MITSUBISHI

PROGRAMMABLE CONTROLLER

MELSEC-K

Instruction Manual
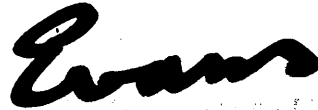
Programming Unit
Type K7PUE

MITSUBISHI ELECTRIC

Contents

1. Scope

The programming unit type K7PU (called PU after this) is a program input/output device which can control MELSEC-K series programmable sequencers. The PU can be used in conjuction with K series sequencers and also with peripheral equipment support bases (PSB).

The PU connected to those devices provides following fruitful functions;

(1)   Program read-out

(2)   Program search

(3)   Program write

(4)   Program insertion

(5)   Program deletion

(6)   Check of operating conditions

(7)   Forcible output

(8)   Set/reset of latched or temporarily stored data

Following descriptions mainly cover the operating method of the PU. Read this instruction manual through, and operate the unit properly, for error-free program input/output and for smooth system maintenance.

2. Specifications

(1)   Operating method   :   With Keypad

(2)   Available keys   :

		Example
POWER keys	2 keys	PW ON
MODE keys	5 keys	READ
INSTRUCTION keys	26 keys	MOV
INPUT/OUTPUT keys	8 keys	X
NUMERICAL keys (commonly used as 16 instruction keys)	16 keys	RST 0
DECLARATION key	1 key	INT
COMMAND keys	2 keys	STEP (+)
CLEAR key	1 key	CLEAR
Total	45 keys	

(3)   Indicating method

Step numbers	4-digit decimal number indication
Instructions	2- to 3-digit alphabetic or 1-digit symbolic indication
Symbols for input/output signals	1-digit alphabetic indication

Input/output signal numbers

X, Y	:	3-digit hexadecimal or 3-digit alphanumeric indication
Other than X, Y	:	3-digit decimal indication

Actual value of T and C	4-digit decimal indication
Data D	4-digit decimal indication
Operating condition	ON/OFF indication

(4)   Indicators

Mode indicator	Red light-emitting diodes
Other indicators	Red 4-digit alphanumeric indicators

(5) Range of indication

	*1	*2
Step number	0 to 2047	(0 to 4095)

Input/output numbers

	*1	*2
X, Y	000 to 0FF	(0 to 1FF)
M	0 to 255	
T, C	0 to 127	
F	0 to 99	
D	0 to 95	
K	0 to 63.	

Setting value, actual value

T	0.1 to 999.9 sec.
C	1 to 9999

NOTE : *1 for PU connected to sequencer K1 CPU, while *2 for PU connected to sequencer K2CPU or PSB.

(6)	Device to be connected	Series K sequencers, PSB
(7)	Power supply	Power is supplied from the above devices to which the PU is connected.

(8)	Ambient temperature range	Operation	:	0 to 40°C
		Storage	:	−10 to 50°C
(9)	Ambient humidity range	Operation	:	Max. 85% RH (no condensation)
		Storage	:	10 to 90% RH (no condensation)
(10)	Dimensions	208 (H) x 87 (W) x 35 (D) mm		
(11)	Weight	0.5 kg		

3. Description of each part

3.1 Operation panel layout

Inidcator

Mode indication

Mode keys

Instruction keys and other keys
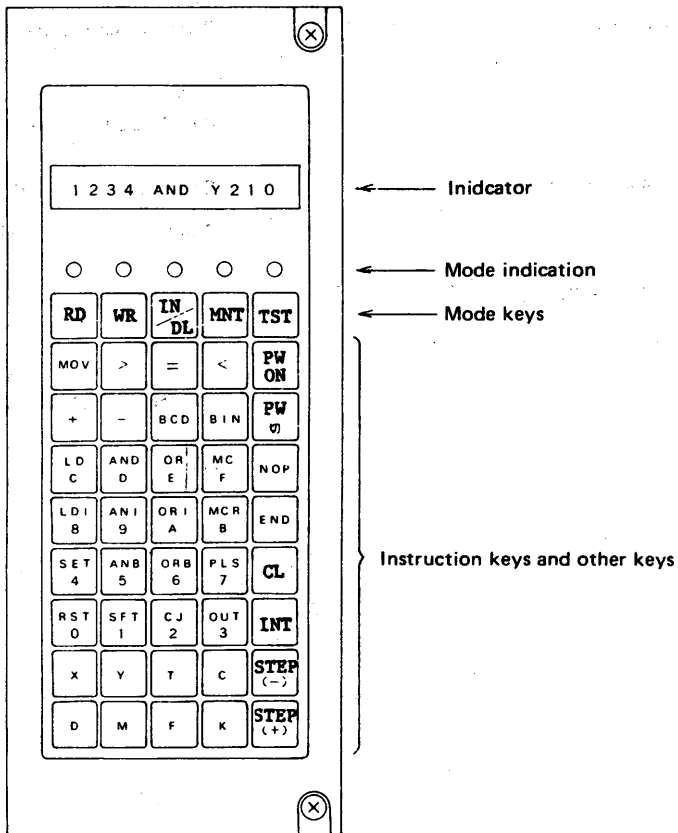
3.2 Power keys [PW ON] , [PW OFF]

