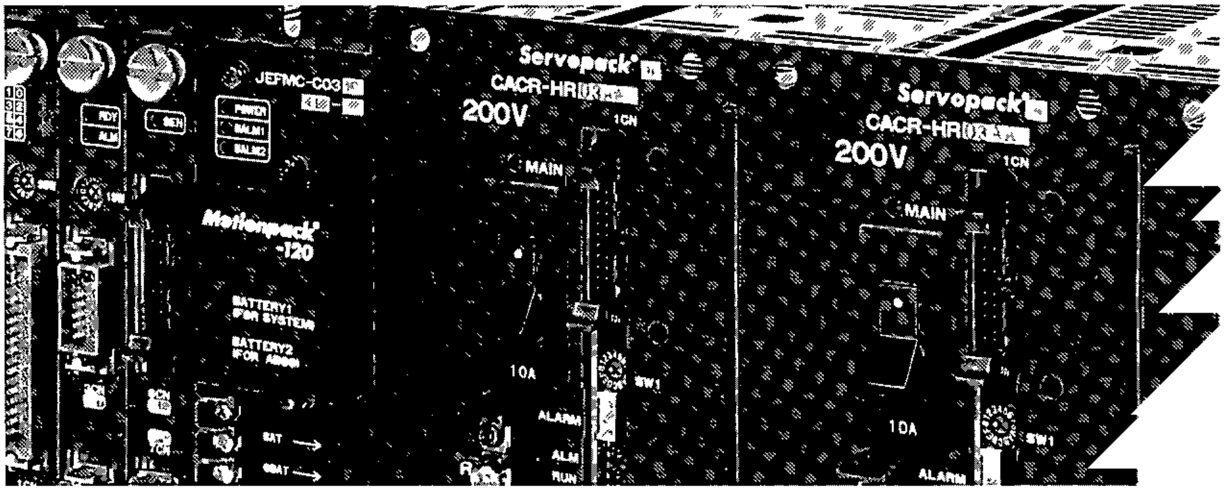
MOTIONPACK-120
DESCRIPTIVE INFORMATION

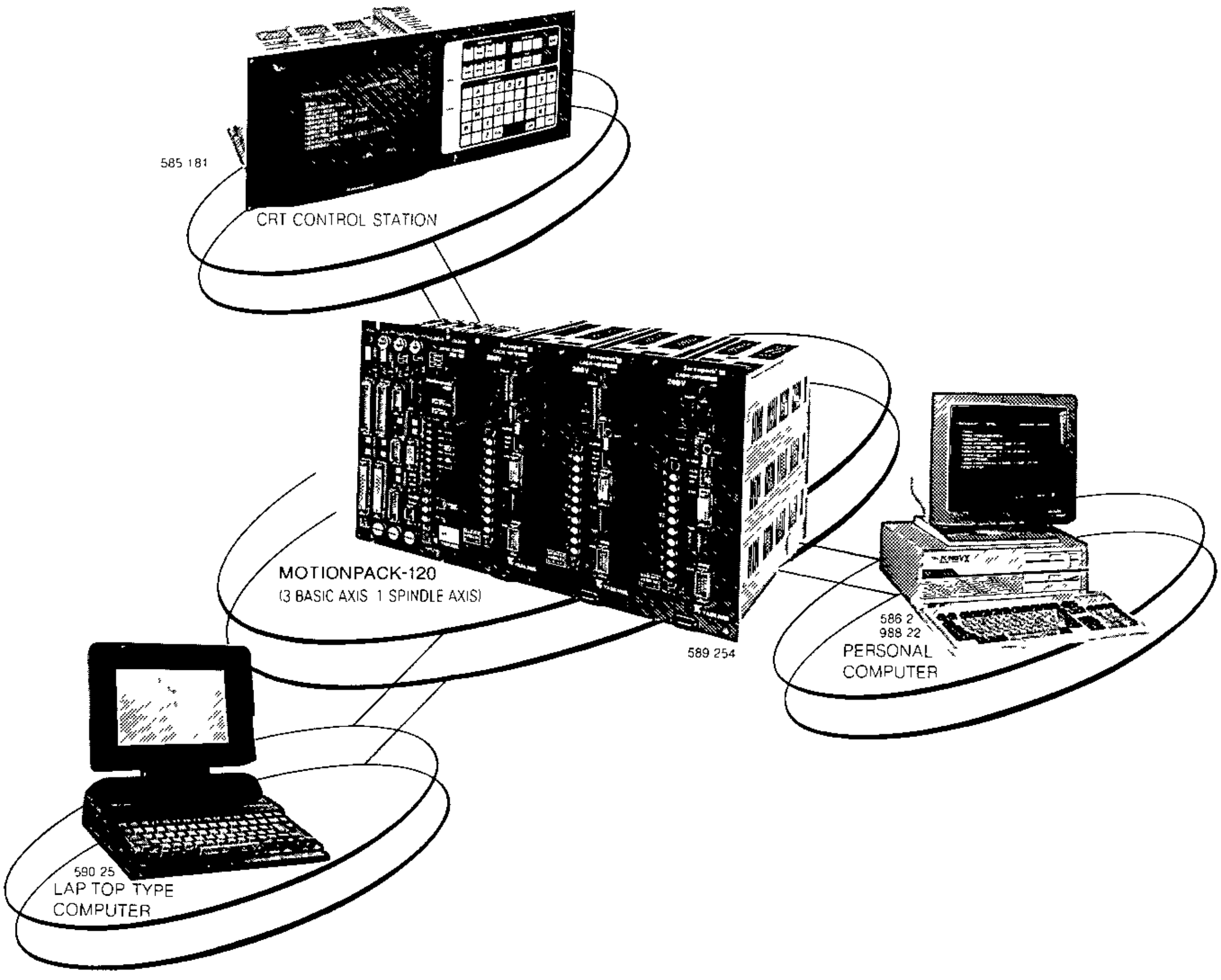
USER'S MANUAL



YASKAWA

SIE-C881-20B

The manual provides the detailed information needed to create effec tive motion control systems utilizing Yaskawa MOTIONPACK-120



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SECTION 1

CONTENTS

1. SYSTEM

1.1 GENERAL

MOTIONPACK-120 is a general purpose controller that provides 3 axes for motion control, 1 axis for spindle control MOTIONPACK-120, with the use of functionally divided standard modules, has the following features

- MOTIONPACK-120 employs YASKAWA compact, high-performance servo controller CACR-HR□□AA Connection with other servo controllers is not possible MOTIONPACK-120 provides adjustment functions of conventional servo controllers in the form of digital control with parameters, thus guaranteeing uniform adjustment among machines The parameters are automatically sent to the servo controller in a batch, via the FA bus when power is turned on

- MOTIONPACK-120 supports an absolute encoder After the mechanism home position is once determined during a trial run, no more home positioning is necessary at power-on

- MOTIONPACK-120 has ample motion control basic functions A variety of functions that achieves top performance of user machines are provided

- The built-in sequencer functions provide positive linkage with external equipment

- MOTIONPACK-120 can be connected to a master computer such as a personal computer to transfer data between them The direct numerical control (DNC) function enables simultaneous motion control while receiving part data, thereby offering enhanced material handling, processing, and fabricating

1.2 SYSTEM CONFIGURATION

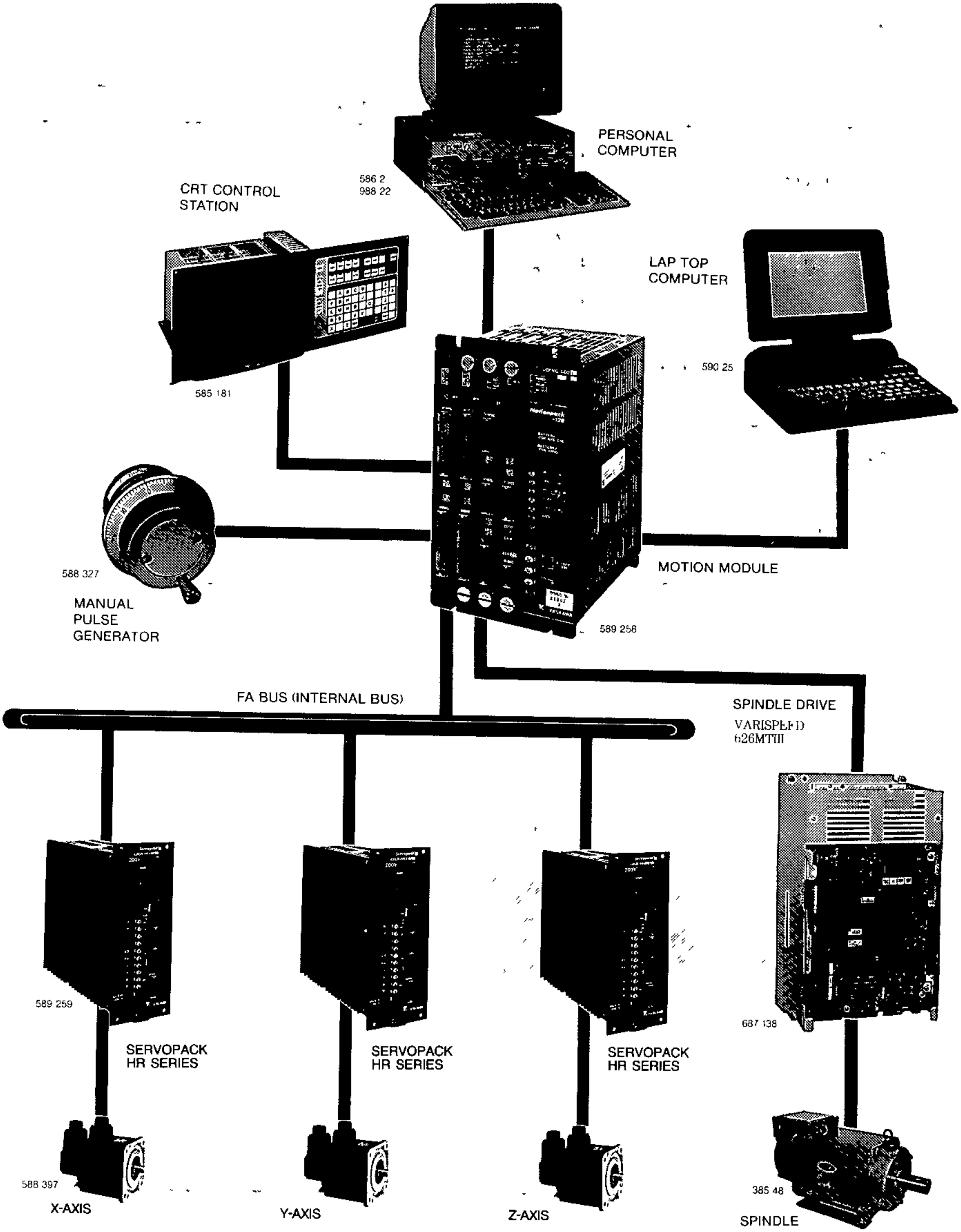


Fig 1 1 MOTIONPACK-120 System Configuration

1.3 SPECIFICATIONS

Table 1 1 MOTIONPACK-120 Specifications

Functions	Specifications
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
Least Output Increment	1 pulse
Max Programmable Dimension	±99999 999 mm (B/A ≦ 100)
Conversion of Input Increment Unit and Pulse	Enable
Feed Function • Rapid Traverse Rate • Feedrate Setting • Feedrate Override	2400 kpps max (at × 4) 36 m/min max at 0 001mm/pulse 24 m/min max at 0 001mm/pulse At 25%, 50% or 100% of the feedrate or available between 10% and 200% (21 steps)
Automatic Acceleration/Deceleration	• Linear and 2-stage linear accel/decel for positioning and manual feed • Exponential for interpolation
Operation Mode • Edit • Automatic MEM DNC • Manual STEP JOG RAPID HANDLE	Motion data programming Automatic operation by program stored in memory Automatic operation by program while receiving part data from the master computer Manual operation of preset distance 3-stage setting of S, M and L (simultaneous 3 axis operation available) Jog feed 16-stage setting (simultaneous 3-axis operation available) Rapid traverse rate 3-stage setting of 25%, 50% or 100% (simultaneous 3-axis operation available) 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 • Manual Return	Automatic return to reference point (G 28) Each axis or simultaneous 3-axis return by JOG or RAPID
Single Block	Automatic operation block-by block using external signals

Table 1 1 MOTIONPACK-120 Specifications (Cont'd)

Functions	Specifications
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 • Pitch Error	 Enable, 0 to 32767 pulses Enable, 0 to ±32767 pulses, 80 points for all axes
Program • Program Number • Sequence Number	NC (part) program in compliance with JIS* B 6313 O 0000 to O 9999 Up to 99 program numbers registered N 0000 to N 9999 Block number
Calling in Programming† Motion Control • Positioning • Linear Interpolation • Circular Interpolation • Dwell • Offset Value Input • Plane Designation • Automatic Return to Reference Point • Skip • Position Offset • Machine Coordinate System Setting Absolute/Incremental Programming • Programming of Absolute Zero Point	Calling and execution from any blocks of programming Max simultaneous 3 axes • Error detect ON mode (G 00) • Error detect OFF mode (point-to-point control available) (G 06) Max simultaneous 3 axes (G 01) Max simultaneous 2 axes • Clockwise (G 02) • Counterclockwise (G 03) Circular radius and circular radius coordinate designation enable 0 001 to 99999 999 s (G 04) Direct input of offset value in program (G 10) Designation of plane for making circular interpolation (G 17, 18, 19) Returning to reference point automatically (G 28) Program advanced to next block when skip signal ON (G 31) → (G 01) • Z-axis (G 43, G44, G 49) • X-, Y-axis (G 45 to G 48) Temporary motion on machine coordinate system (G 53) Movement data designated as to whether absolute or incremental value • Absolute (G 90) • Incremental (G 91) Designation of position of "absolute zero point" (G 92)

* Japanese Industrial Standard
† For CRT Control Station only

Table 1 1 MOTIONPACK-120 Specifications (Cont'd)

Functions	Specifications
Combined Operation Command (Optional)	
• Drilling Cycle	A drilling operation can be expressed with one command (G 81)
• Sport 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 (G 99)
• 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 signal is output at low speed (G68) • Notch signal output reset by G 68 (G 69)
• Specifications B	• A 1-point high speed notch single (G 66) • A 1-point low speed notch single (G 67)
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 (M 02) • 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	Four blocks read in advance
Memory Capacity	64k bytes
Communication Function Personal Computer ↔ Motion Module	Program and parameter transmissions, diagnostic (machine) monitoring signal transmission, commands
Programmable Controller Function	The sequence control is available for external I/O devices

* For CRT Control Station only

(1) Motion Module JEFMC-C03□□

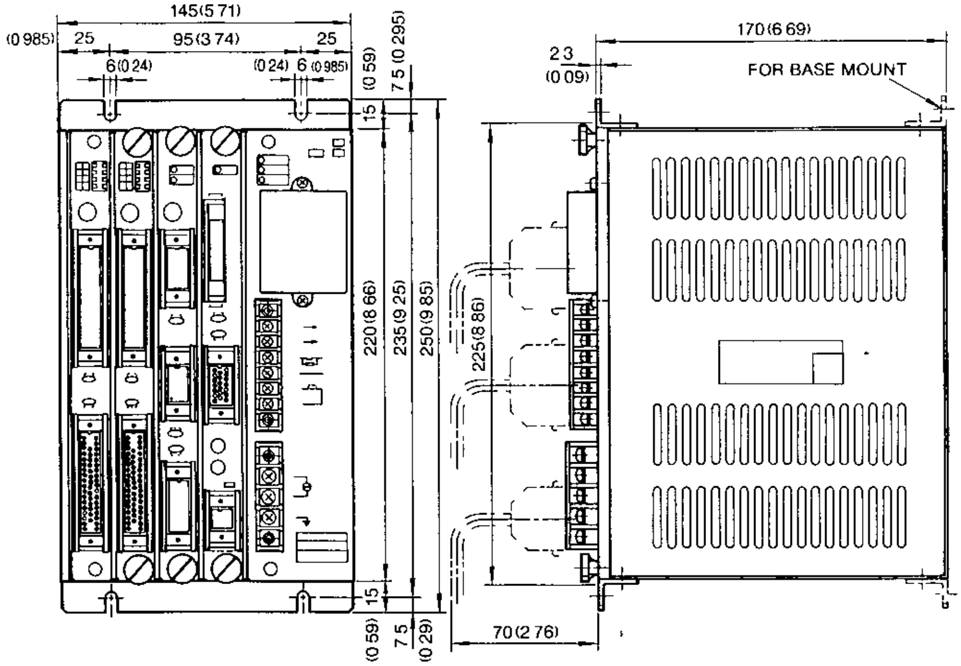
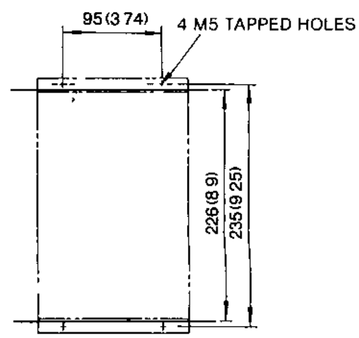


Fig 1 2 Motion Module

• MOTIONPACK-120 Attachments

Connector Symbol	Connector Type	Attachments		Remarks
		Receptacle Type	Case Type	
1 CN	MR-50RMA	MR 50F	MR 50L	Honda Tsushin Co Ltd
2 CN	MR-50RFA	MR-50M	MR 50L	Honda Tsushin Co Ltd
3 CN	MR-20RMA	MR-20F	MR 20L	Honda Tsushin Co , Ltd
4 CN	MR-16RMA	MR 16F	MR 16L	Honda Tsushin Co , Ltd
5 CN	MR-25RMA	MR 25F	MR-25L	Honda Tsushin Co , Ltd
6 CN	FRC2-C20 LI2-OS	—	—	Attached to FA bus cable
7 CN	MR-20RFA	MR 20M	MR 20L	Honda Tsushin Co Ltd
8 CN	MR-8RMA	MR 8F	MR 8L	Honda Tsushin Co , Ltd
9 CN	MR-50RMA	MR 50F	MR 50L	Honda Tsushin Co , Ltd
10 CN	MR-50RFA	MR 50M	MR 20L	Honda Tsushin Co Ltd



Note FA bus cable specifications

- Type JEFMC-W500, FA bus cable for 3 axes (with terminator board)× 1
- 4 stands for mounting terminator board

(2) CRT Control Station JEFMC-H013

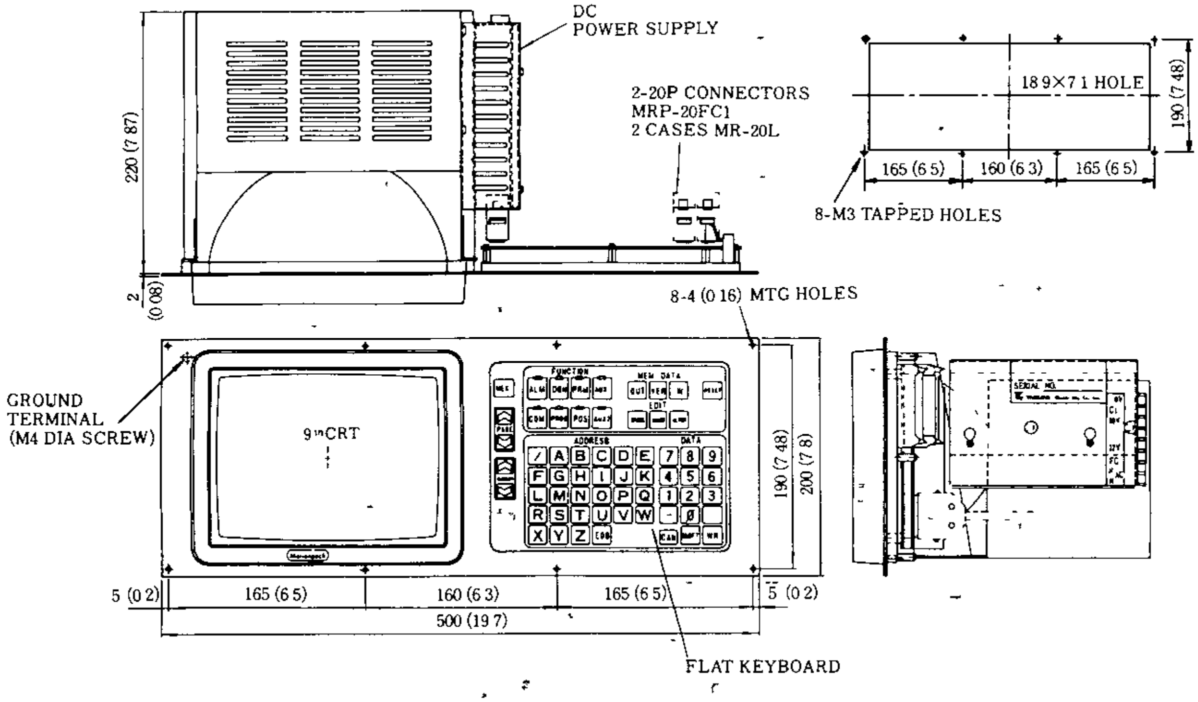


Fig 1 3 CRT Control Station

(3) FA Bus Conversion Module JEFMC-Z030

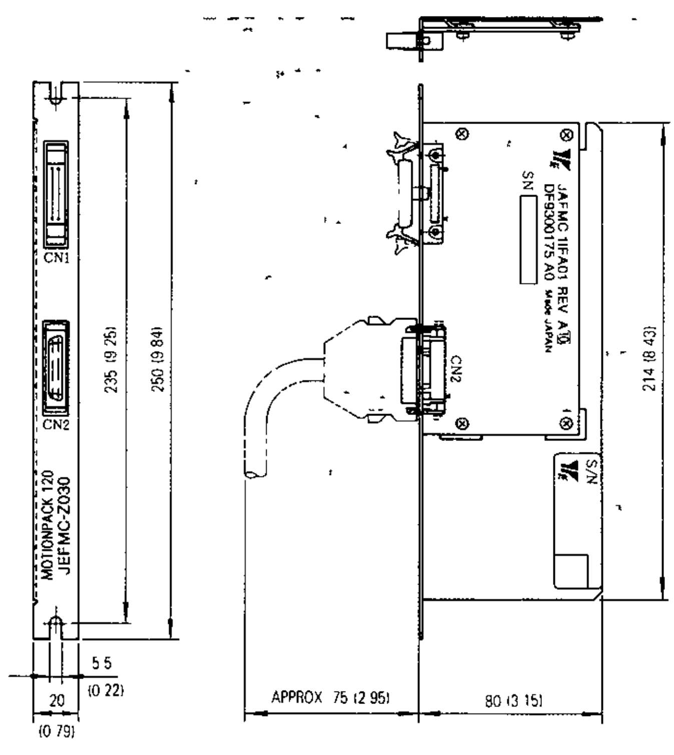
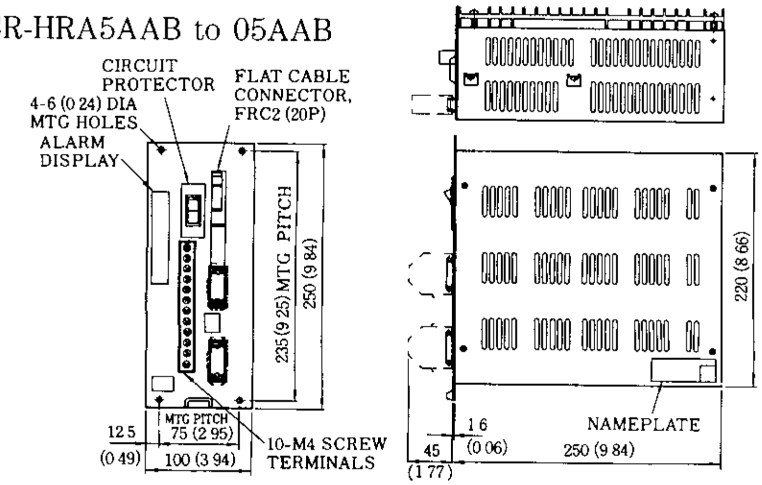


Fig 1 4 FA Bus Conversion Module

(4) SERVOPACK

(a) CACR-HRA5AAB to 05AAB



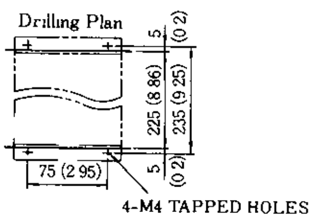
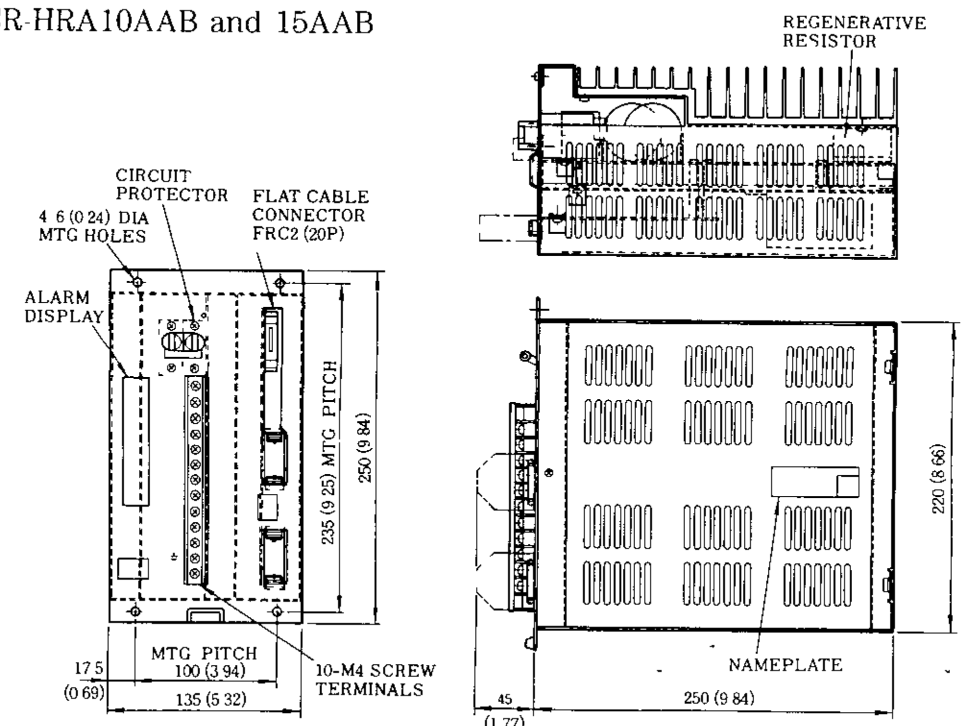


Fig 15

Attachments	
2CN connector for cable	
Cable	R 20L
Receptacle	MR 20M (Made by Honda Tsushin Co)
3CN connector for cable	
Case	MR 20L
Receptacle	MR 20F (Made by Honda Tsushin Co)

(b) CACR-HRA10AAB and 15AAB



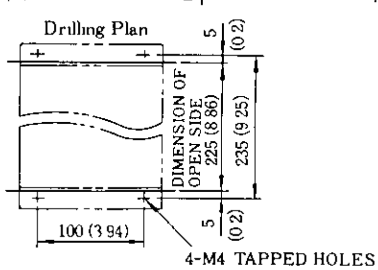


Fig 16

Attachments	
2CN connector for cable	
Cable	MR 20L
Receptacle	MR 20M (Made by Honda Tsushin Co)
3CN connector for cable	
Case	MR-20L
Receptacle	MR 20F (Made by Honda Tsushin Co)

(c) CACR-HR03AB to 15AB

(d) CACR-HR20AB, 30AB

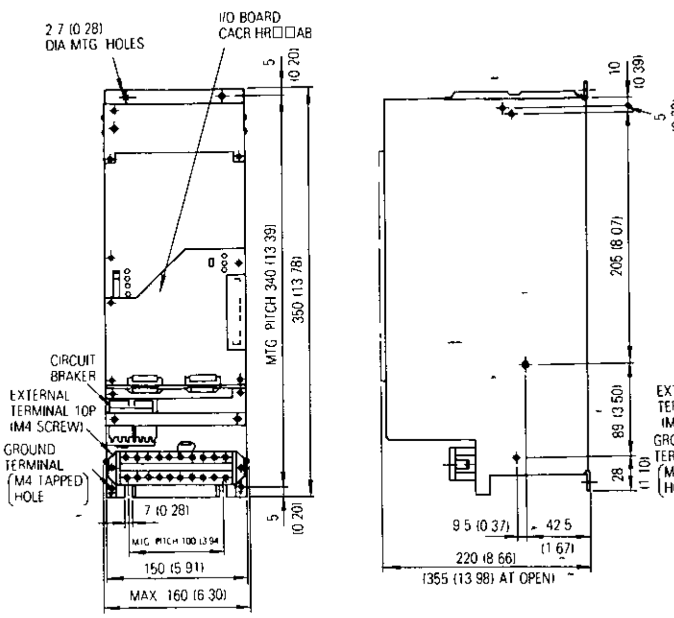


Fig 17

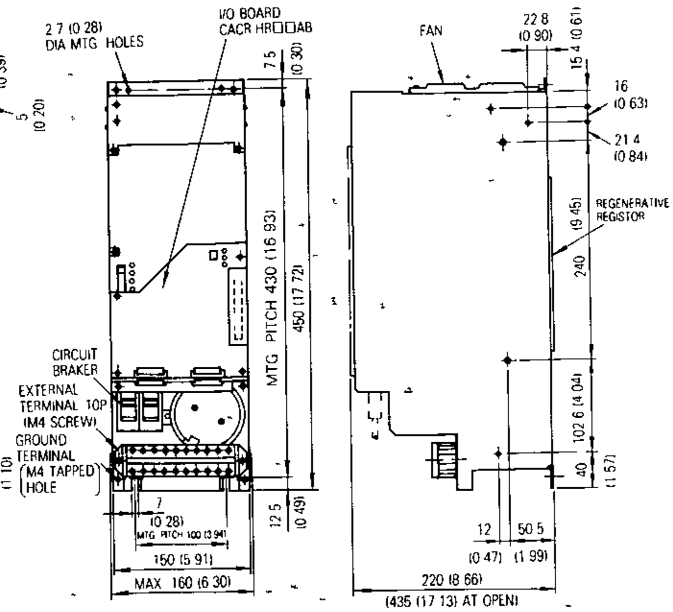


Fig 18

(e) CACR-HR44AB

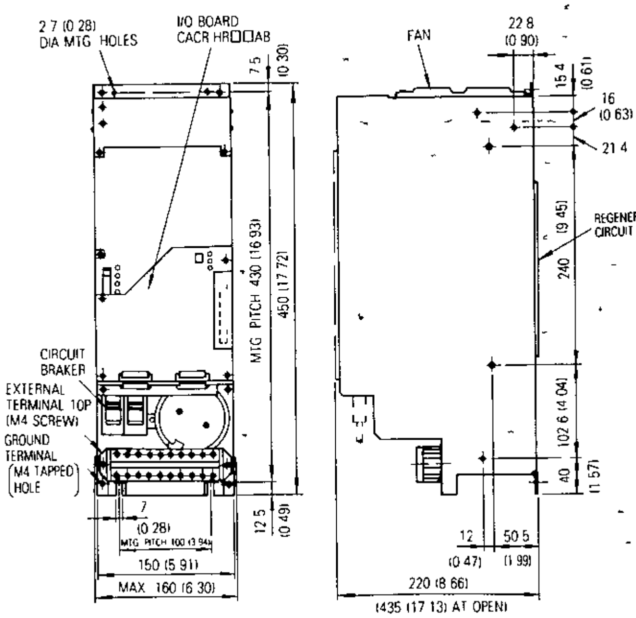


Fig 19

SECTION 2

CONTENTS

2. FUNCTIONS

2.1 TYPES OF OPERATION MODES

MOTIONPACK-120 has the following 8 types of operation modes

(1) Editing Mode (EDIT)
(2) Memory Operation Mode (MEM) Automatic operation
(3) DNC Operation Mode (DNC) Automatic operation
(4) MDI Operation Mode (MDI) Automatic operation
(5) Step Operation Mode (STEP) Manual operation
(6) Manual Feed Mode (HANDLE) Manual operation
(7) Jogging Mode (JOG) Manual operation
(8) Rapid Traverse Motion (RAPID) Manual operation

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

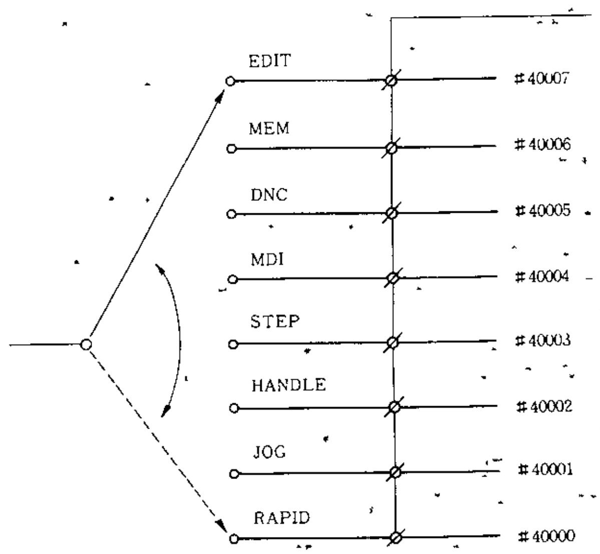


Fig 2.1. Operation Mode Selection

2.1.1 Editing Mode (EDIT # 40007)

This mode is used when altering, adding, or deleting programs in the memory in MOTIONPACK-120, or doing other editing operations These editing operations are executed from the CRT control station, as detailed in Section 4 "OPERATION OF CRT CONTROL STATION"

NOTE

Only one mode is effective in MOTIONPACK-120 system If more than two modes are selected, the first-selected mode is effective

2.1.2 Memory Operation Mode (MEM # 40006)

In this mode, the system automatically operates under the control of the program stored in the memory of MOTIONPACK-120 For details, refer to Par 2 3 "MEMORY OPERATION" or Section 3 "PROGRAMMING"

2.1.3 DNC Operation Mode (DNC # 40005)

This mode is selected for the host computer to operate MOTIONPACK-120 DNC

Automatic operation under motion control is performed while travel data is being received from the host computer DNC operation requires a CRT control station For details, refer to Par 2 4 "DNC OPERTION "

2.1.4 MDI Operation Mode (MDI # 40004)

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 For details, refer to Par 2 8 "MDI OPERATION "

NOTE

This mode is available for MOTIONPACK-120 with CRT control station

2.1.5 Step Operation Mode (STEP # 40003)

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)

Table 2 1

MP2	MP1	Parameter
#40065	#40064	
0	0	Travel length 0
0	1	#1122
1	0	#1123
1	1	#1124

Note #1122 #1123, #1124
1 = 0 001 mm

The feedrate is the same as for jogging (see Par 2 1 7, JOGGING-OPERATION MODE) Simultaneous 3-axis operation is available, and the same feedrate and step length apply to all the axes The signal is desregarded if it is turned on or off while the machine slide is stepping To enter the signal again, wait until the machine stops

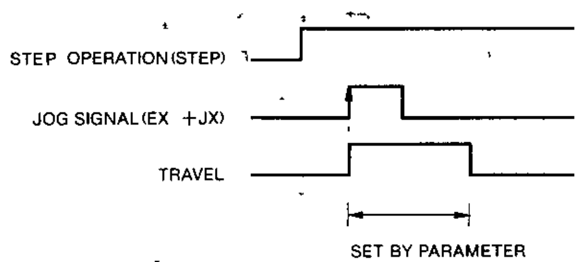


Fig 2 2 Step Operation

2.1.6 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 clockwise or counterclockwise, the machine moves in the forward or reverse direction

The length of travel per handle pulse can be selected from three levels ×1, ×10, and ×100, by setting external input signals (MP1 and MP2)

Simultaneous 1-axis or 3-axis handle operation can be selected by setting the parameters (three handles are necessary for simultaneous 3-axis handle operation)

For simultaneous 1-axis handle operation, only one handle is used The handle direction is determined by the axis change signals (HX for X-axis, HY for Y-axis, and HZ for Z-axis)

For simultaneous 3-axis handle operation, the three handles are assigned to external input signals (HX, HY, and HZ)

(1) # 1002 D6 0 Simultaneous 1-axis
Simultaneous 3-axis

(2) Length of travel (common in simultaneous 1-axis and 3-axis operations)

Table 2 2 Length of Travel in Manual Feed Mode

MP2	MP1	Multiplier
#40065	#40064	
0	0	×0
0	1	×1
1	0	×10
1	1	×100

(Length of travel per handle pulse)

(3) Axis selection

① With # 1002 D6 0 (simultaneous 1-axis), use the following signals to select one axis

For X HX # 40050
For Y HY # 40051
For Z HZ # 40052

② # 1002 D6 1 (simultaneous 3-axis)

(4) Setting maximum achievable manual handle feedrate
1101 1=7 5 mm/min

2.1.7 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

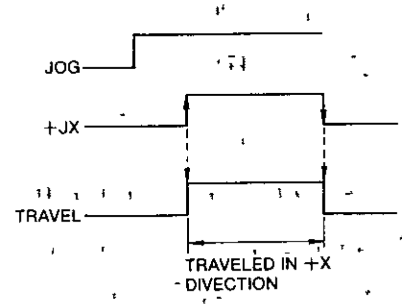
Table 2 3

Signals	Input Signal Address	Travel Axis
+JX	#40030	+X axis
−JX	#40040	−X-axis
+JY	#40031	+Y-axis
−JY	#40041	−Y-axis
+JZ	#40032	+Z-axis
−JZ	#40042	−Z-axis

Table 2 4

JOV8 #40023	JOV4 #40022	JOV2 #40021	JOV1 #40020	Parameter
0	0	0	0	Feedrate 0
0	0	0	1	#1104
0	0	1	0	#1105
0	0	1	1	#1106
0	1	0	0	#1107
0	1	0	1	#1108
0	1	1	0	#1109
0	1	1	1	#1110
1	0	0	0	#1111
1	0	0	1	#1112
1	0	1	0	#1113
1	0	1	1	#1114
1	1	0	0	#1115
1	1	0	1	#1116
1	1	1	0	#1117
1	1	1	1	#1118

Parameter (# 1104 to # 1118)
1 = 1 mm/min
1 ≤ Set value ≤ 3600



2.1.8 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 slected feedrate, and when the signal is turned off, it stops after deceleration The feedrate can be slecected by rapid feed override signals (ROV1 to ROV3) from three levels 100%, 50%, and 25%, with the 100% feedrate specified by parameters Simultaneous 3-axis operation is available, and the 100% feedrate is set separately for each axis

Table 2 5 Travel Reference Input

Signals	Input Signal Address	Travel Axis
+JX	#40030	+X-axis
-JX	#40040	-X-axis
+JY	#40031	+Y-axis
-JY	#40041	-Y-axis
+JZ	#40032	+Z-axis
-JZ	#40042	-Z-axis

Table 2 6 Rapid Traverse Override Reference

ROV3	ROV2	ROV1	Override
#40017	#40016	#40015	
0	0	0	0 %
0	0	1	25 %
0	1	0	50 %
0	1	1	100 %
1	-	-	100 %*

* ROV3 ia s always 100 % feedrate at ON

Table 2 7 Rapid Traverse Setting (100%)

Parameter	Axis
#1130	X-axis
#1131	Y-axis
#1132	Z-axis

1 = 7 5 mm/min

1 ≤ Set value ≤ 4800

2.2 FEEDRATE ACCELERATION/DECELERATION

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

2.2.1 Linear Feedrate Acceleration/Deceleration

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

- Positioning (G00, G06, G28)
- 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 2 3 (different value for each axis)

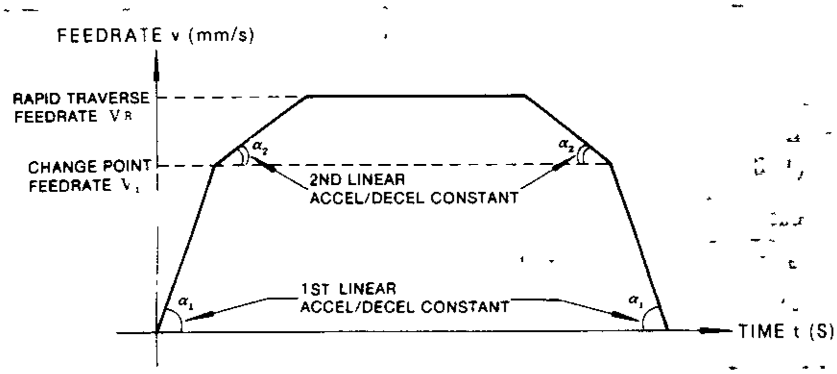


Fig 2 3

		X-axis	Y-axis	Z-axis
Rapid Traverse Feedrate	1 = 7 5mm/min	#1130	#1131	#1132
1st Linear Accel/Decel Constant	1 = 15 625mm/S²	#1404	#1704	#2004
2nd Linear Accel/Decel Constant	1 = 15 625mm/S²	#1405	#1705	#2005
Change Point Feedrate	1 = 7 5mm/min	#1406	#1706	#2006

2.2.2 Acceleration/Deceleration during Interpolation Feed

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

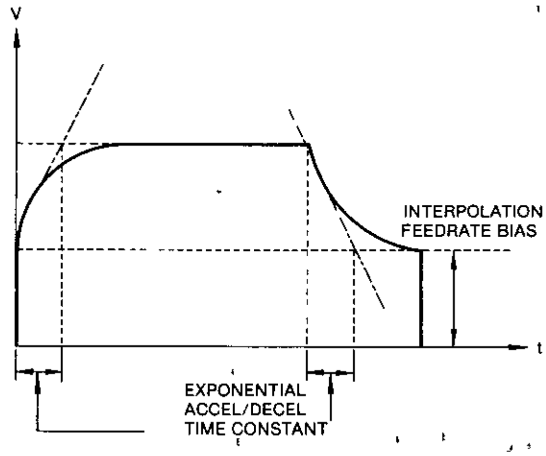


Fig 2 4

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 1 = 7 5 mm/min by parameters

Parameters

	X-axis	Y-axis	Z-axis
Exponential Accel/Decel Time Constant	#1413	#1713	#2013
Interpolation Feedrate Bias	#1412	#1712	#2012

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

2.3 MEMORY OPERATION

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

2.3.1 Program Designation

A program number can be specified by three methods of parameter setting

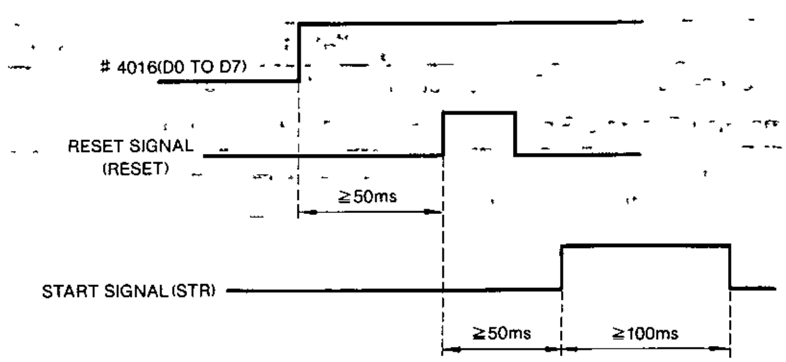
(1) Selection from the Control Station (# 1002 D7=0, # 1002 D0=0)
Select a program number and enter it on the program screen of the Control Station as follows 0□□□□□

(2) Selection using external signals (# 4016 D0 to D7) and the reset signal (# 1002 D7=1, # 1002 D0=0)
Select a program number (O01 to O99) and input it externally using the 2-digit binary coded decimal (BCD) switch, then enter the reset signal

(3) Selection using external signals (# 4016 D0 to D7) and the start signal (STR) (# 1002 D7=0, # 1002 D0=1)
Select a program number (O01 to O99) and input it externally using the 2-digit binary coded decimal (BCD) switch, similar to the above (2), then select this external signal at the trailing edge of the start signal (STR)

[Example] Selection using external signals (# 4016 D0 to D7) and the reset signal

		D7	D6	D5	D4	D3	D2	D1	D0	
External Input signal	# 4016	0	0	1	0	0	1	0	1	BCD Code 25



Program number O25 is selected for execution

Fig 2 5

2.3.2 Program Designation and Temporary Stop

After designating a program, turn off the start signal to execute the program

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 Temporary stop is effective only for traveling

2.3.3 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

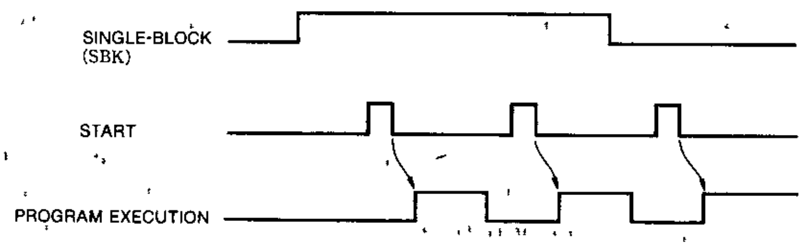


Fig 2 6

2.3.4 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 (Increment, Universal) 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 point 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.

2.3.5 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 This function is not effective in manual operation mode Axis is set by parameter (# 1006)

	D2	D1	D0
#1006	Z-axis	Y-axis	X-axis

2.3.6 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 , In normal operation, 4-block data are read in advance

2.3.7 Manual Interruption of Automatic Operation

When a manual operation (JOG mode, STEP mode, RAPID mode, or HANDLE mode) intervenes in a memory or DNC operation, the movement by the manual operation has the effect of shifting the motion path Therefore, when the memory operation mode is restored and the start signal is turned off, the machine follows the shifted path, regardless of whether the absolute (G90) or incremental (G91) command is used

To cancel the movement of manual operation (to return the machine to the position where it was when the manual operation was started), execute M30 or enter the reset signal

If the system is switched to the manual operation mode while it is waiting for the FIN signal after using the M, T, or S function, the system operates similar to that when the FIN signal is input

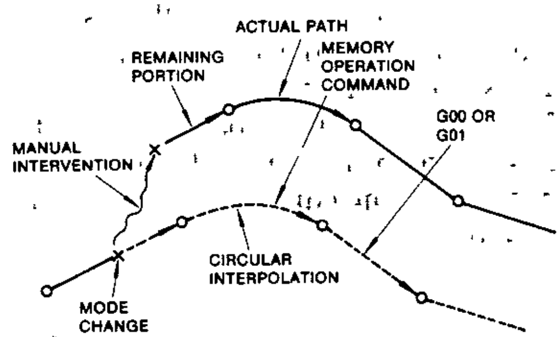


Fig 2 7

2.3.8 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)

2.4 DNC OPERATION FUNCTION

The direct numerical control (DNC) function enables concurrent execution and reception of a part program. The part program is received from the communication port of the Control Station using the serial communication function of the master computer (e.g. a personal computer). This function is useful for execution of a large part program exceeding the MOTIONPACK-120 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 instructions cannot be executed.

2.4.1 Setting Protocol

Before starting DNC operation, protocol must be set using parameter # 1009. After setting protocol, turn off power to MOTIONPACK-120, then turn on it again. The set protocol cannot be changed during DNC operation.

	D7	D6	D5	D4	D3	D2	D1	D0
Parameter # 1009								

(1) Baud Rate (D0 — D3)

					D3	D2	D1	D0
# 1009					Baud rate			

D3	D2	D1	D0	Baud Rate
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

(2) Stop Bit (D4)

				D4				
# 1009								

D4	Stop Bit
0	1 bit
1	2 bit

2.4.1 Setting Protocol (Cont'd)

(3) Bit Length (D5)

			D5					
# 1009								

D5	Bit Length
0	7 bits
1	8 bits

(4) Parity (D6)

		D6						
# 1009								

D6	Parity
0	Yes
1	No

(5) Parity Type (D7)

	D7							
# 1009								

D7	Parity
0	Even
1	Odd

2.4.2 DNC Operation Procedure

For DNC operation, observe the following

(1) Select the DNC mode of MOTIONPACK-120 (# 40005)

(2) Enter the start signal to start DNC operation

(3) MOTIONPACK-120 sends out the ENQ code (05H) and XON code (11H)

(4) Send a part program to the motion module from the RS-422 port (CNB) of the Control Station in start/stop synchronization

(5) Place % before and after the part program

(6) The part program must be written in the ASCII code

The end of a block must be marked with the carriage return code (0D)

[Example of a part program]

```
%
25 ←  ——————————————————————————— Hexadecimal Code
N  0  0  1  G  0  0  X  1  2          [CR]
4E 30 30 31 47 30 30 58 31 32 2E      0D
%
N  0  0  2  g  0  1  y  5  2          [CR]
4E 30 30 32 47 30 30 59 31 32 2E      0D
-- -----
---- ----
%
25
```

Note Odd-numbered lines are written in the mnemonic code
Even numbered lines are written in the hexadecimal code

(7) From the part program, subprogram call (M98) can call up NC programs that are down-loaded to MOTIONPACK-120 in advance

(8) The program repetition instruction (M99 single instruction) cannot be used

(9) A program must end with M30, M00, or M02

(10) The last % indicates the end of the program Because a program unit is recognized with CR, place CR before %, and CR must be commanded individually

2.4.3 Communication Specifications (Internal Specifications)

(1) The capacity of the part-program receiving buffer will be 1k byte

(2) When the start signal is input, the motion module will send the ENQ code (05H) and XON code (11H) to the personal computer to send a part program

(3) After communication is started, data analysis will be started on the earlier of the following events the receiving buffer has received data of 0 5k bytes or more, or the second % is received

(4) The XOFF code (13H) will be sent when 768 bytes of received data are stored in the receiving buffer The XON code (11H) will be sent when received data in the buffer are reduced to 512 bytes or less

2.5 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 funciton 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. Procedure is as follows.

1. Select manual operation mode
2. Depress $\boxed{\text{POS}}$ function key
3. Depress $\boxed{\text{X}}$ and $\boxed{\text{NEXT}}$ keys
4. Depress $\boxed{\text{Y}}$ and $\boxed{\text{NEXT}}$ keys
5. Depress $\boxed{\text{Z}}$ and $\boxed{\text{NEXT}}$ key

2.6 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 H294, H295, and H296, respectively.

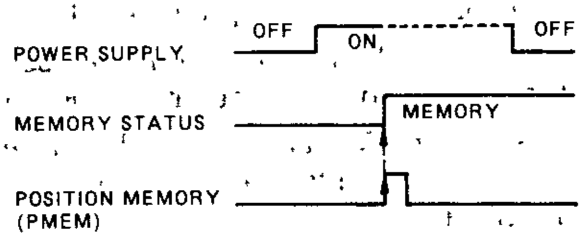


Fig 3 14

Memory Position		Store Location (Offset No.)
Axis Position	X	H294
	Y	H295
	Z	H296

2.7 SPINDLE CONTROL FUNCTION

Simple spindle control can be performed by using D/A output

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 3 6, 6 2, 5 3, and 5 10, respectively

NOTE

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

2.7.1 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 # 1150 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 normal rotaion, 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

2.7.2 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 # 1160, # 1161, and # 1162

The speed command voltage on each gear is as follows

$$\text{Speed Command Voltage} = \frac{\text{S 5-digit Programmed Value (rpm)}}{\text{Each Gear Parameter Setup Value (rpm)}} \times \pm 10\text{V Output}$$

2.8 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-120 with CRT control station

2.8.1 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 blocks cannot be specified

(5) Depress INSRT key The key-in data are registered . The lateset 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

2.8.2 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

2.9 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

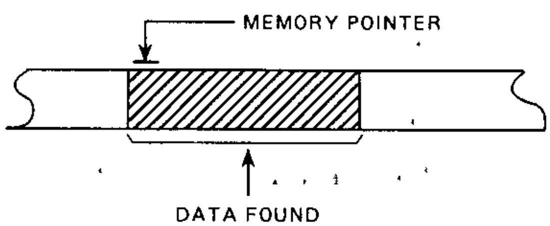
In memory mode, the pointer returns to the top of the program number in MEM mode

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

2.9 ADDRESS SEARCH FUNCTION (Cont'd)

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

2.10 PARAMETER PROTECT FUNCTION

This function disregards write-in parameter from CRT control station When parameter protect signal (PRMP) is turned ON, WR key in parameter display is ineffective and writing can not be changed

NOTE

Even if the signal (PRMP) is ON, written-in parameters from the personal computer are valid

2.11 PROGRAM PROTECT FUNCTION

This function disregards editing of machining program from the CRT control station When program protect signal (PRGP) is turned ON, ERASE , INSRT and ALTER keys are ineffective in EDIT mode

NOTE

Even if the signal (PRMP) is turned ON, the machining program can be transmitted from the personal computer

2.12 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 to # 45081 If there is no alarm, 0 is output If two or more alarms are detected, the first alarm is given priority

(Example)

1 EXTERNAL ERROR

Code	# 4508 D1	# 4508 D0	# 4507 D7	D6	D5	D4	D3	D2	D1	D0
049	0	0	0	0	1	1	0	0	0	1

2 SERVO TRACKING ERR (X)

Code	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
315	0	1	0	0	1	1	1	0	1	1

2.13 MANUAL HOME POSITIONING

With the MOTIONPACK-120 system, the machine home position is used as the system home position, and the system can be brought to this home position from various positions as described below

Usually, a pulse generator with a home position pulse and a limit switch for indicating the home position area are used to determine the home position

The home positioning is started when a JOG signal towards the home position (i,e , +JX or -JX) is turned on while an external home positioning (ZPN) signal is on in the JOG or RAPID mode

When the home positioning is completed, the machine stops, the axis coordinate data becomes "0", and a "home positioning" signal (ZPX, ZPY, or ZPZ for X-, Y-, or Z-axis, respectively) is output

Table 2 8 shows the signals related to the home positioning operation

Table 2 8 Signals Related to Home Positioning

Signals State / Type of Motion	Input Signal: Mode JOG	Input Signal: Mode RAPID	Input Signal: Home Positioning ZRN	Input Signal: Start +JX/-JX	Input Signal: Start +JY/-JY	Input Signal: Start +JZ/-JZ	Output Signal: Completion ZPX	Output Signal: Completion ZPY	Output Signal: Completion ZPZ
X-axis Home Positioning	ON	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
	OFF	ON							
Y-axis Home Positioning	ON	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
	OFF	ON							
Z-axis Home Positioning	ON	OFF	ON	OFF	OFF	ON	OFF	OFF	ON
	OFF	ON							

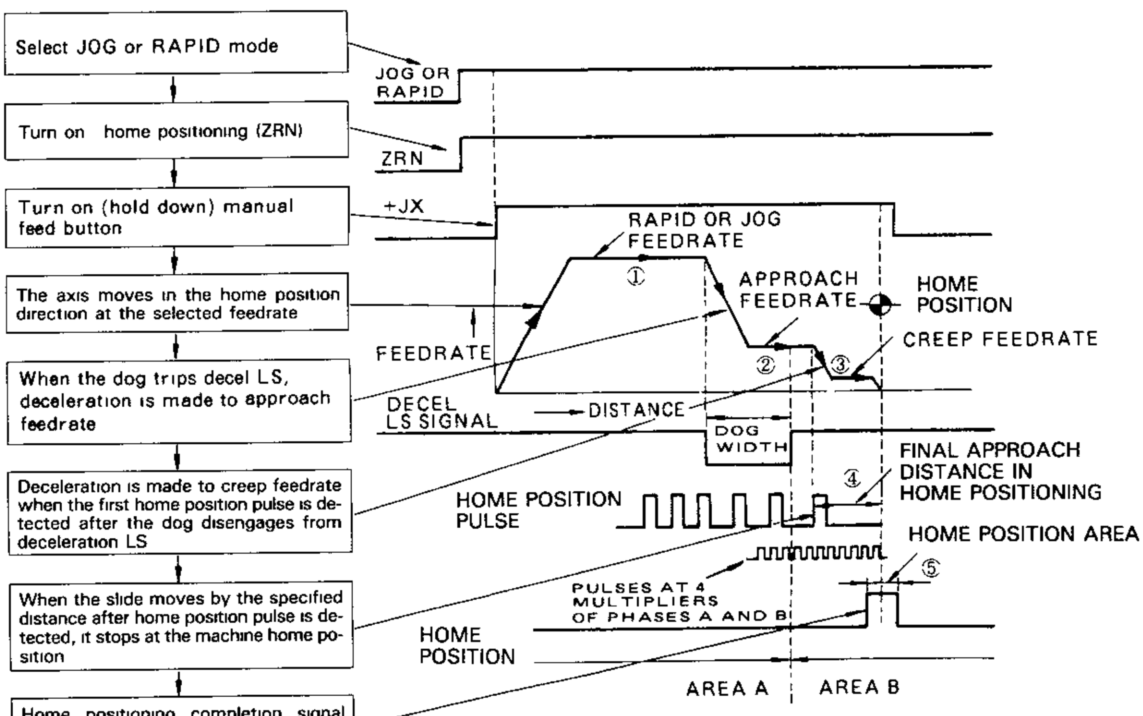


Fig 2 8 Home Positioning Motion

When the JOG signal is turned on, the machine slide returns to the home position as follows

① The jog signal is turned on for the direction specified with the parameter The feedrate is determined by the selected mode (JOG or RAPID) The motion direction is the one set by the parameters (# 1501, # 1801, and # 2101)

② When the dog trips the deceleration LS, the speed is reduced to the approach feedrate, which has been set by the parameter (# 1407, # 1707, # 2007) in advance

③ When the dog moves away from the deceleration LS, and the first home position pulse is detected, the slide further decelerates to the creep feedrate, which has been preset by a parameter (# 1408, # 1708, # 2008)

④ When the slide travels through the preset final approach distance, after detecting the first home position pulse, it stops, and the stop position is taken as the machine home position which is also taken as the system home position The final approach distance has been set by a parameter (# 1409, # 1709, # 2009) in advance

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

NOTE

1 The home positioning 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 2 8), 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

Required dog width (ℓ) is calculated roughly as follows

When Vr = rapid feedrate

α = 1st accel/decel constant

Then, $\ell \geq \frac{1}{2} \cdot \frac{Vr^2}{\alpha}$

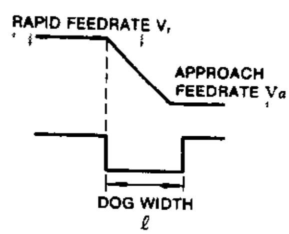


Fig 2 9

3 For the home positioning in the memory operation mode, refer to Par 3 2 9 "AUTOMATIC HOME POSITIONING (G28)"

2.14 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)

└ Y-AXIS ELEMENT
└ X-AXIS ELEMENT

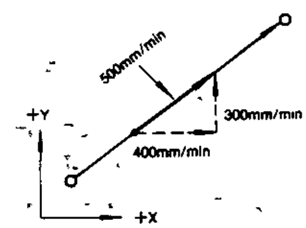


Fig 2 10

(Example 2)

Where, G03X Y I F200,

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

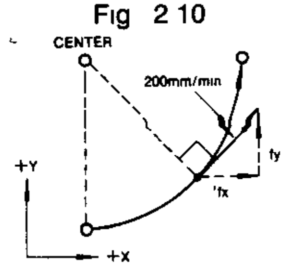


Fig 2 11

(3) 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)

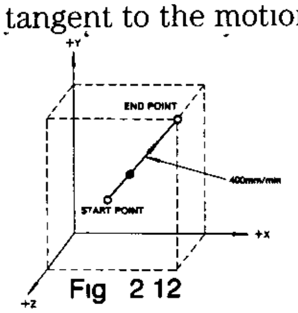


Fig 2 12

(4) The feedrates specified by an F-command can be executed at two levles set by parameters Refer to Par 5 6 3

2.15 AUXILIARY AXES CONTROL FUNCTION (AXIS CONTROL FROM SEQUENCER)

This function moves the auxiliary axes independently by the built-in sequencer or external sequencer from the NC program operation timing apart from the three basic axes (X,Y and Z axes)

Since the auxiliary axes are added to the basic axes, the ststem cannot be constructed without basic axes

2.15.1 Axis Setting

Whether the auxiliary axis is provided is set to parameter #1000 D4 and D5

Parameter #1000 [D7 … D5 D4 … D0]

D4 — A-AXIS PROVIDED/NOT PROVIDED
D5 — B-AXIS PROVIDED/NOT PROVIDED

It is also necessary to set the parameter for the auxiliary axis

For A-axis parameter #2300 ~
For B-axis parameter #2600 ~

The setting contents or setting method is the same as those for the basic axes (X, Y and Z axes)

2.15.2 Operation Command Method

2.15.2 1 Constant amount move command

This method operates the axis by setting the moving amount and moving speed in the offset value area in advance and by inputting the start signal

It is necessary to set parameter #1001 D4 to "1" in order to write-in the parameters of No H300 and after from the CRT control station

The unit of the speed is 7 5mm/min when parameter #1001 D5 is set to "0" and 1mm/min when it is set to "1"

(1) Set the moving amount and speed to consecutive offset value numbers in the offset value area in advance

(Example) H398=20 000 Moving amount (20mm)
H399= 1 000 Moving speed (7500mm/min) when #1001 D5=0

NOTE

Since the moving amount and moving speed are used consecutively, up to H398 can be set for the moving amount

(2) In order to set the moving amount and moving speed, the value of (moving amount setting offset value No -300) is set in binary by the input signal

The offset value No area of (No set by input signal +300) becomes the moving amount setting area, and the next offset value No becomes the speed setting area

2 15 2.1 Constant amount move command (Cont'd)

For A-axis "HA0" to "HA7" (#4211 → #4021)*
For B-axis "HB0" to "HB7" (#4213 → #4023).

* Values in parentheses next to the signal names indicate signal addresses at standard I/O assignment prior to shipment

(3) Whether the moving amount set in the offsett value area is of incremental value or absolute value is set by INC/ABS input signal

For A-axis "$\overline{\text{INC}}$/ABSA" (#4210 D1→#4020 D1)
For B-axis "$\overline{\text{INC}}$/ABSB" (#4212 D1→#4022 D1)
Incremental value at "0"
Absolute value at "1"

(4) The moving direction is set by input signal only at incremental designation

For A-axis "DIRA" (#4210 D2→#4020 D2)
For B-axis "DIRB" (#4212 D2→#4022 D2)
Plus direction at "0"
Minus direction at "1"

When the moving amount is set with a minus sign, the axis moves in the direction opposite to the above

(5) The start signal is turned on after setting the above input signal

For A-axis "STRA" (#4210 D0→#4020 D0)
For B-axis "STRB" (#4212 D0→#4022 D0)

The axis starts moving when the signal starts up

(6) When the axis starts moving, the axis moving signal is output
This signal is turned off when the axis move is completed

For A-axis "MOVA" (#4509 D0→#4307 D0)
For B-axis "MOVB" (#4509 D4→#4307 D4)

[Typical Time Chart]

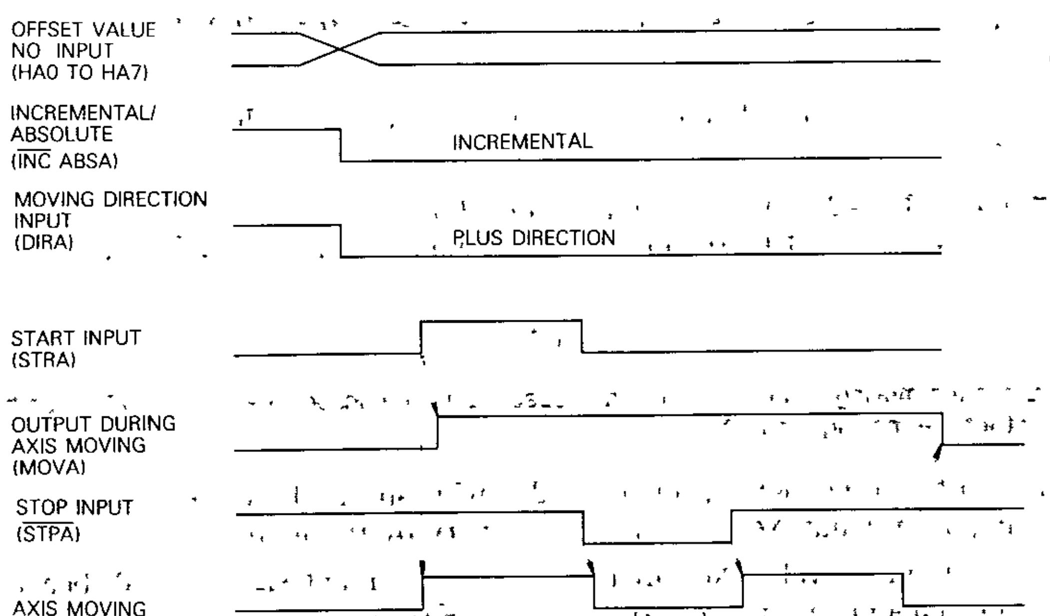


Fig 2 13 Time Chart

2.15 2 2 Jog command

This method moves the axis at the speed set in the offset value area in advance while the jog input signal is input

(1) Set the moving speed in the offset value area in advance
The area where the value can be set is in the range of H301 to H399

NOTE

Speed designation is not possible at H300

(2) When parameter #1002 D4 is set to "0" the moving speed setting offset value No -300 is set in binary
By setting parameter #1002 D4 to "1", the same setting method is used as that of the constant move command Moving amount is not needed for the jog command, but the moving amount setting area No is specified for the value set by the input signal

(3) Turn on the jog input signal in the direction in which the axis is to be moved

For A-axis	"+JA"	(#4210 D4→ #4020 D4)
	"−JA"	(#4210 D5→ #4020 D5)
For B-axis	"+JB"	(#4212 D4→ #4022 D4)
	"−JB"	(#4212 D5→ #4022 D5)

(4) To stop the axis moving, turn off the above jog input signal
When both jog input signals are in the plus and minus directions, the axis stops

(5) The axis moving signal is output during axis moving as well as the constant amount move command

[Typical Time Chart]

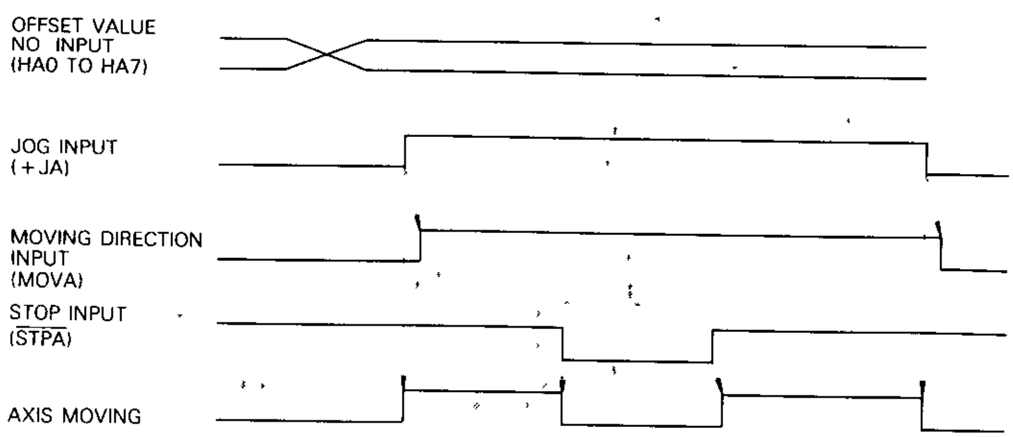


Fig 2 14 Time Chart

2.15.3 Home Positioning Operation

When the home positioning signal ("ZRNA" or "ZRNB") is turned on, the axis starts moving in the home positioning direction set in the parameter to execute home positioning

The speed at which the axis starts moving is set in the offset value area in advance and is specified by the input signal at execution The operation sequence is the same as the home positioning sequence using the deceleration LS of the basic axes

(1) Set the initial speed in the offset value area in advance

(2) Input (offset value No -300) as the input signal as well as when the jog command is provided

("HA0") to "HA7" or "HB0" to "HB7")

(3) Turn on the home positioning signal

For A-axis "ZRNA" (#4210 D6→ #4020 D6)
For B-axis "ZRNB" (#4212 D6→ #4022 D6)

According to the home positioning direction parameter setting, home positioning operation starts in the specified direction

The home positioning sequence is the same as that of the three basic axes

(4) When entering the home position output width, home position output signal ("ZPA", "ZPB") is output

(5) When the home position output is turned on, the time to reach the home position is delayed and the home positioning signal is turned off (Calculate the delay time according to the home position output width and home positioning creep speed) By turning off the home positioning signal during home positioning operation, the operation is interrupted at that time

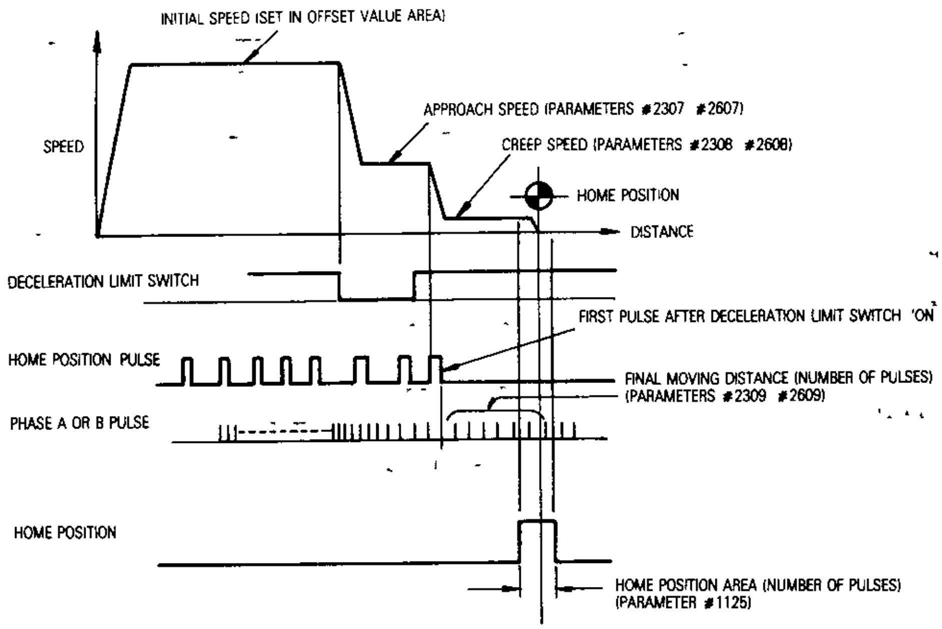
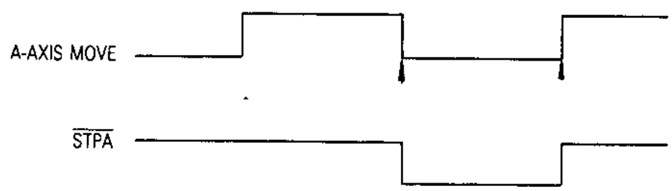


Fig 2 15 Home Positioning Operation

2.15.4 Axis Moving Stop Command

By inputting the stop signal during axis moving (or opening the stop signal), deceleration to a stop is executed, by closing the stop signal, the axis starts moving again



FOR A-AXIS "$\overline{\text{STPA}}$" (#4209 D0→#4024 D0)
FOR B-AXIS "$\overline{\text{STPB}}$" (#4209 D2→#4024 D2)

2.15.5 Absolute Position Setting

It is necessary to teach the absolute home position at the beginning for a system employing an absolute encoder

With auxiliary axes, when the home position designation input signal ("ZPNA", "ZPNB") is turned on in any mode, unlike the three basic axes, that point is stored as the absolute home position However, even if the home position designation input is turned on during axis moving, it is not accepted

For A-axis "ZPNA" (#4210 D3→#4020 D3)
For B-axis "ZPNB" (#4212 D3→#4022 D3)

2.15.6 Auxiliary Axis Servo OFF Function

With the two auxiliary axes, by turning off the servo ON signal ("ASVOK" or "BSVOK"), the servo OFF status (baseblock status) can be entered for each axis
(However, the main circuit is still ON)

Even if the servo ON signal of the auxiliary axis is turned off, an alarm will not occur

To enter the servo ON status, turn on the servo ON signal again

When the servo ON status is entered, the "during servo ON" signal is output

A-axis servo ON signal ASVOK (#4210 D7→#4020 D7)
B-axis servo ON signal BSVOK (#4212 D7→#4022 D7)
During A-axis servo ON SVONA (#4509 D3→#4307 D3)
During A-axis servo ON SVONB (#4509 D7→#4307 D7)

NOTE

When the basic axis servo is turned off, the auxiliary axis servo cannot be turned on

2.15.7 Alarm

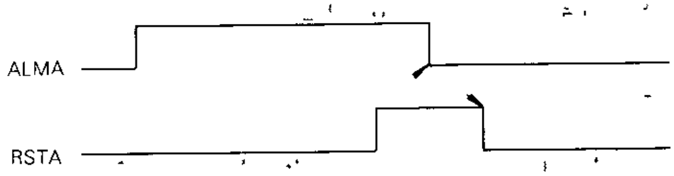
If a servo system alarm occurs even with the auxiliary axis, signals "MC1" and "MC2" output from the MOTIONPACK-120 power supply section is cut off

The alarm contents are the same as those of the three basic axes With A-axis, the alarm has a code in 700s, with B-axis, in 800s For details, refer to the alarm code list

If an alarm occurs, the alarm signal is output

For A-axis "RSTA" (#4209 D1 → #4024 D1)
For B-axis "RSTB" (#4209 D3→ #4024 D3)

(Example)



When the main circuit is cut off because of a servo system alarm, remove the alarm factor after turning off the power supply, and then turn on the power supply again

If the factor has been removed, the alarm signal is not output

2.16 STORING PROGRAM NUMBER

When parameter #1001 D3 is set to "1" at power supply ON, the program No selected at power supply OFF is seclected

⟨Related parameter⟩

#1001 D3 Storing program number
 1 Available
 0 Not available

SECTION 3

CONTENTS

3. PROGRAMMING

The MOTIONPACK-120 system uses the NC program language. An example of programming machine motion is shown below.

