Honeywell

Honeywell Process Solutions

Programmable Logic Controller

MasterLogic-200R

User's Guide

2MLR-CPUH/T, F
2MLR-DBST, F, H
2MLR-M06P
2MLR-E12P
2MLR-AC12,13,22,23
2MLR-DC42
R200
April 2010

Release 200

Honeywell

Notices and Trademarks

Release 200 **April, 2010**

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About This Document

This document describes the specifications and procedures for installing, configuring, and programming the redundant system for the following CPU module models:

- 2MLR-CPUH/T, F
- 2MLR-DBST, F, H
- 2MLR-M06P
- 2MLR-E12P
- 2MLR-AC12,13,22,23
- 2MLR-DC42

ATTENTION

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

Other types of CPU for MasterLogic-200 PLC system are:

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

Release Information

Document Name	Document ID	Release Number	Publication Date
MasterLogic-200R User's Guide	MasterLogic-200R	200	April 2010

References

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

Document Title

Acronyms and Definitions

Acronym/Term	Definition
A/D	Analog to Digital Conversion
Base	The back plane of the PLC on which the power supply, communication, and other modules are installed. Examples: Main base and expansion base.
BCD	Binary Coded Decimal
Cold Restart	One of the CPU restart mode, 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 the IEC standard addressing notations with or without any variable name. They are: %I (input), %Q (output), and %M (internal flags and registers) variables. Address Examples: %IX0.0.2, %QW1.2.1, and %MD1234
FEnet	Fast Ethernet Network
FO	Fiber-Optic
Function	An operation unit that immediately provides the operation results for an input, such as four arithmetical operations and comparative operations.
Function Block	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

Acronym/Term	Definition
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 the regular scan programs. It consists of two types: • Timer Interrupt Task • Internal Flag Interrupt Task
KB	Kilobyte
KStep	Kilo Steps
LSB	Least Significant Bit
MB	Megabyte
ML-200	MasterLogic-200
Module	A standard component with a specific function to configure a system, such as the I/O board assembled that must 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.

Acronym/Term	Definition
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 and 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	One of the CPU restart mode which affects the variable parameters of the I/O image area when the CPU is restarted. With the CPU restart mode 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 completed within the time.

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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 MasterLogic-200R

MasterLogic-200R provides redundant configuration required in various applications. Using the same resources as MasterLogic-200 IEC CPU, you can easily configure the redundant system. This document lists the specifications, and the procedures for installing, handling, configuring, and programming the redundant system.

Redundancy types

The MasterLogic-200R offers the following types of redundancy.

- Redundant CPU
- Redundant Power Supply

Redundant module

Redundant Module consists of following:

- Two Redundant CPUs (CAT5 and Fiber Optic).
- Four Redundant Power Supplies (Standard and Enhanced) – AC100V, AC220V, and DC24V.
- Redundant Main Base (6 Slots: Allows six communication modules).
- Three Extension Drive Modules (CAT5, Fiber Optic, and Hybrid).

CPU module

- CPU Module consists of: IEC 61131-3 Language Support, Ladder Execution Speed of 42ns per Instruction, 1MB (128kstep) Program Capacity, and 131072 I/O points.
- 1 Giga Fiber Optic Communication for CPU Synchronization.
- Built-in Communication Master for Extension Drive.

Dedicated I/O network

- Dedicated I/O network consist of: Extension Drive Module
- Ring Topology (Bus Topology for single network failure)

- Fiber Optic, CAT5, and Hybrid Media
- 100Mbps Industrial Ethernet Technology
- Maximum I/O point : 23808 points (31 stations x 12 slots x 64 points)

Programming tool

Programming tool consists of following:

- SoftMaster for all MasterLogic PLC (ML50, ML200, ML200 IEC, and ML200R)
- IEC 61131-3 Language Support : LD, ST, SFC, and IL (View only)

Features

High-speed processing

- CPU Process Time : 42ns/Step (ML200R)
- High-Speed Back-Plane Speed : 20MB/s
- Maximum Control points: 131072 points
- Program Capacity: 7MB (including Upload, Parameter, System area)
- Long data type (64 bit) and high-speed real number operation (Single and Double)
- Switchover in minimum time: When errors occur, Master CPU Module Switchover happens within 50ms

Compact size

- Compact size enables compact cabinet size
- CPU Module: 55mm x 98mm x 90mm (W x H x D)
- Power Supply Module: 55mm x 98mm x 90mm (W x H x D)

Easy installation with network based extension

- Base extension with network cable
- Maximum 31 extension bases
- USB connection on extension base for program upload/download
- Communication Master module for Modbus and Profibus.

Easy maintenance with System Logs and Network Ring Topology

- System analysis with operation log, system log, and error log
- Single fault tolerant ethernet for network cable failure with network ring topology
- Network Monitoring and Protocol Monitoring
- Graphical monitoring of System Configuration
- Module Changing Wizard for module exchange during operation

Various communication features

- Easy interface with open protocol (Profibus and Modbus)
- 24 Communication Master Module in extension base
- Network diagnosis with network and frame monitoring
- Peer-to-peer communication between MasterLogic PLCs

Various types of digital I/O modules

- Around 8, 16, 32, 64 Input and Output Module (8 and 16 for Relay type)

Enhanced analog features

- Analog Output: Maximum Modules = 300, Maximum Points: 300∗8 = 2400 (includes memory restriction).
- Analog Input: Maximum Modules = 372, Maximum Points: 372∗8 = 2972 (not including AI 16 channel as it is not officially released).
- Isolated Analog modules and temperature sensing module for improved accuracy.
- Easy use of special parameter and flags.
- Enhanced Debugging function flag and data monitor, setting value modification by Special Monitor Window.

Other Features

- Program battery and flash memory backup
- Supports two restart modes (Warm and Cold)
- Management of task program

- Input/output forced ON/OFF
- Clock function
- Module switch on operation
- Fault mask function
- Module skip function
- Support operation log widely (System Log)
- Support detailed error factor (Error Log)
- LED Indication function : Operating information indication

PID Function

- Maximum 256 PID loops supported.
- Parameter setting using SoftMaster and Convenient Loop State monitoring through Trend Monitor.
- Easy configuration of Control Constants by improved Auto Tuning Function.
- Available Forward/Reverse Mixed Operation, support variety control modes like SV PID Control (2 Stages), CASCADE Control, and so on.

– Guarantee for stability like PV MAX, PV Change alarm, and so on.

2. Specifications

2.1 General specifications

<table>
<tr><th>Item</th><th colspan="5">Specifications</th><th>Related Standards</th></tr>
<tr><td>Ambient Temperature</td><td colspan="5">0 ~ 55°C</td><td></td></tr>
<tr><td>Storage Temperature</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="10">Vibration</td><td colspan="4">Occasional vibration</td><td>-</td><td></td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Pulse width</td><td>Sweep Count</td><td rowspan="9">IEC61131-2</td></tr>
<tr><td>10 ≤ f <57Hz</td><td colspan="2">–</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 colspan="2">9.8m/s^2 (1G)</td><td>–</td></tr>
<tr><td colspan="4">Continuous vibration</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Pulse width</td></tr>
<tr><td>10 ≤ f < 57Hz</td><td colspan="2">–</td><td>0.035mm</td></tr>
<tr><td>57 ≤ f ≤ 150Hz</td><td colspan="2">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>
<tr><td>Noise immunity</td><td>Square wave impulse noise</td><td colspan="4">±1500V</td><td>Internal Test Spec</td></tr>
</table>

Item	Specifications				Related Standards
	Electrostatic discharge	Voltage: 4kV (Contact discharge)			IEC61131-2 IEC61000-4-2
	Radiated electromagnetic field noise	27 ~ 500MHz, 10V/m			IEC61131-2, IEC61000-4-3
	Fast transient /Burst noise	Classification	Power supply	Digital/Analog Input/Output, Communication Interface	IEC61131-2 IEC61000-4-4
		Voltage	2kV	1kV	
Atmosphere	Free from corrosive gases and excessive dust				
Altitude	Less than 2000m				
Pollution degree	Less than 2				
Cooling method	Air-cooling				
Agency Certifications	CE 89/336/EEC, EMC Directive EN 50081-2, Emissions, Industrial EN 50082-2, Immunity, Industrial				

ATTENTION

IEC (International Electrotechnical Commission) – Is an international civil community that promotes international cooperation for the standardization of electric/electro technology. It publishes international standards and operates the related suitability assessment system.

Pollution Degree – Is an index to indicate the pollution degree of used environment that determines the isolation performance of the device. For example, pollution degree two means the state to occur the pollution of non-electric conductivity, 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 is 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, and Part 2 – Industrial Environment
- EN 50082- 2 EMC – Generic Immunity Standard, and 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 the 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/1800mAh
Warranty period/Battery Life	5 years (at ambient temperature)
Applications	Program/data backup and RTC operation (in case of power failure)
Dimensions	ϕ 17.0 X 33.5mm

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 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 MasterLogic-200R batteries are designed to use for more than 5 years in any environment.
- If the voltage of a battery dips, the CPU module shows a 'Battery Voltage Drop Warning'. You can check this from the CPU module LED and flag or error message in the SoftMaster and Experion System Alarm.
- The battery works for a limited amount of time, even after 'Battery Voltage Drop Warning' occurs. You are recommended to take some action after the warning, as a part 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 the sales service.

2.3 Performance specifications

CPU performance specifications

Item		Specifications		Remarks
		2MLR-CPUH/F	2MLR-CPUH/T	
Program execution methods		Cyclic scan, time-driven interrupts, and internal memory interrupts		
I/O control method		Scan synchronous batch processing I/O (refresh method)		Direct method by command is not supported.
Program language		Ladder Diagram, Sequential Function Chart, Structured Text, and Instruction List (view only)		
Number of instruction	Operator	18		
	Basic functions	130 + real number operation function		
	Basic function block	41		
	Dedicated function block	Special function blocks, process function blocks		
Processing speed (Basic instruction)	Normal	0.042μs/Step		
	MOV	0.112μs/Step		
	Real number operation	±: 0.602μs (S), 1.078μs (D) ÷: 1.106μs (S), 2.394μs (D) x: 1.134μs (S), 2.660μs (D)		S: Single real number D: Double real number
Program memory		3MB		Including upload program
Maximum number of I/O bases		31		
Maximum number of slots		372 (31 bases x 12 slots)		

Item		Specifications		Remarks
		2MLR-CPUH/F	2MLR-CPUH/T	
Maximum base I/O	Using 64 ch DI/DO module	23808 (64ch ∗ 372 slots)		
	Using 32 ch DI/DO module	11904 (32ch ∗ 372 slots)		
Maximum I/O extension distance per node		100m (CAT5), 2km (Fiber Optic)		
Maximum I/O memory		I : 131072, Q : 131072		
Data Memory Capacity	Input variable (I)	16KB		Input image area
	Output variable (Q)	16KB		Output image area
	Automatic Variable Area (A)	512KB (Maximum, 256KB retain settable)		
	Timer	No point limit Time Range: 0.001 ~ 429,967.295 seconds (1193 hours)		Occupying 20 bytes of automatic variable area per point
	Counter	No point limit Coefficient Range : -32768 ~ +32767		Occupying 8 bytes of automatic variable area per point
	Direct Variable	M, 256 KB (Maximum, 128 KB retain settable)		Fixed area variable
		R, 64KB x 2 blocks		64KB per block
		W, 128KB		Same area with R
	Flag	F, 4KB		System flag

Item		Specifications		Remarks
		2MLR-CPUH/F	2MLR-CPUH/T	
	Variables	K, 18KB (PID 256 loops)		PID flag
		L, 22KB		High-speed link flag
		N, 42KB		P2P flag
		U, 32KB (31 base, 16 slots, and 32 channels)		Analog refresh flag as VAR_GLOBAL
Program Type Allocation	INIT task	1 max		
	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, and so on.		
Built-in Program port		RS-232C(1CH)		Modbus slave supported through RS-232C port
		USB (1CH) @ 12MBPS		
		Note: Additional program connections through Ethernet and serial communication module (local or remote)		

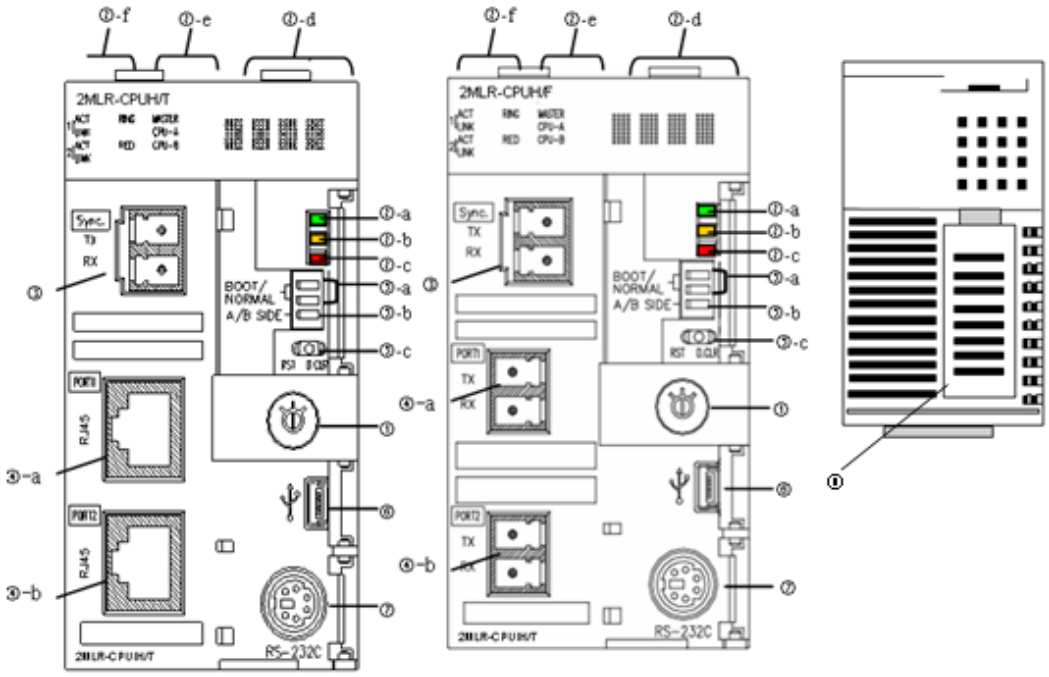
Item		Specifications		Remarks
		2MLR-CPUH/F	2MLR-CPUH/T	
Data storage method at power off		Retain area configuration through Basic parameters Retain setting of auto variable		
Redundancy Feature	Watchdog between CPUs	Sync cable and Ring-type I/O Network		
	Data backup between CPU	1Gbps fiber optic and maximum length 200m (recommended)		
	Synchronization method	Configured in redundancy parameter		
	Delay time for redundant operation	Proportional to data which master transmits to backup - Maximum 15ms -optimization available by user setting Basic 15ms + user designated amount (2kword) * 0.250ms/2kword		
	Master switching time	22ms		
	Operation delay in case of standby start	About 10% more than single operation scan time		
Internal consumption current (mA)		1310mA	980mA	
Weight		276g	257g	

Extended drive performance specifications

Items		Specification	
		100BASE-FX	**100BASE-TX**
Transmission Specification	Transmission method	Base band	
	Maximum extension distance between nodes	2km	100m
	Maximum number of nodes	31	
	Maximum protocol size	1516 byte	
	Communication access method	CSMA/CD	
	Frame error check method	CRC 32 = $X^{32} + X^{26} + X^{23} + ,,,,, + X^2 + X + 1$	
	Maximum mounted number	30	
Communication Media	Cable	Multi-mode fiber	FTP / STP / SFTP
	Transmission speed	100Mbps	
	Flow control	Full duplex	
	Communication port	2 isolated ports	
	Auto crossover	Cross/direct cable is supported (Recommend : cross cable)	
Network Topology		Ring, Line(Bus)	
Conversion Time	Ring → Line(Bus)	10ms	
	Line(Bus) → Ring	500ms	
Basic Specification	Dimensions(mm)	98(H) X 27(W) X 90(D)	
	Current consumption (mA)	DBSF : 850 / DBSH : 660 / DBST : 490	
	Weight (g)	DBSF : 102 / DBSH : 101 / DBST : 99	

Part names and functions – CPU

The Part names and functions of CPU are illustrated as below:



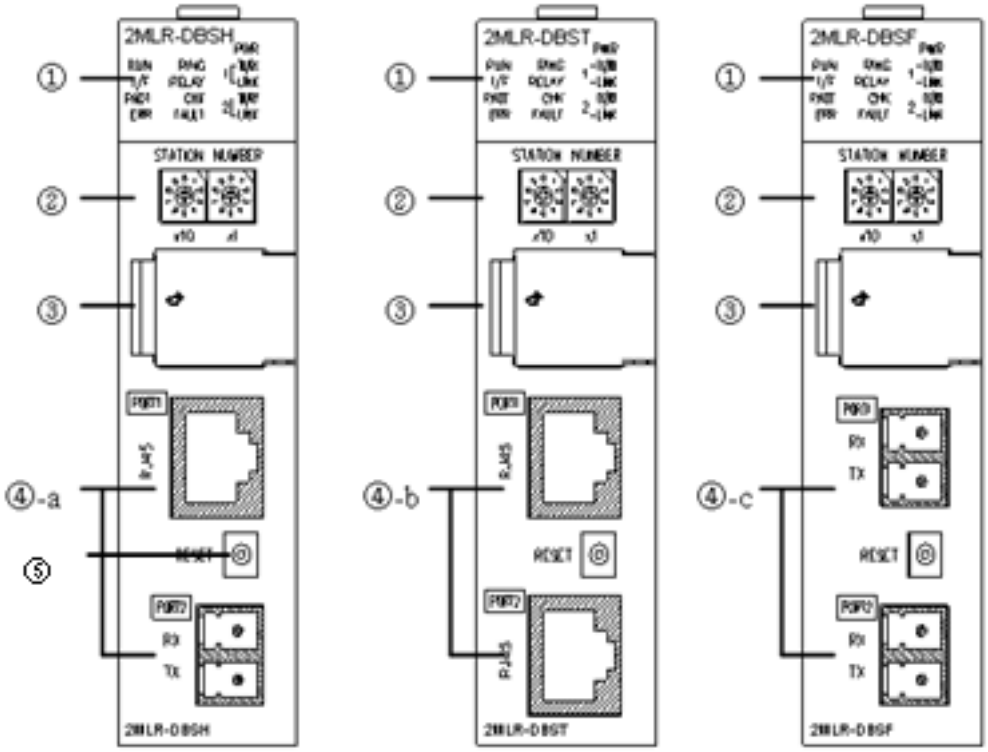
No.	Names	Description
①	Operation mode switch RUN/REM/STOP	• Operation mode of CPU module is configured by key switch. – RUN Mode : Program running – STOP Mode: Program stop – REM Mode : Operation mode can be set by the programming tool • When key switch is changed from RUN◊REM, STOP◊REM operation mode retains the previous mode. • When key switch is changed from REM◊RUN, REM◊STOP

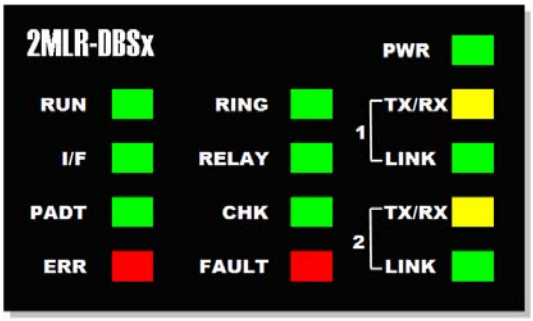
No.	Names	Description
		operation mode changes to the altered mode. • If key switch is not in REM mode, operation mode or program download is not allowed by the programming tool. However, monitoring and data changing are allowed.
②-a	RUN/STOP LED	Shows operation status of CPU module. • Green light: 'RUN' mode; the module is in operation. – 'RUN' operation by operation mode switch. – 'RUN' operation by programming tool with operation mode switch in 'REM'. • Red light: 'STOP' mode; the module is in operation. – 'STOP' operation by operation mode switch. – 'STOP' operation by programming tool with operation mode switch in 'REM'.
②-b	WAR LED	ON(YELLOW): Warning OFF: Normal
②-c	ERR LED	ON(RED): Critical Error OFF: Normal
②-d	BAT LED	Four digit display of the Operation Status (Refer to ML200R Error code) • Normal Operation • Warning • Error
②-e	Displaying redundant status	RED ON: Master/Backup CPU in redundant operation. RED OFF: Master/Backup CPU in single operation. MASTER ON: CPU is operating as Master. MASTER OFF: CPU is operating as Backup. CPU classification : CPU-A and CPU-B
②-f	Displaying extension	Displays communication status with expansion base.

No.	Names	Description
	network status	• ACT ON (YELLOW): Channel is in operation. • LNK ON (GREEN): Channel link is enabled. Channel 1 : ②-a and Channel 2 : ②-b • RING ON (GREEN): Ring topology is established in expansion network. • RING OFF: Ring topology is interrupted and runs in a bus condition or network is not established.
③	Sync. Connector	Interface connector between CPUs for monitoring and data sharing.
④-a ④-b	Connector for extension connector	Connector for expansion base • Two connectors for ring topology. • Two type of CPU for fiber optic and twist pair cable connection.
⑤-a	BOOT/NORMAL switch	O/S Download • ON(Right) : Normal Operation • OFF (Left): You must not use. (O/S Download mode) • Caution: Boot/Nor switch must be in ON condition. OFF mode may cause damage to modules.
⑤-b	A/B side switch (CPU position designation switch)	Switch to define CPU classification • CPU module is 'A', if the switch is set to the left. • CPU module is 'B', if the switch is set to the right. • Two CPU must have different settings (you can check it using software). • A same setting does not affect operation but may not operate in a normal way.
⑤-c	Reset/D. Clear switch	Resets CPU when switch is set to the left. • Left → Center: RESET • Left → more than 3s → Center: Overall RESET

No.	Names	Description
		Clears data when switch is set to the right. • Right → Center: clears memory area for M, auto-allocated retain, general data memory address. • Right → more than 3s → Center: Clears memory area for M, auto-allocated retain, General Data Memory Address and R Area • Caution: Data clear is only performed in 'STOP' mode.
⑥	USB Connector	Connection with Software (USB 1.1)
⑦	RS−232C Connector	Connection with other device • SoftMaster connection
⑧	Battery Cover	Cover for backup battery

Part names and functions – extension drive





No.	Names	Description
①	Module Status Display	Status LED for extension driver module 1) TX/RX ON(YELLOW): Channel is in operation 2) LINK ON(GREEN): Channel link is enabled Channel 1:a, Channel 2 :b 3) RING (GREEN) - ON : Ring topology is established in Expansion network. - BLINK : Ring is changed to Line topology. - OFF : Network is disconnected OR initially configured in line topology. 4) RELAY (GREEN) - ON : Neighboring module is connected. Acting as a data relay. - OFF: No neighboring module is connected. No data relay is established. 5) CHK (GREEN) - ON : Indicated in CPU WAR LED. - BLINK : Duplicate station number in a network (apart from own ID). 6) FAULT (RED) - ON : Duplicate station number in a network (self). - OFF : Frame error. 7) RUN (GREEN) - ON : CPU in RUN mode. - BLINK : Wait Status for CPU acknowledge. - OFF : CPU in STOP mode. 8) I/F (GREEN) - BLINK : Normal. - OFF : Connection not established. 9) PADT (GREEN) - ON : PADT Connection Established. 10) ERR (GREEN) - ON : CPU in ERROR status.
②	Base No. Switch	Switch to configure extension base number. • x10 : 10^{th} digit , x1 : single digit. • Maximum 31 expansion base. • Error LED is ON, if there are same base numbers or more than 31 bases.

No.	Names	Description
③	USB Connector	Connection with software (USB 1.1).
④	Connector for Expansion Network	Connector for expansion base. • Two connectors. • Three types of expansion module for fiber optic, twist pair cable, and hybrid connection.
⑤	Reset Switch for Expansion Driver Module	Resets expansion driver module. • Required when individual module must be reset. • Base must be skipped before the module is reset. – If the base is not skipped before reset, disconnection error occurs. – If base is not skipped before reset, module detach error occurs.

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 expected 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 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 that a product emits.	30~230 MHz QP : 50dBμV/m *1 230~1000 MHz QP : 57 dBμV/m
	EN55011 conducted noise	Measure the noise that a product emits to the power line.	150~500 kHz QP : 79dB Mean : 66dB 500~230 MHz QP : 73 dB Mean : 60dB
EN61131-2	EN61000-4-Electrostatic immunity	Immunity test allowing static electricity to the case of a device.	15kV Air discharge 8 kV Contact discharge
	EN61000-4-4 Fast transient burst noise	Immunity test allowing a fast noise to the power cable and signal cable.	Power line : 2kV Digital I/O : 1kV Analog I/O, signal lines : 1kV

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

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

A PLC is an open type device (a 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.

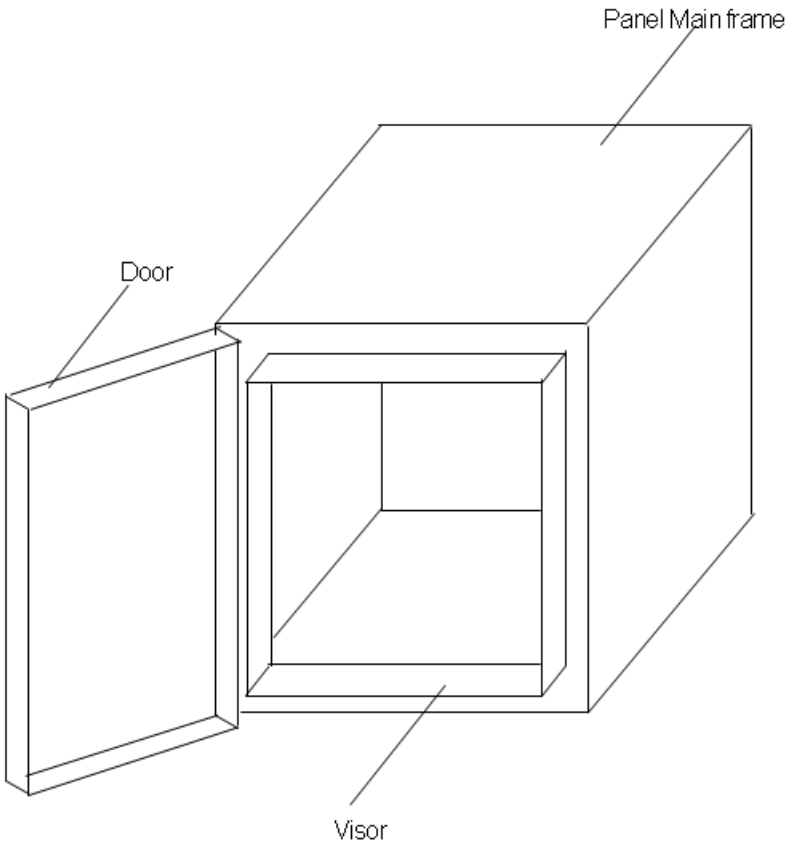
Control panel

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 Electro-Magnetic Interference (EMI).

Control panel specifications

The Masterlogic-200R 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 at least 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 the 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 the 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 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 as thick as possible.

Fixing a cable in the panel

While 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 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 conforms 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 machinery 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.

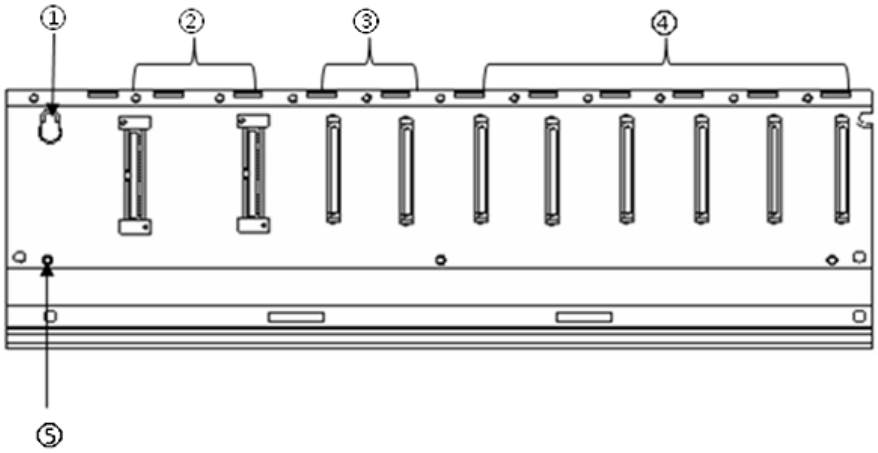
Selecting a MasterLogic-200 Series PLC

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

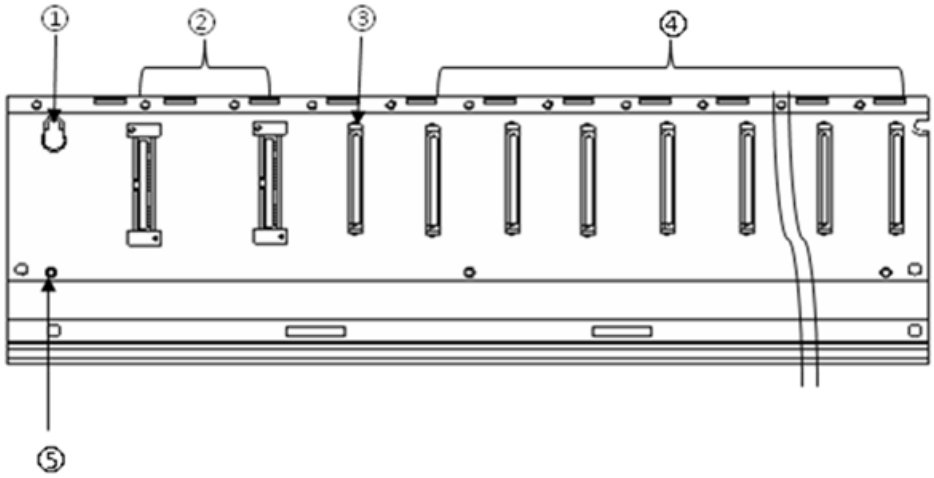
3.1 Parts and functions

Main base



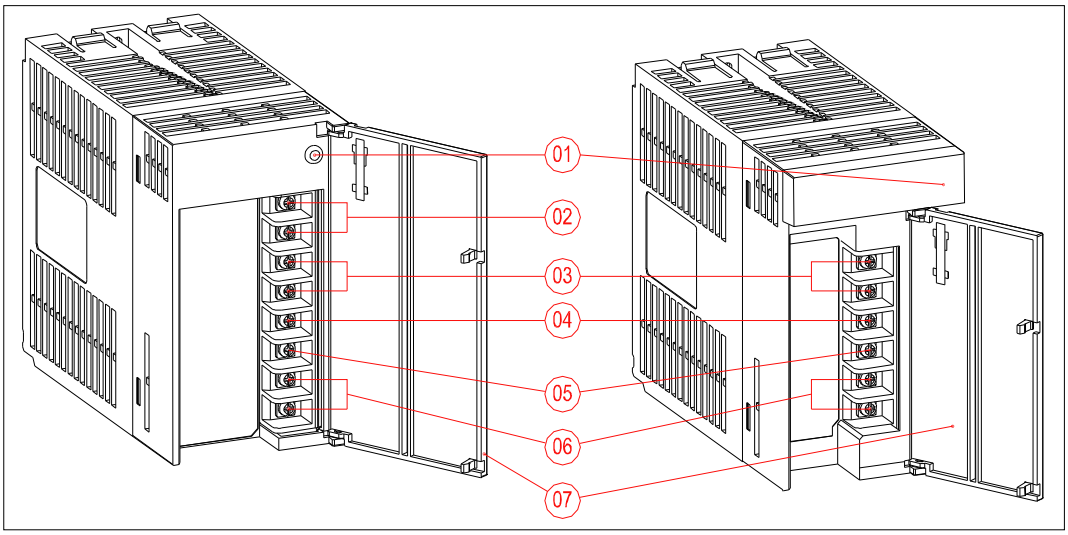
Index	Part	Function
1	Base attached guide hole	For attaching the main base to the panel in the control panel.
2	Power module connector	For installation of Power Supply module.
3	CPU module connector	For installation of CPU module (2 slots).
4	Module built-in connector	For installation of communication modules.
5	FG terminal	The ground terminal connected to the shielded pattern of PCB board.

