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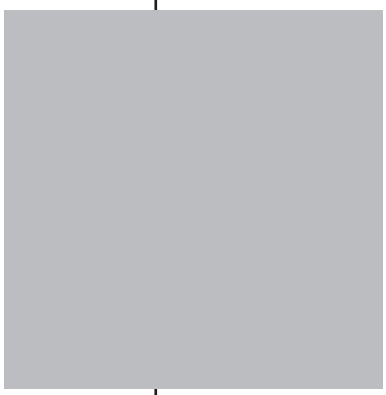
YAMATAKE

No. CP-UM-1423E

One board machine controller MX30

User's Manual



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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Introduction

Thank you for your purchase of One-Board Machine Controller MX30.
This user's manual describes an outline of MX30, its mounting method, connection method, troubleshooting, and specifications.
This user's manual covers necessary items to enable users to use MX30 correctly. MX30 users are requested to read corresponding items without fail before using this machine controller.
The instruction words and programming methods of MX30 are common to those of Yamatake Corporation's machine controller MX100.
Designers and maintenance engineers, who are in charge of operation panels and systems using MX30, are requested to read this user's manual without fail, since this user's manual describes various items required for using MX30 correctly.

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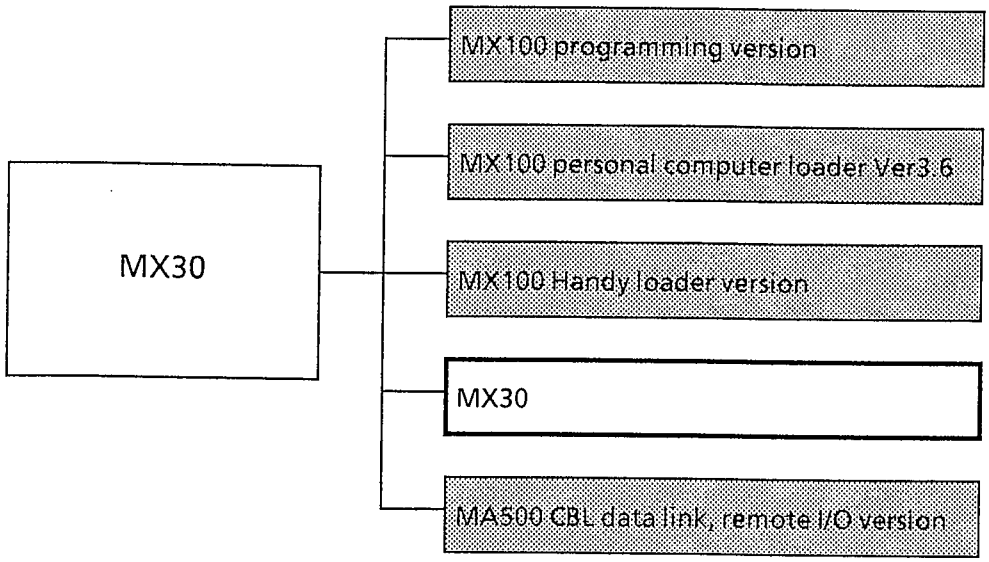
Positioning of this user's manual

This user's manual describes the mounting and connection methods for assembling MX30 to units, maintenance and check, troubleshooting, and specifications of hardware and software.
The entire composition of the user's manual for MX30 is as shown below.



User's manual for machine controller MX100, "Programming version" **CP-UM-1258**
An MX30 programmer is requested to use this user's manual when referring to detailed functions of individual commands.
This manual describes the programming methods every command.

User's manual for machine controller MX100, "Personal computer loader, Ver. 3.6" **CP-UM-1422**
This manual describes the operation methods of the loader for programming on a personal computer.

User's manual for machine controller MX100 "Handy loader version" **CP-UM-1259**
This manual describes the operation methods of the loader for programming on a handy loader.

User's manual for FA controller MA500 "CBL data link, remote I/O version" **FA-UM-1430**
This manual describes the CBL communication of the MA500 communication functions.

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Configuration of this user's manual

This user's manual is composed of the following chapters.

1. General

   This chapter describes an outline of MX30.

2. Configuration

   This chapter describes the configuration of MX30 units, system configuration, models, and the configuration of internal memory. Understand how to use MX30.

3. Names and functions of components

   This chapter describes the names and functions of MX30 components, contents of special relays and special registers, and battery exchange method.

4. Installation and wiring

   This chapter describes the mounting conditions, mounting sizes, wiring method, and input/output circuits which are necessary for mounting and connecting MX30.
   These items are required for mounting MX30 into units. System designers are requested to read this chapter without fail.

5. Operation

   This chapter describes the operation of MX30.

6. CBL functions

   This chapter describes the communication method when a network is constructed by connecting MX30 to CBL (Controller Based Link).

7. Specifications

   This chapter describes general specifications, performance specifications, and the specifications of related parts of MX30.

8. Troubleshooting

   This chapter describes the remedial measures to be observed when a trouble occurred during the use of MX30.

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Contents

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1. General

This one board machine controller MX30 is designed as a one-board type controller to receive and relay the concepts of machine controller MX100, and assemble them inside a mass-produced machine.

■ Features

- One board type

  This one board type controller can be assembled into a limited-space unit where a general-purpose programmable controller cannot be used.

- High-speed processing

  Owing to the compile system, the run speed of basic instructions 2.7μs to 46μs, and compare instructions 3.3μs to 6μs, transfer instructions 4.3μs, and other function instructions is high, in particular.
  Accordingly, MX30 is the most suitable for controlling intelligent machines which frequently use function instructions.

- Combined use with MX100

  By using the general-purpose MX100 for system development, programs are directly applicable to MX30.
  All instruction words and loaders are common to both MX100 and MX30.

- Real-time debugging function

  A program can be checked at a specified position when preset conditions have been satisfied after setting these conditions, so that debugging is easier to improve the program development efficiency by far. Irrespective of the use of this function, the scan time remains almost unchanged as compared with the scan time when the debugger is not used.

- Loader

  The handy loader exclusively used for MX series, NEC's PC-9801 series general-purpose personal computer, and the personal computer loader for using a compatible personal computer of PC-9801 series are prepared.
  The personal computer loader is designed to offer excellent performance higher than the performance of conventional exclusive loaders after researching its operability.

- CBL network

  A communication network can be constructed by the CBL (Controller Based Link).

- A communication port is provided as the standard equipment.

  An RS-232C port is provided for loader connections as the standard equipment.

● A memory card is adopted.

A memory card can be used for saving programs. Since this memory card is small and easily portable, its handling and saving are easy. Data can be written into the memory card, so that any other exclusive writer is not necessary.

■ Precautions to be observed when using MX30

MX30 does not provide any program check function for checking the syntax of user programs. Be careful with the use of the following instructions, accordingly.The program check function in the personal computer loader can be utilized, if this unit is combined.

● ANB/ORB instructions

ANB/ORB instructions processin :
ANB/ORB instructions are stored by rotating the line logic into memory by 8 bits during the processing of LD instructions, LD=instructions, and other instructions that are described at the start of a circuit block, and also, they are processed by running ANB/OR of the stored line logic and present line logic during ANB/ORB instruction processing.

- ANB instructions are a few (while, many LD equivalent instructions are provided.)
  The circuits following the LD equivalent instructions are neglected by the number of circuits of "LD equivalent instructions −(ANB instructions +1) from the first LD equivalent instructions.
- ORB Instructions are a few, while many LD equivalent instructions are provided.The circuits following the LD equivalent instructions are neglected by the number of circuits of "LD equivalent instructions − (ORB instructions +1) from the first LD equivalent instruction.

(Example)

LD	X001	Neglected	
AND	X002	Neglected	
LD	M003		Function
OR	M004		
LD	L005		
AND NOT	L006		
ORB			
OUT	Y000		

- Many ANB/ORB instructions are provided, while LD equivalent instructions are a few. The line logic becomes undefined.
- More than 8 ANB/ORB instructions are provided continuously.
  The line logic becomes undefined.
- After an output instruction, an ANB/ORB instruction follows.
  The subsequent line logic becomes undefined.

(Example)

LD	X000	Neglected	
LD	X001		Function
AND	X002		
LD	M003		
OR	M004		
ANB			
MOV	#1234 Y000		
ORB		Undefined	
OUT	Y200	Undefined	

● LPS-LRD-LPP instructions

LPS instruction processing : Pushes (stores) the present line logic into the stack.

LRD instruction processing : Reads the line logic from the stack.

LPP instruction : Pulls (reads) the line logic from the stack.

- LPS instructions are a few.
  The line logic being read by the subsequent LRD and LPP becomes undefined.
- LPP instructions are a few.
  If the number of short LPPs is less than 32 in total, this may be left out of consideration.
- Many LPS instructions are provided.
  The first LPS is neglected.

(Example)

```
LD      X000
LPS
AND     X001
LPS
AND     X002
OUT     Y000
LPP
AND     M003
OUT     Y001
```

Neglected

Function

- Many LPP instructions are provided.
  The line logic following an excessive LPP becomes undefined.

● JMP-JPE instructions

JMP instruction processing : Sets the banks and pointers to the tables having corresponding numbers so as to jump the processing to the object of the instruction next to JMP in the compile mode.

JPE instruction processing : Sets the banks and pointers of the object where JPE is described to the tables having corresponding numbers. (Jump destination in JMP instruction processing)

- JMP instruction only causes NOP (no operation).
- JPE instruction only causes NOP.
- Processing in the order of JPE and JMP instructions causes NOP.
- When JPE instructions are multiple, the last one is effective, and all other instructions result in NOP.
- Line logic just after JPE instruction
  Turns on when JMP is executed, but sets to the line logic just before JPE, if JMP is not executed.

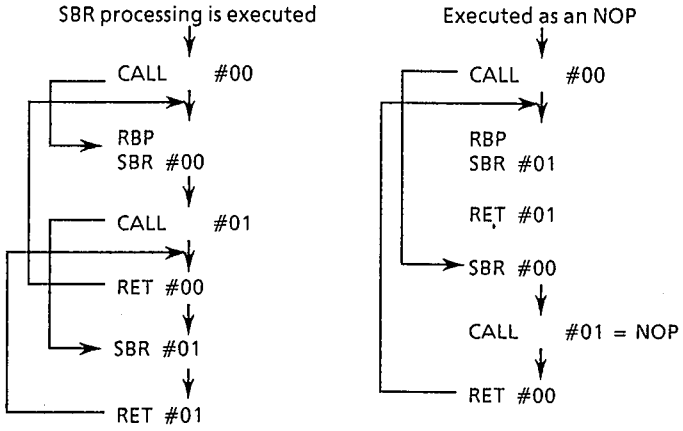
● CALL-SBR-RET instructions

CALL instruction processing : Sets the banks and pointers to the RET tables having corresponding numbers so as to return (jump) to the object of the instruction next to CALL in the compile mode, and also, sets the same data to SBR tables (corresponding to the absence of SBR).

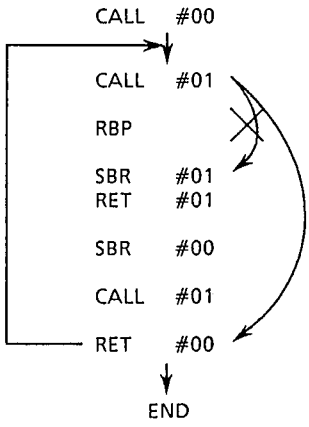
SBR instruction processing : Sets the banks and pointers of the object where SBR is described to the SBR tables having corresponding numbers. (Jump destination in CALL instruction processing)

RET instruction processing : Sets the RET object to NOP, if the contents of SBR table are 0 or they are equal to those of RET table.
This also appliesto, correspondingly, when the contents of RET table is 0.

Example1 : If the other SBR subroutine to be called exists in the higher order when calling it from SBR-RET, it is processed as NOP.



Example2 : The following ladder results in an infinite loop.



Since SBR#01 and RET#01 between the second CALL#01 and END are absent, no calling can done correctly.

- CALL instruction only
  Results in NOP.
- SBR instruction only
  Results in NOP.
- RET instruction only
  Results in NOP.
- CALL-SBR instruction only (without RET instruction)
  Same operation as in JMP-JPE instructions
- CALL-RET instructions only (without SBR instruction)
  Results in NOP.
- SBR-RET instructions only (without CALL instruction)
  Results in NOP.
- Multiple SBR instructions
  The last SBR is effective, but all other SBR instructions result in NOP.
- Multiple RET instructions
  The last RET is effective, but all other RET instructions result in NOP.
- No RBP instruction exists between CALL instruction and SBR-RET instructions.
  After CALL instruction processing, RET processing is done in the main routine to produce an infinite loop between CALL instruction and RET instruction.However, this processing is forcedly transferred to the STOP mode due to user WDT out.If WDT instruction exists between CALL instruction and RET instruction, an infinite loop is produced to cause the system WDT out. (Connect the handy loader without connecting the battery to select STOP mode at the start-up time of the power supply. Then, change the program.)
- Line logic just after SBR instruction
  Turns on when the CALL instruction is executed, and sets to the line logic just before SRB instruction when the CALL instruction is not executed. (In case of the combination with JMP, etc.)

● STOP instruction

STOP instruction processing : Monitors the input contacts in the object to judge whether the STOP action is continued or not.

- Neither LD nor LD NOT instruction exists before STOP instruction.
  - · Continues the STOP operation when the contacts are turned on, or resets the STOP operation when the contacts are turned off according to the contact conditions employed in each instruction in case of AND and OR instructions.
  - · Resets the STOP operation when the contacts are turned on or continues the STOP operation when the contacts are turned off according to the contact conditions employed in each instruction in case of AND NOT and OR NOT instructions.
  - · Data become undefined in case of those other than other instructions.

● RTBL-DTBL instructions

RTBL instruction processing : Adds a specified offset to the address at the start of the table to determine the read address.

DTBL instruction processing : Transfers the tables to the object memory to store the start address of the table.

- DTBL instruction is absent.
  Reads undefined data when RTBL instruction is executed.
- END instruction is absent before DTBL instruction.
  Reads undefined data when RTBL instruction is executed, because that the DTBL instruction is not recognized.
- The read range of RTBL instruction exceeds the table.
  Reads undefined data.

- Multi-input instructions (CNT, STM, UDC, DCNT, DUDC, SR instructions)
  - The input conditions of multi-instructions are more than necessary.
    Neglects the circuits following the LD equivalent instructions by the number of circuits of {LD equivalent instructions − required number} from the first LD equivalent instruction.
  - The input conditions of multi-instructions are less than necessary.
    Data become undefined.

- Timer/counter instructions (TMR, CNT, STM, UDC, DCNT, DUDC instructions)
  The same timer/counter number cannot be used.

◇CAUTIONS◇

- Two timers/counters are exclusively used for DCNT and DUDC instructions.
- A set value change applies to the last timer/counter instruction.

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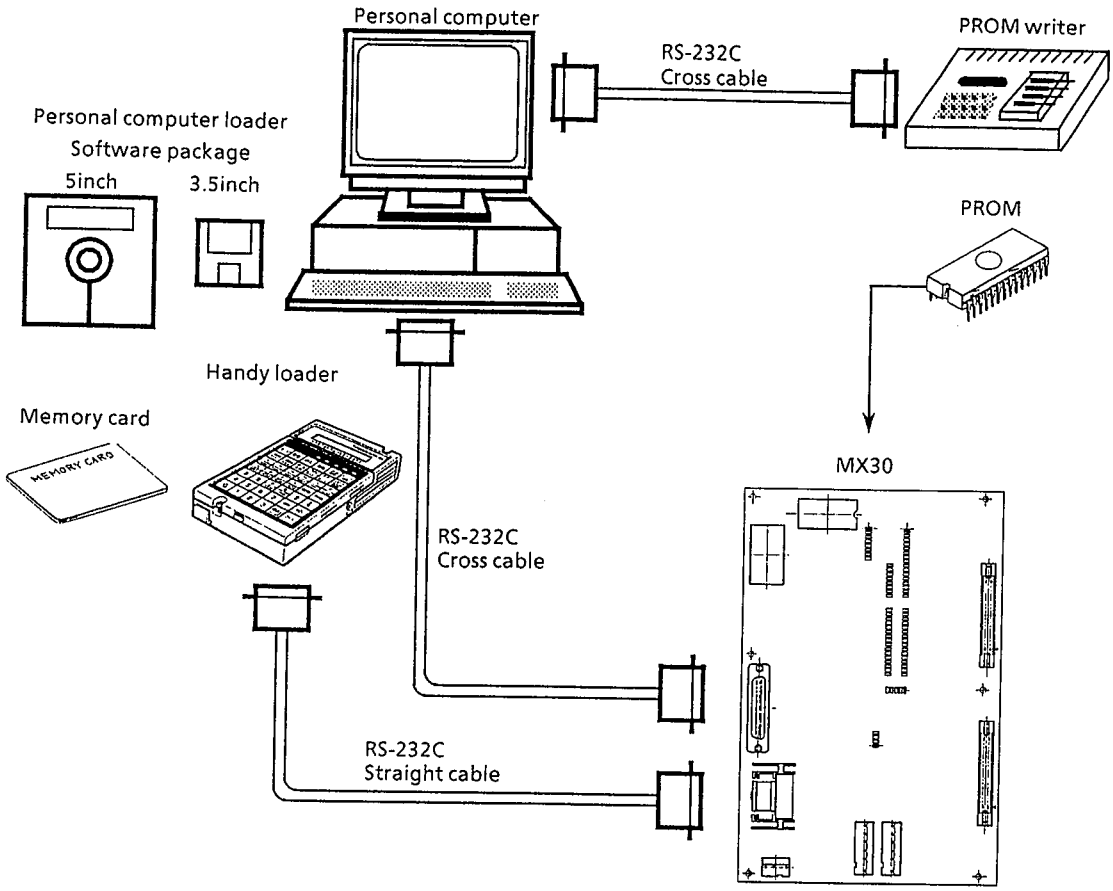
2. Configuration

2 - 1 Composition of units

■ Composition of units



Personal computer loader: Software package to use general-purpose personal computer PC-9801 series (manufactured by NEC) and its compatible units.

RS-232C cable : Connects MX30 to the personal computer or handy loader, or connects the personal computer to PROM writer.
This cable is used to connect from MX30 to the personal computer or handy loader for loading/saving the programs into MX30 after preparing these programs by the personal computer, or it is used to connect MX30 to the PROM writer for writing these program into PROM.

PROM : The PROM operation can be done by connecting PROM to the PROM socket of MX30 after writing user programs into PROM. This PROM is used for a mass-production machine or the like where defined programs are loaded.

2 - 2 Models

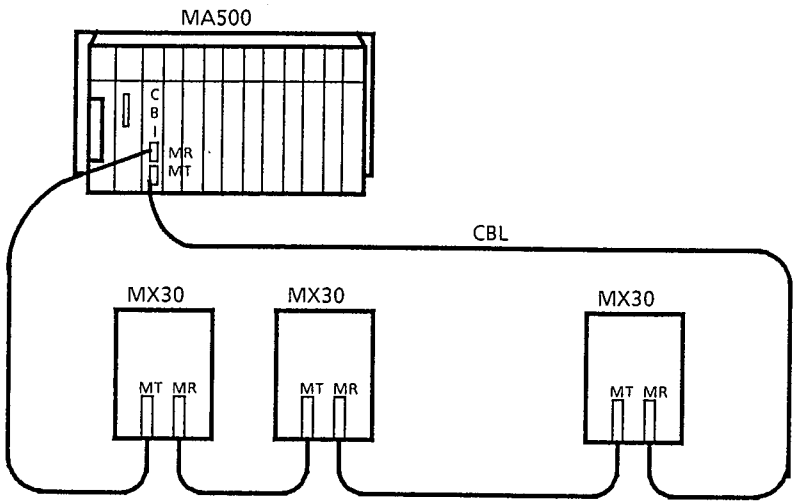
Models		Specifications									
		Power supply DC24V	I/O Power supply 12/24V	Input 24 points	Input 32 points	Transistor output 16 points	Transistor output 24 points	Memory 3KB	Memory 7KB	CBL network	Extension board
Basic boards	MX030FT13121N	○	○	○		○		○			
	MX030FT14131N	○	○		○		○	○			
	MX030FT13121H	○	○	○		○			○		○
	MX030FT14131H	○	○		○		○		○		○
	MX030FT13121N-T	○	○	○		○		○		○	
	MX030FT14131N-T	○	○		○		○	○		○	
	MX030FT13121H-T	○	○	○		○			○	○	○
	MX030FT14131H-T	○	○		○		○		○	○	○
Extension boards	MX030EX1312		○	○		○					
	MX030EX1413		○		○		○				

Article name	Model	Contents
Personal computer loader package	MX100SW21 MX100SW22 MX200SW01 MX200SW02	3.5-inch floppy disk 5-inch floppy disk 3.5-inch floppy disk 5-inch floppy disk Software using PC-9801 series general-purpose personal computer as a loader
Handy loader	MX100PL01 MX100PL01EX	English version
Power cube	MX100PS01	AC adapter exclusively used for handy loader
Memory card	MEM-EE008 MEM-EE016 MEM-EE032	For storing programs of handy loader Memory capacity 8K bytes Memory capacity 16K bytes Memory capacity 32K bytes
RS-232C cable	CBL-RS232P02 CBL-RS232T02 CBL-RS232T08	For handy loader connection, 2m in length For personal computer connection, 2m in length For personal computer connection, 8m in length
Lithium battery	MX100BT01	Memory backup battery
PROM	Equivalent to 27C256D-20 Equivalent to 27C512D-20	A product being available on the market

2 - 3 System configuration

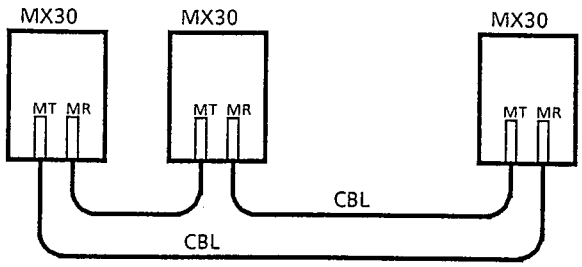
The following figure shows the examples of the system configurations where the CBL network application model is used.

- An Example Using a Host M500



The MA500 CBI (CBL Interface Module) is connected to MX30 by means of CBL as the master station.
MA500 and MX30 are communicable with each other by means of mail communication or remote I/O.

- A Configuration Example of Among MX30



This configuration is oriented to a small-scale system.
A mail link can be established by connecting MX30 to each other.

2 - 4 Loader

This paragraph describes the loader employed for MX30.
This loader is used for programming, debugging, loading, and storage.
The MX30 loader can be combined with either handy loader MX100PL01 or personal computer loader using general-purpose personal computer PC-9801 series.
These loaders are common to MX series.

CAUTION

If the MA500 loader is connected to another station (FA controller MA500, for example) and an MX30 address is assigned in a network, MX30 does not function normally.
Use the MX loader for MX30.

■ Personal computer loader

The personal computer loader consists of a software package (FD) and a personal computer.
Use your PC-9801 series personal computer or its compatible model, and connect it to MX30 by using an RS-232C cable.
Either 5-inch or 3.5-inch floppy disk is available as a software package for loader. The personal computer loader supports all functions of MX30.
For the model names of applicable personal computers and their detailed specifications and operation, refer to the user's manual for machine controller MX series "Personal computer loader operation version" CP-UM-1602, and the user's manual for machine controller MX100 "Personal computer loader Ver3.6" CP-UM-1422.

■ Handy loader

The handy loader is the most suitable for small-capacity programming, and changes and correction at site.
For detailed specifications and operation, refer to the user's manual for machine controller MX100 "Handy loader version" CP-UM-1259.

2 - 5 Memory structure

The internal memory of MX30 consists of the relay area and register area.
The relay area is processed in units of bits, while the register area is processed in units of words, each consisting of 16 bits.
Each area is defined as follows.

Area	Name	Number	Functions
Relay area	Input relays	X000 to X09F	Allocated to external I/O to transfer data to and from I/O.
	Output relays	Y000 to Y09F	
	CBL link relays	X200 to X29F Y200 to Y29F	Transfer data to and from other CBL units, or serve as auxiliary relays if your model has no CBL communication function.
	Auxiliary relays	M000 to M49F	These internal relays of the controller cannot output any signal to the outside directly.
	Holding relays	L000 to L49F	These relays hold data when a power service interruption occurred.
	Special relays	M900 to M99F	Data of these relays are predetermined, such as alarms, error information, etc.
Register area	Special registers	R900 to R939	Data of these registers are predetermined, such as data, error information, etc. required for self-diagnosis.
	Timers/counters	T/C000 to T/C199	These registers function when corresponding timers have reached the preset time (time-up) or corresponding counters have counted up.
	Data registers	R000 to R499	This data area is used for function instructions.

2 - 6 Program memory

■ Program memory types

Two types of program memory units are selectable.

