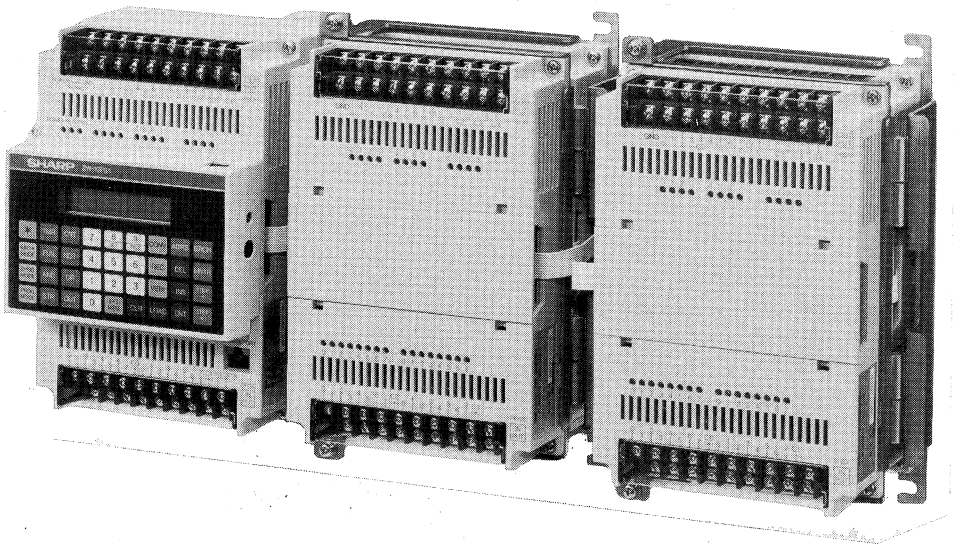
SHARP

New Satellite W1Ø
PROGRAMMABLE CONTROLLER
User's Manual



SHARP CORPORATION

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§ 1 FEATURES

1. Compact design

   Thanks to the high circuit integration technology of today, the I/O and CPU are implemented on the same module, and it enhances control of up to 28 points by the base module only. Use of expansion options (14-point, 28-point) enables to expand the control up to 140 points.
   The base module has small dimensions of 190mm×130mm×85mm and expansion module 190mm×10mm×38mm, and each module can be mounted on top of another module (2 modules at a maximum), so as to save room of the control board.

2. Variety of base modules and expansion modules

   For four kinds of base modules and five kinds of expansion modules are supported, it enhances establishment of a variety of controls and application systems.

3. Programming language and support tools compatible with other W series programmable controller

   Because the programming language of the W10 is compatible with those of advanced model such as W16, W51, and W100, all instruction words for the W10 are included in the W16/W51/W100 instructions. Not only that, it permits connection of the W series support tools such as the programmer, ladder processor, and CF loader.

4. Network enhancement with advanced models

   For it is possible to use the data link module that enhances data transfer between the advanced models such as W16, W51, and W100 and control of remote I/O modules, it allows dispersed system operation and hierarchical system operation.

5. Fast instruction executing times with a variety of high performance instructions

   As there are 25 instructions are available for data transfer, addition and subtraction, in addition to 11 basic instructions, it will permit controlling a wide range of applications.
   For a basic instruction has an average execution time of 5μsec per instruction word, it serves for product quality precision and efficient productivity.

6. High speed counter as a standard equipment

   The W10 employs a 5KHz high speed counter which will accept an output pulse from the rotary encoder in a flicker of a seconds. This permits easier position determination without use of multiple number of limit switches.

7. Choice of three kinds of memory types

   Although a CMOS RAM chip is used as a standard, it is also possible to use EPROM and EEPROM.
   In case there are many design changes are involved, it is suggested to

use the CMOS RAM chip. But, the use of EPROM or EEPROM is recommended when controlling a multiple number of the identical machines at the same time.

8. **Internally contained external source trouble diagnose relay**

   For the W1Ø internally incorporates the external source trouble diagnose relay, it permits easier recognition of a trouble in the external device.

9. **Message prompt capability and manual control command input on the programmer**

   It is feasible to display on the programmer display window the message stored in a register, which may be used to alert an abnormal condition or production status. (Message display function)
   The programmer keyboard can be used for manual command entry key, which may be used to change the timer current value or to manually access the work on the bed. (Device input function)

§ 2 WHAT MUST BE CARED FOR

The following are requisite for the proper operation and storage of the W1Ø.

Installation requirements

Do not install the module under the following environments:

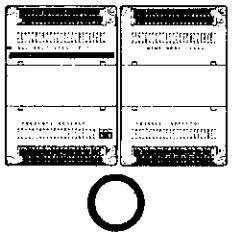
- Where exposed to a direct sunlight or where ambient temperature exceeds a range of Ø to 55℃. It should be Ø to 4Ø℃ when the programmer is installed.
- Where the humidity exceeds a range of 35 to 9Ø%RH or where moisture condensation is met by an abrupt temperature changes.
- Where corrosive gas or inflammable gas is prevailing.
- Where direct vibration or impact is encountered.

For other installations and wirings, refer to Sections [5] and [6].

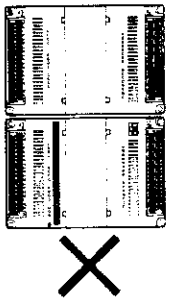
Panel mounting

Install the W1Ø on the flat panel placed in level or the ZW-1ØTL double deck option. Vertical installation of the module may invite a temperature rise.

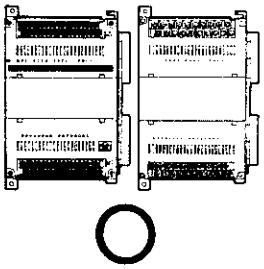
Side by side on flat surface



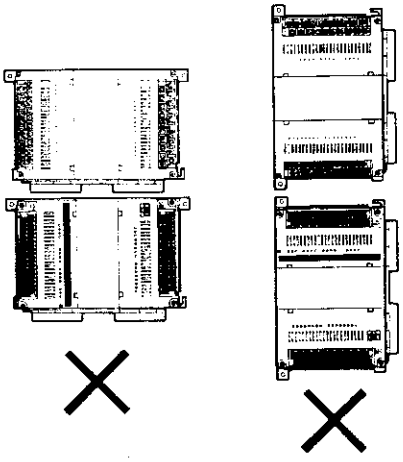
On top of another



Two on the deck on flat surface



Two on the deck on top of another



All screws must be tightened firmly to hold the module secure.

■ Component module interfacing

Component module expansion connectors and expansion cable connectors must be fastened firmly and correctly.
Do not treat the connector locks with a strong force.
Never try to fasten or unfasten the connector while the power is on to the W1Ø. It may result in trouble.
The total distance of the expansion cable must be 7ØØmm at a maximum, in order to avoid malfunction in the machine.

■ Emergency stop

There are the following two ways of emergency stops for the device that incorporates the W1Ø.

1. When the W1Ø detected an external failure

   All outputs can be turned off when the special relay 661 (all outputs disable relay) is turned on.

2. When the W1Ø detected an internal failure

   Although all outputs can be turned off when octal ØØ1 is sent to the system memory #2Ø3 (output state selection while CPU stops), it is preferable to provide an external emergency stop circuit.

■ Ground

Do not share the W1Ø ground line for connection with a high tension ground line, but it has to be connected independently with ground of more than Class 3 ground.

■ Battery

From time to time, pay attention for the expiration period of the memory backup battery to replace it with the fresh one within the given period.
It is also necessary to use the battery to protect the data memory from power supply discontinuation, even if a ROM was used for the memory chip.
Do not remove the battery and leave the W1Ø power off. If the battery is installed in this state, it may possibly affect the life of the battery.
The battery has to be installed after the power is turned on to the W1Ø.
Since the battery in the base module had been factory installed, note the life of the battery noted in the battery expiration label which is attached on the connector cover of the base module.

■ Static electricity

As an irregular static electricity may possibly be encountered under dry climate, it would be necessary to touch your hand with the grounded metallic area to release static before touching the W1Ø directly.

■ Cleaning

Never use such as thinner to clean the module, as it may melt and discolor the cabinet surface.

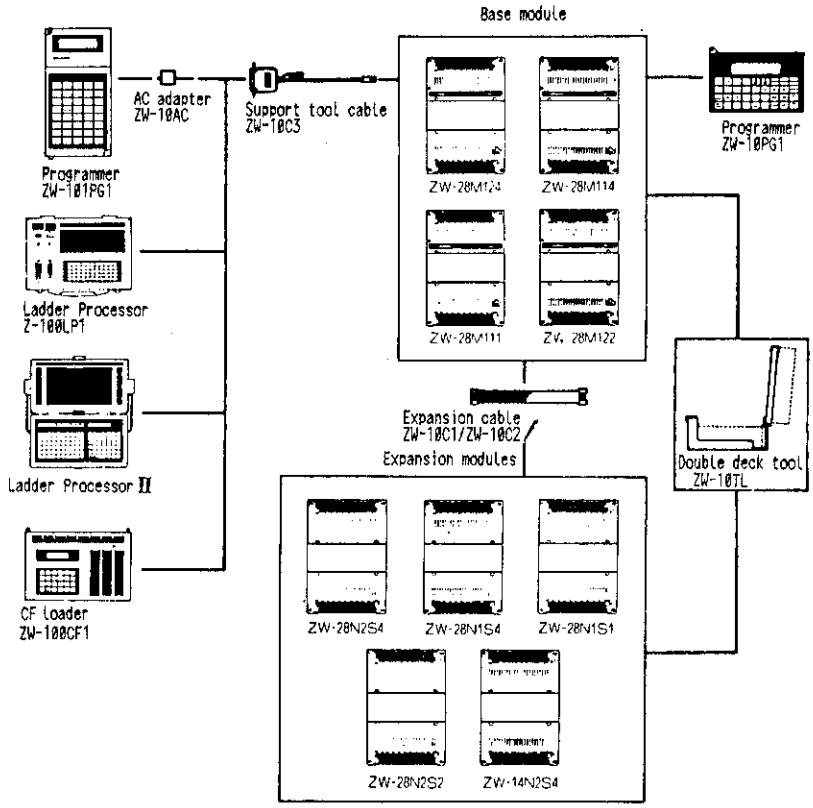
■ Storage

For the base module contains the internal battery, it should not be stored in a hot and damp area.
It has to be within a range of −20 to +70℃ to store the base module and expansion module.

§ 3 SYSTEM CONFIGURATION AND SPECIFICATIONS

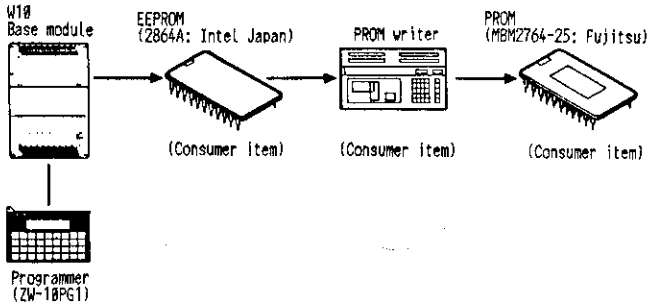
3-1. W10 series system configuration

[1] Basic system configuration

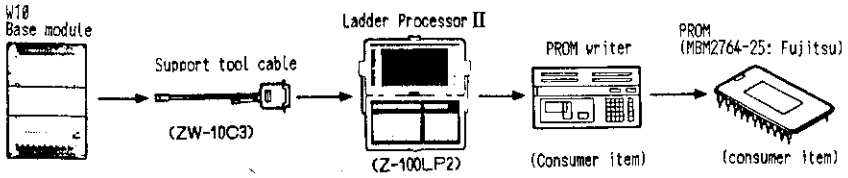


NOTE-1:
There are the following two ways to store the program in the PROM memory.

1. To store with the EEPROM in use

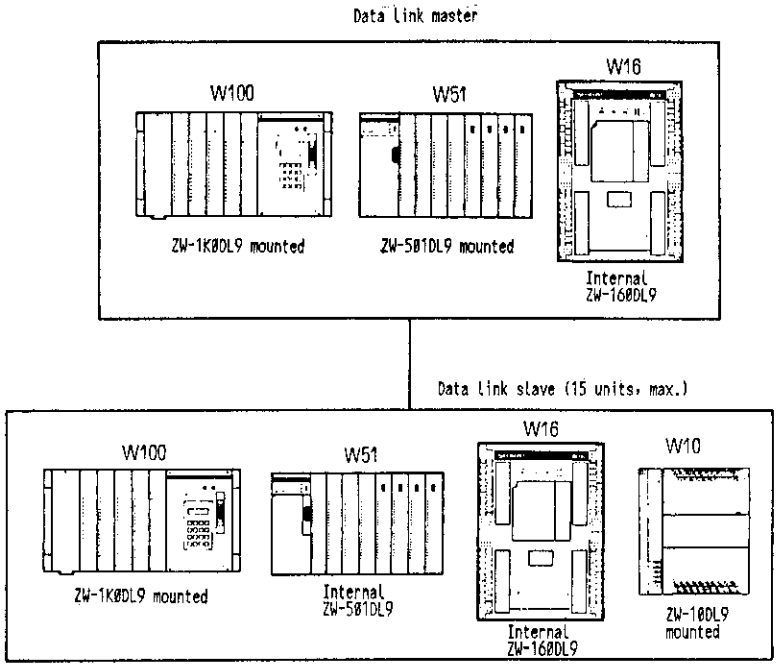


2. To store with the Ladder Processor II in use

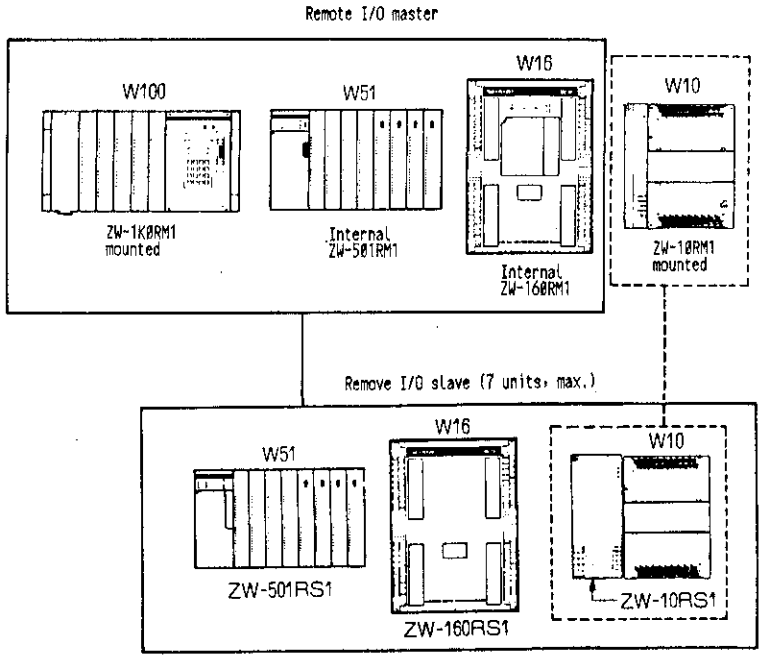


[2] System configuration with the link module in use

■System configuration with the link module



■System configuration with the remote I/O module



NOTE-1:
For detail of the link module, see the instruction book that comes with the link module.
NOTE-2:
When the W1Ø is used in the master remote I/O module, only the W1Ø can be used in the slave module.

3-2. List of modules

Unit name	Model name	Description	Accessory	
			Item name	Qty
Base module	ZW-28M124	Contains CPU, memory, and power supply. Program size: 1920 words DC24V inputs: 16 point Relay outputs: 12 points High speed counter: 1 point	M4x60 screw Instructions	4 1
	ZW-28M114	Contains CPU, memory, and power supply. Program size: 1920 words AC100V inputs: 16 points Relay outputs: 12 points High speed counter: 1 point		
	ZW-28M111	Contains CPU, memory, and power supply. Program size: 1920 words AC100V inputs: 16 points Triac outputs: 12 points High speed counter: 1 point		
	ZW-28M122*	Contains CPU, memory, and power supply. Program size: 1920 words DC24V inputs: 16 points Transistor outputs: 12 points High speed counter: 1 point		
Expansion module	ZW-28N2S4	DC24V inputs: 16 points Relay outputs: 12 points		
	ZW-14N2S4	DC24V inputs: 8 points Relay outputs: 6 points		
	ZW28N1S4	AC100V inputs: 16 points Relay outputs: 12 points		
	ZW-28N1S1	AC100V inputs: 16 points Triac outputs: 12 points		
	ZW-28N2S2*	DC24V inputs: 16 points Transistor outputs:12 points		

*To be released March, 1987.

Unit name	Model name	Description	Accessory	
			Item name	Qty
Programmer	ZW-10PG1	Programmer with a 16-digit LCD dot matrix display	Base module interfacing cable (1.8m) Cassette tape recorder interfacing cable (1.5m)	1 1
	ZW-101PG1	Programmer with two-line 16-digit LCD dot matrix display	W16/W51/W100 control module interfacing cable (3m) Cassette tape recorder interfacing cable (1.5m) Connector lock spring Instruction manual	1 1 1 1
Data link slave module	ZW-10DL9	Can be interfaced with a maximum 16 units of programmable controller 16 points, maximum	Instruction manual	1
Remote I/O master module	ZW-10RM1*	Can be interfaced with a maximum 7 units of W10 slaves 196 points, maximum	Instruction manual	1
Remote I/O slave	ZW-10RS1	Internal power supply 112 remote points, maximum		
Expansion cable	ZW-10C1	Expansion module interface cable (90m)		
	ZW-10C2	Expansion module interface cable (260m)		
Support tool interfacing cable	ZW-10C3	W series interchangeable support tool interfacing cable (1.8m)		
Double deck rack	ZW-10TL	Base/expansion module double mounting rack	Instruction manual	1
AC adapter	ZW-10AC	ZW-101PG1 AC adapter	Instruction manual	1

*To be released March, 1986.
NOTE-1: For detail of date link, remote I/O, and ZW-101PG1 programmer, refer to their instruction manual.

Unit name	Model name	Description	Accessory	
			Item name	Qty
Ladder processor	Z-100LP1	EL display 1 master control + 12 relay contacts + 1 coil (horizontal) 6 relay lines + 2 message lines (vertical)	AC cord Ground cord Printer interface cable Shoulder strap Instruction manual	1 1 1 1 1
Ladder processor Ⅱ	Z-100LP2	EL display 11 relays + 1 coil (horizontal) 11 relay lines + 2 message lines (vertical)	Mini-glass tube fuse (time lug type, 3A) RS232C 25-pin connector CF loader interface cable AC cord Ground cord Printer interface cable Instruction manual	1 1 1 1 1 1 1
CF loader (compact floppy disk loader)	ZW-100CF1	3" compact, two-sided floppy disk Memory size: 312KB Display: 16 characters× 2 lines	Mini-glass tube fuse (AC125V, 2A) Soft case Shoulder belt AC cord Ground cord Instruction manual	1 1 1 1 1 1

NOTE-2:
For detail of the ladder processor, ladder processor Ⅱ, and CF loader, refer to their instruction manual.

3-3. Specifications

[1] General specification (base module, expansion module)

Item	Specification
Supply voltage	AC85V~132V
Supply frequency	50/60Hz
Power failure retention time	Normal operation is guaranteed for an instant power drop of less than 10ms.
Insulation resistance	More than 10MΩ across external high tension line and ground as measured on the DC500V megger.
Dielectric strength	AC1500V, 50/60Hz, one minute, as measured across the external high tension line and ground.
Noise immunity	1000Vp-p, 1μs, across power supply line and ground as measured on the noise simulator.
Storage temperature	−20 to +70℃
Operating temperature	0 to +55℃
Operating humidity	35 to 90%RH (non condensing)
Vibration resistance	Conforms to JIS C-0911. frequency at 16.7Hz, amplitude at 3mmp-p, constantly in direction of X, Y, and Z, two hours each.
Shock resistance	Conforms to JIS C-0912. 10G in direction of X, Y, and Z, three times each.
Power consumption	30W, maximum
Weight	Approximately 1.3kg for the base module. Approximately 0.6kg for the expansion module.
Environmental requirements	Must be free from corrosive fume and dust.
Ground requirement	Class 3.

[2] Performance specification

Item		Specification	
Programming mode		Stored program	
Control mode		Cyclic operation	
Execution speed		5μs/instruction for basic instructions, except for timer, counter, and application instructions.	
Instruction sets		11 Basic instructions 25 application instructions (use of the [RUN]key)	
Programming size		1920 words	
User program area memory chip		CMOS RAM with internal battery backup, or EPROM, EEPROM (individual ROM, optional)	
Battery		Lithium battery cell	
Control I/O points		140 points, maximum	
Data memory	I/O relays	140 points (000~237)	The retention relay area (area to keep the state immediately power failure) can be be incremented or decremented when the system memory (#200) was so programmed.
	Auxiliary relays	224 points (240~577)	
	Retention relays	40 points (600~647)	
	Special relays	External trouble diagnostic relay-1 (646) External trouble diagnostic relay-2 (647) External diagnostic error-1 (650) External diagnostic error-2 (651) Key device switch (652) Display device switch (653) Non-carry flag (654) Error flag (655) Carry flag (656) Zero flag (657) 0.1 second clock (660) All outputs disable (661) High speed counter start (662) High speed counter reset (663) 1 second clock (664) Preset value change switch (665) All time OFF contact (666) Memory failure (670) CPU failure (671) Battery failure (672) I/O failure (673) Option failure (674) ROM failure (676) Power supply failure (677)	

<table>
<tr><th colspan="2">Item name</th><th>Specification</th></tr>
<tr><td></td><td>High speed counter</td><td>1 point (0000~9999), single phase 5KHz</td></tr>
<tr><td></td><td>Timer/counter</td><td>Total 48 points (00~57), b000~b137
Choice of timer duration: 0.1~199.9 sec).
But, 4 points (54~57) can be used as a 10ms timer (0.01~19.99 sec)
Counter preset range: 1~1999.
Counter contents are retained during power down.</td></tr>
<tr><td></td><td>Register</td><td>128 bytes (9000~9177)</td></tr>
<tr><td colspan="2">System memory</td><td>For operational assignment of the base module (retained during power down)
<table><tr><th>Address</th><th>Function</th></tr><tr><td>#307</td><td>Choice of ZW-10PG1 programmer message in English.</td></tr><tr><td>#100</td><td>Base module run/stop</td></tr><tr><td>#101</td><td>Run/stop from link module</td></tr><tr><td>#200</td><td>Retention relay area assign</td></tr><tr><td>#201</td><td>Timer instruction reset/retain at power off</td></tr><tr><td>#202</td><td>Counter instruction ON reset/ OFF reset choice</td></tr><tr><td>#203</td><td>Choice of output state when the main module is at halt</td></tr><tr><td>#210 thru #217</td><td>Error code storage</td></tr><tr><td>#227</td><td>Choice of 10ms timer</td></tr></table>
Refer to Paragraph 8-3 "System memory" for detail of the system memory.</td></tr>
</table>

NOTE-1:
Refer to Paragraph 7-3 "I/O relay number" for presetting of I/O relay number.

Item		Specification						
	Item	Function	PC state	Indicator			Special relay	Error code
				RUN	FAULT	POWER		System memory
Self check	Memory failure	Memory check	Stop	Off	On	On	670	21
	CPU failure	Watchdog timer					671	31
		RAM test (W/R)						32
		ROM test						34
	I/O failure	I/O data bus					673	44
		I/O module						46
	Power supply	Power interrupt/ drop			Off	Off	677	13
	Option module	Option failure			On	On	674	53
	Battery failure	Low battery	Run	On	On	On	672	22

NOTE-1:
A part of the retention relay area (600~647) may be used as a special relay when using the link module of data link and remote I/O.

for detail, refer to the instruction manual of the link module.

NOTE-2:
The error code is in a BCD format.

