BNP-B3794A (ENG)

MITSUBISHI CNC

SINGLE-AXIS AMPLIFIER BUILT-IN CONTROLLER

MODEL E

SPECIFICATION AND SERVO SELECTION MANUAL

ADVANCED AND EVER ADVANCING
MITSUBISHI ELECTRIC

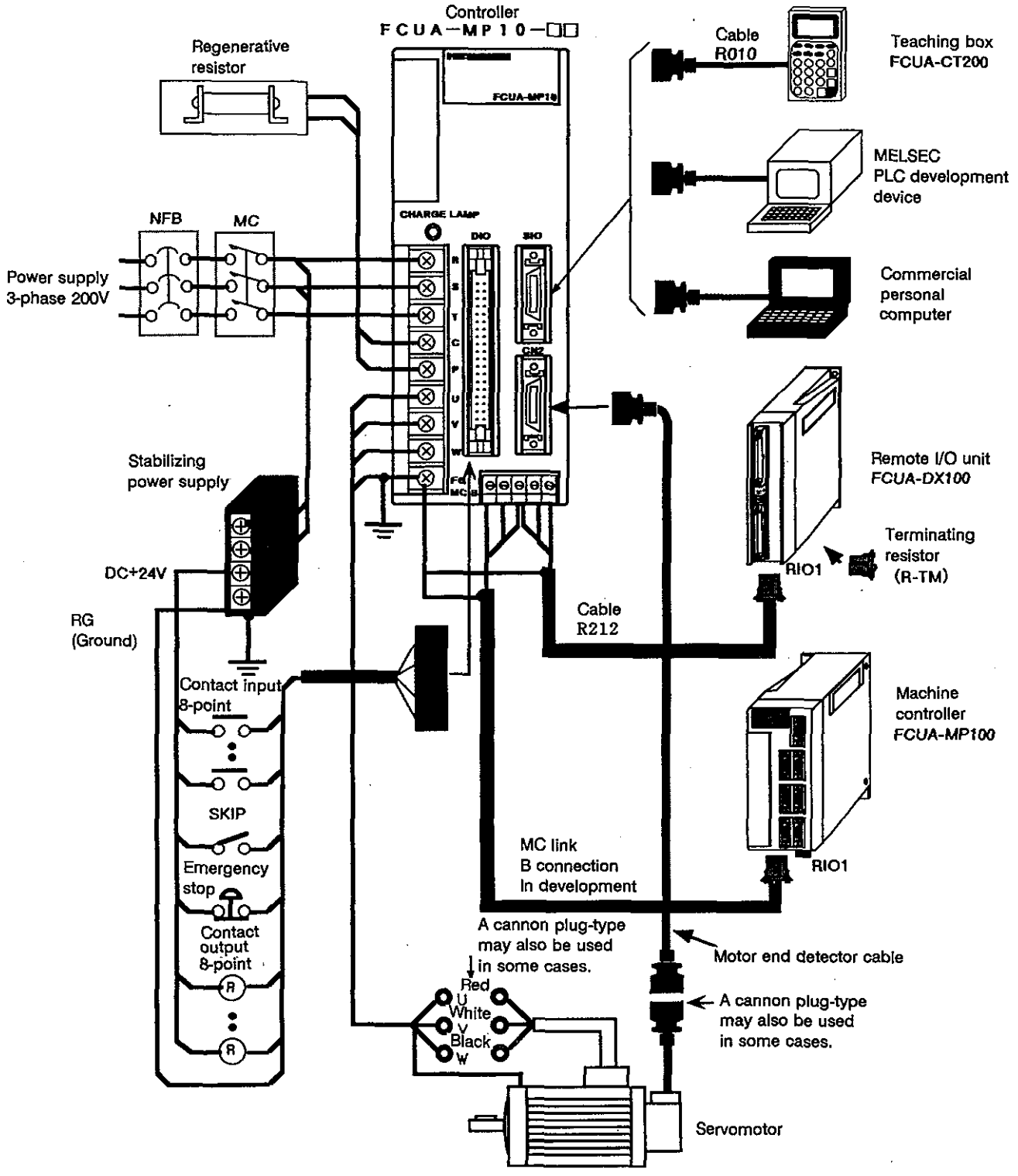
CONTENTS

CHAPTER 1 Controller Specifications