● RAM (Built-in inside the MX30 board)

The MX30 board is provided with a built-in RAM, which is backed up by the battery for a power service interruption.
The programs prepared by the loader are written into this RAM.
Since these programs can easily be changed, this RAM is suitable for a trial run or the like.
Programs are loaded into the RAM once during a run, even if the PROM is used.

● PROM

Programs prepared by the loader are written into the PROM by using a PROM writer now being available on the market.
This is the most suitable for a mass production machine using defined programs.

■ Program memory capacity

Memory type	Model	Memory capacity	Program capacity	Remarks
RAM	Built-in type	4/8K bytes	3/7K bytes	An instruction consists of 2 to 13 bytes according to the instruction words, and RAM can store data up to 3/7K bytes as the total of the number of bytes.
PROM	27C256D-20 27C512D-20	256K bits 512K bits	3/7K bytes 3/7K bytes	PROM capacity is indicated in units of bits, and 256K bits correspond to 32K bytes. The program capacity is max. 3/7K bytes in both RAM and PROM, respectively.

The memory capacity depends upon the models.

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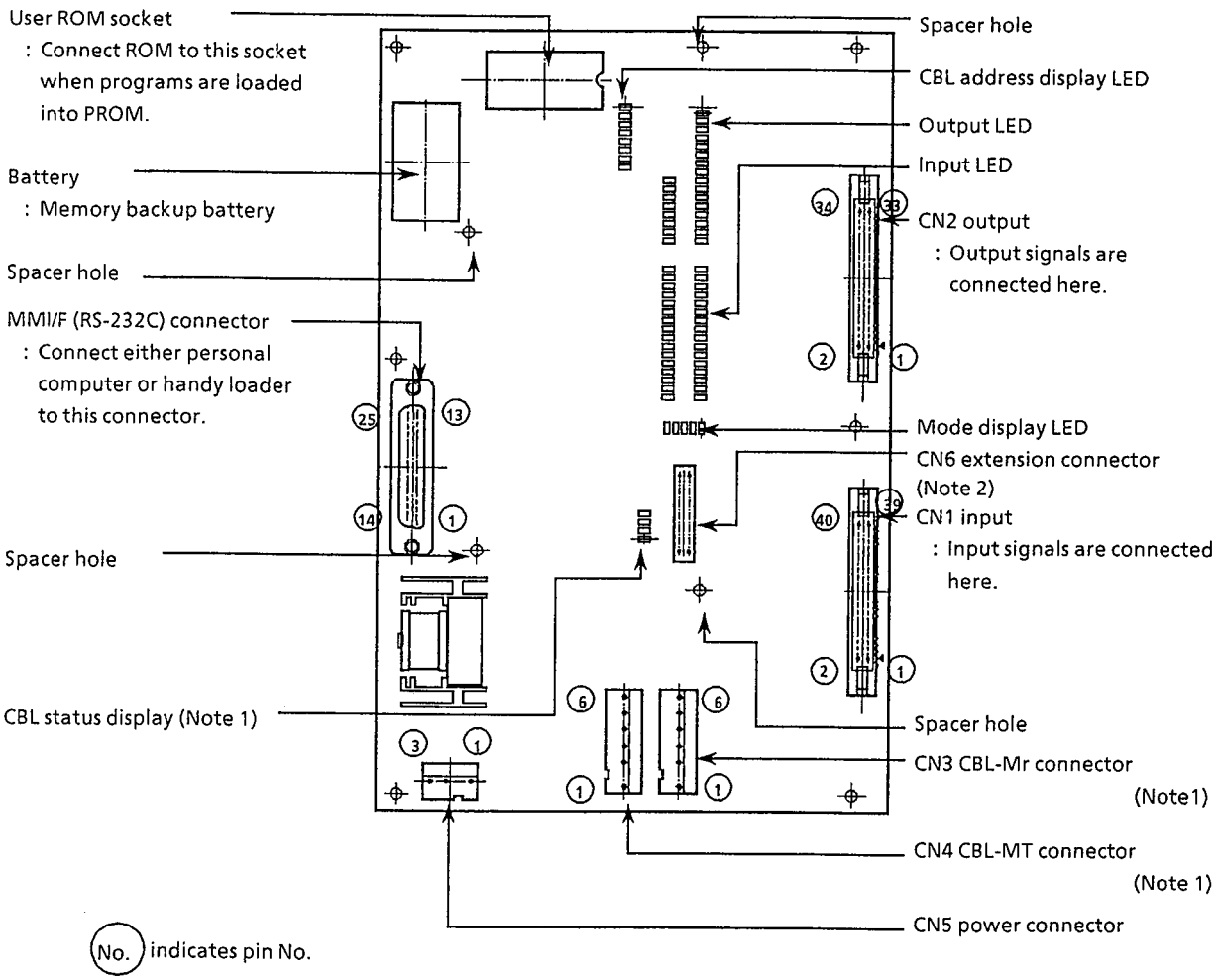
3. Names and functions of components

3 - 1 Names of components

■ Basic board



(Note 1) CBL status display LED, CN3, and CN4 are provided for the model having a CBL communication function.

(Note 2) Extension connector CN6 is mounted for MX0301□1□1H□ type only.

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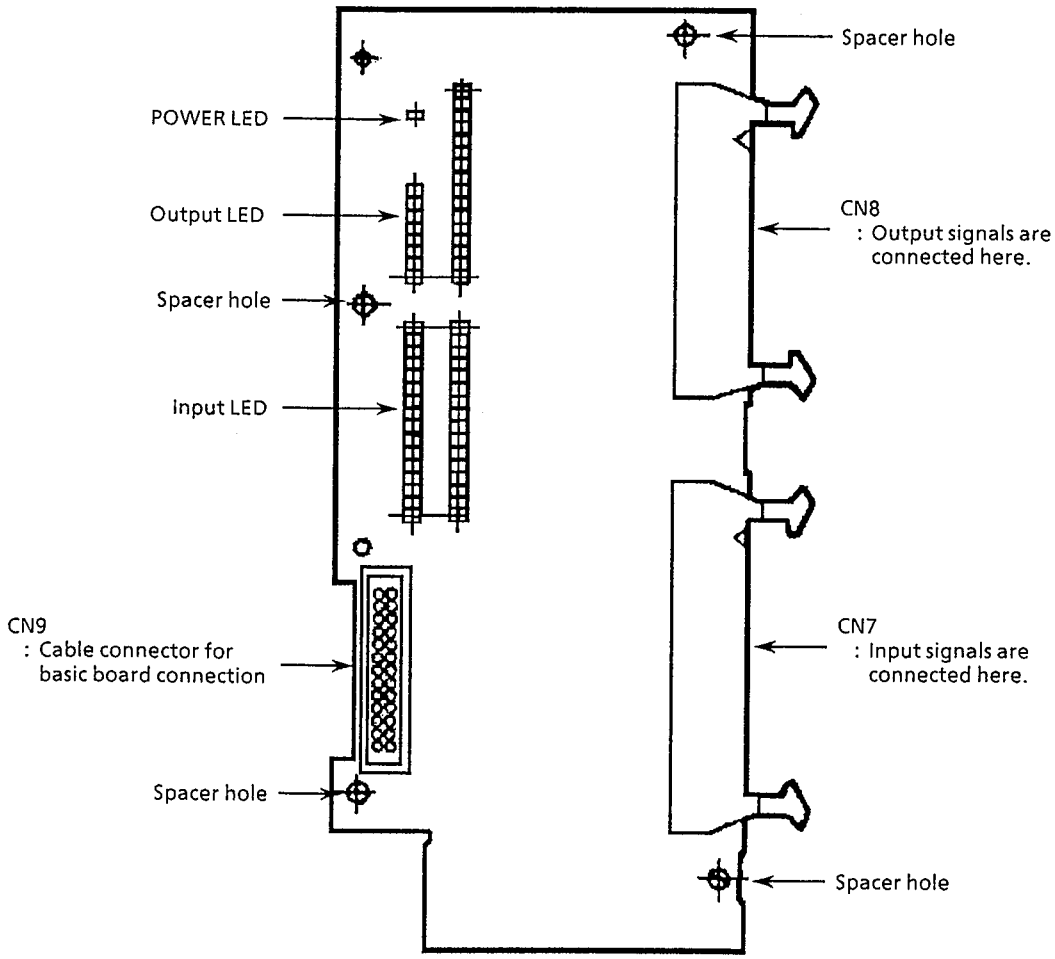
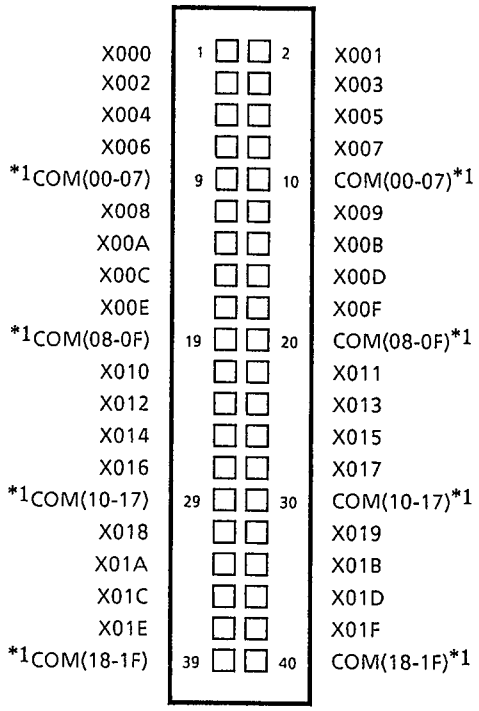
■ Extension board



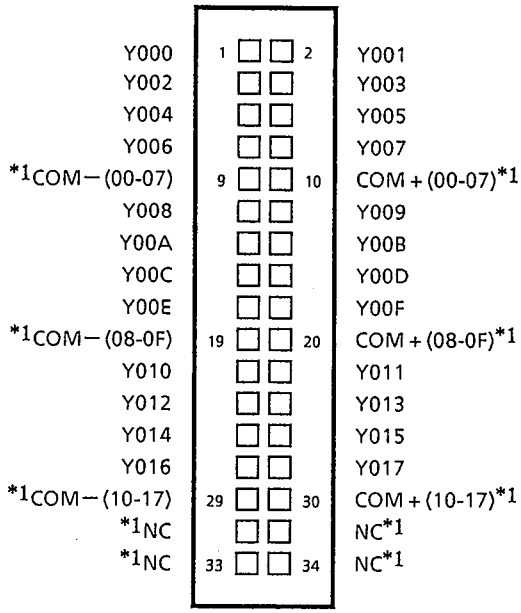
3 - 2 Mounting layout of connector pins

■ Basic board

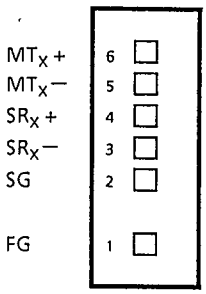
CN1 : Input connector
(Manufactured by HIROSE Electric Co.)
HIF3-40P-2.54DSA (Board side)



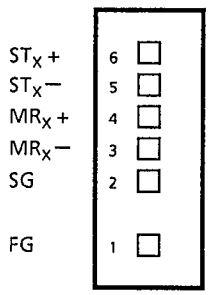
CN2 : Output connector
(Manufactured by HIROSE Electric Co.)
HIF3-34P-2.54DSA (Board side)



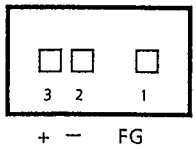
CN4*2 : CBL−MT connector
(Manufactured by Japan Molex Co.)
5289-6A (Board side)



CN3*2 : CBL−MR connector
(Manufactured by Japan Molex Co.)
5289-6A (Board side)



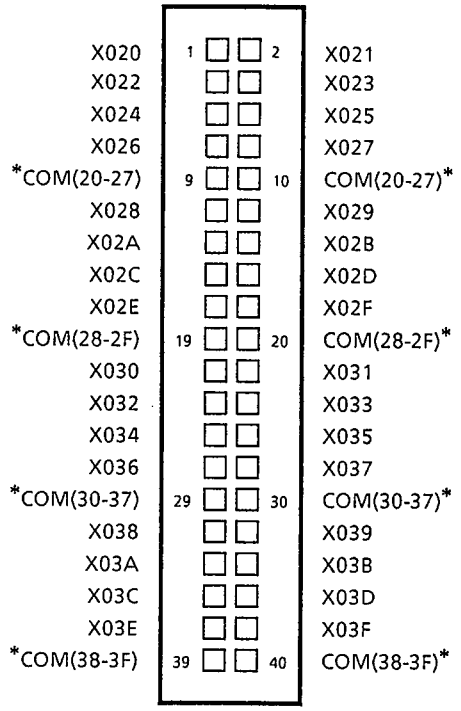
CN5 : Power connector
Manufactured by Japan Molex Co. 5289-3A (Board side)



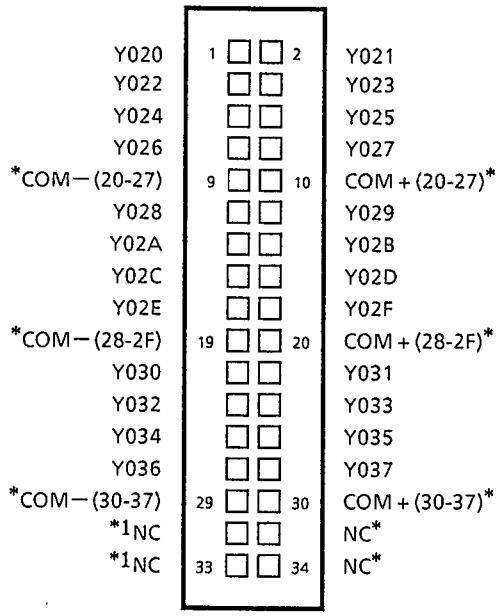
*1 COM indicates common terminals, while NC indicates the disconnected condition.
*2 CN3 and CN4 are provided for only the model having CBL communication function.

■ Extension board

CN7 : Input connector
(Manufactured by HIROSE Electric Co.)
HIF3-40P-2.54DSA (Board side)



CN8 : Output connector
(Manufactured by HIROSE Electric Co.)
HIF3-34P-2.54DSA (Board side)



* COM indicates common terminals, while NC indicates the disconnected condition.

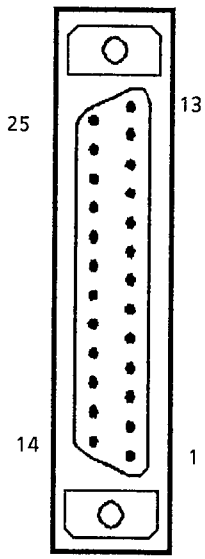
● Applicable connector types

Connector types on the cable side, conforming to connectors CN1 to CN5

Connectors	Makers	Types	Contacts
CN1、CN7	Hirose Electric Co.	HIF3BA-40D-2.54C (For crimp style connection) HIF3A-40D-2.54R(For ribbon cable)	• For AWG #20 to 22 HIF3-2022SCF (Continuous) HIF3-2022SC(Bulk) • For AWG #22 to 26 HIF3- 2226SCFA(Continuous) HIF3-2226SCA(Bulk) • For AWG #24 to 28 HIF3-2428SCFA (Continuous) HIF3-2428SCA(Bulk)
CN2、CN8	Hirose Electric Co.	HIF3BA-34D-2.54C(For crimp style connection) HIF3A-34D-2.54R(For ribbon cable)	
CN3、CN4	Japan Molex Co.	5199-06	5194T (Continuous) 5194TL (Bulk)
CN5	Japan Molex Co.	5199-03	

[Reference] Manual crimp tool for CN3 to CN5 JHTR5904, Japan Molex Co.

● Detail of RS-232C connector



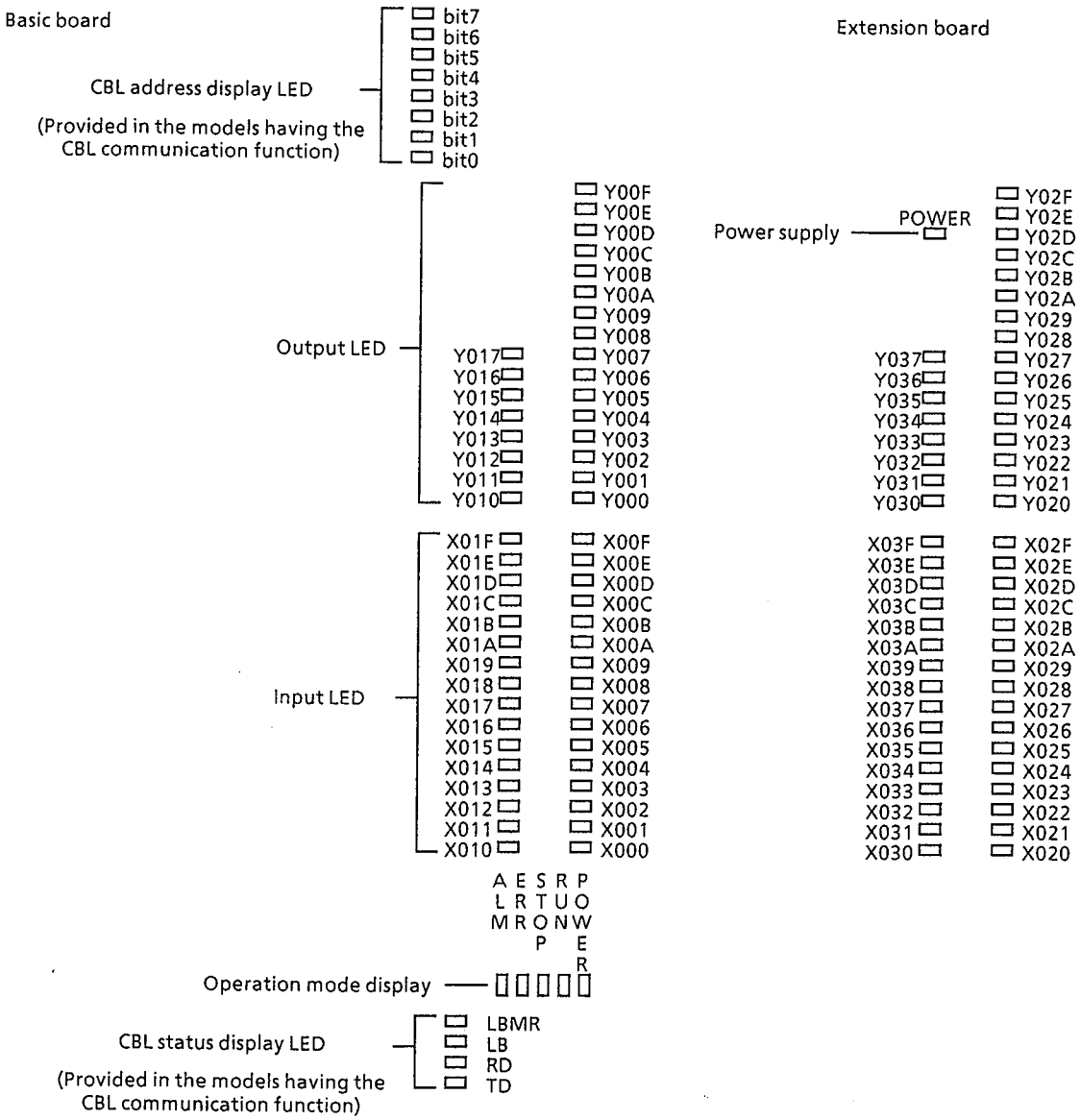
Mounting layout of connector pins for loader connections

Pin No.	Signal name	Pin No.	信号名
1	FG	14	
2	SD Send data	15	
3	RD Receive data	16	
4	RS Request-to-send	17	
5	CS Ready to send	18	+5V
6	DR Data set ready	19	
7	SG	20	ER Data terminal ready
8		21	
9	+5V	22	
10	SG	23	LNK Unit connection detection line
11	SG	24	
12		25	SG
13			

◇CAUTIONS◇

- When No.23 pin is 1 (high level), the loader is connected and when it is 0 (low level), the host communication connection is done.
- The handy loader power supply (+5V) is fed to pin No.18. Check the signal contents of the connector pin when connecting Pin No.18 to another unit.
- Pin No.4 and 5 as well as pin No.6 and 20 are internally connected to each other.

3 - 3 LED display



Operation mode display

Display	Contents
POWER	Lights when the power supply is turned on.
RUN	Blink in RUN mode (running) or TEST mode. Lights when the power supply is turned on to set the MX30 to the RUN mode.
STOP	Lights in the STOP mode. Flickers in the PROG mode.
ERR	Lights under an error condition.
ALM	Lights under an alarm condition.

CBL status display

Display	Contents
LBMR	Lights when the loopback is done on the MR side. (Does not lights when the loopback is done on the MT side.)
LB	Lights when the loopback is done.
RD TD	Lights respectively at the send/receive timing of CBL data under the normal condition.

3 - 4 Special relays and special registers

■ Special relays table

Special relays comprise M900 to M99F.

M900 to M91F : These relays are employable in user programs. They can be read and written.

M920 to M94F : These relays are employable in user programs. They can be read only.

M950 to M99F : These relays can be read in the monitor mode only.

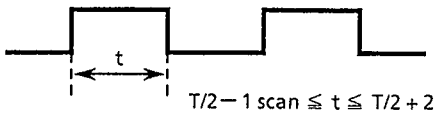
In the "type" column, R shows read, W shows write, and M shows monitor, respectively.

Address	Name of contact	Type	Description
M900	Shift carry	R/W	Carry used for shift related instructions
M901	Overflow	R/W	Turns on when an arithmetic result is more than the processable numeric range
M902	Underflow	R/W	Turns on when an arithmetic result is less than the processable numeric range.
M903	—	R/W	Not used.
M904	Remote send end	R/W	Turns off when data are set to the CBL send buffer at the time of sending Y200 to data to CBI.
M905	Remote data receive	R/W	Turns on when receive data from CBI are set to X200 to.
M906	Remote speed over	R/W	Turns on when the receiving speed from CBI exceeds the MX30 scan time.
M907	CBL undefined instruction receive	R/W	Turns on when a received command is not supported by MX30.
M908	—	R/W	Not used. (AC turns off in MX100)
M909	CBL line trouble	R/W	Turns on, if the communication line is not communicable.
M90A	CBL loopback A	R/W	Turns on under the loopback condition of the main ring due to a send trouble.
M90B	CBL loopback B	R/W	Turns on under the loopback condition of the main ring due to a receive trouble.
M90C	CBL sub-ring trouble	R/W	Turns on when the sub-ring is in trouble under the non-loopback condition.
M90D	—	R/W	Not used.
M90E	Arithmetic error 1	R/W	Turns on when an arithmetic error occurs during the execution of a function instruction, and turns off when the error has been recovered or no error occurs in other instructions.
M90F	Arithmetic error 2	R/W	Latches arithmetic error 1

Address	Name of contact	Type	Description
M910	CBL read command send	R/W	Turns on when CBL: read command send is requested, and turns off in the system when a response is received. (Note)
M911	CBL write command send	R/W	Turns on when CBL: write command send is requested, or turns off in the system when a response is received. (Note)
M912*	CBL broadcast communication	R/W	Turns off in the system when a CBL: broadcast communication command is received. (Note)
M913*	CBL broadcast communication	R/W	Turns on when CBL: broadcast communication command send is requested, and turns off in the system during send. (Note)
M914	Abnormal end of receive	R/W	A CBL receive message was terminated abnormally. (RSR register: RxFL)
M915	Abnormal end of send	R/W	A CBL send message was terminated abnormally (TSR resister: TxFL, DISC, RTYO, UDRN)
M916*	CBL multiple command receive	R/W	Two or more write commands were received within one scan of MX30. (Receiving processing method is determined by bit 5 of R909.)
M917	Excessive CBL receive commands	R/W	CBL receive data exceed the processing capability of CBL LSI. (Message > 31 data > 1024 bytes···) (CESR register ≠ 0)
M918	CBL read parameter error	R/W	CBL read command setting parameter is in error. (Note)
M919	CBL write parameter error	R/W	CBL : write command setting parameter is in error. (Note)
M91A	—	R/W	Not used.
M91B*	CBL broadcast communication error	R/W	CBL : CBL broadcast communication send parameter error (Note)
M91C	CBL read response error	R/W	CBL : read response data are in error. (Note)
M91D	CBL write response error	R/W	CBL : write response data are in error. (Note)
M91E*	CBL broadcast communication receive data error	R/W	CBL : broadcast communication receive data are in error. (Note)
M91F	CBL status typical contact	R/W	CBL : alarm contact OR output (Note) M906、M907、M909、M90A、M90B、M90C、M914、M915、M916、M917、M918、M919、M91B、M91C、M91D、M91E

(Note) For details of M910 to 913, M918, M919, M91B to M91F, see MX30 CBL specifications.