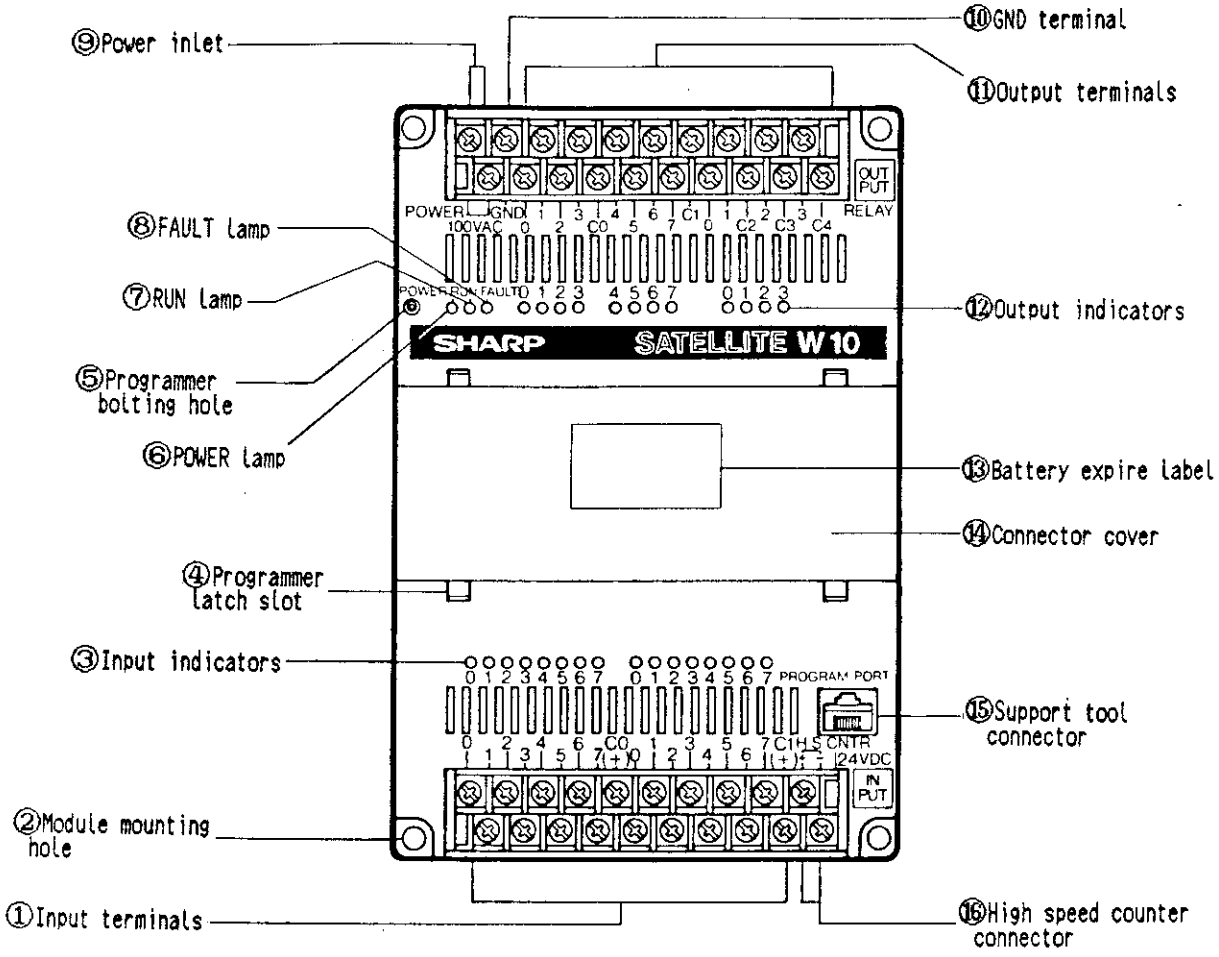
NOTE-3:
The programmable controller stops and the FAULT lamp turns off in the program mode.

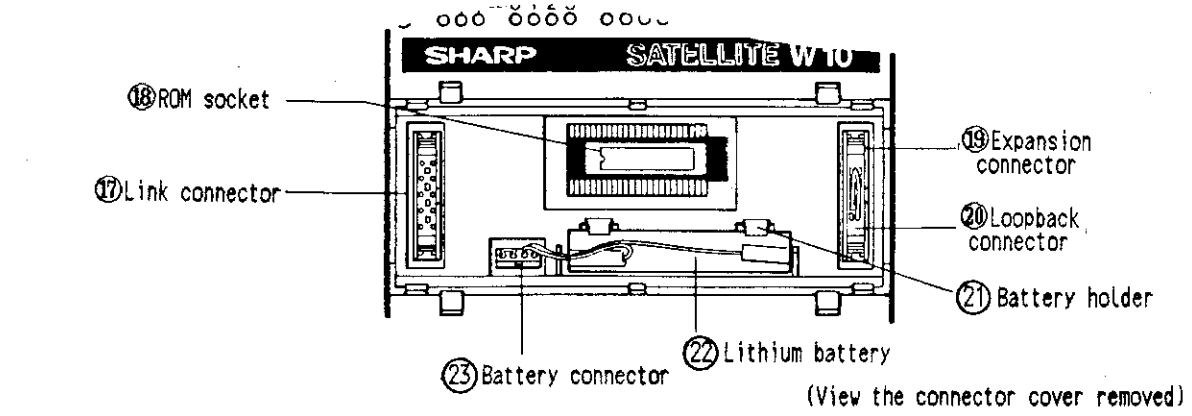
NOTE-4:
In the memory check, the number of differentiate memories are included. The address in memory failure is stored in #054 and #055 of the system memory.

§ 4 CONFIGURATION OF EACH MODULE AND FUNCTIONS

4-1. Base module

[1] Parts identification and functions





(View the connector cover removed)

① Input terminal

The cable from the input module is connected to this terminal.

② Module mounting hole

The base module is mounted and secured on the panel through the hole using the M4×60 screw.

③ INPUT lamp

This LED comes active when an input module is ON.

④ Programmer latch slot

Tab of the ZW-10PG1 programmer cabinet is latched in this hole.

⑤ Programmer bolting hole

Programmer bolting hole.

⑥ POWER lamp, green

The lamp comes active when 5V power is in on to the power supply unit in the base module.

⑦ RUN lamp, green

During normal operation: ON

During programming with the support tool in connection: Flashes (the PC stops operation)

Error found by the self-diagnosis: OFF (ON in the case of a battery failure)

⑧ FAULT lamp, red

ON when an error is detected by the self-diagnosis and the PC stop its operation (the PC continues to operate in the case of a battery failure).

⑨ Power inlet

The power cable is connected to this terminal.

⑩ GND jack

The jack must be connected with the Class 3 ground using the cable used for this purpose only, to prevent electrical hazard.

⑪ Output terminal

The cable from the output module is connected to this terminal.

⑫ OUTPUT lamp

This LED comes active when an output is active.

⑬ Battery expire label

The label shows the expiration date of the memory backup battery. The battery needs to be replaced with the fresh one before the date. The label must be replaced by the new label with the new expire date upon replacement.

⑭ Connector cover

The connector cover has to be removed in one of the following:

When the expansion cable is connected or disconnected to/from the connector.

When the ROM is mounted or dismounted.

When the lithium battery is replaced.

⑮ Support tool connector

To this connector is connected the support tool such as the programmer.

⑯ High speed counter connector.

The cable from the rotary encoder is connected.

⑰ Link module connector

To this connector is connected the expansion cable from the W10 link module (remote I/O master: ZW-10RM1, data link slave: ZW-10DL9).

⑱ ROM socket

On this socket is mounted the PROM or EEPROM CHIP.
When the program contained ROM is mounted on this socket, the control will pick up the ROM as the program residing memory.

⑲ Expansion connector

The expansion cable is connected to this connector.

⑳ Loopback connector

The expansion connector (OUT) of the termination module must be fastened to this connector.

㉑ Battery holder

The lithium battery cell must be installed in this holder.

㉒Lithium battery

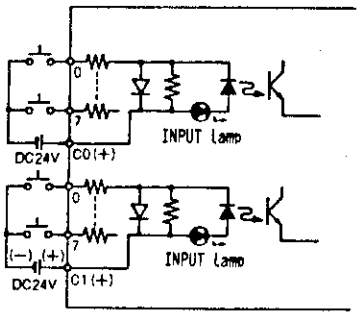
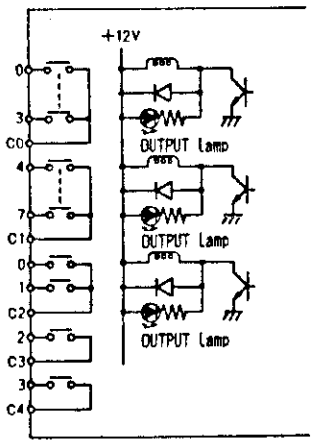
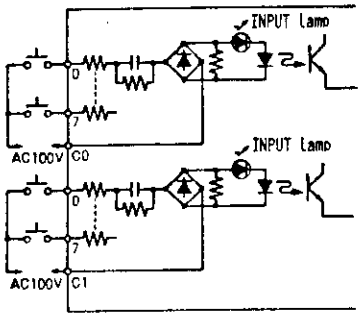
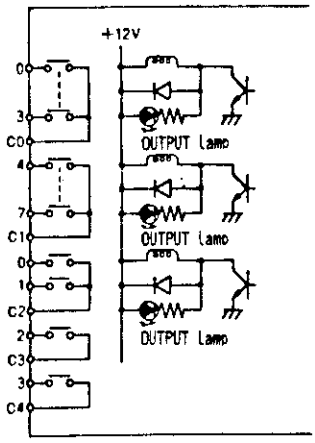
This battery is used for memory backup. It is also required in using the ROM, in order to back up the data memory.
It has to be replaced with a fresh one before the expiration date.

㉓Battery connector

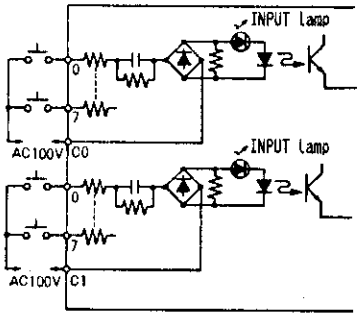
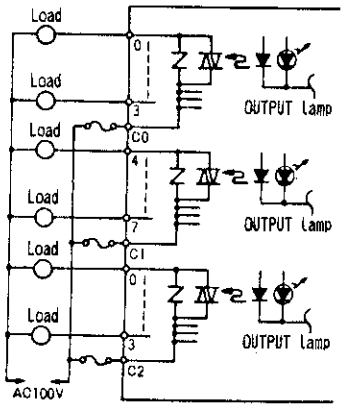
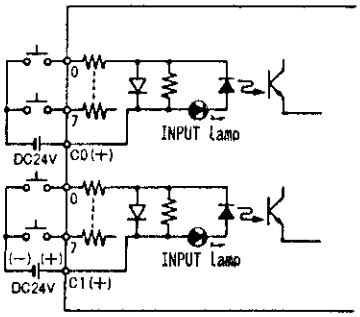
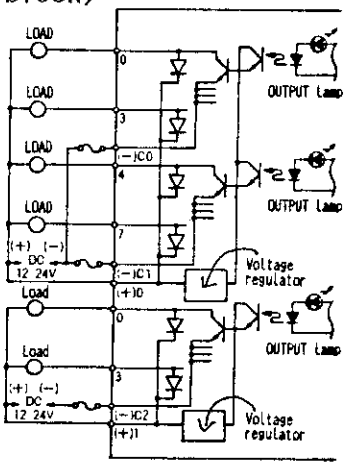
Memory retention power is supplied from the lithium battery through this connector.

[2] Specification

			ZW-28M124	ZW-28M114
Input block	Insulation method		Photocoupler isolated	Photocoupler isolated
	Input points		16 points	16 points
	Rated input voltage		DC24V (Ripple at 15%, max.)	AC100V 50/60Hz, waveform distortion less than 5%
	Maximum input voltage		DC26.4V	AC132V
	Input voltage level	ON level	14V, max.	80V, max.
		OFF level	6V, min.	30V, min.
	Input current level	ON level	4mA, max.	8mA, max.
		OFF level	1.5mA, min.	3mA, min
	Input impedance		Abt 3.5KΩ	Abt 12KΩ (50Hz), Abt 10KΩ (60Hz)
	Response time	OFF→ON	7ms, max.	15ms, max. (AC100V)
		ON→ON	10ms, max.	30ms, max. (AC100V)
	Status display		Active when ON (LED)	Active when ON (LED)
	Terminal block		20-terminal block (16 inputs, 2 commons, 2 high speed counter lines), block made of black resin P=9.525, M3.5×8, self-locking	
	Common terminal		1 common per 8 points ((+) supply, common)	1 common per 8 points
Output block	Insulation method		Relay isolated	
	Output points		12 points	
	Maximum make/break voltage & current		AC250V/DC30V, 2A (resistance load)	
	Minimum load		5V, 10mA	
	Life		Mechanical: 20,000,000 actions, min. Electrical: 1. 100,000 actions, min., for the maximum make/break voltage and current resistance load. 2. 200,000 actions, min., for the magnetic contactor load, AC200V, 0.5A, COSφ=0.4	
	Leak current		None	
	Response time	OFF→ON	15ms, max.	
		ON→OFF	15ms, max.	
	Status display		Active when ON (LED)	
	Terminal block		20-terminal block (12 outputs, 5 commons, 2 AC supply lines, 1 ground), terminal block made of black resin P=9.525, M3.5×8 self-locking	
	Common terminal		1 common per 4 points.....2 circuits 1 common per 2 points.....1 circuit Independent common.....2 circuits	
Weight			Abt 1.3kg	

.	ZW-28M124	ZW-28M114
Note	(Input block) Pay attention to use a proximity switch or photoelectric switch. It may not go off, sometimes.	(Input block) Pay attention to use a proximity switch or photoelectric switch It may not go off, sometimes.
Circuit diagram	(Input block)  (Output block)  	(Input block)  (Output block) 

			ZW-28M111	ZW-28M122 (To be released March, 1987)
Input block	Insulation method		Photocoupler isolated	Photocoupler isolated
	Input points		16 points	16 points
	Rated input voltage		AC100V, 50/60Hz, waveform distortion at 5% maximum	DC24V, ripple at 15%
	Maximum input voltage		AC132V	DC26.4V
	Input voltage level	ON level	80V, max.	14V, max.
		OFF level	30V, min.	6V, min.
	Input current level	ON level	8mA, max.	4mA, max.
		OFF level	3mA, min.	1.5mA, min.
	Input impedance		Abt 12kΩ(50Hz), Abt 10kΩ(60Hz)	Abt 3.5kΩ
	Response time	OFF→ON	15ms max.(AC100V)	7ms, max.
		ON→OFF	30ms max.(AC100V)	10ms, max.
	Status display		Active when ON (LED)	Active when ON (LED)
	Terminal block		20-terminal block (16 inputs, 2 commons, 2 high speed counter lines) P=9.525, M3.5×8 self-locking Terminal block made of black resin	
	Common terminal		8 points per common	8 points per common ((+) supply common)
Output block	Insulation method		Photocoupler isolated	Photocoupler isolated
	Output points		12 points	12 points
	Rated output voltage		AC100/110V, 50/60Hz, waveform distortion at 5%, max.	DC24V
	Output voltage range		AC15～121V	DC10～30V
	Rated maximum output current		AC0.6A/point (1.2A, max. per 1 group, 4 points)	DC1A/point (1.2A, max. per 1 group, 4 points)
	Surge on current		Output element performance 80A (1 cycle)	Output element performance 5A (10ms, max.)
	Leak current		2mA, max. (sine wave)	0.1mA, max.
	On voltage		1.6V, max.(0.6A)	2V, max.(1A)
	Response time	OFF→ON	1ms, max. (resistance load)	1ms, max. (resistance load)
		ON→OFF	10ms, max. (resistance load)	1ms, max. (resistance load)
	Status display		Active when ON (LED)	Active when ON (LED)
	Terminal block		20-terminal block (12 outputs, 3 commons, 2 AC supply lines, 1 ground, 2 unused) P=9.525 M3.5×8 self-locking	20-terminal block 12 outputs, 3 commons, 2 DC supply lines, 1 ground) P=9.525, M3.5×8 self-locking
	Common terminal		1 common per 4 points	1 common per 4 points ((-) supply, common)
Weight			Abt 1.3kg	

	ZW-28M124	ZW-28M114 (To be released March, 1987)
Note	(Input block) Pay attention to use a proximity switch or photoelectric switch. It may not go off, sometimes. (Output block) It may not go off when using a neon lamp, light load relay, etc., because of leak current.	(Input block) Pay attention to use a proximity switch or photoelectric switch It may not go off, sometimes. (Output block) There may be a delay of more than 1 seconds in ON to OFF response time depending on the value of the load, when using a inductive load.
Circuit diagram	(Input block)  (Output block)  	(Input block)  (Output block) 

[3] Precautions in the operation of input and output modules

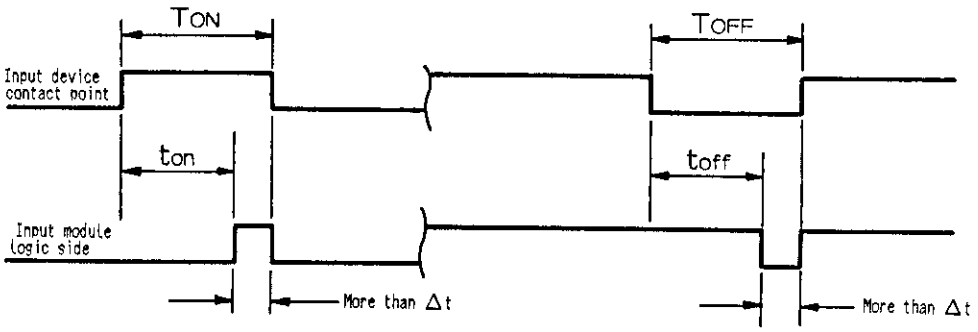
1) Control I/O points

For the maximum number of W10 control I/O points is 140 points, it is possible to interface up to four expansion modules per base module.

2) Input signal OF/OFF timings

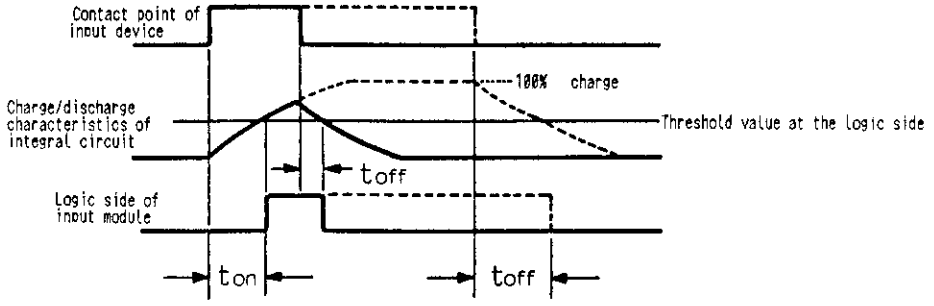
There is a need of satisfying the following condition to firmly reflect the ON/OFF state of the input device (such as limit switch) for the operation of the PC.

Input device ON time (T ON)	T on > Δ t + t_{on}
Input device OFF time (T OFF)	T off > Δ t + t_{off}
	Δ t...One scan time of PC
	t_{on}...Input module OFF to ON response time
	t_{off}..Input module ON to OFF response time



During the I/O processing at the beginning of each scan cycle, the ON/OFF state of the input logic side is stored in the data memory, to be used for the input information required for the operation of the user program during that scan cycle. Therefore, if the ON/OFF time of the input logic side be less than one scan time (Δt), the state of ON/OFF may not be stored in the data memory.

NOTE-1:
Response time of input module depends on the charge/discharge characteristics of the integral circuit of the input module, therefore, it may vary according to the time that ON or OFF state continued.



If the input device ON time were too long (shown with a dotted line), there is a difference in "toff" than the case the ON time is shorter (shown with a solid line).

(Worksheet example when a DC input module is used for input)

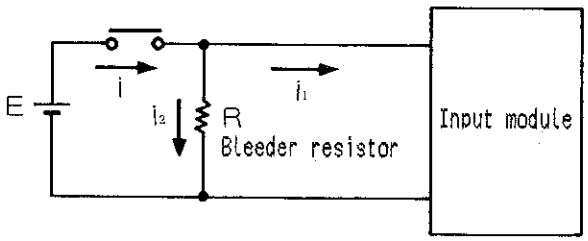
If one scan time is assumed to be 5 ms, the following results.

$$T\ ON > \Delta t + t_{ON} = 5 + 7 = 12(ms)$$

$$T\ OFF > \Delta t + t_{off} = 5 + 10 = 15(ms)$$

3) Bleeder resistor

Only a certain amount of current can flow through the contact points of the input device, depending on the input impedance and input supply voltage. (About 7mA when DC24V is added by the ZW-28M124.)
As it may possibly cause a contact failure with this current depending on the contact type, it is suggested to insert an external bleeder resistor in such event.



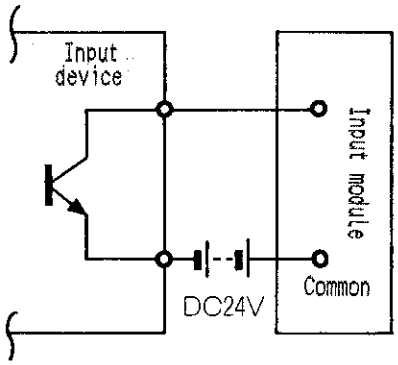
$i = i_1 + i_2 = i_1 + \frac{E}{R}$

Wattage of the bleeder is:

$P > \frac{E^2}{R} \times 2$

4) To connect a transistor output device to the DC input module

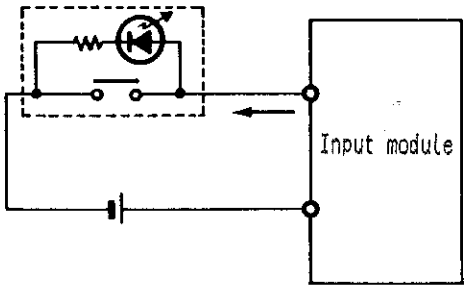
Choose the open collector output type in order to use the input device such as contactless relay, photoelectric switch, or proximity switch.



NOTE-1:
Make sure that the rating of the transistor meets the given input supply voltage and input current.

5) Pay attention for the OFF time current of the input device.

(a) Limit switch with LED



The input module may not turn OFF because of the LED driving current, even if the limit switch was OFF.

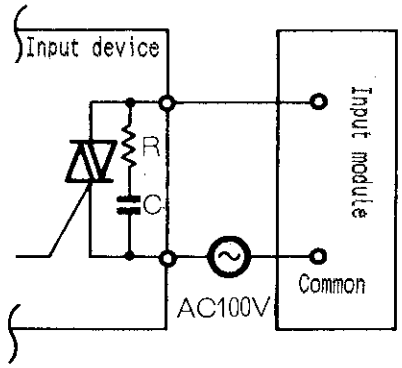
(b) Proximity switch, photoelectric switch

For those of the AC or DC two-wire type, consumption current flows through the detect circuit during the OFF time, which may not turn the input module OFF. As it is noted as "leak current" in the specification of such as the photoelectric switch, make sure that the value is below the OFF level of the input module.

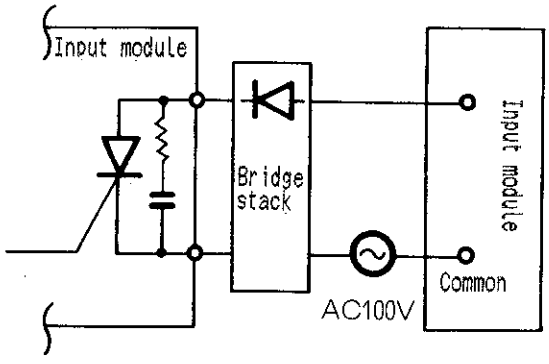
6) **When the output circuit of the input device is of a triac output or thyristor output.**

For a CR network is sometimes implemented as a surge killer to prevent a triac or thyristor arc error, it may impede the input module to turn OFF due to a leak current caused in this CR network. Although it is preferable to remove the CR network, the value of C could be set below 0.033μF for AC100V, in case it is not possible to remove it.

Triac output example



Thyristor output example



7) Maximum voltage and current that can be broken and made at the output module

Within the given rating, output module as solenoid valve and magnetic switch can be directly driven.

Module name	Rated voltage	Maximum voltage	Rated maximum current	Surge on current
ZW-28M111 ZW-28N1S1	AC100V	AC121V	0.6A	80A (per cycle)
ZW-28M122 ZW-28N2S2	DC24V	DC30V	1A	5A, 10ms, max.
ZW-28M124 ZW-28M114 ZW-28N1S4 ZW-28N2S4 ZW-14N2S4		AC250V DC30V	2A	

In case a same group sharing the same common is to be turned on at the same time, the total current must be the value shown in the table below.

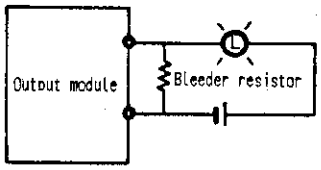
Module name	Points per group	Maximum output current
ZW-28M111 ZW-28N1S1	4 points	1.2A
ZW-28M122 ZW-28N2S2	4 points	1.2A

NOTE-1:
To use the ZW-28M124, ZW-28M114, ZW-28N2S4, ZW-28N1S4, and ZW-14N2S4, take the power-factor into consideration to use the inductive load such as solenoid valve and magnetic switch.

8) Lamp load and rush current

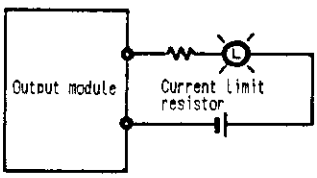
For the incandescent lamp, a rush current of 10 to 20 times the normal current flows for a period of about several ten milliseconds. As a means to reduce the rush current, there are two ways: to insert a bleeder resistor or a current limit resistor.

(a) Insertion of bleeder resistor



Slight degree of current that does not activate the lamp should be applied when the output module is OFF.

