OMRON USER'S MANUAL

Programmable Controller

Model SYSMAC-**S6**

ONICS CO.

INTRODUCTION

"OMRON SYSMAC" is the trade name of OMRON's programmable controllers unparalleled in reliability and versatility. Programmable controllers, which were initially developed to meet the demands by equipment manufacturing industries and large-scale plants for their production facilities, now answer the needs of industries from every field and have become original equipment for installation at factories. The above trend has induced original equipment manufacturers to design the incorporation of programmable controllers in their machinery and equipment, and thus the demand for availability of the programmable controllers that can be handled as easily as components has been increasing. Accordingly, OMRON has sought to develop programmable controllers which are: a. small and economical, b. easy to handle by merely connecting a load and power, and c. easy to operate by anyone at site, in addition to possessing flexibility that permits adapting to changes to the controlled systems or control parameters with simple keyboard operation and high reliability which can be materialized only by electronic control.

OMRON now offers with confidence the OMRON SYSMAC-S6 Module Type Programmable Controller, a first-class programmable controller with "CPU function" and "techniques responding adequately to the needs at every site." Programming with the SYSMAC-S6 can be performed easily and directly from ladder diagrams using the programming console connected to the CPU.

Since the programmable controller adopts the building block system, the I/O units to which controlled devices are connected, can be expanded to a maximum of 64 points in increments of 4 I/O points per unit.

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OMRON SYSMAC-S6 CODING SHEET

1. Features

Highly sophisticated programmable controller in a DIN-96 sized housing.

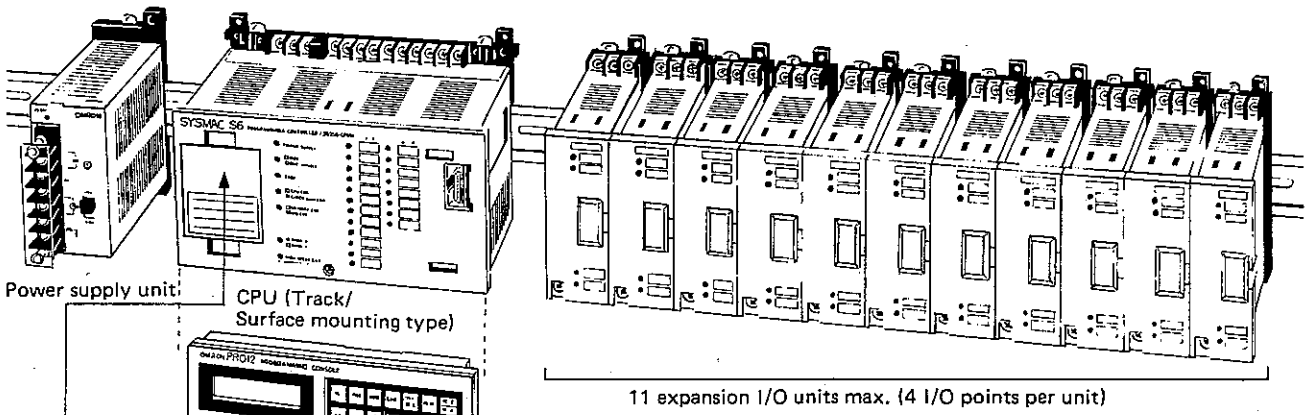
- **Conversational programming system employed**
  The operability of programming and debugging is greatly improved through communications between the CPU and the operator in the dialogue mode via messages on the LCD of the programming console.
- **Programming console removable from the CPU while SYSMAC-S6 is in operation**
  In addition, cassette interface and monitor functions are provided as standard equipment.
- **Abundant functions for improved maintenability and operability**
  The high-speed counter (1kHz max.) and reversible counter instructions are provided for position control or sequential operation control. Furthermore, maintenability and operability are improved by multi-point monitoring, graphic monitoring, diagnostic functions, etc., which offer a wide range of applications.
- **Either ROM or RAM selectable for memory**
  For the ROM memory, two kinds of user programs can be selected by an external signal. The RAM memory is backed up by the built-in capacitor in the CPU and the battery unit, thus protecting the memory from data loss.
- **Flexible mounting style through motherboardless design**
  The SYSMAC-S6 can be mounted as an integrated unit, or as a separate unit either on a DIN rail or on a mounting panel, or can be installed within a control panel because of its unique design that does away with a motherboard.
- **Expandable I/O capacity (4 points per unit)**
  In addition to the standard 12 input points and 8 output points incorporated in the CPU, a maximum of 44 I/O points can be optionally added in units of 4 points for I/O expansion.

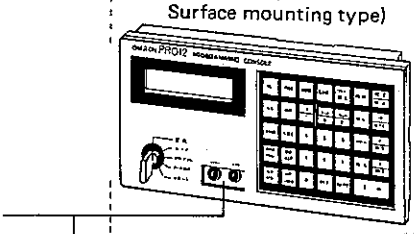
2. System Configuration and Specifications

2.1 Available Types

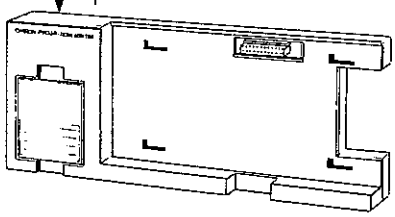
The SYSMAC-S6 consists of a CPU (Central Processing Unit) and input/output units. A programming console, a PROM writer and a power supply unit are available as peripheral equipment.

Classification		Specification	Weight	Type
CPU	Track mounting/ surface mounting	Built-in RAM: 512 words, Contact output, Standard I/O: 12 input points, 8 output points	1kg max.	3G2S6-CPU15
		Built-in RAM: 512 words, Triac output, Standard I/O: 12 input points, 8 output points		3G2S6-CPU17
		Built-in RAM: 512 words, Transistor output, Standard I/O: 12 input points, 8 output points		3G2S6-CPU29
	Flush mounting (with mounting bracket)	Built-in RAM: 512 words, Contact output, Standard I/O: 12 input points, 8 output points		3G2S6-CPU16
		Built-in RAM: 512 words, Triac output, Standard I/O: 12 input points, 8 output points		3G2S6-CPU18
		Built-in RAM: 512 words, Transistor output, Standard I/O: 12 input points, 8 output points		3G2S6-CPU30
Expansion I/O unit	Input unit (4 points)	AC 100 to 200V ±10% (with 13cm I/O connecting cable)	200g max.	3G2A3-IA221
		DC 12 to 48V ±10% (with 13cm I/O connecting cable)	200g max.	3G2A3-ID411
	Output unit (4 points)	Relay contact output: AC 250V/DC 24V, 2A (with 13cm I/O connecting cable)	250g	3G2A3-OC221
		Transistor output: DC 12 to 48V, 500mA (with 13cm I/O connecting cable)	200g	3G2A3-OD411
		Triac output: AC 250V, 2A (with 13cm I/O connecting cable)	250g	3G2A3-OA221
Peripheral equipment	Programming console	–	330g	3G2A3-PRO16
	PROM writer	–	330g	3G2A3-PRW03
	Power supply unit	Input: AC 100 to 120V, 200 to 240V Output: DC 24V, 1.5A max.	560g	3G2A3-PS221
Accessories	I/O connecting cable	Cable length: 1m	19g	3G2A3-CN121
	Programming console connecting cable	Cable length: 2m	66g	3G2A3-CN221
	Memory unit	EPROM (512 words x 2)	38g	3G2A3-MP523
	Battery unit	Lithium battery	40g	3G2A9-BAT07
	Mounting bracket	For flush mounting of programming console	56g	3G2A3-PAT01
	Replacement fuse	For replacement of 4A fuse in output unit (3G2A3-OD411/-OA211)	1g	3G2A3-PAT02
	Cassette connecting cable	Cable length: 1m	50g	SCY-P0R-PLG01
	DIN rail	Rail length: 1m	260g	PFP-100N2
	End plate	For use with DIN rail (supplied in pairs)	5g	PFP-M





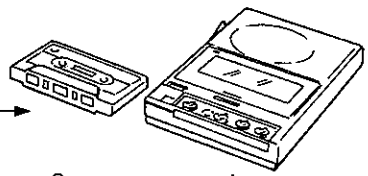
Programming console



PROM writer

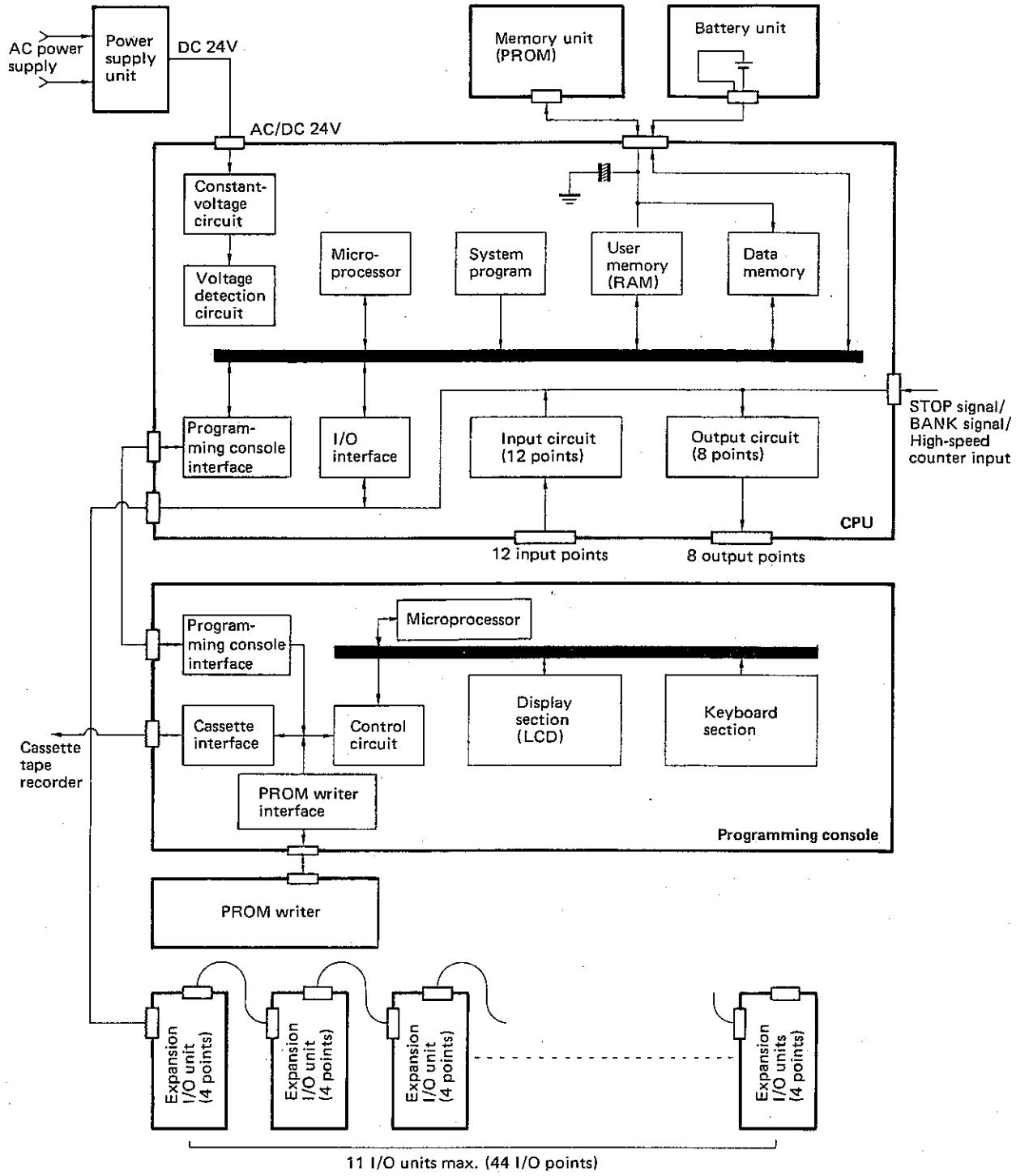
Memory unit

Battery unit



Cassette tape recorder
(Commercially available)

2.2 System Configuration



2.3 Specifications

■ RATINGS

Supply voltage	AC/DC 24V (AC full wave)
Operating voltage range	85 to 110% of rated voltage*
Power consumption	10VA max.**
Insulation resistance	20MΩ min. at DC 500V (between external terminal and outer casing)
Dielectric strength	AC 1,500V, 50/60Hz for 1 minute (between external terminal and outer casing)
Noise immunity	1,000V p-p, rise time: 1nsec, pulse width: 2μsec
Vibration	16.7Hz; 3mm double amplitude (in X, Y and Z directions, each for 2 hrs.)
Shock	10G's (in X, Y and Z directions, each 3 times)
Ambient temperature	Operating: 0 to +50°C Storage: −10 to +70°C
Humidity	30 to 90% RH (without condensation)
Atmosphere	Must be free from corrosive gases.
Structure	Module type
Coating	CPU and I/O Unit: Ivory white
Weight	See Section 2.1 Available Types.

NOTES: * A momentary power failure of less than 10msec is ignored by the programmable controller.
** This value applies to the CPU only, with all the I/O relays within CPU in the ON state.

■ CHARACTERISTICS

Control system	Stored program system
Main control element	LSI, TTL, CMOS
Programming system	Ladder diagram
Instruction word length	1 word (24 bits/word)
Number of instructions	17 kinds
Execution time/word	Average: 10msec/512 words
Programming capacity	RAM*: 512 words EPROM: 512 words x 2
Number of input/output points	Input: 12 points (Relay Nos. 000 to 011), fixed within CPU. Output: 8 points (Relay Nos. 012 to 019), fixed within CPU. Expansion I/O: 44 points (Relay Nos. 020 to 063) by expansion I/O units.
Number of auxiliary relays	40 points (Relay Nos. 064 to 103)
Number of special auxiliary relays	8 points (Relay Nos. 104 to 111) Relay No. 104: Output inhibit Relay No. 105: 0.02sec clock Relay No. 106: 0.1sec clock Relay No. 107: 1sec clock Relay No. 108: 1min clock Relay No. 109: Turns ON for 1 scan time when SYSMAC-S6 starts operating. Relay No. 110: Turns ON when a battery failure occurs. Relay No. 111: Turns ON when a checksum error occurs.
Number of latching relays	8 points (Relay Nos. KR0 to KR7)
Number of Timers	8 points (Timer Nos. TIM0 to TIM7), 0.1 to 99.9sec
Number of Counters	8 points (Counter Nos. CNT0 to CNT7), 0 to 999 counts
Number of high-speed counter and output relays	Counter: 1 point (HDM), 0 to 999 pulses [Multiple output: 32 points (HDM00 to HDM31)]
Number of reversible counter and output relays	Counter: 1 point (RDM), 0 to 999 pulses [Multiple output: 32 points (RDM00 to RDM31)]
Memory protective function against power failure	Status data of respective latching relays, counters, high-speed counter and reversible counter before the power failure are retained in the memory.*
Diagnostic functions	• RUN mode CPU failure (watchdog timer) Checksum error Memory error I/O error Battery failure • PROGRAM mode Syntax error END instruction check Coil duplication check Circuit error check IL-END error check

NOTE: * There are two methods available for protection of the programs stored in the RAM as well as the status data of the respective latching relays, counters, high-speed counter and reversible counter. One is by the charge voltage of the capacitor and the other, by the battery backup.
a. With the super capacitor built in the CPU, memory retention is guaranteed for one week when the capacitor is fully charged.
b. With the battery backup method, the lithium battery in the battery unit backs up the memory for retention. The service life of the built-in battery is about 2 years at a temperature of 25°C. If the ambient temperature at which the lithium battery is to be used exceeds 25°C, the battery life will be shortened.

■ DIAGNOSTIC FUNCTIONS

As the diagnostic functions of the SYSMAC-S6, checks on the items listed in the following tables are performed in the PROGRAM, RUN and MONITOR modes, respectively.

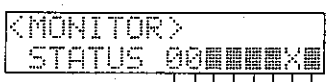
• PROGRAM mode

Diagnostic function		Function	Error message on programming console display
Item	Title		
Program check	Syntax error check	Checks the program for proper syntax.	SYNTAX ER.
	END instruction check	Checks the presence of END instruction at the end of the program.	END MISS
	Coil duplication check	Checks coil number for duplication.	COIL DOUBLE
	Circuit error check	Checks the circuit for configuration.	CIRCUIT ER.
	IL-END error check	Checks if IL and IL-END instructions are being used in pairs.	IL-END MISS

• RUN and MONITOR modes

Diagnostic function		Explain in detail	Front panel of CPU		Special auxiliary relay	Error message on programming console display
Item	Title		ERROR indicators	RUN indicator		
Hardware check	CPU failure	Watchdog timer	"CPU ERR" indicator illuminates.	OFF	–	See note * below.
	Checksum error	Program check	"CHECKSUM ERR" indicator flashes.	–	Relay No. 111 is ON.	
	Memory failure	Detection of Backup error, END instruction missing error, or format error	"MEMORY ERR" indicator illuminates.	OFF	–	
	I/O error	I/O unit check	"I/O ERR" indicator flashes.	–	–	
	Battery failure	Rated voltage check of battery unit	–	–	Relay No. 110 is ON.**	

NOTES: * Indications on the LCD of the programming console



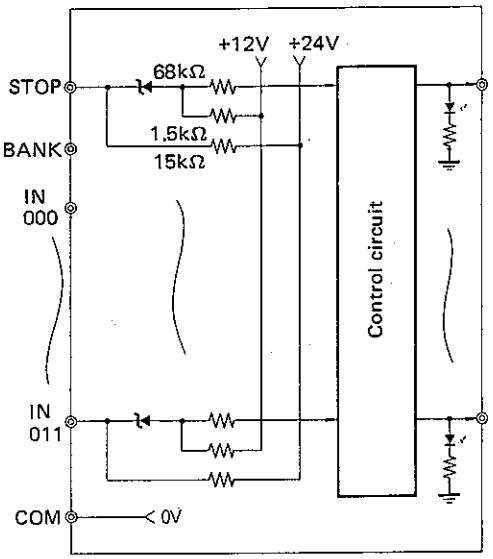
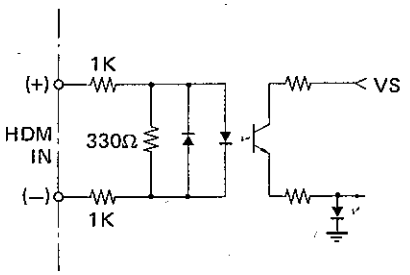
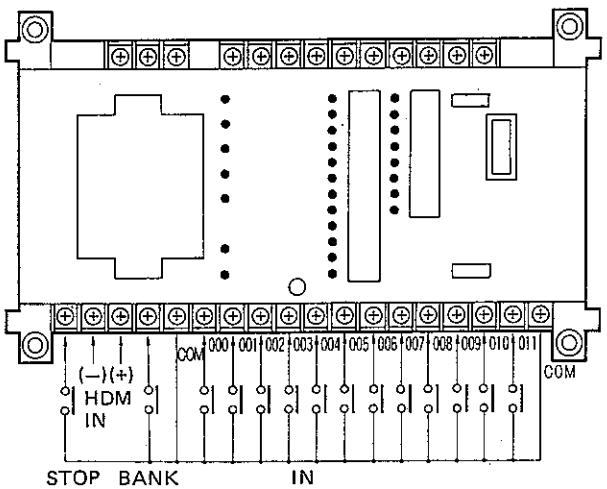
■ indicates normal status.
X indicates that an abnormality has occurred.

- Backup error:
  Indicates a failure or voltage drop of the super capacitor.
- Battery failure:
  Indicates that the battery voltage has dropped below the specified level, or that the battery unit is not mounted.
- Checksum error:
  Indicates that a checksum error has occurred during the program run.
- END instruction missing error:
  Indicates that there is no END instruction at the end of a Program.
- I/O error:
  Indicates that an abnormality has occurred in one of the I/O bus lines, or that the number of I/O units has changed.
- Format error:
  Indicates that an undefined instruction has been detected.
- Memory selection
  00 – RAM
  01 – EPROM bank 0
  10 – EPROM bank 1

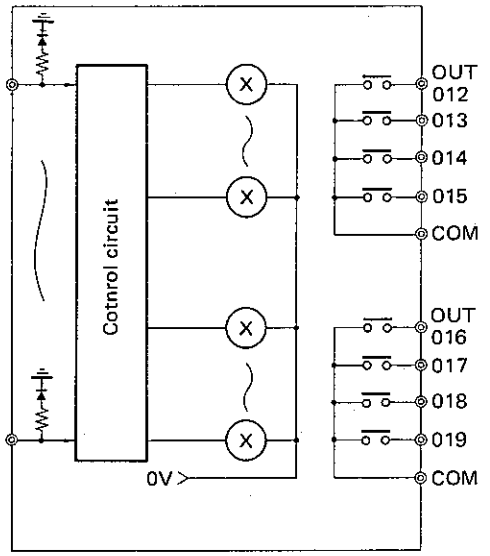
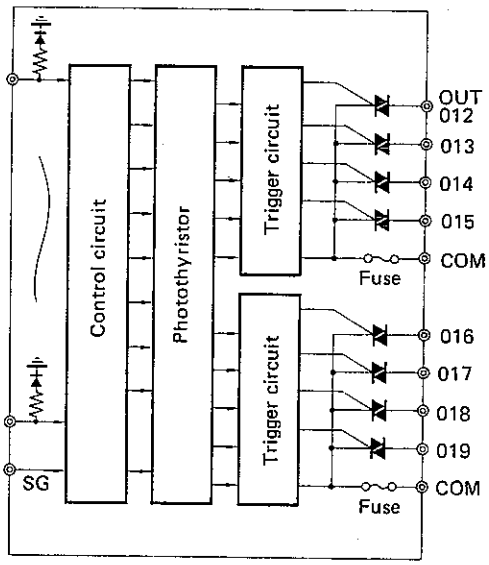
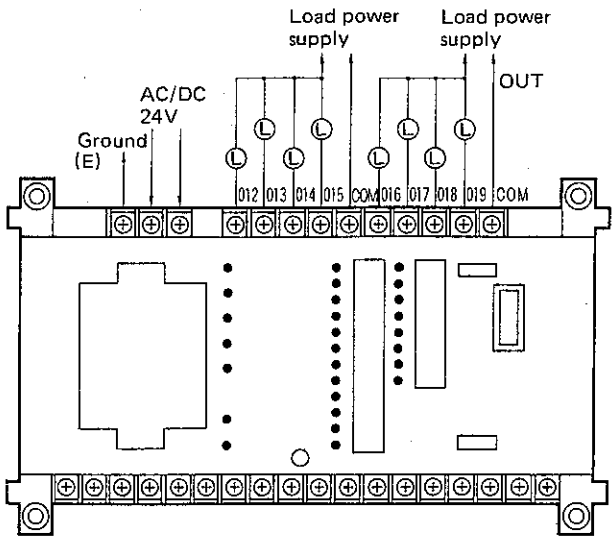
** Be sure to replace the lithium battery with a new one within a week after the Battery Failure indicating relay No. 110 has been turned ON.

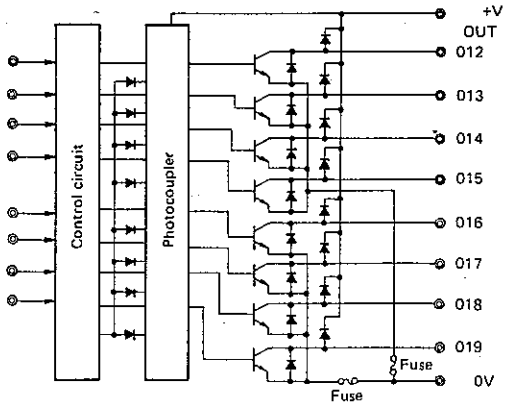
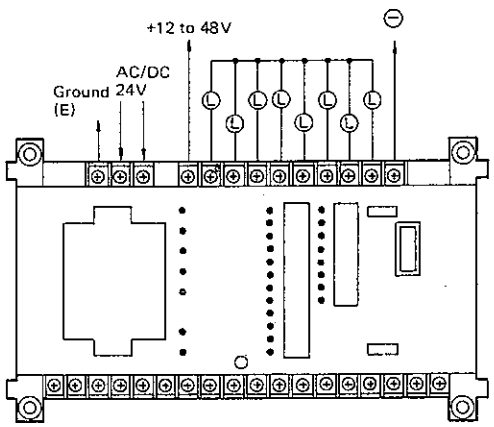
■ SPECIFICATIONS OF I/O UNITS WITHIN CPU

● Input unit

Item \ Type	DC input	High-speed counter input (HDM IN)
Input voltage	No-voltage contact	DC 24V max.
Input impedance	2kΩ	2kΩ
Input current	8mA to 12mA	5mA to 12mA
ON-delay time OFF-delay time	2 scan times	Response frequency: 1kHz max.
Number of circuits	Control input: 2 Sequence input: 12	1
ON current	5mA min.	5mA min.
OFF current	2mA max.	2mA max.
Internal circuit		
Terminal connections		This connection diagram applies to Type 3G2S6-CPU15.

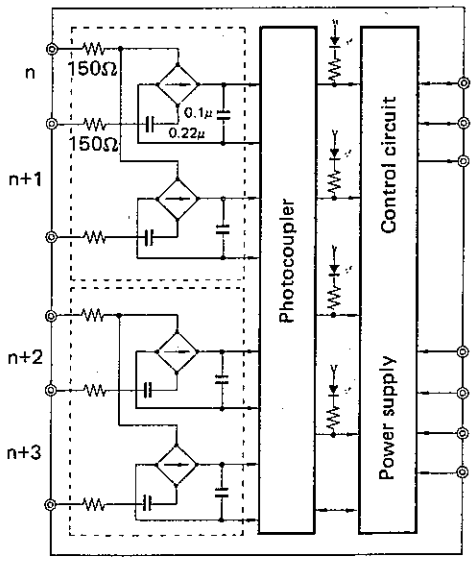
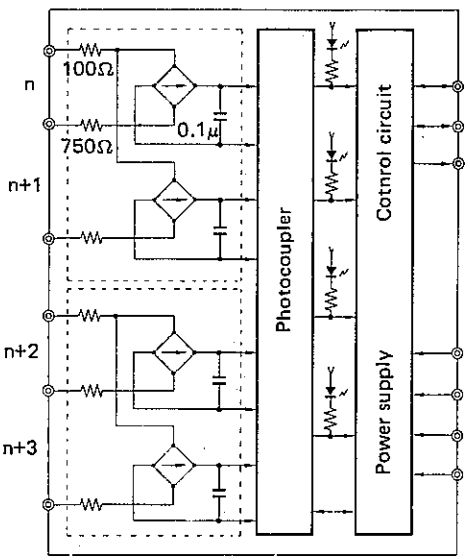
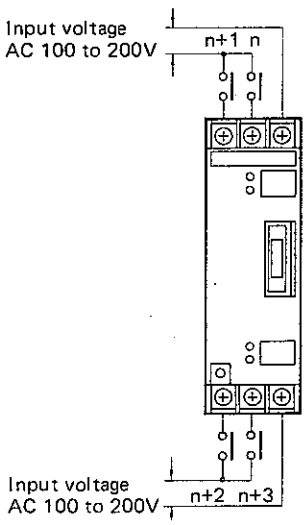
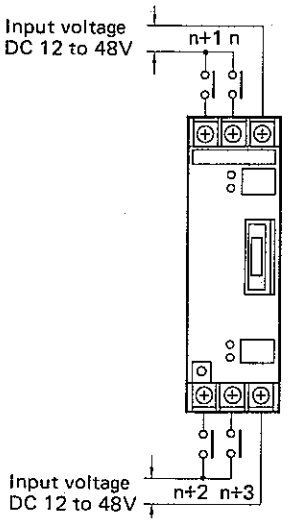
- **Output unit**

Item \ Type	3G2S6-CPU15/-CPU16 (Contact output)	3G2S6-CPU17/-CPU18 (Triac output)
Output switching capacity	Relay contact output (with OMRON Type G4C-112PE relay): AC 250V/DC 24V, 2A max.	–
Maximum switching capacity	–	AC 250V, 1A max. [8A (at 35°C), 4A (at 50°C) max. per unit]
Relay driving voltage	DC 12V (internally supplied)	–
Leakage current	–	3mA max. (at AC 100V) 6mA (at AC 200V)
ON-delay time	15msec max.	2msec max.
OFF-delay time	5msec max.	1/2 load frequency max.
Number of circuits	8	8
Saturation voltage	–	1.5V max. (RMS value) at 1A
Voltage for internal constant-voltage circuit	–	AC 100 to 240V +10%, −15%
Maximum switching frequency	1,800 operations/hr.	–
Service life	100,000 operations min.	–
Internal circuit		
Terminal connections		This connection diagram applies to Type 3G2S6-CPU15.

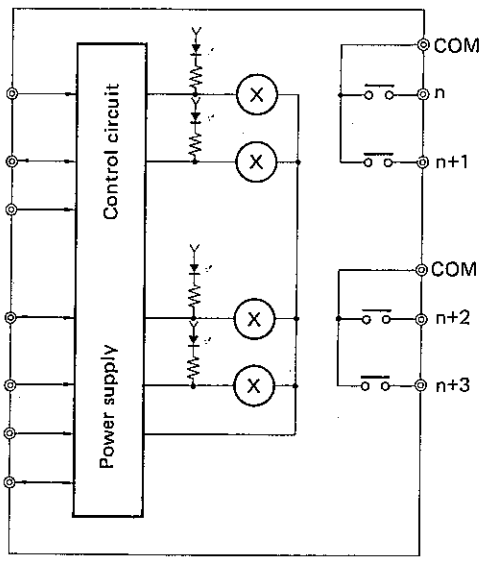
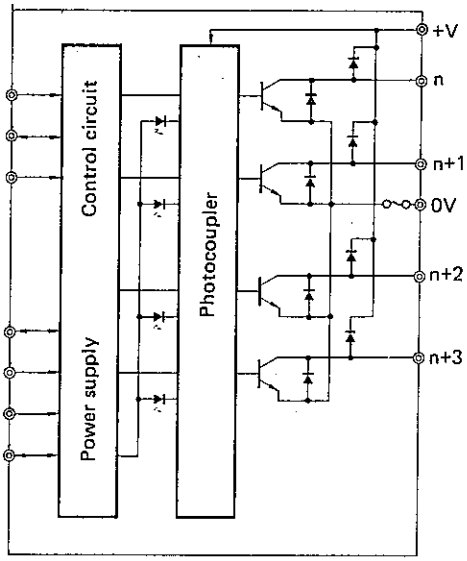
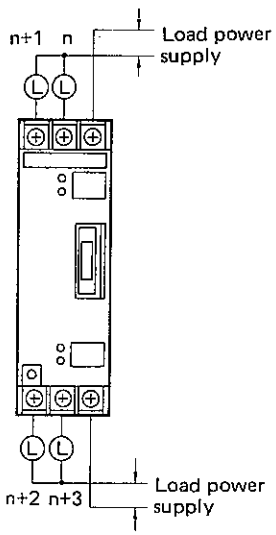
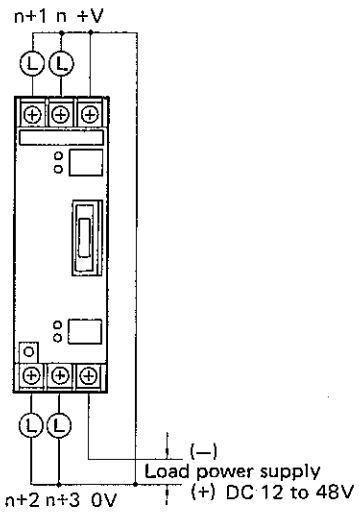
Item \ Type	3G2S6-CPU29/-CPU30 (Transistor output)
Maximum switching capacity	DC 12 to 48V ±10% 500mA
Minimum switching capacity	DC 12 to 48V ±10% 1mA
Leakage current	–
Saturation voltage	1V max. at 500mA
ON-delay time	1msec. max.
OFF-delay time	1msec. max.
Number of circuits	4
Weight	200g
Internal current consumption	0.8W max.
Fuse capacity	One 4A fuse (incorporated)
Internal circuit	
Terminal connections	 This connection diagram applies to Type 3G2S6-CPU15.

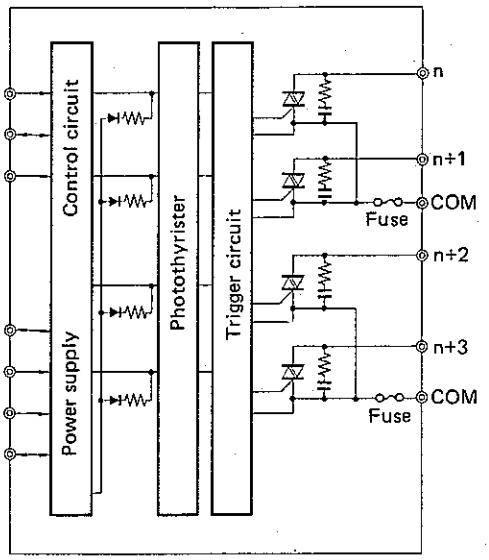
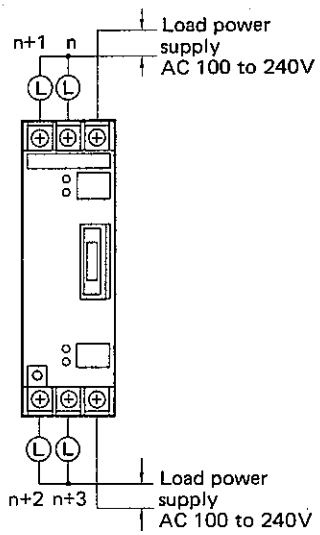
■ SPECIFICATIONS OF EXPANSION I/O UNITS

• Input units

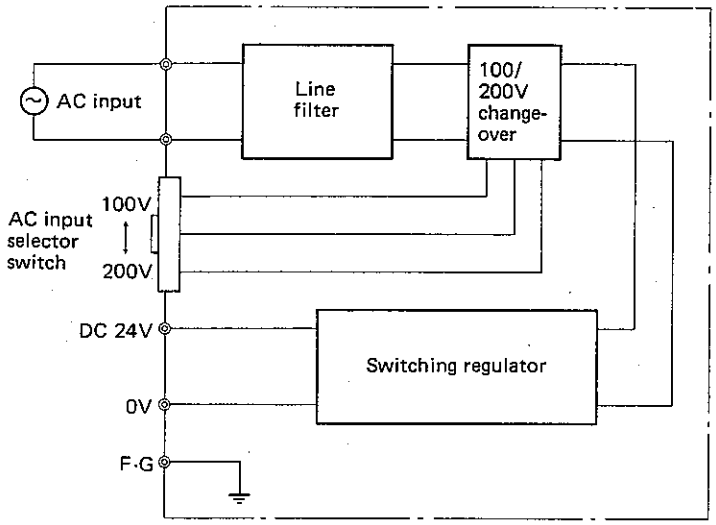
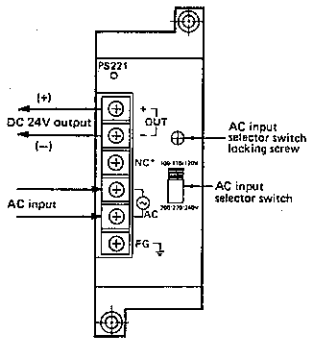
Item \ Type	AC input unit Type 3G2A3-IA221	DC input unit Type 3G2A3-ID411
Input voltage	AC 100V to 200V ±10%, 50/60Hz	DC 12V to 48V ±10%
Input impedance	Approx. 15kΩ (50Hz) Approx. 12kΩ (60Hz)	1.2 to 4.8kΩ
Input current	–	10mA (constant current)
ON-delay time	1 scan time + 2msec max.	2 scan times max.
OFF-delay time	1 scan time + 10msec max.	
Number of circuits	4	4
ON voltage	AC 70V min. (RMS value)	–
OFF voltage	AC 30V max. (RMS value)	–
ON current	–	±8V or ±5mA min.
OFF current	–	±2V or ±2mA max.
Internal current consumption	1W max.	0.6W max.
Internal circuit		
Terminal connections		

- **Output unit**

Item \ Type	Contact output unit Type 3G2A3-OC221	Transistor output unit Type 3G2A3-OD411
Output switching capacity	Relay contact output (with OMRON G4C-112PE relay); AC 250V/DC 24V, 2A (power factor=1) common terminal: 4A max.	–
Maximum switching capacity	–	DC 12 to 48V ±10%, 500mA
Minimum switching capacity	–	DC 12 to 48V ±10%, 1mA
Relay driving voltage	DC 12V (Internal power supply)	–
Relay driving current	–	–
Leakage current	–	–
Saturation voltage	–	1.0V max. at 500mA
ON-delay time	15msec max.	1msec max.
OFF-delay time	5msec max.	1msec max.
Number of circuits	4	4
Internal current consumption	2.2W max.	0.8W max.
Current for internal constant-voltage circuit	–	–
Maximum switching frequency	1,800 operations/hr.	–
Service life	100,000 operations min.	–
Fuse capacity	–	One 4A fuse (incorporated)
Internal circuit		
Terminal connections		

Item \ Type	Triac output unit Type 3G2A3-OA221
Maximum switching capacity	2A/AC 250V (4A max. per unit)
Leakage current	3mA max. (AC 100V), 6mA (AC 200V)
Saturation voltage	1.5V (RMS value) at 2A
Voltage for internal constant-voltage circuit	AC 100 to 240V +10%, −15%
Current for internal constant-voltage circuit	−
ON-delay time	2msec max.
OFF-delay time	1/2 load frequency max.
Number of circuits	4
Internal current consumption	1W max.
Fuse capacity	Two 4A fuses (incorporated)
Internal circuit	
Terminal connections	

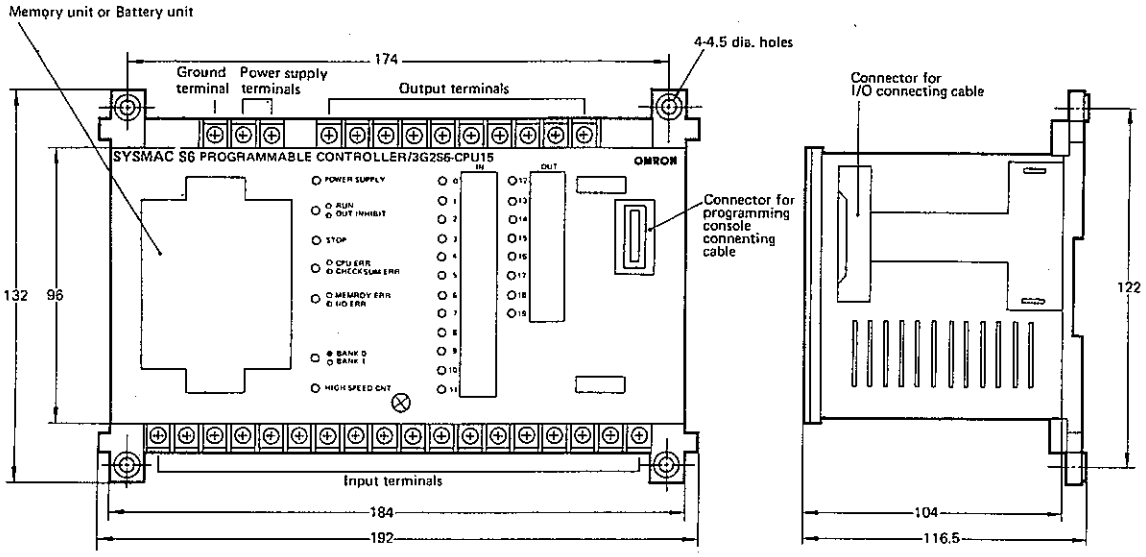
■ SPECIFICATIONS OF POWER SUPPLY UNIT

Item \ Type	3G2A3-PS221
Input voltage	AC 100/110/120V rating: AC 85 to 132V, 50/60Hz ±7Hz AC 200/220/240V rating: AC 170 to 264V, 50/60Hz ±7Hz
Output voltage	24V ±5%
Output capacity	1.5A max. (36W)
Efficiency	70% min.
Momentary power failure	A momentary power failure of less than 10msec is ignored by the CPU.
Inrush current	5A max.
Fuse capacity	One 2A fuse (incorporated)
Leakage current	1mA max. between FG terminal and earth ground
Internal circuit	
Terminal connections	

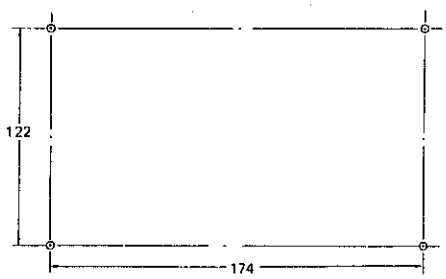
NOTE: * "NC" means "No connection" or "No wiring".