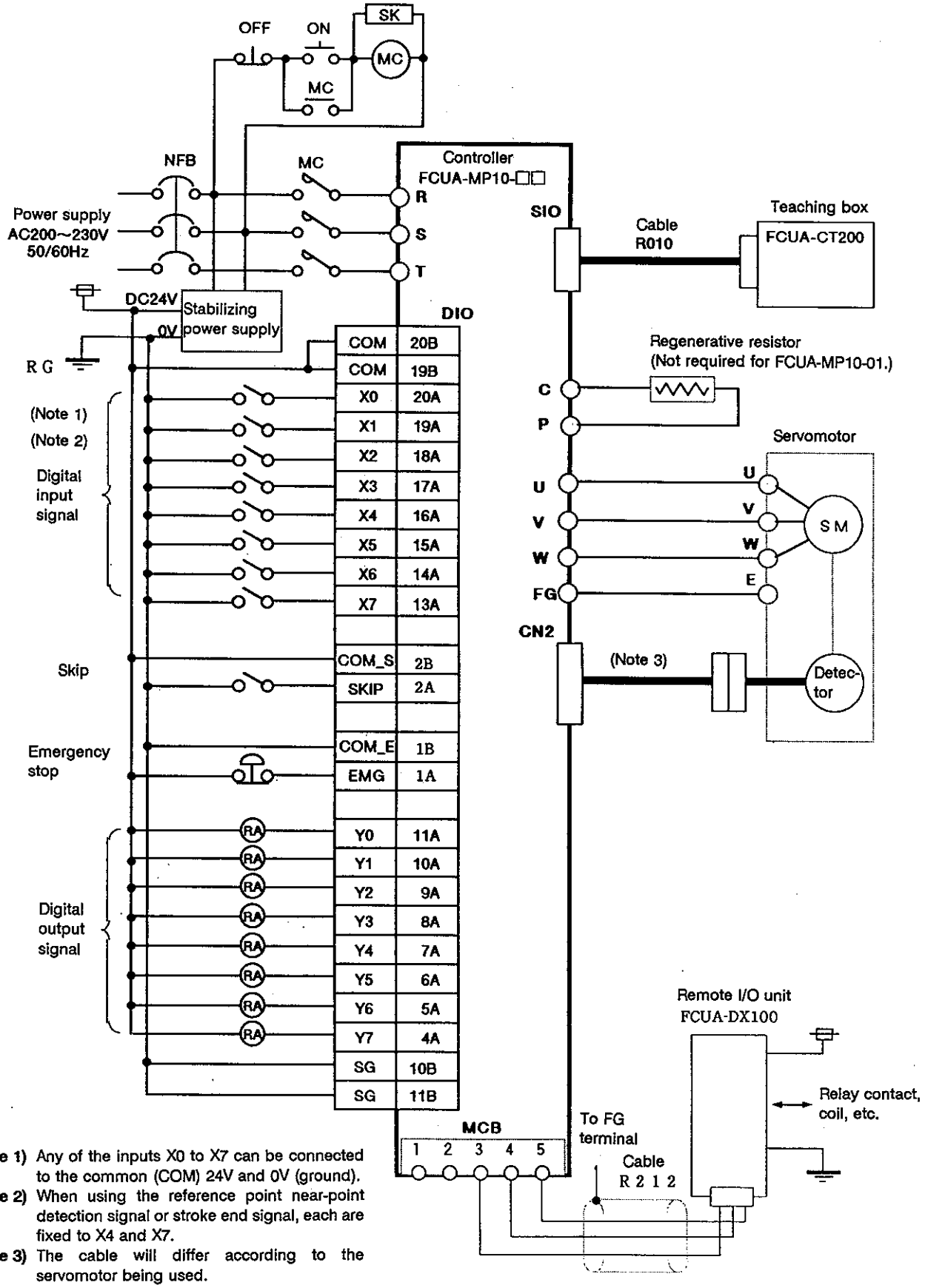
1.1 Outline

The Mitsubishi single-axis amplifier built-in controller was developed for applications such as positioning control and auxiliary axis for multi-axis controllers. This is an all-in-one controller in which many functions are loaded in the compact box.