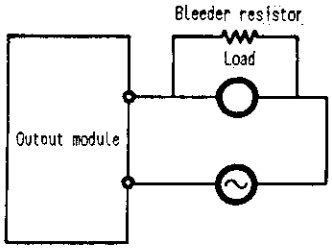
(b) Insertion of current limit resistor



Current must be limited to the value of the current limit resistor. For it abates the voltage added to the lamp if the resistor is too large, the resistor value should be determined on the basis of the brightness required for the lamp.

9) Triac output leak current

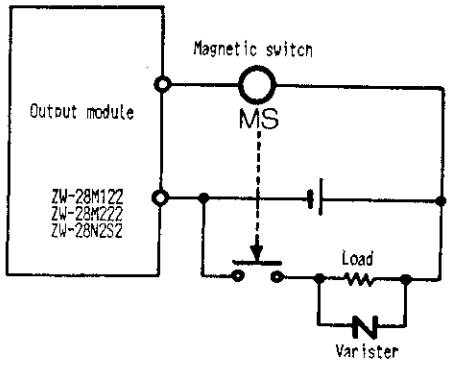
When the triac output module (ZW-28M111, ZW-28N1S1) is OFF, a leak current of less than 2mA flows through. To drive the load that does not go OFF because of this leakage current, a bleeder resistor should be inserted parallel to the load.



The value of resistor must be calculated on the basis of the load used, it may possibly be about 3W, AC100V, for the resistance of about 10kΩ.

10) To drive a large current inductive load by the transistor output module

A surge absorbing diode is implemented in the transistor output module (ZW-28M122, ZW-28N2S2) to prevent destruction of the output transistor by surge caused when connected with the load "L". Energy accumulated in the coil is consumed as Joule in the diode by the resistance of the inductive load heat when the output turns from ON to OFF. Delay will be met for the restoration time until the energy goes below the load retention force.



The delay time is dependent on the value of "L", resistor value, and retention force. If this delay should be a problem after the test, the load should be driven via the magnet switch. It makes the value relatively smaller than the use of the solenoid valve, and it therefore improves the response time.

11) Protect fuse

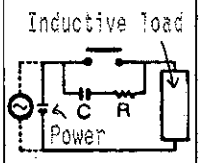
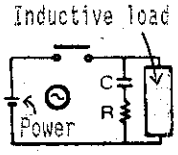
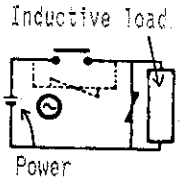
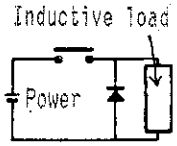
An external fuse must be used for protection of the printed circuit pattern and signal lines from burn-out; one each per group (in the unit of common) in the W10 output module. But, the fuse is not used for overcurrent protection of the output element.
For the installation of the fuse, refer to Paragraph 6-2, "Wirings to modules".

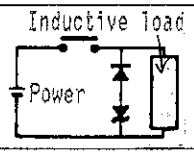
12) Surge preventing means

There is a possible generation of a several thousands volts surge in making and breaking the load "L", depending on the kind of load. Although output surge preventive means has been implemented in the ZW-28M111, ZW-28N1S1, ZW-28M122, and ZW-28N2S2, it requires a surge prevention for the transistor output module (ZW-28M122, ZW-28N2S2), when a long signal wire is used to the load. For it is not possible to implement the internal surge preventive means in the relay output module (ZW-28M124, ZW-28M114, ZW-

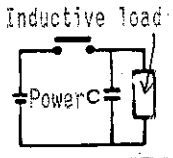
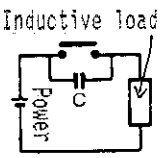
28N2S4, ZW-28N1S4), use of an external surge killer is required to extend the life of contact points, to prevent noise, to reduce carbon arc generation, and raising of nitric acid.
However, incorrect use of the arc killer may invite an adverse effect. Also, it must be noted that the use of the arc killer causes the restoration time to prolong in some degree.

Typical arc killer examples

Circuit example		USE AC	USE DC	Features, etc.	Choice of element
CR method		‡ △	○	‡When operated under AC power, impedance of the load should be smaller than that of the CR network. When the load is a relay and solenoid, a delay may appear in the restore time.	The following may be used for the approximate value: C: 1 to 0.5μF per 1A of contact point current. R: 0.5 to 1Ω per 1V of contact point voltage. They may not coincide necessarily depending on a variation of the load or relay characteristics. Make sure in the actual case, considering that C is used for suppressing discharge during breaking of the contact points and R for current limiting when power is applied next. C must have the voltage withstanding about 200V to 300V. In the case of the AC circuit, use the polarless AC apacitor.
		○	○	When the supply is 24V or 48V, the CR network should preferably be inserted across the load. In the case of 100V to 200V, it should be insserted across contact points.	
Varister method		○	○	In this mode, undesired higher voltage is not added across contact points because of the constant voltage characteristics of the varister. Even with this method, there may be a slight delay in the restore time. When the source voltage is 24V or 48V, it is preferable to insert it across the load for more effects. For 100V to 200V, insert it across the contact points.	
Diode method		×	○	Energy stored in the coil is released in a form of the current through the parallel inserted diode to consume it as joule heat by the resistance of the inductive load. This method requires more delay in the restore time than the CR method.	Use the diode whose counter voltage withstanding is ten times the circuit voltage which has the forward current. For the electronic circuit of not so high in its circuit voltage, it may be possible to use the one that has the counter voltage withstanding of two or or three times the supply voltage.

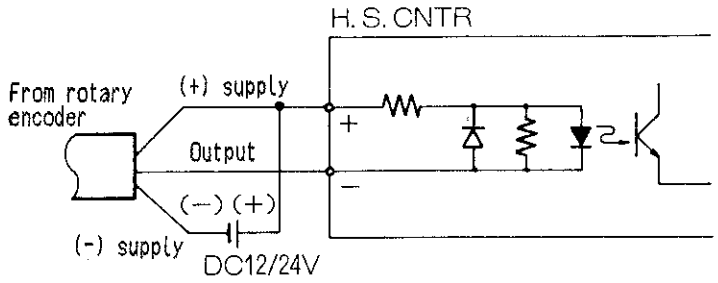
Circuit example		Use AC	Use DC	Features, etc.	Choice of element
Diode + zener diode method		×	○	It is recommended to use when too much delay is met by the diode method.	The zener voltage of diode should be about the same as the supply voltage.

Avoid the use of an arc killer in the following manner:

	Though it is effective to kill arc at circuit breaking, it is likely to melt the contact as charge current flows to C when the contact is closed.		Though it is effective to kill arc at circuit breaking, it is likely to melt the contact as short current flows to C when the contact is closed.

Normally, the DC inductive load is somehow difficult to make and break as compared with the resistance load. But, improvement may be attained as much as the resistance load if a proper arc killer was chosen.

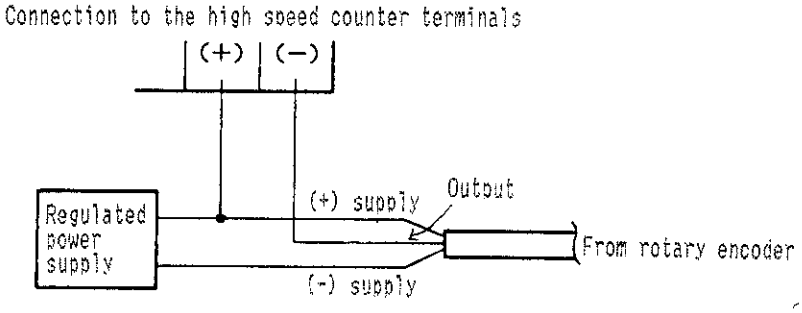
[4] **High speed counter specification** (equipped standard on the base module only)

Item		Specification
Maximum counter speed		5KPPS, square waveform (maximum pulse width: 100μs, min.)
Capacity		4 digits, decimal (counted in the internal relay area ㅋ70 and ㅋ71)
Counter input method		Single phase addition
[External input signal]		
Input voltage level	ON level	DC10.8V
	OFF level	DC2V
Input current level	ON level	6mA
	OFF level	0.5mA
[External power supply]		
Rating		DC12/24V
Maximum added voltage		DC26.4V
Terminals		2(+, -)
Count condition		Counted when the internal relay (662) is on.
Reset condition		Reset when the internal relay (663) is on.
Remarks		Use a transistor open collector output type for the input device such as rotary encoder.
Circuit diagram		
Input impedance		Abt 1.7kΩ/DC12V, abt 1.6kΩ/DC24V

[5] Requirements for the rotary encoder

Device connected to the high speed counter input such as rotary encoder must meet the following requirements.

Item	Requirements
Supply power	DC12V±12% or DC24V±10%
Output waveform	Square waveform (minimum pulse width: 100μs, min.)
Output signal	Single phase
Output circuit	TTL, open collector



NOTE-1:
It must have the output circuit whose sink current is more than 30mA (DC12/24V).
To use the voltage output type or current limiting resistor incorporated encoder, insert a current amplifier between the encoder and the high speed counter input line or remove the current limiting resistor.

[6] ROM installation

The base module has a 2K-word RAM for the program memory. But, it is also possible to user the PROM (MBM2764-25: FUJITSU) or EEPROM (2864A: Intel Japan) to operate with. When the program implemented ROM is mounted on the base module ROM socket, the ROM is automatically selected for the operation. care must be taken in handling the ROM chip as it is liable to static electricity. Pins should never be bend, fold, or touched directly with your fingertip. Also, care must be taken for the installing direction of the chip. Mounting in a wrong direction or in a wrong manner will result in malfunction.

1) Turn off the main power supply to the base module.

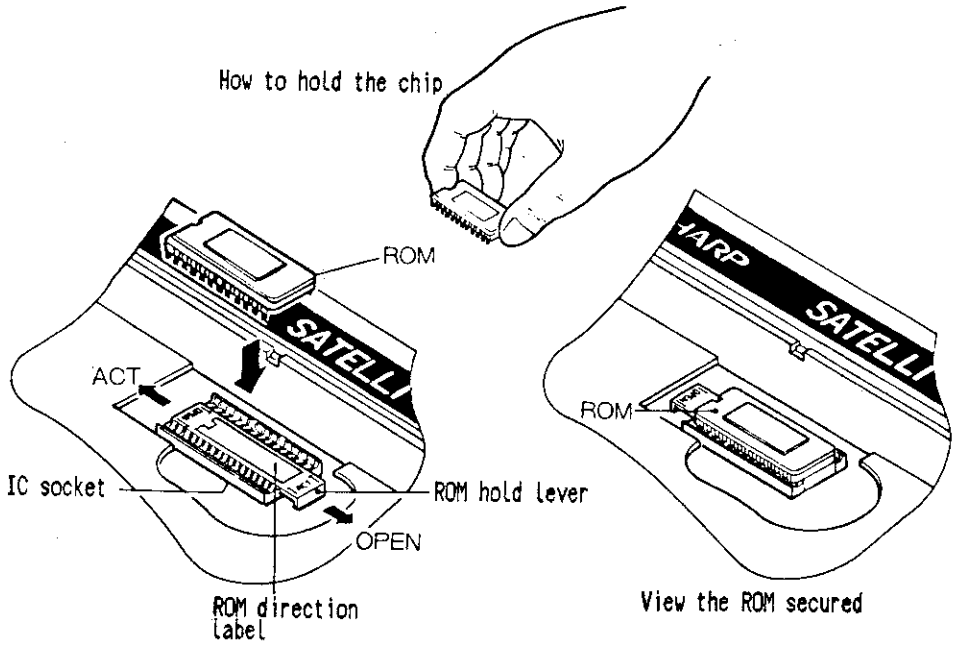
2) Insert the screwdriver into the programmer latch slot and lightly turn the screwdriver to remove the connector cover.

3) Insert the ROM on the ROM socket of the CPU board, placing it in the direction shown on the label of the chip.

4) Check to see that the ROM has been inserted in the given direction, then move the ROM securing lever onto the direction ACT.

5) Make sure that the chip has been installed properly, then replace the connector cover. Insert the under the connector cover onto the hole in the connector cover, and push the both sides of the cover to install.

6) Turn power on to the base module.



NOTE-1:
Use the special tool to remove the ROM chip.

[7] Battery replacement procedure

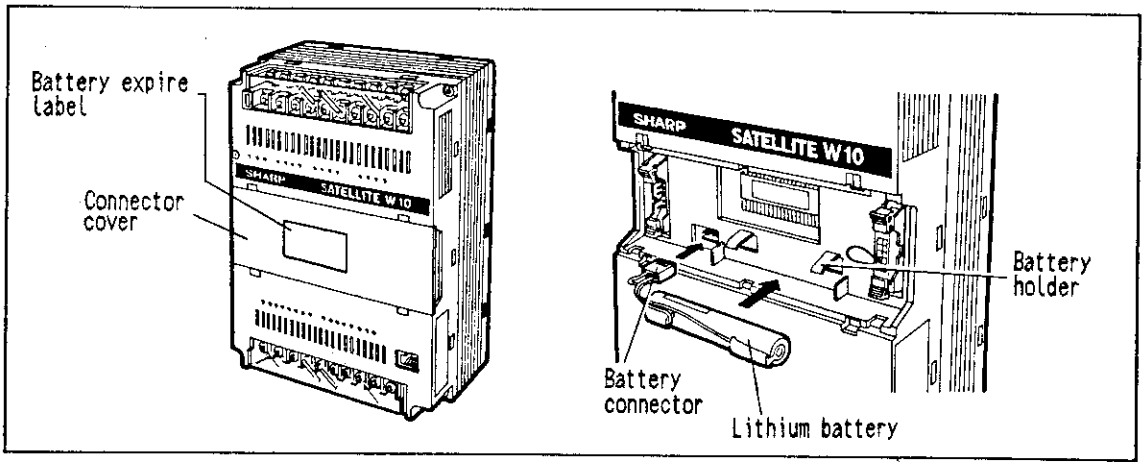
The memory backup battery used in the W1Ø must be replaced with the fresh one before its expiration date. The expiration date is noted on the label posted on the connector cover of the base module.
Contents of both the program memory and the data memory are retained by the backup battery during a power failure.
Even if the PROM is used for the program memory, it also needs battery replacement.
The battery can be replaced while power is on to the base module.

1) Parts code of the battery unit

DUNT-5211NCZZ

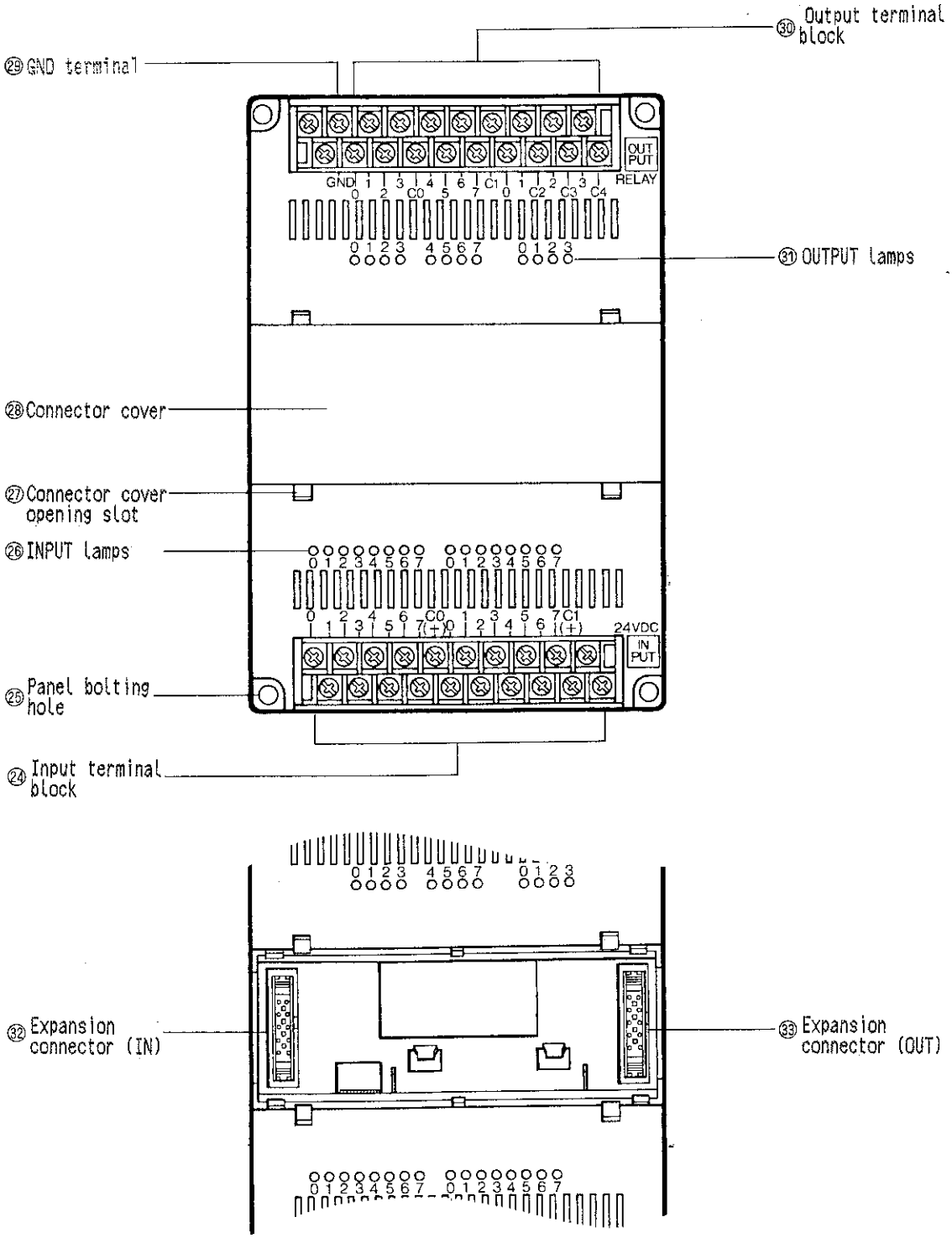
2) Replacement procedure

Get the fresh battery ready.
↓
Remove the base module connector cover.
↓
Unfasten the battery connectors on the CPU board and put back the connectors to the fresh battery within one minute.
↓
Replace the used battery in the battery holder with the fresh battery.
↓
Replace the connector cover and fasten it.
↓
Revise the battery expiration date on the label.
Add 5 years from the date of replacement.



4-2. Expansion modules

[1] Parts identification and functions



(View the connector cover removed)

㉔Input terminal block

Cable from the input device is connected to this block

㉕Module bolting holes

The module is attached to the panel using the M4×10 screws.

㉖INPUT lamps

Come active when the input device is on.

㉗Connector cover opening slots

The connector cover is removed by plying it open with the screwdriver is inserted into slot.

㉘Connector cover

The cover must be removed to install the expansion cable from the base module or expansion module.

㉙GND terminal

The module must be connected to the Class 3 ground using the dedicated ground cable, in order to prevent electrical hazard.

㉚Output terminal block

Cable from the output device is connected to this block.

㉛OUTPUT lamps

Come active when the input device is on.

㉜Expansion connector (IN)

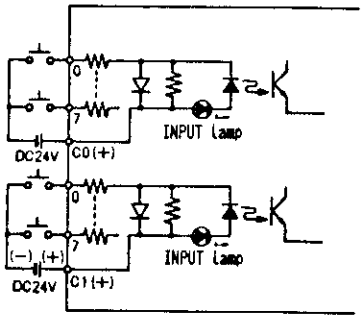
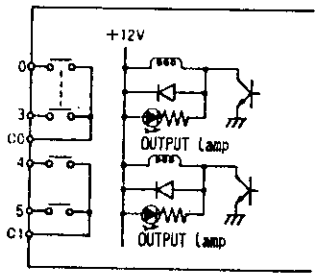
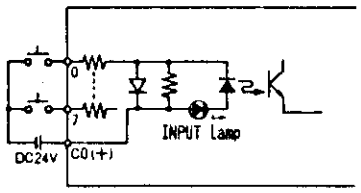
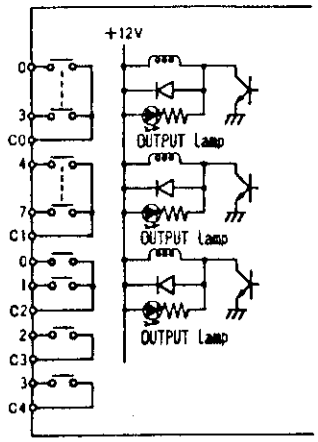
To this connector is connected the cable from the base module, remote I/O slave module (ZW-10RS1) or the expansion module connector (OUT).

㉝Expansion connector (OUT)

To this connector is connected the expansion cable connector to interface a next module or to the loopback connector when the module is the last unit.

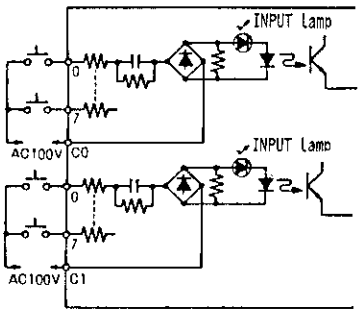
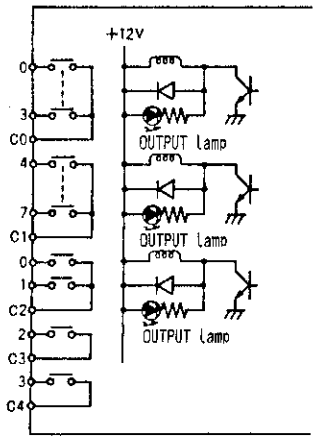
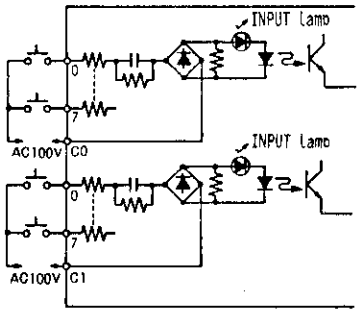
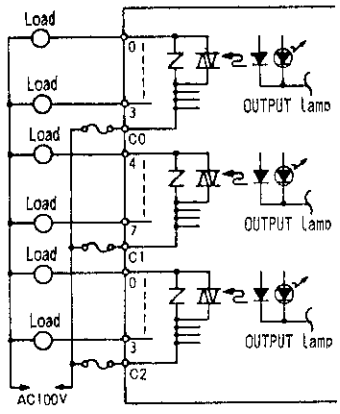
[2] Specification

		ZW-28N2S4	ZW-28N2S4
[Input block]			
Insulation method		Photocoupler isolated	
Input points		16 points	8 points
Rated input voltage		DC24V (Ripple at 15%, max.)	
Maximum input voltage		DC26.4V	
Input voltage level	ON level	14V, max.	
	OFF level	6V, min.	
Input current level	ON level	4mA, max.	
	OFF level	1.5mA, min.	
Input impedance		Abt 3.5KΩ	
Response time	OFF→ON	7ms, max.	
	ON→ON	10ms, max.	
Status display		Active when ON (LED)	
Terminal block		20-terminal block (16 inputs, 2 commons, 2 open), block made of black resin P=9.525, M3.5×8, self-locking	20-terminal block (8 inputs, 1 common, 11 open), block made of black resin P=9.525, M3.5×8, self-locking
Common jack		1 common per 8 points ((+) supply, common)	
[Output block]			
Insulation method		Relay isolated	
Output points		12 points	6 points
Maximum make/break voltage & current		AC250V/DC30V, 2A (resistance load)	
Minimum load		5V, 10mA	
Life		Mechanical: 20,000,000 actions, min. Electrical: 1. 100,000 actions, min., for the maximum make/break voltage and current resistance load. 2. 200,000 actions, min., for the magnetic contactor load, AC200V, 0.5A, COSφ=0.4	
Leak current		None	
Response time	OFF→ON	15ms, max.	
	ON→OFF	15ms, max.	
Status display		Active when ON (LED)	

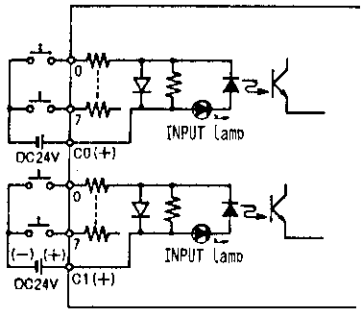
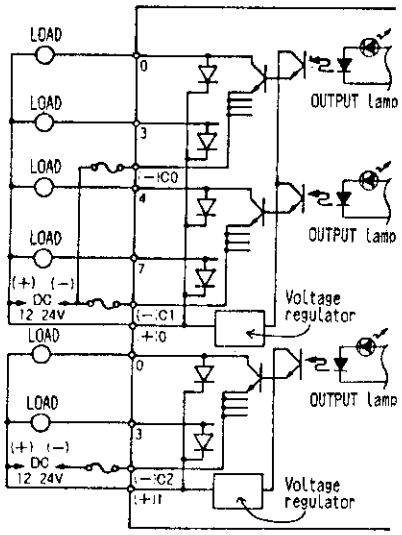
	ZW-28N2S4	ZW-14N2S4
Terminal block	20-terminal block (12 outputs, 5 commons, 1 ground, 2 open) block made of black resin P=9.525, M3.5×8, self-locking	20-terminal block (6 outputs, 2 commons, 1 ground, 11 open) block made of black resin P=9.525, M3.5×8, self-locking
Common terminal	1 common/4 points... 2 circuits 1 common/2 points... 1 circuit Independent common... 2 circuits	1 common/4 points... 1 circuit 1 common/2 points... 1 circuit
Weight	Abt 0.6kg	
Note	Pay attention for the off level when using the proximity switch and photoelectric switch. it may not go off, sometimes.	
Circuit diagram	(Input block)  (Output block)  	(Input block)  (Output block) 

