

MAZATROL M PLUS Series

MAINTENANCE MANUAL (HARDWARE)

Preface

- (1) The contents of this manual include the items required to maintain the entire MAZATROL M PLUS Series CNC unit, so the system configuration may differ according to the target model and specified configuration.
Use this manual with the Instruction Manual, Instruction Manual issued by the machine maker, and other Instruction Manuals.
- (2) This Manual is targeted for the general user and machine maker engineers. If there are any unclear points, please contact Mitsubishi.
- (3) An effort has been made to match the contents of this manual with the NC unit. We ask for your understanding if there are any differences in the contents.
- (4) Related material
MAZATROL M PLUS Series Connection Manual

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1. Outline

The MAZATROL M PLUS Series CNC unit is a product that has thoroughly pursued high productivity and reliability. The following material has been prepared in addition to this Manual. Please refer to these together with this manual.

- (1) Instruction Manual
- (2) Connection Manual
- (3) PLC Interface Manual

■ Features

- (1) A high speed and high precision has been realized with the incorporation of a complete 32-bit microprocessor.
- (2) A high reliability has been realized with the incorporation of high integrated parts such as the custom LSI.
- (3) By fully digitalizing the servo amplifier, a high maintainability, reliability and precision has been achieved.
- (4) Systemization has been realized with the modulation and unitization of the product.

This manual commonly explains the maintenance, troubleshooting, installation adjustment and hardware for the following CNC units. However, the model name is listed for those units having limits in each section.

Model name	Slots	Automatic program	Display
M535MWY	4	Yes	12" CRT Amber
M545MHY	6	Yes	14" CRT Color

1.1 System Configuration

1.1.1 System configuration

The following units are generally used to compose the system using the MAZATROL M PLUS Series.

- (1) Control unit : This unit has the computation processing functions for numerical control. (This is also called the NC unit.)
- (2) Operation board : This unit has the setting and display functions.
(display operation section)
- (3) Servo/spindle control unit : This is a servo/spindle amplifier composed of a converter for obtaining DC from AC and an inverter for obtaining AC from DC.
- (4) Servo/spindle motor : This drive motor moves the machine.
- (5) Position/speed detector : This sensor outputs a pulse that corresponds to the machine movement amount.
- (6) Other peripheral equipment: Peripheral equipment such as external memory and programming support.

This manual explains the sections enclosed with a dotted line in Fig. 1.1.

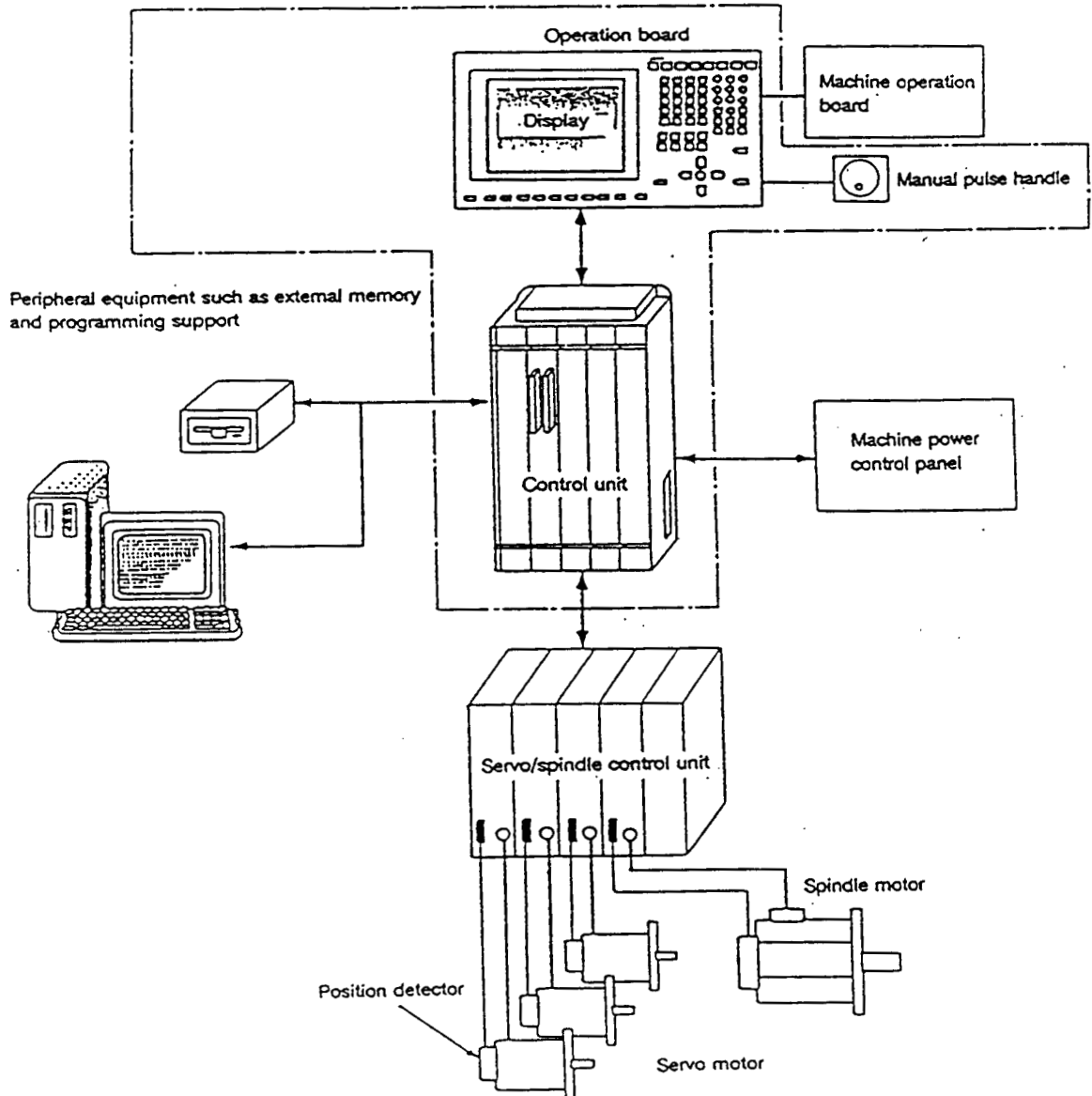
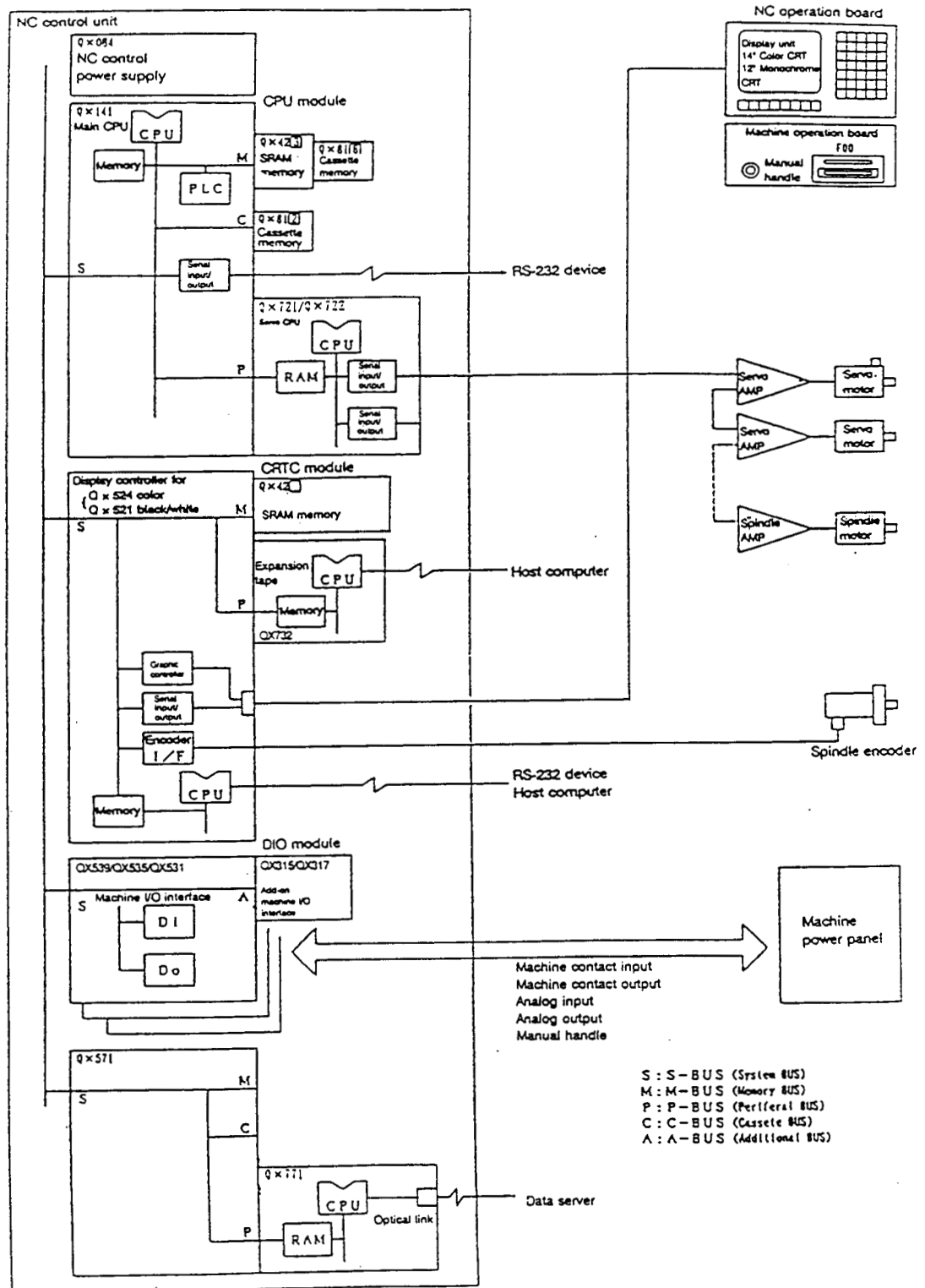