Expansion base



Index	Part	Function
1	Base attached guide hole	For attaching the main base to the panel in the control panel.
2	Power module connector	For installation of power supply module.
3	Extension drive module connector	For installation of extension drive module.
4	Module built-in connector	For installation of I/O, special and other communication modules.
5	FG terminal	The ground terminal connected to the shielded pattern of PCB board.

Power module



Index	Part	Function
1	Power LED	DC5V power indication LED.
2	NC	Not used.
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. 2MLR-AC12, 2MLR-AC13 : AC110V 2MLR-AC22, 2MLR-AC23 : AC220V 2MLR-DC42: DC24V
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, and the Communication module. (Only Ethernet module is allowed in the main base.)

Model / Item	2MLR-M06P
Number of I/O modules installed	Six modules
Dimensions (mm)	346 X 98 X 19
Hole distance to attach panel	326 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)	0.34
Allowed Module	FEnet modules

Expansion base specifications

The expansion base consists of the Power module, Extension Drive module, I/O module, Special module, and the Communication module. (Ethernet module is not allowed in the Extension base.)

Item	Specification			Remarks
	2MLR-DBSF	***2MLR-DBST***	***2MLR-DBSH***	
Media	Optical	Electrical	Mixed	
Maximum distance between extension bases	Optical (2km)	Electrical (100m)	Optical (2km) Electrical (100m)	
Loader connection	Extension drive USB			
Range of station number	1~31 (other no will generate an error)			Number 0: not available
Install position	CPU parts(CPU0 connector) in extension base			
Weight (g)	99	100	102	

Synchronization cable

Model / Item	2MLC-F201	2MLC-F501
Length (m)	2	5
Weight (kg)		
Remarks	Multi mode fiber (maximum 2km)	

Extension cable

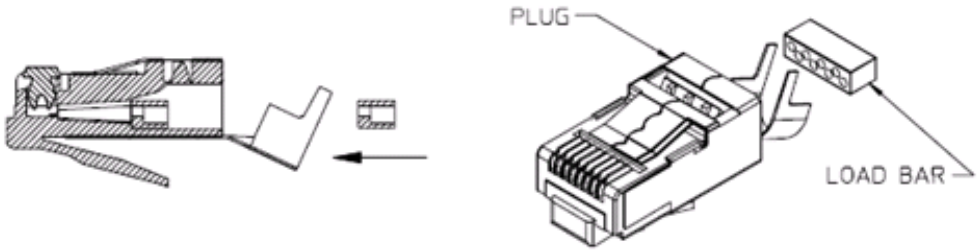
Extension cable is used for connecting the main base and extension bases. Two types of connection cables are available, RJ45 and fiber optic. Especially, for the CAT5 cable, the external noise may affect the system performance, as the data is separated into many micro bits. Hence, for ML200R, use the FTP cables and for the environment where external noises are expected, use the shielded twisted pair cables.

CAUTION	1) Keep the fiber optic cable within 2km between the nodes. 2) Keep the CAT5 cable within 100m between the nodes.

Connector for extension cable

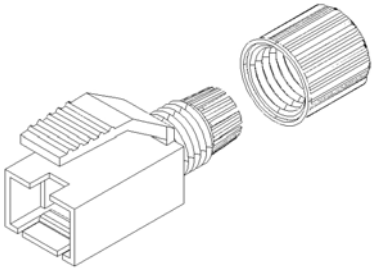
RJ45 extension cable should comply with EMC standards and should be FTP/STP/SFTP type. Use the following plug and fixed housing for the shield cable.

1) Connector plug



Type: RJ45 PLUG / INDUSTRIAL CAT6 (44915-0021)

2) Plug



Type (FTP): RJ45 PLUG protection cover (WRJ45-0702)

Type (STP/SFTP): RJ45 PLUG protection cover (WRJ45-0701)

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 the 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.)

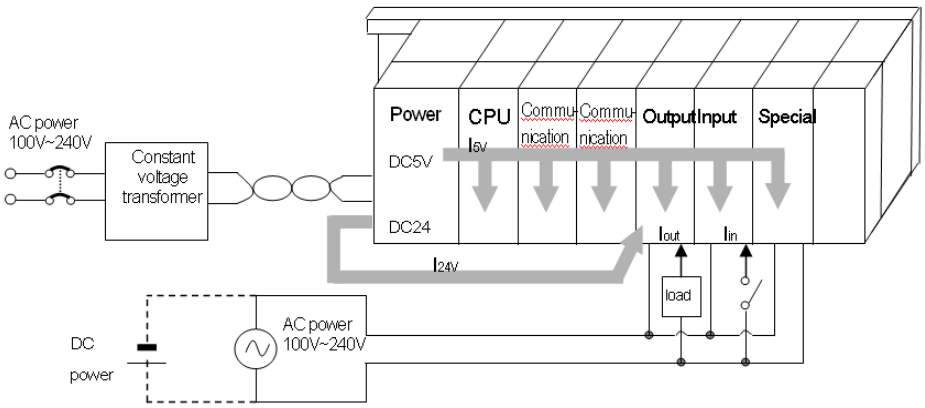
The system does not operate normally, if the rated output capacity of the power module exceeds the predefined limit.

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

Type	Model	Current Consumption (mA)	Type	Model	Current Consumption (mA)
CPU Module	2MLR-CPUH/T	1173	Analog Input Module	2MLF-AV8A	380
	2MLR-CPUH/F	1380		2MLF-AC8A	380
Extension Drive Module	2MLR-DBST	490		2MLF-AD8A	380
	2MLR-DBSF	850		2MLF-AD16A	330
	2MLR-DBSH	660		2MLF-AD4S	580
Digital Input Module (DC24V)	2MLI-D21A	20	Analog Output Module	2MLF-DV4A	190(250)
	2MLI-D22A	30		2MLF-DC4A	190(400)
	2MLI-D22B	30		2MLF-DV8A	190(250)
	2MLI-D24A	50		2MLF-DC8A	190(400)
	2MLI-D24B	50		2MLF-DC4S	200(200)

Type	Model	Current Consumption (mA)	Type	Model	Current Consumption (mA)
	2MLI-D28A	60			
	2MLI-D28B	60	Temperature Input Module	2MLF-TC4S	610
Digital Input Module (AC110V)	2MLI-A12A	30		2MLF-RD4A	490
Digital Input Module (AC220V)	2MLI-A21A	20			
Digital Output Module (Relay)	2MLQ-RY1A	250	High-Speed Counter Module	2MLF-HO2A	270
	2MLQ-RY2A	500		2MLF-HD2A	330
	2MLQ-RY2B	500	Position Module	2MLF-PO3A	400
Digital Output Module (Transistor)	2MLQ-TR2A	70		2MLF-PO2A	360
	2MLQ-TR2B	70		2MLF-PO1A	340
	2MLQ-TR4A	130		2MLF-PD3A	820
	2MLQ-TR4B	130		2MLF-PD2A	750
	2MLQ-TR8A	230		2MLF-PD1A	510
	2MLQ-TR8B	230			
Digital Output Module (Triac)	2MLQ-SS2A	300	Base Module	2MLR-M06P	220

Type	Model	Current Consumption (mA)	Type	Model	Current Consumption (mA)
Snet Module	2MLL-C22A	330		2MLR-E12P	220
	2MLL-C42A	300	FEnet Module	2MLL-EFMF	650
	2MLL-CH2A	340		2MLL-EFMT	420
Profibus-DP Module	2MLL-PMEA	560			
Fiber Ring Module	2MLL-ESHF	1200			



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		2MLR-AC12	2MLR-AC22	2MLR-AC13	2MLR- AC23	2MLR-DC42
Input	Rated input voltage	AC110V	AC220V	AC110V	AC220V	DC24V
	Input voltage range	85V~132V AC	176V~264V AC	85V~132V AC	176V~264V AC	19.2~28.8V DC
	Input frequency	50 / 60 Hz (47 ~ 63Hz)				-
	Maximum Input Power	110VA/42W	176VA72W			-
	Inrush current	20 A peak or less (below 8ms)				80A peak or lower
	Efficiency	65% or more				
	Input fuse	Built-in (Not replaceable) : AC250V/3.15A, UL standard (Time-lag Type) DC power: 125V/10A (Time-lag type) UL approved				
	Allowable momentary shutdown	Within 20ms				
Output1	Output voltage	DC 5V (±2%)				
	Output current	5.5A		8.5A		7.5A
	Over current protect	6.0A ~ 13.0A		9.3A ~ 17.0A		9.0 A~17.0A
	Output power	27.5W @ 55℃		46.75W @ 55℃		37.5W @ 55℃
Relay Output	Application	RUN contact				
	Rated switching voltage/current	DC 24V, 0.5A				
	Minimum switching load	DC 5V,1mA				
	Response time	OFF→ON/ ON→OFF: 10ms or less/12ms or less				
	Life	Mechanical: More than 20000000 contacts				

Items		2MLR-AC12	2MLR-AC22	2MLR-AC13	2MLR- AC23	2MLR-DC42
		Electrical: More than 100000 contacts 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				
Dimension (W x H x Dmm)		55 x 95 x 90		55 x 95 x 110		
Weight		326g	382g	334g	384g	417g
Applied base and install position		Power part of basic/extension base		Power part of extension base		Power part of basic/extension base

ATTENTION

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 shuts down the circuit to stop the system. Rectify the causes, such as lack of current capacity or short circuits that leads to over current, and then restart the system.

Example of current consumption/power calculations

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

Main base

Type	Model	No.	Voltage (5V)
CPU Module	2MLR-CPUH/F	1	1.31A
Main Base	2MLR-M06P	1	0.2A
FEnet Module	2MLL-EFMF	6	0.61A
Current Consumption / Power Consumption		1.31A + 0.61A∗6 = 4.97A / 4.97×5V = 24.85W	

Extension base

Type	Model	No.	Voltage (5V)
Extension Drive	2MLR-DBSF	1	0.65A
Extension Base	2MLR-E12P	1	-
DI Module	2MLI-D24A	2	0.05A
DO Module	2MLQ-RY2A	6	0.5A
AI Module	2MLF-AD4S	2	0.61A
Profibus-DP	2MLL-PMEA	2	0.56A
Current Consumption / Power Consumption		0.65A + 0.05A∗2 + 0.5A∗6 + 0.61A∗2 + 0.56A∗2 = 6.09[a] / 6.09A × 5V = 30.85 W	

Sum of current consumption is 6.09. Hence, use 2MLR-AC13 or AC23.

ATTENTION

Maximum power consumption of PLC can be derived from the efficiency of power module.

Example: Sum of 5V consumption x Minimum efficiency of Power module = 100W/0.65 = 154W.

4. Installation and Wiring

4.1 Installing the PLC

Installation environment

The PLC system is designed to withstand extreme climatic conditions. However, to ensure reliability and stability ensure that the following conditions are considered.

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.
- Ensure incremental Humidity: 5 ~ 95 %.

Don'ts

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

Installation conditions

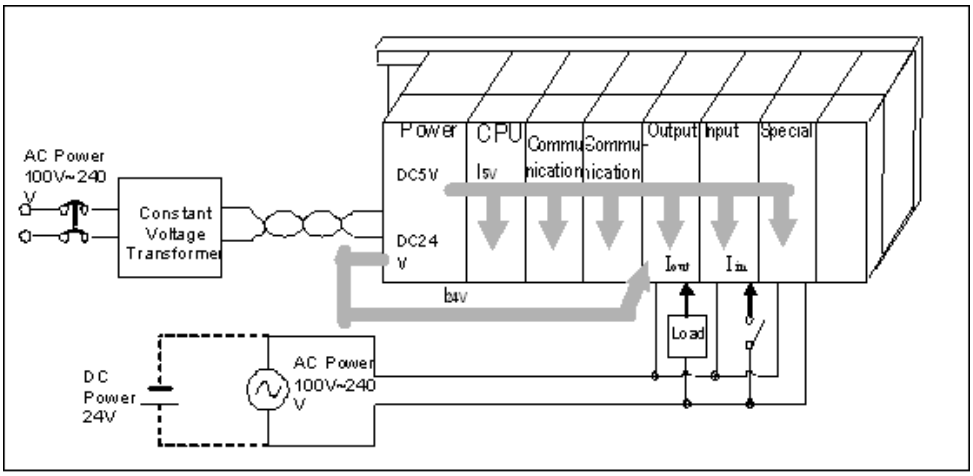
- While drilling holes, fixing screws or wiring, ensure that no wire or any other metallic part enters the PLC.
- Do not install the PLC on a panel that also has a high-voltage device.
- Maintain a distance of at least 50mm from the wiring duct or surrounding modules.
- Ensure the grounding at a place 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 ensured, 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 the 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 the 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 DC 24V is externally supplied or a power module without DC 24V 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.

$$W\ 5V = I5V \times 5 (W)$$

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. $W_{out} = I_{out}$ X V_{drop} X Output point X Simultaneous ON rate (W)
   ii. I_{out}: 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. $W_{in} = I_{in}$ X E X Input point X Simultaneous ON rate (W)
   ii. I_{in}: 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

   W_S = 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 + W_{out} + W_{in} + W_s (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 the 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

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.
- Do not touch the PCB inside the module with bare hands, as this can lead to failure of the PLC Modules.
- Ensure that external materials, such as wiring fragments do not enter the upper part of module casing. Even if such materials accidentally enter the module casing, remove them immediately.

Precautions for installing/handling I/O module

Note the following points while handling or installing the 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.

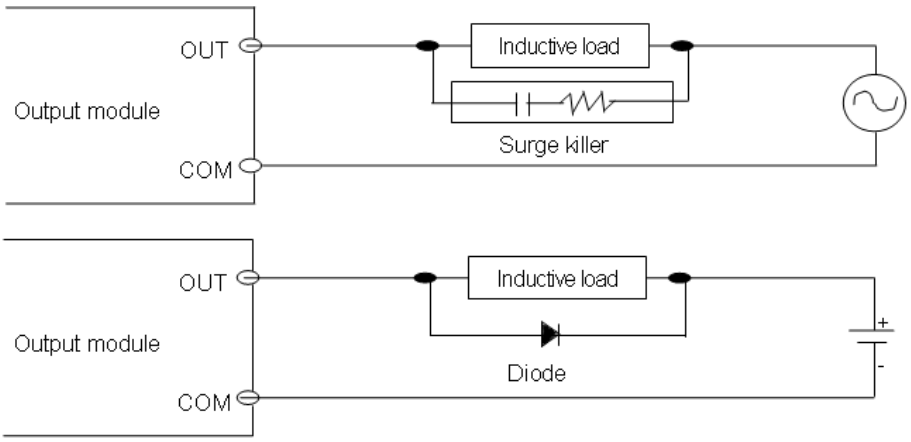
4. **Polarity**

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, parallel to the load.
- Terminal Block Wiring

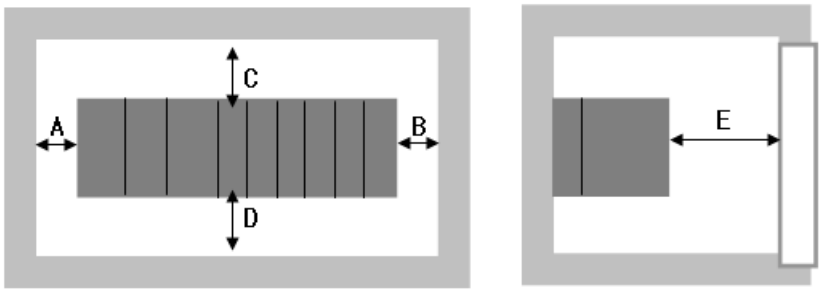


WARNING

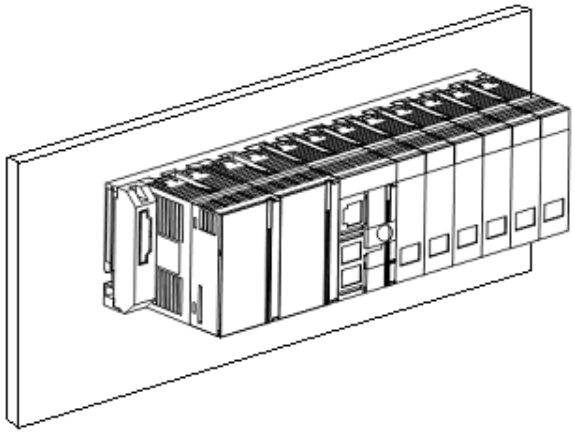
Do not apply excessive pressure on the I/O module or separate the PCB board from the case.

Precautions for installing the base

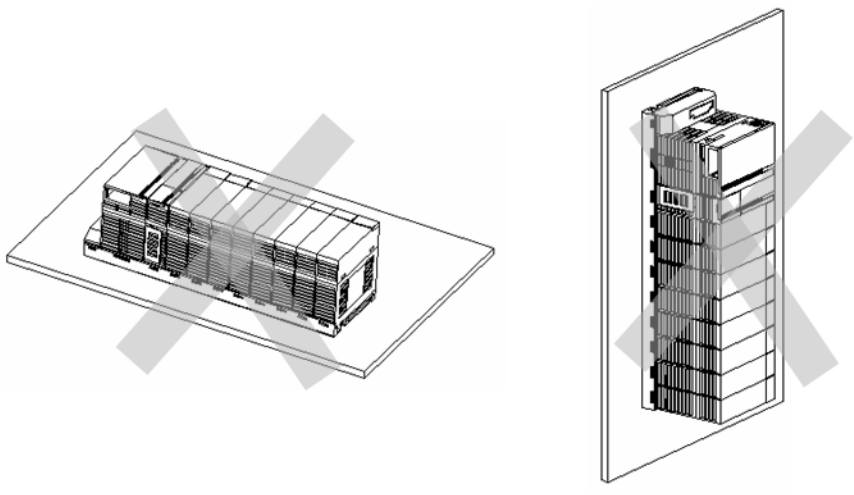
The following precautions must be taken while installing a PLC on the control panel. Ensure sufficient ventilation for the modules, especially the upper part of the modules. This also helps in changing the modules, if required.



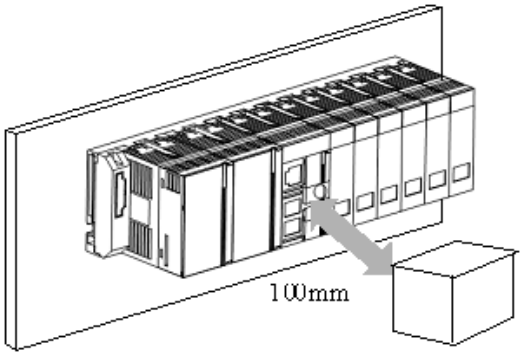
1. A, B: More than 5cm
2. C, D: More than 5cm for easy installation of module.
   - Minimum 3cm for wiring duct, more than 5cm if duct is more than 5cm high)
   - More than 15cm is recommended if fiber optic modules or full loaded power supply is used.
3. F : More than 10cm
   - More than 8cm, if fiber optic cable or connector-type I/O modules are used.
   - More than 10cm, if FTP cable is used.
4. If the PLC is installed near a Contactor/Breaker, it is recommended to use a Contactor/Breaker (Large Size) in a different panel.
5. If necessary, install wiring duct for routing the cables. Consider the following points while 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.
6. Install PLC in the direction as shown in the following figure. This helps in protecting the PLC from radiation.

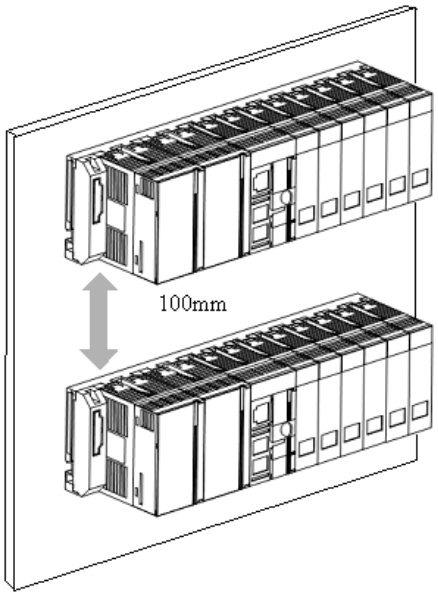


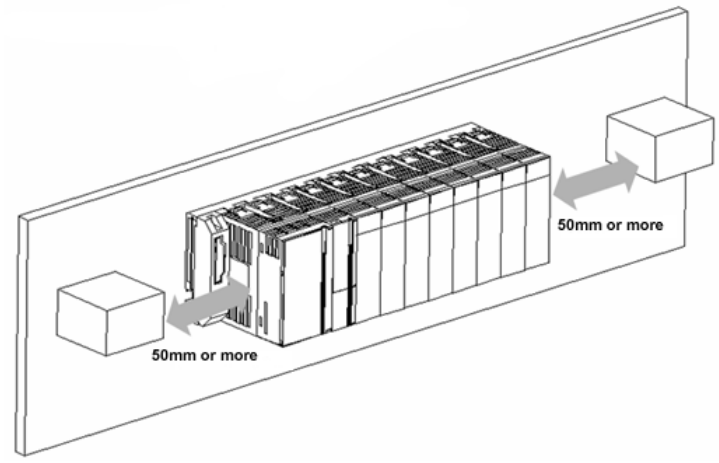
7. Do not install the PLC in the direction displayed in the following figure:



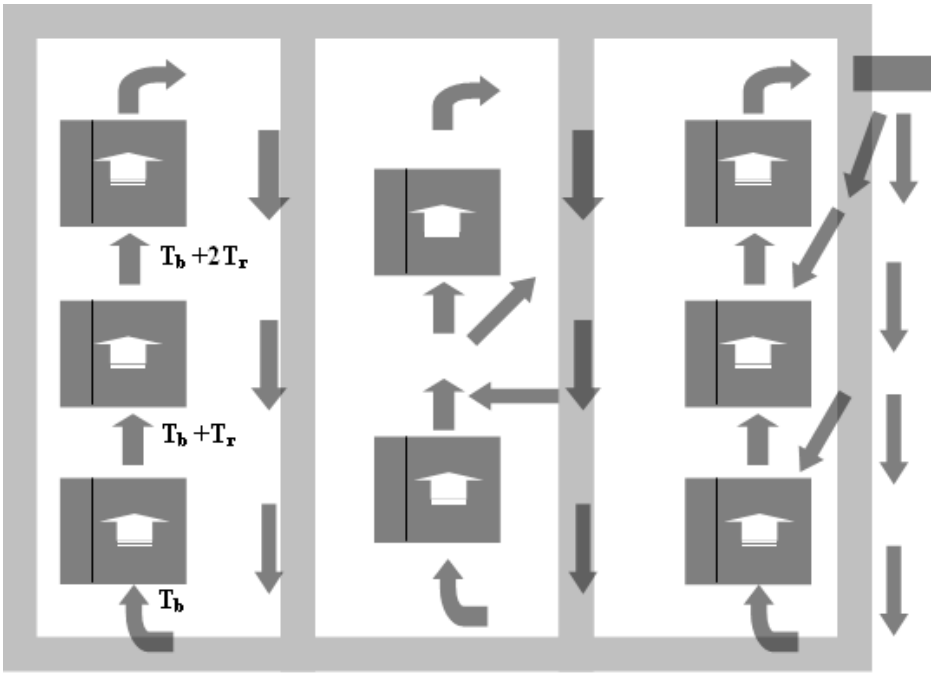
8. To avoid any effect of radiating noise or heat, install the PLC and other devices (relay and electronic contact) with a spacing secured, as indicated in the following figure.




100mm


50mm or more
50mm or more

9. Installing a base on top of another leads to a rise in temperature of the cabinet. Install a fan for air circulation or keep maximum distance between the bases.



ATTENTION

- If bases are installed without enough spacing, the air temperature (Tb + Tr) may rise up to 15°C for the fiber optic module and the module installed right above the power module.
- Ensure that air temperature around the module does not exceed 55°C.

4.2 Inserting/removing modules

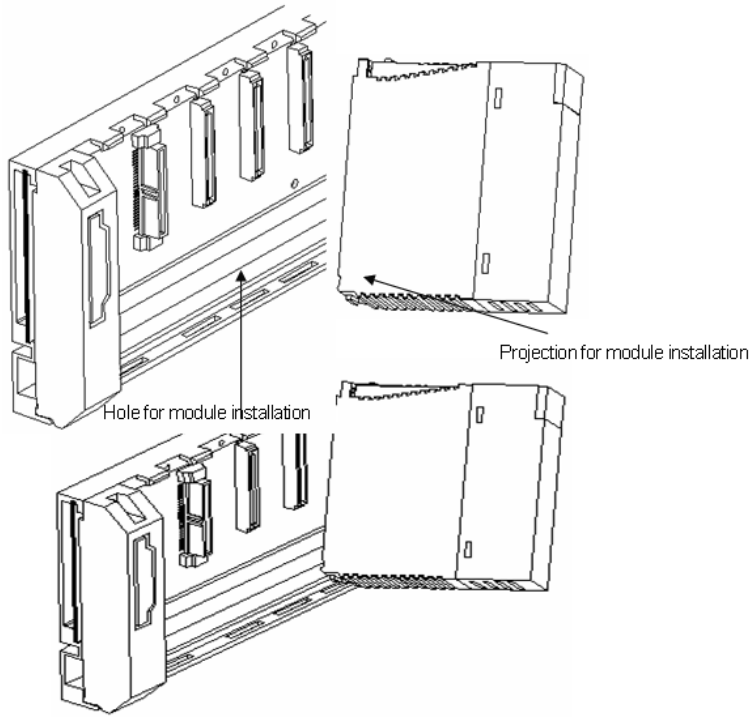
Inserting a module

Perform the following steps 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 the module.



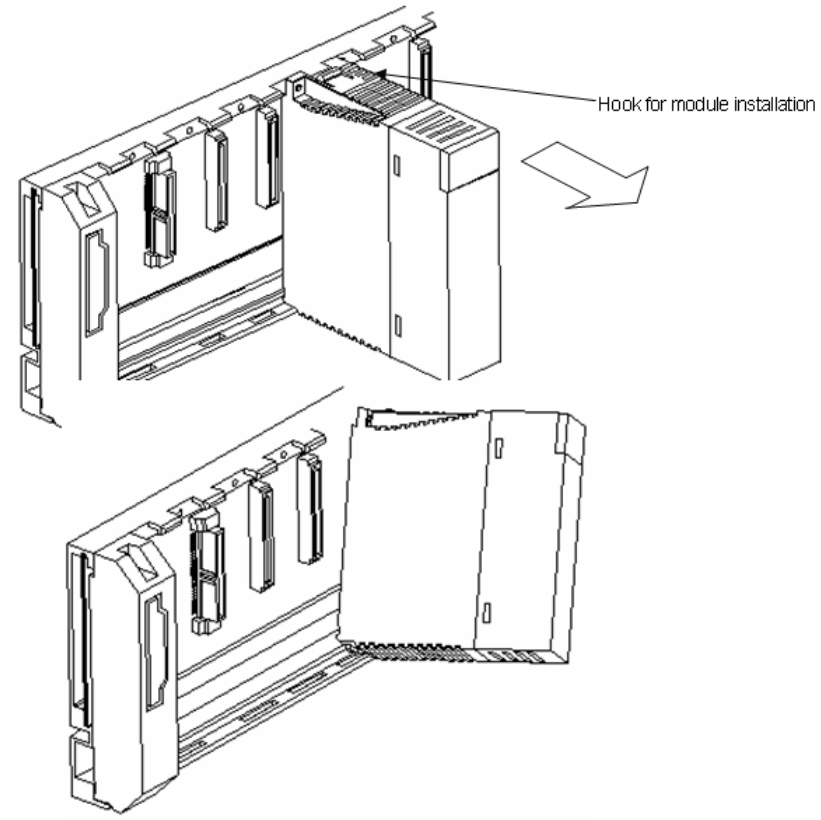
TIP

While 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

Perform the following steps to detach modules.

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

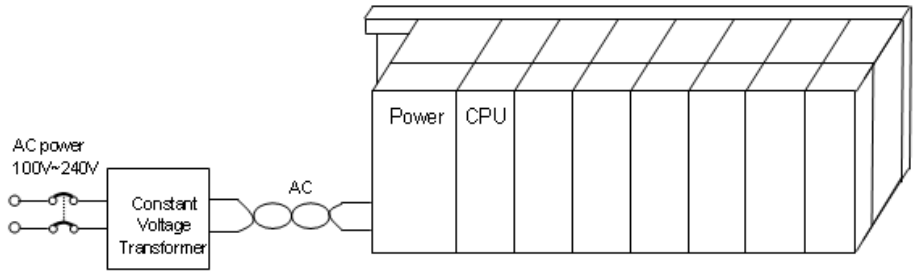


CAUTION	While detaching the module, press the hook and remove the module from the base. Then, remove the fixed projection of the module from the fixed hole of the module. If module is detached forcefully, the hook or the fixed projection of the module might break.

4.3 Wiring

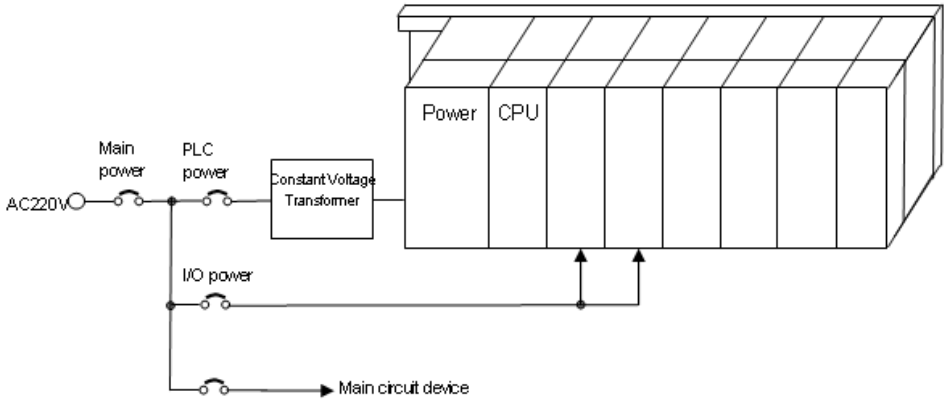
Power wiring

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.

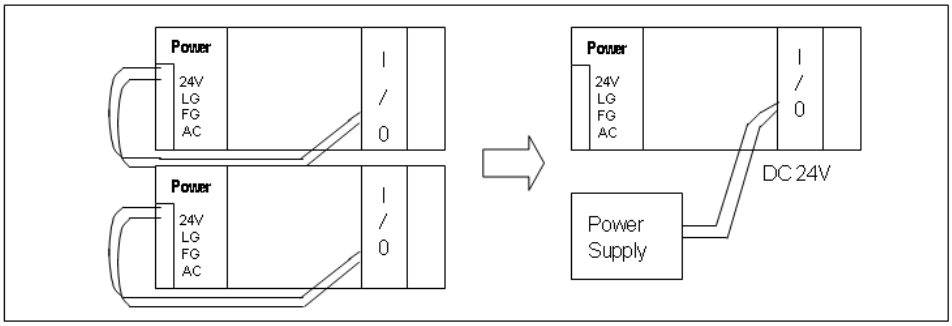
The following figure illustrates the distributions of 220V AC for PLC Power Supply, I/O Modules and other Main Circuit Equipment.



