new figure and depress WR key. Procedure mentioned above enables #8600 - #8999 range data to be changed and set.

Notes:

- The same memory is used for #8600 - #8999 and #7100 - #7499: if a value of #8602 is changed, that of #7102 is changed to the same value.
- When the display can be extended up to 9999, as in Fig. (ii), the even number keep memory data are changed to one lower number and cursor moves there by writing when the cursor is at an uneven keep memory number.
- If #6355 and #6356 are set conversally, pot No. title and pot No. are not normally displayed. However, if #6355 and #6356 have keep memory No. on the same page, pot No. title is displayed. [Refer to Fig. (iii).]
- If uneven number is set by mistake for #6355 when 4-digit display (#6022 D2=1), pot No. is displayed from the even number keep memory No. which is one number higher than the pot No.

DIAGNOSIS	00000 N0000	
P-NO	T-NO	POT NO. TITLE
#8600	01	
#8601	02	
#8602	03	
#8603	04	
#8604	05	
#8605	06	
#8606	07	
#8609	09	

Fig. (iii) #6022 D2=0 #6355=8604 #6356=8602

DIAGNOSIS	00000 N0000
P-NO	T-NO
#8600	0201
#8601	
#8602	0403
#8603	
#8604 (001)	0805
#8605	
#8606 (002)	0807
#8609	

Fig. (iv) #6022 D2=1 #6355=8603 #6356=8606

- If a number lower than that for #6355 is set for #8600, pot number from #8600 is lower than the number already set to display. [Refer to Fig. (v).]

DIAGNOSIS	00000 N0000
P-NO	T-NO
#8600 (010)	01
#8601 (011)	02
#8602 (012)	03

Fig. (v) #6022 D2=0 #6355=7391

- When pot number is not displayed, set 0 for #6355 and #6356.
- In 2-digit display (#6022 D2=0), writing-in more than a 3-digit number is not accepted.

(14) Address Setting of I/O Board

I/O board has a shorting plug for address setting. For shorting plug and address, refer to the table below.

I/O BOARD / MODULE	IO 20-01		IO 20-02		IO 20-03		IO 21	
	INPUT	OUTPUT	INPUT	OUTPUT	INPUT	OUTPUT	INPUT	OUTPUT
MODULE NO.1	#1005 ~ #1009 #1013	#1100 ~ #1105	#1000 ~ #1009 #1013	#1100 ~ #1105	#1000 ~ #1013	#1100 ~ #1107	#1000 ~ #1013	#1100 ~ #1107
MODULE NO.2	#1021 ~ #1025 #1029	#1116 ~ #1121	#1016 ~ #1025 #1029	#1116 ~ #1121	#1016 ~ #1029	#1116 ~ #1123	#1016 ~ #1029	#1116 ~ #1123
MODULE NO.3	#1037 ~ #1041 #1045	#1132 ~ #1137	#1032 ~ #1041 #1045	#1132 ~ #1137	#1032 ~ #1045	#1132 ~ #1139	#1032 ~ #1045	#1132 ~ #1139
MODULE NO.4	#1053 ~ #1057 #1061	#1148 ~ #1153	#1048 ~ #1057 #1061	#1148 ~ #1153	#1048 ~ #1061	#1148 ~ #1155	#1048 ~ #1061	#1148 ~ #1155

Note: IO20 can not be added to YASNAC MX3.

For shoring plug (SW1) setting and I/O module No., refer to the table below.

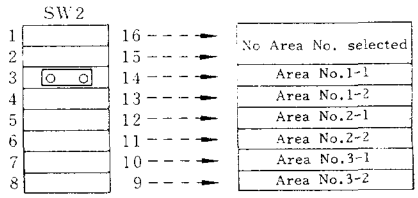
SW1			
1		16	No module selected
2		15	Module No.1
3	O O	14	Module No.2
4		13	Module No.3
5		12	Module No.4
6		11	Spare
7		10	Spare
8		9	Spare

5.2 ADDRESS MAP AND DISPLAY SYMBOL (Cont'd)

CRT Panel Built-in I/O Board

Input	SP 20-02		
	Area No.	Input	Output
Module No.1	1-1	#1000~#1007	#1100~#1103
	1-2	#1008~#1015	#1108~#1111
Module No.2	2-1	#1016~#1023	#1116~#1119
	2-2	#1024~#1031	#1124~#1127
Module No.3	3-1	#1032~#1039	#1132~#1135
	3-2	#1040~#1047	#1140~#1143

For shorting plug (SW2) setting and I/O area No. refer to the table below.



5.3 I/O LIST AND SEQUENCE LADDER

The data list of the address map is called the I/O lists. The I/O lists for LX3 (for lathes) MX3 (for machining centers) are shown in the Appendixes at the end of this manual.

(1) For preparing the sequence ladder, first of all, carry out the assignment of the I/O signals (#1000 and #1100) between the PC and the machine tool.

(2) After the completion of the assignment of the I/O signals, refer to the I/O list as a list for data and freely prepare sequence ladder through the command symbols of the PC. In this case, it is convenient to use the abbreviated names like SW7, SOL A, etc. for element names.

(3) Complete the assignment of the address numbers for each element: internal relay, register, timer, etc. for the completed and checked sequence ladder. Thereby, the complete sequence ladder and a complete I/O list is obtained.

6. SEQUENCE CONTROL METHOD

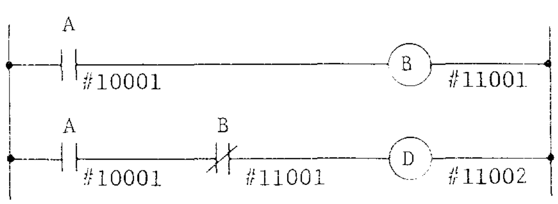
Sequence control through the PC is carried out successively through the software, so the operations are quite different from that of the simultaneous processing in the case of normal relay circuit. So, it is necessary to have clear understanding of this point prior to programming.

6.1 DIFFERENCES IN OPERATION

Relay sequence: Each element is simultaneously processed with regard to time.

PC sequence: Each element is successively processed. The ladder is repeatedly processed at a constant period. This period is called scanning time. (Scanning time Ex.: 8 msec × n times)

Example:



The above PC sequence ladder is operated in the following sequence. Simultaneous processing is never carried out.

① Condition of contact point A is read.

② This is output to internal relay B as it is.

③ Condition of contact point A is read.

④ AND logic is taken from the NC contact point of relay B.

⑤ The result is output to internal relay D.

Due to this successive processing, the internal relay D is not turned on. On the other hand, if the above ladder is executed by the relay sequence, the relay D is turned on for a moment and thereby one shot operation is being carried out. As discussed above, it should always be remembered that the processing in the PC is carried out successively and then programming should be completed. For reference, if the above mentioned PC sequence ladder is coded according to PC command words, it takes the following form.

```
   :
①  LD #10001
②  OUT #11001
③  LD #10001
④  AND NOT #11001
⑤  OUT #11002
   :
```

Example of coded sequence program (called list)

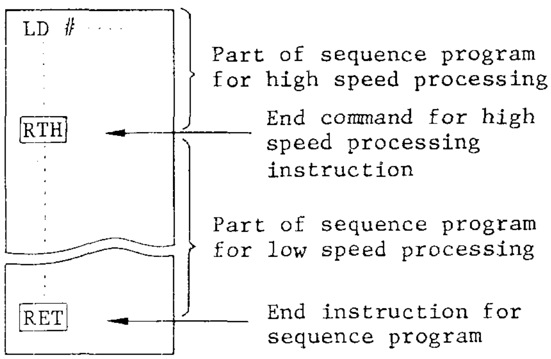
6.2 SCANNING TIME (PROCESSING TIME)

The execution time from the start to the end of a sequence program is called the scanning time. The scanning time for this PC is as follows.

High speed scanning time: 8 msec

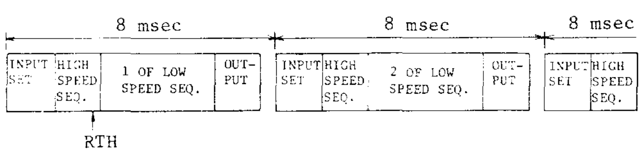
Low speed scanning time: 8 msec × n

That means, in this PC, the sequence program can be processed by dividing it into the high speed processing part and the low speed processing part. In this case, write the program as follows.



The first part of the write sequence program needs high speed processing.

(1) Relationship between High Speed Processing and Low Speed Processing



(a) From the beginning of the sequence to the RTH command, the high speed sequence program (high speed Seq.), as shown in the above figure, is surely executed once within 8 msec. During the execution of this high speed sequence, the input condition does not change.

(b) The low speed sequence program (low speed Seq.) after RTH command is divided into "n" items and one of them is executed in the remaining time of 8 msec. That means, the whole low speed sequence program is executed in 8 msec × "n" times time. Consequently, the value of "n" depends on the capacity of the whole program and the length of the high speed sequence program. Since the low speed program is divided into many parts, so the input condition changes in the middle. So, be sure to take NOTE of item 3 of this section.

(c) At the first part of the 8 msec section, all the input conditions (#1000 and #1200) are taken in the PC at a time.

(d) At the last part of 8 msec section, all the output conditions (#1100 and #1300) are output at a time.

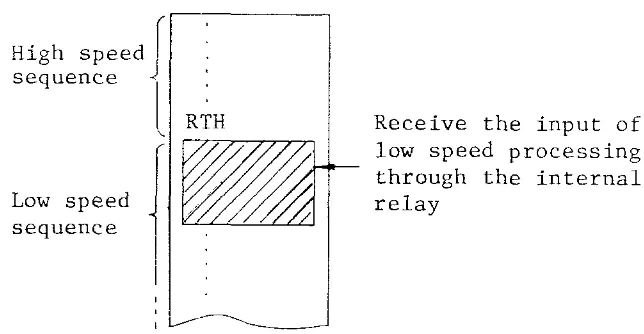
(2) Precautions for High Speed Processing Sequence Program

In this program, only the portion where high speed responses such as counting of ON/OFF are necessary, is handled. So limit it to the least possible size of the sequence program. Limit it within 100 steps when converted into contact point instruction.

(3) Precautions for Low Speed Processing Sequence Program

(a) The scanning time for low speed processing differs depending on the capacity of the total sequence program (8 msec × "n"). (The amount of program that can be executed within 8 msec is approximately 3000 steps when converted into contact point instruction. However, this amount of steps is the combination of high speed and low speed processings.)

(b) Since division processing is carried out during the execution of the low speed processing sequence program, the input condition changes. Consequently, all inputs to be used through the low speed processing sequence program need to be received through the internal relays at the top of the low speed processing sequence program. Then, use the contact point of the receiving relay in place of the input.

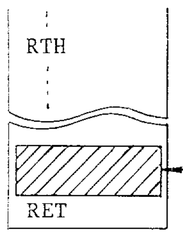


Through the above operations, the input conditions may be kept unchanged during 1 cycle of execution of the low speed processing sequence program.

(c) If the output of the high speed processing sequence program is to be used in the low speed processing sequence program, the processing like (b) needs to be carried out.

(d) The output signals which are not desired to be output until the end of the execution of low speed processing sequence program, once received outputs them through the internal relays without outputting them to the addresses of output of the PC unit. Then, do not connect the same to the address of the external output at the tail of the low speed processing sequence program.

6.2 SCANNING TIME (PROCESSING TIME) (Cont'd)



Write the desired output after one cycle of the low speed processing sequence

6.3 MEMORY CAPACITY OF SEQUENCE PROGRAM

The sequence program is finally written to the EPROM (Erasable Program Rom) and then used. The capacity of one PROM is 256K bits (= 32K bytes). The capacity of the program memory of this PC can be used according to the following distribution.

Division	No. of Bytes	Step Convension	No. of PROMs	PROM Location on PC Board JANCD-MM20
1	16K bytes	Approx. 4000 steps	1	30
2	32K bytes	Approx. 8000 steps	2	30, 31

(Usually, relay instruction is of 3-7 bytes and other commands are of 1-25 bytes range.) For the memory storing the sequence program of 16K bytes, 4000 steps (16K/4 = 4K (4000 steps) is required, if approximately 4 bytes is used for one step.

Note: When message display (SUBP 023) is used, use PROM location 33 in addition to locations listed above.

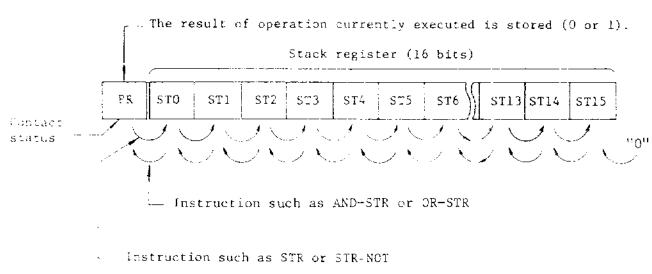
7. PC INSTRUCTIONS

This chapter explains the 61 type basic instructions and 11 type macro instructions that can be used with this PC while describing their functions, display symbols and coded lists.

7.1 PRELIMINARY KNOWLEDGE

(Registers to store intermediate results during logical operation)

(1) PC is provided with a register to store intermediate results of logical operation of sequence programs, and it consists of 1 bit + 16 bits, as shown below.



(2) RR (Result Register)

1-bit register to which the result of operation currently executed is stored. The contact status (0 or 1) can be set into RR by the LD instruction, or the RR contents can be output to the relay address by the OUT instruction. Also, 1-bit shift of the stack register contents to RR (after operation) by the STR or AND-STR instruction is possible.

(3) Stack Register (Stack, ST0 - ST15)

Intermediate operation resulting from long logical operation can be saved into the stack register sequentially up to 16 bits.

Data in RR is shifted to ST0 by the STR or STR-NOT instruction, and data in the stack register is shifted by 1 bit toward right. Also data in ST0 and RR is operated by the AND-STR or OR-STR instruction, set into RR, and data in the stack register is shifted by 1 bit toward left. ST15 is cleared to "0." If the number of STR or STR-NOT instructions does not equal to the number of AND-STR or OR-STR instructions used in a series of long logical operations until the final result is obtained, it results in an error. In other words, the number of times that data is saved in the stack and the number of times that data is fetched out must be equal.

7.2 TYPES OF INSTRUCTIONS AND LISTS

(1) Instruction Types

There are the following types in the instructions used with PC.

Basic instructions (61 types)

①	Instructions for relay:	13 types
②	Instructions for registers:	37 types
③	Instructions for timers:	2 types
④	Control instructions:	9 types
	Total	61 types

Macro instructions

(1) Macro instructions:	11 types
(2) Auxiliary instructions:	4 types

(2) List of instructions for relay

No.	Instruction	*	Meaning	RR after operation	Page
1	LD	1	Reads signal status (0 or 1) and sets it to RR.	↕	16
2	LD-NOT	1	Reads inversion signal status and sets it to RR.	↕	16
3	AND	1	Sets AND of contact and RR to RR (AND).	↕	17
4	AND-NOT	1	Sets AND of inversion signal and RR to RR (Reverse AND)	↕	17
5	OR	1	Sets OR of signal and RR to RR (OR).	↕	17
6	OR-NOT	1	Sets OR of inversion signal and RR to RR (Reverse OR).	↕	17
7	XOR	1	Sets uncoincidence between signal and RR to RR.	↕	17
8	XNR	1	Sets coincidence between signal and RR to RR.	↕	18
9	STR	1	Loads RR contents to stack and executes LD instruction.	↕	18
10	STR-NOT	1	Loads RR contents to stack and executes LD NOT instruction.	↕	18
11	AND-STR	1	Sets AND of RR and stack to RR.	↕	18
12	OR-STR	1	Sets OR of RR and stack to RR.	↕	18
13	OUT	1	Writes operation results (RR) to relay (address).	—	19

Note:
1. The * column shows the execution time converted to the contact instruction
   (1 = One contact instruction)
2. The ↕ mark shows that the RR contents change after instructions are operated.
   The — mark shows that no change occurs.

(3) List of Instructions for Timers

No.	Instruction	*	Meaning	RR after operation	Page
1	TIM	10	Timer processing (Fixed timer)	time up = 1	19
2	TMR	10	Timer processing (Variable timer)	time up = 1	19

7.2 TYPES OF INSTRUCTIONS AND LISTS (Cont'd)

(4) List of Instructions for Registers

No.	Instruction	*	Meaning	RR after operation	Page
1	INR	3	Adds + 1 to register contents.	—	19
2	DCR	3	Adds - 1 to register contents.	—	20
3	CLR	2	Clears the register contents.	—	20
4	CMR	3	Inverts the register contents.	—	20
5	ADI	3	Addition of register contents and numeric.	—	20
6	SBI	3	Subtraction of register contents and numeric.	—	20
7	ANI	3	AND of register contents and numeric.	—	21
8	OBI	3	OR of register contents and numeric.	—	21
9	XRI	3	XOR of register contents and numeric.	—	21
10	DEC	3	Coincidence of register contents and numeric.	↕	21
11	COI	4	Coincidence of register contents and numeric.	↕	21
12	CMP	3	Comparison of register contents and numeric.	↕	22
13	CPI	4	Comparison of register contents and numeric.	↕	22
14	MVI	3	Load numeric to a register.	—	22
15	ADD	4	Adds registers R1 and R2 and stores the result in R2.	—	22
16	SUB	4	Subtracts R1 from R2 and stores the result in R2.	—	22
17	ANR	4	Takes AND of R1 and R2 and stores the result in R2.	—	22
18	ORR	4	Takes OR of R1 and R2 and stores the result in R2.	—	22
19	XRR	4	Takes XOR of R1 and R2 and stores the result in R2.	—	23
20	CPR	5	Checks the result of comparison of R1 with R2, and stores the result in R2.	↕	23
21	COR	5	Checks coincidence between R1 and R2, and sets the result in RR.	↕	23
22	MOV	4	Transfers R1 contents to R2.	—	23
23	DST	5	Transfers AND of R1 contents and numeric to R2.	—	23
24	DIN	7	Data extraction	—	24
25	ADC	4	Double length addition	↕	24

(4) List of Instructions for Registers (Cont'd)

No.	Instruction	*	Meaning	RR after operation	Page
26	ADDW	4	Adds double length registers (WR2 and WR1) and stores the result in WR2.	—	24
27	SUBW	4	Subtracts WR1 from WR2 and stores the result in WR2.	—	25
28	MULW	10	Multiplies double length register (WR2) with register (R1) and stores the result in WR2.	RR is set to "1" when overflow occurs.	25
29	DIVW	15	Divides double length register (WR2) by register (R1) and stores the result in WR2.	○	25
30	1NRW	3	Adds + 1 to double length register contents.	—	26
31	DCRW	3	Adds - 1 to double length register contents.	—	26
32	CLRW	3	Clears double length register contents.	—	26
33	CMRW	2	Inverts double length register contents.	—	26
34	CORW	3	Sets coincidence result of double length registers (WR2 and WR1) to RR.	↕	26
35	CPRW	3	Sets comparison result of double length registers (WR2 and WR1) to RR.	↕	26
36	MVIW	3	Loads numeric to double length register.	—	26
37	DSTW	5	Transfers AND of double length register (WR1) contents and numeric to double length register (WR2).	—	27

(5) List of Control Instructions

No.	Instruction	*	Meaning	RR after operation	Page
1	NOP	1	No-operation.	—	27
2	MCR	1	Start of master control relay.	—	27
3	END	1	End of master control relay.	—	27
4	RET	1	Sequence program termination.	—	27
5	RTI	1	RR is set to "1" and RET instruction is executed.	—	27
6	SET	1	Sets RR to "1."	1	28
7	RTH	1	High speed processing sequence program termination.	—	28
8	JMP	1	Jumps to the location shown by ADR.		28
9	ADR	0	Indicates the location to be jumped by JMP.		28

7.2 TYPES OF INSTRUCTIONS AND LISTS (Cont'd)

(6) List of Macro Instructions

No.	Instruction	*	Meaning	RR after operation	Page
1	SUBP003	Approx 100	Rise signal detection.	↕	29
2	SUBP004		Fall signal detection.	↕	29
3	SUBP005		Counter.	↕	29
4	SUBP006		Rotation (for control of rotating object).	↕	32
5	SUBP007		Code converter.	↕	33
6	SUBP009		Pattern clearance.	↕	34
7	SUBP011		Parity check.	↕	35
8	SUBP014		Data conversion (Binary ⇄ BCD.)	↕	35
9	SUBP017		Data search.	↕	36
10	SUBP018		Index data transfer.	↕	37
11	SUBP023		Message display (Option).	↕	38

(7) List of Auxiliary Macro Instructions

No.	Instruction	*	Meaning	RR after operation	Page
1	IPSH	2	Designation of numeric used by SUBP.	—	28
2	APSH	2	Designation of address of register used by SUBP.	—	28
3	PUSH	2	Designation of address of register used by SUBP.	—	28
4	TPSH	2	Designation of Table No. of PC table used by SUBP.	—	28

7.3 INSTRUCTIONS FOR RELAYS

(1) LD (Load) RR after operation (RR↕)

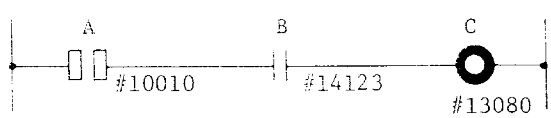
① Format LD # x x x x x

Internal signal name

Example: #10100
#14312

② Reads contact status (1 or 0) and sets the results to RR.

③ Normally this instruction is applied to Contact A (—| |—)



LD #10010
AND #14123
OUT #13080

(2) LD-NOT (Load Not) (RR↕)

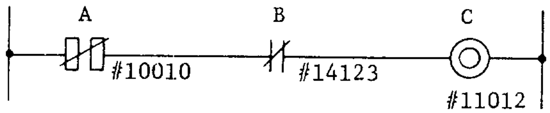
① Format LD-NOT # x x x x x

Internal signal name

Example: #10100
#14321

② Read inversion contact status (1 or 0) and sets the result to RR.

③ Normally this instruction is applied to Contact B (-|/|-).



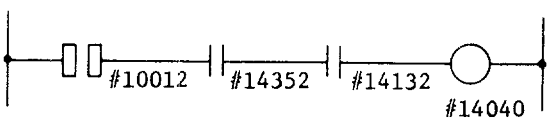
LD-NOT	#10010
AND-NOT	#14123
OUT	#11012

(3) AND {RR↕}

① Format AND # x x x x x

Internal signal name

② Takes AND of contact and RR and loads the result to RR (AND).



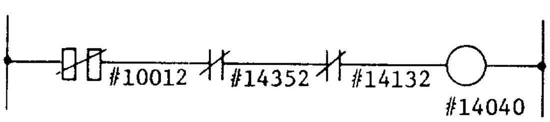
LD	#10012
AND	#14352
AND	#14132
OUT	#14040

(4) AND-NOT {RR↕}

① Format AND-NOT # x x x x x

Internal signal name

② Takes AND of inversion contact and RR and loads the result to RR (Reverse AND).



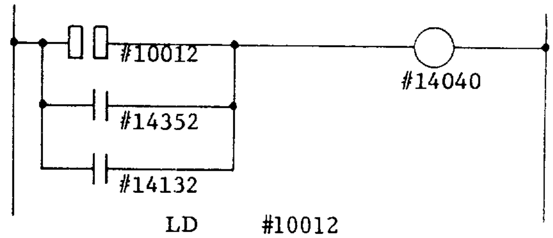
LD-NOT	#10012
AND-NOT	#14352
AND-NOT	#14132
OUT	#14040

(5) OR {RR↕}

① Format OR # x x x x x

Internal signal name

② Takes OR of contact point and RR and loads the result to RR (OR).



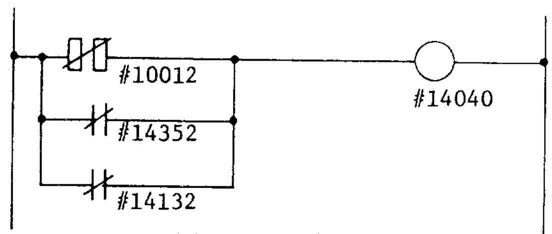
LD	#10012
OR	#14352
OR	#14132
OUT	#14040

(6) OR-NOT {RR↕}

① Format OR-NOT # x x x x x

Internal signal name

② Taken OR of inversion contact point and RR and loads the result to RR (Reverse OR).



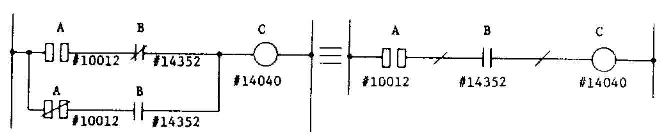
LD-NOT	#10012
OR-NOT	#14352
OR-NOT	#14132
OUT	#14040

(7) XOR (Exclusive OR) {RR↕}

① Format XOR # x x x x x

Internal signal name

② Loads dissidence between contact and RR to RR.



LD	#10012
AND-NOT	#14352
STR-NOT	#10012
AND	#14352
OR-STR	
OUT	#14040

≡

LD	#10012
XOR	#14352
OUT	#14040

A	B	C
0	0	0
1	0	1
0	1	1
1	1	0

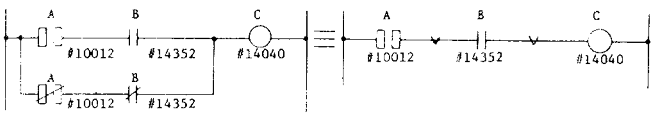
7.3 INSTRUCTIONS FOR RELAYS (Cont'd)

(8) XNR (Exclusive NR) {RR↕}

① Format XNR # x x x x x

Internal signal name

② Loads coincidence between contract and RR to RR.




```
LD        #10012          LD    #10012
AND       #14352     ≡    XNR   #14352
STR-NOT   #10012          OUT   #14040
AND-NOT   #14352
OR-STR
OUT       #14040
```

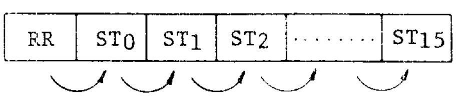
A	B	C
0	0	1
1	0	0
0	1	0
1	1	1

(9) STR (Store) {RR↕}

① Format STR # x x x x x

Internal signal name

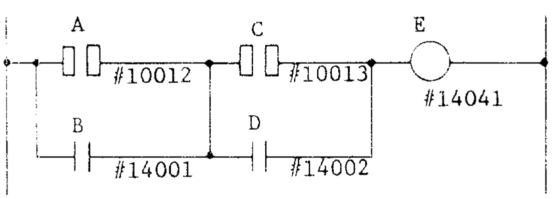
② Loads RR contents to stack.



Can use stacks up to 16.

Then, executes the LD instructions.

③ Normally, this instruction is used for signal of Contact A (─┤├─).



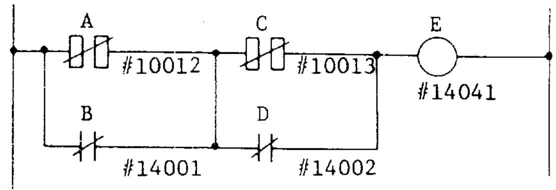

```
LD        #10012
OR        #14001
STR       #10013
OR        #14002
AND-STR
OUT       #14041
```

(10) STR-NOT (Store NOT) {RR↕}

① Format STR-NOT # x x x x x

Internal signal name

② Loads RR contents into stack and then executes the LD NOT instruction.

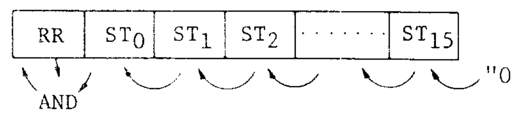


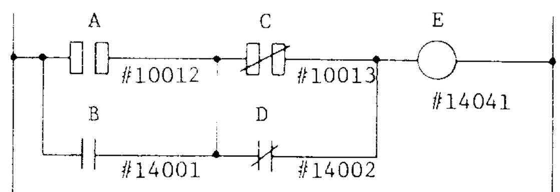

```
LD-NOT    #10012
OR-NOT    #14001
STR-NOT   #10013
OR-NOT    #14002
AND-STR
OUT       #14041
```

(11) AND-STR (AND-Store) {RR↕}

① Format AND-STR

② Executes AND of RR and stack (ST0) and loads the result to RR. The stack shifts by one each toward left.



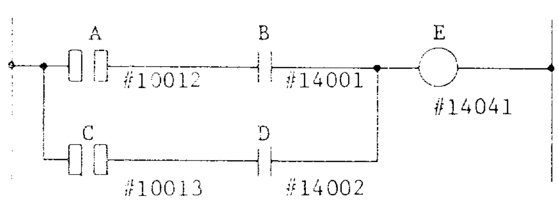



```
LD        #10012
OR        #14001
STR-NOT   #10013
OR-NOT    #14002
AND-STR
OUT       #14041
```

(12) OR-STR (OR-Store) {RR↕}

① Format OR-STR

② Executes OR of RR and stack (ST0) and loads the result to RR.



