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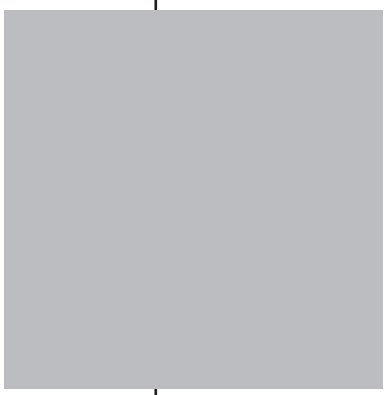
YAMATAKE

No. CP-UM-1654E

MULTI-CHANNEL COMMUNICATIONS-COMPATIBLE BOARD-MACHINE CONTROLLER MX50

User's Manual

Specifications & Installation



Thank you for purchasing the MX50 Multi-channel Communications-compatible Board-Machine Controller.
This manual contains information for ensuring correct use of the MX50 series of controllers. It also provides necessary information for installation, maintenance and troubleshooting.
This manual should be read by those who design and maintain devices, and operator control panels that use the MX50 series of controllers.
The MX50 Multi-channel Communications-compatible Board-Machine Controller is simply referred to as the MX50 from here on in this manual.
Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

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RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment. Accordingly, when used in the applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

REQUEST

Ensure that this User's Manual is handed over to the user before the product is used.

Copying or duplicating this User's Manual in part or in whole is forbidden. The information and specifications in this User's Manual are subject to change without notice.

Considerable effort has been made to ensure that this User's Manual is free from inaccuracies and omissions.
If you should find any inaccuracies or omissions, please contact Yamatake Corporation.

In no event is Yamatake Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

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Safety Precautions

■ About Icons

Safety precautions are for ensuring safe and correct use of the MX50, and for preventing injury to the operator and other people or damage to property. You must observe these safety precautions. The safety precautions described in this manual are indicated by various icons.
The following describes the icons and their meanings. Be sure to read and understand the following descriptions before reading this manual.

⚠ WARNING

Warnings are indicated when mishandling the MX50 might result in death or serious injury to the user.

⚠ CAUTION

Cautions are indicated when mishandling the MX50 might result in minor injury to the user, or only physical damage to the MX50.

■ Examples

	Triangles warn the user of a possible danger that may be caused by wrongful operation or misuse of the MX50. These icons graphically represent the actual danger. (The example on the left warns the user of the danger of electrical shock.)
	White circles with diagonal bar notify the user that specific actions are prohibited to prevent possible danger. These icons graphically represent the actual prohibited action. (The example on the left notify the user that disassembly is prohibited.)
	Black filled-in circles instruct the user to carry out a specific obligatory action to prevent possible danger. These icons graphically represent the actual action to be carried out. (The example on the left instructs the user to remove the plug from the outlet.)

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⚠ WARNING

Before carrying out maintenance on the MX50, be sure to turn the power OFF and allow the MX50 to cool for at least 10 minutes.

Some of the parts in the MX50 become hot during use, and may cause burns if touched.

Do not use the MX50 on units such as life support systems.

⚠ CAUTION

Ground the FG (Frame Ground) on connector CN10 with a resistance of 100 Ω. Failure to ground the MX50 might result in malfunction.

Do not allow wire scraps or metal fragments to contact the board. Doing so might cause short circuits.

Before wiring the MX50, turn the power OFF. Wiring the MX50 with the power turned ON might damage the MX50.

Use the MX50 in the recommended operating environment (regarding vibration, impact, temperature, humidity, etc.).

Before touching components inside the MX50 for maintenance, for example, touch a grounded metal part to discharge any static electricity from the body. Failure to do so might cause static electricity to discharge and damage components.

The MX50 is provided with a built-in lithium battery. When disposing of the lithium battery, remove the battery from the MX50. After removing the battery, either return it to Yamatake-Honeywell or dispose of it according to local bylaws and regulations.

When carrying out reciprocal operation such as forward/reverse operation of a motor controlled by outputs from the MX50 or if there is a risk that outputs from the MX50 may lead to machine damage or accident, provide an external safety interlock circuit.

When supplying power to two or more devices from the same power supply, connect all power switches using the same connection method.

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Unpacking

Check the following when removing the MX50 from its package:

1. Check the catalog number to make sure that you have received the product that you ordered.
2. Check the MX50 for any apparent physical damage.
3. Check the contents of the package against the Packing List to make sure that all accessories are included in the package.

If an inconsistency is found or the package contents are not in order, immediately contact your dealer.

Product List

Name	Accessories	Remarks
Basic Board MX050FT14141HX MX050FT14141HT MX050FT14141HP MX050FT14141NX MX050FT14141NT MX050FT14141NP	Lithium battery MX100BT01 x 1 CBL connectors x 2	Mounted on body at shipment Supplied with MX050FT14141HT and MX050FT14141NT only

Order optional accessories separately as required.

After unpacking, handle the MX50 and its accessories taking care to prevent damage or loss of parts.

Optional Accessories List

Name	Accessories
Mother board MX050EB00002XX MX050EB00004XX	Connector cable x 1 Mounting screws (M3) x 5 Stoppers x 2
I/O board MX250RC44G	Stud (length: 25 mm) x 5
Output board MX250RP21G	Stud (length: 25 mm) x 5

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The Role of This Manual

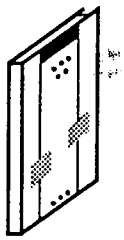
In all, four manuals have been prepared for the MX50. Read the manual according to your specific requirements.
The following lists all the manuals that accompany the MX50 and gives a brief outline of the manual:
If you do not have the required manual, contact Yamatake Corporation or your dealer.

Specifications and Installation

Manual No. CP-UM-1654E

This manual

This manual describes how to install and wire the MX50 into a device, maintenance and inspection, troubleshooting and hardware specifications.



Basic Programming

Manual No. CP-UM-1562E

This manual describes the basic knowledge required for programming the MX series, the internal structure of MX200 registers and memory, and basic programming procedures.

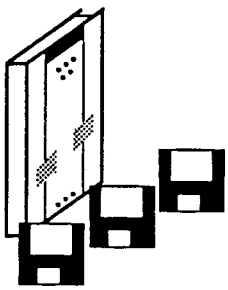
Use the Basic Programming manual together with this manual when making MX50 applications.

Programming Instruction Word

Manual No. CP-UM-1563E

This manual is required reading for programmers who write programs for the MX series.

It gives detailed explanations of each instruction word and so can be used for reference.



Personal Computer Loader Operation

Manual No. CP-UM-1602E

This manual is required reading for those who write programs for the MX series of machine controllers.

This manual comes with a loader software package supplied on floppy disks. The loader software package supports the MX30, MX50, MX100 and MX200, and runs on a PC-9801 series personal computer. This manual describes how to create an "execution system disk" and how to operate the personal computer loader.

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Configuration of This User's Manual

This user's manual comprises the following eight chapters.

Chapter 1 GENERAL

This chapter describes MX50 applications, features and equipment configuration, and gives a list of catalog numbers.

Chapter 2 NAMES & FUNCTIONS OF PARTS

This chapter describes the names and functions of the basic and expansion boards, and how to add on the expansion board.

Chapter 3 INSTALLATION & WIRING

This chapter describes precautions, siting conditions and installation method when installing the MX50 into devices, and how to connect to I/O circuits and peripheral equipment.

Chapter 4 OPERATION

This chapter describes checks to carry out before operating the MX50 and the trial operation procedure.

Chapter 5 HIGH-SPEED COUNTER

This chapter describes the functions of the high-speed counter.

Chapter 6 MAINTENANCE & INSPECTION

This chapter describes inspection items and how to replace maintenance parts to ensure prolonged use of the MX50.

Chapter 7 TROUBLESHOOTING

This chapter describes points to check when the MX50 is not working properly and how to remedy trouble that might occur.

Chapter 8 SPECIFICATIONS

This chapter describes the general specifications, performance specifications, instruction word list and external dimensions of the MX50.

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Conventions Used in This Manual

The following conventions are used in this manual.

HANDLING PRECAUTIONS : Handling Precautions indicate items that the user should pay attention to when handling the MX50.

NOTE : Notes indicate useful information that the user might benefit by knowing.

① ② ③ : Circled numbers indicate steps in a sequence or indicate corresponding parts in an explanation.

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Chapter 1 GENERAL

1-1 Applications and Features

■ Features

● High-speed processing

- The compilation system used on the MX50 speeds up the execution time of basic instructions (min. 1.4 µs), comparison instructions (min. 1.4 µs), move instructions (min. 1.8 µs) and applied instructions, in particular. This makes the MX50 ideal for control of intelligent machines that use lots of applied instructions.
- Two 16-bit CPUs are used. One is used for program execution, and the other is used for I/O transactions. This allows programs to be executed at a high-speed scan time.

● Outstanding interface

The maximum number of I/O is 320 (160 inputs and 160 outputs). In addition, a total of 320 I/Os (160 inputs and 160 outputs) are supported as operator I/O in the interface for the control panel and other interfaces.

Operation indicator lamps and operation switches can be connected to this operator I/O to create easy-to-operate control panels. Operator I/O uses the RS-485 interface, so only five leads is sufficient for wiring.

● Board type

The MX50 is a board type controller, making it ideal for building into devices.

The MX50 also takes up less space than modular controllers which allows devices to made smaller.

● Real-time debugging functions

Execution of the program can be stopped at any specified location to check the program when preset conditions are satisfied. This facilitates debugging and greatly improves the efficiency of program development. Using this function hardly changes the scan time.

● MX series compatibility

Programs are compatible with the MX30, MX100 and MX200 and other MX series controllers. The same MX series personal computer loader is used as the program loader.

[!] HANDLING PRECAUTIONS

- The following MX200 instructions are not supported:
  RSIN, RSOT, WSOT
- Use the data table write (WTBL) instruction only when an event has occurred due to a change in the data table. Frequent execution of write instructions may shorten the scan time or cause data nonconformity between scans.

● Personal computer loader

A PC-9801 series general-purpose personal computer or compatible machine can be used as the personal computer loader.

As a result, the personal computer loader is easier to use and has more functions than conventional dedicated loaders.

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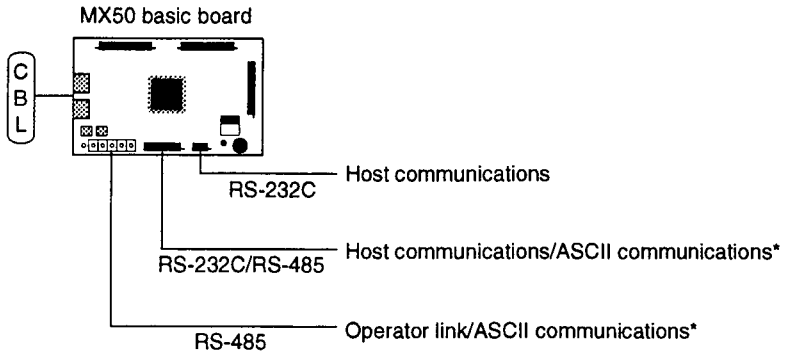
● **Powerful communications functions**

- ASCII communications (standard)
  A general-purpose ASCII communications connector is provided as standard to simply the communications programs.
- Simultaneous programming and host communications
  Monitoring and data setup by host communications via the Smart Terminal or personal computer during programming or debugging is possible.
- Operator link (standard)
  Use of the operator link as the interface facilitates linking between the operator I/O and Smart Terminal ST100/ST221.



* Either of the ASCII connector or operator I/O terminal can be selected for ASCII communications.

[!] HANDLING PRECAUTIONS

Communications via the RS-485 interface cannot be used when host communications is selected.

● **Field network CBL supported**

(MX050FT14141HT, MX050FT14141NT, MX050FT14141HP, MX050FT14141NP)

The MX50 is provided with high-speed field network CBL (Communications Based Link) ideal for machine internal distributed control as standard. CBL supports machine control to suit the expanded scale of the system.

● **PROM**

A PROM can be used for running the program. Low-priced EPROMs can be mounted in the MX50, allowing the operator to make the correct choice between machine performance and cost.

[!] HANDLING PRECAUTIONS

EEPROMs cannot be used on the MX50.

● **Enhanced program development environment**

In addition to ladder programs, programming by label names is possible. When re-using programs, corrections made to existing programs can be kept to a minimum.

The MX50 is also provided with MCL (Machine Control Language) a structured language that optimally merges the C and ladder languages in an optimum format. This allows you to choose the development language to suit the application, improving the efficiency of program development.

● **Library function**

Library functions can be used by mounting a library ROM.

- **High-speed counter (standard on MX050FT14141HX, MX050FT14141HT, MX050FT14141HP)**

  The MX50 is equipped with two HSCs (High Speed Counters) that support three pulsed input methods: phase difference input, 2-pulse input and directional input.

  The MX50 has many input contacts for expressing the HSC states. Compare and preset functions can also be set.

  The MX50 has give external inputs and one output for each channel. External signals can be triggered.

- **I/O contacts**

  The MX50 has external contacts for 32 inputs and 32 outputs on its I/F board. Inputs and outputs can be added on with ease. Also, selection of an expansion board allows the number of I/Os to be freely selected.

  Two expansion boards are available: MX250RC44G I/O board with 32 inputs and 32 outputs, and the MX250RP21G output board with relay output.

■ Selecting the memory type

You can choose from the following two types of program memory.

1. RAM (built into basic board)

   The basic board has RAM built-in as program memory. The battery holds backs up the contents of RAM even in a power interruption. Programs created by the personal computer loader are written to this RAM for use.

   The program can be easily changed by the personal computer loader, making it ideal for trial operation.

   Even when PROM is used, the program is written to RAM before it is run.

2. EPROM

   EPROM can be used by inserting into the IC socket on the rear surface of the MX50. To write programs to EPROM, connect the PROM writer to the personal computer loader, and follow the menu instructions on the personal computer loader.

   For details on PROM specifications, see page 8-16.

   Recommended PROM Catalog Nos.

EPROM	
512K	**1M**
MBM27C512-15 (Fujitsu) M5M27C512AK-15 (Mitsubishi Electric)	µPD27C1001AD-15 (NEC) HN27C101AG-15 (Hitachi)

[!] HANDLING PRECAUTIONS

When using programs in memory cards written on the MX100, install the memory card onto the MX100 Handy Loader, and connect the Handy Loader to the personal computer.

Upload the program to the personal computer via the MX series personal computer loader, and download the program via the LOAD connector (RS-232C) on the MX50 connected to the personal computer.

■ Internal memory configuration

MX50 internal memory has relay area, timer/counter area, register area and data table area.

Relay area can handle data in bit units, and register area can handle data in 16-bit word units or in bit units.

Areas are determined as follows.

Area	Name	High-speed Counter Function		Description
		Supported	Not supported	
Relay Area	Input relays	X000 to X19F	X000 to X15F	I/O relay assignments
	Output relays	Y000 to Y19F	Y000 to Y15F	
	Input relays for high-speed counter	—	X160 to X19F	High-speed counter function (option) assignments
	Output relays for highspeedcounter	—	Y160 to Y19F	
	Operator input relays	X200 to X29F		Operator assignments Carries out transactions with operator I/O, EST and ST series.
	Operator output relays	Y200 to Y29F		
	Auxiliary relays	M000 to M89F		Internal relays that cannot be output
	Special relays	M900 to M99F		Various alarm and error information
	Latch (hold) relays	L000 to L49F		Relays having power interruption function
Register Area	Data registers	R0000 to R0499		Data area used for applied instructions (held at power interruption)
		R1000 to R4999		
	Word input registers	R0500 to R0519	R0508 to R0519	Word I/O data assignments
	Word output registers	R0600 to R0619	R0608 to R0619	
	Input registers for highspeedcounter	—	R0500 to R0507	High-speed counter function (option) assignments
	Output registers for high-speedcounter	—	R0600 to R0607	
	Special registers	R0900 to R0999		Data or error information for self diagnostics
	Link registers	P0000 to P3799		PC link area
		P3800 to P39999		PC link management area
Timer/Counter Area	Timer/counter	T/C000 to T/C255		Operates when timer has reached timeup or when the counter has counted.
Data Table Area	Data table	#0 to #9998		Program area in which data R/W operations are possible

! HANDLING PRECAUTIONS

- Areas assigned for the high-speed counter can be used as regular areas on the following MX50 models:

  MX0505FT14141NX, MX0505FT14141NT, MX0505FT14141NP

- Output relays not assigned for I/O can also be used as auxiliary relays.
- I/O registers not assigned for I/O can also be used as data registers.
- When using ladder programs made on other MX series on an MX50 that supports a high-speed counter function, do not use the following ranges assigned for the high-speed counter as general-purpose relays and registers:
  - X160 to X19F, Y160 to Y19F
  - R0500 to R0507, R0600 to R0607

■ Registering I/O

● General-purpose I/O

I/O are automatically assigned in the following ranges:

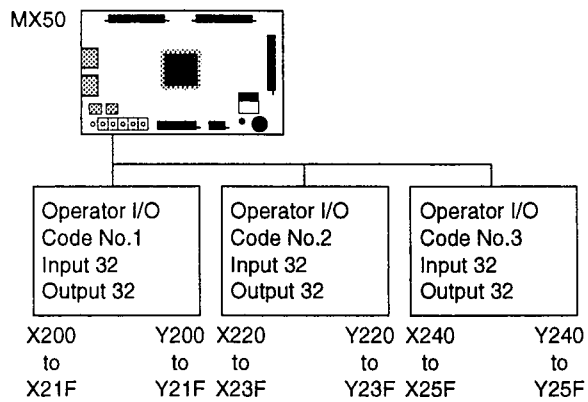
Basic board digital inputs (32 inputs)	X000 to X01F
Basic board digital outputs (32 outputs)	Y000 to Y01F
Expansion board digital input	X020 to X15F
Expansion board digital output	Y020 to Y15F

● Operator I/O

To register operator link I/O, set the number of required words for the number of I/O on the personal computer loader. Inputs are assigned from X200 and outputs are assigned from Y200. A maximum of 160 inputs and outputs can be assigned. Inputs and outputs registered in excess of this figure are ignored.

An alarm is displayed at the following times, and operator I/O does not function even if connected as long as I/O are not assigned on the personal computer.

- When there is no response from the operator I/O when the MX50 is started up
- When the operator I/O mounted data differs from the registered data
- When there is no response from the operator I/O during operation



[!] HANDLING PRECAUTIONS

Automatically connected operator I/O information cannot be read with the operator link I/O not registered.

● High-speed counter assignments

The relay areas and register areas for the high-speed counter are automatically assigned in the following ranges:

High-speed counter input relay	X160 to X19F
High-speed counter output relay	Y160 to Y19F
High-speed counter input register	R0500 to R0507
High-speed counter output register	R0600 to R0607

[!] HANDLING PRECAUTIONS

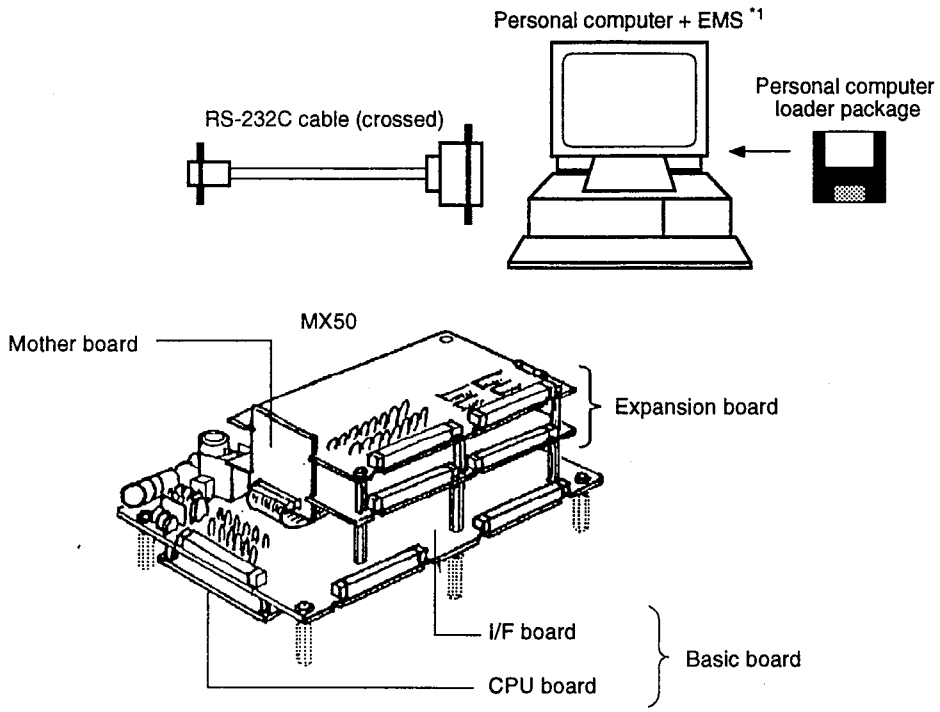
The following MX50 models do not support the high-speed counter function. So, use these assignments for regular I/O relays and I/O registers.

MX050FT14141NX
MX050FT14141NT
MX050FT14141NP

1-2 Equipment Configuration

■ Basic configuration

The following figure shows the basic equipment configuration.



*1: EMS (Expanded Memory Specification) expanded memory

● Basic board

The "basic board" comprises an I/F board and a CPU board. In all, a total of six basic boards are available depending on the combination of CBL and high-speed counter functions. The basic board also supports connection to a personal computer loader, and is provided with ASCII and operator I/O communications ports.

The basic board handles programs of 31 kBytes in size, and features PROM and RAM built-into the CPU board. It also supports 32-input and 32-output DI/O.

● Expansion board

The "expansion board" comprises an I/O board and an output board.

The I/O board has 32-input/32-output DI/O, and the output board has 16 relay outputs.

Mounting a mother board allows up to four expansion boards to be mounted on the basic board. Also, any combination of I/O board and output boards is possible.

The maximum number of I/Os is 320 (maximum 160 inputs and 160 outputs).

● **Peripheral equipment**

The loader software package allows a PC-9801 series general-purpose personal computer or other compatible MS-DOS machines to be used as peripheral equipment.

● **Program memory size**

The program memory size is expressed in byte units or bit units depending on the device. The following table shows the relationship between device and program memory size.

Device	Catalog Listing	Memory size	Program size		Description
			Ladder	Data Table	
RAM (basic board	MX050FT14141HX MX050FT14141HT MX050FT14141HP MX050FT14141NX MX050FT14141NT MX050FT14141NP	64 Kbyte	31 Kbyte	20 Kbyte	Can store programs up to 31 Kbytes comprising 2 to 13-byte instructions (depending on instruction language). 1 Kbyte of space is used for internal processing.
PROM	MBM27C512-15 (Fujitsu) M5M27C512AK-15 (Mitsubishi Electric) µPD27C1001AD-15 (NEC) HN27C101AG-15 (Hitachi)	512 Kbit 1 Mbit	31 Kbyte	20 Kbyte	PROM size is expressed in bits. 512 Kbits is equivalent to 64 Kbytes. However, note that only programs up to 31 Kbytes are supported even if a 1 Mbyte PROM is used.

! HANDLING PRECAUTIONS

PROM cannot hold programs exceeding the maximum MX50 program size of 31 kBytes.

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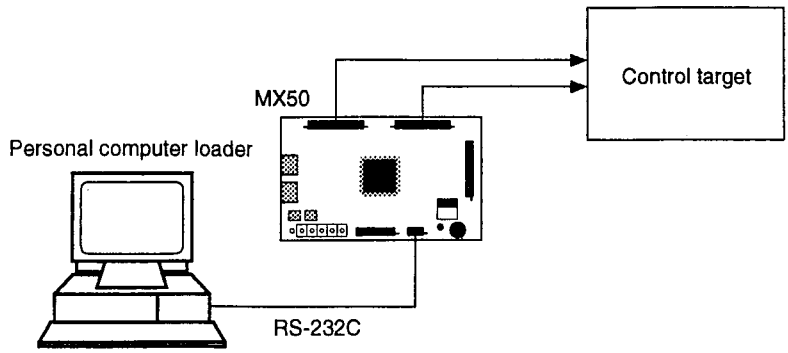
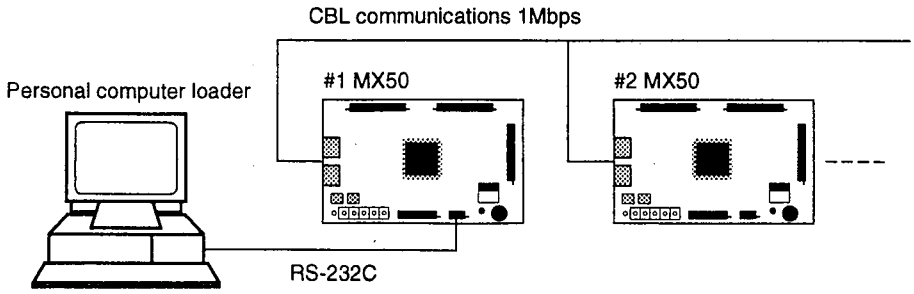
■ Example of package configuration

● Basic configuration



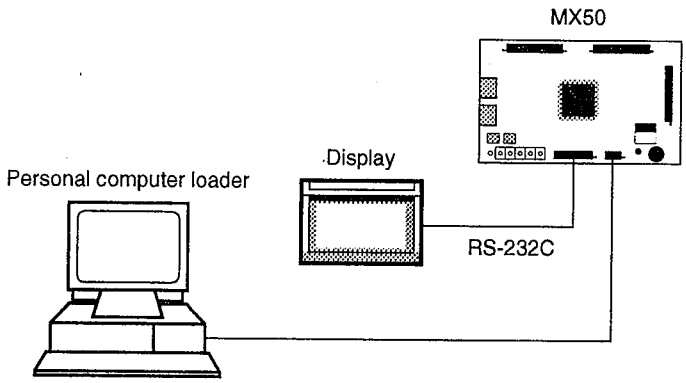
This configuration allows sequence control, positioning control and data processing by digital I/O.

● Host communications/data link configuration



Two or more MX50s are connected by CBL (Controller Based Link) communications allowing mutual PC link and mail communications. This configuration allows programs to be edited on the #2 MX50 via the #1 MX50 and allows system expansion. When configuring a system made up of two or more MX50s, use the MX05014141NT, or MX05014141HP or MX05014141NP type controllers.

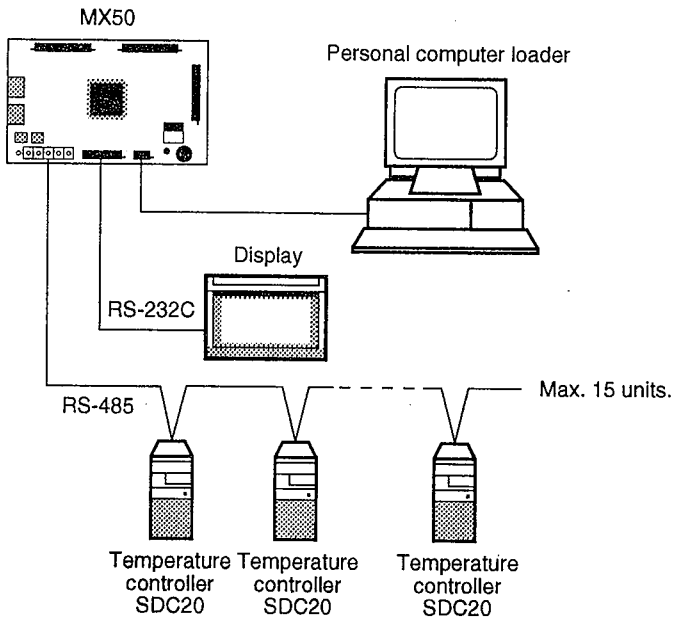
● **Connection with display**



This configuration allows monitoring and data setup on a display (Yamatake Corporation Smart Terminal ST/EST series) while carrying out programming and debugging on a personal computer loader. The ST/EST series achieves program-less operation of the MX50 by host communications.

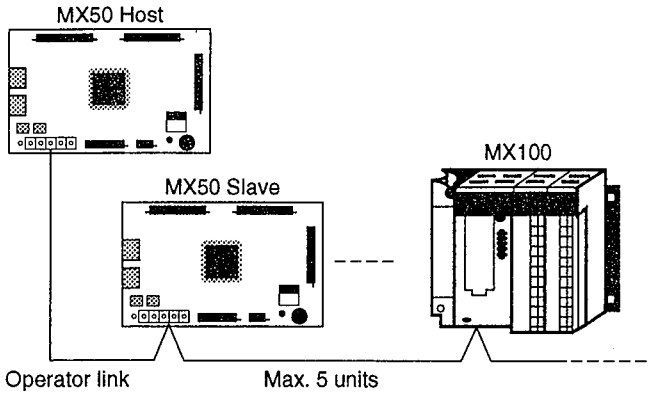
● **Connection with temperature controllers**

Selection of the operator link functions of the basic board allows communication between the ladder program and temperature controllers via RS-485 ASCII communications (multi-drop connection).



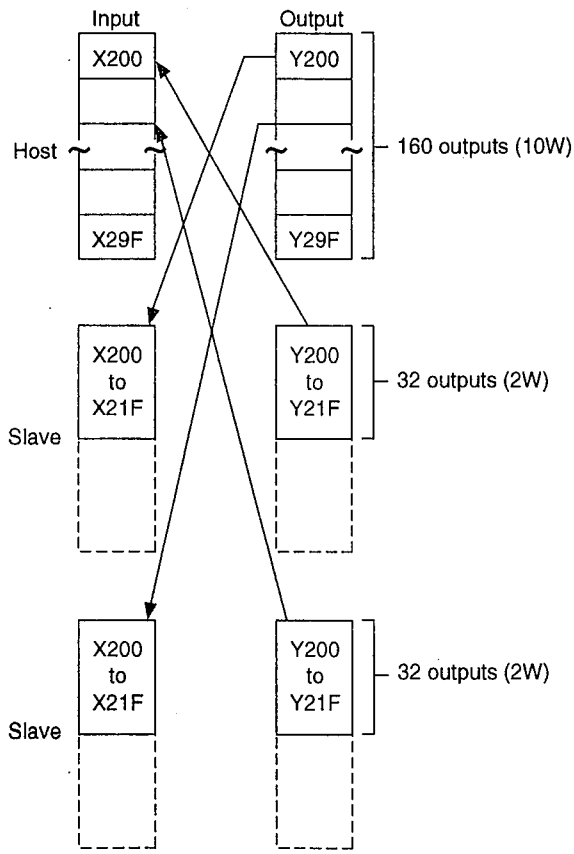
Mounting a communications library ROM (catalog No. MX200LB01) on the MX50 enables program-less communications with a Yamatake Corporation temperature controller (SDC20/21, SDC30/31, SDC40A, CB508).

● **Connection by operator link**



This configuration allows up to 32 I/O relays (X200 to X29F, Y200 to Y29F) for the operator link of the host station MX50 and up to 32 I/O relays (X200 to X21F, Y200 to Y21F) for the operator link of the slave station MX50 to be shared. In this configuration, up to five MX50s can be connected as slave stations.

Operator I/O can also be connected to the operator link.



■ Personal computer loader

The MX50 personal computer loader is a software loader package for use on a general-purpose personal computer.

It supports the NEC PC-9801 series and IBM PC/AT or compatible machines. These machines are connected to the MX50 via an RS-232C cable.

The personal computer loader is provided with MX50 ladder program creation, debugging and save/read functions. It also allows MX50 statuses to be monitored on screen.

For details, refer to the following table and user's manuals.

		MX2005W01	MX2005W01EX
Instruction Manual		CP-UM-1602	CP-UM-1602E
Computer		NEC PC-9801 series	IBM PC/AT compatible
Storage Capacity	**Main Memory**	640 Kbyte (free memory 510 Kbyte)	2 Mbytes min. (protected memory)
	EMS Memory	528 Kbyte min.	528 Kbyte min.
Operating System		MS-DOS Ver. 3.3	DOS 5.x, DOS 6.x
Storage Device		3.5" floppy disk (Hard disk is required for full model.)	3.5" floppy disk (Hard disk is required for full model.)
Printer		PC-PR201 series	ESC/P compatible printer
Description		• Cannot be used under Windows. • Use ATOK7E made by Just Systems for Kanji entry (FEP).	• Cannot be used under Windows. • Set to English mode for use in DOS/Venvironment. • Use COM1 for RS-232C communications

1-3 Catalog Numbers

■ MX50 and related products

The following tables show a list of boards and peripheral equipment used on the MX50.

● MX50

Basic board MX050FT14141□□

- X: CBL communications not supported
- T: CBL (electrical) communications supported
- P: CBL (optical) communications supported
- H: W/ high-speed counter
- N: W/out high-speed counter

Basic Board Catalog Listing	High-speed Counter	CBL Communications		Program Size
		Electrical Type	Optical Type	
MX050FT14141HX	○			31 Kbyte
MX050FT14141HT	○	○		31 Kbyte
MX050FT14141HP	○		○	31 Kbyte
MX050FT14141NX				31 Kbyte
MX050FT14141NT		○	○	31 Kbyte
MX050FT14141NP				31 Kbyte

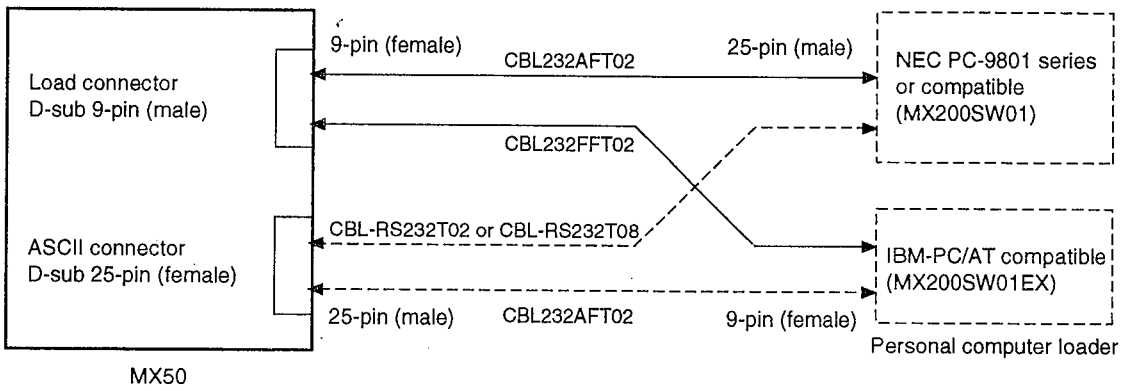
Name	Catalog Listing	Description
Output Board	MX250RP21G	16 relay outputs
Input Board	MX250RC44G	32 inputs, 32 outputs, 24 VDC
Mother Board	MX050EB00002XX MX050EB00004XX	For 2-board expansion add-on For 4-board expansion add-on

● **Related products**

Name	Catalog Listing	Description
Personal Computer Loader Package *1	MX200SW01	3.5" floppy disk (1.2 Mbytes) This software converts NEC PC-9801 series or compatible machines into MX series Japanese language personal computer loaders.
	MX200SW01EX *2	3.5" floppy disk (1.44 Mbytes) This software converts IBM-PC/AT compatible machines into MX series English language personal computer loaders.
RS-23C Cable	CBL232AFT02 CBL232FFT02	25-pin (male)/9-pin (female), cable length: 2 m 25-pin (male)/9-pin (female), cable length: 2 m Connectors used when the LOAD connector is used
	CBL-RS232T02 CBL-RS232T08	25-pin (male)/25-pin (male), cable length: 2 m 25-pin (male)/25-pin (male), cable length: 8 m Connectors used when the ASCII connector is used
Lithium battery	MX100BT01	Battery for memory backup of basic board

*1 The figure below shows how the personal computer loader package is connected.

*2 MX200SW01EX runs on the English version of MS-DOS, and cannot be used in the DOS/V environment.



! HANDLING PRECAUTIONS

- Though the personal computer loader can also be used via the ASCII connector, we recommend use via the LOAD connector.
- When using the personal computer loader on the ASCII connector, set up loader communications via the ASCII connector beforehand on the LOAD connector.
- Use COM1 as the personal computer loader RS-232C connector for an IBM-PC/AT or compatible.
- The RS-22C connector on the computer is a typical connector. If the connector on the computer you are using is not a D-sub 25-pin (female) or D-sub 9-pin (male), prepare a separate conversion adapter.