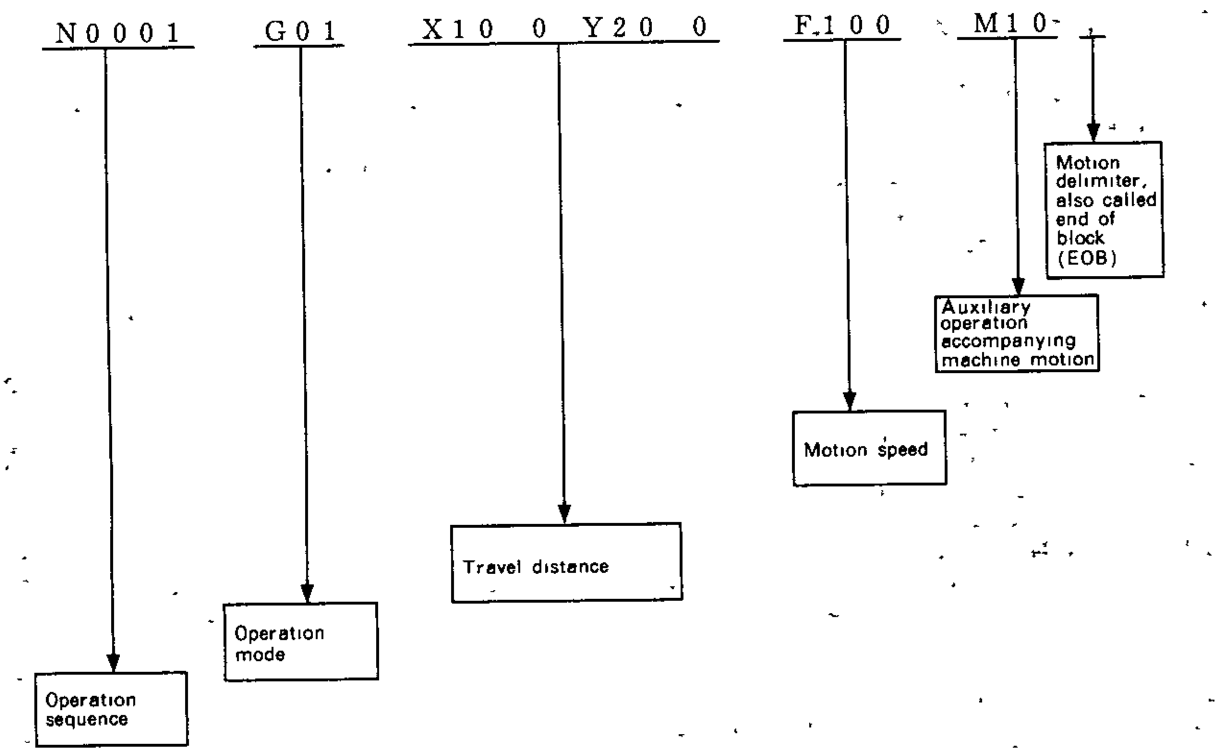


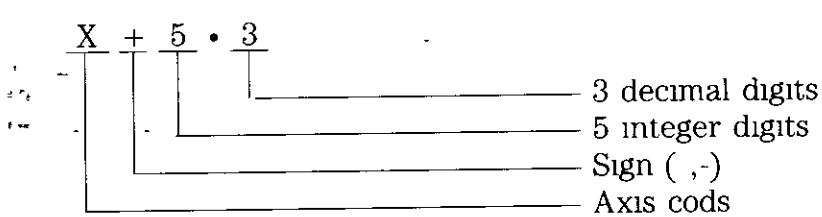
Fig. 3.1

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.

3.1 INPUT FORMAT

3.1.1 Input Format List

The numerals in the Table 3.1 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. 3.1.3 "DECIMAL POINT PROGRAMMING".

Table 3 1 Input Format list

Item	Format	Item	Format
Program No	O4	M-function	M2
Sequence No	N4	S-function	S5
G-function	G2	Offset No	H2 or D2
Axis Word	a+5 3 (Note)	Dwell Command	P5 3
Feedrate per Minute	F5	Program No Designation	P4
T-function	T2	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)

3.1.2 Address Characters

Table 3 2 shows the address codes and their meanings

Table 3 2 Address Characters

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

3.1.3 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,U,V,W,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

3.1.4 Decimal Point Movement

The decimal point position on the current value display can be moved by setting parameter # 1005 D_2—D_0

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 - # 1118 Jog feedrate setting
- Parameters # 1130 - # 1132 Rapid feedrate setting
- Parameters # 1407, # 1707, # 2007 Home positioning approach speed
- Parameters # 1408, # 1708, # 2008 Home positioning creep speed

Acceleration/deceleration:

- Parameters # 1412, # 1712, # 2012 Interpolation feedrate bias setting
- Parameters # 1404, # 1704, # 2004 First stage linear accel/decel constant
- Parameters # 1405, # 1705, # 2005 Second stage linear accel/decel constant
- Parameters # 1406, # 1706, # 2006 Accel/decel constant selection speed

Positions:

- Parameters # 1122 - # 1124 Step feed
- Parameter # 1125 Home position area setting
- Parameters # 1504, # 1804, # 2104 Soft limit boundary value in positive direction
- Parameters # 1505, # 1805, # 2105 Soft limit bonudary value in negative direction
- Parameters # 1202, # 1201 Combined operation command setting data

(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 00 Y12 340, results in an alarm

3.1.5 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 3 5 2 (2) "M-FUNCTION"

3.1.6 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

3.1.7 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 G01 X100,

NOTE

1 Normally, 4 blocks are read in advance Therefore, turn on the skip signal 5 blocks on this side of the programmer

2 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

3 If n in "/n" is omitted, it means "/1"

3.2 G-FUNCTION

3.2.1 List of G-Codes

Table 3 3 List of G-Codes

Function	GI	GII	Group	Command Word	Description
Positioning	G00	G00		G00X Y Z ,	Simultaneous rapid traverse along 3 axes to arrive at position X, Y, or Z
Linear Interpolation	G01	G01	01	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	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	G04		G04P ,	Waiting until the time duration specified by P elapses before starting to execute next block
Error Detect Off Positioning	G06	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	G10		G10H Q ,	Direct input of offset value in program
Plane Designation	G17 G18 G19	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	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 im mediately
Skip	G31	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
Bolt Line Circle Line at Angle Arc Grid (Drilling pattern cycle $)	G34 G35 G36 G37	— — — —	*	G34X Y I J L G35X Y I J L , G36X Y I J K L G37X Y I J K L ,	Performs positioning for individual functions using the coordinates specified by X and Y
Tool Diameter Offset Cancel $ Tool System Offset Command (Right) $ Tool System Offset Command (Left) $	G40 G41 G42	— — —	07	G40, G41D X Y , G42D X Y ,	These functions are started by command G41 or G42 and are canceled by G40 G41 and G42 indicate the direction in which the tool path is offset, in relation to the machine traveling direction
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	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

3.2.1 List of G-Codes (Cont'd)

Table 3 3 List of G-Codes (Cont'd)

Function	GI	GII	Group	Command Word	Description
Notch Signal B Output Command	G66	G66	*	G66X M ,	Signal output at the previously programmed position during positioning
	G67	G67		G67X M ,	
Notch Signal A Output Command	G68	G68	*	G68XH YH ,	Signal output at the previously programmed position during positioning
Notch Signal A Output Reset Command	G69	G69		G69	Notch signal output is reset
Deep Hole Drilling	G71	—		G71X Y Z R Q I L P F ,	Deep hole drilling operation
High-speed Deep Hole Drilling	G73	—		G73X Y Z R Q L F , G73X Y Z R I J K L F ,	High speed deep hole drilling operation
Reverse Tapping	G74	—		G74X Y Z R P L F ,	Reverse tapping operation
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	G90	03	G90	Designating motion data to be absolute
Incremental Command	G91	G91		G91	Designating motion data to be incremental
Programming of Absolute Zero Point	G92	G50	*	G92X Y Z ,	Designating position of "absolute zero point"
Threading Command$	—	G92	01	G92Z(W) F , G92X(U) Z(W) F ,	Threading operation
Feedrate per Minute	—	G98	04	G98,	Feedrate per minute
Feedrate per Revolution	—	G99		G99,	Feedrate per revolution
Constant Surface Speed Control$	—	G96	06	G96	Constant Surface Speed
Constant Surface Speed Cancel$	—	G97		G97,	Constant Surface Speed Cancel

$ Optional

Notes 1 Mark ⌉ indicates that the power is turned on and the marked function is automatically selected

2 GI — Standard G code
GII — G code for lathe

(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) Setting 1 for parameter # 1003 D7 provides specifications for a lathe system Lathe system specifications differ from standard specifications as follows

(a) On the X and Y axes, one pulse stands for 0 5 micron

(b) The following G-functions are disabled combined operation command, drilling pattern cycle, and offset

(c) Functions of the following G-codes are changed

Standard GI	Lathe System GII
G92 Programming of absolute home position	Threading command
G98 Combined operation command initial point return	Feedrate per minute command (mm/min)
G99 Combined operation command R point return	Feedrate per revolution command (mm/rev)

3.2.2 Positioning (G00)

(1) $\boxed{\text{G00 X Y Z ,}}$

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) A fast feedrate can be determined on each axis Three levels of overriding of L, M, and H can be selected A maximum achievable feedrate is 36,000 mm/min

(Program example) G00 X4000 Y4000 Z4000,

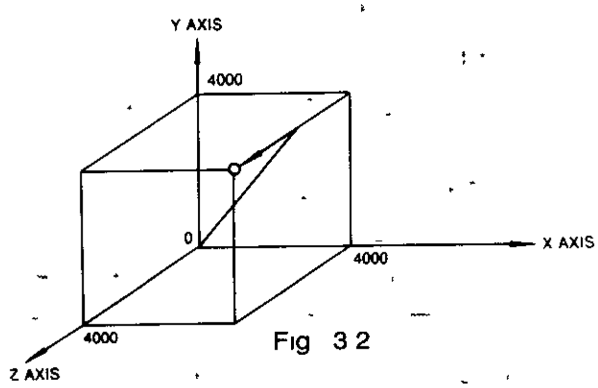


Fig 3 2

Rapid traverse rates
X-Axis 8 m/min
Y-Axis 8 m/min
Z-Axis 4 m/min

(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

3.2.3 Error-Detect-Off Positioning (G06)

$\boxed{\text{G06 X Y Z ,}}$

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

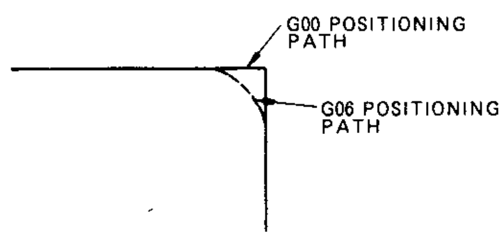


Fig 3 3

3.2.4 Linear Interpolation (G01)

(1) $\boxed{\text{G01 X Y Z F ,}}$

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,

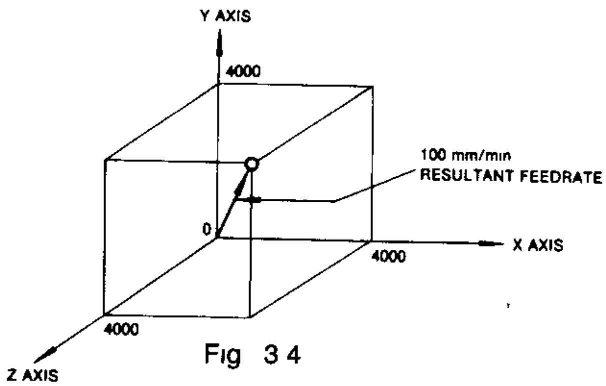


Fig 3 4

(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

$F = 400 = \sqrt{Fx^2 + Fy^2 + Fz^2}$
(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

3.2.5 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

3.2.5 Circular Interpolation (G02, G03) (Cont'd)

The rotating direction of the resultant motion is specified as follows

G02 Clockwise
G03 Counterclockwise

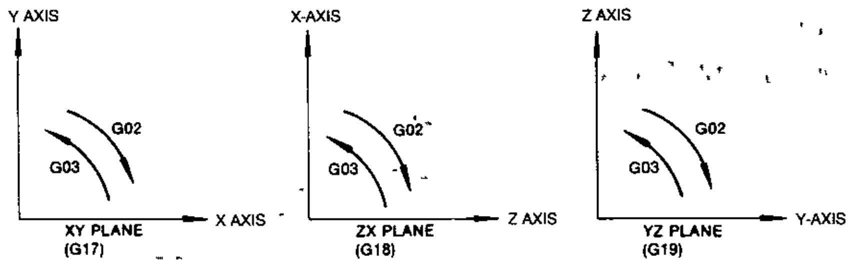


Fig 3 5

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

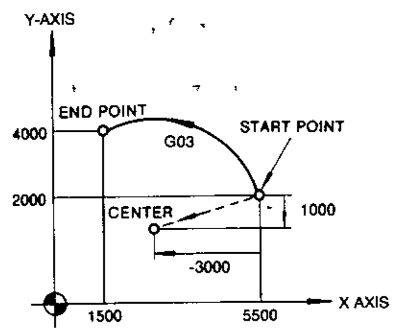
G17 XY plane
G18 ZX plane
G19 YZ plane

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

(Program examples)

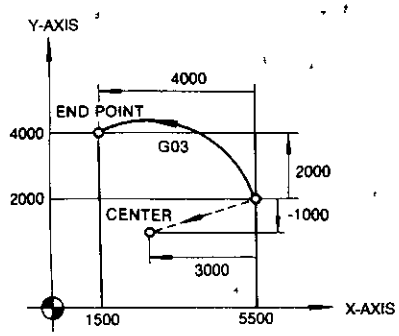
G17 G90 G03 X1500 Y4000 I-3000 J-1000 F150,

Fig 3 6 Absolute Programming (G90)



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

Fig 3 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 3 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 programmend, so when programming a complete circle, it must be divided into two commands

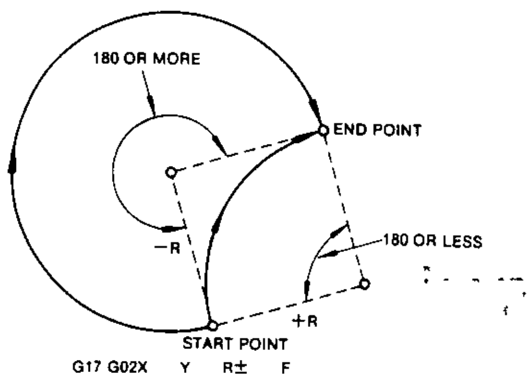


Fig 3 8

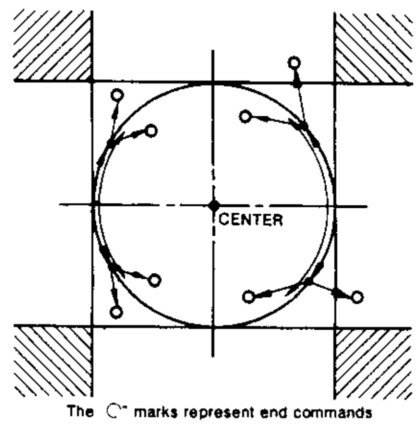


Fig 3 9

(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 ,

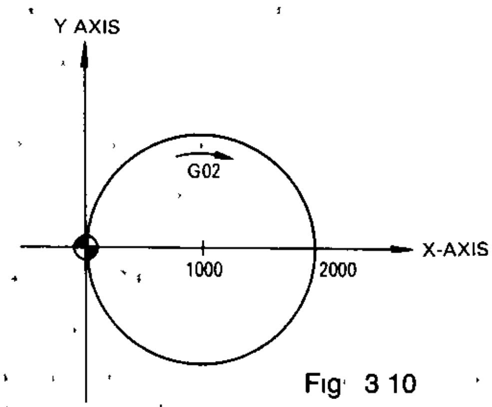


Fig 3 10

3.2.6 Helical Interpolation (G02, G03)

(1) Linear interpolation move is possible by an axis which is not included in the circular arc plane, synchronizing with the circular arc interpolation This movement is called helical interpolation

(2) Command format

(a) XY plane

$$G17 \begin{Bmatrix} G02 \\ G03 \end{Bmatrix} X \quad Y \quad \begin{Bmatrix} R \\ I \quad J \end{Bmatrix} Z \quad F \quad ;$$

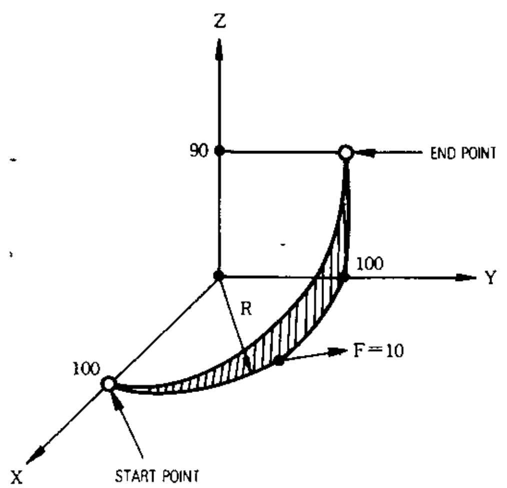
(b) ZX plane

$$G18 \begin{Bmatrix} G02 \\ G03 \end{Bmatrix} Z \quad X \quad \begin{Bmatrix} R \\ K \quad I \end{Bmatrix} Y \quad F \quad ;$$

(b) YZ plane

$$G19 \begin{Bmatrix} G02 \\ G03 \end{Bmatrix} Y \quad Z \quad \begin{Bmatrix} R \\ J \quad K \end{Bmatrix} X \quad F \quad ;$$

[Typical program]



(3) Precautions

(a) A circular arc must be within 360°

(b) Any position can be specified for the start point and end point only if condition (a) is satisfied

(c) Feedrate F indicates the circular arc contact line speed on the circular arc plane

Therefore, speed (F') of the linear axis can be obtained as follows

$$F' = F \times \frac{\text{(Linear axis length)}}{\text{(Circular arc length)}}$$

(d) Tool radius offset C is applied only to a circular arc plane

(e) If the circular arc contact line speed and linear axis speed exceed the value set in parameter #1102, the speed of the fastest axis is controlled so that it will not be larger than parameter #1102 value

3.2.7 Dwell (G04)

(1) $\boxed{\text{G04 P ,}}$

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

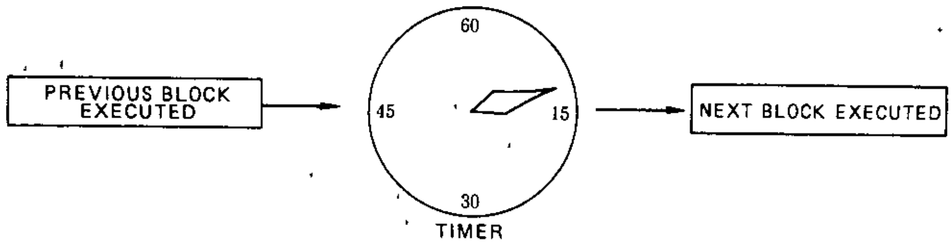


Fig 3 11

(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

3.2.8 Offset Value Input (G10)

Offset value data can be directly written in the program

(1) Offset Value Absolute Command

The command block

$\boxed{\text{G10 H Q ,}}$

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 built-in sequencer or the machine I/O input pin
The command block

$\boxed{\text{G10 H U ,}}$

causes offset value data (BCD signal) input from the input signal number specified in U (U4000-U4599) to be written into the offset number specified in H The previously entered offset value data is updated

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

# 1005	D7	D6	D5	D4	D3	D2	D1	D0
					—	—	—	—

- D4: Two digit designation (1 byte or 8 bits)
- D5: Four-digit designation (2 bytes or 16 bits)
- D6: Six digit designation (3 bytes or 24 bits)
- D7: Eight-digit designation (4 bytes or 32 bits)

NOTE

1 Only numeric values with no decimal point can be designated

2 To designate a minus sign, externally input the external offset data minus sign signal (EINV) together with the offset data
(The plus sign need not be entered) The I/O number for the external offset data minus sign signal is 40074 The signal is assigned to pin 9CN-22 in a standard ladder program

3 If the I/O signal number specified by U is not coded in BCD, alarm 24 occurs

(3) Parameter Value Write Command

Parameters can be changed using the G10.command during MDI or MEM operation Specify a numeric value Q or offset number for the parameter number P in the following format

G10 P Q ,

or

G10 P QH ,

The following parameters can be changed

1006, # 1120 to # 1129, # 1130 to # 1139
1149, # 1200 to # 1209
1400 to # 1459, # 1700 to # 1759, # 2000 to # 2059

Parameters # 1400 to # 1459, # 1700 to # 1759, and # 2000 to # 2059 can be changed when parameter # 1012D7 is 1

NOTE

If parameter number which cannot be changed is specified, alarm 24 occurs

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

# 4210	7	8
# 4211	5	6
# 4212	3	4
# 4213	1	2

(BCD Indication)

or

	D7	D6	D5	D4	D3	D2	D1	D0
# 4210	0	1	1	1	1	0	0	0
# 4211	0	1	0	1	0	1	1	0
# 4212	0	0	1	1	0	1	0	0
# 4213	0	0	0	1	0	0	1	0

(Bit Indication)

G10 H20 U4210,
sets 345678 in offset number H20

3.2.9 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

3.2.10 Automatic Home Positioning (G28)

(1) $\boxed{\text{G28 X Y Z ;}}$

With this command, first, the machine is moved to X, Y, Z by quick feed (G00), and then, to the home position However, immediately after the power is turned on, the machine moves directly to the home position 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 ;

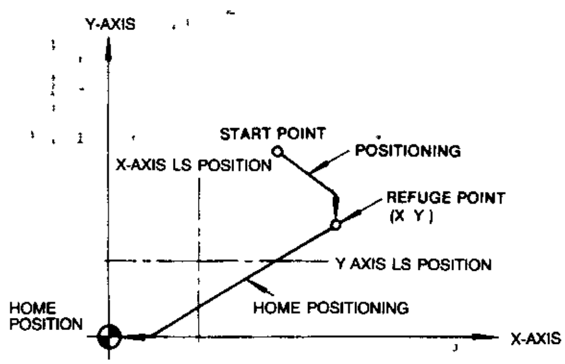


Fig 3 12

NOTE

If an absolute encoder is used, the above is usually not applied If no home position LS is used, the machine is moved to the stroke end

(2) High Speed Home Positioning Specifications

(a) High speed home positioning 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 point return operation is performed only at the first time

NOTE

If an absolute encoder is used, the first return to the reference point has been completed at power-on

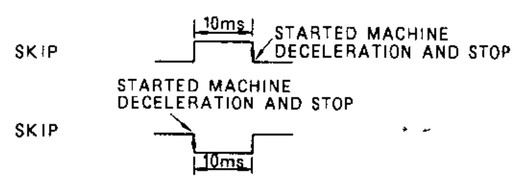
(d) When high speed reference point return specifications are made, a return can be made to the reference point even if the starting position is beyond the area where reference point return is enabled

3.2.11 Skip Function (G31)

(1) $\boxed{\text{G31 X Y Z F ,}}$

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,

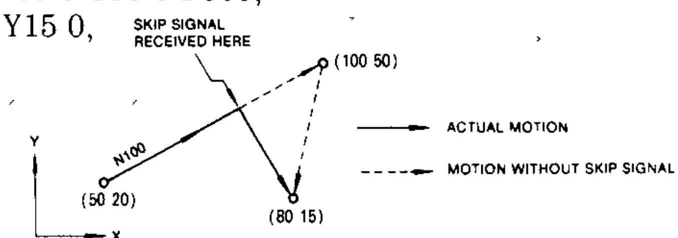
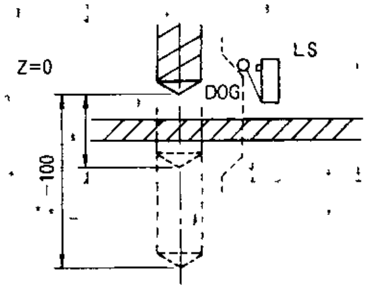


Fig 3 13

3.2.11 Skip Function (G31) (Cont'd)

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

When the skip signal is input (LS is from ON to OFF) during execution of N001, the machine stops at that time Then the program advances to the next block N002



If no skip signal is from ON to 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 from ON to OFF a skip signal, the program is advanced automatically to the next block with no alarm

(4) During the skip operation, the axis position where the skip signal was turned OFF and the machine stopped is written immediately to the following offset area
X H297
Y H298
Z H299

3.2.12 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 4 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

Table 3 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

	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

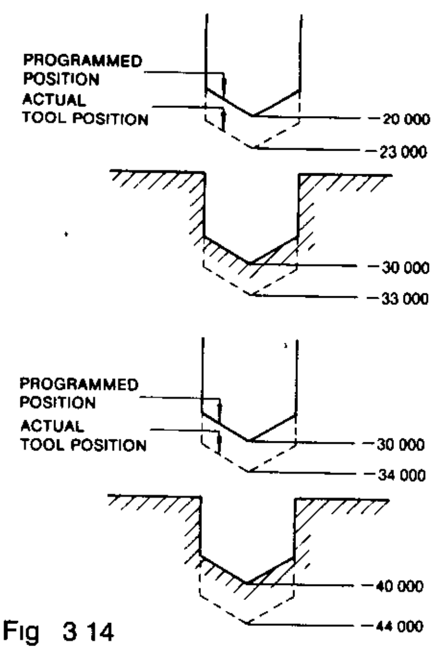


Fig 3 14

3.2.13 Position Offset in X-and Y-Axis (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 3 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,
① G00 G46 X  Y  D01,   REDUCTION
② G01 G47 Y  (D01) F  ,DOUBLE EXTENSION
③        G47 X  (D01),  DOUBLE EXTENSION
④        G47 Y  (D01),  DOUBLE EXTENSION
⑤        G47 X  (D01),  DOUBLE EXTENSION
⑥ G00 G46 X  Y  (D01), REDUCTION
```

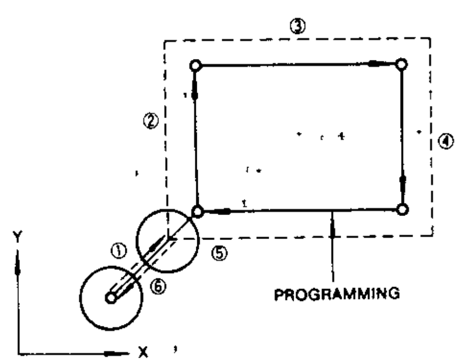


Fig 3 15

(5) Length for Extension or Reduction

(a) One or two times the programmed offset length is added or subtracted, selectively See Fig 3 16

G91 G00 G47 X6000 D10, D10=2000

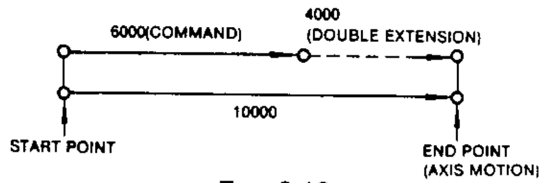


Fig 3 16

(b) When the motion has been extended or reduced 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 3 17

With the same command as above (a)

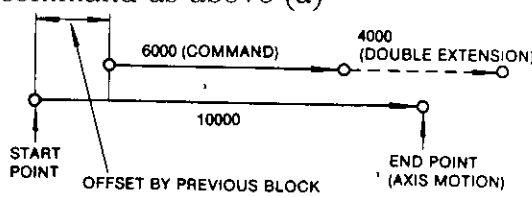


Fig 3 17

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

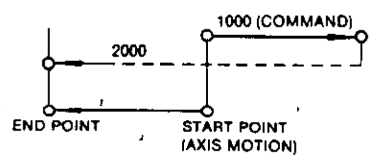


Fig 3 18

(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

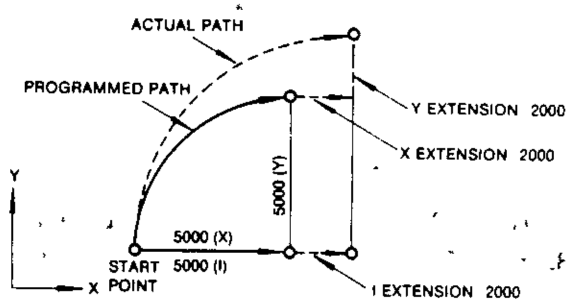


Fig 3 19

3.2.13 Position Offset in X-and Y-Axis (G45 to G48) (Cont'd)

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

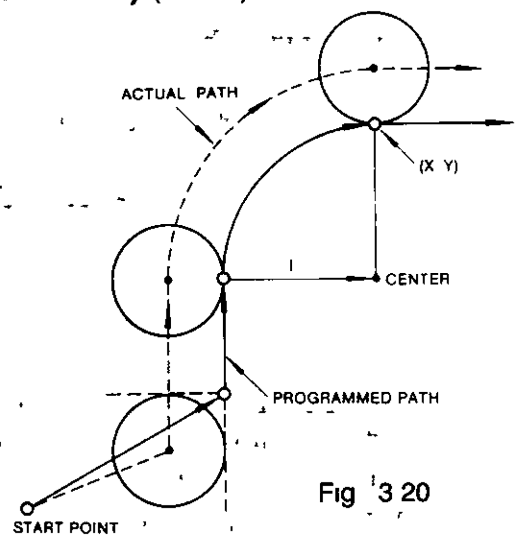


Fig 3 20

(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 3 21

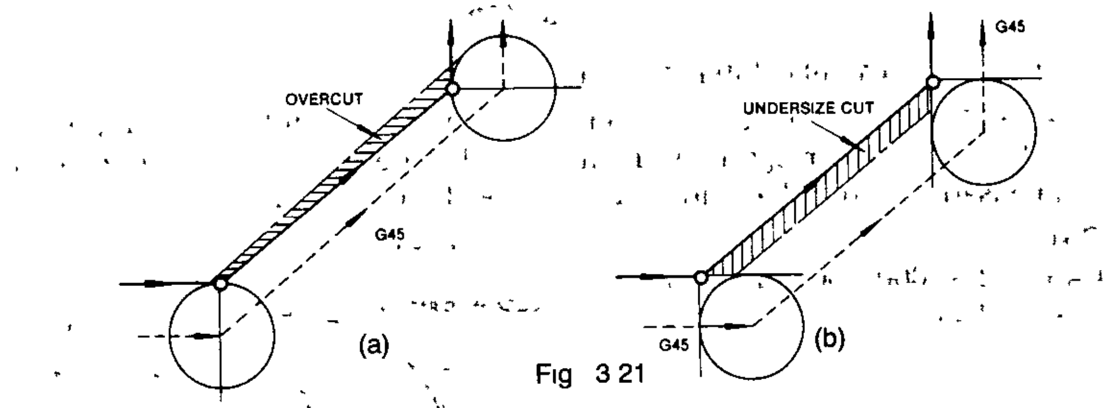


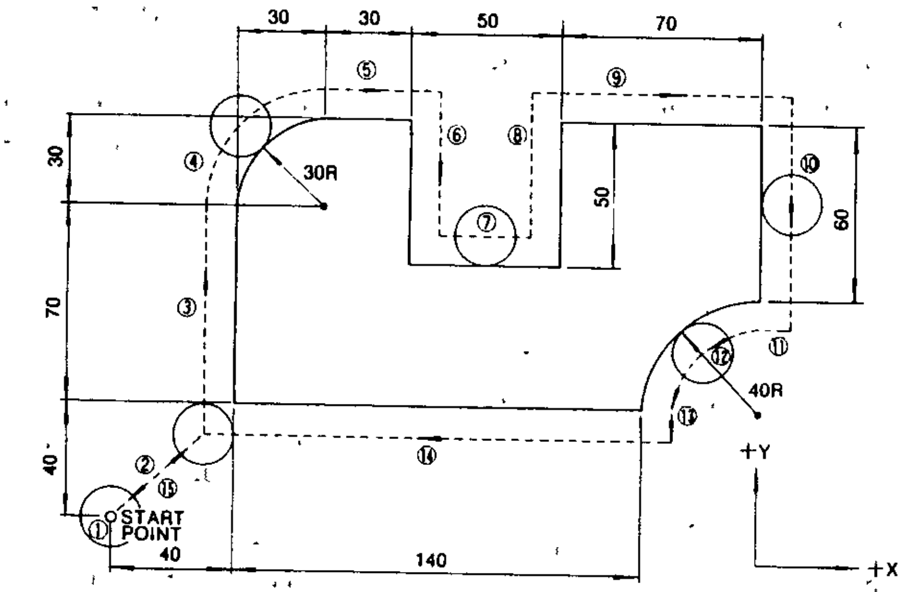
Fig 3 21

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

(Program example)



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

Fig 3 22

3.2.14 Return-to-Machine Coordinate System (G53)

With MOTIONPACK-120, 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 2 13 "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 ,

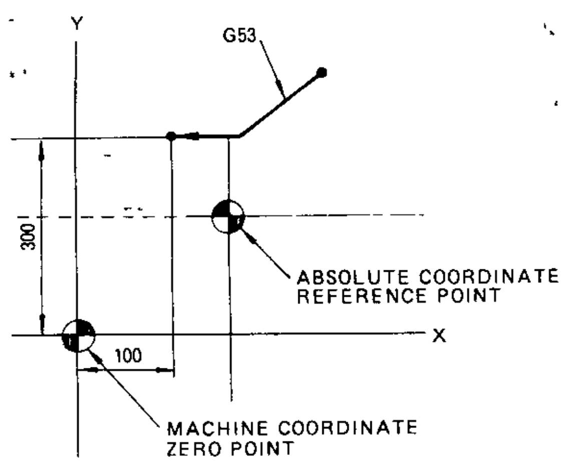


Fig 3 23

3.2.15 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

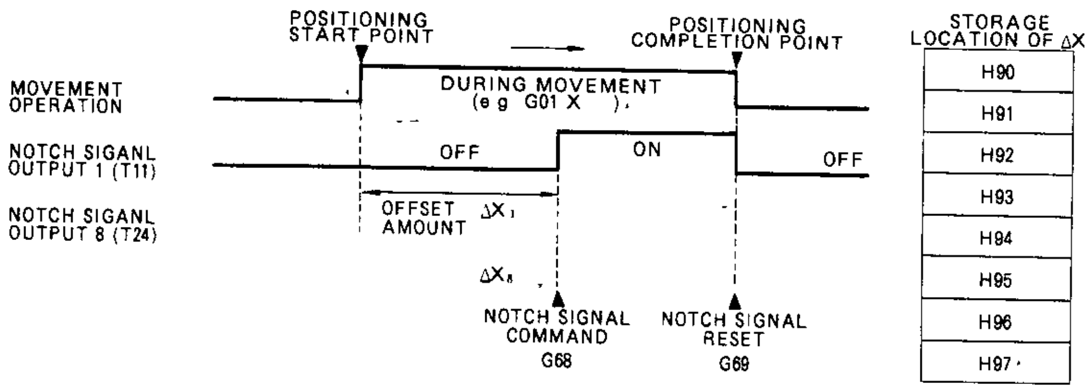


Fig 3 24 Notch Signal

(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 ,	Notch signal output command block
G68 XH90 YH94,	(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, T21 is turned on)
G01 X100 Y200 F50,	Positioning command block
G69,	Notch signal output reset command block

3.2.15 Notch Signal Commands A (G68, G69) (Cont'd)

(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 3 6. A maximum of eight pairs are available

Table 3 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 4 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

3.2.16 Notch Signal Commands B (G66, G67)

The notch signal can be turned ON and output at the previously programmed position (position axis) 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 ,	Notch signal output designation block
G66 X20 M81 ,	Turn on T11 at X20 passing
G67 X50 M85	Turn on T21 at X50 passing
G00 X100 ,	Positioning command block

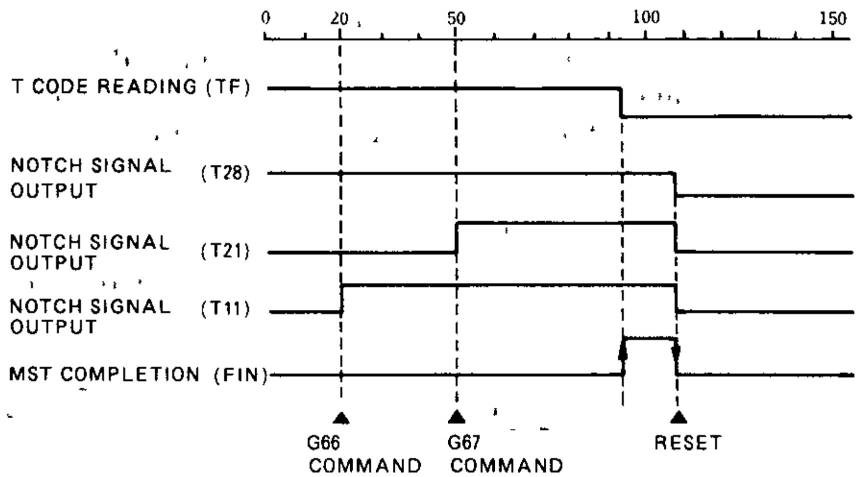


Fig 3 25

(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 3 7 Both high and low speeds can be used at any given point

Table 3 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 signals, 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

3.2.17 Combined Operation Commands (G71 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 used with G83 is set by using parameter # 1202

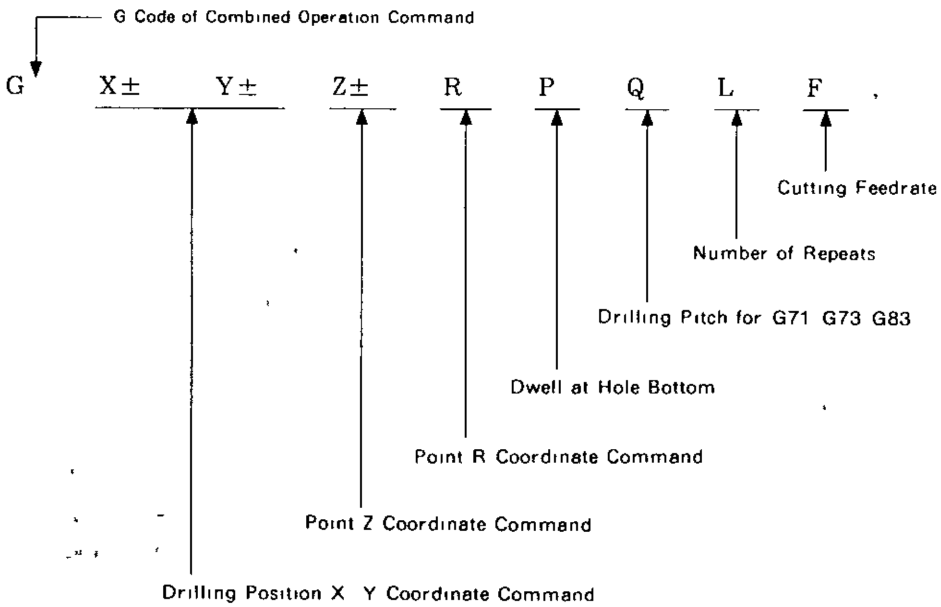
(1) List of Combined Operation Commands

Table 3 8 lists the combined operation command G codes and operations

Table 3 8

G Code	Plunging	At hole bottom	Retraction	Application
G71	Wood pecker feed	Dwell	Rapid traverse	Deep hole drilling
G73	Cutting feed	—	Rapid traverse	Deep hole drilling
G74	Cutting feed	Forward running of spindle after dwell	Reverse running of spindle after cutting feed	Reverse tapping
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 Posotioning 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

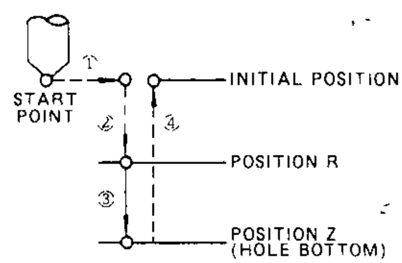


Fig 3 26

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 returning 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 3 9 List of Combined Operation Commands

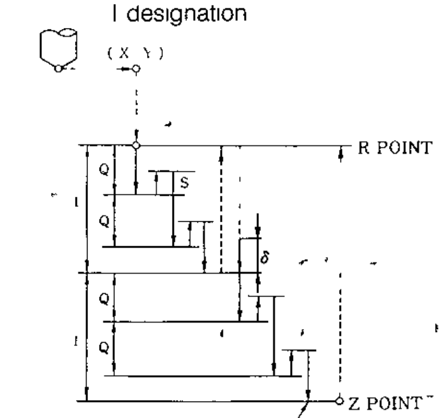
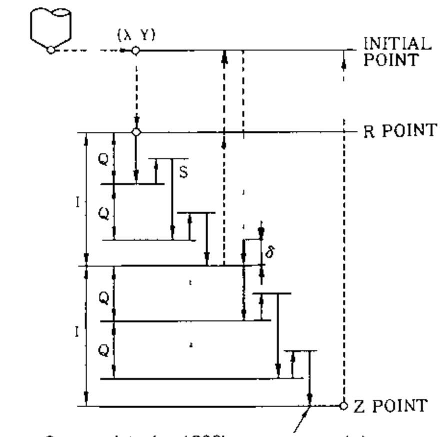
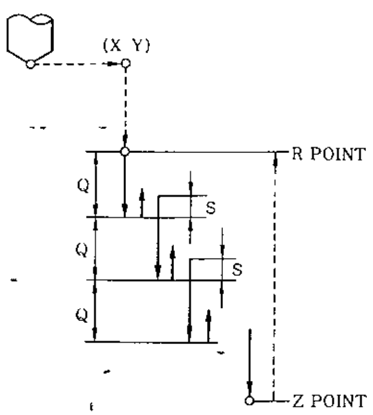
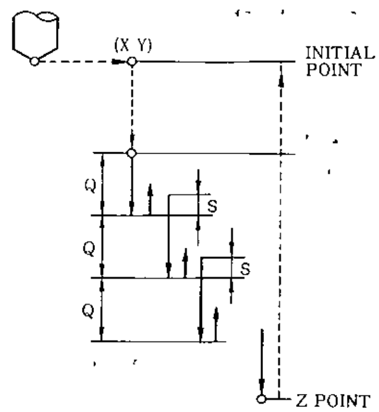
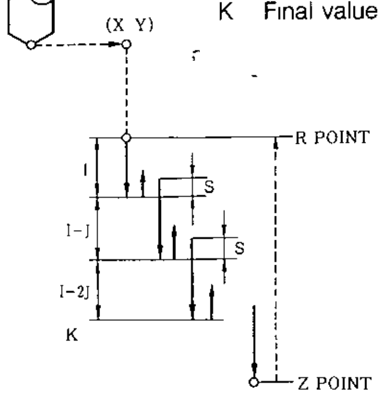
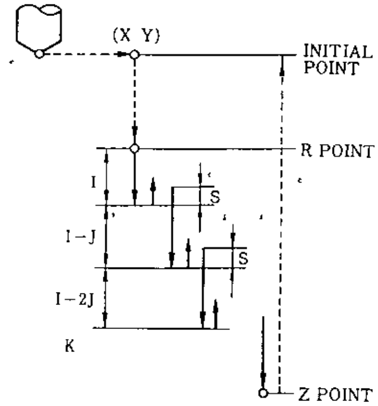
	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G71	G 71 X Y Z R Q I	L P F ,
Deep Hole Drilling	Same as G73 except for I designation  δ Setting data (# 1202) S Setting data (# 1201)	 δ Setting data (# 1202) S Setting data (# 1201)
G73 (Fixed Pitch)	G 73 X Y Z R Q L	F ,
High-Speed Deep Hole Drilling	 S Setting data (# 1201)	 S Setting data (# 1201)
G73 (Variable Pitch)	G 73 X Y Z R I J	K L F ,
High-Speed Deep Hole Drilling	I Initial value J Reducing value K Final value  S Setting data (# 1201)	 S Setting data (# 1201)

Table 3 9 List of Combined Operation Commands (Cont'd)

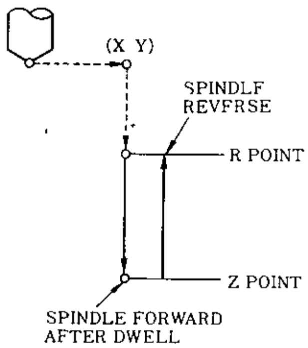
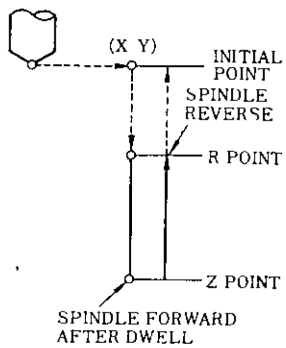
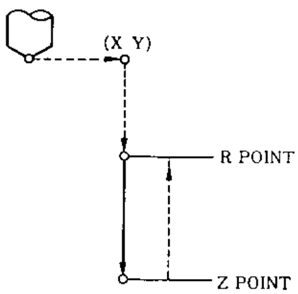
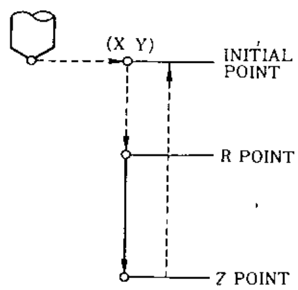
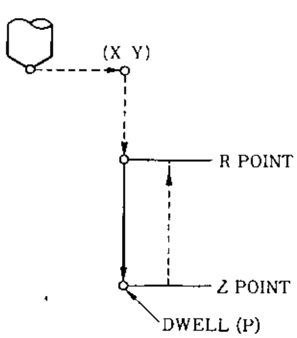
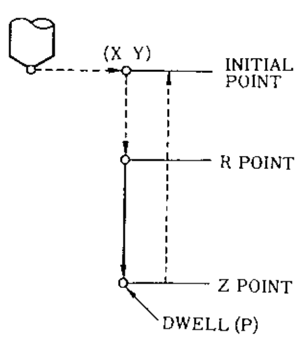
	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G74 Reverse Tapping	G 74 X Y Z R P L F , 	
G80 Cancel	G 80 ,	
G81 Drilling	G 81 X Y Z R L F , 	
G82 Spot Facing	G 82 X Y Z R P L F , 	

Table 3.9 Combined Operation Commands (Cont'd)

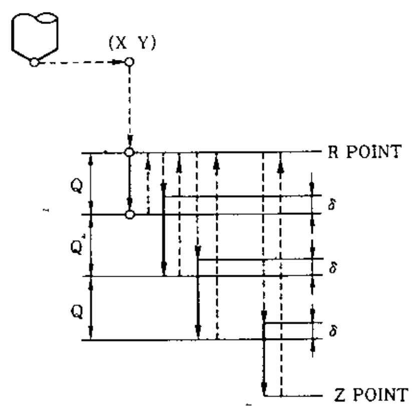
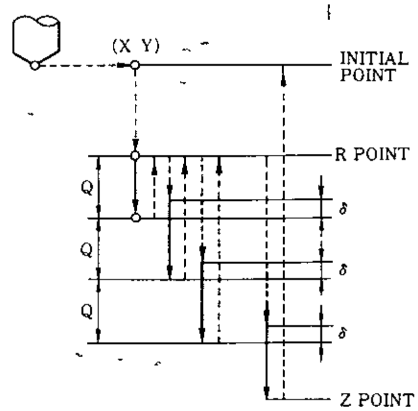
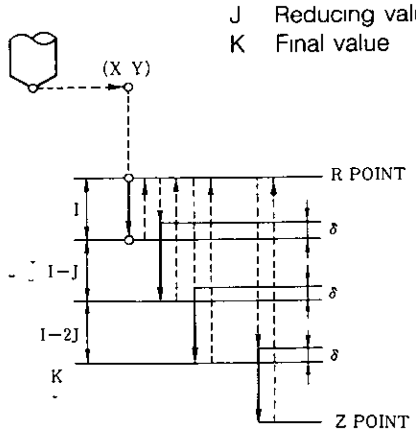
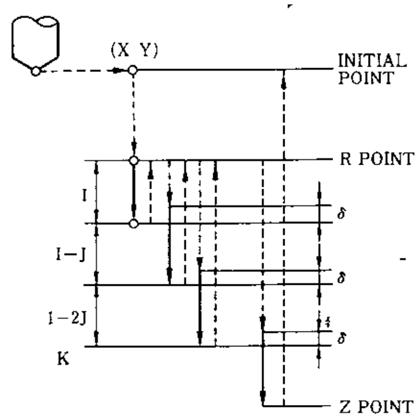
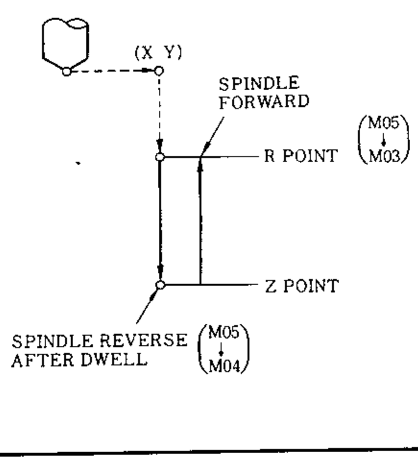
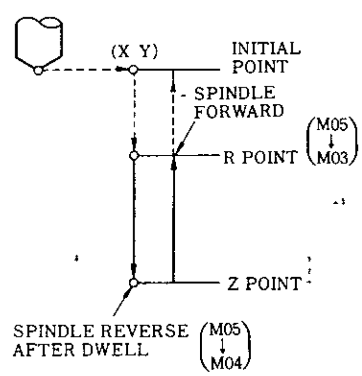
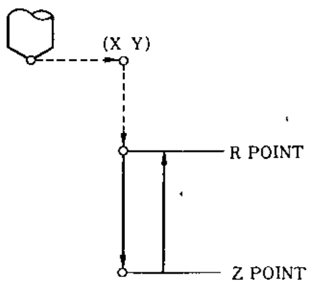
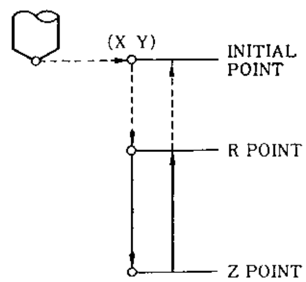
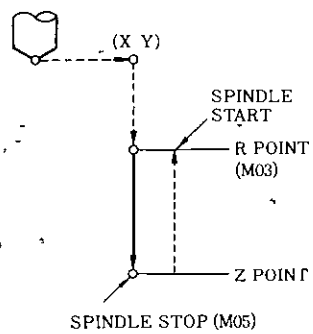
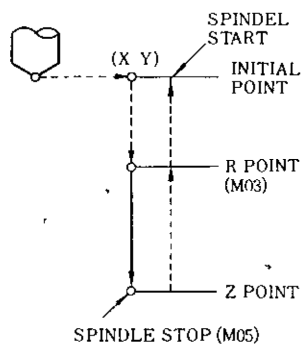
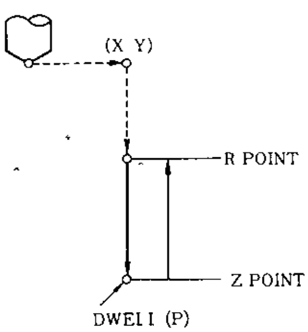
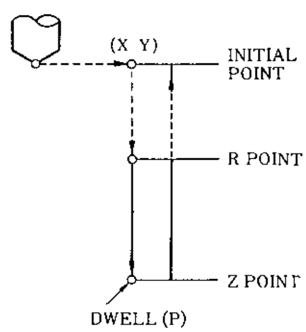
	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G83 (Fixed Pitch)	G 83 X Y Z R Q L	F ,
Deep Hole Drilling	 δ Setting data (# 1202)	 δ Setting data (# 1202)
G83 (Variable Pitch)	G 83 X Y Z R I J I Initial value J Reducing value K Final value	K L F ,
Deep Hole Drilling	 δ Setting data (# 1202)	 δ Setting data (# 1202)
G84	G 84 X Y Z R P L	F ,
Tapping		

Table 3 9 Combined Operation Commands (Cont'd)

	With G99 (Return to R Point)	With G98 (Return to Initial Point)
G85	G 85 X Y Z R L F ;	
Boring		
G86	G 86 X Y Z R L F ;	
Boring		
G89	G 89 X Y Z R P L F ;	
Boring		

3.2.17 Combined Operation Commands (G71 to G99) (Cont'd)

(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 , Return to point R, incremental

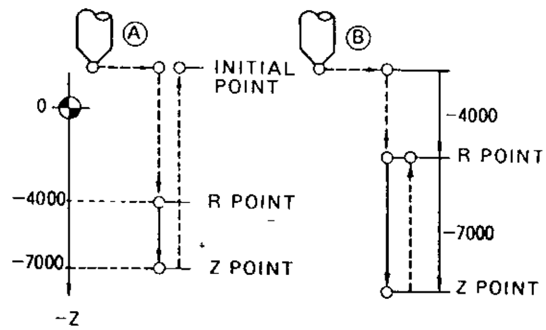


Fig 3 27

Program	Absolute Position Z =	Absolute Position R =	Remarks
Ⓒ N1 G92 X0 Y0 ZO ,			
N2 G98 G90 G81 X1000 Y1000 Z-5000 R-2000 F100 ,	−5000	−2000	Combined operation command
N3 G91 X2000 R-3000 ,	−5000	−3000	Change in X, R
N4 Z-5000 ,	−8000	−3000	Change in Z
N5 G99 Z-4000 R-5000 ,	−9000	−5000	Change in R, Z
N6 G80 G00 Z5000 ,	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

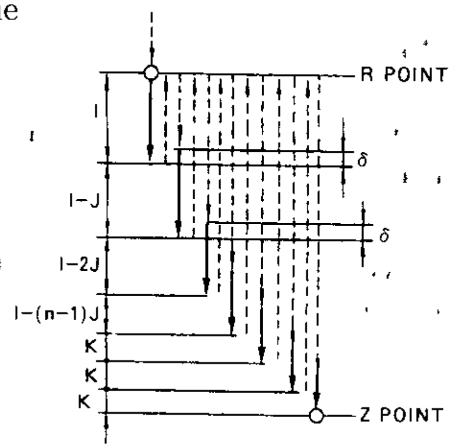
(4) Cautions of Combined Operation Command

(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 3 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

3.2.17 Combined Operation Commands (G71 to G99) (Cont'd)

(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

- After positioning to (X, Y) point
- After positioning to R point
- 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

$\boxed{\text{X, Y, Z}}$

(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

$\boxed{\text{G-codes of * group except for G04}}$

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 foward 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
Z-10 0F ,
X R-7 0 ,
X Z-3 0 ,
R-4 0 Z-11 0 ,

Point R	Point Z
−5 0	−10 0
−7 0	−12 0
−7 0	−10 0
−4 0	−15 0

(Program example)

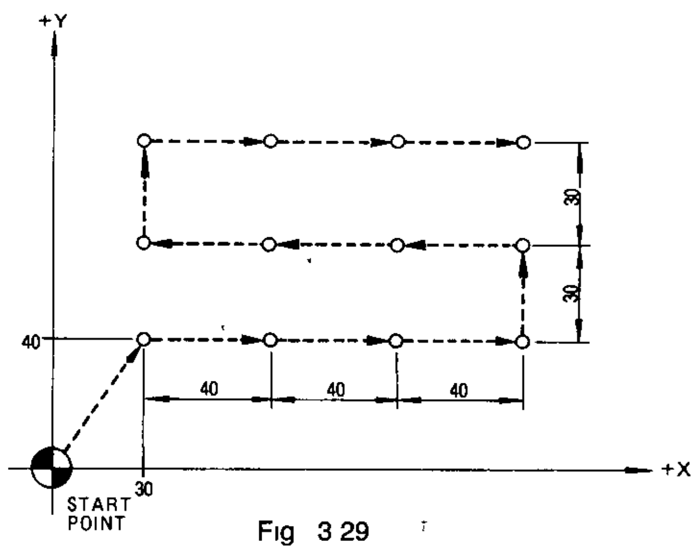


Fig 3 29

⋮

```
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 , }  Subprogram for drilling
N103     Y3000 ,     }  position pattern
N104     X4000 L3 ,  }
N105 G09 G80 ,       }
N106     M99 ,       }
```

3.2.18 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 3 30)

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 3 30)

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

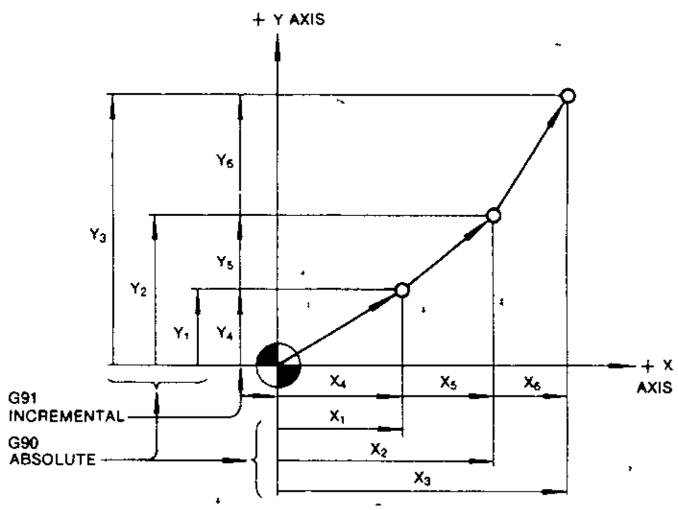


Fig 3 30

3.2.19 Programming of Absolute Reference Point (G92, G50)

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) $\boxed{\text{G92 X \quad Y \quad Z \quad ,}}$

With this commnad, the current machine position is entered as a point (X,Y,Z) in one arbitrarily selected absolute coordinate system This is, this command designates the signed distances in the three coordinate directions from a desired coordinate home position (0, 0, 0), designating home position in this way See Fig 3 31

(Program example)

G92 X50000 Y30000 Z40000,

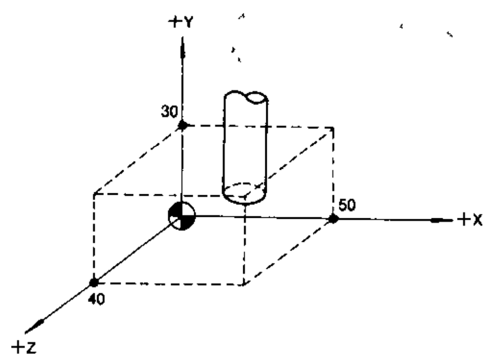


Fig 3 31

(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 home positioning before starting operation

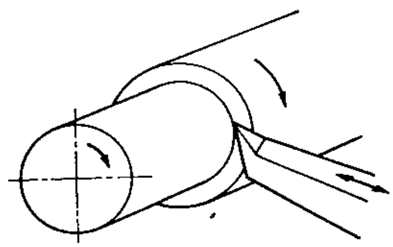
(3) As a special example, coordinate shift equivalent to G92 can be made by position cancel operation from the CRT control station

(4) Lathe system requires G50 If G92 is programmed in the lathe system, it functions as threading command

3.3 LATHE SYSTEM SPECIFICATIONS

When a workpiece shown in the figure is rotated and cut on a lathe, the workpiece finishing shape is guaranteed by diameter-based specifications

MOTIONPACK-120 supports this type of function as the lathe facility To use this facility, switch the parameter setting from standard to lathe system Optional functions such as main spindle feed per revolution (mm/rev) and threading can be used by adding a main spindle module and main spindle encoder



3.3.1 Parameter Setting

In the lathe system specifications, some parameters have a reference value different from that for the standard system One pulse stands for 0 5 micron on the X and Y axes with the lathe system specifications, whereas one pulse stands for 1 micron with the standard system specifications

Some standard system functions are not available with the lathe system specifications

(1) Switching to Lathe System Specifications

#· 1003 D7
1 Lathe system specifications
0 Standard system specifications

Turning on this parameter selects the specifications for the lathe system

(2) Changing Parameter Reference Values for Diameter (Lathe) Commands

When the lathe system specifications are selected, set all parameters with diameter commands

[Example] (Rapid feedrate setting)

On the X-axis # 1130
1 = 3 75 mm/min

- # 1412, # 1712 (interpolation feedrate bias) 1 = 3 75 mm/min
- # 1130, # 1131 (repid feedrate setting) 1 = 3 75 mm/min
- # 1404, # 1704 (first stage linear accel/decel constant) 1 = 7 8125 mm/S²
- # 1406, # 1706 (second stage linear accel/decel switching point speed) 1 = 3 75 mm/min
- # 1405, # 1705 (second stage linear accel/decel constant) 1 = 7 8125 mm/S²
- # 1407, # 1707 (reference point return approach speed) 1 = 3 75 mm/min
- # 1408, # 1708 (reference point return creep speed) 1 = 3 75 mm/min

3.3.2 Feedrate per Minute and per Revolution

(1) Commands

Use the following commands to set feedrate per minute (mm/min) or per revolution (mm/rev)

G98, mm/min
G99, mm/rev

(2) Unit Feedrate ("F") Setting

Feedrate Setting	Unit
Per minute	1 = 1000 pulses/min (No decimal point can be input) For diameter axis specification, 1 = 2000 pulses/min
Per revolution	1 = 1 pulse/rev For diameter axis specification, 1 = 2 pulses/rev Notes 1 If a decimal point is used in the specification, the number of effective digits after the decimal point is determined by the decimal point position parameter (Example) For three digits after decimal point F 1 1234 1123 pulses/rev F 1 12 1120 pulses/rev F123 123 pulses/rev 2 If an override less than 100% is used, feedrate after the least effective digit is disregarded

(3) F-command for Switching Feedrate per Minute and per Revolution

After changing feedrate setting from per-minute to per-revolution or vice versa, specify "F" (feedrate) Because the different units, the previously set feedrate is cleared when per-minute and per-revolution feedrates are changed

If the axial movement command is executed without entering the F-command after changing the feedrate unit, alarm "19" occurs

(4) Specifying Feedrate per Minute using the Per-revolution Command

Feedrate per revolution cannot be specified in a system supporting a PG without a spindle If the user wishes to specify feedrate per revolution, in such a system, convert feedrate per minute to per revolution with the MOTIONPACK-120 controller The feedrates are calculated as follows

F (mm/rev) × S (rpm) = F' (mm/min)

F (mm/rev) and S (rpm) are the specified values in the transfer program

NOTE

The maximum achievable feedrate per revolution satisfies the following
$F \times S \leq 24{,}000{,}000$ pulses/min
When 1 pulse stands for 1 micron, $F \times S \leq 24$ mm/min

3.3.3 Plane Designation

For a normal lathe system, Z-X plane (G18) or Z-Y plane (G19) must be selected for threading commands

When power is turned on, G17 plane is automatically selected for standard system specifications For lathe system specifications, G18 plane is selected

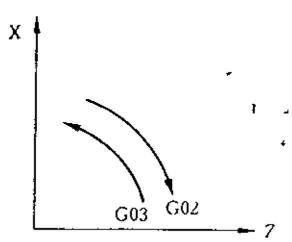


Fig 3 32 Z-X Plane

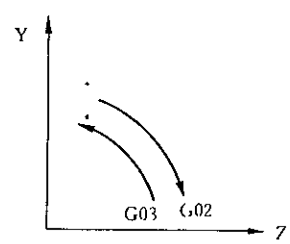


Fig 3 33 Z-Y Plane

3.3.4 Programming of Absolute Reference Point

For standard system specifications, either G92 or G50 can be used for programming of absolute reference point For lathe system specifications, only G50 can be used

3.4 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, defferent 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 coodinate word (X, Y, Z, U, V, W, I, J, K, F, L, P, R, Q)

