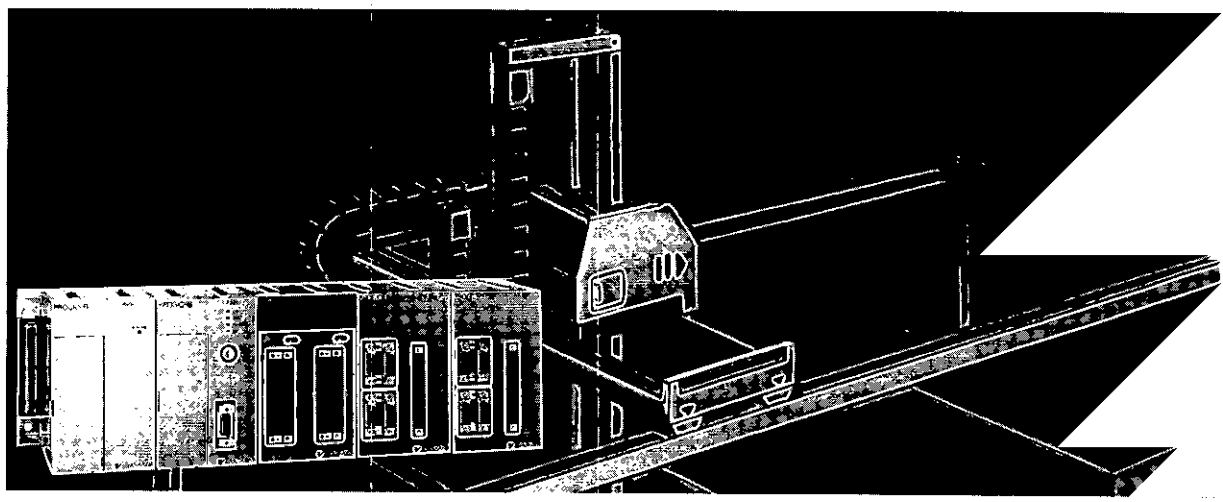
PROGIC-8

MULTIAXES MOTION CONTROLLER

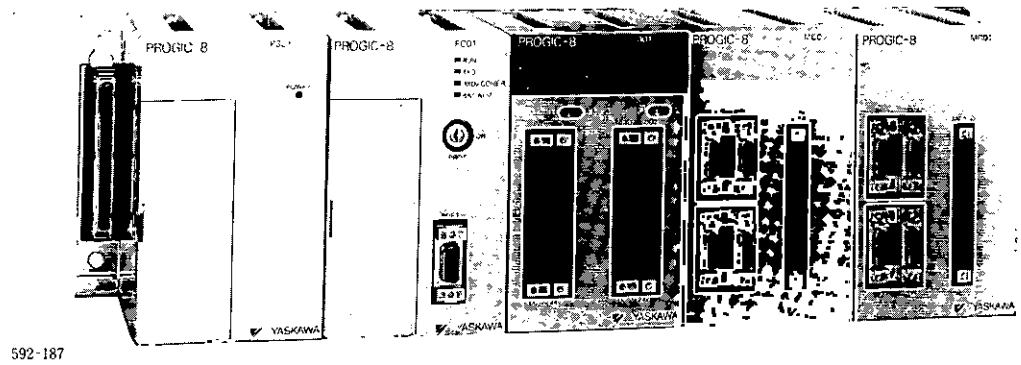
SYSTEM HANDBOOK



YASKAWA

PREFACE

This handbook explains features, system configuration, specifications, installation and wiring, test run and maintenance for PROGIC-8. Read this handbook before constructing your system.



PROGIC-8

Also refer to:

PROGIC-8 PROGRAMMING MANUAL FOR PLC	(SIE-C888-1.1)
PROGIC-8 PROGRAMMING MANUAL FOR MC	(SIE-C888-1.2)
PROGIC-8 PROGRAMMING SYSTEM OPERATION MANUAL	(SIE-C888-1.4)

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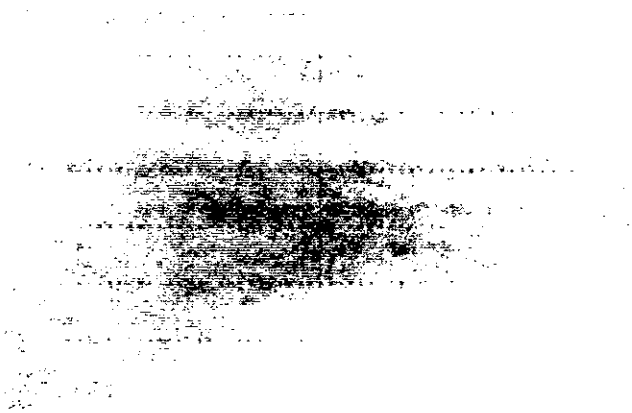

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1 FEATURES

PROGIC-8 is a compact machine controller that serves as motion controller and sequence controller to meet the demands in assembly, handling, transfer, and other applications. PROGIC-8 will control your machine optimally.

- **Fusion of motion control and sequence control**

The MC unit and the PLC unit are connected with a bus so that a large quantity of information can be transmitted between the units at a high speed, enabling integrated control of motion and sequence.

- **Compact unit configuration**

Both MC and PLC units are very compact. The unique structure enables the mounting of necessary units on the mounting base and contributes to space saving, elimination of wiring processes between units, and improvement of reliability.

- **Programming available on a general-purpose personal computer**

Sequence programs for the PLC unit, motion programs and parameters for the MC unit can be loaded, saved, and edited on a general-purpose personal computer.

- **Easy programming**

· Both motion and sequence programs can be edited offline.
· PLC unit : Ladder or mnemonic language is available for easy programming.
· MC unit : Easy motion language is available for programming.

- **Flexible configuration with up to eight axes**

A single PLC unit can be connected to up to two MC units that can control up to four axes each, offering motion control of two four-axis systems.

- **Independent operation and interpolation operation**

The MC unit can perform linear, circular, and helical interpolation. The axes can be moved independently from each other according to the command from the PLC unit.

- **Interface compatible to speed control type servo (SR)**

PROGIC-8 can be connected to Yaskawa's SR type servo. Select an optimum servo considering machine performance. A more compact system can be constructed by combining with the Σ series servo.

2 SYSTEM CONFIGURATION

2.1 Basic System Configuration

2.1.1 Basic Unit List

Table 2.1 List of Product Components

Name	Type	Specifications
MC Unit	JEPMC-MC002	· 4 axes/unit, motion control · Memory : 60kBytes
PLC Unit	JEPMC-PC050	· Memory for ladder : 16k steps · Communication port : RS-232C × 1 port
Power Supply Unit	JEPMC-PS050	· Input voltage : 85 to 264VAC
I/O Unit	JEPMC-IO050	· Input : 80 points 12/24V (2.5/5mA 50% duty) · Output : 48 points 12/24V (100mA 50% duty)
Base Unit (1)	JEPMC-MB041	· For 4 slots · PS050+PC050+IO050+MC002
Base Unit (2)	JEPMC-MB051	· For 5 slots · PS050+PC050+IO050+IO050+MC002
Base Unit (3)	JEPMC-MB052	· For 5 slots · PS050+PC050+IO050+MC002+MC002
Base Unit (4)	JEPMC-MB062	· For 6 slots · PS050+PC050+IO050+IO050+MC002+MC002
Software for Personal Computer PP	—	· For personal computer (IBM compatible) Ladder/mnemonic/MC program Programmer lister

2.1.2 Basic System Configuration

(1) Configuration with four servomotor controlled axes (128 inputs/outputs)

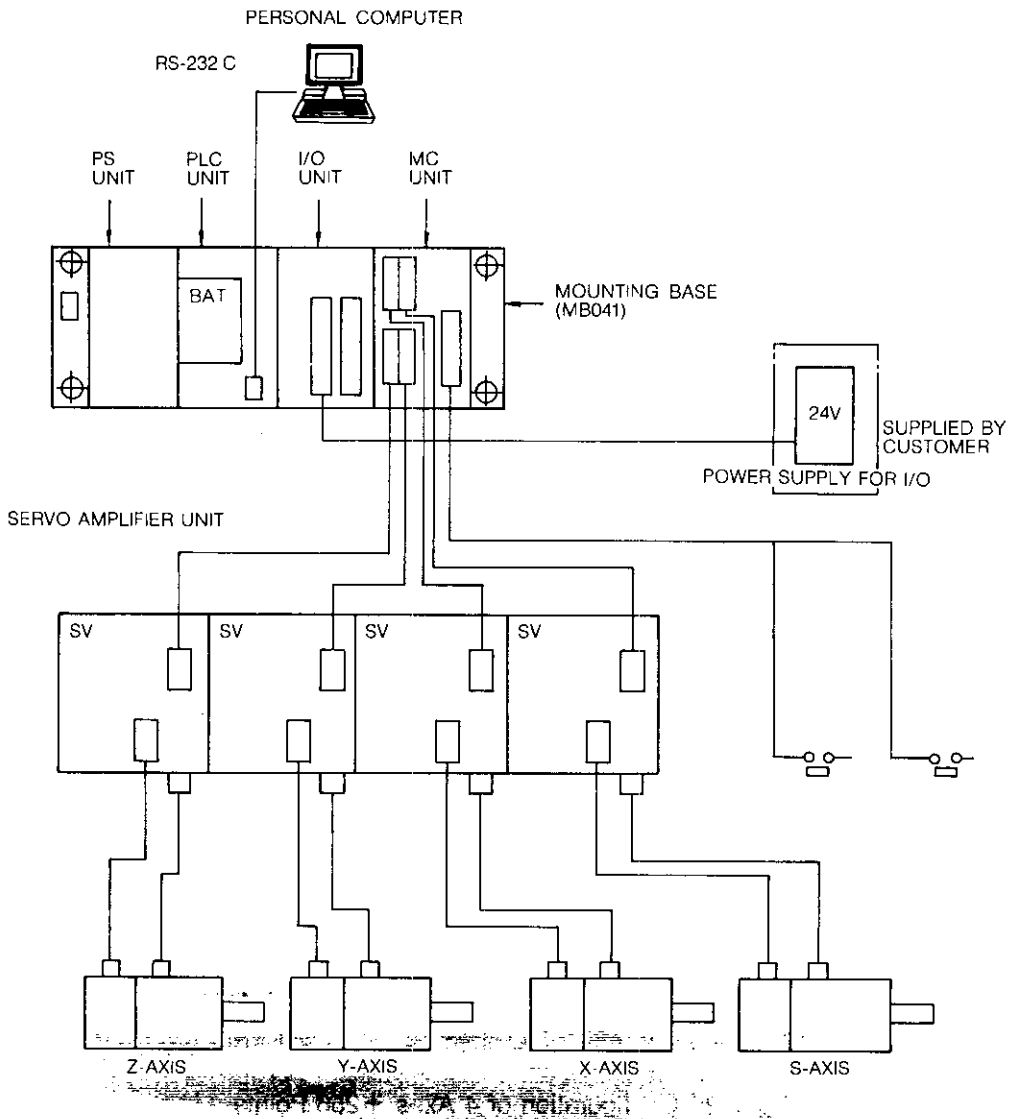


Fig. 2.1 Configuration of 4 Axes +128 Points

(2) Configuration with four servomotor controlled axes (256 inputs/outputs)

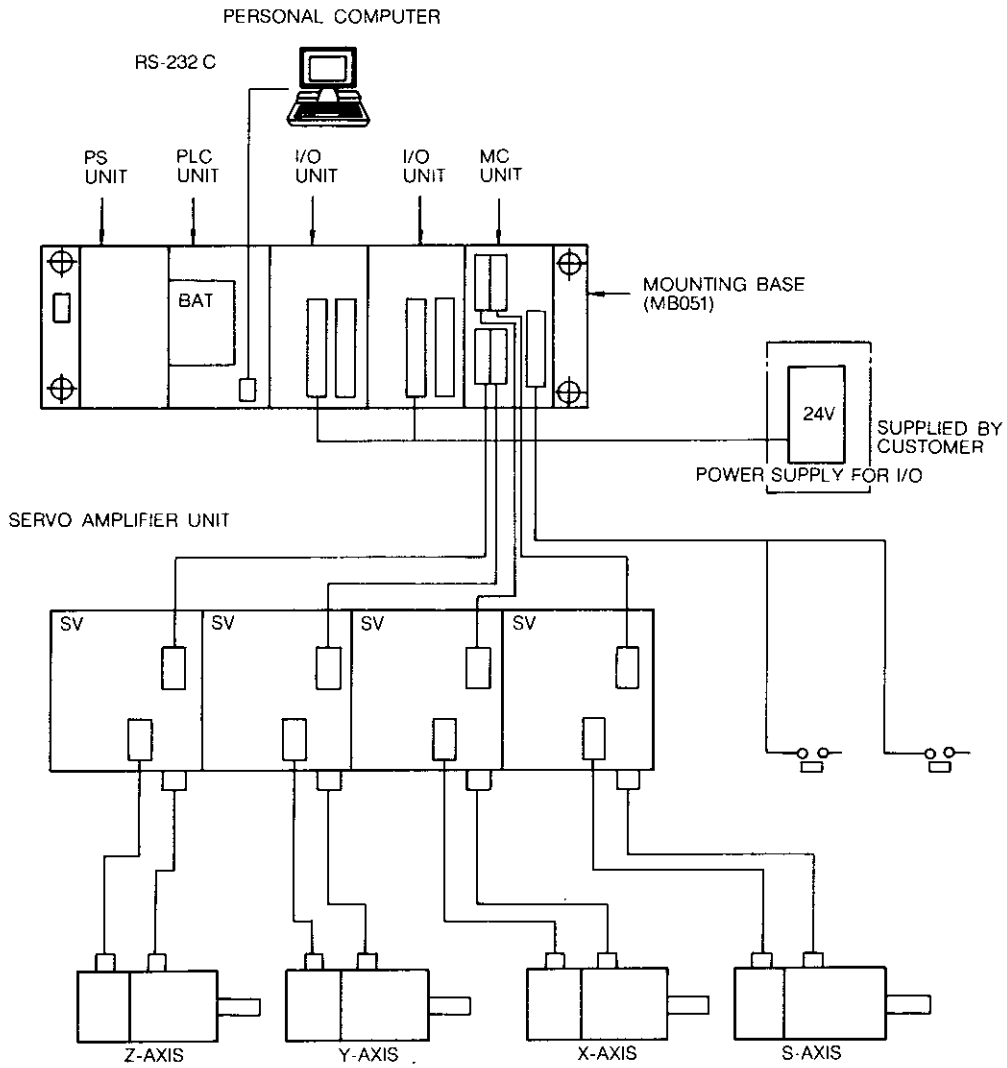


Fig. 2.2 Configuration of 4 Axes +256 Points

(3) Configuration with eight servomotor controlled axes (128 inputs/outputs)

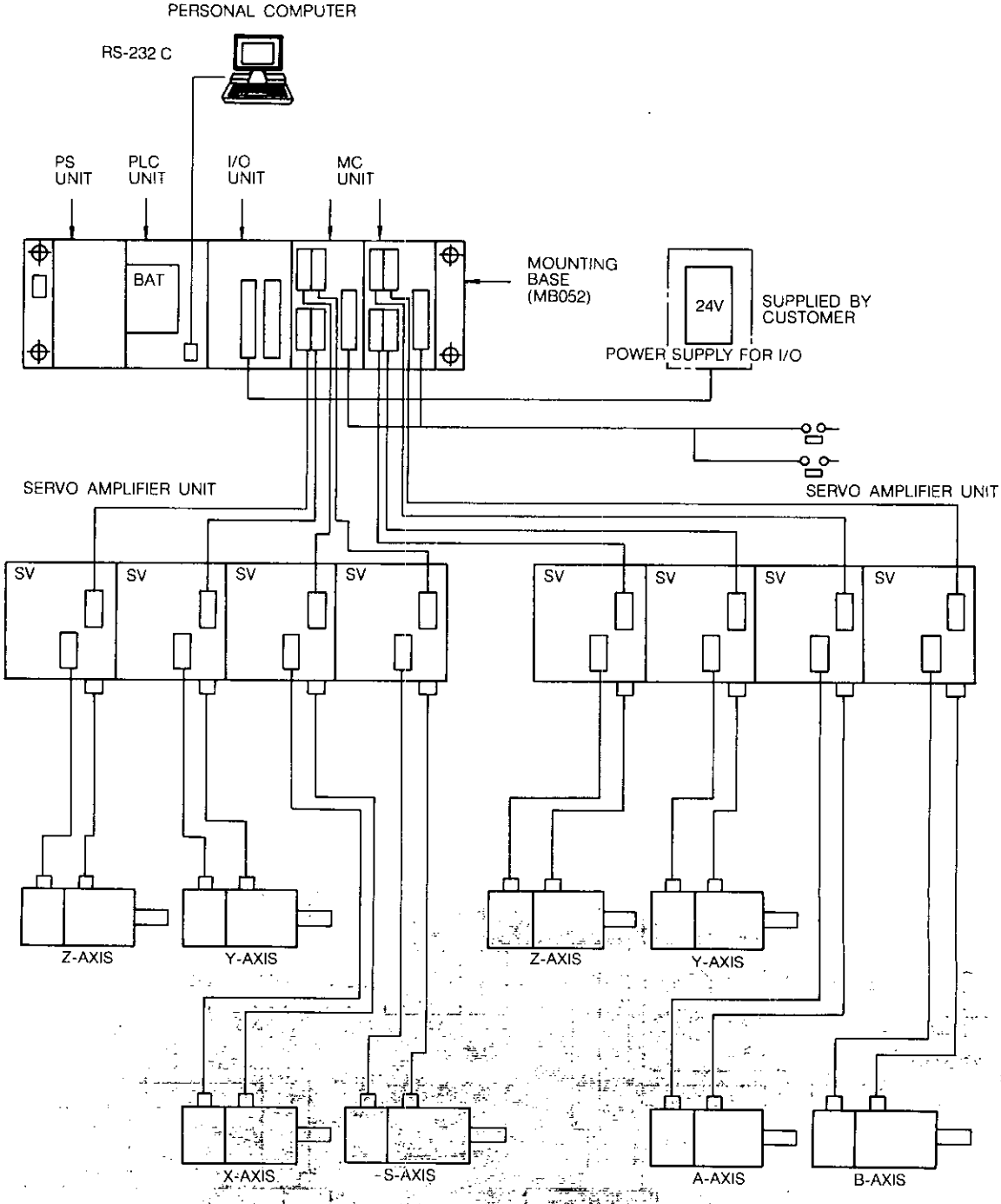


Fig. 2.3 Configuration of 8 Axes + 128 Points

(4) Configuration with eight servomotor controlled axes (256 inputs/outputs)

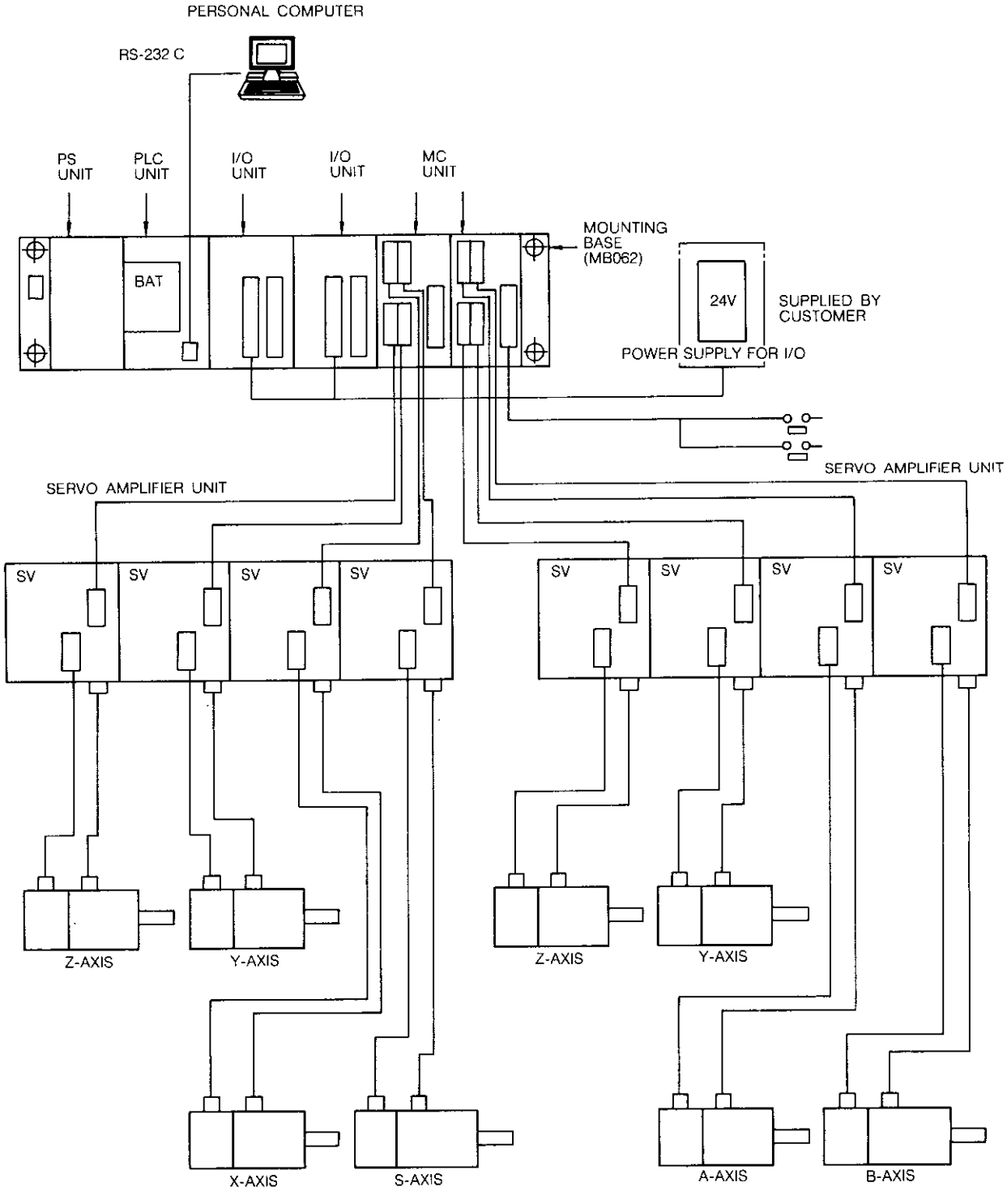


Fig. 2.4 Configuration of 8 Axes +256 Points

(5) MMI connection (Example of four servomotor controlled axes, 128 inputs/outputs)

Using the MEMOBUS communication function, an FA computer can be connected.