Fig. 1.1 General configuration of system using M PLUS Series

1.1.2 Internal system diagram



(Note) The above diagram shows the most general configuration, and the actually mounted hardware configuration may differ according to hardware flexibility and specifications.

1.2 Control Unit Configuration

1.2.1 Control unit configuration

The control unit is composed of baskets (4/6 slots) and the control power and control modules (integrated control section PCB) that are assembled into the baskets. The back panel into which the control power and control modules are mounted is on the back of the basket, and the cooling fan is mounted on the top. The cooling fan is mounted inside the fan cover as shown in Fig. A, and can be replaced easily by removing the fan cover from the basket unit. The control power is mounted on the far left slot of the basket, the CPU module in slot 1, the CRTC model in slot 2, and the number of DIO modules required from the system are mounted from the far right slot. Optional expansion modules are mounted from the left into the empty slots.

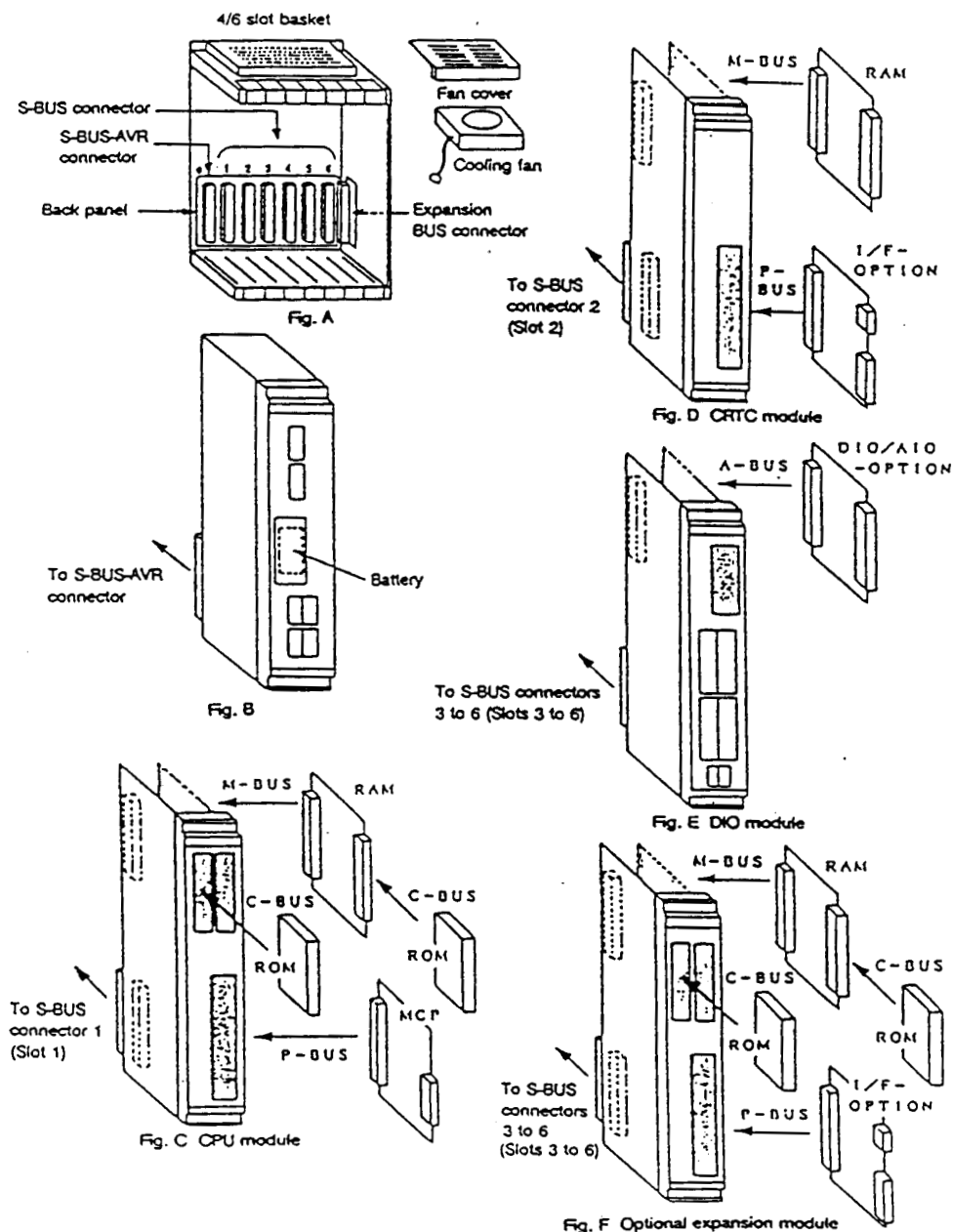


Fig. 1.2.1 Control unit configuration diagram

1.2.2 Control section PCB configuration

The control section PCB uses a control module to which various PCBs are mounted horizontally onto a 300 x 140mm standard size PCB as shown in Figs. C to E shown in Fig. 1.2.1 Control unit configuration diagram.

A system BUS connector that is connected to the back panel is mounted on the lower back of the control module and an interface connector and LED indicator are mounted on the front. A plastic front panel is mounted over this.