```
□ H □□
│    └─ OFFSET NUMBER
└────── COORDINATE WORD
```

(Program example)

① Assuming that the program contains

$\boxed{\text{G01 XH10 YH20,}}$ and

② the offset value contents are

H10 = 50 0 mm, H20 = 5 0mm

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

$\boxed{\text{G01 X-H12 Z-H23,}}$

(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 3 2 7

3.5 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

3.5.1 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 3 34 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. 3.34 shows the time chart covering the above time relationship.

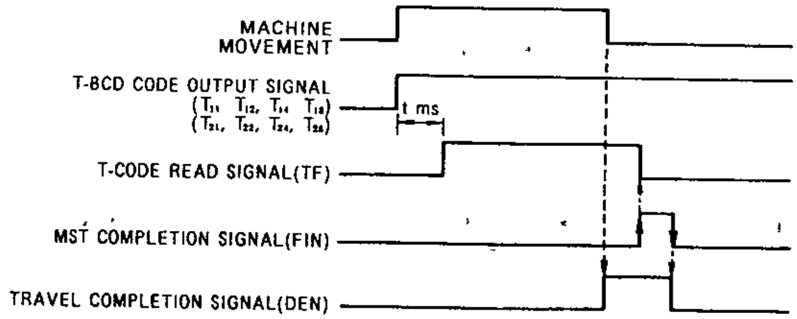


Fig. 3.34

(7) Special Use of T-Function Output Terminal

T-function output terminal can be used for a notch signal output. Refer to Pars. 3.2.14 and 3.2.15.

3.5.2 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 output, and returns an MST 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.

3.5.2 M-Function (Cont'd)

(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 3 35 shows the time chart covering the above time relationship

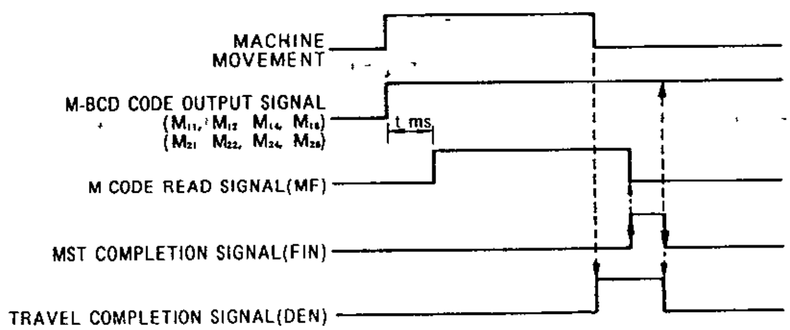


Fig 3 35

3.5.3 M-Codes for Stop (M00, M02, M30)

(1) M00 (Program stop)

M00 is 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 autmatic 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

3.5.4 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

3.5.5 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

M98 P L ,

NUMBER OF REPETITIONS OF SUBPROGRAMS
SUBPROGRAM NO BE INITATE

(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

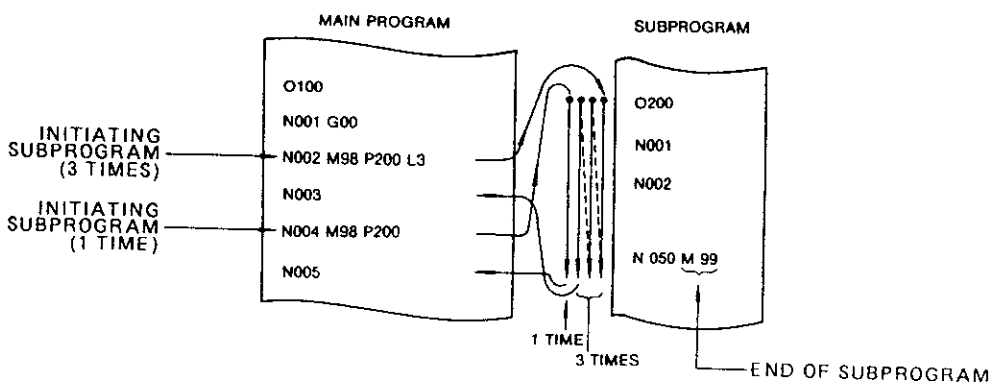


Fig 3 36

(3) Nesting Program

Subprograms can be nested to a maximum of four levels

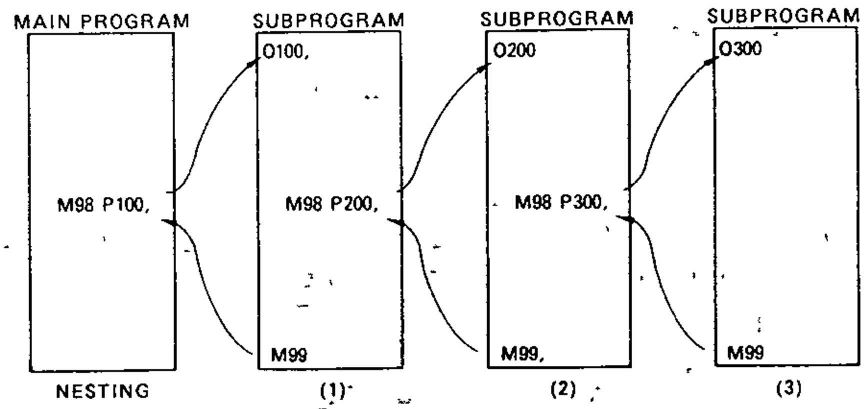


Fig 3 37

(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

3.6 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)

(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 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

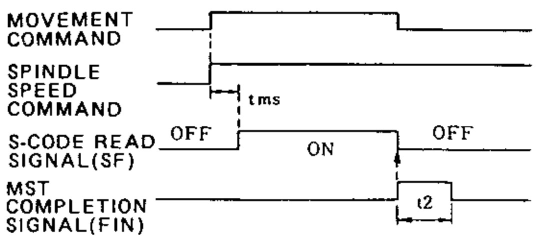


Fig 3 38

NOTE

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

(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

SECTION 4

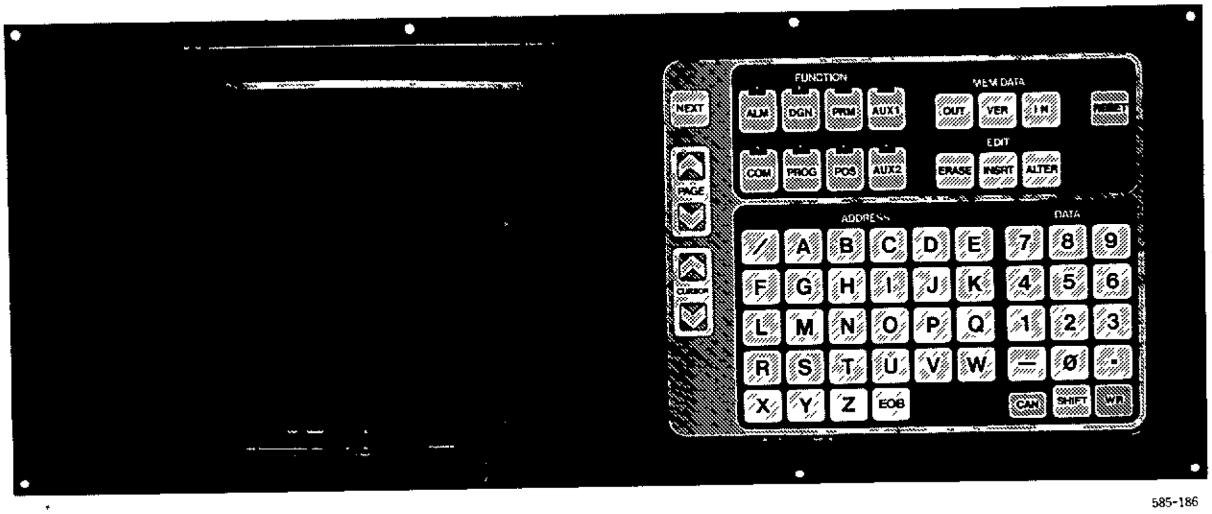
CONTENTS

4. OPERATION OF CRT CONTROL STATION

This chapter explains the CRT control station as the visible face of MOTIONPACK-120

4.1 CHARACTER DISPLAY AND KEYS

Fig 4 1 shows an overall view of the CRT control station The names and functions of operator components are as follows



585-186

Fig 4 1 CRT Control Station

4.1.1 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)]

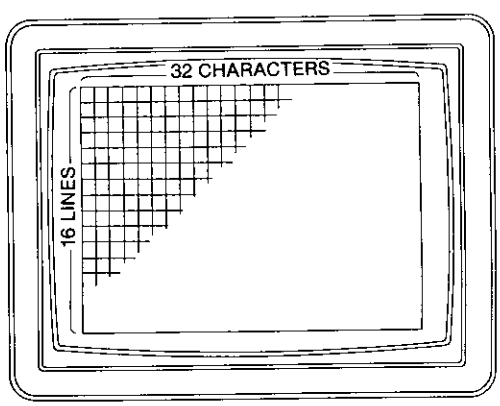
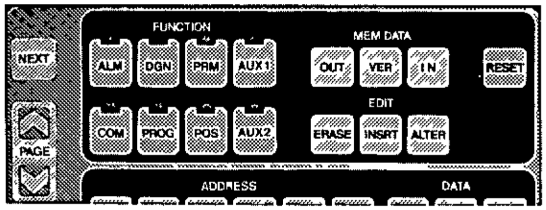


Fig 4 2

4.1.2 Function Keys

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



585-192

Fig 4 3

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

(2) DGN (Diagnosis) key This key is for displaying input/output signal status

(3) PRM (Parameter) key This key is for displaying and writing-in parameters

(4) AUX1 (Auxiliary) key This is an auxiliary key

(5) COM (Command) key This key is displaying command data for automatic operation

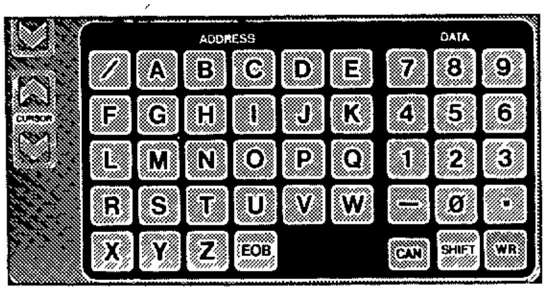
(6) PROG (Program) key This key is for displaying or writing-in programs

(7) POS (Position) key This key is for displaying various current positions

(8) AUX2 (Offset Data) key This key is for displaying or writing-in offset data

4.1.3 Address Keys

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

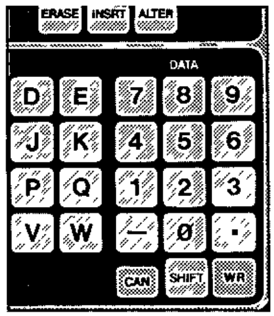


585 192

Fig 4 4

4.1.4 Data Keys

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



585-192

Fig 4 5

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

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

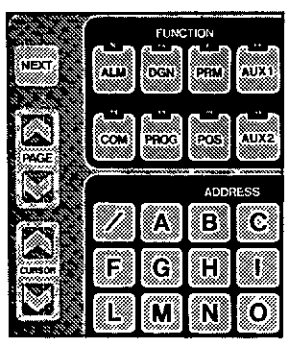
(3) [CAN] (Cancellation) key For cancellation of the numeric value or address data erroneously keyed

(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

4.1.5 Next Key

[NEXT] key is used at position cancel See Par 4 2 3



585-192

Fig 4 6

4.1.6 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 (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 key displays the next page

(2) Depressing key displays the previous page

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

4.1.7 Cursor Keys

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

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

(1) Depressing key moves the cursor backward

(2) Depressing key moves the cursor forward

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

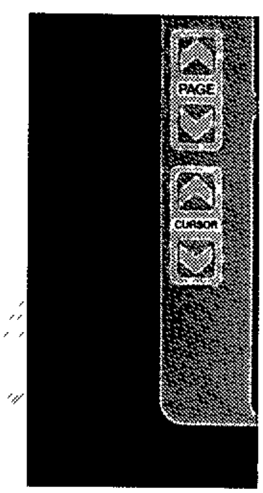


Fig 4 7

585-192

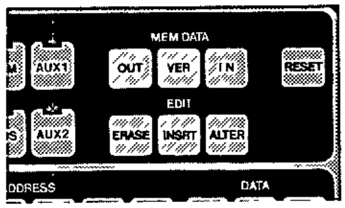
4.1.8 Edit Keys

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



585-192

Fig 4 8

4.1.9 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

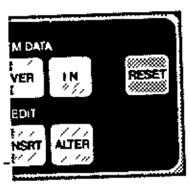
This key is to store various data from personal computers or the like into the memory through data input/output interface

(3) [VER] (Verify) key

This key is to examine and compare data in the memory with data in files of personal computers

4.1.10 Reset Key

This key is to reset the internal status



585 192

Fig 4 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

4.2 DISPLAY AND WRITING OPERATION

4.2.1 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

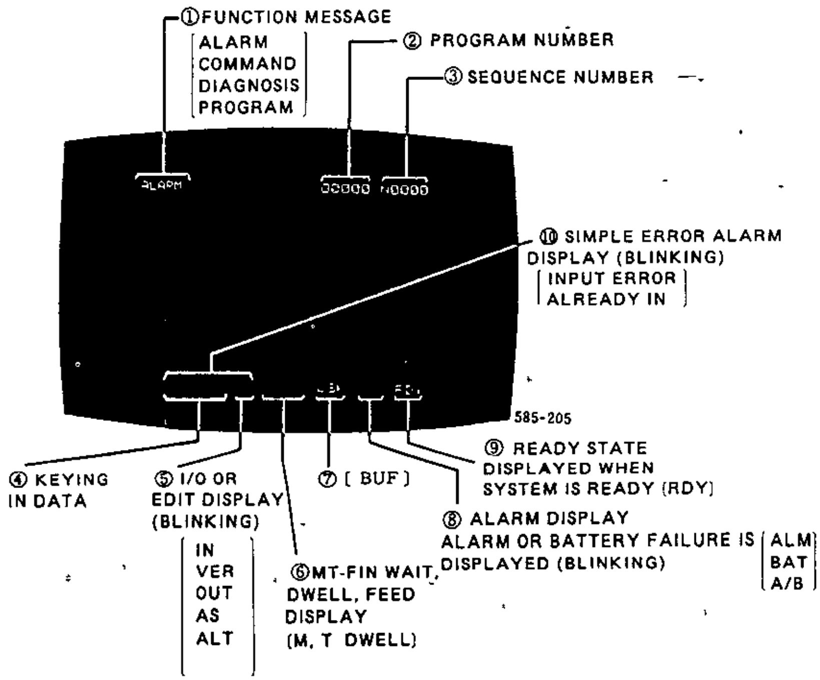


Fig 4 10

(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-comman
"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

4.2.1 General Display (Cont'd)

(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 or registered programs exceed 99
"NOT FOUND!"	Desired data has not been found by searching

4.2.2 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

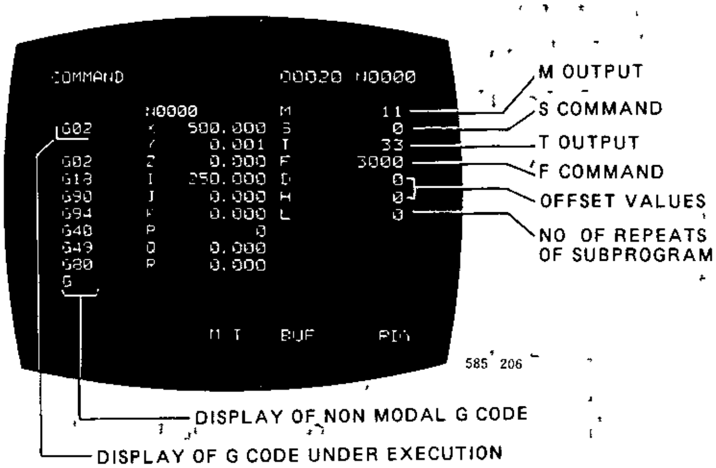


Fig 4 11 Example of Display of Command Data

(3) MDI Operation

(a) Select the MDI mode

(b) Depress the RESET key

After switching to the MDI mode during operation in the MEMORY mode, reset the system to clear the operation data used in the MEMORY mode that are already stored in the buffer

If data are input without depressing the reset button, the data are added to the data already stored in the buffer, and both are used

(c) Confirm that the command value display screen (COMMAND) appears

If the screen is not displayed depress the COM key to display it

(d) Input operation data using the alphabetic and numeric keys

To correct misplaced data, depress the CAN key to cancel the data, then input the data again

(e) Depress the INSRT key to enter data to the operation buffer

Confirm the data again If the data are not correct, depress the RESET key and input the correct data

(f) Turn on and off the start input (STR) to start MDI operation

4.2.3 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

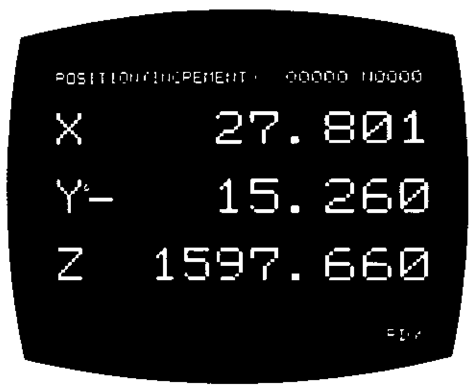
- POSITION (INCREMENT)
- POSITION (UNIVERSAL)
- POSITION (AXIS)
- POSITION (ERROR),

(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



585 207

Fig 4 12 Current Position Display (INCREMENT) Example

(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 dispslayed 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

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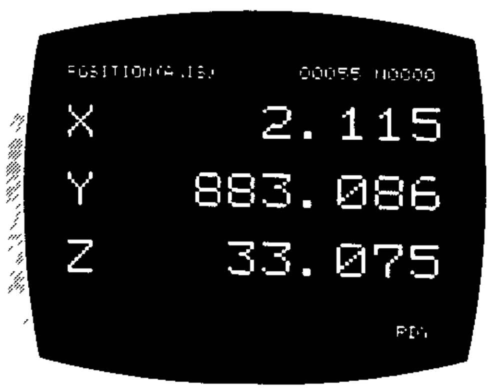
Fig 4 13 Current Position Display (UNIVERSAL) Example

(3) POSITION (AXIS)

Each moved distance of actual axes after returning to reference point is displayed Even if G92 is commanded, the display is not affected by the command



585 209

Fig 4 14 Current Position Display (AXIS) Example

4.2.3 Display of Current Position Values (Cont'd)

(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.

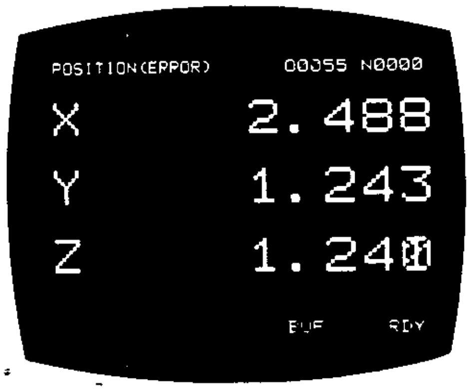


Fig. 4.15 Current Position Display (ERROR) Example

4.2.4 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 funcion. 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 Appendix A "ALARM CODE LIST".

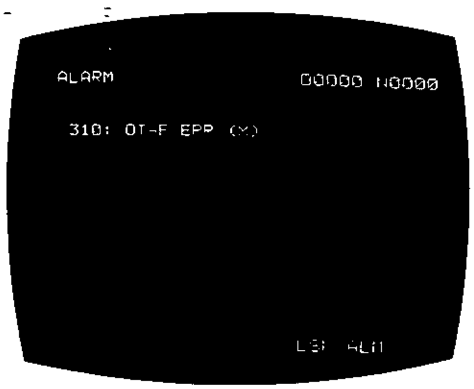


Fig. 4.16 Alarm Display

4.2.5 Displaying State of I/O Signals DGN

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

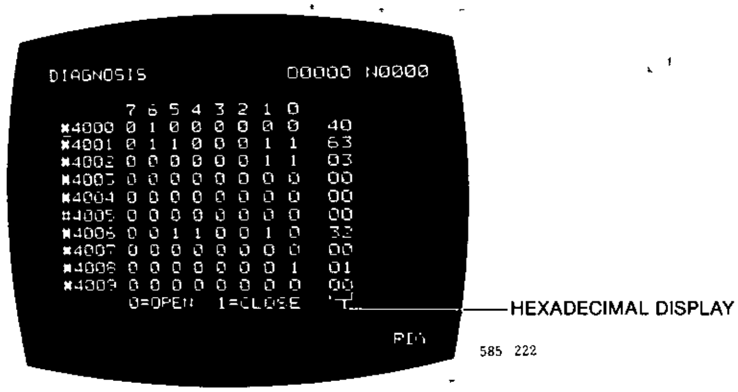


Fig 4 17 Example of DGN Display

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 Derpess DGN key

The state of input/output signals on the page including the disignated 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 PAGE ↑ key

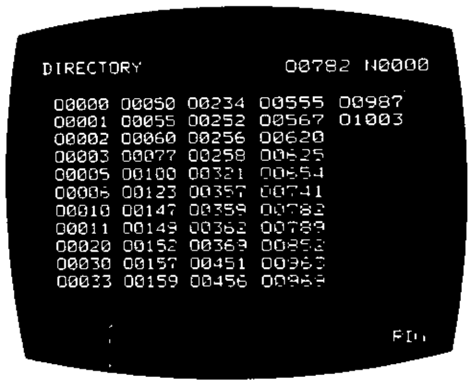
The previous page is displayed

4.2.6 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 displyed Page of the table can be turned by depressing [PAGE ↓] key or [↑ PAGE] key



585 225

Fig 4 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

4.2.7 Display of System Number and Remaining Program Memory Capacity

This function displays the system numbers of the motion module and the Control Station The number of characters that can be input to the program area is also displayed on the same screen

(1) Select the alarm screen and depress the [PAGE ↓] key until the following screen for displaying system numbers and remaining program capacity appears

590-58

Fig 4 19

4.3 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

Parameter numbers of bit display type are # 1000 through # 1009 Parameters larger than # 1100 are of decimal digit display type

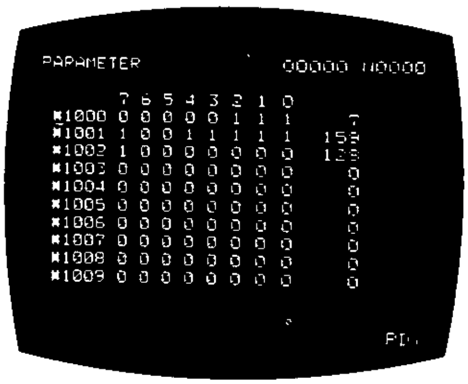


Fig 4 20 Example of Parameters (Bit Display Type)

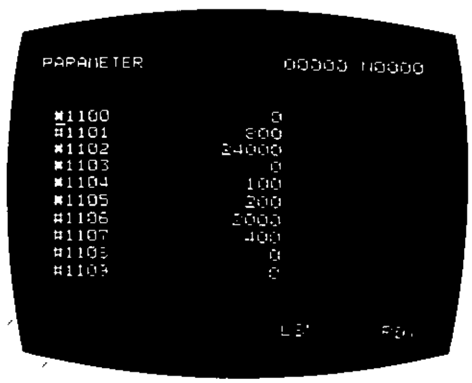


Fig 4 21 Example of Parameters (Ordinary Digit Display Type)

4.3 DISPLAYING AND WRITING PARAMETERS [PRM] (Cont'd)

(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 every 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" ⇄ "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 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 [INSRT] key, [PAGE ↓], or [PAGE ↑] key.

(b) For ordinary digit display type

1 Designate the parameter 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

(5) Parameter All Clear

Depress the [NEXT] and [ERASE] keys (in this order) on the parameter display screen All the parameter areas are cleared to 0

(6) Parameter Reset

Depress the [NEXT] and [WR] keys (in this order) on the parameter display screen The factory-set initial values for the parameters are restored

4.4 DISPLAYING AND WRITING OFFSET DATA [AUX2]

Offset data have been stored in the internal memory of MOTIONPACK-120 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

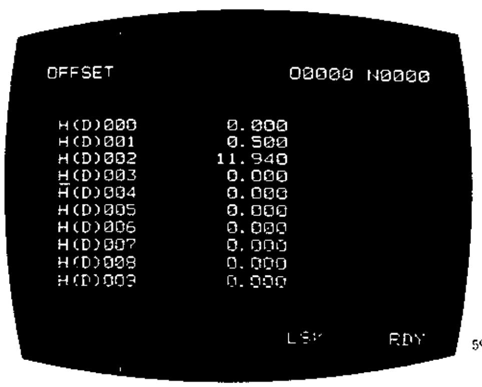
1 Select [AUX2] function key

2 Key in the numbers by using keys such [1] as [O] and 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

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



590-66

Fig 4 21

(2) Writing Offset Data

To write offset data in the internal memory, select incremental or direct values using parameter # 1001, D0

When parameter # 1001, D0 is 0, incremental values are used
When parameter # 1001, D0 is 1, direct values are used

(a) Writing incremental values

1 Set the cursor to the offset number to be written
2 Enter the offset value to be added (To reduce, place a minus sign)
3 Depress the $\boxed{\text{WR}}$ key

The entered incremental value is added

(b) Writing direct values

1 Set the cursor to the offset number to be written
2 Enter the offset value to be added (To reduce, place a minus sign)
3 Depress the $\boxed{\text{WR}}$ key

The entered value is used as the offset

(3) Offset Value All Clear

Depress keys $\boxed{0}$, $\boxed{-}$, $\boxed{9}$, $\boxed{9}$, $\boxed{9}$, $\boxed{9}$, and $\boxed{\text{ERASE}}$ (in this order) on the offset value display screen All the offset value areas are cleared

NOTE

1 Entered offset values are saved in the internal memory of MOTIONPACK-120 and are retained after power is turned off
2 If offset values are changed during automatic operation, the values before the change are used for the blocks being processed and stored in the buffer

4.5 EDITING PROGRAMS

4.5.1 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

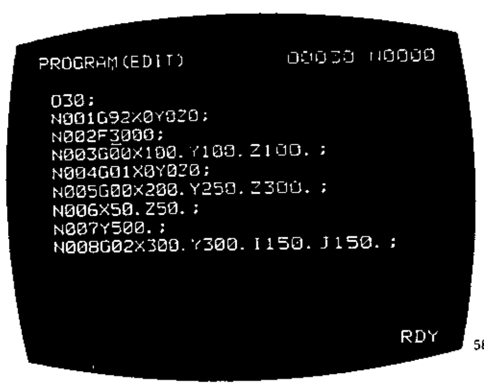


Fig 4 22

(3) Opertion of [PAGE] and [CURSOR] keys

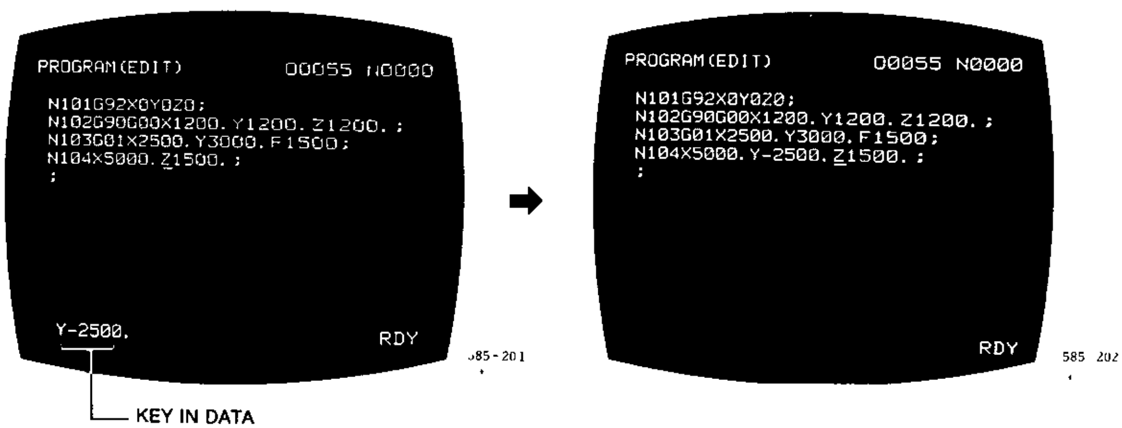
(a) By depressing [PAGE ↑] or [PAGE ↓] key, the previous or next page can be displayed on the CRT

(b) By depressing [CURSOR ↑] or [CURSOR ↓] key, the position of cursor can be moved by one character forward or backward

4.5.2 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

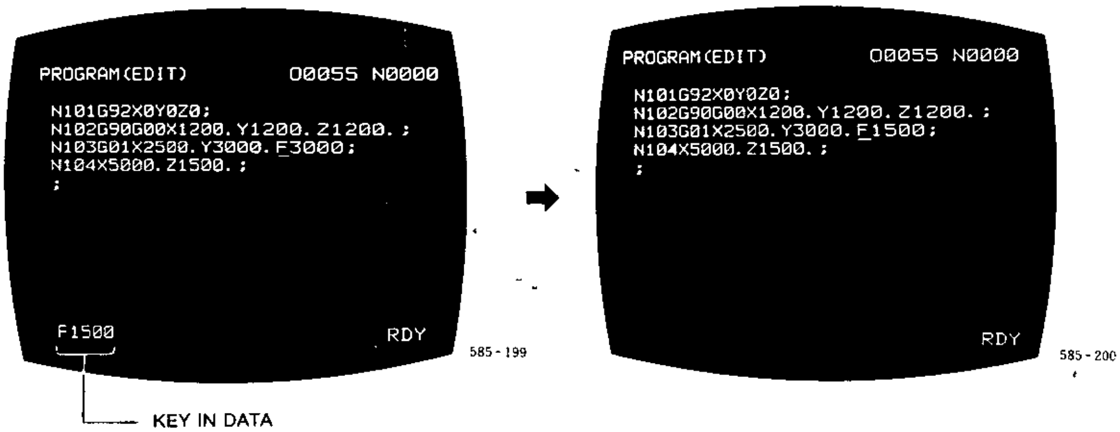


(a) Before Insertion (b) After Insertion

Fig 4 23 Program Insertion

4.5.3 Altering Program 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 4 24 Program Alteration

4.5.4 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) Eransing All Program Numbers

Depress the − 9 9 9 and 9 keys and depress the ERASE key All the program registered will be erased

4.5.5 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 PROG function key

3 Depress RESET key

4 Enter the program number "O"

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

4.5.6 Copying Program

Contents of a program that is already stored with one program can be copied with another program number

(1) Search for the program number of the original program to be copied

(2) Enter the destination program number, then depress $\boxed{\text{C}}$

(3) Depress the $\boxed{\text{WR}}$ key to copy the program

(4) Write the destination program O number at the beginning of the copied program

(Example)

When contents of program number O10 are to be copied to O20

(a) Search for O10 and display O10 on the CRT

(b) Enter $\boxed{\text{O}}$, $\boxed{2}$, $\boxed{\text{O}}$, $\boxed{\text{C}}$, and $\boxed{\text{WR}}$

(c) Change program number at the beginning of the copied O10 to O20

SECTION 5

CONTENTS

5

5. PARAMETERS

5.1 EXPLANATION ON PARAMETERS

To build a system with MOTIONPACK-120, servo drive, servomotor, and load mechanism, control specifications of MOTIONPACK-120 must be tailored to the machine so as to implement required operations of the system Parameters are a set of constants that are set for this purpose

The number of axes to be controlled is a parameter An optimum combination of feedrate and loop gain for smooth motion control is another parameter

Parameters must be determined when the system is designed, and must be set properly in MOTIONPACK-120 by the time the system is operational

Standard parameters for MOTIONPACK-120 are pre-set at the factory Check the parameters before starting operation

If the system is started up without setting servo motor parameters, abnormal vibration may occur To prevent this, start up the system with servo main power left off and set parameters properly before starting a trial run The servo main power is not applied when the I/O input signal SVOK is turned off or the emergency stop switch is depressed

As a rule, MOTIONPACK parameters are validated only after power is turned on once and then turned off After changing parameters, turn power on and off

5.2 PARAMETER LIST

Table 5 1 Parameter List (1/7)

Parameter No	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#1000	0	0	B axis 0 Not used 1 Used	A axis 0 Not used 1 Used	S axis 0 Not used 1 Used	Z-axis 0 Not used 1 Used	Y axis 0 Not used 1 Used	X axis 0 Not used 1 Used	Function switch (operating axis selection)
#1001	0	0	0	0	0	Fast return to reference point 0 No 1 Yes	Gear selection output 0 No 1 Yes	Offset data write 0 Incremental 1 Absolute	Function switch
#1002	Program No selection after reset 0 No 1 Yes	Handle specifi cations 1 Simultaneous 3 axis 0 Simultaneous 1 axis	Positioning command 1 Absolute 0 Incremen tal	0	0	Feed override 0 3 steps 1 21 steps	Feedrate unit per minute mm/min 0 1 00 mm 1 0 001 mm	Program No selection after start 0 No 1 Yes	Function switch
#1003	Lathe system specifications 1 Lathe system 0 Standard	0	0	Notch signal output 0 No 1 Yes	0	0	Position memory 0 No 1 Yes	G31 alarm 0 alarm 1 Disre gard	Function switch
#1004	0	0	DC2/DC4 transmission output 0 No 1 Yes	ISO/ASCII 1 ISO 0 ASCII	0	0	0	0	Function switch
#1005	Offset input 8 digits	Offset input 6 digits	Offset input 4 digits	Offset input 2 digits	4 decimal palces	3 decimal places	2 decimal places	1 decimal place	Function switch
#1006	0	0	0	0	0	Z-axis neglect 0 No 1 Yes	Y axis neglect 0 No 1 Yes	X axis neglect 0 No 1 Yes	Function switch
#1007	0	0	0	0	0	0	0	0	Internally reserved parameter
#1008	0	0	0	0	0	0	0	I/O setting Fixed to 1	Function switch
#1009	Parity 0 Even parity 1 Odd parity	Parity bit 0 No 1 Yes	Data length 0 7 bits 1 8 bits	Stop bit 0 1 bit 1 2 bits	0	Baud rate 1 300 2 600 5 4800 3 1200 6 9600 4 2400			Communication specifications setting

Table 5 1 Parameter List (2/7)

Parameter No	D7	D6	D5	D4	D3	D2	D1	D0	Remarks
#1010	0	0	0	0	0	0	0	0	Internally reserved parameter
#1011	0	0	0	0	0	0	0	0	Internally reserved parameter
#1012	0	0	0	0	0	0	0	0	Internally reserved parameter
#1013	0	A, B axis 'ZPNT'' Disregard 0 Effective 1 Disregard	0	0	0	0	0	0	Internally reserved parameter
#1014	0	0	0	0	0	0	0	0	Internally reserved parameter
#1015	0	0	0	0	0	0	0	0	Internally reserved parameter
#1016	0	0	0	0	0	0	0	0	Internally reserved parameter
#1017	0	0	0	0	0	0	0	0	Internally reserved parameter
#1018	0	0	0	0	0	0	0	0	Internally reserved parameter
#1019	0	0	0	0	0	0	0	0	Internally reserved parameter

Table 5 1 Parameter List (3/7)

Parameter No	Name	Range	Unit
#1100	MF, TF, and SF signals delay time	0 to 32767	8ms
#1101	Maximum manual handle feedrate	1 to 3200	7 5mm/min
#1102	Maximum interpolation feedrate	1 to 24000	1 mm/min
#1103	Internally reserved	Fixed to 0	
#1104 to #1118	Step and jog feedrate	1 to 36000	1 mm/min
#1119 to #1121	Internally reserved	Fixed to 0	
#1122 to #1124	Step feed length	1 to 32767	0 001 mm
#1125	Reference point zone	0 to 32767	±0 001 mm
#1126 to #1129	Internally reserved	Fixed to 0	
#1130 to #1132	Rapid traverse rate	1 to 4800	7 5mm/min
#1133	Spindel gear selection voltage output	1 to 32767	$\frac{10}{32767}$ V
#1134 to #1139	Internally reserved	Fixed to 0	
#1140	Internal sequencer access enable	0, 1	0 Disable 1 , Enable
#1141	Internally reserved	Fixed to 0	

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Table 5 1 Parameter List (4/7)

Parameter No	Name	Range	Unit
#1142	Internal sequencer keep memory area	4800 to 6000	
#1143 to #1145	Absolute position check revolution	0 Chack invalid 1 to 127	Motor r/min
#1146 to #1149	Internally reserved	Fixed to 0	
#1150	Spindle mode selection	1, 3, 7	1 ±D/A output 3 +D/A output 7 ∓D/A output
#1151 to #1159	Internally reserved	Fixed to 0	
#1160 to #1162	Spindle maximum r/min	1 to 32767	1 r/min
#1163 to #1169	Internally reserved	Fixed to 0	
#1200 to #1201	Internally reserved	Fixed to 0	
# 1201	Combined operation instruction (G73) setting data	0 to 32767	0 001 mm
#1202	Combined operation instruction (G83) setting data	0 to 32767	0 001 mm
#1203 to #1279	Internally reserved	Fixed to 0	
#1400 #2300 #1700 #2600 #2000	Internally reserved	Fixed to 0	
#1401 #2301 #1701 #2601 #2001	Servo error detection area	1 to 5000000	Single position detection pulse
#1402 #2302 #1702 #2602 #2002	Position set area	1 to 32767	Single position detection pulse
#1403 #2303 #1703 #2603 #2003	Internally reserved	Fixed to 0	

Table 5 1 Parameter List (5/7)

Parameter No	Name	Range	Unit
#1404 #2304 #1704 #2604 #2004	First stage linear accel/decel constant	1 to 32767	15 625mm/s^2
#1405 #2305 #1705 #2605 #2005	Second stage linear accel/decel constant	1 to 32767	15 625mm/s^2
#1406 #2306 #1706 #2606 #2006	Accel/decel constant change speed	0 to 4800	7 5mm/min
#1407 #2307 #1707 #2607 #2007	Home position approach speed	1 to 4800	7 5mm/min
#1408 #2308 #1708 #2608 #2008	Home position creep speed	1 to 4800	7 5mm/min
#1409 #2309 #1709 #2609 #2009	Home positioning final traveling length	1 to 90000000	Single position detection pulse
#1410 to #1411 #1710 to #1711 #2010 to #2011 #2310 to #2311 #2610 to #2611	Internally reserved	Fixed to 0	
#1412 #1712 #2012	Interpolation feedrate bias	1 to 3200	7 5mm/min
#1413 #1713 #2013	Exponential accel/decel time constant	1 to 127	8ms
#1414 #2314 #1714 #2614 #2014	Software LS check function	0, 1	0 Disabled 1 Enabled
#1415 #2315 #1715 #2615 #2015	Servo system constant	Fixed to 32000	
#1416 to #1419 #1716 to #1719 #2016 to #2019 #2316 to #2319 #2616 to #2619	Internally reserved	Fixed to 0	
#1450 #2350 #1750 #2650 #2050	Position loop gain Kp	1 to 255	1s^{-1}
#1451 #2351 #1751 #2651 #2051	Speed loop gain Kv	1 to 255	2 5Hz
#1452 #2352 #1752 #2652 #2052	Servo system constant	Fixed to 10	

Table 5.1 Parameter List (6/7)

Parameter No	Name	Range	Unit
#1453 #2353 #1753 #2653 #2053	Servo system constant	Fixed to 2	
#1454 #2354 #1754 #2654 #2054	Servo system constant	Fixed to 0	
#1455 #2355 #1755 #2655 #2055	Servo system constant	Fixed to 0	
#1456 #2356 #1756 #2656 #2056	Servo system constant	Fixed to 15	
#1457 #2357 #1757 #2656 #2057	Servo system constant	Fixed to 0	
#1458 #2358 #1758 #2658 #2058	Servo system monitor selection	28, 41	28 Torque monitor 41 Instruction speed
#1459 #2359 #1759 #2659 #2059	Servo system monitor data shift	0 to 3	
#1500 #2400 #1800 #2700 #2100	Motor rotation direction	0, 1	0 CCW when viewed from the load 1 CW when viewed from the load
#1501 #2401 #1801 #2701 #2101	Home positioning direction selection	0, 1	0 Positive 1 Negative
#1502 #2402 #1802 #2702 #2102	Overtravel input check function	0, 1	0 Enable 1 Disable
#1503 #2403 #1803 #2703 #2103	Internally reserved	Fixed to 0	
#1504 #2404 #1804 #2704 #2104	Length of travel,positive boundary value	−99999999 to 99999999	0.001 mm
#1505 #2405 #1805 #2705 #2105	Length of travel negative boundary value	−99999999 to 99999999	0.001 mm
#1506 #2406 #1806 #2706 #2106	Encoder selection	0 Incremental Encoder 1 Absolute Encoder	
#1507 #2407 #1807 #2707 #2107	Backlash offset	0 to 32767	Single position detection pulse

Table 5 1 Parameter List (7/7)

Parameter No	Name	Range	Unit
#1508 #2408 #1808 #2708 #2108	Pitch error offset starting point	-2000000 to 2000000	
#1509 #2409 #1809 #2709 #2109	Pitch error offset interval	1000 to 99999999	0 001 mm
#1510 #2410 #1810 #2710 #2110	Position instruction unit (B/A)	16777216 to 1677721600	
#1511 #2411 #1811 #2711 #2111	Position instruction unit (A/B)	167772 to 16777216	
#1512 #2412 #1812 #2712 #2112	Positive motor current limit	0 to 250	1 6% of motor rating
#1513 #2413 #1813 #2713 #2113	Negative motor current limit	0 to 250	1 6% of motor rating
#1514 #2414 #1814 #2714 #2114	Motor selection	See Table 5 3	
#1515 #2415 #1815 #2715 #2115	Servo system control sequence setting	0, 12	12 Motors of 500 W or less 0 Motors of 600 W or greater
#1516 #2416 #1816 #2716 #2116	Encoder selection	2048 or 512	
#1517 #2417 #1817 #2717 #2117	Servo system constant	Fixed to 0	
#1518 #2418 #1818 #2718 #2118	Servo system constant	Fixed to 116	
#1519 #2419 #1819 #2719 #2119	Servo system constant	Fixed to 0	
#1520 to #1521 #1820 to #1821 #2120 to #2121 #2420 to #2421 #2720 to #2721	Absolute encoder reference point offset		Automatically set by absolute reference point setting
#1522 to #1529 #1822 to #1829 #2122 to #2129 #2422 to #2429 #2722 to #2729	Internally reseved	Fixed to 0	
#1550 to #1629 #1850 to #1929 #2150 to #2229 #2450 to #2529 #2750 to #2829	Pitch error offset	0 to 32767	Single position detection pulse

5.3 SYSTEM SPECIFICATIONS SETTING

5.3.1 Setting Operating Axes (#1000 D0-D2, D4, D5)

MOTIONPACK-120 can control the X, Y, Z, A and B axes Parameters # 1000 D0-D5 specify whether each axis is to be controlled Set 1 for the axis to be controlled Set 0 for the axis not to be controlled

Table 5 2

	Parameter No	Description
Use of axis	# 1000 D0 (X) # 1000 D1 (Y) # 1000 D2 (Z) # 1000 D4 (A) # 1000 D5 (B)	0 Not used 1 Used

5.3.2 Servomotor Selection (#1514, #1814, #2114, #2414, #2714)

Find the motor type and output in Table 5 3, and set the corresponding value for parameters #1514, #1814, #2114, #2414 and #2714, respectively for the X, Y, and Z axes

Table 5 3 Motor Selection Code

Parameter Set Value	Motor Type and Output (kW)		Parameter Set Value	Motor Type and Output (kW)	
0	M series	—	20	S series	0 2
1	M series	0 3	21	S series	0 3
2	M series	0 6	22	S series	0 5
3	M series	0 9	23	S series	0 8
4	M series	1 2	24	S series	1 5
5	M series		25	S series	
6	M series		26	S series	
7	M series		27	S series	
8	M series		28	S series	
9	M series		29	S series	
10	F series	0 2	30	R series (200V)	
11	F series	0 3	31	R series (200V)	
12	F series	0 5	32	R series (200V)	0 05
13	F series	0 9	33	R series (200V)	0 1
14	F series	1 3	34	R series (200V)	0 2
15	F series		35	R series (200V)	0 3
16	F series		36	R series (200V)	0 5
17	F series		37	R series (200V)	0 7
18	F series		38	R series (200V)	
19	F series		39	R series (220V)	

Table 5.3 Motor Selection Code (Cont'd)

Motor Model	Motor Capacity (kW)	Parameter Set Value	Motor model	Motor Capacity (kW)	Parameter Set Value
D Series	—	40	R Series (for 100V)	—	60
	—	41		—	61
	0.5	42		0.05	62
	1.0	43		0.1	63
	1.5	44		0.2	64
	2.2	45		0.3	65
	3.7	46		0.5	66
	—	47		—	67
	—	48		—	68
	—	49		—	69
G Series	0.15	50	P Series	—	70
	0.3	51		—	71
	0.45	52		—	72
	0.85	53		0.1	73
	1.3	54		0.2	74
	1.8	55		0.3	75
	2.9	56		0.5	76
	4.4	57		0.75	77
	—	58		—	78
	—	59		—	79

5.3.3 Sequence Selection (#1515, #1815, #2115, #2415, #2715,)

Set the specified motor output codes for parameters #1515, #1815, #2115 #2415 and #2715 so as to fit the servo system control sequence for the motor output on each axis

Table 5 4

	Parameter No	Description
Control Sequence Setting	#1515 (X) #1815 (Y) #2115 (Z) #2415 (A) #2715 (B)	• Set 12 for a motor of 500 W or less • Set 0 for a motor of 600 W or greater

5.3.4 Encoder Selection (#1506, #1806, #2106, #2406, #2706, #1516, #1816, #2116, #2416, #2716)

Set the specified values for the parameters so as to fit the servo system internal constants to the encoder

Table 5 5

#1002 D5	0 Incremental Encoder 1 Absolute Encoder
#1506 #2406 #1806 #2706 #2106	0 Incremental Encoder 1 Absolute Encoder
#1516 #2416 #1816 #2716 #2116	Set 2048 or 512 (the number of pulses per encoder rotation /4)

5.3.5 Feed Axis Motor Rotation Direction (#1500, #1800, #2100, #2400, #2700)

Set 0 or 1 for parameters #1500, #1800, #2100, #2400 and #2700 to determine the motor rotation direction for a positive direction move instruction for each of the X, Y, Z, A and B axes

Table 5 6

	Parameter No	Description
Feed Axis Motor Rotation Direction	# 1500 (X) #1800 (Y) #2100 (Z) #2400 (A) #2700 (B)	0 CCW when viewed from the load for a positive move instruction 1 CW when viewed from the load for a positive move instruction

5.3.6 Positioning Command (#1102 D5)

Specify whether the system uses incremental or absolute coordinate system commands

Parameter No	Description
#1002 D5	0 Incremental 1 Absolute

5.4 POSITION INSTRUCTION UNIT

5.4.1 Position Instruction Unit and Speed Instruction Unit

To build a positioning system using MOTIONPACK-120, the units of length used in the MOTIONPACK-120 position instructions (which is equivalent to "1" with no decimal point in a program, or "1" at the least significant position in a position indication) must be matched to the unit used for the load mechanism to determine movements and detect positions

MOTIONPACK-120 supports the decimal function that places a decimal point so as to provide easy reading of positions and programs This function must also be adjusted to the instruction and mechanical movement unit system

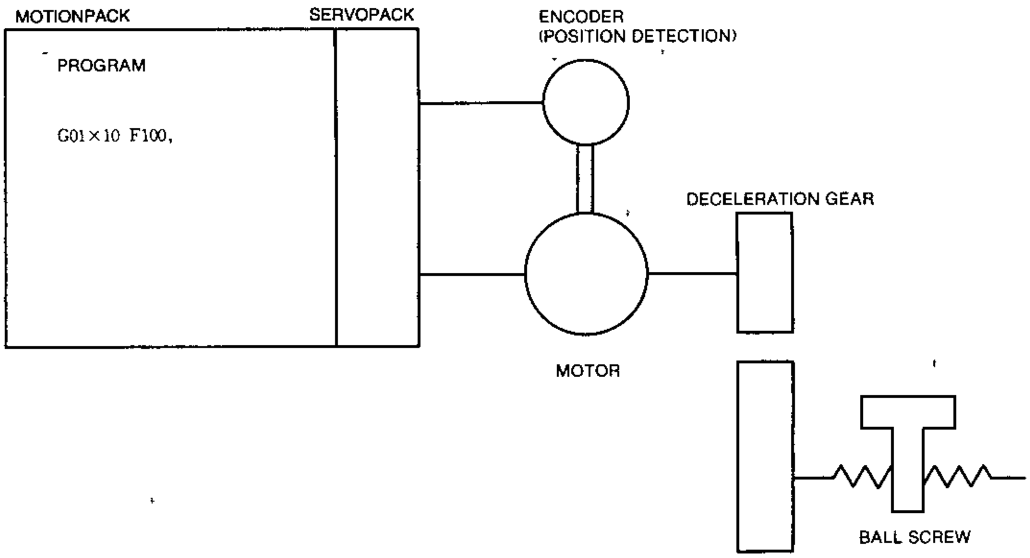


Fig 5 1

In this manual, explanations are intended for a mechanical configuration where conditions for linear positioning using ball screws are as follows

Position instruction unit One thousandth of a millimeter

Decimal places 3

Also, load machine movement (in units of thousandths of a millimeter per minute) is used for speed instructions

If a position instruction unit other than 0 001 mm is used, all data about machine movement and speed must be converted before programming and parameter setting (Some parameters such as the backlash offset and the pitch error offset that are set up in position detection units are excluded)

[Example] The following is a conversion table for a mechanism in which position instructions use 0 01mm as the basic unit

Table 5 7 (1/2)

	Example of Setting	Position Instruction Unit 0 001mm Decimal places 3	Position Instruction Unit 0 01 mm Decimal places 2
Movement Instruction in Program	×1 (no decimal point) ×10	0 001mm 10 000mm	0 01mm 10 00mm
Interpolation Feedrate in Program (per minute)	F500	500×1000×0 001mm/min =500mm/min	500×1000×0 01mm/min =5000mm/min
Interpolation Feedrate in Program (per revolution)	F1 (no decimal point) F10	1×0 001mm/rev=0 001mm/rev 10000×0 001mm/rev =10mm/rev	1×0 01mm/rev=0 01mm/rev 1000×0 01mm/rev=10mm/rev
Maximum Manual Handle Feedrate Parameter (#1101)	100	100×7500×0 001mm/min =750mm/min	100×7500×0 01mm/min =7500mm/min
Maximum Interpolation Feedrate Parameter (#1102)	6000	6000×1000×0 001mm/min =6000mm/min	6000×1000×0 01mm/min =60000mm/min
Jog Feedrate Parameters (#1104 to #1118)	3000	3000×1000×0 001mm/min =3000mm/min	3000X1000X0 01mm/min =30000mm/min
Rapid Feedrate Parameters (#1130 to #1132)	3200	3200×7500×0 001mm/min =24000mm/min	3200×7500×0 01mm/min =240000mm/min
Home Positioning Approach Speed Parameters (#1407, #1707, #2007, #2307, #2607)	200	200×7500×0 001mm/min =1500mm/min	200×7500×0 01mm/min =15000mm/min
Home Positioning Creep Speed Parameters (#1408, #1708, #2008, #2308, #2608)	100	100×7500×0 001mm/min =750mm/min	100×7500×0 01mm/min =7500mm/min
Interpolation Feedrate Bias Parameters (#1412, #1712, #2012)	10	10×7500×0 001mm/min =75mm/min	10×7500×0 01mm/min =750mm/min
First Stage Linear Accel/Decel Constant Parameters (#1404, #1704, #2004, #2304, #2604)	128	128×15625×0 001mm/s^2 =2000mm/s^2	128×15625×0 01mm/s^2 =20000mm/s^2

Table 5 7 (2/2)

	Example of Setting	Position Instruction Unit 0 001mm Decimal Places 3	Position Instruction Unit 0 01mm Decimal Places 2
Second Stage Linear Accel/Decel Constant Parameters (#1405, #1705, #2005, #2305, #2605)	64	$64 \times 15625 \times 0\ 001 mm/s^2$ $= 1000 mm/s^2$	$64 \times 15625 \times 0\ 01 mm/s^2$ $= 10000 mm/s^2$
Accel/Decel Constant Change Speed Parameters (#1406, #1706, #2006, #2306, #2606)	1600	$1600 \times 7500 \times 0\ 001$mm/min = 12000mm/min	$1600 \times 7500 \times 0\ 01$mm/min = 120000mm/min
Step Feedrate Parameters (#1122 to #1124)	1000	$1000 \times 0\ 001$mm = 1mm	$1000 \times 0\ 01$mm = 10mm
Reference Point Extent Parameter (#1125)	10	$10 \times 0\ 001$mm = 0 01mm	$10 \times 0\ 01$mm = 0 1mm
Software Limit Boundary Value Parameters #1504, #1505, #1804, #1805, #2104, #2105, #2404 #2405, #2704 #2705	3000000	$3000000 \times 0\ 001$mm = 3000mm	$3000000 \times 0\ 01$mm = 30000mm
Combined Operation Instruction (G83) Parameter (#1202)	2000	$2000 \times 0\ 001$mm = 2mm	$2000 \times 0\ 01$mm = 20mm

Note Application to a lathe system requires a defferent setting for some parameters
For details, see explanations about lathe systems

5.4.2 Decimal Point (#1005 D0-D3)

Parameters # 1005 D0 to D3 determine the place of a decimal point and the number of figures after the decimal point in a position indication

For example, when a position instruction unit of 0 01mm is used, positions and programs are read easier if there are two places after the decimal point Set only one of the four parameters to 1, and set others to 0

Table 5 8

Parameter Setting	Description
Only #1005 D0 is 1	One place after decimal point
Only #1005 D1 is 1	Two places after decimal point
Only #1005 D2 is 1	Three places after decimal point
Only #1005 D3 is 1	Four places after decimal point
ALL #1005 D0-D3 are 0	No decimal point

Notes

1 The decimal point is displayed to make it easier for the operator to read positions and program inputs MOTIONPACK 120 itself handles position instruction units to control positions and speeds Standard setting used in this manual is as follows

Position instruction unit 0 001 mm
Decimal places 3

For use with load mechanism having a position instruction unit other than 0 001 mm, conversion is required before programming and parameter setting as explained in the preceding section For a conversion example, see Table 5 7

2 Decimal point arrangement is ineffective with the P specification for the G04 (dwell) instruction Dwell time of one second is specified by either of the following descriptions, regardless of decimal point arrangement

G 04 P1000
G 04 P1

5.4.3 Matching Units for Position Instruction and Detection (#1510-#1511, #1810-#1811, #2110-#2111, #2410-#2411, #2710-#2711)

(1) In general, a position detection unit (length per pulse) is determined by the load machine mechanism and the number of pulses of the detector

MOTIONPACK-120 uses two factors, B/A and A/B, for matching the position instruction unit and the position detection unit of the driven machine Fig 5 2 shows the block diagram B/A indicates the number of output pulses per position instruction unit (for instance, 0 001 mm) A/B indicates the machine movement per pulse of the position detector (after the pulse number is multiplied by four) Before setting other parameters, calculate B/A and A/B from the load machine and detector specifications

(a) Integral part of B/A × 16777216 ($1 \leq$ B/A ≤ 100)

(b) Integral part of A/B × 16777216 ($1/100 \leq$ A/B ≤ 1)

Set value (a) for the X, Y, and Z axes for #1510, #1810, #2110, #2410 and #2710, respectively Set value (b) for the X, Y, and Z axes for #1511, #1811, #2111, #2411 and #2711, respectively

NOTE

1 Because only integral parts of values (a) and (b) are used for the parameters, rounding errors may occur

2 A/B must be the inverse of B/A

3 If B/A (or A/B) is 1, (that is, if the position instruction unit and the position detection unit are the same,) set 16777216 for the parameter

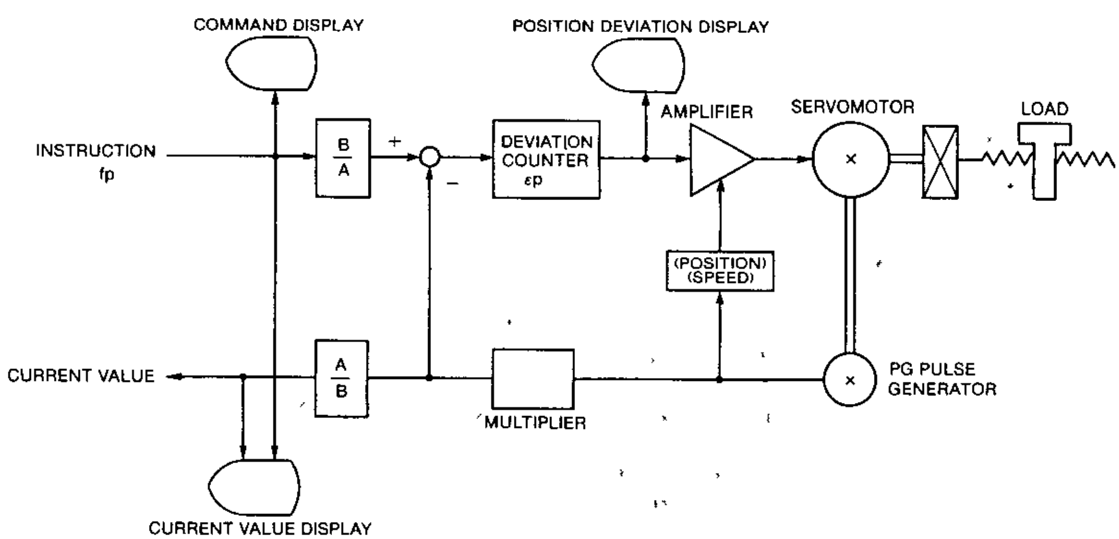


Fig 5 2

5.4.3 Matching Units for Position Instruction and Detection (Cont'd)

(2) Influence on Other Parameters

To set the following parameters, use the position detection unit To set these parameters using the position instruction unit (0 001 mm) when B/A ≠ 1 (A/B ≠ 1), each value to be set must be multiplied by B/A for conversion Each of the parmeters must be an integer Round off the fractional part produced by conversion as required

- Backlash offset (# 1507, # 1807, # 2107, #2407, #2707)
- Positioning completion range (# 1402, # 1702, # 2002, #2302, #2602)
- Pitch error offset (# 1550 - # 1629, # 1850 - # 1929, # 2150 - # 2229, #2450 to #2529, #2750 to #2829)
- Home positioning final traveling length (# 1409, # 1709, # 2009, #2309, #2609)
- Servo error area (# 1401, # 1701, # 2001, #2301, #2601)
- Position deviation indication

(Conversion example)

Backlash offset
Set backlash (0 001 mm) × B/A for the parameter

(3) Calculation of B/A

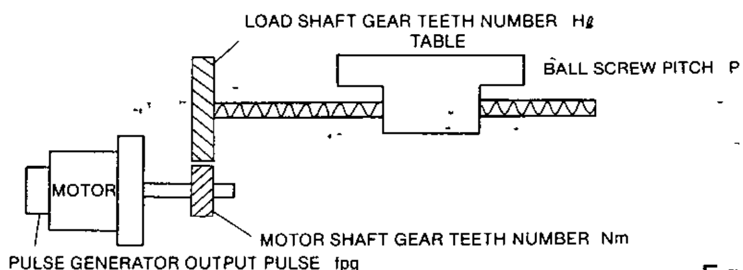


Fig 5 3

Specifications

- Ball screw pitch P (mm/rev)
- Deceleration factor R

  $(R = \frac{N_\ell}{N_m})$

- Minimum position control U (mm/pulse)
- Pulse generator output pulse number 8192 (pulses/rev)

For the above specifications, B/A is calculated as follows

$$\frac{B}{A} = \frac{\text{Controller pulse number}}{\text{Ball screw pulse number}}$$

$$= \frac{8192 \times 4}{\frac{P}{U} \times \frac{1}{R}} \qquad (1)$$

(4) Example of Setting Parameters using Position Instruction Unit

(a) Calculate B/A by substituting values in (1) Also obtain A/B (the reverse of B/A)

(b) Determine the values to be set for parameters using B/A and A/B Round off the fractional part

[Example]

Table driving with a ball screw (in the X-axis direction)

Specifications

- Ball screw pitch $P = 6$ (mm/rev)
- Deceleration factor $R = \dfrac{N_\ell}{N_m} = \dfrac{7}{5}$
- Minimum position control $U = 0.001$ (mm/pulse)
- Pulse generator output pulse number $f_{PG} = 8192$ (pulses/rev)

• Substituting the above values in (1), B/A and A/B are calculated as follows

$$\frac{B}{A} = \frac{8192 \times 4}{\dfrac{6}{0.001} \times \dfrac{5}{7}} = \frac{14336}{1875}$$

$$\frac{A}{B} = \frac{1875}{14336}$$

• The values to be set for the parameters (for the X-axis) are calculated as follows