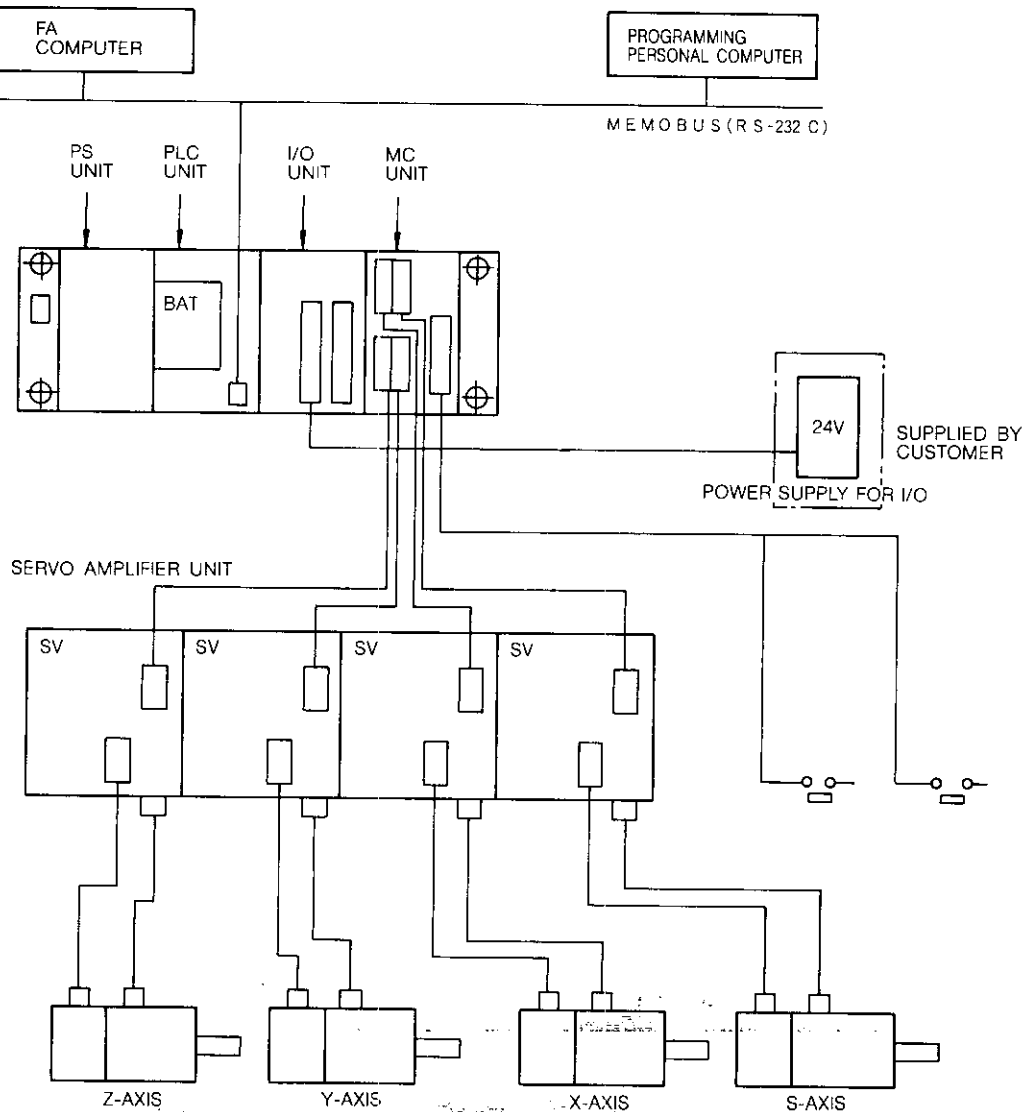


Fig. 2.5 Configuration of MMI Connection

3 SPECIFICATIONS

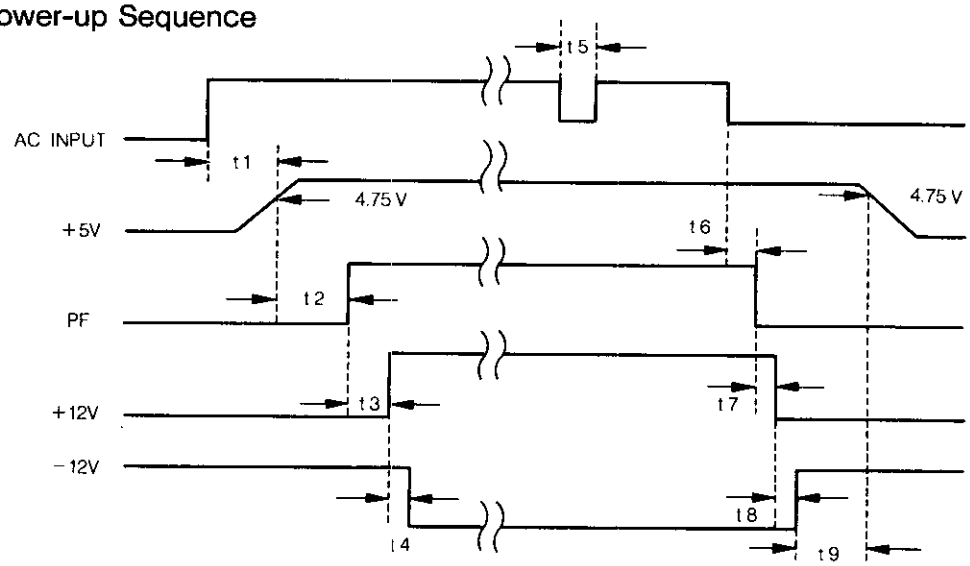
3.1 General Specifications

3.1.1 List of Specifications

Table 3.1 General Specifications

Item	Specifications	Remarks
Power supply	Single-phase, 85 to 264VAC, 47 to 63Hz	JEPMC-PS050
Power consumption	100VA	
Momentary power loss holding time	20ms (Shorter power interruption is not recognized as a loss.)	
Operating ambient temperature	0℃ to 55℃	Additional equipment is excluded.
Storage temperature	−20℃ to +85℃	Lithium battery is excluded.
Humidity	30% to 95% RH (Non-condensing)	
Vibration resistance	1G (10 to 150Hz)	Additional equipment is excluded.
Shock resistance	10G	Additional equipment is excluded.
Atmosphere	Must be free from flammable or corrosive gases. Should be relatively dust-free.	
Grounding	Specialized Class 3 earth connection	
Withstanding voltage	1500VAC, one minute	
Insulation resistance	500VDC, 100 megaohms or greater	
Noise-proof performance	1500V, 1μs, 1ns of rising (by noise simulator)	

3.1.2 Power-up Sequence



NOTE : t1 < 300ms t3 = t7 < 5ms 20ms ≦ t5 20ms < t6 < 40ms
t2 < 100ms t4 = t8 < 5ms 10ms ≦ t9

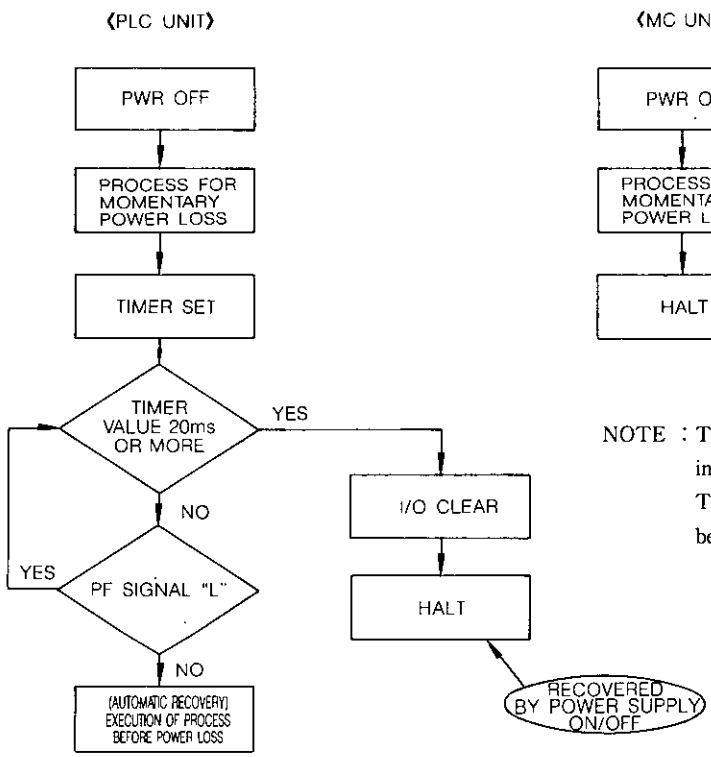
Fig. 3.1 Power-up Sequence

Power sequence is shown above. At power-ON, 5VDC is provided within 300ms after AC power supply is turned ON. Within 100ms after that, PF signal (power normal signal: Active H) is turned ON, and +12V is provided within another five ms, and −12V within 10 ms.

Power interruption is detected on AC power supply side. If an AC power interruption (for more than 20ms) occurs, it is detected as follows. As a rule, if the AC power supply continues OFF for more than one cycle (20ms), it is recognized as a service interruption, and service interruption handling procedure is started. However, this is uncertain if the OFF-state continues only for one or two cycles (20ms to 40ms). The procedure will always start if the interruption lasts longer than 40ms.

If a service interruption (when the AC power supply has been OFF for 20ms or longer) is detected, the PF signal falls immediately, indicating the power loss. This means that the point when PF signal falls is recognized as the time of occurrence of service interruption. From that instant, +12V is maintained for 5ms, −12V for 10ms, and +5V for 20ms.

Fig. 3.2 shows the sequence of service interruption. As seen from the figure, the MC unit always stops whenever a service interruption occurs. To recover, the AC power supply must be cycled. During the service interruption sequence, the PLC unit monitors PF signal and automatically recovers if the AC power supply recovers within 20ms after service interruption occurs. If a longer time has elapsed, neither the PLC unit nor MC unit can be recovered unless the AC power supply is cycled.



NOTE : The MC unit stops after a service interruption.
To recover, the power supply must be turned OFF and ON.

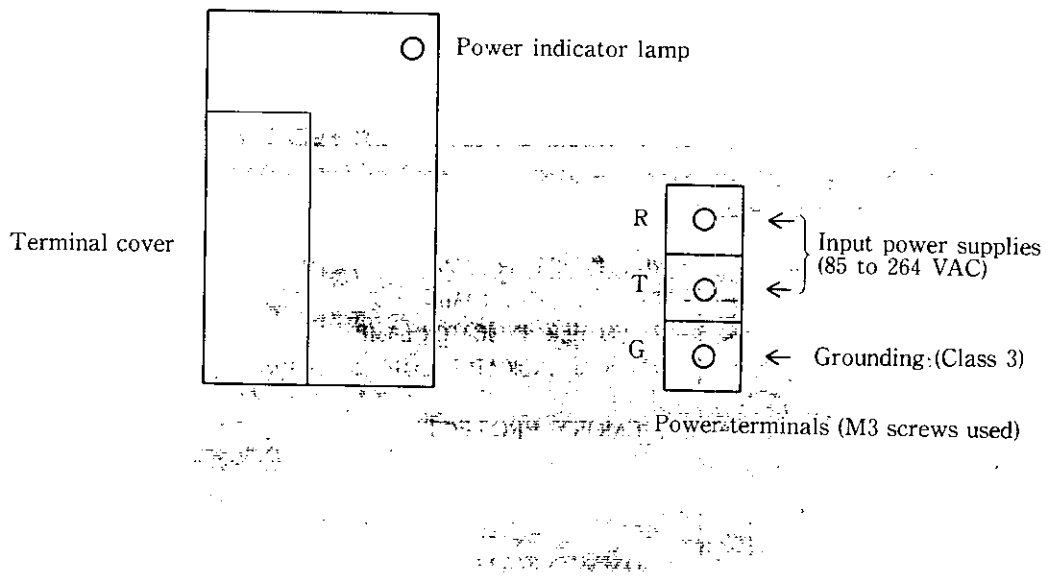
Fig. 3.2 Power Loss Sequence

3.2 Power Supply Unit Specifications

3.2.1 Specifications of Power Supply Unit for Basic System

Table 3.2 Specifications of PS050

Item	Specifications
Type	JEPMC-PS050
Function	Supplies DC power to the PLC and MC units of a basic system
Input power	Single-phase, 85 to 264VAC, 47 to 63Hz
Transient input voltage	308VAC (10ms or shorter)
Inrush current	50A or less (for cold starting at 240V, rated load)
Leak current	1mA or less
Fuse	Ordinary glass tube fuse
Indicator lamp	POWER : Lights when the power supply is normal.
Dimensions (mm)	80(W) × 130 (H) × 100(D)
Approximate mass	0.7kg



3 SPECIFICATIONS

3.3 PLC Unit Specifications

3.3.1 Specifications

Table 3.3 PLC Hardware Specifications

Item	Specifications	
Type	JEPMC-PC050	
Number of I/O terminals	512 discrete I/O terminals and 128 register I/O terminals	
Configuration of I/O	Basic I/O unit	128 discrete I/O terminals (with mounting base JEPMC-MB041 or MB052) 256 discrete I/O terminals (with mounting base JEPMC-MB051 or MB062)
Applicable processor	16-bit processor TMS320C25 (made by Texas Instruments)	
Communication port	Electric specifications	RS-232C 1 port (for connecting with personal computer)
	Transmission conditions	9600bps, 8 data bits, even parity, 1 stop bit
	Communication procedure	MEMOBUS protocol
	Applications	Programming and monitoring for PLC unit and MC unit
Indicator lamps	RUN	Lights (green) while scanning. Goes OFF when scanning stops.
	TXD	Lights (green) while characters are being sent from the communication port.
	RXD/COMER	RXD : Lights (green) while characters are being received from the communication port. COMER : Lights (red) when a parity, overrun, or other communication error occurs.
	BAT ALM	Lights (red) when memory backup battery voltage drops. Goes OFF when the voltage returns to normal.
Memory backup	One lithium battery : BR-2/3A-1 (For model 1), five-year life (at 25℃) Memory backup : 1 year (at 25℃)	
Memory protect switch	ON : Program and data writing from the personal computer to the PLC unit is prohibited.	
Dimensions (mm)	80(W) × 130(H) × 100(D)	
Approximate mass	0.4kg	

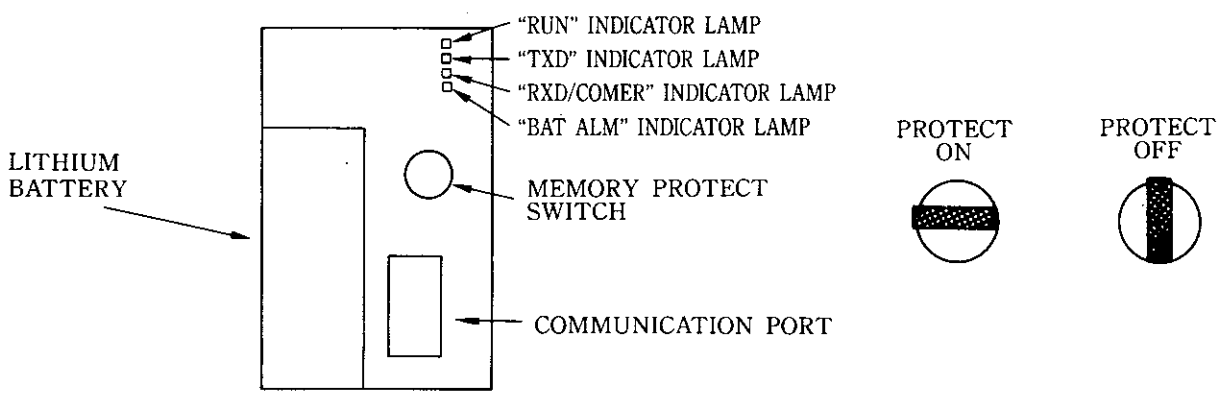


Table 3.4 PLC Software Specifications

Item	Specifications	
Control method	Scanning method by stored program control	
Programming language	Ladder language using relay symbols or command language using mnemonics	
Program memory	16k steps, 24bits/step (Standard : CMOS battery backup memory. Option : EPROM)	
Data memory	Holding registers : 2048 words, 16bits/word Link registers : 1024 words, 16 bits/word	
Basic command processing time	0.125μs/step	
Basic functions	Relays	NO contact, NC contact, transitional contacts (OFF to ON), transitional contacts (ON to OFF), two types of stepping relays
	Coils	Coil, latch coil, set coil, reset coil, timer set coil, counter set coil
	Timers and counters	100ms timer, 10ms timer, up counter, down counter
	Arithmetic operation commands	Addition (ADD), subtraction (SUB), multiplication (MUL), division (DIV), double-length addition (DAD), double-length subtraction (DSB), double-length multiplication (DML), double-length division (DDV)
	Other computation commands	Square root (SQR), double-length square root (DSQ), sine (SIN), cosine (COS)
	Data transfer commands	Register to table move (RTT), table to register move (TTR), table to table move (TTT), block move (BLK), first-in (FIN), first-out (FOT), read status (STT), set table (TST), clear coil (CLR)
	Matrix commands	AND table (ANT), OR table (ORT), exclusive OR (XOR), complement (CMP), compare (CPR), search (SRC), sense (SEN), modify bit (MBT), multi-rotate (MRT)
	Data conversion command	BCD to binary (BIN), binary to BCD (BCD).
	Special commands	Skip (SKP), subroutine (GSB), pulse (PLS)
	Motion commands	Program operation (MVL), single-block operation mode (SMD), independent A-axis operation (MVA), independent B-axis operation (MVB), zero return (ZRN), jog operation (JOG), monitor (MON), set current position (POS), set parameter (PRM), set variable (VAR), reset alarm (ARS), servo-ON (SVN), set mode (MOD), reset MC unit (MRS), emergency signal stop (ESP)
RAS function (RAS : Reliability, Availability and Service ability)	Various self-diagnosis functions (watchdog timer, memory total sum check, program data check, LSI diagnosis) Error message indication, error code history record (for up to four errors)	
Constant sweep function	Constant scan time up to 200ms can be set up in increments of 10ms.	

3.3.2 Scan Time and I/O Service

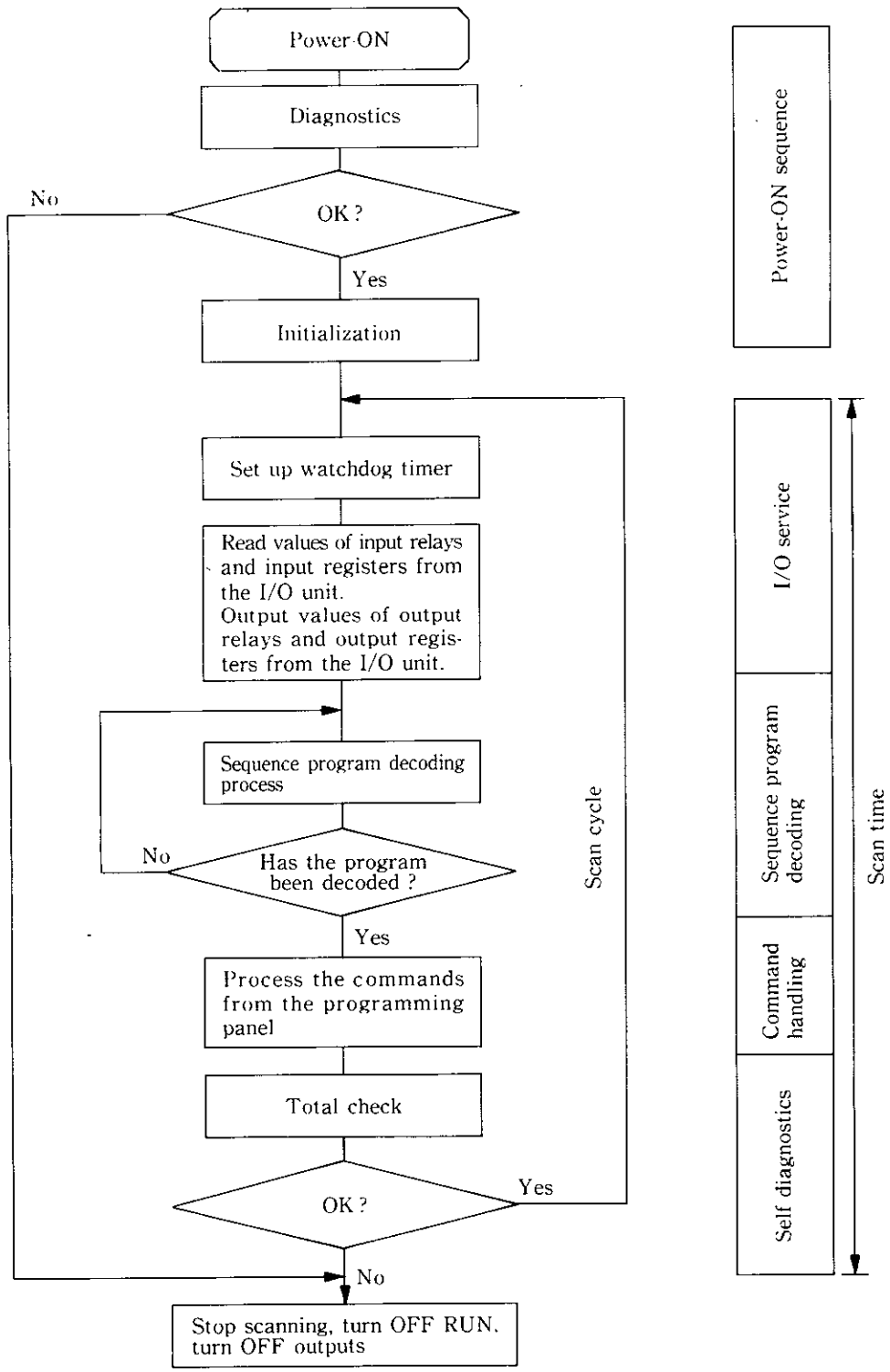


Fig. 3.3 PLC Internal Processing

After power is turned ON and the power-ON sequence is completed, the PLC unit repeats the series of operations of I/O service, sequence program decoding, command handling, and self diagnostics as shown in Fig. 3.3. This series of operations is called the scan cycle. The time required to complete a single cycle is the scan time.
Apart from ordinary I/O service, the PLC unit carries out another form of I/O : Direct I/O service.

Ordinary I/O service depends on the scan time. An input signal is fetched into the PLC only during I/O service, then it is processed by the sequence program decoding, and the results are output. Therefore, I/O response time depends on the PLC scan time and I/O ON-OFF response time. It is also affected by the timing when the PLC unit reads the input signal.

Direct I/O service is a special method to be used for I/O for the MC unit. Unlike ordinary I/O, direct I/O is processed as an interruption of 10ms so that its response takes a specific time regardless of the scan time.

NOTE : Watchdog timer

Watchdog timer is one of the self diagnostics functions. It monitors scan cycle to prevent runaway of the sequence program. Watchdog timer is set up at the beginning of every scan cycle. If the 500ms timer is expired, it is recognized as a scan error and scanning is stopped, the RUN indicator lamp is turned OFF, and all the outputs are disabled.

NOTE : Total check

Total check is another self diagnostics function. It checks the sum of the user program area and the I/O assignment area. If an error is found, scanning is stopped, the RUN indicator lamp is turned OFF, and all the outputs are disabled.

