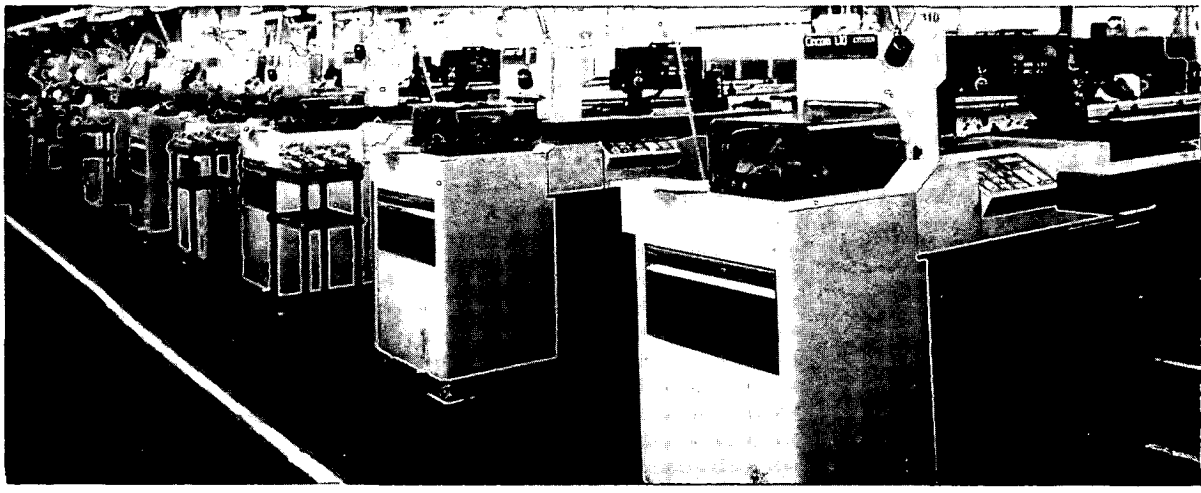
MOTIONPACK-110

YASKAWA MOTION CONTROLLER FOR FA/FMS

FOR UP TO 3-AXIS DRIVE



YASKAWA

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1. INTORODUCTION

With the increasing integration of FA and FMS concepts in manufacturing industries, the demand for flexible motion control systems for material handling, processing and fabricating is mounting.

As an automatic motion control method, numerical control (NC) has been in wide use, but NC has been rather exclusively developed for machine tools, and is not always convenient for use for diverse production activities.

The general purpose motion controller Motionpack-110 has been developed to offer a versatile and convenient means of controlling motions in FA and FMS applications.

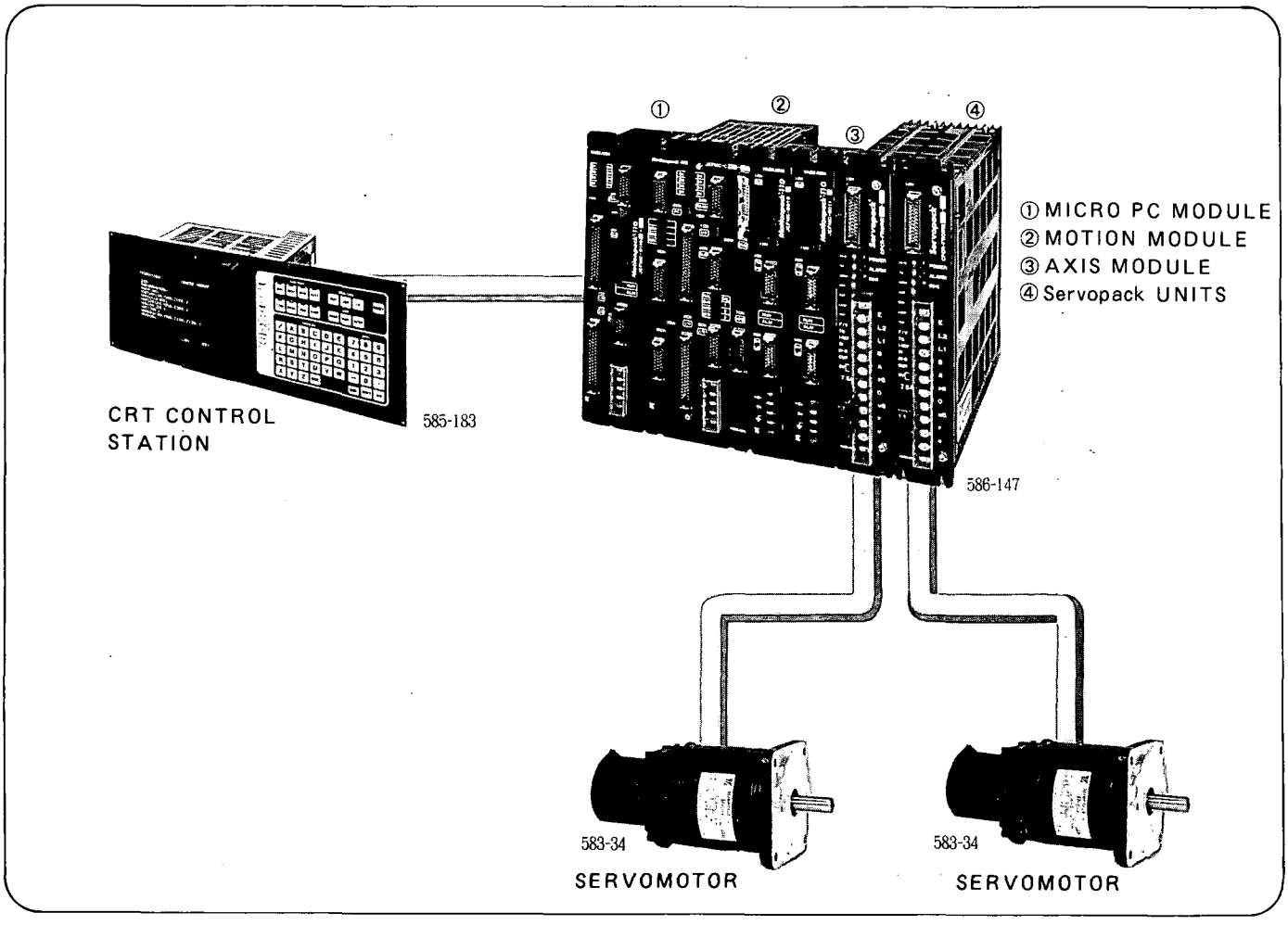
The main features of Motionpack-110 can be described as follows:

- Linear motions of up to 3 components and spindle speed are automatically controlled in combination.
- Diverse motion types such as involved in FA and FMS can be programmed easily.
- The motions can be controlled by personal computers.(DNC function)
- Logic control can be combined with motion control, by micro PC module.
- Building block design in the electro-mechanical composite configuration.

Motionpack-110 with these features is a very convenient and useful means for automatically and flexibly controlling the motions of material handling systems, processing machines and assembly lines.

This manual describes the configuration, programming, operation, and maintenance of motion control systems based on Motionpack-110.

Understanding the contents of this manual will enable you to take full advantage of the performance capabilities of Motionpack-110 in the composition of automatic systems and programs in your plan.



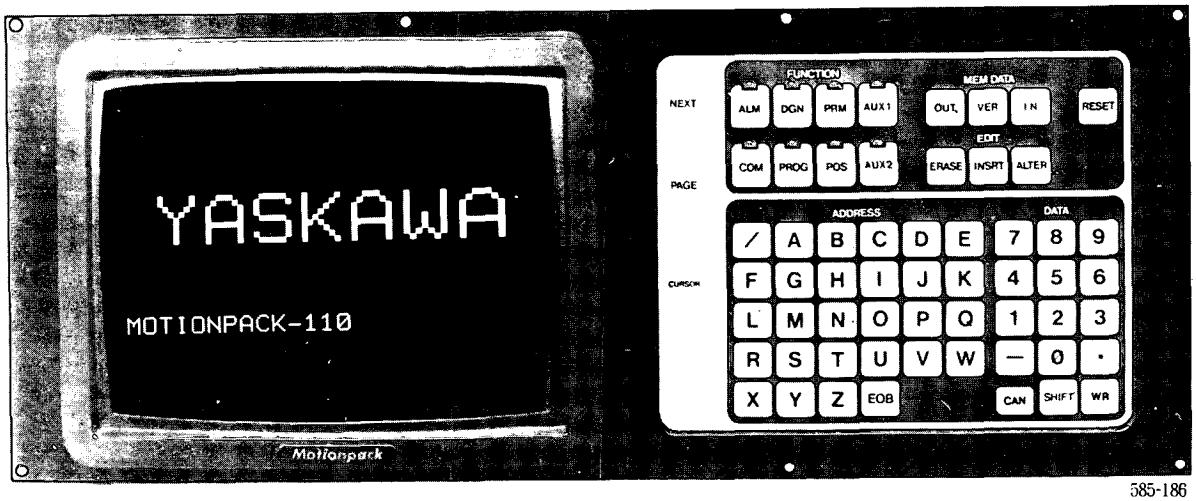
Simple Motion Control System
(Simple 2-Axis Positioning System)

NOTE

1. In this manual, we have endeavored to outline to the greatest extent possible accurate information on individual functions and associated functions. However, while functions that "can" be performed are finite, what "cannot" be performed or "must not" be attempted are virtually limitless. Therefore, things which are not explicitly described as possible should be considered to be impossible.

2. In this manual, one pulse is assumed to be 1 μm. For systems in which 1 pulse is not 1 μm, but 0.01 mm, 0.1°, etc., necessary conversions must be made.

3. The specifications in this manual are subject to change without prior notice.



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2. SYSTEM

2.1 GENERAL

Motionpack-110 is a general purpose controller that realized motion control in 1 to 3 axial directions spindle control and logic control with the use of functionally divided standard modules, and has the following features.

- The modules are individually available in the same way as with YASKAWA Servomotors. Users can easily configure their own systems by freely combining them.

- Motionpack-110 has ample motion control basic functions. Their combinations are easily implemented by programming, by parameters, by inputting from the CRT control station or by a personal computer.

- It uses the established machine tool NC language, supplemented by general industrial application functions.

- It can be connected to a host computer with RS422 transmission (RS232C is also possible) to configure hierarchical systems.

- Motionpack-110 offers enhanced motion control systems for material handling, processing, and fabricating. Because Motionpack-110 can be combined with a simple CAD system by DNC function, it allows part data from a master computer, such as a personal computer, to be received and perform motion control.

- Motion control including logic is available.

- Many types of YASKAWA general-purpose units for system composition are available for connection such as servo controllers, motors, and variable speed drives.

2.2 SYSTEM CONFIGURATION AND SPECIFICATIONS

System configurations of Motionpack-110 are shown in Fig. 2.1 and the specifications in Table 2.1.

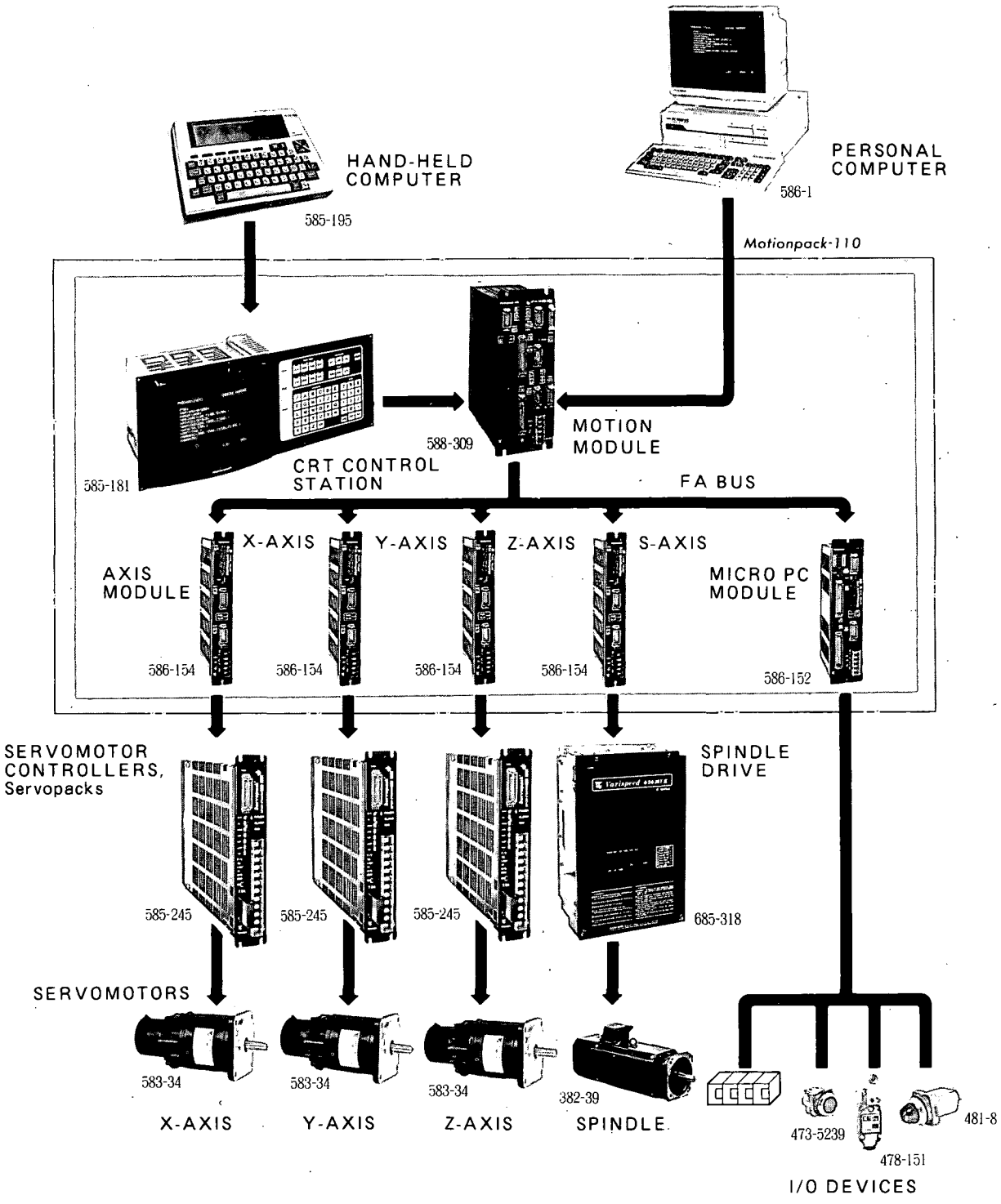


Fig. 2.1 Motionpack-110 System Configuration

2.2 SYSTEM CONFIGURATION AND SPECIFICATIONS (Cont'd)

Table 2.1 Motionpack-110 Specifications

(Mark ○ : available)

Functions	Specifications	Motion Module Type JEFMC-		
		C020	C023	C027
Controlled Axes	1 to 3 axes	○	○	○
Simultaneously Controllable Axes	• 3 axes for positioning	○	○	○
	• 2 axes for circular interpolation • 3 axes for linear interpolation	—	○	○
Spindle Control	Spindle speed command (S5-digit) analog output according to motion control.(Axis module and external power ±15 VDC are required.)	○	○	○
Least Output Increment	1 pulse	○	○	○
Max Programmable Dimension	± 99999999 pulses	○	○	○
Conversion of Input Increment Unit and Pulse	Enable	○	○	○
Feed Function	400 kpps max (at ×4)	○	○	○
• Rapid Traverse Rate	24 m/min max at 0.001mm/pulse	○	○	○
• Feedrate Setting	24 m/min max at 0.001mm/pulse	—	○	○
• Feedrate Override	At 25%, 50% or 100% of the feedrate or available between 10% and 200% (21 steps).	—	○	○
Automatic Acceleration/ Deceleration	• Linear and 2-stage linear acc/dec for positioning and manual feed.	○	○	○
	• Exponential for interpolation.	—	○	○
Operation Mode				
• Edit	Motion data programming	○	○	○
• Automatic				
MEM	Automatic operation by program stored in memory.	○	○	○
DNC	Automatic operation by program while receiving part data from the master computer.	—	—	○
• Manual				
STEP	Manual operation of preset distance : 3-stage setting of S, M and L (simultaneous 3-axis operation available).	○	○	○
JOG	Jog feed : 16-stage setting (simultaneous 3-axis operation available).	○	○	○
RAPID	Rapid traverse rate : 3-stage setting of 25%, 50% or 100% (simultaneous 3-axis operation available).	○	○	○
HANDLE	With up to 3-manual pulse generators, machine responds when pulse generator handle manually turned. Control only in the selected axial direction. Travel distance selection per graduation : Any one of 1, 10 or 100 pulses.	—	○	○
Reference Point Return :				
• Automatic Return	Automatic return to reference point (G 28).	○	○	○
• Manual Return	Simultaneous 3-axis return by JOG or RAPID.	○	○	○
Mechanical Handle	Operation by mechanical handle (simultaneous 3-axis operation available).	○	○	○
Single Block	Automatic operation block-by-block using external signals.	○	○	○

Table 2.1 Motionpack-110 Specifications (Cont'd)

(Mark ○ : available)

Functions	Specifications	Motion Module Type JEFMC-		
		C020	C023	C027
Optional Block Skip	Max 8 blocks skipped when optional skip signal ON.	○	○	○
Machine Lock	Execution of automatic operation program, with the machine standing still, using external signals.	○	○	○
Axis Omission	Only the desired axis can be freed from motion control and subject to an operation by program.	○	○	○
Soft Limit	Enable, ± direction from reference point.	○	○	○
External Reset	Enable by external input signal.	○	○	○
Emergency Stop	Enable by external input signal.	○	○	○
Start	Enable by external input signal.	○	○	○
Stop (Temporary)	Enable by external input signal.	○	○	○
Machine Ready	Enable by external input signal.	○	○	○
Compensation Function :				
• Backlash	Enable, 0 to 127 pulses.	○	○	○
• Pitch Error	Enable, 0 to ±127 pulses, 64 points for all axes.	○	○	○
Program :	NC (part) program in compliance with JIS* B 6313.			
• Program Number	O 0000 to O 9999. Up to 99 program numbers registered.	○	○	○
• Sequence Number	N 0000 to N 9999. Block number.	○	○	○
Calling in Programming	Calling and execution from any blocks of programming.	○	○	○
Motion Control :				
• Positioning	Max simultaneous 3 axes.			
	• Error detect ON mode (G 00).	○	○	○
	• Error detect OFF mode (point-to-point control available) (G 06).	○	○	○
• Linear Interpolation (Optional)	Max simultaneous 3 axes (G 01).	—	○	○
• Circular Interpolation (Optional)	Max simultaneous 2 axes.			
	• Clockwise (G 02)	—	○	○
	• Counterclockwise (G 03)	—	○	○
	Circular radius and circular radius coordinate designation enable.			
• Dwell	0.001 to 99999.999 s (G 04).	○	○	○
• Offset Value Input	Direct input of offset value in program (G 10).	○	○	○
• Plane Designation	Designation of plane for making circular interpolation (G 17, 18, 19).	—	○	○
• Automatic Return to Reference Point	Returning to reference point automatically (G 28).	○	○	○
• Skip	Program advanced to next block when skip signal ON (G 31). → (G 01)	—	○	○
• Position Offset	• Z-axis (G 43, G 44, G 49)	○	○	○
	• X-, Y-axis (G 45 to G 48)	○	○	○
• Machine Coordinate System Setting	Temporary motion on machine coordinate system (G 53).	○	○	○
Absolute/Incremental Programming	Movement data designated as to whether absolute or incremental value.			
	• Absolute (G 90)	○	○	○
	• Incremental (G 91)	○	○	○
• Programming of Absolute Zero Point	Designation of position of "absolute zero point" (G 92).	○	○	○

* Japanese Industrial Standard.

Table 2.1 Motionpack-110 Specifications (Cont'd)

(Mark ○ : available)

Functions	Specifications	Motion Module Type JEFMC-		
		C020	C023	C027
Combined Operation Command (Optional) :				
• Drilling Cycle	A drilling operation can be expressed with one command (G 81).	—	○	○
• Spot Facing Cycle	A drilling operation including spot facing can be expressed with one command (G 82).	—	○	○
• Deep Hole Drilling Cycle	A drilling operation including pecking can be expressed with one command (G 83).	—	○	○
• Tapping Cycle	A tapping operation can be expressed with one command (G 84).	—	○	○
• Boring Cycle 1	A boring operation can be expressed with one command (G 85).	—	○	○
• Boring Cycle 2	A boring operation including a spindle control can be expressed with one command (G 86).	—	○	○
• Boring Cycle 3	A boring operation including a dwell can be expressed with one command (G 89).	—	○	○
• Return ro Initial Point (Part Ready Point)	Z axis returning position designation at the end of combined operation (G 98).	—	○	○
• Return to R Point (Part Start Point)	Z axis returning position designation at the end of combined operation (G99).	—	○	○
• Cancel	The above combined operations are cancelled (G 80).	—	○	○
Notch Signal:	Selection of specifications A or B.			
• Specifications A	• When the specified point is reached during positioning operation, an 8-point signals is output at low speed. (G68)	○	○	○
	• Notch signal output reset by G68. (G69)	○	○	○
• Specifications B	• A 1-point high speed notch single. (G66)	○	○	○
	• A 1-point low speed notch signal. (G67)	○	○	○
Unrestricted Length Positioning	Used to control the machine that continually repeats motion in the same direction.	○	○	○
Position Memory	Retained the current value display (only axis position) on previous turning OFF of the power.	○	○	○
Position Cancel	By keying from the CRT control station, the current position can be indicated as 0.	○	○	○
Decimal-point Movement Indication	The decimal point position on the screen can be changed to the desired place.	○	○	○
Signal Output :				
• Miscellaneous (M) Functions	M2-digit/M2-digit BCD output to external devices.	○	○	○
	• Program stop (M 00).	○	○	○
	• End of program (M02).	○	○	○
	• Return to program head after end of program (M 30).	○	○	○
	• Subroutine program call (M 98).	○	○	○
	• Subroutine program end (Return to main program) (M 99).	○	○	○
• Tool (T) Functions	T2-digit/T2-digit BCD output for tool selection.	○	○	○
Advance Reading Function	One block read in advance.	○	○	○
Memory Capacity	5k bytes (standard) or 64k bytes (optional).	5kB	64kB	64kB
Communication Function Personal Computer ↔ Motion Module	Program and parameter transmissions, diagnostic (machine) monitoring signal transmission, commands.	○	○	○
Micro PC (Programmable Controller) Function	The logic control is available for external I/O devices by Micro PC Module.	○	○	○

2.3 FUNCTIONS AND OPERATION OF MODULES

The operation of the component modules of Motionpack-110 are as follows:

2.3.1 OPERATION OF MOTION MODULES

The motion modules serve as the key to the control of the Motionpack-110 systems, and incorporate an 8-bit microcomputer. They read the parameters and programs when they are input from the CRT control station or from a personal computer. When a start signal is received, they analyze the program, generate position data, and control up to 3 axis and a spindle modules via an FA bus.

They also receive position data, alarm, and status signals from the axis modules via the FA bus, analyze them, and transmit them to the CRT control station and personal computer for display. They also process input/output signals. The motion module is communicated with a micro PC module via the FA bus, as well.

The control block diagram of motion modules is given in Fig. 2.2. Expansion memories and interpolation units are optionally available.

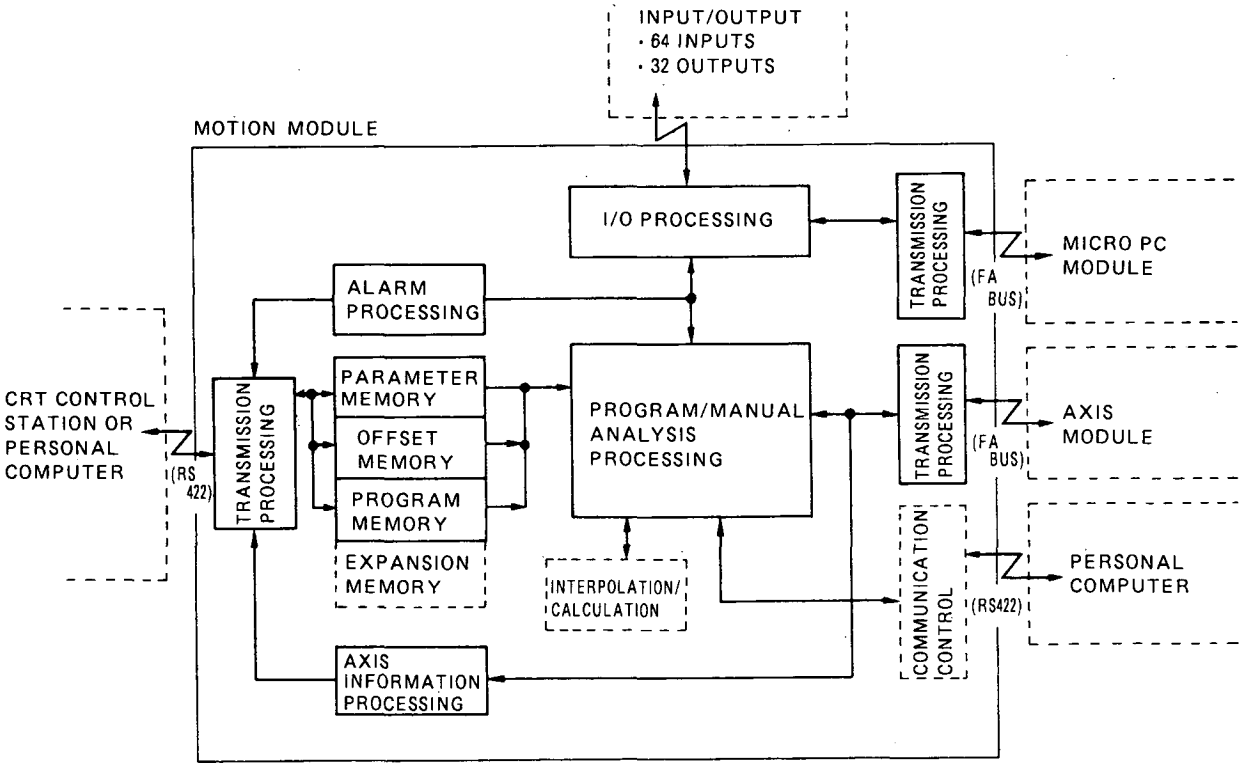


Fig. 2.2 Control Block Diagram of Motion Module

2.3.2 OPERATION OF AXIS MODULES

Axis modules are units each of which controls motion along one axis. They each incorporate an 8-bit microcomputer, read and analyze the position data from the motion modules and external signals, and output speed commands to the Servopack to accomplish the desired motor motions.

They output position data, alarm and status signals as answer-back data for transmission to the motion modules.

(1) Fig. 2.3 shows the axis module control block diagram. The axis modules generate command positions and inputs the data to the error register. The signals generated by the PG and processed into pulses are fed back to the error register as current position signals, so that the contents always represent the current position error. The position error signals are converted into pulse width in the PWM circuit, futher converted into analog voltage signals by the D/A conversion circuit, and output to the Servopack as speed command voltages. When the position destination is reached, the contents of the error register become zero, and the speed command becomes 0V.
During the control process, the contents of the error register are checked for excess error, etc., and when an abnormal state is detected, alarm processing is executed.

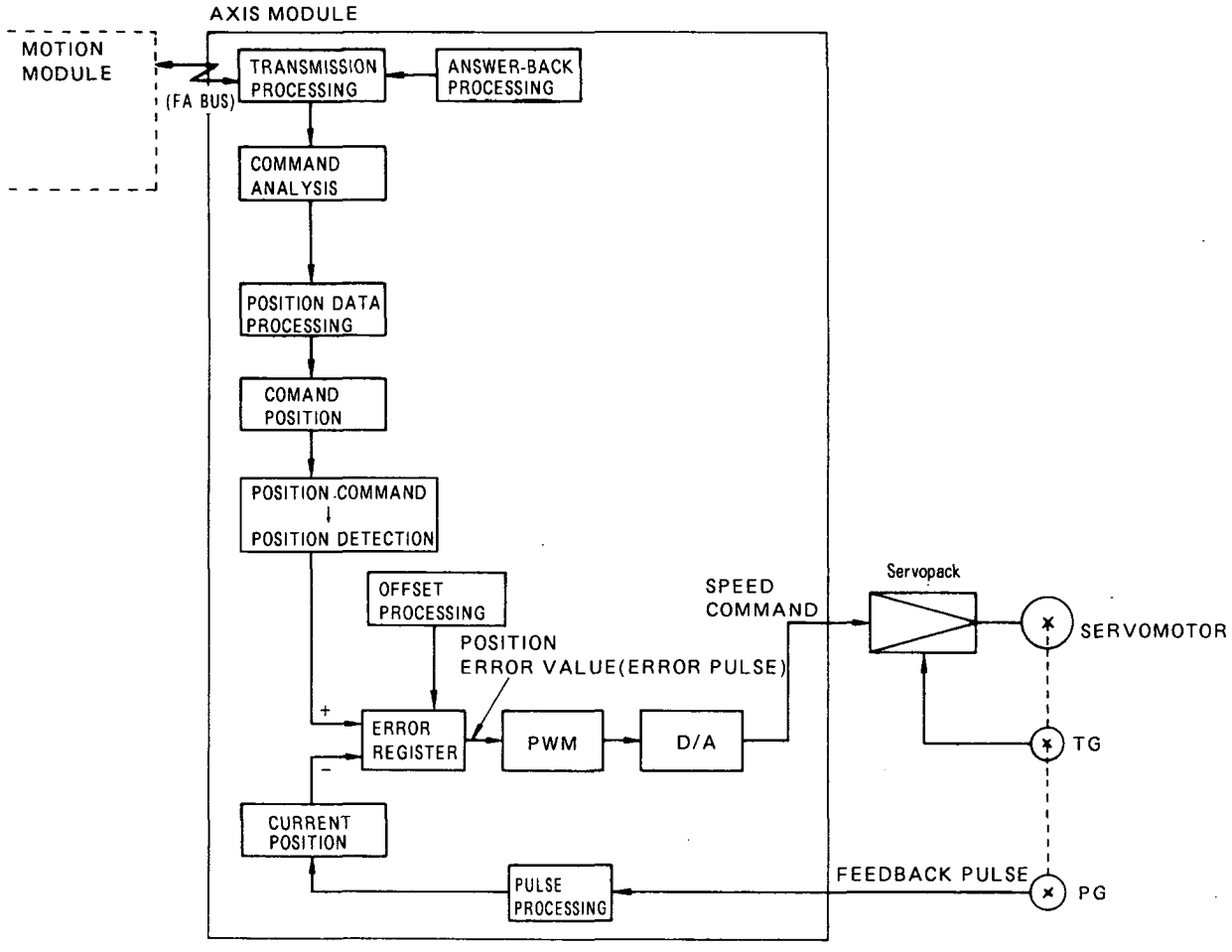


Fig. 2.3 Control Block Diagram of Axis Module
(For Axis Control)

(2) The axis module can be used for spindle control by setting a selection switch. In this case, speed reference analog voltage is output by a reference from the motion module. Fig. 2.4 shows the axis module control block diagram for spindle control.

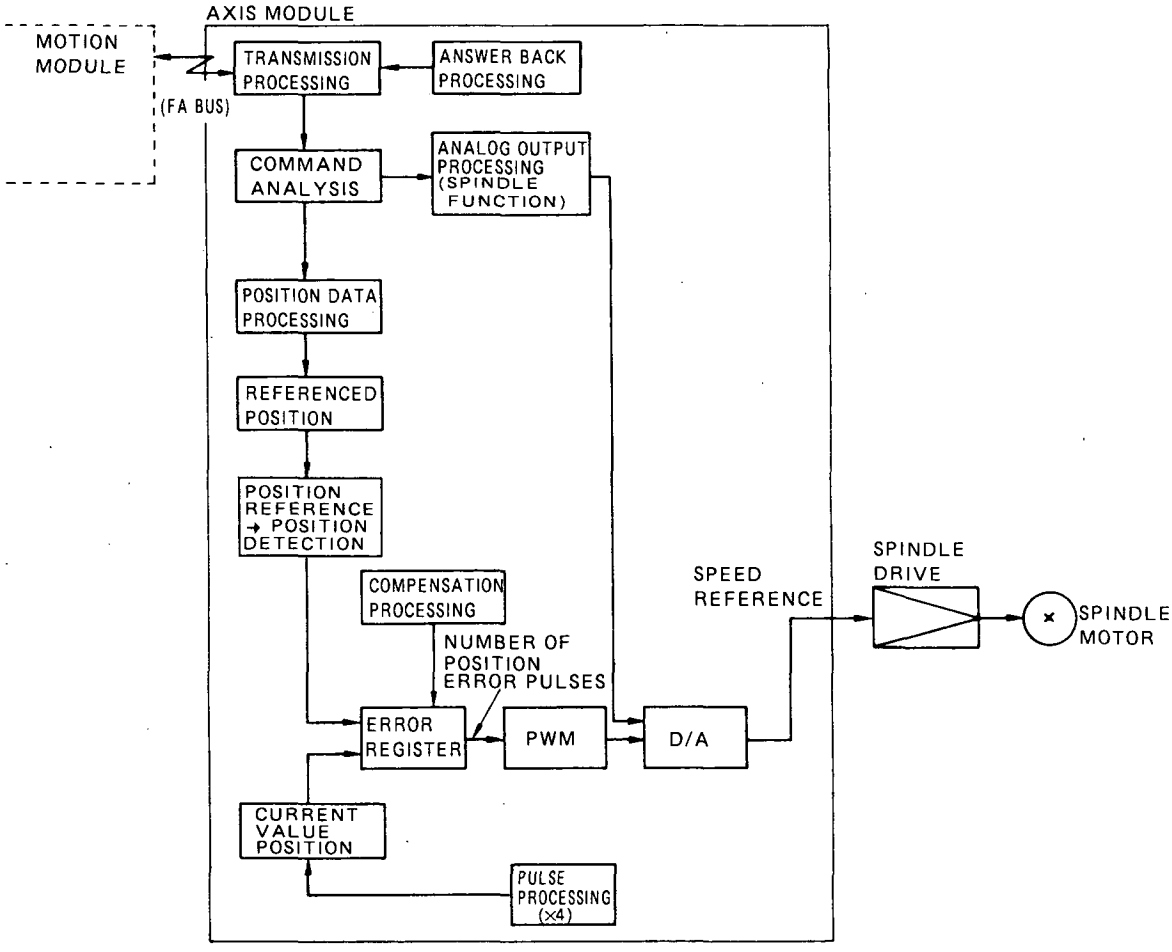


Fig. 2.4 Control Block Diagram of Axis Module (for Spindle Control)

2.3.3 OPERATION OF MICRO PC MODULES

Micro PC module performs a logic control related to total control in Motionpack-110 system. Use of the micro PC module allows expansion I/O (64-input/32-output points) to increase in addition to standard I/O (64-input/32-output points). To change over standard I/O for expansion I/O, alternation of I/O allocation is required. Changing over in the unit of 1 bit is available.

For programming a ladder diagram or monitoring, connect a personal computer (PC8201) to RS-422 port of the micro PC module.

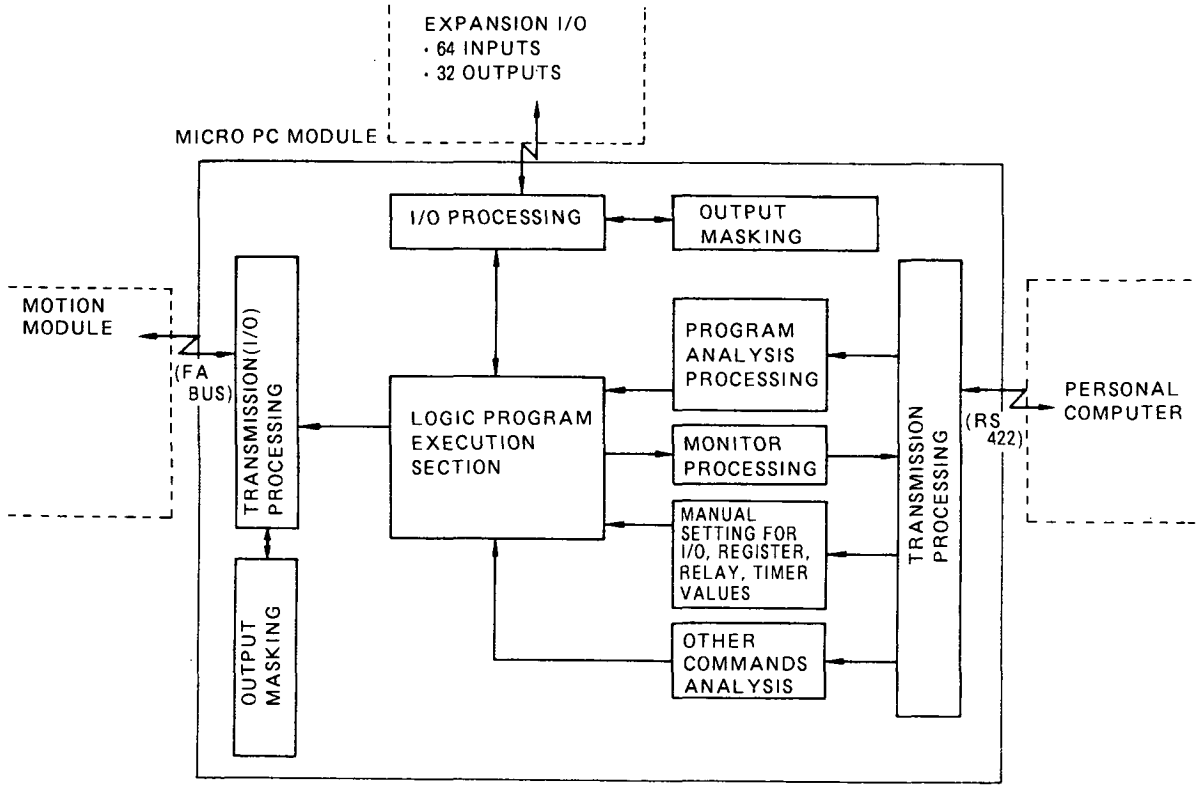


Fig. 2.5 Control Block Diagram of Micro PC Module

2.3.4 OPERATION OF CRT CONTROL STATION

This CRT control station is for formulating and editing programs, displaying the system operation state and position data. It incorporates an 8-bit microcomputer, and exchanges data with the motion module via a serial interface port. It uses a 9-inch CRT, and the maximum character display capacity is 32×16 lines. Data input from the keyboard is transmitted to the motion module via the serial interface port.

(1) Items Transmitted to Motion Module:

- Programming
- Collecting, editing, displaying, calling-up and storing of program
- Displaying, writing and altering of parameter
- Displaying, writing and altering of offset

(2) Items Transmitted from Motion Module:

- Displaying system operating status (alarm, I/O signal status, commands)
- Displaying current value

2.4 GENERAL SPECIFICATIONS OF MODULES

(1) General Specifications of Motion Module, Axis Module and Micro PC Module

Table 2.2 General Specifications of Motion, Axis and Micro PC Modules

Items	Specifications
Power Supply	4.75 to 5.25 VDC
Consumed Current	Motion module: 3 A (including lithium battery*)
	Axis module: 0.5 A
	Micro PC module: 1 A (including lithium battery*)
Holding Time	10 ms
Ambient Temperature	0 to +55℃ (excluding peripheral devices)
Storage Temperature	−20℃ to +85℃ (excluding lithium battery)
Humidity	5 % to 95 % relative (non-condensing)
Vibration-Resistance	In compliance with JIS† C0911 (excluding peripheral devices)
Shock-Resistance	In compliance with JIS† C0912 10G max (excluding peripheral devices)
Environmental Condition	Free from explosive, inflammable, corrosive gases
Grounding	Grounding resistance: 100 Ω or less
Dielectric Strength	1500 VAC for 1 minute
Insulation Resistance	100 MΩ or more at 500 VDC (between FG and 0V)
Noise Immunity	1500 Vp-p, pulse width: 1 μs
Weight	Motion module: 2.8 kg
	Axis module: 0.7 kg
	Micro PC Module: 1.3 kg (including lithium battery)

* Lithium battery: Type JZFMZ-BA01, 3V 1.2AH, with holder, connector and lead
† Japanese Industrial Standard

2.4 GENERAL SPECIFICATIONS OF MODULES (Cont'd)

(2) General Specifications of CRT Control Station

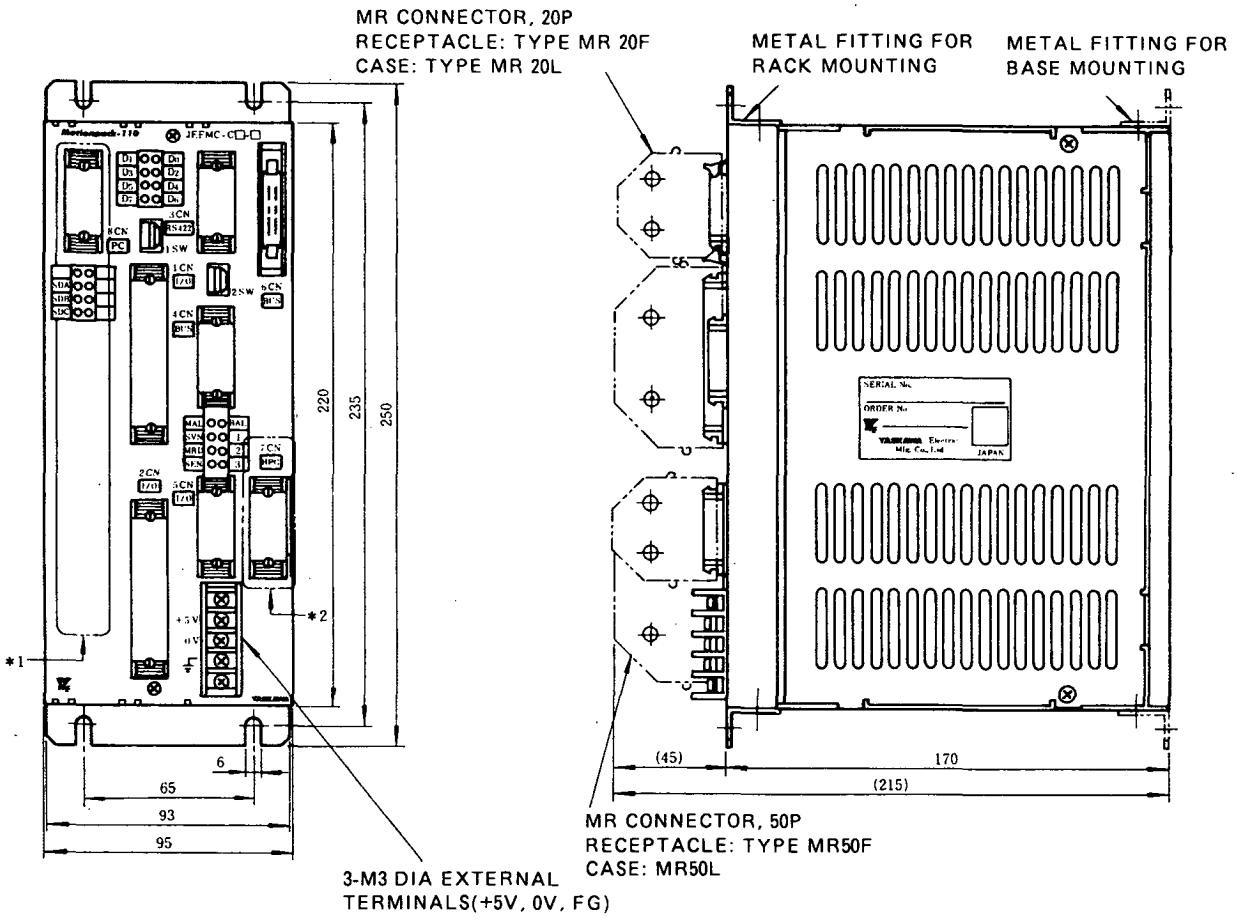
Table 2.3 General Specifications of CRT Control Station

Items	Specifications
Power Supply	85 to 120 VDC, 50/60 Hz
Consumed Current	0.5 A
Holding Time	10 ms
Ambient Temperature	0 to +55℃ (excluding peripheral devices)
Storage Temperature	−20℃ to +85 ℃ (excluding lithium battery)
Humidity	5 % to 95 % relative (non-condensing)
Vibration-Resistance	In compliance with JIS* C 0911 (excluding peripheral devices)
Shock-Resistance	In compliance with JIS* C 0912 10G max (excluding peripheral devices)
Environmental Condition	Free from explosive, inflammable, corrosive gases
Grounding	Grounding resistance: 100 Ω or less
Dielectric Strength	1500 VAC for 1 minute
Insulation Resistance	100 MΩ or more at 500 VDC
Noise Immunity	1500 Vp-p, pulse width: 1 μs
CRT	9", 32 characters ×16 lines
Keyboard	Flat keyboard (function, numeric, edit and cursor keys)
Communication Port	RS422 port ×2
Weight	6 kg

* Japanese Industrial Standard

(3) Dimensions of Modules in mm

(a) Motion Module
Type JEFMC-C02 □



Note:
1. This drawing shows a motion module, type JEFMC-C027. Differences between above module and other motion modules are as follows:

Type JEFMC–	Difference
C020	Not provided with *1 and *2.
C023	Not provided with *1.
C027	The same as diagram above.

2. Specified cable: Type JEFMC–W084

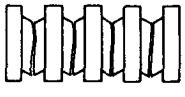


Fig. 2.6 Motion Module

(b) Axis Module
Type JEFMC-B011

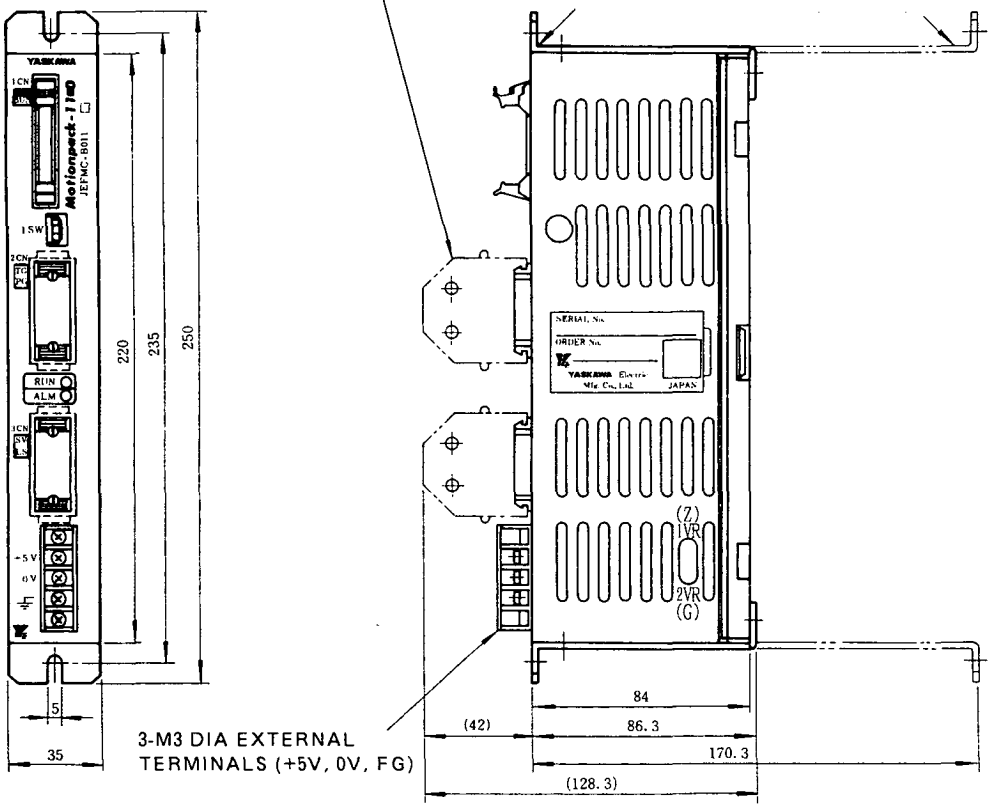


Fig. 2.7 Axis Module

(c) Micro PC Module
Type JEFMC-B110

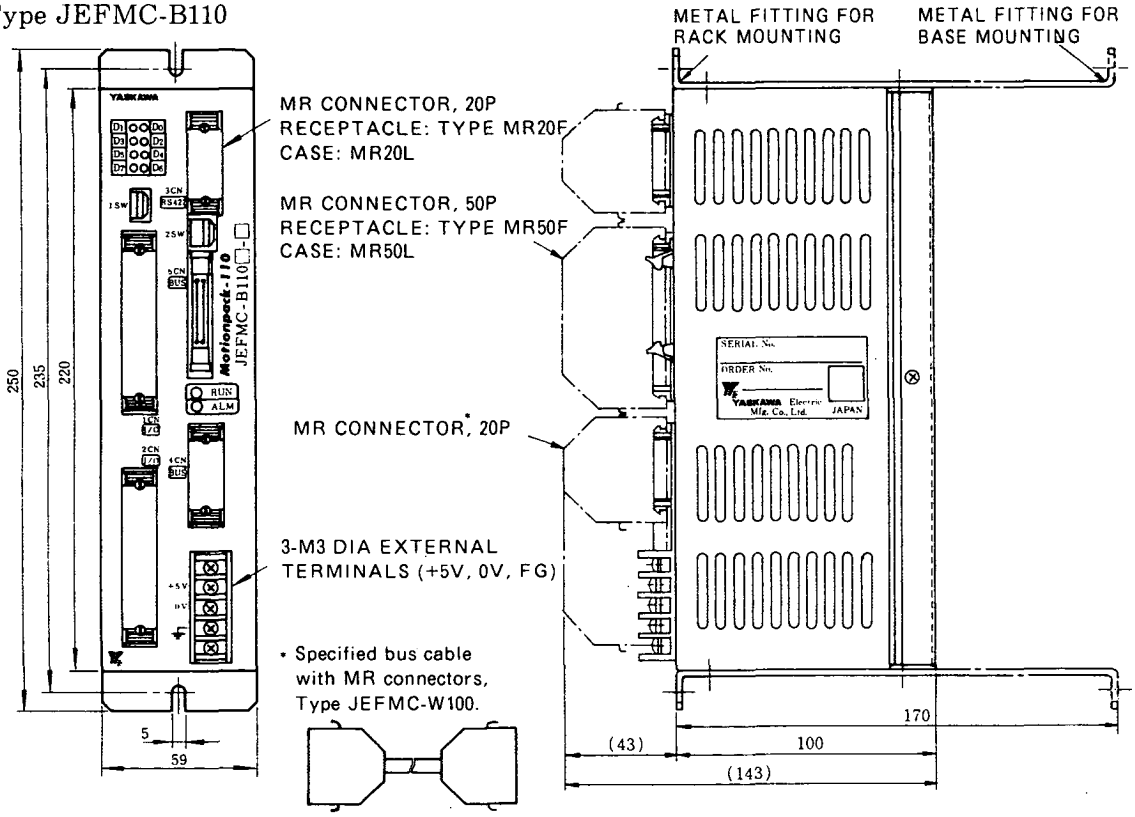


Fig. 2.8 Micro PC Module

(d) CRT Control Station
Type JEFMC-H011

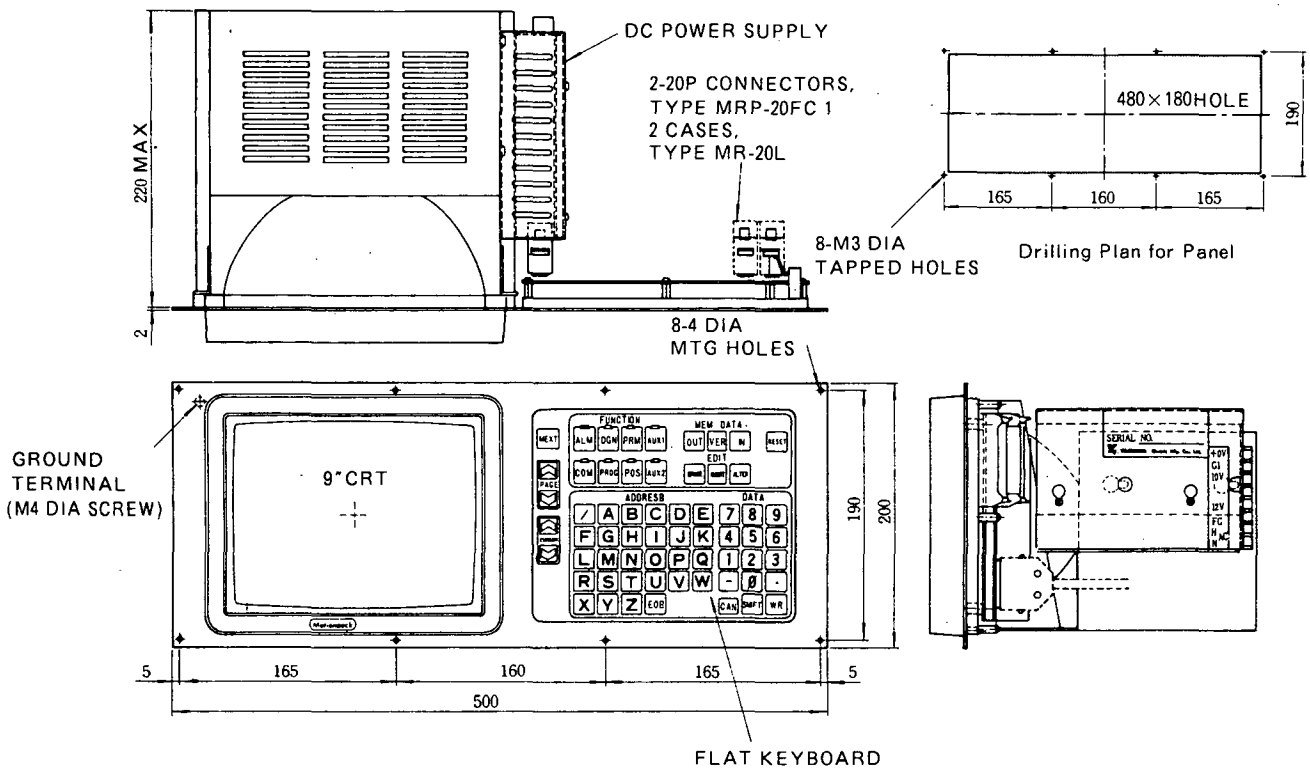


Fig. 2.9 CRT Control Station

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3. FUNCTIONS

3.1 TYPES OF OPERATION MODES

Motionpack-110 has the following 8 types of operation modes:

(1) Editing Mode (EDIT)

(2) Memory Operation Mode (MEM)·····Automatic operation

(3) Jogging Mode (JOG)·····Manual operation

(4) Step Operation Mode (STEP)·····Manual operation

(5) Rapid Feed Motion (RAPID)·····Manual operation

(6) Manual Feed Mode (HANDLE)·····Manual operation

(7) DNC Operation Mode (DNC)·····DNC automatic operation

(8) MDI Operation Mode (MDI)·····Automatic operation (with CRT control station Type H012)

These modes are selected by external input signals EDIT, MEM, JOG, STEP, RAPID, HANDLE, DNC, and MDI.

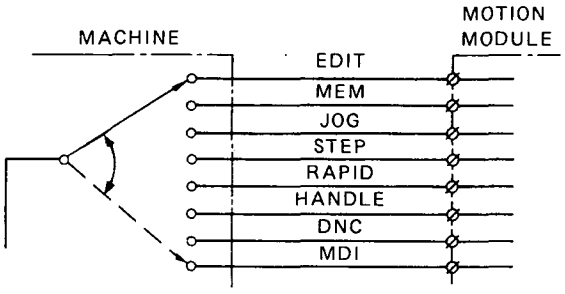


Fig. 3.1

3.1.1 EDITING MODE (EDIT)

This mode is used when writing and reading programs and parameters in the memory in the motion module, or doing other editing operations. These editing operations are executed from the CRT control station or from a personal computer, as detailed in Section 7 "OPERATION OF CRT CONTROL STATION" or Section 8 "PERSONAL COMPUTER".

3.1.2 MEMORY OPERATION MODE (MEM)

In this mode, the system automatically operates under the control of the program stored in the memory of the motion module. Interpolation operation requires feedrate override signals (OV1 to OV8). For details, refer to Para. 3.5 "MEMORY OPERATION".

3.1.3 JOGGING MODE (JOG)

In this mode, the machine is manually controlled in motion. While a JOG signal (e.g. +JX: +direction of X-axis, -JX:−direction of X-axis) is ON, the machine slide moves in the specified direction at the specified feedrate, and when the signal is turned off, it stops after deceleration.

The feedrate is set at 16 stages max by jog feedrate selection signals (JOV1 to JOV8) and parameters, #1104 to #1118. Simultaneous 3-axis operation is available, and the same feedrate applies to all the three axes.

3.1.4 STEP OPERATION MODE (STEP)

This mode is selected when the machine slide is to be manually driven in steps, that is, each time a JOG signal is turned on, the slide of the designated axis moves through one step. The distance covered by a step can be set at three levels by step multiplier signals (MP1, MP2) and parameters (#1122, #1123, #1124). The feedrate is the same as for jogging. Simultaneous 3-axis operation is available, and the same feedrate and step distance apply to all the axes.

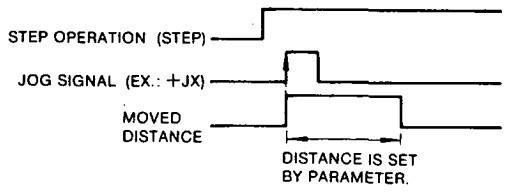


Fig. 3.2 Step Operation

3.1.5 RAPID TRAVERSE MOTION MODE (RAPID)

This mode is used to move the machine manually at a rapid feedrate. While a JOG signal is on, the slide of the axis of the JOG signal moves in the specified direction at the selected feedrate, and when the signal is turned off, it stops after deceleration. The feedrate can be selected by rapid feed override signals (ROV1 to ROV3) from three levels: 100%, 50%, and 25%, with the 100% feedrate specified by parameters (#1500, #1700, #1900). Simultaneous 3-axis operation is available, and the 100% feedrate is set separately for each axis.

3.1.6 MANUAL FEED MODE (HANDLE)

This mode is for manually controlling the feed motion with a manual dial. In this mode, as the manual dial is turned CW or CCW, the machine moves in a positive or negative direction.

The distance to be covered by the slide per dial graduation is selected from three levels: ×1, ×10, and ×100, by an external input signal (MP1, MP2).

3.1.6 MANUAL FEED MODE (HANDLE) (Cont'd)

Simultaneous 1-axis or 3-axis handle operation can be selected by setting the parameter #1002 D6. For simultaneous 1-axis handle operation, one handle is changed by using the axis change signal (HX for the X axis, HY for the Y axis, or HZ for the Z axis).

For simultaneous 3-axis handle operation, the three handles may be operated separately. In addition, only the handle of the axis specified by using the axis change signal (HX for the X axis, HY for the Y axis, or HZ for the Z axis) can be made effective. See 9.2.2.

3.1.7 DNC OPERATION MODE (DNC)

This mode is selected for the host computer to operate Motionpack-110 DNC.

Automatic operation under motion control is performed while travel data is being received from the host computer.

3.1.8 MDI OPERATION MODE (MDI)

This mode is selected to operate automatically for programs which are in one block specified from the CRT control station. The specified programs are not stored in the memory of Motion module.

NOTE

This mode is available for Motionpack−100 with CRT control station, on and after type JEFMC-H012.

3.2 MANUAL RETURN TO REFERENCE POINT

With the Motionpack-110 system, the machine reference point is used as the system reference ponit, and the system can be brought to this reference point from various positions as described below.

When the power is turned off, the reference point data is deleted, and it must be reset after the power supply is turned on again. Usually, a pulse generator with a zero-point pulse and a limit switch for indicating the reference point area are used to determine the reference point.

The motion to return to the reference point is started when a JOG signal towards the reference ponit (i.e., +JX or −JX) is turned on while an external reference return (ZRN) signal is on in the JOG or RAPID mode.

When the machine returns to the reference point, it stops, the axis coordinate data becomes "0", and a "return-to-reference point" signal (ZPX, ZPY, or ZPZ for X-, Y-, or Z-axis, respectively) is output.

Table 3.1 shows the signals related to the return-to-reference point operation.

Table 3.1 Signals Related to Return-to-Reference Point

Type of Motion \ Signal State	Input Signal						Output Signal		
	Mode		Return-to-Reference Point	Start			Completion		
	JOG	RAPID	ZRN	+JX/−JX	+JY/−JY	+JZ/−JZ	ZPX	ZPY	ZPZ
X-axis Return-to-Reference Point	ON	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
	OFF	ON							
Y-axis Return-to-Reference Point	ON	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
	OFF	ON							
Z-axis Return-to-Reference Point	ON	OFF	ON	OFF	OFF	ON	OFF	OFF	ON
	OFF	ON							

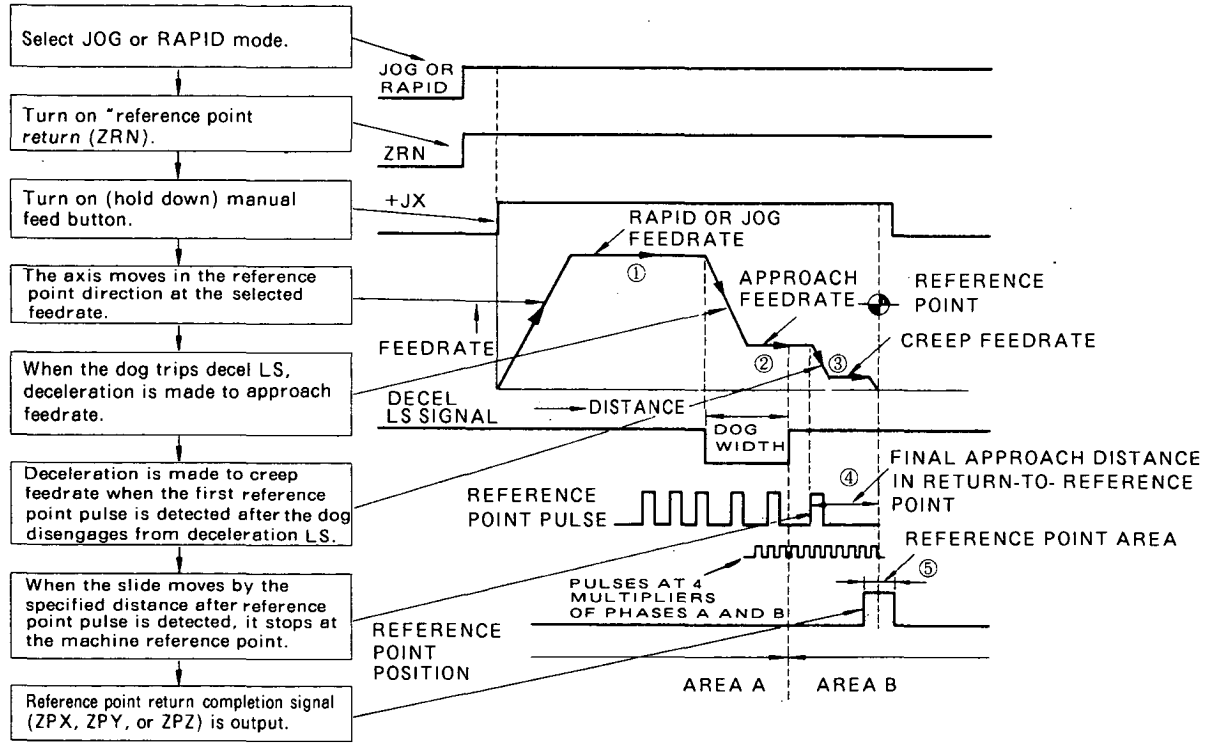


Fig. 3.3 Return-to-Reference Point Motion

When the JOG signal is turned on, the machine slide returns to the reference point as follows:

① The slide starts to move towards the reference point at the feedrate for the selected mode (JOG or RAPID). The motion direction is the one set by the parameter (#1403, #1603, #1803).

② When the dog trips the deceleration LS, the speed is reduced to the approach feedrate, which has been set by the parameter (#1504, #1704, #1904) in advance.

③ When the dog moves away from the deceleration LS, and the first reference point pulse is detected, the slide further decelerates to the creep feedrate, which has been preset by a parameter (#1505, #1705, #1905).

3.2 MANUAL RETURN TO REFERENCE POINT (Cont'd)

④ When the slide travels through the preset final approach distance, after detecting the first reference point pulse, it stops, and the stop position is taken as the machine reference point which is also taken as the system reference point. The final approach distance has been set by a parameter (#1556, #1756, #1956) in advance.

⑤ When the slide comes to rest at the reference point, a signal for indicating the return-to-reference point (ZPX, ZPY or ZPZ) is output. The reference point area has been preset by a parameter (#1125) in advance.

NOTE

1. The return-to-reference motion takes place in principle, regardless of the position of the machine slide when the power supply is turned on again. However, when the slide is in area B (see Fig. 3.3), it cannot return correctly. In this case, as overrun may occur, it must be moved into area A before starting the return motion.

2. The dog width must be at least long enough for the feedrate to decelerate to the approach feedrate.

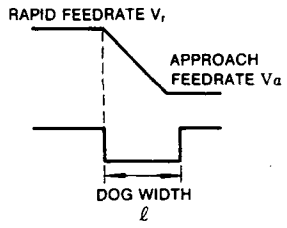


Fig. 3.4

Required dog width (L) is calculated roughly as follows:

When Vr = rapid feedrate

α = 1st accel/decel constant

Then, $l = \frac{1}{2} \cdot \frac{Vr^2}{\alpha}$

3. For the return to the reference point in the memory operation mode, refer to Par. 4.2.9 "AUTOMATIC RETURN-TO-REFERENCE POINT (G28)".

3.3 FEEDRATE

3.3.1 RAPID TRAVERSE RATE

The rapid feedrates are used in positioning (G00) and manual rapid feed (RAPID). The traverse rates differ among the three axes since they are determined by the machine. The basic rapid traverse rates can be reduced by override setting to L, M or H.

Since the machine slides move at different speeds, the resultant motion of the three slides is not a straight line. The upper limit of the rapid traverse rate is 24,000 mm/min.

3.3.2 INTERPOLATION FEEDRATE SETTING (F-FUNCTION)

(1) Five digits following F designate feedrates in mm/min.

(2) The feedrate in the following range can be programmed by an F-program.

Format	Command Range
F5	F1 to F24000 mm/min

Note: A decimal point cannot be used to enter F. If it is entered with a decimal point, an alarm occurs.

(3) The upper limit of the feedrate may be restricted by the servo system and machine system. In this case, the upper limit is set by parameter #1102, so that even when an F-command specifies a value above this limit, the feedrate is fixed at the set upper limit.

(4) The F-command for a linear or circular interpolation by two slides moving in combination, gives feedrates in a tangential direction.

(Example 1)
G90 (absolute designation)
G01 X1200 Y900 F500 ;

With the above command :

$F = 500 = \sqrt{400^2+300^2}$ (mm/min)

- $\sqrt{400^2+300^2}$ └ Y-AXIS ELEMENT
- └ X-AXIS ELEMENT

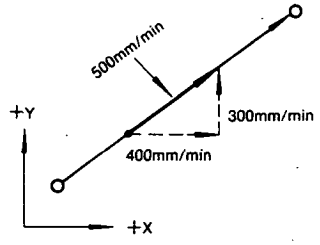


Fig. 3.5

(Example 2)
Where, G03X ··· Y ··· I ··· F200 ;

$F = 200 = \sqrt{fx^2+ fy^2}$ (mm/min)

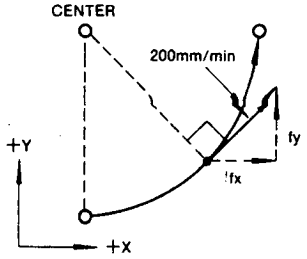


Fig. 3.6

(5) F-commands for linear interpolations involving motions in simultaneously controlled three-axial directions specify feedrates also in the direction tangent to the motion path.

(Example)
Where, G01X···Y···Z···F400 ;

$F = 400 = \sqrt{fx^2 + fy^2 + fz^2}$ (mm/min)

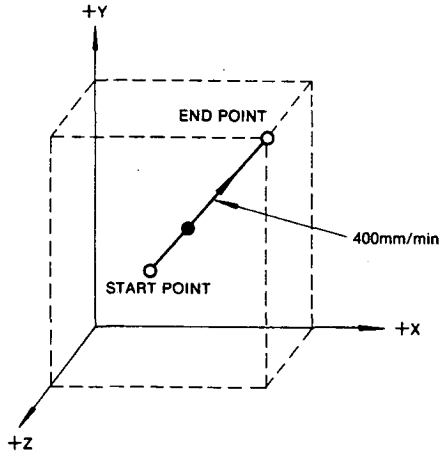


Fig. 3.7

(6) The feedrates specified by an F-command can be executed at three levels: L (25%), M (50%) or H (100%), selectively specified by external signals.

NOTE

1. When an interpolation command is programmed, a feedrate command must also be programmed.

2. Do not program a minus F-commmand.

3.4 FEEDRATE ACCELERATION/DECELERATION

For rapid traversing and interpolation feed motions, the system applies the respective automatic acceleration and deceleration.

3.4.1 ACCELERATION/DECELERATION DURING RAPID TRAVERSE AND JOGGING

During the following operations, linear automatic acceleration and deceleration are applied.

- Positioning (G00)
- Rapid traverse (RAPID)
- Jogging (JOG)
- Step feeding (STEP)

The linear feedrate acceleration and deceleration may be specified in two different rates as shown in Fig. 3.8. (different value for each axis).

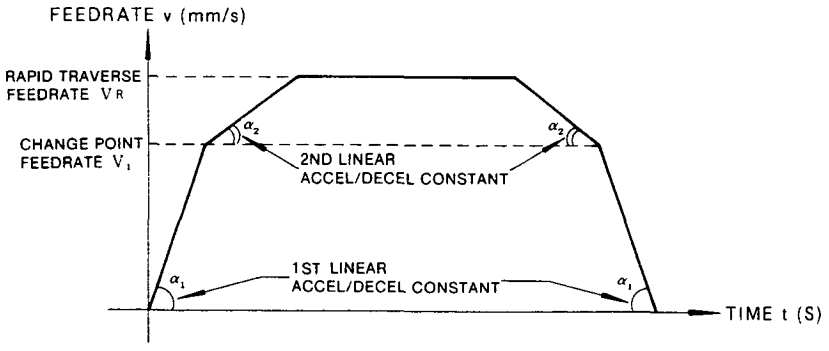


Fig. 3.8

The rapid traverse feedrate and rapid traverse accel/decel constants are present by parameters (#1500 to #1503, #1700 to #1703, #1900 to #1903).

3.4.2 ACCELERATION/DECELERATION DURING INTERPOLATION FEED

The interpolation feedrates are automatically accelerated and decelerated in the exponential mode, and handle mode.

With exponential deceleration, an interpolation feedrate bias is set and used to shorten the time for complete stopping.

Exponential accel/decel time constants are set at 8-ms intervals, and interpolation feedrate bias is set at 125-pps intervals by parameters (#1407, #1607, #1807, #1475, #1675, #1875).

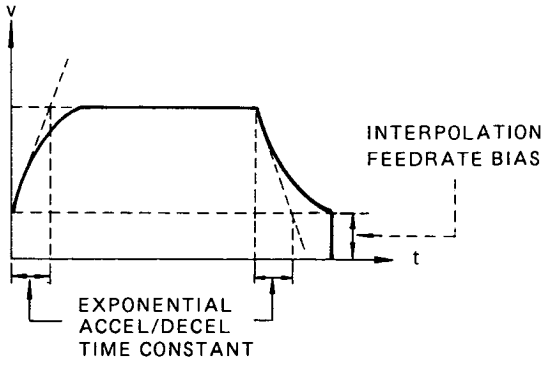


Fig. 3.9

NOTE

Set the parameters for automatic acceleration/deceleration constants at the optimum values for the respective machines.

3.5 MEMORY OPERATION

In this mode, one program is selected among the stored programs and is started for automatic operation by a start signal.

The following functions are executed by the respective external signals.

3.5.1 PROGRAM DESIGNATION AND STARTING

A stored program can be designated by the Control Station or a personal computer. In addition, program Nos. (O01 to O99) can be specified by an external BCD 2-digit switch. To execute a desired program, designate the program No., reset, and turn on the start signal (STR). Whether to designate the program No. by an external switch (reset signal) or not is determined by a parameter (#1002, D7).

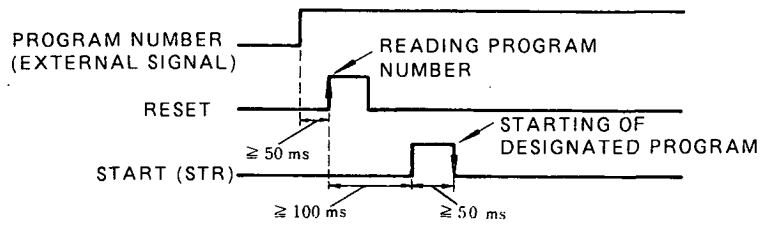


Fig. 3.10

3.5.2 TEMPORARY STOP

If temporary stop signal (STP) is turned on while the system is executing a program, the machine stops after deceleration, and the program is restarted when this signal turned off. For ON-OFF operation, use the maintained contact.

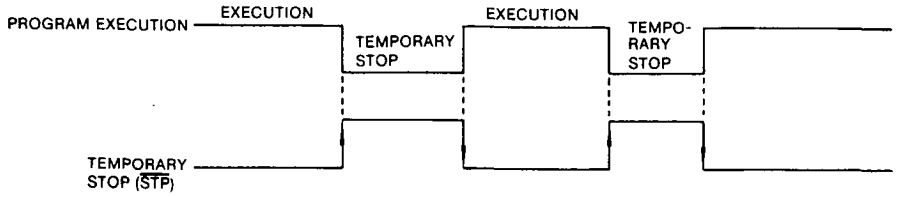


Fig. 3.11

3.5.3 SINGLE-BLOCK OPERATION

In this mode, the program is executed one block at a time. When a single-block signal (SBK) is turned on and a start signal (STR) is turned on, the machine executes one block of the program and stops. When another start signal is turned on, the next block is executed.

When a single-block signal is turned on, while the system is operating continuously, the current block is executed, and the system stops. When the single-block signal is turned off, and subsequently, a start signal is input, the operation will be executed in the continuous mode.

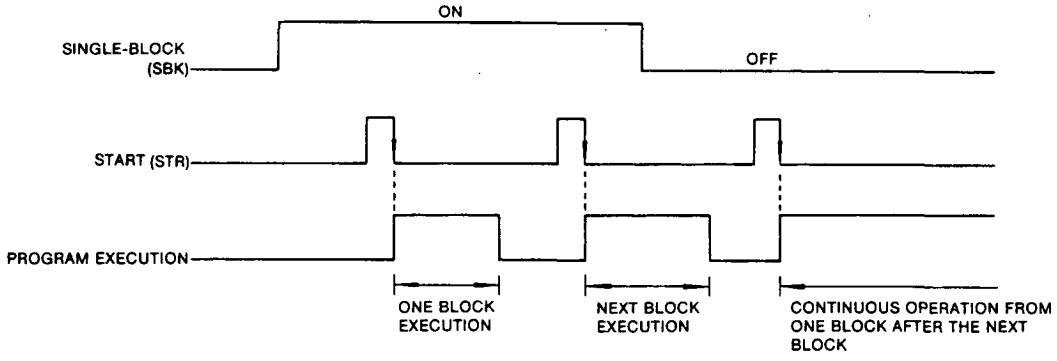


Fig. 3.12

3.5.4 MACHINE LOCK OPERATION

When a machine lock signal (MLK) is turned on, and then, a start signal (STR) is turned on, the current position display starts to change as if the machine were executing the program, but the machine remains at a standstill. However, the M-functions, the S-functions and the T-functions are executed. This mode is used, for example, when presetting the display manually, or for checking the program. Note that while the machine lock signal is on, the return-to-reference motion is not executed.

CAUTION

Be sure to turn on the machine lock signal only while the system remains motionless after completely executing a block.

3.5.5 AXIS OMISSION

Program check, etc., can be made by releasing a specific axis from motion control and performing idle operation.

If start signal (STR) is turned on when axis omission signal (NEG) is on in the memory operation mode (MEM), only the specified axis is not controlled and the machine does not move. The current value display does not change either.

3.5.6 OPTIONAL BLOCK SKIP FUNCTION

When an optional block skip signal (SK1-SK8) is turned on or off, the blocks which contain "/n" (n = 1 to 8) are selectively omitted in the execution of the program.

For example, when an SK2 signal is ON, all the commands in the block containing "/2" are omitted until the block ends.

This function is ineffective on the block under execution or blocks stored in the advance reading buffer. During memory operation, it becomes effective from the block to be read after the signal.

3.5.7 MANUAL INTERRUPTION OF AUTOMATIC OPERATION

When a manual operation (JOG mode, STEP mode, RAPID mode, or HANDLE mode) intervenes during a memory or a DNC operation, the distance covered by the manual operation has the effect of shifting the motion path. Therefore, when the memory opeation mode is restored after the manual interruption and the automatic operation process is restarted by a start signal, the machine follows the shifted path. A machine coordinate system does not depend upon absolute programming (G90) and incremental programming (G91).

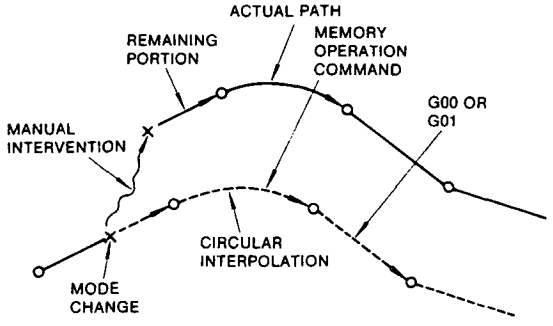


Fig. 3.13

3.5.8 BLOCK PREREAD

In normal operation, one-block data is preread and data processing is performed to prepare for the next operation. The maximum capacity of one-block data is 128 characters (containing EOB).

3.6 DNC OPERATION

The motion module with the communication function (JEFMC-C027) enables DNC operation, that is, concurrent processing in which a part program can be executed while it is being received by using an RS-422 port of the host computer such as a personal computer.

This function is useful for execution of a large part program exceeding the Motionpack-110 memory capacity (maximum of 64k bytes). The DNC mode is used for operation. Program execution is the same as in memory operation, but program repetition instruction cannot be executed.

For transmission protocol and parameter settings, see parameters #1000, #1003, and #1009.

3.7 UNRESTRICTED LENGTH POSITIONING

The maximum programmable dimension in Motionpack-110 basically is restricted to ±99999999 pulses. The unrestricted length positioning function is used to program a dimension exceeding the maximum value.

For example, the function is used to control the machine which repeats positioning in the same direction infinitely.