Max. configuration of system



Example of basic connections



(Note 1) Any of the inputs X0 to X7 can be connected to the common (COM) 24V and 0V (ground).

(Note 2) When using the reference point near-point detection signal or stroke end signal, each are fixed to X4 and X7.

(Note 3) The cable will differ according to the servomotor being used.

1.2 Controller specifications

1.2.1 Configuration of controller and related unit types and names

FCUA – MP10 – 01

- Output capacity (Only for controller)
  - 01 : 100W class
  - 03 : 300W class
  - 06 : 600W class
  - 10 : 1000W class
  - 20 : 2000W class
- MP 10 : Mitsubishi single-axis amplifier built-in controller Model E series
- CT200 : Teaching box
- DX100 : Remote I/O unit

Table of servomotor, regenerative resistor and controller combinations

: Standard : Option

			Controller type FCUA-MP10-				
			01	03	06	10	20
Servomotor	Ultra-low inertia HA-ME series	HA-ME053	50W				
		HA-ME13	100W				
		HA-ME23		200W			
		HA-ME43		400W			
		HA-ME73			750W		
	Low inertia HA-FE/FH series	HA-FE/FH053	50W				
		HA-FE/FH13	100W				
		HA-FE/FH23		200W			
		HA-FE/FH33		300W			
		HA-FE/FH43			400W		
		HA-FE/FH63			600W		
	Medium inertia HA-SE/SH 1000r/min. series	HA-SE/SH81			850W		
		HA-SE/SH121				1200W	
		HA-SE/SH201					2000W
	Medium inertia HA-SE/SH 2000r/min. series	HA-SE/SH52			500W		
		HA-SE/SH102				1000W	
		HA-SE/SH152				1500W	
		HA-SE/SH202					2000W
	Medium inertia HA-SE/SH 3000r/min. series	HA-SE/SH53			500W		
		HA-SE/SH103				1000W	
		HA-SE/SH153				1500W	
		HA-SE/SH203					2000W
Regenerative resistor			Regeneration times (times/min.)				
	None (capacitor regeneration)		Note 1				
	MR-RB013			150	70		
	MR-RB033			450	200		
	MR-RB32 (Two in parallel)					64	25

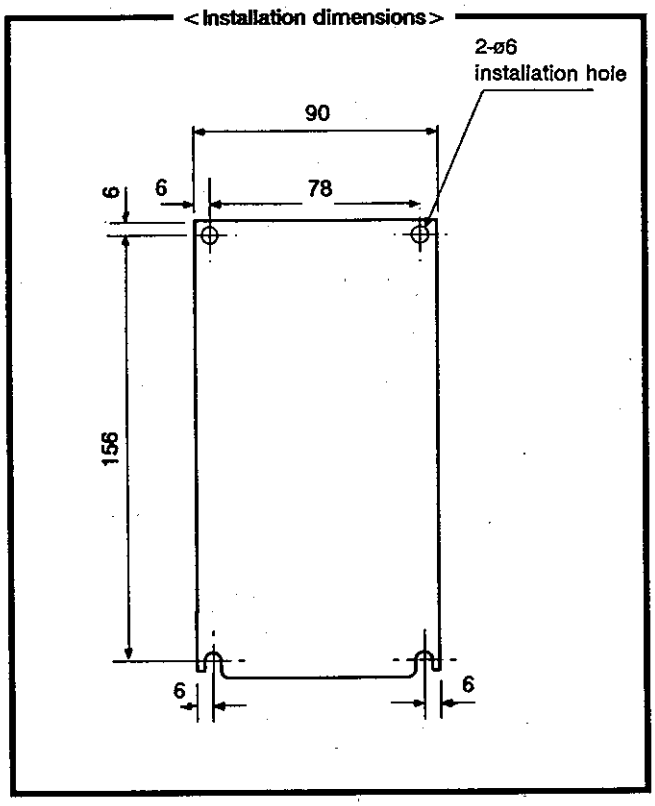
Note 1) There is no limit to the regeneration frequency if the execution torque is within the rated torque range.