3.3.3 Reference List

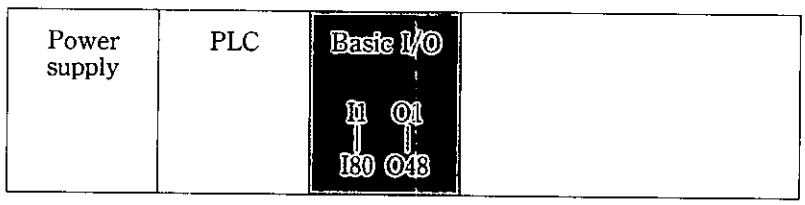
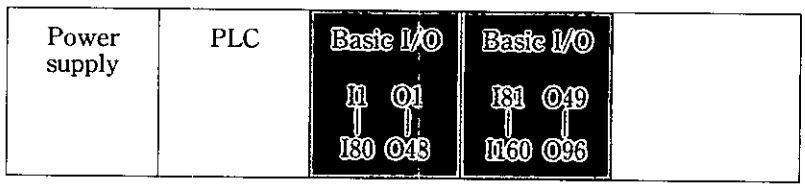
Table 3.5 Reference List

Item	Specifications	
Reference	Output coils	O1 to O512 (O1 to O96 : Basic I/O unit)
	Input relays	I1 to I512 (I1 to I160 : Basic I/O unit)
	Internal coils	N1 to N1536 (N1536 is the battery coil which state is ON when battery voltage is normal.)
	Timer relays	T1 to T256 (T1 to T128 are 100ms timers. T129 to T256 are 10ms timers.)
	Counter relays	C1 to C256 (C1 to C128 are up counters. C129 to C256 are down counters.)
	MC unit coils	Y1 to Y512 (Y1 to Y256 are for MC unit 1 ; Y257 to Y512 are for MC unit 2.)
	MC unit relays	X1 to X512 (X1 to X256 are for MC unit 1 ; X257 to X512 are for MC unit 2.)
	MC control relays	P1 to P256 (P1 to P128 are for MC unit 1 ; P129 to P256 are for MC unit 2.)
	M code relays	MUXX (U is the MC unit number, XX is the code number from 01 to 89.)
	Stepping relays	SYYXX (YY is the stage number from 01 to 32. XX is the step number from 01 to 99.)
	Link coils	D1 to D1024
	Data registers	W1 to W2048 (W1 to W128 are output registers.)
	Input registers	Z1 to Z128
	Link registers	R1 to R1024

3.4 I/O Unit Specifications

3.4.1 Basic I/O Unit

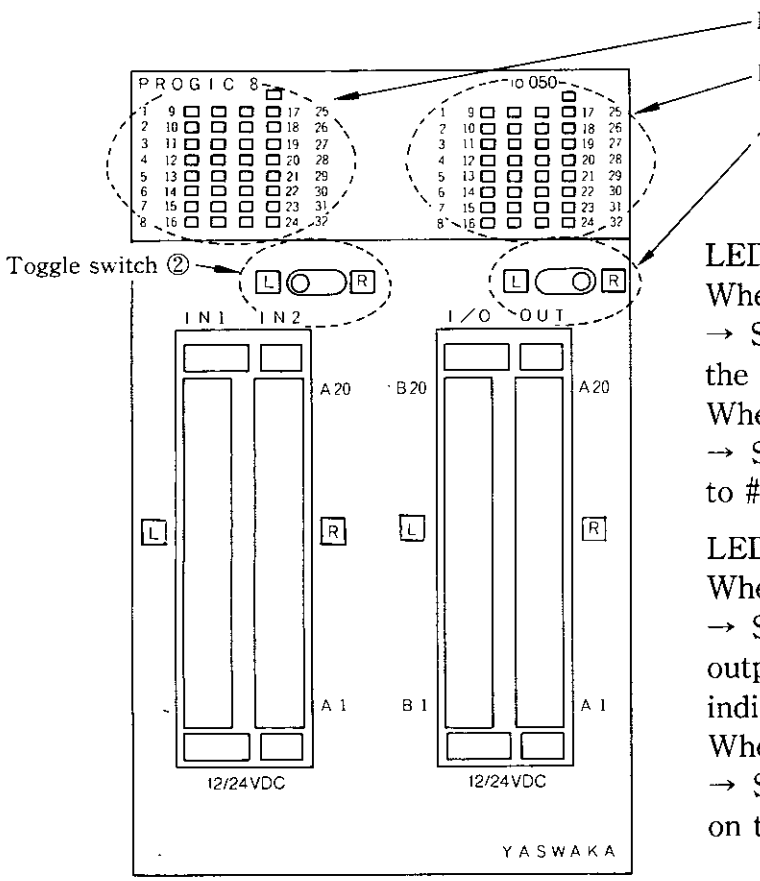
Table 3.6 Basic I/O Specifications

Item	Specifications
Type	JEPMC-IO050
Number of I/O terminals and reference number	Up to 128 discrete inputs and outputs (80 inputs and 48 outputs) per unit (1) If there is one JEPMC-IO050 (When mounting base JEPMC-MB041 or MB052 is used) Input references : I1 to I80 Output references : O1 to O48  (2) If there are two JEPMC-IO050s (When mounting base JEPMC-MB051 or MB062 is used) Input reference : I1 to I160 Output reference : O1 to O96 
Input module specifications	Input voltage : 12VDC or 24VDC Input current : 2.5mA per input at 12VDC or 5mA per input at 24VDC (simultaneous ON 50%/common) Number of common inputs : 16
Output module specifications	Operating voltage :12VDC or 24VDC Load current : 100mA max. per output or 800mA max. per common outputs Number of common outputs : 16
Dimensions	80 (W) × 130 (H) × 100 (D)
Approximate mass	0.5kg

3 SPECIFICATIONS

LED Block display function

For indication of inputs and outputs of the I/O unit, two sets of 32 LEDs (and one for blown fuse) are used. Each LED indicates status of different I/O according to the position of the two toggle switches, as explained below.



LED group ①

When toggle switch ① is at the L position → Status of 32 inputs (inputs #1 to #32 on the IN1 connector) is indicated.

When toggle switch ① is at the R position → Status of another 32 inputs (inputs #33 to #64 on the IN2 connector) is indicated.

LED group ②

When toggle switch ② is at the L position → Status of 16 inputs (inputs #65 to #80 and outputs #1 to #16 on the I/O connector) is indicated.

When toggle switch ② is at the R position → Status of 32 outputs (outputs #17 to #48 on the OUT connector) is indicated.

Detailed correspondence between the LEDs and the terminals is shown below. (The examples are for the IN1 connector and the I/O connector. Arrangement is similar for other connectors.)

IN1	IN9	IN17	IN25
IN2	IN10	IN18	IN26
IN3	IN11	IN19	IN27
IN4	IN12	IN20	IN28
IN5	IN13	IN21	IN29
IN6	IN14	IN22	IN30
IN7	IN15	IN23	IN31
IN8	IN16	IN24	IN32

IN1 connector
(with toggle switch ① set to L)

IN65	IN73	O1	O9
IN66	IN74	O2	O10
IN67	IN75	O3	O11
IN68	IN76	O4	O12
IN69	IN77	O5	O13
IN70	IN78	O6	O14
IN71	IN79	O7	O15
IN72	IN80	O8	O16

I/O connector
(with toggle switch ② set to L)

3.5 MC Unit Specifications

3.5.1 MC Unit Hardware Specifications

Table 3.7 MC Hardware Specifications

Item	Specifications
Type	JEPMC-MC002
CPU configuration	Main CPU : V33 (μPD70136L-16 made by NEC), 16-bit, 16MHz Servo CPU : V40 (μPD70208L-10 made by NEC), 16-bit, 10MHz
Program memory	60kB, battery backup. The MC unit incorporates super capacitors only.
Number of servos connectable	Up to four axes per unit (analog speed command)
I/O signals	Between MC unit and external I/O (24VDC) : Forward and reverse direction overtravel inputs Zero point position signal input, zero-return deceleration dog input Brake control output Between MC unit to servo amp unit : Analog speed command output Position feedback input (for incremental encoder) Forward/reverse direction overtravel outputs Servo-on output, P-operation command output Alarm inputs
Dimensions (mm)	80 (W) × 130 (H) × 100 (D)
Approximate mass	0.5kg

3.5.2 MC Unit Software Specifications

Table 3.8 MC Software Specifications (1)

Item	Specifications
Number of controllable axes	4 Control performance : Up-date time = 8ms Up to two axes can be controlled independently. Up to four axes can be controlled simultaneously in positioning. Up to three axes can be controlled simultaneously in linear and helical interpolation. Up to two axes can be controlled simultaneously in circular and linear interpolation.
Minimum positioning unit	0.001mm for linear motion and 0.001 for rotary motion
Maximum command value	±99999999, infinite positioning is available.
Rapid traverse speed	60m/min. max. (0.001mm/pulse) Reference : 1MPPS 600m/min. max. (0.01mm/pulse)
Interpolation feed speed	60m/min. max. (0.001mm/pulse) Reference : 1MPPS 600m/min. max. (0.01mm/pulse)
Automatic accel/decel	Interpolation feed : Exponential accel/decel Rapid traverse, jog, zero return: Any of S-curve, 1-step, 2-step linear accel/decel can be set up separately for each operation.
Rapid traverse override	1% to 100% of the set value in parameter 31 and parameter 4 (in 15 steps)
Jog override	Same as above
Interpolation feed override	50% to 200% (16 steps in units of 10%)
Manual continuous feed	Simultaneous four axes can be controlled.
Manual step feed	Available
Positioning control	Range (from 1 to 250 command units) of positioning completion can be set up.
Software stroke limit	Available
Coordinate setting	Current position values can be changed.
Backlash compensation	0 to 32767 pulses
Servomotor control	Analog speed command servo amplifier Encoder : Incremental type
Control method	Speed command (position control)

Table 3.9 MC Software Specifications (2)

Item	Specifications
Operation modes	Selected by the sequence command from the PLC unit (1) Edit : Programs and parameters are loaded and saved from the programming personal computer. (2) Auto : Automatic operation is carried out according to a stored program. The operation is started up by the sequence command from the PLC unit. (3) Manual : Jog feed and zero return are carried out. The operation is started up by the sequence command from the PLC unit. (4) Program is prepared on the programming personal computer teaching the current position block-by-block. Jog feed, position teaching, single-block operation, I/O status display, and I/O status change are all possible.
Programmer	Personal computer. Both offline and online edit are available.
Program method	Interpreter method using special motion language
Program functions	Positioning (MOV), linear interpolation (MVS), circular interpolation (MCW, MCC), helical interpolation (MCW, MCC) Disregard single-block mode (SNG), absolute coordinates (ABS), relative coordinates (INC), passing signal (PNT) M code output (SETM89), positioning completion wait (PFN), I/O (#I256, #O256) Arithmetic operations (+, −, *, /), loop (WHILE.. DO..), branch (GOTO..), conditional branch (IF.. GOTO..) Subroutine (GSB)
Program entry	A program number from O01 to O99 and a sequence number from N001 to N999 are used to enter and store a program.
Program capacity	60kB
Program execution	(1) Automatically executed from an arbitrarily selected block according to the specified program number and line number from the PLC unit. (Auto mode) (2) Executed for a single-block according to commands from the PLC unit. (Auto mode) (3) Executed for arbitrarily selected program blocks according to commands from the programming personal computer. (Online edit mode)
Program execution method	While a servomotor control command such as positioning or interpolation is being executed, the command described in the next or later block that orders no servomotor control is executed simultaneously.
Data storage	Programs and parameters are stored in the RAM and backed up by the battery.
Program I/O	Coils of the PLC unit can be referred to from a motion program and the contents can be output to relays.
Self diagnostics	CPU error, memory error
Input signals	Forward/reverse direction overtravel, deceleration point signal, stop position signal
Output signal	Brake timing

Table 3.10 MC Software Specifications (3)

Item	Specifications
Zero return	Performed according to commands from the PLC unit or a motion program. Axes can be moved in a specific order or all at once according to the program. Four modes of return : return direction, return speed, stop position search, speed, and margin can be set up.
Monitor	Current position, I/O status of the PLC unit, and executed program steps can be monitored from the programming personal computer. Also, following error, current speed, commanded speed, number of rotations, system I/O status and alarm status can be monitored.
Utility commands	Utility commands are started up by a sequence command from the PLC unit. They are : program operation, single-block operation, independent axis operation, zero return, jog operation, monitoring, parameter change, offset setup, alarm reset, servo-ON/OFF, mode change, and program number setup.

3.5.3 Command List

Table 3.11 Command List (1)

Command	Function	Input format	Description
MOV	Positioning	①MOV X——Y——Z——S——; ②MOV X——Y——Z——; ③MOV X——Y——; ④MOV X——; X, Y, Z, S : Target position, 0 to ±99999999 (in command units)	· MOV moves four axes simultaneously by rapid traverse [command ①], or three axes [command ②], two axes [command ③], or one axis [command ④]. Only the axes specified by commands are moved. Speed setting F is not available for MOV. · Rapid traverse speed is set up by parameter PA04 (the 1st feed speed) independently for the axes. · Axes specified in the MOV command are moved by rapid traverse independently from each other that the trajectory will not necessarily be linear.
MVS	Linear interpolation	①MVS X——Y——Z——F——; ②MVS X——Y——F——; ③MVS X——F——; X, Y, Z, S : Target position, 0 to ±99999999 (in command units) F : Speed, 1 to 24000 (×1000 command units/min.)	· MVS carries out linear interpolation moving three axes simultaneously [command ①], or two axes [command ②] or one axis [command ③]. · Feed speed is specified by the F code. The set speed for F will be the synthesized speed of all the specified axes. When command ① is used : $F = \sqrt{Fx^2+Fy^2+Fz^2}$ Fx, Fy, and Fz are the speeds of the X, Y, and Z axes, respectively.
MCW MCC	Circular interpolation Helical interpolation	①MCW PXY X——Y——I——J——F——; MCC ②MCW PXY X——Y——R——F——; MCC ③MCW PXY X——Y——I——J——Z——F, MCC ④MCW PXY X——Y——R——Z——F——; MCC MCW : Clockwise (CW) MCC : Counterclockwise (CCW) X, Y, Z, S : Target position, 0 to ±99999999 (in command units) I, J, K, L : Center point, 0 to ±99999999 (in command units) R : Radius, 0 to ±99999999 (in command units) F : Speed, 1 to 24000 (×1000 command units/min.)	· MCW and MCC perform circular interpolation [command ① or ②] or helical interpolation [command ③ or ④]. · Regardless of which command is used, the target position (X, Y, Z, S) and the center point (I, J, K, L) are specified differently depending on whether the absolute command (ABS) or incremental command (INC) takes effect. · An arc can be specified by any of the following two methods. Specifying the coordinates of the end point of the arc and the coordinates of the center point of the arc [commands ① and ③] Specifying the coordinates of the end point of the arc and the radius of the arc [commands ② and ④] · Feed speed F is the speed in the tangent direction of the arc in the arc plain. Therefore, linear axis speed (F') in helical interpolation is calculated as follows. $F' = F \times \frac{\text{(length of the linear axis)}}{\text{(length of the arc)}}$
TIM	Dwell time	TIM P——; P : Wait time, 0.001s to 999.999s	· TIM delays execution of the next block for the time specified by P. This command is non-modal.
PXY PYZ PZX PXS PZS PYS	Arc plain specification	MCW PXY X——Y——I——J——F——;	These commands specify the plain in which circular interpolation is to be performed. PXY : XY plain PXS : XS plain PYZ : YZ plain PZS : ZS plain PZX : ZX plain PYS : YS plain

Table 3.12 Command List (2)

Command	Function	Input format	Description
ZRN	Auto zero-return	①ZRN X——Y——Z——S——; ②ZRN X——Y——Z——; ③ZRN X——Y——; ④ZRN X——;	· Similar to MOV, ZRN moves axes to a target position at the rapid traverse speed (PA04). Then, similar to a series of operations performed by ZRN (zero return) command from the PLC unit, the axes are returned to the zero point. The zero return direction is determined by the value of parameter PA50 (zero return direction). · MOV positioning (relief) is omitted at the initial execution after power-ON.
ABS INC	Absolute mode Incremental mode	ABS ; INC ;	ABS : Reads displacement data as absolute values. INC : Reads displacement data as incremental values. ABS and INC are modal commands; that is, absolute or incremental mode continues until it is changed. Absolute mode is selected immediately after power-ON.
PNT	Notch signal output	①PNT X——Y——Z——MXX ; ②PNT X——Y——Mxx ; X, Y, Z, S : Transit positions 0 to ±99999999 (command units) M : M code (xx : 1 to 89)	· If PNT is placed in front of a block having a positioning command, notch signal will be output (M relay MUxx is turned ON) after a set position is passed by during positioning. Only a single notch point can be specified in one block. The M turned-ON relay can be reset by turning ON the MFIN signal. If MFIN remains OFF, the axes stop after the motion command is completed and wait until it is turned ON and OFF. · A single position cannot be used twice for the same axis.
SET	Wait-for-completion external output	SET Mxx ; M : M code (xx : 1 to 89)	Use this command to intentionally stop the program during execution and start it at receipt of a signal from the PLC unit. When SET Mxx (xx : 1 to 89) is executed, MUxx on the PLC unit is turned ON, entering wait status for the MFIN signal from the PLC unit to go ON. After the MFIN signal is turned ON and OFF again, the next block is started.
STP	Program stop	STP	The program stops after the block containing STP has been executed. Then, when the motion command start signal (input 1) of the PLC unit is turned ON, operation is restarted from the next block.
END	Program end	END ;	The program stops after the block containing END has been executed. Then the program is rewound to the beginning for the next execution.
GSB	Subprogram call	GSB Pxx Lxx ; P : Subprogram number (xx : 1 to 99) L : Number of repetitions (xx : 1 to 99)	GSB execute the subprogram of the program number specified by P, L times. If L is not specified, the subprogram is executed once. Up to four levels of nesting are permitted in calling-up a subprogram from another program.
RET	Subprogram end	RET ;	Specify RET at the end of a subprogram. RET returns to the main program in the next block to the block from where the subprogram was called-up.

Table 3.13 Command List (3)

Command	Function	Input format	Description
PFN	Wait for motion completion (in-position check)	PEN ;	· Halts operation until the axes being positioned within the in-position area (specified by parameters). · Among axis motion commands, MVS, MCW, and MCC move to the next motion command block when pulses have been cleared out. To execute the next motion command after the axes enter the in-position area, insert this command (PFN).
SNG	Disregard single-block signal	SNG MVS———— ; SNG #011=—— ;	· If a command block has SNG on the head, single-block mode signal is disregarded and the next block is executed without pause as for normal program operation. · This command must be placed before other commands, just after the sequence number.
POS	Current position change	①POS X——Y——Z——S—— ; ②POS X——Y——Z—— ; ③POS X——Y—— ④POS X—— ; X, Y, Z, S : Set positions from 0 to ±99999999 (command units)	· POS changes the current coordinates of the axes with the specified values. The new coordinates are used in succeeding motion commands in absolute mode. · Coordinates can be changed by POS as many times as you need. The mechanical coordinate (the destination of zero return) is not affected by POS.
MVM	mechanical coordinate command mode	①MVM MOV X——Y——Z——S—— ; ②MVM MVS X——Y——Z—— ; X, Y, Z, S : Command positions 0 to ±99999999 (command units)	Position of the axes at completion of zero return is stored in memory as mechanical coordinate. The mechanical coordinate is not affected by POS. MVM must be specified at the beginning of a block where positioning (motion) is to be performed. If MVM is specified, the mechanical coordinate is used for the positioning command. The command effects only in that block.
INP	Second in-position setting	①INP X——Y——Z——S ; ②INP X——Y——Z—— ; ③INP X——Y—— ; ④INP X—— ; X, Y, Z, S : Second in-position check range from 0 to 99999999 (command units)	· INP performs in-position check for interpolation commands (MVS, MCW, and MCC) in the area set for the command. · If a positive number other than 0 is set for the second in-position range, the second in-position check takes effect for all the interpolation commands after that. · To cancel, set 0 for the coordinates or turn OFF the power.
IOW	I/O wait command	#O??? = ▽ IOW # O??? = △ (A) # I??? = ▽ (B) # I??? = △ (C) ; ??? : 1 to 256 (I/O variable number) △ : 0, 1 ▽ : 0, 1, 2, 3 0 : OFF 1 : ON 2 : Rising edge 3 : Falling edge	· The value specified for △ is output to the output variable specified by ??? of A. When the input or output variable specified by ??? of B changes to the state specified by ▽, △ is output to the output variable specified by ??? of C, then operation is proceeded to the next block. · A and C can be omitted. If they are omitted, operation proceeds to the next block when the conditions of B are satisfied.

Table 3.14 Command List (4)

Command	Function	Input format	Description
IF GOTO	Branch command	①IF <condition> GOTO n ; ②GOTO n ; n : Sequence number 1 to 999	· If the <condition> is satisfied, a jump is made to the block having sequence number n in the same program. [Command ①] If the condition is not satisfied, operation proceeds to the next block. · Simple jump command is also available. [Command ②] · If there are two or more same sequence numbers, the destination will be the first one found. Examples of condition : #i=#j, #i<=#j, #10=120
WHILE	Repetition command	①WHILE <Condition> Do m ; ⋮ DEND m ; ②DO m ; ⋮ DEND m ; m : ID number 1,2,3	· Blocks from DO m to DEND m are repeated while the <condition> is satisfied. [Command ①] If the condition is not satisfied, a jump is made to the next block to END m. · If <condition> is omitted, blocks from DO m to DEND m are repeated infinitely. [Command ②] Place an IF statement in the middle of this loop so as to exit the loop under specific conditions. · Up to three DO loops can be used in a single program.

3.5.4 Parameters

To build a specific system by combining servo amplifier, servomotors and machines, some constants must be set to tailor the MC unit specifications to the machines and the purpose. These constants are the parameters.

The parameters are shown in a list on the following pages. The parameters determine basic motion control performance so that proper values must be set based on the mechanical and control specifications.

(1) Initial values

The initial values on the table are the values when initializing operation of MC unit is performed.

At power-ON, parameter sum check is executed. If an error occurs during the check, alarm no.79, "PARAMETER SUM ERROR" is issued. If this occurs, parameters must be set again.

(2) Changing parameters

The parameters can be changed either by preparing a parameter table on the Programming Panel and loading it to the MC unit [method ①] or by using the parameter setting command (PRM) of the sequence ladder in the PLC unit [method ②]. If method ① is used, the data are retained after the control power is turned OFF. If method ② is used, the data before the change are restored after the control power is turned OFF.

Note that only specific parameters can be changed from the ladder. See the parameter list.

The parameters for motion control are classified as follows.

A : Parameters that require setting in standard use.
B : Parameters that require setting when necessary.
C : Parameters that usually require no change.
D : Parameters that are fixed to the factory settings which are not supposed to be set by the user. Do not change these types of parameters.

(3) Related parameters

Some parameters have mutual relations. For instance, if the value is set without using parameter PA18 soft limit switch, parameters PA40 and PA41 will have no effect.

(4) Common parameters and individual axis parameters

There are parameters used by all axes in common and those requiring setting for individual axes. Common parameters are P000 to P099. Individual parameters are PA01 to PA99 (with A standing for axis number from 1 to 4).