B/A parameter $= \dfrac{14336}{1875} \times 16777216 = \boxed{128276356}\,6$

Set this value for parameter # 1510

A/B parameter $= \dfrac{1875}{14336} \times 16777216 = \boxed{2194285}\,714$

Set this value for parameter # 1511

NOTE

A lathe system requires a different setting for some parameters For details, see explanations on lathe systems

5.5 PARAMETERS RELATED TO POSITIONING (G00), RAPID FEED (RAPID), JOGGING (JOG), STEPPING (STEP)

5.5.1 Parameters Related to Linear Accel/Decel (#1404-#1406, #1704-#1706, #2004-#2006, #2304 to #2306, #2604-#2606)

Linear accel/decel are applied automatically at positioning (G00), rapid feed, jogging, and stepping

Table 5 9

	Parameter No	Description
First stage linear accel/decel constant	#1404 (X) #1704 (Y) #2004 (Z) #2304 (A) #2604 (B)	Range 1 to 32767 Setup unit 1 = 15 625 mm/s^2
Accel/decel constant change speed	#1406 (X) #1706 (Y) #2006 (Z) #2306 (A) #2606 (B)	Range 0 to 4800 Setup unit 1 = 7 5 mm/min
Second stage linear accel/decel constant	#1405 (X) #1705 (Y) #2005 (Z) #2305 (A) #2605 (B)	Range 1 to 32767 Setup unit 1 = 15 625 mm/s^2

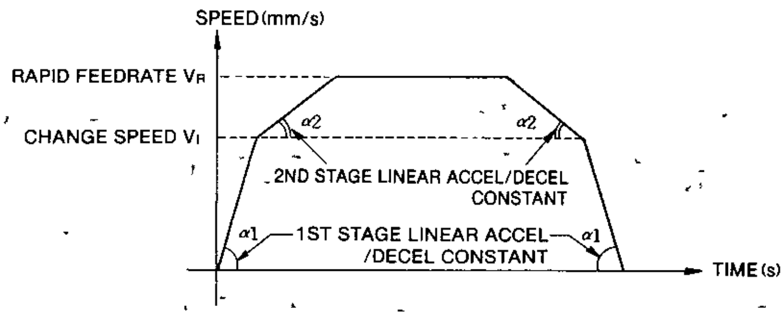


Fig 5 4

[Example]

When rapid feedrate is 12 m/min, startup time is 0 5 s, and position instruction unit is 0 001mm

- Calculate feedrate per second

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

- Calculate acceleration from 0 to 12 mm/min

$$\frac{200}{0\ 5} = 400 \text{ mm/s}^2$$

- Calculate the value to be set for the accel/decel constant parameter

$$\frac{400}{15\ 625} = 25\ 6 \rightarrow 25 \text{ (rounded down)}$$

NOTE

1 To determine the accel/decel constant, use an accel/decel time longer than that required for the load machine

2 To implement a single stage accel/decel use the same accel/decel constant for the first and second stages, and set 0 for the change speed

5.5.2 Rapid Feedrate (#1130, #1131, #1132) 1 ≤ SET VALUE ≤ 4800

For rapid positioning, a choice of low, medium, and high feedrates is provided by a combination of the rapid feed override signal (ROV1, ROV2, and ROV3) to be input

Specify speed for the high feedrate only The medium and low feedrates are automatically determined as 50% and 25% of the high feedrate, respectively

Table 5 10 provides relationships between the rapid feed override signals and feedrates

Table 5 10

	ROV3	ROV2	ROV1	Speed
High	OFF	ON	ON	Value set for the parameter
Medium	OFF	ON	OFF	50% of high feedrate
Low	OFF	OFF	ON	25% of high feedrate
High	ON	—	—	Value set for the parameter

When ROV3 is on, high feedrate is applied regardless of setting for ROV1 and ROV2 Select a speed for the high feedrate for each of the X, Y, and Z axes and specify it for parameters # 1130, # 1131, and # 1132, respectively

Value 1 set for the parameters equals 7 5 mm/min For instance, setting "100" gives a high feedrate of 750 mm/min

Practical rapid feedrate must not exceed value F calculated from load mechanism specifications as follows

$$F = \frac{\text{Motor rated speed (r/min)} \times 8192\ \text{(p/rev)} \times 4}{7500} \times \frac{A}{B}$$

In this case, the rapid feedrate must not exceed motor rated speed

5.5.3 Step and Jog Feedrates (#1104-#1118) 1 ≤SET VALUE ≤ 36000

Parameters #1104 to #1118 set 16 jogging or stepping feedrates A choice of 16 feedrates (including 0) is provided by the combinations of the jog feedrate selection signals (JOV1, JOV2, JOV4, and JOV8) to be input

The same feedrate is used on the X, Y, and Z axes Value 1 set for the parameters equals 1 mm/min For instance, setting "12000" gives a feedrate of 12m/min

Table 5 11 Combinations of Jog Feedrate Selection Signals

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

Note If all jog feedrate selection signals, namely, JOV1, JOV2 JOV4 and JOV8 are turned off, the jog feedrate is reduced to 0 and the machine will not move even when the jog signal is input

5.5.4 Step Feed Length (#1122, #1123, #1124) $1 \leq$ SET VALUE ≤ 32767

These parameters specify step feed lengths Set L_1 (short), L_2 (medium), and L_3 (long) step lengths for parameters # 1122, # 1123, and # 1124, respectively

A choice of 3 step lengths is provided by the combinations of the step multiplying signals (MP1 and MP2)

The jogging feedrate is used for stepping

Table 5 12

	MP 2	MP 1	Parameter No
L_1 (Short)	OFF	ON	#1122
L_2 (Medium)	ON	OFF	#1123
L_3 (Long)	ON	ON	#1124

Value 1 set for the parameters equals 0 001 mm For instance, setting "2000" gives a step length of 2 mm

5.6 PARAMETERS RELATED TO INTERPOLATION FEED (G01, G02, G03), SKIP INSTRUCTION (G31), AND MANUAL FEED

5.6.1 Parameters Related to Exponential Accel/Decel (#1412-#1413, #1712-#1713, #2012-#2013)

Exponential accel and decel are applied automatically at interpolation and manual feed

(1) Exponential Accel/Decel Constants (# 1413, #1713, #2013)

Table 5 13

	Parameter No	Description
Exponential Accel/decel Contants	#1413 (X) #1713 (Y) #2013 (Z)	Range 1 to 127 Setup unit 1 = 8 ms

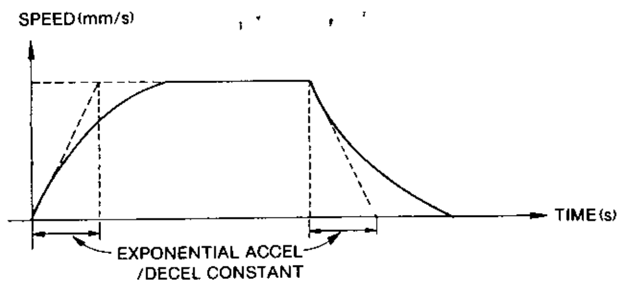


Fig 5 5

For instance, setting "3" gives an accel/decel constant of 24 ms

NOTE

1 For proper functioning of interpolation, the same time constant must be set for the axes

2 Setting "1" makes a stepped speed instruction

(2) Interpolation Feedrate Bias (# 1412, # 1712, # 2012)

These parameters determine exponential accel/decel feedrate biases for interpolation feed.

Table 5.14

	Parameter No	Description
Interpolation bias	#1412 (X) #1712 (Y) #2012 (Z)	Range 1 to 3200 Setup unit 1 = 7.5 mm/min

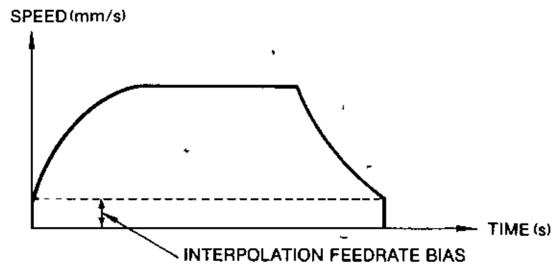


Fig. 5.6

NOTE

For proper functioning of interpolation, the same feedrate bias must be set for the axes.

5.6.2 Maximum Interpolation Feedrate (# 1102) 1 ≤ SET VALUE ≤ 24000

This parameter determines maximum feedrates for simultaneous 2-axis linear or circular interpolation and simultaneous 3-axis linear interpolation.

Value 1 set for the parameters equals 1 mm/min. For instance, setting "10000" gives a maximum feedrate of 10 m/min.

5.6.3 Feed Override Switch (#1002 D2)

This parameter determines 3 or 20 levels of feed override change When 0 is set, three levels of overrides are applied

Table 5 15

	Signal Status		Override Value
	OV2	OV1	
Lo	OFF	OFF	Override 0%
L	OFF	ON	Override 25%
M	ON	OFF	Override 50%
H	ON	ON	Override 100%

When 1 is set, 20 levels of overrides are applied

Table 5 16

Level	Signal Status					Override Value
	OV 16	OV 8	OV 4	OV 2	OV 1	
0	OFF	OFF	OFF	OFF	OFF	0 %
1	OFF	OFF	OFF	OFF	ON	10 %
2	OFF	OFF	OFF	ON	OFF	20 %
3	OFF	OFF	OFF	ON	ON	30 %
4	OFF	OFF	ON	OFF	OFF	40 %
5	OFF	OFF	ON	OFF	ON	50 %
6	OFF	OFF	ON	ON	OFF	60 %
7	OFF	OFF	ON	ON	ON	70 %
8	OFF	ON	OFF	OFF	OFF	80 %
9	OFF	ON	OFF	OFF	ON	90 %
10	OFF	ON	OFF	ON	OFF	100 %
11	OFF	ON	OFF	ON	ON	110 %
12	OFF	ON	ON	OFF	OFF	120 %
13	OFF	ON	ON	OFF	ON	130 %
14	OFF	ON	ON	ON	OFF	140 %
15	OFF	ON	ON	ON	ON	150 %
16	ON	OFF	OFF	OFF	OFF	160 %
17	ON	OFF	OFF	OFF	ON	170 %
18	ON	OFF	OFF	ON	OFF	180 %
19	ON	OFF	OFF	ON	ON	190 %
20	ON	OFF	ON	OFF	OFF	200 %
21	ON	ON	OFF	OFF	OFF	5000 %
22	ON	ON	ON	OFF	OFF	10000 %

Note If a signal status not in the table is set (for instance, all ON), the override value becomes 0%

5.6.4 Interpolation Feedrate Unit (#1002 D1)

This parameter determines the unit of interpolation feedrate per minute used in F-instructions Usually, parameter #1002 D1 is set to 0 This means 1 mm/min is used for the F-instruction unit If slow feed at a speed less than 1 mm/min is required, seting 1 for #1002 D1 enables setting to F1 = 0 001 mm/min

Table 5 17

	Parameter No	Description
Interpolation Feedrate Unit	#1002 D1	0 F1 = 1 mm/min 1 F1 = 0 001mm/min

Note If the feedrate is determined as length per revolution (0 001mm/rev) for the use with a lathe system, this parameter is invalid

5.6.5 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

5.6.6 Handle Specification Setting (# 1002 D6)

This parameter determines the number of handle axes When the parameter is set to 0, simultaneous 1-axis handle operation is per-formed In this mode, the handle connected to the X-axis handle input is used for three axes using switching signals (HX for X-axis, HY for Y-axis, and HZ for Z-axis)

When the parameter is set to 1, simultaneous 3-axis handle operation is performed In this mode, the HX, HY, and HZ input signals serve as the interlock signals that permit only the specified axis to move For example, if the HX input is off, the X-axis is not moved even if the X-axis handle is operated

5.7 HOME POSITION SETTING

5.7.1 Absolute Encoder Home Position Offset (#1520-#1521, #1820-#1821, #2120-2121, #2420-#2421, #2720-#2721)

These parameters determine the mechanism home position in relation to the home position of the absolute value encoder These parameters are automatically set when the mechanism home position is set

5.7.2 Home Position Zone (#1125) 0 ≦ SET VALUE ≦ 32767

This parameter determines the allowable zone in which the home position signals (ZPX, ZPY, ZPZ, ZPA, ZPB) are turned on Value 1 set for the parameter equals 0 001 mm Setting P (mm) gives a home point zone from −P (mm) to +P (mm)

[Example] The ZPX signal status changes when parameter # 1125 is set to 10 as shown in the following

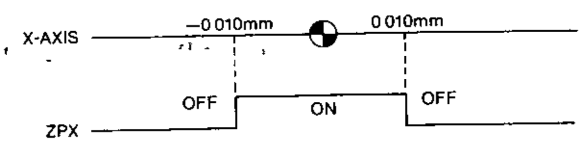


Fig 5 7

5.8 PARAMETERS RELATED TO HOME POSITIONING

When the absolute value encoder is used, home positioning is not required every time power is turned on and off after the machine home position point has been determined at mechanism setup. If the load machine has a limit switch for home positioning, the mechanism home position can be determined using the limit switch input signals, encoder home position pulses (C-phase pulses), and movements set for parameters

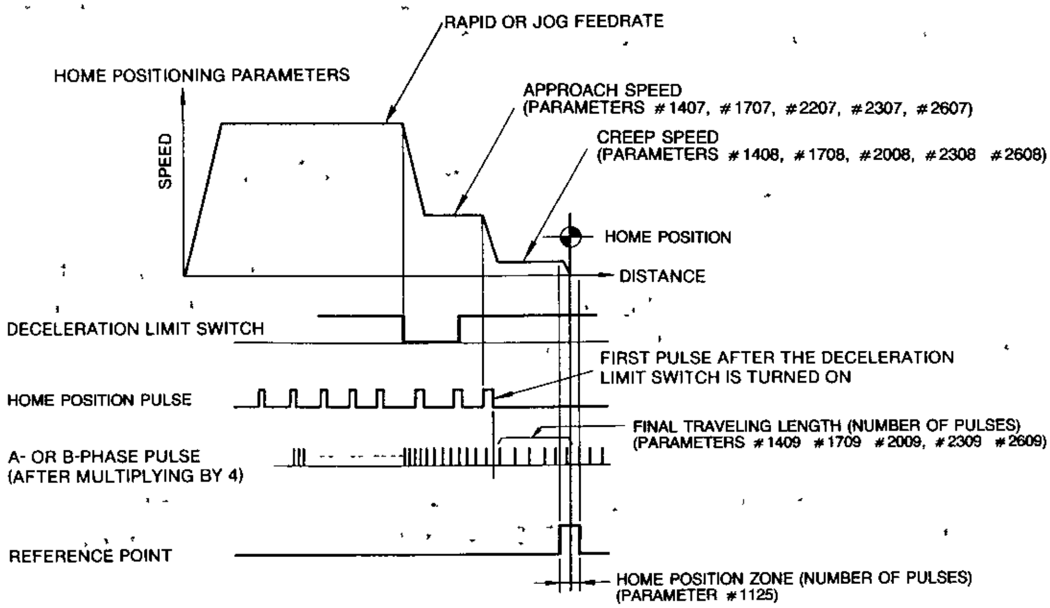


Fig 5 8

5.8.1 Home Positioning Direction Selection (#1501, #1801, #2101, #2401, #2701)

These parameters determine the direction of motion for home positioning. Set 0 for approximating the origin from negative (returning in the positive direction). Set 1 for approximating the origin from positive (returning in the negative direction). Set directions of return along the X, Y, Z, A and B axes, for parameters #1501, #1801, #2101, #2401 and #2701, respectively. These parameters also determine the directions of backlash offset

Note Do not set values other than 0 and 1

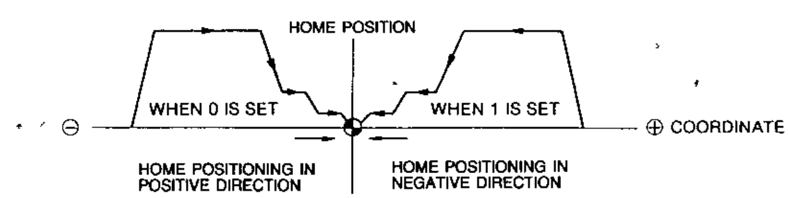


Fig 5 9

5.8.2 Home Positioning Approach Speed (#1407, #1707, #2007, #2307, #2607), 1 ≤ SET VALUE ≤ 4800

These parameters determine the home positioning approach speed Value 1 set for the parameters equals 7 5 mm/min Set speeds along the X, Y, Z, A and B axes for parameters #1407, #1707, #2007, #2307 and #2607, respectively

NOTE

Although up to 4800 can be set for the parameters, practical approach speed must be less than the rapid feedrate (specified for parameters #1130, #1131, and #1132)

5.8.3 Home Positioning Creep Speed (#1408, #1708, #2008, #2308, #2608) 1 ≤ SET VALUE ≤ 4800

These parameters determine the home positioning creep speed Value 1 set for the parameters equals 7 5 mm/min Set speeds along the X, Y, Z, A and B axes for parameters #1408, #1708, #2008, #2308 and #2608, respectively

NOTE

A creep speed must be less than the approach speed along the corresponding axis (specified for parameters #1407, #1707, #2007, #2307 and #2607, respectively)

5.8.4 Home Positioning Final Traveling Length (#1409, #1709, #2009, #2309, #2609) 1 ≤ SET VALUE ≤ 90000000

These parameters determine the final length of travel of a deceleration LS from the point where the first reference point pulse is detected after the LS leaves the dog Value 1 set for the parameters equals 1 pulse (1 feedback pulse after being multiplied by four) Set the lengths along the X, Y, Z, A and B axes for parameters #1409, #1709, #2009, #2309 and #2609, respectively

$$\text{Set value} = \text{Final length of travel (0 001mm)} \times \frac{B}{A}$$

NOTE

The final length of travel must be longer than the required distance for deceleration from the approach to creep speed

Approximate final length of travel (L) is calculated as follows

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

Where, Va Approach speed (mm/s)

α Accel/decel constant (mm/s^2)

5.8.5 Fast Home Positioning Mode (#1001 D2)

When the G28 instruction is used for automatic home positioning in the memory or MDI operation mode, setting parameter #1001 D2 to 1 executes fast home positioning

In fast home positioning, all axes are positioned at fast feed (G00)

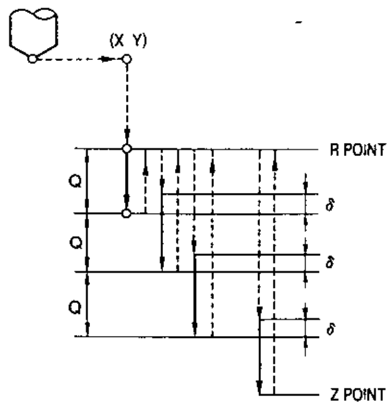
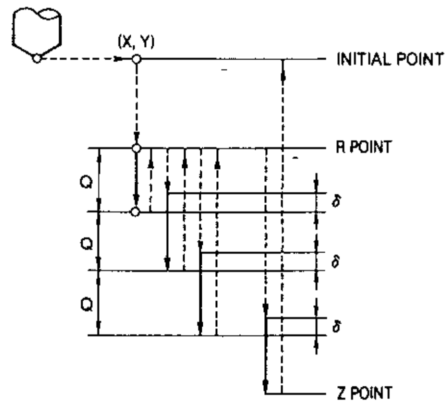
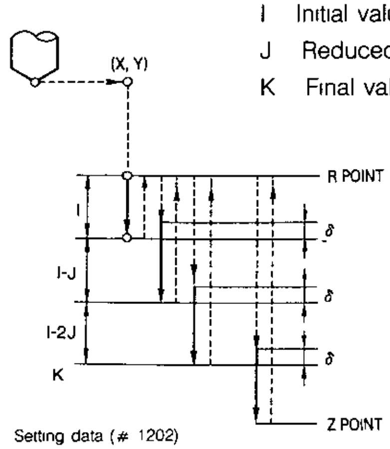
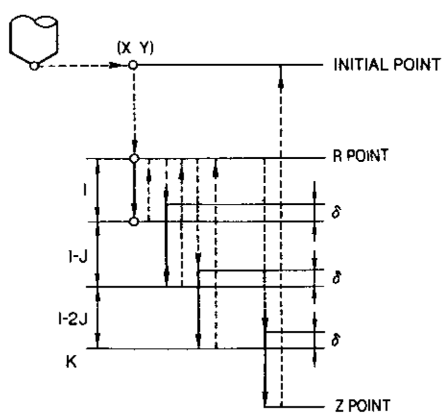
Table 5 18

Parameter No	Description
#1001 D2	0 G28 performs home positioning using limit switch and reference point pulse 1 G28 performs fast home positioning

5.9 COMBINED OPERATION INSTRUCTION (G83) SETTING DATA (#1202) 0 ≤ SET VALUE ≤ 32767

This parameter determines setting data δ to be used for combined operation instruction, deep hole drilling (G83). Value 1 set for the parameter equals 0.001 mm. For instance, setting "2000" gives a setting data of 2 mm.

Table 5.19

	For G99 (Return to R Point)	For G98 (Return to Initial Point)
G83 (Fixed Pitch) Deep Hole Drilling	G83X Y Z R Q L F ,  δ Setting data (# 1202)	 δ Setting data (# 1202)
G83 (Variable Pitch) Deep Hole Drilling	G83X Y Z R I J K L F , I Initial value J Reduced value K Final value  δ Setting data (# 1202)	 δ Setting data (# 1202)

5.10 SPINDLE PARAMETERS

5.10.1 Use of Spindle (# 1000 D3)

This parameter determines the use of the spindle Set 1 for # 1000 D3 to use the spindle

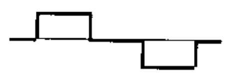
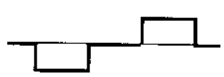
Table 5 20

Parameter No	Description
# 1001 D3	0 Do not use spindle 1 Use spindle

5.10.2 Spindle Mode Setting (# 1150)

This parameter determines the mode of output of the spindle analog speed instruction voltage

Table 5 21

Set Value	Description
1	Bipolar voltage output Outputs positive voltage when forward instruction is given Outputs negative voltage when reverse instruction is given Forward Reverse + 0 – 
3	Unipolar voltage output Outputs positive voltage when forward instruction is given Outputs positive voltage when reverse instruction is given Forward Reverse + 0 – 
7	Bipolar voltage output Outputs negative voltage when forward instruction is given Outputs positive voltage when reverse instruction is given Forward Reverse + 0 – 

Note Do not set values other than 1, 3, or 7

5.10.3 Maximum Spindle Speed (#1160, #1161, #1162)
1 ≦ SET VALUE ≦ 32767

(1) These parameters determine a maximum spindle speed on individual gears (L, M, and H) Select gears using combinations of the spindle gear selection signals (GR1 and GR2) Value 1 set for the parameters equals 1 r/min

Table 5 22

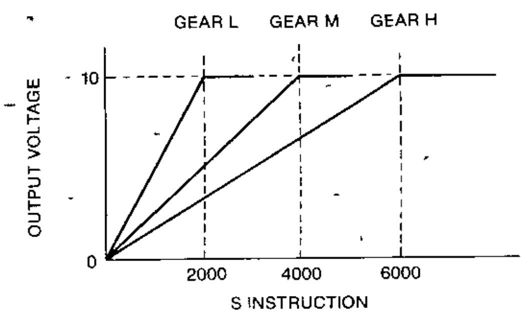
Gear Ratio	GR 2	GR 1	Parameter No
Lo	OFF	OFF	Stop
L	OFF	ON	#1160
M	ON	OFF	#1161
H	ON	ON	#1162

Speed instruction voltages applied to individual gears are determined as follows

$$\text{Speed instruction voltage} = \frac{\text{S five-digit programmed value (r/min)}}{\text{Setup value for maximum speed on each gear (r/min)}} \times 10\ [V]$$

NOTE

Speed instruction voltage must never exceed 10 V



[Example]
Output voltage when the parameters are set as follows
1160 = 2000
1161 = 4000
1162 = 6000

Fig 5 10

(2) When spindle gear selection output is set on, the setup values for the maximum speed on individual gears determine the selection output signal to be output (See Par 5 10 4)

5.10.4 Spindle Gear Selection Output (#1001 D1)

MOTIONPACK-120 supports the gear selection function that compares the S-instruction programmed r/min to the maximum r/min determined for on individual gears (parameters #1160, #1161, and #1162 explained in Par. 5.10.3).

Table 5.23

Parameter No.	Description
#1001 D1	0: Spindle gear selection not output 1: Spindle gear selection output

When 1 is set for parameter # 1001 D1, gear selection output signals GRL and GRH are output as specified in the following table.

Table 5.24

Output Condition	Output Signal	
	GRH	GRL
Programmed Speed < Parameter #1160	OFF	ON
Parameter #1160 ≤ Programmed Speed < parameter #1161	ON	OFF
Parameter #1161 ≤ Programmed Speed	ON	ON

As explained in Par. 5.10.3, the speed instruction voltage output is determined by gear selection inputs GR1 and GR2, and the setup values for maximum speed on individual gears, regardless of the gear selection output status.

If parameter # 1001 D1 is set to 1 and the gear shift inprogress input is on, the setup shift in-progress output voltage is output as speed instruction voltage, regardless of the gear selection input.

5.10.5 Spindle Gear Selection-in-Progress Voltage Output (#1133) 1 ≤ SET VALUE ≤ 32767

This parameter determines the constant-voltage output required for gear selection.

$$\text{Speed instruction output voltage} = \frac{\text{Parameter } \#1133}{32767} \times 10 \text{ [V]}$$

When parameter #1001 D1 is set to 1 and gear shift in-progress input GR0 is on, the above voltage is output whether gear selection input is GR1 or GR2 and the setup values for maximum gear speed on individual gears.

When parameter #1001 D1 is set to 0, the gear selection in-progress voltage output is disabled, and the voltage explained in Par. 5.10.3, (1) is output regardless of gear shift in-progress input GR0.

5.10.5 Spindle Gear Selection-in-Progress Voltage Output (Cont'd)

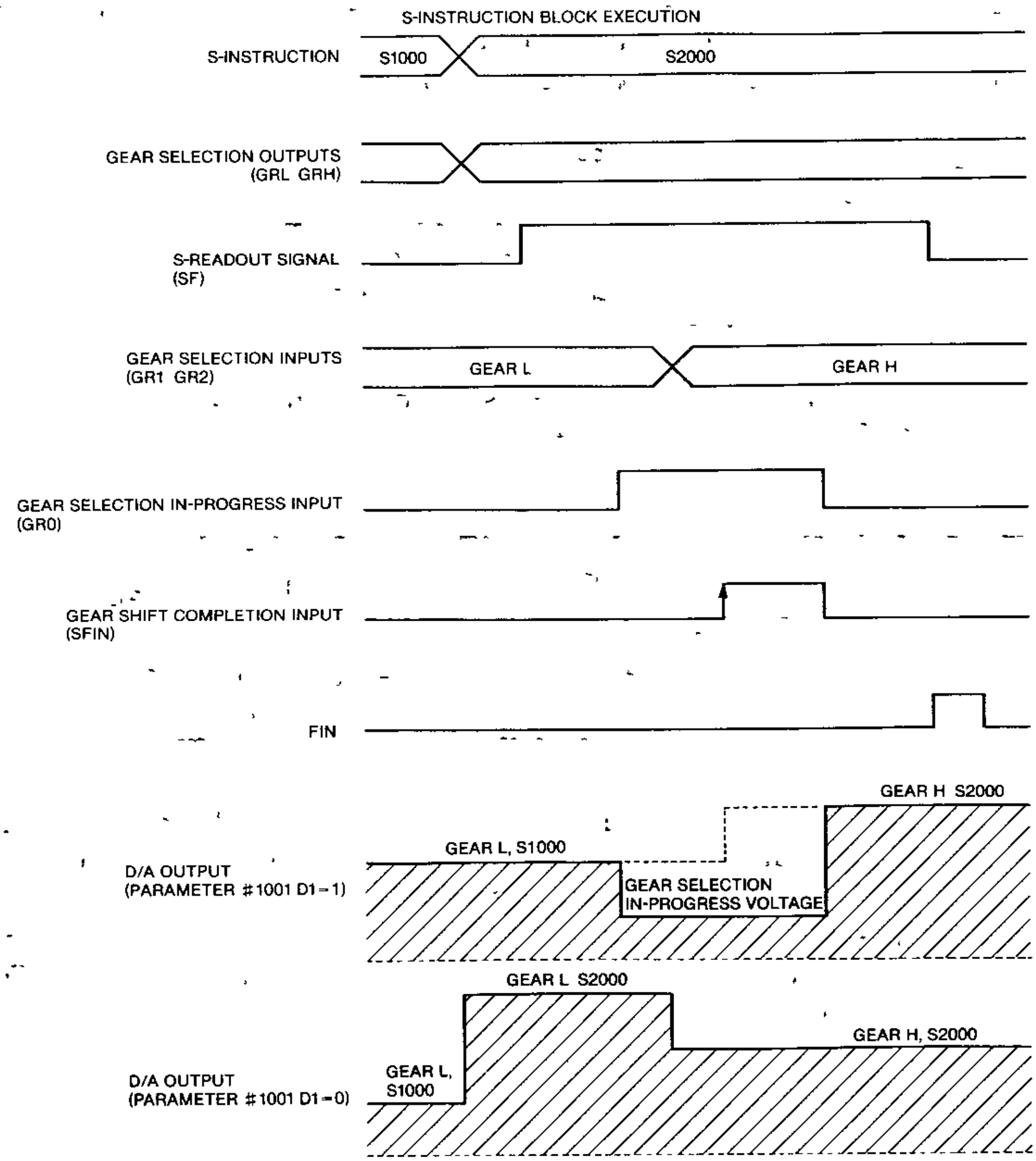


Fig 5 11 Spindle D/A Output Voltage

5.11 SERVO CHARACTERISTIC PARAMETERS

Servo system constants are set for parameters so as to fit servo characteristics to load mechanism

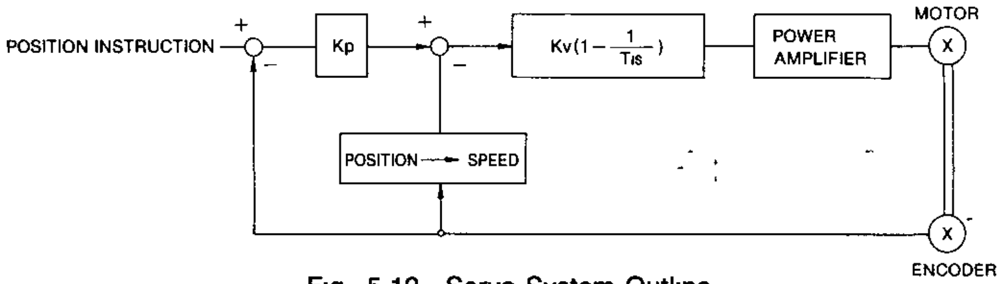


Fig 5 12 Servo System Outline

5.11.1 Position Loop Gain Kp (#1450, #1750, #2050, #2350, #2650)

Position loop gains are set for parameters #1450, #1750, #2050, #2350 and #2650 The setup unit 1 equals 1 s^{-1} Factory setting is 30 s^{-1} Determine the optimum value for the load mechanism during test operation

Table 5 25

	Parameter No	Description
Position Loop Gain Kp	#1450 (X) #1750 (Y) #2050 (Z) #2350 (A) #2650 (B)	Range 1 to 255 Setup unit 1 = $1s^{-1}$

5.11.2 Speed Loop Gain Kv (#1451, #1751, #2051, #2351, #2651)

Speed loop gains are set for parameters #1451, #1751, #2051, #2351 and #2651 The setup unit 1 equals 2 5 Hz Factory setting is 30 (75Hz) Determine an optimum value for the load mechanism during test operation If oscillation occurs, set a smaller value for the parameter

Table 5 26

	Parameter No	Description
Speed Loop Gain Kv	#1451 (X) #1751 (Y) #2051 (Z) #2351 (A) #2651 (B)	Range 1 to 255 Setup unit 1 = 2 5Hz (When load inertia = motor inertia)

NOTE

Actual speed loop gain is affected by load inertia Setup value 1 equals to 2 5 Hz if the load inertia equals the motor inertia Actual speed loop gain Kv is calculated as follows

$$Kv = (\text{Parameter setup value}) \times \frac{5}{1 + \dfrac{(\text{Load inertia})}{(\text{Motor inertia})}} \ (\text{Hz})$$

5.11.3 Fixed Constant Parameters

Parameters listed in Table 5 27 are fixed constant parameters for servo system that have been pre-set at the factory If these parameters must be changed for special purposes, contact your YASKAWA representative

Table 5 27 Fixed Constant Parameters

Parameter No	Factory setting	
#1452, #1752, #2052,	10	← PI integral constant
#1453, #1753, #2053,	2	
#1454, #1754, #2054,	0	
#1455, #1755, #2055,	0	
#1456, #1756, #2056,	15	← Speed loop filter constant
#1457, #1757, #2057,	0	
#1415, #1715, #2015,	32000	
#1517, #1817, #2117,	0	
#1518, #1818, #2118,	116	
#1519, #1819, #2119	0	← Position loop filter constant

5.11.4 Motor Drive Current Limit
(#1512, #1513, #1812, #1813, #2112, #2113, #2412, #2413, #2712, #2713)

These parameters determine the motor drive current limit values Usually, 250 is set for the parameters and there is no limitation

Table 5 28

	Parameter No	Description
Positive Current Limit	#1512 (X) #1812 (Y) #2112 (Z) #2412 (A) #2712 (B)	Range 0 to 250 Setup unit 1 = 1 6% of motor rated current
Negative Current Limit	#1513 (X) #1813 (Y) #2113 (Z) #2413 (A) #2713 (B)	Range 0 to 250 Setup unit 1 = 1 6% of motor rated current

5.11.5 Position Set Range (#1402, #1702, #2002, #2302, #2602) 1 ≦ SET VALUE ≦ 32767

These parameters determine the permissible ranges of position deviation pulse numbers for judging positioning completion.

After a motion instruction such as G00 that requires wait for positioning completion is executed, position deviation pulses may occur because of servo delay after motion pulse distribution. Another instruction (or the next block in MEM operation) is executed only after the number of such pulses is reduced to the setup value for the parameter.

Near the target position, as the number of position deviation pulses decreases, motion is slowed down. For positioning in a practical time, a maximum permissible value within the system precision should be set up.

The setup unit 1 equals 1 pulse (pulse number multiplied by four). Setting P (pulses) gives a position set range from −P pulses to +P pulses. Set ranges on the X, Y, Z, A and B axes for parameters #1402, #1702, #2002, #2302 and #2602, respectively. Conversion from instruction unit (0.001mm) to pulse number is shown in the following.

$$\text{Setup value} = \text{Maximum permissible error (0.001mm)} \times \frac{B}{A}$$

5.11.6 Parameters Related to Servo Characteristics Monitoring (#1458, #1758, #2058, #2358, #2658, #1459, #1759, #2059, #2359, #2659)

To set optimum servo system parameters such as the position loop gain for load machine characteristics, it is useful to observe the servo characteristic analog waveforms. Observing method differs according to the SERVOPACK type.

5.11.6.1 SERVOPACK type HR-□AA

For this SERVOPACK type, specialized monitor JUSP-HRM001 should be prepared.

(1) Connecting the Monitor

1 Confirm that power is off. Disconnect the cable from 3CN of the SERVOPACK of the axis of the waveform which is to be monitored.

2 Connect the monitor to the SERVOPACK as shown in Fig. 5.13.

3 Connect the cable removed from SERVOPACK 3CN to the connector under the monitor. Insert the cable securely. Do not bend the pins when connecting.

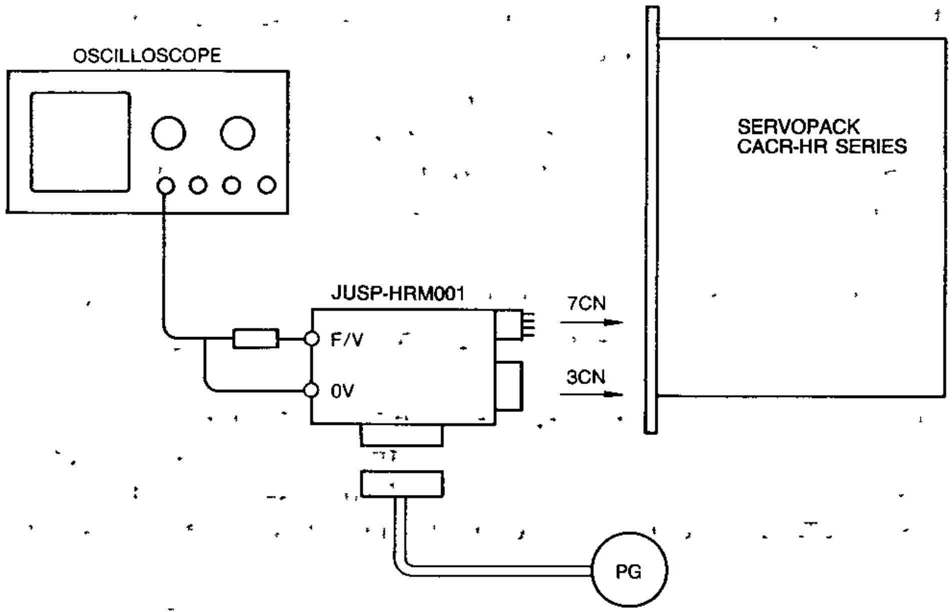


Fig 5 13

(2) Observation of waveform

Monitor unit check terminal voltage waveform is observed by using an oscilloscope, etc

① Motor response

By observing voltage waveform between the motor unit f/V terminal and 0V terminal, the motor rotating speed is observed
Output voltage ±1 2V ±10%/3000r/min

② Load characteristics and speed-reference

Voltage waveform between the motor unit D/A terminal and 0V terminal is observed Waveform to be observed is selected by parameter setting

Table 5 29

	Parameter		Output Voltage
	#1458 (X), #1758 (Y), #2058 (Z), #2358 (A), #2658 (B)	#1459 (X), #1759 (Y), #2059 (Z) #2359 (A), #2659 (B)	
Load Characteristic	28	0	±9 0V ±10%/ ±(300% rated torque)
Speed Reference	41	0	±2V ±10%/ ±1000r/min

5.11.6.2 SERVOPACK type HR-□AB, HR-□AAB

This type of SERV.OPACK incorporates a monitor

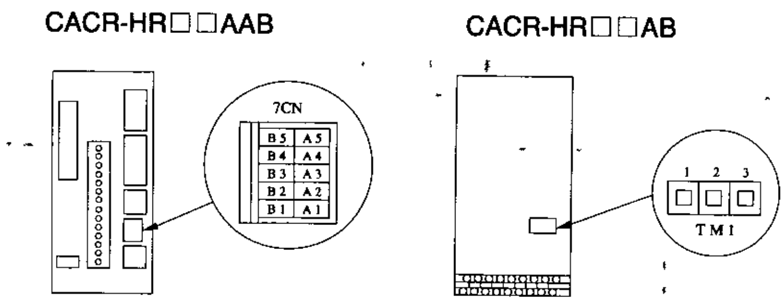


Fig 5 14

Table 5 30

Signal Name	Contents	Rack-mounted Type CACR-HR□□AAB		Base-mounted Type CACR-HR□□AB	
		Pin No	Output Voltage	Pin No	Output Voltage
V_{TG}	Motor rotating speed	7CN-B5	∓2 0V/±1000r/min	TM1-1	$\mp 2\ 0 \times \frac{P^*}{8192}$ V/±1000r/min
T_{MON}	Torque reference	7CN-5A	∓3 0V/±100%	TM1-2	∓3 0V/±100%
	Speed reference		±2 0V/±1000r/min		±2 0V/±1000r/min
GND	0V for signals	7CN-B1	0V	TM1-3	0V

* Value P is the number of pulses per encoder revolution (P/R)

Notes

1 Shortcircuiting with the adjacent pin must be avoided at measurement
For the rack-mounted type, measurement can be performed easily by using pins (type PS 10PE D4R1 A1) made by JAPAN AVIATION ELECTRONICS INDUSTRY, LTD In this case, insert the shorter pin in the servo

2 Torque reference monitor and speed reference monitor are switched alternately by parameter setting as they were

3 The relation between the monitor shift amount parameter set value and monitor output voltage has been changed The output voltage in the above table is the value when "0" is set to monitor shift amount setting parameter for both torque reference and speed reference

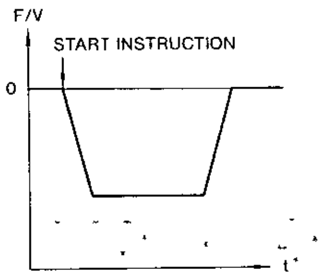
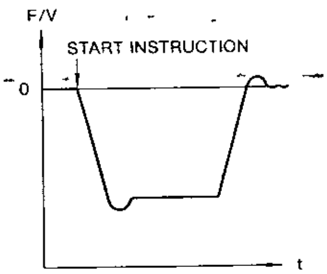
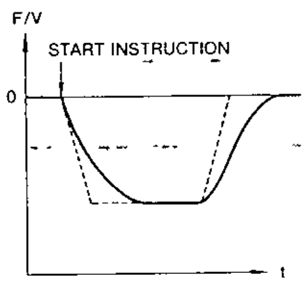
Table 5 31

	Parameter	
	#1458 (X), #1758 (Y), #2058 (Z), #2358 (A), #2658 (B)	#1459 (X), #1759 (Y), #2059 (Z), #2359 (A), #2659 (B)
Torque Reference	28	0
Speed Reference	41	0

5.11.6.2 SERVOPACK type HR-□AB, HR-□AAB (Cont'd)

Monitor the waveform explained in (2)-(a) Follow the procedures in the table to set an optimum parameter value

Table 5 30

Speed Monitored Waveform	Diagnosis	Remarks
	Optimum status with no overshoot or oscillation, showing good follow-up response	This waveform is not always obtainable, depending on the load machine rigidity
	Overshoot and oscillation are observed • Reduce Kp gradually, or • Reduce Kv gradually	If a certain degree of Kp is required and overshoot must be eliminated, set a longer accel/decel time
	Bad follow-up response is observed (1) Increase Kp gradually (2) If Kp cannot be increased for fear of oscillation, reduce Kv gradually	If oscillation occurs as Kv is increased, it is the limit of the follow-up performance of the system including the load mechanism

5.12 MOTIONPACK FUNCTIONS

5.12.1 Offset Data Write (#1001 D0)

This parameter specifies the data writing method for entering offset data from the Control Station.

Table 5.31

Parameter No.	Description
#1001 D0	0 Use incremental value 1 Use absolute value

When parameter #1001 D0 is set to 0, incremental values must be used to write offset data from the Control Station. An incremental value is a value to be added arithmetically to an already set-up value.

[Example] When parameter #1001 D0 = 0,

Table 5.32

Existing Setup Value	Write Data	Result
10 000	1 234	11 234
10 000	−10 000	0 000
10 000	−11 234	−1 234
10 000	0	10 000

When parameter # 1001 D0 is set to 1, absolute values must be used to write offset data from the Control Station. An absolute value is a value to be used as a new setup value.

[Example] When parameter # 1001 D0 = 1,

Table 5.33

Existing Setup Value	Write Data	Result
10 000	1 234	1 234
10 000	−10 000	−10 000
10 000	−11 234	−11 234
10 000	0	0 000

5.12.2 Axis Disregard (#1006 D0-D2)

When the axis disregard signal (NEG) is turned on during memory operation, control on the axis specified by the signal is halted This is the axis disregard function To use this function, the function which takes effect on each axis must be set for parameters #1006 D0-D2

Table 5 34

	Parameter No	Description
Axis Disregard Specification	#1006 D0 (X) #1006 D1 (Y) #1006 D2 (Z)	0 Axis disregard ineffective 1 Axis disregard effective

When the axis disregard signal (NEG) is turned on during memory operation, motion instruction is disregarded on the axes where the axis disregard function is effective On such an axis, the load machine is not moved and the current position indication is left unchanged

5.12.3 Position Memory (#1003 D1)

Motionpack-120 supports a function that keeps the current display axis position (X, Y, Z) in memory as offset data This function is activated when the position memory signal (PMEM) is turned on The X, Y, and Z coordinates are stored to H294, H295, and H296, respectively Parameter #1003 D1 specifies whether this memory function is effective

Table 5 35

Parameter No	Description
#1003 D1	0 Position memory disabled 1 Position memory enabled

5.12.4 Notch Signal Output (#1003 D4)

This parameter specifies whether the notch signal output function is effective When the notch signal output is used for the G66, G67, G68, or G69 instruction, set #1003 D4 to 1 to validate the notch signal output When the notch signal output is effective, the T function output is disabled

Table 5 36

Parameter No	Description
#1003 D4	0 Notch signal output ineffective 1 Notch signal output effective

5.12.5 External Program Selection

The program to be executed in the memory operation mode is selected from the Control Station Also, it can be selected by externally inputting that the program is executed by start input signal or reset signal

(1) Starting Program Number Selection (# 1002 D0)

If parameter # 1002 D0 is set to 1, the value set in the program number input signal is read when signal STR, which starts memory operation, is entered, and a program is selected accordingly

Table 5 37

Parameter No	Description
# 1002 D0	0 Starting program number selection ineffective 1 Starting program number selection effective

(2) Resetting Program Number Selection (# 1002 D7)

If parameter # 1002 D7 is set to 1, the value set in the program number input signal is read when the reset input signal is entered, and a program is selected accordingly

Table 5 38

Parameter No	Description
# 1002 D7	0 Resetting program number selection ineffective 1 Resetting program number selection effective

Note If both the resetting and starting program number selections are effective, the system selects the program having the program number that was input to the program number input signal when the start signal was input

5.13 I/O RELATED PARAMETERS

5.13.1 MF, TF, and SF Signals Delay Time (#1100) 0 ≤ SET VALUE ≤ 32767

The M, T, and S code read signals (MF, TF, and SF) can be output later than the M-BCD and T-BCD code output signals (M11-M28 and T11-T28) and the spindle feedrate instruction Parameter #1100 determines the delay time

The setup unit 1 equals 8 ms For instance, setting "2" provides a delay time of 16 ms

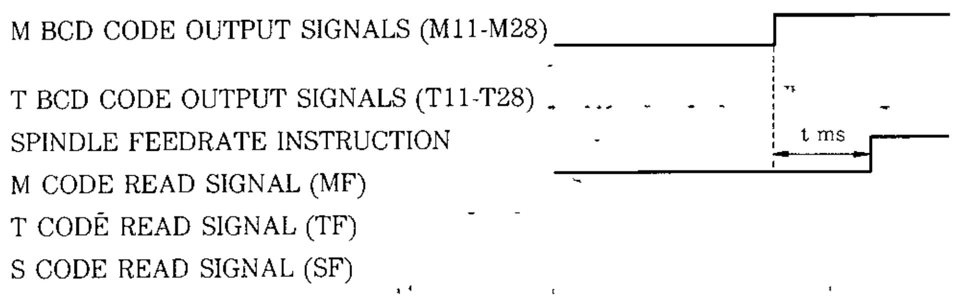


Fig 5 14

5.13.2 I/O Related Fixed Parameter (#1008 D0)

Always set parameter #1008 D0 to 1

5.13.3 External Offset Data Write Digit Number (#1005 D4-D7)

These parameters determine the number of digits composing the BCD data to be externally written as offset data by the G10 instruction via the I/O pin Set only one of D4 to D7 to 1, and set 0 for others

When #1005 D4 is 1, two-digit BCD offset is input
When #1005 D5 is 1, four-digit BCD offset is input
When #1005 D6 is 1, six-digit BCD offset is input
When #1005 D7 is 1, eight-digit BCD offset is input

When four or more digits are specified, a succession of input signals beginning with the programmed U input number are written as offset data

5.14 OFFSET RELATED PARAMETERS

5.14.1 Backlash Offset (#1507, #1807, #2107, #2407, #2707) 0 ≦ SET VALUE ≦32767

Parameters #1507, #1807, #2107, #2407 and #2707 determine the backlash offsets for ball screws on the X, Y, Z, A and B axes, respectively The backlash offset is added to the specified motion value to be compensated The setup unit 1 equals 1 pulse (pulse number multiplied by four) When an offset of ℓ (1=0 001mm) is required, the backlash offset is calculated as follows

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

NOTE

Direction of offsetting of backlash depends on the home positioning direction parameters (#1501, #1801, #2101, #2401 and #2701) If a mechanical reference point was determined without using the home positioning limit switch, set the home positioning direction parameters according to Par 5 7, Reference Point Setting

5.14.2 Pitch Error Offset Related Parameters

(#1508-#1509, #1808-#1809, #2108-#2109, #2408-#2409, #2708-#2709 #1550-#1629, #1850 - #1929, #2150 - #2229, #2450-#2529, #2750-#2829)

Pitch measurement error offset data for a ball screw on each axis can be stored in parameters for automatic compensation of pitch errors The pitch error offset data are collected at points that divide a circle having the origin at the center This function takes effect when home positioning has been performed

Specify the compensation interval, starting point, and offset data on individual positions for the ball screw on each of the X, Y, Z, A and B axes

When an offset of ℓ (1=0 001mm) is required, the pitch error offset is calculated as follows

$$\text{Pitch error offset} = \ell \times \frac{B}{A}$$

5

5.14.2 Pitch Error Offset Related Parameters (Cont'd)

Table 5 39

Item	Parameter No	Description
Compensation Interval	#1509 (X) #2409 (A) #1809 (Y) #2709 (B) #2109 (Z)	• Range 1000 to 99999999 If 0 is set, compensation is disabled • Setup unit 1 = 0 001mm
Compensation Starting Point	#1508 (X) #2408 (A) #1808 (Y) #2708 (B) #2108 (Z)	• Specifies the point where compensation is started Compensation is performed at 80 points including the starting point • Range -2000000 to 2000000 Minus sign indicates that the starting point is below the origin
Offset at Each Position	#1550 to (X) #1629 #2450 to (A) #2529 #1850 to (Y) #1929 #2750 to (B) #2829 #2150 to (Z) #2229	• Range −32767 to 32767 • Setup unit 1 = 1 pulse (pulse number multiplied by four) • Set the pitch error offset at the starting point, for parameters #1550, #1850, #2150, #2450 and #2750, with an incremental value Set offset data at 80 points in the forward direction, to parameters #1551, #1552 #1851, #1852 #2151, #2152 #2451, #2452 #2751 #2752 If the pitch error offset is positive, set negative offset data If the pitch error offset is negative, set positive offset data

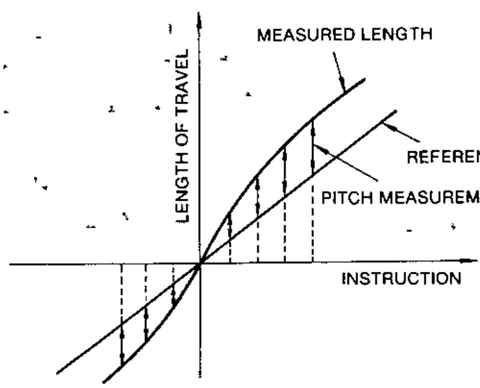


Fig 5 15

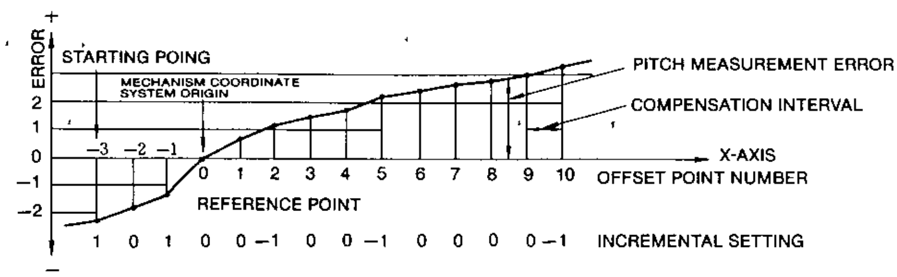


Fig 5 16 Example of Write to X Axis

Assume the following factors in the example shown in Fig 5 16

Compensation interval 1 000 mm
Compensation starting point -3
Number of points 14

To specify the above, set parameters as follows

Compensation interval

#1509	1000

Compensation srarting point

#1508	—3

Table 5 40

Offset Point Number	Parameter No	Offset	
—3	#1550	1	←Offset corresponding to starting point number —3
—2	#1551	0	
—1	#1552	1	
0	#1553	0	←Reference point on X-axis
1	#1554	0	
2	#1555	—1	
3	#1556	0	
4	#1557	0	
5	#1558	—1	
6	#1559	0	
7	#1560	0	
8	#1561	0	
9	#1562	0	
10	#1563	—1	←Offset corresponding to offset point number 10
11 to 76	#1564 to #1629	0	Set 0 for parameters representing sections where compensation is not required

5.15 COMMUNICATION SPECIFICATIONS

The Control Station of MOTIONPACK-120 can be connected to external equipment such as a personal computer for program and-parameter transmission For this purpose, communication specifications of MOTIONPACK-120 and the external equipment must be matched by setting parameters

NOTE

For direct connection of external equipment such as a personal computer to the motion module, the protocol is fixed as follows 9600 Baud, 8-bit data length, 1-stop bit, and even parity

5.15.1 Baud Rate (#1009 D0-D2)

Set baud rate for the parameters as specified in the table

Table 5 41

Parameter #1009			Baud Rate
D2	D1	D0	
0	0	1	300
0	1	0	600
0	1	1	1200
1	0	0	2400
1	0	1	4800
1	1	0	9600

5.15.2 Stop Bit Length (#1009 D4)

Select a 1- or 2-stop bit by setting parameter #1009 D4

Table 5 42

Parameter No	Description
#1009 D4	0 1-stop bit 1 2-stop bit

5.15.3 Data Bit Length (#1009 D5)

Select 7- or 8-bit data length by setting parameter #1009 D5

Table 5 43

Parameter No	Description
#1009 D5	0 7bits 1 8bits

5.15.4 Parity (#1009 D6, D7)

Specify the use of parity and the parity type as follows

Table 5 44

Parameter #1009		Parity
D7	D6	
0	1	Even parity
1	1	Odd parity
0	0	Parity not used
1	0	Parity not used

5.15.5 ISO/ASCII Switch (#1004 D4)

Specify the ISO or ASCII communication data code For communication with a standard personal computer, select the ASCII code

Table 5 44

Parameter No	Description
#1004 D4	0 ASCII code 1 ISO code

5.15.6 Use of DC2/DC4 Codes (#1004 D5)

For communication with external equipment that requires DC2 (tape punch start) and DC4 (tape punch reset) codes, set parameter #1004 D5 to 1 For communication with a standard personal computer, set the parameter to 0

Table 5 46

Parameter No	Description
#1004 D5	0 DC2/DC4 transmission not required 1 DC2/DC4 transmission required

Operation sequence for DC2/DC4 transmission is in the following

(1) Depress the OUT key on the Control Station

(2) DC2 code (12h) is sent from the Control Station

(3) Programs (or parameters) are sent from the Control Station