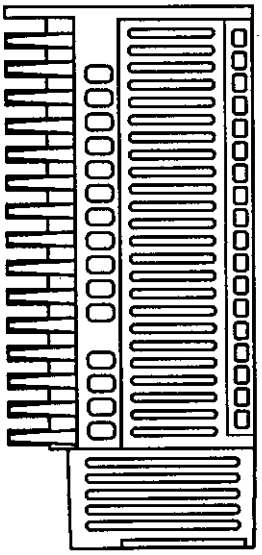
1.2.2 General specifications

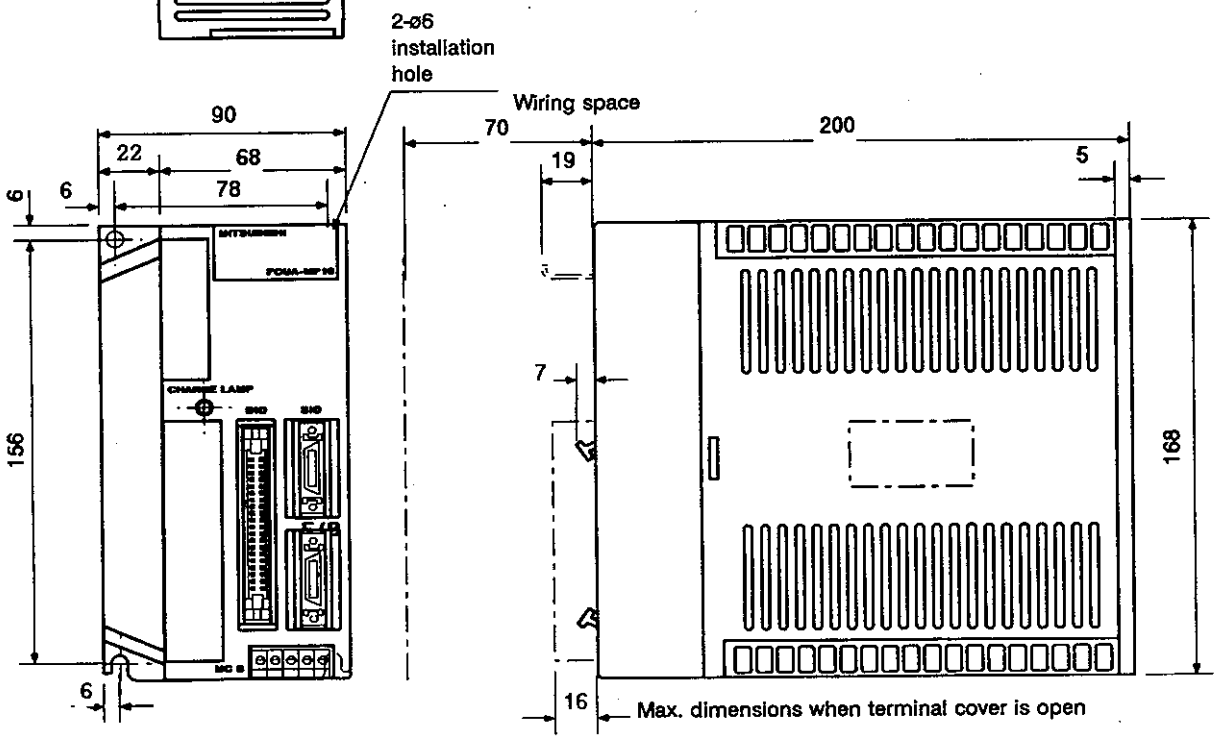
Type FCUA-			MP10-01	MP10-03	MP10-06	MP10-10	MP10-20	DX100	CT200
AC power supply	Voltage/frequency		3-phase AC200~230V 50/60Hz					—	—
	Tolerable voltage fluctuation		AC170~253V (50/60Hz)					—	—
	Tolerable frequency fluctuation		Within ±5%					—	—
	Power facility capacity	(kVA)	0.3	0.7	1.1	1.7	3.5	—	—
DC supply	Voltage		DC24V						—
	Tolerable voltage fluctuation		Within ±5%						—
	Ripple		±5% (p – p)						—
	Power capacity		1A (Note 2)					Note 3)	Note 4)
Continuous output current		(Arms)	1.4	3.0	5.0	8.8	14.0	—	—
Maximum output current		(Arms)	3.9	8.1	17.0	28.0	42.0	—	—
Control method			Sinusoidal wave PWM control					—	—
Regeneration method			Capacitor regenera-tion	External resistor regeneration				—	—
	Regenerative resistor type	Standard	Note 1)	MR-RB013		MR-RB033 Two in parallel		—	—
		Option		MR-RB033				—	—
	Tolerable regeneration frequency (times/min.)	Standard	Note 1)	150	70	64	25	—	—
		Option		450	200			—	—
Recommended load moment of inertia			10 times or less of motor moment of inertia (Note, when using for a machine tool, 2.5 times or less of motor moment of inertia.)					—	—
Environment	Ambient temperature		0 ~ +55°C (with no freezing), Storage: –20 ~ +65°C						
	Ambient humidity		90%RH or less (with no dew condensation)						
	Atmosphere		No corrosive gases or dust						
	Altitude		1000m or less						
	Vibration		5.9m/s (0.6G) or less						
Structure			Open type (in-panel cooling method)						Fully closed type

