Honeywell

Honeywell Process Solutions

Programmable Logic Controller

2MLI-CPUU

CPU User's Guide

2MLI-CPUU
R 200
1/09

Release 200

Notices and Trademarks

Honeywell International

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About This Document

This document describes the specifications, performances, and operations of CPU module (Model: 2MLI-CPUU) of MasterLogic-200 PLC System.

ATTENTION

This document does not describe the I/O modules & other special / communication module and programming. For the functions, refer to the related user's manual.

2MLI-CPUU is one of the CPUs of MasterLogic-200 PLC system and the other types of CPU for MasterLogic-200 PLC system are as follows:

- 2MLK-CPUH and 2MLK-CPUS: Non-redundant CPU using only ladder language.
- 2MLI-CPUU: Non-redundant CPU using IEC standard languages - LD, SFC, ST.
- 2MLR-CPUxxxx: Redundant CPU using IEC standard languages – LD / SFC / ST

Release Information

Document Name	Document ID	Release Number	Publication Date
2MLI-CPUU CPU User's Guide	2MLI-CPUU	200	1/09

References

The following list identifies all the documents that may be sources of reference for material discussed in this publication.

Document Title

Acronyms & definitions

Acronym/Term	Definition
A/D	Analog to Digital Conversion
Base	Base is the back plane of the PLC on which the power supply, communication and other modules gets installed Examples: Main base, expansion base.
BCD	Binary Coded Decimal
Cold Restart	This is one of the CPU restart modes which affects the variable parameters of the I/O image area when the CPU is restarted. With the CPU restart mode set to cold restart, all the parameters (like the internal register, timer and counter) initialize to zero.
CPU	Central Processing Unit
D/A	Digital to Analog Conversion
Direct variable	Memory area which can be directly accessed with IEC standard addressing notations with or without any variable name.They are %I (input), %Q (output), and %M (internal flags & registers) variables. Address Examples: %IX0.0.2, %QW1.2.1, and %MD1234
Dnet	DeviceNet Network.
FEnet	Fast Ethernet Network.
FO	Fiber-Optic
Function	Is an operation unit that immediately outputs the operation results for an input such as four arithmetical operations and comparative operations.
Function Block	Is an operation unit, that memorizes the operation results within the commands such as timer and counter or results derived from several scans. Function blocks are the fundamental element for logic programs. function blocks like timer and counter have input and output connections to indicate the flow.
HSL	High Speed Link Service in MasterLogic-200 communication modules

I/O	Input / Output
I/O image area	Internal memory area of CPU module installed to maintain I/O states.
IEC	International Electrotechnical Commission
Interrupt Task	Interrupt driven task programs executed on meeting a given condition in addition to regular scan programs. It consists of 2 types – • Timer interrupt task • Internal flag Interrupt task
KB	Kilo Bytes
KStep	Kilo Steps
LSB	Least Significant Bit
MB	Mega Bytes
ML-200	MasterLogic-200
Module	A standard component with a specific function to configure a system, such as the I/O board assembled to be inserted into the base motherboard. Examples: CPU module, power module, and I/O module.
MSB	Most Significant Bit
O/S	Operating System
P2P	Point to Point Service in MasterLogic-200 communication modules
PAC	Process Automation Controller
PLC	Programmable Logic Controller
PLC System	A system consisting of a PLC, CPU, modules and peripherals configured to be controlled by a user program.
Pnet	Profibus-DP Network.
RAM	Random Access Memory
RTC	As an abbreviation of Real Time Clock, it is collectively referred as a universal IC, with the function of a clock.

RTC	Real Time Clock
Snet	Serial Link Network.
SoftMaster	Programming tool for creating, editing, and debugging a program.
STP	Shielded Twisted Pair
Symbolic variable	Named Variables which are declared with a name, type but address is automatically allocated in symbolic memory area (%A) by the CPU. For instance, named variables declared as ‘Valve1’, ‘Pump2’ or ‘Speed3’ with any IEC standard data type.
TP	Twisted Pair cables (typically CAT5 cables with RJ45 connectors for Ethernet communication)
UTP	Unshield Twisted Pair
Warm Restart	This is one of the CPU restart modes which affects the variable parameters of the I/O image area when the CPU is restarted. With the CPU restart mode is set to warm restart, all the parameters (like the internal register, timer and counter) retain the previous values.
Watchdog Timer	A timer to monitor pre-determined execution time of a program and to generate a warning, when it is not complete within the time.

Contacts

World Wide Web

For more information, visit the following Honeywell websites.

Honeywell Organization	WWW Address (URL)
Corporate	http://www.honeywell.com
Process Solutions	http://www.honeywell.com/ps

Telephone

Contact us by telephone at the numbers listed.

Location	Organization	Phone
United States and Canada	Honeywell IAC Solution Support Center	1-800-822-7673
Europe	Honeywell TAC-EMEA	+32-2-728-2704
Pacific	Honeywell Global TAC - Pacific	1300-300-4822 (toll free within Australia) +61-8-9362-9559 (outside Australia)
India	Honeywell Global TAC - India	+91-20-2682-2458
Korea	Honeywell Global TAC - Korea	+82-2-799-6317
People's Republic of China	Honeywell Global TAC - China	+86-10-8458-3280 ext. 361
Singapore	Honeywell Global TAC - South East Asia	+65-6580-3500
Taiwan	Honeywell Global TAC - Taiwan	+886-7-323-5900
Japan	Honeywell Global TAC - Japan	+81-3-5440-1303
Elsewhere	Call your nearest Honeywell office.	

Symbol Definitions

The following table lists the symbols used in this document, to denote certain conditions.

Symbol	Definition
	**ATTENTION:** Identifies information that requires special consideration.
	**TIP:** Identifies advice or hints for the user, often in terms of performing a task.
	**REFERENCE - EXTERNAL:** Identifies an additional source of information outside of the bookset.
	**REFERENCE - INTERNAL:** Identifies an additional source of information within the bookset.
CAUTION	Indicates a situation which, if not avoided, may result in equipment or work (data) on the system being corrupted or lost, or may result in the inability to properly operate the process.
	**CAUTION**: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. **CAUTION** symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	**WARNING**: Indicates a potentially hazardous situation, which, if not avoided, could result in serious injury or death. **WARNING** symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	**WARNING, Risk of electrical shock**: Potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.

Symbol	Definition
	**ESD HAZARD:** Danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices.
	**Protective Earth (PE) terminal**: Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	**Functional earth terminal**: Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to Protective Earth at the source of supply, in accordance with the national local electrical code requirements.
	**Earth Ground**: **Functional earth connection.** NOTE: This connection shall be bonded to Protective Earth at the source of supply, in accordance with national and local electrical code requirements.
	**Chassis Ground**: Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

Contents

1. Introduction

1.1 Functional Overview

Overview of 2MLI-CPUU

The 2MLI-CPUU is a MasterLogic-200 PLC CPU using IEC 61131-3 standard programming languages i.e. LD, SFC, ST. This document lists the specifications, and the procedures for installing, handling, configuring and programming the CPU module.

Features

1. **Compact size:**

   The 2MLI-CPUU has all the functionality packed in a compact size, thus enabling installation in small spaces. In addition, it reduces storage & freight costs.

2. **High Speed processing:**

   a) MasterLogic's high performance microprocessor technology provides a record execution speed of :

   - Sequence command: 0.028μs / step
   - MOV instructions time: 0.084μs / step

   b) **Real number operation:** Improved operational speed of single/double preciseness.

Item	+	−	×	÷
Single real	0.602 □	0.602 □	1.106 □	1.134 □
Double real	1.078 □	1.078 □	2.394 □	2.66 □

   c) **Improved Data transmission speed:**

   - 16 point I/O module data process: 0.20 μs ~ 0.80 μs/module

- Analog Channel data process: 0.20 μs ~ 0.80 μs/channel
- 1 KB communication module data process: 12.8 μs.

- Parallel processing of I/O image refresh during program operations

3. **Easy Use of Analog I/O Modules:**

It guarantees precision in data collection, stability, and convenience by using:

- Dedicated '%U' address/memory area for data & status collection.
- Setting Parameters without using memory maps for special modules like Analog Input, Analog Output and so on.

4. **System Configuration:**

The system is effectively configured keeping in mind the user's needs:

- Filter Value of the input modules can be adjusted.
- Output can be kept on hold/clear during emergency.
- Varistor is built-in with a durable relay output module.
- The racks (main base and expansion base) can be extended up to 15m.
- Provides system RUN status contact in power supply module.
- Reduction of installation, commissioning, and maintenance costs by the reinforced self-diagnostic function.

5. **Communication systems:**

The communication module enables the user to communicate with the CPU using different Protocols. It is also used by the CPU for communication with I/O's and Special Modules.

- A network communication can be established without ladder programming.
- The exclusive tool (SoftMaster-NM) monitors the operations and applies the network settings
- Open networks are supported with various international standards.
- Provides a dedicated network to improve communication
- Peer to Peer network compatible with other MasterLogic CPUs.

6. **Online Editing:**

   SoftMaster enables the users to modify programs online, while CPU is in operation. It enables:

   - Program reinforced by symbolic variables.
   - Ability to modify the program during operation and secure the stability
   - Installation and modification of network connections during operation.
   - Use of trend monitoring function
   - User event function.
   - Data trace function.

7. **Improved User experience:**

   Improved user experience with various functions supported:

   - Module Changing Wizard (It is used for changing the module online when PLC is in RUN mode.)
   - System Diagnosis
   - Skip I/O
   - Fault Mask
   - Various Operation History

2. Specifications

2.1 General specifications

<table>
<tr><th>Item</th><th colspan="5">Specifications</th><th>Related Standards</th></tr>
<tr><td>Ambient Temp.</td><td colspan="5">0 ~ 55°C</td><td></td></tr>
<tr><td>Storage Temp.</td><td colspan="5">–25 ~ +70°C</td><td></td></tr>
<tr><td>Ambient humidity</td><td colspan="5">5 ~ 95%RH (Non-condensing)</td><td></td></tr>
<tr><td>Storage humidity</td><td colspan="5">5 ~ 95%RH (Non-condensing)</td><td></td></tr>
<tr><td rowspan="9">Vibration</td><td colspan="4">Occasional vibration</td><td>-</td><td></td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Pulse width</td><td>Sweep Count</td><td rowspan="9">IEC61131-2</td></tr>
<tr><td>10 ≤ f <57Hz</td><td>–</td><td>0.075mm</td><td rowspan="6">10 times each direction (X, Y and Z)</td></tr>
<tr><td>57 ≤ f ≤ 150Hz</td><td>9.8m/s^2 (1G)</td><td>–</td></tr>
<tr><td colspan="3">Continuous vibration</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Pulse width</td></tr>
<tr><td>10 ≤ f < 57Hz</td><td>–</td><td>0.035mm</td></tr>
<tr><td>57 ≤ f ≤ 150Hz</td><td>4.9m/s^2 (0.5G)</td><td>–</td></tr>
<tr><td>Shocks</td><td colspan="5">• Peak acceleration: 147m/s^2(15G)
• Duration: 11ms
• Pulse wave type: Half-sine (3 times in each of X, Y and X directions)</td><td>IEC61131-2</td></tr>
</table>

<table>
<tr><th>Item</th><th colspan="4">Specifications</th><th>Related Standards</th></tr>
<tr><td rowspan="5">Noise immunity</td><td>Square wave impulse noise</td><td colspan="3">±1,500V</td><td>Internal Test Spec</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="3">Voltage: 4kV (Contact discharge)</td><td>IEC61131-2
IEC61000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="3">27 ~ 500MHz, 10V/m</td><td>IEC61131-2,
IEC61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient /Burst noise</td><td>Classification</td><td>Power supply</td><td>Digital/Analog Input/Output, Communication Interface</td><td rowspan="2">IEC61131-2
IEC61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td>1kV</td></tr>
<tr><td>Atmosphere</td><td colspan="4">Free from corrosive gases and excessive dust</td><td></td></tr>
<tr><td>Altitude</td><td colspan="4">Less than 2,000m</td><td></td></tr>
<tr><td>Pollution degree</td><td colspan="4">Less than 2</td><td></td></tr>
<tr><td>Cooling method</td><td colspan="4">Air-cooling</td><td></td></tr>
<tr><td rowspan="2">Agency Certifications</td><td colspan="4">UL 508 Industrial Control Equipment</td><td rowspan="2"></td></tr>
<tr><td colspan="4">89/336/EEC, EMC Directive
EN 50081-2, Emissions, Industrial
EN 50082-2, Immunity, Industrial</td></tr>
</table>

ATTENTION

IEC (International Electrotechnical Commission) – An international civil community that promotes international cooperation for standardization of electric/ electro technology, publishes international standard and operates suitability assessment system related to the above.

Pollution Degree – An index to indicate the pollution degree of used

environment that determines the isolation performance of the device. For example, pollution degree 2 means the state to occur the pollution of non-electric conductivity generally, but the state to occur temporary electric conduction according to the formation of dew.

Compliance to European Union Directives. This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives:

EMC Directive. This apparatus is tested to meet Council Directive 89/ 336/ EEC Electromagnetic Compatibility (EMC) using a technical construction file and the following standards, in whole or in part:

- EN 50081- 2 EMC – Generic Emission Standard, Part 2 – Industrial Environment
- EN 50082- 2 EMC – Generic Immunity Standard, Part 2 – Industrial Environment
- The product described in this document is intended for use in an industrial environment.

Low Voltage Directive. This product is also designed to meet Council Directive 73/ 23/ EEC Low Voltage, by applying the safety requirements of EN 61131– 2 Programmable Controllers, Part 2 – Equipment Requirements and Tests.

2.2 Battery

Battery Specifications

Item	Specifications
Battery Type	Manganese Dioxide Lithium Battery
Nominal Voltage/Current	DC 3.0 V/1,800 mAh
Warranty period / Battery Life	5 years (at ambient temperature)
Applications	Program/data backup, RTC operation, in case of power failure.
Dimensions	ϕ 17.0 X 33.5 mm

Cautions for usage

CAUTION

- Heating up the battery or welding the electrode may reduce battery life.
- Attempting to measure the voltage of the battery with a tester; it may cause a short circuit and fire.
- Do not disassemble the battery.

Battery Life

- The durability of the battery normally depends on power time-out, ambient temperature and so on. However, the 2MLI-CPUU batteries are designed for use for over 5 years in any environment.

If the voltage of a battery is lowered, CPU module shows a 'Battery Voltage Drop Warning'. It is possible to check this from the CPU module LED and flag or error message in SoftMaster and Experion System Alarm.

- The battery works for a limited amount of time, even after 'Battery Voltage Drop Warning' occurs you can take an action after warning in the system of daily checking.

CAUTION

In general, the battery generates a warning, 5 years after purchase. You may get an early warning, in case of excessive discharge because of defects or leakage in the battery. If you get a warning, shortly after replacing the battery, contact after-sales service.

2.3 Performance specifications

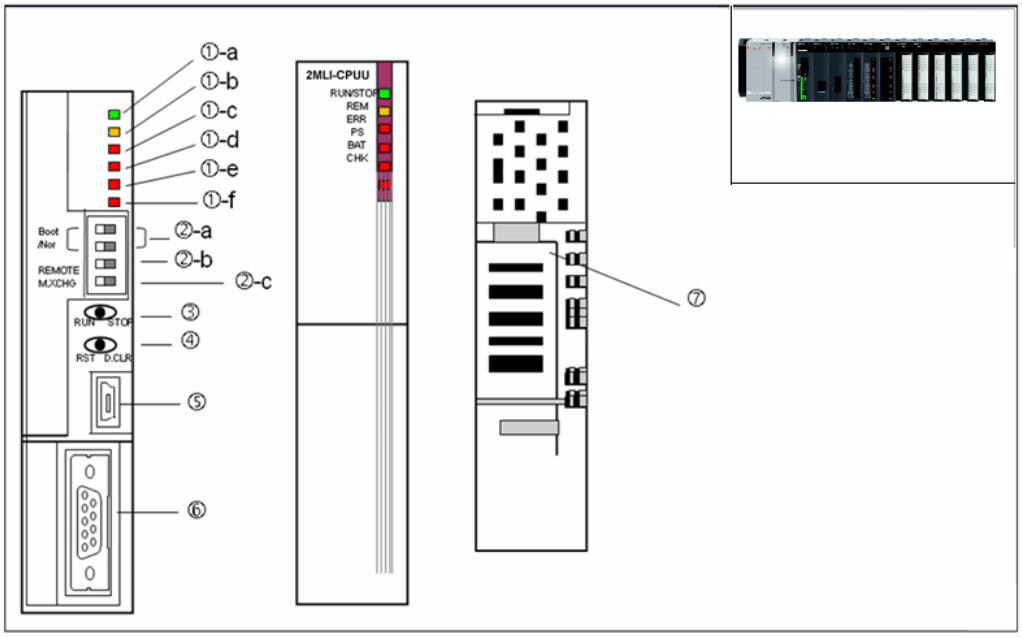
2MLI-CPUU performance specifications

Item		Specifications	Related Standards
		2MLI-CPUU Non-redundant	
Program Execution methods		Cyclic scan, Time-driven interrupts, Internal Memory interrupts	
I/O control method		Scan synchronous batch processing I/O (refresh method), Direct I/O method by program instruction	
Program language		Ladder Diagram, Sequential Function Chart, Structured Text, Instruction List (view only)	
Number of instructions	Operator	18	
	Basic functions	136 + real number operation function	
	Basic function block	43	
	Dedicated function block	Dedicated communication function blocks (P2P)	
Processing speed (Basic instruction)	LD	0.028µs/Step	
	MOV	0.084µs/Step	
	Real number operation	±: 0.392µs (S), 0.924µs (D) ÷: 0.924µs (S), 2.254µs (D) x: 0.896µs (S), 2.240µs (D)	S: Single real number D: Double real number
Program memory capacity		1MB (approx 128 KSteps)	
Max # I/O bases		8 (main + 7 extension)	
Max # slots		96	
Max base	Using 64 ch	6,144 (64ch * 96 slots)	

Item		Specifications	Related Standards
		2MLI-CPUU Non-redundant	
I/O	DI/DO module		
	Using 32 ch DI/DO module	3,072 (32ch * 96 slots)	
Max I/O extension distance		15m (proprietary cable)	+open standards
Network / Remote I/O (Max I/O memory)		128,000	Using Smart I/O modules
Data Memory Capacity	Symbolic Variable Area (A)	512 KB (Maximum, 256 KB retain settable)	
	Timer	No point limit Time Range: 0.001 ~ 4,294,967.295 seconds (1,193hours)	Occupying 20 bytes of symbolic variable area per point
	Counter	No point limit Coefficient Range : -32,768 ~ +32,767	Occupying 8 bytes of symbolic variable area per point
	Direct Variable	M	Fixed Area Variable
		R	
		I	Input Image Area
		Q	Output Image Area
		W	
	Flag Variables	%F	System Flag
		%K	PID Flag
		%L	High Speed Link Flag
		%N	P2P Flag

Item		Specifications	Related Standards
		2MLI-CPUU Non-redundant	
		%U	Analog Refresh Flag as VAR_GLOBAL
Program Type Allocation	INIT task	1max	
	Timer Interrupt tasks	32 max	
	Internal Device Interrupt tasks	32 max	
	Scan program	Balance: 256 minus sum of above	
	Total	256 max	
CPU operation mode		RUN, STOP, DEBUG	
CPU restart mode		Cold or warm restart	
Self-diagnosis		Watchdog timer, memory error, I/O error, battery error, power error, communication error etc.	
Built-in Program port		RS-232C(1CH)	Modbus slave supported via RS-232C port
		USB (1CH) @ 12MBPS	
		Note: Additional program connections via Ethernet & serial communication module (locate or remote)	
Data storage method at power off		Retain area configuration via Basic parameters	
Internal consumption current		960mA	
Weight		0.12kg	
Switchover Time		NA	
Flash area		16MB	

Part Names and Functions



No.	Names	Description
①-a	RUN/STOP LED	Specifies the operation state of CPU module. • **Green ON**: CPU operation is in 'RUN' mode state either by: – RUN/STOP switch in CPU set to RUN mode (or) – REMOTE 'RUN' operation through SoftMaster even when the local switch is at 'STOP' mode • **Green Blink:** Warning or error during RUN operation • **Red ON:** CPU operation is in 'STOP' mode state either by: – RUN/STOP switch in CPU set to STOP mode (or) – REMOTE 'STOP' operation through SoftMaster even when the local switch is at 'RUN' mode • **Red Blink**:

No.	Names	Description
		– Warning or error during 'STOP' operation (if an error occurs, stop the ongoing operation).
①-b	REM LED	• **Yellow ON:** 'Remote enabled' in case 'REMOTE' switch is 'ON' • **OFF:** 'Remote disabled' in case 'REMOTE' switch is 'OFF'
①-c	ERR LED	• **Red ON:** Error has occurred and CPU cannot operate normally. • **OFF**: Normal operation
①-d	PS LED (Programmable Status)	• **Red ON**: o 'User assigned flag' is 'ON' o Operating in the error state by 'operation proceeding in the error' setting o Module is detached or new module is installed in the state where 'M.XCHG' switch is 'ON' • **OFF:** Normal operation
①-e	BAT LED	**ON (Red)**: Battery voltage is low **OFF**: Normal operation
①-f	CHK LED	• **Red ON**: – Setting is different from standard setting (its is possible to add/delete [clear] by parameter) – 'Module change' switch is set as 'Module change' – Operating in 'DEBUG mode' – 'Forced ON' setting state – 'Fault mask', 'SKIP' flag is set – Warning occurs during operation – Extended base power error • **Red Blink**: Arithmetic Operation Error during RUN. • **OFF**: Normal operation
②-a	Boot/Nor switches	Used to download new O/S or upgrade of CPU firmwares before releasing the product.

No.	Names	Description
		• **ON (right):** For normal CPU operation mode. • **OFF (left):** Used for download of new O/S. It is reserved for use by Honeywell factory / authorized personnel. Switching to this position by user is strictly prohibited. **Note:** Both Boot/Nor switches must always be set to ON (right) side. Setting it to OFF (left) side, may cause abnormal operation.
②-b	REMOTE enable switch	Used to enable the PLC to operate remotely • **ON (right):** All functions enabled for remote control • **OFF (left):** Limited remote functions
②-c	M.XCHG (Module exchange switch)	Used while changing any module online during CPU operation (hot-swapping). • **ON (right):** Before changing the module, put the switch in ON position. • **OFF (left):** After the module is changed put the switch back to OFF position.
③	RUN/STOP mode Switch	Sets the operation mode of CPU module. • **STOP → RUN:** executes the program • **RUN → STOP:** stops the program • The above commands operates irrespective of the REMOTE switch setting.
④	Reset/ D.Clear Switch	• If this switch is moved to: – left and returned to center - executes RESET action – left and held for more than 3s, then returned to center: executes Overall RESET action • If this switch is moved to – Right and pressed - it executes DATA CLEAR action. – right and returned to center - clear Latch 1 area data and general data area – right, held for more than 3s and then returned to center - it clears Latch 2 area data and general data area

No.	Names	Description
		Note: DATA CLEAR acts only in “STOP” operation mode.
⑤	USB connector	USB connector to connect with SoftMaster PC (Supports version USB 1.1 onwards)
⑥	RS−232C connector	• A connector to connect with peripherals − SoftMaster connection with PLC − Any Modbus equipment connection: Modbus slave protocol support − TX: no.7 Pin, RX: no.8 Pin, GND: no.5 Pin
⑦	Battery built-in Cover	Back-up battery built-in cover (bottom side)

2.4 Conformance to EMC Specifications

EMC Specifications

The EMC Directive specifies that products must 'be so constructed that they do not cause excessive electromagnetic interference (emissions) and are not unduly affected by electromagnetic interference (immunity)'. The applicable products are requested to meet these requirements.

This section summarizes the precautions for the MasterLogic-200 PLC to ensure conformance to the EMC Directive. Details of these precautions are based on the requirements and the applicable standards. However, Honeywell does not guarantee that the overall system manufactured according to these details conforms to the directives listed in the following table.

The method of conformance to the EMC directive and the judgment on whether or not the system conforms to the EMC Directive must be finally determined by the manufacturer of the system.

The standards applicable to the EMC Directive are as follows:

Specification	Test items	Test details	Standard value
EN50081-2	EN55011 Radiated noise □2	Measure the wave emitted from a product.	30~230 □ QP : 50 □ □/m □1 230~1000 □ QP : 57 □□/m
	EN55011 conducted noise	Measure the noise that a product emits to the power line.	150~500 □ QP : 79 □ Mean : 66 □ 500~230 □ QP : 73 □ Mean : 60 □
EN61131-2	EN61000-4- Electrostatic immunity	Immunity test allowing static electricity to the case of a device.	15 □ Air discharge 8 □ Contact discharge
	EN61000-4-4 Fast transient burst noise	Immunity test allowing a fast noise to power cable and signal cable.	Power line : 2 □ Digital I/O : 1 □ Analog I/O, signal lines : 1 □

Specification	Test items	Test details	Standard value
	EN61000-4-3 Radiated field AM modulation	Immunity test injecting electric field to a product.	10Vm, 26~1000 □ 80% AM modulation@ 1 □
	EN61000-4-12 Damped oscillatory wave immunity	Immunity test allowing attenuation vibration wave to power cable.	Power line : 1 □ Digital I/O(24V and higher) : 1 □

QP: Quasi Peak, **Mean**: average value.

A PLC is an open type device (device installed on another base) and must be installed on a control panel. The system tests are performed after installing the PLC on a control panel.

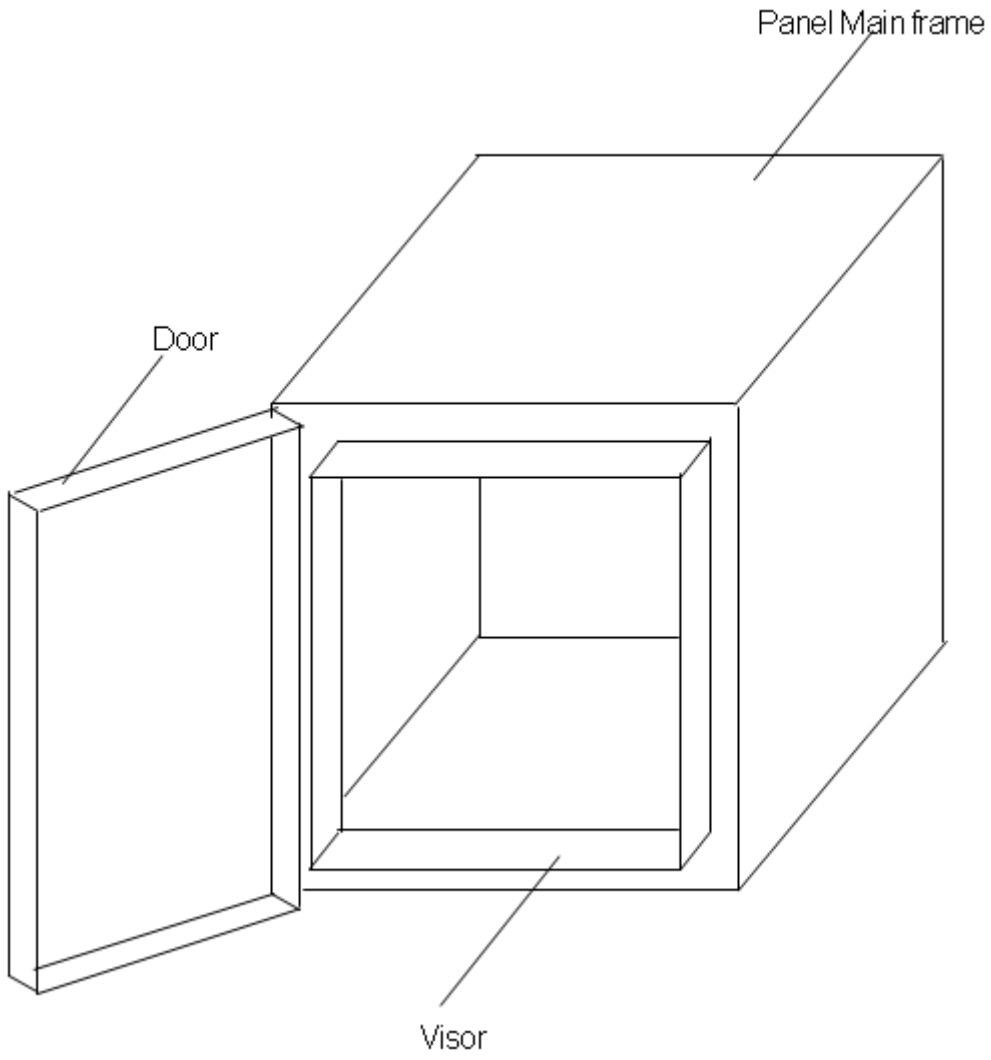
Control Panel

The PLC is a device susceptible to noise. To protect it from noise, it must be installed on a control panel. This also prevents chances of electric shock and reduces PLC-generated noise. Installing the PLC on a metallic panel reduces PLC-generated EMI (Electro-magnetic interference).

Control Panel specifications

The Masterlogic-200 PLC must be installed on a metallic panel to restrict EMI emitted from the product. The specifications of the metallic panel are as follows:

1. Use SPCC (Cold Rolled Mild Steel) for the control panel.
2. The thickness of the steel plate must be atleast 1.6mm.
3. Use isolating transformers to protect power supply from external surge voltage.
4. The control panel must have a structure that prevents radio waves from entering. For example, make the door as a box-structure so that the panel body and the door overlap each other. This structure reduces the surge voltage generated by PLC.



Power Cable and Grounding specifications

Grounding and power supply wires for the PLC system must be connected as follows:

1. Ground the control panel with a thick wire so that a low impedance connection to ground can be ensured even at high frequencies.

2. The function of LG (Line Ground) and FG (Frame Ground) terminals is to pass the noise generated in the PLC system to the ground, to ensure an impedance as low as possible.

3. To prevent the grounding wire from acting as an antenna and generating noise, keep the wire as short and thick as possible.

Cables

Extension cable connection

The extension cables contain high frequency noise. Therefore, attach a ferrite core to the extension cable as shown in the following figure, to meet the CE conformance standards.