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

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

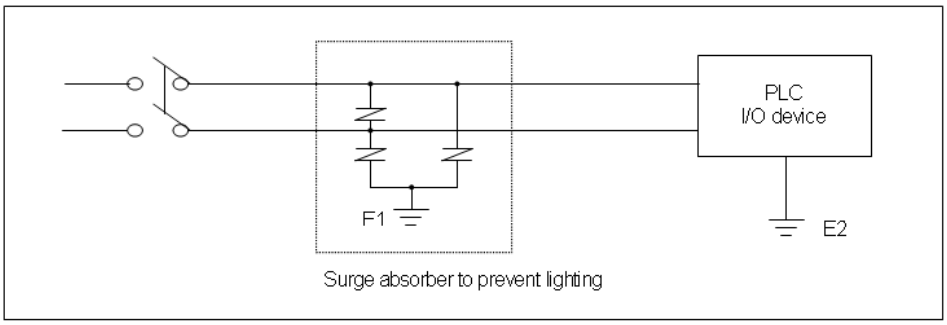
   b) If DC 24V output capacity of a power module is not sufficient for the PLC I/O modules, supply the external DC 24V power, as shown in the following figure.



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

5. AC110V/AC220V cable must be as thick as possible (2mm^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.

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

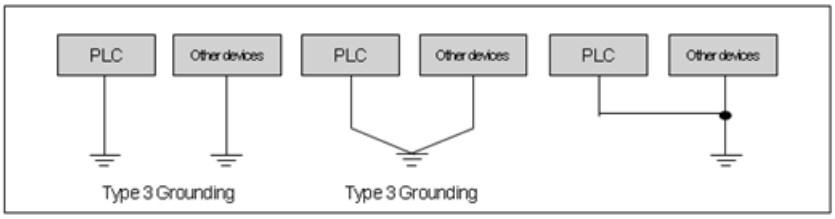


TIP

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 at least 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.



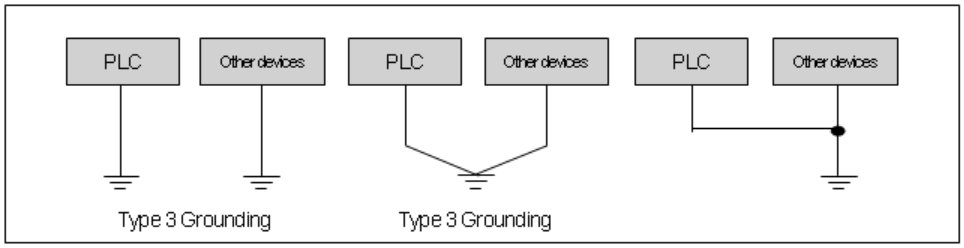
5. In case of pipe wiring, check the pipe for grounding properly.
6. Separate output cable of DC 24V from AC 110V cable or AC 220V cable.

ATTENTION

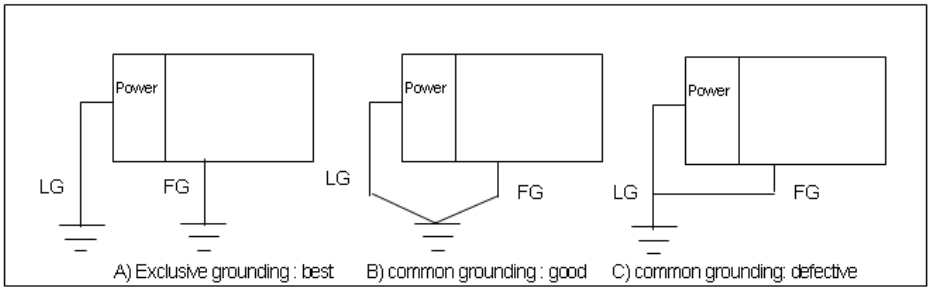
Current leakage may take place for wiring distances longer than 200m, caused by the capacitance between the cables.

Grounding

1. Sufficient measures against noise are taken in the PLC, making it possible to be used without grounding.
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.



5. Use more than 2mm^2 cables for grounding. Place the earth point near the PLC as much as possible to limit the length of grounding cable.
6. Separate Line Ground (LG) of power module and Frame Ground (FG) of base board for grounding.



7. If a 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

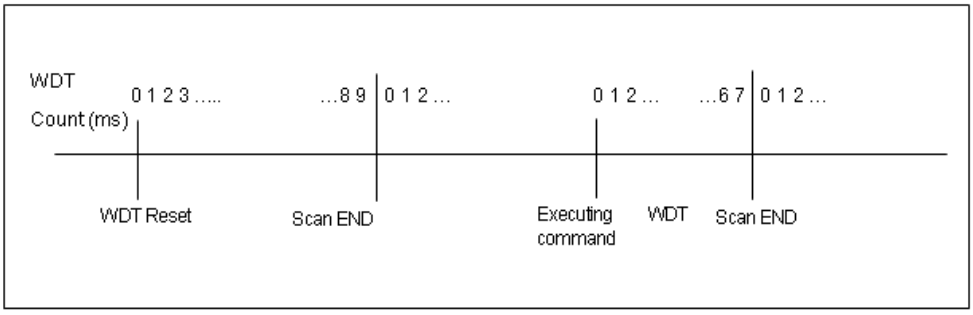
5.1 Self-diagnostic function

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

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

1. WDT is the timer, used for detecting the 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 WDT 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 WDT 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 for checking the error state of an I/O module during the beginning of an operation or during an 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, the low-battery warning lamp (BAT), located at the front of the CPU module glows.

Error logs

The CPU module has a function that records error history and analyzes the cause of these errors. This enables you 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, refer to Error codes list.

Troubleshooting errors

Classification of errors

An error is classified as a 'Fatal Error' and 'Non-Fatal Error'. A fatal error stops the operation for system safety and 'Non-Fatal Error' warns you 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 an 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 the 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 WDT or the built-in I/O module is unable to function normally, the system stops.

- 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 _ANNUM_ER when a fatal error is detected.

The error codes are saved in _ANNUM_WAR when a non-fatal error is detected.

REFERENCE - INTERNAL

For additional information on the Flags, refer to Flag list .

5.2 Clock function

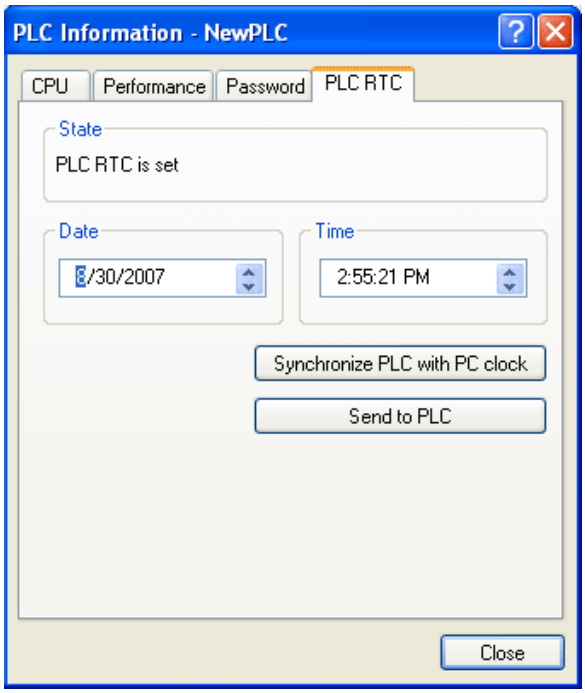
The CPU module has an in-built Real-time Clock device (RTC). In a power OFF or instantaneous interruption, the RTC continues to function using the battery backup. The clock data of the RTC is used for providing the time control for operations or fault logs.

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

Read from SoftMaster/setting

To view PLC information:

- From the SoftMaster, click **Online > PLC Information.** The following dialog box displays.



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 by selecting **Synchronize PLC with PC clock**. This transmits 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	Example	Size	F Area	Description
_RTC_TIME[0]	16#08	BYTE	%FB12	Current Time [Year, 20XX]
_RTC_TIME[1]	16#02	BYTE	%FB13	Current Time [Month]
_RTC_TIME[2]	16#23	BYTE	%FB14	Current Time [Day]
_RTC_TIME[3]	16#14	BYTE	%FB15	Current Time [Hour]
_RTC_TIME[4]	16#16	BYTE	%FB16	Current Time [Minute]
_RTC_TIME[5]	16#17	BYTE	%FB17	Current Time [Second]
_RTC_TIME[6]	16#06	BYTE	%FB18	Current Time [Day of week]
_RTC_TIME[7]	16#20	BYTE	%FB19	Current Time [Year, XX08]

The time data of _TIME_DAY_DT is displayed on 24 hr 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.

Flags to Read the Clock	Example	Size	F Area	Description
_RTC_TIME_USER[0]	16#00	BYTE	%FB3860	Time [Year, 20XX]
_RTC_TIME_USER [1]	16#00	BYTE	%FB3861	Time [Month]
_RTC_TIME_USER [2]	16#00	BYTE	%FB3862	Time [Day]
_RTC_TIME_USER [3]	16#00	BYTE	%FB3863	Time [Hour]
_RTC_TIME_USER [4]	16#00	BYTE	%FB3864	Time [Minute]
_RTC_TIME_USER [5]	16#00	BYTE	%FB3865	Time [Second]

Flags to Read the Clock	Example	Size	F Area	Description
_RTC_TIME_USER [6]	16#00	BYTE	%FB3866	Time [Day of week]
_RTC_TIME_USER [7]	16#00	BYTE	%FB3867	Time [Year, XX08]

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 for representing 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, refer to *MasterLogic-200 Instructions User Guide*.

5.3 Remote functions

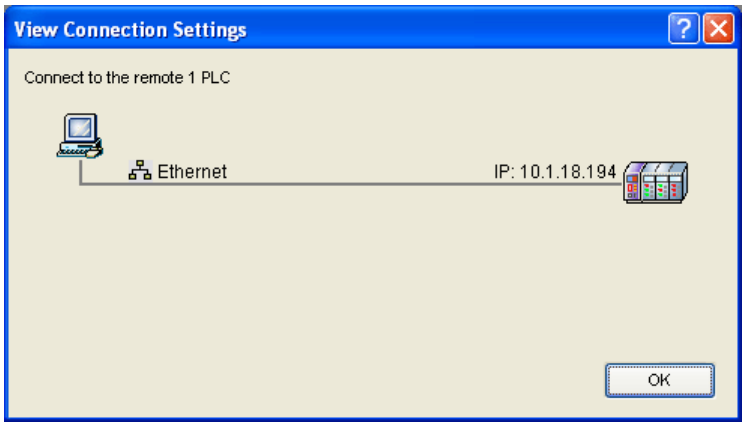
Overview of remote functions

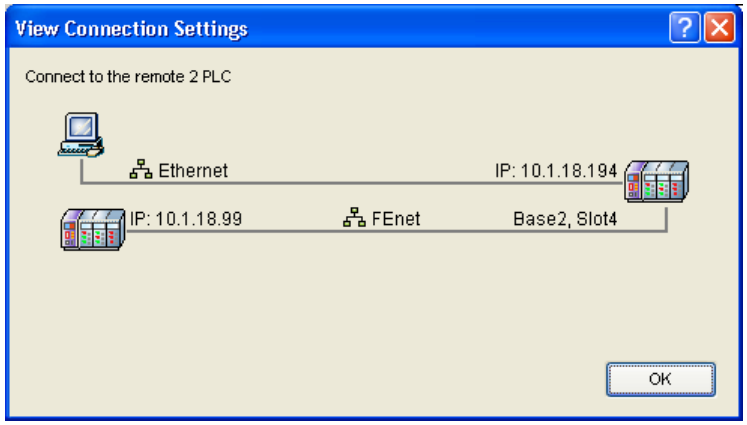
The key switch installed on the local CPU is used for operating a remote CPU, connected to it. To operate the CPU remotely, set 'REM' switch (second dip switch of four pin dip switch) of the CPU module 'ON' and move 'RUN/STOP' switch to 'STOP' position.

Types of remote operation

You can perform remote operation by:

- Connecting the SoftMaster through the USB or RS-232 port available in the CPU module.
- 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 for resetting 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 more information about remote functions, refer to ‘Online’ section in the *SoftMaster User’s Guide*.

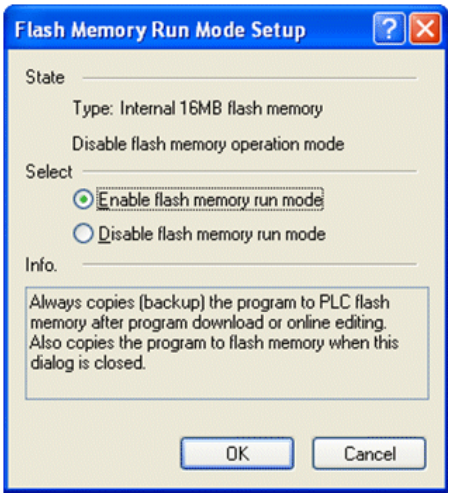
Flash memory operation mode

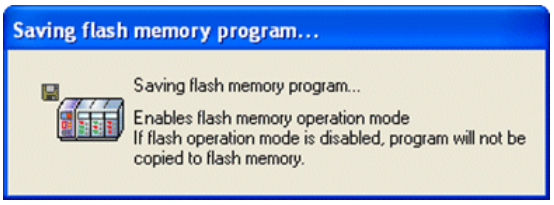
In the flash memory operation mode, the system operates from the backup program in flash memory, in case the program data in the RAM is corrupted. When you select **Flash Memory Operation Mode**, the program is saved into flash memory. The flash memory operation starts when the operation mode is changed to RUN mode from any other mode or while restarting.

Flash Memory Operation Mode Setting: You can check the operation mode setting.

Perform the following steps to save the program to flash memory.

Step	Action
1	Click **Online** > **Set Flash Memory** and then select **Enable flash memory run mode**.
2	Click **OK**. The **Flash Memory Run Mode Setup** dialog box displays.
3	Select **Enable flash memory run mode**. The saving flash memory program… message displays and the programs are copied from the user program area to the flash memory.



Step	Action
	

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 in SoftMaster. This is done, while executing flash ‘operation mode setting’, after program debugging is complete with the flash memory operation mode OFF.
- 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 will 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.

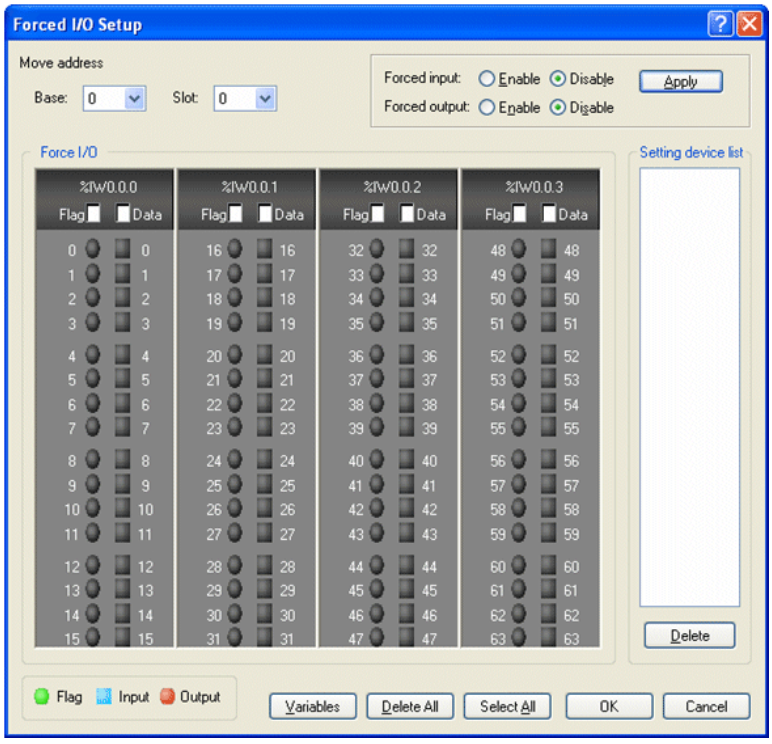
Flash Memory Operation Mode Setting	Description
ON	If program memory data is corrupted because flash memory and program memory are different or battery voltage is low, it downloads the program saved in the flash memory to the program memory.
OFF	CPU detects that the flash memory does not have any program 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 for forcibly turning ON or OFF I/O channels, irrespective of the program execution results.

Perform the following steps to turn ON or OFF I/O channels.

Step	Action
1	Click **Online > Force I/O**.
2	
3	Select appropriate flag, and then 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. 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. 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 energize the I/O and may cause serious malfunction in the process or threat to human life.

REFERENCE - INTERNAL

For more information on Forced I/O setting, refer to *SoftMaster User's Guide.*

Forced On/Off processing time and processing method

Forced input

The input forces the data of the contact point (Digital Input) selected and sets 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 sets 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 is not installed.
- The data set in the CPU is retained till it is cleared.
- Forced I/O data is not cleared even if 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 you 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 more information about the DIREC_IN,DIREC_OUT' function, refer to SoftMaster *Instruction Guide*.

5.5 Viewing PLC error/event log

Overview of operation history

The four types of logs are as follows:

- 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 2048 messages. The error history is automatically stored 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.

- It saves the date, time, and mode change information.
- It saves up to 1024 mode change events.

Power shut down log

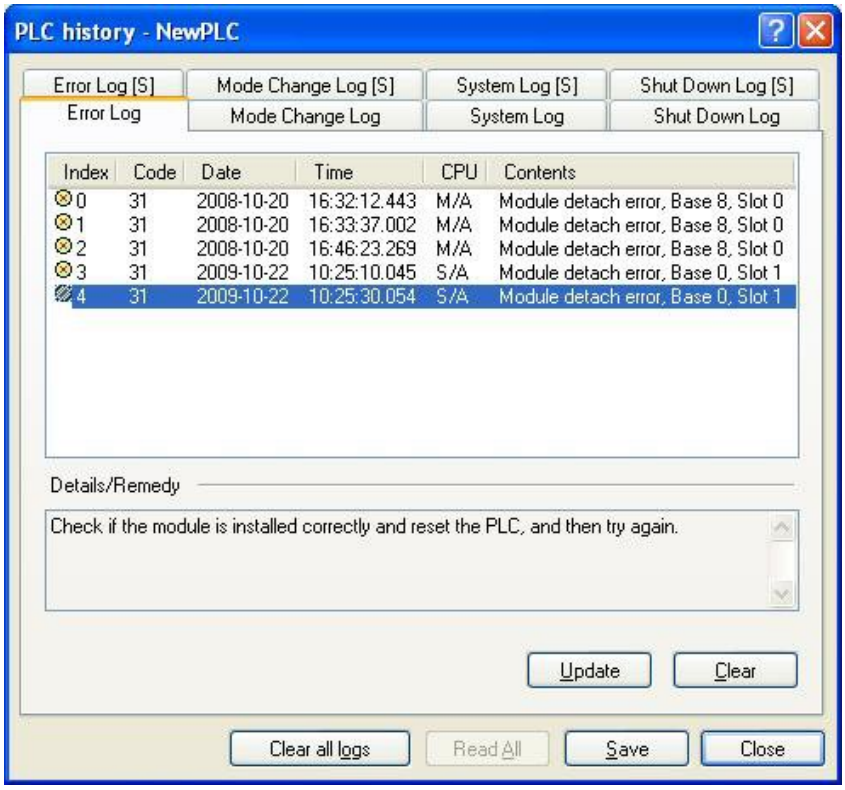
The PLC saves power ON/OFF data, with its time stamp. It saves On/Off information, date and time. It saves a maximum of 1024 power ON/OFF events.

System log

The PLC saves operation history of the system during operation.

- It saves the date, time, and operation changes.

- It saves the SoftMaster operation data, key switch change information.
- It saves instantaneous interruption data and network operation.
- It saves a maximum of 2048 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 are available in a flag as a real-time value. This flag enables the indication of an external device error without preparing a complicated program.

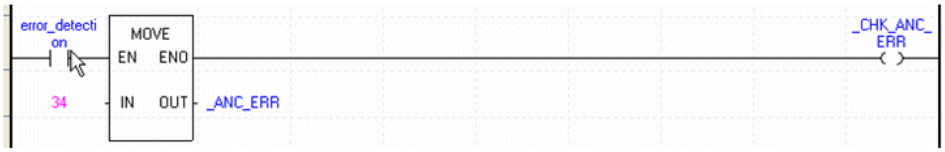
Detection/classification of external device fault

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

- 'Non-Fatal Error' (warning) that continues the PLC operation. It only gives an indication about the error state according to the contents of detected error.
- 'Fatal Error' that stops the PLC operation. For 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

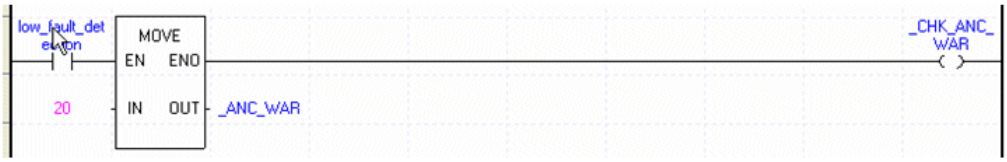
1. When a non-fatal error (warning) in an external device occurs, select the flag of the corresponding position as ON '_ANC_WB' according to user identification from system flag. At the end of the scan program, if a warning is detected when checking from '_ANC_WB [0]', it is indicated by the system representative 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.

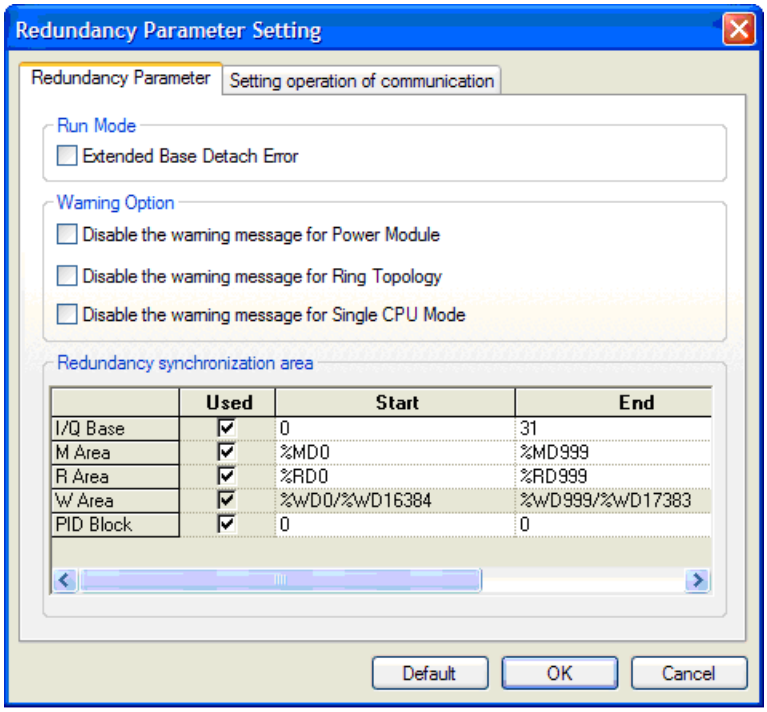
3. If the non-fatal error of external device is released, from '_ANC_WB[n]' after performing the user program, it is automatically removed from the '_ANC_WAR[n]' flag and if all are released, '_ANNUN_WR' system flag '_CNF_WAR' is reset.

Example



5.7 Redundant system operation mode

Redundancy parameter is configured for redundant operation. Redundant parameter consists of RUN mode and redundancy synchronization area.



Unlike the other parameters, redundancy parameter can be changed during operation and modified parameter is synchronized between the master and the standby CPU, as soon as the parameters are written to the PLC.

Note that you must use the **Write to PLC** function, to download the modified parameter.

Single CPU run mode

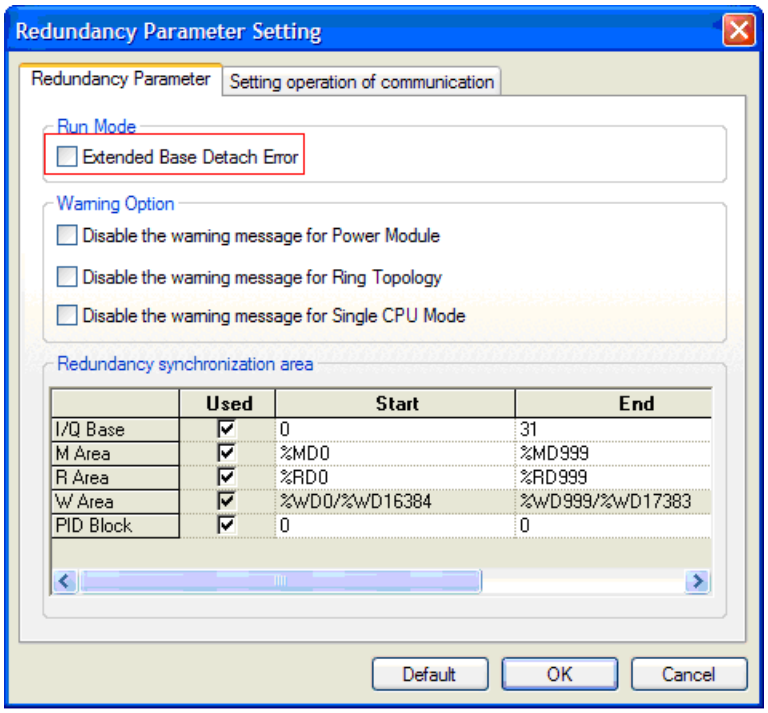
If the Master CPU is running without Standby CPU, a warning message displays. If the project requires only Master CPU without redundant operation, select **Disable the warning message for Single CPU Mode** option.

ATTENTION

It is recommended to configure redundancy for MasterLogic-200R. In case of Single CPU run mode, the system fails, if there is an error in the CPU.

Extended base detach error

This section defines procedure to handle the situation if the extension base is detached (or power off).



a) Clear the **Extended Base Detach Error** check box.

This is a default setting. If there is an error in one of the extension bases, the system restarts and the CPU waits until the base in failure is normalized. The base failure is indicated with 'Ebxx' in the CPU indicator panel.

b) Select the **Extended Base Detach Error** check box.

If there is an error in one of the extension bases, other bases operate as per error settings defined in the basic parameter.

If it is set to **Keep output when an error occurs** in the basic parameters, the output of other bases keep the last output.

Redundancy synchronization area

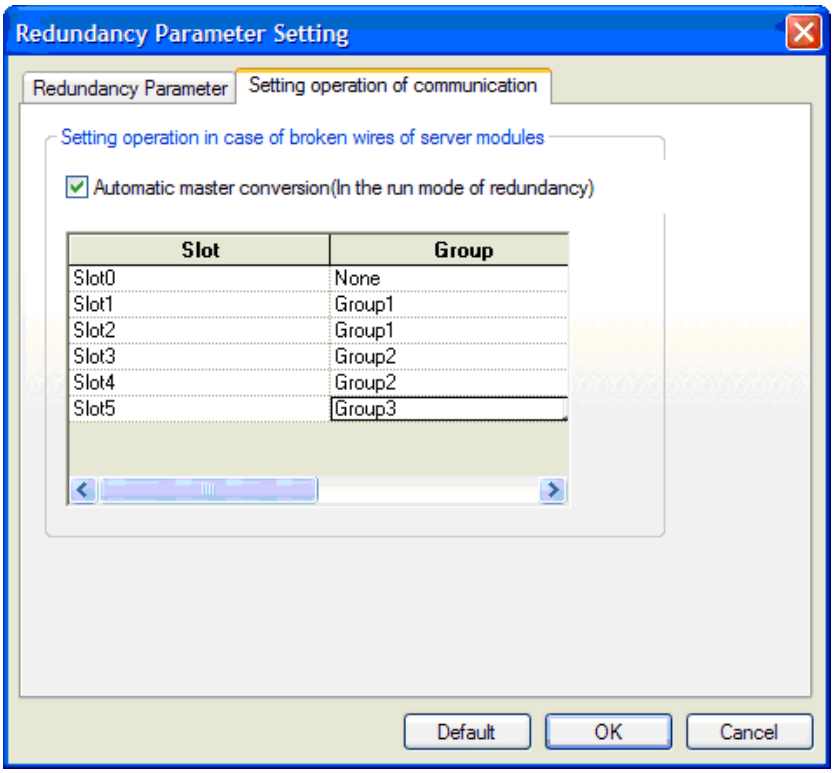
- M Area : %MW0 ~ %MW131071 (default setting is %MW0 ~ %MW2000)
- I/Q Base: 0 ~ 31
- PID Block: 0 ~ 7
- R(W) Area: %RW0 ~ %RW32767 (default setting is %RW0 ~ %RW2000)

ATTENTION

1. Retain area for %M can be defined in basic parameters. Refer to Redundant system operation.
2. If Master/Standby CPU continues with redundant operation, the following area is synchronized automatically.
   - L (High-Speed Link flag) and N (P2P parameter) area.
   - F (System flag): However, individual flag area is not synchronized
   - U (Special flag)
3. If you change the value in the variable monitoring window, the value is applied to both Master and Standby CPU, regardless of synchronization area.

5.8 Setting operation of communication

You can set operation when FEnet module's cable is disconnected. According to setting, master CPU and Standby CPU are converted automatically when FEnet module is disconnected.



Automatic master conversion

Automatic master conversion setting

When cable of FEnet module is disconnected which is set as server, check for the Automatic master conversion of setting. This setting is applied only in case of redundancy operation.

Detail option

It sets the condition for automatic master conversion through detail option. This means setting the group for each FEnet module installed at main base. Each module can be set

as same or different group. When automatic master conversion setting and detail option setting are done, if the following two conditions are met, master conversion occurs.

1. All master base FEnet modules belonging to one group are disconnected.
2. At least one standby base FEnet module belonging to the above group is under normal connection status.

For example, in case you set slot 1 and slot 2 as group 1, slot 3 and slot 4 as group 2 and slot 5 as group 3, master conversion occurs under the following three conditions. (Assume that FEnet modules on standby base has normal connection status.)

1. Slot 1 and slot 2 are disconnected or
2. Slot 3 and slot 4 are disconnected or
3. Slot 5 is disconnected

Global status variable

After installing FEnet module, you can check the server connection status of FEnet module and physical cable connection status through global variable in SoftMaster. In order to monitor global variable, register relevant variable at **Variable Monitoring** Window. To register relevant variable, click **Edit** > **Register Special/Communication Module Variable** in SoftMaster. And the variables can be used at user program.

Variable Monitoring Window

	PLC	Program	Variable Name/Address	Value	Type	Address/Variable Name	Comment
1	NewPLC	<GLOBAL>	%LX60312	10	BOOL	_0001_LINKUP_INFO	FEnet : Link up/down information
2	NewPLC	<GLOBAL>	%LW3774	HEX	WORD	_0001_SC_INFO	FEnet: Server connection state
3							

Monitor 1 | Monitor 2 | Monitor 3 | Monitor 4

Sever connection status variable

Sever connection status variable indicates connection status of each client connected to server. Each bit indicates each client status in order of connection to server and if bit is on, it is normal connection status. Each bit indicates status of each client in the order as connected and if it's ON, its normal connection.

Link up/down information variable

Link up/down information variable indicates physical cable connection status of relevant FEnet module. If variable is on, it means normal connection and if variable is off, it means disconnection or detachment.

ONE IP solution

You can connect to the master base FEnet module of 2MLR redundancy system with one IP regardless of master conversion through ONE IP Solution. For this, in case of master conversion, master base FEnet module and standby FEnet module change each other's IP address.