* Applicable to one-address communication (without response)

Address	Name of contact	Type	Description
M920	Normally ON	R	Turns on after power supply has been turned on.
M921	Normally off	R	Turns off after power supply has been turne on.
M922	One-scan ON	R	Turns on during one scan only after starting a program in the RUN/TEST mode.
M923	One-scan OFF	R	Turns off during one scan only after starting a program in the RUN/TEST mode
M924	Scan pulse	R	Repeats ON/OFF operation every scan in the RUN/TEST mode.
M925	20ms clock	R	Repeats ON/OFF operation at a cycle of the clock time.  T/2−1 scan ≦ t ≦ T/2+2 scan
M926	100ms clock	R	
M927	1-sec. clock	R	
M928	1-min. clock	R	
M929 to M92C	—	—	Not used. (M929 causes OP I/O scan to end in MX100)
M92D	Alarm OR output	R	OR output of causes of alarms (M909, M90E, M90F, M931, M933)
M92E	—	—	Not used. (Monitoring in progress in MX100)
M92F	—	—	Not used. (OP I/O is being connected in MX100.)
M930	—	—	Not used.
M931	Battery error	R	Program backup battery voltage has dropped. (Battery exchange is necessary.)
M932	—	—	Not used. (Fuse is blown out in MX100.)
M933	MMI/F communication failure	R	Communication failure to loader (SUM error or frame error)
M934 to M93F	—	—	Not used. (M934 RS-485 communication error or M935 OP I/O collating error in MX100)

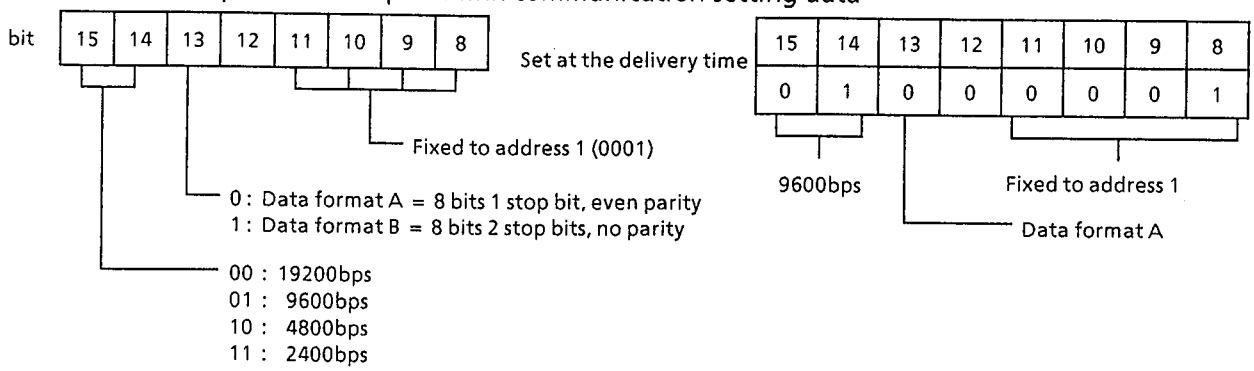
Address	Name of contact	Type	Description	
M940	STB instruction executing	R	Y000 to 008	Turns on when STB instruction is being executed. Turns off when STB instruction is not being executed.
M941			Y010 to 018	
M942			Y020 to 028	
M943			Y030 to 038	
M944			Y040 to 048	Turns on when STB instruction is being executed. Turns off when STB instruction is not being executed. (Does not correspond to I/O, but the flag action is done.)
M945			Y050 to 058	
M946			Y060 to 068	
M947			Y070 to 078	
M948			Y080 to 088	
M949			Y090 to 098	
M94A to M94F	—	—	Not used. (M94F is fixed to I/O in MX100.)	

Address	Name of contact	Type	Description
M980	—	—	Not used. (Compile is in progress in MX100.)
M981	RUN mode	M	RUN mode is selected.
M982	TEST mode	M	TEST mode is selected.
M983	STOP mode	M	STOP mode is selected.
M984	PROG mode	M	PROG mode is selected.
M985	—	—	Not used.
M986	Error	M	OR output of causes of errors (M994, M995, M998 to M99B)
M987	Alarm	M	OR output of causes of alarms: Same as in M92D
M988	—	—	Not used.
M989	—	—	Not used.
M98A	—	—	Not used.
M98B	—	—	Not used.
M98C to M98F	—	—	Not used.
M990 to M993	—	—	Not used (M990 bus error, M991 I/O collating error, M992 I/O module error in MX100)
M994	User ROM error	M	User program ROM is abnormal.
M995	CBL LSI failure	M	CBL LSI hardware is abnormal.
M996	—	—	Not used.
M997	—	—	Not used.
M998	User WDT	M	User WDT has reached its preset time (time-out).
M999	Program damage	M	User program check sum collating error
M99A	Program unfinished	M	Syntex error of user program
M99B	Compile error	M	User program contains a code which cannot be compiled.
M99C to M99F	—	—	Not used.

■ Special registers table

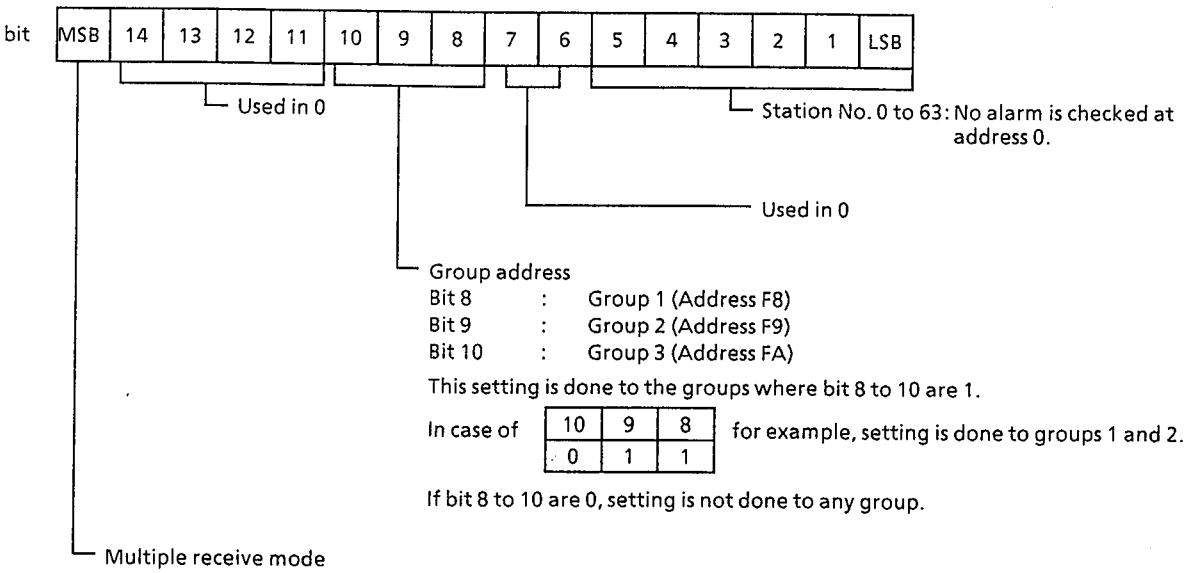
Address	Register name	Bit configuration				Contents
		15 12	11 8	7 4	3 0	
R900	Scan time MIN	$\times 10^3$	$\times 10^2$	$\times 10$	$\times 1$	Minimum value of scan time (ms)
R901	Scan time LAST	$\times 10^3$	$\times 10^2$	$\times 10$	$\times 1$	Latest value of scan time (ms)
R902	Scan time MAX	$\times 10^3$	$\times 10^2$	$\times 10$	$\times 1$	Maximum value of scan time (ms)
R903	CBL address display	—		Address LED display data		CBL R909 low-order setting address is displayed when power supply is turned on.
R904	Arithmetic error -1	Step No.				Step number where an arithmetic error occurs Arithmetic errors are sequentially recorded, starting with older errors, and none of the 5th and subsequent errors is recorded. Error 1 is the oldest, while error 4 is the latest. These errors are cleared when the mode is selected from STOP to RUN or from STOP to TEST.
R905	Arithmetic error -2	Step No.				
R906	Arithmetic error -3	Step No.				
R907	Arithmetic error -4	Step No.				
R908	Personal computer link communication setting data	Personal computer link data		—		See the host communication setting data to personal computer (Note 1).
R909	CBL setting address		Group	Setting address		See the CBL station No., group address, etc. (Note 2).
R910	CBL: READ command parameter designation	0 to 499 (Register No. designation)				Designates the area to set parameters required for sending or receiving various commands of CBL. (Designates to R000 to 499) Example) Sets WRITE command parameter from R200 to R911 = 200D (00C8H))
R911	CBL: WRITE command parameter designation	0 to 499 (Register No. designation)				
R912	CBL: Informatin transfer receive parameter designation	0 to 499 (Register No. designation)				
R913	CBL: Information transfer send parameter designation	0 to 499 (Register No. designation)				
R914 to R919	—	—				Not used.
R920	Remote communication default/variable length switching	30H		0000 0000		No. of remote I/O words is changed to the value designated by R921.
		Without 30H		0000 0000		Default value = 3-word input/3-word output
R921	Remote communication data length designation	No. of input words (00H to0AH)		No. of output words (00H to 0AH)		When the high-order byte of R920 is 30H, the high-order byte of R921 is set to No. of remote input words, while the low-order byte of R921 is set to No. of remote output words, respectively. If it is set more than 10 words, it is corrected to 10 words.

(Note 1) R908 personal computer link communication setting data



◇CAUTION◇ • If your personal computer does not support 19,200bps, the communication cannot be done any more when 19,200bps is selected by the loader. In such a case, take a remedial measure, referring to chapter 7 Troubleshooting (Page 7-10).

(Note 2) CBL setting address



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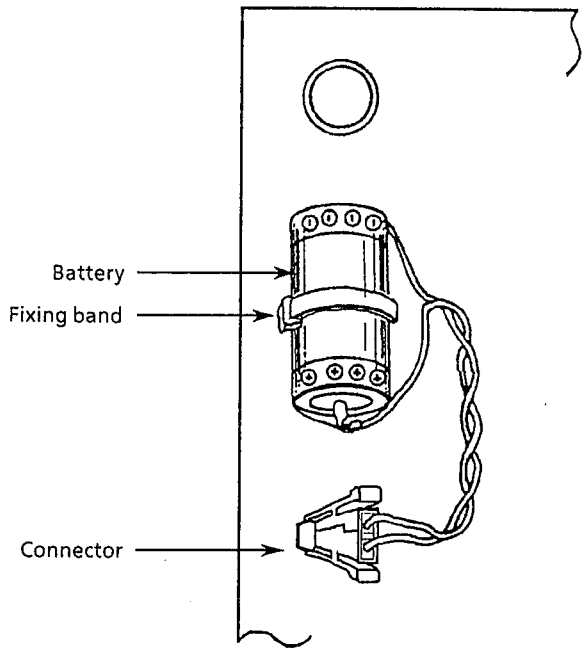
Address	Name of register	Bit structure				Contents
		15 12	11 8	7 4	3 0	
R922 to R927	—	—				Not used.
R928	No. of CBL receive times	CBL receive count number				No. of data receive times from MA500 — CBI (Binary value)
R929	—	—				Not used. Data on the blown-out failure of fuse in MX100
R930	—	—				Not used. I/O collating error data in MX100
R931	I/O bits/words identification	0000	0000	0000	0000	Indicates that all I/O are bit type (fixed data).
R932	I/O entry data	0000	0010	0000	0000	Indicates 32-point inputs or 24-point outputs (fixed data) (See Note.)
R933		0000	0000	0000	0000	
R934		0000	1110	0000	0000	
R935		0000	0000	0000	0000	
R936	I/O packaging data	0000	0010	0000	0000	Indicates 32-point inputs or 24-point outputs (fixed data) (See Note.)
R937		0000	0000	0000	0000	
R938		0000	1110	0000	0000	
R939		0000	0000	0000	0000	

(Note) R932 to 939 are set as 32-point inputs and 24-point outputs, even in case of 24-point inputs and 16-point outputs.

3 - 5 Battery exchange

For replacing the battery, observe the following procedure.

1. Turn off the power supply.
2. Disconnect the battery connector.
3. Remove the fixing band of the battery by cutting it with cutting pliers or the like.
4. Fix new battery to PC board by using the bundling band or the like.
5. Connect the battery connector.
   This connector cannot be connected reversely. However, be careful with its polarity.
   Face the connector pins toward the PC board when inserting the connector.



◇CAUTION◇

- Special contact M931 turns on, if the battery is defective.
- Continue feeding power for longer than 10 minutes before turning off the power supply. In this case, the circuit voltage is held by the capacitor for a certain time even after the battery has been removed. However, replace the battery as soon as possible. (The guaranteed backup time is 10 minutes.)
- Replace the battery once every 5 years.
- Don't short the battery.
- Don't disassemble any unused battery, or don't throw it into a fire, otherwise a dangerous accident may occur. Return it to our company or our agent.

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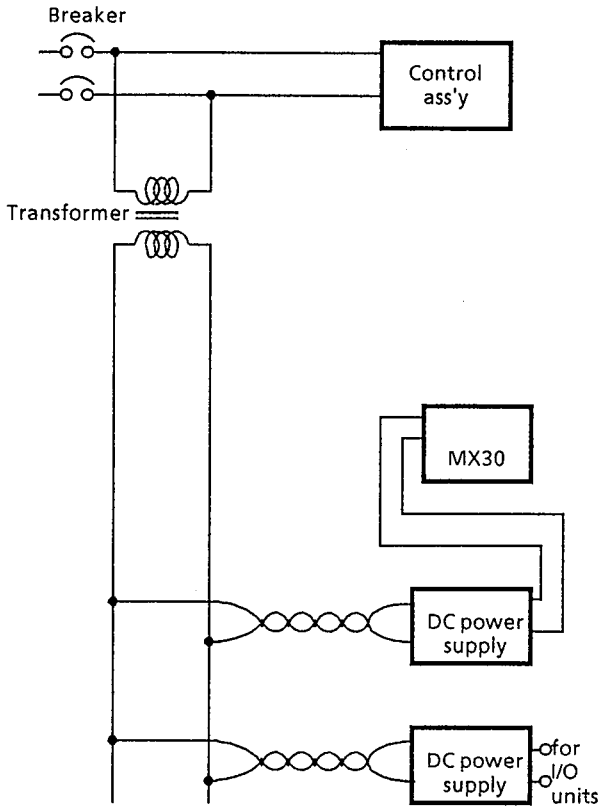
4. Installation and wiring

4 - 1 Precautions on system configuration

- Wiring of power systems
  Separate the power supplies for the drive system, controller system, and DC system from each other by systems for the purpose of preventing a wrong operation due to induction interferences or other failures.

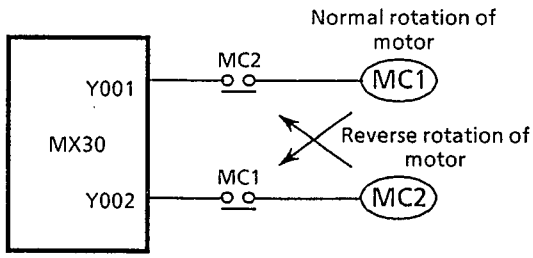


An example of AC power supply

- Separate the MX30 power supply from the I/O power supply as an exclusive power supply.
  Isolate this MX30 power supply from AC input and I/O power supply.
  Prepare a DC power supply of 24V DC ±10%, 0.5A or higher for MX30, and a DC power supply of 12/24V DC for I/O units.

- Consideration to power failures
  When the MX30 power supply is turned on and off, it may function abnormally but temporarily, because of a transient time difference between the MX30 power supply and the external power supply.
  Prepare an external interlock circuit or an external emergency stop circuit so as not to allow these failures or troubles to cause a trouble of the entire system, or cause a damage or accident of a machine due to abnormal functions.

- Interlock circuit
  Assemble an external interlock circuit at portions which may cause the damage or accidents of the machine when a counter operation, like the normal and reverse rotation of a motor, is done by an MX30 output.
  In this example, MC1 and MC2 are not turned on simultaneously, even if output Y001 and Y002 are turned on at a time.



4 - 2 Mounting environment

Take the following precautions into account when mounting MX30 for the purpose of enhancing the system reliability and fully displaying the functions.

■ Mounting place

Don't mount MX30 at the following places.

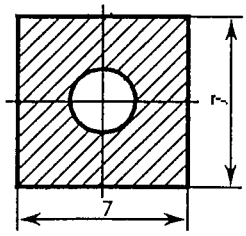
- A place where the ambient temperature exceeds a range of 0 to 55°C
- A place where the ambient humidity exceeds a range of 30 to 90%
- A place where the temperature changes abruptly and the dew condensation is possible
- A corrosive gas atmosphere or a combustible gas atmosphere
- A place where dust particles, salt, iron powder, and other conductive substances exist or organic solvents or the like exist much
- A place exposed to the direct sunlight
- A place where the MX30 unit is directly subjected to vibrations and shocks
- A place where MX30 is splashed with water, oil, chemicals, etc.
- A place where a strong electric field or a strong magnetic field is generated

■ Precautions on installation

Be careful with the following precautions when mounting MX30 to a panel or other systems.

Take the environmental resistance, maintenability, and operability into account, referring to the following description.

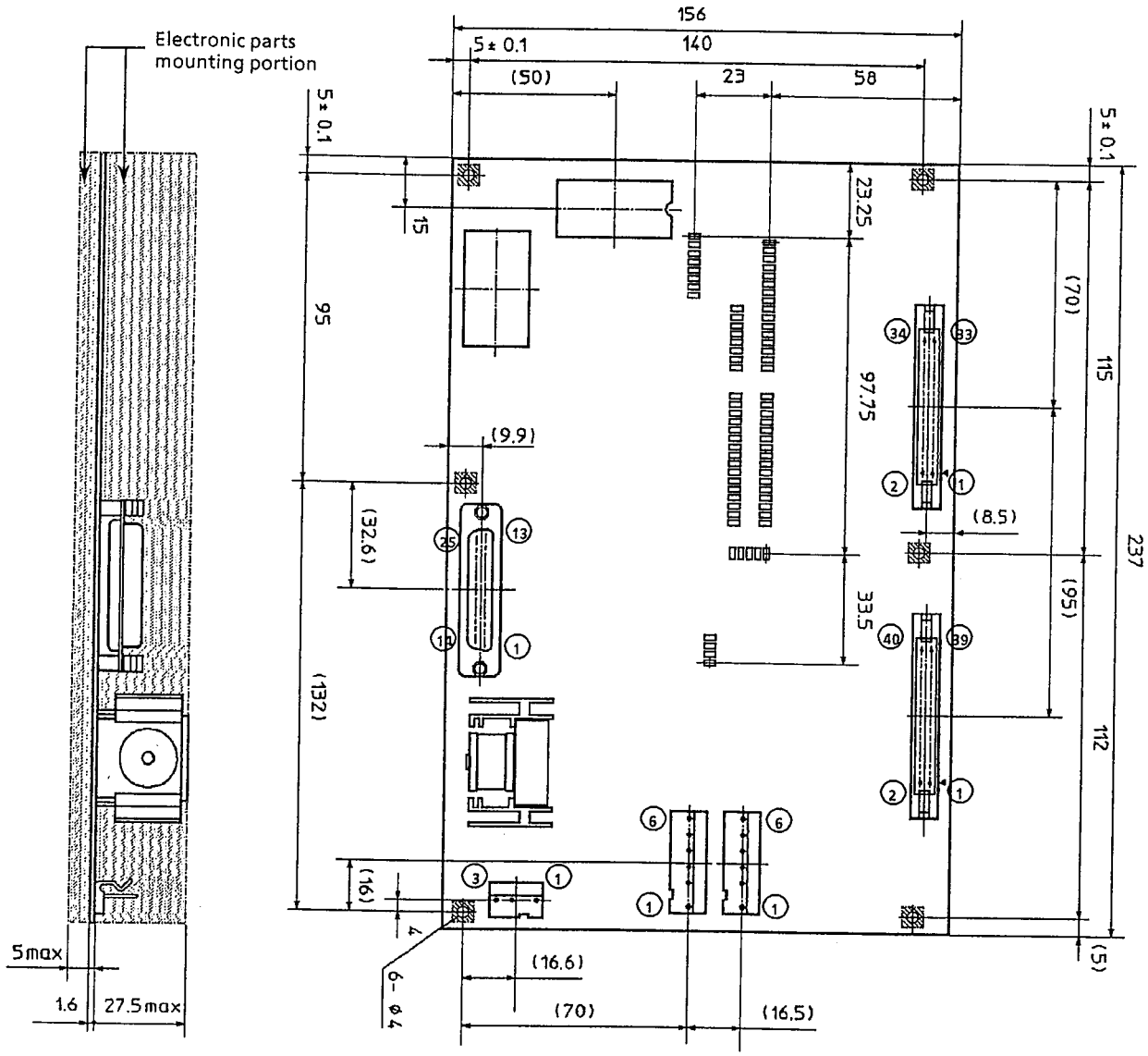
- Keep a space sufficiently for well-ventilation.
- Don't mount MX30 just above a unit having a big heating value (transformer, large-capacity resistor, or the like) inside a panel.
- Mount MX30 on a flat and distortion-free mounting face.
- Separate MX30 from a high voltage unit, a drive power unit, or wiring as far as possible or, mount it on a separate panel.
- Use a wiring duct as occasion demands, but don't interfere with the mounting or dismounting of the ventilation and modules.
- Connect MX30 to the ground as much as possible for improving its noise resistance.
- Don't touch any PCB parts directly by hand, because MX30 is designed as a one-board type.
- Don't touch any PCB parts directly by hand when connecting the connector or when fixing the PCB.
- Keep the PCB fixing support within 7mm square.



4 - 3 External dimensions

■ External dimensions

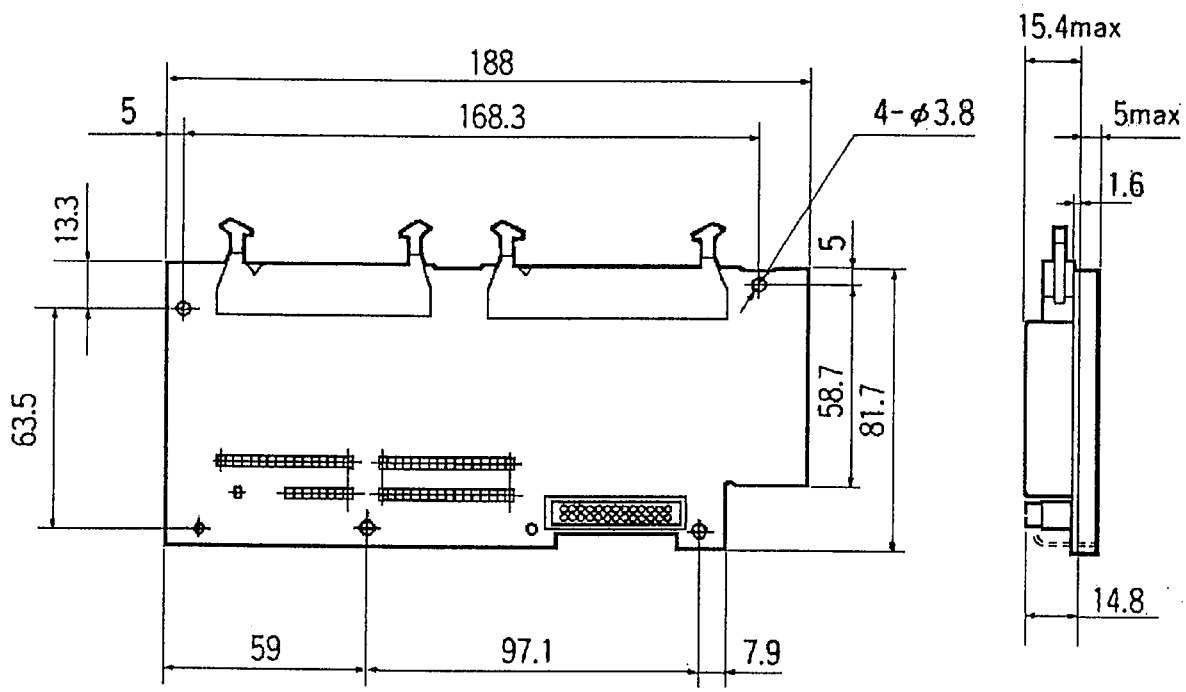
● Basic board



(No.) indicates pin No.