Fig. 1.2.2 shows the state from the front and side when the control module's front panel is removed. Fig. 1.2.2 shows the CPU module, and the M-BUS PCB, P-BUS PCB are mounted on the 300 x 140mm standard PCB (S-BUS PCB) so that the part mounting face faces the S-BUS PCB. Cassette memory can be mounted freely onto the front surface of the S-BUS PCB and M-BUS PCB.

This is possible with other control modules if the various add-on PCBs listed above are mounted. In some PCBs, this is not possible due to limits in the configuration, however, the ideology is the same.

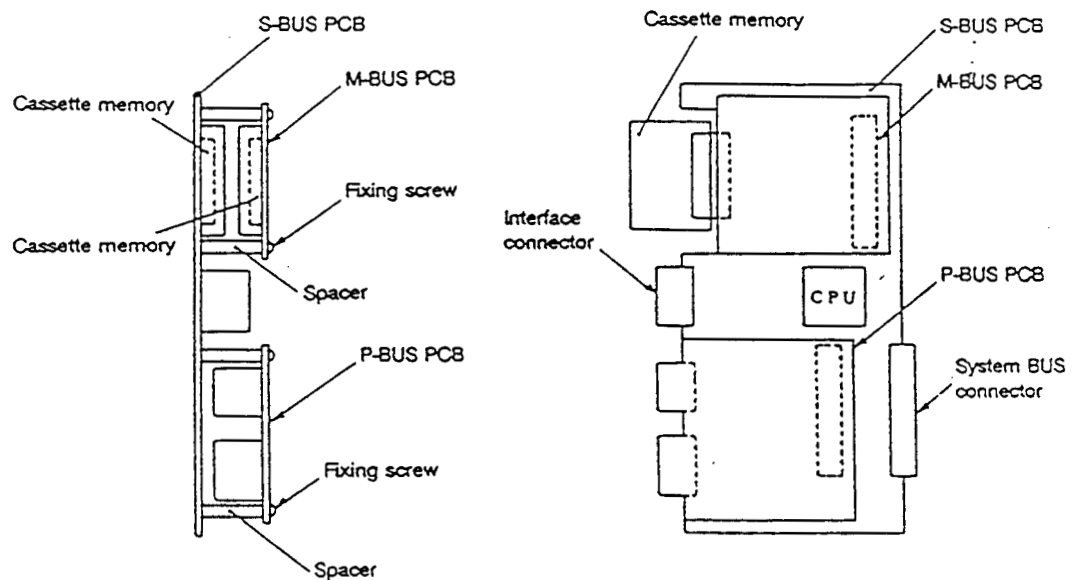


Fig. 1.2.2 Example of control module (integrated PCB)

1.3 Operation Board Configuration

An example of the operation board configuration is shown in Fig. 1.3.

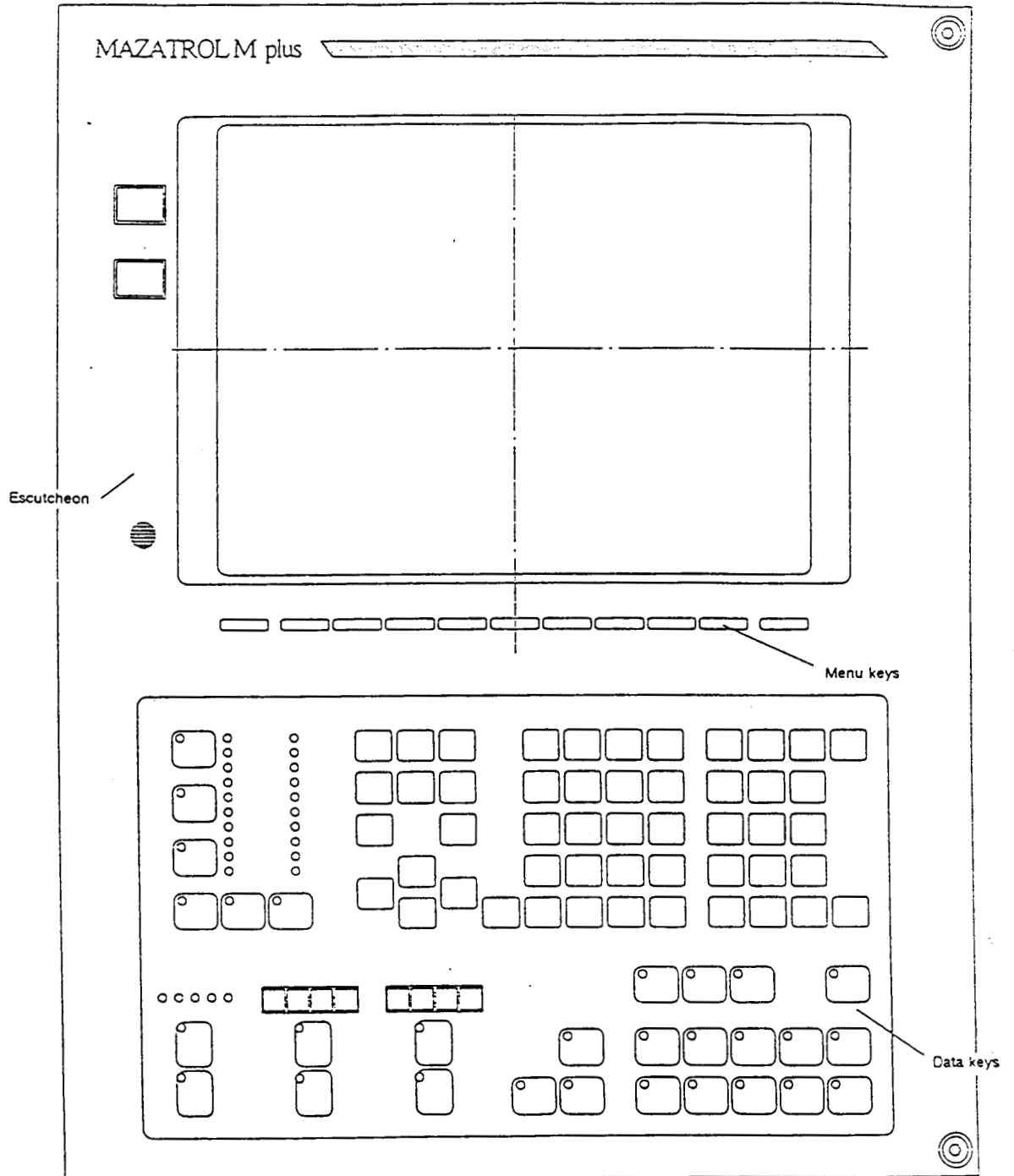


Fig. 1.3 Operation board configuration

1.4 Table of Configuration Units

(1) Control unit

No.	Model name		Function	Remarks
	Model name	Configuration element name		
1	4MU401A	QX041 QX084	4-slot control unit 4-slot back panel Control power supply	
2	4MU601A	QX061 QX084	6-slot control unit 6-slot back panel Control power supply	
3	4MU251A	QX025	2-slot expansion control unit 2-slot expansion back panel	

(2) Control section printed circuit boards (PCB)

The items marked with Δ in the table are options.