Model	Manufacturer
CU1330D	E-TECH ELECTRONICS
ZCAT3035-1330	TDK

Fixing a cable in the panel

When connecting an extension to the metal panel, maintain a space of at least 1cm from the panel. The metal board of the control panel has a shielding effect that blocks noise. If a metal panel is in in contact with a cable it could serve as an antenna and thereby be a source of noise.

CAUTION Keep all high-speed signal transmission cables at a safe distance from the metal board.

2.5 Complying with the low voltage directive

The low-voltage directive requires each device that operates with power supply ranging from 50V to 1000VAC and 75V to 1500VDC to satisfy the safety requirements. This section describes the precautions to ensure the installation and wiring of the MasterLogic-200 series conform to the low-voltage directive.

WARNING

The contents of this section are based on the requirements and the applicable standards control. However, Honeywell does not guarantee that the overall product manufactured according to these details conforms to the low voltage regulation.

Specifications applicable to MasterLogic-200 Series

- The MasterLogic-200 series follows EN6100-1 (safety of devices used in measurement rooms, control rooms or laboratories).
- The MasterLogic-200 series modules that operate at the rated voltage of AC 50V/DC 75V or above are also developed to conform to the low voltage standards.

Selecting a MasterLogic-200 Series PLC

1. **Power Module:** The voltages inside the power supply modules are extremely dangerous. Peak voltage can be higher than 42.4V for the AC 110/220V rated I/O voltages. Therefore, the CE mark-compliant models are internally enhanced in isolation between the primary and secondary.

2. **Digital I/O Module:** The voltages inside the Digital I/O modules are extremely dangerous. Peak voltages can be higher than 42.4V for the AC 110/220V rated I/O voltages. Therefore, the CE mark-compliant models are internally enhanced in isolation between the primary and secondary.

   The I/O modules of DC 24V or of less rating are out of the low-voltage directive application range.

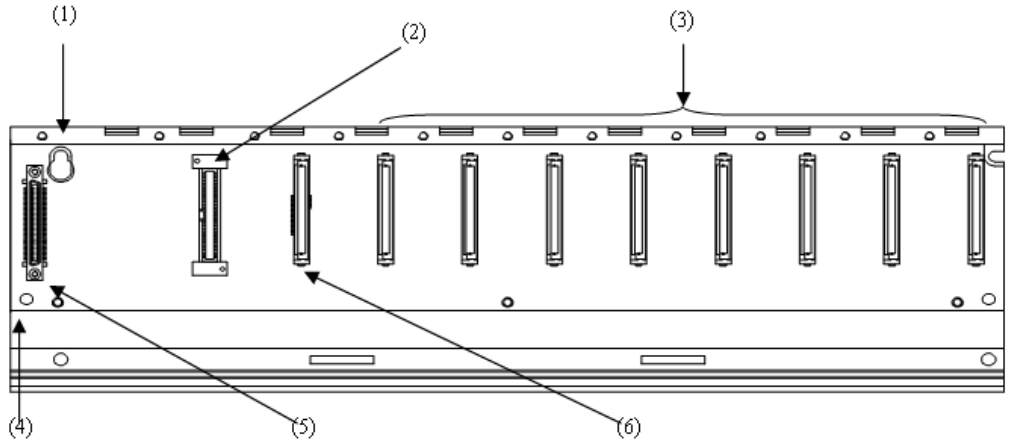
3. **CPU Module, Base Unit:** These modules use DC 5V and 3.3V circuits, so they are out of the low-voltage directive application range.

4. **Special Module, Communication Module:** The special module and communication modules use DC 24V or less rated voltage, therefore they are out of the low-voltage directive application range.

3. Hardware - Specifications

3.1 Parts and functions

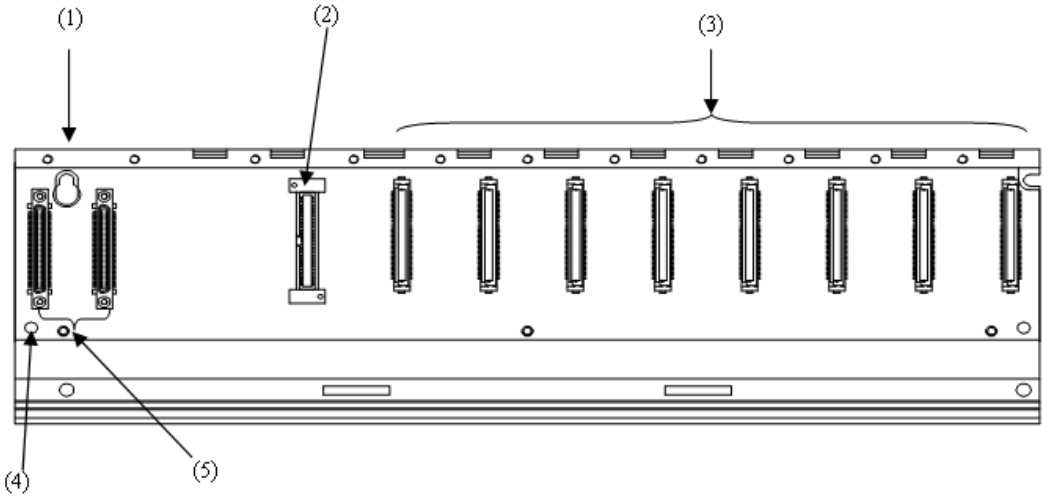
Main Base



Index	Part	Function
1	Base attached guide hole	It is used to attach the main base to the panel in control panel
2	Power module connector	For installation of Power Supply module
3	Module built-in connector	For installation of I/O, special & other communiucation modules
4	FG terminal	Ground terminal connected to the shielded pattern of PCB board
5	Extended cable connector	Connects the extended cable by send/receive connector with extended base.

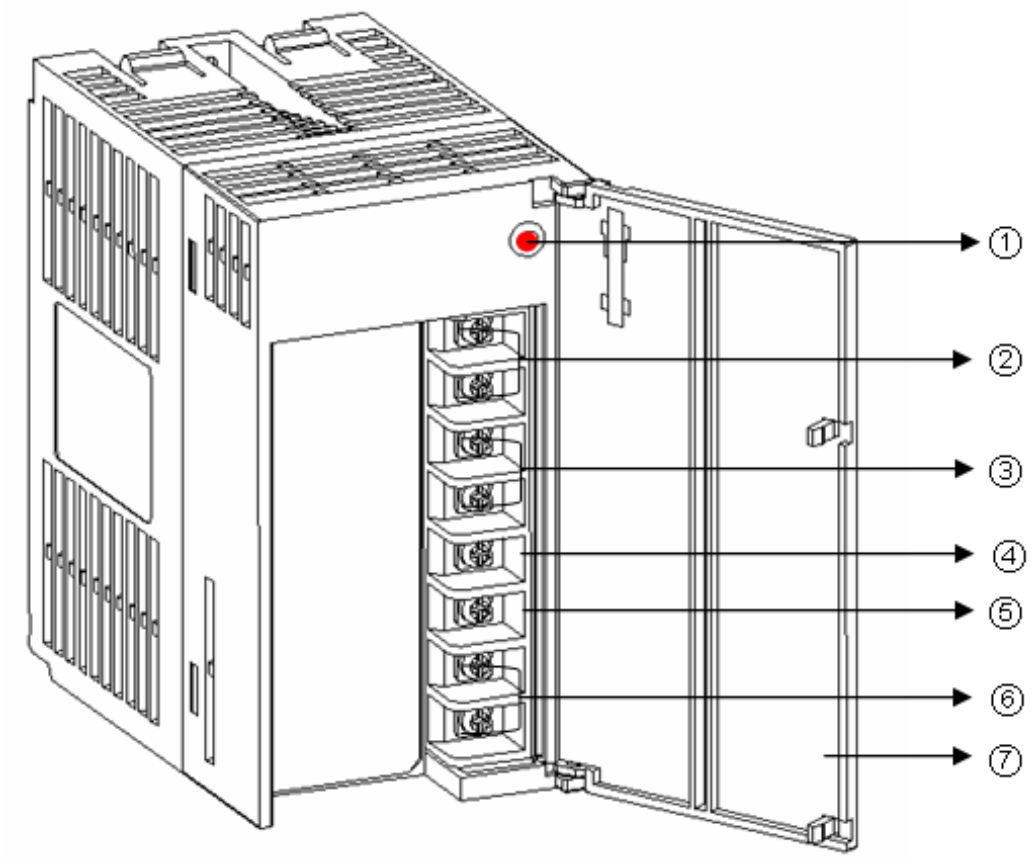
6	CPU module connector	For installation of CPU module

Expansion Base



Index	Part	Function
1	Base attached guide hole	It is used to attach the main base to the panel in control panel
2	Power module connector	I/O module built-in connector
3	Module built-in connector	I/O module built-in connector
4	FG terminal	Ground terminal connected to the shielded pattern of PCB board
5	Extended cable connector	Connects the extended cable by send/receive connector with extended base.

Power Module



Index	Part	Function
1	Power LED	DC5V power indication LED
2	DC24V, 24G terminal	Power supply to the module required for DC24V in output module. 2MLP-ACF2, 2MLP-ACF3 does not print out DC24V.
3	RUN terminal	Indicates RUN state of system. OFF when CPU STOP error occurs. OFF when CPU mode is changed to STOP mode.

4	FG terminal	Ground terminal for electric shock prevention
5	LG terminal	Ground terminal of power filter
6	Power input terminal	Power input terminal 2MLP-ACF1, 2MLP-ACF2, 2MLP-AC23, 2MLP-DC42
7	Terminal cover	Terminal block protection cover

3.2 Main and Expansion Base

Main base specifications

The Main base consists of the Power module, CPU module, I/O module, Special module, and the Communication module.

Item \ Model	2MLB-M12A	2MLB-M08A	2MLB-M06A	2MLB-M04A
No. of I/O modules installed	12	8	6	4
Dimensions (mm)	426 X 98 X 19	318 X 98 X 19	264 X 98 X 19	210 X 98 X 19
Hole distance to attach panel	406 X 75	298 X 75	244 X 75	190 X 75
Hole size to attach panel	ϕ 4.5 (using M4 screw)			
Screw size for FG connection	(+)PHM 3 X 6 washer(ϕ 5)			
Weight (kg)	0.54	0.42	0.34	0.28

Expansion Base specifications

The expansion base consists of the Power module, I/O module, Special module, and the Communication module.

Model / Item	2MLB-E12A	2MLB-E08A	2MLB-E06A	2MLB-E04A
No. of I/O modules	12	8	6	4
Dimensions (mm)	481 X 98 X 19	318 X 98 X 19	264 X 98 X 19	210 X 98 X 19
Distance of hole for panel attachment	461 X 75	298 X 75	244 X 75	190 X 75
Specification of hole for panel attachment	ϕ 4.5 (M4 screw used)			
Specification of screw for FG connection	(+)PHM 3 X 6 washer (ϕ 5)			
Weight (kg)	0.59	0.47	0.39	0.33

Extended Cable specifications

Model / Item	2MLC-E041	2MLC-E061	2MLC-E121	2MLC-E301	2MLC-E501	2MLC-E102	2MLC-E152
Length (m)	0.4	0.6	1.2	3	5	10	15
Weight (kg)	0.15	0.16	0.22	0.39	0.62	1.2	1.8

ATTENTION

Do not exceed the length of 15m, in case of a combination of extended cables.

3.3 Power Module

Power Module specifications

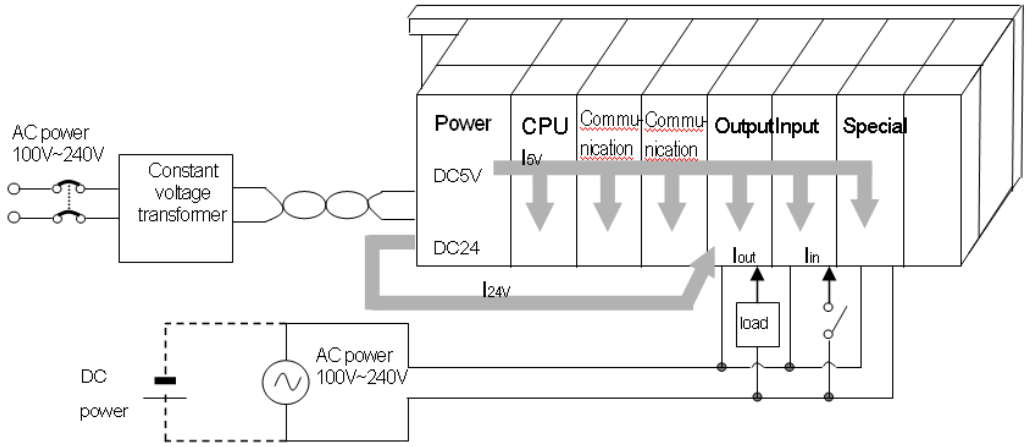
The selection of a power module is determined by the current and voltage needed by the system. The voltage requirement of a system is calculated as a sum of the current consumption by the digital I/O modules, special modules, CPU module, power module and the communication module (installed on the same base as the power module.)

The system does not operate normally if the rated output capacity of the power module exceeds the predefined limit.

The following table lists the current consumption per module (DC 5V):

Module	Model	Current consumption (mA)	Module	Model	Current consumption (mA)
CPU module	2MLI-CPUU	960	A/D conversion module	2MLF-AV8A	420
				2MLF-AC8A	420
DC12/24V input module	2MLI-D21A	20		2MLF-AD4S	610
	2MLI-D22A	30	D/A conversion module	2MLF-DV4A	190 (250)
	2MLI-D22B	30		2MLF-DC4A	190 (400)
	2MLI-D24A	50		2MLF-DC4S	200 (200)
	2MLI-D24B	50		2MLF-DV8A	147 (180)
	2MLI-D28A	60		2MLF-DC8A	243 (300)
	2MLI-D28B	60	High Speed Counter module	2MLF-HO2A	270
AC110V input module	2MLI-A12A	30		2MLF-HD2A	330

Module	Model	Current consumption (mA)	Module	Model	Current consumption (mA)
AC220V input module	2MLI-A21A	20	Positioning module	2MLF-PO3A	400
Relay output module	2MLQ-RY1A	250		2MLF-PO2A	360
	2MLQ-RY2A	500		2MLF-PO1A	340
	2MLQ-RY2B	500		2MLF-PD3A	860
Transistor output module	2MLQ-TR2A	70		2MLF-PD2A	790
	2MLQ-TR2B	70		2MLF-PD1A	510
	2MLQ-TR4A	130	Thermocouple input module	2MLF-TC4S	610
	2MLQ-TR4B	130	Resistance temperature detector input module	2MLF-RD4A	490
	2MLQ-TR8A	230			
	2MLQ-TR8B	230			
Triac output module	2MLQ-SS2A	300	Profibus-DP module	2MLL-PMEA	560
FEnet module (optical/electrical)	2MLL-EFMF	650	Snet module	2MLL-C22A	330
	2MLL-EFMT	420		2MLL-C42A	300
FDEnet module(Master)	2MLL-EDMF	650		2MLL-CH2A	340



I_{5V}: current consumption of each module DC5V circuit (internal current consumption)
I_{24V}: average current consumption of DC24V for output module

The following table lists the specifications of the Power Module:

Items		**2MLP-ACF1**	**2MLP-ACF2**	**2MLP-AC23**	**2MLP-DC42**
Input	Rated input voltage	AC 100V – AC 240V		AC 200V – AC 240V	DC 24V
	Input voltage range	AC 85V ~ AC 264V		AC 170V ~ AC 264V	-
	Input frequency	50 / 60 Hz (47 ~ 63 Hz)			-
	Inrush current	20 A_{Peak} or less			80A_{Peak} or less
	Efficiency	65% or more			60% or more
	Input fuse	Built-in (user no change), UL standard (Slow Blow Type)			
	Allowable momentary shutdown	Within 20ms			
Output1	Output voltage	DC 5V (±2%)			DC5V (±2%)
	Output current	3.0A	6.0A	8.5A	6.0A
	Over current protect	3.2A or more	6.6A or more	9.0A or more	6.6A or more
	Over voltage protect	5.5V ~ 6.5V			

Output2	Output voltage	DC 24V (±10%)	-	-
	Output current	0.6A		
	Over current protect	0.7A or more		
	Over voltage protect	None		
Relay Output	Application	RUN contact (Refer to the section 8.3)		
	Rated switching voltage/current	DC 24V, 0.5A		
	Minimum switching load	DC 5V,1 □		
	Response time	OFF→ON/ ON→OFF: 10 □ or less/12 □ or less		
	Life	Mechanical: More than 20,000,000 times Electrical: More than 100,000 times at rated switching voltage/current		
RUN signal output		Relay output, Rating: DC24V, 0.5A		
Voltage indicator		Output voltage normal, LED ON		
Cable specification		0.75 ~ 2mm^2		
Compressed terminal		RAV 1.25 - 3.5, RAV 2 - 3.5		
Weight		0.4kg	0.6kg	0.5kg

1. Allowable Momentary Power Failure Time: The time that input voltage keeps normal output voltage (normal operation) in the state that AC110/220V voltage is lower than the rated value (AC85 / 170V).
2. Over current protection: If the current is more than the standard and flows in DC5V, DC24V circuit, the over current protection device shutsdown the circuit to stop the system. Remove the causes such as lack of current capacity or short circuits that leads to over current and then restart the system.
3. Over voltage protection: The over voltage protection device shuts down the circuit to stop the system, if the voltage is greater than the standard and is applied to the DC5V circuit

Example of Current Consumption/Power Calculations

This section describes which power supply module must be used in coordination to the corresponding modules for MasterLogic-200.

Type	Model	No.	Voltage	
			5V	24V
CPU module	2MLI-CPUU	1	0.96A	-
12 Slot basic base	2MLB-M12A	-	-	-
Input module	2MLI-D24A	4	0.2A	-
Output module	2MLQ-RY2A	4	2.0A	-
FDEnet module	2MLL-EDMF	2	1.3A	-
Profibus-DP	2MLL-PMEA	2	1.12A	-
Current consumption	Calculation		0.96+0.2+2+1.3+1.12	-
	Result		5.58A	-
Power consumption	Calculation		5.58×5V	-
	Result		27.9W	-

As the value of 5V current consumption is 5.58A, use 2MLP-ACF2 (5V: 6A) or 2MLP-AC23 (5V: 8.5A). The system does not operate if 2MLP-ACF1 (5V: 3A) is used.

4. Installation and Wiring

4.1 Installing the PLC

Installation Environment

The PLC system is designed to withstand extreme climatic conditions. However, care must be taken for the following items to ensure reliability and stability.

Environmental Conditions

Dos

- Install the PLC in a control panel which is waterproof and can withstand vibration.
- Install the PLC away from areas with high vibration.
- Ensure an ambient temperature of 0 ~ 55 °C.
- Esure incremental Humidity: 5 ~ 95 %.

Don'ts

- Do not expose the PLC to direct sun-light.
- Avoid exposing the PLC to sudden changes in the temperature.
- Do not expose the PLC to corrosive or inflammable gases.

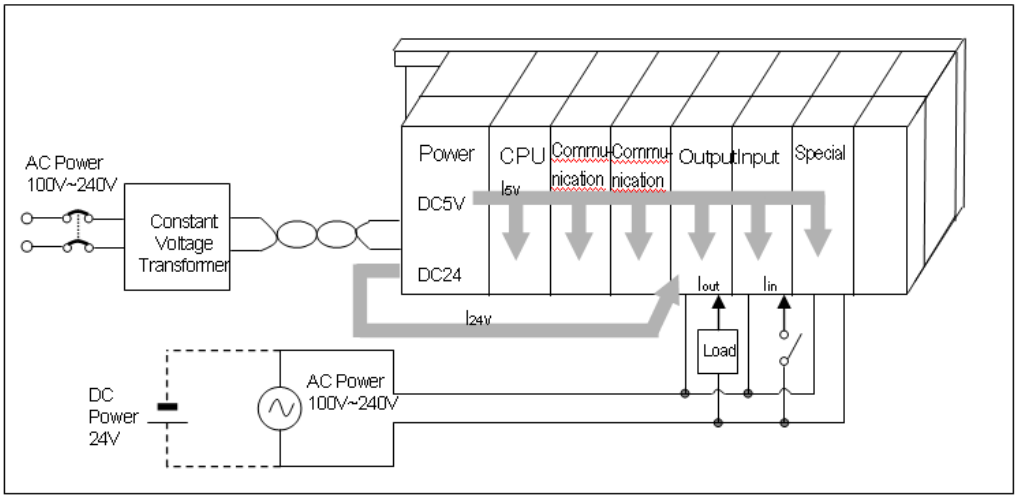
Installation Conditions

- While drilling holes, fixing screws or wiring, do not let wire or any other metallic part enter the PLC.
- Do not install the PLC on a panel that has a high-voltage device
- Maintain a distance of atleast 50mm from the wiring duct or surrounding modules.
- Ensure the grounding at a place where surrounding noise is minimal.

Heat Protection Design of Control Panel

- In case the PLC is installed in an airtight control panel, the heat protection design must be esnured considering the radiation of other equipment, and heat from the PLC. When air circulation is provided using a vent or a general fan, the flow of dust particles or gas can hamper the functioning of the PLC system.
- Installing a filter or use of an airtight heat exchanger is recommended.

The following figure illustrates the method used for calculating the current consumption of PLC system necessary for heat protection design.



Power consumption of each part

1. Current Consumption of Power Module

The current conversion efficiency of the power module is around 70 %. Radiation consumes 30%, and current consumption is 3/7 of the output power. The calculation is as follows.

$$W_{pw} = 3/7 \{(I5V \times 5) + (I24V \times 24)\} (W)$$

I (5V)	Current consumption of DC 5V circuit of each module (internal current consumption)
I (24V)	Average current consumption of DC 24V of output module (current consumption of simultaneous ON point)

If DC24V is externally supplied or a power module without DC24V is used, it is not applicable.

2. Sum of DC 5V circuit current consumption: The DC 5V output circuit current of the power supply module is the sum of current consumption of each module.

   W 5V = I5V X 5 (W)

3. DC 24V Average current consumption (current consumption of simultaneous ON point): DC 24V output circuit average current of power module is the sum of current consumption of each module.

   W 24V = I24V X 24 (W)

4. Average current consumption by output voltage drop of output module (current consumption of simultaneous ON point)

   i. Wout = Iout X V drop X output point X simultaneous ON rate (W)
   ii. Iout: Output current (current in actual use) (A)
   iii. V drop: Voltage drop of each output module (V)

5. Input average current consumption of input module (current consumption of simultaneous ON point)

   i. Win = lin X E X input point X simultaneous ON rate (W)
   ii. Iin: Input current (actual value in case of AC) (A)
   iii. E: Input voltage (voltage in actual use) (V)

6. Current consumption of Special module power assembly

   WS = I5V X 5 + I24V X 24 + I100V X 100 (W)

The sum of the current consumption calculated for each block is the total current consumption of PLC system.

W = WPW + W5V + W24V + Wout + Win + Ws (W)

Calculate the amount of radiation according to this total current consumption (W) and review the temperature rising in the control panel. Use the following formula for the calculation of the temperature rise in control panel.

T = W / UA [°C]

Where,

W = power consumption of the entire PLC system (the calculated value)

A = surface area of control panel [m^2]

U : if equalizing the temperature of the control panel by using a fan and others - - - 6

If the air inside the panel is not ventilated - - - - - - - - - - 4

Precautions for installing/handling the PLC modules

Take the following precautions while handling or installing modules.

- Do not drop the PLC module or apply excessive force on it.
- Avoid touching the PCB inside the module with bare hands as this can lead to failure of the PLC Modules.
- Ensure that foreign materials such as wiring fragments do not enter the upper part of modules casing. Even if such materials accidentally enter the module casing, remove them immediately.

Precautions for installing/handling I/O module

Note the following points about handling or installing I/O module.

1. **Recheck I/O module specifications**

Check the input voltage for input modules. For output modules, check if the voltage applied exceeds the maximum Open/Close capacity. Over voltage may lead to failure, damage or sparking.

2. **Cable selection**

Select the appropriate cable after considering its capacity to withstand temperature and intensity of current flowing through it. The minimum specification of cable must be AWG22 ($0.3mm^2$).

3. **Environment**

When wiring an I/O module, ensure that it is not too close to a heat emitting equipment. In addition, avoid the wires from coming in direct contact with oil, as it may cause a short circuit, breakage or can cause abnormal errors during operation.

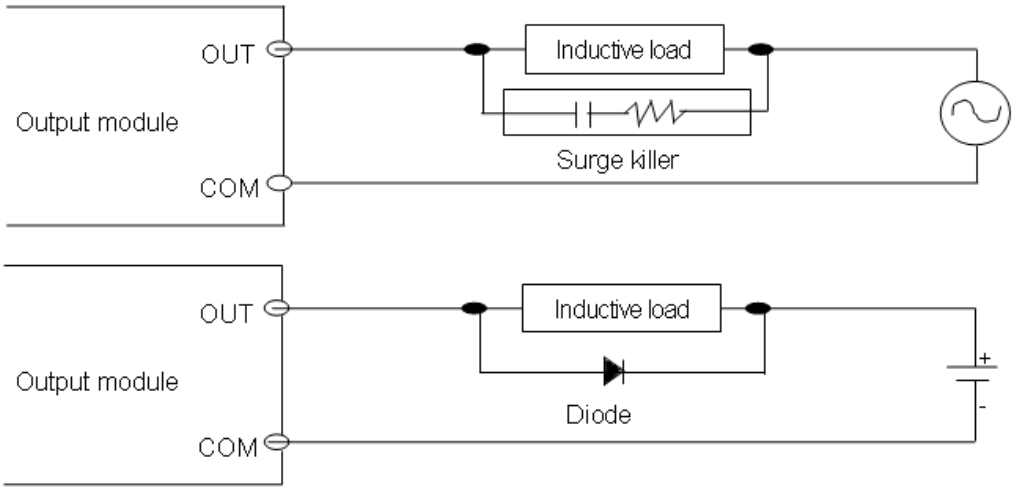
4. **Polarity**

The polarity of the module terminals and that of the field signal must be the same.

5. **Wiring**

- The I/O must be wired using high-voltage cables or power cables. Lower voltage wires can cause inductive disturbance that may result in abnormalities or failure of PLC operation.

- Ensure that the cables do not pass in front of the I/O operation indicator (LED) as it may obstruct the indicator.
- When inductive load is connected to output module, connect a surge absorber or diode in parallel to the load.
- Terminal Block Wiring



WARNING

Do not apply apply excessive pressure on the I/O module or separate the PCB board from the case.

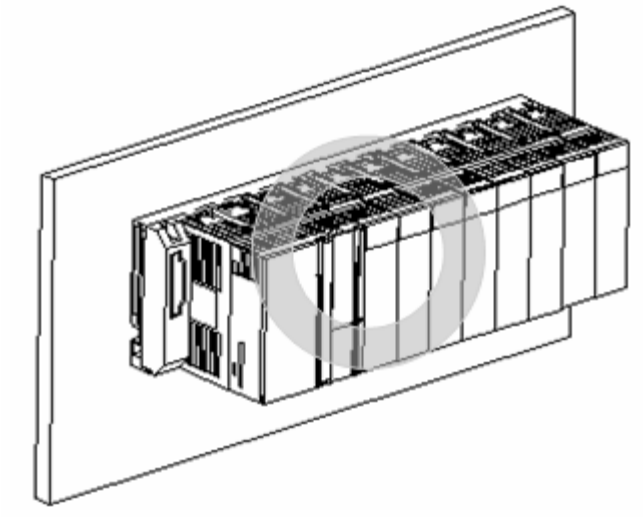
Honeywell does not bear any responsibility if the user removes the PCB board from the case.

Precautions for installing the base

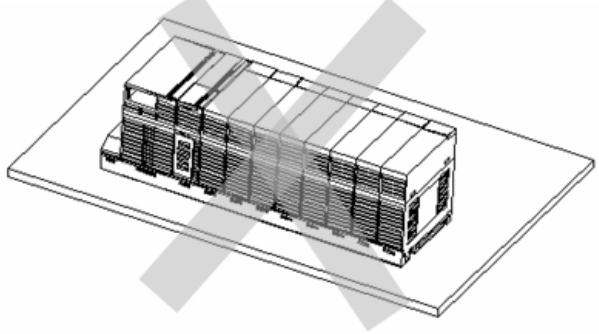
The following precautions must be taken while installing a PLC on the control panel.

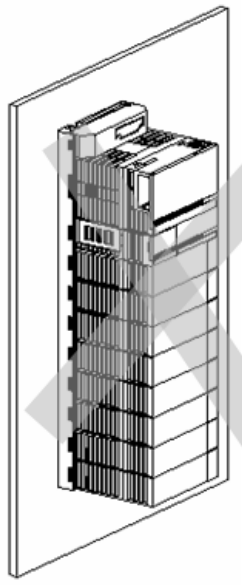
1. Ensure sufficient ventilation for the modules, especially the upper part of the modules. This also helps in changing the modules, if required.
2. If the PLC is installed near a Contactor/Breaker, it is recommended to use a Contactor/Breaker (Large Size) in a different panel.

3. If necessary install wiring duct for routing the cables. Make note of the following points when installing a wiring duct:
   - When installing the wiring duct on the upper part of the PLC, ensure that its distance is more than 50mm to enable adequate ventilation. Maintain sufficient distance from the upper part of the PLC, so that the module can be removed easily.
   - When installing the wiring duct on the lower part of the PLC, take into account the connection of the optical cable or coaxial cable, and the minimum cable radius without breaking the cable.
4. Install PLC in the direction as shown in the following figure. This helps in protecting the PLC from radiation.