These keys are for turning on/off of the PU controller power supply. The power to the sequencer CPU is not controlled by these switches.
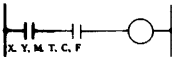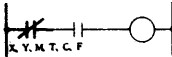
3.3 Mode keys
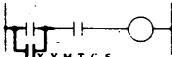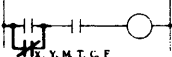
The five mode keys select the PU operation modes.
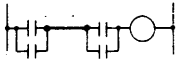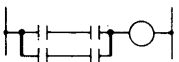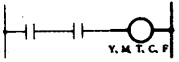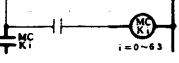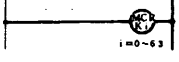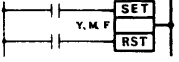
Operation mode	Function and application
[RD] (Read)	Used for reading out the programs stored in the memory, and also for searching step nos. by instructions or by I/O nos. Memory data can be checked.
[WR] (Write)	Used for writing the programs or setting values T or C, and for consecutive wiring of NOP instructions. Writing in and modification of programs are possible.
[IN/DL] (Insert/delete)	Used for inserting a program step into the designated step no., after shifting down all steps below the designated step no. by one step. Also, it is used for deleting a program step written at the designated step no., shifting up all steps below the designated +1 step no. by one step.
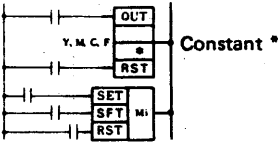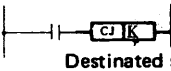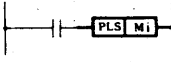
MONITOR	Used for monitoring the on/off status of X, Y, M, T, C, F, and K, and also the actual value of T and C, and data in D. Checking of operating conditions is possible.
TEST	Used for forcible output of Y, setting/resetting of M, T and latch, resetting of contacts and actual values of T and C, and resetting of the data in D. When error code is indicated, reading out of erroneous program step no. is possible by this function. Useful for testing and checking of the program operation and initial testing after installation.

3.4 Instruction keys

(1.) Sequence instructions

No.	Instruction key name	Function	Schematic indication
1	[LD] Load	Logical operation start (NOC operation start)	
2	[LDI] Load inverse	Logical negation start (NCC operation start)	
3	[AND] AND	Logical multiplication (NOC series connection)	
4	[ANI] AND inverse	Negation on logical multiplication (NCC series connection)	
5	[OR] OR	Logical summation (NOC parallel connection)	
6	[ORI] OR inverse	Negation on logical summation (NCC parallel connection)	

No.	Instruction key name	Function	Schematic indication
7	[ANB] AND block	AND on logical blocks (series connection of blocks)	
8	[ORB] OR block	OR on logical blocks (parallel connection of blocks)	
9	[OUT] Out	Coil output (YM) Timer output (T) Counter output (C) Error no. output (F)	Y, M T, C, F
10	[MC] Master control	Master control start	MC Ki i = 0~63
11	[MCR] Master control reset	Master control reset	MCR Ki i = 0~63
12	[INT] Set	Set Y, M or F	Y, M F SET RST

No.	Instruction key name	Function	Schematic indication
13	[RST] Reset	Reset Y, M or F, or reset actual counter value	Y, M, C, F OUT / RST Constant *
14	[SFT] Shift	Shift of temporarily stored data	SET / SFT Mi / RST
15	[CJ] Conditional jump	Jump	CJ K Destinated step no.
16	[PLS] Pulse	Pulse. Pulses for a period corresponding to one program cycle at rising edge of the input signal.	PLS Mi
17	[NOP]	No operation	For deleting programs or for spacing.
18	[END] End	Program end	Be sure to write this END at the end of programs.

* Constant for C

(2)　Data instructions

No.	Instruction key name	Function	Schematic indication
1	[MOV] Move	Data transfer S to D	*4 　*1 *2 ⊣⊢─[MOV｜S｜D]
2	[>] Larger than	Comparison (S larger than D)	*5 ⊣⊢[>｜S｜D]─◯ Y. M. T. C. F
3	[<] Smaller than	Comparison (S smaller than D)	*5 ⊣⊢[<｜S｜D]─◯ Y. M. T. C. F
4	[=] Equal	Equal (S equals D)	*5 ⊣⊢[=｜S｜D]─◯ Y. M. T. C. F
5	[+] Plus	Addition (D + S → D)	*3 *3 ⊣⊢─[+｜S｜D]
6	[−] Minus	Subtraction (D − S → D)	*3 *3 ⊣⊢─[−｜S｜D]
7	[BCD] BCD	Binary to BCD code conversion S → BCD conversion → D	⊣⊢─[BCD｜S｜D]

No.	Instruction key name	Function	Schematic indication
8	[BIN] Binary	BCD to binary code conversion S → Binary conversion → D	⊢⊣⊢━[BIN S D]━⊢

NOTES :

    *1 :   SOURCE .....   indicates origin (source) of the data.

    *2 :   DESTINATION .....   indicates destination.

    *3 :   Does not deal with negative values. Deals BCD numbers of up to 4 digits.

    *4 :   As an input signal for starting arithmetic operation, either X, Y, M, T, C, or F can be designated.

    *5 :   These three instructions are dealt as instructions for normally open contacts connected in series. Other instructions are dealt as instructions for coils.

3.5 Input/output keys

Device	Name	
X	Input signal	Example X 0 1 0
Y	Output signal Latch, analog timer	Y 0 2 0
M	Temporary memory	M 1 2 3
T	Timer	T 1 6
C	Counter	C 3 2
F	Memory for external failure	F 5 5
D	Data register	D 1 8

Device	Name
K	(1) Constant number K 1 2 3 (2) Number of digits K 4 Y 0 1 0 (3) MC and MCR no. K 1 2

3.6 Numerical keys [0] through [F]

Those keys are for setting step nos., input/output nos., and constant values. They are commonly used as some of instruction keys.

3.7 Declaration key [INT]

The key for declaring the setting of step number.

3.8 Command keys [STEP +] , [STEP −]

Press this key at the end of each set of key operations for execution. Confirm the keyed-in data or instructions on the indicator before pressing this key.

$\boxed{\text{STEP} +}$:   Used for execution of the sequence of designated step no., insertion of additional sequence to the designated step no., and for forcible output.

$\boxed{\text{STEP} -}$:   Used for execution of the sequence of designated step no., deletion of unnecessary sequence from the designated step no., and for forcible deactivation of output signal.

3.9   Clear key ($\boxed{\text{CL}}$)

Clears the indicated and keyed-in data. It does not clear directly the stored CPU program. Use this key for confirming the ready status after turning on the power, or for restarting operation when operator has made erroneous operation.