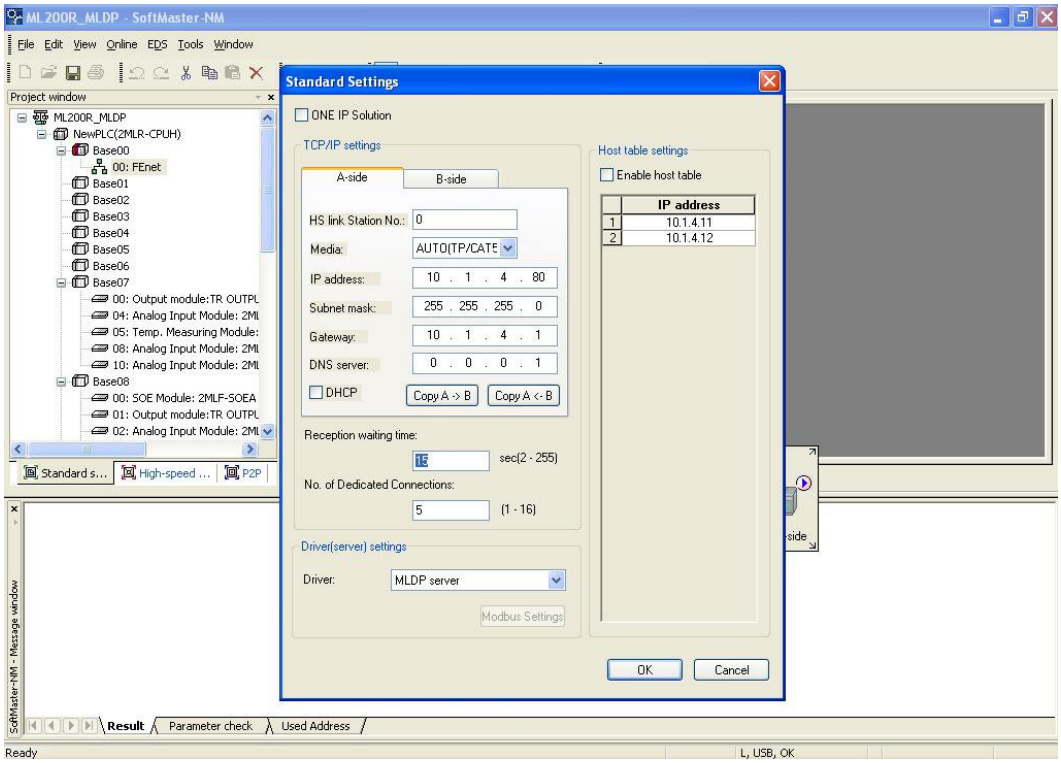
IP setting

You can set IP of FEnet module at standard setting window after registering FEnet module at SoftMaster-NM. If you check ONE IP Solution of standard setting window, ONE IP Solution function will be activated and you can set only one IP address for FEnet in a slot.

REFERENCE - INTERNAL

Refer FENet user's guide for how to set IP address when ONE IP Solution is not activated.

When using ONE IP Solution, IP address should be an even number. This IP address becomes IP address of master base FEnet module and master base FEnet module's IP address + 1, becomes IP address of standby base FEnet module.



IP change

If you use ONE IP Solution, in case of master conversion caused by error, communication disconnection occurs. Master base and standby FEnet modules interchange each other's IP address and individual module reset will happen automatically.

ATTENTION

Individual module reset must be complete after master conversion. So master conversion must not occur again within 3 seconds (time for completing individual module reset) after master conversion.

5.9 Fault mask function

Fault mask operational overview

The fault mask enables uninterrupted program execution, even in case of errors 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 in 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 mask setting, refer to *SoftMaster User's Guide*.

For additional information on setting fault mask through a program, refer to Flag list .

Releasing fault mask

The fault mask can be released in the following ways.

- Setting release from online menu in SoftMaster.
- Release by program.
- Automatic release in case memory backup is lost because of battery voltage falling.
- Reset Key when it is pressed for more than 3 seconds.

The fault mask is not released in the following cases.

- Power Off→On
- Operation mode change
- Program download
- Reset key
- 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.

5.10 I/O module skip function

I/O module skip operational overview

The I/O module skip function is used for excluding 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 for operating it temporarily, excluding the fault.

Setting and processing I/O data

The SoftMaster is used for configuring the skip setting on the I/O module.

REFERENCE – INTERNAL

For additional information about skip setting, refer to *SoftMaster User's Guide*.

- 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 is 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 in SoftMaster
- Releasing by overall reset
- Automatically released, in case of memory backup failure because of low-battery level.
- Reset Key when it is pressed for more than 3 seconds.

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

- Power Off→On
- Operation mode change
- Program download
- Reset key
- 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 of the skip with fault mask set and check the operation of the module.

5.11 Replacing a module during operation

Overview of replacing modules

The MasterLogic-200R system enables you to change the 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

- Replaceable modules during operation are digital I/O, analog I/O, RTD, and TC modules. HSC and APM modules can be replaced but does not retain the previous values.
- Communication module 2MLL-PMEA can be connected as long as the network is set (using Sycon software).
- While 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

Replaceable modules during operation are digital I/O, analog I/O, RTD, TC, and Base modules. This guide only provides a guideline to replace modules by changing wizard in SoftMaster

Using the module changing wizard in SoftMaster

REFERENCE – INTERNAL

For additional information, refer to *SoftMaster User's Guide.*

Using the base changing wizard in SoftMaster

Extension base can be replaced during online. In line configuration, only the last extension base in the line can be replaced. However, in the ring configuration, any extension base part of ring topology can be replaced during operation.

REFERENCE – INTERNAL

For additional information, refer to *SoftMaster User's Guide.*

CAUTION

- You can replace only one extension base at a time.
- Main base cannot be replaced during operation.

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 the base number, slot position, and module type. The number is allocated by the fixed method in the 2MLR-CPUH.

Program modification during operation

During the 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 to *SoftMaster User's Guide.*

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

Redundancy components list

MasterLogic-200R system consists of the following redundant components.

Item	Type	Description
Redundant CPU module	2MLR-CPUH/F	Maximum I/O points: 23808, Program capacity: 1MB Fiber Optic
	2MLR-CPUH/T	Maximum I/O points: 23808, Program capacity: 1MB RJ45
Redundant Main Base	2MLR-M06P	Main base for Redundant CPU, Power Supply 6 communication modules
Redundant Extension Base	2MLR-E12P	Extension base for I/O modules 12 I/O modules
Extension Drive Module	2MLR-DBST	Communication module for 2MLR extension base operation. Electrical media
	2MLR-DBSF	Communication module for 2MLR extension base operation. Optical media
	2MLR-DBSH	Communication module for 2MLR extension base operation. Electrical/optical media mixing
Redundant Power Supply	2MLR-AC12	DC5V: 5.5A, AC110V
	2MLR-AC22	DC5V: 5.5A, AC220V
	2MLR-AC13	DC5V: 8.5A, AC110V
	2MLR-AC23	DC5V: 8.5A, AC220V
	2MLR-DC42	DC5V: 7.5A, DC24V
Sync Cable	2MLC-F201	LC type optical cable (Multi core), length:2m

Item	Type	Description
	2MLC-F301	LC type optical cable (Multi core), length:3m
	2MLC-F501	LC type optical cable (Multi core), length:5m
I/O Extension Cable	2MLC-C001	Twisted pair cable FTP used
	2MLC-F201	LC type optical cable (Multi core), length:2m
	2MLC-F301	LC type optical cable (Multi core), length:3m
	2MLC-F501	LC type optical cable (Multi core), length:5m
Dustproof module	2MLR-DMMA	Dustproof module for not used power module slot

Common components list for MasterLogic-200

Item	Type	Description
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

Item		Type	Description
		2MLQ-TR2A	Transistor output, 16 points (0.5A, sink output)
		2MLQ-TR4A	Transistor output, 32 points (0.1A, sink output)
		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)
Digital I/O Mixed Module		2MLH-DT4A	DC 24V input, 16 points (current source / sink input) Transistor output, 16 points (0.1A, sink output)
Anti-vibration Module		2MLT-DMMA	Anti-vibration module for unused slots
Process and Motion Control 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
		2MLF-AD8A	Voltage/Current input: 8 channels
		2MLF-AD16A	Voltage/current input: 16 channels

Item		Type	Description
	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-DV4S	Voltage output: 4 channels, insulated channel
		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
	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

Item		Type	Description	
		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-II) 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	
		2MLL-ESHF	Optical switch module for fast Ethernet	
	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	
	Profibus-DP I/F module	2MLL-PMEA	Profibus-DP Master module	

Item		Type	Description
	Ethernet/IP I/F Module	2MLL-EIPT	EtherNet/IP (electricity) 100/10Mbps supported
	Dustproof module	2MLT-DMMA	Dustproof module for not used slot

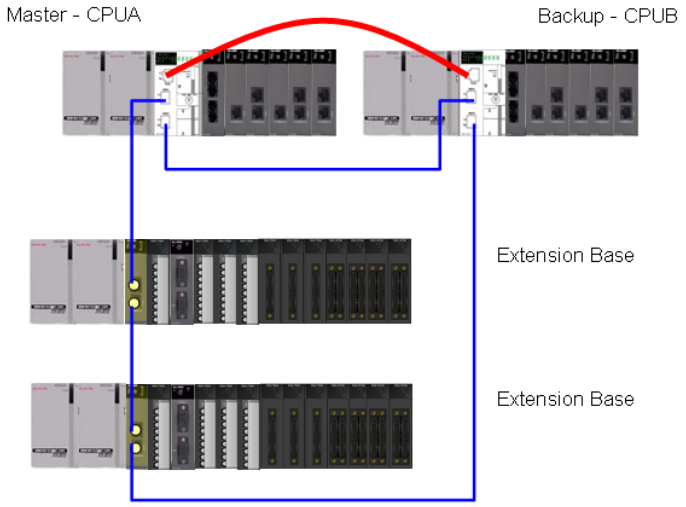
ATTENTION

For further information on the above modules, refer to the respective user's guide.

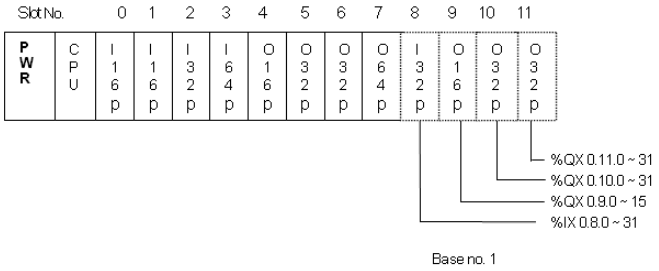
6.2 Redundant configuration

Configuring the redundant system

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



Item	2MLR-CPUH
Main Base	2 main base with same module configuration
Maximum Extension Base	31 Extension bases
Maximum I/O point	16 points module : 5952 points 32 points module : 11904 points 64 points module : 23808 points
Maximum distance between nodes	Fiber Optic : 2km Twisted pair cable : 100m
Allocation of I/O Address in Extension base	Start address of input and output point is determined by the station number set in the extension drive module.

Item	2MLR-CPUH
	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 to any I/O address. A special module is controlled by a dedicated function block and the address is automatically allocated to the memory. For instance, the I/O number of 12 slot base is allocated as follows: 
Allocation of I/O Address in main base	Only communication module is allowed in the main base, hence, I/O addressing is not required. However, same number of points (that is, 768 points) is assigned to main base and main base has station number of 0.

ATTENTION

- The base has its base number as '0' and the extension base has a switch to set the base number.
- CPU module is only allowed in the main base and two slots are required for CPU module.
- The module starts operating after the module type and I/O parameter are set using SoftMaster and the correct module type is mounted on the base.

CPU redundancy

MasterLogic-200R has a redundant system for CPU, power supply, and communication.

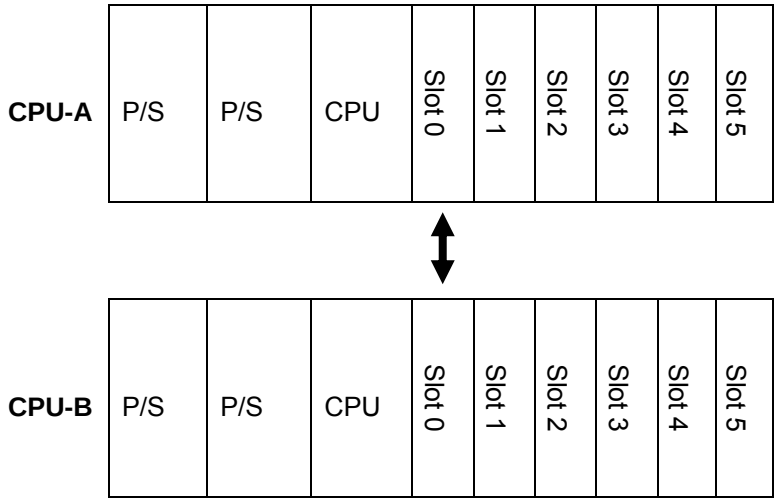
Install two identical sets of main bases consisting of same power supply, CPU, and communication and connect two CPU modules with synchronization cable.

One of the two CPU modules is a master system in control of main operation and another is a standby system for backup control, in case the master fails during operation.

After recovering from a fault, ex-Master CPU can be operated as a standby system and you can switch the master with a programming tool or a key switch.

You can select CPU side by a switch on the CPU module (that is, A or B) and duplication of sides gives an error.

The configuration of redundant main base is as follows:



The modules allowed in the main base are as follows:

Item	Model
CPU	2MLR-CPUH/T, 2MLR-CPUH/F
Power supply	2MLR-AC12, 2MLR-AC22, 2MLR-AC13, 2MLR-AC23, 2MLR-DC42
Communication	FEnet
Base	2MLR-M06P

ATTENTION

- CPU module cannot be installed in the extension base.
- Both CPU modules must have the same O/S version.
- The configuration of both CPU modules must be in the same sequence. Example: If 2MLL-EFMT is installed in the slot 0 of CPU-A, 2MLL-EFMT in the CPU-B must be installed in the slot 0.

Power supply redundancy

Redundant power supply can be installed in both main and extension bases. When one of the power supplies fails to operate, the system can seamlessly operate with another power supply. Faulty power supply module can be repaired during operation.

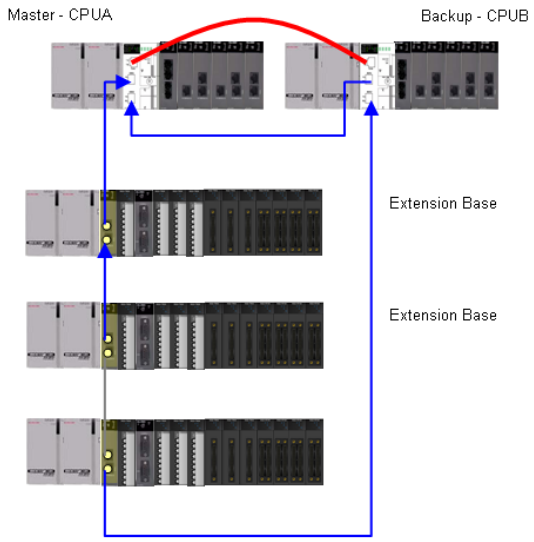
I/O bus redundancy

Extension bases and cables can be configured as a ring topology so that single communication cable fault does not stop the system and operate with another cable attached.

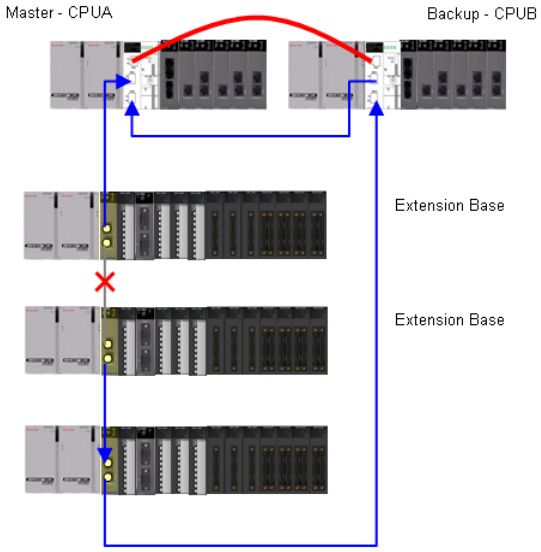
In a normal ring configuration, the communication is enabled to the path nearest to Master CPU.

The system continues to operate in a line configuration when there is a single fault in communication cable.

RUN mode in Ring Topology

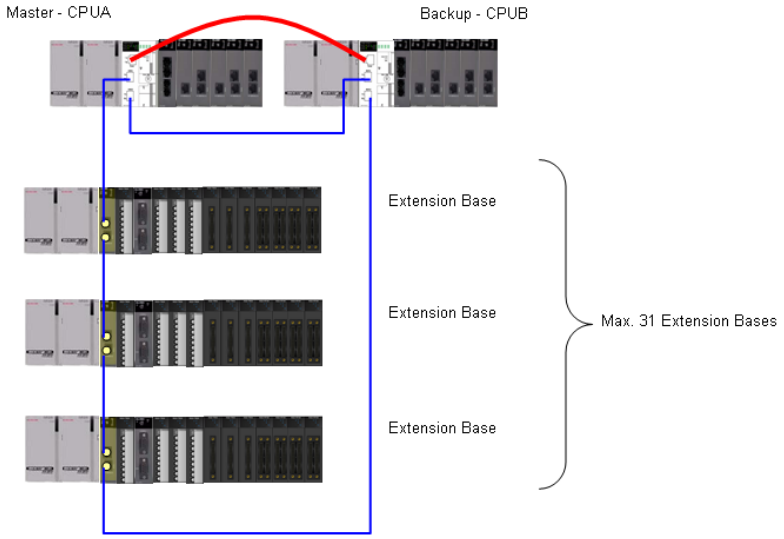


RUN mode in Line Topology



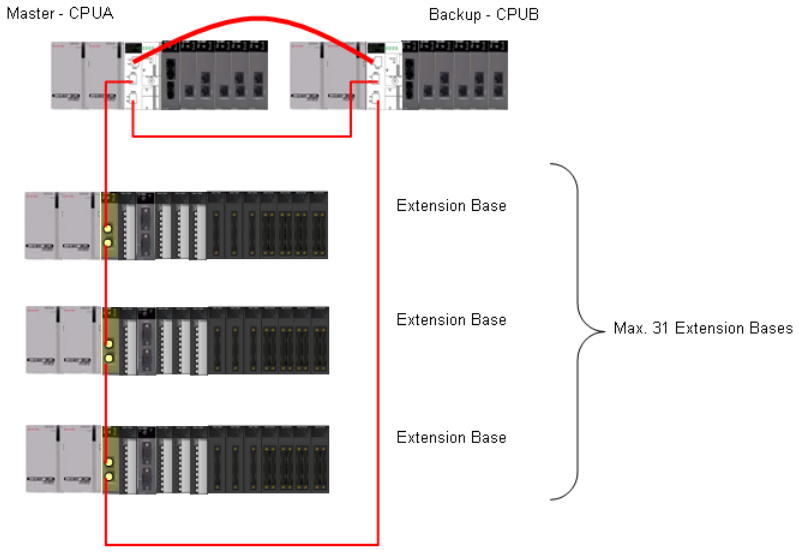
Examples of redundant configuration

1. System configuration with twisted-pair cable (RJ45)



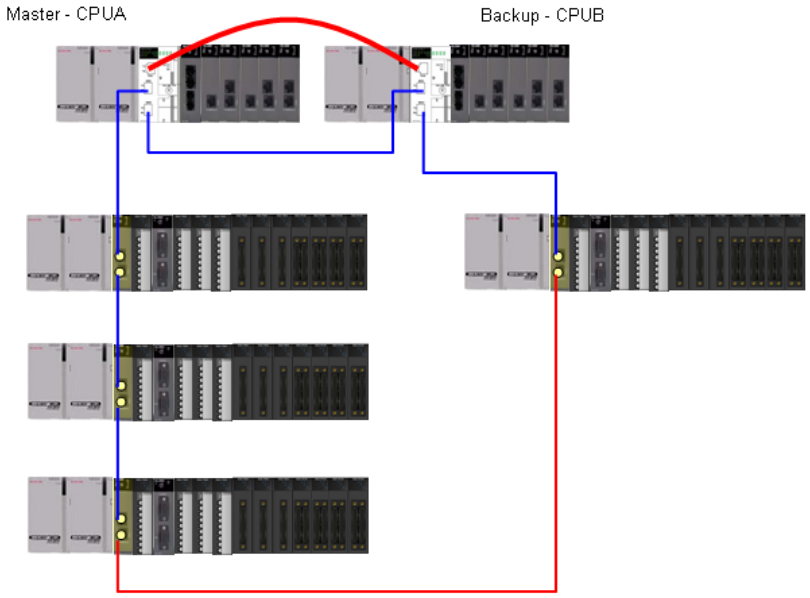
2MLR-CPUH/T for both CPUs, 2MLT-DBST for extension drive module.

2. System configuration with fiber optic cable



*2MLR-CPUH/F for both CPUs, 2MLT-DBSF for extension drive module.

3. System configuration with fiber optic cable



* 2MLR-CPUH/T for both CPUs, 2MLR-DBST for extension base 1 and 2, and 2MLR-DBSH for extension base 3 and 4.

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 and multi-mode fiber-optic media. This module can 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, for example, RS232, RS422/485 on proprietary or open MODBUS protocols.
- Profibus-DP master module (Pnet) for communication with Profibus-DP devices.

Local network

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

High-speed link service

In the MasterLogic-200 CPU, a maximum 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, and Pnet modules. Each HSL is further divided into 128 blocks of data transfer for modularity. Examples where HSL services are applicable are:

- Peer-to-peer communication between PLC A and PLC B through FENet or FDEnet modules, with configurable data areas into manageable blocks.
- To read/write I/O values between Profibus-DP 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 maximum 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 through FDEnet modules.

The following table lists the communication capacity of the CPU.

Modules/applications	2MLR-CPUH
Maximum number of high-speed link services per CPU	12
Maximum number of P2P services per CPU	8
Maximum number 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 Snet module's user's guide.

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.

I/O allocation method and I/O address assignment

- Variables can be allocated to the remote I/O by the high-speed link parameters in 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.

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 guide.

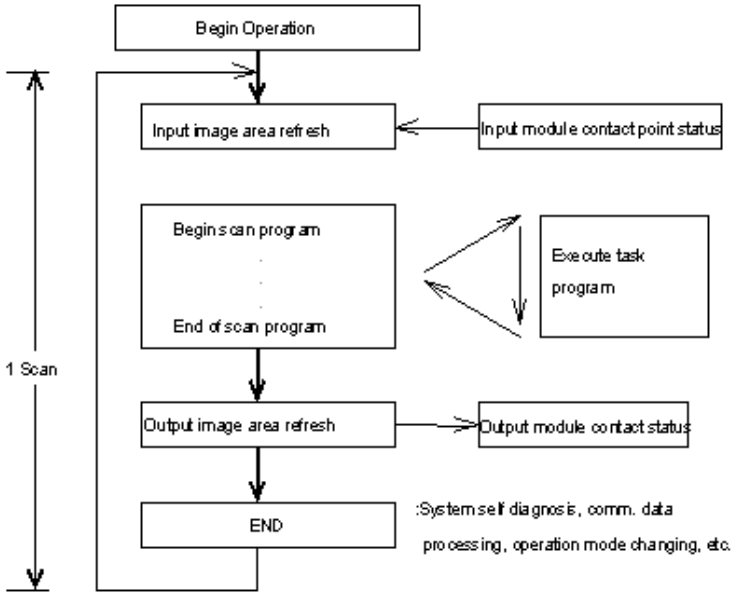
7. Program Structure and Operation Method

7.1 Program basics

Program structure and execution

The program for the 2MLR PLC is configured with SoftMaster, compiled into an executable program, and transmitted to PLC for execution.

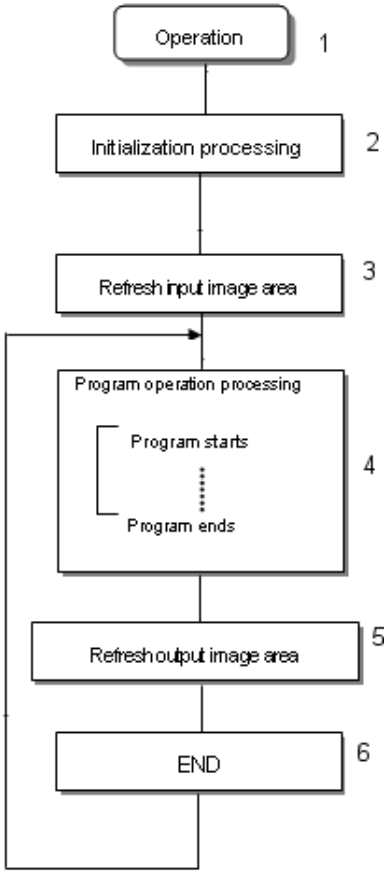
- The programs can be classified into scan programs and task programs. The scan programs are executed at every scanning, and the task programs are executed by a task.
  - Scan program: the program executed at every scan repeatedly
  - Task program: the program executed by task
- A scan program runs from the first to the last step registered in the project in the registered order, and terminates the scanning (END). The entire process is referred to as '1 scan'.
- The process methodology which runs a program from the beginning to the end and then runs the entire process again, is called 'cyclic operation method'.
- Before starting the operation of a scan program, the status of the input module is read and saved in the input image area, and the status of the output image area is entered in the output module when the operation of the scan program is completed. This process is called 'I/O Refresh'.
- 2MLR PLC series is based on the cyclic operation method. In the operation process, input or output status is not entered directly, but the operation is executed by I/O refreshing by scan unit basis. To this end, the statuses of the input and output contact points are stored in the memory area of the PLC. This area is called image area.



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 following figure depicts the scan program process.

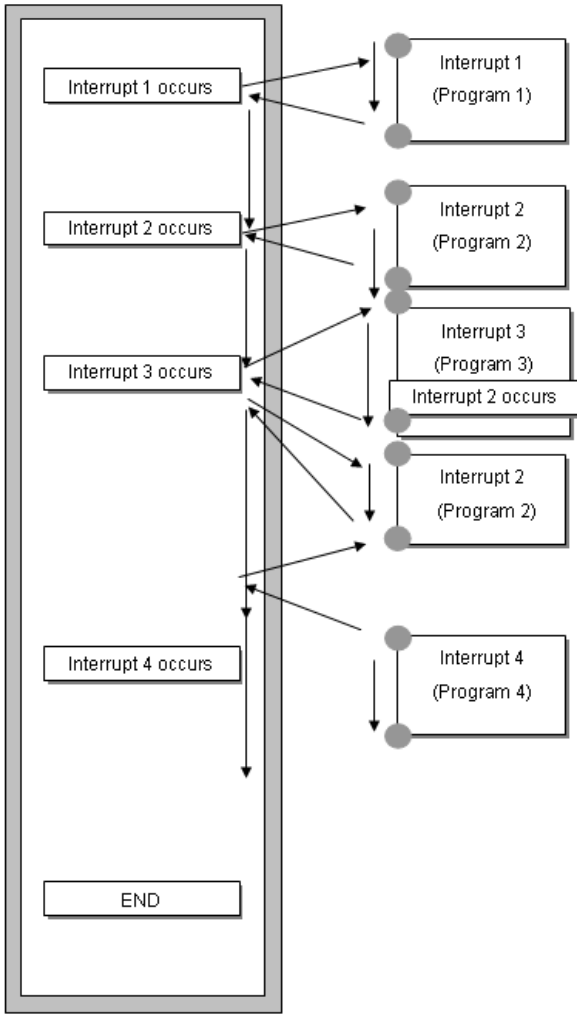


Stage	Processing Description
Operation	With the program downloaded into the PLC, the instruction from the user is received.
Initialization processing	The scan processing starts at this stage. It is executed every time when power is applied or when reset command is executed. It involves the following: • I/O module reset • Self-diagnosis execution

Stage	Processing Description
	• Data clear • Address allocation and type register of I/O module
Refresh Input image area	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 follows: • Update the current value of timer and counter, and so on. • Execute user event and data trace service. • Execute self-diagnosis. • Execute high-speed link and P2P e-Service. • Check the state of key switch for mode setting.
	 **ATTENTION** The data synchronization between master CPU and standby CPU begins after the start-up of the standby CPU.

Interrupt operation (time-driven, internal device)

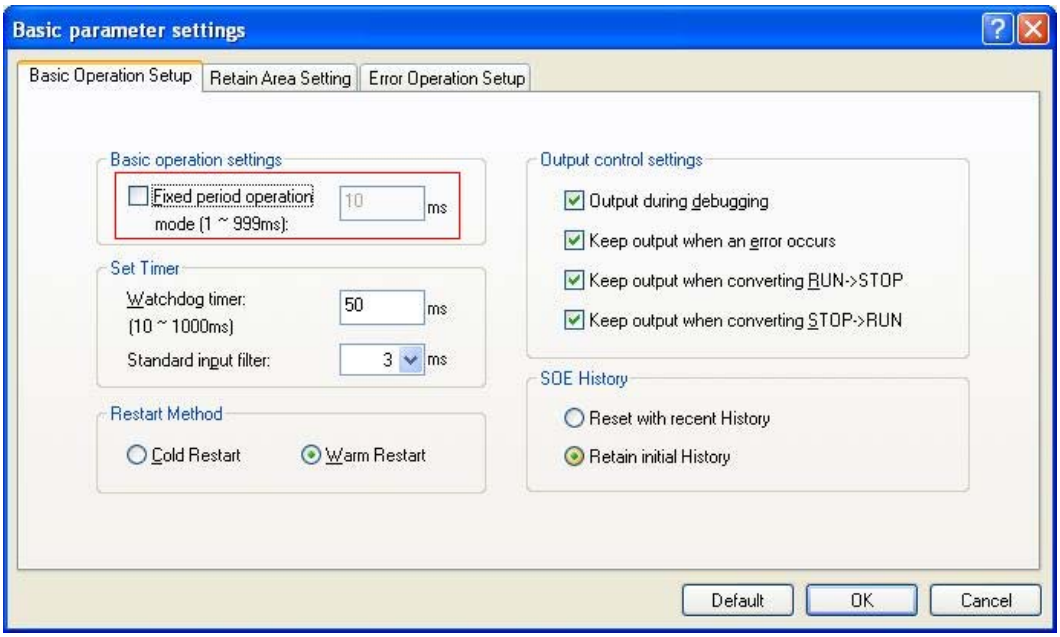
- In this method, if an interruption occurs, the program being executed on the PLC is temporarily stopped. The interrupt operation carries out a process corresponding to the interrupt subroutine and then returns to the main program being executed.
- The signal that informs the urgent interruption to 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 synchronization.

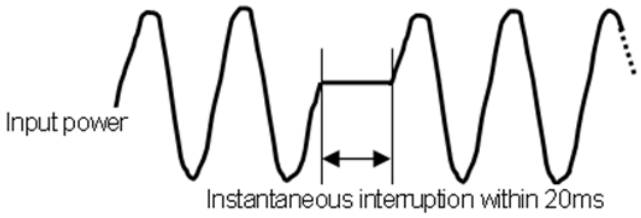
- In constant scan operation, the scan time indicates the net program processing time where the standby time is deducted. In case the scan time is greater than 'constant', '_CONSTANT_ER [%FX2140]' flag is switched ON.



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:

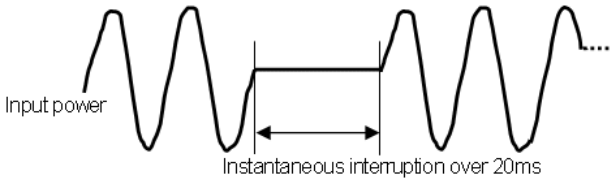
1. In case the instantaneous interruption is less than 20ms.