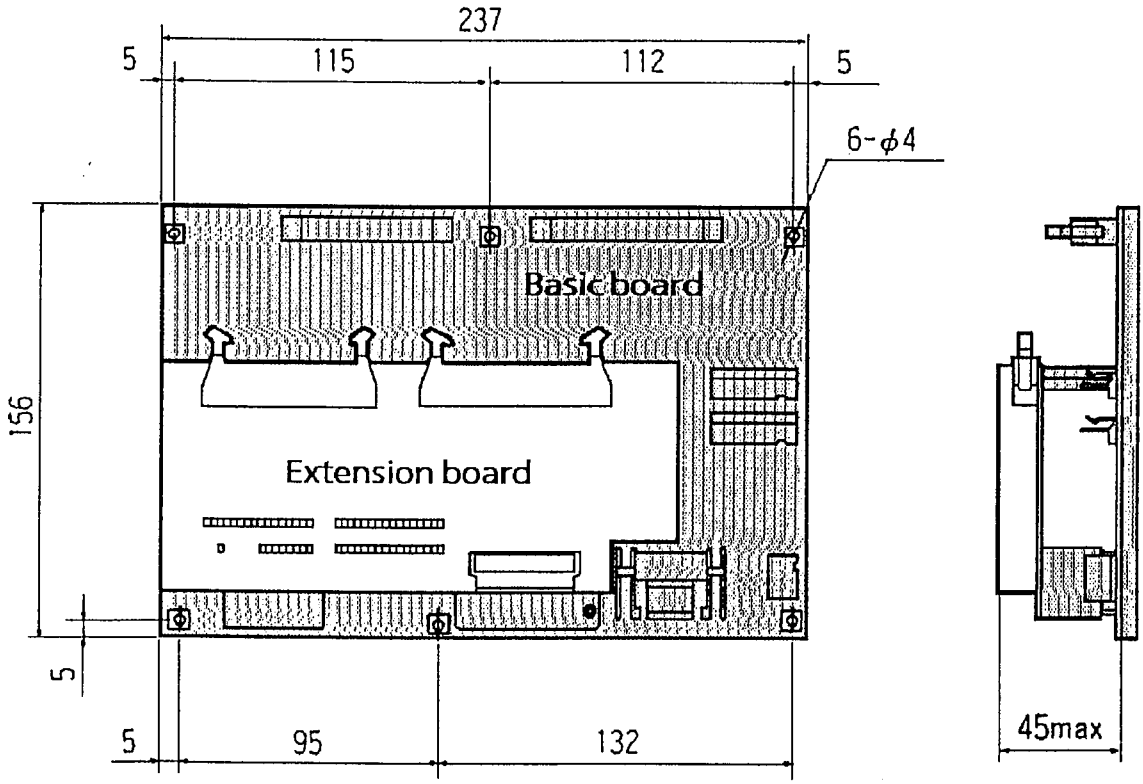
● Extension board

(Unit: mm)



● When the extension board is assembled with the basic board

(Unit: mm)



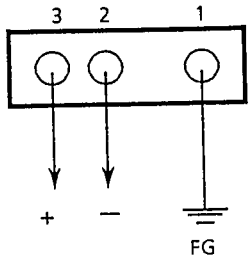
4 - 4 Assembly of extension board

Assemble the extension board to the basic board according to the following procedure when using the extension board.

1. Fix four attached spacers to the extension board by its setscrews. The spacer holes are marked with a white circle on the extension board.
2. Connect the attached connection cable of the extension board to the extension board. The connector is connectable at either end.
   However, be careful with its fitting direction so as not to allow its protrusion to interfere with the board.
3. Connect the other end of the connection cable to the extension connector of the basic board. Be careful not to allow the protrusion to interfere with the board when inserting it.
4. Fix the released end of the spacer to the basic board by the screw.

4 - 5 Wiring

■ Wiring of power supply

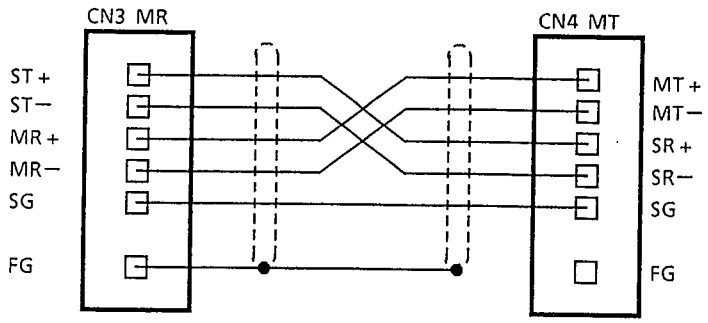


The power supply is 24V DC ± 10%.

- Use the power supply within the allowable voltage range.
- Use a power cable of larger than 2mm^2 so as to prevent a voltage drop.
- Twist the power cable in use.
- Reduce noises by feeding power via an insulation transformer, if noises are superimposed on the power line noticeably.
- Separate the power cable from the drive cable and I/O signal cable from each other. Don't bundle these cables together, or don't put them to be close to each other.
- Connect FG to the ground by using an exclusive grounding wire (category 3 grounding) for preventing noises.
- Use a grounding wire of larger than 2mm^2.

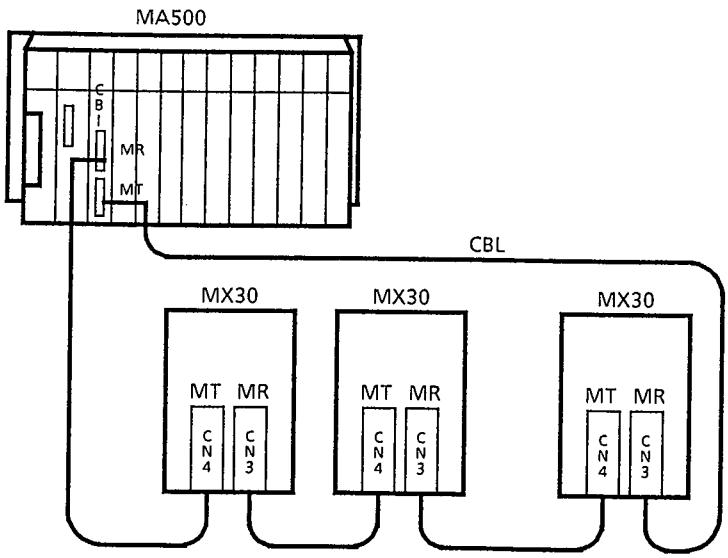
■ Wiring of CBL connector

Basic connection between MT and MR



A recommendable cable is UL-2464-SX-2TX22AWG (3-twisted×2, 6-conductor cable).

Connect the shield of a twisted pair cable to FG on the connector MR side, in principle.



MT : Main ring transmission (Normal transmission side)
MR : Main ring receiving (Normal receiving side)
ST : Subring transmission (Loopback transmission side)
SR : Subring receiving (Loopback receiving side)

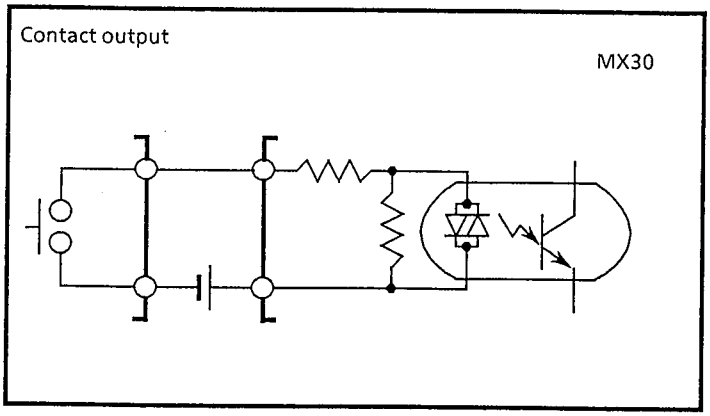
■ Connection to input units

The following figures show the switches and sensors connectable as input units.

Refer to these figures when selecting or connecting input units.

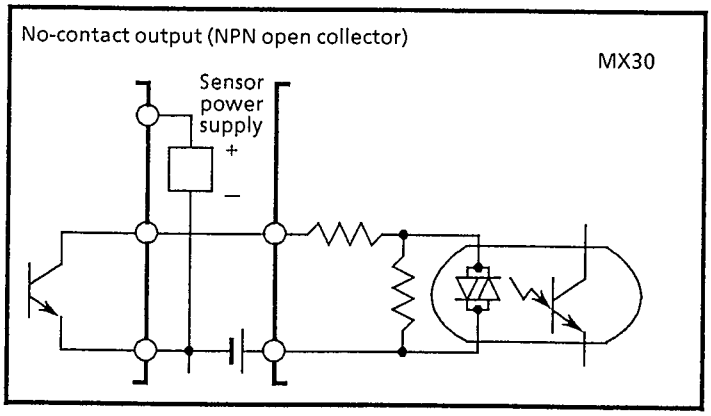
Contact output

MX30



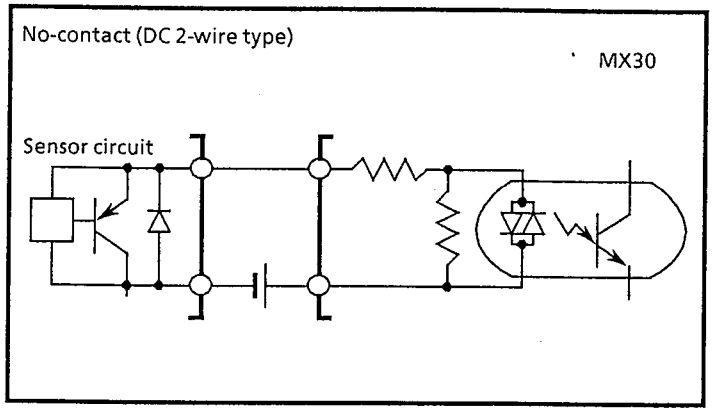
No-contact output (NPN open collector)

MX30



No-contact (DC 2-wire type)

MX30



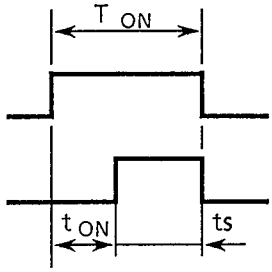
■ Input circuit

● Input circuit

Connect the power supply and contact or no-contact outputs (2-wire type sensor, NPN open collector output, etc.).The input circuit is isolated from the internal circuit by a photocoupler.Apply the specified voltage to turn on and off the input securely.When the input circuit turns on, the input display LED lights.

● ON/OFF time of input signals

The input circuit is provided with a filter circuit for preventing a wrong operation due to noises.
As a result, a response delay occurs due to an ON→OFF and OFF→ON change of inputs.
A certain time is necessary for the controller to recognize whether input is ON or OFF correctly.
Since the input status is read at the start of every scan cycle, the ON-OFF time of an input must be longer than the scan time "ts" at least for reading each input correctly.
The required minimum ON or OFF time is "scan time plus response time".

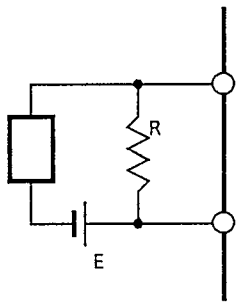


ON time T_{ON} > t ON(Response time OFF →ON) + ts (Scan time)

OFF time T_{OFF} > t ON(Response time ON → OFF) + ts (Scan time)

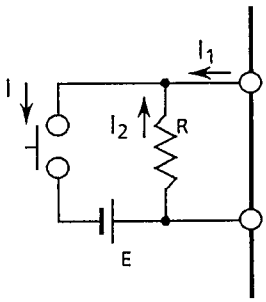
● A leak current of input units

When an LED display is mounted in parallel with contacts, a leak current flows, even if the input is turned off in case of a 2-wire type sensor.
If this leak current is larger than the maximum OFF current, the contacts don't turn off.
In such a case, mount a bleeder resistor to reduce the input impedance as shown in the right figure.



● An input current of a contact input

When an input unit uses contacts, a constant current determined by the input impedance of the input module and input power voltage flows to the contacts.
This current may cause a poor contact failure of certain contacts. In such a case, use bleeder resistor R to increase the contact current.The contact current setting depends upon the contact structure and rating. Check the specifications of the switch employed.



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

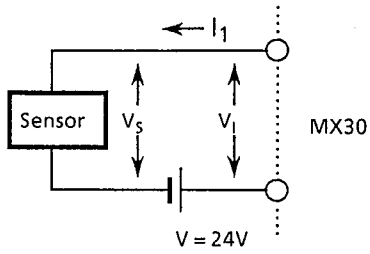
$$R = \frac{E}{I - I_1}$$

Set the resistor capacitance to

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

● A connection example to DC 2-Wire type sensor

Assume that the following parts are used.
Sensor FL7M-2J6 (DC 2-wire type proximity switch)
Input unit power supply 24V DC



Input rating

ON voltage	Higher than 10V
OFF voltage	Lower than 3.5V
OFF current	Lower than 1.5mA
Input current	10mA type (24V DC)
Input impedance	About 2.4kΩ

Sensor rating

Working voltage	DC10 to 30V
Current consumption	0.9mA max.
Residual voltage	3.5V max.
Maximum switching current	100mA
Minimum switching current	5mA

- When the sensor is turned on

The MX30 input voltage is obtained by;

$V_1 = V - V_s = 24 - 3.5 = 20.5(V)$ from the sensor terminal voltage (residual voltage $V_s = 3.5(V)$.
Since $20.5(V) > 10(V)$, MX30 turns on.
The sensor current is within a range of the switching current of the sensor, because $5(mA) < 10(mA) < 100(mA)$ from MX30 input current $I_1 = 10(mA)$.

- When the sensor is turned off

The MX30 input voltage is obtained by;

From the current consumption of the sensor, $I_1 = 0.9(mA)$.
Since $0.9(mA) < 1.5(mA)$, MX30 turns off.
Sensor power voltage $V_s = V - V_1$
$V_1 = 2.4k\Omega \times 0.9(mA) = 2.16(V)$
$V_s = 24(V) - 2.16(V) = 21.84(V)$
Since $8.5(V) < 21.84(V) < 30(V)$, the sensor power voltage is within the range of working voltage of the sensor.

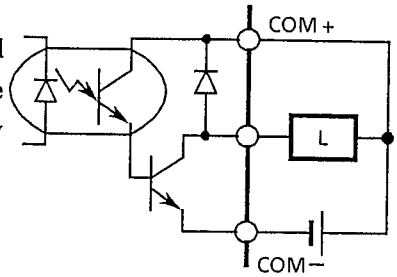
◇CAUTIONS◇

- Perform this calculation under the least favorable condition, if the input unit power voltage fluctuates.
- Assume that the input unit power supply is 12V in the above case. The MX30 input voltage is obtained by Vs = V−VI = 12−3.5 = 8.5(V) when the sensor turns on.
  Accordingly, since the MX input voltage is lower than the ON voltage (10V), MX30 is not employable.
- A certain DC 2-wire sensor turns on transiently when the power supply is turned on.
  For details, refer to the instruction manual for the sensor.

■ Output circuit

● Voltage and current ranges

Particularly be careful not to connect any load exceeding the maximum output current to the output, otherwise a failure or damage may results.



● Output short-circuit protection

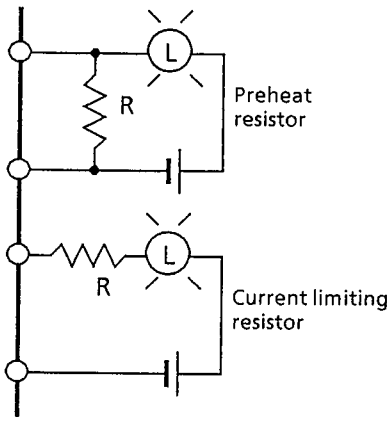
If a load connected to the output connector is shorted, the output element may be broken or the PCB may be burnt.
Mount a fuse externally to protect them from being overloaded.

● Output current limitation

The output current flow per output point and the flowing current per common are limited, respectively.
The maximum output current is 0.2A per point, but it is 0.8A per common.
In this case, the output current per common is not obtained by;0.2A × 8 points = 1.6A

● Lamp load

In case of an incandescent lamp load, a rush current exceeding 10 times the rated current flows for several 10ms when the lamp lights.
This rush current can be reduced by inserting a preheat resistor to dim the lamp even during the output off, or by inserting a current limiting series resistor.
The resistance value must be determined to such an extent as the lighting of the lamp is not recognizable during the output off in case of the former, or to such an extent as the lamp is not too dark during the output on in case of the latter.



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5. Operation

5 - 1 Items to be checked before starting operation

Check the following items before starting operation.

No.	Check items	Contents
1	Connections of power cable and I/O cable	1. Check if 24V DC power supply is fed. 2. Check if a correct cable is connected to each connector. 3. Check if the power connector, I/O connector, and CBL connector are connected securely without looseness.
2	Battery	1. Check if the lead wires and connectors are connected securely. 2. Check if the battery voltage is normal without any drop. (Nominal 3.6V DC)
3	Connection cable	1. Check if the RS-232C cable is connected to the connectors correctly.
4	Mounting of PROM (In case of ROM run)	1. Check if the program capacity loaded in PROM is within 3/7K bytes. 2. Check if PROM is connected to the socket securely. Note) A program is started writing with 4000H in case of a 32K bytes PROM.

5 - 2 Operation start-up procedure

Observe the following start-up procedure for operation after the end of preliminary check before starting operation

	Description
Start of operation	
↓	
1 Turning on the power supply	1. Check the power voltage 2. Check the power voltage for I/O units 3. Turn on the power supply, and make sure that the MX30 POWER LED lights.
↓	
2 Programming	· Write programs into MX30 by using the handy loader or personal computer loader.
↓	
3 Input wiring check	· Set the STOP mode by using the loader, and check the input wiring by I/O multipoint monitor or input display LED.
↓	
4 External output wiring check	· Keep the STOP mode as it is. Turn off all external outputs by the I/O multipoint monitor and the forced reset function of the loader. Check the external outputs one by one by the forced setting function. Note) Forced set and reset can be done up to 128 points.
↓	
5 Operation	· Start running the program in the RUN mode after checking actual program again in TEST mode.
↓	
6 Program check	· Check the sequence operation.
↓	
7 Program correction	· Correct programs, if defective.
↓	
8 Storage of programs	1. When the storage of programs is necessary, write programs into the memory card from the handy loader or into the floppy disk or PROM from the personal computer loader. 2. Programs are printed on the printer as occasion demands.
↓	
End	

◇CAUTION◇ • MX30 is set to the RUN mode to start operating when turning on the power supply.

5 - 3 ROM operation

■ PROM operation method

This paragraph describes the method of operating the MX30 by loading programs into PROM, and then, mounting the PROM to the PROM socket of MX30.

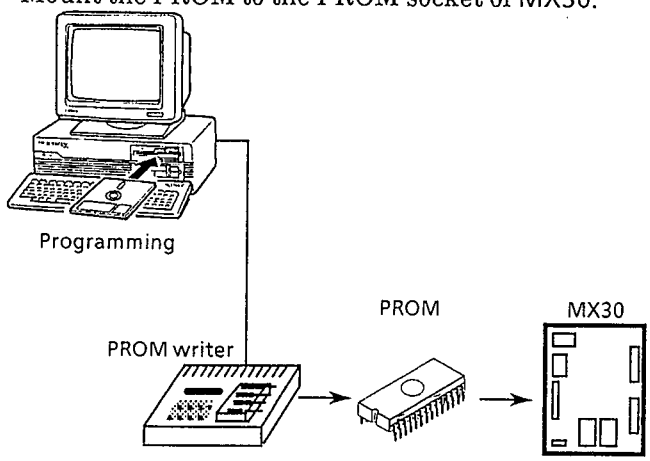
When ROM is used;

(1) The system returns to the PROM programs by turning on the power supply, even if programs are changed in the program mode.

(2) This also applies to the timer and counter set values, correspondingly.

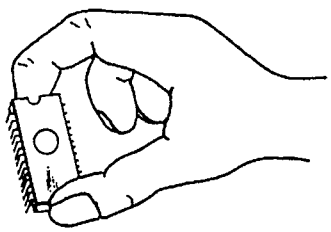
PROM operation

- Prepare programs by the personal computer loader.
  Use a PROM write being available on the market, and connect it to the personal computer by an RS-232C cable.
- Mount the PROM to the PROM socket of MX30.



● Mounting of PROM

1. Prepare the PROM containing written programs
2. Turn off the power supply.
3. Insert the PROM into the IC socket on the PCB.
   Don't touch the PROM leads by hand.
4. Check if the PROM is inserted into the socket securely.



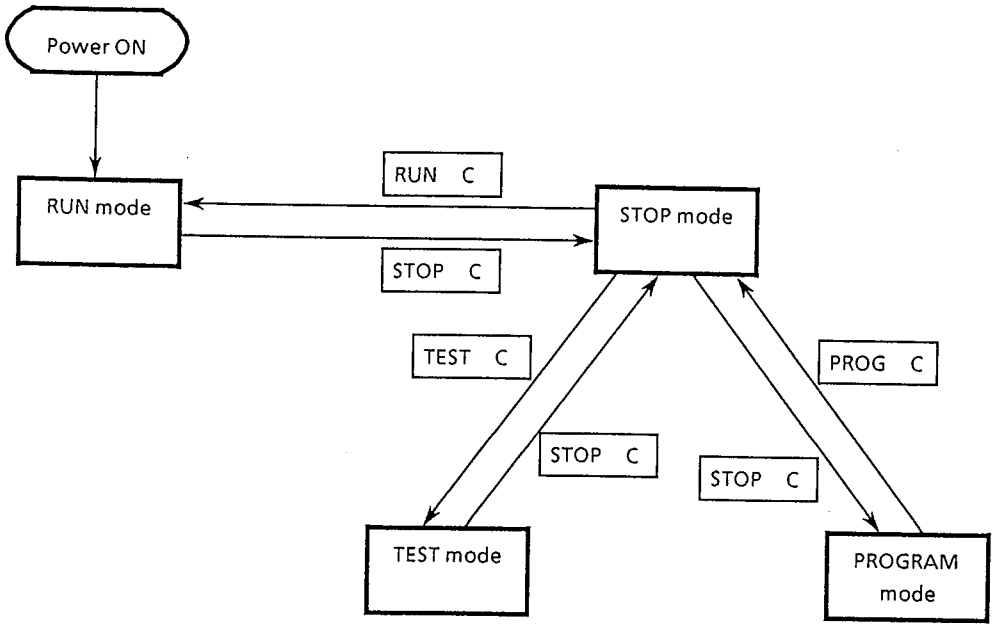
Mounting of PROM

◇CAUTIONS◇

- Never touch the leads by hand, otherwise PROM-IC may be broken by static electricity.
- Be careful with the direction of PROM-IC when inserting PROM into the socket.

5 - 4 Status transition

The operation modes are correlated with each other as follows.



Note) (RUN C), (STOP C), and (PROG C) indicate the mode selection selection commands to be input from the loader.

RUN, TEST, and PROGRAM modes are transferred to each other via STOP mode.

The output is turned off in the STOP mode.

Since MX30 adopts the compile system, it takes 1 to 3sec as a compile time in the following cases.

(1) When the power supply has been turned on or the RESET switch has been pressed;

(2) When the mode is transferred from PROGRAM mode;

(3) When the mode is transferred from TEST mode;

For details, refer to User's manual for machine controller MX series, "Personal computer loader operation version" CP-UM-1602 and user's manual for machine controller MX100 "Handy loade version" CP-UM-1259.

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6. CBL function

6 - 1 General

■ General of CBL

The CBL (Controller Based Link) is a system communication network for decentralizing the system control by arranging various control components decentralizedly. The CBL has comprehensive specifications for connecting various components to the network.

On the other hand, individual control components select their optimum specifications from the entire specifications of CBL to apply these specifications.

MX30 realizes this system by limitedly selecting a part of all specifications of CBL. Now, the entire specifications of CBL will be outlined.

The CBL has two major features shown below.

(1) A communication network established by integrating multiple functions

(2) A highly reliable communication network

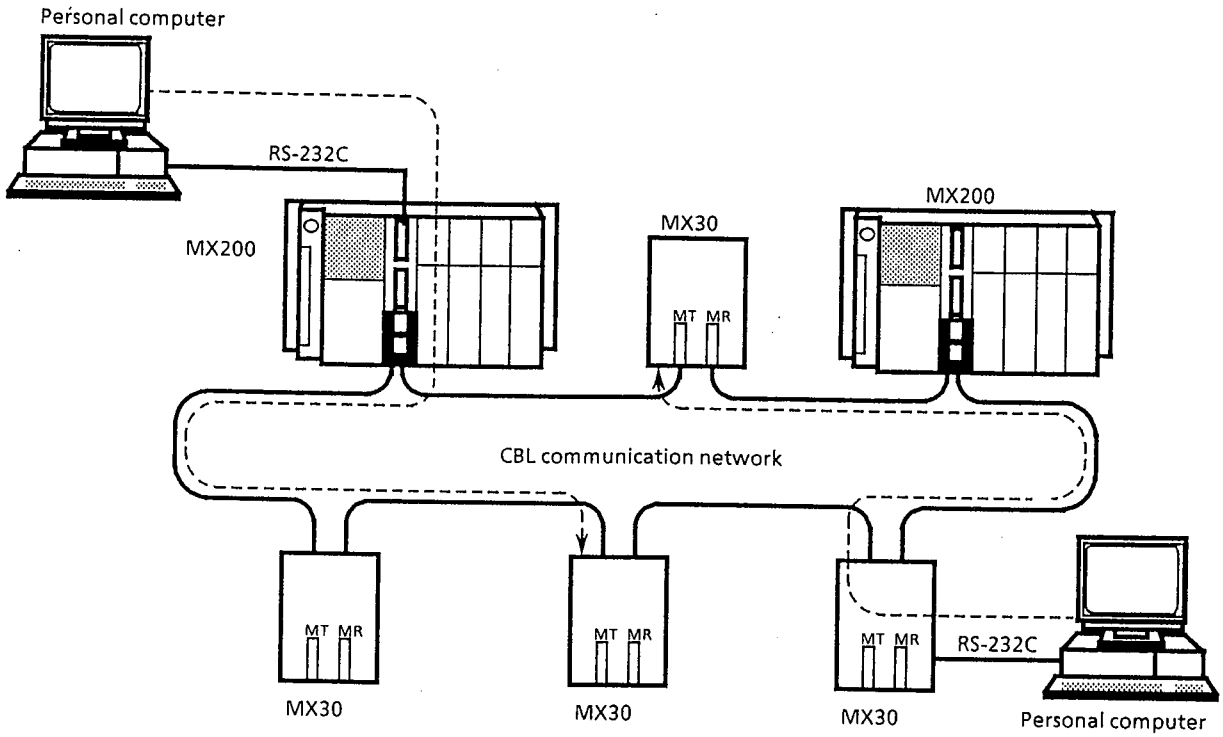
These features will be described in detail.