(5) Parameter list

Table 3.15 Common Parameter List (1)

Parameter no.	Parameter name	Range of setting	Unit	Related parameter no.	Rewrite from ladder	Validation timing	Initial value	Parameter type
P000	ID code	4 half-size alphanumeric characters	ASCII		× (impossible)	Immediately	0	B
P001	Axis 1 designation b0=X b1=Y b2=Z b3=S b4=A b5=B	Set 1 for only 1 bit from b0 to b5. (Clear all the bits to 0 if the axis is not to be used.)	Set the parameter in characters on personal computer P.P.		×	Power-ON	1 (X)	C
P002	Axis 2 designation b0=X b1=Y b2=Z b3=S b4=A b5=B	Set 1 for only 1 bit from b0 to b5. (Clear all the bits to 0 if the axis is not to be used.)	Set the parameter in characters on personal computer P.P.		×	Power-ON	2 (Y)	C
P003	Axis 3 designation b0=X b1=Y b2=Z b3=S b4=A b5=B	Set 1 for only 1 bit from b0 to b5. (Clear all the bits to 0 if the axis is not to be used.)	Set the parameter in characters on personal computer P.P.		×	Power-ON	4 (Z)	C
P004	Axis 4 designation b0=X b1=Y b2=Z b3=S b4=A b5=B	Set 1 for only 1 bit from b0 to b5. (Clear all the bits to 0 if the axis is not to be used.)	Set the parameter in characters on personal computer P.P.		×	Power-ON	8 (S)	C
P005	Decimal point position	1−3			×	Reset	3	B
P006 to P009	Reserved							
P010	Maximum interpolation feed speed	1−240000	×1000 command units/min.		○	Immediately	24000	A
P011 to P012	Reserved							

Individual parameter list
(A in the parameter number stands for axis number 1 to 4.)

Table 3.16 Individual Axis Parameter List (1)

Parameter No.	Parameter name	Range of setting	Unit	Related parameter No.	Rewrite from ladder	Validation timing	Initial value	Parameter type
PA01	Position loop gain Kp	0−200	S^{-1}		○ (possible)	Reset	30	A
PA02	Reserved							
PA03	Reserved							
PA04	1st feed speed	1−240000	×1000 command units/min.		○	Immediately	60	A
PA05	Linear accel/decel constant (1)	1−32767	15625 command units/s^2		○	Reset	100	A
PA06	Positioning completion range	0−250	Command unit	07	○	Reset	1	A
PA07	Positioning completion check time	0−32767	ms [multiple of 4 ms]	06	○	Reset	0	A
PA08	Encoder pulse	32768	Pulse	63	×	Power-ON	2048	Fixed
PA09	Servo tracking error	1−99999999	Pulse		○	Reset	30000	A
PA10	Reserved							
PA11	Mechanical 1 rotation	1−1500000	Command unit		×	Power-ON	32768	A
PA12	Gear ratio setting (motor rotation speed)	1−10000000	Rotation		×	Power-ON	1	A
PA13	Gear ratio setting (load rotation speed)	1−10000000	Rotation		×	Power-ON	1	A
PA14	Mode setting							
	b0: Motor rotation direction (reverse rotation connection)	0: Forward 1: Reverse	——	——	×	Power-ON	0	B
	b1: Finite/infinite	0:Finite 1:Infinite	——	18-b0			0	B
	b2: Linear/rotary	0:Linear 1:Rotary	——	——			0	C

Table 3.17 Individual Parameter List (2)

Parameter No.	Parameter name	Range of setting	Unit	Related parameter No.	Rewrite from ladder	Validation timing	Initial value	Parameter type
PA15	Reserved							
PA16	Reserved							
PA17	Function selection 1							
	b1 : Reserved							
	b2 : 2-step accel/decel	0 : 1-step 1 : 2-step	———	38, 39			0	B
	b3 : Speed setting	0 : Not set	———	46			0	B
		1 : Set			×	Reset		
	b4 : Accel/decel	0 : Not set	———	68 to 71,			0	B
	type selection	1 : Set		76, 77				
				47, 48				
PA18	Function selection 2							
	b0 : Soft limit switch	0 : Not set	———	40, 41			0	B
		1 : Set			×	Power-ON		
	b1 : Use of backlash	0 : No 1 : Yes	———	42			0	B
	compensation							

Table 3.18 Individual Parameter List (3)

Parameter No.	Parameter name	Range of setting	Unit	Related parameter No.	Rewrite from ladder	Validation timing	Initial value	Parameter type
PA19	Function selection 3 b0 : OT signal b2 : Brake release signal	 0 : Do not mask 1 : Mask 0 : Do not mask (Use) 1 : Mask (Do not use)	 —— ——	 19-b6 72-b1	 ×	 Power-ON	 0	 B
PA20	Function selection 4 b3 : S-curve accel/decel	 0 : Do not use 1 : Use		 68,70,71	 ×	 Reset	 0	 B
PA21 ⋮ PA30	Reserved							
PA31	2nd feed speed	1−240000	×1000 command units/min.	——	○	Immediately	1	A
PA32 to PA34	Reserved							

Table 3.19 Individual Parameter List (4)

Parameter No.	Parameter name	Range of setting	Unit	Related parameter No.	Rewrite from ladder	Validation timing	Initial value	Parameter type
PA35	Reserved							
PA36	Reserved							
PA37	Reserved							
PA38	Linear accel/decel constant (2)	1−32767	15625 command units/s²	4, 5, 39	○	Reset	100	Fixed
PA39	Linear accel/decel constant switching speed	0−240000	×1000 command units/min.	4, 5, 39	○	Reset	24000	B
PA40	Forward soft limit switch	+99999999 to −99999999	Command unit	18-b0	○	Reset	+9999 9999	B
PA41	Reverse soft limit switch	+99999999 to −99999999	Command unit	18-b0	○	Reset	−9999 9999	B
PA42	Backlash compensation	0−32768	Pulse	18-b1	○	Reset	0	B
PA43	Brake time	8−1000	ms		○	Reset	8	B
PA44	Brake-ON ; motor rotation speed	1−10000	r/min		○	Reset	1	B
PA45	Reserved							
PA46	Speed setting value	0−240000	×1000 command units/min.	17-B3	○	Immediately	24000	B
PA47	Exponential accel/ decel time constant	8−1000	ms		○	Reset	100	B
PA48	Exponential accel/ decel bias speed	0−240000	×1000 command units/min.		○	Reset	0	B

Table 3.20 Individual Parameter List (5)

Parameter No.	Parameter name	Range of setting	Unit	Related parameter No.	Rewrite from ladder	Validation timing	Initial value	Parameter type
PA49	Zero-return mode	0 : DEC+C 1 : ZERO 2 : DEC+ZERO 3 : C			×	Power-ON	1	B
PA50	Zero-return direction	0 : Forward direction 1 : Reverse direction			×	Power-ON	0	B
PA51	Zero-return feed speed	1−240000	×1000 command units/min.	49 50	○	Reset	1	B
PA52	Zero-return approach speed	1−240000	×1000 command units/min.	51 52	○	Reset	1	B
PA53	Zero-return creep speed	1−240000	×1000 command units/min.	53 54	○	Reset	1	B
PA54	Zero-return final traveling distance	0−99999999	Command unit	55 56	○	Reset	0	B
PA55	Zero point output width	0−32767	Pulse		○	Reset	10	B
PA56	Zero point pulse polarity selection	0, 1	0 : Rising 1 : Falling		×	Power-ON	0	C
PA57 to PA62	Reserved							

Table 3.21 Individual Parameter List (6)

Parameter No.	Parameter name	Range of setting	Unit	Related parameter No.	Rewrite from ladder	Validation timing	Initial value	Parameter type
PA63	Pulse signal form	0 : Phase A and B multiplied by 1 1 : Multiplied by 2 2 : Multiplied by 4	——	18	×	Power-ON	2	B
PA64 PA67	Reserved							
PA68	Accel/decel form setting (for MOV)	0 : 1-step linear 1 : 2-step linear 2 : S-curve			×	Reset	0	B
PA69	Accel/decel form setting (for JOG)	0 : 1-step linear 1 : 2-step linear 2 : S-curve			×	Reset	0	B
PA70	Accel/decel form setting (for MVA/MVB)	0 : 1-step linear 1 : 2-step linear 2 : S-curve			×	Reset	0	B
PA71	Accel/decel form setting (for ZRN)	0 : 1-step linear 1 : 2-step linear 2 : S-curve			×	Reset	0	B
PA72	Reserved							
PA73 PA75	Reserved							
PA76	S-curve time constant	8−128	ms	20-b3	×	Reset	8	B
PA77	Accel/decel form setting (for WDA/WDB)	0 : 1-step linear 1 : 2-step linear 2 : S-curve			×	Reset	0	B
PA99	Reserved							

3.6 Mounting Base

3.6.1 Mounting Base for Basic Systems

Table 3.22 Basic System Mounting Base Specifications

Item	Specifications
Name	JEPMC-MB041 [capable of mounting 1 basic I/O unit (128 I/Os) and 1 MC unit] JEPMC-MB051 [capable of mounting 2 basic I/O units (256 I/Os) and 1 MC unit] JEPMC-MB052 [capable of mounting 1 basic I/O unit (128 I/Os) and 2 MC units] JEPMC-MB062 [capable of mounting 2 basic I/O units (256 I/Os) and 2 MC units]
Function	Mounts power supply units, PLC unit, I/O units, and MC units.
Dimensions (mm)	JEPMC-MB041 : 360 (W) × 130 (H) × 10 (D) JEPMC-MB051 : 440 (W) × 130 (H) × 10 (D) JEPMC-MB052 : 440 (W) × 130 (H) × 10 (D) JEPMC-MB062 : 520 (W) × 130 (H) × 10 (D)
Approximate mass	0.8kg (MB041)×1.0kg (MB051/MB052)/1.2kg (MB062)

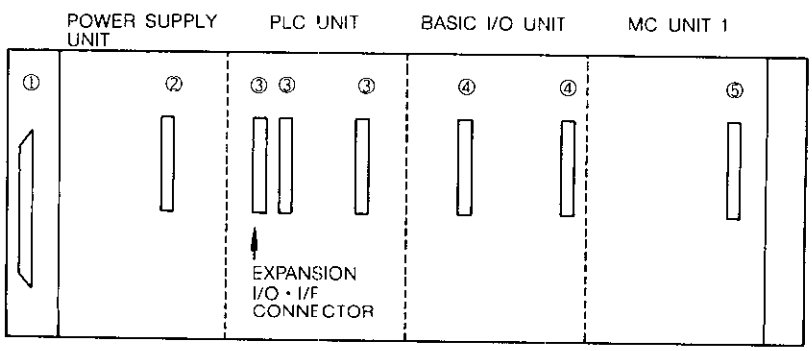


Fig. 3.4 Configuration of Mounting Base JEPMC-MB041

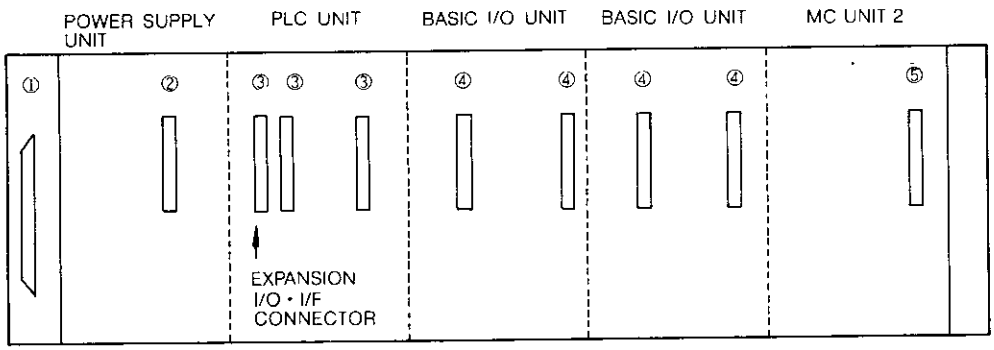


Fig. 3.5 Configuration of Mounting Base JEPMC-MB051

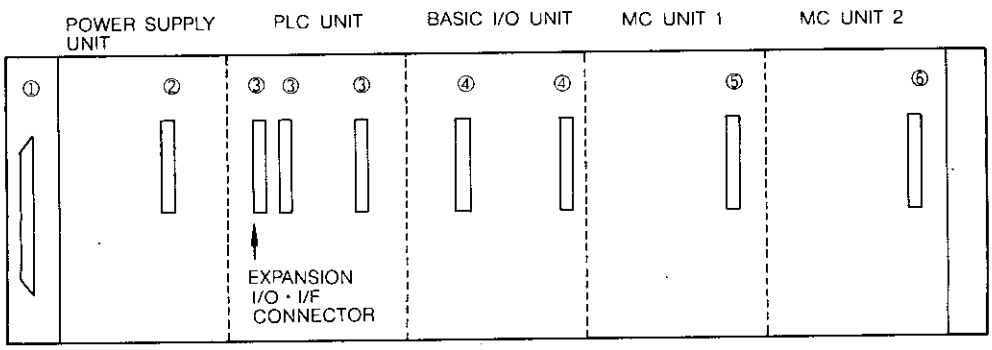


Fig. 3.6 Configuration of Mounting Base JEPMC-MB052

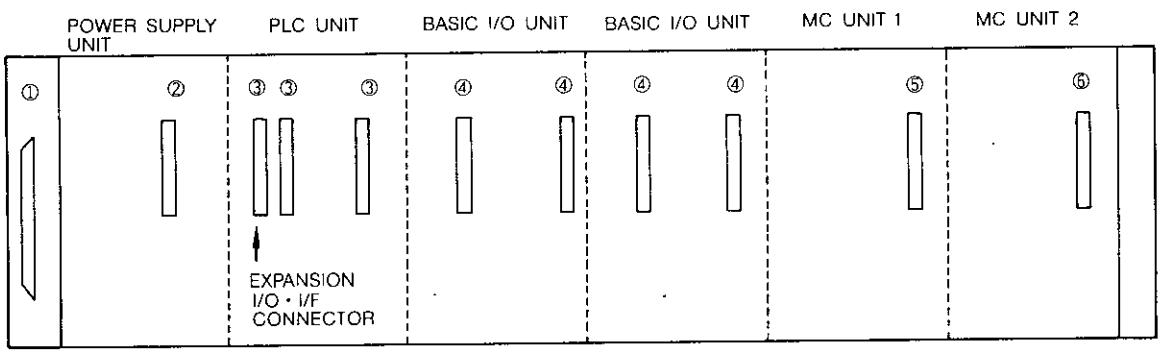


Fig. 3.7 Configuration of Mounting Base JEPMC-MB062

① Expansion I/O unit connector
② Power supply unit (JEPMC-PS050) connector
③ PLC unit (JEPMC-PC050) connector
④ Basic I/O unit (JEPMC-IO050) connector
⑤ MC unit 1 connector
⑥ MC unit 2 connector

3.7 Specifications of the Personal Computer Programmer

Table 3.23 Personal Computer Programmer Specifications

Item		Specifications
PLC programmer	Mnemonic programmer	* Mnemonic programming function (Creates and edits sequence programs in mnemonic language.) * Compilation function (Converts sequence program in mnemonic language into ladder.)
	Ladder programmer	* Ladder display function (Displays compiled object file as ladder logic.) PLC load function (Loads and saves ladder object files between the PLC unit and personal computer.) Ladder monitor function (Monitors sequence programs in the PLC unit using ladder language.) Ladder program function (Creates and changes sequence programs in the PLC unit using ladder language.) Data monitor function (Monitors data of coils, relays, and registers in the PLC unit.) Data setting function (Sets up and changes data of coils, relays, and registers in the PLC unit.) PLC operation control function (Starts and stops PLC scanning on the personal computer.) PLC memory clear function (Clears memory in the PLC unit.) * I/O assignment functions (direct I/O, extended I/O, assignment functions) Memory assignment function (Main ladder program, subroutine program assignment functions) * Reverse compilation function (Converts ladder object files into mnemonic programs on the personal computer.)
MC programmer	Programmer	* Program editing function (Creates and edits motion programs.) Online program editing function (Integrates the current value into program when creating motion programs.) * Parameter creation function (Creates parameter files set to MC unit.)
	Loader	Program loader function (Loads and saves motion programs.) Parameter loader function (Loads and saves parameters.)
	Monitor	Position monitor function (Monitors the current position of servo axes of the MC unit.) Program monitor function (Monitors motion program steps being executed on the MC unit.)

NOTE : The asterisk indicates offline functions (operation for the personal computer itself). Other functions are online functions (that function in connection with the PLC unit.)

3 SPECIFICATIONS

3.8 SERVOPACK and Motor Specifications

Any SERVOPACK of analog command type can be used. As a typical example, specifications of the Σ series servo (SGD/SGM series) are shown below. Compact system is achieved by this combination.

3.8.1 Ratings and Specifications of SERVOPACK

Table 3.24 SERVOPACK Specifications (1)

Voltage			200V class						100V class			
SERVOPACK type		SGD-	A3AS	A5AS	01AS	02AS	04AS	08AS	A3BS	A5BS	01BS	02BS
Maximum applicable motor capacity		W	30	50	100	200	400	750	30	50	100	200
Combination specifications	Applicable motor: Type	SGM-	A3A□	A5A□	01A□	02A□	04A□	08A□	A3B□	A5B□	01B□	02B□
	Applicable motor: Motor capacity	W	30	50	100	200	400	750	30	50	100	200
	Applicable motor: Rated and maximum r/min		3000/4500r/min						3000/4500r/min			
	Applicable motor: Applicable encoder		Incremental encoder 2048 P/R									
	Applicable motor: Allowable load inertia (*1) $J_L(\times 10^{-4}kg\cdot m^2)$		0.63	0.78	1.20	3.69	3.82	13.4	0.63	0.78	1.20	3.69
	Continuous output current	A(rms)	0.42	0.60	0.83	2.0	2.6	5.5	0.63	0.90	2.2	2.7
	Maximum output current	A(rms)	1.3	1.9	2.8	6.0	8.0	14.8	2.0	2.9	7.1	8.4
Basic specifications	Input power supply		Single-phase 200VAC to 230VAC, +10% to −15%, 50Hz/60Hz (*2)						Single-phase 100VAC to 115VAC, +10% to −15%, 50Hz/60Hz (*2)			
	Control method		Single-phase full-wave rectification, PWM									
	Feedback		Incremental encoder 2048 P/R									
	Operating conditions: Operating temperature		0℃ to 55℃ (*3)									
	Operating conditions: Storage temperature		−20℃ to 85℃									
	Operating conditions: Operating and storage humidity		90% or lower (must be non-condensing)									
	Operating conditions: Vibration and shock resistance		0.5/2G									
	Structure		Book type									
	Approximate mass	kg	1.2				1.5	2.0	1.2			1.5
Performance	Speed control range (*4)		1 : 5000									
	Speed regulation (*5): Load variation		0.01% or lower at 0% to 100% load (at rated speed)									
	Speed regulation (*5): Voltage variation		0 %									
	Speed regulation (*5): Temperature variation		0.1% or lower at 25℃ ± 25℃									
	Frequency characteristics		150Hz (at $J_L = J_M$)									
	Torque control (reproducibility)		±2.0%									
	Accel/decel time setting		0s to 10s									

* 1 : Allowable load inertia specifies the range in which an optional regeneration unit is not required. The range is 30 times the motor rotor inertia for the 30W to 200W classes, and 20 times for the 400W and 750W classes. To use out of this range, some restrictions must be imposed or the regenerative unit will be needed.

* 2 : It is impossible to run at power voltage over the limit 230V + 10% (253V) or 115V + 10% (127V). If there is a risk that the voltage may rise beyond the limit, use a step-down transformer.

* 3 : Keep ambient temperature in this range. If the system is housed in a cabinet, keep the inside of the cabinet within the prescribed temperature range.

* 4 : The lower limit of speed control range is determined in the range where operation is not stopped at 100% load.

* 5 : Speed regulation is defined as follows.

$$\text{Speed regulation} = \frac{\text{(no-load rotation speed} - \text{full-load rotation speed)}}{\text{rated rotation speed}} \times 100\ [\%]$$

In practice, the amplifier may drift or operation resistance may vary because of voltage variations and temperature fluctuations, affecting the rotational speed. The proportion of the fluctuations in the rotation speed to the rated rotational speed are the speed variations caused by voltage and thermal variations.

* 6 : N is the encoder pulse number.

Table 3.25 SERVOPACK Specifications (2)

Voltage				200V class						100V class			
SERVOPACK type SGD-				A3AS	A5AS	01AS	02AS	04AS	08AS	A3BS	A5BS	01BS	02BS
Input signals	Speed command input		Rated command voltage	±2VDC to ±10VDC (The motor turns forward by positive command) at rated speed									
			Input impedance	Approx. 30kΩ									
			Circuit time-constant	Approx. 47 μs									
	Torque command input		Rated command voltage	±3VDC (The motor turns forward by positive command) at rated torque									
			Input impedance	Approx. 30kΩ									
			Circuit time-constant	Approx. 47 μs									
I/O signals	Position output		Output form	Phase A, phase B, and phase C line driver outputs									
			Dividing ratio	(16 to N)/N N=2048 (*1)									
	Sequence inputs			Servo-ON, P operation (or zero clamp operation, torque control, or fwd/rev operation of the motor at an internally set speed), forward rotation prohibit (P-OT), reverse rotation prohibit (N-OT), current limit forward selection (or internal speed selection), current limit reverse selection (or internal speed selection), and alarm reset									
	Sequence outputs			TGON (or current limit detected), speed coincidence, external brake interlock, servo alarm, and alarm code (3 bits)									
DB stop				Automatic built-in DB that functions at power-OFF, servo alarm, and overtravel.									
External regeneration				Required if an assumed load inertia is out of the allowable range (*2).									
Overtravel				DB stop or deceleration stop when P-OT or N-OT is activated									
Protection functions				Overcurrent, ground fault, overload, overvoltage, accel/decel, command input read error, runaway prevention, zero point error, CPU error, and encoder error									
Display				Alarm and power LED on the drive Digital operator (option)									
Monitor output				Speed : 0.5V/1000 r/min. Torque : 0.5V/100%									
Others				torque control, stop position loop operation, soft start-stop, brake interlock signal output, reverse rotation connection, jog operation, and auto tuning									

* 1 : N is the encoder pulse number.
* 2 : Allowable load inertia specifies the range in which an optional regeneration unit is not required. The range is 30 times the motor rotor inertia for the 30W to 200W classes, and 20 times for the 400W and 750W classes. To use out of this range, some restrictions must be imposed or the regenerative unit will be needed.