2.4 Dimensions and Names of Respective Parts

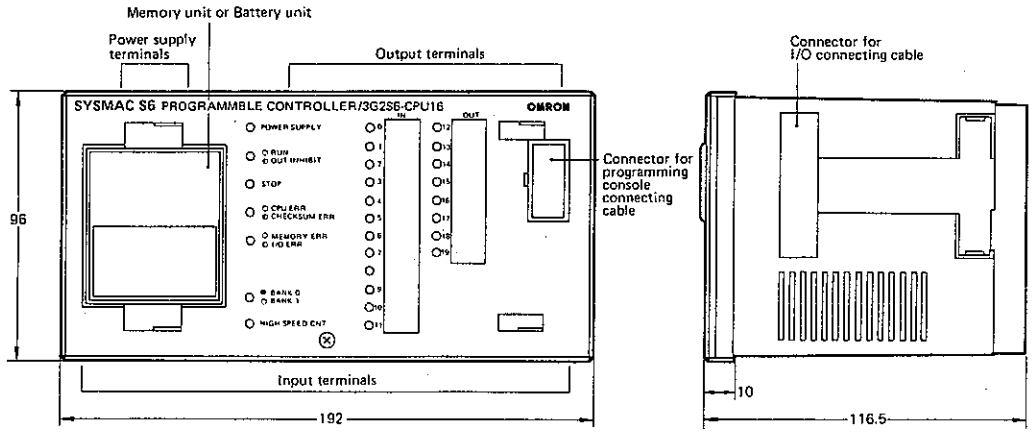
- **CPU (Surface mounting type)**
  Type 3G2S6-CPU15/-CPU17/-CPU29



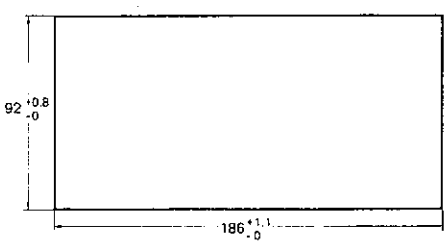
Mounting holes



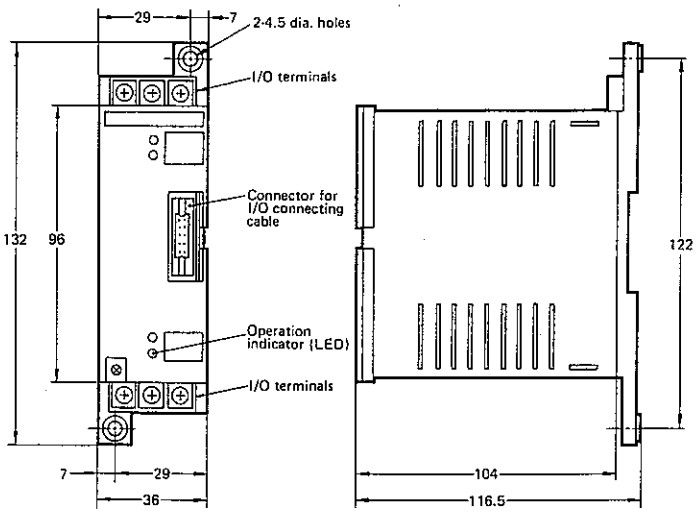
- **CPU (Flush mounting type)**
  Type 3G2S6-CPU16/-CPU18/-CPU30



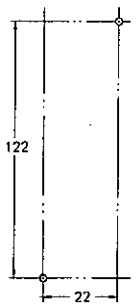
Panel cutout



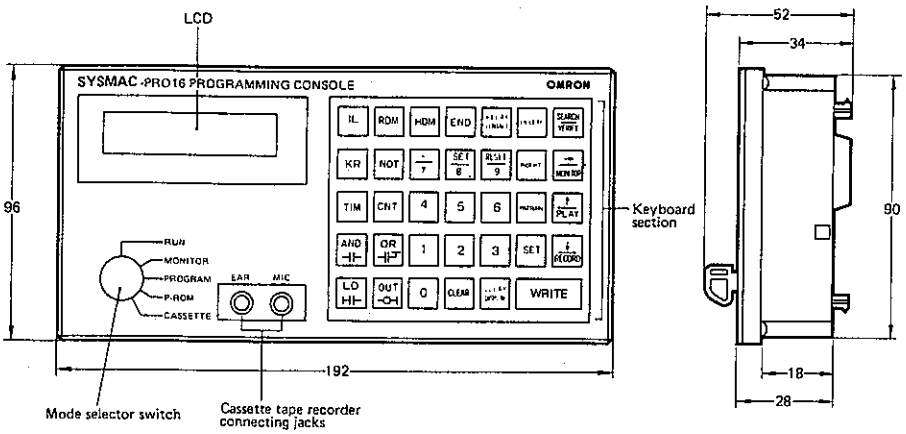
- **Expansion I/O Unit**
  Type 3G2A3-IA221/-ID411/-OC221/-OD411/-OA221



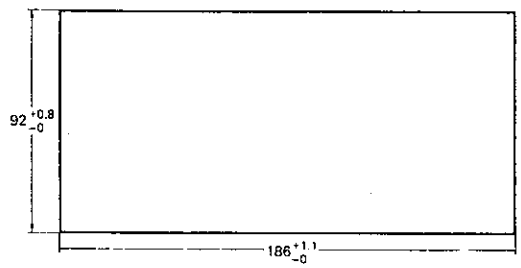
Mounting holes



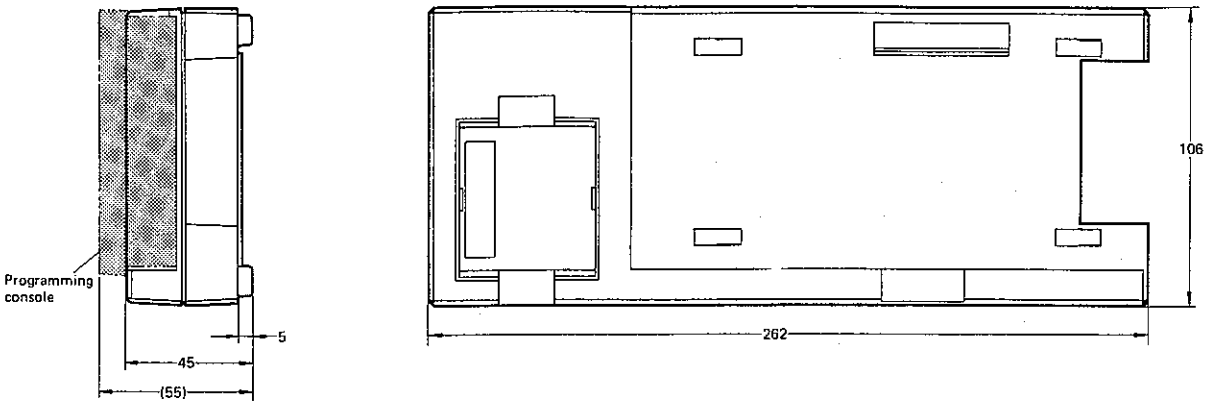
- **Programming console**
  Type 3G2A3-PRO16



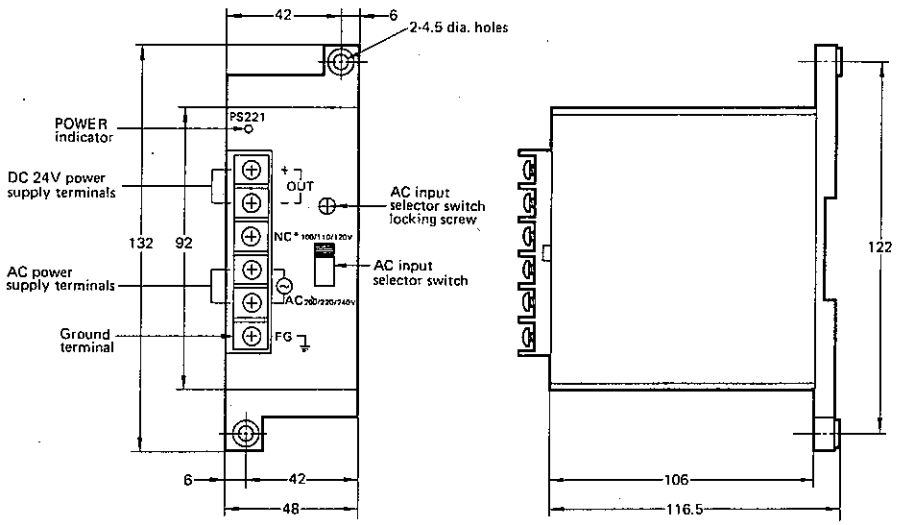
Panel cutout



- **PROM writer**
  Type 3G2A3-PRW03

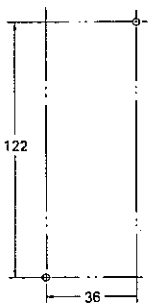


- **Power supply unit**
  Type 3G2A3-PS221



NOTE: * NC means "NO connection" or "NO wiring."

Mounting holes



3. Assignment of Relay Numbers

Relay numbers correspond to the data memory areas and the operating state (ON/OFF) of each relay is stored in the corresponding memory area.
The method of assigning relay numbers used for the SYSMAC-S6 is as follows.

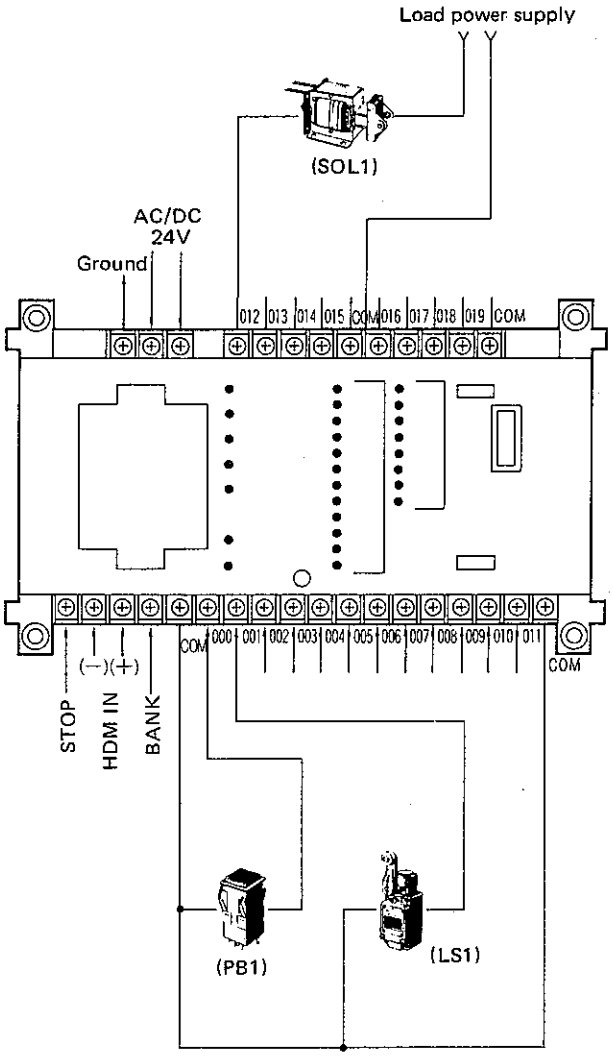
3.1 List of relay numbers

Name	No. of points	Symbol	Relay number									
Input relay in CPU	12	—	000	001	002	003	004	005	006	007	008	009
			010	011								
Output relay in CPU	8	—			012	013	014	015	016	017	018	019
Expansion I/O relay	44	—	020	021	022	023	024	025	026	027	028	029
			030	031	032	033	034	035	036	037	038	039
			040	041	042	043	044	045	046	047	048	049
			050	051	052	053	054	055	056	057	058	059
			060	061	062	063						
Internal auxiliary relay	40	—					064	065	066	067	068	069
			070	071	072	073	074	075	076	077	078	079
			080	081	082	083	084	085	086	087	088	089
			090	091	092	093	094	095	096	097	098	099
			100	101	102	103						
Latching relay	8	KR	0	1	2	3	4	5	6	7		
Timer	8	TIM	0	1	2	3	4	5	6	7		
Counter	8	CNT	0	1	2	3	4	5	6	7		
High-speed counter	1	HDM										
High-speed counter output	32	HDM	00	01	02	03	04	05	06	07	08	09
			10	11	12	13	14	15	16	17	18	19
			20	21	22	23	24	25	26	27	28	29
			30	31								
Reversible counter	1	RDM										
Reversible counter output	32	RDM	00	01	02	03	04	05	06	07	08	09
			10	11	12	13	14	15	16	17	18	19
			20	21	22	23	24	25	26	27	28	29
			30	31								
Special auxiliary relay	8	—	104		When this relay turns ON, the load (i.e., final output) is inhibited but program execution continues.							
			105		This relay is used to generate 0.02sec clock.							
			106		This relay is used to generate 0.1sec clock.							
			107		This relay is used to generate 1sec clock.							
			108		This relay is used to generate 1min clock.							
			109		This relay turns ON for 1 scan time upon start of operation by the SYSMAC-S6.							
			110		This relay turns ON when the battery is abnormal.							
			111		This relay turns ON when a program checksum error occurs.							

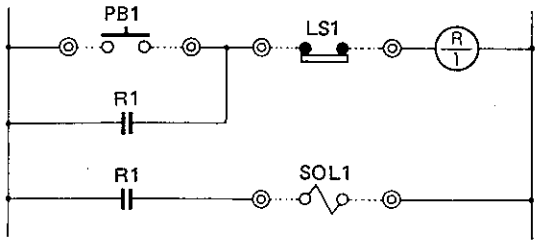
3.2 Determination of I/O Relay Numbers

1. In a sequence circuit diagram which is generally known, a sequence circuit is drawn with input/output devices included and I/O device symbols and relay numbers are arbitrarily determined. However, since the SYSMAC cannot recognize such arbitrary I/O device symbols and relay numbers, it is necessary to determine the I/O terminals to which I/O devices are to be connected.
2. The ladder diagram of the SYSMAC-S6 requires the relay numbers corresponding to the I/O devices. The relay numbers are determined by the locations (I/O terminals) of I/O terminal blocks, to which the I/O devices are connected. Each of these relay numbers must be used for ladder diagrams and programming.

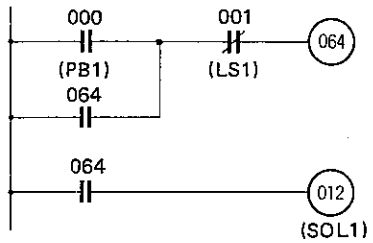
Example of Wiring I/O Device



Circuit Example



General sequence circuit



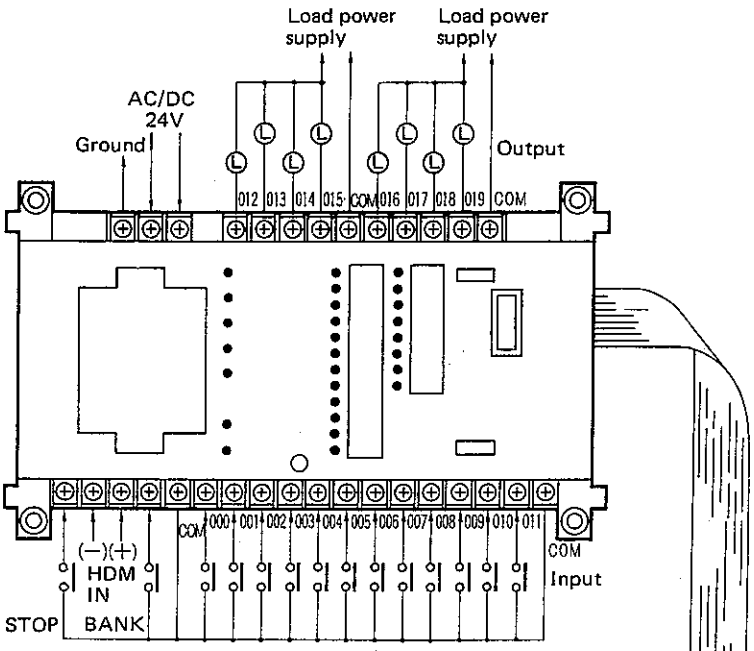
Ladder diagram

- PB1 and LS1 are connected to the input unit while SOL1 is connected to the output unit. R1 employs an internal auxiliary relay (064). In this case, SOL1 may be connected directly to the output unit wihtout using the internal auxiliary relay.

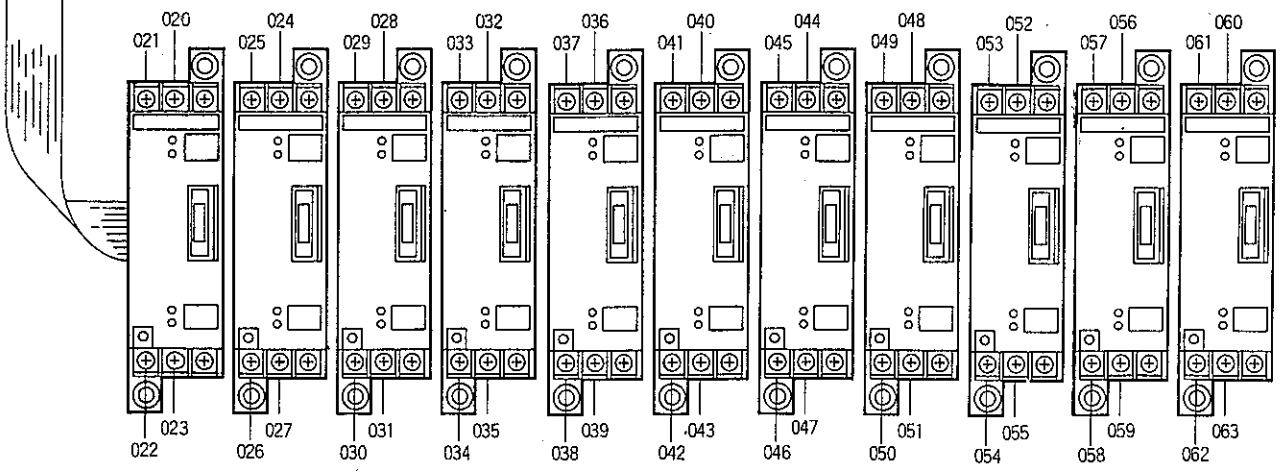
NOTES:
1. The realy numbers to which no expansion I/O unit is inserted, can be used as auxiliary relay numbers.
2. The relay numbers to which an expansion input unit is inserted, cannot be used as auxiliary relay numbers.
3. The relay numbers to which an expansion output unit is inserted but no output device is connected, can be used as internal auxiliary relay numbers. (However, the output relay will turn ON/OFF.)
4. The relay numbers at which no output device is connected to any output terminal in the CPU, can be used as internal auxiliary relay numbers. (However, the output relay will turn ON/OFF.)

- The relay numbers of the I/O relays within the CPU are fixed. In case of expansion I/O units, relay numbers are automatically assigned to the relays in each I/O unit according to the sequence of connection of the unit from the CPU.

RELAY NUMBERS OF I/O RELAYS WITHIN CPU



RELAY NUMBERS OF EXPANSION I/O UNITS



NOTE: The mounting locations of expansion I/O units are free. The CPU judges whether the unit located is an input unit or an output unit.

3.3 Determination of Internal Auxiliary Relay Numbers

The SYSMAC-S6 has 40 internal auxiliary relays which are used for internal data transfer in sequence circuits. They are independent of I/O devices in sequence. Since the internal auxiliary relays are the data memories incorporated in the CPU, no I/O unit is required to be mounted.

- Relay numbers 064 to 103 may not necessarily be assigned consecutively.
- Relay coil numbers cannot be used in duplication within the same program.
- If more than 40 internal auxiliary relays are required, expansion I/O relay numbers to which no expansion I/O unit is connected may be used. When an expansion output unit to which no output device is connected is mounted, its output relay numbers may also be used as internal auxiliary relays.

3.4 Determination of Special Auxiliary Relay Numbers

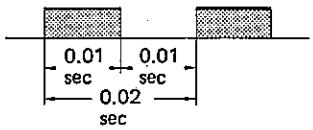
8 special auxiliary relays are provided. These relays are sort of internal auxiliary relays which operate and release according to the internal conditions controlled by hardware and are independent of the I/O devices in sequence.

Relay No. 104:

When relay No. 104 is turned ON by a program, the final output is inhibited. In this case, however, the program execution (in the RUN or MONITOR mode) continues.

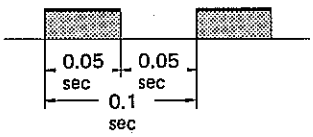
Relay No. 105:

This relay is used to generate 0.02sec clock. When used in junction with a counter, it functions as a timer for memory retention during a power failure and as a short-time timer.



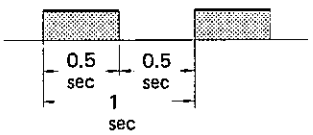
Relay No. 106:

This relay is used to generate 0.1sec clock. When used in combination with a counter, it functions as a timer for memory retention during a power failure.



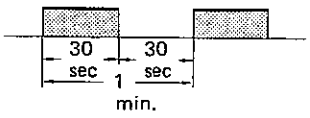
Relay No. 107:

This relay is used to generate 1sec clock. When used in combination with a counter, it functions as a timer for memory retention during a power failure and as a long-time timer. The relay output can also be used as a flicker signal.



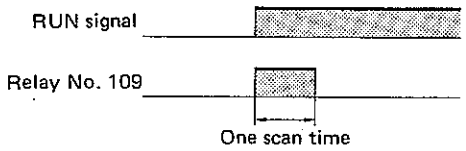
Relay 108:

This relay is used to generate 1min clock. When used in combination with a counter, it functions as a timer for memory retention during a power failure and as a long-time timer.



Relay No. 109:

When the SYSMAC-S6 starts operating, this relay operates only for one scan time. Use this relay as an initial reset signal for counter, high-speed counter, reversible counter or latching relay.



Relay No. 110:

This relay operates when a battery failure occurs and releases when the battery is returned to normal. If the Battery Failure signal is desired to be transmitted externally, prepare and program a circuit using the contacts of this relay.

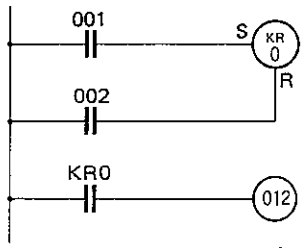
Relay No. 111:

This relay operates when a checksum error occurs. When the relay operates, the "CHECKSUM ERR" indicator on the front panel of the CPU flashes. If the Checksum Error signal is desired to be transmitted externally, prepare and program a circuit using the contacts of this relay.

3.5 Determination of Latching Relay Numbers

The SYSMAC-S6 has 8 latching relays whose operating states before a power failure can be retained in the data memory. Since the operating states of these relays are stored in the memory, all their outputs at the time of the power failure are turned off, but the relays will return to the state before the power failure when power is applied again.

- Relay numbers 0 to 7 may not necessarily be assigned consecutively.
- When using a latching relay, the letters "KR" must be prefixed to the relay number (e.g., KR5),
- Relay coil numbers cannot be used in duplication. However, the number of relay contacts is not limited.
- When set and reset input signals are applied simultaneously, the reset input signal takes precedence over the set input signal.
- These relay outputs cannot be transmitted directly to an output terminal. If any of the relay outputs is desired to be transmitted externally, prepare and program a circuit so that the relay output may be transmitted externally through an output relay.



3.6 Determination of Timer Numbers

The SYSMAC-S6 has 8 timers, which are used for timer numbers in programming.

- Timer numbers 0 to 7 may not necessarily be assigned consecutively.
- Timer coil numbers cannot be used in duplication. However, the number of timer contacts is not limited.
- When using a timer, the letters "TIM" must be prefixed to the relay number (e.g., TIM3).

3.7 Determination of Counter Numbers

The SYSMAC-S6 has 8 counters, which are used for counter numbers in programming.

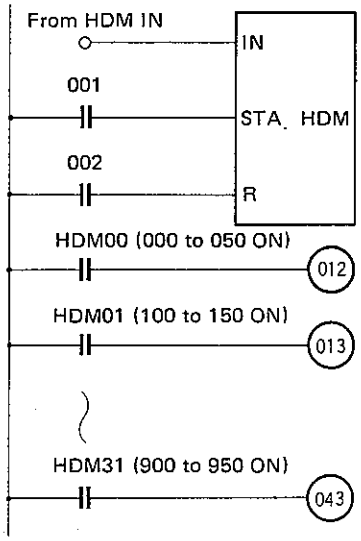
- Counter numbers 0 to 7 may not necessarily be assigned consecutively.
- Counter coil numbers cannot be used in duplication. However, the number of counter contacts is not limited.
- When using a counter, the letters "CNT" must be prefixed to the relay number (e.g., CNT4).

3.8 Determination of High-speed Counter Output Numbers

The SYSMAC-S6 has one high-speed counter and 32 outputs which are used in programming for multiple preset value setting.

The high-speed counter does not require its coil number and cannot be used in duplication.

- High-speed counter output numbers 00 to 31 may not neccessarily be assigned consecutively. When using a high-speed counter output, the letters "HDM" must be prefixed to the output number (e.g., HDM31).
- The number of contacts for high-speed counter outputs is not limited. These outputs cannot be transmitted directly to an output terminal. If any of the relay outputs is desired to be transmitted externally, prepare and program a circuit so that the relay output is transmitted externally through an output relay.
- When set and reset input signals are applied simultaneously, the reset input signal takes precedence over the set input signal.
- For count input of the high-speed counter, connect the external input directly to the HDM IN terminal.

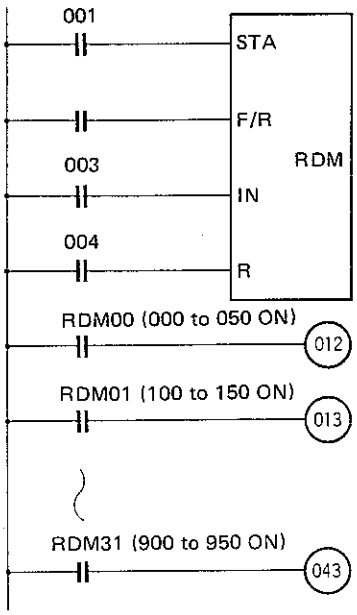


3.9 Determination of Reversible Counter Output Numbers

The SYSMAC-S6 has one reversible counter and 32 outputs which are used in programming for multiple preset value setting.

The reversible counter does not require its coil number and cannot be used in duplication.

- Reversible counter output numbers 00 to 31 may not necessarily be assigned consecutively. When using a reversible counter output, the letters "RDM" must be prefixed to the output number (e.g., RDM31).
- The number of contacts for reversible counter output is not limited. These outputs cannot be transmitted directly to an output terminal. If any of the relay outputs is desired to be transmitted externally, prepare and program a circuit so that the relay output is transmitted externally through an output relay.
- When set and reset input signals are applied simultaneously, the reset input signal takes precedence over the set input signal.



4. Instruction Words

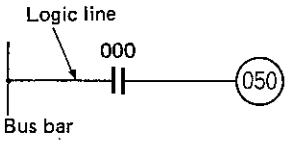
4.1 List of Instructions

No.	Instruction	Symbol	Function	Word length	Data
1	LOAD	LD	Logical start operation	1	Input/output relays 000 to 063 Internal auxiliary relays 064 to 103 Special auxiliary relays 104 to 111 Timers TIM0 to TIM7 Counters CNT0 to CNT7 Latching relays KR0 to KR7 High-speed counter outputs HDM00 to HDM31 Reversible counter outputs RDM00 to RDM31
2	LOAD NOT	LD NOT	Logical NOT start operation	1	
3	AND	AND	Logical AND operation	1	
4	AND NOT	AND NOT	Logical AND NOT operation	1	
5	OR	OR	Logical OR operation	1	
6	OR NOT	OR NOT	Logical OR NOT operation	1	
7	AND LOAD	AND LD	Logical AND operation with the previous condition	1	
8	OR LOAD	OR LD	Logical OR operation with the previous condition	1	
9	OUT	OUT	Outputs the result of a logical operation to the specified output relay, internal auxiliary relay, latching relay or shift register.	1	Input/output relays 012 to 063 Internal auxiliary relays 064 to 103 Special auxiliary relay 104
10	Timer	TIM	On-delay timer operation	1	Timers TIM0 to TIM7
11	Counter	CNT	Down counter operation	1	Counters CNT0 to CNT7
12	Latching relay	KR	Latching relay operation	1	Latching relays KR0 to KR7
13	High-speed counter	HDM	High-speed Up counter operation	1	–
14	Reversible counter	RDM	Reversible counter operation	1	–
15	Interlock	IL	Causes all the relay coils between IL instruction and IL·END instruction to be reset or not reset according to the result immediately before this instruction.	1	–
16	Interlock End	IL END	Clears the IL instruction.	1	–
17	END	END	The end of a program	1	–

4.2 Explanation of Instruction Words

■ LOAD (LD) & OUTPUT (OUT) INSTRUCTIONS

If each logic line starts with an NO contact, use the LD instruction. Use the OUT instruction for relay coil.



Coding

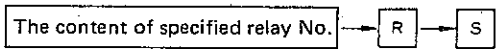
Address	OP	Data
200	LD	000
201	OUT	050

Contents of Registers

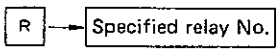
R	S
000	——
000	——

- **Operation of each register**

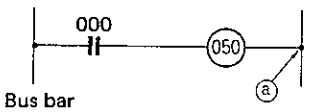
The LD instruction causes the content (ON or OFF state) of the specified relay number to be stored into the RESULT REGISTER (hereafter referred to as "R register"). It also causes the previous result in the R register to be transferred to the STACK REGISTER (hereafter referred to as "S register").



The OUT instruction causes the content of the R register to be output to the specified relay number. In this case, the content of the R register will remain unchanged.



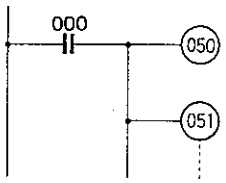
- Bus bar of a different phase is not required to be programmed.



Connection to the bus bar of different phase (part ⓐ) is accomplished automatically by programming an OUT instruction.

- **Consecutive OUT instructions**

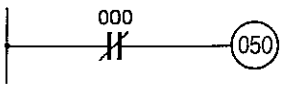
If the OUT instruction is followed by another OUT instruction, this condition is regarded as a circuit error during the program check. However, each output relay operates normally.



OP	Data
LD	000
OUT	050
OUT	051
⋮	⋮

■ LOAD NOT (LD·NOT) INSTRUCTION

If each logic line starts with an NC contact, use the LD·NOT instruction in place of the LD instruction.



Coding

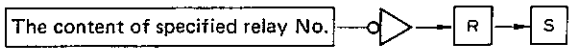
Address	OP	Data
200	LD·NOT	000
201	OUT	050

Contents of Registers

R	S
000	——
000	——

- **Operation of each register**

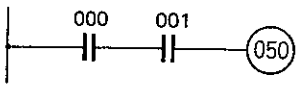
The LD·NOT instruction causes the content of the specified relay number to be inverted and then stored into the R register.



Like the LD instruction, this instruction causes the previous result in the R register to be transferred to the S register.

■ AND INSTRUCTION

NO contacts in series are processed by the AND instruction.



Coding

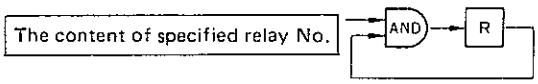
Address	OP	Data
200	LD	000
201	AND	001
202	OUT	050

Contents of Registers

R	S
000	——
000 001	——
000 001	——

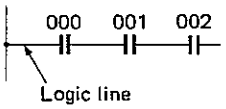
- **Operation of each register**

The AND instruction causes the logical AND operation to be performed between the content of the specified relay number and the content of the R register. The result of the logical AND operation will be newly stored in the R register.



- **Number of contacts**

The number of contacts is not limited for use on a logic line. As many NO contacts as required can be connected by means of the [AND] key.

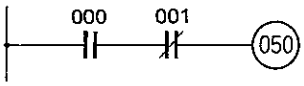


OP	Data
LD	000
AND	001
AND	002
⋮	⋮

In this case, the contact of the first relay number 000 is at the start of each logic line.
Therefore, the relay contact must be programmed as "LD000".

■ AND·NOT INSTRUCTION

If an NC contact is connected in series, use the AND·NOT instruction in place of the AND instruction.



Coding

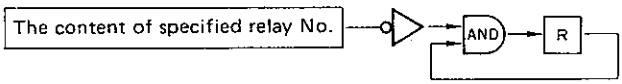
Address	OP	Data
200	LD	000
201	AND·NOT	001
202	OUT	050

Contents of Registers

R	S
000	——
000 001	——
000 001	——

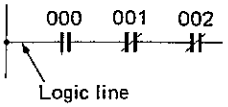
- **Operation of each register**

The AND·NOT instruction causes the content of the specified relay number to be inverted and then ANDed with the content of the R register. The result of the logical AND operation will be newly stored in the R register.



- **Number of contacts**

The number of contacts is not limited for use on a logic line. As many NC contacts as required can be connected in series by means of [AND] [NOT] keys.

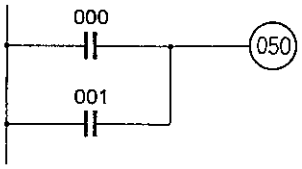


OP	Data
LD	000
AND·NOT	001
AND·NOT	002
⋮	⋮

In this case, the contact of the first relay number 000 is at the start of each logic line. Therefore, the relay contact must be programmed as "LD000".

■ OR INSTRUCTION

NO contacts in parallel are processed by the OR instruction.



Coding

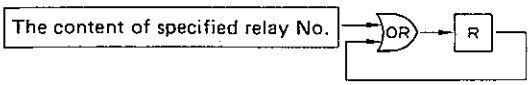
Address	OP	Data
200	LD	000
201	OR	001
202	OUT	050

Contents of Registers

R	S
000	——
000 001	——
000 001	——

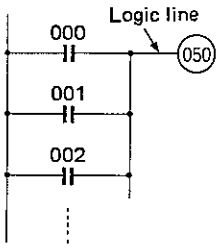
- **Operation of each register**

The OR instruction causes the logical OR operation to be performed between the content of the specified relay number and the content of the R register. The result of the logical OR operation will be newly stored in the R register.



- **Number of contacts**

The number of contacts is not limited for use on a logic line. As many NO contacts as required can be connected by means of the [OR] key.

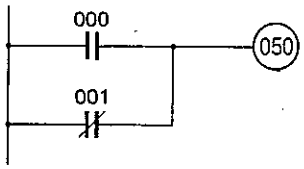


OP	Data
LD	000
OR	001
OR	002
⋮	⋮
OUT	050

In this case, the contact of the first relay number 000 is at the start of each logic line. Therefore, the relay contact must be programmed as "LD000".

■ OR·NOT INSTRUCTION

If an NC contact is to be connected in parallel, use the OR·NOT instruction in place of the OR instruction.



Coding

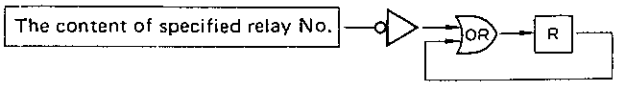
Address	OP	Data
200	LD	000
201	OR·NOT	001
202	OUT	050

Contents of Registers

R	S
000	—
000 / 001	—
000 / 001	—

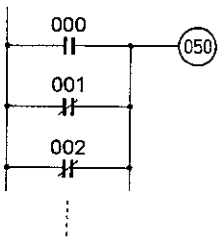
- **Operation of each register**

The OR·NOT instruction causes the content of the specified relay number to be inverted and then ORed with the content of the R register. The result of the logical OR operation will be newly stored in the R register.



- **Number of contacts**

The number of contacts is not limited for use on a logic line. As many NC contacts as required can be connected by means of [OR] [NOT] keys.

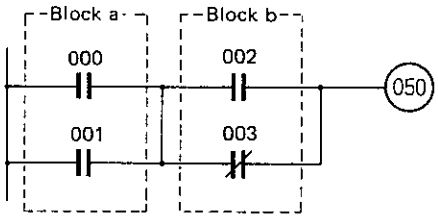


OP	Data
LD	000
OR·NOT	001
OR·NOT	002
⋮	⋮
OUT	050

In this case, the contact of the first relay number 000 is at the start of each logic line.
Therefore, the relay contact must be programmed as "LD000".

■ AND·LOAD (AND·LD) INSTRUCTION

For inter-block AND operation between two or more blocks, use the AND·LD instruction.



Coding

Address	OP	Data
200	LD	000
201	OR	001
202	LD*	002
203	OR·NOT	003
204	AND·LD**	—
205	OUT	050

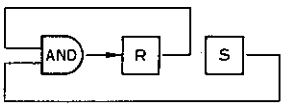
Contents of Registers

R	S
000	—
000 / 001	—
002	000 / 001
002 / 003	000 / 001
000 002 / 001 003	—
000 002 / 001 003	—

NOTES: * Use this instruction as the first instruction for the next block to be ANDed with the preceding block.
** Use the AND·LD instruction for series connection of two blocks (blocks a and b).

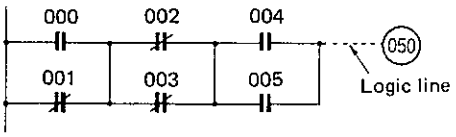
- **Operation of each register**

1. By the LD000 and OR001 instructions, the result of the logical OR operation in block a is stored into the R register.
2. By the LD002 instruction in block b, the result of the operation in block a is transferred into the S register, while the result of the logical operation by instructions LD002 and OR·NOT003 in block b is stored into the R register.
3. AND·LD instruction causes the logical AND operation to be performed between the R register (block b) and the S register (block a). The result of the logical AND operation will be newly stored into the R register.



- **Number of blocks**

The number of blocks is not limited for AND·LD operation of a logic line. As many blocks as required can be continued for series connection by means of [LD] ~ [AND] [LD] keys.

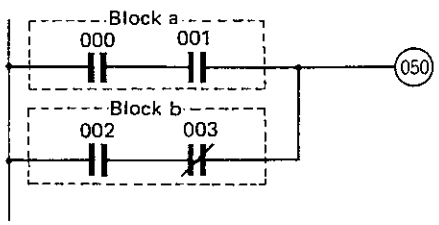


OP	Data
LD	000
OR·NOT	001
LD·NOT	002
OR·NOT	003
AND·LD	—
LD	004
OR	005
AND·LD	—
⋮	⋮
OUT	050

The AND-LOAD instruction is used when each block normally consists of a combination of two or more contacts.

■ OR-LOAD (OR-LD) INSTRUCTION

For inter-block OR operation between two or more blocks, use the OR-LOAD instruction.



Coding

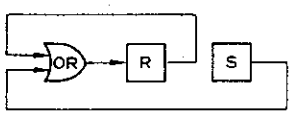
Address	OP	Data
200	LD	000
201	AND	001
202	LD*	002
203	AND-NOT	003
204	OR-LD**	–
205	OUT	050

Contents of Registers

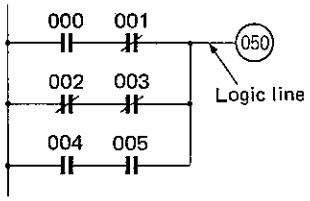
R	S
000	——
000 001	——
002	000 001
002 003	000 001
000 001 002 003	——
000 001 002 003	——

NOTES:
* Use this LD instruciton as the first instruction of the next block to be ORed with the preceding block.
** Use the OR-LD instruction for parallel connection of two blocks (blocks a and b).

- **Operation of each register**
  1. By the LD000 and AND001 instructions, the result of the logical AND operation in block a is stored into the R register.
  2. By the LD002 instruction in block b, the result of the operation in block a is transferred into the S register, while the result of the logical operation by instructions LD002 and AND-NOT003 in block b is stored into the R register.
  3. The OR-LD instruction causes the logical OR operation to be performed between the R register (block b) and the S register (block a). The result of the logical OR operation will be newly stored into the R register.



- **Number of blocks**
  The number of blocks is not limited for OR-LD operation on a logic line. As many blocks as required can be continued for parallel connection by means of [LD] ~ [OR] [LD] keys.

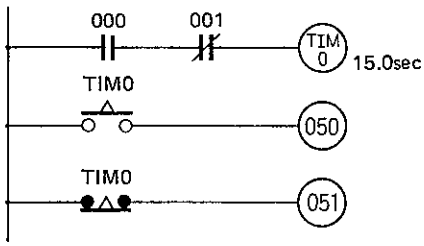


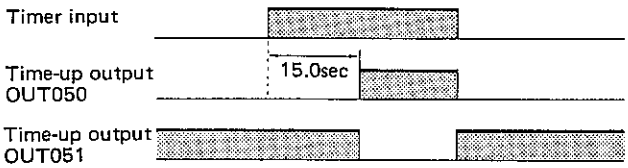
OP	Data
LD	000
AND-NOT	001
LD-NOT	002
AND-NOT	003
OR-LD	–
LD	004
AND	005
OR-LD	–
⋮	⋮
OUT	050

The OR-LD instruction is used when each block normally consists of a combination of two or more contacts.

■ TIMER (TIM) INSTRUCTION

The TIM instruction can be used as an ON-delay timer in the same manner as a relay circuit.





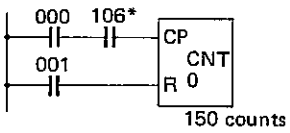
Coding

Address	OP	Data
200	LD	000
201	AND-NOT	001
202	TIM 0*	150**
203	LD-TIM	0
204	OUT	050
205	LD-NOT-TIM	0
206	OUT	051

NOTES:
1. *Timer number 0 to 7.
2. **Time setting value 000 to 999 x 0.1sec. In this example, 150 denotes 15.0sec.
3. The program at the part of the timer coil (TIM) requires one address.

- **Operation of each register**
  The timer starts when the content of the R register is logical 1 and resets when the content of the R register is logical 0.
- **Number of contacts**
  A time-up contact designates the timer number itself. Both NO and NC contacts can be used in the required quantity.
- **Timer is of decrementing type**
  The timer is of a decrementing type which produces an output when the present value (time remaining) becomes "000". When the timer input is turned off, the present value of the timer returns to the preset value. The timer output is transmitted externally through an output relay as shown in the above circuit example.

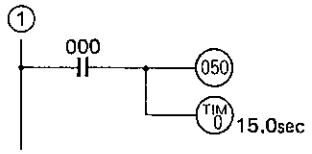
- **Timer is reset at the time of a power failure**
  If a power failure occurs, the timer is reset and the present value returns to the preset value. Therefore, if it is required to retain the present value of the timer in the memory, a memory retentive type timer circuit as shown below must be used for programming.
- **Memory retentive type timer**
  A circuit to memorize the present value of the timer during a power failure is configured using a combination of clock instruction and counter (CNT) instruction.