(1) Integrated communication network

Four communication modes shown below are constructed to function on one network of CBL.

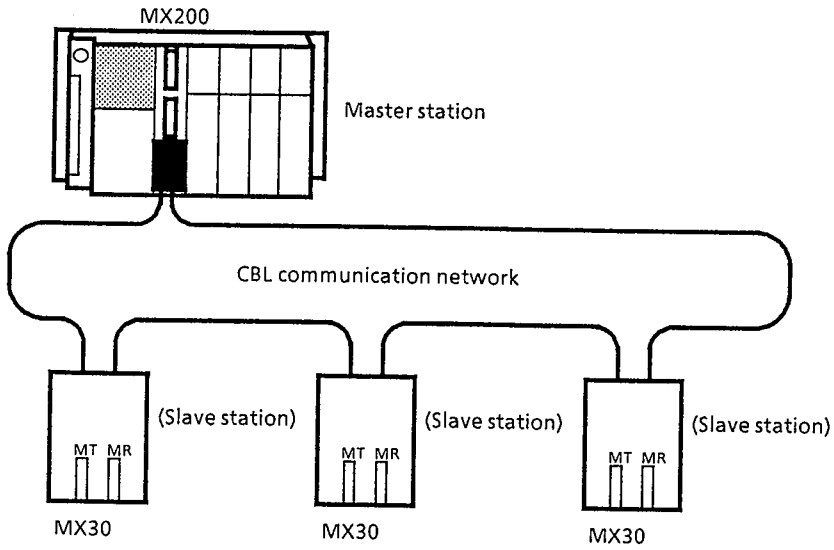
- Host communication

  The host communication (master-slave communication) can be done via the network between the host computer and the nodes other than connection nodes by connecting the host computer to an optional node (station) on the network; on condition that the communication procedure between the host computer and the node as an object of communication conforms to the exclusive Yamatake Corporation procedure.



- PC link : This communication function is provided to exchange data among multiple MX processors being decentralized on the network to use these data as common data. In the PC link, slave and master stations are not identified from each other.
  MX30 does not provide this function.

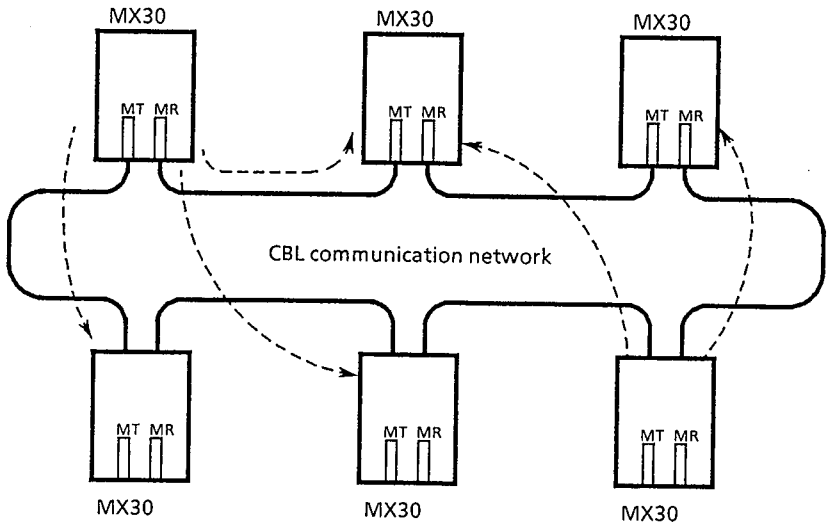
- Remote I/O : This communication function is provided to operate the decentralized I/O on the network in the same way as in the local I/O which directly belong to the processor. Remote I/O contain the master station (processor) and slave stations. MX30 functions as a remote I/O slave station only.



- Mail communication

  This function is provided to exchange data via other nodes and network as occasion demands by setting application programs to a node on the network. This mail communication comprises two operation modes shown below.

  Mail communication
  - One-address communication:
    Sends or receives data from an optional node to the other optional node.
  - Broadcast communication :
    Sends data to all nodes belonging to the same group.



(2) Highly realible communication network

- Communication control by token passing method
  This system maintains the system order by circulating the tokens of the nodes in turn.
  No master station to supervise the network is provided. Accordingly, the loads and risks of the network control are not centralized into one station, and the network functions can be maintained and continued by other nodes, even if an optional node is down.

- Dual communication channels & loopback
  The communication channels are duplicated so that the communication can be continued without trouble by a subcommunication channel, even if the main communication channel is interrupted.
  The network functions can be maintained and continued by other nodes after disconnecting the down node, even if a node should be down.

- Cyclic operation check of main and sub-communication channels
  In the dual communication channels, the subcommunication channel is also checked for normal operation periodically to be ready for use if the main communication channel should have been interrupted.

■ MX30 CBL functions

(1) Hot communication function
(2) Remote I/O slave station function
(3) Mail communication function

■ MX30 CBL specifications

Items	Specifications
Communication control system	Token passing
Channel type	Dual ring
Communication medium	6-conductor twisted pair cable UL-2464-SX-2TX22AWG (Manufactured by Hitachi Cable Co.)
Address setting range*	2 to 63
No. of connection units**	32 units
Communication distance	100m between stations Total extension: 4km
Communication modes	Host communication Remote I/O slave station Mail communication : One-address communication, broadcast communication
Transmission speed	1Mbps
Communication procedure	Conforms to HDLC (JIS 6363)
Error detection	CRC $(X^{16} + X^{12} + X^5 + 1)$
Loopback function	Automatic disconnection of abnormal nodes and automatic reset after recovery
Connection node	MX200, ASCII adapter, POP adapter, CBI module

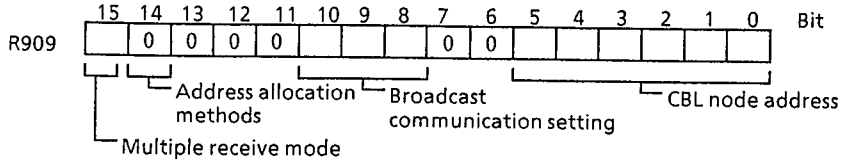
* Set the CBL addresses to 2 to 63 when CBL function is used in MX30.
The CBL function cannot be used, if the address is set to 0.
Don't use address 1.

** No. of connection units is max. 32 units.
The station numbers can be set up to 32 out of 2 to 63.

6 - 2 Preparation for CBL communication

■ CBL communication setting

Various setting to MX30 is necessary for CBL communication.
Set the addresses and communication mode to each bit of special register R909 by the following meaning.
Each bit of register R909 means as illustrated below.



Bit	Setting contents
15	0: Receiving data are written directly in interrupt processing when 2 or more write commands are received during one scan or when the broadcast communication is received. Data are not skipped processing due to the absence of simultaneity of data. 1: The second and subsequent data are neglected when two or more write commands are received during one scan or broadcast communication is received.Data are skipped processing.
14	Address allocation methods of parameter setting area (Applies to version S09 or higher.) 0: Decimal setting 1: BCD setting
13 to 11	Set to 0 at all times.
10	Broadcast communication to group 3 (FAH) 0: Does not receive. 1: Receives
9	Broadcast communication to group 2 (F9H) 0: Does not receive. 1: Receives
8	Broadcast communication to group 1 (F8H) 0: Does not receive. 1: Receives
7	Set to 0 at all times.
6	Set to 0 at all times.
5 to 0	Station No. of CBL node (2 to 63) CBL function is not employable when station No. is 0. Not accessible from MX30 of station No.2 to 63 by means of host communication via CBL when station No. is 1.

The register area designated by R91□ is set as the parameter area, and the send/receive operation is done according to the contents of parameters
The register area is designated by decimal numbers when bit 14 of R909 is 0 or by BCD when bit 14 is 1.
For example, R100 to become the parameter area when bit 14 = 0 and R91□ = K100, or R200 to become the parameter area when bit 14 = 1 and R91□ = #200 (200H).

◇CAUTIONS◇

- New setting becomes effective after resetting the system (after starting up the power supply again) when setting of R909 was newly replaced by the loader or the like.
- When address is set to 0, the CBL function cannot be used. Don't set address to 1.

- The CBL alarm check function depends upon the setting addresses. The CBL communication LSI failure is checked in all cases, irrespective of the setting contents. However, the CBL communication operating conditions are not checked at address 0. Even if MX30 is not connected to the CBL network, it is not recognized as an alarm in an extreme case. Set the address to 0, if MX30 having CBL function is used independently as an intentional action.

CBL address	CBL communication LSI M995	Communication condition M909 to M90C
Address 0	1 in case of a trouble	All 0
Address 2 to 63	1 in case of a trouble	Status display

M909 : Occurrence of a CBL line trouble
M90A : CBL loopback A condition
M90B : CBL loopback B condition
M90C : CBL sampling error

- Set bit 15 to 0 when real-time status monitoring or real-time error processing is necessary.

6 - 3 Host communication function

The host communication function of MX30 is provided to communicate with other MX30 on the network by connecting a personal computer to optional MX30 on the CBL network.
The communication protocols between the personal computer and MX30 must be Yamatake-Corporation's exclusive procedures (called CPL communication standard.)
Since the communication protocols of MX personal computer loader conform to the CPL communication standard, the personal computer loader can be operated in the online mode via the CBL network.

■ Operation method

(1) Connect a personal computer to RS-232C port of MX30.
(2) Set the data format/transmission speed to meet the MX30 to which the loader is connected.
(3) Start up the MX loader in the on-line mode.
(4) Set the communication conditions by pressing [HOME CLR] key.

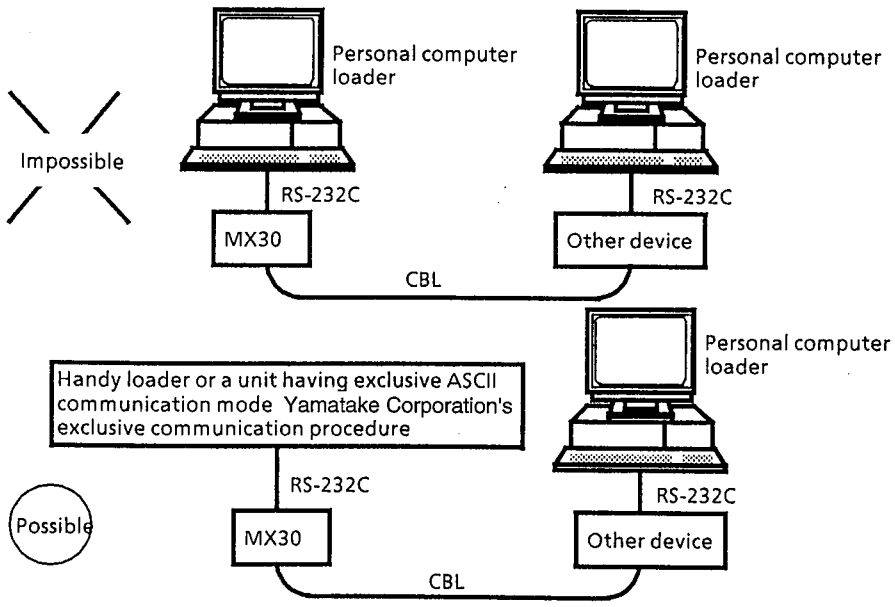
■ Precaution to be observed when the access is made to MX30 from two or more hosts simultaneously by means of host communication.

● Access to MX30 cannot be done simultaneously from two or more hosts via CBL, otherwise monitoring function, etc. are not executed correctly to cause a communication timeout error.

● For simultaneous accesses to MX30 from two systems consisting of the host communication and RS-232C port via CBL.

- Set the transmission speed of the RS-232C port (to which the personal computer is connected) to less than 9600bps.
- Neither user program nor device data can be changed.
- Device data can be monitored.

● Access to MX30 cannot be done by the personal computer loader from two systems.
Access of the personal computer loader can be done from other stations via CBL to the MX30 where a unit other than the personal computer loader is connected.



6 - 4 Remote I/O slave station function

The remote I/O slave station function is provided to operate MX30 as a remote I/O of MX200 (remote I/O master station).
The I/O allocation is necessary for remote I/O in the same way as in general-purpose I/O.
The remote I/O allocation can be done by two methods.

- Default value allocation (MX30: input 3 words/output 3 words)
- Variable data length allocation by special registers R920 and R921

■ Default Value Allocation

- MX200 - MX30

P register area: 3 words ← Output 3 words: Y200 to 22F
P register area: 3 words → Input 3 words: X200 to 22F

■ Variable data length allocation

Default/variable selection and data length designation are done by special registers R920 and R921.
Default/variable data length switching setting register: R920
When the high-order byte value of R9200 is 30H, the data length is changed to the value specified by R921.
When the high-order byte value of R920 is other than 30H, R921 data are neglected.

- Data length designation register : R921
  High-order byte of R921 : No. of MX30 input words (No. of MX200 output words)
  Maximum setting number 10
  Low-order byte of R921 : No. of MX30 output words (No. of input words of MX200)
  Maximum setting number 10

R920 and R921 values at the start-up time of the system (MX200, MX30) power supply becomes effective.
When R920 and R921 have been changed, the changed MX30 and MX200 must be reset.
(Example)
Conditions
MX30 : CBL address 3, remote input 7 words, remote output 5 words
MX200 : Remote I/O master station, operated in twin mode
Set the registers as follows.
R920 = #3000H、 R921 = #0705H
The following remote I/O network is constructed.

- MX200 - MX30

P0300 to P0306 ← Output 7 words: Y200 to 26F
P0350 to P0354 → Input 5 words: X200 to 24F

◇CAUTION◇

- As viewed from MX200 side, the MX30 output is reversely related with MX200 input, while MX30 input is reversely related with MX200 output.

6 - 5 Mail communication function

The mail communication function is provided to exchange data as occasion demands by controlling the nodes on the network from an optional MX30 by means of user programs.
The mail communication comprises the following functions.

(1) One-address communication
(2) Broadcast communication

MX30 realizes the mail communication by using special contacts, special registers, and register area (R000 to R499). The setting methods and processing methods in these communication functions are based on the same concept.

Special registers : The register area specified by R91□ is designated as a parameter area, and data are sent and received according to the content of the parameters in this parameter area.
The register area is specified by decimal digits if bit 14 of R909 is 0 or by BCD if bit 14 of R909 is 1.
R100 to becomes the parameter area when bit 14=0 and R91□=K100, or R200 to becomes the parameter area when bit 14=1 and R91□=#200(200H), for example.

In the send processing, a communication command is issued when M91□ has changed from OFF to ON.
In the receive processing, receiving data/status are loaded into the parameter area.

■ Comparison table of mail communication functions

Function	Type of mail			
	One-address communication		Broadcast communication	
	Read	Write	Receive	Send
Objective area	All devices*	All devices*	All devices*	All devices*
Communication object	1 node	1 node	Group	Group
Response check	Checked	Checked	Not checked	Not checked
Special contact	M910	M911	M912	M913
Special register	R910	R911	R912	R913
Parameter length	5 to 123	5 to 123	6 to 123	6 to 123
Send data length	0	1 to 119	0	1 to 118
Receive data length	1 to 119	0	1 to 118	0

* All devices mean X, Y, L, M, R, T/C areas of MX30

◇CAUTIONS◇

- If a mail is issued to an absent node address on the network during mail communication, the communication retry processing is started repeatedly. As a result, the CBL communication is delayed to cause the normal communication response time to be not attainable. Issue a mail to an existing node without fail.
- MX30 executes the send processing to the network once every scan only.
  The send processing comprises the remote I/O communication, host communication, response to the other stations, etc. in addition to the mail communication.
  If these request-to-send are issued simultaneously, the issue of intraoffice mail is kept standing by for several scans until the mail has been sent after the request-to-send (M90q) was turned on.

- For the data to be accessed in the mail communication, their simultaneity and consistency are generally secured in one scan in the same way as in I/O data employed by user programs.
  Use them in the multiplex receive disable mode (received data are updated at the scan boundary) normally.
  Since MX30 is provided with one receive buffer, it discards the second and subsequent receive commands, if multiple commands are received in one scan.
  Select the multiplex communication mode for data which represent the status of units, or other real-time information and cannot be skipped.

■ One-Address communication

This function is provided to send or receive data from an optional node to other optional node.

This one-address communication comprises the following two communication modes according to whether a response is issued to verify the arrival of a communication message to the opposite address or not.

(1) Response returns : Since the termination of messages can be verified, the communication can be done securely.

(2) No response returns : Since communication messages can be sent without waiting for the response to verify the termination, the communication can be done speedily.

● One-Address communication (with a response)

One-address communication (with a response) offers two functions shown below.

Read function : Reads data of a designated device of a designated node.

Write function : Writes data into a designated device of a designated node.

- Read function

The read function reads data of a device designated into the parameter area of own node by issuing a command (to turn on the special contact M910 by the user program).

This read function is started according to the following procedure.

(1) Set the "read parameters" to the register area designated by special register R910.

(2) Turn on special contact M910.

(3) A command is issued from MX30.

(4) MX30 turns off M910 automatically when a response to the command has returned.

(5) The contents of the return to the command are stored into the register area designated by R910.

- Read parameter area

Register	(High-order bytes)	(Low-order bytes)
Rn	Command(08H)	Transfer parameter length
Rn + 1	Opposite node address	Opposite subaddress
Rn + 2	Communication status	No. of read data
Rn + 3	Read address	
Rn + 4	Read data	
⌇		

Rn : Register No. designated to R910

Command : 08H

Opposite node address : 1 to 63(excluding own node addresses)

Opposite subaddress : 0 to 255 This is set for only an opposite device which requires setting.

No. of read data : 1 to 119(words)Designates a desired No. of data to be read by words.

Read address : 0 to FFFF(H) Designates a device address to be read.Refer to the device address table. (on page 6-20)

When a response to the command is received, the following data are stored into the(▒)portion of the parameter area.

Transfer parameter length : Total length of response (No. of words) 5 to 123

Communication status : Refer to the communication status (page 6-19)

◇CAUTION◇

- If a parameter error occurs during the issue of a command, (M918: ON) does not send any command. Request-to-send (M910) remains turned on.

- Read command parameter check
  The following table shows the check contents to be done by MX30 automatically during the command send and the functions of individual special contacts. If a command cannot be sent (M910 remains turned on without being turned off), locate an abnormal parameter, and correct it, referring to the following table.

Item	Normal parameter	Abnormal parameter	Request-to-send M910	Parameter error M918	Response error M91C
Command	08H	Other than 08H	Remains turned on	ON	-
Transfer parameter length	-	-	-	-	-
Opposite node address	1 to 63	0, 64 to 255	Remains turned on	ON	-
Opposite subaddress	0 to 255	-	-	-	-
No. of read data	1 to 119	0, 120 to 255	Remains turned on	ON	-
Read address	0 to FFFF	-	-	-	-

- Read response check
  The following table shows the check contents to be done by MX30 automatically and the functions of special contacts during the response receive.

Item	Normal parameter	Abnormal parameter	Request-to-send M91 0	Parameter error M918	Response error M91C
Command	08H	-	OFF	-	-
Transfer parameter length	No. of read data +4 (5 to 123)	-	OFF	-	-
Opposite node address	1 to 63	-	OFF	-	-
Opposite subaddress	0 to 255	-	OFF	-	-
Communication status	0000 0000	*000 ***1 *000 *1*1 Bit 0: An error occurs. Bit 2: Parameter error	OFF	Turns on when bit 0 = 1 and bit 2 = 1.	Turns on when bit 0 = 1.
No. of read data	Same number as in command send	A different number from the number in command send	OFF	-	ON
Read address	Same address as in command send	A different address from the address in command send	OFF	-	ON

- Write function

  The write function writes data in the parameter area of own nodes into a device designated in a designated node by issuing a command (to turn on special contact M911 by a user program).

  Whether data have been written correctly or not can be checked by the common status in the parameter area of own node.

  The write address node cannot sense any written data.

  (Same as in data change by the host communication of MX100)

  The write function is started according to the following procedure.

  (1) Set "write parameters" to the register area designated by special register R911.

  (2) Turn on special contact M911.

  (3) A command is issued from MX30.

  (4) MX30 turns off M911 automatically when a response to the command has returned.

  (5) The contents of the response to the command are stored into the register area designated by R911.

- Write parameter area

Register	(High-order byte)	(Low-order byte)
Rn	Command(09H)	Transfer parameter length
Rn + 1	Opposite node address	Opposite subaddress
Rn + 2	Communication status	No. of write data
Rn + 3	Write address	
Rn + 4	Write data	
⌇		

Rn : 09H

Command : 5 to 123

Opposite node address : 1 to 63(excluding own node addresses)

Opposite subaddress : 0 to 255

Write destination address : 0 to FFFF(H) Designate a device address to be read.
Refer to the device address table
(on page 6-20)

The following data are stored into the (▒▒) part of the parameter area when a response to the command is received.

Communication status : Refer to the communication status (page 6-19)

◇CAUTIONS◇

- Write data length (word length) n is n = transfer parameter length − 4: 1 to 119 words.
- If a parameter error occurs during the issue of a command, (M919: ON), the command is not sent.
  Send-to-request (M911) remains turn on.

- Write command parameter check

  The following table shows the check contents to be done by MX30 automatically and the functions of special contacts during the command send.

  If a command cannot be sent (M911 remains turned on without being turned off), locate an abnormal parameter, and correct it, referring to the following table.

Item	Normal parameter	Abnormal parameter	Request-to-send M911	Parameter error M919	Response error M91D
Command	09H	Other than 09H	Remains turned on	ON	-
Transfer parameter length	5to123	0 to 4, 124 to 255	Remains turned on	ON	-
Opposite node address	1to63	0, 64 to 255	Remains turned on	ON	-
Opposite subaddress	0to255	-	-	-	-
Write address	0toFFFF	-	-	-	-
inal write data loading register ⑨	to R499	Exceeds R499. Example: R911 = K495 Transfer parameter length ≧ 6	Remains turned on	ON	-

- Write response check

  The following table shows the contents of the check to be done by MX30 automatically and the functions of special contacts during the response receive.

Item	Normal parameter	Abnormal parameter	Request-to-send M911	Parameter error M919	Response error M91D
Command	09H	-	OFF	-	-
Transfer parameter length	Same number as in command send	A different number from the number in command send	OFF	-	ON
Opposite node address	1 to 63	-	OFF	-	-
Opposite subaddress	0 to 255	-	OFF	-	-
Communication status	0000 0000	*000 ***1 *000 *1*1 Bit 0: An error occurs. Bit 2: Parameter error	OFF	Turns on when bit 0 = 1 and bit 2 = 1.	Turns on when bit 0 = 1.
No. of write data	Transfer parameter length −4 (5to123)	-	OFF	-	-
Write address	Same address as in command send	A different address from the address in command send	OFF	-	ON

● One-address communication (without a response)

For the one-address communication without response, set the following receive and send functions.

Receive: This function is provided to read a message to own node issued by another node.

The receive function is started according to the following procedure.

(1) Set "receive parameters" to the register area designated by special register R912.

(2) Turn on special contact M912 (receive enable flang).

(3) MX30 turns off M912 automatically when it has received the command.

(4) The message contents are stored into the register area designated by R912.

- Receive parameter area

The parameters preset in the send source are read into this parameter area, except for [command (8B(H))].

Register	High-order bytes	Low-order bytes
Rn	Command (8BH)	Transfer parameter length
Rn + 1	Opposite node address	Opposite subaddress
Rn + 2		No. of receive data
Rn + 3	Write destination address	

Rn : Register number designated to R912

Command : Designates OB(H). No receive is done without this command setting.

When the message is received, the following data are stored into the (▒) part of the parameter area.