Normally, unrestricted length feed can be made in manual operation (JOG, RAPID, STEP, or HANDLE), but requires that an incremental movement command (G91) from the current position is programmed in the memory operation.

However, since the function is of endless operation, the following functions cannot be used: (Do not set parameters, etc.)

- Pitch error compensation
- Soft limit check function (available for axis used with restricted length.)
- Absolute command (G90)

The current value is displayed in the increment mode on the CRT control station screen. In other modes, the current value exceeding ±99999.999 is not displayed correctly.

3.8 POSITION CANCEL

Only the current value display universal position in the manual operation mode (JOG, STEP, RAPID, or HANDLE) can be canceled and set to 0 regardless of the currently displayed value. However, it does not affect other current value displays (increment position, axis position).

The function is equivalent to shifting the coordinates to 0 by using G function reference coordinate system setting G92. Position cancel can be made for each of the X, Y, and Z axes. See Par. 7.2.3 for operation.

3.9 POSITION MEMORY

The current value display (only axis position) on previous turning OFF of the power can be retained in the offset area even after the power is turned OFF. Normally, the position memory should be executed at the machine stop. To effect this function, set the system parameter #1003 D1 to "1."

When the position memory signal (PMEM) is turned ON, current display axis positions X, Y and Z are retained in the offset numbers H87, H88 and H89, respectively.

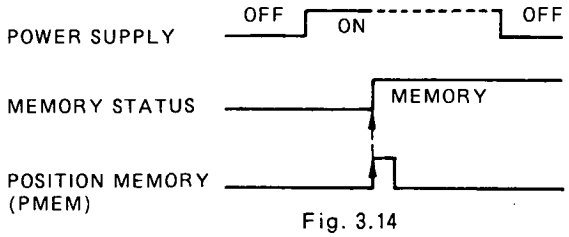


Fig. 3.14

Memory Position		Store Location (offset No.)
Axis Position	X	H87
	Y	H88
	Z	H89

3.10 MECHANICAL HANDLE

When the servo subsystem power is off and the machine is moved with the mechanical handle, the current value position display follows it.

However, generally when the servo subsystem power is off, alarm (No.51 SERVO POWER NOT SUPPLY) occurs, thus the function should be used by turning on the alarm clear signal (ACR) to prevent the alarm from occurring.

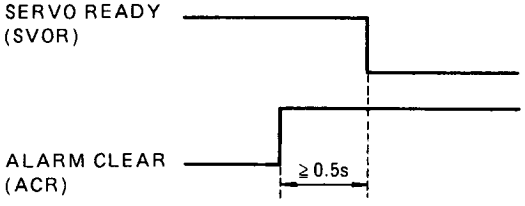


Fig. 3.15

3.11 SPINDLE CONTROL FUNCTION

Simple spindle control can be performed by using axis module D/A output. Operation for the spindle is performed by setting the axis module axis setup number to 4. See Par. 10.3.

For the feedrate command, the rotation speed of the spindle (rpm) is programmed in a numeric value of five digits following code S.

Normal rotation, reverse rotation, and stop of the spindle are controlled by using input signals and parameters. For details of S -function, programming, input, and parameters, see Pars. 4.5, 9.2.2, 5.3 and 5.8, respectively.

NOTE

1. The function does not contain acceleration/deceleration. Use a spindle drive with the acceleration/deceleration function as required.

2. The D/A output of the standard axis module (Type JEFMC-B011) is adjusted to a maximum ±5 V. To use a spindle drive with 10V input, prepare the axis module (Type JEFMC-B011B) that the D/A output is adjusted to ± 10V, and ±15 VDC external power supply.

3.11.1 NORMAL ROTATION, REVERSE ROTATION, AND STOP OF SPINDLE

Normal rotation, reverse rotation, and stop of the spindle are controlled by setting axis module D/A output to the positive side (+) , negative side (−) , and 0V, respectively, using the spindle normal rotation signal (FRN), spindle reverse rotation signal (RRN), spindle stop signal (SSTP), and parameter #2004 in combination when the spindle rotation speed is programmed with S. A standard Servopack is used for spindle without adjustment.

When the drive unit only for the spindle is used, normal rotation signals should be always input to Motionpack. The noral rotation, reverse rotation, and stop command of the spindle that M-BCD output of M-signal (M03, M04, M05 etc.) in programming are decoded can be controlled by input directly to the spindle drive unit.

3.11.2 SPINDLE GEAR CHANGE

The speed command voltage can be changed in accordance with spindle gear change. Gear change can be made at three stages (L, M, and H) by using gear ratio selection signals GR1 and GR2. The maximum rotation speed of the spindle for each of L, M, and H is set by using parameters #2150, #2151, and #2152.

The speed command voltage on each gear is as follows:

$$\text{Speed Command Voltage} = \frac{\text{S 5-digit Programmed Value (rpm)}}{\text{Each Gear Parameter Setup Value (rpm)}} \times \frac{\text{Axis Module}}{\text{Max D/A output}}$$

The axis module maximum D/A output is as follows:

- ±5V: axis module type JEFMC-B011 (standard)
- ±10V: axis module type JEFMC-B011B

3.12 MDI OPERATION

Programs which are input from CRT operator's panel are operated automatically without storing in the memory of Motion module. This mode is available for Motionpack-110 with CRT control station, on and after type JEFMC-H012.

3.12.1 PROGRAM INPUT IN MDI MODE

(1) Select MDI mode.
(2) Depress [COM] key on CRT control station. COMMAND display appears.
(3) Depress [RESET] key.
(4) Input programs by using address and data keys. Max. 32 characters can be entered at one time. The input data are displayed on the bottom line of the CRT, from left to right.

NOTE
The plural block cannot be specified.

(5) Depress [INSRT] key. The key-in data are registered. The latest display goes out and is displayed again above the line.

NOTE
If wrong data are input, begin again from (3), [EOB] key need not be depressed.

3.12.2 OPERATION IN MDI MODE

(1) Input block data are executed at cycle start (STR) ON in MDI mode.
(2) When the data execution is completed, the block display will go out.

3.13 ADDRESS SEARCH FUNCTION

Search continues until data (character string) held in the memory which coincide with the data (character string) entered through the NC operator's panel is found. The contents of the part program memory can be searched in MEM or EDIT mode.

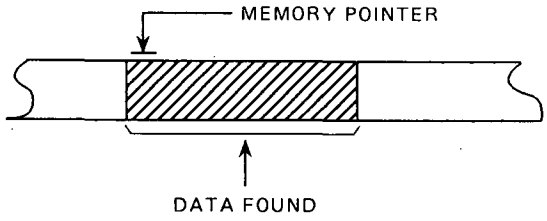
(1) Operation
① Select MEM or EDIT mode.
② Depress [PROG] function key.
③ Depress [RESET] key.

In memory mode, the pointer returns to the top of the program number in MEM mode.

④ Enter the data (string of not more than 10 characters headed by address) to be searched.
⑤ Depress [CURSOR] key. Search starts.

(2) End of search

① The pointer of the part program memory points to the top of the data found (pointed by the cursor). In all cases, only search will be performed but neither BUF display nor advance reading will be performed.



② "NOT FOUND!" appears on the CRT if the desired data is not found. This message will disappear when a key (CAN normally) of the control station is depressed.

(3) Remarks

- Do not omit leading zeros of the search data. The data itself which has been entered through the keyboard will be compared with those in the part program memory.

  When searching a program number, leading zeros may be omitted.

- Commands encountered during search will be disregarded even if they are modal commands.

- On Cycle Start after search, the data of a block which the cursor points to will be read and executed.

3.14 PARAMETER/PROGRAM PROTECT FUNCTION

This function ignores write-in parameter from CRT control station and editing of machining program.

When protect signal (PRT) is turned ON, ERASE , ALTER and INSRT keys are ineffective in EDIT mode. WR key in parameter display is also ineffective and writing can not be changed.

NOTE

IN and OUT keys on a personal computer are not affected.

3.15 ALARM CODE OUTPUT FUNCTION

This function signals an alarm occurance and the alarm No. to the external I/O device during alarm. The alarm No. is converted to binary number and output to the ports between #45070 and #45077. If there is no alarm, 0 is output. If two or more alarms are detected, the first alarm is given priority.

(Example)

	Code
1. EXTERNAL ERROR	049
2. SERVO ALARM (Z)	062

Port #4707

128	64	32	16	8	4	2	1
D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	0	0	0	1

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	1	1	0

NOTE

When using this function, change or add the I/O allocation because these outputs are not included in standard I/O allocation.

CONTENTS

4. PROGRAMMING

The Motionpack-110 system uses the NC program language. An example of programming machine motion is shown below:

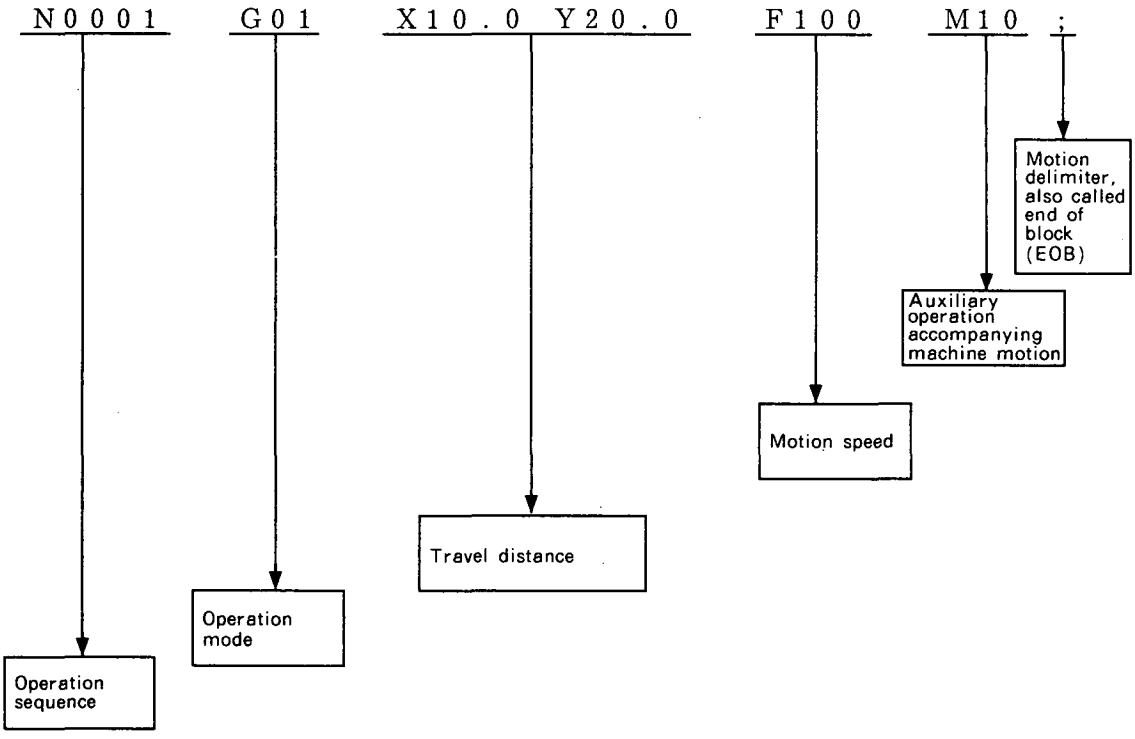


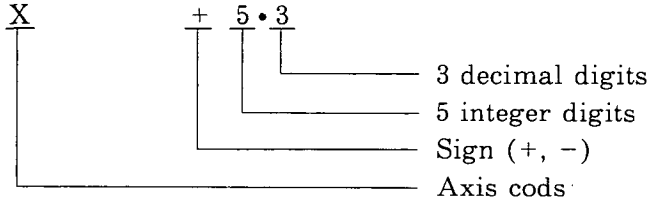
Fig. 4.1

As shown above, a program is written with alphabetical codes A through Z and digits. At the end of a block, CR (;) appears, and a program consists of several blocks.

4.1 INPUT FORMAT

4.1.1 INPUT FORMAT LIST

The numerals in the table indicate the maximum number of digits permitted for entry in the input data.



Normally, decimal points are not written. If decimal points are written, different treatment is required. Refer to Par. 4.1.3 "DECIMAL POINT PROGRAMMING".

Table 4.1 Input Format list

Item	Format
Program No.	O4
Sequence No.	N4
G-function	G2
Axis Word	a+5.3 (Note)
Feedrate per Minute	F5
T-function	T2
M-function	M2
S-function	S5
Offset No.	H2 or D2
Dwell Command	P5.3
Program No. Designation	P4
Number of Repeats	L8

Note: In the above table, "a" represents an axis code (X, Y, Z, I, J, K, R, or Q).

With the digit codes following alphabetical codes, the leading zeroes and + are omitted. Minus signs (−) cannot be omitted.

(Example) X00123 → X123
X+123 → X123
K−123 → K−123

With the CRT control station, the end of block (EOB) code is represented by ";". With a personal computer, it is represented by CR (ASCII code).

4.1.2 ADDRESS CHARACTERS

Table 4.2 shows the address codes and their meanings.

Table 4.2 Address Characters

Character	Meaning
D	Offset No.
F	Interpolation feedrate
G	G-function
H	Offset No.
I	X-coordinate of arc center
J	Y-coordinate of arc center
K	Z-coordinate of arc center
L	Number of repeats
M	M-function
N	Sequence No.
O	Program No.
P	Dwell time, Program No. with sub-routine programming
Q	Cut depth and shift value of combined operation command
R	Radius designation of circular arc
S	S-function
T	T-function
X	X-function
Y	Y-coordinate
Z	Z-coordinate

4.1.3 DECIMAL POINT PROGRAMMING

For coordinate (distance), time and feedrate, numerals including a decimal point can be used.

(1) A decimal point can be used with the following address characters:
Coordinate: X, Y, Z, I, J, K, R, Q
Time: P

(Example) Where 0.001 mm/p,
X15. means X-axis 15.000 mm.
Y20.5 means Y-axis 20.500 mm.
G04P1. means dwell time 1.000s.

(2) When numerals without a decimal point are programmed.
"1" is regarded as "0.001" (for 0.001 mm/p).

(Example)
X15 means X-axis 0.015 mm.

4.1.4 DECIMAL POINT MOVEMENT

The decimal point position on the current value display can be moved by setting parameter #1005 D2-D0.

When the number of decimal places is two
X15.: X15.00 mm
Y20.5: Y20.50 mm
X45: X0.45 mm
Y01: Y0.01 mm

(1) The decimal point movement range is as follows:

① The number of decimal places is three in standard setting (0.001 mm/command pulse in handling the minimum setup units).

② The number of decimal places is two in standard setting (0.01 mm/command pulse in handling the minimum setup units).

③ The number of decimal places is one in standard setting (0.1 mm/command pulse in handling the minimum setup units).

④ There is no decimal point in standard setting (1 mm/command pulse in handling the minimum setup units).

(2) The decimal point is moved simply to facilitate display and input method. The units in the control subsystem functioning in Motionpack do not change. In the User's Manual, the number of decimal places is also three in standard setting. As a rule, in this manual, one command pulse = 0.001 mm.

(3) If decimal point specification in ① is not made, conversion between the specified value and actual machine travel distance is required. This affects the following programmed values and parameters:

Speed (feedrate):

- Interpolation feedrate F specification in program
- Parameter #1101: Maximum manual handle feedrate setting
- Parameter #1102: Maximum interpolation feedrate setting
- Parameters #1104-#1106: Jog feedrate setting
- Parameters #1500, #1700, #1900: Rapid feedrate setting
- Parameters #1504, #1704, #1904: Reference point return approach speed
- Parameters #1505, #1705, #1905: Reference point return creep speed

Acceleration/deceleration:

- Parameters #1475, #1675, #1975: Interpolation feedrate bias setting
- Parameters #1501, #1701, #1901: First stage linear acceleration/deceleration constant
- Parameters #1502, #1702, #1902: Second stage linear acceleration/deceleration constant

Positions:

- Parameters #1122-#1124: Step feed
- Parameter #1125: Reference point position area setting
- Parameters #1550, #1750, #1950: Soft limit boundary value in positive direction
- Parameters #1551, #1751, #1951: Soft limit boundary value in negative direction

(Example) When decimal point movement is used by setting one command pulse (0.01 mm) two decimal places in movement, all of the programmed values and parameter setup values described above are affected: each becomes 10 times the standard setup unit of one command pulse (0.001 mm)($\frac{0.01\ \text{mm}}{0.001\ \text{mm}}$ =10). That is, if F12 is programmed in F setting, movement is made at the rate of 120 mm/min.

- If parameter #1102 (maximum interpolation feedrate) is set to 2400, movement is made at the rate of 24000 mm/min.
- The maximum programmable value ±99999.999 becomes ±999999.99.
  For example, X15. is displayed as X15.00 mm;
  Y20.5 is displayed as Y20.50 mm; and
  Z45 is displayed as Z 0.45 mm.

(4) If memory operation is performed by programming numeric values having a decimal point different from the specified one, alarm (No.16: PROG ERROR) occurs.

(Example) When #1005 = 2 (two decimal places) is set,
The command block G00 X10.00 Y12.34; is executed normally.
The command block G00 X10.000 Y12.340; results in an alarm.

4.1.5 PROGRAM NUMBER

Program Nos. are prefixed to the programs to identify them.

(1) Up to 4 digits can be used as program Nos. written after the character O (O0001-O9999). Up to 99 programs can be stored in the memory of a motion module in range of memory capacity. Two-digit numbers between O01 and O99 can be designated by external input signals.

(2) Program start with program Nos., and end in M02, M30 (or M99). M02 and M30 indicate the end of main programs. For the explanation of M02, M30 and M99, refer to Par. 4.4.2 "M-FUNCTION".

4.1.6 SEQUENCE NUMBER

Address N followed by up to 4 digits can be programmed at the leading end of a block (N0001-N9999).

These digits are used to identify the blocks, but do not have any effect on the internal control or program execution sequence. Therefore, the digits may be selected in sequence, but they can just as well be any numbers, such as numbers out of sequence, duplicate numbers, or no numbers at all. Using sequential numbers are normally most convenient to identify the blocks.

4.1.7 OPTIONAL BLOCK SKIP

Those blocks in which "/n" (n = 1 to 8) is written are skipped from the "/n" to the end of the block when the external optional block skip switch of that "n" number is ON. The "/n" can be written also at some position in the middle of blocks.

(Example)
/2 N1234 G01 X100 /3 Y200;

When switch SK2 is ON, this block is totally ignored and when switch SK3 is ON, this block is executed only as if it is N1234 G00 X100;

NOTE

1. The optional block skip function is processed when the instruction is read from the memory to the buffer. When it is already read into the buffer, subsequent switching on of the switch will not be effective to skip the block.

2. If n in "/n" is omitted, it means "/1".

4.2 G FUNCTION

4.2.1 LIST OF G CODES

Table 4.3 List of G Codes

Function	Code	Group	Command Word	Description
Positioning	G00	01	G00X··· Y ··· Z ··· ;	Simultaneous rapid traverse along 3 axes to arrive at position X, Y, or Z.
Linear Interpolation	G01		G01X··· Y ··· Z ··· F ··· ;	Simultaneous feed motion along 3 axes resulting in linear motion to position X, Y, or Z at feedrate F.
Circular Interpolation	G02 G03		G02X··· Y ··· I ··· J ··· F··· ; G02G18Z··· X ··· K ··· I ··· F ··· ; G02G19Y··· Z ··· J ··· K ··· F ··· ; G02X··· Y ··· R ··· ;	Resultant circular motion to position X, Y (or ZX, YZ) with the center at IJ (or KI, JK), or with a radius of R, at a tangential feedrate of F. G02: Clockwise G03: Counterclockwise
Dwell Command	G04	*	G04P··· ;	Waiting until the time duration specified by P elapses before starting to execute next block.
Error Detect Off Positioning	G06		G06X··· Y ··· Z ··· ;	After the allocation of motion pulses to X, Y, Z, the subsequent block execution is started immediately without waiting for complete positioning.
Offset Value Input	G10		G10H·· Q ··· ;	Direct input of offset value in program.
Plane Designation	G17 G18 G19	02	—	Designation of the plane on which to execute circular interpolation G17: X-Y plane G18: Z-X plane G19: Y-Z plane
Return-to-Reference Point	G28	*	G28X··· Y ··· Z ··· ;	Return-to-reference point after moving to X, Y, Z. However, when the power is first turned on, it returns to the reference point immediately.
Skip	G31		G31X··· Y ··· Z ··· F ··· ;	When skip signal is turned on or off during linear interpolation at feedrate F toward X, Y, Z, resulting from simultaneous motion along 3 axes, the motion decelerates and stops. Then the next block is executed.
Z-axis Offset + Z-axis Offset −	G43 G44	05	G43Z··· H·· ;	Motion distance in Z direction is increased or decreased by offset memory value designated by H. G43: Plus G44: Minus
Z-axis Offset Command Cancel	G49		G49;	Cancelling contents of memory of offset value designated by H.
X-Y Axes Offset Command + X-Y Axes Offset Command −	G45 G46	*	G45X··· Y ··· D·· ;	Motion distances in X-Y directions are increased or decreased by offset memory value designated by D.
X-Y Axes Offset Command Double + X-Y Axes Offset Command Double −	G47 G48		G47X··· Y ··· D·· ;	Motion distances in X-Y directions are increased or decreased by twice the offset memory value designated by D.
Machine Coordinate System Setting	G53		G53X··· Y ··· Z ··· ;	Returning to reference point (X, Y, Z) of machine coordinate system.

Note: Mark ◥ indicates that the power is turned on and the marked function is automatically selected.

4.2.1 LIST OF G CODES (Cont'd)

Table 4.3 List of G Codes (Cont'd)

Function	Code	Group	Command Word	Description
Notch Signal B Output Command	G66		G66X···M·· ;	Signal output at the previously programmed position during positioning.
	G67		G67X···M·· ;	
Notch Signal A Output Command	G68		G68XH··YH·· ;	Signal output at the previously programmed position during positioning.
Notch Signal A Output Reset Command	G69		G69;	Notch signal output is reset.
Combined Operation Command Cancel	G80	09	G80;	Combined operation command is canceled.
Combined Operation Command Drilling	G81		G81X···Y···Z···R···L ···F··· ;	Drilling operation.
Combined Operation Command Spot Facing	G82		G82X···Y···Z···R···P ···L···F··· ;	Dwell on hole bottom in drilling operation.
Combined Operation Command Deep Hole Drilling	G83		G83X···Y···Z···R···Q ···L···F··· ; G83X···Y···Z···R···I ···J···K···L···F··· ;	Cut depth and shift distance can be specified.
Combined Operation Command Tapping	G84		G84X···Y···Z···R···P ···L···F··· ;	Tapping operation.
Combined Operation Command Boring	G85		G85X···Y···Z···R···L ···F··· ;	Boring operation.
Combined Operation Command Boring	G86		G86X···Y···Z···R···L ···F··· ;	Spindle stops at Z point in boring.
Combined Operation Command Boring	G89		G89X···Y···Z···R···P ···L···F··· ;	Dwell at Z point in boring.
Combined Operation Command Initial Point Return	G98	10		Return to initial point level after combined operation ends.
Combined Operation Command R Point Return	G99			Return to R point level after combined operation ends.
Absolute Command	G90	03	G90;	Designating motion data to be absolute.
Incremental Command	G91		G91;	Designating motion data to be incremental.
Programming of Absolute Zero Point	G92	*	G92X···Y···Z··· ;	Designating position of "absolute zero point."

Note: Mark ⌝ indicates that the power is turned on and the marked function is automatically selected.

(1) The G functions marked by * are non-modal and effective only for the block in which they are programmed.

(2) The G functions in groups 01 through 10 and modal, remaining effective until another G function in the same group is programmed next.

(3) The G functions in the * group cannot be programmed in the same block in which another G function is programmed. Any such G function must be programmed in a separate block.

4.2.2 POSITIONING (G00)

(1) G00 X··· Y··· Z···;

With this command, the tool is sent to the specified position, with the slides in the 3 axial directions moving simultaneously. A slide for which no command is programmed remains motionless.

(2) The rapid traverse rates for the three axes are independently set.

(3) Motions in the three axes are independent of each other, and, therefore, the resultant tool path is not necessarily straight. This requires particular attention.

(4) G00 is a modal G code belonging to the 01 group.

(Program example)
G00 X4000 Y4000 Z4000;

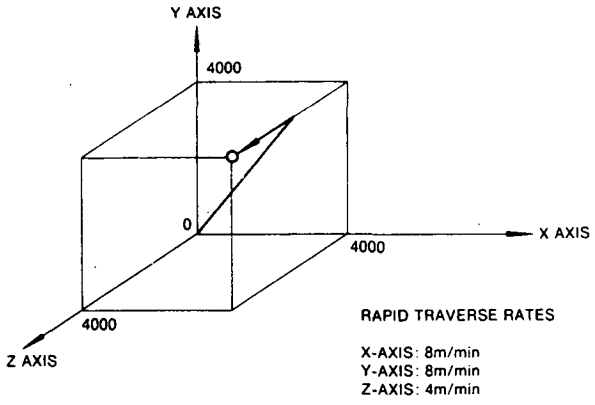


Fig. 4.2

4.2.3 ERROR-DETECT-OFF POSITIONING (G06)

G06 X··· Y··· Z···;

With this command, the same positioning motions take place as with G00 commands, with the following differences:

(1) A G00 command is executed in the error-detect-on mode. The execution of a block is started only when the servo-delay pulses are confirmed to have been reduced to within a permissible range after the allocation of the motion pulses. With this mode, the corners of motion paths are sharp.

With the error-detect-off mode of G06, the program advances as soon as the motion pulses have been allocated.

(2) With G06, the program advances to the next block as soon as the positioning by a block in the * group has been completed. Therefore, the motion path is rounded at the corners.

(3) G06 is a non-modal G function in the * group, effective only in the programmed block.

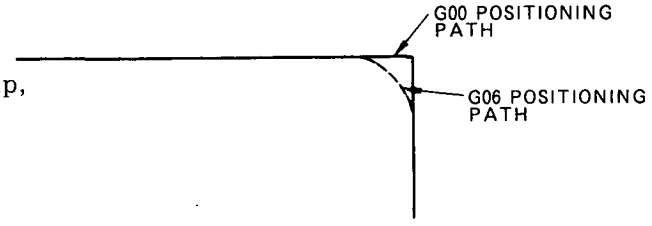


Fig. 4.3

4.2.4 LINEAR INTERPOLATION (G01)

(1) G01 X··· Y··· Z··· F···;

With this command, the three slides move simultaneously, resulting in a linear motion. Where commands are missing for some axes, those axes remain motionless.

(Program example)
G01 X4000 Y4000 Z4000 F100;

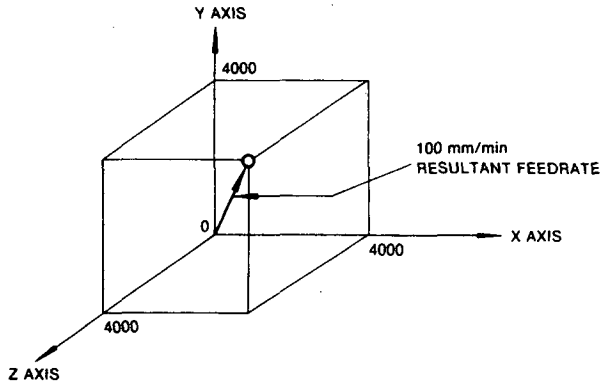


Fig. 4.4

(2) With G01, the program advances to the next block in the error-detect-on mode as soon as the pulse distribution of a block has been completed.

(3) The feedrate is specified by the F code. The resultant speed of the motions of the moving slides become the command feedrate.

$F = 400 = \sqrt{F_x^2 + F_y^2 + F_z^2}$ (mm/min)

(Fx, Fy, Fz denote feedrates in X, Y, or Z direction.)

(4) If no F code is programmed in the block of G01 or in the preceding block, the alarm state [No.19: PROG ERROR (F)] is turned on.

4.2.5 CIRCULAR INTERPOLATION (G02, G03)

There are the following two types of commands for circular motion:
- By approached and central coordinate points of circular motion path.
- By approached coordinate point and radius of circular motion path.

(1) Command by Approached and Central Coordinate Points

With the following commands, the machine slide motions are controlled to give resultant circular motion on the XY, ZX, or YZ plane at a tangential feedrate specified by F.

XY plane

G17 G02 X··· Y··· I··· J··· F···;
G03

ZX plane

```
G18 G02 Z··· X··· K··· I··· F···;
    G03
```

YZ plane

```
G19 G02 Y··· Z··· J··· K··· F···;
    G03
```

The rotating direction of the resultant motion is specified as follows:
G02: Clockwise
G03: Counterclockwise

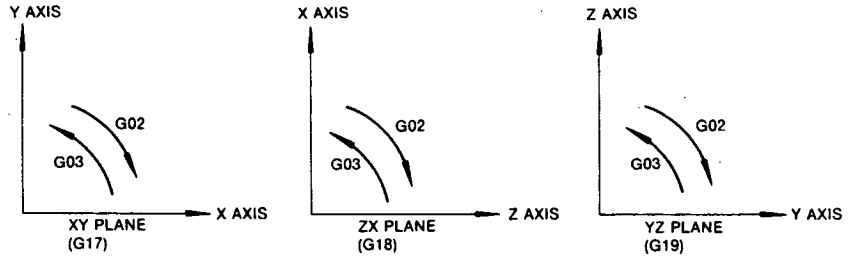


Fig. 4.5

When programming circular interpolations (G02, G03), make a preliminary specification of the plane for interpolation with G17, G18, or G19, beforehand.

G17: XY plane
G18: ZX plane
G19: YZ plane

Immediately after turning on the power, the XY plane (G17) is automatically selected, if not otherwise programmed.

(Program examples)

G17 G90 G03 X1500 Y4000 I-3000 J-1000 F150;

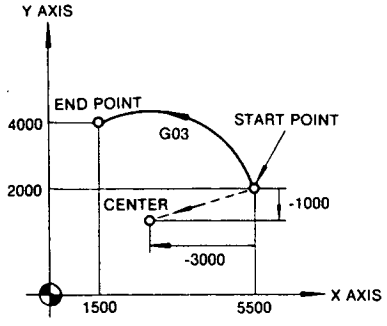


Fig. 4.6 Absolute Programming (G90)

G17 G91 G03 X-4000 Y2000 I-3000 J-1000 F150;

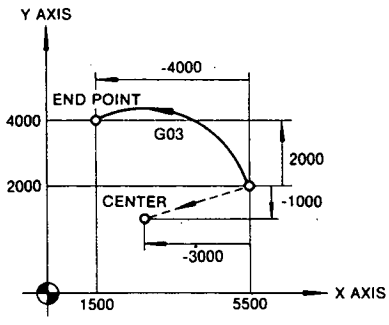


Fig. 4.7 Incremental Programming (G91)

NOTE

Central coordinate point must be designated by viewing from start point regardless of G90 and G91.

(2) Radius Designation

In programming circular interpolation, the radius of the circular motion path may be programmed by R, instead of designating the coordinate of the center by I, J or K. This is called "radius R designation in circular interpolation command".

Note that
When R>0, the segment angle is less than 180°.
When R<0, the segment angle is greater than 180°.

NOTE

If the coordinate value of the end point of a circular interpolation motion is not on the correct circular path due to errors in calculation, etc., corrections are made as shown in Fig. 4.9.

When the end point is programmed in the hatched areas, alarm state [No.21: PROG ERROR (G02/G03)] occurs.

One complete circle cannot be programmed, so when progamming a complete circle, it must be divided into two commmands.

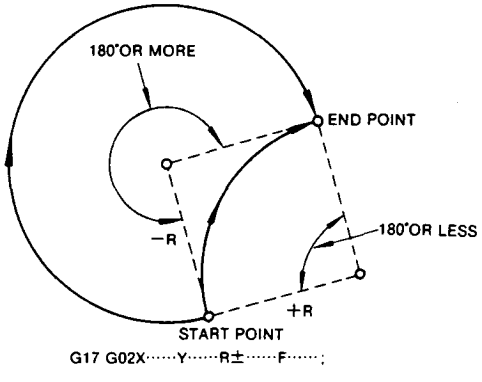


Fig. 4.8

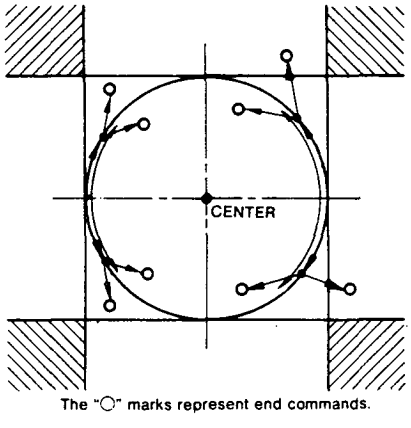


Fig. 4.9

(3) Complete Circle Designation

A completely closed circle can be programmed in one block.

(Program example)
G00 X0 Y0 ;
G02 X0 Y0 I1000 J0 F100 ;

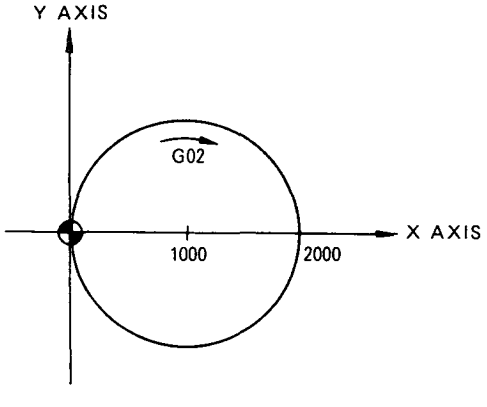


Fig. 4.10

4.2.6 DWELL (G04)

(1) G04 P···;

With this command, the execution time of the next block is delayed as long as the time specified by P.

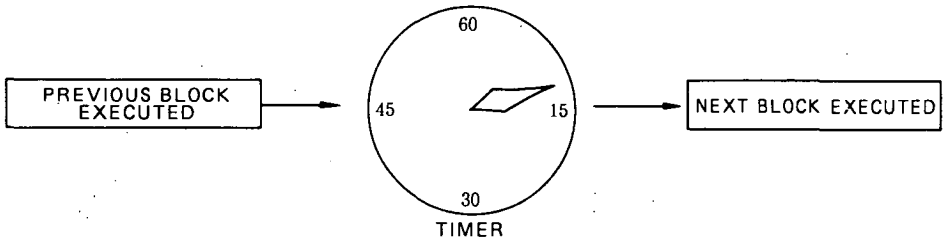


Fig. 4.11

(2) A dwell command is programmed as an independent block.

(3) The time of halt can be specified within the following range by P.

Format	Dwell Designation Range
P5.3	0.001 to 99999.999 s

Note: The values are not affected by metric or inch I/O units.

(Program example)

G04 P2500;
or
G04 P2.5;

} Dwell time: 2.5 seconds

4.2.7 OFFSET VALUE INPUT (G10)

Offset value data can be directly written in the program.

(1) Offset Value Absolute Command

The command block

G10 H·· Q····;

causes the offset value data specified in Q···· to be written into the offset number specified in H···. The previously entered offset value data is updated.

Program example: G10 H20 Q1.23;
G10 H21 Q-456;

This sets 1.23 in offset number H20 and -456 in offset number H21.

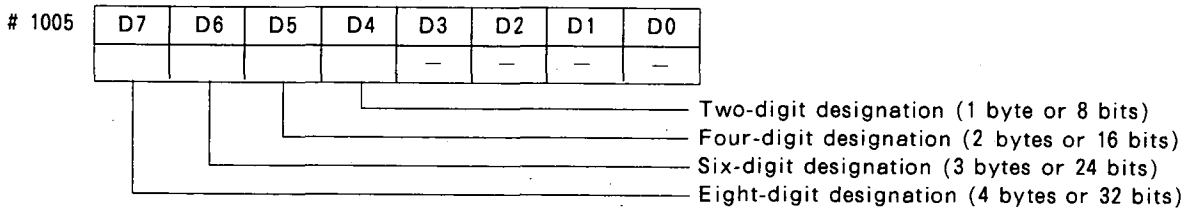
(2) External Input Signal Write Command

Offset value data are read from outside of Motion module by using the input from μ-PC or the machine I/O input pin.
The command block

G10 H··· U···;

causes offset value data (BCD signal) input from the input signal number specified in U··· (U4011-U4014) to be written into the offset number specified in H····. The previously entered offset value data is updated.

However, this function cannot be executed if standard I/O allocations are made because the designated area to the input signal numbers is #4011 to #4014. I/O reallocations are required. The number of offset value data digits to be written can be set in the range of two to eight by using parameter #1005 D7-D4.



NOTE

1. Only numeric values with no decimal point can be designated.

2. To designate the sign ⊖ input, input simultaneously the external offset data sign ⊖ data signal (EINV) and external offset data. The sign ⊕ input is not needed. External offset data sign ⊖ signal is required for the I/O allocation of I/O signal #40074.

Program example:

- When parameter #1005 contains
  D7 = 0, D6 = 1, D5 = 0, D4 = 0
  six digits (3 bytes or 24 bits) are specified for the number of data digits.
- When the input signal state is
  the command block

# 4011	7	8
# 4012	5	6
# 4013	3	4
# 4014	1	2

(BCD Indication)

or

	D7	D6	D5	D4	D3	D2	D1	D0
# 4011	0	1	1	1	1	0	0	0
# 4012	0	1	0	1	0	1	1	0
# 4013	0	0	1	1	0	1	0	0
# 4014	0	0	0	1	0	0	1	0

(Bit Indication)

G10 H20 U4011;
sets 345678 in offset number H20.

4.2.8 PLANE DESIGNATION (G17, G18, G19)

(1) The planes for executing circular interpolation are designated by G17, G18 or G19.
G17: XY plane
G18: ZX plane
G19: YZ plane

(2) Motion commands for any single slide can be programmed without regard to the plane designation by G17, G18, G19.

For example, when "G17 Z···;" is programmed, the slide along the Z axis moves.

(3) Immediately after turning on the power, G17 (XY plane) is automatically turned on.

4.2.9 AUTOMATIC RETURN-TO-REFERENCE POINT (G28)

(1) G28 X··· Y··· Z···;

With this command, first, the machine is moved to X, Y, Z by quick feed (G00), and then, to the reference point. However, immediately after the power is turned on, the machine moves directly to the reference point without first moving to X, Y, Z.

(a) The machine moves along the three axes simultaneously, but any axis, not commanded, does not move.

(Program example)
G28 X20. Y10.;

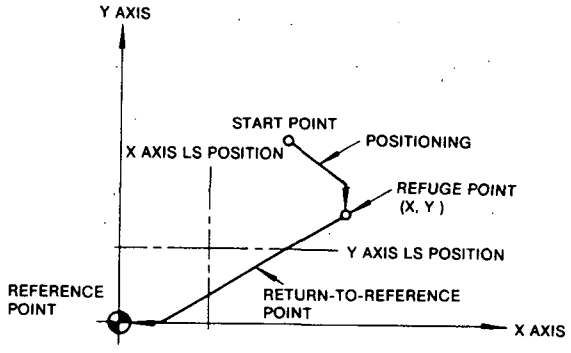


Fig. 4.12

(2) High Speed Reference Point Return Specifications

(a) High speed reference point return specifications can be made in place of the automatic reference point return described above by setting parameter #1001 D2.

(b) The high speed reference point return differs from the automatic reference point return in that axis movement is always positioned in rapid positioning (G00). Thus, axis movement is not decelerated to approach or creep speed around the reference point, enabling a return to the reference point in a short period of time.

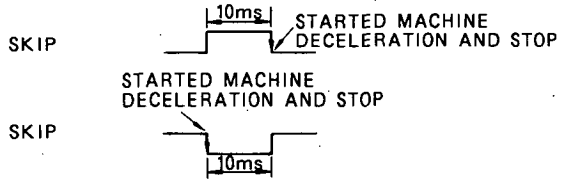
(c) However, the high speed reference point return is enabled after a manual return to the reference point is made after power on or after completion of normal reference point return operation for all axes by using the G28 command. If G28 command is given abruptly with the high speed reference point return specifications after power on, automatic reference ponit return operation is performed only at the first time.

(d) When high speed reference point return specifications are made, a return can be made to the reference point even if the starting position is beyond the area where reference point return is enabled.

4.2.10 SKIP FUNCTION (G31)

(1) G31 X··· Y··· Z··· F···;

With this command, a special linear interpolation is executed as follows:
When a skip signal (SKIP) is turned ON/OFF during this interpolation, the machine decelerates and stops, the remaining motion is neglected and omitted, and the program advances to the next block. In other command except for G31, ON/OFF operation of the skip signal is ignored.



(2) G31 is a non-modal function and effective for block commanded.
(Program example)
N100 G90 G31 X100.0 Y50.0 F300;
N200 G01 X80.0 Y15.0;

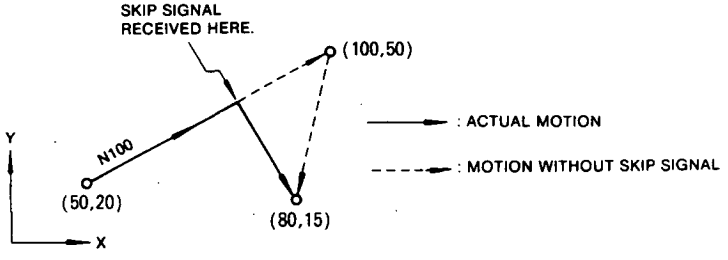
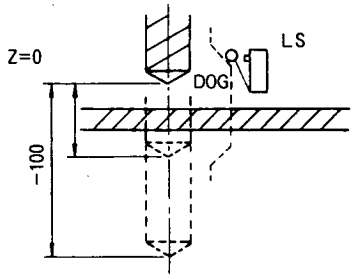


Fig. 4.13

(Operation example)
N001 G90 G31 Z-100. F100;
N002 G01 Z100. F1000;

When the skip signal is input (LS is ON/OFF) during execution of N001, the machine decelerates and stops. Then the program advances to the next block N002.



If no skip signal is ON/OFF during the execution of a G31 block, the machine stops at the end of the block, and an alarm (No.28: PROG ERROR G31) occurs.

(3) When parameter #1003 DO is set, after the execution of a G31 block without turing ON/OFF a skip signal, the program is advanced automatically to the next block with no alarm.

4.2.11 POSITION OFFSET IN Z-AXIS (G43, G44, G49)

This command is for adding or subtracting the contents of the offset memory to or from the Z-axis command value for correcting the Z position. See Par. 7.4 "DISPLAYING AND WRITING OFFSET DATA".

(1) G codes for Z Offset Functions and Offset Direction

The actual offset direction is determined by the offset value sign specified with the H code and the G code. Generally, offset value should be processed as plus value for the sake of clear understanding.

Tabel 4.4

G Code	Meaning	Offset Value Sign	
		(+)	(−)
G43	(+) direction	(+) direction	(−) direction
G44	(−) direction	(−) direction	(+) direction
G49	Cancelling	—	—

(2) Once G43 or G44 is commanded, it remains effective until cancelled by G49. They are modal.

(3) G49 command cancels Z offset commands.

(4) H00 command also cancels Z-axis offset commands. (H00 is a unrewritable value, because its content is fixed to 0.)

(5) Z-axis offset commands are programmed as follows:

(a) (G01)

G43 (G44) Z··· H···;

With this command, the offset memory content designated by H is added (or subtracted) to or from the Z command position, and the movement is made to the corrected position.

(b)

(G01) Z···; G43(G44) H···;

With this command, the offset value designated by H only is covered by the Z motion.

(c)

G43(G44) Z··· H···; H···;

With this command, the H motion covers the difference between the offset prior to command (2) and the new offset.

(6) When programming G43, G44, G49, the 01 group G code must be G00 or G01. When G02 or G03 is programmed, the alarm state occurs.

NOTE

If a G92 command involving Z-axis is commanded, while a Z-axis offset is under execution, the offset is cancelled. In principle, specify G92 with an offset cancelled state.

(Program example)

H10 OFFSET VALUE −3.0
H11 OFFSET VALUE 4.0

	CRT DISPLAY WITH OFFSET ADDED (Z-AXIS ONLY) ⇩
N101 G92 Z0;	0.000
N102 G90 G00 X1.0 Y2.0;	0.000
N103 G43 Z−20. H10;	−23.000
N104 G01 Z−30. F1000;	−33.000
N105 G00 Z0 H00;	0.000
⋮	
N201 G00 X−2.0 Y−2.0;	
N202 G44 Z−30. H11;	−34.000
N203 G01 Z−40. F1000;	−44.000
N204 G00 Z0 H00;	0.000

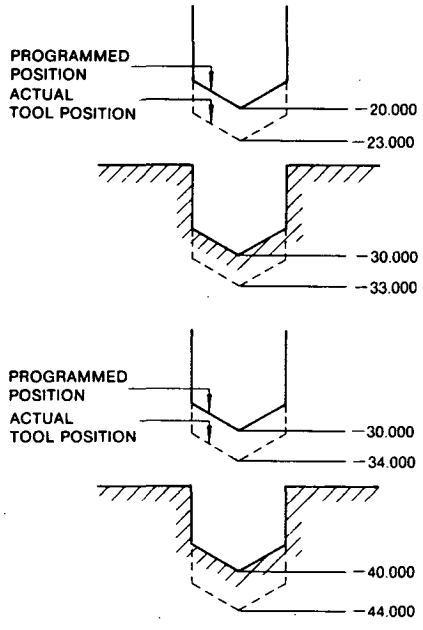


Fig. 4.14

4.2.12 POSITION OFFSET IN X- AND Y-AXES (G45 TO G48)

G01 G45 X··· Y··· D··· F···;

X, Y position offset is for extending or reducing the programmed moving distances by the values in the offset memory, and is mainly used to compensate for tool radius in machining rectangular workpieces.

(1) G Codes for X, Y Position Offset

Extension or reduction is determined by the sign of the offset value designated by the D code and the G codes.

Generally, offset values should be processed as plus values for the sake of clear understanding.

Table 4.5

G Code	Group	Meaning	Sign of Offset Value	
			(+)	(−)
G45	*	Extension	Extension	Reduction
G46	*	Reduction	Reduction	Extension
G47	*	Double extension	Double extension	Double reduction
G48	*	Double reduction	Double reduction	Double extension

(2) G45 to G48 extend or reduce the motions along the axis designated by these blocks. The extension or reduction is effective only in the block in which G45 to G48 are programmed, and the motions in other blocks are unaffected. Therefore, to restore the originally programmed values, the opposite offset must be programmed.

(3) To clarify the above operation, programming these commands in the incremental mode (G91) is helpful. In the absolute mode (G90), adding or reducing offset values may be unwieldy.

(4) When programming G45 to G48, specify the offset memory No. by D. However, since D is modal, when the same D value is used before, it need not be programmed.

(Program example)

```
G91;
①G00 G46 X·····Y···D01; ·····REDUCTION
②G01 G47 Y·····(D01)F; ·····DOUBLE  EXTENSION
③    G47 X·····(D01); ·····DOUBLE  EXTENSION
④    G47 Y·····(D01); ·····DOUBLE  EXTENSION
⑤    G47 X·····(D01); ·····DOUBLE  EXTENSION
⑥G00 G46 X·····Y···(D01); ·····REDUCTION
```

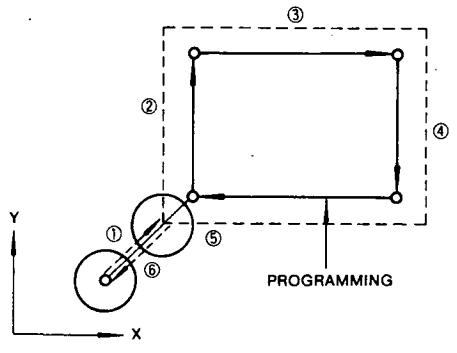


Fig. 4.15

(5) Length for Extension or Reduction

(a) One or two times the programmed offset length is added or subtracted, selectively. See Fig. 4.16.

(b) When the motion has been extended or shortened by offsetting in the preceding block, the starting point for the present block is offset. The overall move distance, however, is the same as in the above case. See Fig. 4.17.

G91 G00 G47 X6000 D10; D10=2000

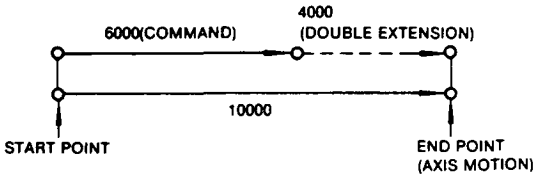
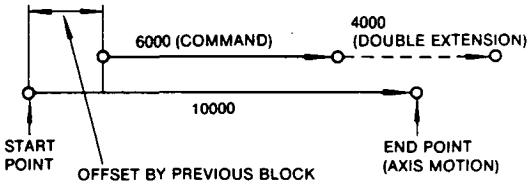


Fig. 4.16

With the same command as above (a).



Fog. 4.17

NOTE

When the offset is larger than the motion distance programmed in a block, the offset may result in reverse motion.

G46 X1000 D10; D10=2000

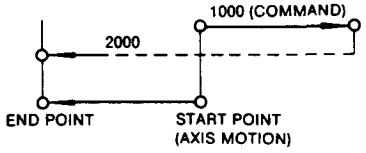


Fig. 4.18

(6) Application to Circular Interpolation

When I, J, K, R are programmed in the same block with G45 to G48, extension or reduction is made respectively in the same direction as X, Y, Z. Therefore, radius compensation is possible with 1/4 circle, or 3/4 circle only.

G91;
G45 G02 X5000 Y5000 I5000 D10;
D10 = 2000

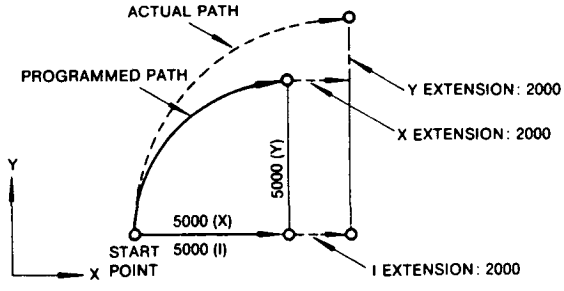


Fig. 4.19

In practice, if an offset is applied in the preceding block as given below, the radius of an arc can be offset correctly.

G91 G01 F……;
G46 X…… Y…… D10;
G45 Y……;
G45 G02 X…… Y…… I……;
G01 X……;

NOTE

To program a 1/2 circle, combine two 1/4 circle commands.

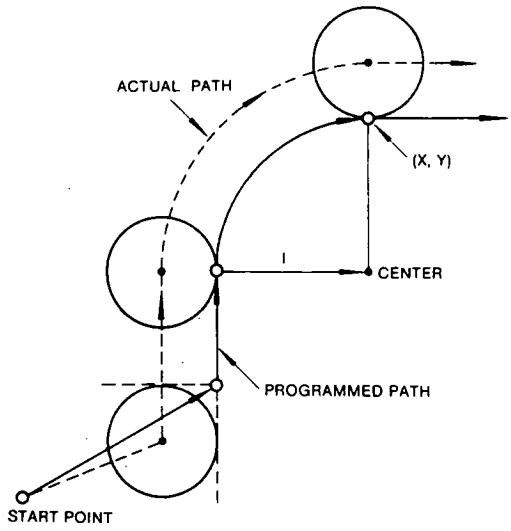


Fig. 4.20

(7) When programming G45 to G48, only 01 group G codes (G00, G01, G02, G03) can be programmed. G-code programming other G01 group causes the alarm state.

(8) In the incremental designation mode (G91), since only the motion for the offset is required, program "0" for movement.

G91 G01 G45 X0 Y0 D10F ···;
The machine moves through the offset distance corresponding to D10 in both the X- and Y-axes directions.

G91 G00 G46 X0 D11;
The machine moves only in the X direction through the offset of D11 in the minus direction.

Giving a sign to "0" is meaningless.

NOTE

1. When G45 to G48 are programmed to effect simultaneous motions on two axes, the extension or reduction is effective along both axes. If this is applied to a cutting tool, an overcut or undersize cut will result. This requires careful attension. See Fig. 4.21.

2. This X, Y position offset can be programmed in addition to the Z-axis position offset.

3. When G92 is programmed in the offset mode, the coordinate system setting process is executed after the cancellation of the offset in the designated axis. In principle, specify G92 after restoring the offset position by programming a reverse offset.

4. Execute a return-to-reference point command after cancelling this command.

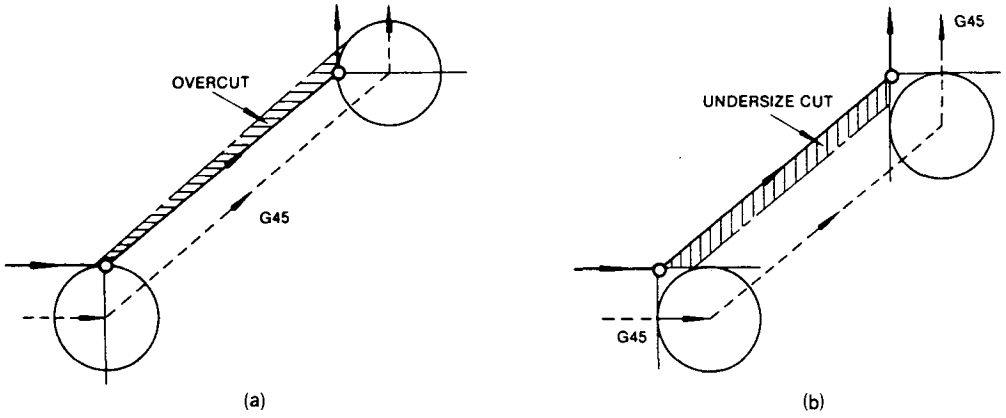
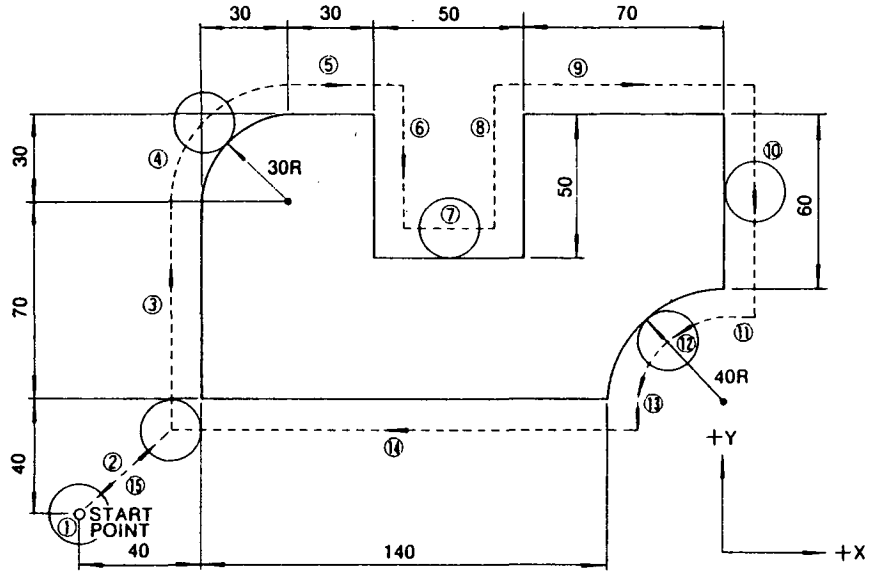


Fig. 4.21

(Program example)



① G91 G01 Z-25. F150;
② G46 X40. Y40. D10 F300;
③ G45 Y70.;
④ G45 G02 X30. Y30. I30.;
⑤ G45 G01 X30.;
⑥ Y−50.;
⑦ G48 X50;
⑧ Y50.;
⑨ G47 X70.;
⑩ G47 Y−60.;
⑪ G47 X0;
⑫ G46 G03 X−40. Y−40. J−40.;
⑬ G46 G01 Y0;
⑭ G47 X−140.;
⑮ G46 X−40. Y−40.;
⑯ Z25.;

Fig. 4.22

4.2.13 RETURN-TO-MACHINE COORDINATE SYSTEM (G53)

With Motionpack-110, there are two types of coordinate systems: machine coordinate system (intrinsic coordinate system of the machine, to the zero point of which automatic return is easily made in accordance with Par. 3.2 "MANUAL RETURN-TO-REFERENCE POINT"), and the absolute coordinate system (to be established by G92).

Command G53 is programmed, as given below, to move the machine from the current position designated in the absolute coordinate system temporarily to position X, Y, or Z expressed in the machine coordinate system in that block only.

(G90) G53 X ··· Y··· Z···;

NOTE

1. Program G53 only with G00 or G01 belonging to the 01 group.

2. When G53 command is given while a position offset is on, the offset is temporarily cancelled. Generally, cancel any offset before giving a G53 command.

3. If the machine lock function is ON when a G53 command is given, the command values that are only displayed while the machine lock function is OFF are also displayed to the end. If the machine lock function is switched on and off during a G53 block, correct positioning cannot be obtained.

   However, if the entire G53 block is executed in the machine lock OFF state, correct positioning is possible even when a machine lock operation intervenes prior to the execution.

4. Execute a G53 command by designating G90. Even if the G91 designation is left unchanged, the values are treated as G90 values.

(Program example)
G90 G53 G00 X100. Y300. ;

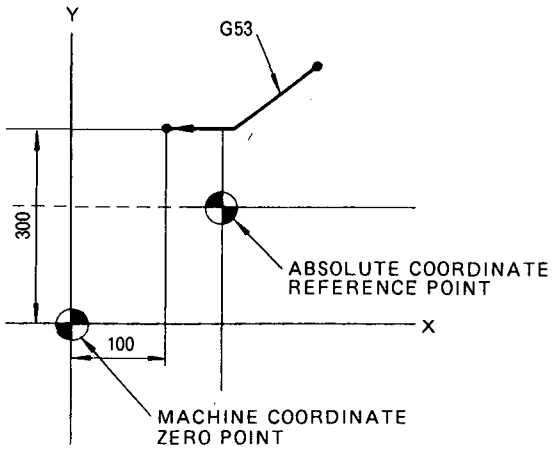


Fig. 4.23

4.2.14 NOTCH SIGNAL COMMANDS A (G68, G69)

The notch signal can be turned ON and output at the previously programmed position by the time the positioning point is reached after positioning starts.

Whether or not the notch signal is used is specified by using parameter #1003 D4.

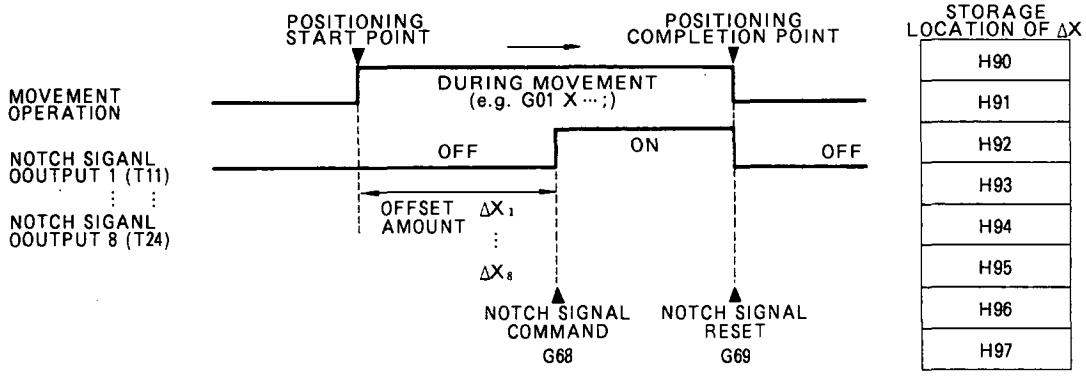


Fig. 4.24 Notch Signal

(1) Command Method

The notch signal is commanded in G68 prior to a positioning command block; it is output at the position where the offset value data indicated by offset value number H·· is passed through from the positioning start point.

The output signal is reset by using the G69 command.

(Program example)

```
G68 XH··YH··;
      :
G68 XH90 YH94;
```

···Notch signal output command Block
(When the X-axis passes through the position indicated by H90, T11 is turned on; when the Y-axis passes through the position indicated by H94, T22 is turned on.)

```
G01 X100. Y200. F50;
G69;
```

···Positioning command Block
···Notch signal output reset command Block

(2) Output and Number of Output Points

T-BCD code output signal is used. Combinations of the offset value number H·· and output signal are fixed as listed in Table 4.6. A maximum of eight pairs are available.

Table 4.6

Offset Number	Output Signal Name
H90	T11
H91	T12
H92	T14
H93	T18
H94	T21
H95	T22
H96	T24
H97	T28

(3) Offset Value Data Write-in

(a) Offset value data write-in from the CRT control station is the same as normal offset value write-in. See Par. 7.4.
(b) When offset value data is written in the program, offset value write-in command G10 is used.

G10 H··· Q···;

Where the offset value number is specified in H and offset value data is specified in Q.

(4) Notes on Use of the Command
(a) The output signals vary a maximum of 0.6 sec. Note that the command cannot be used for applications requiring high precision.
(b) If the notch signal is used, the T function cannot be used.

4.2.15 NOTCH SIGNAL COMMANDS B (G66, G67)

The notch signal can be turned ON and output at the previously programmed position by the time the positioning point is reached after positioning starts, the same as for notch signal commands A.

Whether or not the notch signal is used is specified by using parameter #1003 D4.

Notch Signals A and B cannot be used at the same time. The usable output points are one pont for high speed (G66) and one point for low speed (G67).

(1) Command Method

G66 X··· M8□;	or	G67 Y··· M8□;

The notch signal is commanded in G66 (high speed) or G67 (low-speed) prior to positioning command block; it is output at the position where the setting value of X- Y- or Z-axis occurs. Output signal designation is commanded at output command code M81 to M88.

To reset the output signal, turn on the MST completion signal (FIN). The mode selection, reset operation and alarm occurrence are also reset.

(Program example)

```
G00  X0. ;
G66  X20. M81 ;   ... Notch signal output designation block
G67  X50. M85 ;       (Turn on T11 at X20. passing.
                       Turn on T22 at X50. passing.)
G00  X100 ;       ... Positioning command block
```

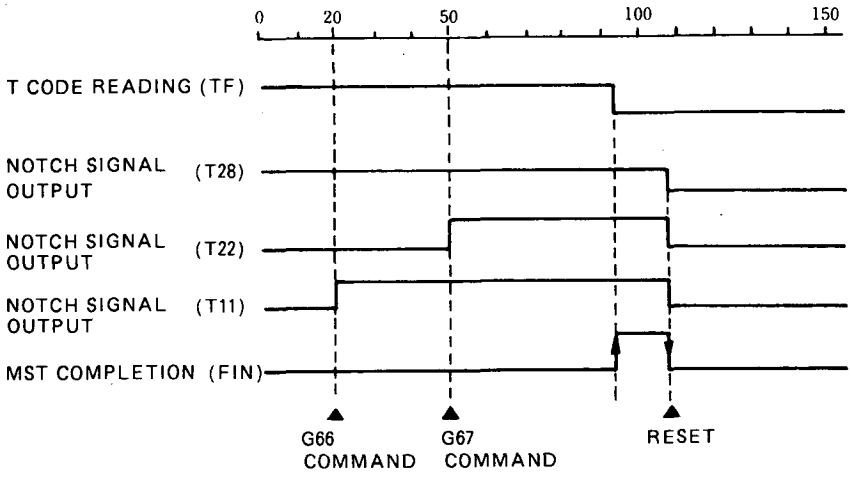


Fig. 4.25

(2) Output Signal and Output Designation Code

T-BCD code output signal is used. Output designation code and output signal name are fixed, as listed in Table 4.7. Both high and low speeds can be used at any given point.

Table 4.7

Output Designation Code	Output Signal Name
M81	T11
M82	T12
M83	T14
M84	T18
M85	T21
M86	T22
M87	T24
M88	T28

(3) Notes on Use of the Command

(a) If the notch signal is used, the T function or M81 to M88 in the M function cannot be used.

(b) Only for G66 and G67, M-BCD code output signals by the M code commanded in the same block are not output.

(c) Output signal T28 is turned ON automatically if the two-point notch signals (G66 and G67) are used simultaneously during one movement. For using two-point notch singls, output designation code M88 cannot be commanded.

(d) If the G66 and G67 are commanded two times or more during one movement, the latest commanded block is effected.

4.2.16 COMBINED OPERATION COMMANDS (G80 to G99)

A specific motion extending over blocks is simplified by using the combined operation command in a block. Eight types of combined operation commands are available. G80 is used to cancel these commands. Initial point level return and R point level return can be specified in G98 and G99. Setting data σ used with G83 is set by using parameter #1202.

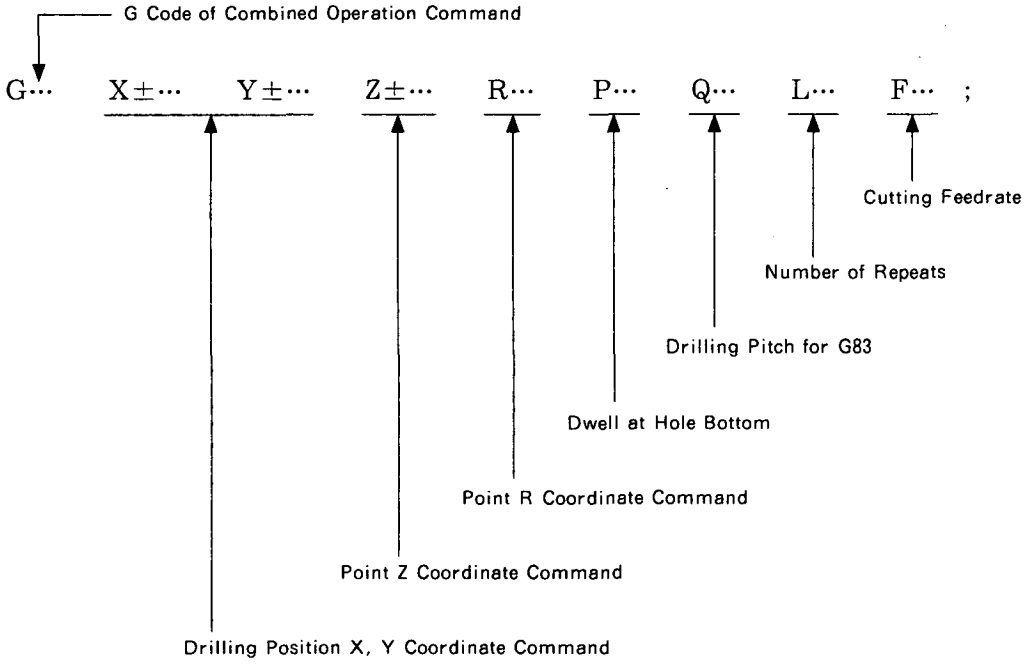
(1) List of Combined Operaion Commands

Table 4.8 lists the combined operation command G codes and operations.

Table 4.8

G Code	Plunging	At hole bottom	Retraction	Application
G80	—	—	—	Cancel
G81	Cutting feed	—	Rapid traverse	Drilling
G82	Cutting feed	Dwell	Rapid traverse	Spot facing
G83	Wood pecker feed	—	Rapid traverse	Deep hole drilling
G84	Cutting feed	Reverse running of spindle after dwell	Forward running of spindle after cutting feed	Tapping
G85	Cutting feed	—	Cutting feed	Boring
G86	Cutting feed	Spindle stop	Rapid traverse → spindle start	Boring
G89	Cutting feed	Dwell	Cutting feed	Boring

(2) Command Format



Operations ① through ④ are executed in one cycle with the commands shown above.

① Positioning the drilling position (X, Y)
② Rapid traverse to R point
③ Drilling to Z point
④ Return to R point or to initial point

Note: ---- : Rapid traverse
——— : Interpolation traverse

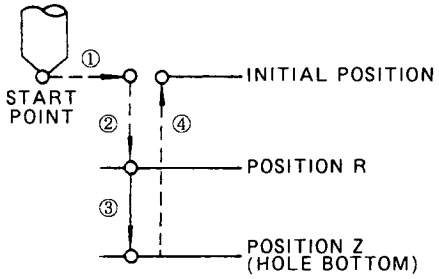


Fig. 4.26

Number of repeats is specified by the symbol L. Where L is not given, number of repeats is regarded as "1." If 0 is given for L, only positioning to (X, Y) is made. Z axis returing position at the end of combined operation can be designated by the following G code.

G Code	Meaning
G98	Initial level return
G99	Position R level return

If there are many drilling points in a short distance, R point level return can be used to perform drilling in a short period of time as compared with initial point level return.

(3) List of Combined Operation Commands

Table 4.9 List of Combined Operation Commands

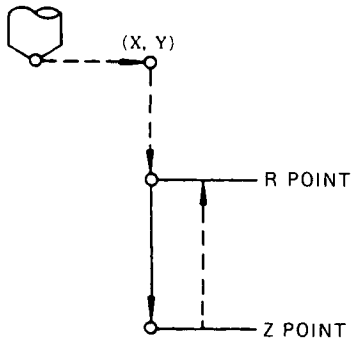
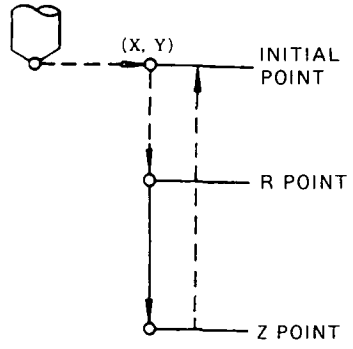
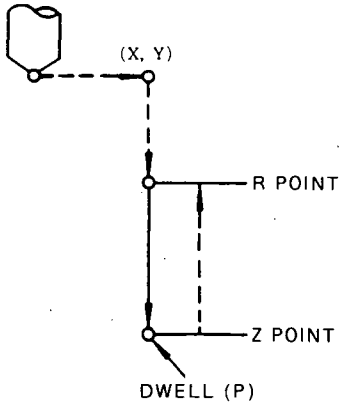
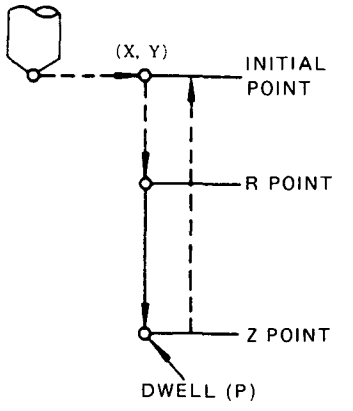
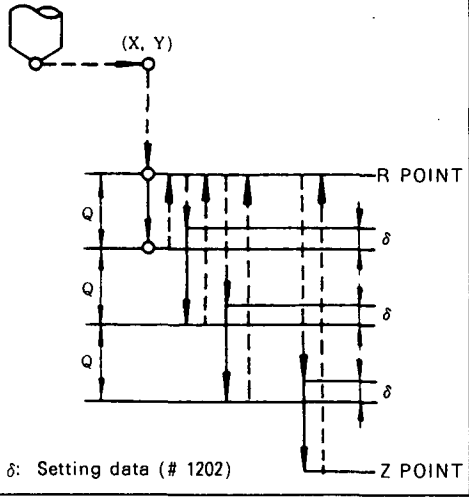
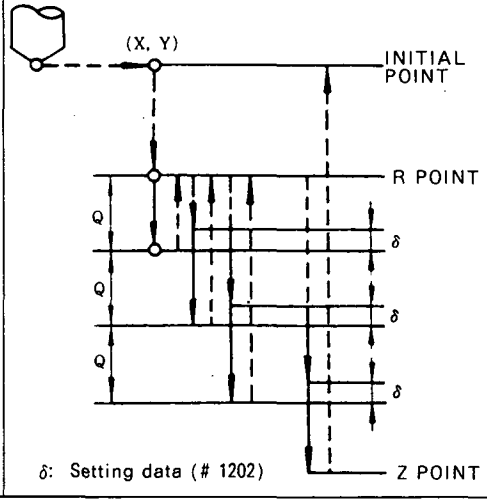
	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G80 Cancel	G80;	
G81 Drilling	G81 X ··· Y ··· Z ··· R ··· L ··· F ··· ; 	
G82 Spot Facing	G82 X ··· Y ··· Z ··· R ··· P ··· L ··· F ··· ; 	
G83 (Fixed Pitch) Deep Hole Drilling	G83 X ··· Y ··· Z ··· R ··· Q ··· L ··· F ··· ;  δ: Setting data (# 1202)	 δ: Setting data (# 1202)

Table 4.9 Combined Operation Commands (Cont'd)

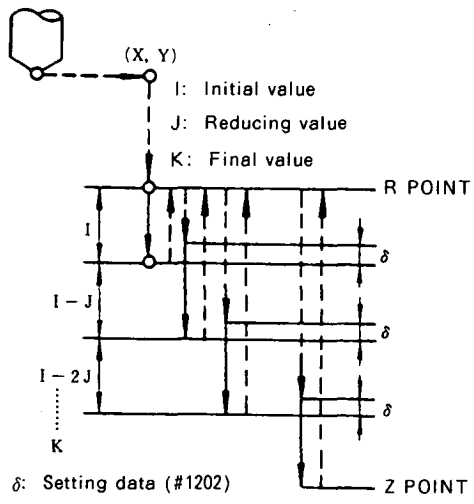
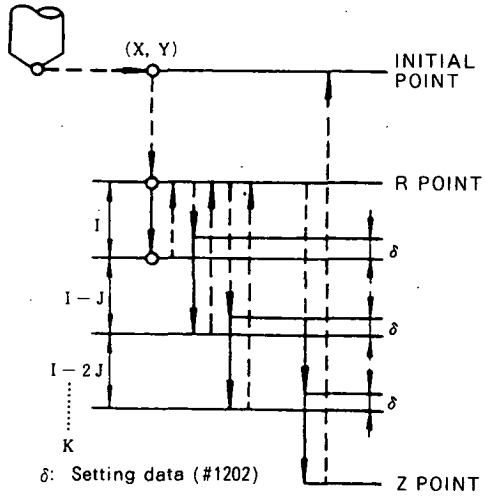
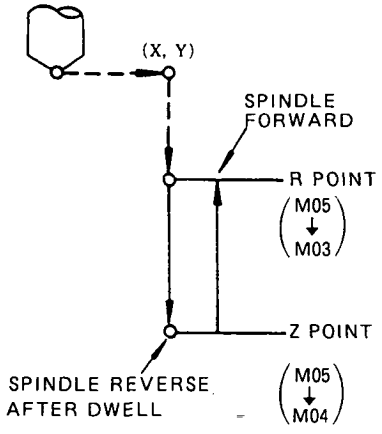
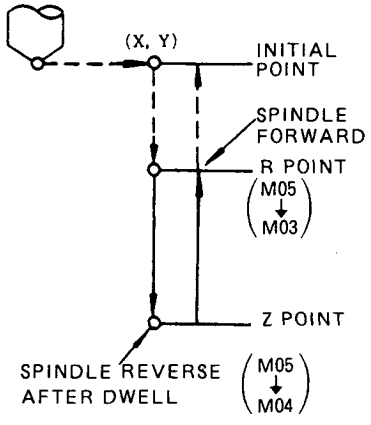
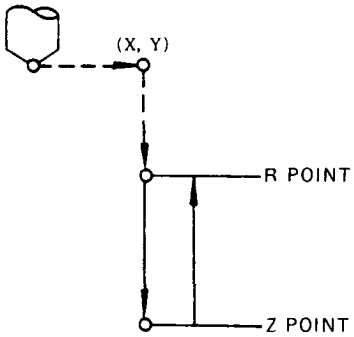
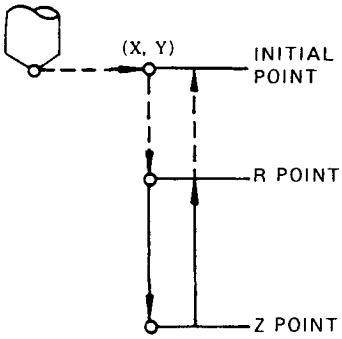
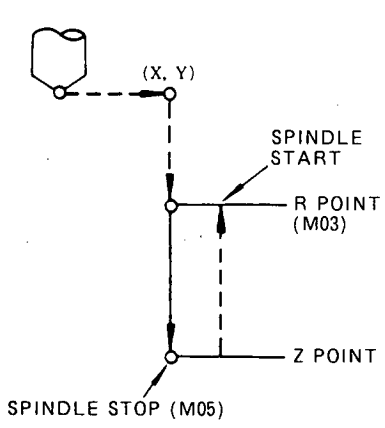
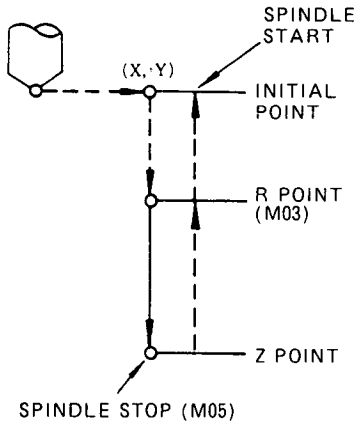
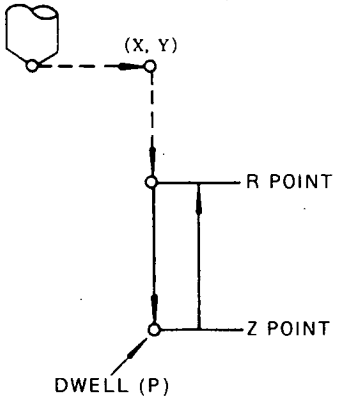
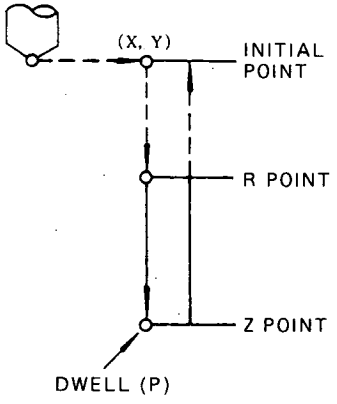
	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G83 (Variable Pitch) Deep Hole Drilling	G83 X ··· Y ··· Z ··· R ··· I ··· J ··· K ··· L ··· F ··· ; 	
G84 Tapping	G84 X ··· Y ··· Z ··· R ··· P ··· L ··· F ··· ; 	
G85 Boring	G85 X ··· Y ··· Z ··· R ··· L ··· F ··· ; 	

Table 4.9 Combined Operation Commands (Cont'd)

	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G86	G86 X ··· Y ··· Z ··· R ··· L ··· F ··· ;	
Boring		
G89	G89 X ··· Y ··· Z ··· R ··· P ··· L ··· F··· ;	
Boring		

(Program example)

Ⓐ G98 G90 G81 X··· Y··· Z-7000 R-4000 F··· ;
··· Return to initial point, absolute

Ⓑ G99 G91 G81 X··· Y··· Z-7000 R-4000 F··· ;
··· Rturn to point R, incremental

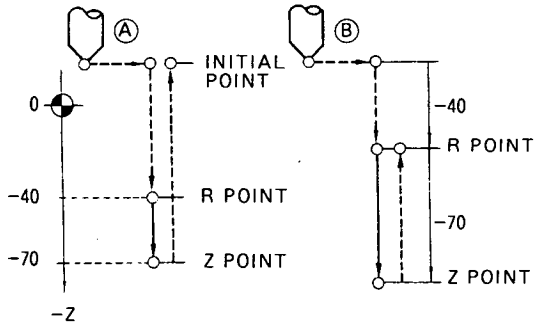


Fig. 4.27

© N1 G92 X0 Y0 Z0 ;
N2 G98 G90 G81 X1000 Y1000
Z-5000 R-2000 F100 ; →
N3 G91 X2000 R-3000 ; →
N4 Z-5000 ; →
N5 G99 Z-4000 R-5000 ; →
N6 G80 G00 Z5000 ; →

Absolute Position		Remarks
Z =	R =	
−5000	−2000	Combined operation command
−5000	−3000	Change in X, R
−8000	−3000	Change in Z
−9000	−5000	Change in R, Z
Tool moves to Z = 0		Combined operation command cancel

Newly programmed addresses only are changed including the case where switching is made from G90 to G91 such as N2→ N3 indicated in the above case. As for the non-programmed addresses, the positions programmed in the earlier blocks are maintained.