No.	Model name		Mounting position							Function	Applications			
	Model name	Configuration element name	S	M	P	A	C	C'			A	B		
1	CPU module									CPU, memory, servo I/F				
		QX141	○							Main CPU (With floating point operator)	○	○		
		QX423		○						SRAM memory	○	○		
		QX818						○		Main memory	○	○		
		QX812							○	User PLC memory	○	○		
		QX722			○					Servo CPU (2ch) Skip × 8	○	○		
2	CRTC module									I/F with display unit, memory, others				
		QX524	○							14" CRT control, color		○		
		QX521	○							12" CRT control, monochrome	○			
		QX423		○						Large capacity memory 512K	Δ	Δ		
		QX429		○						Large capacity memory 1.5M	Δ	Δ		
		QX425		○						Large capacity memory 2.0M	Δ	Δ		
3	DIO module									Machine input/output I/F				
		QX539	○							Honda connector type DI/DO: 64/64	○	○		
		QX535	○							Flat connector type DI/DO: 80/80	Δ	Δ		
		QX531	○							Honda connector type DI/DO: 64/48	Δ	Δ		
		QX315					○			Manual handle 3-axis	Δ	Δ		
4	Expansion module									AI/AO: 4/2	Δ	Δ		
		QX571	○							Expansion I/F (Base has no functions)	Δ	Δ		
		QX721			○					Servo CPU (1ch) (Skip × 4)	Δ	Δ		
		QX771			○					Data server	Δ	Δ		

Note 1) The symbols listed in the Mounting position column above are as follow.

Refer to the section 2.5 Control unit configuration for the mounting positions.

S : S-BUS A : A-BUS
M : M-BUS C : C-BUS
P : P-BUS C' : C'-BUS

Note 2) The symbols listed in the Applications column above are as follow.

A : M535MWY B : M545MHY

(3) Operation board

Display section

No.	Model name		Function
	Model name	Configuration element name	
1	4YZ407A-3		14" color CRT
		CD1472D1M2	14" color CRT unit
		KS-4MB401	Menu keys
		QY221	Board controller
		QY901	PCB
2	4YZ207A-3		12" monochrome CRT
		MDT-1283-02	12" monochrome CRT unit
		KS-4MB201	Menu keys
		QY221	Board controller
		QY901	PCB

Operation section

No.	Model name		Function
	Model name	Configuration element name	
1	4YZ10A-3		For vertical machining center
		QY904	Mechanical PCB
2	4YZ11A-3		For horizontal machining center
		QY904	Mechanical PCB

2. Daily Maintenance and Periodic Inspection and Maintenance

2.1 Maintenance Instruments

(1) Measurement instruments

The following instruments are used for measurement to confirm that the power is being properly supplied to the NC unit and that the wiring to the NC unit is correct, and during simple troubleshooting.

Table 2.1 Maintenance instruments

Instrument	Conditions	Application
Tester		Check that the wiring to the NC unit is correct before turning on the power.
AC voltmeter	The AC power voltage is measured. The tolerable difference is $\pm 2\%$ or less.	The AC power voltage supplied to the NC unit is measured.
DC voltmeter	Maximum scale 10V 30V tolerable difference is $\pm 2\%$ or less.	The DC power voltage is measured. External supply 24V (I/O interface DIO-A) Battery voltage QX084 DC output
Phase rotation meter		Check the order of AC 3-phase input power connection
Oscilloscope		For general measurement and simple troubleshooting

(Note 1) Currently, a high precision digital multimeter has been generally diffused as a tester, and is most commonly used. This digital multimeter can also be used for the AC voltmeter and DC voltmeter.

(Note 2) A logic analyzer (200MHz or more) is required for complicated troubleshooting.

(2) Tools

Screwdriver (large, medium, small)

2.2 Maintenance Items

Maintenance is divided into daily, periodic inspection and maintenance (items not performed daily but as designated), and periodic maintenance replacement (replacement of parts whose life is up).

Table 2.2 List of maintenance items

Class	Name	Life	Inspection/ replacement	Remarks
Daily maintenance	Cleaning of escutcheon and CRT		Daily	Refer to the section "Cleaning the operation board escutcheon and CRT".

2.3 Battery Replacement

Data that must be backed up such as the parameters and machining programs, etc., are saved by the lithium battery mounted in the front panel on the front of the control power supply when the power is turned OFF.

Battery used	: BR-CC7P with connector (Matsushita Denchi Kogyo with Mitsubishi specifications)
Battery voltage	: 3.0V
Alarm voltage	: 2.6V
Battery capacity	: 5.000mAH
Battery back up time	: 7 years
Battery life	: 7 years
Discharge current	: 100 μ A or less

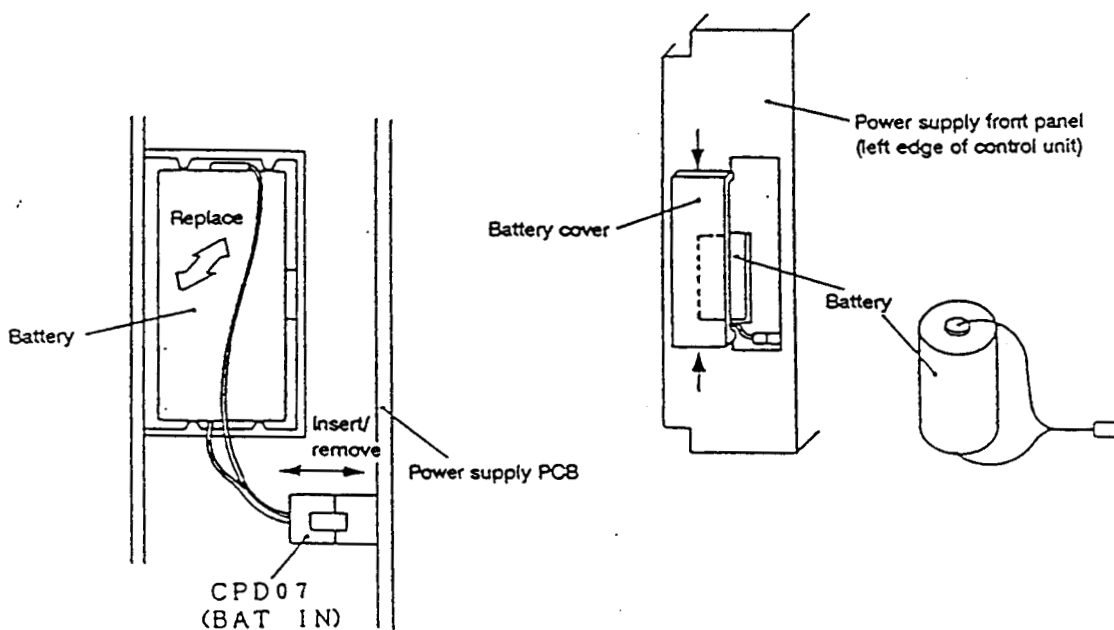
The battery must be replaced before the life is up to ensure proper operation of the system.
(If the battery alarm is displayed, the internal data may be destroyed.)

Replacement procedure

The machine (NC) power may be ON or OFF.

- (1) Remove the battery cover on the front panel of the control power supply.
- (2) Disconnect the connector on the battery.
- (3) Replace the battery and connect the connector.
- (4) Replace the battery cover.

If the power is turned OFF, complete this procedure within 30 minutes.



State with battery cover removed (enlarged view)

3. Trouble Diagnosis and Measures

If any trouble occurs during operation, it is necessary to accurately find the cause so that appropriate measures can be taken. Perform the following check to find the cause.

3.1 Confirmation of State of Trouble Occurrence

Confirm "when", "what was done" and "what kind of trouble" has occurred.

(1) When did the trouble occur?

The time that the trouble occurred.

(2) What was done?

What mode was the NC operating in?

- During automatic operation: Program No., sequence No., and program details of when the trouble occurred.
- During manual operation : What was the manual operation mode?
What was the procedure?
What were the last and next steps?
- What is on the setting and display unit screen?
- Was data being input or output?
- What was the machine side state?
- Were tools being exchanged?
- Has hunting occurred in the control axis?