Transfer parameter length : Total length of data sent from the send source (6 to 123 words)

Opposite node address : Sent node address 1 to 63

Opposite subaddress : Sent node subaddress (0 to 255)

Receive data length : Written receive data length (1 to 118 words)

Write destination address : Data loading destination address.Refer to the communication status(on page 6-19).

- Receive parameter check

Item	Normal parameter	Abnormal parameter	Receive flag M912	Receive error M91E
Command	8BH	Other than 8BH	Remains turned on	-
Transfer parameter length	6to123	(5, 124 to 255)	OFF	-
Opposite node address	1to63	-	OFF	-
Opposite subaddress	0to255	-	OFF	-
No. of receive data	1to118	0, 119 to 255	OFF	ON
Receive address	Effective byte address of MX30	Other than effective byte address of MX30	OFF	ON

Send: This function is provided to write a message to a designated address. This send function is started according to the following procedure.

(1) Set "send parameters" to the register area designated by special register R913.

(2) Turn on the special contact M913 (communication start flag).

(3) MX30 turns off M913 automatically when a command is issued to the network.

◇CAUTION◇

- Whether data have been written into the send address correctly or not cannot be verified in the send source node.
  The send source node can detect that data have been written by a change of special contact M912.

- Send parameter area

Register	(High-order bytes)	(Low-order bytes)
Rn	Command (8BH)	Transfer parameter length
Rn + 1	Opposite node address	Opposite subaddress
Rn + 2	0	
Rn + 3	Write destination address	
Rn + 4	0	
Rn + 5	Write data	
≀		

Command : 8B(H)
Transfer parameter length : 6 to 123words
Opposite node address : 1 to 63
Opposite subaddress : 0 to 255
Write destination address : 0 to FFFF(H)
Refer to device address(on page 6-20)

◇CAUTION◇

- No data are sent if a parameter error occurs.

- Send parameter check
  The following table shows the contents to the check to be done by MX30 automatically and the functions of special contacts during the send.

Item	Normal parameter	Abnormal parameter	Send-to-request M913	Parameter error M91B
Command	8BH	Other than 8BH	Remains turned on	ON
Transfer parameter length	6 to 123	0 to 5, 124 to 255	Remains turned on	ON
Opposite node address	1 to 63	0, 64 to 255	Remains turned on	ON
Opposite subaddress	0 to 255	-	-	-
Write address	0 to FFFF	-	-	-
Final write data loading resistor	to R499	Exceeds R499. Example: R913 = K494 Transfer parameter length ≧ 7	Remains turned on	ON

■ Broadcast communication

This function is provided to send data to all nodes belonging to the same group at the same time.

Broadcast command : Start command of broadcast communication issued by the send source of broadcast communication

Broadcast message : Parameters and data to be sent together with broadcast command

For the broadcast communication, the broadcast receive and broadcast send functions must be set.

● Broadcast receive

This function receives a broadcast command issued from another node, and reads a broadcast message.

The broadcast receive is issued according to the following procedure.

(1) Set "broadcast receive parameters" to the register area designated by special register R912.

(2) Turn on the special contact M912 (broadcast receive enable flag).

(3) MX30 turns off M912 automatically when it has received the broadcast command.

(4) The contents of the broadcast message are stored into the register area designated by R912.

● Broadcast receive parameter

The parameters being set by the broadcast send source can be read into this parameter area, except for [command [8B(H)]].

Register	(High-order byte)	(Low-order-byte)
Rn	Command (8BH)	Transfer parameter length
Rn + 1	Opposite node address	Opposite subaddress
Rn + 2		No. of receive data
Rn + 3	Write address	

Rn : Register No. designated to R912

Command : 8B(H) is designated. Broadcast receive is not executed by other setting.

When the broadcast message is received, the following data are loaded into the (▨) part of the parameter area.

Transfer parameter length : Total length of data sent from the send source (6 to 123 words).

Opposite node address : Node address where broadcast send was done (1 to 63).

Opposite subaddress : Node subaddress where broadcast send was done (0 to 255).

Receive data length : Written receive data length (1 to 118 words).

Write destination address : Data loading destination address

Refer to the device address table. (page 6-20)

● Broadcast receive check

Item	Normal parameter	Abnormal parameter	Receive flag M912	Receive error M91E
Command	8BH	Other than 8BH	Remains turned on	-
Transfer parameter length	6to123	(5, 124 to125)	OFF	-
Opposite node address	1to63	-	OFF	-
Opposite subaddress	0to255	-	OFF	-
No. of receive data	0~118	0,119~255	OFF	ON
Receive address	Effective byte address of MX30	Other than effective byte address of MX30	OFF	ON

● Broadcast send

This function is provided to send a broadcast command to send a broadcast message.

This broadcast send function is started according to the following procedure.

(1) Set "broadcast send parameters" to the register area designated by special register R913.

(2) Turn on the special contact M913(broadcast communication start flag).

(3) When the broadcast command is issued to the network, MX30 turns off M913 automatically.

◇CAUTION◇

- Whether data have been written into the send address correctly or not cannot be verified by the issue source node.
  The send destination node can detect that data have been written by a change of special contact M912.

● Broadcast Send Parameter Area

Register	(High-order byte)	(Low-order-byte)
Rn	Command (8BH)	Transfer parameter length
Rn + 1	Opposite node address	Opposite subaddress
Rn + 2	0	
Rn + 3	Write address	
Rn + 4	0	
Rn + 5	Write data	
⋮		

Command : 8BH

Transfer parameter length : 6to123

Opposite node address : F8(H)=248[when addressed to broadcast group1]
F9(H)=249[when addressed to broadcast group2]
FA(H)=250[when addressed to broadcast group3]

Opposite subaddress : 0 to 255

Write destination address : 0toFFFF(H)
Refer to the device address table.(on page 6-18)

◇CAUTIONS◇

- Don't use any addresses other than the above group addresses as opposite node addresses.
- The broadcast send is not done if a parameter error occurs.

● Broadcast send check

The following table shows the contents to the check to be done by MX30 automatically and the functions of special contacts during the broadcast send.

Item	Normal parameter	Abnormal parameter	Receive flag M913	Receive error M91B
Command	8B(H)	Other than 8BH	Remains turned on	ON
Transfer parameter length	6 to 123	(0 to 5, 124 to 125)	Remains turned on	ON
Opposite node address	248, 249, 250	0 to 247 251 to 255	Remains turned on	ON
Opposite subaddress	0 to 255	-	-	-
Write address	(0 to FFFF)	-	-	-
Final write data loading register ⑨	to R499	Exceeds R499. Example: R913 = K494 Transfer parameter length ≧ 7	Remains turned on	ON

■ Details of parameters

Out of the parameters required for realizing the mail communication function, the device addresses and communication status will be described below.

● Device addresses

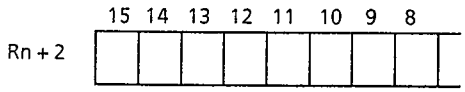
In MX programs (ladder or MCL), devices are identified from each other by prefixing X/Y/M/L/T/C to bit devices, or R to word devices. In the CBL communication, the addressing is done by a series of numbers which integrate the bit devices and word devices. These series of numbers are called "device addresses".
In practice, users must be conscious of devices in "mail communication" only out of the CBL communication. In the mail communication functions, the device addresses given on the next page are used as read destination/write destination addresses to be set to parameters.

◇CAUTION◇

- The numerics of these addresses are decimal numbers. They are set to parameters as binary values.
  Example: M300 → 230(D) → 00E6(H)

● Communication status

The status are common to all responses when the read command/write command of one-address communication are issued.



The following table shows the means of individual bits.

Bit	Meaning of bit
8	0 : Normal 1 : Abnormal The contents are shown by the following bits.
9	1 : A non-supported response was received.
10	1 : A command parameter error
11	1 : A command was terminated abnormally.
15	1 : Others

- Device addresses table

Device area	Device addresses	No. of words
X000 to X09F	0 to 9	10
X200 to X29F	20 to 29	10
Y000 to Y09F	50 to 59	10
Y200 to Y29F	70 to 79	10
L000 to L49F	100 to 149	50
M900 to M99F	150 to 159	10
M000 to M49F	200 to 249	50
T/C contact T/C000 to T/C199	*300 to 312	13
T/C000 to 199 Present value	1000 to 1199	200
T/C000 to 199 Set value	1400 to 1599	200
R000 to R499	2000 to 2499	500
R500 to R519	2500 to 2519	20
R600 to R619	2600 to 2619	20
R900 to R939	2900 to 2939	40

* T/C contacts (300 to 312) allocate a T/C contact to 1 bit of each word. The correspondence to each T/C number (T/C000 to T/C199) is shown in the following table.

Device address	Bit number															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
300	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
301	031	030	029	028	027	026	025	024	023	022	021	020	019	018	017	016
302	047	046	045	044	043	042	041	040	039	038	037	036	035	034	033	032
303	063	062	061	060	059	058	057	056	055	054	053	052	051	050	049	048
304	079	078	077	076	075	074	073	072	071	070	069	068	067	066	065	064
305	095	094	093	092	091	090	089	088	087	086	085	084	083	082	081	080
306	111	110	109	108	107	106	105	104	103	102	101	100	099	098	097	096
307	127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112
308	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129	128
309	159	158	157	156	155	154	153	152	151	150	149	148	147	146	145	144
310	175	174	173	172	171	170	169	168	167	166	165	164	163	162	161	160
311	191	190	189	188	187	186	185	184	183	182	181	180	179	178	177	176
312	—	—	—	—	—	—	—	—	199	198	197	196	195	194	193	192

- Method of designating the addresses every device

[1] Device addresses in X, Y, L, M (other than special ones) area

Example : M290 to 29F (in units of words)

From the comparison table, M290→0229(D) = 00E5(H)

[2] M900 to Device addresses in special contact area

Example : M930 to 93F (in units of words)

From the comparison table, M930→0153(D) = 0099(H)

[3] Device addresses in R area

Example : R439

From the comparison table, R439→2439(D) = 0987(H)

Example : R910

From the comparison table, R910→2910(D) = 0B5E(H)

[4] Device addresses of T/C contact area

Example : T120 contact

From the comparison

T120 contact →307(D) = 8th bit of 0133(H)

[5] Device addresses of T/C present value and set value area

Example : T070 present value, set value

From the comparison table;

T070 present value→1070(D) = 042E(H

T070 set value→1470(D) = 05BE(H)

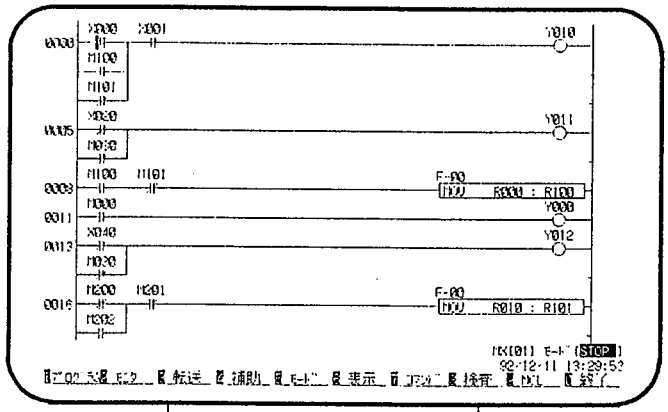
6 - 6 Examples of uses

This paragraph shows the examples of using the following CBL functions.

(1) Host communication function
(2) Remote I/O slave station function
(3) Mail communication function (Read function: MX30 ↔ POP adapter)

◇CAUTION◇ • The examples of loader screens described here are obtained by using MX100SW21 / MX100SW22. A part of the screen displays differs, if MX200SW01 / MX200SW02 is used.

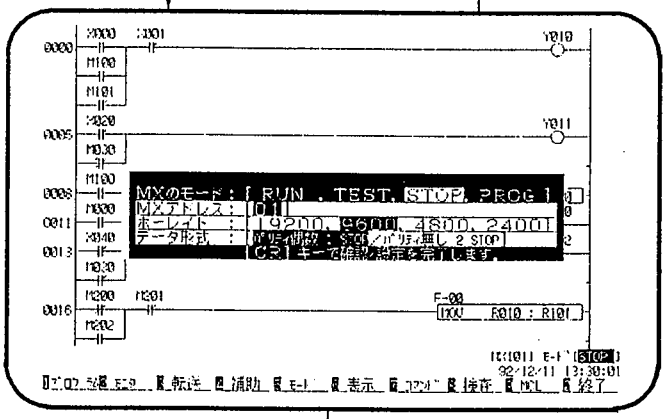
■ Host communication function



Display : Initial screen

Operation : The left screen is displayed by initializing the MX loader system in on-line.

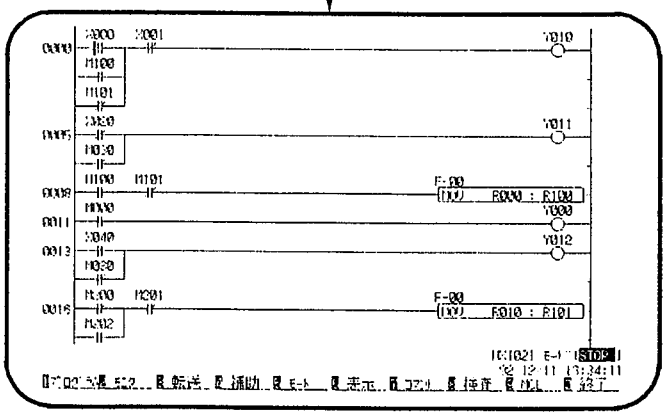
Press [HOME CLR] key. Press [ESC] key.



Display : communication condition setting screen

Operation : Reverse the address setting by [↓][↑] keys, designate a desired node address for host communication by [←] [→] keys, and press ↵ key.

Press ↵ key.

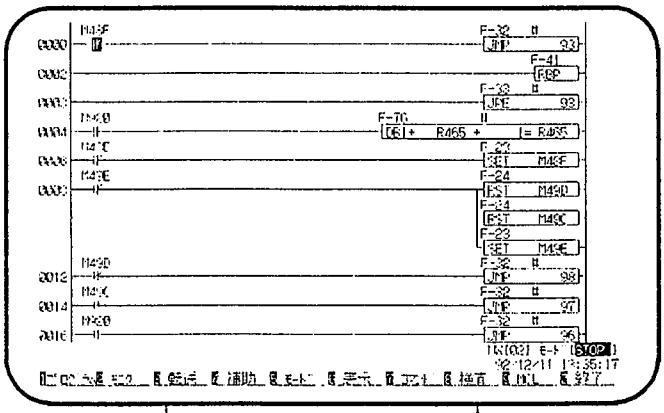


Display : Initial screen
The system is connected to the node designated by the loader. Normal loader operation can be done.

CAUTION •The displayed program shows the data of the last node. For displaying the program of the new node, set the system to the off-line mode once, and then, set it to the on-line mode again for up-loading.

■ Remote I/O

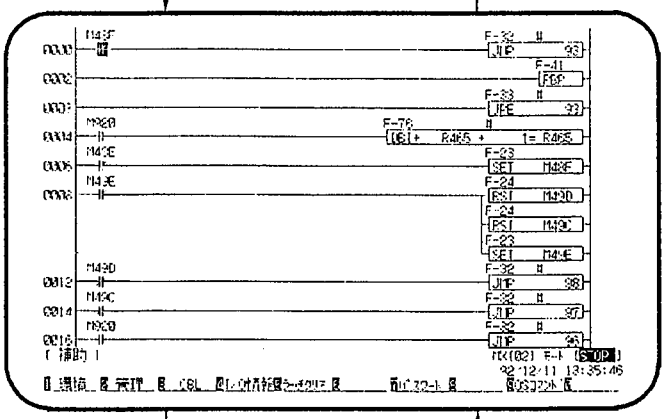
Allocate the remote I/O by operating the loader as follows.



Display : Initial screen

Operation : The left screen is displayed by initializing the MX loader system in the online.

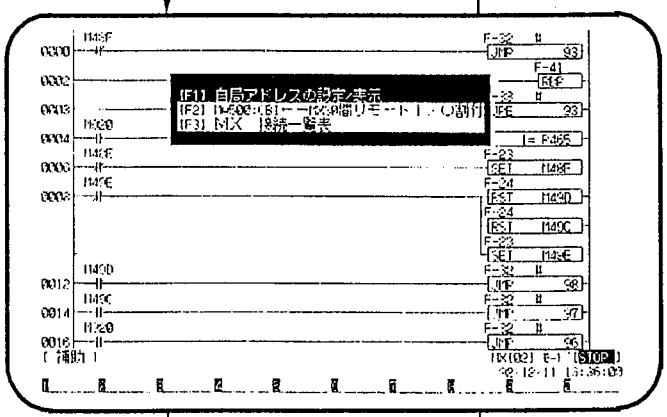
Press [f·4] key. Press [ESC] key.



Display : Auxiliary function screen

Operation : Press [f·3] key.

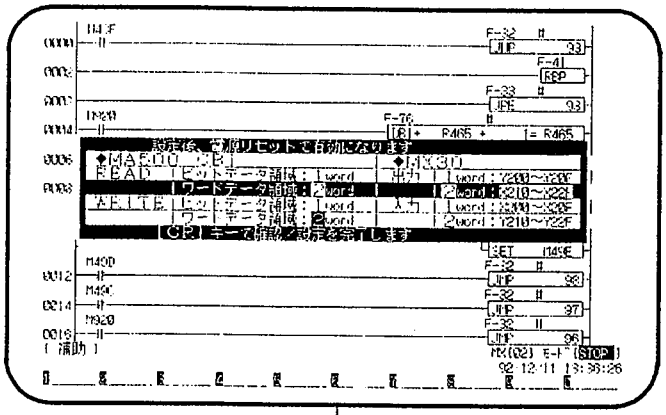
Press [f·3] key. Press [ESC] key.



Display : CBL screen

Operation : Select remote I/O allocation by pressing [f·2] key or by pressing [↓][↑] keys, and then, press ↵ key.

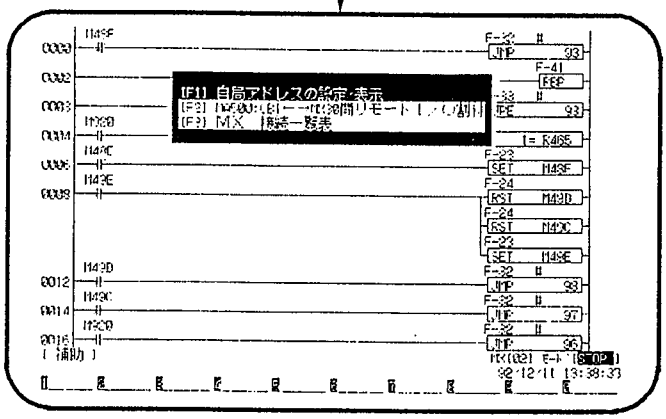
Press [f·2] key. Press [ESC] key.



Display : Remote I/O allocation screen

Operation : Select input/output by [↓] [↑] keys and designate No. of allocation words by [←] [→] keys.
Define it by ↵key.

Press [ESC] key.



Display : CBL screen

Operation : Send the allocation I/O data to the remote I/O master station by automatic exchange.

Turn off the MX30 power supply, and initialize it again.

◇CAUTION◇

- For remote I/O function, the setting in the remote master station is necessary in addition to the setting in MX30.

■ Mail communication function

An example of connecting MX30, POP adapter (CBP501-T2□), and stationary type bar code reader (PS500) by using the read function of one-address communication is shown below.

● Control contents

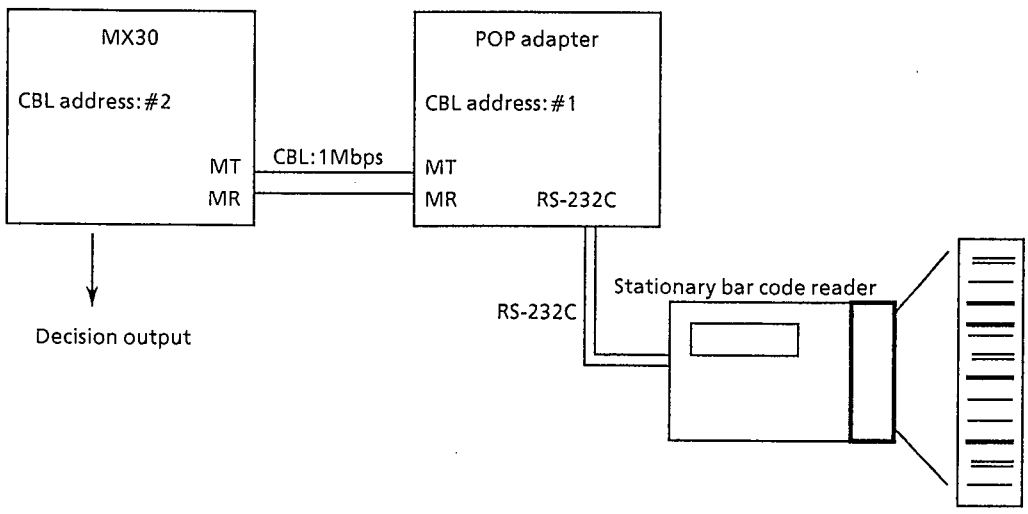
- When the bar code reader recognizes a bar code, it reads the bar code automatically, and transfers data to the POP adapter.
- MX30 cyclically checks if bar code data exist in the POP adapter, and reads them, if any.
- MX30 outputs data according to read data contents.

● Conditions

- Data presence check cycle : 100ms
- MX30 read parameter area : R100 to

● Configuration

Special register : R910=100(D)



● An example of programs

An example of execution programs is shown on page 6-27.

- Summary of program operation
  (1) READ parameter is set to R100to from the data table in the first scan of the RUN mode. (R910 = K100(0064H)
  (2) The read address is designated to the status information of the POP adapter every 100ms to read and check the data ready flag.
  (3) If a receive data exists, the read address is changed to the bar code data area to read the receive data.
  (4) Data are sorted according to the number of bytes of bar code data, and the decision output is sent according to the data contents as follows.