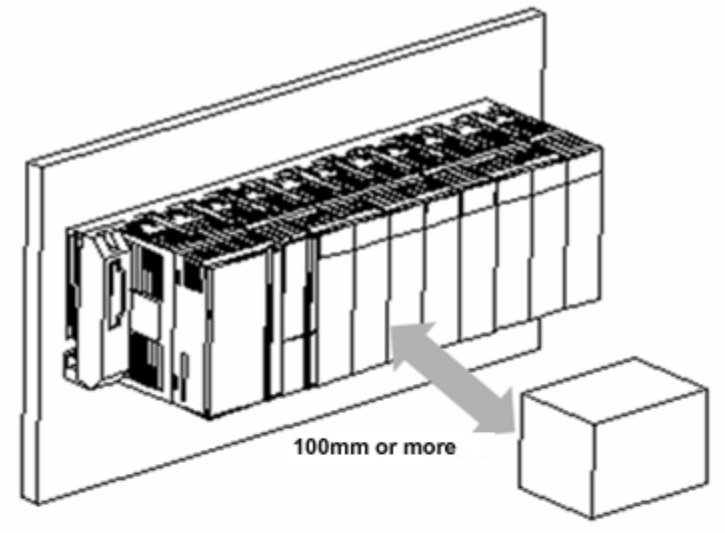


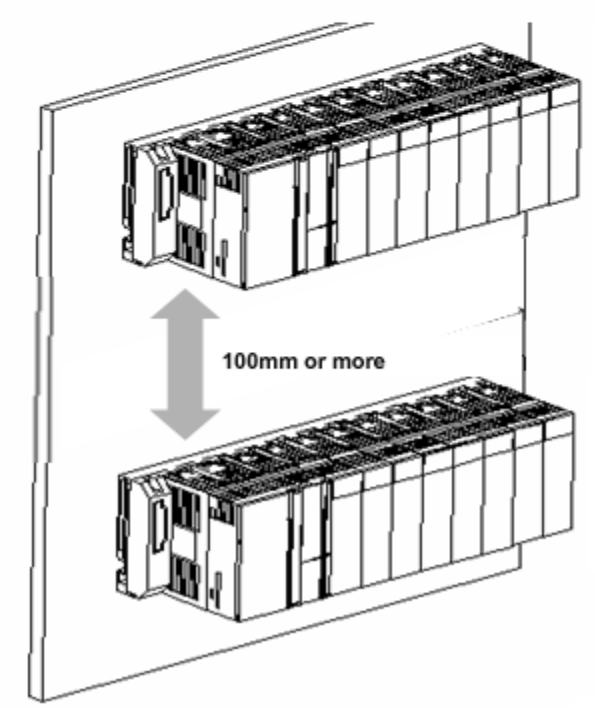
Do not install the PLC in the direction, as in the following figure:

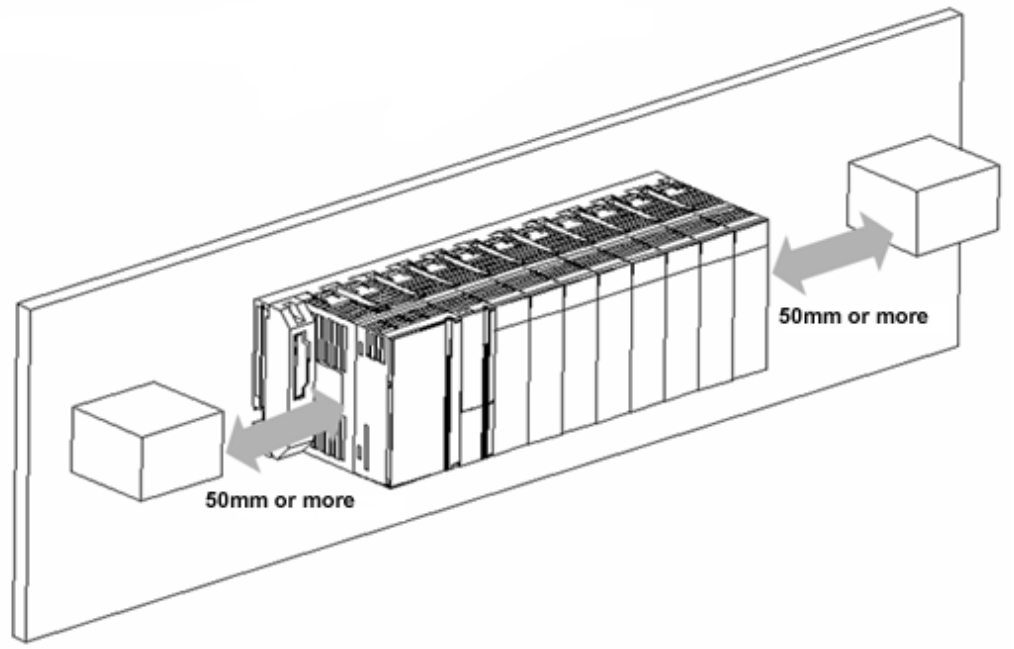




To avoid any effect of radiating noise or heat, install the PLC, and other devices (relay and electronic contact) with a spacing secured, as indicated in the following figure:


100mm or more


100mm or more


50mm or more
50mm or more

4.2 Inserting/Removing Modules

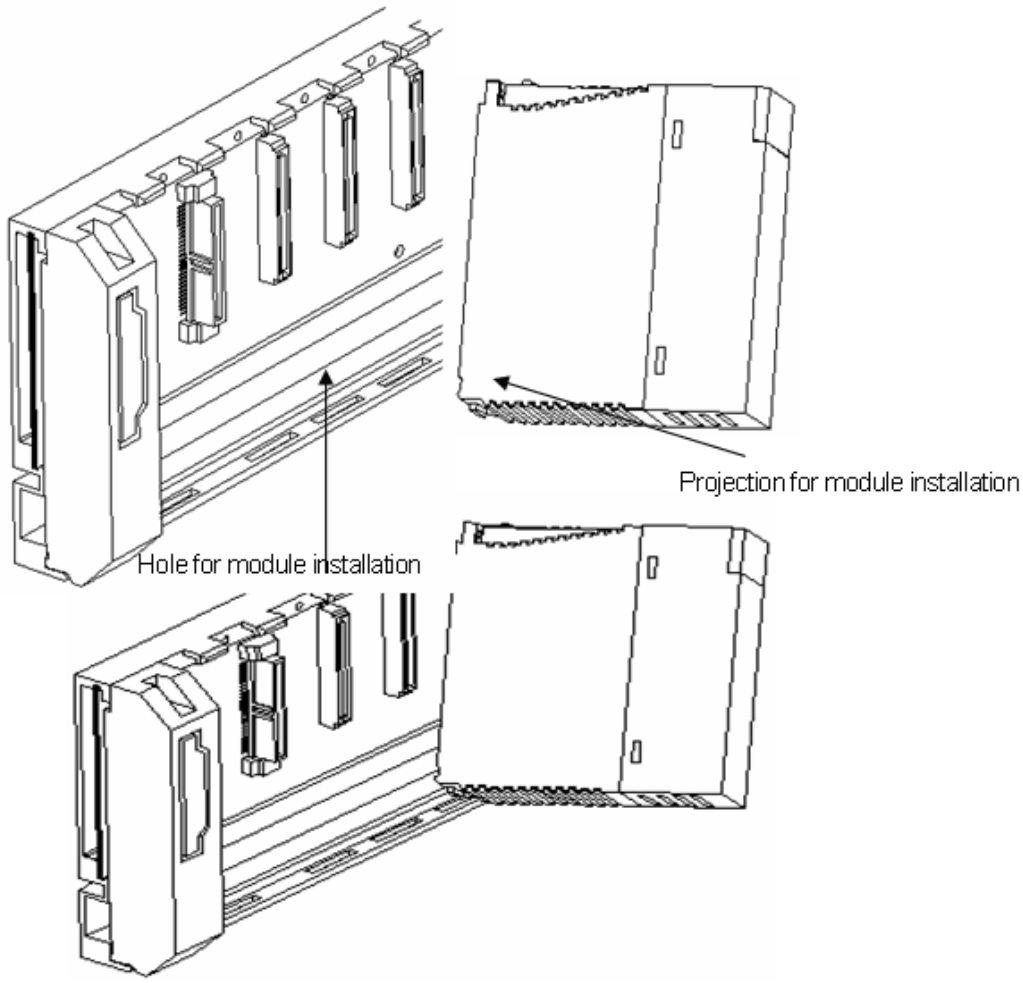
Inserting a module

Use the following procedure to attach a module:

Step	Action
1	Insert the projection on the lower part of the module into the Module fixing hole of the PLC base as shown in the following figure.
2	Slide the upper part of module to fix into the base. Use the screws in the upper part of the module to hold the module firmly to the base.

TIP

To check if the module is properly installed in the base, slowly pull the upper part of module.



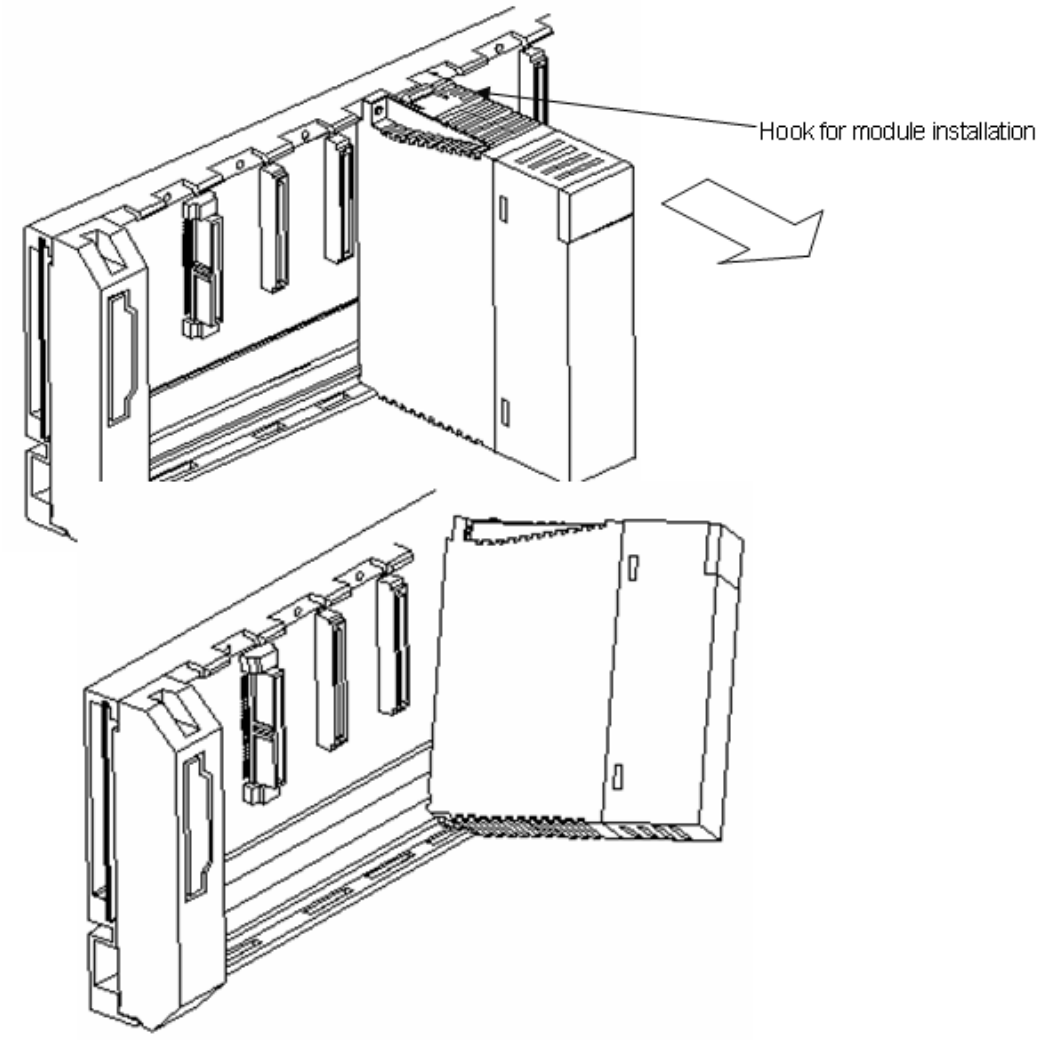
TIP

When installing modules, insert the fixed projection of the module into the module-fixing hole and then press it. The module may break if the module is forced onto the base in an incorrect position.

Detaching modules

To detach modules, perform the following steps:

Step	Action
1	From the base, loosen the fixed screws on the upper part of the module.
2	Hold the module using both hands and thoroughly press the fixed hook of the module.
3	Pull the upper part of the module from the axis of the lower part, by pressing the hook.
4	By lifting the module upward, remove the fixed projection of the module from the fixing hole.

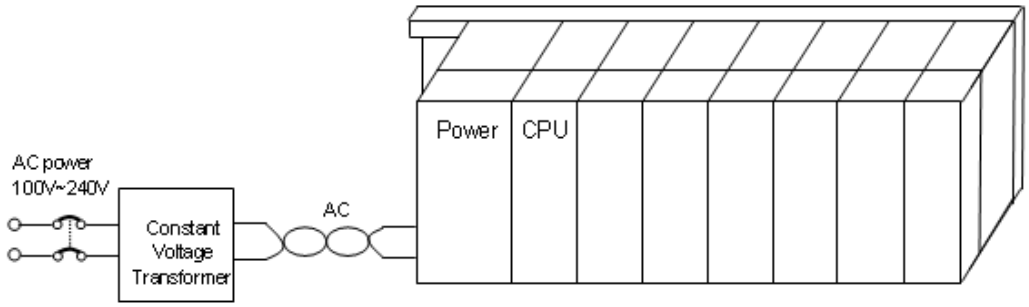


CAUTION	While detaching the module, press the hook and remove the module from the base, only then remove the fixed projection of the module from the fixed hole of module. In this case, if module is detached forcefully, a hook or the fixed projection of the module can break.

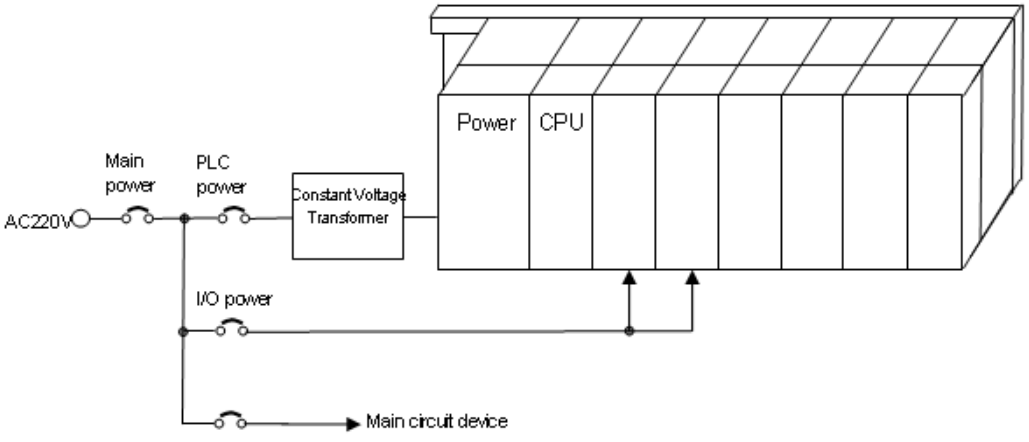
4.3 Wiring

Power Wiring

1. Connect a voltage regulated transformer if the power variance is higher than the specified range.



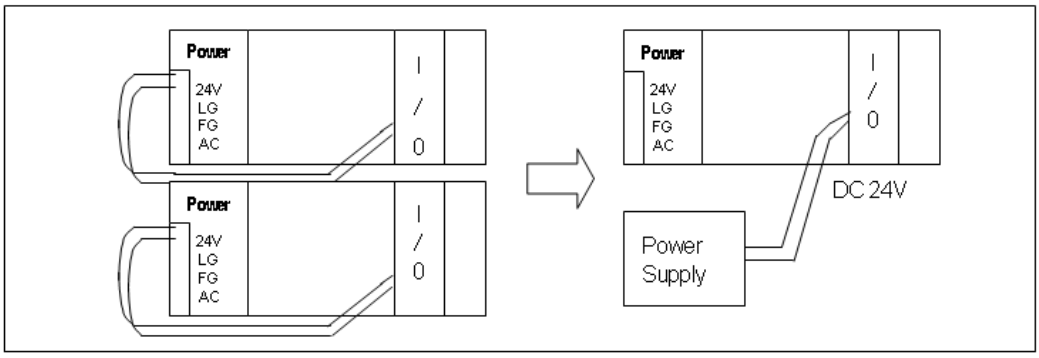
2. In case of excessive interference (noise) use an Isolation transformer.
3. The following figure illustrates the distributions of 220V AC for PLC Power Supply, I/O Modules and other Mains Circuit Equipment.



4. While using Power Module of DC 24V output:

   a) Do not connect the module in parallel with the output of several power modules.

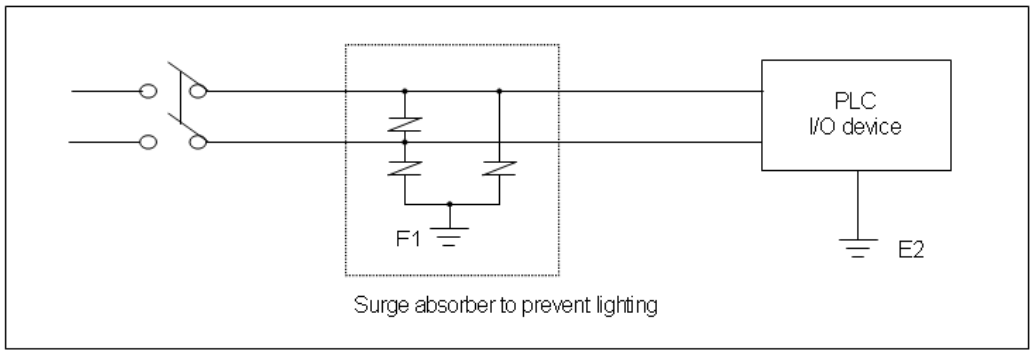
   b) If DC 24V output capacity of a power module is not sufficient for the PLC I/O modules, supply the external DC 24V power as shown in the following figure.



5. AC110V/AC220V/DC24V cables must be properly twisted and connected in the shortest distance.

6. AC110V/AC220V cable must be as thick as possible (2_{mm}^{2}), to reduce voltage drop. AC110V/ DC24V cables must not be installed close to main circuit cable (high voltage/high current) and I/O signal cable. They must be 100mm away from such cables.

7. Use a surge absorber as a protection against lightning as shown in the following figure.

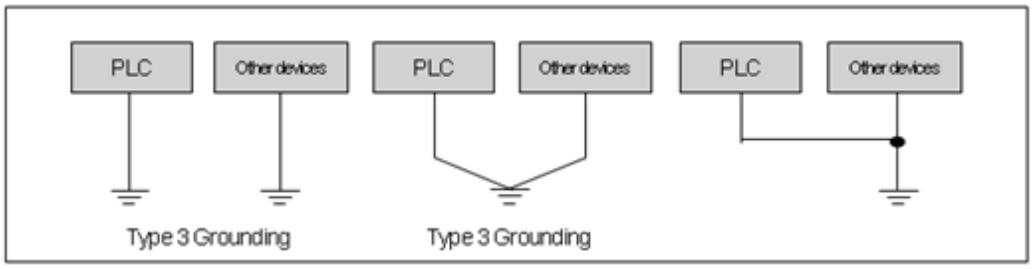


TIP

1. Separate PLC earth (E2) from earth (E1) of surge absorber against lightning.
2. In case of an increase in voltage, the surge absorber ensures that it does not increase more than the predefined maximum limit.
3. Use a shielded Isolation transformer or noise filter in areas where higher noise levels are expected.
4. It is advisable to use twisted cable for input power. Ensure that the shielded transformer or noise filter wiring does not pass the duct.

I/O Device Wiring

1. The cable used for I/O wiring must be 0.3~2.0mm^2.
2. Use a separate input and output cable for wiring.
3. I/O signal cable must be separated by a distance of atleast 100mm from the main circuit cable of high voltage/high current.
4. If it is not possible to separate the main circuit cable and power cable, use the shielded cable in all cases and ground the PLC.



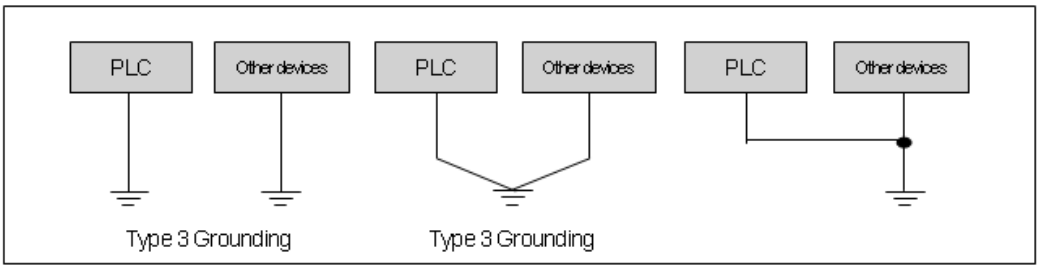
5. In case of pipe wiring, check the pipe for grounding properly.
6. Separate output cable of DC 24V from AC 110V cable or AC 220V cable.

ATTENTION

Current leakage may take place for wiring distances longer than 200m, caused by the capacitance between the cables.

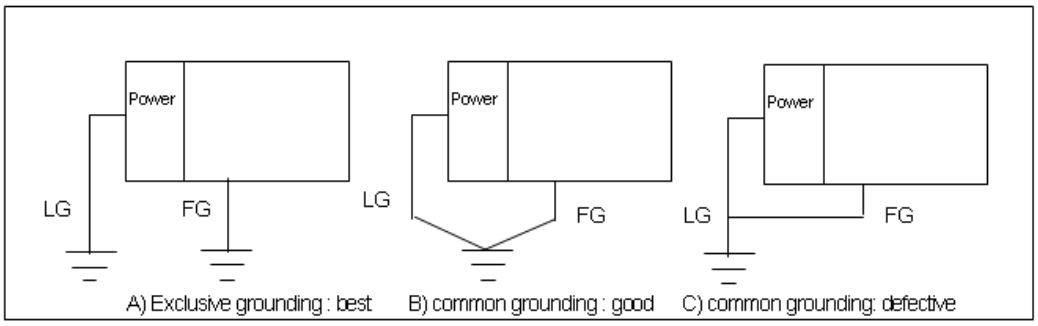
Grounding

1. Sufficient measures against noise are taken in the PLC, making it possible to be used without grounding. When there is lot of noise its better to ground the PLC as shown in the following figure.
2. Use dedicated grounding for the wires as far as possible.
3. In case the grounding is functional, use class 3 grounding (grounding resistance must be 100Ω or less).
4. If it is not possible to use dedicated grounding, use common grounding as depicted in the following figure.



Use more than 2mm2 cables for grounding. Place the earth point near the PLC as much as possible to limit the length of earth cable.

Separate LG (Line Ground) of power module and FG (Frame Ground) of base board for earth.



If any malfunction on grounding is detected, separate the FG of the base from the grounding.

Specifications of Wiring Cable

The specifications of cable used for wiring are as follows:

Types of external connection	Cable specification (mm^2)	
	Lower limit	Upper limit
Digital input	0.18 (AWG24)	1.5 (AWG16)
Digital output	0.18 (AWG24)	2.0 (AWG14)
Analog I/O	0.18 (AWG24)	1.5 (AWG16)
Communication	0.18 (AWG24)	1.5 (AWG16)
Main power	1.5 (AWG16)	2.5 (AWG12)
Protective grounding	1.5 (AWG16)	2.5 (AWG12)

5. Functions of the CPU Module

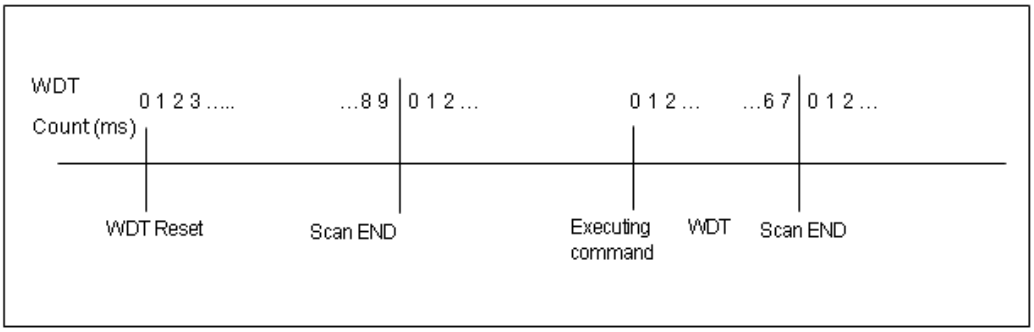
5.1 Self-diagnostic Function

The CPU module can perform a self-diagnosis to locate any errors in the PLC system. It can also prevent abnormal operations resulting from the error.

Scan Watchdog Timer

WDT (Watchdog Timer) is a function run by the CPU module that detects program congestion through hardware and software errors of PLC.

1. WDT is the timer, used to detect operation delay by user program error. The detection time of WDT is set in basic parameter using SoftMaster.
2. If WDT detects the excess of setting time during the scan while watching the operation, it stops the operation of PLC immediately, and switches off all the outputs.
3. If the excess of Scan Watchdog Timer is expected during program processing of the specific part while performing the user program (FOR ~ NEXT instruction, CALL instruction), clear the timer by using 'WDT' instruction.
4. The 'WDT' instruction initializes the elapsed time of Scan Watchdog Timer and starts the time measurement from 0 again.
5. Use the following method to clear the error state of watchdog:
   - Power reset, operation of manual reset switch
   - Mode conversion to STOP mode.



TIP

The range of WDT is between 10 ~ 1000ms (resolution of 1ms).

I/O Module Check

This function is used to check the error state of an I/O module during the beginning of an operation or during operation.

1. In case the module installed physically is not as per the module type configured in the software (I/O parameter settings) then it shows an error.
2. In case the I/O module is removed or error occurs during operation, the error is detected and indicated by the warning lamp (ERR) and the CPU module ceases to operate.

Battery Voltage Check

The CPU module is capable of detecting a battery voltage drop below the memory backup voltage. On detecting a low battery level and the low battery warning lamp (BAT), located on front of CPU module is turned on.

Error Logs

The CPU module has a function that records error history and analyzes the cause of these errors. This enables the user to take appropriate corrective action when the error occurs subsequently. This function saves each error code in a special flag F0006.

All results of self-diagnosis are recorded in the '%F' address/memory area.

REFERENCE – INTERNAL

For additional information on self-diagnostic and troubleshooting errors see section on ‘Error Codes during CPU Operation’.

Troubleshooting errors

Classification of Errors

An error is classified as a ‘Fatal Error’ and ‘Non Fatal Error’. A fatal error stops operation for system safety and ‘Non Fatal Error’ warns the user about the error and continues to operate.

The PLC system normally encounters the following types of errors:

1. PLC hardware error
2. Error in system configuration
3. Operation error during user program processing
4. Error detection by external device failure

Mode of Operation on detecting a fault

When error occurs, the PLC records the error comments, flags it, and stops all operations or continues to operate in Error Mode.

- PLC hardware error

  In case of a fatal hardware error, the CPU module and power module of the PLC is disabled and the system stops. However if the error is non-fatal such as a battery error, then the system continues operating in Error Mode.

- Error in system configuration

  This error occurs when hardware configuration of the PLC is not in line with the software configuration. This causes the system to stop.

- Operation Error during User Program Processing

  This error occurs while user program is being executed and also in case of numeric operation error. The error is recorded, flagged and the system continues to operate. However if the operation time exceeds the scan watchdog time or the built-in I/O module is unable to function normally, the system stops.

TIP

The operation process is determined by selecting 'Basic Parameters → Error Operation Setup → Continue running when an arithmetic error occurs'.

The default is set to 'Continue running when an arithmetic error occurs'.

- Error detection by external device error

  This is to detect an error in an external control device by using the PLC program. In case of a fatal error the system stops, but in case of non fatal error the system provides an indication about the error state and continues to operate.

TIP

The error codes are saved in special flag %F1026 when a fatal error is detected.

The error code is saved in %F1027 when a non-fatal error is detected.

REFERENCE - INTERNAL

For additional information on the Flags, see ***Appendix 1***.

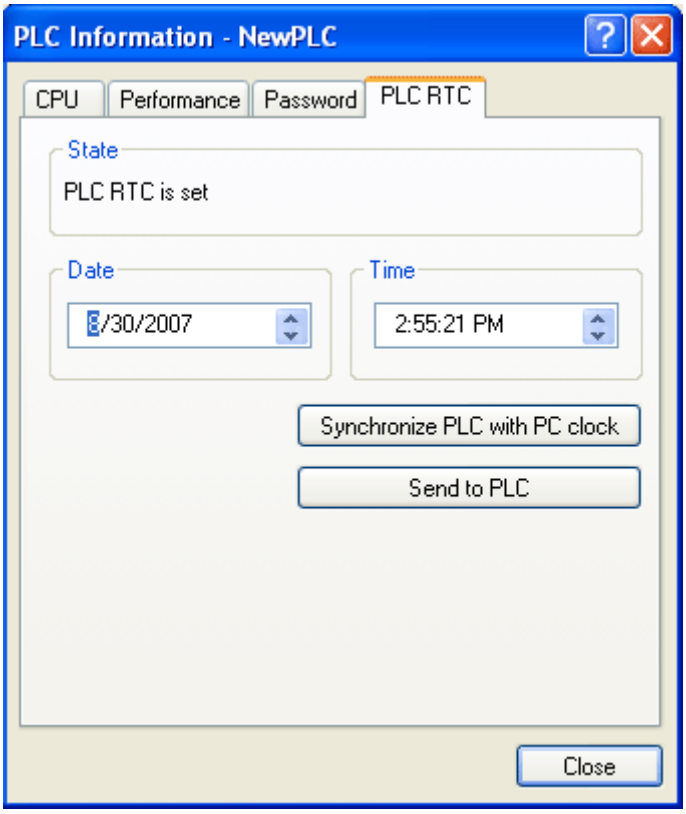
5.2 Clock Function

The CPU module has an in-built real-time clock device (RTC). In a power OFF or instantaneous interruption, the RTC continues to function using the battery back-up. The clock data of the RTC is used to provide the time control for operations or fault logs.

The current time of the RTC is updated to the clock-related %F address/memory area at every scan period.