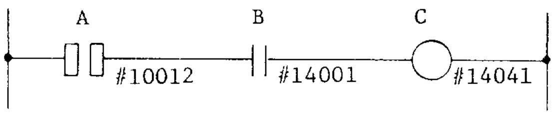

```
LD        #10012
AND       #14001
STR       #10013
AND       #14002
OR-STR
OUT       #14041
```

(13) OUT {RR–}

① Format OUT # x x x x x

Internal signal name

② Writes operation result (RR) to relay.




```
LD   #10012
AND  #14001
OUT  #14041
```

7.4 INSTRUCTIONS FOR TIMERS

(1) TIM (Fixed Timer) {RR time up = 1}

① Format TIM # x x x x, x x H

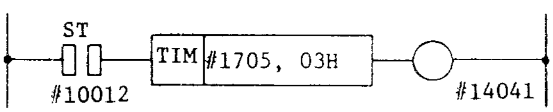
#1700 - #1799 — Timer set time (hexadecimal)

② The timer counts up in the state that the ST contact is ON (RP = 1), and sets TM on after the set time. In the state of the ST contact being OFF (RR = 0), TM is cleared and the timer is reset.

③ The timer set value is in the range of 0 - 255 (decimal notation). However, make sure to write this in a hexadecimal notation (NOTE 1). The CRT display is also in a hexadecimal notation.

④ Five types of timers can be used.

Address	Types	No. of Timers
#1700-#1709, #1760-#1769	Timer of 1 = 8 msec	20
#1710-#1729, #1790-#1799	Timer of 1 = 0.1 sec	30
#1730-#1749, #1780-#1789	Timer of 1 = 50 msec	30
#1750-#1759	Timer of 1 = 1 sec	10
#1770-#1773	Timer of 1 = 1 min	4




```
LD   #10012
TIM  #1705, 03H
OUT  #14041
```

Note:
1. A conversion table between decimal and hexadecimal notation is provided in Appendix 3 at the end.
2. The same address must not be used in fixed timer and variable timer, for normal operation cannot be guaranteed.

(2) TMR (Variable Timer) {RR time up = 1}

① Format TMR # x x x x, # x x x x

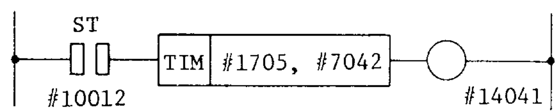
#1700 - #1799 — #7000 - #7294 address of sequence parameter

② The timer counts up in the state of the ST contact being ON (RR = 1), and TM is set on after the set time. When the ST contact is OFF (RR = 0), TM is cleared and the timer is reset.

③ The timer set value is in the range of 0 - 127 (decimal notation).

④ Set the aforementioned timer value through the NC keyboard in the procedures of "Parameter Write Operation." In this case, the write can be in a decimal notation, and the CRT display is also in a decimal notation.

⑤ The same as with the TIM instruction, 5 types of timers can be used with TMR.




```
LD   #10012
TMR  #1705, #7042
OUT  #14041
```

7.5 INSTRUCTIONS FOR REGISTERS

(1) INR (Increment Register) {RR –}

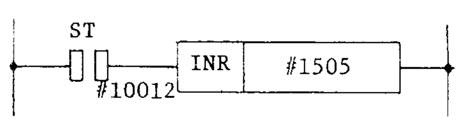
① Format INR # x x x x

#1400 - #1499
#1500 - #1599
#1600 - #1699
#1800 - #1899
#1900 - #1999 (register number)

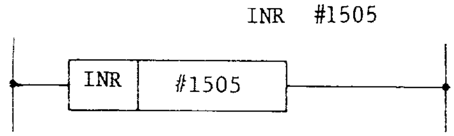
② Adds + 1 to the register contents when the ST contact is ON (RR = 1). This instruction is not executed when the ST contact is OFF (RR = 0).

③ The ST contact must be made before the INR instruction.

④ When the ST contact is ON, + 1 is added to the register contents in every 8 x "n" msec.




```
LD   #10012
INR  #1505
```



Cannot use this method

7.5 INSTRUCTIONS FOR REGISTERS (Cont'd)

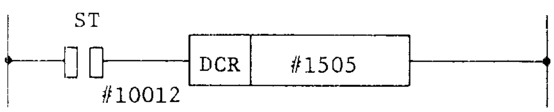
(2) DCR (Decrement Register) |RR -|

① Format DCR # x x x x

#1500 - #1599
#1800 - #1899
#1900 - #1999
(register number)

② When the ST contact is ON (RR = 1), - 1 is added to the register contents. This instruction is not executed when the ST contact is OFF (RR = 0). The RR contents remain unchanged.

③ The ST contact must be made before the DCR instruction.



LD #10012
DCR #1505

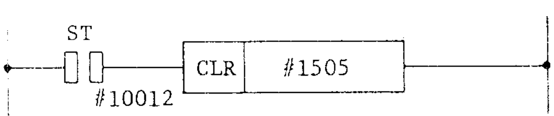
④ When the ST contact is ON, - 1 is added to the register contents in every 8 x "n" msec.

(3) CLR (Clea) |RR-|

① Format CLR # x x x x

#1500 - #1599
#1800 - #1899
#1900 - #1999
(register number)

② Clears the register contents when the ST contact is ON (RR = 1). This instruction is not executed when the contact is OFF (RR = 0). The RR contents remain unchanged



LD #10012
CLR #1505

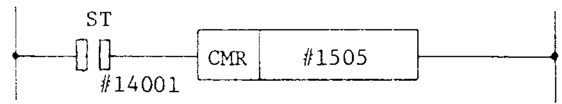
(4) CMR (Complement Register) |RR-|

① Format CMR # x x x x

#1500 - #1599
#1800 - #1899
#1900 - #1999
(register number)

② Inverts the register contents when the ST0 contact is ON (RR = 1). This instruction is not executed when the contact is OFF (RR = 0). The RR contents remain unchanged.

③ The ST contact must be made before the CMR instruction.



LD #14001
CMR #1505

④ The register contents are inverted in every 8 x "n" msec when the ST contact is ON.

(5) ADI (Added Immediate) |RR-|

① Format ADI # x x x x, x x H

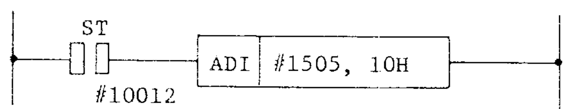
#1500 - #1599
#1800 - #1899
#1900 - #1999
(register number)

Numeric (hexadecimal)

② Adds the register contents and numeric and loads the result to the register when the ST contact is ON (RR = 1). This instruction is not executed when the contact is OFF (R = 0). The RR contents remain unchanged.

③ The ST contact must be made before the ADI instruction.

④ The ADI instruction is executed in every 8 x "n" msec when the ST contact is ON.



LD #10012
ADI #1505, 10H

(6) SBI (Subtract Immediate) |RR-|

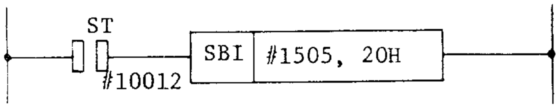
① Format SBI # x x x x, x x H

#1500 - #1599
#1800 - #1899
#1900 - #1999
(register number)

Numeric (hexadecimal)

② Subtracts the register contents and numeric and loads the result to the register when the ST contact is ON (RR = 1). If it is OFF, the instruction is not executed. The RR contents remain unchanged.

③ The ST contact must be made before the SBI instruction.



LD #10012
ADI #1505, 20 H

④ The SBI instruction is executed in every 8 x "n" msec when the ST contact is ON.

(7) ANI (And Immediate) {RR-}

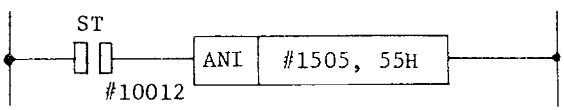
① Format ANI # x x x x, x x H

#1500 - #1599
#1800 - #1899
#1900 - #1999
(register number)

Numeric (hexadecimal)

② AND of the register contents and numeric is taken and loaded in the register when the ST contact is ON (RR = 1). If the contact is OFF (RR = 0), the instruction is not executed. The RR contents remain unchanged.

③ The ST contact must be made before the ANI instruction



LD #10012
ANI #1505, 55H

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Register	0	0	1	1	0	0	1	1
Numeric	0	1	0	1	0	1	0	1
Result	0	0	0	1	0	0	0	1

(8) ORI (Or Immediate) {RR-}

① Format ORI # x x x x, x x H

#1500 - #1599
#1800 - #1899
#1900 - #1999

Numeric (hexadecimal)

② OR of the register contents and numeric is taken and loaded in the register when the ST contact is ON (RR = 1). If the contact is OFF (RR = 0), the instruction is not executed. The RR contents remain unchanged.

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Register	0	0	1	1	0	0	1	1
Numeric	0	1	0	1	0	1	0	1
Result	0	1	1	1	0	1	1	1

(9) XRI (Exclusive or Immediate)

① Everything is the same as in the ORI instruction, with an exception of the following table.

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Register	0	0	1	1	0	0	1	1
Numeric	0	1	0	1	0	1	0	1
Result	0	1	1	0	0	1	1	0

(10) DEC (Decode) {RR ↕}

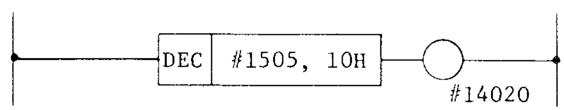
① Format DEC # x x x x, x x H

Numeric (hexadecimal)

Register and contact set

② RR is one when the data and numeric of the 8 bits of the register and contact set are equal. This will occur irrelevant to RR of the input side.

③ No contact can be added before the DEC instruction. Use the COI instruction when a contact must be added.



DEC #1505, 10H
OUT #14020

④ For example, if the M function output is #1222, to set on/off M11 with an M11 signal, the following must be given.

DEC #1222, OBH
OUT #14100 (relay for M11)

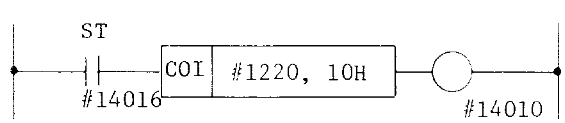
(11) COI (Coincide Immediate) {RR↕}

① Format COI # x x x x, x x H

Numeric

Register and contact set

② RR is set to "1" when the data and numeric of the register or contact set coincide when the ST contact is ON(RR = 1). If the contact is OFF (RR = 0), the COI instruction is not executed. RR is cleared.



LD #14016
COI #1220, 10H
OUT #14010

7.5 INSTRUCTIONS FOR REGISTERS (Cont'd)

(12) CMP (Compare) {RR↕}

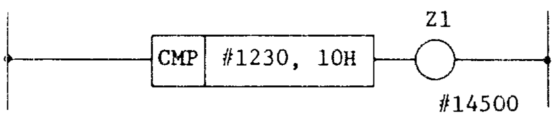
① Format CMP # x x x x, x x H

Numeric (hexadecimal)

Register and contact set

② If the comparison result of the 8-bit data and numeric of the register and contact set is that the register (contact set) is equal or greater than the numeric, RR is set to "1." If the register (contact set) is smaller than the numeric, RR is cleared. This is executed irrelevant to RR of the input side.

③ No contact can be added before the CMP instruction. Use the CPI instruction when a contact must be added.



#1230 ≧ 10H → Z1 = ON

#1230 < 10H → Z1 = OFF

```
CMP    #1230, 10H
OUT    #14500
```

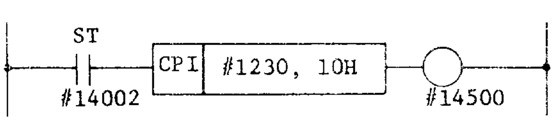
(13) CPI (Compare Immediate) {RR↕}

① Format CPI # x x x x, x x H

Numeric (hexadecimal)

Register and contact set

② RR is set to "1" if the comparison result of the data and numeric of the register or contact set is that the register (contact set) is greater or equal to the numeric when the ST contact is ON (RR = 1). When the ST contact is OFF (RR = 1), the CPI instruction is not executed. RR is cleared.




```
LD     #14002
CPI    #1230, 10H
OUT    #14500
```

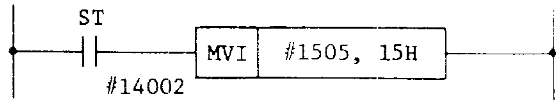
(14) MVI (Move Immediate) {RR-}

① Format MVI # x x x x, x x H

Register

Numeric (hexadecimal)

② This instruction transfers the numeric to the register when the ST contact is ON (RR = 1). If the contact is OFF (RR = 0), the MVI instruction is not executed.




```
LD     #14002
MVI    #1505, 15H
```

③ RR is not affected by the MVI instruction.

④ If the ST contact is ON, the MVI instruction is executed in every 8 x "n" msec.

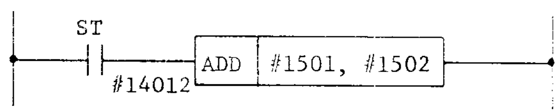
(15) ADD (ADD Register) {RR-}

① Format ADD # x x x x, # x x x

Register to be operated (R2)

Operating register (R1)

② When the ST contact is ON (RR = 1), the register (R2) contents and register (R1) are added and the result is loaded in register (R2). The R1 register contents remain unchanged. The RR contents also remain unchanged. The ADD instructions not executed when the ST contact is OFF (RR = 0).




```
LD     #14012
ADD    #1501, #1502
```

Note: In ADD or SUB, detection of overflow or underflow is not performed. With ADD, make the result less than 255 (FFH); with SUB, do not make $R_1 > R_2$.

(16) SUB (Sub Register) {RR-}

① Everything is the same as the ADD instruction, except here the operation is subtraction (R2-R1 → R2).

(17) ANR (And Register) {RR-}

① Everything is the same as the ADD instruction, except here the operation is AND, (R2 AND R1 → R2)

(18) ORR (Or Register) {RR-}

① Everything is the same as the ADD instruction, except here the operation is OR. (R2 OR R1 → R2)

(19) XRR (Excluse or Register) {RR-}

① Everything is the same as the ADD instruction, except here the operation is XOR. (R2 XOR R1 → R2)

(20) CPR (Compare Register) {RR↕}

① Format CPR # x x x x, # x x x x

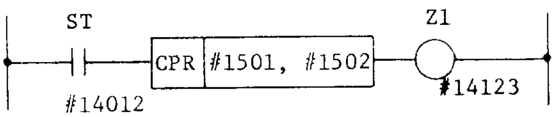
Register or contact set (R2)

Register or contact set (R1)

② When the ST contact is ON (RR = 1), the difference between R1 and R2 is taken, and;

RR is cleared if R is smaller than R2, and RR is set to "1" if R1 is greater than or equal to R2.

CPR is not executed when the ST contact is OFF (RR = 0). The RR contents remain unchanged.




```
LD    #14012
CPR   #1501, #1502
OUT   #14123
```

#1501 < #1502 ··· Z1 is set.
#1501 ≥ #1502 ··· Z1 is cleared.

③ The data in R1 and R2 remain unchanged when the CPR instruction is executed.

Note: The instructions for registers described in (16) through (20) execute their commands by 8 x ηms when the ST contact is on. The instructions ADD, SUB and XRR will change their register contents by 8 x ηms.

(21) COR (Coincide Register) {RR↕}

① Format COR # x x x x, # x x x x

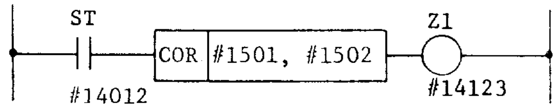
Register or contact set (R2)

Register or contact set (R1)

② When the ST contact is ON (RR = 1):

If R1 is equal to R2, Z1 is set.
If R1 is not equal to R2, Z1 is cleared.

When the ST contact is OFF (RR = 0), the COR instruction is not executed, and the RR contents remain unchanged.




```
LD    #14012
COR   #1501, #1502
OUT   #14123
```

#1501 = #1502 ··· Z1 is set.
#1501 = #1502 ··· Z1 is cleared.

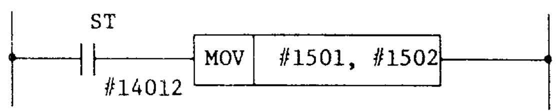
③ The data of R1 and R2 remains unchanged when the COR instruction is executed.

(22) MOV (Move Register) {RR-}

① Format MOV # x x x x, # x x x x

Register (R1) Register (R2)

② The R1 register contents are transferred to Register R2 when the ST contact is ON (RR = 1). The Register R1 contents remain unchanged.




```
LD    #14012
MOV   #1501, #1502
```

③ RR is not affected by the MOV instruction.

(23) DST (Data Store) {RR-}

① Format DST # x x x x, # x x x x, x x H

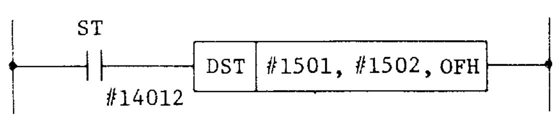
Numeric (hexadecimal)

Register (R2)

Register (R1)

② When the ST contacts in ON (RR = 1);

Register R1 and the numeric are ANDed, and the result is transferred to R2.
Register R1 remains unchanged.
When the ST contact is OFF (RR = 0);
The DST instruction is not executed.




```
LD    #14012
DST   #1501, #1502, OFH
```

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Reg. R1	B	B	B	B	B	B	B	B
Numeric	0	0	0	0	1	1	1	1
Reg. R2	0	0	0	0	B	B	B	B

B: "1" or "0"

7.5 INSTRUCTIONS FOR REGISTERS (Cont'd)

③ RR is not affected by execution of the DST instruction.

(24) DIN (Data Insert) {RR-}

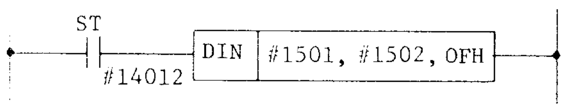
① Format DIN # x x x x, # x x x x, x x H

Numeric (hexadecimal)

Register or contact set (R2)

Register or contact set (R1)

② When the ST contact is ON (RR = 1), the R1 data and numeric are ANDed and the result is ORed with the AND of the R2 data and the numeric complement. The result is stored in R2 (data extraction). When the ST contact is OFF (RR = 1), the DIN instruction is not executed.




```
LD     #14012
DIN    #1501, #1502, OFH
```

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
R1	A	A	A	A	A	A	A	A
R2	B	B	B	B	B	B	B	B
n	0	0	0	0	1	1	1	1
Result	B	B	B	B	A	A	A	A

A, B: Data is "1" or "0."

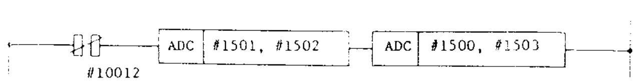
(25) ADC (Add with Carry) {RR}

① Format ADC # x x x x, # x x x x

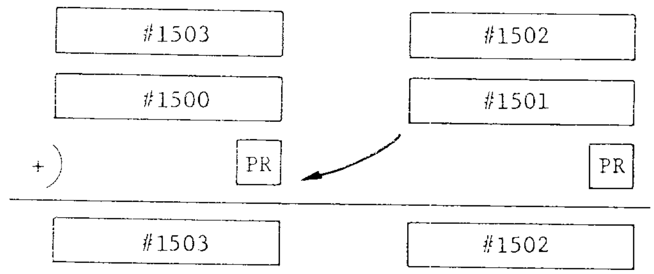
Register or contact set (R2)

Register or contact set (R1)

② Register R1, R2 and RR are added, and the result stored in Register R2. RR is set to "1" when a carry occurs.




```
LD NOT    #10012
ADC       #1501, #1502
ADC       #1500, #1503
```



③ RR must be cleared to execute the ADC instruction.

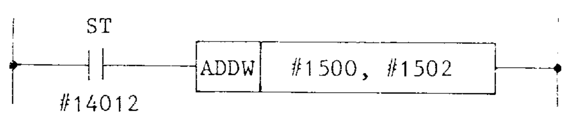
(26) ADDW (Add Word Register) {RR-}

① Format ADD # x x x x, # x x x x

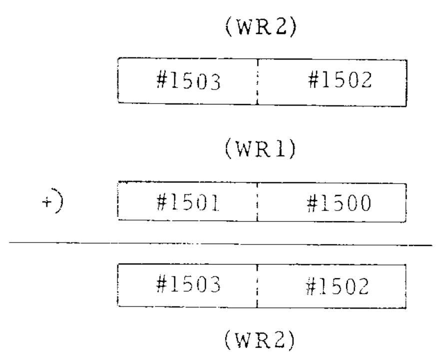
Low side of double length register (WR2)

Low side of double length register (WR1)

② When the ST contact is ON (RR = 1), the contents of double length registers, WR2 and WR1, are added and the result is stored in WR2. WR1 remains unchanged. (WR2) + (WR1) → (WR2). The RR contents do not change by the operation. When the ST contact is OFF (RR = 0), the ADDW instruction is not executed. The numeric is judged without code.




```
LD      #14012
ADDW    #1500, #1502
```



(27) SUBW (Sub Word Register) {RR- }

① Format SUBW # x x x x, # x x x x

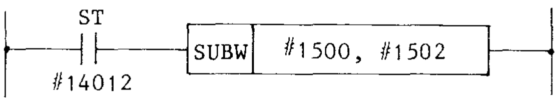
Low side of double length register (WR2)

Low side of double length register (WR1)

② When the ST contact is ON (RR = 1), the results of the contents of double length registers, WR2 minus WR1 is stored in WR2. WR1 remains unchanged.

(WR2) - (WR1) → (WR2)

When the ST contact is OFF (RR = 0), the SUBW instruction is not executed. The numeric is judged without code.



LD #14012
INRW #1500, #1502

(WR2)

#1503	#1502

(WR1)

-) | #1501 | #1500 |

#1503	#1502

(WR2)

(28) MULW (Mul Word Register) {RR↕ }

① Format MULW # x x x x, # x x x x

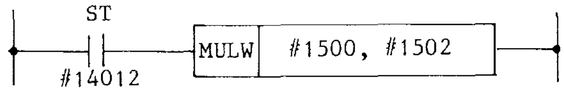
Low side of double length register (WR2)

Register (R1)

② When the ST contact is ON (RR = 1), the contents of double length register, WR2 and register R1 are multiplied, and the result is stored in WR2. R1 remains unchanged.

(WR2) × (R1) → (WR2)

When the ST contact is OFF (RR = 0), the MUL instruction is not executed. The numeric is judged without code. If the result is overflown, more than "FFFFH," RR equals one.



LD #14012
MUL #1500, #1502

(WR2)

#1503	#1502

(R1)

×) | #1500 |

#1503	#1502

(WR2)

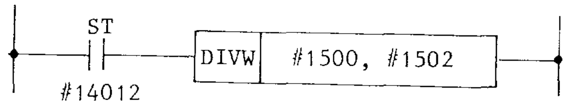
(29) DIVW (Division Word Register) {RR- }

① Format DIVW # x x x x, # x x x x

Low side of double length register (WR2)

Register (R1)

② When the ST contact is ON (RR = 1), the contents of double length register WR2 is divided by register R1 and the result is stored in WR2. WR1 remains unchanged. When the ST contact is OFF (RR = 0), DIV instruction is not executed. The numeric is judged without code. If WR1 is "0," operation will not be executed.



LD #14012
DIV #1500, #1502

(WR2)

#1503	#1502

(R1)

÷) | #1500 |

#1503	#1502

(WR2)

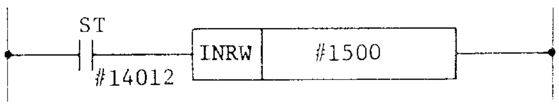
7.5 INSTRUCTIONS FOR REGISTERS (Cont'd)

(30) INRW (Increment Word Register) {RR-}

① Format INRW # x x x x

Low side of double length register

② When the ST contact is ON, +1 is added to the double length register contents.




```
LD    #14012
INRW  #1500
```

(31) DCRW (Decrement Word Register) {RR-}

① The same as INRW, but the operation here is addition of -1 to the double length register contents.

(32) CLRW (Clear Word Register) {RR-}

① The same as INRW, but here the double length register contents are cleared.

(33) CMRW (Complement Word Register) {RR-}

① The same as INRW, but here the double length register contents are inverted.

(34) CORW (Coincide Word Register) {RR↕}

① Format CORW # x x x x, # x x x x

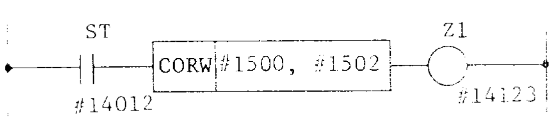
Double length register (WR2)

Double length register (WR1)

② When the ST contact is ON (RR = 1), WR1 and WR2 are checked for the coincidence;

If WR1 and WR2 are equal, RR is set to 1.
If WR1 and WR2 are not equal, RR is cleared.

When the ST contact is OFF (RR = 0), the CORW instruction is not executed, and the RR contents remain unchanged.




```
LD    #14012
CORW  #1500, #1502
OUT   #14123
```

#1500 = #1502 ··· Z1 is set.
#1500 = #1502 ··· Z1 is cleared.

③ The data of WR1 and WR2 do not change when the CORW instruction is executed.

(35) CPRW (Compare Word Register) {RR↕}

① Format CPRW # x x x x, # x x x x

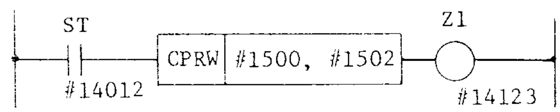
Double length register (WR2)

Double length register (WR1)

② When the ST contact is ON (RR = 1), WR1 and WR2 are checked for the difference;

If WR1 is smaller than WR2, RR is cleared.
If WR1 is greater than or equal to WR2, RR is set.

When the ST contact is OFF (RR = 0), the CPRW instruction is not executed. The RR contents remain unchanged.




```
LD    #14012
CPRW  #1500, #1502
OUT   #14123
```

#1500 < #1502 ··· Z1 is set.
#1500 ≥ #1502 ··· Z1 is cleared.

(36) MVIW (Move Immediate Word Register) {RR-}

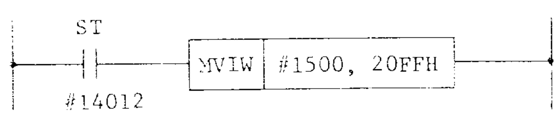
① Format MVIW # x x x x, x x x x H

Numeric (Low side)

Numeric (High side)

Double length register

② When the ST contact is ON (RR = 1), the numeric is transferred to the register. When the ST contact is OFF (RR = 0), the MVIW instruction is not executed.



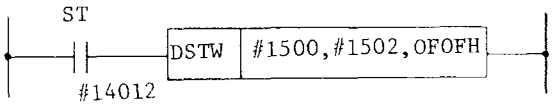
③ The RR contents are not affected by execution of the MVIW instruction.

(37) DSTW (Data Store Word Register) {RR-}

① Format DSTW #xxxx, #xxxx, xxxxH

- #xxxx: Register (WR1)
- #xxxx: Register (WR2)
- xxxxH: Numeric

② When the ST contact is ON (RR = 1), Register WR1 and the numeric and ANDed and the result is transferred to Register WR2. The WR1 contents remain unchanged. When the ST contact is OFF (RR = 0), the DSTW instruction is not executed.



LD #14012
DSTW #1500, #1502, OFOFH

	D_{15}	D_{14}	D_{13}	D_{12}	D_{11}	D_{10}	D_9	D_8
Reg. WR1	B	B	B	B	B	B	B	B
Numeric	0	0	0	0	1	1	1	1
Reg. WR2	0	0	0	0	B	B	B	B

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Reg. WR1	B	B	B	B	B	B	B	B
Numeric	0	0	0	0	1	1	1	1
Reg. WR2	0	0	0	0	B	B	B	B

B: "1" or "0"

③ The RR contents remain unchanged when the DST instruction is executed.

7.6 CONTROL INSTRUCTIONS

(1) NOP (No Operation) {RR-}

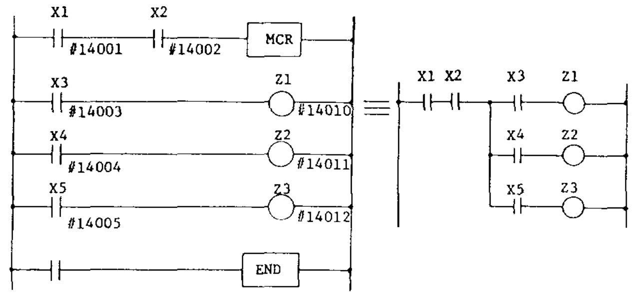
① Format NOP

② No operation is conducted and the system moves to the next step. The RR contents remain unchanged.

(2) MCR (Master Control) {RR-}

① Format MCR

② When the X1 and X2 contacts are ON (RR = 1), the sequence ladder is released.
When the X1 and X2 contacts are OFF (RR = 0), the ladder up to END is executed in the state of RR being "0."



LD #14001
AND #14002
MCR

LD #14003
OUT #14010

LD #14004
OUT #14011

LD #14005
OUT #14012

END

Where X1 and X2 contacts are off, is given from internal relays Z1, Z2 and Z3.

③ Another MCR instruction can be given between MCR and END (7 levels max).

④ When a timer instruction is included in MCR, the timer is cleared when MCR is OFF.