OP	Data
LD	000
AND	106
LD	001
CNT 0	150

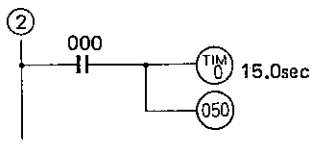
NOTE:
* Special auxiliary relay 106 is for 0.1sec clock. (Special auxiliary relay 107 is for 1sec clock.)

- **Consecutive OUT instruction and TIM instruction**
  The operations of the circuits ① and ② below are the same, either of which may be used for programming.



OP	Data
LD	000
OUT	050
TIM 0	150

When the NO contact 000 turns ON, output relay 050 is energized and at the same time, timer 0 starts operating.



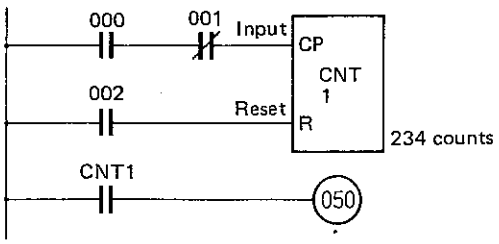
OP	Data
LD	000
TIM 0	150
OUT	050

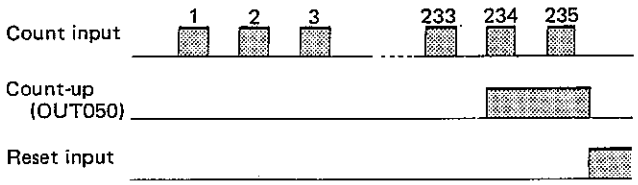
When the NO contact 000 turns ON, timer 0 starts operating and at the same time, output relay 050 is energized.

- The set value of the timer can be changed while the SYSMAC-S6 is in operation when the RAM is used as a user memory.

■ COUNTER (CNT) INSTRUCTION

The CNT instruction can be used as a preset counter in the same manner as a relay circuit.



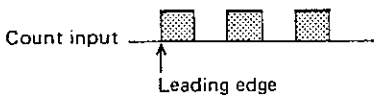


Coding

Address	OP	Data
200	LD	000
201	AND·NOT	001
202	LD	002
203	CNT 1*	234**
205	LD·CNT	1
206	OUT	050

NOTES:
1. A counter program must be entered in the order of a count input circuit, a reset input circuit and a counter coil.
2. * Counter number 0 to 7.
3. ** Counter setting value 000 to 999.

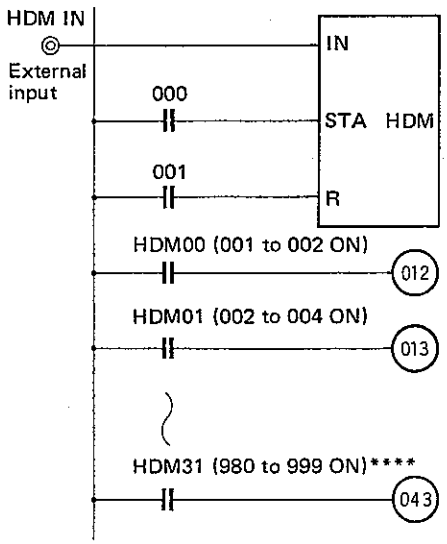
- **Operation of each register**
  The counter resets when the content of the R register is logical 1 and is enabled to count when the content of the R register is logical 0. A count input is provided from the S register.
- **Number of contacts**
  A count-up contact designates the counter number itself. Both NO and NC contacts can be used in the required quantity.
- **Counter is of decrementing type**
  The counter is of a decrementing type which produces an output when the present value becomes "000" to indicate that the preset value is up. The present value of the counter returns to the preset value when a reset input is applied. The counter output is transmitted externally through an output relay as shown in the circuit example.
- After the preset value is up, subsequent count inputs are ignored.
- At the leading edge (i.e., from OFF to ON) of a count input signal, the counter decrements the present value by 1.



- When both a count input and a reset input are applied simultaneously, the reset input takes precedence over the count input. Even if the reset input is removed after this, the counter performs no counting operation.
- The present value of the counter is retained in memory during a power failure.
  If a power failure occurs, the counter is not reset and the present value (i.e., count remaining) of the counter is retained in the memory. A memory retentive type timer can be programmed using a combination of clock instruction and a counter (CNT) instruction. For details, refer to TIMER (TIM) INSTRUCTION.
- The preset value of the counter can be changed while the SYSMAC-S6 is in operation when the RAM is used as a user memory.

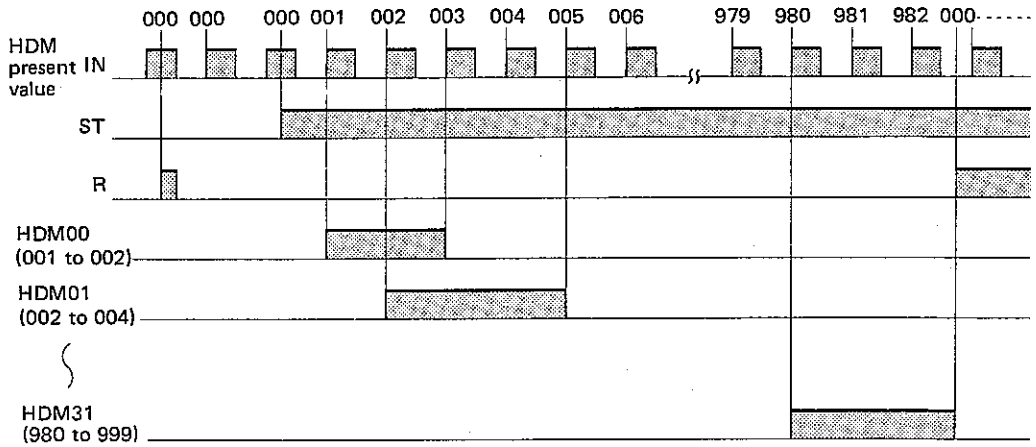
■ HIGH-SPEED COUNTER (HDM) INSTRUCTION

The HDM instruction can be used as a high-speed counter by software. A count input signal must be directly connected to the HDM IN terminal of the CPU. The counter can respond to input signals at up to 1kHz.



Coding

Address	OP	Data	
200	LD	000	*
201	LD	001	*
202	HDM	–**	
203	LD·HDM	00	***
204	OUT	012	
205	LD·HDM	01	
206	OUT	013	
265	LD·HDM	31	
266	OUT	043	



NOTES:

* A high-speed counter program must be entered in the order of a start signal (STA) and a reset signal (R).

** The high-speed counter does not require its coil number and cannot be used in duplication.

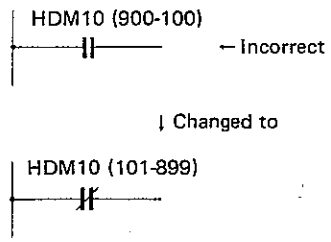
*** The high-speed counter has 32 outputs (HDM00 to HDM31) for multiple preset value setting. These outputs are programmed similarly to the timer and counter contacts.

**** The high-speed counter output (HDM31) continues to be in the ON state when the present count value is between 980 to 999. For programming preset values, refer to Section 6.7, Value Setting Operation.

- When the reset input is logical 1, it takes precedence over any other signals and the CPU ignores other signals. The set value of the high-speed counter is reset to "000".
- When the start signal is logical 1, the high-speed counter (HDM) is in the operable state. When the start signal is logical 0, the counter is in the halt state.
- At the leading edge (i.e., from OFF to ON) of a count input signal, the high-speed counter increments the present value by 1.
- The high-speed counter has 32 outputs for multiple preset value setting (HDM00 to HDM31). For these relays, both NO (⊣⊢) and NC (⊣/⊢) contacts can be used in the required quantity.
- For each high-speed counter output, both preset values A and B must be registered into the value setting table.

High-speed counter (HDM) output number	Value setting table	
	Preset value A	Preset value B
HDM00	000 to 999	000 to 999
HDM01	000 to 999	000 to 999
HDM02	000 to 999	000 to 999
HDM03	000 to 999	000 to 999
HDM04	000 to 999	000 to 999
HDM05	000 to 999	000 to 999
HDM06	000 to 999	000 to 999
HDM07	000 to 999	000 to 999
HDM08	000 to 999	000 to 999
HDM09	000 to 999	000 to 999
HDM10	000 to 999	000 to 999
HDM11	000 to 999	000 to 999
HDM12	000 to 999	000 to 999
HDM13	000 to 999	000 to 999
HDM14	000 to 999	000 to 999
HDM15	000 to 999	000 to 999
HDM16	000 to 999	000 to 999
HDM17	000 to 999	000 to 999
HDM18	000 to 999	000 to 999
HDM19	000 to 999	000 to 999
HDM20	000 to 999	000 to 999
HDM21	000 to 999	000 to 999
HDM22	000 to 999	000 to 999
HDM23	000 to 999	000 to 999
HDM24	000 to 999	000 to 999
HDM25	000 to 999	000 to 999
HDM26	000 to 999	000 to 999
HDM27	000 to 999	000 to 999
HDM28	000 to 999	000 to 999
HDM29	000 to 999	000 to 999
HDM30	000 to 999	000 to 999
HDM31	000 to 999	000 to 999

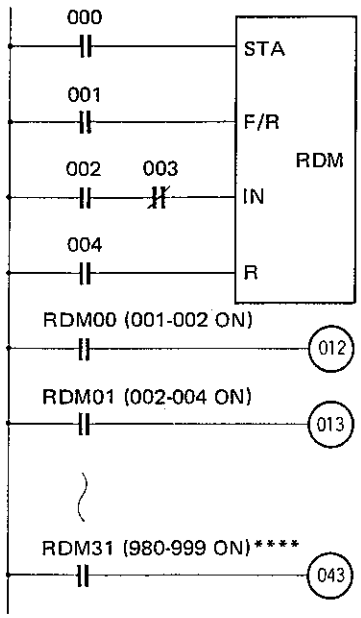
- The following condition must be satisfied when setting both preset values in the value setting table.
  Preset value A $\leq$ Preset value B
  For example, if a value set in the value setting table exceeds 999, change the circuit by using an NC contact.



- Preset values in the value setting table can be changed in MONITOR mode only when the RAM is used as a user memory. When the EPROM is used for user programs, preset values in the value setting table cannot be changed.
- The present value of the high-speed counter is retained in the memory during a power failure. If it is required to reset the value upon power application, use the NO contact of special auxiliary relay No. 109 to apply a reset input.
- The counter responds to input signals at up to 1kHz (by hardware processing). However, note that there may be an average delay of 10msec for start, reset, and value setting output signals, as they are processed by software.

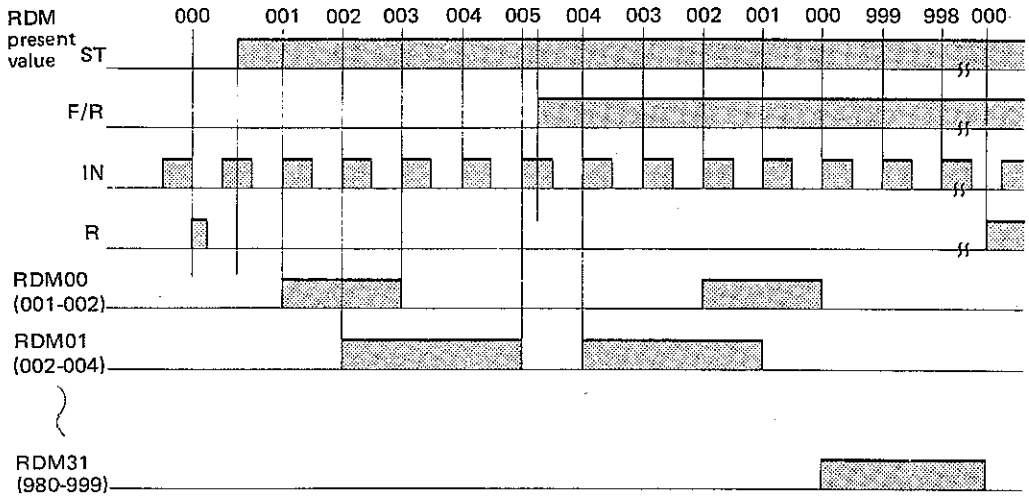
■ REVERSIBLE COUNTER (RDM) INSTRUCTION

The RDM instruction can be used as a reversible counter by software.



Coding

Address	OP	Data	
200	LD	000	*
201	LD	001	
202	LD	002	
203	AND-NOT	003	
204	LD	004	
205	RDM	—**	
206	LD-RDM	00	***
207	OUT	012	
208	LD-RDM	01	
209	OUT	013	
⋮	⋮	⋮	
268	LD-RDM	31	
269	OUT	043	



NOTES:

* A reversible counter program must be entered in the order of a start signal (STA), a Forward/Reverse signal (F/R), an input signal (IN), and a reset signal (R).

** The reversible counter does not require its coil number and cannot be used in duplication.

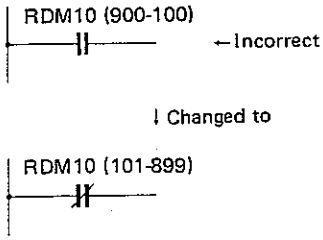
*** The reversible counter has 32 outputs (RDM00 to RDM31) for multiple preset value setting. These outputs are programmed similarly to the timer and counter contacts.

**** The reversible counter output (RDM31) continues to be in the ON state when the present count value is between 980 to 999 or between 999 to 980. For programming preset values, refer to Section 6.7 Value Setting Operation.

- When the reset input is logical 1, it takes precedence over any other signals and they are ignored. The present value of the reversible counter is reset to "000".
- When the start signal is logical 1, the reversible counter (RDM) is in the operable state. When the start signal is logical 0, the counter is in the halt state.
- When a Forward/Reverse (F/R) signal is logical 0, the reversible counter functions as an up counter. And when the F/R signal is logical 1, it functions as a down counter.
- At the leading edge (i.e., from OFF to ON) of a count input signal, the reversible counter increments or decrements the present value by 1.
- The reversible counter has 32 outputs for multiple preset value setting (RDM00 to RDM31). For these outputs, as many of both NO (⊣⊢) and NC (⊣/⊢) contacts as required can be used.
- For each reversible counter output, both preset values A and B must be registered into the value setting table.

Reversible counter (RDM) output number	Value setting table	
	Preset value A	Preset value B
RDM00	000 to 999	000 to 999
RDM01	000 to 999	000 to 999
RDM02	000 to 999	000 to 999
RDM03	000 to 999	000 to 999
RDM04	000 to 999	000 to 999
RDM05	000 to 999	000 to 999
RDM06	000 to 999	000 to 999
RDM07	000 to 999	000 to 999
RDM08	000 to 999	000 to 999
RDM09	000 to 999	000 to 999
RDM10	000 to 999	000 to 999
RDM11	000 to 999	000 to 999
RDM12	000 to 999	000 to 999
RDM13	000 to 999	000 to 999
RDM14	000 to 999	000 to 999
RDM15	000 to 999	000 to 999
RDM16	000 to 999	000 to 999
RDM17	000 to 999	000 to 999
RDM18	000 to 999	000 to 999
RDM19	000 to 999	000 to 999
RDM20	000 to 999	000 to 999
RDM21	000 to 999	000 to 999
RDM22	000 to 999	000 to 999
RDM23	000 to 999	000 to 999
RDM24	000 to 999	000 to 999
RDM25	000 to 999	000 to 999
RDM26	000 to 999	000 to 999
RDM27	000 to 999	000 to 999
RDM28	000 to 999	000 to 999
RDM29	000 to 999	000 to 999
RDM30	000 to 999	000 to 999
RDM31	000 to 999	000 to 999

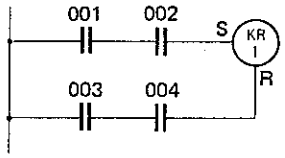
- The following condition must be satisfied when setting both preset values in the value setting table.
  Preset value A $\leq$ Preset value B
  For example, if a value in the value setting table exceeds 999, change the circuit by using an NC contact.



- Preset values in the value setting table can be changed in MONITOR mode only when the RAM is used as a user memory. When the EPROM is used for user programs, preset values in the value setting table cannot be changed.
- The present value of the reversible counter is retained in the memory during a power failure. If it is required to reset the value upon power application, use the NO contact of special auxiliary relay No. 109 to apply a reset input.

■ LATCHING RELAY (KR) INSTRUCTION

The KR instruction can be used as a latching relay in the same manner as a relay circuit.



Coding

Address	OP	Data
200	LD	001
201	AND	002
202	LD	003
203	AND	004
204	KR*	1**

Contents of Registers

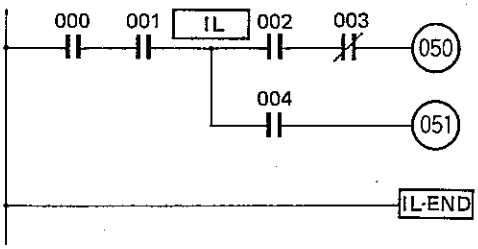
R	S
001	—
001 002	—
003	001 002
003 004	001 002
003 004	001 002

NOTE: * A latching relay program must be entered in the order of a set input circuit, a reset input circuit and a latching relay coil. Use the KR instruction to program a latching relay coil.
** Latching relay number KR0 to KR7.

- **Operation of each register**
  The latching relay operates when the content of the R register is logical 0 and the content of the S register is logical 1. The relay releases when the content of the R register is logical 1.
- When both a set input and a reset input are applied simultaneously, the reset input takes precedence over the set input.
- The content of the latching relay is retained in the memory during a power failure. It continues to be retained until application of a reset input.

■ INTERLOCK (IL)/INTERLOCK END (IL·END) INSTRUCTIONS

The IL and IL·END instructions are used in pairs when branching a circuit to plural OUT instructions.

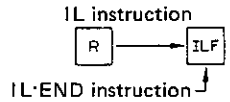


Coding

Address	OP	Data	
200	LD	000	
201	AND	001	
202	IL	–	
203	LD	002	*
204	AND·NOT	003	
205	OUT	050	
206	LD	004	
207	OUT	051	
208	IL·END	–	

NOTE: * When IL and IL·END instructions are used in programming, be sure that an LD instruction will always follow the IL and IL·END instructions, respectively.

- **Operation of register**
  The IL instruction causes the content of the R register to be transferred to the interlock flip-flop (ILF). Accordingly, the ILF is set to "0" if the content of the R register is "0" and to "1" if the content of the R register is "1".



The IL·END instruction causes the ILF to be set to "1" irrespective of the content of the R register. In other words, when the IL condition is OFF (i.e., when input 000 or 001 is OFF), the state of each relay between the IL and IL·END instructions is as follows.

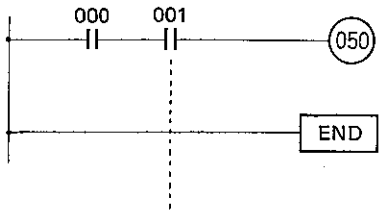
Output relay, internal auxiliary relay	OFF
Timer	Reset
Counter, latching relay	Holds present state

However, when the IL condition is ON, the state of each relay is the same as that in an ordinary relay circuit without IL/IL·END instructions.

CAUTION:
IL and IL·END instructions must always be used in pairs. A pair of IL and IL·END instructions cannot be used by inserting in between another IL/IL·END pair.

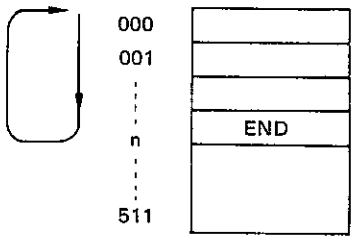
■ END INSTRUCTION

Insert this instruction at the end of a program.



Address	OP	Data
000	LD	000
001	AND	001
002	OUT	050
⋮	⋮	⋮
400	END	–

- The program memory of the SYSMAC-S6 is provided with addresses 000 to 511. The CPU scans program data from address 000 to the address with an END instruction according to the sequence diagram.



- When performing a test run, insert an END instruction at each end of a sequence circuit and then delete the END instruction after confirming each circuit. In this manner, the test run can be executed smoothly.
- If the mode selector switch is changed to "MONITOR (or RUN)" to execute a program without inserting an END instruction, neither will the RUN indicator be illuminated nor can the SYSMAC-S6 be operated. In this case, the "END MISS" message will appear on the LCD, and the MEMORY ERR indicator on the CPU front panel will be illuminated.

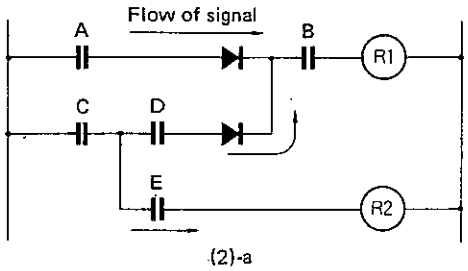
5. Programming

5.1 How to Program

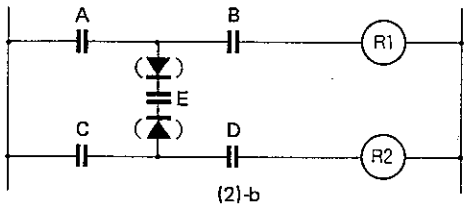
With the SYSMAC-S6, a sequence circuit is controlled according to the sequence of the instructions stored in the CPU memory. Therefore, it is necessary to observe the hints on correct programming and programming order.

■ HINTS ON CORRECT PROGRAMMING

1. Since the number of contacts is not limited for input/output relays, internal auxiliary relays, timers, etc., it can be said that the best way to design a sequence circuit is to configure a simple, clear circuit, rather than a complicated circuit created by reducing the number of contacts.
2. In the SYSMAC-S6, signals will flow from the left to the right. In other words, signals will flow as if diodes are inserted in the circuit as shown in (2)-a or (2)-b. To operate a circuit without diodes in the same manner as the circuit configured with general control relays, it is necessary to rewrite the circuit.

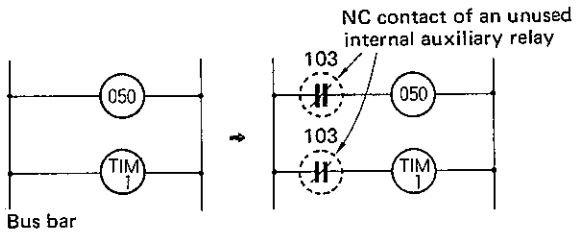


(2)-a

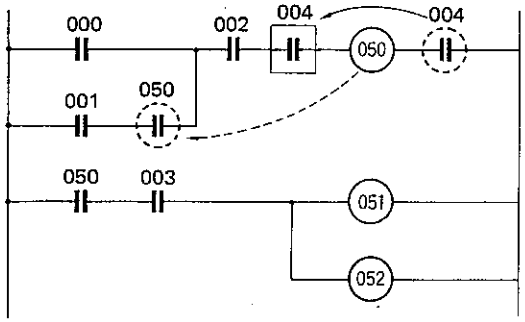


(2)-b

3. In a series-parallel circuit, the number of contacts that can be connected in series is not limited, as well as the number of contacts that can be connected in parallel.
4. No output relay can be connected directly from the bus bar. If necessary, connect it through the NC contact of an unused internal auxiliary relay.



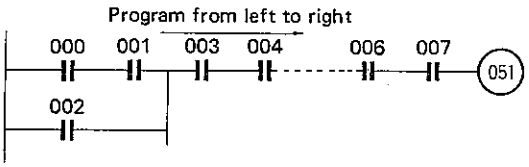
5. All output relays are provided with auxiliary contacts that can be used on a circuit, in addition to the output signal contacts to drive loads actually. The number of contacts that can be used per output relay is not limited.



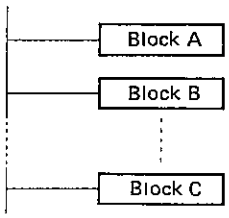
6. No relay contact can be inserted next to an output coil. If necessary, insert it before the output coil.
7. Two or more output coils can be connected in parallel.
8. For contact and coil numbers on the circuit, use the I/O relay numbers described in Section 3.1.
9. Output coil numbers (including those for timers, counters and latching relays) cannot be used in duplication.

■ PROGRAMMING ORDER

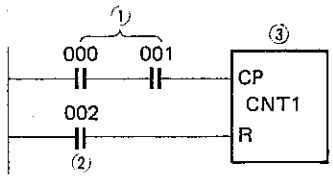
1. Program a circuit from its left to right.



2. Assume the circuit elements located from the bus bar to an output relay as one block. If a number of blocks are in line, programming can be started from any block. However, pay attention in the case of circuits utilizing scan time or timing such as differentiator, shift register, etc.



3. When composite instructions such as counter, high-speed counter (HDM), reversible counter (RDM), latching relay, etc., are used, their order of programming is predetermined. Be sure to perform the programming according to the predetermined order.

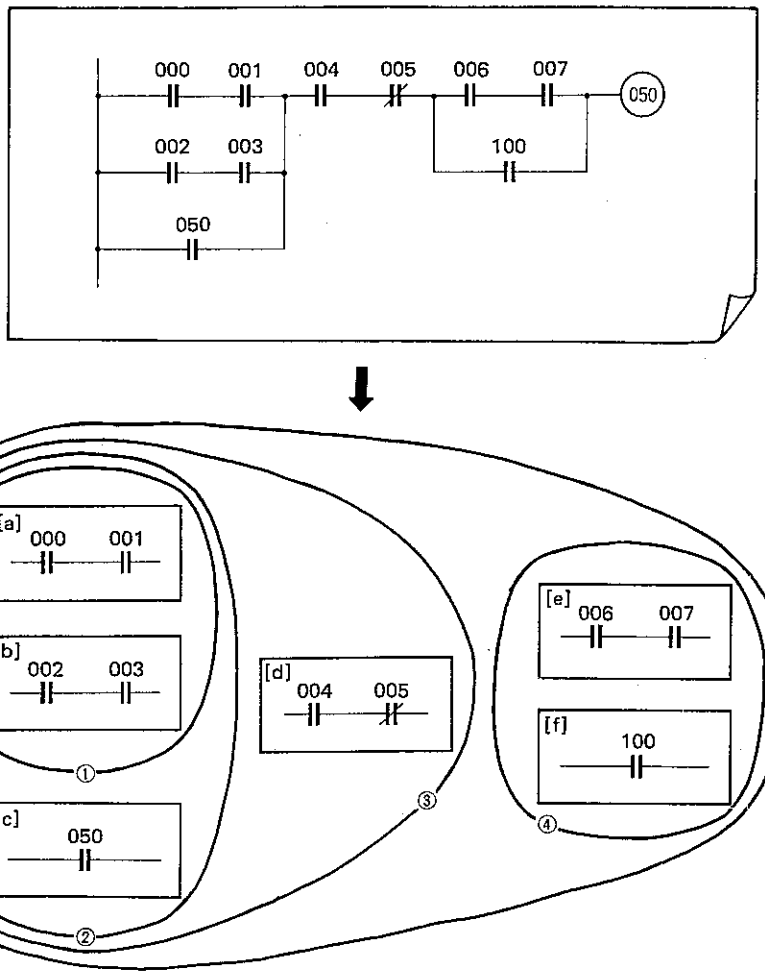


Program in the order of ① to ③.

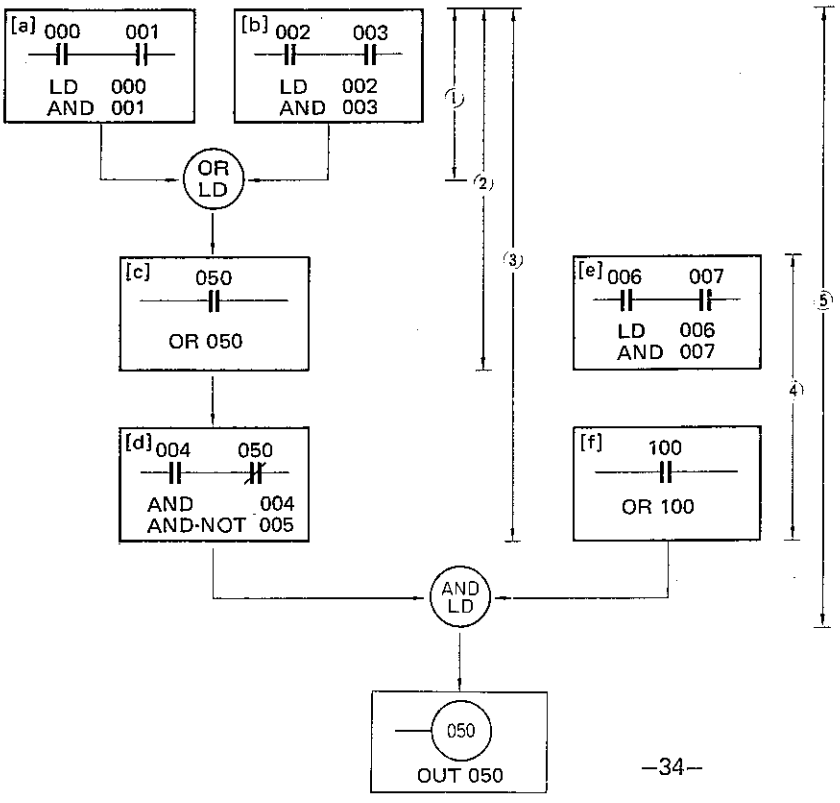
Address	OP	Data
⋮		⋮
n	LD	000
n + 1	AND	001
n + 2	LD	002
n + 3	CNT 1	056
⋮		⋮

4. A ladder diagram such as the one shown below can be divided into small blocks as shown below, to program each block in the order of ① to ⑤. Eventually, the circuit will be programmed as one large block such as ⑤.

- **Ladder diagram**



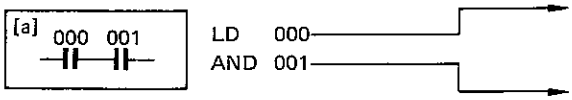
- **Programming procedure**

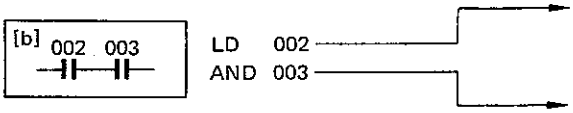


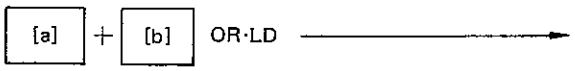
- **Coding**

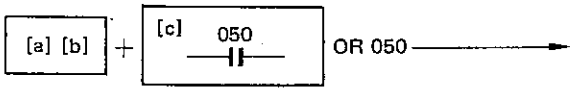
Address	OP	Data
200	LD	000
201	AND	001
202	LD	002
203	AND	003
204	OR·LD	—
205	OR	050
206	AND	004
207	AND·NOT	005
208	LD	006
209	AND	007
210	OR	100
211	AND·LD	—
212	OUT	050
⋮		⋮
n	END	

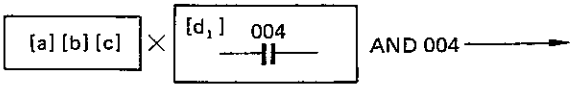
- **Operations of R and S registers**

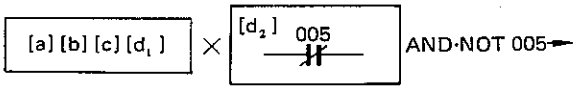
1. 

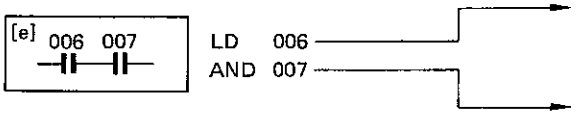
2. 

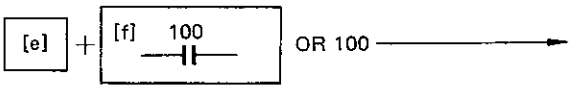
3. 

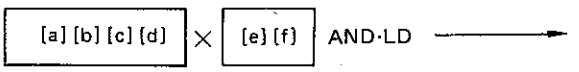
4. 

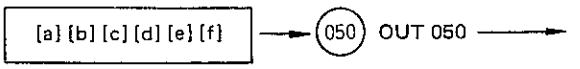
5. 

6. 

7. 

8. 

9. 

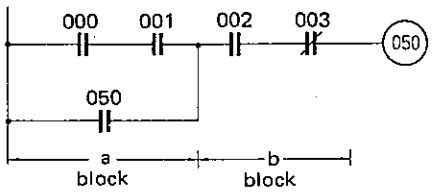
10. 

Content of register	R register	S register
The content ("1" or "0") of 000 is stored in R register.	000	Vacant
The content of R register is ANDed with the content of 001 and the result of operation is stored in R register.	Result of 000 001 = [a]	Vacant
The previous content of R register is transferred to S register and the content of 002 is newly stored in R register.	002	[a]
The content of R register is ANDed with the content of 003, and the result of operation is stored in R register.	Result of 002 003 = [b]	[a]
The content of R register (result [b]) is ORed with the content of S register (result [a]), and the result of operation is stored in R register.	Result of ORing [a] with [b] = [a] [b]	Vacant
The content of 050 is ORed with the content of R register, and the result of operation is stored in R register.	Result of ORing [a] [b] with [c] = [a] [b] [c]	Vacant
The content of 004 is ANDed with the content of R register, and the result of operation is stored in R register.	Result of ANDing [a] [b] [c] with [d_1] = [a] [b] [c] [d_1]	Vacant
The content of 005 is ANDed with the content of R register and the result of operation is stored in R register.	Result of ANDing [a] [b] [c] [d_1] with [d_2] = [a] [b] [c] [d]	Vacant
The previous content of R register is transferred to S register, and the content of 006 is stored in R register.	006	[a] [b] [c] [d]
The content of R register is ANDed with the content of 007, and the result of operation is stored in R register.	Result of 006 007 = [e]	[a] [b] [c] [d]
The content of R register is ORed with the content of 100, and the result of operation is stored in R register.	Result of ORing [e] with [f] = [e] [f]	[a] [b] [c] [d]
The content of R register is ANDed with the content of S register, and the result of operation is stored in R register.	[a] [b] [c] [d] [e] [f]	Vacant
The result of R register is output to output relay OUT050.	[a] [b] [c] [d] [e] [f]	Vacant

5.2 Applied Programs

■ WHEN LD/OR/AND/NOT INSTRUCTIONS ARE USED

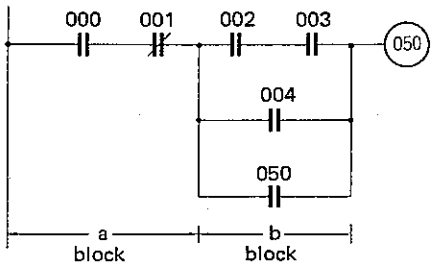
1. An example of parallel-series circuit



OP	Data	
LD	000	a
AND	001	
OR	050	
AND	002	b
AND·NOT	003	
OUT	050	
⋮	⋮	
END		

- Process block b after programming block a (parallel circuit).
- For coding, enter I/O relay numbers in the data field.

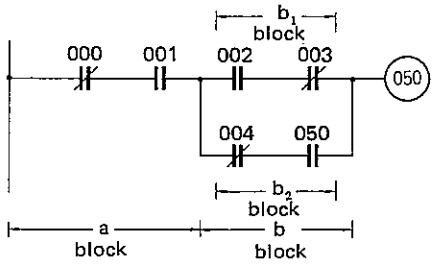
2. An example of series-parallel circuit



OP	Data	
LD	000	a
AND·NOT	001	
LD	002	b
AND	003	
OR	004	
OR	050	
AND·LD	—	
OUT	050	
⋮	⋮	
END		

- Divide the circuit into blocks a and b and program each block.
- Then combine blocks a and b by AND·LD instruction.

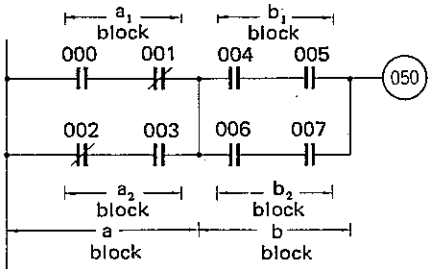
3. An example of series-parallel circuit



OP	Data	
LD·NOT	000	a
AND	001	
LD	002	b_1
AND·NOT	003	
LD·NOT	004	b_2
AND	050	
OR·LD	—	b_1+b_2
AND·LD	—	a·b
OUT	050	
⋮	⋮	
END		

- Program block a.
- Program block b_1 and then block b_2.
- Combine blocks b_1 and b_2 using OR·LD instruction.
- Combine blocks a and b using AND·LD instruction.

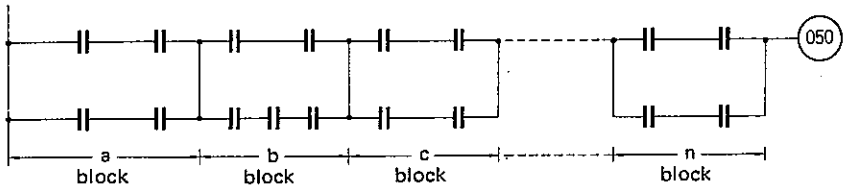
4. An example of connecting parallel circuits in series



OP	Data	
LD	000	a_1
AND·NOT	001	
LD·NOT	002	a_2
AND	003	
OR·LD	—	a_1+a_2
LD	004	b_1
AND	005	
LD	006	b_2
AND	007	
OR·LD	—	b_1+b_2
AND·LD	—	a·b
OUT	050	
⋮	⋮	
END		

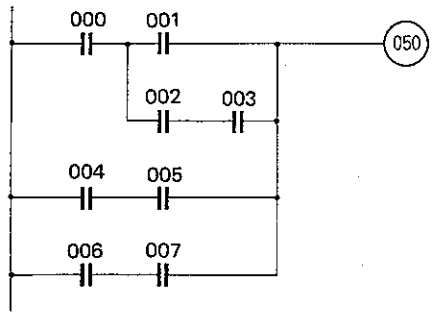
- Program block a_1 and then block a_2 and combine both blocks using OR·LD instruction.
- Program blocks b_1 and b_2 in the same manner as above.
- Combine blocks a and b using AND·LD instruction.

5. An example of connecting parallel circuits in series



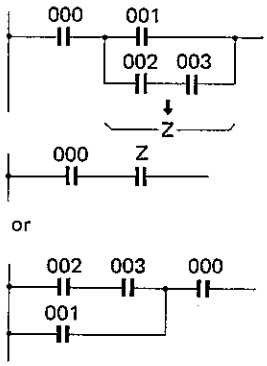
- When a number of blocks continue from block number a to n, the programming procedure is the same as paragraph 4 above. Namely, program the circuit in the following sequence.
  ① block a → ② block b → ③ blocks a·b → ④ block c → ⑤ blocks a·b·c → ⑥ .....
- Or, program as follows.
  ① block a → ② block b → ③ block c → ..... ⓜ n → (m+1) AND-LD → (m+2) AND-LD → (m+3) AND-LD .....

6. An example of complicated parallel circuit

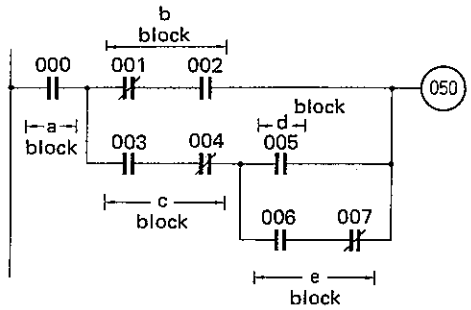


OP	Data	
LD	000	
LD	001	Z
LD	002	Z
AND	003	Z
OR·LD	—	
AND·LD	—	
LD	004	
AND	005	
OR·LD	—	
LD	006	
AND	007	
OR·LD	—	
OUT	050	
⋮	⋮	
END		

- If this circuit is regarded as either one of the following circuits, it will be easier to understand the program.

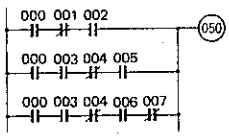


7. An example of complicated circuit



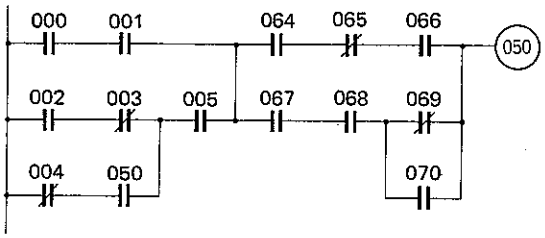
OP	Data		
LD	000	a	
LD·NOT	001	b	
AND	002	b	
LD	003	c	
AND·NOT	004	c	
LD	005	d	
LD	006	e	
AND·NOT	007	e	
OR·LD	—		d+e
AND·LD	—		(d+e)·c
OR·LD	—		(d+e)·c+b
AND·LD	—		[(d+e)·c+b]·a
OUT	050		
⋮	⋮		
END			

- The circuit shown on the left may be re-written as follows.