```
%
O 100,
G 00 X 0 ,
     |
     |
M30,
%
```

(4) DC4 code (14h) is sent from the Control Station

5.16 PARAMETERS RELATED TO ALARM DETECTION

5.16.1 Parameters Related to Software Limit Switch Check
(#1414, #1714, #2014, #1504-#1505, #1804-#1805, #2104-#2105, #2404-#2405, #2704-#2705)

The software limit check function is provided aside from the actual limit switches (LS) on the X, Y, Z, A and B axes. The software LS function is implemented by memory in the motion module containing the motion range boundaries. Usually, the software boundaries are set within that of the LS.

The software LS check function requires two types of parameters. One specifies the use of the function, and the other sets the motion range boundaries. When the software LS check function is enabled, movement is stopped by deceleration near the boundaries.

(1) Software LS Check Function (#1414, #1714, #2014, #2314, #2614)

Set the use of the software LS check function on the X, Y, Z, A and B axes, for parameters #1414, #1714, #2014, #2314 and #2614, respectively. Set 1 to use the function. Set 0 when not using the function.

NOTE

Do not set values other than 1 or 0.

(2) Travel Length Limit in Positive Direction (#1504, #1804, #2104, #2404, #2704)
-99999999 ≦ Set Value ≦ 99999999

Set the permissible distance from the orgin in the positive direction on the X, Y, Z, A and B axes, for parameters #1504, #1804, #2104, #2404 and #2704, respectively.

The setup unit 1 equals 0.001 mm. For instance, setting "10000" provides a permissible distance of 10.000 mm from the origin. If motion beyond this point is attempted, an alarm occurs.

(3) Travel Length Limit in Negative Direction (#1505, #1805, #2105, #2405, #2705)
-99999999 ≦Set Value ≦ 99999999

Set the permissible distance from the origin in the negative direction on the X, Y, Z, A and B axes, for parameters #1505, #1805, #2105, #2405 and #2705, respectively.

The setup unit 1 equals 0.001mm. For instance, setting "-20000" provides a permissible distance of -20.000mm from the origin. If motion beyond this point is attempted, an alarm occurs.

Table 5 47

	Parameter No	Description
Software LS Check ON/OFF	#1414 (X) #1714 (Y) #2014 (Z) #2314 (A) #2614 (B)	0 Software LS check disabled 1 Software LS check enabled
Software LS Check Positive Limit	#1504 (X) #1804 (Y) #2104 (Z) #2404 (A) #2704 (B)	Range −99999999 to 99999999 Setup unit 1 = 0 001mm
Software LS Check Negative Limit	#1505 (X) #1805 (Y) #2105 (Z) #2405 (A) #2705 (B)	Range −99999999 to 99999999 Setup unit 1 = 0 001mm

5.16.2 Overtravel On/Off (#1502, #1802, #2102, #2402, #2702)

Set whether the HR servo overtravel input is effective on the X, Y, Z, A and B axes, for parameters #1502, #1802, #2102, #2402 and #2702, respectively

Table 5 48

	Parameter No	Description
Overtravel Input ON/OFF	#1502 (X) #1802 (Y) #2102 (Z) #2402 (A) #2702 (B)	0 Overtravel input effective 1 Overtravel input ineffective

When this parameter is set to 0 to validate the overtravel input, an overtravel alarm is activated if a positive OT signal is input during motion in the positive direction or if a negative OT signal is input during motion in the negative direction After this alarm occurs, the machine stops immediately by the zero speed instruction that holds for about 250 msec Then the machine stops at the position after positioning adjustment

5.16.3 Servo Error Detection Area (#1401, #1701, #2001, #2301, #2601) 1 ≤ SET VALUE ≤ 5000000

Thess parameters are used to detect errors in the servo system Set a maximum number of position deviation pulses that may occur in normally functioning servo system Set the value for each of the X, Y, Z, A and B axes, for parameters #1401, #1701, #2001, #2301 and #2601, respectively

The setup unit 1 equals 1 pulse (pulse number multiplied by four) If the set number of position deviation pulses is exceeded, an alarm (SERVO TRACKING ERROR) occurs

Usually, set about twice as many as the number of position deviation pulses calculated from the position loop gain parameter

[Example] When an S series motor is used at the rated speed and 30 (sec^{-1}) is set for the position loop gain parameter, the position deviation pulse number is calculated as follows

$$\text{Position deviation } \varepsilon = \frac{8192\,(\text{pulse/rev}) \times 4 \times 3000\,(\text{r/min}) \times \frac{1}{60}}{30\,(\text{sec}^{-1})} = 54613\,(\text{pulses})$$

For servo error detection parameters, set up about double the above position deviation pulse number, for instance, 110000

5.16.4 Absolute Position Check Function

When absolute values are used, MOTIONPACK checks number of motor revolution to which power is not applied If a non-powered motor shows number of revolution greater than a value preset in parameter #1143, #1144, or #1145, an alarm (ABSO POS CHECK ERROR) (alarm code 096, 097, or 098) is activated when power is turned on

This function prevents inadvertent operation of the load machine in case of misalinment of the machine or a fault in the encoder that may occur while power is off

If the alarm occurs, reset it after confirming that the position of the machine and the MOTIONPACK position indication are normal

If any error is found, check the encoder pulse number, setup values for B/A and A/B parameters, wiring among the SERVOPACK, absolute encoder equipment, and battery After the check, reset the encoder and set the reference point

Table 5 49

	Parameter No	Description
Absolute Position Check Number of Revolution	#1143 (X) #1144 (Y) #1145 (Z)	Range 1-127 (When 0 is set, check is skipped) Setup unit 1 = 1 revolution

Note This function checks number of motor revolution to which power is not applied If power is turned on and off after the alarm is issued it disappears

5.16.5 G31 (SKIP) Instruction Alarm Detection (#1003 D0)

This parameter specifies whether an alarm should be activated if no skip signal is input during execution of the G31 block

Table 5 50

Parameter No	Description
#1003 D0	0 Activate alarm if no skip signal is input for G31 instruction 1 Do not Activate alarm even if no skip signal is input for G31 instruction

5.17 PARAMETERS RELATED TO BUILT-IN SEQUENCER

5.17.1 Interaction with Built-in Sequencer (#1140)

This parameter must be set to 0 during normal operation To turn MOTIONPACK power ON or OFF, set this parameter to 1. Turning on MOTIONPACK power when parameter #1140 is 1 enables interaction with the MOTIONPACK built-in sequencer Ladder program loading and data loading for writing ladder to PROM can be accomplished only in this status

After loading ladder programs, reset parameter #1140 to 0, and turn MOTIONPACK power on and off

Table 5 51

Parameter No	Description
#1140	0 Activate interaction with built-in sequencer 1 Stop interaction with built-in sequencer

Note Do not set values other than 0 or 1

5.17.2 Built-in Sequencer Keep Memory Area (#1142) 4800 ≦ SET VALUE ≦ 6000 (If 0 is set, 4800 is used.)

The internal relays and registers (address #4800 to #5999) of the built-in sequencer can be set as keep memory (that retains data after MOTIONPACK power is turned off)

When keep memory is to be used, set the start address of the keep memory for parameter #1142 When keep memory is not to be used, set 0 or 6000 for parameter #1142

When all addresses from #4800 through #5999 are to be used for keep memory, set 4800 for parameter #1142 When addresses from #5000 through #5999 are to be used for keep memory, set 5000 for parameter #1142

5.18 LATHE SYSTEM PARAMETERS

(1) Selection of Lathe System (#1003 D7)

This parameter selects specifications for a lathe system

Table 5 52

	Parameter No	Description
Lathe System Selection	#1003 D7	0 Standard specifications 1 Lathe system specifications

(2) Parameters that should be set differently from those for standard system

With specifications for a lathe system, position instructions along the X and Y axes are processed as diameter instructions Hence, parameters B/A and A/B must be set so that a programmed instruction for a movement of 0 001 mm makes a practical machine movement (by a radial instruction) of 0 0005 mm This means that all setup values for position- and speed-related parameters based on the position instruction unit system must be converted to diameter instruction values To convert radial instruction values to diameter instructions, double the values

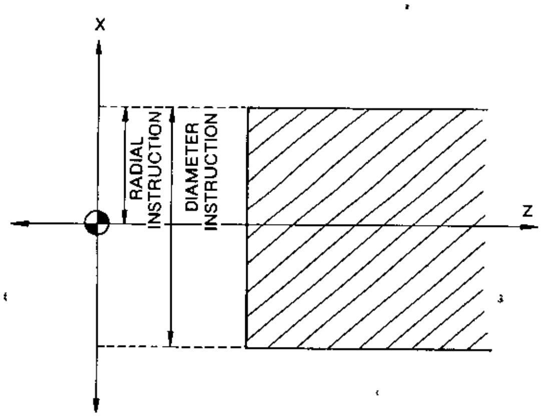


Fig 5 17

5.19 STORING PROGRAM NUMBER (#1001 D3)

When parameter #1001 D3 is set to "1" at power supply ON, the program No selected at power supply OFF is selected

Table 5 55

Parameter No	Contents
#1001 D3	0 Storing program No invalidated 1 Storing program No validated

5.20 PARAMETERS RELATED TO AUXILIARY AXES

5.20.1 Writing Offset Value No. 300's from CRT (#1001 D4)

Writing offset value No H300 and after from the CRT control staion is enabled by parameter setting

Table 5 56

Parameter No	Contents
#1001 D4	0 Writing compensated value No 300's invalidated 1 Writing compensated value No 300's validated

5.20.2 Auxiliary Axis Speed Selection (#1001 D5)

The unit of the auxiliary axis moving speed can be selected by parameter setting

Table 5 57

Parameter No	Contents
#1001 D5	0 "1" = 7 5 mm/min 1 "1" = 1mm/min

5.20.3 Auxiliary Axis Speed No. Designation (#1002 D4)

To specify the jog command for the auxiliary axes, select the offset value No to set the moving speed The offset value No is specified by offset value No input #4021 and #4023 for A and B axes, respectively

Table 5 58

Parameter No	Contents
#1002 D4	0 Moving speed is the offset No value of the value set in the offset value No input (#4021, #4023) added with 300 1 Moving speed is the offset No value of the value set in the offset value No input (#4021, #4023) added with 301

SECTION 6

CONTENTS

6

6. EXPLANATION OF I/O SIGNALS

6.1 OUTLINE OF I/O SIGNALS

The MOTIONPACK system supports four types of I/O signals

(1) Motion Module General-Purpose I/O Signals

This type of I/O signal is generally used for operation mode selection, start-stop, and M-code output These signals are connected to 1CN, 2CN, 9CN, and 10CN of the motion module

When incorporated PLC functions are to be used, internal signals can be assigned to the actual external signals on the connector by ladder programming

A standard ladder program is provided to assign external and internal signals Figs 6 1 and 6 2 show the factory setting of the allocation

(2) Motion Module Exclusive I/O Signals

These are input signals that require high speed processing such as the skip signal This type of signal is assigned without variation to connector 4CN of the motion module

(3) Motion Module Pin I/O Signals

The emergency stop input signal and the servo main power control signal are controlled by electric circuits, and therefore, are assigned to fixed I/O channels These signals are connected to 2TM pin of the motion module

(4) SERVOPACK I/O Signals

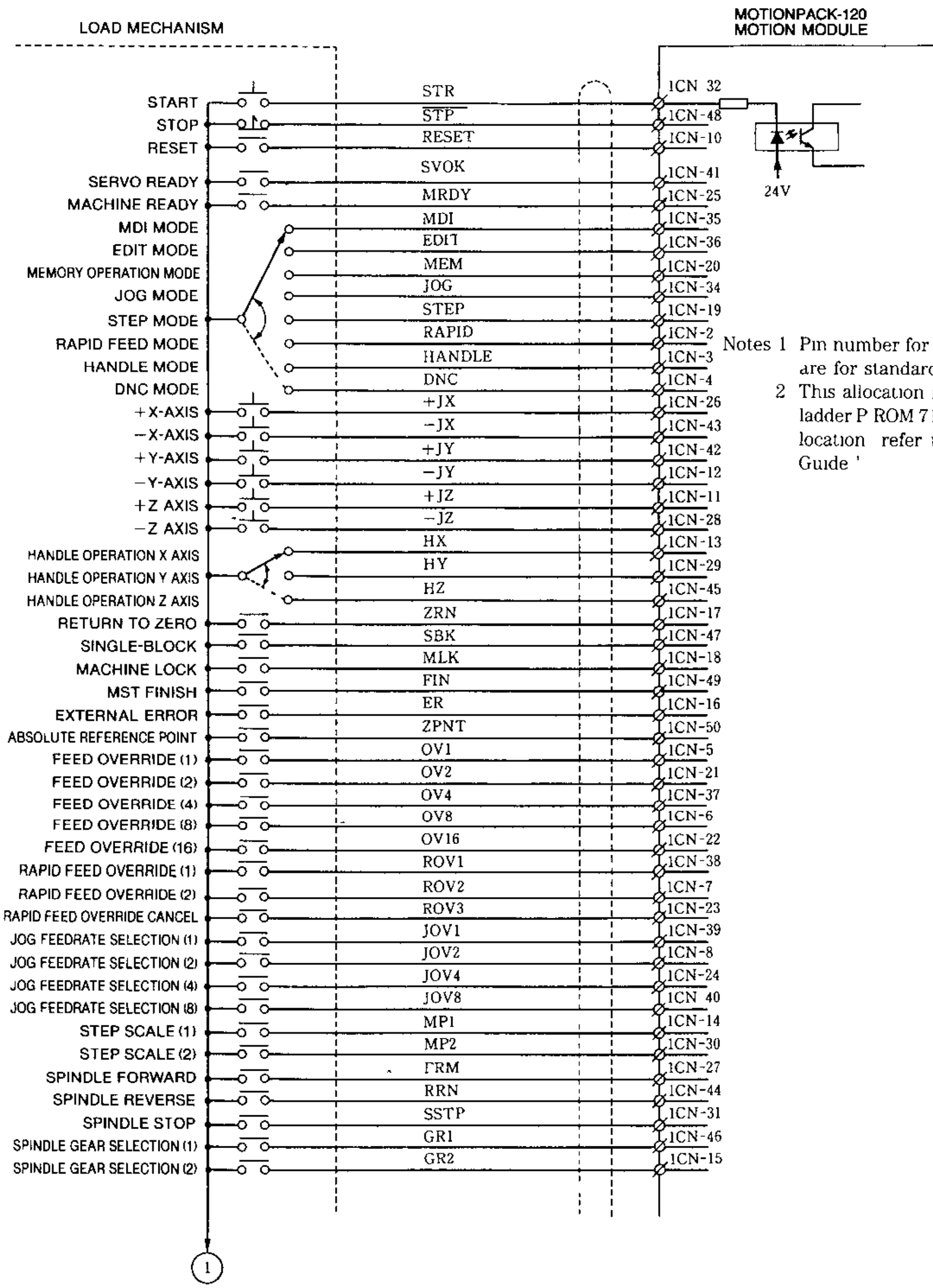
Signals that require high speed processing on individual axes, such as overtravel and home positioning deceleration limit switch signals, are connected to the Servopack of individual axes

All of the four types of the signals can be checked on the diagnostic screen on the Control Station Details about the I/O signals are explained in the following

6.2 MOTION MODULE GENERAL-PURPOSE I/O SIGNALS

(1) Details of General-Purpose Input Signals

Fig 6 1 shows allocation of general-purpose input signals in the standard ladder program



Notes 1 Pin number for the motion module are for standard I/O allocation

2 This allocation is based on data in ladder P ROM 71 To change the allocation refer to the Sequencer Guide '

6.2 MOTION MODULE GENERAL-PURPOSE I/O SIGNALS (Cont'd)

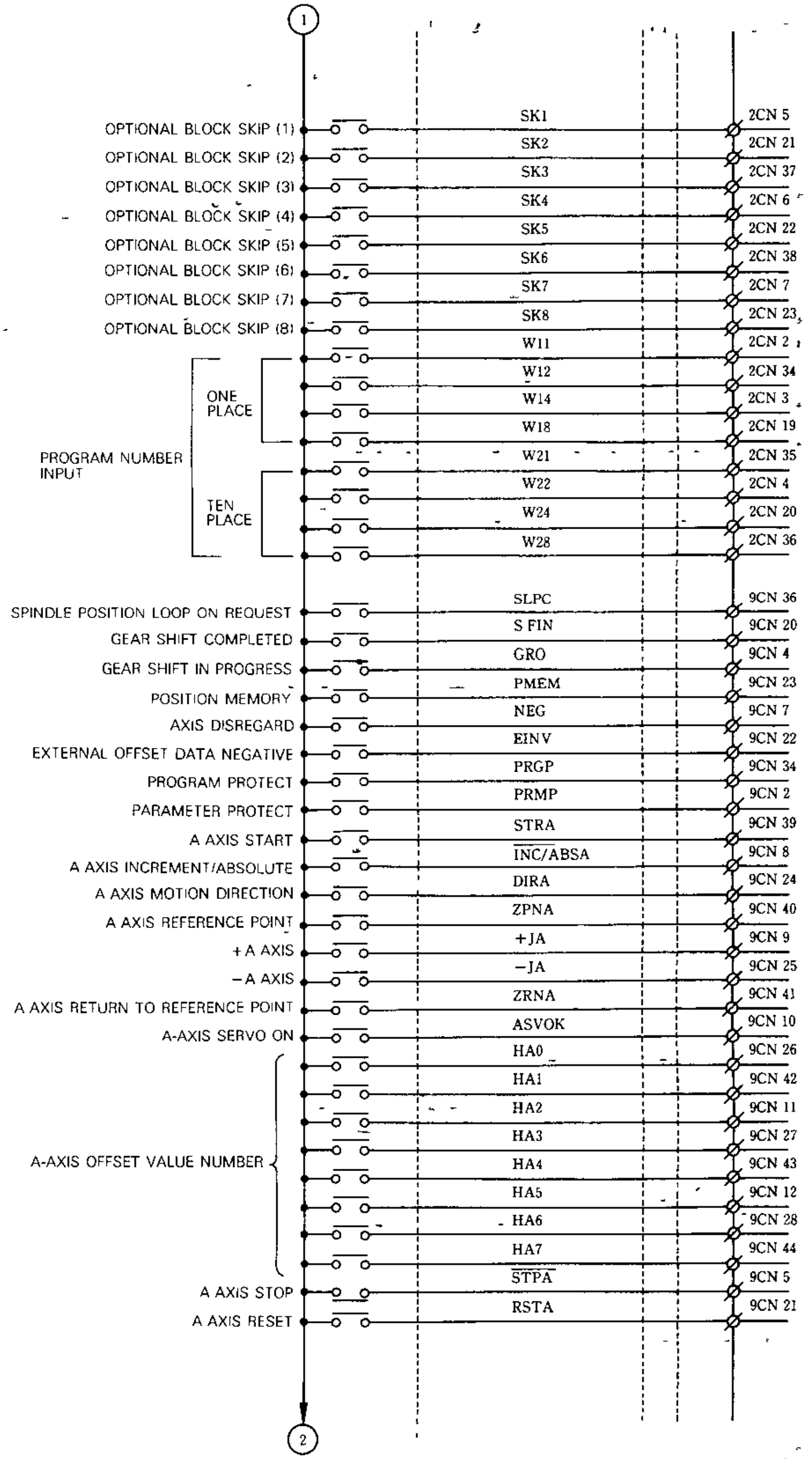


Fig 6 1 General-purpose I/O Signal Allocation (1/2)

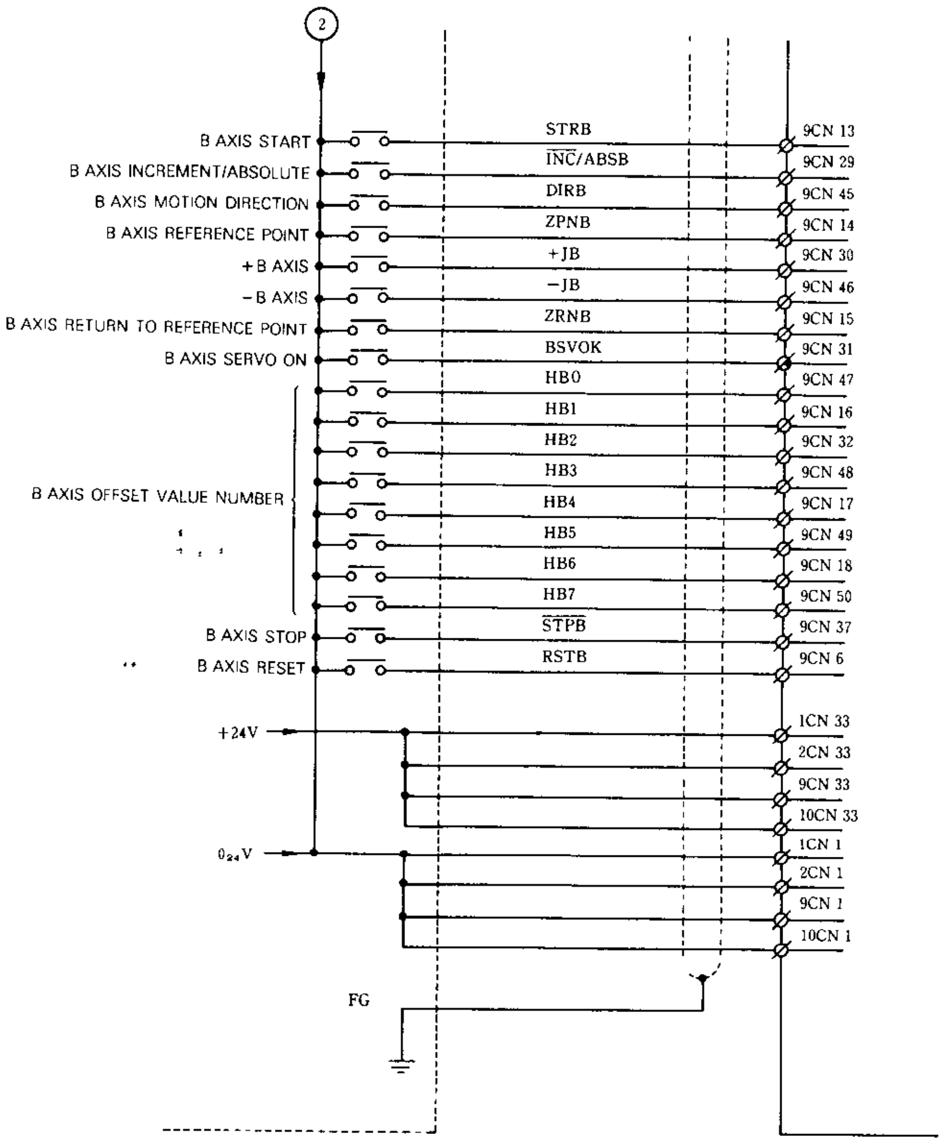
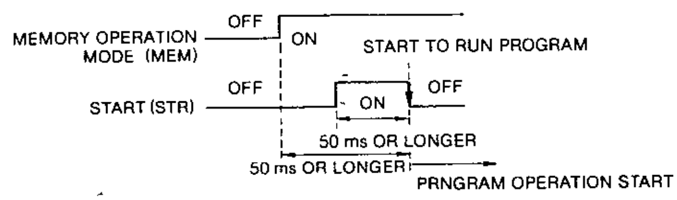
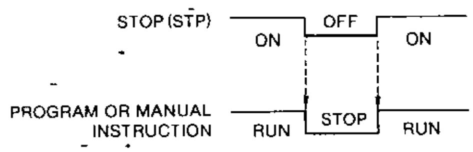
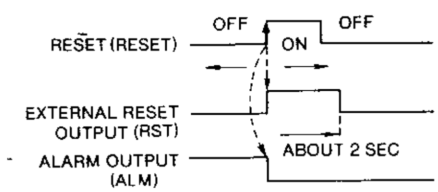


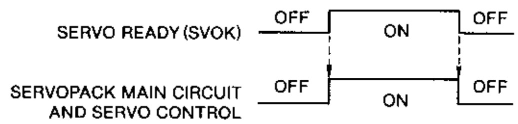
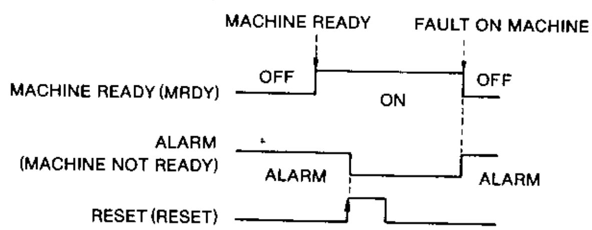
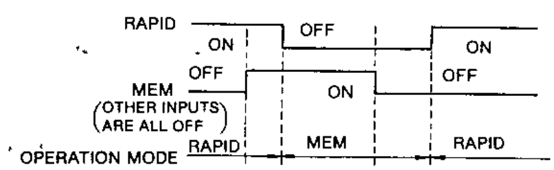
Fig 6 1 General-purpose I/O Signal Allocation (2/2)

Table 6.1 Input Signal Function, Operation and Timing (1/17)

<table>
<tr><th>Name</th><th>Signal Name</th><th>Function, Operation, and Timing</th></tr>
<tr><td>Start</td><td>STR</td><td>This is the start signal in the memory operation mode. Turning this signal on after specifying a program number starts automatic execution of the program.

</td></tr>
<tr><td>Stop(Hold)</td><td>STP</td><td>This is the stop signal for jogging, rapid feed, stepping, and handle operation in the memory and manual operation modes.
If the stop signal is turned on during execution of a program or manual operation, the processing slows down and stops. When the signal is turned off again, the program is restarted.

</td></tr>
<tr><td>Reset</td><td>RESET</td><td>When this signal is turned on, the alarm output signal (ALM) is reset. When the reset signal is turned on or off, the external reset signal output (RST) goes on or off simultaneously.
The reset signal has the same function as that of the RESET key on the Control Station. For details of the reset function, see Par. 4.1.10, Reset Key.


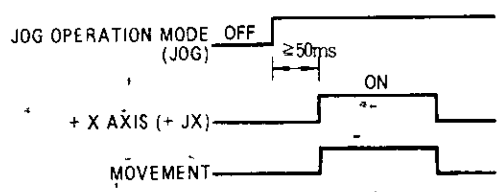
1. Use the external reset signal output (RST) for the load machine reset signal.
2. If the reset signal is turned on during memory operation, operation is slowed down and stopped, then the beginning of the program number is restored.</td></tr>
</table>

Table 6 1 Input Signal Function, Operation and Timing (2/17)

Name	Signal Name	Function, Operation, and Timing
Servo ready	SVOK	When this signal is turned on, main circuit power to the SERVOPACK is turned on When the signal is turned off, the main circuit goes off The signal can be input again 
Machine ready	MRDY	This is the interlock signal between the machine side and the MOTION PACK Turn on this signal immediately after the machine gets ready (If no preparation is required for the machine, set this signal on initially) 
Edit mode Memory mode Jog mode Step mode Rapid feed mode Handle mode DNC mode MDI mode	EDIT MEM JOG STEP RAPID HANDLE DNC MDI	When one of the mode selection input signals goes on, the mode of operation selected by the input signal is started If two or more selection signals go on at the same time, the current mode of operation is continued If all the mode selection signals go off, the current mode of operation is continued  Edit mode Editing such as writing programs and parameters from the Control Station or the personal computer is performed

(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (3/17)

Name	Signal Name	Function, Operation, and Timing
		Memory mode Programmed automatic operation is performed Jog mode Continuous manual feed is performed Step mode Stepping manual feed is performed Rapid feed mode Manual rapid feed is performed Handle mode Handle operation using the manual pulse generator is performed DNC mode DNC operation is performed while receiving data from the master computer MDI mode Execution of a signale block instruction is performed according to the instructions from the Control Station
+X-Axis	+JX	This signal is the start signal for manual operations (including jogging, stepping, and rapid feed) in the positive direction on the X-axis In the jog or rapid feed mode, machine moves when this signal is on, and slows down and stops when this signal is off In the step mode, machine moves for one step length when this signal turns from off to on [Example]  Wait for at least 50 ms before turning on the + JX signal after the signaling operation for jogging, stepping, or rapid feed is completed
-X-Axis	-JX	This signal is the same as the +JX except that the direction of movement is positive on the X-axis
+Y-Axis	+JY	This signal is the same as the +JX except that the direction of movement is positive on the Y-axis

(Cont'd)

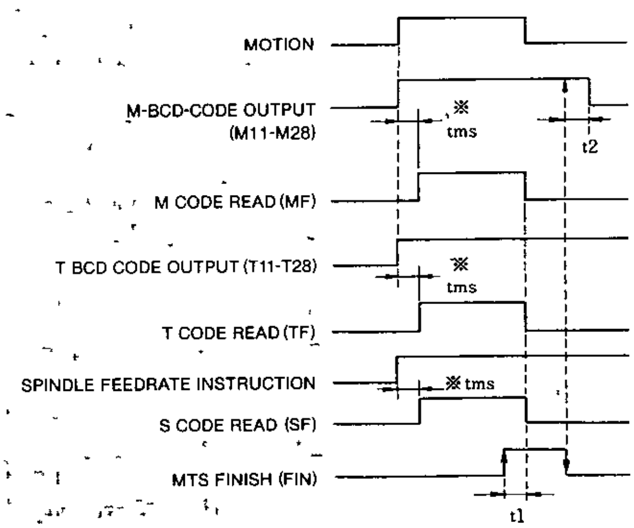
Table 6 1 Input Signal Function, Operation and Timing (4/17)

Name	Signal Name	Function, Operation, and Timing
– J-Axis	– JY	This signal is the same as the + JX except that the direction of movement is negative on the Y-axis
+ Z-Axis	+ JZ	This signal is the same as the + JX except that the direction of movement is positive on the Z-axis
– Z-Axis	– JZ	This signal is the same as the + JX except that the direction of movement is negative on the Z-axis
Handle Operation on X-Axis	HX	When simultaneous 1-axis manual operation is performed in the handle operation mode, turning this signal on provides control on the X-axis with the handle During simultaneous 3-axis handle operation (when parameter #1002 D6 = 1), this signal serves as an interlock signal When this signal is off, the X-axis is not moved if the X-axis handle is operated
Handle Operation on Y-Axis	HY	When simultaneous 1-axis handle operation is performed in the handle operation mode, turning this signal on provides control on the Y-axis with the handle During simultaneous 3 axis handle operation (when parameter #1002 D6 = 1), this signal serves as an interlock signal When this signal is off, the Y-axis is not moved if the Y-axis handle is operated
Handle Operation on Z-Axis	HZ	When simultaneous 1-axis handle operation is performed in the handle operation mode, turning this signal on provides control on the Z-axis with the handle During simultaneous 3-axis handle operation (when parameter #1002 D6 = 1), this signal serves as an interlock signal When this signal is off, the Z-axis is not moved if the Z-axis handle is operated
Home Positioning	ZRN	When this signal goes on, the home positioning mode is started Turn on this signal in the jog or rapid mode for home positioning

Signal / Home Positioning	ZRN	+ JX (-JX)	+ JX (-JY)	+ JZ (-JZ)
X-axis Home Positioning	ON	ON	OFF	OFF
Y-axis Home Positioning	ON	OFF	ON	OFF
Z-axis Home Positioning	ON	OFF	OFF	ON

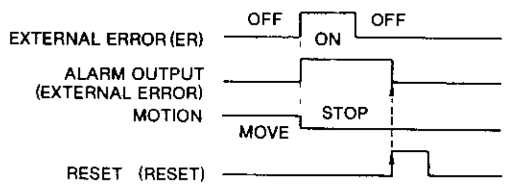
(Cont'd)

Table 6.1 Input Signal Function, Operation and Timing (5/17)

Name	Signal Name	Function, Operation, and Timing
Single Block	SBK	This signal is the single block operation signal in the memory operation mode. When the single block signal is on, processing stops when the current block has been executed. Turn on the start signal (STR) to execute the next block.
Machine Lock	MLK	If the start signal (STR) is turned on while this signal is on in the memory operation mode, the current position indication (UNIV) changes according to instructions although the machine does not move. In this state, the M-, S-, and T-functions are executed. Use this signal to check programs.
MST Finish	FIN	This signal clears the current output signal of the MOTIONPACK and proceeds to the next block of the program. When this signal goes on, the M, S, and T signal outputs change as follows.  * Set by parameter #1100 t1, t2 About 30 msec is required to process the FIN signal

(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (6/17)

<table>
<tr><th>Name</th><th>Signal Name</th><th>Function, Operation, and Timing</th></tr>
<tr><td>External Error</td><td>ER</td><td>This is the load machine error signal When this signal is on, the alarm signal output (ALM) is output and the system enters the halt status


To reactivate, reset the system</td></tr>
<tr><td>Axis Disregard</td><td>NEG</td><td>When this signal is on, the specified axis is not controlled and the load machine is not moved although the start signal (STR) is turned on in the memory operation mode Also, the current position display is not changed Specify the axes for parameter # 1006</td></tr>
<tr><td>Feed override (1)
Feed override (2)</td><td>OV1
OV2</td><td>These are three levels of override select signals for interpolation feed Three levels of override rates of L, M, and H are selected by combinations of OV1 and OV2, according to the feedrate ordered with the F-code in memory operation
Setting parameter # 1002 D2 to 0 enables these signals
Three levels of override rates are as follows
<table>
<tr><th rowspan="2"></th><th colspan="2">Signal Status</th><th rowspan="2">Override Rate</th></tr>
<tr><th>OV2</th><th>OV1</th></tr>
<tr><td>LO</td><td>OFF</td><td>OFF</td><td>Override 0%</td></tr>
<tr><td>L</td><td>OFF</td><td>ON</td><td>Override 25%</td></tr>
<tr><td>M</td><td>ON</td><td>OFF</td><td>Override 50%</td></tr>
<tr><td>H</td><td>ON</td><td>ON</td><td>Override 100%</td></tr>
</table>
L Low M Medium, H High

Note
OFF → Open
ON → Close</td></tr>
</table>

(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (7/17)

Name	Signal Name	Function, Operation, and Timing
Feed Override (1) Feed Override (2) Feed Override (4) Feed Override (8) Feed Override (16)	OV1 OV2 OV4 OV8 OV16	These signals are 23 levels ob override select signals for interpolation feed Twenty one levels of override rates are selected by combinations of OV1 OV2, OV4, OV8, and OV16 according to the feedrate ordered with the F-code in memory operation Setting parameter # 1002 D2 to 1 enables these signals Twnety one levels of override rates are as follows

	Signal Status					Override
	OV16	OV8	OV4	OV2	OV1	Rate
0	OFF	OFF	OFF	OFF	OFF	0%
1	OFF	OFF	OFF	OFF	ON	10%
2	OFF	OFF	OFF	ON	OFF	20%
3	OFF	OFF	OFF	ON	ON	30%
4	OFF	OFF	ON	OFF	OFF	40%
5	OFF	OFF	ON	OFF	ON	50%
6	OFF	OFF	ON	ON	OFF	60%
7	OFF	OFF	ON	ON	ON	70%
8	OFF	ON	OFF	OFF	OFF	80%
9	OFF	ON	OFF	OFF	ON	90%
10	OFF	ON	OFF	ON	OFF	100%
11	OFF	ON	OFF	ON	ON	110%
12	OFF	ON	ON	OFF	OFF	120%
13	OFF	ON	ON	OFF	ON	130%
14	OFF	ON	ON	ON	OFF	140%
15	OFF	ON	ON	ON	ON	150%
16	ON	OFF	OFF	OFF	OFF	160%
17	ON	OFF	OFF	OFF	ON	170%
18	ON	OFF	OFF	ON	OFF	180%
19	ON	OFF	OFF	ON	ON	190%
20	ON	OFF	ON	OFF	OFF	200%
21	ON	ON	OFF	OFF	OFF	5000%
22	ON	ON	ON	OFF	OFF	10000%

Note If a combination of signals not listed above is specified, (for in stance, if all signals are turned ON), the override rate is reduced to 0%

(Cont'd)

Table 6.1 Input Signal Function, Operation and Timing (8/17)

Name	Signal Name	Function, Operation, and Timing
Rapid Feed Override (1) Rapid Feed Override (2)	ROV1 ROV2	These signals are override select signals for rapid feed. Three levels of override rates of L, M, and H are selected by combinations of ROV1 and ROV2, according to the rapid feedrate specified by parameters # 1130, # 1131 and # 1132. The override rates are as follows.

	Signal Status		Override Rate
	ROV2	ROV1	
LO	OFF	OFF	Override 0%
L	OFF	ON	Override 25%
M	ON	OFF	Override 50%
H	ON	ON	Override 100%

L: Low, M: Medium, H: High

Name	Signal Name	Function, Operation, and Timing
Rapid Feed Override Cancel	ROV3	When this signal is on, the override rate determined by ROV1 and ROV2 is disregarded and the 100% of feedrate is used.
Jog Feedrate Selection (1) Jog Feedrate Selection (2) Jog Feedrate Selection (4) Jog Feedrate Selection (8)	JOV1 JOV2 JOV4 JOV8	These signals are feedrate select signals for jogging. Sixteen levels of feedrates are selected using combinations of JOV1, JOV2, JOV4, and JOV8. The feedrates and the corresponding parameter number are as follows.

Level	Signal Status				Jog Feedrate
	JOV8	JOV4	JOV2	JOV1	
0	OFF	OFF	OFF	OFF	Zero 0
1	OFF	OFF	OFF	ON	Parameter Setting (# 1104)
2	OFF	OFF	ON	OFF	Parameter Setting (# 1105)
3	OFF	OFF	ON	ON	Parameter Setting (# 1106)
4	OFF	ON	OFF	OFF	Parameter Setting (# 1107)
5	OFF	ON	OFF	ON	Parameter Setting (# 1108)
6	OFF	ON	ON	OFF	Parameter Setting (# 1109)
7	OFF	ON	ON	ON	Parameter Setting (# 1110)
8	ON	OFF	OFF	OF	Parameter Setting (# 1111)
9	ON	OFF	OFF	ON	Parameter Setting (# 1112)
10	ON	OFF	ON	OFF	Parameter Setting (# 1113)
11	ON	OFF	ON	ON	Parameter Setting (# 1114)
12	ON	ON	OFF	OFF	Parameter Setting (# 1115)
13	ON	ON	OFF	ON	Parameter Setting (# 1116)
14	ON	ON	ON	OFF	Parameter Setting (# 1117)
15	ON	ON	ON	ON	Parameter Setting (# 1118)

(Cont'd)

Table 6.1 Input Signal Function, Operation and Timing (9/17)

<table>
<tr><th>Name</th><th>Signal Name</th><th>Function, Operation, and Timing</th></tr>
<tr><td>Step Scale

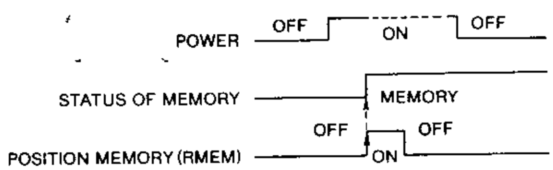
(Handle Scale)</td><td>MP1
MP2</td><td>
These signals select feed length per step for stepping Three levels of step feed length can be selected using the step feed length parameters

<table>
<tr><th rowspan="2"></th><th colspan="2">Signal Status</th><th rowspan="2">Feed Length/Step</th></tr>
<tr><th>MP2</th><th>MP1</th></tr>
<tr><td>L_0</td><td>OFF</td><td>OFF</td><td>Feed length = 0</td></tr>
<tr><td>L_1</td><td>OFF</td><td>ON</td><td>Parameter setting (# 1122)</td></tr>
<tr><td>L_2</td><td>ON</td><td>OFF</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

Also, these signals select scale of feed length per pulse in manual handle operation

<table>
<tr><th rowspan="2">Scale of Feed Length per Pulse</th><th colspan="2">Signal Status</th></tr>
<tr><th>MP2</th><th>MP1</th></tr>
<tr><td>× 0</td><td>OFF</td><td>OFF</td></tr>
<tr><td>× 1</td><td>OFF</td><td>ON</td></tr>
<tr><td>× 10</td><td>ON</td><td>OFF</td></tr>
<tr><td>× 100</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>Position Memory</td><td>PMEM</td><td>
When this signal is turned on, the currently displayed axis position is saved in the offset area The data are retained after power is turned off This function is enabled by setting parameter # 1003 D1 to 1

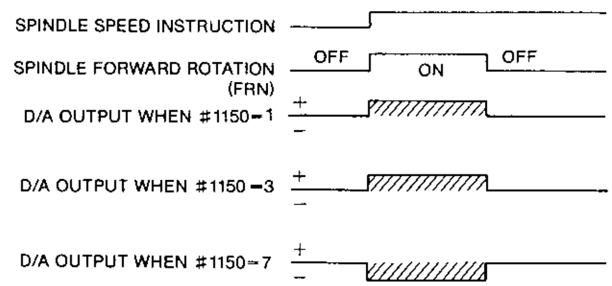


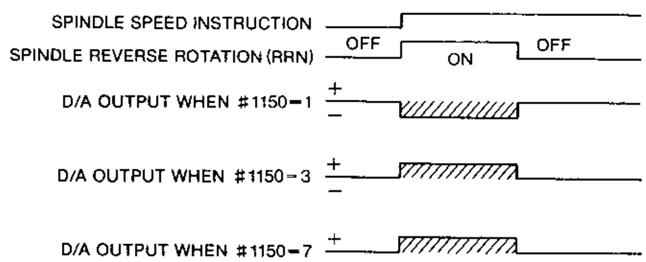
<table>
<tr><th colspan="2">Memory Position</th><th>Save Area (Offset Number)</th></tr>
<tr><td rowspan="3">Axis Position</td><td>X</td><td>H294</td></tr>
<tr><td>Y</td><td>H295</td></tr>
<tr><td>Z</td><td>H296</td></tr>
</table>
</td></tr>
</table>

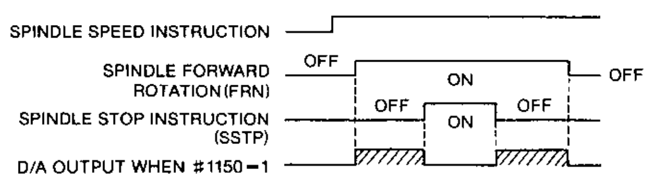
(Cont'd)

Table 6.1 Input Signal Function, Operation and Timing (10/17)

<table>
<tr><th>Name</th><th>Signal Name</th><th>Function, Operation, and Timing</th></tr>
<tr><td>Spindle Forward Rotation</td><td>FRN</td><td>When this signal is input in memory operation the spindle speed is instructed by the S-code, the signal functions in combination with parameter # 1150 to control D/A output for the spindle


</td></tr>
<tr><td>Spindle Reverse Rotation</td><td>RRN</td><td>Similar to FRN, this signal controls D/A output for the spindle

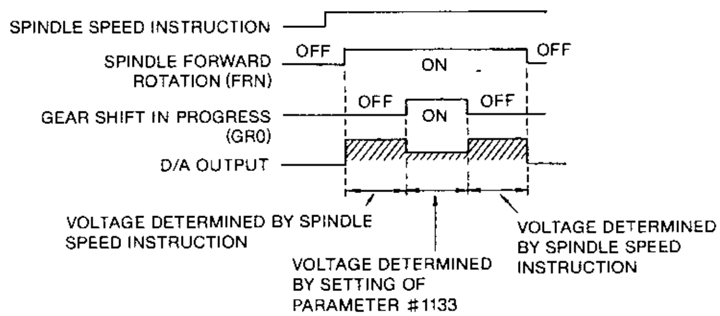

</td></tr>
<tr><td>Spindle Stop</td><td>SSTP</td><td>This signal orders to stop D/A output for the spindle


</td></tr>
<tr><td>Spindle Gear Selection (1)
Spindle Gear Selection (2)</td><td>GR1
GR2</td><td>These are gear ratio select signals for spindle gear shift. Three levels of gear ratios of L, M and H are selected by combinations of GR1 and GR2. Maximum Speed for each gear is specified parameter # 1160, # 1161, or # 1162.

<table>
<tr><th rowspan="2">Gear Ratio</th><th colspan="2">Signal Status</th><th rowspan="2">Maximum Speed</th></tr>
<tr><th>GR2</th><th>GR1</th></tr>
<tr><td>Lo</td><td>OFF</td><td>OFF</td><td>Stop</td></tr>
<tr><td>L</td><td>OFF</td><td>ON</td><td>Parameter setting (# 1160)</td></tr>
<tr><td>M</td><td>ON</td><td>OFF</td><td>Parameter setting (# 1161)</td></tr>
<tr><td>H</td><td>ON</td><td>ON</td><td>Parameter setting (# 1162)</td></tr>
</table></td></tr>
</table>

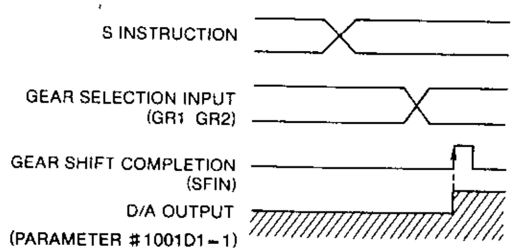
(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (11/17)

Name	Signal Name	Function, Operation, and Timing
Gear Shift in-progress	GR0	This input signal outputs necessary constant voltage to select gear When this signal is turned on, output voltage is calculated as follows using the value set for parameter $$\text{Output voltage} = 10V \times \frac{\text{setup value for parameter } \#1133}{32767}$$ This signal takes precedence over the programmed spindle instruction The voltage is output only if the spindle forward input signal (FRN) or the spindle reverse input signal (RRN) is on 
Optional block Skip (1) Optional block Skip (8)	SK1 SK2 SK3 SK4 SK5 SK6 SK7 SK8	These signals select whether or not to disregard block data containing a slash (/) in memory operation When one of these signal is on, the selected blocks are disregarded For instance, when signal SK1 is on, all instructions in a block containing "/1" are disregarded until the end of the block These signals are ineffective for blocks in memory During memory operation, the signals take effect from the new block to be read
Program Number Input	W11 W12 W14 W18 W21 W22 W24 W28	These signals are used to externally specify program numbers Program numbers from 01 to 99 can be specified using two-digit BCD codes
O 9900 + O 9999 Work Number Search	(W99)	If this signal is turned on when specifying program numbers externally by program number input (W11 +W28), program numbers from O 9900 to O 9999 can be selected

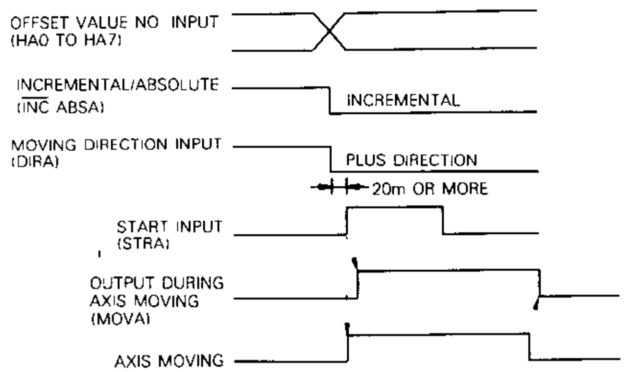
(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (12/17)

Name	Signal Name	Function, Operation, and Timing
Spindle Position Loop request Signal	SLPC	This signal is used with the solid tap funcion When this signal is turned on while the G93M output signal is on, a spindle position loop is formed Turn on this signal after the spindle stops
Gear Shift Coupleted	SFIN	After S 5-digit instruction is executed, if parameter #1001, D1 is 1, D/A output is not changed immediately D/A is output after the gear shift completion input signal goes on, according to the gear input Until then, the current D/A output is retained (If the gear shift in-progress input signal is on, constant voltage is output 
Absolute home positioning	ZPNT	If this signal is turned on and off when the home positioning signal (ZRN) is on in any manual feed mode (JOG, RAPID, STEP, or HANDLE), position of the X, Y, and Z axes at that time is set as the absolute zero for the machine This sets up reference point data for all feed axes, and the position display indicates zero At the same time, the reference point offset parameters (#1520, #1 521, #1820, #1821, #2120, #2121) are also set up automatically This signal is used in an absolute encoder system
External Offset data negative Sign	EINV	This signal is used to write offset data from the external input pin When this signal is on, the offset data (in two to eight digits) take a negative value

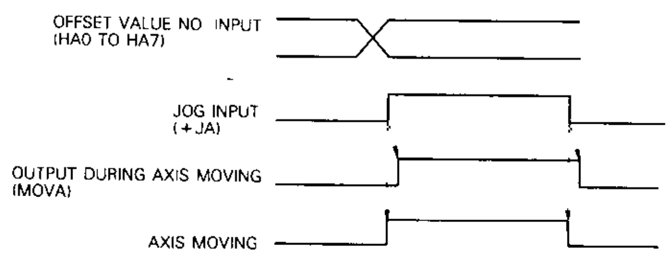
(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (13/17)

Name	Symbol	Function Operation and Timing
Program Protect	PRGP	When this signal is turned on (closed), program creation or change by using the CRT control station is prohibited Used for prevention of program destruction by improper operation
Parameter Protect	PRMP	When this signal is turned on (closed), parameter change from the CRT control station is prohibited Used for prevention of parameter destruction by improper operation
A-axis Start	STRA	When this signal is turned on (closed), A axis constant amount is started according to the offset value No input, incremental/absolute input or moving direction input 
B-axis Start	STRB	When this signal is turned on (closed), B-axis constant amount move is started according to the offset value No input, incremental/absolute input or moving direction input
A-axis Incremental/Absolute	$\overline{INC}$/ABSA	An input to determine whether moving amount is specified by incremental value or absolute value at A-axis constant amount move When this signal is turned off (closed), the incremental command is validated
B-axis Incremental/Absolute	$\overline{INC}$/ABSB	An input to determine whether moving amount is specified by incremental value or absolute value at B-axis constant amount move When this signal is turned off (close), the incremental command is validated

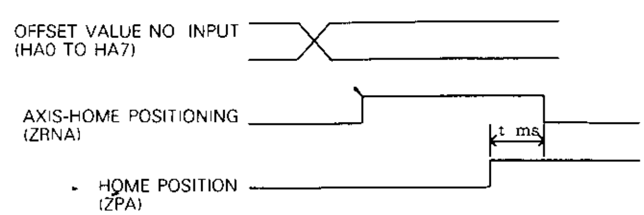
(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (14/17)

Name	Symbol	Function Operation and Timing
A-axis Moving Direction	DIRA	An input to determine the moving direction at A-axis constant amount move When this signal is turned on (closed), "-" (minus) direction command is validated
B-axis Moving Direction	DIRB	An input to determine the moving direction at B-axis constant amount move When this signal is turned on (closed), "-" (minus) direction command is validated
A-axis Home Position	ZPNA	An input to store A axis absolute home position for a system using an absolute encoder When this signal is turned on (closed) in any operation mode (only if the axis is not moving) A-axis absolute home position is stored and the position display becomes zero
B-axis Home Position	ZPNB	An input to store B-axis absolute home position for a system using an absolute encoder When this signal is turned on (closed) in any operation mode (only if the axis is not moving) B-axis absolute zero-point position is stored and the position display becomes zero
+A-axis	+JA	An input signal to specify A-axis jog command in the "+" (plus) direction When this sgnal is turned on (closed), the axis moves with the speed data specified by A-axis offset value No input 

(Cont'd)

Table 6 1 Input Signal Function, Operation and Timing (15/17)

Name	Symbol	Function Operation and Timing
+ B-axis	+ JB	An input signal to specify B-axis jog command in the "+" (plus) direction When this signal is turned on (closed), the axis moves with the speed data specified by B-axis offset value No input
– A-axis Direction	– JA	An input signal to specify A-axis jog command in the "–" (minus) direction When this signal is turned on (closed), the axis moves with the speed data specified by A-axis offset value No input
– B-axis	– JB	An input signal to specify B-axis jog command in the "–" (minus) direction When this signal is turned on (closed), the axis moves with the speed data specified by B-axis offset value No input
A-axis Home Positioning	ZRNA	An input to execute A-axis home positioning operation (using deceleration LS) When this signal is turned on (closed), home positioning starts with the speed data specified by the offset value No input in the home positioning direction set to parameter #2401 When home positioning is completed and the home position output signal is output, delay the timing a little and turn off (open) this signal By turning off (opening) this signal during home positioning operation, the operation is interrupted at that time 

(Cont'd)

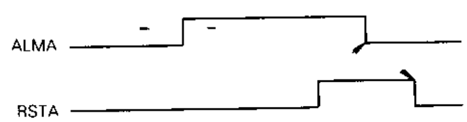
Table 6·1 Input Signal Function, Operation and Timing (16/17)

Name	Symbol	Function Operation and Timing
B-axis Home Positioning	ZRNB	An input to execute B-axis home positioning operation (using deceleration LS) When this signal is turned on (closed), home positioning starts with the speed data specified by the offset value No input in the home positioning direction set to parameter #2701 When home positioning is completed and the home position output signal is output, delay the timing a little and turn off (open) this signal By turning off (opening) this signal during home positioning operation, the operation is interrupted at that time
A-axis Servo ON	ASVOK	When this signal is turned on (closed), A-axis baseblock is released By turning off (opening) this signal, A-axis enters the baseblock status At this time, an alarm will not occur The signal can be turned on again from this status
B-axis Servo ON	BSVOK	When this signal is turned on (closed), B-axis baseblock is released By turning off (opening) this signal, B-axis enters the baseblock status At this time, an alarm will not occur The signal can be turned on again from this status
A-axis Offset Value No	HA0 HA1 HA2 HA3 HA4 HA5 HA6 HA7	An input to specify the moving amount and speed data at A-axis constant amount move or specify the speed data at jog move or home positioning The value at the lower 2 digits of the stored offset value No of each data item is set in binary [Example]

Signal Name	HA7	HA6	HA5	HA4	HA3	HA2	HA1	HA0
Status	0	0	1	1	0	0	1	0

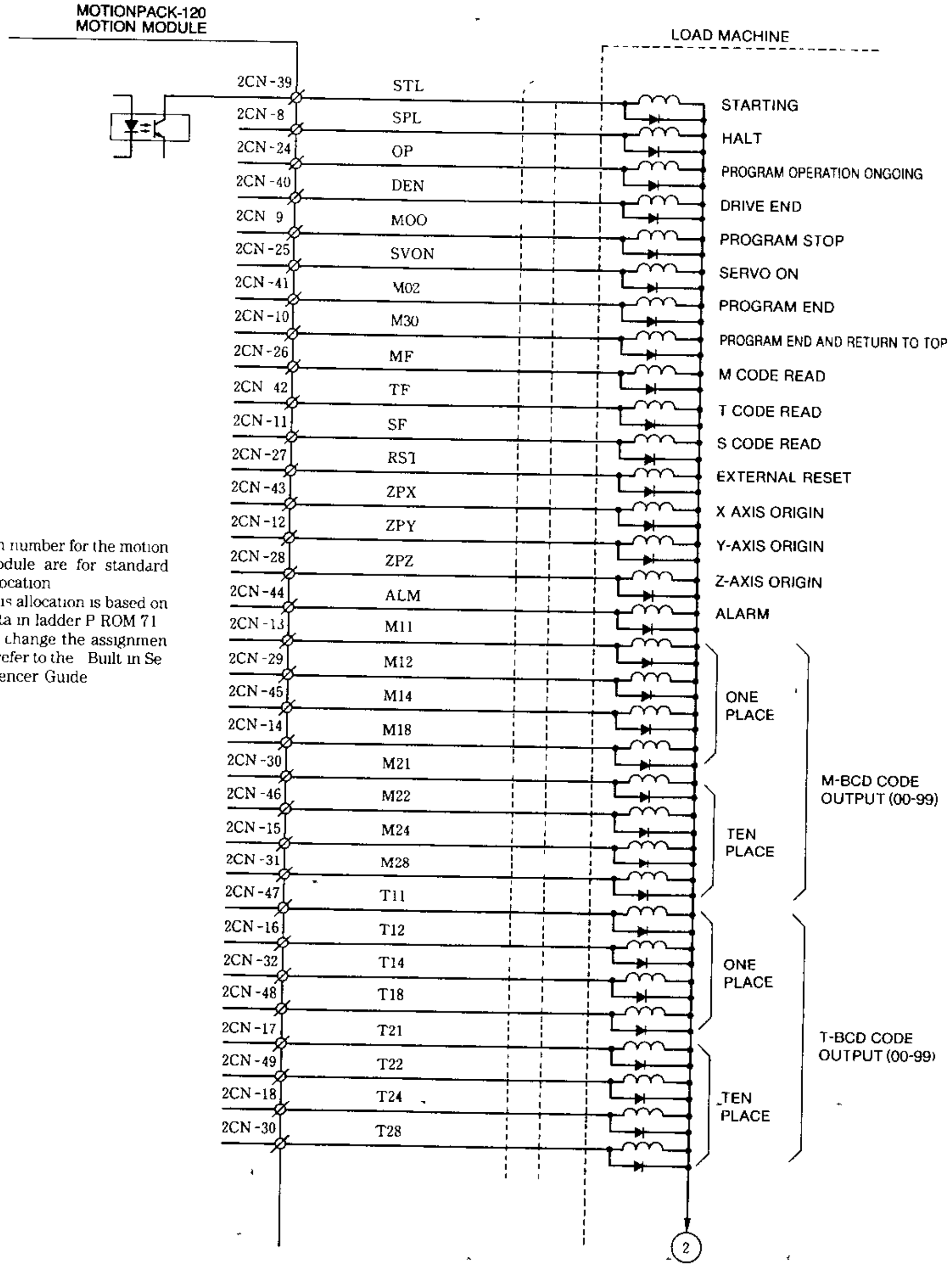
(Cont'd)

Table 6.1 Input Signal Function, Operation and Timing (17/17)

Name	Symbol	Function Operation and Timing
B-axis Offset Value No	HB0 HB1 HB2 HB3 HB4 HB5 HB6 HB7	An input to specify the moving amount and speed data at B-axis constant amount move or specify the speed data at jog move or home positioning The value at the lower 2 digits of the stored offset value No of each data item is set in binary
A-axis Stop	$\overline{STPA}$	An input to stop A-axis moving temporarily Only when this signal is turned on (closed), A-axis move is enabled By turning off (opening) this signal during axis moving, the axis stops moving, turning on (closing) this signal again continues the axis move However, this signal is invalidated during home positioning operation after the approach speed is entered at home positioning operation
B-axis Stop	$\overline{STPB}$	An input to stop B-axis moving temporarily Only when this signal is turned on (closed), B-axis move is enabled By turning off (opening) this signal during axis moving, the axis stops moving, turning on (closing) this signal again continues the axis move However, this signal is invalidated during home positioning operation after the approach speed is entered at home positioning operation
A-axis Reset	RSTA	An input to release A-axis alarm output When this signal is turned on (closed), A-axis alarm output is released 
B-axis Reset	RSTB	An input to release B-axis alarm output When this signal is turned on (closed), B-axis alarm output is released

(2) Details of General-Purpose Output Signals

Fig 6 2 shows allocation of general-purpose output signals in the standard ladder program



Notes
1 Pin number for the motion module are for standard allocation
2 This allocation is based on data in ladder P ROM 71 To change the assignment refer to the Built in Sequencer Guide

Fig 6 2 Connection of General-Purpose Output Signal (1/2)

6.2 MOTION MODULE GENERAL-PURPOSE I/O SIGNALS (Cont'd)

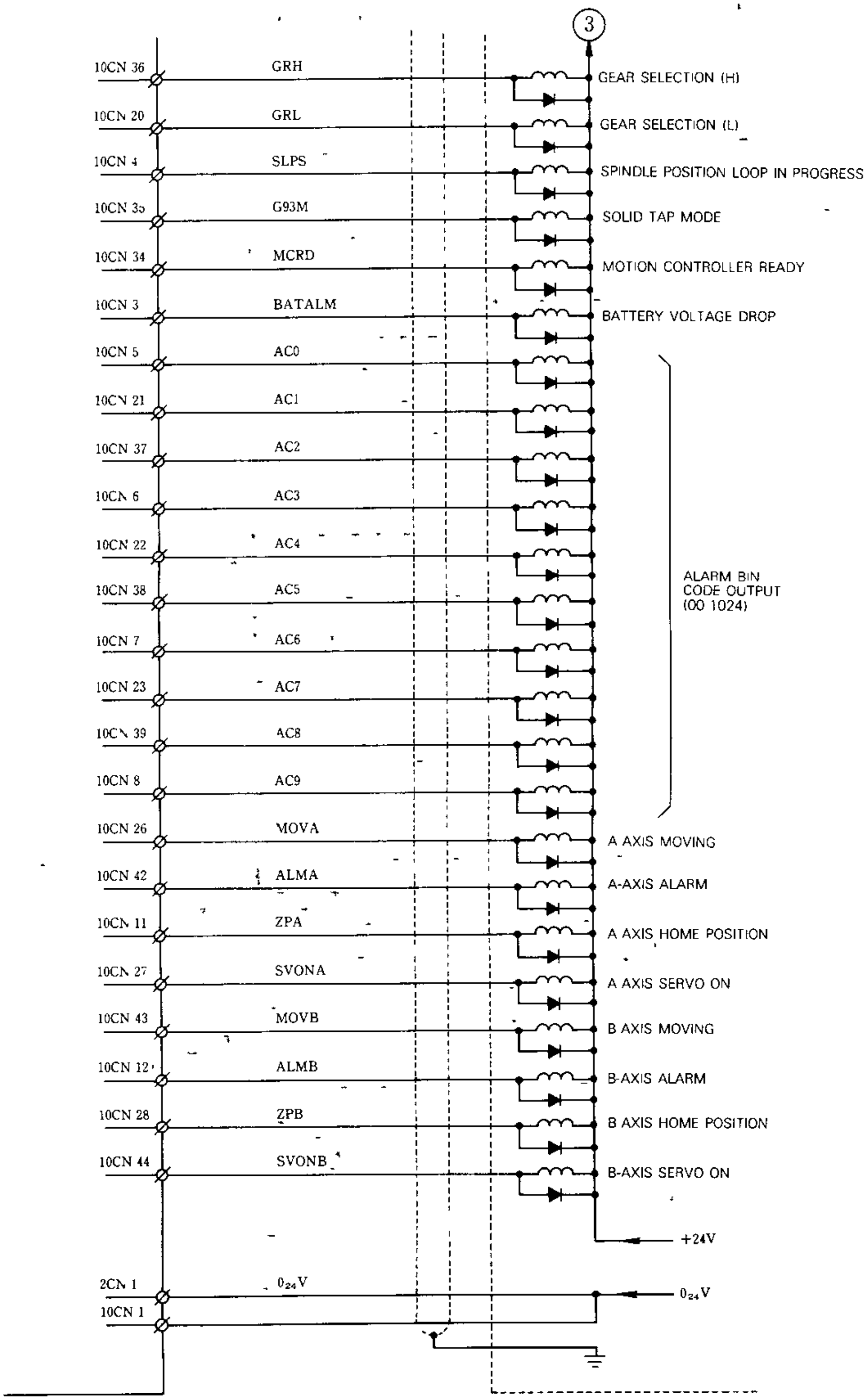
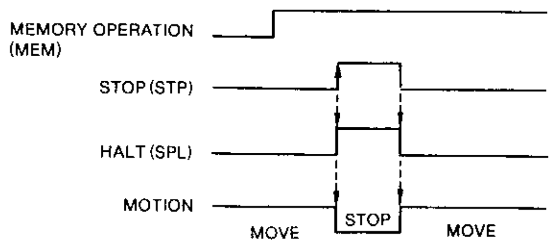


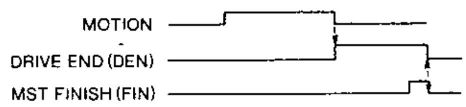
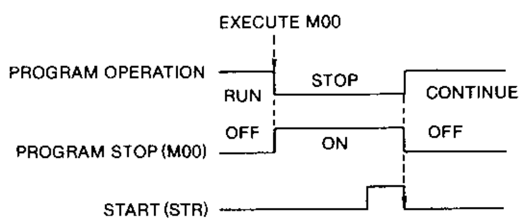
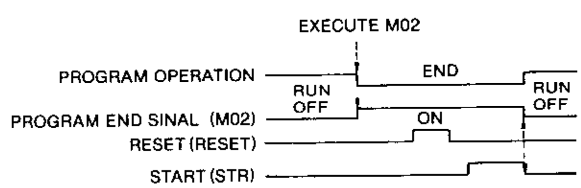
Fig 6 2 Connection of General-Purpose Output Signal (2/2)

Table 6 2 Output Signal Function, Operation and Timing (1/7)

Name	Signal Name	Function, Operation, and Timing
Motion Controller Ready	MCRD	This is the interlock signal between the load machine and the motion module When this signal is on, the load machine prepares for operation
Alarm	ALM	When this signal is on, an alarm status is settling For information about alarms, see Appendix A, "Alarm Code List"
Starting	STL	This signal indicates that automatic operation is ongoing The signal goes on during memory operation or single-block operation ① When an alarm occurs ② When the system is reset ③ While the stop signal is on
Halt	SPL	This signal is output when operation is halted by the stop signal (STP) 