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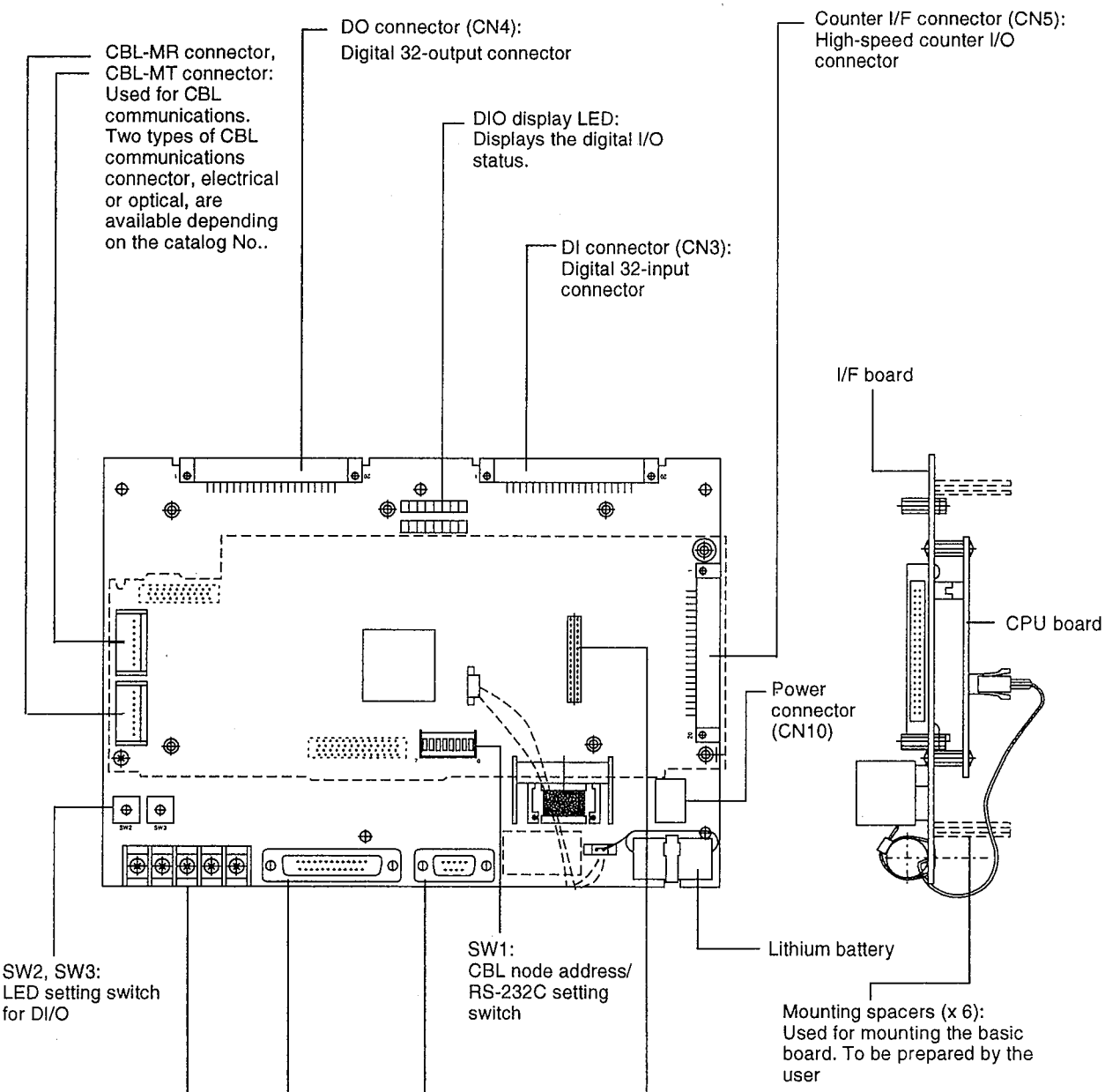
Chapter 2 NAMES & FUNCTIONS OF PARTS

2-1 Basic Board

■ Layout of basic board parts

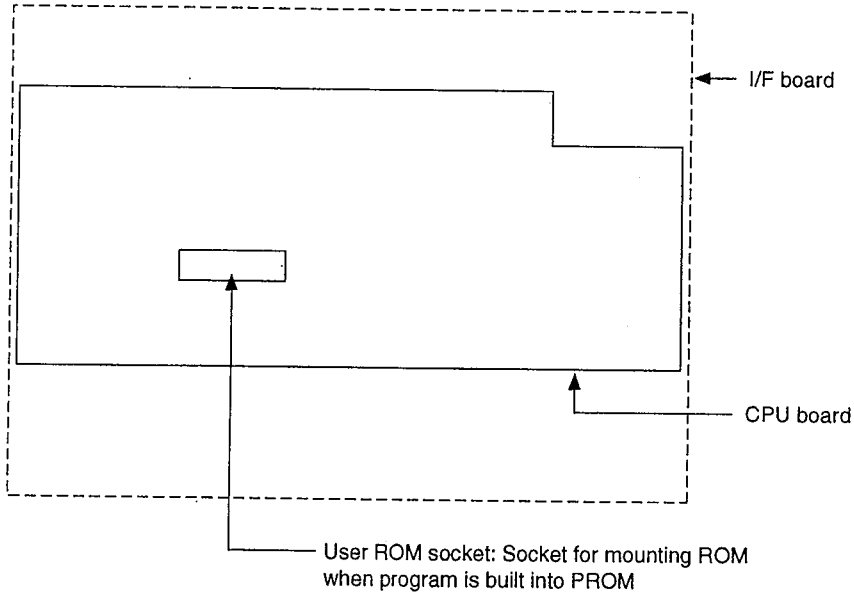
● I/F board



ASCII connector (CN8):
Use the RS-232C connector for connecting to the personal computer loader, host computer or ASCII device. Use an RS-232C crossed cable for connecting to the personal computer. When connecting with the Yamatake-Honeywell ST/ EST series, setting this connector as the host communications function allows program-less communications.
Cable catalog Nos.: CBL-RS232T02 Cable length 2 m, or
CBL-RS232T08 Cable length 8 m

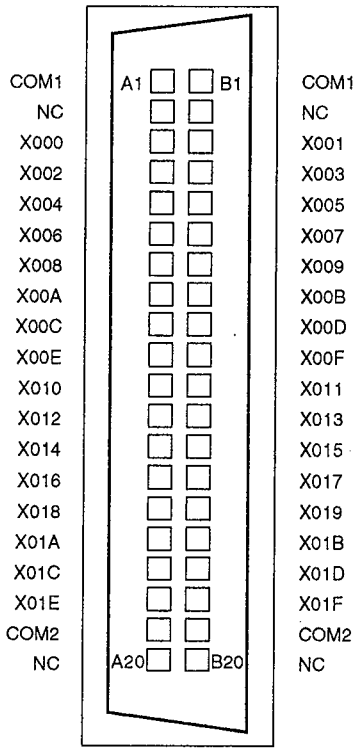
Operator I/O terminal (CN9):
Used for connecting to the operator I/O and for connecting to general-purpose ASCII devices (e.g. bar code reader)

● **CPU board side**



■ Connector signals

● DI connector (CN3)

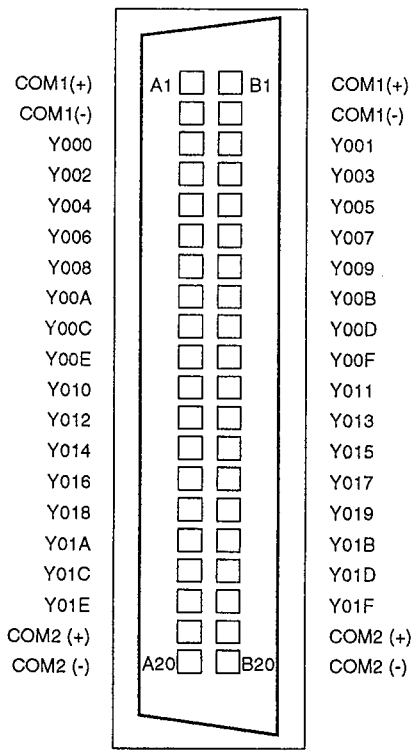


Board connector:	Fujitsu	FCN-365P040-AU
Compatible connectors:	Fujitsu	FCN-361J040-AU
	Fujitsu	FCN-362J040-AU
	Fujitsu	FCN-367J040-AU

[!] HANDLING PRECAUTIONS

The maximum current per pin is 1 A. Pins A1 and B1, and A19 and B19 are shorted internally. Because of the maximum current, connect all pins separately.

● DO connector (CN4)



Board connector:	Fujitsu	FCN-365P040-AU
Compatible connectors:	Fujitsu	FCN-361J040-AU
	Fujitsu	FCN-362J040-AU
	Fujitsu	FCN-367J040-AU

[!] HANDLING PRECAUTIONS

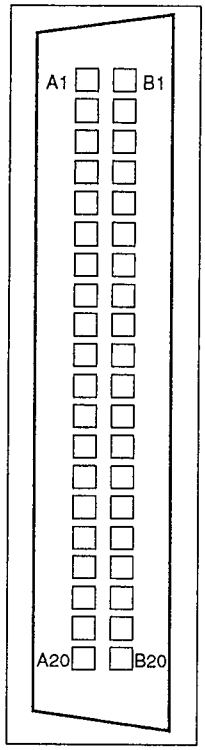
The maximum current per pin is 1 A. Pins A1 and B1, A2 and B2, A19 and B19 and A20 and B20 are shorted internally. Because of the maximum current, connect all pins separately.

● Counter I/F connector (CN5)

Board connector: Fujitsu FCN-365P040-AU

Compatible connectors: Fujitsu FCN-361J040-AU
Fujitsu FCN-362J040-AU
Fujitsu FCN-367J040-AU

PCMP_COM+	(PCMP power + ch1)
PCMP1_COM-	(PCMP power - ch1)
PA1_24V	(PA input 24 V ch1)
PA1_5V	(PA input 5 V ch1)
PB1_24V	(PA input 24 V ch1)
PB1_5V	(PB input 5 V ch1)
PZ1_24V	(PZ input 24 V ch1)
PZ1_5V	(PZ input 5 V ch1)
PRST1	(PRST input ch1)
PENB1	(PENB input ch1)
PA2_24V	(PA input 24 V ch2)
PA2_5V	(PA input 5 V ch2)
PB2_24V	(PB input 24 V ch2)
PB2_5V	(PB input 5 V ch2)
PZ2_24V	(PZ input 24 V ch2)
PZ2_5V	(PZ input 5 V ch2)
PRST2	(PRST input ch2)
PENB2	(PENB input ch2)
PCMP2_COM+	(PCMP power + ch2)
PCMP2_COM-	(PCMP power - ch2)



FG	
PCMP1	(PCMP output ch1)
PA1_12V	(PA input 12 V ch1)
PA1_COM	(PA common ch1)
PB1_12V	(PB input 12 V ch1)
PB1_COM	(PB common ch1)
PZ1_12V	(PZ input 12 V ch1)
PZ1_COM	(PZ common ch1)
PRST1_COM	(PRST common ch1)
PENB1_COM	(PENB common ch1)
PA2_12V	(PA input 12 V ch2)
PA2_COM	(PA common ch2)
PB2_12V	(PB input 12 V ch2)
PB2_COM	(PB common ch2)
PZ2-12V	(PZ input 12 V ch2)
PZ2-COM	(PZ common ch2)
PRST2_COM	(PRST common ch2)
PENB2_COM	(PENB common ch2)
FG	
PCMP2	(PCMP output ch2)

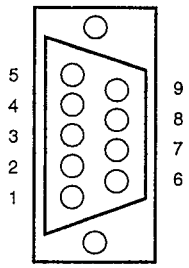
● LOAD connector (CN7)

Board connector: Hirose Electric SDEB-9P

Compatible connectors: CBL232AFT02
CBL232FFT02

Use an RS-232C crossed cable for connecting to the personal computer.

D-sub 9-pin



Pin No.	Signal Name	Definition
1		NC
2	RD	Receive data
3	TD	Transmit data
4	DTR	Data terminal ready
5	SG	Signal ground
6	DSR	Data set ready
7	RTS	Request transmission
8	CTS	Clear transmission
9		NC

4 and 6 are not connected in MX50.

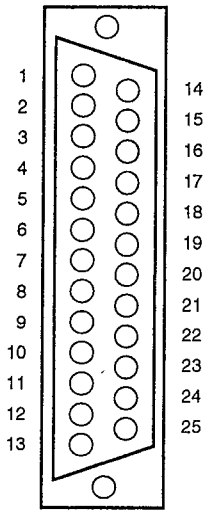
● **ASCII connector (CN8)**

Board connector: Hirose Electric SDBB-25S

Compatible connectors: CBL-RS232T02
CBL-RS232T08

Use an RS-232C crossed cable for connecting to the personal computer.

D-sub 25-pin



Pin No.	Signal Name
1	FG
2	SD (RS-232C transmission)
3	RD (RS-232C reception)
4	RS (RS-232C transmission request)
5	CS (RS-232C reception request)
7	SG
9	+5V
10	Reserve pin
11	SDA (RS-485 transmission)
12	RDA (RS-485 reception)
23	SDB (RS-485 transmission)
24	RDB (RS-485 reception)

8, 13 to 22 and 25 are not connected in MX50.

● **Operator I/O terminal (CN9)**

Board connector: Fujicon F2041NAX-4L-5P

Terminal screws: M3 screw tightening torque 0.5 N•m {5 kgf•cm}

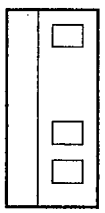
1 SDA (RS-485 transmission)
2 SDB (RS-485 transmission)
3 RDA (RS-485 reception)
4 RDA (RS-485 reception)
5 SG

● **Power connector (+24 VDC) (CN10)**

Board connector: Morex 5289-3A

Compatible connector: Morex 5199-03

Contact pieces: Morex 5194T (continuous)
Morex 5194TL (separate)



1 FG
2 GND
3 24 DCV

NOTE Use the JHTR5904 (made by Nihon Morex) as the manual crimping tool for CN10.

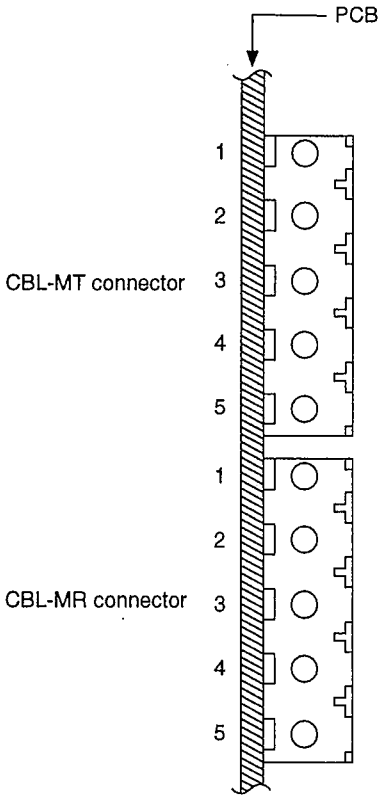
● **CBL connector**

MX050FT14141HT, MX050FT14141NT (electrical type)

Connected by twisted pair cable.

Board connector: Weidmuller SLA5

Compatible connector: Weidmuller BLA5



Pin No.	Signal Name
1	SG (signal ground)
2	SR- (sub-reception -)
3	SR+ (sub-reception +)
4	MT- (main transmission -)
5	MT+ (main transmission +)

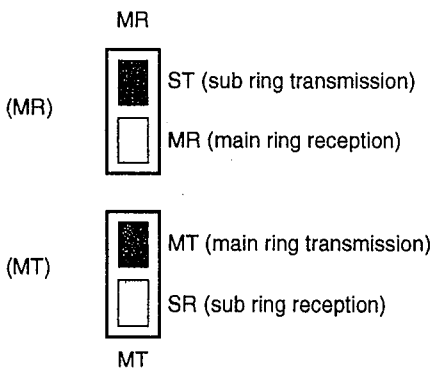
Pin No.	Signal Name
1	SG (signal ground)
2	MR- (main reception -)
3	MR+ (main reception +)
4	ST- (sub-transmission -)
5	ST+ (sub-transmission +)

MX050FT14141HP, MX050FT14141NP (optical type)

Connected by dedicated optical connector.

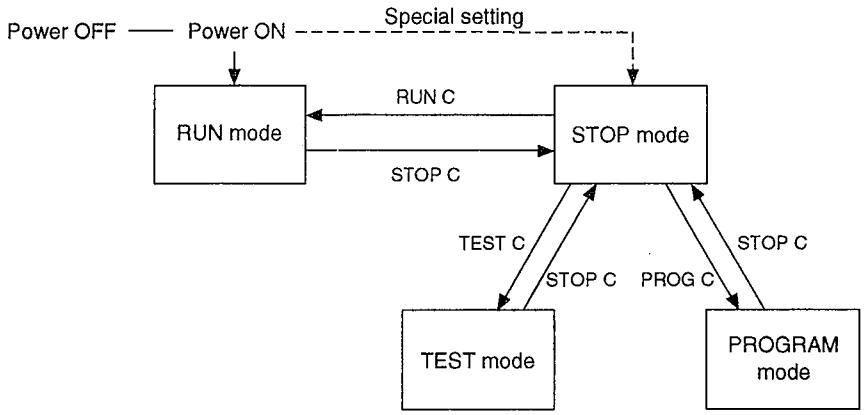
Board connector: Toshiba TODX270

Compatible connector: Toshiba TOCP200Q-☐☐MB
(☐☐ is cable length.)



■ Status transition

The following figure shows the relationship between the MX50 operation modes.



Transition between the RUN, TEST and PROG modes is carried out by passing via the STOP mode. In the STOP mode, output is OFF. The MX50 uses the compilation system, so it takes a few seconds to compile in the following instances:

① When the power is turned ON

② When moving from the PROG mode

③ When moving from the TEST mode

! HANDLING PRECAUTIONS

- RUN C, STOP C and PROG C indicate mode selection commands input from the personal computer loader.
- When an output instruction is executed on the personal computer loader, the instruction is output for only one scan even in the STOP mode.
- The mode when the power is turned ON can be operated from the STOP mode by special settings set on the rotary switch.

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■ CBL node address/RS-232 setting switch (SW1)

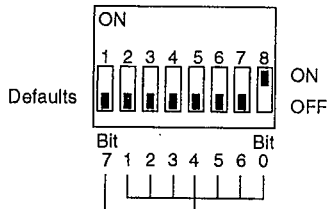
Defaults are as follows:

CBL node address: 1 RS-232C: Terminal

The MX50 can carry out communications with the personal computer loader and CBL communications. During communications, commands issued to the self station address are processed. For this reason, the communications address must be set.

The communications address is set using the lower seven contacts (6 to 0) of DIP switch SW1. The communications address can be set within the range 1 to 63, and to 127. If set to 127, CBL communications is not carried out. CBL communications is supported on the following controller models:

MX050FT14141HT
MX050FT14141NT
MX050FT14141HP
MX050FT14141NP



Bit 7	RS-232C Settings
ON	9600 bps 8 bits Even parity
OFF	Set at Terminal

Even if bit 7 is ON, the communications conditions can be changed by a personal computer loader or other methods during MX50 operation.

: Defaults

1: ON
0: OFF

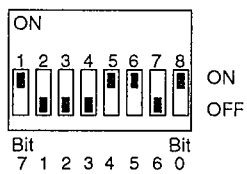
Node Address	Bit						
	6	5	4	3	2	1	0
1 (01)	0	0	0	0	0	0	1
2 (02)	0	0	0	0	0	1	0
3 (03)	0	0	0	0	0	1	1
4 (04)	0	0	0	0	1	0	0
5 (05)	0	0	0	0	1	0	1
6 (06)	0	0	0	0	1	1	0
7 (07)	0	0	0	0	1	1	1
8 (08)	0	0	0	1	0	0	0
9 (09)	0	0	0	1	0	0	1
10 (0A)	0	0	0	1	0	1	0
11 (0B)	0	0	0	1	0	1	1
12 (0C)	0	0	0	1	1	0	0
13 (0D)	0	0	0	1	1	0	1
14 (0E)	0	0	0	1	1	1	0
15 (0F)	0	0	0	1	1	1	1
16 (10)	0	0	1	0	0	0	0
17 (11)	0	0	1	0	0	0	1
18 (12)	0	0	1	0	0	1	0
19 (13)	0	0	1	0	0	1	1
20 (14)	0	0	1	0	1	0	0
21 (15)	0	0	1	0	1	0	1
22 (16)	0	0	1	0	1	1	0
23 (17)	0	0	1	0	1	1	1
24 (18)	0	0	1	1	0	0	0
25 (19)	0	0	1	1	0	0	1
26 (1A)	0	0	1	1	0	1	0
27 (1B)	0	0	1	1	0	1	1
28 (1C)	0	0	1	1	1	0	0
29 (1D)	0	0	1	1	1	0	1
30 (1E)	0	0	1	1	1	1	0

Node Address	Bit						
	6	5	4	3	2	1	0
31 (1F)	0	0	1	1	1	1	1
32 (20)	0	1	0	0	0	0	0
33 (21)	0	1	0	0	0	0	1
34 (22)	0	1	0	0	0	1	0
35 (23)	0	1	0	0	0	1	1
36 (24)	0	1	0	0	1	0	0
37 (25)	0	1	0	0	1	0	1
38 (26)	0	1	0	0	1	1	0
39 (27)	0	1	0	0	1	1	1
40 (28)	0	1	0	1	0	0	0
41 (29)	0	1	0	1	0	0	1
42 (2A)	0	1	0	1	0	1	0
43 (2B)	0	1	0	1	0	1	1
44 (2C)	0	1	0	1	1	0	0
45 (2D)	0	1	0	1	1	0	1
46 (2E)	0	1	0	1	1	1	0
47 (2F)	0	1	0	1	1	1	1
48 (30)	0	1	1	0	0	0	0
49 (31)	0	1	1	0	0	0	1
50 (32)	0	1	1	0	0	1	0
51 (33)	0	1	1	0	0	1	1
52 (34)	0	1	1	0	1	0	0
53 (35)	0	1	1	0	1	0	1
54 (36)	0	1	1	0	1	1	0
55 (37)	0	1	1	0	1	1	1
56 (38)	0	1	1	1	0	0	0
57 (39)	0	1	1	1	0	0	1
58 (3A)	0	1	1	1	0	1	0
59 (3B)	0	1	1	1	0	1	1
60 (3C)	0	1	1	1	1	0	0
61 (3D)	0	1	1	1	1	0	1
62 (3E)	0	1	1	1	1	1	0
63 (3F)	0	1	1	1	1	1	1
127 (7F)	1	1	1	1	1	1	1

- Setting example
  Set the DIP switch as shown in the figure on the right to set the following conditions:

  Node address: 13

  RS-232C: 9600 bps, 8 bit, even parity

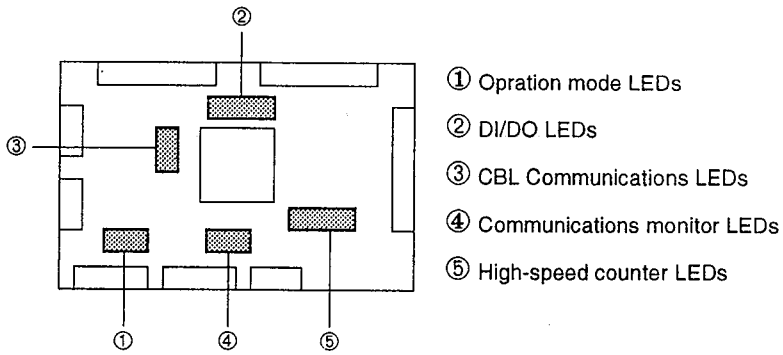


! HANDLING PRECAUTIONS

- Before setting the communications conditions, turn the power OFF. The conditions will not change if the communications conditions are changed while the MX50 power is ON.
- The communications address can be set within the range 1 to 63, and to 127. If an address outside of this range is set, MX50 operation cannot be assured.

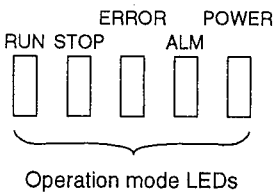
■ LED display

The MX50 has the following five LED groups that allow the operator to check internal statuses.



● Operation mode LEDs

These LEDs indicate the operating status of the MX50. When all five LEDs are lit, this indicates that a system error has occurred inside the MX50.



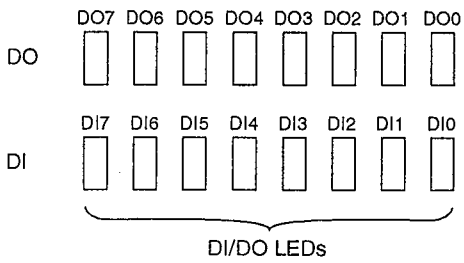
LED Name	Description
POWER	Lights when power is supplied to MX50.
ALM	Lights when an alarm occurs. Flashes when a battery error occurs. Flashes when a battery error occurs and another alarm occur at the same time.
ERROR	Lights when an error occurs.
STOP	Lights in the STOP mode. Flashes in the PROG mode. Goes out in either of the STOP or PROG modes.
RUN	Lights in the RUN mode. Flashes in the TEST mode. Goes out in either of the RUN or TEST modes.

● **DI/DO LEDs**

These LEDs indicate the DI/DO statuses of the MX50.

In addition to the standard DI/DO, the MX50 supports up to four optional expansion boards. The DI/DO operating status is indicated by changing the settings of rotary switches (SW2, SW3). Rotary switch SW2 selects the target DI/DO, and SW3 selects the display bit. The following table shows the details of these switches.

SW2	Select DI/DO
0	Standard DI/DO
1	Expansion board (1)
2	Expansion board (2)
3	Expansion board (3)
4	Expansion board (4)
5	Reserved for system
6	Reserved for system
7	Reserved for system
8	Reserved for system
9	Special setting



SW3	DI LED	DO LED
0	Input status (bits 0 to 7)	Output status (bits 0 to 7)
1	Input status (bits 8 to 15)	Output status (bits 8 to 15)
2	Input status (bits 16 to 23)	Output status (bits 16 to 23)
3	Input status (bits 24 to 31)	Output status (bits 24 to 31)
4	Input status (bits 32 to 39)	Output status (bits 32 to 39)
5	Input status (bits 40 to 47)	Output status (bits 40 to 47)
6	Input status (bits 48 to 55)	Output status (bits 48 to 55)
7	Input status (bits 56 to 63)	Output status (bits 56 to 63)
8	Reserved for system	Reserved for system
9	Reserved for system	Reserved for system

HANDLING PRECAUTIONS

- The expansion board is optional

  MX250RP12G: Output board (16 outputs)

  MX250RC44G: I/O board (32 inputs/32 outputs)

- When setting rotary switches (SW2, SW3), avoid system reserved areas, and set DI/DO that actually exist. If the rotary switches are set to other DI/DO, lighting of the LEDs is meaningless.
- Some input statuses and output statuses are outside of the range depending on the board connected to the MX50. As the standard DI/DO supports 32 I/O, lighting of the DI/DO LEDs is meaningless when SW3 is set to 4 to 7.

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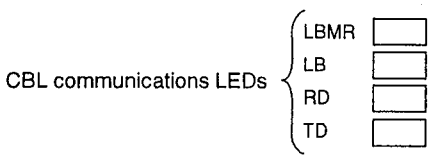
● CBL communications LEDs

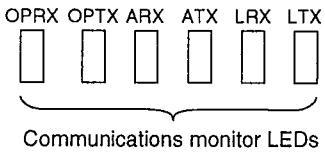
These LEDs are provided on MX50s that support the CBL communications function.



LED Name	Description
LBMR	Lights when loopback occurs at MR side. (Does not light when loopback occurs at MT side.)
LB	Lights when loopback occurs.
RD	Lights when CBL communication data is being received.
TD	Lights when CBL communication data is being transmitted.

● Communications monitor LEDs

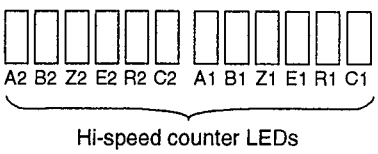
The MX50 has three communications interfaces in addition to CBL communications. These LEDs indicate the reception/transmission status on each of these interfaces.



LED Name	Description
LTX	Lights when LOAD (CN7) is transmitting.
LRX	Lights when LOAD (CN7) is receiving.
ATX	Lights when ASCII (CN8) is transmitting.
ARX	Lights when ASCII (CN8) is receiving.
OPTX	Lights when operator (CN9) is transmitting.
OPRX	Lights when operator (CN9) is receiving.

● High-speed counter LEDs

These LEDs indicate the external I/O statuses of the high-speed counter function. Two channels of counter matching signals are provided for output signals, and two channels of reset, enable, PA, PB and PZ signals are provided for input signals



LED Name	Description
A2	Lights when A phase input of channel 2 is ON.
B2	Lights when B phase input of channel 2 is ON.
Z2	Lights when Z phase input of channel 2 is ON.
E2	Lights when external enable signal input of channel 2 is ON.
R2	Lights when external reset signal input of channel 2 is ON.
C2	Lights when counter matching output of channel 2 is ON.
A1	Lights when A phase input of channel 1 is ON.
B1	Lights when A phase input of channel 1 is ON.
Z1	Lights when A phase input of channel 1 is ON.
E1	Lights when external enable signal input of channel 1 is ON.
R1	Lights when external reset signal input of channel 1 is ON.
C1	Lights when counter matching output of channel 1 is ON.

■ Special settings

"Special settings" refers to settings used when configuring the system. These are used when starting the ladder program in the STOP mode while it is being designed. These settings also disable the ladder program in user ROM so that the user can make a new ladder program in RAM.

● Regular setting startup

The following table shows the three conditions for power ON when the MX50 special settings have not been set.

Operation Mode Setting	RUN mode*1
Program Transfer Setting	ROM → RAM transfer*2
Data Table Transfer Setting	ROM → RAM transfer*2

*1: The ladder program must be free from errors, and errors must not be occurring.
*2: The normal user ROM must be inserted.

● Special setting methods

Special settings are set by rotary switches SW2 and SW3 when the power is turned ON. Set SW2 to "9" and SW3 to any setting. The following table shows the relationship between setting values and operation.

SW2	9			
		Operation Mode Setting	**Program Transfer Setting**	**Data Table Transfer Setting**
SW3	0	—	—	—
	1	STOP mode	—	—
	2	—	Cancel transfer	—
	3	STOP mode	Cancel transfer	—
	4	—	—	Cancel transfer
	5	STOP mode	—	Cancel transfer
	6	—	Cancel transfer	Cancel transfer
	7	STOP mode	Cancel transfer	Cancel transfer

—: Startup in regular setting state

! HANDLING PRECAUTIONS

- Special settings are enabled only when the power is tuned ON. Special settings cannot be changed after the power is turned ON.
- If an error (serious trouble) occurs due to program damage, the STOP mode not the RUN mode is entered. Eliminate the cause of the error and restart the MX50.
- Both the program area and data table areas will not be set to ROM→RAM move unless the user ROM is inserted.
- Special settings are enabled when the SW2 and SW3 conditions are satisfied.
- When using the library ROM, ROM→RAM move will not be set. However, note that when using ROM containing both the user program and library ROM, the MX50 is started up at the regular setting

2-2 Expansion Board

The "expansion board" is for adding on external I/O contacts, and comprises the following two boards:

- I/O board (32 inputs/32 outputs)
- Output board (16 outputs by relay circuit)

The MX50 is provided with 32-input/32-output digital I/O as part of the standard specification. However, when designing systems, many external I/O contacts are required for completing a system with a higher degree of freedom.

Up to four expansion boards can be added. These can be used to increase the number of inputs and outputs to 160, respectively, enabling a higher design-oriented system to be built.

Use the optional mother board to connect the expansion board to the MX50.

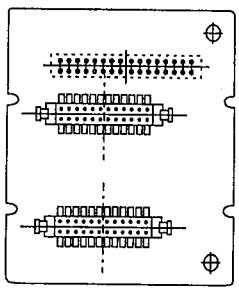
⚠ CAUTION

Before connecting the expansion board and mother board to the MX50, be sure to turn the power OFF. Failure to turn the power OFF might result in MX50 trouble.

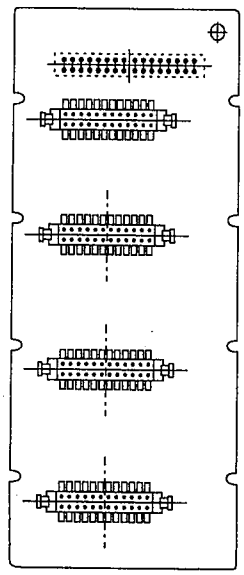
■ Mother board

The mother board is for connecting the expansion board to the MX50. Select either of the following mother boards according to the number of expansion boards mounted on the MX50.

Catalog Listing	Application
MX050EB00002XX	Two expansion boards are mounted.
MX050EB00004XX	Four expansion boards are mounted.



MX050EB00002XX (for two boards)

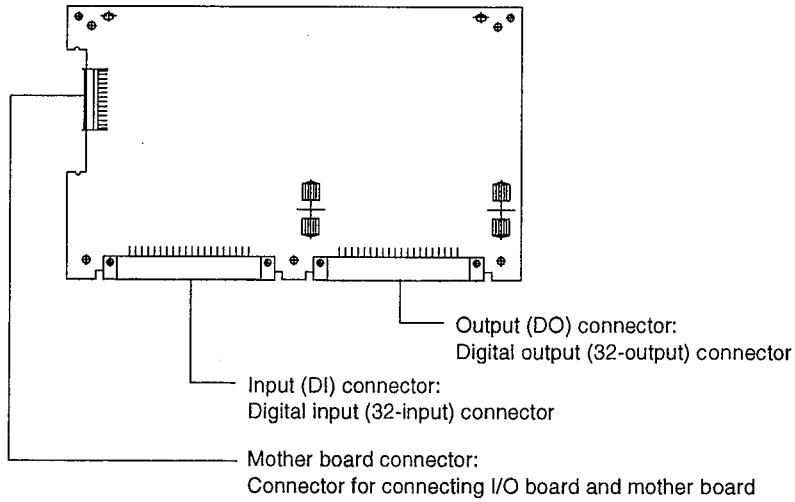


MX050EB00004XX (for four boards)

I/O board

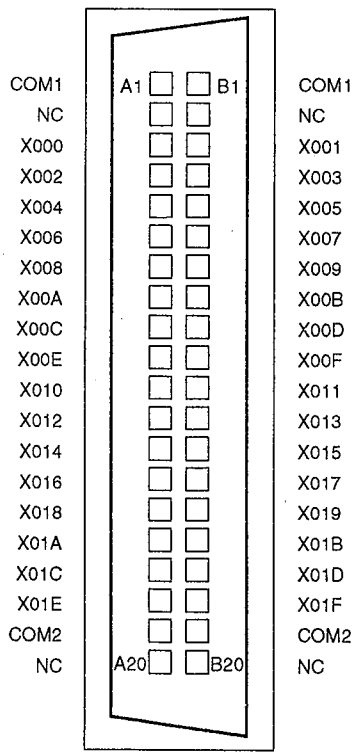
The I/O board is a 32-input/32-output expansion board that contains digital circuits. For details, see 8-3 Expansion Board I/O Specifications (page 8-10).

Model: MX250RC44G



● Input (DI) connector

Board connector:	Fujitsu	FCN-365P040-AU
Compatible connectors:	Fujitsu	FCN-361J040-AU
	Fujitsu	FCN-362J040-AU
	Fujitsu	FCN-367J040-AU



! HANDLING PRECAUTIONS

The maximum current per connector pin is 1 A. Pins A1 and B1, and A19 and B19 are shorted internally. Because of the maximum current, connect all pins separately.

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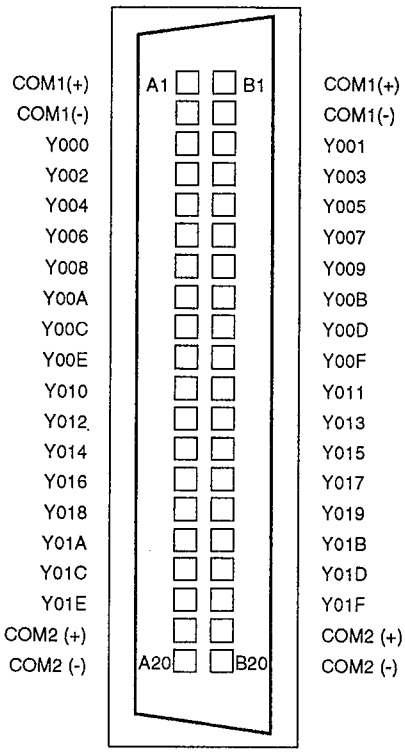
● **Output (DO) connector**

Board connector:	Fujitsu	FCN-365P040-AU
Compatible connectors:	Fujitsu	FCN-361J040-AU
	Fujitsu	FCN-362J040-AU
	Fujitsu	FCN-367J040-AU



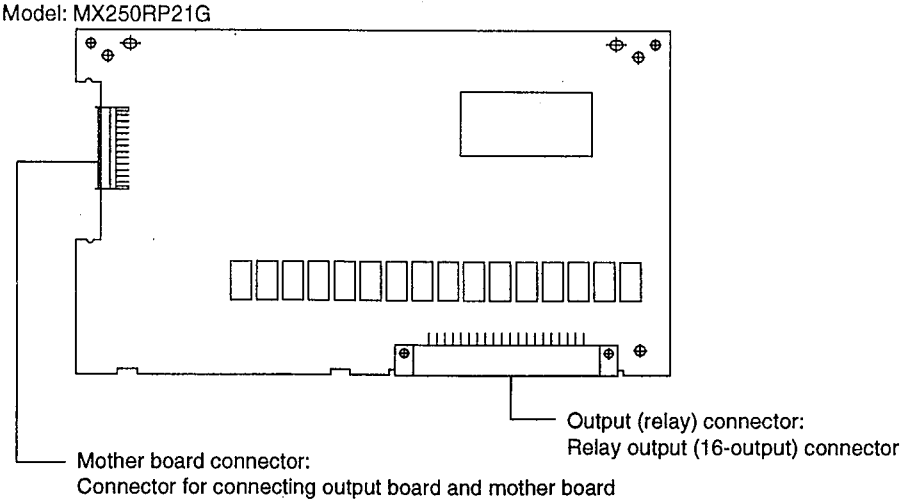
■ Output board

⚠ CAUTION

When the relay has reached the end of its life, replace the output board. If the output board is used as it is, this may result in fire or malfunction.

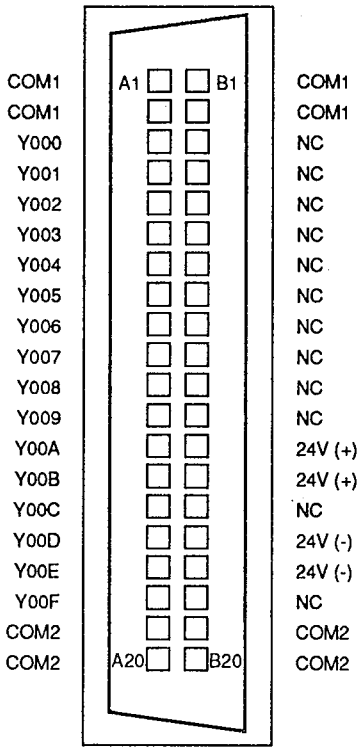
The output board is a 16-output expansion board that contains a relay circuit. For details, see page 8-12.