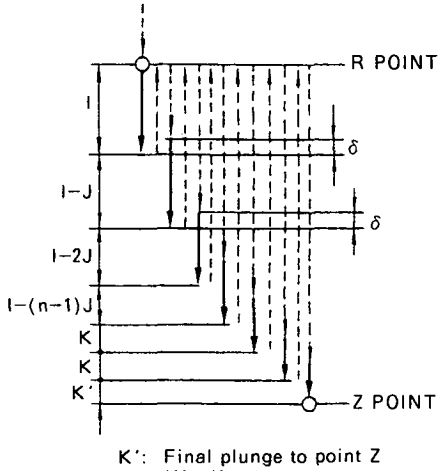
NOTE

Since symbols P, Q, I, J and K are modal in combined operation command mode, if once commanded, they are effective until the combined operation command is cancelled.

(4) Cautions of Combined Operation Command

(a) Variable pitch command (G83)
In the deep hole drilling cycles of G83, variable drilling pitch can be programmed with symbols I, J, K instead of symbol Q for programming a constant drilling pitch.

I: Initial value
J: Reducing value in 2nd and subsequent plunges
K: Final value
} Command is given without signs.



K': Final plunge to point Z
K' ≦ K

Fig. 4.28

The value of δ is given by setting (#1202).

NOTE

1. Q, I, J, K are modal during combined operation command modes and are effective until the combined operation command is cancelled. Specify them without signs.

2. Variable pitch can also be programmed by symbol Q instead of I. Furthermore, when instructions Q, I, J, K are given simultaneously, drilling cycle is executed with variable drilling pitch with Q as the initial value.

   Q0 must be commanded in the block including modal G code before programming variable pitch with I, J, and K.

(Program Example)

G91 G83 X··· Y··· T-30. Z-5500 I1000 J100 K400 F···;

Drilling pitch			
1st plunge	···	10 mm	⇦ I1000
2nd plunge	···	9 mm	
3rd plunge	···	8 mm	
4th plunge	···	7 mm	
5th plunge	···	6 mm	
6th plunge	···	5 mm	⇦ K400
7th plunge	···	4 mm	
8th plunge	···	4 mm	
9th plunge	···	2 mm	⇦ K'
Total		55.00 mm	⇦ Z-5500

(b) When the combined operations are executed by turning on the SINGLE BLOCK switch, a temporary stop is made in an intermediate position, and the temporary stop lamp lights up.

(1) After positioning to (X, Y) point
(2) After positioning to R point
(3) After termination of each cycle, if L command has been given.

The single block stop after the completion of combined operation is normal, and the FEED HOLD lamp does not light up.

(c) Be sure to designate the R point and Z point by programming R and Z before entering the combined operation command mode. R point and Z point are cleared when combined operation commands are cancelled.

(d) When executing combined operation commands with the symbol data changed, the block requires any of the following symbol commands. The combined operation will not be executed otherwise.

X, Y, Z

(e) When M, S or T code is given in the combined operation command, M, S, T signals are sent at the first positioning in the block. In general, M, S, T should be commanded in their own block.

(f) An input error is triggered when any one of the following G codes is programmed in the combined operation command mode.

G codes of * group except for G04

When programming G92, G28 etc., make sure to cancel the combined operation command in advance.

(g) During the combined operation command mode, only a dwell block (G04) can be inserted. Correct dwell will be served.

(h) Start of spindle forward or reverse (M03 or M04) should be executed by automatic operation commands before entering combined operations. Do not enter into combined operations after manually switching the spindle between forward and reverse.

(i) Execution of subprogram (M98) in combined operation command mode. In a combined operation command mode, M98P··· L···; can be programmed to call up subprogram and the combined operation is continued in the subprogram. The address P (program No. of the first block of subprogram) with M98 command destroys temporary the contents of address P for designation of dwell time, but after the jumping to subprogram, it resumes the contents.

Programming consideration of M98 in the combined operation command mode is the same as those of other than combined operation command modes. (e.g. Restriction of execution to no more than four levels.)

(j) Changing of R point and Z point

When R is commanded instead of Z during the execution of combined operation in G91 mode, Z becomes incremental value from the new R point. Care should be taken.

G92 X0 Y0 Z0
G91 X··· Y··· R-5.0

	Point R	Point Z
Z-10. 0F··· ;	−5.0	−10.0
X··· R-7.0 ;	−7.0	−12.0
X··· Z-3.0 ;	−7.0	−10.0
R-4.0 Z-11.0 ;	−4.0	−15.0

(Program example)

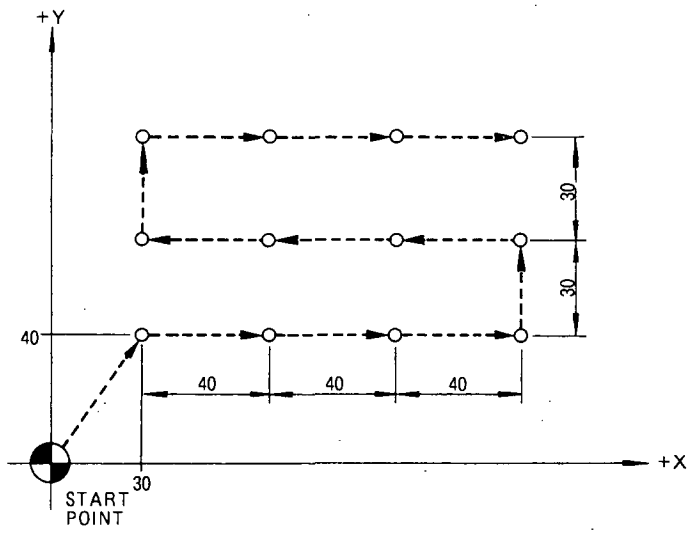


Fig. 4.29

```
  :
N10  G92  X0  Y0  Z0 ;
N11  G90  G98 ;                    ···    Return to initial point, Absolute
N12  G81  X3000  Y4000  R-2000  Z-3000  F-200 ;  ···  Drilling cycle
N13       M98    P400 ;            ···    Jump to subprogram
N14  G00  X0  Y0 :
N15       T05  ;                   ···    Tapper selection
N16       M06 ;                    ···    Tool change
N17  G84  X3000  Y4000  R-2000  Z-3000  F2000 ;  ···  Tapping cycle
N18       M98  P400 ;              ···    Jump to subprogram (Note)
N19  G00  X0  Y0 ;
  :
O400 ;
N100  G91 X4000   L3 ;
N101      Y3000 ;
N102      X-4000  L3 ;
N103      Y3000 ;
N104      X4000   L3 ;
N105  G09 G80   ;
N106      M99   ;
```

Subprogram for drilling position pattern.

4.2.17 ABSOLUTE/INCREMENTAL COMMAND DESIGNATION (G90, G91)

These G codes are for designating whether the movement data following the axis codes are absolute values or incremental values.

(1) G90·····Absolute Designation (Fig. 4.29)

In all the blocks following a block containing G90, the movement data following X, Y, Z are regarded as absolute values.

G90 G00 X··· Y··· Z···; → Absolute command

(2) G91·····Incremental Designation (Fig. 4.29)

In all the blocks subsequent to a block containing G91, motion data are treated as incremental.

G91 G01 X··· Y··· Z··· F···; → Incremental command

(3) G90 and G91 are modal G codes in the same group and remain in absolute or incremental command values unless command change (G91 for G90 or G90 for G91) is programmed.

NOTE

When the power is turned on, G90 absolute is automatically selected.

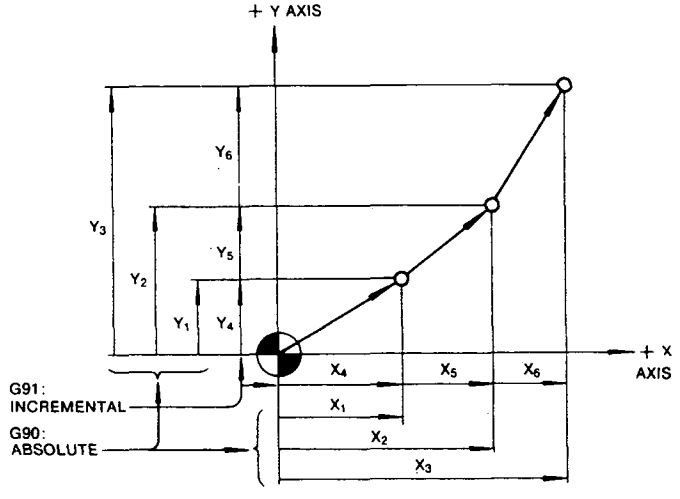


Fig. 4.30

4.2.18 PROGRAMMING OF ABSOLUTE ZERO POINT (G92)

Before programming movement commands, an absolute coordinate system may be established, so that all the subsequent absolute movement commands will be effected on this coordinate system.

(1) G92 X··· Y··· Z···;

With this command, the current machine position is entered as a point (X, Y, Z) in one arbitrarily selected absolute coordinate system. That is, this command designates the signed distances in the three coordinate directions from a desired coordinate zero point (0, 0, 0), designating zero point in this way. See Fig. 4.30.

(2) G92 cannot be programmed with other G codes, F, M, or T codes in the same block.

NOTE

1. In principle, program G92 while all position offset commands are cancelled.
2. When the power is turned on, the current position is set as coordinate (0, 0, 0). Be sure to execute the return motion to the reference point before starting operation.

(3) As a special example, coordinate shift equivalent to G92 can be made by position cancel operation from the CRT control station.

(Program example)
G92 X50000 Y30000 Z40000;

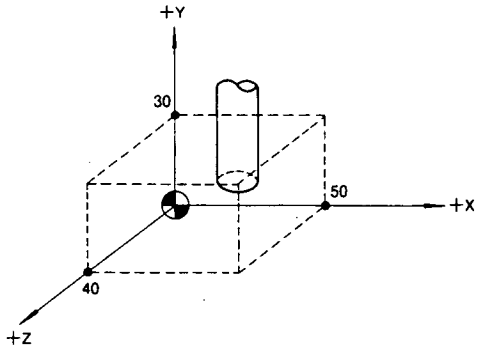


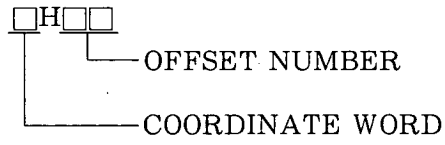
Fig. 4.31

4.3 EXTERNAL OFFSET COMMAND (INDIRECT SPECIFICATION)

In memory operation, movement can be made by assuming data stored in the programmed offset number to be travel distance.

That is, different movements can be made in a single program by changing the offset value rather than the program.

(1) The offset number is specified immediately following the coordinate word (X, Y, Z, I, J, K, F, L, P, R, Q).



(Program example)

① Assuming that the program contains
G01 XH10 YH20; and

② the offset value contents are
H10 = 50.0 mm, H20 =5.0 mm
the program in ① becomes equivalent to
G01 X50.0 Y5.0;

③ when the offset value contents are changed to
H10 = 65.0 mm, H20 = 3.5 mm
the program in ① becomes equivalent to
G01 X65.0 Y3.5;

④ When the sign ⊖ is added immediately preceding the H, pluse and minus signs of the offset value contents are converted.

G01 X-H12 Z-H23;

(2) The offset value is changed by directly depressing the keys on the CRT control station keyboard, writing a new offset value in a program, or reading the external value in I/O for offset value write-in. For details, see Par. 4.2.7.

4.4 SIGNAL OUTPUT COMMANDS

These commands are for causing the machine (auxiliary machines, etc.) to perform movements under programs. The commands are in two function types; T-function and M-function.

4.4.1 T-FUNCTION

The T-function commands are used to designate tool Nos., etc.

(1) Command Format

Two digits following the code T designate T Nos. Leading zeros may be omitted.

T□□
└── T-designation number

(2) Output

Where a movement command and a T-command are programmed in the same block, a BCD 2-digit T-code output signal (T_{11} to T_{28}) is output from the Motionpack to the machine simultaneously with the movement command, and then, with a delay of t msec, a T-code read signal (TF) is output. The delay time is set by a parameter #1100.

(3) Completion Signal

The machine reads the T-BCD code output, and returns and MT completion signal (FIN) to Motionpack. Then, the T-code read signal is cleared. It is also cleared by a resetting operation or a mode change operation.

(4) Effective Range

However, the T-BCD code output signal (T_{11} to T_{28}) is not cleared when an MT completion signal is received, but is retained until a new T-command is received. This means that T-code signals are modal, and remain effective after being used until a subsequent T-command is given. Fig. 4.32 shows the time chart covering the above time relationship.

(5) Related Signal (Travel Completion Signal, DEN)

Travel completion signal (DEN) is output after completing travel, when T code is commanded in the same block as travel command. With T code only commanded, the DEN is output with BCD code simultaneously. Selecting only the travel command does not make any command.

The DEN is released by MST completion signal (FIN), resetting, or mode changing.

(6) Where several T codes are commanded in the same block, a final command among commanded T codes is effective. Fig. 4.32 shows the time chart covering the above time relationship.

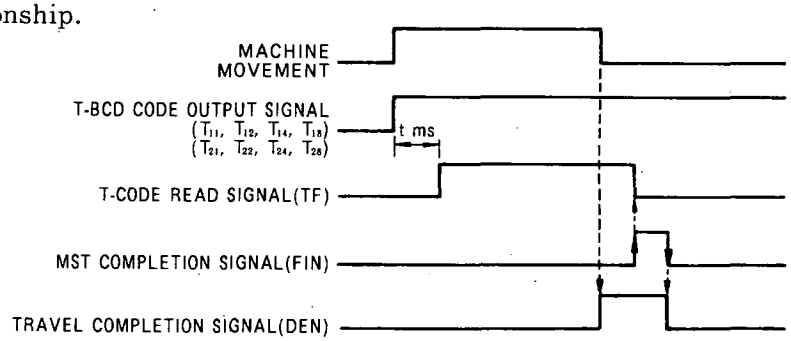


Fig. 4.32

(7) Special Use of T Function Output Terminal

T function output terminal can be used for a notch signal output. Refer to Par. 4.2.15.

4.4.2 M-FUNCTION

(1) Command Format

M-functions are programmed by M and the two digits following it. Except for special M-codes, the definitions of M03 to M89 are left to the user.

M□□
└── M-designation number

(2) Output

Where a movement command and an M-command are programmed in the same block, a BCD 2-digit M-code output signal (M_{11} to M_{28}) is output from the Motionpack to the machine simultaneously with the movement command, and then, with a delay of t ms, an M-code read signal (MF) is output. The delay time is the same as that for T-code read signal. It is set by parameter, #1100. M-code read signal (MF) is not output in M00, M02, M30 or internal processing M-code (M90 to M99).

(3) Completion Signal

The machine reads the M-BCD code outpout, and returns an MT completion signal (FIN) to Motionpack. Then, the M-code read signal is cleared. It is also cleared by a resetting operation or a mode change operation.

(4) Related Signal (Travel Completion Signal, DEN)

Travel completion signal (DEN) is output after completing travel, when M code is commanded in the same block as travel command. With M code only commanded, the DEN is output with BCD code simultaneously. Selecting only the travel command does not make any command.

The DEN is released by MST completion signal (FIN), resetting, or mode changing.

(5) Where several M codes are commanded in the same block, the final command among commanded M codes is effective. Fig. 4.33 shows the time chart covering the above time relationship.

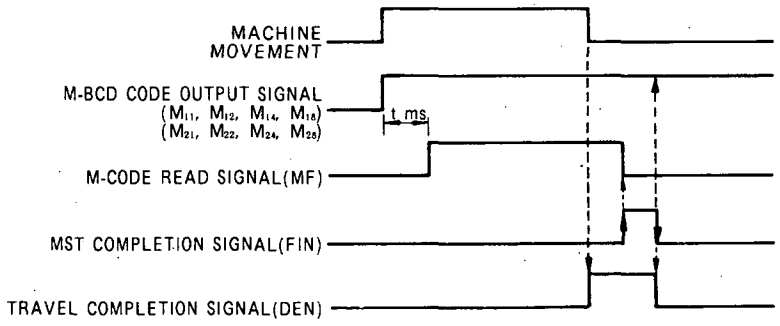


Fig. 4.33

4.4.3 M-CODES FOR STOP (M00, M02, M30)

(1) M00 (Program stop)

M00 is to be programmed in a command when an automatic operation must be interrupted at a certain position. When M00 is read, the system stops the execution of the program after that block, and, at the same time, outputs an M00 signal. To restart the program, a start signal (STR) is turned on.

(2) M02 (Program end)

M02 is programmed at the end of one program. When the system reads an M02, it stops the automatic operation after that block, and, simultaneously, it outputs an M02 signal. The system will not start again even when a start signal is input immediately afterward. To restart the system, a reset signal must be turned on, followed by a start signal.

(3) M30 (End of program, wait at leading end)

M30 is programmed at the end of a program. when the system reads an M30 during automatic operation, it stops the automatic operation after executing that block, and, simultaneously, outputs an M30 signal. Then, it returns to the leading end of the program and waits. The program is restarted when a start signal is turned on. Simultaneously, M30 signal output is OFF.

(4) External output signal (BCD code output) is not output in M00, M02, or M30.

4.4.4 M-CODES FOR INTERNAL PROCESSING (M90 to M99)

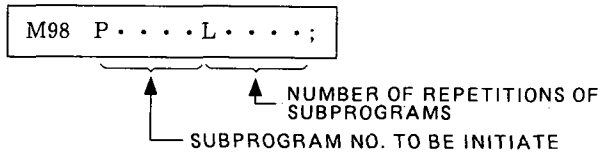
M90 through M99 are used for internal processing, and they do not output any signals (BCD). M98 and M99 are for initiating subprograms and for ending them.

4.4.5 SUBPROGRAM (M98, M99)

Numbered and stored subprograms can be called up as many times as desired for execution.

(1) Initiating Subprograms (M98)

The subprogram designated by P is initiated, and executed L times. When no L is programmed, the subprogram is executed only once.



(2) Subprogram End (M99)

M99;

M99 is written at the end of a subprogram in a separate block. When M99 comes at the end of the subprogram to which M98 designated, the program returns automatically to the block next to the M98 block.

(Program example)

The sequence in which the main program initiates a subprogram and the subprogram is executed, are shown below.

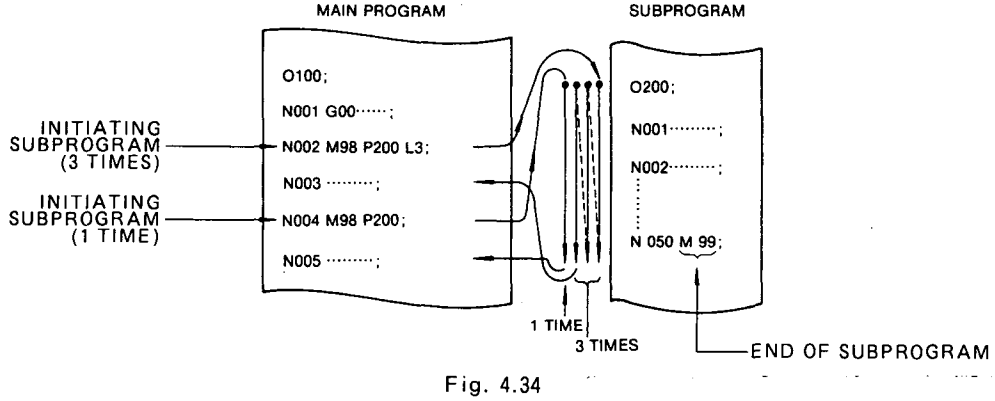


Fig. 4.34

(3) Nesting Program

Subprograms can be nested to a maximum of four levels.

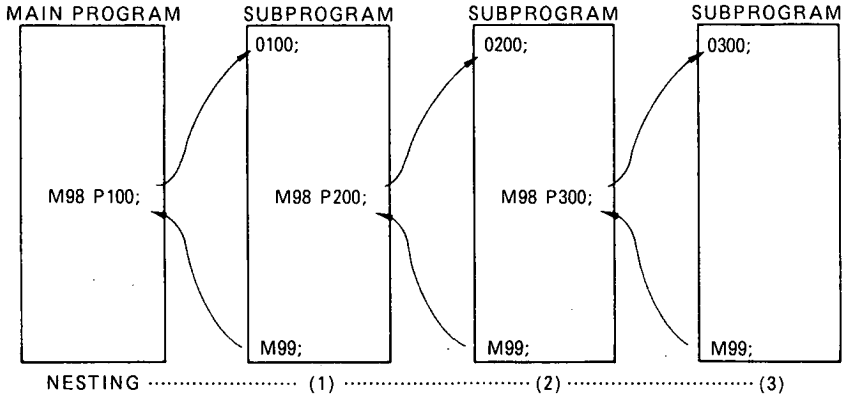


Fig. 4.35

(4) Special Use of M99

When M99; is written in end of the main program in the separate block, the main program returns to its leading end and will be re-executed endlessly.

NOTE

1. If the subprogram No. specified by P is not found, an alarm state occurs.

2. Attempt to next subprograms over 4 times causes an alarm.

4.5 S FUNCTION

The S function is used to program the spindle rotation speed.

(1) Command Format

The spindle rotation speed (rpm) is directly specified in a 5-digit numeric value following code S. The leading zeros can be omitted.

S□□□□□
PROGRAMMED SPEED(rpm)

4.5 S FUNCTION (Cont'd)

(2) Output

When the S code is programmed in the block within which a movement command appears, speed command analog voltage is output to the spindle drive unit from the Motionpack (axis module for the spindle) simultaneously with the movement command. In addition, S code read signal (SF) is output in a delay of t ms. The delay time is set in parameter #1100 as with the T code read signal.

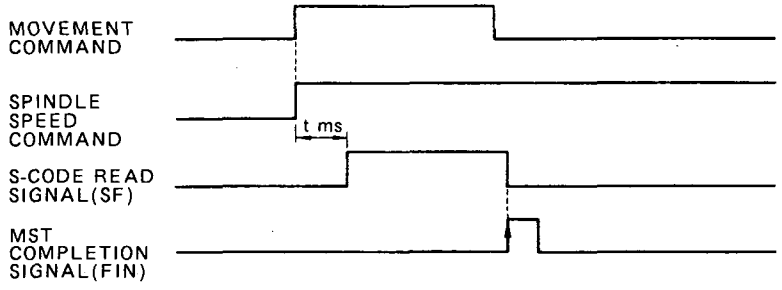


Fig. 4.36

NOTE

To operate the spindle, the spindle normal rotation signal (FRN), spindle reverse rotation signal (RRN), and spindle stop signal (SSTP) are also required. See Par. 9.2.2.

(3) Completion Signal

When the spindle reaches the speed indicated by the S signal on the spindle drive unit and MST finish signal (FIN) is returned to the Motionpack, program execution shifts to the next block. If the S code is programmed in the block within which the M or T code appears, return the MST finish signal (FIN) after all conditions have been arranged in addition to read of M code output signal, T code output signal.

(4) Effective Range

Once, the S command which is modal is programmed, it is effective until another S command is given.

The S command value is held even if the spindle stop signal (SSTP) is returned, the spindle stops, and output voltage from the Motionpack is disconnected.

Thus, if the spindle normal rotation signal (FRN) or spindle reverse rotation signal (RRN) is input again, the spindle is started according to the previously given S command value.

(5) To change the S command after the S axis starts, do not exceed the spindle speed range for the selected spindle gear.

CONTENTS

5. PARAMETERS

5.1 DESCRIPTION OF PARAMETERS

When composing a system by combining Motionpack-110 units, servo drives and servomotors with a machine, various constants must be set to designate the control specification of the Motionpack-110 to adapt the system performance to the requirement and to the machine performance. These constants are given as parameters to Motionpack-110.

Examples of parameter constants include the number of axes to be controlled, the feedrate range, and the range of position loop gains. The parameters must be determined in the system design stage, and must be set prior to the start of operation.

Before shipment from the factory, Motionpack-110s are set to the standard parameters. The preset parameters must be checked prior to starting operation.

5.2 VARIETIES OF PARAMETERS

The parameters are classified into six groups: system specifications, position command units, machine specifications, servo specifications, return-to-reference point, and spindles, as explained below.

Table 5.1 List of Parameters

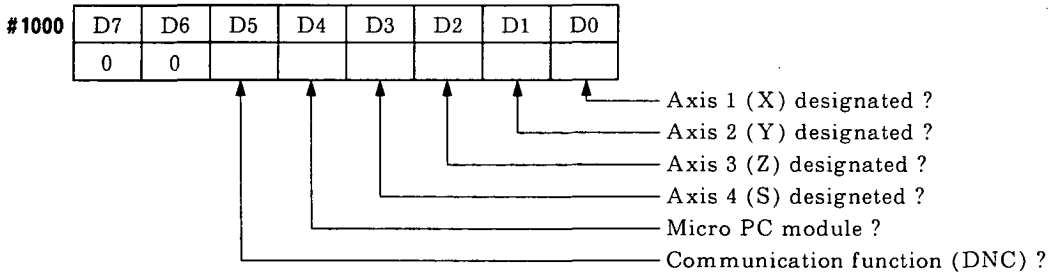
Parameter No.	Name	Range	Setting Unit
#1000	Function selection (setting axis to be used)	"0" or "1" in a bit	—
#1001	Function selection (expansion memory)	"0" or "1" in a bit	—
#1002	Function selection (program No. designation)	"0" or "1" in a bit	—
#1003	Function selection (notch signal)	"0" or "1" in a bit	—
#1004	Internally reserved	Fixed by "0"	—
#1005	Function selection (decimal point)	"0" or "1" in a bit	—
#1006	Axis omission designation	"0" or "1" in a bit	—
#1007 - #1008	Internally reserved	Fixed by "0"	—
#1009	Transmission setting in communication function	"0" or "1" in a bit	—
#1100	MF, SF, TF signal delay time setting	0 to 32767	8 ms
#1101	Max feedrate setting at manual feed	1 to 3200	7.5 mm/min
#1102	Interpolation max feedrate setting	1 to 24000	1 mm/min
#1103	Internally reserved	Fixed by "0"	—
#1104 - #1118	Jogging feedrate setting	1 to 24000	1 mm/min
#1119 - #1121	Internally reserved	Fixed by "0"	—
#1122 - #1124	Step feed displacement distance setting	1 to 32767	0.001 mm
#1125	Reference point area	0 to 32767	±0.001 mm
#1126 - #1129	Internally reserved	Fixed by "0"	—
#1200 - #1201	Internal data area	—	—
#1202	Combined operation command (G83) setting data	0 to 32767	0.001 mm
#1203 - #1209	Internal data area	—	—
#1400 #1600 #1800	Internally reserved	Fixed by "0"	—
#1401 #1601 #1801	Dorift compensation	Fixed by "1" ("0" under adjustment)	—
#1402 #1602 #1802	Soft LS checking	"0" or "1"	—
#1403 #1603 #1803	Direction of return-to-reference point	"0" or "1"	—
#1404 #1604 #1804	Internally reserved	Fixed by "0"	—

Parameter No.	Name	Range	Setting Unit
#1405 #1605 #1805	Backlash compensation value setting	0 to 127	1 pulse
#1406 #1606 #1806	Position setting range	1 to 127	±1 pulse
#1407 #1607 #1807	Exponential accel/decel time constant	1 to 127	8 ms
#1408 #1608 #1808	Feedrate command voltage setting	Fixed by "7"	—
#1409 #1609 #1809	Internally reserved	Fixed by "0"	—
#1410–#1473 #1610–#1673 #1810–#1873	Pitch error compensation setting	0 to ±127	1 pulse
#1474 #1674 #1874	Position loop gain setting	1 to 127	—
#1475 #1675 #1875	Interpolation feedrate bias setting	1 to 127	7.5 mm/min
#1476–#1479 #1676–#1679 #1876–#1879	Internally reserved	Fixed by "0"	—
#1500 #1700 #1900	Rapid traverse feedrate setting	1 to 3200	7.5 mm/min
#1501 #1701 #1901	1st linear accel/decel constant	1 to 1536	15.625 mm/s²
#1502 #1702 #1902	2nd linear accel/decel change point, feedrate	1 to 3200	7.5 mm/min
#1503 #1703 #1903	2nd linear accel/decel constant	1 to 1536	15.625 mm/s²
#1504 #1704 #1904	Return-to-reference-point approach feedrate setting	1 to 3200	7.5 mm/min
#1505 #1705 #1905	Return-to-reference-point creep feedrate setting	1 to 3200	7.5 mm/min
#1506–#1509 #1706–#1709 #1906–#1909	Internally reserved	Fixed by "0"	—
#1550 #1750 #1950	Move distance + limit value setting	100 to 99999999	0.001 mm
#1551 #1751 #1951	Move distance − limit value setting	−100 to −99999999	0.001 mm
#1552 #1752 #1952	Pitch error correction interval	500 to 99999999	0.001 mm
#1553 #1753 #1953	Pitch error correction start point	−2000000 to 2000000	—
#1554 #1754 #1954	Internally reserved	Fixed by "0"	—
#1555 #1755 #1955	Servo error range	1 to 16777216	1 pulse
#1556 #1756 #1956	Return-to-reference-point approach distance setting	1 to 90000000	1 pulse
#1557 #1757 #1957	Position command unit setting (B/A)	167772 to 1677721600	—
#1558 #1758 #1958	Position command unit setting (A/B)	167772 to 1677721600	—
#1559 #1759 #1959	Internally reserved	Fixed by "0"	—
#2000 - #2002	Internally reserved	Fixed by "0"	—
#2003	Internally reserved	Fixed by "0"	—
#2004	Spindle mode setting	1 or 3	1: ±D/A output, 3: +D/A output
#2005	Internally reserved	Fixed by "0"	—
#2006	Internally reserved	Fixed by "0"	—
#2007 - #2073	Internally reserved	Fixed by "0"	—
#2074	Internally reserved	Fixed by "0"	—
#2075 - #2100	Internally reserved	Fixed by "0"	—
#2101	Internally reserved	Fixed by "0"	—
#2102	Internally reserved	Fixed by "0"	—
#2103	Internally reserved	Fixed by "0"	—
#2104	Internally reserved	Fixed by "0"	—
#2105	Internally reserved	Fixed by "0"	—
#2106 - #2109	Internally reserved	Fixed by "0"	—
#2150	Max rotation speed of gear (L)	1 to 32767	1 rpm
#2151	Max rotation speed of gear (M)	1 to 32767	1 rpm
#2152	Max rotation speed of gear (H)	1 to 32767	1 rpm
#2153 - #2154	Internally reserved	Fixed by "0"	—
#2155	Internally reserved	Fixed by "0"	—
#2156	Internally reserved	Fixed by "0"	—
#2157 - #2159	Internally reserved	Fixed by "0"	—

5.3 SYSTEM SPECIFICATION PARAMETERS

5.3.1 SETTING AXIS FOR USE (#1000)

Motionpack-110 controls up to 4 axes (X, Y, Z, S), and the axes to be used are designated by this parameter as follows:



Set "1" for use, and "0" for non-use.
Set "0" for no designation.

(Example)

Using one axis (X)

#1000	D7	D6	D5	D4	D3	D2	D1	D0
	0	0	0	0	0	0	0	1

Using 2 axes (X, Z)

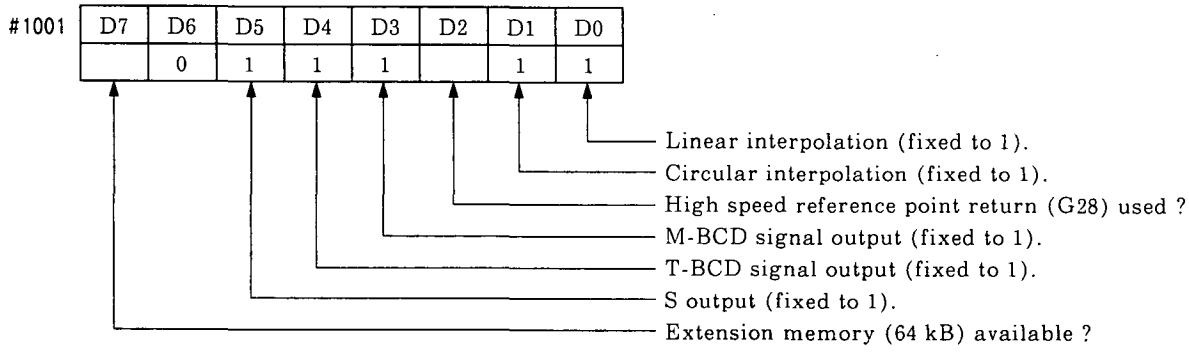
#1000	D7	D6	D5	D4	D3	D2	D1	D0
	0	0	0	0	0	1	0	1

(1) Parameter #1000-D4 is set only when there is a micro PC module, type JEFMC-B110.

(2) Parameter #1000-D5 is set only when there is a motion module with the communication function, type JEFMC -C027.

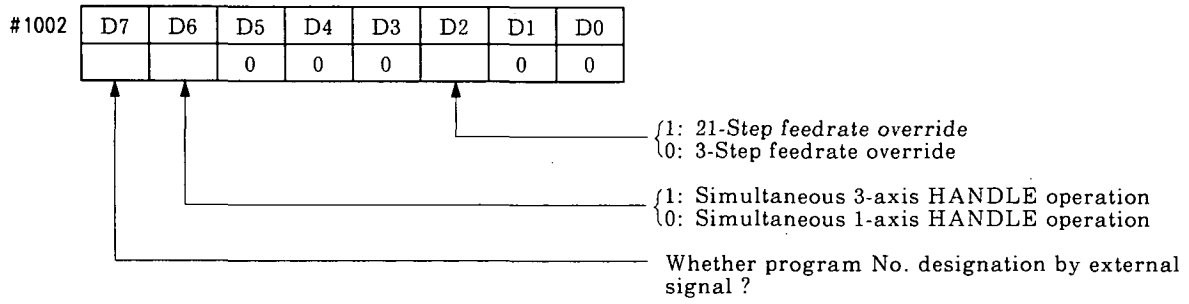
5.3.2 FUNCTION SELECTION (#1001, #1002, #1003, #1005, #1006, #1009)

This parameter is used to specify the availability of optional functions, or their use or non-use. When the optional function is required, set the corresponding bit to 1; when not required, set it to 0. Set no-designation bit to 0.



(1) If #1001-D2 is set to 0, normal automatic reference point return operation (G28) is performed. See Par. 4.2.9.

(2) Parameter #1001-D7 setting is valid only for motion modules, types JEFMC-C023 and -C027.

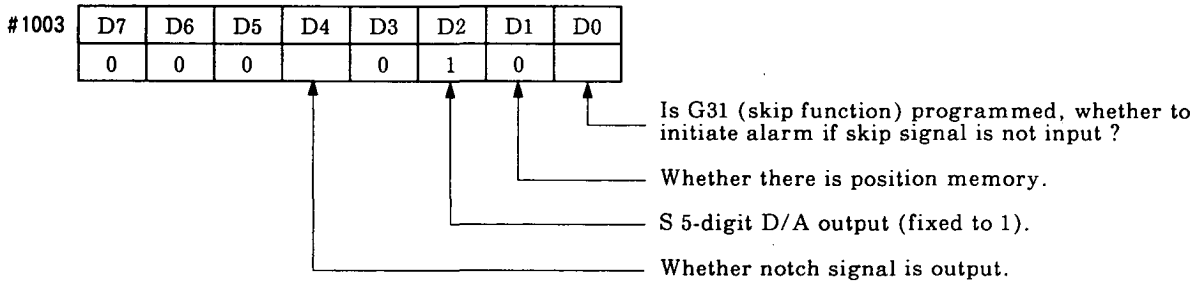


(1) If #1002 D6 is set to 0, the simultaneous 1-axis handle operation function is selected, and the axis is selected by changing the input signal (HX, HY, HZ). If #1002 D6 is set to 1, the simultaneous 3-axis handle operation function is selected.

(2) If #1002 D7 is set to 1, the program number specified in external BCD switch input is read at reset time, and there will be a delay for execution of program in memory corresponding to the number. If it is set to 0, reset has no effect.

NOTE

In parameter #1002 setting, if the program No. designation by external signal is required, reset operation in EDIT mode makes the designated-program execution dwell. In this case, 0 No. at upper-right position on program screen of CRT control station is changed for the specified No.. But the specified program does not appear on the screen, except in RUN mode.

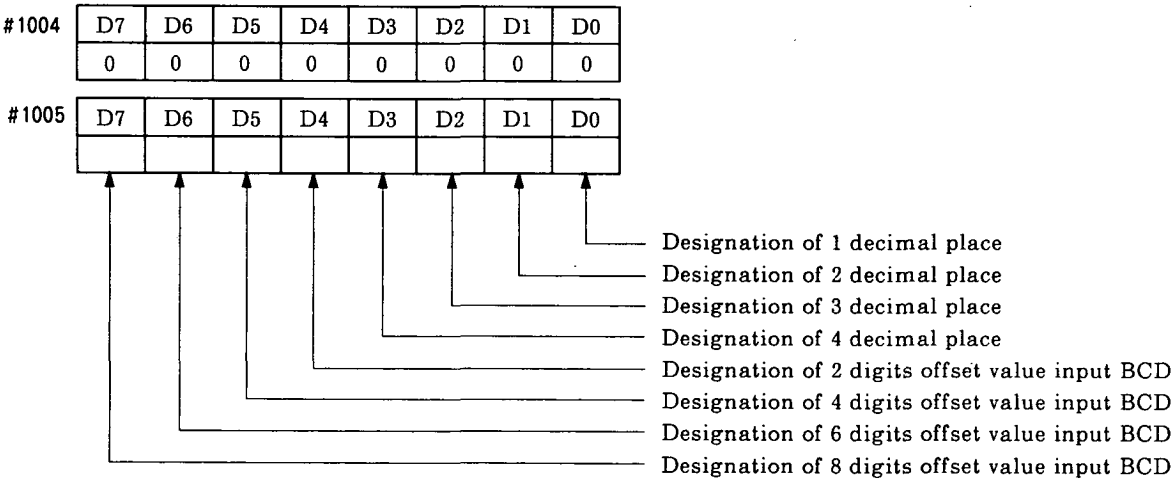


(1) If #1003 D0 is set to 1, no alarm is activated; if it is set to 0, an alarm is activated.

(2) If #1003 D1 is set to 1, the position memory is activated.

(3) If #1003 D4 is set to 1, the T function output pins (T_{11}-T_{28}) are used for notch signal output. See Par. 4.2.15.

(4) Parameters #1003-D5 and -D6 are set to specify transmission items in the communication function (DNC). If the communication function is not set, set the bits to 0.

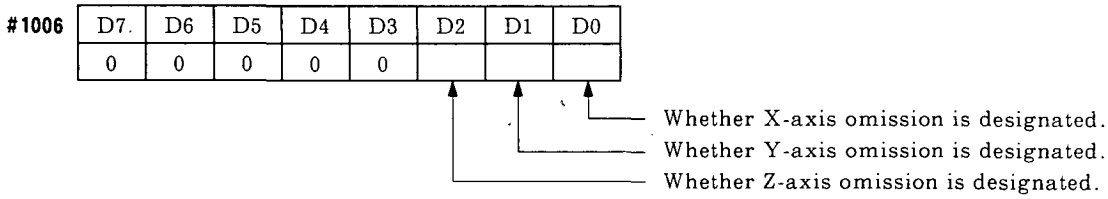


(1) If #1005-D0 to -D2 are all set to 0, decimal point representation is not made.

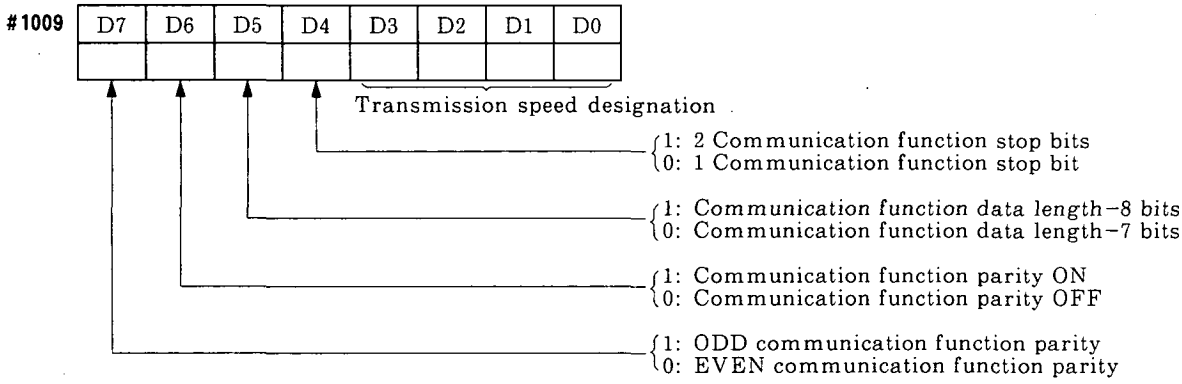
NOTE
Set only one of D0 to D2 to 1.

(2) Offset value input from an external source is made by using input signal numbers #4011 to #4014. See Par. 4.2.7.

NOTE
Set only one of D4 to D7 to 1.



(1) The axis omission function is applied only to the specified axis by turning on the axis omission signal (NEG).



(1) #1009-D0 to -D7 are set to specify transmission items in the communication function (DNC). If the communication function is not included, set all of D0 to D7 to 0.

(2) #1009-D0 to -D3 are set to specify the transmission speed (baud rate) as listed below:

D3	D2	D1	D0	Transmission Speed
0	0	0	1	300 bps
0	0	1	0	600 bps
0	0	1	1	1200 bps
0	1	0	0	2400 bps
0	1	0	1	4800 bps
0	1	1	0	9600 bps

5.3.3 MF, SF, TF SIGNAL DELAY TIME SETTING (#1100) 0 ≦ SET VALUE ≦ 32767

When the M-code read signal (MF), T-code read signal (TF) or S-code read signal (SF) is output after the M-BCD code output signal (M_{11} to M_{28}), T-BCD code output signal (T_{11} to T_{28}) or spindle speed command with a delay, the delay time is set by this parameter.

The delay can be set, with "1" representing 8 ms. For example, setting "2" means a delay of 16 ms.

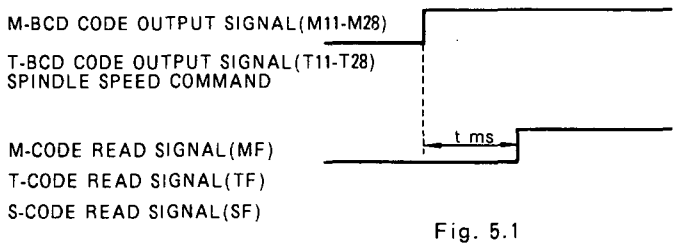


Fig. 5.1

5.4 SPECIAL PARAMETERS

5.4.1 POSITION COMMAND UNIT SETTING (#1557, #1558, #1757, #1758, #1957, #1958)

(1) Generally, the position detection unit (distance per pulse) is determined by the drive system and the position detector.

Witn Motionpack-110, two coefficients, B/A and A/B, are used to match the position command unit for the drive system with the position detection unit. Fig. 5.2 shows a block diagram.

B/A represents the number of output pulses per the minimum input unit (e. g., 0.001 mm), and represents the feed distance of the machine per pulse of quadruple PG.

Prior to determining the parameters, B/A and A/B should be calculated frome the specifications of the machine and the detector in advance, and

$$\frac{B}{A} \times 16777216(\text{integer portion only}) \left(\frac{1}{100} \leqq \frac{B}{A} \leqq 100\right)$$

$$\frac{A}{B} \times 16777216(\text{integer portion only}) \left(\frac{1}{100} \leqq \frac{A}{B} \leqq 100\right)$$

should be set as the parameter values.

Parameters for B/A for the X-, Y- and Z-axes are #1557, #1757 and #1957, and those for A/B are #1558, #1758 and #1958, respectively.

NOTE

1. Using only the integer portions of B/A (or A/B) $\times$ 16777216 results in rounding errors.

2. The value of A/B must be the reciprocal of B/A.

3. When B/A (or A/B) is 1, (that is when the position command unit and the position detection unit are equal) set the parameters to 16777216.

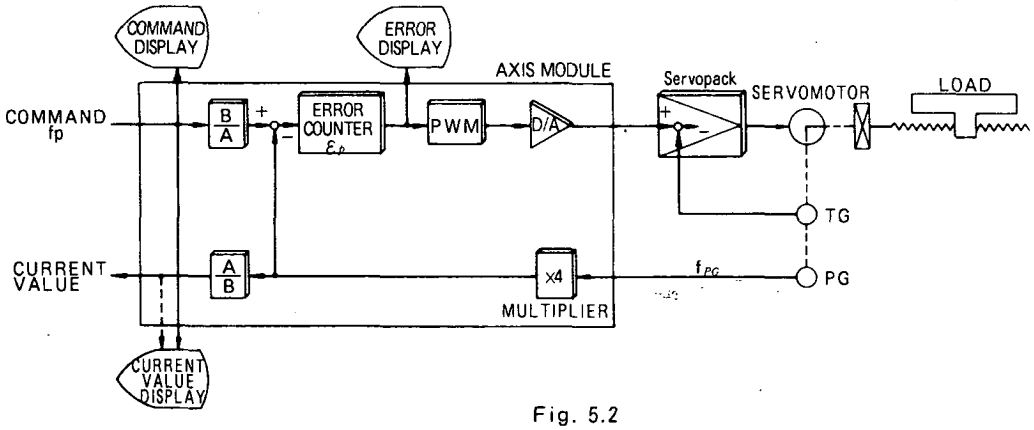


Fig. 5.2

(2) Influence on Other Parameters

When $\boxed{B/A} \neq 1$ ($\boxed{A/B} \neq 1$), the parameters listed below are set in the position detection units. Thus, if the parameters are set based on the position detection units (0.001 mm), each must be multiplied by A/B for conversion. Integer values are set in the parameters. Discard the fractions resulting from conversion or count them as a whole number, as required.

- Backlash offset amount setting (#1405, #1605, #1805)
- Position set area setting (#1406, #1606, #1806)
- Pitch error offset amount setting (#1410-#1473, #1610-#1673, #1810-#1873)
- Reference point return last running distance setting (#1556,.#1756, #1956)
- Servo error area setting (#1555, #1755, #1955)

(Conversion example)

When backlash offset amount is set, backlash distance [0.001 mm] $\times$ B/A is set as a parameter.

5.4.1 POSITION COMMAND UNIT SETTING
(#1557, #1558, #1757, #1758, #1957, #1958)(Cont'd)

(3) Calculation Expression of B/A

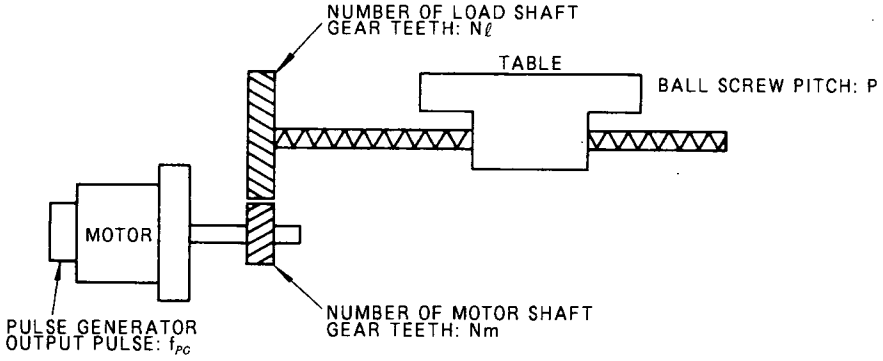


Fig. 5.3

Specifications:

- Ball screw pitch: P (mm/rev)
- Deceleration ratio: R (where R = Nℓ/Nm)
- Minimum position command: U (mm/pulse)
- Pulse generator: f_{PG} (pulses/rev)

In these specifications, B/A is as follows:

$$\frac{B}{A} = \frac{\text{Number of pulses of command side}}{\text{Number of pulses of ball screw side}}$$

$$= \frac{f_{PG} \times 4}{\frac{P}{U} \times \frac{1}{R}} \qquad \cdots\cdots\cdots\cdots\text{Expression ①}$$

(4) Examples of Position Command Unit Parameter Setting

(a) First, select a detector.
Select a pulse generator so that the motor shaft pulse generator generates a quarter pulse or more when the machine moves by the minimum detection unit distance.
If proper selection of pulse output and deceleration ratio per revolution results in $B/A = A/B = 1$, eliminating the need for any conversion.

(b) After detector determination, find B/A according to expression ①. Find A/B by calculating the reciprocal of B/A.

(c) Find the parameter setup value from the numeric values of B/A and A/B. Discard the fractions and set the integer part in the parameter.

(Example 1) Table drive by using ball screw (X-axis direction)

Specifications:
- Ball screw pitch P = 6 (mm/rev)
- Deceleration ratio R = $\frac{2}{1}$ = 2
- Minimum position command unit U = 0.001 (mm/pulse)
- Pulse generator output: Undefined

Change expression ① and calculate back pulse generator output so that B/A results in 1.00.

$$f_{PG} = \frac{1}{4} \times \frac{P}{U} \times \frac{1}{R} \times \frac{B}{A} \quad \cdots\cdots\cdots\cdots\text{Expression ②}$$

$$= \frac{1}{4} \times \frac{6}{0.001} \times \frac{1}{2} \times 1.00$$

$$= 750 \text{ (pulses/rev)}$$

Therefore, select a pulse generator conforming to the 750 pulses/rev specifications.
Then, set "16777216" in X-axis position command parameters B/A (#1557), A/B (#1558).

(Example 2) Assuming that deceleration ratio R = Nℓ/Nm = $\frac{7}{5}$ in example 1,

$$f_{PG} = \frac{1}{4} \times \frac{6}{0.001} \times \frac{1}{\frac{7}{5}} \times 1.00$$

$$= 1071.428 \cdots\text{(pulses/rev)}$$

Therefore, f_{PG} results in an incomplete value. Select an already existing pulse generator which generates greater than 1071.4 pulses/rev.
For example, if with 2000 pulses/rev, again B/A is calculated from expression ①,

$$\frac{B}{A} = \frac{2000 \times 4}{\frac{6}{0.001} \times \frac{5}{7}} = \frac{28}{15}$$

$$\frac{A}{B} = \frac{15}{28}$$

If the last parameter (X-axis) is calculated,

$$\frac{B}{A} \text{ parameter} = \frac{28}{15} \times 16777216 = \boxed{31317469}.87$$

This value is set in parameter #1557.

$$\frac{A}{B} \text{ parameter} = \frac{15}{28} \times 16777216 = \boxed{8987794}.286$$

This value is set in parameter #1558.

5.5 MACHINE SPECIFICATION PARAMETERS

5.5.1 MAX. FEEDRATE SETTING AT MANUAL FEED (#1101) 1 ≦ SET VALUE ≦ 3200

This parameter sets the maximum feedrate for manually moving the machine with the manual pulse generator. The manual feedrate cannot exceed the value set by this parameter.

The setting unit "1" represents 7.5 mm/min. For example, "10" means 75 mm/min.

5.5.2 INTERPOLATION MAX. FEEDRATE SETTING (#1102) 1 ≦ SET VALUE ≦ 24000

This parameter is for setting the maximum feedrate for linear interpolation and circular interpolation by two slides moving along the two axes simultaneously, and for linear interpolation by 3 simultaneous movements along the 3 axes.

The setting unit "1" represents 1 mm/min. For example, "10000" means 10m/min.

5.5.3 JOGGING FEEDRATE SETTING (#1104 TO #1118) 1 ≦ SET VALUE ≦ 24000

Parameters #1104 to #1118, respectively, set 16-level jogging or step feedrates. The designated feedrates are selectively initiated by the combinations of the inputs of jog feedrate setting signals JOV1, JOV2, JOV4, and JOV8. The feedrate is the same in each axis (X, Y and Z).

Table 5.2 Combination of Jog Feedrate Signals for Jogging Feedrate Setting

Level	JOV1	JOV2	JOV4	JOV8	Parameter No.
0	OFF	OFF	OFF	OFF	Override 0 %
1	ON	OFF	OFF	OFF	#1104
2	OFF	ON	OFF	OFF	#1105
3	ON	ON	OFF	OFF	#1106
4	OFF	OFF	ON	OFF	#1107
5	ON	OFF	ON	OFF	#1108
6	OFF	ON	ON	OFF	#1109
7	ON	ON	ON	OFF	#1110
8	OFF	OFF	OFF	ON	#1111
9	ON	OFF	OFF	ON	#1112
10	OFF	ON	OFF	ON	#1113
11	ON	ON	OFF	ON	#1114
12	OFF	OFF	ON	ON	#1115
13	ON	OFF	ON	ON	#1116
14	OFF	ON	ON	ON	#1117
15	ON	ON	ON	ON	#1118

Feedrates can be set, with "1" representing 1 mm/min. For example, setting 12000 means 12m/min.

NOTE

When both the jog feedrate selection signals JOV1, JOV2, JOV4, and JOV8 are OFF, the jogging feedrate is 0, and the machine will not move even when a jogging signal is input.

5.5.4 RAPID TRAVERSE FEEDRATE SETTING (#1500, #1700, #1900)
1 ≦ SET VALUE ≦ 3200

Parameters #1500, #1700 and #1900 are for setting the rapid traverse feedrates for X-axis, Y-axis and Z-axis, respectively. The set feedrates are executed selectively at 100% (high), 50% (middle) or 25% (low) by the combinations of the inputs of rapid traverse override signals (ROV1, ROV2, and ROV3).

The combinations of the inputs of rapid traverse override signals and the feedrates are given below:

Table 5.3

	ROV1	ROV2	ROV3	Feedrate
High	ON	ON	OFF	Parameter setting
Middle	OFF	ON	OFF	50 % of high
Low	ON	OFF	OFF	25 % of high
High	—	—	ON	Parameter setting

The rapid traverse feedrates can be set, with "1" representing 7.5 mm/min. For example, setting "100" gives a high feedrate of 750 mm/min.

The actual setting must be an integer not exceeding the value calculated by:

$$\frac{\text{Motor rated speed (rpm)} \times \text{PG (pulse/rev)} \times 4}{7500} \left(\times \frac{A}{B}\right)$$

Where the position command parameters (#1557, #1558, #1757, #1758, #1957, #1958) are taken into consideration, the factor A/B must be multiplied.

(Example)

When a ***Minertia*** RM Series motor (rated speed: 3000 rpm) is used with a 500 pulse/rev feedback pulse generator, the rapid traverse feedrate can be calculated as follows:

$$\frac{3000 \times 500 \times 4}{7500} = 800$$

The parameters may be set to 800.

5.5.5 STEP FEED DISPLACEMENT DISTANCE SETTING (#1122, #1123, #1124)
1 ≦ SET VALUE ≦ 32767

These parameters set the displacement distance in step operation. Parameters #1122, #1123 and #1124 set respectively L1 (short), L2 (middle) and L3 (long) distances.

These three distances are selectively executed by the combinations of the two step multiplier signals (MP1 and MP2) as follows. Speed under step feed operation is the same as that of jog feed operation.

Table 5.4

	MP1	MP2	Parameter No.
L1 (short)	ON	OFF	#1122
L2 (middle)	OFF	ON	#1123
L3 (long)	ON	ON	#1124

The setting unit "1" represents 0.001 mm. For example, "2000" means a displacement distance of 2 mm for 1 step.

5.5.6 SOFTWARE LIMIT SWITCH FUNCTION
(#1402, #1602, #1802, #1550, #1551, #1750, #1751, #1950, #1551, #1751, #1951)

The software limit switch function is a function of storing motion limit positions in the motion modules which have the same effect on the machine movement as actual limit switches (LS) positioned along the movement path. Generally, the limit positions should be set inside of LS.

The use or non-use of the software LS is designated by one parameter for each axis, and the position (distance) of the software LS is designated by another parameter for each axis.

(1) Software LS Use/Non-Use Parameter (#1402, #1602, #1802)

Parameters #1402, #1602 and #1802 are for selectively using or not using the software LS function, respectively, along the X-, Y-, and Z-axes.

For using the software LS function, set the parameter to "1", and when not using, to "0". When the system is returned to the reference point after power application, this function is automatically turned on.

NOTE

1. Do not set any digits other than "1" or "0".

2. Where using the software LS function in unrestricted length positioning, set the parameter to "0".

(2) Move Distance + Limit Value Setting (#1550, #1750, #1950) 100 ≦ Set Value ≦ 99999999

Parameters #1550, #1750 and #1950 are for setting the software LS in the + direction from the origin on the X-, Y- and Z-axes, respectively.

The setting unit "1" represents 0.001 mm. For example, "10000" means 10.000 mm, and when motion beyond this distance from the reference point is attempted, an alarm occurs.

(3) Move Distance — Limit Value (#1551, #1751, #1951) −99999999 ≦ Set Value ≦ −100

Parameters #1551, #1751 and #1951 are for designating the software LS position as measured from the reference point along the X-, Y- and Z-axes, in the − direction. The setting unit "1" represents 0.001 mm. For example, "−20000" means a movable range from the reference point to −20.000 mm, and any attempt to move beyond the LS will cause an alarm.

(4) Limit positions set value = Actual move distance $\times \frac{B}{A}$

5.5.7 BACKLASH COMPENSATION VALUE SETTING (#1405, #1605, #1805) 0 ≦ SET VALUE ≦ 127

Parameters #1405, #1605 and #1805 are for setting the backlash compensation values for the ball screws, etc. of the X-, Y-, and Z-axes, respectively. The set backlash compensation values are automatically added to the movement command values. The setting unit "1" represents 1 pulse. Where the compensation amount is ℓ (μm),

$$\text{Backlash compensation value} = \ell \times \frac{B}{A}$$

5.5.8 PITCH ERROR COMPENSATION (#1552, #1752, #1952, #1553, #1753, #1953, #1410 TO #1473, #1610 TO #1673, #1810 TO #1873)

For each axis, the ball screw pitch error for successive intervals, starting from the reference zero point, may be stored as a parameter value for use for automatic compensation. This function becomes effective after a return-to-reference point.

The compensation interval length, the compensation start point, and the compensation amount are set for X-, Y- and Z-axes as parameter values. Where the compensation amount is ℓ (μm),

$$\text{Pitch error compensation set value} = \ell \times \frac{B}{A}$$

5.5.8 PITCH ERROR COMPENSATION

(#1552, #1752, #1952, #1553, #1753, #1953, #1410 TO #1473, #1610 TO #1673, #1810 TO #1873)
(Cont'd)

Table 5.5

Item	Parameter	Description
Compensation Interval	#1552 (X) #1752 (Y) #1952 (Z)	Setting range: 500 to 99999999 Setting unit "1" represents 0.001 mm
Compensation Start Point	#1553 (X) #1753 (Y) #1953 (Z)	Compensation start point, from which 64 points, including the start point, are compensated in + direction. Setting range: −2000000 to 2000000 The minus sign means setting start point in the negative direction from zero point.
Compensation Amount at Each Point	#1410 to #1473 (X) #1610 to #1673 (Y) #1810 to #1873 (Z)	Setting range: 0 to ±127 Setting unit "1" is 1 pulse (feedback pulse after 4 multipliers). For #1410, #1610 and #1810, set the pitch error compensation amounts at each compensation start point in incremental value, and thereafter, set the compensation values for 64 points, #1411, #1412··· #1611, #1612 ··· #1811, #1812··· in the + direction in sequence. Where the measured pitch error is positive, set the compensation amount in negative, and vice versa.

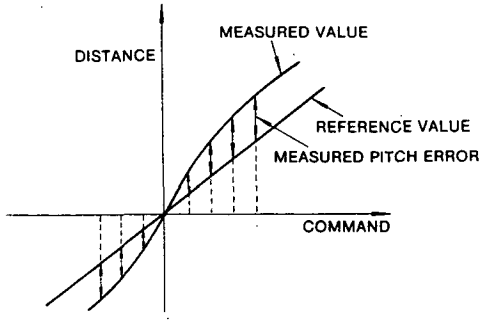


Fig. 5.4

In Fig. 5.5 assuming

Compensation interval: 1.000 mm.

Compensation start point: −3

Compensation points: 14

the parameters are set as follows:

Compensation interval: | #1552 | 1000 |

Compensation start point: | #1553 | −3 |

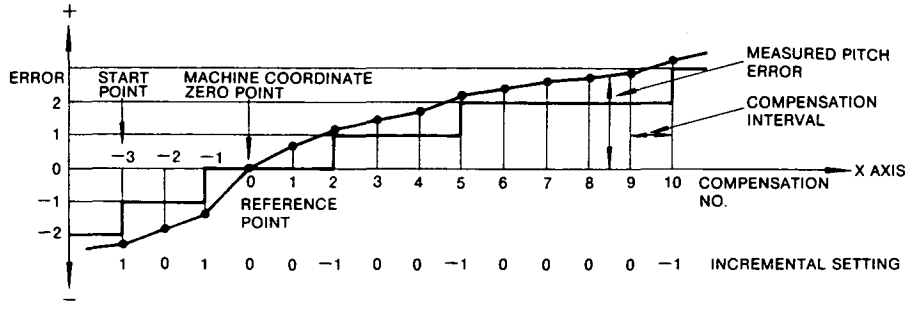


Fig. 5.5 Example of Writing into X-axis

Table 5.6

Compensation Point No.	Parameter No.	Compensation Amount	
−3	#1410	1	← Compensation amount for start point No. −3.
−2	#1411	0	
−1	#1412	1	
0	#1413	0	← Reference point on X-axis
1	#1414	0	
2	#1415	−1	
3	#1416	0	
4	#1417	−1	
5	#1418	0	
6	#1419	0	
7	#1420	0	
8	#1421	0	
9	#1422	0	
10	#1423	−1	← Compensation amount for compensation No. 10.
11 to 61	#1424 to #1473	0	← Set "0" for no-compensation intervals.

5.5.9 COMBINED OPERATION COMMAND (G83) SETTING DATA (#1202)

Setting data σ used in combined operation command, deep hole drilling (G83) is set. For the setup units, "1" corresponds to 0.001 mm. For example, if "2000" is set, 2 mm is actually set. for details, see Par. 4.2.15.

5.6 SERVO-RELATED PARAMETERS

5.6.1 ACCELERATION/DECELERATION CONSTANT (#1407, #1607, #1807, #1501 TO #1503, #1701 TO #1703, #1901 TO #1903)

For rapid traverse, jogging and manual control feeding, linear acceleration/deceleration is automatically applied, and for interpolation feedrate, exponential automatic acceleration/deceleration is applied.

(1) Linear Acceleraton/Deceleration

Table 5.7

	Parameter No.	Description
1st Linear Accel/Decel/ Constant	#1501 (X) #1701 (Y) #1901 (Z)	Setting range: 1 to 1536 Setting unit: "1" = 15625 mm/s²
2nd Linear Accel/Decel Change Point Feedrate	#1502 (X) #1702 (Y) #1902 (Z)	Setting range: 1 to 3200 Setting unit: "1" = 7.5 mm/min
2nd Linear Accel/Decel Constant	#1503 (X) #1703 (Y) #1903 (Z)	Setting range: 1 to 1536 Setting unit: "1" = 15625 mm/s²

5.6.1 ACCELERATION/DECELERATION CONSTANT
(#1407, #1607, #1807, #1501 TO #1503, #1701 TO #1703, #1901 TO #1903) (Cont'd)

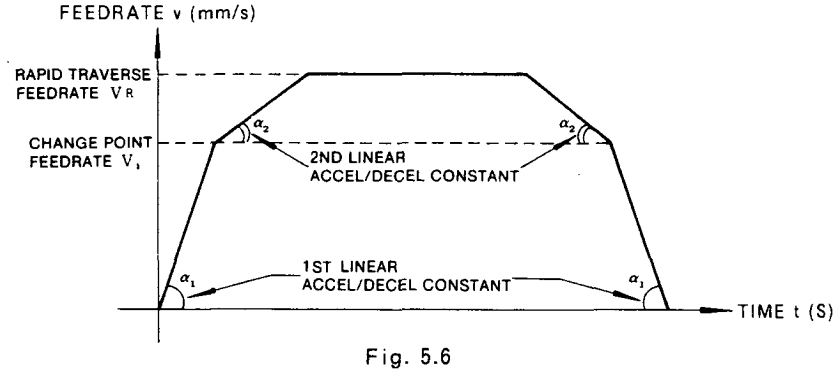


Fig. 5.6

(Example) When rapid feedrate = 12 m/min, rising time = 0.5 s, and unit system = 0.001 mm;

• 12 m/min is converted to the rate per second as follows:

$$12000 \times \frac{1}{60} = 200 \text{ mm/s}$$

• Acceleration from 0 to 12 m/min is $\frac{200}{0.5} = 400 \text{ mm/s}^2$.

• The value set in the acceleration/deceleration constant parameter is $\frac{400}{15.625} = 25.6$. Thus, "25" is set.

NOTE

1. When determining the acceleration/deceleration constant, measure the acceleration/deceleration time of the machine system, and adopt an acceleration/deceleration constant that does not give acceleration/deceleration time shorter than the measured time.

2. When accelerating/decelerating in one step, set the 1st and the 2nd accel/decel constant to the same value and the change point feedrate to 0.

3. When accelerating/decelerating in 2 steps, set the 1st accel/decel constant larger than the 2nd accel/decel constant. Set the change point feedrate lower than the rapid traverse feedrate. ($\alpha_1 > \alpha_2$, $V_R > V_1$)

(2) Exponential Accel/Decel Time Constant (#1407, #1607, #1807)

These parameters are for setting the exponential acceleration/deceleration time constant for interpolation motions.

Table 5.8

	Parameter No.	Description
Exponential Accel/ Decel Time Constants	#1407 (X) #1607 (Y) #1807 (Z)	Setting range: 1 to 127 Setting unit: 1 = 8 ms

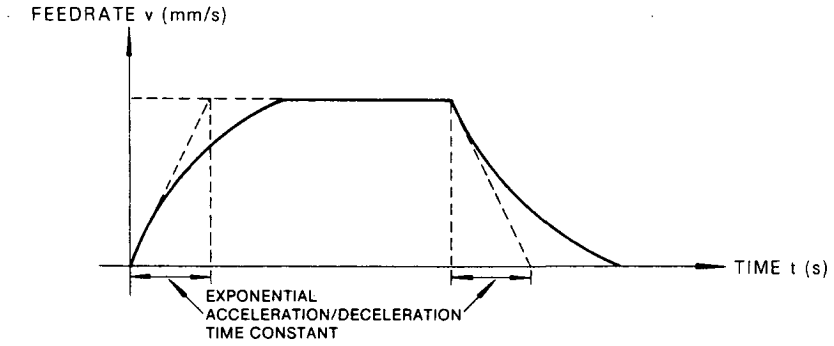


Fig. 5.7

For example, when the parameter is set to "3", the acceleration/deceleration time constant is 24 ms.

NOTE

1. To secure correct interpolation, all the axes must be set to the same time constant.

2. If the set value is "1", stepped speed command can be obtained.

5.6.2 INTERPOLATION FEEDRATE BIAS (#1475, #1675, #1875)

These parameters are for setting the exponential acceleration/deceleration feedrate bias for interpolation.

Table 5.9

	Parameter No.	Description
Interpolation Feedrate Bias	#1475 (X) #1675 (Y) #1875 (Z)	Setting range: 1 to 127 Setting unit: 1 = 7.5 mm/min

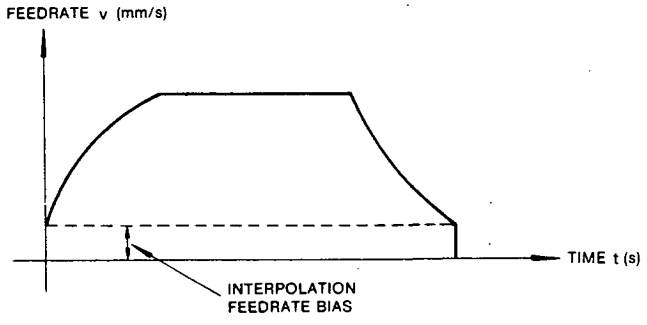


Fig. 5.8

NOTE

1. For correct interpolation, the feedrate bias of all the axes must be set equal.

2. If using circular interpolation (G02, G03), set a small value (1-5).

5.6.3 FEEDRATE COMMAND VOLTAGE SETTING (#1408, #1608, #1808)

These parameters are for adjusting the upper limit of the feedrate command voltages in combined use with Servopacks. Parameters #1408, #1608 and #1808 are for X-, Y- and Z-axes, respectively. The setting range is 0 to 7. For Servopack, the setting is "7".

5.6.4 POSITION LOOP GAIN (#1474, #1674, #1874) $1 \leqq$ SET VALUE $\leqq 127$

To these position loop gain adjustment parameters, the integer of the following value should be set (omitting the decimal).

$$n_{Kp} = \frac{2^{15}\,(=32768)}{\varepsilon} \qquad \cdots\cdots\cdots\cdots\text{Expression ①}$$

Parameters #1474, #1674 and #1874 are for X-, Y- and Z-axes, respectively.
ε is the position lag pulses calculated by the formula below:

$$\varepsilon = \frac{\text{Maximum rapid traverse feedrate (pulses/s)}}{K_p}$$

$$= \frac{4 \times f_{PG} \times \frac{1}{60} \times RP_{Max}}{K_p} = \frac{4 \cdot f_{PG} RP_{Max}}{60 K_p} \qquad \cdots\cdots\cdots\cdots\text{Expression ②}$$

[Where f_{PG}: Output per revolution of pulse generator (pulses/rev)
RP_{Max}: Motor speed during rapid feed (rpm)]

Expression ② is assigned to expression ①.

$$n_{Kp} = \frac{32768 \times 60 \times K_p}{4 \times f_{PG} \times RP_{Max}} \qquad \cdots\cdots\cdots\cdots\text{Expression ③}$$

K_p is the position loop gain varying with the servomotor used. The guideline values are given below. For details, see Par. 12.1.3 "SERVO PERFORMANCE CHECK". Fine adjustments of K_p are made on the Servopack. For details, see Par. 11.2.2.

Table 5.10

Motor Type	Kp Value (s^{-1})
Hi-Cup Motor	30
Cup Motor	
Minertia Motor J Series	
Mineatia Motor RM Series	
Print Motor	40

(Example)

When a Minertia motor RM Series (rated speed: 3000 rpm), a 600 pulse/rev feedback PG, and a Servopack type CPCR-FR are used with K_p set at $30s^1$, the value of n is as follows:

$$\varepsilon = \frac{4 \times 600 \times 3000}{60 \times 30} = 4000 \text{ pulses}$$

$$n_{Kp} = \frac{2^{15}\,(= 32768)}{4000} = 8.192$$

Therefore, the parameter is set to "8".

5.6.5 SERVO ERROR RANGE (#1555, #1755, #1955) 1 ≦ SET VALUE ≦ 16777216

For the purpose of checking for faulty servo system, these parameters are set to the position lag values that are not likely to be exceeded when the servo system is in order. Parameters #1555, #1755 and #1955 are for X-, Y- and Z-axes, respectively. The setting unit "1" is 1 pulse (feedback pulse after 4 multipliers).

When the position lag pulse exceeds the set value, an alarm [No.57, 58, 59: SERVO ERROR] occurs. Normally, these parameters are set to twice the position deviation pulse obtained from the position loop gain as follows:

(Example)

In the case of the example under Par. 5.6.4, since $\varepsilon = 4000$, double this value, 8000 is set as the servo error range.

NOTE

The number of position lag pulses can be seen in the current value display POSITION ERROR on the CRT control station. See Par. 7.2.3.

5

5.6.6 POSITION SETTING RANGE (#1406, #1606, #1806) 1 ≦ SET VALUE ≦ 127

These parameters are used to set the permissible range of position lag pulses for positioning completion judgement. Where the movement command for positioning completion hold, such as G00, is executed, after the assignment of motion pulses, it holds until the position pulse lag caused by servo delay comes within this parameter setting value. And then, next command (next block in MEM operation) is executed.

Near the goal position, as the number of position lag pulses decreases, the moving speed slows down and the final stopping will be late. To obtain a reasonably short stopping time, the number of permissible position lag pulses should be set at the maximum value permitted by the accuracy requirement.

The setting unit "1" represents 1 pulse (feedback pulse after 4 multipliers). When the parameter is set to P, the position setting range is ±P (pulses). Parameters #1406, #1606 and #1806 are for X-, Y- and Z-axes.

$$\text{Set value} = \text{Max. allowable error } (\mu\text{m}) \times \frac{B}{A}$$

5.6.7 DRIFT OFFSET (#1401, #1601, #1801)

These parameters are used to make available the zero drift offset function of servo including D/A output section in axis module. If "1" is set, the offset function is available. If "0" is set, the offset function is not available.

Normally, set to "1." Only during zero-point adjustment of Servopack with axis module, set to "0."

5.7 RETURN-TO-REFERENCE POINT

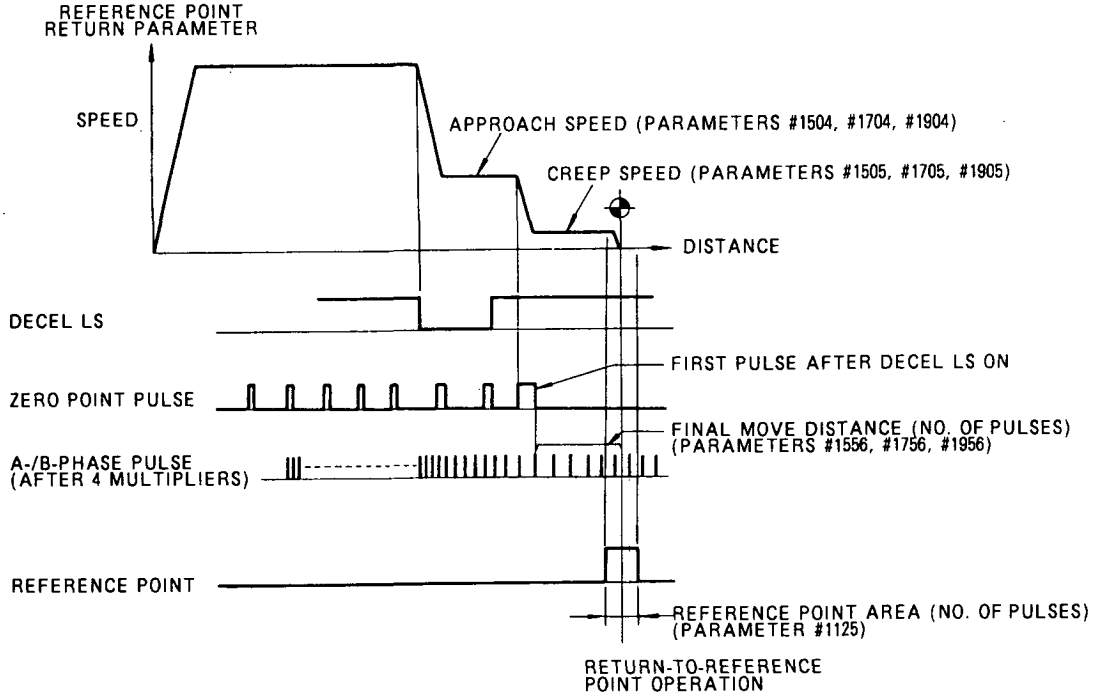


Fig. 5.9

5.7.1 DIRECTION OF RETURN-TO-REFERENCE POINT (#1403, #1603, #1803)

These parameters are for setting the direction of returning to the reference point. To return in the + direction, set it to "0", and to return in the − direction, set it to "1". Parameters #1403, #1603 and #1803 are for the X-, Y- and Z-axes.

NOTE

Do not set values other than "0" and "1".

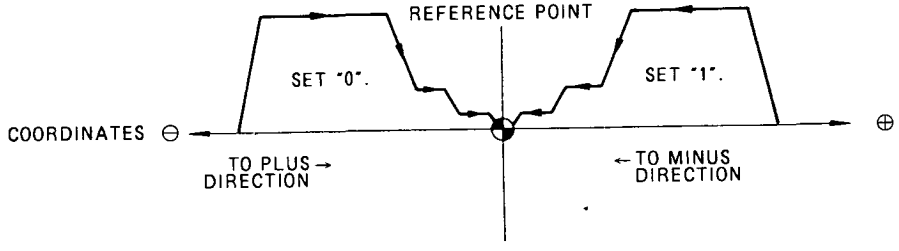


Fig. 5.10

5.7.2 RETURN-TO-REFERENCE-POINT APPROACH FEEDRATE SETTING (#1504, #1704, #1904) $1 \leqq$ SET VALUE $\leqq 3200$

These parameters are for setting the return-to-reference-point approach feedrates. The setting unit "1" represents 7.5 mm/min.

Parameters #1504, #1704 and #1904 are for X-, Y- and Z-axes, respectively.

NOTE

The setting range covers up to 3200, but, actually, set values below the rapid traverse feedrate set by #1500, #1700 and #1900.

5.7.3 RETURN-TO-REFERENCE-POINT CREEP FEEDRATE SETTING (#1505, #1705, #1905) 1≦ SET VALUE≦ 3200

These parameters are for setting the creep feedrate for returning to the reference point. The setting unit "1" represents 7.5 mm/min. Parameters #1505, #1705 and #1905 are for the X-, Y- and Z-axes, respectively.

NOTE

The creep feedrate should be set below approach feedrates set by parameters #1504, #1704 and #1904.

5.7.4 RETURN-TO-REFERENCE-POINT APPROACH DISTANCE (#1556, #1756, #1956) 1≦SET VALUE ≦90000000

These parameters are for setting the final distance from the detection of the first reference point pulse, after the dog trips the slowing LS, during the reference-return process.

The setting unit "1" represents 1 pulse (feedback pulse after 4 multipliers). Parameters #1556, #1756 and #1956 are for the X-, Y- and Z-axes, respectively.

$$\text{Set value} = \text{Approach distance } (\mu\text{m}) \times \frac{B}{A}$$

NOTE

The approach distance must be set longer than the distance required to decelerate from the approach feedrate to the creep feedrate. The final approach distance L is roughly calculated by the following formula:
Where, V_a : approach feedrate
α : acceleration/deceleration constant

$$L = \frac{V_a^2}{2\alpha}$$

5.7.5 REFERENCE POINT AREA (#1125) 0 ≦ SET VALUE ≦ 32767

This parameter sets the area in which the reference point signals (ZPX, ZPY, ZPZ) can be turned on.