(Note 1) There is no limit to the regeneration frequency if the execution torque is within the rated torque range.
(Note 2) This is the power for driving the external devices such as the relays, connected to the digital input/output interface.
(Note 3) Maintain a capacity that ensures 0.7A (internal control circuit) + 2.25A (total of current consumed by connected relays, etc.)
(Note 4) The power is supplied from the controller (FCUA-MP10). A power supply device does not need to be prepared specially.

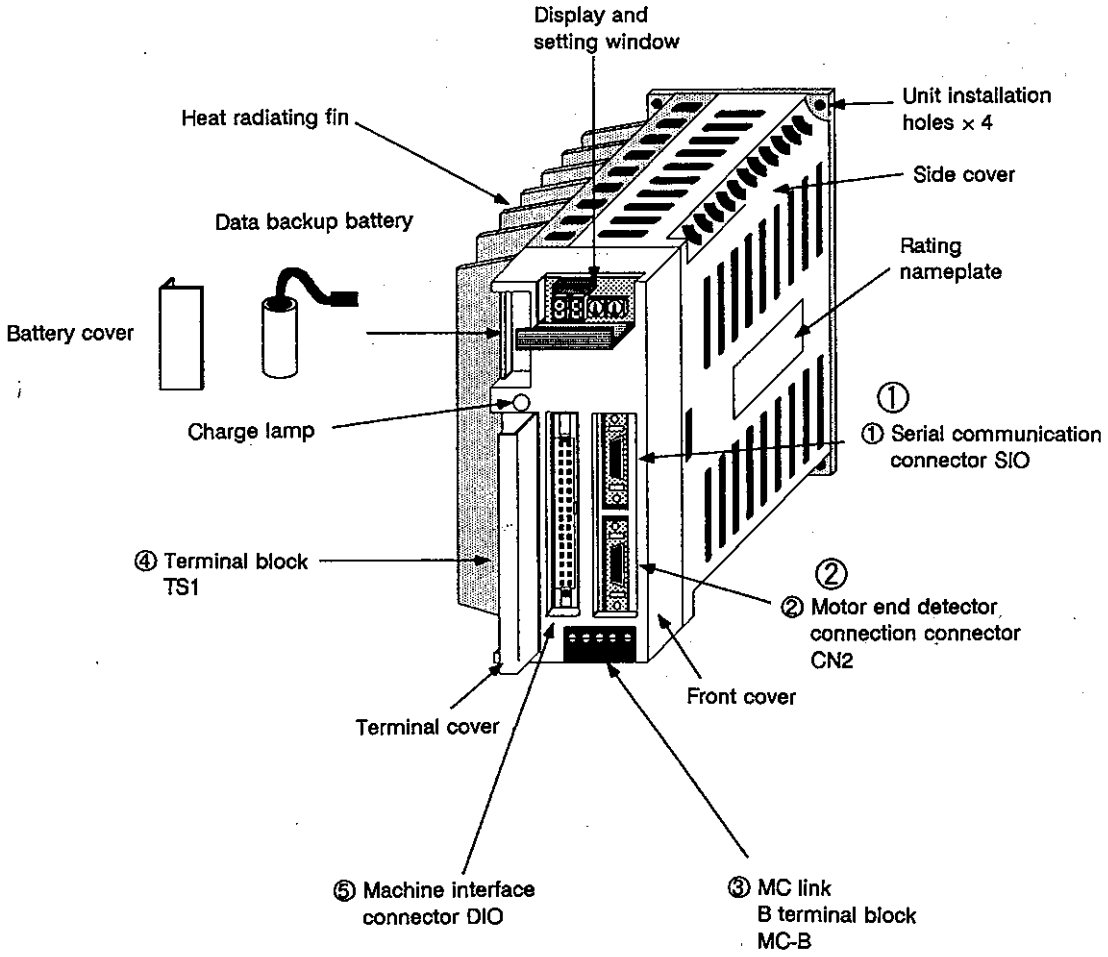
1.2.3 Outline and installation dimensions for controller FCUA-MP10-□□