Model: MX250RP21G



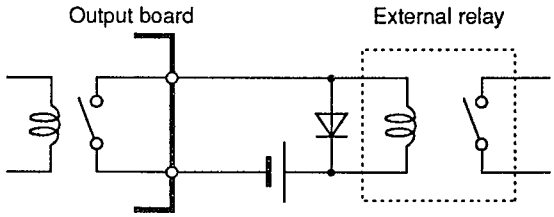
● **Output (relay) connector**

Board connector:	Fujitsu	FCN-365P040-AU
Compatible connectors:	Fujitsu	FCN-361J040-AU
	Fujitsu	FCN-362J040-AU
	Fujitsu	FCN-367J040-AU



! HANDLING PRECAUTIONS

- The maximum current per connector pin is 1 A. Pins A1 and B1, A2 and B2, A19 and B19 and A20 and B20 are shorted internally. Because of the maximum current, connect all pins separately.
- The output connector is not provided with a surge killer, so install one on the outside of the output connector. When driving an external relay by a DC power supply, insert a diode into the wiring path as shown in the figure below.



■ How to add-on the expansion board

⚠ CAUTION

- Before adding on the expansion board, be sure to turn the power OFF. Failure to turn the power OFF might result in MX50 trouble.
- Firmly connect connectors. Loose connections might cause malfunction or trouble.
- Firmly tighten studs. Loose connections might cause malfunction or trouble.

● Items to prepare

Prepare the following items when adding on the expansion board:

- Expansion board (option)
- Mother board (option)

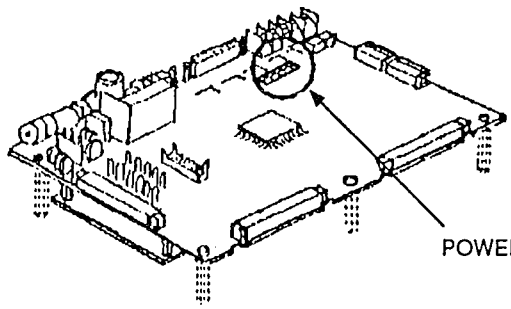
[!] HANDLING PRECAUTIONS

- When fixing the expansion board, user the studs (provided with the expansion board).
- When handling boards, take care not to touch the component mounting surface or soldered surface.

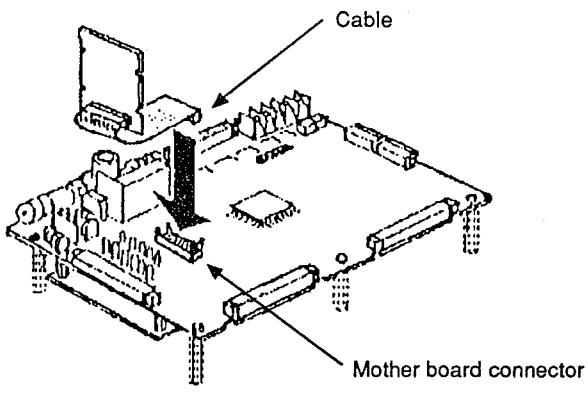
● Procedure

① Turn the MX50's power supply OFF.

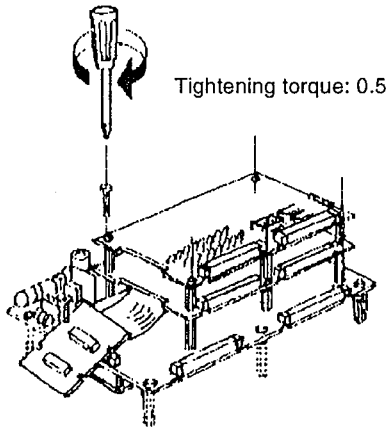
Make sure that the POWER LED goes out.



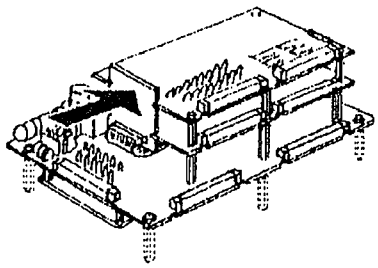
② Insert the mother board cable into the MX50 mother board connector.



③ Fix the expansion board onto the MX50 using the studs (provided with the expansion board).

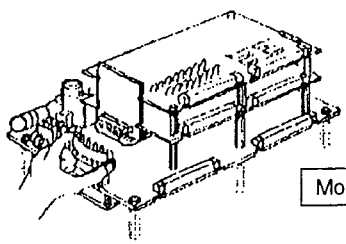


④ Insert the mother board into the expansion board connector.

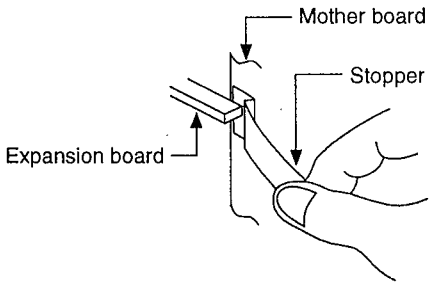


⑤ Install the stoppers (provided with the mother board).

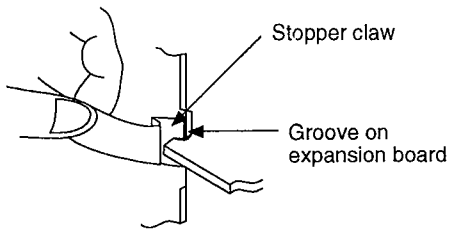
Install one stopper each at the topmost and bottom-most rack of the expansion board. When one expansion board is added on, install one stopper.



1. Fit the stopper claws into the grooves on the expansion board.



2. Fit the other claw into the groove on the expansion board.



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Chapter 3 INSTALLATION & WIRING

3-1 Installation

To improve machine control reliability and to fully demonstrate the functions of the MX50, pay attention to the following points when installing the MX50.

■ Siting conditions

Avoid installing the MX50 in the following locations:

① Locations outside of the operating temperature range (0 to 55°C)

② Locations outside of the operating humidity range (30 to 90%RH)

③ Locations subject to rapid temperature change or condensation

④ Locations subject to corrosive or flammable gases

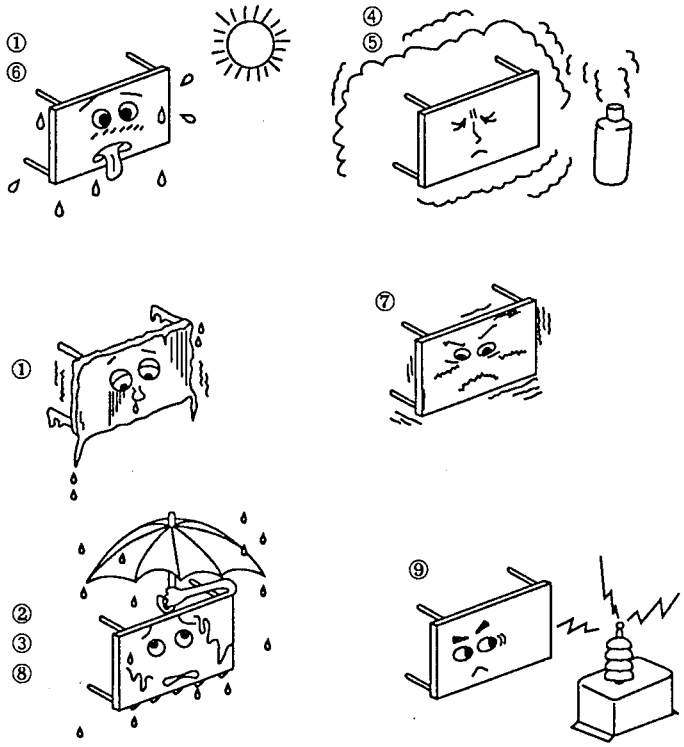
⑤ Locations where large amounts of electrically conductive materials (e.g. dust, salt, iron powder) and organic solvents are placed

⑥ Locations subject to the direct sunlight

⑦ Locations that directly subject the body to vibration or impact

⑧ Locations that subject the MX50 to splashing by water, oil and chemicals

⑨ Locations where powerful electrical and magnetic fields are generated



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■ Precautions

⚠ CAUTION

Before wiring the MX50, turn the power OFF. Wiring the MX50 with the power turned ON might damage the MX50.

The following describes the precautions to follow when mounting the MX50 on a panel, for example. Pay attention to the following precautions mainly to ensure environmental resistance, maintainability and operability.

① Maintain sufficient space around the MX50 to ensure proper ventilation.

② Avoid installing the MX50 on top of devices (e.g. transformers, large-capacity resistors) that generate a large calorific value inside the panel.

③ Mount the MX50 on a flat surface free from protrusions or indentations.

④ Keep the MX50 as far away from high-voltage devices, motors or wiring. Otherwise, mount the MX50 on a separate panel.

⑤ Mount the MX50 at a height of 1,000 to 1,500 mm from the site floor to facilitate operation.

⑥ Use wiring ducts as necessary. However, wire the MX50 in such a way that ventilation, or installation or removal of other modules is not obstructed.

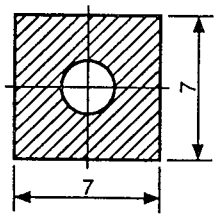
⑦ Ground the MX50 with an earth resistance of 100 Ω to improve resistance against noise.

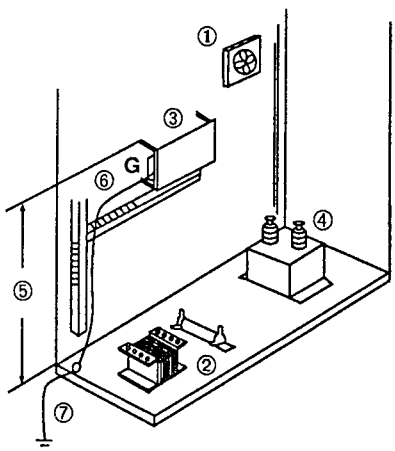
⑧ When mounting the expansion board, do not install the MX50 with the DI/DO connectors face up.

⑨ The MX50 is a board model. For this reason, do not touch the components on the printed circuit board directly with your hands.

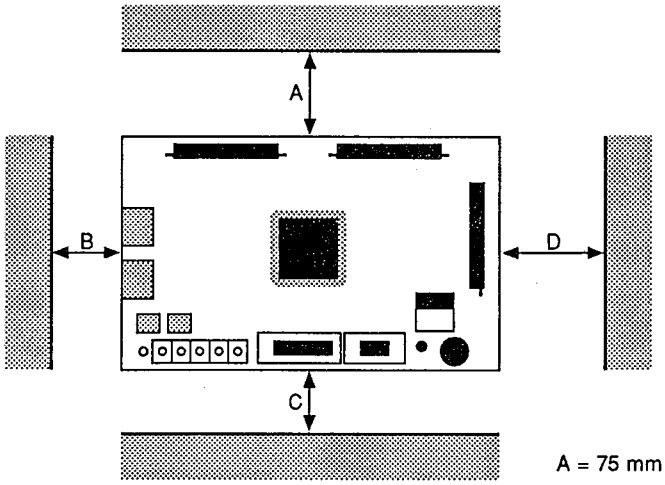
⑩ When connecting connectors or fixing the board, do not touch the components on the board directly with your hands.

⑪ The support for fixing the board must be 40 mm long and 7 mm square at the most.



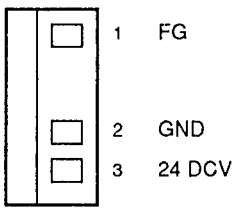


⑫ Maintain sufficient space between the MX50 and surrounding devices as follows. The figures indicated for distances A to D are for reference only. These figures vary according to the connectors and cables used, and must be adjusted as necessary to ensure easy access and maintenance.



A = 75 mm min.
B = 40 mm min.
C = Distance not specified.
D = 75 mm min.

■ Wiring the power supply



Power supply is 24 VDC ± 10%.

! HANDLING PRECAUTIONS

- Use a power supply that is within the rated voltage specification.
- Use power leads of at least 2 mm square to prevent voltage drops.
- Use twisted pair cable for the power leads.
- When there is a lot of noise on the power line, provide an insulated transformer between the power supply and the MX50 to reduce noise.
- Separate power supply leads, power lines and input leads from each other, and do not bring harness bands near each other.
- Ground the FG (Frame Ground) on connector CN10 with a resistance of 100 Ω to prevent the influence of noise.
- Use leads of at least 2 mm square for grounding the MX50.
- When supplying power to two or more devices from the same power supply, connect all power switches using the same connection method.
- Maintain the fluctuation of the 24 VDC power voltage to within 10%. A power voltage outside of this permissible range may cause the MX50 to malfunction or program damage.

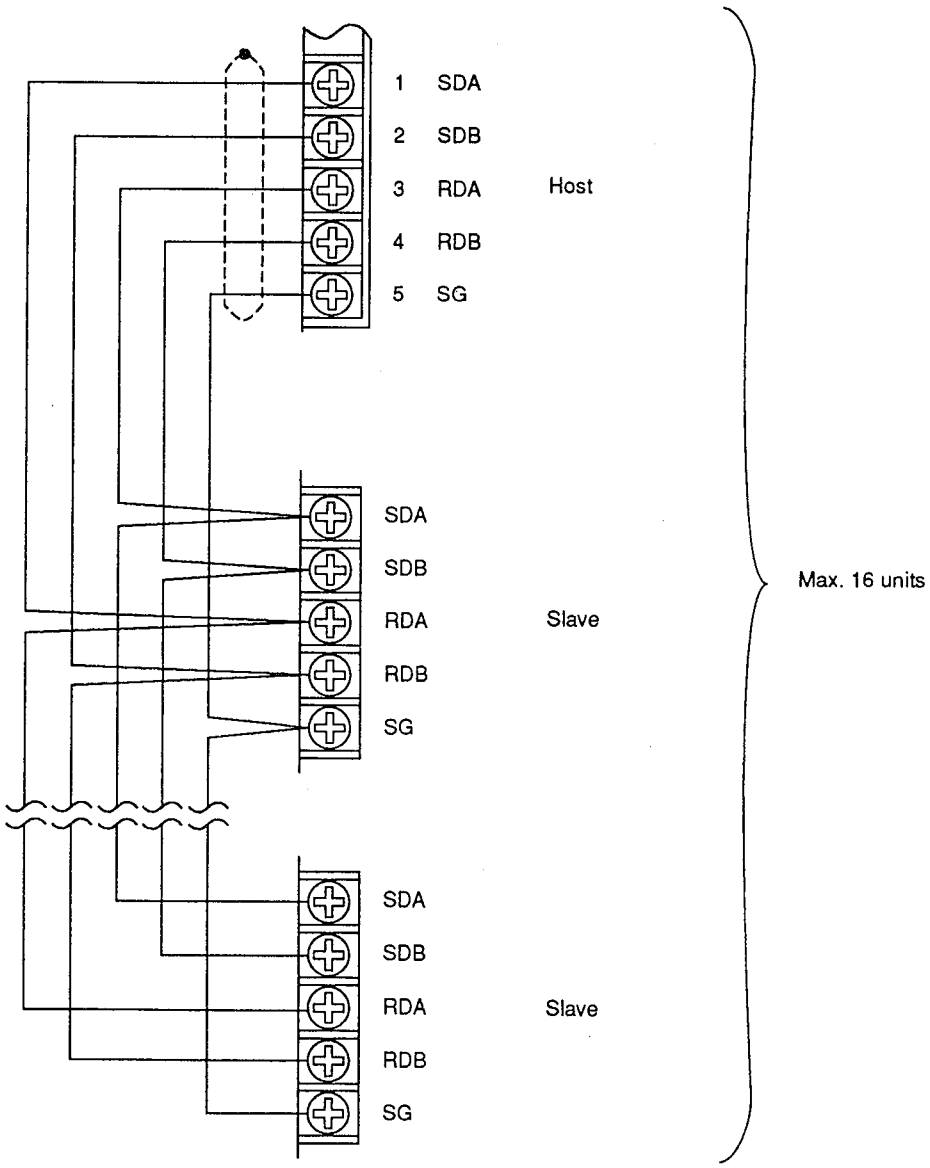
3-2 RS-485 Connection

■ Wiring

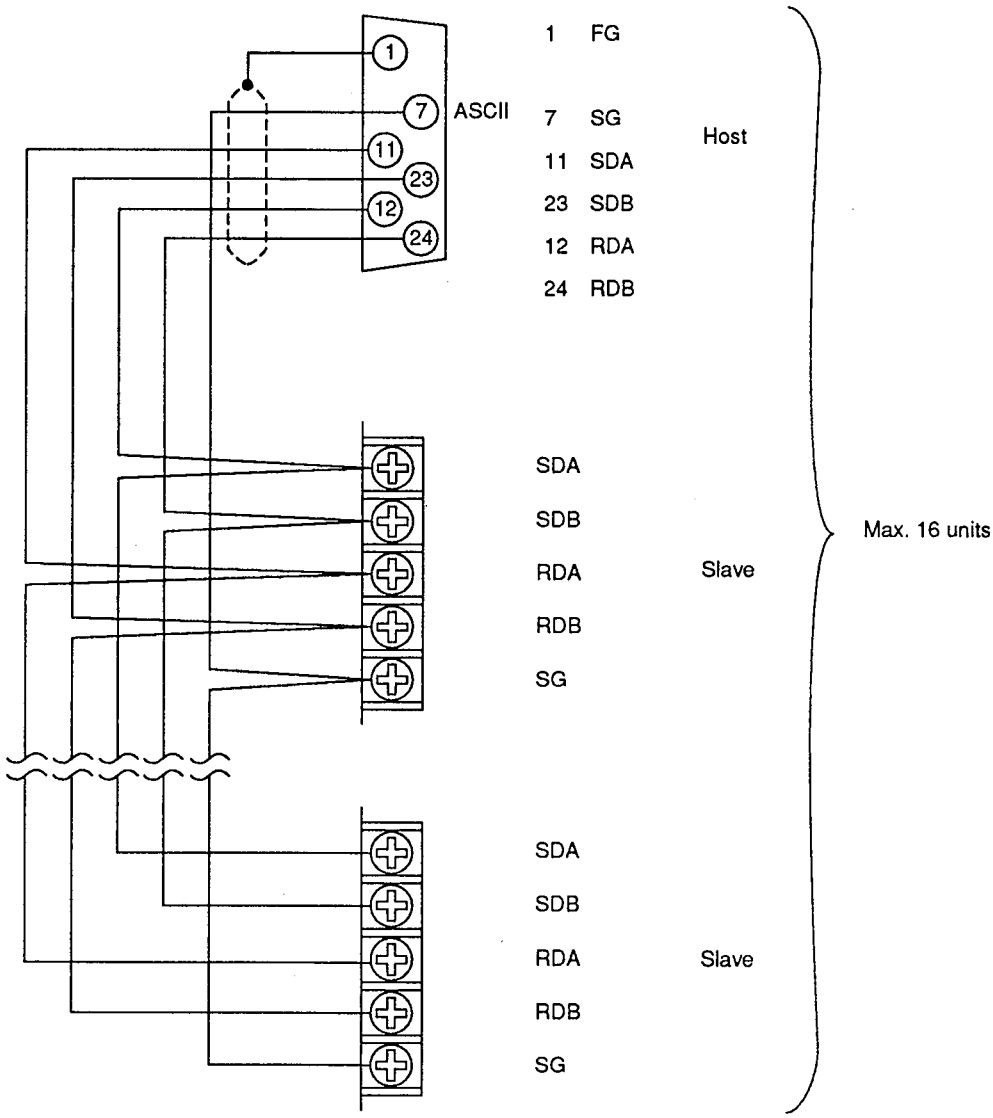
The RS-485 terminal is the operator I/O terminal (CN9) on the basic board, and is the terminal for connecting the MX50 to operator I/O.

Four terminals are provided for two transmission lines (SDA and SDB) and two reception lines (RDA and RDB). Up to six devices including the master station can be connected. The maximum transfer distance is 300 m.

This terminal can also be used for ASCII communications depending on the bit setup on the personal computer loader. When using the terminal for ASCII communications, up to 16 devices including the master station can be connected.



ASCII connector (CN8) can be used for ASCII communications depending on the bit setup of the personal computer loader. When using the terminal for ASCII communications, up to 16 devices including the master station can be connected. The maximum transfer distance is 300 m.



3-3 CBL Communication Connection

The following four MX50 models support CBL communications:

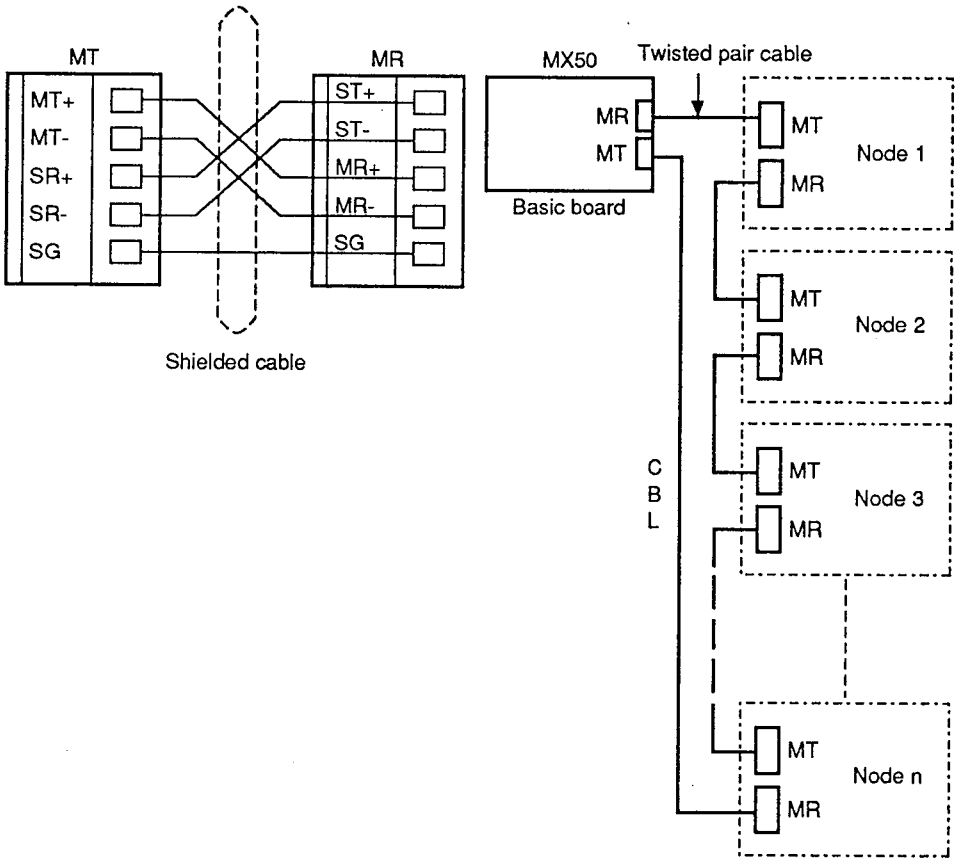
- MX050FT14141HT, MX050FT14141NT (electrical type, connected by twisted pair cable)
- MX050FT14141HP, MX050FT14141NP (optical type, connected by optical fiber cable)

For details on CBL communications functions, see the MX200/50 Communications User's Manual.

■ Connecting to MX50 by twisted wire cable

Connect the MT and MR connectors as follows.

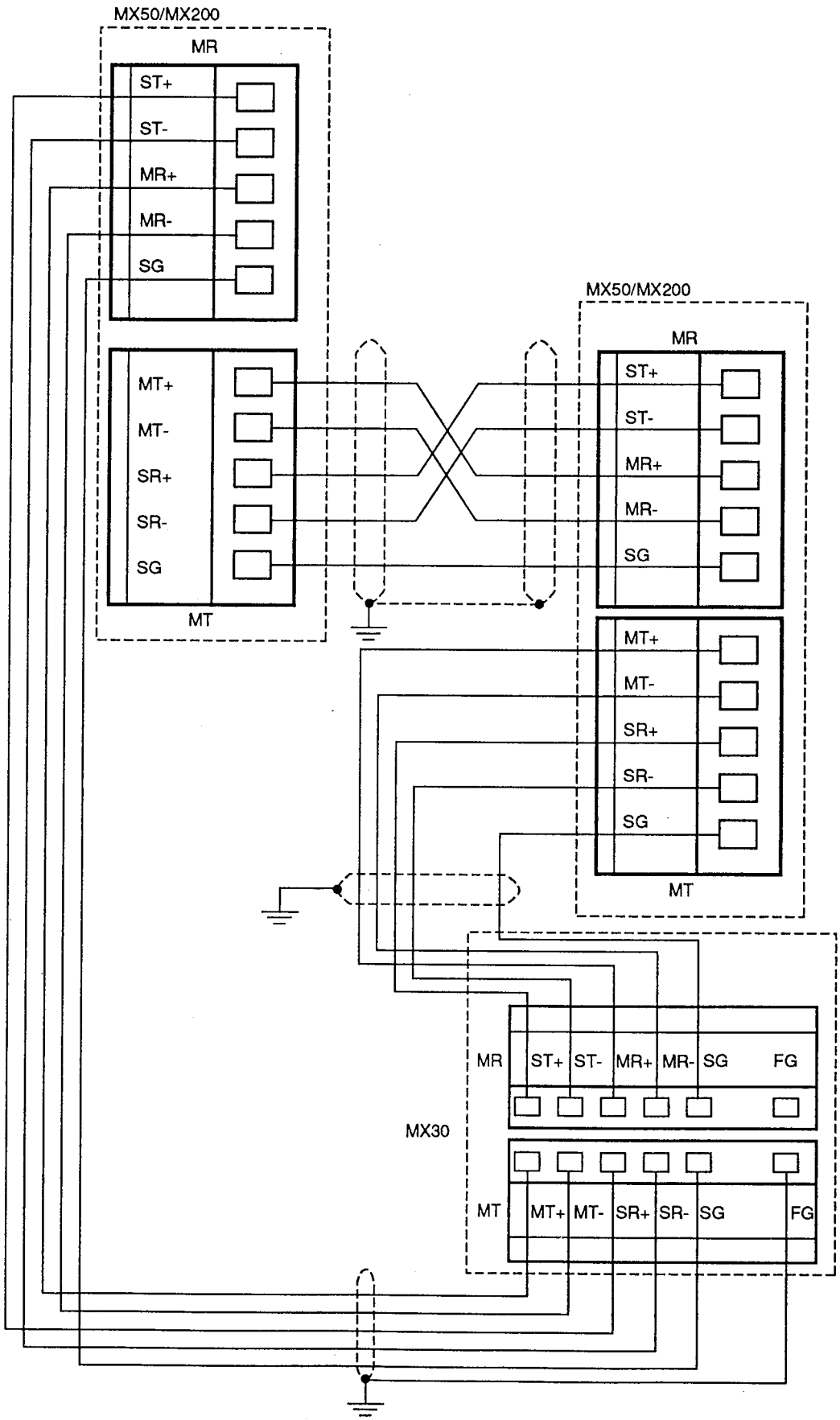
See the following pages for details of connection examples.



- The maximum number of nodes on CBL including the MX50 is 32.
- The maximum distance between nodes is 100 m.
- The total length is 3.2 km.
- Connectors

Board receptacle	SLA5 (Weidmuller)
Cable plug	BLA5 (Weidmuller)
Recommended cable	Shielded 6-core twisted pair cable UL2464-SX-2TX22AWG (Hitachi)

● **Connection details**



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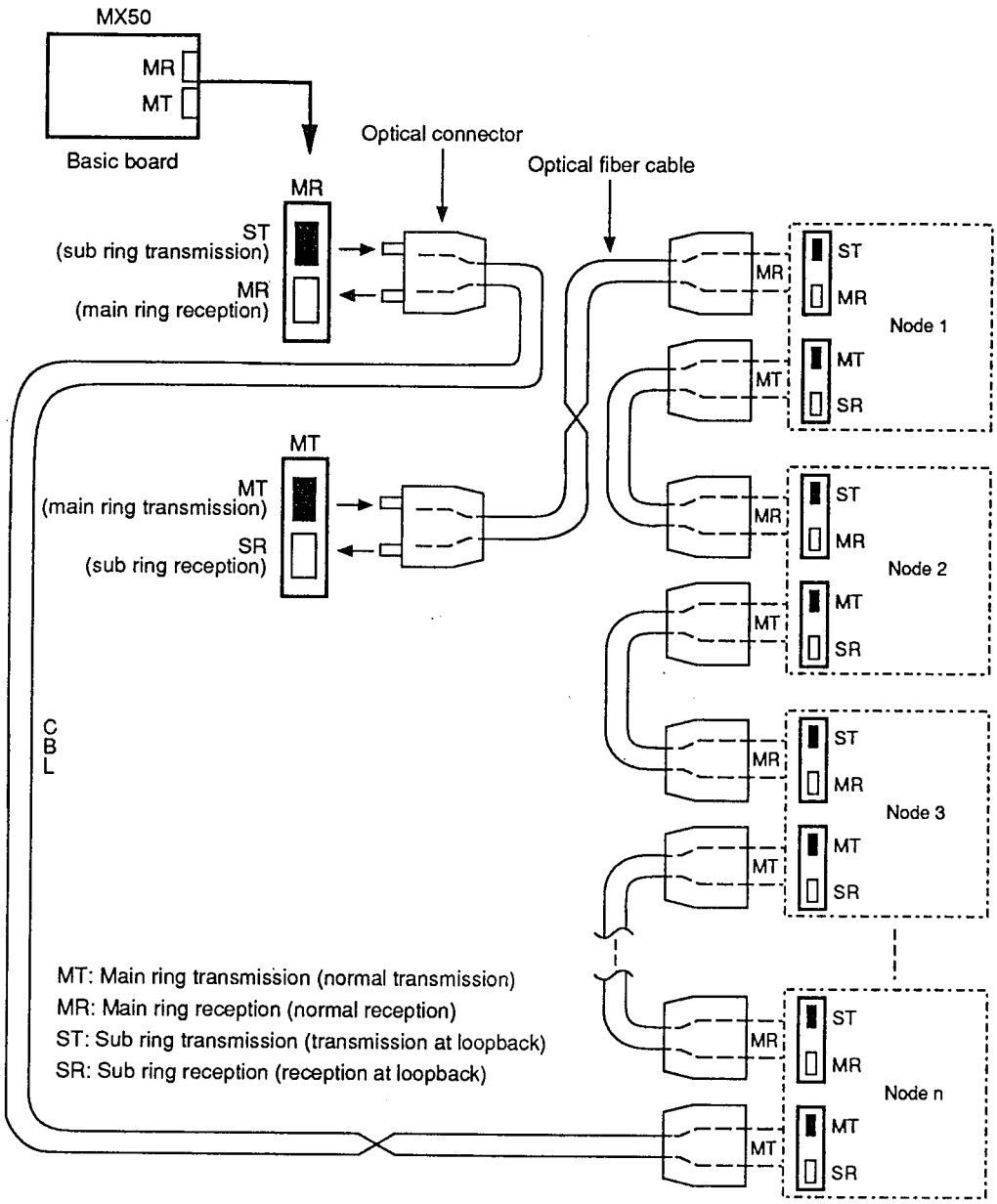
■ Connecting to MX50 by optical fiber cable



- The maximum number of nodes on CBL including the MX50 is 32.
- The maximum distance between nodes is 500 m.
- The total length is 10 km.
- ■ indicates the transmission side, and □ indicates the reception side. Connect ■ to □.
- For details on how to install optical fiber cables, see Optical Fiber Cable Installation Procedures, FA-UM-1442.
- Connectors
  Board receptacle — Bi-directional optical module Toshiba TODX270
  Cable w/ connector — Toshiba TOCP200Q- MB □□ (□□ is cable length.)

3-4 I/O Connections

■ Input circuit

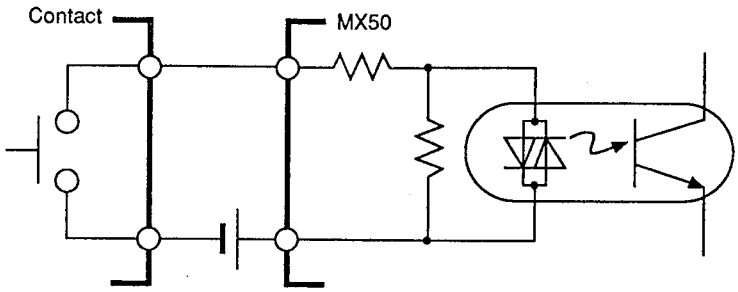
● Input circuit

The power supply and contact or non-contact output (2-lead sensor, NPN open collector output) are connected to the input connector.

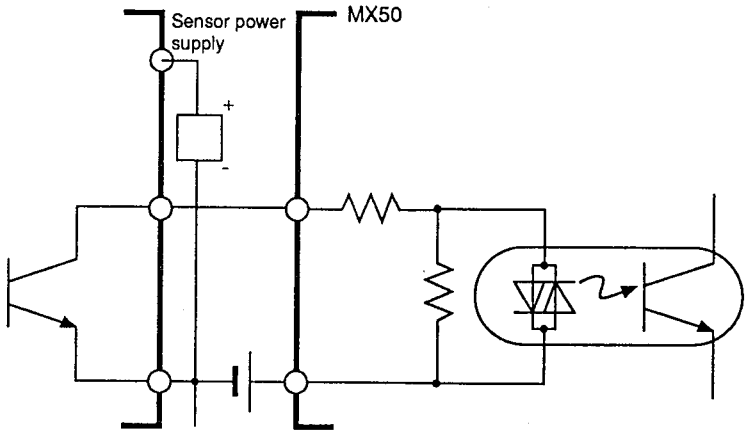
The input circuit is insulated from internal circuits by a photocoupler. Apply the rated voltage to turn inputs ON and OFF. When inputs are turned ON, the input display LED lights.

● Connection with input device

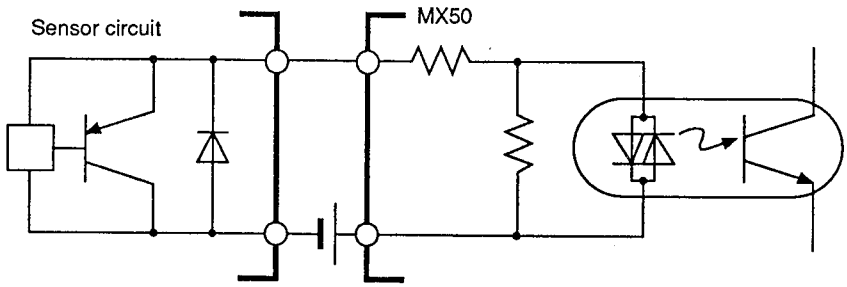
The following figures show switches or sensors that can be connected to the MX50 as inputs. Use these figures for reference when selecting and connecting input devices.



Non-contact (NPN open collector)



Non-contact (DC2 lead)



! HANDLING PRECAUTIONS

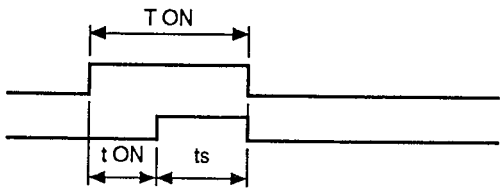
When using the expansion board, refer to 8-3 Expansion Board I/O Specifications (page 8-10).

- **Input signal ON/OFF time**

The input circuit is provided with a filter circuit to prevent malfunction caused by noise. For this reason, a response delay occurs with respect to the input state changing from ON to OFF and from OFF to ON. A fixed amount of time is required for the controller to identify input ON as ON and input OFF as OFF. As the input state is read at the beginning of each scan cycle, it sometimes cannot be read if the scan time is not time ts or more even if the input ON and OFF times are small. The time obtained by adding the response time to the scan time is required as the minimum ON and OFF times.

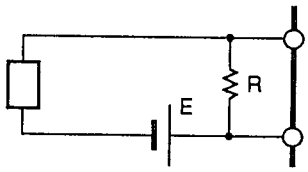
ON time: T ON > t ON (response time OFF → ON)
+ ts (scan time)

OFF time: T OFF > t OFF (response time ON → OFF)
+ ts (scan time)



- **Input device leakage current**

Leakage current flows at input OFF in the case of a 2-lead sensor when LED indicators, for example, are connected in parallel to contacts. This leakage current will not turn OFF if it is smaller than the minimum ON current. In the case of a DC power supply, a bleeder resistor must be inserted in the input circuit to lower the input impedance as shown in the following figure when the leakage current is 4 mA (12 V) or more.



- **Input current of contact input**

When using the contact for an input device, the current that flows to the contact is a fixed current determined by the input impedance of the input module and the power voltage for the input. This current may cause faulty contact depending on the contact used.

In this case, use bleeder resistance R to increase the contact current.

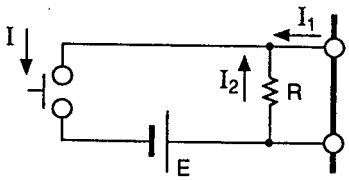
The setting of the contact current depends on the structure and rating of the contact. So, check the specifications of the switches you are using. Due to the following relationship,

$$I=I_1+I_2=I_1+\frac{E}{R}$$

$$R=\frac{E}{I-I_1}$$

Set the resistor capacity as follows:

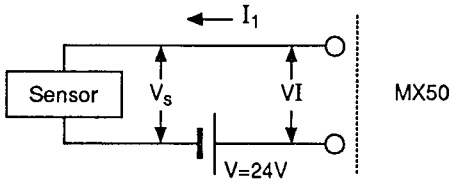
$$P>\frac{E^2}{R}\times 2$$



● **Connection example with DC2 lead sensors**

In the following example, the following sensor and input device power supply are used:

Sensor FL7M-2J6 (DC2 lead proximity switch)
Input device power supply 24 VDC



Input Rating	ON voltage	10 V min.
	OFF voltage	3.5 V max.
	OFF current	1.5 mA max.
	Input current	10 mA type (24 VDC)
	Input impedance	Approx. 2.4 kΩ
Sensor Rating	Operating voltage	10 to 30 VDC
	Current consumption	0.9 mA max.
	Residual voltage	3.5 V max.
	Max. switching current	100 mA
	Min. switching current	5 mA

At sensor ON:

MX50 Input Voltage	VI = V-V_s = 24-3.5 = 20.5 (V) by sensor terminal voltage (residual voltage) V_s = 3.5 As 20.5 (V) > 10 (mA), MX50 turns ON.
Sensor Current	As 5 (mA) < 10 (mA) < 100 (mA) by MX50 input voltage I_1 = 10 (mA), the current is within the sensor switching current range.