– CPU stops the operation and holds the output in the state when momentary power failure occurred.

- If the momentary power failure 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 may be executed normally.

2. In case the instantaneous interruption exceeds 20ms.



- Initialization occurs.
- In redundant operation, CPU switches over.

3. In case of redundant power supply, it carries out the operation as follows:
   - If one of the power supplies has instantaneous interruption, the system is not affected.
   - If both of the power supplies have instantaneous interruption less than 20ms, the behavior of the system is as per condition (1).
   - If both of the power supplies have instantaneous interruption for more than 20ms, the behavior of the system is as per condition (2).

TIP

Instantaneous interruption is momentary power failure means the state in which 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.

If both the power supplies in the Master base have an instantaneous interruption for more than 20ms, the system tries to switchover to the standby CPU.

Scan time

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

1. Operation and performance of MasterLogic-200R.

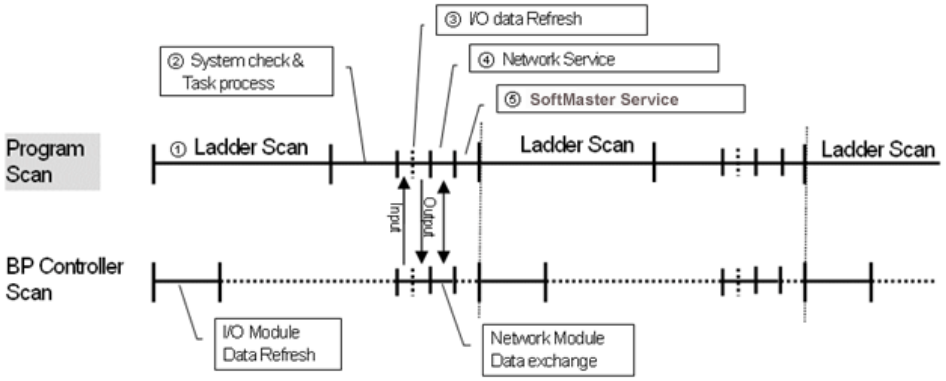
   The program execution time, I/O data process time and communication service time are important factors affecting the scan time.

   – The MasterLogic-200R 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		Extension Processing Time	BP Controller Processing Time		
	Ladder Execution (32kstep)	System Task	CPU-Extension Drive	Digital I/O Module (32 points, 1module)	Analog Module (8 ch, 1module)	Communication Module (basic/extension) (200 byte, 1 block)
CPUH	2.752 ms	1.0ms	Explained in the item 7.	20μs	75 us	170 + 44μs

Calculation of Scan Time (Single CPU operation).

The CPU module executes the scan program in the following sequence. You can estimate the scan time performance of a system using the following calculation.



- Scan time (μs) = Scan program process + system check and task process + I/O data refresh + network service + SoftMaster Service + user task program process + CPU–extension drive processing

  a) Scan program process = number of program steps created x 2 x 0.042 (μs)
  *Precise scan time requires in addition of processing time for used instructions.
  *x 2 refers to the number of average execution code per instruction step.

  b) System check and task process: 800μs ~ 1.0ms [parameter depending on the usage of auxiliary functions].

  c) SoftMaster service process time: 100μs at the maximum data monitor.
  *10% of maximum scan time, there is a setting in the connection settings to improve the process time.

  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 program.

  e) CPU-extension process time: Synchronization between CPU and extension drive module.
  *Basic process time (1500μs) + number of bases x 250μs + 1000μs per communication service (HS/P2P) + size of PUTGET (1000μs per 1000byte)

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:

(Two extension bases are used.)

Scan time(μs) = 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 2 x 0.042) + (20 x 6) + (75 x 6) + (185 x 8 x 4) + (100) + (1500 + 250 x 2 + 1000 x 4 + 1000)

= 14934μs

= 14.9μs

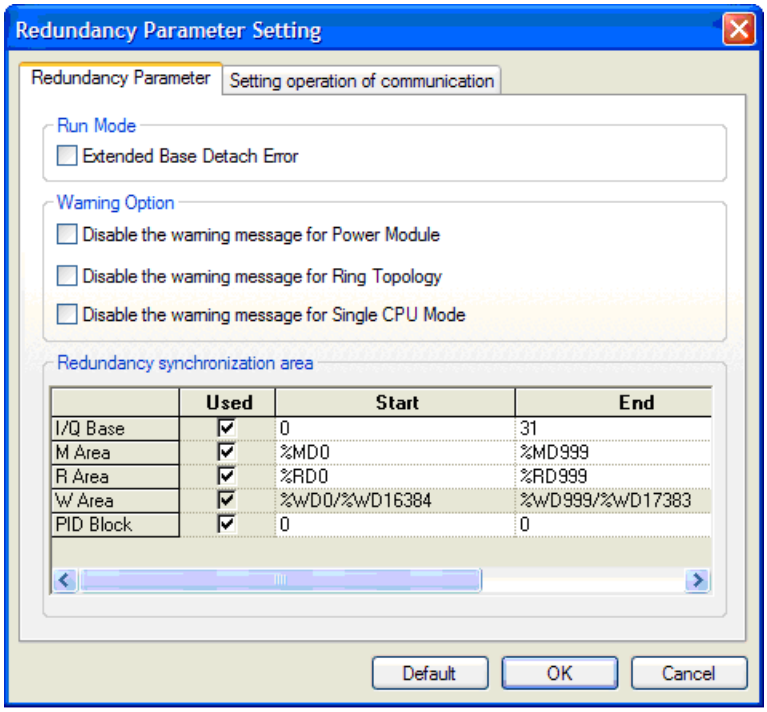
2. Scan time monitor.

   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).

3. Scan time during redundant operation.

   - During redundant operation, the data synchronization between the master and the standby CPU and the scan time varies with the data size that you set.



   - Synchronization data between CPUs: Basic data like system flag, communication flag, and so on. (2.8ms)
   - Redundancy synchronization area.

     a) I/Q base : 1ms/32 bases

b) M area : 250μs per 2kword (16ms for 128kword)

c) R area: 1.5ms per 2kword (12ms for maximum 16kword)
(If 2kword of R area is transferred, 2kword of W area is also transferred; hence, a total of 4kword is transferred.)

d) PID block : 0.5ms per block (4ms for 8 PID blocks)

Example:

The scan time of a system consisting of a CPU (program 16kstep) + 32 points, 6 I/O modules + 6 analog modules (PUTGET size of 1000byte) + 4 communication modules (200 bytes 8 blocks per module) is as follows:

(2 extension bases are used, 2kword of M area, 2 PID blocks)

Scan time = Single CPU execution time + Synchronization time

= Single CPU execution time + Sync system data + I/Q base + M area + R area + PID block

= 14.9 + 2.8 + 1.0 + 0.25 + 0.5x2

= 19.95ms

4. Delay in time, to operate in redundancy.

- If CPU is added for redundant operation during single CPU mode, the current scan time is momentarily increased by 10%, compared to scan time of single CPU mode. This is to synchronize the data to the standby CPU.

TIP

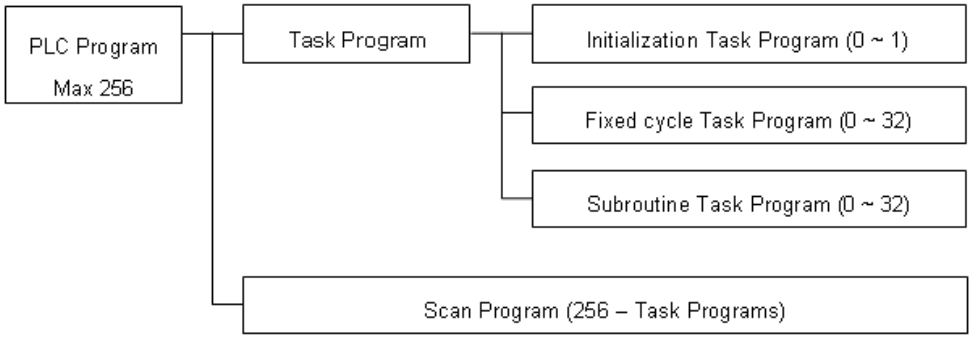
In single CPU mode including when the standby CPU is in stop mode, data between master and standby CPU is not synchronized, hence, data may be different from each other.

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 below.



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.

Task program

1. Initialization task program

The initialization task programs are used for system initialization when starting PLC operation in cold or warm restart mode.

During the execution of an initialization task program, the system operation status information flag _INIT_RUN is turned to ON.

The initialization task program executes cycle operation including I/O refresh until the _INIT_DONE flag is ON.

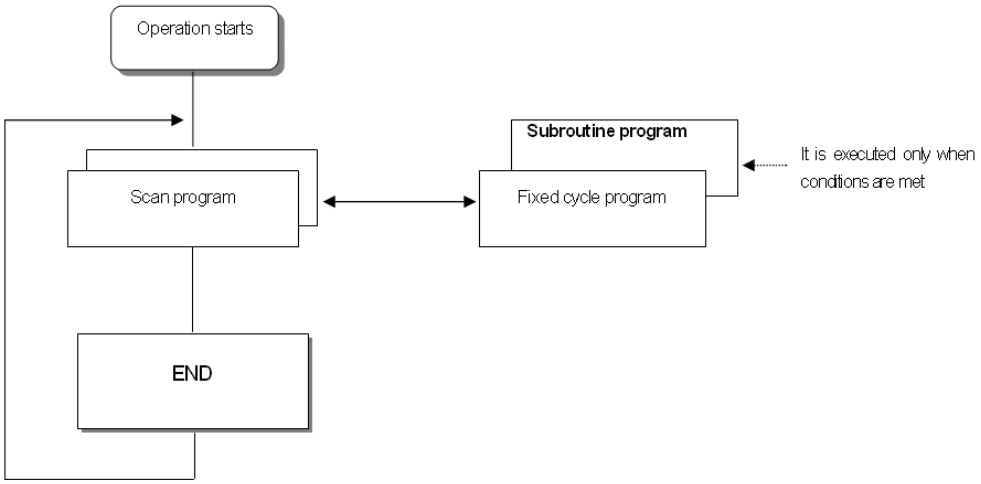
2. Fixed cycle task program

Fixed cycle task programs are executed in repetition with the cycle setup in the task.

3. Internal contact point task program

The internal contact point task programs are executed when such events such as rise, fall, transition, on, or off of the internal contact points occur.

The point of time of execution is determined by the condition of event occurrence after the completion of scan program.



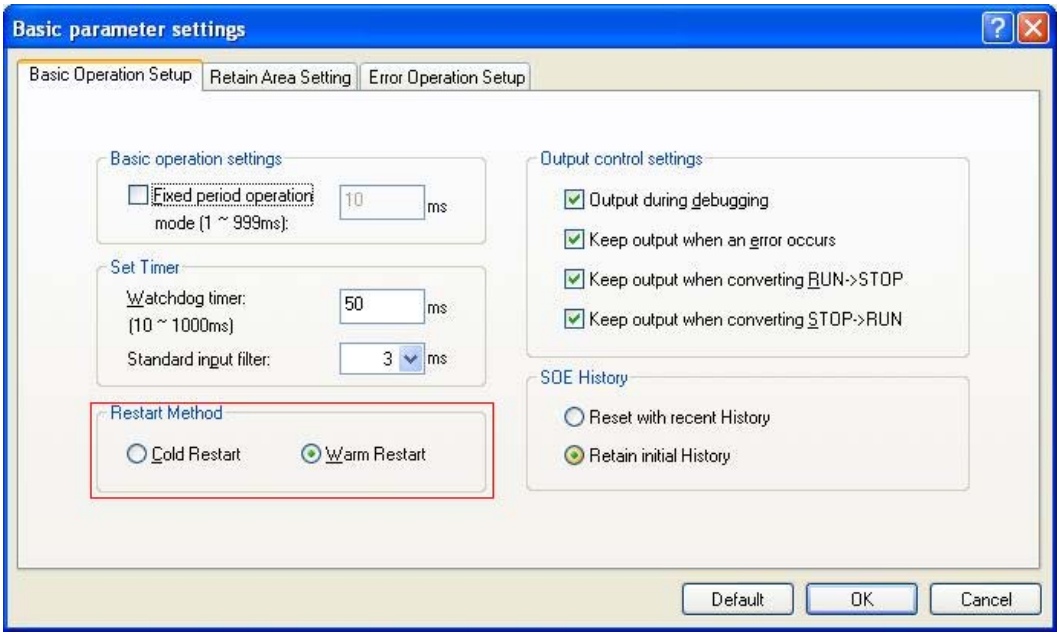
Scan program

- 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 the Scan Program, it stops the program being executed and executes the related interrupt service program.

Restart mode

The restart mode sets up the method of initializing variables and the system at the start-up of PLC operation.

Restart mode has two types; cold and warm restart, which can be set up in the basic parameters of the SoftMaster.



When the standby CPU starts up, it executes the initialization according to the restart mode and receives the program and data backup from the master. When set up in flash operation mode, it receives the flash data backup from the master too.

When the standby CPU is switched to master CPU during operation, it is not a restart, therefore, no further action is taken.

The conditions of the execution of the restart modes are as follows:

1. Cold restart

   - All data is reset (deleted) to '0'. Here, the 'all data' means the M area, R area, and automation variables. The flag area, such as PID, which does not belong to this category, is not deleted.
   - Only the variables whose initial values are set up are reset to the initial values.
   - Even though the parameter is set up to warm restart mode, at the first execution after changing the program to be executed, the next program is executed with cold restart mode.

- Press the manual rest switch for 3 seconds (same as the overall reset of the SoftMaster), the system will start in cold restart mode regardless of the set up restart mode.

2. Warm restart

- The data which was set up to maintain previous value maintains the previous value. The data which has user-defined initial value is reset to the initial value. Other data will be deleted to '0'.
- When set up in warm restart mode, at the first execution, after an interruption by program download or error, is started in cold restart mode.
- When set up in warm restart mode, if the data is abnormal (data was not maintained during a power failure), the system is started in cold restart mode.
- Press the manual reset switch for less than 5 seconds during power-on, same as the reset instruction in the SoftMaster, if the setting is warm restart mode, the operation begin in warm restart mode.

Data initialization according to the restart modes are as follows:

The variables related with restart mode are default, retain, and initialization variables. The method of initializing the variables in the execution of restart mode is as follows.

Mode / Variable	Cold	Warm
Default	Initialize to '0'	Initialize to '0'
Retain	Initialize to '0'	Maintain the previous value
Initialization	Initialize to user-defined value	Initialize to user-defined value
Retain and Initialization	Initialize to user-defined value	Maintain the previous value

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 and internal device signals.

The following are the two types of task programs.

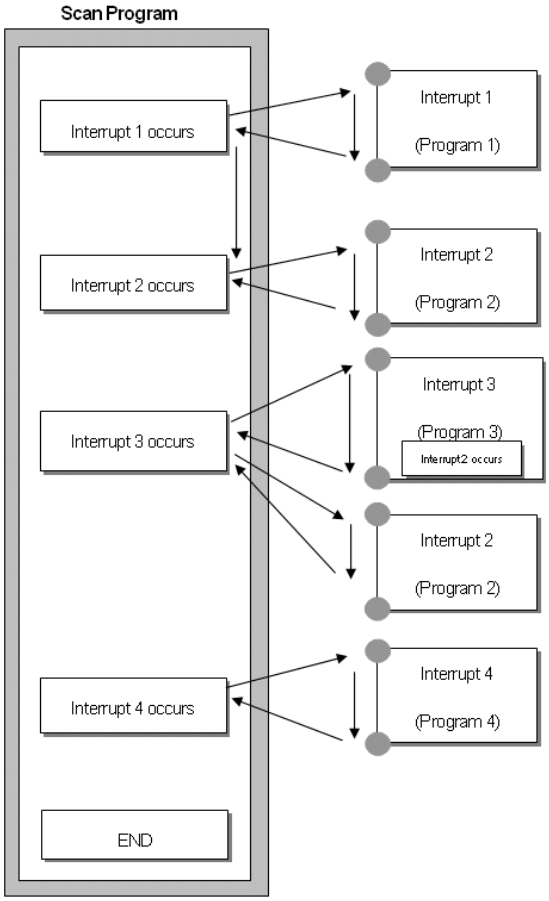
- **Time-driven interrupt task program** – Executes according to fixed time intervals.
- **Internal device interrupt task program** – Executes when condition of internal device occurs. The device start condition is detected after the scan program.

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, refer to *SoftMaster User's Guide*.

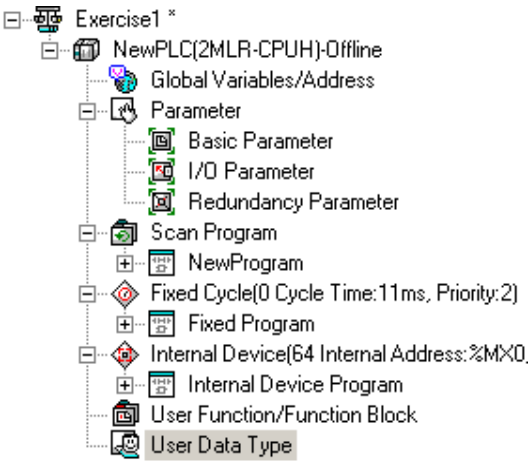


TIP

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 in 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, refer to *SoftMaster User's Guide*.

Task types

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

Spec. \ Type	Initialization	Fixed Cycle Task Parameters that can be Configured using SoftMaster and their Functions are as follows: (Interval task)	Internal Contact Task (single task)
Number	1	32	32
Operation condition	When entering RUN mode, prior to start scan program	Fixed cycle (Can be set up to 4294967.295s at the unit of 1ms).	Conditions of internal device designation.
Detection/execution	Execute until the flag _INIT_DONE is ON	Cyclically execute at the pre-defined interval.	Execute by conditional search after completing scan program.

Type / Spec.	Initialization	Fixed Cycle Task Parameters that can be Configured using SoftMaster and their Functions are as follows: (Interval task)	Internal Contact Task (single task)
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	-	Assign it between 0~31, so that it is not duplicated.	Assign 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 10s of fixed cycle is used with a timer and a counter, the timer may have a maximum error of 10s, while the counter checks every 10s. Any counter input changed within 10s 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 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'.

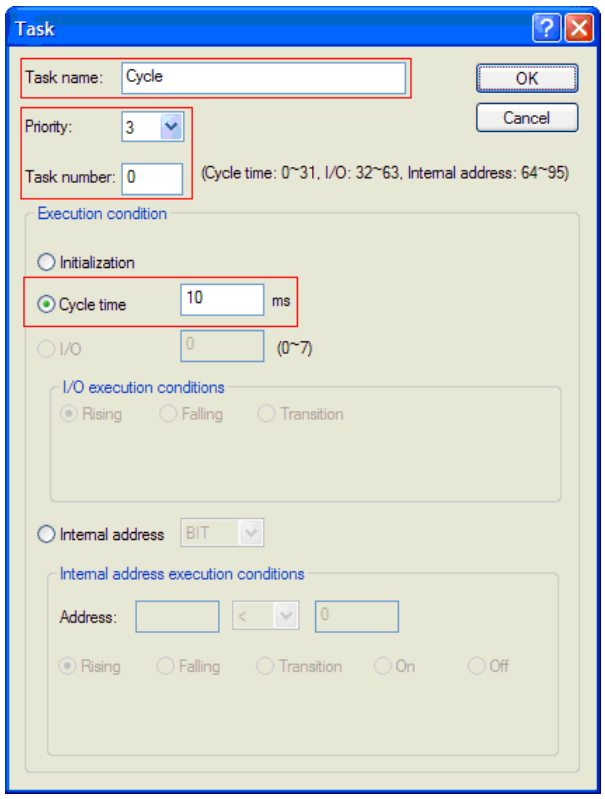
TIP

If a task program priority is identical, the program execution follows the order in which the task programs are 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 you are using four fixed cycle task programs, of which the cycle is 2, 4, 10, and 20s, respectively, it may have simultaneous execution of four programs every 20s. 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.
   - In SoftMaster, Click **Project** > **Add Item** > **Task**.
   - Set the 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, after 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 and verify it.

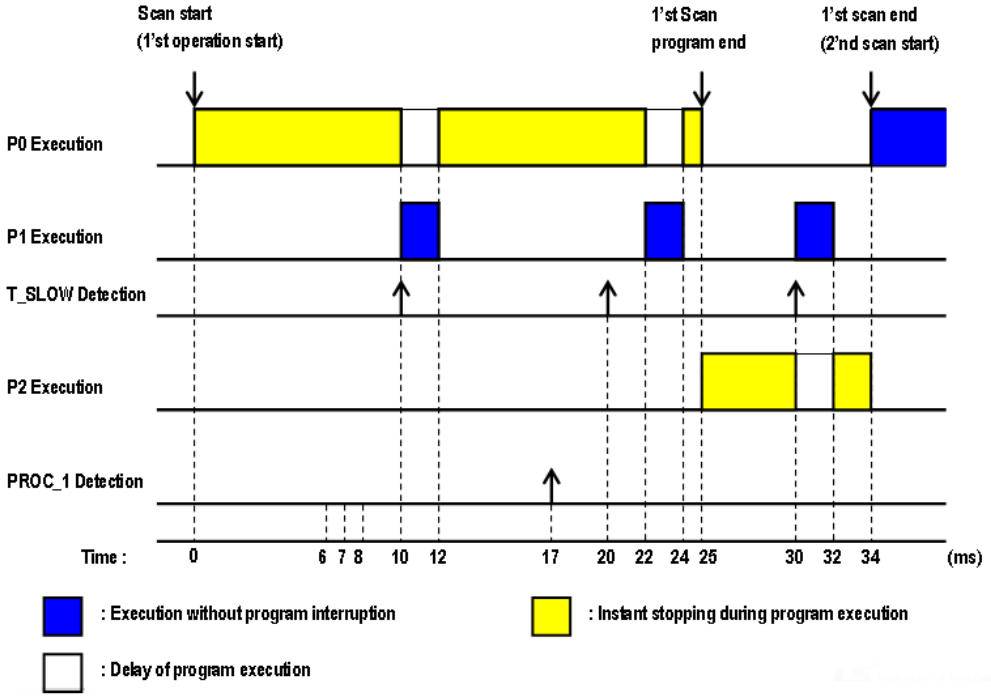
1. Is the task set properly?
   - If a task occurs excessively or several tasks occur simultaneously in a scan period, it may cause longer scan time or irregularity. If a task setting cannot be changed, check the maximum scan time.
2. Is the task priority well arranged?
   - A low priority task program 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 recommended to set 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.

Time (ms)	Processing
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 2MLR-CPUH has three operation modes. Each mode describes the operation process at each operation mode.

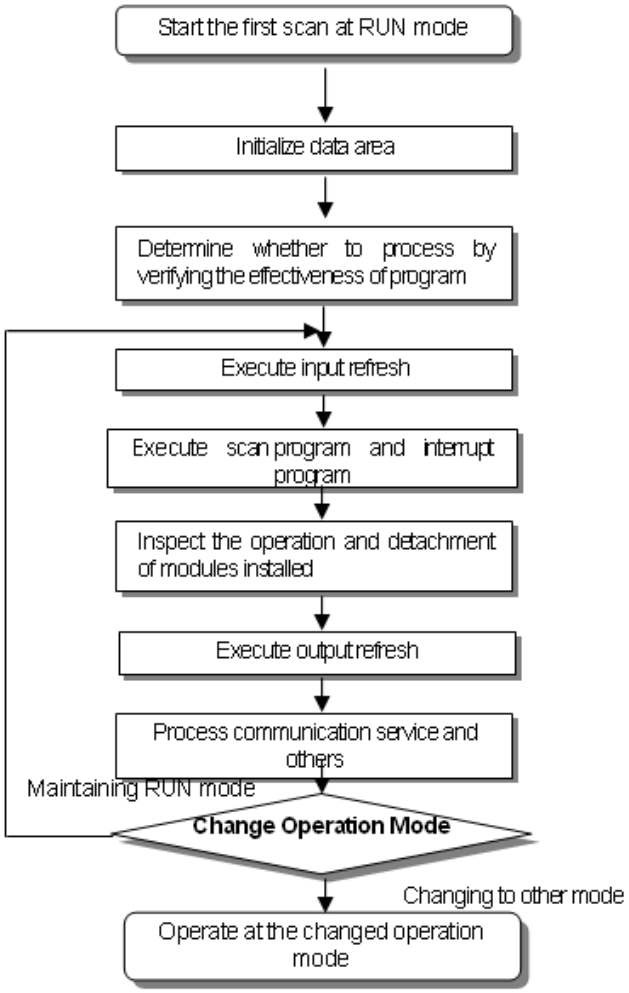
- RUN mode
- STOP mode
- DEBUG mode

RUN mode

The CPU executes a program operation normally.

WARNING

Changing the operation mode can energize 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 for finding errors from a program or tracing an operation procedure. The DEBUG mode can be changed only from the STOP mode. In the DEBUG mode, you 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.

  The following are the 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 in 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, refer to Debugging in *SoftMaster User's Guide.*

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 energize the field and may cause serious threat to human life.

Setting operation mode

Mode Key Switch	Operation Mode
RUN	Local RUN
STOP	Local STOP
STOP → REM	Remote STOP
REM → RUN	Local RUN
RUN → REM	Remote RUN
REM → STOP	Local STOP

Setting remote operation mode

The operation mode can be set as follows:

Mode Key Switch	Mode Change	SoftMaster Command	By Communication Command
REM	Remote STOP → Remote RUN	OK	OK
	Remote STOP → DEBUG	OK	N/A
	Remote RUN → Remote RUN	OK	OK

	Remote RUN → DEBUG	N/A	N/A
	DEBUG → Remote STOP	OK	OK
	DEBUG → Remote RUN	N/A	N/A

ATTENTION

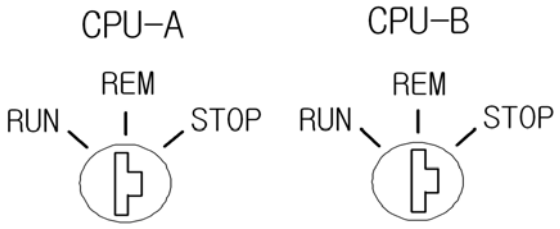
While changing the remote ‘RUN’ mode to ‘RUN’ mode using the switch, the PLC operates continuously, without suspension.

Editing during the RUN is possible in the ‘RUN’ mode by switch. But the mode change is restricted by SoftMaster. Set local RUN mode only when you want to keep remote mode change.

7.4 Redundant system operation

Redundant operation mode

In a redundant system, there is a synchronization cable for data transfer between CPUs and each CPU module has a key switch.



The following table defines the operation status of redundant system.

Sync Cable Between CPU	Current Status	CPU-A(B) Operation Mode	CPU-B(A) Operation Mode	Remarks
Connected	Standalone Operation	RUN	STOP	CPU-A or CPU-B is in RUN mode.
	Redundant Operation	RUN	RUN	CPU-A and CPU-B is in redundant operation mode with master and standby configuration.
	STOP	STOP	STOP	CPU-A and CPU-B is in redundant operation mode but operation is in STOP mode.
Disconnected	Standalone Operation	RUN/STOP	-	Single CPU mode.

ATTENTION

To configure redundant operation by adding a standby CPU to a single CPU in operation, follow these steps:

- Configure the standby base with the same configuration as the master base with power supply OFF.
- Mount standby CPU module in the CPU slot.
- Connect the sync cable and the extension cable.
- Turn ON the power supply for standby base.
- Change the operation mode switch to the local RUN, which operates standby CPU to a redundant mode.
- Standby CPU may be in redundant operation mode, to run with the same program.

1. Change in redundant operation mode

The redundant operation mode is changed by SoftMaster and key switch.

Status	Mode Change		Remarks
	Master	Standby	
Single Operation (RUN/STOP)	RUN → STOP	Remain in STOP	If master CPU is in STOP, the system is in STOP status.
	(No change: RUN)	→ RUN	If standby CPU is in RUN mode, the system is operated in redundancy mode.
Redundant Operation (RUN/RUN)	→ STOP	(No change: RUN)	If master CPU is in STOP, standby CPU takes over the master and the system is in single CPU mode.
	(No change: RUN)	→ STOP	If standby CPU is in STOP, the system is in single CPU mode.
Operation in STOP (STOP/STOP)	→ RUN	(No change :STOP)	CPU which is changed to RUN mode, is a master CPU and the system is operated in single CPU mode.

2. Change in master during redundant operation

- Condition for automatic switchover

i. Power supplies of master is turned OFF

ii. Master CPU is in STOP due to faulty operation

iii. Module is detached from the master base

iv. Fault in the CPU (CPU detach)

v. Module in the extension base is detached

vi. System error in the master CPU (abnormal completion of CPU and scan watchdog error)

- Condition for manual switchover

i. Key switch in the master CPU is set to STOP

ii. CPU mode is changed to STOP by SoftMaster

iii. Master switchover command from SoftMaster

iv. MST_CHG instruction

v. Module in the extension base is detached

vi. System error in the master CPU (abnormal completion of CPU and scan watchdog error)

- Condition in which switchover does not take place

i. Failure in redundant power supply

ii. Standby CPU is already faulty when there is a fault in the master CPU
- The system stops, if the same fault occurs.
- Switchover does not take place, if there is a mask flag set for error.

iii. Standby CPU is not in RUN mode

Startup of redundant system

1. Creating a program
   - Create a program using SoftMaster
   - Write program to PLC
2. Startup method
   - By local key

     After setting a key switch to REM and write the program to PLC, set a key switch to RUN.
   - By SoftMaster

     After setting a key switch to REM, select RUN in the Online menu.
   - By turning on the power supply
     Set the key switch to RUN and turn on the power supply. If the system is in remote RUN before the shutdown, turning on the power supply starts the system operation.
   - By reset

     There are two ways to restart the system: Reset and Overall reset
     i) Reset: Press the reset switch in front of CPU module for less than 3s and dot matrix of CPU module shows RST. This has the same effect as the power on/off.

     ii) Overall Reset: Press the reset switch for more than 3s and dot matrix of CPU module shows RSTC. The system restarts in the cold restart mode.
3. Initial startup

   This is the system settings and startup method for the very first operation.
   - Create a required program.
   - Set synchronization area in the redundancy parameter.
   - When program is completed, check for availability by compiling.
   - Download the program using a communication port in the CPU module.
   - Change the Master CPU to a RUN mode using a key switch or SoftMaster.
   - Change the Standby CPU to a RUN mode and enable redundant operation.

- Stop Master CPU and check for switchover.

4. Standby CPU participation in redundant operation

Synchronizes the standby CPU as per the following method:

- Initialize CPU *.
- Check for redundant configuration *.
- Transfer fixed data from the master CPU *.
- Transfer variable from the master CPU **.
- Check for synchronization **.
- Operate in redundant mode at the same time as the master CPU **.

ATTENTION

Redundant operation mode and parameter settings are described in the Redundant System Operation Mode section.

* indicates the tasks are executed separately so that each scan time does not exceed 50ms.

** indicates the tasks are executed at every scan and do not exceed a scan time of 50ms. (Around 50ms can be exceeded with number of variables exceeding the standard value. Refer to section, Scan time.)

5. Details of standby CPU participation in redundant operation

a) Turn ON the power supply.

- Check for master CPU operation.
- Check for Standby participation mode.
- Check for CPU self-diagnosis.
- Check for Program transfer from master (record in RAM, memory module).

b) Check for redundant configuration.

- Check for IO access.

- Check for IO module information transferred from master.
- Scan IO module information in the standby.
- Compare with IO parameter settings.

c) Transfer fixed data from master.

- Receive flag details from master (separately transferred, if necessary).
- Check if flags are unchanged and proceed to step (d).

d) Transfer variables from master.

- User data area and system buffer.

e) Check for synchronization with master.