⑤ Even if a self-holding circuit is formed between MCR and END instructions, the circuit output is OFF when MCR input contact is OFF.

(3) END (Master Control End) {RR-}

① Format END

② Indicates that MCR is at the end.

(4) RET (Return) {RR-}

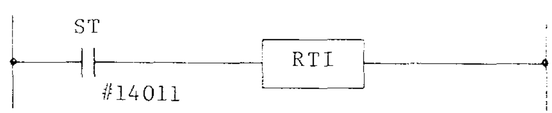
① Format RET

② Indicate the end of sequence program.

(5) RTI (Return Indirect) {RR-}

① Format RTI

② When the ST contact is OFF, ladder of the next step is executed.



LD #14011
RTI

7.6 CONTROL INSTRUCTIONS (Cont'd)

(6) SET (Set Return Register) {RR-}

① Format SET

② Forcibly sets RR to "1."

(7) RTH (Return High Sequence) {RR-}

① Format RTH

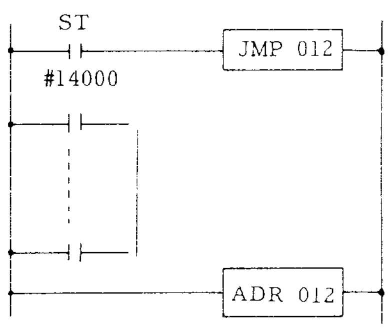
② Indicates the end of a high speed sequence program.

(8) JMP (Jump) {RR-}

① Format JMP x x x

Label number to which this instruction jumps

② When the ST contact is ON (RR = 1), this jumps to the label 1 indicated by ADR. When the ST contact is OFF (RR = 0), ladder of the next step is executed.




```
LD   #14000
JMP     012
```

Note: In JMP instruction output coil to ADD is retained when RR=0

(9) ADR (Address) {RR-}

① Format ADR x x x

Label number

② Indicates a destination which JMP instruction jumps to.

Note: As shown in the above example, JMP and ADR are used as a pair. Label numbers of JMP and ADR shall be the same value.

7.7 MACRO INSTRUCTIONS

Macro instructions (SUBPxxx) are provided to enable the operators to simply arrange operations of machine tools with which ladders cannot be prepared easily with basic instructions (relay instruction, register instruction, etc.) only. The following explains further details. The format of macro instructions is as follows:

SUBP x x x

Macro instruction number

The following auxiliary instructions are used with macro instructions:

A. IPSH (Immediate Push) {RR-}

① Format IPSH x x x x H

Numeric (hexadecimal)

② Directly designate the numeric used with SUBP.

B. APSH (Address Push) {RR-}

① Format APSH # x x x x

Register

② Designate the address of the register used with SUBP.

C. PUSH (Push) {RR -}

① Format PUSH # x x x x

Register

② Designate the address where the numeric used with SUBP is stored.

D. TPSH (Table Push) {PR-}

① Format TPSH x x x x

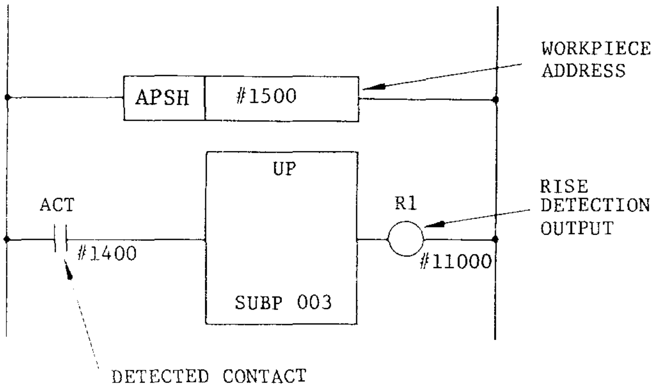
Table number

② Designates the table number of PC table used with SUBP.

(1) SUBP 003 (UP: Rise Signal Detection)

① Function: Detects signal rise.

② Form



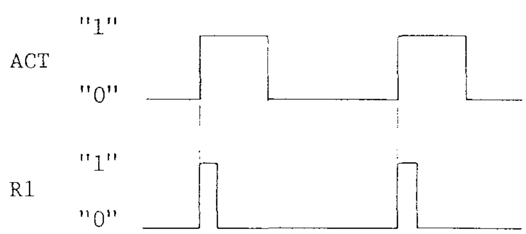
APSH #1500	...	Workpiece address
LD #14000	...	Detected contact
SUBP 003	...	UP instruction
OUT #11000	...	Rise detection output

③ Control conditions

- Workpiece address (APSH#xxxx)

  Designate an address that is not used by other instructions. 1 byte is needed for one SUBP 003.

- Detected contact (ACT) and rise detection output (R1).



ACT = 0: Not detected. R1 = 0

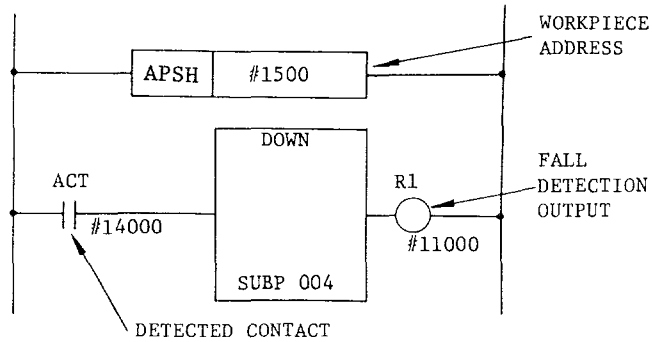
ACT = 1: At the rise of "0" to "1," the R1 status shifts from "0" to "1" and then "0."

Note: If ACT is "1" at the time of power turning on, it is regarded as the rise.

(2) SUBP 004 (DOWN: Fall signal detection)

① Function: Detects signal fall.

② Form



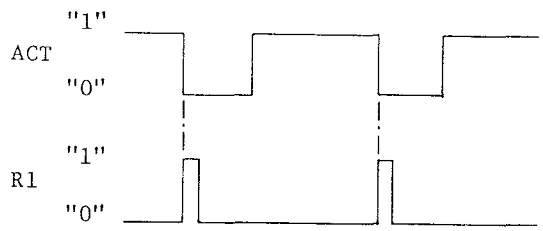
APSH	#1500	...	Workpiece address
LD	#14000	...	Detected contact
SUBP	004	...	DOWN instruction
OUT	#11000	...	Fall detection output

③ Control conditions

(a) Workpiece address (APSH#xxxx)

Designate an address that is not used by other instructions. 1 byte is needed for one SUBP 004.

(b) Detected contact (ACT) and rise detection output (R1)



ACT = 1: Not detected. R1 = 0

ACT = 0: At the fall of "1" to "0," the R1 status shifts from "0" to "1" and then "0."

Note: Even if ACT is "0" at the time of power turning on, it is not regarded as the fall.

(3) SUBP 005 (Counter)

① Function: This counter can be used in many ways to control machine tool operation according to the applications, as described below.

(a) Ring counter

This counter is ring counter. Accordingly, it returns to the initial value when a count signal is input after counting up to the preset value.

7.7 MACRO INSTRUCTIONS (Cont'd)

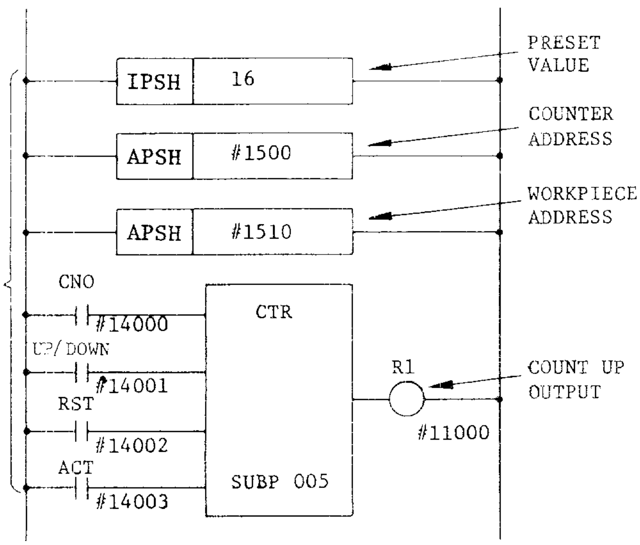
(b) Preset counter

If a count number is preset, and the count value reaches the set value, COUNT UP is output.

(c) Up/Down counter

This counter can be used for up count and down count also.

② Form




```
IPSH 16        ... Preset value
APSH #1500     ... Counter address
APSH #1510     ... Workpiece address
LD   #14000    ... CNO
STR  #14001    ... UP DOWN
STR  #14002    ... RST
STR  #14003    ... ACT
SUBP 005       ... COUNTER instruction
OUT  #11000    ... COUNT UP output
```

③ Control conditions

(a) Preset value designation (IPSH xx)

Directly designate a preset value.
To designate a variable value, use the PUSH instruction, instead of IPSH, and designate the address. The preset value becomes the address contents.

Example:

PUSH #1550

If the above designation is given, the two byte of #1550 and #1551 are used. Do not use #1551 for others even if only one byte is to be used.

(b) Counter address designation (APSH #xxxx)

Designate the counter address.
If APSH #1500 is designated, the continuous two bytes, that is, #1500 and #1501, are used for the counter address.

(c) Workpiece address designation (APSH#xxxx)

Designate an address that is not used by other instructions. 1 byte is needed for one SUBP 005. When two or more SUBP 005 are used, designate an address to each of it.

(d) Initial value designation (CNO)

CNO = 0: The counter cumulative value starts at "0."
(0, 1, 2, 3, 4, ... n)

CON = 1: The counter cumulative value starts at "1."
(1, 2, 3, 4, 5, ... n)

(e) UP/DOWN designation

UP/DOWN = 0: Up counter
Initial value is "0" with CNO = 0
Initial value is "1" with CON = 1

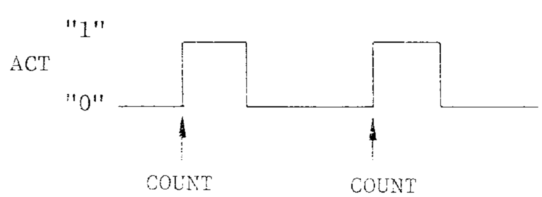
UP/DOWN = 1: Down counter
The initial value is the preset value.

(f) Reset (RST)

RST = 0: Reset release

RST = 1: Reset
R1 is cleared. The cumulative values is set to the initial value.

(g) COUNT signal (ACT)



ACT = 0: The counter does not operate. The R1 contents remain un-changed.

ACT = 1: Counts at the rise of "0" to "1."

Note:
If the counter contents are greater than the preset value at the time of power turn on:

In the case of Up counter:
Returns to the initial value with the first ACT.

In the case of Down counter:
Counts down each time ACT is applied, and when the value enters within the preset value, the operation afterward is normal.

(h) COUNT UP output (R1)

Up counter:
R1 is set to "1" upon counting up to the preset value.

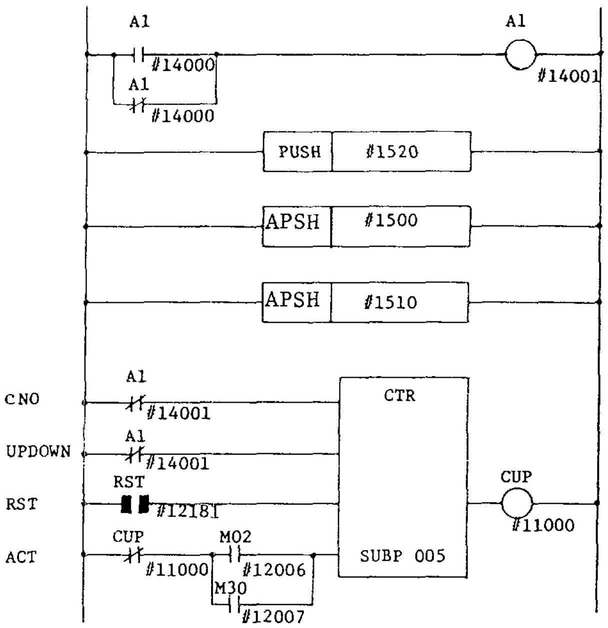
Down counter:
When CON = 0
R1 is set to "1" when counted down to "0."

When CON = 1
R1 is set to "1" when counted down to "1."

④ Counter use example

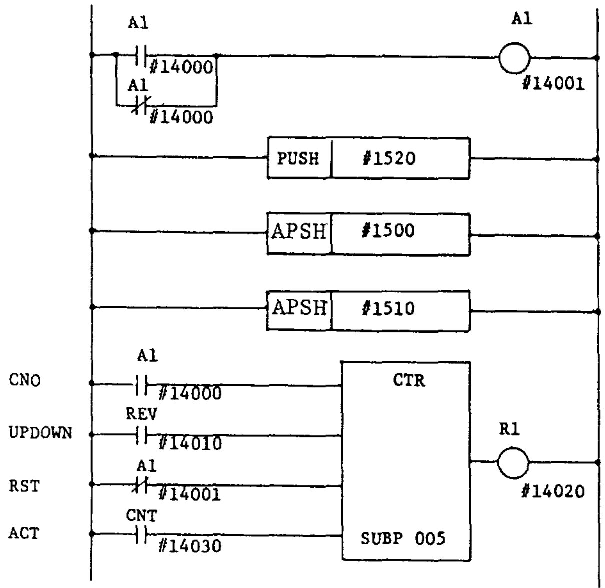
(a) Example of using the counter as a preset counter

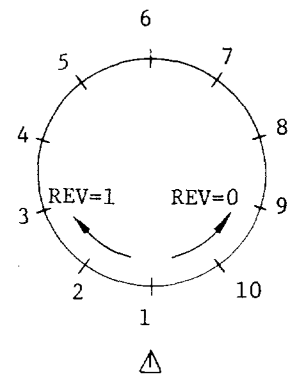
The number of machined workpieces is counted. When the count reaches the set value, the COUNT UP signal is output.



- A1 is the circuit to create Logic "1."
- NC contact of A1 is used to clear CNO since the count range used is 0 to 9999.
- NC contact of A1 used to clear UP DOWN as it is used as an UP counter.
- RST, the input signal from the NC unit, is used as the counter reset signal.
- The count signal is the input signal from the NC unit, M02 or M30. NC contact of CUP is contained in this signal the counter does not count once it counted up unless it is reset.

(b) Example of using the counter to memorize the rotating object position.





INDEXED POSITION

- A1 is circuit to create Logic "1."
- With the rotating object of 10 angles, as shown in the figure, the count start number is 1. Therefore, NO contact of A1 is used to CNO to "1."
- REV is a signal that changes according to the rotation direction. It is "0" for forward rotation and "1" for revers set CNO to "1."
- REV is a signal that changes according to the rotation direction. It is "0" for forward rotation and "1" for reverse rotation. Therefore, it operates as an Up counter for forward rotation and as a Down counter for reverse rotation.
- Since no reset signal is used in this example, it is kept to "0" always. Therefore, NC contact of A1 is used.
- The CNT count signal is a signal to turn ON/OFF 10 times for one rotation of the rotation object.
- Set 10 and 0 to the preset value addresses of #1520 and #1521, respectively.

7.7 MACRO INSTRUCTIONS (Cont'd)

(4) SUBP 006 (ROTATION)

① Function:

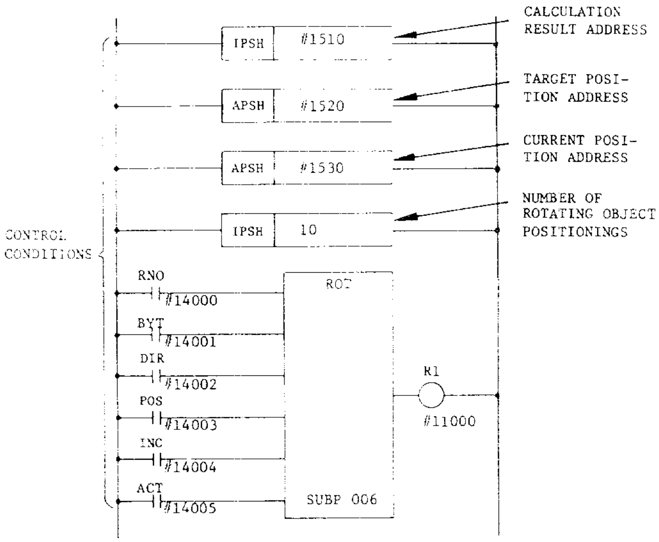
This instruction is used to control rotation objects such as blade base, ACT and rotating table. It has the following functions:

(a) Judgement of short-cut rotation direction

(b) Calculation of number of steps between the current position and target position

(c) Calculation of the position of one step before the target position or the number of steps up to one step before the target position.

② Form



APSH #1510	...	Calculation result output address
APSH #1520	...	Target position input address
APSH #1530	...	Current position address
IPSH 10	...	Number of rotating object positionings
LD #14000	...	The position number is from "0" or "1."
STR #14001	...	The position data is in 1 byte or 2 bytes.
STR #14002	...	The rotation direction is constant or in shortcut.
STR #14003	...	Target position or one step before
STR #14004	...	Position number of number of steps
STR #14005	...	Execution
SUBP 006	...	ROT instruction
OUT #11000	...	Rotation direction output

③ Control conditions

(a) Designation of calculation result storage address (APSH#xxxx)

The ROT instruction calculates the number of steps that the rotating object should rotate, step number of one step before or the position of one step before the target position, and the result is stored in the designated address.

(b) Designation of target position address (APSH#xxxx)

Designate the address at which the target position is contained. In other words, this is the address in which the T command from the NC unit is contained.

(c) Designation of current position address (APSH#xxxx)

Designate the address where the current position is stored. For example, this is the address of the counter that memorizes the rotating object position.

(d) Designation of initial value of the position number of rotating object (RNO)

RNO = 0: The position number of rotating object starts from "0."

RNO = 1: The position number of rotating object starts from "1."

(e) Designation of number of bytes of position data (BYT)

BYT = 0: Binary 1 byte

BYT = 1: Binary 2 bytes

(f) Designation of whether or not short-cut direction should be determined (DIR)

DIR = 0: No determination is made on short-cut direction. The rotation direction is forward only.

DIR = 1: Determines short-cut direction.

(g) Designation of operation conditions (POS)

POS = 0: Calculate the number of steps to the target position.

POS = 1: Calculates the position or number of steps of one step before the target.

(h) Designation of position or number of steps (INC)

INC = 0: Calculates the position number.

INC = 1: Calculates the number of steps.

(i) Execution command (ACT)

ACT = 0: No execution of ROT instruction. R1 is not affected.

ACT = 1: Execute the ROT instruction. (This is not a rise signal.)

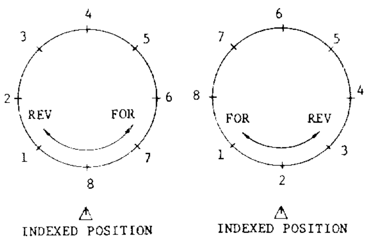
(j) Rotation direction output (R1)

R1 = 0: The rotation direction is forward.

R1 = 1: The rotation direction is reverse.

Note:

1. The rotation direction is defined as shown below:

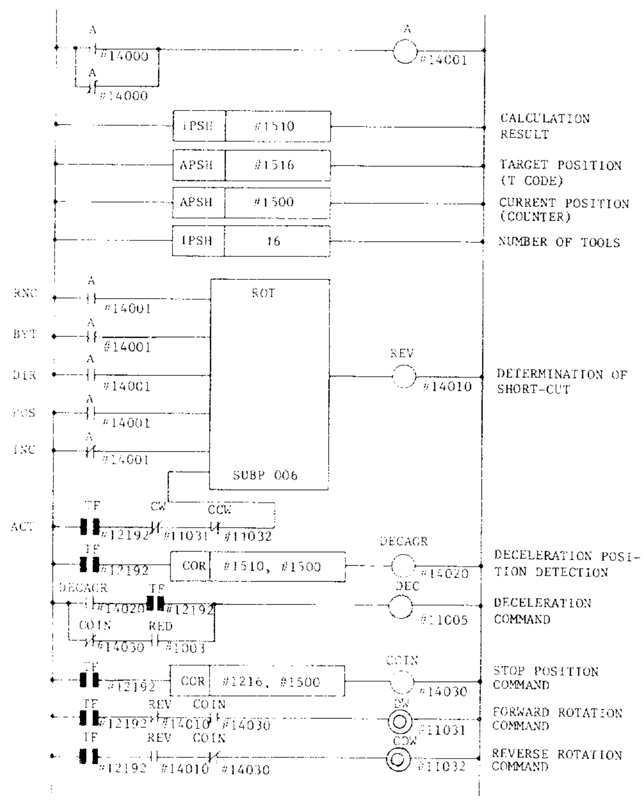


The rotation direction in which the number increases from the indexed position is the forward direction. The direction in which the number decreases is the reverse direction.

2. When the current position is equal to the target position, the calculation result of the number of steps of one step before the target position (POS = 1, INC = 1) is "0."

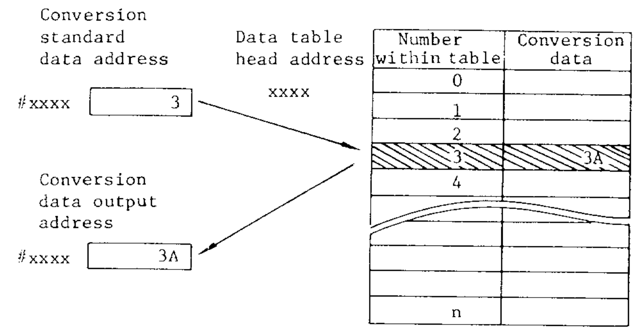
④ Use of example of ROT instruction

The following shows the control of a 16-position rotating object, without short-cut control but for deceleration at the position of one step before the target position.

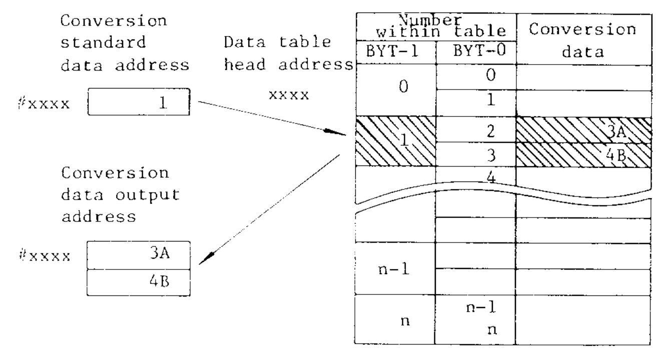


(5) SUBP 007 (CODE CONVERSION)

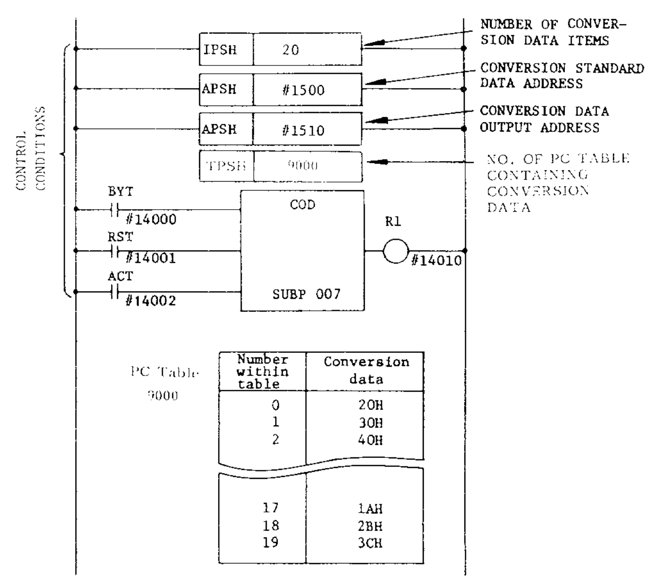
① Function: Converts data using the PC table prepared on the ladder.



- When "3" is instructed for the conversion standard data address with BYT = 0, as shown in the above figure, the data of the third address from the head of the table is stored in the conversion data output address. The head address of the table is "0."
- The status when BYT is set to "1" is shown below. At this time, check that the size of the conversion data table is in a even byte number.



② Form



7.7 MACRO INSTRUCTIONS (Cont'd)

IPSH 20	...	Size of conversion data table (Number of bytes).
APSH #1500	...	Conversion data address
TPSH #9000	...	No. of PC table containing conversion data.
APSH #1510	...	Converted data store address.
LD #14000	...	Data of data table is in 1 byte or 2 bytes.
STR #14001	...	Reset
STR #14002	...	Execution
SUBP 007	...	COD instruction
OUT #14010	...	ERROR output

-20H
-30H
-40H
.
.
.
.
-1AH
-2BH
-3CH

Conversion data table

③ Control conditions

(a) Designation of number of conversion data items (IPSH xx)

Designate the size (number of bytes) of the conversion data table. The maximum size is 256 bytes.

(b) Designation of conversion standard data address (APSH #xxxx)

Data in the conversion data table is fetched out by designating the number inside the data table. Designate this number inside the table.

(c) Designation of conversion data output address (APSH #xxxx)

Designate the address to output the data stored in the number inside the table that is designated by Item b. When BYT is "1," data at the higher side is output to the address next to the designated address.

(d) Designation of conversion data table (TPSH xxxx)

Table size is different depending on PC table No.

- 9000 - 9007: 256 bytes max
- 9008 - 9023: 128 bytes max
- 9024 - 9087: 64 bytes max
- 9088 - 9215: 32 bytes max
- 9216 - 9435: 16 bytes max

(e) Designation of data size (BYT)

BYT = 0: When data of the conversion data table is in 1 byte.

BYT = 1: When data of the conversion data table is in 2 bytes.

(f) Reset (RST)

RST = 0: No reset.

RST = 1: ERROR output R1 is cleared.

(g) Execution command (ACT)

ACT = 0: No execution. R1 does not change.

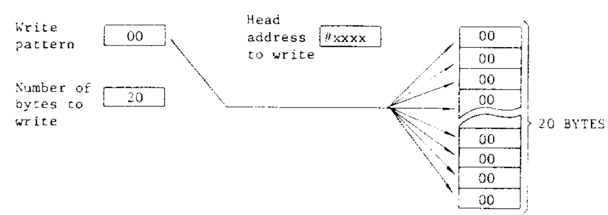
ACT = 1: Executes.

(h) Error output (R1)

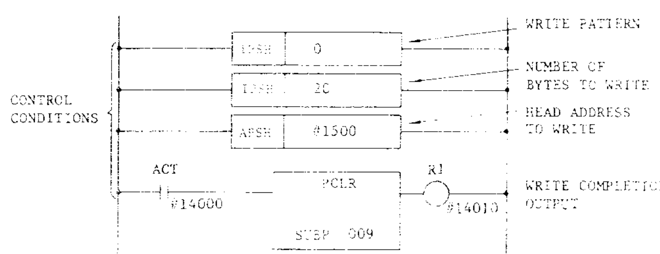
An error that has occurred during execution of the COD instruction (when a numeric that is greater than the table size).
R1 is set to "1" to notify the error.

(6) SUBP 009 (PATTERN CLEAR)

① Function: Writes the same numeric for the designated number of bytes from the designated address.



② Form



IPSH 0	...	Write pattern
IPSH 20	...	Number of bytes to write
APSH #1500	...	Head address to write
LD #14000	...	Execution
SUBP 009	...	PCLR instruction
OUT #14010	...	Write completion output

③ Control conditions

(a) Designation of write pattern (IPSH xx)

Designate a write pattern.
If the pattern is to be variable, use PUSH, instead of IPSH, and designate the address.

(b) Designation of number of bytes to write (IPSH xx)

Designate the number of bytes for pattern clear.

(c) Designation of the head address to write (APSH #xxxx))

Designate the head address for PATTERN CLEAR start. PATTERN CLEAR is executed for the designated number of bytes from the address.

(d) Execution command (ACT)

ACT = 0: No execution.

ACT = 1: Executes.

(e) Write completion output (R1)

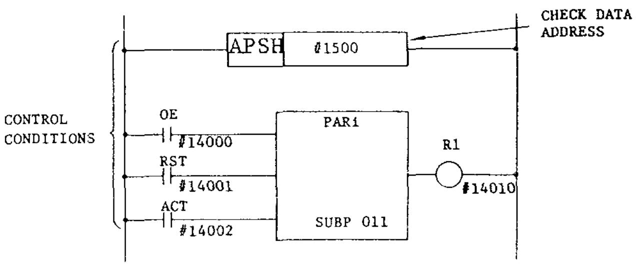
R1 = 0: Write not completed yet.

R1 = 1: Write completed.

(7) SUBP 011 (PARITY CHECK)

① Function: Parity check (even and odd) of the check data (1-byte data).
If not normal, an ERROR output it made.

② Form



APSH #1500	...	Check data address
LD #14000	...	Even/odd parity switching
STR #14001	...	Reset
STR #14002	...	Execution command
SUBP 011	...	PARI instruction
OUT #14010	...	ERROR output

③ Control conditions

(a) Designation of check data address (APSH #xxxx).