At sensor OFF:

MX50 Input Voltage	As 0.9 (mA) < 1.5 (mA) by sensor current consumption I_1 = 0.9 (mA), MX turns OFF.
Sensor Power Voltage	V_s = V - VI VI = 2.4 kΩ x 0.9 (mA) = 2.16 (V) V_s = 24 (V) - 2.16 (V) = 21.84 (V) As 8.5 (V) < 21.84 (V) < 30 (V), the power voltage is within the sensor operating voltage range.

! HANDLING PRECAUTIONS

- When the voltage of the input device power supply fluctuates, calculate the input voltage of the MX50 under the worst conditions.
- In the above example, let's assume that the input device power supply is 12 V. When the sensor is ON, the input voltage of the MX50 is VS = V - VI = 12 - 3.5 = 8.5 (V). As the ON voltage does not exceed 10 V, this input voltage cannot be used.
- Some DC2 lead sensors turn excessively ON when the power supply is turned ON.
  For details, refer to the user's manual of the sensor you are using.

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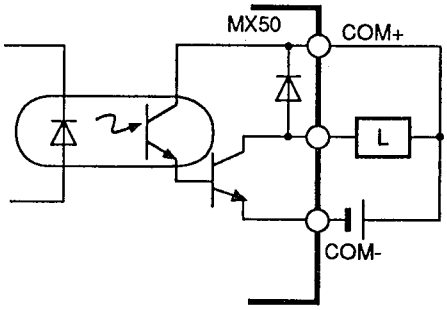
■ Output circuit

● Connection with output device

The following figure shows an example of a load circuit connected as an output.



● Voltage and current ranges

Connecting a load that exceeds the maximum output current to the output may cause MX50 malfunction or damage.

● Output rating protection

If a load connected to the output connector short-circuits, the output elements may become damaged or the printed circuit board may burn.

Provide an external fuse for overload protection.

● Output current limitations

The output currents allowed to flow to each output and each common terminal are limited. Wire all common terminals.

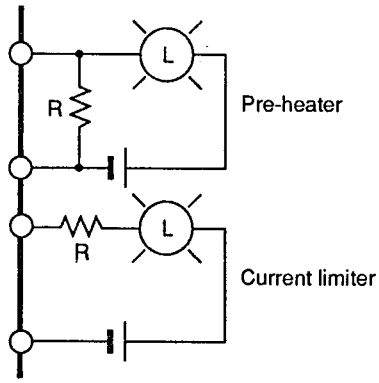
For example, the maximum output current per output is 0.2 A, and the output current per common is 1.6 A. In this case, the output current becomes 3.2 A as there are 16 0.2 A outputs per common.

● Lamp load

When a load from a white incandescent lamp is applied, a rush current 10 times that of the rated current flows for several tens of ms when the lamp is turned ON. There are two ways of reducing this rush current. Either insert a pre-heating resistor for dark-lighting the lamp when lamp output is OFF, or insert a series resistor for limiting the current.

With the former method, the resistance value must be determined so that lighting of the lamp is not apparent when lamp output is OFF.

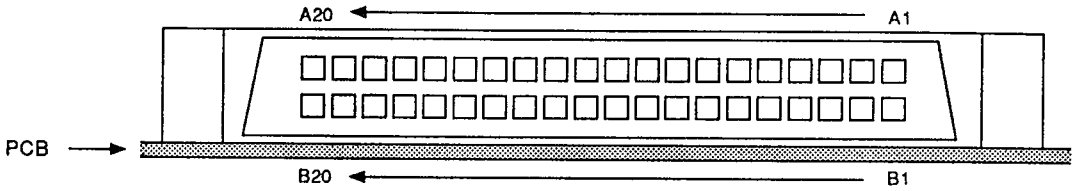
With the latter method, the resistance value must be determined so that the lamp is not too dark when output is ON.



! HANDLING PRECAUTIONS

When using the expansion board, refer to 8-3 Expansion Board I/O Specifications (page 8-10).

■ DI connection diagram



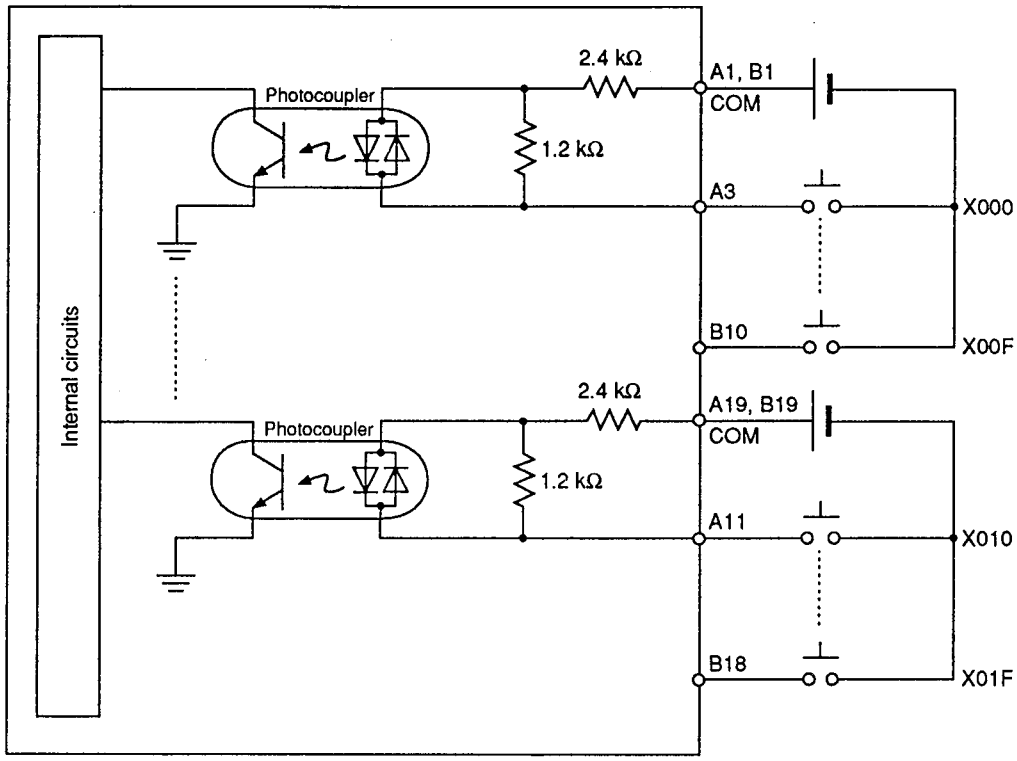
Compatible connectors
FCN-361J040-AU
FCN-362J040-AU
FCN-367J040-AU

Pin No.	Signal Name	Pin No.	Signal Name
A1	COM	B1	COM
A2	NC	B2	NC
A3	X000	B3	X001
A4	X002	B4	X003
A5	X004	B5	X005
A6	X006	B6	X007
A7	X008	B7	X009
A8	X00A	B8	X00B
A9	X00C	B9	X00D
A10	X00E	B10	X00F
A11	X010	B11	X011
A12	X012	B12	X013
A13	X014	B13	X015
A14	X016	B14	X017
A15	X018	B15	X019
A16	X01A	B16	X01B
A17	X01C	B17	X01D
A18	X01E	B18	X01F
A19	COM	B19	COM
A20	NC	B20	NC

! HANDLING PRECAUTIONS

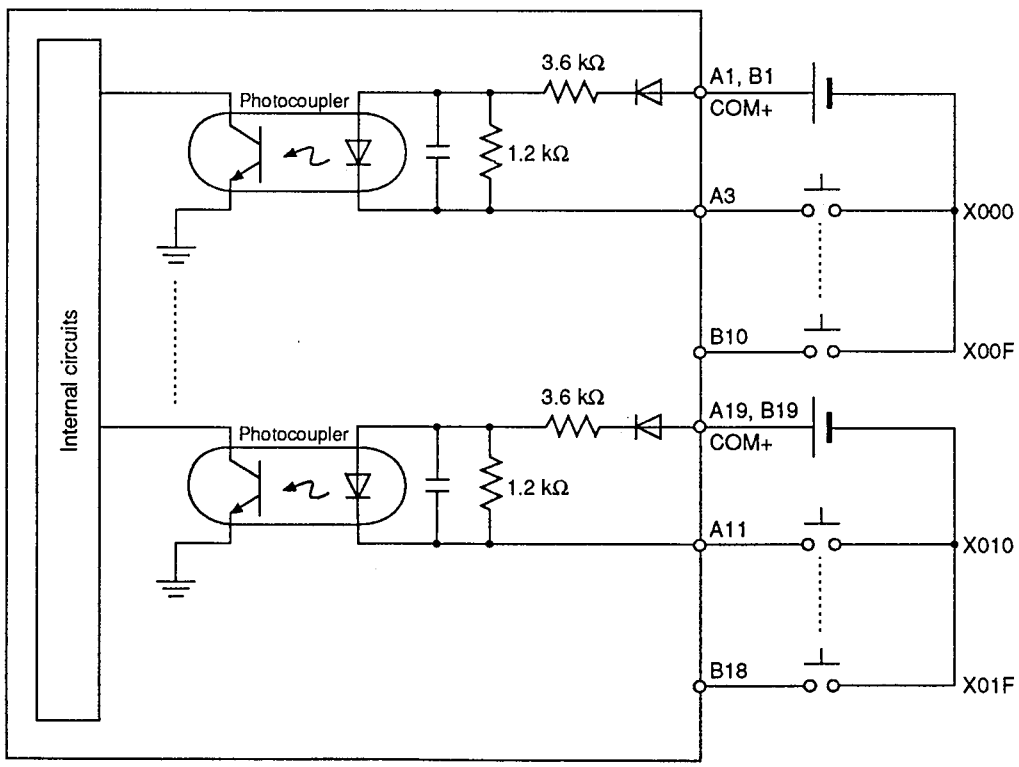
- The maximum current per connector pin is 1 A. Pins A1 and B1, and A19 and B19 are shorted internally. Because of the maximum current, connect all pins separately.
- The basic board is two-way input. Use the COM pins for COM+ or COM-.
- The expansion board is one-way input only. Use the COM pins for COM+.

● **Basic board DI**



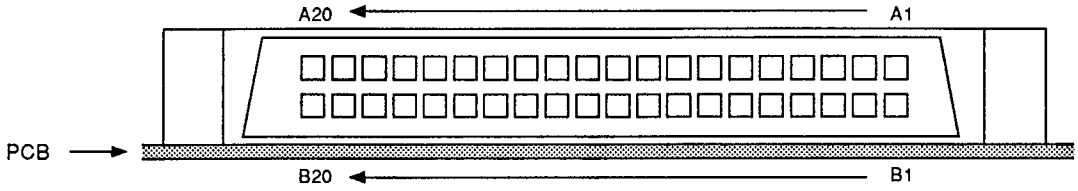
MX50

● **Expansion board DI**



MX250RC44G

■ DO connection diagram



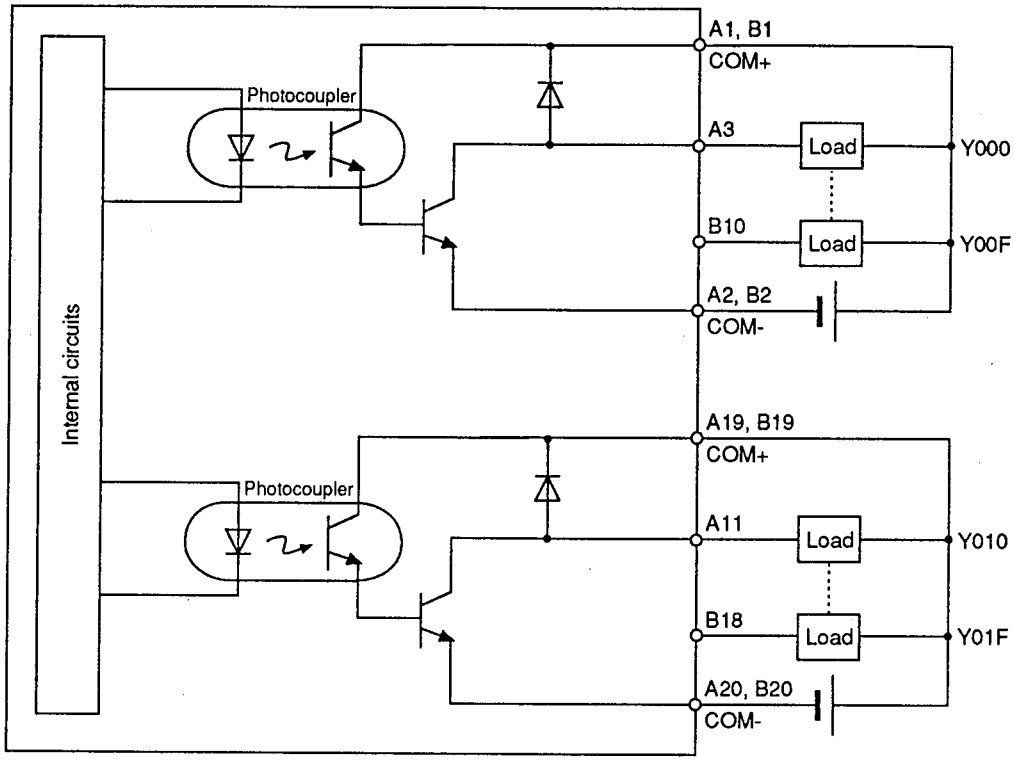
Compatible connectors
FCN-361J040-AU
FCN-362J040-AU
FCN-367J040-AU

Pin No.	Signal Name	Pin No.	Signal Name
A1	COM+	B1	COM+
A2	COM-	B2	COM-
A3	Y000	B3	Y001
A4	Y002	B4	Y003
A5	Y004	B5	Y005
A6	Y006	B6	Y007
A7	Y008	B7	Y009
A8	Y00A	B8	Y00B
A9	Y00C	B9	Y00D
A10	Y00E	B10	Y00F
A11	Y010	B11	Y011
A12	Y012	B12	Y013
A13	Y014	B13	Y015
A14	Y016	B14	Y017
A15	Y018	B15	Y019
A16	Y01A	B16	Y01B
A17	Y01C	B17	Y01D
A18	Y01E	B18	Y01F
A19	COM+	B19	COM+
A20	COM-	B20	COM-

! HANDLING PRECAUTIONS

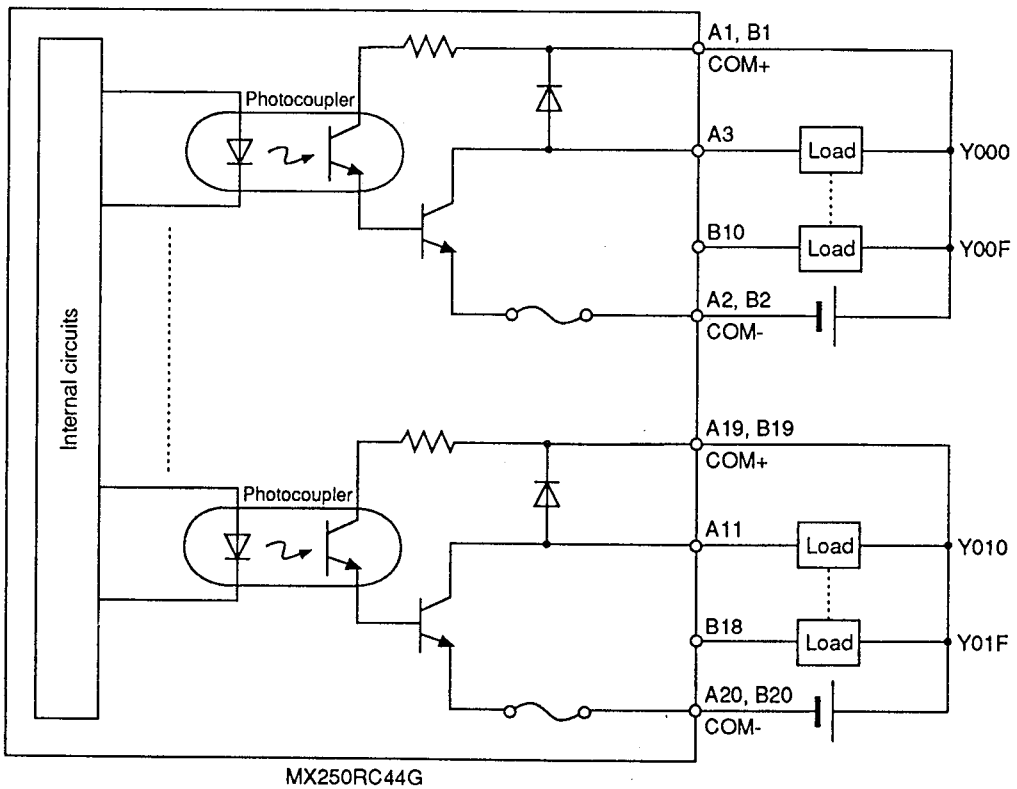
- The maximum current per connector pin is 1 A. Pins A1 and B1, and A19 and B19 are shorted internally. Because of the maximum current, connect all pins separately.

● **Basic board DO**



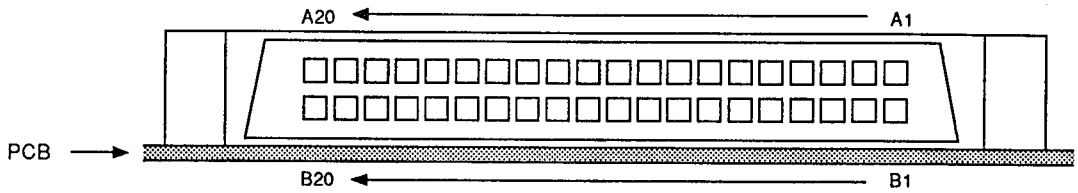
MX50

● **Expansion board DO**



MX250RC44G

■ Relay connection diagram

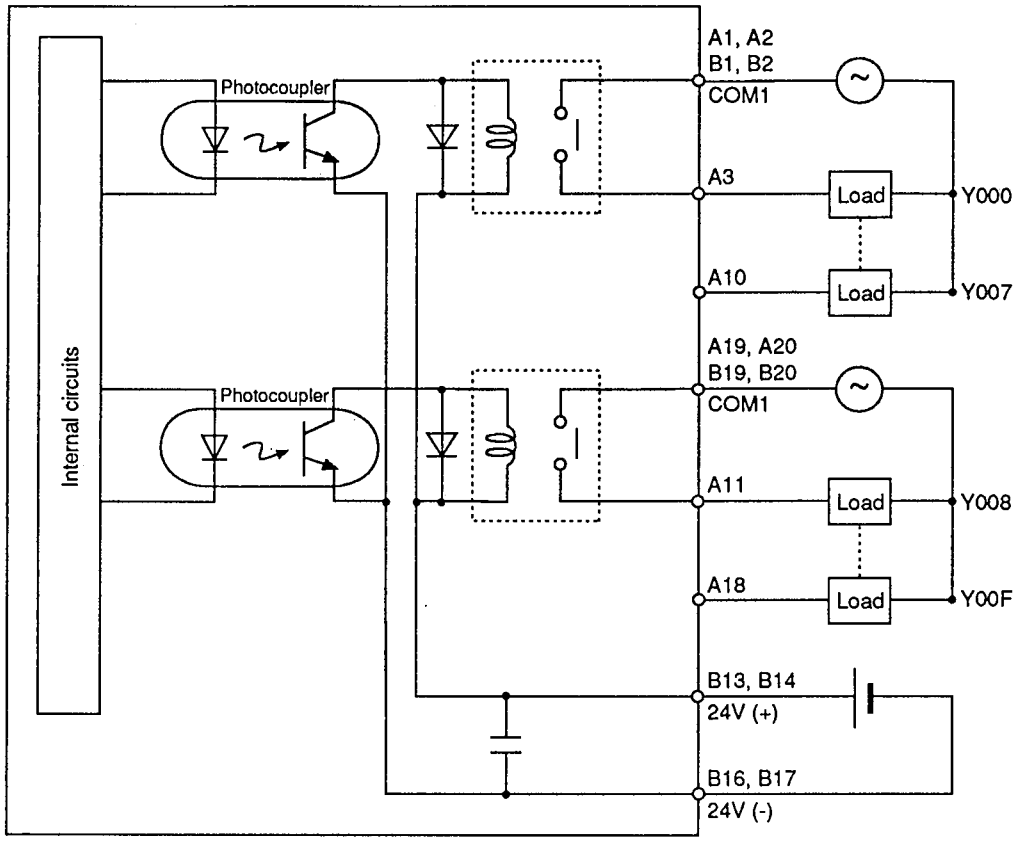


Compatible connectors
FCN-361J040-AU
FCN-362J040-AU
FCN-367J040-AU

Pin No.	Signal Name	Pin No.	Signal Name
A1	COM1	B1	COM1
A2	COM1	B2	COM1
A3	Y000	B3	NC
A4	Y001	B4	NC
A5	Y002	B5	NC
A6	Y003	B6	NC
A7	Y004	B7	NC
A8	Y005	B8	NC
A9	Y006	B9	NC
A10	Y007	B10	NC
A11	Y008	B11	NC
A12	Y009	B12	NC
A13	Y00A	B13	24V(+)
A14	Y00B	B14	24V(+)
A15	Y00C	B15	NC
A16	Y00D	B16	24V(-)
A17	Y00E	B17	24V(-)
A18	Y00F	B18	NC
A19	COM2	B19	COM2
A20	COM2	B20	COM2

! HANDLING PRECAUTIONS

The maximum current per connector pin is 1 A. Pins A1 and B1, and A19 and B19 are shorted internally. Because of the maximum current, connect all pins separately.



MX250RP21G

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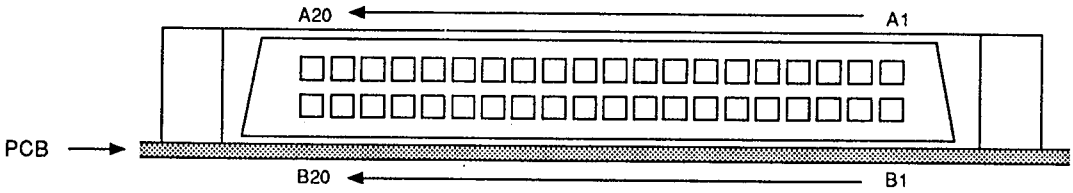
■ HSC connection diagram



Compatible connectors
FCN-361J040-AU
FCN-362J040-AU
FCN-367J040-AU

Pin No.	Signal Name	Pin No.	Signal Name
A1	PCMP_COM+	B1	FG
A2	PCMP1_COM-	B2	PCMP1
A3	PA1_24V	B3	PA1_12V
A4	PA1_5V	B4	PA1_COM-
A5	PB1_24V	B5	PB1_12V
A6	PB1_5V	B6	PB1_COM-
A7	PZ1_24V	B7	PZ1_12V
A8	PZ1_5V	B8	PZ1_COM-
A9	PRST1	B9	PRST1_COM-
A10	PENB1	B10	PENB1_COM-
A11	PA2_24V	B11	PA2_12V
A12	PA2_5V	B12	PA2_COM-
A13	PB2_24V	B13	PB2_12V
A14	PB2_5V	B14	PB2_COM-
A15	PZ2_24V	B15	PZ2_12V
A16	PZ2_5V	B16	PZ2_COM-
A17	PRST2	B17	PRST2_COM-
A18	PENB2	B18	PENB2_COM-
A19	PCMP2_COM+	B19	FG
A20	PCMP2_COM-	B20	PCMP2

! HANDLING PRECAUTIONS

- All input contacts are COM-.
- The PRST input signal also doubles as an edge detection signal.
- The PENB input signal also doubles as a level detection signal.

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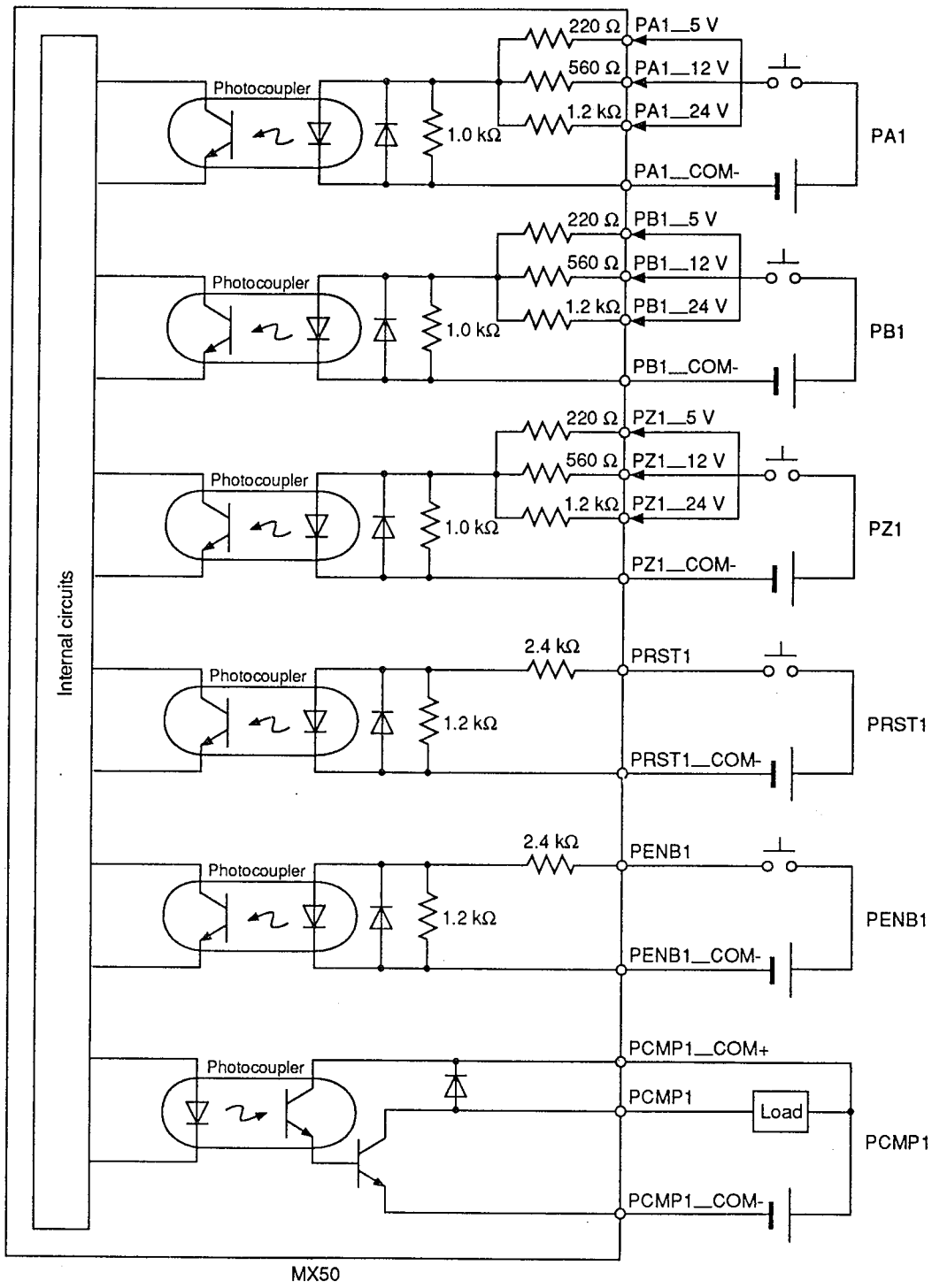

! HANDLING PRECAUTIONS

The above figure shows an HSC (1 ch) connection. When connecting HSC (2 ch), swap 1's with 2's in the figure.

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Chapter 4 OPERATION

4-1 Checks before Operation

■ Check items

Before operation, check the items in the following table after wiring the MX50 at initial installation.

No.	Check Item	Description
1	DIP switch settings	(1) Are the CBL node address RS-232C communication conditions set by SW2 when CBL communications is in use?
2	Setup data settings	(1) Are the setup data correctly set in the setup menu of the personal computer loader? (In particular, make sure that address settings are set when using host communications operator I/O.)
3	Power, I/O lead connections	(1) Is 24 VDC power being supplied? (2) Aare the correct cables connected to the connectors? (3) Are the power connector, I/O connector terminals and screws loose? (4) Are the crimped terminals short-circuited?
4	Connector cables	(1) Is the operator I/O connector cable connected firmly to the basic board by twisted pair cable? (2) Is the RS-232C cable correctly connected to the connector in a host communications configuration? (3) Is the CBL communications connector correctly conected?
5	Battery	(1) Are the leads and connectors firmly connected? (2) Has the battery voltage dropped?
6	Mounting of EPROM (in case of ROM operation)	(1) Is the size of the program currently stored in EPROM within 31 Kbytes? (2) Is the EPROM firmly inserted into its socket?

[!] HANDLING PRECAUTIONS

If the power is turned ON without CBL connected to an MX50 that supports CBL communications, the CBL communications alarm will occur.

When CBL is not used on an MX50 that supports CBL communications, the alarm can be averted by connecting the CBL MR and MT connectors on the MX50 self station,

■ Preparations for safe operation

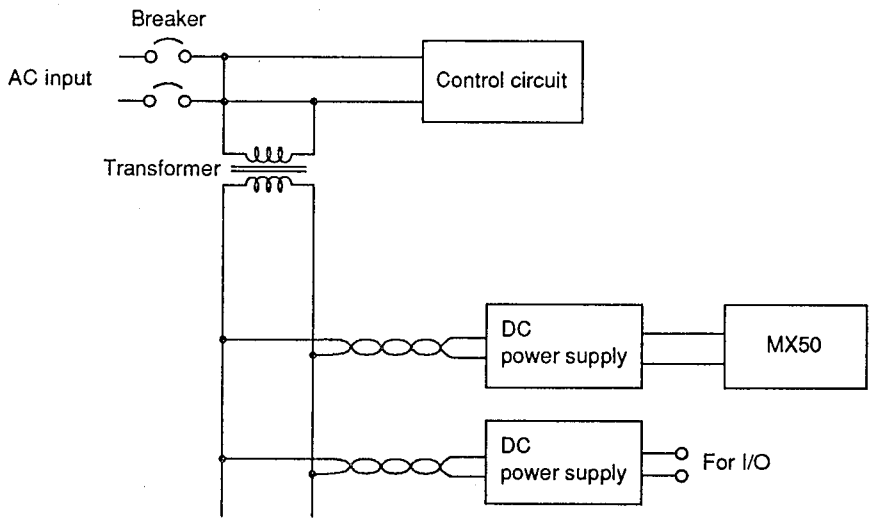
● Operation at instantaneous power interruption

The MX50 may malfunction if an instantaneous power interruption occurs. So, design the circuit that includes the power supply for the external I/O device and the power supplies for the other control circuits for the device to prevent an instantaneous power interruption.

● Wiring of power supply systems

Separate the power supplies for the power system, controller system and DC system to prevent malfunction caused by induced noise.

Provide separate dedicated power supplies for the MX50 and I/O. The power supply for AC input must be insulated from the power supply for I/O. Provide a 24 VDC ±10%, 0.5 A power supply for the MX50, and a 12/24 VDC power supply for I/O.



AC Power Supply (example)

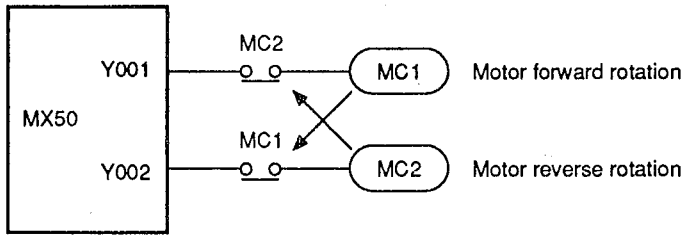
● Precautions for power supply error

The MX50 may malfunction temporarily when the MX50's power is turned ON or OFF due to an excessive time difference between the MX50 power supply and external power supplies. Provide an external interlock circuit or emergency stop circuit to prevent this kind of trouble or error from becoming an overall system error or to prevent malfunction from damaging the machine or causing an accident.

● **Interlock circuit**

When carrying out reciprocal operation such as forward/reverse operation of a motor controlled by outputs from the MX50 or if there is a risk that outputs from the MX50 may lead to machine damage or accident, provide an external interlock circuit.

In the following example, MC1 and MC2 are set not to turn ON simultaneously even if outputs Y001 and Y002 turn ON simultaneously.



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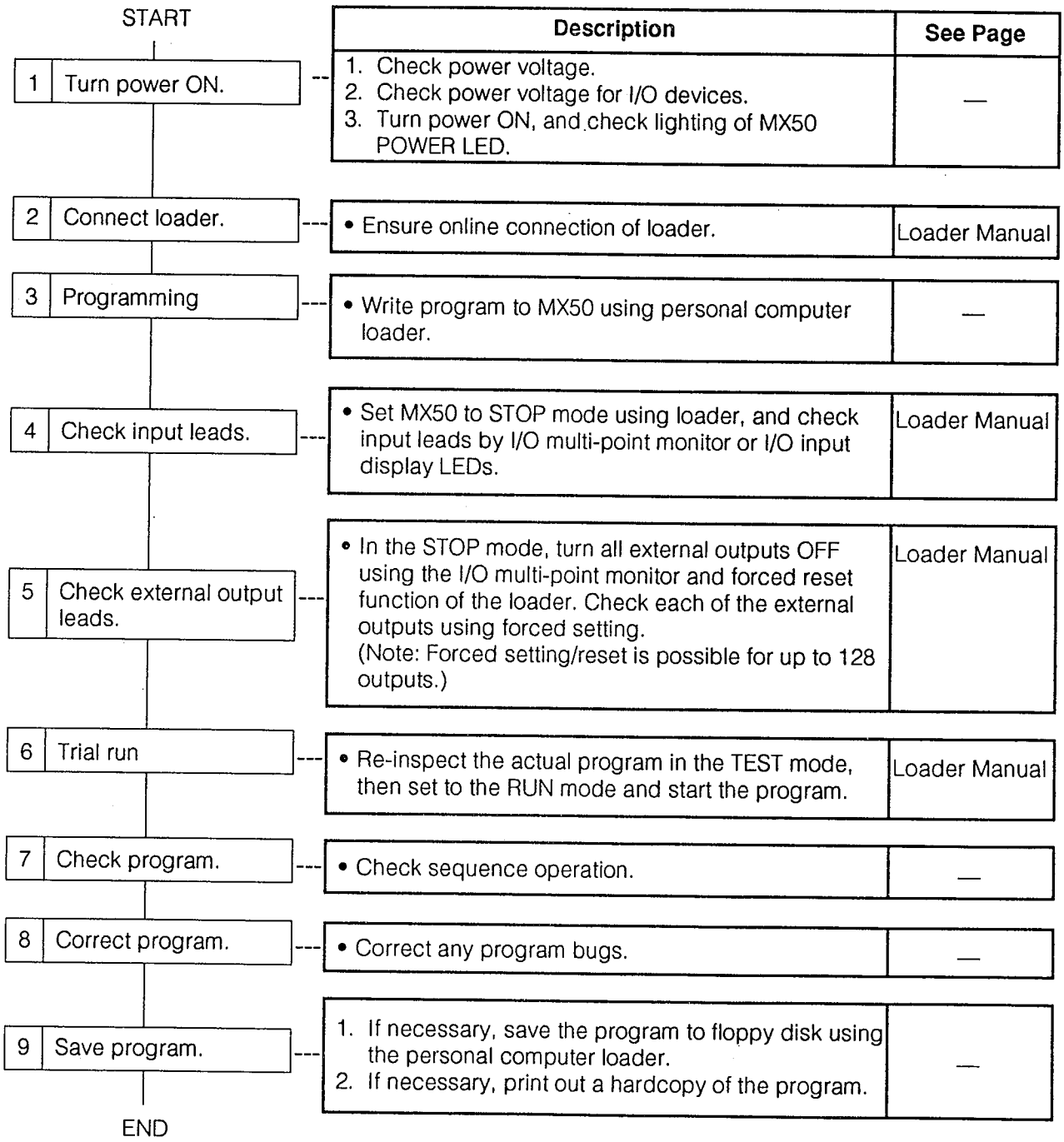
4-2 Trial Operation

■ Outline

The following figure shows the procedure of operations from checks carried out before operation to trial operation.



	Description	See Page
1	1. Check power voltage. 2. Check power voltage for I/O devices. 3. Turn power ON, and check lighting of MX50 POWER LED.	—
2	• Ensure online connection of loader.	Loader Manual
3	• Write program to MX50 using personal computer loader.	—
4	• Set MX50 to STOP mode using loader, and check input leads by I/O multi-point monitor or I/O input display LEDs.	Loader Manual
5	• In the STOP mode, turn all external outputs OFF using the I/O multi-point monitor and forced reset function of the loader. Check each of the external outputs using forced setting. (Note: Forced setting/reset is possible for up to 128 outputs.)	Loader Manual
6	• Re-inspect the actual program in the TEST mode, then set to the RUN mode and start the program.	Loader Manual
7	• Check sequence operation.	—
8	• Correct any program bugs.	—
9	1. If necessary, save the program to floppy disk using the personal computer loader. 2. If necessary, print out a hardcopy of the program.	—

4-3 ROM Operation

This section describes how to operate the MX50 from ROM when the program is written to a mounted PROM.