		ZW-28N1S4	ZW-28N1S1
[Input block]			
Insulation method		Photocoupler isolated	
Input points		16 points	
Rated input voltage		AC100V, 50/60Hz, waveform distortion at 5% maximum	
Maximum input voltage		AC132V	
Input voltage level	ON level	80V, max.	
	OFF level	30V, min.	
Input current level	ON level	8mA, max.	
	OFF level	3mA, min.	
Input impedance		Abt 12KΩ(50Hz), abt 10kΩ(60Hz)	
Response time	OFF→ON	15ms max.(AC100V)	
	ON→OFF	30ms max.(AC100V)	
Status display		Active when ON (LED)	
Terminal block		20-terminal block (16 inputs, 2 commons, 12 open) P=9.525, M3.5×8 self-locking Terminal block made of black resin	
Common terminal		8 points per common	
[Output block]			
Insulation method		Relay isolated	Photocoupler isolated
Output points		12 points	12 points
Maximum make/break voltage & current		AC250V/DC30V, 2A (load resistance)	- - - - - - - -
Minimum load		5V, 10mA	
Life		Mechanical: 20,000,000 actions, minimum Electrical: 1. 100,000 actions, maximum make/break voltage & current 2. AC200V, 0.5A, COSφ=0.4, 200,000 actions, minimum	- - - - - - - -
Rated output voltage		- - - - - - - -	AC100/110V, 50/60Hz, waveform distortion at 5%, max.
Output voltage range		- - - - - - - -	AC15~121V
Rated maximum output current		- - - - - - - -	0.6A/point (1.2A, max., per group, 4 points)

		ZW-28N1S4	ZW-28N1S1
Surge on current		- - - - - - - - -	Output element performance 8ØA (1 cycle)
On voltage		- - - - - - - - -	1.6V, max. (Ø.6A)
Leak current		None	2mA, max. (sine wave)
Response time	OFF→ON	15ms, max.	1ms, max. (resistance load)
	ON→OFF	15ms, max.	1Øms, max. (resistance load)
Status display		Active when ON (LED)	Active when ON (LED)
Terminal block		2Ø-terminal block (12 outputs, 5 commons, 1 ground, 2 open) P=9.525 M3.5×8 self-locking Terminal board made black resin	2Ø-terminal block 12 outputs, 3 commons, 1 ground, 4 open) P=9.525, M3.5×8 self-locking Terminal board made black resin
Common terminal		1 common/4 points... 2 circuits 2 common/2 points... 1 circuit Independent common... 2 circuits	1 common/4 points
Weight		About Ø.6kg	

	ZW-28N1S4	ZW-28N1S1
Note	(Input block) Pay attention for the OFF level when using a proximity switch or photoelectric switch, as it may not go off, sometimes.	(Output block) It may fail to go OFF because of a leak current, when using a neon lamp or light load relay.
Circuit diagram	(Input block)  (Output block)  	(Input block)  (Output block) 

		ZW-28N2S2 (To be released March, 1987)
[Input block]		
Insulation method		Photocoupler isolated
Input points		16 points
Rated input voltage		DC24V, ripple at 15%, max.
Maximum input voltage		DC24.6V
Input voltage level	ON level	14V, max.
	OFF level	6V, min.
Input current level	ON level	4mA, max.
	OFF level	1.5mA, min.
Input impedance		Abt 3.5KΩ
Response time	OFF→ON	7ms max.
	ON→OFF	10ms max.
Status display		Active when ON (LED)
Terminal block		20-terminal block (16 inputs, 2 commons, 2 open) P=9.525, M3.5×8, self-locking Terminal block made of black resin
Common terminal		8 points per common ((+) supply, common)
[Output block]		
Insulation method		Photocoupler isolated
Output points		12 points
Maximum output voltage		DC24V
Output voltage range		DC10~30V
Rated maximum output current		DC1A/point (1.2A, max. per group, 4 points)
Surge on current		Output element performance, 5A (10ms, max.)
Leak current		0.1mA, max.
On voltage		2V, max. (1A)
Response time	OFF→ON	1ms, max. (resistance load)
	ON→OFF	1ms, max. (resistance load)
Status display		Active when ON (LED)
Terminal block		20-terminal block (12 outputs, 3 commons, 2 DC supply lines, 1 ground, 2 open) P=9.525 M3.5×8, self-locking Terminal board made of black resin
Common terminal		1 common/4 points (-) supply, common
Weight		0.6kg

	ZW-28N2S2 (To be released March, 1987)
Note	[Input block] Pay attention when using a proximity switch or photoelectric switch as it may fail to go OFF level. [Output block] When an inductive load is used, there may be a delay of more than one second, depending on the value of the load "L".
Circuit diagram	[Input block]  [Output block] 

4-3. Link module

[1] Data link slave module

(1) General description

The ZW-10DL9 data link slave module can be used operated in the data link system which has the preceding W series model (W16, W51, W100 for its master module.

(2) Specifications

■ Specification

Item	Specification
Data link stations	16 stations, max. (1 master + 15 slaves)
Total number of link points	2048 points, max. (256 bytes) 960 points, max. (64 points×15 units) for the slave of the W10 only.
Points per slave station	64 points, max. (8 bytes)
Communication mode	1:N
Weight	About 0.8kg

■ Communication specification

Item	Specification
Communication method	EIA RS422 compatible
Transmission speed	153.6K bits per second
Transmission format	Conforms to JIS C-6363, high level data link control procedure, HDLC frame structure.
Coding system	NRZI (Non Return to Zero Inverted)
Check method	CRC
Synchronization	Bit synchronized
Transmission method	Multiplexed, cyclic digital method
Data transmission line	Party line Overall cable distance at 1km, max. Shielded twist pair wire (Use the shielded twist pair wire of a good frequency characteristics whose nominal cross section area is more than 0.5mm².) Recommended: Hitachi Densen's S-IREV SW, 2-core shield wire, with nominal cross section area of 0.5mm² or its equivalent.

NOTE-1:
See 3-3-[1] for general specification.

NOTE-2:
See the instruction manual that comes with the data link slave module for more details.

[2] Remote I/O module

(1) General description

For the ZW-10RM1 master module and the ZW-10RS1 slave module are available for the W10, it enhances system implementation by the W10 only. It is also possible to establish the system having the previous W series (W16, W51, W100) for the master and the W10 for its slaves.

(2) Specification

■ Master module (ZW-10RM1: to be released March, 1987)

Item	Specification
Remote I/O stations	7 stations, max.
Remote I/O points	196 points, max. (112 points, max. per station)
Weight	Abt 0.8kg

■ Slave module (ZW-10RS1)

Item	Specification
Remote I/O slaves	7 units, max.
Remote I/O total points	●Maximum 896 points when the master is W16, W51, W100 and the slave W10, W16, W51. ●Maximum 784 points (112 points×7 units when the master is W16, W51, W100 and the slave W10. ●Maximum 196 points when both master and slave is W10.
Points per slave	112 points, max.
Power consumption	25W at maximum (with the ZW-10RS1 in use)
Weight	Abt 1.5kg

■ Communication specification

Item	Specification
Communication method	EIA RS422 compatible
Transmission speed	307.2K bits per second
Transmission format	Conforms to JIS C-6363, high level data link control procedure, HDLC frame structure.
Coding system	NRZI (Non Return to Zero Inverted)
Check method	CRC
Synchronization	Bit synchronized
Transmission method	Multiplexed, cyclic digital method
Data transmission line	Party line Overall cable distance at 500m, max. Shielded twist pair wire (Use the shielded twist pair wire of a good frequency characteristics whose nominal cross section area is more than 0.5mm²). Recommended: Hitachi Densen's S-IREV SW, 2-core shield wire, with nominal cross section area of 0.5mm² or its equivalent.

NOTE-1:
See 3-3-[1] for general specification.

NOTE-2:
See the instruction manual that comes with the data link slave module for more details.

§ 5 INSTALLATION

5-1. Precautions

The following conditions must be taken into consideration during installation in order to establish a reliable system, as well as utilizing full performance of all functions that were implemented in the W10 programmable controller designed for operation under severe working conditions.

Installation requirements

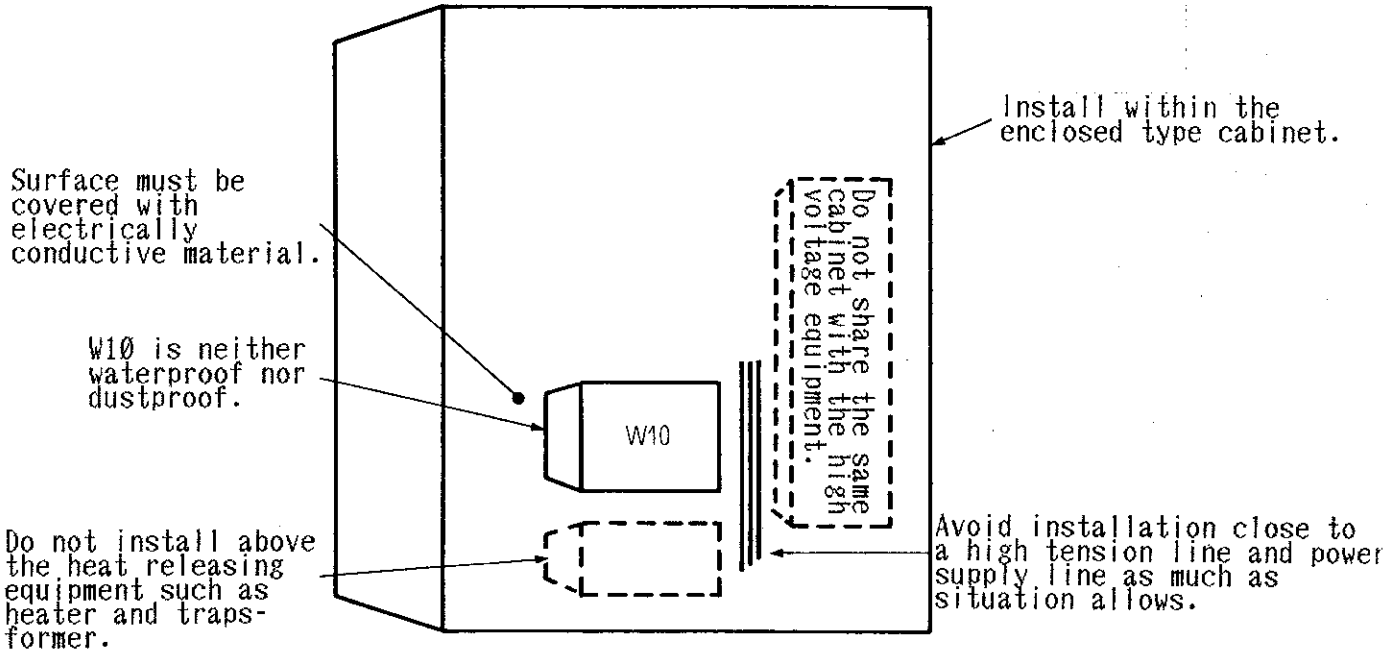
Do not install it under any of the following conditions.

- Where exposed to direct sunlight.
- Place where ambient temperature is out of 0 to 55℃; 0 to 40℃ for the programmer installation.
- Where abrupt temperature changes are met and moisture condensation occurs.
- Where the absolute humidity is out of 35 to 90%.
- Where corrosive fume or inflammable gas is prevailing.
- Where dust, steel dust, or salty air is prevailing.
- Where the W10 is subjected to direct vibration or shock.
- Where exposed to moisture, oil, or chemicals.

On panel installation

Pay attention to the following when installing the W10 on the panel.

- Because the module is not dustproof or waterproof, it has to be installed inside the enclosed type cabinet, so far as condition allows.
- Avoid installing on the location where attacked by strong vibration or shock from time to time.
- Avoid installing the W10 directly above the heat releasing equipment such as heater, transformer, large size capacitor, etc.
  Neither, install it close to another equipment.
- Do not share the same cabinet with a high voltage equipment.
- Avoid installing it near the high tension power supply line.
- Install the module on the surface that covered with an electrically conductive material for the purpose of insuring good ground connection and for better noise immunity. Avoid installing it on a paint finished board.
- Use the galvanized M4 screw for securing the module

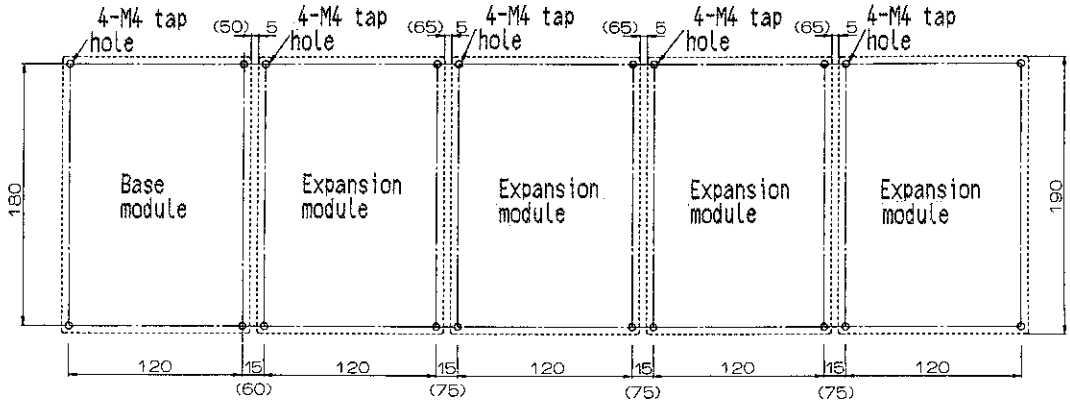

Install within the enclosed type cabinet.
Surface must be covered with electrically conductive material.
W1Ø is neither waterproof nor dustproof.
Do not install above the heat releasing equipment such as heater and transformer.
Avoid installation close to a high tension line and power supply line as much as situation allows.
Do not share the same cabinet with the high voltage equipment.
W10

5-2. Installing base module or expansion module

[1] Installing on the panel

■ Side by side installation

(1) Installation area



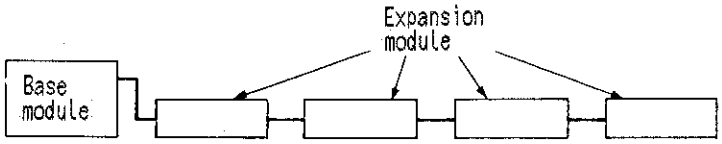
NOTE-1:
Figure enclosed is a maximum size.

NOTE-2:
The link module must be installed to left of the base module.

(2) Installation procedure

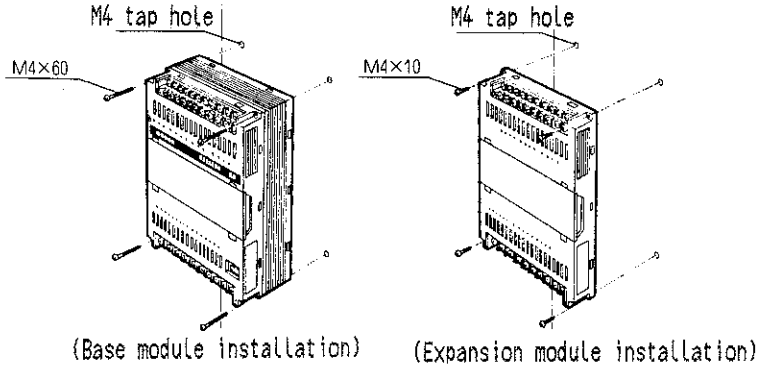
Use M4×6Ø screws that come with the base module to secure the base module and use M4×1Ø screws that do not come with the expansion module to secure the expansion module on the control panel.

① Bore the M4 tapping holes in the control panel.



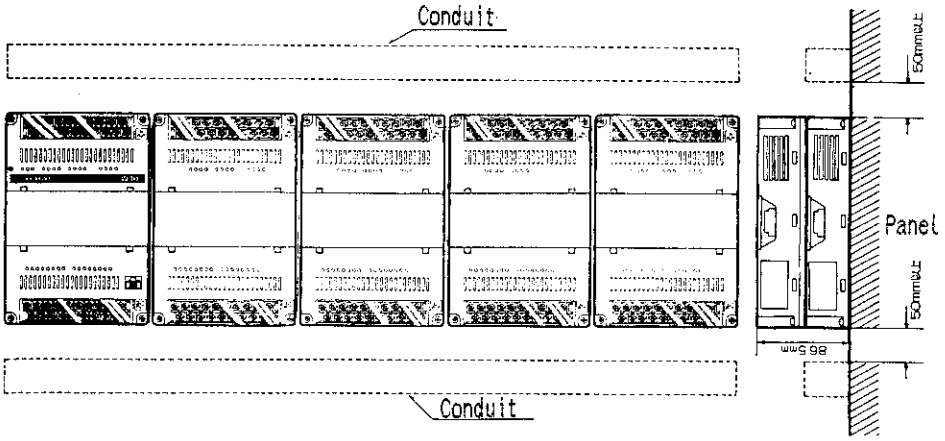
2Ø M4 tap holes are required in the panel.

② Secure the base module on the control panel using four pieces of M4×6Ø screws that come with the base module. Secure the expansion module on the control panel using M4×1Ø screws that provided by the client himself. The output block must face up when installing.



(Base module installation) (Expansion module installation)

(3) Installation view



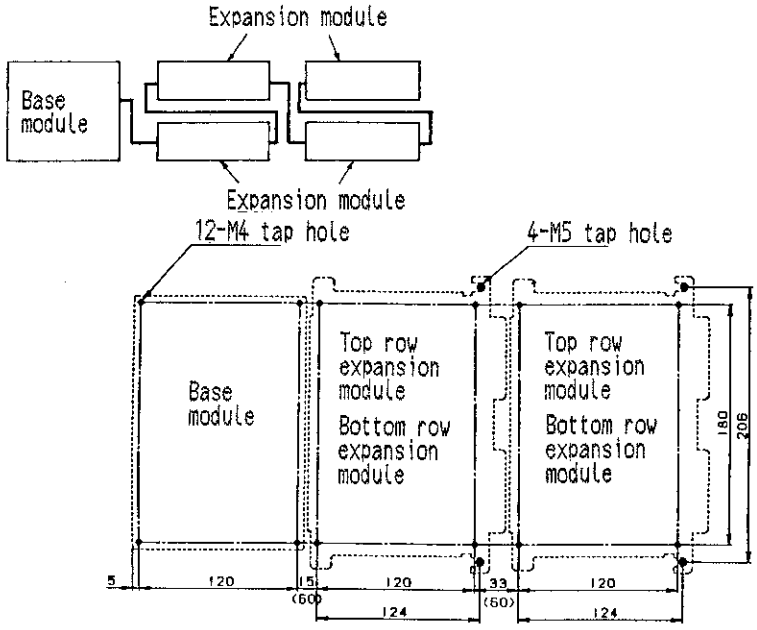
NOTE-1:
There should be a distance of 50mm at least between the W10 and the conduit, in order to avoid temperature rise.

■ Double row installation using the double deck rack

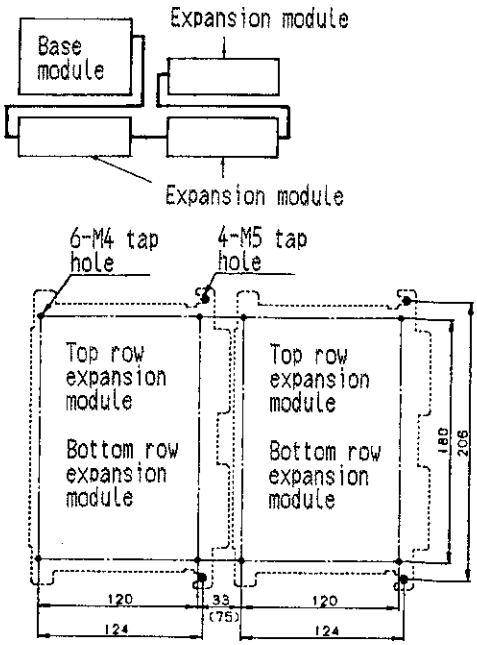
Bring the hinge to the right side when installing the double deck rack on the panel.
To open the deck, remove the top row securing screws of the first deck first, then screws of a next deck, until the desired deck is opened.

(1) Installation area

● Installing the expansion module double deck rack



● Installing the base module double deck rack



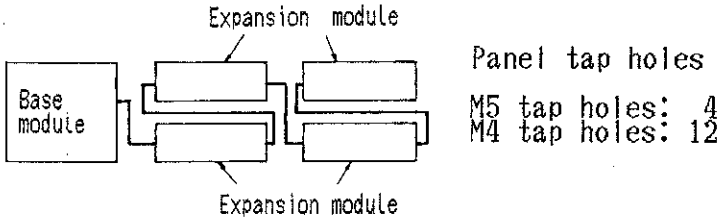
NOTE-1:
Figure enclosed is a maximum size.

NOTE-2:
The link module must be installed to left of the base module.

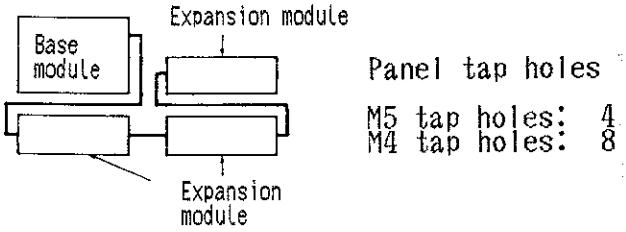
(2) Installation procedure

1. Bore M4 and M5 tapping screw holes in the control panel.

(a) To use the double deck rack (case-1)...Expansion module



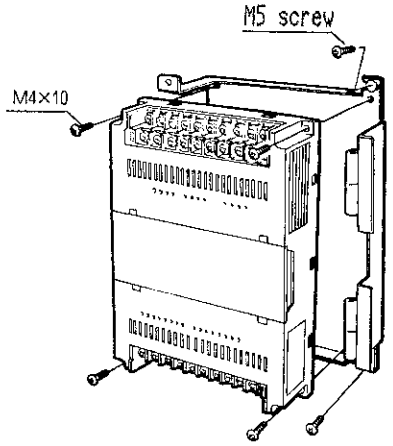
(b) To use the double deck rack (case-2)...Base module



Description next deals with the step (b) above.

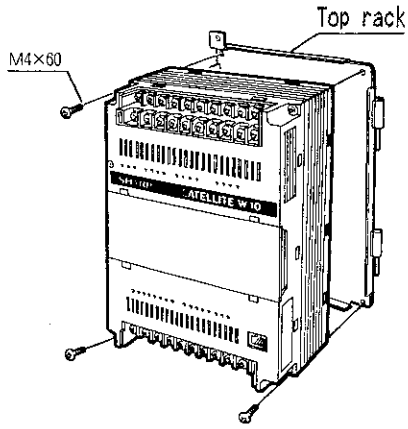
2. Remove the screws that secure the top row of the double deck rack and separate the top row from the bottom row housing.

3. Secure the bottom housing on the control panel using the M5 screws, then secure the expansion module on the control panel at four locations.

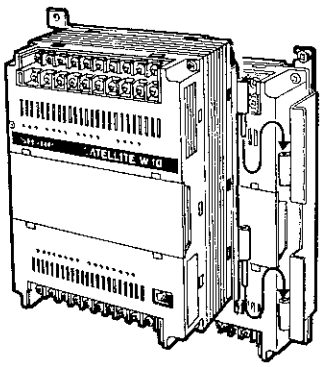


4. Route the wires to the terminal block of the expansion module that mounted on the bottom rack and install the terminal board cover. See 6-2 "Wirings to modules". For connection of the expansion cable, see 5-3 "Expansion cable connection".

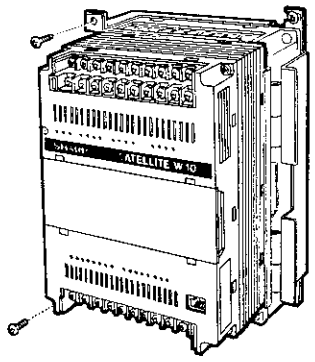
5. Secure the base module on the top rack using the M4×60 screws. Use the M4 screws in the case of the expansion module.