3.8.2 Ratings and Specifications of Servomotors

Σ standard (for 200V class)

Ratings and specifications of Σ series AC servomotors

Time rating : Continuous
Insulation : Class B
Vibration : V15
Withstand voltage : 1500VAC for one minute
Insulation resistance : 500VDC 10MΩ or higher
Enclosure : Totally-enclosed, self-cooled
Ambient temperature : 0℃ to 40℃
Ambient humidity : 20% to 80% (non-condensing)
Excitation : Permanent magnet type
Drive method : Direct drive
Installation : Flange-mounted

Table 3.26 Servomotor Specifications (1)

Item \ Motor Type SGM-		A3A	A5A	01A	02A	04A	08A
Rated Output*	W (HP)	30 (0.04)	50 (0.07)	100 (0.13)	200 (0.27)	400 (0.53)	750 (1.01)
Rated Torque*	N·m	0.095	0.159	0.318	0.637	1.27	2.39
	(oz·in)	(13.52)	(22.56)	(45.12)	(90.08)	(180.8)	(337.6)
Instantaneous Peak Torque*	N·m	0.29	0.48	0.96	1.91	3.82	7.1
	(oz·in)	(40.48)	(67.68)	(135.4)	(270.4)	(542.4)	(1012)
Rated Current*	A (rms)	0.42	0.6	0.87	2.0	2.6	4.4
Instantaneous Max Current*	A (rms)	1.3	1.9	2.8	6.0	8.0	13.9
Rated Speed*	r/min	3000					
Instantaneous Max Speed*	r/min	4500					
Torque Constant*	N·m/A (rms)	0.255	0.286	0.408	0.355	0.533	0.590
	(oz·in/A) (rms)	(35.84)	(40.32)	(57.44)	(49.92)	(75.04)	(83.04)
Moment of inertia J_M ($=GD^2_M/4$)	$kg \cdot m^2 \times 10^{-4}$	0.021	0.026	0.040	0.123	0.191	0.671
	$(oz \cdot in \cdot s^2 \times 10^{-3})$	(0.288)	(0.368)	(0.576)	(1.74)	(2.70)	(9.52)
Power Rating*	kW/s	4.36	9.63	25.4	32.8	84.6	85.1
Rated Angular Acceleration*	rad/s^2	45200	61200	79500	51800	66600	35600
Inertia Time Constant	ms	1.5	0.9	0.5	0.4	0.3	0.3
Inductive Time Constant	ms	1.5	1.8	1.9	5.4	6.4	13

NOTES : 1. Items marked with * and torque-speed characteristic are measured when the armature winding combined with the SERVOPACK is 100℃. Other figures are measured when the temperature is 20℃. All the figures are typical values.

2. Rated torque is the continuous allowable torque when the motor is mounted on a heat sink of 250 × 250 × 6 (mm) and the ambient temperature of 40℃.

Σ standard (for 100V class)
Ratings and specifications of Σ series AC servomotors

Time rating : Continuous
Insulation : Class B
Vibration : V15
Withstand voltage : 1500VAC for one minute
Insulation resistance : 500VDC 10MΩ or more
Enclosure : Totally-enclosed, self-cooled
Ambient Temperature : 0℃ to 40℃
Ambient Humidity : 20% to 80% (non-condensing)
Excitation : Permanent magnet type
Drive method : Direct drive
Installation : Flange-mounted

Table 3.27 Servomotor Specifications (2)

Item \ Motor Type SGM-		A3B	A5B	01B	02B
Rated Output*	W (HP)	30 (0.04)	50 (0.07)	100 (0.13)	200 (0.27)
Rated Torque*	N·m (oz·in)	0.095 (13.52)	0.159 (22.56)	0.318 (45.12)	0.637 (90.08)
Instantaneous Peak Torque*	N·m (oz·in)	0.29 (40.48)	0.48 (67.68)	0.96 (135.4)	1.91 (270.4)
Rated Current*	A (rms)	0.63	0.9	2.2	2.7
Instantaneous Max Current*	A (rms)	2.0	2.9	7.1	8.4
Rated Speed*	r/min	3000			
Instantaneous Max Speed*	r/min	4500			
Torque Constant*	N·m/A (rms) (oz·in/A) (rms)	0.168 (23.52)	0.194 (27.36)	0.156 (21.92)	0.255 (35.84)
Moment of inertia J_M $(=GD^2_M/4)$	$kg \cdot m^2 \times 10^{-4}$ $(oz \cdot in \cdot s^2 \times 10^{-3})$	0.021 (0.288)	0.026 (0.368)	0.040 (0.576)	0.123 (1.74)
Power Rating*	kW/s	4.36	9.63	25.4	32.8
Rated Angular Acceleration*	rad/s²	45200	61200	79500	51800
Inertia Time Constant	ms	1.6	0.9	0.6	0.4
Inductive Time Constant	ms	1.3	1.6	1.6	5.7

NOTES : 1. Items marked with * and torque-speed characteristic are measured when the armature winding combined with the SERVOPACK is 100℃. Other figures are measured when the temperature is 20℃. All the figures are typical values.

2. Rated torque is the continuous allowable torque when the motor is mounted on a heat sink of 250 × 250 × 6 (mm) and the ambient temperature of 40℃.

4 INSTALLATION AND WIRING

4.1 Installation Environment

For high reliability and performance of the system, the following precautions must be taken into account at installation and wiring.

4.1.1 Installation Site

Avoid the following locations.

- Where ambient temperature may fall below 0℃ or rise over 55℃.
- Where ambient humidity may fall below 30% RH or rise over 95% RH.
- Where condensation may occur because of excessive thermal variations.
- Where corrosive or flammable gas is present.
- Where dust, iron power or other conductive powder, oil mist, or salt is abundant.
- Where exposed to direct sunlight.
- Where an intense electric or magnetic field develops.
- Where vibration or shock may be applied directly to the system.

4.1.2 Notes on Installation of the Unit

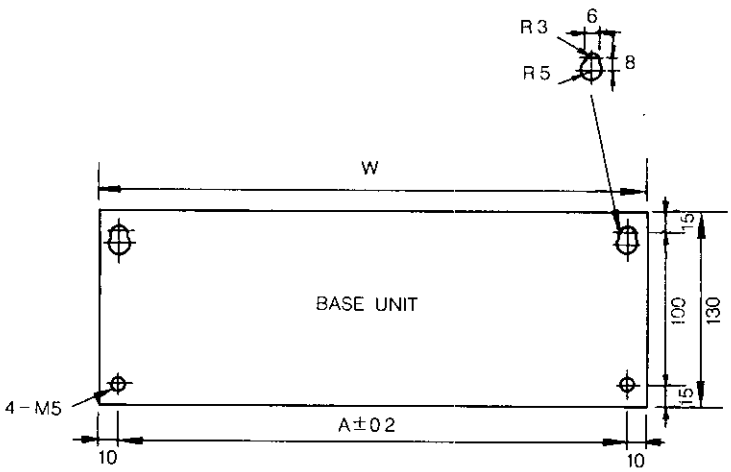
(1) Forced ventilation of the panel is advisable if inside panel temperature may exceed 55℃.

(2) Keep the system as far as possible from high-voltage and power equipment for security of maintenance and operation.

(3) Keep the system away from power feeders by 200㎜ or more.

4.2 Panel Interior Installation

4.2.1 Installation dimensions



Base Unit Type	A±0.2	W
MB041	340	360
MB051	420	440
MB052	420	440
MB062	500	520

Fig. 4.1 Mounting Base Installation Dimensions

4.2.2 Unit Removing Method

(1) Suspend the lock hooks of the units on the base unit.
(Swing mechanism)

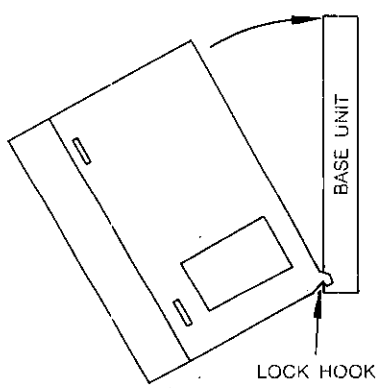


Fig. 4.2 Swing Mechanism

Verify that the lock hooks are engaged securely with the base unit.

(2) Insert the units to the base unit connectors securely. If insertion is not easy, the lock hook may not be engaged securely. Do not use excessive force to insert.

4.2.3 Installation Method

(1) Determine base unit installation considering panel interior installation location, width of cable ducts, wiring, ventilation, and unit replacement.

(2) Take ventilation and unit replacement into account. Place cable ducts over or below the unit leaving clearance (of 20㎜ or greater). Leave clearance of 20㎜ or greater above the unit and 25㎜ or greater below.

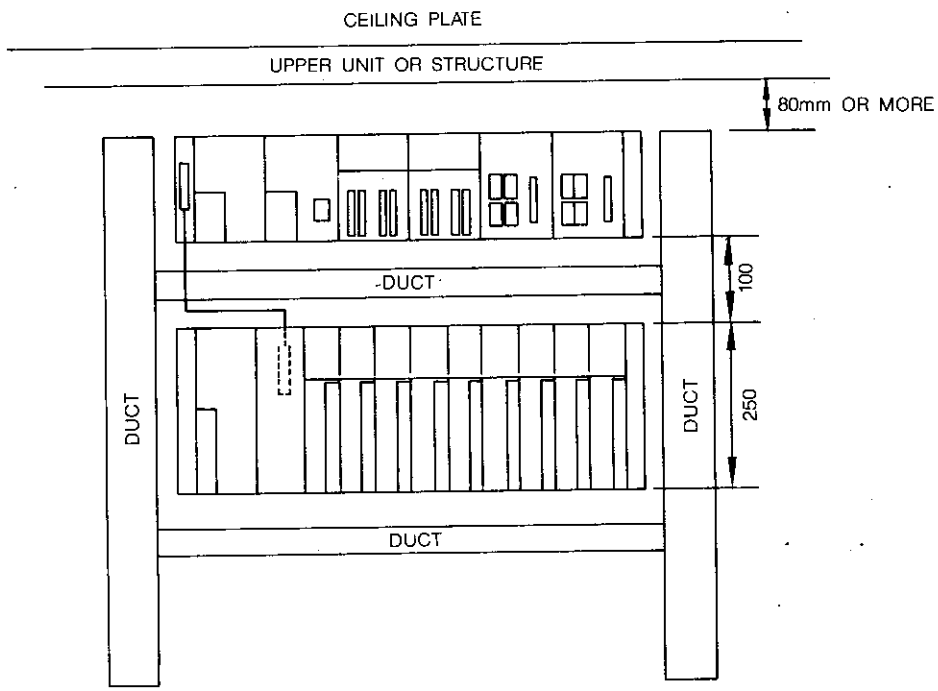


Fig. 4.3 System Installation Dimensions

(3) Fasten the units by tightening the two screws on the top. The Phillips type screwdriver needs to be slightly tilted when fastening, so that clearance (of 20㎜ or greater) must be left above the peripheral equipment.

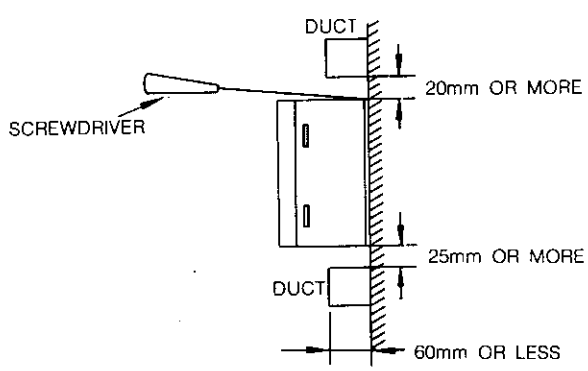
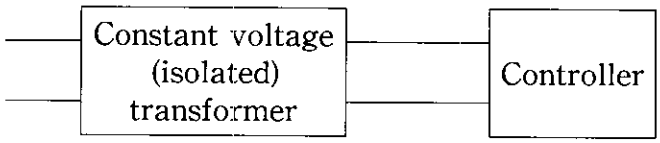


Fig. 4.4 Unit Installation Method

4.3 Notes on Wiring the System

4.3.1 Power Wiring

(1) If voltage variations exceed the specifications, use a constant voltage transformer. If noise is high, use an isolated transformer.



(2) Separate wiring of the controller power supply and power equipment from that of I/O equipment.

(3) Place the 100VAC, 200VAC, and 12 to 24VDC wires near each other and connect the units by the minimum distance.

(4) The 100VAC or 12 to 24VDC wires must not be bundled with or even placed near the main circuit (high-voltage, large-current) wires or I/O signal cables. It is recommended to separate these cables by 100mm or greater.

(5) Connect a lightning surge absorber.

4.3.2 Wiring I/O Units

(1) AWG22-26 wires are recommended for the terminal block connector.

(2) Separate the input and output cables.

(3) Keep I/O signal cables away from the high-voltage, large-current main circuit wires by 100mm or more. If this is impossible, use shielded cables.

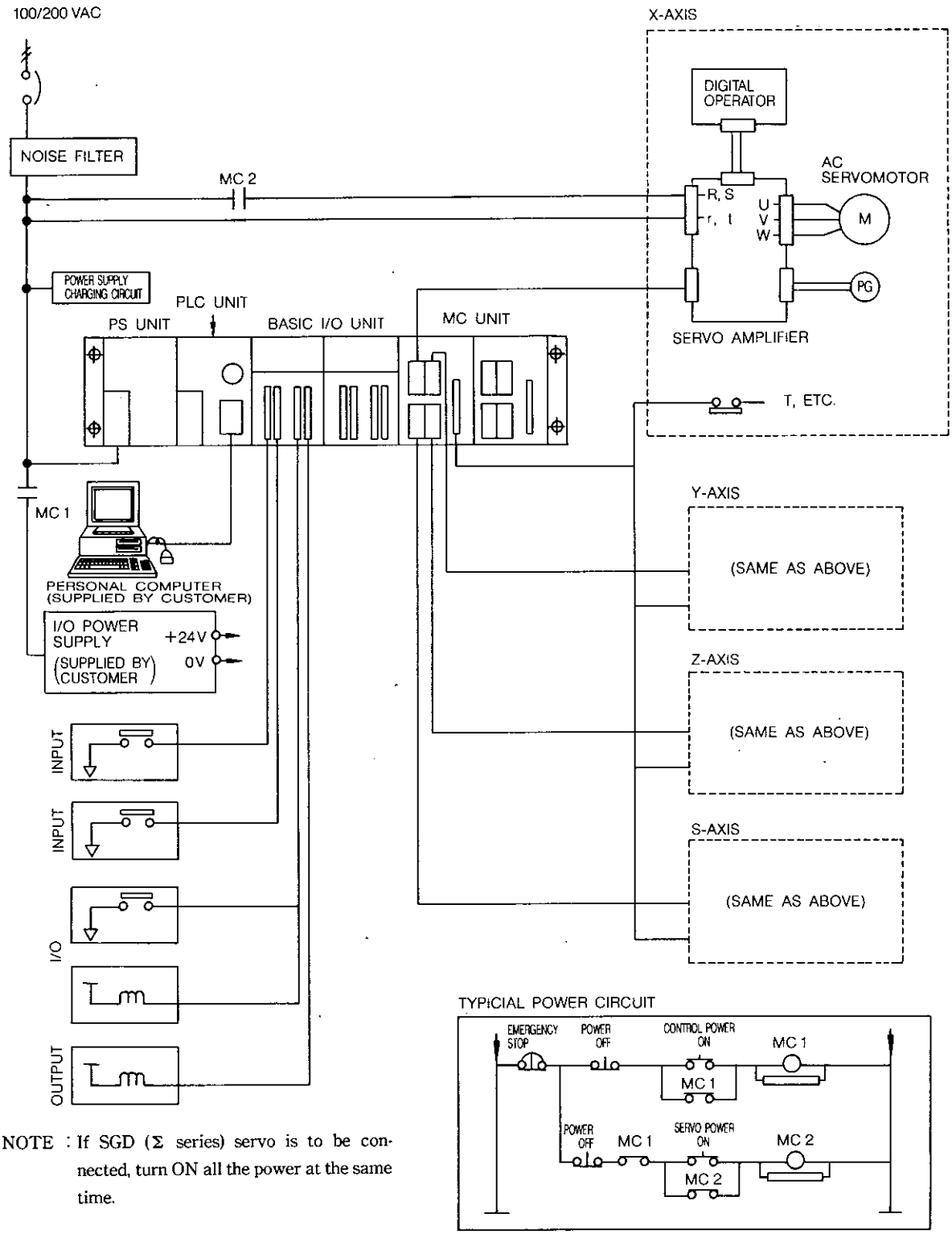
(4) The I/O cables are 12 to 24VDC. Separate them from 100VAC and 200VAC wires.

4.3.3 Grounding

(1) Exclusive grounding (class 3 grounding) is recommended. (At grounding resistance of 100Ω or less)

(2) Ground as near the controller as possible to reduce the length of the grounding wire.

4.4 Example of System Wiring



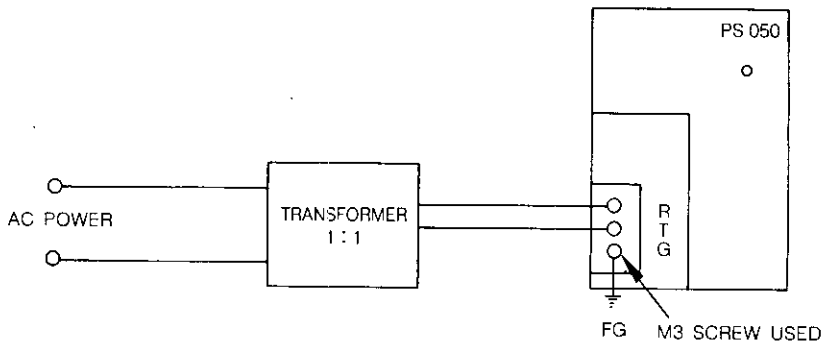
NOTE : If SGD (Σ series) servo is to be connected, turn ON all the power at the same time.

Fig. 4.5 System Wiring Diagram

4.5 Wiring of Individual Units

4.5.1 Power Supply Wiring

Power supply unit (PS050)



(1) AC power

- Supply 100VAC to 240VAC power.
- Use power supplies within the allowable power voltage variations.

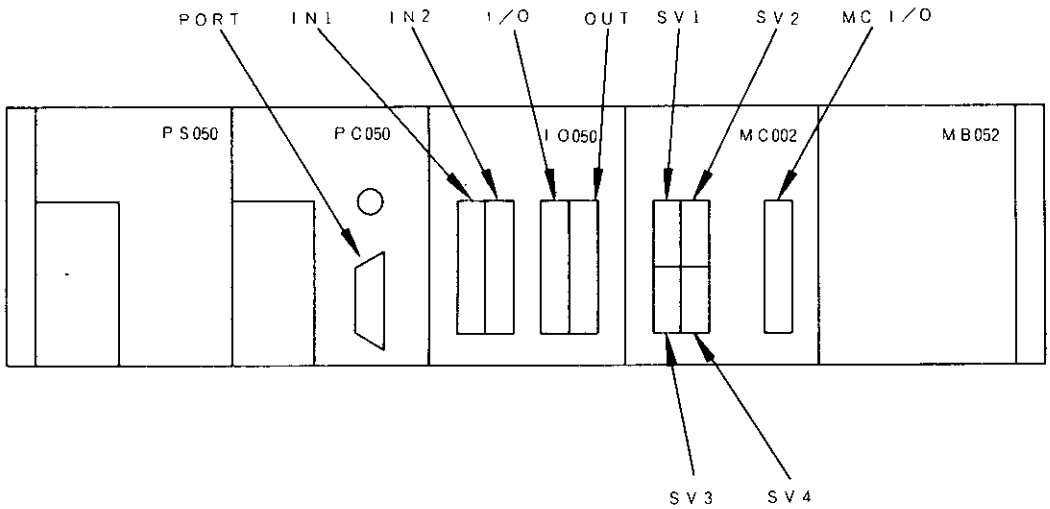
Power Supply Voltage	Allowable Power Supply Voltage Variation Range
100 to 240 VAC	85 to 264 VAC

(2) Transformers

- If voltage variations are excessive, supply power via a constant voltage transformer.
- It is recommended to supply power via an isolated transformer to remove ground noise.

4.5.2 Individual Unit Wiring

(1) Connector type list



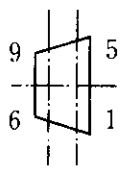
Unit	Connector Name	Unit Side	Cable Side	Manufacturer
PLC Unit	PORT	17LE−13090−27 (D2BC)	17JE−23090−02(D8B)	DDK
I/O Unit	IN1	FCN−365P−040−AU	FCN−361J040−AU	Fujitsu
	IN2	FCN−365P−040−AU	FCN−361J040−AU	
	I/O	FCN−365P−040−AU	FCN−361J040−AU	
	OUT	FCN−365P−040−AU	FCN−361J040−AU	
MC Unit	MC I/O	FCN−365P−040−AU	FCN−361J040−AU	
	SV1	10220−L8A9VE	10120−3000VE 10320−52A0−008 (Cover)	3M
	SV2	10220−L8A9VE	10120−3000VE 10320−52A0−008 (Cover)	
	SV3	10220−L8A9VE	10120−3000VE 10320−52A0−008 (Cover)	
	SV4	10220−L8A9VE	10120−3000VE 10320−52A0−008 (Cover)	

NOTE : I/O unit and MC unit cable connectors are soldered type. Crimp type is also available.

(2) Connector pin assignment

(a) PLC unit (PC050)

① Programming Panel connector (PORT)



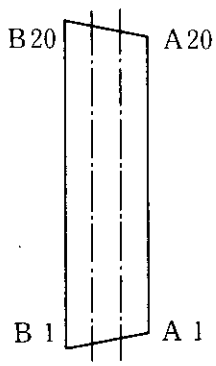
Pin No.	Signal Name
1	FG
2	TXD
3	RXD
4	RTS
5	CTS
6	DSR
7	GND
8	No connection
9	DTR

Unit side connector : 17LE-13090-27 (D2BC) (DDK)

NOTE : Any 9-pin D-SUB connector can be used. (The fastening screw is M3.)