(3) What kind of trouble occurred?

- What alarm is being displayed on the alarm diagnosis screen in the setting and display unit?
Display the alarm diagnosis screen and confirm the displayed details.
- What is displayed on the drive amplifier's status display?
Look at the display of the drive amplifier's status and confirm the alarm details.
- What is displayed for the machine sequence alarm?
- Is the CRT screen normal?

(4) How frequently does the trouble occur?

- When did the trouble occur? How frequently? (During operation of other machines?) If the trouble occurs infrequently, the power voltage may be incorrect, or noise may be the cause. Check that the power voltage is correct (does the power voltage drop instantaneously when other machines are operated), and confirm that measures against noise have been taken.
- Did the trouble occur in a specific mode?
- Did the trouble occur when the ceiling crane was operated?
- What is the frequency of occurrence in the same workpiece.
- Repeat the operation to see if the same trouble occurs during the same step.
- Confirm whether the same trouble occurs when the conditions are changed.
(Try changing the override, program contents, and operation steps, etc.)
- What is the ambient temperature?
(Was there a sudden change in temperature? Is the fan on the top of the control unit rotating?)
- Are there any defective cable contacts or defective insulation?
(Has oil or cutting fluids splattered on the cables?)

3.2 Examples of Troubles and Troubleshooting

3.2.1 Examples of trouble

(1) The NC power does not turn on.

- Is the power being supplied to the NC unit?
- Is the power supply section fuse blown?

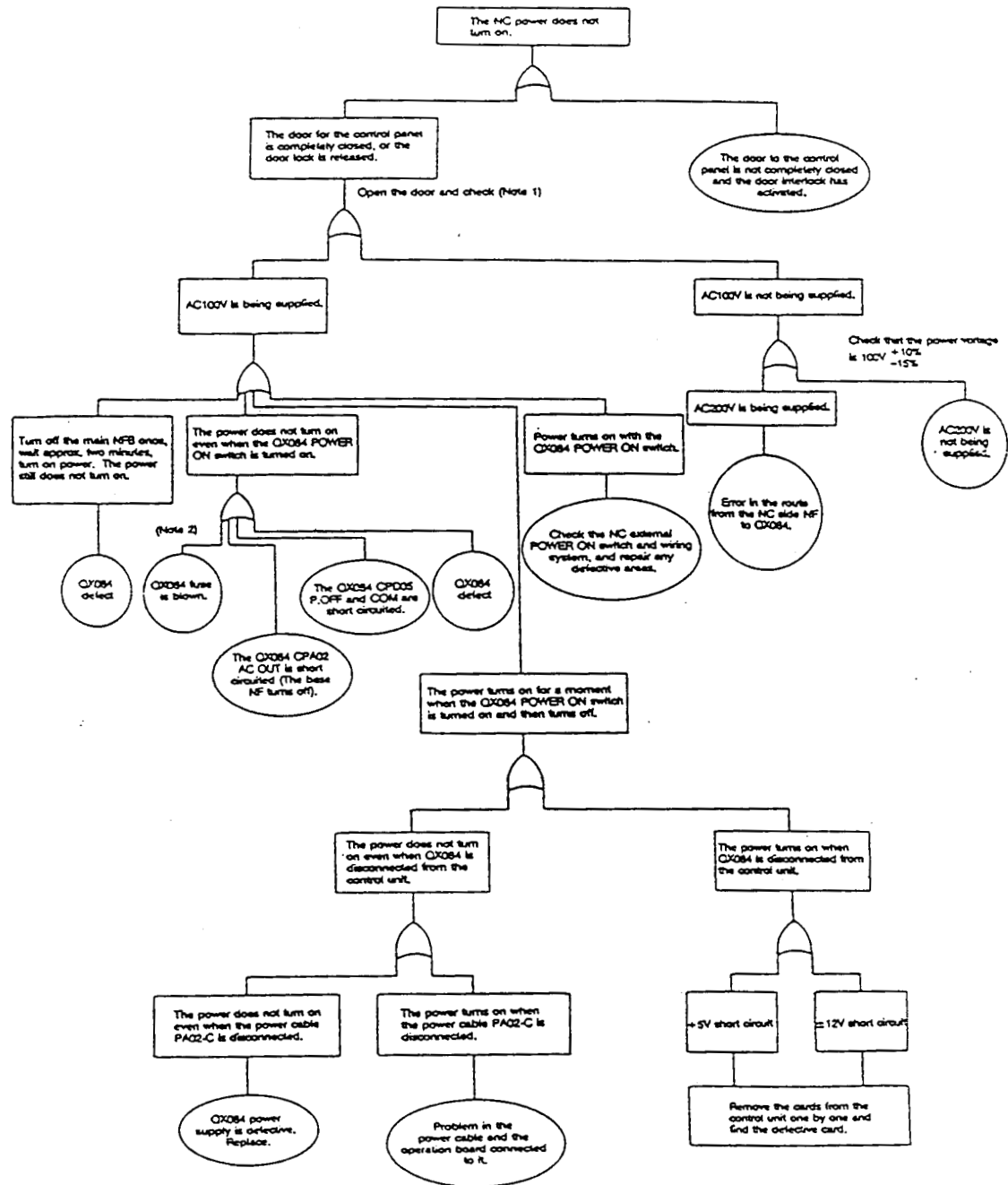
(2) The unit does not operate even when started up.

- Is the correct mode selected?
- Is the tape correctly mounted during tape operation?
- Are the starting conditions correct?
(In some machines, the start up will be locked unless specific conditions are satisfied. Confirm the conditions with the "Instruction Manual" issued by the machine maker.)
- Is the override or manual speed setting 0?
- Is the reset signal input?
- Is the feed hold signal input?
- Is the machine lock on?

3.2.2 Examples of troubleshooting

Power supply related troubleshooting

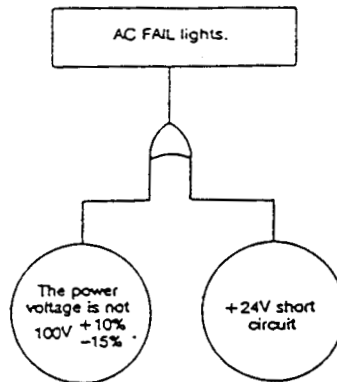
- ① The NC power does not turn on.



(Note 1) When the NC body door is opened, the door interlock limit switch will turn off. Turn the door interlock switch off with the door interlock key and then open the door. Always return the door interlock switch to ON after removing the trouble, and then close the door.

(Note 2) Refer to section 5.3.1 for details on blown fuses.

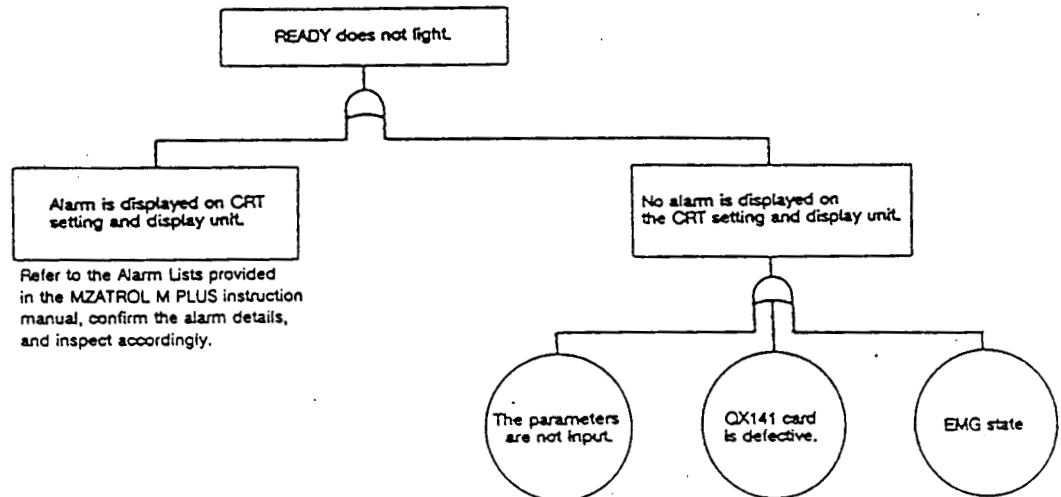
- ② AC FAIL (red) on QX084 lights.