Read from SoftMaster/Setting

Click **Online>PLC Information** on the SoftMaster menu bar**.** The following dialog box is displayed.



The RTC displays the time set in the PLC. You can adjust the time on the RTC by setting the time to be directly transmitted to the PLC or select 'Synchronize with PC clock' to transmit the PC time connected to the PLC.

Clock Reading by Flag

It can be monitored by flags as detailed in the following table.

Flags to read the clock	Address	Sample Value	Description
_MON_YEAR_DT	%FW1034	h0599	May, xx99
_TIME_DAY_DT	%FW1035	h1512	3 P.M., 12th
_SEC_MIN_DT	%FW1036	h4142	42 minutes 41 seconds
_HUND_WK_DT	%FW1037	h2001	20xx, Monday

The time data of _TIME_DAY_DT is displayed on 24 hrs basis.

RTC Data Modification through Program

You can set the RTC value using the SoftMaster program. This function is used when the time is manually set using the external digital switch or by designing a system that periodically calibrates the clock time on the network.

Set 'DATEWR' to ON and insert the setting value in the %F address/memory area and enter the time in RTC at scan END.

Clock Writing Flag	Description	Range
_MON_YEAR_DT	Month/Year	Jan ~ Dec ,1984 ~ 2163
_TIME_DAY_DT	Hour/Date	0~23 hrs , 1st ~31st
_SEC_MIN_DT	Second/Minute	0 ~ 59 seconds, 0 ~ 59 minutes
_HUND_WK_DT	Hundred years/day of the week	00 ~ 99, 0 ~ 6

Enter the time data in the format prescribed in the table. Monitor the RTC read device to check if the RTC data is modified correctly.

The Weekday expression method is used to represent the weekday in a Ladder Program. For example, 3 represents a Wednesday wherever we need to specify a date as indicated in the following table.

Number	0	1	2	3	4	5	6
Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Time tolerance

The RTC tolerance depends on the ambient temperature. Time tolerance according to temperature per day is indicated in the following table:

Operating Temperature	Maximum error (sec/date)	Ordinary (sec/date)
0 °C	- 4.67 ~ 1.38	-1.46
25 °C	- 1.64 ~ 2.42	0.43
55 °C	- 5.79 ~ 0.78	-2.29

ATTENTION

- Initially, the RTC may not have any clock data.
- Set the clock data correctly before beginning to use the CPU module.
- In case the data is out of range of the clock data written in the RTC, it may not function normally. Example: 14Month 32Day 25Hour
- RTC may stop or give an error because of battery error. If new clock data is written in the RTC, the error is cleared.

REFERENCE – INTERNAL

For additional information on modifying the clock data, see '*MasterLogic-200 Instructions User Guide*'.

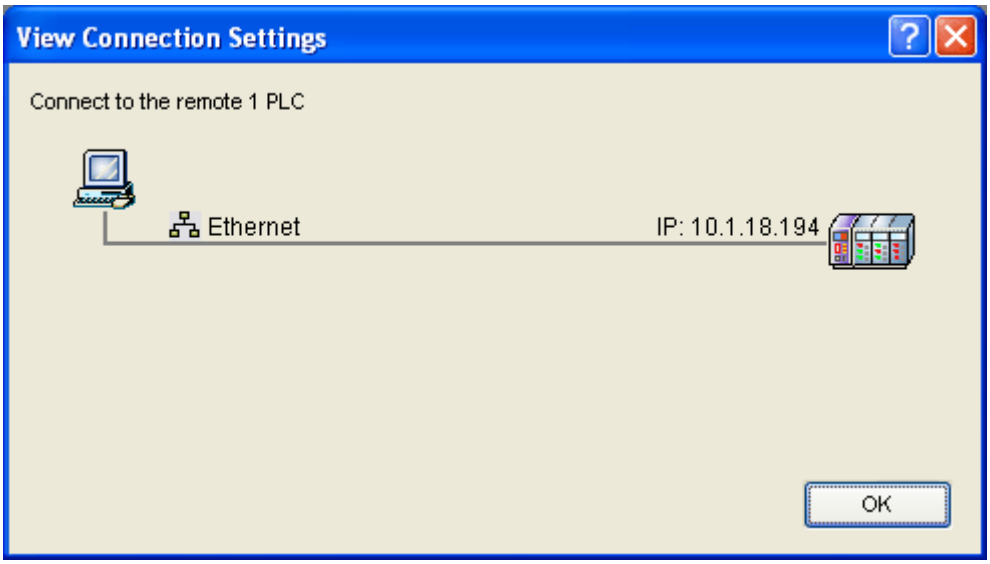
5.3 Remote Functions

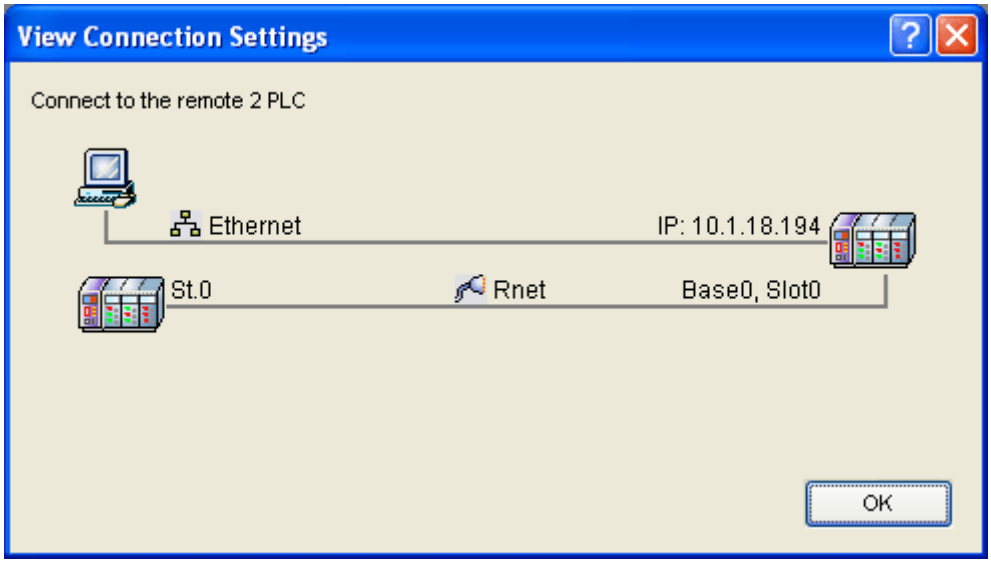
Overview of Remote functions

The key switch installed on the local CPU is used to operate a remote CPU, connected to it. To operate the CPU remotely, set 'REM' switch (no. 2 dip switch of 4 pin dip switch) of the CPU module 'ON' and move 'RUN/STOP' switch to 'STOP' position.

Types of Remote Operation

- By connecting the SoftMaster through the USB or RS-232 port available in CPU module.
- By using SoftMaster to connect to another PLC on the same network as illustrated in the following figures.





Remote RUN/STOP

- Remote RUN/STOP function performs RUN/STOP when the DIP switch of the CPU module is in REMOTE position and RUN/STOP switch is in STOP position.
- When the CPU module is installed in an inaccessible location and is difficult to operate, it is convenient to control it using Remote RUN/STOP.

Remote DEBUG

- Remote DEBUG is a function that performs DEBUG operation when DIP switch of the CPU module is in REMOTE position and RUN/STOP switch is in STOP position.
- It is convenient to check the execution state of a program or the contents of each data from Debugging function using REMOTE DEBUG Mode.

Remote Reset

- Remote Reset function is used to reset a CPU module by running a remote operation when an error occurs and it is not possible to operate a CPU module.
- This supports ‘Reset’ and “Overall Reset’ like an operation by switch.

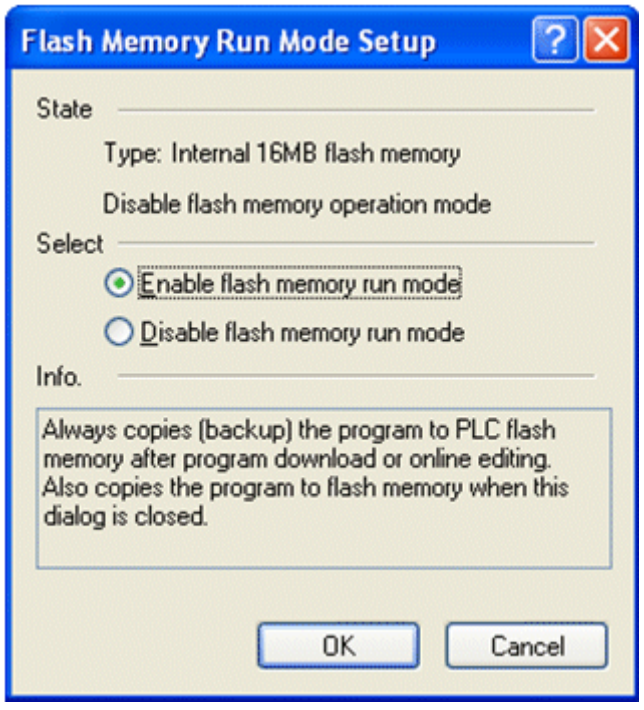
REFERENCE - INTERNAL

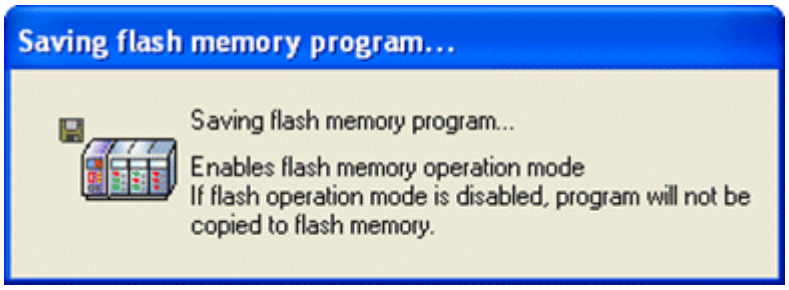
For the further information about remote functions, refer to the 'Online' section in the *SoftMaster User's Manual*.

Flash Memory Operation Mode

In the Flash memory operation mode, the system operates from the program in flash memory, in case the program in the RAM is corrupted. When "Flash Memory Operation Mode" is enabled, the program is saved into flash memory. The flash memory operation starts when the operation mode is changed to RUN mode from any other mode or while CPU restart.

- Flash Memory Operation Mode Setting. Check the operation mode setting by using **Online > Set Flash Memory > Enable flash memory run mode** and click **OK**. When "Enable flash memory run mode" selection is accepted, a dialog box appears stating "Saving flash memory program" and copies the program from user program area to flash memory.





ATTENTION

The default option is 'Flash Memory Operation Mode not selected'.

Flash Memory Operation Mode can be changed, irrespective of RUN/STOP mode.

Flash Memory Operation Mode can be set from the online menu of SoftMaster.

If the flash memory operation setting is modified to flash memory operation mode during RUN and the program is successfully written in the flash memory, the changed program shall be applied only when it restarts. Note that if the PLC restarts before a program is saved into flash memory, the previous program that was saved earlier operates, instead of the changed program.

If flash memory operation mode is changed from 'disable' to 'enable', the flash memory operation mode is applied until the flash memory writing is complete. In case the PLC restarts before completing program writing, "Flash memory operation mode" is released.

Flash memory operation method

Depending on the Flash Memory operation mode setting, the PLC operates as indicated in the following table when the PLC is restarted or its operating mode is ON:

Flash memory operation mode setting	Description

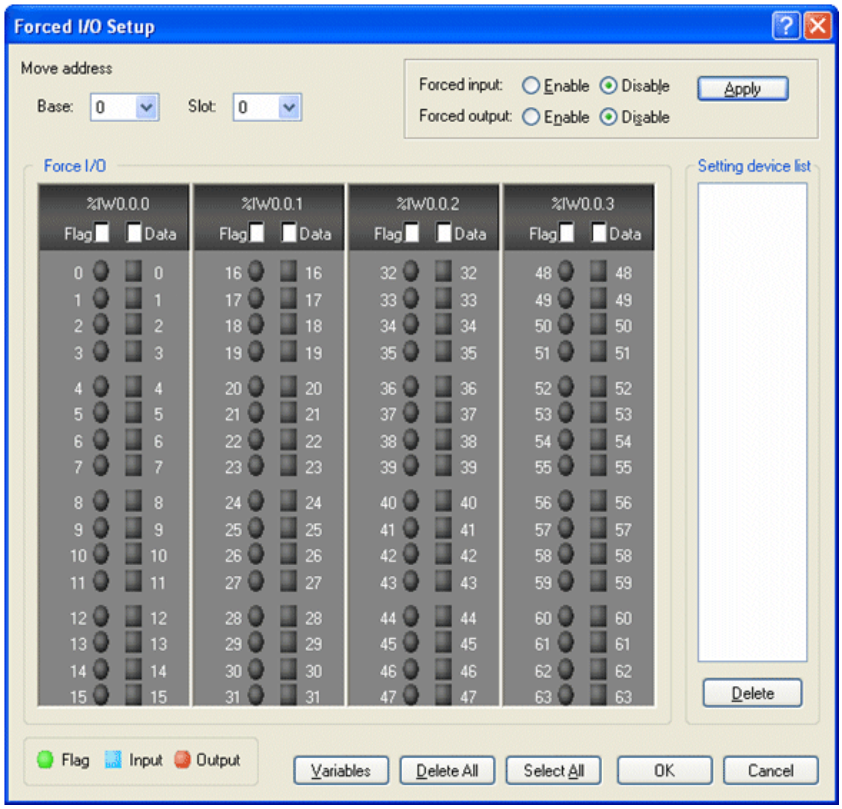
Flash memory operation mode setting	Description
On	If program memory data is corrupted because flash memory and program memory are different or battery voltage is low, it downloads the program saved in the flash memory to the program memory.
Off	CPU detects that the flash memory does not have any program and operates by the program saved in the RAM.

5.4 Forced ON/OFF of I/O

Forced I/O Setting

The forced I/O setting function is used to forcibly turn ON or OFF I/O channels, irrespective of the program execution results.

To force I/O ON/OFF, perform the following steps:

Step	Action
1	Click **Online>Force I/O…**on the SoftMaster menu bar.
2	
3	Select appropriate flag and select appropriate data check box of P device to set Forced I/O.
4	To set the value “1”, select corresponding bit data and flag.

Step	Action
5	To set the value “0”, select only the flag.
6	The setting is applied when forced input or output is enabled.

ATTENTION

- Forced I/O setting is applicable only on DI/DO modules. It is not applicable to special modules.
- Forced I/O setting is available only in local I/O modules. It cannot be set in remote I/O module (smart I/O module). When forced I/O is set, “CHK LED” is ON.
- The forced I/O setting is maintained, even after a new program is downloaded.

WARNING

Forcing can energise the I/O and may cause serious malfunction in the process or threat to human life.

REFERENCE - INTERNAL

For additional information on Forced I/O setting, see *SoftMaster User's Manual.*

Forced On/Off Processing

Forced input

The input forces the data of the contact point (Digital Input) selected and set as forced ON/OFF. At the time of input refresh the forced data is updated to the input image area. Therefore, the user program operates with actual input data while the forced setting area operates with forced setting data.

Forced output

The Output replaces data of contact point (Digital Output) selected and set as forced ON/OFF from the data of output image area. This is achieved during output refresh, on completion of the user program operation execution with the forced setting data. It makes changes in the output module. In case of output, the data of output image area does not change by forced ON/OFF setting.

Cautions for using forced I/O

- For Forcing the point the Force Flag needs to be set .
- It is possible to set the forced input even if the actual I/O module not installed.
- The data set in the CPU is retained till it is cleared.
- Forced I/O data is not cleared even CPU is in Stop mode.
- Click 'Delete all' to clear all settings and set forced value again.

Direct I/O Operation

The 'DIREC_IN, DIREC_OUT' function is used to change the I/O values. This enables the user to read the state of input and output contact points directly during program execution.

ATTENTION

When DIREC_IN,DIREC_OUT' function is used, the value is applied immediately, and it precedes Forced I/O.

REFERENCE - INTERNAL

For additional information about the DIREC_IN,DIREC_OUT' function, see the SoftMaster *Instruction manual*.

5.5 Viewing PLC Error/Event Log

Overview of operation history

There are four types of logs:

- Error log
- Mode change log
- Shut down log
- System log

The PLC saves the time, frequency, and operation of each event in memory. This can be monitored from SoftMaster. The operation log is continuously saved in the PLC unless it is deleted using SoftMaster.

Error Log

The PLC saves the errors that occur during operation into an error log. It saves the following details of errors:

- Error code, date, time, and error details.
- Error history of the errors that occur during operation

It saves a maximum of 2,048 messages. The saving of error history is automatically diabled in case memory backup fails due to low battery

Mode Change Log

In the event of a change in operation mode, the PLC saves this information with a time-stamp:

- Saves the date, time, and mode change information
- Saves up to 1,024 mode change events

Power shut down Log

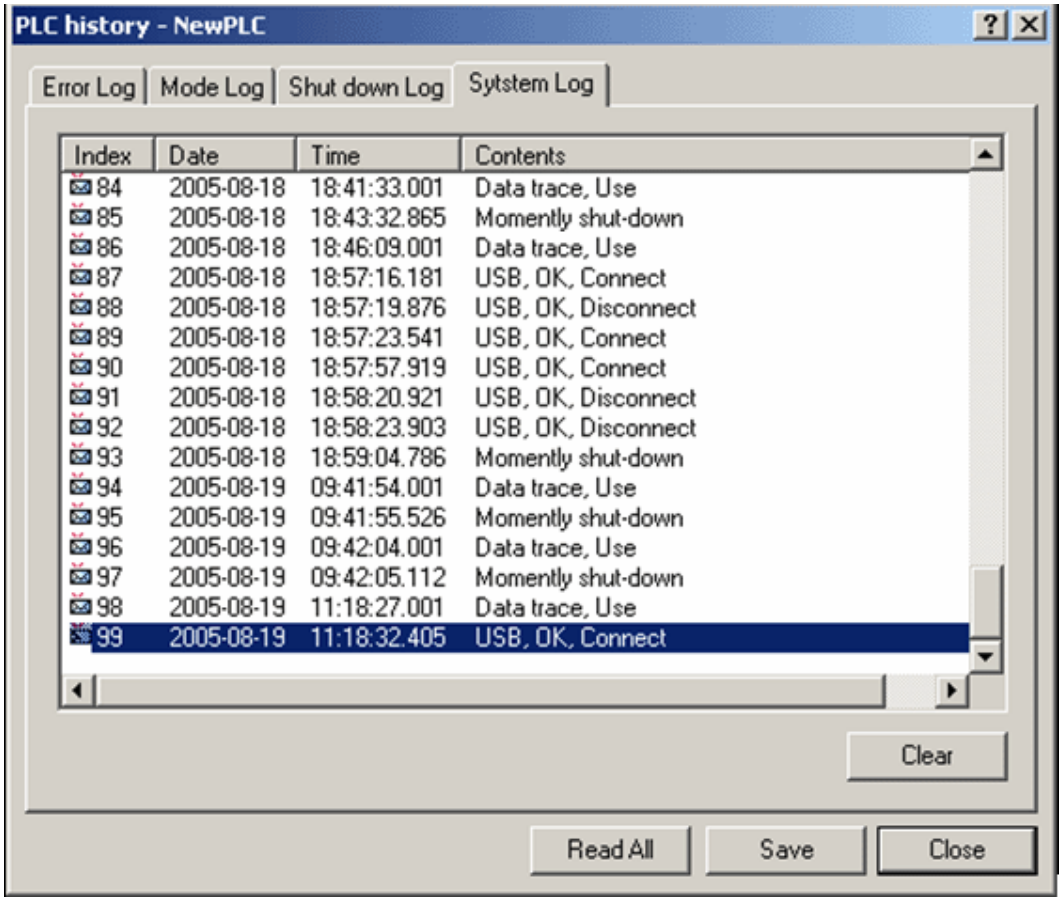
The PLC saves power ON/OFF data, with its time stamp. It saves On/Off information, date and time. It saves a maximum of 1,024 power ON/OFF events.

System Log

The PLC saves operation history of the system during operation:

- Saves the date, time, and operation changes

- Saves the SoftMaster operation data, key switch change information
- Saves instantaneous interruption data and network operation
- Saves a maximum of 2,048 operation history events



ATTENTION

- The saved information is not deleted until you select the delete menu from SoftMaster.
- In case there are more than 100 events, the 'Read All' button is enabled. Click **Read All** to check the history.

5.6 Diagnosing Faults of an External Device

All the Errors in an external device (devices wired to I/O modules) are detected by CPU and is available in a Flag as a real time value. This flag enables the indication of an external device error without preparing a complicated program.

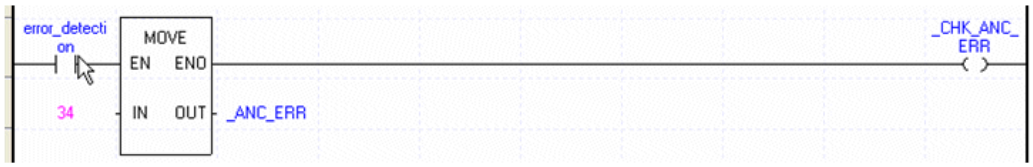
Detection and classification of external device fault

The errors in an external device can be detected by the user program. They are classified as the following types:

- 'Non-Fatal Error' (warning). When this type of error occurs, the PLC continues to operate in RUN mode. It only gives an indication about the device state according to the contents of detected warning.
- 'Fatal Error', this type of error occurs, the PLC stops operation and goes to STOP mode. Fatal error, '_ANC_ERR' flag is used and for non fatal error, '_ANC_WAR ' flag is used.

Handling a fatal error in an external device

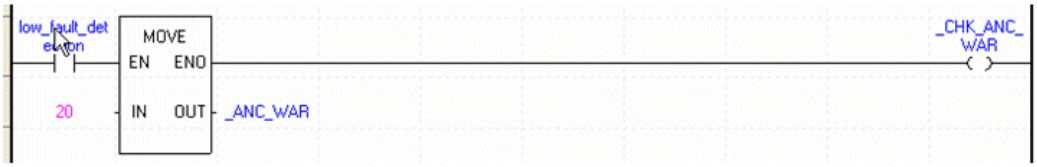
1. In a user program, if a fatal error of external device is detected, the error type can be set by a user program. For this, the user needs to write the value except '0' in the system flag, '_ANC_ERR'. While checking Scan Program completion time, if any error occurs, it is indicated in the system representative error flag '_ANNUM_ER' of '_CNF_ER'. PLC then shuts off all output modules and gives an error.
2. If case of an error, a user can find the cause by using SoftMaster or by monitoring the '_ANC_ERR' flag.
3. The ERR LED, P.S LED, and CHK LEDs are turned ON by the fatal fault error flag of an external device. The LEDs can be turned OFF by resetting the PLC. Turn the PLC OFF and then ON to turn off the LEDs.



Handling a non-fatal error in an external device.

1. When a Non-fatal Error (warning) in an external device occurs, select the flag of the corresponding position as ON '_ANC_WB' according to user identification from system flag. At the end of the scan program, if a warning is detected when checking from '_ANC_WB [0]', it is indicated by the system representative error flag, '_ANNUN_WR' of '_CNF_WAR'. The number of non-fatal error of external device is recorded in the order of occurrence from '_ANC_WAR [0]' to '_ANC_WAR [7]'.
2. If any error occurs, a user can find the cause of that error using SoftMaster or the cause of warning by monitoring '_ANC_WAR' and '_ANC_WB' flags directly.
3. If the non-fatal error of external device is released, from '_ANC_WB[n]' after performing the user program, it is automatically removed from the '_ANC_WAR[n]' flag and if all are released, '_ANNUN_WR' system flag '_CNF_WAR' is re-set.

Example



5.7 Fault Mask Function

Fault Mask Operational overview

Fault mask enables uninterrupted program execution even in the case of an error in the module.

- If the error occurs in the module where the Fault Mask is set, the corresponding module stops operation. However the rest of the system continues to operate.
- If the module error occurs when the PLC is in RUN mode, the CPU module sets the error flag and the front “PS LED” turns “ON”. You can see the error state through SoftMaster.

Setting Fault Mask

The Fault mask can be set from the online menu of SoftMaster. Fault mask can be also set by a program. It is achieved by setting fault mask flag with a program.

REFERENCE - INTERNAL

For additional information on Fault Mast setting, see *SoftMaster User's Manual*.

For additional information on setting fault mask through a program, see Appendix 1 Flags list.

Releasing Fault Mask

The Fault mask can be released in the following ways:

- Setting release from online menu of SoftMaster.
- Release by program.
- Automatic release in case memory backup is lost because of battery voltage falling.

The fault mask is not released in the following cases:

1. Power Off→On
2. Operation mode change
3. Program download
4. Reset key (released only when it is pressed for 3 seconds and longer.)
5. Data clear

ATTENTION

Check the state of the error flag before releasing the Fault Mask flag. The system goes to STOP mode if the Fault Mask is released without clearing the Error Flag.

5.8 I/O Module Skip Function

I/O Module skip operational overview

The I/O module skip function is used to exclude a designated module from operation while the PLC is in RUN Mode. The I/O data updation and error diagnosis ceases for the designated module. It is used when to operate it temporarily, excluding the fault.

Setting and Processing I/O Data

The SoftMaster is used to configure the skip setting on the I/O module.

REFERENCE – INTERNAL

For additional information about skip setting, see *SoftMaster User's Manual*.

- Input (I) image area suspends input refresh, and maintains the value set before the skip setting. At this time, it is possible to operate the image by forced ON/OFF.
- The actual output of the output module is set to OFF, when setting the skip function. But output image changes depending on a user program's operation, irrespective of the skip setting. After the skip setting, the output value of the output module cannot be controlled by forced ON/OFF.
- The skip function executed similarly as described above, even while using I/O function.

Releasing Skip Function

The I/O module skip function is released by the following methods:

- Using the online menu of SoftMaster
- Releasing by overall reset
- Automatically release, in case of memory backup failure because of low battery level

Note that the fault mask is not released in the following cases:

- Power Off→On.
- Operation mode change.
- Program download.
- Reset key (Released only when it is pressed for 3 seconds and longer.)

- Data clear.

ATTENTION

If a fault is found in a module when releasing the skip function, the system may stop. Before releasing the skip function, ensure the release os the skip with fault mask set and check the operation of a module.

5.9 Replacing a Module during Operation

Overview of replacing modules

The MasterLogic-200 system enables the user to change modules while the PLC is in RUN mode. However, special care must be taken while changing the modules as it can lead to abnormalities in the system.

CAUTION

During PLC operation:

- Do not replace the base and power module.
- Some communication modules (2MLL-PMEA, 2MLL-DMEA) can be connected as long as network is set (using Sycon software).
- When replacing a module, align the bottom of the base and the holding part of a module before inserting it. Incorrect installation may cause the system to shutdown.

Replacing Modules

Following are the methods to change modules:

Using the "Module Replacement Wizard" of SoftMaster.

REFERENCE – INTERNAL

For additional information, see *SoftMaster User's Manual.*

Using the CPU module switch.

Step	Action
1	Set "Module change switch (M.XCHG)" in front of CPU module to right (ON).
2	Remove the module. (PS LED is ON).
3	Setup the new module. (In case of normal module setup, PS LED is OFF)
4	Check if module operates normally.
5	Set "Module change switch (M.XCHG)" to left (OFF).

Using fault mask and skip function of SoftMaster

Step	Action

Step	Action
1	Set fault mask to a slot, to replace a module using SoftMaster.
2	Set skip to a slot, to replace a module using SoftMaster.
3	Replace a module.
4	Release the skip setting of a part from SoftMaster.
5	Check the operation for any errors (Refer to Appendix 1, *Flag List*).
6	Even while replacing a module again, because of a fault of replaced module, it must be repeated from (1).
7	Release the fault mask and restore to normal operation.

ATTENTION

- During the procedure, the I/O module operating on the same base may provide incorrect data instantaneously.
- Because of a fault in the replaced module, a fault of another module may be detected. It is safe to set fault mask for the entire base.
- While replacing a module, isolate the load power for safety.
- While replacing an input module, check the input image status by using forced On/Off.

WARNING

Incorrect installation of a module may cause malfunction of another module on the same base.

5.10 I/O Address

Allocating I/O address

I/O address allocation refers to assigning the address to the I/O terminal of each module. This enables reading data from an input module and transmitting the data to an output module.

The I/O number allocation is related with base number, slot position and module type. The number is allocated by the fixed method in the 2MLI-CPUU.

The base has its base number as '0' and the extension base has a switch to set the base number. The following table provides the guidance for base number setting:

Base Number	Setting
0	 0001
1	 0011
2	 0100
3	 0111

REFERENCE – INTERNAL

To see examples of I/O number allocation, see section on *Basic System Configuration*.

5.11 Program Modification

Program Modification during Operation

During PLC operation, a program and some parameters can be modified without interruption to the control.

REFERENCE – INTERNAL

For additional information on Program modification during operation, refer *SoftMaster User's Manual.*

The items modifiable during operations are as follows:

- Program.
- Communication parameters.