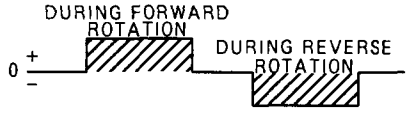
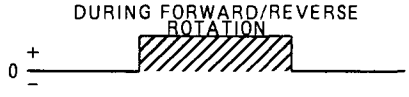
The setting unit "1" represents 0.001 mm. Setting the parameter to P (mm) means a reference point area of $\pm P$ (mm).

5.8 SPINDLE PARAMETER SETTING

5.8.1 SPINDLE MODE SETTING (#2004)

When the axis module is used as an analog speed command voltage output device for the spindle, the spindle mode is set.

Table 5.11

Set Value	Contents (Mode)
"1"	Bipolar command voltage • Positive voltage is output during forward rotation command. • Negative voltage is output during reverse rotation command. 
"3"	Unipolar command voltage • Positive voltage is output during forward rotation command. • Negative voltage is output during reverse rotation command. 

Note: Be sure to set "1" or "3".

5.8.2 MAXIMUM ROTATION SPEED ON EACH GEAR (#2150, #2151, #2152)

The maximum rotation speed of the spindle on each gear (L, M, H) is set. A gear selection depends on a combination of spindle gear selection signals (GR1, GR2). For the setup units, "1" corresponds to 1 rpm.

Table 5.12

Gear Ratio	GR1	GR2	Parameter No.
L_0	OFF	OFF	Stop
L	ON	OFF	#2150
M	OFF	ON	#2151
H	ON	ON	#2152

The speed command voltage on each gear is as follows:

$$\text{Speed command voltage} = \frac{\text{S five-digit programmed value (rpm)}}{\text{Each gear parameter setup value (rpm)}} \times \text{Axis module max D/A output}$$

5.9 NO-USING PARAMETER SETTING

For parameters not used (not listed in Table 5.1), be sure to set "0".

CONTENTS

6. I/O ALLOCATIONS

The standard motion module I/O (input/output) is provided with 64 general and eight designated input points and 32 general and eight designated output points. Addition of a micro PC module also enables an additional 64 input and 64 output points. (See Fig. 6.1.)

Motionpack-110 adopts I/O allocation system which enables the signals to be combined for use as desired. Thus, before using them, the input/output signals must be logically allocated to the signal addresses (simple addresses) in Motionpack-110.

Prior to shipping from the factory, they are allocated as listed in Tables 6.1 and 6.2. Generally, they can be used as is. However, if the motion module is used with difference functions from the standard allocation or micro PC module is used, new I/O allocation must be made.

6.1 I/O SIGNAL TYPES AND ALLOCATION AREA

The input/output signals are specified with the addresses according to the application, as shown in Fig. 6.1. The relation between input and output mentioned here is based on the allocation area: Signals entering the allocation area are called input signals; those exiting from the area are called output signals.

Thus, note that the relation between input and output is reversed from the motion module control or micro PC module to the allocation area.

I/O Signal Types

	Input Adress	Output Address
• General/special I/O signals of motion module	#3000–#3008	#3500–#3504
• Fixed I/O signals for motion module control	#4500–#4509	#4000–#4019
• I/O signals between motion and micro PC modules	#5100–#5107	#5000–#5007
• Motion module communication command I/O signals	#6000–#6007	#6500–#6507

The I/O signals are explained below according to the application:

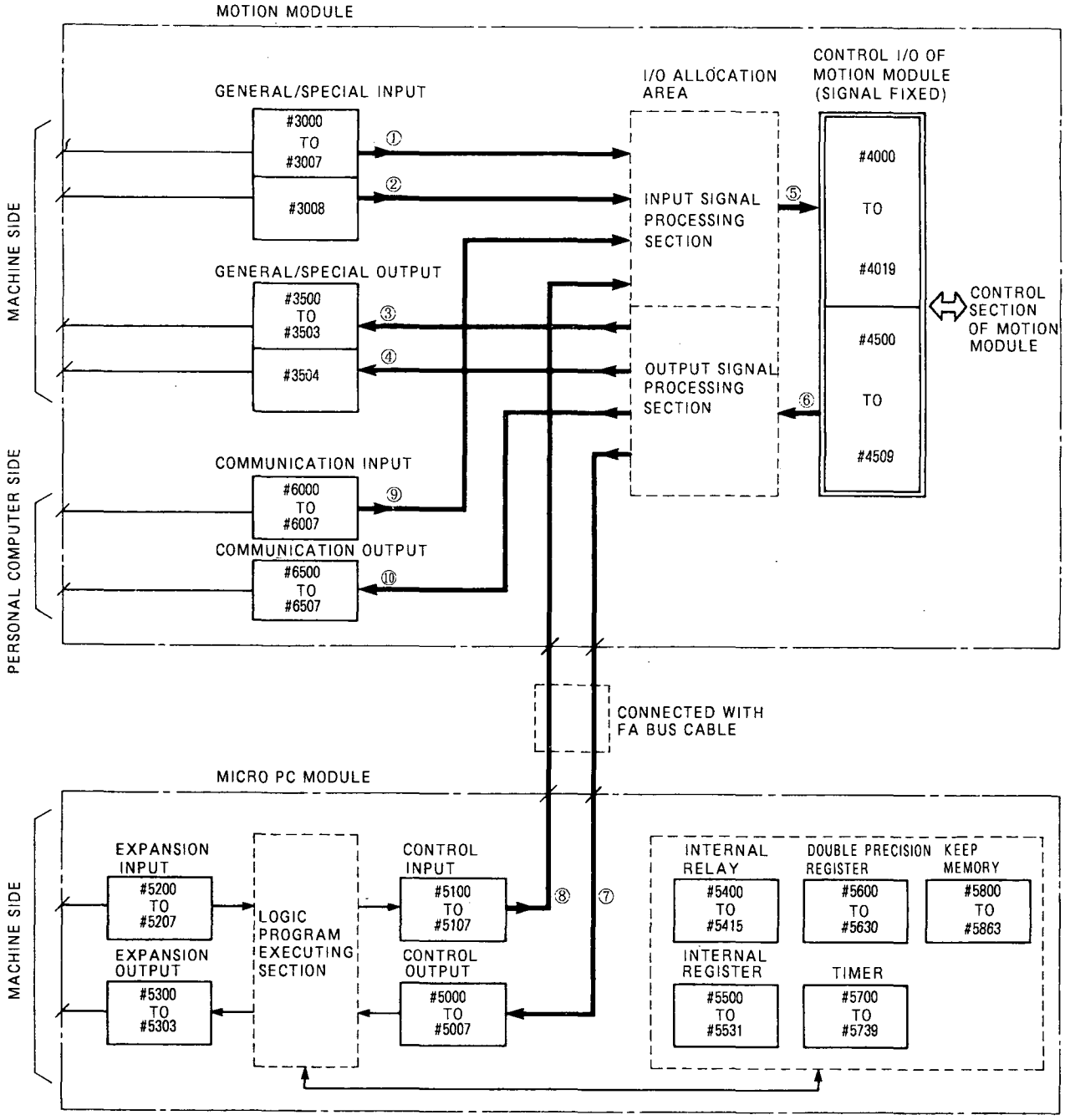


Fig. 6.1 I/O Address and Allocation Area

6.1 I/O SIGNAL TYPES AND ALLOCATION AREA (Cont'd)

(1) #3000 - #3007 (64 Points) (Table 6.3)

These are motion module general input addresses directly connected to external connector (1CN, 2CN). In standard allocation, the machine input contacts are read in.

• Input contact signal example:
EDIT, +JX, ZRN, etc.

(2) #3008 (8 Points) (Table 6.3)

This is a motion module designated input address directly connected to external connector (5CN). In standard allocation, the machine input contacts are read in.

• Input contact signal example:
STR, $\overline{\text{STP}}$, SVOK, etc.

(3) #3500 - #3503 (32 Points) (Table 6.4)

These are motion module general output addresses directly connected to external connector (2CN). In standard allocation, the output contacts are output to the machine.

• Output contact signal example:
M30, ZPX, RST, etc.

(4) #3504 (8 Points) (Table 6.4)

This is a motion module designated output address directly connected to external connector (2CN). In standard allocation, the output contacts are output to the machine.

• Output contact signal example:
ALM, $\overline{\text{MCRD}}$, etc.

(5) #4000 - #4019 (160 Points) (Table 6.5)

These are fixed addresses for motion module control. The addresses are fixed to the signal names in one-to-one correspondence. The operation commands issued to the motion module are directly controlled as the signal names. Thus, the area becomes the allocated side for general input and the micro PC module.

In standard allocation, general/designated input (#3000 - #3008) is allocated to #4000 - #4019.

(6) #4500 - #4509 (80 Points) (Table 6.6)

These are fixed output addresses for motion module control. The addresses are fixed to the signal names in one-to-one correspondence. Motion module control output is sent as the signal names. Thus, the area becomes the allocating side for general output and the micro PC module.

In standard allocation, #4500 - #4509 are allocated to general/designated output (#3500 - #3504).

(7) #5000 - #5007 (64 Points) (Table 6.7)

These are input addresses to read signal output from the motion module into the micro PC module program execution block.

The micro PC module analyzes, the sequence ladder by using the read signals.

NOTE

Refer to Micro PC Module Manual for micro PC module output (addresses #5300 - #5303 directly connected to external connecor).

(8) #5100 - #5107 (64 Points) (Table 6.8)

These are addresses to output the sequence ladder analysis results made by the micro PC module program execution block to the motion module.

Protocols for the signals used in the micro PC module are defined as desired. In addition to motion module control signals, any signals defined on logic control, register output, and timer output can be sent to the motion module.

NOTE

Refer to the Micro PC Module Manual for micro PC module input (addresses #5200 - #5207 directly connected to external connector).

(9) #6000 - #6007 (64 Points) (Table 6.9)

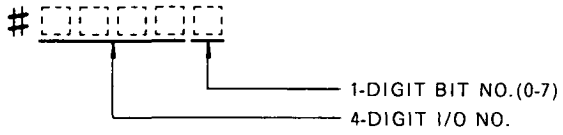
These are input addresses to read communication commands from the communication control block to the motion module control block in the motion module with the communication function (type JAFMC-C027).

(10) #6500 - #6507 (64 Points) (Table 6.10)

These are output addresses to return command response from the motion module control block to the communication control block in the motion module with the communication function (type JEFMC-C027).

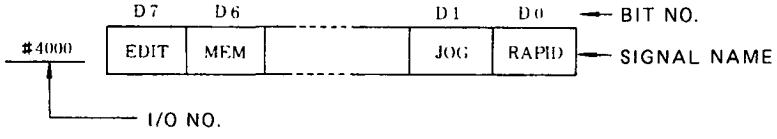
6.2 I/O SIGNAL FORMAT

The address designation format of an input/output signal is shown below:



The address is represented by five digits consisting of the I/O number and bit number. One I/O number represents I/O of eight points (bits). One I/O point corresponds to one bit.

An example of signal addressing for each point is given below:



#4000-D7 (EDIT) is addressed by "#40007".

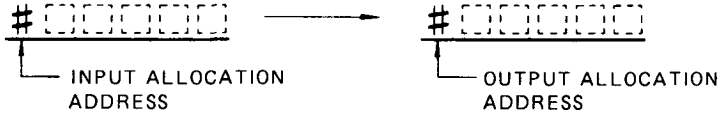
NOTE

Sometimes, the 4-digit I/O number is also called an address.

6.3 CAUTIONS ON ALLOCATION

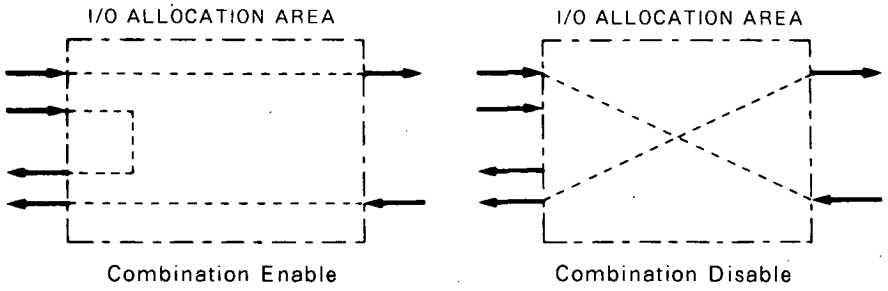
(1) ALLOCATION FORMAT

Set one input allocation address to the left and one output allocation address to the right, as shown below:



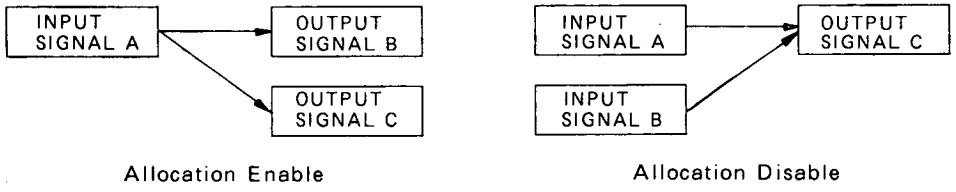
(2) ALLOCATION DIRECTION AND COMBINATION

Allocation can be made only from the input side to the output side in the I/O direction based on the allocation area shown in Fig. 6.1 as reference. That is, allocation can be made only in correct arrow direction combinations, as shown below:



(3) MULTIPLE ALLOCATION

A single input signal can be allocated to more than one output signal, but more than one input signal cannot be allocated to a single output signal. If erroneous specification is made, the last allocation becomes valid.



6.4 I/O SIGNAL DETERMINATION (PREPARATION FOR ALLOCATION)

To prepare allocation, the signal allocation destinations are determined conforming to the machine specifications. The necessary input signal names, output signal names, and external connector pin numbers should be listed to preclude setting errors such as omission and duplicate registration. Allocation examples are given below:

Example 1: Contact signal input to general input address #30033 (1CN-27) is used as +JX (+X-axis start signal). +JX is contained in the fixed address for motion module control, #40030. Thus, allocation becomes "#30033 → #40030".

Example 2: ZPY (Y-axis reference point position signal) is output to the output address for micro PC module control, #50007, and sequence processing is performed in the micro PC module. ZPY is contained in the fixed address for motion module control, #45031. Thus, allocation becomes "#45031 → #50007".

6.4 I/O SIGNAL DETERMINATION (PREPARATION FOR ALLOCATION) (Cont'd)

(Allocation Table Example)

	Input Allocation		Output Allocation		Signal Name
	Connector Pin No.	Input signal Address	Output signal Address	Connector Pin No.	
			#40000		RAPID
	(1CN-34)	#30001	#40001		JOG
			#40002		HANDLE
			⋮		
Example 1 →	(1CN-27)	#30033	#40030		+JX (+X-axis start)
			⋮		
		#45000	#35000	(2CN-39)	STL (Starting)
		#45001			SPL (Stop)
		#45002			OP (Program operating)
		⋮			
Example 2 →		#45031	#50007	—	ZPY (Y-axis reference point position)
		⋮			

6.5 ALLOCATION METHOD

After completion of preparation for allocation in Par. 6.4, allocation data is created on a personal computer (e.g. PC8201 manufactured by NEC or another personal computer having equivalent communication function to PC8201).

■ Commands That Can be Used:

- CIO (data all clear)
- DIO (data batch change) from personal computer to motion module
- UIO (data save) from motion module to personal computer
- WIO (partial change of data)
- RIO (data check)

6.5.1 ALLOCATION OPERATION (Use of Personal Computer)

■ Operation Procedure:

① Set the system switch (2SW) on the motion module panel front to 9.
② Connect the personal computer to motion module connector 3CN.
③ Set the personal computer communication function:

9600 BAUD EVEN PARITY 8-BIT 1-STOP BIT XON/OFF CONTROLL	→	For using the PC8201, set the communication function as follows: STAT=8E81XS

After setting, open the communication port by placing PC8201 in terminal mode.
④ Turn on Motionpack-110.
⑤ Enter commands through the personal computer.
For the commands, see Par. 6.5.2.
⑥ After completion of command entry, turn off Motionpack-110.
⑦ Disconnect the personal computer (when the CRT control station is included).
⑧ Connect the CRT control station (when it is included).
⑨ Restore the motion module system switch (2SW) to 0.
⑩ Turn on Motionpack-110.
⑪ Check input/output on the DIAGNOSIS screen of the CRT control station.

6.5.2 EXPLANATION OF ALLOCATION COMMANDS

(1) CIO (Data All Clear)

Enter only the command.

(2) DIO (Data Batch Change)

Create data in the format shown below by using the personal computer prior to entering the command. After the command is entered, the data is transferred.

```
DIO [CR]

% [CR]
#30006  #40005 [CR]
#30046  #40020 [CR]
   |       |
#45004  #35015 [CR]
#45012  #35031 [CR]
% [CR]
```

→ Create on personal computer.

NOTE

Execute the CIO command before DIO command execution.

(3) UIO (Data Save)

Beforehand, make the personal computer ready to receive. Next, transfer the command. After the command is analyzed in the motion module, data is transferred in the same format as the DIO command from the motion module.

(4) WIO (Partial Change of Data)

First, enter the command. Next, enter new allocation data in the format of "#input data, #output data[CR]." Enter as many data pieces as necessary in the format for change. Finally, enter "%[CR]."

```
WIO [CR]
#45031 #35000 [CR]
#30011 #40011 [CR]
% [CR]
```

(5) RIO (Data Check)

First, enter the command. Next, enter the allocation data to be checked in the format of "#input (output) data [CR]." After it is entered, the allocated data is sent from the motion module. Check as many data pieces as necessary in the format. Finally, enter "% [CR]."

```
RIO [CR]
#45031 [CR]

#45031 → #40001 [CR] [LF] }
#30011 → #40011 [CR] [LF] } (From motion module to personal computer)

% [CR]
```

6.6 STANDARD ALLOCATION

The motion module I/O (general/special) has been standardizedly factory-allocated before shipping as listed in Tables 6.1 and 6.2. If other allocation is needed, the motion module requires I/O reallocation.

Table 6.1 Motion Module Input Standard Allocation

Allocation Side		Allocated Side (Signal Fixed)	
Connector Pin No.	Input Signal Address	Control Input Signal Address	Signal Name
1CN-2	# 30000	# 40000	RAPID
1CN-34	# 30001	# 40001	JOG
1CN-3	# 30002	# 40002	HANDLE
1CN-19	# 30003	# 40003	STEP
		# 40004	—
1CN-4	# 30005	# 40005	DNC
1CN-20	# 30006	# 40006	MEM
1CN-36	# 30007	# 40007	EDIT
1CN-5	# 30010	# 40010	OV1
1CN-21	# 30011	# 40011	OV2
1CN-37	# 30012	# 40012	OV4
1CN-6	# 30013	# 40013	OV8
1CN-22	# 30014	# 40014	OV16
1CN-38	# 30015	# 40015	ROV1
1CN-7	# 30016	# 40016	ROV2
1CN-23	# 30017	# 40017	ROV3
1CN-39	# 30020	# 40020	JOV1
1CN-8	# 30021	# 40021	JOV2
1CN-24	# 30022	# 40022	JOV4
1CN-40	# 30023	# 40023	JOV8
		# 40024	—
		# 40025	—
		# 40026	—
		# 40027	—
1CN-26	# 30030	# 40030	+JX
1CN-42	# 30031	# 40031	+JY
1CN-11	# 30032	# 40032	+JZ
		# 40033	—
		# 40034	—
		# 40035	—
		# 40036	—
		# 40037	—
1CN-43	# 30034	# 40040	-JX
1CN-12	# 30035	# 40041	-JY
1CN-28	# 30036	# 40042	-JZ
		# 40043	—
		# 40044	—
		# 40045	—
		# 40046	—
		# 40047	—
1CN-13	# 30040	# 40050	HX
1CN-29	# 30041	# 40051	HY
1CN-45	# 30042	# 40052	HZ
		# 40053	—
		# 40054	—
		# 40055	—
		# 40056	—
		# 40057	—
5CN-1	# 30080	# 40060	STR
5CN-2	# 30081	# 40061	$\overline{\text{STP}}$
5CN-4	# 30083	# 40062	SKIP*

*Requires positively an allocation.

Table 6.1 Motion Module Input Standard Allocation (Cont'd)

Allocation Side		Allocated Side (Signal Fixed)	
Connector Pin No.	Input Signal Address	Control Input Signal Address	Signal Name
1CN-17	# 30054	# 40063	ZRN
1CN-14	# 30043	# 40064	MP1
1CN-30	# 30044	# 40065	MP2
		# 40066	—
		# 40067	—
1CN-47	# 30050	# 40070	SBK
1CN-9	# 30024	# 40071	PMEM
1CN-32	# 30052	# 40072	ACR
1CN-48	# 30053	# 40073	NEG
		# 40074	EINV
1CN-32	# 30052	# 40075	ABSO_ZPOINT
1CN-18	# 30056	# 40076	MLK
1CN-27	# 30033	# 40077	PRT
2CN-5	# 30070	# 40080	SK1
2CN-21	# 30071	# 40081	SK2
2CN-37	# 30072	# 40082	SK3
2CN-6	# 30073	# 40083	SK4
2CN-22	# 30074	# 40084	SK5
2CN-38	# 30075	# 40085	SK6
2CN-7	# 30076	# 40086	SK7
2CN-23	# 30077	# 40087	SK8
1CN-25	# 30025	# 40090	RRN
1CN-41	# 30026	# 40091	FRN
1CN-10	# 30027	# 40092	SSTP
		# 40093	—
1CN-44	# 30037	# 40107	TBXON
1CN-46	# 30045	# 40095	GR1
1CN-15	# 30046	# 40096	GR2
1CN-31	# 30047		
5CN-6	# 30085	# 40100	MRDY
		# 40101	—
		# 40102	—
5CN-3	# 30082	# 40103	RESET
		# 40104	—
		# 40105	—
1CN-49	# 30055	# 40106	FIN
		# 40107	—
		# 40110	E11
		# 40111	E12
		# 40112	E14
		# 40113	E18
		# 40114	E21
		# 40115	E22
		# 40116	E24
		# 40117	E28
		# 40120	E31
		# 40121	E32
		# 40122	E34
		# 40123	E38
		# 40124	E41
		# 40125	E42
		# 40126	E44
		# 40127	E48
		# 40130	E51
		# 40131	E52
		# 40132	E54
		# 40133	E58

Table 6.1 Motion Module Input Standard Allocation (Cont'd)

Allocation Side		Allocated Side (Signal Fixed)	
Connector Pin No.	Input Signal Address	Control Input Signal Address	Signal Name
		# 40134	E61
		# 40135	E62
		# 40136	E64
		# 40137	E68
		# 40140	E71
		# 40141	E72
		# 40142	E74
		# 40143	E78
		# 40144	E81
		# 40145	E82
		# 40146	E84
		# 40147	E88
5CN-5	# 30084	# 40150	SVOK
		# 40151	—
	# 30086	# 40152	$\overline{\text{SVALM}}$*
	# 30087	# 40153	$\overline{\text{BATALM}}$*
1CN-16	# 30051	# 40154	ER
1CN-50	# 30057	# 40155	ESP
		# 40156	—
		# 40157	—
2CN-2	# 30060	# 40160	W11
2CN-34	# 30061	# 40161	W12
2CN-3	# 30062	# 40162	W14
2CN-19	# 30063	# 40163	W18
2CN-35	# 30064	# 40164	W21
2CN-4	# 30065	# 40165	W22
2CN-20	# 30066	# 40166	W24
2CN-36	# 30067	# 40167	W28
		# 40170	—
		# 40171	—
		# 40172	—
		# 40173	—
		# 40174	—
		# 40175	—
		# 40176	—
		# 40177	—
		# 40180	—
		# 40181	—
		# 40182	—
		# 40183	—
		# 40184	—
		# 40185	—
		# 40186	—
		# 40187	—
		# 40190	—
		# 40191	—
		# 40192	—
		# 40193	—
		# 40194	—
		# 40195	—
		# 40196	—
		# 40197	—

*Requires positively an allocation.

6.6 STANDARD ALLOCATION (Cont'd)

Table 6.2 Motion Module Output Standard Allocation

Allocation Side (Signal Fixed)		Allocated Side	
Signal Name	Control Output Signal Address	Output Signal Address	Connector Pin No.
STL	# 45000	# 35000	2CN-39
SPL	# 45001	# 35001	2CN-8
OP	# 45002	# 35002	2CN-24
DEN	# 45003	# 35003	2CN-40
M00	# 45004	# 35004	2CN-9
—	# 45005		
M02	# 45006	# 35006	2CN-41
M30	# 45007	# 35007	2CN-10
ALM	# 45010	# 35040	5CN-14
RST	# 45011	# 35013	2CN-27
—	# 45012		
MCRD*	# 45013	# 35043	5CN-17
SVON*	# 45014	# 35044	5CN-18
—	# 45015		
—	# 45016		
—	# 45017		
MF	# 45020	# 35010	2CN-26
SF	# 45021	# 35012	2CN-11
TF	# 45022	# 35011	2CN-42
—	# 45023		
—	# 45024		
—	# 45025		
—	# 45026		
—	# 45027		
ZPX	# 45030	# 35014	2CN-43
ZPY	# 45031	# 35015	2CN-12
ZPZ	# 45032	# 35016	2CN-28
		# 35017	2CN-44
—	# 45034		
—	# 45035		
—	# 45036		
—	# 45037		
—	# 45040		
—	# 45041		
—	# 45042		
—	# 45043		
—	# 45044		
—	# 45045		
—	# 45046		
—	# 45047		
M11	# 45050	# 35020	2CN-13
M12	# 45051	# 35021	2CN-29
M14	# 45052	# 35022	2CN-45
M18	# 45053	# 35023	2CN-14
M21	# 45054	# 35024	2CN-30
M22	# 45055	# 35025	2CN-46
M24	# 45056	# 35026	2CN-15
M28	# 45057	# 35027	2CN-31
T11	# 45060	# 35030	2CN-47
T12	# 45061	# 35031	2CN-16
T14	# 45062	# 35032	2CN-32
T18	# 45063	# 35033	2CN-48
T21	# 45064	# 35034	2CN-17
T22	# 45065	# 35035	2CN-49
T24	# 45066	# 35036	2CN-18
T28	# 45067	# 35037	2CN-50
A11	# 45070		
A12	# 45071		

* Requires positively an allocation.

Table 6.2 Motion Module Output Standard Allocation (Cont'd)

Allocation Side (Signal Fixed)		Allocated Side	
Signal Name	Control Output Signal Address	Output Signal Address	Connector Pin No.
A14	# 45072		
A18	# 45073		
A21	# 45074		
A22	# 45075		
A24	# 45076		
A28	# 45077		
S11	# 45080		
S12	# 45081		
S14	# 45082		
S18	# 45083		
S21	# 45084		
S22	# 45085		
S24	# 45086		
S28	# 45087		
—	# 45090		
—	# 45091		
—	# 45092		
—	# 45093		
—	# 45094		
—	# 45095		
—	# 45096		
—	# 45097		

6.7 I/O ALLOCATION ADDRESS LIST

Tables 6.3 to 6.10 show addresses for each application.

Table 6.3 Motion Module Input Allocation Address

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
# 3000	1CN-36	1CN-20	1CN-4	1CN-35	1CN-19	1CN-3	1CN-34	1CN-2	← Set by user.
# 3001	1CN-23	1CN-7	1CN-38	1CN-22	1CN-6	1CN-37	1CH-21	1CN-5	← Set by user.
# 3002	1CN-10	1CN-41	1CN-25	1CN-9	1CN-40	1CN-24	1CN-8	1CN-39	← Set by user.
# 3003	1CN-44	1CN-28	1CN-12	1CN-43	1CN-27	1CN-11	1CN-42	1CN-26	← Set by user.
# 3004	1CN-31	1CN-15	1CN-46	1CN-30	1CN-14	1CN-45	1CN-29	1CN-13	← Set by user.
# 3005	1CN-50	1CN-18	1CN-49	1CN-17	1CN-48	1CN-32	1CN-16	1CN-47	← Set by user.
# 3006	2CN-36	2CN-20	2CN-4	2CN-35	2CN-19	2CN-3	2CN-34	2CN-2	← Set by user.
# 3007	2CN-23	2CN-7	2CN-38	2CN-22	2CN-6	2CN-37	2CN-21	2CN-5	← Set by user.
# 3008	*$\overline{\text{BATALM}}$	*$\overline{\text{SVALM}}$	5CN-6	5CN-5	5CN-4 *SKIP	5CN-3	5CN-2	5CN-1	← Set by user.

Note: Signal with * cannot be allocated for other application, because they are fixed.

Table 6.4 Motion Module Output Allocation Address

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
# 3500	2CN-10	2CN-41	2CN-25	2CN-9	2CN-40	2CN-24	2CN-8	2CN-39	← Set by user.
# 3501	2CN-44	2CN-28	2CN-12	2CN-43	2CN-27	2CN-11	2CN-42	2CN-26	← Set by user.
# 3502	2CN-31	2CN-15	2CN-46	2CN-30	2CN-14	2CN-45	2CN-29	2CN-13	← Set by user.
# 3503	2CN-50	2CN-18	2CN-49	2CN-17	2CN-48	2CN-32	2CN-16	2CN-47	← Set by user.
# 3504				5CN-18 *SVON	5CN-17 *MCRD			5CN-14 *ALM	

Note: Signal with * cannot be allocated for other application, because they are fixed.

Table 6.5 Motion Module Control Input Address (Signal Fixed)

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#4000	EDIT	MEM	DNC		STEP	HANDLE	JOG	RAPID	
#4001	ROV3	ROV2	ROV1	OV16	OV8	OV4	OV2	OV1	
#4002					JOV8	JOV4	JOV2	JOV1	
#4003						+JZ	+JY	+JX	
#4004						−JZ	−JY	−JX	
#4005						HZ	HY	HX	
#4006			MP2	MP1	ZRN	SKIP	$\overline{\text{STP}}$	STR	
#4007	PRT	MLK		EINV	NEG	ACR	PMEM	SBK	
#4008	SK8	SK7	SK6	SK5	SK4	SK3	SK2	SK1	
#4009		GR2	GR1			SSTP	FRN	RRN	
#4010	TBXON	FIN			RESET			MRDY	
#4011	E28	E24	E22	E21	E18	E14	E12	E11	
#4012	E48	E44	E42	E41	E38	E34	E32	E31	
#4013	E68	E64	E62	E61	E58	E54	E52	E51	
#4014	E88	E84	E82	E81	E78	E74	E72	E71	
#4015			ESP	ER	$\overline{\text{BAT ALM}}$	$\overline{\text{SVALM}}$		SVOK	
#4016	W28	W24	W22	W21	W18	W14	W12	W11	
#4017									
#4018									
#4019									

6.7 I/O ALLOCATION ADDRESS LIST (Cont'd)

Table 6.6 Motion Module Control Output Address (Signal Fixed)

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#4500	M30	M02		M00	DEN	OP	SPL	STL	
#4501				SVON	MCRD		RST	ALM	
#4502						TF	SF	MF	
#4503					ZPS	ZPZ	ZPY	ZPX	
#4504									
#4505	M28	M24	M22	M21	M18	M14	M12	M11	
#4506	T28	T24	T22	T21	T18	T14	T12	T11	
#4507	A28	A24	A22	A21	A18	A14	A12	A11	
#4508	S28	S24	S22	S21	S18	S14	S12	S11	
#4509									

Table 6.7 Micro PC Module Control Output Address

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#5000									← Set by user.
#5001									← Set by user.
#5002									← Set by user.
#5003									← Set by user.
#5004									← Set by user.
#5005									← Set by user.
#5006									← Set by user.
#5007									← Set by user.

Table 6.8 Micro PC Module Control Input Address

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#5100									← Set by user.
#5101									← Set by user.
#5102									← Set by user.
#5103									← Set by user.
#5104									← Set by user.
#5105									← Set by user.
#5106									← Set by user.
#5107									← Set by user.

Table 6.9 Motion Module Communication Input Address

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#6000									← Set by user.
#6001									← Set by user.
#6002									← Set by user.
#6003									← Set by user.
#6004									← Set by user.
#6005									← Set by user.
#6006									← Set by user.
#6007									← Set by user.

Table 6.10 Motion Module Communication Output Address

Address \ Bits	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#6500									← Set by user.
#6501									← Set by user.
#6502									← Set by user.
#6503									← Set by user.
#6504									← Set by user.
#6505									← Set by user.
#6506									← Set by user.
#6507									← Set by user.

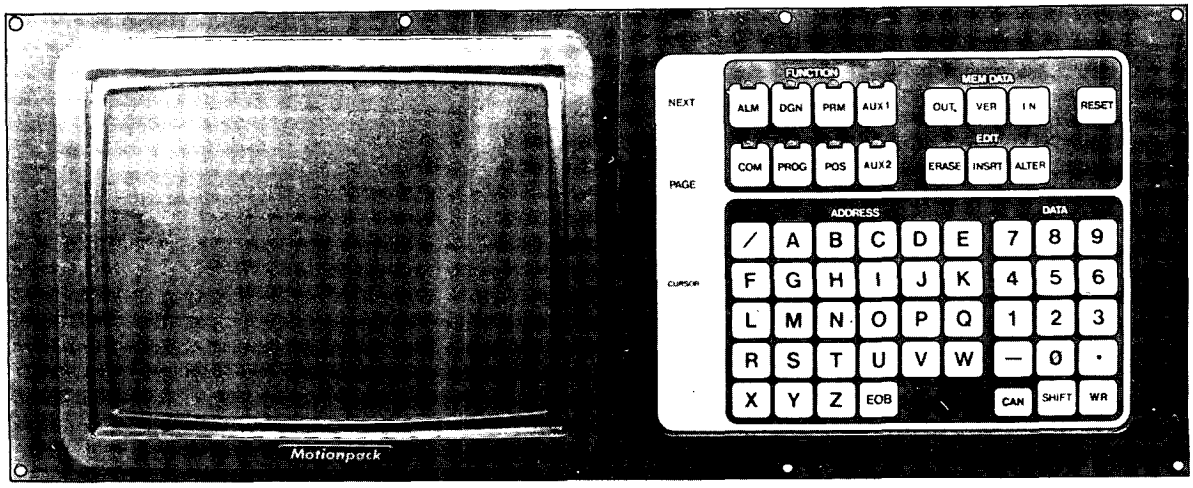
CONTENTS

7. OPERATION OF CRT CONTROL STATION

This chapter explains the CRT control station as the visible face of Motionpack-110.

7.1 CHARACTER DISPLAY AND KEYS

Fig. 7.1 shows an overall view of the CRT control station. The names and functions of operator components are as follows.



585-186

Fig. 7.1 CRT Control Station

7.1.1 CRT CHARACTER DISPLAY

According to each operation, this display indicates alpha-numerical data in regular size (1×1) or expanded size (3×3).

CRT size: 9 inches

Maximum number of characters:

32 characters × 16 lines = 512 characters
(at regular size)

Indicating characters:

Numerals 〔0 through 9, −,.〕
Alphabetic characters 〔A through Z〕
Special characters 〔; (EOB), /(slash)〕

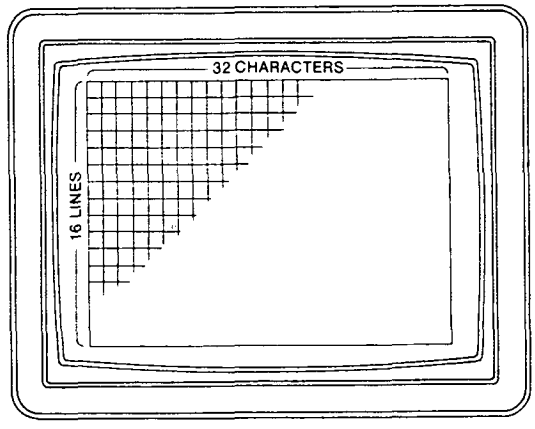


Fig. 7.2

7.1.2 FUNCTION KEYS

These are the selection keys for displaying and writing-in. Depressing a key provides a corresponding function and the key light.

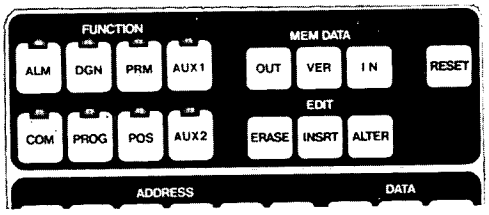


Fig. 7.3

(1) 

(Alarm) key: This key is for displaying an alarm code. This function is automatically selected when the power is turued on.

(2) 

(Diagnosis) key: This key is for displaying input/output signal status.

(3) 

(Parameter) key: This key is for displaying and writing-in parameters.

(4) 

(Auxiliary) key: This is an auxiliary key.

(5) 

(Command) key: This key is displaying command data for automatic operation.

(6) 

(Program) key: This key is for displaying or writing-in programs.

(7) 

(Position) key: This key is for displaying various current positions.

(8) 

(Offset Data) key: This key is for displaying or writing-in offset data.

ALM DGM PRM AUXL COM PROG POS AUX2

7.1.3 ADDRESS KEYS

These keys are for designating address characters when writing-in various data.

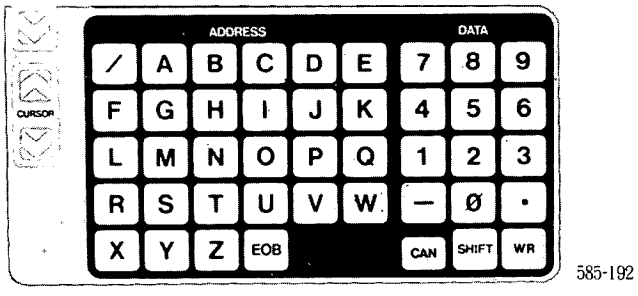


Fig. 7.4

7.1.4 DATA KEYS

These keys consist of 15 keys in total, such as [Ø] through [9], [—], [•], [CAN], [SHIFT], and [WR] and can be used for writing-in of such numeral values as offset values, parameter data, numeral values of programs and so on.

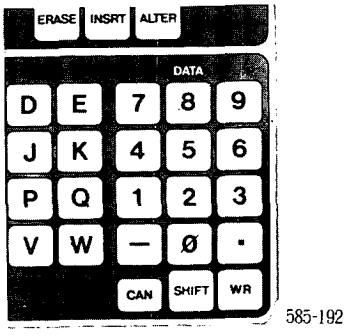


Fig. 7.5

(1) [Ø] to [9], [—] (Minus) keys: For input of numeral data.

(2) [•] (Decimal Point) key: For input of decimal point.

(3) [CAN] (Cancellation) key: For cancellation of the numeric value or address data erroneously keyed.

(4) [WR] (Write) key: For storing address data (=words) keyed by address keys and data keys into buffer storage.

(5) [SHIFT] (Shift) key: This is an auxiliary key.

7.1.5 NEXT KEY

[NEXT] key is used at position cancel. See Par. 7.2.3.

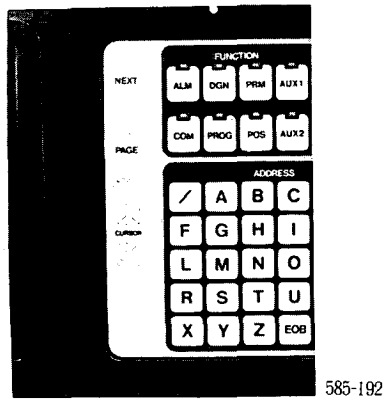


Fig. 7.6

7.1.6 PAGE KEYS

The page is used to display the next page or previous page when CRT screen is regarded as a page.

For example, use this key for displaying the next group of parameter data when [PRM] (parameter) has been selected and a group of parameter data are being displayed. This is just like turning the pages of a book.

(1) Depressing [PAGE ▽] key displays the next page.

(2) Depressing [△ PAGE] key displays the previous page.

(3) Keeping the PAGE key depressed makes the page step automatically forward or backward, as selected.

7.1.7 CURSOR KEYS

The cursor control key is used to move the cursor forward or backward on CRT screen.

For example, if [PRM] (parameter) has been selected and a group of parameter data is being displayed, this key can be used to move the cursor to the position of parameter number to be designated.

(1) Depressing [CURSOR ▽] key moves the cursor backward.

(2) Depressing [△ CURSOR] key moves the cursor forward.

(3) Keeping the cursor control key depressed makes the cursor move automatically backward or forward, as selected.

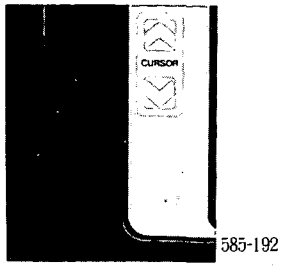


Fig. 7.7

7.1.8 EDIT KEYS

These keys are for editing a program stored in the memory.

(1) [ERASE] (Erase) key:
For erasing data in the memory.

(2) [INSRT] (Insert) key:
For inserting data in the memory.

(3) [ALTER] (Alter) key:
For altering data in the memory.

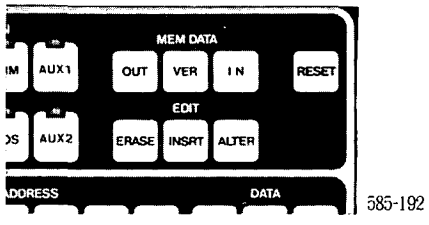


Fig. 7.8

7.1.9 MEMORY DATA KEYS

These keys are used to start the operation related to the memory except in the automatic operation. They are effective only in edit mode.

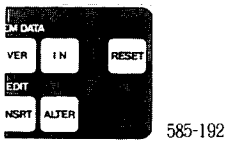
(1) [OUT] (Out) key:
This key is to output various data from the memory to personal computers or the like through data input/output interface.

(2) [IN] (In) key:
This key is to store various data from personal computers or the like into the memory through data input/output interface.

(3) [VER] (Verify) key:
This key is to examine and compare data in the memory with data in files of personal computers.

7.1.10 RESET KEY

This key is to reset the internal status.



585-192

Fig. 7.9

(1) The following operations can be executed by depressing [RESET] key:

(a) Move command cancel
(b) Buffer clear
(c) Alarm code release, if the cause has been eliminated
(d) Offset cancel
(e) Auxiliary function cancel
(f) Memory rewind
(g) Sequence number reset

(2) The following will not be affected by operating the RESET key.

(a) Current position of each axis
(b) F-commands
(c) T-commands
(d) Offset values and parameter data

NOTE

Depressing the RESET key or remote reset pushbutton (RESET input) is defined as "reset operation " in this manual.

7.2 DISPLAY AND WRITING OPERATION

7.2.1 GENERAL DISPLAY

The following display is made at both the top and bottom of the screen of CRT, irrespective of the FUNCTION key currently selected.

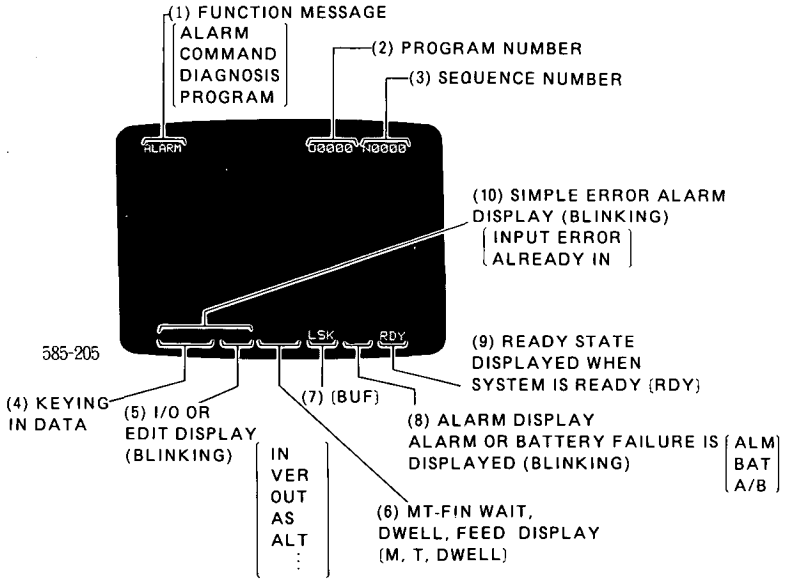


Fig. 7.10

(1) Function Message

Any one of the following seven function messages corresponding to the applicable function key is displayed at the top of the CRT screen.

ALARM	COMMAND
DIAGNOSIS	PROGRAM
PARAMETER	POSITION
OFFSET	

(2) Program Number

Program number under execution is always displayed with "0" and four subsequent digits on the top line of the CRT screen, irrespective of the function key selected.

(3) Sequence Number

Sequence number under execution is always displayed with "N" and four subsequent digits on the top line of the CRT screen, irrespective of the function key selected.

(4) Display of Keying Data

Keyed-in data are displayed. Up to ten characters can be shown. Data are processed by using [ERASE] key, [INSRT] or [ALTER] key, depending on the contents.

(5) IN/OUT and Editing Display

The following messages are displayed during input/output of various data, address search, or editing.

"IN "..... Inputting data
"VER " ..... Verifying data
"OUT " ..... Outputting data
"AS "..... Address searching
"ALT " ..... Altering data in EDIT mode
"INS " ..... Insering data in EDIT mode
"ERS " ..... Erasing data EDIT mode

(6) Display of M, S, T-FIN Signal Waiting and Dwelling

"M " ..... Waitting FIN signal of M-command
"S " ..... Waitting FIN signal of S-command
"T " ..... Waitting FIN signal of T-command
"DWELL " ... Dwelling
M, S, and T are displayed independently of each other.

(7) Display of the State of Buffer Full

"BUF " ..... Displayed upon completion of advanced reading.

(8) Display of Alarm

Alarm is continuously displayed until the cause is removed and reset operation is made.
"ALM " ..... Indicates an alame state.
"BAT " ..... Indicates battery alarm.
"A/B " ..... Indicates both the alarm and battery alarm.

(9) Display of Ready State

"RDY " ..... Indicates that the system is normal and operable.

(10) Display of Simple Errors

Error displays shown below are for minor errors that may occur during keying or searching operation different from the alarm display. If an error display of this kind occurs, it can be erased by depressing some key (normally [CAN] key).

"INPUT ERROR!"..... Format error during inputting keyed-in data.
"ALREADY IN!" ..... A program of the same number is already stored.
"MEMORY OVER!"..... Memory capacity is exceeded when storing a program.
"PROGRAM OVER!" ... Namber of registered programs exceed 99.
"NOT FOUND!" ..... Desired data has not been found by searching.

7.2.2 COMMAND DATA DISPLAY [COM]

Command data (COMMAND) are displayed. This shows the block data under execution in an automatic mode other than EDIT mode. Conditions of data to be displayed are as follows.

(1) Contents of active register are displayed during automatic operation or feed hold.

(2) Contents of the buffer register are displayed while the control is stopped at a block end. If the buffer register is blank (BUF is not displayed), the contents of the previously executed block are displayed.

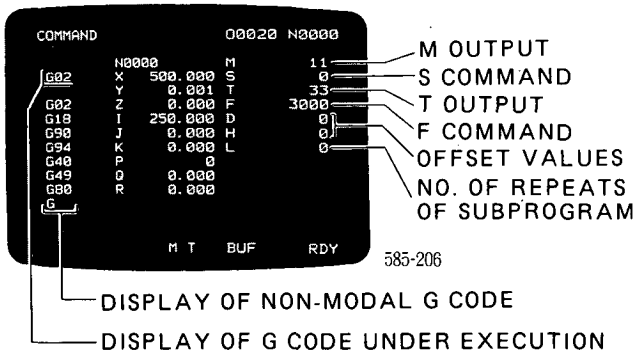


Fig. 7.11 Example of Display of Command Data

7.2.3 DISPLAY OF CURRENT POSITION VALUES [POS]

Current position values can be displayed at any time irrespective of the mode. The following operation is accomplished. When [POS] key is depressed, one of the following displays can be made.

- POSITION (INCREMENT)
- POSITION (UNIVERSAL)
- POSITION (AXIS)
- POSITION (ERROR)

(1) POSITION (INCREMENT)

Display in this case is:

(a) Continuous travel distance up to the end point of the block in memory run mode.

(b) Travel distance up to the point of start of manual operation in manual mode. Display of manual increment values can be canceled by setting the mode to memory run, then inputting start signals.

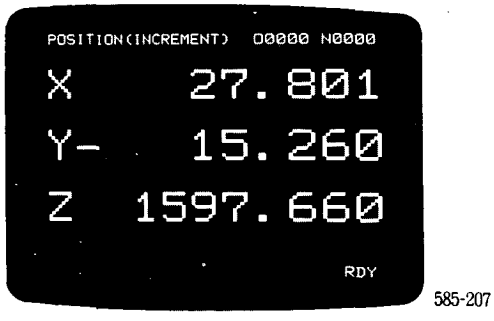


Fig. 7.12 Current Position Display (INCREMENT) Example

7.2.3 DISPLAY OF CURRENT POSITION VALUES [POS] (Cont'd)

(2) POSITION (UNIVERSAL)

(a) The position in the coordinate system set up by G92 is displayed.

(b) Universal display of the axis for which position cancel is made in manual operation mode is canceled and set to 0 regardless of the value displayed up to this time. Operate the keys as follows:

Depress [X] , [NEXT] successively. X 0.000 is displayed.
Depress [Y] , [NEXT] successively. Y 0.000 is displayed.
Depress [Z] , [NEXT] successively. Z 0.000 is displayed.

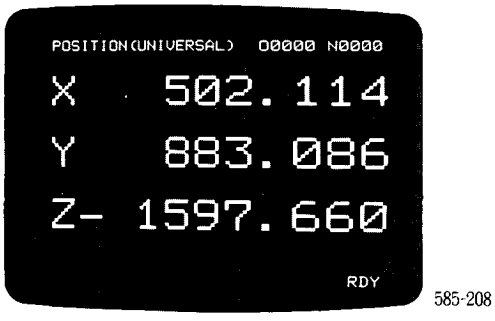


Fig. 7.13 Current Position Display(UNIVERSAL)Example

(3) POSITION (AXIS)

Each moved distance of actual axes after returning to reference point is displayed. Even if G29 is commanded, the display is not affected by the command.

Fig. 7.14 Current Position Display (AXIS)Example

(4) POSITION (ERROR)

Display in this case is:

(a) Contents of position error register are displayed.

(b) Use this position error function when adjusting a servo system of a machine. Do not use this function in other cases.

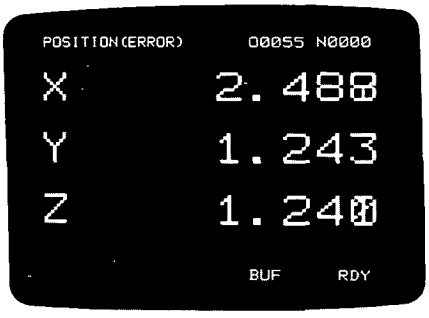


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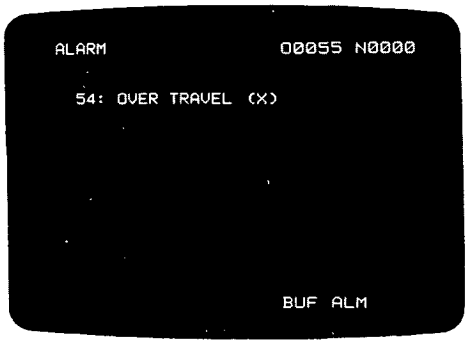
Fig. 7.15 Current Position Display (ERROR)Example

7.2.4 DISPLAY OF ALARM CODES [ALM]

If an alarm state occurs, "ALM " (for alarm), "BAT " (for battery alarm) or "A/B " (for alarm and battery alarm) is displayed on the lowest line of the CRT screen, regardless of mode or function. In this case, the detail of the alarm can be displayed by the following operation.

Depress [ALM] key. Alarm code and alarm message are displayed. By removing the cause of alarm and then depressing [RESET] key, the alarm state and alarm display can be released. For the details of alarm codes, refer to Par. 13.1 "ALARM CODE LIST".



585-211

Fig. 7.16 Alarm Display

7.2.5 DISPLAYING STATE OF I/O SIGNALS

When [DGN] function key is depressed, ON/OFF state of the input/output signals is displayed on CRT screen. The display of the state of input/output signals is always possible including during automatic operation.

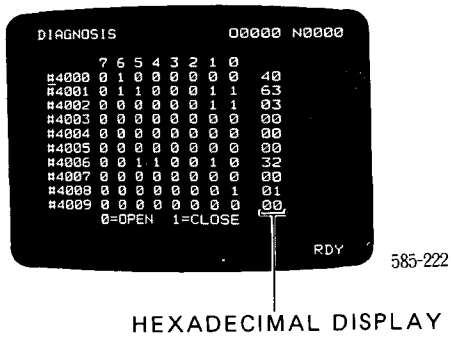


Fig. 7.17 Example of DGN Display

For the purpose of maintenance, etc., only the display of the state of input/output signals is made in 16-place digits at the right of screen.

(1) Operating Method for Input/Output Signal Display

1. Depress [DGN] key.
   The state of input/output signals on the page including the designated diagnosis number is displayed in a 16-place digit, consisting of "1" or "0".
2. Enter the diagnosis number to be displayed and then depress [CURSOR ▽] or [CURSOR △] key.
   Then, the display is switched to the page including the diagnosis number.
3. Depress [CURSOR ▽] key.
   The cursor moves to the position of diagnosis number plus one. When this key is depressed in succession, the cursor moves downward. When the cursor comes to the lowest line, the display is switched to the next page.
4. Depress [CURSOR △] key.
   The cursor moves to the position of diagnosis number minus one. When this key is depressed in succession, the cursor moves upward. When the cursor comes to the highest line, the display is switched to the previous page.
5. Depress [PAGE ▽] key.
   The next page is displayed.
6. Depress [CURSOR △] key.
   The previous page is displayed.

7.2.6 DISPLAY OF REGISTERED PROGRAM NUMBER [ALM]

All the program numbers registered are displayed.

(1) Select the alarm display and depress [PAGE ▽] key.

(2) All the numbers of programs already registered are displayed. Page of the table can be turned by depressing [PAGE ▽] key or [△ PAGE] key.

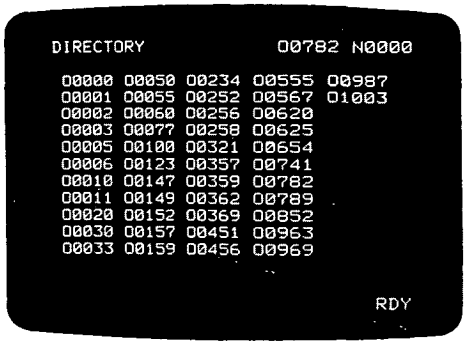


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Fig. 7.18 Registered Program Number Display

NOTE

This display is used only for looking at the registered programs. Registration of program numbers can be made in EDIT mode. Registration up to 99 programs is possible.

7.3 DISPLAYING AND WRITING PARAMETERS [PRM]

In this system, various parameters are stored in the internal memory, and the operating conditions of the system, such as quick feed rate, are determined by the contents of the parameters. For details, refer to Section 5. "PARAMETERS". Display of parameters can be made, at any time, including the time of automatic operation, irrespective of the display of parameters.

(1) Depress [PRM] key. The parameter number and the contents are displayed.

(2) Kinds of Parameters

There are two kinds of parameters: bit display type and ordinary decimal digit display type.

7.3 DISPLAY AND WRITING PARAMETERS [PRM] (Cont'd)

Parameter numbers of bit display type are #1000 through #1009. Parameters larger than #1100 are of decimal digit display type.

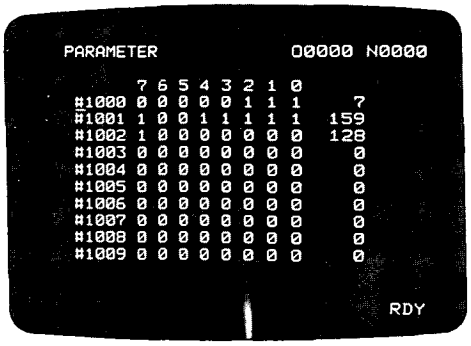

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Fig. 7.19 Example of Parameters (Bit Display Type)

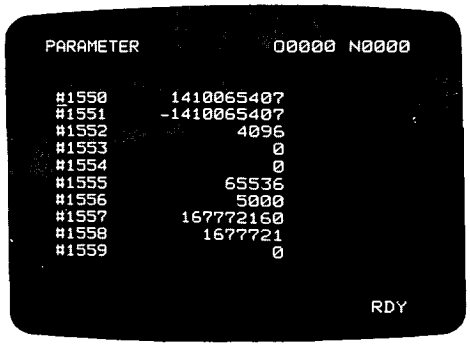

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Fig. 7.20 Example of Parameters (Ordinary Digit Display Type)

(3) Display of Parameters

(a) Key in the parameter number and depress [CURSOR] key or [CURSOR] key. However, keying of "#" is not required. A maximum of ten sets of parameter numbers and the contents can be displayed simultaneously.

(b) Designation of parameter number can be updated by [CURSOR] key or [CURSOR] key, and the CRT screen can be updated by [PAGE] key or [PAGE] key.

(4) Writing Parameters

Set the optimum values of parameters suited to the performance and purpose of the machine.

(a) For bit display type

1. Designate the parameter number to be written.

2. Depress [INSRT] key.
   Cursor will move from parameter number to bit display, and the bit position of D7 is first designated.

3. Depress [CURSOR] key.

   The cursor will be shifted by 1 bit toward the bit position of D0 evey time the key is depressed. Thus, move the cursor to the bit position to be altered.

4. Depress [WR] key.

   The designated bit data will be inverted in this way: "0" $\rightleftarrows$ "1". If the key is depressed again, the data will be inverted again.

5. Data writing by keying decimal numbers is possible only when the cursor is adjusted to the position of decimal digit display at the right end.
(Example): Writing decimal number of bit display

Keyed in Data	7 6 5 4 3 2 1 0	
[0] [WR]	0 0 0 0 0 0 0 0	0
[2] [5] [5] [WR]	1 1 1 1 1 1 1 1	255

6. To shift the cursor from bit display area to parameter number area, depress [INSRT] key.

7. Repeat steps 2 and 5 and write desired parameter data. If [CURSOR ▽] or [CURSOR △] key is kept depressed, the cursor on the screen automatically and continuously.

8. To change the display from bit display type to ordinary digit display type, depress [PAGE ▽] or [PAGE △] key.

(b) For oridinary digit display type

1. Designate the paramter number to be written.

2. Key in the numerals and depress [WR] key, then the writing to the parameter number shown by the cursor is performed.

3. The parameter number designation or screen can be updated by [CURSOR ▽] or [CURSOR △] key or [PAGE ▽] or [PAGE △] key.

NOTE

When parameters are changed, be sure to turn off the power once and then turn it on again. Otherwise, the system might fail to operate properly.

7.4 DISPLAYING AND WRITING OFFSET DATA [AUX2]

Offset data have been stored in the internal memory of Motionpack-110. Displaying and writing these offset data can be made, at any time, including the time of memory operation regardless of mode.

(1) Display of Offset Data

1. Select [AUX2] function key.

2. Key in the numbers by using keys such as [1] and [0] and then depress [CURSOR ▽] or [CURSOR △] key. Then, ten sets of offset numbers and offset data, including the offset number of keyed-in numerals, will be displayed. At the same time, the cursor is displayed below the designated offset number.

7.4 DISPLAYING AND WRITING OFFSET DATA [AUX2] (Cont'd)

3. By depressing [CURSOR] or [CURSOR] key, the next or previous offset number can be esignated. If the operation is made beyond the offset number shown on the screen, 10 new sets of offset numbers and offset data will be displayed automatically.

4. By depressing [PAGE] or [PAGE] key, the next or previous screen can be displayed. In this case, the cursor will show the first number of the displayed offset numbers.

5. Offset data are displayed in units of 0.001 mm, and the maximum value is 99999.999 mm.

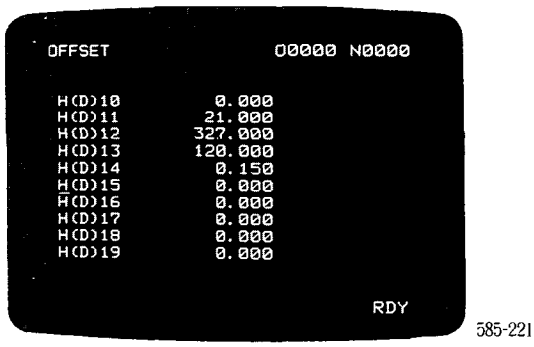

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Fig. 7.21

(2) Writing Offset Data

To write offset data in the internal memory, use increment values. That is, arithmetically add the increments to the offset data already stored in the memory.

1. Use cursor to designate the offset number to be written.

2. Enter the increment to be added to the offset data.(For subtract, add sign ⊖ precides the increment.)

3. Depress [WR] key.

Then, the increment of offset data just entered is written.

NOTE

1. Offset data are stored in the internal memory and held even if the power is turned off.

2. Offset data changed during automatic operation become effective when the system starts to read commands for a new block. Previous offset data remain effective for the current block as well as the blocks whose data are already read into the buffer for advance reading.

7.5 EDITING PROGRAMS

7.5.1 PROGRAM REGISTER AND CALL

Programs stored in the memory can be displayed on CRT screen and their contents can be checked by the operator.

(1) Program No. Register

1. Select EDIT mode.
2. Depress [RESET] and [PROG] keys.
3. Key-in the program number "[O][ ][ ][ ][ ]".
4. Depress [WR] key to change 0 number displayed at the top of the CRT for the keyed-in program number.

By the above procedure, the program number is registered completely. Next, edit the program by keying-in " [O][ ][ ][ ][ ][EOB] ", then depressing [INSRT] key.

NOTE

If the registering operation is executed for an already registered program number again, "ALREDY IN!" is displayed at the bottom of the CRT. This display can be deleted by depressing [CAN] key on the CRT control station.

(2) Registered Program Call

1. Select EDIT mode.
2. Depress [RESET] and [PROG] keys.
3. Input the program number " [O][ ][ ][ ][ ] " and depress [CURSOR] .

The specified program number will be searched and ten lines of data from the beginning of the program will be displayed on the CRT. If the program number is not found by searching, "NOT FOUND!" will blink at the bottom of the CRT. Depress the [CAN] to reset the display.

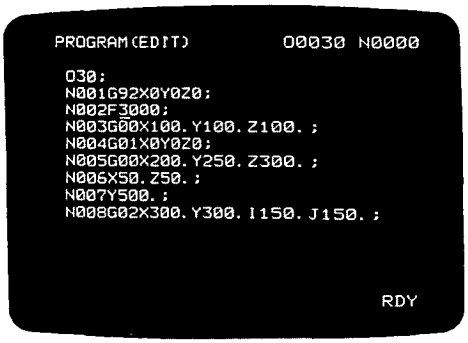


Fig. 7.22

7.5.1 PROGRAM REGISTER AND CALL (Cont'd)

(3) Operation of [PAGE] and [CURSOR] keys

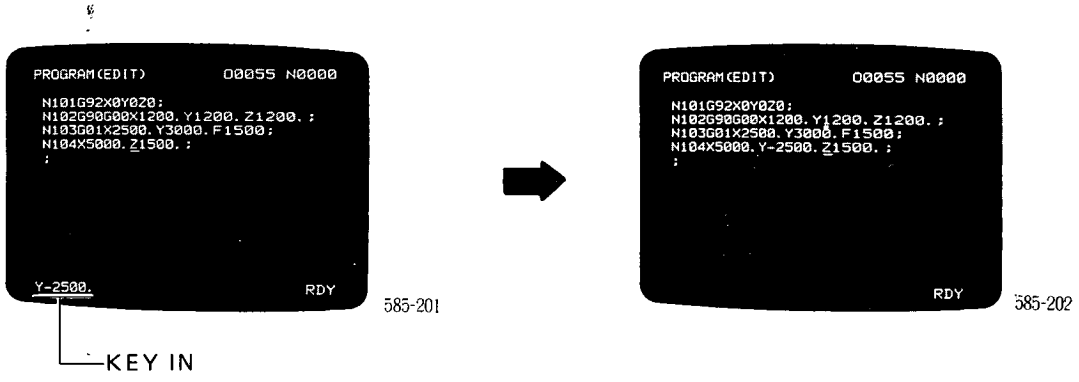
(a) By depressing [PAGE] or [PAGE] key, the previous or next page can be displayed on the CRT.

(b) By depressing [CURSOR] or [CURSOR] key, the position of cursor can be moved by one character forward or backward.

7.5.2 INSERTION OF PROGRAMS [PROG]

Editing new a program or altering a registered program is made entirely in edit mode by [PROG] function. Designate the word before the words to be added using cursor, key in the data to be added, and depress the [INSRT] key. Then, the new data will be inserted immediately after the word designated by the cursor.

The above insertion can be made for multiple words entered (less than 32 characters) as one group.

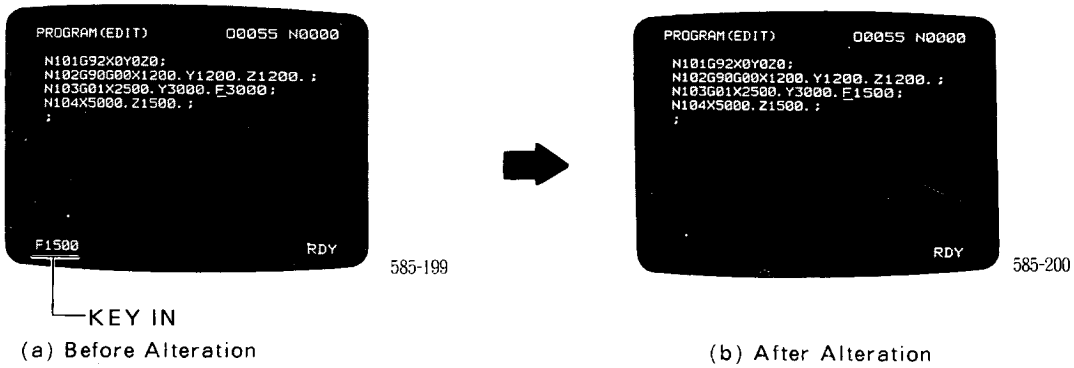


(a) Before Insertion (b) After Insertion

Fig. 7.23 Program Insertion

7.5.3 ALTERING PROGRAMS [ALTER]

Alteration of program (new or registered program) can be performed entirely in edit mode by the [PROG] function. Set the cursor to the head of the character string to be altered, enter the contents to be altered, and depress the key. Number of the characters to be altered is the same as that of characters entered.



(a) Before Alteration (b) After Alteration

Fig. 7.24 Program Alteration

7.5.4 PROGRAM ERASE [ERASE]

Program erase (new or registered program) is all performed in edit mode by [PROG] function. The program can be erased in unit of character, program or whole programs.

(1) Erasing Characters

Set the cursor to a character to be erased and depress the [ERASE] key. Only that character will be erased.

(2) Erasing Program Numbers

Enter the program number " [O][ ][ ][ ][ ] " and depress the [ERASE] key.
The program number just entered and its program will be erased.

(3) Erasing All Program Numbers

Depress the [O] [−] [9] [9] [9] and [9] keys and depress the [ERASE] key.
All the programs registered will be erased .

7.5.5 SEARCH FUNCTIONS

Data (character string) entered by the keys on the NC operator's station with CRT are collated with data (character string) in the memory and displayed on the CRT.

(1) Method of Operation

1. Select EDIT mode.
2. Depress [PROG] function key.
3. Depress [RESET] key.
   The beginning of program number will be set.
4. Enter the data to be searched (a character string of not more than 10 alpha-numerical characters).
5. Depress [CURSOR] key.
   Search is started and "AS" is displayed at the bottom of the CRT during search.

(2) Completion of Search

1. When the search is completed, "AS" disappears, the head of the data searched is specified (indicated by cursor) and the searching operation stops.
2. If the desired data cannot be found, "AS"disappears and, at the same time, "NOT FOUND!" is displayed on the CRT. This display can be erased by depressing [CAN]key on CRT control station.

NOTE

Leading zero may not be omitted for the data to be searched.
Data entered by keys will be collated with the data in the memory.

(3) Searching Program Numbers

The search function also can find a program (finding the head of the program) which was stored in the program memory.

1. Select the memory operation or edit mode.
2. Depress [RESET] function key.
3. Depress [RESET] key.
4. Enter the program number " [Ø][ ][ ][ ][ ] ".
5. Depress the [CURSOR] key.

The desired program number can be searched. Results of the search can be obtained as stated in (2) above. Therefore, in the case of memory operation mode, turn the start signal (STR) to ON immediately after completing the search. Then the automatic operation can be performed from the beginning of the program.

NOTE

Leading zero may be omitted for the program to be searched.

CONTENTS

8. PERSONAL COMPUTER

In the Motionpack-110 system, the input/output of various data can be made by means of an external personal computer. The personal computer can be connected to motion modules through the CRT control station or can be directly connected to motion modules. However, the setting and the operation will be slightly different between the former and the latter. Refer to Fig. 2.1.

8.1 INTERFACE WITH Motionpack-110

Interface between Motionpack-110 and personal computer conforms to RS-422 (RS-232C is also possible).

(1) Transmission Method

Asynchronous method (start-stop synchronism) is employed.
Word length: 8-bit length (personal computer ⟷ motion module)
7-bit length (personal computer ⟷ operator's station with CRT)
Parity: Even parity
Stop bit: 1 stop bit
Transmission control: X ON/X OFF

(2) Baud Rate

Baud rate shows the number of transmission bits per second in bps (bit/s). Baud rate of Motionpack-110 is 9,600 (bps).

(3) Transmission Character Code

ASCII code

(4) Connection Method

(a) If a personal computer is provided with RS-422 interface port, the computer can be directly connected to the motion module or the CRT control station.

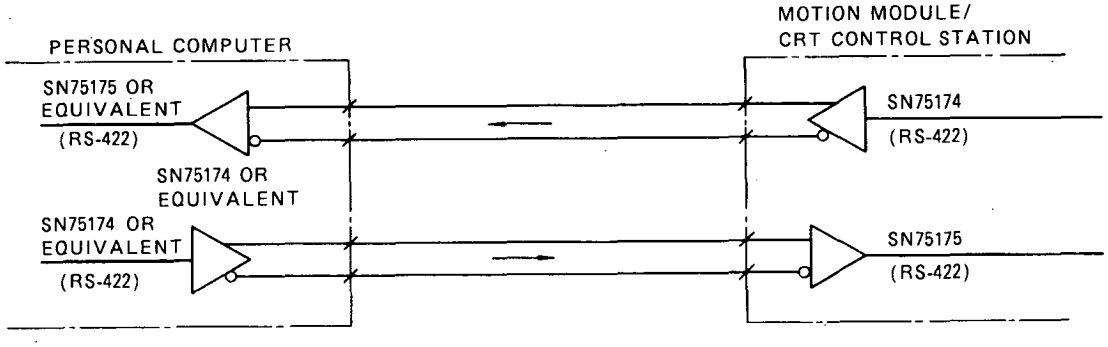


Fig. 8.1

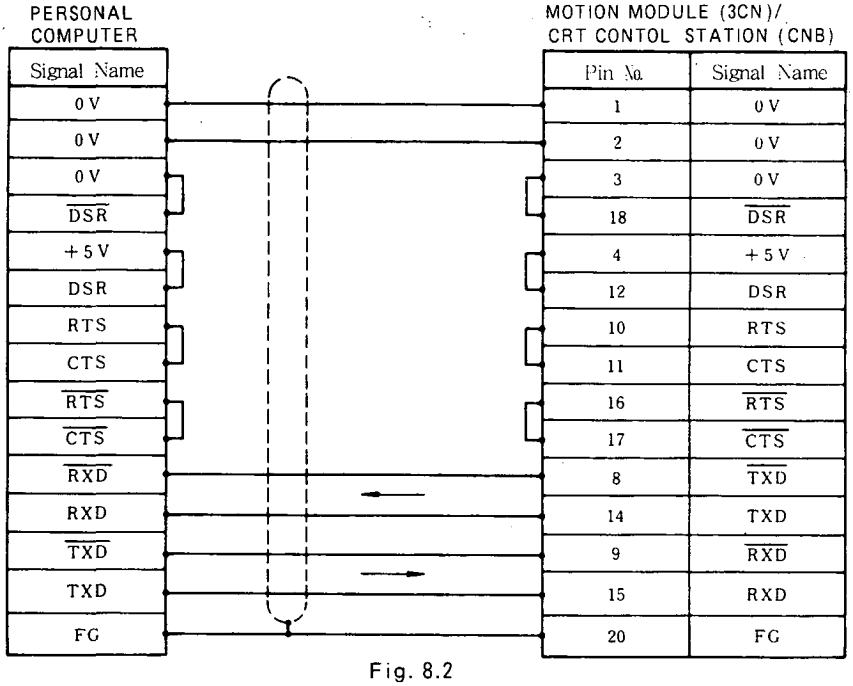


Fig. 8.2

(b) If the personal computer is provided with RS-232C interface port, the computer can be directly connected to the motion module or the CRT control station by changing the wiring as follows.

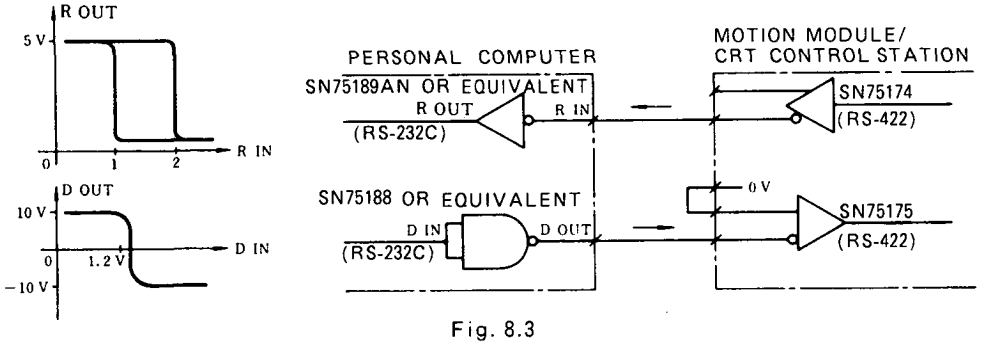


Fig. 8.3

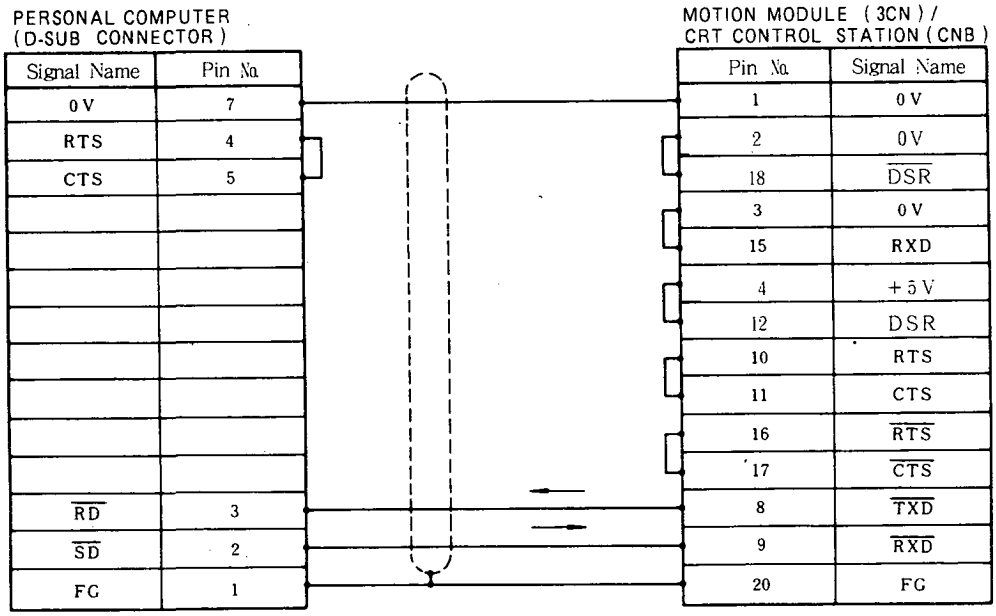


Fig. 8.4

8.1 INTERFACE WITH Motionpack-110 (Cont'd)

Where a model PC8201 is used as the personal computer, connection shown in Fig. 8.5 is required.

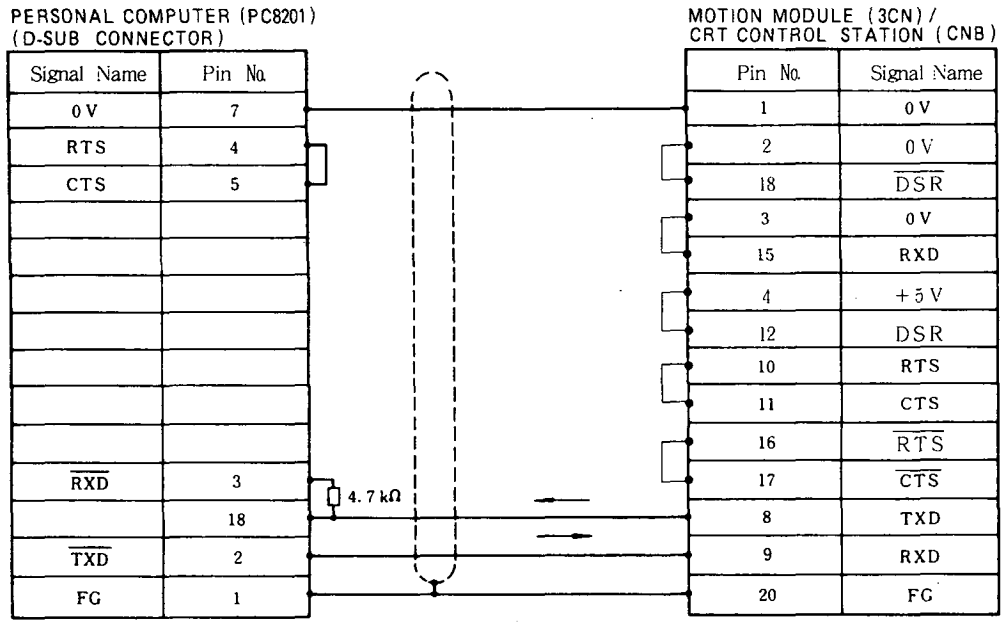


Fig. 8.5

When the personal computer contains an RS-232C interface port, the motion module and personal computer differ in signal level (RS-422, RS-232C) , but can be connected to each other by wiring as shown above. However, the connection cable length should be within 1 m because of lower noise interference.

If the cable length exceeds 1 m, it is recommended to use RS-422 or RS-232C converters available on the market.

8.2 OPERATING METHOD WHEN USING PC-8201

(1) Setting to "TELCOM" Mode

Set the PC-8201 in "TELCOM" mode (terminal function) in order to use the PC-8201 as a terminal of Motionpack-110. Setting to "TELCOM" mode can be made as follows.