3.10 Indicators

Name	Example of indication	Function
Step no. (the left four digits)	`1` `2` `3`	Indicates step no., actual value of timer or counter, and data in the data register, suppressing redundant zeros in higher digits.) Example : 0056 → 56
Instruction, constant value, or 'ON', 'OFF' (the center four digits)	(1) `A` `N` `D` (2) `K` (3) `O` `F` `F`	(1) Indication of instructions (2) Indication of constants and digit symbol K (3) ON/OFF indication in monitor mode.
Input/output (the right four digits)	`X` `0` `1` `0`	Indicates input/output no. (device no.) with hexa-decimal numbers for X and Y, and with decimal numbers for other signals, suppressing redundant zeros in higher digits.

With all of those three indicators, the unit also indicates messages.

Example : `MODE` `SET` `ERR.`

4. Function and operating method of each operation mode

4.1 Preparations

— Connections with sequencer :

Although it is possible to connect this programming unit with sequencer during operation, it is recommended to perform connection while the sequencer is not in operation. If operator has to equip or remove the unit during the operation of the sequencer, pay sufficient attention to the electrical noises, etc.

(1) Equipment

    1) Connect the programming unit (PU) to the connector of sequencer CPU.

    2) Tighten the PU fixing screws securely.

    3) Press the ⏛PW ON⏛ (power on) key on the PU to turn on the PU control power. Confirm the RDY (ready) indication on the PU.

    4) Press the applicable mode key and select the desired operation mode.

NOTES : For selecting write or insert/delete modes, stop the sequencer CPU before pressing the ⏛WR⏛ or ⏛IN/DL⏛ key, since these keys are not operative while the CPU is running. If they are pressed while the CPU is running, the unit gives following error message.

⏛CANT⏛ ⏛OPE.⏛

If operator does not select operation mode before pressing other keys, the unit gives following indication.

| MODE | | SET | | ERR. |

(See page 55.)

By the above four procedures, the preparation is complete, and following operations are possible.

(2) Removal

1) Press the | CL | (clear) key.

2) Turn off the PU control power by pressing the | PW OFF | switch.
   All the indications on the PU is turned off.

3) Remove the PU fixing screws.

4) CHECK TO BE SURE THAT THE PU IS TURNED OFF, then remove the PU from the CPU.

— Connection to support base (PSB)

The PU can be connected to the PSB in the similar procedure as to the sequencer CPU. Equip/remove the PU with the PSB power turned off.

PSB has two connectors for peripheral unit connection. PU may be connected to either one of these two. However, two same peripheral units cannot be equipped at the same time.

4.2 Key operations

(1) Key operations

When operator presses any key other than $\boxed{\text{PW ON}}$ and $\boxed{\text{PW OFF}}$, the unit gives a buzzer tone. Each of the data input from the keypad is shown on the indicator. Operate keys, confirming the correct input by these indications.

(2) Instruction keys and numerical keys

The 16 numerical keys are commonly used as instruction keys. The unit automatically determines whether the operators' input is numerical data or instruction by sensing the operation immediately before one of these 16 keys was pressed, as shown below.

Common keys after pressing $\boxed{\text{INT}}$ or input/output keys : Numerical

Common keys after pressing mode keys, $\boxed{\text{STEP +}}$ or
$\boxed{\text{STEP} -}$ key, or $\boxed{\text{CL}}$ (clear) key   : Instruction key

(3) When operator pressed keys erroneously

In the case of mode keys, instruction keys, and the input/output keys, the function of key pressed lastly is effective, and applicable indication is given.

If the operator erroneously pressed numerical keys, first press [0] three or four times to make the indicated data 0, and then key-in correct data.

PRECAUTION :

If the $\boxed{\text{CL}}$ (clear) key is pressed after erroneous key operation, the indication turns to RDY (ready), and the preceding step number disappears. Instead, press $\boxed{\text{RD}}$, $\boxed{\text{WR}}$ keys again without pressing $\boxed{\text{CL}}$, and the step number is kept indicated.

(4)　On error message (for further details, see page 55,)

In this case, step no. indication disappears, and error message is indicated instead. On error message, press again mode keys ($\boxed{\text{RD}}$, $\boxed{\text{RW}}$, etc.). The step no. indicated before the error message was given appears again.

(5)　Pressing change of the mode keys does not clear the step no. indication.
Therefore, it is not necessary to set again the step no. after changing the modes from $\boxed{\text{RD}}$ to $\boxed{\text{WR}}$, $\boxed{\text{IN/DL}}$ to $\boxed{\text{RD}}$, etc. or vice versa.

(6)　Flickering of step no. indication

In case of $\boxed{\text{WR}}$ (write) or $\boxed{\text{IN}}$ (insert) where the PU itself cannot judge whether writing new or additional step is completed or not, it gives a flickering step no. indication to notify the operator that the function of the PU itself is duly executed.

On the other hand, in $\boxed{\text{RD}}$ (read), $\boxed{\text{DL}}$ (delete), $\boxed{\text{MNT}}$ (monitor), or $\boxed{\text{TST}}$ (test) modes, the step no. does not flicker; instead, the result of execution is indicated. Also, in the [WR] (write) mode operation during the sequencer CPU is running, the step no. does not flicker.

(7)   If the RUN indication on CPU flickers

In this case, first set the ‎$\boxed{\text{RUN-STOP}}$‎ switch on the CPU to STOP position, and reset the CPU with the ‎$\boxed{\text{RESET}}$‎ switch. Otherwise, the PU does not operate. Re-start the PU oeration by turning ‎$\boxed{\text{PW ON}}$‎.

(8)   After actuating ‎$\boxed{\text{RESET}}$‎ switch on CPU

When the CPU is reset, the PU power turns off. Restart the PU operation from turning ‎$\boxed{\text{PW ON}}$‎.

(9)   Before removing PU

BE SURE TO TURN OFF THE POWER BEFORE REMOVING PU.

4.3   READ mode

The READ mode is for reading out contents of memory for sequencer CPU or of PSB RAM. The data can be read out either during the CPU is in RUN or in STOP condition.

When reading out the data while CPU is running, however, there may be cases where it takes about 10 seconds to read out 1 K steps. Wait until the read-out contents are indicated.

For reading-out in the machine language basis, see section 4.8.