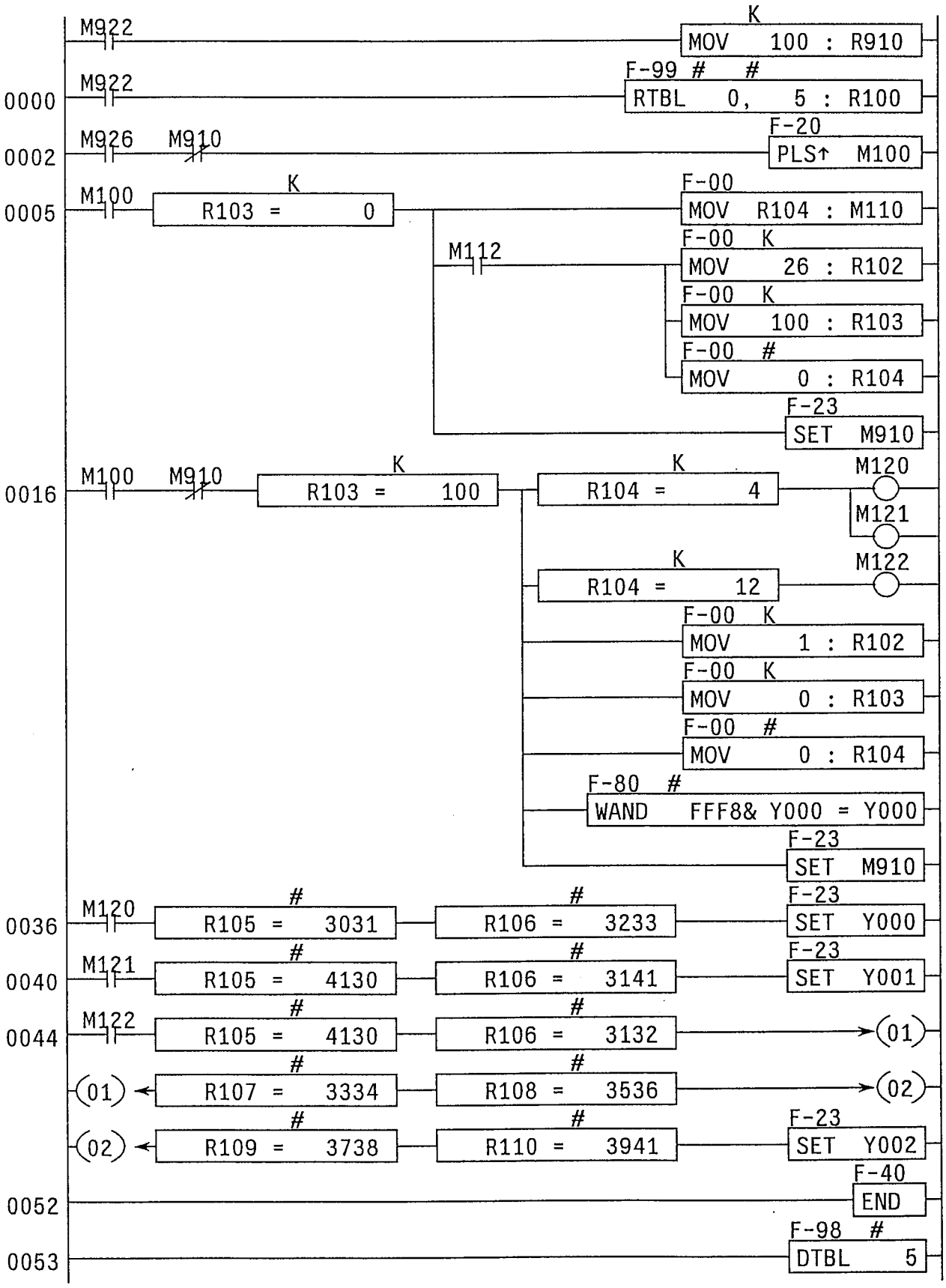
"0123"	→	Y000:ON
"A12A"	→	Y001:ON
"A0123456789A"	→	Y002:ON
None of them	→	Y000:OFF Y001: OFF Y002: OFF

MX30 read parameter area

Register	(High-order bytes)	(Low-order bytes)
R100	Command(08H)	Transfer parameter length
R101	Opposite node address	Opposite subaddress
R102	Communication status	No. of read data
R103	Read address	
R104 ≀	Read data	

CB I/F buffer allocation of POP adapter

Address		
0000	DI	Bit 2 = Data ready flag 1 : Receive data exists. 0 : No receive data exists.
0001	DO	
≀		
0100	Data length	
0101	(1) (2)	
0102	(3) (4)	
0103	(5) (6)	
0104	(7) (8)	When data are less than 50 bytes, the unoccupied area is filled with 00H.
0105 ≀ 0125	(50)	
0126		


M922
K
MOV 100 : R910
F-99 # #
0000
M922
RTBL 0, 5 : R100
F-20
0002
M926 M910
PLS↑ M100
K
F-00
0005
M100
R103 = 0
MOV R104 : M110
F-00 K
M112
MOV 26 : R102
F-00 K
MOV 100 : R103
F-00 #
MOV 0 : R104
F-23
SET M910
K K
M120
0016
M100 M910
R103 = 100
R104 = 4
M121
K
M122
R104 = 12
F-00 K
MOV 1 : R102
F-00 K
MOV 0 : R103
F-00 #
MOV 0 : R104
F-80 #
WAND FFF8& Y000 = Y000
F-23
SET M910
# #
F-23
0036
M120
R105 = 3031
R106 = 3233
SET Y000
# #
F-23
0040
M121
R105 = 4130
R106 = 3141
SET Y001
# #
0044
M122
R105 = 4130
R106 = 3132
(01)
# #
(01)
R107 = 3334
R108 = 3536
(02)
# #
F-23
(02)
R109 = 3738
R110 = 3941
SET Y002
F-40
0052
END
F-98 #
0053
DTBL 5

Data No.	F	E	D	C	B	A	9	8	–	7	6	5	4	3	2	1	Hexadecimal No.	K decimal No.	ASCII
0	□	□	□	□	■	□	□	□	–	□	□	□	□	□	□	□	0800	2048	
1	□	□	□	□	□	□	□	■	–	□	□	□	□	□	□	□	0100	256	
2	□	□	□	□	□	□	□	□	–	□	□	□	□	□	□	■	0001	1	
3	□	□	□	□	□	□	□	□	–	□	□	□	□	□	□	□	0000	0	
4	□	□	□	□	□	□	□	□	–	□	□	□	□	□	□	□	0000	0	

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7. Specifications

7 - 1 General specifications

■ General specifications

Items	Specifications
Power voltage	DC24V
Current consumption	Lower than 250mA MX30 unit only (Note)
Working temperature range	0 to 55°C
Storage temperature range	−20 to 70°C
Working humidity range	30 to 90% RH No dew condensation is allowable.
Storage humidity range	5 to 95% RH No dew condensation is allowable.
Dielectric strength	500V AC, 50/60Hz, 1min across DC power connectors and FG
Insulation resistance	Higher than 5MΩ across DC power connector and FG by using a 500V DC megger
Vibration resistance	Conforms to JIS C 0911, 10 to 55Hz, 1G{9.8m/s²}
Shock resistance	Conforms to JIS C 0912, 10G{98m/s²}, 3 directions, three times, each
Noise resistance	Noise simulator, noise 1500Vp-p, pulse width 1μs (power supply)
External dimensions	237(H) × 156(W) × 32(H)mm
Weight	Approx. 0.3kg
Attachments	None

◇CAUTIONS◇

- The DC power supply is of a non-insulation type. Use the control power supply and I/O power supply separately to be independently of each other.
- When the handy terminal and extension board are used, the current consumption of these units is added to the above value.

■ Performance specifications

Item	Specifications
Control system	Stored program system
I/O control system	Cyclic scan system
Program system	Ladder diagram/nmemonic system
Types of instruction	Basic instructions 12 types (2 to 4 bytes/instruction) Function instructions 117 types (2 to 13 bytes/instruction)
Processing time	Basic instructions 2 to 46μs, compare instructions 3.3 to 13μs, transfer instructions 4.3 to 77μs
Program capacity	3K bytes/7K bytes (Depends upon models.)
No. of input points	24 to 64 points (Depends upon models and board configuration)
No. of output points	16 to 48 points (Depends upon models and board configuration)
Auxiliary relay	800 points (M000 to M49F)
Hold relay	800 points (L000 to L49F)
Special relay	160 points (M900 to M99F)
Special register	40 words (R900 to R939) 16 bits/word
Timer/counter	200 points Timer setting time 0.01 to 99.99s 0.1 to 999.9s 1 to 9,999s Counter setting range 1 to 99,999,999
Data register	500 words
Memory backup	A lithium battery is built in (25°C, 5 years, Allowable exchange time 10min)
Self-diagnosis	System program ROM check, internal RAM read/write check, user program sum check, user WDT check, system WDT check
Loader interface	RS-232C 19200/9600/4800/2400bps Address is set to 1 at the delivery time.
External connection connector (Board side)	Input HIF3-40P-2.54DSA (Manufactured by Hirose Electric Co.) HIF3-40PA-2.54DSA
	Output HIF3-34P-2.54DSA (Manufactured by Hirose Electric Co.) HIF3-34PA-2.54DSA
	CBL 5289-6A (Manufactured by Japan Molex Co.)
	Power supply 5289-3A (Manufactured by Japan Molex Co.)

(Note) For the applicable connector types, see page 3-5.

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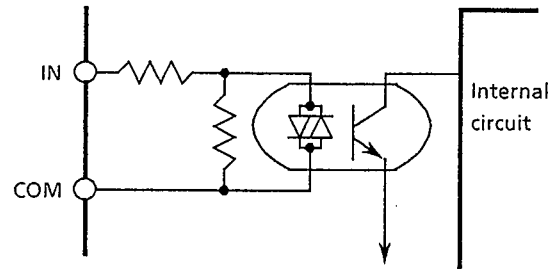
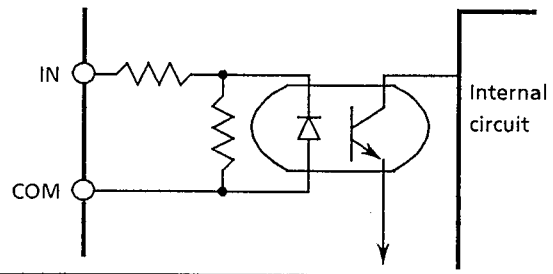
7 - 2 I/O specifications

■ Input specifications

Items	Specifications	
Model	MX030FT1413□□□□ MX030EX1413	MX030FT1312□□□□ MX030EX1312
No. of input points	32 points (8 points/common, 4 circuits)	24 points (8 points/common, 3 circuits)
Input voltage range	DC10 to 26.4V	
Input current	5mA(DC12V) / 10mA(DC24V)	
Input impedance	Approx. 2.4kΩ	
ON voltage	Higher than 10V DC	
OFF voltage	Lower than 3.5V DC	
OFF current	Lower than 1.5mA	
Response time OFF⇔ON	Shorter than 1ms	
Response time ON⇔OFF	Shorter than 1.5ms	
Circuit structure	In case of MX030FT □□□□□□□□ 	
	In case of MX030EX □□□□ 	

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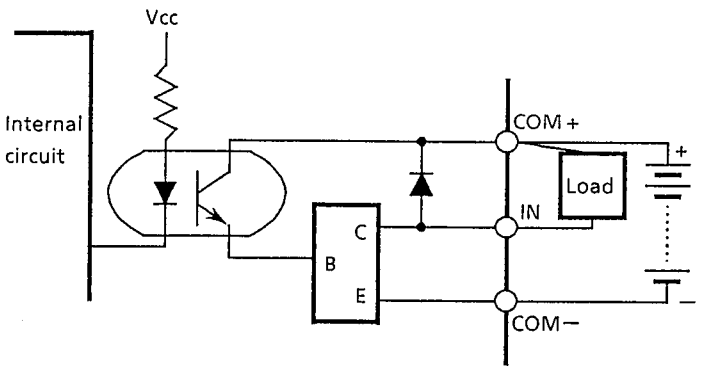
■ Output specifications

Items	Specifications	
Model	MX030FT1413□□□ MX030EX1413	MX030FT1312□□□ MX030EX1312
No. of output points	24 points (8 points/common, 3 circuits)	16 points (8 points/common, 2 circuits)
Load voltage range	DC10 to 26.4V	
Maximum output current	0.2A/point 0.8A/common	
Surge current	Max. 1A (Shorter than 10ms)	
Leak current	Lower than 0.3mA	
Maximum voltage drop during ON	1.6V(0.2A)	
Response time OFF⇔ON	Lower than 1.5ms	
Response time ON⇔OFF	Lower than 1ms	
Surge killer	Clamp diode	
Circuit structure		

7 - 3 Summary of instructions

This paragraph indicates the summary of instructions employable in MX30.
MX30 can execute various programming by using 129 types of instructions.
For detailed description of instructions and programming method, refer to User's manual for machine controller MX100 "Programming version" PC-UM-1258.
All instruction words are common to those in MX100.

Classification	No. of instructions	Description
Basic instruction	12	LD, AND, OR, OUT, etc.
Compare instruction	18	=, ≠, <,>, etc, for comparison of 16-bit data
Double-length compare instruction	18	=, ≠, <,>, etc, for comparison of 32-bit data
Transfer instruction	9	MOV, BMOV, DCPY, etc.
BCD operation instruction	10	Addition, subtraction, multiplication, and division of BCD data
Quasi basic instruction	9	PLS ↑, PLF ↓, SET, etc.
Branch instruction	12	MC, MCR, JMP, CALL, END, etc.
Conversion instruction	10	Binary ⇔ BCD, 4 ⇔ 16, and other conversion
Shift instruction	7	Shift, rotate, etc.
BIN operation instruction	10	Addition, subtraction, multiplication, and division of binary data
Logical operation instruction	4	AND, OR, etc. of 16-bit data
Special instruction	10	Read/write of set value and present value of timer/counter

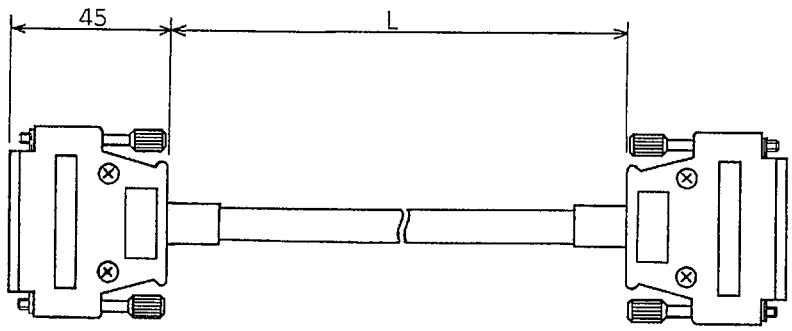
7 - 4 Other specifications

■ RS-232C cable

This cable is used to connect MX30 to the personal computer loader or handy loader.
Two types of cables are provided for connecting MX30 to the personal computer loader, and one type of cable is provided for connecting MX30 to the handy loader.

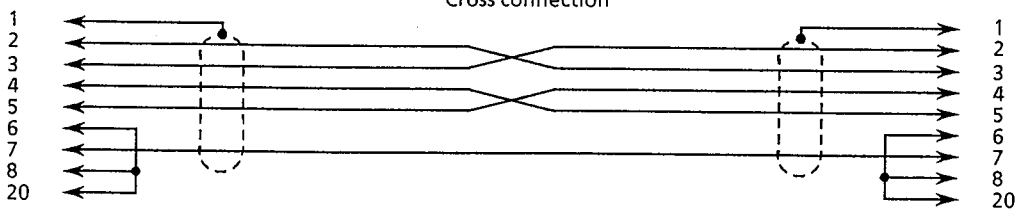
Item	Specifications		
Use	For personal computer loader connection		For handy loader connection
Model	CBL-RS232T02	CBL-RS232T08	CBL-RS232P02
Connection type	Cross	Cross	Straight
Cable length	2m	8m	2m
Connector	Pin ↔ Pin	Pin ↔ Pin	Pin ↔ Socket
Type of cable	ϕ8 round cable	ϕ8 round cable	ϕ8 round cable
Weight	Approx. 0.25kg	Approx. 0.8kg	Approx. 0.25kg

RS-232C cable

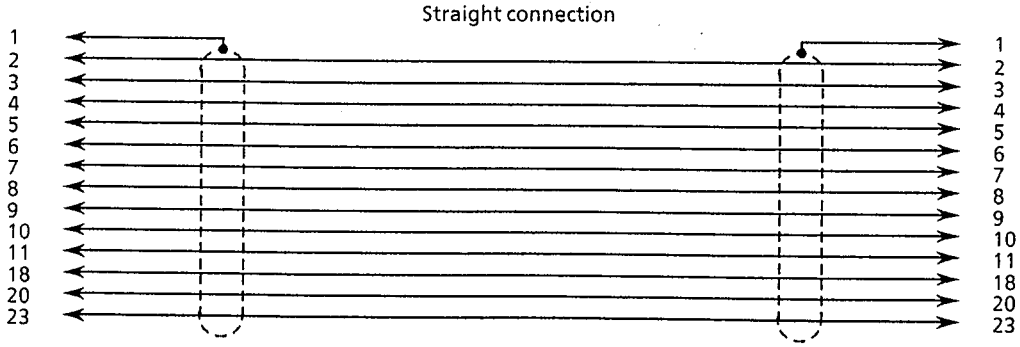


Cable connection diagram

Cross connection



Straight connection

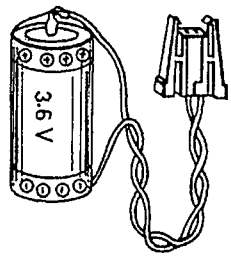


■ Lithium battery

This battery is used for RAM memory backup and data hold functions during power interruption.
A exclusive connector cable is attached.

Item	Specifications
Model	MX100BT01
Nominal voltage	DC3.6V
Battery life	5 years(25°C)
Power interruption guarantee	Same as specified in the battery life
External dimensions	ϕ20×36mm

Lithium battery



■ Memory card

The memory card is a program memory used for the handy loader.

Item	Specifications		
Model	MEM-EE008	MEM-EE016	MEM-EE032
Memory type	E^2PROM type memory card		
Memory capacity	8K bytes	16K bytes	32K bytes
External dimensions	86 (W) × 54 (H) × 2.25 (t)		

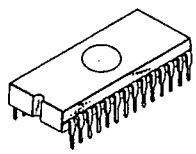
Memory card

■ PROM

This PROM is used for ROM programming.
Use the following PROM being available on the market. Select a PROM whose access time is shorter than 200ns.
For writing into PROM, a PROM writer being available on the market is used.

Item	Specifications	
Memory type	CMOS EPROM	
Memory capacity	64K words × 8 bits	64K words × 8 bits
Recommendable type	27C256-20 or equivalent	27C512-20 or equivalent
External profile	28P DIL	

PROM



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8. Troubleshooting

8 - 1 Error/alarm display and countermeasures

When a trouble occurs, MX30 executes self-diagnosis to detect errors (heavy faults) and alarms (light faults) separately, and display them by LED.

■ Error and alarm display table

Division	Display	Name	Processor conditions	Transferrable mode					Monitor	Special relay address
				COMPL	RUN	TEST	STOP	PROG		
Errors	LED's other than POWER LED go out.	System error	STOP	●	●	●	●	●	—	—
	ERR LED	User PROM error	STOP	●	●	●	○	●	M	M994
		User W.D.T error	STOP	●	●	●	○	●	M	M998
		Program information	STOP	●	●	●	○	○	M	M999
		Program error	STOP	●	●	●	○	○	M	M99A
		Compile error	STOP	○	●	●	○	○	M	M99B
Alarms	ALM LED	Battery error	RUN	○	○	○	○	○	R	M931
		RS-232C communication error	RUN	○	○	○	○	○	R	M933
		Arithmetic operation error 1	RUN	○	○	○	○	○	R/W	M90E
		Arithmetic operation error 2	RUN	○	○	○	○	○	R/W	M90F

Processor conditions : The processor is transferred to STOP mode when an error occurs.
If an alarm occurs, it is displayed, but the processor does not stop functioning.

Transferrable modes : This column indicates the modes which are selectable or not by the loader when an error or an alarm occurs.
○ Transferrable mode
● Non-transferrable mode

Monitor M : Monitoring can be done by the loader.
R : Flag operation can be read into the program.
R/W : Flag operation can be read and written into the program.
("Write" means the reset of the flag)

Division	Name	Transferrable mode					Resetting method	Program condition	Monitor
		COMPL	RUN	TEST	STOP	PROG			
Errors	System error	● Impossible	● Impossible	● Impossible	● Impossible	● Impossible	Eliminate causes, and reset the power supply.	Stop	Impossible
	User PROM error	● Impossible	● Impossible	● Impossible	○ Possible	● Impossible	Eliminate causes, and reset the power supply.	Stop	Monitoring can be done by loader.
	User WDT error	● Impossible	● Impossible	● Impossible	○ Possible	● Impossible	Eliminate causes, and reset the power supply.	Stop	Monitoring can be done by loader.
	Program damage	● Impossible	● Impossible	● Impossible	○ Possible	● Impossible	Eliminate causes, and reset the power supply.	Stop	Monitoring can be done by loader.
	Program error	● Impossible	● Impossible	● Impossible	○ Possible	○ Possible	Eliminate causes, and reset the power supply.	Stop	Monitoring can be done by loader.
	Compile error	○ Possible	● Impossible	● Impossible	○ Possible	○ Possible	Eliminate causes, and reset the power supply.	Stop	Monitoring can be done by loader.

Special relay address	Diagnostic contents	Remedial methods	Page
—	• A system error occurred. TRAP error A command error occurred. CPU judges it as an undefined command to be unexecutable. ROM error A check sum error occurs in MX30 ROM. RAM error A bit failure occurs in MX30 RAM.	• Reset the power supply, and start it again. • Replace the PC board	Programming version, page 3-8 and 4-7
M994	• The following errors occur in user PROM (1) User PROM check sum is not correct. (2) User PROM program capacity exceeds the MX30 memory. (3) User PROM identification code (ID) is not proper. (4) User PROM program contains a syntax error.	• Mount the user PROM to the ROM socket securely. • Check the user PROM memory program, and correct its error. • Replace PROM with new one containing correct programs.	Handy loader version, page 2-10
M998	• Program exceeds the preset scan time value. Scan time value is settable up to 100ms to 2s by means of WDT instruction (FUN 95). (up to 100ms, if not specified)	• Correct the program, and set the scan time value to be less than the set value (100ms at the delivery time from the factory). • If the program cannot be corrected, correct the scan time set value (100ms to 2s) by WDT instruction.	Programming version
M999	• Program memory check sum results are in error. • Program is broken. Correct it.	• Check if each unit is assembled, and wiring is correct when writing the program. • Check the battery for deterioration and assembly failure. • Rewrite the program correctly into MX30. • Replace MX30.	Handy loader version, page 3-11
M99A	• Program contains a syntax error. Correct it.	• Correct a program error, and write program into MX30 again.	Programming version
M99B	• A compile error occurred A program error occurred	• Write the program into MX30 again, and then, restart it.	Programming version

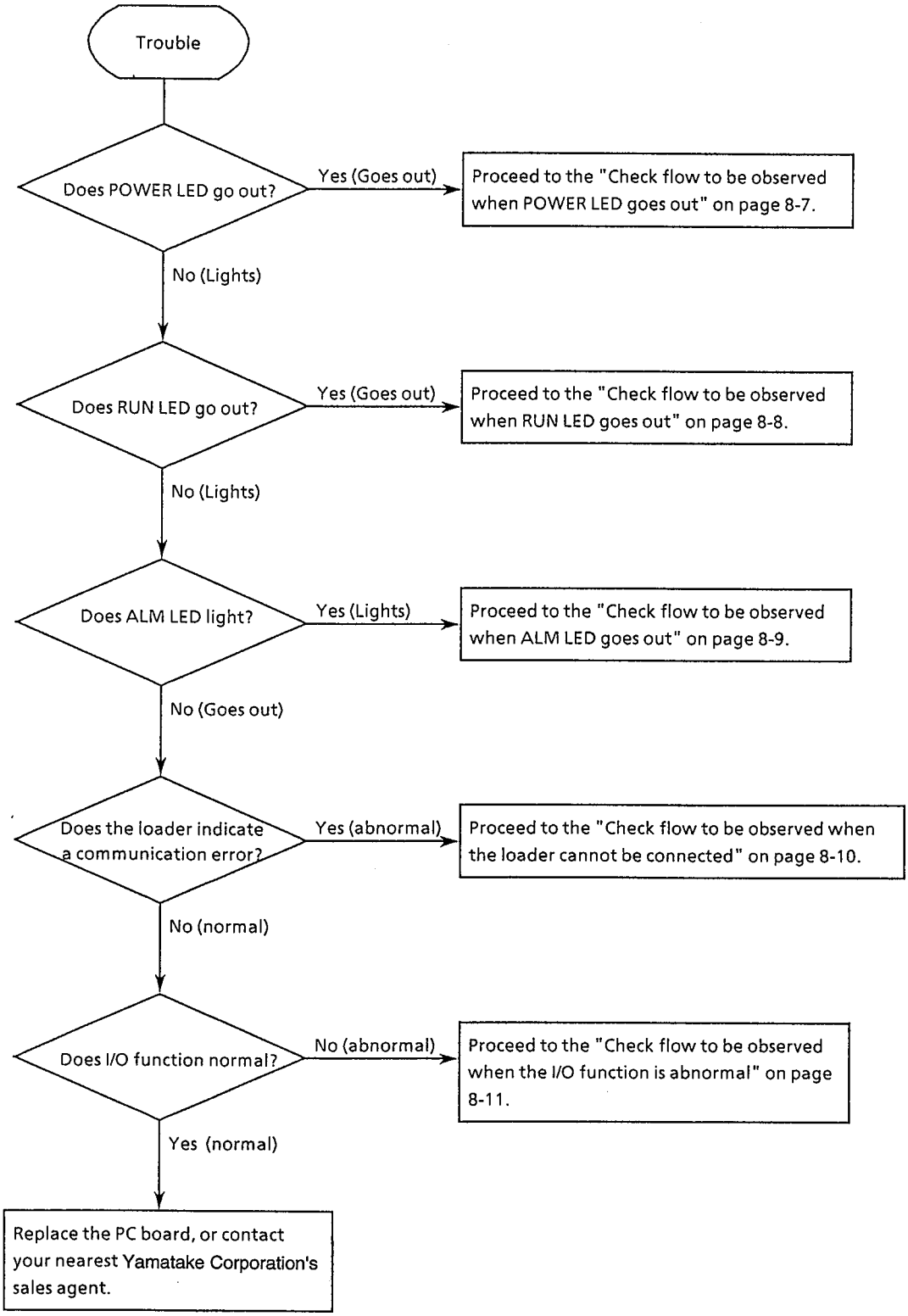
Division	Name	Transferrable mode					Resetting method	Program condition	Monitor
		COMPL	RUN	TEST	STOP	PROG			
Alarm	Battery error	○ Possible	○ Possible	○ Possible	○ Possible	○ Possible	Eliminate causes	Run	Monitoring can be done by reading special relay or loader.
	RS-232C communication error	○ Possible	○ Possible	○ Possible	○ Possible	○ Possible	Eliminate causes	Run	Monitoring can be done by reading special relay or loader.
	Arithmetic operation error 1	○ Possible	○ Possible	○ Possible	○ Possible	○ Possible	Eliminate causes, and write into special relays.	Run	Monitoring can be done by reading special relays (writable) or loader.
	Arithmetic operation error 2	○ Possible	○ Possible	○ Possible	○ Possible	○ Possible	Eliminate causes, and write into special relays.	Run	Monitoring can be done by reading special relays (writable) or loader.