Designate the address where the data to be checked is stored. This data to be checked is in 1 byte (8 bits).

(b) Odd/Even command (OE)

OE = 0: Even parity check

OE = 1: Odd parity check

(c) Reset

RST = 0: No reset.

RST = 1: Resets ERROR output R1.

(d) Execution command (ACT)

ACT = 0: No execution of PARI instruction. R1 does not change.

ACT = 1: Executes PARI instruction.

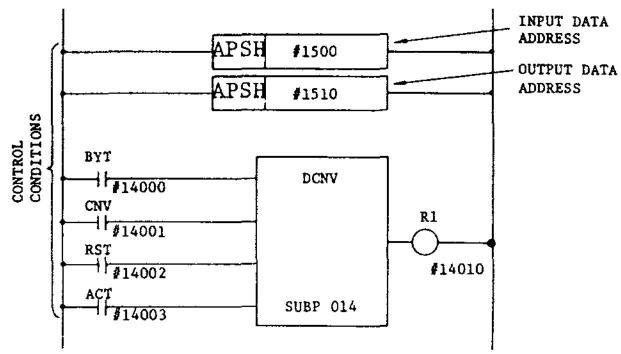
(e) Error output (R1)

When an odd parity resulting from even parity check or even parity resulting from odd parity check, ERROR output R1 is set to "1."

(8) SUBP 014 (DATA CONVERSION)

① Function:
Converts binary data to BCD data, or vice versa.

② Form



APSH #1500	...	Data address to be converted
APSH #1510	...	Conversion result storing address.
LD #14000	...	1-byte or 2-bytes processing.
STR #14001	...	Conversion from binary to BCD or vice versa.
STR #14002	...	Reset
STR #14003	...	Execution
SUBP 014	...	DCNV instruction
OUT #14010	...	ERROR output

③ Control conditions

(a) Input address of data to be converted (APSH #xxxx)

Designate the address where the data to be converted is stored. In the case of BYT = 1, two continuous bytes are used for the address.

7.7 MACRO INSTRUCTIONS (Cont'd)

(b) Conversion result storing address

This address stores the converted data. Where BYT = 1, continuous bytes are used.

(c) Designation of number of bytes of data (BYT)

BYT = 0: The processing data is in one byte.

BYT = 1: The processing data is in two bytes.

(d) Designation of conversion form (CNB)

CNV = 0: Converts binary data to BCD data.

CNV = 1: Converts BCD data to binary data.

(e) Reset (RST)

RST = 0: No reset.

RST = 1: Resets error output R1.

(f) Execution command (ACT)

ACT = 0: No execution.

ACT = 1: Execution.

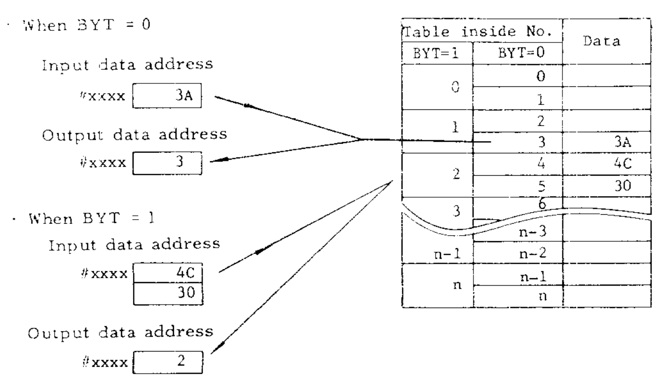
(g) ERROR output (R1)

R1 = 0: Normal

R1 = 1: Abnormal (The data to be converted was binary data when CNV = 1, or the byte length was exceeded when CNV = 0.)

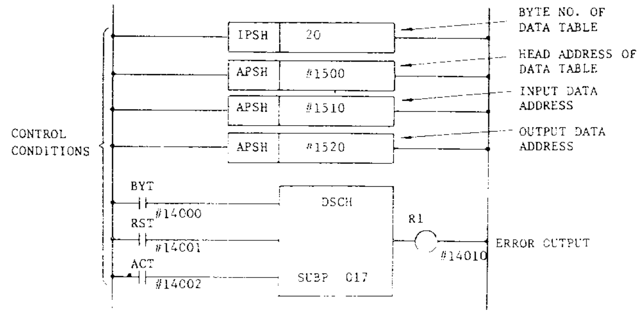
(9) SUBP 017 (DATA SEARCH)

① Function:
Searches the same data as the input data in the table. If there is, the relative address from the table head is stored in the output data address. If the same data is not found, an ERROR output is made.



Note: Check that the table size is in as even byte number when BYT = 1.

② Form



IPSH 20	...	Number of bytes of data table
APSH #1500	...	Head address of data table
APSH #1510	...	Search data address
APSH #1520	...	Table inside number storing address
LD #14000	...	The processing data is in one byte or two bytes.
STR #14001	...	Reset
STR #14002	...	Execution
STR #14003	...	Execution
SUBP 017	...	DSCH instruction
OUT #14010	...	ERROR output

③ Control conditions

(a) Designation of number of data items of data table (IPSH xx)

Designate the data table size (number of bytes).

(b) Designation of head address of data table (APSH #xxxx)

Designate the head address of the data table. The data table may be created in any place.

(c) Designation of input data address (APSH #xxxx)

Designate the address where the data to be searched is stored.

(d) Designation of output data address (APSH #xxxx)

If the searched data is found (R1 = 0), the number inside the table where the data is stored is output. Designate the output address.

(e) Designation of data size (BYT)

BYT = 0: The stored in the data table is in one byte.

BYT = 1: The data stored in the data table is in two bytes.

(f) Execution command (ACT)

ACT = 0: No execution

ACT = 1: Execution

(g) Reset (RST)

RST = 0: Not reset.

RST = 1: Reset. R1 is cleared.

(h) ERROR output (R1)

R1 = 0: The search data is found.

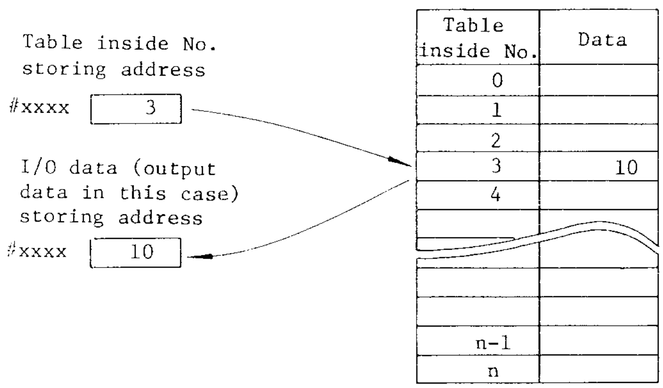
R1 = 1: The search data is not found.

(10) SUBP 018 (INDEX DATA MOVE)

① Function: Reads or re-writes data from the data table.

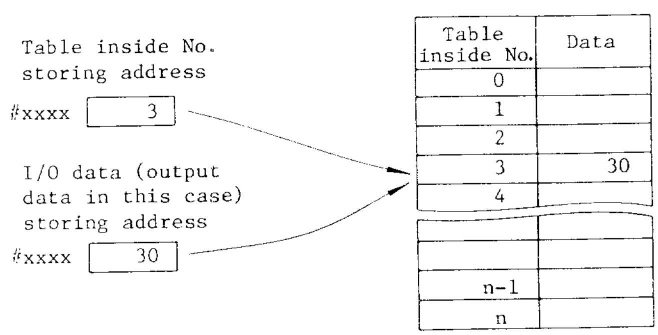
(a) Read

- "3" was designated as the table inside number and the contents were read.

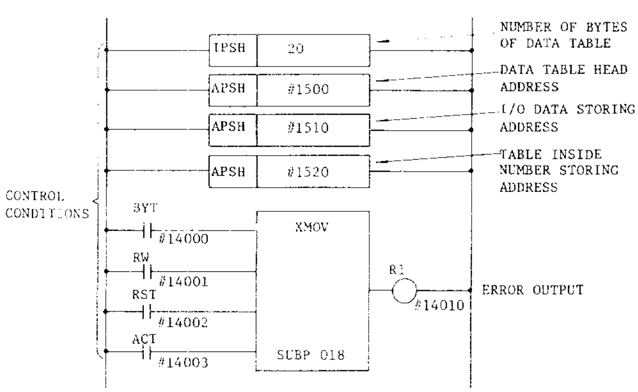


(b) Re-write

- "3" was designated as the table inside number and the contents were re-written.



② Form



IPSH 20	...	Number of bytes of data table
APSH #1500	...	Data table head address
APSH #1510	...	I/O data storing address
APSH #1520	...	Table inside number storing address
LD #14000	...	The processing data is in one byte or two bytes.
STR #14001	...	Read or Re-write
STR #14002	...	Reset
STR #14003	...	Execution
SUBP 018	...	XMOV instruction
OUT #14010	...	ERROR output

③ Control conditions

(a) Designation of number of data items of data table (IPSH xx)

Designate the data table size (number of bytes).

(b) Designation of data table head address (APSH #xxxx)

Designate the data table head address. The data table may be created in any place.

(c) Designation of I/O data storing address (APSH #xxxx)

RW = 0: Address to store output data.

RW = 1: Address to store input data.

(d) Designation of table inside number storing address (APSH #xxxx)

Designate which data in the data table should be read or re-written with a table inside number. The table inside number designates the storing address.

(e) Designation of data size (BYT)

BYT = 0: The data stored in the data table is in one byte.

BYT = 1: The data stored in the data table is in two bytes.

(f) Designation of read or re-write (RW)

RW = 0: Reads data from the data table.

RW = 1: Re-writes data from the data table.

(g) Reset (RST)

RST = 0: Not reset.

RST = 1: Reset. R1 is cleared.

(h) Execution command (ACT)

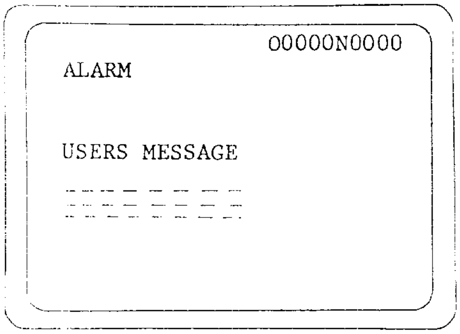
ACT = 0: No execution

ACT = 1: Execution

7.7 MACRO INSTRUCTIONS (Cont'd)

(11) SUBP 023 (MESSAGE DISPLAY)

① Function: Displays messages on the CRT of NC.



The message is displayed under the title of USERS MESSAGE.

The message is displayed under the title of USERS MESSAGE.

Max. number of characters and types of messages are as follows. One of each is selected.

Max. number of characters	Type	Table address
16 bytes	220	#9216 ~ #9435
32 bytes	128	#9088 ~ #9215
64 bytes	64	#9024 ~ #9087

The following shows the max. number that can be displayed on the CRT at the same time.

Max. number of characters	Number of simultaneous displays
16 bytes	3 sets
32 bytes	2 sets
64 bytes	1 set

- Up to 4 messages are displayed on the CRT screen. If there is a request to display more messages, low order bits are given the priority. Messages of higher priority are displayed sequentially.
- The displayed messages set the corresponding bits to "1," and messages to be cleared clear the corresponding bits. The figure below shows the correspondence.

Display request	7	6	5	4	3	2	1	0	#1500
	15	14	13	12	11	10	9	8	#1501
Display status	7	6	5	4	3	2	1	0	#1502
	15	14	13	12	11	10	9	8	#1503
Display request	23	22	21	20	19	18	17	16	#1504
	31	30	29	28	27	26	25	24	#1505
Display status	23	22	21	20	19	18	17	16	#1506
	31	30	29	28	27	26	25	24	#1507

Note:

1. Do not set bits containing no message data to "1."
2. This instruction is an instruction to display messages on the CRT screen. The instruction cannot set NC to an alarm state (1-block atop, decelerated stop, and immediate stop).

② Form

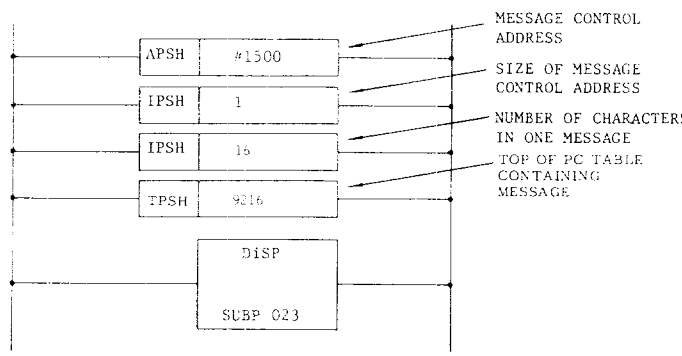


Table addresses	Display request	Message contents
#9216	#15000	SPINDLE-ALARM
#9217	#15001	MO6 ERROR
#9218	#15002	TAPPING ERROR
#9219	#15003	
#9229	#15015	UNUSABLE S-CODE
#9230	#15016	UNUSABLE M-CODE
#9231	#15017	PARAMETER ERROR

APSH #1500 ... Message data control address

IPSH 1 ... Size of message control address

IPSH 16 ... Number of characters of one message data

TPSH 9216 ... Top of PC table containing message.

SUBP 023 ... DISP instruction

③ Control conditions

(a) Designation of message control address (APSH #xxxx)

Designate the head address that request the message.

(b) Designation of size of message control address (IPSH xx)

Designate the size (number of bytes) of message control address.

For example, when the message control address is designated as APSH #1500 if IPSH 1 is specified, continuous 4 bytes from #1500 are used, and if IPSH 2 is specified, continuous 8 bytes from #1500 are used.

Note: Up to 16 types of messages are available when IPSH 1 is specified.

(c) Designation of number of characters per message (IPSH xx)

The number of characters for each message varies. Designate the maximum number of characters in the PC table to be used.

(d) Designation of top number of PC table containing message (TPSH xxxx)

④ DISP instruction use example

When contacts AL1 - AL4 are set on, the message corresponding to the request bits are displayed on the CRT screen, and deceleration stop is performed. The display goes out when a reset signal is given.

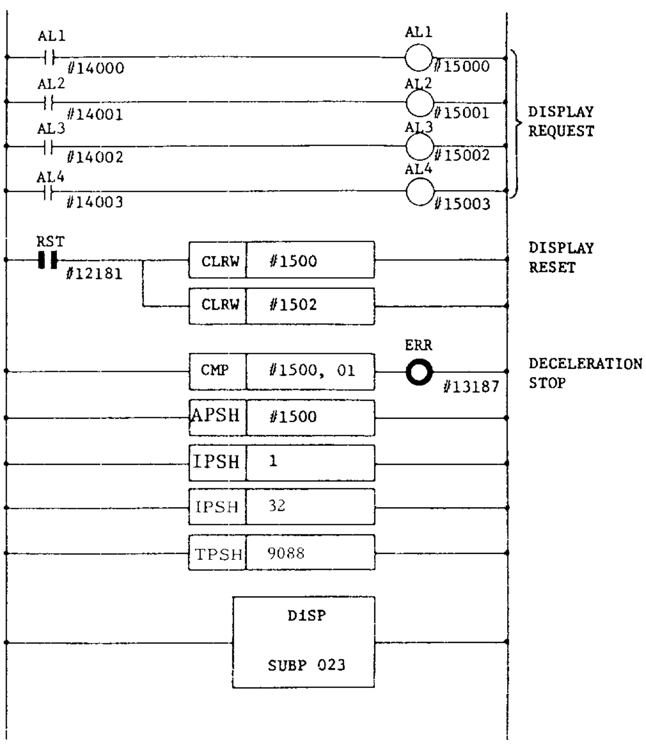


Table addresses	Display request	Message contents
#9088	#15000	PARAMETER ERROR
#9089	#15001	SPINDLE SERVO ALARM
#9090	#15002	MO6 ERROR
#9091	#15003	KEY-LOCK ERROR

⑤ Improving USERS MESSAGE function (MX3 only)

This fucction displays messages on NC CRT screen from PC input signals having operation mistakes or machine defects.

The following messages are displayed:

(i) Regarding ERROR code and ERROR contents.

(ii) Showing machine operation condition.

(iii) Showing operation procedure, etc.

These messages can be displayed in NC USERS MESSAGE screen.

There is no distinction between the ways of displaying messages for easy operation.

USERS MESSAGE display selection

USERS MESSAGE display is selected by the following operation:

① The established USERS MESSAGE 1 display is selected by depressing ALM key to select alarm display.

② Added USERS MESSAGE 2 display is selected by depressing ALM key again.

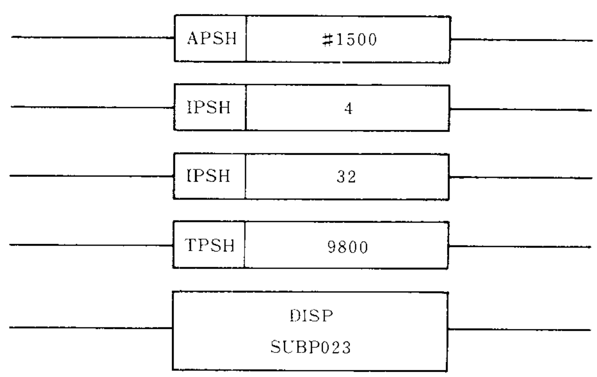
③ Depressing the ALM key again calls up USERS MESSAGE 1.

MESSAGE 1.

a. MESSAGE DISPLAY instruction

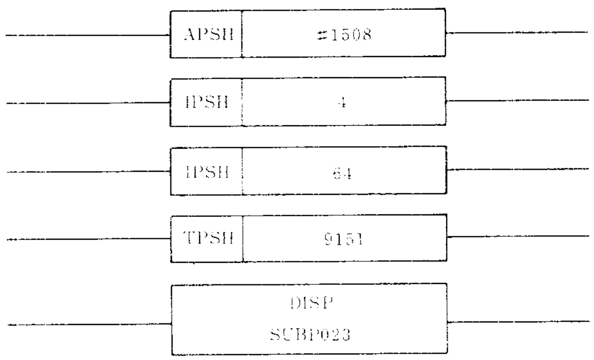
Two SUBP023s can be used on the ladder.

First SUBP023



7.7 MACRO INSTRUCTIONS (Cont'd)

Second SUBP023



SUBP023 which has been used first on the ladder is displayed under the title of USERS MESSAGE 1 on the message screen (USERS MESSAGE 1).

Depress ALM key, and SUBP023, which has been used later, is displayed under the title of USERS MESSAGE 2 on the message screen (USERS MESSAGE 2).

By depressing ALM key again, the display is reverse displayed to USERS MESSAGE 1 from USERS MESSAGE 2.

Note: USERS MESSAGE 1 has only on display. By depressing PAGE key the previous display is called up.

b. Display specifications

Number of characters in a message and message types.

16 characters * 220 types (Max.)
32 characters * 128 types (Max.)
64 characters * 64 types (Max.)

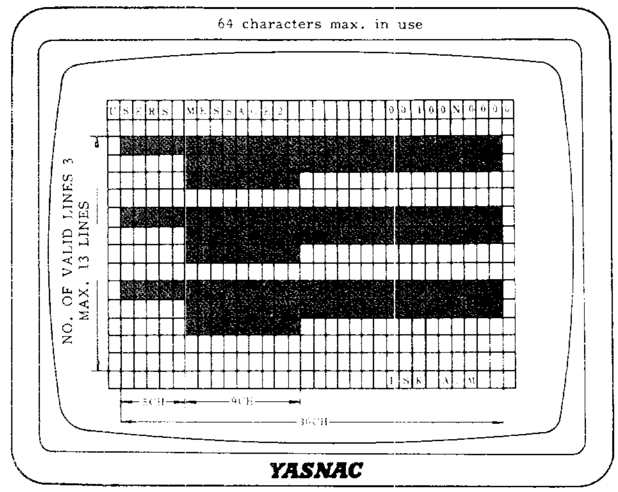
For two SUBP023s, the same characters can be used. In this case, however, the total number of the message types of two SUBP023s should be less than the maximum of each message.

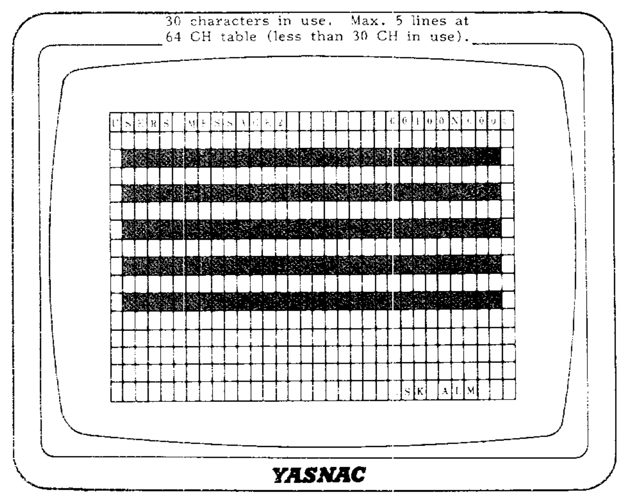
Display table

64 character
64 addresses between 9024 and 9087.
32 character
128 addresses between 9088 and 9215.
16 character
220 addresses between 9216 and 9435.

USERS MESSAGE 2 display range

Simultaneous display range
Valid width .... 30 characters
Valid lines .... 10 lines
Valid No. of message ... 3 to 5 types within the range of valid 10 lines or less.





Note: When the table shown above is used for another SUBP023, range of display table is decreased.

When the display table is used for another SUBP02 for other purposes, max. display type is limited b available table capacity.

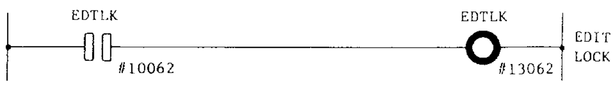
When making a table, put "SPACE" if necessary.

Characters under "FF" are disregarded.

8. SEQUENCE PROGRAM EXAMPLE

8.1 SERIES CONNECTION

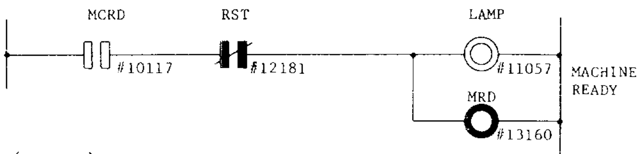
(1)



(LIST)

LD	#10062
OUT	#13062

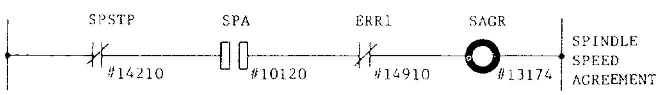
(2)



(LIST)

LD	#10117	OUT	#11057
AND-NOT	#12181	OUT	#13160

(3)

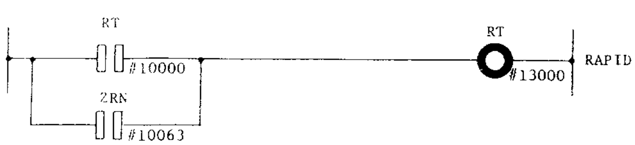


(LIST)

LD-NOT	#14210	AND-NOT	#14910
AND	#10120	OUT	#13174

8.2 PARALLEL CONNECTION

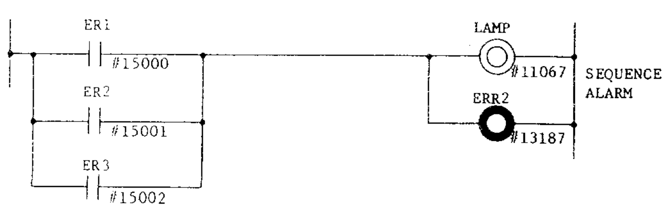
(1)



(LIST)

LD	#10000
OR	#10063
OUT	#13000

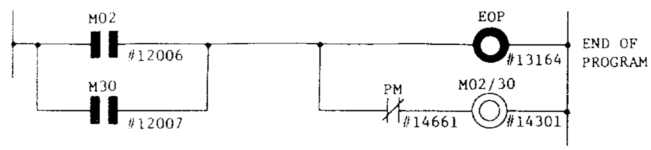
(2)



(LIST)

LD	#15000	OUT	#11067
OR	#15001	OUT	#13187
OR	#15002		

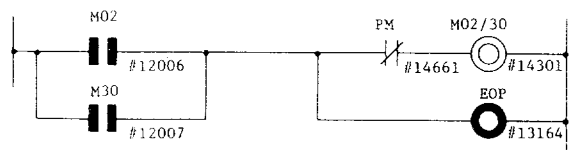
(3)
(a)



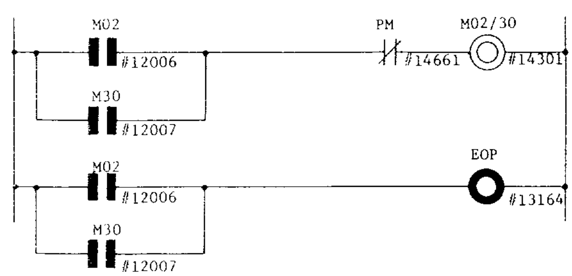
(LIST)

LD	#12006	AND-NOT	#14661
OR	#12007	OUT	#14301
OUT	#13164		

(b)

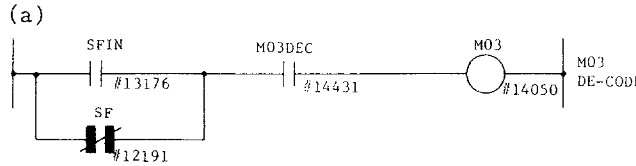


Note: In this program, coding cannot be made. Make a sequence as described in (3) a, or change the ladder as follows.



8.3 SERIES AND PARALLEL CONNECTION

(1)
(a)

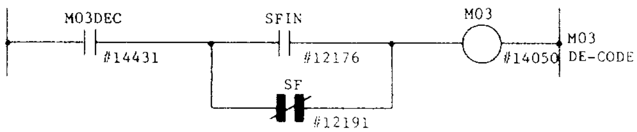


(LIST)

LD	#13176	AND	#14431
OR-NOT	#12191	OUT	#14050

8.3 SERIES AND PARALLEL CONNECTION (Cont'd)

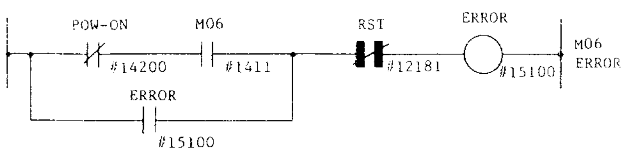
(b)



(LIST)

LD	#14431	AND-STR	
STR	#13176	OUT	#14050
OR-NOT	#12191		

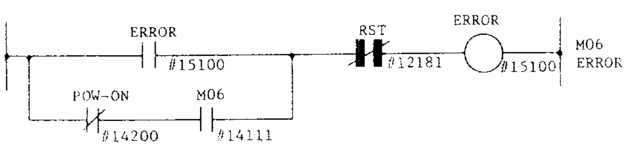
(2)
(a)



(LIST)

LD-NOT	#14200	AND-NOT	#12181
AND	#14111	OUT	#15100
OR	#15100		

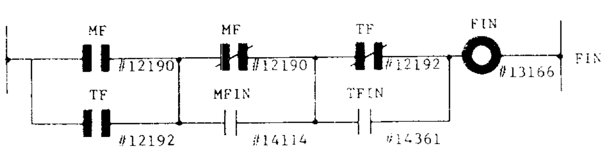
(b)



(LIST)

LD	#15100	OR-STR	
STR-NOT	#14200	AND-NOT	#12181
AND	#14111	OUT	#15100

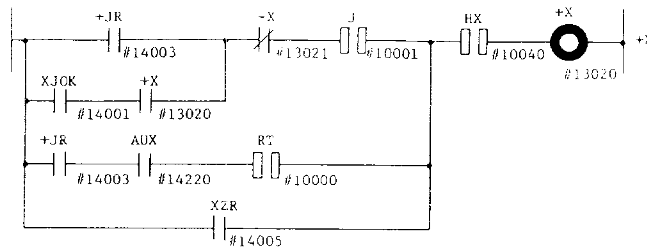
(3)



(LIST)

LD	#12190	ATR-NOT	#12192
OR	#12192	OR	#14361
STR-NOT	#12190	AND-STR	
OR	#14114	OUT	#13166
AND-STR			

(4)

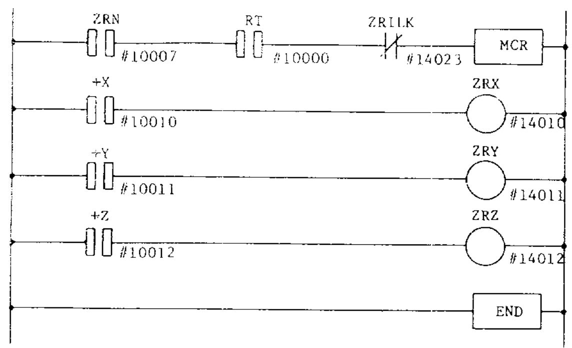


(LIST)

LD	#14003	AND	#14220
STR	#14001	AND	#10000
AND	#13020	OR-STR	
OR-STR		OR	#14005
AND-NOT	#13021	AND	#10040
AND	#10001	OUT	#13020
STR	#14003		

8.4 MASTER CONTROL RELAY APPLICATIONS

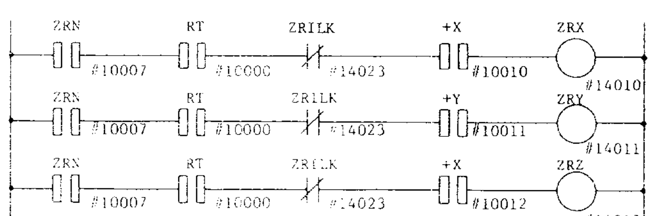
(1)



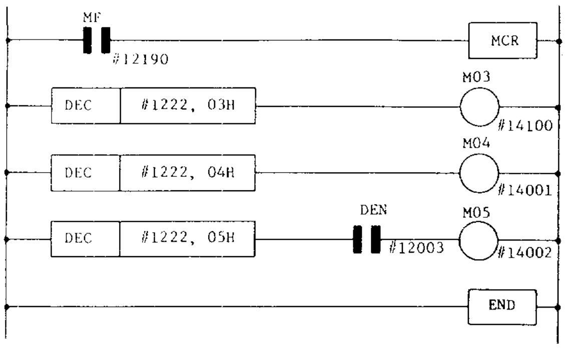
(LIST)

LD	#10007	LD	#10011
AND	#10000	OUT	#14011
AND-NOT	#14023	LD	#10012
MCR		OUT	#14012
LD	#10010	END	
OUT	#14010		

The above ladder has the same meaning as that of the ladder below.