1. Turn the power switch to ON.

2. Display on the screen is made in the MENU mode as shown below.

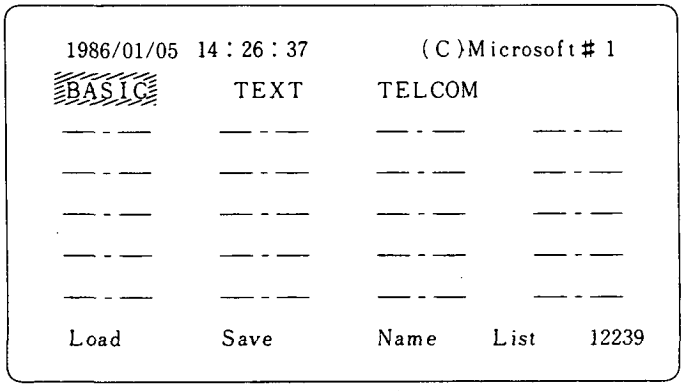


Fig. 8.6

3. Shift the cursor by using the ✳ key to the position above "TELCOM" and depress the ↵ key, then "TELCOM" mode can be obtained.

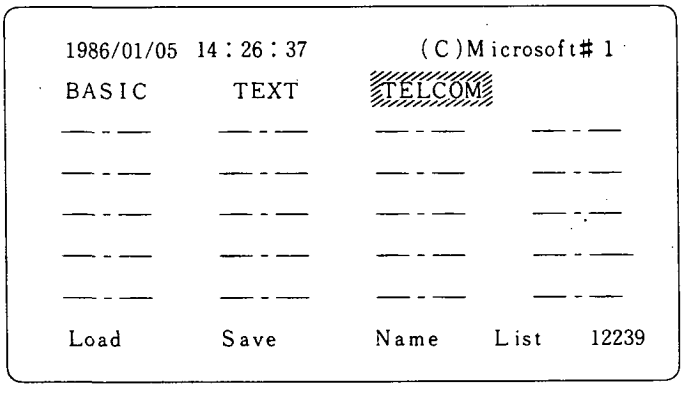


Fig. 8.7

4. The screen is cleared, the parameter of transmission method currently set is shown on the first line, TELCOM mode is shown on the second line, and input-waiting state begins.

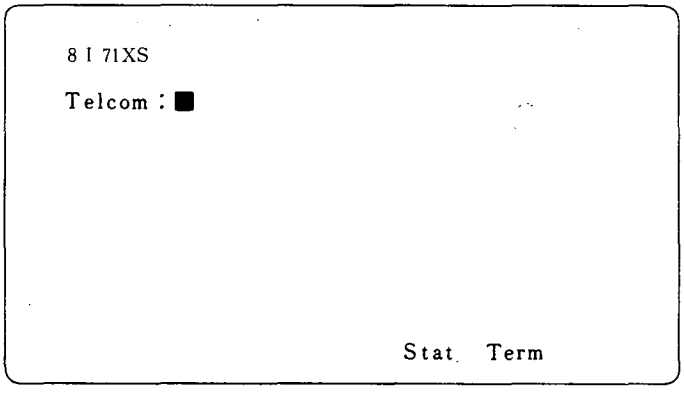


Fig. 8.8

The value of parameter of transmission method should be selected depending on the interface to be connected.

- For personal computer ⟷ motion module: "8E81XS"
- For personal computer ⟷ through operator's station: "8E71XS"

5. If the parameter of transmission method shown on the screen is not correct, depress the [F • 4] key (Stat), enter a correct value of parameter and go to Step 6.

6. If the parameter of transmission method shown on the screen is correct, then depress the [F • 5] key (Term). Then, the terminal mode begins and transmission to the personal computer becomes possible.

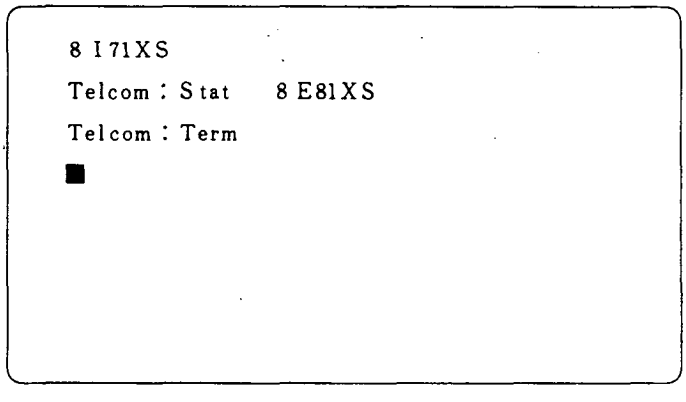


Fig. 8.9

When the above operation has been completed, transmission between the personal computer and motion module can be made.

(2) Creating and Editing Files

Use "TEXT" mode when creating a new file in the RAM of the personal computer and editing an existing file in the RAM.

Editing Method for New Files

1. Select "TEXT" mode on the MENU screen.
2. Screen is cleared and "File To Edit?" is asked.
3. Input the file name. File name [↵]
4. When the screen is cleared, input the program.
5. Complete the program by using edit commands (such as addition, modification or deletion).
6. Upon completion of edit, the MENU screen can be obtained by depressing the [F • 10] key (or [SHIFT] + [F • 5] keys) or depressing the [ESC] key twice in succession.

Editing Method for Existing Files

1. Shift the cursor to the existing file name on the MENU screen and depress the [↵] key.
2. Then the file contents are displayed on the screen and "TEXT" mode begins.
3. Correct and complete the program by using edit commands.
4. Upon completion of edit, execute Step 6, above.

(3) Transmitting Files in RAM of Personal Computer to Motion Module (UPLOAD [F • 4] Command)

UPLOAD [F • 4] command should be used when transmitting a file stored in the RAM of personal computer to the motion module. UPLOAD [F • 4] command should be as follows.

1. When [F • 4] key is depressed, "File to Upload? " is asked, and the system waits for the input of file name to be trans mitted.

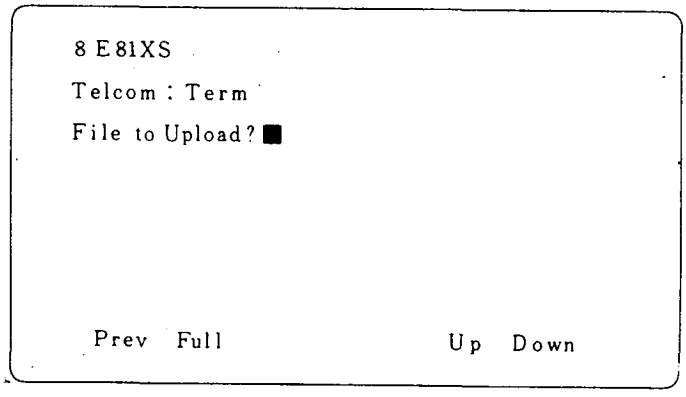


Fig. 8.10

2. If the file name which is not present in the RAM is input, an error display will be made. In this case , depress the [F • 4] key again.

3. If the file name is normally accepted, the transmission is started immediately after depressing the [↵] key. "UP" becomes a reversed display during UPLOAD, thereby indicating that the file in the RAM is being transmitted.

4. To stop the transmission halfway, depress the [STOP] key.

(4) Receiving File from Motion Module and Storing It into RAM of Personal Computer (DOWNLOAD [F • 4] Command)

The DOWNLOAD [F • 5] command should be used when receiving a file transmitted from the motion module and storing it into the RAM in accordance with the command from personal computer. DOWNLOAD [F • 5] command should be as follows.

1. When the [F • 5] key is depressed, "File to Download?" is asked, and the system waits for the input of file name.

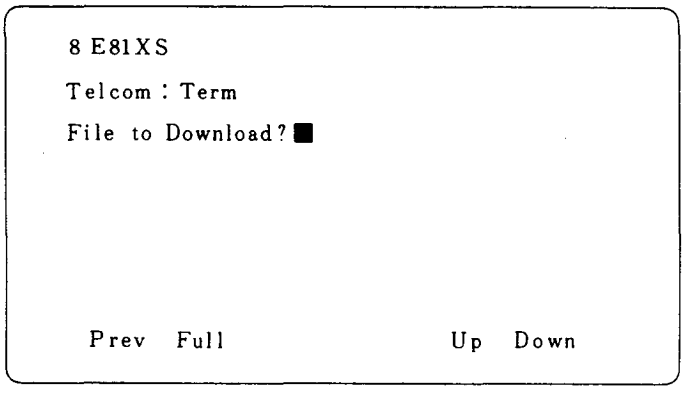


Fig. 8.11

2. Input the file name and depress the [↵] key, then a new file with this file name is created. If the same file name already exists, the contents of the old file are erased and replaced with the contents of the new file.

3. After the input of file name, all the data received by the personal computer are stored into the RAM. "DOWN" becomes a reversed display during DOWNLOAD, thereby indicating the state of receiving data into the RAM.

4. The state of DOWNLOAD continues until the [F • 5] key is depressed again. When the required data are all placed in the file, depress the [F • 5] key again in order to terminate the DOWNLOAD.

8.3 DATA INPUT/OUTPUT BETWEEN CRT CONTROL STATION AND PERSONAL COMPUTER

The method of using a personal computer described in this part is the operation method via the CRT control station, as shown in Fig. 8.12. Thus, set the status (Stat) to 8E71XS and perform the operations listed below. Various data (programs, parameters, offset data) are input/output and collated with each other.

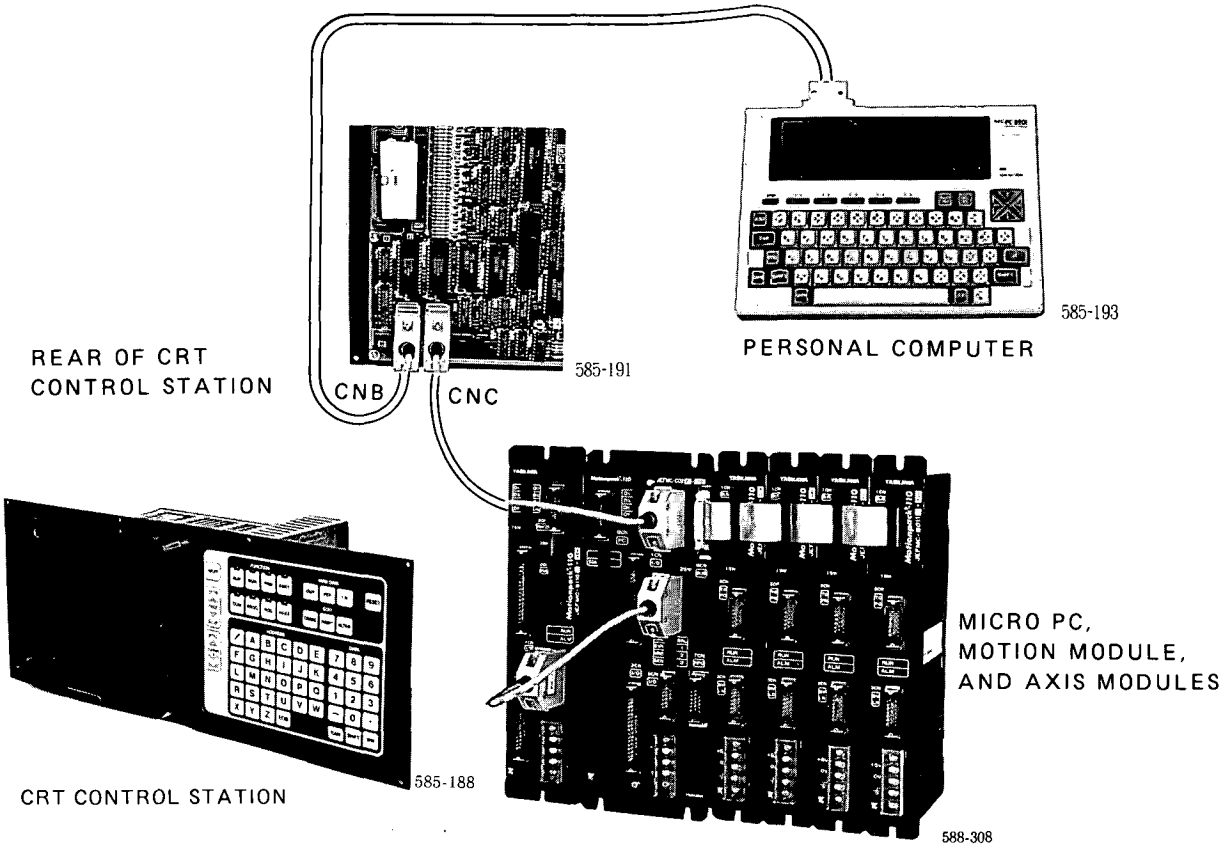


Fig. 8.12

8.3.1 INPUT OF PROGRAM FROM PERSONAL COMPUTER

Procedures for input operation for programs from personal computer are as follows.

1. Select the edit mode.
2. Depress the [PROG] key.
3. Depress the [RESET] key.
4. Depress the [IN] key.
5. The program is transmitted from the personal computer. For the setting during transmission, refer to Par. 8.1 "INTERFACE WITH Motionpack-110". (For PC 8201, use the UPLOAD command of terminal mode.)
6. Start the reading of program. The characters following "%" at the head of a program are deemed as data. Program number " [0][ ][ ][ ][ ] " is first read and newly registered.
7. When the last % is received from the personal computer, the display of IN is erased, thereby terminating the reading. However, whether the program number is duplicated or not must be checked in advance. If duplicated, "ALREADY IN!" is displayed. In this case, erase the relevant program number already registered and then repeat Steps 3 to 7.

8.3.2 OUTPUT OF PROGRAM TO PERSONAL COMPUTER

Procedures for output operation for programs to personal computer are as follows.

1. Depress the [RESET] key.
2. Select the edit mode.
3. Depress the [PROG] function key.
4. Make preparations for receiving and accepting at the personal computer side. For setting the personal computer, refer to Par. 8.1 "INTERFACE WITH Motionpack-110". (For PC 8201, use the DOWNLOAD command of terminal mode.)
5. Key-in the program number " [0][ ][ ][ ][ ] ". Leading 0 can be omitted.
6. Depress the [OUT] key.

   Program with the program number just entered is output to the personal computer. The operation automatically stops when the output of the program is completed. "OUT " is always displayed during the output of data.
7. Depress the [RESET] key if it is desired to halt the output. But any subsequent operation is not possible. The output operation must be started from the first step at any time the output is halted by the [RESET].

8.3.3 COLLATION OF PROGRAM WITH FILE IN PERSONAL COMPUTER

Procedures for the collation of a program with a file in the personal computer are as follows.

1. Select the edit mode.
2. Depress the [PROG] function key.
3. Depress the [RESET] key.
4. Key-in the program number " [0][ ][ ][ ][ ] ". Leading 0 can be omitted.
5. Depress the [VER] key.
6. Transmit the file to be checked from the personal computer side. For setting the computer in this case, refer to Par. 8.1 "INTERFACE WITH Motionpack-110 ". (For PC 8201, use the UPLOAD command of terminal mode.) Collate the contents of the program with those of the file in the computer. "VER " is displayed at the bottom of the CRT during collation. If no coinciding is found after collation, "INPUT ERROR" is displayed. If all the contents coincide and the collation is completed, the display of "VER " is erased.

8.3.4 INPUT OF PARAMETERS FROM PERSONAL COMPUTER

Parameters are input from the NC operator's station but can be also input as data in the memory of personal computer. Parameters can be input as a file. The format is as shown in Fig. 8.13.

```
%;
PM   1000      7;
PM   1001    159;
PM   1002    128;
  :
%;
```

Fig. 8.13

8.3.4 INPUT OF PARAMETERS FROM PERSONAL COMPUTER (Cont'd)

Procedures for parameter input operation from personal computer are as follows.

1. Select the edit mode.
2. Depress the [RESET] key.
3. Depress the [PRM] key.
4. Depress the [IN] key. Make preparations for reading. "IN" will be displayed at the bottom of the CRT screen.
5. Transmit the data from the personal computer. For the setting of personal computer, refer to Par. 8.1 "INTERFACE WITH Motionpack-110". (For PC 8201, use the UPLOAD command of terminal mode.)
6. When "%" is read, "IN" displayed on the CRT screen is erased. Upon completion of input, turn the power off and then turn it on again.

8.3.5 OUTPUT OF PARAMETERS TO PERSONAL COMPUTER

Procedures for parameter output operation to personal computer are as follows.

1. Select the edit mode.
2. Depress the [RESET] key.
3. Depress the [PRM] key.
4. Make preparations for receiving and accepting at the personal computer side. For the setting of personal computer, refer to Par. 8.1 "INTERFACE WITH Motionpack-110". (For PC 8201, use the DOWNLOAD command of terminal mode.)
5. Depress the [OUT] kye.
6. For halting the output, depress the [RESET] key. However, any subsequent operation is not possible after halting. The output operation must be started from the first step any time it is halted by the RESET.

8.3.6 INPUT OF OFFSET DATA FROM PERSONAL COMPUTER

Offset data are normally input from NC operator's station but can also be input as one group from the personal computer. Input format for offset data is as indicated in Fig. 8.14.

```
%;
H01        1.000;
H02        2.000;
D03       -10.089;
  :
%;
```

Note: Either H or D symbol may be used.

Fig. 8.14

Procedures for offset data input from personal computer are as follows.

1. Select the edit mode.
2. Depress the [RESET] key.
3. Depress the [AUX2] key.
4. Depress the [IN] key.
   Make preparations for reading. The display of "IN" is made at the bottom of the CRT.
5. Transmit data from personal computer. For the setting of the personal computer, refer to Par. 8.1 "INTERFACE WITH Motionpack-110". (For PC 8201, use the UPLOAD command of terminal mode.)
6. When "%" is read, the display of "IN" on the CRT is erased. The input operation is now completed.

8.3.7 OUTPUT OF OFFSET DATA TO PERSONAL COMPUTER

Offset data set in the current system can be output to the files in personal computer. Procedures for offset data output to personal computer are as follows.

1. Select the edit mode.
2. Depress the [RESET] key.
3. Depress the [AUX2] key.
4. Make preparations for receiving and accepting at the personal computer. For the setting of personal computer, refer to Par. 8.1 "INTERFACE WITH Motionpack-110". (For PC 8201, use DOWNLOAD command of terminal mode.)
5. Depress the [OUT] key.
   Offset data are output. The system will automatically stop after outputting all the contents of the offset data memory.
6. For halting the output, depress the [RESET] key. However, any subsequent operation is not possible. The operation must be started from the first step at any time it is halted by the RESET.

8.4 DIRECT TRANSMISSION BETWEEN MOTION MODULE AND PERSONAL COMPUTER

The Motionpack-110, if connected directly to a personal computer as shown in Fig. 8.15, can transmit or receive data directly. If PC 8201 is used as personal computer, it may be used as it. But an application program must be provided if another kind of personal computer is to be employed.

8.4.1 INTERFACE BETWEEN MOTION MODULE AND PERSONAL COMPUTER

The connecting method between a motion module and a personal computers is shown in Fig 8.15.

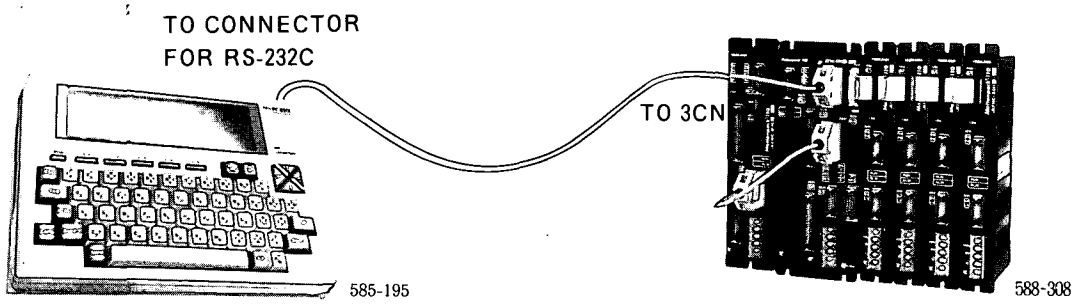


Fig. 8.15

8.4.2 COMMANDS

The commands which can be sent from the personal computer to motion module are as listed below. These commands are effective only for predetermined modes (shown by "0" in Table 8.1).

Table 8.1 List of Commands

Mode / Command	Edit	Memory Operation	Step Operation	Jog Operation	Quick Feed Operation	Contents
①DWL	○					Batch input of file (program)
②UPL	○					Batch output of UPLOAD file (program)
③DEL	○					Erase of UPLOAD file (program)
④CLR	○					Erase of all files
⑤DIR	○					Display of registered program No.
⑥WRT	○	○	○	○	○	Input of parameters
⑦RED	○	○	○	○	○	Output of parameters
⑧PDW	○	○	○	○	○	Batch input of parameter file
⑨PUP	○	○	○	○	○	Batch output of parameter file
⑩PUN		○	○	○	○	Display of current position (Axis)
⑪PER		○	○	○	○	Display of position lag pulse
⑫OST	○					Finding the head of program No.
⑬ORD	○	○				Display of finding the head of program No.
⑭ONN	○	○	○	○	○	Display of program and sequence No.
⑮HWT	○	○	○	○	○	Input of offset data
⑯HRD	○	○	○	○	○	Output of offset data
⑰HDW	○	○	○	○	○	Batch input of offset data file
⑱HUP	○	○	○	○	○	Batch output of offset data file

Note: Please consult your Yaskawa representative for additional information for the commands.

8.5 CREATING PROGRAMS

8.5.1 INPUT OF PROGRAMS FROM CRT CONTROL STATION

Input the program No. first and then the program. Refer to Par. 7.5.

(Example)

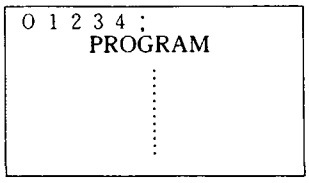


Fig. 8.16

8.5.2 INPUT OF PROGRAMS FROM PERSONAL COMPUTER

Input the program No. after "%" and then the program.

(Example)

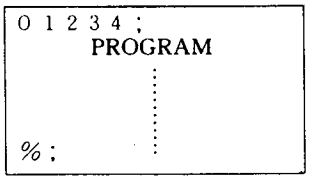


Fig. 8.17

When storing a program from the personal computer into the memory of motion module, the program is stored from % to %. Therefore, the omission of first % and last % is not permitted.

8.5.3 EXAMPLES OF PROGRAMS

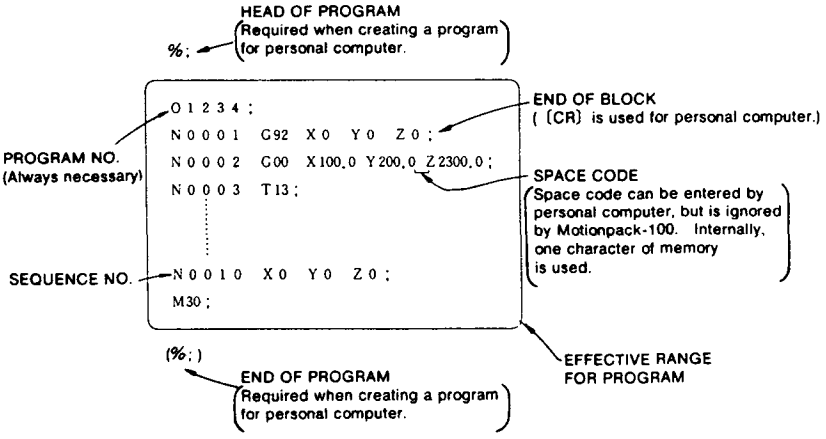
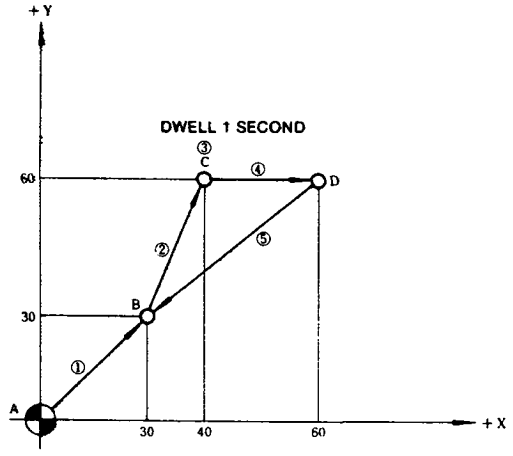


Fig. 8.18 Program Example A

8.5.3 EXAMPLES OF PROGRAMS (Cont'd)

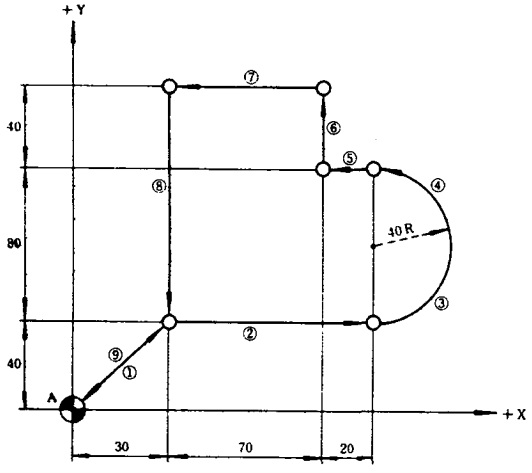
(Programmed by G90 Absolute)




```
   0 2 3 4 5;
①  N1 G90 G01 X30. Y30. F200;
②  N2 X40. Y60.;
③  N3 G04 P1.; ···Stopped for 1 second at point C(Dwell)
④  N4 X60. F100;
⑤  N5 X30. Y30. F150;
   N6 M30;
```

Fig. 8.19 Program Example B

(Programmed by G91 Incremental)



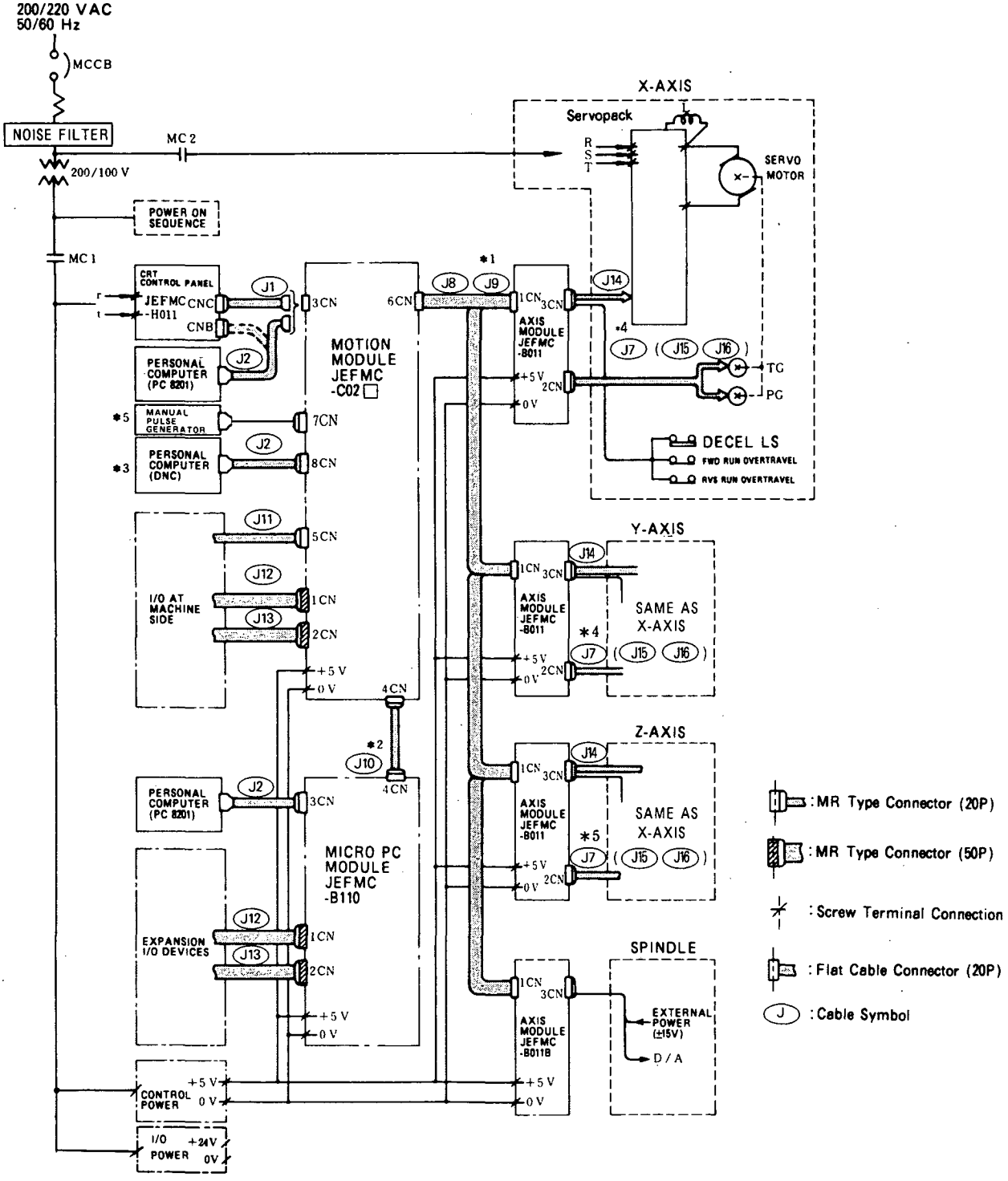

```
   0 3 4 5 6;
①  G91 G01 X30. Y40. F100;
②  X90.;
③  G17 G03 X40. Y40. J40.;
④       G03 X−40. Y40. I−40.;
⑤       G01 X−20.;
⑥           X40.;
⑦           X−70.;
⑧           Y−120.;
⑨           X−30. Y−40.;

   M30;
```

Fig. 8.20 Program Example C

CONTENTS

9. INTERFACE BETWEEN EQUIPMENT

The connecting diagram for equipment, such as motion modules, axis modules, micro PC modules, Servopacks and motors combined to form a system is shown in Fig. 9.1.



*1 Cable (J8) is attached to the motion module as a standard.
*2 Cable (J10) is attached to the micro PC module as a standard.
*3 DNC function is available only for use of the motion module, type JEFMC-C027.
*4 For AC servo drive, cable (J15) is used.
*5 For 12 V optional encoder, cable (J16) is used.
*6 HANDLE function is available only for use of the motion module, type JEFMC-C023 and -C027.

Note: Each module is provided with a solder type connector as a standard. Cables except thoes of (J8) and (J10) should be provided by customer.

Fig. 9.1 Connection Diagram of Motionpack-110 Control System

9.1 ITEMS RELATED TO POWER SUPPLY

9.1.1 POWER-ON SEQUENCE

Make a power-on sequence that will first turn on the AC power supply, then the control power supply (5VDC), I/O power supply (24VDC) and CRT control station power supply (100 VAC). Approximately one second later the servo power supply will be turned on. For an example of the connecting power-on circuit, refer to Fig. 12.3.

When the power supply of Motionpack-110 is turned off, a no control status may occur temporarily. This status may send out an unnecessary output signal instantaneously. In this case, make a power-off sequence that will first turn off I/O power supply, then the control power supply.

9.1.2 CONTROL POWER UNITS

Power units for motion modules, axis modules, input/output signals and PG (optical encoder) are not furnished and must be prepared by the user. These power units must have enough power capacity for the system (see par. 2. 4.), providing the required functions within the working temperature range (0 to 55℃) of the Motionpack-110. Examples of models of these power units are explained below for your reference.

9.1.2.1 Power Units for Motion Modules, Axis Modules and Micro PC Modules

A 5 VDC power unit is necessary as control power unit for motion modules, axis modules and micro PC modules. This unit must meet the specifications shown in Table 9.1.

Table 9.1 Specifications for 5 VDC Power Unit

Item		Specifications
Input Voltage		100/110 VAC, 50/60 Hz
Rated Voltage		5 V
Rated Current		5 A
Output Stability		Less than ±5 %
Ripple Noise		Less than 300 mVp-p
Leak Current		Less than 0.5 mA
Overcurrent Protection		Provided
Working Temperature		0 to +55°C
Storing Temperature		−20°C to +85°C
Relative Humidity		30 to 90 % (non-condesing)
Insulation	Input ⟷ Frame	Withstand voltage: 1500 VAC, 1 minute Resistance: Greater than 100 MΩ at 500 VDC
	Input ⟷ Output	
	Onput ⟷ Frame	

Example of model:

(1) Type: EY 05005
Manufacturer: Shindengen Kogyo KK
Input: 85 to 132 VAC, 47 to 63 Hz
Output: 5V, 5A

(2) Type: BY05011
Manufacturer: Shindengen Kogyo KK
Input: 85 to 115 VAC, 47 to 440 Hz
Output: 5 V, 11 A

Where axis module is used for spindle, ±10 V output is applied. In this case, ±15 VDC power unit is required. Table 9.2 shows the specifications for ±15 VDC power unit.

Table 9.2 Specifications for ± 15 VDC Power Unit

Item		Specifications
Input Voltage		100/110 VAC, 50/60 Hz
Rated Voltage		± 15V
Rated Current		± 20mA
Output Stability		Less than ±5 %
Ripple Noise		Less than 300 mVp-p
Leak Current		Less than 0.5 mA
Overcurrent Protection		Provided
Working Temperature		0 to +55°C
Storing Temperature		−20°C to +85°C
Relative Humidity		30 to 90 % (non-condensing)
Insulation	Input ⟷ Frame	Withstand voltage: 1,500 VAC, 1 minute Resistance: Greater than 100 MΩ at 500 VDC
	Input ⟷ Output	
	Output ⟷ Frame	

Example of model:

(1) Type: BYG 800/01
Manufacturer: Shindengen Kogyo KK
Input: 90 to 129 VAC, 47 to 63 Hz
Output: +5V, 10A
+5 to +15 V, 1 A
−5 to −15 V, 1 A
Working Temperature:
• Natural air cooled − 0 to 50°C
• Forced air cooled − 0 to 60°C

(2) Type: BYG 430/01
Manufacturer: Shindengen kogyo KK
Input: 90 to 129 VAC, 47 to 63 Hz
Output: +5 V, 5.5 A
+5 to +15 V, 0.5 A
−5 to −15 V, 0.5 A

9.1.2.2 Power Supply for PG

A 12 VDC power unit is necessary for feedback unit TFUE-□□ZC7 or TFUE-□□SAB. A power unit meeting the specifications shown in Table 9.3 should be provided.

Table 9.3 Specifications for 12 VDC Power Unit

Item		Specifications
Input Voltage		100/110 VAC, 50/60 Hz
Rated Voltage		12 V
Rated Current		200 mA (per 1 unit of PG)
Output Stability		Less than ±5 %
Ripple Noise		Less than 300 mVp-p
Leak Current		Less than 0.5 mA
Overcurrent Protection		Provided
Working Temperature		0 to +55°C
Storing Temperature		−20°C to +80°C
Relative Humidity		30 to 90% (non-condensing)
Insulation	Input ⟷ Frame	Withstand voltage: 1,500 VAC, 1 minute Resistance: Greater than 100 MΩ at 500 VDC
	Input ⟷ Output	
	Output ⟷ Frame	

Example of model:

Type: AYS 1201
Manufacturer: Shindengen Kogyo KK
Input: 90 to 110 VAC, 47 TO 500 Hz
Output: 12 V, 1 A

As a compound power unit for both 5 V and 12 V, the following model is recommended.

Type: CYG 500/01
Manufacturer: Shindengen Kogyo KK
Input: 85 to 132 VAC, 47 to 63 Hz
Output: 5V, 5A; 12 V, 2.5 A; −12 V, 0.4 A

9.1.2.3 Power Supply for Input/Output Signals

A 24 VDC power unit is necessary for input/output signals. A power unit meeting the specifications of Table 9.4 should be provided.

Table 9.4 Specifications for 24 VDC Power Supply

Item		Specifications
Input Voltage		100/110 VAC, 50/60 Hz
Rated Voltage		24 V
Rated Current		2 A (3-axis system)
Output Stability		Less than ±10 %
Ripple Noise		Less than 300 mVp-p
Leak Current		Less than 0.5 mA
Overcurrent Protection		Provided
Working Temperature		0 to +55°C
Storing Temperature		−20°C to +85°C
Relative Humidity		30 to 90% (non-condensing)
Insulation	Input ⟷ Frame	Withstand voltage: 1,500 VAC, 1 minute Resistance: More than 100 MΩ at 500 VDC
	Input ⟷ Output	
	Output ⟷ Frame	

Example of model:

Type: BY242R5
Manufacturer: Shindengen Kogyo KK
Input: 85 to 115 VAC, 47 to 440 Hz
Output: 24 V, 2.5 A

9.2 INPUT/OUTPUT AT MACHINE SIDE

9.2.1 RULES FOR INPUT/OUTPUT SIGNALS

9.2.1.1 Rules for Input Signals

Input signals referred to herein are those sent from the machine side to Motionpack-110. For connection, 0V common method (True-Low method) shown in Fig. 9.3 is applied. Effective condition of the input voltage is as follows.

(1) ON or OFF input signals with a duration longer than 50 ms are effective.

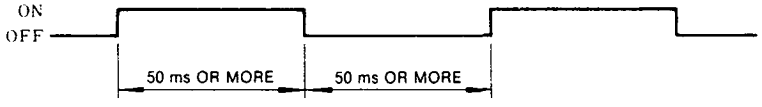


Fig. 9.2

(2) Input contact capacity should be about 5 mA to 5 A with a rated voltage of 24 VDC. Chattering time of the contact should be less than 5 ms.

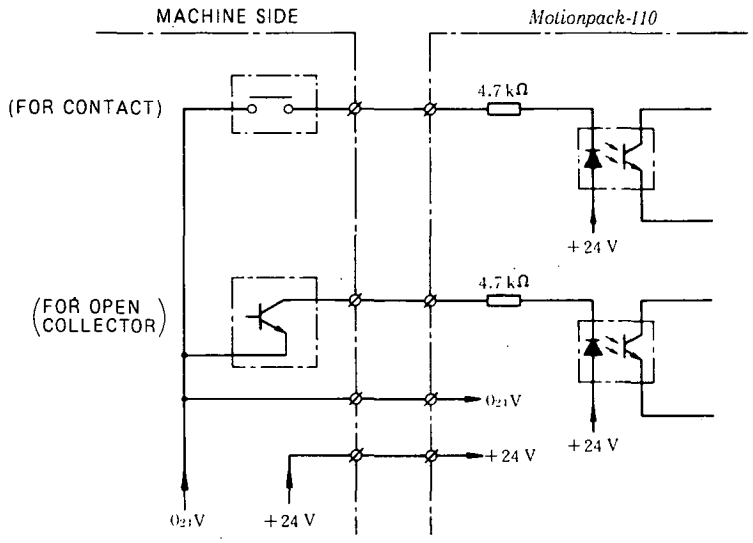


Fig. 9.3

9.2.1.2 Rules for Output Signals

Signals sent from Motionpack-110 to machine side must have the output capacity and protective measures as explained below.

(1) Output capacity is less than 24 VDC and 80 mA.

(2) Non-contact output.

(3) The following measures are necessary to protect non-contact output.

- When connecting an inductive load such as a relay coil, be sure to connect a spark suppressor in parallel to the load at a distance of 20 cm from the load.
- The spark suppressor must be connected with correct polarity. Otherwise, non-contact output circuit of Motionpack-110 might be destroyed.

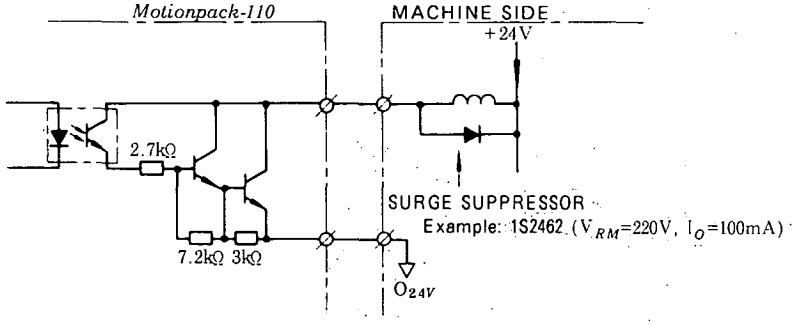


Fig. 9.4

- In the case of lamp load, connect a preheating resistor so as to use the lamp below the rated capacity including rush current.

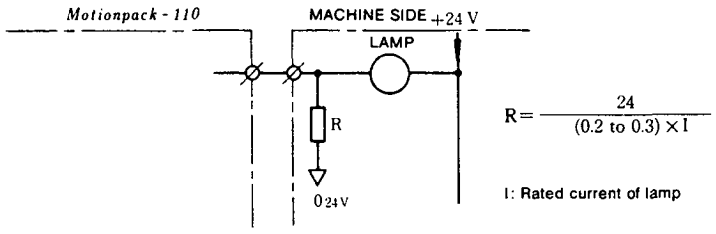


Fig. 9.5

- Reduce the current through the lamp to 20 to 30% of the rating of the lamp by connecting the preheating resistor.

9.2.2 DETAIL OF INPUT SIGNALS

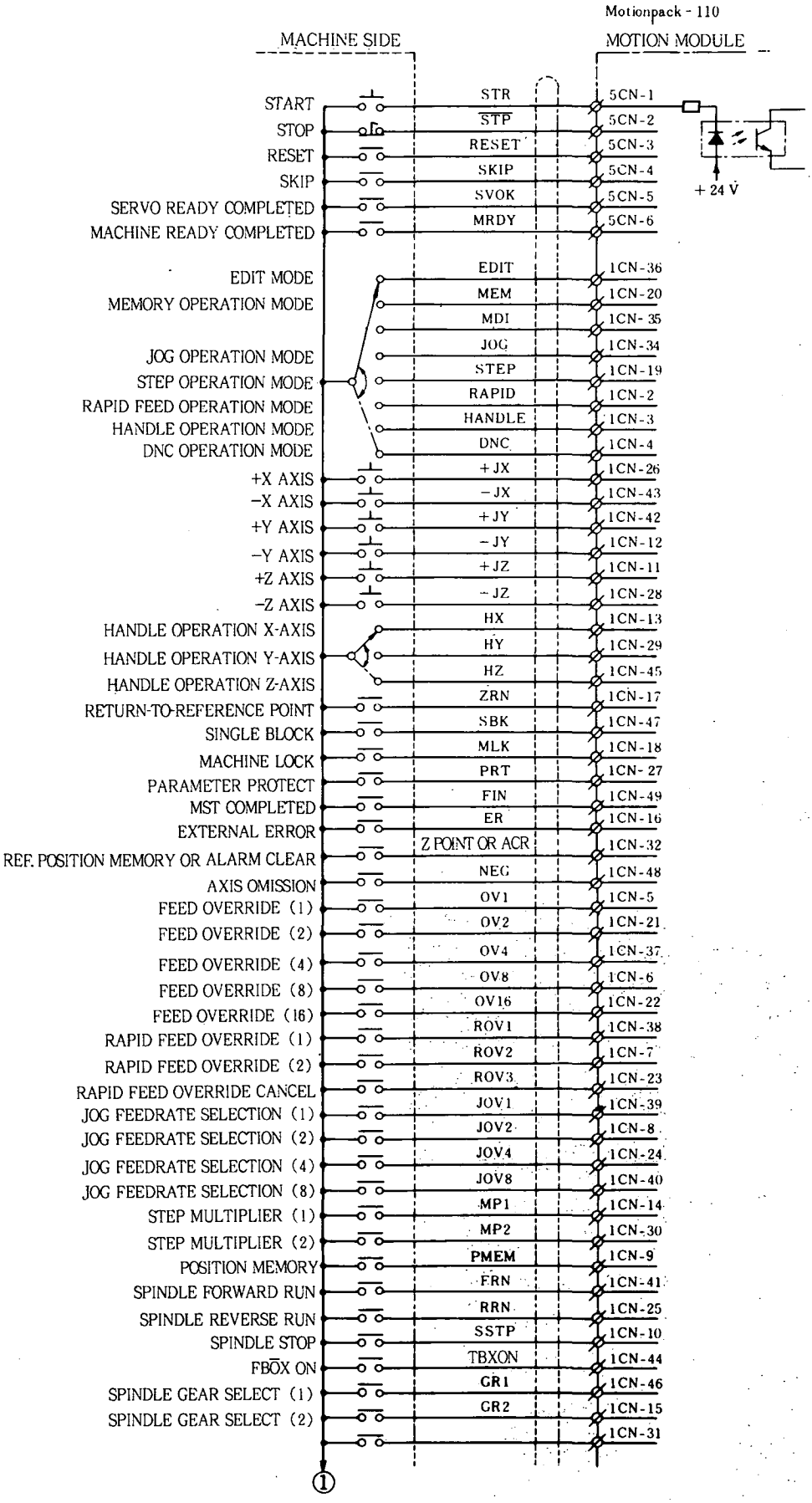
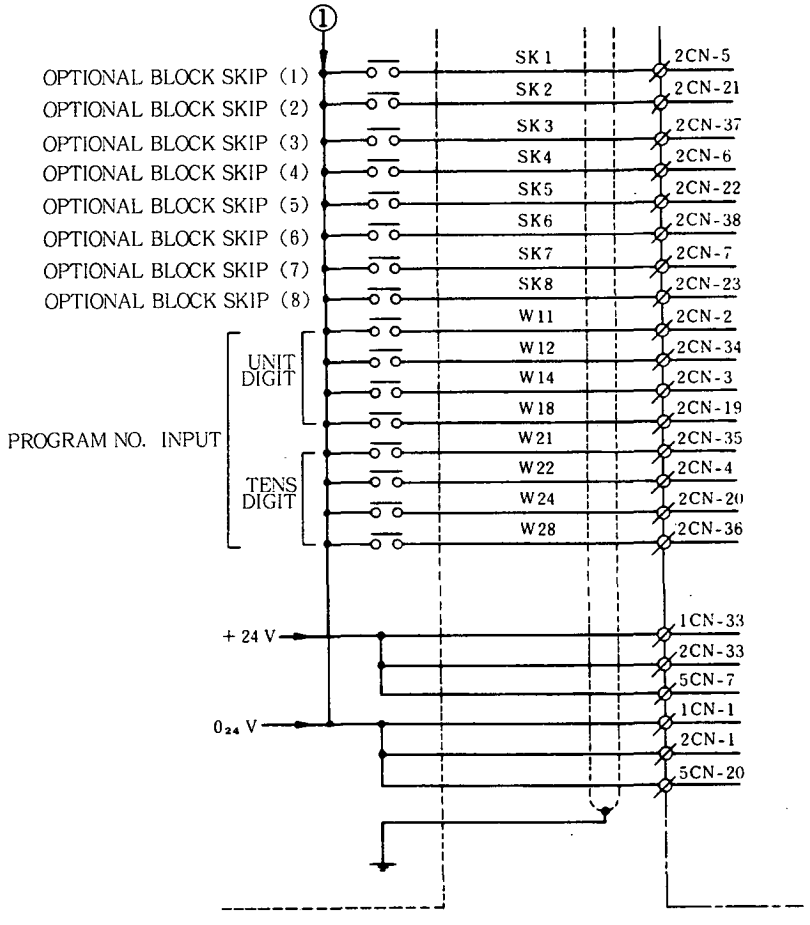


Fig. 9.6 Connection of Input Signal



Note: Terminal numbers of motion module indicate those in standard I/O allocation.

Fig. 9.6 Connection of Input Signal

Table 9.5 Function, Operation and Timing of Input Signals (8-1)

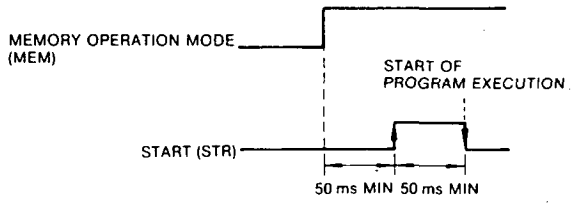
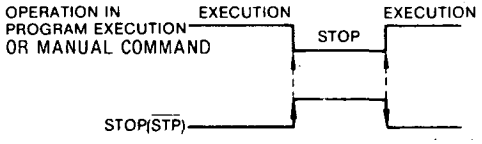
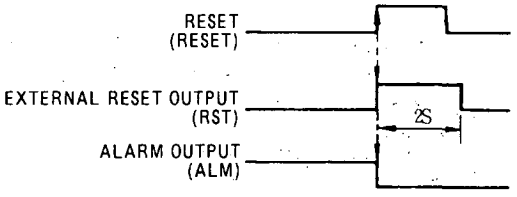
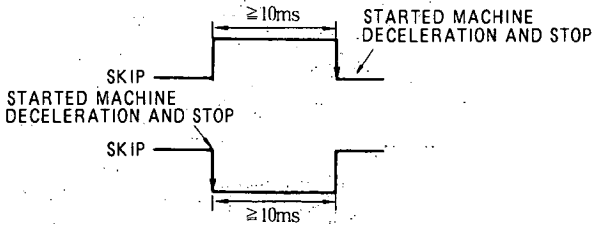
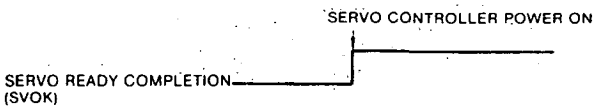
Signal Name	Signal Symbol	Function, Operation and Timing
Start	STR	Start signal in memory operation mode. When this signal is turned on after designating a program number, the automatic operation of the designated program is started. 
Stop (Temporary)	$\overline{\text{STP}}$	Stop signal in memory operation mode and manual operation mode (JOG, RAPID, STEP, HANDLE). When the stop signal is turned on during the execution of a program or manual operation, the system is decelerated and stops. When it is turned off, the program continues execution. 
Reset	RESET	When this signal is turned on, an alarm output signal (ALM) is reset. When the reset signal is turned on and off, the external reset signal (RST) is turned on and off at the same time. This signal has the same functions as [RESET] key of CRT control station. For details, refer to Par. 7.1.10.  1. Use the external reset signal (RST) as reset signal at machine side. 2. When the reset signal is turned on during memory operation, the system decelerates, stops and returns to the head of the program number.
Skip	SKIP	When this signal is turned on or off during operation, the system decelerates, stops, halts the remainder of moving command and advances to the next block. See Par. 4.2.10. 
Servo Ready Completion	SVOK	This signal is the interlock signal between servo controller and Motionpack-110. This signal is turned on when the power is applied to the servo controller. 

Table 9.5 Function, Operation and Timing of Input Signals (8-2)

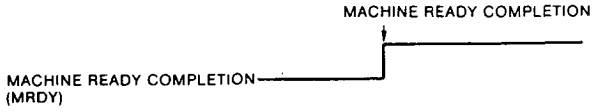
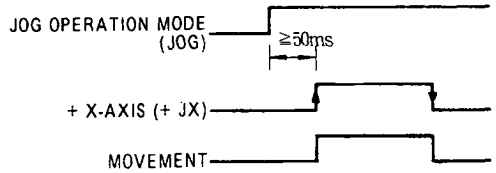
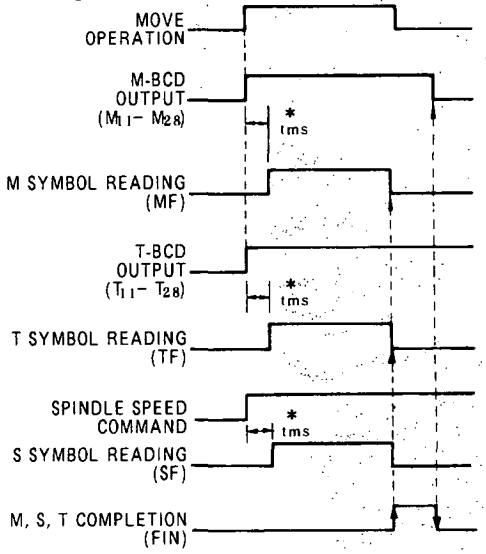
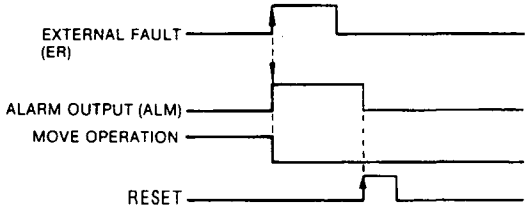
Signal Name	Signal Symbol	Function, Operation and Timing
Machine Ready Completion	MRDY	This is an interlock signal between machine and Motionpack-110. When the preparations are completed at the machine side (if needed), this signal is turned on. 
Edit Mode	EDIT	When this signal is turned on, edit mode begins. Then, editing operation such as writing programs or parameters from CRT control station or personal computer can be made.
Memory Operation Mode	MEM	When this signal is turned on, the memory operation mode begins. Automatic operation by programs can be made.
Jog Operation Mode	JOG	When this signal is turned on, the jog operation mode begins. Continuous feed can be made manually.
Step Operation Mode	STEP	When this signal is turned on, the step operation mode begins. Step operation can be made manually.
Rapid Feed Operation Mode	RAPID	When this signal is turned on, the rapid feed operation mode begins. Rapid feed operation can be made manually.
Manual Operation Mode	HANDLE	When this signal is turned on, the manual operation mode begins. Manual operation by manual pulse generator is possible.
DNC Operation Mode	DNC	When this signal is turned on, the DNC operation mode is entered. DNC operation can be performed while movement data from the host computer is being received.
+X-Axis	+JX	This is the start signal in +X-axis direction in manual system (jog, step, and rapid feed operations). In jog operation mode or rapid operation mode, the system moves while the signal is on and decelerates and stops when the signal is off. In step operation mode, the system moves by one step when the signal rises from OFF to ON.  Turn on +JX signal after the elapse of at least 50 ms upon completion of the signal operation of jog, step or rapid feed operation.
−X-Axis	−JX	Moving direction is changed to −X-axis direction by this signal. Other functions are the same as in the case of +JX.
+Y-Axis	+JY	Moving direction is changed +Y-axis direction by this signal. Other functions are the same as in the case of +JX.
−Y-Axis	−JY	Moving direction is changed to −Y-axis direction by this signal. Other functions are the same as in the case of +JX.
+Z-Axis	+JZ	Moving direction is changed to +Z-axis direction by this signal. Other functions are the same as in the case of +JX.
−Z-Axis	−JZ	Moving direction is changed to −Z-axis direction by this signal. Other functions are the same as in the case of +JX.

Table 9.5 Function, Operation and Timing of Input Signals (8-3)

<table>
<tr><th>Signal Name</th><th>Signal Symbol</th><th>Function, Operation and Timing</th></tr>
<tr><td>Handle Operation, X-Axis</td><td>HX</td><td>When this signal is turned on during simultaneous 1 -axis handle operation in handle operation mode, manual operation is possible for X-axis. If this signal is turned on, during simultaneous 3-axis handle operation (related parameter #1002 D6 = "1"), handle operation of the X-axis only can be performed.</td></tr>
<tr><td>Handle Operation, Y-Axis</td><td>HY</td><td>When this signal is turned on during simultaneous 1-axis handle operation in handle operation mode, manual operation is possible for Y-axis. If this signal is turned on, during simultaneous 3-axis handle operation (related parameter #1002 D6 = "1"), handle operation of the Y-axis only can be performed.</td></tr>
<tr><td>Handle Operation, Z-Axis</td><td>HZ</td><td>When this signal is turned on during simultaneous 1-axis handle operation in handle operation mode, manual operation is possible for Z-axis. If this signal is turned on, during simultaneous 3-axis handle operation (related parameter #1002 D6 = "1"), handle operation of the Z-axis only can be performed.</td></tr>
<tr><td>Return-to-Reference Point</td><td>ZRN</td><td>When this signal is turned on, the return-to-reference point mode begins. Operation of return-to-reference point for each axis is started by the signals listed below
<table>
<tr><th>Signal / Reference Point Return Operation</th><th>ZRN</th><th>+JX (−JX)</th><th>+JY (−JY)</th><th>+JZ (−JZ)</th></tr>
<tr><td>X-axis</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>Y-axis</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>Z-axis</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
</table></td></tr>
<tr><td>Single Block</td><td>SBK</td><td>This is the single block operation signal in memory operation mode. When the single block signal is on, the current block is executed and the system stops when the block is completed. Turn on the start signal (STR) for executing the next block.</td></tr>
<tr><td>Machine Lock</td><td>MLK</td><td>When this signal is turned on in memory operation mode and the start signal (STR) is turned on, the current position display changes depending on command, but the machine will not move. However, M, S, and T functions are executed. Use this signal when checking programs.</td></tr>
<tr><td>M, S, and T Completion</td><td>FIN</td><td>This signal clears the signal output from the Motionpack-110 and advances the program to the next block. When this signal is turned on, M, S, and T signal outputs are as follows.


* Set by parameter #1100.</td></tr>
</table>

Table 9.5 Function, Operation and Timing of Input Signals (8-4)

<table>
<tr><th>Signal Name</th><th>Signal Symbol</th><th>Function, Operation and Timing</th></tr>
<tr><td>External Fault</td><td>ER</td><td>This is the fault signal at machine side. When this signal is turned on, alarm output signal (ARM) is output and temporary stop state occurs.
 

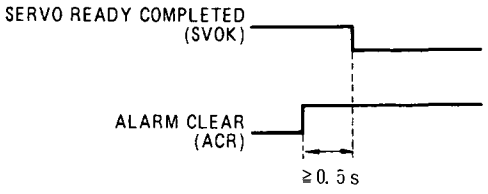
Be sure to reset for restarting.</td></tr>
<tr><td>Axis Omission</td><td>NEG</td><td>When this signal is turned on beforehand even if the start signal (STR) is turned on in the memory operation mode, only the specified axis is not controlled and the machine does not move. The current value display does not change either. The axis is specified in parameter #1006.</td></tr>
<tr><td>Alarm Clear</td><td>ACR</td><td>When this signal is turned on beforehand, even if the servo ready signal (SVOK) is turned off, no alarm occurs. Normally, turn off the signal and turn it on only if using the mechanical handle.
 
</td></tr>
<tr><td>Feed Override (1)
Feed Override (2)</td><td>OV1
OV2</td><td>This is the feed override selection signal. For the feed rate commanded by F symbol in the memory operation, three stages of L, M and H overrides can be selected by the combination of OV1 and OV2. This function is effective by setting parameter #1002–D2 to "0".
Three-stage override values are as follows.
<table><tr><th></th><th colspan="2">Signal State</th><th rowspan="2">Override Value</th></tr><tr><th></th><th>OV1</th><th>OV2</th></tr><tr><td>L0</td><td>OFF</td><td>OFF</td><td>0% override</td></tr><tr><td>L</td><td>ON</td><td>OFF</td><td>25% override</td></tr><tr><td>M</td><td>OFF</td><td>ON</td><td>50% override</td></tr><tr><td>H</td><td>ON</td><td>ON</td><td>100% override</td></tr></table>L: Low speed M: Medium speed H: High speed</td></tr>
</table>

Table 9.5 Function, Operation and Timing of Input Signals (8-5)

<table>
<tr><th>Signal Name</th><th>Signal Symbol</th><th>Function, Operation and Timing</th></tr>
<tr><td>Feed Override (1)
Feed Override (2)
Feed Override (4)
Feed Override (8)
Feed Override (16)</td><td>OV1
OV2
OV4
OV8
OV16</td><td>This is the 21-stage feed override selection signal. For the feed rate commanded by F symbol in the memory operation, any one of the 21-stage overrides can be selected by the combination of OV1, OV2, OV4, OV8 and OV16. This function is effective by setting parameter #1002-D2 to "1". The 21-stage override values are as follows.
<table>
<tr><th rowspan="2">Stage</th><th colspan="5">Signal State</th><th rowspan="2">Override Value</th></tr>
<tr><th>OV1</th><th>OV2</th><th>OV4</th><th>OV8</th><th>OV16</th></tr>
<tr><td>0</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>0%</td></tr>
<tr><td>1</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>10%</td></tr>
<tr><td>2</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>20%</td></tr>
<tr><td>3</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>30%</td></tr>
<tr><td>4</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>40%</td></tr>
<tr><td>5</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>50%</td></tr>
<tr><td>6</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>60%</td></tr>
<tr><td>7</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>70%</td></tr>
<tr><td>8</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>80%</td></tr>
<tr><td>9</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>90%</td></tr>
<tr><td>10</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>100%</td></tr>
<tr><td>11</td><td>ON</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>110%</td></tr>
<tr><td>12</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>120%</td></tr>
<tr><td>13</td><td>ON</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>130%</td></tr>
<tr><td>14</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td><td>140%</td></tr>
<tr><td>15</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td><td>150%</td></tr>
<tr><td>16</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>160%</td></tr>
<tr><td>17</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>170%</td></tr>
<tr><td>18</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>180%</td></tr>
<tr><td>19</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>190%</td></tr>
<tr><td>20</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>200%</td></tr>
</table>
Note: Override value of combinations not listed above will be 0%.</td></tr>
<tr><td>Rapid Feed Override (1)

Rapid Feed Override (2)</td><td>ROV1

ROV2</td><td>The signals are used to select override in rapid feedrate operation. The rapid feedrate set in parameters #1500, #1700 and #1900 can be overridden by combining ROV1 and ROV2 to select any override value among three stages L, M, and H. Override values are listed below:
<table>
<tr><th rowspan="2"></th><th colspan="2">Signal State</th><th rowspan="2">Override Value</th></tr>
<tr><th>ROV1</th><th>ROV2</th></tr>
<tr><td>L0</td><td>OFF</td><td>OFF</td><td>0% override</td></tr>
<tr><td>L</td><td>ON</td><td>OFF</td><td>25% override</td></tr>
<tr><td>M</td><td>OFF</td><td>ON</td><td>50% override</td></tr>
<tr><td>H</td><td>ON</td><td>ON</td><td>100% override</td></tr>
</table>
L: Low speed M: Medium speed H: High speed</td></tr>
<tr><td>Rapid Feed Override Cancel</td><td>ROV3</td><td>When this signal is turned on, the override value by ROV1 and ROV2 is ignored and 100% of speed is used.</td></tr>
</table>

Table 9.5 Function, Operation and Timing of Input Signals (8-6)

<table>
<tr><th>Signal Name</th><th>Signal Symbol</th><th>Function, Operation and Timing</th></tr>
<tr><td>Jog Feedrate Selection (1)

Jog Feedrate Selection (2)

Jog Feedrate Selection (4)

Jog Feedrate Selection (8)</td><td>JOV1

JOV2

JOV4

JOV8</td><td>The signals are used to select feedrate in jog operation. Any feedrate value can be selected among 16 stages by using ON/OFF combination of JOV1, JOV2, JOV4, and JOV8. The feedrate values and parameter numbers are listed below:
<table>
<tr><th rowspan="2">Stage</th><th colspan="4">Signal State</th><th rowspan="2">Jog Feedrate Setting</th></tr>
<tr><th>JOV1</th><th>JOV2</th><th>JOV4</th><th>JOV8</th></tr>
<tr><td>0</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Feedrate 0%</td></tr>
<tr><td>1</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Parameter setting (#1104)</td></tr>
<tr><td>2</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>Parameter setting (#1105)</td></tr>
<tr><td>3</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>Parameter setting (#1106)</td></tr>
<tr><td>4</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>Parameter setting (#1107)</td></tr>
<tr><td>5</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>Parameter setting (#1108)</td></tr>
<tr><td>6</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>Parameter setting (#1109)</td></tr>
<tr><td>7</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td><td>Parameter setting (#1110)</td></tr>
<tr><td>8</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>Parameter setting (#1111)</td></tr>
<tr><td>9</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>Parameter setting (#1112)</td></tr>
<tr><td>10</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>Parameter setting (#1113)</td></tr>
<tr><td>11</td><td>ON</td><td>ON</td><td>OFF</td><td>ON</td><td>Parameter setting (#1114)</td></tr>
<tr><td>12</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>Parameter setting (#1115)</td></tr>
<tr><td>13</td><td>ON</td><td>OFF</td><td>ON</td><td>ON</td><td>Parameter setting (#1116)</td></tr>
<tr><td>14</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>Parameter setting (#1117)</td></tr>
<tr><td>15</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>Parameter setting (#1118)</td></tr>
</table></td></tr>
<tr><td>Step Multiplier

(HANDLE Multiplier)</td><td>MP1
MP2</td><td>This is the signal for selecting the quantity of feed of one step in step operation. The quantity of feed of one step can be selected in three stages and is set by parameters.
<table>
<tr><th></th><th colspan="2">Signal State</th><th rowspan="2">Feed Amount/Step</th></tr>
<tr><th></th><th>MP1</th><th>MP2</th></tr>
<tr><td>L_0</td><td>OFF</td><td>OFF</td><td>Feed amount = 0</td></tr>
<tr><td>L_1</td><td>ON</td><td>OFF</td><td>Parameter setting (#1122)</td></tr>
<tr><td>L_2</td><td>OFF</td><td>ON</td><td>Parameter setting (#1123)</td></tr>
<tr><td>L_3</td><td>ON</td><td>ON</td><td>Parameter setting (#1124)</td></tr>
</table>
L_1: Short, L_2: Medium, L_3: Long

This signal also selects the multiplier of move amount per pulse in manual operation.
<table>
<tr><th rowspan="2">Multiplier of Move Amount per Pulse</th><th colspan="2">Signal State</th></tr>
<tr><th>MP1</th><th>MP2</th></tr>
<tr><td>×0</td><td>OFF</td><td>OFF</td></tr>
<tr><td>×2</td><td>ON</td><td>OFF</td></tr>
<tr><td>×10</td><td>OFF</td><td>ON</td></tr>
<tr><td>×100</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
</table>

Table 9.5 Function, Operation and Timing of Input Signals (8-7)

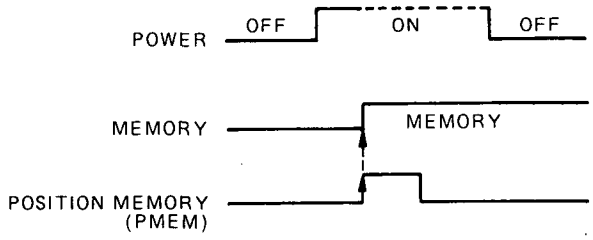
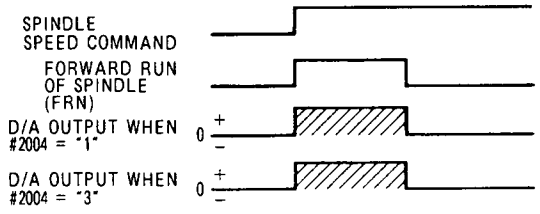
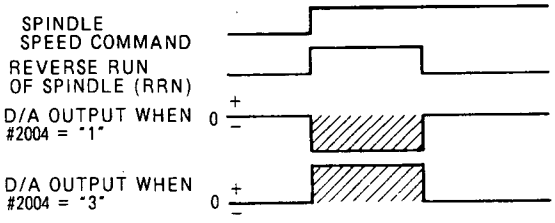
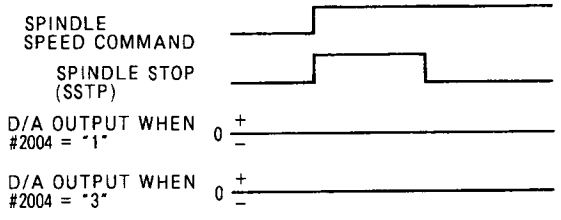
Signal Name	Signal Symbol	Function, Operation and Timing
Position Memory	PMEM	When this signal is turned ON, axis position displayed current value is retained in the offset area. This memory is kept even after the power is turned OFF. To validate this function, set the system parameter #1003 D1 to 1.  Memory Position / Storing Position (offset No.) Axis Position: X H87; Y H88; Z H89
Forward Run of Spindle	FRN	If this signal is input when the spindle rotation speed is programmed with the S code in memory operation, spindle axis module D/A output is controlled according to combination with parameter #2004. 
Reverse Run of Spindle	RRN	As with FRN, spindle axis module D/A output is controlled. 
Spindle Stop	SSTP	As with FRN, spindle axis module D/A output is controlled. 

Table 9.5 Function, Operation and Timing of Input Signals (8-8)

<table>
<tr><th>Signal Name</th><th>Signal Symbol</th><th>Function, Operation and Timing</th></tr>
<tr><td>Spindle Gear Select(1)

Spindle Gear Select(2)</td><td>GR1

GR2</td><td>The siganls are used to select gear ratio in spindle gear change. Gear ratio can be selected among three stages L, M, and H by combining GR1 and GR2. The maximum rotation speed on each gear is specifiedin the parameter.
<table>
<tr><th rowspan="2">Gear Ratio</th><th colspan="2">Signal State</th><th rowspan="2">Max Rotation Speed</th></tr>
<tr><th>GR1</th><th>GR2</th></tr>
<tr><td>Lo</td><td>OFF</td><td>OFF</td><td>Stop</td></tr>
<tr><td>L</td><td>ON</td><td>OFF</td><td>Parameter setting (#2150)</td></tr>
<tr><td>M</td><td>OFF</td><td>ON</td><td>Parameter setting (#2151)</td></tr>
<tr><td>H</td><td>ON</td><td>ON</td><td>Parameter setting (#2152)</td></tr>
</table></td></tr>
<tr><td>Optional Block Skip (1)
to
Optional Block Skip (8)</td><td>SK1
SK2
SK3
SK4
SK5
SK6
SK7
SK8</td><td>This signal determines whether the data of a block containing "/" (slash) are to be ignored or not in memory operation mode. When this signal is turned on, the selected block is ignored. For example, if SK1 signal is on, commands up to the end of block containing "/" are all ignored.
Operation of this signal is ineffective for a block being executed or a block stored in the buffer for advance reading. In the case of memory operation, the operation becomes effective from the block which has just been read.</td></tr>
<tr><td>Program Number Input</td><td>W11
W12
W14
W18
W21
W22
W24
W28</td><td>This signal is used for designating the program number from an external. Designation is possible from 01 to 99 with 2 BCD digits.</td></tr>
</table>

9.2.3 DETAIL OF OUTPUT SIGNALS

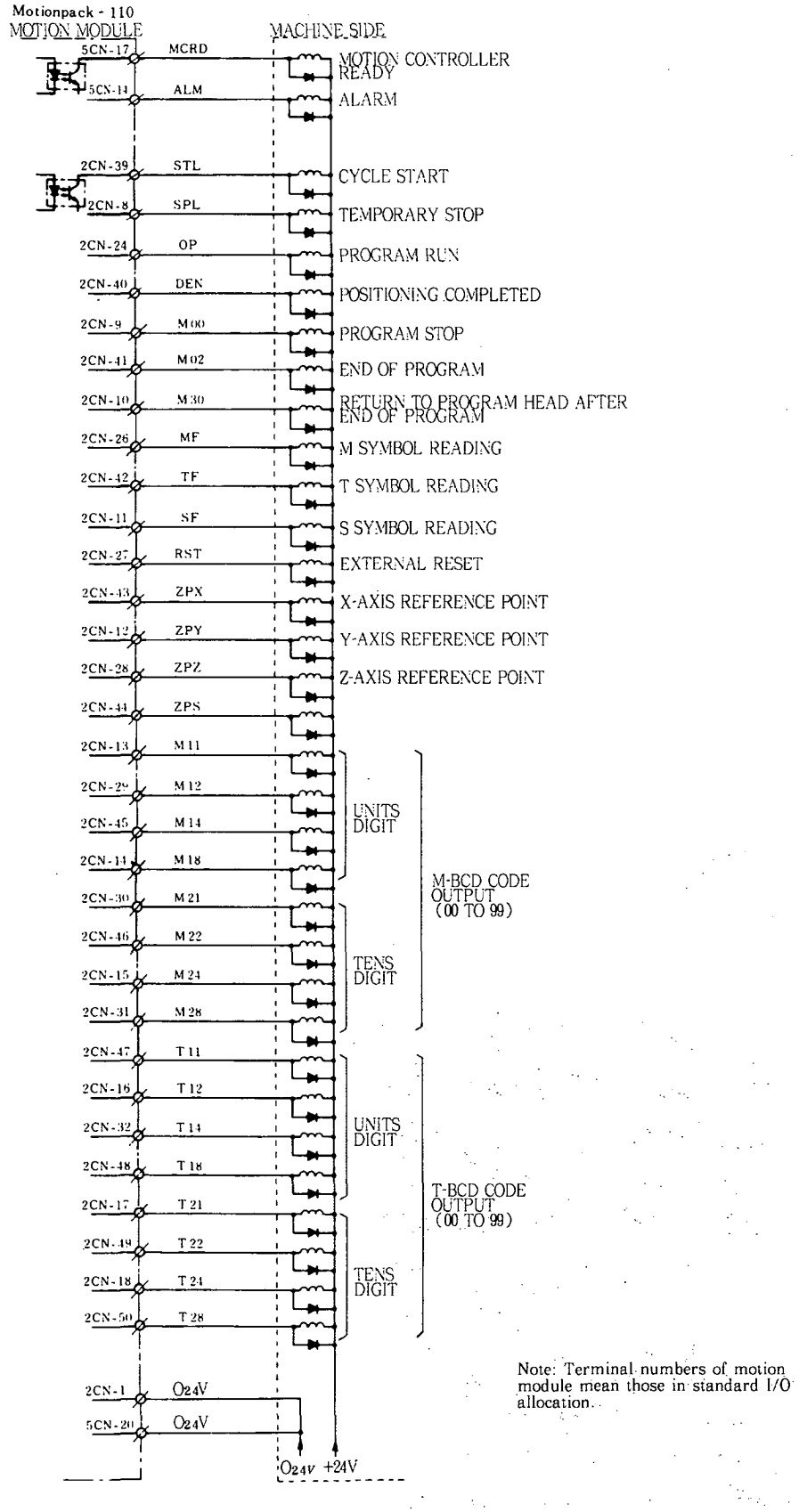


Fig. 9.7 Connection of Output Signal

9.2.3 DETAIL OF OUTPUT SIGNALS (Cont'd)

Table 9.6 Function, Operation and Timing of Output Signals (3-1)

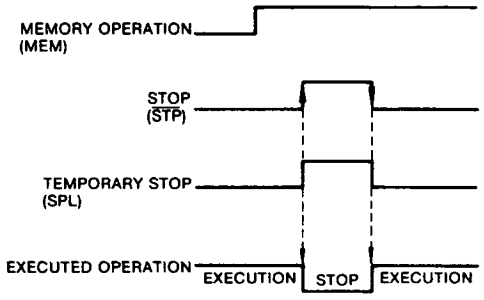
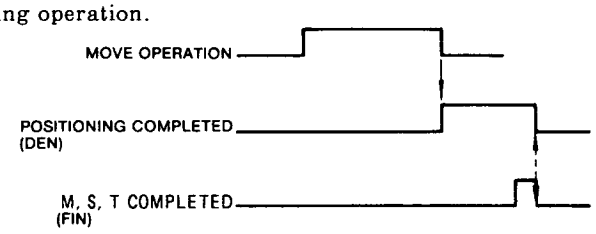
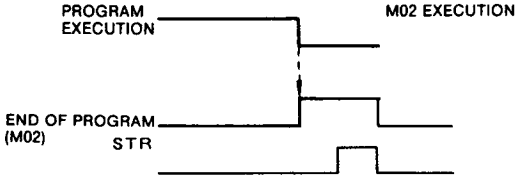
Signal Name	Signal Symbol	Function, Operation and Timing
Motion Controller Ready	MCRD	This is the interlocking signal between the machine and motion module. When this signal is on, preparations for starting begin at the machine side.
Alarm	ALM	When this signal is on, there is an alarm state in the system. For the contents of alarm, refer to APPENDIX-1 LIST OF ALARM CODE.
Cycle Start	STL	This signal shows the automatic operation in progress and is turned on during memory operation or single-block operation. The following shows conditions which turn the cycle start signal off: • Alarm • Reset operation • Stop signal ON
Temporary Stop	SPL	This signal is turned on when an automatic operation is halted by stop signal ($\overline{STP}$) during automatic operation. 
Program Run	OP	This signal is used to indicate program running and turned on during memory or single-block operation. Under the following conditions, the signal is turned off.The current block executed for single-block signal. • Reset operation executed • Program ended (M00, M02, M30)
Positioning Completed	DEN	When M and T codes were commanded by the same block of move command, this signal is output after the completion of the move command. When there is no move command and M and T codes are commanded, this signal is output at the same time as BCD code. This signal is not output if there is a move command. DEN signal output is released when M and T completion signal (FIN) if returned to Motionpack-110. It is also released by reset operation or mode switching operation. 
Program Stop	M00	If M00 is read during automatic operation, the operation of the relevant block is executed, automatic operation is halted and then M00 signal is output, Restarting from the next block is possible after turning on the start signal (STR).
End of Program	M02	M02 is commanded at the end of program. When M02 is commanded during automatic operation is halted, and M02 signal is output. 

Table 9.6 Function, Operation and Timing of Output Signals (3-2)

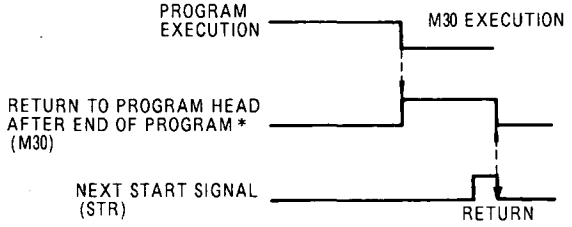
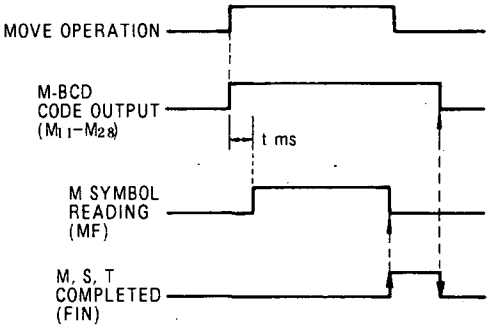
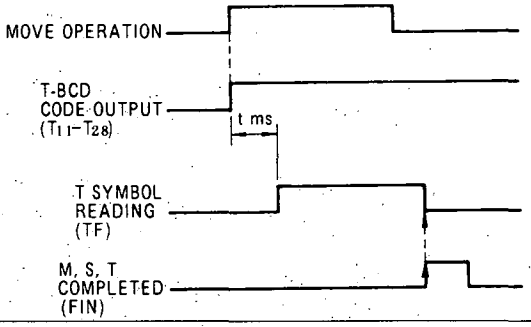
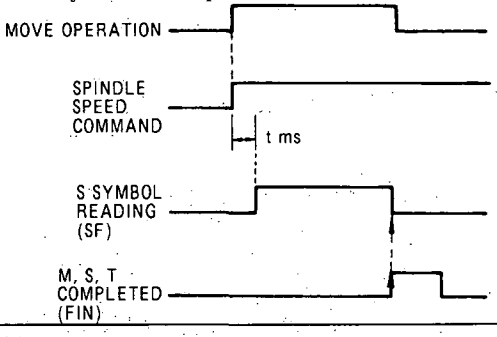
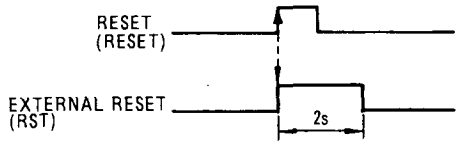
Signal Name	Signal Symbol	Function, Operation and Timing
Return to Program Head after End of Program	M30	M30 is normally commanded at the end of program. When M30 is read during automatic operation, the operation of relevant block is executed, automatic operation is halted, and M30 signal is output.  • Returns to the head of program after M30 execution and waits.
M Symbol Reading	MF	This signal reads "M-BCD code output". The M symbol read signal is output t msec after the "M-BCD code" output. Delay time is set by parameters, #1100. The M symbol read signal is released when M, S, and T completion signal (FIN) is returned to Motionpack-110. It is also released by reset operation or mode switching operation. MF is not output in M00, M02, M30 or internal processing M symbols (M90 to M99). 
T Symbol Reading	TF	This is the read signal of "T-BCD code output". T symbol read signal is output t msec after "T-BCD code output". Delay time is set by parameters, #1100. T symbol read signal is released when the M and T completion signal (FIN) is returned to Motionpack-110. It is also released by the reset operation or mode switching operation. 
S Symbol Reading	SF	This is the read signal of "spindle speed command". T symbol read signal is output t msec after "spindle speed command". Delay time is set by parameter, #1100. T symbol read signal is released when the M, S, and T completion signal (FIN) is returned to Motionpack-110. It is also released by the reset operation or mode switching operation. 