(1)   Reading out programs of designated step no. [RD]

        Example :   For reading out step no. 50

Operation   Indication

INT	5	0		S T E P ±		5 0		L D		X 0 1 0

                  | S T E P + | | 5 1 | | O   U   T | | T   1   2 |

                  | S T E P + | | 5 2 | | K | | 1   2   3 |

                  | S T E P + | | 5 3 | | E   N   D | | |

                  | S T E P − | | 5 2 | | K | | 1   2   3 |

                  | S T E P − | | 5 1 | | O   U   T | | T   1   2 |

| STEP ± | :   Press either | STEP + | or | STEP − | .

| STEP + | is for reading out the contents in the succeeding step.

| STEP − | is for reading out the contents in the preceding step.

− 23 −

(2) Reading out step number by instruction or instruction plus input/output number [RD]

While the CPU is running, it takes about 10 seconds per 1 K steps to read out the step nos. Just wait until the unit gives an indication.

Example 1 :

For searching with instruction and input/output number

Operation

| L D I | | M | | 5 | | STEP ± |

Indication

| 5　6　7 | | L　D　I | | M　　　5 |

Note 1. | STEP ± |　　| 8　0　3 | | L　D　I | | M　　　5 |

Note 1. | STEP ± |　Note 2. | C　A　N　T | | F　I　N　D | | |

－ 24 －

Example 2 :

Search with instruction only

(note that the usable instructions are ANB, ORB, CJ, NOP, END, and data instructions.)

Operation   Indication

| ORB | | STEP ± | | 8 0 5 | | O R B | | |

Note 1. | STEP ± | | 9 0 0 | | O R B | | |

Note 1. | STEP ± | Note 2. | C A N T | | F I N D | | |

NOTES : 1° Pressing | STEP ± | consecutively will make the PU search the next step no.

2° If the searched step no. is not found, an error message of | CANT | | FIND | is indicated.

(3) Reading out of step number and instructions by input/output number [RD]

While the CPU is running, it takes about 10 seconds per 1 K steps to read out the step nos. Just wait until the unit gives an indication.

Example :

For searching the relay Y1F ;

Operation

Y		1		F		STEP±

	STEP±

	STEP±

Indication

4 6		O U T		Y 0 1 F

5 3		L D		Y 0 1 F

6 2		O R I		Y 0 1 F

Pressing [STEP ±] consecutively will make the PU search the steps from the leading step numbers. If the designated number is not found, an error message of [CANT] [FIND] is indicated.

4.4 WRITE mode

Use this mode for writing new programs in the RAM memory, or partially modifying already-written program. For writing method of programs with machine language, see section 4.8.

(a) Writing during the operation of CPU

Writing of programs is possible while the sequencer CPU is running. But by changing initial setting, writing during the operation of CPU can be inhibited.

i) For inhibiting writing during the operation of CPU

This is the standard mode of operation. Press the ⌈PW ON⌉ (power on) key on the PU. After confirming the RDY indication, press the ⌈WR⌉ (write) key. The step number can be increased by pressing the ⌈STEP ±⌉ key, which makes the step no. indication flicker.

ii) For enabling writing during the operation of CPU

Press the ⌈PW ON⌉ key with the ⌈WR⌉ key pressed. The interlock (inhibition against writing) is cleared by pressing the ⌈PW OFF⌉ key. During writing, the step number can be increased by pressing the ⌈STEP ±⌉ key, but it does not make the indicated step no. flicker.

Any instruction in the memory can be rewritten while the sequencer CPU is running. However, it is recommended to limit the usage of this mode only for changing the set value of timers or counters, because if erroneously rewritten program is executed, there may be cases where the CPU stops, RUN indication flickers, and accidental condition may occur.

Note that it is impossible to insert/delete any step during the operation of CPU, because it imposes the step number in the program under execution to change. It should be to set ⌈NOP⌉ beforehand, or to write into ⌈NOP⌉ instruction.

(b)   Writing END

Be sure to write END at the end of each program. Without END, the RUN indication on the CPU keeps flickering and the sequencer does not operate.

(c)   Check of the same coil designation (impossible by write in during RUN)

On ⌞WR⌟ (write) or ⌞IN⌟ (insert), the unit checks whether there are instructions on the same coil, and if there are, it gives an error message of [DUAL] [COIL] [ERR.]. The next step no., which flickers in general operations, does not flicker in this case. However, as long as the written or inserted program is correct, the operator can further write the program as in the usual cases.

Check on the same coil designation is performed only for the following O marked combinations.

	Y	M	T	C	F	K
O U T	O	O	O	O		
S E T	O	O				
S F T		O				
P L S		O				
M C						O

— The unit does not check OUT F and SET F instructions.

— The unit does not check RST and MCR instructions.

(1) All clear $\boxed{\text{WR}}$

Erasing of all the programs written in the program memory (RAM). Before writing new programs, clear all programs in the RAM. By all clear, NOPs are written in step 0 through the last step.

Operation   Indication

| $\boxed{\text{INT}}$ | $\boxed{0}$ | $\boxed{\text{STEP}\pm}$ | • | $\boxed{0}$ | $\boxed{}$ | $\boxed{}$ |

| $\boxed{\text{NOP}}$ | $\boxed{\text{K}}$ | $\boxed{2 \quad 0 \quad 4 \quad 7}$ | $\boxed{\text{STEP}\pm}$ | • | $\boxed{0}$ | $\boxed{\text{NOP}}$ | $\boxed{2 \quad 0 \quad 4 \quad 7}$ |

$\uparrow$

The last step in the memory   1023 (1K)
                                    2047 (2K)
                                    4095 (4K)

"*" for flickering indications.

(2) Writing sequence instructions | WR |

Example :   For writing sequence instruction program from step 0 ;

The programming procedure is indicated on the next page. Wirte OUT T, OUT C, and CJ plus destination
step no. consecutively, because they are two-step instructions. In case the destination step no. for CJ (condi-
tional jump) instruction is not fixed, write K0 (step 0) temporarily, and rewrite it after the step no. is finally
determined. (For correction, see page 34.)