Special relay address	Diagnostic contents	Remedial methods	Page
M931	• Battery voltage is lower than specified (2.5 ±0.2V DC). Replace the battery. • Display goes out when this alarm is recovered. However, the battery may be recovered temporarily, and the LED lights, too in such a case. Replace the battery in this case.	• Replace the battery. • Check if the battery cord and connector are connected securely.	Programming version, page 7-4
M933	• MX20 is not communicable with loader or personal computer loader due to a channel disconnection, a power failure of personal computer or loader, a communication setting failure, etc.	• Check if the channel is connected correctly between the handy loader/personal computer loader and MX30, and check if they are assembled securely. • Check if the power supply of each unit is normal. Check if signal line and other wiring are free of influences of induction noises, etc.	Programming version
M99E	• An error occurred in the arithmetic operation part in the program by a function instruction or an arithmetic operation error is not eliminated.	• Correct a program error.	Programming version
M99F	• An error occurred in the arithmetic operation part in the program by a function instruction.	• Correct a program error.	Programming version

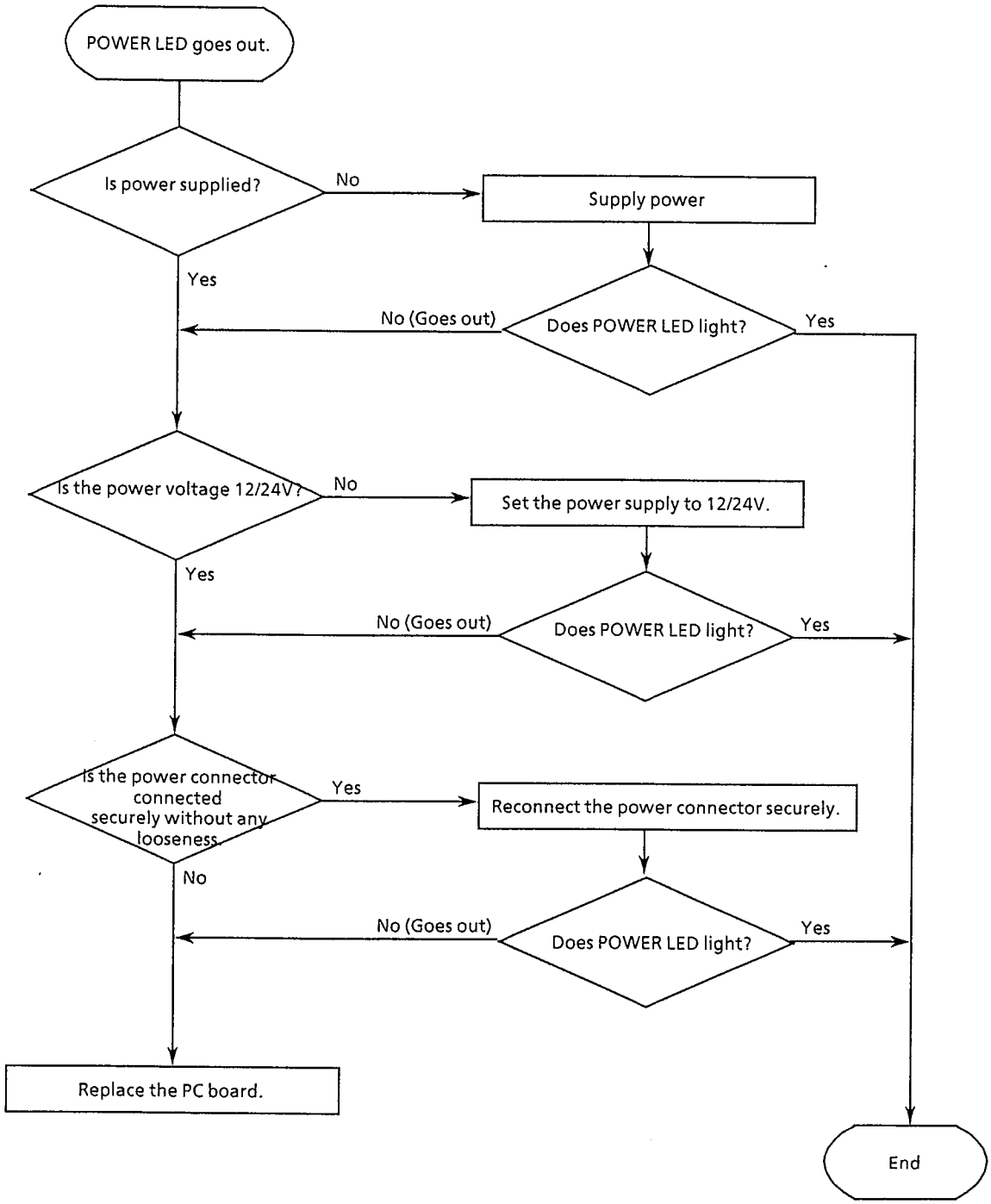
8 - 2 Flow chart

■ Troubleshooting flow chart

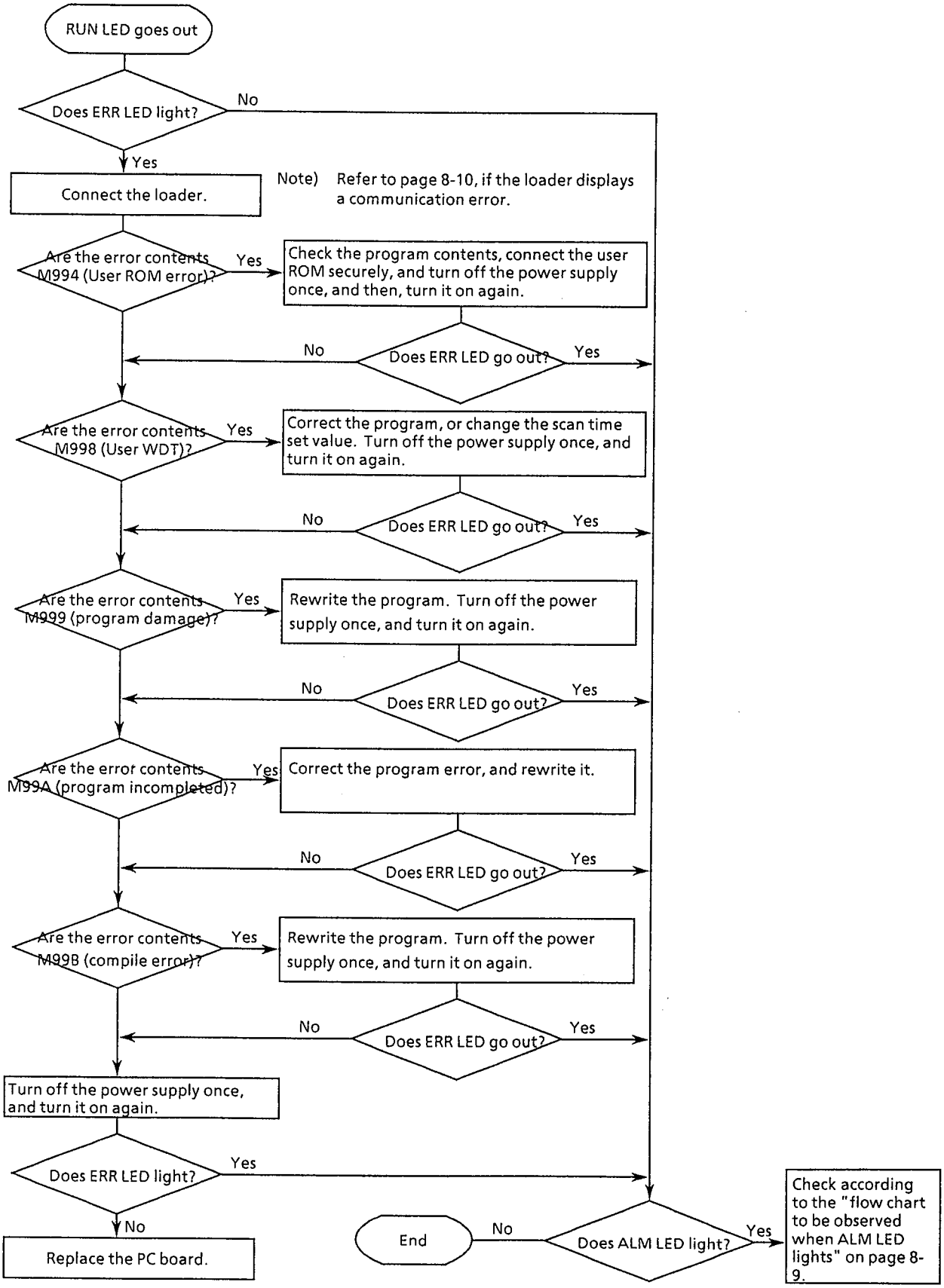
If a trouble occurred, check it according to the following flow chart, and take remedial measures according to the instructions.



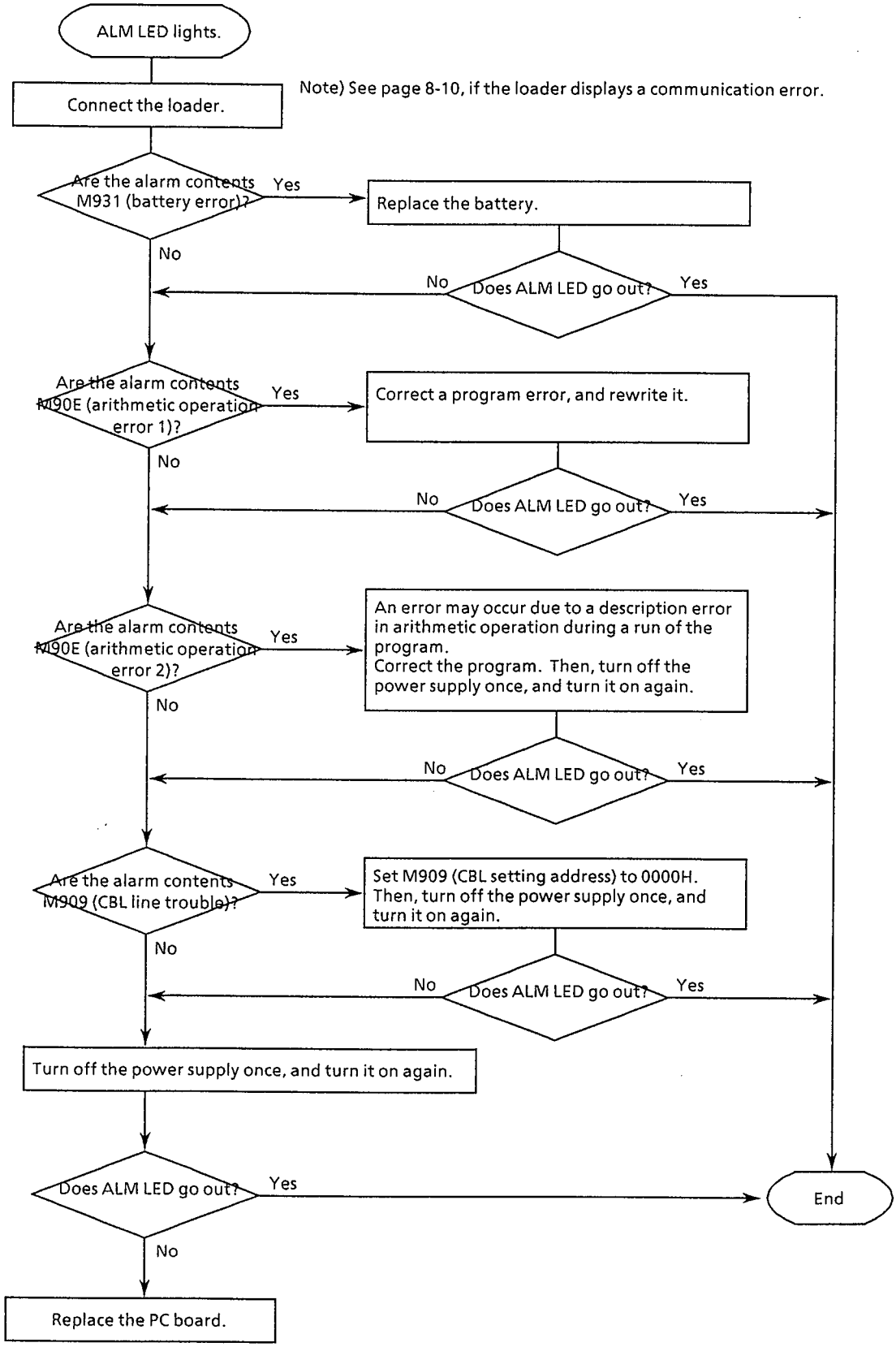
■ Flow chart to be observed when POWER LED goes out



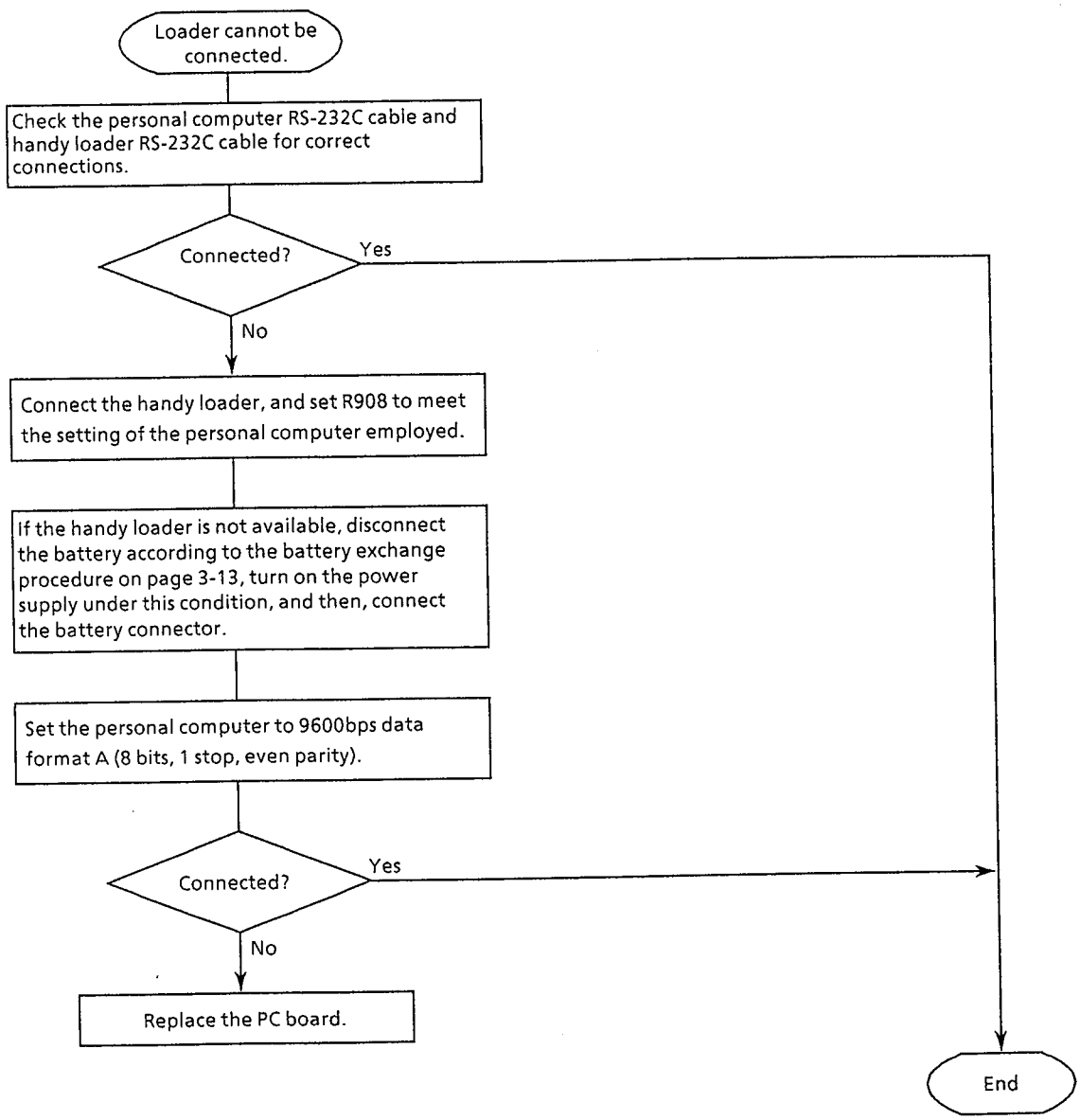
■ Check flow to be observed when RUN LED goes out



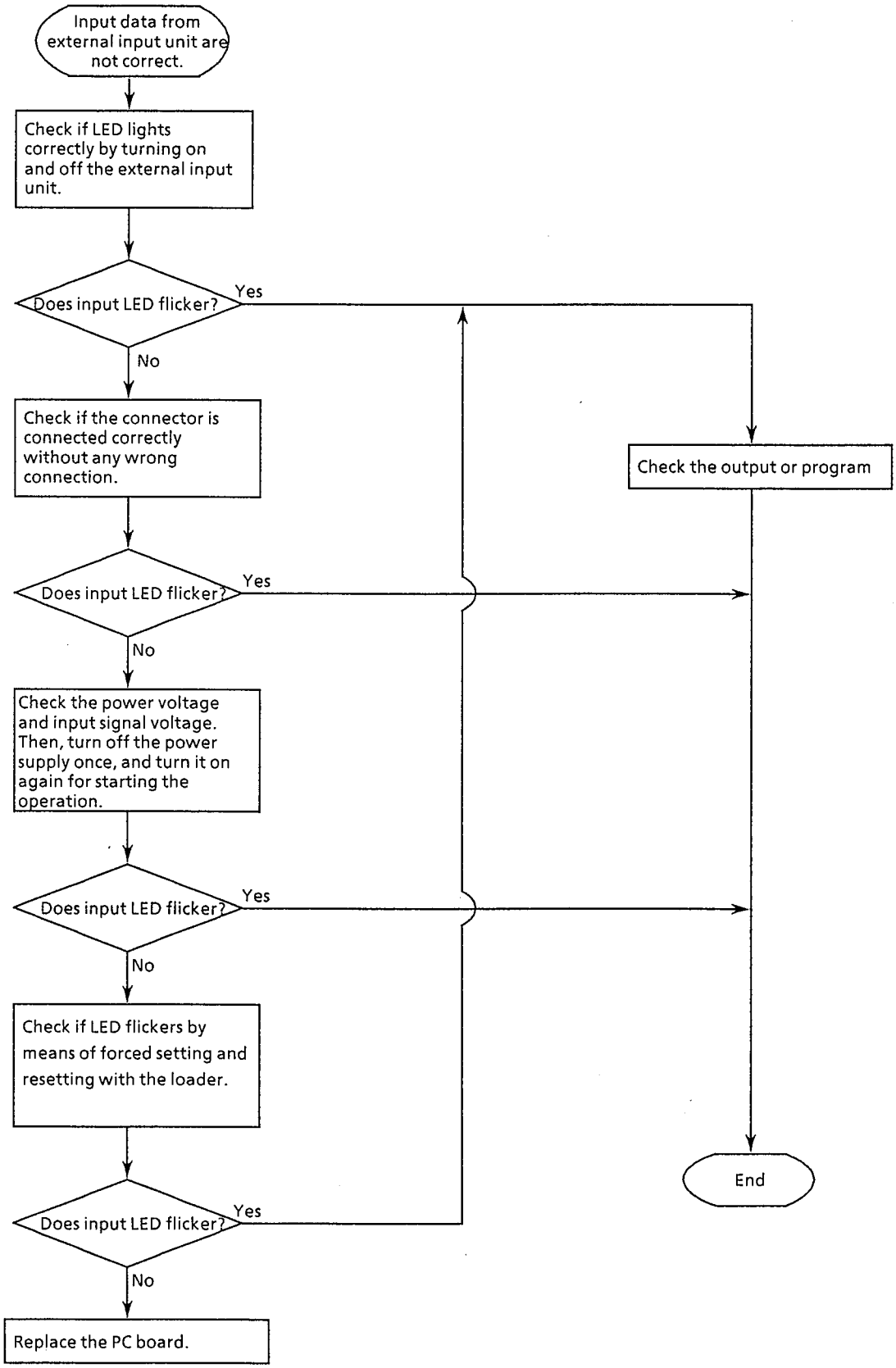
■ Check flow to be observed when ALM LED goes out

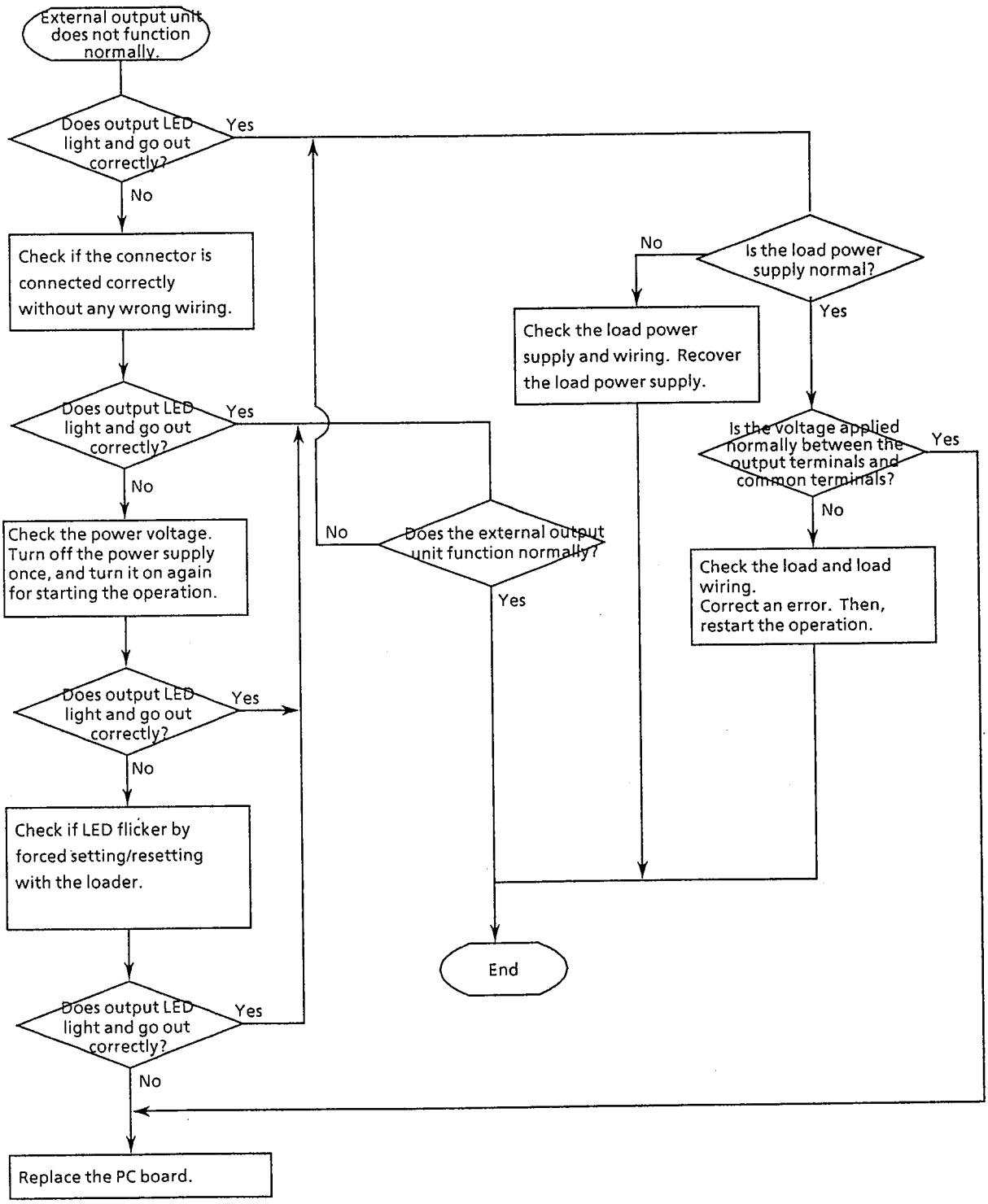


■ Check flow to be observed when the loader cannot be connected



■ Check flow to be observed when the I/O operation is abnormal




External output unit does not function normally.
Does output LED light and go out correctly?
Yes
No
Check if the connector is connected correctly without any wrong wiring.
Does output LED light and go out correctly?
Yes
No
Check the power voltage. Turn off the power supply once, and turn it on again for starting the operation.
Does output LED light and go out correctly?
Yes
No
Check if LED flicker by forced setting/resetting with the loader.
Does output LED light and go out correctly?
Yes
No
Replace the PC board.
No
Does the external output unit function normally?
Yes
Is the load power supply normal?
No
Yes
Check the load power supply and wiring. Recover the load power supply.
Is the voltage applied normally between the output terminals and common terminals?
Yes
No
Check the load and load wiring.
Correct an error. Then, restart the operation.
End

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Revision History

Printed Date	Manual Number	Edition	Revised pages	Description
94-04	**CP-UM-1423E**	**1st Edition**		
02-11		**2nd Edition**		Company name changed.

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Specifications are subject to change without notice.

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