Table 9.6 Function, Operation and Timing of Output Signals (3-3)

Signal Name	Signal Symbol	Function, Operation and Timing
External Reset	RST	This is used as reset signal for other than Motionpack-110. This is synchronized with the reset signal (RESET) of Motionpack-110. 
X-axis Reference Point	ZPX	This signal is output only when the position is at the reference point of X-axis.
Y-axis Reference Point	ZPY	This signal is output only when the position is at the reference point of Y-axis.
Z-axis Reference Point	ZPZ	This signal is output only when the position is at the reference point of Z-axis.
M-BCD Code Output (2-digit Output)	M11 M21 M12 M22 M14 M24 M18 M28	This is "M-BCD code" output signal. It is output at the same time as the start of a block containing M symbol. "M-BCD code" output is released when M and T completion signal (FIN) is returned to Motionpack-110. It is also released by reset operation or mode switching operation. M-BCD code is not output in M00, M02, M30 or internal processing M symbols (M90 to M99).
T-BCD Code Output (2-digit Output) (Notch Signal Output)	T11 T21 T12 T22 T14 T24 T18 T28	This is "T-BCD code" output signal and is used to designate or select tools. It is output at the same time as the start of a block containing "T-BCD code". The output is not released even though the M and T completion signal returns to Motionpack-110. It is held until a new T symbol is designated. As a special example, this signal is also used as notch signal output. However, if it is used as notch signal output, the T function cannot be used. See Par. 4.2.14 and Par. 4. 2.15.
Alarm Code Output	A11 A21 A12 A22 A14 A24 A18 A28	This signal is output alarm code at hexadecimal. When an alarm does not occur, these signals are all OFF (0).

9.3 CONNECTION BETWEEN MOTION MODULE AND CRT CONTROL STATION AND PERSONAL COMPUTER

Signals related to the CRT control station must be connected to 3 CN connector of the motion module. For RS-422, the maximum cable wiring distance is 15 m. Shielded twisted pair cables should be used.

9.3.1 CONNECTION BETWEEN CRT CONTROL STATION AND MOTION MODULE

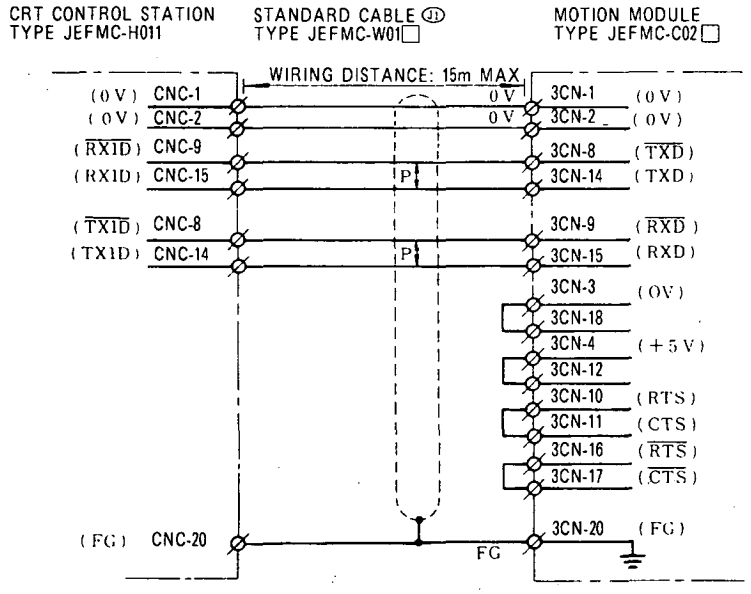
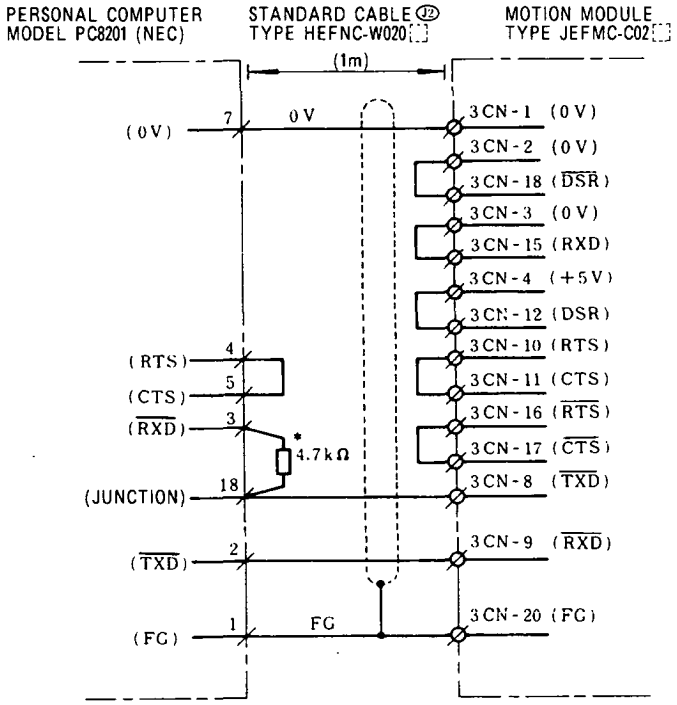


Fig. 9.8 Connection between CRT Control Station and Motion Module

9.3.2 CONNECTION BETWEEN PERSONAL COMPUTER AND MOTION MODULE

Where the personal computer is used for programming, parameter transmission or system status monitoring, the personal computer can be connected directly to motion module (to 3CN) or through the CRT control station (to CNB) to the motion module. The same cables can be used in both the cases.

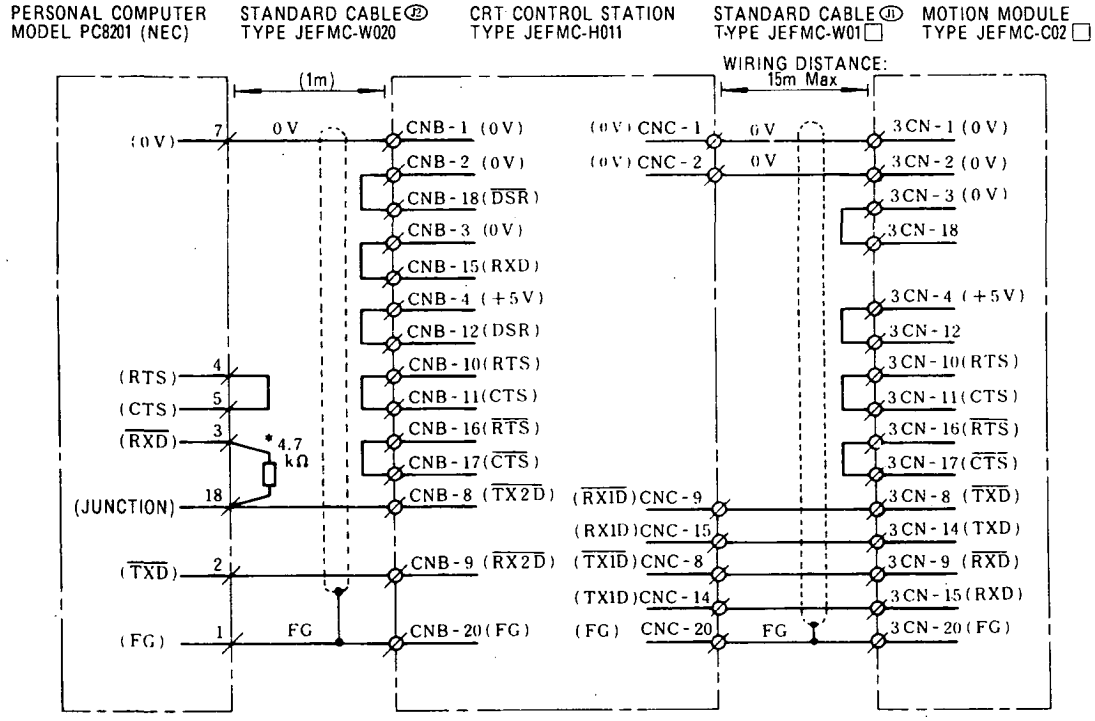
9.3.2.1 Personal Computer ⟷ Motion Module



* Resistor (4.7 kΩ) may not be required in accordance with type of personal computer. In that case, shortcircuit across terminal numbers 3 and 18.

Fig. 9.9 Connection between Personal Computer and Motion Module

9.3.2.2 Personal Computer↔CRT Control Station↔Motion Module

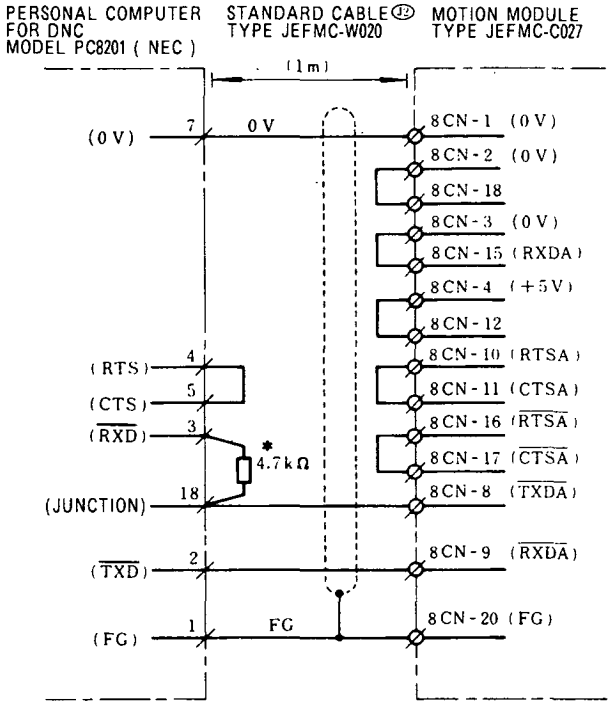


* Resistor (4.7 kΩ) may not be required in accordance with type of personal computer. In that case, shortcircuit across terminal numbers 3 and 18.

Fig. 9.10 Connection between Personal Computer and Motion Module via CRT Control Station

9.3.3 CONNECTION BETWEEN DNC PERSONAL COMPUTER AND MOTION MODULE

Where the personal computer is used for DNC communication, the computer is connected to motion module (to 8CN).



* Resistor (4.7 kΩ) may not be required in accordance with type of personal computer. In that case, shortcircuit across terminal numbers 3 and 18.

Fig. 9.11 Connection between Personal Computer for DNC and Motion Module

9.4 CONNECTION BETWEEN MOTION MODULE AND AXIS MODULES

Transmission between the motion module and axis modules is made through FA bus signal cables. Up to 4 axis modules can be connected to the motion module via standard cable (J8).

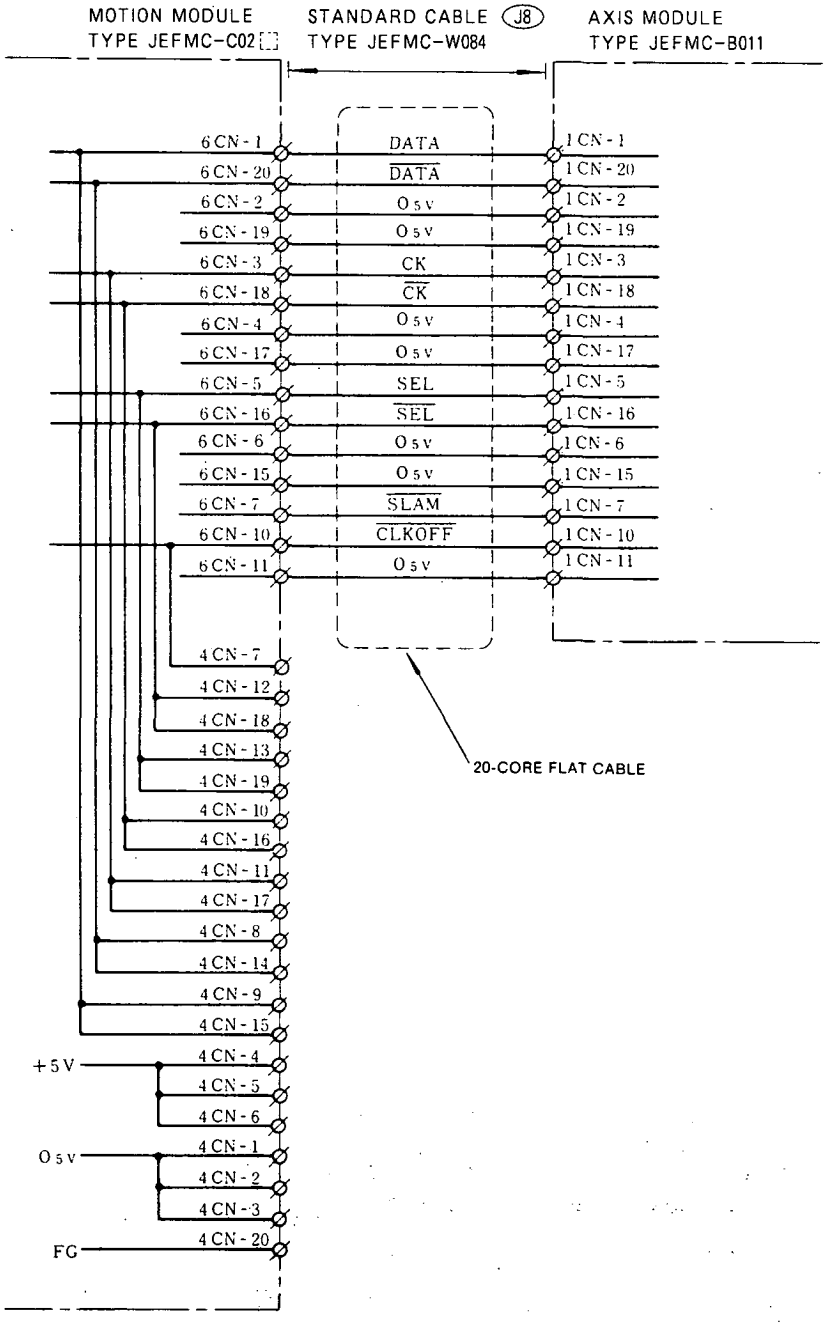


Fig. 9.12 Connection between Motion Module and Axis Module

9.5 CONNECTION BETWEEN AXIS MODULES AND *Servopack*, TG AND PG

9.5.1 CONNECTION BETWEEN AXIS MODULES AND *Servopack*

Signals related to the servo should be connected to 3CN connectors of axis modules. These signals include speed command signals, TG feedback signals, BASE BLOCK signals, etc. Use shielded twisted pair cables.

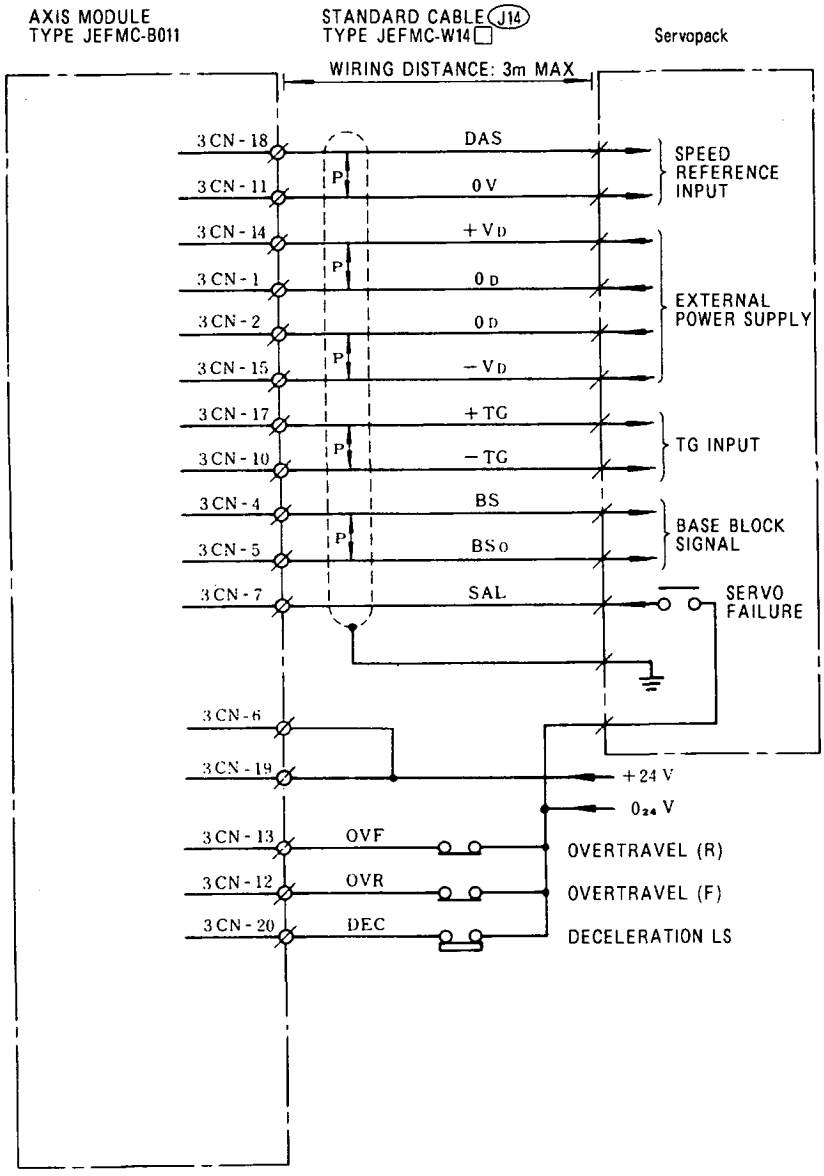


Fig. 9.13 Connection between Axis Module and Servopack

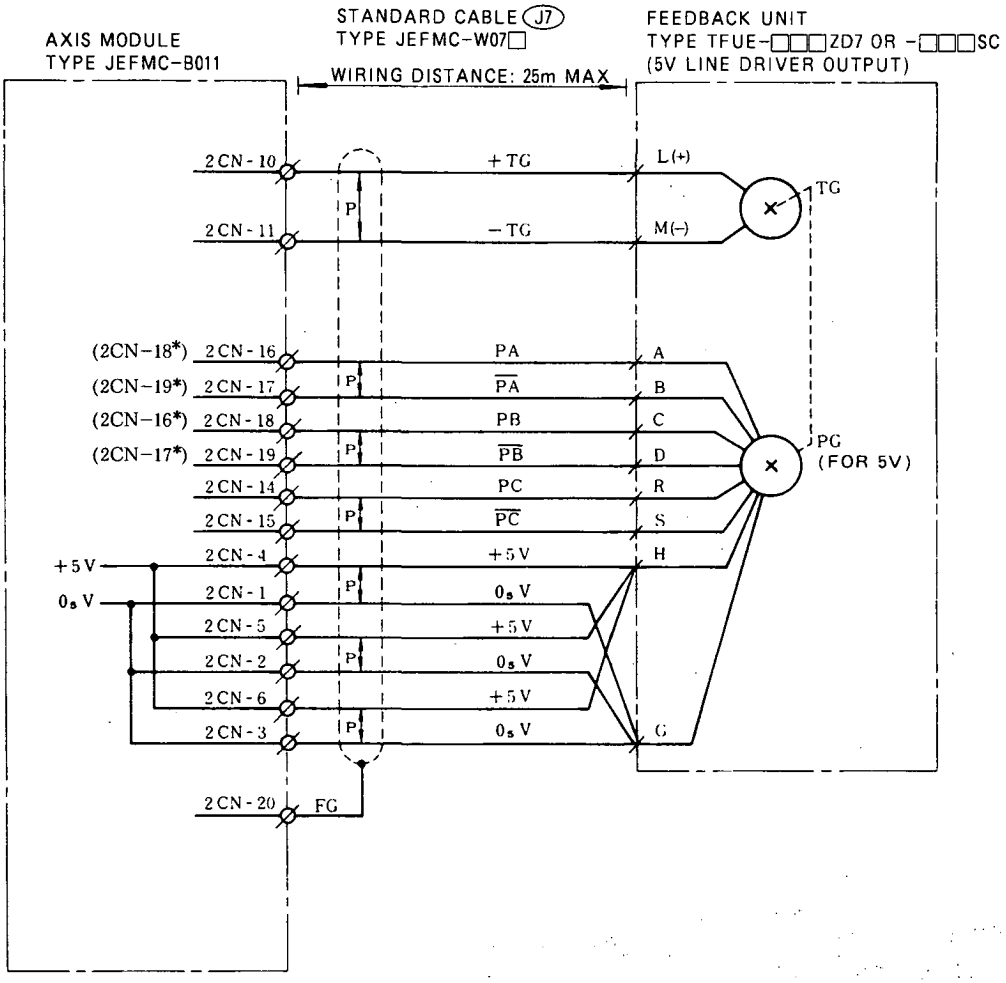
9.5.2 CONNECTION BETWEEN AXIS MODULES AND TG AND PG

For using DC Servomotor, signals related to TG (speed detector) and PG (position detector) should be connected to 2CN of axis modules. Two kinds of 5 V line driver output types and 12 V transistor output types are available for PG, requiring a suitable connection for each type.

For using AC Servomotor, PG signal should be input via the AC Servopack due to PG and TG signal processing in the AC Servopack.

9.5.2.1 For DC Servomotor 5 V Line Driver Output PG

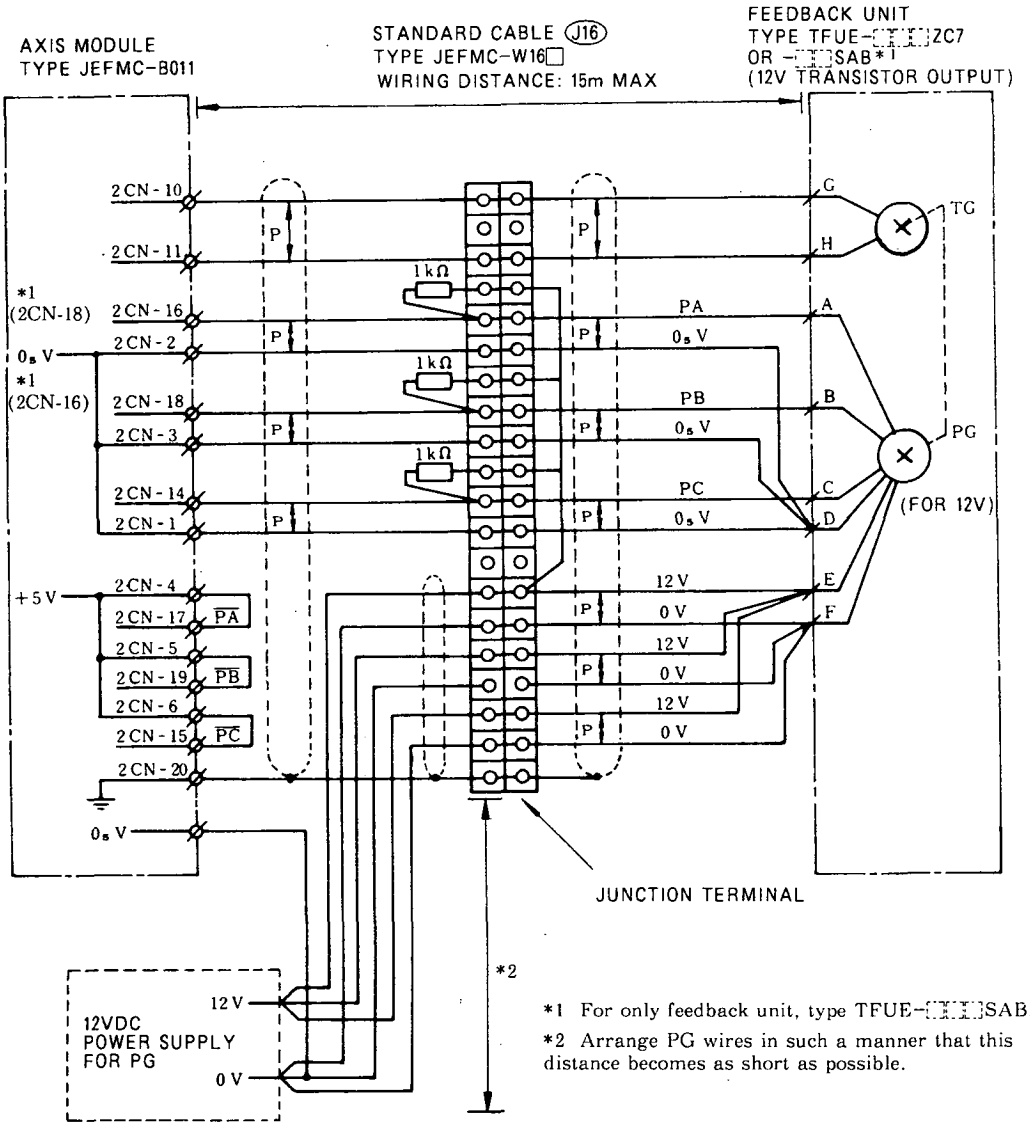
As an IC for 5 V line driver, it is recommended that type SN75174 or equivalent be used.



*For only feedback unit, type TFUE-□□□SC.

Fig. 9.14 Connection between Axis Module and Feedback Unit with 5V PG

9.5.2.2 For DC Servomotor 12 V Transistor Output PG



*1 For only feedback unit, type TFUE-□□□SAB.

*2 Arrange PG wires in such a manner that this distance becomes as short as possible.

Fig. 9.15 Connection between Axis Module and Feedback Unit with 12V PG

Connections of shielded cables at the junction terminals should be as shown below.

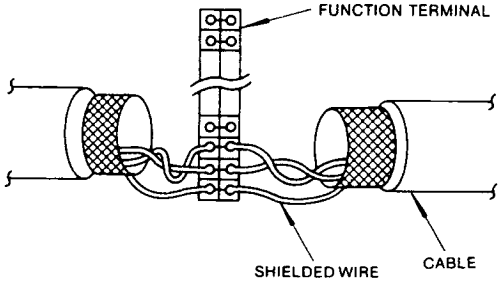
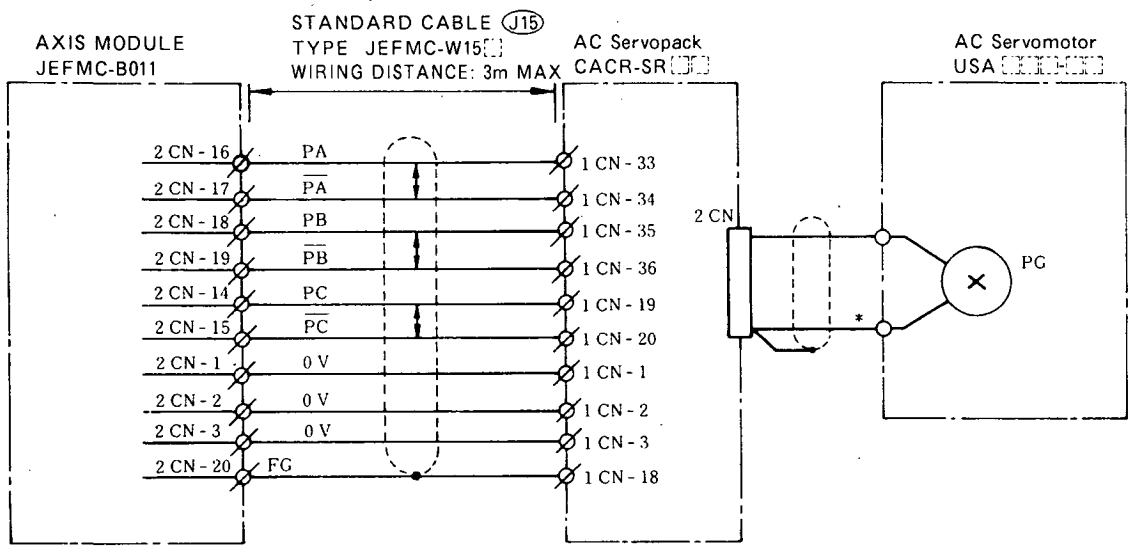


Fig. 9.16 Shielded Cable Connection using Junction Terminals

9.5.2.3 PG for AC Servomotor



• For detailed information, see the technical manual.

Fig.9.16 Connection between Axis Module and PG for AC Servomotor

9.6 CONNECTION BETWEEN AXIS MODULES AND SPINDLE DRIVES

For transmission of speed reference signal from AC adjustable speed drives, connector 3CN is used. Power supply (±15V, 20 mA) is needed.

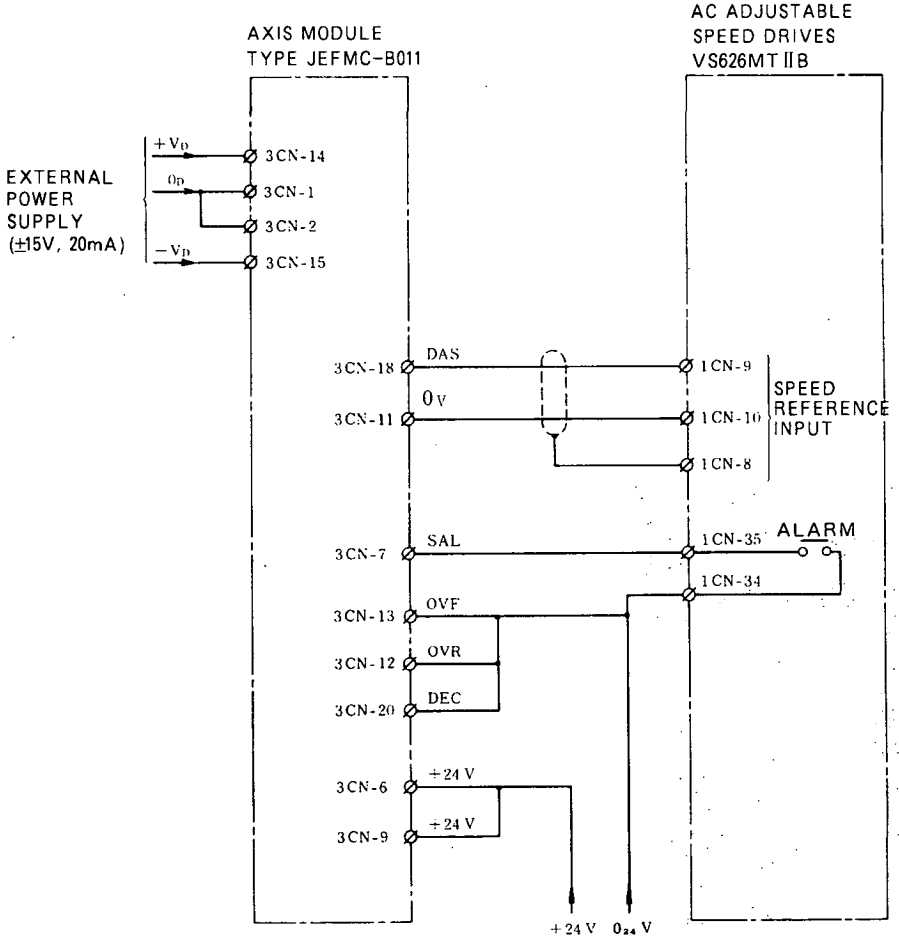


Fig. 9.17 Connection between Axis Module and Spindle Drive

9.7 CONNECTION BETWEEN MICRO PC MODULE AND MOTION MODULE/PERSONAL COMPUTER

9.7.1 CONNECTION BETWEEN MICRO PC MODULE AND MOTION MODULE

Transmission between the micro PC module and the motion module is made through FA but signal cables (standard cable (J10)).

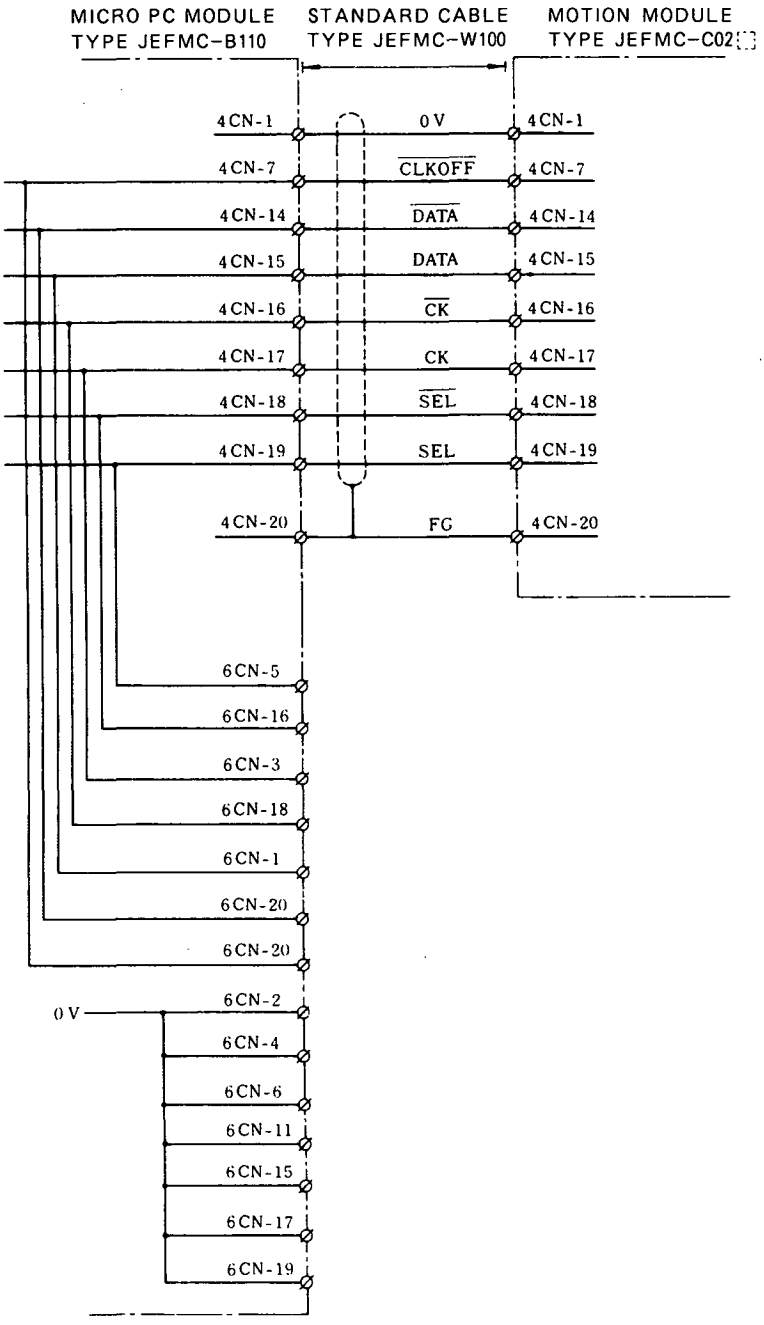
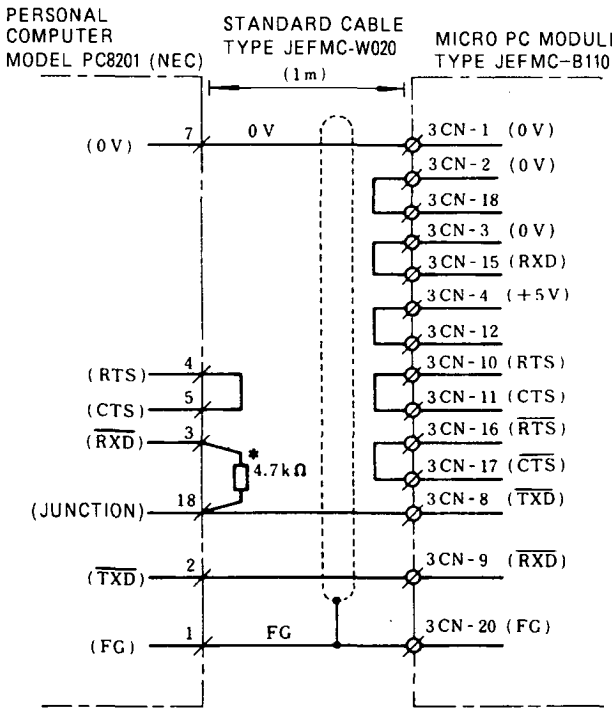


Fig. 9.18 Connection between Micro PC Module and Motion Module

9.7.2 CONNECTION BETWEEN MICRO PC MODULE AND PERSONAL COMPUTER

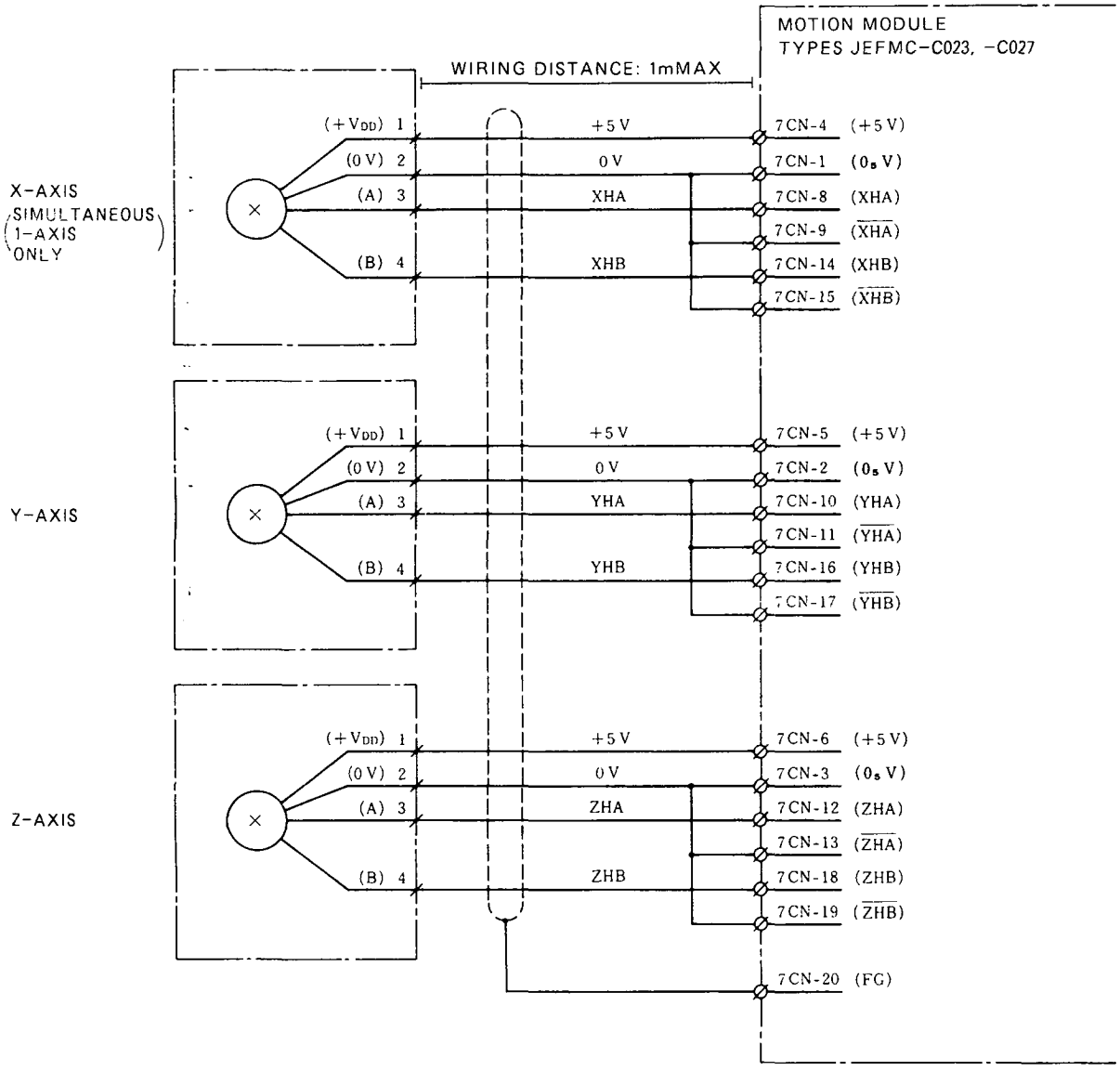


* Resistor (4.7 kΩ) may not be required in accordance with type of personal computer. In that case, shortcircuit across terminal numbers 3 and 18.

Fig. 9.19 Connection between Micro PC Module and Personal Computer

9.8 CONNECTION BETWEEN MANUAL PULSE GENERATOR AND MOTION MODULE

Fig. 9.20 shows connection of the manual pulse generator and motion module. For the manual pulse generator which operates on 5 V, the power supply incorporated in the motion module can be used. For the manual pulse generator which operates on 12 V, an external power unit of 12 V must be provided. Supply voltage of manual pulse generator type RPEH-2E5T/100M ranges from 5 VDC to 12 VDC.



Note:

1. Connect to the X-axis terminal, when manual handle (1-axis) is used simultaneously. The axis is changed by axis change signals (HX, HY, HZ).
2. When manual handle (3-axis) is used simultaneously, the axis change signals HX, HY, and HZ must be turned on. See Par. 9.2.2.
3. To use 12 V power supply, connect external power supply 12 V and 0 V to pulse generator terminals 1 and 2, respectively.

Fig. 9.20 Connection between 5V Pulse Generator and Motion Module (for 3 Axis)

9.9 CONNECTOR TERMINAL NUMBER AND SIGNAL NAMES

9.9.1 MOTION MODULE, TYPE JEFMC-C02 □

Connector terminal numbers on the panel of motion module and signal names are as shown below. Power supply terminals for 5 VDC are also provided. Signal names of connectors with * show those in standard I/O allocation.

CONNECTOR 1CN* (MR-50RMA)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
$O_{24}V$	RAPID	HANDLE	DNC	OV1	OV8	ROV2	JOV2	PMEM	SSTP	+JZ	−JY	HX	MP1	GR2	ER	ZRN	MLK
		19	20	21	22	23	24	25	26	27	28	29	30	31	32		
		STEP	MEM	OV2	OV16	ROV3	JOV4	RRN	+JX	PRT	−JZ	HY	MP2	SOR	ACR (ABSO)		
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+24V	JOG	MDI	EDIT	OV4	ROV1	JOV1	JOV8	FRN	+JY	−JX	CLP	HZ	GR1	SBK	NEG	FIN	ESP

CONNECTOR 2CN* (MR-50RMA)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
$O_{24}V$	W11	W14	W22	SK1	SK4	SK7	SPL	M00	M30	SF	ZPY	M11	M18	M24	T12	T21	T24
		19	20	21	22	23	24	25	26	27	28	29	30	31	32		
		W18	W24	SK2	SK5	SK8	OP		MF	RST	ZPZ	M12	M21	M28	T14		
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+24V	W12	W21	W28	SK3	SK6	STL	DEN	M02	TF	ZPX	ZPS	M14	M22	T11	T18	T22	T28

CONNECTOR 3CN (MR-20RMA)

1	2	3	4	5	6	7
O_5V	O_5V	O_5V	+5V	+5V	+5V	
	8	9	10	11	12	13
	$\overline{TXD}$	$\overline{RXD}$	RTS	CTS		
14	15	16	17	18	19	20
TXD	RXD	$\overline{RTS}$	$\overline{CTS}$			FG

CONNECTOR 4CN (MR-20RMA)

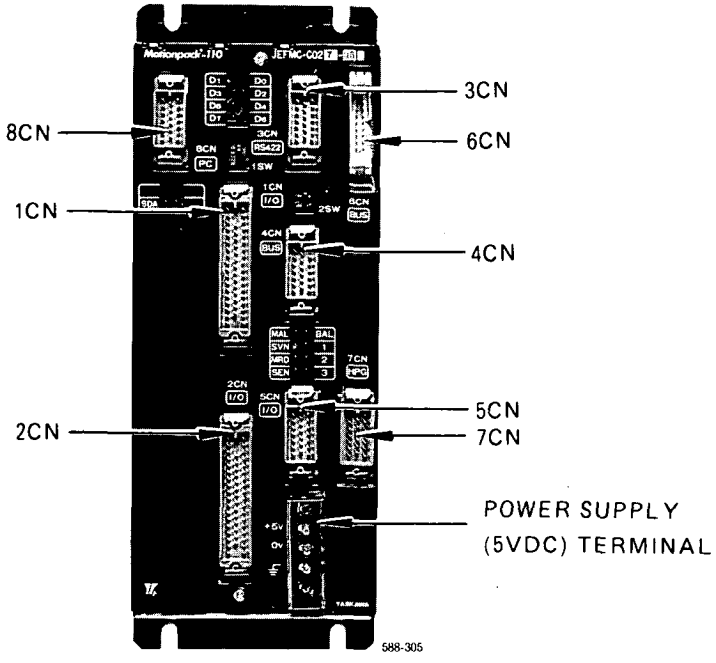
1	2	3	4	5	6	7
O_5V	O_5V	O_5V	+5V	+5V	+5V	$\overline{CLKOFF}$
	8	9	10	11	12	13
	$\overline{DATA}$	DATA	$\overline{CK}$	CK	$\overline{SEL}$	SEL
14	15	16	17	18	19	20
$\overline{DATA}$	DATA	$\overline{CK}$	CK	$\overline{SEL}$	SEL	FG

CONNECTOR 5CN* (MR-20RMA)

1	2	3	4	5	6	7
STR	$\overline{STP}$	RESET	SKIP	SVOK	MRDY	+24V
	8	9	10	11	12	13
14	15	16	17	18	19	20
ALM			MCRD	SVON		$O_{24}V$

CONNECTOR 6CN (3428-6002)

1	2	3	4	5	6	7	8	9	10
DATA	O_5V	CK	O_5V	SEL	O_5V	$\overline{SLAM}$			$\overline{CLKOFF}$
20	19	18	17	16	15	14	13	12	11
$\overline{DATA}$	O_5V	$\overline{CK}$	O_5V	$\overline{SEL}$	O_5V				O_5V



Note: Each pin number and signal name is described in the place shown below.

Fig. 9.21 Connector Terminals (Pins) and Signal Names of Motion Module

- For only Motion Modules Types JEFMC-C023 and -C027

CONNECTOR 7CN (MR-20RMA)

1	2	3	4	5	6	7
0₀V	0₀V	0₀V	+5V	+5V	+5V	
	8	9	10	11	12	13
	XHA	$\overline{\text{XHA}}$	YHA	$\overline{\text{YHA}}$	ZHA	$\overline{\text{ZHA}}$
14	15	16	17	18	19	20
XHB	$\overline{\text{XHB}}$	YHB	$\overline{\text{YHB}}$	ZHB	$\overline{\text{ZHB}}$	FG

- For only Motion Module Type JEFMC-C027

CONNECTOR 8CN (MR-20RMA)

1	2	3	4	5	6	7
0₀V	0₀V	0₀V	+5V	+5V	+5V	
	8	9	10	11	12	13
	$\overline{\text{TXDA}}$	$\overline{\text{RXDA}}$	RTSA	CTSA		
14	15	16	17	18	19	20
TXDA	RXDA	$\overline{\text{RTSA}}$	$\overline{\text{CTSA}}$			FG

Fig. 9.21 Connector Terminals (Pins) and Signal Names of Motion Module (Cont'd)

9.9.2 AXIS MODULE, TYPE JEFMC-B011

Connector terminal numbers on the panel of axis module and signal names are as shown below. Power supply terminals for 5 VDC are also provided.

CONNECTOR 1CN (FRC2-C20L11-OS)

1	2	3	4	5	6	7	8	9	10
DATA	O5V	CK	O5V	SEL	O5V	$\overline{\text{SLAM}}$			$\overline{\text{CLKOFF}}$
20	19	18	17	16	15	14	13	12	11
$\overline{\text{DATA}}$	O5V	$\overline{\text{CK}}$	O5V	$\overline{\text{SEL}}$	O5V				O5V

CONNECTOR 2CN (MR-20RMA)

1	2	3	4	5	6	7
O5V	O5V	O5V	+5V	+5V	+5V	
	8	9	10	11	12	13
			+TG	−TG		
14	15	16	17	18	19	20
PC	$\overline{\text{PC}}$	PA	$\overline{\text{PA}}$	PB	$\overline{\text{PB}}$	FG

CONNECTOR 3CN (MR-20RMA)

1	2	3	4	5	6	7
OD	OD		BS	BSO	+24V	SAL
	8	9	10	11	12	13
			−TG	OV	OVR	OVF
14	15	16	17	18	19	20
+VD	−VD		+TG	DAS	+24V	DEC

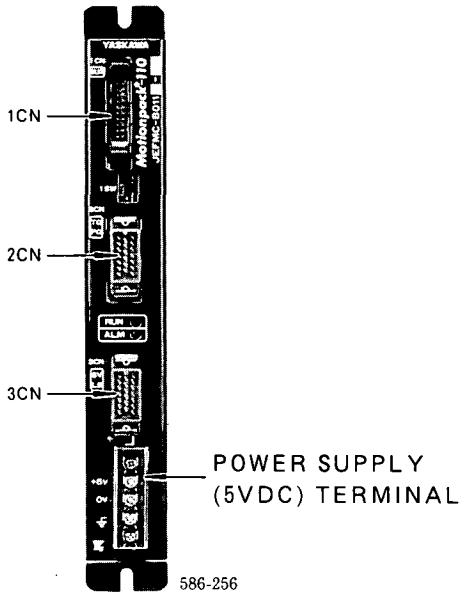


Fig. 9.22 Connector Terminals (Pins) and Signal Names of Axis Module

9.9.3 CRT CONTROL STATION, TYPE JEFMC-H011

Connector terminal numbers on the rear of CRT control station (JEFMC-H011) and signal names are as shown below. Power supply terminals for 100/110 VAC are also provided.

CONNECTOR CNB (MR-20RMA)

1	2	3	4	5	6	7
O5V	O5V	O5V	+5V	+5V	+5V	
	8	9	10	11	12	13
	$\overline{\text{TX2D}}$	$\overline{\text{RX2D}}$	$\overline{\text{RTS2}}$	CTS2	DSR2	
14	15	16	17	18	19	20
TX2D	RX2D	$\overline{\text{RTS2}}$	$\overline{\text{CTS2}}$	$\overline{\text{DSR2}}$		FG

CONNECTOR CNC (MR-20RMA)

1	2	3	4	5	6	7
O5V	O5V					
	8	9	10	11	12	13
	$\overline{\text{TX1D}}$	$\overline{\text{RX1D}}$				
14	15	16	17	18	19	20
TX1D	RX1D					FG

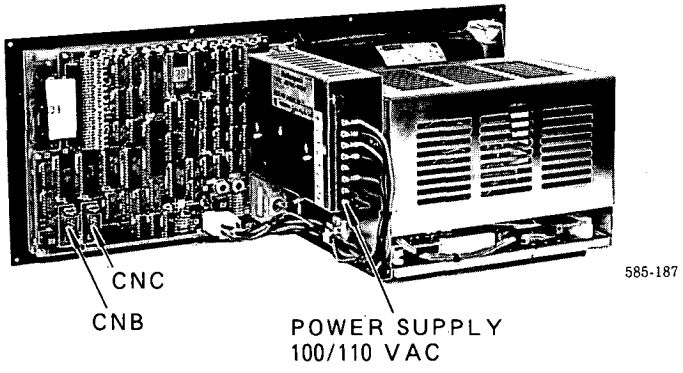


Fig. 9.23 Connector Terminals (Pins) and Signal Names of Rear of CRT Control Station

9.9.4 MICRO PC MODULE, TYPE JEFMC-B110

Connector terminal numbers on the panel of micro PC module and signal names are as shown below. Power supply terminals for 5 VDC are also provided. Signal names of connectors with * show those in standard I/O allocation.

CONNECTOR 1CN (MR-50RMA)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0$_{24}$ V	#5200 D 0	#5200 D 2	#5200 D 5	#5201 D 0	#5201 D 3	#5201 D 6	#5202 D 1	#5202 D 4	#5202 D 7	#5203 D 2	#5203 D 5	#5204 D 0	#5204 D 3	#5204 D 6	#5205 D 1	#5205 D 4	#5205 D 6
		19	20	21	22	23	24	25	26	27	28	29	30	31	32		
		#5200 D 3	#5200 D 6	#5201 D 1	#5201 D 4	#5201 D 7	#5202 D 2	#5202 D 5	#5203 D 0	#5203 D 3	#5203 D 6	#5204 D 1	#5204 D 4	#5204 D 7	#5205 D 2		
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+24V	#5200 D 1	#5200 D 4	#5200 D 7	#5201 D 2	#5201 D 5	#5202 D 0	#5202 D 3	#5202 D 6	#5203 D 1	#5203 D 4	#5203 D 7	#5204 D 2	#5204 D 5	#5205 D 0	#5205 D 3	#5205 D 5	#5205 D 7

CONNECTOR 2CN (MR-50RMA)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0$_{24}$ V	#5206 D 0	#5206 D 2	#5206 D 5	#5207 D 0	#5207 D 3	#5207 D 6	#5300 D 1	#5300 D 4	#5300 D 7	#5301 D 2	#5301 D 5	#5302 D 0	#5302 D 3	#5302 D 6	#5303 D 1	#5303 D 4	#5303 D 6
		19	20	21	22	23	24	25	26	27	28	29	30	31	32		
		#5206 D 3	#5206 D 6	#5207 D 1	#5207 D 4	#5207 D 7	#5300 D 2	#5300 D 5	#5301 D 0	#5301 D 3	#5301 D 6	#5302 D 1	#5302 D 4	#5302 D 7	#5303 D 2		
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+24V	#5206 D 1	#5206 D 4	#5206 D 7	#5207 D 2	#5207 D 5	#5300 D 0	#5300 D 3	#5300 D 6	#5301 D 1	#5301 D 4	#5301 D 7	#5302 D 2	#5302 D 5	#5303 D 0	#5303 D 3	#5303 D 5	#5303 D 7

CONNECTOR 3CN (MR-20RMA)

1	2	3	4	5	6	7
0$_s$ V	0$_s$ V	0$_s$ V	+5 V	+5 V	+5 V	
	8	9	10	11	12	13
	$\overline{\text{TXD}}$	$\overline{\text{RXD}}$	RTS	CTS		
14	15	16	17	18	19	20
TXD	RXD	$\overline{\text{RTS}}$	$\overline{\text{CTS}}$			FG

CONNECTOR 4CN (MR-20RMA)

1	2	3	4	5	6	7
0$_s$ V	0$_s$ V	0$_s$ V	+5 V	+5 V	+5 V	$\overline{\text{CLKOFF}}$
	8	9	10	11	12	13
	$\overline{\text{DATA}}$	DATA	$\overline{\text{CK}}$	CK	$\overline{\text{SEL}}$	SEL
14	15	16	17	18	19	20
$\overline{\text{DATA}}$	DATA	$\overline{\text{CK}}$	CK	$\overline{\text{SEL}}$	SEL	FG

CONNECTOR 6CN (3428-6002)

1	2	3	4	5	6	7	8	9	10
DATA	0$_s$ V	CK	0$_s$ V	SEL	0$_s$ V	$\overline{\text{SLAM}}$			$\overline{\text{CLKOFF}}$
20	19	18	17	16	15	14	13	12	11
$\overline{\text{DATA}}$	0$_s$ V	$\overline{\text{CK}}$	0$_s$ V	$\overline{\text{SEL}}$	0$_s$ V				0$_s$ V

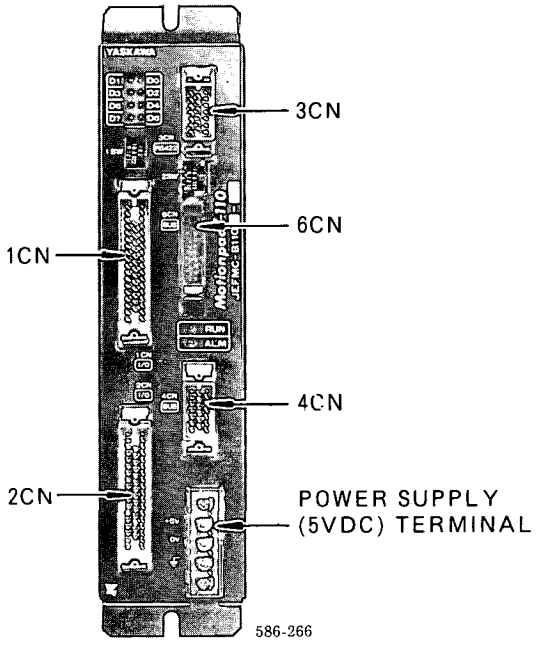
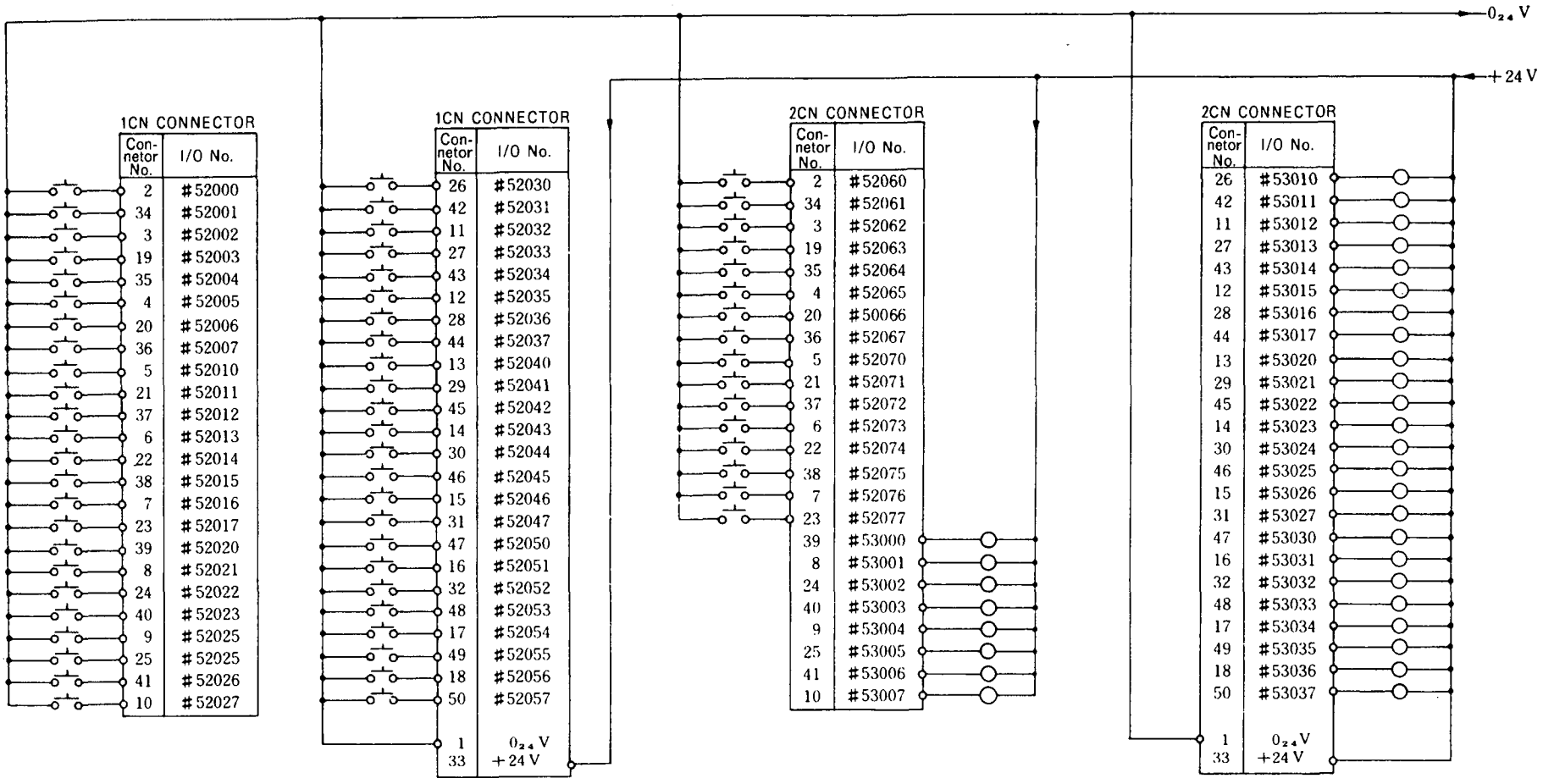
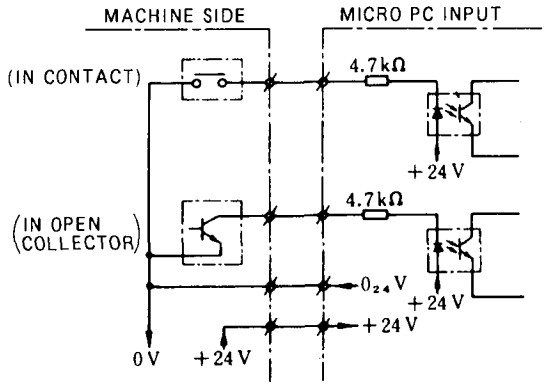
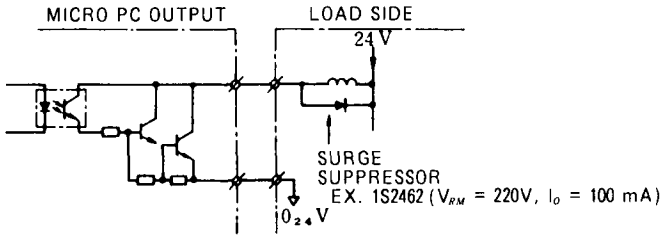


Fig. 9.24 Connector Terminals (Pins) and Signal Names of Micro PC Module


0₂₄ V
+24 V
1CN CONNECTOR
Con-netor No.
I/O No.
2 #52000
34 #52001
3 #52002
19 #52003
35 #52004
4 #52005
20 #52006
36 #52007
5 #52010
21 #52011
37 #52012
6 #52013
22 #52014
38 #52015
7 #52016
23 #52017
39 #52020
8 #52021
24 #52022
40 #52023
9 #52025
25 #52025
41 #52026
10 #52027
1CN CONNECTOR
Con-netor No.
I/O No.
26 #52030
42 #52031
11 #52032
27 #52033
43 #52034
12 #52035
28 #52036
44 #52037
13 #52040
29 #52041
45 #52042
14 #52043
30 #52044
46 #52045
15 #52046
31 #52047
47 #52050
16 #52051
32 #52052
48 #52053
17 #52054
49 #52055
18 #52056
50 #52057
1 0₂₄ V
33 +24 V
2CN CONNECTOR
Con-netor No.
I/O No.
2 #52060
34 #52061
3 #52062
19 #52063
35 #52064
4 #52065
20 #50066
36 #52067
5 #52070
21 #52071
37 #52072
6 #52073
22 #52074
38 #52075
7 #52076
23 #52077
39 #53000
8 #53001
24 #53002
40 #53003
9 #53004
25 #53005
41 #53006
10 #53007
2CN CONNECTOR
Con-netor No.
I/O No.
26 #53010
42 #53011
11 #53012
27 #53013
43 #53014
12 #53015
28 #53016
44 #53017
13 #53020
29 #53021
45 #53022
14 #53023
30 #53024
46 #53025
15 #53026
31 #53027
47 #53030
16 #53031
32 #53032
48 #53033
17 #53034
49 #53035
18 #53036
50 #53037
1 0₂₄ V
33 +24 V


MACHINE SIDE
MICRO PC INPUT
(IN CONTACT)
4.7kΩ
+24 V
(IN OPEN COLLECTOR)
4.7kΩ
0₂₄ V
+24 V
+24 V
0 V
+24 V


MICRO PC OUTPUT
LOAD SIDE
24 V
SURGE SUPPRESSOR
EX. 1S2462 (V_RM = 220V, I_o = 100 mA)
0₂₄ V

9.10 SIGNAL CABLES

9.10.1 LIST OF CABLES

Cables are listed in Table 9.7. Usually cables are to be prepared by the users, but the YASKAWA can provide them if desired. Shown in Fig. 9.1 are the connections between units with standard configuration and also cable names.

Table 9.7 List of Cables

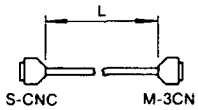
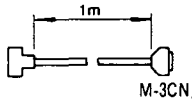
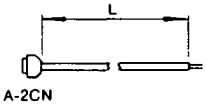
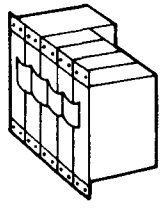
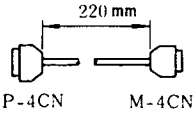
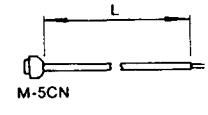
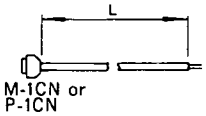
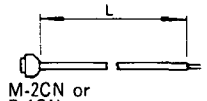
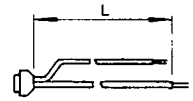
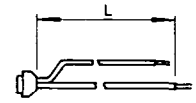
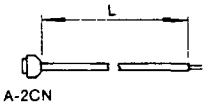
Cable Symbol	Application	Connector	Cable Type	Cable Specifications Supplied by Yaskawa
(J1)	Communication cable Control panel↔ Motion module	MRP-20F/MR-20L	KQVV-SW 3P×AWG26	 Type JEFMC / L: -W010 5 m; -W011 10 m; -W012 15 m
(J2)	Communication cable Personal computer↔ Motion module/ Micro PC module	MRP-20F/MR-20L DB-25P/DB-C2-JG	KQVV-SW 3P×AWG26	 Type JEFMC-W020
(J7)	TG, PG signal Axis module↔ Servomotor	MRP-20F/MR-20L	KQVV-SB 10P×0.2 Packaged shield	 Type JEFMC / L: -W070 10 m; -W071 15 m; -W072 25 m
(J8)	FA bus signal Rack-mounted type	3421-6520SB FRC2-AO20-10 FRC2-AA20-10	20-core Flat cable	 TYPE JEFMC-W084 (For 1- to 4-axis)
(J10)	FA bus signal Micro PC module↔ Motion module	MRP-20F/MR-20L	KQVV-SB 10P×0.2 Packaged shield	 Type JEFMC-W100
(J11)	I/O signal Motion module ↔Machine side I/O	MRP-20F/MR-20L	KQVV-SB 10P×0.2 Packaged shield	 Type JEFMC / L: -W110 1 m; -W111 2 m; -W112 5 m
(J12)	I/O signal Motion module ↔Machine side I/O Micro PC module↔ Machine side expansion I/O	MRP-50F/MR-50L	KQVV-SB 50C×0.2	 Type JEFMC / L: -W120 1 m; -W121 2 m; -W122 5 m

Table 9.7 List of Cables

Cable Symbol	Application	Connector	Cable Type	Cable Specifications Supplied by Yaskawa
(J13)	I/O signal Motion module ↔ Machine side I/O Micro PC module ↔ Machine side expansion I/O	MRP-50F/MR-50L	KQVV-SB 50C×0.2	 Type JEFMC / L -W130 / 1 m -W131 / 2 m -W132 / 5 m
(J14)	AC/DC Servopack Axis module ↔ AC/DC Servopack	MRP-20F/MR-20L	KQVV-SB 10P×0.2 Packaged shield	 Type JEFMC / L -W140 / 0.5 m -W141 / 1 m -W142 / 3 m
(J15)	AC Servo PG signal Axis module ↔ AC Servopack	MRP-20F/MR-20L	KQVV-SB 4P×AWG26 Packaged shield	 Type JEFMC / L -W150 / 0.5 m -W151 / 1 m -W152 / 3 m
(J16)	AC Servo, 12V PG signal Axis module ↔ DC Servomotor	MRP-20F/MR-20L	Combined Signal cable 4P×0.2 Packaged shield	 Type JEFMC / L -W160 / 10 m -W161 / 15 m -W162 / 25 m

9.10.2 CABLE SPECIFICATIONS

Signal lines of Motionpack-110 should be connected with MR connectors. Cables should be selected in accordance with Tables 9.8 and 9.9. Twisted cable should be KQVV-SB 10P × 0.2 mm² (or 3P × AWG26) shown in Table 9.10.

Table 9.8 Cables

	MRP-50F/MR-50F	MRP-20F/MR-20F
Type	Crimp type/solder type	Crimp type/solder type
No. of Cores	50 cores	20 cores
Applicable Wire	AWG #24-#28	AWG #24-#28
Cutter Diameter	16 mm dia max	10 mm dia max
Recommended Cable	Plastic multicore control cable	
	(Example) KQVV50C×0.2 (0.2 mm², 50 cores) manufactured by Fujikura Ltd.	(Example) KQVV20C×0.2 (0.2 mm², 20 cores) manufactured by Fujikura Ltd.
	Cores: 0.2 mm² tin-plated soft copper standard wires, 16/0.12 (cores/mm) Insulating material: Bridged vinyl Thickness: 0.3 mm Funished outer dia: 1.1 mm	

Table 9.9 Dimensions of Cores

AWG	Sectional Area of Conductor mm²	Standard Outer Dia of Vinyl Insulation mm
#24	0.21	1.5 ← Recommended
#26	0.13	1.3
#28	0.08	1.2

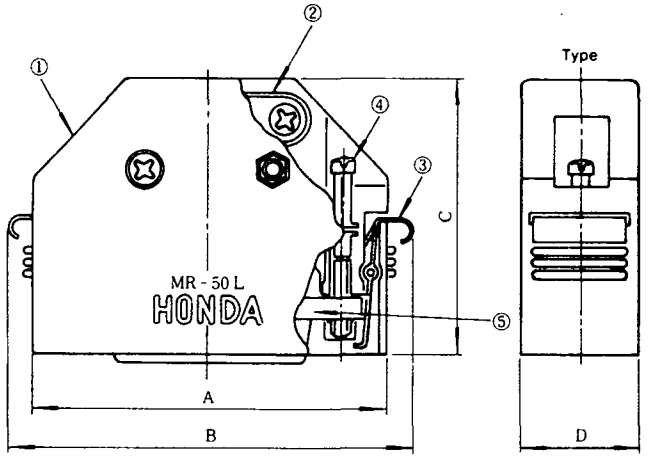
9.10.2 CABLE SPECIFICATIONS (Cont'd)

Table 9.10 Twisted Cables

Item		Unit	Specifications
			KQVV-SB
No. of Pairs		Pair	10
Conductor	Material	—	Tin-plated soft copper stranded wires
	Nominal Sectional Area	mm	0.2
	Configuration	Numbers/mm	16/0.12
	Outer Diameter	mm	0.55
Insulation	Material	—	Bridged rinyl
	Thickness	mm	0.3
Circuit Configuration		—	Paired strands with pitch of 18, 22, 25, 32
Holding		—	Wound with paper tape
Shielding		—	Tin-plated soft copper wire braid
Sheath	Material and Color	—	Vinyl, black
	Thickness	mm	1.2
Approx Finished Outer Dia		mm	10.0
Approx Weight		kg/km	130

9.10.3 CONNECTOR

9.10.3.1 External Dimensions in mm



Type \ Symbol	A	B	C	D
MR-20L	39.3	44.9	39.8	17
MR-50L	67.9	73.5	44.8	18

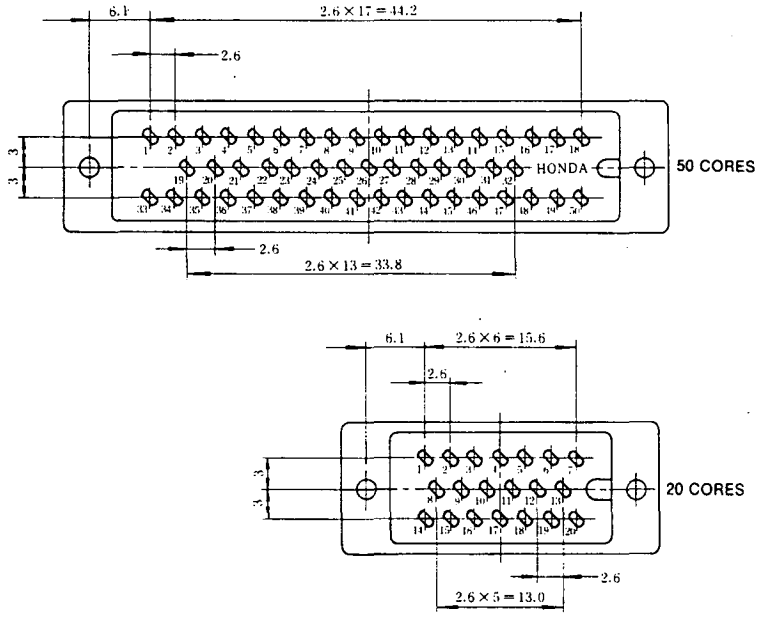
Symbol	Name
①	Connector cover
②	Cable clamps
③	Connector clamp spring
④	Connector clamp screw
⑤*	Connector (MRP-$^{20F}_{50F}$ MR-$^{20F}_{50F}$)

* MRF-$^{20F}_{50F}$: Crimp type, MR-$^{20F}_{50F}$: Solder type.

Note:
1. Manufacturer: Honda Tsushin Kogyo Co.
2. Applicable cable outer dia:
   MR-20L—10mm dia max
   MR-50L—16mm dia max
3. Special tools are necessary for crimp type.

Fig. 9.25 External Dimensions of Connector in mm

9.10.3.2 Terminal Number and Dimensions in mm



Note: Figures above are viewed from wiring side of the connector.

Fig. 9.26 Connector Terminal Number and Dimensions in mm

9.11 WIRING PRECAUTIONS

9.11.1 PREVENTION OF INTERFERENCE BETWEEN WIRES

In the Motionpack-110 system, various cables with different power levels and signal speeds are located in proximity, such as wires for main circuit of motor and wires for PG signals. If a cable for applying a large current, such as main circuit for motor, is located near high speed signal lines for PG or bus signals, noise might be induced in the signal lines, resulting in an erroneous operation.

It is important to prevent interference between wires. Wiring can be roughly divided into three kinds as shown in Table 9.11.

Table 9.11 Classification of Wiring

Classification	Category I	Category II	Category III
Contents	Wires carrying large currents or high speed signals which may induce noise in other wires.	Wires which may be adversely affected by noise induction from other wires.	Wires for digital or analog signals which are relatively stable.
Applicable Wiring	• Wiring between Servopack and motor. • Wiring between Servopack and input wires of AC power supply. • Wiring for regenerative resistance units.	• Wiring between PG, TG and axis module, (J7) ((J15) , (J16)). • Wiring between Servopack and axis modules, (J14). • Wiring between CRT control station and motion module, (J1). • Wiring between personal computer and motion module, (J2). • Wiring between motion module and axis module, (J8). • Wiring between micro PC module and motion module, (J10).	• I/O signal, (J11), (J12), (J13).

9.11.1 PREVENTION OF INTERFERENCE BETWEEN WIRES (Cont'd)

Be sure that wires in different categories are not located close to each other. For category II wires, the following precautions must be taken.

- They should not be laid in parallel to or close to the wires of category I.
- They should not be laid near parts or units which generate noise. They should not be laid in parallel to the wires for these parts or units.

9.11.2 INSERTION OF SURGE SUPPRESSORS INTO COILS

Be sure to connect the surge suppressors to the coils of relays, contactors and solenoids.

Examples of suppressors:

- For 200 VAC: Surge Suppressor CR50500 (Okaya Denki Co.)
- For 100 VAC: Surge Suppressor AU1201 (Okaya Denki Co.)
- For 24 VDC: Diode 1S2462 (Toshiba)

9.11.3 USE OF INSULATING TRANSFORMERS AND LINE FILTERS

Be sure to connect insulating transformers and line filters to control power supply lines. In this case, the following precautions should be taken.

- Separate the primary side or the secondary side of insulating transformer or line filter.
- Ground the insulating transformer or line filter using a large diameter wire running the shortest possible distance.
- Make wiring as short as possible to the input terminals of insulating transformer or line filter to prevent noise induction.

9.11.4 GROUNDING METHOD

One-point grounding (100Ω or less) should be made using wires larger than 2 mm^2. If the servomotor is to be insulated from machine, be sure to ground the motor. Fig. 9.27 shows the grounding method. Connect a single line from each unit or module to the grounding point of the control panel, and then make one-point grounding (100Ω or less) from there.

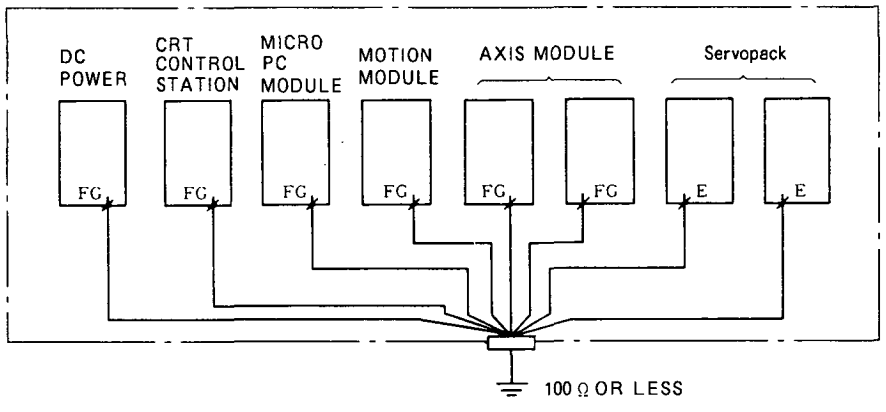


Fig. 9.27 Grounding Method

9.11.5 POWER SUPPLY OF 5 VDC

To prevent a voltage drop due to common impedance, wiring for 5 VDC power supply for motion modules or axis modules should be carefully made, and large diameter wires (larger than 2 mm^2) should be used.