(2)



(LIST)

```
LD     #12190              OUT   #14101      ; M04
MCR                        DEC   #1222, 05H
DEC    #1222, 03H          AND   #12003
OUT    #14100      ; M03   OUT   #14102      ; M05
DEC    #1222, 04H          END
```

This is the code detection ladder for M code. By use of MCR, ladder can be completed without inserting MF in each M code.

9. SEQUENCE PROGRAM EDITING SYSTEM

This section describes the functions provided by a "sequence program editor (SD20)" in temporary connection with the NC unit YASNAC LX3 or MX3, together with the operating procedures for the editor.

The functions of the sequence program editing system fall into three major categories:

(1) Editing Sequence Programs

To erase, alter and insert commands from, in and to sequence program.

(2) Providing Hard-copy of Edited Sequences Programs

To punch a sequence program onto a tape and transfer data to P-ROM writer.

(3) Checking Edited Sequence Programs

To check a sequence program in C-MOS and another program written in P-ROM through execution.

The following paragraph discuss the functions and operating procedures in detail.

9.1 BLOCK DIAGRAM OF SEQUENCE PROGRAM EDIT SYSTEM

Figure below shows the hardware constitution of sequence program edit system.

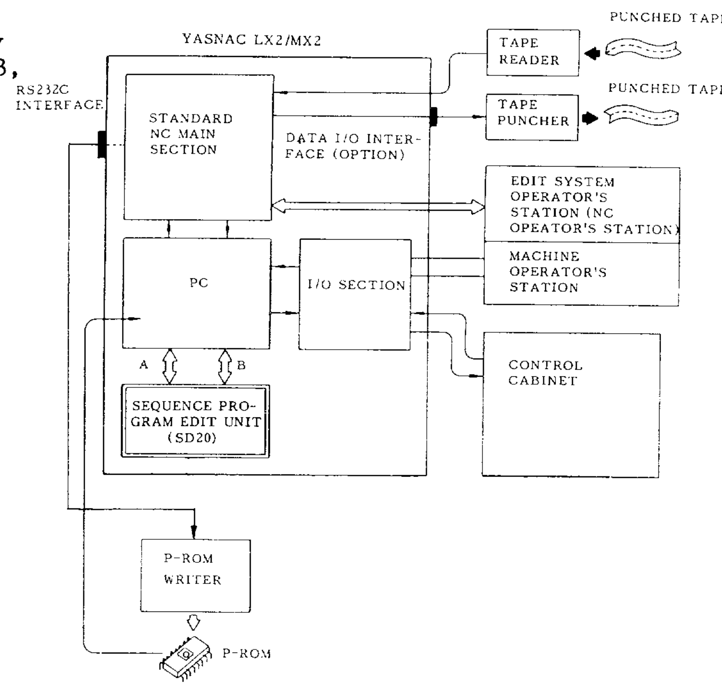


Fig. 9.1 Block Diagram of Sequence Program Edit System

(1) The sequence program editor (SD20) should be mounted with 2 screws on the CPU rack in the NC unit before being wired.

(2) To operate a sequence program editing system, use the NC operator panel with a CRT as an operator panel for the editing system.

(3) A tape reader is used to load into sequence program editor memory a list tape with a sequence ladder coded in it or a P-ROM format tape written in machine language.

(4) A tape puncher is used to punch out the final sequence program that was edited and checked on a list tape or P-ROM format tape.

9.1 BLOCK DIAGRAM OF SEQUENCE PROGRAM EDIT SYSTEM (Cont'd)

(5) A commercially available P-ROM writer can be connected to the NC RS232C interface to write the final sequence program into P-ROM.

9. 2 SEQUENCE PROGRAM EDITOR (SD20)

(1) The name and the type of the sequence program editor are as follows:

Name: Sequence Program Editor

Type: JZNC-SD20

External view of the SD20 is shown in Fig. 9.2.

(2) The SD20 has a C-MOS memory backed up by battery. It can store up to a 128K-byte sequence program to be edited. The stored sequence program is on the level of the P-ROM format in machine language.

(3) SD20 components along with their functions are listed below.

(a) Two mounting holes with screws:
Mounts the SD20 with attached screw on the CPU rack in the NC unit.

(b) CNF (96-core) connector:
: Supplies power (+5 V) to the SD20.
: Used to connect the NC main section with the PC section.

(c) ROM/RAM select switch:
Selects P-ROM in the P.C. system or C-MOS in the SD20 for operation or controlling.

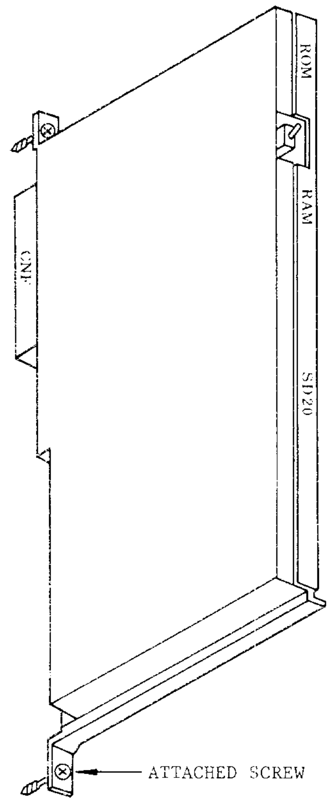


Fig. 9.2 External View of SD20

9. 3 CONNECTING SEQUENCE PROGRAM EDITOR

Follow the steps given below to connect the SD.

(1) Turn off the NC unit power supply and open its door.

(2) Remove the printed circuit board support on CPU rack.

(3) Install the XSD20 with attached screws onto the CPU rack, as shown in Fig. 9.3.

(4) Mount the printed circuit boartd support on CPU rack.

(5) Fig. 9.4 shows a setup with all connections completed.

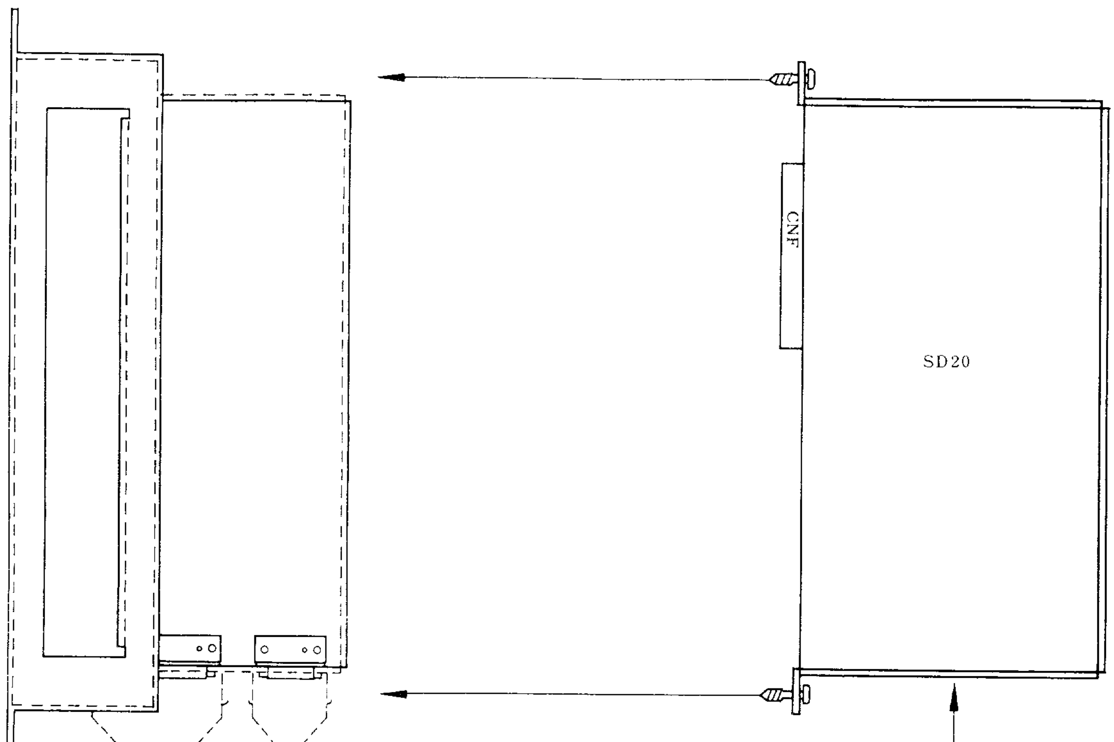


Fig. 9.3 SD20 Installation

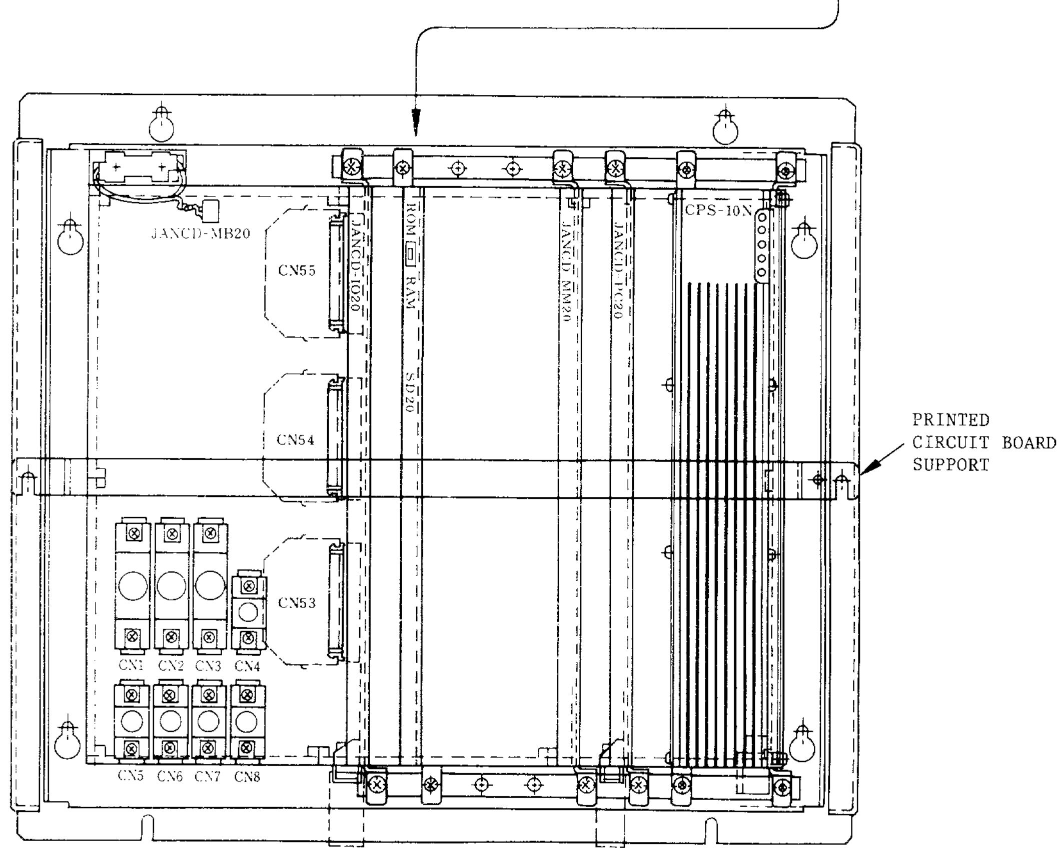


Fig. 9.4 SD20 Connection on CPU Rack

9.4 EDIT SYSTEM OPERATOR'S STATION

The NC operator's station with CRT is used for sequence program editing, when used as a sequence program editing unit.

Fig. 9.5 shows the NC operator's station respectively for YASNAC MX3 and LX3.

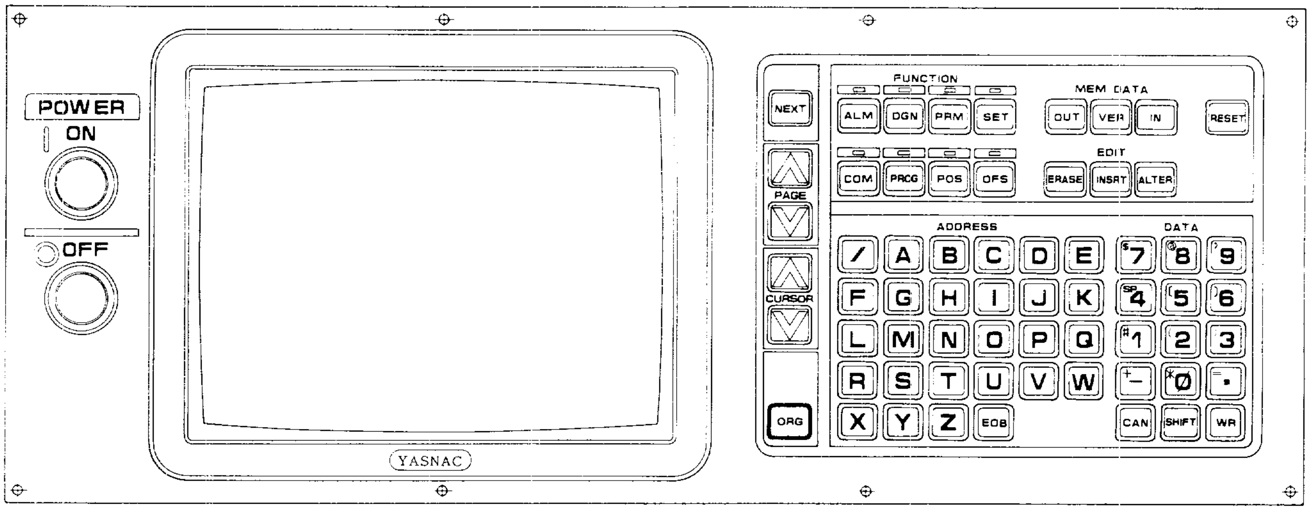


Fig. 9.5 Operator's Station for LX3/MX3

(1) POWER ON/OFF Pushbuttons

- POWER ON pushbutton

  To turn on the power for the control: Depress the pushbutton first to turn on the control power and depress it again to turn on the servo power. (Push this button to recover the servo power after an emergency stop.)

- POWER OFF pushbutton

  To turn off the power for the control: Depress it to turn off both the servo and control powers.

(2) DATA Key

For 0 to 9, data keys of 0 to 9 are used. For hexadecimal A to F, address keys of A to F are used. Commands and address input can be made by using address keys.

(3) $\boxed{\text{CAN}}$ (cancellation) key:

For cancellation of the input data.

(4) $\boxed{\text{WR}}$ (write) key:

For storing the input data into buffer storage.

(5) CURSOR Keys

The CURSOR control key is used to move the cursor. It is used to start address search.

- Depressing CURSOR ▽ key moves the cursor forward.
- Depressing △ CURSOR key moves the cursor backward.
- Keeping the cursor control key depressed makes the cursor move automatically forward or backward.

(6) PAGE Keys

Depressing the PAGE ▽ key increases the editing page by one. Depressing the △ PAGE key moves the cursor backward.

(7) NEXT Key (Function Mode Select Keys)

Depressing the NEXT key increases the function mode number by one. Mode 6 changes to mode 1 by depressing the NEXT key. For details of mode 1 to 6, refer to par. 9.5.

(8) ERS, INS, ALT, and EOB Keys

(a) ERS key:
For erasure of a block of data in a sequence program.

(b) INS key:
For insertion of a block of data in a sequence program

(c) ALT key:
For alteration of a block of data in a sequence program

(d) EOB key:
For storing a block of data in a sequence ladder. The block stored using the EOB key will be the last block in a sequence program.

(9) IN, VER, and OUT Keys

(a) IN key:
To start storing data on paper tape into memory through tape reader.

(b) VER key:
To start verifying between memory data and punched tape data.

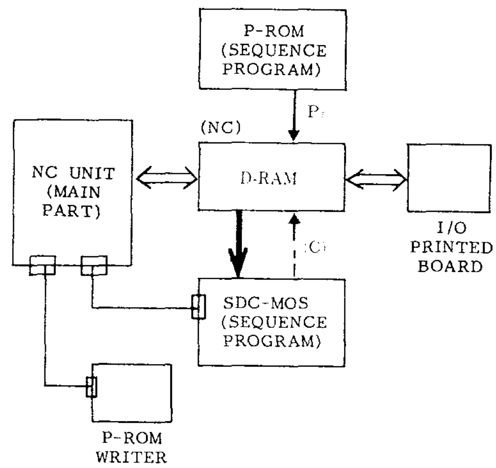
(c) OUT key:
To start outputting various data in memory through data I/O interface.

(d) RESET key:
To return the editing pointer to the head of sequence ladder. Also used for releasing alarm codes if their causes are eliminated.

9.5 FUNCTION MODE OF EDIT SYSTEM

When the control unit is used as a sequence program unit, four function modes can be selected. Use the NEXT key for mode selection.

LX3/MX3 PC System Structure



(1) SD20 board ROM/RAM select switch

$\xrightarrow{(P)}$: From P-ROM } Transfer at power ON

$\dashrightarrow_{(C)}$: From C-MOS }

(2) ⟶ : Stores the edited D-RAM data in C-MOS of SD20 board. (See (4) in the column of MODE 4.)

9.5 FUNCTION MODE OF EDIT SYSTEM (Cont'd)

Table 9.5 List of Function Modes and Functions

Function Mode No.	Function Mode	Function
Mode 1	Edit mode (LADDER EDIT)	· Alteration, insertion, and deleting sequence programs, address search, and writing by MDI. · Storing, collating, and punching out of P-ROM former tape.
Mode 2	List tape mode (SOURCE TAPE)	· Storing, collating, and punching out of list tape.
Mode 3	PROM writer mode (ROM WRITER)	· Transferring sequence programs to P-ROM writer.
Mode 4	Parameter mode (PARAMETER)	(1) Registration of version number (2) Registration of tape comments (3) Setting Baud rate (4) Transfer of DRAM to C-MOS (5) Punch-out of DEC format tape (6) Transfer of P-ROM to DRAM or C-MOS to DRAM. (7) P-ROM type selection (8) Resetting of edit area (9) Returning to NC mode (10) I/O device selection
Mode 5	PC data edit mode (PC TABLE EDIT)	(1) Editting of PC table and address searching (2) Storing, collating, and punching-out of P-ROM format tape
Mode 6	Address check mode (ADDRESS CHECK)	Checking for address duplication in sequence program.

9.6 HOW TO ENTER EDITING SYSTEM MODE

Given below are the EXIT STEPS to leave the NC system mode (NC Mode), and to enter the editing system mode (SD mode) in which the device is used as sequence program editing system. After switchover to the SD mode, the device permits operations described in par. 9.7 through 9.11.

9.6.1 When NC Unit is in Offline State (System NO. 6 → SD MODE)

The NC unit in the offline state is an NC unit that cannot operate in the NC mode upon power-on, with no sequence program stored in PC P-ROM or CD20 C-MOS.

Switching from the offline state to the SD mode requires the following operations, provided that the SD20 has been connected as explained in par. 9.3:

(1) Set the System No. switch to 6.

(2) Snap the ROM/CMOS select switch to RAM on the SD20.

(3) Depress the POWER ON pushbutton to apply power. A comment "OPTIONAL JOB" will appear on the CRT.

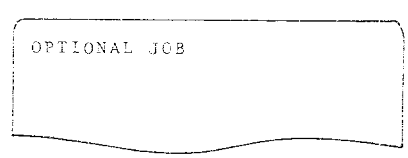


Fig. 9.6

(4) Deress the $\boxed{X}$, $\boxed{S}$ and $\boxed{D}$ keys, in that order. Then depress the $\boxed{ORG}$ key. A commen "SEQUENCER EDITOR" will appear on the CRT.

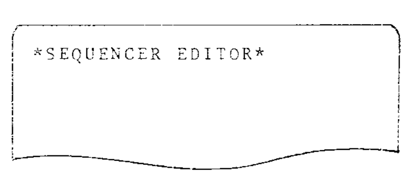


Fig. 9.7

About 2 seconds later, MODE 1 of the SD mode is entered.

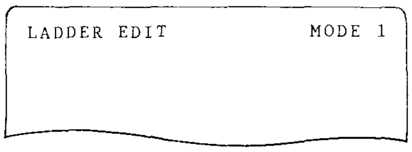


Fig. 9.8

(5) Then operate the PAGE keys to select one of six MODEs in the SD mode.

Note: Generally, the parameter mode of MODE 4 is later entered to clear the edit area, followed by the storing of the list tape in the list tape mode of MODE 2. For more details, refer to par. 9.14, "OPERATING PROCEDURE."

9.6.2 When NC Unit is in Online State (System NO.4 → SD MODE)

The NC unit in the online state is an NC unit that can operate in the NC mode upon power-on, with the sequence program stored in P-ROM or C-MOS.

Switching from this online state to the SD mode requires the following operations, provided that the SD20 has been connected as explained in par. 9.3:

(1) When the sequence program is stored in P-ROM, snap the ROM/RAM select switch to ROM on the SD20. Set the switch to C-MOS for the program stored in C-MOS.

(2) Depress the POWER ON pushbutton to apply power (set the System No. switch to 0 or 4 beforehand). The NC mode will be entered.

(3) When a test run is performed here for sequence program check, stop all NC functions by Feed Hold or other operations and press the RESET key afterward.

(4) Set the System No. switch to 4.

(5) Depress the DGN function key, and depress the NEXT key. A comment "(STORED)" will appear following another comment "DIAGNOSIS" on the CRT.

(6) Depress the X, S and D keys, in that order. Then depress the ORG key. A comment "SEQUENCER EDITOR" will appear on the CRT (Fig. 9.7). About 2 seconds later, MODE 1 of the SD mode is entered (Fig. 9.8).

(7) Then operate the PAGE keys to select one of six MODEs in the SD mode.

NOTE

1. The NC unit in the online state can enter the SD mode by the following parameters. #6030D1 = 1 for MX3. #6030D7 = 1 for LX3.
2. After switchcover from the online state to the SD mode, the PC output signals remain as they were just before the SD mode was entered.

   Example:
   A flashing PC output signal remains on when SD mode is selected during on state.
3. The minimum condition for the SD mode to be entered by the above steps is that "RTH" (end command of high-speed sequence program) and "RET" (end command of sequence program) have been written in P-ROM or C-MOS.

9.7 EDITING MODE (MODE 1)

This mode permits the following operations:

(1) After, insert, erase, and address search operation on sequence programs.

(2) MDI write operation on sequence programs.

(3) Loading, verifying and punching out P-ROM format tapes.

9.7.1 Sequence Program Editing

(1) CRT display in MODE 1

(a) As shown below, 10 lines of a sequence program stored in C-MOS are displayed in MODE 1. A blank line is counted as one line.

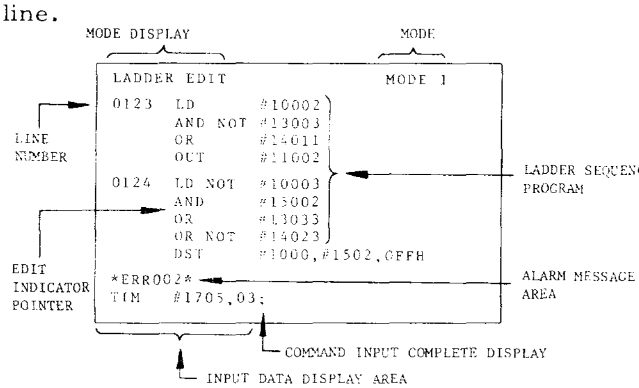
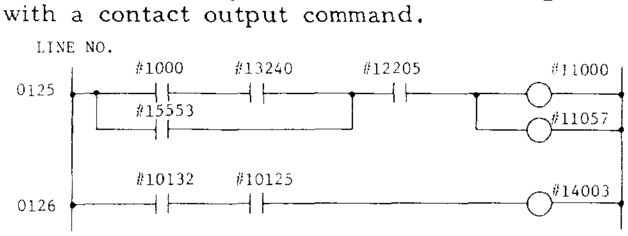


Fig. 9.9

(b) A line number is a serial number attached to a closed circuit group beginning with a contact input command and ending with a contact output command.



(c) A cursor is positioned to the command to be edited. See the next paragraph "Address search function" for how to specify the cursor.

```
LADDER EDIT                         MODE 1

0001    LD           #10013
        AND-NOT      #15034
        OUT          #11007

0002    SET
        DSTW         #1402,#1500,0FFFFH

0003    LD-NOT       #14020
        OR           #10000
        TMR          #1711,#7012
```

CURSOR

Fig. 9.10

Note: If MODE 1 of the SD mode is entered from the System No. switch at [6], an error comment "*DISASSEMBLE*" will appear on the CRT because no sequence program is currently stored. In this case, enter the parameter mode of MODE 4 and clear the edit are ((6) in par. 9.10) to reset the error comment. Commands "RTH" and "RET" will appear on the CRT. Then normal edit operations are possible.

(2) ADDRESS SEARCH

Address Search searches the commands or line to be edited. The searching procedure is as follows.

(a) Key in the commands to be searched

Keying in "0," "R," "WR," "1," "0," "0," "0," "0," through the keyboard causes OR #10000; to display at the bottom of the CRT screen.

(b) Depress the [CURSOR ↓] key.

Search starts. When the search is completed, ten-line commands including the searched command will be displayed on the CRT screen.

(c) If the keyed-in command cannot be found, "*ERR008*" will be shown on the CRT screen. Release the alarm code by depressing [CAN] or [RESET] key.

```
LADDER EDIT                         MODE 1

0001    LD           #10013
        AND-NOT      #15034
        OUT          #11007

0002    SET
        DSTW         #1402,#1500,0FFFFH

0003    LD-NOT       #14020
   ---> OR           #10000
        TMR          #1711,#7012


OR           #10000;
```

SEARCHED COMMAND

CURSOR indicates the searched command.

Fig. 9.11

Note:

1. The command can be searched by keying-in the part of the command data.

   Example: For DST #1200, #1100, FF commands keying-in "D," "S," "T," "WR" can search the DST commands regardless of #1200, #1100, and FF.

2. Address search can be done by using only one address

   Example: For DST #1200, #1100, FF commands, keying-in "#" "1," "2," "0," "0," "WR" can search the commands which use #1200 regardless of DST, #1100, and FF.

3. Address search can be done continuously.

   Searching can be continued if [CURSOR ↓] key is pressed again after address search.

   Depress [CAN] key to quit searching.

4. When the data to be searched is near the [CURSOR↑], use the [CURSOR↓] key to reach the required data.

(3) Key input operations

Below are the steps to key in commands and display them at bottom left on the CRT screen for editing or address search.

(a) Press the ADDRESS keys to sequentially key in the alphabetics of the commands to be entered.

Example:

(Command)	(Key-in operations)
SET	[S], [E], [T]
OR	[O], [R]
AND-STR	[A], [N], [D], [−], [S], [T], [R]

Use the Minus key instead of the Hyphen key.

Alphabetic strings will appear at bottom left of the CRT screen.

(b) Depress the [WR] key.

i. For commands not requiring address numbers (SET, END, etc.), a semicolon (;) is displayed after each to complete the key-in operation.

ii. For commands requiring address numbers (OR, MOV, etc.), a symbol "#" is displayed after each to prompt further entry.

iii. Entering an alphabetic string other than the commands causes a comment "*ERR01*" to appear on the CRT. This is reset by depressing the [CAN] or [RESET] key.

(c) Key-in address numbers (followed by bit numbers if necessary). For commands requiring one address number (e.g., OR), entering the required number of digits causes a semicolon (;) to appear automatically after each number, thus completing the key-in operation.