End of program
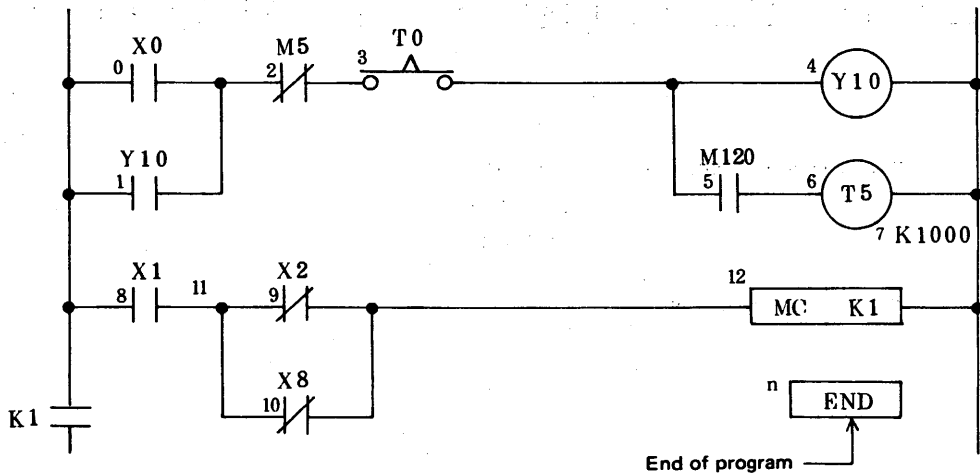
Operation			Indication			
INT	0		STEP ±	* 0		
L D	X	0	STEP ±	* 1	L D	X 0 0 0
O R	Y	1 0	STEP ±	* 2	O R	Y 0 1 0
A N I	M	5	STEP ±	* 3	A N I	M 5
A N D	T	0	STEP ±	* 4	A N D	T 0
O U T	Y	1 0	STEP ±	* 5	O U T	Y 0 1 0
A N D	M	1 2 0	STEP ±	* 6	A N D	M 1 2 0
O U T	T	5	STEP ±	* 7	O U T	T 5
K	1 0 0 0		STEP ±	* 8	K	1 0 0 0
L D	X	1	STEP ±	* 9	L D I	X 0 0 1
L D I	X	2	STEP ±	* 10	L D I	X 0 0 2
O R I	X	8	STEP ±	* 11	O R I	X 0 0 8
A N B			STEP ±	* 12	A N B	
M C	K	1	STEP ±	* 13	M C	K 1
E N D			STEP ±	* n + 1	E N D	

- By $\boxed{\text{LD}}$ $\boxed{\text{X}}$ $\boxed{\text{0}}$ $\boxed{\text{STEP} \pm}$, ON/OFF status of the normally open contact of the relay X0 is stored in the step 0. The indicated step no. is increased by one, and the '1' flickers, showing that the unit is ready for writing operation. ("*" for flickering indications.)

- Just like for other instructions, be sure to write END at the end of program, pressing the $\boxed{\text{STEP} \pm}$ after that.

- Be sure to write 2-step instructions continuously. If another instruction is written before the latter part of 2-step instruction, an error message of $\boxed{\text{INS.}}$ $\boxed{\text{SET}}$ $\boxed{\text{ERR.}}$ is given.

- In case where the program is written while the sequencer CPU is running, if instructions for any coil which has been turned on are re-written to other coil, the former coil will be kept turning ON without OFF, that should be cautioned.

(3)   Data instruction write $\boxed{\text{WR}}$

Example : For writing data instruction program from step no. 20 ;
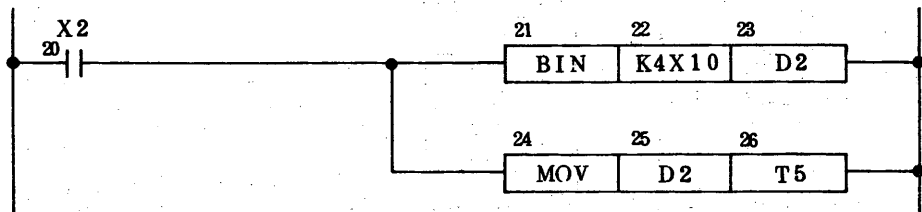
Operation			Indication		
INT 2 0	STEP±	* 2 0			
LD X 2	STEP±	* 2 1	L D	X 0 0 2	
BIN	STEP±	* 2 2	B I N		
K 4 X 1 0	STEP±	* 2 3	K 4	X 0 1 0	
D 2	STEP±	* 2 4		D 2	
MOV	STEP±	* 2 5	M O V		
D 2	STEP±	* 2 6		D 2	
T 5	STEP±	* 2 7		T 5	

— Write data instructions as contiguous 3-step instructions. Note that there are limitations on the combination of data instructions. Writing other instructions before completing any 3-step data instruction writing will cause an error message of INS.   SET   ERR.

(4)   Correction of program   RD → WR

Example :   For correcting X1 in step no. 50 to X10 ;

$$\overset{X1 \leftarrow X10}{\underset{50}{| |}} \quad | | \quad \bigcirc$$
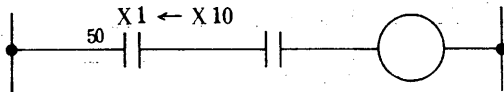
Operation				Indication			
RD							
INT	5	0	STEP ±	5 0	L D		X 0 0 1
WR				5 0			
LD	X	1 0	STEP ±	5 1	L D		X 0 1 0

※

— It is not necessary to re-set the step no. when writing programs after reading-out.

— For insertion and deletion, see section 4.5.

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- ※ for flickering indications. It shows that the step 50 is corrected as above, and that writing to the next step no. 51 is enabled.

- Correcting to NOP has the same function as deleting.

(5) Consecutive NOP instructions [WR]

From the designated starting step through the ending step, the unit consecutively writes the NOP instructions. Used for deleting some part of programs, or for inserting redundant space in programs. The operating procedure is almost the same as the All clear operation.