- Synchronize internal operation details of CPU.

f) Operate in redundant mode at the same time as the master CPU.

- Start at input refresh.

6. Operation by startup condition.

a) Normal startup.

Master CPU checks for system configuration when the power is supplied. When the power supply is delayed for extension base, the base is displayed in the dot matrix as 'Eb-xx' and waits for power supply.

For stop mode, the system changes to stop mode after 10s.

- Initial operation starts with cold restart after the change in program.
- The system which is stopped in a normal condition restarts as per parameter settings (Example: Key switch, SoftMaster, Power on/off and reset).
- To restart the system previously set in warn restart mode to a cold restart mode, reset key, SoftMaster, Overall reset may be used.
- In case operation is stopped by an error, restart method is determined by type of error or error remedy. (Refer to section Troubleshooting).

b) In case of I/O skip

- The error check does not include the module with I/O skip and the module is in operation only when I/O skip is removed. Refer to I/O module skip function .

c) In case of fault mask

- The error check includes the module with fault mask. However, the operation continues if there is a module mismatch error. Refer to Fault mask function .
- If whole base is masked with base power turned off, CPU is in wait status for the power supply.

7.5 CPU memory

Overview of CPU memory

The CPU module contains two types of memory that you can use.

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

Program memory

The total program memory area is 25MB. The storage capacity and data area type of the program memory are as follows:

Memory Specification	Memory size	Remarks
Built-in Flash Memory	16MB	For program and data backup
Program Memory	7MB	For program execution, upload, system parameters
Data Memory	2MB	Direct variables and symbolic (named) variables

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

Item (area)		Capacity
	P2P flag	42KB
Input image area (%I)		16KB
Output image area (%Q)		16KB
R area (%R)		128KB
Direct parameter area(%M)		256KB
Symbolic parameter area (Maximum)		512KB
Stack area		256KB
Total		2MB

Data retain area setting

The default (auto.) parameter RETAIN is used for saving 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
%A, Auto-allocated	O	Retain can be set, if adding a parameter to the auto parameter area.
%M	O	Retain can be set, into internal contact area by parameter.
%K (PID)	X	Contact that is kept as contact status, in case of interrupt.
%F	X	System flag area.
%U	X	Analog data register (retain cannot be set).

Address/Memory Area	Retain Setting	Feature
%L	X	High-speed link/P2P service status contact of communication module (always retained).
%N	X	P2P service address area of communication module (always retained).
%R	X	Exclusive flash memory area (always retained).

TIP

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

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

%K, %L, and %N address/memory areas can be deleted in the memory deletion window of PLC, on **Online** menu in SoftMaster:

Click **Online > Clear PLC** > **Clear Memory** to delete memory.

REFERENCE - INTERNAL

For additional information on data retention, refer to Online section in *SoftMaster User's Guide*.

Data initialization by restart mode

There are three parameters related to the restart mode: DEFAULT, INITIALIZATION, and 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 (3s and longer: Overall Reset).
- RESET by SoftMaster (Overall Reset).
- Deleting memory at STOP mode by SoftMaster.
- Configuring by initialization task

To configure:

  - In the project tree, right-click the offline CPU, click **Add Item** > **Task**.
  - Select the **Execution condition** as Initialization.

- Writing '0' FILL in the monitoring mode in SoftMaster.

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 3s, six 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 (3s)	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 is not set to maintain the initial/previous value.
- Initialization (INIT) variable: A variable is set to maintain the initial value.
- Retain variable: A variable is 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 in every 6 months.

Checklist		Judgment Basis	Actions
Power supply		Within the power variance range. (Between –15% and +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 shaken.	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.

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 the LED is ON.	LED On (off is error).	Refer to Performance specifications.
	RUN LED	Check whether the LED is ON in RUN state.	LED On (off or blinking is error).	
	STOP LED	Check whether the LED is Off in RUN state.	Blinking is error.	
	Input LED	Check whether the LED is On or Off.	LED On with input ON and LED Off with input OFF.	
	Output LED	Check whether the LED is On or Off.	LED On with output ON and LED Off with output OFF.	

Periodic inspection

Check the following items once or twice in 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 (environmental 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.

Checklist	Check Method	Judgment Basis	Actions
Fuse	Visual inspection.	• No fuse blown condition.	To be replaced regularly because element may have deteriorated due to inrush current.

9. Troubleshooting

9.1 Introduction

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

9.2 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).
    a) Power On/Off status.
    b) I/O device status.
    c) Wiring status (I/O wiring, extension, and communication cable).
    d) The status of each displays (POWER LED, RUN/STOP LED, I/O LED, and so on), connect to peripherals, and check the operation condition and program.
2. Check for any abnormality.

    Observe how a fault changes by executing the following:

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

    Estimate by which factor, a fault occurs:

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

9.3 Troubleshooting

Basic trouble shooting procedure

To improve the reliability of a system, it is important to take a corrective measure promptly if a trouble occurs, as well as to use highly reliable devices. To operate a system immediately, it is the most important to quickly detect potential causes of a trouble and take corrective measures. To troubleshoot the system correctly, make sure to take the following cautions and procedures.

This section describes the troubleshooting scenarios, common faults, and error codes associated with the PLC.

Check by visual inspection

Check the followings visually:

- Operation status(Stop, Run)
- Power On/Off status
- I/O device status
- Wiring status(I/O wiring, extension, and communication cable)
- Check the status of each display (POWER LED, RUN/STOP LED, I/O LED and so on), connect to peripherals, and check the operation condition and program

Check any abnormality

Observe how a fault changes by executing the followings.

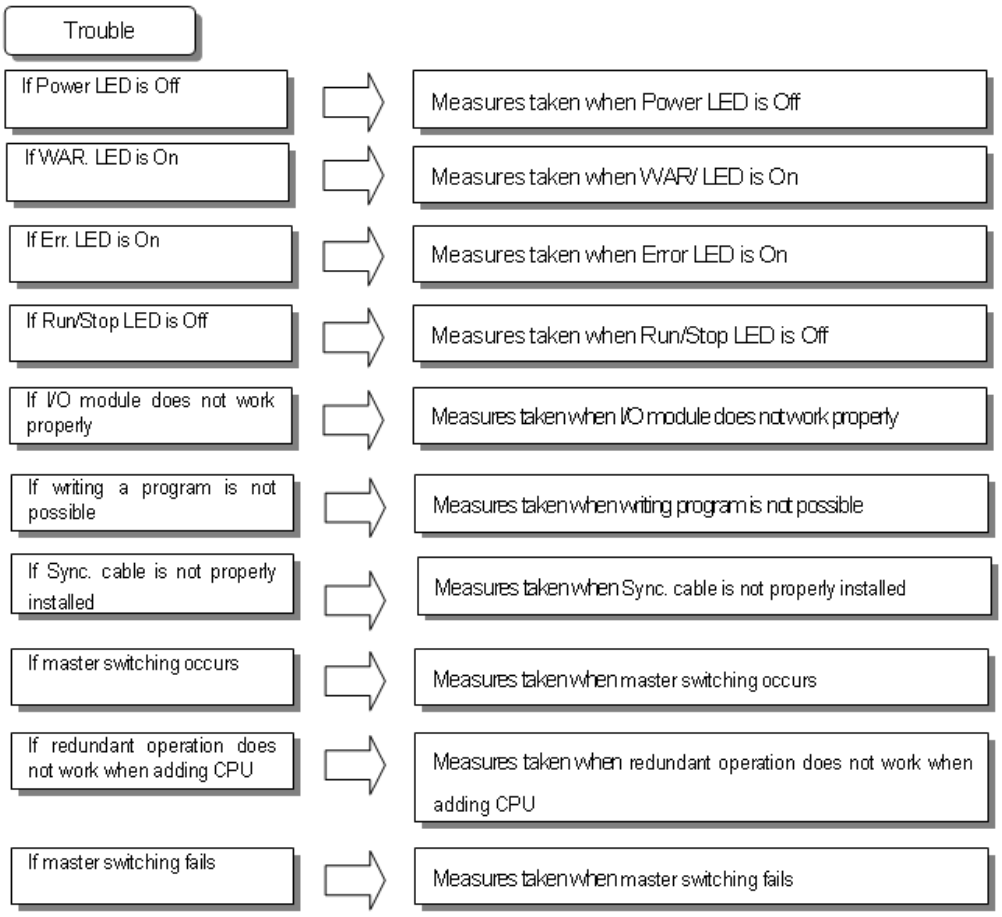
- Move the key switch to STOP and turn it On/Off

Restricting range

Estimate by which factor a fault occurs by the following methods.

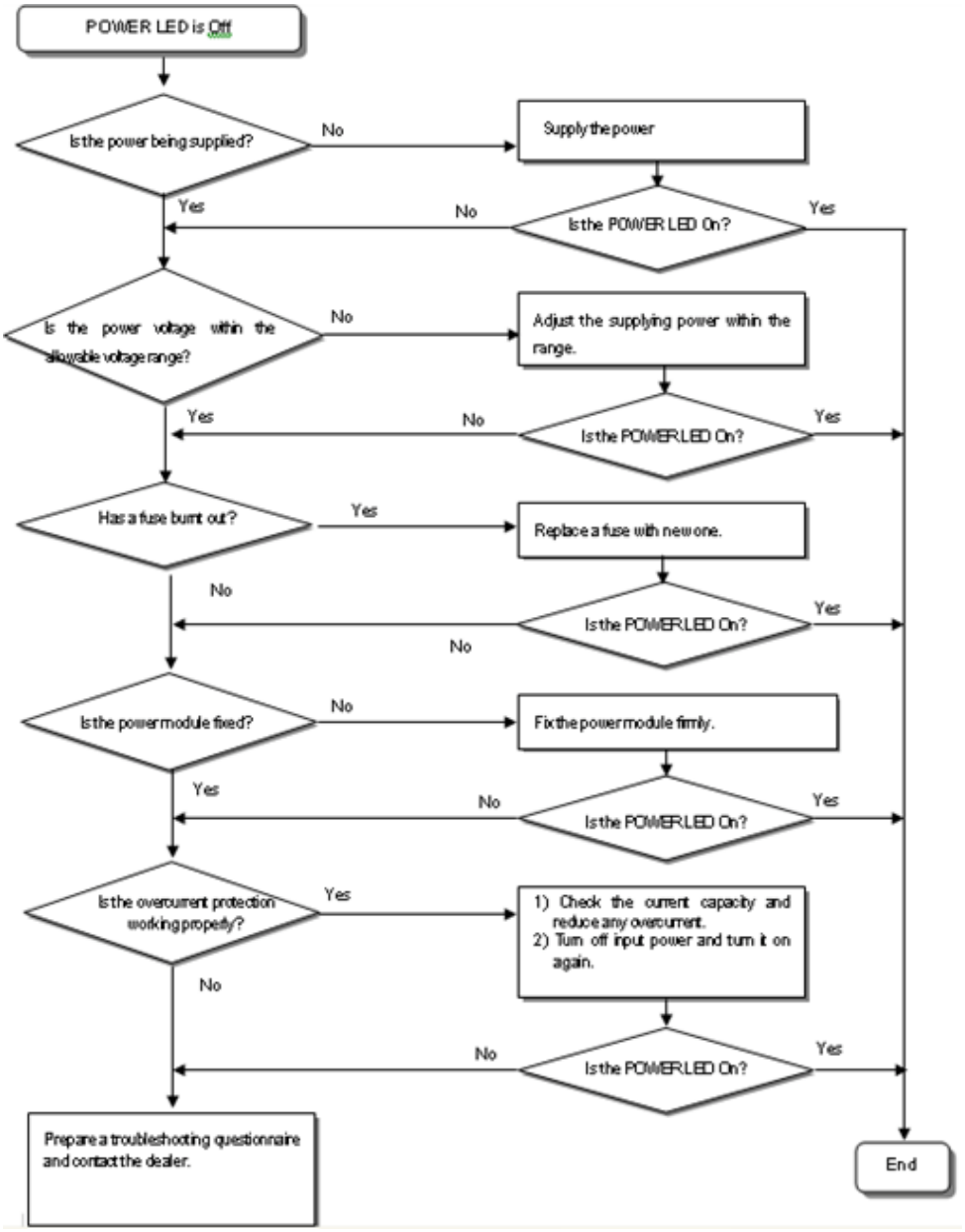
- Is it from the PLC or external factor?
- I/O module or others?
- PLC program?

The above stated detection methods, description for error codes, and measures are explained in the following procedure.



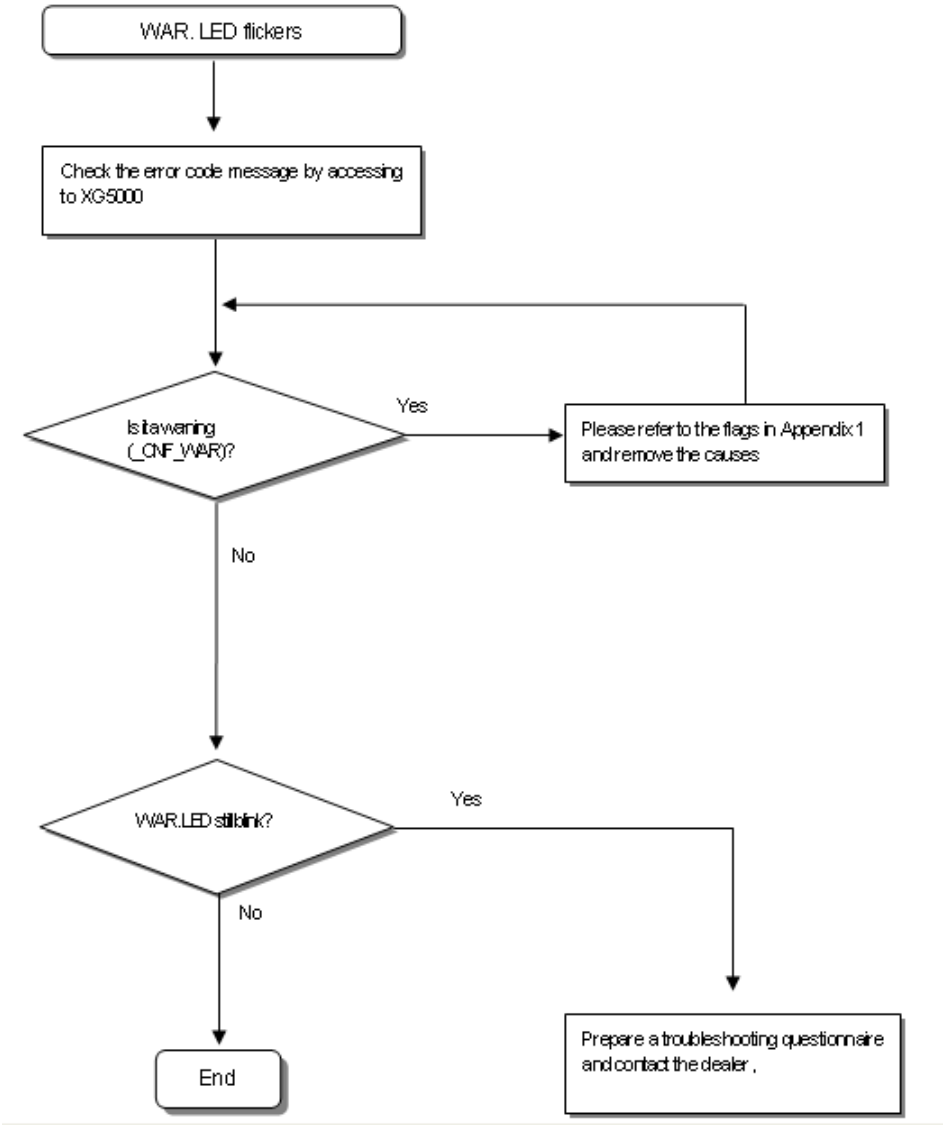
Action when POWER LED is OFF

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


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
No
Is the POWER LED On?
Yes
Is the power module fixed?
No
Fix the power module firmly.
Yes
No
Is the POWER LED On?
Yes
Is the overcurrent protection working propetly?
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 WAR (Warning) LED is ON

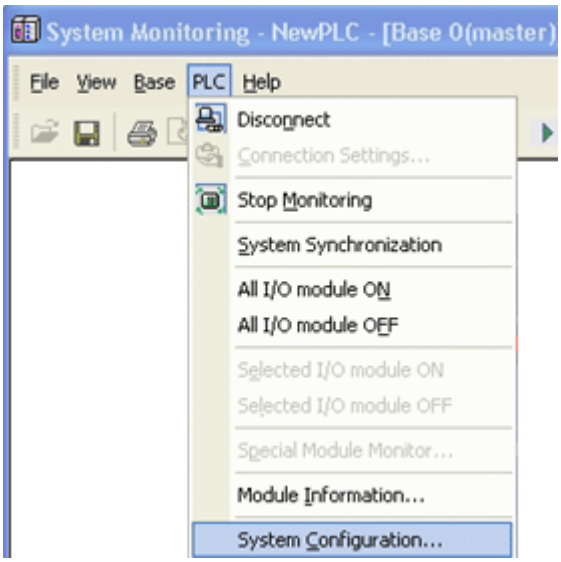
This section describes the orders of taking a measure if WAR.LED is On, when turning it on, starting operation or operating.



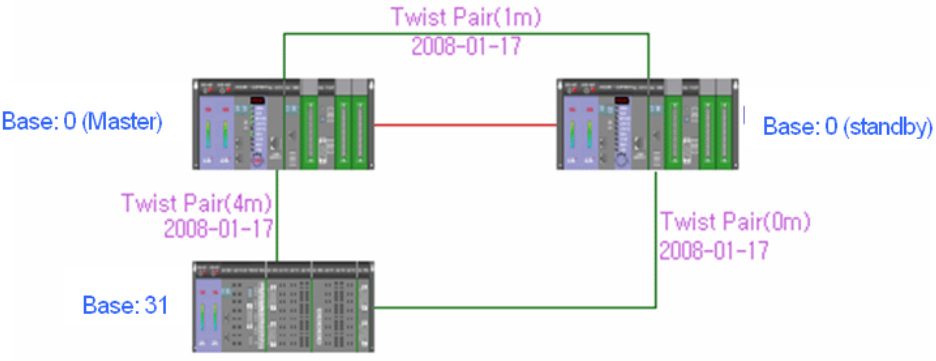
CAUTION	If warning error occurs, the PLC system does not stop but it is necessary to check the error message and take a corrective measure or it may cause an error.

It describes measure when WAR.LED is on because redundant system runs in single or configure b line mode.

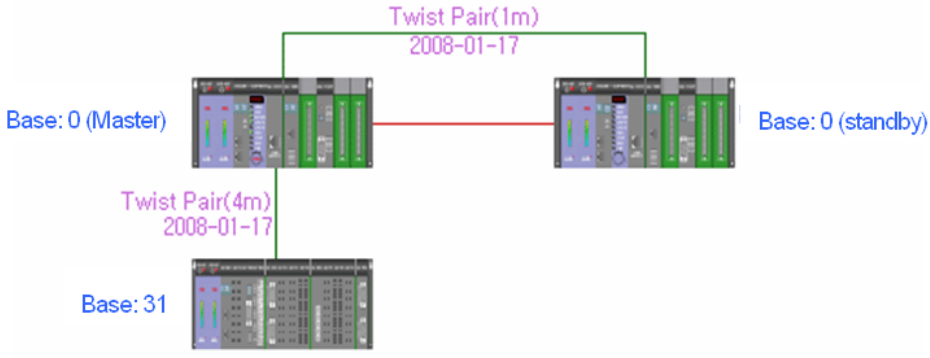
1. Connect to SoftMaster.
2. Click **Monitor** > **System Monitoring**. The System Monitoring window appears.
3. Click **PLC** > **System Configuration** as shown below..



The following figure illustrates system configuration (in case of ring configuration).

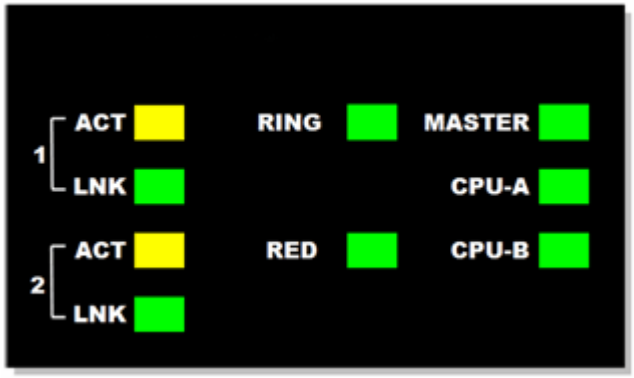


The following figure illustrates system configuration (in case of line configuration).

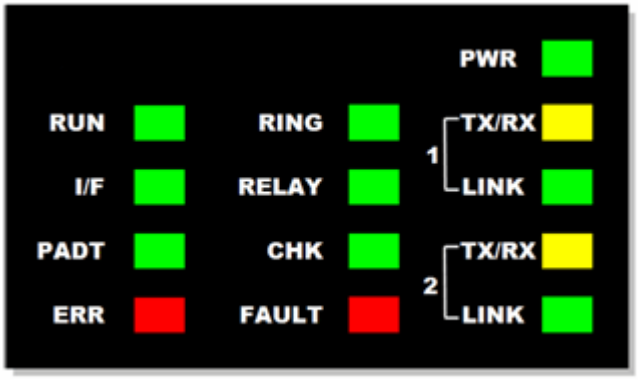


In case system is configured as ring, basic base and extension base is displayed by ring like structure. In case system is configured as line, disconnection between bases is displayed. This can be checked by LED. In case system starts with line topology, RING LED turns off. In case it starts with ring topology and it changes the topology to line, RING LED flickers

The following figure illustrates the CPU module LED.

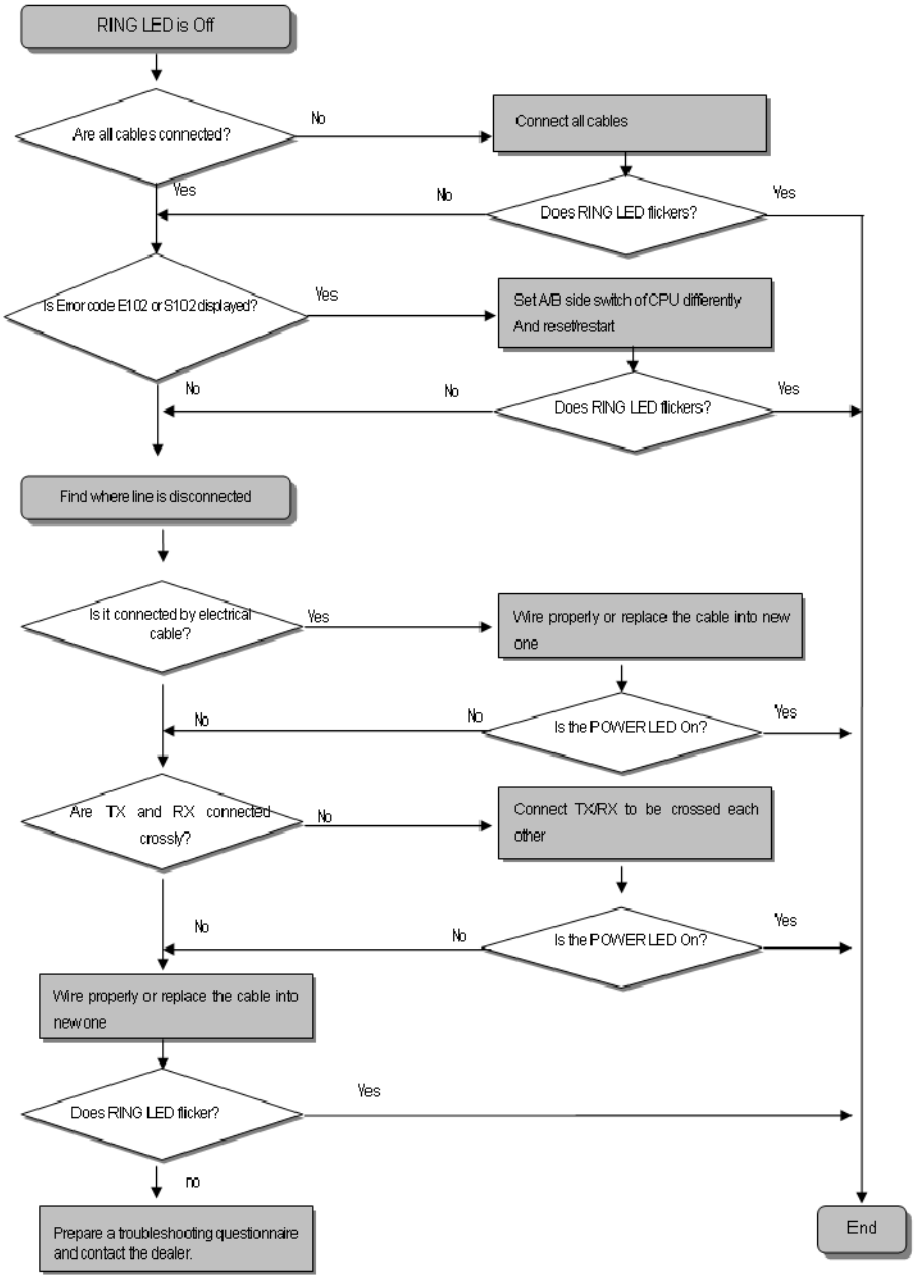


The following figure illustrates the extension drive LED.



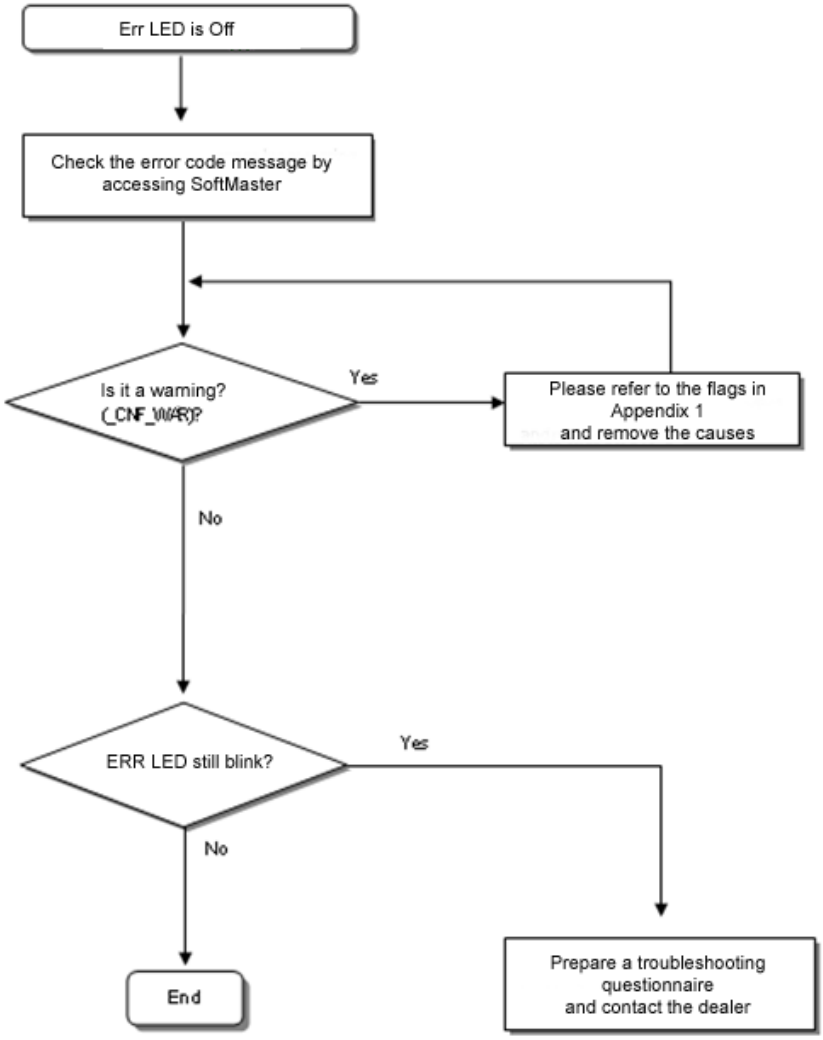
CAUTION	Since optical cable consists of two couples unlike electrical cable, TX and RX can be changed in case of installation. Make sure that direction of TX and RX does not change (TX should be connected with RX, and RX with TX.)

The following figure depicts the sequence of recommended steps, if RING LED is OFF or flickers when turning it ON, starts operation.


RING LED is Off
Are all cables connected?
No
Connect all cables
Yes
No
Does RING LED flickers?
Yes
Is Error code E102 or S102 displayed?
Yes
Set A/B side switch of CPU differently And reset/restart
No
No
Does RING LED flickers?
Yes
Find where line is disconnected
Is it connected by electrical cable?
Yes
Wire properly or replace the cable into new one
No
No
Is the POWER LED On?
Yes
Are TX and RX connected crossly?
No
Connect TX/RX to be crossed each other
No
No
Is the POWER LED On?
Yes
Wire properly or replace the cable into new one
Does RING LED flicker?
Yes
no
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.

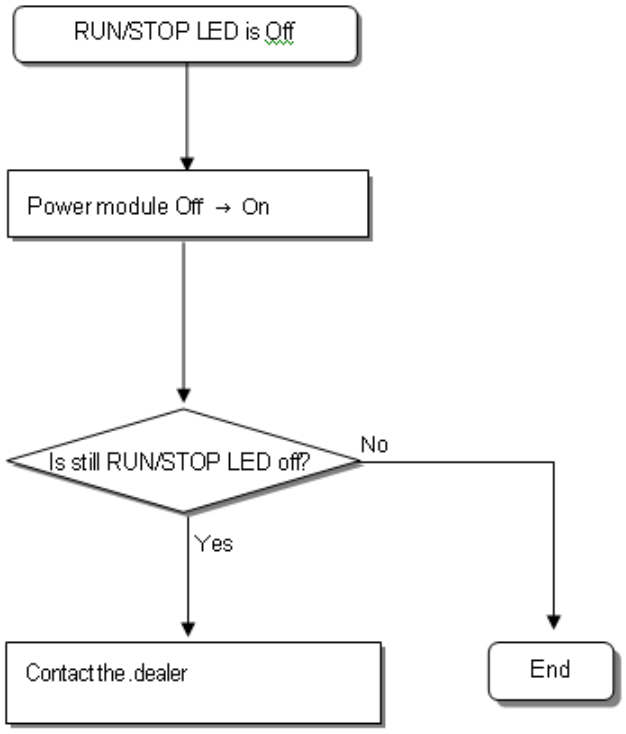


ATTENTION

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.