Program Operation Ongoing	OP	This signal indicates program operation is ongoing The signal goes on during memory operation and single block operation The signal goes off under the following conditions ① When the system is reset ② When the program terminates (M00, M02, M30) ③ When one block is terminated during single-block operation

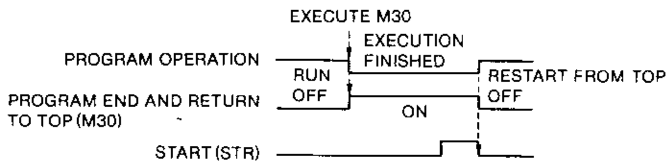
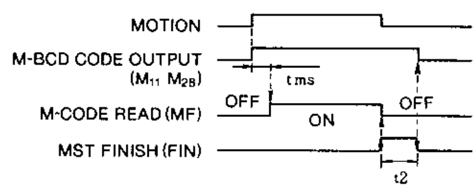
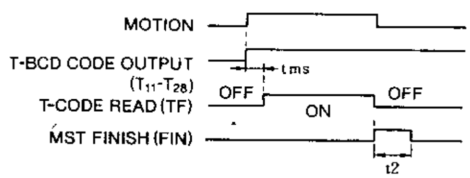
(Cont'd)

Table 6.2 Output Signal Function, Operation and Timing (2/7)

Name	Signal Name	Function, Operation, and Timing
Drive End	DEN	This signal is output when the M-, S-, or T-code is described in the same block with the motion instruction. If the M-, S-, or T-code is described with no motion instruction, this signal is output together with the BCD code. This signal is not output if only the motion instruction is coded. the signal is cleared when the MST finish signal (FIN) is returned to the MOTIONPACK. This signal is also cleared when reset or mode change is accomplished. 
Servo On	SVON	This signal indicates the state of motor power from the SERVOPACK. This signal goes on when there is no alarm and power is applied to the motor from the SERVOPACK. This signal goes off when the servo is off because of an alarm.
Program Stop	M 00	If code M00 is read during automatic operation, the operation is stopped and the M00 signal is output after the block operation is completed. To restart operation, turn on the start signal (STR). The operation is restarted from the next block. This signal is not cleared when the system is reset. 
Program End	M 02	Code M02 is placed at the end of a program. If M02 is read during automatic operation, the operation is stopped and the M02 signal is output after the block operation is completed. This signal is not cleared when the system is reset. 

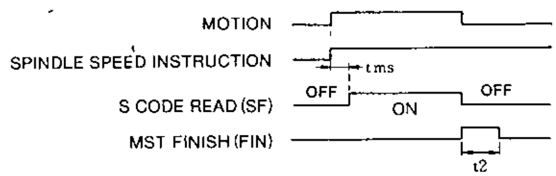
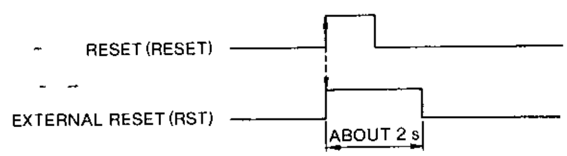
(Cont'd)

Table 6 2 Output Signal Function, Operation and Timing (3/7)

<table>
<tr><th>Name</th><th>Signal Name</th><th>Function, Operation, and Timing</th></tr>
<tr><td>Program End and Return to Top</td><td>M 30</td><td>Usually code M30 is described at the end of a program
When M30 is read during automatic operation, the operation is stopped and the M30 signal is output after the program operation is completed
Then the system enters the wait status preparing to start the program again from the beginning
This signal is not cleared when the system is reset

</td></tr>
<tr><td>M-Code Read</td><td>MF</td><td>This signal is output when the M-BCD code is found and is output after the M-BCD code by t ms Parameter #1100 sets the delay time
This signal is cleared when the MST finish signal (FIN) is returned to the Motionpack
This signal is also cleared by reset or mode change
This signal is not output when M00, M02, M30, or internally processed M-codes (M90-M99) is found

</td></tr>
<tr><td>T-Code Read</td><td>TF</td><td>This signal is output when the T-BCD code is found and is output after the T-BCD code by t ms Parameter #1100 sets the delay time
This signal is cleared when the MST finish signal (FIN) is returned to the Motionpack This signal is also cleared by reset or mode change

</td></tr>
</table>

(Cont'd)

Table 6.2 Output Signal Function, Operation and Timing (4/7)

Name	Signal Name	Function, Operation, and Timing
S-Code Read	SF	This signal is output when the spindle speed instruction (S output) is found. This signal is output after the spindle speed instruction by t ms. Parameter #1100 sets the delay time. This signal is cleared when the MST finish signal (FIN) is returned to the MOTIONPACK. This signal is also cleared by reset or mode change. 
External Reset	RST	This signal is used as a reset signal for external equipment of MOTION-PACK. This signal is synchronized with the MOTIONPACK reset signal (RESET). 
X-Axis Zero Point	ZPX	This signal is output only when the X-axis is at the zero point set by parameter #1125.
Y-Axis Zero Point	ZPY	This signal is output only when the Y-axis is at the zero point set by parameter #1125.
Z-Axis Zero Point	ZPZ	This signal is output only when the Z-axis is at the zero point set by parameter #1125.

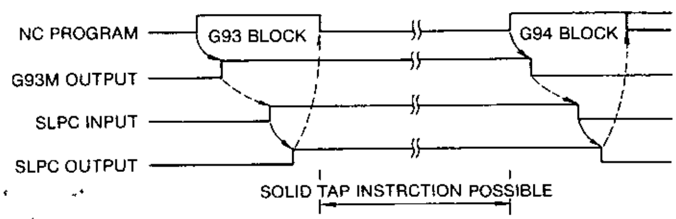
(Cont'd)

Table 6.2 Output Signal Function, Operation and Timing (5/7)

Name	Signal Name	Function, Operation, and Timing
M-BCD Code Output (2 digit Output)	M11, M21 M12, M22 M14, M24 M18, M28	This is M-BCD code output signal This signal is output when a block containing the M-code is started This signal is cleared when the MST finish signal (FIN) is returned to the MOTIONPACK This signal is also cleared by reset and mode change This signal is not output for blocks containing the M00, M02, M30, or internally processed M-codes (M90-M99)
T-BCD Code Output (2 digit Output) (Notch Signal Output)	T11, T21 T12, T22 T14, T24 T18, T28	This T-BCD code output signal is used for selecting tools This signal is output when a block containing the M-code is started This signal is not cleared when the MST finish signal (FIN) is returned to the MOTIONPACK The signal is retained until a new T-code is read This signal can also be used as the notch signal output on special occasions When the signal is used as the notch signal output, the T-function is disabled For details, see Pars 3 2 14, "Notch Signal Instruction A (G68, G69)", and 3 2 15, "Notch Signal Instruction B (G66, G67)"
Alarm Code Output	A0, A1 A2, A3 A4, A5 A6, A7 A8, A9	These signals output hexadecimal If there is no alarm, all these signals are off (0) If more than one alarm occurs the code that indicates the first detected alarm is output

(Cont'd)

Table 6.2 Output Signal Function, Operation and Timing (6/7)

<table>
<tr><th>Name</th><th>Signal Name</th><th>Function, Operation, and Timing</th></tr>
<tr><td>Solid Tap Mode</td><td>G93M</td><td>These signals are output when the solid tap function is used. The G93M signal is output when the G93 command is executed, and is turned off by the G94 command.
The SLPS signal is turned on when the SLPC input signal goes on and the spindle
position loop is formed. The signal is turned off when the SLPC input goes off during execution of the G94 command.</td></tr>
<tr><td>Spindle Position Loop Formed</td><td>SLPS</td><td>I/O signal timing chart


• The G93M and SLPS outputs are turned off when reset occurs.
• The SLPC signal must be turned off by load machine sequence processing.</td></tr>
<tr><td>Gear Selection</td><td>GRL
GRH</td><td>Combinations of these two signals indicate the selected gear ratio: gear 1 (L), gear 2 (M), and gear 3 (H).
In the MOTIONPACK, the selected gear ratio is compared with the following values set for the specified parameters. If the required condition is satisfied, the gear selection output signal pattern is determined and output.
<table>
<tr><th rowspan="2">Output Condition</th><th colspan="2">Output Signal Status</th></tr>
<tr><th>GRH</th><th>GRL</th></tr>
<tr><td>Programmed Speed < Parameter #1160</td><td>OFF</td><td>ON</td></tr>
<tr><td>Parameter #1160 ≦ Programmed Speed < Parameter #1161</td><td>ON</td><td>OFF</td></tr>
<tr><td>Parameter #1161 ≦ Programmed Speed</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>Emergency Stop Input Moniter</td><td>ESP</td><td>This is monitor output of the emergency stop input from pin 2TM of the motion module. This signal is used to form a sequence incorporating the emergency stop input with the internal PC function.
This signal is not assigned to any external output connected in the standard ladder program.</td></tr>
</table>

(Cont'd)

Table 6 2 Ouput Signal Function, Operation and Timing (7/7)

Name	Signal Name	Function, Operation, and Timing
During A-axis Moving	MOVA	Output signal during A-axis moving It is output during A-axis constant amount move or jog move and turned off at completion of the axis move It is not turned off during axis stop by stop input Completion of constant amount move is to be judged by the fall of this signal
During B-axis Moving	MOVB	Output signal during B-axis moving It is output during B-axis constant amount move or jog move and turned off at completion of the axis move It is not turned off during axis stop by stop input Completion of constant amount move is to be judged by the fall of this signal
A-axis Alarm	ALMA	Output when an A-axis servo system alarm occurs or when the moving amount or speed data cannot be read in because of improper setting of offset value No This signal is released by A-axis reset input
B-axis Alarm	ALMB	Output when an B axis servo system alarm occurs or when the moving amount or speed data cannot be read-in because of improper setting of offset value No This signal is released by B-axis reset input
A-axis Zero-Point Position	ZPA	This signal is output only when A-axis position is in the zero point position area set in parameter #1125
B-axis Zero-Point Position	ZPB	This signal is output only when B-axis position is in the zero-point position area set in parameter #1125
During A-axis Servo ON	SVONA	This signal is output only when A-axis servo is turned on (A-axis servo ON input is turned on)
During B-axis Servo ON	SVONB	This signal is output only when B-axis servo is turned on (B-axis servo ON input is turned on)

6.3 MOTION MODULE EXCLUSIVE I/O

I/O connector 4CN of the motion module implements direct I/O with the controller The connector cannot be used for junction or output for the PLC function

Only three signals (SKIP, RDY, and ALM2) are assigned to this connector Other pins are reserved and must not be used

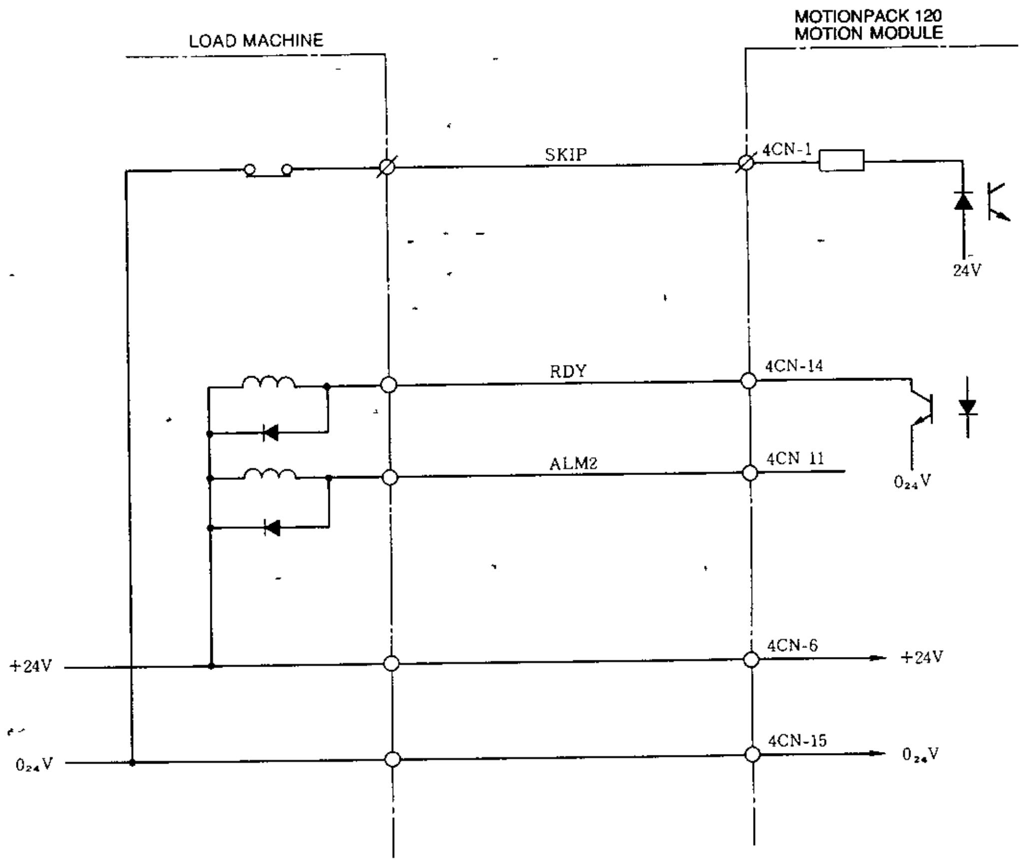
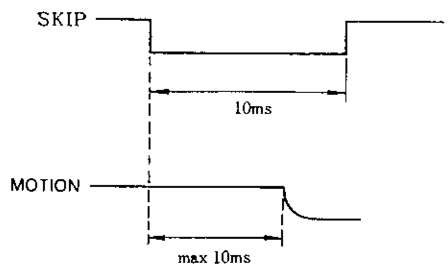


Fig 6 3

• Exclusive Input Name

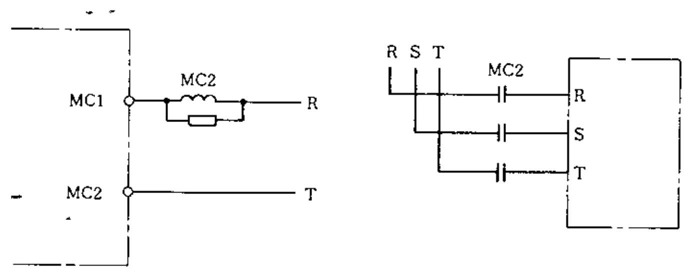
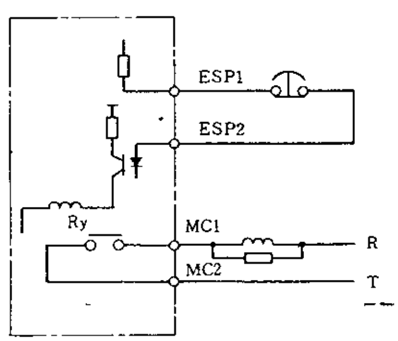
Name	Signal Name	Function, Operation, and Timing
Skip	SKIP	When this signal is turned off while the G31 skip instruction is executed, operation is slowed down and stopped The rest of the motion instruction is aborted and the next block is started This signal performs skipping on all axes at the same time See Par 3 2 10, "Skip Instruction"



• Exclusive Output Name

Name	Signal	Function, Operation, and Timing
Motion Controller Ready	RDY	This signal is obtained from the watchdog signal in the motion module The RDY signal is off while the motion module is functioning normally The signal goes on when an error occurs Connect this signal to a master cell controller This signal and the RDY lamp of the LED motor on the Control Station are one output
Alarm 2	ALM 2	The output cinditions and the meaning of this signal is the same as that of signal ALM This signal and the ALM lamp on the the Control Station are one output This signal goes on when an alarm occurs

6.4 I/O VIA PIN 2TM OF MOTION MODULE

Name	Description
BAT OBAT	These are outputs from the absolute encoder backup battery Connect BAT to pin 6 of 2CN, and OBAT to pin 7 of 2CN, for all Servopacks to be used
MC 1 MC 2	These are control outputs for the electromagnetic contactor of the servo main circuit  The outputs control the servo main circuit according to inputs such as emergency stop and SVOK and the status of alarms in MOTIONPACK and SERVOPACK
ESP 1 ESP 2	These are input pins for the emergency stop signal  This signal is on during normal operation, and goes off at emergency stop When this input goes off, an emergency stop alarm occurs, output pins MC1 and MC 2 of 2TM are disconnected to shut down main power to the SERVOPACK

6.5 SERVOPACK I/O

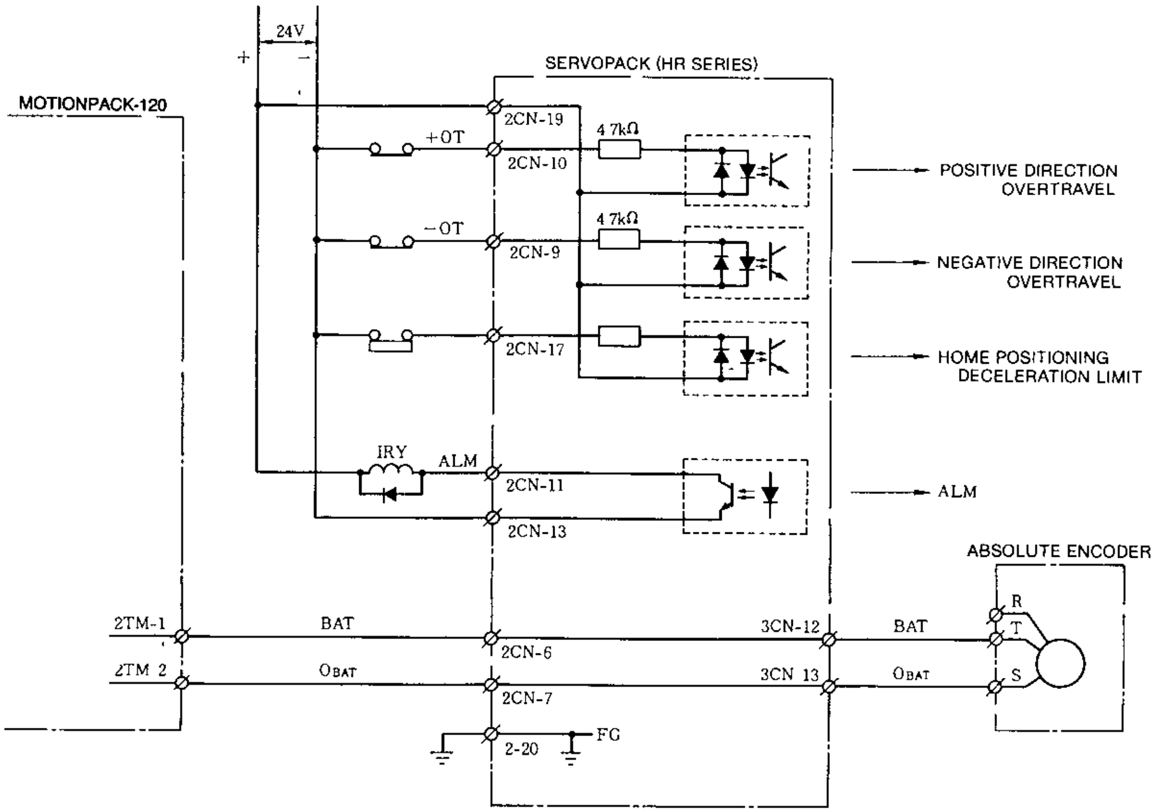


Fig. 6.4 Connection of I/O Signals with 2CN and External Signal Processing

Table 6 3 Input Signals

Signal	No	Outline	
+ $\overline{OT}$ - $\overline{OT}$	10 9	Positive Overtravel Negative Overtravel	For linear drive, connect limit switch signals to each pin These signals are on during normal opertion Set signals so that they go off when the limit switch is activated
BAT	6	Battery Backup	This is power input for the position data backup for the abso lute encoder (MOTIONPACK battery rated voltage 3 6 V)
OBAT	7	Battery Common	This is the common for the above power supply
$\overline{DEC}$	17	Home Positioning Deceleration LS	This is the deceleration limit switch input for home positioning

Note Select a signal wire for battery backup so as to reduce voltage drop to a minimum level

Table 6 4 Output Signals

Signal	No'	Outline	
ALM	11	Servo Alarm	Turns off the transistors in the SERVOPACK when an alarm occurs in the SERVOPACK or the watchdog timer expires Transistors are turned on during normal operation

SECTION 7

CONTENTS

7. COMPONENT ARRANGEMENT CONCEPT

7.1 MODULE SPECIFICATIONS

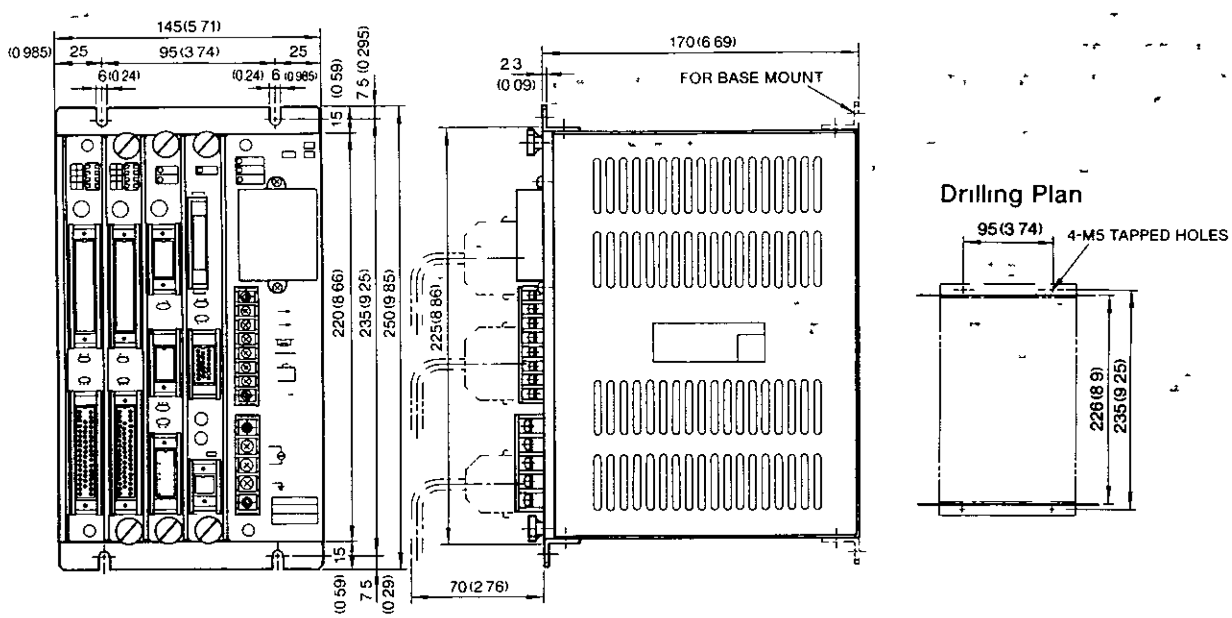
7.1.1 Motion Module

(1) Type Designation

JEFMC - C03 [1] - [01] - [ ]

- JEFMC: MOTIONPACK SERIES
- C03: MODULE MODEL
  C03□
  For MOTIONPACK-120
- 1: MODULE SPECIFICATION
  1 Standard
- 01 / □: DESIGN REVISION ORDER

(2) Dimensions in mm (inch)



(3) General Specifications

Table 7 1 General Specifications

Items	Specifications
Power Supply	Single-phase 85 to 264 VAC (100V/200V class continuous input)
Consumed Power	100 V, 0 9A or less 200 V, 0 45A or less
Inrush Current	30A, 15ms or less
Holding Time	10 ms
Ambient Temperature	0 to +55°C (excluding peripheral devices)
Storage Temperature	−20°C to +85°C (excluding lithium battery)
Humidity	30% to 85% relative (non-condensing)
Vibration-Resistance	In compliance with JIS* C0911 1G max (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	10 MΩ or more at 500 VDC (between FG and 0V)
Noise Immunity	1500 Vp-p pulse width 1 μs (by a noise simulator)
Approx Weight	3 kg

* Japanese Industrial Standard

(4) Connection

(a) Connector

Table 7 2 Connector Type

Connector Name	Connector Type	Attachments		Remarks
		Receptacle Type	Case Type	
1 CN	MR-50RMA	MR-50F	MR-50L	Honda Tsushin Co , Ltd
2 CN	MR-50RFA	MR 50M	MR 50L	Honda Tsushin Co Ltd
3 CN	MR-20RMA	MR 20F	MR-20L	Honda Tsushin Co , Ltd
4 CN	MR-16RMA	MR-16F	MR 16L	Honda Tsushin Co , Ltd
5 CN	MR-25RMA	MR 25F	MR 25L	Honda Tsushin Co Ltd
6 CN	FRC2-C20 LI2-OS	—	—	Attached to FA bus cable
7 CN	MR-20RFA	MR 20M	MR 20L	Honda Tsushin Co Ltd
8 CN	MR-8RMA	MR 8F	MR 8L	Honda Tsushin Co Ltd
9 CN	MR-50RMA	MR-50F	MR-50L	Honda Tsushin Co , Ltd
10 CN	MR-50RFA	MR 50M	MR 20L	Honda Tsushin Co , Ltd

(b) FA bus Cable

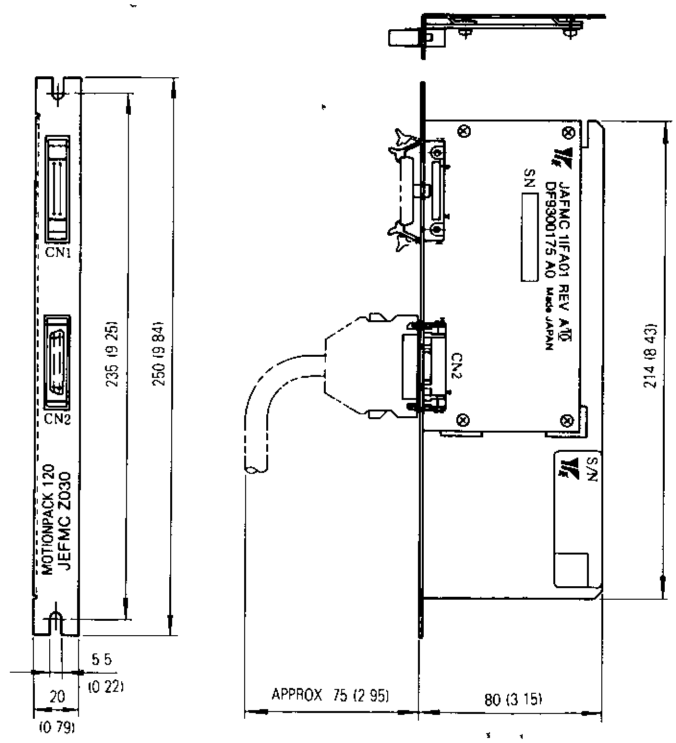
- Type JEFMC-W500, FA bus cable for 3 axes (with terminator board)× 1
- 4-stands for mounting terminator board

(5) FA bus conversion module

When several SERVOPACKS of rack-mounted type (type HR-AAB) and base-mounted type (type HR-AB) are used together, an FA bus conversion module is needed to convert connectors between types HR-AAB and HR-AB

① Model   JEFMC-Z030

② External dimensions in mm



7.1.2 CRT Control Station

(1) Type JEFMC-H013

(2) Dimensions in mm (inch)

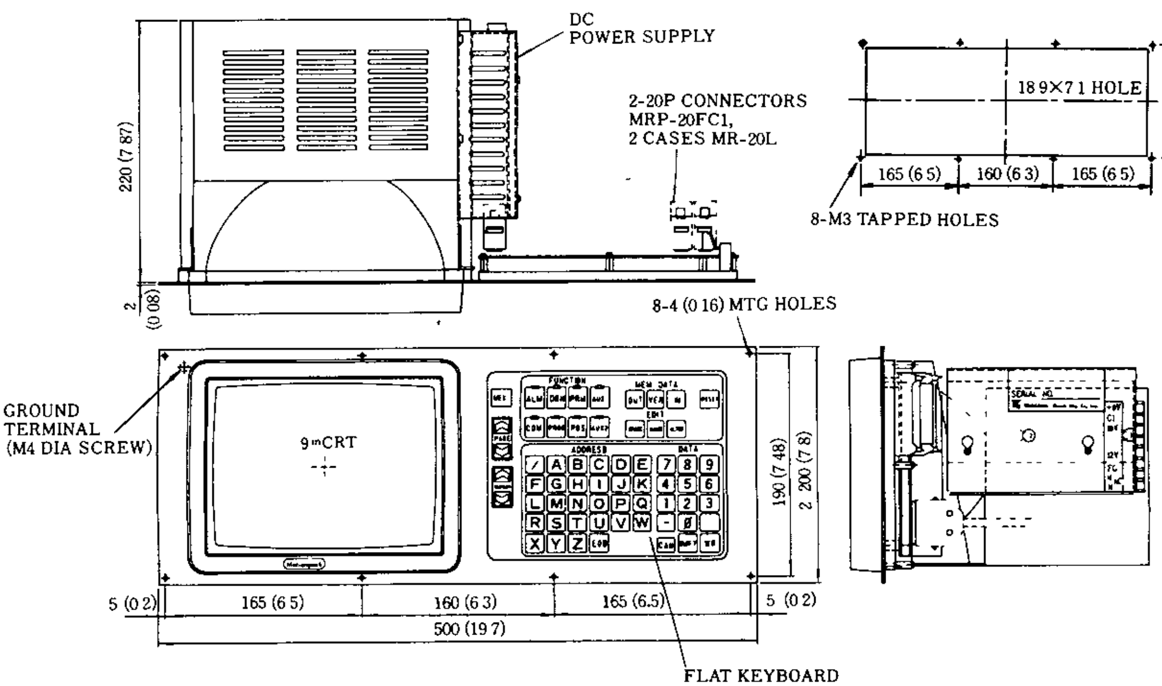


Fig 7 1 CRT Control Station

(3) General Specifications

Table 7 3 General Specifications of CRT Control Station

Items	Specifications
Powre Supply	85 to 120 VDC, 50/60 Hz
Consumed Current	0 5 A
Holding Time	10 ms
Ambient Temperature	0 to +55°C (excluding peripheral devices)
Storage Temperature	−20°C to +85°C (excluding lithium battery)
Humidity	30% to 85% relative (non-condensing)
Vibration-Resistance	In compliance with JIS* C 0911 1G max (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	10 MΩ or more at 500 VDC
Noise Immunity	1500 Vp-p, pulse width 1 μs (by a noise simulator)
CRT	9", 32 characters × 16 lines
Keyboard	Flat keyboard (function, numeric, edit and cursor keys)
Communication Port	RS422 port × 2
Approx Weight	6 kg

* Japanese Industrial Standard

7.1.3 Servo Drives

(1) Type Designation

(a) Servomotor

USAREM-05CS2□□

- **US** — AC SECRVOMOTOR
- **AR** — SERIES
  - AM M Series
  - AF F Series
  - AS S Series
  - AR R Series
- **E** — ENCLOSURE
  - Totally-enclosed, Self-cooled Type
  - K Totally-enclosed, Externally Fan-cooled Type
- **M** — MAGNET TYPE
  - D Ferrite
  - M Rare Earth
- **05** — MOTOR OUTPUT
- **C** — DESIGN REVISION ORDER (A, B, C F M)
- **S** — WITH ABSOULUTE ENCODER
- **2** — SHAFT TYPE
  - 1 Taper
  - 2 Straight
- **□** — DRIVE END SPECIFICATION
  - O Without Keyway when Opp Drive End Specification is Provided
  - K With Keyway
  - S With Oil Seal
  - T Wtih Keyway & Oil Seal
- **□** — OPPOSITE DRIVE END SPECIFICATION
  - Blank Standard
  - B Wtih Holding Brake

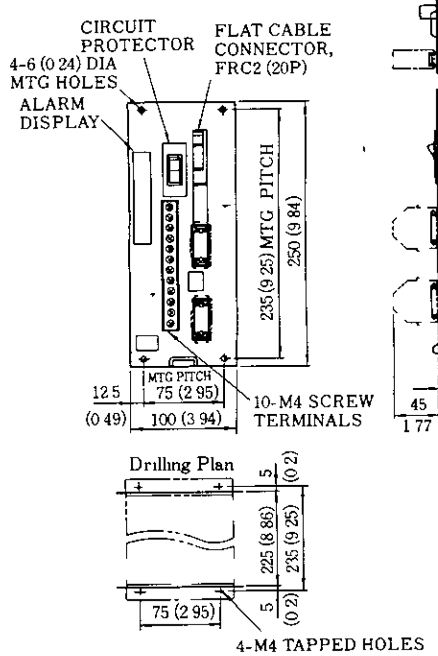
(b) SERVOPACK

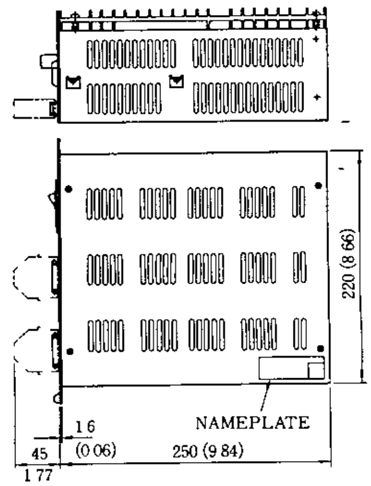
CACR-HR05AAB12

- **CACR** — AC SERVOPACK SERIES
- **HR** — CONTROL TYPE
  Multi-function
  Positioning Control
- **05** — MOTOR OUTPUT
  A5 50W, 01 100W, 02 200W
  03 300W, 05 500W
  10 1 0kW 15 1 5kW
- **A** — APPLICATION
  A For MOTIONPACK
- **A** — STRUCTURE
  A Rack-mounted
  B Base-mounted
- **B** — DESIGN REVISION ORDER (—, B,)
- **1** — SINGLE-PHASE POWER
- **2** — POWER VOLTAGE (Provided at single-Phase)
  1 100V
  2 200V

(2) Dimensions in mm (inch)

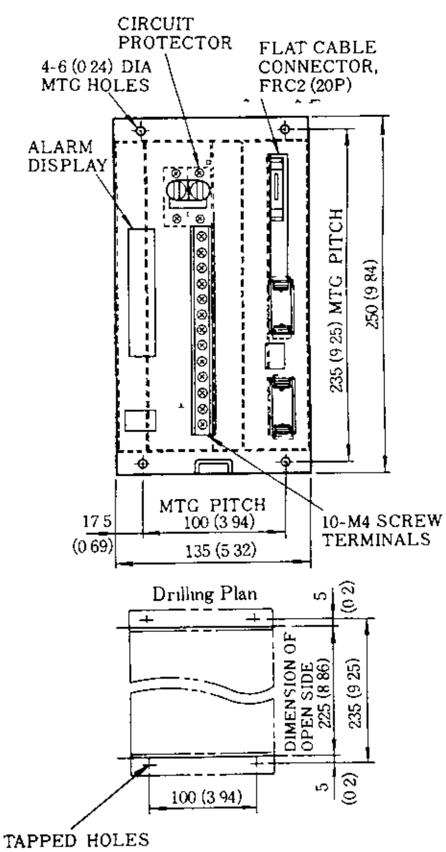
(a) CACR-HRA5 to 05AAB

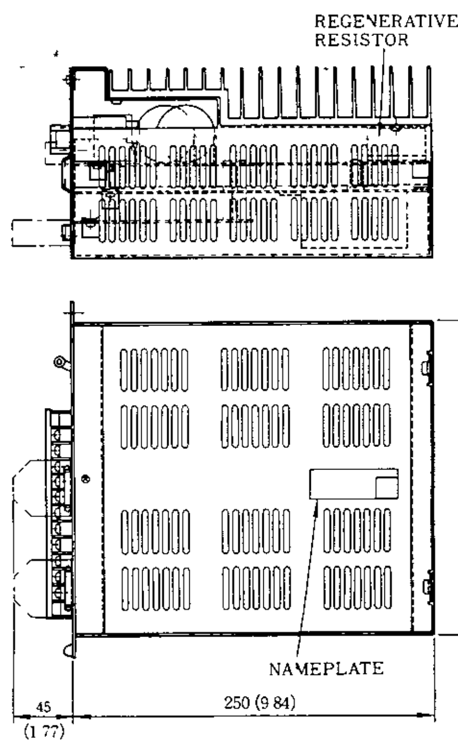




Attachments
2CN connector for cable Case MR 20L Receptacle MR 20M (Made by Honda Tsushin Co)
3CN connector for cable Case MR-20L Receptacle MR 20F (Made by Honda Tsushin Co)

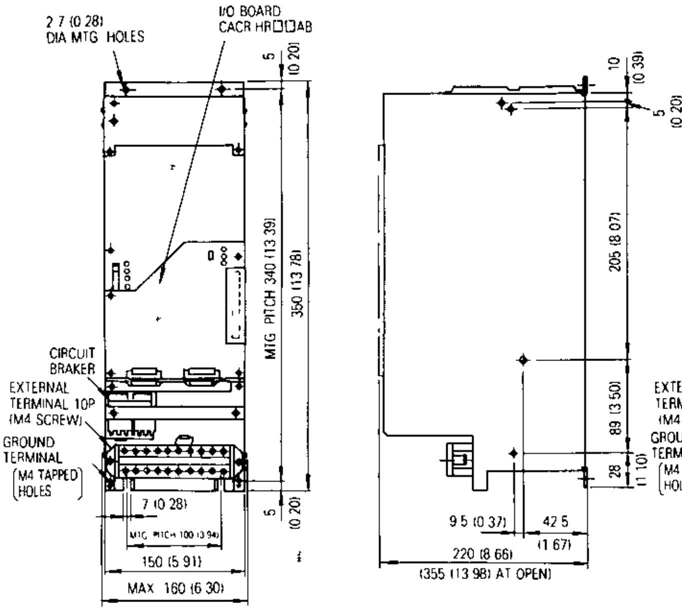
(b) CACR-HR10 to 15AAB



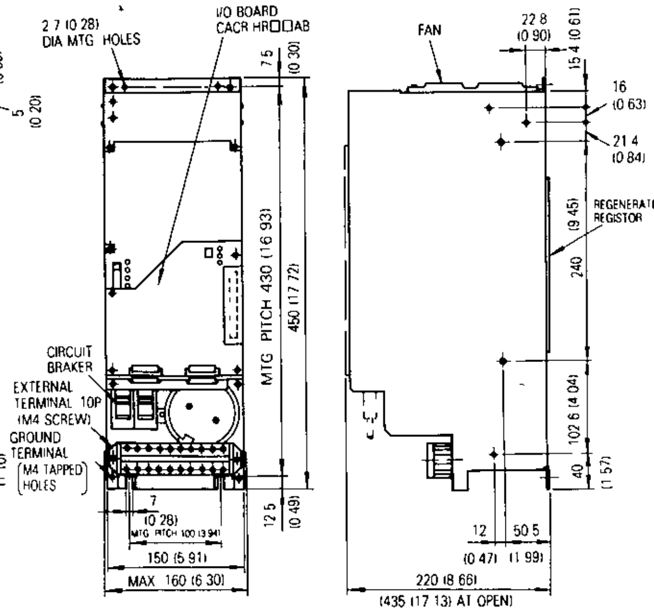


Attachments
2CN connector for cable Case MR-20L Receptacle MR-20M (Made by Honda Tsushin Co)
3CN connector for cable Case MR 20L Receptacle MR-20F (Made by Honda Tsushin Co)

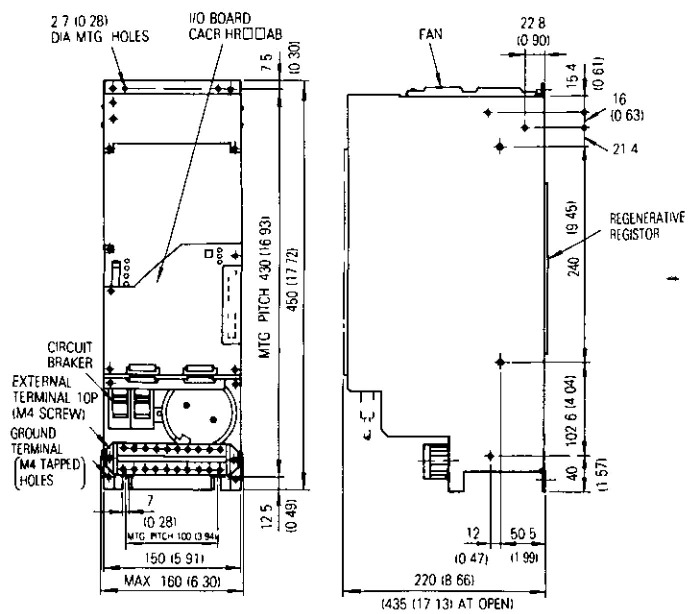
(c) CACR-HR03AB to 15AB



(d) CACR-HR20AB, 30AB



(e) CACR-HR44AB



(3) SERVOPACK Specifications M Series, F Series, G Series, D Series and S Series

Table 7 4 Rack-mounted Type SERVOPACK (200VAC)

Configuration, Main Circuit Voltage			Rack-mounted Type, Single-phase 200VAC						Rack-mounted Type, 3-phase 200VAC		
Type CACR-HR			A5AAB12	01AAB12	02AAB12	03AAB12		05AAB12	10AAB		15AAB
M series	Applicable Servomotor	Type USAMED-	—	—	—	03B□1		—	06B□1	09B□1	12B□1
		Output kW	—	—		0 3		—	0 6	0 9	1 2
		Output HP				0 4			0 8	1 2	1 6
		Speed r/min	—	—	—	Rating 1000/Max 2000		—	Rating 1000/Max 2000		
	Continuous Output Current Arms		—	—	—	3 0		—	5 8	7 6	11 7
	Max Output Current Arms		—	—	—	7 3		—	13 9	16 6	28 0
	Allowable J_L (=GD_L^2/4)	kg cm²	—	—	—	67 5		—	121 5	183 5	334
		lb in s² × 10⁻³				60			107 5	162 5	256
F series	Applicable Servomotor	Type USAFED-	—	—	—	02C□1	03C□1	05C□1	09C□1		13C□2
		Output kW	—	—	—	0 15	0 3	0 45	0 85		1 3
		Output HP				0 2	0 4	0 6	1 1		1 7
		Speed r/min	—	—	—	Rating 1500/Max 2000			Rating 1500/Max 2000		
	Continuous Output Current Arms		—	—	—	3 0	3 0	3 8	6 2		9 7
	Max Output Current Arms		—	—	—	8 5	8 5	11 0	17 0		27 6
	Allowable J_L (=GD_L^2/4)	kg cm²	—	—	—	6 5	10	67 5	121 5		183 5
		lb in s² × 10⁻³				5 75	9	60	107 5		162 5
G series	Applicable Servomotor	Type USAGED-	—	—	—	02A□1	03A□1	05A□1	09A□1		13A□2
		Output kW	—	—	—	0 15	0 3	0 45	0 85		1 3
		Output HP				0 2	0 4	0 6	1 1		1 7
		Speed r/min	—	—	—	Rating 1500/Max 2000			Rating 1500/Max 2000		
	Continuous Output Current Arms		—	—	—	3 0	3 0	3 8	7 6		11 7
	Max Output Current Arms		—	—	—	8 5	8 5	11 0	17 0		28 0
	Allowable J_L (=GD_L^2/4)	kg cm²	—	—	—	6 5	10	67 5	121 5		183 5
		lb in s² × 10⁻³				5 75	9	60	107 5		162 5
D series	Applicable Servomotor	Type USADED-	—	—	—	—		05E□	—		10E□
		Output kW	—	—	—	—		0 5	—		1 0
		Output HP						0 67			1 34
		Speed r/min	—	—	—	—		Rating 2000 Max 2500	—		Rating 2000 Max 2500
	Continuous Output Current Arms		—	—	—	—		3 5	—		7 9
	Max Output Current Arms		—	—	—	—		10 6	—		25 2
	Allowable J_L (=GD_L^2/4)	kg cm²	—	—	—	—		105			160
		lb in s² × 10⁻³						91			143

Table 7 4 Rack-mounted Type SERVOPACK (200VAC) (Cont'd)

Configuration, Main Circuit Voltage			Rack-mounted Type, Single-phase 200VAC					Rack mounted Type 3-phase 200VAC	
Type CACR-HR			A5AAB12	01AAB12	02AAB12	03AAB12	05AAB12	10AAB	15AAB
S Series	Applicable Servomotor	Type USASEM-	—	—	02A□2	03A□2	05A□2	08A□2	15A□2
		Output kW	—	—	0 154	0 308	0 462	0 771	1 54
		Output HP			0 2	0 4	0 6	1 0	2 1
		Speed r/min	—	—	Rating 3000/Max 4000			Rating 3000/Max 4000	
	Continuous Output Current Arms		—	—	2 1	3 0	4 2	5 3	10 4
	Max Output Current Arms		—	—	6 0	8 5	11 0	15 6	28 0
	Allowable J_L ($=GD_L^2/4$)	kg cm²	—	—	0 65	2 55	3 75	14 25	16 5
		oz in s² × 10^{-3}			0 55	2 25	3 35	12 65	14 4
R Series	Applicable Servomotor	Type USAREM-	A5CS	01CS	02CS	03CS	05CS	07CS	—
		Output kW	50	100	200	300	500	700	—
		Output HP	0 07	0 13	0 27	0 40	0 67	0 94	
		Speed r/min	Rating 3000/Max 4500					Rating 3000/Max 4500	—
	Continuous Output Current Arms		0 71	1 0	2 0	2 7	3 6	5 7	—
	Max Output Current Arms		2 1	2 8	5 7	7 8	10 6	16 3	—
	Allowable J_L ($=GD_L^2/4$)	kg cm²	0 775	1 25	5 075	7 65	27 2	37 2	—
		lb in s² × 10^{-3}	10 8	17 8	71 8	109	386	528	
P Series	Applicable Servomotor	Type USAPEM-	—	01CW	02CW	03CW	05CW	07CW	—
		Output kW	—	100	200	300	500	700	—
		Output HP		0 13	0 27	0 40	0 67	0 94	
		Speed r/min	—	Rating 3000/Max 4500				Rating 3000/Max 4500	—
	Continuous Output Current Arms		—	1 0	2 0	2 7	3 6	5 7	—
	Max Output Current Arms		—	2 8	5 7	7 8	10 6	16 3	—
	Allowable J_L ($=GD_L^2/4$)	kg cm²	—	1 95	3 2	4 9	23 9	32 85	—
		oz in s² × 10^{-3}		27 75	45 15	69 5	339	465	

Table 7 5 Rack-mounted Type SERVOPACK (Single-phase 100VAC)

Configuration, Main Circuit Voltage			Rack-mounted Type, Single-phase 100VAC				
Type CACR-HR			A5AAB11	01AAB11	02AAB11	03AAB11	05AAB11
R Series	Applicable Servomotor	Type USAREM-	A5DS	01DS	02DS	03DS	05DS
		Output kW	50	100	200	300	500
		Output HP	0 07	0 13	0 27	0 40	0 67
		Speed r/min	Rating 3000/Max 4000				
	Continuous Output Current Arms		1 2	1 7	2 9	3 6	5 5
	Max Output Current Arms		3 6	5 0	8 5	10 6	16 3
	Allowable J_L ($GD_L^2/4$)	kg cm²	0 775	1 25	5 075	7 65	27 2
		oz in s² × 10^{-3}	10 8	17 8	71 8	109	386

Table 7 6 Base-mounted Type SERVOPACK (3-phase 200VAC)

Configuration, Main Circuit Voltage			Base-mounted Type, 3-phase 200VAC								
Type CACR-HR			03AB	05AB	10AB		15AB	20AB	30AB	44AB	60AB
M Series	Applicable Servomotor	Type USAMED-	03B□1	—	06B□1	09B□2	12B□2	20B□2	30B□2	44A□2	USAMKD-60B□2
		Output kW	0 3	—	0 6	0 9	1 2	2 0	3 0	4 4	6 0
		Output HP	0 4		0 8	1 2	1 6	2 7	4 1	5 9	8 2
		Speed r/min	Rating 1000/Max 2000		—	Rating 1000/Max 2000				Rating 1000/Max 1500	
	Continuous Output Current Arms		3 0	—	5 8	7 6	11 7	18 8	26 0	33 0	45 0
	Max Output Current Arms		7 3	—	13 9	16 6	28 0	42 0	56 5	70 0	80 6
	Allowable J_L (= GD_L^2/4)	kg cm²	67 5	—	121 5	183 5	334	550	715	1200	1200
		lb in s² × 10⁻³	60		107 5	162 5	296	486	633 5	1063	1063
F Series	Applicable Servomotor	Type USAFED-	02C□1	03C□1	05C□1	09C□1	13C□2	20C□2	30C□2	44C□2	—
		Output kW	0 15	0 3	0 45	0 85	1 3	1 8	2 9	4 4	—
		Output HP	0 2	0 4	0 6	1 1	1 7	2 4	3 9	5 9	
		Speed r/min	Rating 1500/Max 2500								
	Continuous Output Current Arms		3 0	3 0	3 8	6 2	9 7	15 0	20 0	33 0	—
	Max Output Current Arms		8 5	8 5	11 0	17 0	27 6	42 0	56 5	77 0	—
	Allowable J_L (= GD_L^2/4)	kg cm²	6 5	10	67 5	121 5	183 5	290	550	715	—
		lb in s² × 10⁻³	5 75	9	60	107 5	162 5	256	486	633 5	
G Series	Applicable Servomotor	Type USAGED-	02A□1	03A□1	05A□1	09A□1	13A□2	20A□2	30A□2	44A□2	—
		Output kW	0 15	0 3	0 45	0 85	1 3	1 8	2 9	4 4	—
		Output HP	0 2	0 4	0 6	1 2	1 8	2 4	3 9	5 9	
		Speed r/min	Rating 1500/Max 3000								—
	Continuous Output Current Arms		3 0	3 0	3 8	7 6	11 7	19 0	26 0	33 0	—
	Max Output Current Arms		8 5	8 5	11 0	17 0	28 0	42 0	56 5	70 0	—
	Allowable J_L (= GD_L^2/4)	kg cm²	6 5	10	67 5	121 5	183 5	290	550	715	—
		lb in s² × 10⁻³	5 75	9	60	107 5	162 5	256	486	633 5	
D Series	Applicable Servomotor	Type USADED-	—		05E□	—	10E□	15E□	22E□	37E□	—
		Output kW	—		0 5	—	1 0	1 5	2 2	3 7	—
		Output HP			0 67		1 3	2 0	2 9	5 0	
		Speed r/min	—		Rating 2000/ Max 2500	—	Rating 2000/Max 2500				—
	Continuous Output Current Arms		—		3 5	—	7 9	12 6	16 6	23 3	—
	Max Output Current Arms		—		10 6	—	25 2	40 7	54 0	77 0	—
	Allowable J_L (= GD_L^2/4)	kg cm²	—		105	—	160	310	415	740	—
		lb in s² × 10⁻³			91		143	274 5	367 5	655	
S Series	Applicable Servomotor	Type USASEM-	02A□2	03A□2	05A□2	08A□2	15A□2	—	30A□2	—	—
		Output kW	0 154	0 308	0 462	0 771	1 54	—	3 08	—	—
		Output HP	0 2	0 4	0 6	1 0	2 1		4 1		
		Speed r/min	Rating 3000/Max 4000					—	Rating 3000/ Max 4000	—	—
	Continuous Output Current Arms		2 1	3 0	4 2	5 3	10 4	—	19 9	—	—
	Max Output Current Arms		6 0	8 5	11 0	15 6	18 0	—	56 5	—	—
	Allowable J_L (GD_L^2/4)	kg cm²	0 65	2 55	3 75	14 25	16 5	—	28 7	—	—
		oz in s² × 10⁻³	0 55	2 25	3 35	12 65	14 4		25 45		

Note The combination of the SERVOMOTOR and encoder is as follows

Servomotor \ Detecting Method / Slit	Incremental Encoder 2048	Incremental Encoder 2500	Incremental Encoder 8192	Absolute Encoder 1024	Absolute Encoder 8192
M Series	○	—	◎	○	◎
F Series	○	—	◎	○	◎
G Series	○	—	◎	○	◎
D Series	◎	—	○	◎	○
S Series	◎	○	—	○	◎
R Series		—			◎
P Series		—		◎	

◎ Standard

○ Sub Standard

7.2 INSTALLING MODULE

7.2.1 Ambient Conditions

The cabinet for the controller unit, AC Servo Drive, and the Control Stations should be designed and manufactured by the load machine manufacturer The cabinet must be installed at a location where the ambient conditions listed in Table 7 7 are satisfied

Also refer to Pars 7 2 2, ''Structural Design of Cabinet'' and 7 2 3, ''Thermal Design of Cabinet'' to meet the conditions

Table 7 7

Item	Requirements
Ambient Temperatures During Operation During Storage and Transport	0°C to +45°C [Difference between temperatures in and outside the panel must be within 10°C, and the panel inside temperature must be +55°C or below] -20 °C to +60°C
Humidity	10% to 90% RH (non-condensing)
Vibration	0 5 G or less during operation
Atmosphere	Avoid locations where excessive dust, iron powder, organic sprays or corrosive gases are present

7.2.2 Structural Design of Cabinet

Take the following into consideration to design the cabinet for the motion module and other units

(1) They must have an enclosed frame

① Enclosed panel

Insulate the inside of the panel from the atmosphere (Fill gaps with packing)

For cooling, dissipate heat from the fin box and heat exchanger Enclossure prevents entry of dust, iron powder, or oil mist

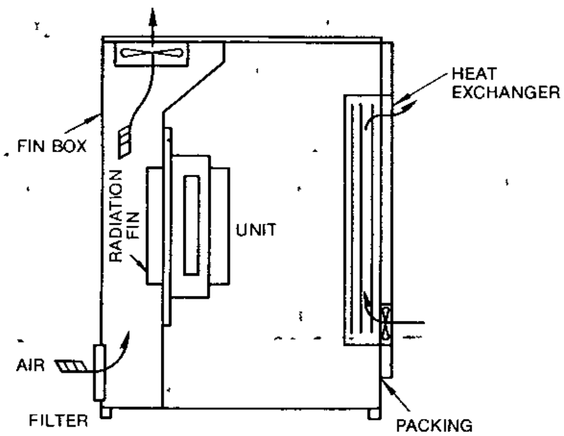


Fig 7 2 Enclosed Panel

② Dust-proof panel

If there is little oil mist and turnings, a ventilated cabinet can be used, provided that the following are taken into consideration

(a) Joints in the cabinet must be filled with packing

(b) An air filter must be used in the air inlet

(c) The unit must not be exposed to direct blowing from the fan Direct blowing may deposit oil mist or dust on the unit and cause malfunctioning

(d) The air outlet must be positioned so as to prevent entry of dust and oil mist

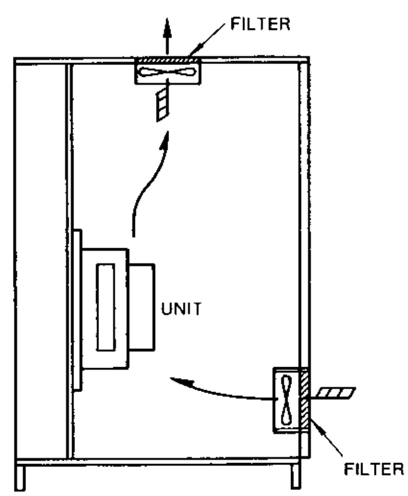
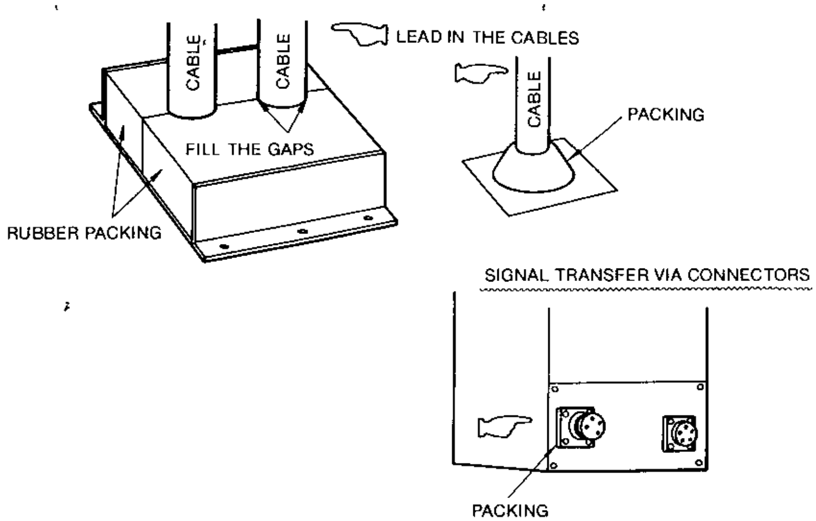


Fig 7 3 Dust-proof Panel

(2) Lead-in from Outside

Securely seal the cable entrances and doors Signals are transferred between the panel and the load machine through cable entrances Cable entrances tend to loosen and allow entry of dust and turnings Be sure to seal the gaps



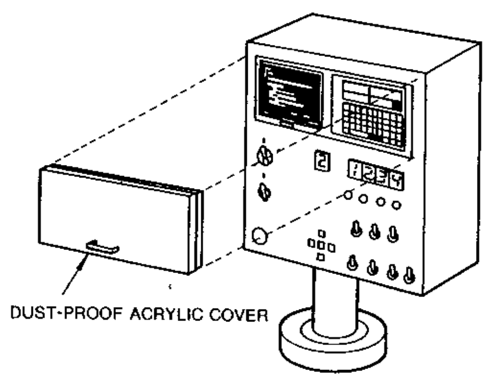
(3) CRT Display Jitter

Care must be taken because extra high voltage is applied to the CRT unit and it collects dust from the atmosphere For installation enclosure for the CRT unit, observe the following

(a) CRT display jitter caused by magnetism

Display on the CRT may jitter because of ambient magnetism The CRT unit must be placed at a distance of 300 mm from any source of magnetism (for instance, transformers, reactors, fans, electromagnetic switches, solenoid relays, and AC power cables) This figure is only an approximate standard More distance may be required Check magnetic influence before laying out the epuipment

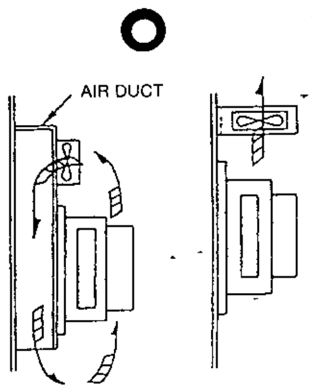
(b) Units on the surface of the cabinet such as the CRT unit have dust-proof fronts Avoid locations where cutting oil splashes on the units Securely seal the joint and protect the surface of the unit with an acrylic cover



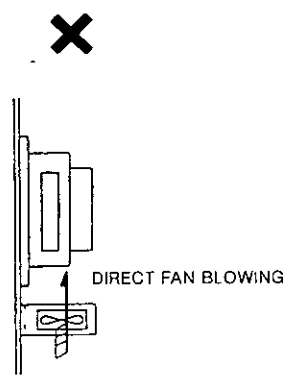
7.2.2 Structural Design of Cabinet (Cont'd)

(4) Temperature in the cabinet must not exceed 10°C above ambient temperature For thermal design of the cabinet, see Par 7 2 3

(5) For enclosed type cabinet, move air with a fan to improve cooling efficiency in the cabinet and to prevent local temperature rise Air flow rate over the PC boards in the units must be 0 6 m/s or more The PC boards must not be exposed to direct blowing from the fan



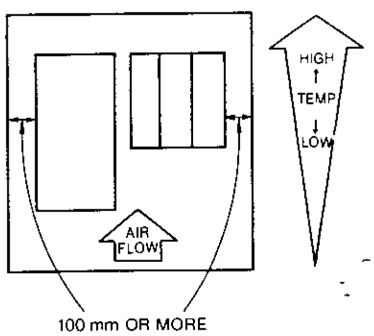
(a) Good



(b) Bad

Leave a clearance of 50 mm over and a 100 mm under the unit for ventilation

(6) Leave clearances of 100 mm or greater between a cabinet wall and parts for ventilation

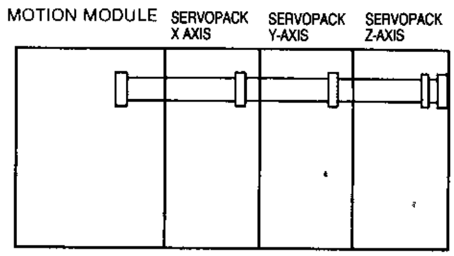


Place units that emit a large amount of heat at upper positions

At lay-out, ease of maintenance such as part change and inspection of units and ducts must be taken into consideration

(7) Laying out Motion Module and SERVOPACK

Connect the motion module and SERVOPACK with the attached cable This requires the motion module be placed left of the SERVOPACKs in a row



(8) Notes on Installing Motion Module

Observe the following to install the motion module

(a) The unit must be placed in the direction shown in Fig 7 4

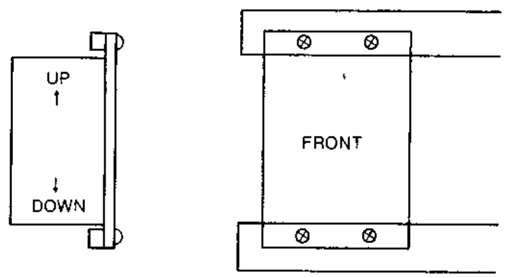


Fig 7 4 Unit Installation

(b) Be sure that air flows at 0 6 m/s or faster in the unit The control unit must not be exposed to direct blowing from the fan

(9) For installation of feed servo unit and the spindle drive unit, refer to the individual operation manuals

(10) Units must be placed at a distance of 100 mm from cables and parts bearing 90 VDC or greater voltage and cables and parts of AC power supply Also observe the following

(a) Separate the AC and DC cables

(b) Separate the primary and secondary transformers and line filters

(11) Install the units so that inspection, removal, and installation for maintenance can be performed easily

7.2.3 Thermal Design of Cabinet

The cabinet for the motion module and other units must be enclosed and the internal temperature must not exceed 10°C above the ambient temperature .

This may require a heat exchanger in the cabinet, depending on the heat emission from the components

Calculate the capacity of the heat exchanger as follows Factors

ΔT	Temperature rise in the cabinet (°C)
Pu	Total heat emission from the electric parts (W)
K	Thermal transmission factor [(W/(m²•°C)] use 6 W/(m²•°C) for K when a fan is used
A	Cabinet effective radiation area (m²)
qh	Required heat exchange rate of the heat exchanger

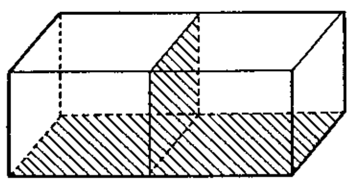
(1) Calculate Pv, the total heat emission of electric parts

Pv = Σ (heat emission of individual units)

(2) Calculate A, the effective radiation area

$$A = 4 \times \{W\ (\text{width}) \times H\ (\text{height})\} + 2\{W\ (\text{width}) \times D\ (\text{depth})\} + 2\{D\ (\text{depth}) \times H\ (\text{height})\}$$

Surfaces not exposed to the atmosphere are regarded as ineffective



Bottom area is regarded as ineffective if clearance between the unit and the floor is 50 mm or less

(3) Calculate Pv', the permissible heat emission for suppressing the internal temperature rise Δ T to 10°C or less

$$Pv' = K \cdot A \cdot \underbrace{\Delta T}_{10°C}, \quad K = 6W/(m^2 \cdot °C)$$

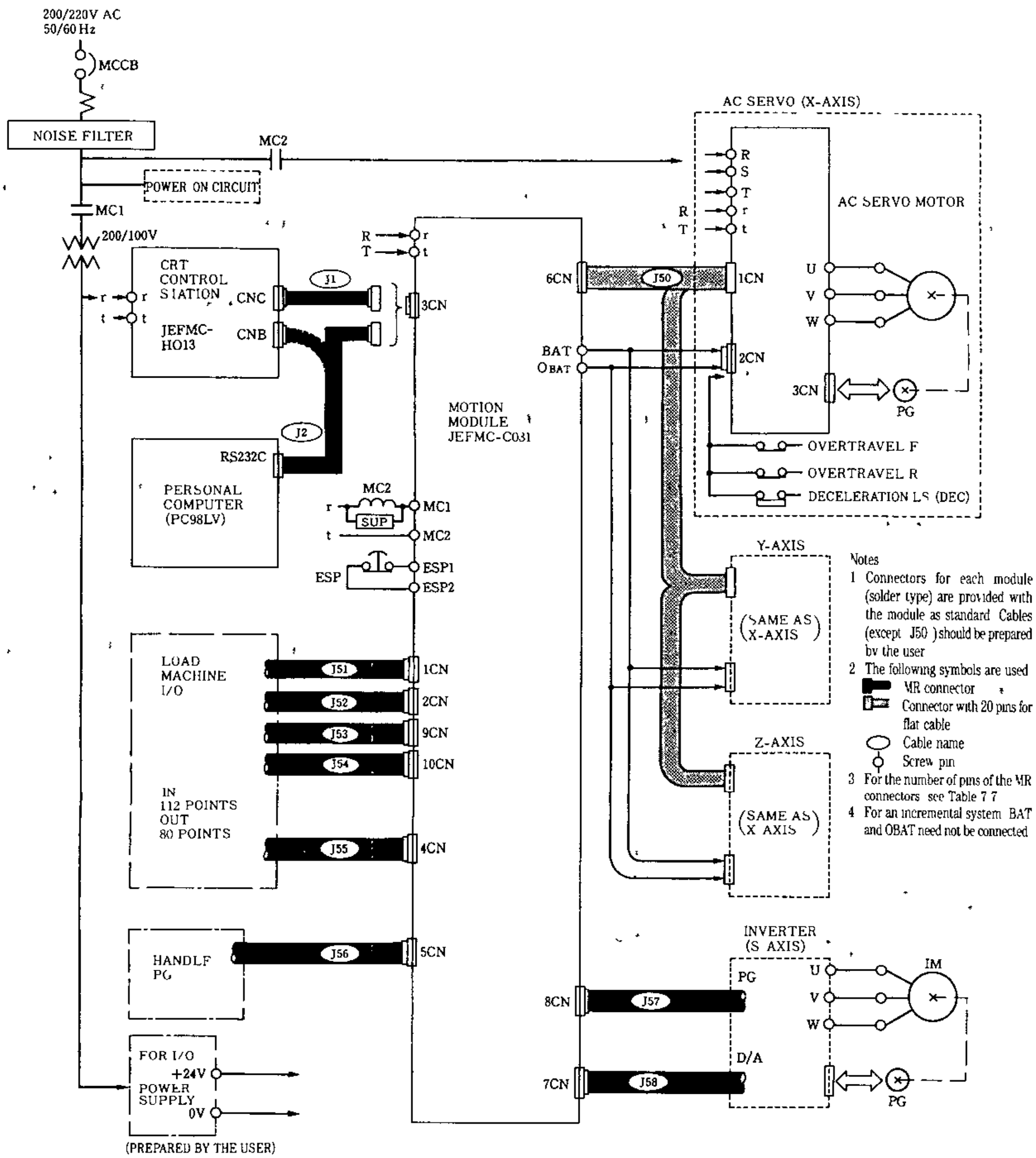
(4) No heat exchanger is required if (total heat emission Pv) ≦ (permissible heat emission Pv')

(5) If (total heat emission Pv) > (permissible heat emission Pv'), a heat exchanger having the following heat exchange factor (capacity) must be installed

$$qh = (PV - Pv') / \underbrace{\Delta T}_{10°C} \qquad (W/°C)$$

7.3 INTERFACES BETWEEN UNITS

7.3.1 MOTIONPACK-120 System Connections



Notes

1. Connectors for each module (solder type) are provided with the module as standard. Cables (except J50) should be prepared by the user.
2. The following symbols are used
   - MR connector
   - Connector with 20 pins for flat cable
   - Cable name
   - Screw pin
3. For the number of pins of the MR connectors see Table 7 7
4. For an incremental system BAT and OBAT need not be connected

Fig 7 5 MOTIONPACK-120 System Connections

7.3.2 Power Supply

(1) Input Power Supply

MOTIONPACK-120 has a built-in power supply for the controller Connected to power supply of 100-200 VAC via the AC power supply pin, MOTIONPACK-120 becomes operational immediately

(2) Power-on sequence

The sequence must be designed so that the I/O power supply (24 VDC) and the Control Station power supply (100 VAC) go on at the same time after the AC power supply is turned on

The motion module supports a built-in power-on sequence for the main circuit of the servo power supply Therefore, servo power is turned on in the next sequence by connecting magnetic contactor MC2 between terminals MC1 and MC2

① Turn on the AC power supply, I/O power supply, and CRT power supply simultaneously by turning on MC1

② Execute system initialization (for about five seconds)

③ Excite MC2 and turn on servo power supply

Depending on the timing of power off, state of the controller may be unstable for a while and an instantaneous abnormal output may occur If this causes a problem, design a sequence that turns off the I/O-related power supply before the control power supply

(3) Power-on Circuit

See Fig 7 5 for an exampel of connection of the power-on circucit Specifications of connection pins of the motion module are as follows

(a) MC1 and MC2

- Equipment to be connected Magnetic contactor (surge suppress or provided)
- Maximum input voltage 30 VDC or 250 VAC
- Maximum input current 5 A

(b) ESP1 and ESP2

- Equipment to be connected Switch (B-contact)
- Output voltage +24 V

(4) I/O Signal Power Supply

For I/O signals, 24 VDC power supply is required This power supply is not provided with the MOTIONPACK-120 Prepare the following power supplies or equivalents Table 7 8 provides the required specifications

Table 7 8 Power Supply Specifications

Item		Specification
Input Voltage		100/110 VAC, 50/60 Hz,
Rated Voltage		or 200/220 VAC, 50/60 Hz
Rated Current		2A (3-axis system)
Output Constancy		±10% or less
Ripple Noise		300 m Vpp or less
Leak Current		0 5 mA or less
Overcurrent Protection		Provided
Operating Temperature		0°C to +55°C
Storage Temperatur		−20°C to +85 °C
Ambient Humidity		30% to 90% RH (non-condensing)
Insulation	Input ←→ Frame	Withstand voltage 1500VAC, 1 minute Insulation resistance 100 MΩ or greater at 500 VDC
	Input ←→ Output	
	Output ←→ Frame	

[Recommended Power Supplies]

(1) 100 VAC Input
Type BY242R5
Manufactured by Shin Dengen Industry, Co , Ltd
Input 85-115 VAC, 47-440 Hz
Output 24 V, 2 5 A

(2) 200 VAC Input
Type EV242R1
Manufactured by Shin Dengen Industry, Co , Ltd
Input 170-264 VAC, 47-63 Hz
Output 24 V, 2 1 A

7.3.3 Input/Output at Machine Side

(1) Rules for Input Signals

Input signals referred to herein are those sent from the machine side to MOTIONPACK-120 For connection, 0V common method (True-Low method) shown in Fig 7 6 is applied

Effective condition of the input voltage is as follows

(a) ON or OFF input signals with a duration longer than 50 ms are effective

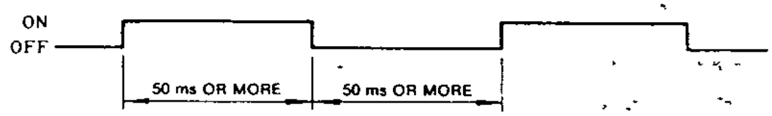


Fig 7 6

(b) Input contact capacity should be about 5 mA with a rated voltage of 24 VDC Chattering time of the contact should be less than 5 ms

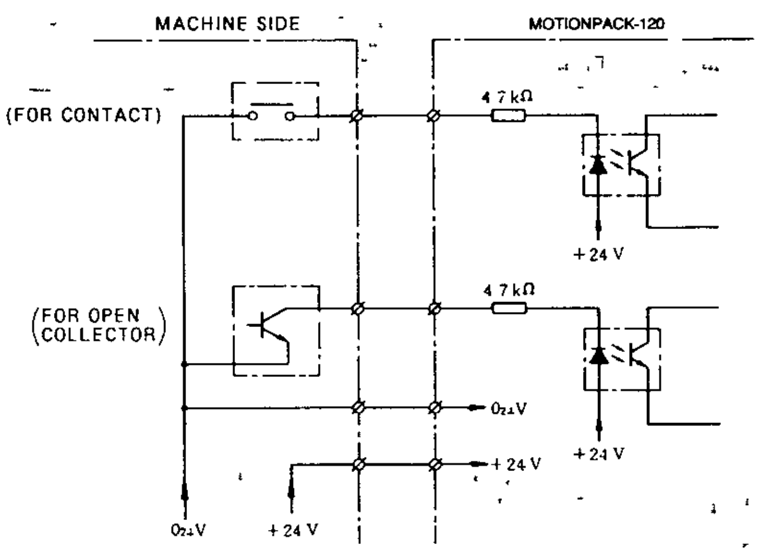


Fig 7 7

(2) Rules for Output Signals

Signals sent from MOTIONPACK-120 to machine side must have the output capacity and protective measures as explained below

(a) Output capacity is less than 24 VDC and 80 mA

(b) Non-contact output

(c) 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-120 might be destroyed

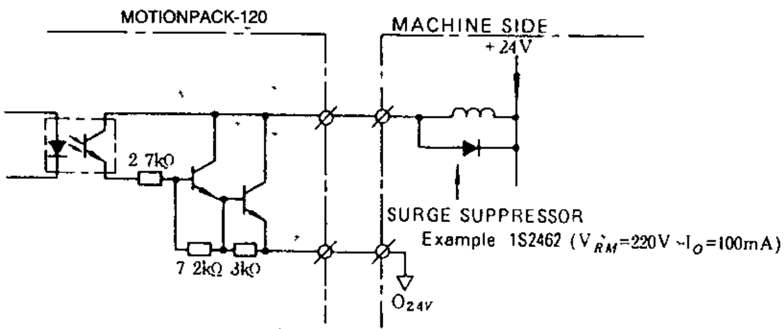


Fig 7 8

- In the case of lamp load, connect a preheating resistor so as to use the lamp below the rated capacity including rush current

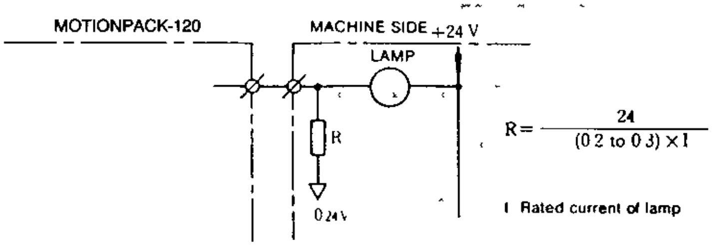


Fig 7 9

- Reduce the current through the lamp to 20 to 30% of the rating of the lamp by connecting the preheating resistor

7.3.4 Connection between CRT Control Station and Motion Module

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

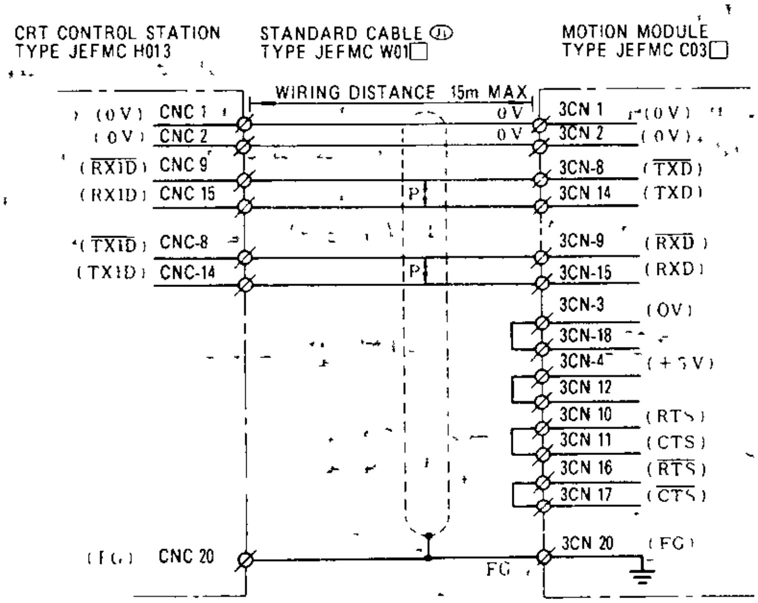


Fig 7 10 Connection between CRT Control Station and Motion Module

7.3.5 Connection between Personal Computer and CRT Control Station

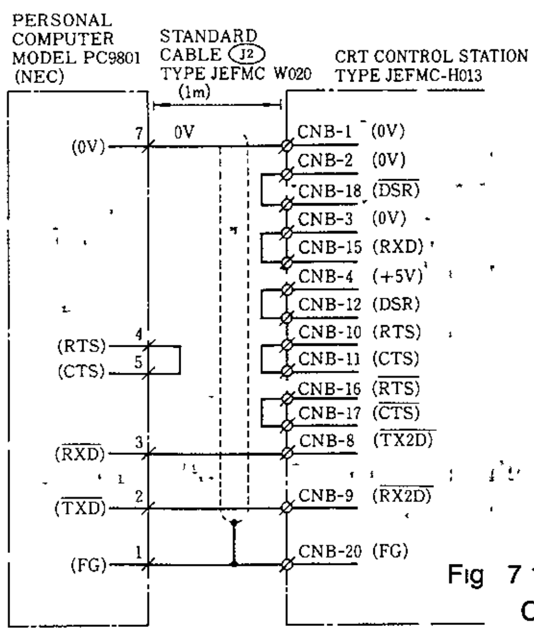


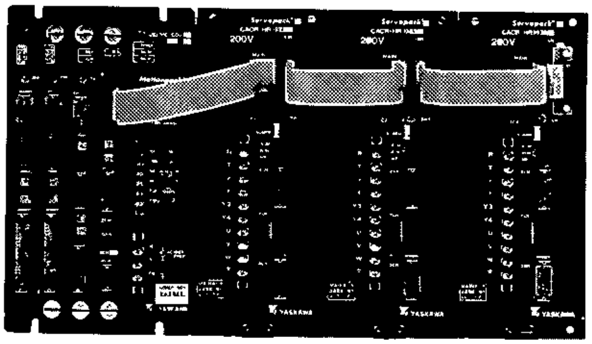
Fig 7 11 Connection between Personal Computer and CRT Control Station

7.3.6 Connection between Motion Module and SERVOPACK (HR SERIES)

To connect the motion module and the SERVOPACK, connect the exclusive FA bus signal cable and the absolute encoder battery

(1) FA Bus Signal Cable

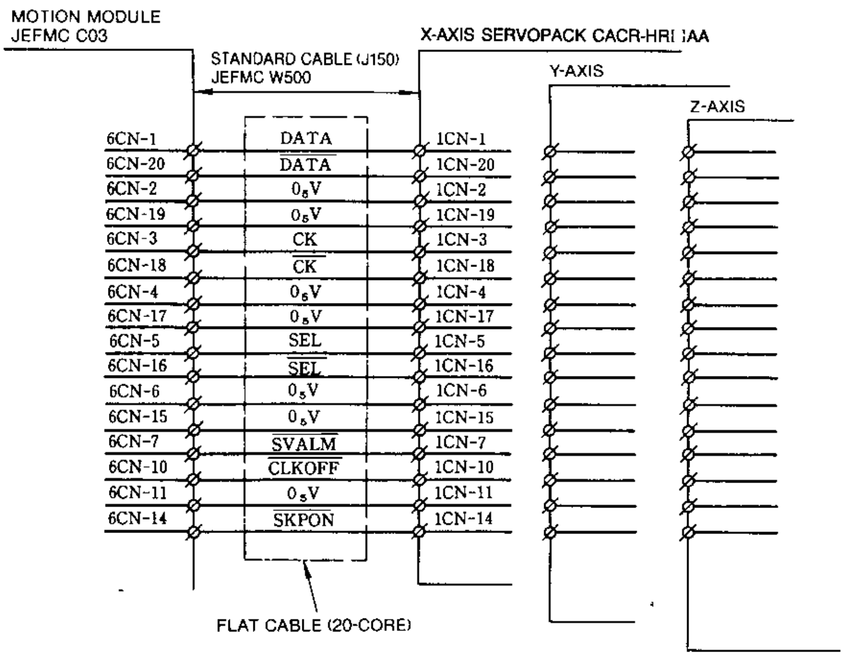
This signal has a terminator resistor board on the right end to connect 3-axis or 5-axis SERVOPACKs with the MOTIONPACK If the number of axes to be used differs from that on the cable, cut off the unnecessary part before use Fix the terminator resistor board on the farthest right SERVOPACK using the provided nylon stud



J89 255

Standard cable (J50) (JEFMC-W500 attached to motion module) can connect up to three SERVOPACKs If fewer SERVOPACKs are to be used, cut off the unnecessary part of the FA bus signal cable before use

Note FRC connector pin numbers are arranged as follows



1	20
2	19
3	18
4	17
5	16
6	15
7	14
8	13
9	12
10	11

Fig 7 12 Connection between Motion Module and SERVOPACK

(2) Connecting Absolute Encoder Battery

Connect the built-in battery of the motion module to the absolute encoder via the SERVOPACK

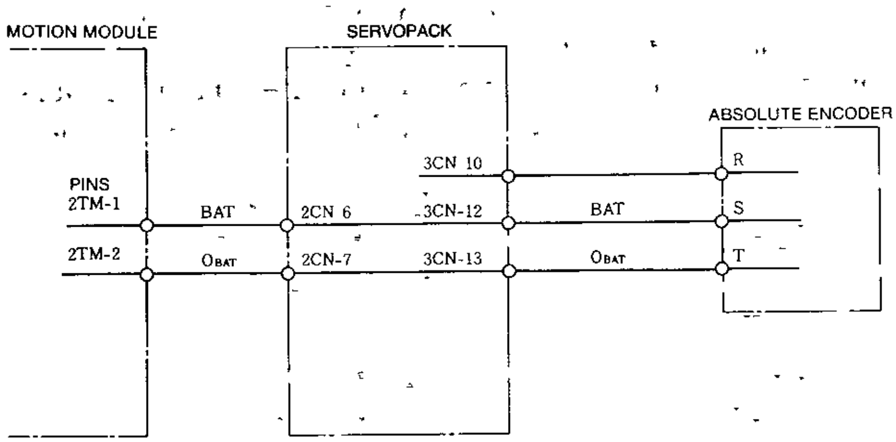


Fig 7 13

7.3.7 Connection between Motion Module and Spindle Drive

Connect the speed reference signal to connector 8CN of the motion module As D/A output, ± 10 V (± 5%) is output No power supply is necessary Cables must be shielded

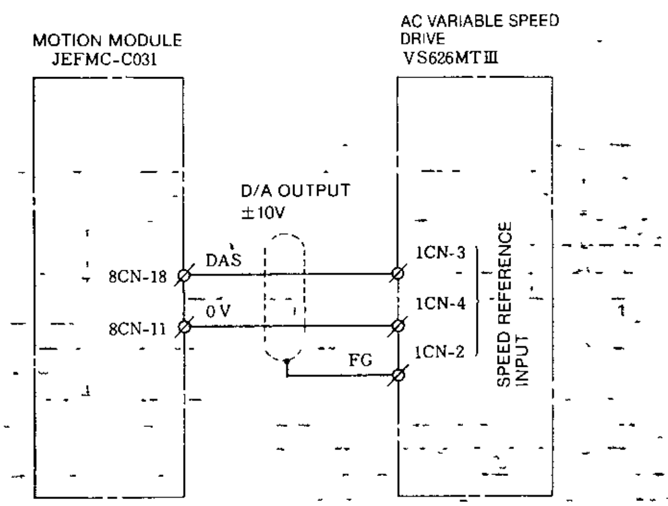
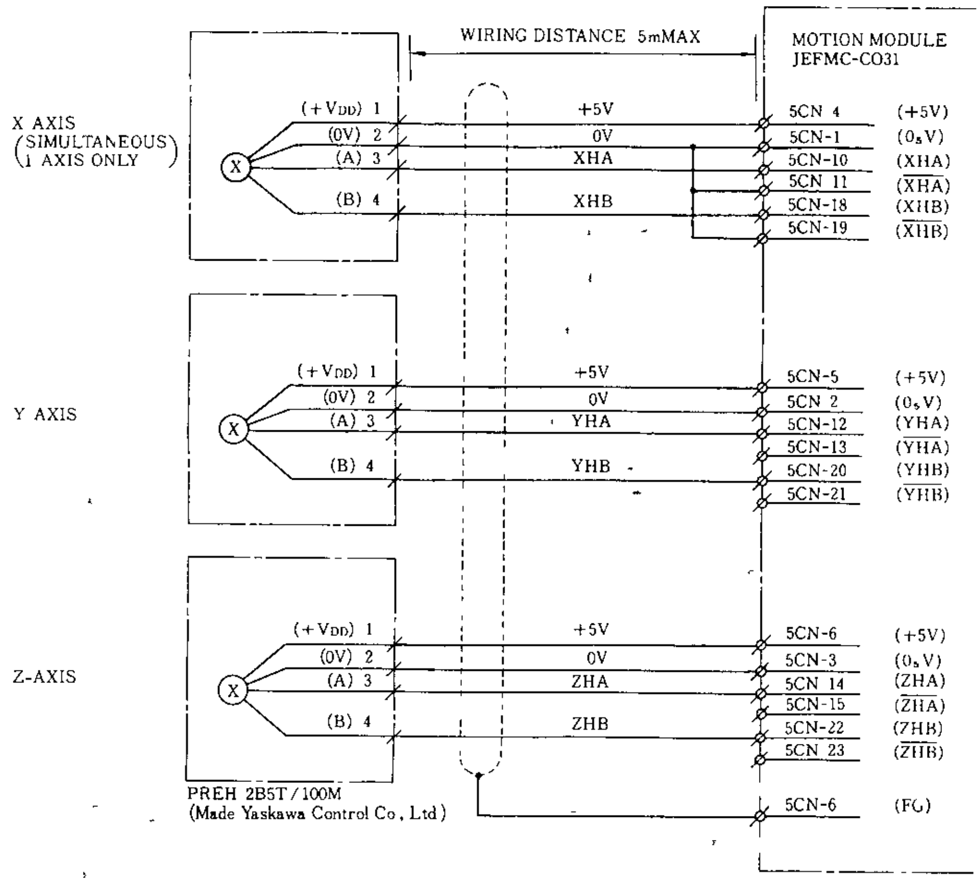


Fig 7 14 Connection between Motion Module and Spindle Drive

7.3.8 Connection between Manual Pulse Generator and Motion Module

Fig 7 15 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 PREH-2E5T/100M ranges from 5 VDC to 12 VDC

(1) 5 V Manual Pulse Generator



Notes

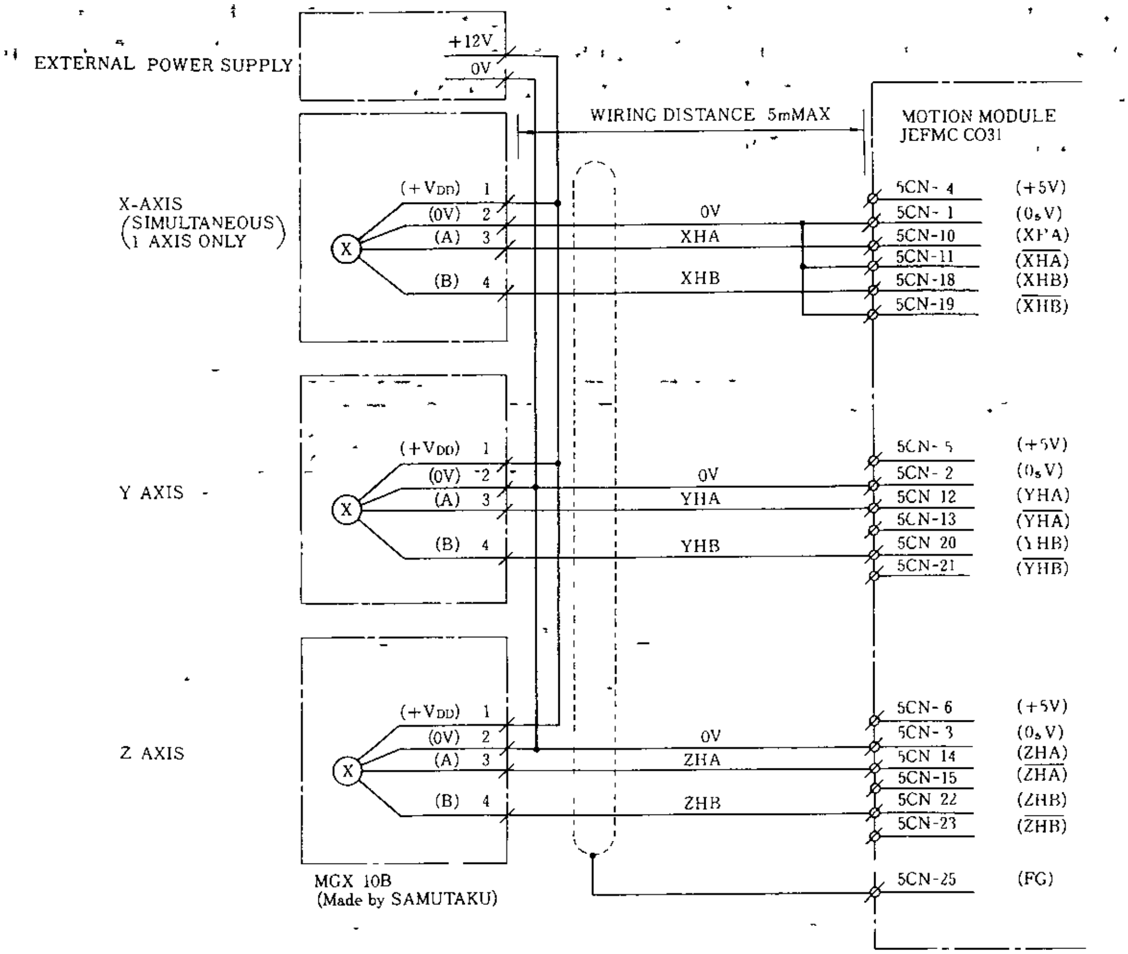
1 Connect to the X axis terminal when manual handle (1 axis) is used simultaneously The axis is changed by axis change signals (HX,HY,HZ)

2 When manual handle (3 axis) is used simultaneously the axis change shignals HX HY and HZ must be turned on See Par 6 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 7 15 Connection between 5V Pulse Generator and Motion Module (for 3 Axis)