(b) I/O Unit (IO050)

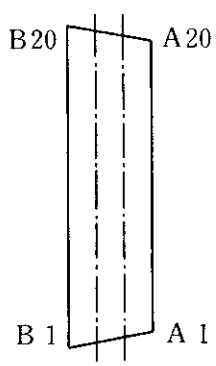
① Input signal connector (IN1) : L of the left connector



Pin No.	Signal Name	Pin No.	Signal Name
B20	COMMON1	A20	COMMON1
B19	No connection	A19	No connection
B18	I1	A18	I2
B17	I3	A17	I4
B16	I5	A16	I6
B15	I7	A15	I8
B14	I9	A14	I10
B13	I11	A13	I12
B12	I13	A12	I14
B11	I15	A11	I16
B10	I17	A10	I18
B9	I19	A9	I20
B8	I21	A8	I22
B7	I23	A7	I24
B6	I25	A6	I26
B5	I27	A5	I28
B4	I29	A4	I30
B3	I31	A3	I32
B2	COMMON2	A2	COMMON2
B1	No connection	A1	No connection

Unit side connector : FCN-365P-040-AU (made by Fujitsu)

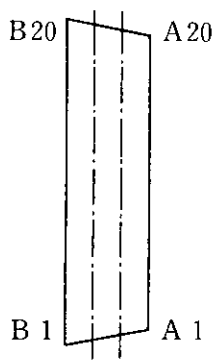
② Input signal connector (IN2) : R of the left connector



Pin No.	Signal Name	Pin No.	Signal Name
B20	COMMON3	A20	COMMON3
B19	No connection	A19	No connection
B18	I33	A18	I34
B17	I35	A17	I36
B16	I37	A16	I38
B15	I39	A15	I40
B14	I41	A14	I42
B13	I43	A13	I44
B12	I45	A12	I46
B11	I47	A11	I48
B10	I49	A10	I50
B9	I51	A9	I52
B8	I53	A8	I54
B7	I55	A7	I56
B6	I57	A6	I58
B5	I59	A5	I60
B4	I61	A4	I62
B3	I63	A3	I64
B2	COMMON4	A2	COMMON4
B1	No connection	A1	No connection

Unit side connector : FCN-365P-040-AU (made by Fujitsu)

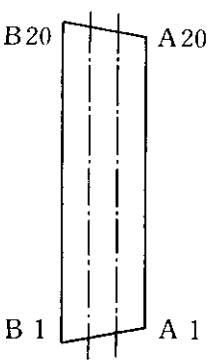
③ I/O signal connector (I/O) : L of the right connector



Pin No	Signal Name	Pin No.	Signal Name
B20	COMMON-5	A20	COMMON-5
B19	No connection	A19	No connection
B18	I65	A18	I66
B17	I67	A17	I68
B16	I69	A16	I70
B15	I71	A15	I72
B14	I73	A14	I74
B13	I75	A13	I76
B12	I77	A12	I78
B11	I79	A11	I80
B10	O1	A10	O2
B9	O3	A9	O4
B8	O5	A8	O6
B7	O7	A7	O8
B6	O9	A6	O10
B5	O11	A5	O12
B4	O13	A4	O14
B3	O15	A3	O16
B2	+12V/+24V−6	A2	+12V/+24V−6
B1	0_{12}V/O_{24}V−6	A1	0_{12}V/O_{24}V−6

Unit side connector : FCN-365P-040-AU (made by Fujitsu)

④ Output signal connector (OUT) : R of the left connector



Pin No.	Signal Name	Pin No.	Signal Name
B20	+12V/+24V−7	A20	+12V/+24V−7
B19	0_{12}V/0_{24}V−7	A19	0_{12}V/0_{24}V−7
B18	O17	A18	O18
B17	O19	A17	O20
B16	O21	A16	O22
B15	O23	A15	O24
B14	O25	A14	O26
B13	O27	A13	O28
B12	O29	A12	O30
B11	O31	A11	O32
B10	O33	A10	O34
B9	O35	A9	O36
B8	O37	A8	O38
B7	O39	A7	O40
B6	O41	A6	O42
B5	O43	A5	O44
B4	O45	A4	O46
B3	O47	A3	O48
B2	+12V/+24V−8	A2	+12V/+24V−8
B1	O_{12}V/O_{24}V−8	A1	O_{12}V/O_{24}V−8

Unit side connector : FCN-365P-040-AU (made by Fujitsu)

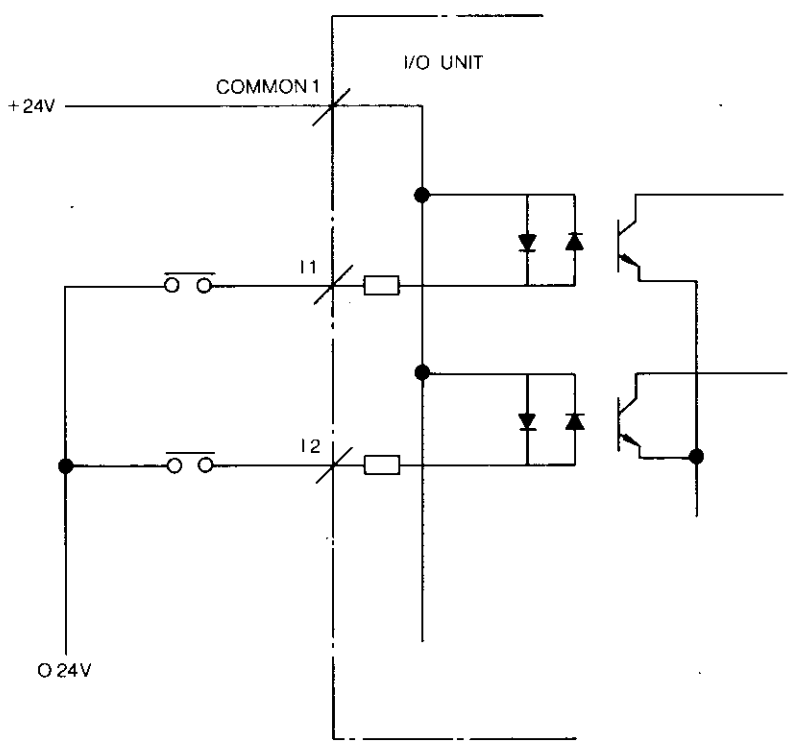
(c) Connecting I/O signals to the I/O unit

① Input signals

The common signals are the input signal power supply lines.

COMMON1	I1 to I16
COMMON2	I17 to I32
COMMON3	I33 to I48
COMMON4	I49 to I64
COMMON5	I65 to I80

The input signal circuit employs a bi-directional input photocoupler and is available as either 0V common or 24V common of 12VDC or 24VDC. However, it is recommended to use a 0V common to prevent damage to the unit in case of misconnection of the IN and OUT connectors.

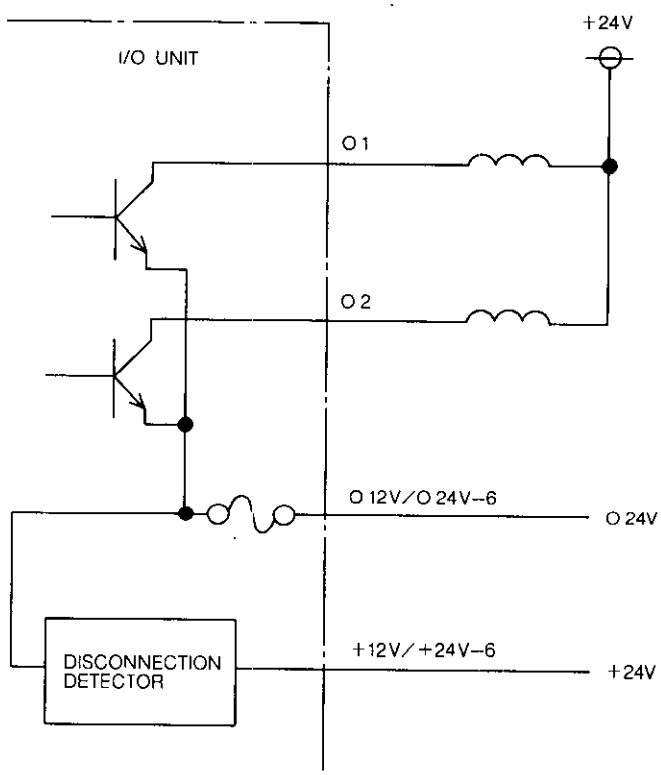


② Output circuit

+12V/+24V, 0_{12}V/0_{24}V are the output signal power supply.

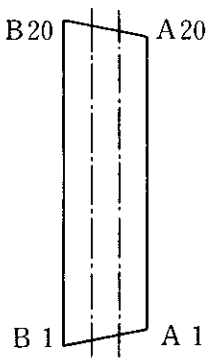
+12V/+24V−6, 0_{12}V/0_{24}V−6	O1 to O16
+12V/+24V−7, 0_{12}V/0_{24}V−7	O17 to O32
+12V/+24V−8, 0_{12}V/0_{24}V−8	O33 to O48

The output circuit handles 12VDC/24VDC, open collector type, and supports a disconnection detector in the common line.



(d) MC unit (MC002)

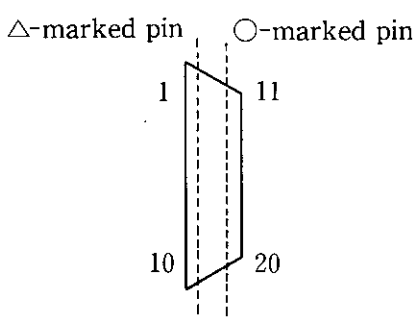
① I/O signal connector (MCI/O)



Pin No.	Signal Name	Pin No.	Signal Name
B20	+24V	A20	0_{24}V
B19	+24V	A19	0_{24}V
B18	No connection	A18	No connection
B17	COMMON1	A17	COMMON1
B16	OTF1	A16	OTR1
B15	DEC1	A15	ZERO1
B14	OTF2	A14	OTR2
B13	DEC2	A13	ZERO2
B12	COMMON2	A12	COMMON2
B11	OTF3	A11	OTR3
B10	DEC3	A10	ZERO3
B9	OTF4	A9	OTR4
B8	DEC4	A8	ZERO4
B7	No connection	A7	No connection
B6	No connection	A6	No connection
B5	No connection	A5	No connection
B4	No connection	A4	No connection
B3	0_{24}V	A3	0_{24}V
B2	BRK1	A2	BRK2
B1	BRK3	A1	BRK4

Unit side connector : FCN-365P-040-AU (made by Fujitsu)

② Servo I/F connector (SV1-SV4)



Pin No.	Signal Name	Pin No.	Signal Name
1	PA	11	SVON
2	$\overline{PA}$	12	PCON
3	PB	13	OTF_OUT
4	$\overline{PB}$	14	OTR_OUT
5	PC	15	SVALM
6	$\overline{PC}$	16	0_{24}OUT (Reserved)
7	D/A	17	0_{24}OUT
8	GND	18	0_{24}OUT
9	GND	19	+24OUT
10	GND	20	+24OUT

○-MARKED PIN

FG (Shielded wire connected from connector body)

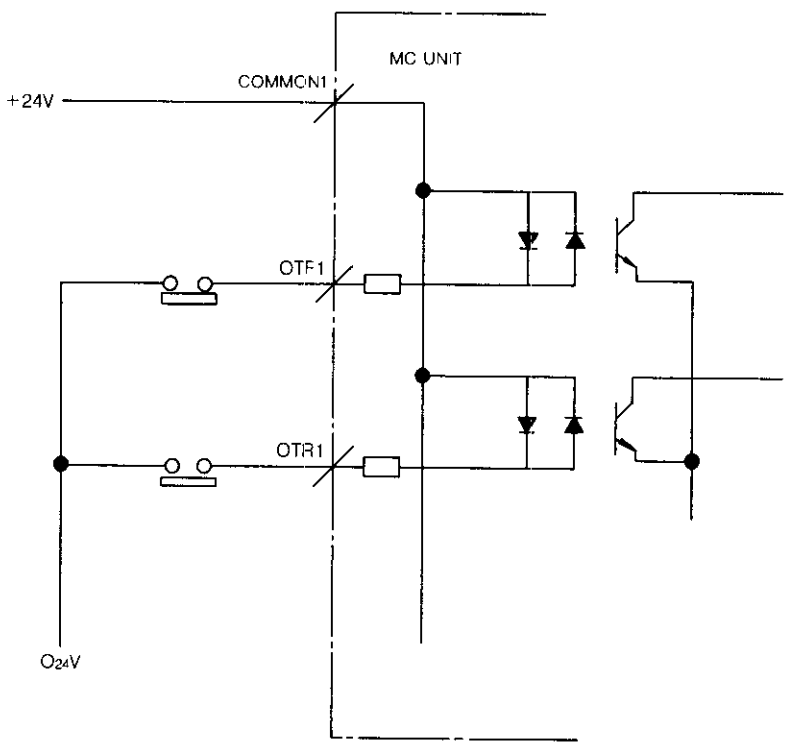
Unit side connector : 10220-L8A9VE (3M)

(e) MC unit signals

① I/O connector signals

Signal name	Description
+24V	I/O power input
0_{24}V	I/O power input
COMMON1, 2	Input signal common lines (*), +24V or 0_{24}V
OTF1-4	Forward overtravel inputs "Open" when overtravel occurs (NC contact)
OTR1-4	Reverse overtravel inputs "Open" when overtravel occurs (NC contact)
DEC1-4	Zero-return deceleration dog input (NC contact) For zero return using deceleration dog and phase C pulse
ZERO1-4	Zero return, zero point signal inputs For zero return using proximity switches Make this signal open if phase C pulse is used for zero return.
BRK1-4	Brake control outputs (open collector outputs) Output transistor is ON when the brake is released.

* COMMON1 is the power supply for the input signals for axes 1 and 2. COMMON2 is the power supply for the input signals for axes 3 and 4.
It is recommended to use input signals as 0V common, although they can also be used as 24V common.



② SV1-SV4 connector signals

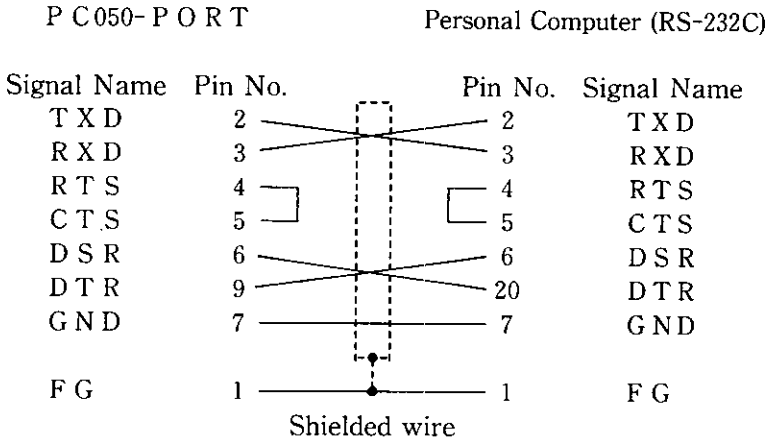
Signal name	Description
+24 OUT	Power supply output for servo I/O signals Connect to the I/O signal power input on the servo.
0_{24} OUT	Power supply output for servo I/O signals Connect to the I/O signal power input on the servo.
GND	Control power supply, 0V for speed command outputs
SVON	Servo-ON command output (open collector output) The output transistor is ON when servo is ON.
PCON	P operation command output (open collector output) The output transistor is ON when P operation is commanded.
OTF_OUT	Forward overtravel output (open collector output) The OTF signal input to the MC unit I/O connector is output to the servo. The output transistor is OFF when an overtravel occurs.
OTR_OUT	Reverse overtravel output (open collector output) The OTR signal input to the MC unit I/O connector is output to the servo. The output transistor is OFF when overtravel occurs.
SVALM	Servo alarm signal input (NC contact) "Open" when an alarm occurs.
PA, $\overline{PA}$ PB, $\overline{PB}$ PC, $\overline{PC}$	Feedback signal inputs (differential line receiver inputs) PG signal outputs from the servo are connected.
D/A	Speed command output analog speed command output

(3) Individual cable specifications

(a) Cable between PC050－PORT and personal computer PP

Type JEPMC－W5310－03 (2.5m)
－15 (15m)

Specifications



PC050－PORT side connector : 17JE－23090－02 (D8B) (DDK)

(b) Cable between IO050 and machine / 24VDC power supply

Type JEPMC-W5410−05 (0.5m)
−10 (1m)
−30 (3m)

Specifications

IO050 Pin No.		Machine Side I/O, 24V Power Supply Marker
B 2 0	———	B 2 0
A 2 0	———	A 2 0
B 1 8	———	B 1 8
A 1 8	———	A 1 8
B 1 7	———	B 1 7
A 1 7	———	A 1 7
B 1 6	———	B 1 6
A 1 6	———	A 1 6
B 1 5	———	B 1 5
A 1 5	———	A 1 5
B 1 4	———	B 1 4
A 1 4	———	A 1 4
B 1 3	———	B 1 3
A 1 3	———	A 1 3
B 1 2	———	B 1 2
A 1 2	———	A 1 2
B 1 1	———	B 1 1
A 1 1	———	A 1 1
B 1 0	———	B 1 0
A 1 0	———	A 1 0
B 9	———	B 9
A 9	———	A 9
B 8	———	B 8
A 8	———	A 8
B 7	———	B 7
A 7	———	A 7
B 6	———	B 6
A 6	———	A 6
B 5	———	B 5
A 5	———	A 5
B 4	———	B 4
A 4	———	A 4
B 3	———	B 3
A 3	———	A 3
B 2	———	B 2
A 2	———	A 2
B 1	———	B 1
A 1	———	A 1

I/O050 side : FCN−361J040−AU (FUJITSU), soldered jack
Connector : FCN−360C040−B (FUJITSU), cover
Machine side : Untied wire (pin No. indicated in each line by marker)
Cable used : AWG #24

(c) Cable between MC002−MCI/O and Machine / 24VDC power supply

Type JEPMC-W5550−05 (0.5m)
−10 (1m)
−30 (3m)

Specifications

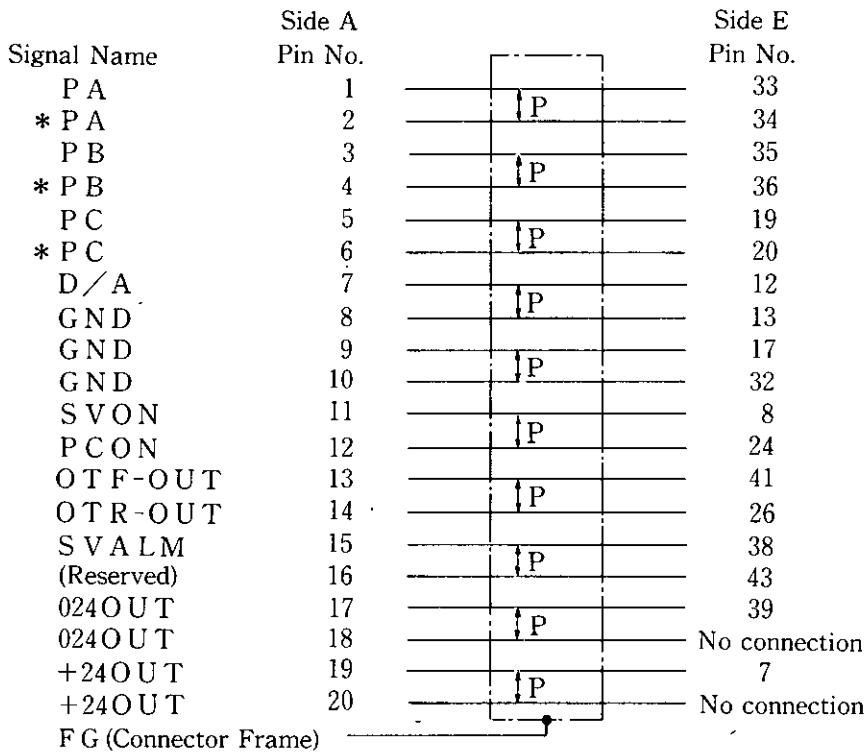
MC002−MC I/O Pin No.		Marker	Machine Side I/O, 24V Power Supply
B 2 0	———	+24V	+24V
B 1 9	———	+24V	+24V
A 2 0	———	0_{24}V	0_{24}V
A 1 9	———	0_{24}V	0_{24}V
B 1 7	———	COM1	+24V
A 1 7	———	COM1	+24V
B 1 6	———	OTF1	1st axis forward direction overtravel SW (0V common)
A 1 6	———	OTR1	1st axis reverse direction overtravel SW (0V common)
B 1 5	———	DEC1	1st axis zero-point return deceleration limit SW (0V common)
A 1 5	———	ZERO1	1st axis zero-point position SW (0V common)
B 1 4	———	OTF2	2nd axis forward direction overtravel SW (0V common)
A 1 4	———	OTR2	2nd axis reverse direction overtravel SW (0V common)
B 1 3	———	DEC2	2nd axis zero-point return deceleration limit SW (0V common)
A 1 3	———	ZERO2	2nd axis zero-point position SW (0V common)
B 1 2	———	COM2	+24V
A 1 2	———	COM2	+24V
B 1 1	———	OTF3	3rd axis forward direction overtravel SW (0V common)
A 1 1	———	OTR3	3rd axis reverse direction overtravel SW (0V common)
B 1 0	———	DEC3	3rd axis zero-point return deceleration limit SW (0V common)
A 1 0	———	ZERO3	3rd axis zero-point position SW (0V common)
B 9	———	OTF4	4th axis forward direction overtravel SW (0V common)
A 9	———	OTR4	4th axis reverse direction overtravel SW (0V common)
B 8	———	DEC4	4th axis zero-point return deceleration limit SW (0V common)
A 8	———	ZERO4	4th axis zero-point position SW (0V common)
B 2	———	BRK1	1st axis brake control relay
A 2	———	BRK2	2nd axis brake control relay
B 1	———	BRK3	3rd axis brake control relay
A 1	———	BRK4	4th axis brake control relay
B 3	———	0_{24}V	0_{24}V
A 3	———	0_{24}V	0_{24}V

MC002 side : FCN−361J040−AU (FUJITSU), soldered jack
Connector : FCN−360C040−B (FUJITSU), cover
Machine side : Untied wire (marker indicated in each line)
Cable used : AWG #24

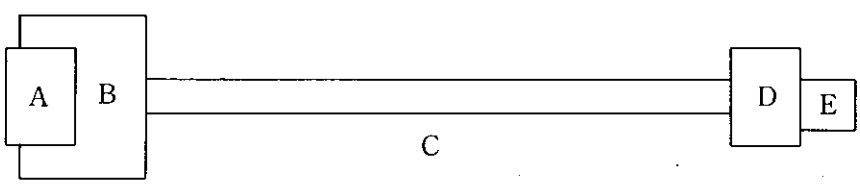
(d) Cable between MC002-SV1 to SV4 and SERVOPACK : SR

Type JEPMC−W5510−05 (0.5m)
−10 (1m)
−30 (3m)

Specifications



Form



MC002 side connector

A : 10120−6000EL (3M)	Press fit plug
B : 10320−52A0−008 (3M)	Plastic shell
C : SSRFPVV−SB 28×10P	Cable used (AWG #28)

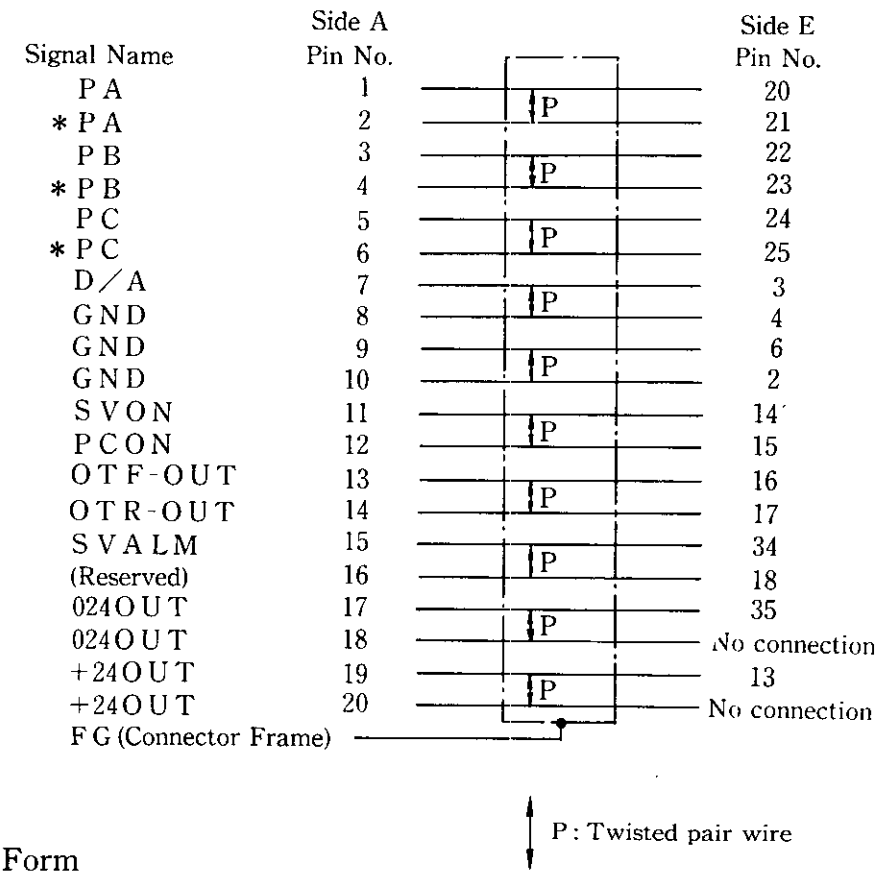
Servo side connector

D : MR−50L (HONDA)
E : MR−50F (HONDA)