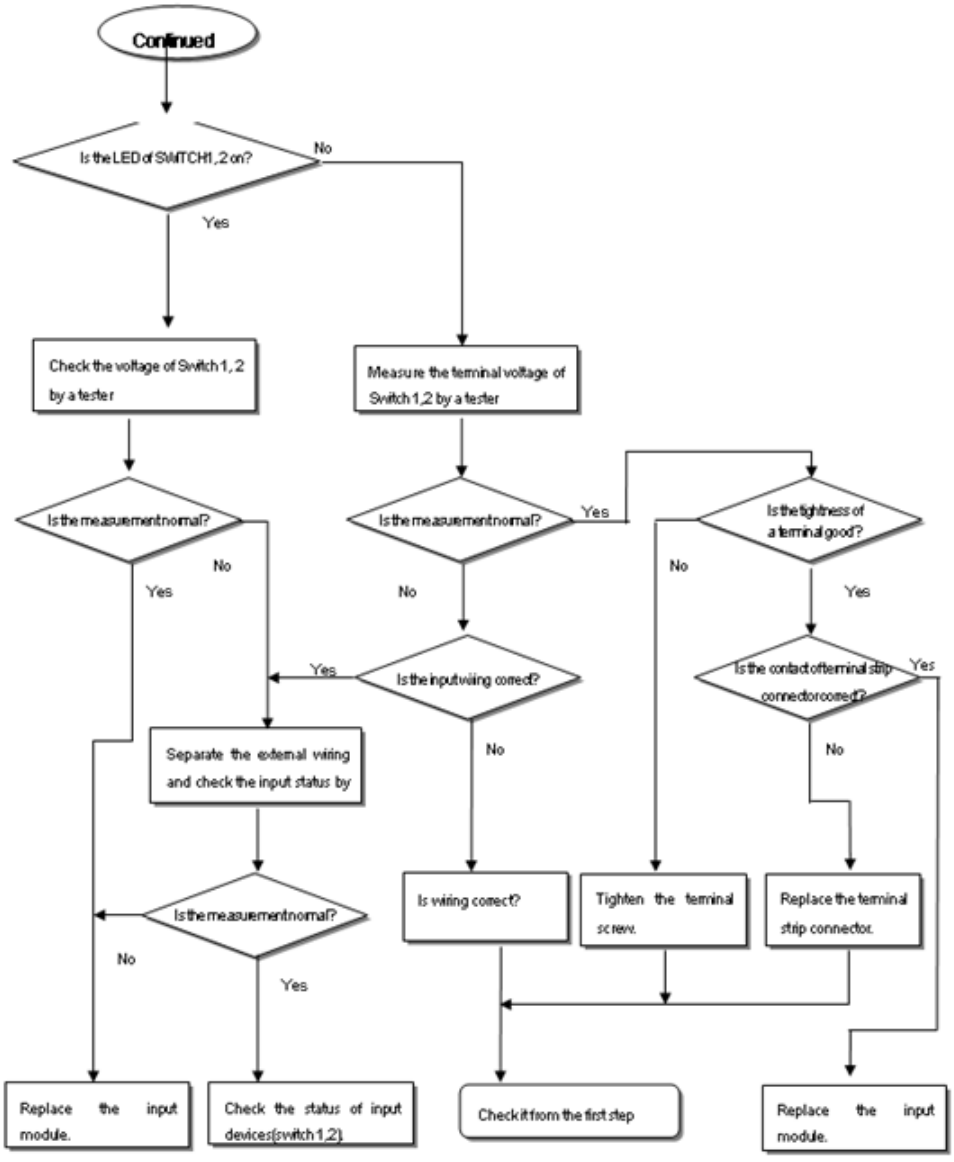


Action when I/O module does not function properly

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.

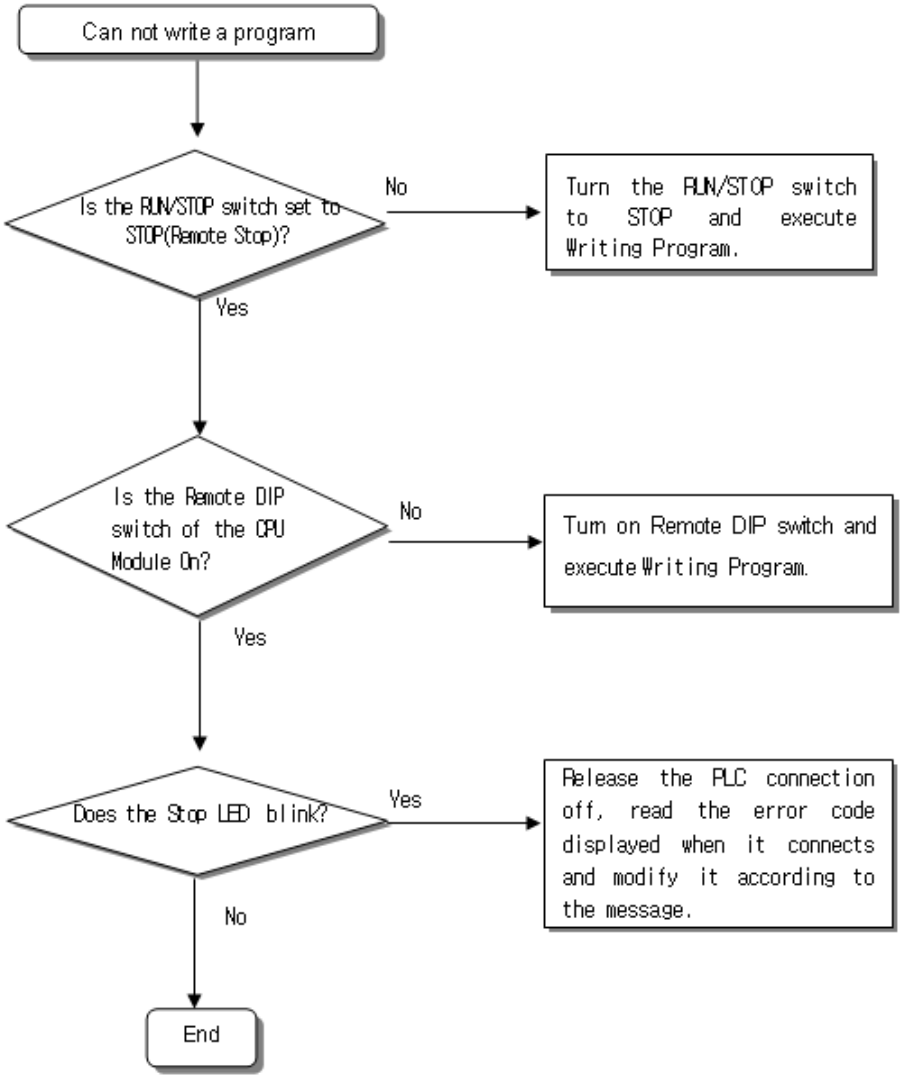

SWITCH1
SWITCH2
SOL1
SOL1


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 SCL1 by SoftMaster
Is the measurement normal?
No
Is the output wiring correct?
No
Is the contact of terminal strip connector fine?
No
Is it normal?
No
Yes
Yes
Yes
Yes
Continued
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

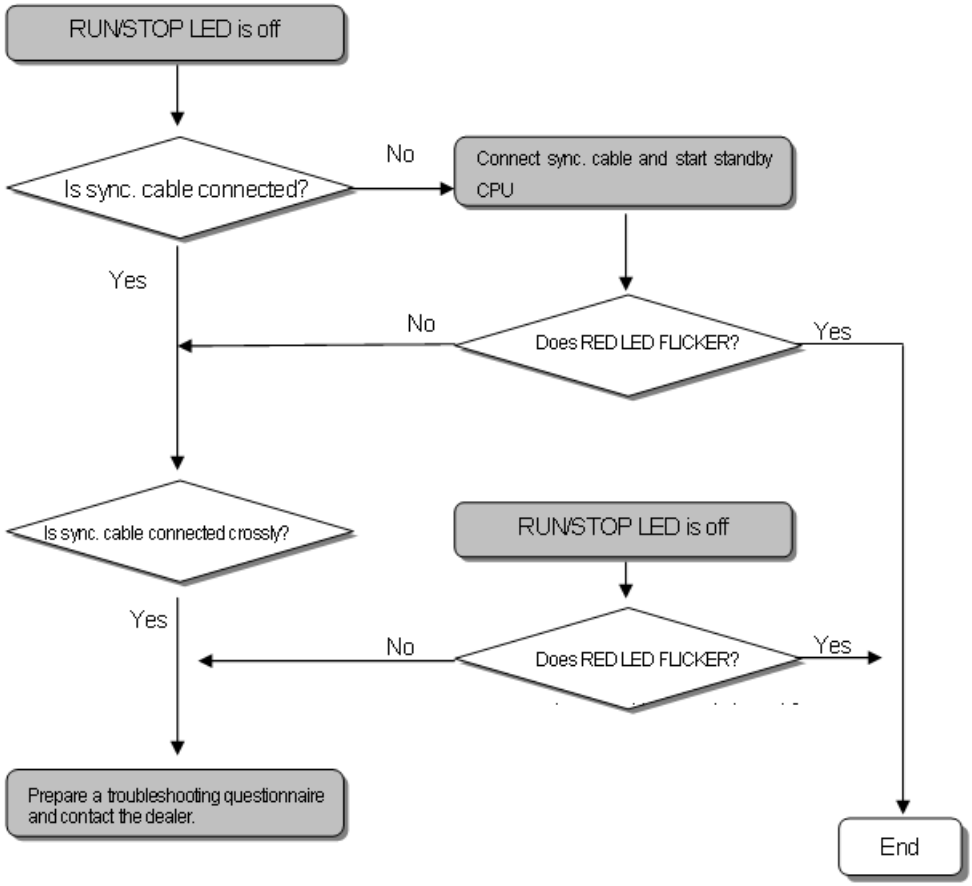

Continued
Is the LED of SWITCH1, 2 on?
No
Yes
Check the voltage of Switch 1, 2 by a tester
Measure the terminal voltage of Switch 1,2 by a tester
Is the measurement normal?
Is the measurement normal?
Yes
Is the tightness of a terminal good?
No
Yes
No
No
Yes
Is the input wiring correct?
Yes
Is the contact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

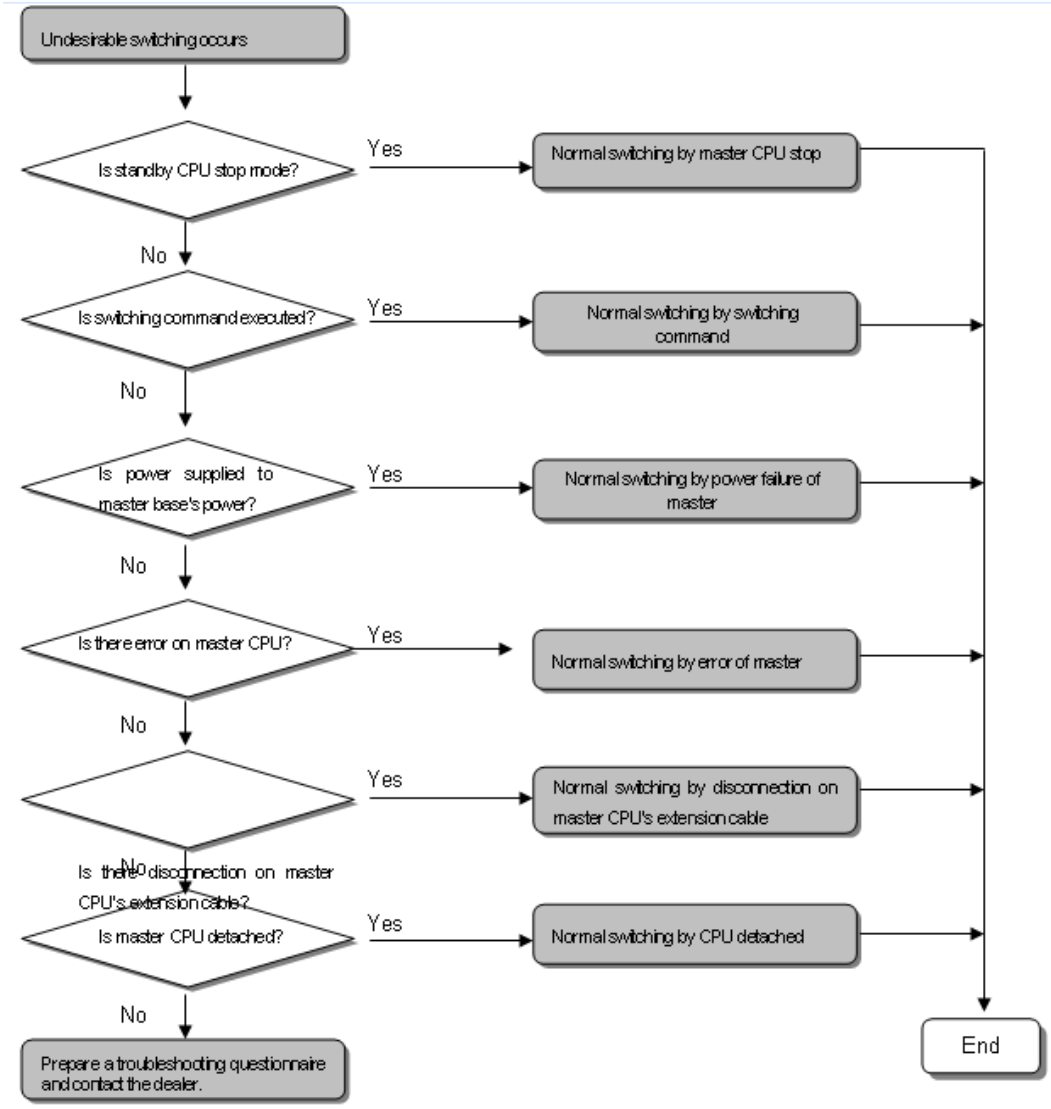
Use the following sequence of steps when writing a program to the CPU module fails.



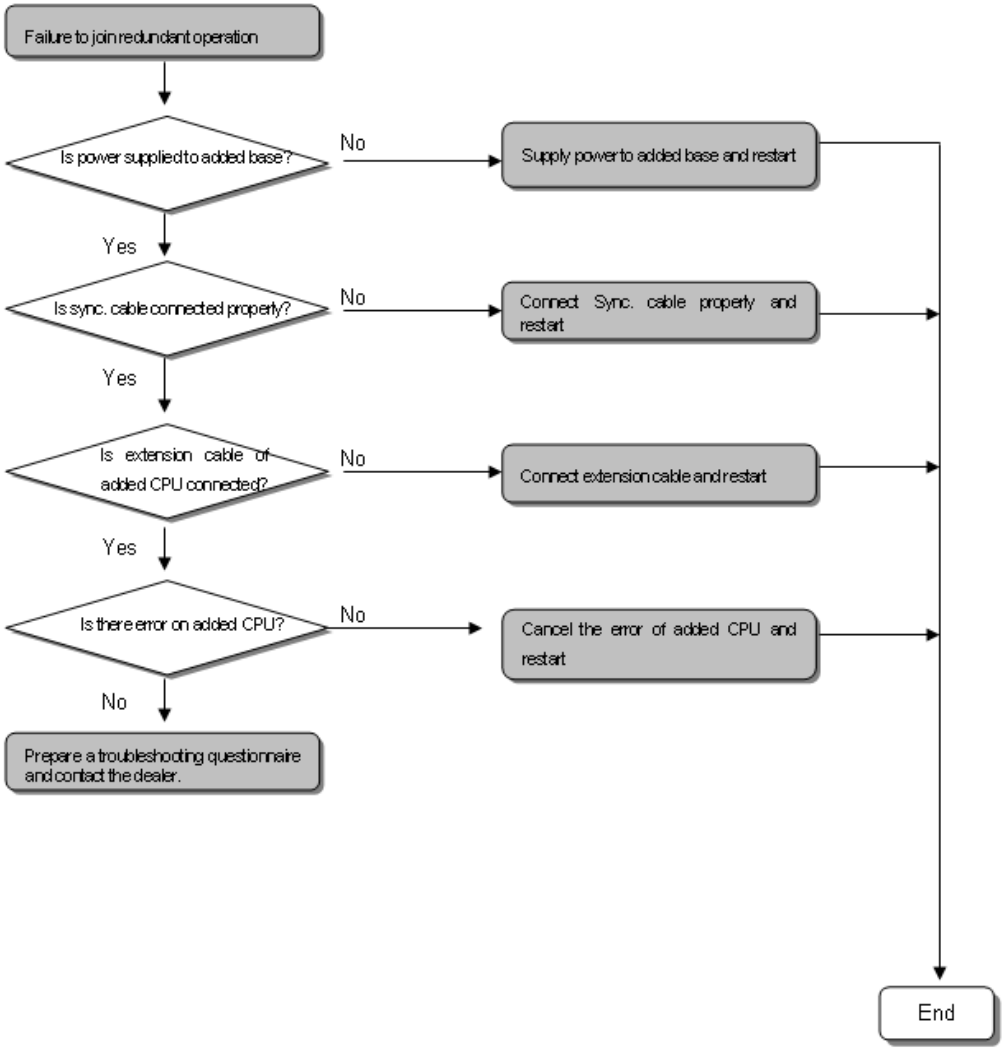
Action when sync. cable is not installed properly



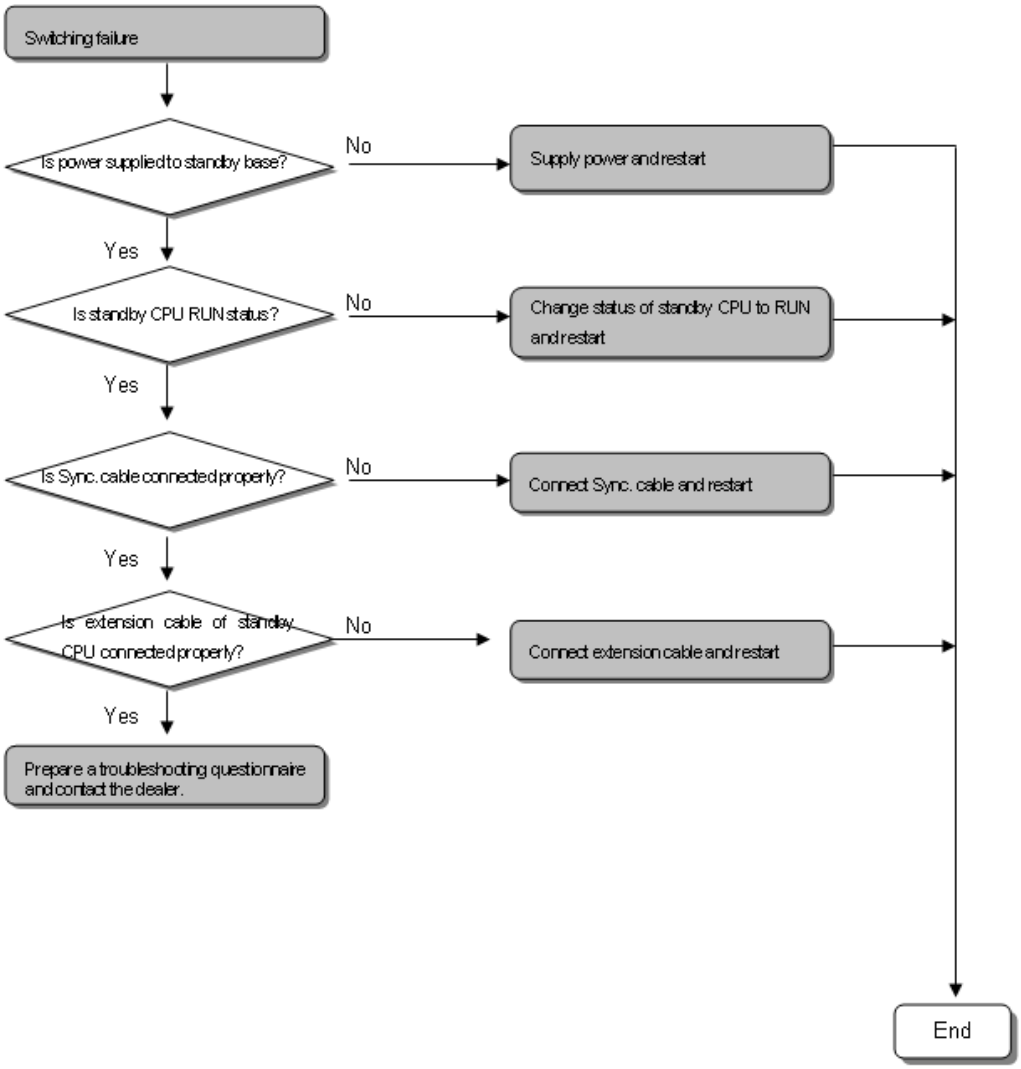
Action when undesirable master switching occurs



Action when newly added CPU does not join redundant operation



Action when failing to switch master



9.4 Troubleshooting questionnaire

Questionnaire

If any trouble is found while using the 2MLR series, fill the follwing form and fax it.

For an error relating to special/communication modules, fill out the questionnaires attached in the user's guide of the product.

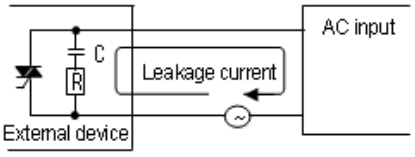
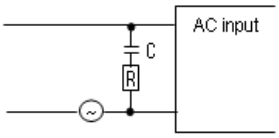
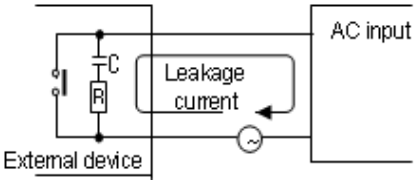
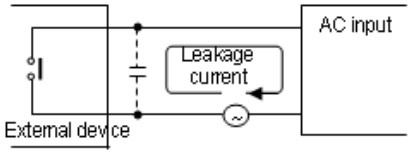
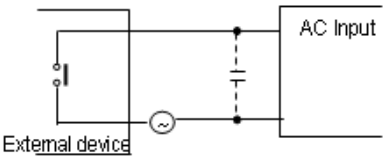
1	Customer's Contact Details	TEL: FAX:
2	Model	
3	Details of the Product	
	Details of the CPU module	OS version ( ) Product's serial number ( ) SoftMaster Version number used for program compiling
4	Brief description of a device and system	
5	Modules using the CPU module	Operation by key switch ( ) Operation by SoftMaster or Communication ( ) Memory module operation ( )
6	STOP LED On of the CPU module?	Yes( ) No( )
7	Error message generated from the SoftMaster	
8	Measures taken against the error code in the above 7	
9	Other troubleshooting measures against the error	
10	Features of the error	Reiterative( ): Periodic( ), Relating to a

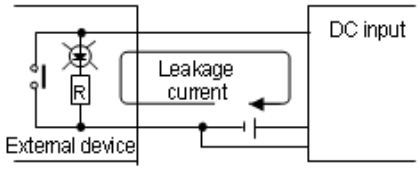
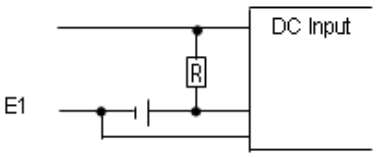
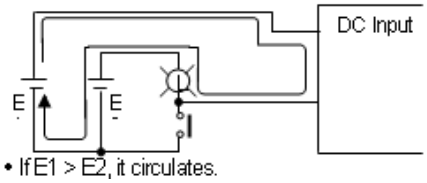
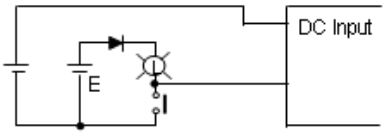
		specific sequence level( ) Relating to the environment( )
		Intermittent( ): Approx. interval of the error occurrence ( )
11	Detail description for the erroneous phenomena	
12	Configuration of the applied system	

9.5 Cases

Trouble types and measures of input circuit

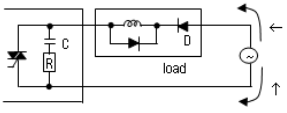
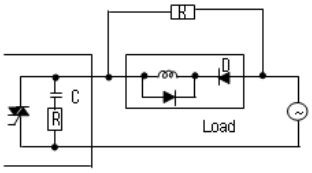
The followings table describes the examples of common faults and the recommended measures.

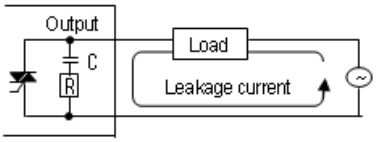
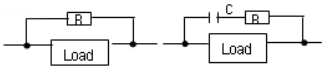
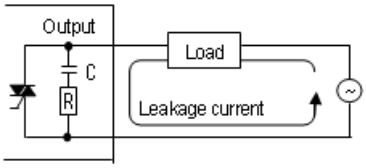
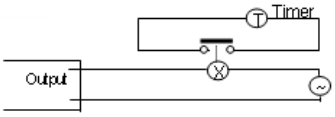
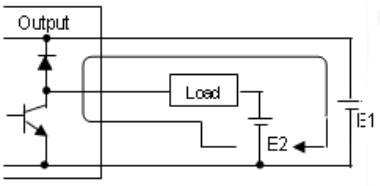
Phenomena	Causes	Measures
Input signal cannot be off	Leakage current of an external device (if operating by proximate switch and others) 	• Connect a proper resistance or capacitor so that the voltage between terminals of input module is below the return voltage. 
Input signal cannot be off (it could be that a neon lamp is still on)	Leakage current of an external device (operation by a limit switch with neon lamp) 	• CR value is determined by the value of leakage current. – Recommended value C : 0.1 ~ 0.47μF R : 47 ~ 120Ω (1/2W) • Or, separate a circuit completely and install another display circuit.
Input signal cannot be off	Leakage current from the capacity between wires of wiring cable 	• Install the power on an external device as in the following figure. 
Input signal cannot be off	Leakage current of an external device (operation by a switch with LED mark)	• Connect a proper resistance so that the voltage between input module terminal and common terminal is higher than off voltage as in the

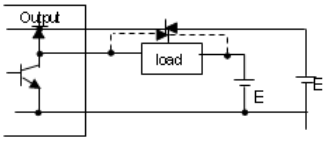
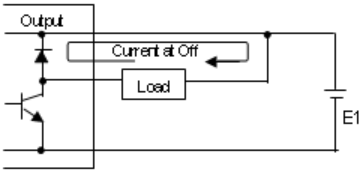
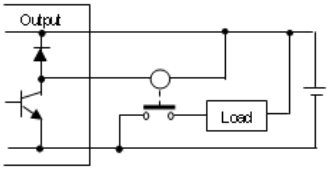
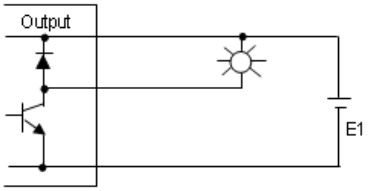
Phenomena	Causes	Measures
		following figure. 
Input signal cannot be off	• Circulating current by using plural different power sources 	• Change plural to singular power • Connecting to a circulating current preventive diode (following figure) 

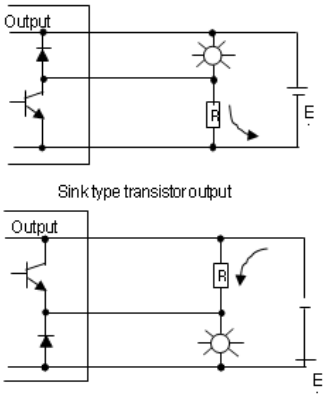
Trouble types and measures of output circuit

The followings table describes the examples of common faults and the recommended measures.

Phenomena	Causes	Measures
Excessive voltage is allowed to load when output contact is off	• If load contains half-wave rectification (solenoid valve may have it) • If the polarity is ←, C is charged while the voltage + power voltage charged to C is allowed to both ends of diode (D). When the polarity is ↑. The maximum voltage is approx. 2√2. 	• Connect a dozens ~ several hundreds kΩ resistor to a load in parallel. 

Phenomena	Causes	Measures
	Note: when using it as the above, the output element does not have any problem but the performance of diode (D) in load may be reduced, probably causing a trouble.	
Load cannot be off	• Leakage current from surge absorbing circuit connected to an output element in parallel. 	• Connect a dozen of kΩ resistor or C-R of which impedance is equal to the resistance to load in parallel. Note: If the length of wiring from output module to load is long, it may have leakage current from capacity of cables. 
Abnormal time when load is a C-R type timer	• Leakage current from surge absorbing circuit connected to an output element in parallel. 	• Operate the C-R type timer by mediating a relay. • Use other one but a C̃-R type timer. Note: A timer's internal circuit may have half-wave rectification. 
Load can not be off (DC)	• Circulating current resulting from two different power source 	• Adjusting plural to singular power source. • Connecting to circulating current preventive diode (figure below)

Phenomena	Causes	Measures
	• It circulates if E1< E2. • It also circulates even when E1 is Off (E2 is On).	
Off response from load takes a longer time	• Over current at Off If a large current load such as solenoid (time constant L/R is large) is directly operated by transistor output.  • Since current is allowed through diode when transistor output is off, it may be delayed for 1s and longer depending on load.	• Insert a magnetic connector and others of which time constant is small as presented in the figure and operate load by the contact 
Output transistor is destructed	• Inrush current of glow lamp  As soon as it lights up, it may have 10 times and higher inrush current.	• To restrict inrush current, it should allow dark current that is 1/3 ~ 1/5 of the rated current of glow lamp.

Phenomena	Causes	Measures
		 source type transistor output

Error codes list

Code	Error 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	Fault	ERR : On	When turning it on

Code	Error causes	Measures (restart mode after the measure)	Operation Status	LED Status	Diagnostic Timing
		on again.			
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 converting to RUN mode
22	The program of backup flash is defective	Restart after modifying the program of backup flash.	Fault	ERR : On	Reset converting to RUN mode
23	If a program to execute is not normal	Operate after 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 converting 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 converting to RUN mode
25	Abnormal basic parameter	Restart after basic parameter is reloaded. Replace a battery in case of defective battery.	STOP	ERR : On	Reset Converting to RUN mode

Code	Error causes	Measures (restart mode after the measure)	Operation Status	LED Status	Diagnostic Timing
		After basic parameter is reloaded, check the storage condition and if any fault is found, replace the CPU module.			
30	The module set in parameter and the actually installed module do not coincide	Check the wrong slot position by SoftMaster, modify a module or parameter and then, restart. Reference flag: module type inconsistence error flag.	STOP (RUN)	ERR : On (P.S. : On)	Converting to RUN mode
31	Module detachment or module addition during operation	Check any detached/added slot position by SoftMaster, modify the installment and restart (according to parameter). Reference flag: module attachment error flag.	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
32	Fuse of a module holding a fuse is burnt out during operation	Check the position of a slot of which fuse is burnt out by SoftMaster, replace a fuse and restart (according to parameter). 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 by SoftMaster, replace the module and restart (according to parameter) Reference flag: I/O Module Write/Read error flag	STOP (RUN)	ERR : On (P.S. : On)	When scan ends

Code	Error causes	Measures (restart mode after the measure)	Operation Status	LED Status	Diagnostic Timing
34	Special/link module data cannot be successfully accessed during operation	Check the position of a slot with access error by SoftMaster, replace the module and restart (according to parameter). Reference flag: Special/Link Module interface error	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
39	CPU is incompletely closed or in trouble	System is closed abnormally due to noise or abnormal hardware 1) Contact A/S service if it still exists after turning it on again. 2) Take a measure against 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	Eliminating an operation error → reload the program and restart(check). If STOP: Check the details of operation error by SoftMaster and modify the program If RUN: refer to the error steps of F area.	STOP (RUN)	ERR : On (CHK: blink)	When program is executed
42	Exceeding the specified stack range during	Restart	STOP	RUN: On ERR : On	When program is executed

Code	Error causes	Measures (restart mode after the measure)	Operation Status	LED Status	Diagnostic Timing
	program				
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 of 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 is converted to 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
502	Low-battery voltage	Replace a battery with the power on	-	BAT: On	Always

ATTENTION

- Error Codes during CPU Operation can be checked at the A/S Service Center.
- The other errors can be checked by using the error log in SoftMaster.

10. Appendix

10.1 Flag list

User flags

Address	Flag Name	Type	Write	Contents	Description
%FX6144	_T20MS	BOOL	-	20ms cycle clock	
%FX6145	_T100MS	BOOL	-	100ms cycle clock	
%FX6146	_T200MS	BOOL	-	200ms cycle clock	
%FX6147	_T1S	BOOL	-	1s cycle clock	
%FX6148	_T2S	BOOL	-	2s cycle clock	
%FX6149	_T10S	BOOL	-	10s cycle clock	
%FX6150	_T20S	BOOL	-	20s cycle clock	
%FX6151	_T60S	BOOL	-	60s cycle clock	
%FX6153	_ON	BOOL	-	Always ON	Always On state flag, used when writing user program.
%FX6154	_OFF	BOOL	-	Always OFF	Always Off state flag, used when writing user program.
%FX6155	_1ON	BOOL	-	1st scan ON	Only 1st scan On after operation start.
%FX6156	_1OFF	BOOL	-	1st scan OFF	Only 1st scan Off after operation start.
%FX6157	_STOG	BOOL	-	Reversal every scan	On/Off reversed flag per every scan when user program is working. (On state for first scan).
%FX6163	_ALL_OFF	BOOL	-	All output Off	‘On’ only in case of all output is ‘Off’.
%FX30720	_RTC_WR	BOOL	OK	RTC data writing	RTC data writing.