6. Insert the pin of the hinge to secure it with other side hinge. Hinges on both racks must be fastened.

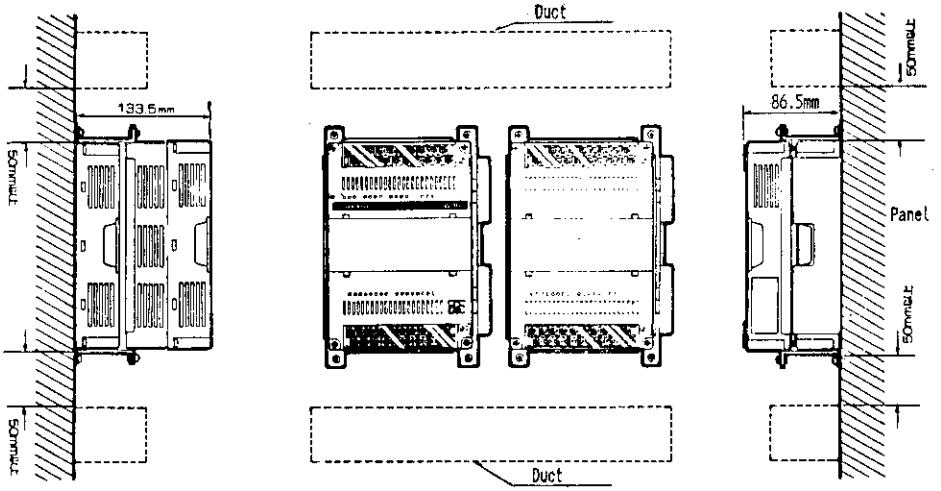


7. Secure the top rack to the bottom rack using two screws that removed in Step 1 above.



8. After routing wirings to the terminal block of the base or expansion module installed on the top rack, cover the terminal block. See 6-2 "Wirings to modules" for detail of wirings to the terminal block and see 5-3 "Expansion cable connection" for connection of the expansion cable.

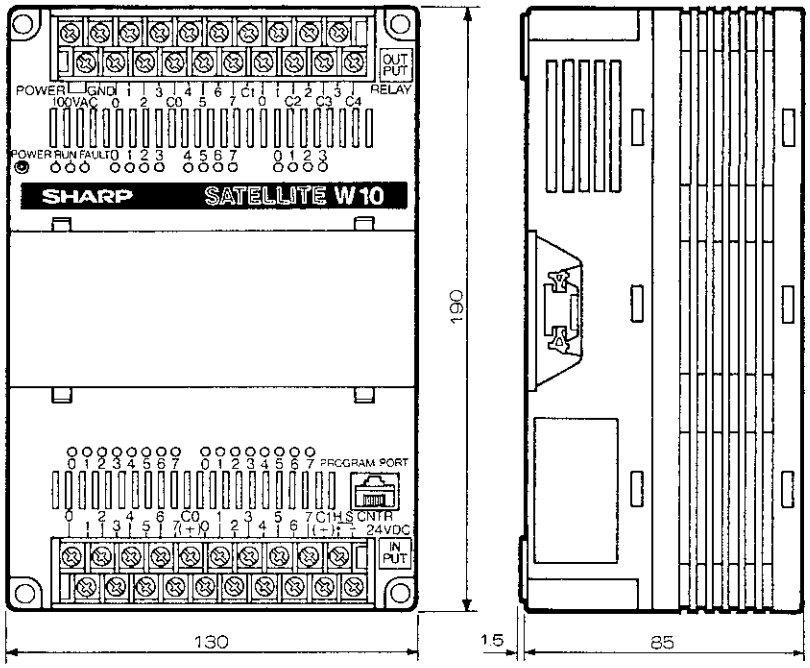
(3) Installation view



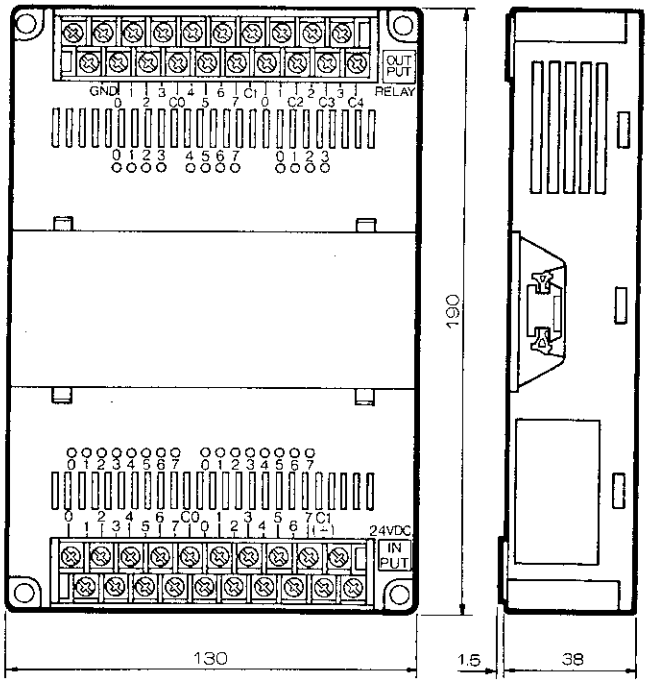
NOTE-1:
Leave a distance of more than 50mm between the W10 and the duct, in order to avoid temperature rise.

[2] Physical dimensions

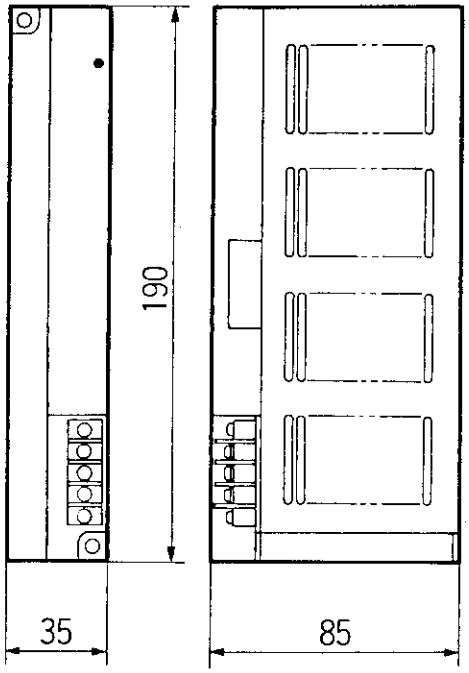
■ Base module



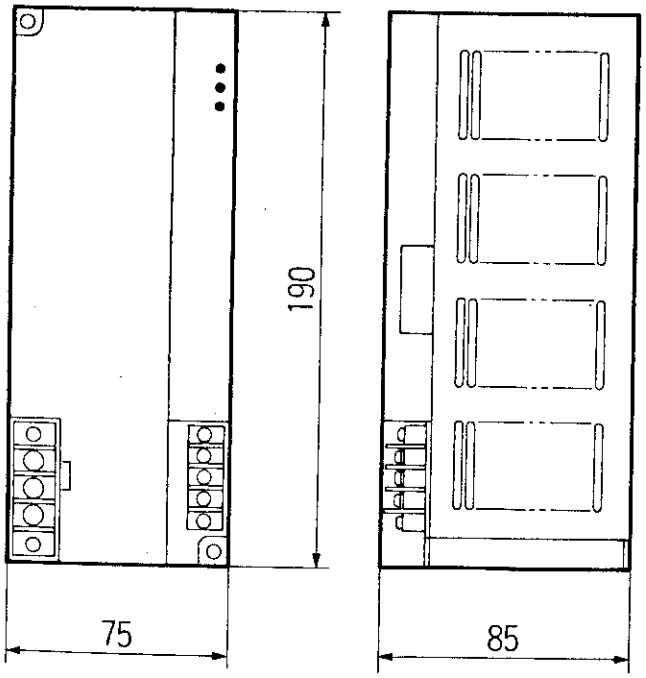
■ Expansion module



■ Remove I/O master module and data link slave module



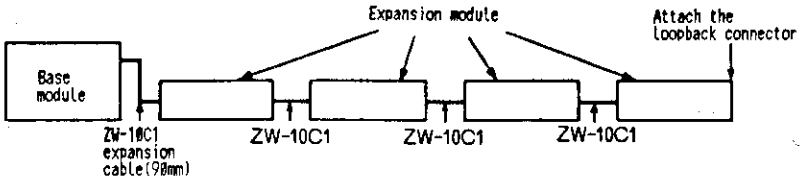
■ Remove I/O slave module



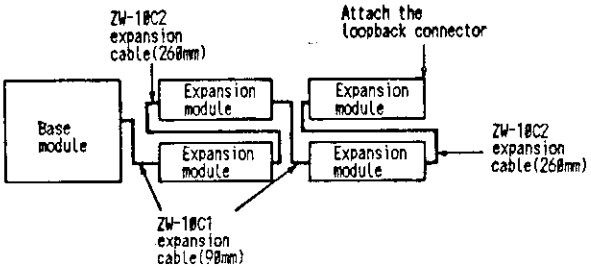
5-3. Expansion cable connection

The expansion cable must be connected to the expansion connector in the following manner.

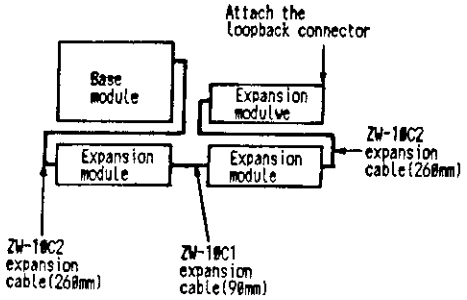
(a) When not using the double deck rack (side by side installation)



(b) When using the double deck rack (expansion modules on the rack)



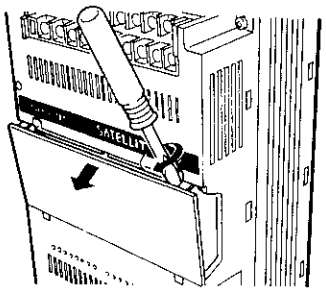
(c) When using the double deck rack (base modules on the rack)



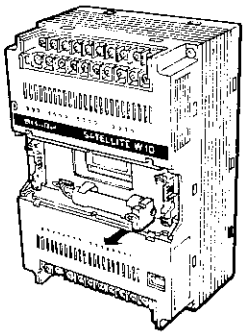
NOTE-1:
Do not allow the expansion cable total distance to exceed 700mm, that is, use of three or more ZW-10C2, in order to avoid unnecessary trouble.

The expansion connector must be connected in the following manner.

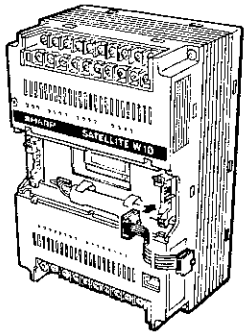
1. Ply open the connector cover of the base module using the screwdriver.



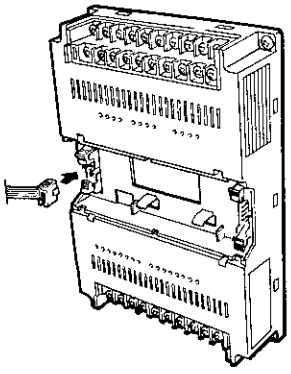
2. Remove the loopback connector attached to the base module expansion connector (OUT).



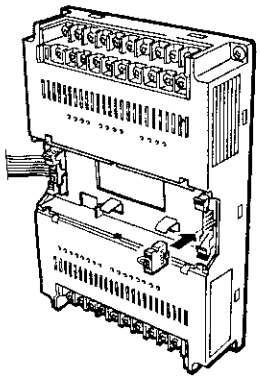
3. Fasten the 90mm long ZW-10C1 expansion cable connector to the expansion connector (OUT) from which the loopback connector was removed.



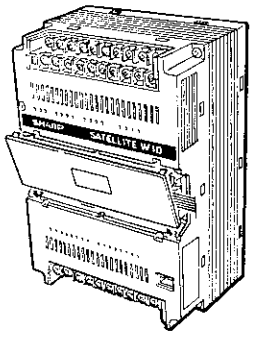
4. Fasten the connector of other expansion connector to the expansion connector (IN).

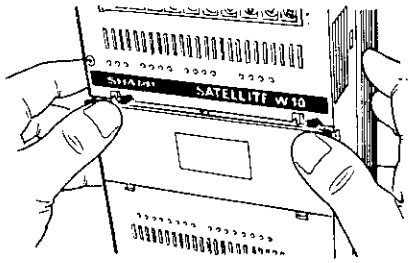


5. Fasten the loopback connector to the expansion connector (OUT) of the expansion module.



8. Replace the connector cover of the base or expansion module. To fix the connector cover, insert lower side tabs of the cover into the cover latching slots, then push in both sides of the cover to install.

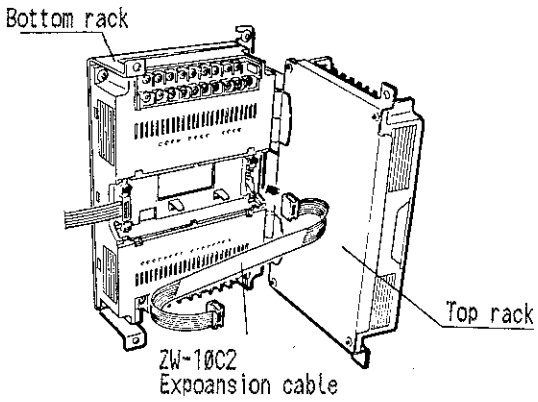




NOTE-2:
The connector of the expansion cable must be fastened firmly to avoid unnecessary trouble.

NOTE-3:
Fasten the loopback connector to the expansion connector (OUT) of the last module of the W10. When only the base module is used, leave the loopback connector attached. If operated without the loopback connector, it may result in a malfunction.

NOTE-4:
When using the double deck rack, route the ZW-10C2 expansion cable through a clearance between the expansion module on the bottom rack and the top rack.



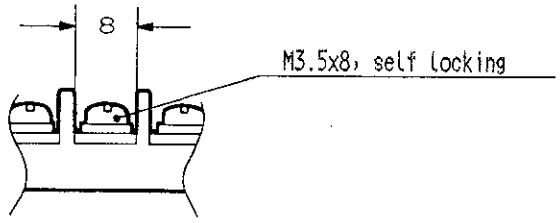
§ 6 Wirings

6-1. Wiring precautions

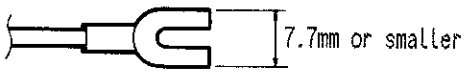
Pay attention to the following when routing wire in the W1Ø.

- Avoid to install the W1Ø power supply line from the I/O signal lines and do not install them side by side.
- The power supply and I/O signal lines should never be stretched on air. The W1Ø does not carry the lightening arrestor.
- For connection to the power input terminal, use the twisted wire of more than K1V1.25 square.
- Use more than K1VØ.5 square wire to the input terminal board.
- Use more than K1VØ.75 square wire to the output terminal block for those a large capacity such as solenoid valve. For others, use more than K1VØ.5 square wire.
- For connection other than to the input terminal block and output terminal block, use the wire of more than K1V1.25 square.
- In case it is not suitable for ground connection of the W1Ø because an entire factory is high tension grounded, merely connect the ground terminal to the chassis ground.
- Use the crimp-on terminal for wiring to any W1Ø terminal block.

Terminal block size



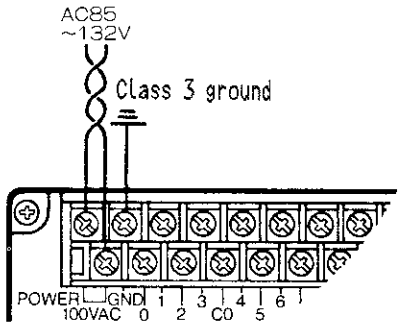
Crimp-on U lug used



6-2. Wiring to modules

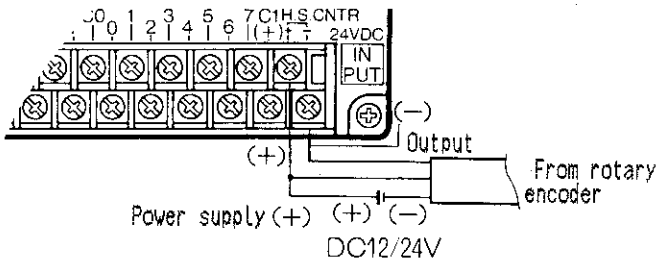
[1] Wiring to power supply line and GND terminal

Twist wires of the power supply input and have the power supplied within an allowable voltage range of AC85 to 132V.
The GND terminal must necessarily be connected to the Class 3 ground to avoid electrical hazard. Do not share the GND line with those of other equipments.



[2] Wiring to the high speed counter terminal

The high speed counter is equipped standard in the base module (ZW-28M114, ZW-28M111, ZW-28M122.



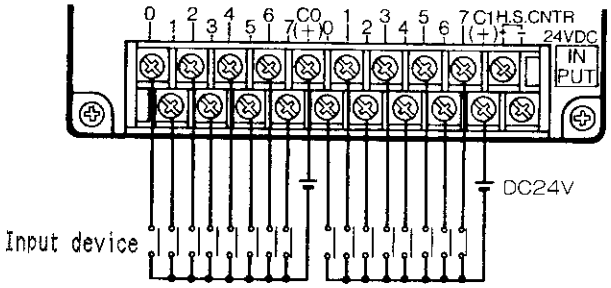
[3] Wiring to the input terminal

For the base and expansion modules, the lower side terminal block is the input terminal block. The illustration below shows an example of wiring to the input terminal.

■ DC input

ZW-28M124, ZW-28M122
ZW-28N2S4, ZW-14N2S4
ZW-28N2S2

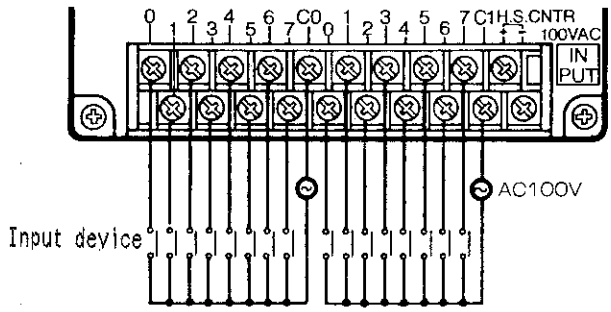
DC power supply...DC24V



■ AC input

ZW-28M114, ZW-28M111
ZW-28N1S4, ZW-28N1S1

AC power supply...AC100V



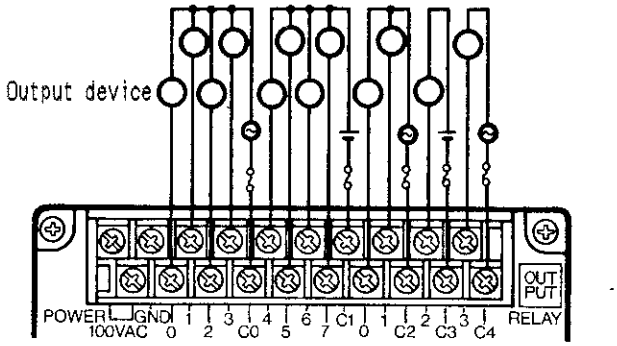
[4] Wiring to the output terminal

For the base and expansion modules, the upper side terminal block is the output terminal block. The illustration below shows an example of wiring to the output terminal.

■ Relay output

(ZW-28M124, ZW-28M114
ZW-28N2S4, ZW-14N2S4
ZW-28N1S4)

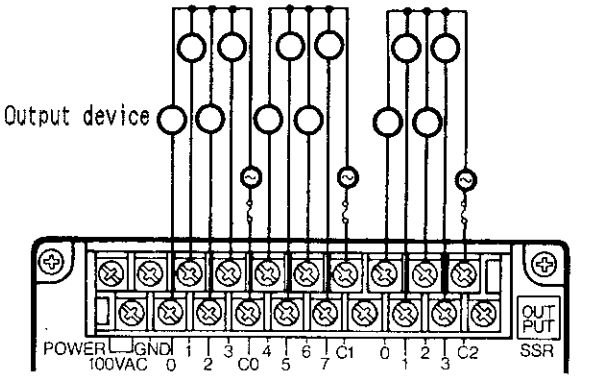
AC power supply...AC200V
DC power supply...DC24V
Fuse...AC125V, 10A, or
AC250V, 10A



■ Triac output

(ZW-28M111
ZW-28N1S1)

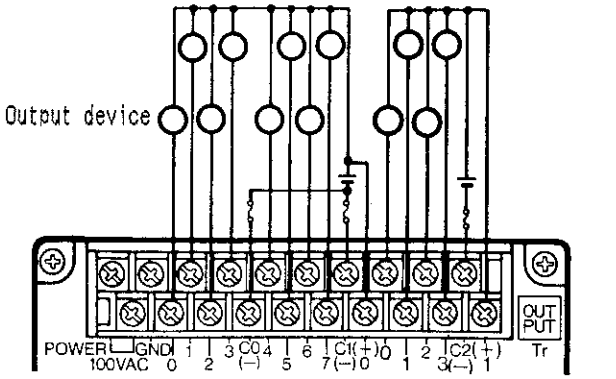
AC power supply...AC100V/110V
Fuse...ac125v, 2A



■ Transistor output

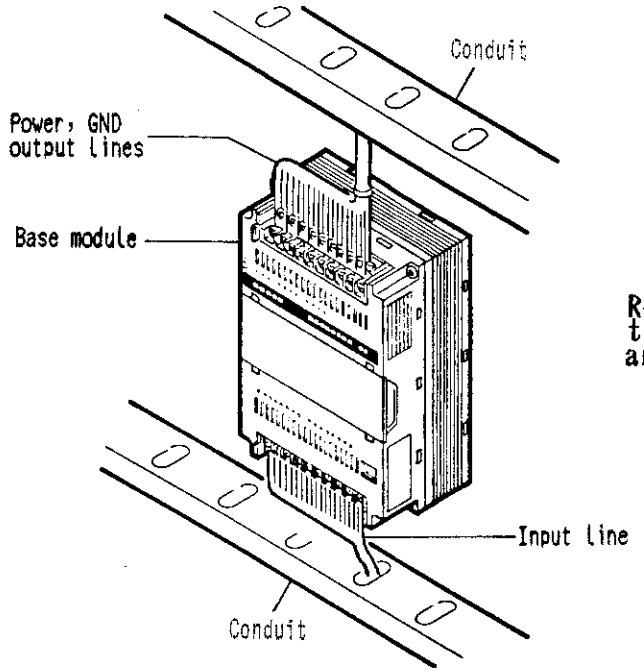
(ZW-28M122
ZW-28N2S2)

DC power supply...DC24V
Fuse...AC125V, 10A



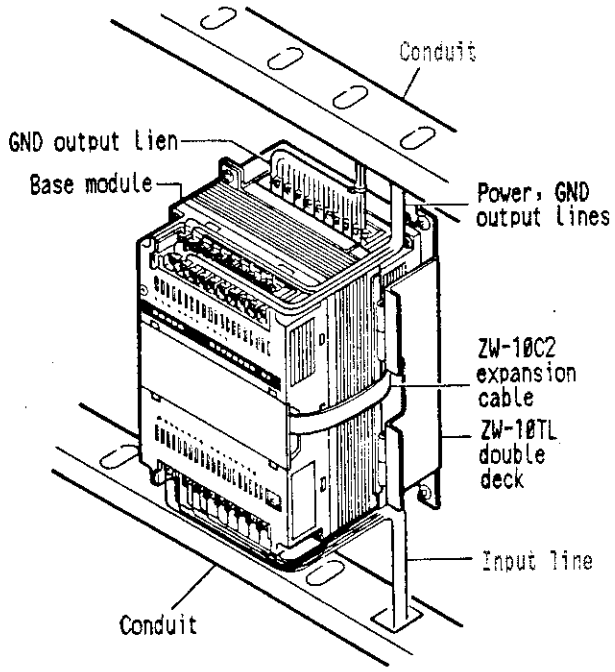
6-3. Examples of wire routed inside the panel

[1] Side by side



Reserve a distance of more than 50mm between the duct and the module.

[2] Double deck mounting (base moduleand expansion module, for example)



-Reserve a distance of more than 50mm between the duct and the module.
-For the top rack open around the hinge, hold the cable at the pivot and permit an allowance in the cable length.
-Same applies to the double deck expansion modules.