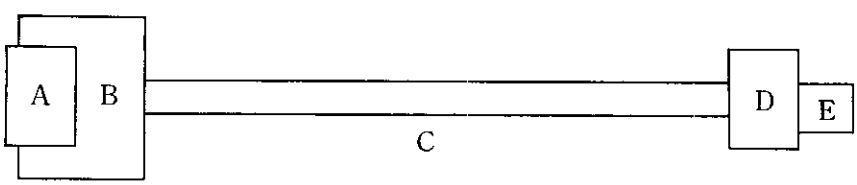
(e) Cable between MC002-SV1 to SV4 and SERVOPACK : SGD (Σ Series)

Type JEPMC−W5530−05 (0.5m)
−10 (1m)
−30 (3m)

Specifications



Form



MC002 side connector

A : 10120−6000EL (3M) Press fit plug
B : 10320−52A0−008 (3M) Plastic shell
C : SSRFPVV−SB 28×10P Cable used (AWG #28)

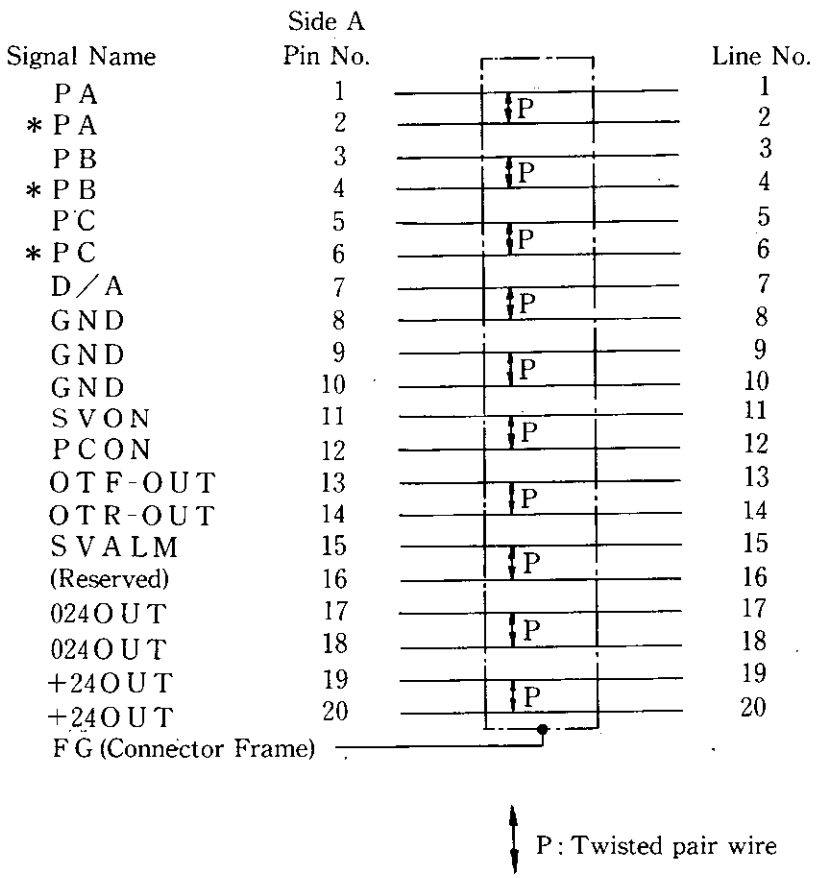
Servo side connector

D : 10336−52A0−008 (3M) Plastic shell
E : 10136−6000EL (3M) Press-fit plug

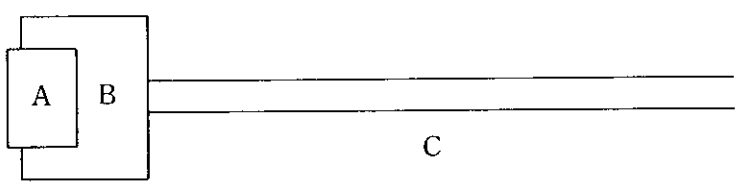
(f) Cable between MC002-SV1 to SV4 and SERVOPACK : General purpose

Type JEPMC−W5540−10 (1M)
−20 (2M)

Specifications



Form



MC002 side connector

A : 10120−6000EL (3M)	Press fit plug
B : 10320−52A0−008 (3M)	Plastic shell
C : SSRFPVV−SB 28×10P	Cable used (AWG #28)

5 TEST RUN AND MAINTENANCE

5.1 Preparation Before Test Run

5.1.1 Installation

The PROGIC-8 consists of the power supply unit (PS050), PLC unit (PC050), I/O unit (IO050), MC unit (MC002), and mounting base (MB041, MB051, MB052, or MB062). Verify that each unit is securely fastened on the specified locations on the mounting base (with two screws).

The MC unit and the I/O unit can be expanded depending on the system configuration. Refer to this manual to check unit configuration.

5.1.2 Connecting Power Supplies

Apply single-phase 85VAC to 246VAC (47Hz to 63Hz) power. Connect to terminals R and T of the power supply unit (PS050). Be sure to ground the G terminal.
Connect the external I/O power supply (24VDC) to the specified pins of the I/O connectors.

5.1.3 Connecting Cables

Insert cable connectors in the corresponding connectors on the controller. Tighten with lock screws. Clamp the cables to prevent applying the weight or tension of the cables to the connectors and the controller.

5 TEST RUN AND MAINTENANCE

5.2 Test Run Procedure

Fig. 5.1 shows the outline of test run and adjustment procedure of the PROGIC-8 system.

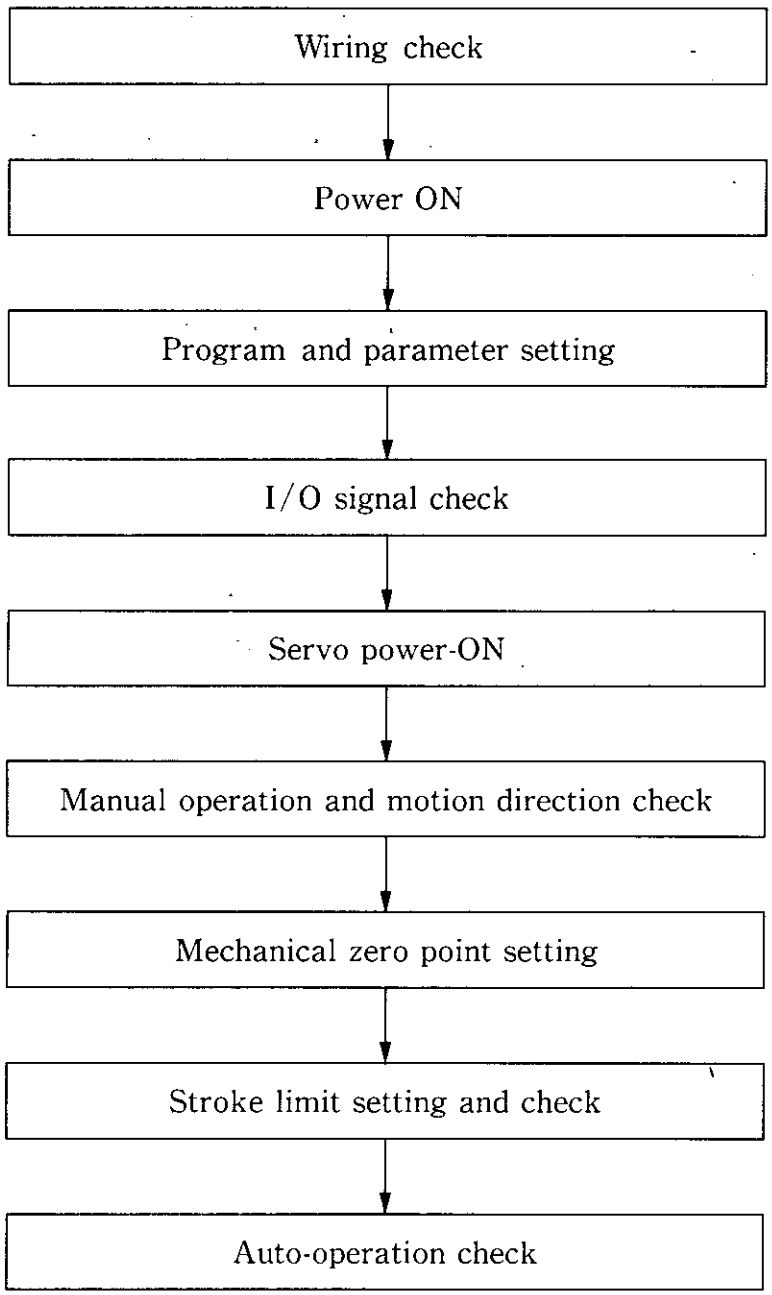


Fig. 5.1

The individual steps are explained in the following pages.

5.2.1 Wiring check

Check wiring carefully. If anything is overlooked during wiring check, abnormal operation may occur in test run, which often requires extensive troubleshooting to find the cause. Perfect wiring check is essential to smooth test run.

Not only verify circuit connections but also check the wiring routes, cable size and types, use of surge suppressors and polarity as well.

5.2.2 Power-ON

Connect the Programming Panel (IBM compatible PC) and the PLC unit (PC050) with the exclusive communication cable, then turn ON power.

First, install Programming System by the following procedure.

(1) Install MS-DOS.
Check whether MS-DOS is installed on the hard disk of the programming terminal. If not, initialize the hard disk.
(2) Start up MS-DOS.
(3) Insert system disk #1 in drive B.
Drive A : Hard disk
Drive B : Floppy disk
(4) The "A>" prompt is displayed on the screen. Type "B : " and depress the return key to move to drive B.
(5) Type "INSTALL" and depress the return key to start up the installation program.

5.2.3 Program and Parameter Setting

Load PLC programs, MC programs, and parameters from the Programming Panel to the PROGIC-8 by the following procedure.

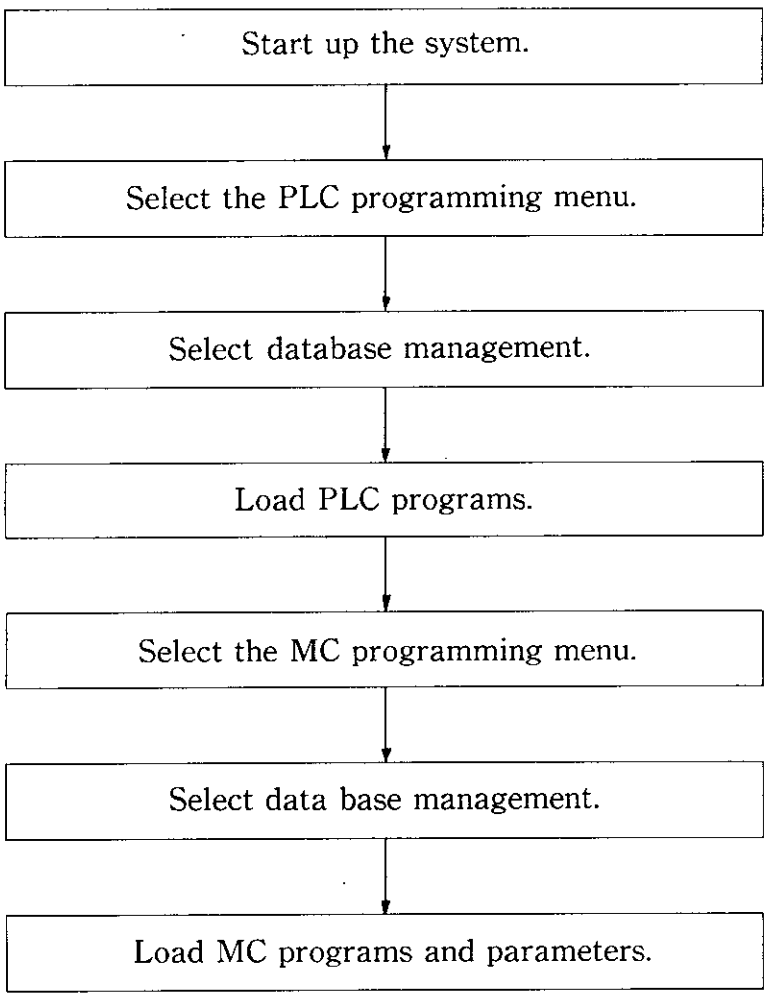


Fig. 5.2

5.2.4 I/O Signal Check

Check that input signals are connected correctly to the I/O connector of the I/O unit (IO050) and the MC unit (MC002).

(1) Checking the I/O unit

Select a connector by the monitor switch (L or R) and check input signals by the LEDs.

(2) Checking I/O with the MC unit

Select the MC unit I/O status on the Programming Panel and check input signals to the MC I/O connectors.

5.2.5 Servo Power-ON

After setting parameters according to system specifications, turn ON power to the servo. Servo-ON signal is output from the PLC unit to the individual axis to clear baseblock of the SERVOPACK enabling it to function.

When turning ON power, watch the machine carefully. If the machine runs away when servo power is turned ON, shut OFF power immediately. Machine runaway results from any of the following. Check wiring and parameters again.

(1) Motor wiring error

(2) Encoder wiring error

(3) Parameter setting error

If no alarm occurs and the motor is servo-locked (the machine standstill) after power is turned ON, it can be safely assumed that the motor and the encoder are properly wired.

5.2.6 Manual Operation and Motion Direction Check

Carry out manual operation for checking.

Manual operation (jog) procedure

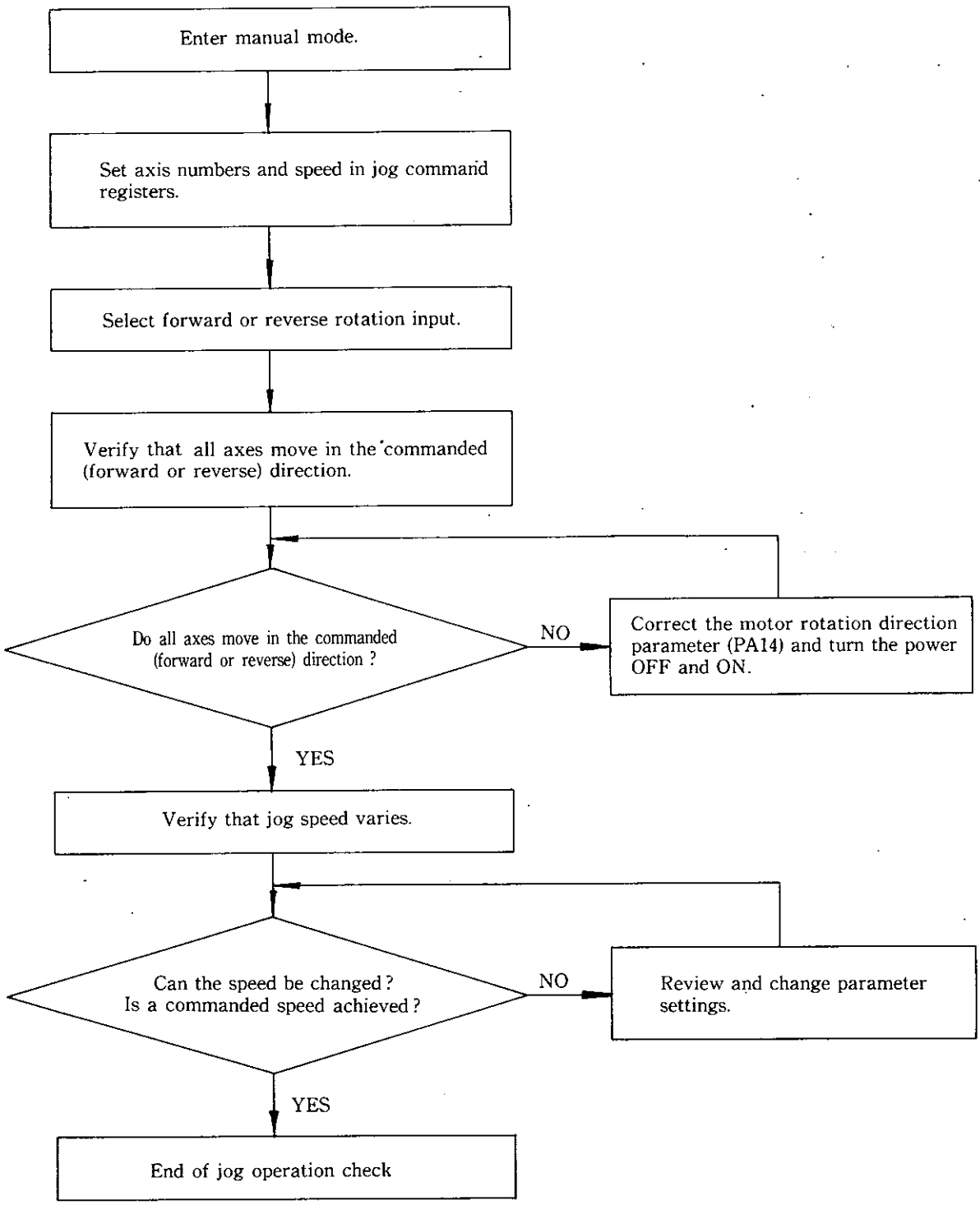


Fig. 5.3

5.2.7 Mechanical Zero Point Setting

Set up the mechanical zero point by zero return operation.

Zero return can be performed in manual mode by executing ZRN command on the PLC unit or in auto mode by executing ZRN command from the program started by the PLC unit.

Select the zero return direction in a program using a parameter.

5.2.8 Stroke Limit Setting and Check

The PROGIC-8 system supports two types of stroke limit detection functions : the overtravel detection that uses limit switches and the soft limit switch that checks mechanical position.

(1) Checking the overtravel detection function

Overtravel is detected by monitoring the motion direction and the overtravel limit switch signal in that direction. The + and − limit switch signals are connected to the MC unit of the individual axes.

If overtravel input signal becomes open during execution of a motion command, an immediate stop is commanded. After stopping, the machine is servo-locked in that position and an alarm is issued. To retract the axis, reset the alarm by the alarm reset command (ARS) then command a motion in the opposite direction.

The overtravel detection function can be enabled or disabled by a parameter.

(2) Checking soft limit switch

Soft limit switch checks the target position of motion commands with boundary position data set by parameters. If a motion beyond the boundary is commanded, the machine slows down and stops at the boundary, and an alarm is issued. To retract the axis, reset the alarm and command a motion in the opposite direction.

Soft limit switch can be enabled or disabled by a parameter.

5.2.9 Auto-operation Check

Check automatic operation by single-block operation.

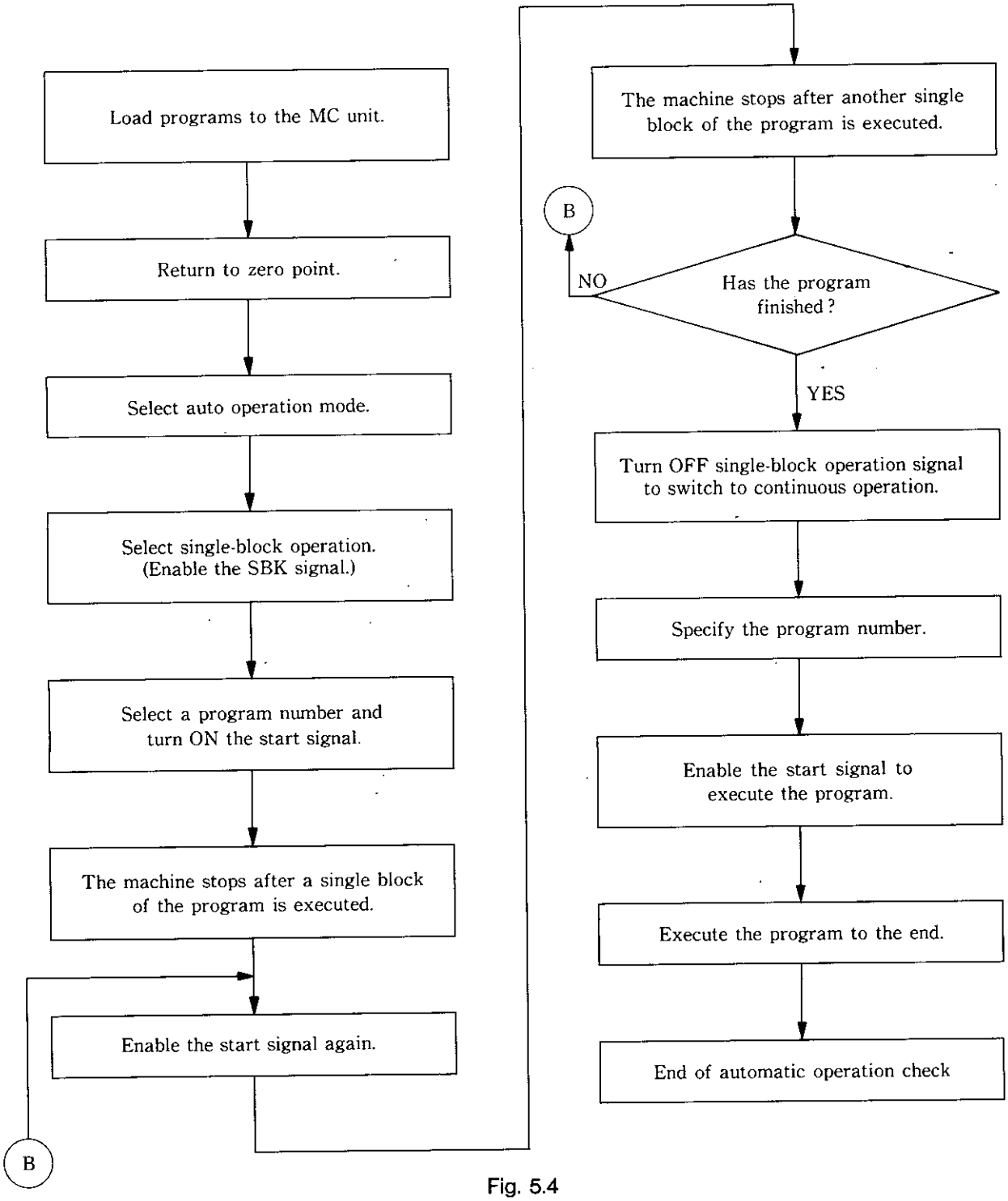


Fig. 5.4

5.3 Unit Replacement

If the PROGIC-8 should go out of order, locate the defective unit from the unit indicator lamps and the Programming Panel and replace the unit. The system is designed so that locating a defective unit and replacement takes little time and reduces system downtime to a minimum. Observe the following procedure to replace a unit.

(1) Turn OFF power.

Turn OFF the AC power to the PROGIC-8 and the external power supply to the I/O unit. Note that momentary abnormal output may occur if the I/O unit is installed while power of PROGIC-8 is alive.

(2) Remove connectors.

Remove cables and connectors from the unit. The power supply units has terminal blocks.

(3) Loosen unit fastening screws.

Loosen the two fastening screws that fix the unit on the mounting base.

(4) Remove the unit.