Address	Flag Name	Type	Write	Contents	Description
%FX30721	_SCAN_WR	BOOL	OK	Scan value initialization	Initialize the scan value.
%FX30722	_CHK_ANC_ERR	BOOL	OK	Request of the external heavy fault	Request of heavy fault detection from external device.
%FX30723	_CHK_ANC_WAR	BOOL	OK	Request of the external light fault	Request of light fault detection from external device.
%FX30724	_MASTER_CHG	BOOL	OK	Switchover Master	To change Standby as a Master.
%FW3860	_RTC_TIME_USER	ARRAY[0..7] OF BYTE	OK	User-Define Time	To set user-defined time.

System error flags

Address	Flag Name	Type	Bit Location	Contents	Description
%FD65	_CNF_ER	DWORD		System error (heavy fault error)	Handles error flags about non-operation fault error as below.
%FX2081	_IO_TYER	BOOL	BIT 1	Error when module type mismatched	Representative flag displayed when I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location. (Refer '_IO_TYER_N, _IO_TYER[n]')
%FX2082	_IO_DEER	BOOL	BIT 2	Module detachment error	Representative flag displayed when the module configuration for each slot is changed while running. (Refer '_IO_DEER_N, _IO_DEER[n]')
%FX2083	_FUSE_ER	BOOL	BIT 3	Fuse cutoff error	Representative flag displayed when the fuse of module is cut off. (Refer '_FUSE_ER_N, _FUSE_ER[n]')

Address	Flag Name	Type	Bit Location	Contents	Description
%FX2086	_ANNUM_ER	BOOL	BIT 6	Heavy fault detection error in external device	Representative flag displayed when heavy fault error detected by user program is recorded in '_ANC_ERR[n]'.
%FX2088	_BPRM_ER	BOOL	BIT 8	Basic parameter error	It is abnormal to the basic parameter.
%FX2089	_IOPRM_ER	BOOL	BIT 9	I/O parameter error	It is abnormal to the I/O configuration parameter.
%FX2090	_SPPRM_ER	BOOL	BIT 10	Special module parameter error	It is abnormal to the special module parameter.
%FX2091	_CPPRM_ER	BOOL	BIT 11	Communication module parameter error	It is abnormal to the communication module parameter.
%FX2092	_PGM_ER	BOOL	BIT 12	Program error	Indicates that there is problem with user-made program checksum.
%FX2093	_CODE_ER	BOOL	BIT 13	Program code error	Indicates that while user program is running, the program code cannot be interpreted.
%FX2094	_SWDT_ER	BOOL	BIT 14	CPU abnormal ends	Displayed when the saved program gets damages by an abnormal end of CPU or program cannot work.
%FX2095	_BASE_POWER_ER	BOOL	BIT 15	Power error	Indicates that base power is abnormal.
%FX2096	_WDT_ER	BOOL	BIT 16	Scan watchdog error	Indicates that the program scan time exceeds the scan watchdog time specified by a parameter.
%FX2097	_BASE_INFO_ER	BOOL	BIT 17	Wrong base information	Wrong information for main base.

Address	Flag Name	Type	Bit Location	Contents	Description
%FX2102	_BASE_DEER	BOOL	BIT 22	Extension base detach error	Extension base is detached.
%FX2103	_DUPL_PRM_ER	BOOL	BIT 23	Error in the redundancy parameter	Error in the redundancy parameter.
%FX2104	_INSTALL_ER	BOOL	BIT 24	Module install error	Wrong module installed in main/extension base.
%FX2105	_BASE_ID_ER	BOOL	BIT 25	Duplicate extension base number error	Duplicate number for extension base.
%FX2106	_DUPL_SYNC_ER	BOOL	BIT 26	Synchronization error	Error in the synchronization between master and standby CPU.
%FX2107	_AB_SIDEKEY_ER	BOOL	BIT 27	Duplicate key settings for A/B SIDE	Duplicate key settings for CPU side (that is, A/B SIDE).

Standby CPU flag

Address	Flag Name	Type	Bit Location	Contents	Description
%FD129	_SB_CNF_ER	DWORD		System error(heavy fault error)	Handles error flags about non-operation fault error as below.
%FX4129	_SB_IO_TYER	BOOL	BIT 1	Error when module type mismatched	Representative flag displayed when I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location.

Address	Flag Name	Type	Bit Location	Contents	Description
					(Refer '_IO_TYER_N, _IO_TYER[n]')
%FX4130	_SB_IO_DEER	BOOL	BIT 2	Module detachment error	Representative flag displayed when the module configuration for each slot is changed while running. (Refer '_IO_DEER_N, _IO_DEER[n]')
%FX4131	_SB_FUSE_ER	BOOL	BIT 3	Fuse cutoff error	Representative flag displayed when the fuse of module is cut off. (Refer '_FUSE_ER_N, _FUSE_ER[n]')
%FX4134	_SB_ANNUM_ER	BOOL	BIT 6	Heavy fault detection error in external device	Representative flag displayed when heavy fault error detected by user program is recorded in '_ANC_ERR[n]'.
%FX4136	_SB_BPRM_ER	BOOL	BIT 8	Basic parameter error	It is abnormal to the basic parameter.
%FX4137	_SB_IOPRM_ER	BOOL	BIT 9	I/O parameter error	It is abnormal to the I/O configuration parameter.
%FX4138	_SB_SPPRM_ER	BOOL	BIT 10	Special module parameter error	It is abnormal to the special module parameter.
%FX4139	_SB_CPPRM_ER	BOOL	BIT 11	Communication module parameter error	It is abnormal to the communication module parameter.
%FX4141	_SB_CODE_ER	BOOL	BIT 13	Program error	Indicates that there is problem with user-made program checksum.
%FX4142	_SB_SWDT_ER	BOOL	BIT 14	CPU abnormal ends.	Displayed when the saved program gets damaged by an abnormal end of

Address	Flag Name	Type	Bit Location	Contents	Description
					CPU or program cannot work.
%FX4143	_SB_BASE_POWER_ER	BOOL	BIT 15	Power error	Indicates that base power is abnormal.
%FX4144	_SB_WDT_ER	BOOL	BIT 16	Scan watchdog error	Indicates that the program scan time exceeds the scan watchdog time specified by a parameter.
%FX4145	_SB_BASE_INFO_ER	BOOL	BIT 17	Base information error	Wrong base information.
%FX4150	_SB_BASE_DEER	BOOL	BIT 22	Extension base detach error	Extension base is detached.
%FX4151	_SB_DUPL_PRM_ER	BOOL	BIT 23	Error in the redundancy parameter	Error in the redundancy parameter.
%FX4152	_SB_INSTALL_ER	BOOL	BIT 24	Module install error	Wrong module installed in main/extension base.
%FX4153	_SB_BASE_ID_ER	BOOL	BIT 25	Duplicate extension base number error	Duplicate number for extension base.
%FX4154	_SB_DUPL_SYNC_ER	BOOL	BIT 26	Synchronization error	Error in the synchronization between master and standby CPU.
%FX4156	_SB_CPU_RUN_ER	BOOL	BIT 28	Standby CPU run error	Standby CPU fails to operate in redundancy mode when master CPU fails.

Master CPU error flags

Address	Flag Name	Type	Write	Contents	Description
%FW	_IO_TYER	ARRAY[0..31] OF	-	Error when Module type	Representative flag displayed when I/O configuration parameter for each

Address	Flag Name	Type	Write	Contents	Description
424	R	WORD		mismatched	slot is not matched with practical module configuration or a specific module is applied in the wrong location.
%FW456	_IO_DEERR	ARRAY[0..31] OF WORD	-	Module detachment error	Representative flag displayed when the module configuration for each slot is changed while running.
%FW488	_FUSE_ERR	ARRAY[0..31] OF WORD	-	Fuse cutoff error	Representative flag displayed when the fuse of module is cut off.
%FD83	_BASE_DEERR	DWORD	-	Extension base detach error	Indicate detached base.
%FD574	_BASE_POWER_FAIL	DWORD	-	Base information with power error	Indicate base number with power failure.
%FW416	_IO_TYER_N	WORD	-	Slot number of mismatched module type	When I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong position, this is displayed as the lowest slot number after detecting these mismatch error in slot locations.
%FW417	_IO_DEER_N	WORD	-	Slot number of module detachment	When slot module configuration is changed while the PLC is running, this is displayed as the lowest slot number after detecting the detachment error in slot locations.
%FW418	_FUSE_ER_N	WORD	-	Slot number of fuse cut off	When a fuse equipped to module is cut off, this is displayed as the lowest slot number after detecting this error in slot locations.
%FW1922	_ANC_ERR	WORD	OK	Heavy fault information of external device	Heavy fault of external device is detected by user program, and that error is saved at this zone as numbers which can identify 16 error types.

Standby CPU error flag

Address	Flag Name	Type	Write	Contents	Description
%FD147	_SB_BASE_DEERR	DWORD	-	Extension base detach error	Indicate detached base.
%FW588	_SB_IO_TYERR	WORD	-	Module type error	Module type error for n step of extended base.
%FW589	_SB_IO_DEERR	WORD	-	Module detachment error	Module detachment error for n step of extended base.

System warning flags (master CPU)

Address	Flag Name	Type	Bit Location	Contents	Description
%FD66	_CNF_WAR	DWORD		System warning	Representative flag displaying the system warning state.
%FX2112	_RTC_ER	BOOL	BIT 0	RTC error	Indicates that RTC data is abnormal.
%FX2114	_BASE_EXIST_WAR	BOOL	BIT 2	Base not in operation	Indicate base that is not in operation.
%FX2115	_AB_SD_ER	BOOL	BIT 3	Stop by operation error	Stopped by abnormal operation.
%FX2116	_TASK_ER	BOOL	BIT 4	Task collision	It is collided to the task.
%FX2117	_BAT_ER	BOOL	BIT 5	Battery error	It is the error in the battery state.
%FX2118	_ANNUM_WAR	BOOL	BIT 6	External device fault	Indicates that the light fault in the external device is

Address	Flag Name	Type	Bit Location	Contents	Description
					detected.
%FX2120	_HS_WAR	BOOL	BIT 8	High-speed link parameter error	It is abnormal to the high-speed link parameter.
%FX2121	_REDUN_WAR	BOOL	BIT 9	Redundancy configuration warning	System is not in redundancy mode (not in Single CPU mode).
%FX2122	_OS_VER_WAR	BOOL	BIT 10	Warning for O/S version mismatch	OS version between CPU, Network, and Extension Driver is different.
%FX2123	_RING_WAR	BOOL	BIT 11	Warning for ring topology	Ring Topology is not established.
%FX2132	_P2P_WAR	BOOL	BIT 20	P2P parameter error	It is abnormal to the P2P parameter.
%FX2140	_CONSTANT_ER	BOOL	BIT 28	Fixed cycle fault	Fixed cycle fault.
%FX2141	_BASE_POWER_WAR	BOOL	BIT 29	Abnormal power module	One of the two power modules has an error or turned off.
%FX2142	_BASE_SKIP_WAR	BOOL	BIT 30	Base skip warning	When base skip is disabled, IO parameter and hardware configuration is different.

Address	Flag Name	Type	Bit Location	Contents	Description
%FX2143	_BASE_NUM_OVER_WAR	BOOL	BIT 31	Base number config error	Base number of extension driver is not within 1 ~ 31

System warning flags (standby CPU)

Address	Flag Name	Type	Bit Location	Contents	Description
%FD130	_SB_CNF_WAR	DWORD		System warning	Representative flag displaying the system warning state.
%FX4160	_SB_RTC_ER	BOOL	BIT 0	RTC error	Indicates that RTC data is abnormal.
%FX4162	_SB_BASE_EXIST_WAR	BOOL	BIT 2	Base not in operation	Indicate base that is not in operation.
%FX4163	_SB_AB_SD_ER	BOOL	BIT 3	Stop by operation error	Stopped by abnormal operation.
%FX4164	_SB_TASK_ER	BOOL	BIT 4	Task collision	It is collided to the task.
%FX4165	_SB_BAT_ER	BOOL	BIT 5	Battery error	It is the error in the battery state.
%FX4166	_SB_ANNUM_WAR	BOOL	BIT 6	External device fault	Indicates that the light fault in the external device is detected.
%FX4168	_SB_HS_WAR	BOOL	BIT 8	High-speed link parameter error	It is abnormal to the high-speed link parameter.
%FX4170	_SB_OS_VER_WAR	BOOL	BIT 10	Warning for O/S version mismatch	OS version between CPU, Network, extension Driver is different.
%FX4171	_SB_RING_WAR	BOOL	BIT 11	Ring topology warning	Connect extension cable and establish ring topology.
%FX4180	_SB_P2P_WAR	BOOL	BIT 20	P2P parameter error	It is abnormal to the P2P parameter.

Address	Flag Name	Type	Bit Location	Contents	Description
%FX4188	_SB_CONSTANT_ER	BOOL	BIT 28	Fixed cycle fault	Fixed cycle fault.
%FX4189	_SB_BASE_POWER_WAR	BOOL	BIT 29	Warning for ring topology	Ring topology is not established.
%FX4190	_SB_BASE_SKIP_WAR	BOOL	BIT 30	Base skip warning	When base skip is disabled, IO parameter and hardware configuration is different.
%FX4191	_SB_BASE_NUM_OVER_WAR	BOOL	BIT 31	Base number config error	Base number of extension driver is not within 1 ~ 31.

Communication warning flags (Master CPU)

Address	Flag Name	Type	Write	Contents	Description
%FX2624	_HS_WARN	ARRAY[0..11] OF BOOL	-	High-speed link parameter error	It is abnormal to the high-speed link parameter n (n: 1~12).
%FX2640	_P2P_WARN	ARRAY[0..7] OF BOOL	-	P2P parameter error	It is abnormal to the P2P parameter n (n: 1~8).
%FD587	_BASE_ACPF_WAR	DWORD	-	Momentary power loss warning	Indicate base with momentary power loss.
%FW164	_HS_WAR_W	WORD	-	High-speed link parameter error	It is abnormal to the high-speed link parameter n (n: 1~12).
%FW165	_P2P_WAR_W	WORD	-	P2P parameter error	It is abnormal to the P2P parameter n (n: 1~8).
%FW1923	_ANC_WAR	WORD	-	Heavy fault information of external device	Heavy fault of external device is detected by user program, and that error is saved at this zone as numbers which can identify

Address	Flag Name	Type	Write	Contents	Description
					16 error types.

Communication warning flags (standby CPU)

Address	Flag Name	Type	Write	Contents	Description
%FX4672	_SB_HS_WARN	ARRAY[0..11] OF BOOL	-	High-speed link parameter error	It is abnormal to the high-speed link parameter n (n: 1~12).
%FX4688	_SB_P2P_WARN	ARRAY[0..7] OF BOOL	-	P2P parameter error	It is abnormal to the P2P parameter n (n: 1~8).
%FW292	_SB_HS_WAR_W	WORD	-	High-speed link parameter error	It is abnormal to the high-speed link parameter n (n: 1~12).
%FW293	_SB_P2P_WAR_W	WORD	-	P2P parameter error	It is abnormal to the P2P parameter n (n: 1~8).

System operation flags (master CPU)

Address	Flag Name	Type	Bit Location	Contents	Description
%FD64	_SYS_STATE	DWORD		PLC mode and operation status	
%FX2048	_RUN	BOOL	BIT 0	Run	
%FX2049	_STOP	BOOL	BIT 1	Stop	
%FX2050	_ERROR	BOOL	BIT 2	Error	
%FX2051	_DEBUG	BOOL	BIT 3	Debug	

Address	Flag Name	Type	Bit Location	Contents	Description
%FX2052	_LOCAL_CON	BOOL	BIT 4	Local control	Indicates operation mode changeable state only by the mode key and SoftMaster.
%FX2054	_REMOTE_CON	BOOL	BIT 6	Remote mode On	It is remote control mode.
%FX2058	_RUN_EDIT_DONE	BOOL	BIT 10	Editing during Run	Edit is done during Run.
%FX2059	_RUN_EDIT_NG	BOOL	BIT 11	Editing during Run	Edit is ended abnormally during Run.
%FX2060	_CMOD_KEY	BOOL	BIT 12	Operation mode change	Operation mode changed by key.
%FX2061	_CMOD_LPADT	BOOL	BIT 13	Operation mode change	Operation mode changed by local PADT.
%FX2062	_CMOD_RPADT	BOOL	BIT 14	Operation mode change	Operation mode changed by remote PADT.
%FX2063	_CMOD_RLINK	BOOL	BIT 15	Operation mode change	Operation mode changed by remote communication module.
%FX2064	_FORCE_IN	BOOL	BIT 16	Forced input	Forced On/Off state about input contact.
%FX2065	_FORCE_OUT	BOOL	BIT 17	Forced output	Forced On/Off state about output contact.
%FX2066	_SKIP_ON	BOOL	BIT 18	Input/output skip	I/O skip on execution.
%FX2067	_EMASK_ON	BOOL	BIT 19	Fault mask	Fault mask on execution.
%FX2069	_USTOP_ON	BOOL	BIT 21	Stopped by STOP function	Stopped after scan completion by ‘STOP’ function while RUN mode operation.
%FX2070	_ESTOP_ON	BOOL	BIT 22	Stopped by ESTOP function	Instantly stopped by ‘ESTOP’ function while RUN mode operation.
%FW19	_SL_OS_V	ARR	-	OS version of	Indicate O/S version of installed

Address	Flag Name	Type	Bit Location	Contents	Description
2	ER	AY[0..31] OF WORD		extension driver	extension driver.
%FW600	_BASE_INFO	ARRAY[0..31] OF WORD	-	Base information	Indicate number of slots in a base.
%FB12	_RTC_TIME	ARRAY[0..7] OF BYTE	-	Current Time	Indicate current time.
%FX2072	_INIT_RUN	BOOL	-	Initialization task on execution	User-defined initialization program on execution.
%FX2074	_AB_SIDE	BOOL	-	CPU side	CPU side (A-SIDE: ON, B-SIDE: OFF).
%FX2076	_PB1	BOOL	-	Program code 1	Select program code 1.
%FX2077	_PB2	BOOL	-	Program code 2	Select program code 2.
%FX30736	_INIT_DONE	BOOL	OK	Initialization task execution completion	If this flag is set by user's initial program, it is started to execution of scan program after initial program completion.
%FW584	_RTC_DATE	DATE	-	Current date of RTC	Indicated on the basis of 1 Jan1984.
%FD67	_OS_VER	DWORD	-	OS version	Indicates OS version number.
%FD68	_OS_DATE	DWORD	-	OS date	Indicates OS distribution date.

Address	Flag Name	Type	Bit Location	Contents	Description
%FD69	_CP_OS_VER	DWORD	-	OS version of extension manager	OS version of extension manager.
%FD573	_OS_TYPE	DWORD	-		
%FW1081	_FALS_NUM	INT	-	FALS no	Indicates the number of False.
%FD293	_RTC_TOD	TIME_OF_DAY	-	Current time of RTC (unit : ms)	Indicates a data for the time of the day on the basis of 00:00:00 (unit: ms).
%FD582	_RUN_EDIT_CNT	UDINT	-	Online edit count	Online edit count.
%FW140	_AC_F_CNT	UINT	-	Indicates momentary shutdown times	Indicates the instant power off count during the RUN mode operation.
%FW158	_POWER_OFF_CNT	UINT	-	Power Off count	Indicate no of power failure.
%FW386	_SCAN_MAX	UINT	OK	Maximum scan time	Indicates maximum scan time during operation Unit: 0.1ms.
%FW387	_SCAN_MIN	UINT	OK	Minimum scan time	Indicates minimum scan time during operation Unit: 0.1ms.
%FW388	_SCAN_CUR	UINT	OK	Current scan time	Indicates current scan time during operation Unit: 0.1ms.
%FW585	_RTC_WEEK	UINT	-	Current 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).
%FW14	_CPU_TYP	WOR	-	CPU Type Information.	Indicates the operation mode and

Address	Flag Name	Type	Bit Location	Contents	Description
1	E	D		(2MLR - 0xA801)	operation state information.
%FW633	_RBANK_NUM	WORD	-	Active block no.	Indicates active block number
%FD125	_BASE_SKIP_INFO	DWORD	-	Base skip information	Indicates base skip information.
%FD124	_BASE_EMASK_INFO	DWORD	-	Base fault mask information	Indicates base fault mask information.
%FW1372	_SLOT_EMASK_INFO	ARRAY[0..31] OF WORD	-	Slot fault mask information	Indicates slot fault mask information.
%FW1404	_SLOT_SKIP_INFO	ARRAY[0..31] OF WORD	-	Slot skip information	Indicates slot skip information.

System operation flags (Standby CPU)

Address	Flag Name	Type	Bit Location	Contents	Description
%FD128	_SB_SYS_STATE	DWORD		System state information	
%FX4096	_SB_RUN	BOOL	BIT 0	Run	
%FX4097	_SB_STOP	BOOL	BIT 1	Stop	
%FX40	_SB_ERRO	BO	BIT 2	Error	

Address	Flag Name	Type	Bit Location	Contents	Description
98	R	OL			
%FX4100	_SB_LOCAL_CON	BOOL	BIT 4	Local control	Local control.
%FX4102	_SB_REMOTE_CON	BOOL	BIT 6	Remote mode ON	Remote mode ON.
%FX4106	_SB_RUN_EDIT_DONE	BOOL	BIT 10	Editing during Run	Edit is done during Run.
%FX4107	_SB_RUN_EDIT_NG	BOOL	BIT 11	Editing during Run	Edit is ended abnormally during Run.
%FX4108	_SB_CMOD_KEY	BOOL	BIT 12	Operation mode change	Operation mode changed by key.
%FX4109	_SB_CMOD_LPADT	BOOL	BIT 13	Operation mode change	Operation mode changed by local PADT.
%FX4110	_SB_CMOD_RPADT	BOOL	BIT 14	Operation mode change	Operation mode changed by Remote PADT.
%FX4111	_SB_CMOD_RLINK	BOOL	BIT 15	Operation mode change	Operation mode changed by remote communication module.
%FX4112	_SB_FORCE_IN	BOOL	BIT 16	Forced Input	Forced On/Off state about input contact.
%FX4113	_SB_FORCE_OUT	BOOL	BIT 17	Forced Output	Forced On/Off state about output contact.
%FX4114	_SB_SKIP_ON	BOOL	BIT 18	Input/Output Skip	I/O skip on execution.
%FX4115	_SB_EMASK_ON	BOOL	BIT 19	Fault mask	Fault mask on execution.
%FX4117	_SB_USTOP_ON	BOOL	-	Stopped by STOP function	Stopped after scan completion by ‘STOP’ function while RUN mode operation.
%FX4118	_SB_ESTOP_ON	BOOL	-	Stopped by ESTOP function	Instantly stopped by ‘ESTOP’ function while RUN mode operation.

Address	Flag Name	Type	Bit Location	Contents	Description
%FD131	_SB_OS_VER	DWORD	-	OS version	Indicates OS version number.
%FD132	_SB_OS_DATE	DWORD	-	OS date	Indicates OS distribution date.
%FD133	_SB_CP_OS_VER	DWORD	-	OS version of extension manager	OS version of extension manager.
%FW286	_SB_POWER_OFF_CNT	UINT	-	Power off count	Indicates number of power failure.
%FW269	_SB_CPU_TYPE	WORD	-	CPU type information. (2MLR - 0xA801)	Indicates the operation mode and operation state information.
%FW632	_SB_BASE_INFO	WORD	-	Base information	Indicates number of slots in a base.

Redundant operation flags

Address	Flag Name	Type	Bit Location	Contents	Description
%FD0	_REDUN_STATE	DWORD		Redundant operation information	
%FX0	_DUAL_RUN	BOOL	BIT 0	Redundant RUN	CPUA and CPUB are in normal operation.
%FX1	_RING_TOPOLOGY	BOOL	BIT 1	Ring topology	Ring topology is established.
%FX2	_LINE_TOPOLOGY	BOOL	BIT 2	Line topology	Extension base is in line topology.
%FX4	_SINGLE_	BO	BIT 4	A-SIDE single	Only CPUA is in RUN mode.

Address	Flag Name	Type	Bit Location	Contents	Description
	RUN_A	OL		RUN mode	
%FX5	_SINGLE_RUN_B	BOOL	BIT 5	B-SIDE single RUN mode	Only CPUB is in RUN mode.
%FX6	_MASTER_RUN_A	BOOL	BIT 6	A-SIDE is master and RUN (in the presence of standby CPU)	In redundant operation, CPUA is Master and in RUN mode.
%FX7	_MASTER_RUN_B	BOOL	BIT 7	B-SIDE is master and RUN (in the presence of standby CPU)	In redundant operation, CPUB is Master and in RUN mode.

Calculation error flags

Address	Flag Name	Type	Write	Contents	Description
%FX672	_ARY_IDX_ERR	BOOL	OK	Overflow error flag array index range	Error flag displayed when exceeding the setting array numbers.
%FX704	_ARY_IDX_LER	BOOL	OK	Overflow error latch flag array index range	Error latch flag displayed when exceeding the setting array numbers.
%FX6160	_ERR	BOOL	OK	Operation error flag	Operation error flag on the basis of operation function (FN) or function block (FB), is renewed every time operation works.
%FX6165	_LER	BOOL	OK	Operation error latch flag	Operation error latch flag on the basis of program block (PB), the error indication which occurs while program block running keeps until the program ends. It is available to delete by a program.

Operation mode key switch

Address	Flag Name	Type	Write	Contents	Description
%FX291	_REMOTE_KEY	BOOL	-	Remote key switch status information	CPU key switch status information - (OFF in Remote mode, ON not in remote mode).
%FX294	_STOP_KEY	BOOL	-	STOP key switch status information	CPU key switch status information - (OFF in STOP mode and ON not in STOP mode).
%FX295	_RUN_KEY	BOOL	-	RUN key switch status information	CPU key switch status information - (OFF in RUN mode and ON not in RUN mode).

10.2 Link flags (L) list

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

Communication flag list according to high-speed link number.

(High-speed link number 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. After the 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: the flag is also ON. 1. The station set in the parameter is not in RUN mode. 2. There is an error in the 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. After the condition returns to normal state, it turns OFF again.

No.	Keyword	Type	Contents	Description
	_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 operation error mode	Indicates if errors occur in the communication state of k data block of parameter.
	_HSn_SETBLOCKk	Bit Array	High-speed link parameter ‘n’, k block setting	Indicates whether or not to set k data block of parameter.

ATTENTION

High-Speed Link no.	L area address	Remarks
1	L000000~L00049F	Comparing with high-speed link 1 from [Table 1], the flag address of different high-speed link station number is as follows, computed by a simple formula: ∗ Calculation formula : L area address = L000000 + 500 x (High-speed link no. – 1) In case of using high-speed line flag for Program and monitoring, you can use the flag map registered in SoftMaster.
2	L000500~L00099F	
3	L001000~L00149F	
4	L001500~L00199F	
5	L002000~L00249F	
6	L002500~L00299F	
7	L003000~L00349F	
8	L003500~L00399F	
9	L004000~L00449F	
10	L004500~L00499F	
11	L005000~L00549F	

'k' means block number and appears 8 words by 16 per word, for 128 blocks from 000~127.

For example, mode information (_HS1MOD) appears from block 0 to block 15 for L00010, and block 16~31, 32~47, 48~63, 64~79, 80~95, 96~111, 112~127 information for L00011, L00012, L00013, L00014, L00015, L00016, L00017. Thus, mode information of block number 55 appears in L000137.

Communication flag list according to P2P service setting

P2P parameter number (n) : 1~8, P2P block(xx) : 0~63

No.	Keyword	Type	Contents	Description
P2P	_P2Pn_NDRxx	Bit	P2P parameter n, xx Block service normal	Indicates P2P parameter n, xx block service normal end.

No.	Keyword	Type	Contents	Description
			end	
	_P2Pn_ERRxx	Bit	P2P parameter n, xx Block service abnormal end	Indicates P2P parameter n, xx block service abnormal end.
	_P2Pn_STATUSxx	Word	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	P2P parameter n, xx Block service normal count	Indicates P2P parameter n, xx block service normal count.
	_P2Pn_ERRCNTxx	Double word	P2P parameter n, xx Block service abnormal count	Indicates P2P parameter n, xx block service abnormal count.

10.3 Communication flags (P2P) list

Link register list according to P2P number

P2P Parameter Number (n) : 1~8, P2P Block(xx) : 0~63

No.	Flags	Type	Contents	Description
N00000	_PnBxxSN	Word	P2P parameter n, xx block another station number	Saves another station number of P2P parameter 1, 00 block. In case of using another station number at SoftMaster-NM, it is possible to edit while in RUN mode by using P2PSN command.
N00001 ~ N00004	_PnBxxRD1	Device structure	Area device 1 to read P2P parameter n, xx block	Saves area device 1 to read P2P parameter n, xx block.
N00005	_PnBxxRS1	Word	Area size 1 to read P2P parameter n, xx block	Saves area size 1 to read P2P parameter n, xx block.
N00006 ~ N00009	_PnBxxRD2	Device structure	Area device 2 to read P2P parameter n, xx block	Saves area device 2 to read P2P parameter n, xx block.
N00010	_PnBxxRS2	Word	Area size 2 to read P2P parameter n, xx block	Saves area size 2 to read P2P parameter n, xx block.
N00011 ~ N00014	_PnBxxRD3	Device structure	Area device 3 to read P2P parameter n, xx block	Saves area device 3 to read P2P parameter n, xx block.
N00015	_PnBxxRS3	Word	Area size 3 to read P2P parameter n, xx block	Saves area size 3 to read P2P parameter n, xx block.

No.	Flags	Type	Contents	Description
N00016 ~ N00019	_PnBx xRD4	Device structure	Area device 4 to read P2P parameter n, xx block	Saves area device 4 to read P2P parameter n, xx block.
N00020	_PnBx xRS4	Word	Area size 4 to read P2P parameter n, xx block	Saves area size 4 to read P2P parameter n, xx block.
N00021 ~ N00024	_PnBx xWD1	Device structure	Area device 1 to save P2P parameter n, xx block	Saves area device 1 to save P2P parameter n, xx block.
N00025	_PnBx xWS1	Word	Area size 1 to save P2P parameter n, xx block	Saves area size 1 to save P2P parameter n, xx block.
N00026 ~ N00029	_PnBx xWD2	Device structure	Area device 2 to save P2P parameter n, xx block	Saves area device 2 to save P2P parameter n, xx block.
N00030	_PnBx xWS2	Word	Area size 2 to save P2P parameter n, xx block	Saves area size 2 to save P2P parameter n, xx block.
N00031 ~ N00034	_PnBx xWD3	Device structure	Area device 3 to save P2P parameter n, xx block	Saves area device 3 to save P2P parameter n, xx block.
N00035	_PnBx xWS3	Word	Area size 3 to save P2P parameter n, xx block	Saves area size 3 to save P2P parameter n, xx block.
N00036 ~	_PnBx xWD4	Device structu	Area device 4 to save P2P	Saves area device 4 to save P2P parameter n, xx block.

No.	Flags	Type	Contents	Description
N00039		re	parameter n, xx block	
N00040	_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 number, block index. The area not used by P2P service as address is divided, can be used by internal device.

10.4 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

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