ATTENTION

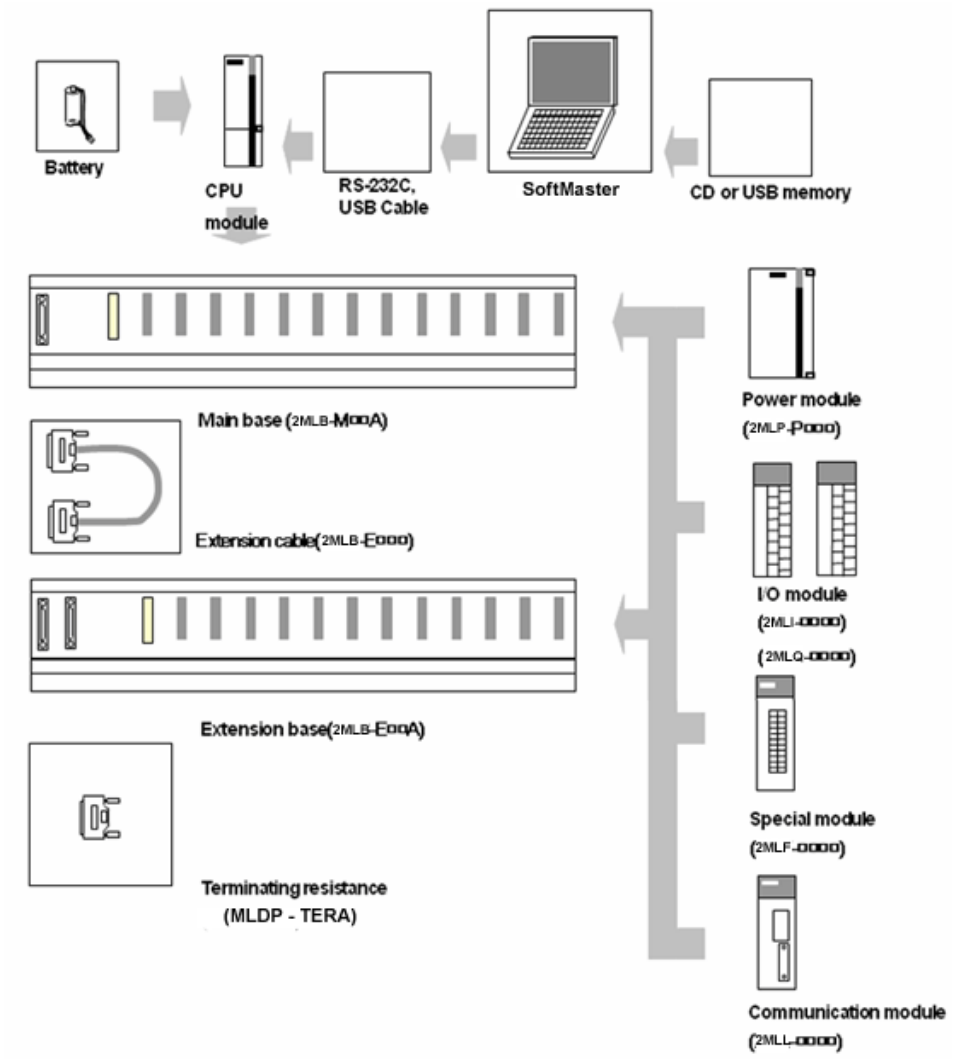
The basic parameters and I/O parameters cannot be modified during operation. To modify these parameters, it is necessary to stop operation.

6. Configuration

6.1 System configuration

2MLI-CPUU System Configuration

The system configuration of the 2MLI-CPUU is as follows:


Battery
CPU
module
RS-232C,
USB Cable
SoftMaster
CD or USB memory
Main base (2MLB-M□□A)
Extension cable(2MLB-E□□□)
Extension base(2MLB-E□□A)
Terminating resistance
(MLDP - TERA)
Power module
(2MLP-P□□□)
I/O module
(2MLI-□□□□)
(2MLQ-□□□□)
Special module
(2MLF-□□□□)
Communication module
(2MLL-□□□□)

Components List

2MLI-CPUU system consists of the following components.

Item	Type	Description
CPU module	2MLI-CPUU	CPU module (Maximum I/O points: 6,144, Program capacity: 1MByte).
Digital input module	2MLI-D21A	DC 24V input, 8 points (current source/sink input).
	2MLI-D22A	DC 24V input, 16 points (current source/sink input).
	2MLI-D24A	DC 24V input, 32 points (current source/sink input).
	2MLI-D28A	DC 24V input, 64 points (current source/sink input).
	2MLI-D22B	DC 24V input, 16 points (current source input).
	2MLI-D24B	DC 24V input, 32 points (current source input).
	2MLI-D28B	DC 24V input, 64 points (current source input).
	2MLI-A12A	AC 110V input, 16 points.
	2MLI-A21A	AC 220V input, 8 points.
Digital output module	2MLQ-RY1A	Relay output, 8 points (2A, independent COM).
	2MLQ-RY2A	Relay output, 16 points (2A).
	2MLQ-RY2B	Relay output, 16 points (2A), built-in Varistor.
	2MLQ-TR2A	Transistor output, 16 points (0.5A, sink output).
	2MLQ-TR4A	Transistor output, 32 points (0.1A, sink output).

Item	Type	Description	
	2MLQ-TR8A	Transistor output, 64 points (0.1A, sink output).	
	2MLQ-TR2B	Transistor output 16 points (0.5A, source output).	
	2MLQ-TR4B	Transistor output 32 points (0.1A, source output).	
	2MLQ-TR8B	Transistor output 64 points (0.1A, source output).	
	2MLQ-SS2A	Triac output, 16 points (0.6A).	
Main base	2MLB-M04A	For 4 modules.	
	2MLB-M06A	For 6 modules.	
	2MLB-M08A	For 8 modules.	
	2MLB-M12A	For 12 modules.	
Extension base	2MLB-E04A	For 4 modules.	
	2MLB-E06A	For 6 modules.	
	2MLB-E08A	For 8 modules.	
	2MLB-E12A	For 12 modules.	
Power module	2MLP-ACF1	AC100V~240V input.	DC5V: 3A, DC24V: 0.6A.
	2MLP-ACF2	AC100V~240V input.	DC5V: 6A.
	2MLP-AC23	AC200V~240V input.	DC5V: 8.5A.
	2MLP-DC42	DC24V input.	DC5V: 6A.
Extension cable (Total length must	2MLC-E041	Length : 0.4 m.	
	2MLC-E061	Length: 0.6 m.	

Item		Type	Description
be 15m or less)		2MLC-E121	Length: 1.2 m.
		2MLC-E301	Length: 3.0 m.
		2MLC-E501	Length: 5.0 m.
		2MLC-E102	Length: 10 m.
		2MLC-E152	Length: 15 m.
Terminating resistance		2MLT-TERA	Necessary when extension base is connected.
Dummy module		2MLT-DMMA	Dust protection module for an unused slot.
Special module	A/D conversion module	2MLF-AV8A	Voltage input: 8 channels. DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / −10 ~ +10V.
		2MLF-AC8A	Current input: 8 channels. DC 4 ~ 20mA / 0 ~ 20mA.
		2MLF-AD4S	Voltage/Current input: 4 channels, inter-channel isolation.
	D/A conversion module	2MLF-DV4A	Voltage output: 4 channels. DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / −10 ~ +10V
		2MLF-DC4A	Current output: 4 channels. DC 4 ~ 20mA / 0 ~ 20mA
		2MLF-DC4S	Current output: 4 channels, inter-channel isolation.
		2MLF-DV8A	Voltage output: 8 channels. DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / −10 ~ +10V
		2MLF-DC8A	Current output: 8 channels. DC 4 ~ 20mA / 0 ~ 20mA

Item		Type	Description	
	Thermocouple input module	2MLF-TC4S	Temperature (T/C) input, 4 channels, inter-channel isolation.	
	Resistance temperature detector input module	2MLF-RD4A	Temperature (RTD) input 4 channels.	
		2MLF-RD4S	Temperature (RTD) input, 4 channels (inter-channel isolation type).	
	High Speed Counter module	2MLF-HO2A	Voltage input type (Open Collector type) 200kpps, 2 channels.	
		2MLF-HD2A	Differential input (Line Driver type) 500kpps, 2 channels.	
	APM module (Advanced Position module)	2MLF-PO3A	Pulse output (Open Collector type), 3 axes.	
		2MLF-PO2A	Pulse output (Open Collector type), 2 axes.	
		2MLF-PO1A	Pulse output (Open Collector type), 1 axis.	
		2MLF-PD3A	Pulse output (Line Driver type), 3 axes.	
		2MLF-PD2A	Pulse output (Line Driver type), 2 axes.	
		2MLF-PD1A	Pulse output (Line Driver type), 1 axis.	
	Motion control module	2MLF-M16M	Motion-dedicated net (Mechatrolink-□) type, 16 axes.	
Communication Module	FEnet I/F module (Optical/Electric)	2MLL-EFMF	Fast Ethernet (optical), Master 100/10 Mbps supported.	'Optical' does not support 10Mbps.
		2MLL-EFMT	Fast Ethernet (electrical), Master 100/10 Mbps supported.	

Item		Type	Description	
	Snet I/F module	2MLL-C22A	Serial communication RS-232C, 2 channels.	
		2MLL-C42A	Serial communication RS-422(485), 2 channels.	
		2MLL-CH2A	Serial communication RS-232C 1 ch/RS-422(485) 1 ch.	
	FDEnet I/F module (Master)	2MLL-EDMF	Exclusive ethernet (optical), Master. Deterministic communication supported. 100/10 Mbps supported.	'Optical' does not support 10Mbps.
		2MLL-EDMT	Exclusive ethernet (electrical), Master. Deterministic communication supported. 100/10 Mbps supported.	Changed to dedicated communication
	Profibus-DP I/F module	2MLL-PMEA	Profibus-DP Master module.	
	DeviceNet I/F module	2MLL-DMEA	DeviceNet Master module.	

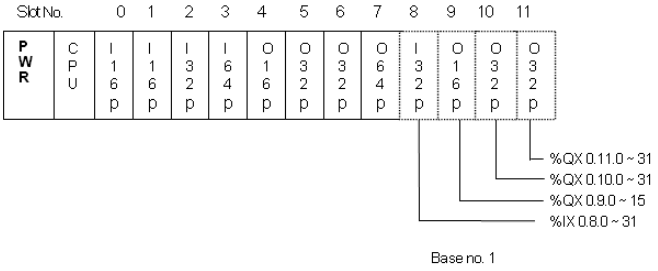
ATTENTION

For further information on the above modules, please refer to the respective user's manual. For further information on Smart I/O (block type remote I/O module), refer to the respective communication network manual for FEnet, Snet, Pnet.

6.2 Basic system configuration

Configuring the Basic System

The basic system consisting of the main base and the extension base has the following features.

Item	2MLI-CPUU
Maximum extension bases	7 bases
Maximum number of I/O module (including the extension mounted)	96 modules
Maximum I/O point (including extension mounted)	16 points module : 1,536 points 32 points module : 3,072 points 64 points module : 6,144 points
Maximum extension length	15m
	Each slot of the base is allocated 64 points (fixed), irrespective of the type of module mounted. Special modules can be mounted in any position. Unlike digital I/O modules, a special module is not allocated any I/O address. A special module is controlled by a dedicated function block and the address is automatically allocated to the memory.
Allocation of I/O Address. (12 slot base)	For instance, the I/O number of 12 slot base is allocated as follows. 

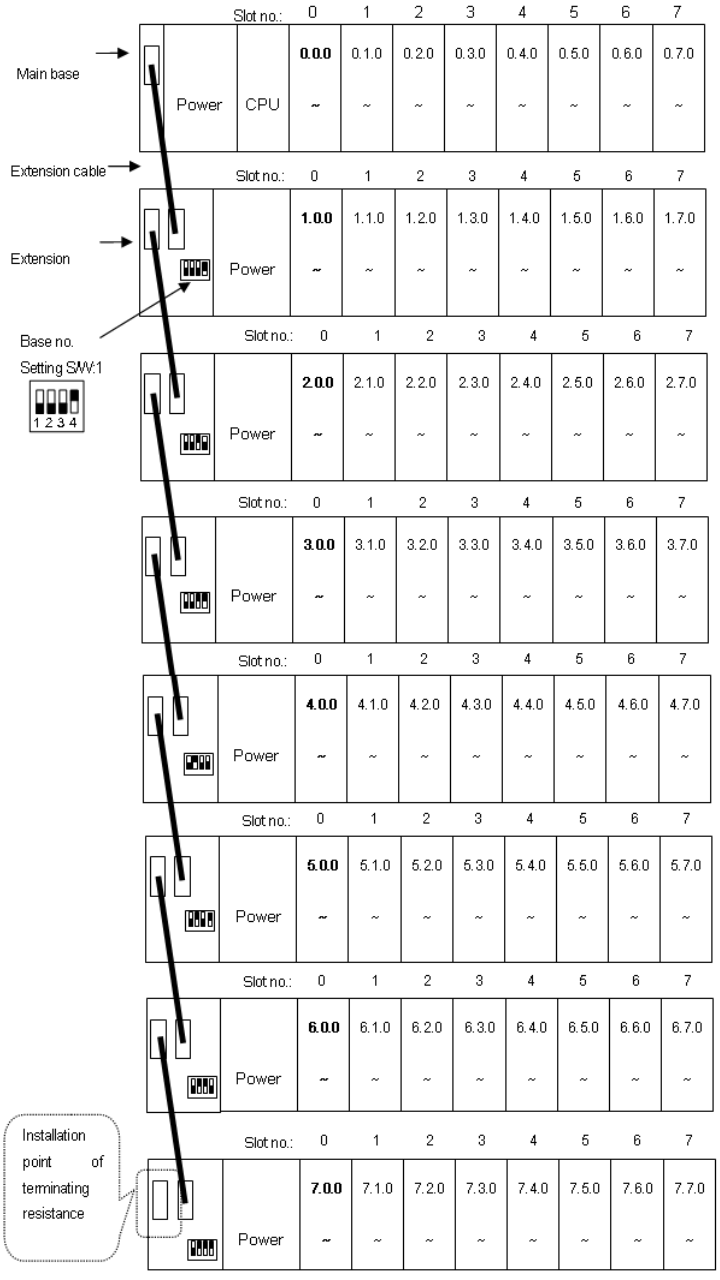
ATTENTION

- The base has its base number as ‘0’ and the extension base has a switch to set the base number.
- The module starts operating once the the module type and I/O parameter are set using SoftMaster and the correct module type is mounted on the base.

Maximum Configuration of the Base System

System Configuration example:

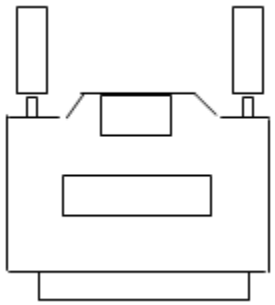
- 2MLI-CPUU
- 12 slot base (if 64 point module is installed)


Slot no.: 0 1 2 3 4 5 6 7
Main base
Power
CPU
0.0.0 0.1.0 0.2.0 0.3.0 0.4.0 0.5.0 0.6.0 0.7.0
Extension cable
Slot no.: 0 1 2 3 4 5 6 7
Extension
Power
1.0.0 1.1.0 1.2.0 1.3.0 1.4.0 1.5.0 1.6.0 1.7.0
Base no.
Setting SW:1
1 2 3 4
Slot no.: 0 1 2 3 4 5 6 7
Power
2.0.0 2.1.0 2.2.0 2.3.0 2.4.0 2.5.0 2.6.0 2.7.0
Slot no.: 0 1 2 3 4 5 6 7
Power
3.0.0 3.1.0 3.2.0 3.3.0 3.4.0 3.5.0 3.6.0 3.7.0
Slot no.: 0 1 2 3 4 5 6 7
Power
4.0.0 4.1.0 4.2.0 4.3.0 4.4.0 4.5.0 4.6.0 4.7.0
Slot no.: 0 1 2 3 4 5 6 7
Power
5.0.0 5.1.0 5.2.0 5.3.0 5.4.0 5.5.0 5.6.0 5.7.0
Slot no.: 0 1 2 3 4 5 6 7
Power
6.0.0 6.1.0 6.2.0 6.3.0 6.4.0 6.5.0 6.6.0 6.7.0
Slot no.: 0 1 2 3 4 5 6 7
Installation point of terminating resistance
Power
7.0.0 7.1.0 7.2.0 7.3.0 7.4.0 7.5.0 7.6.0 7.7.0

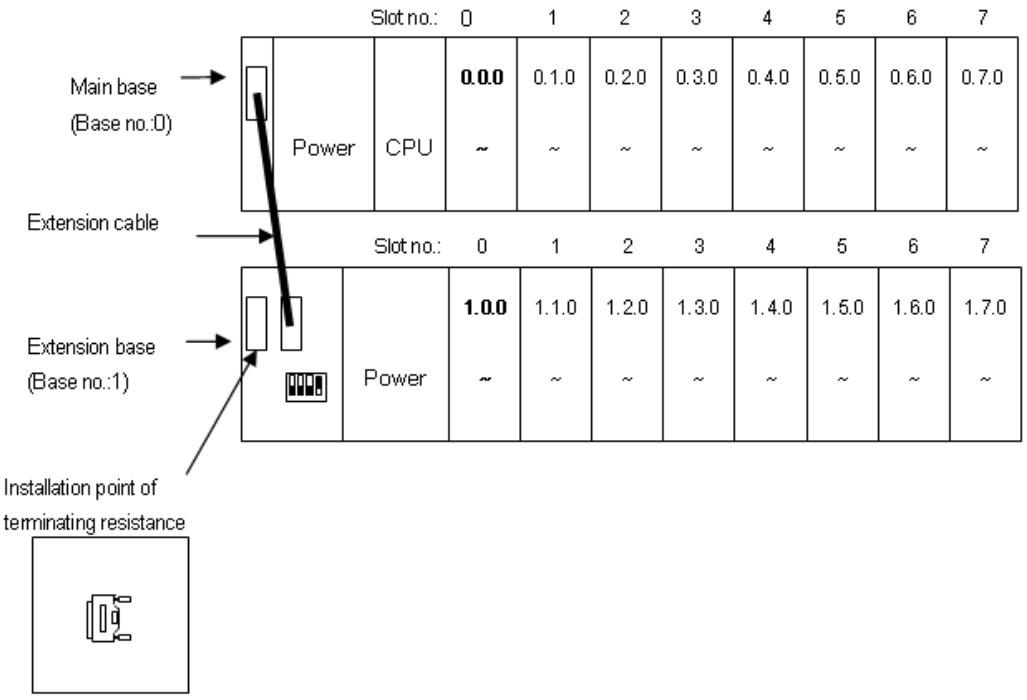
Connecting the Terminating Resistance

If a system requires the main base and the extension base to be connected, the terminating resistance must be attached to the extension connector (OUT) of the last extension base. If only the main base is used, the terminating resistance need not be installed.

7. Structure



8. Installation Position


Slot no.: 0 1 2 3 4 5 6 7
Main base
(Base no.:0)
Power
CPU
0.0.0
0.1.0
0.2.0
0.3.0
0.4.0
0.5.0
0.6.0
0.7.0
Extension cable
Slot no.: 0 1 2 3 4 5 6 7
Extension base
(Base no.:1)
Power
1.0.0
1.1.0
1.2.0
1.3.0
1.4.0
1.5.0
1.6.0
1.7.0
Installation point of
terminating resistance

6.3 Network system

Inter-System Network

MasterLogic-200 series supports various open networks through several communication modules for easy system configuration.

- High speed Ethernet (FEnet) module for communication with Experion PKS or other HMI systems in both TP-CAT5 or multi-mode fiber-optic media. This module can be also be used for peer-to-peer communication between MasterLogic-200 PLCs.
- High speed Dedicated Ethernet (FDEnet) module for high performance peer-to-peer communication between MasterLogic-200 PLCs on both TP-CAT5 and fibre-optic media
- Serial Communication (Snet) module for communication between PLC and serial devices e.g. RS232, RS422 / 485 on proprietary or open MODBUS protocols.
- Profibus-DP master module (Pnet) for communication with Profibus-DP devices including our Smart I/O modules
- DeviceNet master module (Dnet) for communication with Dnet devices including our Smart I/O

Local Network

A maximum of 24 communication modules can be installed on a MasterLogic-200 PLC. They can be installed on either a main base or an expansion base. It is recommended that the communication modules having high communication capacity should be installed on the main base.

The constraints per CPU module are shown in the below table.

High Speed Link Service

In the MasterLogic-200 CPU, a max of 12 High Speed Link (HSL) services can be configured using SoftMaster. HSL services are communication threads that runs in CPU configured to perform selected communication functions related to FEnet, FDEnet, Pnet, Dnet modules. Each HSL is further divided into 128 blocks of data transfer for modularity. Examples where HSL services are applicable:

- peer-to-peer communication between PLC A & PLC B via FENet or FDEnet modules, with configurable data areas into manageable blocks.
- to read/write I/O values between Profibus-DPor DeviceNet master module and Smart I/O modules on respective open network.

P2P service

P2P services are communication threads that runs in CPU configured to perform communication functions related to Snet, FEnet or FDEnet module. In a MasterLogic-200 CPU, a max of 8 P2P services can be configured using SoftMaster. Each P2P is further divided into 128 blocks of data transfer. For example, one HSL can be assigned to transfer configured memory data from PLC A to PLC B via FDEnet modules.

The following tablelists the communication capacity of the CPU:

Modules/applications	2MLI-CPUU
Maximum No. of high speed link services per CPU	12
Maximum No. of P2P services per CPU	8
Maximum No. of communication modules per CPU	24

ATTENTION

Point to Point (P2P) service : 1:1 communication.

Computer Link (Snet I/F) System: Snet I/F system is designed to exchange data between computers, peripherals and CPU modules by using the RS-232C or RS-422 (or RS-485) ports of the Snet module.

REFERENCE – INTERNAL

For additional information on the Snet module, refer to the user's manual of Snet module.

The Snet module allows you to install a maximum of 24 modules (including other communication modules), regardless of the Main base and Expanded base.

Snet does not provide high speed link and it supports up to 8 modules for P2P service.

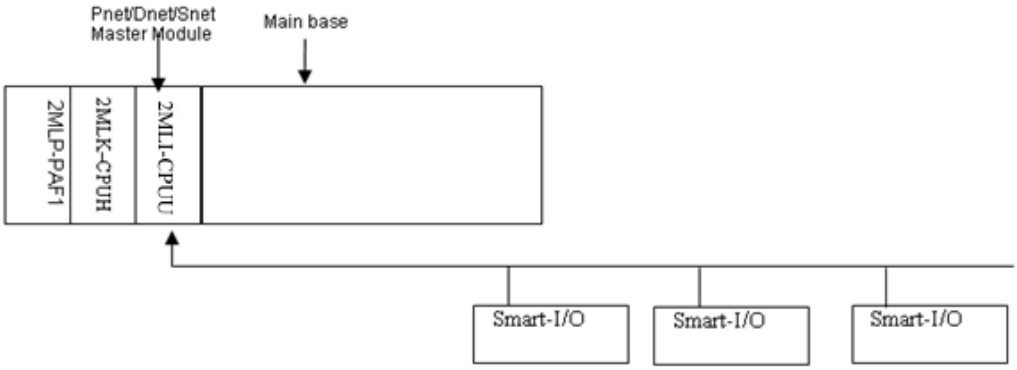
Smart I/Os Modules (Remote I/O)

Smart I/O modules are intelligent I/O modules (digital and analog) which can be located remotely and communicates with the host on open international standard protocols e.g. Profibus-DP, DeviceNet, Snet (MODBUS). They can be connected to either MasterLogic-200 PLC system or other PLCs/controllers from different manufacturers.

The Smart I/O modules are classified as follows.

Class	Network type	Network Master Module
1	Profibus-DP	2MLL-PMEA
2	DeviceNet	2MLL-DMEA
3	Modbus(Snet)	2MLL-CH2A 2MLL-C42A

System Configuration



Maximum number of installations and modules per service are same as the local network.

ATTENTION

The specifications may vary with respect to the performance. For accurate and latest information, refer to the manual of the respective network system.

I/O allocation method and I/O address assignment

- Variables can be allocated to the Remote I/O by the high speed link parameters of SoftMaster-NM.
- I/O variables or internal variables can be designated as I/O.
- It is recommended to use 'I' and 'Q' areas, to use forced On/Off function and the initialization reset function.
- The maximum number of I/O points available is 32,765.

ATTENTION

- While assigning remote station number and areas, the station numbers of sending/receiving areas must not be duplicated.
- Forced On/Off I/O service is provided only when assigning the I/O points by I/O variables (%IW %QW).
- Pay special attention when assigning I/O using internal variables.

REFERENCE – INTERNAL

For details on setting fast link parameters for the modules, refer to the respective network manual.

7. Program Structure and Operation Method

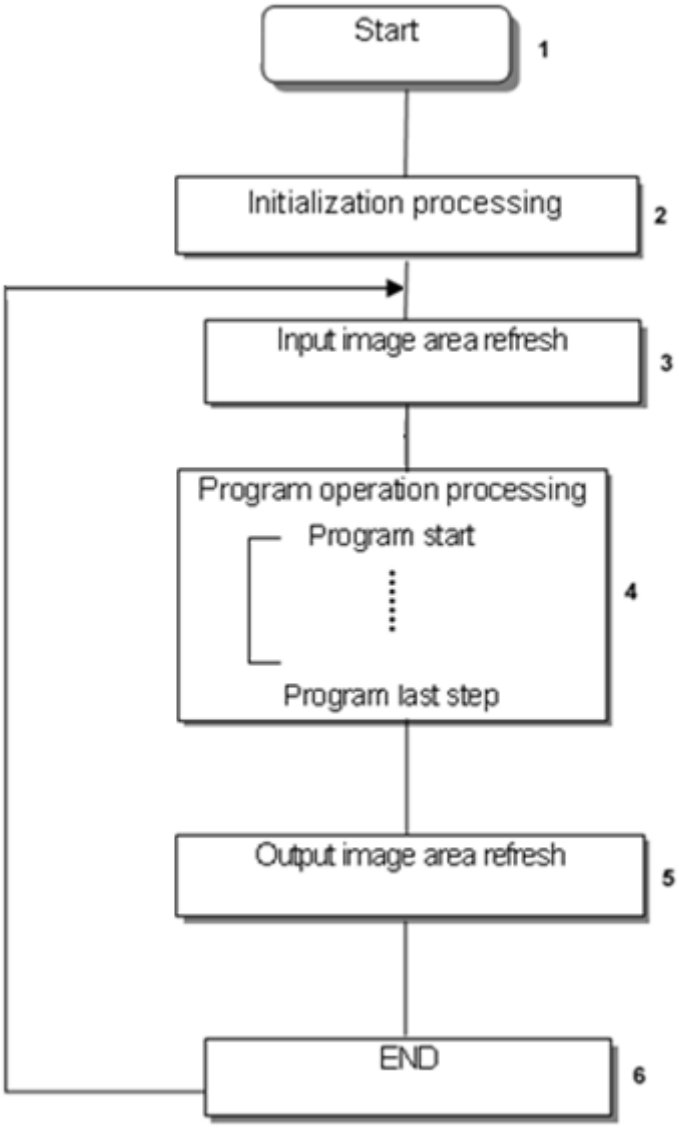
7.1 Program Introduction

Program Operation Methods

Cyclic Operation (Scan)

This is a basic method of executing a program on a PLC. It repeatedly performs the same operations as per the program starting from the first step to the last step, and is called 'Scan program'. The processing is divided per stage. The process and its description are given below:

The following figure depicts the Scan program process:


Start
1
Initialization processing
2
Input image area refresh
3
Program operation processing
Program start
Program last step
4
Output image area refresh
5
END
6

Stage	Processing Description
Initialization processing	At this stage the scan processing is started. It is executed every time when power is applied or when Reset command is executed. It involves the following: • I/O module reset • Self-diagnosis execution • Data clear Address allocation of I/O module and type register
Input image area refresh	The CPU reads the state of input module and saves it in input image area before executing the program.
Program operation processing	The CPU then executes the program as per the identified steps.
Output image area refresh	If the program operation is completed, it prints out the contents saved in output image area to the output module.
END	The program re-executes all the steps and returns to the first step after CPU module completes one scan processing. The program processing performed is as below. • Update the current value of timer and counter etc. • User event, data trace service • Self-diagnosis • High speed link, P2P e-Service • Check the state of key switch for mode setting

Interrupt Operation (Time-driven, Internal Device)

- In this method if an interrupt occurs the program being executed on the PLC is temporarily stopped. The Interrupt Operation carries out a process corresponding to the interrupt subroutine and then returns to the main program being executed.
- The signal that informs the urgent interruption to the CPU module is called ‘Interrupt Signal’. It can be configured to trigger at pre-defined time intervals.

- Interrupt program can also be triggered by change in the state of internal devices assigned for that purpose.

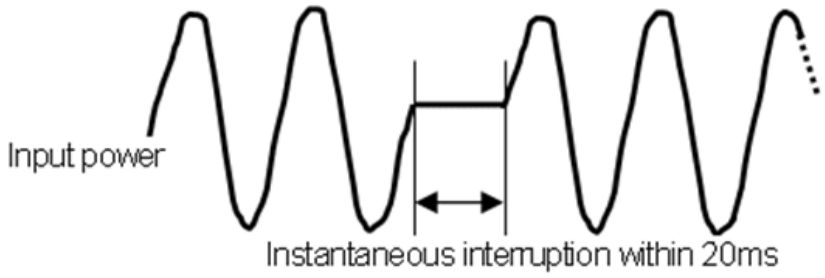
Constant Scan (Fixed Period)

- In this method all the programs being executed are scanned, after a specific time interval. Scanning stops after all the programs are scanned.
- The features that differentiate it with the other programs are the update of input/output and to perform in synchronization.
- In constant scan operation, the scan time indicates the net program processing time where the standby time is deducted. In case that scan time is bigger than 'constant', '_CONSTANT_ER [F0005C]' flag will be switched ON.

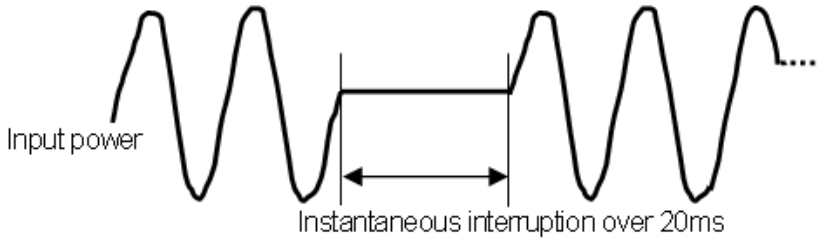
Operation of Instantaneous Interruption

The CPU module detects momentary power failure when the input power voltage supplied to the power module is lower than the normal voltage. If the CPU module detects the momentary power failure, it carries out the operation as follows.

1. In case of instantaneous interruption less than 20ms.



- CPU stops the operation and holds the output in the state when momentary power failure occurred.
- If momentary normal power resumes, the operation continues.
- Output voltage of power module keeps the value within the standard range.
- Even if the operation stops momentary, timer measurement and interrupt timer measurement shall be executed normally.
- Momentary power failure exceeding 20ms



Processing will be restarted at the power supply input.