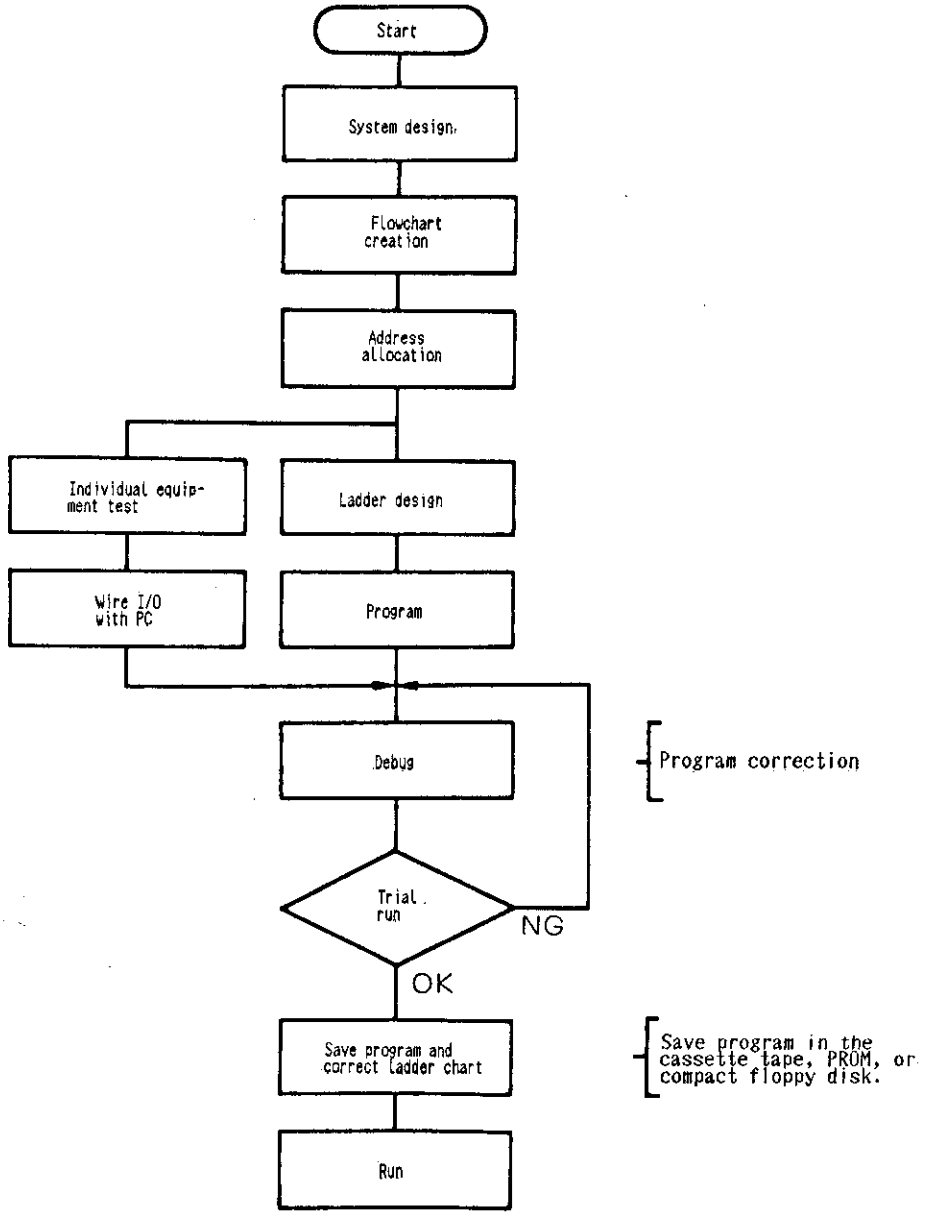
-Get the AC power supplied from the same source.

-Isolated the high speed counter input line from the input line.

§ 7 System design

7-1. System design procedures

Procedures required for designing of the control system operated under the programmable controller, which will be simply referred to as PC hereinafter, are similar to those of the relay sequence controller.
A typical example of the programmable controller operation system is shown next.



7-2. Precautions at the time of system design

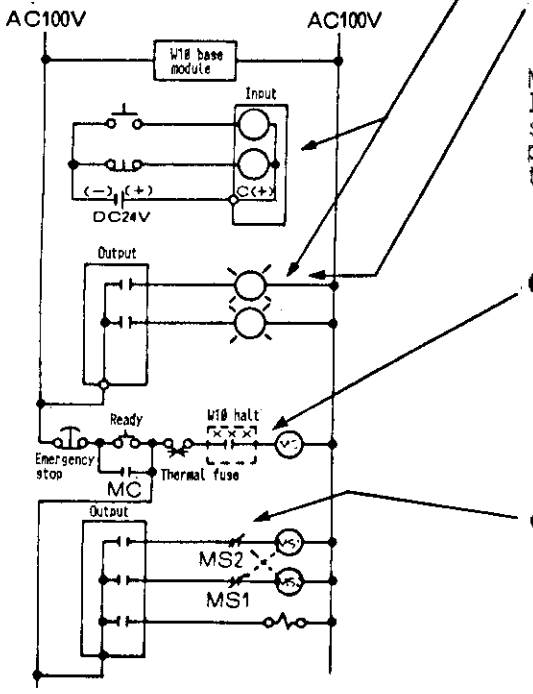
Major difference of the PC with the conventional relay circuit is that the PC handles the control program in a cyclic (serial) sequence while the relay circuit performs parallel processing.
Although only a part of operation is affected with the relay circuit at a time of a failure because it operates parallel. But with the PC, it affects an entire system.
In terms of the fail-safe concept, it is preferable not to depend everything on the PC, but to constitute in the external source the critical components that might be evoke machine destruction and human casualty on account of the PC at a failure, which will be such as:

Emergency stop circuit

Protective circuit

High tension equipment operating circuit

And, attention must be paid to a response time because the PC operates under the cyclic mode.



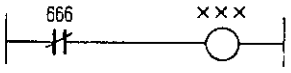
● Connecting the input block or lamp drive output block in front of the emergency stop circuit will enable you to recognize the halt state of the facility.

● When the PC is at halt, all output modules will retain the ON/OFF state immediately before the stop.

NOTE-1:
If the output reset address was set in the system memory, it will reset all output points, provided that power is on to the PC.

● Emergency stop circuit

Keep the W10 output contact closed at all time and connect the line to the emergency stop circuit.



● Interlock circuit

An interlock circuit must be provided externally for such a part that may be liable to a human casualty, machine destruction, or causing contradictory action like forward vs.. reverse machine actions.

NOTE-2:
If the DC output module were to be used for the output, use the AC relay with its contact connected to the emergency stop circuit.

7-3. Input and output relay numbers

Input and output relay numbers must be consecutive in order of the input modules to output modules.
For the W1Ø, use it within a maximum input and output points of 14Ø points.

(I/O relay number allocation)

	Base module	28-p exp. module	28-p exp. module	28-p exp. module	28-p exp. module
Output relay	020~033	060~073	120~133	160~173	220~233
Input relay	000~017	040~057	100~117	140~157	200~217
Output points	12	24	36	48	60
Input points	16	32	48	64	80
Total points	28	56	84	112	140

	Base module	28-p exp. module	28-p exp. module	28-p exp. module	14-p exp. module
Output relay	020~033	060~073	120~133	160~173	210~213
Input relay	000~017	040~057	100~117	140~157	200~207
Output points	12	24	36	48	54
Input points	16	32	48	64	72
Total points	28	56	84	112	126

	Base module	28-p exp. module	28-p exp. module	14-p exp. module	28-p exp. module
Output relay	020~033	060~073	120~133	150~155	200~213
Input relay	000~017	040~057	100~117	140~147	160~177
Output points	12	24	36	42	54
Input points	16	32	48	56	72
Total points	28	56	84	98	126

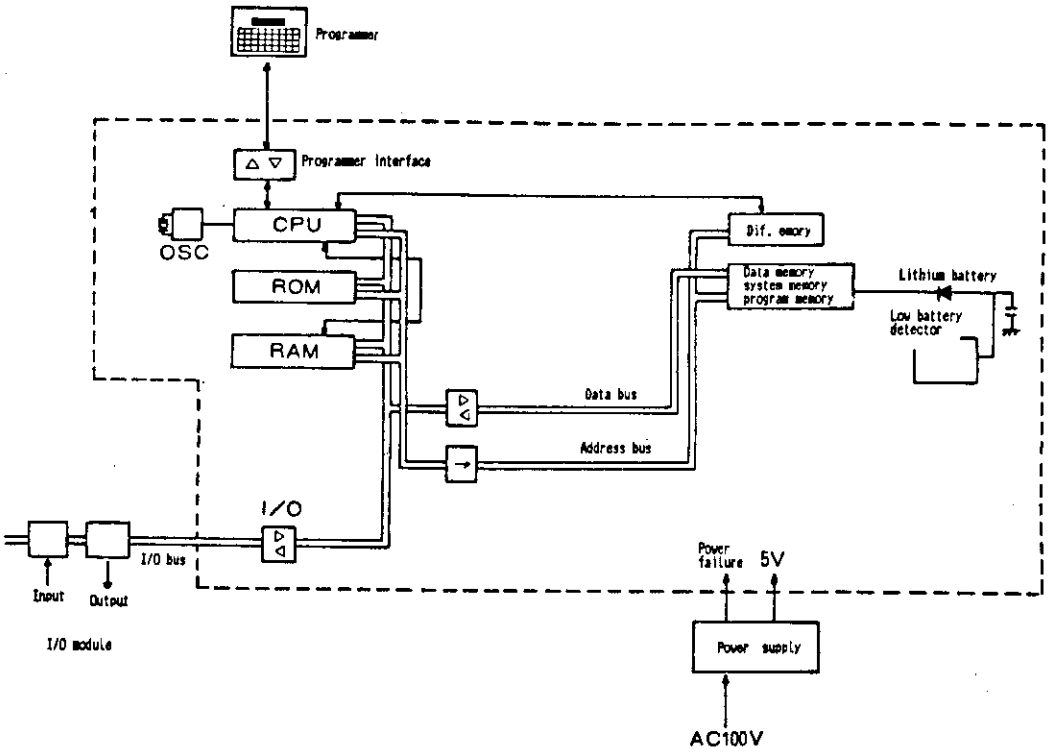
	Base module	28-p exp. module	14-p exp. module	28-p exp. module	14-p exp. module
Output relay	020~033	060~073	110~115	140~153	200~213
Input relay	000~017	040~057	100~107	120~137	160~177
Output points	12	24	30	42	54
Input points	16	32	40	56	72
Total points	28	56	70	98	126

	Base module	14-p exp. module	28-p exp. module	28-p exp. module	28-p exp. module
Output relay	020~033	050~055	100~113	140~153	200~213
Input relay	000~017	040~047	060~077	120~137	160~177
Output points	12	18	30	42	54
Input points	16	24	40	56	72
Total points	28	42	70	98	126

NOTE-1:
A maximum of four expansion modules connected to one base module and it is not possible to connect five or more expansion modules.

§ 8 Base module configuration and functions

8-1. Base module configuration



Block diagram description

Name	Description
CPU	The microprocessor employed to control the entire W10 system which has the following functions: ① Data transfer with input and output modules. ② Data communication with the programmer. ③ Program transfer to the user memory area. ④ Sequential operation.
I/O	The port through which data exchange is carried out between the I/O modules and the CPU.
Program memory	Sequential program storage which is backed up by the lithium battery.
Data memory	Memory area for I/O, timer, counter, and register which are backed up by the lithium battery.
Differential memory	The memory used to detect the rising edge of relay software-wise.
System memory	The memory used to assign the CPU function, to store error code, and to assign the function for the optional module.

8－2． Data memory

[1] Kind of data memory

Kind	Capacity	Relay number (bit address)	Byte address	State after power failure
I/O relay	140 points	000～237	ㅋ00～ㅋ23	Cleared (NOTE-2)
Aux. relay	224 points	240～577	ㅋ24～ㅋ57	Cleared (NOTE-2)
Retention relay	40 points	600～647	ㅋ60～ㅋ64	Retained (NOTE-2)
Special relay	42 points	646～717	ㅋ64～ㅋ71	Cleared (NOTE-3)
Timer, counter	48 points		b000～b137	Timer cleared, counter retained (NOTE-4)
Register	128 bytes		9000～9177	Retained

NOTE-1:
Data memory address is in the octal notation for both bit address and byte address, except for the fourth digit of the register area.
Thus, the address next to 007 is 010, not 008. For detail, refer to [7] "Data memory address map".

NOTE-2:
Retention relay is the data memory relay area which retains the state immediately before power failure until the power is on again. It is possible to expand or reduce the retention relay area by writing the retention relay area in the system memory #200.
Since this area (600～647) was factory setup, the area is called retention relay. For more details, refer to 8-3 "System memory". The area not assigned will be cleared when power is turned on.

NOTE-3:
The high speed counter area ㅋ70 and ㅋ71 are retained during power failure.

NOTE-4:
The timer contents can be retained by the setup of the system memory #201.

[2] Data memory functions

I/O relay]	
Input relay area	●ON/OFF state of the input module is stored in this area during input/output operation at each scan cycle and retained for one scan cycle period. (NOTE-1) ●Used by the program for the input information (contact, data).
Output relay area	●Operational results are stored in this area by the user program for coil destination. ●ON/OFF state is transferred to the output module during I/O operation. ●Operational results can be used for contact and source in the program.
Module open area	●Operational results are written into this area by the user program. ●Can be used for auxiliary relay.
Area used at receiving from data link	●Data received from the master are stored in this area, when responding to the request from the data link slave module. ●Used by the program for the input information (contact, data).
Area used at sending to data link	●Operational results are stored in this area by the user program for coil destination. ●Data are transferred to the buffer of the data link slave module to be sent to the master when responding to the request from the data link slave module. ●Operational results can be used for contact and source in the program.
Area used for remote I/O input	●ON/OFF state of the slave input module is read by the remote I/O master when responding to the request from the remote I/O master. ●Used by the program for the input information (contact, data).
Area used for remote I/O output	●Operational results are written into this area by the user program. ●Data are transferred to the buffer of the remote I/O master to be sent to the remote I/O slave output module when responding to the request from the remote I/O master. ●Operational results can be used for contact and source in the program.

[Auxiliary relay]	
Area not used for the data link remote I/O	●Operational results are stored in this area by the user program for coil destination. ●Used for a temporary storage of the operational results that may not be sent outside. ●Operational results can be used for contact and source in the program.
Area used for the data link remote I/O	●Similar as the I/O relay is used for data link receive/send or remote I/O input/ output.
[Retention relay]	
Area not used for the data link remote I/O	●Operational results are stored in this area by the user program for coil destination. ●Used for a temporary storage of the operational results that may not be sent outside. ●Operational results can be used for contact and source in the program. ●Used for storage of the contact and data that should be retained at a power failure.
Area used for the data link remote I/O	●Similar as the I/O relay is used for data link receive/send or remote I/O input/ output.
[Special relay]	
Special relay area (646～677)	●It is area in which error codes and flags are stored and may not be used for the coil destination in the program. But it may be used for contact and source. However, it is possible to use 7 points of 646, 647, 653, 661, 662, 663, 655 can be used for coil.
High speed counter area (700～717)	●Area in which the high speed counter current value is stored. ●Operational results can be used for contact and source in the program. ●Data will be retained during power failure.
[Timer, counter area]	
Area used for the timer	●When the current value turns to Ø, the timer contacts come closed. ●Timer contact may used as many times as required in the program. ●The current value can be used for source (or destination as a special usage) in the program.

Area used for the counter	●When the current value turns to Ø, the counter contacts come closed. ●Counter contact may used as many times as required in the program. ●The current value can be used for source (or destination as a special usage) in the program.
Area not used for timer and counter	●The current value area (bxxx) can be used for a register.
[Register]	
Area not used for data link	●Operational results are written by the program as the destination. ●Operational results can be used in the program as the source. ●Data from such as programmer may be stored in the area in the parameter entry mode.
Area used for data link receive	●Receive data from the master are stored in response to the request from the data link slave. ●Used by the program for the input information (data).
Area used for data link send	●Operational results are written by the program as the destination. ●Transferred to the data link slave module buffer to be sent to the master in response to the request from the data link slave module. ●Operational results can be used in the program as the source.

NOTE-1:
The input relay area retains to a next I/O cycle the ON/OFF state of the present I/O operation. But, the data will be revised by the operational results in the cycle, if it was used for the coil destination in the program.

NOTE-2:
Source and destination are referred to application instruction. The register in which the operational results are stored is called destination. The register in which the data before the operation is stored is called source.

NOTE-3:
For detail of the data link and remote I/O, refer to instruction manual of the respective option.

NOTE-4:
For detail of the special relay, refer to 8-2-[3] "Special relay".

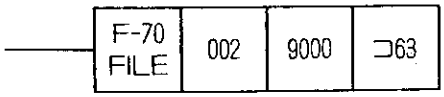
[3] Special relay

There are the following for the special relays.

646	External trouble diagnose relay-1
647	External trouble diagnose relay-2
650	External diagnose error-1
651	External diagnose error-2
652	Key device switch
653	Display device switch
654	Non-carry flag
655	Error flag
656	Carry flag
657	Zero flag
660	Ø.1 second clock
661	All outputs disable
662	High speed counter start
663	High speed counter reset
664	1 second clock
665	Preset value change switch
666	All time OFF contact
667	
670	Memory failure
671	CPU failure
672	Battery failure
673	I/O failure
674	Option failure
675	
676	ROM failure
677	Power supply failure
700	High speed counter current value
701	BCD (1st digit)
702	
703	
704	High speed counter current value
705	BCD (2nd digit)
706	
707	
710	High speed counter current value
711	BCD (3rd digit)
712	
713	
714	High speed counter current value
715	BCD (4th digit)
716	
717	

As these special relay areas are written by the CPU except for 646, 647, 653, 661, 662, 663, 665, 700～717, they can be used for contact and source by the user program.
Pay attention not to use them for coil and destination by the user program. Special attention is required when using the instruction that handles two bytes or more and batch transfer.

(Example)



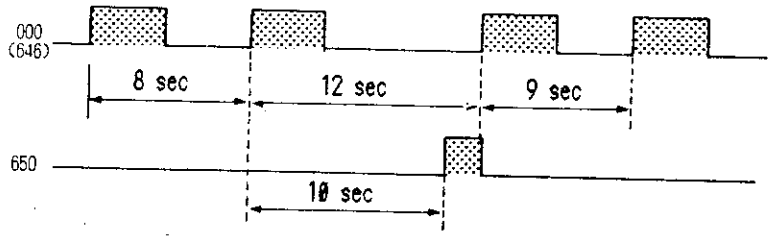
The operational results are written in the special area of □64.

① 646, 647 (external trouble diagnose relay-1, -2)
650, 651 (external trouble diagnose error-1, -2)

- Trouble in the external device can be diagnosed when the external trouble diagnose relay (646, 647) is used for the coil.
- If a time required for 646 or 647 to rise again were to be longer than the data (in an increment of 0.1 second) stored in the external trouble diagnose register (9155, 9156), it causes the external diagnose error (650, 651) to turn on.
- 646 must be used in conjunction with 650 and the register 9155, and 647 in conjunction with 651 and the register 9156.

Register 9155 = 100 (decimal)

As a change in 000 is monitored, an error is established when a rise-to-rise time is more than ten seconds.



- Even if the external diagnose error was active, it will be reset after a low to high transition of the external trouble diagnose relay.
- Refer to [6] "Special register".

② 652 (key device switch)

- 652 goes active for a single scan time after depression of any of 16 keys on the keyboard, when the ZW-10PG1 programmer is in the device mode.
- Refer to ZW-10PG1 Manual "Device input function".

③ 653 (display device switch)

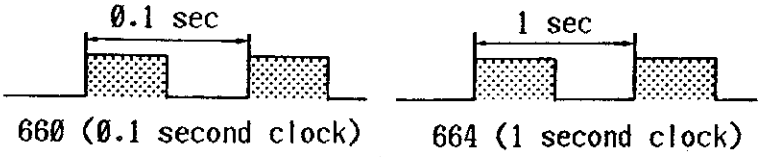
- Used for control of the display timing, when the display output function of the ZW-10PG1 programmer is used.
- For more details, refer to ZW-10PG1 Manual "Display output function".

④ 654~657 (flag)

- Flag will be set active according to the contents of the operation, when executing the application instruction that affects flag.

⑤ 660 (0.1 second clock), 664 (1 second clock)

- Used for the clock of the counter and application instruction.



⑥ 661 (all output disable)

- All outputs turn off, when this coil is set on by the program.

⑦ 662 (high speed counter start), 663 (high speed counter reset)

- The high speed counter current value is counted when 662 is on.
- The high speed counter current value is reset when 663 is on.
- Counting does not take place when both 662 and 663 are off.
- For more details, refer to 8-6 "High speed counter".

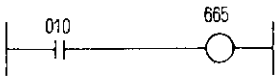
⑧ 665 (preset value change switch)

- It is possible to set or reset the retention relay (600~647) in the change mode, but it is set 665 active program-wise to set or reset relay (000~577) other than retention relay or to write data in the register (D00~D71, b000~b137, 9000~9177) from support tool such as programmer.

- Program to set active at all times

Uses the contact 666 which is off at all times.

● Program to set active by the external switch



655 keeps to be on while the switch connected to Ø1Ø is on.

⑨ 666 (all time OFF contact)

● Used by the program for the contact that keeps to be inactive (a-contact) or active (b-contact)

⑩ 67Ø~677 (self-diagnostic result)

● The contacts come closed according to the nature of error, when there is an error found as a result of self-diagnoses.

● For more details, refer to 8-5 "Self-diagnosis".

⑪ 7ØØ~717 (high speed counter current value)

● The area in which the high speed counter current value is stored.

● May be used as retention relay, when the high speed counter is not used.

● For more details, refer to 8-6 "High speed counter".

NOTE-1:
When the remote I/O option or data link option is used, a part of the retention relay area of 6ØØ~645 may turn to be special area.. For detail,refer to the instruction manual of the option unit.

[4] Timer, counter data storage area

96 bytes of bØØØ~b137 are the areas in which the timer and counter current values are stored.
There are 48 points of timer and counter. Each point occupies two bytes. See the list below for the relation of timer and counter numbers vs. bxxx.

(Table-1)

TMR, CNT number	Data storage
00	b000, b001
01	b002, b003
02	b004, b005
03	b006, b007
≈	≈
56	b134, b135
57	b136, b137

(Table-4)

	7	6	5	4	3	2	1	0
TMR	(×10⁰)				(×10⁻¹)			
	"8"	"4"	"2"	"1"	"8"	"4"	"2"	"1"
	0	For TMR 0	Reset NOTE-1	(×10³) "1"	(×10¹) "8"	"4"	"2"	"1"
CNT	(×10¹)				(×10⁰)			
	"8"	"4"	"2"	"1"	"8"	"4"	"2"	"1"
	0	For CNT 1	Reset NOTE-1	(×10³) "1"	(×10²) "8"	"4"	"2"	"1"

Timer and counter value can be used for operation, if bØØØ~b137 is assigned by the data processing instruction such as F-ØØ.

Table-2 shows the data format of b000~b137.

NOTE-1:
It will go 0 (OFF) if forced to reset in the parameter change mode, though normally 1 (ON).

NOTE-2:
Figures are handled in the BCD notation for b000~b137.

[5] Relay area byte address

The W10 is a programmable controller that performs not only bit to bit operation like AND and OR, but, it also can perform addition, subtraction, and data transfer. The data processing instruction is handled by byte.
In order to process data in the input/output relay, auxiliary relay, and retention relay area, it needs to have the address with which the area specified in term of byte. The byte address is the address expressed in byte that corresponds to the relay number. To clearly indicate that it is a high order two digits abandoning the least significant digit of a three-digit relay number, the special term "⊐" is prefixed.

(Example)

137	136	135	134	133	132	131	130

For instance, the above byte address is ⊐13.

[6] Special register

There are the following for the special registers.

9155	External trouble diagnose register-1
9156	External trouble diagnose register-2
9157	Key device register
9160 ~ 9177	Display output register

① 9155, 9156 (external trouble diagnose register-1, -2)

- In this register is set a high to high signal time interval for the external trouble diagnose relay (646, 647).
- Time can be set within a range of 0.1 to 25.5 seconds (1~255).
- Refer to 646, 647, 650, 651, "Special relay".

② 9157 (key device register)

- 16 keys are set in this register, when the ZW-10PG1 programmer is in the device mode.
- For more details, refer to ZW-10PG1 Manual Device input function".

③ 9160～9177 (display output register)

- The ASCII characters (16 characters) contained in 9160～9177 are brought on the display window, when the ZW-10PG1 programmer is in the device mode.
- The data are displayed when the display device switch (653) changed from OFF to ON.
- For more details, refer to ZW-10PG1 Manual "Display output function".