(d) Press the WR key. For commands requiring two address numbers (e.g., MOV), symbols ",#" will automatically appear after entry of the first number.

(e) Key in the next address number, and the number will be displayed.

(f) Press the WR key. A semicolon (;) will be displayed to complete the key-in operation. If an inadvertent key is pressed in each section explained above, press the CAN key and then press the correct key.

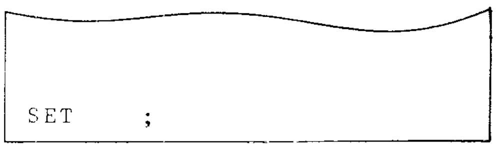


Fig. 9.12

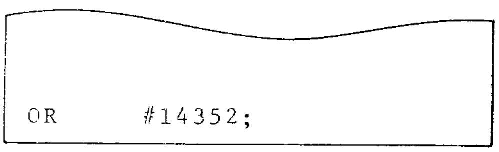


Fig. 9.13

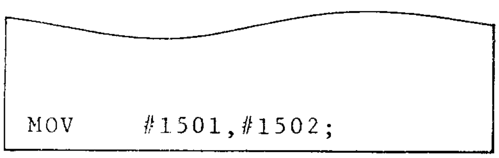


Fig. 9.14

The above procedure covers most of the commands, with only a few differences for some. In any case, a semicolon (;) appearing at the end of the entered data indicates the end of the key-in operation. On the data thus keyed in, address search and editing functions by the INSRT, ALTER and EOB keys are available.

(4) Edit Operation (ALTER, INSRT, ERASE)

The command specified by the cursor can be altered, inserted or erased.

(a) Alter operation

Depress the ALTER key. The command specified by the cursor will be erased and replaced by the command just entered. After alteration, the command that replaced the old one remains specified.

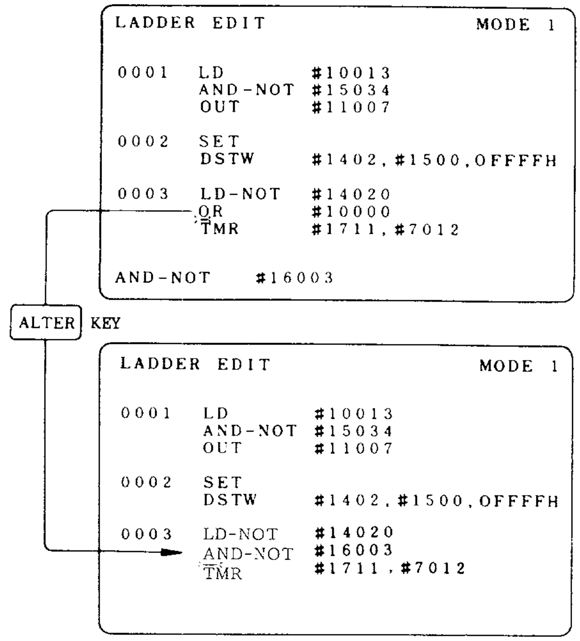


Fig. 9.15

(b) Insert operation

Press the INSRT key. The command just entered will be inserted following the command specified by the cursor. After insertion, the command just inserted remains specified.

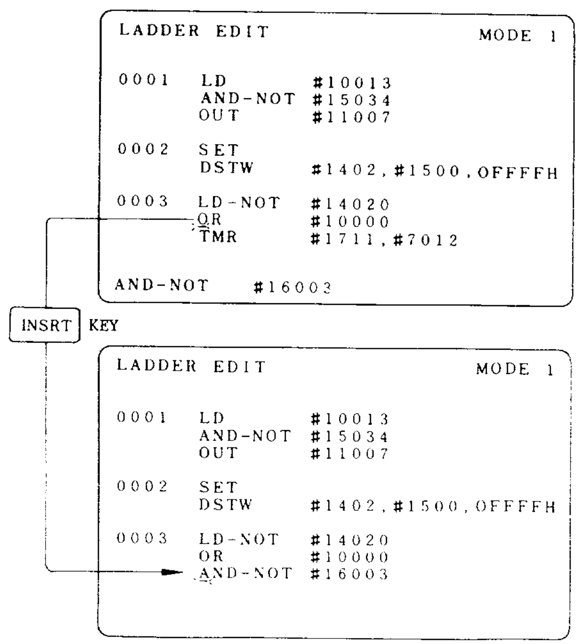


Fig. 9.16

(c) Erase operation

Press the ERASE key. The command specified by the cursor will be erased. After erasure, the command following the erased command is specified.

9.7.1 Sequence Program Editing (Cont'd)

```
LADDER  EDIT                          MODE  1

0001   LD          #10013
       AND-NOT     #15034
       OUT         #11007

0002   SET
       DSTW        #1402,#1500,0FFFFH

0003   LD-NOT      #14020
       OR          #10000
       TMR         #1711,#7012
```

ERASE KEY

```
LADDER  EDIT                          MODE  1

0001   LD          #10013
       AND-NOT     #15034
       OUT         #11007

0002   SET
       DSTW        #1402,#1500,0FFFFH

0003   LD-NOT      #14020
       TMR         #1711,#7012
       OUT         #11050
```

Fig. 9.17

(5) Low-speed processing sequence program division

When the edit operation of sequence program is completed in the edit mode, the sequence program should be divised for low speed processing.

Depress the [RESET] key, and then [ORG] key with MODE 1. The programs are automatically divided for low-speed processing and number of section count is indicated.

9.7.2 MDI Write Operation on Sequence Program

In MODE 1, a sequence program can be written by MDI key-in operations from the beginning. The write operations are as follows:

(1) Operate the NEXT to select MODE 4.
Clear the edit area (see par. 9.10 (6) on page 59.)

(2) Operate the NEXT key to return to MODE 1. This operation returns the cursor to the beginning of memory. Commands "RHT and "RET;" will appear on the CRT.

(3) Key in the desired command by the operation of par. 9.7.1 (3) on page 49.

(4) Depress the [INSRT] key, and the command just keyed in will be inserted following the command specified by the cursor. The inserted command will be specified anew.

(5) Repeat the operations of (3) and (4) above to write the sequence program consecutively.

(6) Finally, depress the [R], [E]," [T] and [EOB] keys, in that order, to complete the writing of the sequence program (RET = sequence program end command).

NOTE

1. Depressing the [EOB] key inserts the command just keyed-in following the command specified by the cursor, and erases all the subsequent commands. That is, the command stored by the [EOB] key becomes the last command of the sequence program at that time.
2. Consequently, in the edit operation of par. 9.7.1 (4), the [EOB] key can be used to erase all commands following a specific command (see Fig. 9.18).

   Depressing the [EOB] key inserts AND-NOT command after OR command and deletes all the commands stored after AND-NOT.

```
LADDER  EDIT                          MODE  1

0001   LD          #10013
       AND-NOT     #15034
       OUT         #11007

0002   SET
       DSTW        #1402,#1500,0FFFFH

0003   LD-NOT      #14020
       OR          #10000
       TMR         #1711,#7012

AND-NOT     #16003
```

EOB KEY

```
LADDER  EDIT                          MODE  1

0001   LD          #10013
       AND-NOT     #15034
       OUT         #11007

0002   SET
       DSTW        #1402,#1500,0FFFFH

0003   LD-NOT      #14020
       OR          #10000
       AND-NOT     #16003
```

Fig. 9.18

3. Section count display function: Upon completion of a ladder sequence editing process, depress the [RESET] or [ORG] key to produce the section and CHECK SUM (total). Then the section count is displayed as shown below. [CAN] or [RESET] key can clear this.

```
LADDER  EDIT                          MODE  1

0001   LD  #100013
       AND NOT   #15034

0002   SET
       DST   #1402, #1500, 0FFFFH


EXIT  COUNT=n
```

SECTION COUNT

Fig. 9.19

9.7.2 MDI Write Operation on Sequence Program (Cont'd)

4. Search function of section marked ****

After finding the section count by keying [ORG], the portions in the ladder where the section is inserted can be searched.

(a) Key-in [*0] and then, [SHIFT] four times. The section count "n" (two digits) to be searched, and [WR].

(b) Key-in [CURSOR].

(c) When the search process has been completed, the sequence ladder for that portion is displayed. If *ERR.008* (search error) is displayed, clear it by depressing the [RESET] key.

9.7.3 P-ROM Format Tape Input/Output Function ([IN], [OUT])

MODE 1 permits a P-ROM format tape on the machine language level to be inputted, verified and punched out.

(1) Inputting P-ROM Format Tape ([IN])

A sequence program stored in the form of P-ROM format tape is reedited.

(a) Set a P-ROM format tape on the tape reader.

(b) Depress the [IN] key. This will move the contents of the P-ROM format tape into PC20 RAM memory (edit area). If an inadvertent tape read operation or an erroneous entry is detected, *ERR003* is displayed on the CRT screen and the tape stops on an 16K-byte boundary. Although depressing the [IN] key again can reset the error and continue loading the tape contents, it is recommended to run the tape from the beginning. Should the error recur, the tape is not usable.

(2) Punching Out P-ROM Format Tape ([OUT])

An edited sequence program is punched out onto a P-ROM format tape.

(a) Connect the tape puncher (see NOTE 1) via the data I/O interface option of the NC unit.

(b) Depress the [RESET] key and [ORG] key orderly. The cursor will return to the beginning of the sequence program.

(c) Depress the [OUT] key. The contents of PC20 RAM memory will be punched out onto a P-ROM format tape on the machine language level.

REMARKS:

i. To verify whether or not the contents are punched out correctly, continue the vertification of (2) above.

ii. A feed hole punch portion about 75 cm long is provided at the both ends of the tape.

NOTE

1. The storage devices and tape punchers for P-ROM format tapes and list tapes are designated by MODE4, FUNCTION 10.

2. Storing data on P-ROM format tape is only about one tenth as bulky as that on list tapes. However, a list tape cannot be produced directly from a P-ROM format tape. This format is convenient for punching each substantial amount of data for storage.

9.8 LIST TAPE INPUT/OUTPUT MODE (MODE 2)

MODE 2 allows a list tape with a sequence ladder coded in PC instruction words to be loaded, verified and punched out.

(1) CRT Display in MODE 2

Operate the PAGE keys to select MODE 2, and the following screen will appear on the CRT:

```
SOURCE TAPE                              MODE 2



MEMORY



TAPE


```

Fig. 9.20

Note: SOURCE TAPE should be regarded as the same as LIST TAPE.

(2) List Tape Definition and Rules on List Tape Creation

(a) The list tape is defined as a punched tape with a sequence ladder coded in PC instruction words. See Fig. 9.21.

9.8 LIST TAPE INPUT/OUTPUT MODE (MODE 2) (Cont'd)

(b) The rules for creating a list tape are as follows:

i. The list tape may be punched either in EIA or ISO code; the code is automatically identified when the tape is read in.

ii. The beginning and end of the list tape should be in the following format:

For EIA code

For ISO code

iii. The following rules should be observed in punching a list tape from a hand-written list (Fig. 9.22):

① Punching CR (or LF/NL) at the beginning of a line specifies a line feed.

② All blanks must be filled with space code.

③ In a label part, punch a number (line No.) or space.

④ For PC table, follow the format in Fig. 9.23.

NOTE

Line numbers and comments are only for readability and are insignificant in assembling. The line numbers may or may not match those that were entered; The editor internally processes the line numbers regardless of the entered line numbers for display on the CRT and printing. No comments are stored in memory, nor are they displayed on the CRT or printed out. "#" is used for ISO code. "N" is used for EIA code.

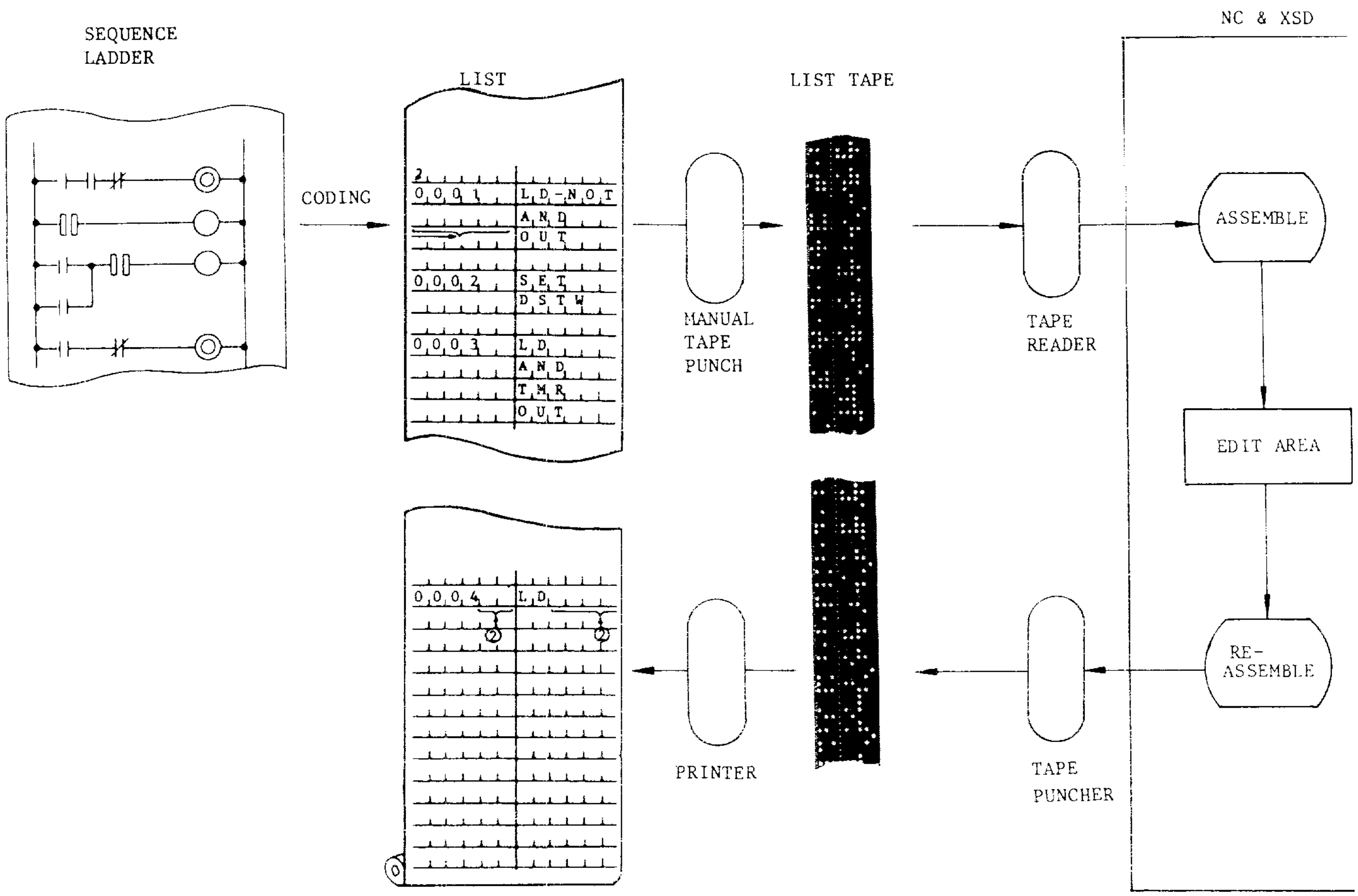


Fig. 9.21

Line

Line	Lable (1–6)	Command (7–14)	Address (15–32)	Contents (33–63)
1				
① 2	2			
3	0001	LD-NOT	#10002 2	
4		AND	#10113 2	
③ 5		OUT	#11003 2	
6	2			
7	0002	SET 2		
8		DSTW	#12031, #13000, 0FFFFH	2
9	2			
10	0003	LD	#15037 2	
11		AND	#10014 2	
12		TMR	#1710, #7012 2	
13		OUT	#15011 2	
14	2			
15	0004	LD	#13053 2	
16				
17	②	②		
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Note. Symbol "2" indicates CR or LF/NL.

Fig. 9.22

CODING SHEET

Line

Line	Lable (1–8)	Command (9–16)	Address (17–32)	Contents (33–63)
1	Example 1			
2				
3	N9000/A,	B, C, 1#-	-------2	
4				
5				
6				
7				
8				
9				
10	(Example 2)			
11	N9100-2.0	H, 50, 3AH	, 68------2	
12–30				

ASCII CODE

PROGRAM THE DATA BITS CORRESPONDING TO PC TABLE NO. (256 BYTES FOR #9000)

CONSTANT CODE

SUFFIX H SHOWS DEC.

SUFFIX H SHOWS HEX.

MEMOCON CODING SHEET

Fig. 9.23

9.8 LIST TAPE INPUT/OUTPUT MODE (MODE 2)(Cont'd)

(3) Assembling and Storing List Tape ([IN])

A designed sequence ladder is coded and its data used for editing.

(a) Set a list tape on the tape reader.

(b) Depress the [IN] key. List tape data will be loaded into DRAM memory (edit area) as they are assembled. If a code error or punch error is detected, the tape is kept read in and the error is loaded as "NOP" code. No error indication is given.

Note: "Assemble" operation means converting PC instruction words in list form into machine language. It follows that the PC20 edit area holds data in machine language.

(4) Punching Out List Tape ([OUT])

The edited sequence program for listing on a printer is punched out in the form of list tape.

(a) Connect the FACIT 4070 or equivalent tape puncher via the data I/O interface option of the NC unit. Refer to MODE 4 FUNCTION 10.

(b) Depress the [RESET] key. The cursor will return to the beginning of the sequence program.

(c) Depress the [OUT] key. The contents of PC20 memory will be punched out onto a list tape of the PC instruction word level.

(5) Reading-in, punching-out, and verifing of PC data tables ([IN], [OUT], [VER])

Operations of reading-in, punching-out, and verifing PC data tables should follow the procedures shown below.

Reading-in ([IN])... Press [T] and [IN] keys.

Punching-out ([OUT]) ... Press [T] and [OUT] keys.

(6) PAUSE function

Since length of list tapes tends to become long, more than two tapes are sometimes needed. Therefore, PAUSE function is provided for the [IN], and [OUT] operations of list tapes.

(a) [OUT] (punch-out)

If [CAN] key is pressed while a list tape is punched out, then up to the end part (i.e. AND #10013; %) of a command code will be punched out, "OUT PAUSE" will be displayed on the CRT, and the punching out stops. If the OUT key is pressed again in this state, then following data will be punched out. However, if RESET key is pressed then the punching out starts again from the beginning of the data.

(b) [IN] (reading in and verifing)

For reading-in and verifing operations of a list tape, when the last "%" of a command code is read-in, "IN PAUSE" is displayed and a corresponding operation stops. If [IN] key is pressed after changing a tape then following data will be stored or verified. However, if [RESET] key is pressed, then storing or verifing starts again from the first part of the data.

NOTE

1. Continue the verification of (2) above to check that the program is correctly punched out.
2. A feed hole punch portion about 75 cm long is provided at the beginning and the end of the punched-out tape.
3. The above steps apply to the punching of data in ISO code. To punch out in EIA code, press the [OUT] key while keeping the [E] key depressed.

9.9 P-ROM WRITER MODE (MODE 3)

This mode is used to transfer a sequence program or PC table data from DRAM memory to a commercially available P-ROM writer connected to the control via the RS232C interface of the NC.

(1) CRT Display in MODE 3

Operate the NEXT key to select MODE 3. The following screen will appear:

```
ROM   WRITER   LADDER                      MODE 3


           FUNCTION 1—INTEL HEX
                    2
                    3—
                    4—
                    5—

      USED   PROM   LOCATION   NUMBER
       #30    #31      #          #
       #      #        #          #
```

Fig. 9.25 Display in Mode 3

The line "30-33" indicates the 64K bytes edit area of the SD20, and the location number shows the field in which the sequence program is actually written. Numbers 30, 31 and 33 represent location numbers of P-ROMs (32K each) for further identification. That is, the edit area is represented in terms of P-ROMs. The above example indicates that a sequence program occupying 2 P-ROMS, #30 and #31 is stored.

To transfer PC table data, set the display shown below by [PAGE] key.

```
ROM WRITER PC TABLE                         MODE 3


          FUNCTION 1 - INTEL HEX
                   2 -
                   3 -
                   4 -
                   5 -

          USED  PROM  LOCATION  NUMBER
          #33    #       #        #
          #      #       #        #
```

Fig. 9.26

(2) Selection P-ROM Writer

(a) The user is expected to prepare a commercially available P-ROM writer with the following 4 features:

(i) Reading in the "Intel Hex Format" is available for data transfer.

(ii) Writing to the P-ROM 27256 (made by INTEL) is available.

(iii) The RS232C interface is provided.

(iv) One of the data transfer baud rates shown in Table 9.2 on page 61 is usable.

(b) The following are some recommended P-ROM writers that meet the above requirements:

Recommended P-ROM Writers

P-ROM Writer	Manufacturer
P-ROM Programmer: MODEL 1866	MINATO ELECTRONICS INC.
PECKER-10: PKW-1000 + Personal Module "UN-3F"	AVAL (U. S. A.) Represented by Tokyo Tsushin Kogyo

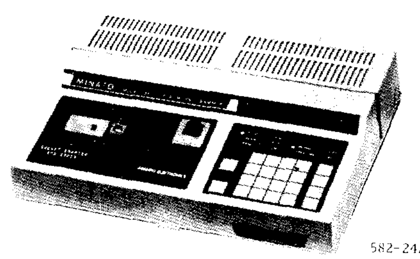


Fig. 9.27 P-ROM Writer

(3) Connecting the P-ROM Writer

Prepare the plug connector for RS232C interface receptacle (DB-25P) furnished with the NC. Form a cable by coupling the connector with its counterpart attached to the P-ROM writer, as indicated in Table 9.1. The cable length should be about 3 meters (10 ft.) or less. No special cable (shielded, etc.) is needed. For installing this cable, refer to Fig. 9.2 on page 43.

Table 9.1 Specifications of Cable for P-ROM Writer

XSD (DB-25P)			Connections	P-ROM Writer	
Abbreviation	Signal	Pin No.		Pin No.	Abbreviation
	Not used	1	Blank		
SD	Send data	2		2	SD
RD	Received data	3		3	RD
RS	Send requirement	4		4	RS
CS		5		5	CS
DR		6	Blank	6	DR
SG	Signal ground	7		7	SG
	Not used	8 ~ 19			
ER	Data processing relay	20	Blank	20	ER
	Not used	21 ~ 25			

Note: Connections applicable to terminal connections.

9.9 P-ROM WRITER MODE (MODE 3) (Cont'd)

(4) Writing Operation to P-ROMs

Steps to write to P-ROMs by use of the P-ROM writer PKW-1000 of Toyo Tsushin Kogyo. For details, refer to the instructions for P-ROM writers:

(a) Transfer conditions of PKW-1000

· P-ROM selection

Select type 27256 FUJI made by Fujitsu Ltd. or type 27256 INTEL made by INTEL Co.

· Bit construction setting of serial data

DATA (Number of data bits): 8
PARITY: No
STOP (stop bits): 1

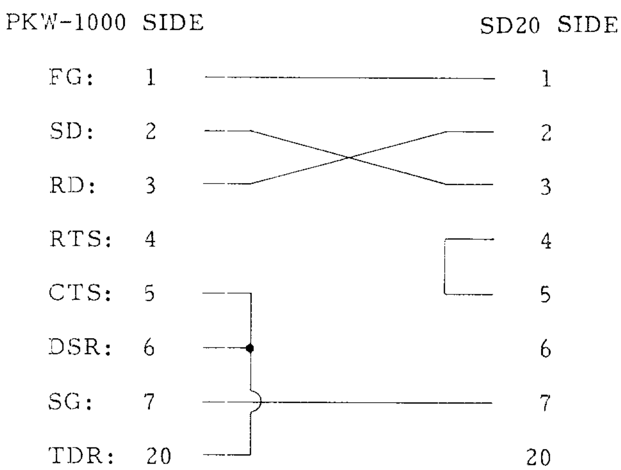
· Baud rate setting

Select "4800 BPS."

· Transfer format setting

Select "INTELLEC HEX."

(b) Connection of cable RS-232C



(c) Writing to P-ROM writer PKW-1000

i. Connect the P-ROM wirter to the RS232C interface of NC.

ii. Turn on the NC unit and switch to the XSD mode.

iii. Set the baud rate of the P-ROM writer (4800 bps) to "09" according to the procedure of the parameter mode "SD MODE 4" (4) on page 63.

iv. Return to the P-ROM writer mode of MODE 3. Viewing the CRT screen, note down the location numbers of the P-ROMs to write-in (Fig. 9.25). For, example, note down #30 and #31 in the above case.

v. Turn on the P-ROM writer. (Transfer condi- tion setting of PKW-1000 should be completed before turning on the P-ROM writer.)

vi. Depress the $\boxed{1}$ and $\boxed{WR}$ keys on the editing panel. (See Fig. 9.28)

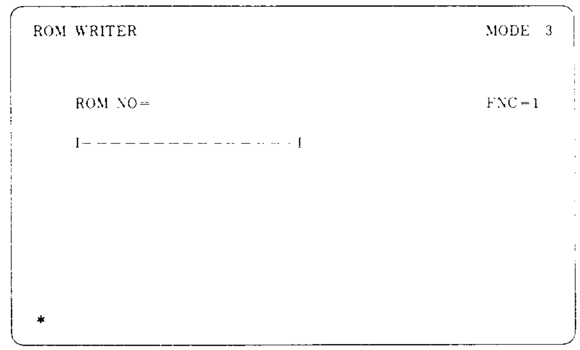


Fig. 9.28

vii. Key-in a desired 2-digit P-ROM location number (noted numbers in procedure iv.)from editing panel. If the 3 , 0 and $\boxed{WR}$ keys are keyed-in, display as shown in Fig. 9.29 will appear.

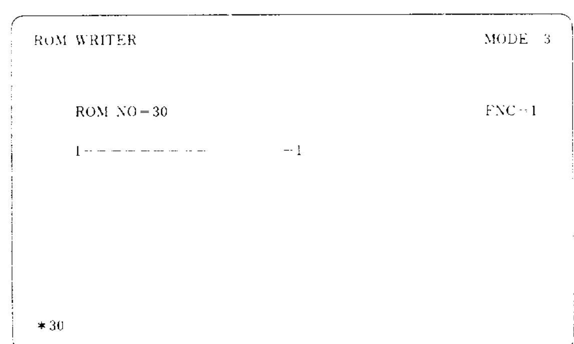


Fig. 9.29

viii. Reset the P-ROM writer by reset key $\boxed{RST}$ on PKW-1000. There are two transfer methods from the SD20 to buffer RAM on PKW-1000: data receiving command method and CPU communicate mode method. The CPU communicate method is recommended.

ix. Depress $\boxed{JOB}$, $\boxed{F}$ and $\boxed{SET}$ keys on PKW-1000 so as to be in CPU commu- nicate mode. The asterisk (*) is dis- played on the screen as the response.

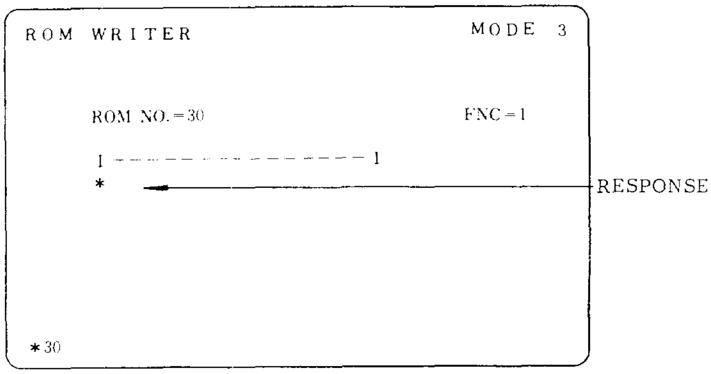
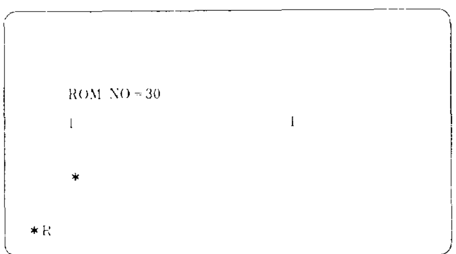
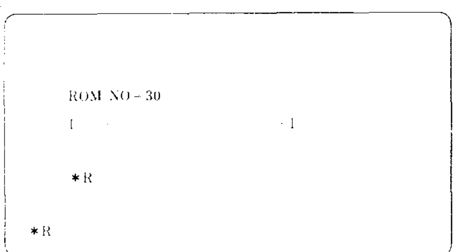


Fig. 9.30

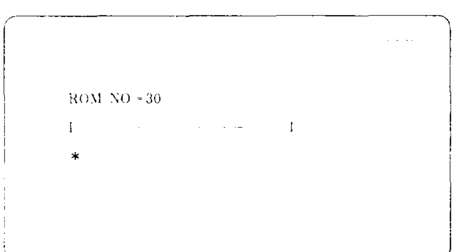
x. Key in [R] and [WR] on editing panel. When [R] key is depressed, buzzer in P-ROM writer sounds as the response. Data is transferred from the SD to the P-ROM writer and increase asterisks (*) on the screen. (See Fig. 9.31.)