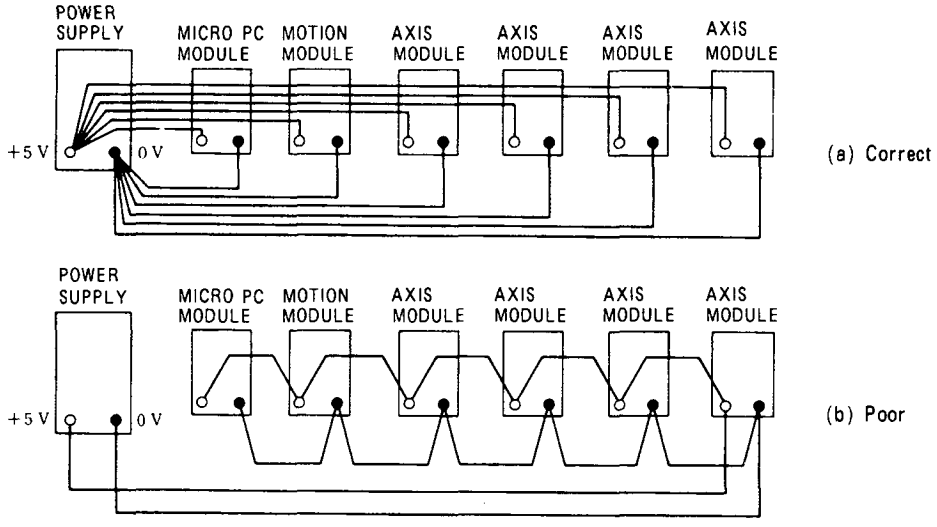


Fig. 9.28 Wiring Method of Power Supply

CONTENTS

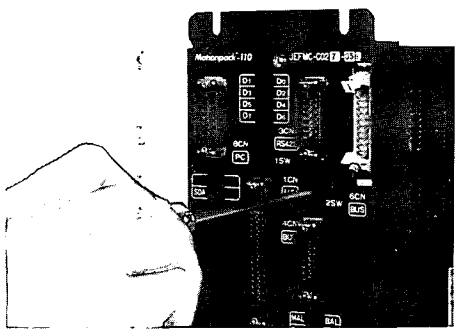
10. SETTINGS AND INDICATIONS FOR MODULES

10.1 MOTION MODULE SYSTEM SETTING

When the motion module control system is used by changing the normal on-line mode to off-line mode, the system switch (2SW) is set, e.g., in micro PC module I/O allocations.

Fig. 10.1 shows the system operation contents according to the "2SW" setup value. To use the normal on-line system, be sure to set the switch to "0" position.

The switch is preset to "0" at the factory before shipping. Do not set the switch to any position other than "0" and "9".



2SW Setting	System Operation Contents
"0"	On-line (during normal use of system)
"9"	Off-line (only in micro PC module I/O allocation)

Fig. 10.1 Motion Module System Setting

Set the system with a screwdriver, through the square hole of 2SW on the motion module, as shown in Fig. 10.1.

10.2 INDICATIONS FOR MOTION MODULES

10.2.1 INDICATIONS OF INPUT SIGNAL MONITOR

These indications are used to check whether the input signals are normally entering into the input connectors (1CN, 2CN, 5CN) of motion module. There are eight indicator lamps, but the input signals at 64 points can be checked since the lamps are combined with the indication changeover switch (1SW). Lamps are lit when the input signals are on and turned off when input signals are off. Fig. 10.3 shows the checking method of input signal, and Table 10.1 gives the list of indications and input signals.

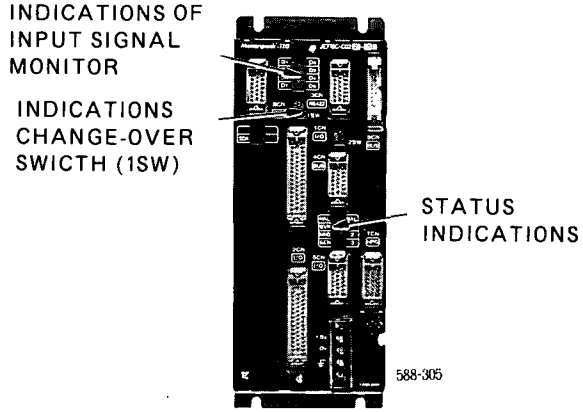


Fig.10.2 Indications of Motion Module

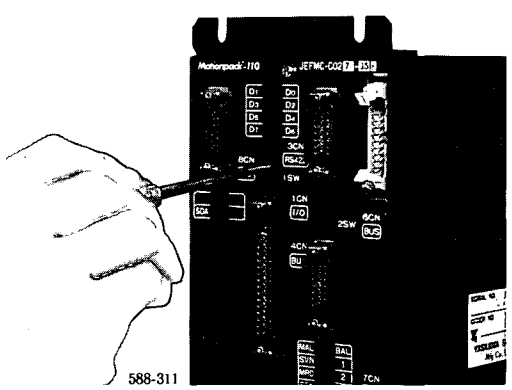


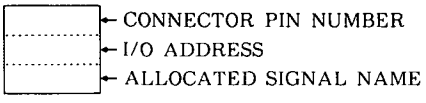
Fig.10.3 Checking of Input Signal

Table 10.1 List of Indications and Input Signals

ISW Selection No. \ Indicator	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
0	1CN-36	1CN-20	1CN- 4	1CN-35	1CN-19	1CN- 3	1CN-34	1CN- 2
	#30007	#30006	#30005	#30004	#30003	#30002	#30001	#30000
	(EDIT)	(MEM)	(DNC)	—	(STEP)	(HANDLE)	(JOG)	(RAPID)
1	1CN-23	1CN- 7	1CN-38	1CN-22	1CN- 6	1CN-37	1CN-21	1CN- 5
	#30017	#30016	#30015	#30014	#30013	#30012	#30011	#30010
	(ROV3)	(ROV2)	(ROV1)	(OV16)	(OV8)	(OV4)	(OV2)	(OV1)
2	1CN-10	1CN-41	1CN-25	1CN- 9	1CN-40	1CN-24	1CN- 8	1CN-39
	#30027	#30026	#30025	#30024	#30023	#30022	#30021	#30020
	(SSTP)	(FRN)	(RRN)	(PMEM)	(JOV8)	(JOV4)	(JOV2)	(JOV1)
3	1CN-44	1CN-28	1CN-12	1CN-43	1CN-27	1CN-11	1CN-42	1CN-26
	#30037	#30036	#30035	#30034	#30033	#30032	#30031	#30030
	(TBXON)	(−JZ)	(−JY)	(−JX)	—	(+JZ)	(+JY)	(+JX)
4	1CN-31	1CN-15	1CN-46	1CN-30	1CN-14	1CN-45	1CN-29	1CN-13
	#30047	#30046	#30045	#30044	#30043	#30042	#30041	#30040
		(GR2)	(GR1)	(MP2)	(MP1)	(HZ)	(HY)	(HX)
5	1CN-50	1CN-18	1CN-49	1CN-17	1CN-48	1CN-32	1CN-16	1CN-47
	#30057	#30056	#30055	#30054	#30053	#30052	#30051	#30050
	(ESP)	(MLK)	(FIN)	(ZRN)	(NEG)	(ACR)	(ER)	(SBK)
6	2CN-36	2CN-20	2CN- 4	2CN-35	2CN-19	2CN- 3	2CN-34	2CN- 2
	#30067	#30066	#30065	#30064	#30063	#30062	#30061	#30060
	(W28)	(W24)	(W22)	(W21)	(W18)	(W14)	(W12)	(W11)
7	2CN-23	2CN- 7	2CN-38	2CN-22	2CN- 6	2CN-37	2CN-21	2CN- 5
	#30077	#30076	#30075	#30074	#30073	#30072	#30071	#30070
	(SK8)	(SK7)	(SK6)	(SK5)	(SK4)	(SK3)	(SK2)	(SK1)

Note:

1. Each pin number, I/O address and allocated signal name is described in the place shown below:



2. Signal names indicate those in standard I/O allocation.

10.2.2 STATUS INDICATIONS

Kinds of status indications are alarm [MAL], servo on [SVN], motion ready [MRD], transmission [SEN] and battery alarm [BAL]. Six green lamps are turned on during normal status. See Fig. 10.4 and Table 10.2.

Table 10.2 Status Indications

Signal Name	Lamp ON	Lamp OFF
MAL (Alarm) Ⓡ	Alarm	Normal
SVN (Servo on) Ⓖ	Operation	No-operation
MRD (Motion Controller Ready) Ⓖ	Operation	No-operation
SEN (Transmission) Ⓖ	Operation	No-operation
BAL (Battery Alarm) Ⓡ	Alarm	Normal
MCRD (Motion Controller Ready) Ⓖ	Operation	No-operation

Note:
1. 1 and 2 are spare lamps.
2. 3 means motion controller ready (MCRD).

Ⓡ : Red lamp
Ⓖ : Green lamp

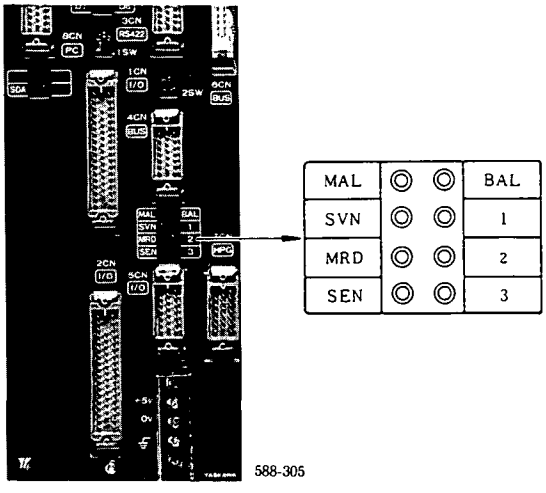
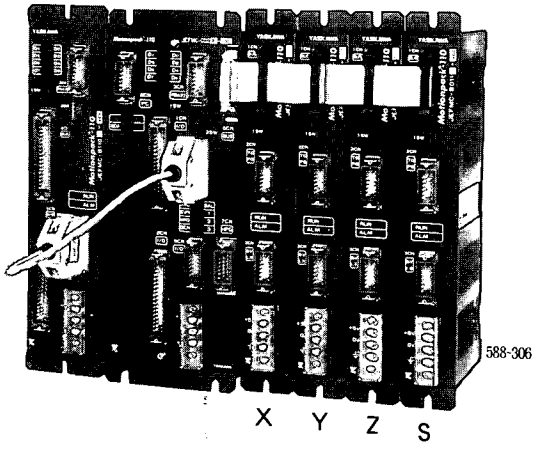


Fig.10.4 Status Indications

10.3 AXIS MODULE ADDRESSING (AXIS SETTING)

Data is transferred between the motion and axis modules on the FA bus. The axis module addresses on the bus must be defined to identify the axis module signals for each axis.

For the axis module, axis designation, that is, addressing is made by setting the axis a selection switch (1SW). Fig. 10.5 shows the relationship between the axis names and axis selection switch (1SW) setting. Do not set the switch to any position other than "1" to "4".



Axis Designation	1SW Setting
Axis Module X-Axis	"1"
Axis Module Y-Axis	"2"
Axis Module Z-Axis	"3"
Axis Module S-Axis	"4"

Fig. 10.5 Axis Module Addressing

When adjusting the axis selection switch (1SW), there are two approaches, as shown in Fig. 10.6: One is from the front of the module using a minus screw driver and the other is from the side using a plus screw driver.

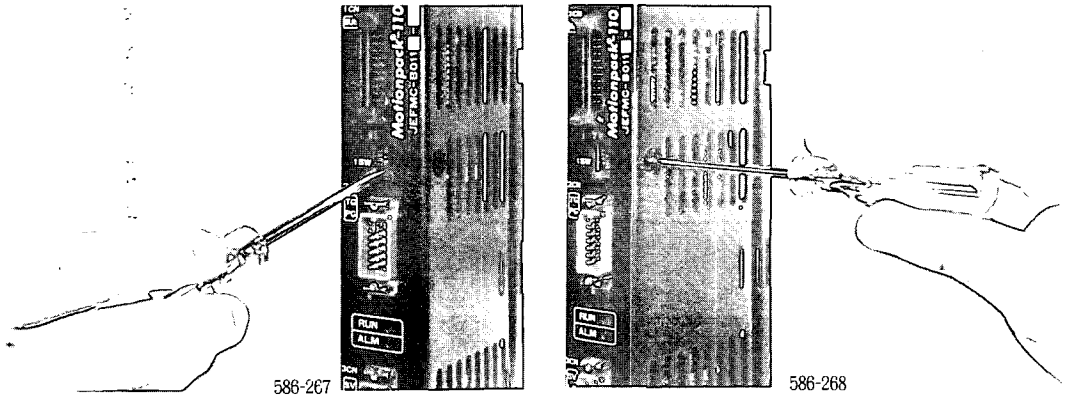


Fig. 10.6 Axis Setting

10.4 INDICATIONS FOR AXIS MODULES

RUN and ALM indications are provided for axis modules (refer to Fig. 10.7). RUN indicates the normal operation of axis modules and normal data transmission between motion modules and axis modules. When a servo alarm condition occurs, the red lamp of ALM is turned on. Normally only the green lamp of RUN lights up.

Table 10.3 Indications of RUN and ALM

	Lamp ON	Lamp OFF
RUN (G)	Normal	Error
ALM (R)	Servo alarm status	Servo on status

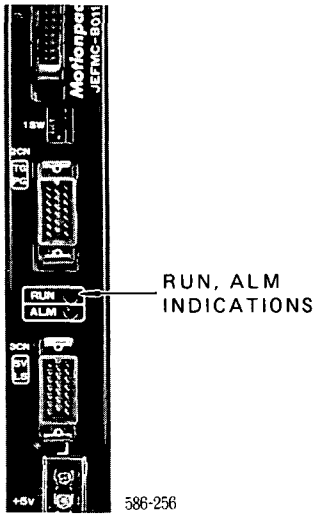
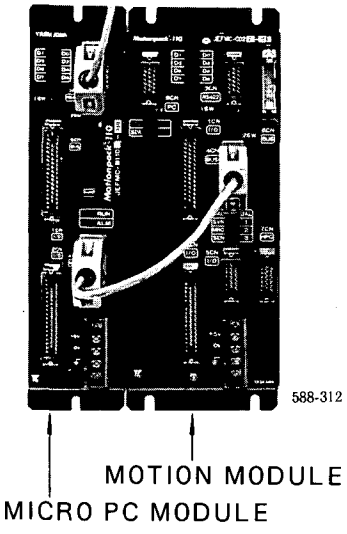


Fig. 10.7 Indications of Axis Module

10.5 MICRO PC MODULE ADDRESSING

Data is transferred between the motion and micro PC modules via the FA bus. The micro PC module address on the bus must be defined to identify the micro PC module signals.

For the micro PC module, addressing is made by setting the address selection switch (2SW) to the "5" position. Do not set the switch to any position other than "5".



Address Designation	2SW Setting
Micro PC Module	"5"

Fig. 10.8 Micro PC Module Addressing

10.5 MICRO PC MODULE ADDRESSING (Cont'd)

Set the address with a minus screw driver through the square hole of 2SW on the micro PC module, as shown in Fig. 10.9.

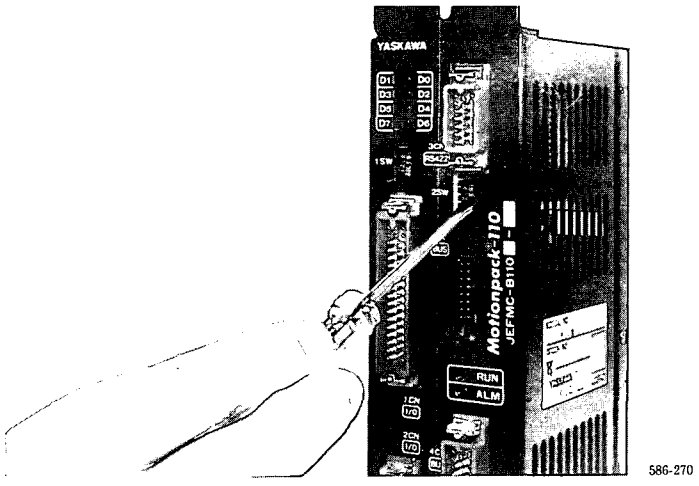


Fig. 10.9

10.6 INDICATIONS FOR MICRO PC MODULES

10.6.1 INDICATIONS OF INPUT SIGNAL MONITOR

These indications are used to check whether the input signals are normally entering into the input connectors (1CN, 2CN, 5CN) of micro PC module. There are eight indicator lamps, but the I/O signals on machine side can be checked since the lamps are combined with the indication changeover switch (1SW). Lamps are lit when the input signals are on and turned off when input signals are off. Fig. 10.10 shows the checking method of input signal, and Table 10.4 gives the list of indications and input signals.

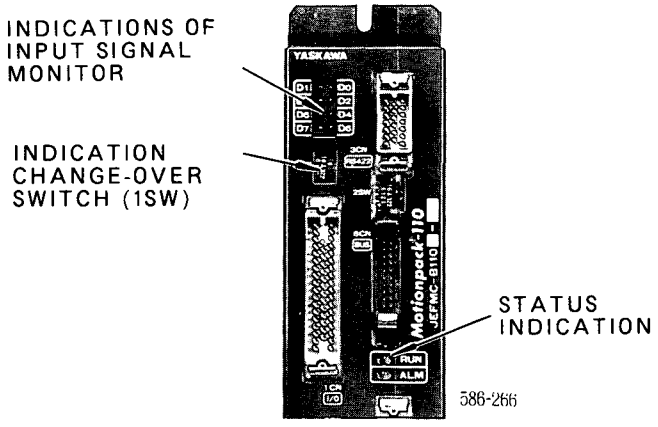


Fig. 10.10 Indications of Micro PC Module

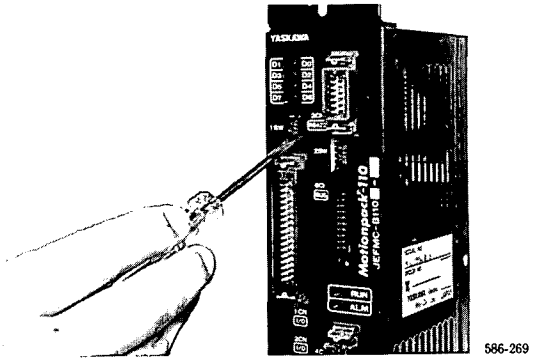
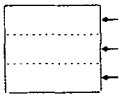


Fig. 10.11 Checking of Input Signal

Table 10.4 List of Indications and Input Signals

ISW Selection No. \ Indicator	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
0	1CN-36	1CN-20	1CN- 4	1CN-35	1CN-19	1CN- 3	1CN-34	1CN- 2
	#52007	#52006	#52005	#52004	#52003	#52002	#52001	#52000
1	1CN-23	1CN- 7	1CN-38	1CN-22	1CN- 6	1CN-37	1CN-21	1CN- 5
	#52017	#52016	#52015	#52014	#52013	#52012	#52011	#52010
2	1CN-10	1CN-41	1CN-25	1CN- 9	1CN-40	1CN-24	1CN- 8	1CN-39
	#52027	#52026	#52025	#52024	#52023	#52022	#52021	#52020
3	1CN-44	1CN-28	1CN-12	1CN-43	1CN-27	1CN-11	1CN-42	1CN-26
	#52037	#52036	#52035	#52034	#52033	#52032	#52031	#52030
4	1CN-31	1CN-15	1CN-46	1CN-30	1CN-14	1CN-45	1CN-29	1CN-13
	#52047	#52046	#52045	#52044	#52043	#52042	#52041	#52040
5	1CN-50	1CN-18	1CN-49	1CN-17	1CN-48	1CN-32	1CN-16	1CN-47
	#52057	#52056	#52055	#52054	#52053	#52052	#52051	#52050
6	2CN-36	2CN-20	2CN- 4	2CN-35	2CN-19	2CN- 3	2CN-34	2CN- 2
	#52067	#52066	#52065	#52064	#52063	#52062	#52061	#52060
7	2CN-23	2CN- 7	2CN-38	2CN-22	2CN- 6	2CN-37	2CN-21	2CN- 5
	#52077	#52076	#52075	#52074	#52073	#52072	#52071	#52070
8	2CN-10	2CN-41	2CN-25	2CN-9	2CN-40	2CN-24	2NN-8	2CN-39
	#53007	#53006	#53005	#530004	#53003	#53002	#53001	#53000
9	2CN-44	2CN-28	2CN-12	2CN-43	2CN-27	2CN-11	2CN-42	2CN-26
	#53017	#53016	#53015	#530014	#53013	#53012	#53011	#53010
A	2CN-31	2CN-15	2CN-46	2CN-30	2CN-14	2CN-45	2CN-29	2CN-13
	#53027	#53026	#53025	#530024	#53023	#53022	#53021	#53020
B	2CN-50	2CN-18	2CN-49	2CN-17	2CN-48	2CN-32	2CN-16	2CN-47
	#53037	#53036	#53035	#530034	#53033	#53032	#53031	#53030

Note:
1. Each pin number, I/O address and allocated signal name is described in the place shown below:



2. Signal names show those allocated by the customer.

10.6.2 STATUS INDICATIONS

Micro PC module is provided with two status indication lamps, Fig. 10.12. Lamp RUN indicates the following status:

- Correct data transmission between micro PC module and motion module,
- Under execution of the logic program of micro PC module.

If a transmission error occurs, lamp ALM (red) lights. In normal ON status, RUN (green) is lit.

Table 10.5 Indications of RUN and ALM

	Lamp ON	Lamp OFF
RUN (Green)	Under execution of data transmission and logic program	Error
ALM (Red)	Battery alarm	Normal

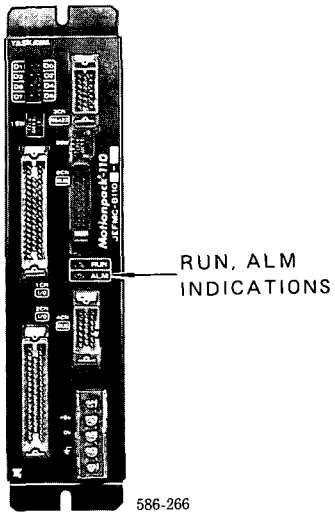


Fig.10.12 Status Indications of Micro PC Module

CONTENTS

11. TEST RUN

11.1 TEST RUN METHOD

Outline of the test run method for the Moritonpack-110 is as shown in the flow chart of Fig. 11.1. Contents of each item are explained below.

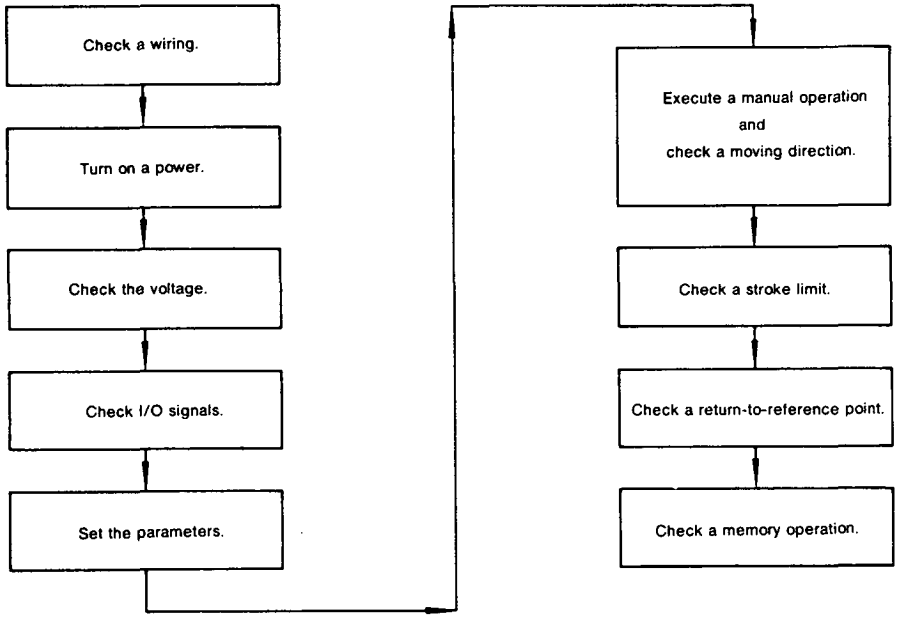


Fig. 11.1 Flow Chart of Test Run Method

11.1.1 WIRING CHECK

Wiring check is very important and must be carefully made. If checking of some items is overlooked during wiring check, abnormal operations may frequently occur in a late stage of trial run adjustment. In this case, it is very time-consuming to locate the causes of the abnormal operations. Complete wiring check is the basis of carrying out the trial run adjustment smoothly. In the wiring check, it is necessary to confirm not only the proper connections of circuits but also to check wiring route, size and kind of wires, presence and polarity of surge suppressors, etc.

11.1.2 POWER-ON CHECK

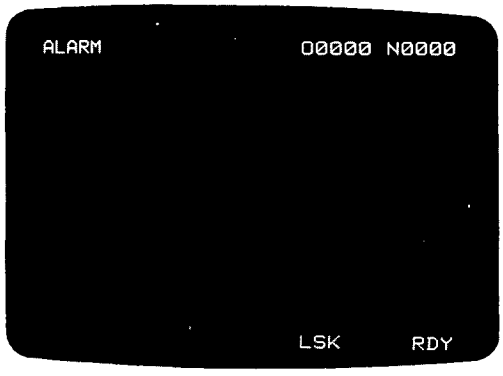
When the wiring check is completed, the power to the system should be turned on. When the power is turned on, the control power unit (5 VDC and 100VAC, power supply, of CRT control station are simultaneously turned on) is first turned on and then the servo power unit approximately two seconds later.

The power to the system should be turned on while carefully monitoring the system. If the machine runs roughly or uncontrollably at the time of turn-on of servo power, immediately turn off the power. The machine may run abnormally in the following cases and the wiring must be rechecked.

- Motor connections are reversed.
- Tachometer-generator connections are reversed.
- A-phase and B-phase of PG connections are reversed.

If there are no abnormal conditions (the machine is stationary) after turning on the servo power unit, the connections of motor, tachometer-generator and PG are considered to be correct. Display of the CRT control station is as follows after turning the power on.

585-204



585-205

Fig. 11.2 Display of CRT Control Station after Turning the Power on

11.1.3 VOLTAGE CHECK

After tuning on the power for the system, make sure that the voltage is normal at the following points.

(1) Power supply voltage: 200/220VAC ±10% or 100/110 VAC±10%
(2) Control power supply voltage: 100 VAC±10%, 5 VDC±5%, 24 VDC±10%
(3) PG voltage: 5 VDC±5% or 12 VDC±5%
(4) Servo power supply voltage: Varies depending on the model of Servopack. Refer to technical sheets for Servopack.

11.1.4 INPUT SIGNAL CHECK

Check whether normal input signals are present at the input connectors (1CN, 2CN) of the motion module. This checking can be made by one of the following methods.

(1) Check by input signal monitor lamps of motion module. Refer to Par. 10.2 "INDICATION FOR MOTION MODULES".
(2) Check on the CRT of control station. See Fig. 11.3.

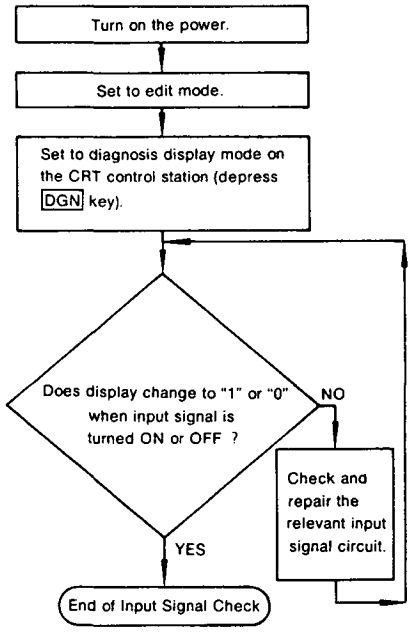


Fig. 11.3 Checking of Input Signals

11.1.5 INPUT/OUTPUT DIAGNOSIS NUMBER LIST

(1) Control Fixed I/O of Motion Module

	D7	D6	D5	D4	D3	D2	D1	D0
Indication	0	0	0	0	1	1	1	1

D3: 1 = Closed Contact; D2: 1 = Closed Contact; D1: 1 = Closed Contact; D0: 1 = Closed Contact; D7–D4: 0 = Open Contact

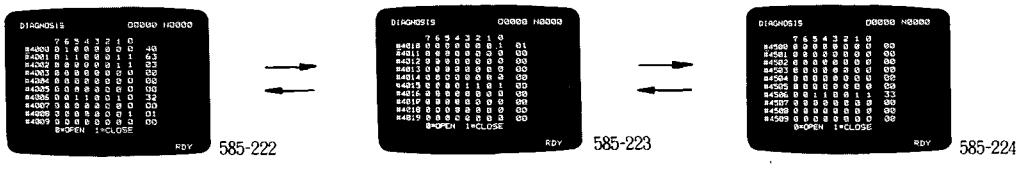
INPUT SIGNAL

Address	D7	D6	D5	D4	D3	D2	D1	D0
#4000	EDIT	MEM	DNC	MDI	STEP	HANDLE	JOG	RAPID
	Edit	Memory Operation	DNC Operation	MDI Operation	Step Operation	Manual Operation	Jog Operation	Rapid Feed Operation
#4001	ROV3	ROV2	ROV1	OV16	OV8	OV4	OV2	OV1
	Rapid Feed Override Cancel	Rapid Feed Override				Feed Override (21 Steps)		Feed Override (3 Steps)
#4002					JOV8	JOV4	JOV2	JOV1
						Jog Feedrate Selection		
#4003						+JZ	+JY	+JX
						+Z-Axis	+Y-Axis	+X-Axis
#4004						−JZ	−JY	−JX
						−Z-Axis	−Y-Axis	−X-Axis
#4005						HZ	HY	HX
						Selection of Manual Operation Axis		
#4006			MP2	MP1	ZRN	SKIP	$\overline{\text{STP}}$	STR
			Step Multiplier		Return-to-Reference Point	Skip	Stop	Start
#4007	PRT	MLK	ABSO	EINV	NEG	ACR	PMEM	SBK
	Protect	Machine Lock	Absolute Ref. Point	External Offset Data Sign⊖	Axis Omission	Alarm Clear	Position Memory	Single Block
#4008	SK8	SK7	SK6	SK5	SK4	SK3	SK2	SK1
					Optional Block Skip			
#4009		GR2	GR1			SSTP	FRN	RRN
			Gear Selection			Stop	Forward Run	Reverse Run
#4010	TBXON	FIN			RESET			MRDY
		M, S, T, Completed			Reset			Machine Ready Completed
#4011	E28	E24	E22	E21	E18	E14	E12	E11
	External Offset Data BCD Input							
#4012	E48	E44	E42	E41	E38	E34	E32	E31
	External Offset Data BCD Input							
#4013	E68	E64	E62	E61	E58	E54	E52	E51
	External Offset Data BCD Input							
#4014	E88	E84	E82	E81	E78	E74	E72	E71
	External Offset Data BCD Input							
#4015			ESP	ER	$\overline{\text{BAT ALM}}$	$\overline{\text{SVALM}}$		SVOK
				External Fault				Servo Ready Completed
#4016	W28	W24	W22	W21	W18	W14	W12	W11
	Program No. BCD Input							
#4017								
#4018								
#4019								

CONTROL OUTPUT SIGNAL	Address	D7	D6	D5	D4	D3	D2	D1	D0
	#4500	M30	M02		M00	DEN	OP	SPL	STL
		Program End, Head Waiting	End of Program		Program Stop	Positioning Completed	Program Operation	Temporary Stop	Cycle Start
	#4501				SVON	MCRD		RST	ALM
						Motion Controller Ready		External Reset	Alarm
	#4502						TF	SF	MF
							T Symbol Reading	S Symbol Reading	M Symbol Reading
	#4503						ZPZ	ZPY	ZPX
							Z-Axis Reference Point	Y-Axis Reference Point	X-Axis Reference Point
	#4504								
	#4505	M28	M24	M22	M21	M18	M14	M12	M11
		M-BCD Code Output (0-99)							
	#4506	T28	T24	T22	T21	T18	T14	T12	T11
		T-BCD Code Output (0-99)							
	#4507	A28	A24	A22	A21	A18	A14	A12	A11
		Alarm Code (Hexa.)							
	#4508	S28	S24	S22	S21	S18	S14	S12	S11
	#4509								

NOTE

1. Signal name with a bar "−" (e.x. $\overline{\text{STP}}$) shows a reverse signal. The signal without description (e.x. SVON) connot be used for internal processing.
2. When [DGN] key is depressed, the display of 10 lines at a time is made starting from #4000.
3. For changing a page of the display screen, depress the [PAGE ▽] or [PAGE △] key.
4. When the [PAGE ▽] or [PAGE △] key is depressed, the screen is shifted in the following order.



585-222 585-223 585-224

Example:
- If set to memory operation mode (MEM), "D_6" of #4000 becomes "1".
- If the start signal (STR) is turned on, "D_0" of #4006 becomes "1".
  If it is turned off, "D_0" becomes "0".

11.1.5 INPUT/OUTPUT DIAGNOSIS NUMBER LIST (Cont'd)

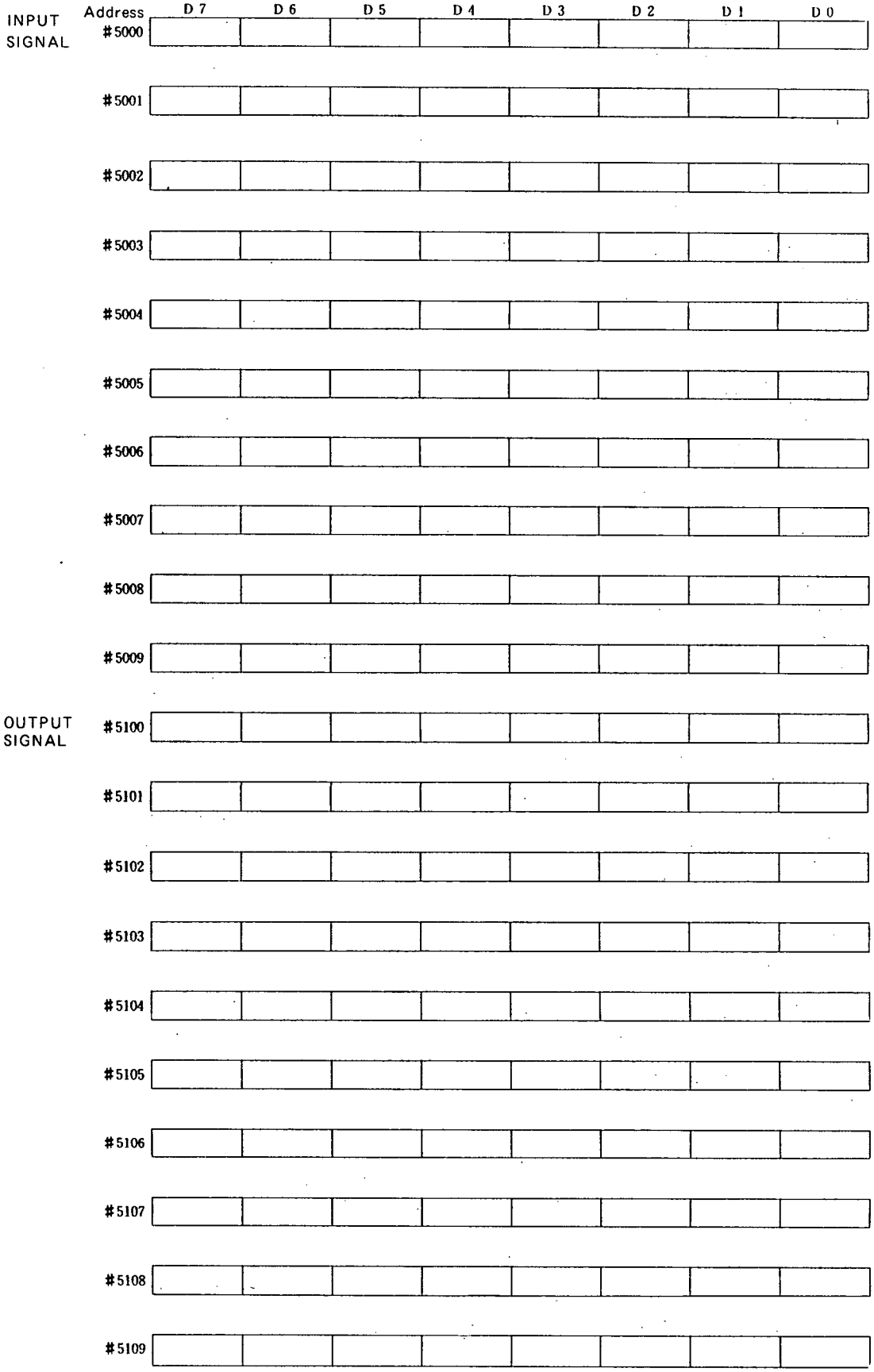
(2) General/Special I/O of Motion Module

Indication in ☐ shows connector pin No. Signal name will be specified at I/O allocation.

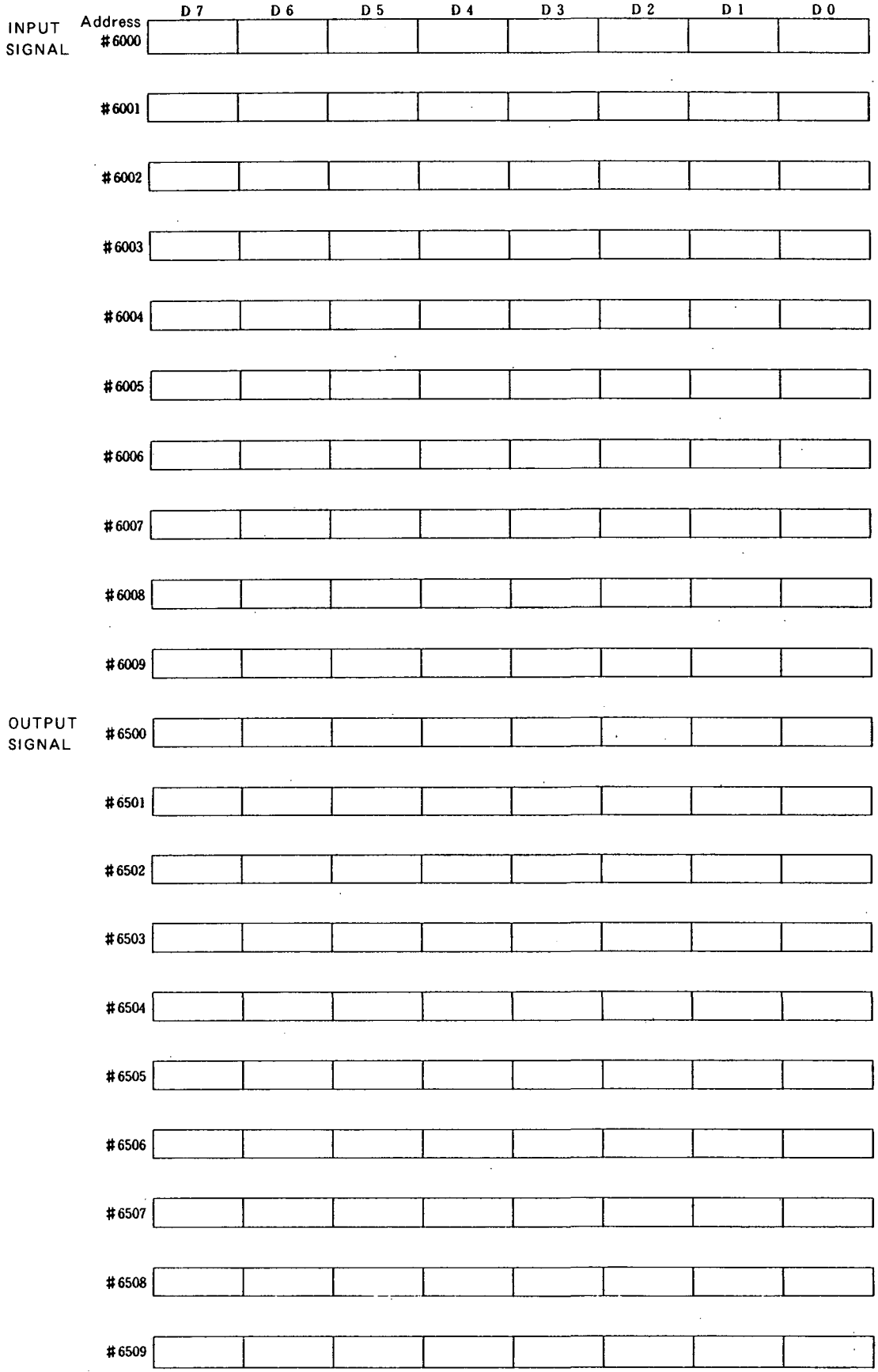
	Address	D7	D6	D5	D4	D3	D2	D1	D0
INPUT SIGNAL	#3000	1CN-36	1CN-20	1CN-4	1CN-35	1CN-19	1CN-3	1CN-34	1CN-2
	#3001	1CN-23	1CN-7	1CN-38	1CN-22	1CN-6	1CN-37	1CN-21	1CN-5
	#3002	1CN-10	1CN-41	1CN-25	1CN-9	1CN-40	1CN-24	1CN-8	1CN-39
	#3003	1CN-44	1CN-28	1CN-12	1CN-43	1CN-27	1CN-11	1CN-42	1CN-26
	#3004	1CN-31	1CN-15	1CN-46	1CN-30	1CN-14	1CN-45	1CN-29	1CN-13
	#3005	1CN-50	1CN-18	1CN-49	1CN-17	1CN-48	1CN-32	1CN-16	1CN-47
	#3006	2CN-36	2CN-20	2CN-4	2CN-35	2CN-19	2CN-3	2CN-34	2CN-2
	#3007	2CN-23	2CN-7	2CN-38	2CN-22	2CN-6	2CN-37	2CN-21	2CN-5
	#3008			5CN-6	5CN-5	5CN-4	5CN-3	5CN-2	5CN-1
	#3009								
OUTPUT SIGNAL	#3500	2CN-10	2CN-41	2CN-25	2CN-9	2CN-40	2CN-24	2CN-8	2CN-39
	#3501	2CN-44	2CN-28	2CN-12	2CN-43	2CN-27	2CN-11	2CN-42	2CN-26
	#3502	2CN-31	2CN-15	2CN-46	2CN-30	2CN-14	2CN-45	2CN-29	2CN-13
	#3503	2CN-50	2CN-18	2CN-49	2CN-17	2CN-48	2CN-32	2CN-16	2CN-47
	#3504				5CN-18	5CN-17			5CN-14
	#3505								
	#3506								
	#3507								
	#3508								
	#3509								

(3) Control I/O of Micro PC Module

Signal name will be specified at I/O allocation.



(4) Communication I/O of Motion Module
Signal name will be specified at I/O allocation.



11.1.6 SETTING PARAMETERS

Parameters are important data for teaching the system specifications to the controller. Therefore, the parameters must be set before operation. Also, if parameters are not set or their values are incorrect, the system cannot operate normally. The setting of parameters can be made on the CRT Control Station or on the personal computer. Figs. 11.4 and 11.5 show the flow chart of the setting procedure for parameters.

11.1.6.1. For Setting Parameters on the CRT Control Station

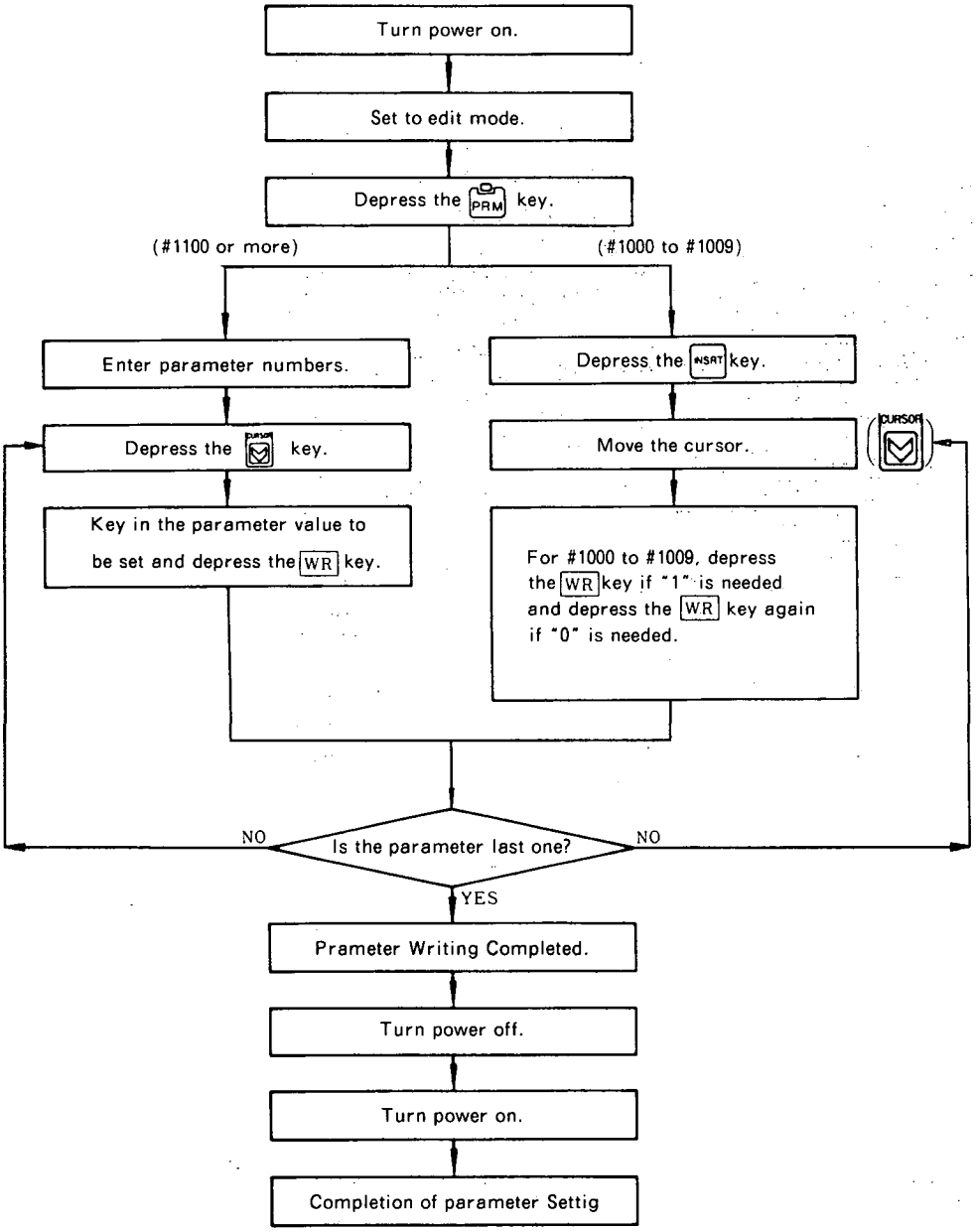


Fig. 11.4 Parameter Setting Procedure using CRT Control Station

11.1.6.2 For Setting Parameters on the Personal Computer

For setting parameters on the personal computer, there are two methods: setting the parameters one by one; and batch transferring and setting by file.
Check the STAT of the personal computer as follows:

- Personal computer – motion module: "8E81XS"
- Personal computer – CRT control station – motion module: "8E71XS"

(1) Setting Parameters One by One

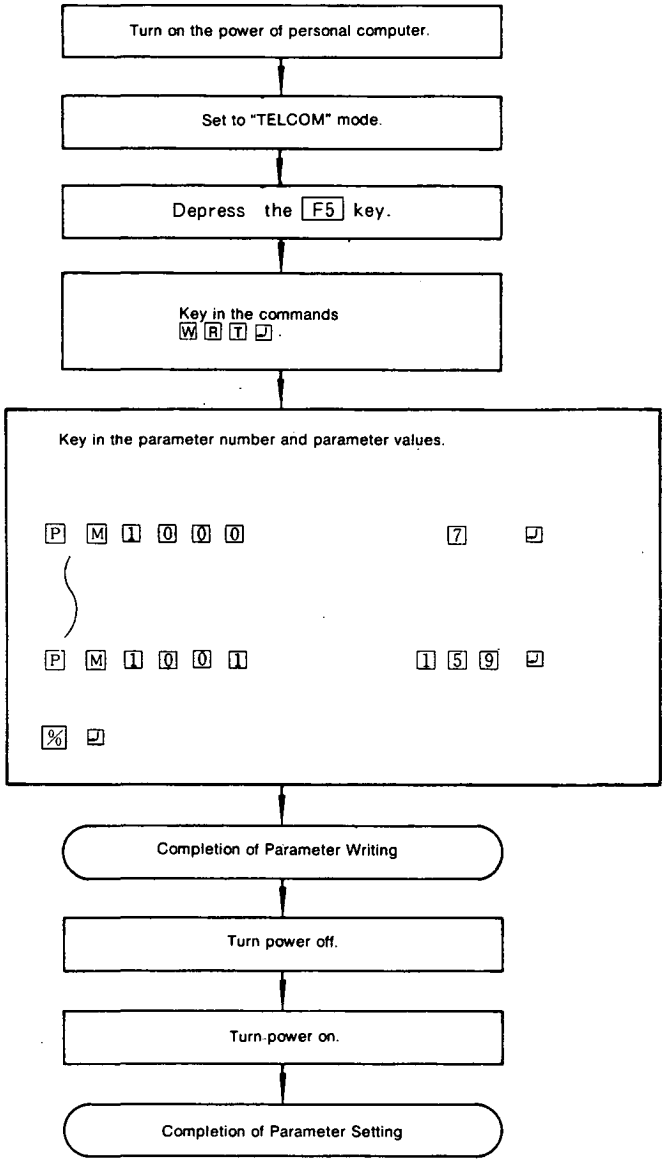


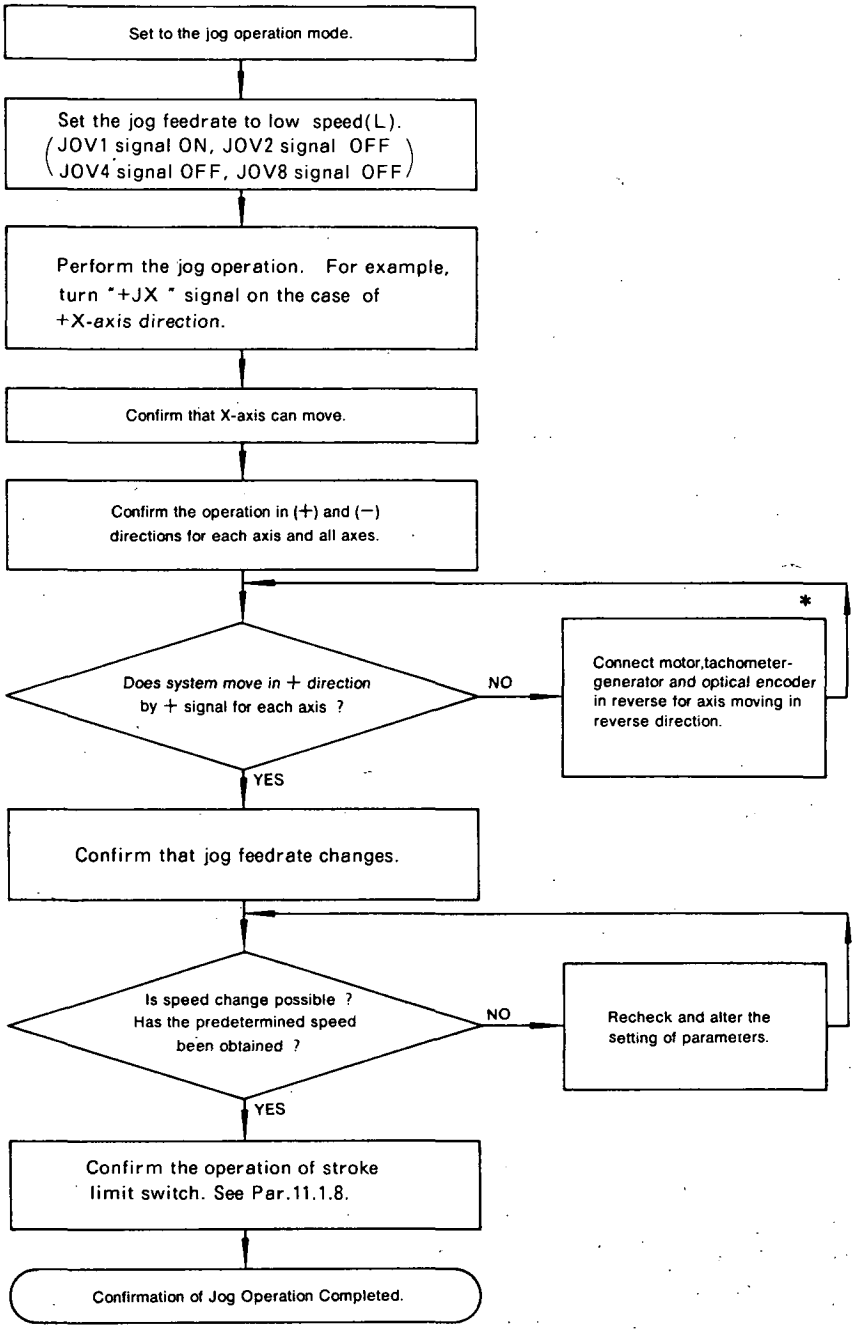
Fig. 11.5 Parameter Setting Procedure using Personal Computer

(2) Batch Transferring and Setting by File

Refer to Par. 8.3.4 "INPUT OF PARAMETERS FROM PERSONAL COMPUTER". Parameter numbers begin from #1000. Parameter values are tentatively set at the time of shipping so be sure to set the parameters at the time of trial run.

11.1.7 MANUAL OPERATION AND CONFIRMATION OF MOVING DIRECTION

Operate the system manually and confirm the operation.
Procedure of Manual Operation (Jog Operation)



* To achieve reverse running of the motor, reverse the following connections:
  - Motor terminals A and B
  - TG terminals ⊕ and ⊖
  - Terminals for phases A and B of optical encoder

Fig. 11.6 Procedure of Manual Operation (Jog Operation)

11.1.8 CONFIRMATION OF STROKE LIMIT

Stroke limit should be confirmed at low speed in jog operation.

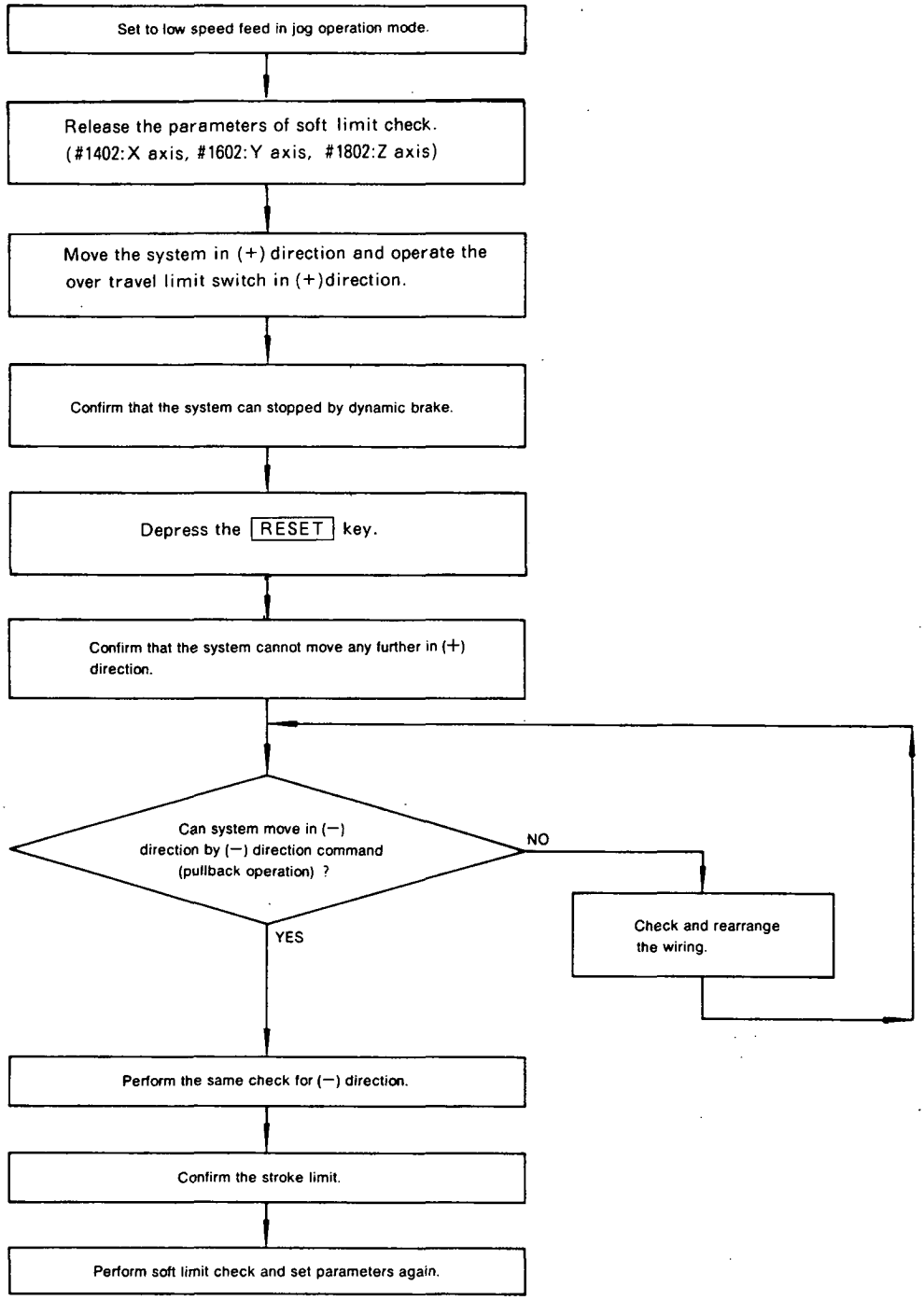


Fig. 11.7 Confirmation of Stroke Limit

11.1.9 CONFIRMATION OF RETURN-TO-REFERENCE POINT OPERATION

For the return-to-reference point, confirm the operation by using a temporary reference. Then perform the adjustment. For the adjusting method, refer to Par. 11.2.1 "ADJUSTMENT OF REFERENCE POINT".

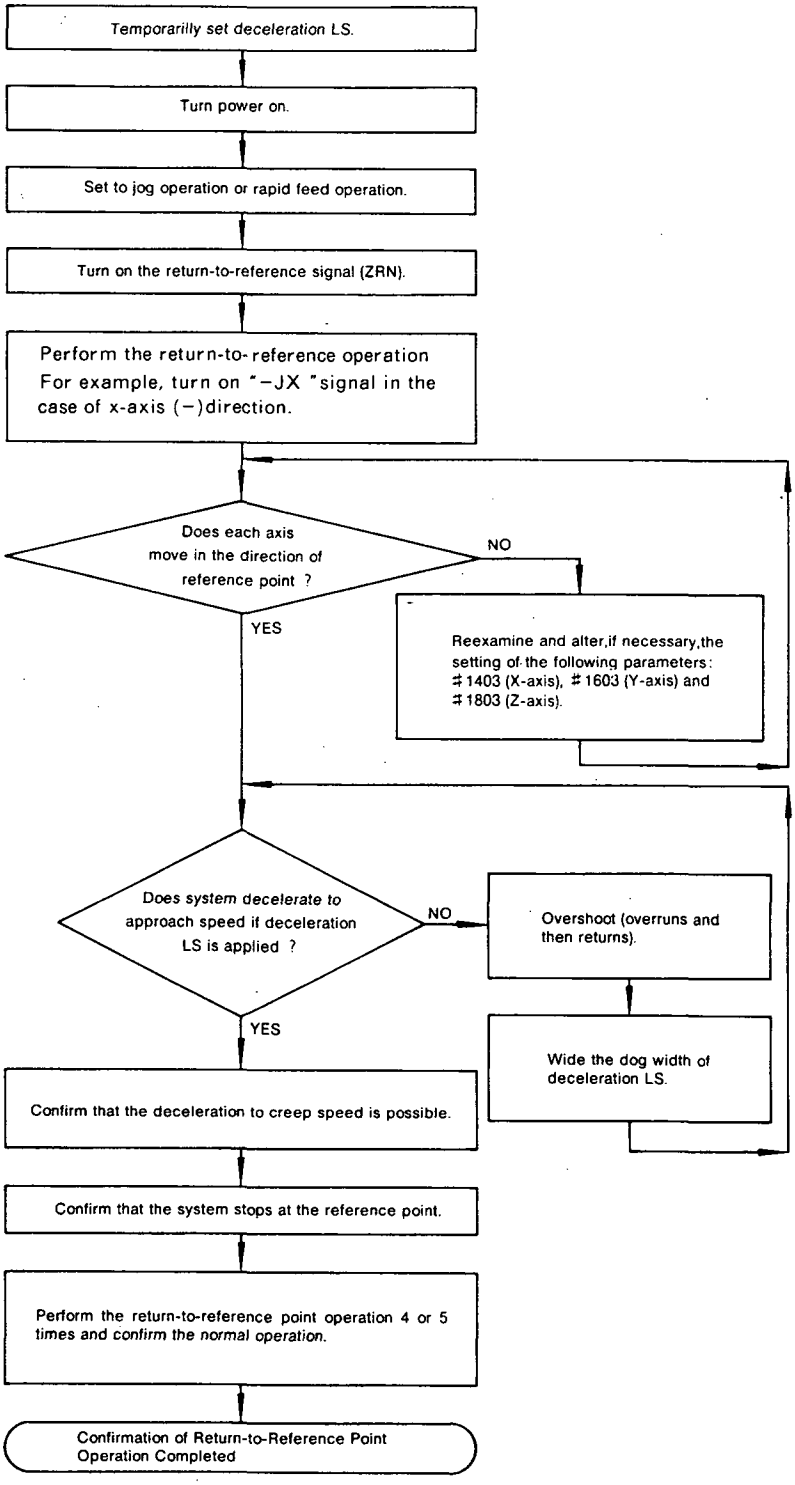


Fig. 11.8 Confirmation of Return-to-Reference Point Operation

11.1.10 CONFIRMATION OF MEMORY OPERATION

To check the memory operation, perform the single block operation.

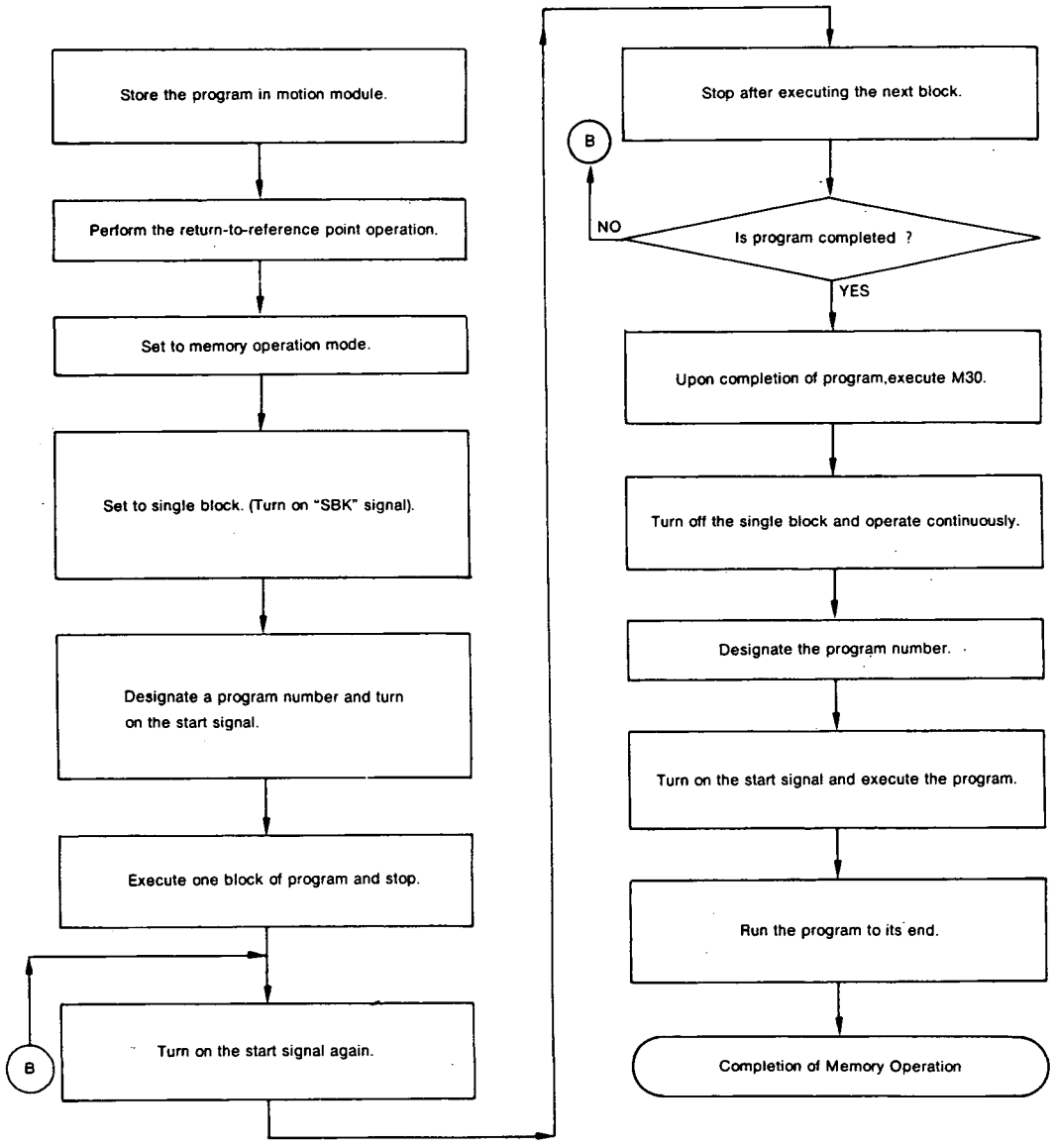


Fig. 11.9 Confirmation of Memory Operation

11.2 ADJUSTMENT METHOD

If fine adjustment is necessary after confirming the operation of the system in accordance with Par. 11.1 "TEST RUN METHOD", the fine adjustment should be made as follows.

11.2.1 ADJUSTMENT OF REFERENCE POINT

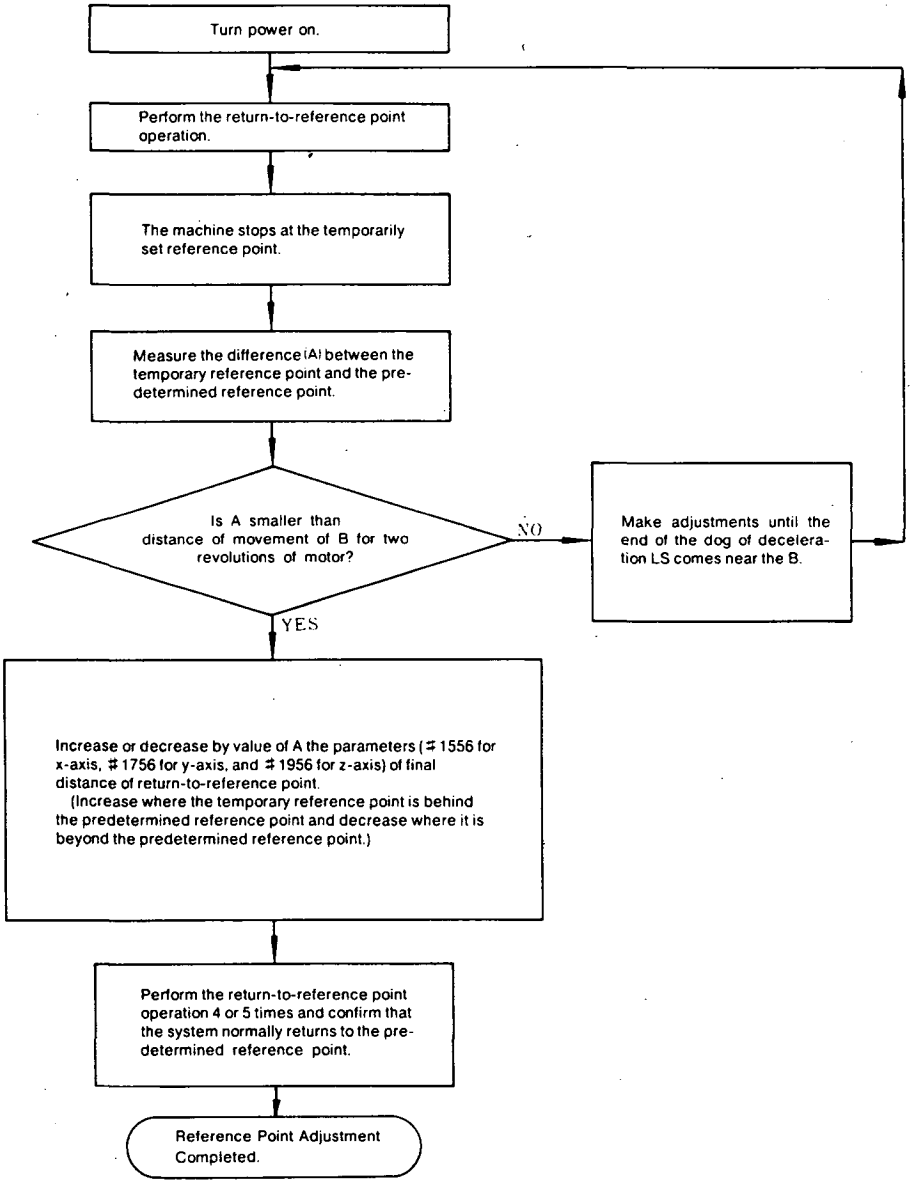


Fig. 11.10 Fine Adjustment of Reference Point

11.2.2 ADJUSTMENT OF POSITION LOOP GAIN (VALUE OF K_P)

Perform a rough adjustment of position loop gain by setting parameters (#1474, #1674, #1874) and fine adjustment by adjusting IN-B potentiometer of Servopack. The adjustment must be made by rapid feed operation.

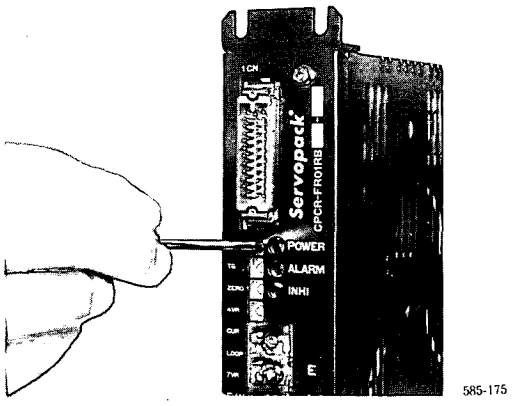


Fig. 11.11 Adjusting of Position Loop Gain

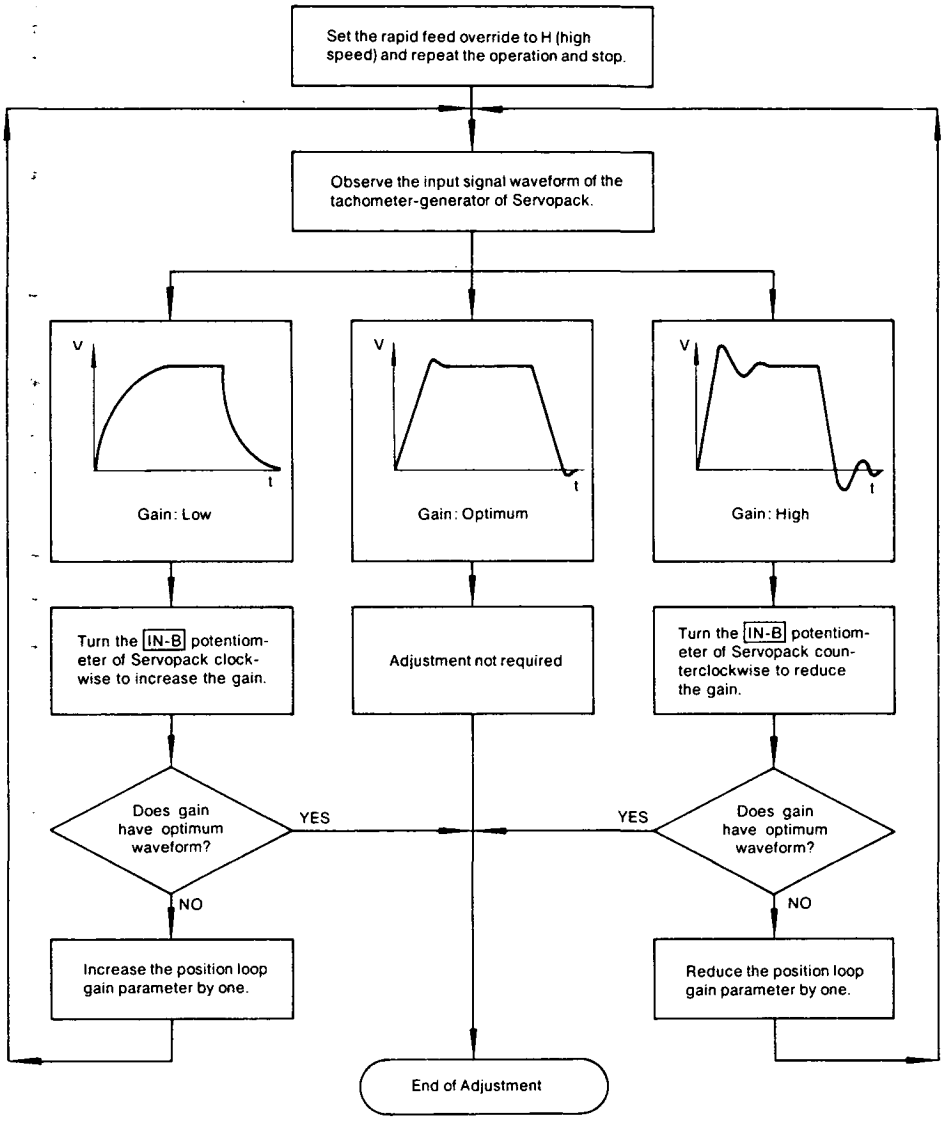


Fig. 11.12 Adjustment of Position Loop Gain

CONTENTS

12. APPLICATIONS

12.1 SELECTION OF SERVOMOTOR AND *Servopack*

12.1.1 CONFIRMATION OF MACHINE SPECIFICATIONS

To control machines, they must be designed based upon the full knowledge of the required specifications of machines, taking into account the performance necessary for control, workability, safety environment and other conditions. As basic items, the specifications and dimensions of the target machine must be studied, examined and determined. As the calculation data for the selection of servomotor and for the start and stop time, the following items must be considered.

- Positioning speed: V [m/min]
- Weight of moving part: W [kg]
- Coefficient of friction: μ
- Efficiency of machine: η
- Load GD^2 (converted to motor shaft): $GD^2{}_L$ [kg • m^2]
- Load torque (converted to motor shaft): T_L [kg • m]
- Duty cycle

  Moreover, the following specifications are needed as positioning characteristics:
- Detecting resolution: ℓ_0[mm/pulse]
- Stopping accuracy: $\pm \ell$ [mm/rev]
- Ball screw pitch: P[mm]
- Number of output pulses of PG: F_{PG} [pulses/rev]

12.1.2 SELECTION OF SERVOMOTORS

When the machine configuration is as shown in Fig. 12.1, the motor power P required to drive the moving part (table) at a constant speed is given by

$$P = \frac{\mu WV}{6.120 \times \eta} \text{ [kW]} \cdots\cdots (1)$$

Also, acceleration torque T_a required for accelerating in the acceleration time t (s) is given by

$$T_a = \frac{GD^2{}_L \times N_M}{375 \times t} + T_L \text{ [kg • m]} \cdots\cdots (2)$$

where, N_M is the number of revolutions of motor (rpm).
Then, a motor having the capacity satisfying equations (1) and (2) shoul tentatively selected. Its type should be determined, and the acceleration torque T_A including GD^2 of the motor itself must be determined from the equation shown below.

$$T_A = \frac{(GD^2{}_L + GD^2{}_M) \times N_M}{375 \times t} + T_L \text{ [kg • m]} \cdots\cdots (3)$$

When starting and stopping are repeated very frequently, the thermal capacity may sometimes become insufficient due to acceleration and deceleration torque, so that effective torque must be calculated to check the capacity. When the operation is made with a pattern as shown in Fig. 12.2, the effective torque T_{rms} required for the motor is given by

$$T_{rms} = \sqrt{\frac{T_A^2 \cdot t_1 + T_L^2 \cdot t_2 + (T_A - T_L)^2 \cdot t_3}{t_1 + t_2 + t_3 + t_4}} \quad [\text{kg} \cdot \text{m}] \quad \cdots\cdots (4)$$

The rated torque of the motor selected must be greater than T_{rms}.

As seen in equation (3), the motor selected must have a large starting torque and a small value of GD^2 in order to reduce the acceleration time. That is, a motor with a large power rating must be selected (power rating is obtained by dividing the equare value of the rated torque of motor by motor inertia; servo performance becomes better as the power rating increases). As reference, the load GD^2 ($GD^2{}_L$) can be calculated from the following equations:

- GD^2 ($GD^2{}_T$) for table

$$GD^2{}_T = 0.101W \left(\frac{V}{N_M}\right)^2 \quad [\text{kg} \cdot \text{m}^2] \quad \cdots\cdots (5)$$

- GD^2 ($GD^2{}_B$) for ball screw

$$GD^2{}_B = 125\pi \rho L D_o{}^4 \quad \cdots\cdots (6)$$

where, ρ: Specific gravity of the material of ball screw[g/cm^3]
L: Length of ball screw [m]
D_o: Diameter of ball screw [m]

- GD^2 ($GD^2{}_C$) of coupling

Sum of values of GD^2 shown above is equal to the load GD^2. That is,

$$GD^2{}_L = GD^2{}_T + \frac{1}{N^2} GD^2{}_B + GD^2{}_C$$

where, $\frac{1}{N}$: reduction ratio

GD^2 for coupling is often ignored but it must always be included in calculation.