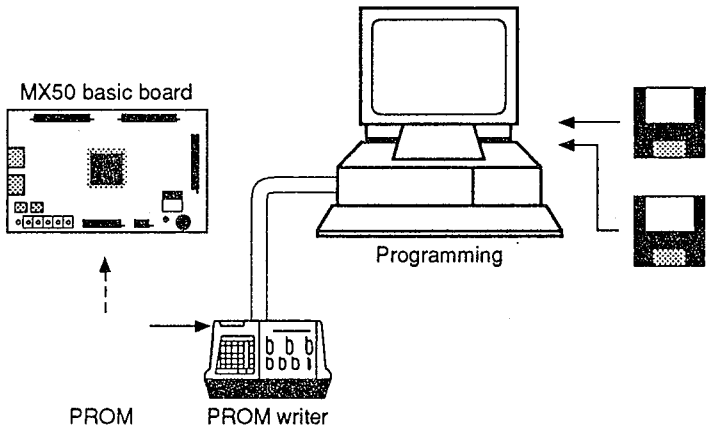
■ Writing to PROM

- Create the program on the personal computer loader.

  Use a commercially available PROM writer to write the PROM, and connect the MX50 to the personal computer via the RS-232C interface.

  For details on how to write to PROM, see Personal Computer Loader Operation, CP-UM-1602.

  Also follow the directions in the PROM writer user's manual.



! HANDLING PRECAUTIONS

- The program cannot be changed when PROM is in use. To change the program, first cancel ROM → RAM move on the personal computer loader.
- Turning the power back ON returns the program to the program in PROM even if the program has been changed in the program mode. (For details when special settings have been made, see Special Settings, page 2-13.)
- The timer and counter setting values are cleared to "0" (zero) when the power is turned ON.
- The recommended PROM writer is the PECKER made by AVAL DATA.

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■ Mounting PROM

⚠ CAUTION

Do not touch the PROM pins with your hands. Doing so might discharge static electricity and damage the PROM-IC.

● Items to prepare

- PROM containing the required program
- Flat-head screwdriver

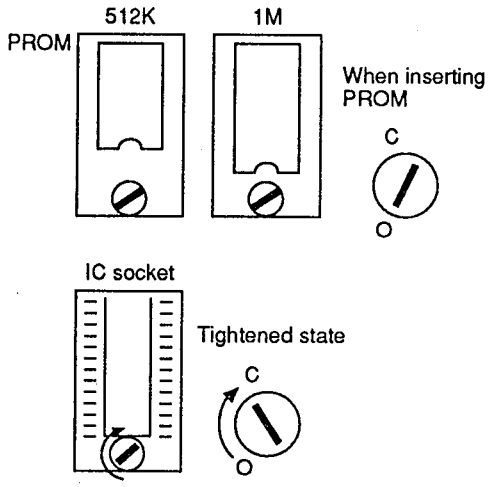
● Procedure

① Turn the MX50's power supply OFF.

② Insert the PROM in the IC socket making sure that it is inserted in the correct direction. The insertion position changes according to the type of PROM as shown in the figure on the right.

③ Make sure that the PROM is properly inserted in the socket.

④ Tighten the screw at the bottom of the IC socket by turning CW by about 90°.



! HANDLING PRECAUTIONS

Pay attention to the direction in the PROM is inserted.

Chapter 5 HIGH-SPEED COUNTER

5-1 Outline

■ Operation

The MX50 supports HSC (High Speed Counter) functions on two independent channels (ch1, ch2).

The HSC has a dedicated processing circuit independent of the sequence controller, and supports high-speed pulsed input that cannot be tracked by regular DI.

Three HSC functions are supported. Selection of the required function allows the MX50 to be used as a machine controller supporting various applications.

1. Pulsed input methods

   By pulsed input, you can select the desired input method: phase difference input, 2-pulse input and directional input. When phase difference input is selected, you can either select frequency multiplication (x1, x2, x4) or select incrementing or decrementing using the phase difference of the PA and PB inputs.

Selection Function	Contact Name	Contact No.	
		1CH Contact	2CH Contact
Phase Difference Input (1x) (2x) (4x) 2-pulsed Input Directional Input	Pulsed input method bit	Y170 to Y172	Y190 to Y192
Incremented Count Decremented Count	Increment/decrement selection bit	Y175	Y195

2. Count mode

   Two count modes are provided: linear count and ring count. When linear count is selected, counting within the range -8388608 to 8388607 is possible. When ring count is selected, cyclical counting is possible within a range starting from "0" (zero) up to any plus setting value (preset value).

Selection Function	Contact Name	Contact No.	
		1CH Contact	2CH Contact
Linear Count Mode Ring Count Mode	Count mode bit	Y173	Y193

3. Counter operation mode

   This function switches counter operation during HSC operation. Two counter operation modes are supported: constant count and gate count.

   When the constant count mode is selected: counter operation is carried out at all times during HSC operation. When the gate count mode is selected, execution and stopping of counter operation can be controlled by the state of the counter enable (PENB) external input signal.

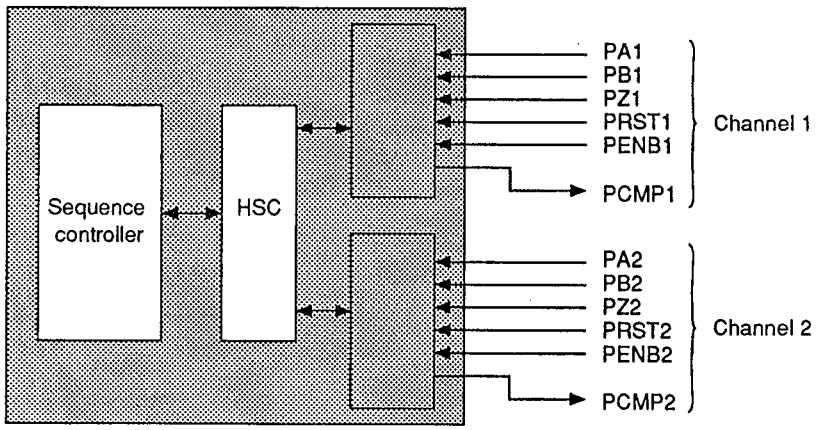
Selection Function	Contact Name	Contact No.	
		1CH Contact	2CH Contact
Constant Count Mode Gate Count Mode	Counter operation control bit	Y174	Y194

■ External I/O

The HSC has external I/O terminals for five inputs and one output for each channel. Wire the following I/O signals as required to the external terminals. I/O statuses can be confirmed by the LEDs on the basic board. The logic of the I/O signals can be selected as desired (plus or minus) by the polarity bits.

For details on external connections, see Counter I/F connector (CN5) (page 2-4).

Signal Name	I/O	LED Name		Description	Polarity Bit	
		1CH	2CH		1CH	2CH
PA	Input	A1	A2	Pulsed input A phase signal	Y17A	Y19A
PB	Input	B1	B2	Pulsed input B phase signal	Y17B	Y19B
PZ	Input	Z1	Z2	Pulsed input Z phase signal. Setting and preset operations can be carried out by setting conditions.	Y17C	Y19C
PZ	Input	R1	R2	Counter reset signal used for externally resetting the count value. Also doubles as an edge detection signal.	Y17D	Y19D
PENB	Input	E1	E2	Counter enable signal. Controls execution/ stop of counter operation in the gate count mode. Also doubles as a level detection signal.	Y17E	Y19E
PCMP	Output	C1	C2	Count value matching output signal. This latch signal is output when the count and compare values match.	Y17F	Y19F



High-speed Counter Block Diagram

PA1, PA2: A phase (input)
PB1, PB2: B phase (input)
PZ1, PZ2: Z phase (input)
PRST1, PRST2: Reset signals (input)
PENB1, PENB2: Enable signals (input)
PCMP1, PCMP2: Matching signals (output)

■ Internal device assignments

The HSC function can be used in the MX50's ladder program. Create the ladder program using the I/O relays (I/O contacts) and I/O registers for HSC.

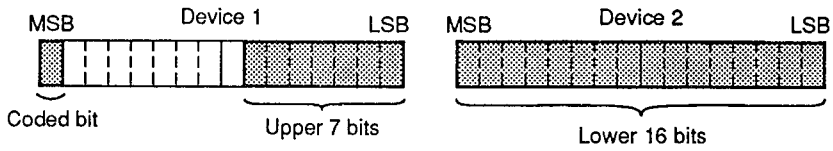
The following table shows the devices (I/O contacts and I/O registers) used on the HSC.

Device Type		Device	
		1CH	2CH
Input Contacts	Status data	X160 to X16F	X180 to X18F
	HSC error data	X170 to X17F	X190 to X19F
Output Contacts	Parameter data	Y160 to Y16F	Y180 to Y18F
	Setup data	Y170 to Y17F	Y190 to Y19F
Input Registers	Count value	R0501:R0500	R0505:R0504
	Compare execution value	R0503:R0502	R0507:R0506
Output Registers	Compare setting value	R0601:R0600	R0605:R0604
	Preset value	R0603:R0602	R0607:R0606

NOTE The meaning of the range (e.g. X160 to X16F) in the Device column and ":" in the above table are as follows:

device 1 to device 2 Range from device 1 to device 2

device 1:device 2 Double-word type device that takes device 1 as the uppermost device and device 2 as the lowermost device.



Bits 7 to 14 of Device 1 are ignored by the input register. In the output register, when the sign bit is "1", all bits are "1" and when "0" (zero), all bits are "0".

● **Status data**

The input contact indicates the status of the HSC. The following table shows the functions of the status data.

Contact No.		Contact Name	Remarks
1CH	2CH		
X160	X180	PENB input status bit	
X161	X181	PRST input status bit	
X162	X182	PZ input status bit	
X163	X183	Ring mode error bit	
X164	X184	Typical error bit	
X165	X185	—	Reserved for system
X166	X186	Max. count value bit	
X167	X187	Min. count value bit	
X168	X188	Count value matching bit	
X169	X189	Counter "operating" bit	
X16A	X18A	Reset completion bit	
X16B	X18B	Preset completion bit	
X16C	X18C	"Counting" bit	
X16D	X18D	Counter overflow bit	
X16E	X18E	Counter underflow bit	
X16F	X18F	Counter zero bit	

! HANDLING PRECAUTIONS

"Reserved for system" is fixed to "0" (zero). If this is set to "1", normal operation of the MX500 cannot be assured.

● **HSC error data**

The input contact indicates the error status if an illegal setting has been made to HSC. If an HSC error occurs, the typical error bit turns ON. If the HSC error occurs during counter operation, counter operation is maintained at the setting state that was active before the error occurred. The following table shows the HSC error data.

Contact No.		Contact Name	Remarks
1CH	2CH		
X170	X190	Setup data write error bit	
X171	X191	Preset value setting error bit	
X172	X192	Preset value write error bit	
X173	X193	PZ input condition error bit	
X174	X194	—	Reserved for system
X175	X195	—	Reserved for system
X176	X196	—	Reserved for system
X177	X197	—	Reserved for system
X178	X198	—	Reserved for system
X179	X199	—	Reserved for system
X17A	X19A	—	Reserved for system
X17B	X19B	—	Reserved for system
X17C	X19C	—	Reserved for system
X17D	X19D	—	Reserved for system
X17E	X19E	—	Reserved for system
X17F	X19F	—	Reserved for system

! HANDLING PRECAUTIONS

- "Reserved for system" is fixed to "0" (zero). If this is set to "1", normal operation of the MX500 cannot be assured.
- If an error occurs, counter operation is maintained at the setting state that was active before the error occurred.

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● **Parameter data**

The output contact is for setting or changing the HSC operating status. The following table shows the parameter data.

Contact No.		Contact Name	Remarks
1CH	2CH		
Y160	Y180	—	Reserved for system
Y161	Y181	Compare value latch bit	
Y162	Y182	Forced reset bit	
Y163	Y183	Forced preset bit	
Y164	Y184	—	Reserved for system
Y165	Y185	—	Reserved for system
Y166	Y186	—	Reserved for system
Y167	Y187	—	Reserved for system
Y168	Y188	Matching output disable bit	
Y169	Y189	Re-reset disable bit	
Y16A	Y18A	Re-preset disable bit	
Y16B	Y18B	Matching output clear bit	
Y16C	Y18C	External reset disable bit	
Y16D	Y18D	External preset disable bit	
Y16E	Y18E	Counter disable bit	
Y16F	Y18F	Start/stop bit	

! HANDLING PRECAUTIONS

- "Reserved for system" is fixed to "0" (zero). If this is set to "1", normal operation of the MX500 cannot be assured.
- When the count value is changed using the compare value latch bit, forced reset bit and forced preset bit, do not operate the counter in the same scan in which the counter was started.

● **Setup data**

The output contact is for setting HSC basic operations. Pulsed input method or HSC operation mode can be set by the setup data. If the setup data is changed to set basic operation with the counter already started, the setup data write error (X170, X190) will occur.

The following table shows the setup data.

Contact No.		Contact Name	Remarks
1CH	2CH		
Y170	Y190	Pulsed input method bit	
Y171	Y191		
Y172	Y192		
Y173	Y193	Count mode bit	
Y174	Y194	Counter operation control bit	
Y175	Y195	Increment/decrement selection bit	
Y176	Y196	—	Reserved for system
Y177	Y197	Preset condition bit	
Y178	Y198	Reset condition bit	
Y179	Y199		
Y17A	Y19A	PA input logic bit	
Y17B	Y19B	PB input logic bit	
Y17C	Y19C	PZ input logic bit	
Y17D	Y19D	PRST input logic bit	
Y17E	Y19E	PENB input logic bit	
Y17F	Y19F	PCMP output logic bit	

! HANDLING PRECAUTIONS

- "Reserved for system" is fixed to "0" (zero). If this is set to "1", normal operation of the MX500 cannot be assured.
- If the setup data is changed during counter operation, the setup data write error will occur.

● **Input registers**

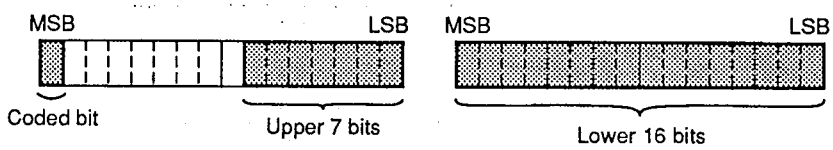
These registers indicate the current count value and compare value during HSC startup.

The following table shows details of input registers.

Register No.		Register Name	Remarks
1CH	2CH		
R0500	R0504	Count value	Lower 16 bits
R0501	R0505		Upper 8 bits (including sign)
R0502	R0506	Compare execution value	Lower 16 bits
R0503	R0507		Upper 8 bits (including sign)

! HANDLING PRECAUTIONS

- Set upper registers in the range -128 to 127. If registers are set outside of this range, normal operation of the MX50 cannot be assured.
- Registers are configured as follows:



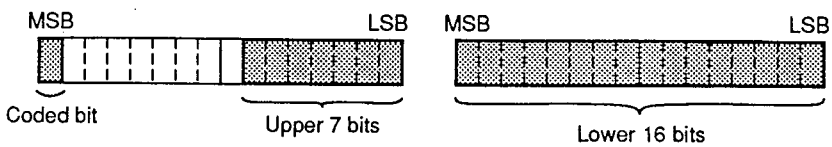
● **Output registers**

These registers indicate the compare value and preset value of the HSC. The following table shows details of output registers.

Register No.		Register Name	Remarks
1CH	2CH		
R0600	R0604	Compare setting value	Lower 16 bits
R0601	R0605		Upper 8 bits (including sign)
R0602	R0606	Preset value	Lower 16 bits
R0603	R0607		Upper 8 bits (including sign)

! HANDLING PRECAUTIONS

- Set upper registers in the range -128 to 127. If registers are set outside of this range, normal operation of the MX50 cannot be assured.
- Registers are configured as follows:



5-2 High-speed Counter Functions

The logic of HSC external I/O can be changed by the setting of the setup data. Five inputs (PA, PB, PZ, PRST, PENB) and one output (PCMP) are provided as external I/O. "Logic" refers to the logic of the I/O signals, and signals are either plus or minus logic. Plus logic is expressed as "logic 1" when the signal is ON, and minus logic is expressed as "logic 0" when the signal is OFF. Minus logic is the reverse logic of plus logic.

All of the timing charts showing counter operation in this manual are described in plus logic, the HSC default. When using minus logic settings, invert ON/OFF in the timing charts for the desired signals.

Also, figures in brackets that describe I/O contacts and I/O registers describe figures for channels ch1 and ch2 in that order.

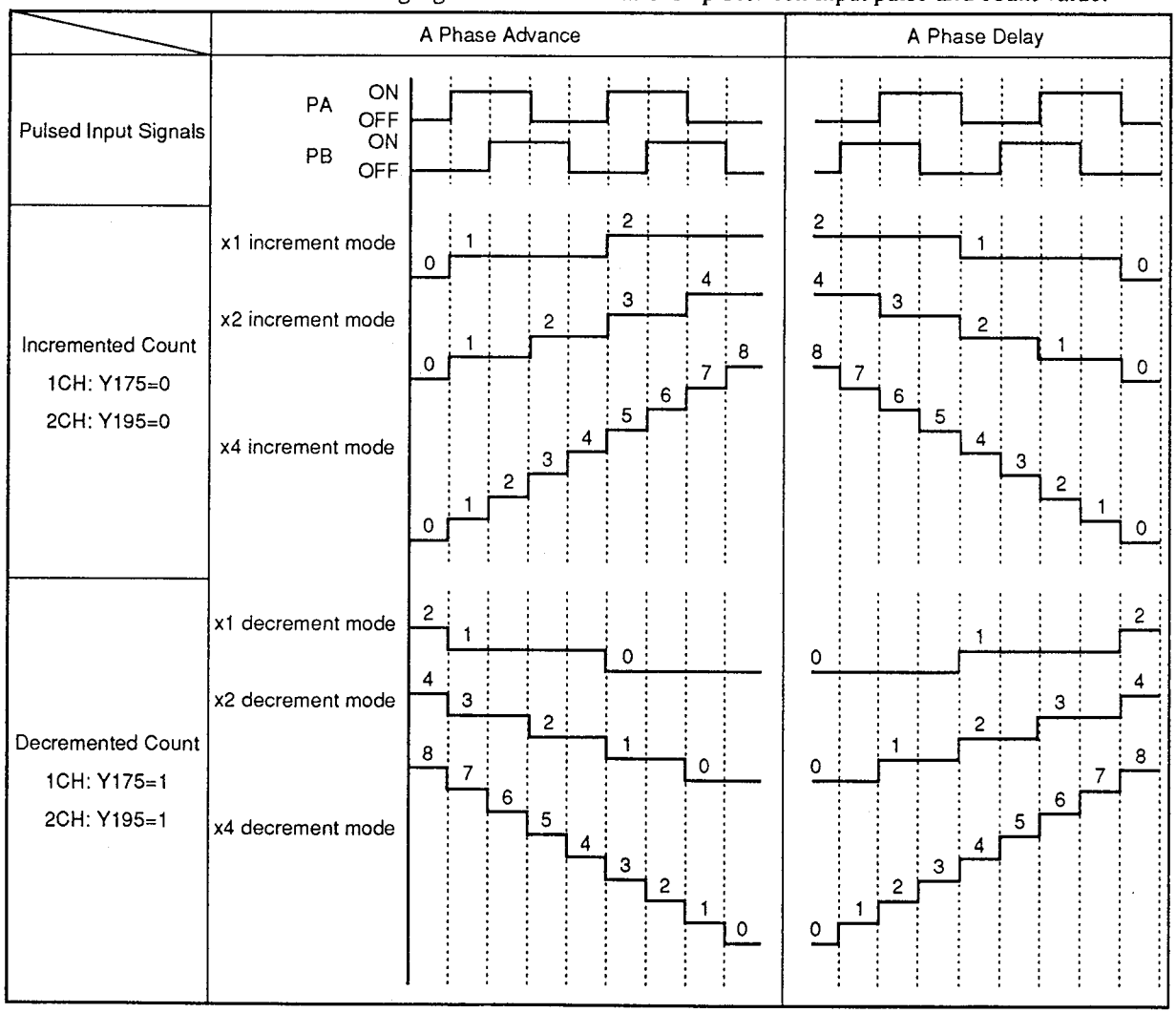
■ Pulsed input method

With the high-speed counter, three pulsed input modes (phase difference input, 2-pulse input, directional input) can be selected by the setting of the setup data. For details on setup data, see page 5-23.

● Phase difference input mode

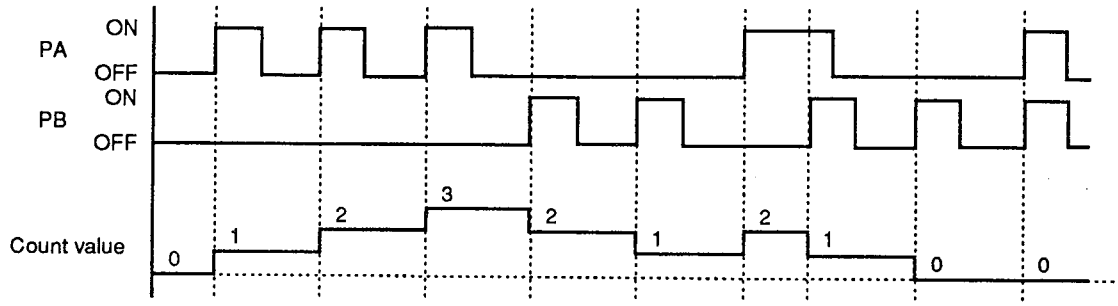
In this mode, the count value is incremented or decremented according to the phase difference taking the two phases PA and PB as the inputs. Counting with the frequency of the input multiplied is also possible. Use frequency multiplication to raise the resolution. Three frequency multiplication settings are provided: x1, x2 and x4. These are selected according to the setup data.

The following figure shows the relationship between input pulse and count value.



● **2-pulse input mode**

In this mode, the increment function is applied to PA and the decrement function is applied to PB. Increment/decrement is carried out at the rising edge of each pulse. The following figure shows each of these operations.

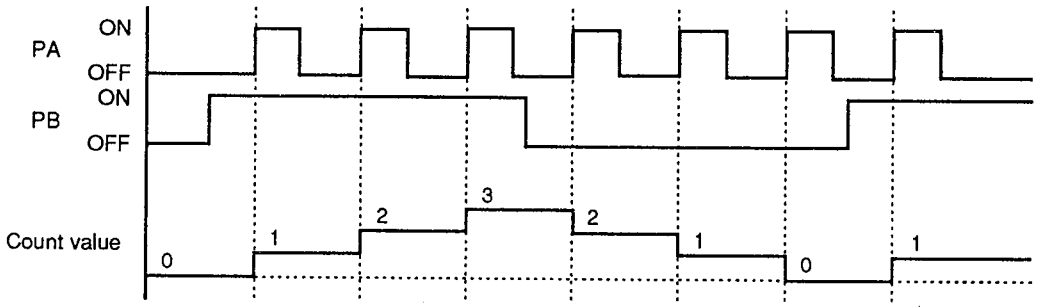


! HANDLING PRECAUTIONS

The count value does not change when PA and PB are input simultaneously.

● **Directional input mode**

In this mode, PA is taken as pulsed input, the count value is incremented when PB is ON and decremented when PB is OFF. The following figure shows pulsed input and count value operation.



! HANDLING PRECAUTIONS

The count value does not change when PA and PB are input simultaneously.

■ Count mode

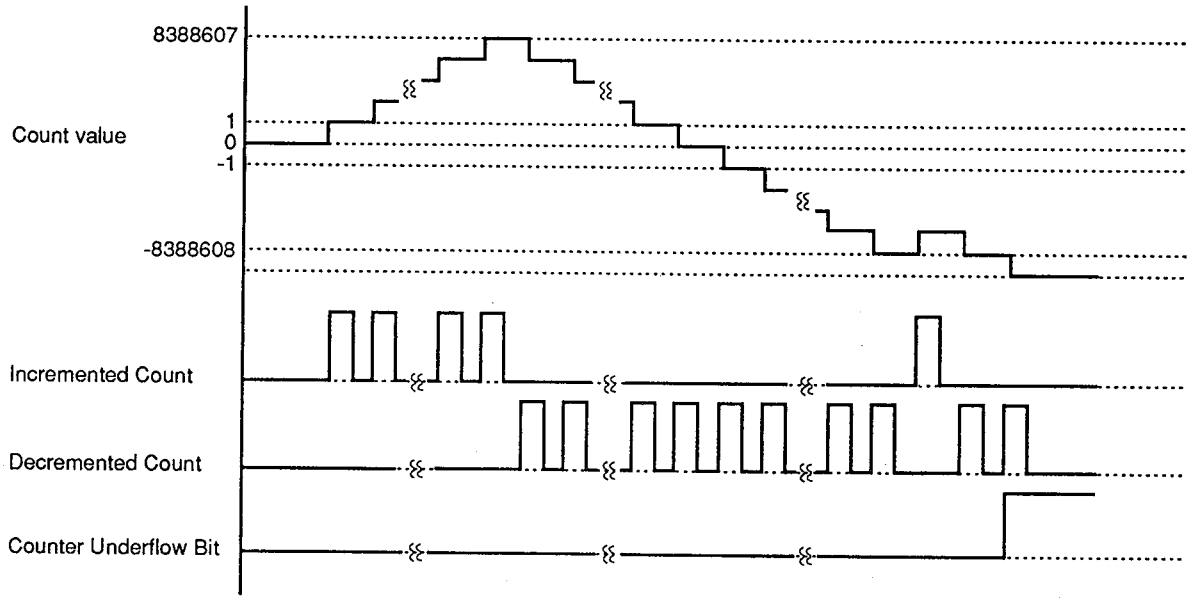
The high-speed counter has two modes: linear count mode and ring count mode. In the linear count mode, all ranges from the minimum to the maximum values supported by the counter function can be handled. In the ring count mode, the range starting from "0" (zero) through to the preset value is handled cyclically. Any value can be set as the preset value (plus value).

Selection of these two modes is set according to the setup data. For details on setup data, see page 5-23.

● Linear count

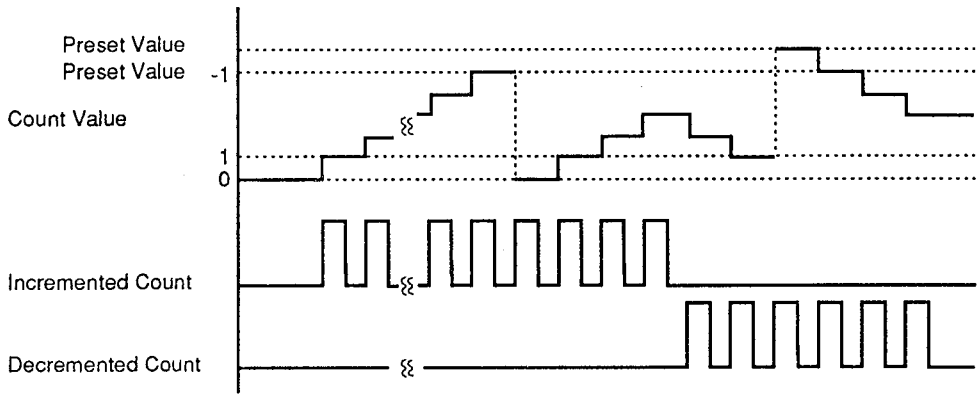
In this mode, the count value changes in the range from the minimum to the maximum values supported by the counter function. The count value can be incremented/decremented freely within the range -8388608 to 8388607. If the count value extends outside of this range, the overflow/underflow error occurs. When this error occurs, count operation stops.

The following figure shows count operation.



● **Ring count**

In this mode, counting is carried out in the range from "0" (zero) and the preset value (plus value) set to each channel. When the count value reaches the preset value, it changes to "0", and when it reaches "0" it changes to the preset value.



■ Counter operation mode

The high-speed counter supports two counter operation modes: constant count and gate count.

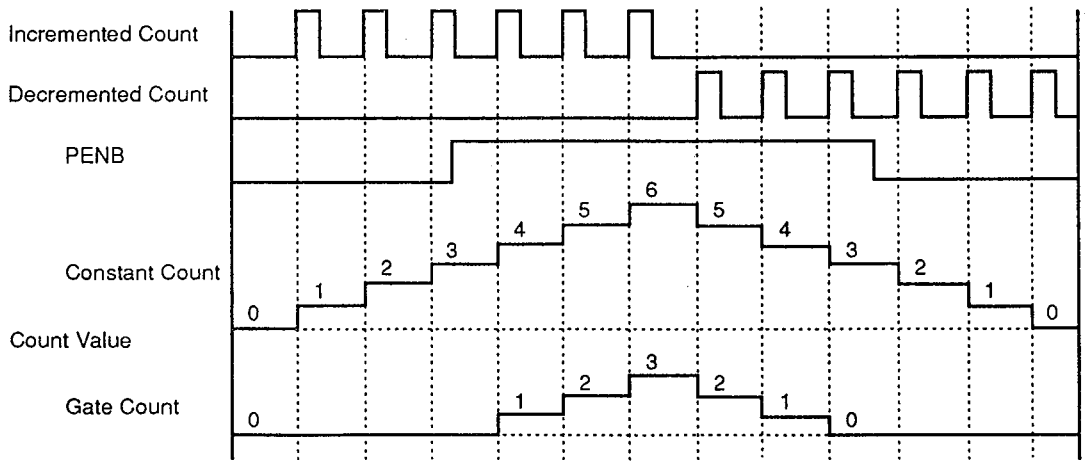
Selection of these two modes is set according to the setup data. For details on setup data, see page 5-23.

● **Constant count mode**

In this mode, input pulses are counted at all times.

● **Gate count mode**

In this mode, count operation is carried out when the external enable signal is ON. Counting is not carried out when the enable signal is OFF.



■ Reset operation

"Reset" refers to clearing the count value to "0" (zero) during counter operation. The MX50 supports two resets: forced reset and external reset. If reset is carried out correctly, the reset completion bits (X16A, X18A) are set to ON to indicate that the reset operation has ended. The reset completion bit can be set to OFF by setting the external reset disable bits (Y16C, Y18C) to ON.

[!] HANDLING PRECAUTIONS

When the external reset disable bit is set to ON, the reset completion bit does not become ON.

● Forced reset

Forced reset" refers to resetting the count value by the ladder program. Reset can be carried out unconditionally during counter operation.

To set a forced reset, set the forced reset bits (Y162, Y182) of the parameter data to ON. This resets the count value of each of the channels.

When forced reset ends, the reset completion bits (X16A, X18A) in the parameter data are set to ON. However, note that the reset completion bit stays OFF when the external reset disable bits (Y16C, Y18C) are set to ON.

● External reset

"External reset" refers to triggering the external signal input to the MX50 to reset the count value. When the count value is externally reset, the reset completion bits (X16A, X18A) in the status data are set to ON. Which external input signal is to be triggered can be selected by reset condition bits (Y178, Y179, Y198, Y199) in the setup data.

- External reset prohibit

  External reset can be prohibited in the ladder program. Setting the external reset disable bits (Y16C, Y18C) to ON prohibits the reset operation when the external reset signal has been input.

- Re-reset prohibit

  Re-reset can be prohibited when the external reset signal is input again after reset operation has ended. (This function disables the external reset during the time that the reset completion bit is ON.)

  To prohibit re-reset, set the re-reset disable bits (Y169, Y189) in the parameter data to ON.

● **Reset operation conditions**

Input Contact	Output Contact		Reset Operation Possible/ Impossible
Reset Completion Bit	Re-reset Disable Bit	External Reset Disable Bit	
X16A, X18A	Y169, Y189	Y16C, Y18C	
0 (OFF)	0 (OFF)	0 (OFF)	○ (possible)
0 (OFF)	1 (ON)	0 (OFF)	○ (possible)
1 (ON)	0 (OFF)	0 (OFF)	○ (possible)
1 (ON)	1 (ON)	0 (OFF)	X (impossible)
0 (OFF)	0 (OFF)	1 (ON)	X (impossible)
0 (OFF)	1 (ON)	1 (ON)	X (impossible)
1 (ON)	0 (OFF)	1 (ON)	X (impossible)
1 (ON)	1 (ON)	1 (ON)	X (impossible)

■ Preset operation

"Preset" refers to clearing the count value to the preset value during counter operation. The MX50 supports two presets: forced preset and external preset. If preset is carried out correctly, the preset completion bits (X16B, X18B) are set to ON to indicate that the preset operation has ended. The preset completion bit can be set to OFF by setting the external preset disable bits (Y16D, Y18D) to ON.

[!] HANDLING PRECAUTIONS

When the external preset disable bit is set to ON, the preset completion bit does not become ON.

● Forced preset

"Forced preset" refers to resetting the count value by the ladder program. Preset can be carried out unconditionally during counter operation.

To set a forced preset, set the forced preset bits (Y163, Y183) of the parameter data to ON. This presets the count value of each of the channels.

When forced preset ends, the preset completion bits (X16B, X18B) in the parameter data are set to ON. However, note that the preset completion bit stays OFF when the external preset disable bits (Y16D, Y18D) are set to ON.

● External preset

"External preset" refers to triggering the external signal input to the MX50 to preset the count value. When the count value is externally preset, the preset completion bits (X16B, X18B) in the status data are set to ON. The PZ signal is used as the external input signal. The enable/disable setting of the PZ signal can be selected by preset condition bits (Y177, Y197) in the setup data.

- External preset prohibit

  External preset can be prohibited in the ladder program. Setting the external preset disable bits (Y16C, Y18C) to ON prohibits the preset operation when the external preset signal has been input.

- Re-preset prohibit

  Re-preset can be prohibited when the external preset signal is input again after preset operation has ended. (This function disables the external preset during the time that the preset completion bit is ON.)

  To prohibit re-preset, set the re-preset disable bits (Y16A, Y18A) in the parameter data to ON.

● **Preset operation conditions**

Input Contact	Output Contact		Preset Operation Possible/ Impossible
Preset Completion Bit	Re-preset Disable Bit	External Preset Disable Bit	
X16B, X18B	Y16A, Y18A	Y16D, Y18D	
0 (OFF)	0 (OFF)	0 (OFF)	○ (possible)
0 (OFF)	1 (ON)	0 (OFF)	○ (possible)
1 (ON)	0 (OFF)	0 (OFF)	○ (possible)
1 (ON)	1 (ON)	0 (OFF)	x (impossible)
0 (OFF)	0 (OFF)	1 (ON)	x (impossible)
0 (OFF)	1 (ON)	1 (ON)	x (impossible)
1 (ON)	0 (OFF)	1 (ON)	x (impossible)
1 (ON)	1 (ON)	1 (ON)	x (impossible)

■ Count value comparison

● **Count value size comparison**

This operation indicates the status of the count value with respect to the compare execution value (R0503:R0502, R0507:R0506).

- Count value > Compare execution value

  When the count value is greater than the compare execution value, the maximum count value bits (X166, X186) in the status data are set to ON.

  The maximum count value bits only indicate the status, and are set to OFF when the "count value > compare execution value" relationship is inverted.

- Count value < Compare execution value

  When the count value is smaller than the compare execution value, the minimum count value bits (X167, X187) in the status data are set to ON.

  The minimum count value bits only indicate the status, and are set to OFF when the "count value > compare execution value" relationship is inverted.

● **Count value match (matched output)**

When the count value and the compare execution values (R0503:R0502, R0507:R0506) match, the count value matched bits (Y168, Y188) are set to ON. At the same time, the count value matched signal (PCMP signal) is output as the external signal.

Matched output can be cleared (set to OFF) by setting the matched output clear bits (Y16B, Y18B) to ON.

The compare execution value can be set by setting the compare value latch bits (Y161, Y181) in the parameter data to ON after setting the compare setting value (R0601:R0600, R0605:R0604) to any value. The compare execution value can be set within the range -8388608 to 8388607.

For details on external connections, see HSC connection diagram, page 3-19.

- Matched output prohibit

  Counter matched output can be prohibited in the ladder program. To prohibit matched output, set the matched output disable bits (Y168, Y188) to ON. Though output is prohibited when these bits are set to ON, this is reflected in the count value matched bits (X168, X188) in the status data, the input contacts of the ladder program.