(2) 12V Manual Pulse Generator



Notes

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 Pr 6 2 (1)

Fig 7 16 Connection between 12V Pulse Generator and Motion Module (for 3 Axis)

(3) Example of Manual Pulse Generator

A manual pulse generator manufactured by YASKAWA Control Sales Co , Ltd is shown in the following Any manufacturer's product can be used provided that the specifications are satisfied

Table 7 9 gives the specifications Fig 7 17 shows an example A manual pulse generator is used as the controller in the manual operation mode

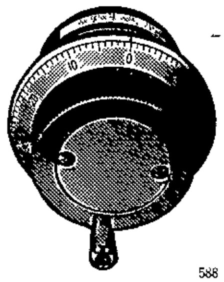


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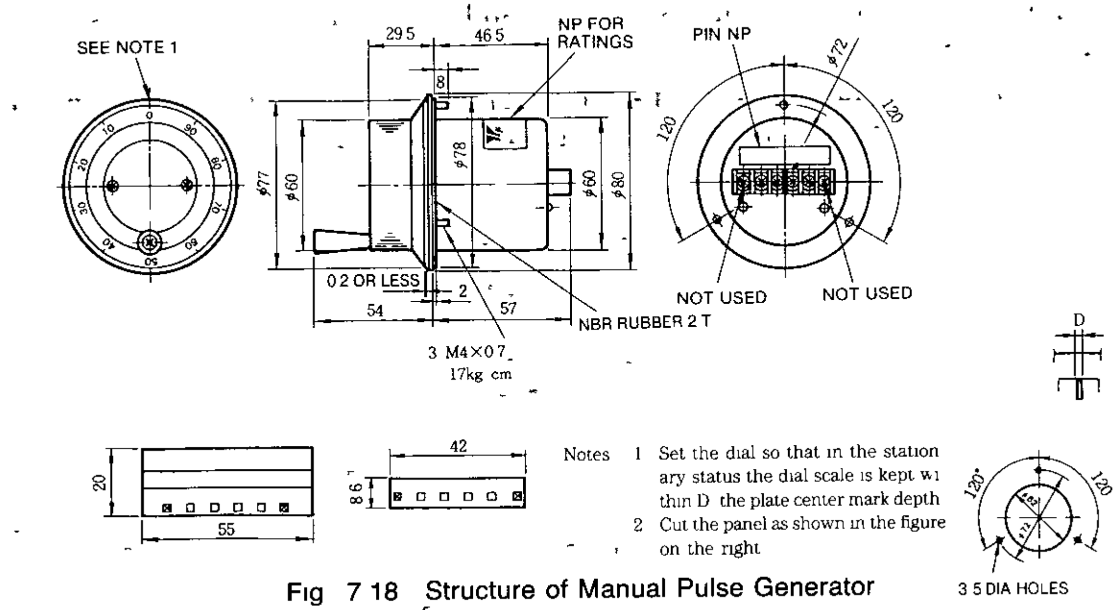
Fig 7 17

Table 7 9 Manual Pulse Generator Specifications

Model	PREH-2E5T/100M1
Power Supply	4 5 to 13 2 VDC, 50 mA
Output Waveform and Type	Rectangular voltage output, open collector
Output Level	1 power voltage 1 V or greater 0 0 5 V or below
Tr Collector Current	20 mA
Output Impedance	2kΩ
Pulse Duty	50±10%
Output Phase Difference	25±10%
Response Frequency	0 to 10 kHz
Allowable Maximum Speed	500 r/min
Starting Torque	150 to 600 g cm
Operating Ambient Temperature	0°C to +60°C
Storage Ambient Temperature	-30°C to +70°C
Ambient Humidity	30% to 85% RH (non-condensing)
Withstand Vibration	2G 50Hz
Withstand Shock	30G/11ms
Atmosphere	Must be free from inflammable or corrosive gases
Dimensions	77 mm (dia) × 117 mm (D)
Approx Weight	540 g

Manual Pulse Generator

Module PREH-2E5T/100-M



Notes 1 Set the dial so that in the stationary status the dial scale is kept within D the plate center mark depth
2 Cut the panel as shown in the figure on the right

Fig 7 18 Structure of Manual Pulse Generator

7.3.9 SERVOPACK I/O Signals

I/O circuit for overtravel (OT) and servo alarm (ALM) signals consist of a contactless circuit insulated by a photocoupler Therefore, external circuits must be built in compliance with specified voltage and current specifications

Input Circuit

24VDC ± 1V, 20mA or greater (about 5mA/circuit)

There are overtravel (OT) and home positioning deceleration limit (DEC) input signals Use 24V power supply for the input circuit (See Fig 7 19) Supply 24 V power from external

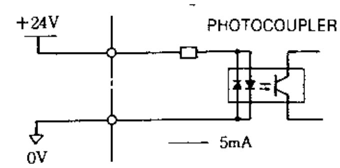


Fig 7 19 Input Circuit

Output Circuit

Applied voltage (V_{MAX}) ≦ 30V,
Conducting current (Ip) ≦ 50mA

The servo alarm (ALM) requires an output circuit This is a contactless circuit using a transistor Supply 24 V power from external

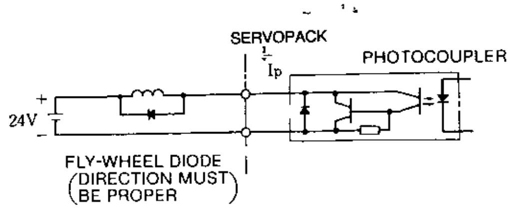
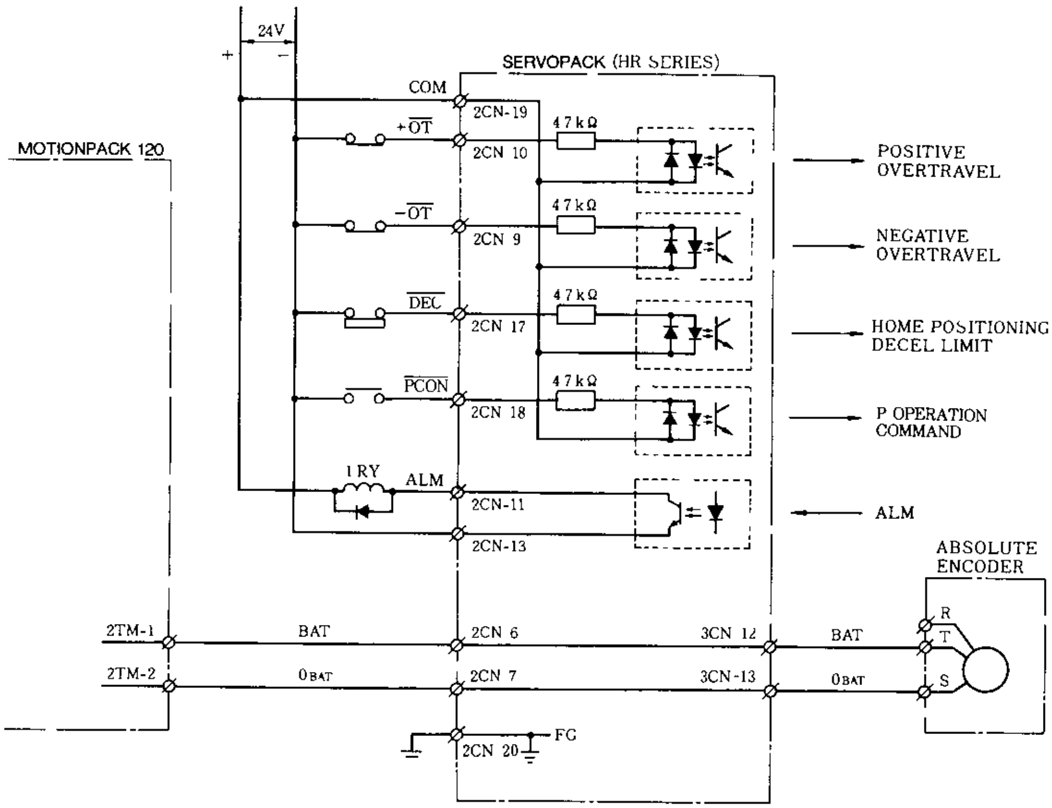


Fig 7 20 Output Circuit



Note For an incremental system, BAT and 0BAT need not be connected

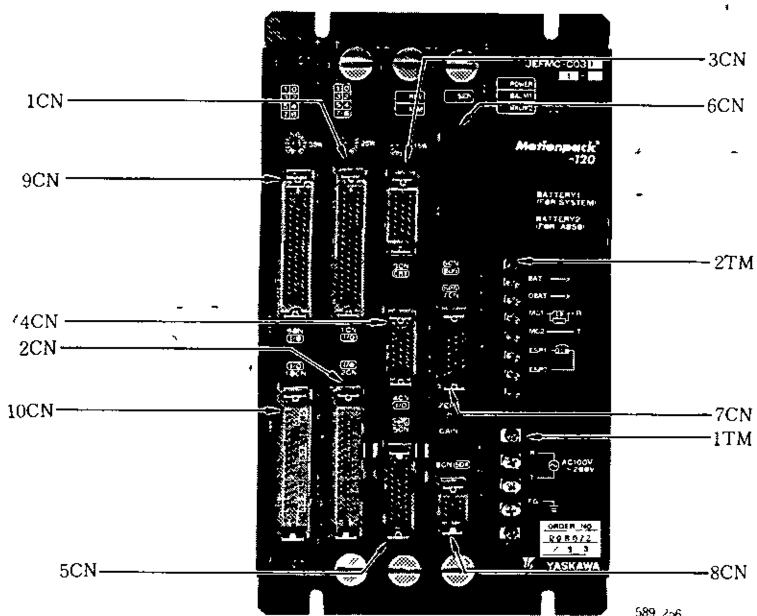
Fig 7.21 Connection of I/O Signals to 2CN and External Signal Processing

7.3.10 Connection between SERVOPACK and Motor, Encoder

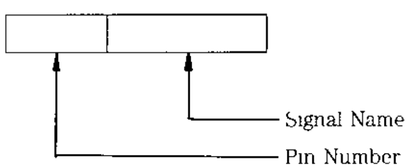
Refer to the SERVOPACK Bulletin for correct connection Cable size depends on the motor capacity

7.3.11 Connector Pin Number and Signal Name

(1) Fig 7 22 shows assignment of the connector pin numbers and signals on the panel of motion module JEFMC-C031-



Note Pin numbers and signal names are indicated as follows



① I/O Allocation by Standard Ladder Program

9CN (MR-50 RMA) IN

18	HB 6			50	HB 7
17	HB 4			49	HB 5
16	HB 1	32	HB 2	48	HB 3
15	ZRNB	31	BSVOK	47	HB 0
14	ZPNB	30	+JB	46	−JB
13	STRB	29	$\overline{\text{INC}}$/ABSB	45	DIRB
12	HA 5	28	HA 6	44	HA 7
11	HA 2	27	HA 3	43	HA 4
10	ASVOK	26	HA 0	42	HA 1
9	+JA	25	−JA	41	ZRNA
8	$\overline{\text{INC}}$/ABSA	24	DIRA	40	ZPNA
7	NEG	23	PMEM	39	STRA
6	RSTB	22	EINV	38	TBXON
5	$\overline{\text{STOPA}}$	21	RSTA	37	$\overline{\text{STOPB}}$
4	GR 0	20	SFIN	36	SLPC
3		19		35	TBXON
2	PRMP			34	PRGP
1	0_{24}V			33	+24V

1 CN (MR-50 RMA) IN

18	MLK			50	ZPNT
17	ZRN			49	FIN
16	ER	32	STR	48	$\overline{\text{STP}}$
15	GR 2	31	SSTP	47	$\overline{\text{SBK}}$
14	MP 1	30	MP 2	46	GR 1
13	HX	29	HY	45	HZ
12	−JY	28	−JZ	44	RRN
11	+JZ	27	FRN	43	−JX
10	RESET	26	+JX	42	+JY
9		25	MRDY	41	SVOK
8	JOV 2	24	JOV 4	40	JOV 8
7	ROV 2	23	ROV 3	39	JOV 1
6	OV 8	22	OV 16	38	ROV 1
5	OV 1	21	OV 2	37	OV 4
4	DNC	20	MEM	36	EDIT
3	HANDLE	19	STEP	35	MDI
2	RAPID			34	JOG
1	0_{24}V			33	+24V

10 CN (MR-50 RFA) OUT

1	0_{24}V			33	+24V
2				34	MCRD
3	BATALM	19		35	G 93 M
4	SLPS	20	GRL	36	GRH
5	AC 0	21	AC 1	37	AC 2
6	AC 3	22	AC 4	38	AC 5
7	AC 6	23	AC 7	39	AC 8
8	AC 9	24		40	
9		25		41	
10		26	MOVA	42	ALMA
11	ZPA	27	SVONA	43	MOVB
12	ALMB	28	ZPB	44	SVONB
13		29		45	
14		30		46	
15		31		47	
16		32		48	
17				49	
18				50	

2 CN (MR-50 RFA) IN/OUT

1	0_{24}V			33	+24V
2	W 11			34	W 12
3	W 14	19	W 18	35	W 21
4	W 22	20	W 24	36	W 28
5	SK 1	21	SK 2	37	SK 3
6	SK 4	22	SK 5	38	SK 6
7	SK 7	23	SK 8	39	STL
8	SPL	24	OP	40	DEN
9	M 00	25	SVON	41	M 02
10	M 30	26	MF	42	TF
11	SF	27	RST	43	ZPX
12	ZPY	28	ZPZ	44	ALM
13	M 11	29	M 12	45	M 14
14	M 18	30	M 21	46	M 22
15	M 24	31	M 28	47	T 11
16	T 12	32	T 14	48	T 18
17	T 21			49	T 22
18	T 24			50	T 28

Fig 7 22

② I/O Address for General-purpose I/O

9 CN (MR-50 RMA) IN

18	#42136			50	#42137
17	#42134			49	#42135
16	#42131	32	#42132	48	#42133
15	#42126	31	#42127	47	#42130
14	#42123	30	#42124	46	#42125
13	#42120	29	#42121	45	#42122
12	#42115	28	#42116	44	#42117
11	#42112	27	#42113	43	#42114
10	#42107	26	#42110	42	#42111
9	#42104	25	#42105	41	#42106
8	#42101	24	#42102	40	#42103
7	#42096	23	#42097	39	#42100
6	#42093	22	#42094	38	#42095
5	#42090	21	#42091	37	#42092
4	#42085	20	#42086	36	#42087
3	#42082	19	#42083	35	#42084
2	#42080			34	#42081
1	0_{24}V			33	+24V

1 CN (MR-50 RMA) IN

18	#42056			50	#42057
17	#42054			49	#42055
16	#42051	32	#42052	48	#42053
15	#42046	31	#42047	47	#42050
14	#42043	30	#42044	46	#42045
13	#42040	29	#42041	45	#42042
12	#42035	28	#42036	44	#42037
11	#42032	27	#42033	43	#42034
10	#42027	26	#42030	42	#42031
9	#42024	25	#42025	41	#42026
8	#42021	24	#42022	40	#42023
7	#42016	23	#42017	39	#42020
6	#42013	22	#42014	38	#42015
5	#42010	21	#42011	37	#42012
4	#42005	20	#42006	36	#42007
3	#42002	19	#42003	35	#42004
2	#42000			34	#42001
1	0_{24}V			33	+24V

10 CN (MR-50 RFA) OUT

1	0_{24}V			33	+24V
2	#43040			34	#43041
3	#43042	19	#43043	35	#43044
4	#43045	20	#43046	36	#43047
5	#43050	21	#43051	37	#43052
6	#43053	22	#43054	38	#43055
7	#43056	23	#43057	39	#43060
8	#43061	24	#43062	40	#43063
9	#43064	25	#43065	41	#43066
10	#43067	26	#43070	42	#43071
11	#43072	27	#43073	43	#43074
12	#43075	28	#43076	44	#43077
13	#43080	29	#43081	45	#43082
14	#43083	30	#43084	46	#43085
15	#43086	31	#43087	47	#43090
16	#43091	32	#43092	48	#43093
17	#43094			49	#43095
18	#43096			50	#43097

2 CN (MR-50 RFA) IN/OUT

1	0_{24}V			33	+24V
2	#42060			34	#42061
3	#42062	19	#42063	35	#42064
4	#42065	20	#42066	36	#42067
5	#42070	21	#42071	37	#42072
6	#42073	22	#42074	38	#42075
7	#42076	23	#42077	39	#43000
8	#43001	24	#43002	40	#43003
9	#43004	25	#43005	41	#43006
10	#43007	26	#43010	42	#43011
11	#43012	27	#43013	43	#43014
12	#43015	28	#43016	44	#43017
13	#43020	29	#43021	45	#43022
14	#43023	30	#43024	46	#43025
15	#43026	31	#43027	47	#43030
16	#43031	32	#43032	48	#43033
17	#43034			49	#43035
18	#43036			50	#43037

(2) Others

3 CN (MR-20 RMA)

7				20	FG
6	+5V	13		19	
5	+5V	12		18	
4	+5V	11	CTS	17	$\overline{CTS}$
3	0V	10	RTS	16	$\overline{RTS}$
2	0V	9	$\overline{RXD}$	15	RXD
1	0V	8	$\overline{TXD}$	14	TXD

4 CN (MR-16 RAM)

6	+24V			16	FG
5		10		15	0_{24}V
4	IN 3	9		14	OUT 3
3	IN 2	8		13	OUT 2
2	IN 1	7		12	OUT 1
1	SKIP			11	ALM

5CN (MR-25RMA)

9				25	FG
8		16		24	
7		15	$\overline{ZHA}$	23	$\overline{ZHB}$
6	+5V	14	ZHA	22	ZHB
5	+5V	13	$\overline{YHA}$	21	$\overline{YHB}$
4	+5V	12	YHA	20	YHB
3	0V	11	$\overline{XHA}$	19	$\overline{XHB}$
2	0V	10	XHA	18	XHB
1	0V			17	

6CN (FRC2-C20L12-OS)

20	0V	19	$\overline{CLKOFF}$
18		317	
16		15	
14	$\overline{SKPON}$	13	$\overline{SVALM}$
12	0V	11	0V
10	$\overline{SEL}$	9	SEL
8	0V	7	0V
6	$\overline{CK}$	5	CK
4	0V	3	0V
2	$\overline{DATA}$	1	DATA

7 CN (MR-20 RFA)

7				20	FG
6	+5V	13		19	$\overline{PB}$
5	+5V	12		18	PB
4	+5V	11		17	$\overline{PA}$
3	0V	10		16	PA
2	0V	9		15	$\overline{PC}$
1	0V	8		14	PC

8 CN (MR-8RMA)

3				8	FG
2		5		7	
1	0V	4	DAS	6	

2TM (M3 SCREW TERMINAL)

1	BAT
2	0_{BAT}
3	MC 1
4	MC 2
5	ESP 1
6	ESP 2

1TM (M4 SCREW TERMINAL)

1	R
2	T
3	FG

(3) CRT Control Station (JEFMC-H013□)

Connector terminal numbers on the rear of CRT control station (JEFMC-H013) 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
0sV	0sV	0sV	+5V	+5V	+5V	
	8	9	10	11	12	13
	$\overline{TX2D}$	$\overline{RX2D}$	$\overline{RTS2}$	CTS2	DSR2	
14	15	16	17	18	19	20
TX2D	RX2D	$\overline{RTS2}$	$\overline{CTS2}$	$\overline{DSR2}$		FG

CONNECTOR CNC (MR-20RMA)

1	2	3	4	5	6	7
0sV	0sV					
	8	9	10	11	12	13
	$\overline{TX1D}$	$\overline{RX1D}$				
14	15	16	17	18	19	20
TX1D	RX1D					FG

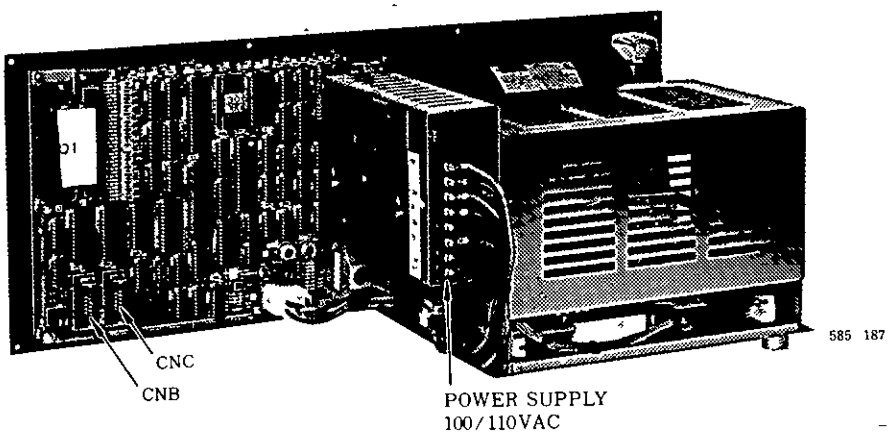


Fig 7 23 Connector Pins and Signal Names of Rear of CRT Control Station

7.3.12 Signal Cables

(1) List of Cables

Cables are listed in Table 7 10 Usually cables are to be prepared by the users, but the YASKAWA can provide them if desired Shown in Fig 7 5 are the connections between units with standard configuration and also cable names

Table 7 10 List of Cables

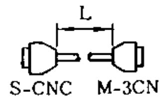
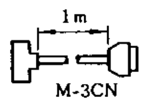
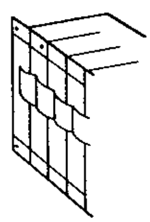
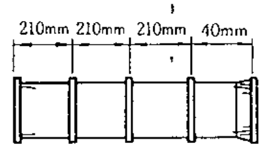
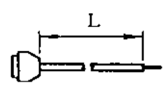
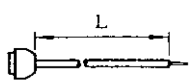
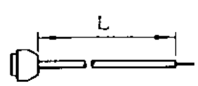
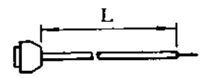
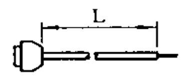
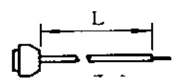
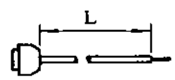
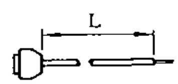
Cable Symbol	Application	Connector	Cable Type	Cable Specifications Supplied by Yaskawa
J1	Communication cable Control panel ↔ Motion module	MRP-20F/MR-20L	KQVV-SW 3P × AWG26	 Type JEFMC / L -W010 / 5m -W011 / 10m -W012 / 15m
J2	Communication cable Personal computer ↔ Motion module/ Micro PC module	MRP-20F/MR-20L DB-25P/DB-C2-JG	KQVV-SW 3P × AWG26	 Type JEFMC W020
J50	FA bus signal Rack-mounted type	FRC2 A020-10	20-core Flat cable	  Type JEFMC-W500 (For 1- to 3-axis)
J51	I/O signal Motion module ↔ Machine side I/O	MR-50M/MR-50L	KQVV-SB 50C × 0 2	 M-1CN Type JEFMC / L -W510 / 1m -W511 / 2m -W512 / 5m
J52	I/O signal Motion module ↔ Machine side I/O	MR-50F/MR-50L	KQVV-SB 50C × 0 2	 M-2CN Type JEFMC / L -W520 / 1m -W521 / 2m -W522 / 5m
J53	I/O signal Motion module ↔ Machine side I/O	MR 50F/MR-50L	KQVV-SB 50C × 0 2	 M-9CN Type JEFMC / L -W530 / 1m -W531 / 2m -W532 / 5

Table 7 10 List of Cables (Cont'd)

Cable Symbol	Application	Connector	Cable Type	Cable Specifications supplied by Yaskawa
J54	I/O signal Motion module ↔ Machine side I/O	MR 50F/MR-50L	KQVV SB 50C × 0 2	 M-10CN Type JEFMC / L: -W540 1m -W541 2m -W542 5m
J55	Specified I/O signal Motion module ↔ Machine side I/O	MR-16F/MR-16L	KQAA SB 20C × 0 2	 M-4CN Type JEFMC / L: -W550 1m -W551 2m -W552 5m
J56	Motion module for handle PG ↔ Handle PG	MRP-25F/MR-25L	KQVV-SB 10P × 0 2	 M-5CN Type JEFMC / L: -W560 1m -W561 2m -W562 5m
J57	Motion module for spindle PG ↔ Spindle position coder	MRP-25F/MR-25L	KQVV-SB 10P × 0 2	 M-7CN Type JEFMC / L: -W570 1m -W571 2m -W572 5m
J58	Motion module for D/A output ↔ Spindle D/A input	MR 8F/MR8L	KQVV-SW 3P × WG26	 M 8CN Type JEFMC / L: -W580 1m -W581 2m -W582 5m

(2) Cable Specifications

Signal lines of MOTIONPACK-120 should be connected with MR connectors Cables should be selected in accordance with Tables 7 11 and 7 12 Twisted cable should be KQVV-SB 10P × 0 2 mm^2 (or 3P × AWG26) shown in Table 7 13

Table 7 11- Cables

Cable \ Connector	MRP-50M/MR-50M MRP-50F/MR-50F	MRP-16F/MR-16F MRP-20F/MR-20F	MRP-25F/MR-25
Type	Crimp type/solder type	Crimp type/solder type	Crimp type/solder type
No of Cores	50 cores	20 cores	25 cores
Applicable Wire	AWG #24 to #28	AWG #24 to #28	AWG #24 to #26
Cutter Diameter	16 mm dia max	10 mm dia max	13 mm dia max
Recommended Cable	Plastic multi-core control cable		
	(Example) KQVV50C × 0 2 (0 2 mm^2, 50 cores) manufactured by Fujikura Ltd	(Example) KQVV20C × 0 2 (0 2 mm^2, 20 cores) manufactured by Fujikura Ltd	(Example) KQVV25C × 0 2 (0 2 mm^2, 25 cores) namufactured by Fujikura Ltd
	Cores 0 2 mm^2 tin-plated soft copper standard wires, 16/0 12(cores/mm) Insulating material Bridged vinyl Thickness 0 3 mm Funished outer dia 1 1mm		

Table 7 12 Dimensions of Cores

AWG	Sectional Area of Conductor mm^2	Standard Outer Dia of Vinyl Insulation mm
#24	0 21	1 5 ← Recommended
#26	0 13	1 3
#28	0 08	1 2

(2) Cable Specifications (Cont'd)

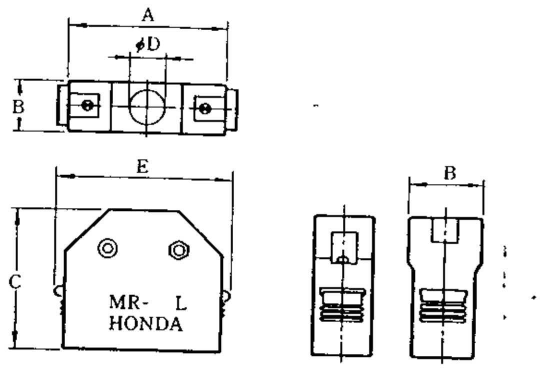
Table 7.13 Twisted Cables

Item		Unit	Specifications KQVV-SB
No. of Pairs		Pair	10
Conductor	Material	—	Tin-plated soft copper stranded wires
	Nominal Sectional Area	mm^2	0.2
	Configuration	Numbers/mm	16/0.12
	Outer Diameter	mm	0.55
Insulation	Material	—	Bridged vinyl
	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 Diameter		mm	10.0
Approx. Weight		kg/km	130

(3) Connector

(a) MR Connector (for Control Signal)

① Dimensions in mm



No of Cores	Type	A	B*	C	φ D	E*
8	MR- 8L	31 0	19	39 8	11	(36 6)
16	MR-16L	36 7	18	39 8	9	(45 3)
20	MR-20L	39 3	18	39 8	11	(47 9)
25	MR-25L	44 5	18	40 5	13 5	(53 1)
50	MR 50L	67 9	18	44 8	16	(76 5)

* Maximum value

Notes

1 Applicable cable outer dia
MR-16L, MR 20L, MR 25L – 10mm dia max
MR 50L – 16mm dia max

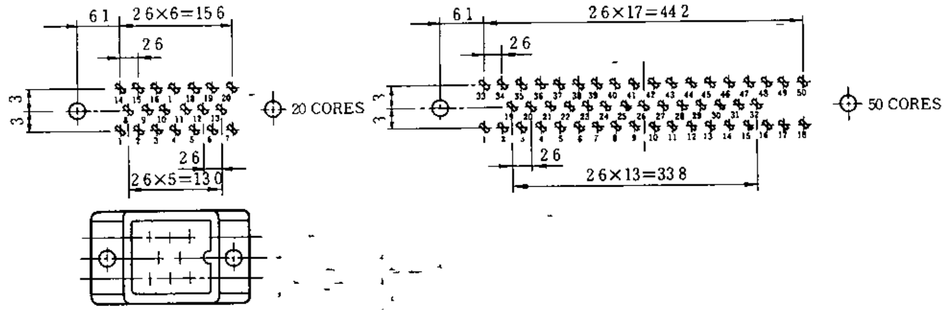
2 Special tools are necessary for crimp type For detailed information contact Honda Tsushin Co Ltd

3 Standard connector is soldering type

Fig 7 24 External Dimensions of Connector

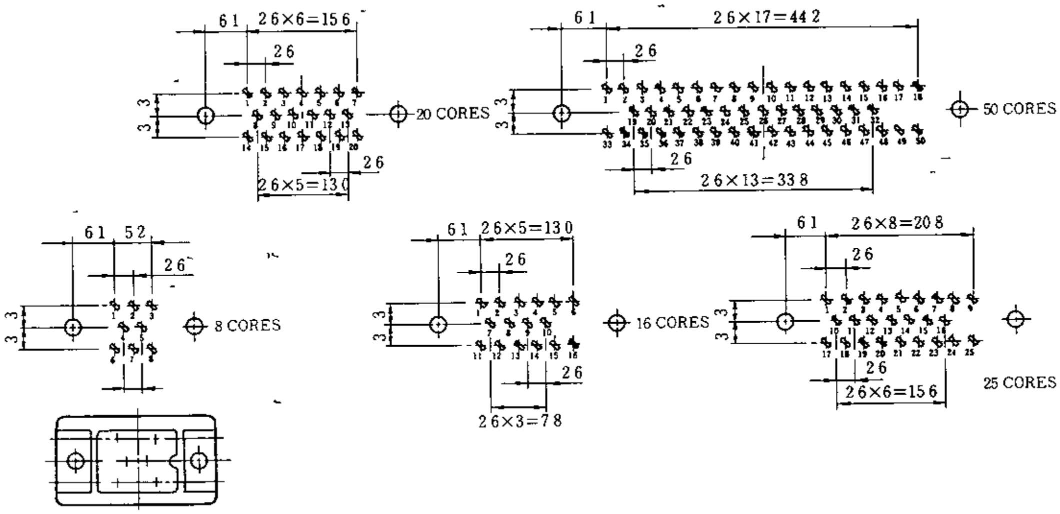
② Connector terminal (pin) number

• Type MR-□M



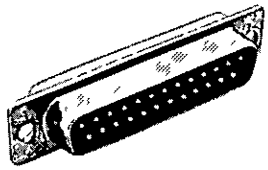
Note Figure above is viewed from wiring side of the connector

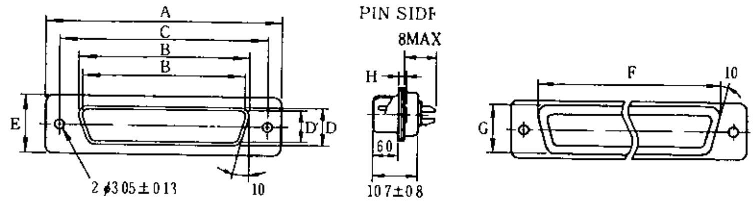
• Type MR-□F



Note Figure above is viewed from wiring side of the connector

(b) D-SUB Connector (for RS232C)





No of Cores	Type	A ±0 5	B ±0 25	B′ ±0 25	C ±0 13	D ±0 25	D′ ±0 25	E ±0 5	F ±0 4	G ±0 4	H ±0 4	K ±0 25
25	DB-25P-N	53 0	—	39 01	47 04	—	8 40	12 6	41 3	10 7	1 5	3 23

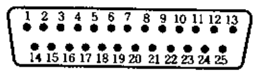
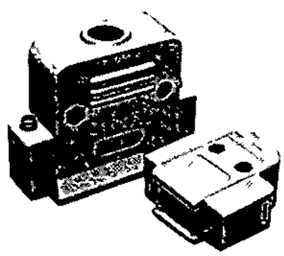
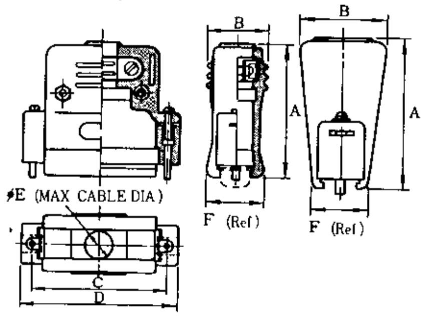


Figure viewed from connection side

(c) Junction Shell





Shell	Type	A ±1	B ±1	C ±0 25	D ±1	ϕE	F (Ref)
DB	DB-C2-J9-S3	46	21	47 04	55	10	20

7.4 WIRING PRECAUTIONS

7.4.1 Prevention of Interference between Wires

In the MOTIONPACK-120 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 7 14

Table 7 14 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 (m s) • Wiring for regenerative resistance units • Wiring for MOTIONPACK and input wires of AC power supply	• Wiring between PG, TG and SERVOPACK • Wiring between SERVOPACK and motion modules • Wiring between CRT control station and motion module • Wiring between personal computer and motion module • Wiring between motion module and position coder • Wiring between manual pulse generator and motion module • Wiring between motion module and inverter drive	• I/O signal

7.4.2 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)

7.4.3 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 filters
- 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

7.4.4 Grounding Method

One-point grounding (100Ω or less) should be made using wires larger than 3 5 mm² If the servomotor is to be insulated from machine, be sure to ground the motor Fig 7 25 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 gro unding (100Ω or less) from there

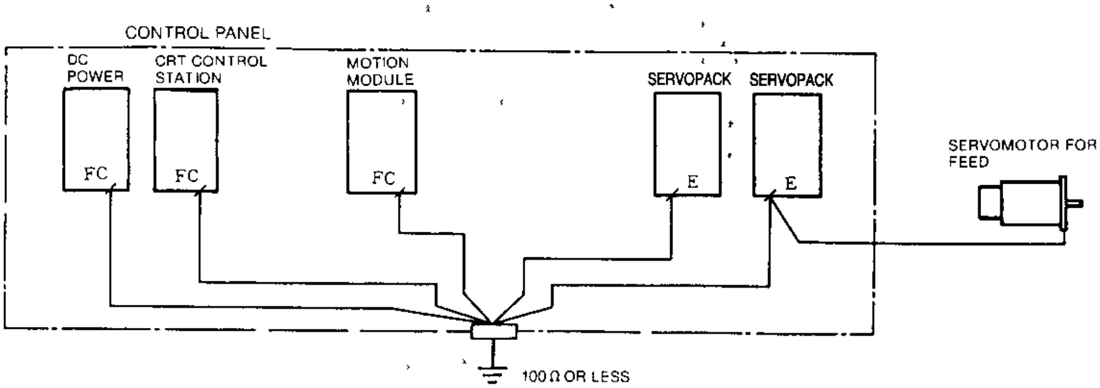


Fig 7 25 Grounding Method

7.4.4 Grounding Method (Cont'd)

• Motor frame grounding

When the motor is grounded via the frame of the load machine, Cf dv/dt current flows from the PWM power section through the motor stray capacitance (Cf) Be sure to ground the motor E terminal (motor frame) to the grounding pin (⏚)of the SERVOPACK to prevent influence of this current (The grounding pin (⏚) of the SERVOPACK must be grounded directly)

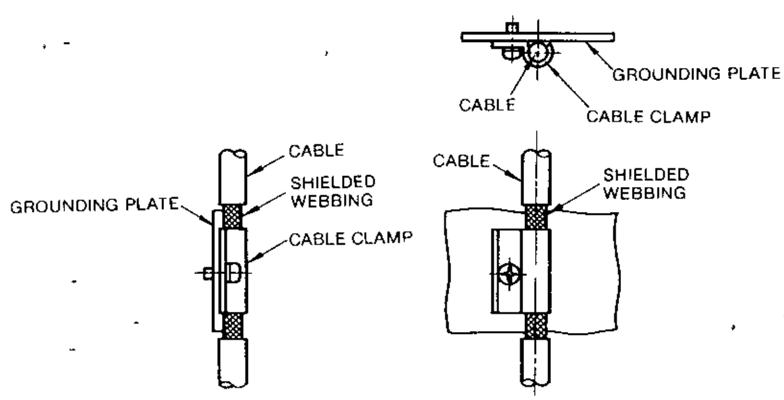
• SERVOPACK SG 0V

If noise inferferes with the input signal line, ground SG 0V If the motor cables are run in a metal conduit, be sure to ground the conduit and box

All the above grounding is accomplished by one-point grounding

7.4.5 Fastening Cables

Be sure to tighten the lock screws on the MR connectors for the signal cables Be sure to use cable clamps to relieve the connector from weight and tension on the cable Fig 7 26 shows a secure clamp To ground the shieldings to the frame ground (FG) efficiently, remove the webbing of the shielded cable



Note The cable webbing need not be removed to clamp an unshielded cable

Fig 7 26 Cable Clamp

SECTION 8

CONTENTS

8. SETTING AND INDICATIONS FOR MODULES

8.1 MOTION MODULE SYSTEM SETTING

Before using the MOTIONPACK, set the system switch (1SW) of the motion module to 0 If the swtich is set to other than 0, the motion module enters the test mode and does not function normally The switch is preset to 0 at the factory If the switch is set to other than 0, reset it

Fig 8 1 shows the system switch setting Use a Phillips screwdriver through the hole of 1SW on the front of the motion module

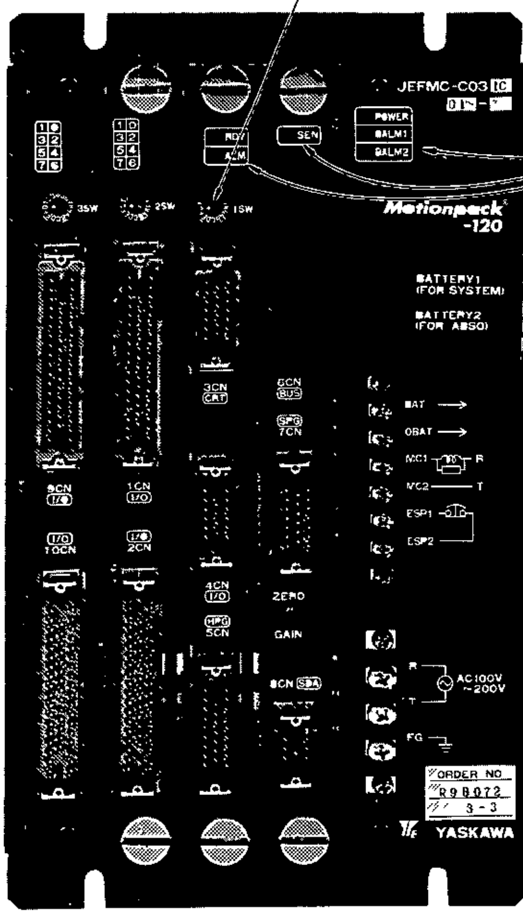


Fig 8 1 Motion Module

8.2 MOTION MODULE INDICATIONS

(1) Input Signal Monitor Indication

Whether input signals are incoming normally to the motion module input connectors (1CN, 2CN, and 9CN) can be checked by viewing the indications

Eitht lamps are provided above each of 2SW and 3SW

Combinations of the lamps and the indication select switches (2SW and 3SW) allow the operator to check input signals at 112 points Each lamp goes on and off as the corresponding input signal is turned on and off

Fig 8 2 shows the indication lamps and indication select switches Tables 8 1 and 8 2 list the indicated input signals

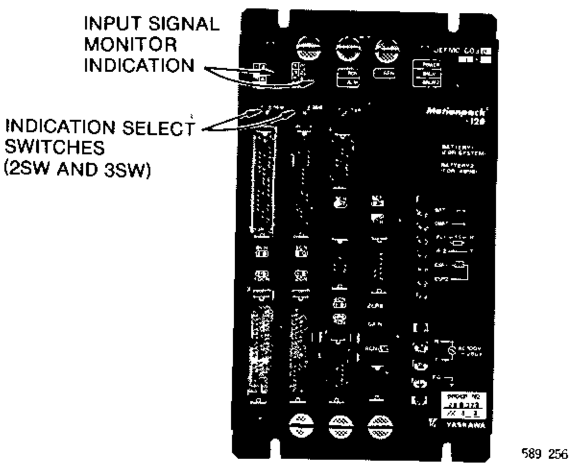


Fig 8 2 Indications on Motion Module

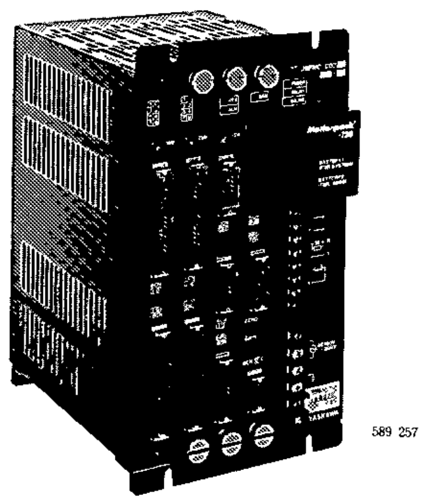


Fig 8 3 Checking Input Signals

Table 8 1 Input Signal Indications

2SW Select No \ Indicator	D7	D6	D5	D4	D3	D2	D1	D0
0	1CN 36	1CN-20	1CN-4	1CN-35	1CN-19	1CN-3	1CN-34	1CN-2
	#42007	#42006	#42005	#42004	#42003	#42002	#42001	#42000
	(EDIT)	(MEM)	(DNC)	(MDI)	(STEP)	(HANDLE)	(JOG)	(RAPID)
1	1CN 23	1CN 7	1CN-38	1CN-22	1CN-6	1CN-37	1CN-21	1CN 5
	#42017	#42016	#42015	#42014	#42013	#42012	#42011	#42010
	(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
	#42027	#42026	#42025	#42024	#42023	#42022	#42021	#42020
	(RESET)	(SVOK)	(MRDY)	—	(JOV8)	(JOV4)	(JOV2)	(JOV1)
3	1CN-44	1CN-28	1CN-12	1CN-43	1CN-27	1CN 11	1CN-42	1CN-26
	#42037	#42036	#42035	#42034	#42033	#42032	#42031	#42030
	(RRN)	(— JZ)	(— JY)	(— JX)	(FRN)	(+ JZ)	(+ JY)	(+ JX)
4	1CN-31	1CN-15	1CN 46	1CN-30	1CN-14	1CN-45	1CN 29	1CN-13
	#42047	#42046	#42045	#42044	#42043	#42042	#42041	#42040
	(SSTP)	(GR2)	(GR1)	(MP2)	(MP1)	(HZ)	(HY)	(HX)
5	1CN-50	1CN-18	1CN 49	1CN-17	1CN-48	1CN 32	1CN-16	1CN-47
	#42057	#42056	#42055	#42054	#42053	#42052	#42051	#42050
	(ZPNT)	(MLK)	(FIN)	(ZRN)	(STP)	(STR)	(ER)	(SBK)
6	2CN-36	2CN-20	2CN 4	2CN-35	2CN-19	2CN-3	2CN-34	2CN-2
	#42067	#42066	#42065	#42064	#42063	#42062	#42061	#42060
	(W28)	(W24)	(W22)	(W21)	(W18)	(W14)	(W12)	(W11)
7	2CN-36	2CN 7	2CN-38	2CN 22	2CN-6	2CN-37	2CN 21	2CN 5
	#42077	#42076	#42075	#42074	#42073	#42072	#42071	#42070
	(SK8)	(SK7)	(SK6)	(SK5)	(SK4)	(SK3)	(SK2)	(SK1)

Table 8 2 Input Signal Indications (3SW)

2SW Select No \ Indicator	D7	D6	D5	D4	D3	D2	D1	D0
0	9CN-36	9CN-20	9CN-4	9CN-35	9CN-19	9CN-3	9CN-34	9CN-2
	#42087	#42086	#42085	#42084	#42083	#42082	#42081	#42080
	(SLPC)	(SFIN)	(GR0)	—	—	—	(PRGP)	(PRMP)
1	9CN 23	9CN 7	9CN-38	9CN-22	9CN 6	9CN-37	9CN-21	9CN-5
	#42097	#42096	#42095	#42094	#42093	#42092	#42091	#42090
	(PMEM)	(NEG)	(TBXON)	(EINV)	(RSTB)	($\overline{\text{STOPB}}$)	(RSTA)	($\overline{\text{STOPA}}$)
2	9CN-10	9CN-41	9CN-25	9CN-9	9CN-40	9CN-24	9CN-8	9CN-39
	#42107	#42106	#42105	#42104	#42103	#42102	#42101	#42100
	(ASVOK)	(ZRNA)	(−JA)	(+JA)	(ZPNA)	(DIRA)	($\overline{\text{INC}}$/ABSA)	(STRA)
3	9CN-44	9CN-28	9CN-12	9CN-43	CN-27	9CN-11	9CN-42	9CN-26
	#42117	#42116	#42115	#42114	#42113	#42112	#42111	#42110
	(HA7)	(HA6)	(HA5)	(HA4)	(HA3)	(HA2)	(HA1)	(HA0)
4	9CN-31	9CN-15	9CN-46	9CN 30	9CN-14	9CN-45	9CN-29	9CN-13
	#42127	#42126	#42125	#42124	#42123	#42122	#42121	#41210
	(BSVOK)	(ZRNB)	(−JB)	(+JB)	(ZPNB)	(DIRB)	($\overline{\text{INC}}$/ABSB)	(STRB)
5	9CN-50	9CN-18	9CN-49	9CN 17	9CN-48	9CN-32	9CN-16	9CN-47
	#42137	#42136	#42135	#42134	#42133	#42132	#42131	#42130
	(HB7)	(HB6)	(HB5)	(HB4)	(HB3)	(HB2)	(HB1)	(HB0)

Note Description in column

← CONNECTOR PIN NO
← I/O ADDRESS
← ALLOCATED SIGNAL NAME

(2) Status Indications

Motion module is provided with 6-status indication lamps on its face plate

Table 8.3 Status Indications

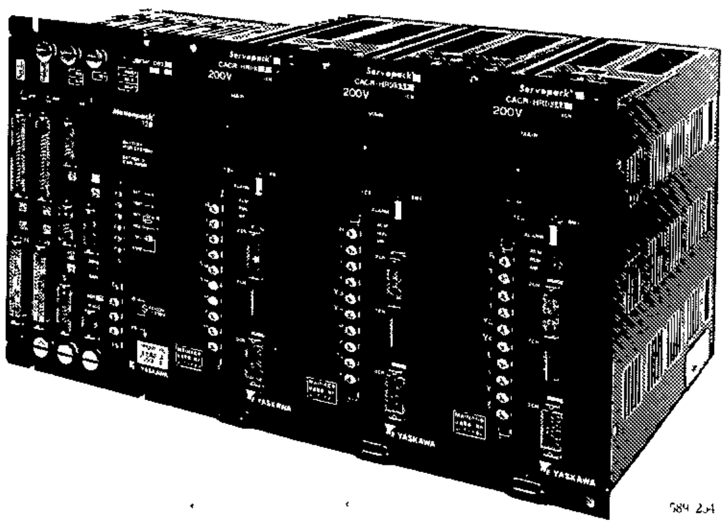
Signal aname	Contents	Lamp ON	Lamp OFF	Corrective Actions
ALM (Alarm) Ⓡ	Motion module alarm	Alarm	Normal	Remove alarm See Alarm List
RDY (Ready) Ⓖ	Motion module ready	Operation	Trouble	Replace the motion module
SEN (Transmission) Ⓖ	During transmission in FA bus	Operation	Trouble	Replace the motion module
POWER (Power) Ⓖ	Controller power ON	ON	OFF	Replace the motion module
BALM1 (Battery Alarm1) Ⓡ	Voltage drop of system back-up battery	Alarm	Normal	Replace the battery
BALM2 (Battery Alarm2) Ⓡ	Voltage drop of absolute encoder back-up battery	Alarm	Normal	Replace the battery

Note Ⓡ Red lamp
Ⓖ Green lamp

8.3 SETTING ADDRESSES FOR SERVOPACKs (AXIS SETTING)

Data are transferred between the motion module and SERVOPACKS via the FA bus The SERVOPACKS must be assigned to bus addresses so as to identify SERVOPACK-related signals for individual axes

The axis select switch (SW1) is used for axis specification, that is, address specification for a SERVOPACK Fig 8 4 shows the relationship between axis names and axis select switch (SW1) settings (Do not set positions other than 1 to 3)



Specified Axis	SW1 Setting
SERVOPACK X-axis	"1"
SERVOPACK Y-axis	"2"
SERVOPACK Z-axis	"3"

Fig 8 4

8.4 SERVOPACK INDICATIONS

The SERVOPACK indicates its internal status and alarms with four LEDs and an 8-segment LED

Table 8 4 LED Indications

Type of Indication	Name	Description
Alarm	ALM	Lights when an alarm occurs
Communication	RUN	Lights when the FA bus communication is normal
Power	MP	Lights when main power is turned on normally
	MAIN	Lights when capacitor is charged with voltage

Table 8.5 SERVOPACK 8-Segment LEDs and MOTIONPACK Alarm Codes

Indication	Contents	MOTIONPACK Alarm Codes
	Base-block relased (Power supply to motor is ON)	
-	Base blocked (Power supply to motor is OFF)	Alarm 51
_	FA bus communication wait	
0	Absolute error	Alarm 348, 448, 548
1	Overcurrent	Alarm 349, 449, 549
2	Circuit protector tripped	Alarm 350, 450, 550
3	Regenerative trouble	Alarm 351, 451, 551
4	Overvoltage	Alarm 352, 452, 552
5	Overspeed	Alarm 353, 453, 553
6	Undervoltage	Alarm 354, 454, 554
7	Overload	Alarm 355, 455, 555
8	Position error	Alarm 356, 456, 556
C	PG line disconnection	Alarm 359, 459, 559
F	Open pahse	Alarm 363, 463, 563
H	DSP trouble	Alarm 361, 461, 561
J	Servo tracking error	Alarm 315, 415, 515
L	Overrun prevention	Alarm 360, 460, 560
P	Positive overtravel	Alarm 310, 410, 510
n	Negative overtravel	Alarm 311, 411, 511
E	System error	Alarm 302, 402, 502 Alarm 304, 404, 504 Alarm 307, 407, 507 Alarm 308, 408, 508 Alarm 332, 432, 532 Alarm 333, 433, 533 Alarm 334, 434, 534
OFF	CPU error, control power defect	

SECTION 9

CONTENTS

9. TEST RUN

9.1 TEST RUN METHOD

Outline of the test run method for the MOTIONPACK-120 is as shown in the flow chart of Fig 9 1 Contents of each item are explained below

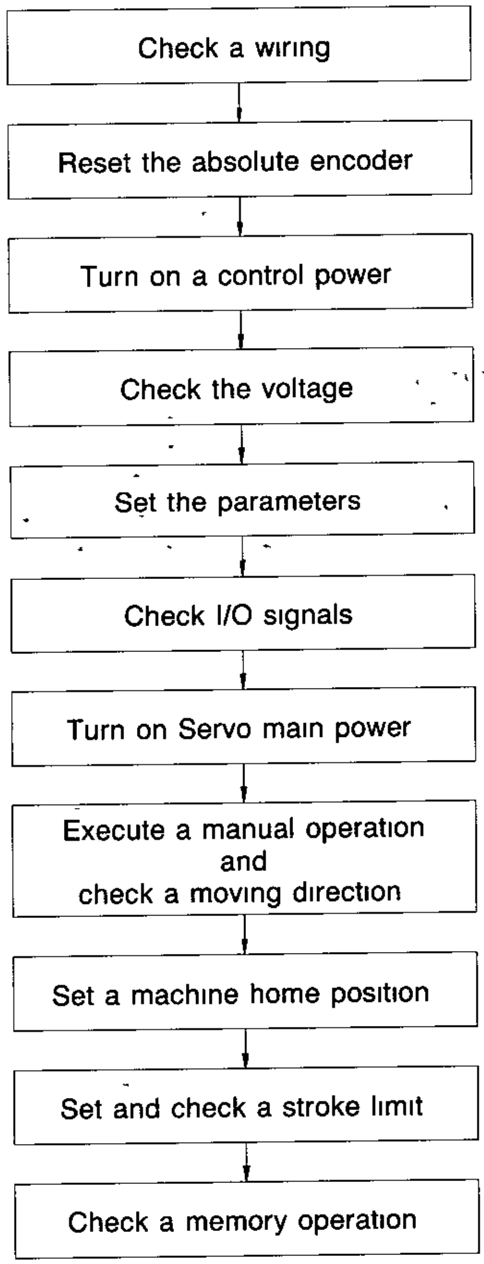


Fig 9 1 Flow Chart of Test Run Method

9.1.1 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

9.1.2 Resetting Encoder

The absolute encoder must detect motor rotation even when power is off For this purpose, the encoder is backed up by its large built-in capacitor and the motion module by a built-in battery To connect the battery, connect the battery output from terminal (2TM) of the motion module to the encoder via the SERVOPACK

There may be an indeterminate level of residual voltage in the built-in capacitor in the encoder that could disrupt the encoder operation Before trial run, to prevent this, reset the encoder by the following procedure

1 Connect pins R and S of the encoder for 2 minutes or longer
2 Connect the cables properly, then connect the battery to the encoder
3 Start up the control power as explained in Par 9 1 3 If an alarm occurs in the SERVOPACK, restart from step 1

NOTE

1 The number of motor revolution is reset to 0 when the encoder is reset
2 If the system needs to be set up with the motor installed in the load machine and not in contact with the encoder connectors, set the PG cable as shown in Fig 9 2, disconnect 2CN of the SERVOPACK, and connect the wires on the end to the SERVOPACK connector

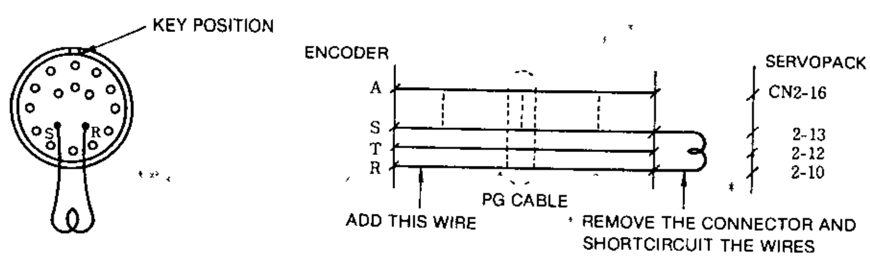


Fig 9 2

After resetting the encoder, be careful to remove or connect the connectors so as not to remove the battery when the capacitor is not charaged

9.1.3 Turning Control Power ON

Because parameters are not set by this time, turning on the servo main power together with the control power may cause servo system error such as motor vibration

After checking wiring and resetting the encoder, disconnect the emergency input of 2TM of the motion module to block the servo main power, then turn on the control power

Fig 9 3 shows display on the Control Station after the control power is turned on

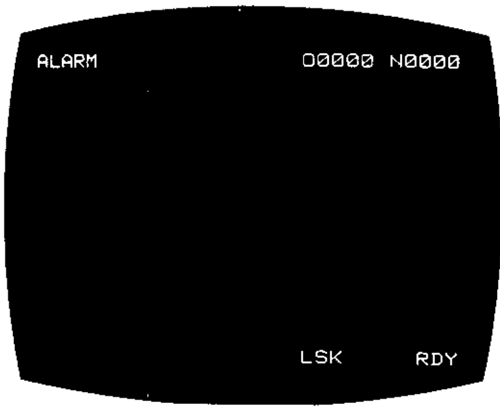


Fig 9 3

If nothing appears on the Control Station, check the wiring between the Control Station and the modules Also check the power circuit of the Control Station Make sure to turn on power to the Control Station and the motion module at the same time

If alarm 0 is displayed on the 8-segment LED of the SERVOPACK, check the wiring and reset the encoder again In checking wiring, take extra care for the SERVOPACK and encoder wiring

9.1.4 Voltage Check

After turning on the power for the system, make sure that the voltage is normal at the following points

(1) Main power supply voltage 200/220 VAC ±10 % or 100/110 VAC ±10 %

(2) Control power supply voltage 200/220 VAC ±10 %, 100/110 VAC ±10 %

(3) I/O power supply voltage 24 VDC ±10 %

(4) Servo power supply voltage Varies depending on the model of SERVOPACK Refer to bulletins for SERVOPACK

9.1.5 Setting Parameters

Parameters are important data that introduce system specifications into the controller Therefore, parameters must be set before operation If there are invalid or omitted parameters, the system fails to function normally Parameters are set on the Control Station If already prepared parameter data are on a personal computer, the data can be passed to the system by file transfer protocol parameters which are set from the Control Station

Fig 9 4 shows procedure for setting parameters from the Control Station

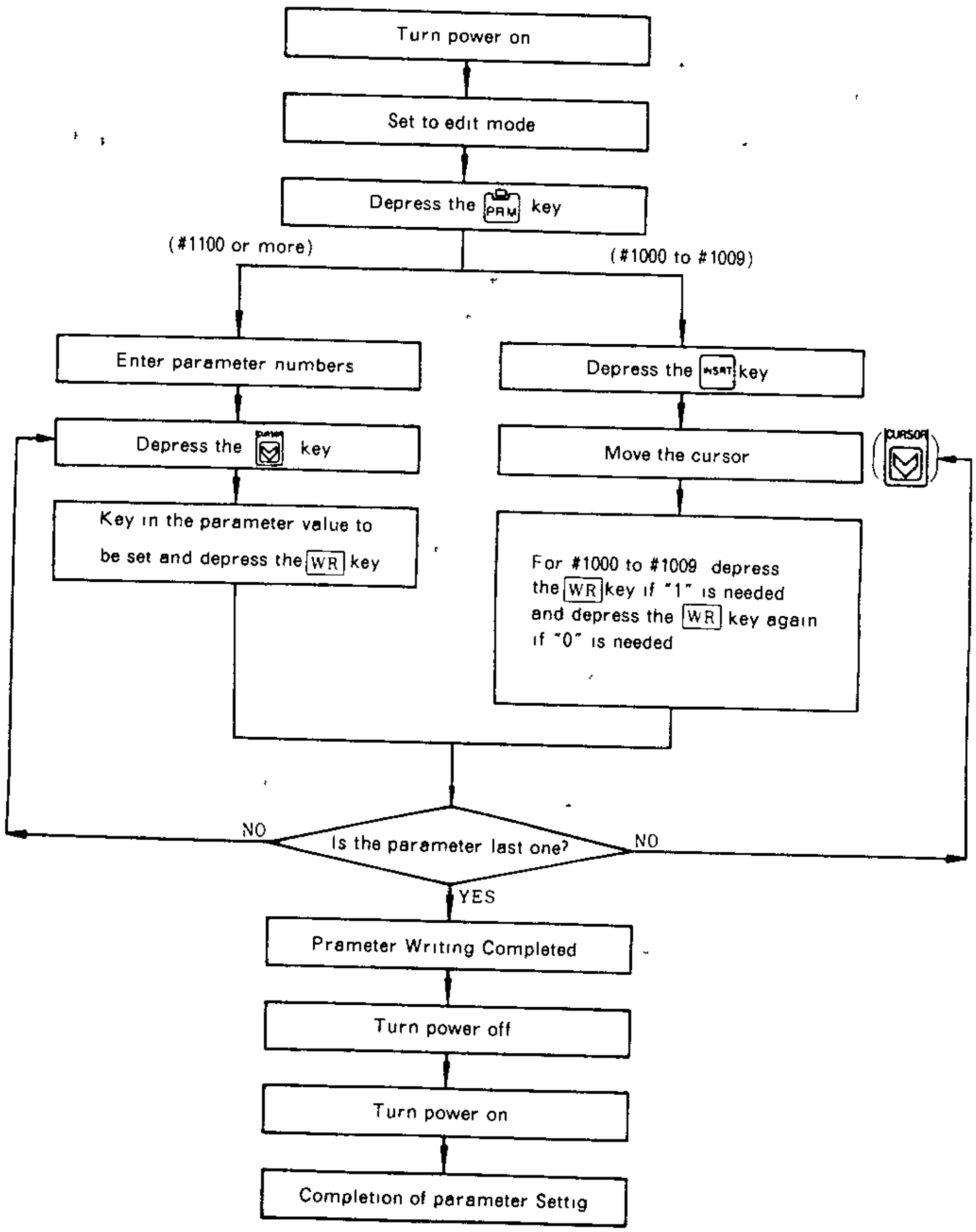


Fig 9 4 Parameter Setting Procedure Using CRT Control Station

After setting parameters, turn the control power to ON and OFF to set exactl parameters

9.1.6 Input Signal Check

Check whether normal input signal are present at the input connectors (1CN, 2CN, 4CN, 9CN) 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 8 2 "MOTION MODULE INDICATIONS"

(2) Check on the CRT of control station

To check input signals on the CRT of the Control Station, observe the flowchart in Fig 9 5 For the signal addresses on the diagnostic screen, see Par 9 1 7 "I/O Diagnosis Number List" To check the signals on the screen of the Control Station, servopack input signals can also be checked at diagnostic screen addresses of #6000 Also check the input signals to the SERVOPACK, such as overtravel input

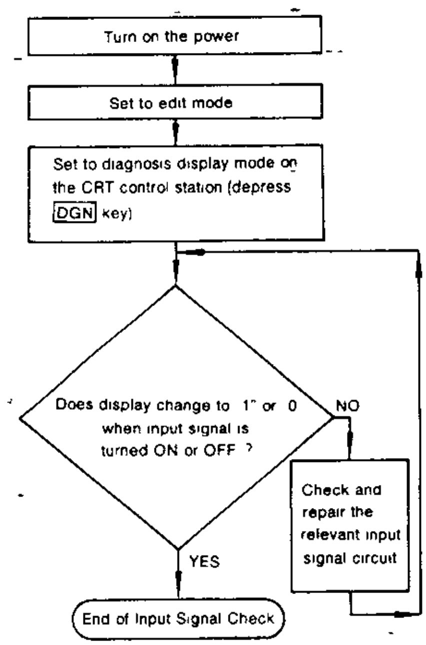


Fig 9 5 Checking of Input Signals

9.1.7 I/O Diagnosis Number List

(1) Control Fixed Input of Motion Module

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4000	EDIT	MEM	DNC	MDI	STEP	HANDLE	JOG	RAPID
#4001	ROV 3	ROV 2	ROV 1	OV 16	OV 8	OV 4	OV 2	OV 1
#4002					JOV 8	JOV 4	JOV 2	JOV 1
#4003						+ JZ	+ JY	+ JX
#4004						− JZ	− JY	− JX
#4005						HZ	HY	HX
#4006	PRGP	PRMP	MP 2	MP 1	ZRN		$\overline{\text{STP}}$	STR
#4007		MLK	ZPNT	EINV	NEG		PMEM	SBK
#4008	SK 8	SK 7	SK 6	SK 5	SK 4	SK 3	SK 2	SK 1
#4009		GR 2	GR 1	GR 0	SLPC	SSTP	FRN	RRN

ADDRESS	D7	D6	D5	D4	D3	D2	D1	D0
#4010	SFIN	FIN	TBXON		RESET	(W 99)		MRDY
#4011								
#4012								
#4013								
#4014								
#4015				ER	(BATALM3)			SVOK
#4016	W 28	W 24	W 22	W 21	W 18	W 14	W 12	W 11
#4017								

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
#4020	ASVOK	ZRNA	−JA	+JA	ZPNA	DIRA	$\overline{\text{INC}}$/ABSA	STRA	A
									A
#4021	HA 7	HA 6	HA 5	HA 4	HA 3	HA 2	HA 1	HA 0	A
									A
#4022	BSVOK	ZRNB	−JB	+JB	ZPNB	DIRB	$\overline{\text{INC}}$/ABSB	STRB	B
									B
#4023	HB 7	HB 6	HB 5	HB 4	HB 3	HB 2	HB 1	HB 0	B
									B
#4024					RSTB	$\overline{\text{STOPB}}$	RSTA	$\overline{\text{STOPA}}$	
#4025									
#4026									
#4027									
#4028									
#4029									

Note Signal name in ( ) is not specified at standard I/O allocation

(2) Control Fixed Output of Motion Module

ADDRESS	D7	D6	D5	D4	D3	D2	D1	D0
#4500	M30	M02		M00	DEN	OP	SPL	STL
#4501	BATALM			SVON	MCRD	(ESP)	RST	ALM
#4502						TF	SF	MF
#4503						ZPZ	ZPY	ZPX
#4504				GRH	GRL	SLPS	G93M	
#4505	M28	M24	M22	M21	M18	M14	M12	M11
#4506	T28	T24	T22	T21	T18	T14	T12	T11
#4507	AC7	AC6	AC5	AC4	AC3	AC2	AC1	AC0
#4508							AC9	AC8
#4509	SVONB	ZPB	ALMB	MOVB	SVONA	ZPA	ALMA	MOVA

Note Signal name in ( ) is not specified at standard I/O allocation

(3) Input Signal of Motion Module 1CN, 2CN

Indication in top column Signal name specified at standard I/O allocation
Indication in bottom column Connector pin No

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4200	EDIT	MEM	DNC	MDI	STEP	HANDLE	JOG	RAPID
	1 CN - 36	1 CN - 20	1 CN - 4	1 CN - 35	1 CN - 19	1 CN - 3	1 CN - 34	1 CN - 2
#4201	ROV 3	ROV 2	ROV 1	OV 16	OV 8	OV 4	OV 2	OV 1
	1 CN - 23	1 CN - 7	1 CN - 38	1 CN - 22	1 CN - 6	1 CN - 37	1 CN - 21	1 CN - 5
#4202	RESET	SVOK	MRDY		JOV 8	JOV 4	JOV 2	JOV 1
	1 CN - 10	1 CN - 41	1 CN - 25	1 CN - 9	1 CN - 40	1 CN - 24	1 CN - 8	1 CN - 39
#4203	RRN	− JZ	− JY	− JX	FRN	+ JZ	+ JY	+ JX
	1 CN - 44	1 CN - 28	1 CN - 12	1 CN - 43	1 CN - 27	1 CN - 11	1 CN - 42	1 CN - 26
#4204	SSTP	GR 2	GR 1	MP 2	MP 1	HZ	HY	HX
	1 CN - 31	1 CN - 15	1 CN - 46	1 CN - 30	1 CN - 14	1 CN - 45	1 CN - 29	1 CN - 13
#4205	ZPNT	MLK	FIN	ZRN	$\overline{\text{STP}}$	STR	ER	SBK
	1 CN - 50	1 CN - 18	1 CN - 49	1 CN - 17	1 CN - 48	1 CN - 32	1 CN - 16	1 CN - 47
#4206	W 28	W 24	W 22	W 21	W 18	W 14	W 12	W 11
	2 CN - 36	2 CN - 20	2 CN - 4	2 CN - 35	2 CN - 19	2 CN - 3	2 CN - 34	2 CN - 2
#4207	SK 8	SK 7	SK 6	SK 5	SK 4	SK 3	SK 2	SK 1
	2 CN - 23	2 CN - 7	2 CN - 38	2 CN - 22	2 CN - 6	2 CN - 37	2 CN - 21	2 CN - 5

(4) Output Signal of Motion Module 2CN

Indication in top column Signal name specified at standard I/O allocation

Indication in bottom column Connector pin No

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4300	M 30	M 02	SVON	M 00	DEN	OP	SPL	STL
	2 CN - 10	2 CN - 41	2 CN - 25	2 CN - 9	2 CN - 40	2 CN - 24	2 CN - 8	2 CN - 39
#4301	ALM	ZPZ	ZPY	ZPX	RST	SF	TF	MF
	2 CN - 44	2 CN - 28	2 CN - 12	2 CN - 43	2 CN - 27	2 CN - 11	2 CN - 42	2 CN - 26
#4302	M 28	M 24	M 22	M 21	M 18	M 14	M 12	M 11
	2 CN - 31	2 CN - 15	2 CN - 46	2 CN - 30	2 CN 14	2 CN - 45	2 CN - 29	2 CN - 13
#4303	T 28	T 24	T 22	T 21	T 18	T 14	T 12	T 11
	2 CN - 50	2 CN - 18	2 CN - 49	2 CN 17	2 CN - 48	2 CN - 32	2 CN - 16	2 CN - 47

(5) Output Signal of Motion Module 9CN

Indication in top column   Signal name specified at standard I/O allocation
Indication in bottom column   Connector pin No

ADDRESS	D7	D6	D5	D4	D3	D2	D1	D0
#4208	SLPC	S-FIN	GR0				PRGP	PRMP
	9CN-36	9CN-20	9CN-4	9CN-35	9CN-19	9CN-3	9CN-34	9CN-2
#4209	PMEM	NEG	TBXON	EINV	RSTB	$\overline{\text{STOPB}}$	RSTA	$\overline{\text{STOPA}}$
	9CN-23	9CN-7	9CN-38	9CN-22	9CN-6	9CN-37	9CN-21	9CN-5
#4210	ASVOK	ZRNA	−JA	+JA	ZPNA	DIRA	$\overline{\text{INC}}$/ABSA	STRA
	9CN-10	9CN-41	9CN-25	9CN-9	9CN-40	9CN-24	9CN-8	9CN-39
#4211	HA7	HA6	HA5	HA4	HA3	HA2	HA1	HA0
	9CN-44	9CN-28	9CN-12	9CN-43	9CN-27	9CN-11	9CN-42	9CN-26
#4212	BSVOK	ZRNB	−JB	+JB	ZPNB	DIRB	$\overline{\text{INC}}$/ABSB	STRB
	9CN-31	9CN-15	9CN-46	9CN-30	9CN-14	9CN-45	9CN-29	9CN-13
#4213	HB7	HB6	HB5	HB4	HB3	HB2	HB1	HB0
	9CN-50	9CN-18	9CN-49	9CN-17	9CN-48	9CN-32	9CN-16	9CN-47

(6) Output Signal of Motion Module 10CN

Indication in top column Signal name specified at standard I/O allocation
Indication in bottom column Connector, pin No

ADDRESS	D7	D6	D5	D4	D3	D2	D1	D0
#4304	GRH	GRL	SLPS	G93M		BATALM	MCRD	
	10CN-36	10CN-20	10CN-4	10CN-35	10CN-19	10CN-3	10CN-34	10CN-2
#4305	AC7	AC6	AC5	AC4	AC3	AC2	AC1	AC0
	10CN-23	10CN-7	10CN-38	10CN-22	10CN-6	10CN-37	10CN-21	10CN-5
#4306							AC9	AC8
	10CN-10	10CN-41	10CN-25	10CN-9	10CN-40	10CN-24	10CN-8	10CN-39
#4307	SVONB	ZPB	ALMB	MOVB	SVONA	ZPA	ALMA	MOVA
	10CN-44	10CN-28	10CN-12	10CN-43	10CN-27	10CN-11	10CN-42	10CN-26
#4308								
	10CN-31	10CN-15	10CN-46	10CN-30	10CN-14	10CN-45	10CN-29	10CN-13
#4309								
	10CN-50	10CN-18	10CN-49	10CN-17	10CN-48	10CN-32	10CN-16	10CN-47

SERVOPACK I/O Monitor

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
#6000	SKIP			$\overline{\text{DEC}}$	PCON		$\overline{\text{OT - R}}$	$\overline{\text{OT - F}}$	X
#6001	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T - LIM	S - LIM	PRDY	PC	PB	PA	
#6002	SKIP			$\overline{\text{DEC}}$	PCON		$\overline{\text{OT - R}}$	$\overline{\text{OT - F}}$	Y
#6003	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T - LIM	S - LIM	PRDY	PC	PB	PA	
#6004	SKIP			$\overline{\text{DEC}}$	PCON		$\overline{\text{OT - R}}$	$\overline{\text{OT - F}}$	Z
#6005	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T - LIM	S - LIM	PRDY	PC	PB	PA	
#6006				$\overline{\text{DEC}}$	PCON		$\overline{\text{OT - R}}$	$\overline{\text{OT - F}}$	A
#6007	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T - LIM	S - LIM	PRDY	PC	PB	PA	
#6008				$\overline{\text{DEC}}$	PCON		$\overline{\text{OT - R}}$	$\overline{\text{OT - F}}$	B
#6009	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T - LIM	S - LIM	PRDY	PC	PB	PA	

9.1.8 Turning Servo Main Power

After setting parameters in compliance with the system specifications, turn on the servo main power Reset the emergency stop input of 2TM of the motion module that was disconnected at control power-on and parameter setting, then turn on control power Provided the I/O input signals such as SVOK are properly connected, about five seconds after turning on the control power, contact signals MC1 and MC2 of motion module 2TM come on, and the servo main power is turned on

To turn on power to equipment, watch the machine carefully If the machine overruns when the servo main power is turned on, immediately shut off the power Overrun results from any of the following Check wiring and parameters again

- Improper wiring of motor
- Improper wiring in encoder
- Improper setting of system parameters

When no alarm occurs and the motor is servo-locked (or the machine stops), it is assumed that wiring to the motor and the encoder is proper

9.1.9 Manual Operation and Confirmation of Moving Direction

Operate the system manually and confirm the operation

Procedure of Manual Operation (Jog Operation)

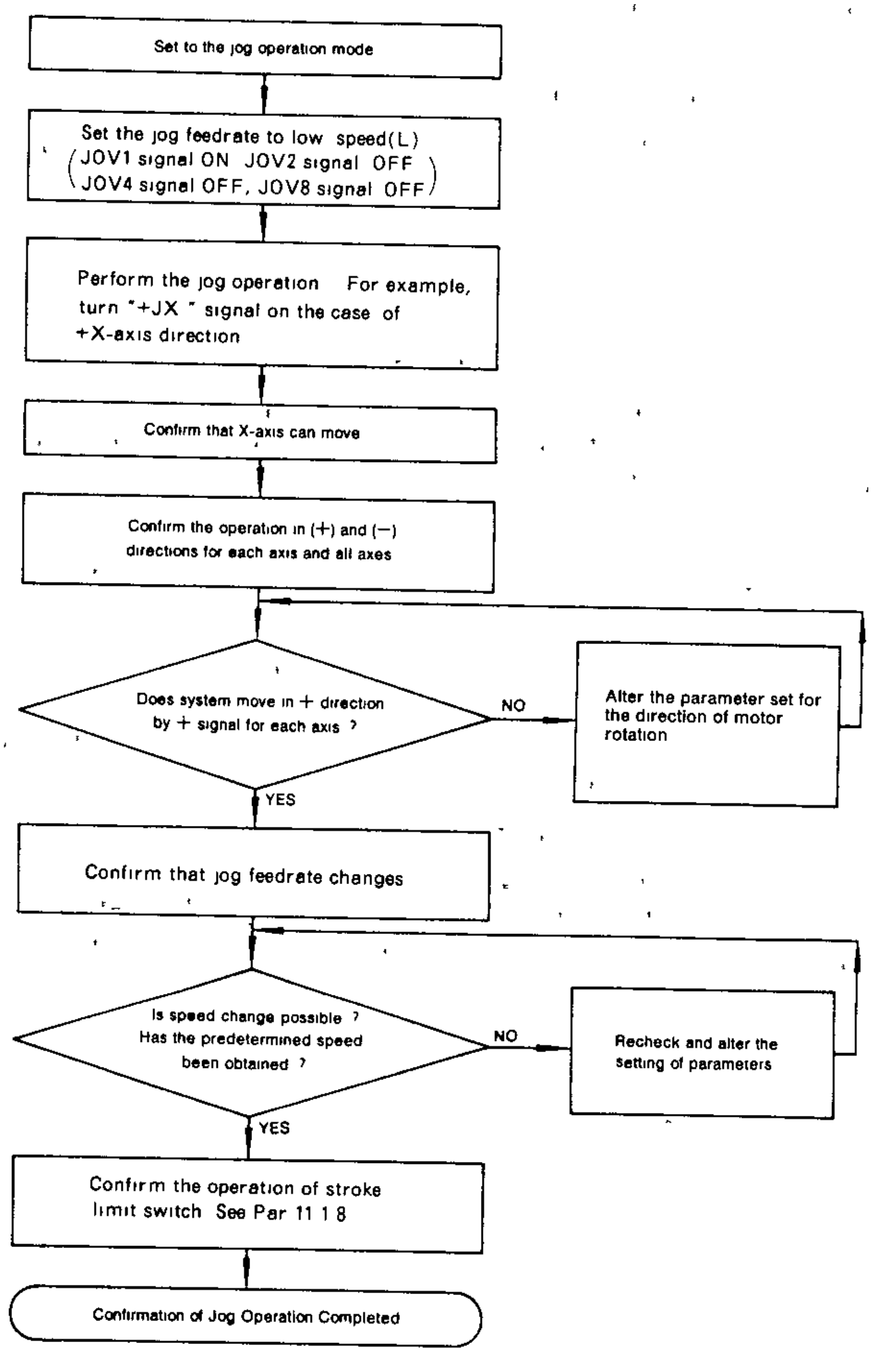


Fig 9 6 Procedure of Manual Operation (Jog Operation)

9.1.10 Setting Machine Home Position

Even for a system with an absolute encoder, a reference point for the load machine position must be input to the controller once at setup. This is performed in MOTION-PACK as follows. The load machine is positioned to the home position, then the position is input to the system as absolute zero by I/O signals.

Positioning the machine to the home position can be accomplished by two methods.

(1) Positioning using Limit Switch

If a limit switch for home positioning is provided on the load machine, positioning can be made by manual operation. In this method, the machine-reference point is determined using the limit switch, encoder zero-point pulse (C-phase pulse), and movements set for parameters.

(Procedure)

1. Setting necessary parameters to return to zero.

   Set all parameters related to home positioning, such as the home-positioning direction and home positioning length of travel. Then turn on and off power to the MOTIONPACK to make the parameters effective.

2. Setting return-to-home position mode

   Turn on input signal ZRN to set the return-to-home position mode.

3. Positioning to reference point

   Turn on the jog signal in the home positioning direction in a manual feed mode, either JOG or RAPID, and place the machine to the reference point.
   The above steps position the machine to the origin and the position indication displays 0. Repeat the steps for all (X to Z) axes to be used.

4. Saving machine reference point data

   After positioning the machine on all axes, turn on and off ZPNT, the machine zero point set input signal, in the manual feed JOG or RAPID mode. This sets up the reference point data on all axes. At the same, the home position offset parameters are automatically set up.

5. Exiting from the return-to-home position mode

   Turn off input signal ZRN to clear the return-to-home position mode. The machine home position has been set up.

(2) Positioning using No-limit Switch

The machine reference point can set without using a limit switch by marking the machines for positioning in advance and positioning the machine using manual feed functions

(Procedure)

1 Presetting parameters

Set the backlash offset parameter to 0, then turn on and off power to MOTIONPACK to make the parameter effective

2 Positioning load machine to reference point

Position the machine to home position in the JOG, RAPID, STEP, or HANDLE mode, on each axis Note the direction of the last travel in this positioning step because it must be set for a parameter in step 6

3 Setting return-to-home position mode

Turn on input signal ZRN to set the return-to-home position mode

4 Saving machine reference point data

Turn on and off ZPNT, the machine zero point set input signal, in the manual feed (JOG, RAPID, STEP, or HANDLE) mode This sets up the reference point data on all axes and displays 0 for the position indication At the same, the home position offset parameters are automatically set up

5 Exiting from the return-to-home position mode

Turn off input signal ZRN to clear the return-to-home position mode

6 Setting parameters

For, setting the backlash offset, set backlash offset amount and direction for parameters Set the direction of the last movement of home positioning in step 2 for the home positioning direction parameter (Set 0 for positive direction, 1 for negative direction) If positioning was performed as shown in Fig 9 7, set 1 for the parameter