OP	Data
LD	000
AND·NOT	001
AND	002
LD	000
AND	003
AND·NOT	004
AND	005
OR·LD	—
LD	000
AND	003
AND·NOT	004
AND	005
AND·NOT	007
OR·LD	—
OUT	050
⋮	⋮
END	

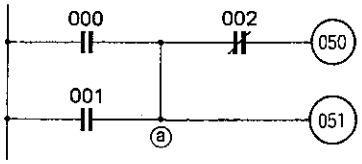
8. An example of complicated circuit



OP	Data
LD	000
AND	001
LD	002
AND·NOT	003
LD·NOT	004
AND	050
OR·LD	—
AND	050
OR·LD	—
LD	064
AND·NOT	065

OP	Data
AND	066
LD	067
AND	068
LD·NOT	069
OR	070
AND·LD	—
OR·LD	—
AND·LD	—
OUT	050
⋮	⋮
END	

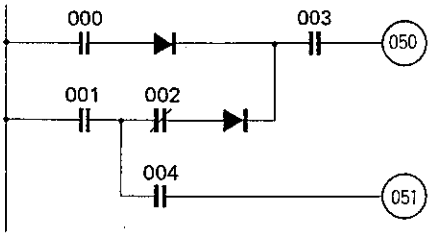
9. An example of circuit requiring caution



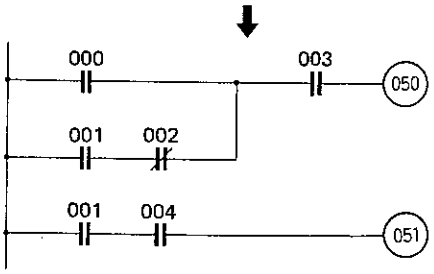
OP	Data
LD	000
OR	001
OUT	051
AND·NOT	002
OUT	050
⋮	⋮
END	

- In such a case as shown on the left, program relay contact $\frac{002}{}$ after programming output relay 051. This action is necessary for the following reason. Even if an output is sent to output relay 050, the content of the R register at point ⓐ will remain unchanged. However, if $\frac{002}{}$ is programmed before output relay 050, the content of the R register at point a will change and differ from the content sent to output relay 051.

10. An example of circuit requiring caution

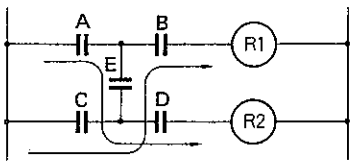


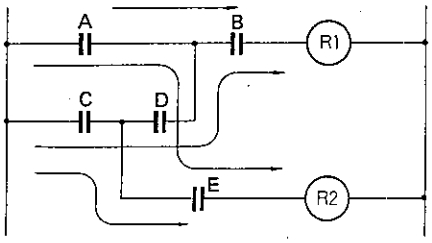
Separate the circuit as shown below.

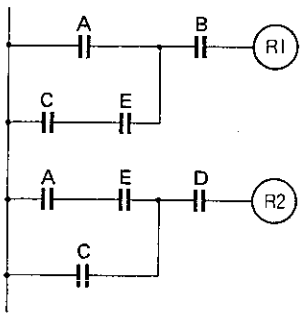


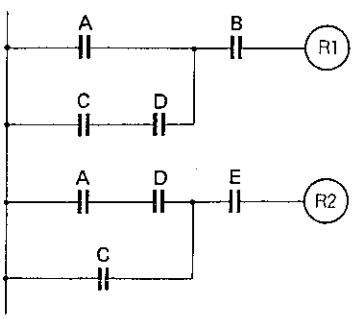
OP	Data
LD	000
LD	001
AND·NOT	002
OR·LD	—
AND	003
OUT	050
LD	001
AND	004
OUT	051
⋮	⋮
END	

11. Examples of circuit requring rewrite







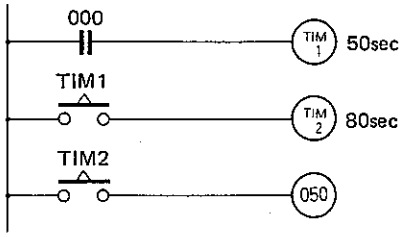


- Such circuits as shown on the upper left cannot be programmed and must therefore be rewritten as shown directly below.
- Since the two upper circuits are respectively configured with control relays, the circuits operate even by the flows of signals shown by the arrows. To permit the similar circuit operation with the SYSMAC-S6, the two upper circuits must be rewritten into the corresponding circuits shown below.

■ WHEN TIM/CNT INSTRUCTIONS ARE USED

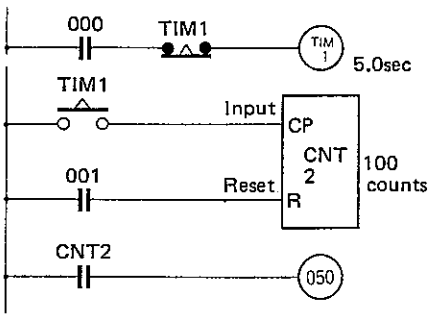
1. Long-time timer

a. Series connection of TIM instructions (e.g., 130sec)



OP	Data
LD	000
TIM 1	500
LD·TIM	1
TIM 2	800
LD·TIM	2
OUT	050
⋮	⋮
END	

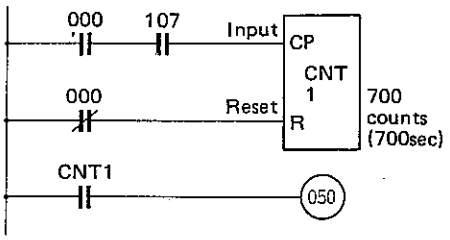
b. Use of CNT instruction (e.g., 500sec)



OP	Data
LD	000
AND·NOT· TIM	1
TIM 1	050
LD·TIM	1
LD	001
CNT 2	100
LD·CNT	2
OUT	050
⋮	⋮
END	

- In this circuit, a pulse is generated every 5 seconds by timer TIM1 and then pulses at intervals of 5 seconds are counted by counter CNT2. The example shown here is a 500sec timer. The setting time of the timer is (timer + scan time) x number of counts.
- The present count value of the counter is retained in memory even if the power switch of the SYSMAC-S6 is turned off.

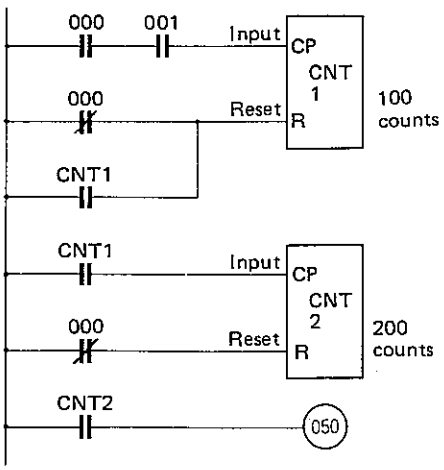
c. Use of internal clock pulse (e.g., 700sec)



OP	Data
LD	000
AND	107
LD·NOT	000
CNT 1	700
LD·CNT	1
OUT	050
⋮	⋮
END	

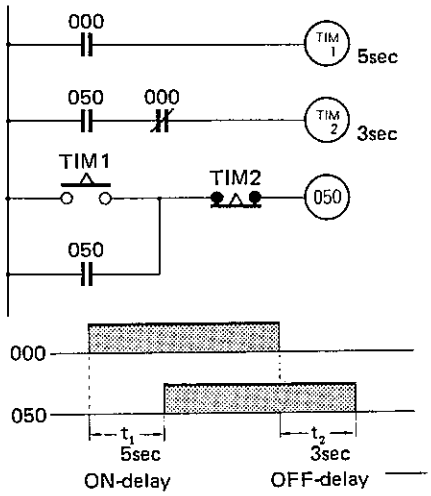
- The SYSMAC-S6 has three types of internal clock pulses (0.1sec clock: 106, 1sec clock: 107, 1min clock: 108). By counting any of the types of pulses with a counter, a long-time timer can be developed.
- As CNT instruction is employed, the present count value is retained in memory even after the power is turned off.
- By programming counter circuits in multiple stages, it is possible to develop a multi-digit counter which counts more than 999.

2. Multi-digit counter (e.g., 20,000 counts)



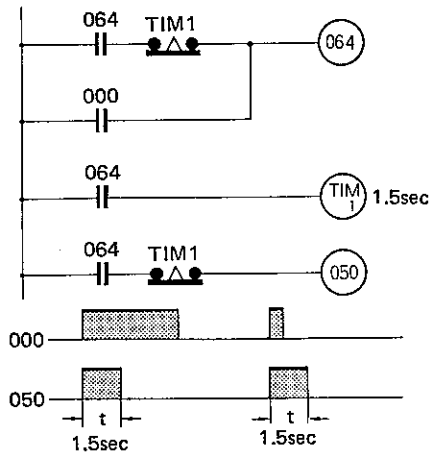
OP	Data
LD	000
AND	001
LD·NOT	000
OR·CNT	1
CNT 1	100
LD·CNT	1
LD·NOT	000
CNT 2	200
LD·CNT	2
OUT	050
⋮	⋮
END	

3. An example of ON/OFF-delay timer circuit



OP	Data
LD	000
TIM 1	050
LD	050
AND-NOT	000
TIM 2	030
LD-TIM	1
OR	050
AND-NOT-TIM	2
OUT	050
⋮	⋮
END	

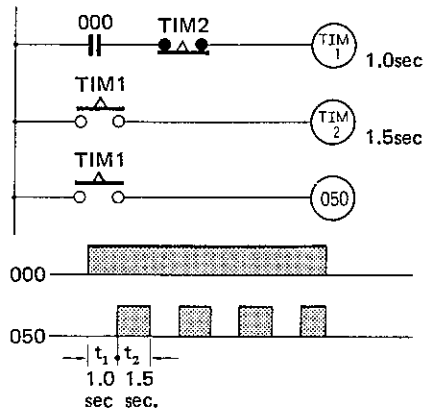
4. An example of one-shot timer circuit



OP	Data
LD	064
AND-NOT-TIM	1
OR	000
OUT	064
LD	064
TIM 1	015
LD	064
AND-NOT-TIM	1
OUT	050
⋮	⋮
END	

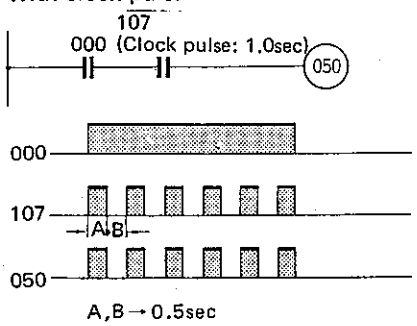
- One-shot-output is produced for only the set time of TIM1 after an input signal is applied. (Input 000 > scan time)

5. Examples of flicker circuit
   a. With 2 timers used



OP	Data
LD	000
AND-NOT-TIM	2
TIM 1	010
LD-TIM	1
TIM 2	015
LD-TIM	1
OUT	050
⋮	⋮
END	

b. With clock pulse

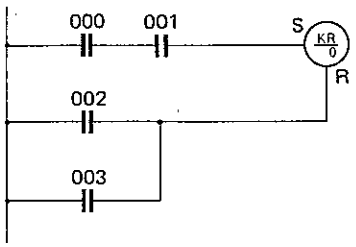


OP	Data
LD	000
AND	107
OUT	050
⋮	⋮
END	

- Using an internal clock pulse (0.1sec or 1.0sec), a flicker circuit can be processed easily. In this case, however, the flickering time is available only in the following 2 types.
  Special auxiliary relay number 106: 0.1sec clock pulse
  Special auxiliary relay number 107: 1.0sec clock pulse

■ WHEN LATCHING RELAY IS USED

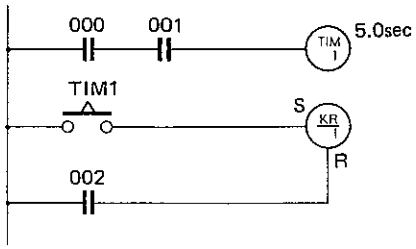
1. Basic circuit



OP	Data
LD	000
AND	001
LD	002
OR	003
KR	0
⋮	⋮
END	

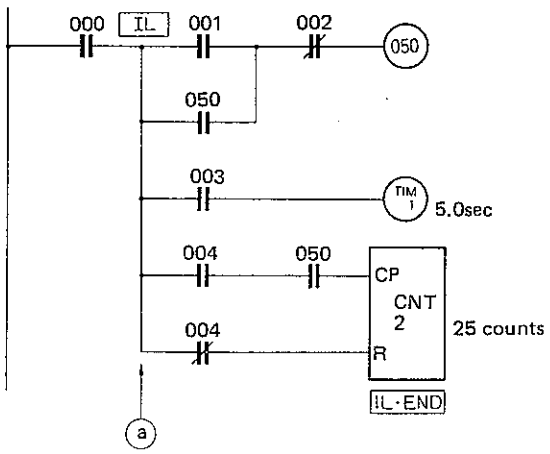
- In the event of a power failure, the ON/OFF state before the power failure can be retained in memory, using a latching relay. SYSMAC-S6 has 8 latching relays with relay numbers KR0 to KR7.
- Memory retention time after a power failure is about the same as that of the program memory. (Refer to Section 2.3, Specifications.)

2. A circuit to keep the time-up state



OP	Data
LD	000
AND	001
TIM 1	050
LD·TIM	1
LD	002
KR	1
⋮	⋮
END	

■ WHEN IL INSTRUCTIONS ARE USED



OP	Data
LD	000
IL	—
LD	001
OR	050
AND·NOT	002
OUT	050
LD	003
TIM 1	050
LD	004
AND	050
LD·NOT	004
CNT 2	025
IL·END	—
⋮	⋮
END	

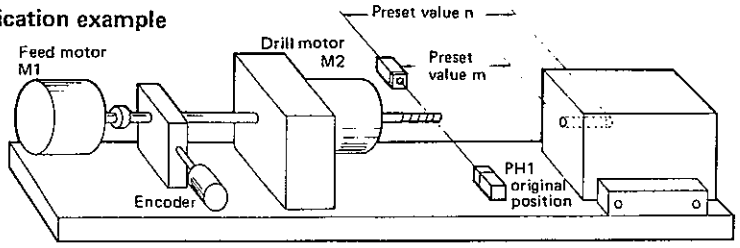
- Program the circuit by taking the common line (a) after the IL instruction, as a bus bar.
- An IL·END instruction must always be added to the end of a circuit employing an IL instruction. The instructions between the IL and IL·END instructions are executed.
- When input 000 is OFF, timer TIM1 is reset but the present value of counter CNT2 is retained.
- When preparing an automatic/manual circuit, the circuit shown on the left can be operated only in the automatic mode by turning input 000 on automatically.

■ WHEN HDM INSTRUCTION IS USED

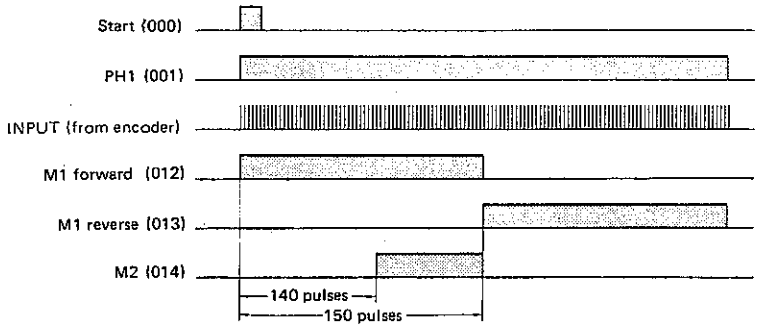
1. Application to positioning control.

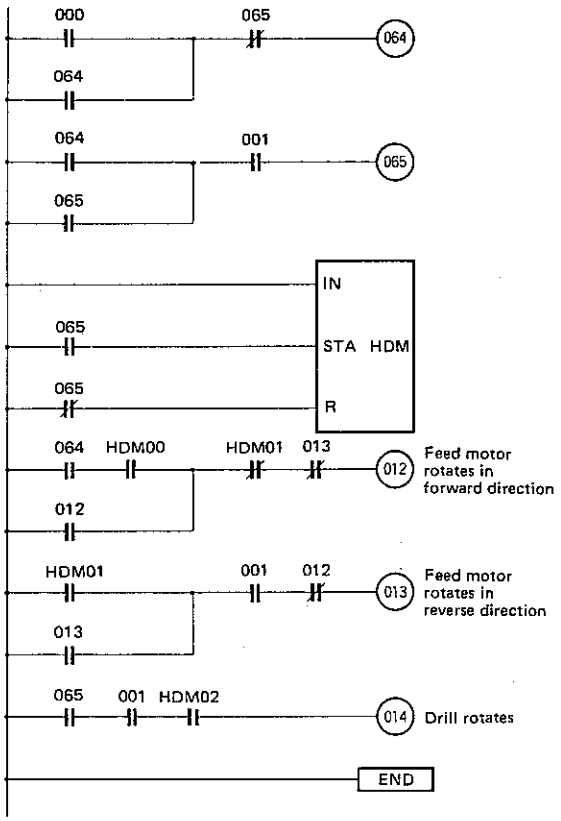
In controlling the depth of each machined hole, depth positioning is performed by counting the number of high-speed pulses. Feed motor M1 and drill rotating motor M2 are controlled by the pulses indicating the drill movement received from the encoder and the original position signal received from photoelectric switch PH1.

- **Application example**



- **Timing chart**





HDM output number	Value setting table	
	Preset value A	Preset value B
HDM00	000	010*
HDM01	150	160*
HDM02	140	150

NOTE: * Preset value B is satisfactory if it is equal to or more than preset value A. In this example, preset value B is set with an allowance of 10 pulses by taking the backlash of the feed motor into account.

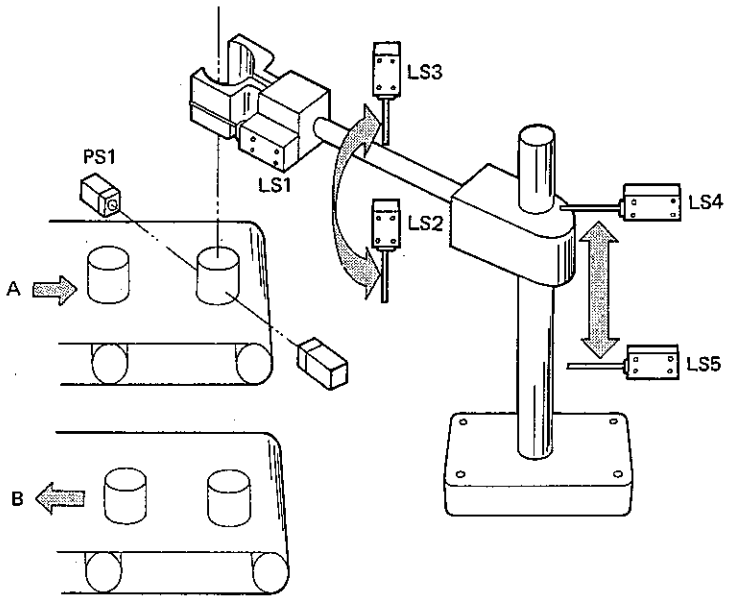
Coding

OP	Data
LD	000
OR	064
AND-NOT	065
OUT	064
LD	064
OR	065
AND	001
OUT	065
LD	065
LD-NOT	065
HDM	
LD	064
AND-HDM	00
OR	012
AND-NOT-HDM	01
AND-NOT	013
OUT	012
LD-HDM	01
OR	013
AND	001
AND-NOT	012
OUT	013
LD	065
AND	001
AND-HDM02	
OUT	014
END	

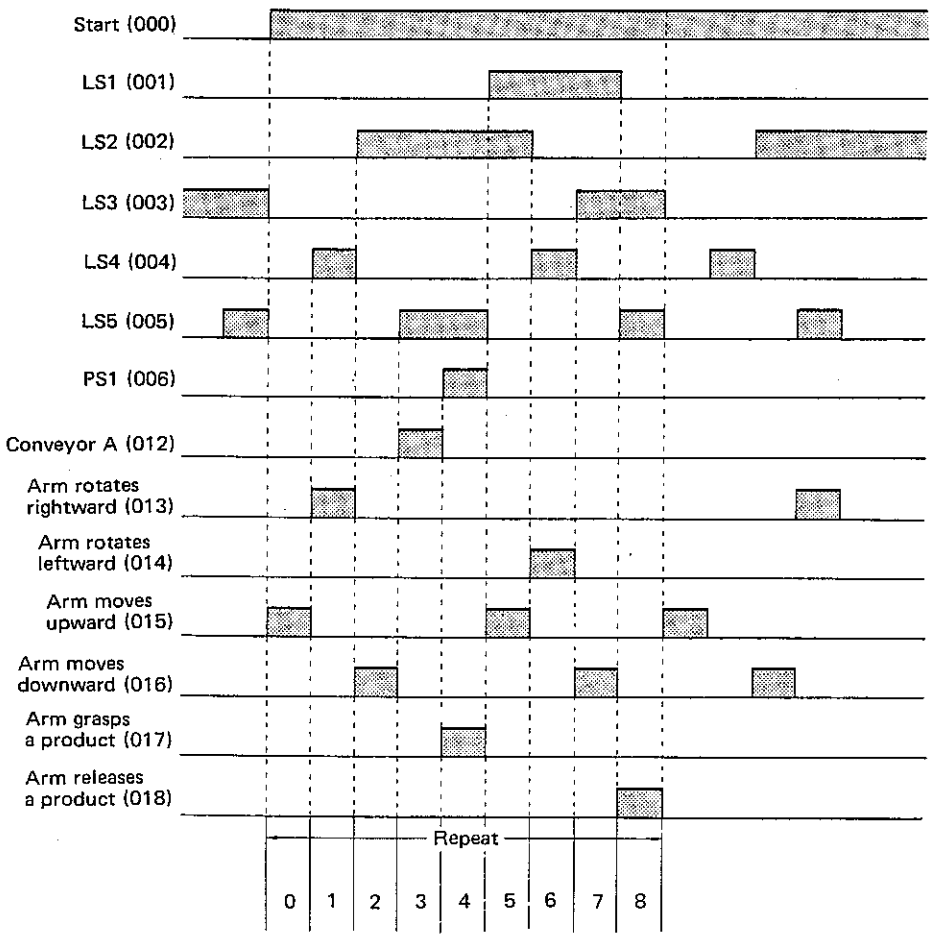
■ WHEN RDM INSTRUCTION IS USED

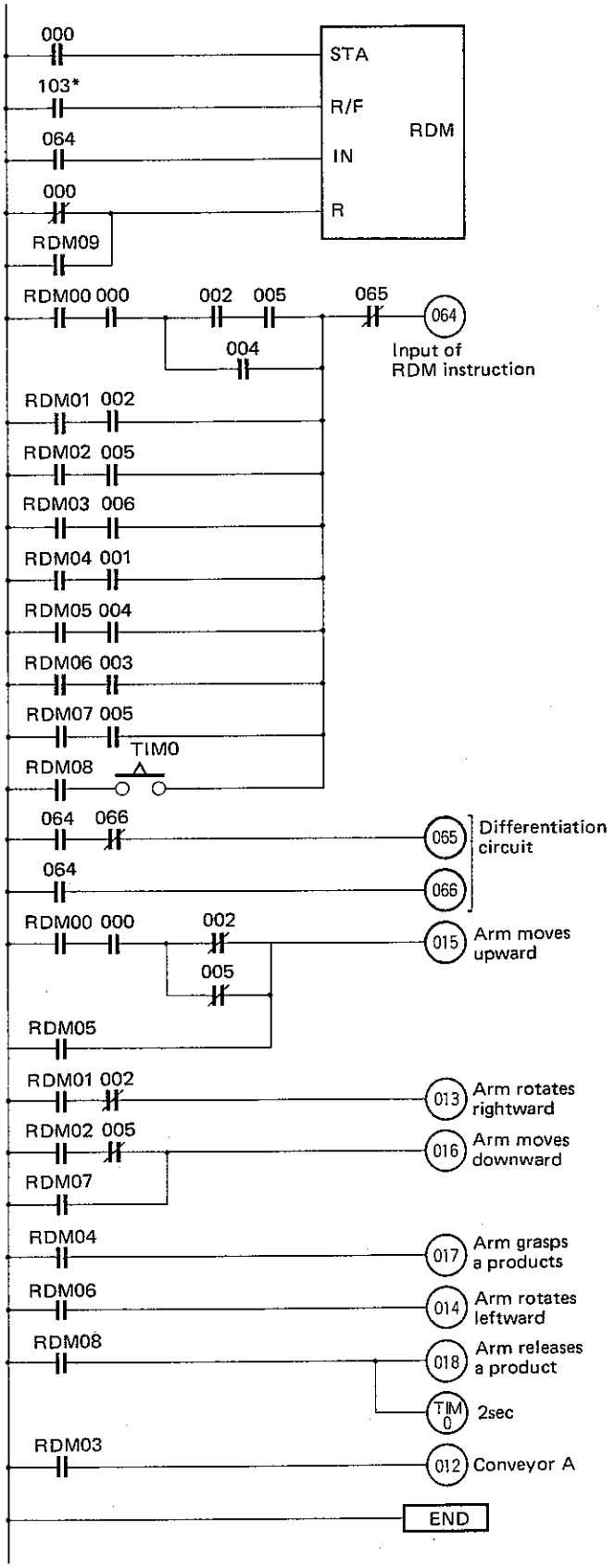
1. Application to step advance control.
   The movements of an industrial robot arm to transfer products from conveyor A to conveyor B, such as rightward or leftward, up and down, grasp, release, etc., are controlled by the SYSMAC-S6.

- **Application example**



- **Timing chart**





NOTE: * Relay 103 is unused internal-auxiliary relay.

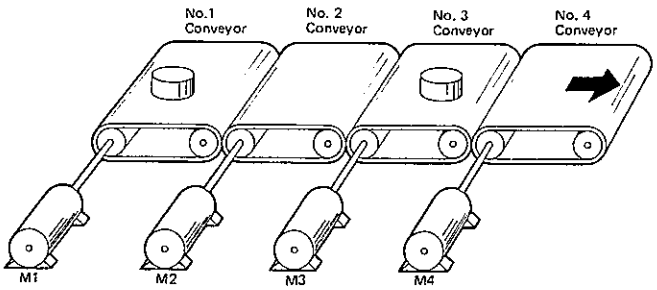
RDM output number	Value setting table	
	Preset value A	Preset value B
RDM00	000	000
RDM01	001	001
RDM02	002	002
RDM03	003	003
RDM04	004	004
RDM05	005	005
RDM06	006	006
RDM07	007	007
RDM08	008	008
RDM09	009	009

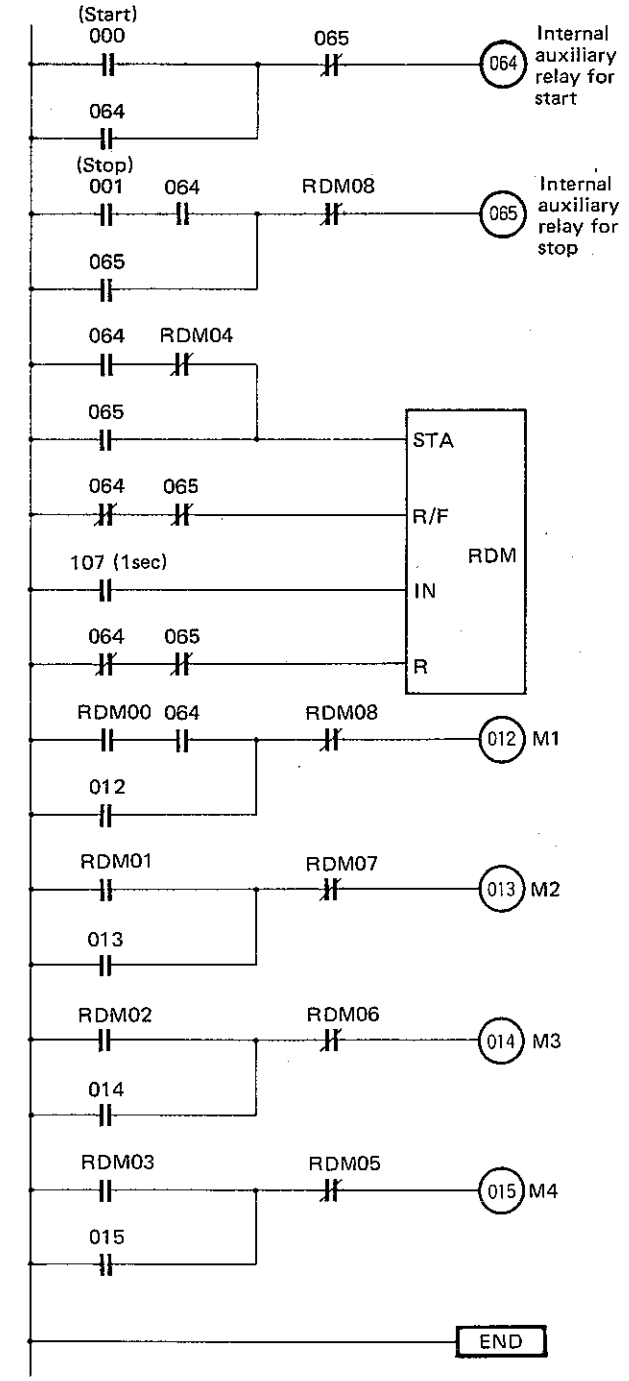
Coding

OP	Data	OP	Data
LD	000	OR·LD	–
LD	103	AND·NOT	065
LD	064	OUT	064
LD·NOT	000	LD	064
OR·RDM	09	AND·NOT	066
RDM	–	OUT	065
LD·RDM	00	LD	064
AND	000	OUT	066
LD	002	LD·RDM	00
AND	005	AND	000
OR	004	LD·NOT	002
AND·LD	–	OR·NOT	005
LD·RDM	01	AND·LD	–
AND	002	OR·RDM	05
OR·LD	–	OUT	015
LD·RDM	02	LD·RDM	01
AND	005	AND·NOT	002
OR·LD	–	OUT	013
LD·RDM	03	LD·RDM	02
AND	006	AND·NOT	005
OR·LD	–	OR·RDM	07
LD·RDM	04	OUT	016
AND	001	LD·RDM	04
OR·LD	–	OUT	017
LD·RDM	05	LD·RDM	06
AND	004	OUT	014
OR·LD	–	LD·RDM	08
LD·RDM	06	OUT	018
AND	003	TIM 0	020
OR·LD	–	LD·RDM	03
LD·RDM	07	OUT	012
AND	005	END	
OR·LD	–		
LD·RDM	08		
AND·TIM	0		

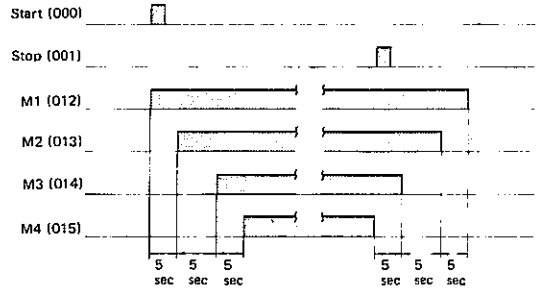
2. Application to sequential start/stop control.
When a number of conveyors are to be operated in a conveyor line, sequential start/stop control is often effected by providing a time lag between the start or stop of one conveyor and that of the next conveyor.

- **Application example**





- **Timing chart**



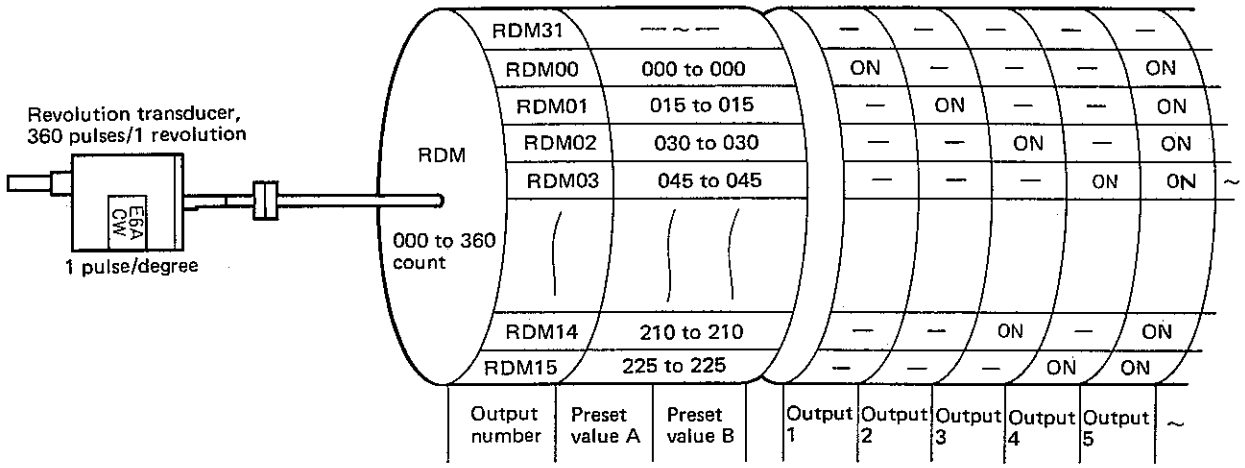
RDM output number	Value setting table	
	Preset value A	Preset value B
RDM00	000	004
RDM01	005	009
RDM02	010	014
RDM03	015	019
RDM04	019	035
RDM05	020	024
RDM06	025	029
RDM07	030	034
RDM08	035	035

Coding

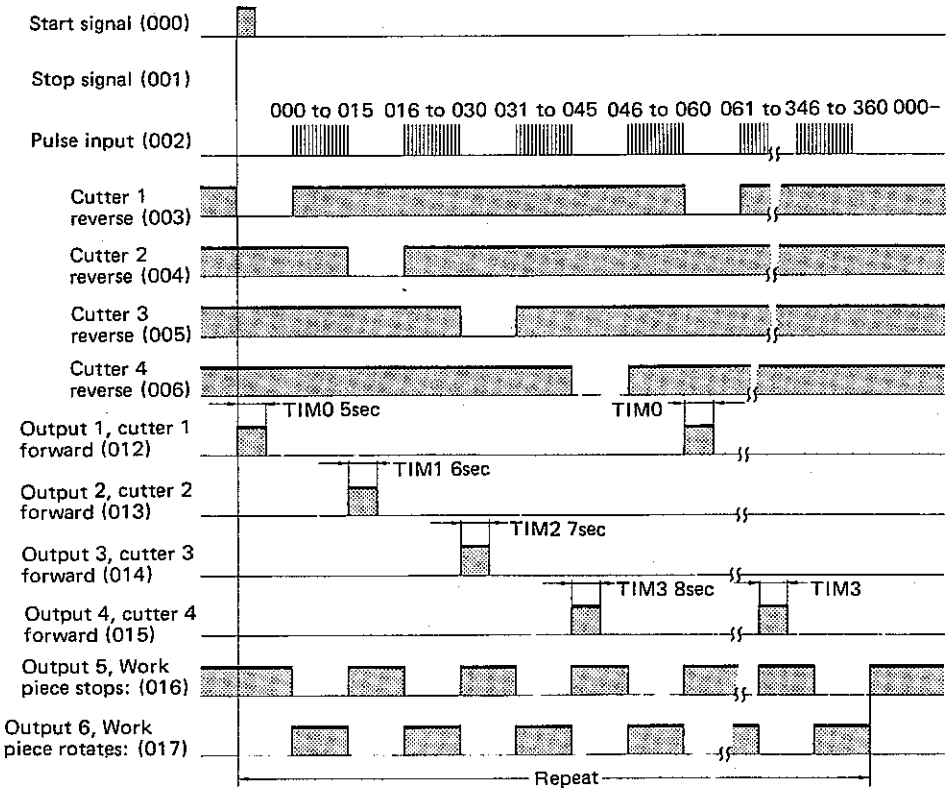
OP	DATA	OP	DATA
LD	000	LD·RDM	00
OR	064	AND	064
AND·NOT	065	OR	012
OUT	064	AND·NOT·RDM	08
LD	001	OUT	012
AND	064	LD·RDM	01
OR	065	OR	013
AND·NOT·RDM	08	AND·NOT·RDM	07
OUT	065	OUT	013
LD	064	LD·RDM	02
AND·NOT·RDM	04	OR	014
OR	065	AND·NOT·RDM	06
LD·NOT	064	OUT	014
AND·NOT	065	LD·RDM	03
LD	107	OR	015
LD·NOT	064	AND·NOT·RDM	05
AND·NOT	065	OUT	015
RDM		END	

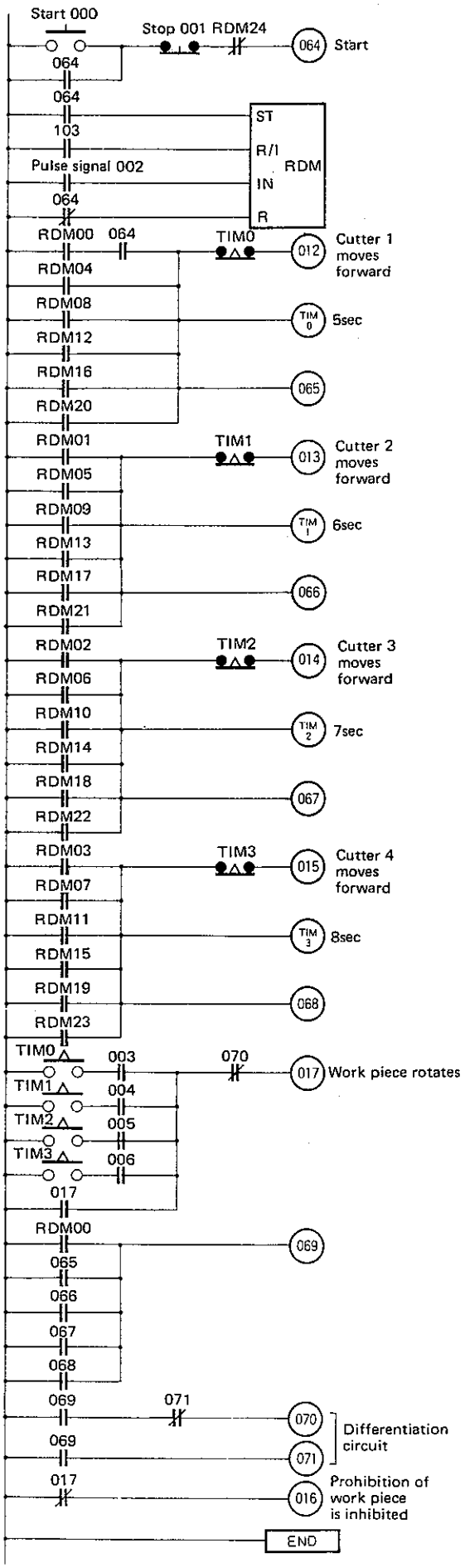
3. Application to drum control.
   In a machine tool, the machine tool operation can be controlled by the rotation angle of the drum.

- **Application example**



- **Timing chart**





RDM output number	Value setting table: Preset value A	Preset value B
RDM00	000	000
RDM01	015	015
RDM02	030	030
RDM03	045	045
RDM04	060	060
RDM05	075	075
RDM06	090	090
RDM07	105	105
RDM08	120	120
RDM09	135	135
RDM10	150	150
RDM11	165	165
RDM12	180	180
RDM13	195	195
RDM14	210	210
RDM15	225	225
RDM16	240	240
RDM17	255	255
RDM18	270	270
RDM19	285	285
RDM20	300	300
RDM21	315	315
RDM22	330	330
RDM23	345	345
RDM24	360	360

RDM reset

Coding

OP	Data
LD	000
OR	064
AND-NOT	001
AND-NOT-RDM	24
OUT	064
LD	064
LD	103
LD	002
LD-NOT	064
RDM	–
LD-RDM	00
AND	064
OR-RDM	04
OR-RDM	08
OR-RDM	12
OR-RDM	16
OR-RDM	20
OUT	065
TIM 0	050
AND-NOT-TIM	0
OUT	012
LD-RDM	01
OR-RDM	05
OR-RDM	09
OR-RDM	13
OR-RDM	17
OR-RDM	21
OUT	066
TIM 1	060
AND-NOT-TIM	1
OUT	013
LD-RDM	02
OR-RDM	06
OR-RDM	10
OR-RDM	14
OR-RDM	18
OR-RDM	22
OUT	067
TIM 2	070
AND-NOT-TIM	2

OP	Data
OUT	014
LD-RDM	03
OR-RDM	07
OR-RDM	11
OR-RDM	15
OR-RDM	19
OR-RDM	23
OUT	068
TIM 3	080
AND-NOT-TIM	3
OUT	015
LD-TIM	0
AND	003
LD-TIM	1
AND	004
OR-LD	–
LD-TIM	2
AND	005
OR-LD	–
LD-TIM	3
AND	006
OR-LD	–
OR	017
AND-NOT	070
OUT	017
LD-RDM	00
OR	065
OR	066
OR	067
OR	068
OUT	069
LD	069
AND-NOT	071
OUT	070
LD	069
OUT	071
LD-NOT	017
OUT	016
END	

6. Operating Procedure

6.1 Cautions in Operating SYSMAC-S6

When operating the SYSMAC-S6, pay attention to the following points.

CAUTIONS:

- The key inserted into the mode selector switch on the programming console can be pulled out only in the RUN position.
  Even after the removal of the key, such operations as "search", "monitor", "trace check", etc., can be performed.
- The programming console can be mounted or dismounted to or from the CPU while the SYSMAC-S6 is in "RUN" mode.
  1. When the programming console is dismounted
     The CPU remains in the operation mode immediately before the programming console is dismounted.
     If the power is turned OFF and then ON with the STOP input in the OFF state, the operation mode of the CPU will change from the existing mode to "RUN".
  2. When the programming console is mounted
     The CPU remains in the operation mode immediately before the programming console is mounted. If the existing operation mode of the CPU is different from the operation mode of the programming console, the message "ENTER PASSWORD!" is displayed on the LCD of the programming console. In such a case, specify the operation mode of the programming console as required and depress the [CLR] and [MONITOR] keys, and the operation mode of the CPU will change to that specified by the programming console. Turning the power OFF and then ON will also cause the existing mode of the CPU to change to that specified by the programming console. If the operation mode of both the CPU and the programming console is the same, the CPU remains in the mode under execution.