Example : For writing NOP instructions from step 1000 through 1499 ;

Operation

| INT | | 1 | 0 | 0 | 0 | |
| NOP | K | | 1 | 4 | 9 | 9 |

Indication

				※								
STEP±	1·0	0	0									
				※								
STEP±	1	0	0	0		N	O	P		1	4	9	9

NOTE : If the keyed-in starting step no. is larger than ending step no., a message of [CJ] [STEP] [ERR.] is given.

4.5 |IN/DL| **(insert/delete) mode (Not operative during CPU operation)**

Used for adding and deleting programs in RAM for modification.

The |IN| (insertion) inserts new program steps at designated step nos., shifting and increasing the successive step nos. by the number of added steps. If the entire range of the available memory is occupied by existing programs, the END statement at the end of the program will drop from the last step no. (either 1023, 2047, or 4095), which will cause an error.

The |DL| (deletion) deletes programs in designated step nos., shifting up the program steps from the next step of the deleted part to the last step and decreasing step nos. by the number of steps deleted. (For maintaining the step no. from the next step of the deleted step and thereafter, write NOP instructions, instead.)

If there are CJ instructions after the inserted or deleted steps, the destination step nos. for the CJ instructions are automatically renumbered.

(1)   Insertion of programs (Not operative during CPU operation) $\boxed{\text{RD}}$ → $\boxed{\text{IN}}$

Set the step no. to which the new program is inserted, and perform the similar operation as writing. It is recommended to read out the existing program in the step no. to which the new program is inserted, for checking before executing the insertion.

For testing purpose, END statements can be inserted at any step of the program. After completing the test, however, be sure to delete these END statements.

Example :

Circuit to be inserted.

After insertion, the instruction of OUT Y80 shifts to the step no. 104.
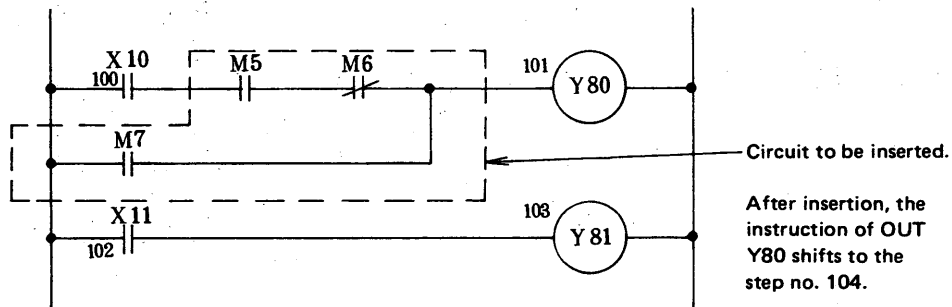
Operation				Indication		
[RD]						
INT	1 0 1	STEP±		1 0 1	OUT	Y 0 8 0
[IN/DL]				1 0 1 ※		
AND	M	5	STEP+	1 0 2 ※	AND	M 5
ANI	M	6	STEP+	1 0 3 ※	ANI	M 6
OR	M	7	STEP+	1 0 4	OR	M 7
[RD]			STEP+	1 0 4	OUT	Y 0 8 0

(2) Deletion of programs (Not operative during CPU operation.) $\boxed{\text{RD}}$ → $\boxed{\text{DL}}$

Set the step no. to be deleted, and press the [STEP —] key. The program in the set step will be deleted. It is recommended to read out the existing program to be deleted for checking, before actually out the existing program to be deleted for checking, before actually deleting the step. Note that if the program step to be deleted comprises either LD, LDI, ANB, or ORB instructions, there may be cases where the circuit after deletion is completely different from the one before deletion.

Example :
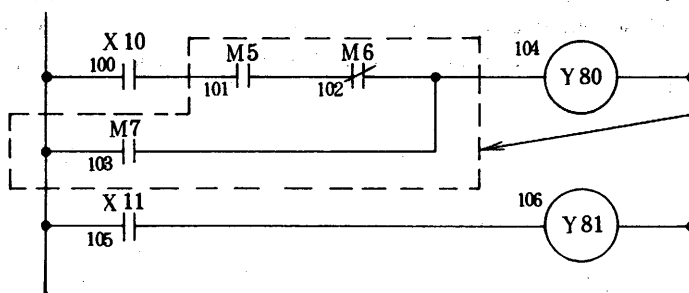
Circuit to be deleted.

After deletion, the instruction of OUT Y80 shifts to the step no. 101.

Operation			Indication		
[RD]					
[INT]	1 0 1	STEP±	1 0 1	A N D	M 5
[IN/DL]		STEP−	1 0 1	A N I	M 6
		STEP−	1 0 1	O R	M 7
		STEP−	1 0 1	O U T	Y 0 8 0

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Precautions for deletion [DL]

[DL] and NOP

Deletion after writing a complete program will change the total number of steps of the program. To keep the number of steps, write NOP instructions in [WR] (write) mode, instead. (For correction, see page 34.)

Deleting only OUT instructions

There are cases, when deleting devices for Y, M, T, C, or F, only the coils are deleted with the contact points kept remained. Since such deletion may cause errors, be sure to delete also the contact points or rewrite them to NOP.

Deletion of 2-step or 3-step instructions

Be sure not to delete only one step, but delete the entire part of the instructions.

4.6 Monitor mode (Operative during CPU operation)

Allows the operator to monitor the operating conditions of the sequencer.

(1) For monitoring ON/OFF conditions of X, Y, M, F, MC and K

Example : ON/OFF conditions of X0 and preceding and succeeding Xs.

Operation   Indication

| X | 0 |

STEP±	[ ]	ON	X 0 0 0
STEP+	[ ]	OFF	X 0 0 1
STEP-	[ ]	ON	X 0 0 0
STEP-	[ ]	ON	* X 0 FF
STEP+	[ ]	ON	X 0 0 0
STEP+	[ ]	OFF	X 0 0 1
STEP+	[ ]	OFF	X 0 0 2

— Pressing STEP + consecutively will make input/output numbers X, Y, M, F, K increased by one, respective-ly. Increment from the maximum number results in 0.