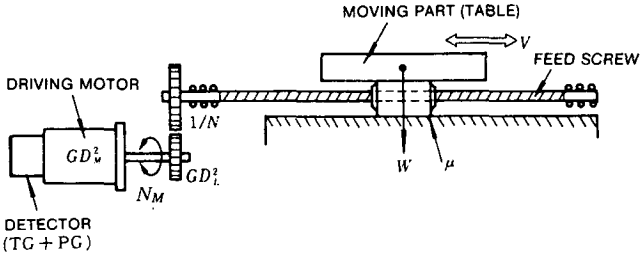


Fig. 12.1 Machine Configuration

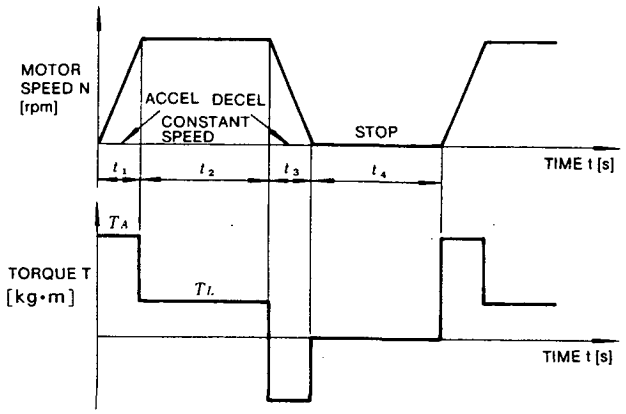


Fig. 12.2 Operation Pattern

12.1.3 EXAMINATION OF SERVO PERFORMANCES

For the servo system having a position feedback loop, as in the case of Motionpack-110, the position loop gain (sensitivity) must be set to the optimum value. If the gain is too high, the machine tends to operate roughly but, if the gain to too low, a longer time is needed for positioning. The position loop gain is called the K_P value and expressed by the ratio between positional deviation pulse ε and maximum command pulse f_{in}

$$K_P = \frac{f_{in}\ [\text{pulse/s}]}{\varepsilon\ [\text{pulse}]}\ [1/\text{s}] \quad \cdots\cdots (7)$$

Servo performance is enhanced as the K_P value increases. The largest possible K_P value (largest possible K_P value) can be calculated from the following formulas:

$$K_P \fallingdotseq \frac{1.46}{t}\ [1/\text{s}] \quad \cdots\cdots (8)$$

$$t = \frac{GD^2_L + GD^2_M + N_M}{375\,(T_A + T_L)}\ [\text{s}] \quad \cdots\cdots (9)$$

where, t: Acceleration time of motor.

For example, if V = 30 [m/min], ℓ_o = 0.01 [mm] and t = 0.05 [s], then K_P value is approximately 1.46/0.05 = 29.2 [1/s].

Also, from equation (7), ε = 50,000/29.2 ≒ 1712 pulses. That is, deceleration begins at 1712 pulses or 17.12 mm behind and then the system stops. (However, deceleration constant is zero.)

Note: $f_{in} = \dfrac{30{,}000/60}{0.01}$ = 50,000 [PPs]

More accurate values of K_P can be obtained if K_P is calculated using equations (8) and (9) when setting the parameters for position loop gain adjustment.

12.1.4 SELECTION OF DETECTOR

In a machine configuration as shown in Fig. 12.1, the number of PG output pulses required (F_{PG}) is given by

$$F_{PG} = \frac{1}{4} \times \frac{P}{\ell_o \cdot N} \quad \cdots\cdots (10)$$

Since the pulses from PG are multiplied by 4 internally in the case of Motionpack-110, it is necessary to multiply it by a coefficient of 1/4.

For example, if detection resolution ℓ_o = 0.001 [mm/pulse], ball screw pitch P = 6 [mm], and reduction ratio 1/N = 1/2, the number of PG output pulses, F_{PG}, is given by

$$F_{PG} = \frac{1}{4} \times \frac{6}{0.001 \times 2} = 750 \text{ (pulses/rev)}$$

As the detector, a feedback unit consisting of PG (for detecting position) and tachometer- generator (for detecting speed) is installed at the side opposite the load of the motor.

The number of PG output pulses available from YASKAWA is shown in Table 12.1 for your selection.

If the number of pulses of PG determined from equation (10) is other then those shown in Table 9.1, then it is necessary to select a PG having the number of output pulses larger than the calculated value of F_{PG} and then correct it by the setting of special parameter position command unit of the Motionpack-110. Refer to Par. 5.4 "SPECIAL PARAMETERS". For instance, if ℓ_o = 0.001, P = 6 and 1/N = 5/7 in Fig. 12.1.

$$F_{PG} = \frac{1}{4} \times \frac{6}{0.001 \times 7/5} = 1071.428\cdots$$

In this case, 2000 pulses may be selected as encoder of the number of output pulses larger than 1071.4, then the following calculations may be made as parameter of position command unit.

$$\frac{B}{A} = \frac{\text{Detection side}}{\text{Ballscrew side}} = \frac{(\text{Number of encoder output pulses}) \times 4}{\text{Pitch of ball screw}} \Big/ \text{Detection resolution} \times \frac{1}{\text{Reduction ratio}}$$

$$= \frac{2000 \times 4}{\dfrac{6}{0.001 \times \dfrac{7}{5}}} = \frac{28}{15}$$

Then, 3137469 of 28/15 × 16777216 = 31317469.87 and the integer portion 8987794 of 15/28 × 16777216 = 8987794.286 should be set as parameter.

As the type of PG pulse output, 5 VDC line driver method or 12 VDC transistor output should be used. (5 VDC transistor output cannot be used.)

12.1.4 SELECTION OF DETECTOR (Cont'd)

Table 12.1 List of PG Output Pulses

Servomotor \ Item		Detector	Number of Output Pulses (pulse/rev)
DC	Print Motor Standard Series	Feedback Unit	3000, 2500, 2000, 1800, 1500, 1000, 750, 720, 600, 500, 450, 400, 360, 300, 240
	Minertia Motor J Series		
	Cup Motor		
	Hi-Cup Motor		
	Minertia Motor Standard Series		
	Minertia Motor RM Series		2500, 2000, 1500, 1000, 800, 600, 500, 400, 300, 200
AC	F Series 1000 rpm	Optical Encoder	6000 (4000, 3000, 2400, 2000, 1500, 1200, 1000, 800, 750, 600, 500, 480, 400, 375, 300, 250, 240, 200, 150, 125, 120, 100) * 5000 (2500, 2000, 1250, 1000, 625, 500, 400, 250, 200, 125, 100)
	S Series 1500 rpm		* 4000 (2000, 1600, 1000, 800, 500, 400, 320, 250, 200, 160, 100, 80)
	S Series 3000 rpm		2500 (1250, 1000, 625, 500, 250, 200, 125, 100, 50) 1500 (1000, 750, 600, 500, 375, 300, 250, 200, 150, 125, 120, 100, 75, 60, 50) * 1000 (500, 400, 250, 200, 100, 80, 50, 40)
	C Series 3000 rpm		1500 (1000, 750, 600, 500, 375, 300, 250, 200, 150, 125, 120, 100, 75, 60, 50) * 1000 (500, 400, 250, 200, 100, 80, 50, 40)

* Semi-standard number of output pulses.

Note:

1. If the output pulses from AC Servopack are used, the number of pulses shown in ( ) may be used as the number of pulses for PG.
2. Feedbuck unit types:
   - TFUE-□□ZD7 (5V line driver output),
   - TFUE-□□ZC7 (12V transistor outpuut),
   - TFUE-□□SC (5V line driver output for RM series),
   - TFUE-□□SAB (12V transistor output for RM series).
3. Optical encoder types:
   - UTOPE-□□□YN for M, F series,
   - UTOPI-□□□YR for S series,
   - UTOPI-□□□YR for C series.

12.1.5 SELECTION OF SERVOMOTOR TYPE AND Servopack TYPE

The type of servomotor can be selected when the servomotor and the number of PG output pulses are determined. Selection of Servopack will depend on the type of servomotor. For details, refer to relevant technical sheets.

12.2 APPLICATION CIRCUITS

Figs. 12.3 to 12.10 show examples of application circuits.

(1) Power-on Circuit (Fig. 12.3)

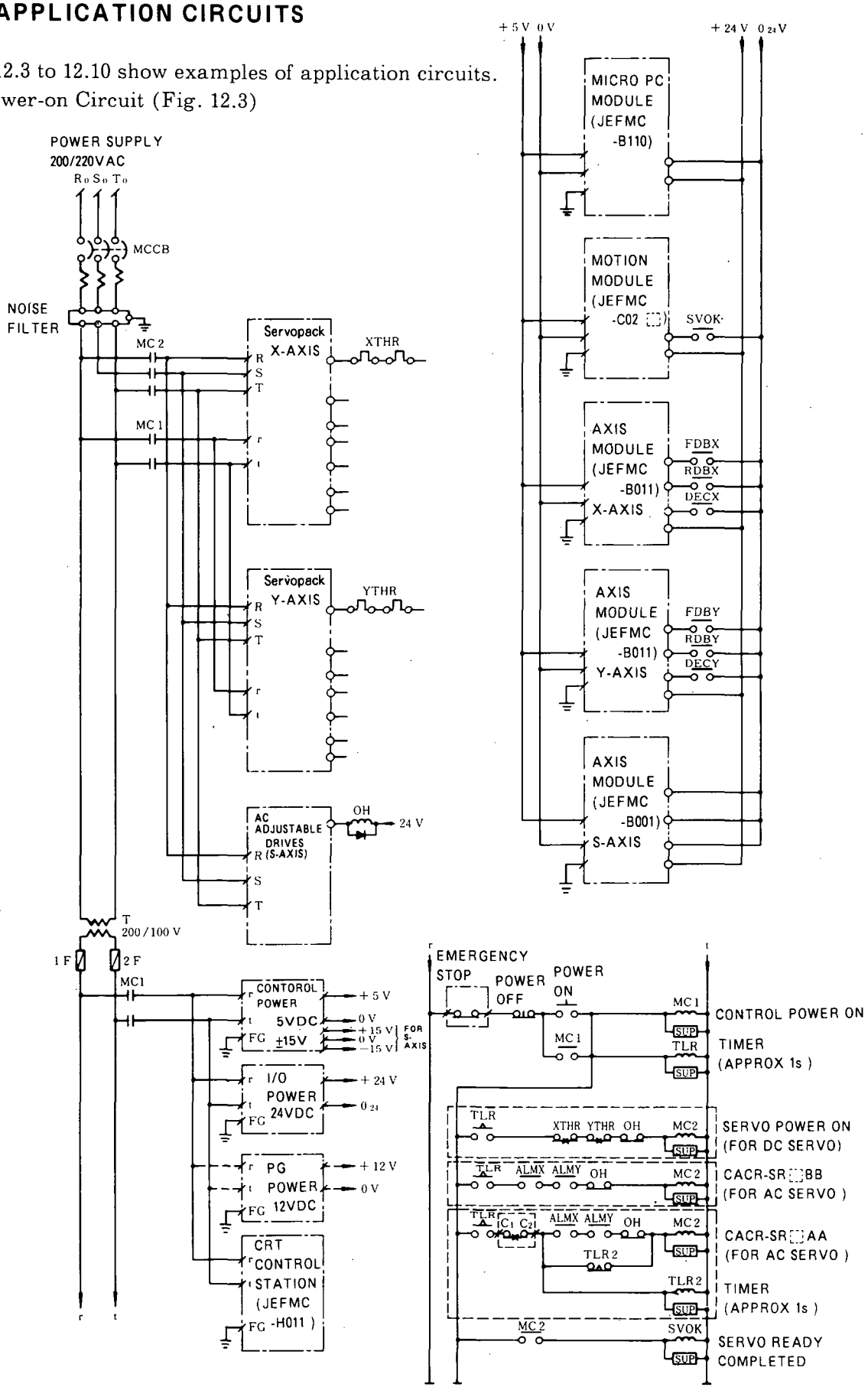


Fig. 12.3 Power-on Circuit (Example of X-, Y-, S-Axis)

12.2 APPLICATION CIRCUITS (Cont'd)

(2) Typical Connections of DC Servopack and Motionpack-110 (Figs. 12.4 to 12.9)

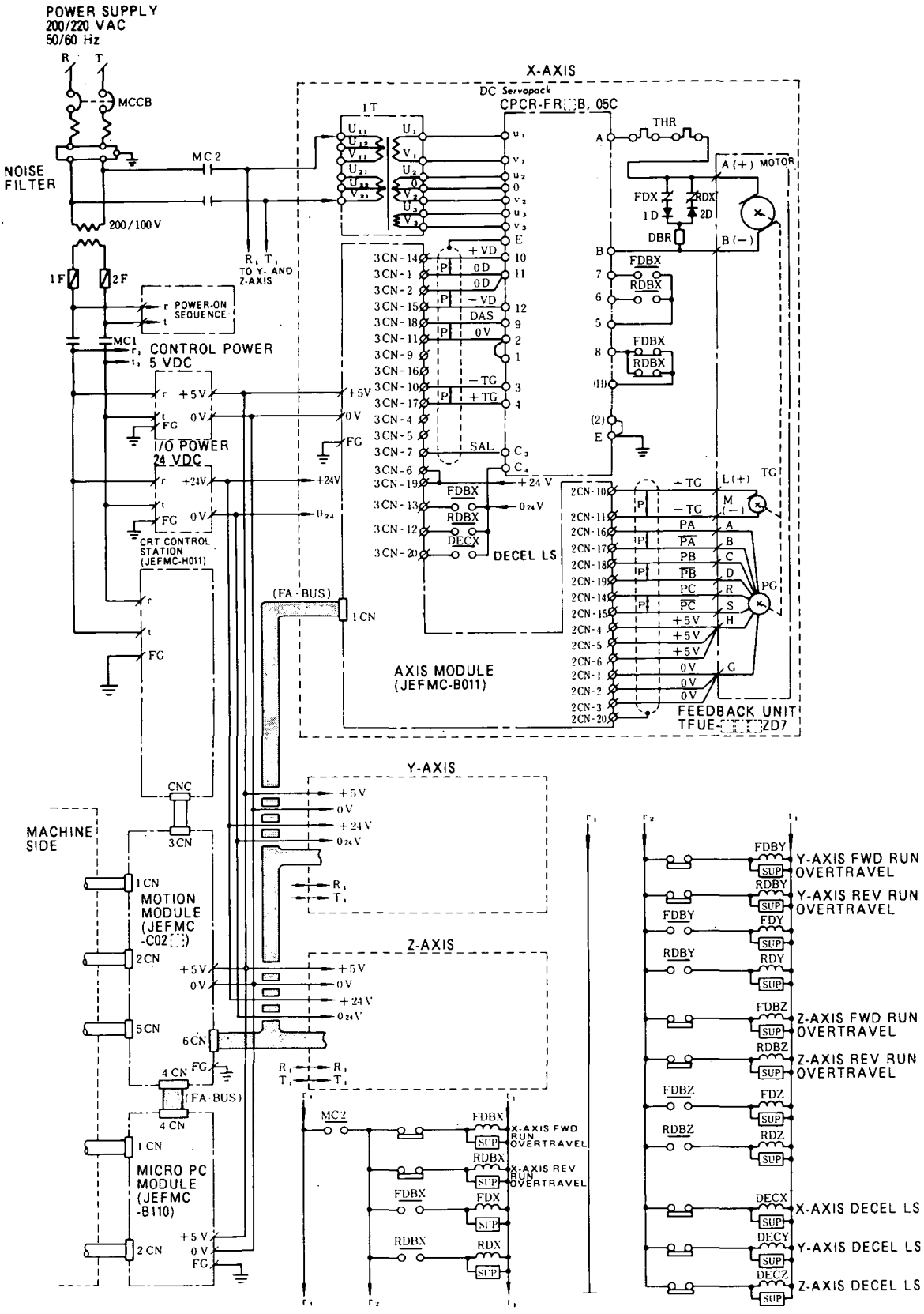


Fig. 12.4 Typical Connection of DC Servopack Type CPCR-FR□B and Motionpack-110

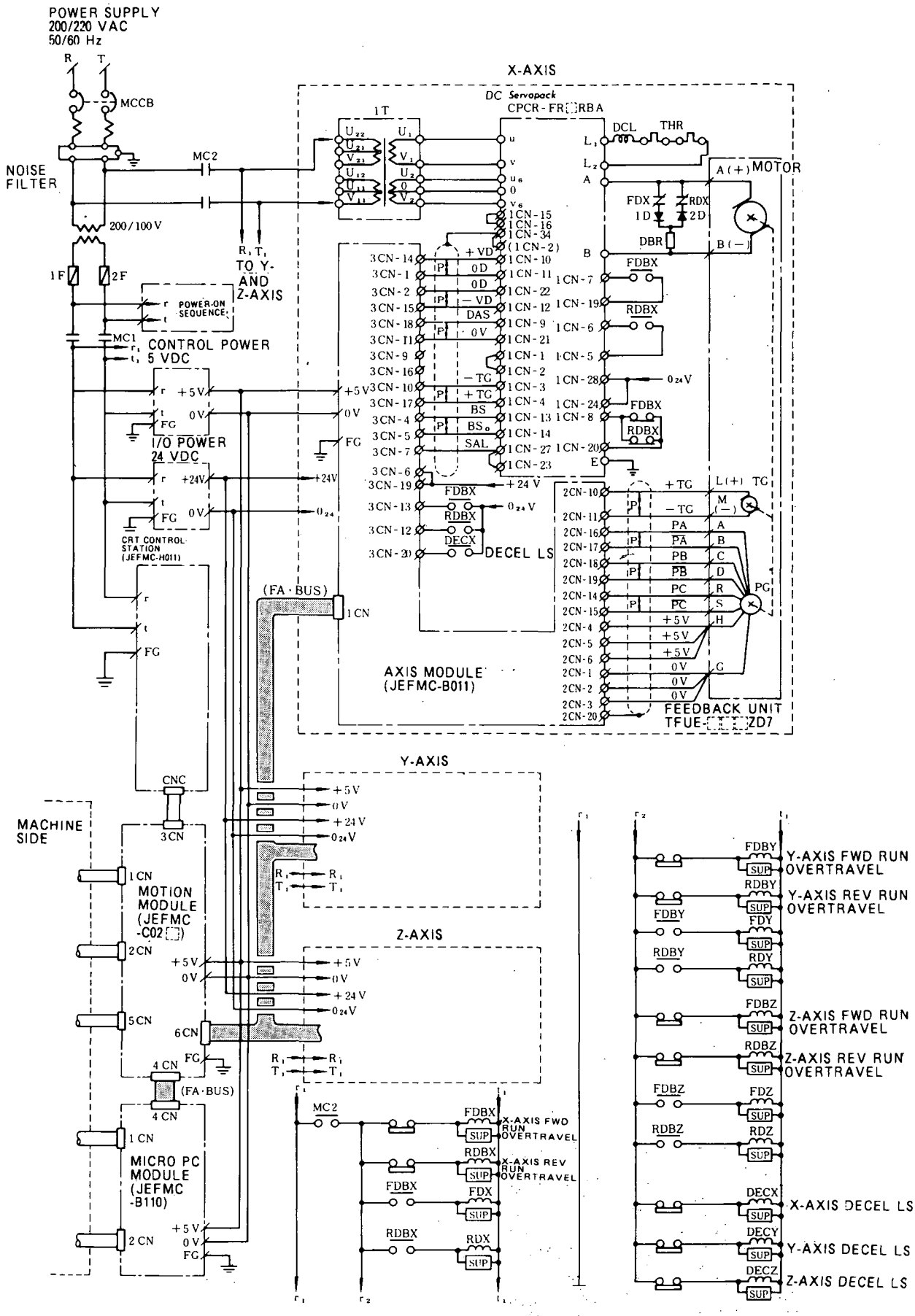


Fig. 12.5 Typical Connection of DC Servopack Type CPCR-FR RBA and Motionpack-110

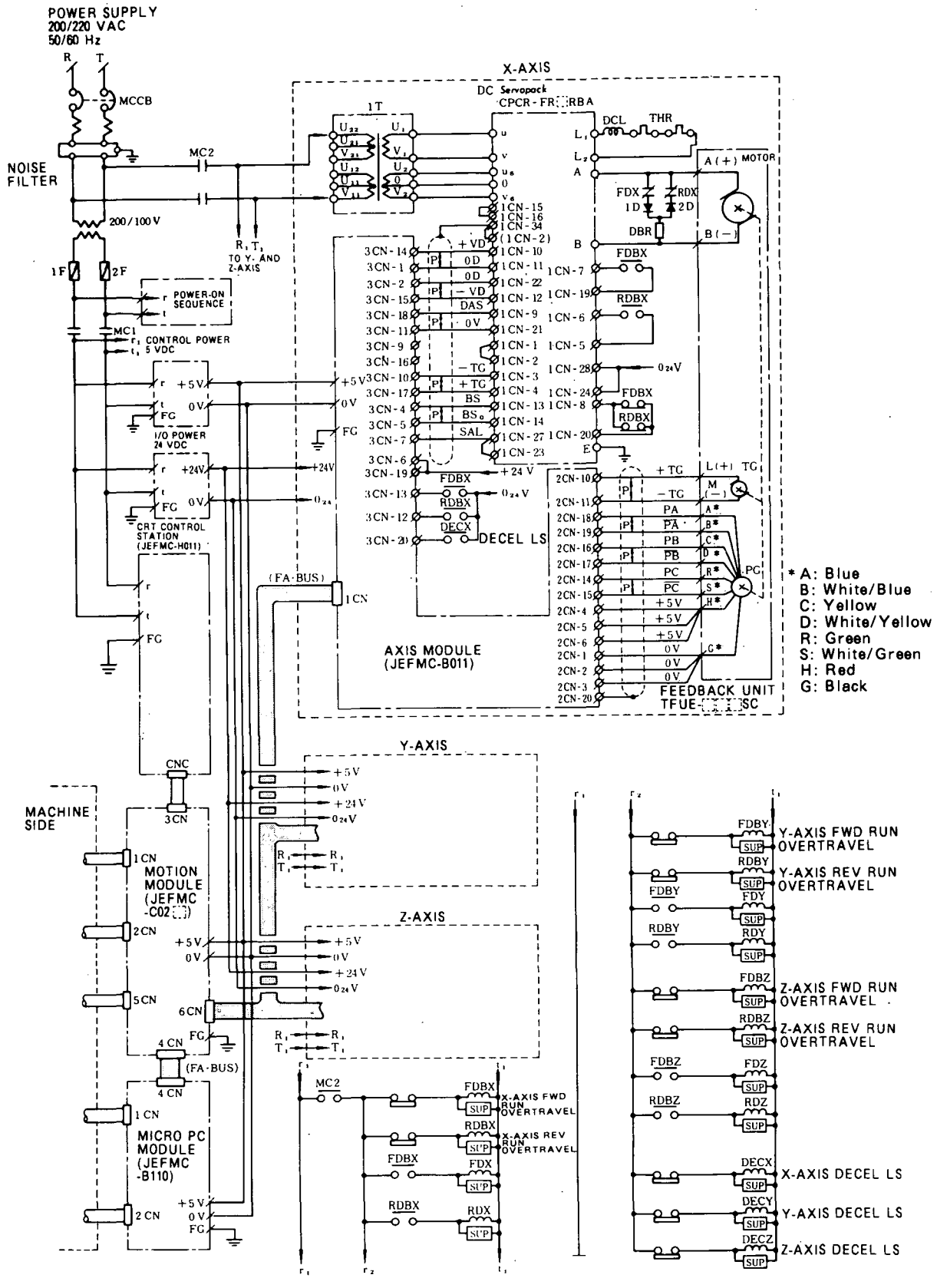


Fig. 12.6 Typical Connection of DC Servopack Type CPCR-FR RBA and Motionpack-110
(Feedback Unit: Type TFUE-SC)

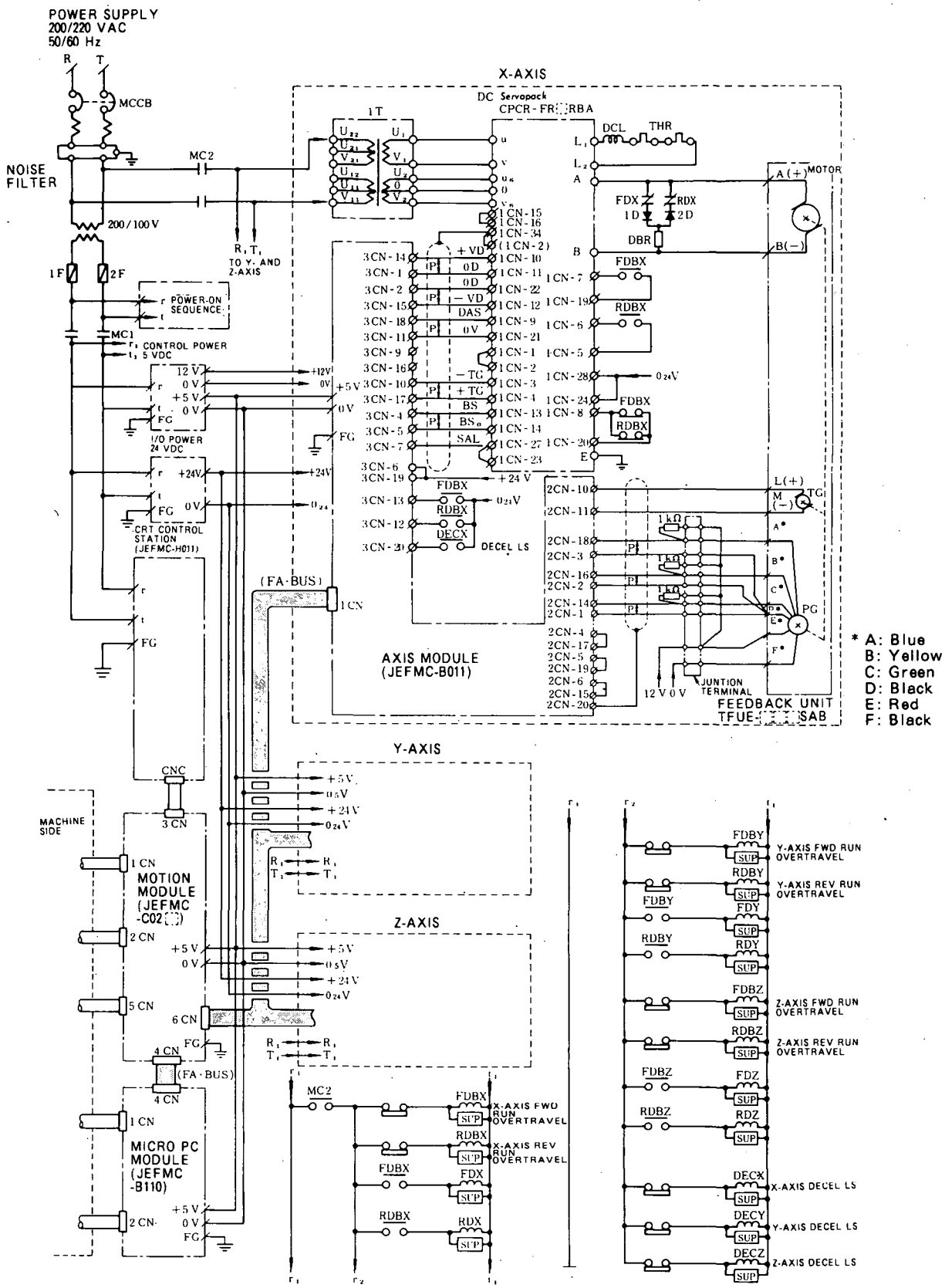


Fig. 12.7 Typical Connection of DC Servopack Type CPCR-FR□RBAand Motionpack-110
(Feedback Unit: Type TFUE-□□□SAB)

12.2 APPLICATION CIRCUITS (Cont'd)

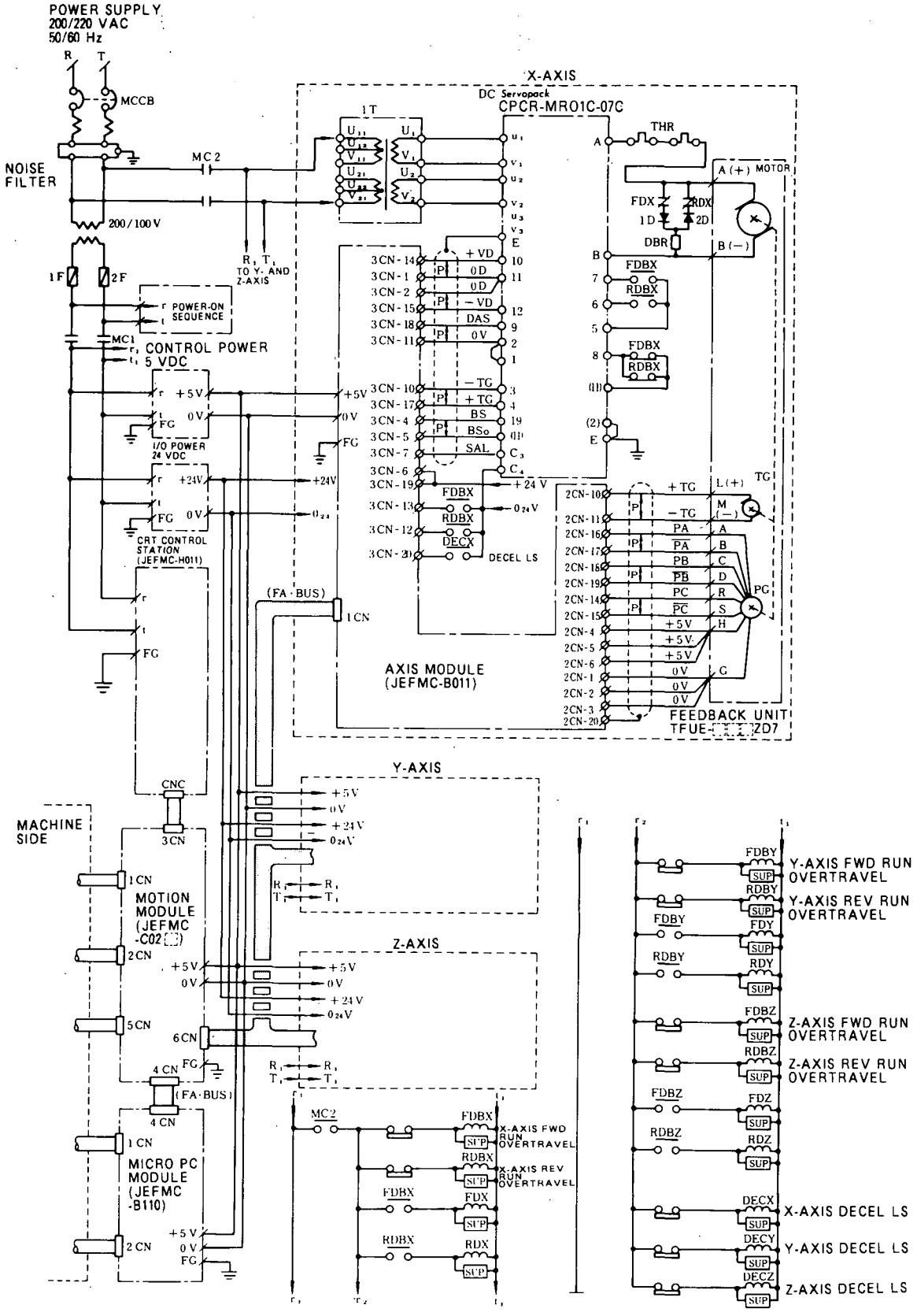


Fig. 12.8 Typical Connection of DC Servopack Types CPCR-MR01C to 75C and Motionpack-110

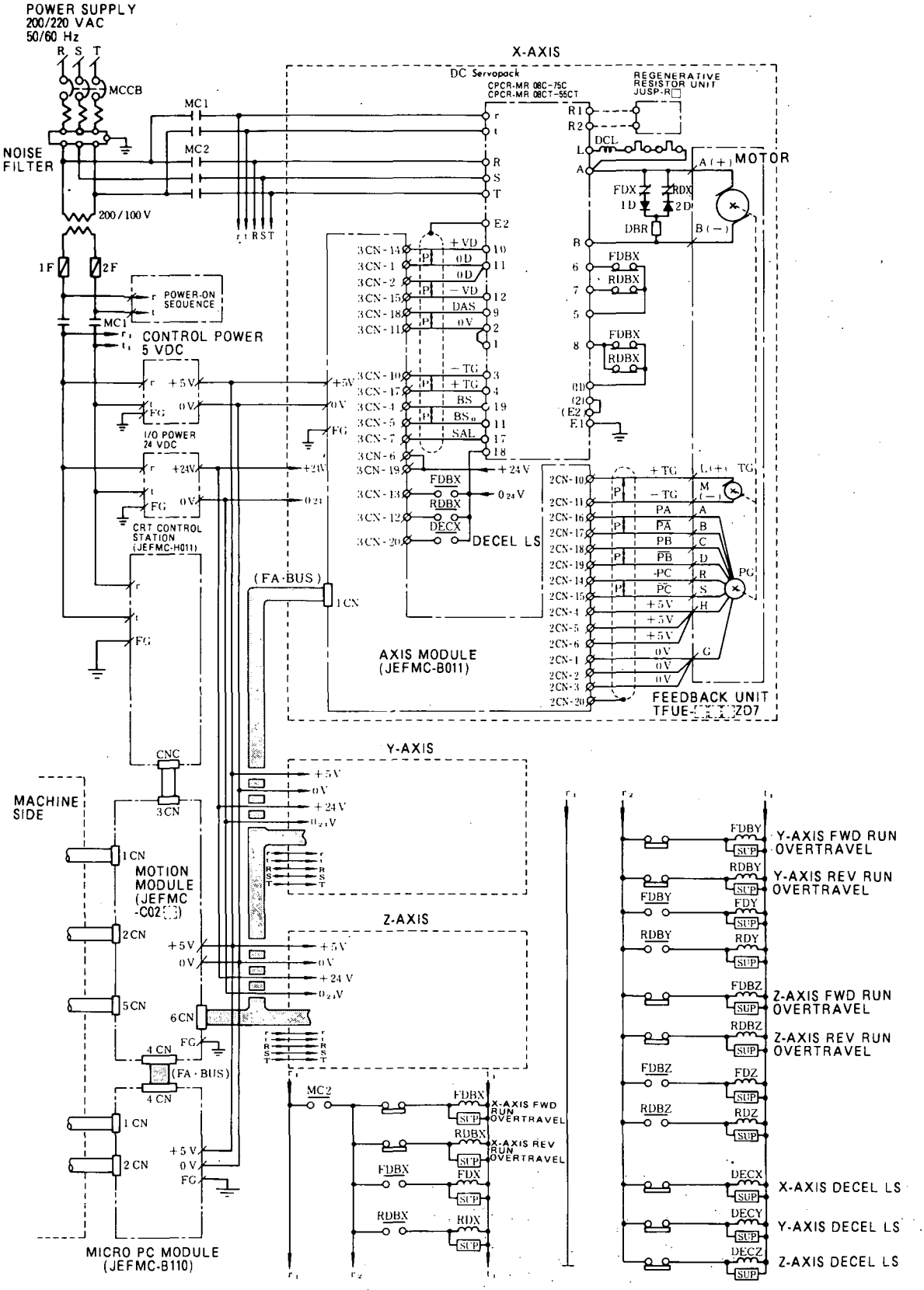


Fig. 12.9 Typical Connection of DC Servopack Types CPCR-MR08C to 75C and Motionpack-110

12. 2 APPLICATION CITCUITS (Cont'd)

(3) Typical Connections of AC Servopack and Motionpack-110 (Figs. 12.10 ~ 12.13)

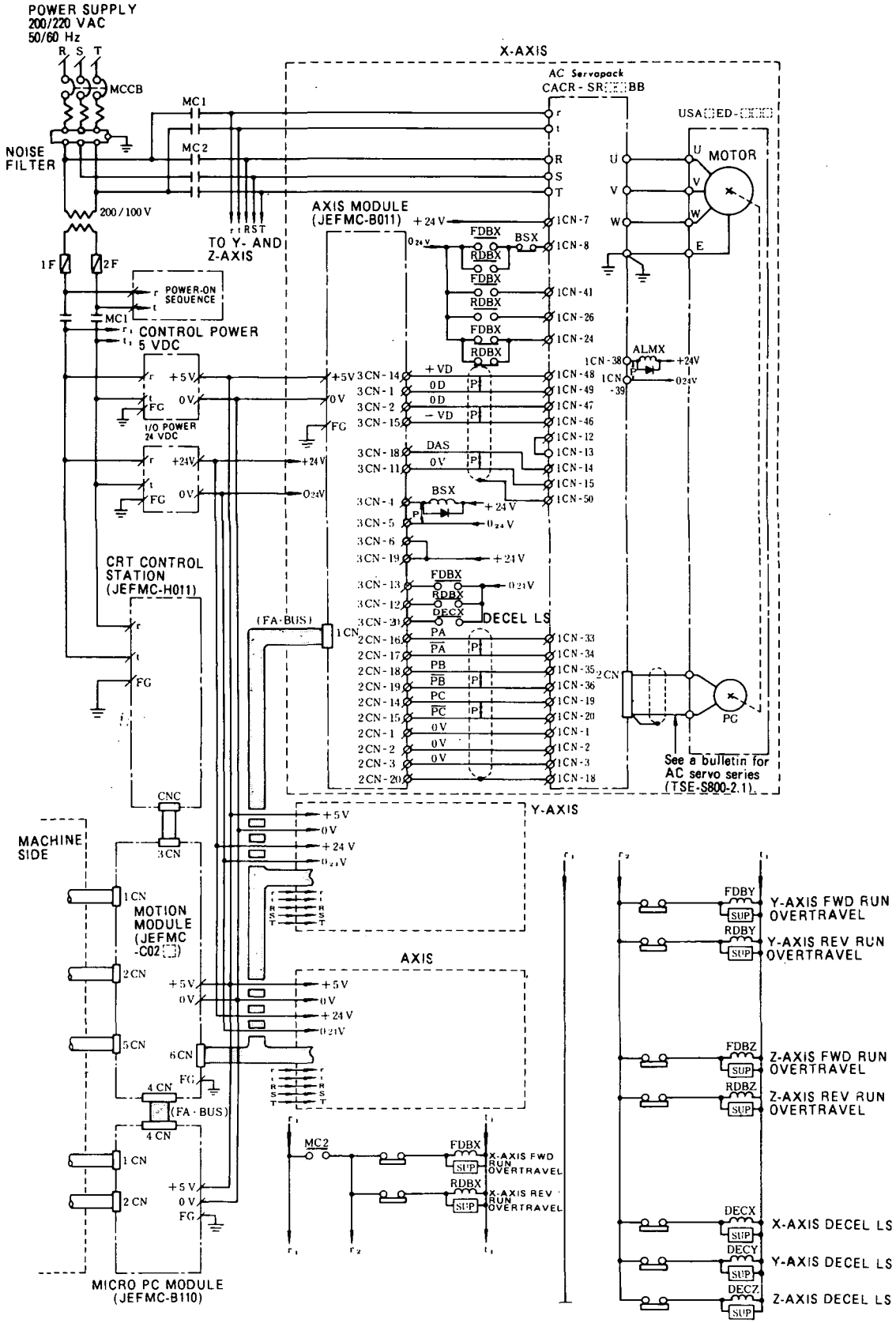


Fig. 12.10 Typical Connection of AC Servopack Type CACR-SR□□BB (M, F, S, Series, Rated Speed: 1000 rpm) and Motionpack-110

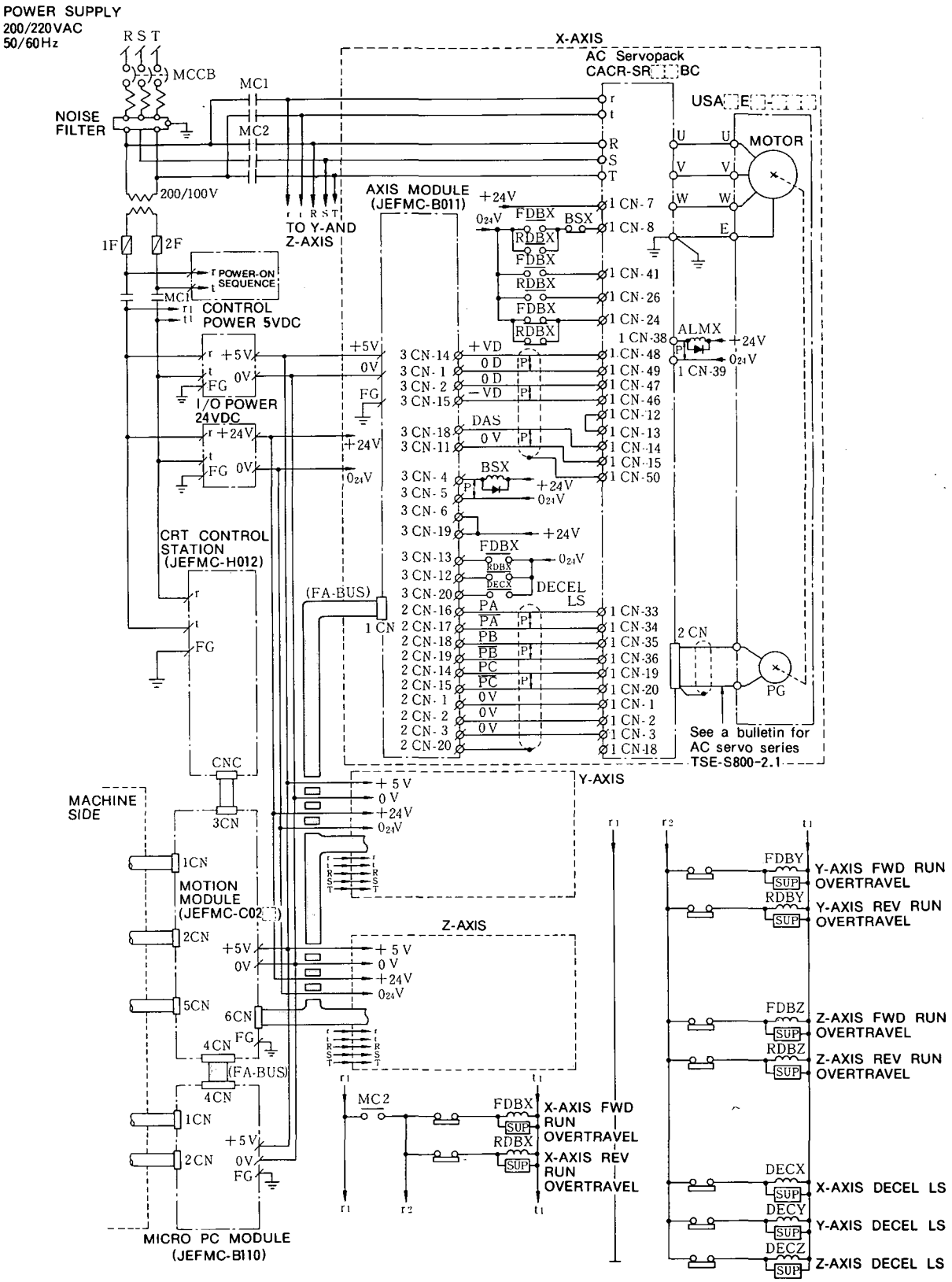


Fig. 12.11 Typical Connection of AC Servopack Type CACR-SR□□BC
(M, F, S, Series, Rated speed: 1000rpm) and Motionpack-110

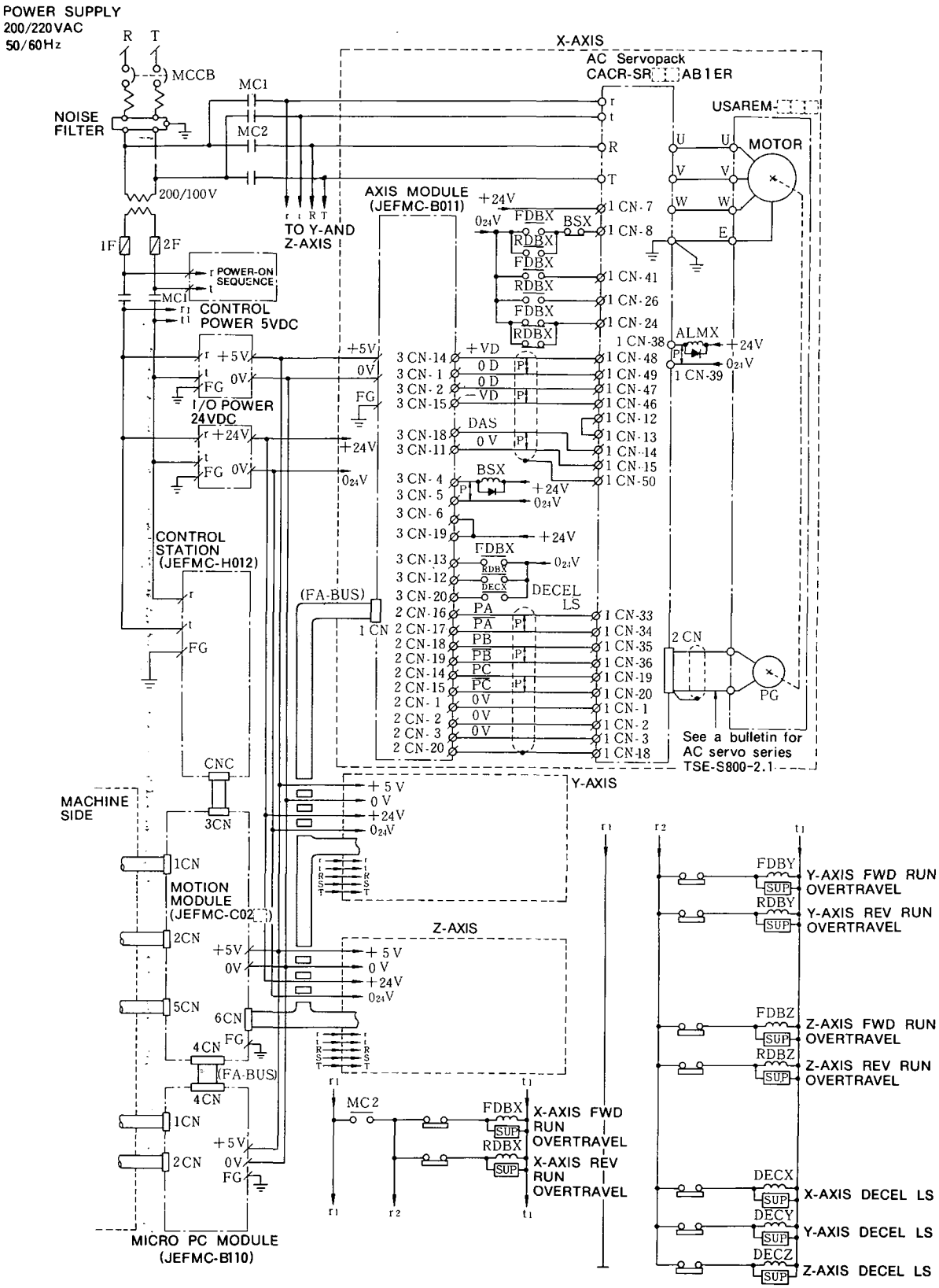


Fig. 12.12 Typical Connection of AC Servopack Type CACR-SR□□B1
(R Series, Rated Speed: 3000 rpm) and Motionpack-110

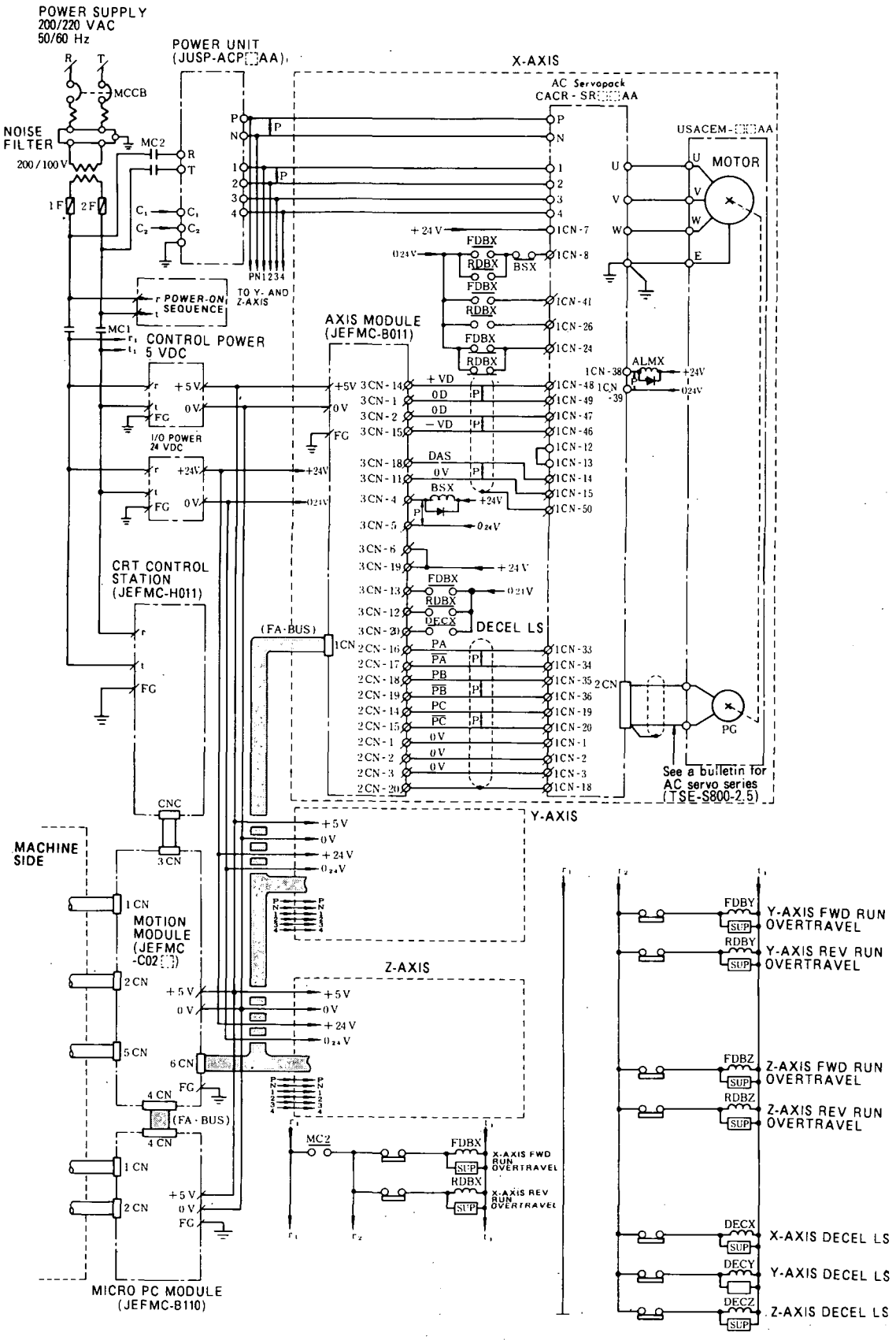


Fig. 12.13 Typical Connection of AC Servopack Type CACR-SR□□AA (C Series, Rated Speed: 3000 rpm) and Motionpack-110

12.2 APPLICATION CIRCUITS (Cont'd)

(4) Typical Connection of AC Adjustable Speed Drive and Motionpack-110 (Fig. 12.14)

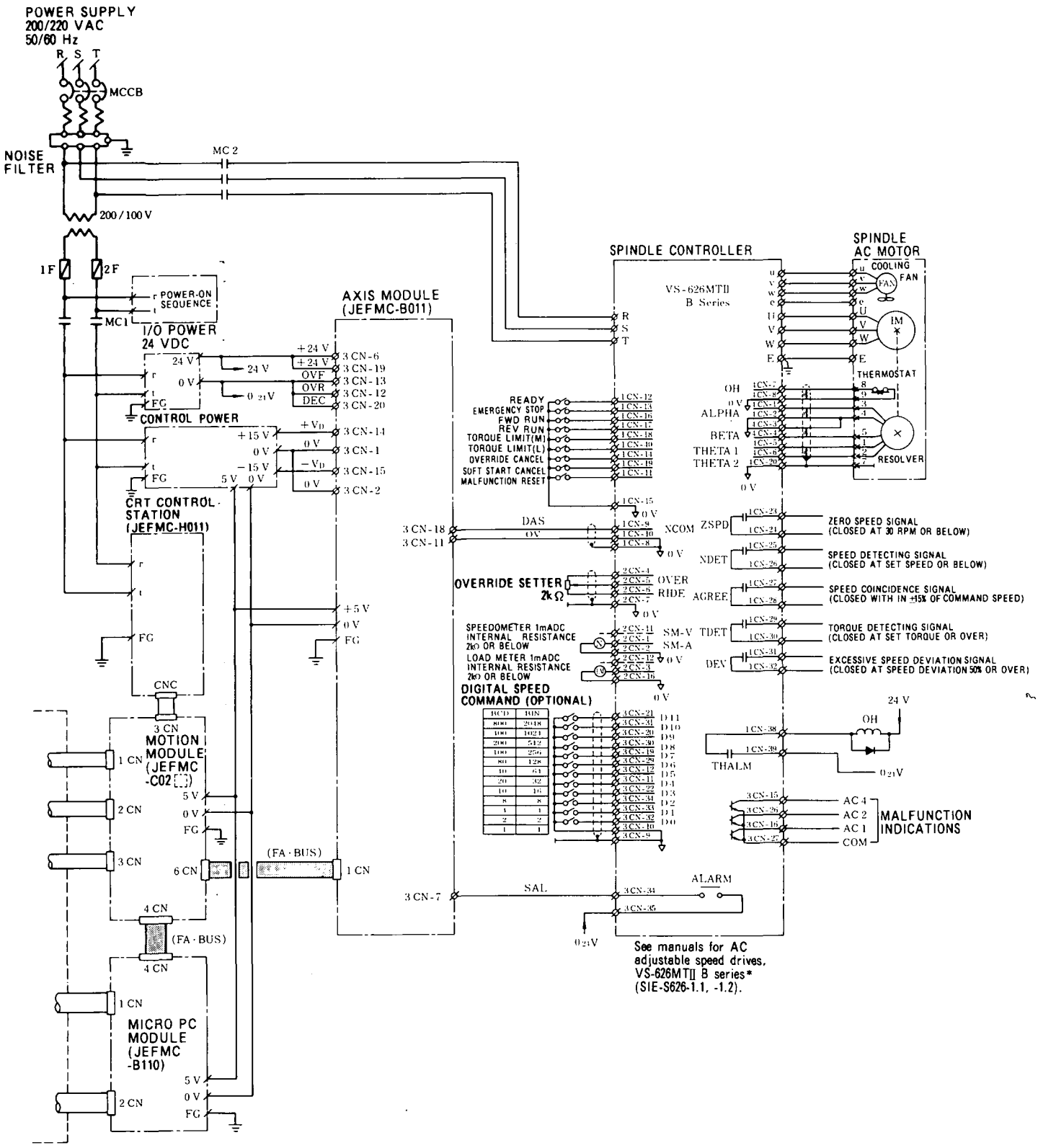


Fig. 12.14 Typical Connection of AC Adjustable Speed Drives, VS-626MT II B Series and Motionpack-110

CONTENTS

APPENDIX–1 LIST OF ALARM CODES

Code	Contents	Cause	Corrective Action
010	NOTCH ERROR	• Notch parameter is not set. • Offset number designation error.	Set parameter #1003.
011	PROG ERROR (M90)	M code (M90-M97) for internal processing is used.	Correct the program.
012	OVER FLOW (128ch)	The number of the characters in a block exceeds the limit (128) .	Correct the number of characters in a program.
013	PROG ERROR (NO ADDRESS)	• No data after address. • No address before data.	Correct the program (words).
014	PROG ERROR ("–", "0")	• "–", "0" are not used correctly. • Use of decimal point movement is erroneous.	Correct the program.
015	PROG ERROR (UNUSE CH)	Character that cannot be used in significant information section is programmed.	Correct the program.
016	PROG ERROR (8 DIGITS)	Input data digits overflow (more than 8).	Correct the number of digits in the program.
017	PROG ERROR (G)	G code that cannot be used is programmed.	Correct G code in the program.
018	PROG ERROR (G)	Use of G group in a block is erroneous.	Correct G code in the program.
019	PROG ERROR (F)	F is not programmed in interpolation operation.	Add F command to the program.
020	PROG ERROR (R=O)	Radius is 0 in circular command.	Correct the program (I, J or R).
021	PROG ERROR (G02/G03)	Out-of-area designation error in circular command.	Correct the program (X, Y, or R)
022	PROG ERROR (P)	The value of P is not in parameter area.	Correct the program (P).
023			
024	PROG ERROR (G10)	Axis data is programmed in G10 block.	Delete axis data in the program.

Code	Contents	Cause	Corrective Action
025	M02 RESTART	After stop with M02,cycle start is depressed.	After reset, start at top of program.
026			
027	FG ERROR (G01, G02, G03)	• Interpolation module error • Plane designation error • End point designation error	Check the program.
028	PROG ERROR (G31)	Skip signal is not input in G31 block.	Check the skip signal.
029	OFFSET ERROR	• G43 or G44 is used in G02 or G03 mode. • G45-G48 are used in any mode other than G00-G03.	Correct the program (G43-G48).
030	PROG ERROR (M98)	P is not designated in M98 block.	Add P to the program.
031	PROG ERROR (M98/M99)	In call with M98 and M99, program number is not found.	Check the related program.
032	PROG ERROR (M98 NEST)	Subprograms are nested exceeding five levels.	Nest the subprograms in a maximum of four levels.
033	PROG ERROR (AXIS)	Axis designation is made in G04 block.	Delete the axis data in the program.
034	PROG ERROR (M02/M30/M99)	There is not M code for the program completion in the end of the program.	Add the M code for the program completion (M02, M30, or M99).
035			
036			
037			
038	NO AXIS	The axis to be used is not effective.	Set parameter #1000.
039	PROG ERROR (G80)	G code (G40-G49) related to error compensation during combined operation command is specified.	• Correct the program. • Execute G80 reference before references related to compensation.
040	SOT (X)	An alarm occurred in soft limit switch (X-axis).	After reset, return the X-axis, in the opposite direction and check the program.

APPENDIX–1 LIST OF ALARM CODES (Cont'd)

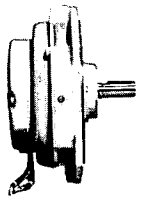
Code	Contents	Cause	Corrective Action
041	SOT (Y)	An alarm occurred in soft limit switch (Y-axis).	After reset, return the Y-axis in the opposite direction and check the program.
042	SOT (Z)	An alarm occurred in soft limit switch (Z-axis).	After reset, return the Z-axis in the opposite direction and check the program.
043			
044			
045			
046	P-SET ERROR (X)	At the termination of positioning operation, the position error pulse exceeds the allowable value (X-axis).	Adjust the machine and parameters (#1406, #1474).
047	P-SET ERROR (Y)	At the termination of positioning operation, the position error pulse exceeds the allowable value (Y-axis).	Adjust the machine and parameters (#1606, #1674).
048	P-SET ERROR (Z)	At the termination of positioning operation, the position error pulse exceeds the allowable value (Z-axis).	Adjust the machine and parameters (#1806, #1874).
049	EXTERNAL ERROR	Error caused by "external error ER" signal input.	Examine the "external error ER" signal.
050	MACH UNREADY	External signal "machine ready (MRDY)" is not turned on.	Check the "machine ready MRDY" signal.
051	SERVO POWER NOT SUPPLY	Signal "servo ready SVOK" from the servo controller is not turned on.	Check the "Servo ready SVOK" signal and servo power.
052	MP UNREADY	Motionpack is not in READY status.	• Check the signal from the servo system. • Check FABUS cable.
053	EMERGENCY STOP	Emergency stop	Clear emergency stop.
054	OVER TRAVEL (X)	Over-travel signal input (X-axis).	Check over-travel LS. After reset, return the X-axis in the opposite direction.
055	OVER TRAVEL (Y)	Over-travel signal input (Y-axis).	Check over-travel LS. After reset, return the Y-axis in the opposite direction.
056	OVER TRAVEL (Z)	Over-travel signal input (Z-axis).	Check over-travel LS. After reset, return the Z-axis in the opposite direction.

Code	Contents	Cause	Corrective Action
057	SERVO ERROR (X)	Error excess (X-axis)	Examine the servo system, motor system, and mahcine system (X-axis).
058	SERVO ERROR (Y)	Error excess (Y-axis)	Examine the servo system, motor system, and machine system (Y-axis).
059	SERVO ERROR (Z)	Error excess (Z-axis)	Examine the servo system, motor system, and machine system (Z-axis).
060	SERVO ALARM (X)	Servo system error alarm (X-axis)	Check the servo system (fuse, heatsink, etc.). (X-axis)
061	SERVO ALARM (Y)	Servo system error alarm (Y-axis)	Check the servo system (fuse, heatsink, etc.). (Y-axis)
062	SERVO ALARM (Z)	Servo system error alarm (Z-axis)	Check the servo system (fuse, heatsink, etc.). (Z-axis)
063			
064			
065			
066	COMM ERROR (X)	Transmission error between motion and axis modules (X axis)	Check the setting of parameter and rotary switches. If the error occurs again after power is turned on, notify maintenance personnel.
067	COMM ERROR (Y)	Transmission error between motion and axis modules (Y axis)	
068	COMM ERROR (Z)	Transmission error between motion and axis modules (Z axis)	
069	COMM ERROR (S)	Transmission error between motion and axis modules (S axis)	
090	ABSO ENCODER ERROR (X)	Interface error of absolute encoder (X axis)	Check the wiring of servo and motor systems (X axis).
091	ABSO ENCODER ERROR (Y)	Interface error of absolute encoder (Y axis)	Check the wiring of servo and motor systems (Y axis).
092	ABSO ENCODER ERROR (Z)	Interface error of absolute encoder (Z axis)	Check the wiring of servo and motor systems (Z axis).

Code	Contents	Cause	Corrective Action
093	ABSO POSITION OVERFLOW ERROR (X)	Reference value for ref. unit system or pulse system exceeds ± 2147483647. (X axis)	Check the reference value or parameter. (X axis)
094	ABSO POSITION OVERFLOW ERROR (Y)	Reference value for ref. unit system or pulse system exceeds ± 2147483647. (Y axis)	Check the reference value or parameter. (Y axis)
095	ABSO POSITION OVERFLOW ERROR (Z)	Reference value for ref. unit system or pulse system exceeds ± 2147483647. (Z axis)	Check the reference value or parameter. (Z axis)
100	DNC ERROR	Machining program reading error during DNC operation	Check the program for DNC operation transfer. Check the parameter.
200		In data transmission to/from personal computer, buffer becomes full, and input is disabled.	Turn power on again. Change the program.
255		Transmission error between motion and axis modules	If the error occurs again after power is turned on, notify maintenance personnel.

APPENDIX-2 LIST OF SERVOMOTORS

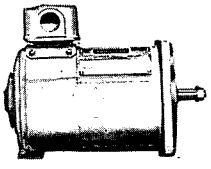
DC Servo | Print Motor Standard Series



580-357

Item \ Type	(UG)PMES -09A2	(UG)PMES -12A2	(UG)PMES -16A2	(UG)PMES -20A2
Rated Output W	100	200	500	1000
Rated Torque kg·cm	2.43	6.5	19.5	32.5
Rated Speed rpm	4000	3000	2500	3000
Rotor Inertia ($GD^2/4$) kg·cm^2	0.46	1.5	6.2	20.3

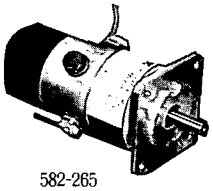
DC Servo | Minertia Motor Standard Series



580-56

Item \ Type	UGMMEM -06AA1	UGMMEM -13AA1	UGMMEM -25AA1	UGMMEM -50AA1	UGMMEM -1AAA1	UGMMKR -2AAA1
Rated Output W	185	401	771	1540	3080	6170
Rated Torque kg·cm	6.0	13	25	50	100	200
Rated Speed rpm	3000	3000	3000	3000	3000	3000
Rotor Inertia ($GD^2/4$) kg·cm^2	0.567	1.41	2.83	9.00	25.2	52.5

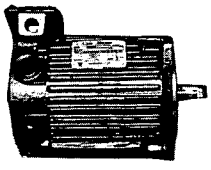
DC Servo | Minertia Motor RM Series



582-265

Item \ Type	UGRMEM -02SA2	UGRMEM -02MA2	UGRMEM -04SA2	UGRMEM -04MA2	UGRMEM -08SA2	UGRMEM -08MB2
Rated Output W	60	100	120	200	300	500
Rated Torque kg·cm	1.95	3.25	3.9	6.5	9.74	16.2
Rated Speed rpm	3000	3000	3000	3000	3000	3000
Rotor Inertia ($GD^2/4$) kg·cm^2	0.157	0.28	0.96	1.68	5.1	8.33

DC Servo | Cup Motor

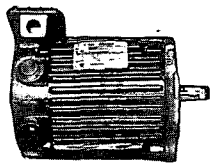


281-30

Item \ Type	UGCMED -04AA1	UGCMED -08AA1	UGCMED -15AA1	UGCMED -22AA1	UGCMED -37AA1	UGCMED -55AA1	UGCMFD -75AA1
Rated Output kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Rated Torque kg·cm	22.3	41.7	83.5	123	206	306	417
Rated Speed rpm	1750	1750	1750	1750	1750	1750	1750
Rotor Inertia ($GD^2/4$) kg·cm^2	22.4	44.2	101	152	298	723	723

APPENDIX-2 LIST OF SERVOMOTORS (Cont'd)

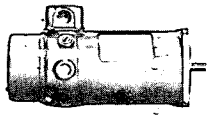
DC Servo | Hi-Cup Motor



281-30

Item \ Type	UGHMED -03GG1	UGHMED -06AA2 (-06GG1)	UGHMED -12AA2 (-12GG2)	UGHMED -20AA2 (-20GG2)	UGHMED -30AA2 (-30GG2)	UGHMED -44AA2	UGHMED -60AA2
Rated Output kW	0.25	0.6(0.51)	1.2(1.2)	2(1.8)	3(2.88)	4.4	6.0
Rated Torque kg·cm	24	58.4(50)	117(117)	195(175)	292(280)	428	584
Rated Speed rpm	1000	1000(1000)	1000(1000)	1000(1000)	1000(1000)	1000	1000
Rotor Inertia ($GD^2/4$) kg·cm²	20.3	73(33)	134(134)	292(234)	494(365)	1138	1138

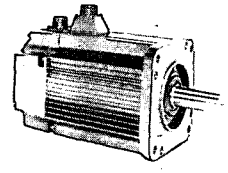
DC Servo | Minertia Motor J Series



580-53

Item \ Type	UGJMED -10MA2	UGJMED -40MA2	UGJMED -40LA2	UGJMED -60MA2	UGJMED -60LA2	UGJMED -80MA2	UGJMED -80LA2	UGJMED -80KA2
Rated Output kW	0.1	0.16	0.25	0.45	0.85	1.1	1.8	2.6
Rated Torque kg·cm	9.7	15.6	24.4	44	83	107	175	255
Rated Speed rpm	1000	1000	1000	1000	1000	1000	1000	1000
Rotor Inertia ($GD^2/4$) kg·cm²	6	16	20	44	63	140	245	35

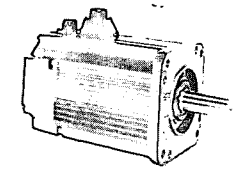
A C Servo | M Series (1000 rpm)



386-5

Item \ Type	USAMED -03MA1	USAMED -06MA	USAMED -09MA	USAMED -012MA	USAMED -20MA	USAMED -30MA	USAMED -44MA	USAMK -60MA
Rated Output kW	0.3	0.6	0.9	1.2	2.0	3.0	4.4	6.0
Rated Torque kg·cm	29	58	88	117	195	290	428	584
Rated Speed rpm	1000							
Inst. Max Speed rpm	2000						1500	
Inst. Max Torque kg·cm	73	144	197	286	449	650	930	1080
Inertia ($GD^2/4$) kg·cm²	13.5	24.3	36.7	66.8	110	166	263	263

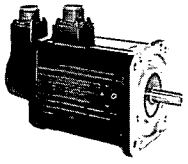
A C Servo | F Series (1500 rpm)



386-5

Item \ Type	USAFED -05FA1	USAFED -09FA1	USAFED -13FA2	USAFED -20FA2	USAFED -30FA2	USAFED -44FA2
Rated Output kW	0.45	0.85	1.3	1.8	2.9	4.4
Rated Torque kg·cm	29	55	85	117	190	290
Rated Speed rpm	1500					
Inst. Max Speed rpm	2500					
Inst. Max Torque kg·cm	91	155	252	347	552	778
Inertia ($GD^2/4$) kg·cm²	13.5	24.3	36.7	66.8	110	166

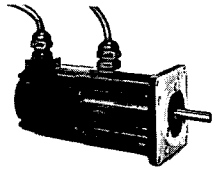
AC Servo S Series (3000rpm)



586-34

Item \ Type	USASEM -03AE2	USASEM -05AE2	USASEM -08AC1	USASEM -15AC1	USASEM -30AC1
Rated Output kW	0.308	0.462	0.771	1.54	3.08
Rated Torque kg·cm	10	15	25	50	100
Rated Speed rpm	3000				
Inst. Max Speed rpm	4000				
Inst. Max Torque rpm	30	41	75	147	231
Inertia ($GD^2/4$) kg·cm^2	0.51	0.76	2.85	3.3	5.74

AC Servo C Series (3000rpm)

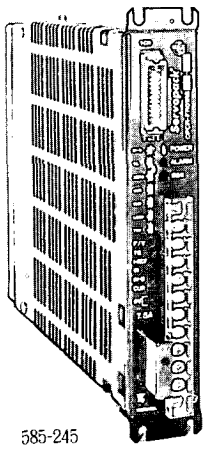


586-39

Item \ Type	USACEM -A5AA2	USACEM -01AA2	USACEM -02AA2	USACEM -03AA2	USACEM -05AA2
Rated Output kW	0.05	0.10	0.20	0.30	0.50
Rated Torque kg·cm	1.62	3.25	6.49	9.74	16.2
Rated Speed rpm	3000				
Inst. Max Speed rpm	3000				
Inst. Max Torque rpm	5.97	10.2	20.6	29.5	49.8
Inertia ($GD^2/4$) kg·cm^2	0.06	0.11	0.45	0.70	2.50

APPENDIX-3 LIST OF *Servopack* UNITS

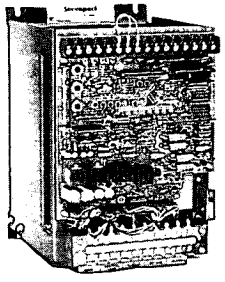
DC Servo | *Servopack* Type CPCR-FR□□RBA Series



585-245

Item \ Type CPCR-	FR01RBA	FR02RBA	FR05RBA
Servomoter Output W	100	200	500
Control Method	Single-phase, full-wave rectified PWM control		
Main Circuit Power Supply	Single-phase, 100/110 VAC ±10% or 200/220 VAC ±10% at 50/60 Hz		
Control Circuit Power Supply	18 V-0 V-18 VAC (by power transformer)		
Rated Voltage/Current	32 V/5.5 A	42 V/6.2 A	83 V/7.3 A
Instantaneous Max Output Current A	12	20	20
Waveform Factor	1.05 max		
Derating Factor	95% min		
Speed Control Range	1 : 1000 min		

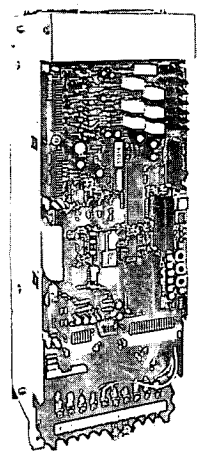
DC Servo | *Servopack* Type CPCR-MR□□C Series



581-188

Item \ Type CPCR-	MR 01C	MR 02C	MR 05C	MR 07C	MR 08C	MR 15C	MR 22C	MR 55C	MR 75C	MR 99C
Servomotor Output kW	0.1	0.2	0.5	0.7	0.8	1.5	2.2	3.7-5.5	7.5	11
Control Method	Single-phase, full-wave rectifying, transistorized PWM control				Three-phase, full-wave rectifying, transistorized PWM control					
Power Supply	Single-phase, 100/110 VAC ±10% or 200/220 VAC ±10% at 50/60 Hz				Three-phase, 200/220 VAC ±10% at 50/60 Hz					
Speed Control Range	1 : 1000									
Waveform Factor	1.5 max									
Derating Factor	95% min									

A C Servo | *Servopack* M Series (1000 rpm)

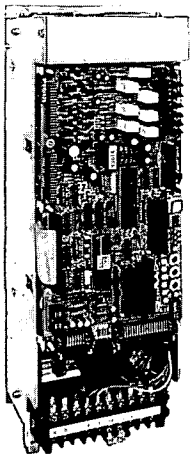


586-22

SPEED CONTROL, TYPE CACR-SR□□BB

Item \ Type CACR-		SR 03 BB	SR 07 BB	SR 10 BB	SR 15 BB	SR 20 BB	SR 30 BB	SR 44 BB	SR 60 BB
Speed Control Range		1 : 3000							
Servomotor Output kW		0.3	0.6	0.9	1.2	2.0	3.0	4.4	6.0
Power Supply	Main Cricuit	Three-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz							
	Control Cricuit	Single-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz							
Continuous Output Current (rmsA)		3.0	5.8	7.6	11.7	18.8	26.0	33.0	45.0
Max Output Current (rmsA)		7.3	13.9	16.6	28.0	42.0	56.5	70.0	80.6

A C Servo | **Servopack** F Series (1500 rpm)

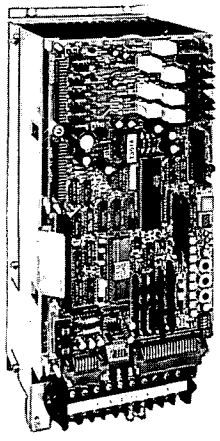


586-22

SPEED CONTROL, TYPE CACR-SR□□BB

Item \ Type CACR-	SR 05 BB	SR 10 BB	SR 15 BB	SR 20 BB	SR 30 BB	SR 44 BB
Speed Control Range	1 : 3000					
Servomotor Output kW	0.45	0.85	1.3	1.8	2.9	4.4
Power Supply — Main Circuit	Three-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz					
Power Supply — Control Circuit	Single-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz					
Continuous Output Current (rmsA)	3.8	6.2	9.7	15.0	20.0	30.0
Max Output Current (rmsA)	11.0	17.0	27.6	35.7	56.5	77.0

AC Servo | **Servopack** S Series (3000rpm)

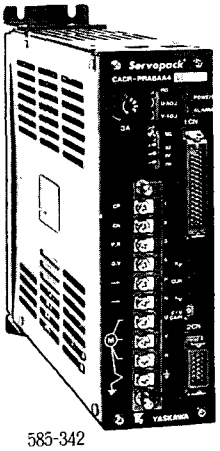


586-25

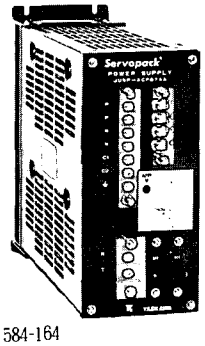
SPEED CONTROL, TYPE CACR-SR□□BB

Item \ Type CACR-	SR03BB	SR05BB	SR10BB	SR15BB	SR30BB
Speed Control Range	1 : 3000				
Servomotor Output kW	0.308	0.462	0.771	1.54	3.08
Power Supply — Main Circuit	Three-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz				
Power Supply — Control Circuit	Single-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz				
Continuous Output Current (rmsA)	3.0	4.2	5.3	10.6	26
Max Output Current (rmsA)	8.5	11	15.6	28	57.6

A Servo | ***Servopack*** C Series (3000 rpm)



585-342



584-164

Servopack, SPEED CONTROL, TYPE CACR-SR□□AA

Item \ Type CACR-	SRA5AA	SR01AA	SR02AA	SR03AA	SR05AA
Speed Control Range	1 : 1000				
Servomotor Output kW	0.05	0.10	0.20	0.30	0.50
Power Supply — Main Circuit	100 to 160 VDC (Supplied by power unit)				
Power Supply — Control Circuit	24 VDC, 1.4 A (Supplied by power unit)				
Continuous Output Current rmsA	1.0	1.6	2.9	4.2	5.3
Max Output Current rmsA	3.5	4.9	9.2	12.7	16.3

POWER UNIT

Specifications \ Type JUSP-		ACP07AA	ACP15AA	ACP20AA
Power Supply	Voltage	Single-phase 100/110 VAC $^{+10\%}_{-15\%}$ at 50/60 Hz		
	Capacity (Rated Output)	1.5 kVA	3 kVA	5 kVA
Main Circuit	Continuous Output Voltage	100 to 160 VDC		
	Continuous Output Current	7 ADC	15 VDC	20 ADC
Control Circuit Continuous Output Voltage		24 VDC, 6 A		
Protective Function		Circuit breaker		
Ambient Temperature	Operation	0 to 60°C		
	Storage	−20 to +85°C		
Mounting Structure		Base mounted		
Applicable Range	No. of Axes	4 max	4 max	4 max
	Total Output of Servomotors	Approx 0.6 kW	Approx 1.2 kW	Approx 1.8 kW

APPENDIX-4 LIST OF *Motionpack-110*

The following Table shows each type of standard modules and cables used for Motionpack-110 control system.

Components			Type JEFMC-
Motion Module		5 kB+P to P	C 020
		64 kB+Interporation	C 023
		64 kB+Interporation+DNC Communications	C 027
Axis Module			B 011
Micro PC Module			B 110
CRT Control Station			H 011
Cable	J1	For Communication Cable (CRT ⟷ Motion Module)	W 010 (5m) W 011 (10m) W 012 (15m)
	J2	ForCommunication Cable (Personal Computer ⟷ Motion Module)	W 020 (1m)
	J7	For Tach-gen/Optional Encorder Signals (Axis Module ⟷ DC Servopack/Servomotor)	W 070 (10m) W 071 (15m) W 072 (25m)
	J8	For FA Bus (Motion Module ⟷ Axis Module)	W 084 (for up to 4 axes)
	J10	For FA Bus (Motion Module ⟷ Micro PC Module)	W 100
	J11	For I/O Signals (I/O Devices ⟷ Motion Module (5CN))	W 110 (1m) W 111 (2m) W 112 (5m)
	J12	For I/O Signals (• I/O Devices ⟷ Motion Module • Expansion I/O Devices ⟷ Micro PC Module)	W 120 (1m) W 121 (2m) W 122 (5m)
	J13		W 130 (1m) W 131 (2m) W 132 (5m)
	J14	For AC/DC Servo Controller, Servopack (Axis Module ⟷ AC/DC Servopack)	W 140 (0.5m) W 141 (1m) W 142 (3m)
	J15	For AC Servo Optical Encorder Signals (Axis Module ⟷ AC Servopack)	W 150 (0.5m) W 151 (1m) W 152 (3m)
	J16	For DC Servo 12V Optical Encorder Signals (Axis Module ⟷ DC Servomotor)	W 160 (10m) W 161 (15m) W 162 (25m)

Note :

1. J8 is the standaerd attachment to the motion module.
2. J 10 is the standard attachment to the micro PC module.
3. The connector (solder type) to each module is the standard attachment.

MOTIONPACK-110

YASKAWA MOTION CONTROLLER FOR FA/FMS

FOR UP TO 3-AXIS DRIVE

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YASKAWA ELECTRIC CORPORATION

Due to ongoing product modification/improvement, data subject to change without notice.

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