TIP

What is instantaneous interruption?

Momentary power failure means the state that the voltage of supply power at power condition designated by PLC is lowered as it exceeds the allowable variable range and the short time (usually in ms) interruption is called 'momentary power failure.

Scan Time

The processing time from program step 0 to the next step 0 is called 'Scan Time'.

1. Operation and performance of 2MLI-CPUU

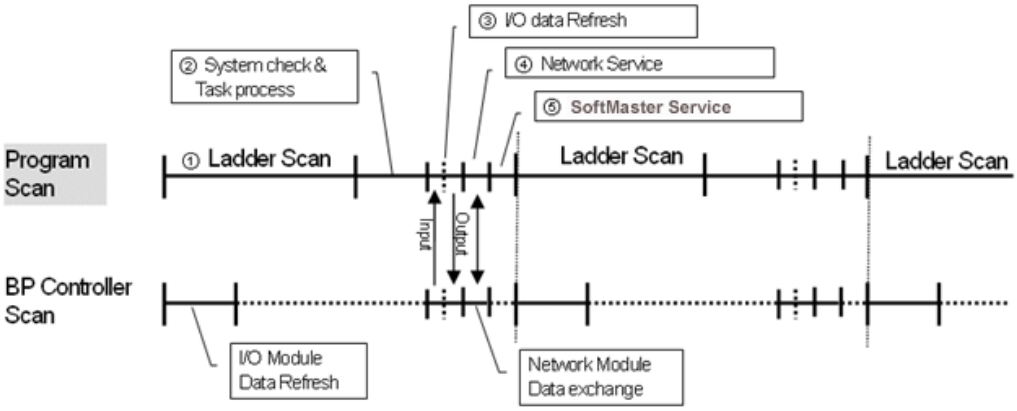
   The Program execution time, I/O data process time and communication service time are important factors affecting the 'scan time.'

   - The 2MLI –CPUU reduces scan time through improved data reception performance through ladder program execution and backplane, ladder program execution by MPU, and parallel execution of I/O data scan, and so on.

Type	MPU processing time		BP Controller processing time		
	Ladder execution (32kstep)	System Task	Digital I/O module (32 points, 1module)	Analog module (8 ch, 1module)	Communication module (basic/extension) (200 byte, 1 block)
2MLI-CPUU	0.896 ms	0.6 ms	20 us	75 us	185 us

2. Calculation of Scan Time

The CPU module executes the scan program in the following sequence. A user can estimate the scan time performance of a system from the following calculation.



- Scan time (□) = Scan program process □System check and Task process □ I/O data Refresh + Network Service + SoftMaster Service + User Task Program process.

  a) Scan program process = no. of program steps created x 0.028 (□)

  b) System check and Task process: 600 □ ~ 1.0 ms [parameter depending on the usage of auxiliary functions]

  c) SoftMaster Service process time: 100 □ at the max data monitor

  d) Task Program process time: Sum of task processing time that occurs within a scan; the time calculation by task programs are the same as of scan a program.

Example:

The scan time of a system consisting of a CPU (program 16kstep) + 32 points, 6 I/O modules + 6 analog modules + 4 communication modules (200 bytes 8 blocks per module) is as follows:

Scan time(□) = ladder execution time + system processing time + digital module I/O processing time + analog I/O processing time + communication module processing time + SoftMaster Service processing time.

= (16000 x 0.028) + (600) + (20 x 6) + (75 x 6) + (185 x 8 x 4) + (100)

= 7638 □

= 7.6 □

(However, if the monitor is changed, scan time increases temporarily. If connected by "Max. USB Writing", it is 6ms; if connected by "Normal USB Writing", it is 1.6ms.)

- Scan time monitor

  Scan time is saved into the following flag (%F) address/memory areas.

  - _SCAN_MAX: Maximum value of scan time (resolution of 0.1ms).
  - _SCAN_MIN: Minimum value of scan time (resolution of 0.1ms).
  - _SCAN_CUR: Current value of scan time (resolution of 0.1ms).

7.2 Program Execution

Program Configuration

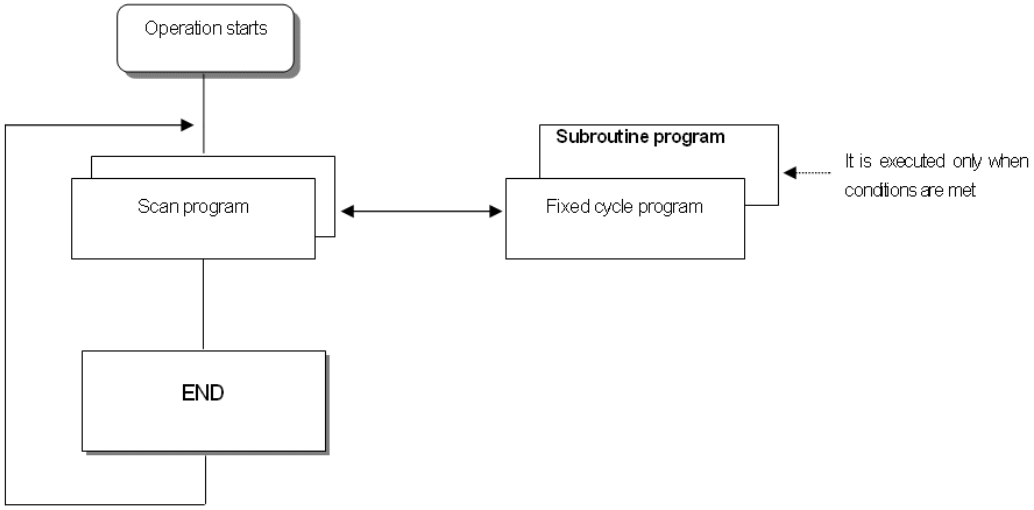
A Program consists of all functional elements necessary for executing a control saved in the RAM of the CPU module or flash memory.

The functional elements can be categorized as:

Functional Elements	Operation Description
Scan program	Process a signal that repeats uniformly per scan.
Fixed cycle interrupt program	Program is executed at a fixed interval if time conditional process is required as follows: • If a faster processing is required than the average processing time of a scan. • If requiring longer time interval than the average processing time of a scan. • If a process is to be executed at a fixed interval.
Subroutine program	Executed only when a specific condition is met, (if the input condition of CALL command is On).

Program Execution

It describes the program execution, when the power is turned ON or the key switch of the CPU module is in RUN. The program processes an operation according to the following configuration.



Scan Program

Function

- This program sequentially executes all operations from step 0 to the last step, and is repeated regularly for every scan.
- In case interrupt program is running while executing Scan Program, it stops the program being executed and executes the related interrupt service program.

Interrupt Task Program

This program stops the execution of the Scan Program and then executes the interrupt service program. The interrupt can be triggered by periodic/non-periodic, internal device signals.

The following are the two types of Task program:

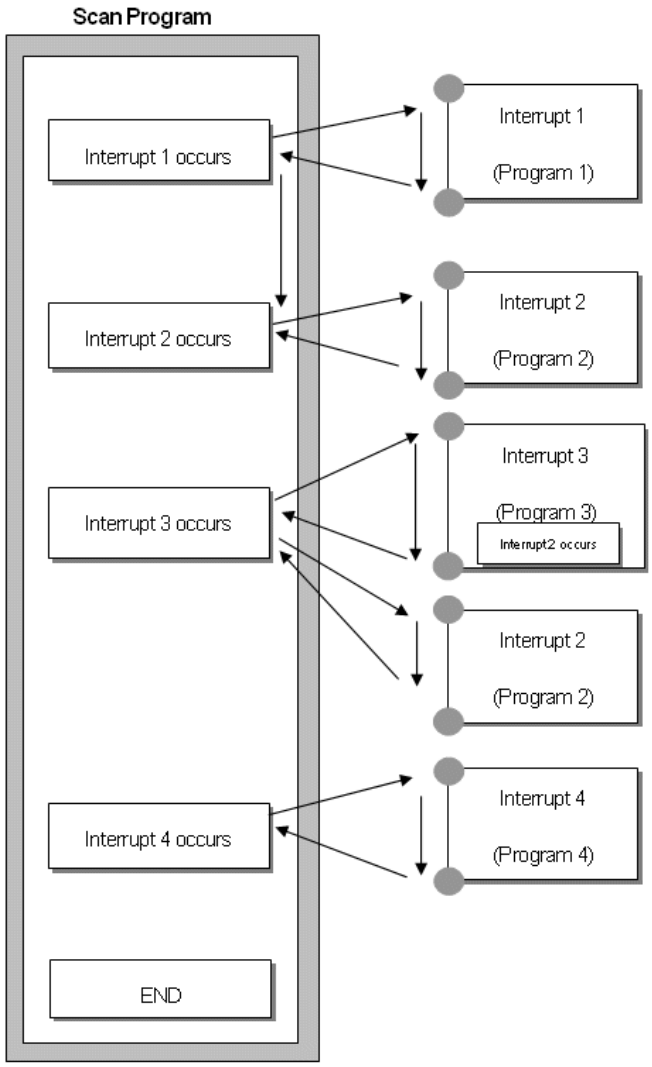
- **Time-driven interrupt task program** – Executes according to the fixed time internals.
- **Internal device interrupt task program** – Executes when condition of internal device occurs. The device start condition is detected after the Scan Program.

Interrupt

The following flowchart illustrates the execution of interrupt programs during execution of regular scan program. It depicts how interrupt tasks are configured in SoftMaster (programming software for MasterLogic-200).

ATTENTION

For additional information on the SoftMaster, see SoftMaster User's Manual.

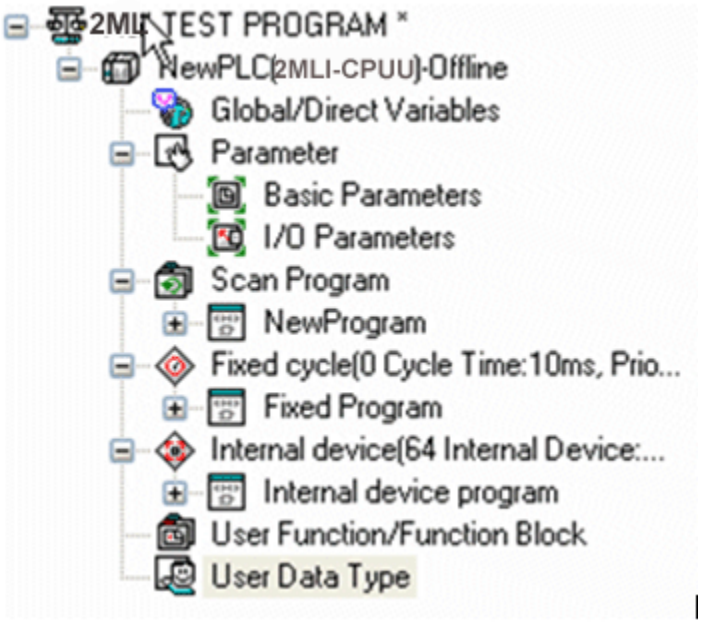


TIP

When the power is switched ON, all Interrupts are in the 'Disable' state.

Configuring an Interrupt Task program

Create a task in the project window of SoftMaster as shown in the following figure and add a program to be performed by each task.



REFERENCE - INTERNAL

For additional information on creating an interrupt program, see SoftMaster User's Manual.

Task Types

The various task parameters that can be configured using SoftMaster and their functions are as follows.

Spec. \ Type	Fixed cycle task parameters that can be configured using SoftMaster and their functions are as follows. (interval task)	Internal contact task (single task)

Number	32	32
Operation condition	Fixed cycle (settable up to 4,294,967.295 seconds at the unit of 1ms)	Conditions of internal device designation.
Detection/execution	Cyclically execute at the pre-defined interval.	Execute by conditional search after completing scan program.
Detection delay time	Delayed as long as a maximum of 0.2ms.	Delayed as long as the maximum scan time.
Execution priority	Setting 2 ~ 7 levels (level 2 is the highest priority)	2 ~ 7 level setting (2 level is highest priority)
Task number	Assigning it between 0~31, so that it is not duplicate	Assigning it between 64~95, so that it is not duplicated.

Processing an Interrupt Task Program

The following points describe the common processing methods and notices for assigning a Task Program.

1. Features of a Task program.
   - A Task program does not reiteratively process like a scan program.It executes only when the execution conditions occur. Consider this aspect when creating a task program.
   - For instance, if a task program with 10 seconds of fixed cycle is used with a timer and a counter, the timer may have a maximum error of 10 seconds, while the counter checks every 10 seconds.Any counter input changed within 10 seconds is not taken into account.
2. Execution priority
   - If several tasks are in queue to be executed, it processes from the highest priority task program. If there are several tasks of same priority, they are processed by the order in which they occur.
   - The task priority is applied only to a task.
   - Set the priority of task program, considering the program features, importance level, and urgency in execution.

3. Process delay time

   the delay of task program processing occurs due to the following factors. Consider this aspect when setting a task or creating a program.

   - Task detection delay. (Refer to details of each task.)
   - Program execution delay due to the execution of the preceding task program.

4. Correlation between scan program and task program in the initialization.

   - A user defined task/scan program does not execute when the initialization task program is executing.
   - The scan program has a low priority over user defined Task program. Whenever a user defined task program occurs, the scan program is stopped and the task program execution takes precedence over the scan program.
   - If user defined tasks frequently occur during the first scan or intensively and intermittently occur, a scan time may increase drastically. Pay special attention while setting the conditions of task.

5. Protection from task program of a currently running program.

   - If program execution continuity is lost by executing a higher priority program, you can partially protect the task program from being executed, for a problematic part. Currently, a program can be protected by application function commands of 'DI (task program operation disabled)' or 'EI (task program operation enabled)'
   - Insert the 'DI'application function command, into the beginning position of a program section to be protected and 'EI' to the program section to cancel it. Initialization task is not affected by the application function commands of 'DI' and 'EI'.

TIP

If a task program priority is identical, the program execution follows the order in which the task programs were created.

Processing Method of Fixed Cycle Task Program

It describes the processing method when a Task Program is set at the fixed cycle.

1. Task settings

- Sets the execution cycle and priority of a task, which is the operation condition of a task program. Check the task number to manage tasks.

2. Fixed cycle task processing

- Executes a fixed cycle task program at a pre-defined interval.

Cautions for using a fixed cycle task program

- If a same task program is to be executed when a fixed cycle task program is in operation or waiting for execution, the new task is ignored.
- During the operation mode in RUN, a timer executing a fixed cycle program is counted. Any interruption time is ignored.
- Note that several fixed cycle task programs are simultaneously executed in certain conditions. This happens when the execution cycle of a fixed cycle task program is set as in the following example.

If using 4 fixed cycle task programs, of which cycle is 2, 4, 10 and 20 seconds respectively, it may have simultaneous execution of 4 programs every 20 seconds. This may result in a longer scan time.

CAUTION	A short fixed cycle is not executed if the total duration in which the fixed cycle programs are simultaneously executed is greater than the time specified for the simultaneous execution of several fixed cycle tasks. Ensure that the cycle time of the fixed cycle task is greater than the scan cycle time of the task for successful execution of the task.

Processing Method of Internal Device Task Program

The Internal Device Task program describes the processing method of an internal device task program, of which the task (operation condition) execution range is extended from contact to device.

1. Task settings

- Set the conditions (Select the CPU in the Project window and go to **Project>Add Item>Task** in SoftMaster) and priority of a device which is the operation condition of a task program to execute. Check the task number to manage tasks.

2. Internal device task processing

- After a scan program is executed in the CPU module, the task is processed if the conditions of devices (that are the operation conditions of internal device task program) are met, according to the priority.

3. Cautions for using internal device task program

- Internal device task program is executed after a scan program is completely executed. Therefore, although a scan program or task program (fixed cycle, external contact) generates the execution conditions of internal device task program, it is not immediately executed.

- The execution request of internal device task program checks the conditions of execution when a scan program is completely executed. Therefore, if the execution conditions of internal device task occur and disappear by a scan program or task program(fixed cycle, external contact) during the first scan, a task is not executed because it is not detected when the execution conditions are checked.

- Task Processing in Instantaneous Interruption

On resuming operation after a long instantaneous interruption, waiting tasks and tasks that occur during the interruption are ignored. On resuming operation, tasks after the interruption are processed.

If an interruption is 20ms or less, a waiting task is executed once the interruption is over. Any fixed cycle interrupt task that is duplicated during the interruption is ignored.

Verification of Task Program

After creating a task program, use the following checklist to verify it.

1. Is the task set properly?

- If a task occurs excessively or several tasks occur simultaneously in a scan period, it may cause longer scan time or irregularity. If a task setting cannot be changed, check the maximum scan time.

2. Is the task priority well arranged?

- A low priority task program may not be processed in a specified time due to a delay in a higher priority task program. When a new task is preceded by a delayed task, it may cause a task collision. The priority must be set in consideration of the urgency of task, execution time, and so on.

3. Is the task program created as short as possible?

- A longer execution time of a task program may cause a longer scan time or irregularity. In addition, it may cause task program collision. It is recommendedto et the execution time as short as possible (especially, create a fixed cycle task program so that it could be executed within 10% of the shortest task cycle among several tasks.)

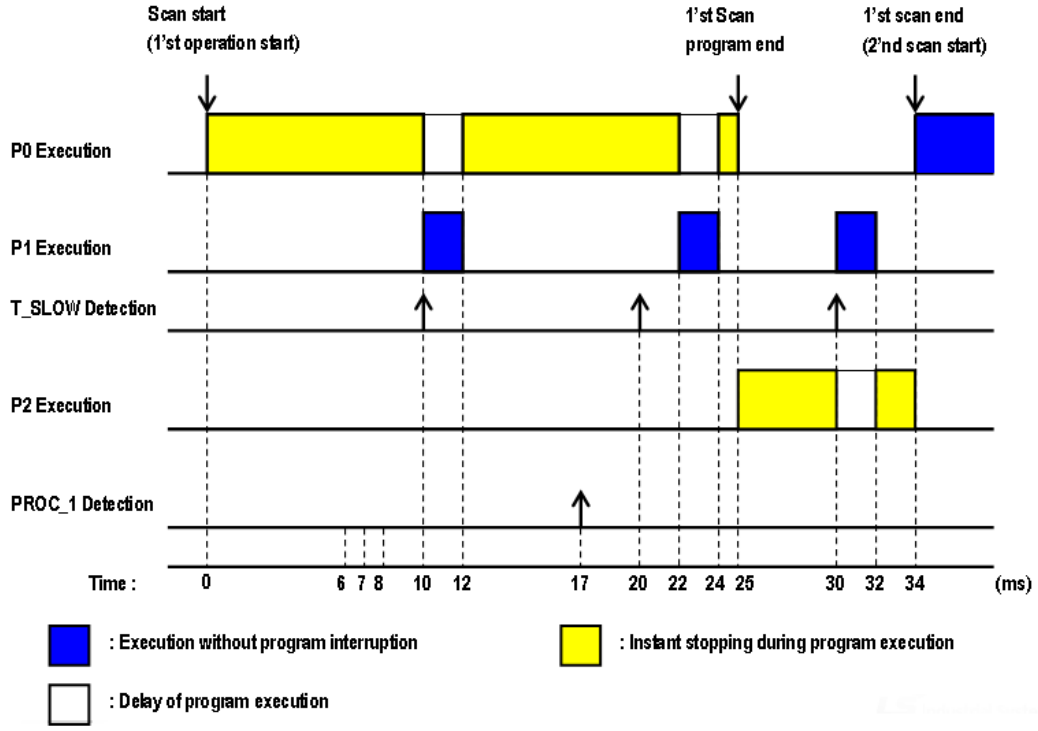
4. Is the program for the highest priority task protected during the execution of the program?

   - If a different task breaks into a task program execution, it completes the current task and then executes the task with the highest priority among waiting tasks. Different tasks breaking into a scan program can be prevented by using 'DI'/'EI' application functional commands. It may cause a fault while processing a global parameter process commonly used with other program or a special or communication module.

Program Configuration and Example of Processing

Register task and program as follows:

- Registering a task:
  - T_SLOW (fixed cycle : = 10ms, Priority := 3)
  - PROC_1 (internal contact : = M0, Priority := 5)
- Registering a program:
  - Program --> P0 (scan program)
  - Program --> P1 (operating by task T_SLOW)
  - Program --> P2 (operating by task PROC_1)
- If the program execution time and occurrence of external interrupt signal are same,
  - Execution time of each program: P0 = 21ms, P1 = 2ms and P2 = 7ms,
- PROC_1 occurrence: During a scan program, the program is executed as follows:



- Processing by time period:

Time(ms)	Processing
0	Scan starts and the scan program P0 starts operation.
0~10	Program P0 is executed.
10~12	P0 stops due to the execution request from P1 and P1 is executed.
17	Execution request for P2.
12~20	P1 execution is complete and the suspended P0 resumes.
20~24	P0 stops due to the execution request from P1 and P1 is executed.
24~25	As P1 execution is complete, the suspended P0 is completely executed.
25	Check the execution request for P2 at the moment when scan program (P0) is complete and execute P2.

25~30	Execute program P2.
30~32	P2 stops due to the execution request from P1 and P1 is executed
32~34	As P1 execution is completed at 32, the suspended P2 is executed until 34.
34	Start a new scan (P2 execution starts)

7.3 Operation Mode

Overview of the Operation MODE

The 2MLI-CPUU has three operation modes. Each mode describes the operation process at each operation mode.

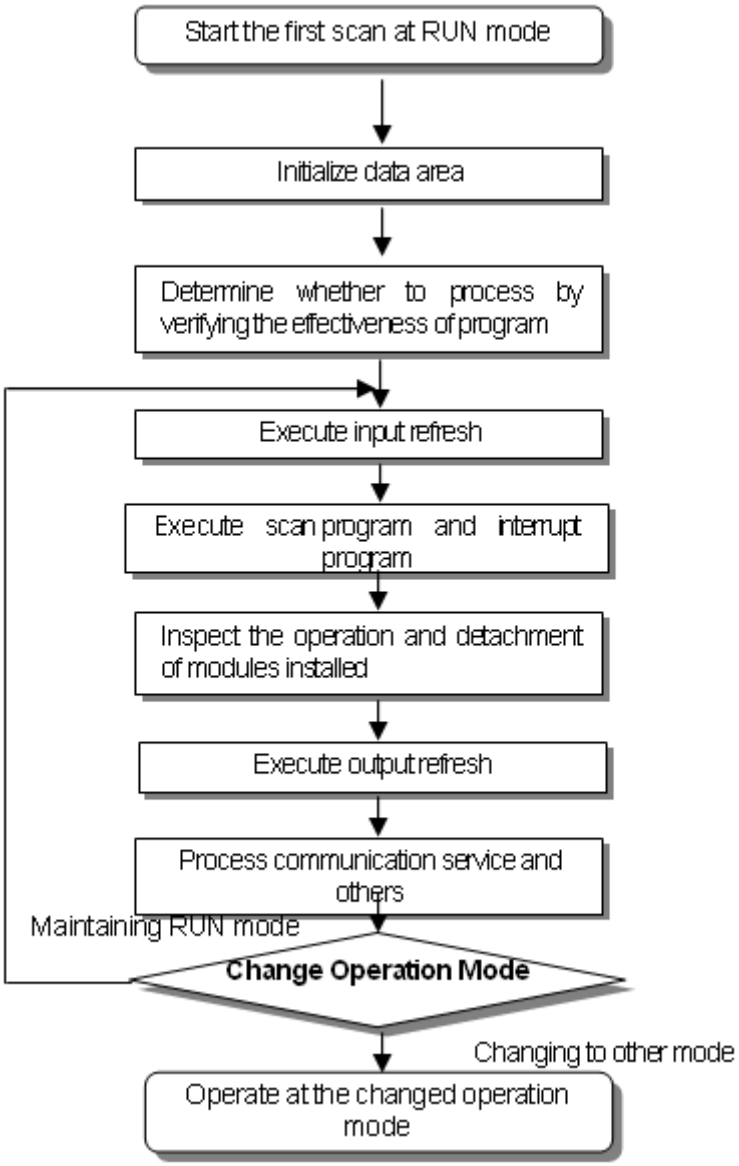
- RUN mode
- STOP mode
- DEBUG mode

RUN Mode

The CPU executes a program operation normally.

WARNING

Changing the operation mode can energise the field and may cause serious threat to human life.



1. Processing when a mode is changed

At the beginning, the data area is initialized and it determines whether to execute it by verifying the effectiveness of the program.

2. Operation process

Execute I/O refresh and program operation.

- Execute the interrupt program by detecting the operation conditions of the interrupt program.
- Inspect the operation and detachment of modules installed.
- Process communication service and other internal operations.

STOP Mode

The CPU stops when there is no program to run. Program can be controlled from SoftMaster if the following switches on the CPU module are set:

- Remote switch on the CPU module is ON
- RUN/STOP switch on the CPU module is in STOP.

1. Processing when a mode is changed
   Remove the output image area and execute refresh. All output data is changed to off state.
2. Operation process
   a) Perform an I/O refresh.
   b) Inspect the operation and detachment of modules installed.
   c) Process communication service and other internal operations.

DEBUG Mode

The Debug mode is used to find errors from a program or trace an operation procedure. The DEBUG mode can be changed only from the STOP mode. In the DEBUG mode, a user can verify a program while checking the program execution and data.

Processing when a mode is changed.

- When the mode is changed, initialize the data area.
- Clear the output image area and execute input refresh.

Operation process

- Execute I/O refresh.
- Debug the operation, depending on the settings.
- After debugging the operation until the end of the program, it executes output refresh.
- Inspect the operation and detachment of the modules installed.
- Process the communication service and other internal operations.
- Debug operation conditions

  There are four conditions in Debug operation and in case it reaches break point, it is possible to set other type of break point.

Operation condition	Description
Execute by one operation unit (step over)	With operation instruction, it executes only one operation unit and stops.
Execute according to Break Point	If break point is assigned in the Program, it stops at the assigned break point.
Execute according to the state of contact point	If the contact area desired to be watched and the desired stop state (Read, Write, Value are assigned, it stops when the assigned operation occurs at the assigned contact point.
Execute according to scan times	If scan time to operate is assigned, it operates as per the assigned scan times and stops.

Operation method

a) Set the debug operation conditions at SoftMaster and execute the operation.

b) Interrupt Program mode can be set to Enable or Disable state (Enable/Disable) by each Interrupt unit.

REFERENCE - INTERNAL

For additional information on operation, see section on ”Debugging” of the *SoftMaster User’s Manual.*

Changing Operation Mode

An operation mode can be changed by the following methods:

- Using the mode key of the CPU module.
- Using the programming tool (SoftMaster).
- Using SoftMaster to change the operation mode of a remote CPU module networked with the main CPU.
- Using SoftMaster, HMI, and the computer link module, which are networked.
- Using the 'STOP' command, while a program is operating.

WARNING

Changing the operation mode can energise the field and may cause serious threat to human life.

Setting operation mode

The operation mode can be set as follows:

Operation mode switch	Remote switch	SoftMaster command	Operation mode
RUN	X	X	Run
STOP	On	Run	Remote Run
		Stop	Remote Stop
		Debug	Debug Run
	Off	Mode change	Transfer (changed) operation mode
RUN → STOP	X	-	Stop

- Remote mode can be changed with 'Remote: On' and 'Mode switch: Stop'
- To change the remote 'RUN' mode to 'Stop' by switch, move the switch (STOP) > RUN > STOP.

ATTENTION

While changing the remote 'RUN' mode to 'RUN' mode using the switch, the

PLC operates continuously, without suspension. Editing during RUN is possible in the 'RUN' mode by switch, but the mode change is restricted by SoftMaster. Change the mode only when the mode change is not remotely allowed.

7.4 CPU Memory

Overview of CPU memory

The CPU module contains two types of memory that can be used by a user:

- Program memory: to save a user program created to construct a system
- Data memory: to provide a address/memory area and save the data during operation.

Program Memory

The total program memory area is 10 MB. The storage capacity and data area type of the program memory are as follows:

Item (area)	Capacity
System area: • System program area • Backup area	1MB
Parameter area: • Basic parameter area • I/O parameter area • High speed link parameter area • P2P parameter area • Interrupt setting data area • Reserved area	1MB
Execution program area: • Scan program area • Task program area	2MB

Program storage area • Scan program backup area • Task program area • Upload area • User-defined function/Function block area • Parameter initialization data area • Preserved parameter designation data area • Reserved area	6MB

Data Memory

The total data memory area is 2MB. The storage capacity and data area type of the data memory are as follows:

Item(area)		Capacity
System area: • I/O data table • Forced I/O table • Reserved area		770KB
Flag area	System flag	4KB
	Analog image flag	8KB
	PID flag	16KB
	High speed link flag	22KB
	P2P flag	42KB
Input image area (%I)		16KB
Output image area (%Q)		16KB
R area (%R)		128KB

Direct parameter area(%M)	256KB
W area (%W)	128 KB
Symbolic parameter area (Maximum)	512KB
Stack area	256KB
Total	2046KB

Data Retain Area Setting

The default (auto.) parameter RETAIN is used to save the data necessary for operation or to save the data collected during operation even when the PLC stops and resumes operation. Alternatively, a part of the M area device may be used as the retain area by the parameter setting.

The following table summarizes the features of retain settable device.

Address/memory area	Retain setting	Feature
Default	O	Retain settable if adding a parameter to the auto parameter area.
%M	O	Retain settable into internal contact area by parameter.
%K	X	Contact that is kept as contact status, in case of interrupt.
%F	X	System flag area.
%U	X	Analog data register (retain not settable).
%L	X	High speed link/P2P service status contact of communication Module (retained).
%N	X	P2P service address area of communication module (retained).
%R	X	Exclusive flash memory area (retained).

TIP

O indicates 'available' and X indicates 'not available'.

%K, %L, %N and %R address/memory area are basically retained.

%K, %L and %N address/memory areas can be deleted in the memory deletion window of PLC, an online menu of SoftMaster (**Online>Clear PLC>Clear Memory**).

REFERENCE - INTERNAL

For additional information on data retention, see the 'Online' section of the *SoftMaster User's manual*.

Data initialization by restart mode.