(Note) When the QX084 24V output is being used for the I/O interface DIO-A, the machine output signal may be short circuited due to mis-wiring, etc.
In the above case, the IC in the I/O interface DIO-A card may be destroyed.

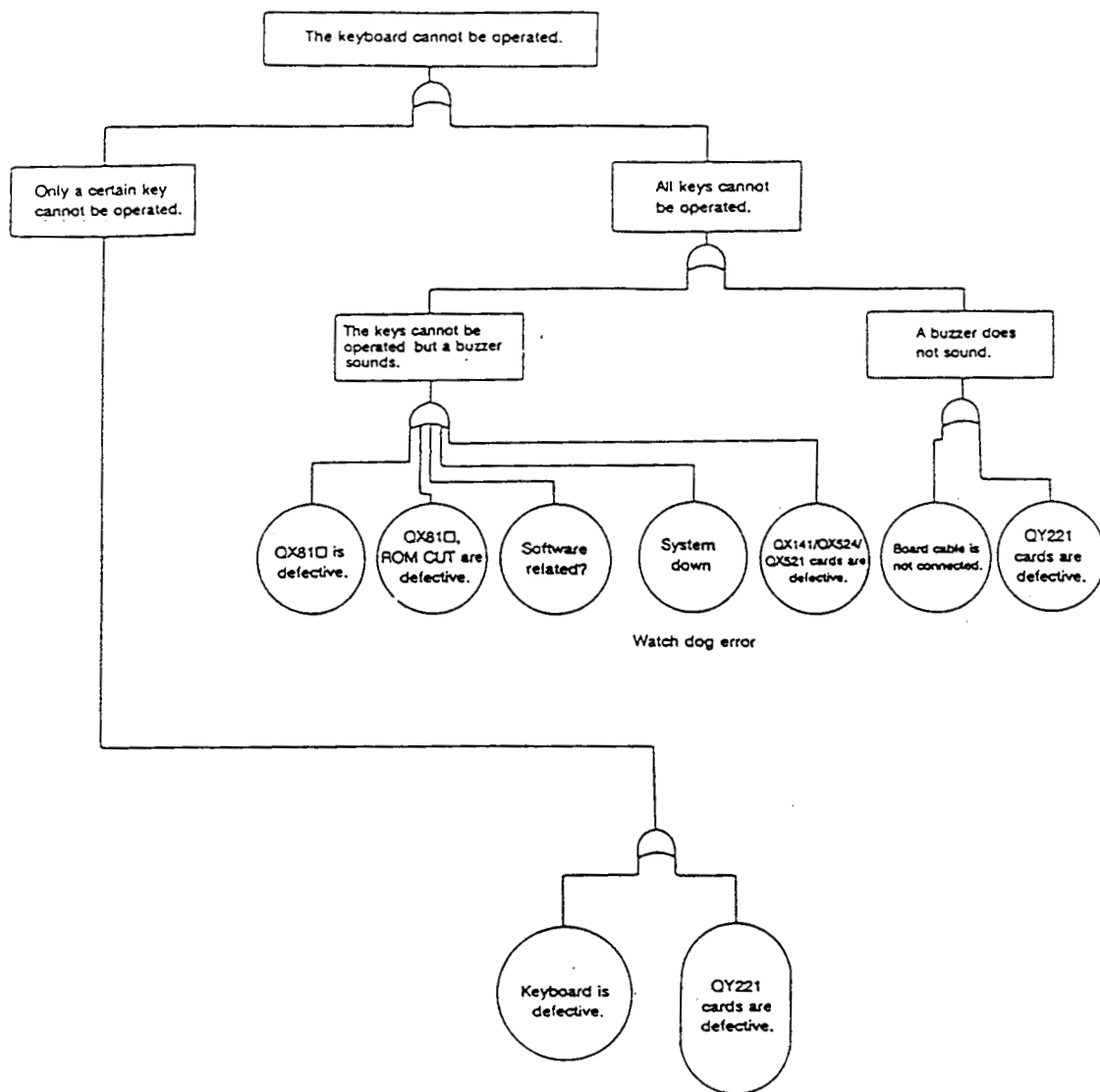
Troubleshooting in operation preparation stage

- ① Operation preparation (READY) cannot be entered.

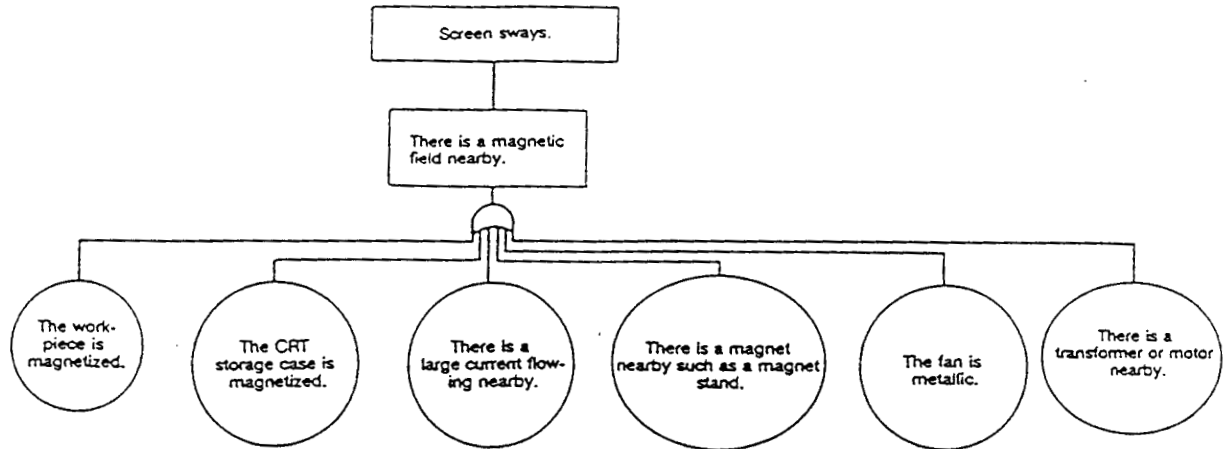


Operation board related troubleshooting

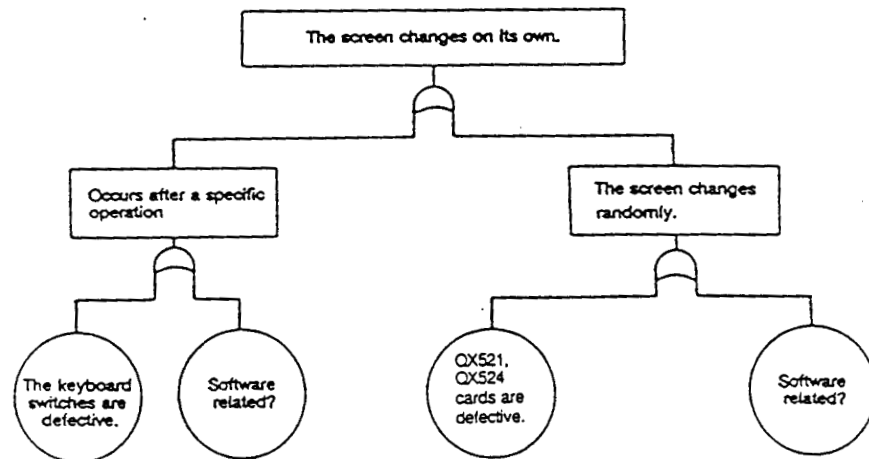
- ① The operation keyboard cannot be operated.