— Pressing STEP − consecutively will make input/output numbers X, Y, M, F, K decreased by one, respective-ly. Decrement from 0 results in the maximum number. In the above example, the OFF with '*' is for K1CPU. In the case of K2CPU, indication for this step is '1FF'.

(2)   Actual value of T, C and ON/OFF status of contacts |MNT|

Example :   Monitoring of timer T1 and preceding and succeeding registers

Operation   Indication

| T | | 1 | | S T E P ± | | 3 0 | | O F F | | T   1 |

                   | S T E P + | | 1 4 0 | | O N | | T   2 | ★

                   | S T E P − | | 3 5 | | O F F | | T   1 |
                                        ↑   ↑
                                   Indicates the actual   Indicates the ON/OFF
                                   value in decimal.   status of contacts.

The same memory device is commonly used for timer and counter. In the above example, no. 1 is used as a timer and no 2 as a counter. The contents shown with "★" for T2 in the example actually shows the contents of the counter C2.

Pressing |C| |2| |STEP ±| will make the indication |140| |ON| |C2| .

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(3) Monitoring D [MNT]

Example : For monitoring D1

Operation   Indication

| D | | 1 | | S T E P ± | | 1 2 3 4 | [   ] | D   1 |

                 | S T E P + | | 1 0 | [   ] | D   2 |

                                          ↑
                                    Indicates the
                                    contents of D
                                    in decimal.

(4) Continuity check of coils [RD] → [MNT]

In case any of the coils does not operate, the cause of the fault can be checked by monitoring the ON/OFF status of relay contacts, tracing the step nos. in the ascending order from the coil. Monitoring in the descending order is also possible.

a) Press the ☐RD (read out) key to make the required step no. indicated, and further press the ☐MNT ☐STEP ±. The ON/OFF status of the contact before or after the read-out step is indicated.

b) Indication of the ON/OFF status of relay contact is given in terms of normally open contact. This means that in the case of normally close contacts, the close status is indicated as OFF. On timers and counters, also check whether their contacts are before or after energizing. 'Before energizing' is indicated as OFF, while 'after energizing' is ON.

c) In the case of instructions MOV, +, −, etc., which are not directly related to ON/OFF of contacts, only the instructions are indicated.

d) In the case of T and C, no step no. is indicated, because they are indicated with their actual values. For checking their step nos., press ☐RD ☐STEP ± .

e) Pressing other keys will reset the monitor mode.

Example : Monitoring around the output Y10 (Step no. for Y10 is 1.)
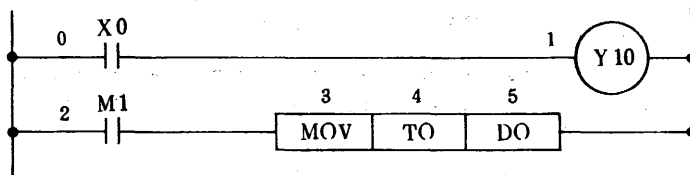
Operation			Indication			
[RD]	[INT]	1	STEP ±	1	OUT	Y 0 1 0
[MNT]			STEP +	1	OFF	Y 0 1 0
			STEP −	0	OFF	X 0 0 0
			STEP +	1	OFF	Y 0 1 0
			STEP +	2	ON	M 1
			STEP +	3	MOV	
			STEP +	1 2 3 4	OFF	T 0
			STEP +	1 2 3 4		D 0

4.7   Test mode (Operative during CPU operation)

The testing function not only facilitates the unit test of sequencer and testing of devices controlled by this PU, but also allows the operator to trace the fault location (step no.) in case the sequencer stops by any trouble.

(1)   Forcible ON/OFF of output Y $\boxed{\text{TST}}$

While the CPU is not operating, the output Y is forcibly turned ON or OFF as designated, irrespective of the program. During the operation of CPU, priority is on the execution of the sequencer program, and the output just turns ON instantaneously. For maintaining the ON status, a latch circuit which keeps the ON status actuated by the instant-aneous ON can be considered as example 2.

Example 1 : For turning ON/OFF the output Y1F forcibly
(while the CPU is not running)

Operation   Indication

| Y | | 1 | | F | | S T E P + | | | | | | | | Y 0 1 F |

The output is turned ON.

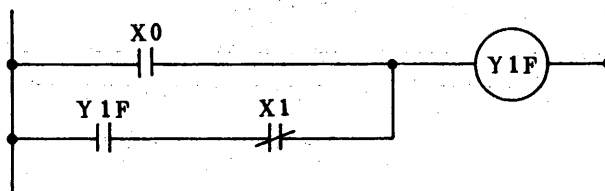| S T E P − | | | | | | | | Y 0 1 F |

The output is turned OFF.

Turned ON by | STEP + | .   Turned OFF by | STEP − | .

Example 2 :   ON/OFF of latch circuit (during CPU operation)

In the following sequence, although the X0 is OFF, when the Y1F is forcibly turned ON by PU, it is kept ON until either it is turned OFF by PU or the X1 turns ON.

(2) Set/reset of M, F, T, C, and D $\boxed{\text{TST}}$

(Operative during CPU operation)

Sets/resets M and F, and resets T, C, and D. On T and C, the contacts and the actual values are reset. If the set/reset operation is performed while the CPU is running, the execution of the program has the priority.

Example : For setting/resetting the M5

Operation   Indication

$\boxed{\text{S E T}}$ $\boxed{\text{M}}$ $\boxed{\text{5}}$ $\boxed{\text{S T E P} \pm}$ $\boxed{\text{1}}$ $\boxed{\text{S \quad E \quad T}}$ $\boxed{\text{M} \qquad 5}$

$\boxed{\text{R S T}}$ $\boxed{\text{M}}$ $\boxed{\text{5}}$ $\boxed{\text{S T E P} \pm}$ $\boxed{\text{0}}$ $\boxed{\text{R \quad S \quad T}}$ $\boxed{\text{M} \qquad 5}$

— '1' shows that the setting is complete, while '0' shows that the resetting is complete.