There are 3 parameters related to the restart mode: DEFAULT, INITIALIZATION, and RETAIN retain parameter. The initialization methods of each parameter are as follows in the restart mode.

Mode / Parameter	Cold	Warm
Default	Initializing as '0'	Initializing as '0'
Retain	Initializing as '0'	Maintaining the previous value
Initialization	Initializing as a user-defined value	Initializing as a user-defined value
Retain and initialization	Initializing as a user-defined value	Maintaining the previous value

Operation in the data retain area

Retain data can be deleted by using the following methods:

- D.CLR switch of the CPU module.
- RESET switch of the CPU module(3 seconds and longer: Overall Reset)
- RESET by SoftMaster (Overall Reset).

- Deleting memory at STOP mode by SoftMaster.
- Configuring by a initialization task (In the project tree, right click on offline CPU and select **Add Item>Task…**Select the **Execution condition** as Initialization).
- Writing '0' FILL, and so on at SoftMaster monitor mode.

D.CLR clear does not function in RUN mode. To use the D.CLR switch, change it to STOP mode. In addition, the default area is initialized when clearing by D.CLR switch.

When instantaneously operating D.CLR, only the retain area is deleted. If maintaining D.CLR for 3 seconds, 6 LEDs blink and during that time, if the switch returns, even R area data is deleted.

For the maintenance or reset (clear) of the retain area data according to the PLC operation, refer to the following table.

Operation	Retain	M area retain	R area retain
Reset	Maintaining the previous value	Maintaining the previous value	Maintaining the previous value
Over all reset	Initializing as '0'	Initializing as '0'	Maintaining the previous value
D.CLR	Initializing as '0'	Initializing as '0'	Maintaining the previous value
D.CLR (3sec)	Initializing as '0'	Initializing as '0'	Initializing as '0'
STOP→RUN	Maintaining the previous value	Maintaining the previous value	Maintaining the previous value

TIP

- Default variable: A variable not set to maintain the initial/previous value.
- Initialization (INIT) variable: A variable set to maintain the initial value.
- Retain variable: A variable set to maintain the previous value.

Data Initialization

Every device memory is cleared up as '0' when memory deletion occurs. The data value may be assigned initially depending on a system and the initialization task required must be used.

8. Maintenance

8.1 Repairs and Maintenance

The following routine and periodic inspections are recommended to maintain the PLC in good condition.

I/O Module maintenance

The I/O module mainly consists of semiconductor elements. Hence, the life of a PLC is subject to the health of its semiconductor parts. Regular checks must be carried out as errors in the elements may occur due to the effect of the surrounding environment.

Refer to the following table for the items to be checked, once or twice every 6 months.

Checklist		Judgment basis	Actions
Power supply		Within the power variance range (Between –15% to +10%)	Adjust the power within the allowable voltage variance range.
I/O power		I/O specifications of each module	Adjust the power within the allowable voltage variance range.
Environment	Temperature	0 ~ + 55°	Adjust the temperature and humidity conditions properly.
	Humidity	5 ~ 95%RH	
	Vibration	None	Use vibration-preventive rubber or other measures.
Shakes of modules		Must not have shake	Every module must be protected from shaking.
Loose terminal screw		No looseness	Tighten any loose screw.

Spare parts	Check whether the amount and conditions of spare parts are proper	Replenish insufficient parts and improve the storage condition.

8.2 Routine Inspection

The following items must be routinely inspected.

Checklist		Check point	Judgment basis	Actions
Attachment of the base		Check any loose screw	Screws must be firmly tightened.	Tightening
Attachment of I/O module		• Check the screws are firmly tightened • Check any separation of module cover	Must be firmly tightened.	Tightening
Attachment of terminal strip and extension cable		Loose screw	Not loose	Tightening
		Proximity with clamped terminal	Proper spacing	Rearrangement
		Connector of extension cable	Connector must be tightened	Rearrangement
Display LED	Power LED	Check whether it is LED ON	LED On (off is error)	Refer to section on *Performance specifications.*
	RUN LED	Check whether it is LED ON in RUN state	LED On (off or blinking is error)	
	STOP LED	Check whether it is LED Off in RUN state	Blinking is error	
	Input LED	Check whether LED On or Off	LED On with input ON and LED Off with input off	
	Output LED	Check whether LED On or Off	LED On with output ON and LED Off with output off	

8.3 Periodic Inspection

Check the following items once or twice every six months and take necessary actions.

Checklist		Check method	Judgment basis	Actions
Environment	Temperature	Measure by thermometer/hygrometer	0 ~ 55 °C	Adjusting according to the general spec.(environmentmental condition in the panel)
	Humidity		5 ~ 95%RH	
	Contamination level	Measure corrosive gas	Free of corrosive gas	
PLC status	Loose Module/shake	Try to carefully feel the movement of each module	Must be firmly attached	Tightening
	Built-in dust/impurities	Visual inspection	No built-in dust/impurities	-
Connector status	Loose connector	Tightening with a screwdriver	No loosened screws	Tightening
	Proximity of clamped terminal	Visual inspection	Proper spacing	Rearrangement
	Loosened connector	Visual inspection	No looseness	Tightening connector screws
Check power voltage		Check the voltage of input terminal by using a multimeter	AC100~240V:AC 85~ 264V DC24V:DC19.2 ~ 28.8V	Change the power supply

Battery	Check the battery replacement timing and voltage drop	• Check the total interruption time and warranty period • No battery voltage drop display	A battery must be replaced, if the warranty period has expired despite no display.
Fuse	Visual inspection	• No fuse blown condition	To be replaced regularly because element may have deteriorated due inrush current.

9. Troubleshooting

The chapter describes types of potential errors that occur while operating the system, causes of errors, how to detect them, and corrective measures.

9.1 Basic Troubleshooting Procedure

To improve the reliability of a system, it is important to take corrective measures promptly, when a trouble/fault occurs. To recover the system from the fault immediately, it is most important to quickly detect the potential causes of a fault and take corrective measures. To troubleshoot the system correctly, ensure the following cautions and procedures.

1. Check the following manually.
    a) Operation status (Stop and Run).
    b) Power On/Off status.
    c) I/O device status.
    d) Wiring status (I/O wiring, extension and communication cable).
    e) The status of each display (POWER LED, RUN/STOP LED, I/O LED, and any other status display), connect to peripherals, and check the operation condition and program.
2. Check for any abnormality

Observe how a fault changes by executing the followings.

    a) Move the key switch to STOP and turn it On/Off.

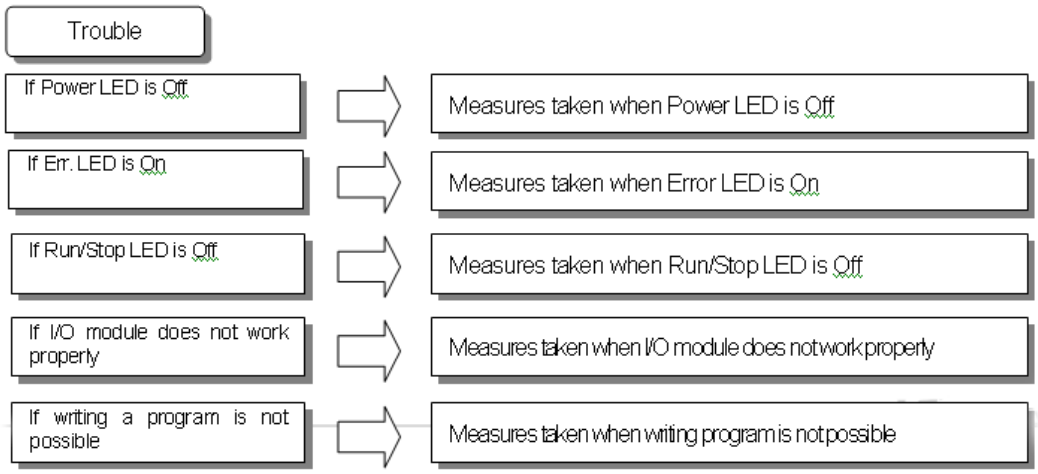
3. Restricting Range

Estimate by which factor, a fault occurs by the following methods:

    a) Is it from the PLC or external factor?
    b) I/O module or others?
    c) PLC program?

9.2 Troubleshooting

The following section illustrates how to troubleshoot a fault in the PLC. This section describes the troubleshooting scenarios, common faults, and error codes associated with the PLC.



Action when POWER LED is OFF

This section describes the sequence of steps to be taken, if the POWER LED is Off.

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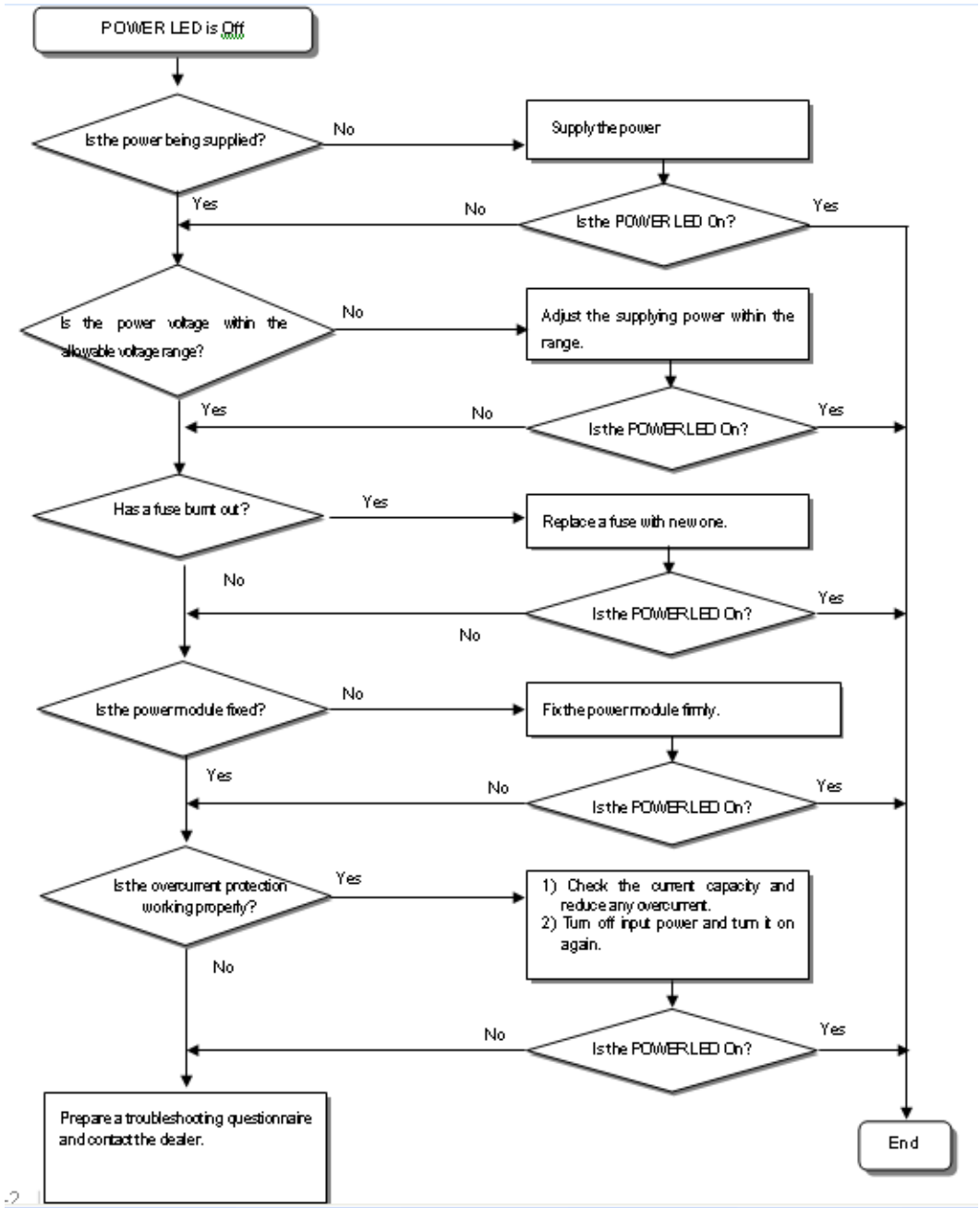
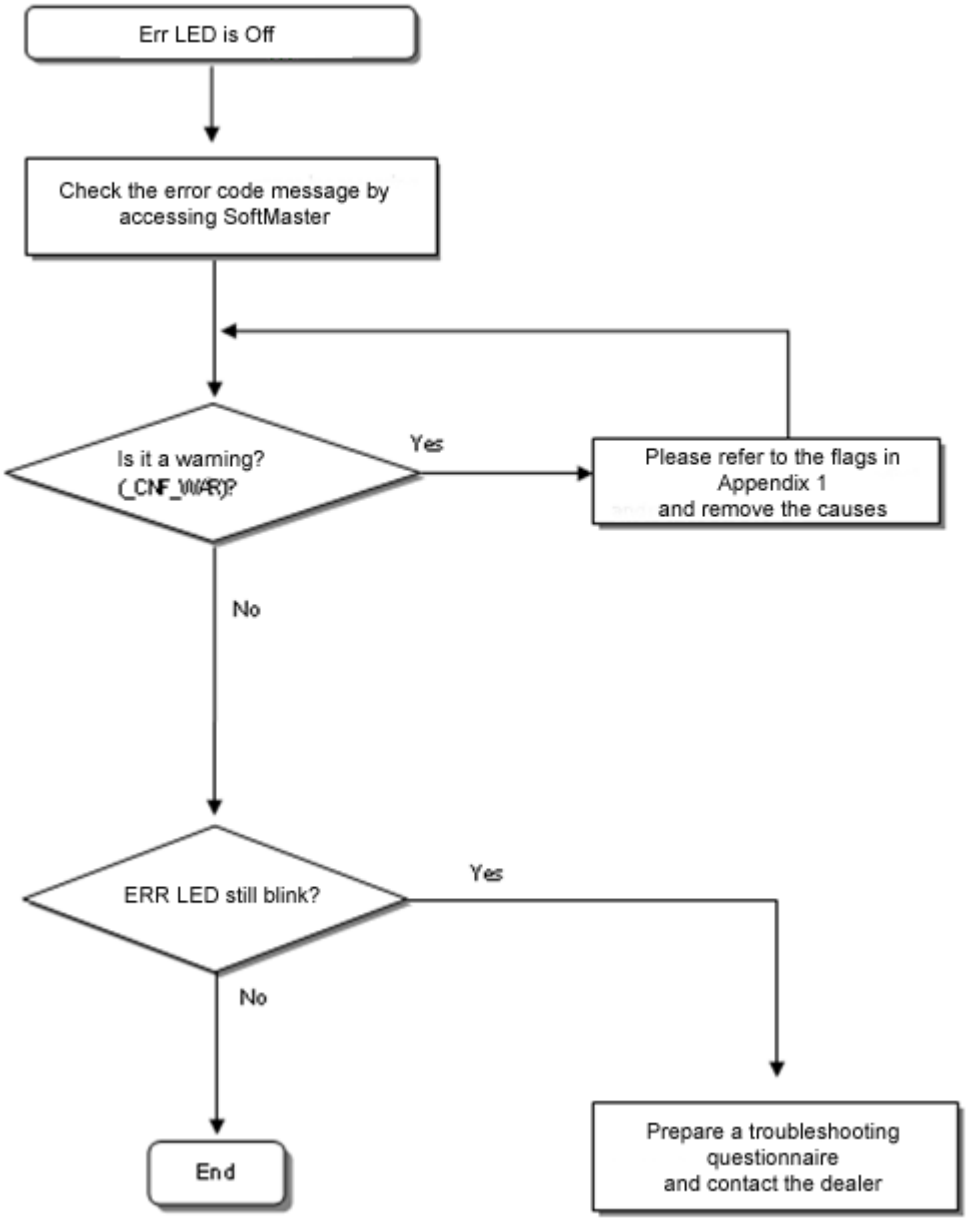

POWER LED is Off
Is the power being supplied?
No
Supply the power
Yes
No
Is the POWER LED On?
Yes
Is the power voltage within the allowable voltage range?
No
Adjust the supplying power within the range.
Yes
No
Is the POWER LED On?
Yes
Has a fuse burnt out?
Yes
Replace a fuse with new one.
No
Is the POWER LED On?
Yes
No
Is the power module fixed?
No
Fix the power module firmly.
Yes
No
Is the POWER LED On?
Yes
Is the overcurrent protection working properly?
Yes
1) Check the current capacity and reduce any overcurrent.
2) Turn off input power and turn it on again.
No
No
Is the POWER LED On?
Yes
Prepare a troubleshooting questionnaire and contact the dealer.
End

Action when ERR. LED is ON

This section describes the sequence of steps to be taken if the ERR. LED is ON.

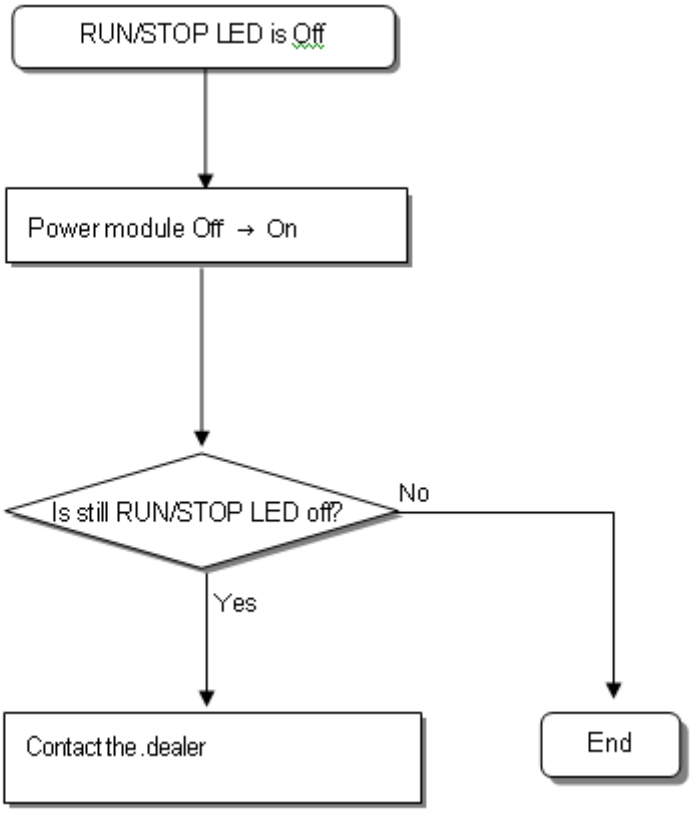

Err LED is Off
Check the error code message by accessing SoftMaster
Is it a warning? (_CNF_WAR)?
Yes
Please refer to the flags in Appendix 1 and remove the causes
No
ERR LED still blink?
Yes
No
End
Prepare a troubleshooting questionnaire and contact the dealer

ATTENTION

If warning error occurs, the PLC system does not stop but it is necessary to check the warning message and take a corrective action. Or it may cause an error.

Action when RUN/STOP LED is Off

This section describes the sequence of steps to be taken if RUN/STOP LED is OFF.

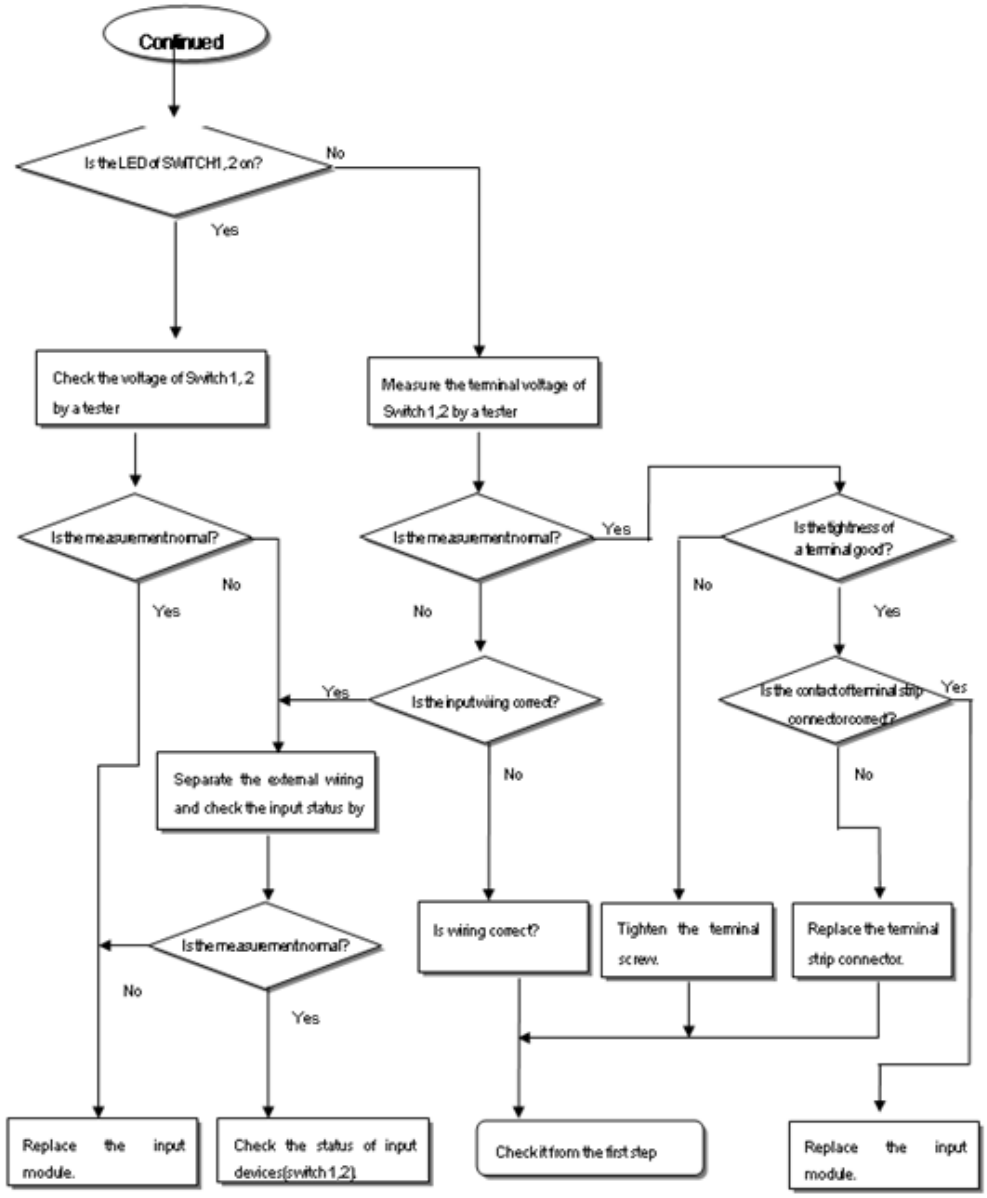


Action when I/O module does not function properly

The following points describe the procedure to be followed when I/O Module does not function normally during operation, as shown in the following program example.

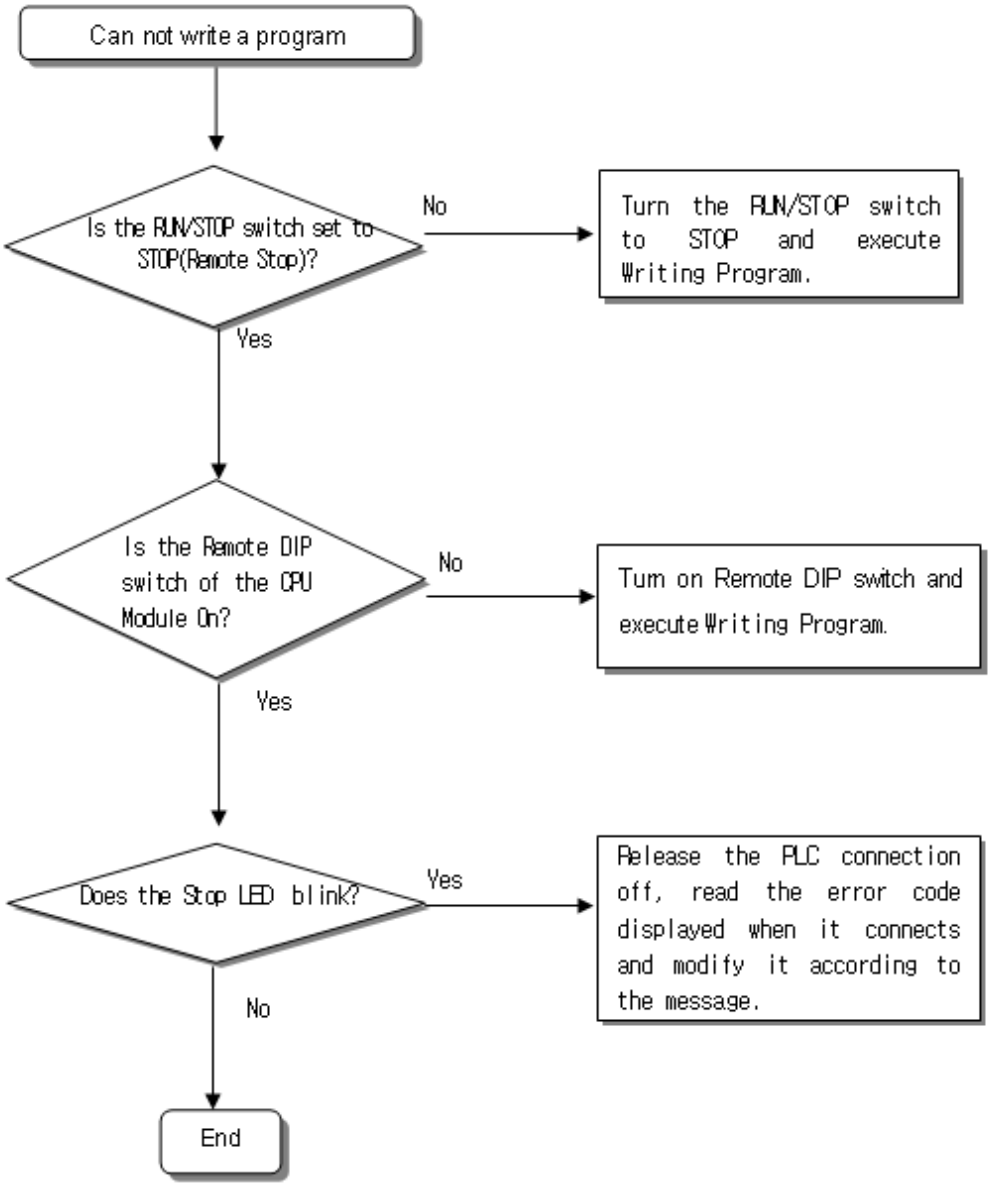

SWITCH1
SWITCH2
SOL1
SOL1


If IO module does not function normally
SOL1 OutputLED is On?
No
Yes
Measure the terminal voltage of SOL1 by tester
Correct the wiring.
Replace the terminal strip connector.
Monitor the status of SOL1 by SoftMaster
Is the measurement normal?
No
Is the output wiring correct?
No
Is the contact of terminal strip connector fine?
No
Yes
Is it normal?
No
Yes
Continued
Yes
Separate the external wiring and check the power connection of the module output
Yes
Is it normal?
No
Check the status of output device(SOL1).
Replace the output module


Continued
Is the LED of SWITCH1,2 on?
No
Yes
Check the voltage of Switch 1, 2 by a tester
Measure the terminal voltage of Switch 1,2 by a tester
Is the measurement normal?
No
Yes
Is the measurement normal?
Yes
No
Is the tightness of a terminal good?
No
Yes
Is the input wiring correct?
Yes
No
Is the contact of terminal strip connector correct?
Yes
No
Separate the external wiring and check the input status by
Is the measurement normal?
No
Yes
Is wiring correct?
Tighten the terminal screw.
Replace the terminal strip connector.
Replace the input module.
Check the status of input devices(switch 1,2).
Check it from the first step
Replace the input module.

Action when Writing a Program to the CPU fails

Use the following sequence of steps when writing a program to the CPU Module fails.