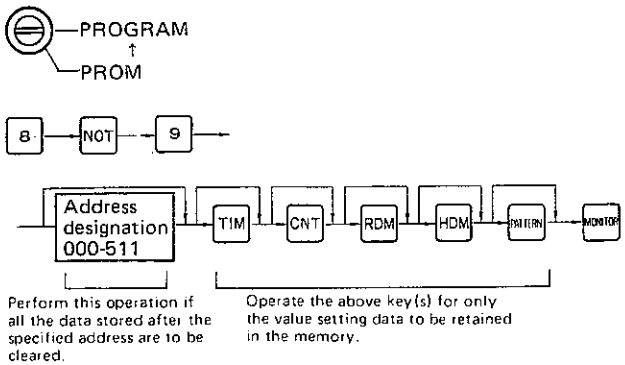
6.2 Basic Functions

Item of Operation	Description
All program clear	Since the CPU retains previously stored data in the RAM memory (by battery or capacitor backup), all the memory contents must be cleared to write a new program into the RAM memory.
Address setting	Address setting is required to designate an address in such operations as program read, program write, etc.
Program write	This operation is to store a program in the specified memory address.
Program read	This operation is to confirm whether or not data has been programmed properly in the specified memory address.
Value setting	This operation is to write the preset value of the timer, counter, reversible counter (RDM) or high-speed counter (HDM) in the specified value setting table.
Preset value read	This operation is to confirm whether or not the preset values have been written properly into the specified value setting table.
Pattern write	This operation is to store the ON/OFF states of I/O relays in the specified pattern number.
Pattern read	This operation is to confirm whether or not the set and reset conditions in the pattern write operation have been written properly into the specified pattern number.
Program check	This operation is to confirm whether or not the program data written into the memory through the programming console are in agreement with the predetermined rules (syntax).
Search	When a circuit change is to be made in a program simulation or test run, this operation allows an address where an instruction or relay number has been written in a program to be searched.
Contact (coil) number change	This operation is to change an instruction or contact (or coil) number in a program due to a circuit modification.
Contact (coil) addition	This operation is to add an instruction or contact (or coil) number to a program due to a circuit modification.
Contact (coil) deletion	This operation is to delete an instruction or contact (or coil) number from a program due to a circuit modification.
Hardware check	This operation is to check the hardware of the programming console and CPU. In the programming console check, the LCD, keyboard, and mode selector switch are checked for proper operation. In the CPU check, the memory unit, RAM memory, system program, "RUN" indicator, "CPU ERR." indicator, and "MEMORY ERR." indicator are checked for proper operation.
RUN	This operation is to place the SYSMAC-S6 in the RUN (Program Execution) mode.
Multi monitor	This operation is to monitor and display the operating states of I/O relays, internal auxiliary relays, latching relays and special auxiliary relays, the present and preset values of timers and counters, etc., in units of 4 points, during the execution of a program.
Forced set/reset	This operation is to set or reset by force the operating state of each of the I/O relays, internal auxiliary relays, special auxiliary relays and latching relays or the present value of each timer or counter during the execution of a program in the MONITOR mode.
Graphic monitor	This operation is to display the operating states of all the 64 input/output relays (000 – 063) collectively during the execution of a program. In addition, the present values of the reversible counter (RDM) and high-speed counter (HDM) are displayed in both graphics and digits.
Trace (continuity) check	When a circuit operation is to be checked in a program simulation or test run, this operation allows the operating state of each relay number to be displayed while tracing the programming sequence of the circuit.
Pattern monitor	This operation is to display the pattern numbers registered in output ON/OFF format in the previous Pattern Write operation.

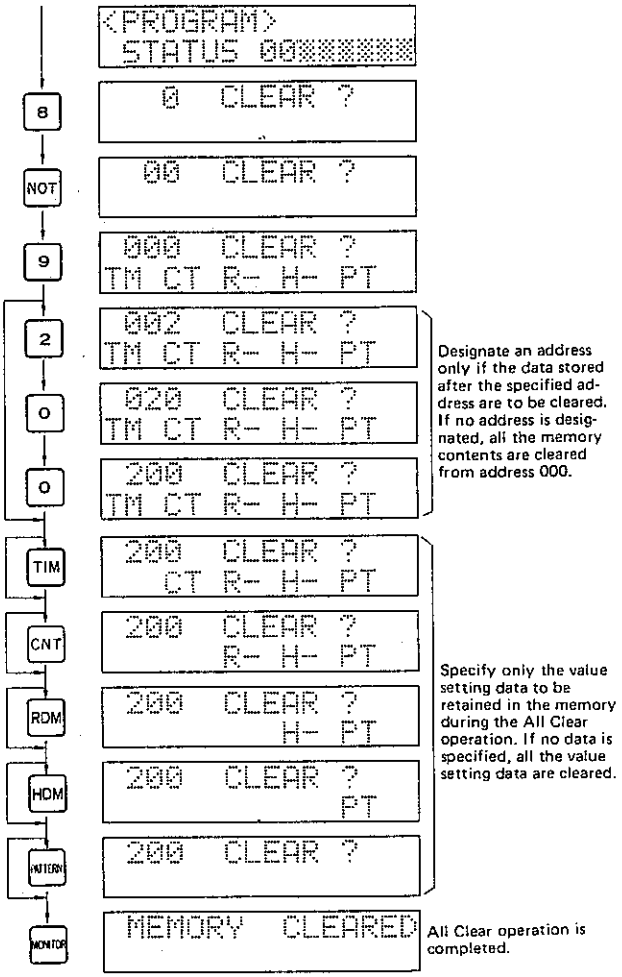
6.3 All Program Clear Operation

When the RAM memory is used as a user memory, previously stored programs and/or data are retained in the memory (by battery or capacitor backup) even if a power failure occurs. Therefore, all the RAM memory contents must be cleared to write a new program into the memory. (Although the new program may be written over the previously stored data, this practice is not recommended as it can easily cause program error.)

- Operating procedure



- Display



NOTES:

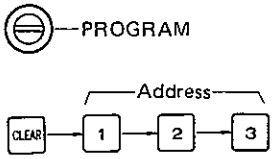
1. All the programs and data stored in addresses from the designated address to address 511, except the value setting data which are not specified as those to be retained in the memory, are cleared by the All Clear operation. If no address designation is made, all the data stored in addresses from 000 to 511 are cleared.
2. Before the key operation, change the mode selector switch position from "PROM" to "PROGRAM". At this point, avoid changing the mode selector switch position from "MONITOR" to "PROGRAM". This practice is dangerous, as the CPU is in the RUN state in the MONITOR mode and the load if any connected at that time may operate.
3. Upon depression of the MONITOR key, the address displayed on the LCD is extinguished. Subsequent depression of the CLEAR key will cause the LCD to indicate address "000".

CAUTION:
After the PROGRAM mode selection, depression of the CLEAR key or any key other than those keys shown above will not allow All Clear operation to be executed. In this case, repeat the operation starting from the mode selection.

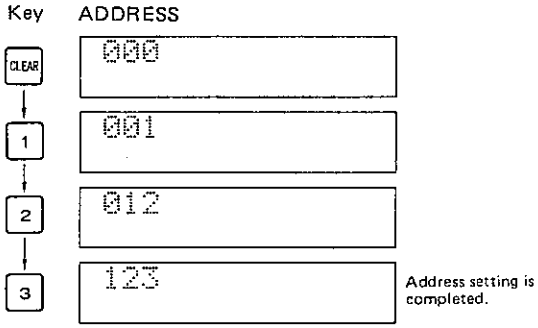
6.4 Address Setting Operation

Address setting is required to designate an address in such operations as program read, program write, etc.

- Operating procedure



- Display



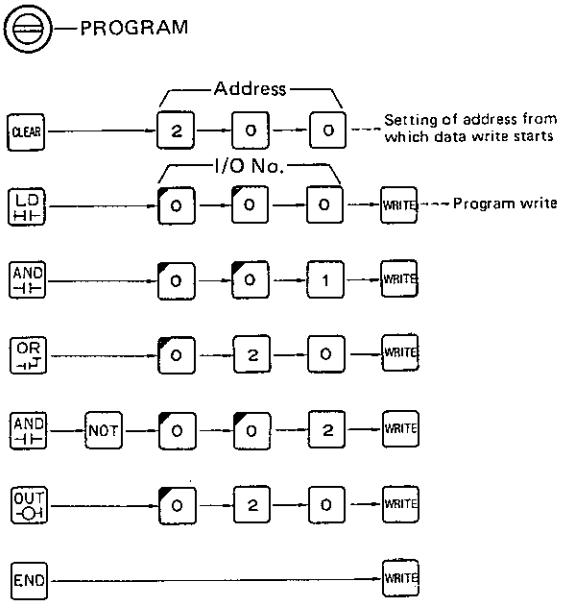
NOTES:

1. Each address is set in 3 digits using numeric 000 to 511. To set address "000", no numeric entry is required. To set address "003", depress only numeric key [3] and to set address "023", depress only numeric keys [2] and [3] .
2. At each depression of a numeric key, the previously displayed number will shift to the left by one digit on the LCD. In address setting, if the first digit of the 3-digit address entered is 6, it is displayed as "0".
3. No data will be displayed on the LCD by the address setting operation alone. To display any data, either [·] or [,] key must be depressed first.

6.5 Program Write Operation

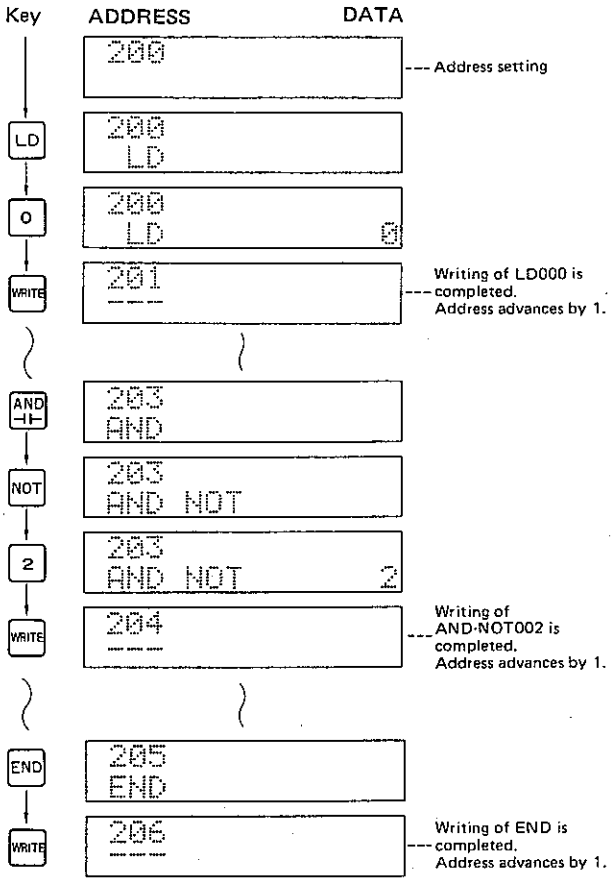
This operation is to store a program in the specified memory address.

- Operating procedure

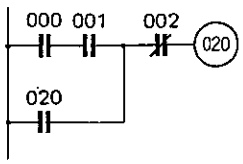


NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



- **Circuit for exercise and programming example**



Address	OP	Data
200	LD	000
201	AND	001
202	OR	020
203	AND-NOT	002
204	OUT	020
205	END	–

NOTE:
At each depression of the WRITE key, the data appearing on the OP and DATA sections of the LCD are written into memory.

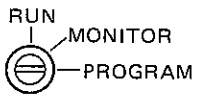
Correction procedures when an error occurs in program write

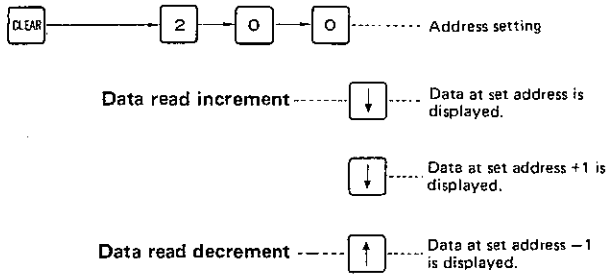
1. If an error in programming is noticed before depressing the WRITE key, depress the CLEAR DISPLAY key and the re-entry operation becomes effective.
2. If an error in programming is discovered after depressing the WRITE key, repeat the operation from the address setting, or return to the address in which the error exists by depressing the [↑] key and then depress the CLEAR DISPLAY key and the re-entry operation becomes effective.

6.6 Program Read Operation

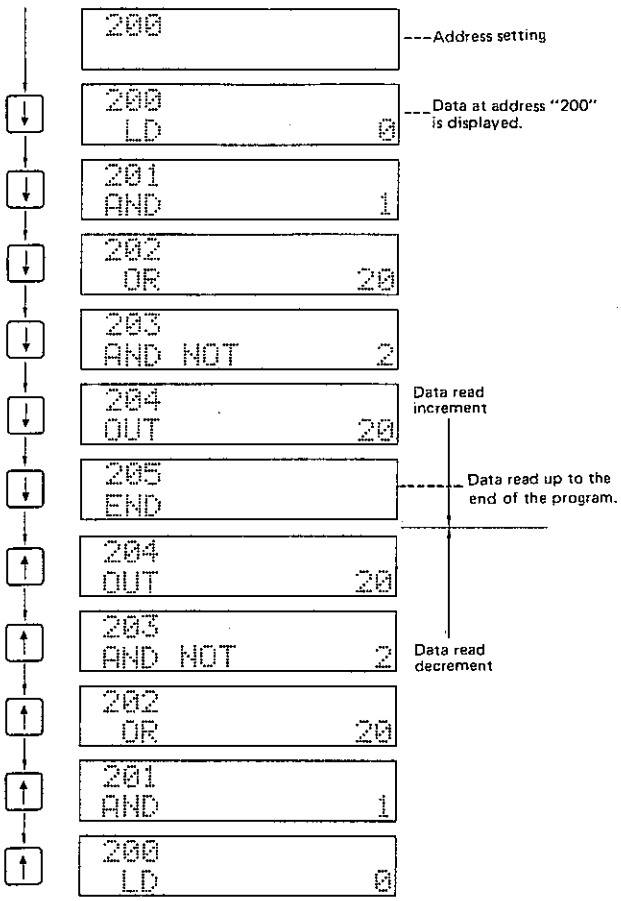
This operation is to confirm whether or not the data has been programmed properly in the specified memory address.

- **Operating procedure**

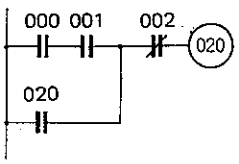




- **Display**



- **Circuit for exercise and programming example**



Address	OP	Data
200	LD	000
201	AND	001
202	OR	020
203	AND-NOT	002
204	OUT	020
205	END	–

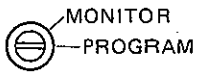
NOTES:

1. At each depression of the [↓] key, the data at the set address +1 is displayed (i.e., data read increment).
2. At each depression of the [↑] key, the data at the set address −1 is displayed (i.e., data read decrement).

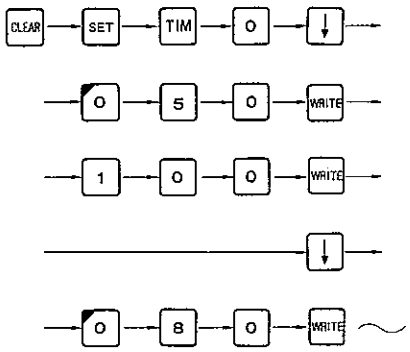
6.7 Value Setting Operation

Timer (TIM), counter (CNT), reversible counter (RDM) and high-speed counter (HDM) have their own value setting tables, into which preset time or count values must be registered before executing TIM, CNT, RDM and HDM instructions, respectively. However, with TIM and CNT instructions, this value setting operation may be omitted since the preset values of timers and counters can be entered in a Program Write operation. The preset values written into the respective value setting tables can be changed in the MONITOR mode.

- **Operating procedure**

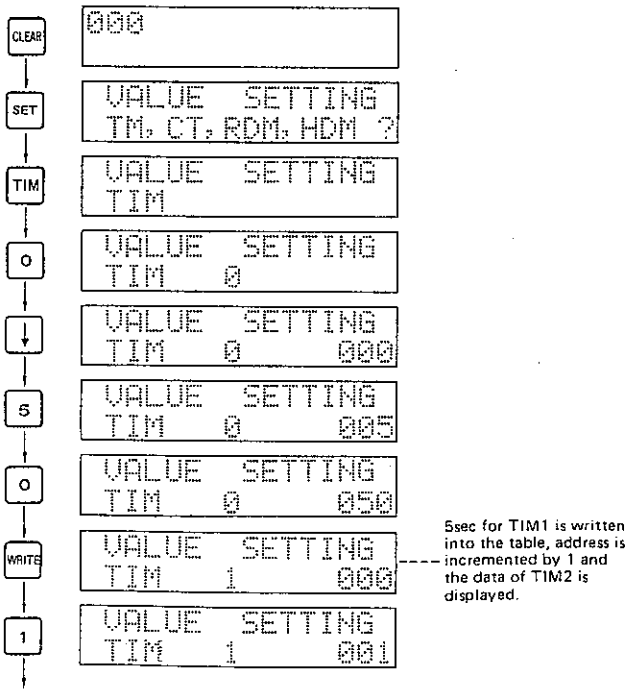


- **Value setting for timer**

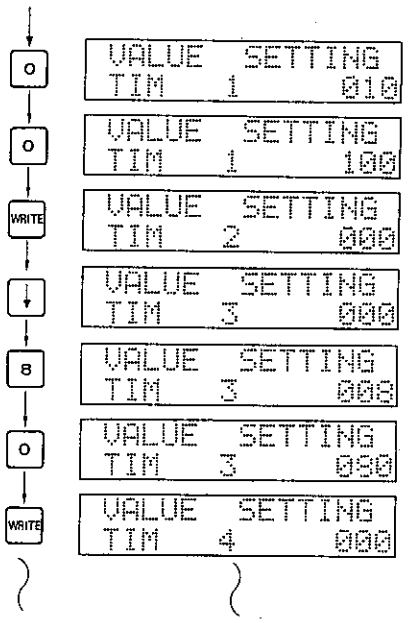


NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



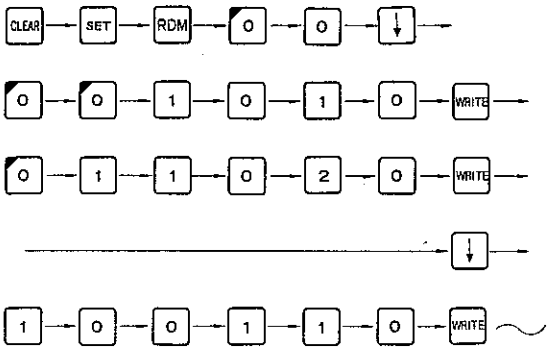
5sec for TIM1 is written into the table, address is incremented by 1 and the data of TIM2 is displayed.



Timer value setting table

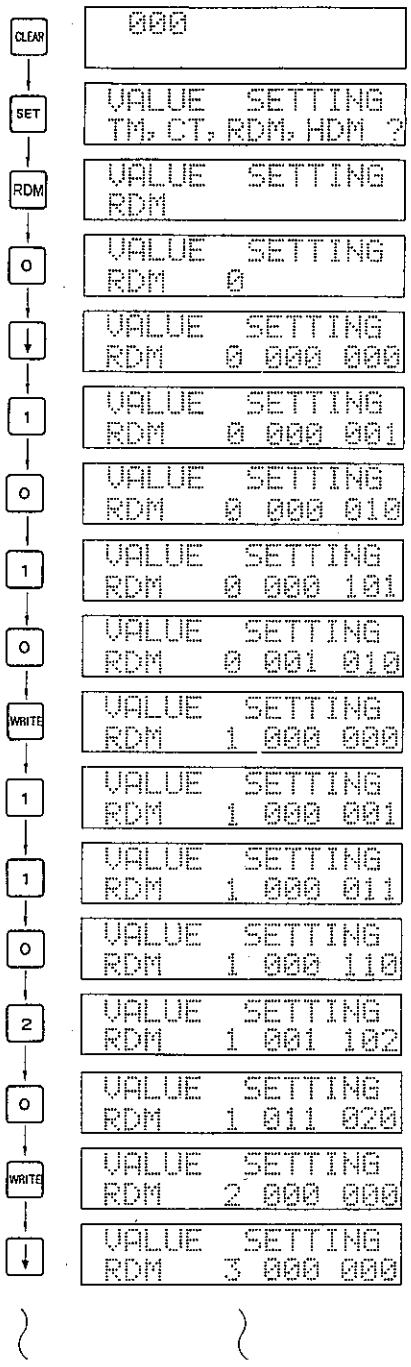
Timer No.	Preset value
TIM0	5sec
TIM1	10sec
TIM2	–
TIM3	8sec
TIM4	3sec
TIM5	

- **Value setting for reversible counter**



NOTE: The zero key marked [0] may or may not be depressed.

- Display



Reversible counter value setting table

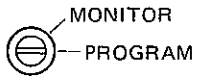
RDM output No.	Preset value A	Preset value B
RDM 00	001	010
RDM 01	011	020
RDM 02	–	–
RDM 03	100	110
RDM 04	200	205
RDM 05	500	550
RDM 06		

NOTE:
For each reversible counter output number, both preset values A and B must be set by satisfying the following condition:
Preset value A $\leq$ Preset value B

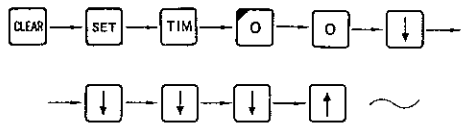
6.8 Preset Value Read Operation

This operation is to confirm whether or not the preset values have been correctly written into the Value Setting Tables specified for the timer, counter, reversible counter and high-speed counter, respectively. In the case of timer and counter preset values, this check can be made by a normal Program Read operation.

- **Operating procedure**

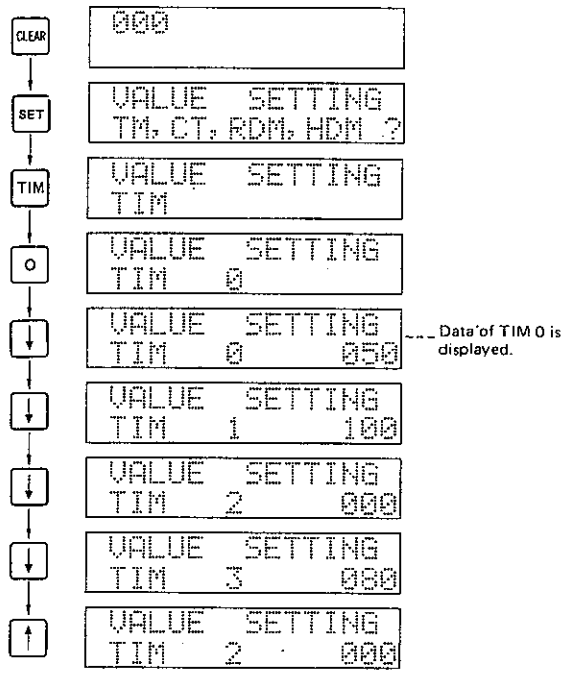


- **Preset value read for timer**



NOTE: The zero key marked [0] may or may not be depressed.

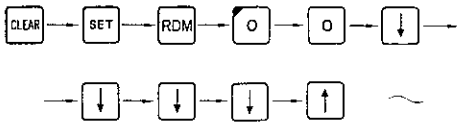
- **Display**



Timer Value Setting table

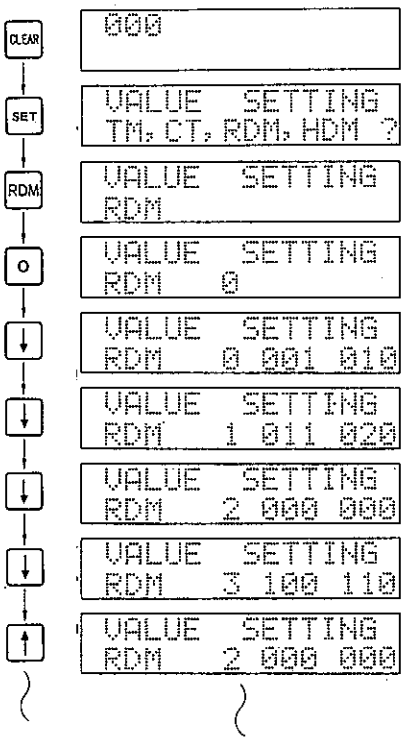
Timer No.	Preset value
TIM 0	5sec
TIM 1	10sec
TIM 2	–
TIM 3	8sec
TIM 4	3sec
TIM 5	

- **Preset value read for reversible counter**



NOTE: The zero key marked [0] may or may not be depressed.

- Display



Reversible counter value setting table

RDM output No.	Preset value A	Preset value B
RDM 00	001	010
RDM 01	011	020
RDM 02	—	—
RDM 03	100	110
RDM 04	200	205
RDM 05	500	550
RDM 06		

NOTES:

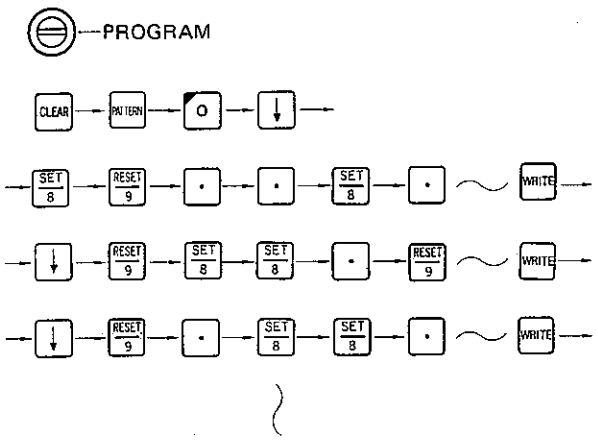
1. At each depression of the [↓] key, the displayed timer number, counter number, reversible counter output number, or high-speed counter output number is incremented by one, and the preset value(s) of the incremented timer, counter RDM or HDM output number are indicated on the LCD.
2. At each depression of the [↑] key, the dispalyed timer number, counter number, reversible counter output number or high-speed counter output number is decremented by one, and the preset value(s) of the decremented timer, counter, RDM orHDM output number are indicated on the LCD.

6.9 Pattern Write Operation

The pattern monitoring is a diagnostic function which detects at an early stage whether the controller is operating normally or in the halt state due the occurrence of an abnormality. For this purpose, 10 patterns are provided: Patterns 0 to 9. The operation of the controller is divided into 10 patterns and the ON/OFF states of input/output relays (000 – 063) in each pattern are registered in Patterns 0 to 9, respectively.

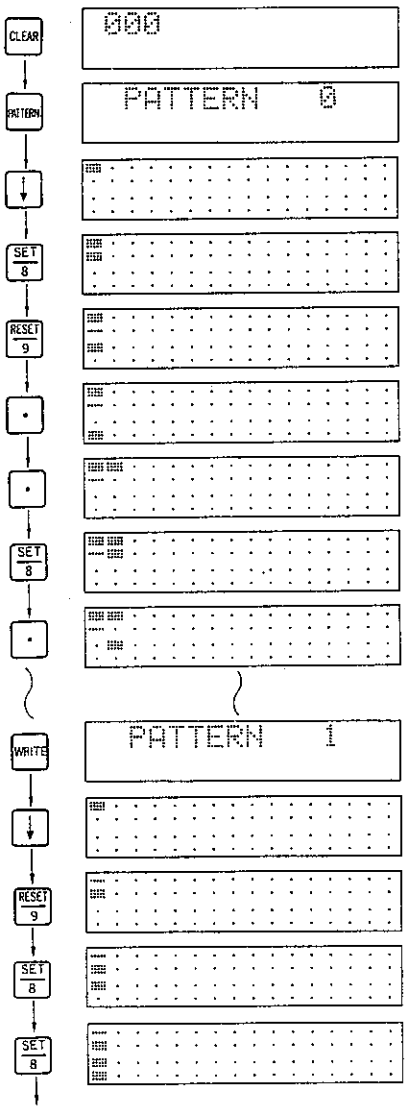
When the controller is in operation, the LCD screen moves in the sequence of the patterns which are coincident with those registered. If the controller stops due to the occurrence of an abnormality, the pattern at that time remains displayed on the LCD. This pattern display thus facilitates maintenance and inspection of the controller.

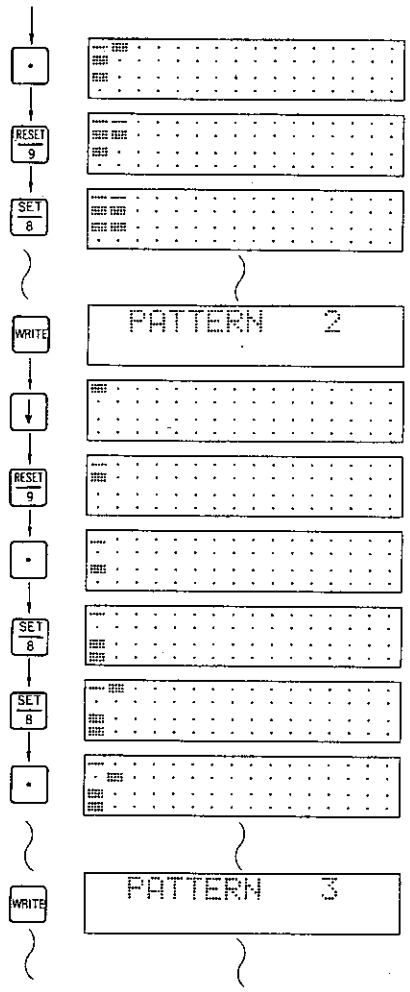
- Operating procedure



NOTES: The zero key marked [0] may or may not be depressed.

- Display





Pattern setting table

Relay No.	Pattern 0	Pattern 1	Pattern 2	Pattern 3
001	ON	OFF	OFF	OFF
001	OFF	ON	–	ON
002	–	ON	ON	–
003	–	–	ON	–
004	ON	OFF	–	
005	–	ON	ON	
006				

NOTES:

1. The pattern display positions for the respective 64 I/O relay numbers are as shown below.

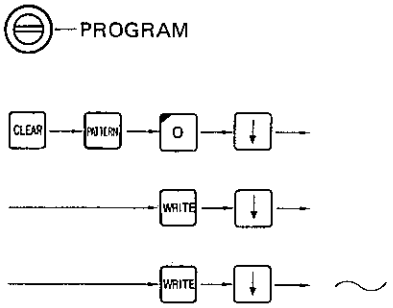
000	004	008	012	016	020	024	028	032	036	040	044	048	052	056	060
001	005	009	013	017	021	025	029	033	037	041	045	049	053	057	061
002	006	010	014	018	022	026	030	034	038	042	046	050	054	058	062
003	007	011	015	019	023	027	031	035	039	043	047	051	055	059	063

2. At the set (ON) and reset (OFF) positions, the STATUS indication flickers.
3. The [SET 8] key is used to write the ON state. This state is indicated by " ▪▪ " on the display.
4. The [RESET 9] key is used to write the OFF state. This state is indicated by " ▬ " on the display.
5. The [·] key is used when the ON/OFF state is not clear. This state is indicated " · " on the display.
6. At each depression of the [SET 8], [RESET 9], [·] or [↓] key, the set or reset indicating position is incremented by 1.
7. At each depression of the [↑] key, the set or reset indicating position is decremented by 1.
8. At each depression of the [–] key, the set or reset indicating position is incremented by 4.

6.10 Pattern Read Operation

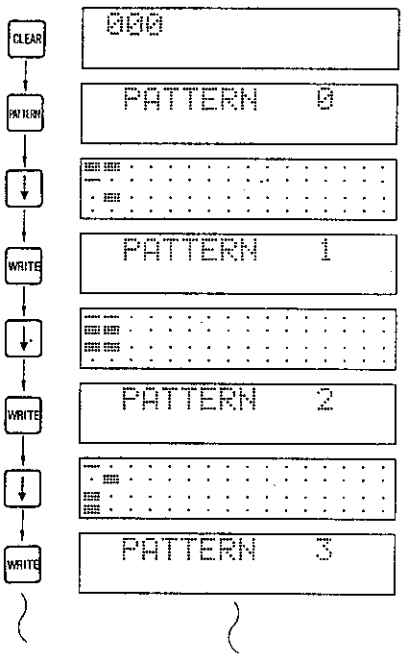
This operation is to confirm whether or not the set and reset conditions (i.e., ON/OFF states of I/O relays) in the pattern write operation have been correctly written into the specified pattern number.

- **Operating procedure**



NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



Pattern setting

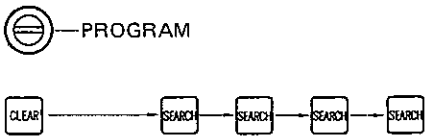
Relay No.	Pattern 0	Pattern 1	Pattern 2	Pattern 3
001	ON	OFF	OFF	OFF
001	OFF	ON	–	ON
002	–	ON	ON	–
003	–	–	ON	–
004	ON	OFF	–	
005	–	ON	ON	
006				

6.11 Program Check Operation

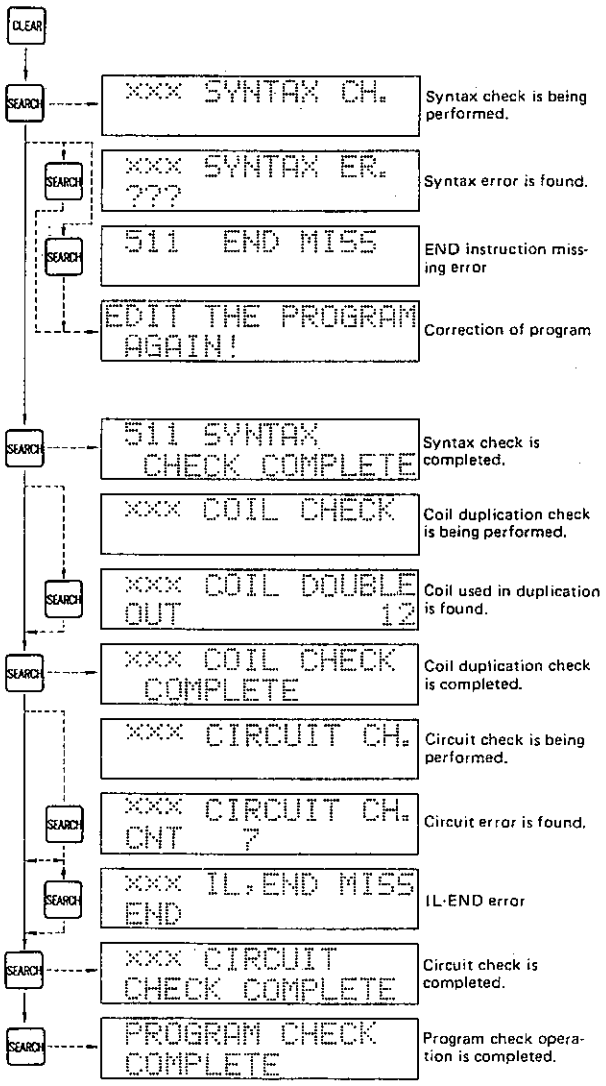
This operation is to confirm whether or not the program data written into the memory through the program console are in agreement with the predetermined rules (syntax).

Program Check Items
* Syntax error (SYNTAX ER.)
* Coil duplication error (COIL DOUBLE)
* Circuit error (CIRCUIT ER.)
* IL·END instruction missing error (IL·END MISS)
* END instruction missing error (END MISS)

- **Operating procedure**



- **Display**



NOTES:
1. If a program error exists, the address where the error exists and its contents are displayed on the LCD at each depression of the SEARCH key.
2. In the display for program check operation shown above, the continuous line between SEARCH keys shows the normal flow of operation when no error exists.
3. For details, refer to 9.3, List of Erro Messages and Remedies.

- **Error conditions**

1. Syntax error
   The message "SYNTAX ER." is displayed on the LCD when an undefined instruction is programmed or when the memory is destroyed.
2. Coil duplication error
   The message "COIL DOUBLE" is displayed on the LCD when the OUT, KR, TIM, CNT, RDM or HDM instructions of the same relay number are contained in a program.
3. Circuit error
   The R register and S register are controlled by computing a difference between the number of logical start instructions (LD and LD-NOT) and the number of inter-block logical instructions (AND-LD and OR-LD). If the difference is abnormal according to the nature of the instructions used when the result (OUT, KR, TIM, CNT, RDM, HDM) is executed, it is regarded as a circuit error, and the message "CIRCUIT ER." is displayed on the LCD.
4. IL/END MISS error
   IL and IL-END instructions must be used in pairs. When this rule is not observed in a program as shown below, the message "IL-END MISS" is displayed on the LCD.
   ① IL-END instruction is missing such as IL . . . IL.
   ② IL instruction is missing and only IL-END instruction is present.
   ③ The program ends with an IL instruction before the END instruction or the last address.
5. END instruction missing error
   In the absence of an END instruction at the end of a program, the message "END MISS" is displayed on the LCD.

CAUTIONS:
1. **If a syntax error or an END instruction missing error occurs, no other items can be checked unless the program is edited again and corrected for proper syntax.**
2. **A circuit error is detected by taking that portion of the circuit from the LD-LD-NOT instruction after an OUT instruction to the next OUT instruction as a unit subject to detection.**
3. **Even if any of the following errors occurs, the CPU can still perform the RUN operation. However, be sure to correct the error to execute the proper program.**
   - **Coil duplication error**
   - **Circuit error**
   - **IL/END MISS error**

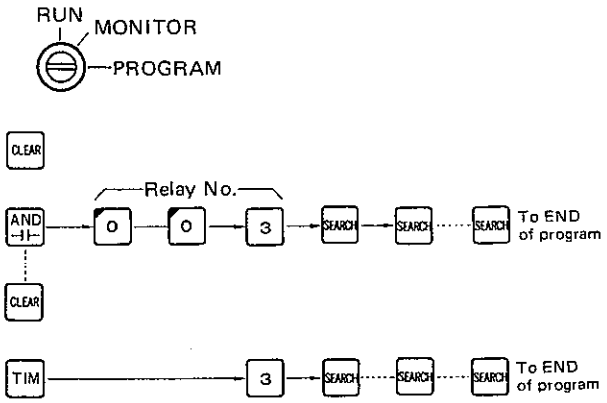
6.12 Search Operation

When a circuit change is to be made in a program simulation or test run, this operation allows an address where an instruction or relay number has been written in a program to be searched.

■ SEARCH OPERATION OF INSTRUCTION WORD

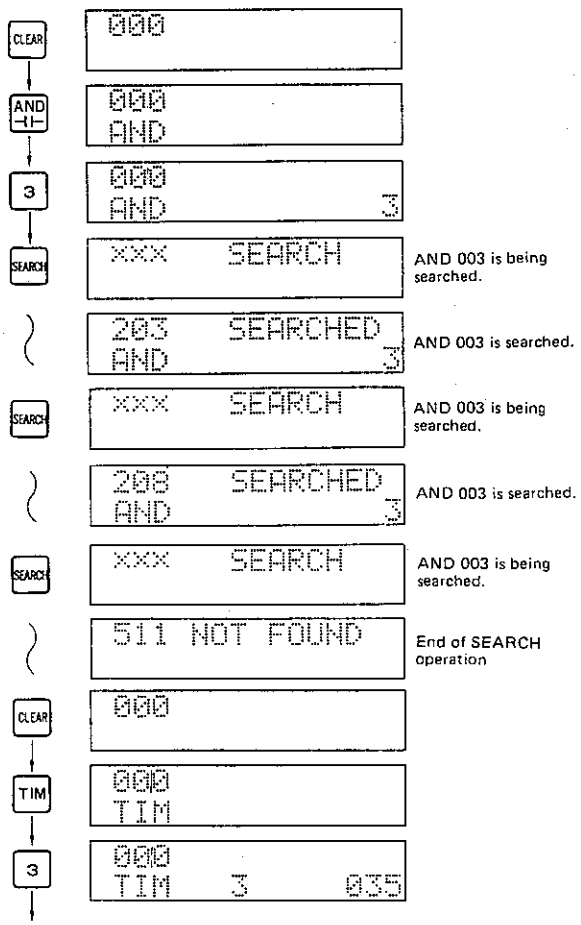
- **Operating procedure**

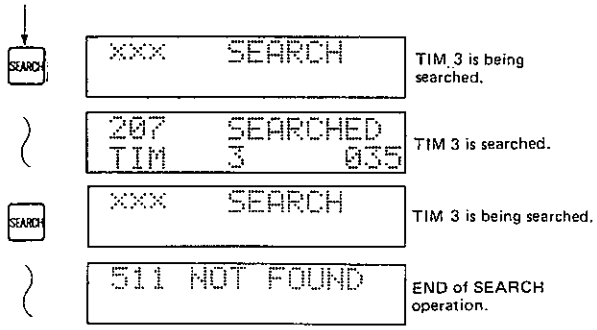
  Referring to the circuit for exercise and programming example shown below, an example of searching 003 ⊣⊢ and —(TIM 3) instructions is explained here.



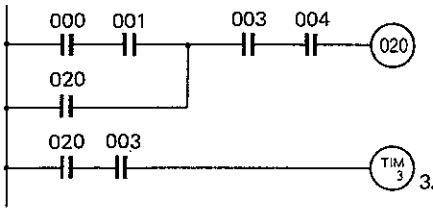
NOTE: The zero key marked [0] may or may not be depressed.