Hold the upper and lower parts of the unit. Turn down the upper part toward you and pull the unit out.

(5) Install a new unit.

Hold the new unit tilting it toward you. Align the lock hook on the lower part of the unit with the guide hole in the mounting base. Push the hook into the hole by standing the unit upright. Turn the two fastening screws on the upper part of the unit to fasten the unit onto the mounting base.

(6) Connect connectors.

Install the connectors that were removed in (2).

(7) Turn ON power.

Verify the unit type and wiring before turning ON power.

(8) Re-load programs.

If the PLC or MC unit has been replaced, load the programs and parameters that have been saved before replacement.

5.4 Replacing Backup Battery

Memory of the PLC and MC units is backed up by a battery. It is recommended to replace this battery every second year. The life of the battery depends on the operating environment (temperature and humidity) and accumulated power OFF period.

(1) Battery specifications

Table 5.1 shows the specifications of the battery used in the PROGIC-8.

Table 5.1 Battery Specifications

Item	Specification
Construction	Lithium battery
Type	BR-2/3A-1
Manufacturer	Matsushita Battery Ind.
Nominal voltage	3 V
Nominal capacity	1200mAh
Operating ambient temperature	0 to +55℃
Storage temperature	−20 to +45℃
Life	Guaranteed battery life : 5 years (at 25℃) Total memory contents retention time at power-loss : 1 year (at 25℃)
Approximate mass	15g

(2) Battery replacement period

The battery can be used up to five years provided that the total power-loss time is one year or less. If "BAT ALM" lamp on the PLC unit lights, replace the battery within one month. Determine the battery replacement period depending on the PROGIC-8 operating status (energized time) as follows :

- 12 hours per day : 2 years
- 16 hours per day : 3 years
- 20 hours per day : 4 years

The above operation time is an all-time average including holidays.

(3) Battery replacement procedure

When replacing the battery, keep the PROGIC-8 energized by AC power with the PLC unit mounted on the mounting base.

If the battery is removed when AC power is not supplied, memory contents will be lost. The memory contents remain if non-energized time is less than 30 minutes. Observe the following procedure to replace the battery.

① Confirm that the "POWER" lamp on the power unit is ON (AC power is ON).

② Open the front cover of the PLC unit.

③ Remove the connector on the end of the lead from the PLC unit. Remove the battery from the battery holder.

④ Place a new battery in the battery holder. Connect the connector on the lead end to the PLC unit connector. (Note that the connector cannot be inserted in the opposite direction.)

⑤ Confirm that the "BAT ALM" lamp on the PLC unit is OFF.

⑥ Close the PLC unit cover.

The above procedure completes battery replacement.

5.5 Troubleshooting

The PROGIC-8 has many components and it can prove difficult to locate a fault if one occurs. It is the design concept of the PROGIC-8 that faulty units could be replaced for easy maintenance by arerage workers.

If an error occurs, it is essential to recognize the situation and carry out maintenance according to a prescribed procedure. Use the general check flowcharts below to find the faulty unit in the PROGIC-8.

NOTE : The symbols in the maintenance procedure flow have the following meanings.

□ : Work ⬭ : Start, end or comment ◇ : Decision ○ : Node

In the maintenance procedure flowcharts, power-ON/OFF step is omitted. As a rule, turn OFF power before a series of operations and turn it ON after that.

(1) Power unit check

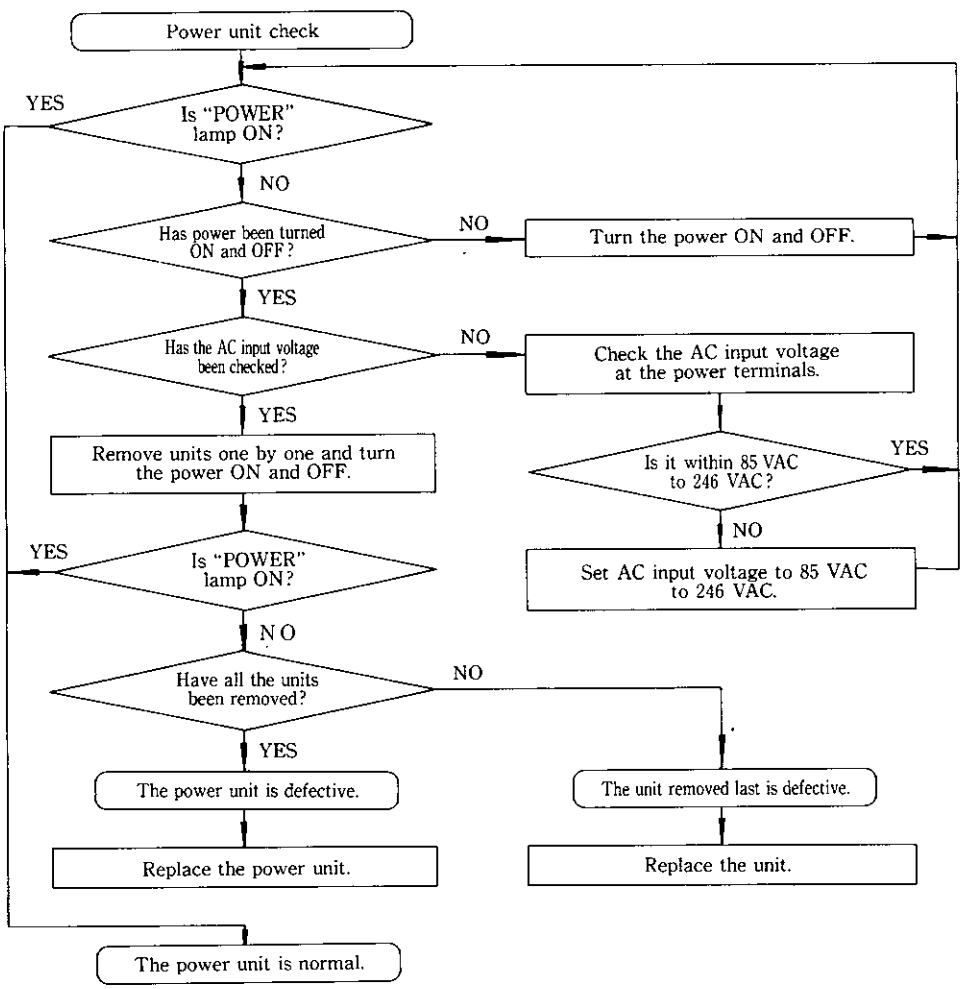


Fig. 5.5 Power Unit Check Flow

(2) PLC unit check

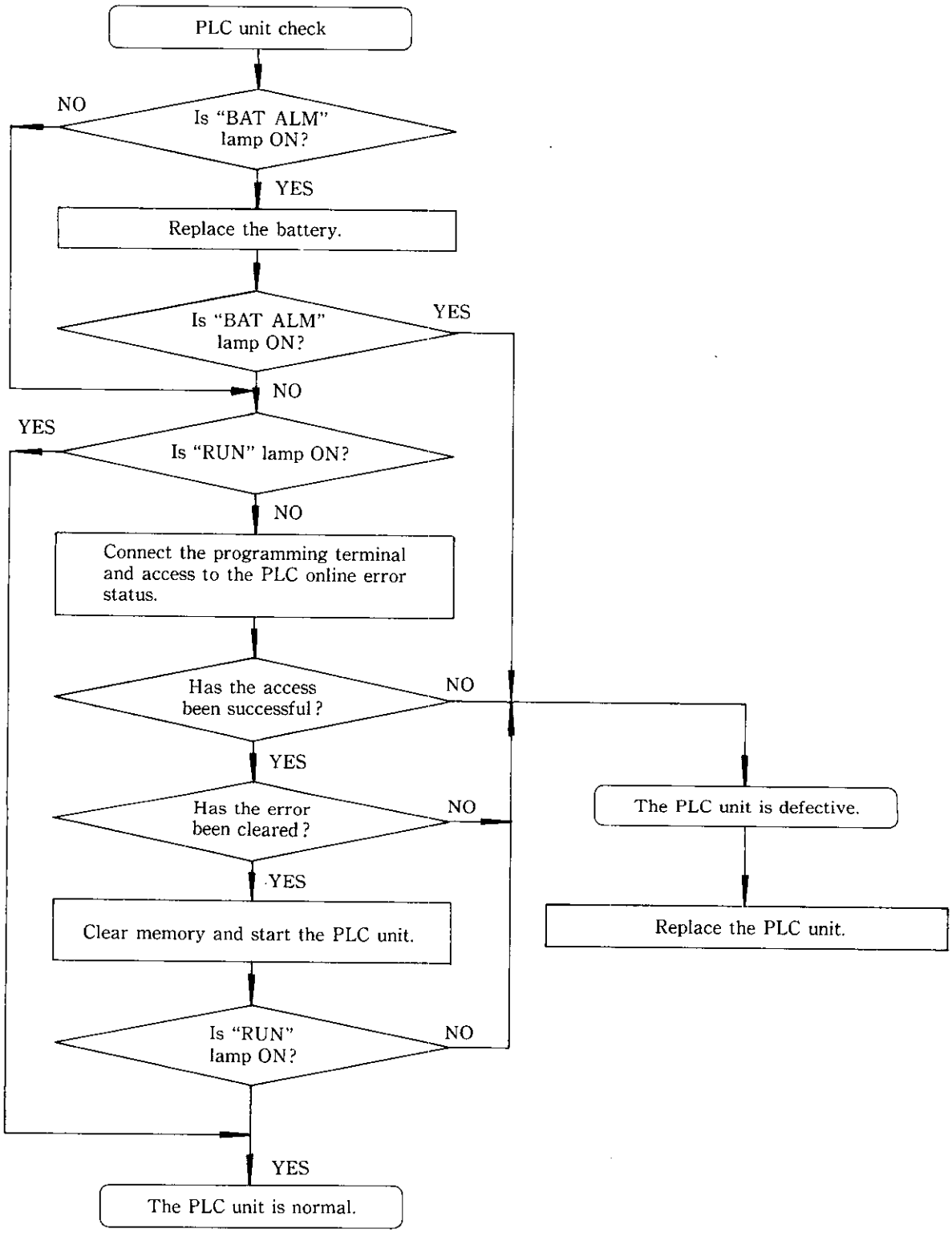
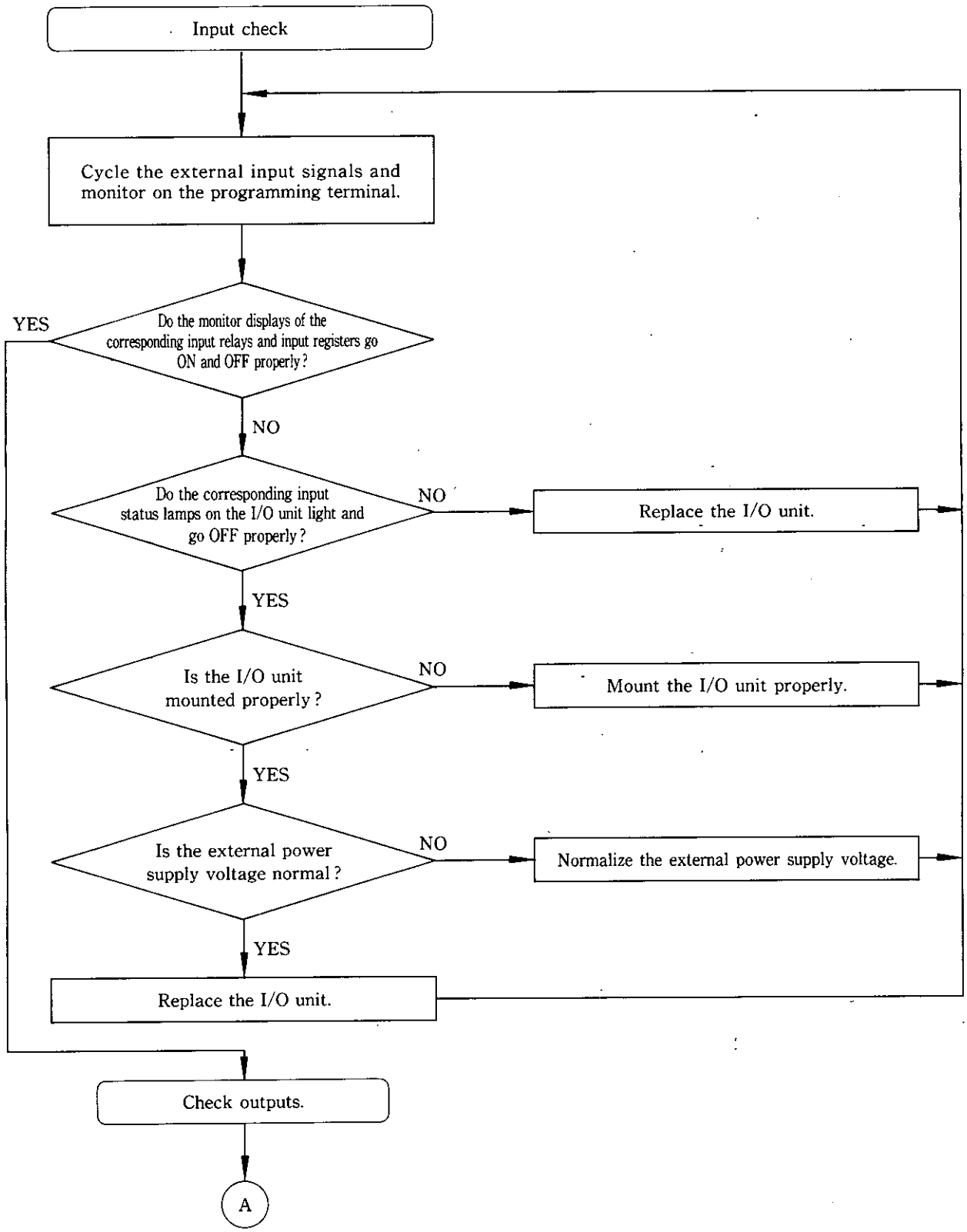


Fig. 5.6 PLC Unit Check Flow

(3) I/O unit check



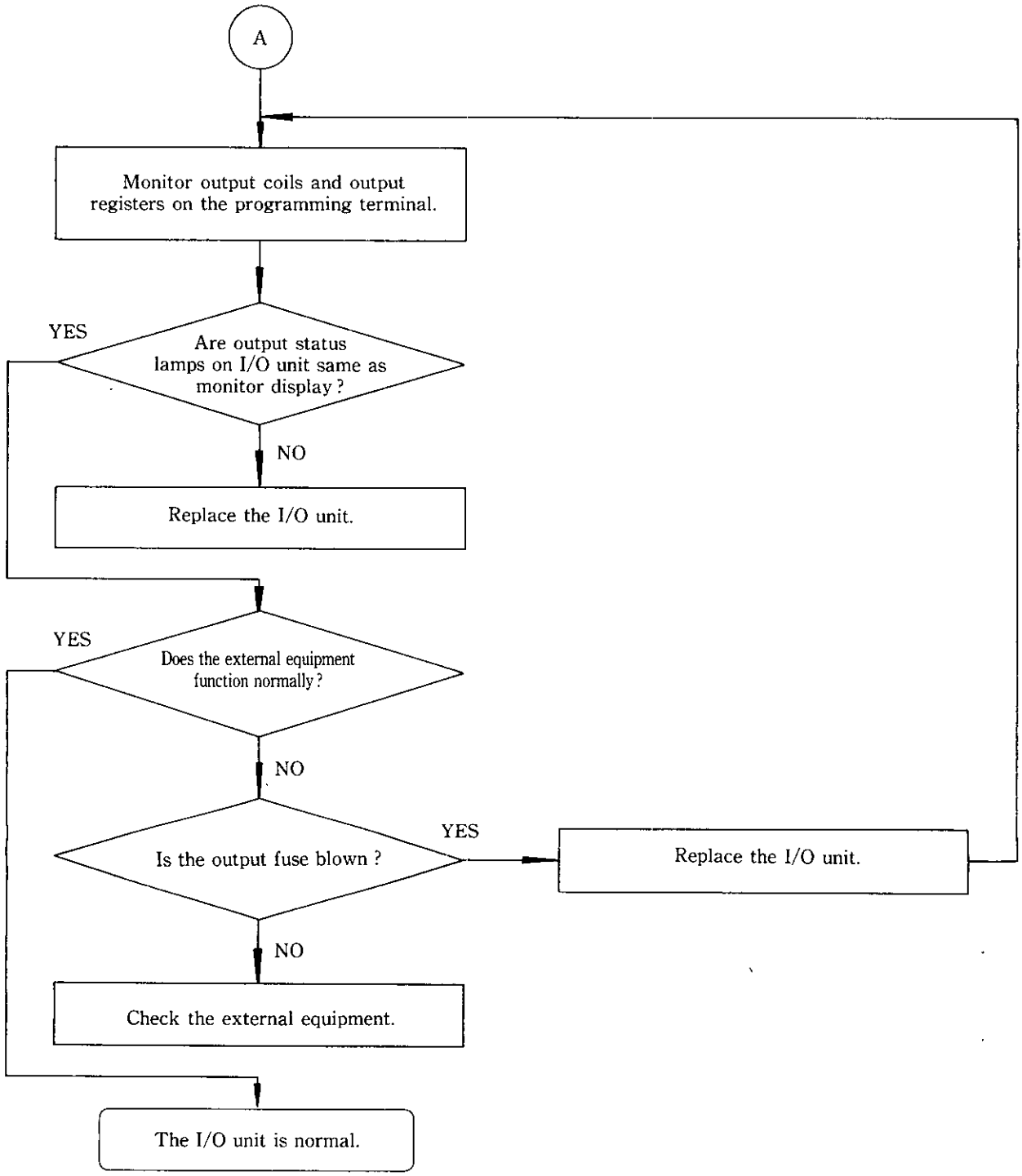


Fig. 5.7 I/O Unit Check Flow

(4) MC unit check

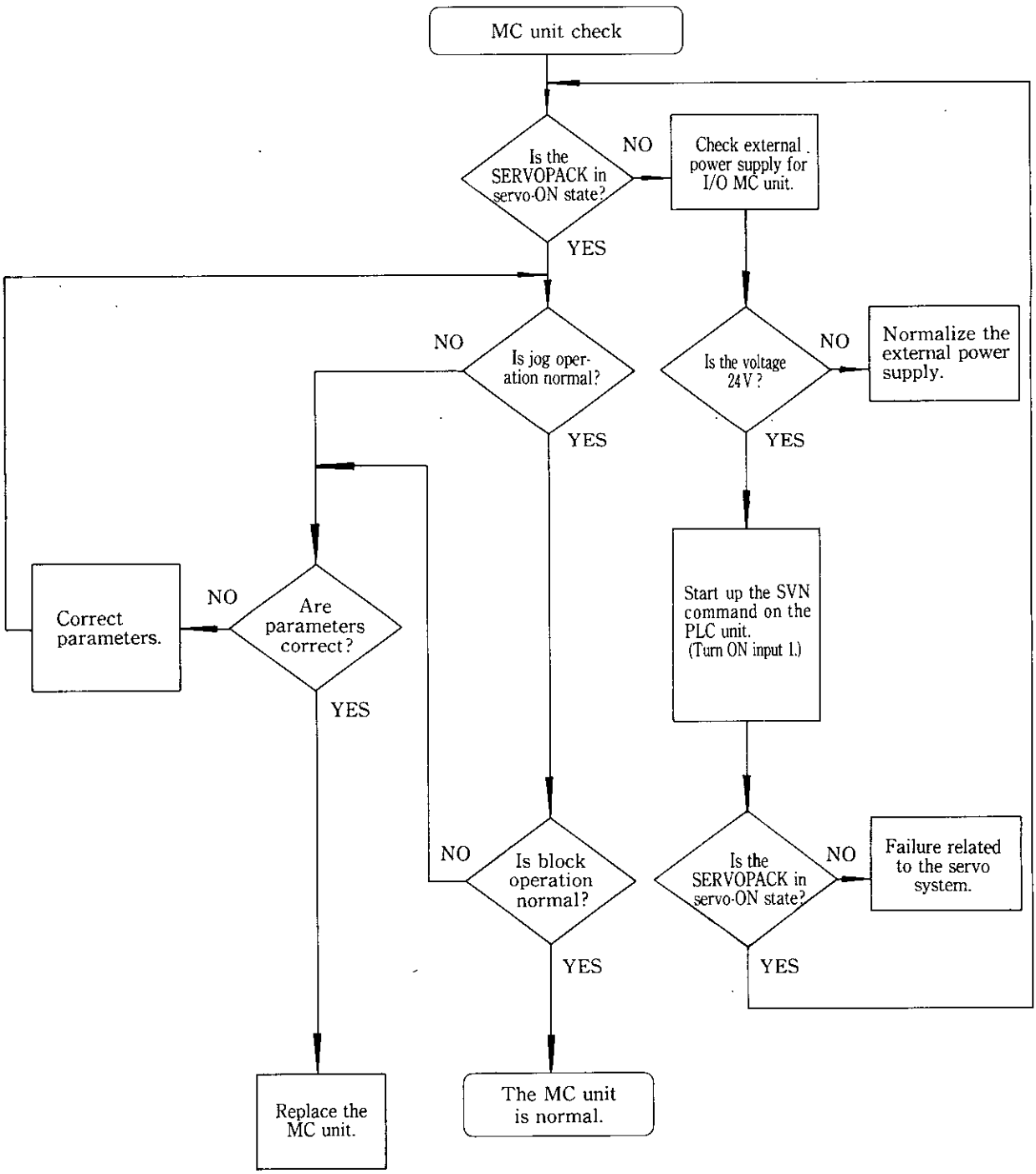


Fig. 5.8 MC Unit Check Flow

5.6 Maintenance and Inspection

This section also describes peripheral equipments.

5.6.1 Controller (PROGIC-8)

Since the PROGIC-8 uses reliable semiconductors, thereby eliminating contacts, special maintenance is not necessary. It is recommended to replace the battery in the PLC unit every second year.

5.6.2 AC SERVOMOTOR

The AC SERVOMOTOR has no wearable parts so that simple daily inspection is enough. Table 5.2 lists check items. The inspection periods in the table are for reference. Perform inspection at appropriate intervals depending on the operating environment and conditions. Never disassemble the motor. If it must be, contact your YASKAWA representative.

5.6.3 SERVOPACK

Since the SERVOPACK uses reliable semiconductors, thereby eliminating contacts, special maintenance is not necessary. Simply clean to remove dust and tighten screws.

Table 5.2 Inspection and Maintenance Procedure

Inspection and maintenance	Inspection period	Method	Remarks
Check for vibration and abnormal sound.	Daily	Touch and hear.	Must be free from fluctuations and increase compared to normal operation.
Check and clean external appearance.	When necessary.	Clean with cloth or compressed air.	
Measure insulation resistance.	Annually	Disconnect from the control panel. Check the terminals with a 500V megger. 10MΩ or higher is normal.	If the resistance is lower than 10MΩ, contact your YASKAWA representative.
Complete inspection.	20,000 hours or 5 years	Tear down to replace wearable parts and perform necessary maintenance work.	Contact your Yaskawa representative.
Replace the oil seal (if there is any).	5000 hours	Remove the motor from the machine and replace the oil seal.	

PROGIC-8

MULTIAXES MOTION CONTROLLER

SYSTEM HANDBOOK

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