④ CRT screen sways (is distorted).



⑤ The screen changes on its own.



3.3 LED List of Each PCB (unit)

Fig. 3.3. shows the conventional hardware configuration (max. configuration) of a normal system. Refer to section 5.3.2 "PCB functions and handling" for details on PCBs not listed here.

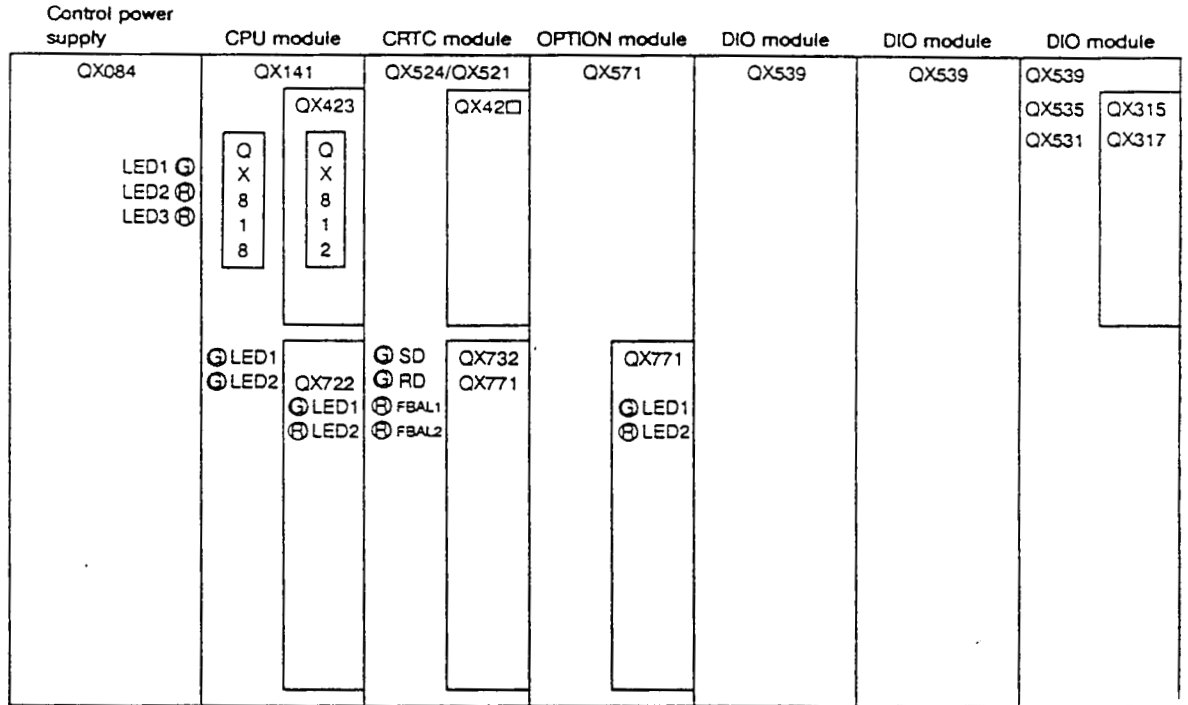


Fig. 3.3 Conventional hardware configuration (max. configuration)

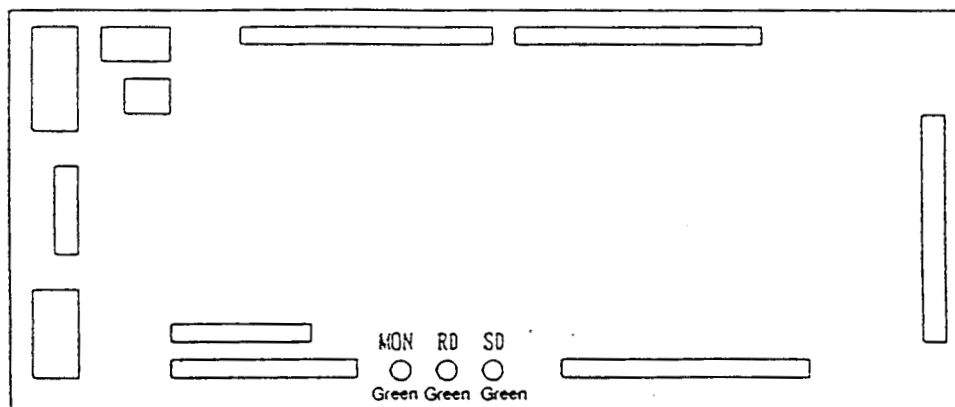
Table 3.3 shows a list of LEDs. Some of the PCBs not listed here do have LEDs, so refer to section 5.3.2 "PCB functions and handling" for details.

Table 3.3 LED list

Card name	LED name	State		Details of display	Measures during error
		Normal	Error		
Control power supply QX084	LED1 (Green) (POWER)	Lit	Not lit	Control power ON	Refer to "(1) The NC power does not turn on". Measure AC input voltage.
	LED2 (Red) (AC FAIL)	Not lit	Lit	AC input overvoltage, undervoltage	
	LED3 (Red) (BAT.AL)	Not lit	Lit	DC24V output OFF Battery alarm (2.6V and less)	Is DC24V load too high? Replace battery immediately.
QX141	LED1 (Green, Red)	Green LED flickers	Red LED stable	Watch dog alarm	One of the PCBs in the CPU module may be defective.
	LED2 (Green, Red)	Green LED flickers	Red LED stable	Memory parity error	The DRAM in the QX141 card or one of the QX421 cards may be defective.
QX721/QX722	LED1 (Red) LED2 (Green)	Not lit	Lit	Watch dog alarm Software monitor	The PCB may be defective.
QX524/QX521	SD (Green)	Lit	Not lit	Indicates that data is being transferred between operation board.	Either the PCB or cable may be defective.
	RD (Green) FBAL1 (Red)	Lit Not lit	Not lit Lit	Same as above Spindle encoder no signal alarm	Same as above The cable may be broke or the spindle encoder may be defective.
	FBAL2 (Red)	Not lit	Lit	Same as above	Same as above

LED on operation board side

QY221



Card name	LED name	State		Details of display	Measures during error
		Normal	Error		
QY221	RD (Green)	Lit	Not lit	Data reception (Indicates that communication data from the control unit is being received.)	If RD goes out or SD lights when MON is flickering, the cable may be broken or the PCB on the control unit may be defective. If both RD and SD are out, this PCB may be defective.
	SD (Green)	Lit	Not lit	Data transmission (Indicates that communication data is being transmitted to the control unit.)	
	MON (Green)	Flicker	Lit Not lit	System monitor	The PCB may be defective. However, if all LEDs (RD, SD, MON) are out, the DC24V supply OFF (NC power supply) may be interrupted.