[7] Data memory address map

1) I/O relay (000～237)

007	006	005	004	003	002	001	000
017	016	015	014	013	012	011	010
027	026	025	024	023	022	021	020
037	036	035	034	033	032	031	030
047	046	045	044	043	042	041	040
057	056	055	054	053	052	051	050
067	066	065	064	063	062	061	060
077	076	075	074	073	072	071	070
107	106	105	104	103	102	101	100
117	116	115	114	113	112	111	110
127	126	125	124	123	122	121	120
137	136	135	134	133	132	131	130
147	146	145	144	143	142	141	140
157	156	155	154	153	152	151	150
167	166	165	164	163	162	161	160
177	176	175	174	173	172	171	170
207	206	205	204	203	202	201	200
217	216	215	214	213	212	211	210
227	226	225	224	223	222	221	220
237	236	235	234	233	232	231	230

Code for one byte (8 bits) representation

⊐ 00
⊐ 01
⊐ 02
⊐ 03
⊐ 04
⊐ 05
⊐ 06
⊐ 07
⊐ 10
⊐ 11
⊐ 12
⊐ 13
⊐ 14
⊐ 15
⊐ 16
⊐ 17
⊐ 20
⊐ 21
⊐ 22
⊐ 23

2) Auxiliary relay (240~577)

247	246	245	244	243	242	241	240
257	256	255	254	253	252	251	250
267	266	265	264	263	262	261	260
277	276	275	274	273	272	271	270
307	306	305	304	303	302	301	300
317	316	315	314	313	312	311	310
327	326	325	324	323	322	321	320
337	336	335	334	333	332	331	330
347	346	345	344	343	342	341	340
357	356	355	354	353	352	351	350
367	366	365	364	363	362	361	360
377	376	375	374	373	372	371	370
407	406	405	404	403	402	401	400
417	416	415	414	413	412	411	410
427	426	425	424	423	422	421	420
437	436	435	434	433	432	431	430
447	446	445	444	443	442	441	440
457	456	455	454	453	452	451	450
467	466	465	464	463	462	461	460
477	476	475	474	473	472	471	470
507	506	505	504	503	502	501	500
517	516	515	514	513	512	511	510
527	526	525	524	523	522	521	520
537	536	535	534	533	532	531	530
547	546	545	544	543	542	541	540
557	556	555	554	553	552	551	550
567	566	565	564	563	562	561	560
577	576	575	574	573	572	571	570

Code for one byte (8 bits) representation

⊐ 24
⊐ 25
⊐ 26
⊐ 27
⊐ 30
⊐ 31
⊐ 32
⊐ 33
⊐ 34
⊐ 35
⊐ 36
⊐ 37
⊐ 40
⊐ 41
⊐ 42
⊐ 43
⊐ 44
⊐ 45
⊐ 46
⊐ 47
⊐ 50
⊐ 51
⊐ 52
⊐ 53
⊐ 54
⊐ 55
⊐ 56
⊐ 57

3) Retention relay (600~647)

607	606	605	604	603	602	601	600
617	616	615	614	613	612	611	610
627	626	625	624	623	622	621	620
637	636	635	634	633	632	631	630
647	646	645	644	643	642	641	640

Code for one byte (8 bits) representation

⊐ 60
⊐ 61
⊐ 62
⊐ 63
⊐ 64

4) Special relay (646~717)

646	External trouble diagnose relay-1
647	External trouble diagnose relay-2
650	External diagnose error-1
651	External diagnose error-2
652	Key device switch
653	Display device switch
654	Non-carry flag
655	Error flag
656	Carry flag
657	Zero flag
660	Ø.1 second clock
661	All outputs disable
662	High speed counter start
663	High speed counter reset
664	1 second clock
665	Preset value change switch
666	All time OFF contact
667	
670	Memory failure
671	CPU failure
672	Battery failure
673	I/O failure
674	Option failure
675	
676	ROM failure
677	Power supply failure
700	High speed counter current value BCD (1st digit)
701	
702	
703	
704	High speed counter current value BCD (2nd digit)
705	
706	
707	
710	High speed counter current value BCD (3rd digit)
711	
712	
713	
714	High speed counter current value BCD (4th digit)
715	
716	
717	

A part of 600~645 may become the special area, when an option is used. For more details, refer to the instruction manual of the option.

5) TMR, CNT (ØØ~57)

00	b 000
	b 001
01	b 002
	b 003
02	b 004
	b 005
03	b 006
	b 007
04	b 010
	b 011
05	b 012
	b 013
06	b 014
	b 015
07	b 016
	b 017
10	b 020
	b 021
11	b 022
	b 023
12	b 024
	b 025
13	b 026
	b 027
14	b 030
	b 031
15	b 032
	b 033
16	b 034
	b 035
17	b 036
	b 037

20	b 040
	b 041
21	b 042
	b 043
22	b 044
	b 045
23	b 046
	b 047
24	b 050
	b 051
25	b 052
	b 053
26	b 054
	b 055
27	b 056
	b 057
30	b 060
	b 061
31	b 062
	b 063
32	b 064
	b 065
33	b 066
	b 067
34	b 070
	b 071
35	b 072
	b 073
36	b 074
	b 075
37	b 076
	b 077

40	b 100
	b 101
41	b 102
	b 103
42	b 104
	b 105
43	b 106
	b 107
44	b 110
	b 111
45	b 112
	b 113
46	b 114
	b 115
47	b 116
	b 117
50	b 120
	b 121
51	b 122
	b 123
52	b 124
	b 125
53	b 126
	b 127
54	b 130
	b 131
55	b 132
	b 133
56	b 134
	b 135
57	b 136
	b 137

6) Register (9000~9177)

9007	9006	9005	9004	9003	9002	9001	9000
9017	9016	9015	9014	9013	9012	9011	9010
9027	9026	9025	9024	9023	9022	9021	9020
9037	9036	9035	9034	9033	9032	9031	9030
9047	9046	9045	9044	9043	9042	9041	9040
9057	9056	9055	9054	9053	9052	9051	9050
9067	9066	9065	9064	9063	9062	9061	9060
9077	9076	9075	9074	9073	9072	9071	9070
9107	9106	9105	9104	9103	9102	9101	9100
9117	9116	9115	9114	9113	9112	9111	9110
9127	9126	9125	9124	9123	9122	9121	9120
9137	9136	9135	9134	9133	9132	9131	9130
9147	9146	9145	9144	9143	9142	9141	9140
9157	9156	9155	9154	9153	9152	9151	9150
9167	9166	9165	9164	9163	9162	9161	9160
9177	9176	9175	9174	9173	9172	9171	9170

9155~9177 can be used as a special register shown next.

9155	External trouble diagnose register-1
9156	External trouble diagnose register-2
9157	Key device register
9160 ~ 9177	Display output register

8-3 System memory

The system memory consists of 256 bytes of #000~#377 and is backed up by the battery power.

· Do not write data in the address other than shown below.

(1) Base module and programmer functional area

<table>
<tr><th>Address</th><th>Item</th><th>Description</th></tr>
<tr><td>#037</td><td>English and Japanese selection for the ZW-10PG1 programmer</td><td>Selection is made whether it will be English or Japanese in display for the ZW-10PG1 programmer.
Choice should be made in an octal figure.
000...Japanese
252...English
Default value is 000.</td></tr>
<tr><td>#200</td><td>Retention relay area</td><td>To be programmed to expand or reduce the retention relay area from the default setup.
Use an octal figure to set the data memory address. Since the default setup is 600. it had been set to 060 by the parameter.
<table>
<tr><th>Relay</th><th>Relay adrs</th><th>Byte adrs</th><th>Parameter</th></tr>
<tr><td>I/O relay</td><td>000
~
237</td><td>⊐00
~
⊐23</td><td>000
~
023</td></tr>
<tr><td>Aux. relay</td><td>240
~
577</td><td>⊐24
~
⊐57</td><td>024
~
057</td></tr>
<tr><td>Retention relay</td><td>600
~
647</td><td>⊐60
~
⊐64</td><td>060
~
064</td></tr>
</table>
It can be set in an increment of 8 points (1 byte).</td></tr>
<tr><td>#201</td><td>Entry of timer reset condition</td><td>Timer function at the time of power recovery is set. Use an octal figure.
000...Reset upon power recovery.
001...Restore the state before power failure.
Default setup is 000.</td></tr>
<tr><td>#202</td><td>Entry of counter reset condition</td><td>CNT instruction, F-60 (F/B SFR), F-62 (U/D CNT) reset input condition is set. Use an octal figure.
000...Reset when on.
001...Reset when off.
Default setup is 000.</td></tr>
<tr><td>#203</td><td>Choice of output retention</td><td>The function of the output module is set at a time of power interrupt.
000...Restores the output at the time of power interrupt.
001...Resets the output at the time of power interrupt.</td></tr>
</table>

Address	Item	Description
#227	Choice of 10ms timer function	Choice is made to use 4 points of 54～57 for the 10ms timer or the 100ms timer. Use an octal figure. 000...100ms timer 345...10ms timer Default setup is 000.

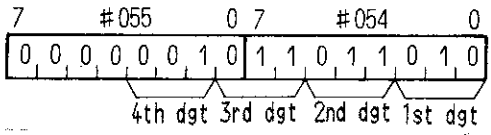
(2) Area in which a PC error code is stored

#210 ～#217	Error code as a result of self-diagnosis	If an error is recognized as a result of self-diagnosis, the error respective to the error kind is stored.

#210～#217 works as a shift register and it can store eight errors. For more details of the error code, refer to 8-5 "Self-diagnosis".

NOTE-1:
For the contents are not cleared after clearing the error, it has to be cleared with 00 using the support tool such as programmer.

(3) Area in which memory error address is stored

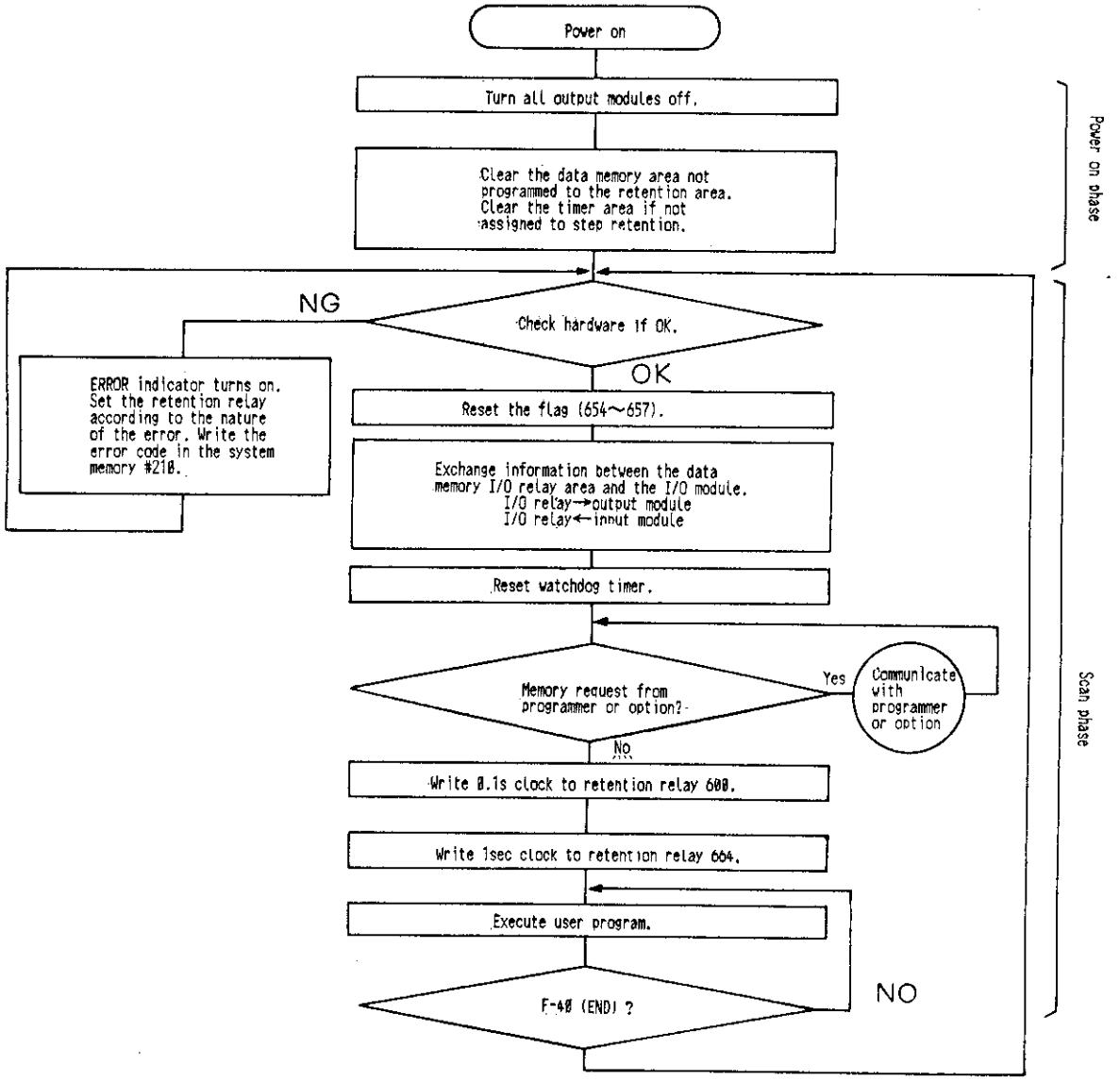
#054 #055	Memory error address	Stores the address in error that was found during memory check by the self-diagnosis.  In an above example, an error occurred in address 1332.

(4) Area in which used by an option unit

Refer to the instruction manual of the remote I/O and data link.

8－4 Operation cycle

[1] Operational flowchart



[2] Power on phase

After power on, the power down signal (which keeps low for 10ms after complete establishment of the 5V supply) is interrogated if existing. If not found, the data memory is begun to initialize. The following data memory are established after the completion of initialization.

Data memory	Address	State after initialization
I/O relay Aux. relay Retention relay	000~237 240~577 600~647	The retention start address can be set in the system memory #200. Address before retention is set... all OFF. Address after retention is set... retains the ON/OFF state before power interrupt.
Special relay	646~717	646, 647, 700~717 retain their ON/OFF state before power down.
Timer, counter	00~57	[Timer] The condition upon power on can be set in the system memory #201. 000...The current value is adopted for the parameter and the timer contacts are reset. 001...The value before power interrupt is retained in the current value. the timer contacts retain its ON/OFF state before power down.
		[Counter] The value before power down is retained in the current value. The counter contacts retain its ON/OFF state before power down.
Register	9000~9177	The value before power down is retained.

NOTE-1:
Prior to initializing at power on, output data latch within all the output modules are reset to turn all outputs off.

NOTE-2:
The data memory is initialized as described above at power on, but the following changes take place in the data memory input/output relay area during the first scan cycle in the I/O operation.

(1) Input relay area

Turn ON or OFF according to the ON/OFF state of the input device (such as limit switch) that connected to the input module.

(2) Output relay area and unassigned I/O relay area

The state after the initialization keeps unchanged until the user program began to execute.

NOTE-3:
During power on, the W1Ø checks the number of I/O modules interfaced to it. If there should be a change in the number of modules after the power on, an error will be evoked as the I/O module numbers are checked by the self-diagnosis.

[3] Scan cycle

It goes into the scan cycle upon completion of the power-on procedure. The scan cycle starts from checking the hardware and ends in the step where the program termination instruction (F-4Ø) is encountered. After completion of program execution, it returns to the hardware check step and repeats the above procedure, for which time required for one cycle is called a scan time.

(1) Hardware check

Self-diagnostic is carried out to check proper operation of the base module hardware.

a. ROM test

The CRC code of the ROM on the CPU board is checked. The microprogram is stored in the ROM for the internal processing by the CPU. The ROM test is carried out just for one cycle immediately after power on and will not be done thereafter.

NOTE-1:
No test is done for the EPROM and EEPROM which is used under the control of the ROM.

b. RAM test
The RAM is tested to see if it is capable of reading and writing.

NOTE-1:
In addition to the above two, there are the following for the self-diagnosis.

① I/O module numbers

② Watchdog timer

③ Memory test

④ Power supply failure

⑤ Option unit failure

⑥ Battery failure

Refer to 8-5 "Self-diagnosis".

(2) Flag clear

Among data processing instructions, some of them affect the operational result and flag. So, the flags are cleared prior to executing the user program at every scan cycle.

(3) I/O processing

Data exchange takes place between the I/O module and the data memory. Execution starts from the I/O module of the youngest number to a next younger and so on.
If it is the input module, the ON/OFF state of the input device connected to the input module (such as limit switch) is stored in the data memory address respective to the module.
If it is the output module, the contents of the data memory respective to the address of the output module are written in the latch of the output module, and its state changes from ON to OFF and vice versa.
The data bus is tested during data exchange. If also checks in the loopback mode if there was any change in the number of module connected.

NOTE-1:
In the first cycle after power on, the contents of the data memory initialized by the power-on procedure are written in the output module. In each cycle thereafter, the operational result in the immediately cycle is written in the output module.

NOTE-2:
In regard to the input relay area, a part that not connected with the input device is written in the data memory as OFF during the I/O operation. So, it may not be used for the auxiliary relay.

NOTE-3:
In regard to the output relay area, a part that not connected with the output device may not be used for the auxiliary relay, though the contents of the data memory are written into the output module during the I/O operation and the LED of the output module comes activated.

NOTE-4:
If an I/O relay open area or the output relay area, to which an output device is not connected, was used for the auxiliary relay, attention must be paid to the fact that there may arise a major revision in the program in order to use that area for addition of an input/output device in future, that is, relocating the auxiliary relay in other area.

(4) Watchdog timer

The watchdog timer is employed to check if the CPU is operating proper in accordance with the internal processing procedure.
Since the CPU resets the watchdog timer when the scan cycle is executed normally, it does not cause any timeup.
If a scan error was established, the watchdog timer will evoke timeup without reset from the CPU. The RUN indicator on the panel goes out and the FAULT indicator goes active. Refer to 8-5 "Self-diagnosis".

(5) Action in response to the request from the programmer or option module

The W1Ø accepts the monitor or change command from the programmer or the data communication command with the remote I/O. If there was a memory request, which is used to request to write or read the data memory in the base module or the user program memory, the CPU within the base module takes action to communicate the the programmer or option module.
In the program mode, the watchdog timer must be reset in order that the watchdog timer may not evoke a timeup, if too long a time were to be required for the job.

(6) Set/reset the Ø.1 second clock (66Ø), 1 second clock (664)

The hardware created ON/OFF state of the Ø.1-second clock is set in the special relay 66Ø and the ON/OFF state of the Ø.1 second clock oriented 1 second clock is written in the special relay 664.

(7) User program execution

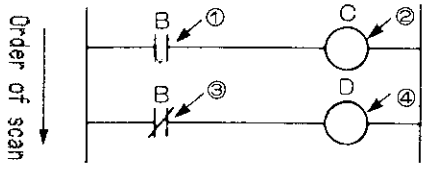
The program is read from the top of the user program area to perform operation according to the program description.
For STR, STR NOT, AND, AND NOT, OR, OR NOT, AND STR, OR STR instruction, the operational results are stored in the accumulator and stack register.
For OUT, TMR, CNT, and almost any kind of application instruction (F-xx), the operational results are stored in the data memory.

NOTE-1:
For more details of the instruction word, refer to Section 9, "Instruction word description"..

NOTE-2:
An abnormal condition like "input racing" would not occur as the ON/OFF states of the input modules are read into the data memory altogether for the I/O operation and the data memory contents are referred in executing instruction, prior to executing the user program.

REFERENCE: Input racing phenomenon
The following may occur for the PC which employs the method to read the ON/OFF state of the input module every time an instruction is executed.

(Example)



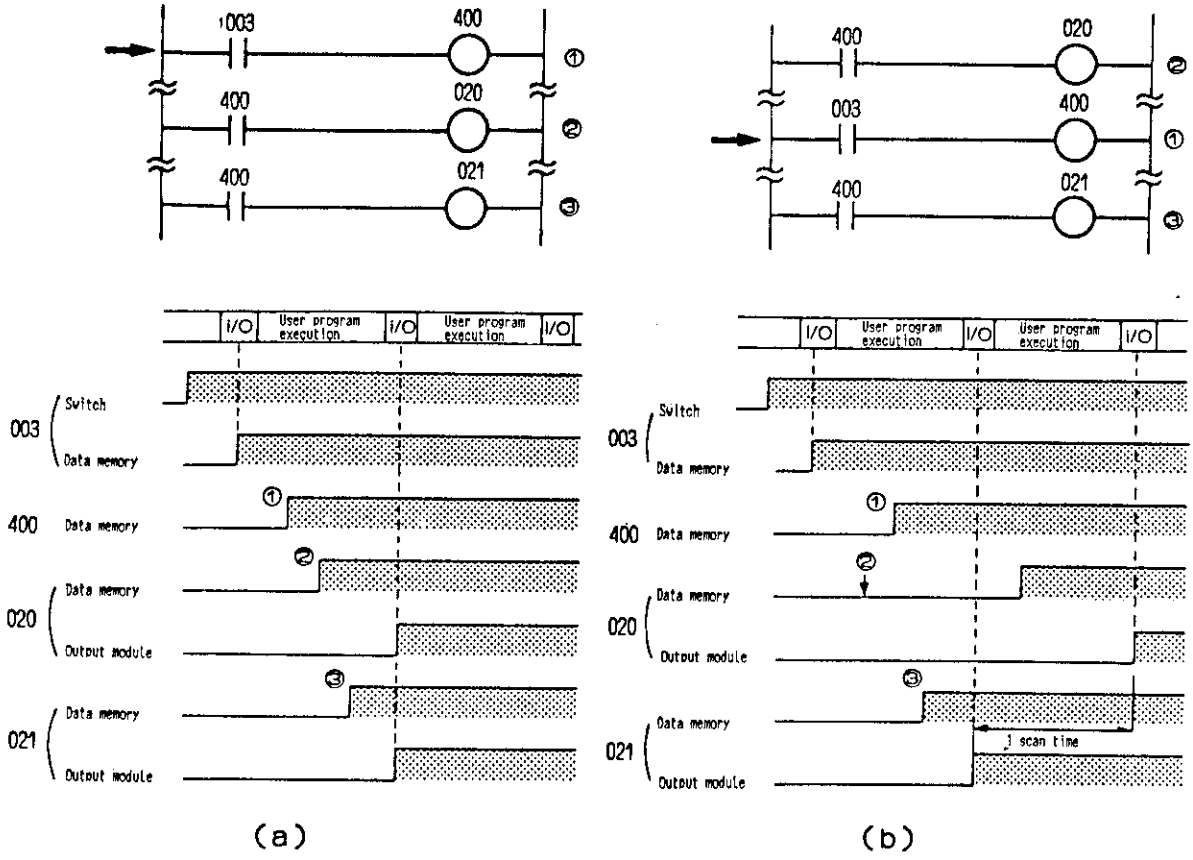
(The program which sets the coil C on if the input B is on, or sets the coil D on if the input B is off.)

Although $C=\overline{D}$ should be established in the above example, assume it now that B was ON when the state of the input B is read from the input module to the accumulator at ① (C is ON). But, if there should be change in the state of the input B (to OFF) before the operation at ③, B is taken for OFF in the operation at ③ and, therefore, the coil D comes active which is contradictory that the coil D went ON and that both C and D are ON.
As introduced, there may be possible involvement of a trouble whose cause is unknown because a change takes place depending on the input timing.
However, such a problem would not occur with the PC that the I/O operation is carried out throughout steps.

NOTE-3:
For the instruction like the OUT instruction that the operational results are stored in the data memory, the results are written in the data memory every time an instruction was executed. But the state of the output block may not change until an I/O operation in a next scan cycle.

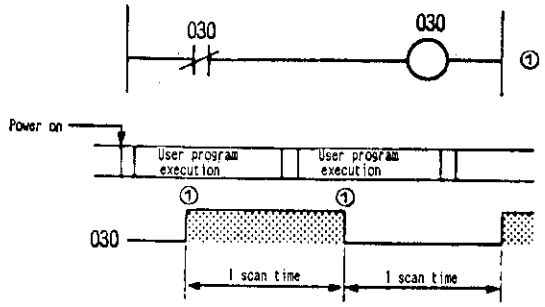
NOTE-4:
If there is an instruction that uses the respective data memory for the contact in succession to the instruction that stores the operational results in the data memory, (i.e. OUT instruction), the operation takes place in accordance with the contents that revised by the OUT instruction.

(Example-1)



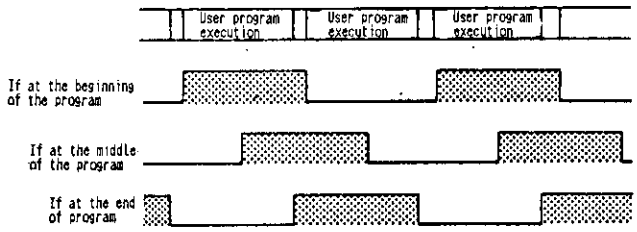
If the programming sequence (a) is swapped by (b), it will produce a different result. There would be no difference between (a) and (b) with the relay board for which parallel operation takes place. But, with the programmable controller that performs serial operation (almost every programmable controller currently on market is this type), the above mentioned phenomenon may be encountered. Thus, attention must be paid to the following point in using the auxiliary contact of the coil (400 in Example-1).
Transition in the auxiliary contact written before the coil takes place in a next scan cycle that the state of the coil has changed.