[!] HANDLING PRECAUTIONS

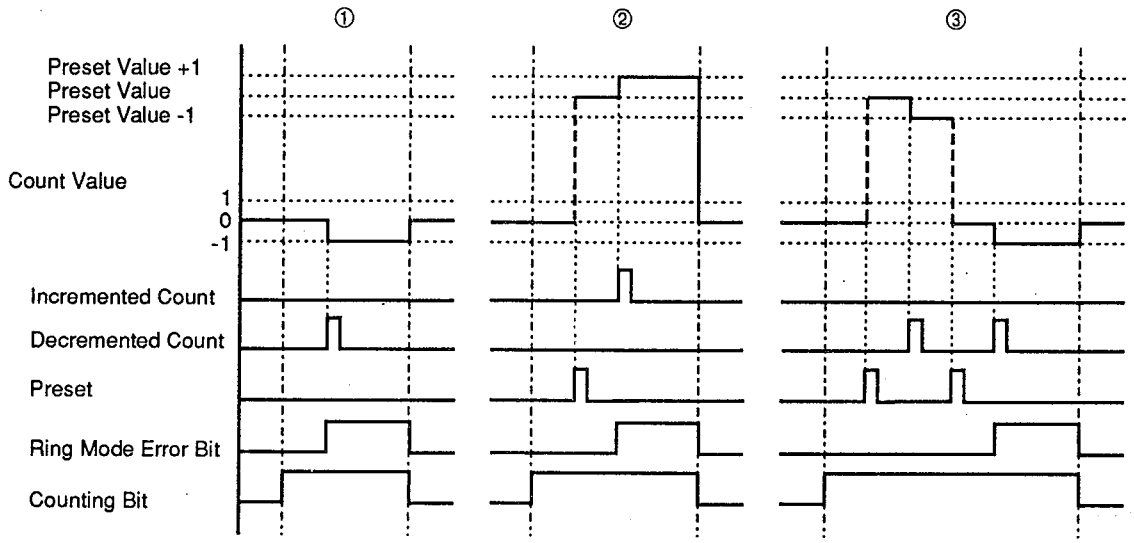
Matched output does not become ON when the matched output clear bit is set to ON.- Matched output prohibit

5-3 Details High-speed Counter I/O Data

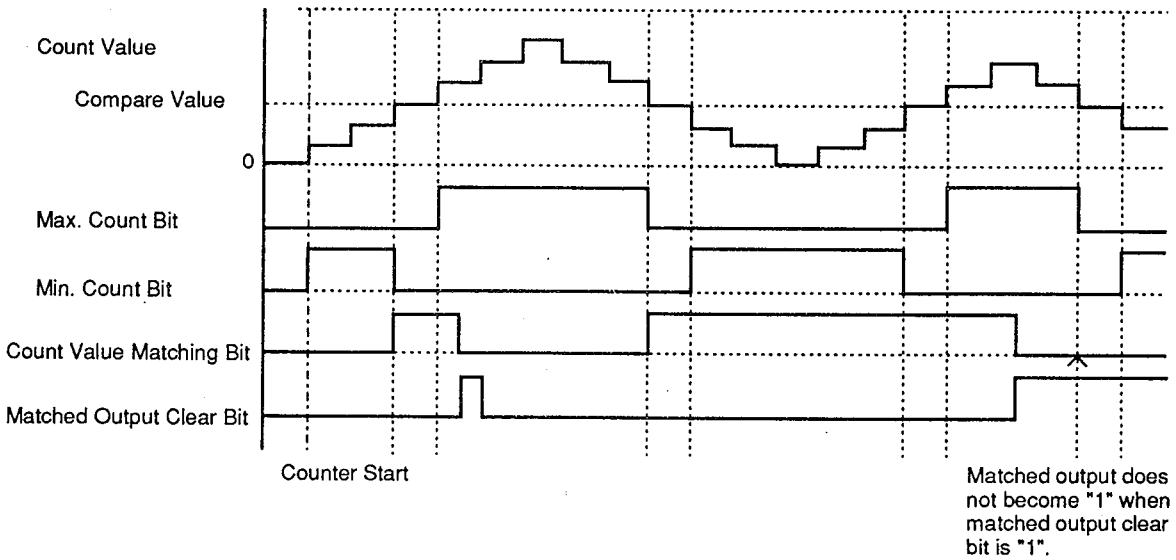
■ Status data

Name	Status	Description
PENB input status bit 1CH: X160 2CH: X180	0	PENB input signal "0" (OFF)
	1	PENB input signal "1" (ON)
PRST input status bit 1CH: X161 2CH: X181	0	PRST input signal "0" (OFF)
	1	PRST input signal "1" (ON)
PZ input status bit 1CH: X162 2CH: X182	0	PZ input signal "0" (OFF)
	1	PZ input signal "1" (ON)
Ring mode error bit *1 1CH: X163 2CH: X183	0	No setting error in ring count mode
	1	Error has occurred in ring count mode (count from 0 to outside of preset value range) and count operation has stopped.
Typical error bit 1CH: X164 2CH: X184	0	No parameter setting errors
	1	Parameter setting error (X170 to X173, X190 to X193) has occurred.
Max. count value bit *2 1CH: X166 2CH: X186	0	State other than count value > compare value
	1	Count value > compare value
Min. count value bit *2 1CH: X167 2CH: X187	0	State other than count value < compare value
	1	Count value < compare value
Count value matching bit *3 1CH: X168 2CH: X188	0	State other than count value = compare value
	1	Count value = compare value
Counter "operating" bit *3 1CH: X169 2CH: X189	0	Counter stopped
	1	Counter started
Reset completion bit 1CH: X16A 2CH: X18A	0	Reset operation is not being carried out, or reset completion bit has been cleared by external reset disable bit.
	1	Reset completed
Preset completion bit 1CH: X16B 2CH: X18B	0	Preset operation is not being carried out, or preset completion bit has been cleared by external preset disable bit.
	1	Preset completed
"Counting" bit 1CH: X16C 2CH: X18C	0	Count stopped
	1	Counting in progress
Counter overflow bit 1CH: X16D 2CH: X18D	0	Count value is 8388607 (007F:FFFF) or less
	1	Indicates count value of FF80:0000 and count operation is stopped when count value has reached outsude of count range.
Counter underflow bit 1CH: X16E 2CH: X18E	0	Count value is -8388608 (FF80:0000) or more
	1	Indicates count value of 007F:FFFF and count operation is stopped when count value has reached outsude of count range.
Counter zero bit *4 1CH: X16F 2CH: X18F	0	Count value is a value other than "0", or "0" continued for more than two sequencer scans.
	1	Only single sequencer scan turns ON when count value is "0". However, note that this bit is disabled in the ring count mode when this bit is "0" during counter operation, reset and setting.

*1: The following figures details the circumstances that the ring mode error occurs.
A "ring mode error" occurs when the count value is decremented at "0" (zero) in ring count modes (1) and (3) in the figure, or when it is incremented by the preset value (2).

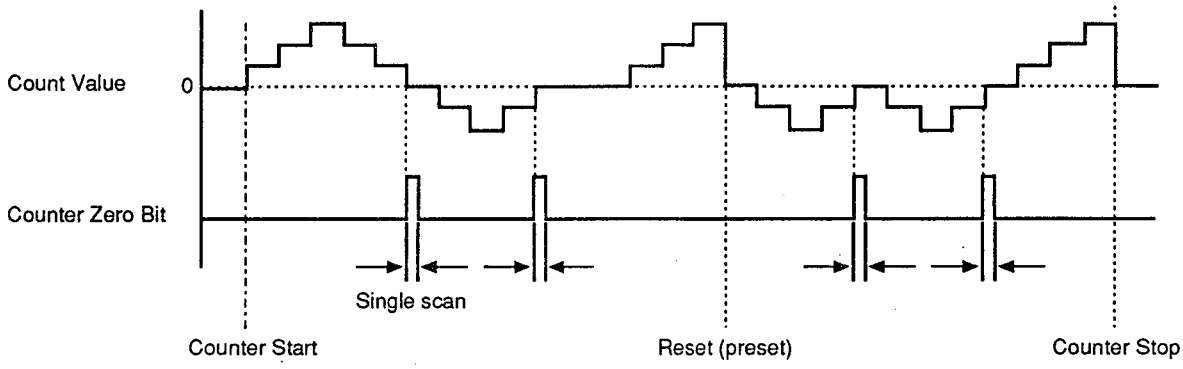


*2: The following figure shows the relationship between the count value and the compare value.



*3: This bit value is the same as the parameter data start/stop bit.

*4: The counter zero bit is insignificant in the ring count mode. The following figure shows the relationship between the count value and the counter zero bit.



■ HSC error data

Name	Status	Description
Setup data write error bit 1CH: X170 2CH: X190	0	Setup data write error has not occurred.
	1	Setup data has been changed during counter operation.
Preset value setting error bit 1CH: X171 2CH: X191	0	Preset value setting error has not occurred.
	1	Preset value has been set to a minus value in the ring count mode, or the mode has been changed to the ring count mode when a minus preset value has been set.
Preset value write error bit 1CH: X172 2CH: X192	0	Preset value write error has not occurred.
	1	Preset value has been reset during counter operation in ring count mode.
PZ input condition error bit 1CH: X173 2CH: X193	0	PZ input condition error has not occurred.
	1	PZ input has been specified in both reset and preset conditions.

! HANDLING PRECAUTIONS

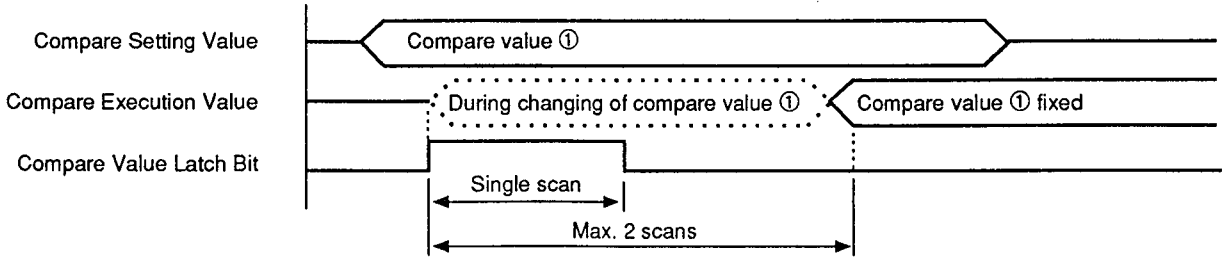
If a setting error occurs during counter operation, counter operation is maintained at the setting state that was active before the error occurred.

■ Parameter data

Name	Status	Description
Compare value latch bit *1, 4 1CH: Y161 2CH: Y181	0	Disables compare setting value.
	1	Enables compare setting value. (Sets compare setting value to compare execution value.)
Forced reset bit *2, 4 1CH: Y162 2CH: Y182	0	Disables forced reset.
	1	Enables forced reset. (Forcibly resets count value.)
Forced preset bit *3, 4 1CH: Y163 2CH: Y183	0	Disables forced preset.
	1	Enables forced preset. (Forcibly presets count value.)
Matching output disable bit 1CH: Y168 2CH: Y188	0	Enables matching output (PCMP).
	1	Disables matching output (PCMP).
Re-reset disable bit *2 1CH: Y169 2CH: Y189	0	Enables re-reset operation.
	1	Disables re-reset operation.
Re-preset disable bit *3 1CH: Y16A 2CH: Y18A	0	Enables re-preset operation.
	1	Disables re-preset operation.
Matching output clear bit 1CH: Y16B 2CH: Y18B	0	Does not clear matching output.
	1	Clears counter value matching bit and matching output.
External reset disable bit *2 1CH: Y16C 2CH: Y18C	0	Enables external reset operation.
	1	Disables external reset operation. Clears (OFF) reset completion bit.
External preset disable bit *3 1CH: Y16D 2CH: Y18D	0	Enables external preset operation.
	1	Disables external preset operation. Clears (OFF) preset completion bit.
Counter disable bit 1CH: Y16E 2CH: Y18E	0	Enables count operation.
	1	Disables count operation.
Start/stop bit 1CH: Y16F 2CH: Y18F	0	Stops the counter.
	1	Starts the counter.

Shaded area indicates default.

*1: Setting the compare value latch bit to "1" resets the data set to the compare setting value to the compare execution value. This enables the preset compare value. However, note that for a maximum of two scans from the scan where the compare value latch bit was set to "1", normal operation of the MX50 cannot be assured as a result of comparison (maximum count value bit, minimum count value bit, count value matching bit) using the compare execution value. The following figures shows the details when the compare value latch bit is set to "1".



*2: For details of operation, see page 5-13.

*3: For details of operation, see page 5-13.

*4: When the count value is changed using the compare value latch bit, forced reset bit and forced preset bit, do not operate the counter in the same scan in which the counter was started.

■ Setup data

This data is for setting up operation of the high-speed counter. Setup data cannot be changed once the counter has started operating. If the setup data is changed by mistake, the states of "setup data write error" and "typical setting error" change to "1". When this happens, the newly changed value will not be reflected in the setup data, and counter operation is continued at the value that was active before the setup data was changed.

Name	Status	Description
Pulsed input method bit 1CH: Y170 to Y172 2CH: Y190 to Y192 * * * └ Y170 (Y190) └ Y171 (Y191) └ Y172 (Y192)	000	Phase difference (1x) input mode
	001	Phase difference (2x) input mode
	010	Phase difference (4x) input mode
	011	Same as 000
	100	2-pulsed input mode
	101	Directional input mode
	110	Same as 000
	111	Same as 000
Count mode bit 1CH: Y173 2CH: Y193	0	Linear count mode
	1	Ring count mode
Counter operation control bit 1CH: Y174 2CH: Y194	0	Constant count mode (increments/decrements count value at all times)
	1	Gate count mode (increments/decrements count value when PENB input is "1")
Increment/decrement selection bit 1CH: Y175 2CH: Y195	0	Incremented count mode PA is incremented one phase ahead of PB in phase difference input mode.
	1	Decremented count mode PA is decremented one phase ahead of PB in phase difference input mode.
Preset condition bit 1CH: Y177 2CH: Y197	0	Does not preset by external input.
	1	Presets when PZ input is "1".
Reset condition bit 1CH: Y178, Y179 2CH: Y198, Y199 * * └ Y178 (Y198) └ Y179 (Y199)	00	Does not reset by external input.
	01	Resets when PZ input is "1".
	10	Resets when PRST input is "1".
	11	Resets when PZ and PRST inputs are both "1".
PA input logic bit 1CH: Y17A 2CH: Y19A	0	Sets plus logic of PA input (ON › "1", OFF › "0").
	1	Sets minus logic of PA input (ON › "0", OFF › "1").
PB input logic bit 1CH: Y17B 2CH: Y19B	0	Sets plus logic of PB input (ON › "1", OFF › "0").
	1	Sets minus logic of PB input (ON › "0", OFF › "1").
PZ input logic bit 1CH: Y17C 2CH: Y19C	0	Sets plus logic of PZ input (ON › "1", OFF › "0").
	1	Sets minus logic of PZ input (ON › "0", OFF › "1").
PRST input logic bit 1CH: Y17D 2CH: Y19D	0	Sets plus logic of PRST input (ON › "1", OFF › "0").
	1	Sets minus logic of PRST input (ON › "0", OFF › "1").
PENB input logic bit 1CH: Y17E 2CH: Y19E	0	Sets plus logic of PENB input (ON › "1", OFF › "0").
	1	Sets minus logic of PENB input (ON › "0", OFF › "1").
PCMP output logic bit 1CH: Y17F 2CH: Y19F	0	Sets plus logic of PCMP input ("1" › ON, "0" › OFF).
	1	Sets minus logic of PCMP input ("0" › ON, "1" › OFF).

Shaded area indicates defaults.

Input registers

Name	Description
Count Value *1 1CH: R0501:R0500 2CH: R0505:R0504	Current count value (24-bit) Hex (-8388608 to 8388607) Hex (FF80:0000 to 007F:FFFF)
Compare Execution Value 1CH: R0503:R0502 2CH: R0507:R0506	Comparison value with count value (used for count value matching, max. and min. count values)

*1: The count value returns to the default when the start/stop bit is set to "0" (stop). (default: "0")

Output registers

Name	Description
Compare Setting Value *1 1CH: R0601:R0600 2CH: R0505:R0604	For setting comparison value with count value (Becomes execution value when compare value is enabled.)
Preset Value *2 1CH: R0603:R0602 2CH: R0607:R0606	For presetting count value. Upper limit value in ring count mode

*1: The compare value can be set within the range -8388608 to 8388607. If the compare value exceeds this range, normal operation of the MX50 cannot be assured. Also, if the compare value is changed during operation, note that the compare operation will not be carried out for two scans.

*2: In the linear count mode, the preset value can be set within the range -8388608 to 8388607. if the preset value exceeds this range, normal operation of the MX50 cannot be assured. Also, if the preset value is changed during operation, note that the preset operation will not be carried out for two scans.
In the ring count mode, the preset value can be set within the range 1 to 8388607. If the preset value exceeds this range, the preset value setting error occurs.

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5-4 High-speed Counter Program

■ Concept

Design the ladder program that uses the HSC function taking the following points and limitations into consideration.

① When the output contacts or output registers have been manipulated, the newly changed data is reflected in HSC after the scan has ended. (batch refresh)

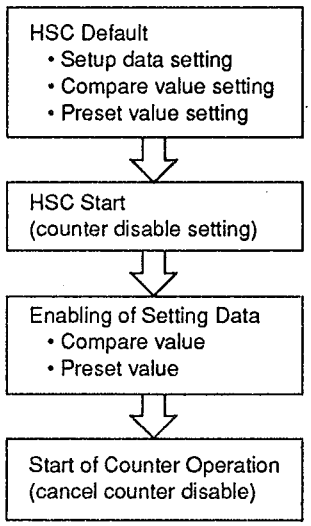
② When the same contact is manipulated at two or more locations, the last manipulation is effective. Accordingly, HSc operates according to the result of the last manipulation.

③ "Reserved for system" areas are fixed to "0" (zero). Do not change.

④ When the HSC alarm has occurred during HSC operation, HSC operation is continued at the state that was active one scan previous.

⑤ When the count value is changed using the compare value latch bit, forced reset bit and forced preset bit, do not operate the counter in the same scan in which the counter was started.

⑥ Start the high-speed counter according the following procedure dividing the scans by blocks.



■ Example

The ladder program shown below was made on the MX series personal computer loader.

This example is given as a reference program for when the user is making his own program. Accordingly, all MX50 operations cannot be assured.

● Sample program

In this sample program, HSC is started, and the compare values and preset values are changed. Close to actual operations are possible by wiring the HSC external I/O.

Check the I/O contact and I/O register information during HSC operation on the personal computer loader. Also, the match, reset and preset counts are already stored to registers. The register numbers to which these counts are stored are as follows.

Register No.	Description
R0000	Number of count value matches
R0001	Number of resets
R0002	Number of presets

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• HSC setup data settings

Setting Item	Description
Pulsed Input Method	2-pulsed input mode
Count Mode	Ring count mode
Counter Operation Control	Constant count mode
Increment/Decrement Selection	Increment/decrement operation mode
Preset Condition	Preset executed at PZ input
Reset Condition	Reset executed at PRST input
PA Input Logic	Plus logic
PB Input Logic	Plus logic
PZ Input Logic	Plus logic
PRST Input Logic	Plus logic
PENB Input Logic	Plus logic
PCMP Output Logic	Plus logic

● Execution of sample program

Input sample programs on the MX series personal computer loader. When the program has been correctly input, change the MX50 status from the STOP mode to the RUN mode, and execute the sample program.

When the MX50 status shifts to the RUN mode, the default (line 00000) during ladder program operation is executed, and the MX50 stands by for an operation instruction. By the operation instruction, set the target contact to ON using the device data change function on the personal computer loader.

The following tables describes program execution.

Setting Item	Description
HSC Startup (lines 00007 to 00024)	The data of M000 is changed to ON to execute HSC startup. HSC startup is carried out divided into four stages (scans). The compare execution and preset values at startup are set as follows: • Compare execution value = 118481 (0011:1111h) • Preset value = 2236962 (0022:2222h)
Compare Value Change (line 00026)	The data of M001 is changed to ON to change the compare value. • Compare execution value = 1193046 (0012:3456h)
Preset Value Change (line 00030)	The data of M002 is changed to ON to change the preset value. The preset value to be changed is set as folows: • Preset value = 5592405 (0055:5555h)
Forced Preset Execution (line 00034)	The data of M003 is changed to ON to execute forced preset. "Forced preset" is a function for forcibly changing the count value to the preset value. When forced preset is executed, the count value changes to the following value: • Count value = 5592405 (0055:5555h)
Forced Reset Execution (line 00036)	The data is M004 is changed to ON to execute forced reset. "Forced reset" is a function for forcibly changing the count value to "0". • Count value = 0 (0000:0000h)

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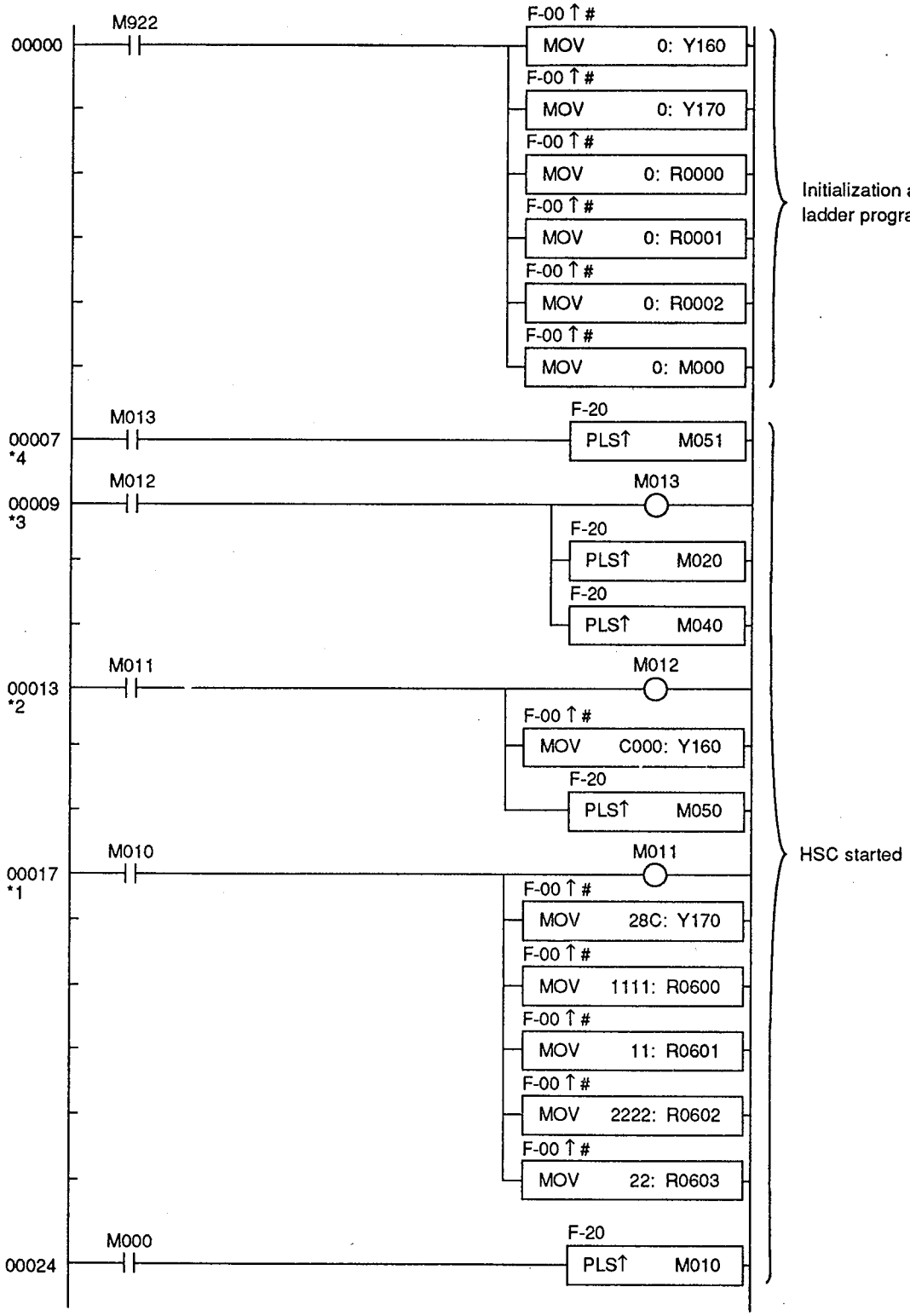

*1 HSC default

*2 HSC started (counter disable setting)

*3 Enabling of setup data

*4 Counter operation started (counter disable released)

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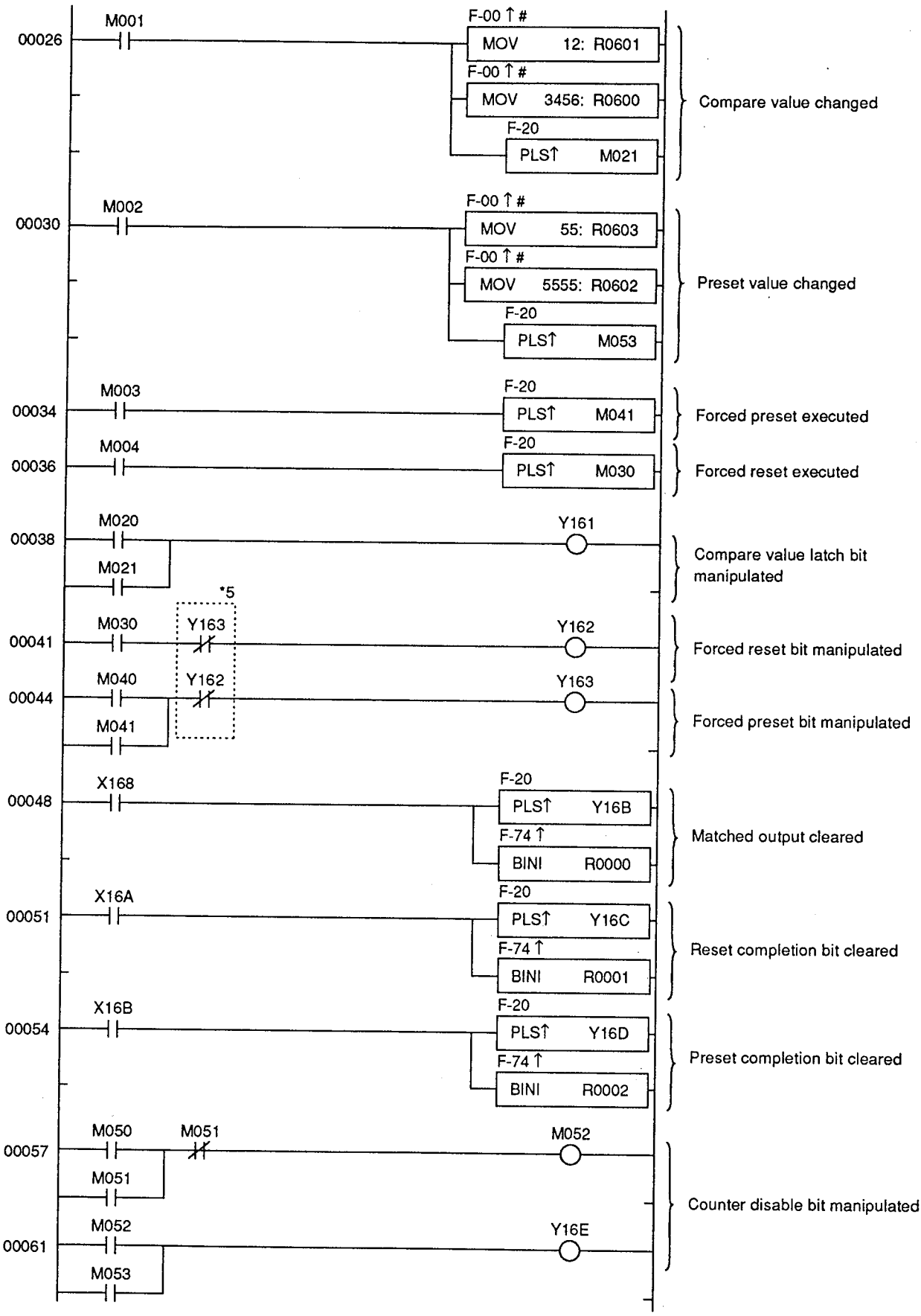

*5 This interlock circuit prevents simultaneous execution of reset and preset operation.

Chapter 6 MAINTENANCE & INSPECTION

6-1 Inspection Items

This chapter describes items that must be inspected daily or periodically to ensure that your MX50 is in an optimum working condition.

We also recommend preparing spare maintenance parts such as fuses and batteries.

⚠ CAUTION

Large amounts of static electricity are sometimes generated in dry locations or by the weather. Before touching components inside the MX50 for maintenance, for example, touch a grounded metal part to discharge any static electricity from the body. Failure to do so might cause static electricity to discharge and damage components.

Do not use organic solvents such as thinners for cleaning. Doing so might dissolve the surface of the MX50 or cause it to change color.

■ Daily inspection items

The following table shows items that must be inspected daily.

Item		Inspection Details	Judgment Criteria	Remedy
Mounting	Basic board	Check for loose screws.	Basic board must be firmly mounted.	Tighten screws. Re-install.
Connections	Terminal screws	Check for loose screws, and pitch between crimped terminals.	Loose screws not allowed. Pitch must be appropriate. Connectors must not be loose.	Tighten screws. Correct pitch. Tighten connectors.
	Connectors	Check fitting of connectors. Check connector fixing screws.		
Basic Board	POWER LED ALM LED ERROR LED STOP LED RUN LED	Check lighting of LED. Check turning out of LED. Check turning out of LED. Check turning out during operation. Check lighting during operation.	Lit Out Out Out Lit	Remedy according to Chapter 7 Troubleshooting Guide.
I/O	Input Output	Flashes according to operation Flashes according to operation	Lit at input Lit at output	

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■ Periodic inspection items

The following table shows items that must be inspected once or twice a year.

Item		Inspection Details	Judgment Criteria	Remedy
Operating Environment	Temperature	Within operating temperature range?	0 to 55°C	Maintain an optimum operating environment.
	Humidity	Within operating humidity range?	30 to 90% RH	
	Atmosphere	Corrosive gases present?	Corrosive gases not allowed	Clean.
		Dust present?	Dust not allowed	
Power Voltage		Check input voltage.	24 VDC ± 10%	Change power supply line, transformer tap, etc.
Mounted State	Basic board	Check for loose screws.	Make sure that board is firmly mounted.	Tighten, or remount.
Connections	Terminal screws	Check for loose screws, and pitch between crimped terminals.	Loose screws not allowed. Make sure that pitch is appropriate.	Tighten screws. Correct pitch.
	Connectors	Check fitting of connectors. Check connector fixing screws.	Loose connectors not allowed.	Tighten.
Battery		Service life	5 years	Replace after 5 years.

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■ Replacing the battery

⚠ CAUTION

Do not disassemble or dispose of unwanted batteries in fires.

After removing the lithium battery, either return the battery to Yamatake-Honeywell or dispose of it according to local bylaws and regulations.

The following describes the procedure for replacing the battery.

● **Items to prepare**

- Lithium battery MX100BT01
- Nippers

● **Procedure**

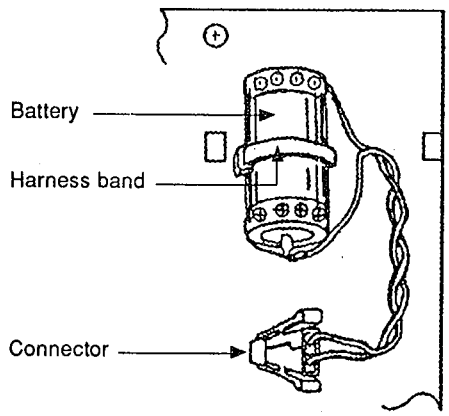
① Turn the MX50's power supply OFF.

② Disconnect the battery connector.

③ Cut the band holding the lithium battery in place with the nippers to remove.

④ Fix the new lithium battery onto the board using the harness band.

⑤ Insert the battery connector.
The battery connector cannot be inserted in the opposite direction. However, make sure that it is inserted in the correct direction. Insert the connector so that the side where its pins are visible is on the board side.



! HANDLING PRECAUTIONS

- When a battery error occurs, the ALM LED blinks and special contact M931 turns ON.
- Leave the power ON for at least 10 minutes before turning the power OFF. Even if the lithium battery is removed, the circuit voltage is held for a fixed period of time by a capacitor. Replace the batteries as soon as possible. (During this procedure, the warranty backup time is 10 minutes.)
- Replace with a new lithium battery every five years.
- Do not short circuit the battery.

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6-2 Inspection Parts List

Part Name	Catalog Listing	Rating	Application
Lithium Battery	MX100BT01	3.6 DCV	Basic board
RS-232C Cable	CBL232AFT02	25-pin/9-pin crossed 2 m	For connection to personal computer loader (connector used when LOAD connector is used)
	CBL232FFT02	9-pin/9-pin crossed 2 m	
	CBL-RS232T02	25-pin/25-pin crossed 2 m	For connection to personal computer loader (connector used when ASCII connector is used)
	CBL-RS232T08	25-pin/25-pin crossed 8 m	
PROM	Commercially available		Basic board
Fuse	MX100FS01	2A	For I/O board (MX250RC44G)

Chapter 7 TROUBLESHOOTING

7-1 Error and Alarm Displays and Remedies

■ Troubleshooting

The MX50 is designed for maximum reliability and safety, and has been manufactured under a strict quality control system. Nevertheless, the MX50 is provided with self-diagnostic functions to minimize system down time in the event that an error or inconsistency occurs.

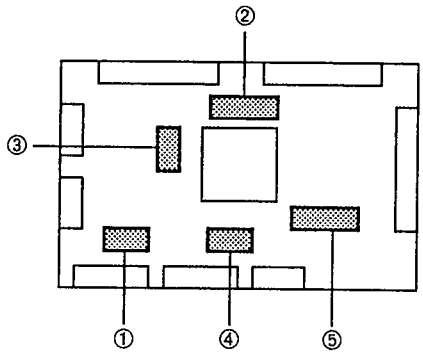
The results of self diagnostic are displayed by LEDs on the MX50. If an error (serious trouble) occurs, the ERROR LED lights, and if an alarm (light trouble) occurs, the ALM LED lights to notify the operator. If a battery error occurs, the ALM LED blinks. If the entire MX50 system is in error, all of the LEDs in the operation mode LED group (POWER, ALM, ERROR, STOP, RUN) light to notify the operator of a system error.

Sequence controller statuses when an error or an alarm occur are as follows:

Error: The MX50 enters the STOP mode.

Alarm: LED only lights, and the MX50 does not enter the STOP mode.

System error: In this state, the MX50 cannot be controlled.



① Operation mode LEDs
② DI/DO LEDs
③ CBL communications LEDs
④ Communications monitor LEDs
⑤ High-speed counter LEDs

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● System errors

When an error occurs on the MX50 basic board, all of the operation mode LEDs (POWER, ALM, ERROR, STOP, RUN) light.

Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
System Errors □ POWER □ ALM □ ERROR □ STOP □ RUN All operation mode LEDs light.	●	●	●	●	None	Stop	●	●	●

● = Impossible

● Errors (serious trouble)

When an error occurs on the MX50, the program forcibly moves to the STOP mode, and the sequence mode LED ERROR lights. Follow the procedure on the following tables to remedy the error. The special relay area can only be monitored and cannot be verified by the user program.

Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
I/O Bus Error	●	●	○	○	Remove cause of error, and turn power OFF then back ON again.		○	●	●
I/O Verification Error	●	●	○	○			○	●	●
I/O Module Error	●	●	○	○			○	●	●
User PROM Error	●	●	○	○			○	●	●

● = Impossible
○ = Possible

Special Relay	Diagnosis	Remedy
—	• System error (TRAP error, ROM error, RAM error, processor error) occurred. TRAP error: Command corruption has occurred. The CPU judges that the command is undefined and program cannot be executed. ROM error: Checksum error has occurred in system ROM. RAM error: Defective bit in system RAM Processor error: Error in ROM and RAM due to main and sub processors	• Turn power OFF then back ON again. If this does not remedy the system error, ask for repair.

Special Relay	Diagnosis	Remedy
M990	• Trouble has occurred on the I/O bus line. The expansion board cannot be accessed normally.	• Check connectors between MX50 and mother board for defective contact caused by faulty connections. • Check boards for scratches or cracks.
M991	• The expansion board assignment status is compared when the power is turned ON, and an unidentifiable expansion board is mounted. (Note) When the expansion board is removed when the power is turned OFF, the expansion board in the next slot is assigned, and the I/O assignment changes.	• Check expansion board for loose connection. Firmly insert expansion board. • Make sure that the set I/O (I/O assignment) and expansion board insertion positions are correct by "I/O information."
M992	• A normally identifiable board is mounted as the expansion board. • An expansion board that does not give a normal response is mounted. • Expansion board internal trouble	• Check connectors between expansion board and mother board for defective contact. • Replace expansion board.
M994	• Following error in user PROM ① Checksum error ② Program size exceeds MX50 internal memory. ③ Identification sign (ID) error ④ Program syntax error	• Firmly insert the user PROM into the MX50 socket. • A syntax error has been found in the program written to user PROM. Check and correct the program. • Replace with a new user PROM containing the correct program.

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Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
CBL communications LSI error	●	●	○	○	Remove cause of error, and turn power OFF then back ON again.	Stop	○	●	●
User WDT error	●	●	○	○			○	●	●
Program damage	●	●	○	○			○	●	●
Program incomplete	●	●	○	○			○	●	●
Compilation error	●	●	○	○			○	●	●
Object code size exceeded	●	●	○	○			○	●	●

● = Impossible
○ = Possible

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Special Relay	Diagnosis	Remedy
M995	• Error found during checking of CBL communications LSI	• Ask for repair.
M998	• A single program scan took longer than the preset scan time value. (Note) The scan time value can be set within the range 100 ms to 2 s by the WDT instruction (FUNC95). (default: 100 ms)	• Correct the program so that the scan time is less than the setting value (default: 100 ms). • If the program cannot be corrected, set the scan time setting value (within range 100 ms to 2 s) using the WDT instruction.
M999	• Checksum result of MX50 internal memory program in error • Program damaged • Data table damaged *1	• Incorporate program writing devices, and make sure that wiring is correct. • Check for worn down battery and defective installation (battery errors also occur in this case). • Write program correctly to MX50. • Execute clearing of data tables from personal computer loader.
M99A	• Syntax error in program	• Correct program errors and write to MX50 again.
M99B	• Error occurred during program compilation. • Program corruption occurred.	• Write program again to MX50 and restart.
M99E	• The size of the object code in the user program exceeded the compiler RAM size.	• Program size too large. Review and shorten the program. (Summarizing basic instructions as an applied instruction is effective.)

*1: Use the data table write (WTBL) instruction only when an event has occurred due to a change in the data table. Frequent execution of write instructions may shorten the scan time or cause data nonconformity between scans.

To clear the data table, either clear the data table from the personal computer loader or load the data table.

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● **Alarms (minor trouble)**

When an alarm occurs on the MX50, the program continues to run and the sequence mode LED ALM lights. Follow the procedure on the following tables to remedy the error. The special relay area can be read or written by the user program.

Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
Battery error	○	○	○	○	• Remove cause of error.	Continue	○	●	●
Operation error 1	○	○	○	○	• Remove cause of error. • Write to special relay (M90E).		○	○	○
Operation error 2	○	○	○	○	• Remove cause of error, and turn power OFF then back ON again. • Write to special relay (M90E). • Change from STOP to RUN mode.		○	○	○
Loader communications error (RS-232C communications error)	○	○	○	○	• Remove cause of error.		○	○	○
Operator I/O communications error (RS-485 communications error optical link station No.1 to 7)	○	○	○	○			○	○	○
Operator I/O communications error (RS-485 communications error optical link station No.8 to 15)	○	○	○	○			○	○	○

● = Impossible
○ = Possible

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Special Relay	Diagnosis	Remedy
M931	• Battery voltage has dropped below rated voltage (2.5 ±0.2 VDC), and needs to be replaced. • Display of this error disappears when error is restored. However, replace the battery as the voltage is only temporarily restored.	• Replace the battery. • Make sure that battery connectors are firmly connected. • If detection of battery error is not required, set bit 13 of R0903 to ON.
M90E	• An operation error has occurred during execution of applied instructions, and the operation error has not been solved. • An operation error has occurred during execution of applied instructions, and the operation error has not been solved.	• How instructions are used is in error. Review the instruction operand. • How instructions are used is in error. Review the instruction operand.
M90F		
M933	• Defective communications has occurred between the MX50 and personal computer loader or host communications device. • The communications path is disconnected, the power of the loader or host device is turned OFF, or communications setup is defective.	• Check the leads along the communications path between the personal computer loader and the MX50. Make sure that the MX50 is properly built-in. • Make sure that the device power supply is ON, and check the signal leads for influence of induction noise.
M934	• A communications defect has occurred between the MX50 and the operator I/O (operator link station codes 1 to 7). • Either a disconnection occurred during communications or the operator I/O power supply turned OFF midway.	• Check the communications path between the operator I/O and the MX50 for disconnection, noise or other abnormalities. Make sure that the MX50 is properly built-in. • Make sure that the operator I/O power supply is not OFF.
M934	• A communications defect has occurred between the MX50 and operator I/O (operator link station codes 8 to 15). • Either a disconnection occurred during communications or the operator I/O power supply turned OFF midway.	• Check the communications path between the operator I/O and MX50 for disconnection, noise or other abnormalities. Make sure that MX50 is properly built-in. • Make sure that the operator I/O power supply is not OFF.

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Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
Operator I/O verification error (Operator link station No.1 to 7)	○	○	○	○	• Eliminate the cause of the error.	Continue	○	○	○
Operator I/O verification error (Operator link station No.8 to 15)	○	○	○	○			○	○	○
ASCII communications alarm (typical bit)	○	○	○	○	• Eliminate the cause of the error, and change from STOP to RUN or from STOP to TSET mode.		○	○	●
ASCII parameter error	○	○	○	○			○	●	●
CBL communications alarm (typical bit)	○	○	○	○			○	○	●
CBL communications mail link error	○	○	○	○			○	○	●

● = Impossible
○ = Possible

Special Relay	Diagnosis	Remedy
M935	• Registered operator I/O (operator link station No.1 to 7) is not connected (cannot be identified at MX50).	• Make sure that the operator I/O power supply is OFF. • Register operator I/O again and correct to correct I/O.
M935	• Registered operator I/O (operator link station No.8 to 15) is not connected (cannot be identified at MX50).	• Make sure that the operator I/O power supply is OFF. • Register operator I/O again and correct to correct I/O.
M93F	• One of the following errors occurred during ASCII communication: ① ASCII communication timeout (M93A) ② ASCII reception buffer full (M93B) ③ ASCII response error (M93C) ④ ASCII reception data error (M93D) ⑤ ASCII reception checksum error (M93E) • Turns ON by one of M93A to M93E turning ON. Becomes OFF when all M971 to M97E are OFF.	• Check ASCII communications status, and correctly set ASCII communications parameters. Probable causes are as follows: M93A: Either connection of communications destination device is incorrect, or communications parameters are in error. M93B: Either received data does not contain end code (erroneous parameter setup) or a large volume of data has been received at one time. M93C: Response code in special mode is other than "00". M93D: Communications parameter (baudrate, parity, stop bit) setups are in error. M93E: Received data checksum results are in error. • If ASCII communications alarms M936 and M93F need not be input to typical alarm M92D, set bit 4 of R0903 to ON.
M936	• Reception was carried out with a value, by which ASCII transmission/reception parameters cannot be executed, set as it is.	• Probable causes are ASCII communications parameters (R0941 to R0949) set outside of the register area, or an illegal sum position. • If ASCII communications alarms M936 and M93F need not be input to typical alarm M92D, set bit 4 of R0903 to ON.
M970	• Typical bit of alarm (M971 to M97E) that occurred in CBL communications • Turns ON by one of M971 to M97E turning ON. Becomes OFF when all M971 to M97E are OFF.	• Check main causes (M971 to M97E) of alarms, and remedy according to alarm type.
M971	• Transmission in mail communications ended in error.	• Check the mail communications parameters (transmission destination addresses).

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Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
CBL communications PC link error	○	○	○	○	• Eliminate the cause of the error.	Continue	○	○	●
CBL communications remote I/O error	○	○	○	○	• Eliminate the cause of the error.		○	○	●
CBL communications address setup error	○	○	○	○	• Eliminate the cause of the error and restart MX50.		○	○	●
CBL communications line trouble	○	○	○	○	• Eliminate the cause of the error.		○	○	●
CBL communications loopback MT (TX) error	○	○	○	○			○	○	●
CBL communications loopback MR (RX) error	○	○	○	○			○	○	●
CBL communications loopback occurrence	○	○	○	○			○	○	●

● = Impossible
○ = Possible

Special Relay	Diagnosis	Remedy
M972	• PC link data transmission was interrupted for 1 second (R0955 = 1) or 500 ms (R0955 = 0) or more.	• Check the error station in the PC error station information (P0020 to P0023) in the network info, and make sure that the station is executing the PC link properly. (Note) When the PC link is received even once, turn the power OFF then back ON again so that the reception station bit in PC link reception station configuration (P0016 to P0019) for MX50 turns ON, and subsequent PC link reception configurations are cleared. If bit 0 of R0903 is set to ON, the PC link reception configuration is cleared every 5 seconds, and alarms are not latched.
M973	• Remote I/O do not function properly due to remote I/O assignment error or non-establishment of remote.	• Check remote I/O assignments by the personal computer loader. • Check the states (number of units, addresses) of connected remote slave stations. • Re-register remote slave station information if it differs with the current configuration (number of units, addresses).
M974	• CBL address setting values in error	• Non-settable address (other than 1 to 63) is set. Reset addresses. (Note) Address 7FH is non-CBL communications mode.
M975	• Communication between both CBL stations not possible. • Both MT (transmission) and MR (reception) CBL connectors are not connected.	• Check cable connections at connector MT and MR sides, and make sure that the power supplies at both stations are ON.
M976	• Loopback occurred at CBL lead MT (transmission) side.	• Check cable connections at connector MT side, and make sure that the power supply at MT station is ON.
M977	• Loopback occurred at CBL lead MR (reception) side.	• Check cable connections at connector MR side, and make sure that power supply at MR station is ON.
M978	• Loopback occurred on CBL network including MX50.	• If M976 and M977 have occurred, check cable connections at connector MT and MR sides, and make sure that the power supply of the MT station is ON. • If M976 and M977 have not occurred, check the network information loopback addresses (MT:P0006, MR:P0007) connections between the MT and MR, and check the power supplies of stations in between.

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Name	Transition Mode				Reset Method	Program Status	Monitor		
	RUN	TEST	STOP	PROG			Loader	Read	Write
CBL sub-link error	○	○	○	○	• Eliminate the cause of the error.	Continue	○	○	●
PC link transmission/ reception error	○	○	○	○			○	○	●
Remote I/O transmission/ reception error	○	○	○	○			○	○	●
Remote slave information error	○	○	○	○			○	○	●
Address overlap error	○	○	○	○			○	○	●

● = Impossible
○ = Possible

Special Relay	Diagnosis	Remedy
M979	• Sub-link error has occurred on CBL network including MX50 in a non-loopback state.	• Check the address bits of the stations where the network information sub-link error occurred. • Go back over the ring towards the connector MR of the self station, and check the sub-link cable before the first station where the data of the station where the sub-link error became ON.
M97A	• There was 100-word data transmission from the transmission side in the dual mode when the receiving side MX50 was in the single mode. (The lower 50 words are discarded.) • There was a reception of PC link data from station No. 32 onwards in the dual mode.	• Either set the reception side to the dual mode, or set the transmission side to the single mode. • Either set the reception side to the single mode, or set the transmission side to the dual mode.
M97B	• Transmission/reception of 26 words of data or more was executed regardless of the single mode setting. • There was a reception of link data from the station of address No. 32 onwards in the dual mode.	• Set to the dual mode (max. 50 words) when transmitting data of 26 words or more. • Set to the single mode.
M97D	• Remote slave station information is in error.	• Register remote slave station information again by the personal computer loader.
M97E	• A station to which the same address as the self station MX50 is set exists on the network.	• Reset the addresses so as not to overlap.

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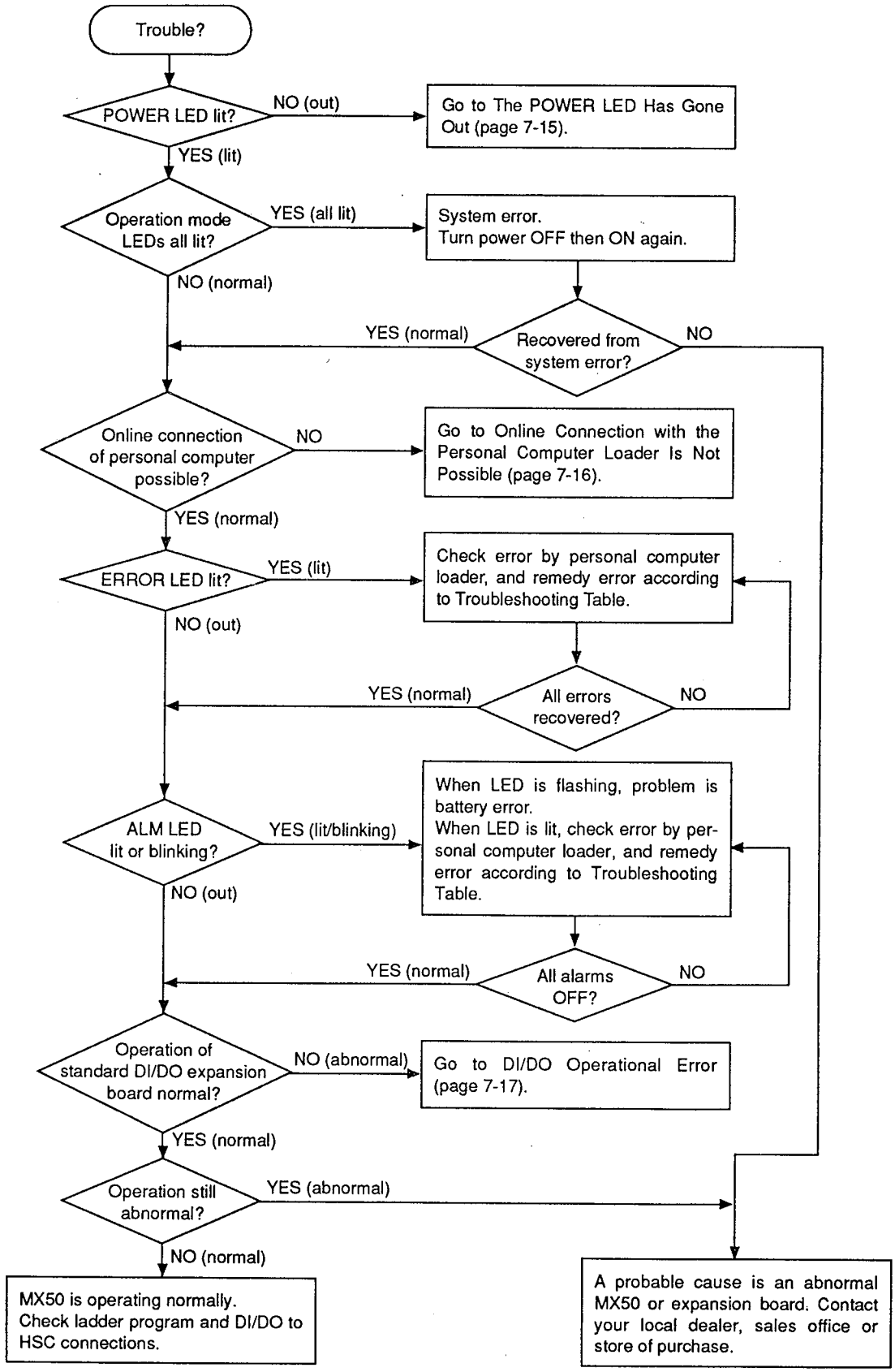
7-2 Flowcharts

■ Troubleshooting flowcharts

If you feel that trouble or an error has occurred, check the flowcharts on the following pages and remedy the problem as required.



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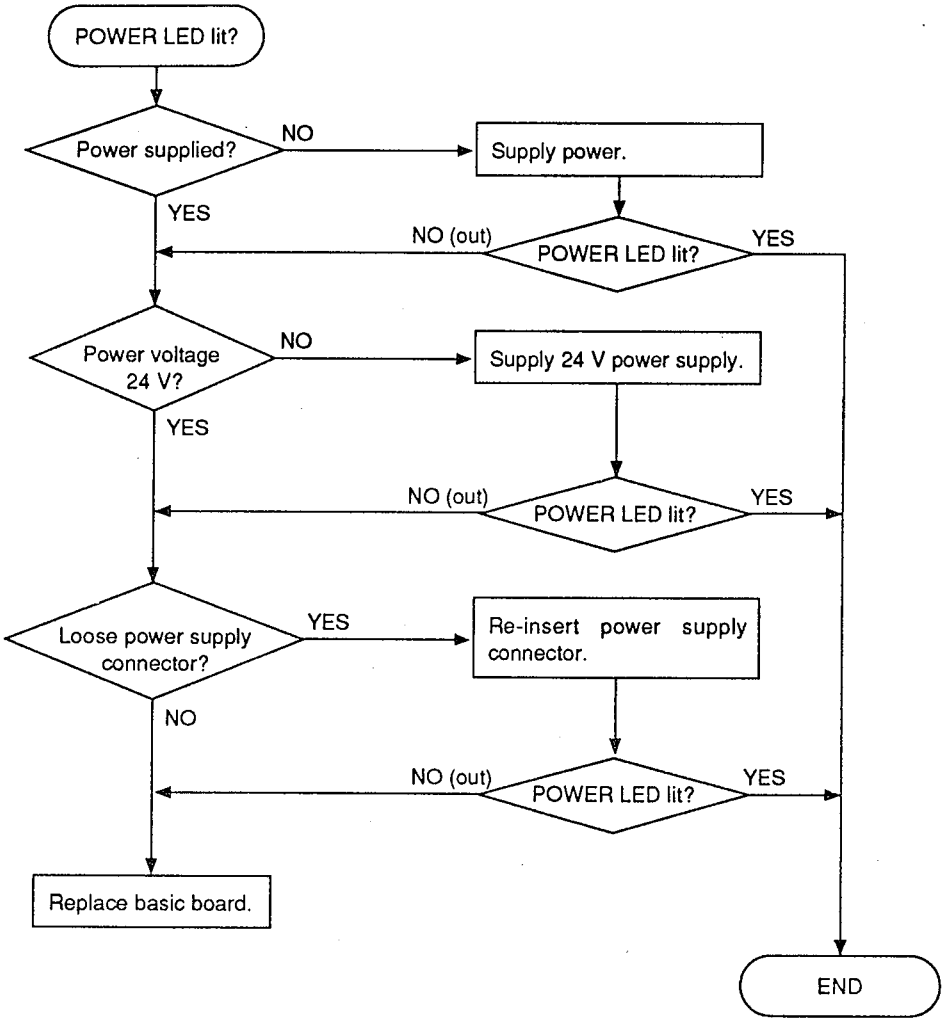
● **The POWER LED has gone out.**



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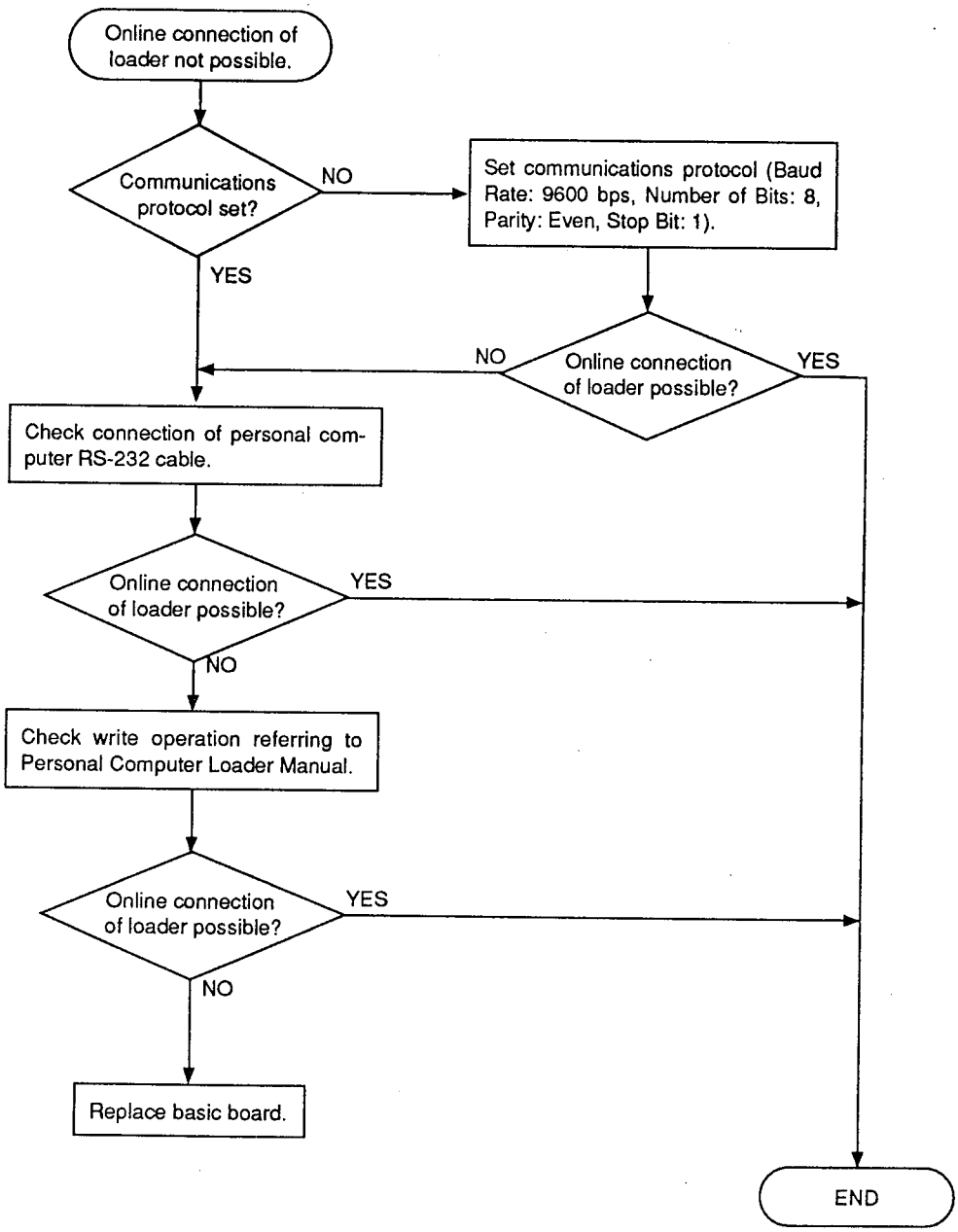
● **Online connection with the personal computer loader is not possible.**



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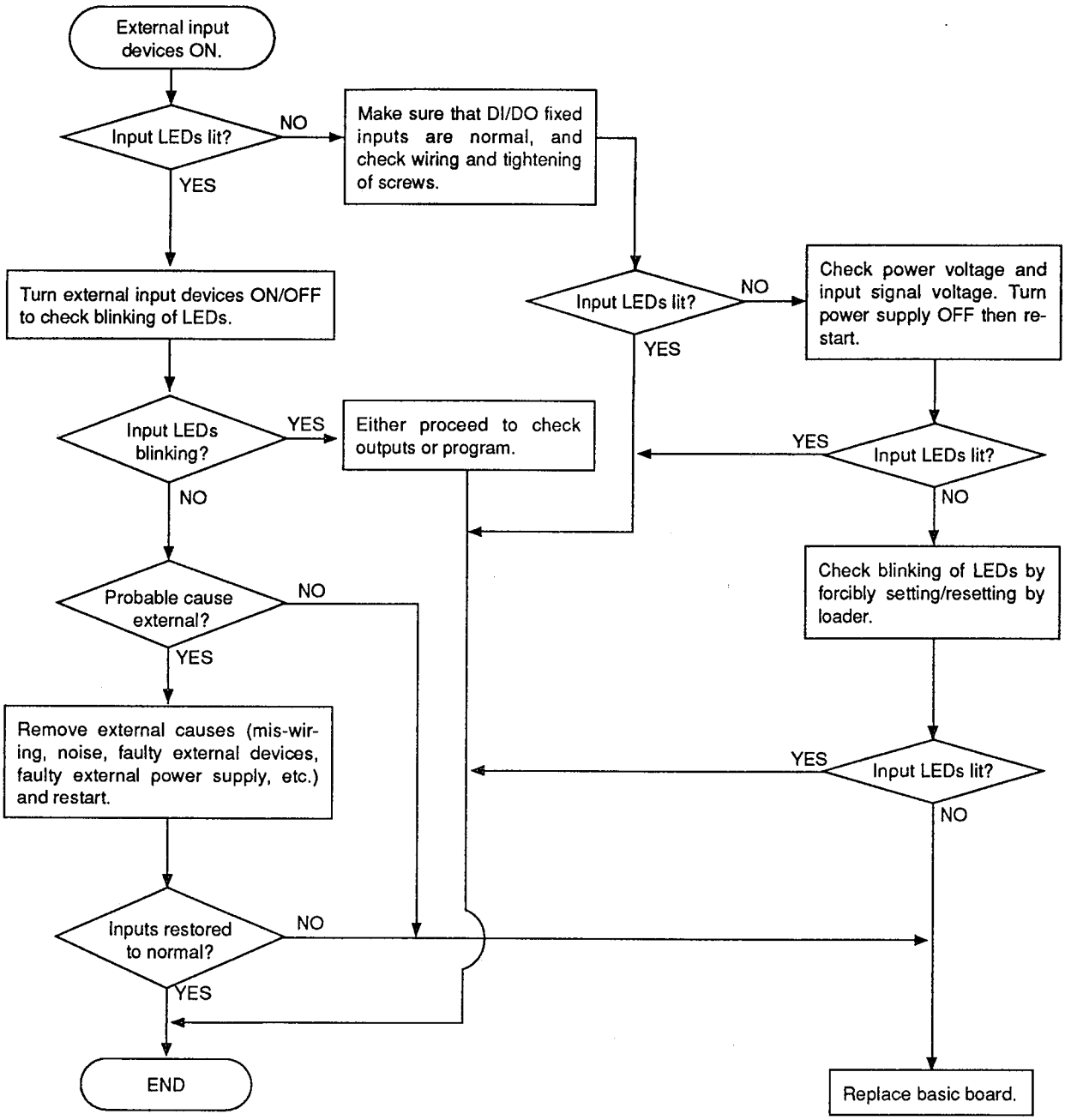
● **DI/DO operational error**



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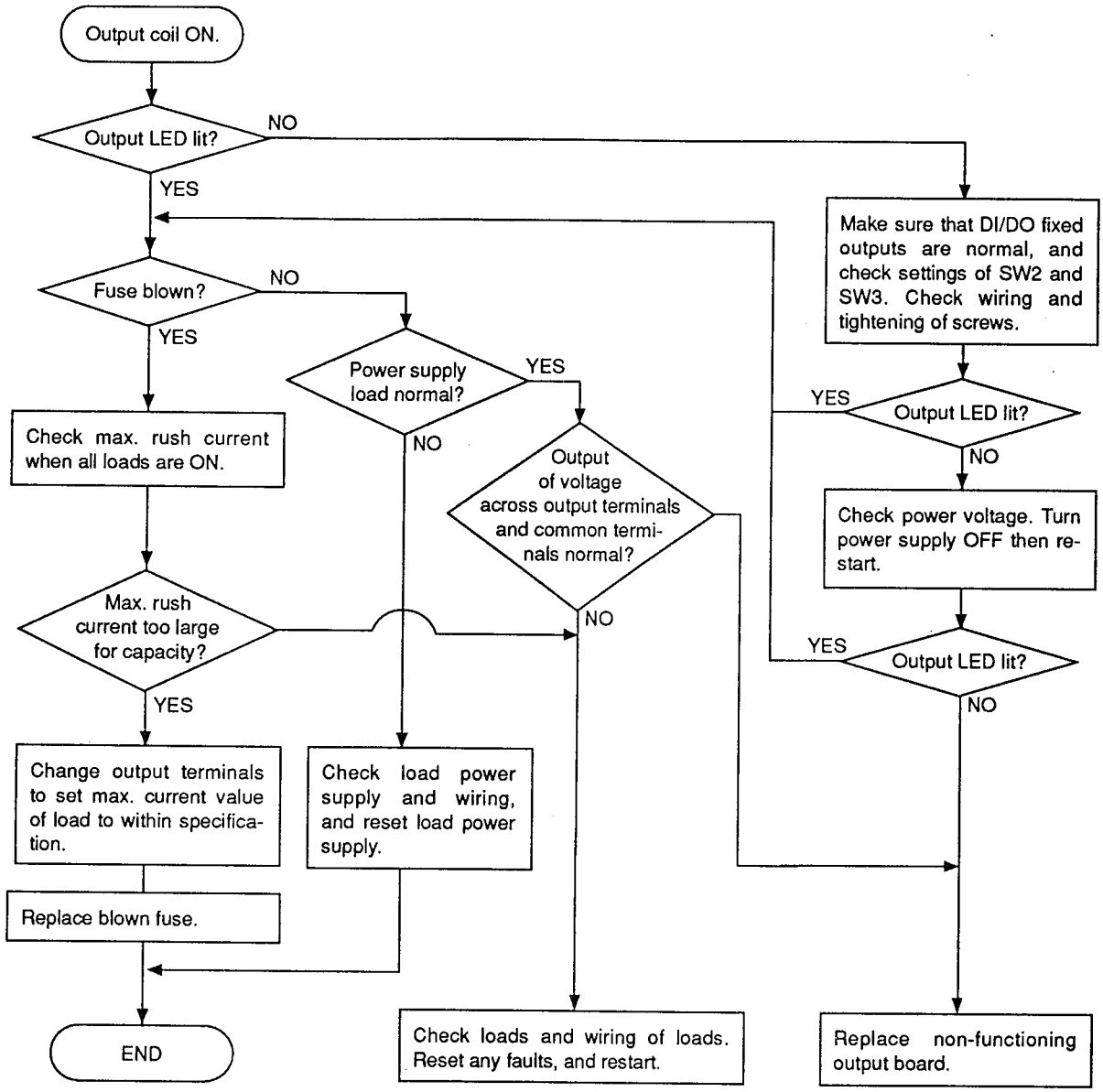
Output coil ON.
Output LED lit?
NO
YES
Fuse blown?
NO
YES
Power supply load normal?
YES
NO
Check max. rush current when all loads are ON.
Output of voltage across output terminals and common terminals normal?
NO
Max. rush current too large for capacity?
YES
Change output terminals to set max. current value of load to within specification.
Check load power supply and wiring, and reset load power supply.
Replace blown fuse.
END
Check loads and wiring of loads. Reset any faults, and restart.
Make sure that DI/DO fixed outputs are normal, and check settings of SW2 and SW3. Check wiring and tightening of screws.
YES
Output LED lit?
NO
Check power voltage. Turn power supply OFF then restart.
YES
Output LED lit?
NO
Replace non-functioning output board.

Chapter 8 SPECIFICATIONS

8-1 Basic Specifications

■ General specifications

Item	Specifications
Rated Power Voltage	24 VDC ±10%
Current Consumption	250 mA max. (basic board only)
Operating Temperature	0 to 55°C
Storage Temperature	-20 to 70°C
Operating Humidity	30 to 90% RH (condensation not allowed)
Storage Humidity	5 to 95% RH (condensation not allowed)
Dielectric Strength	Across DC power supply connector and (Frame Ground) FG terminal: 500 VAC, 50/60 Hz for one minute
Insulation Resistance	Across DC power supply connector and (Frame Ground) FG terminal: Min. 5 MΩ (at 500 VDC)
Vibration Resistance	Conforming to JIS C 0911 10 to 55 Hz, 9.8 m/s²
Impact Resistance	Conforming to JIS C 0912 98m/s², 3times in X,Y and Z directions
Noise Resistance	Noise simulator: Noise voltage 1000 vpp, pulse width 1 μs
External Dimensions	238 (H) x 171 (W) x 60 (D) mm
Mass	Approx. 600 g (basic board only)

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■ Performance specifications

Item	Specifications
Control Method	Stored program
I/O Control Method	Cyclic scan
Programming Method	Ladder diagram/mnemonic
Instruction Types	Basic instructions: 11 (2 to 4 bytes/instruction) Applied instructions: 148 (2 to 13 bytes/instruction)
Processing Time	Basic instructions: 1.4 µs or more, Comparison instructions: 1.4 µs or more, Move instructions: 1.8 µs or more
Program Size	Ladder program: 31 kBytes max.
I/O Number *1	Inputs: 320 (X000 to X19F), Outputs: 320 (Y000 to Y19F)
I/O Number for Operator Link	Inputs: 160 (X200 to X29F), Outputs: 160 (Y200 to Y29F)
Number of Auxiliary Relays	1440 (M000 to M89F)
Number of Hold Relays	800 (L000 to L49F)
Number of Special Relays	160 (M900 to M99F)
I/O Registers *1	Input: 20 words (R0500 to R0519) Output: 20 words (R0600 to R0619)
Special Registers	100 words (R0900 to R0999), 16 bits/word
Timers/Counters	256 Timer setting time: 0.01 to 99.99 seconds 0.1 to 999.9 seconds 1 to 9999 seconds Counter setting range: 1 to 99,999,999
Data Registers	4500 words (R0000 to R0499, R1000 to R4999)
Data Tables	#0 to #9998
Link Registers	4000 words (P0000 to P3999) P0000 to P0049 are for network information P3800 to P3999 are for mail communication setting area
Battery Backup	Battery life: 5 years (at 25°C) Data backup when battery is removed: 10 minutes (at 25°C)
Self Diagnostic Functions	• System program ROM sum check • User program sum check • Internal RAM R/W check • I/O bus • Battery error • Disconnected expansion board detection • Watchdog timer

*1: On the following MX50s that support high-speed counters, X160 to X19F, Y160 to Y19F, R0500 to R057 and R0600 to R0607 are assigned for high-speed counter use.

- MX050FT14141HX
- MX050FT14141HT
- MX050FT14141HP

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● Communications specifications

Item	Function	
Host communication	Communications path	RS-232C
	Communications procedures	Yamatake host communications
	Baudrate	2400, 4800, 9600, 19200 bps
	Transfer distance	15 m max.
	Connection mode	1:1
ASCII or host communications * * Same as above	Communications path	RS-232C or RS-485
	Baudrate	600, 1200, 2400, 4800, 9600, 19200 bps
	Transfer distance	RS-232C: 15 m max., RS-485: 300 m max.
	Connection mode	RS-232C: 1:1, RS-485: 1:n (n: 15 units max.)
Operator link or ASCII communications * * Same as above	Communications path	RS-485
	Communications procedures	Operator link exclusive procedures (polling selection system)
	Baudrate	2400, 4800, 9600, 19200 bps
	Transfer distance	300 m max.
	Connection mode	1:n (n: 5 units max.) (Number of units varies according to connected devices.)
	Operator link connected device	ST100, ST221, operator I/O, MX100, MX200
CBL communications MX050FT14141HT MX050FT14141NT or MX050FT14141HP MX050FT14141NP type	Communications type and description	PC Link The reception groups are set on CBL (overlapped setting possible). Link areas are divided in 100-word (or 50-word) units, and which reception group the self 100 words (or 50 words) are sent is set for each station. Mail Communications • 1-destination communications (with response) Command (read or write) is issued to the specified station when conditions are satisfied, and the response is received. 119 words max., 1:1 communications • 1-destination communications (without response), polling communications Data is written to the specified station when conditions are satisfied. 118 words max., 1:n communications (polling to two or more stations possible) Remote I/O The DI/DO or word data of the remote slave station on CBL is exchanged without using the program. (The MX50 cannot become the remote slave station.)
	Communications control method	Token passing
	Communications mode	Double ring
	Baudrate	1 Mbps
	Max. distance between nodes	Electrical : 100 m, Optical : 500 m
	Total extended distance	Electrical : 3.2 km, Optical : 10 km
	Number of connected units	32 (including self station)
	Cable	Electrical : Shielded twisted pair cable, Optical : Optical cable
	Connected devices	MX200, MA500AH (CBL1), distributed remote I/O, ASCII adapter, MX30, VCB300, etc.

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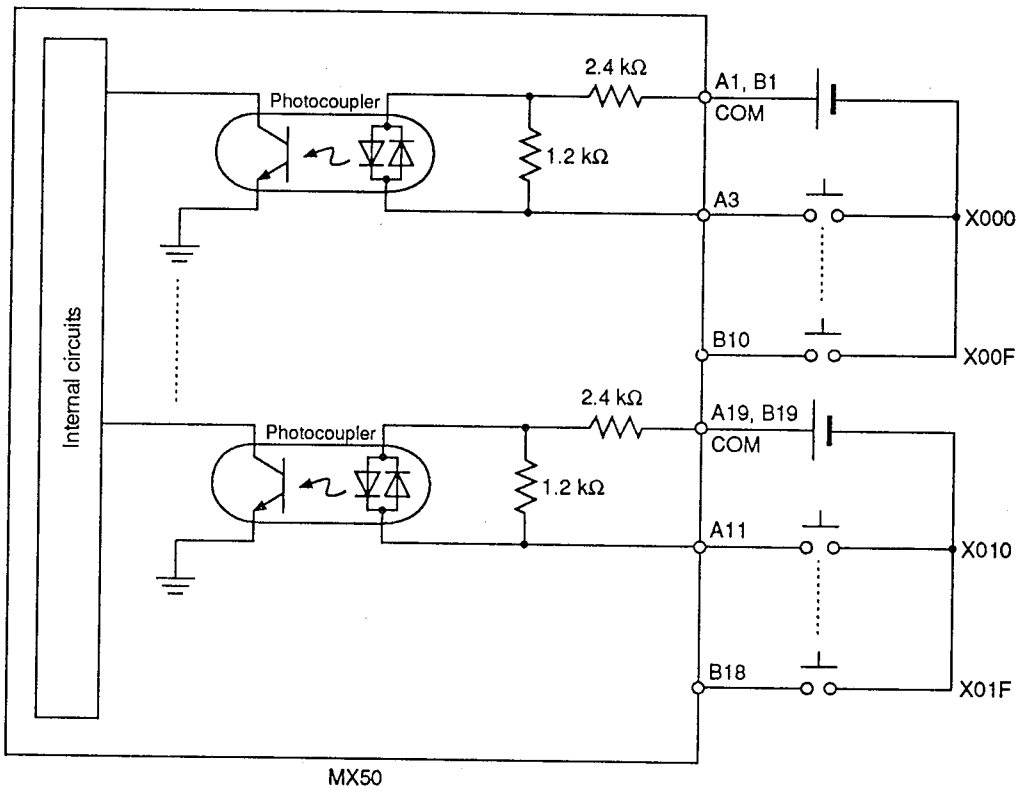
8-2 Basic Board I/O Specifications

■ Digital I/O

● DI

Item	Specifications
Number of Inputs	32 two-way (16 inputs/common, 2 circuits)
Input Voltage Range	10 to 26.4 VDC
Input Current	5 mA (12 VDC)/10 mA (24 VDC)
Input Impedance	Approx. 2.4 kΩ
ON Voltage	10 VDC min.
OFF Voltage	3.5 VDC max.
OFF Current	1.5 mA max.
Response Speed OFF → ON	1 ms max.
Response Speed ON → OFF	1.5 ms max.