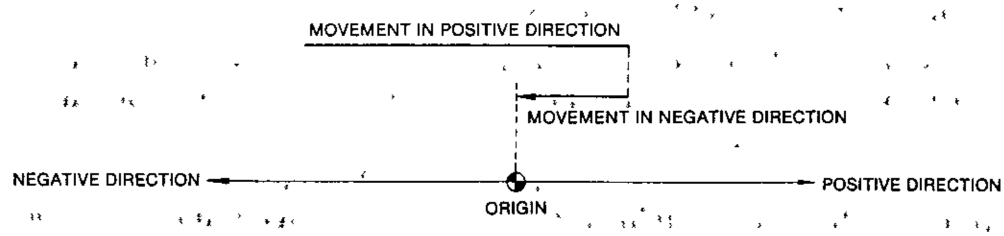


Fig 9 7

(3) Check

Confirm that the machine zero point has been set properly

(Procedure)

1 After setting machine home position, move all axes at random with manual operation

2 Stop the axes Check and note the position using the Control Station

3 Turn on and off power

4 Confirm that position indication of each axis is not changed before or after turning power on and off (In a system supporting no brake, position may change slightly before and after turning power on and off)

5 If position indication changed much, check the system setup parameters and repeat setting of reference point again

(4) Notes after Setting Machine Home Position

The following operations disrupt the setup data of machine home position Be careful and avoid these operations If any of the following has occured, reset machine home position again

1 Removal of motor from machine

2 Resetting of absolute encoder

3 Change of parameter for feed axis motor rotation direction

4 Change of encoder set parameters

5 Change of setting of parameters (B/A and A/B) for matching the position instruction unit and position detection unit

6 Change of home position offset data or parameter data transfer from personal Computer

9.1.11 Checking Stroke Limit

The MOTIONPACK-120 system supports two stroke limit detection functions the over-travel detection function that uses a limit switch and the software limit switch that checks machine position

(1) Checking Overtravel Detection Function

Overtravel is detected by the overtravel limit switch signal in the direction of the motion instruction Limit switch signals in positive and negative directions are connected to the SERVOPACK on each axis

If it is detected that the overtravel input signal went-off during execution of motion instruction, the zero speed instruction orders immediate stop After the machine stops, it is servo-locked at the position Correction of overtravel is made by motion instruction in the reverse direction after resetting

Whether the function is effective is determined by parameter setting

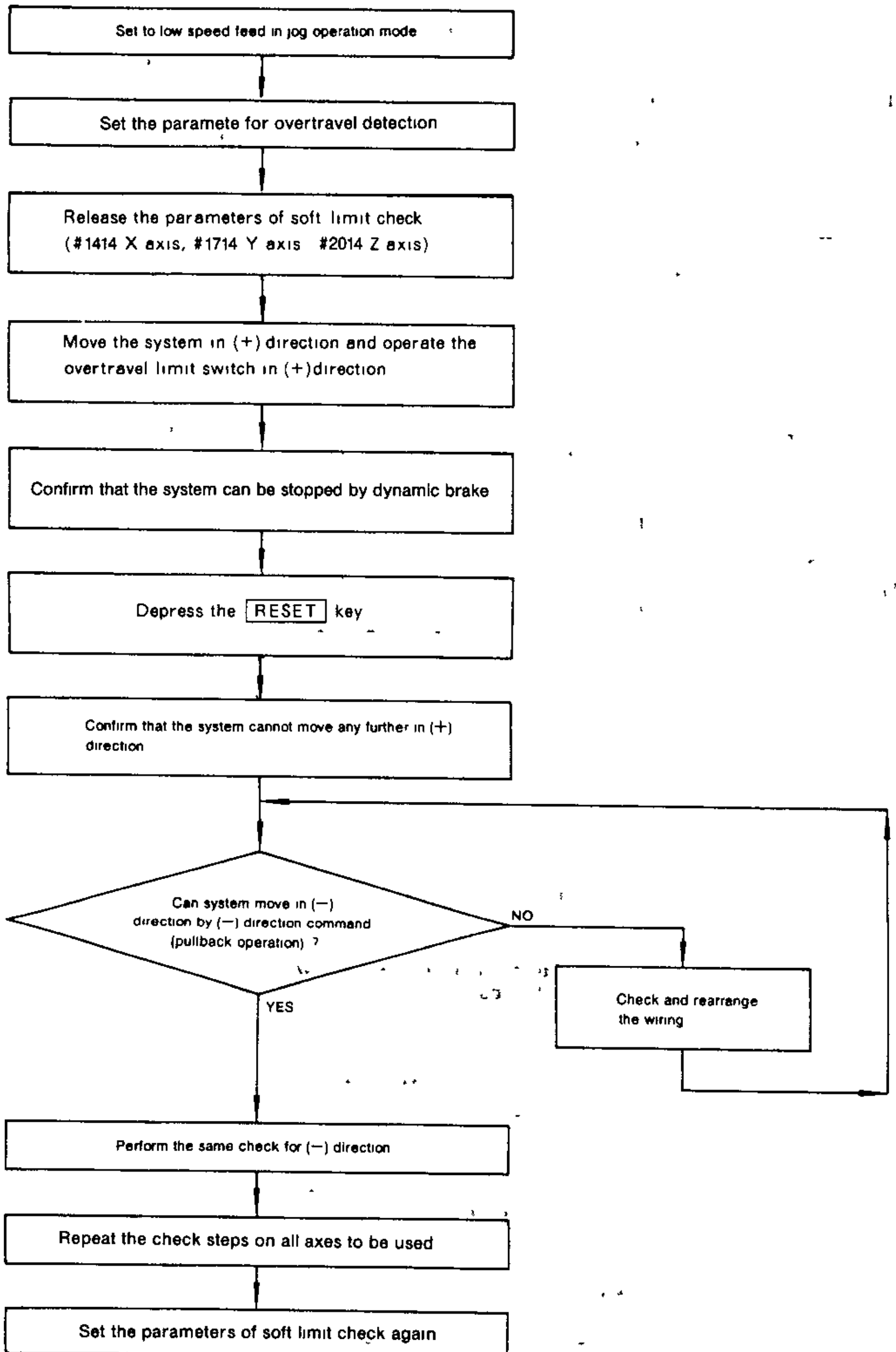

Set to low speed feed in jog operation mode
Set the paramete for overtravel detection
Release the parameters of soft limit check
(#1414 X axis, #1714 Y axis #2014 Z axis)
Move the system in (+) direction and operate the overtravel limit switch in (+)direction
Confirm that the system can be stopped by dynamic brake
Depress the RESET key
Confirm that the system cannot move any further in (+) direction
Can system move in (−) direction by (−) direction command (pullback operation) ?
NO
Check and rearrange the wiring
YES
Perform the same check for (−) direction
Repeat the check steps on all axes to be used
Set the parameters of soft limit check again

Fig 9 8

(2) Checking Software Limit Switch

Software limit switch detects a stroke limit using the target position of motion instruction and boundary position data set for parameters

If motion beyond the boundary is ordered, the machine is moved to the boundary and slows down and stops on the boundary Then an alarm occurs Necessary correction is made by motion instruction in the reverse direction after resetting

Whether the function is effective is determined by parameter setting

Table 9 1

	Parameter No	Contents
Software LS Check ON/OFF	#1414 (X) #1714 (Y) #2014 (Z)	0 Software LS check disabled 1 Software LS check enabled
Software LS Positive Direction Boundary Data	#1504 (X) #1804 (Y) #2104 (Z)	Range -99999999 to 99999999 Setup unit 1 = 0 001 mm
Software LS Negative Direction Boundary Data	#1505 (X) #1805 (Y) #2105 (Z)	Range -99999999 to 99999999 Setup unit 1 = 0 001 mm

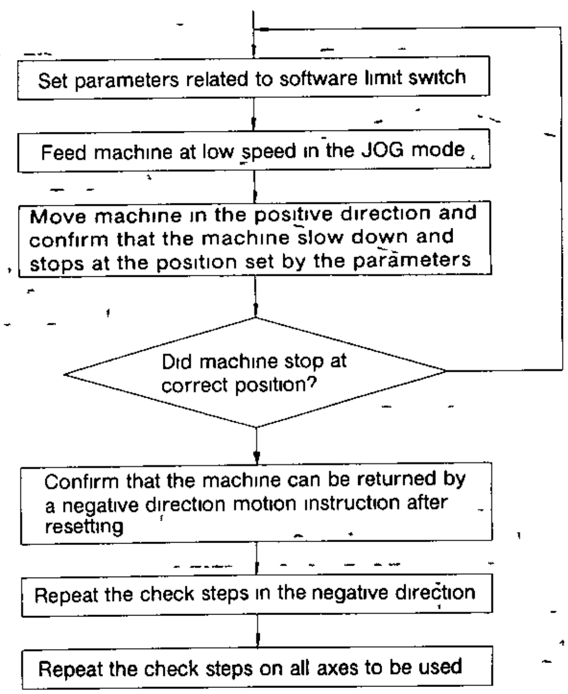


Fig 9 9

9.1.12 Confirmation of Memory Operation

To check the memory operation, perform the single block operation

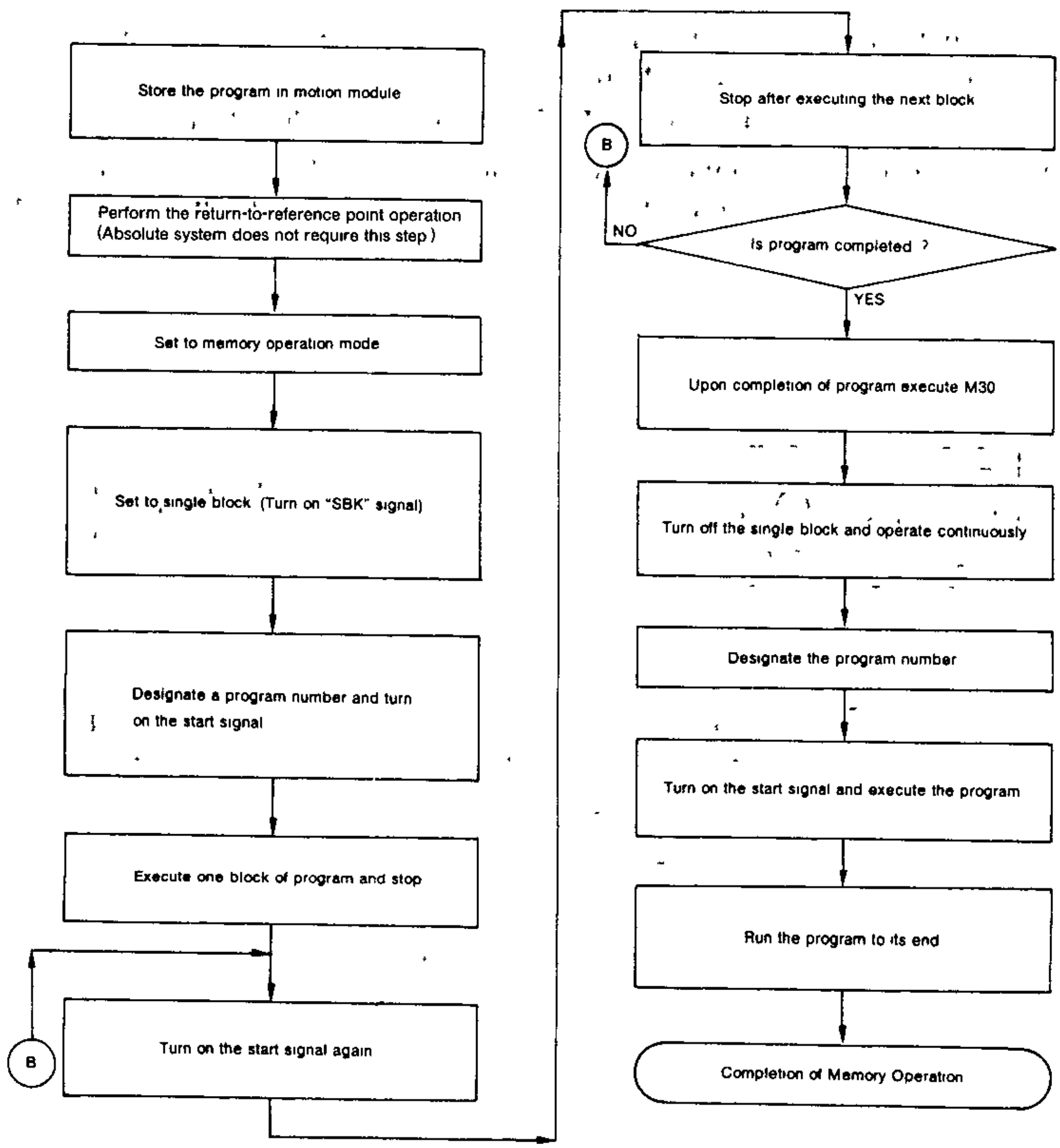


Fig 9 10 Confirmation of Memory Operation

9.2 ADJUSTING SERVO SYSTEM

Adjust the servo system using parameters To set optimum servo system parameters such as the position loop gain for the load machine characteristics, it is useful to observe the servo characteristics as analog waveformes For this purpose, use the special monitor, JUSP-HRM001

(1) Connecting Monitor

1 Confirm that power is off Disconnect the cable from 3CN of the SERVOPACK of the axis of which waveform is to be monitored

2 Connect the monitor to the SERVOPACK as shown in Fig 9 11

3 Connect the cable to be connected to 3CN of the SERVOPACK to the connector under the monitor Insert the cable securely Do not bend the pins at connecting

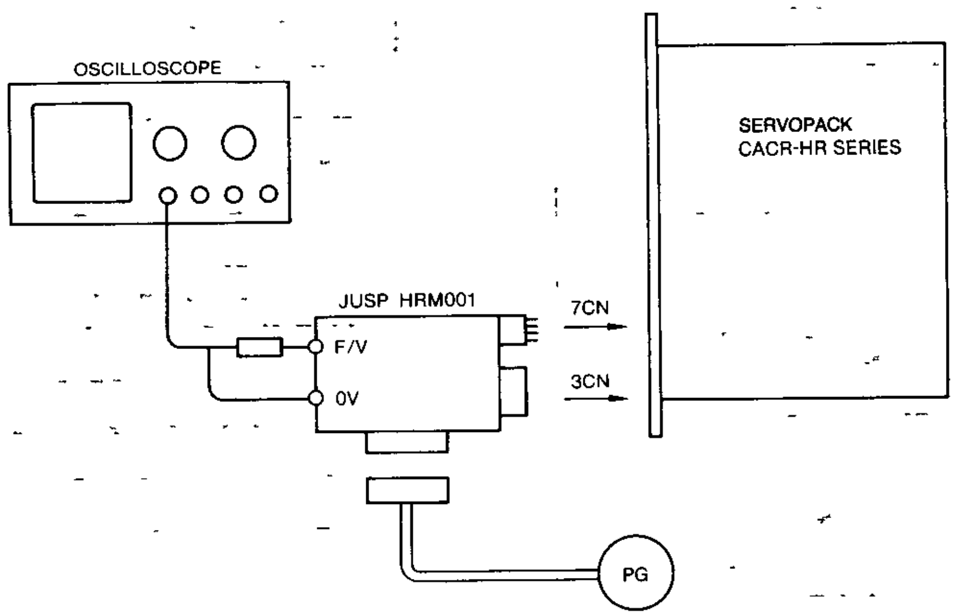


Fig 9 11

(2) Monitoring Waveform

Check the voltage waveform at the check pin of the monitor using an oscilloscope

(a) Motor response characteristic

Observe the voltage waveform between the F/V pin and 0 V pin of the monitor to check motor speed

Output voltage ±1 2 V ±10%/±3000 r/min

(b) Load characteristic and speed reference

Observe the voltage waveform between the D/A pin and 0 V pin of the monitor Select waveform to be monitored by setting parameters

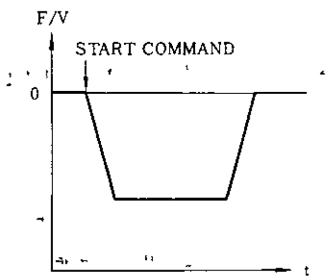
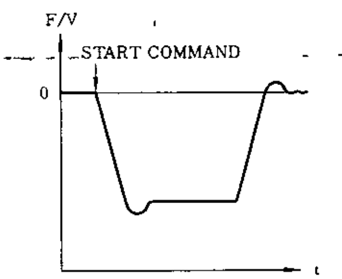
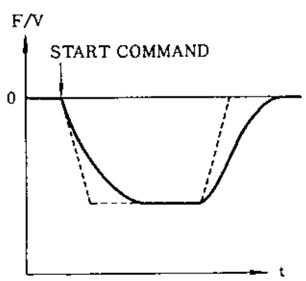
Table 9 2

	Parameter		Output Voltage
	#1458 (X), #1758 (Y), #2058 (Z)	#1459 (X), #1759 (Y), #2059 (Z)	
Load Characteristic	28	0	±3 0V ±10%/ ±(300% of rated torque)
Speed Reference	41	2	±1 2V ±10%/ ±3000r/min

(3) Adjustment of Kp, Kv

Monitor the waveform explained in (2)-(a) Follow the procedures in Table 9 3 to adjust parameter set values

Table 9 3

Monitored Speed Waveform	How to Adjust	Remarks
	Optimum status with no overshoot or oscillation, showing good servo response	This waveform is not always obtainable depending on the load machine rigidity
	Overshoot and oscillation are observed • Reduce Kp (position loop gain) gradually, or • Reduce Kv′ (speed loop gain) gradually	If a certain degree of Kp is required and overshoot must be eliminated, set a longer accel/decel time
	Bad servo response is observed (1) Increase Kp gradually (2) If Kp cannot be increased for fear of oscillation, increase Kv′ gradually	If oscillation occurs as Kv′ is increased, it is the limit of the servo performance of the system including the load machine

(4) Saving Parameters

After adjusting the servo system, transfer the parameter data to the personal computer and save it on a floppy disk, or prepare a parameter setting table so as to keep a record of the setting data

9.3 BATTERY MAINTENANCE

MOTIONPACK-120 uses two lithium batteries to back up the CMOS memory that contains NC programs and the absolute encoder Although these batteries are connected at the factory, check the batteries if a battery alarm occurs

Also check batteries if voltage drop is observed at the end of life Replace batteries as shown in Fig 9 12

Table 9 4 Battery Specifications

Product Name	Lithium thionyl chloride battery (manufactured by Toshiba Battery Co , Ltd)
Model	ER6C-3 (YASKAWA code No BA505)
Nominal Voltage	3 6V
Standards	2000 mAh (after continuous discharge at 1 kΩ stop voltage 25 V, temperature 20°C
Allowable Max Current	3 mA
Standard Weight	17 0 g
Pins	Materials for positive and negative pins PS 5SD S4C2 (manufactured by Japan Aviation Electrics Industry Ltd) for connector housing 031 50831 (manufactured by Japan Aviation Electrics Industry Ltd) for connector contact

Name	Application	Standard Life (Year)		Remarks
		Power Applied	No Power Applied	
BATTERY 1	System backup	5	1	—
BATTERY 2	Absolute encoder backup	5	1	For 3-axis encoder

Note The standard life is at ambient temperature of 25°C

To replace the batteries, observe the following steps

Turn on power to MOTIONPACK-120 and the SERVOPACK, and wait for 30 minutes or more

The super capacitor incorporated aside from the batteries enables backup without the batteries

↓

Turn off power

↓

Replace the batteries

The super capacitor assures back-up for about eight hours or longer

↓

Turn on power to the system

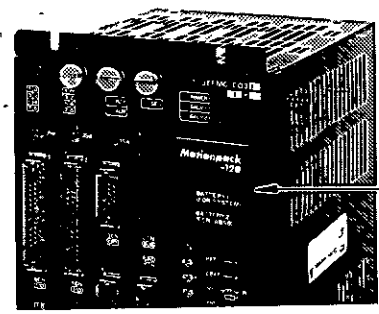


Fig 9 12

> Note that if the batteries are removed when the super capacitor in the absolute encoder is not charged, data in the encoder are lost

NOTE

1 Replace the two batteries at the same time
2 Do not connect the positive and negative poles of the batteries
3 Avoid high temperature, high humidity, and condensation during storage
4 Do not expose batteries to direct sunlight or splash water on them

Typical Connections

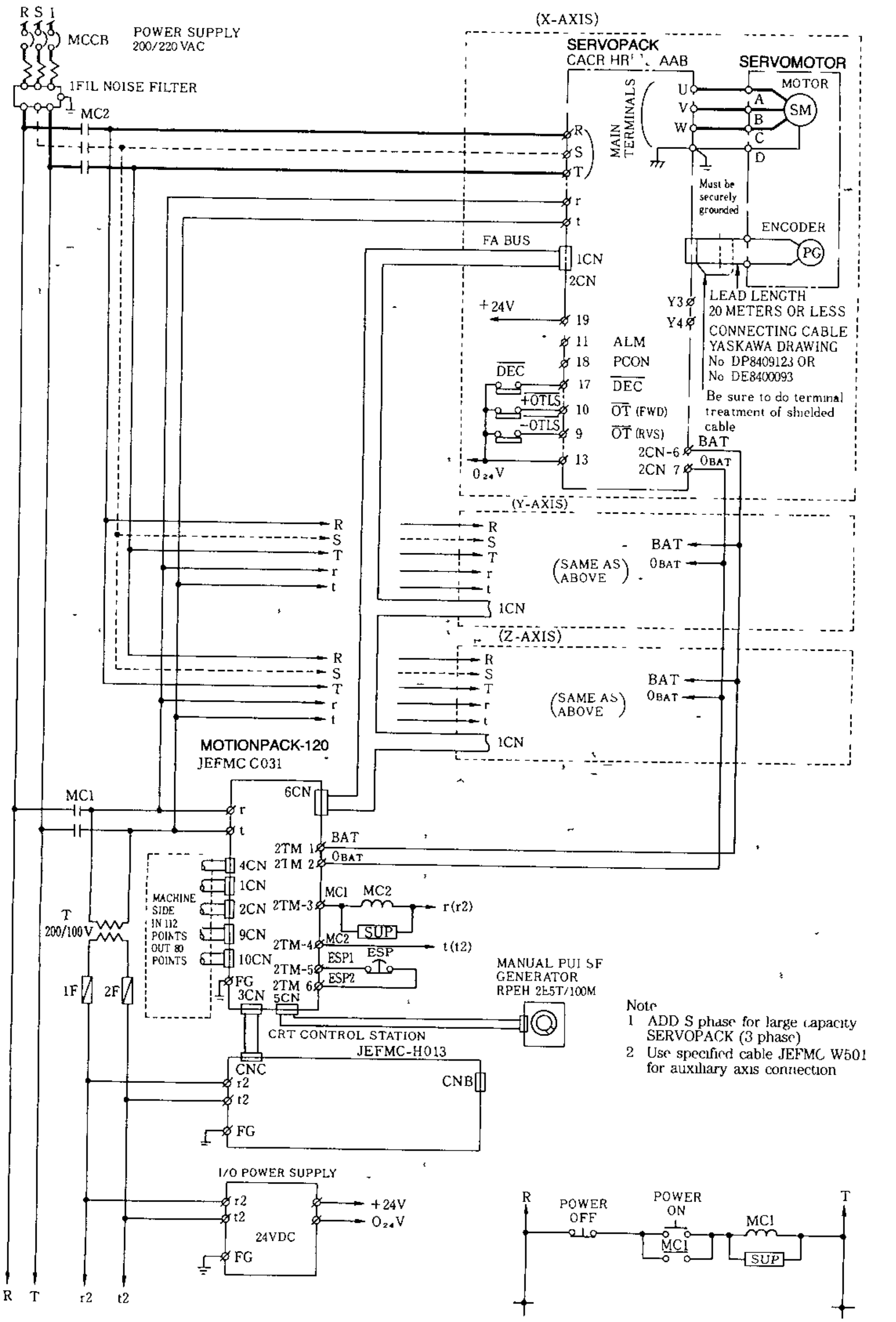


Fig 9.13 Typical Connection of AC SERVOPACK Type CACR-HR-AAB and MOTIONPACK-120

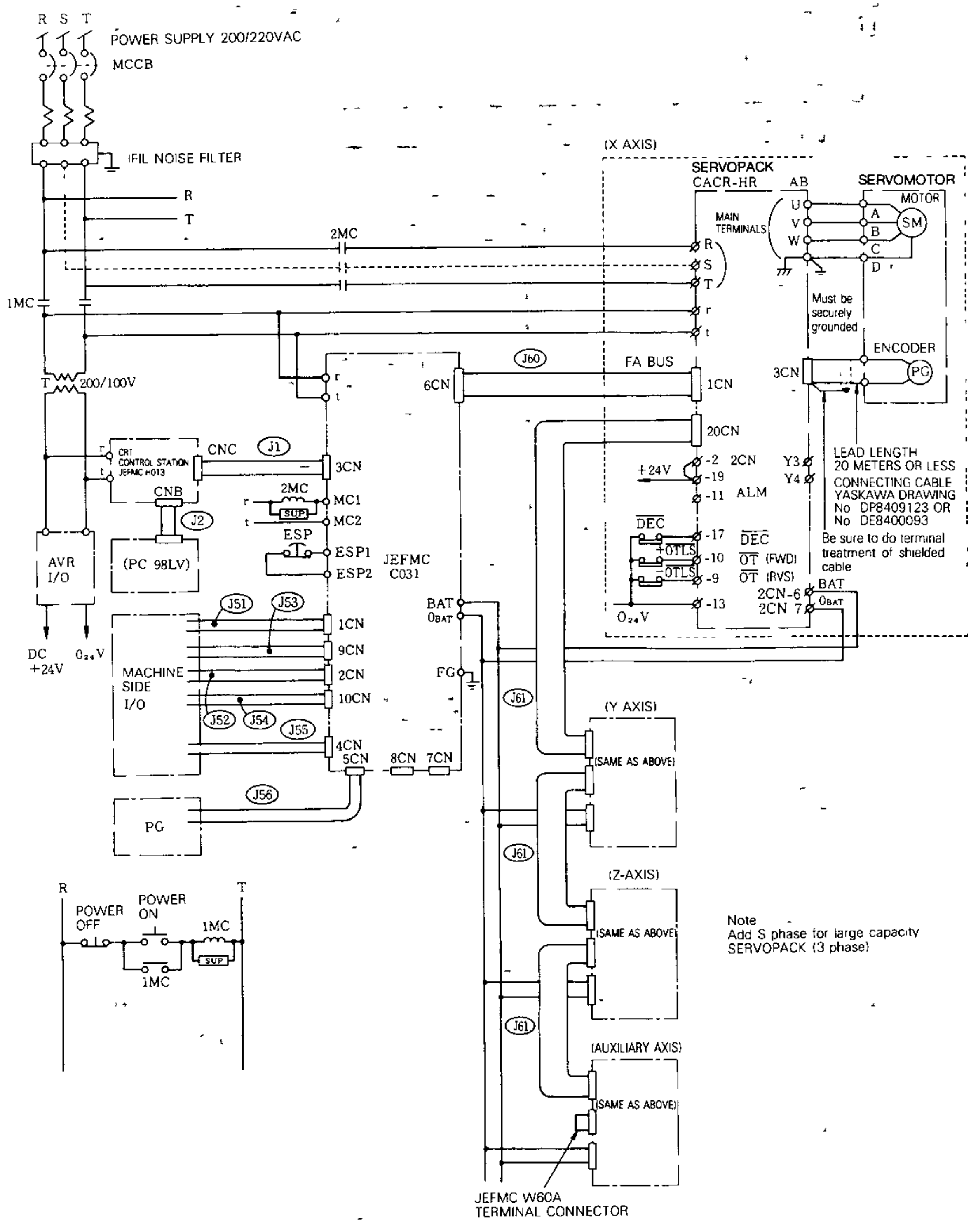


Fig 9 14 Typical Connection of AC SERVOPACK Type CACR-HR-AB and MOTIONPACK-120

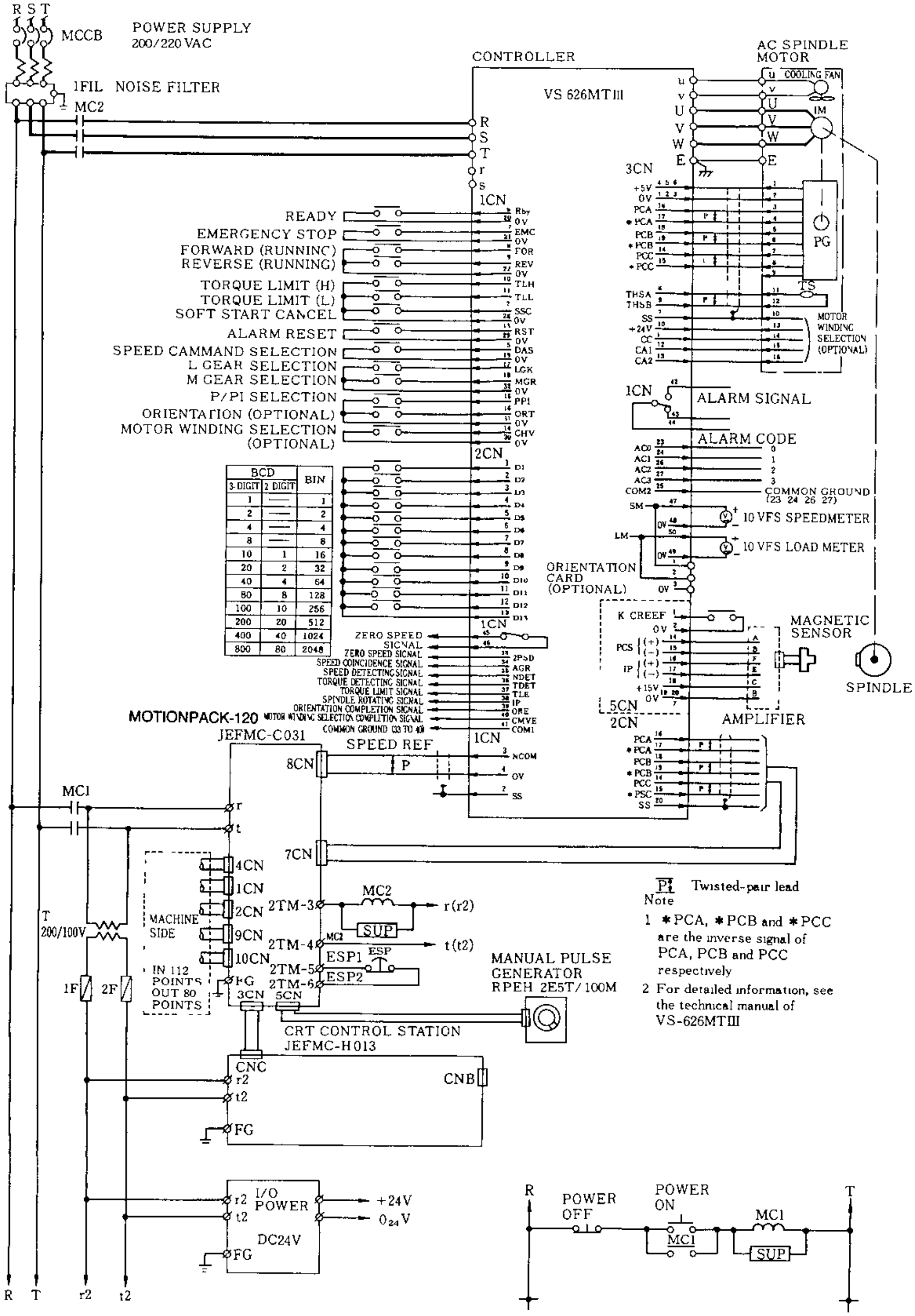


Fig 9 15 Typical Connection of AC Spindle Inverter VS-626MTIII and MOTIONPACK-120

APPENDIX

CONTENTS

1. ALARM CODE LIST

Code	Contents	Cause	Corrective Action
000			
001			
002			
003			
004			
005			
006			
007	SOLID TAPP ERROR	Solid tap program error	· Correct the program
008	PROG ERROR (G 76／G 92／G 93)	Threading fixed cycle program error	· Correct the program
009	PROG ERROR (G 41／G 42)	· Tool diameter offset instruction error · Tool offset cross-point calculation error	· Review and correct the program
010	NOTCH ERROR	Parameter setting error Offset number specification error	· Check function set parameters · Correct the program

Code	Contents	Cause	Corrective Action
011	PROG ERROR (M 90)	· Internally processed M - code with number M90-M97 are used	· Correct the program
012	OVER FLOW (128 ch)	· More than 128 characters were used in a single block	· Correct the program (the number of characters)
013	PROG ERROR (NO ADDRESS)	· No data follow the code (address) · No code (address) is placed before data	· Correct the program
014	PROG ERROR ("-", "0", ".")	· Invalid usage of minus sign, 0, or decimal point · The decimal point is placed in incorrect position	· Correct the program Check the decimal point set parameter
015	PROG ERROR (UNUSABLE CH)	An invalid character is used in the significant information section	· Correct the program
016	PROG ERROR (DIGITS)	· Invalid number of digits were used in input data	· Correct the program (the number of digits in data)
017	PROG ERROR (G)	Unavailable G - code is used · An option is used in a module where the optional function is not supported	· Correct the program (G) · Check the option
018	PROG ERROR (G)	· Conflicting G - codes are used in a single block	· Correct the program (G)
019	PROG ERROR (F)	· No F - instruction is programmed for interpolation operation	· Correct the program (F or G)
020	PROG ERROR (R = 0)	· Radius for the circular instruction is set to 0	· Correct the program (R, I, or J)
021	PROG ERROR (G 02/G 03)	· Out-of-area specification error in the circular instruction	· Correct the program · (X, Y, or R)

Code	Contents	Cause	Corrective Action
022	PROG ERROR (P)	· Setup value for P is out of range	Correct the program (P)
023			
024	PROG ERROR (G 10)	Axial data are programmed in block G10	· Correct the program (Delete the axial data)
025	M 02 RESTART	· Cycle start was input after machine stops with code M02	· Restart from the top of the program after resetting
026			
027	FG ERROR (G 01, G 02, G 03)	· Interpolation instruction error · Place instruction error · End point instruction error	· Correct the program
028	PROG ERROR (G 31)	· No skip input signal is input in block G31 · Parameter setting error	· Check the skip signal Check parameters related to alarm detection
029	OFFSET ERROR	· G43 and G44 are used in the G02 or G03 mode · G45 to G48 are used in the mode except G00 to G03	· Correct the program (G43-G48)
030	PROG ERROR (M 98)	· P is not specified in block M98	· Correct the program (P)
031	PROG ERROR (M 98/M 99)	· The program number called by M98 or M99 was not found	· Check the related programs
032	PROG ERROR (M 98 NEST)	· Level of nesting subprogram call is five or greater	· Correct the program so that the level of nesting subprogram call becomes four or less

Code	Contents	Cause	Corrective Action
033	PROG ERROR (AXIS)	Axial specification is in block G04	· Correct the program (Delete the axial specification)
034	PROG ERROR (M 02/M 03/M 99)	· No M-code for ending is programmed at the end of the program	· Add ending M-code (M02, M30, or M99)
035			
036			
037			
038	PROG ERROR (NO AXIS)	· The axis to be used is not effective	· Correct the program · Check system setup parameters
039	PROG ERROR (G 80/G 34)	· Offset of X-or Y-axis (G40-G42 or G45-G48) was specified while combined operation instruction was executed	· Code cancel of the G80 combined operation before the offset-related instruction
040			
041			
042			
043			

Code	Contents	Cause	Corrective Action
044			
045			
046			
047			
048			
049	EXTERNAL ERROR	External error input signal (ER) is input	• Check the external error input signal (ER)
050	MACH UNREADY	The machine ready input signal (MRDY) is off	Check the machine ready input signal (MRDY)
051	SERVO POWER NOT-SUPPLIED	• Another alarm occurred • Servo on-conditions are not satisfied Servo main power is off • Parameter setting error	• Check the input signals such as SVON Check the servo main power and sequencer • Check system setup parameters
052			
053	EMERGENCY STOP	Emergency stop	• Reset emergency stop Check emergency stop input
054			

Code	Contents	Cause	Corrective Action
055			
056			
057			
058			
059			
060			
061			
062			
063			
064			
065			

Code	Contents	Cause	Corrective Action
066	COMN ERROR (X)	FA bus communication error · Parameter setting error	Check FA bus cable connection · Check SERVOPACK 1SW setting · Check system setup parameters · Examine countermeasures against noise
067	COMN ERROR (Y)	· FA bus communication error · Parameter setting error	· Check FA bus cable connection · Check SERVOPACK 1SW setting Check system setup parameters · Examine countermeasures against noise
068	COMN ERROR (Z)	· FA bus communication error · Parameter setting error	· Check FA bus cable connection · Check SERVOPACK 1SW setting · Check system setup parameters · Examine countermeasures against noise
069			
070			
071			
072			
073			
074			
075			
076			

Code	Contents	Cause	Corrective Action
077			
078			
079			
080			
081			
082			
083			
084			
085			
086			
087			

Code	Contents	Cause	Corrective Action
088			
089			
090			
091			
092			
093			
094			
095			
096	ABSO POS CHECK ERROR (X)	Axial' movement while power is off Parameter setting error · Encoder defect	· Check the machine position and indicated position, then reset the system Check the system setup and alarm detection parameters Check wiring to the encoder Reset the encoder
097	ABSO POS CHECK ERROR (Y)	Axial movement while power is off · Parameter setting error · Encoder defect	Check the machine position and indicated position, then reset the system · Check the system setup and alarm detection parameters Check wiring to the encoder Reset the encoder
098	ABSO POS CHECK ERROR (Z)	Axial movement while power is off · Parameter setting error · Encoder defect	Check the machine position and indicated position, then reset the system Check the system setup and alarm detection parameters Check wiring to the encoder · Reset the encoder

Code	Contents	Cause	Corrective Action
99			
100	DNC ERROR	· More than 128 characters were used in a single block on DNC operation (The end of block code is lacking, etc)	· Check the communication circuit · Check the way of data conversion
101			
102			
103			
104			
105			
106			
107			
108			
109			

Code	Contents	Cause	Corrective Action
110			
111			
112			
113			
114			
115			
116			
117			
118			
119	SPINDLE RPM ALARM	· Large spindle load fluctuation · Spindle PG counter malfunction · Parameter setting error	· Examine spindle load · Check spindle PG wiring · Examine countermeasure against noise · Check parameters related to spindle fluctuation check
120			

Code	Contents	Cause	Corrective Action
121			
122			
123			
124			
125			
126			
127			
128			
129			
130			
131			

Code	Contents	Cause	Corrective Action
132			
133			
134			
135			
136			
137			
138			
139			
140			
141			
142			

Code	Contents	Cause	Corrective Action
143			
144			
145			
146			
147			
148			
149			
150			
151			
152			
153			

Code	Contents	Cause	Corrective Action
154			
155			
156			
157			
158			
159			
160			
161			
162			
163			
164			

Code	Contents	Cause	Corrective Action
165			
166			
167			
168			
169			
170			
171			
172			
173			
174			
175			

Code	Contents	Cause	Corrective Action
176			
177			
178			
179			
180	RAM ERROR (1)	· MOTIONPACK defect	· Contact your YASKAWA representative
181	RAM ERROR (2)	· MOTIONPACK defect	· Contact your YASKAWA representative
182	RAM ERROR (3)	· MOTIONPACK defect	Contact your YASKAWA representative
183	RAM ERROR (4)	MOTIONPACK defect	· Contact your YASKAWA representative
184	RAM ERROR (5)	MOTIONPACK defect	Contact your YASKAWA representative
185	RAM ERROR (I/O)	MOTIONPACK defect	· Contact your YASKAWA representative
186	RAM ERROR (CRT)	MOTIONPACK defect	Contact your YASKAWA representative

Code	Contents	Cause	Corrective Action
187			
188			
189	PARAMETER SUM ERROR	· Backup battery is disconnected · Power supply fault MOTIONPACK fault	· Check the MOTIONPACK built-in batteries Check power supply Reset the parameters, program, and offset values If the error persists, contact your YASKAWA representative
190	ROM ERROR (MM)	MOTIONPACK defect	Contact your YASKAWA representative
191	ROM ERROR (1)	· MOTIONPACK defect	· Contact your YASKAWA representative
192	ROM ERROR (2)	MOTIONPACK defect	Contact your YASKAWA representative
193	ROM ERROR (3)	· MOTIONPACK defect	· Contact your YASKAWA representative
194	ROM ERROR (4)	· MOTIONPACK defect	· Contact your YASKAWA representative
195	ROM ERROR (I/O)	MOTIONPACK defect	Contact your YASKAWA representative
196	ROM ERROR (CRT)	· MOTIONPACK defect	· Contact your YASKAWA representative
197			

Code	Contents	Cause	Corrective Action
198			
199			
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206			
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Code	Contents	Cause	Corrective Action ,
209			
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211			
212			
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216			
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219			

Code	Contents	Cause	Corrective Action
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221			
222			
223			
224			
225			
226			
227			
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230			

Code	Contents	Cause	Corrective Action
231			
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Code	Contents	Cause	Corrective Action
242			
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Code	Contents	Cause	Corrective Action
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Code	Contents	Cause	Corrective Action
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Code	Contents	Cause	Corrective Action
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Code	Contents	Cause	Corrective Action
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Code	Contents	Cause	Corrective Action
297			
298			
299			
300			
301 401 501			
302 402 502 702 802	TIMING ERR (X) (Y) (Z) (A) (B)	· FA bus communication error	· Check connection of the FA bus cable Check setting of SERVOPACK 1SW · Examine countermeasure against noise
303 403 503			
304 404 504 704 804	ANS MISS (X) (Y) (Z) (A) (B)	· FA bus communication error	· Check connection of the FA bus cable · Check setting of SERVOPACK 1SW · Examine countermeasure against noise
305 405 505			
306 406 506			
307 407 507 707 807	RX MISS (X) (Y) (Z) (A) (B)	· FA bus communication error	· Check connection of the FA bus cable · Check setting of SERVOPACK 1SW · Examine countermeasure against noise

Code	Contents	Cause	Corrective Action
308 408 508 708 808	P COUNT ERR (X) (Y) (Z) (A) (B)	· FA bus communication error	· Check connection of the FA bus cable · Check setting of SERVOPACK 1SW · Examine countermeasure against noise
309 409 509			
310 410 510 710 810	OT-F ERR (X) (Y) (Z) (A) (B)	· Positive direction overtravel signal input · Operation or program error · Parameter setting error	· Check the overtravel LS, reset, and move in the reverse direction Check parameters related to OT alarm detection · Check the SERVOPACK overtravel input signal
311 411 511 711 811	OT-R ERR (X) (Y) (Z) (A) (B)	· Negative direction overtravel signal input · Operation or program error · Parameter setting error	· Check the overtravel LS, reset, and move in the reverse direction · Check parameters related to OT alarm detection · Check the SERVOPACK overtravel input signal
312 412 512			
313 413 513			
314 414 514			
315 415 515 715 815	SERVO TRACKING ERROR (X) (Y) (Z) (A) (B)	· Servo system servo deviation excessive	Check connection between the SERVOPACK and the motor · Check setting of parameters related to system setup and servo characteristics Chack machine load
316 416 516 716 816	SOT-F ERR (X) (Y) (Z) (A) (B)	· Positive direction software limit switch Operation or program error · Parameter setting error	· Check program and operation, reset, move in the reverse direction Check setting of parameters related to software limit switch
317 417 517 717 817	SOT-R ERR (X) (Y) (Z) (A) (B)	· Negative direction overtravel signal input Operation or program error · Parameter setting error	· Check program and operation, reset, move in the reverse direction Check setting of parameters related to software limit switch
318 418 518 718 818	PSET-ERR (X) (Y) (Z) (A) (B)	· Positioning error	· Check connection between the SERVOPACK and the motor Check setting of parameters related to servo characteristics Check machine load

Code	Contents	Cause	Corrective Action
319 419 519			
320 420 520			
321 421 521			
322 422 522			
323 423 523			
324 424 524			
325 425 525			
326 426 526			
327 427 527			
328 428 528			
329 429 529			

Code	Contents	Cause	Corrective Action
330 430 530			
331 431 531 731 831	CMD ERR (X) (Y) (Z) (A) (B)	· FA bus communication error · Wrong operation	· Check FA bus cable connection · Operate according to manual
332 432 532 732 832	RAM - ERR 1 (X) (Y) (Z) (A) (B)	SERVOPACK defect	· Contact your YASKAWA representative
333 433 533 733 833	RAM - ERR 2 (X) (Y) (Z) (A) (B)	· SERVOPACK defect	· Contact your YASKAWA representative
334 434 534 734 834	ROM ERR (X) (Y) (Z) (A) (B)	· SERVOPACK defect	· Contact your YASKAWA representative
335 435 535			
336 436 536			
337 437 537			
338 438 538			
339 439 539			
340 440 540			

Code	Contents	Cause	Corrective Action
341 441 541			
342 442 542			
343 443 543			
344 444 544			
345 445 545			
346 446 546			
347 447 547			
348 448 548 748 848	ABSOLUTE ENCODER ERROR (X) (Y) (Z) (A) (B)	· Parameter setting error · Absolute encoder defect	· Check system setup parameters Check connection between the encoder and the SERVOPACK · Check the batteries · Reset the encoder
349 449 549 749 849	OVER CURRENT (X) (Y) (Z) (A) (B)	· System setting error · Improper wiring to the motor · SERVOPACK defect	· Check the system setup parameters · Check connections of the motor and servo system Contact your YASKAWA representative
350 450 550 750 850	MCB TRIPPED (X) (Y) (Z) (A) (B)	· SERVOPACK circuit protector is in the trip status from start-up · SERVOPACK defect	· Turn on the circuit protector Contact your YASKAWA representative
351 451 551 751 851	REGENERATIVE TROUBLE (X) (Y) (Z) (A) (B)	· Break in wire in the regenerative resistor · SERVOPACK defect	· Check and replace the regenerative resistor Contact your YASKAWA representative

Code	Contents	Cause	Corrective Action
352 452 552 752 852	OVER VOLTAGE (X) (Y) (Z) (A) (B)	Excessive load inertia · SERVOPACK defect	· Check load machine inertia converted into motor axes · Contact your YASKAWA representative
353 453 553 753 853	OVER SPEED (X) (Y) (Z) (A) (B)	· Improper wiring to the motor · Improper wiring to the encoder · Parameter setting error	· Check the system setup and servo characteristic parameters · Check wiring to the motor · Check wiring to the encoder
354 454 554 754 854	VOLTAGE DROP (X) (Y) (Z) (A) (B)	· SERVOPACK defect	· Contact your YASKAWA representative
355 455 555 755 855	OVER LOAD (X) (Y) (Z) (A) (B)	Parameter setting error SERVOPACK overload · Improper wiring to the motor	· Check the system setup and servo characteristic parmeters · Review load
356 456 556 756 856	POSITIONING ERROR (X) (Y) (Z) (A) (B)	· Improper wiring to the encoder · Internal pulse counter malfunction · SERVOPACK defect	· Check wiring to the encoder · Examine countermeasure against noise · Contact your YASKAWA representative
357 457 557			
358 458 558			
359 459 559 759 859	PG LINE DISCONNECTION (X) (Y) (Z) (A) (B)	· Improper wiring or break in wire to the encoder · Encoder or SERVOPACK defect	· Check wiring to the encoder · Contact your YASKAWA representative
360 460 560 760 860	OVER RUN PREVENTION (X) (Y) (Z) (A) (B)	· Parameter setting error · Improper wiring to the motor or encoder · SERVOPACK overrun detected SERVOPACK defect	· Check system setup parameters · Check wiring to the motor and encoder Review the servo system, for instance, modify setting for the servo characteristic parameters Contact your YASKAWA representative
361 461 561 761 861	DSP ERROR (X) (Y) (Z) (A) (B)	· SERVOPACK defect	· Contact your YASKAWA representative
362 462 562			

Code	Contents	Cause	Corrective Action
363 463 563 763 863	OPEN PHASE (X) (Y) (Z) (A) (B)	Parameter setting error · Open phase in three-phase power supply Improper wiring to three-phase power supply	· Check the system setup parameters Check wiring to SERVOPACK power supply
364 464 564			
365 465 565			
366 466 566			
367 467 567			
368 468 568			
369 469 569			
370 470 570			
371 471 571			
372 472 572			
373 473 573			

Code	Contents	Cause	Corrective Action
374 474 574			
375 475 575			
376 476 576			
377 477 577			
378 478 578			
379 479 579			
380 480 580			
381 481 581			
382 482 582			
383 483 583			
384 484 584			

Code	Contents	Cause	Corrective Action
385 485 585			
386 486 586			
387 487 587			
388 488 588			
389 489 589			
390 490 590			
391 491 591			
392 492 592			
393 493 593			
394 494 594			
395 495 595			

Code	Contents	Cause	Corrective Action
396 496 596			
397 497 597			
398 498 598			
399 499 599			

2. SERVOPACK ALARM CODE LIST

SERVOPACK alarms are indicated on the 7-segment indicator on the SERVOPACK as shown in the following table Apart from the causes listed in the table, alarm may result from setting errors in parameters such as motor selection, controller selection, and encoder pulse number Parameters must be checked especially at test run

	Lighting Condition	Probable Cause	Corrective Action
0 Absolute Encoder Error	Comes on when only control power is applied	Control board defect	Replace the SERVOPACK
	Comes on after several seconds after control power is turned on	Absolute encoder malfunction Internal element malfunction	· Turn off power once, then turn it on
		Absolute encoder malfunction · Batteries not connected	Set up the absolute encoder again
		· Improper wiring to the absolute encoder	Connect cables correctly
		Absolute encoder defect	· Replace the motor
1 Overcurrent	Comes on when only control power is applied	Control board defect	Replace the SERVOPACK
	Comes on when servo is turned off after main power is turned on (a) MCCB does not trip	Current feedback circuit fault Main circuit transistor module defect	Replace the SERVOPACK
	Comes on when servo and main power are turned on (b) MCCB also trips	Motor grounding Main circuit transistor module defect	Replace the motor Replace the SERVOPACK
	Comes on when only main power is turned on	Main circuit transistor module defect	· Replace the SERVOPACK
2 Circuit Protector Tripped	· Comes on when only control power is applied	Control board defect	Replace the SERVOPACK
	Comes on when main power is turned on	Main circuit diode bridge defect	Replace the SERVOPACK
		MCCB does not trip	Check for break in wire in lead to the SERVOPACK Also check conductivity at joints
3 Regenerative Circuit Error	Comes on when only control power is applied	Control board defect	· Replace the SERVOPACK
	Comes on after about 0 5 to 1 second after power is applied to the main circuit	Regenerative transistor defect	Replace the SERVOPACK
		Break in wire in regenerative resistor	Check and replace the regenerative resistor (Replace the SERVOPACK)
4 Overvoltage	Comes on when the motor starts or slows down	Excessive load inertia	Check load inertia converted into motor axes
		Regenerative processing circuit defect	Replace the SERVOPACK
5 Overspeed	Comes on after fast operation when a reference is input	Improper wiring to the motor Improper wiring to the optical encoder	Correct motor wiring Check and correct pulses of phases A, B, C, U, V, and W on 2CN
6 Voltage Drop	Comes on when power is applied to the main circuit	Main circuit thyristor/diode mixed module defect	Replace the SERVOPACK

	Lighting Condition	Probable	Corrective Action
7 Overload	Comes on when only control power is applied	· Control board defective	· Replace the SERVOPACK
	· Comes on during operation When control power is turned off and then again on, operation is restarted	· More than the rated load is applied	Review and examine the load (Overload)
	· Although the motor rotates, necessary torque is not obtained After a while, the alarm lamp comes on When control power is turned off and then again on, torque is insufficient as before	Motor circuit wiring error such as U→V, V→W, or W→U Single phase connection (one phase missing because of break in wire)	Correct connection
8 Position Error	Comes on when only control power is applied	· Control board defective	Replace the SERVOPACK
	· Comes on during operation Comes on frequently	· Improper wiring to the absolute encoder	Check and correct phase -A, -B, and -C pulses of 2CN
		· Internal PG pulse counter malfunction	· Examine countermeasure against noise
C PG Disconnection	· Comes on when only control power is applied	Improper wiring to the absolute encoder	· Correct wiring
		Absolute encoder defective	Replace the motor
F Open Phase	Comes on when only control power is applied	Control board defective	· Replace the SERVOPACK
	· Comes on when power is applied to the main circuit	· Connection omission in 3-phase power supply	· Check connection
H DSP Error	Comes on when only control power is applied	Control board defective	Replace the SERVOPACK
J Excessive Servo Deviation	Comes on during operation	· Same as system alarm of MOTIONPACK-120	· Same as system alarm of MOTIONPACK-120
L Overrun Prevention	Comes on when only control power is applied	Control board defective	· Replace the SERVOPACK
	· Comes on after slight move at starting	· Improper wiring to the motor	Correct motor connection
		Improper wiring to the absolute encoder	· Check and correct phase -A and -B pulses of 2CN
P +Overtravel	Comes on when only control power is applied	· Wiring error, LS defective	Check at the corresponding position
	Comes on during operation	+OT LS was input	Move the machine in reverse direction
n −Overtravel	· Comes on when only control-power is applied	Wiring error, LS defective	· Check at the corresponding position
	Comes on during operation	· −OT LS was input	Move the machine in reverse direction
E System Error	Comes on when only control power is applied	Control board defective	· Replace the SERVOPACK
	Comes on during operation	If the alarm occurs frequently, · Control board defective	Replace the SERVOPACK

	Lighting Condition	Probable Cause	Corrective Action
No Lighting, CPU Error	Comes on during operation	Control board defective	· Replace the SERVOPACK Control power defective
− Base Blocked	(Power is not applied to the motor)		
_ Wait for FA Bus Communication			
Normal	Indication in normal status (Power is applied to the motor)		

3. I/O DIAGNOSIS NUMBER LIST

(1) Control Fixed Input of Motion Module

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4000	EDIT	MEM	DNC	MDI	STEP	HANDLE	JOG	RAPID
#4001	ROV 3	ROV 2	ROV 1	OV 16	OV 8	OV 4	OV 2	OV 1
#4002					JOV 8	JOV 4	JOV 2	JOV 1
#4003						+ JZ	+ JY	+ JX
#4004						− JZ	− JY	− JX
#4005						HZ	HY	HX
#4006	PRGP	PRMP	MP 2	MP 1	ZRN		$\overline{\text{STP}}$	STR
#4007		MLK	ZPNT	EINV	NEG		PMEM	SBK
#4008	SK 8	SK 7	SK 6	SK 5	SK 4	SK 3	SK 2	SK 1
#4009		GR 2	GR 1	GR 0	SLPC	SSTP	FRN	RRN

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4010	SFIN	FIN	TBXON		RESET			MRDY
#4011								
#4012								
#4013								
#4014								
#4015				ER	(BATALM3)			SVOK
#4016	W 28	W 24	W 22	W 21	W 18	W 14	W 12	W 11
#4017								

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
#4020	ASVOK	ZRNA	−JA	+JA	ZPNA	DIRA	$\overline{\text{INC}}$/ABSA	STRA	A
#4021	HA 7	HA 6	HA 5	HA 4	HA 3	HA 2	HA 1	HA 0	A
#4022	BSVOK	ZRNB	−JB	+JB	ZPNB	DIRB	$\overline{\text{INC}}$/ABSB	STRB	B
#4023	HB 7	HB 6	HB 5	HB 4	HB 3	HB 2	HB 1	HB 0	B
#4024					RSTB	$\overline{\text{STOPB}}$	RSTA	$\overline{\text{STOPA}}$	
#4025									
#4026									
#4027									
#4028									
#4029									

Note Signal in ( ) is not for standard I/O allocation

(2) Control Fixed Output of Motion Module

ADDRESS	D7	D6	D5	D4	D3	D2	D1	D0
#4500	M30	M02		M00	DEN	OP	SPL	STL
#4501	BATALM			SVON	MCRD	(ESP)	RST	ALM
#4502						TF	SF	MF
#4503						ZPZ	ZPY	ZPX
#4504				GRH	GRL	SLPS	G93M	
#4505	M28	M24	M22	M21	M18	M14	M12	M11
#4506	T28	T24	T22	T21	T18	T14	T12	T11
#4507	AC7	AC6	AC5	AC4	AC3	AC2	AC1	AC0
#4508							AC9	AC8
#4509	SVONB	ZPB	ALMB	MOVB	SVONA	ZPA	ALMA	MOVA

Note Signal name in ( ) is not specified at standard I/O allocation

(3) Input Signal of Motion Module 1CN, 2CN

Indication in top column Signal name specified at standard I/O allocation

Indication in bottom column Connector pin No

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4200	EDIT	MEM	DNC	MDI	STEP	HANDLE	JOG	RAPID
	1 CN - 36	1 CN - 20	1 CN - 4	1 CN - 35	1 CN - 19	1 CN - 3	1 CN - 34	1 CN - 2
#4201	ROV 3	ROV 2	ROV 1	OV 16	OV 8	OV 4	OV 2	OV 1
	1 CN - 23	1 CN - 7	1 CN - 38	1 CN - 22	1 CN - 6	1 CN - 37	1 CN - 21	1 CN - 5
#4202	RESET	SVOK	MRDY		JOV 8	JOV 4	JOV 2	JOV 1
	1 CN - 10	1 CN - 41	1 CN - 25	1 CN - 9	1 CN - 40	1 CN - 24	1 CN - 8	1 CN - 39
#4203	RRN	− JZ	− JY	− JX	FRN	+JZ	+JY	+JX
	1 CN - 44	1 CN - 28	1 CN - 12	1 CN - 43	1 CN - 27	1 CN - 11	1 CN - 42	1 CN - 26
#4204	SSTP	GR 2	GR 1	MP 2	MP 1	HZ	HY	HX
	1 CN - 31	1 CN - 15	1 CN - 46	1 CN - 30	1 CN - 14	1 CN - 45	1 CN - 29	1 CN - 13
#4205	ZPNT	MLK	FIN	ZRN	STP	STR	ER	SBK
	1 CN - 50	1 CN - 18	1 CN - 49	1 CN - 17	1 CN - 48	1 CN - 32	1 CN - 16	1 CN - 47
#4206	W 28	W 24	W 22	W 21	W 18	W 14	W 12	W 11
	2 CN - 36	2 CN - 20	2 CN - 4	2 CN - 35	2 CN - 19	2 CN - 3	2 CN - 34	2 CN - 2
#4207	SK 8	SK 7	SK 6	SK 5	SK 4	SK 3	SK 2	SK 1
	2 CN - 23	2 CN - 7	2 CN - 38	2 CN - 22	2 CN - 6	2 CN - 37	2 CN - 21	2 CN - 5

(4) Output Signal of Motion Module 2CN

Indication in top column Signal name specified at standard I/O allocation

Indication in bottom column Connector pin No

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4300	M 30	M 02	SVON	M 00	DEN	OP	SPL	STL
	2 CN - 10	2 CN - 41	2 CN - 25	2 CN - 9	2 CN - 40	2 CN - 24	2 CN - 8	2 CN - 39
#4301	ALM	ZPZ	ZPY	ZPX	RST	SF	TF	MF
	2 CN - 44	2 CN - 28	2 CN - 12	2 CN - 43	2 CN - 27	2 CN - 11	2 CN - 42	2 CN - 26
#4302	M 28	M 24	M 22	M21	M 18	M 14	M 12	M 11
	2 CN - 31	2 CN - 15	2 CN - 46	2 CN - 30	2 CN - 14	2 CN - 45	2 CN - 29	2 CN - 13
#4303	T 28	T 24	T 22	T 21	T 18	T 14	T 12	T 11
	2 CN - 50	2 CN - 18	2 CN - 49	2 CN - 17	2 CN - 48	2 CN - 32	2 CN - 16	2 CN - 47

(5) Input Signal of Motion Module 9CN

Indication in top column: Signal name specified at standard I/O allocation

Indication in bottom column: Connector pin No

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4208	SLPC	S-FIN	GR 0				PRGP	PRMP
	9 CN - 36	9 CN - 20	9 CN - 4	9 CN - 35	9 CN - 19	9 CN - 3	9 CN - 34	9 CN - 2
#4209	PMEM	NEG	TBXON	EINV	RSTB	$\overline{\text{STOPB}}$	RSTA	$\overline{\text{STOPA}}$
	9 CN - 23	9 CN - 7	9 CN - 38	9 CN - 22	9 CN - 6	9 CN - 37	9 CN - 21	9 CN - 5
#4210	ASVOK	ZRNA	−JA	+JA	ZPNA	DIRA	$\overline{\text{INC}}$/ABSA	STRA
	9 CN - 10	9 CN - 41	9 CN - 25	9 CN - 9	9 CN - 40	9 CN - 24	9 CN - 8	9 CN - 39
#4211	HA 7	HA 6	HA 5	HA 4	HA 3	HA 2	HA 1	HA 0
	9 CN - 44	9 CN - 28	9 CN - 12	9 CN - 43	9 CN - 27	9 CN - 11	9 CN - 42	9 CN - 26
#4212	BSVOK	ZRNB	−JB	+JB	ZPNB	DIRB	$\overline{\text{INC}}$/ABSB	STRB
	9 CN - 31	9 CN - 15	9 CN - 46	9 CN - 30	9 CN - 14	9 CN - 45	9 CN - 29	9 CN - 13
#4213	HB 7	HB 6	HB 5	HB 4	HB 3	HB 2	HB 1	HB 0
	9 CN - 50	9 CN - 18	9 CN - 49	9 CN - 17	9 CN - 48	9 CN - 32	9 CN - 16	9 CN - 47

(6) Output Signal of Motion Module 10CN

Indication in top column Signal name specified at standard I/O allocation
Indication in bottom column Connector pin No

ADDRESS	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
#4304	GRH	GRL	SLPS	G 93 M		BATALM	MCRD	
	10 CN - 36	10 CN - 20	10 CN - 4	10 CN - 35	10 CN - 19	10 CN - 3	10 CN - 34	10 CN - 2
#4305	AC 7	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0
	10 CN - 23	10 CN - 7	10 CN - 38	10 CN - 22	10 CN - 6	10 CN - 37	10 CN - 21	10 CN - 5
#4306							AC 9	AC 8
	10 CN - 10	10 CN - 41	10 CN - 25	10 CN - 9	10 CN - 40	10 CN - 24	10 CN - 8	10 CN - 39
#4307	SVONB	ZPB	ALMB	MOVB	SVONA	ZPA	ALMA	MOVA
	10 CN - 44	10 CN - 28	10 CN - 12	10 CN - 43	10 CN - 27	10 CN - 11	10 CN - 42	10 CN - 26
#4308								
	10 CN - 31	10 CN - 15	10 CN - 46	10 CN - 30	10 CN - 14	10 CN - 45	10 CN - 29	10 CN - 13
#4309								
	10 CN - 50	10 CN - 18	10 CN - 49	10 CN - 17	10 CN - 48	10 CN - 32	10 CN - 16	10 CN - 47

SERVOPACK I/O Monitor

ADDRESS	D7	D6	D5	D4	D3	D2	D1	D0	
#6000	SKIP			$\overline{\text{DEC}}$	PCON		$\overline{\text{OT-R}}$	$\overline{\text{OT-F}}$	X
#6001	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T-LIM	S-LIM	PRDY	PC	PB	PA	X
#6002	SKIP			$\overline{\text{DEC}}$	PCON		$\overline{\text{OT-R}}$	$\overline{\text{OT-F}}$	Y
#6003	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T-LIM	S-LIM	PRDY	PC	PB	PA	Y
#6004	SKIP			$\overline{\text{DEC}}$	PCON		$\overline{\text{OT-R}}$	$\overline{\text{OT-F}}$	Z
#6005	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T-LIM	S-LIM	PRDY	PC	PB	PA	Z
#6006				$\overline{\text{DEC}}$	PCON		$\overline{\text{OT-R}}$	$\overline{\text{OT-F}}$	A
#6007	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T-LIM	S-LIM	PRDY	PC	PB	PA	A
#6008				$\overline{\text{DEC}}$	PCON		$\overline{\text{OT-R}}$	$\overline{\text{OT-F}}$	B
#6009	$\overline{\text{ALM}}$	$\overline{\text{BRK}}$	T-LIM	S-LIM	PRDY	PC	PB	PA	B

NOTES

MOTIONPACK-120
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