9.3 Error Codes List

Error Codes during CPU Operation

Error Code	Causes	Measures (Restart mode after the measure)	Operation status	LED status	Diagnostic timing
2	Abnormal Data Bus	Contact A/S service, if it still exists after turning it on again.	Fault	Blink according to LED orders	When turning it ON
3	Abnormal Data RAM	Contact A/S service,,if it still exists after turning it on again.	Fault	Blink according to LED orders	When turning it ON
4	Abnormal Click IC(RTC)	Contact A/S service, if it still exists after turning it on again.	Fault	ERR : On	When turning it ON
6	Abnormal program memory	Contact A/S service, if it still exists after turning it on again.	Fault	ERR : On	When turning it ON
10	Abnormal USB IC	Contact A/S service, if it still exists after turning it on again.	Fault	ERR : On	When turning it ON
11	Abnormal backup RAM	Contact A/S service, if it still exists after turning it on again.	Fault	ERR : On	When turning it ON
12	Abnormal backup Flash	Contact A/S service, if it still exists after turning it on again.	Fault	ERR : On	When turning it ON
13	Abnormal base information	Contact A/S service, if it still exists after turning it on again.	STOP	ERR : On	When turning it ON changing to RUN mode
22	The program of backup flash is defective.	Restart after modifying the program of the backup flash.	Fault	ERR : On	Reset changing to RUN mode

Error Code	Causes	Measures (Restart mode after the measure)	Operation status	LED status	Diagnostic timing
23	The program to execute is not normal.	Operate after the program is reloaded. Replace a battery, in case of abnormal battery. After a program is reloaded, check the storage condition and if any fault is found, replace the CPU module.	STOP	ERR : On	Reset changing to RUN mode
24	Abnormal I/O parameter	Restart after I/O parameter is reloaded. Replace a battery, in case of defective battery. After I/O parameter is reloaded, check the storage condition and if any fault is found, replace the CPU module.	STOP	ERR : On	Reset changing to RUN mode
25	Abnormal basic parameter	Restart after basic parameter is reloaded. Replace a battery in case of defective battery. After basic parameter is reloaded, check the storage condition and if any fault is found, replace the CPU module.	STOP	ERR : On	Reset changing to RUN mode
30	The module set in configuration and the installed module do not match.	Check the wrong slot position in SoftMaster, modify a module slot position or configuration and then, restart. Reference flag: "Module type inconsist"error flag.	STOP (RUN)	ERR : On (P.S. : On)	Changing to RUN mode
31	Module removal or module addition during operation	Check any removed/added slot position in SoftMaster. Modify the installed slot and restart (according to the configuration). Reference flag: Module attachment error flag.	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
32	Fuse of a module blown during operation	Check the position of a slot of where fuse has blown out in the SoftMaster. Replace the fuse and restart (as per the configuration). Reference flag: Fuse disconnection error flag.	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
33	IO module data cannot be successfully accessed during operation	Check the position of a slot with access error in SoftMaster. Replace the fuse and restart (as per the configuration). Reference flag: I/O Module Write/Read error flag.	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
34	Special/link module data cannot be successfully accessed during operation	Check the position of a slot with access error in SoftMaster. Replace the module and restart (as per configuration). Reference flag: Special/Link Module interface error.	STOP (RUN)	ERR : On (P.S. : On)	When scan ends

Error Code	Causes	Measures (Restart mode after the measure)	Operation status	LED status	Diagnostic timing
39	CPU is suddenly abnormal	System is suddenly abnormal due to noise or abnormal hardware. 1) Contact A/S service, if it still exists after turning it ON again. 2) Develop methods to prevent noise.	STOP	RUN: On ERR : On	Always
40	The scan time of a program exceeds the scan delay watchdog time designated by parameter during operation	Check the scan delay watchdog time designated by parameter, modify parameter or program and restart.	STOP	RUN: On ERR : On	When program is executed
41	Operation error while executing user program	To eliminate an operation error → reload the program and restart. If STOP: Check the details of operation error by the SoftMaster and modify the program. If RUN: Refer to the error steps in %F address/memory area.	STOP (RUN)	ERR : On (CHK: blink)	When program is executed
42	Exceeding the specified stack range during program	Restart	STOP	RUN: On ERR : On	When program is executed
44	Use of Timer Index error	Modify the timer index program, reload and start.	STOP (RUN)	RUN: On ERR : On	When scan ends
50	Error due to external device is detected by a user program during operation	Repair a fault device by referring to error detection flag of external device and restart (according to parameter).	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
60	E_STOP function execution	Eliminate the causes of error operating E_STOP function in the program and turn it on again.	STOP	RUN: On ERR : On	When program is executed
500	Data memory backup is not possible	Turn it on again, if battery is normal. It changesto STOP mode in Remote Mode.	STOP	ERR : On	Reset
501	Abnormal clock data	Reset the time by SoftMaster, if battery is normal.	-	CHK: On	Always

Error Code	Causes	Measures (Restart mode after the measure)	Operation status	LED status	Diagnostic timing
502	Low battery voltage	Replace a battery when the power ON.	-	BAT: On	Always

ATTENTION

- Error No. 2 through 13 from “Error Codes during CPU Operation” can be checked at the A/S Service Center.
- The other errors from 22 and above can be checked by using the error log of SoftMaster.

10. Appendix 1

10.1 Flag List

The Flags of Operation Mode and State Flags

Flags Name	Type	Address	Contents	Description
_SYS_STATE	DWORD	%FD0	PLC Mode and operation state	Indicates PLC mode and operation state of the system.
_RUN	BOOL	%FX0	Run	Run state
_STOP	BOOL	%FX1	Stop	Stop state
_ERROR	BOOL	%FX2	Error	Error state
_DEBUG	BOOL	%FX3	Debug	Debug state
_LOCAL_CON	BOOL	%FX4	Local control	Indicates operation mode changeable state, only by the Mode key and SoftMaster.
_REMOTE_CON	BOOL	%FX6	Remote Mode On	The Remote control mode
_RUN_EDIT_ST	BOOL	%FX8	Editing during Run	Editing program download during Run.
_RUN_EDIT_CHK	BOOL	%FX9		Internal edit processing during Run.
_RUN_EDIT_DONE	BOOL	%FX10		Edit is done during Run.
_RUN_EDIT_NG	BOOL	%FX11		Edit ends abnormally during Run.

Flags Name	Type	Address	Contents	Description
_CMOD_KEY	BOOL	%FX12	Operation mode change	Operation mode changed by key.
_CMOD_LPADT	BOOL	%FX13		Operation mode changed by local PADT.
_CMOD_RPADT	BOOL	%FX14		Operation mode changed by Remote PADT.
_CMOD_RLINK	BOOL	%FX15		Operation mode changed by Remote communication module.
_FORCE_IN	BOOL	%FX16	Forced Input	Forced On/Off state of input contact.
_FORCE_OUT	BOOL	%FX17	Forced Output	Forced On/Off state of output contact.
_SKIP_ON	BOOL	%FX18	Input/Output Skip	I/O Skip on execution.
_EMASK_ON	BOOL	%FX19	Fault mask	Fault mask on execution.
_MON_ON	BOOL	%FX20	Monitor on execution	Monitor on execution.
_USTOP_ON	BOOL	%FX21	Stopped by STOP function	Stopped after scan completion by ‘STOP’ function while RUN mode operation.
_ESTOP_ON	BOOL	%FX22	Stopped by ESTOP function	Instantly stopped by ‘ESTOP’ function during RUN mode operation.
_INIT_RUN	BOOL	%FX24	Initialization task on execution	User defined Initialization program on execution.

Flags Name	Type	Address	Contents	Description
_PB1	BOOL	%FX28	Program Code 1	Selected program code 1.
_PB2	BOOL	%FX29	Program Code 2	Selected program code 2.
_RTC_WR	BOOL	%FX16384	RTC data writing	RTC data writing.
_SCAN_WR	BOOL	%FX16385	Scan value initialization	Initialize the scan value.
_CHK_ANC_ERR	BOOL	%FX16386	Request of the external fatal fault	Request of fatal fault detection from the external device.
_CHK_ANC_WAR	BOOL	%FX16387	Request of the external non-fatal fault	Request of non-fatal fault detection from the external device.
_INIT_DONE	BOOL	%FX16400	Initialization task execution completion	If this flag is set by user's initial program, it starts the execution of scan program, after initial program completion.
_KEY	DWORD	%FD43	Current key state	Indicates current state of local key.

System Error Flags

Flags Name	Type	Address	Contents	Description
_CNF_ER	DWORD	%FD1	System error(fatal fault error)	Handles error flags about non-operation fault error as per the following errors.

Flags Name	Type	Address	Contents	Description
_IO_TYER	BOOL	%FX33	Error when Module type mismatched	Representative flag displayed when I/O.configuration parameter for each slot is not matched with actual module configuration or a specific module is applied in the wrong location. (Refer to "_IO_TYER_N, _IO_TYER[n]")
_IO_DEER	BOOL	%FX34	Module detachment error	Representative flag displayed, when the module configuration for each slot is changed while running. (Refer to "_IO_DEER_N, _IO_DEER[n]")
_FUSE_ER	BOOL	%FX35	Fuse cutoff error	Representative flag displayed, when the fuse of module blows out. (Refer to "_FUSE_ER_N, _FUSE_ER[n]")
_IO_TYER_N	UINT	%FW90	Slot number of mismatched module type	When I/O configuration for a slot does not match with the inserted module (module in the wrong position), this flag is displayed as the lowest slot number after detecting the mismatch error.
_IO_DEER_N	UINT	%FW91	Slot number of module detached	When the slot module configuration is changed while PLC is running, this flag is displayed as the lowest slot number after detecting the detach error.

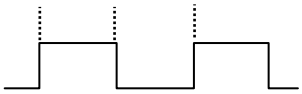
Flags Name	Type	Address	Contents	Description
_FUSE_ER_N	UINT	%FW92	Fuse of the slot number blown out.	When a fuse equipped to module blows out, this flag is displayed as the lowest slot number after detecting the error.
_ANNUM_ER	BOOL	%FX38	Fatal fault detection error in external device	Representative flag displayed, when the fatal fault error detected by the user program is recorded in "_ANC_ERR[n]".
_BPRM_ER	BOOL	%FX40	Basic parameter error	Basic parameter error
_IOPRM_ER	BOOL	%FX41	I/O parameter error	I/O parameter error
_SPPRM_ER	BOOL	%FX42	Special module parameter error	Special module parameter error
_CPPRM_ER	BOOL	%FX43	Communication module parameter error	Communication module parameter error
_PGM_ER	BOOL	%FX44	Program error	Indicates that there is a problem with user-made program checksum.
_CODE_ER	BOOL	%FX45	Program code error	Indicates that while user program is running, the program code cannot be interpreted.
_SWDT_ER	BOOL	%FX46	CPU abnormal ends.	Displayed when the saved program is corrupted by an abnormal end of CPU or the program cannot function.
_BASE_POWER_ER	BOOL	%FX47	Power error	Indicates that base power is abnormal.
_WDT_ER	BOOL	%FX48	Scan watchdog error	Indicates that the scan program time exceeds the scan watchdog time specified by a parameter.

System Warning Flags

Flag Name	Type	Address	Contents	Description
_CNF_WAR	DWORD	%FD2	System warning	Representative flag displayed as the system warning.
_RTC_ER	BOOL	%FX64	RTC error	Indicates that RTC data is abnormal.
_TASK_ER	BOOL	%FX68	Task collision	If two or more tasks collide during execution
_BAT_ER	BOOL	%FX69	Battery error	Error in the battery state.
_ANNUM_WAR	BOOL	%FX70	External device fault	The non-fatal fault in the external device is detected.
_BASE_INFO_ER	BOOL	%FX49	Base information error	Base information error
_HS_WARn	BOOL	%FX928	High speed link parameter error	High speed link parameter error
_P2P_WARn	BOOL	%FX944	P2P parameter error	P2P parameter error
_CONSTANT_ER	BOOL	%FX92	Fixed cycle fault	Fixed cycle fault.
_ANC_ERR	UINT	%FW1026	Fatal fault information of external device	Fatal fault of external device is detected by the user program, and that error is saved at this zone, as numbers which can identify 16 error types.
_ANC_WAR	UINT	%FW1027	Non-fatal fault information of external device	Non-fatal fault in external device is detected by the user program, and the bit position of the occurred error is displayed as an integer in the occurrence order.

User's Flags

Flag Name	Type	Address	Contents	Description

Flag Name	Type	Address	Contents	Description
_T20MS	BOOL	%FX144	20ms cycle clock	Clock signal used in a user program reverses On/Off per a half cycle. Use the clock signal longer than PLC scan time. Clock signal starts from Off condition, when initialization program starts or when scan program starts. _T100ms clock example 50ms 50ms 
_T100MS	BOOL	%FX145	100ms cycle clock	
_T200MS	BOOL	%FX146	200ms cycle clock	
_T1S	BOOL	%FX147	1s cycle clock	
_T2S	BOOL	%FX148	2s cycle clock	
_T10S	BOOL	%FX149	10s cycle clock	
_T20S	BOOL	%FX150	20s cycle clock	
_T60S	BOOL	%FX151	60s cycle clock	
_ON	BOOL	%FX153	Ordinary time On	Always On state flag, used while writing the user program.
_OFF	BOOL	%FX154	Ordinary time Off	Always Off state flag, used while writing the user program.
_1ON	BOOL	%FX155	1’st scan On	Use only 1’st scan On after operation start.

Flag Name	Type	Address	Contents	Description
_1OFF	BOOL	%FX156	1'st scan Off	Only 1'st scan Off after operation start. For all further scans, it is ON.
_STOG	BOOL	%FX157	Reversal every scan	On/Off reversed flag per every scan when user program is working. (On state for first scan)

Operation result flags

Flags Name	Type	Address	Contents	Description
_ERR	BOOL	%FX176	Operation error flag	Operation error flag on the basis of Operation Function (FN) or Function Block (FB), is renewed every time the operation works.
_LER	BOOL	%FX181	Operation error latch flag	Operation error latch flag on the basis of Program Block (PB). The error indication which occurs while program block is running continuously until the end of the program.It is possible to delete the same in the program.
_ARY_IDX_ERR	BOOL	%FX28864	Overflow error flag array index range	Error flag displayed when exceeding the setting array numbers.
_ARY_IDX_LER	BOOL	%FX28896	Overflow error latch flag array index range	Error latch flag displayed when exceeding the setting array numbers.
_ALL_OFF	BOOL	%FX179	All output Off	Use "On", only when all outputs are "Off".

The flags of the information of the system operation state

Flags Name	Type	Address	Contents	Description
_CPU_TYPE	UINT	%FW44	CPU Type Information.	Indicates the operation mode and operation State information.
_CPU_VER	UINT	%FW45	CPU version	Indicates CPU version number.
_OS_VER	DWORD	%FD23	OS version	Indicates OS version number.
_OS_DATE	DWORD	%FD24	OS date	Indicates OS distribution date.
_SCAN_MAX	UINT	%FW50	Maximum scan time	Indicates maximum scan time during operation. Unit:0.1ms
_SCAN_MIN	UINT	%FW51	Minimum scan time	Indicates minimum scan time during operation. Unit:0.1ms
_SCAN_CUR	UINT	%FW52	Current scan time	Indicates current scan time during operation. Unit:0.1ms
_RTC_DATE	UINT	%FW136	Current date of RTC	Indicated on the basis of 1.Jan.1984.
_RTC_WEEK	UINT	%FW137	Current a day of the week of RTC	Indicates a day of the week. (0: Mon. 1: Tue. 2: Wed. 3: Thu. 4: Fri. 5: Sat. 6:Sun)
_RBANK_NUM	UINT	%FW158	Active block no.	Indicates active block no.
_CA_ERR_CNT	UINT		Service error count of block data	Increases when block data service is abnormal.

Flags Name	Type	Address	Contents	Description
_BUF_FULL_CNT	UINT		Full count of CPU internal buffer	Increases when CPU internal buffer is full.
_AC_F_CNT	UINT	%FW13	Indicates momentary shutdown times	Indicates the instant power off count during the RUN mode operation.
_FALS_NUM	UINT	%FW14	FALS no	Indicates the number of False No.

10.2 Appendix Link Flags (L) List

This Appendix describes the data link communication Flags (L).

Communication Flag List according to High speed link no.

Typical address ranges from %LX0 to %LX9471. For additionla information, see SoftMaster Global variables/address.

(High speed link no. 1 ~ 12)

No.	Keyword	Type	Contents	Description
High Speed LInk	_HSn_RLINK	Bit	High speed link parameter “n” normal operation of all station	Indicates the normal operation of all the stations, according to the parameter set in High speed link and the bit is ON, in the following conditions. 1. All stations set in parameter are in RUN mode and there is no error. 2. All data blocks set in parameter are communicated normally. 3. The parameter set in each station is communicated normally. Once RUN_LINK is ON, it continues to be ON, unless stopped by LINK_DISABLE.
	_HSn_LTRBL	Bit	Abnormal state after _HSn_RLINK ON	If _HSmRLINK flag is ON and if the communication state of the station set in the parameter and data block is as follows, this flag is also ON. 1. The station set in the parameter is not in RUN mode. 2. There is an error in the

No.	Keyword	Type	Contents	Description
				station set in the parameter. 3. The communication state of data block set in the parameter is not good. LINK TROUBLE is ON when the above three conditions are met. Once the the condition returns to normal state, it turns OFF again.
	_HSn_STATEk (k=000~127)	Bit Array	High speed link parameter “n”, k block general state	Indicates the general state of communication information for each data block of setting parameter. HS1STATEk=HS1MODk&_HS1TR X k&(~_HSnERRk)
	_HSn_MODk (k=000~127)	Bit Array	High speed link parameter “n”, k block station RUN operation mode	Indicates operation mode of station set in k data block of the parameter.
	_HSn_TRXk (k=000~127)	Bit Array	Normal communication with High speed link parameter “n”, k block station	Indicates if communication state of k data of parameter is communicated smoothly according to the setting.
	_HSn_ERRk (k=000~127)	Bit Array	High speed link parameter “n”, k block station	Indicates if errors occur in the communication state of k data block of parameter.

No.	Keyword	Type	Contents	Description
			operation error mode	
	_HSn_SETBLOCKk	Bit Array	High speed link parameter “n”, k block setting	Indicates whether or not to set k data block of parameter.

Communication Flag List according to P2P Service Setting

P2P parameter no.(n) : 1~8, P2P block(xx) : 0~63

No.	Keyword	Type	Address	Contents	Description
P2P	_P2Pn_NDRxx	Bit	%LX10000~%LX59056	P2P parameter n, xx Block service normal end	Indicates P2P parameter n, xx Block service normal end.
	_P2Pn_ERRxx	Bit	%LX10001~%LX59057	P2P parameter n, xx Block service abnormal end	Indicates P2P parameter n, xx Block service abnormal end.
	_P2Pn_STATUSxx	Word	%LW626~%LW3692	P2P parameter n, xx Block service abnormal end error Code	Indicates error code in case of P2P parameter n, xx Block service abnormal end.
	_P2Pn_SVCCNTxx	Double word	%LW627~%LW3693	P2P parameter n, xx Block service normal count	Indicates P2P parameter n, xx Block service normal count.
	_P2Pn_ERRCNTxx	Double word	%LW629~%LW3695	P2P parameter n, xx	Indicates P2P parameter n, xx Block service abnormal count.

No.	Keyword	Type	Address	Contents	Description
				Block service abnormal count	

10.3 Appendix Communication Flags (P2P) List

Link Register List according to P2P No.

P2P Parameter No. (n) : 1~8, P2P Block(xx) : 0~63

Flags	Type	Contents	Description
_PnBxxSN	Word	P2P parameter n, xx block another station no	Saves another station no. of P2P parameter 1, 00 block. In case of using another station no. at SoftMaster-NM, it is possible to edit while in RUN mode by using P2PSN command.
_PnBxxRD1	Device structure	Area device 1 to read P2P parameter n, xx block	Saves area device 1 to read P2P parameter n, xx block.
_PnBxxRS1	Word	Area size 1 to read P2P parameter n, xx block	Saves area size 1 to read P2P parameter n, xx block.
_PnBxxRD2	Device structure	Area device 2 to read P2P parameter n, xx block	Saves area device 2 to read P2P parameter n, xx block.
_PnBxxRS2	Word	Area size 2 to read P2P parameter n, xx block	Saves area size 2 to read P2P parameter n, xx block.
_PnBxxRD3	Device structure	Area device 3 to read P2P parameter n, xx block	Saves area device 3 to read P2P parameter n, xx block.

_PnBxxRS3	Word	Area size 3 to read P2P parameter n, xx block	Saves area size 3 to read P2P parameter n, xx block.
_PnBxxRD4	Device structure	Area device 4 to read P2P parameter n, xx block	Saves area device 4 to read P2P parameter n, xx block.
_PnBxxRS4	Word	Area size 4 to read P2P parameter n, xx block	Saves area size 4 to read P2P parameter n, xx block.
_PnBxxWD1	Device structure	Area device 1 to save P2P parameter n, xx block	Saves area device 1 to save P2P parameter n, xx block.
_PnBxxWS1	Word	Area size 1 to save P2P parameter n, xx block	Saves area size 1 to save P2P parameter n, xx block.
_PnBxxWD2	Device structure	Area device 2 to save P2P parameter n, xx block	Saves area device 2 to save P2P parameter n, xx block.
_PnBxxWS2	Word	Area size 2 to save P2P parameter n, xx block	Saves area size 2 to save P2P parameter n, xx block.
_PnBxxWD3	Device structure	Area device 3 to save P2P parameter n, xx block	Saves area device 3 to save P2P parameter n, xx block.
_PnBxxWS3	Word	Area size 3 to save P2P parameter n, xx block	Saves area size 3 to save P2P parameter n, xx block.

_PnBxxWD4	Device structure	Area device 4 to save P2P parameter n, xx block	Saves area device 4 to save P2P parameter n, xx block.
_PnBxxWS4	WORD	Area size 4 to save P2P parameter n, xx block	Saves area size 4 to save P2P parameter n, xx block.

ATTENTION

N area is set automatically while setting P2P parameter by using SoftMaster-NM. It can be modified while in RUN mode, by using P2P dedicated command.

N area has a different address classified according to P2P parameter setting no., block index. The area not used by P2P service as address is divided, can be used by internal device.

10.4 Appendix 1.4 Reserved Words

The following is a list of predefined words to be used in the system. These words must not be used as an identifier.

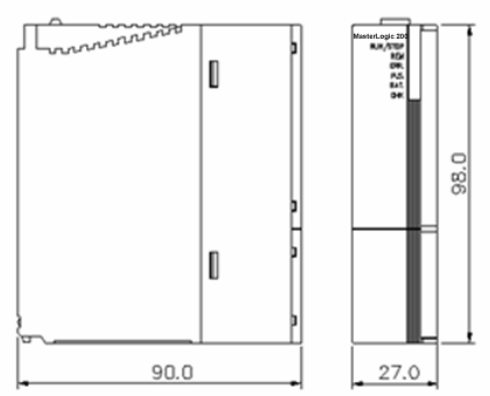
1. ACTION ... END_ACTION
2. ARRAY ... OF
3. AT
4. CASE ... OF ... ELSE ... END_CASE
5. CONFIGURATION ... END_CONFIGURATION
6. Name of Data Type
7. DATE#, D#
8. DATE_AND_TIME#, DT#
9. EXIT
10. FOR ... TO ... BY ... DO ... END_FOR
11. FUNCTION ... END_FUNCTION
12. FUNCTION_BLOCK ... END_FUNCTION_BLOCK
13. Names of Function Block
14. IF ... THEN ... ELSIF ... ELSE ... END_IF
15. OK
16. Operator (IL Language)
17. Operator (ST Language)
18. PROGRAM
19. PROGRAM ... END_PROGRAM
20. REPEAT ... UNTIL ... END_REPEAT
21. RESOURCE ... END_RESOURCE
22. RETAIN

23. RETURN
24. STEP ... END_STEP
25. STRUCTURE ... END_STRUCTURE
26. T#
27. TASK ... WITH
28. TIME_OF_DAY#, TOD#
29. TRANSITION ... FROM... TO ... END_TRANSITION
30. TYPE ... END_TYPE
31. VAR ... END_VAR
32. VAR_INPUT ... END_VAR
33. VAR_OUTPUT ... END_VAR
34. VAR_IN_OUT ... END_VAR
35. VAR_EXTERNAL ... END_VAR
36. VAR_ACCESS ... END_VAR
37. VAR_GLOBAL ... END_VAR
38. WHILE ... DO ... END_WHILE
39. WITH

11. Appendix 2 Dimensions (Unit: mm)

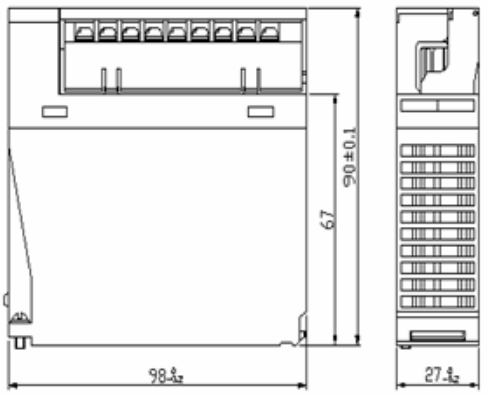
CPU Module

2MLI-CPUU

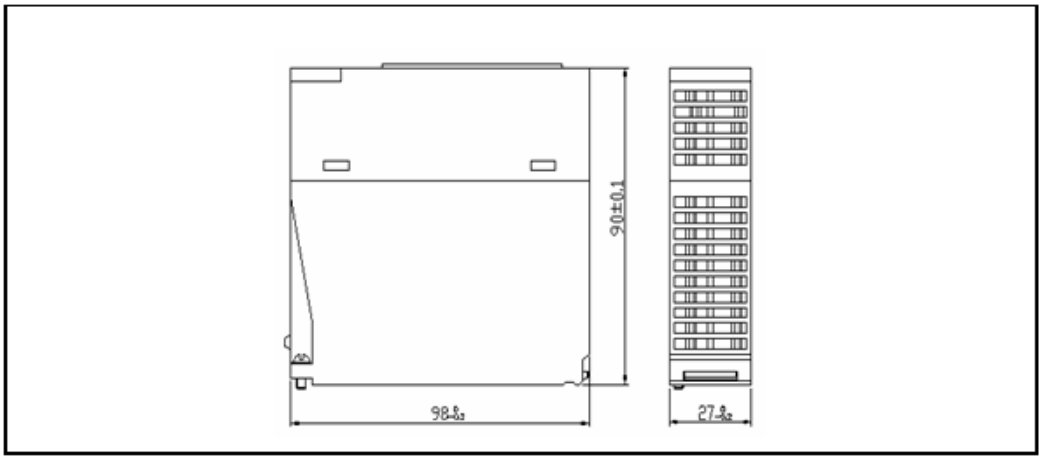


I/O Module

I/O Module (Terminal Block type)

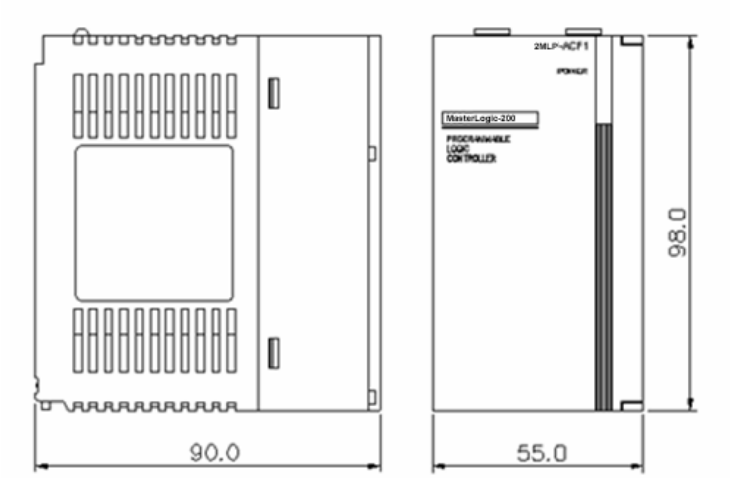


I/O Module connector type

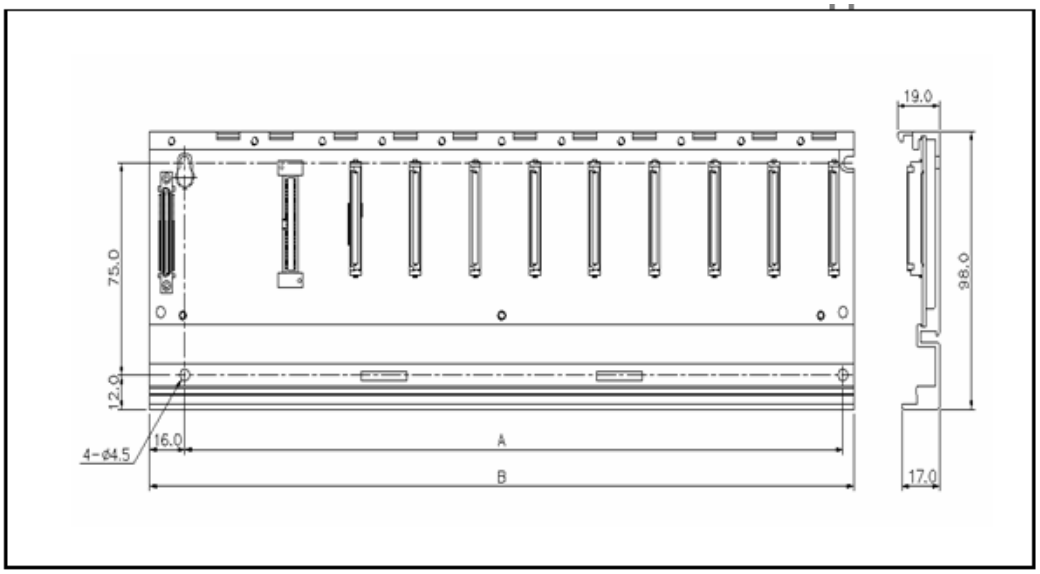


Power Module

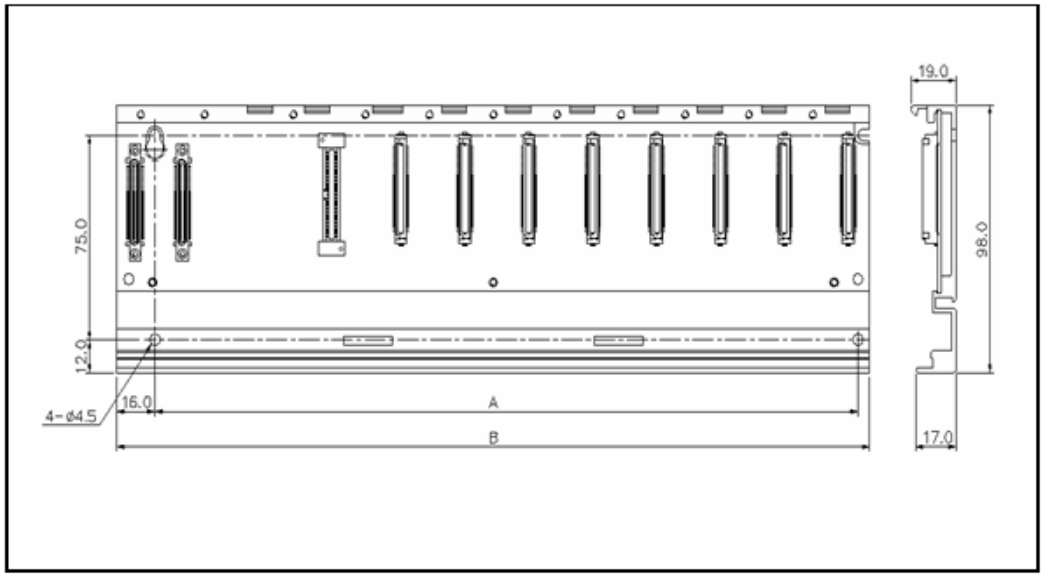
Power Module



Main/Expansion Base



Expansion Base



Classification	A	B
2MLB-M04A/2MLB-E04A	190	210
2MLB-M06A/2MLB-E06A	244	264
2MLB-M08A/2MLB-E08A	298	318
2MLB-M12A/2MLB-E12A	406	426