2. The messages shown below are alarms that do not necessarily cause the system to stop.

Message	Details	Possibility of hardware defect	Measures for hardware
Z07 CRC error	There is a defect in the ROM mounted on QX81□.	Large	Replace QX81□ Reprogram
Z11 RAM error	There is an error in the DRAM mounted on QX141.	Large	Replace QX141
Z51 EEROM error	This occurs when the parameters were not correctly written into the EEROM.	Small	Replace QX141
Z52 Battery drop	The voltage of the battery mounted to save the data in the NC has dropped. (Life)	100%	Replace battery
Z53 Overheat	The temperature of QX141 or the operation board has risen over the specified value. Specified value QX141 ON at $70\pm5^{\circ}\text{C}$ OFF at $55\pm5^{\circ}\text{C}$ Operation board ON at $70\pm5^{\circ}\text{C}$ OFF at $60\pm5^{\circ}\text{C}$	Small (FAN)	Fan trouble However, in most cases this is caused by the working environment, so confirm the heat measures taken for the body as explained in the "Connection Manual".
Z55 DIO 24V error	The required 24V power is not being supplied to the I/O interface DIO-A card (DIO card).	Small	Replace DIO card Confirm 24V power supply connection Check for short circuit of 24V load on machine side
Z10 QX42□ SRAM error	An error (memory parity error, etc.) occurred in the machining program registration memory (QX42□). A memory parity error in QX42□ of the CPU module will cause the (1) system stopping.	Large	Replace battery Replace QX42□ Initialize the registration memory

There are primary alarms (alarms which when occur, another alarm also occurs), and secondary alarms (alarms that occur even with other cause). Here, the presumed caused of the primary alarm must be investigated.

Example

- (1) If both the parity error and watch dog error occur simultaneously, investigate the parity error.
- (2) If battery drop and another alarm occur simultaneously, investigate the battery drop first.

3.4 Presumed Causes for Alarms

The presumed causes for alarm related to the hardware in the MAZATROL M PLUS Series are explained in this section.

1. The messages shown below display on the screen together with the register of the error occurrence point when the system stops due to a system error.

Note down the displayed register, and then contact the service center.

Message	Details	Possibility of hardware defect	Alarm generated simultaneously
Parity error	RAM error	Great	Watch dog error
Bus error	An address that does not exist was accessed.	Small	Watch dog error
Zero divide	Division of a denominator that is zero was attempted.	Very small	
Watch dog error	The system operation stopped.	Medium	
Illegal exception	An illegal interrupt occurred.	Small	

2. The messages shown below are alarms that do not necessarily cause the system to stop.

Message	Details	Possibility of hardware defect	Measures for hardware
Z07 CRC error	There is a defect in the ROM mounted on QX81□.	Large	Replace QX81□ Reprogram
Z11 RAM error	There is an error in the DRAM mounted on QX141.	Large	Replace QX141
Z51 EEROM error	This occurs when the parameters were not correctly written into the EEROM.	Small	Replace QX141
Z52 Battery drop	The voltage of the battery mounted to save the data in the NC has dropped. (Life)	100%	Replace battery
Z53 Overheat	The temperature of QX141 or the operation board has risen over the specified value. Specified value QX141 ON at $70\pm5^{\circ}\text{C}$ OFF at $55\pm5^{\circ}\text{C}$ Operation board ON at $70\pm5^{\circ}\text{C}$ OFF at $60\pm5^{\circ}\text{C}$	Small (FAN)	Fan trouble However, in most cases this is caused by the working environment, so confirm the heat measures taken for the body as explained in the "Connection Manual".
Z55 DIO 24V error	The required 24V power is not being supplied to the I/O interface DIO-A card (DIO card).	Small	Replace DIO card Confirm 24V power supply connection Check for short circuit of 24V load on machine side
Z10 QX42□ SRAM error	An error (memory parity error, etc.) occurred in the machining program registration memory (QX42□). A memory parity error in QX42□ of the CPU module will cause the (1) system stopping.	Large	Replace battery Replace QX42□ Initialize the registration memory

There are primary alarms (alarms which when occur, another alarm also occurs), and secondary alarms (alarms that occur even with other cause). Here, the presumed caused of the primary alarm must be investigated.

Example

- (1) If both the parity error and watch dog error occur simultaneously, investigate the parity error.
- (2) If battery drop and another alarm occur simultaneously, investigate the battery drop first.

(1) Parity error

(a) Meaning

A parity bit is added to improve the reliability of the CPU card DRAM and memory card QX42□ SRAM.

When data is written into the above RAMs, the data is written into the parity bit memory so that the number of '1' bits, including the parity bit, becomes an odd number, for each byte. Then, if the memory details change for any reason, the change will be detected when the data is read out, and a parity error will occur.

(The changes cannot be detected when two bits are changes simultaneously. However, the probability that two bits will change in all addresses that the software accesses is very low.)

7	6	5	4	3	2	1	0	P
1	0	1	0	0	1	0	1	1

The number of bit 0 to 7's '1's are even, so '1' is written in.

(b) Cause and measures

Handling of this error will differ according to whether this is a CPU card DRAM parity error or a QX42□ SRAM parity error. It is important to determine which parity error has occurred.

How to determine the error

List of presumed causes

No.	Presumed cause	Presumed cause (details)	Measures	Probability
1	SRAM Parity error	<ul style="list-style-type: none"> The voltage of the back up battery (Li battery mounted on front of QX084) has dropped. If the message 'Z52 Battery drop' appears on the screen after the power is turned on, and the QX084 BAT.AL LED lights, the battery voltage has dropped. The details registered in the SRAM may have been lost when the power was turned off. 	Replace with a new battery.	Great
		<ul style="list-style-type: none"> Memory card defect If the battery voltage has not dropped, the card may be defective. 	Replace QX42□.	Medium
2	DRAM Parity error	The CPU card DRAM may be defective.	Replace QX141□.	Medium
3	Software	<ul style="list-style-type: none"> The RAM area has not been initially cleared, so a SRAM parity error has occurred. 	Initial clear	Great
		<ul style="list-style-type: none"> An illegal address (area where memory is not mounted) was accessed. normally a bus error will occur. 	Change to the newest software version, and see how it works.	Small
4	Others	<ul style="list-style-type: none"> AC FAIL and MLOCK are not possible when the power is turned off due to control power QX084 defect. 	Replace QX084	Small

(2) Bus error

(a) Meaning

Each PCB (and internal circuit) mounted in the control unit has a characteristic address assigned to it looking from the MPU of the CPU card QX141, etc. (This is called the address MAP or memory MAP.)

When the software runs away or an area other than this designated address is accessed, an answer will not be returned and a bus error will occur.

(b) Cause and measures

List of presumed causes

No.	Presumed cause	Presumed cause (details)	Measures	Probability
1	Card defect	<ul style="list-style-type: none">Card defect Replace the control modules in the order of the CPU module, CRTC module, DIO module, etc. When the alarm stops when one of the above control modules is replaced, replace the PCBs on that control modules. For example, if it is the CPU module, replace the PCBs one by one in the order of QX141, QX721/QX722, QX42□, QX81□.	<p>Replace with a good control module.</p> <p>Replace with a good PCB.</p>	Great
2	Noise	<ul style="list-style-type: none">Noise If measures against noise have not been taken, the system may be malfunctioning due to noise that is entering the NC through the power cable and connection cables.	<p>Confirm the "cable clamp treatment", "grounding treatment", "surge killer treatment of relays, etc.", according to the "Connection Manual", and treat if treatment has not been executed already.</p>	Small
3	Software	<ul style="list-style-type: none">Malfunction during a specific operationThe user PLC software accessed an illegal address.	<p>Change to the newest software version, and see how it works.</p> <p>Confirm the software list.</p>	<p>?</p> <p>?</p>

(3) Zero divide

(a) Meaning

When calculating $A \div B$, $B=0$.

(b) Cause and measures

Contact the service center.