(Example-2)

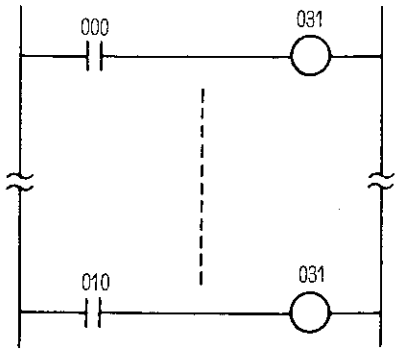


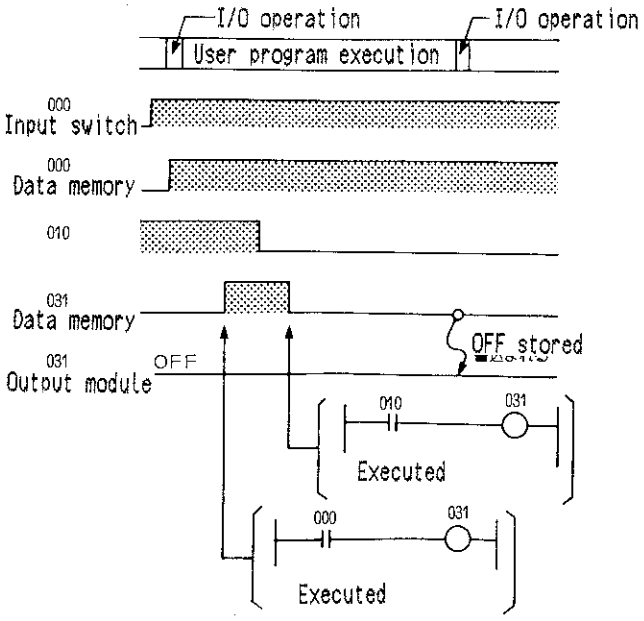
Example-2, on the other hand, utilizes the theory that a transition in the state of the auxiliary contact written before the coil takes place at a next scan time, which repeats ON and OFF at every scan. (Oscillation circuit)
This pulse may be used for the basic clock of flashing circuit or operation start signal at every other single scan.

NOTE:
As shown in the timing chart, the ON/OFF timing may vary depending on where the oscillation circuit written in the user program. Care must be taken in using this pulse for an operation start signal.



NOTE-5:
When the same relay number is used for a number of times for the coil in the program, the result of the coil used last is left in the data memory at the end of the program and is written in the output module during I/O operation in a next scan cycle. And, so, it may evoke the action that does not meet the programmed purpose.





With the W10 programmer (ZW-100PG1), repeated use of the same coil will be detected as "DOUBLE OUT" when program test is carried out.

(8) Scan time

The time required from the hardware test to the execution of the F-40 END instruction is called scan time which may approximated in the following manner.
The time required for execution of the request from the program or option is not basically included in the scan time, because it varies depending on existence of request and the nature of the operation. And the time required for the hardware test, writing the 0.1 second and 1 second clock to the special relay, or resetting the flag can be disregarded as its time can be ignored.

1 scan time (T) = I/O operation time(t1) + user program execution time(t2)

① I/O operation time (t1)

It is the time required for the CPU to read the input information from the input module and to write the output information to the output module. The I/O operation time for the W10 is dependent on the number of modules in connection.

$t1 = tk + tz1 + m \times tz2$

where,
tk: I/O operation time of the base module (577μs)
tz1: I/O operation time of the 28-point expansion module (440μs)
tz2: I/O operation time of the 14-point expansion module (220μs)
n: number of 28-point expansion modules in connection (0~4)
m: number of 14-point expansion modules in connection (0~4)

(Example)

Base module×1
28-point expansion module×1
14-point expansion unit×1

$t1 = tk + tz1 + tz2 = 577 + 440 + 220 = 1237(\mu s)$

② User program execution time (t2)

It is the total time required for the execution of all instructions from the program address 00000 to the END instruction. For detail of execution time required for independent instruction, refer to 9-1 "List of instruction words".

NOTE-1:
Execution time of application instruction may vary according to when executed and not executed.

③ END instruction

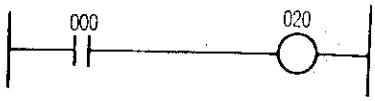
When the program memory is cleared, an entire program memory area is padded with NOP instruction and the F-40 (END instruction) is written

at the last program address. If instructions are written to the middle of the program memory in this condition, the time required for the execution of the NOP instruction is added to the scan time. If F-40 is written at a next address the program ends, it saves the whole scan time for the user program execution terminates at that address.

● NOP instruction execution time: 1.09μs

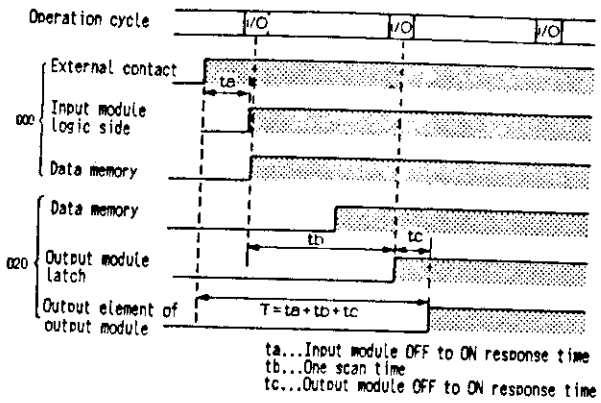
NOTE-2:
If the scan time becomes to be more than 40ms, there may arise an error in the 0.1 second and 1 second clocks.

NOTE-3:
See the figure below for overall PC response time that includes the base and expansion module response times.

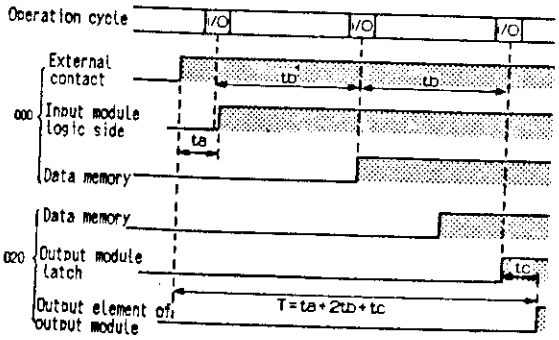


Shown next is the time required for the output element of the output module (transistor, triac, relay) to make transition after a change in the external contact 000, with respect to the above example.

(a) When shortest

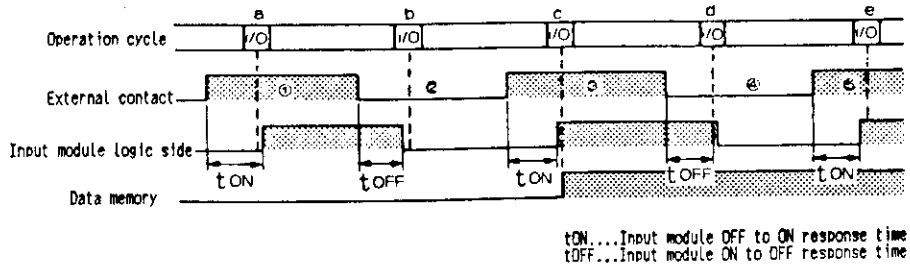


(b) When longest



In the case of ON to OFF, a delay may be encountered due to the response time of the input module and output module.

NOTE-4:
In order to transplant the ON/OFF state of the external contact successfully into the data memory, more than one scan time is needed for ON or OFF time on the input module logic side.



In regard to the ON state of the external contact at ①, the data memory remains OFF as the input module logic side was OFF immediately before the I/O operation of "b", because the I/O operation of the respect input had terminated when the input module logic side has turned ON.

In regard to the ON state of the external contact in the ON state at ③, ON is written in the data memory as the input module logic side was ON immediately before the I/O operation of "c".

In regard to the OFF state of the external contact in the OFF state at ④, the data memory keeps ON as the input module logic side was still ON during I/O operation of "d". In the I/O operation at "e", the data memory keeps ON as the input module is again ON.

If the ON/OFF time on the input module logic side were shorter than one scan cycle, it may or may not be read into the data memory.

For detail of the input module logic side ON/OFF time and base and expansion module response time, refer to 4-1-[3] "Precautions in the use of I/O module".

8-5 Self-diagnosis

The following self-diagnoses are used by the W1Ø.

Failure	Item	PC state	Indicator			Special relay	Error code	
			RUN	FAULT	POWER		System memory	Priority
Memory	Memory test	Stop	Off	On	On	670	21	6
CPU	Watchdog timer					671	31	1
	RAM test (R/W)						32	4
	ROM test						34	2
I/O	I/O data bus					673	44	5
	I/O module						46	5
Power	Power down, low voltage			Off	Off	677	13	3
Option	Option module failure			On	On	674	53	7
Battery	Low battery	Run	On			672	22	8

NOTE-1:
All error codes are in BCD representation.

[1] Contents of self-diagnosis

1. Memory test

Program memory areas are checked during the hardware check, and prior to starting the operation, parity in all memory areas are checked, illegal command is checked, and the number of differential memories in use is also checked.

2. Watchdog timer

The watchdog timer is reset upon execution of I/O operation.
The watchdog timer comes timeup when an error is met in the operation cycle.

3. RAM test

Prior to going into every operational cycle, read/write test is carried out for the data memory RAM.

4. ROM test

The CRC code check is done in the microprogram ROM at power on.

5. I/O data bus

Prior to the I/O operation, the I/O data bus is examined in the loopback mode if it is proper operating.

6. I/O module numbers

At power on, the number of I/O modules in connection are checked and that it will be interrogated during the I/O cycle if there was any change in it.

7. Power supply

- For a momentary power interrupt of less than 10ms, the W10 will continue to operate. But, a power failure of more than that period will cause the CPU to stop. Upon the power supply is restored, it automatically resumes the operation.

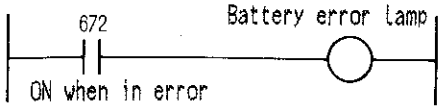
- If the supply voltage drops to 80% of the rated voltage after a gradual power drop (slow down), the CPU will come to stop. In this event, the operation will be resumed after it has recovered to the rated supply voltage.

8. Option module failure

When option module such as data link, remote I/O are being used, a failure in those modules are checked.

9. Battery

Supply voltage of the backup battery is checked if normal.
It is possible to activate the battery error lamp or to alert with the buzzer using the special relay 672.
Although nothing will affect the PC operation as long as the power is on to the PC even if a battery failure was encountered, it is preferable to replace the battery with the fresh one within the given period, in order to be ready for an unexpected power supply failure.



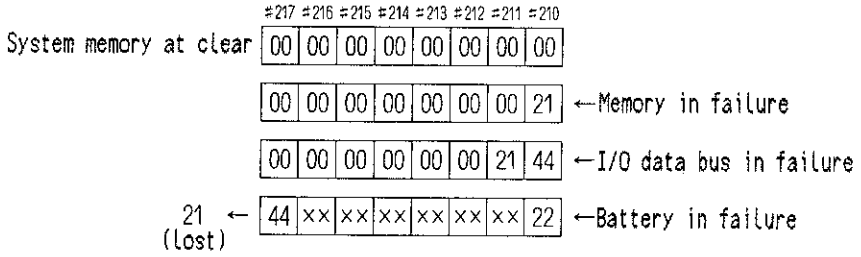
[2] Special relay

Results of self-diagnosis are written in the special relay area of the data memory.
When the PC stops after establishment of an error as a result of self-diagnosis, it is possible to find the nature of the error by searching the special relay area (670~677) using the support tool.

NOTE-1:
Because the self-diagnosis runs at every operational cycle, the PC will resume the operation upon recovery from the error.
The self-diagnostic special relay is also reset.

[3] Error code

When an error is established as a result of self-diagnosis, the respective error code is written in the system memory (#210～#217) which functions as shift register in which eight error codes can be stored. If errors should occur more than eight, the error codes will be replaced in terms of first out and last in.



- The error code in the system memory would not be cleared after the recovery from the error. To clear the error code, write ØØ in the system memory (#210～#217) using the support tool such as programmer.

- Occurrence of the same error is not written.

[4] ON/OFF state of the output module during error

Depending on how the system memory (#2Ø3) is programmed to retain the output, it determines ON/OFF state of the output module when the programmable controller halts as a result of self-diagnosis.

Contents of #2Ø3

ØØØ...Retains the ON/OFF state immediately before the stop.
ØØ1...OFF.

But, it may not turn the output module OFF depending on the nature of the failure. So, the output which needs to turn OFF at a time of PC error must be connected serial with the external emergency stop output. Refer to 7-2 "Precautions at the time of system design" and 8-3 "System memory".

8-6 High speed counter

(1) High speed counter operation

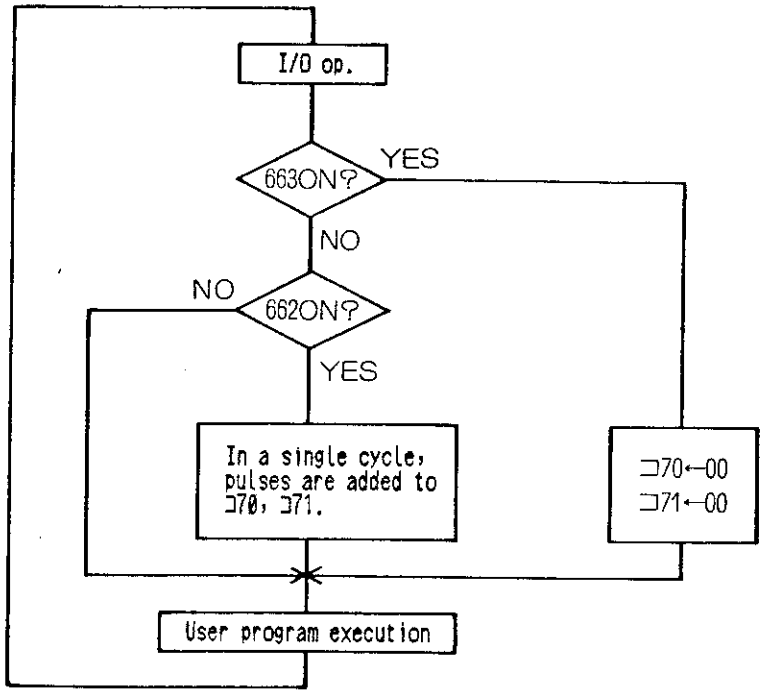
A high speed pulse signal may be read any when the PC is in operation. The data in the current value storage area (□70, □71) may be revised depending on the state of the high speed counter start relay (622) and the high speed counter reset relay (663).

High speed counter count condition	Current value
High speed counter start relay(662) at ON	Does count
Both high speed counter start relay(662) and high speed counter reset relay(663) at OFF	Does not change
High speed counter reset relay(663) at ON	Cleared

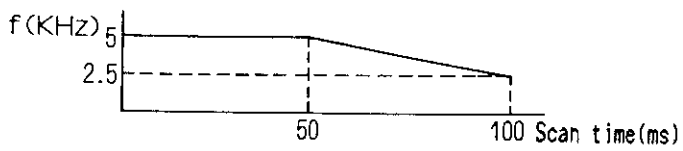
The data (current value) will be stored in the current value area (□70, □71) in four digits of BCD mode, as shown below.

□71				□70			
7 6 5 4		3 2 1 0		7 6 5 4		3 2 1 0	
BCD 4th digit		BCD 3rd digit		BCD 2nd digit		BCD 1st digit	

The following shows the operational flowchart.



The maximum frequency will be as follows, according to the scan time.



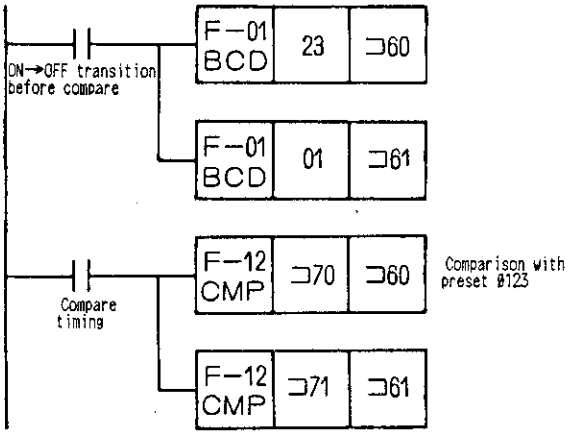
(2) Comparison of the current value vs. parameter

The current value can be compared with the parameter using the compare instruction (F-12, Fc12). The results are stored in the non-carry flag, carry flag, and zero flag. But, attention must paid to the following.

1. When the compare instruction (F-12, Fc12) is used independently, there are need of repeating two instructions because the F-12 and Fc12 instruction is for comparison of a single byte, while the current value consists of four digits (two bytes).

2. To use the register-to-register compare instruction (F-12), transfer the constant to the register using the BCD constant transfer instruction (F-Ø1) before the comparison is done. Also, it is possible to compare directly with the constant if Fc12 is used.

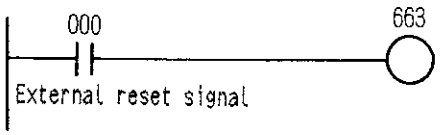
(Example)



(3) Reset

It is possible to reset the current value (ØØØØ) using the high speed counter reset relay (663). To reset with an external signal, get it through the input module.

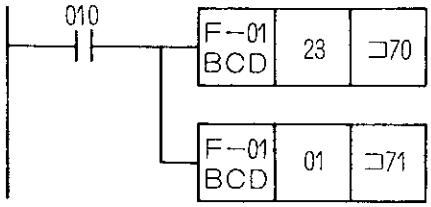
(Example)



(4) Preset

It is possible to preset the current value when the current value storing area is specified by the transfer instruction (F-Ø1, etc.).

(Example)



In the above example, Ø123 is preset at an OFF to ON transition of the current value Ø1Ø.

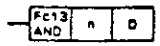
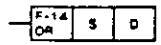
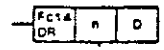
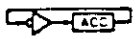
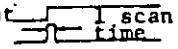
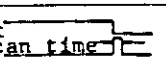
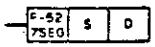
Instruction	Symbol	Size	Function	Performance	Condition	ACC	Stack S_1 S_2 S_3 S_4 S_5 S_6 S_7 S_8	Flag ① ② ③ ④	Execution time (μs) ⑤
STR		1	Operation starts with the a-contact and intermediate result is stored.			↕	A		4.34
STR NOT		1	Operation starts with the b-contact and intermediate result is stored.			↕	A		5.42
AND		1	Logical AND			↕			4.34
AND NOT		1	Logical AND NOT			↕			4.34
OR		1	Logical OR			↕			4.34
OR NOT		1	Logical OR NOT			↕			4.34
AND STR		1	Logical AND with the intermediate result			↕	0		3.26
OR STR		1	Logical OR with the intermediate result			↕	0		3.26
OUT		1	Output of operational result				↕ ↕ ↕ ↕ ↕ ↕ ↕ ↕		1.41
TMR		2	Timer (decremental) (1)Start input (2)TMR number(00~57) (3)Preset value (0.1~199.9sec) Internal clock 0.1-second	Current value is decremented by one every 0.1 second while the start input is ON, and makes the TMR contact ON with the current value at 0.	Start input ON				111.4 [95.2]
CNT		2	Counter (decremental) (1)Counter input (2)Reset input NOTE-3 (3)CNT number(00~57) (4)Preset value (1~1999) NOTE-3	Current value is decremented by one at the rising edge of the counter input while the reset input is OFF, and makes the CNT contact ON with the current value at 0.	Counter input ∫				104.9 [88.7]

①: Non-carry(654) ②: Error(655) ③: Carry(656) ④: Zero(657)

⑤ : Figure shown in parenthesis: when not executing

Instruction	Symbol	Size	Function	Performance	Condition	ACC	Stack S_1 S_2 S_3 S_4 S_5 S_6 S_7 S_8	Flag ① ② ③ ④	Execution time (μs) ⑤
F-00	F-00 XFER S D	3	One byte transfer between data registers	S → D	∫				91.9 [48.8]
F-01	F-01 BCD n D	3	Transfer BCD constant	(BCD) n → D n=00~99	∫				77.8 [52.1]
F-03	F-03 →BIN S D	3	Convert from BCD to binary	(BCD) (BIN) S → D	∫			0 ↕ 0 0	123.7 [51.8]
F-04	F-04 →BCD S D	3	Convert from binary to BCD	(BIN) (BCD) S → D <D>=00~99	∫				128 [86] NOTE-1
F-07	F-07 DEM n D	3	Transfer decimal constant	(Decimal) n → D n=000~255	∫				77.8 [52.1]
F-08	F-08 OCT n D	3	Transfer octal constant	(Octal) n → D n=000~377(8)	∫				77.8 [52.1]
F-10	F-10 ADD S_1 S_2 D	4	Add register with register in BCD 2-digit	$S_1 + S_2 \rightarrow D$	∫			↕ ↕ ↕ ↕	183.4 [68.4]
Fc10	Fc10 ADD S_1 n D	4	Add register with BCD 2-digit constant	(BCD) $S_1 + n \rightarrow D$ n=00~99	∫			↕ ↕ ↕ ↕	157.3 [74.9]
F-11	F-11 SUB S_1 S_2 D	4	Subtract register from register in BCD 2-digit	$S_1 - S_2 \rightarrow D$	∫			↕ ↕ ↕ ↕	192.8 [68.4]
Fc11	Fc11 SUB S_1 n D	4	Subtract 2-digit BCD constant from register	(BCD) $S_1 - n \rightarrow D$ n=00~99	∫			↕ ↕ ↕ ↕	162.8 [74.9]
F-12	F-12 CMP S_1 S_2	3	Compare register with register	$S_1 <=> S_2$	ON			↕ 0 ↕ ↕	107.4 [44.5]
Fc12	Fc12 CMP S_1 n	3	Compare register with constant	$S_1 <=> n$ n=000~377(8)	ON			↕ 0 ↕ ↕	87.9 [45.6]
F-13	F-13 AND S D	3	Logical AND registers	S ∩ D → D	∫				97.7 [52.1]

①: Non-carry(654) ②: Error(655) ③: Carry(656) ④: Zero(657)
⑤ : Figure shown in parenthesis: when not executing.

Instruction	Symbol	Size	Function	Performance	Condition	ACC	Stack S_1 S_2 S_3 S_4 S_5 S_6 S_7 S_8	Flag ① ② ③ ④	Execution time (μs) ⑤
Fc13		3	Logical AND register with constant	n ∩ D → D n=000~377(8)	∫				85.7 [55.3]
F-14		3	Logical OR registers	S ∪ D → D	∫				99.8 [51.8]
Fc14		3	Logical OR register with constant	n ∪ D → D n=000~377(8)	∫				87.9 [55.3]
F-30		1	Set master control	F-31 (operation up to MCR is ANDed with MCS condition)					10.9
F-31		1	Reset master control	Indicates the termination of master control					7.6
F-40		1	END instruction	Indicates the end of operation and the control proceeds to a next scan cycle					9.8
F-41		1	Set jump control	Operation up to F-42 (JCR) is not executed when the input condition is OFF					13.8
F-42		1	Reset jump control	Indicates the termination of jump control					7.6
F-43	 (CPL)	1	Complement bit			↕			7.6
F-44		1	Differentiate at ON			↕			38.8
F-45		1	Differentiate at OFF			↕			44.5
F-52		3	7SEG	S(Low order 4 bits) → D(Code for 7 segments)	∫				97.6 [51.8]

①: Non-carry(654) ②: Error(655) ③: Carry(656) ④: Zero(657)
⑤ : Figure shown in parenthesis: when not executing

Instruction	Symbol	Size	Function	Performance	Condition	ACC	Stack S_1 S_2 S_3 S_4 S_5 S_6 S_7 S_8	Flag ① ② ③ ④	Execution time (μs) ⑤
F-55	F-55 SWAP S D	3	Swap high order 4 bits with lower order 4 bits	S → D	∫				94.4 [52.1]
F-60	① ② ③ ④ F-60 F/B SFR D	2	Shift register bidirectional (1) Shift direction input (2) Data input (3) Shift input (4) Reset input NOTE-3	(1) When shift direction input is ON Carry flag — Data input 656 (1) When shift direction input is OFF Data input — Carry flag 656	Shift input ∫			↕ 0 ↕ ↕	102.0 [65.1]
F-62	① ② ③ F-62 U/D CNT D	2	Increment or decrement BCD 2-digit counter (1) Up/down conter direct input (2) Counter input (3) Reset input NOTE-3	(1) When up/down direct input is ON <D> + 1 → D (1) When up/down direct input is OFF <D> - 1 → D	Counter input ∫			↕ ↕ ↕ ↕	107.4 [68.4]
F-70	F-70 FILE n S D	4	Transfer n-byte in batch mode	S,....S+n-1 → D,...D+n-1 n=000~200(8)	∫				98.4+23.8m [59.5] NOTE-4
F-71	F-71 CONS n D_1 D_2	4	Transfer octal constant in batch mode	n → D_1,...,D_2 n=000~377(8)	∫				101.7+5.4m [56.4] NOTE-4
NOP		1	Not operated instruction	Moves to a next step without any action					1.09

①: Non-carry(654) ②: Error(655) ③: Carry(656) ④: Zero(657)
⑤ : Figure shown in parenthesis: when not executing

NOTE-1:
Execution time may vary depending the kind of data. The number in the table shows the maximum execution time.

NOTE-2:
An error may occur in the Ø.1 second clock and 1 second clock, when the scan time extends beyond 40ms.

NOTE-3:
Reset condition for CNT, F-6Ø, and F-62 depends on how the system memory (#2Ø2) was programmed. (ØØØ: reset W/ON, ØØ1: reset W/OFF).

NOTE-4:
"m" in the F-7Ø and F-71 execution time represents the byte number of transferred (decimal number).

LEGEND:
: May vary as affected by the operation.

: Stores the contents of the accumulator up to that time.

: Turns to Ø as a result of the operation.

: Executed at a low to high transition (OFF→ON) of the input.

When the column of the ACC, stack (S1~S8), and flag is blank, no influence is given by the operation.