- **Display**





- **Circuit for exercise and programming example**

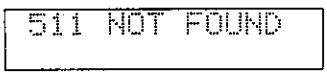


Address	OP	Data
200	LD	000
201	AND	001
202	OR	020
203	AND	003
204	AND	004

Address	OP	Data
205	OUT	020
206	LD	020
207	TIM 3	035
208	AND	003
209	END	—

NOTES:

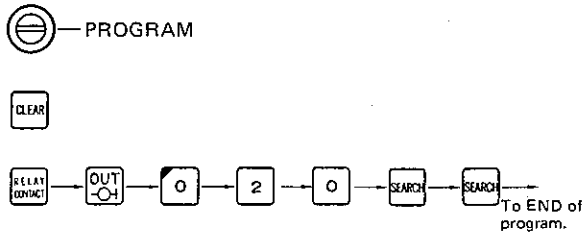
1. When the SEARCH key is depressed after entering an instruction, the first address where the instruction is stored is displayed on the LCD. Continued depression of the SEARCH key causes all the addresses containing this instruction to be searched until the last address. In other words, the search operation of an instruction will be executed from the address currently being displayed on the LCD to the last address 511 in the memory.
2. If the data being searched is not found, the message "NOT FOUND" appears on the LCD.



■ SEARCH OPERATION OF RELAY NUMBER

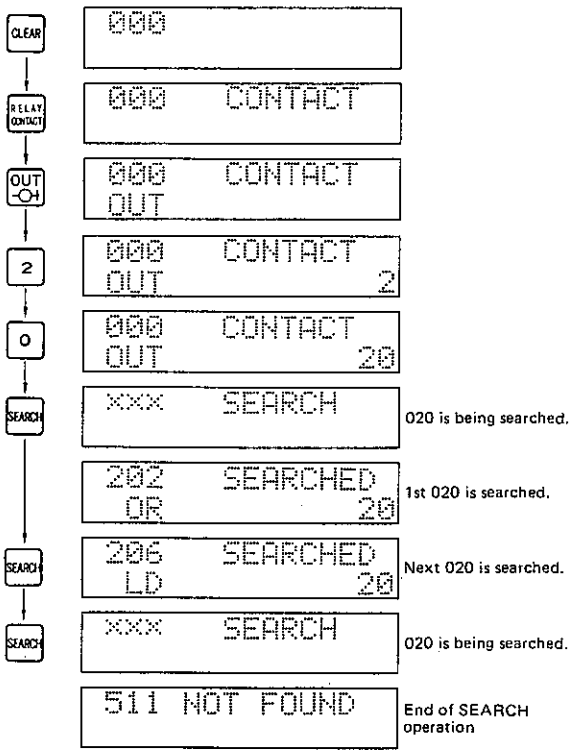
Referring to the circuit for exercise and programming example shown below, an example of searching relay No. 020 throughout all addresses is explained here.

- **Operating procedure**



NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



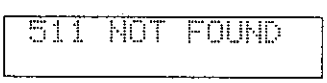
- **Circuit for exercise and programming example**

Address	OP	Data
200	LD	000
201	AND	001
202	OR	020
203	AND	003
204	AND	004

Address	OP	Data
205	OUT	020
206	LD	020
207	TIM 3	035
208	END	—

NOTES:

1. When the SEARCH key is depressed after depressing the RELAY CONTACT and [OUT] keys and entering the relay number, the first address where the instruction is stored is displayed on the LCD. Continued depression of the SEARCH key causes all the addresses containing this instruction to be searched until the last address. In other words, the search operation of a relay number will be executed from the address currently being displayed on the LCD to the last address 511 in the memory.
2. If the data being searched is not found, the message "NOT FOUND" appears on the LCD.

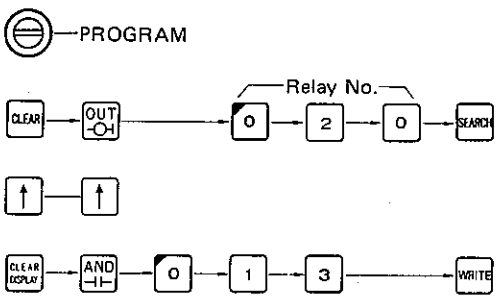


6.13 Instruction/Contact (Coil) Number Change Operation

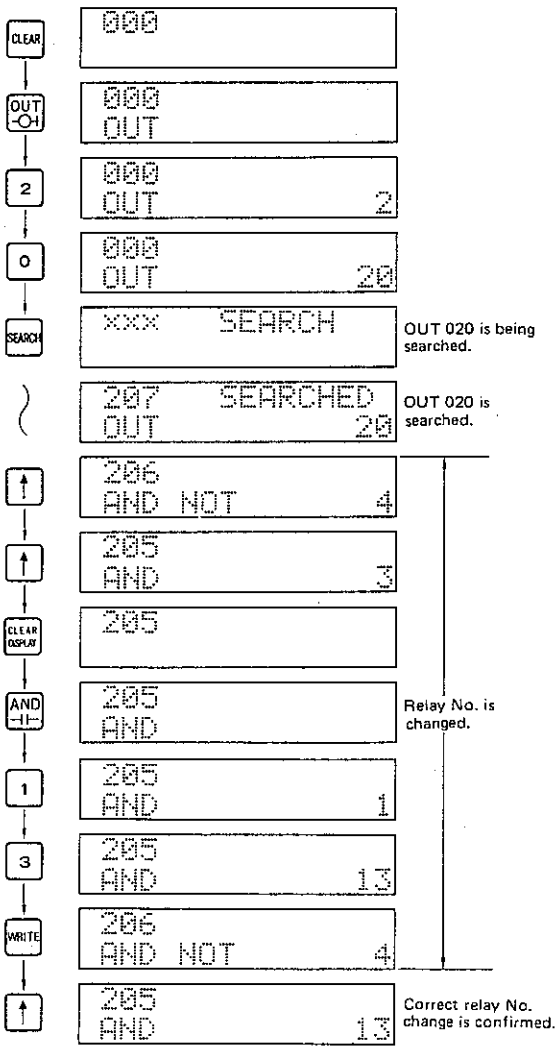
This operation is to change the contact (or coil) number in a program due to a circuit modification.

- **Operating procedure**

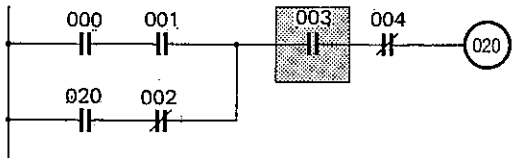
  Referring to the circuit for exercise and programming example shown on below, an example of changing output relay No. 003 to 013 is explained here.



- **Display**



- **Circuit for exercise and programming example**



Relay No. 003 □ is changed to 013.

Address	OP	Data
200	LD	000
201	AND	001
202	LD	020
203	AND-NOT	002
204	OR-LD	–

Address	OP	Data
205	AND	003
206	AND-NOT	004
207	OUT	020
208	END	–

NOTES:

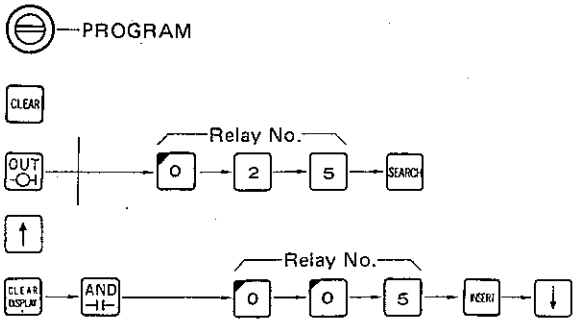
1. After an OUT instruction has been searched, depress the [↑] key continuously to decrement the address number until the address where the contact (or coil) number is to be changed. The instruction to be changed at an intended address may be searched directly. However, the same instruction may in some cases be stored in other memory addresses of the same program. Therefore, it is necessary to check instructions before and after the intended address. Since no two OUT instructions with an identical relay number exists in one program, the instruction to be changed can be found easily and quickly by first searching the OUT instruction and then searching before and after the OUT instruction.
2. When an OUT, TIM, CNT, KR, RDM or HDM instruction is to be changed to another instruction, also check the circuit related to the instruction.
3. After the contact (or coil) number has been changed, be sure to perform the Program Check operation ([CLEAR] → [SEARCH]) to confirm that the program is free from any programming error.

6.14 Instruction/Contact (Coil) Addition Operation

This operation is employed when the contact (or coil) number is to be added to a program due to a circuit modification.

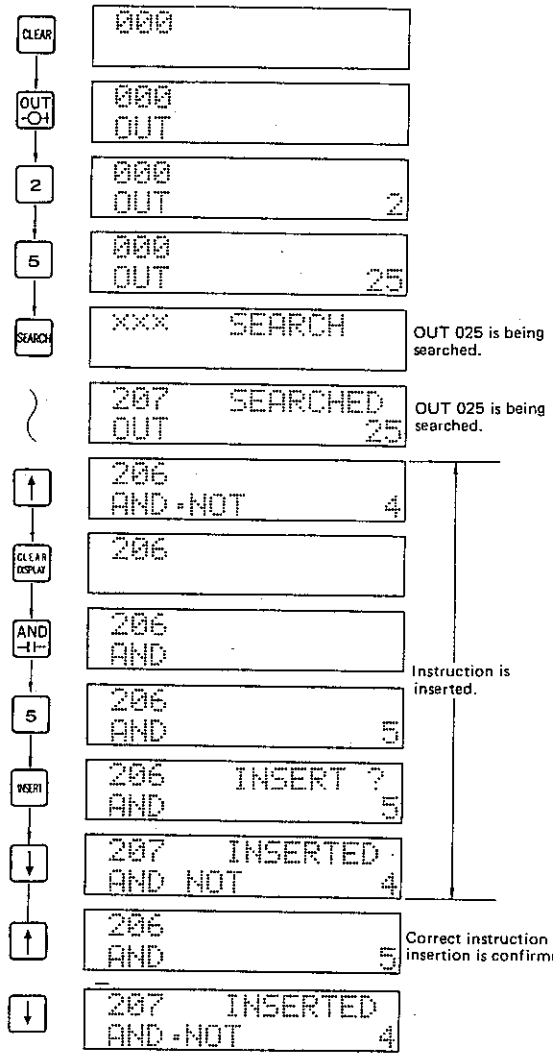
- **Operating procedure**

In the following, the procedure of adding —|005|— between —|003|— and —|/004|— is shown.

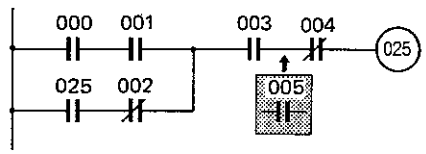


NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



- **Circuit for exercise and programming example**



Before insertion

Address	OP	Data
200	LD	000
201	AND	001
202	LD	025
203	AND-NOT	002
204	OR-LD	–

Address	OP	Data
205	AND	003
206	AND-NOT	004
207	OUT	025
208	END	–

After insertion

Address	OP	Data
200	LD	000
201	AND	001
202	LD	025
203	AND-NOT	002
204	OR-LD	–

Address	OP	Data
205	AND	003
206	AND	005
207	AND-NOT	004
208	OUT	025
209	END	–

NOTES:
1. Search an OUT instruction, depress the [↑] key repetitively to advance the program up to the address where the instruction is to be inserted. Next, depress the CLEAR DISPLAY key, enter the instruction to be inserted and then depress the INSERT and [↓] keys. The address number after the inserted instruction will automatically be incremented by 1.
2. After the contact (or coil) number has been inserted, be sure to perform the Program Check operation ([CLEAR] → [SEARCH]) to confirm that the program is free from any programming error.
3. If an attempt is made to insert an instruction to a program when the memory is full up to the last address (address 511), the instruction cannot be inserted. This condition is informed by the following message on the LCD.

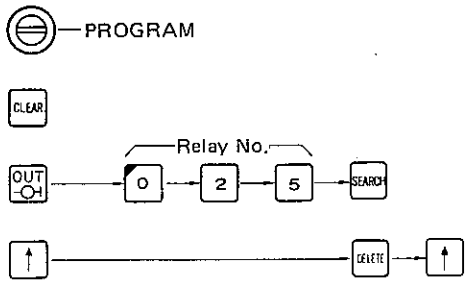
```
MEMORY OVERFLOW
```

6.15 Instruction/Contact (Coil) Deletion Operation

This operation is to delete contact (or coil) number(s) from a program due to a circuit modification.

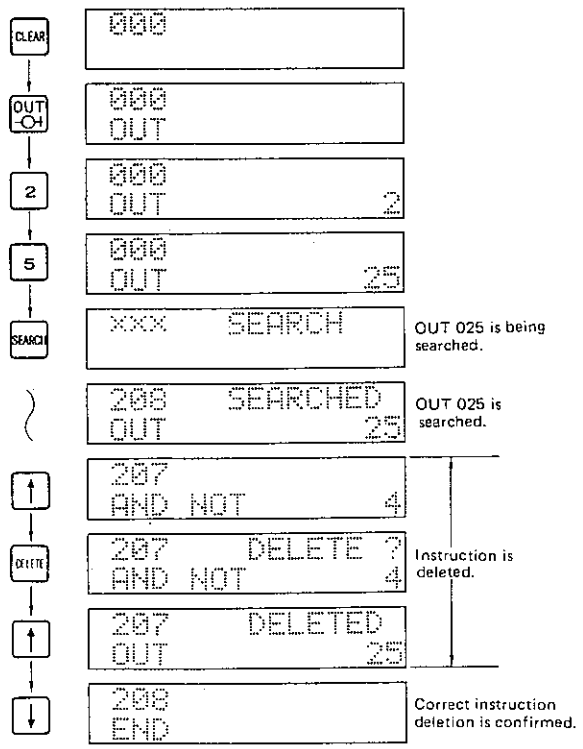
- **Operating procedure**

  Referring to the circuit for exercise shown below, an example of deleting —004|— is explained.

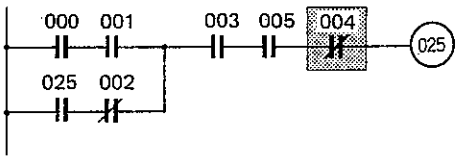


NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



- **Circuit for exercise and programming example**



Before deletion

Address	OP	Data
200	LD	000
201	AND	001
202	LD	025
203	AND-NOT	002
204	OR-LD	—

Address	OP	Data
205	AND	003
206	AND	005
207	AND-NOT	004
208	OUT	025
209	END	—

After deletion

Address	OP	Data
200	LD	000
201	AND	001
202	LD	025
203	AND-NOT	002
204	OR-LD	—

Address	OP	Data
205	AND	003
206	AND	004
207	OUT	025
208	END	—

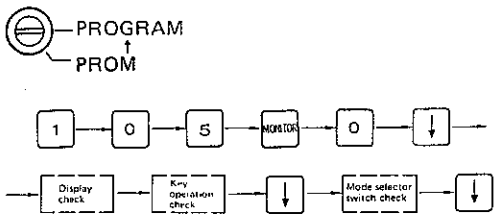
NOTES:
1. Search an OUT instruction, depress the [↑] key to advance the program up to the address where the instruction to be deleted is located, and depress the DELETE and [↑] keys. All the address numbers after the deleted instruction will automatically be decremented by 1.
2. After the instruction has been deleted, confirm instructions before and after the deleted address.
3. After the deletion of the instruction, be sure to execute the Program Check operation ([CLEAR] → [SEARCH]).
4. At each successive depression of the DELETE and [↑] keys, the instruction displayed on the LCD will be deleted. Be careful not to delete the required instruction by operating these two keys unintentionally.

6.16 Hardware Check Operation

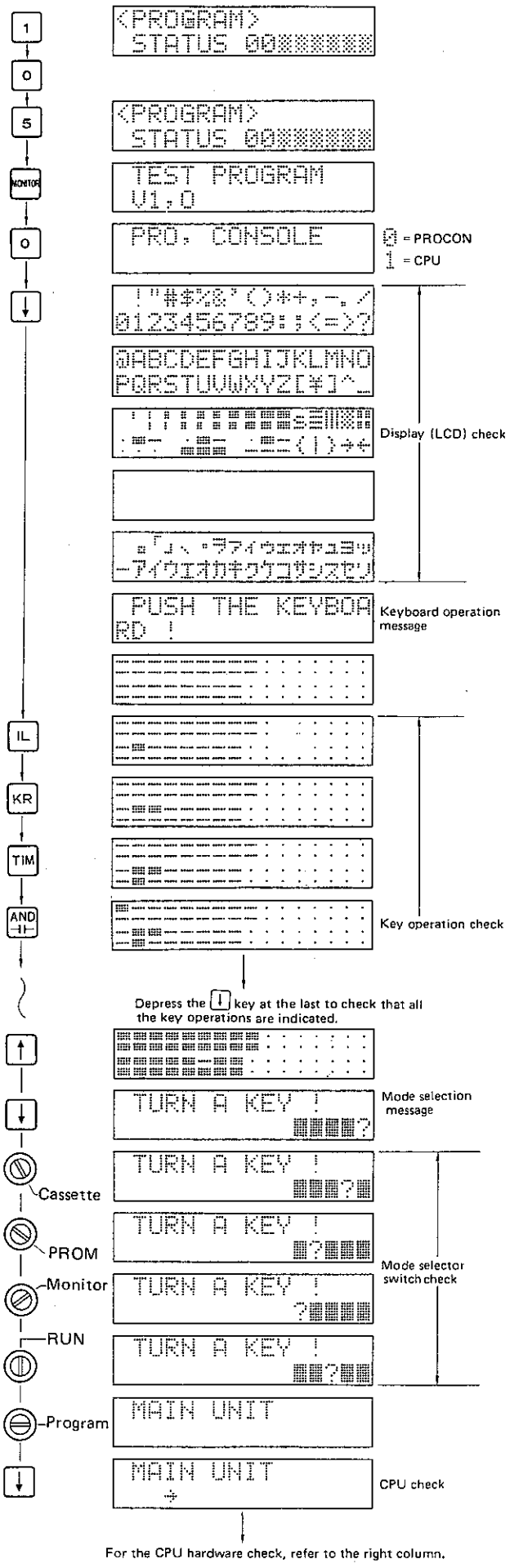
This operation is to check the hardware of the programming console and CPU. In the programming console hardware check, the LCD section, keyboard and mode selector switch are checked for proper operation. In the CPU hardware check, the ROM memory unit, RAM memory, system program, "RUN" indicator, "CPU ERR" indicator and "MEMORY ERR" indicator are checked for proper operation.

■ PROGRAMMING CONSOLE HARDWARE CHECK

- **Operating procedure**



- **Display**

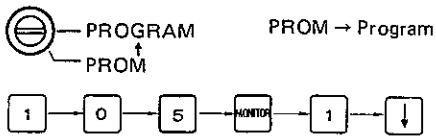


NOTES:

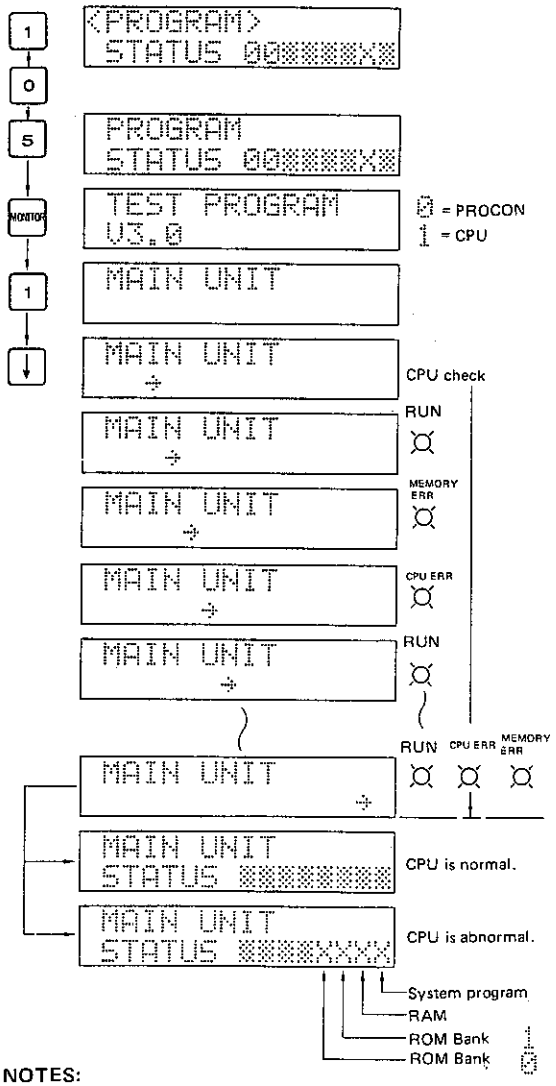
1. If the programming console is checked first, the CPU hardware check can be performed continuously subsequent to the programming console check.
2. Either of the following two numeric keys are to be depressed after the depression of MONITOR key.
   0 = Programming console check
   1 = CPU check
3. During the display check, the data on the LCD screen moves in succession. To make the displayed data static, depress the ↑ key. Depress the ↓ key to return to the previously displayed data.
4. In the key operation check, be sure to depress the ↓ key at the last. Note that if the ↓ key is depressed first, the hardware check routine will jump to the mode selector switch check.

■ CPU HARDWARE CHECK

- **Operating procedure**



- **Display**



NOTES:

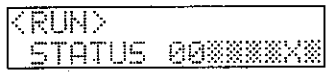
1. If the programming console is checked first, the CPU check can be performed continuously subsequent to the programming console check.
2. Either of the following two numeric keys must be depressed after depression of the MONITOR key:
   0 = Programming console check
   1 = CPU check

6.17 RUN Operation

This operation is to place the SYSMAC-S6 in the RUN (Program Execution) mode.

- **Operating Procedure**

- **Display**



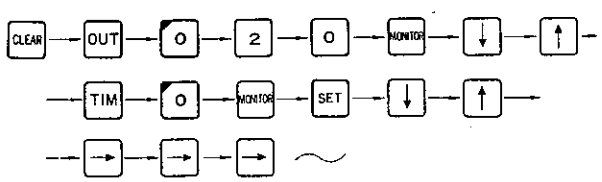
NOTES:
1. When the mode selector switch is set to the "RUN" or "MONITOR" position with the stop signal at the STOP terminal of CPU in the OFF state, the "RUN" indicator illuminates.
2. Even if any key on the keyboard is operated during RUN operation, the CPU operation is not affected.

CAUTIONS:
1. **In the absence of an END instruction in a program, the CPU operation cannot be performed even if the mode is changed to "RUN" or "MONITOR". The message "END MISS" is displayed on the LCD of the programming console. In such a case, write an END instruction to correct the program in the PROGRAM mode.**
2. **If a CPU error or memory error occurs in "RUN" or "MONITOR" mode, the CPU operation stops, and the "CPU ERR" or "MEMORY ERR" indicator on the front panel of the CPU illuminates. At the same time, the message "CPU ER." or "MEMORY ER." is displayed on the LCD of the programming console and all external outputs are turned off.**
3. **In other than RUN or MONITOR mode, all external outputs are turned off.**

6.18 Multi Monitor Operation

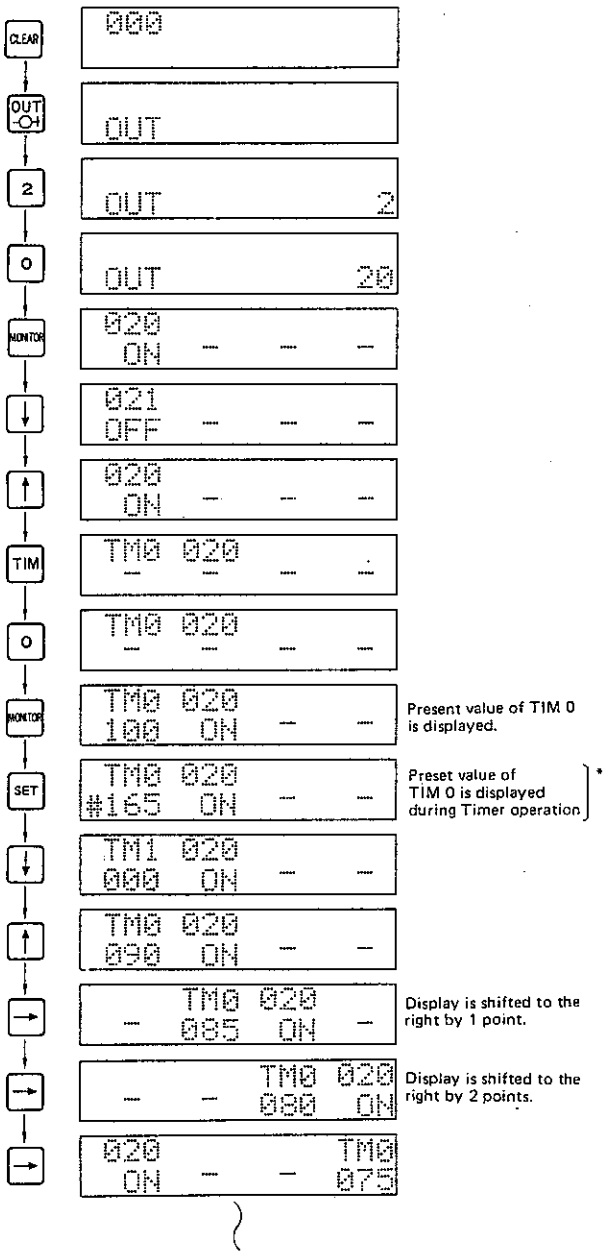
This operation is to monitor and display the operating states of input/output relays, internal auxiliary relays, latching relays, and special auxiliary relays, the status of the reversible counter and the high-speed counter output relays, and the present values and preset values of timers and counters, in units of 4 points during the excution of a program.

- **Operating procedure**

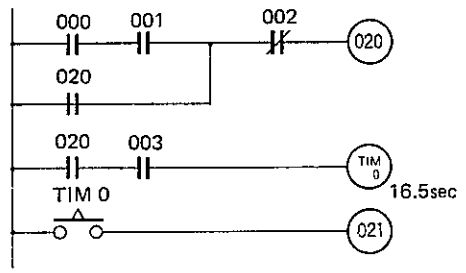


NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



- **Circuit for exercise and programming example**



Address	OP	Data
200	LD	000
201	AND	001
202	OR	020
203	AND-NOT	002
204	OUT	020
205	LD	020

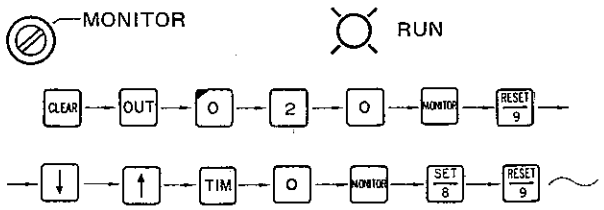
Address	OP	Data
206	AND	003
207	TIM 0	165
208	LD-TIM	0
209	OUT	021
210	END	–

NOTES:
1. The operating (ON/OFF) state of each relay, the present value and preset value of each timer or counter, etc., are displayed on the LCD of the programming console. Depression of the [SET] key during the monitoring of a timer also causes the preset value of the timer to be dispalyed.
2. If the [↓] or [↑] key is depressed after the depression of the MONITOR key, the displayed relay, timer, or counter number is incremented or decremented by 1, respectively.
3. Each depression of the [→] key causes the monitor display point to move rightwards and return to the first point of the 4-point monitor display on the LCD.
4. [↓], [↑] and keys are effective only for the leftmost item on the monitor display of each relay, timer or counter.

6.19 Forced Set/Reset Operation

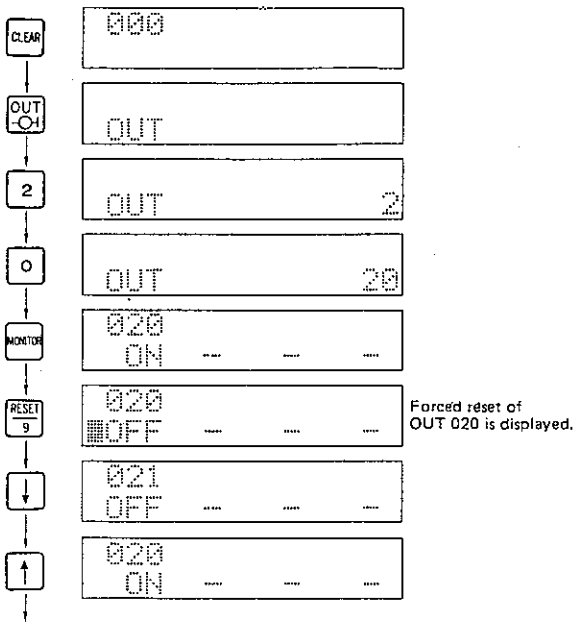
This operation is to set or reset by force the operating state of each of the input/output relays, internal auxiliary relays, special auxiliary relays and latching relays, or the preset value of each timer or counter during the execution of a program in the MONITOR mode.
In this forced set/reset operation, the operating state of a relay is caused to be set or reset while the [SET 8] or [RESET 9] key is being depressed, and to return to the original state when the [SET 8] or [RESET 9] key is released.
In the forced set/reset operation of a timer or counter, the present value of the timer or counter is up when the [SET 8] key is depressed and the preset value is restored when the [RESET 9] key is dpressed.

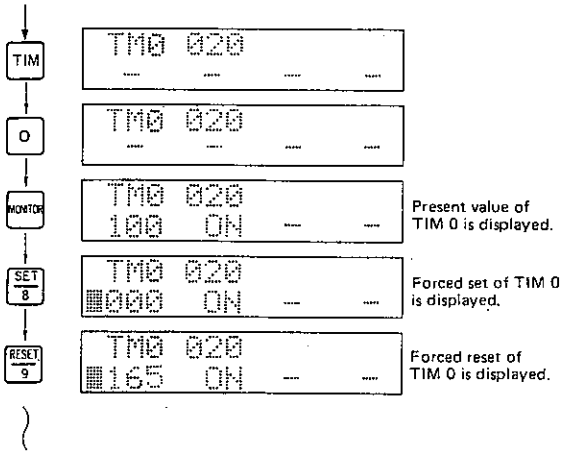
- **Operating procedure**



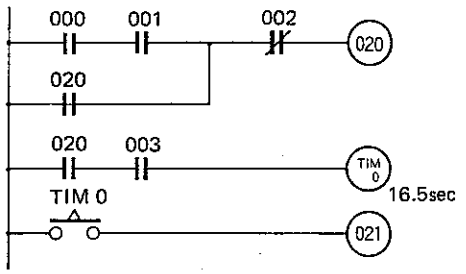
NOTE: The zero key marked [0] may or may not be depressed.

- **Display**





- **Circuit for exercise and programming example**



Address	OP	Data
200	LD	000
201	AND	001
202	OR	020
203	AND-NOT	002
204	OUT	020
205	LD	020

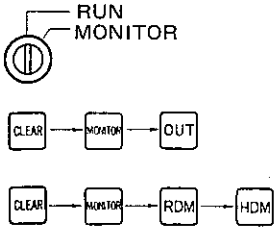
Address	OP	Data
206	AND	003
207	TIM 0	165
208	LD-TIM	0
209	OUT	021
210	END	–

NOTES:
1. The operating (ON/OFF) state of each relay, the present value and preset value of a timer or counter, etc., are displayed on the LCD of the programming console.
2. If the [↓] key or [↑] key is depressed after depression of the MONITOR key, displayed relay number is incremented or decremented by 1, respectively.
3. Each depression of the [→] key causes the monitor display point to move rightwards and return to the first point of the 4-point monitor display on the LCD.
4. A forced set or reset is effective only for the leftmost displayed item on the LCD of the programming console.

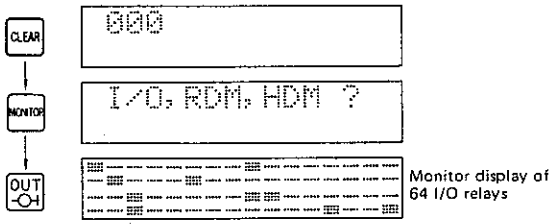
6.20 Graphic Monitor

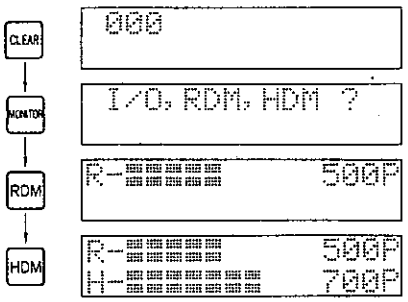
This operation is to display the operating states of all the 64 input/output relays (000 – 063) collectively during the execution of a program. In addition, the present values of the reversible counter and high-speed counter are displayed in both graphics and digits.

- **Operating procedure**



- **Display**





NOTES:
1. The monitor display locations of the 64 I/O relays are as shown below.

000	004	008	012	016	020	024	028	032	036	040	044	048	052	056	060
001	005	009	013	017	021	025	029	033	037	041	045	049	053	057	061
002	006	010	014	018	022	026	030	034	038	042	046	050	054	058	062
003	007	011	015	019	023	027	031	035	039	043	047	051	055	059	063

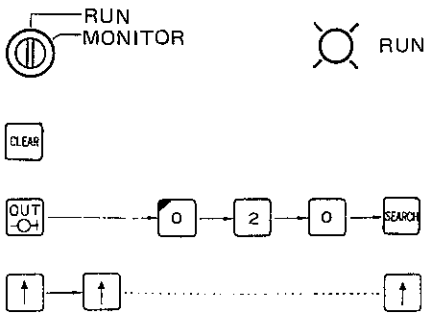
2. On the monitor display for each of the 64 I/O relays, graphic symbol " ▦ " indicates that the relay is in the ON state, while graphic symbol " ▪▪▪▪ " indicates that the relay is in the OFF state.

6.21 Trace (Continuity) Check Operation

When a circuit operation is to be checked in a program simulation or test run, this operation allows the operating state of each relay number to be displayed while tracing the programming sequence of the circuit. In this operation, a program read can also be performed in the sequence of address.

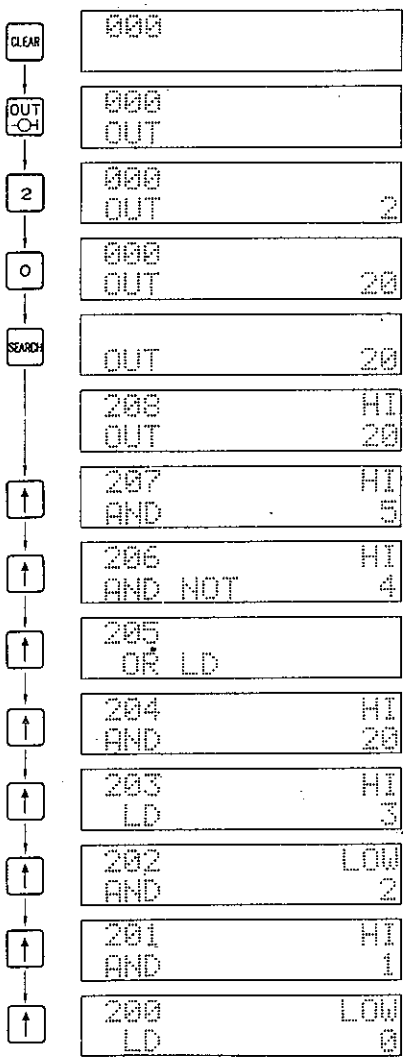
- **Operating procedure**

In the circuit for exercise shown on the right column, the procedure to check the operating state of from (020) to 000 in the programming sequence is shwon below.

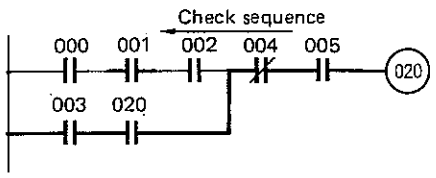


NOTE: The zero key marked [0] may or may not be depressed.

- **Display**



- **Circuit for exercise and programming examples**



Address	OP	Data
200	LD	000
201	AND	001
202	AND	002
203	LD	003
204	AND	020

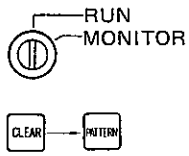
Address	OP	Data
205	OR-LD	–
206	AND-NOT	004
207	AND	005
208	OUT	020
209	END	–

NOTES:
1. The following two methods of trace check are available.
   - Check starting from address 000
     [CLEAR] → [↓] ····· [↓]
   - Check starting from an OUT instruction.
     Refer to the foregoing operating procedure.
2. The instructions that can be searched in this operation are only output instructions (OUT, KR, TIM, CNT, RDM and HDM).
3. The message "HI" is displayed on the LCD when continuity exists, while "LOW" is displayed when no continuity exists. However, this message will not appear for IL, IL-END, OR-LD, AND-LD, RDM, HDM and END instructions.

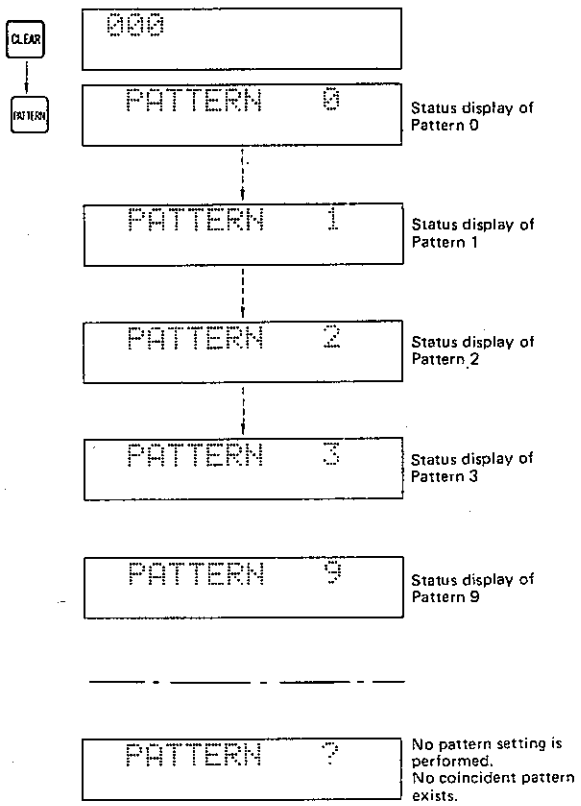
6.22 Pattern Monitor

This operation is to display the pattern numbers registered in output ON/OFF format in the previous Pattern Write operation.

- **Operating procedure**



- **Display**



Pattern setting

Relay No.	Pattern 0	Pattern 1	Pattern 2	Pattern 3
000	ON	OFF	OFF	OFF
001	OFF	ON	–	ON
002	–	ON	ON	–
003	–	–	ON	–
004	ON	OFF	–	
005	–	ON	ON	
006				

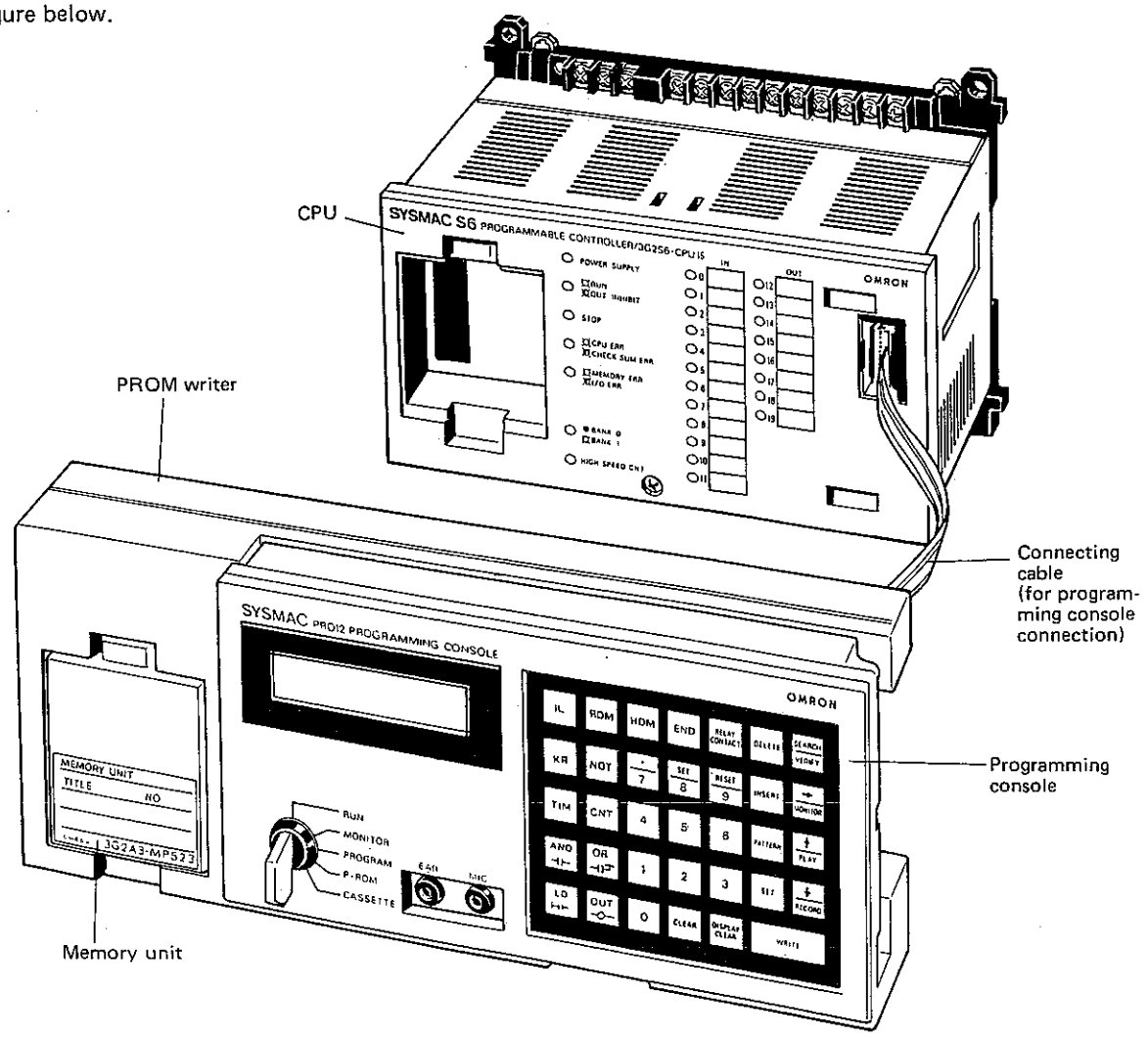
7. EPROM Chip and Cassette Tape Handling

7.1 Basic Functions

Item of operation	Description
EPROM write	This operation is to transfer the contents of the RAM memory in the CPU to the EPROM chip in the memory unit mounted on the PROM writer.
EPROM read	This operation is to transfer the contents of the EPROM chip in the memory unit mounted on the PROM writer to the RAM memory in the CPU.
EPROM load	This operation is to transfer the contents of the EPROM chip in the memory unit mounted on the CPU to the RAM memory in the CPU.
EPROM verify	This operation is to verify the contents of the EPROM chip in the memory unit against the contents of the RAM memory in the CPU.
Tape write	This operation is to record the contents of the RAM memory on a cassette tape.
Tape read	This operation is to transfer the program data recorded on the cassette tape into the RAM memory.
Tape verify	This operation is to verify the contents of the RAM memory against the programmed data recorded on a cassette tape.