— Pressing again $\boxed{\text{STEP +}}$ increases the device number by one, on which the set/reset is effected. Pressing again $\boxed{\text{STEP} -}$ decreases the device no. by one, and set/reset is effected on that number.

(3)   Reading out of erroneous step when error code is indicated $\boxed{\text{TST}}$

In case an error occurs during the operation of the sequencer, the RUN indication flickers on the CPU of sequencer to notify the operator of the programming error or memory trouble.

This function is used for tracing the step no. where the error is caused.

Operation   Indication

$\boxed{\text{K}}$ $\boxed{\text{S T E P} \pm}$ $\boxed{1 \quad 2 \quad 3 \quad 4}$ $\boxed{\text{K} \qquad\qquad}$ $\boxed{\qquad\qquad\qquad}$

                                                    ↑
                                        Indicates the step no.
                                        at which the trouble
                                        occurs.

NOTE :   When the sequencer stops in the midst of operation, the programming error can be checked by this function.

4.8 Read and write with machine language

This function is available when microcomputer — based CPUs K1CPU-S2, K2 CPU-S1 or -S3, etc., are used as the sequencer CPU.

Indications in [TST] (test) mode are given with machine language. The address indicated is the real address in hexa-decimal.

(1) Read-out with machine language (Operative during CPU operation) [TST]

Operation   Indication

[TST]   [INT]   40A0   STEP+   40A0   [   ]   [C 3   ]

                        STEP+   40A1   [   ]   [A F   ]

                        STEP+   40A2   [   ]   [4 1   ]

                        STEP-   40A1   [   ]   [A F   ]

(2) Write with machine language (Not operative during CPU operation) TST

After the display of the read-out with machine language is provided, writing is possible.

Operation   Indication

                                        | 4 0 A 1 | | | | A F |
                                             *
| K | | A B | | S T E P + | | 4 0 A 2 | | | | A B |

For writing execusion following the above read-out ;

                                             *
| K | | C 2 | | S T E P + | | 4 0 A 3 | | | | C 2 |
                                             *
| K | | 1 2 | | S T E P + | | 4 0 A 4 | | | | 1 2 |

"*" shows flickering of the next step nos.

5. Error messages and troubleshooting

On improper keying-in by operators, the PU gives an error message on the indicator. Method of troubleshooting depends on the type of error message indicated. The simplest method for each of the error messages is shown in the following table. Confirm the given message before pressing keys, because the error message will disappear by pressing any key.

The following error messages are tabulated in the alphabetic order.

No.	Message	Possible cause	Troubleshooting
1	CANT FIND	The designated step no. cannot be found in searching. (Not a real error.)	Continue the following key operation.
2	CANT OPE	Writing, insertion and deletion is inhibited while the CPU is running.	Stop the CPU and start PU operation again. If it still does not operate, RESET the CPU. (* Writing while the operation of CPU is possible when the initial setting is changed.) (See pages 27 and 28.)

No.	Message	Possible cause	Troubleshooting
3	CJ STEP ERR.	In [WR] (Write) or [IN] (insert) mode, 1) Step no. junior than the CJ instruction is designated as a destination address. 2) The program size exceeds the max. no. of steps for CPU (2047 or 4095) 3) The program size exceeds the allowed maximum by the insertion. (Insertion is executed in this case.)	Press the mode keys [WR] or [IN] again, and re-set the destination step no., or correct the program.
4	DUAL COIL ERR.	Same coil is designated in [WR] or [IN] mode. In this case keyed-in program step is written in the memory.	Correct the program. (There may be cases where designation of the same coil is not an error.) If the program is correct, continue writing the program.

No.	Message	Possible cause	Troubleshooting
5	INS. CODE ERR.	Improper code is keyed-in, which cannot be converted into instruction.	Rewrite the correct instruction in the WR mode.
6	INS. SET ERR.	In WR (write) or IN (insert) mode, 1) The instruction and the input/output are erroneously combined. 2) Instructions are not fully written in 2- or 3-step instructions.	Press again the mode key WR or IN , and rewrite the instruction with the instruction keys.
7	IO SET ERR.	I/O no. which can not be set is keyed-in.	Set the I/O no. within the allowed range.
8	IO NO. OVER ERR.	The number of keyed-in I/O nos. exceeds the allowed maximum.	Set the I/O no. within the allowed range.
9	MODE SET ERR.	Keys other than CL are pressed before pressing mode keys.	First select the operation mode with mode keys.

No.	Message	Possible cause	Troubleshooting
10	OPE. ERR.	Operator has made improper keying in. (Operation other than described in section 4. has been performed.)	Operate the PU again from setting with [INT] .
11	RDY	Indicated in normal conditions. 1) When the PU power is turned ON by pressing the [PW ON] key. 2) When the [CL] (clear) key is pressed.	As long as RDY is indicated, continue the key operation. If RDY is not indicated by the operations left ; 1) Press [PW OFF] once, and then [PW ON]. If RDY is not still indicated, hardware defect is suspected. 2) Loose connection of PU can also be considered. Remove the PU once, and equip it again.
12	STEP OVER ERR.	The keyed-in step no. is larger than the allowed maximum.	Re-set the correct step no. with [INT] key.

No.	Message	Possible cause	Troubleshooting
13	WR. ERR.	Program cannot be written in the memory. (Mismatch of programs is found by the automatic verification, after writing a program.)	1) Check to be sure that the RAM is correctly mounted. 2) Check to be sure that P-ROM is not mounted in place of RAM. 3) Check to be sure that the RAM is correctly inserted into the socket. 4) If error still occurs after rewriting the program, defect of RAM is suspected. Replace the RAM.

6. Maintenance

(1) Maintenance

The PU is free from adjustment, checking and exchange. Since dirts are apt to stick on the surface of the face panel made of acrylic resin, wipe it from time to time with soft cloths. Rubbing it strongly will make scratches on the panel surface. Do not use the organic detergent.

(2) Storage and transportation

Use the case for storage and transporation of the PU. The PU can be stored/transported as equipped on the PSB.

Specification subject to change without notice