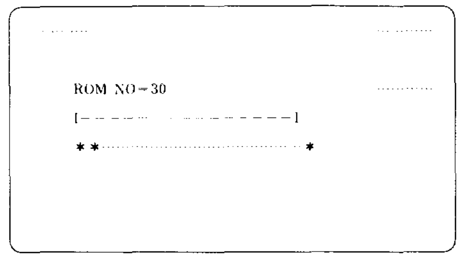
[R] key on the editing panel is depressed.



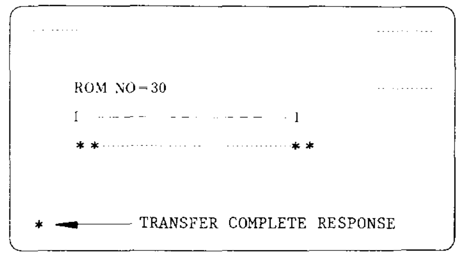
The response appears on the screen.



[WR] key on the editing panel is depressed.



Data transfer is completed.



The response appears on the screen.

Fig. 9.31

xi. After the data is transferred completely, reset the P-ROM writer by [RST] key.

With steps i. through xi., data transfer from SD to PKW-1000 and write-in to buffer RAM will have been completed.

Steps to write to P-ROMs by use of the P-ROM writer, MODEL 1866 of Minato Electronics Inc. For details, refer to the instructions for P-ROM writers.

(a) Writing to P-ROM writer Model 1866

i. Connect the P-ROM writer to the RS232C interface of NC.

ii. Turn on the NC unit and switch to the SD mode.

iii. Set the baud rate of the P-ROM writer according to the procedure of the parameter mode "SD MODE 4"(4) on page 63.

iv. Return to the P-ROM writer mode of MODE 3. Viewing the CRT screen, note down the location numbers of the P-ROMs to write-in (Fig. 9.25). For example, note down #30 and #31 in this case.

v. Turn on the P-ROM writer.

9.9 P-ROM WRITER MODE (MODE 3) (Cont'd)

vi. When depressing the 1 and WR keys on the editing panel, POM WRITER screen will appear.

vii. Key-in desired 2-digit P-ROM location number from the editing panel. The first keys to be depressed, in this case, are 3 and 0.

viii. Depress the WR key. The typed P-ROM number will be displayed, and the specified sequence program data will become ready for transfer to the P-ROM writer.

```
RCM WRITER                                MODE 3

      ROM NO =30                          FNC=1

      I ---------------- I
      ***

  *
```

Fig. 9.32

ix. Reset the P-ROM writer, and place it in the remote mode. The CRT screen will give the response "#."

x. Depress R, L and WR Keys on the editing panel. Data will be transferred from XSD to the P-ROM writer and increase asterisks (*) on the screen (Fig. 9.32). With the data transfer completed, a comment "OK" or an equivalent response will appear on the screen. If the transfer is stopped midway, repeat from step viii.

xi. Reset the P-ROM writer.

xii. Set an erased P-ROM on the P-ROM writer.

xiii. Press the CNT and ST keys, in that order, on the editing panel. The data will be written to the P-ROM.

xiv. Pull out the P-ROM with data written in it from the P-ROM writer and keep it for future use (writing to #30 P-ROM completed).

xv. Depress the RESET key on the editing panel. Control will return to the mode in which to specify the P-ROM number.

xvi. To write to all P-ROMs, repeat steps vi. through xiv. In this example, repeat steps vii. through xv. for writing to #31.

9.10 PARAMETER MODE (MODE 4)

(1) CRT Display and Functions in Parameter Mode

Operate the NEXT key to select MODE 4. The screen shown below will appear, displaying the functions available in this mode. Keying-in one of the numbers (1 to 10) corresponding to the desired function selects that function. Given below is a detailed description of how each function can be utilized.

```
PARAMETER                                  MODE 4

     FUNCTION      1--VERSION NO.
                   2--TAPE COMMENT
                   3--I/O DEFINE
                   4--SYSTEM SAVE
                   5--DEC TAPE
                   6--ROM SELECT
                   7--SYSTEM LOAD
                   8--LADDER CLEAR
                   9--SYSTEM RETURN
                  10--I/O SELECT

*        1234567:0013765
```

Fig. 9.33

1. Version No. registration
2. Tape comment registration
3. Baud rate seeting
4. Data transfer from DRAM to C-MOS
5. Punch-out of DEC tape
6. Selection of P-ROM type
7. Data transfer from P-ROM to DRAM
8. Edit area clear
9. Reset to NC mode
10. I/O device selection

(2) Registering Version Number (1. VERSION NO.

This function is used to register a sequence program version number. Be sure to register the number before writing to P-ROM.
The steps to do this are as follows:

(a) Operate the NEXT key to select MODE 4.

(b) Depress the 1 , WR key.

(c) Key in a 7-digit number for the desired version number.

(d) Depress the WR key. The 7-digit number will be registered as the version number.

The registered version number is displayed as shown in Fig. 9.34, upon applying power to the NC system.

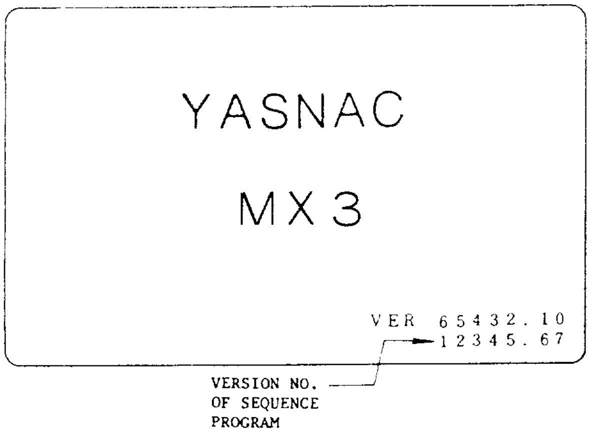


Fig. 9.34

The high-order 5 digits are separated by a decimal point from the low-order 2 digits. What the digits signify for easiest identification is up to you.

(3) Registering Tape Comment
(2. TAPE COMMENT)

This function is used, upon punching out a P-ROM format tape or list tape, to punch a registered tape comment in perforated ornate characters following the feed hole portion.

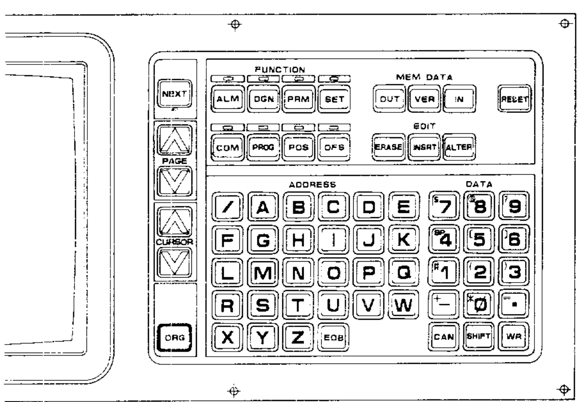
The steps to make registration are as follows:

(a) Operate the NEXT key to select MODE 4.

(b) Depress the 2, WR key.

(c) Key-in a comment in 10 characters or less. The keys shown shaded in Fig. 9.33 are usable.

(d) Depress the WR key. The typed characters will be registered as the tape comment.



Typical Ornate Characters
(10 characters or less in practice)

Fig. 9.35

(4) Setting Baud Rate (3. I/O DEFINE)

This function is used to match the baud rate of the SD with the data transfer rate, or baud rate, of the RS232C interface.
The steps to do this are as follows:

(a) Operate the NEXT key to select MODE 4.

(b) Depress the 3, WR key.

(c) Key in one of 2-digit numbers "00" to "19" that corresponds to the baud rate of the P-ROM writer. Refer to Table 9.2.

(d) Depress the WR key. The baud rate will be registered.

Table 9.2

P-ROM Writer Baud Rate	Key-Input Value	
	Data stop signal = 1 bit	Data stop signal = 2 bits
50	00	10
100	01	11
110	02	12
150	03	13
200	04	14
300	05	15
600	06	16
1200	07	17
2400	08	18
4800	09*	19

* Baud rate "09" is automatically set when the SD mode is entered. The rate remains unchanged if the above operations are not performed.

Note: Number of bits in data stop signal depends on P-ROM writer.

(5) Data transfer from DRAM to C-MOS
(4. SYSTEM SAVE)

This function transfers the contents of an edit area (DRAM) to a save area (CMOS).
The steps are as follows:

(a) Depress the NEXT key and select MODE 4.

(b) Depress 4 key and then WR key.

(c) Depress L key and then WR key to save ladders. Depress T key and then WR key to save tables.

(d) "SAVE END" will be displayed when the saving is completed. "SAVE ERROR" will be displayed when an error is detected. If an error is made then repeat from the step b.

(6) Tape punch-out of DEC format
(5. DEC TAPE)

This function punches-out a tape (DEC tape) which can be used to check the contents of a PROM in a system which does not have the SD20. Data in sequence ladders or PC tables are sometimes edited in the SD20 and then they are transferred to the PROM. Following steps show the procedures.

(a) Depress the NEXT key and select MODE 4.

(b) Depress [5] key and then [WR] key.

(c) Depress [L] key and [WR] key to punch-out ladders, if needed.

(d) To verify this tape, select system NO. [3] and then apply power. "OFF LINE JOB" will be displayed on the CRT screen so that press [VER] key on the operator's panel at the time. When these operations are completed, "RDY" will be displayed on the CRT. If an error is found while verifying, the contents of error's address memory will be displayed. To verify the tape continuously, press [VER] key again.

(7) P-ROM type selection (6. ROM SELECT)

When reading-in, punching-out, or verifying a P-ROM tape or when selecting data for a P-ROM of MODE 3, this function selects P-ROM type. P-ROM type is 27256 when power is applied. This function is not used in this system because all the P-ROM types become 27256 in advance in the system.

(8) Data transfer from P-ROM to RAM and from C-MOS to RAM (7. SYSTEM LOAD)

This function transfers a sequence program which has been changed to a type of hardware by a P-ROM in a PC or a program which is stored in a C-MOS memory of the SD20 into a RAM memory in the SD20 (edit area). Operations should follow the steps shown below.

(a) By using the ROM/CMOS switch on the SD20, choose from which part (ROM or CMOS) the transfer to DRAM is to be made.

(b) Depress NEXT key and select MODE 4.

(c) Depress [7] key and then [WR] key.

(d) Depress [L] key and then [WR] key. The contents of the P-ROM or C-MOS is transferred to the edit area of the SD20.

(e) For PC table, press [T] key and then [WR] key.

(f) When the data transfer is completed, "LOAD END" will be displayed. When an error is made, "LOAD ERROR" will be displayed. If an error is made then restart from the step c.

(9) Clearing of the edit area (8. LADDER CLEAR)

This function clears the edit area in the SD20 (DRAM memory) or the save area (C-MOS). Make sure to perform this operation loading a sequence program into the edit area for the first time in the SD mode or after replacing the battery. Following steps show the procedure.

(a) Depress the NEXT key and select the MODE 4.

(b) Depress [8] key and then [WR] key.

(c) Clear operation

For ladder clear: Depress the keys in the following order.

(i) C-MOS side [L], [C], [WR]

(ii) RAM side [T], [R], [WR]

For PC table: Press the keys in the following order.

(i) C-MOS side [T], [C], [WR]

(ii) RAM side [T], [R], [WR]

(10) Return to the NC mode
(9. SYSTEM RETURN)

This function returns a mode from the XSD mode to the NC mode. This will be explained in the par. 9.11.

(11) Input/Output device selection
(10. I/O SELECT)

This function selects I/O port used in the SD mode.

(a) Depress the NEXT key and select the MODE 4.

(b) Depress [I] key, [O] key, and then [WR] key

(c) Depress [N] and then [WR] key. Here, the contents of (n) is given by the Table 9.3. The initial value of (n) when power is applied is zero. Once (n) is determined, the value will be retained until power is turned off or the mode returns to the NC mode.

Table 9.3

n	Input Device	Output Device
0	1RO	1RO
1	2RO	1RO
2	1RO	2RO
3	2RO	2RO

SIO: Serial Interface

9.11 PC DATA TABLE EDIT MODE

Following operations can be done in this mode.

(1) Editing and address searching of PC data tables.

(2) Storing, verifying, and punching-out of P-ROM format tapes.

9.11.1 Editing of PC Data Tables

(1) CRT display in the MODE 5

(a) When the NEXT key is pressed and MODE 5 is selected, the CRT displays the following figure (shown in the Fig. 9.36)

```
TABLET EDIT                              MODE5


          TABLE PARAMETER
            1 : USING TABLE
            0 : NOT USING
             SETTING : 0
```

Fig. 9.36

(b) Fix the SETTING to "1" by pressing 1 and WR. This operation makes the PC data table usable. When the table is not used, fix the SETTING to "0" by pressing 0 and the WR.

(c) Actual edit mode is given by depressing PAGE key shown in Fig. 9.37.

```
TABLE EDIT                               MODE 5


       TC000    FF
         CST


                            ..............
                               PAGE 1
```

Fig. 9.37

(2) Address search function

This function searches table numbers.

(a) Key-in a table number to be searched.

Example: By keying-in 9, 1, 0, 0, the CRT displays 9100.

(b) Depress CURSOR key. The cursor moves to the table number which has been searched.

(3) Key input operation

(a) Each data can be fit into a literal data or an ASCII code data. CST reads in input data at the HEX and displays them. ASC reads in input data as ASCII code and displays them. Anything which is not present in the ASCII code is displayed as "@." CST in Fig. 9.37 indicates that the data is currently a literal data. If the cursor is moved to this position and WR key is pressed, then ASC and CST can be changed alternately.

(b) Data can be rewritten in this state.

Example:
In case of literal data Key-in "4," "1," WR. In case of ASCII code data Key-in A, WR.

9.11.2 Reading-in, punch-out, and verify a P-ROM format tape (IN, OUT, and VER operations)

Like the ladder in the MODE 1, this can be done by using IN, OUT, and VER keys.

Refer to the P-ROM Format Tape I/O function in par. 9.7.3 for details.

9.12 ADDRESS CHECK MODE (MODE 6)

This function checks address duplications in the sequence ladder created by the SD20.

(1) Check address area

#1000 to #1099 (Input from a machine)

#1100 to #1199 (Output from a machine)

#1200 to #1299 (Input from the NC)

#1300 to #1399 (Output from the NC)

#1400 to #1999 (Internal registers)

#1700 to #1799 (Timer)

#7000 to #7099 (Sequence parameter)

#7100 to #7999 (Keep memory area)

(2) Check operation

Number of "OUT #xxxxx" will be counted in the sequence ladder.

(i) For #1000's, #1200's and #1700's, an address error will be displayed, if, for example, a command such as #17521 (this address not an output address) can be found.

(ii) For #1100's, #1300's from #1400's to #1900's and from #7100 to #7900 or more, if, for example, more than two commands such as "OUT #11112" can be found then an address error will be displayed.

9.12 ADDRESS CHECK MODE (MODE 6)(Cont'd)

(3) CRT display and its operation method

(a) When the NEXT key is pressed and MODE 6 is selected, the CRT displays Fig. 9.38.

```
ADDRESS CHECK                              MODE 6

 0  #1000     70  #7000
 1  #1100     71  #7100
 2  #1200     72  #7200
 3  #1300     73  #7300
 4  #1400     74  #7400
 5  #1500     75  #7500
 6  #1600     76  #7600
 7  #1700     77  #7700
 8  #1800     78  #7800
 9  #1900     79  #7900
10  ALL ADDRESS
```

Fig. 9.38

(b) Specify a number of a range to be checked. For example, if #1300's (#1300 to #1399) will be checked then press [3], [WR].

(c) When the above is keyed-in, the CRT displays the figure below (Fig. 9.39).

```
ADDRESS CHECK

  #1300      CHECK
```

Fig. 9.39

"#1300" shown above flashes.
In case of ALL ADDRESS CHECK, the screen continuously changes from #1000.

(d) When checking is completed, the CRT displays Fig. 9.40 and Fig. 9.41.

```
ADDRESS CHECK                              MODE 6

  #1300      OK
```

Fig. 9.40

"#1300" shown above flashes. In ALL ADDRESS CHECK, the CRT displays "ALL" as shown in the Fig. 9.42 instead of "1300."

```
ADDRESS CHECK                              MODE 6

  ALL        OK
```

Fig. 9.41

```
ADDRESS CHECK

  NG ADDRESS      USED COUNT
  #13101          2
  #13102          3
```

Fig. 9.42

Maximum USED COUNT is 255. If there exists more than 10 NG ADDRESS's, they will be displayed in the next page by using [PAGE] key. In ALL ADDRESS, check if a check result is NG then the operation will halt when the address or higher number address in its corresponding range is checked.

To continue checking, press [CURSOR ↓] key.

To cancel the checking, press [CAN] key. The CRT will display the screen shown in Fig. 9.37.

9.13 RETURN TO NC SYSTEM MODE (MODE 4)

The information that follows explains how to switch from the SD20 editing mode to the NC system mode.

9.13.1 When NC Unit Entered SD Mode from Offline State

Do not return to the NC mode if the SD mode was entered by setting the System No. switch to [6] (See par. 9.6.1, When NC Unit is in Online State.)

After setting the sequence ladder to SAVE, be sure to turn off power. [For SAVE setting, see par. 9.10 (5).] When the edit area has been cleared in parameter mode, applying power supply again causes the NC mode to be entered.

Turn off power now even if a sequence program has already been edited.

9.13.2 When NC Unit Entered SD Mode from Online State

Operate the steps below if the SD mode was entered by setting the System No. switch to 4 . (See par. 9.6.2 When NC Unit is in Online State.)

(a) Depress the NEXT key to select MODE 4.

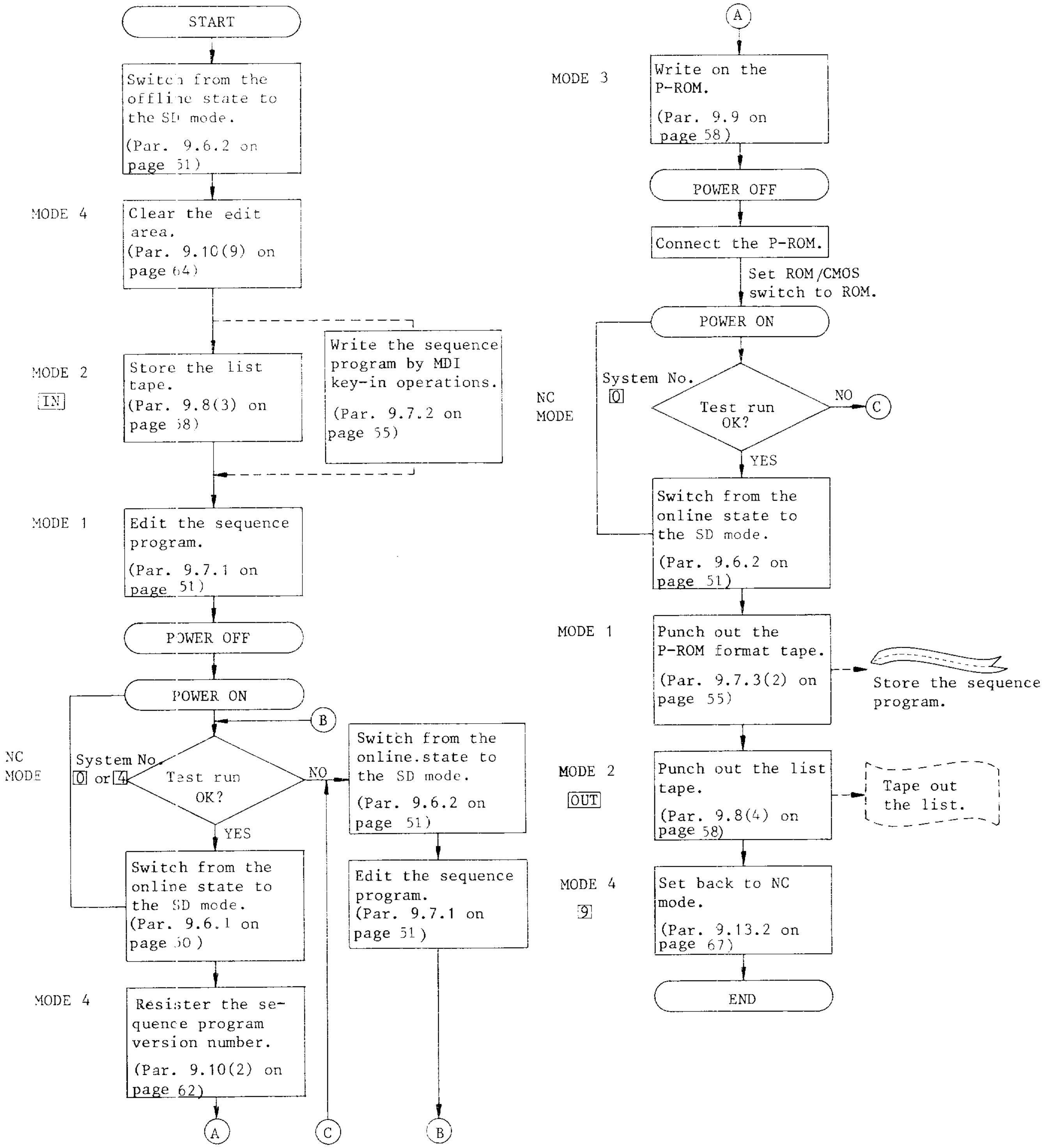
(b) Press the [9] and [WR] key.

(c) Press the [N] , [C] and [ORG] keys, in that order. The system will be changed from the SD mode to the NC mode.

Then setting the System No. switch to 0 or 4 in the NC mode enables operation check on the edited sequence program.

9.14 OPERATING PROCEDURE

Operating procedure for editing sequence program is shown in the flow chart below.



(2) Table 9.4 list the alarm codes at SD mode and operation for releasing them.

Table 9.4 Alarm Codes at SD Mode

Alarm Code	Cause	CAN key	RESET key	Remarks
ERR001	Wrong command keyed in.	○	○	—
ERR003	Reading or punching error of P-ROM format	×	○	Alarms can be released by IN or VER key.
ERR006	Memory overflow	○	○	During storing from list tape or by MDI.
ERR008	Address search unable	○	○	—
ERR020	Verifying error of list tape	×	○	Alarms can be released by VER or CURSOR key.
ERR050	Table keyed-in not correct	○	○	—
ERR051	Table search unable	○	○	—
DISASSEMBLE	Memory contents not cleared	×	×	Alarms can be released by clearing MODE 4 edit area.
VER. ERR	Verifying error of PROM format tape	×	○	Alarm can be released by VER key.

○ : Operating the key can release the alarm.

× : Operating the key cannot release the alarm.

APPENDIX 1 I/O LIST FOR YASNAC LX3 (FOR LATHES)

This I/O list shows the following I/O board composition.

List No. 1: CPU built-in I/O board

List No. 2: CRT panel built-in I/O board

< Input from Machine >

	D7	D6	D5	D4	D3	D2	D1	D0
#1000	54—36	54—21	54—05	54—35	54—20	54—34	54—19	54—33
#1001	54—24	54—08	54—38	54—23	54—07	54—37	54—22	54—06
#1002	54—11	54—41	54—26	54—10	54—40	54—25	54—09	54—39
#1003	54—45	54—14	54—44	54—13	54—43	54—12	54—42	54—27
#1004	54—49	54—18	54—48	54—17	54—47	54—16	54—46	54—15
#1005	55—06	55—07	55—38	55—39	55—20	55—21	55—22	55—23
#1006	55—08	55—09	55—40	55—10	55—24	55—25	55—11	55—12
#1007	55—13	55—37	55—05	55—14	55—15	55—16	55—17	55—18
#1008	55—41	55—26	55—27	55—19	55—33	55—34	55—35	55—36
#1009	55—42	55—43	55—44	55—45	55—46	55—47	55—48	55—49
#1010	53—11	53—41	53—26	53—10	53—40	53—25	53—09	53—39
#1011	53—45	53—14	53—44	53—13	53—43	53—12	53—42	53—27
#1012	53—49	53—18	53—48	53—17	53—47	53—16	53—46	53—15
#1013	52—16	52—09	52—03	52—15	52—08	52—02	52—14	52—01

<Input from Machine >

	D7	D6	D5	D4	D3	D2	D1	D0
#1016	04—36	04—20	04—04	04—35	04—19	04—03	04—34	04—02
#1017	04—23	04—07	04—38	04—22	04—06	04—37	04—21	04—05
#1018	04—10	04—41	04—25	04—09	04—40	04—24	04—08	04—39
#1019	04—44	04—28	04—12	04—43	04—27	04—11	04—42	04—26
#1020	04—31	04—15	04—46	04—30	04—14	04—45	04—29	04—13
#1021	04—50	04—18	04—49	04—17	04—48	04—32	04—16	04—47
#1022	05—36	05—20	05—04	05—35	05—19	05—03	05—34	05—02
#1023	05—23	05—07	05—38	05—22	05—06	05—37	05—21	05—05

APPENDIX 1 I/O LIST FOR YASNAC LX3 (FOR LATHES) (Cont'd)

<Output to Machine>

	D7	D6	D5	D4	D3	D2	D1	D0
#1100	51—05	51—06	51—07	51—08	51—41	51—27	51—26	51—25
#1101	51—09	51—10	51—19	51—20	51—21	51—22	51—23	51—24
#1102	51—33	51—34	51—35	51—36	51—37	51—38	51—39	51—40
#1103	51—11	51—12	51—13	51—14	51—15	51—16	51—17	51—18
#1104	51—42	51—43	51—44	51—45	51—46	51—47	51—48	51—49
#1105	51—07	51—12	51—06	51—11	51—05	51—17	51—10	51—04
#1106	53—36	53—21	53—05	53—35	53—20	53—34	53—19	53—33
#1107	53—24	53—08	53—38	53—23	53—07	53—37	53—22	53—06

<Cutput to Machine>

	D7	D6	D5	D4	D3	D2	D1	D0
#1116	05—10	05—41	05—25	05—09	05—40	05—24	05—08	05—39
#1117	05—44	05—28	05—12	05—43	05—27	05—11	05—42	05—26
#1118	05—31	05—15	05—46	05—30	05—14	05—45	05—29	05—13
#1119	05—50	05—18	05—49	05—17	05—48	05—32	05—16	05—47

< Input from NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1200	M28	M24	M22	M21	M18	M14	M12	M11
	M FUNCTION BCD OUTPUT							
#1201	M30R	M02R	M01R	M00R	M38	M34	M32	M31
	M30 DECODE OUTPUT	M02 DECODE OUTPUT	M01 DECODE OUTPUT	M00 DECODE OUTPUT				
#1202	TF	SF	MF	SINVA	IER	*ESPS	RST	ALM
	T-FUNCTION	S-FUNCTION	M-FUNCTION	S-4 DIGIT OUT INVERT STATUS	INPUT ERROR OUTPUT	EMERGENCY STOP OUTPUT	RESET OUTPUT	ALARM OUTPUT
	SAMPLING OUTPUT							
#1203		EDTS	AUTO	MAN	THC	RWDS	OP	DEN
		EDIT OPERATING STATUS	AUTO MODE STATUS	MANUAL MODE STATUS	THREAD CUTTING STATUS	REWIND STATUS	FEEDING	POSITIONING END
#1204	S28	S24	S22	S21	S18	S14	S12	S11
	S FUNCTION BCD OUTPUT							
#1205	T28	T24	T22	T21	T18	T14	T12	T11
	T FUNCTION BCD OUTPUT							
#1206	2ZPZ	2ZPX	ZPZ	ZPX			SPL	STL
	Z AXIS	X AXIS	Z AXIS	X AXIS			FEED HOLD LAMP	CYCLE START LAMP
	NO. 2 REFERENCE POSITION		REFERENCE POSITION					
#1207								
#1216	R08(SDD7)	R07(SDD6)	R06(SDD5)	R05(SDD4)	R04(SDD3)	R03(SDD2)	R02(SDD1)	R01(SDD0)
	EXTERNAL OUTPUT FOR S-COMMAND (S4 DIGIT) NO. 1							
#1217	(SDD15)	(SDD14)	(SDD13)	(SDD12)	R012(SDD11)	R011(SDD10)	OR10(SDD9)	R09(SDD8)
	EXTERNAL OUTPUT FOR S-COMMAND (S4 DIGIT) NO. 2							
#1218								