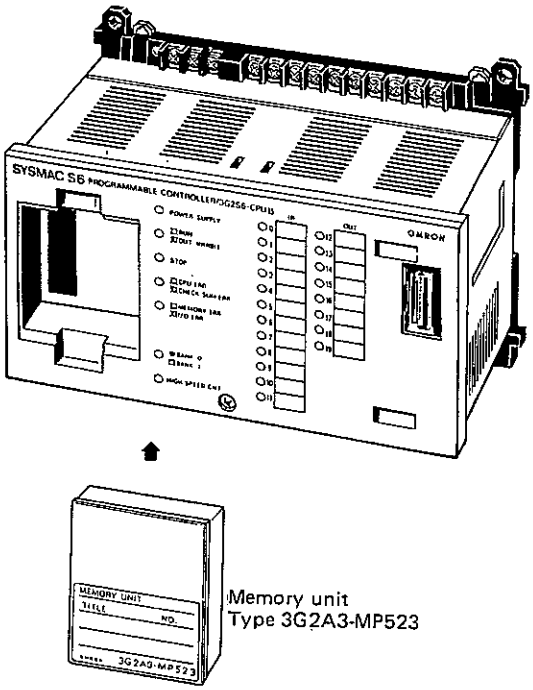
7.2 PROM Writer and MEMORY Unit Handling

Set the PROM writer and the memory unit as shown in the figure below.



7.3 Selection of RAM or ROM memory

Either ROM or RAM can be selected as the program memory of the SYSMAC-S6.



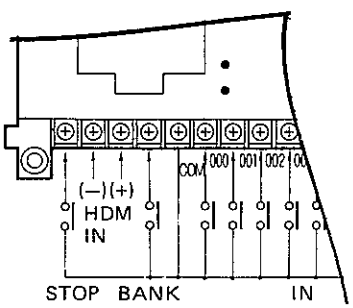
Memory unit
Type 3G2A3-MP523

- **RAM mode**

1. When the memory unit is not inserted in the CPU, the CPU will operate according to the programs in the built-in RAM.
2. If the contents of the EPROM chip of the specified bank number are blank with the memory unit inserted in the CPU, the CPU will operate according to the programs in the built-in RAM.

- **ROM mode**

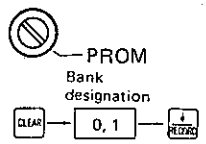
1. When the memory unit is inserted in the CPU and any user program is contained in the EPROM chip of the specified bank number, the CPU will operate according to the programs in the EPROM.
2. When the BANK input at the BANK terminal of CPU is OFF, bank 0 will be specified and when the input signal is ON, bank 1 will be specified.



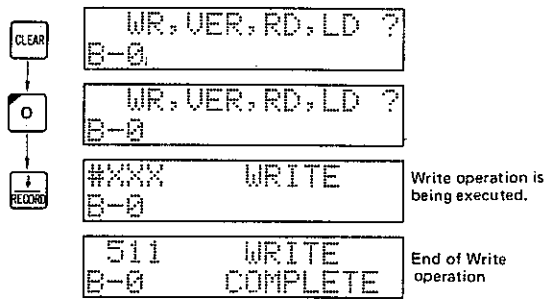
7.4 EPROM Write Operation

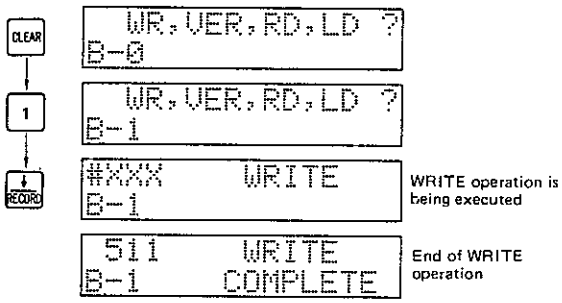
This operation is to transfer the contents of the RAM memory incorporated in the CPU to the EPROM mounted on the PROM writer.

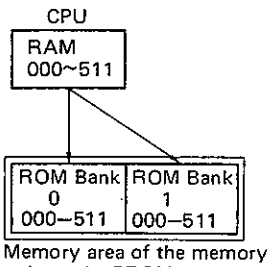
- **Operating procedure**



- **Display**



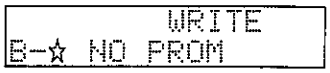




Memory area of the memory unit on the PROM writer

NOTES:

1. When no memory unit is mounted, the following message appears on the LCD.



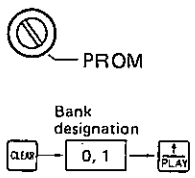
NOTE: ☆ indicates bank 0 or 1.

2. After all the programs have been written into the EPROM, the bank code of bank 0 or 1 is also written into the EPROM.
3. Therefore, the presence or absence of any programs in the specified EPROM bank can be confirmed by checking whether or not the bank code has been written into memory.

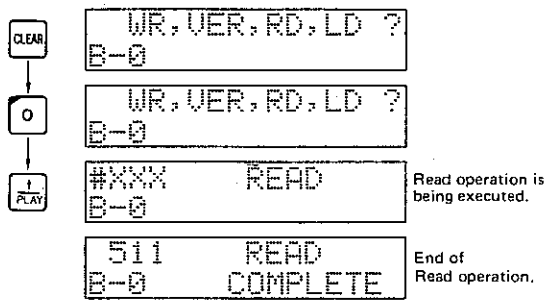
7.5 EPROM Read Operation

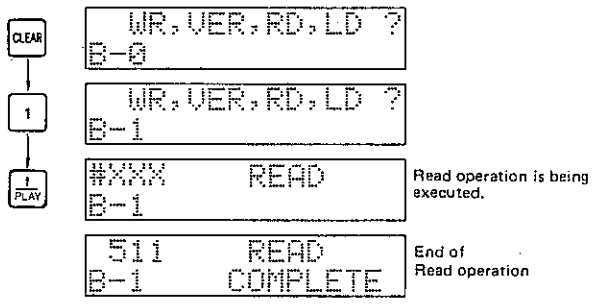
This operation is to transfer the contents of the EPROM chip in the memory unit mounted on the PROM writer to the RAM memory incorporated in the CPU.

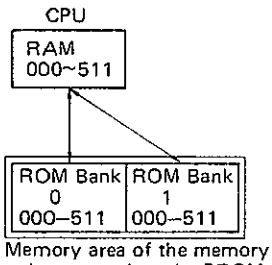
- **Operating procedure**



- **Display**

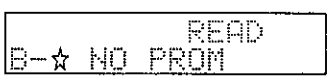






Memory area of the memory unit mounted on the PROM writer

NOTE:
When no memory unit is mounted, the following message appears on the LCD.

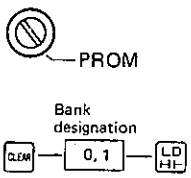


NOTE: ☆ indicates bank 0 or 1.

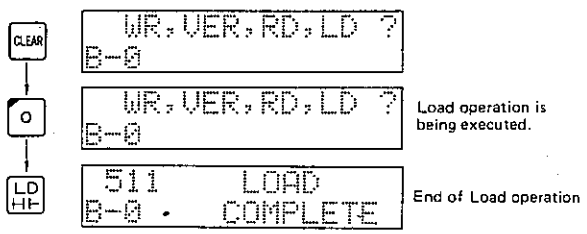
7.6 EPROM Load Operation

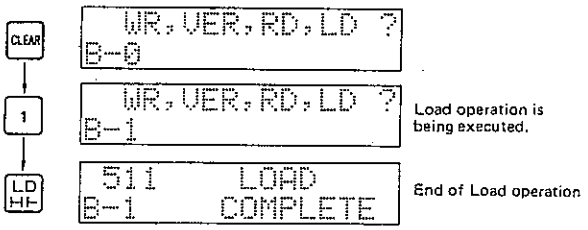
This operation is to load the contents of the EPROM chip in the memory unit mounted on the CPU, into the RAM memory incorporated in the CPU.

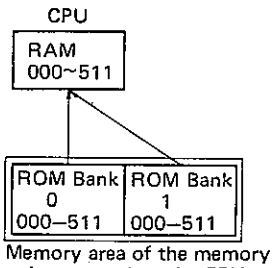
- **Operating procedure**



- **Display**

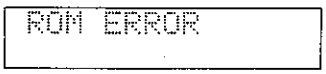






Memory area of the memory unit mounted on the CPU

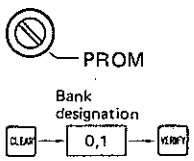
NOTE:
When no memory unit is mounted, the following message appears on the LCD.



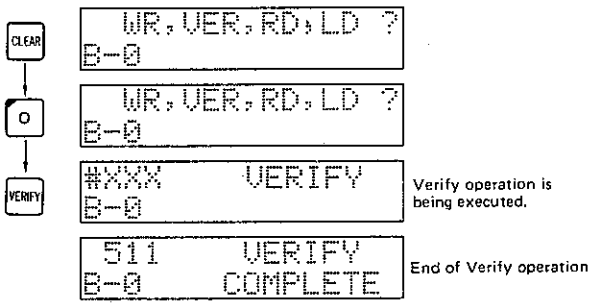
7.7 EPROM Verify Operation

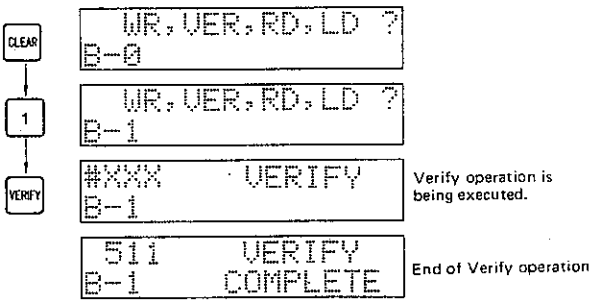
This operation is to verify the contents of the EPROM chip in the memory unit against the contents of the RAM memory in the CPU.

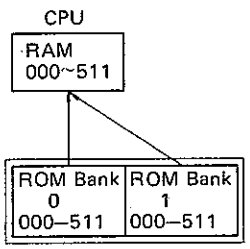
- **Operating procedure**



- **Display**

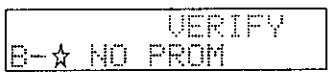






Memory area of the memory unit mounted on the PROM writer.

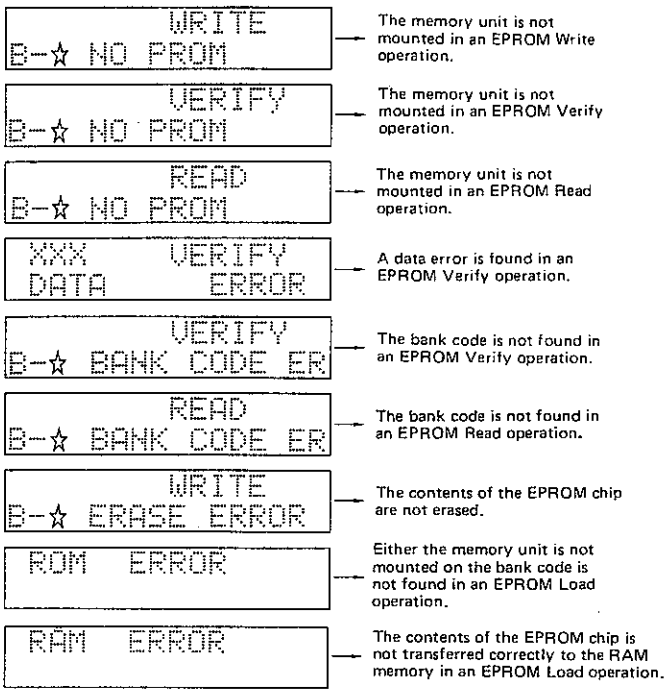
NOTE:
When no memory unit is mounted, the following message appears on the LCD.



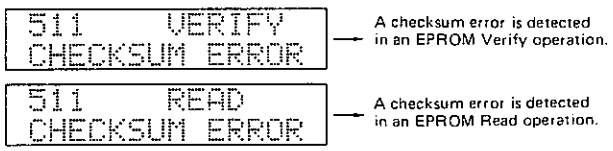
NOTE: ☆ indicates bank 0 or 1.

7.8 Error Messages in PROM Mode

In the PROM mode, one of the following messages may appear on the LCD of the programming console.



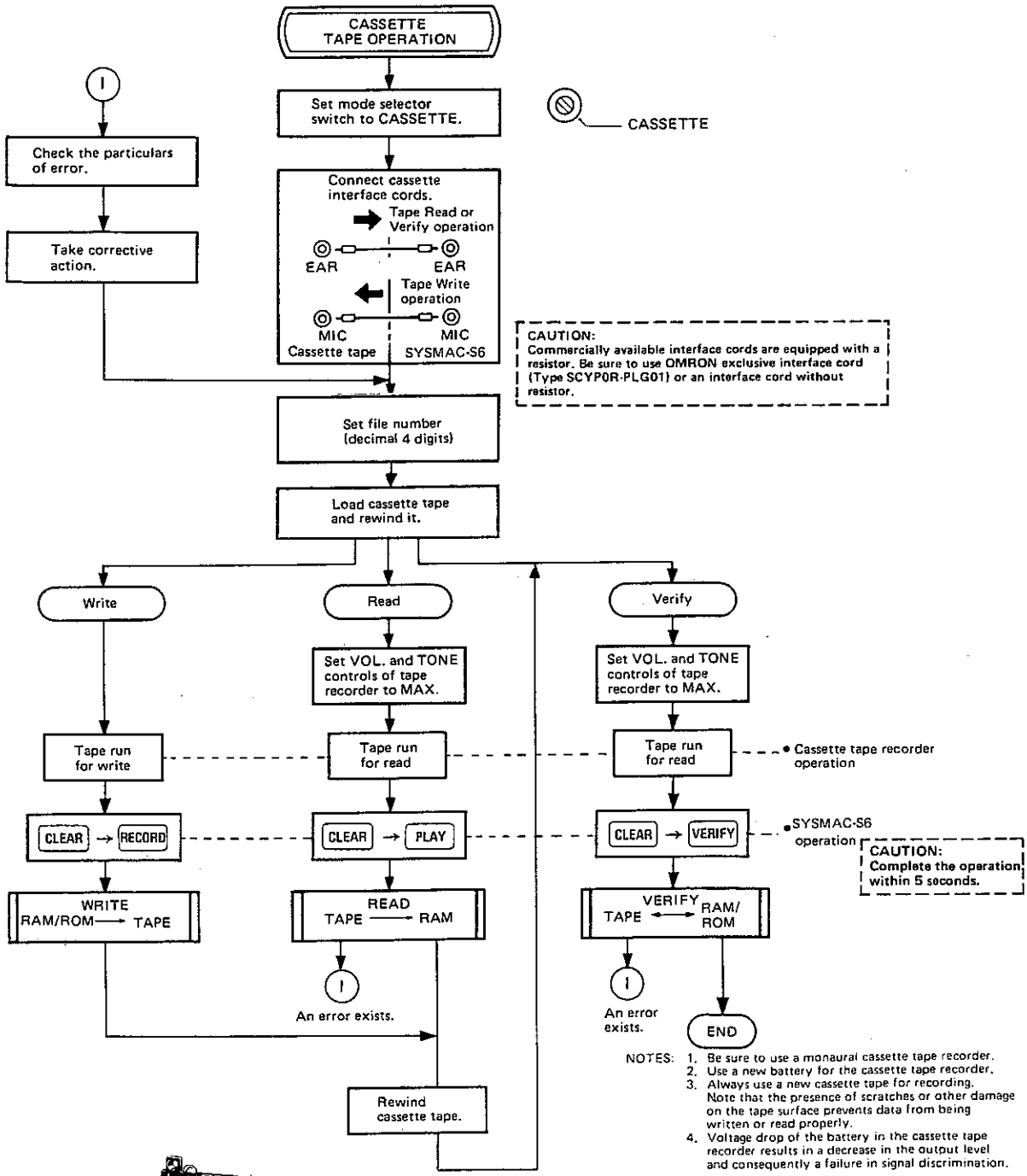
NOTE:
For details, refer to 9.3, List of Error Messages and Remedies.



NOTE: ☆ indicates bank 0 or 1.

7.9 Cassette Tape Handling

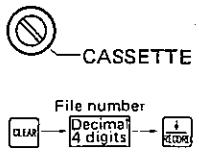
As a method of keeping user programs in storage, data may be recorded on a cassette tape by using a commercially available cassette tape recorder.



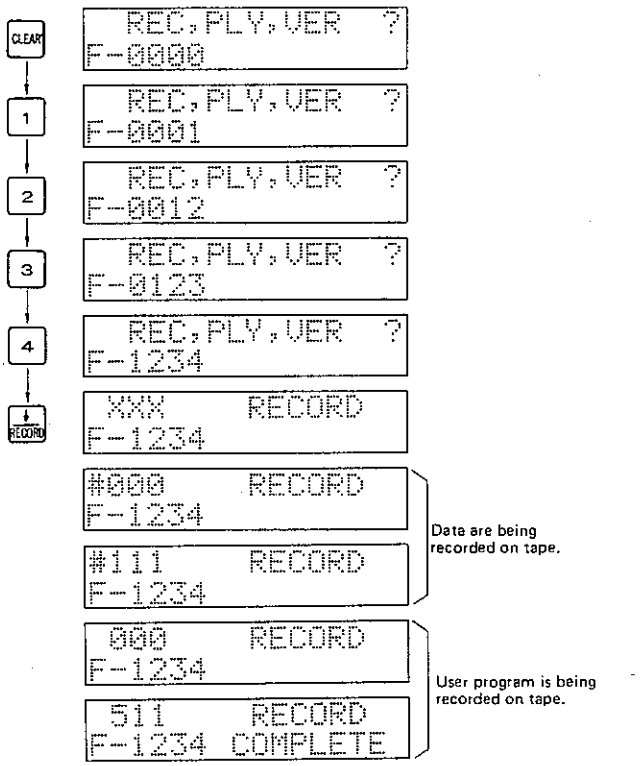
7.10 Tape Write Operation

This operation is to record the contents of the user memory (RAM/ROM) on a cassette tape.

- **Operating procedure**



- **Display**



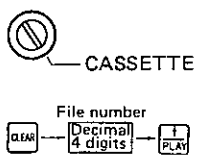
NOTES:

1. Upon completion of the Tape Write operation, be sure to perform the Tape Verify operation to confirm that the data have been recorded properly on the tape.
2. Even if the tape does not run, data will be transferred unilaterally from the RAM/ROM. So, be sure to confirm that the tape is running smoothly.
3. If the power is turned off or the cassette is ejected during the Tape Write operation, the tape write will be interrupted. Retry the tape write operation from the beginning.
4. To stop the Tape Write operation under execution, operate the mode selector switch (to other than the "CASSETTE" position).
5. For the Tape Write operation, use the MIC jacks on both the programming console and cassette tape recorder to connect one of the two cassette tape interface cords. For subsequent verify operation, use EAR jacks to connect the other interface cord.
6. The program number is recorded as the file number on the tape.

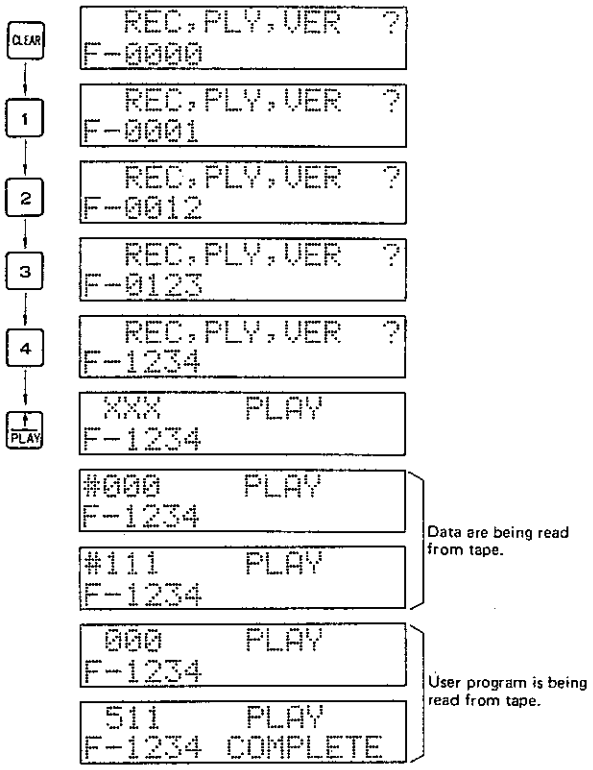
7.11 Tape Read Operation

This operation is to transfer the program data recorded on the cassette tape into the user memory (RAM).

- **Operating procedure**



- **Display**



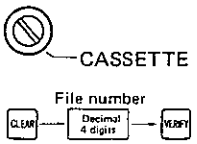
NOTES:

1. Upon completion of the Tape Read operation, be sure to perform the Tape Verify operation to confirm that the data have been transferred properly from the tape to the RAM.
2. If the power is turned off or the cassette is ejected during the Tape Read operation, the tape read will be interrupted. Retry the tape read operation from the beginning.
3. To stop the Tape Read operation under execution, operate the mode selector switch (to other than the "CASSETTE" position).
4. Be sure to set the volume control and tone control of the cassette tape recorder to maximum.
5. If the file number does not coincide with the file number recorded in the Tape Write operation, this condition is regarded as an error and no Tape Read operation will be performed.

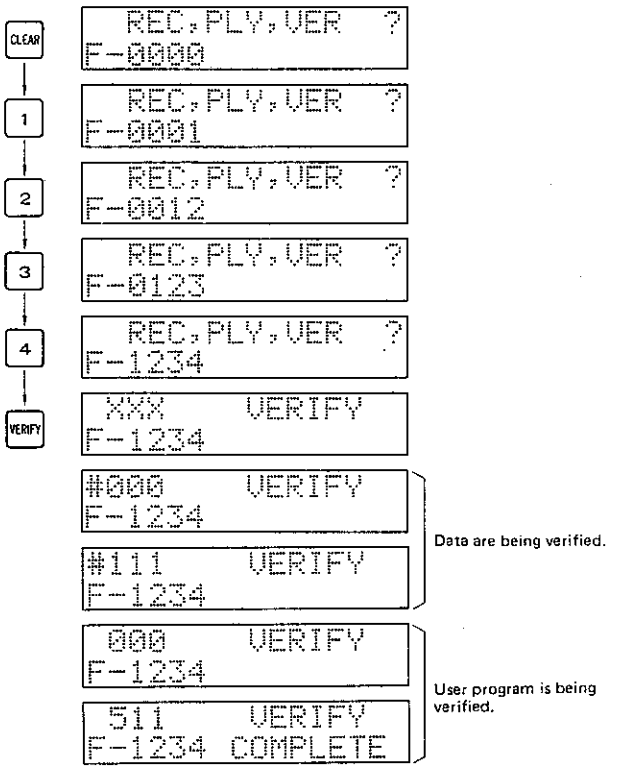
7.12 Tape Verify Operation

This operation is to verify the contents of the user memory (RAM) against the programmed data recorded on a cassette tape.

- **Operating procedure**



- **Display**



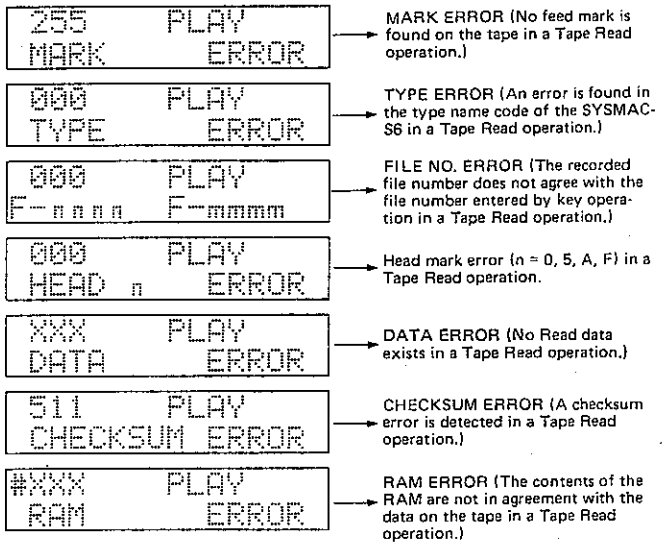
NOTES:

1. If the power is turned off or the cassette tape is ejected during the Tape Verify operation, the tape read will be interrupted. Retry the Tape Verify operation from the beginning.
2. To stop the Tape Verify operation under execution, operate the mode selector switch (to other than the "CASSETTE" position).
3. Be sure to set the volume control and tone control of the cassette tape recorder to maximum.
4. If the number does not coincide with the file number recorded in the Tape Write operation, the condition is regarded as an error and no Tape Verify operation will be performed.

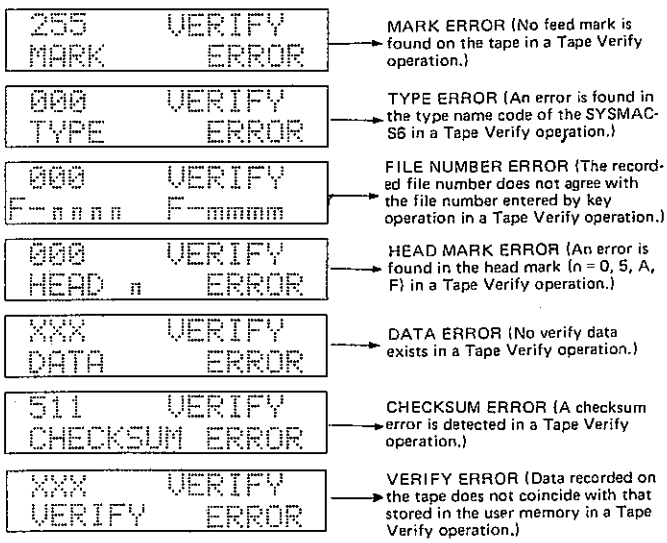
7.13 Error Messages in CASSETTE Mode

In the CASSETTE mode, one of the following error messages may appear on the LCD of the programming console.

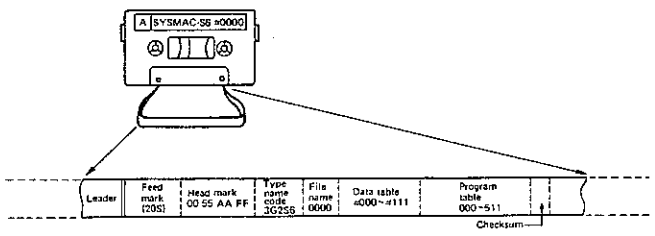
- **In Tape Read operation**



- **In Tape Verify operation**



- **Tape Format**



NOTE:
For details, refer to 9.3, List of Error Messages and Remedies.

8. Installation and Wiring

The SYSMAC-S6 is a highly reliable programmable controller which is resistant to adverse environmental conditions. However, in order to permit the programmable controller to fully exhibit its functions, as well as to enhance its reliability, care must be exercised on the following points when installing the programmable controller.

8.1 Mounting Locations and Environmental Conditions

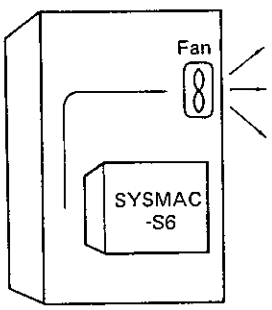
When installing the SYSMAC-S6 programmable controller, avoid the following locations.

- Location where the ambient temperature is beyond the range of 0 to 50°C.
- Location where temperature changes abruptly, thus resulting in condensation.
- Location where relative humidity exceeds the range of 30 to 90%.
- Location subject to corrosive gas or flammable gas.
- Location subject to excessive dust, salt, or iron particles.
- Location subject to vibration or shock.
- Location subject to direct sunlight.

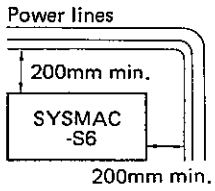
8.2 Mounting Positions within Control Panels

When mounting the SYSMAC-S6 in a control panel, take into consideration the operability, maintenability and environmental resistance of the programmable controller.

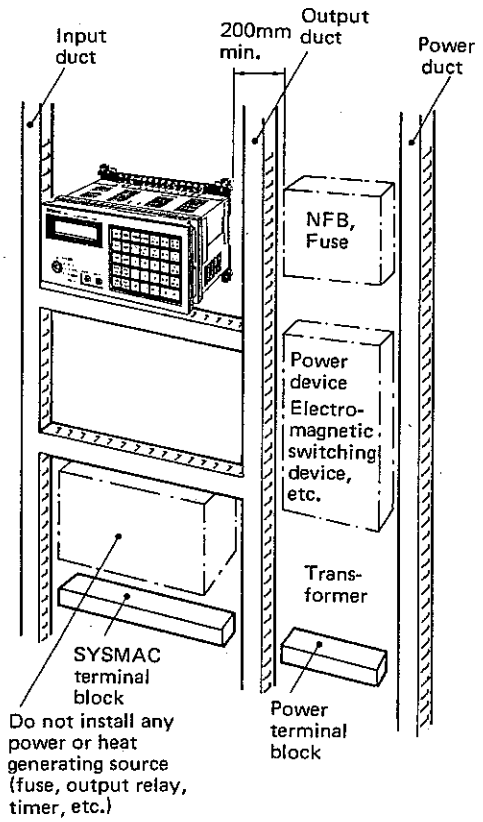
1. To permit the use of the SYSMAC-S6 within the ambient operating temperature range, pay attention to the following points.
   a. Provide the programmable controller with adequate space for ventilation.
   b. Avoid mounting the controller directly above any heat generating source (heater, transformer, resistor of high capacity).
   c. Install a fan for forced ventilation if the ambient temperature exceeds 50°C.



2. Avoid mounting the SYSMAC-S6 in a panel in which high-tension equipment is installed.
3. Provide a distance of more than 200mm between the high-tension or power lines and the SYSMAC-S6.



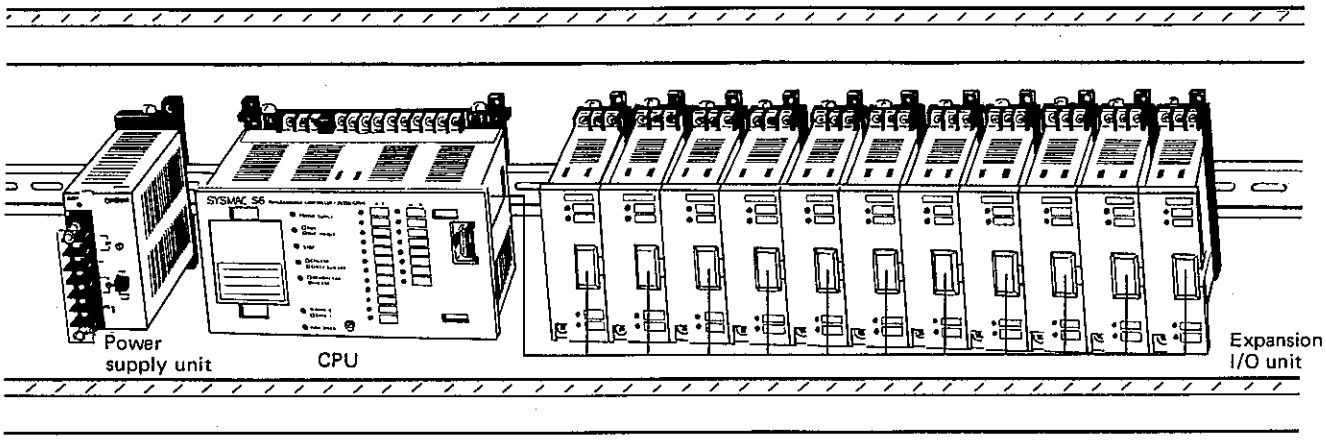
4. Mount the SYSMAC-S6 as far away as possible from high-tension equipment or power devices for the sake of safety in maintenance and operation.



8.3 How to Install within Control Panels

■ TRACK MOUNTING

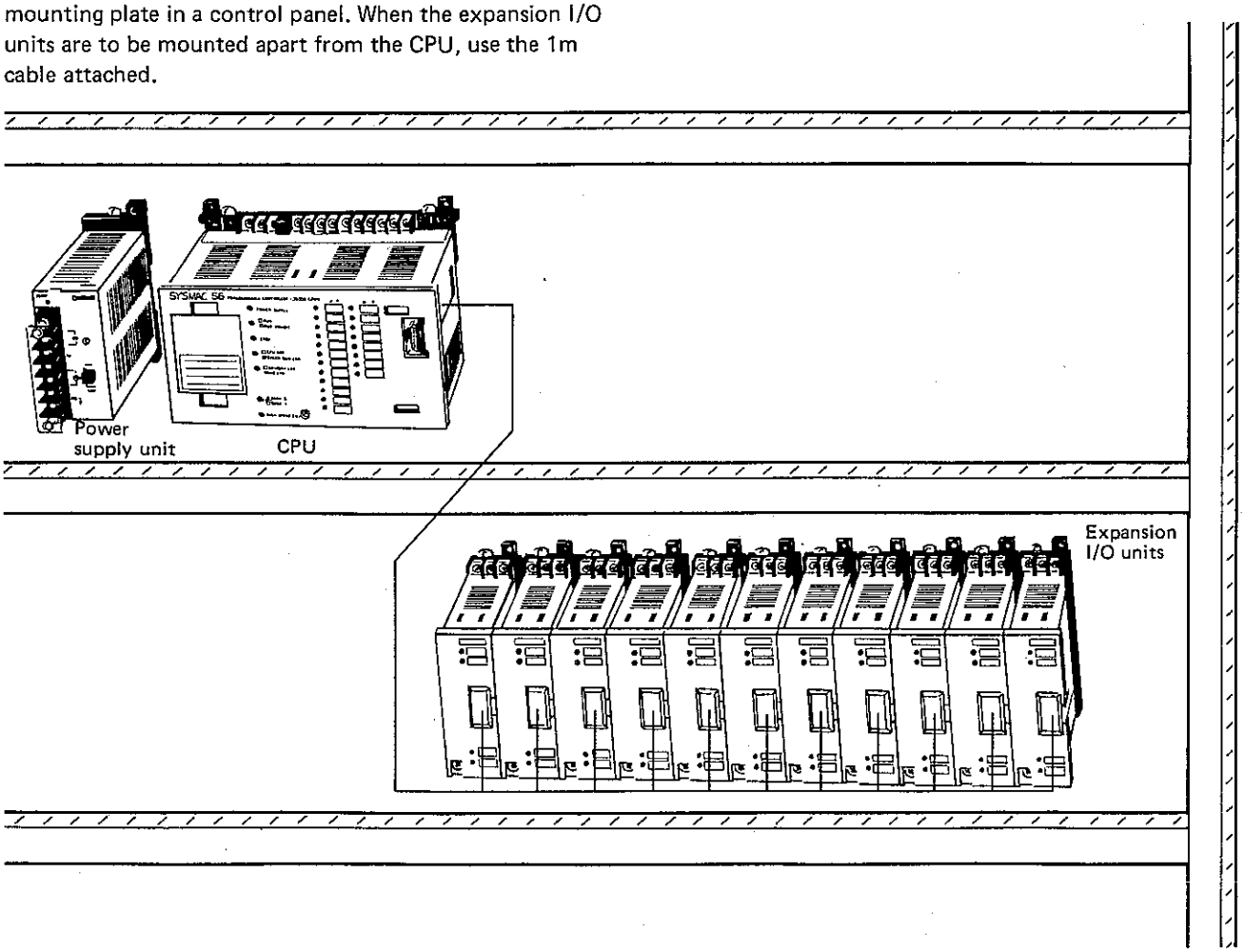
When mounting the SYSMAC-S6 programmable controller within a control panel, all the respective component units of the SYSMAC-S6 can be mounted simply on a DIN rail.



NOTE: Use OMRON Type PFP-100N2 DIN rail.

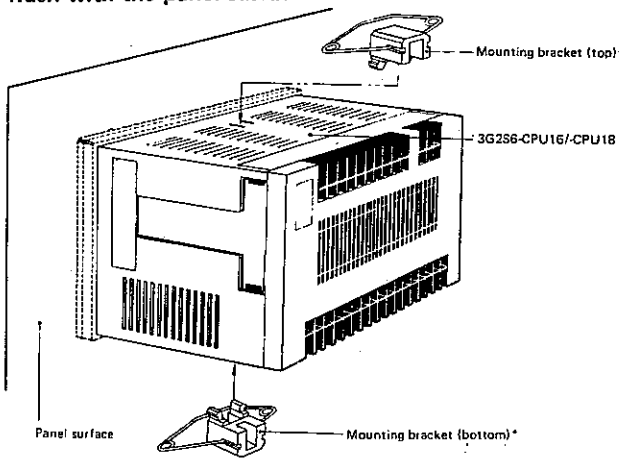
■ SURFACE MOUNTING

The programmable controller may also be secured to the mounting plate in a control panel. When the expansion I/O units are to be mounted apart from the CPU, use the 1m cable attached.



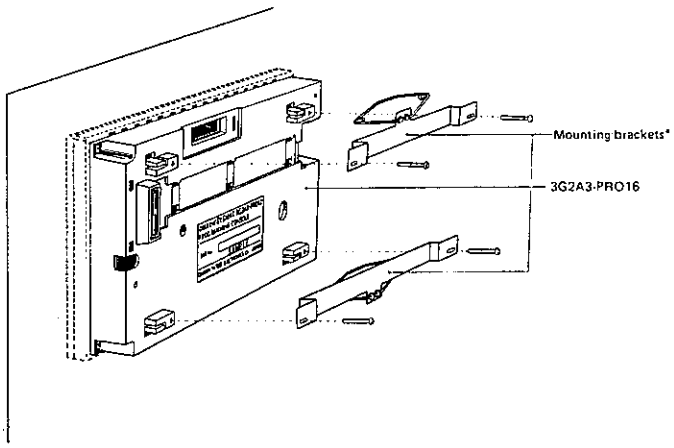
■ FLUSH MOUNTING

- To mount Type 3G2S6-CPU16/-CPU18 flush with the panel surface



NOTE: *A pair of mounting brackets are supplied as the accessories of the CPU16, and CPU18.

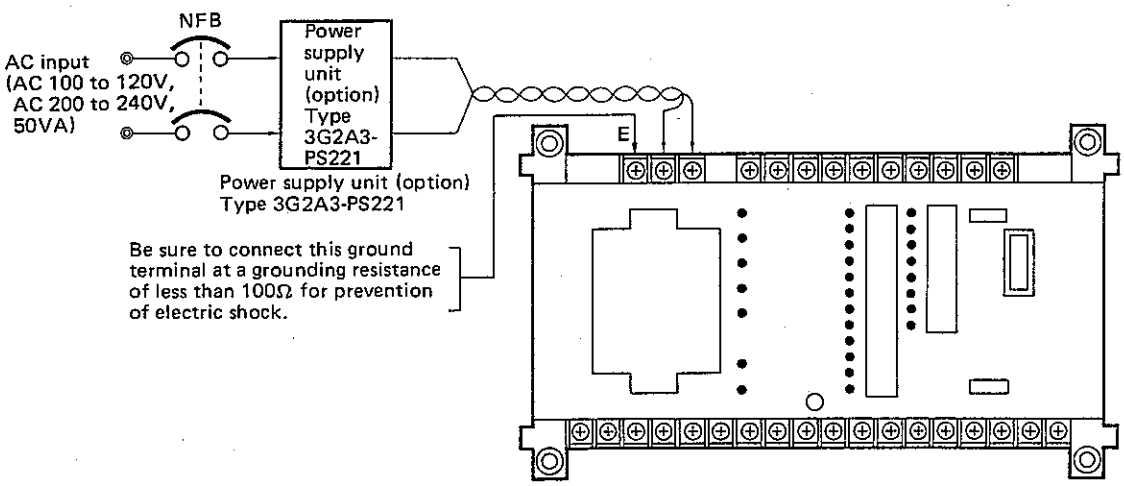
- To mount Type 3G2A3-PRO16 flush with the panel surface



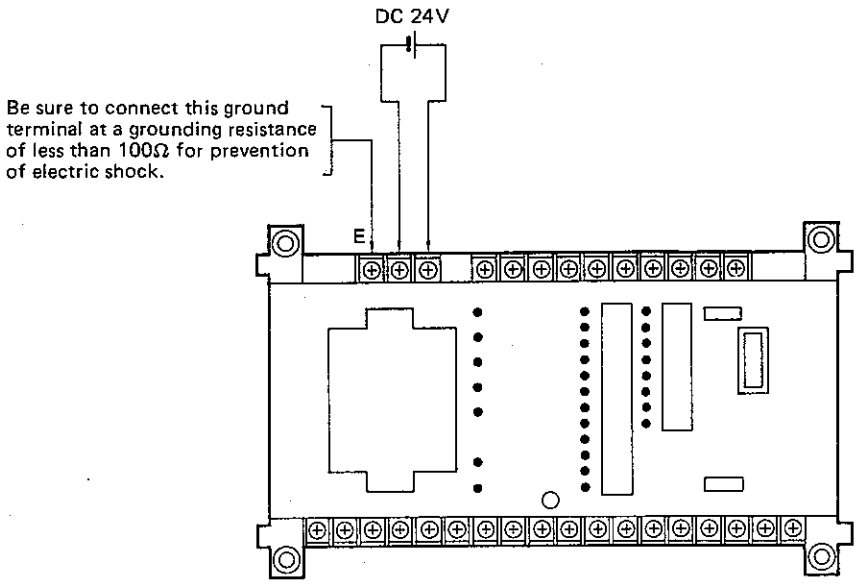
NOTE: * A pair of mounting brackets are optional.