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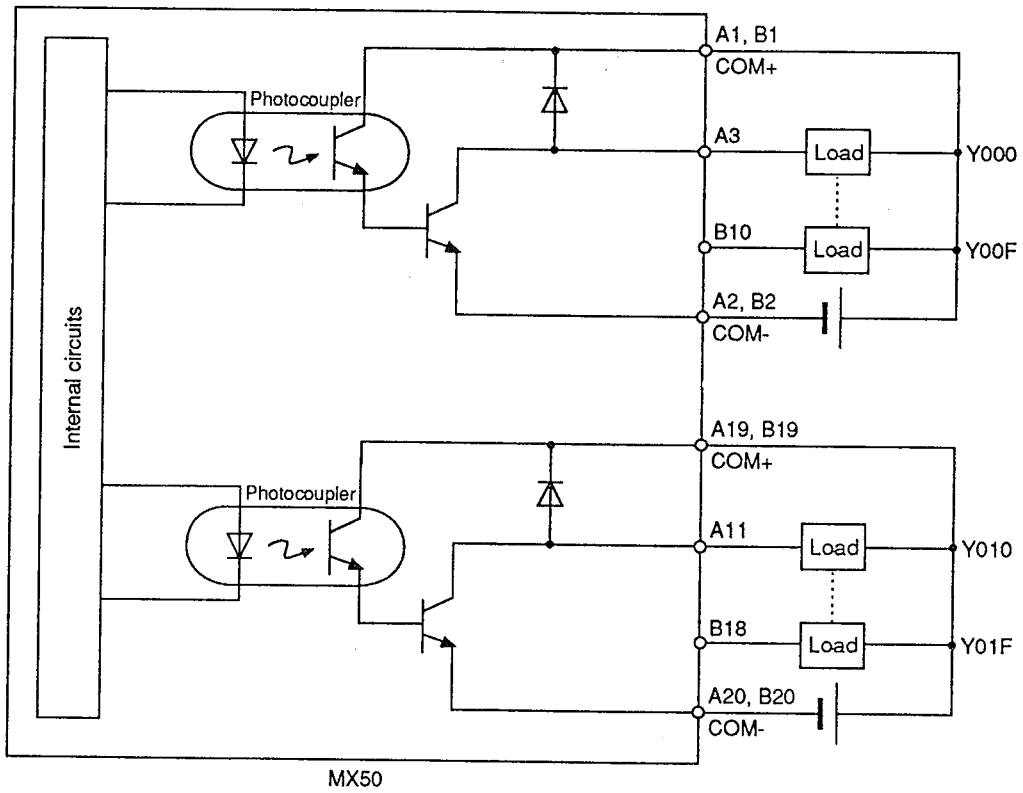
● DO

Item	Specifications
Number of Outputs	32 two-way (16 outputs/common, 2 circuits)
Load Voltage Range	10 to 26.4 VDC
Max. Output Current	0.2 A/output, 1.6 A/common
Surge Current	1 A max. (10 ms max.)
Leakage Current	0.3 mA max.
Max. Voltage Drop at Power ON	1.6 V (at 0.2 A)
Response Speed OFF → ON	1.5 ms max.
Response Speed ON → OFF	1 ms max.
Surge Killer	Clamp diode



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■ High-speed counter

● Performance specifications

Item	Specifications
Counter	24-bit binary (with plus/minus sign) increment/ decrement counter
Number of Channels	2
Count Input Frequency	20 kHz max.
Number of Counts	-8388608 to 8388607
Input Pulsed Signal Level	5/12/24 VDC selectable
Input Modes	Phase difference, 2-pulse, directional
xxx Function	x1/x2/x4 selectable in phase difference input mode
Count Operation Control	Constant count, gate count
Count Modes	Linear count, ring count
Reset/Preset	Enabled by external input or ladder setting
Reset Input (PRST)	Each channel independent
Enable Input (PENB)	Each channel independent
Matched Output (PCMP)	Each channel independent (output when count value matches compare value)
Parameter Setting	Set by ladder program

● Input specifications

Item	Pulsed Inputs PA, PB, PZ			Input Signals PRST, PENB
	5 VDC	12 VDC	24 VDC	
Input Voltage Range	4.5 to 5.5 VDC	10.8 to 13.2 VDC	21.6 to 26.4 VDC	10 to 26.4 VDC
Input Current	4.2 mA (typ.)	8 mA (typ.)	11 mA (typ.)	5 to 10 mA (typ.)
ON Voltage	3.5 V min.	6 V min.	10 V min.	10 V min.
OFF Voltage	1.5 V max.	2 V max.	3.5 V max.	3.5 V max.
Response Time OFF → ON	1.5 ms max.	1.5 ms max.	1.5 ms max.	1.5 ms max.
Response Time ON → OFF	1.5 ms max.	1.5 ms max.	1.5 ms max.	1.5 ms max.

● Output specifications

Item	Output Signal PCMP
Load Voltage Range	10 to 26.4 VDC
Max. Output Current	0.2 A
Leakage Current	0.3 mA
Max. Voltage at ON	1.6 V (0.2 A)
Response Time OFF → ON	1.5 ms max.
Response Time ON → OFF	1.5 ms max.

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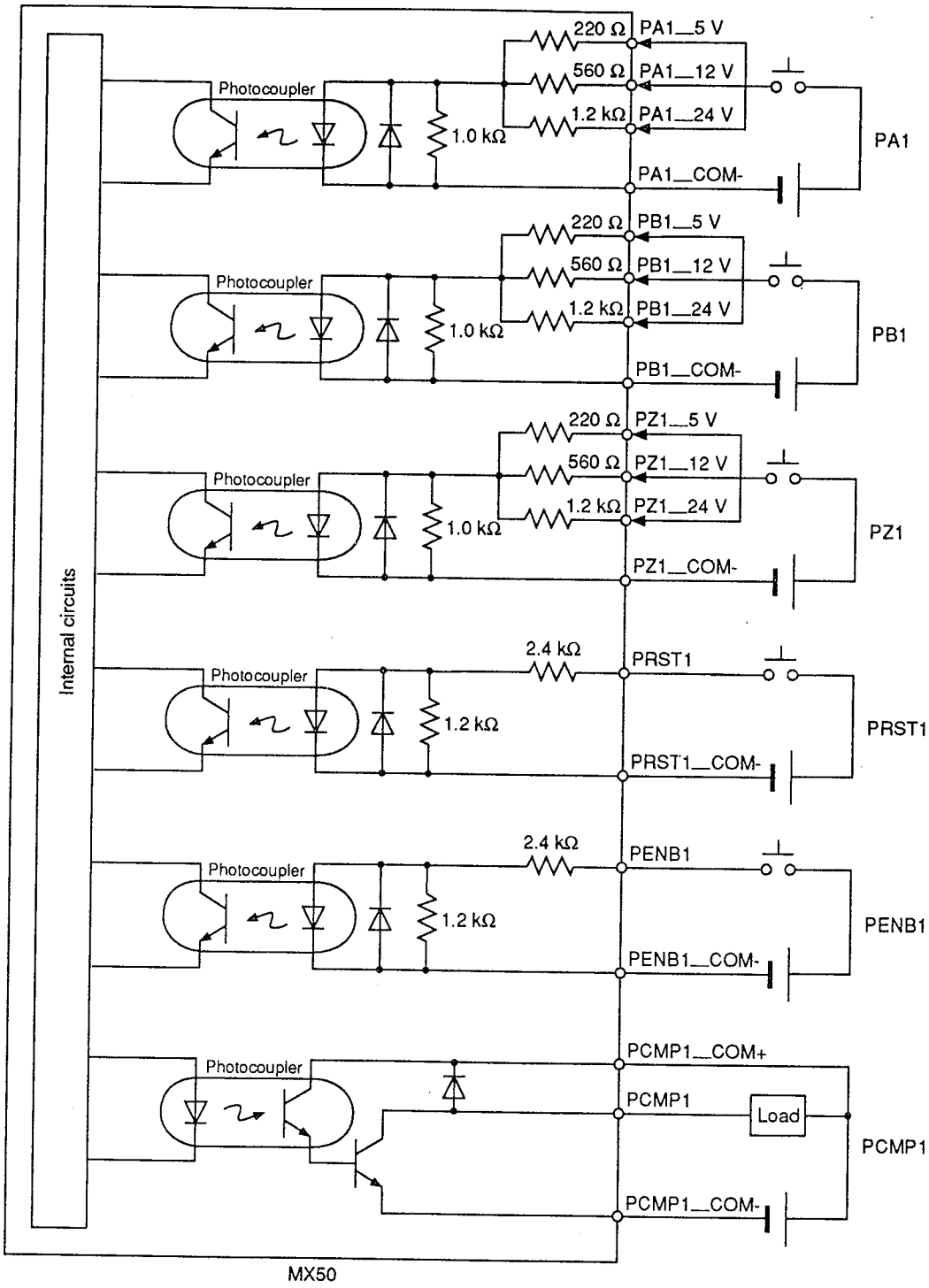
Internal circuits
Photocoupler
220 Ω
560 Ω
1.2 kΩ
1.0 kΩ
PA1_5 V
PA1_12 V
PA1_24 V
PA1_COM-
PA1
PB1_5 V
PB1_12 V
PB1_24 V
PB1_COM-
PB1
PZ1_5 V
PZ1_12 V
PZ1_24 V
PZ1_COM-
PZ1
2.4 kΩ
PRST1
PRST1_COM-
PRST1
PENB1
PENB1_COM-
PENB1
PCMP1_COM+
PCMP1
Load
PCMP1_COM-
PCMP1
MX50

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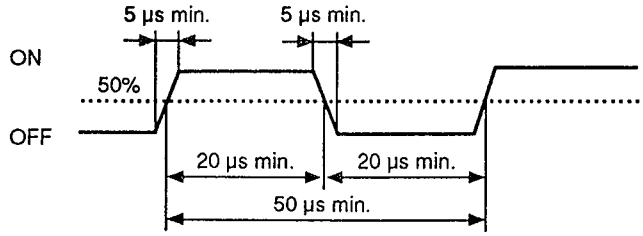
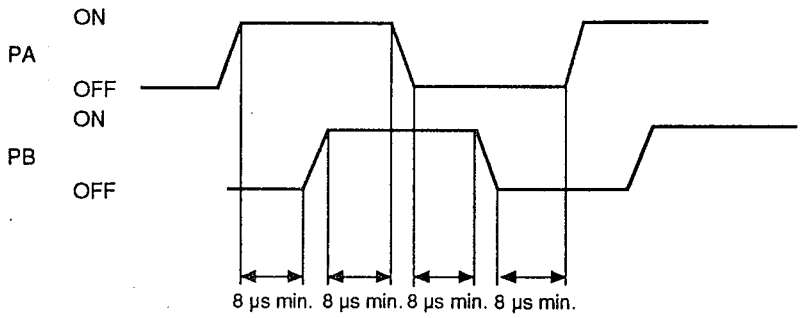
● I/O pulsed timing specifications

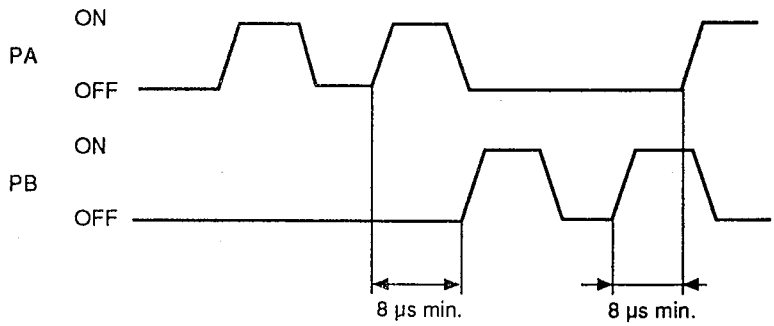
- PA, PB, PZ input



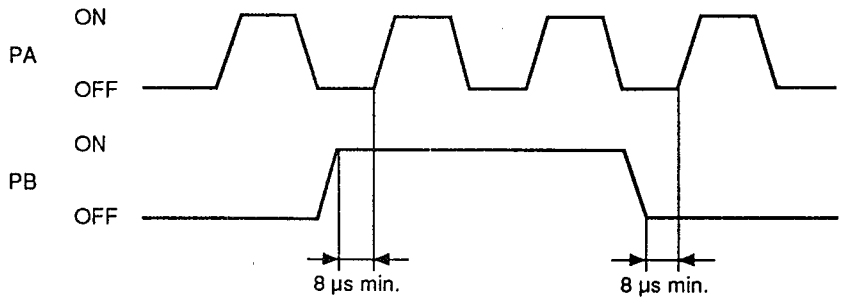
(relationship between A and B phases at phase difference input)



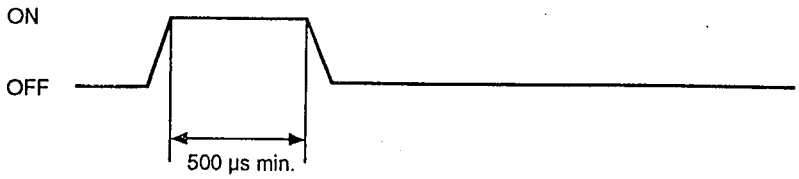
(relationship between PA and PB phases in 2-pulse input mode)



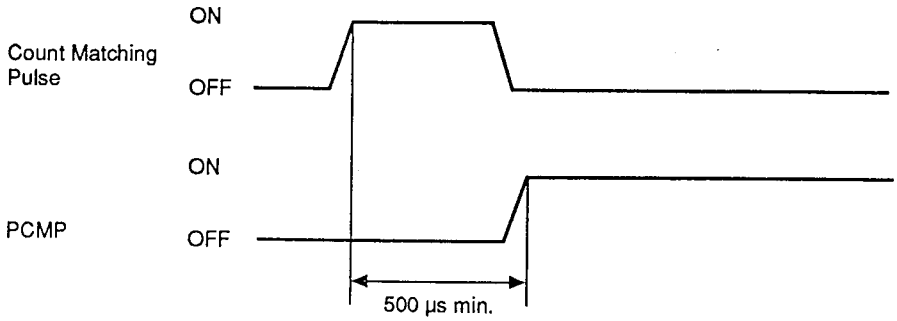
(relationship between PA and PB phases in directional input mode)



- PRST, PB, PENB input



- PCMP output



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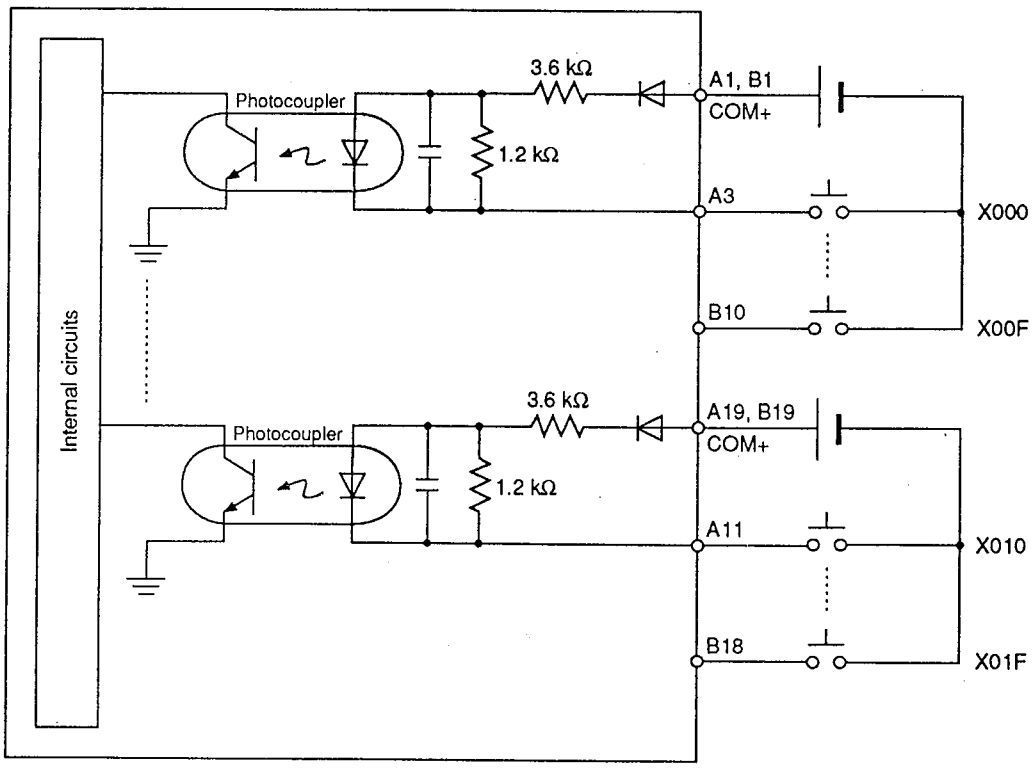
8-3 Expansion Board I/O Specifications

■ I/O board: MX250RC44G

● DI

Item	Specifications
Number of Input Contacts	32
Input Voltage Range	24 VDC ±10%
Input Current	6.7 mA (typ.)
Input Impedance	Approx. 3.6 kΩ
ON Voltage	20 VDC min.
OFF Voltage	3.5 VDC max.
OFF Current	1.5 mA max.
Response Time OFF → ON	0.5 ms max.
Response Time ON → OFF	0.5 ms max.
Common Method	Plus common, 16 inputs/common, 2 circuits



MX250RC44G

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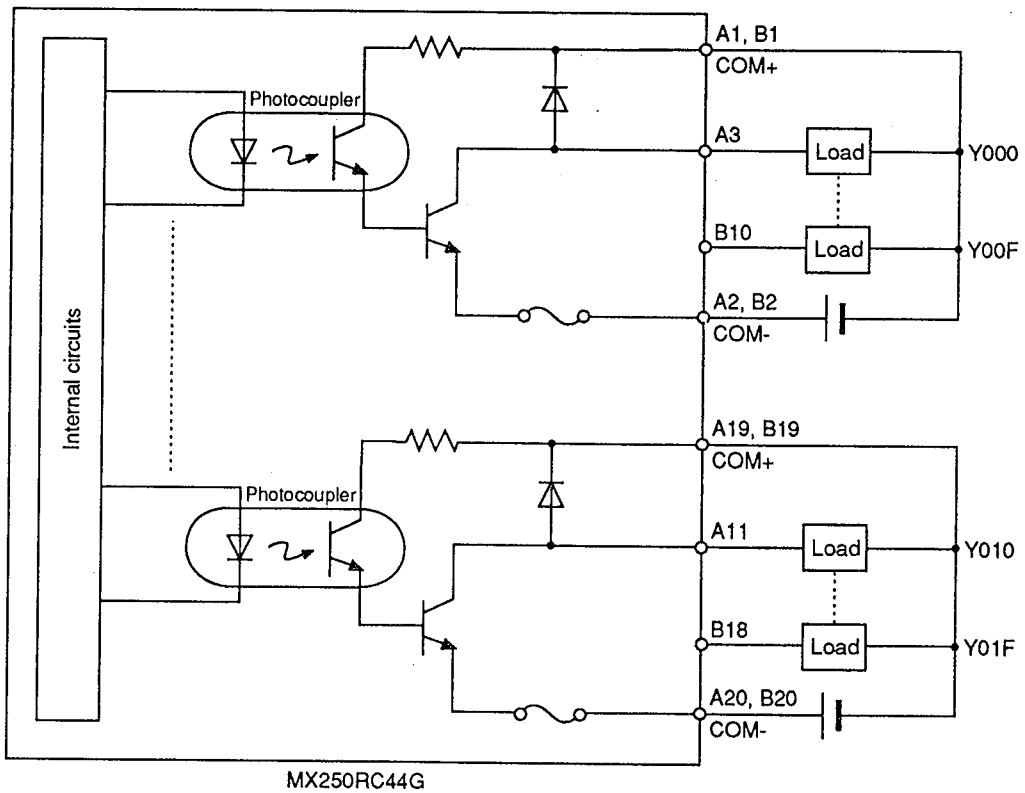
● DO

Item	Specification
Number of Output Contacts	32
Load Voltage Range	24 VDC ± 10%
Max. Output Current	0.15 A/output and 0.6 A/circuit
Surge Current	Max. 1 A (10 ms max.)
Leakage Current	0.3 mA max.
Max. Voltage Drop at ON	1.6 V (0.2 A)
Response Time OFF → ON	1.5 ms max.
Response Time ON → OFF	1.5 ms max.
Surge Killer	Clamp diode
Fuse Rating	2A, one per common
Common Method	16 outputs/common, 2 circuits



MX250RC44G

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■ Output board: MX250RP21G

⚠ CAUTION

When the relay has reached the end of its life, replace the output board. If the output board is used as it is, this may result in fire or malfunction.

Item	Specifications
Max. Number of Outputs	16
Max. Switching Voltage	250 VAC/30 VDC
Max. Switching Current	1 A/output, 4 A/common (resistive load: 250 VAC)
Min. Switching Capacity	100 mA, 5 V
Relay Life (mechanical)	20 million uses min.
Relay Life (electrical) *1	0.3 million uses min. (resistive load: 250 VAC, 1 A)
Max. Switching Frequency	3600 operations/hour
Response Time OFF → ON	15 ms max.
Response Time ON → OFF	15 ms max.
Surge Killer	Not provided
Fuse	Not provided
Common Method	8 outputs/common, 2 circuits
External Power Supply	24 VDC ±10%, 9 mA (typ.)/output

*1: Sometimes shorter depending on conditions of use

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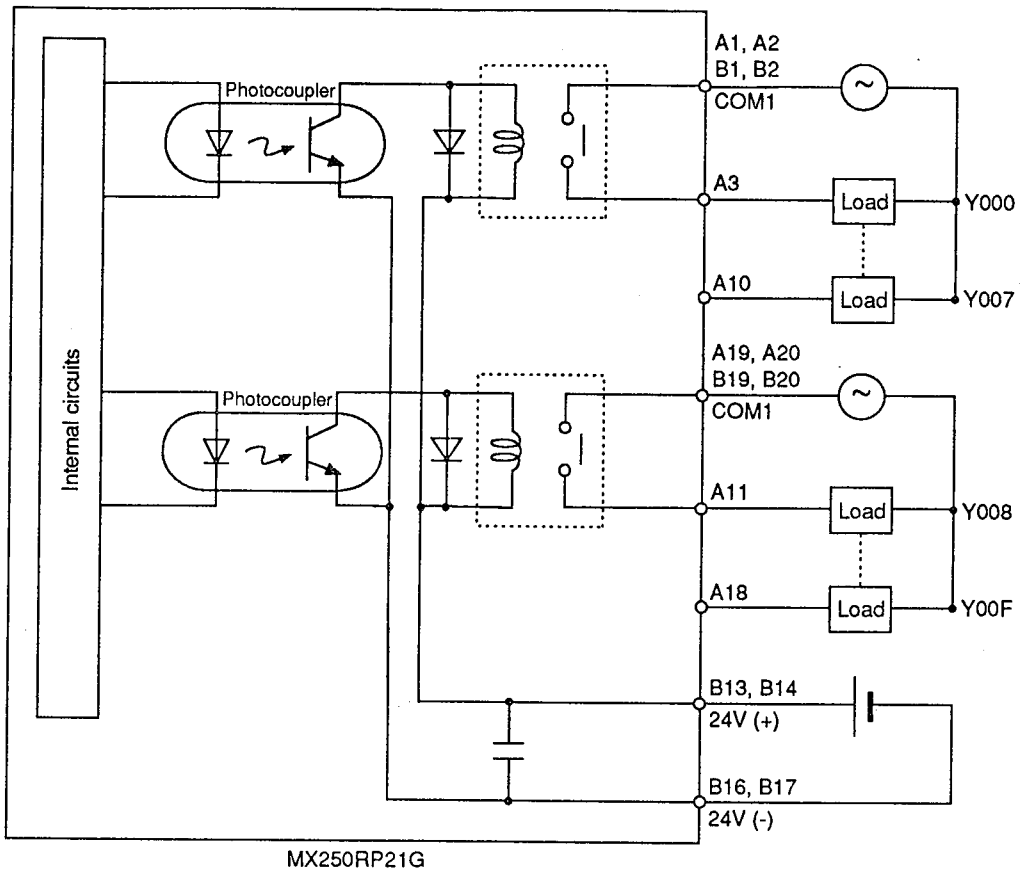
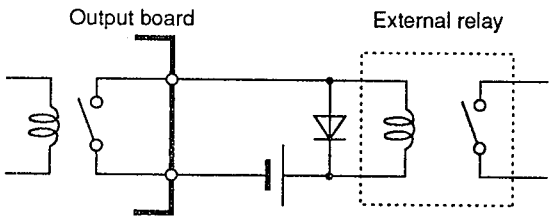


MX250RP21G

! HANDLING PRECAUTIONS

The output connector is not provided with a surge killer, so install one on the outside of the output connector. When driving an external relay by a DC power supply, insert a diode into the wiring path as shown in the figure below.



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8-4 Instruction Language List

The following table briefly outlines the instructions that can be used on the MX50.

The MX50 supports 159 instructions, allowing you to make a wide range of programs. For details on these instructions and programming, refer to the following manuals:

MX Series, Basic Programming CP-UM-1562

MX Series, Programming Instruction Word CP-UM-1563

Category	Number	Description
Basic Instructions	11	LD, AND, OR, OUT, etc.
Compare Instructions	18	=, ≠, <, >, etc., comparison of 16-bit data
Double-length Compare Instructions	18	=, ≠, <, >, etc., comparison of 32-bit data
Move Instructions	9	MOV, BMOV, DCPY, etc.
BCD Operation Instructions	10	Addition, subtraction, multiplication, subtraction of BCD data
Semi-basic Instructions	9	PLS↑, PLF↓, SET, etc.
Branch Instructions	12	MC, MCR, JMP, CALL, END, etc.
Convert Instructions	10	Binary↔BCD, 4↔16 conversions, etc.
Shift Instructions	7	Shift, rotate, etc.
BIN Operation Instructions	10	Addition, subtraction, multiplication, subtraction of binary data
Logic Operation Instructions	4	AND, OR, etc. of 16-bit data
Special Instructions	10	Read/write of timer/counter SP/PV
Bit Processing Instructions	7	Bit processing of register area, PC link area
Expand and Move Instructions	1	Data table write (WTBL) instruction *
ASCII Communication Instructions	3	ASCII continuous word read/write
Text String Processing Instructions	16	Linking of text strings, length check, ASCII text string-to-decimal conversion, text string extraction, Hex↔Hex/ASCII text string conversion, etc.
Expanded Auxiliary Instruction	2	Reading of internal flags, reading of operation information error
Expanded	1	Bit SUM instruction
Library Instruction	1	Execution of library

* Use the data table write (WTBL) instruction only when an event has occurred due to a change in the data table. Frequent execution of write instructions may shorten the scan time or cause data nonconformity between scans.

To clear the data table, clear the data table from the personal computer loader.

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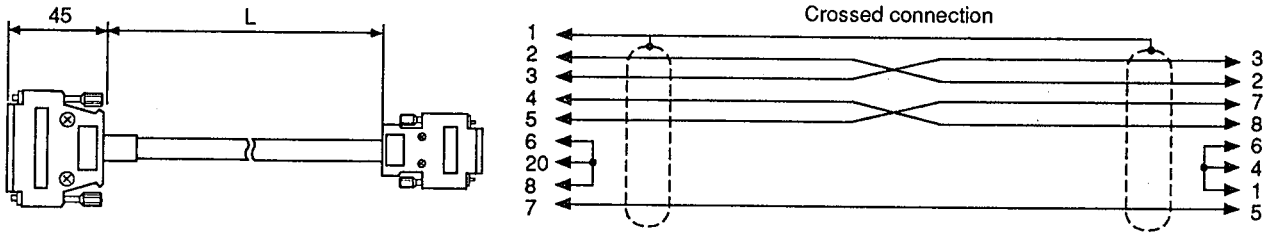
8-5 Other

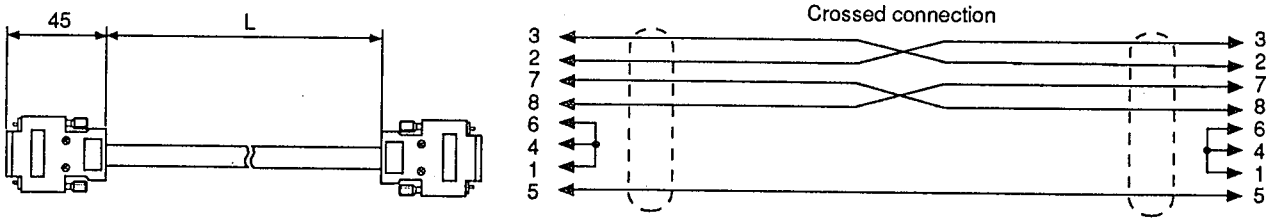
■ RS-232C cable

The RS-232C cable is used for connecting the basic board to the personal computer loader. The following four RS-232C cables are available.

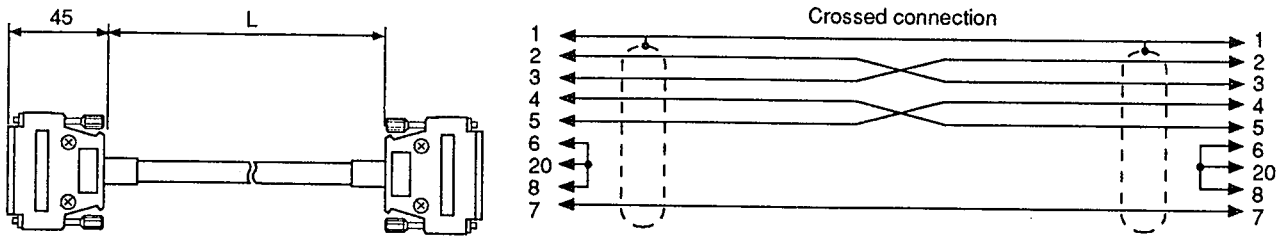
Item	Catalog Listing and Specifications			
	CBL232AFT02	CBL232FFT02	CBL-RS232T02	CBL-RS232T08
Connection Type	Crossed	Crossed	Crossed	Crossed
Cable Length (L)	2 m	2 m	2 m	2 m
Connector	25-pin↔9-pin	9-pin↔9-pin	25-pin↔25-pin	25-pin↔25-pin
Cable Type	7 mm dia. round-hole cable	7 mm dia. round-hole cable	8 mm dia. round-hole cable	8 mm dia. round-hole cable
Mass	Approx. 0.2 kg	Approx. 0.2 kg	Approx. 0.25 kg	Approx. 0.8 kg
External Dimensions/ Connection Diagram	A	B	C	C



RS-232C Cable External View - Connection Diagram A



RS-232C Cable External View - Connection Diagram B



RS-232C Cable External View - Connection Diagram C

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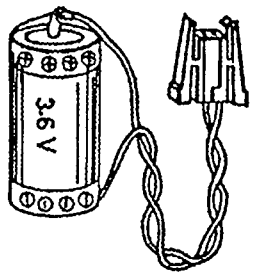
■ Lithium battery

The lithium battery is used for backing up RAM memory.

Item	Specifications
Catalog Listing	MX100BT01
Nominal Voltage	3.6 VDC
Battery Life	5 years (at 25°C)
External Dimensions	20 dia. x 36 mm



■ PROM

The PROM is used when the program is incorporated in ROM. Use the following commercially available PROMs having an access time of 150 ns max.

Use a commercially available PROM writer for writing to PROM.

Item	Specifications	
	512 kByte	1 MByte
Memory Type	CMOS EPROM	CMOS EPROM
Memory Size	64 kWord x 8 bits	128 kWord x 8 bits
Access Time	150 ns max.	150 ns max.
Shape	28-pin DIP	32-pin DIP
Recommended Catalog Listings	MBM27C512-15 (Fujitsu) M5M27C512AK-15 (Mitsubishi Electric)	µPD27C1001AD-15 (NEC) HN27C101AG-15 (Hitachi)

■ Fuse

The fuse is used on the I/O board (MX250RC44G).

Item	Specifications
Catalog Listing	MX100FS01
Rated Current	2 A
Shape	Glass tube
External Dimensions	5.2 dia. x 20 mm
Recommended Parts	SOC, MT4-2-N1

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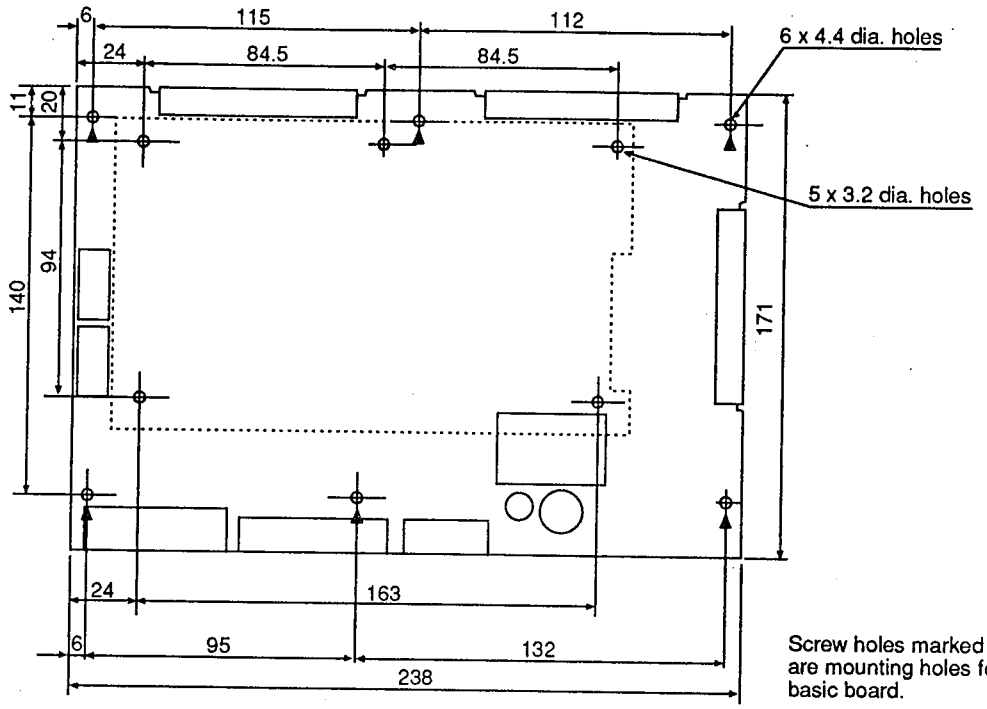
8-6 External Dimensions

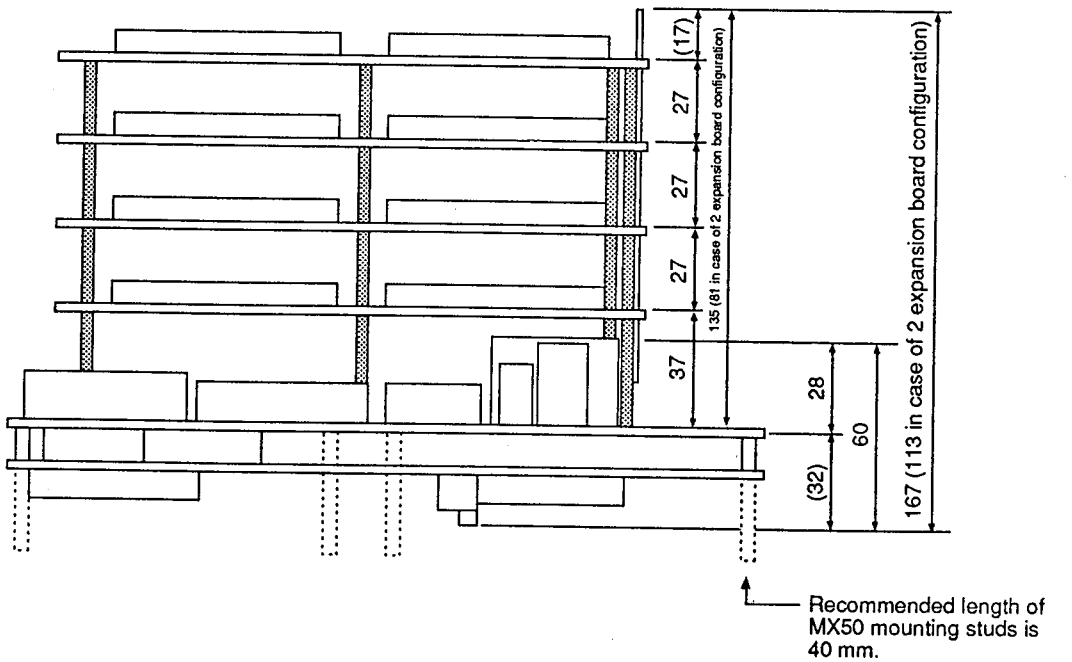
■ Basic board diagram

Unit: mm



■ Expansion board mounting diagram

Unit: mm



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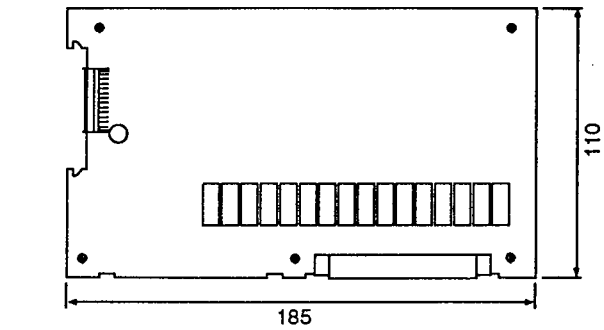
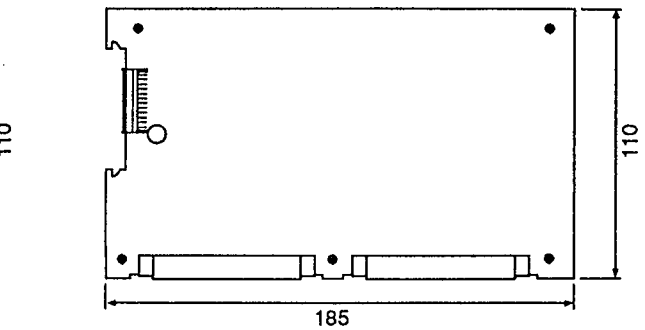
■ Expansion board diagram

Unit: mm



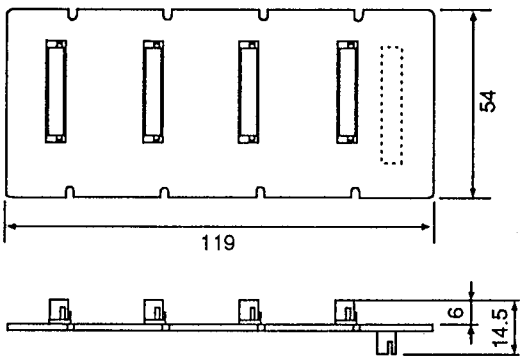
Output board MX250RP21G



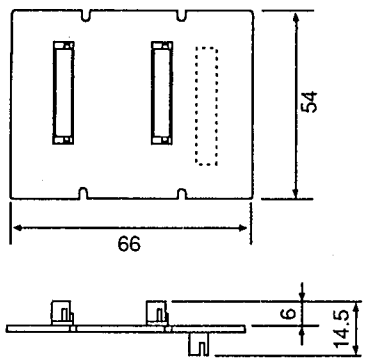
I/O board MX250RC44G

■ Mother board diagram

Unit: mm



MX050EB00004XX



MX050EB00002XX

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Specifications

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Revision History

Printed Date	Manual Number	Edition	Revised pages	Description
96-05	**CP-UM-1654E**	**1st Edition**		
02-11		**2nd Edition**	8-1,8-15	Company name changed. 1G deleted of vibration resistance, 10G to 98m/s^2 changed of impact resistance, weight to mass changed.

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Specifications are subject to change without notice.

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Printed in Japan.
1st Edition: Issued in May, 1996
2nd Edition: Issued in Nov., 2002(N)

This has been printed on recycled paper.