< Input from NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1219					TLCH	SIDX0	TPSA	SIDXA
					TOOL CHANGE COMMAND (TOOL LIFE CONTROL)	SPINDLE INDEX EXECUT-ING	S.S. LIMIT AREA CHANGE END	SPINDLE INDEX END
#1220	U07	U06	U05	U04	U03	U02	U01	U00
	OUTPUT FOR "USER'S MACRO" NO. 1							
#1221	U015	U014	U013	U012	U011	U010	U09	U08
	OUTPUT FOR "USER'S MACRO" NO. 2							
#1222								
#1223								
#1280	SSW3	SSW2	SSW1	SSW0				SKIP
	SYSTEM NO. SWITCH							
#1281		*OFFPB		ONPB	*QLD	SVALM	*ESP	*OHT
		POWER OFF PB.		POWER ON PB.	OVER-LOAD	SERVO ALARM	EMERGENCY STOP	OVER-HEAT
#1282	1HP7	1HP6	1HP5	1HP4	1HP3	1HP2	1HP1	1HP0
	NO. 1 MANUAL PULSE GENERATOR MONITOR							
#1283								
#1284	SVMX	SVMX						
	SERVO POWER ON (= "NRD")							
#1285	0	0	0	0	0	0	0	1
	CONSTANT "1"							

< Input from NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1286	0	0	0	0	0	0	0	0
	CONSTANT "0"							
#1287		PCS	PBS	PAS				
		PHASE-C	PHASE-B	PHASE-A				
		SIGNAL FROM SPINDLE PG						
#1288	TGONX	PCX	PBX	PAX	*ALX	*OLX	FUX	SRDX
	X-AXIS TG ON	PHASE-C	PHASE-B	PHASE-A	MONITOR FOR SERVO UNIT OF X AXIS			
		SIGNAL FROM X-AXIS PG						
#1289	TG ONZ	PCZ	PBZ	PAZ	*ALZ	*OLZ	FUZ	SRDZ
	Z-AXIS TG ON	PHASE-C	PHASE-B	PHASE-A	MONITOR FOR SERVO UNIT OF Z AXIS			
		SIGNAL FROM Z-AXIS PG						
#1290								
#1291								
#1292								
#1293								
#1294	ALM28	ALM24	ALM22	ALM21	ALM18	ALM14	ALM12	ALM11
	ALARM CODE MONITOR							
#1295					ALM38	ALM34	ALM32	ALM31
					ALARM CODE MONITOR			

APPENDIX 1 I/O LIST FOR YASNAC LX3 (FOR LATHES) (Cont'd)

< Output to NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1300	EDT	MEM	D	T		H/S	J	RT
	EDIT	MEMORY	MDI	TAPE		HANDLE/ STEP	MANUAL JOG	MANUAL RAPID
#1301	MP1	ROV2	ROV1	FV16	FV8	FV4	FV2	FV1
	MANUAL PG MULTIPLE SELECT	RAPID SPEED OVERRIDE		FEEDRATE OVERRIDE/MANUAL JOG SPEED				
#1302	HZ	HX	-Z	+Z	-X	+X	MP4	MP2
	MANUAL PG AXIS SELECT		MANUAL TRAVERSE AXIS DIRECTION SELECT				MANUAL PG MULTIPLY SELECT	
#1303	INHEDT	AFL	ABS	DRN	BDT	DLK	MLK	SBK
	INHIBIT EDIT	M.S.T LOCK	MANUAL ABS.	DRY RUN	BLOCK DELETE	DISPLAY LOCK	MACHINE LOCK	SINGLE BLOCK
#1304	ZRN	CDZ	SMZ	RWDH	SRN	PSI	*SP	ST
	RETURN TO REFER-ENCE	THREAD CUT UP	ERROR DETECT	HIGH SPEED REWIND	SET UP POINT RETURN	POSITION SET	FEED HOLD	CYCLE START
#1305	ERR1	ERR0	STLK	RWD	EOP	ERS	FIN	MRD
	EXTERNAL ERROR INPUT		INTER-RUPT	REWIND	END OF PROGRAM	EXTERNAL RESET	MST FIN	MACHINE READY
#1306	SAGR		*DCZ	*DCX	*-LZ	*+LZ	*-LX	*+LX
	SPINDLE SPEED AGREE-MENT		DECREASE INPUT FOR REFERENCE POINT		OVERTRAVEL INPUT			
#1307	GRS	GSC	SSTP	SINV	GR4	GR3	GR2	GR1
	S-COMMAND CON-STANT	SPINDLE SPEED CONSTANT	S-COMMAND "0"	S-COMMAND INVERT	SPINDLE GEAR RANGE SELECT			
#1308	EOUT	EVER	EIN	DRSZ	DRSX			EXTC
	NC PROGRAM PUNCH OUT	NC PROGRAM VERIFY	NC PROGRAM INPUT	DISPLAY RESET				TIME COUNT
#1309	BDT9	BDT8	BDT7	BDT6	BDT5	BDT4	BDT3	BDT2
	ADDITIONAL BLOCK DELETE							
#1310	WN16	WN8	WN4	WN2	WN1	SPC	SPB	SPA
	EXTERNAL WORK NUMBER SEARCH					SPINDLE OVERRIDE		

<Output to NC>

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1311				CPRN	HOFS	MIX	PRST	OVC
				CUTTING POINT RETURN	AUTO MODE HANDLE OFFSET	X-AXIS MIRROR IMAGE	PROGRAM RESTART	OVERRIDE CANCEL
#1312				COV16	COV8	COV4	COV2	COV1
				G71/G72 CUTTING OVERRIDE				
#1313								
#1316	SID8	SID7	SID6	SID5	SID4	SID3	SID2	SID1
	SPINDLE INDEX POSITION SET							
#1317	TP8	TP4	TP2	TP1	SID12	SID11	SID10	SID9
	TOOL NO. SET FOR STORED STROKE LIMIT				SPINDLE INDEX POSITION SET			
#1318	TLTM		TLSKP	TLRST	SIDXI	SIDXINC	TPS	SIDX
	TIMER COUNT		TOOL SKIP	TOOL RESET	SPINDLE INDEX RESTART	SPINDLE INDEX POSITION INCRE-MENTAL DESIGNA-TION	TOOL NO. CHANGE FOR S.S. LIMIT	SPINDLE INDEXING
	SIGNAL FOR TOOL LIFE CONTROL							
#1319	ROV4	SPE	SPD	TLA21	TLA18	TLA14	TLA12	TLA11
	EXTENDED RAPID TRAVERSE OVERRIDE	EXTENDED SPINDLE OVERRIDE		CHANGE TOOL NO. (TOOL LIFE CONTROL)				
#1320								
#1321								
#1322								
#1323	RI8(SDI7)	RI7(SDI6)	RI6(SDI5)	RI5(SDI4)	RI4(SDI3)	RI3(SDI2)	RI2(SDI1)	RI1(SDI0)
	EXTERNAL INPUT OF S-COMMAND (S4 DIGIT) NO. 1							

APPENDIX 1 I/O LIST FOR YASNAC LX3 (FOR LATHES) (Cont'd)

< Output to NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1324	(SDI15)	(SDI14)	(SDI13)	(SDI12)	(SDI11)	(SDI10)	(SDI9)	(SDI8)

EXTERNAL INPUT FOR S-COMMAND (S4 DIGIT) NO. 2

#1325	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0

INPUT FOR "USER'S MACRO" No. 1

#1326	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8

INPUT FOR "USER'S MACRO" NO. 2

#1327	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0

EXTERNAL DATA INPUT NO. 1

#1328	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8

EXTERNAL DATA INPUT NO. 2

#1329	EDCL	EDS2	EDS1	EDS0	EDSD	EDSC	EDSB	EDSA

CONTROL SIGNAL FOR EXTERNAL DATA INPUT

APPENDIX 2 I/O LIST FOR YASNAC MX3 (FOR MACHINING CENTERS)

This I/O list shows the following I/O board composition.

List No. 1: External mounted I/O board

List No. 2: External mounted I/O board

< Input from Machine >

	D7	D6	D5	D4	D3	D2	D1	D0
#1000	04—36	04—21	04—05	04—35	04—20	04—34	04—19	04—33
#1001	04—24	04—08	04—38	04—23	04—07	04—37	04—22	04—06
#1002	04—11	04—41	04—26	04—10	04—40	04—25	04—09	04—39
#1003	04—45	04—14	04—44	04—13	04—43	04—12	04—42	04—27
#1004	04—49	04—18	04—48	04—17	04—47	04—16	04—46	04—15
#1005	05—06	05—07	05—38	05—39	05—20	05—21	05—22	05—23
#1006	05—08	05—09	05—40	05—10	05—24	05—25	05—11	05—12
#1007	05—13	05—37	05—05	05—14	05—15	05—16	05—17	05—18
#1008	05—41	05—26	05—27	05—19	05—33	05—34	05—35	05—36
#1009	05—42	05—43	05—44	05—45	05—46	05—47	05—48	05—49
#1010	03—11	03—41	03—26	03—10	03—40	03—25	03—09	03—39
#1011	03—45	03—14	03—44	03—13	03—43	03—12	03—42	03—27
#1012	03—49	03—18	03—48	03—17	03—47	03—16	03—46	03—15

APPENDIX 2 I/O LIST FOR YASNAC MX3 (FOR MACHINING CENTERS) (Cont'd)

—◎— < Output to Machine >

	D7	D6	D5	D4	D3	D2	D1	D0
#1100	01—05	01—06	01—07	01—08	01—41	01—27	01—26	01—25
#1101	01—09	01—10	01—19	01—20	01—21	01—22	01—23	01—24
#1102	01—33	01—34	01—35	01—36	01—37	01—38	01—39	01—40
#1103	01—11	01—12	01—13	01—14	01—15	01—16	01—17	01—18
#1104	01—42	01—43	01—44	01—45	01—46	01—47	01—48	01—49
#1105	02—07	02—12	02—06	02—11	02—05	02—17	02—10	02—04
#1106	03—36	03—21	03—05	03—35	03—20	03—34	03—19	03—33
#1107	03—24	03—08	03—38	03—23	03—07	03—37	03—22	03—06

—◎— < Output to Machine >

	D7	D6	D5	D4	D3	D2	D1	D0
#1116	01—05	01—06	01—07	01—08	01—41	01—27	01—26	01—25
#1117	01—09	01—10	01—19	01—20	01—21	01—22	01—23	01—24
#1118	01—33	01—34	01—35	01—36	01—37	01—38	01—39	01—40
#1119	01—11	01—12	01—13	01—14	01—15	01—16	01—17	01—18
#1120	01—42	01—43	01—44	01—45	01—46	01—47	01—48	01—49
#1121	02—07	02—12	02—06	02—11	02—05	02—17	02—10	02—04
#1122	03—36	03—21	03—05	03—35	03—20	03—34	03—19	03—33
#1123	03—24	03—08	03—38	03—23	03—07	03—37	03—22	03—06

< Output to NC (Special Signals) >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1180	SDAC8	SDAC7	SDAC6	SDAC5	SDAC4	SDAC3	SDAC2	SDAC1
	S-FUNCTION D/A OUTPUT							
#1181	SDAC16	SDAC15	SDAC14	SDAC13	SDAC12	SDAC11	SDAC10	SDAC9
	S-FUNCTION D/A OUTPUT							
#1182	SBO8	SBO7	SBO6	SBO5	SBO4	SBO3	SBO2	SBO1
	S-FUNCTION NON-CONTACT OUTPUT							
#1183					SBO12	SBO11	SBO10	SBO9
					S-FUNCTION NON-CONTACT OUTPUT			
#1184							SEN1	SEN0
							EXTERNAL D/A	INTERNAL D/A

< Input from NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1200	M30	M02	M01	M00	DEN	OP	SPL	STL
					POSITIONING COMPLETED	FEEDING	TEMPORARY STOP	CYCLE START
#1201	2ZPα	2ZPZ	2ZPY	2ZPX	1ZPα	1ZPZ	1ZPY	1ZPX
	SECOND REFERENCE POINT LAMP				FIRST REFERENCE POINT LAMP			
#1202	4ZPα	4ZPZ	4ZPY	4ZPX	3ZPα	3ZPZ	3ZPY	3ZPX
	FOURTH REFERENCE POINT LAMP				THIRD REFERENCE POINT LAMP			
#1203					4ZPβ	3ZPβ	2ZPβ	1ZPβ
					FOURTH REFERENCE POINT LAMP			
#1204								
#1205								
#1206								
#1207								
#1208								
#1209								

APPENDIX 2 I/O LIST FOR YASNAC MX3 (FOR MACHINING CENTERS) (Cont'd)

< Input from NC >

#	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1210								
#1211								
#1212								
#1213								
#1214								
#1215								
#1216	T8/T28	T7/T24	T6/T22	T5/T21	T4/T18	T3/T14	T2/T12	T1/T11
	T-FUNCTION BINARY/BCD OUTPUT							
#1217	T16/T48	T15/T44	T14/T42	T13/T41	T12/T38	T11/T34	T10/T32	T9/T31
	T-FUNCTION BINARY/BCD OUTPUT							
#1218	TAP	M04S	TLMO	G80S	EREND	ESEND	RST	AL
	TAPPING	SPINDLE REVERSING	TOOL LENGTH MEASUREMENT	CANNED CYCLE	EXTERNAL DATA INPUT COMPLETED	EXTERNAL DATA INPUT COMPLETED	RESET	ALARM
#1219	SRV	SSP	FMF	EF	BF	TF	SF	MF
	SPINDLE REVERSE	SPINDLE STOP	MF	EXTERNAL OPERATION	B-FUNCTION	T-FUNCTION	S-FUNCTION	M-FUNCTION
	FOR CANNED CYCLE							
#1220	SB8	SB7	SB6	SB5	SB4	SB3	SB2	SB1
	S-FUNCTION BINARY OUTPUT							
#1221					SB12	SB11	SB10	SB9
					S-FUNCTION BINARY OUTPUT			
#1222	M8	M7	M6	M5	M4	M3	M2	M1
	M-FUNCTION BINARY							
#1223	OS	EDTS	IER	4NGC	AUTO	MAN	RDY	RWD
	ORIENTATION	EDITING	INPUT ERROR	4TH AXIS DISREGARD	AUTOMATIC	MANUAL	LT PREPARATION COMPLETED	REWIND

< Input from NC >

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1224	SDA8	SDA7	SDA6	SDA5	SDA4	SDA3	SDA2	SDA1
	SPINDLE OPERATION COMMAND							
#1225	SDA16	SDA15	SDA14	SDA13	SDA12	SDA11	SDA10	SDA9
	SPINDLE OPERATION COMMAND							
#1226								
#1227								
#1228								
#1229								
#1230								
#1231								
#1232	B8/B28	B7/B24	B6/B22	B5/B21	B4/B18	B3/B14	B2/B12	B1/B11
	B-FUNCTION BINARY/BCD OUTPUT							
#1233	B16/B48	B15/B44	B14/B42	B13/B41	B12/B38	B11/B34	B10/B32	B9/B31
	B-FUNCTION BINARY/BCD OUTPUT						LOW-SPEED GEAR	HIGH-SPEED GEAR
#1234	S28	S24	S22	S21	S18	S14	S12/GRH	S11/GRL
	S-FUNCTION BCD OUTPUT							
#1235	S48	S44	S42	S41	S38	S34	S32	S31
	S-FUNCTION BCD OUTPUT							
#1236	U7	U6	U5	U4	U3	U2	U1	U0
	USER MACRO							
#1237	U15	U14	U13	U12	U11	U10	U9	U8
	USER MACRO							
#1238								
#1239								

APPENDIX 2 I/O LIST FOR YASNAC MX3 (FOR MACHINING CENTERS) (Cont'd)

< Input from NC >

#	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1280	1	1	1	R	F	SN3	SN2	SN1
				TAPE FEED SWITCH		SYSTEM NO. SWITCH		
#1281				ON-PB	OLD	SVALM	ESP	OHT
				POWER ON SWITCH	OVERLOAD	SERVO ALARM	EMERGENCY STOP	OVERHEAT
#1282	1HP7	1HP6	1HP5	1HP4	1HP3	1HP2	1HP1	1HP0
	HANDLE PULSE							
#1283	EXT	0	RST5	RST4	RST3	RST2	RST1	RST0
	DSP BSY		EXTERNAL DISPLAY RESET PUSHBUTTON					
#1284	SVON	NRD						
	SERVO POWER ON	NC READY						
#1285	0	0	0	0	0	0	0	0
	CONSTANTS "1"							
#1286	0	0	0	0	0	0	0	0
	CONSTANTS "0"							
#1287	5NGC	0	0	SRDβ	SRDα	SRDZ	SRDY	SRDX
	5TH AXIS DISREGARD				SERVO READY			
#1288	ALMX	PGALX	SMCALX	*TGALX	*SDALX	*OLX	FUX	SRDYX
	X-AXIS ALARM	PG ALARM	SERVO ERROR	TG ALARM	DRIVE ALARM	OVER-LOAD	FUSE ALARM	SERVO READY
				X-AXIS SERVO UNIT MONITOR				
#1289	ALMY	PGALY	SMCALY	*TGALY	*SDALY	*OLY	FUY	SRDYY
	Y-AXIS ALARM	PG ALARM	SERVO ERROR	TG ALARM	DRIVE ALARM	OVER-LOAD	FUSE ALARM	SERVO READY
				Y-AXIS SERVO UNIT MONITOR				
#1290	ALMZ	PGALZ	SMCALZ	*TGALZ	*SDALZ	*OLZ	FUZ	SRDYZ
	Z-AXIS ALARM	PG ALARM	SERVO ERROR	TG ALARM	ALARM	OVER-LOAD	FUSE ALARM	SERVO READY
				Z-AXIS SERVO UNIT MONITOR				

<Input from NC>

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
#1291	ALMα	PGALα	SMCALα	TGALα	SDALα	OLα	FUα	SRDYα	
	4TH AXIS ALARM	PG DIS-CONNEC-TION	SERVO ERROR	TG ALARM	DRIVE ALARM	OVER-LOAD	FUSE ALARM	SERVO READY	
				α-AXIS SERVO UNIT MONITOR					
#1292	ALMβ	PGALβ	SMCALβ	TGALβ	SDALβ	OLβ	FUβ	SRDYβ	
	β AXIS ALARM	PG ALARM	SERVO ERROR	TG ALARM	DRIVE ALARM	OVERLOAD	FUSE ALARM	SERVO READY	
				β-AXIS SERVO UNIT MONITOR					
#1293				ZNGC	ABSC	EDITLKC			
				Z-AXIS DISRE-GARD	MANUAL ABSO-LUTE	EDIT LOCK			
#1294	AFLC	MLKC	OPTC	DRNC	BTDC	DLKC	STLKC	SBKC	SETTING MONITOR
	AUX FUNC-TION LOCK	MA-CHINE LOCK	OP-TIONAL STOP	DRY RUN	OP-TIONAL BLOCK SKIP	DIS-PLAY LOCK	START LOCK	SINGLE BLOCK	
#1295			PLBKC	MIβC	MIαC	MIZC	MIYX	MIXC	
			PLAY-BACK	β	α	Z	Y	X	
				MIRROR IMAGE AXIS					

<Output to NC>

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1300	EDT	MEM	D	T	S	H	J	RT
	EDIT	MEMORY	MDI	TAPE	STEP	HANDLE	MANUAL FEED	RAPID TRAVERSE
#1301	OVC	ROV2	ROV1	OV16	OV8	OV4	OV2	OV1
	OVERRIDE CANCEL	RAPID TRAVERSE RATE OVERRIDE		FEEDRATE OVERRIDE				
#1302	-α	+α	-Z	+Z	-Y	+Y	-X	+X
	MANUAL FEEDRATE SELECTION							
#1303	SPC	SPB	SPA	JV16	JV8	JV4	JV2	JV1
	SPINDLE SPEED OVERRIDE			MANUAL FEEDRATE OVERRIDE				
#1304	DRS	MP4	MP2	MP1	Hα	HZ	HY	HX
	DISPLAY RESET	HANDLE PULSE MULTIPLY			HANDLE AXIS SELECTION			
#1305	AFL	MLK	OPT	DRN	BDT	DLK		SBK
	AUXILIARY FUNCTION LOCK	MACHINE LOCK	OPTIONAL STOP	DRY RUN	BLOCK DELETE	DISPLAY LOCK		SINGLE BLOCK
#1306	SRN	F1	RET	TLMI	ZRN	EDTLK	*SP	ST
	PROGRAM RESTART	F1-DIGIT	RETRACT	MEASURED LENGTH	ZERO RETURN	EDIT LOCK	FEED HOLD	CYCLE START

APPENDIX 2 I/O LIST FOR YASNAC MX3 (FOR MACHINING CENTERS) (Cont'd)

<Output to NC>

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1307	PINT	ANG	ABS	MIβ	MIα	MIZ	MIY	MIX
	PROGRAM INTERRUPTION	Z-AXIS DISREGARD	MANUAL ABSOLUTE	MIRROR IMAGE				
#1308	9BDT	8BDT	7BDT	6BDT	5BDT	4BDT	3BDT	2BDT
	SPECIAL BLOCK DELETE							
#1309		5NG	4NG					
		5TH AXIS DISREGARD	4TH AXIS DISREGARD					
#1310				2Hβ	2Hα	2HZ	2HY	2HX
				SECOND HANDLE AXIS SELECT				
#1311				3Hβ	3Hα	3HZ	3HY	3HX
				THIRD HANDLE AXIS SELECT				
#1312	PLYBK						ESC1	ESC0
	PLAY-BACK						EXT STROKE CHECK SELECTION	
#1313 (5TH AXIS)							*-Lβ	*+Lβ
							OVERTRAVEL	
#1314 (5TH AXIS)							*-EDβ	*+EDβ
							EXTERNAL DECELERATION	
#1315 (5TH AXIS)				Hβ			-β	+β
				HANDLE AXIS SELECTION			MANUAL FEED	
#1316	FFIN	FIN	RWD	EOP	ERS	EXTC	STLK	MRD
	CANNED CYCLE FIN	MST COMPLETION	EXTERNAL REWIND	END PROGRAM	EXTERNAL RESET	EXTERNAL TIME COUNT	CYCLE START INTERLOCK	MACHINE READY COMPLETED
#1317	S-INV	S-FIN		SAGR	SOR	GRB	GRA	GST
	SPINDLE REVERSE	S CODE COMPLETED		SPINDLE COINCIDENCE	SPINDLE ORIENTATION	GEAR SELECTION		GEAR SHIFT
#1318	ERR2	ERR1	ERR0			EXOUT	EXVER	EXIN
	DEC TO STOP	IMMEDIATE STOP	BLOCK STOP			EXTERNAL OUTPUT	EXTERNAL VERIFY	EXTERNAL INPUT
#1319	*-Lα	*+Lα	*-LZ	*+LZ	*-LY	*+LY	*-LX	*+LX
	OVERTRAVEL							

<Output to NC>

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
#1320				*ITβ	*ITα	*ITZ	*ITY	*ITX
				AXIS INTERLOCK				
#1321	*-EDα	*+EDα	*-EDZ	*+EDZ	*-EDY	*+EDY	*-EDX	*+EDX
	EXTERNAL DECELERATION							
#1322				*SVOFβ	*SVOFα	*SVOFZ	*SVOFY	*SVOFX
				SERVO OFF				
#1323	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
#1324	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8
	USER MACRO							
#1325	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
	EXTERNAL DATA INPUT							
#1326	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
	EXTERNAL DATA INPUT							
#1327	EDCL	EDAS2	EDAS1	EDAS0	EDSD	EDSC	EDSB	EDSA
	EXTERNAL DATA INPUT CONTROL SIGNAL							
#1328				*DECβ	*DECα	*DECZ	*DECY	*DECX
				DECELERATION LS				
#1329								SKIP
								SKIP SIGNAL
#1330								
#1331								

APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3

< Internal Relays >

	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#1400								
#1401								
#1402								
#1403								
#1404								
#1405								
#1406								
#1407								
#1408								
#1409								
#1410								
#1411								
#1412								
#1413								
#1414								
#1415								
#1416								
#1417								
#1418								
#1419								
#1420								
#1421								
#1422								
#1423								
#1424								

	D7	D6	D5	D4	D3	D2	D1	D0
#1425								
#1426								
#1427								
#1428								
#1429								
#1430								
#1431								
#1432								
#1433								
#1434								
#1435								
#1436								
#1437								
#1438								
#1439								
#1440								
#1441								
#1442								
#1443								
#1444								
#1445								
#1446								
#1447								
#1448								
#1449								

APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#1450								
#1451								
#1452								
#1453								
#1454								
#1455								
#1456								
#1457								
#1458								
#1459								
#1460								
#1461								
#1462								
#1463								
#1464								
#1465								
#1466								
#1467								
#1468								
#1469								
#1470								
#1471								
#1472								
#1473								
#1474								

	D7	D6	D5	D4	D3	D2	D1	D0
#1475								
#1476								
#1477								
#1478								
#1479								
#1480								
#1481								
#1482								
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#1493								
#1494								
#1495								
#1496								
#1497								
#1498								
#1499								

APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

< Register >

#1500	
#1501	
#1502	
#1503	
#1504	
#1505	
#1506	
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#1698
#1699

APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

TMR < Sequencer Timer >

(8 ms Timer)		Set Value
#1700		
#1701		
#1702		
#1703		
#1704		
#1705		
#1706		
#1707		
#1708		
#1709		

(0.1 s Timer)		
#1710		
#1711		
#1712		
#1713		
#1714		
#1715		
#1716		
#1717		
#1718		
#1719		
#1720		
#1721		
#1722		
#1723		
#1724		
#1725		
#1726		
#1727		
#1728		
#1729		

(50 ms Timer)		
#1730		
#1731		
#1732		
#1733		
#1734		
#1735		
#1736		
#1737		
#1738		
#1739		
#1740		
#1741		
#1742		
#1743		
#1744		
#1745		
#1746		
#1747		
#1748		
#1749		

(1 s Timer)		Set Value
#1750		
#1751		
#1752		
#1753		
#1754		
#1755		
#1756		
#1757		
#1758		
#1759		

(1 min Timer)		
#1770		
#1771		
#1772		
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APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

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	D7	D6	D5	D4	D3	D2	D1	D0
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APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

	D7	D6	D5	D4	D3	D2	D1	D0
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APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

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APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

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APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

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APPENDIX 3 LIST OF INTERNAL RELAYS, REGISTERS FOR YASNAC LX3/MX3 (Cont'd)

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APPENDIX 4 CONVERSION TABLE OF DECIMAL AND HEXADECIMAL NOTATION

Hex	Dec	Hex	Dex	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec
00	0	20	32	40	64	60	96	80	128	A0	160	C0	192	E0	224
01	1	21	33	41	65	61	97	81	129	A1	161	C1	193	E1	225
02	2	22	34	42	66	62	98	82	130	A2	162	C2	194	E2	226
03	3	23	35	43	67	63	99	83	131	A3	163	C3	195	E3	227
04	4	24	36	44	68	64	100	84	132	A4	164	C4	196	E4	228
05	5	25	37	45	69	65	101	85	133	A5	165	C5	197	E5	229
06	6	26	38	46	70	66	102	86	134	A6	166	C6	198	E6	230
07	7	27	39	47	71	67	103	87	135	A7	167	C7	199	E7	231
08	8	28	40	48	72	68	104	88	136	A8	168	C8	200	E8	232
09	9	29	41	49	73	69	105	89	137	A9	169	C9	201	E9	233
0A	10	2A	42	4A	74	6A	106	8A	138	AA	170	CA	202	EA	234
0B	11	2B	43	4B	75	6B	107	8B	139	AB	171	CB	203	EB	235
0C	12	2C	44	4C	76	6C	108	8C	140	AC	172	CC	204	EC	236
0D	13	2D	45	4D	77	6D	109	8D	141	AD	173	CD	205	ED	237
0E	14	2E	46	4E	78	6E	110	8E	142	AE	174	CE	206	EE	238
0F	15	2F	47	4F	79	6F	111	8F	143	AF	175	CF	207	EF	239
10	16	30	48	50	80	70	112	90	144	B0	176	D0	208	F0	240
11	17	31	49	51	81	71	113	91	145	B1	177	D1	209	F1	241
12	18	32	50	52	82	72	114	92	146	B2	178	D2	210	F2	242
13	19	33	51	53	83	73	115	93	147	B3	179	D3	211	F3	243
14	20	34	52	54	84	74	116	94	148	B4	180	D4	212	F4	244
15	21	35	53	55	85	75	117	95	149	B5	181	D5	213	F5	245
16	22	36	54	56	86	76	118	96	150	B6	182	D6	214	F6	246
17	23	37	55	57	87	77	119	97	151	B7	183	D7	215	F7	247
18	24	38	56	58	88	78	120	98	152	B8	184	D8	216	F8	248
19	25	39	57	59	89	79	121	99	153	B9	185	D9	217	F9	249
1A	26	3A	58	5A	90	7A	122	9A	154	BA	186	DA	218	FA	250
1B	27	3B	59	5B	91	7B	123	9B	155	BB	187	DB	219	FB	251
1C	28	3C	60	5C	92	7C	124	9C	156	BC	188	DC	220	FC	252
1D	29	3D	61	5D	93	7D	125	9D	157	BD	189	DD	221	FD	253
1E	30	3E	62	5E	94	7E	126	9E	158	BE	190	DE	222	FE	254
1F	31	3F	63	5F	95	7F	127	9F	159	BF	191	DF	223	FF	255

MEMO

YASNAC LX3/MX3 PC SYSTEM

INSTRUCTION MANUAL

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