8.4 Wiring and Power Supplies of CPU

■ AC POWER SUPPLY



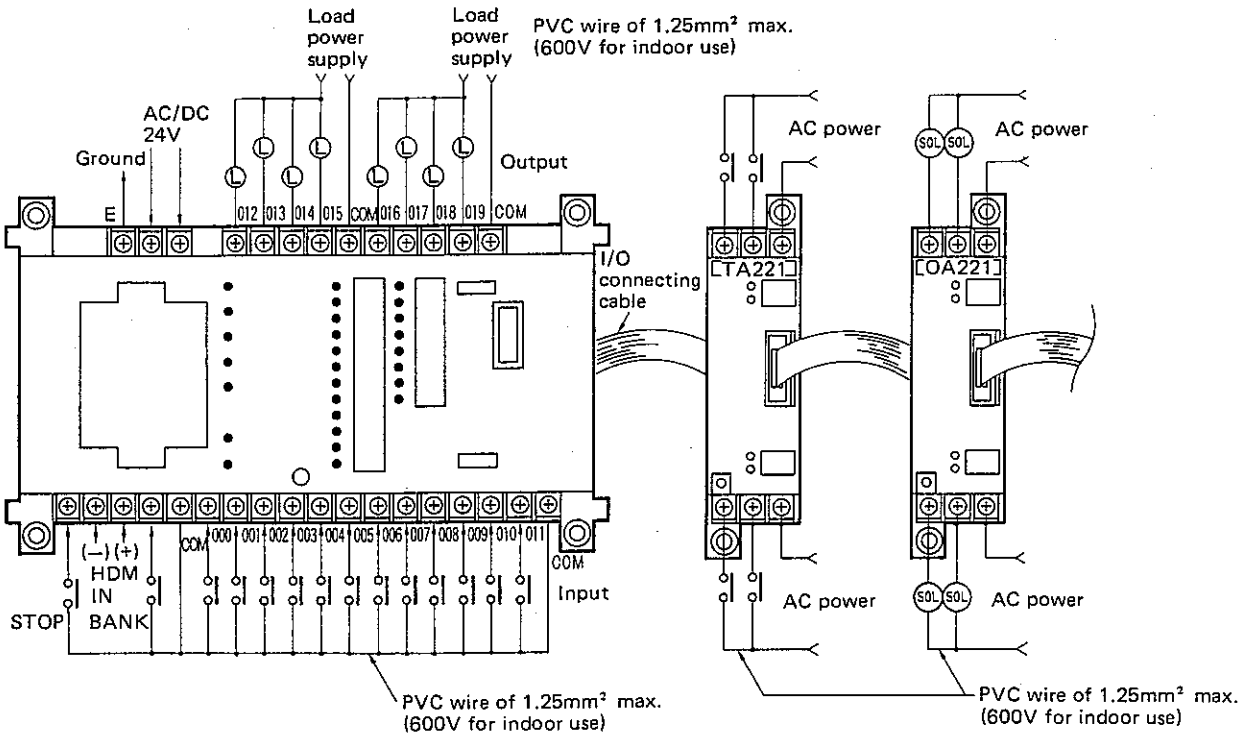
■ DC POWER SUPPLY



- Power supply capacity
  The power consumption of the SYSMAC-S6 is less than 10VA. However, upon power application, inrush current of about 5 times the steady-state current will flow through the programmable controller. Take this point into account.
- Power supply wiring
  Use a wire of 2mm^2 min. as the power supply line of the SYSMAC-S6 so as to prevent voltage drop. (Use of twisted pair wires is recommended.)
- For general noise on the power supply line, the noise suppressing circuit in the SYSMAC-S6 is sufficient. However, supplying power through a transformer having a transformer voltage ratio of 1:1 will help reduce equipment-to-ground noise to a great extent and installation of such a transformer is recommended.
  Terminal E of the SYSMAC-S6 is a ground terminal used for prevention of electric shock. Use an exclusive ground wire (having a conductor cross-sectional area of 2mm^2 min.) for grounding at a grounding resistance of less than 100Ω. Note that common use of the grounding line with other equipment or connecting to the beam of the building may adversely affect the system.
  Keep the length of the ground wire within 20m. Care must be taken as to the grounding resistance since it varies depending on the nature of ground, water content, season and the time elapsed after the underground laying of the ground wire.

8.5 Connection of CPU and Expansion I/O Units and I/O Wiring

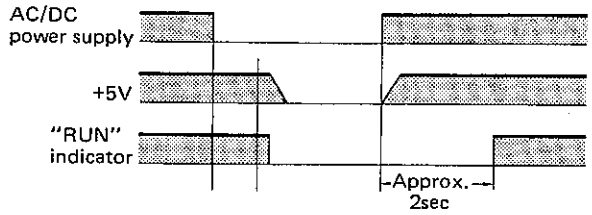
- The CPU and expansion I/O units are interconnected with I/O unit connecting cables.
- Two types of I/O unit connecting cables are available.
  1m cable (Type 3G2A3-CN121)
  13cm cable (attached to each I/O unit)
- A maximum of three 1m I/O unit connecting cables can be used in one system.



8.6 Operation at Power Failure

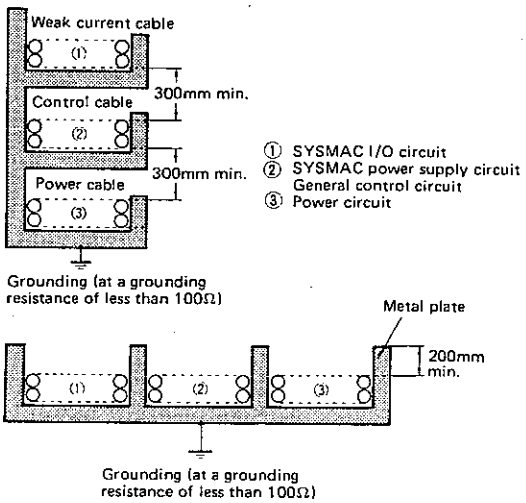
1. As the power supply of the SYSMAC-S6, supply power within +10%, −15% of the supply voltage.
2. The power sequence circuit is incorporated in the power supply unit of the SYSMAC-S6 to prevent the programmable controller from malfunctioning due to a momentary power failure or a decrease in the supply voltage.
   a. Supply voltage drop
      If the supply voltage drops below its 85%, the operation of the SYSMAC-S6 stops, causing external output relays to turn off.
   b. Momentary power failure
      The CPU continues to operate even if a momentary power failure of less than 10msec occurs.
   c. Automatic restart
      The CPU will automatically restart after more than 85% of the supply voltage is restored.

CPU RUN/STOP Timing operation



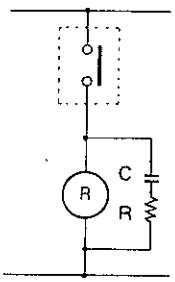
8.7 External Wiring

1. Be sure to process the input/output lines of the SYSMAC-S6 separately from other control lines. (Do not share the conductors of the I/O cable with others.)
2. To process the cables for the SYSMAC-S6 with power cables rated at 400V 10A max. or 220V 20A max.:
   a. Be sure to provide a minimum distance of 300mm between both cables when their racks are paralleled.
   b. Be sure to screen them with grounded metal plate when both cables are placed in the same duct at the termination process of the cable laying work.



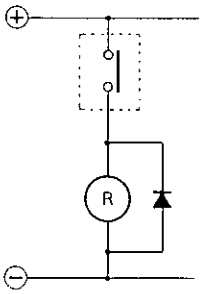
8.8 Hints on Use of Output Contacts

If any electrical devices, which are likely to generate electric noise, are to be employed as the output loads of the SYSMAC-S6, be sure to take measures to absorb such noise. For example, electromagnetic relays, valves, etc., generating a noise of 1,200 to 1,300V minimum are subject to noise suppression. For AC operated noise sources, connect a surge suppressor in parallel with the coil of each device. For DC operated noise sources, connect a diode in parallel with the coil of each device.



AC power source

C: 0.5μF ±20% min.
Nonpolarity
Withstand voltage: 1,500V min.
R: 50Ω ±30%, 0.5W



DC power source

Select a diode with the breakdown voltage and current ratings according to the load.

9. Maintenance and Inspection

To sustain the proper system operation at all times, it is necessary to inspect the SYSMAC-S6 daily. If any trouble occurs in the SYSMAC-S6, how the system should be protected and how soon it can be recovered from the failure become important. In this chapter, the items to be inspected on the SYSMAC-S6 and the actions to be taken if the SYSMAC-S6 fails are described.

9.1 Inspection

To make the most of the functions of the SYSMAC-S6 under the best condition, it is necessary to inspect the SYSMAC-S6 daily or periodically.

■ INSPECTION ITEMS

The SYSMAC-S6 employs semi-conductors as its main component elements. However, the semi-conductors may deteriorate depending on the environmental conditions and must therefore be inspected periodically. The standard inspection cycle is 6 months to 1 year. According to the environmental conditions, it is recommended to advance the date of inspection. As a result of the daily or periodical inspection, if the SYSMAC-S6 is found to be outside the criteria in the following table, be sure to correct the SYSMAC-S6 so that it falls within the prescribed criteria.

No.	Inspection item	Particulars of inspection	Criteria
1	AC power supply (a) Voltage (b) Fluctuation	(1) Is the rated voltage available when measured at the AC input terminal of the Power Supply unit (Type 3G2A3-PS221)?	AC 85 to 132V or AC 170 to 264V
		(2) Does a momentary power failure occur frequently or is there any sharp rise or drop in the supply voltage?	The supply voltage must be within the permissible fluctuation range described above.
2	Environmental conditions (a) Ambient temperature (b) Humidity (c) Vibration (d) Dust, etc.	Are the temperature and humidity within the respective range? (When the SYSMAC-S6 is installed in a control panel, the temperature within the panel may be regarded as the ambient temperature of the programmable controller.)	(a) 0 to +50°C (b) 30 to 90% RH (c) Must be free from vibration. (d) Must be free from dust.
3	Power supply of expansion I/O unit (a) Voltage (b) Ripple	Are the voltage and ripple within the operating range when measured at the terminal board of each I/O unit?	Must conform with the specifications of each I/O unit.
4	Mounting conditions	(1) Are the CPU unit and expansion I/O units secured firmly?	The mounting screws must not be loose.
		(2) Is each expansion I/O unit fixed firmly?	Each I/O unit must not be loose.
		(3) Is the I/O connecting cable inserted completely?	The connecting cable must not be loose.
		(4) Is there any loose screw in the external wiring?	The screw terminals must not be loose.
		(5) Is there any broken cable in the external wiring?	The external wiring must be free from any abnormalities in appearance.
5	Service life	(1) Output relays in the CPU and expansion I/O units.	Electrically: 100 x 10^3 operations Mechanically: 10,000 x 10^3 operations
		(2) Battery	2 years

CAUTION:
Be sure to turn off the power before replacing any unit of the SYSMAC-S6.

■ NOTES ON INSPECTION

1. If a defective unit is discovered and replaced, confirm whether or not the replaced unit is abnormal.
2. In the event of a faulty contact of the cable, wipe the connector pins with a clean all-cotton cloth moistened with industrial alcohol. Be sure to plug in the flat cable after removing the cloth waste.

■ TOOLS AND TESTING EQUIPMENT REQUIRED FOR MAINTENANCE

In the maintenance of the SYSMAC-S6, the following tools and testing equipment will facilitate the daily or periodic inspection of the programmable controller.

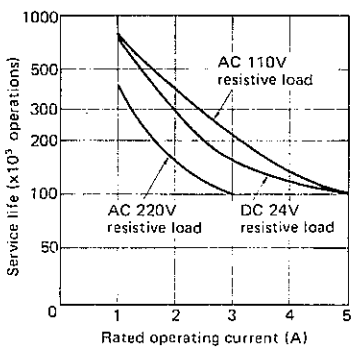
1. Tools and testing equipment recommended as mandatory equipment
   - Screwdrivers (Phillips and round-blade)
   - Tester or digital voltmeter
   - Industrial alcohol and all-cotton cloth.
2. Measuring instruments recommended only if required
   - Synchroscope
   - Pen-recording oscilloscope

■ MAINTENANCE PARTS

1. Spare parts
   If the SYSMAC-S6 fails, its repair is impossible without any spare parts no matter how early the trouble is discovered. So, it is recommended to have at least one I/O unit as a spare part.
2. Consumables
   Fuse for overload protection in each output unit:
   4A, AC 200V
3. Replacement parts
   - Battery unit (Type 3G2A9-BAT07)
     Service life of battery: 2 years
   - Relay contact output unit
     Replacement must be made on a unit basis.
     Type 3G2A3-OC221
     Service life of relay:
     Electrically: 100 x 10^3 operations
     Mechanically: 10,000 x 10^3 operations
   - Output relays in the CPU
     Replacement must be made on a unit basis.
     Type 3G2S6-CPU15 (Surface mounting type)
     Type 3G2S6-CPU16 (Flush mounting type)
     Service life of relay:
     Electrically: 100 x 10^3 operations
     Mechanically: 10,000 x 10^3 operations

■ CHARACTERISTIC DATA

- **Life test curve of Type G4C-112P-E output relay**

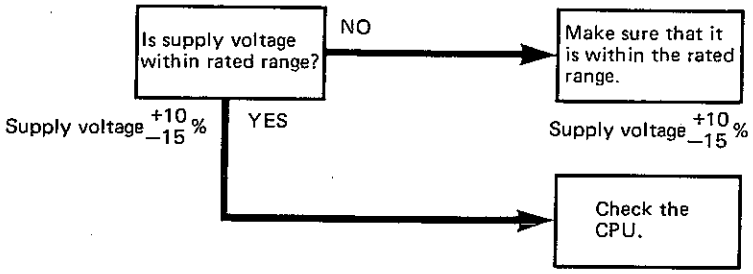


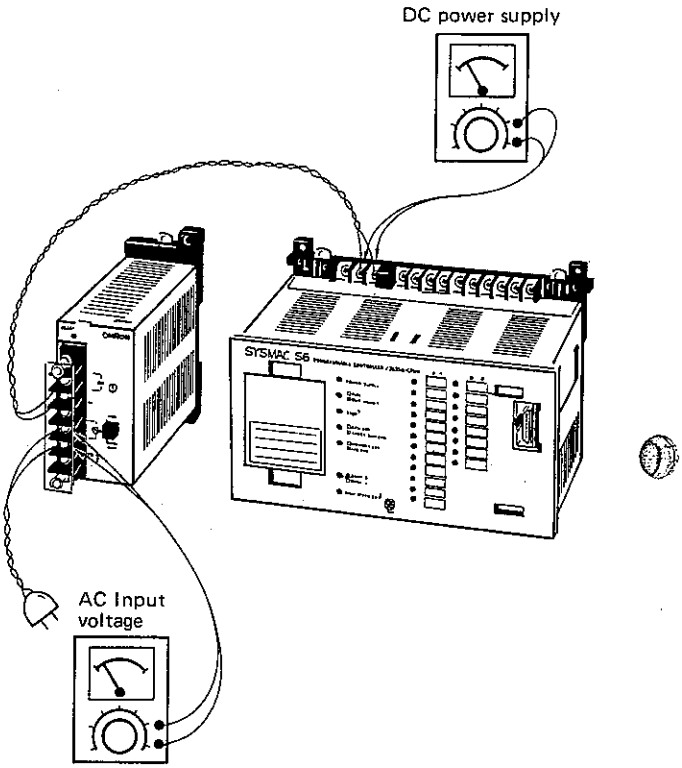
9.2 Troubleshooting

If any abnormality occurs in the SYSMAC-S6, thoroughly grasp the condition of trouble, check whether the symptom is reproducible or is caused through relationship with other equipment, and then follow the troubleshooting flowcharts shown below.

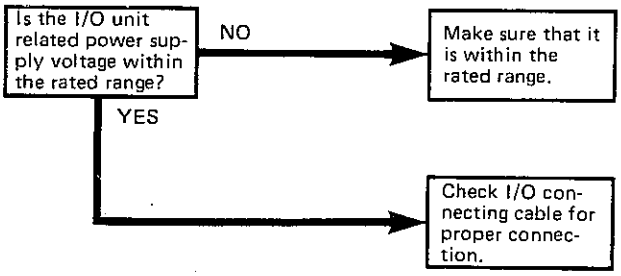
■ POWER SUPPLY

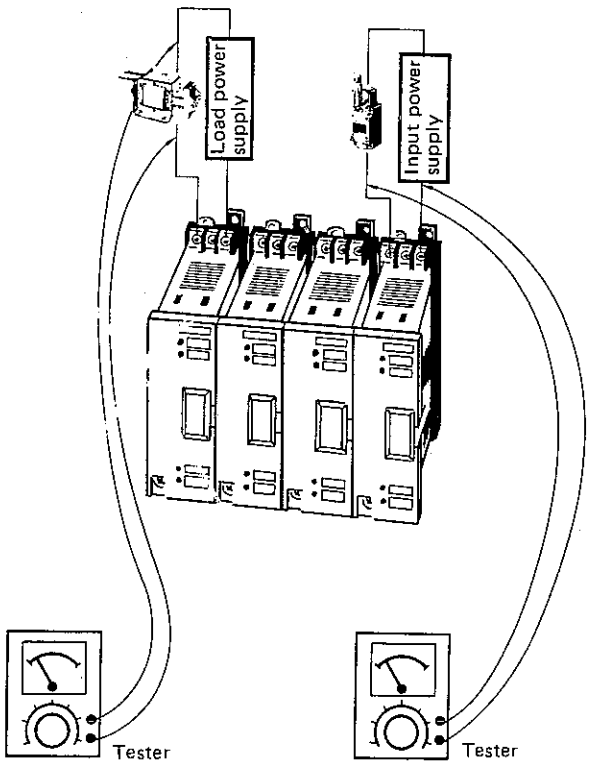
1. Main power supply check
   In this check, the AC power being supplied to the SYSMAC-S6 is confirmed if it is within the rated range (+10%, −15% of rated voltge).



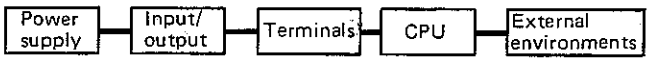


2. I/O unit related power supply check
   The power supply for loads is connected to the terminals of each I/O unit. Should any abnormality occur in this power supply, the I/O device connected to the I/O unit will not operate.



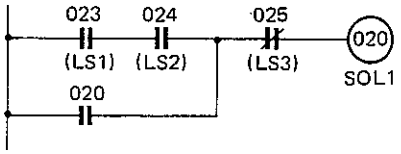


■ INPUT/OUTPUT UNIT

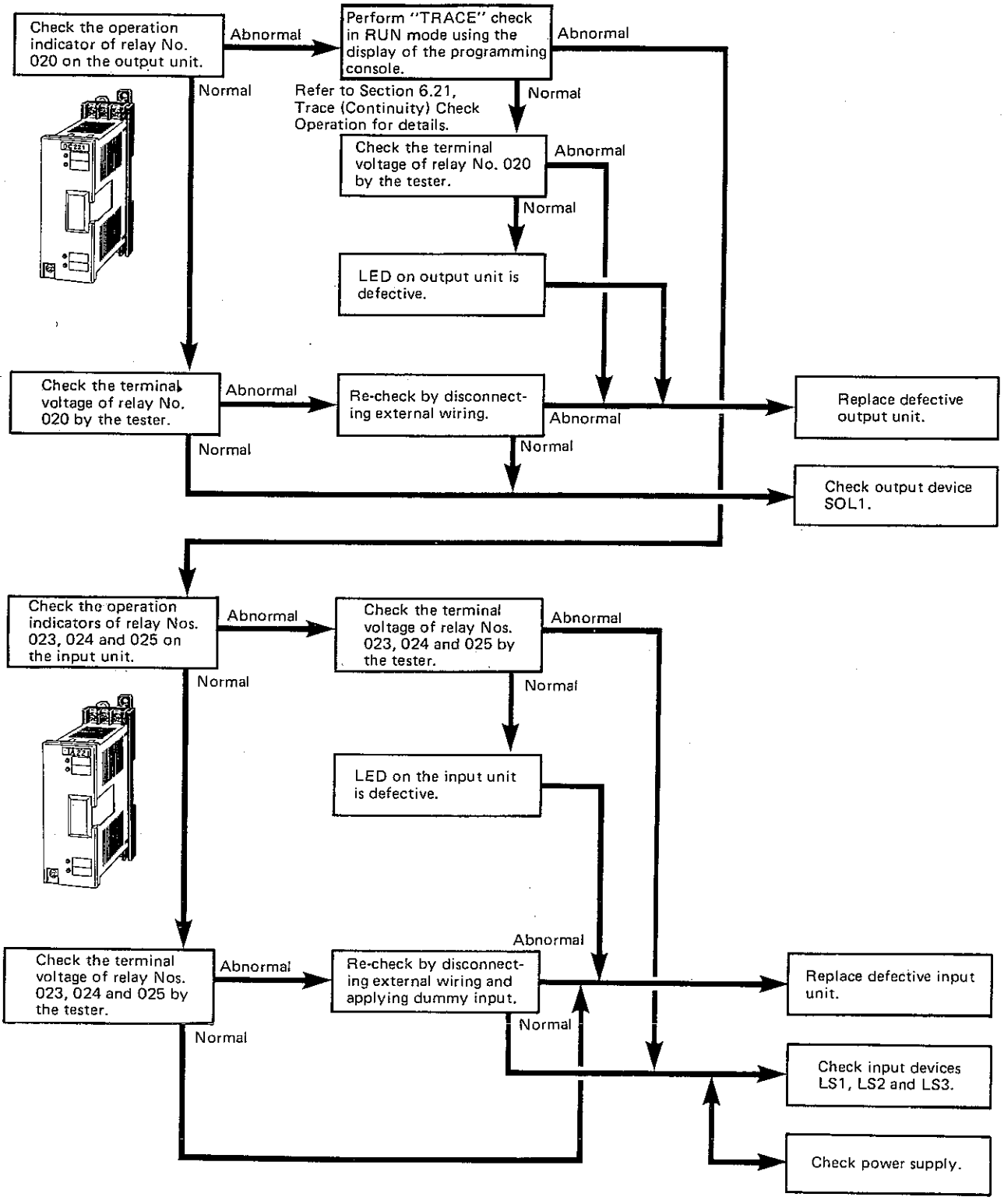


The following flowchart is indicated on the assumption that the maintenance spare parts are provided. If no spare part is provided, first check I/O devices thoroughly. The flowchart is illustrated based upon the circuit example shown at the right.

Circuit example

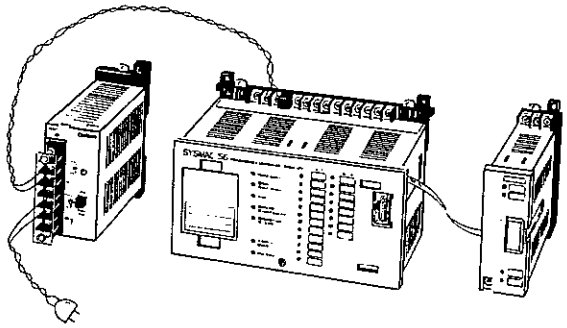


SOL1 malfunctions!!



■ TERMINALS

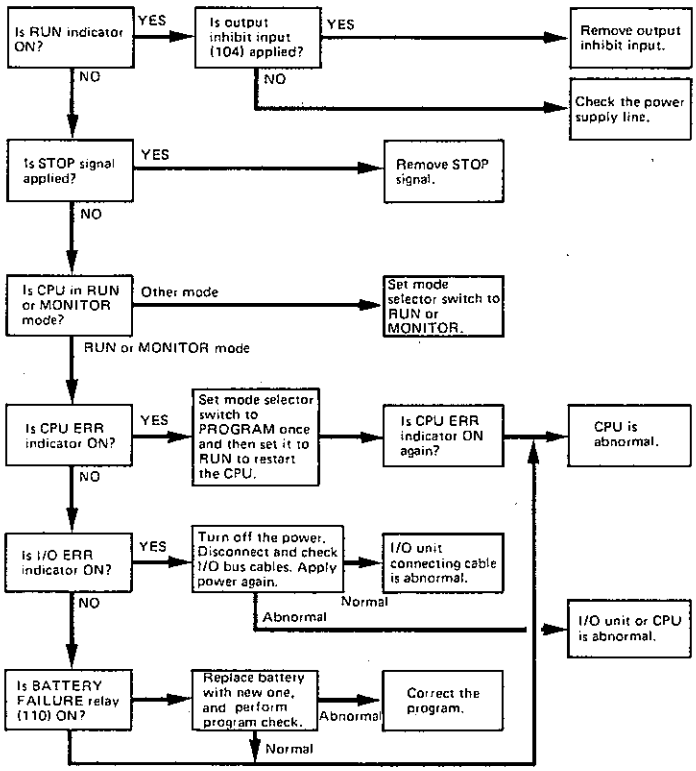
Power supply — Input/output — Terminals — CPU — External environments



① Check each I/O unit for loose terminals.
② Check the power supply terminals for loose connection.
③ Check each unit for loose mounting screws.
④ Check the I/O connecting cable for proper mounting.

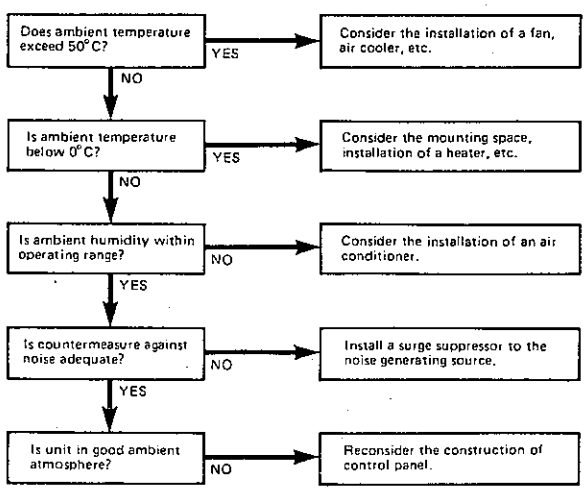
■ CPU

Power supply — Input/output — Terminals — CPU — External environments



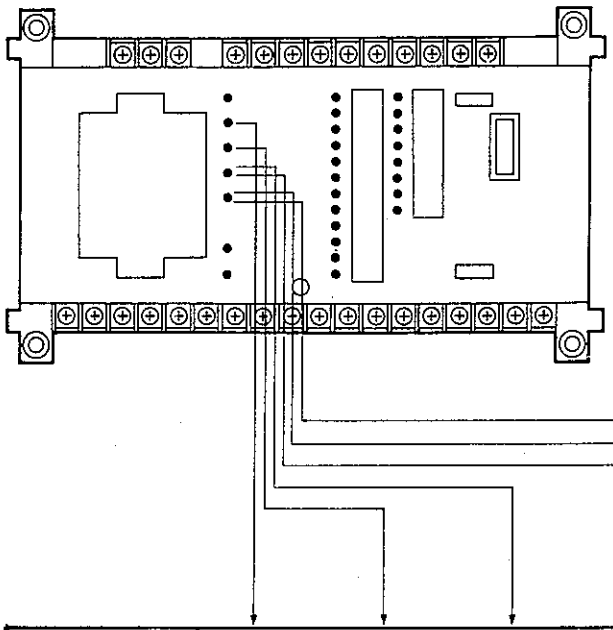
■ EXTERNAL ENVIRONMENTS

Power supply — Input/output — Terminals — CPU — External environments



9.3 List of Error Messages and Remedies

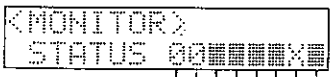
■ LIST OF ERROR MESSAGES IN MONITOR/PROGRAM MODE



Item / Condition	Indicators on CPU front panel						Special auxiliary relay	Output indicator	Error message on programming console display
	RUN	STOP	CPU ERR	CHECK-SUM ERR	MEMORY ERR	I/O ERR			
When a momentary power failure occurs	OFF	–	–	–	–	–	–	OFF	–
When the supply voltage drops	OFF	–	–	–	–	–	–	OFF	–
When STOP signal (external) is ON	OFF	ON	–	–	–	–	–	OFF	–
When output inhibit special auxiliary relay (104) is ON	–	–	–	–	–	–	–	OFF	–
When mode selector switch is changed from RUN/MONITOR to other mode	OFF	–	–	–	–	–	–	OFF	–
When a CPU error occurs	OFF	–	ON	–	–	–	–	OFF	NOTE
When a check-sum error occurs	–	–	–	Flashes ON/OFF		–	Relay No. 111 is ON.	–	NOTE
When a memory error occurs	OFF	–	–	–	ON	–	–	–	NOTE
When an I/O error occurs	–	–	–	–	–	Flashes ON/OFF		OFF	NOTE
When a battery failure occurs	–	–	–	–	–	–	Relay No. 110 is ON.	–	NOTE

Message	Definition	Cause	Remedies
WARNING ! STATUS 00▒▒▒XX▒	Abnormality detection	One or more of the following errors have occurred. • Backup error • Battery failure • Checksum error • END instruction missing error • I/O error • Format error For details of each error, see note below.	1. Confirm the contents of the error or failure status and take appropriate measures as necessary. 2. To simply reset the status, change the position of the mode selector switch on the programming console.
READY	Ready	The system has activated normally upon power application.	(Normally, this message will change into next one within 1 or 2 sec.)
ENTER PASSWORD !	Mode error	The existing operation mode of the CPU is different from that specified by the mode selector switch on the programming console.	Check the position of the mode selector switch and if it is positioned correctly, depress the " [CLEAR] " and " [MONITOR] " keys.
TRANS MISSION ERROR	I/O error	An error has occurred in the signal transmission between the CPU and an expansion I/O unit.	Check the connection of each unit and turn off the power supply to reset.

NOTE: Indication on the LCD of the programming console



▒ Indicates normal status.
X Indicates that an abnormality has occurred.

Backup error:
Indicates a failure or voltage drop of the super capacitor.

Battery failure:
Indicates that the battery voltage has dropped below the specified level, or that the battery unit is not mounted.

Checksum error:
Indicates that a checksum error has occurred during the program run.

END instruction missing error:
Indicates that there is no END instruction at the end of a program.

I/O error:
Indicates that an abnormality has occurred in one of the I/O bus lines, or that the number of I/O units has changed.

Format error:
Indicates that an undefined instruction has been detected.

Memory selection
00 – RAM
01 – EPROM bank 0
10 – EPROM bank 1

■ ERRORS DURING PROGRAM DEBUGGING IN PROGRAM MODE

Message	Definition	Cause	Remedies
xxx SYNTAX ER. ???	Syntax error	1. An undefined instruction has been detected in a program. 2. A framing error has occurred.	1. Rewrite the program for proper syntax. 2. Perform hardware check.
511 END MISS	END instruction missing error	There is no END instruction at the end of a program.	Add an END instruction at the end of the program.
EDIT THE PROGRAM AGAIN!	The program must be corrected.	The operation of a program has been performed without correcting a syntax error or END instruction missing error.	Rewrite the program for proper syntax.
xxx COIL DOUBLE OUT 12	Coil duplication error	The same coil number is used in duplication in a program.	Check the circuit and if any problem exists, rewrite the program for proper syntax.
xxx CIRCUIT ER. CNT ?	Circuit error	1. A circuit error has been found in a program. 2. Plural OUT instructions are used in a program.	Check the circuit and if any problem exists, rewrite the program for proper syntax.
xxx IL.END MISS END	IL-END instruction missing error	1. One of the following errors is detected in a program. ① No IL-END instruction is used between IL instructions. ② An IL-END instruction exists in a program while no IL instruction is used. ③ An IL instruction exists in a program while no IL-END instruction is used.	Check the circuit and if any problem exists, rewrite the program for proper syntax.
511 NOT FOUND	Instruction is not found.	During the Search operation of an instruction, the data being searched is not found.	Check to see if the data is correct and retry the Search operation.
MEMORY OVERFLOW	Memory overflow error	An attempt is made to insert an instruction to a program when the memory is full up to the last address (address 511).	Rewrite the program so that the entire program is within the range of the 511 addresses.

■ LIST OF ERROR MESSAGES IN PROM MODE

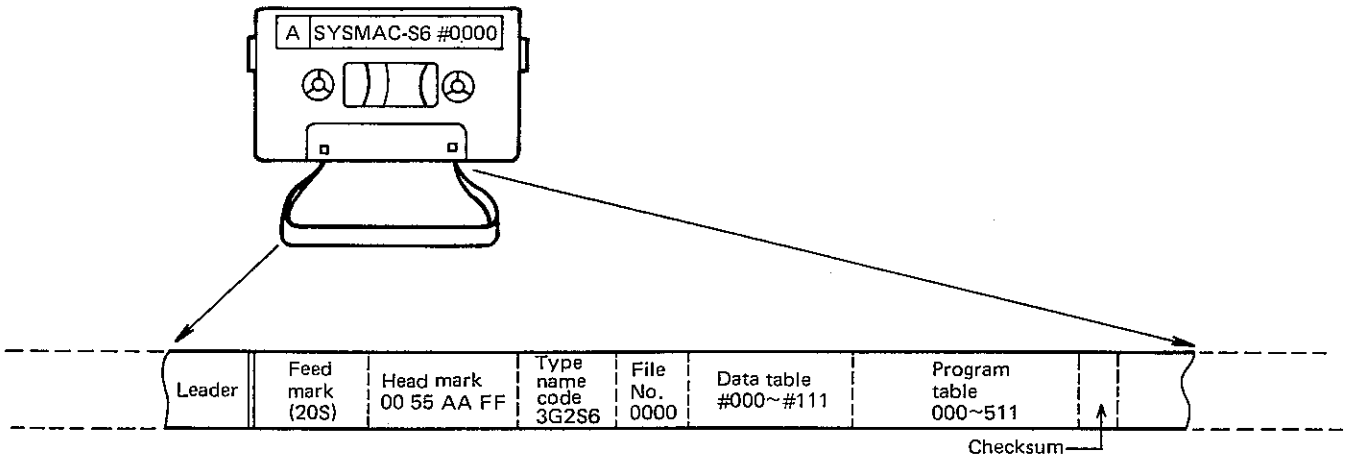
- **Errors in write operation**

Message	Definition	Cause	Remedies
WRITE B-☆ NO PROM	Memory unit is not mounted.	The memory unit is not mounted on the PROM writer in an EPROM Write operation.	Mount the memory unit of which the contents have been completely erased to the PROM writer.
WRITE B-☆ ERASE ERROR	EPROM erase error	The contents of the memory unit mounted on the PROM writer have not been erased in an EPROM Write operation.	Completely erase the contents of the EPROM chip mounted in the memory unit.

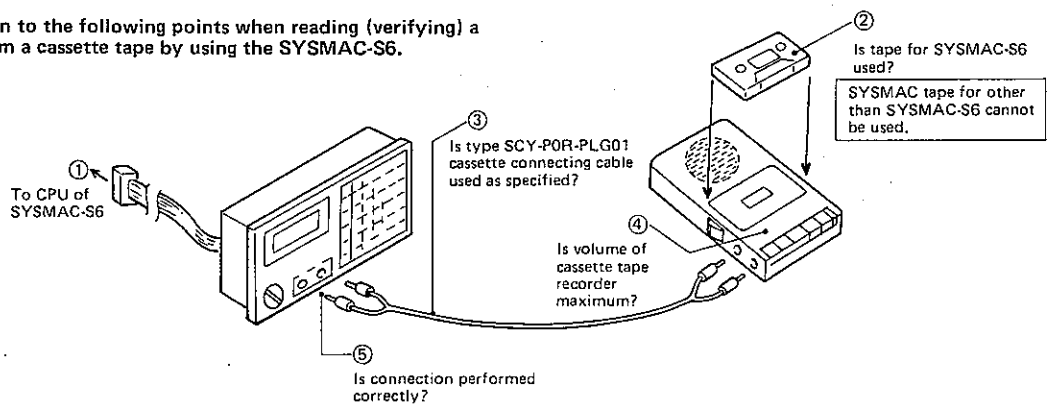
- **Errors in verify/read/load operation**

Message	Definition	Cause	Remedies
VERIFY B-☆ NO PROM	Memory unit is not mounted.	The memory unit is not mounted on the PROM writer in an EPROM Verify operation.	Mount the memory unit on which data have been already written.
XXX VERIFY DATA ERROR	Verify data error	Either no program or a program has uncorrectly been written in the memory unit mounted on the PROM writer in an EPROM Verify operation.	Perform Write operation again.
VERIFY B-☆ BANK CODE ER	Bank code is not found.	1. No data is written in the memory unit. 2. Wrong bank code is specified.	1. Perform Write operation again. 2. Specify the correct bank code.
511 VERIFY CHECKSUM ERROR	Checksum error	The checksums of the RAM memory and of the EPROM chip are not in agreement with one another in an EPROM Verify operation.	Perform Write operation again.
RAM ERROR	RAM verify error	The contents of the EPROM chip have not been transferred to the RAM memory in an EPROM load operation.	Perform Load operation again.
READ B-☆ NO PROM	Memory unit is not mounted.	The memory unit is not mounted on the PROM writer.	Mount the memory unit on which data have been already written.
READ B-☆ BANK CODE ER	Bank code is not found.	Wrong bank code is specified in an EPROM Read operation.	Specify the correct bank code.
511 READ CHECKSUM ERROR	Checksum error	The checksums of the RAM memory and of the EPROM chip are not in agreement with one another in an EPROM Read operation.	Perform Read operation again.
ROM ERROR	Memory unit is not mounted.	The memory unit is not mounted to the CPU in an EPROM load operation.	Mount the memory unit for Write operation.

■ LIST OF ERROR MESSAGES IN CASSETTE MODE



CAUTION:
Pay attention to the following points when reading (verifying) a program from a cassette tape by using the SYSMAC-S6.



- **Errors in Tape Read operation (1)**

Message	Definition	Cause	Remedies
255 PLAY MARK ERROR	No feed mark is found.	1. An error has occurred in Tape Read operation. 2. The volume of the tape recorder is too low.	1. Perform the Tape Read operation again. 2. Turn up the volume of the tape recorder.
000 PLAY TYPE ERROR	Type error	1. An attempt has been made to read a tape other than that for the SYSMAC-S6 (e.g., a tape for SYSMAC-M1R has been read). 2. The type code of the SYSMAC-S6 has not been read normally.	1. Check the ID label on the cassette tape. 2. Perform the Tape Read operation again. 3. Turn up the volume of the tape recorder.
000 PLAY F-nnnn F-mmmm	File No. error	Wrong file number has been specified, or the file number has not been specified.	Specify the correct file number.
000 PLAY HEAD n ERROR	Head mark error	No head mark code (0055AAFF) has been detected.	1. Check the ID label on the cassette tape. 2. Perform Tape Read operation again. 3. Turn up the volume of the tape recorder.
XXX PLAY DATA ERROR	Data error	The data table or program table has not been read.	1. Check the ID label on the cassette tape. 2. Turn up the volume of the tape recorder.

- **Errors in Tape Read operation (2)**

Message	Definition	Cause	Remedies
511 PLAY CHECKSUM ERROR	Checksum error	1. The checksums of the RAM memory and of the tape are not in agreement with one another.	Perform the Tape Read operation again.
#XXX PLAY RAM ERROR	RAM verify error	The contents of the RAM are not in agreement with the data on the tape in a Tape Read operation.	Perform the Tape Read operation again.

- **Errors in Tape Verify operation**

Message	Definition	Cause	Remedies
255 VERIFY MARK ERROR	Feed mark is not found.	1. An error occurred in a Tape Write operation. 2. The volume of the tape recorder is too low.	1. Perform the Tape Write operation again. 2. Turn up the volume of the tape recorder and perform the Tape Verify operation.
000 VERIFY TYPE ERROR	Type error	An error occurred in a Tape Write operation.	Perform the Tape Write operation again.
000 VERIFY F-nnnn F-mmmm	File No. error	Either a wrong or no file number has been specified.	Specify the correct file number.
000 VERIFY HEAD n ERROR	Head mark error	An error occurred in a Tape Write operation.	Perform the Tape Write operation again.
XXX VERIFY DATA ERROR	Data error	The data table or program table has not been written on the tape in a Tape Write operation.	Perform the Tape Write operation again.
511 VERIFY CHECKSUM ERROR	Checksum error	The checksums of the memory and of the tape are not in agreement with one another.	Perform the Tape Write operation again.
XXX VERIFY VERIFY ERROR	Verify error	The bit in the contents of the memory does not agree with the bit in the contents of the tape.	Perform the Tape Write operation again.