1.3 Connector layout and external connection specifications



Detailed explanation of connectors

①	**Name :** SIO **Connector type:**
	Application: Connection of teaching box, MELSEC development device, commercial personal computer
	Recommended connector for cable side:
	<Pin assignment>

RS-422 MELSEC development device

RS-232-C Teaching box

20		10	
19	DTR*	9	DTR
18	RXD*	8	RXD
17	TXD*	7	TXD
16	DSR*	6	DSR
15	GND	5	GND
14	DTR	4	DSR
13		3	
12	TXD	2	RXD
11	GND	1	GND

FG

Note: Select one of the methods and connect.

②

Name : CN2 **Connector type:**

Application: Servo F/B

Recommended connector for cable side:

<Pin assignment>

20	+5 V	10	+5 V
19	+5 V	9	BT
18	LR*/V*	8	LR/W
17	HR*/V*	7	HR/V
16	HD*/LD*/U*	6	HD/LD/U
15	RG	5	MOH
14	Z*	4	Z
13	B*	3	B
12	A*	2	A
11	GND	1	GND

FG

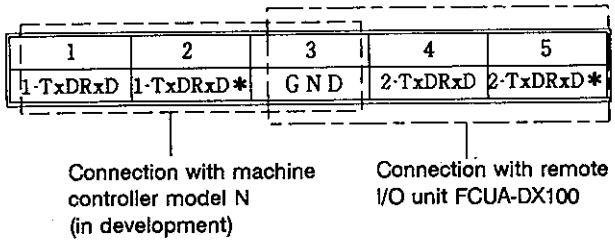
③

Name : MC-B **Connector type:** Terminal block

Application: MC link B (Connection of remote I/O unit)

Recommended connector for cable side:

<Pin assignment>



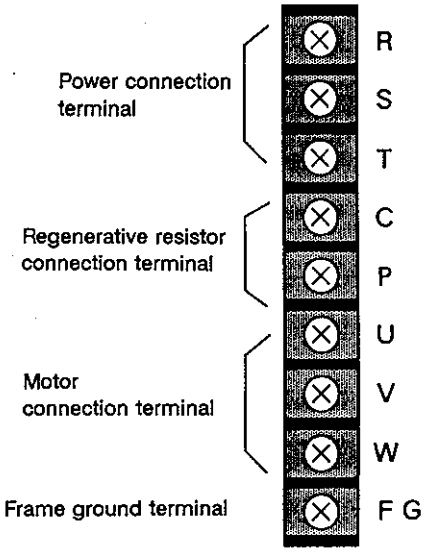
④

Name : TS **Connector type:** Terminal block (M3.5 × 9)

Application: Connection of input power supply, motor drive wire, regenerative resistor

Recommended connector for cable side:

<Pin assignment>



⑤

Name : DIO **Connector type:**

Application: Digital machine interface

Recommended connector for cable side:

<Pin assignment>

* Front view of connectors on controller

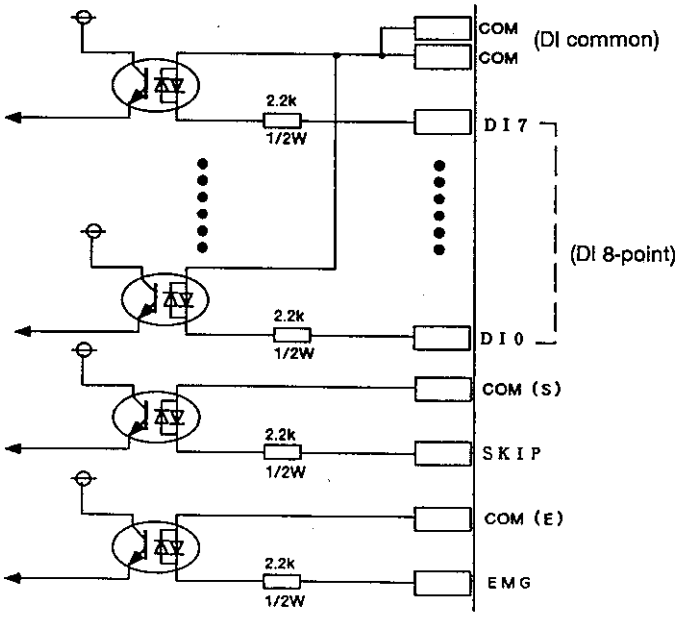
	B	A
20	COM(X)	X0
19	COM(X)	X1
18		X2
17		X3
16		X4
15		X5
14		X6
13		X7
12		
11	COM(Y)	Y0
10	COM(Y)	Y1
9		Y2
8		Y3
7		Y4
6		Y5
5		Y6
4		Y7
3		
2	COM (S)	SKIP
1	COM (E)	EMG

SKIP signal exclusive common

Emergency stop exclusive common

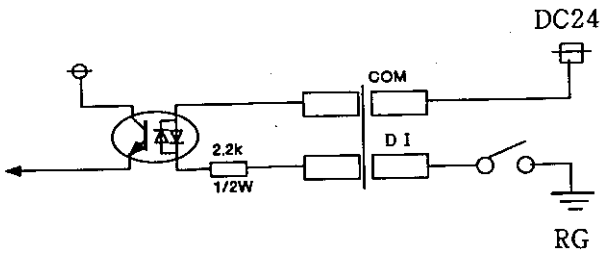
<Input circuit (X0 to X7, SKIP, EMG emergency stop)>
Either "common — DC24V" connection or "common — ground" connection can be used for the input circuit. The SKIP and EMG emergency stop signal commons are separated from other commons.

Input circuit (X0 to X7, SKIP, EMG emergency stop)

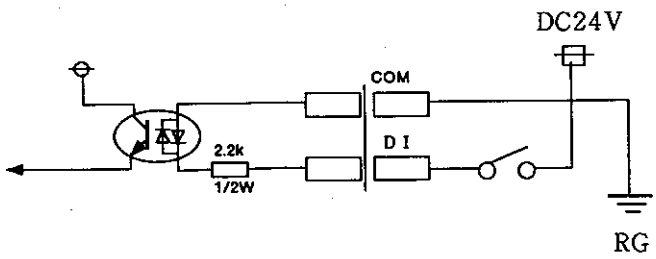


⑤

Example of "common — DC24V"



Example of "common — ground"



Input signal conditions

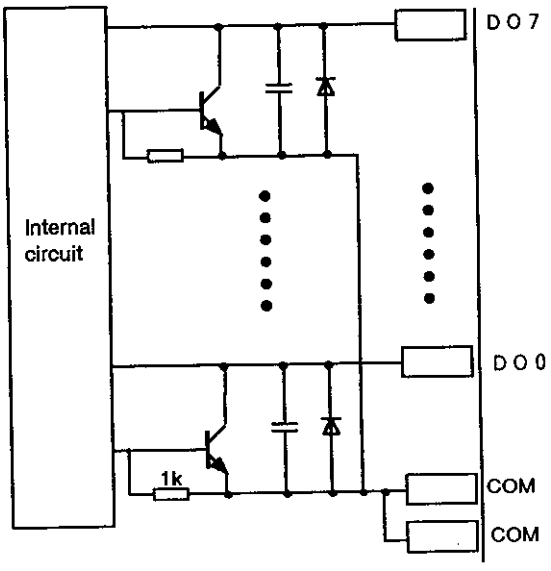
	X0 ~ X7,EMG	SKIP
Max. input voltage	26V	26V
Input ON voltage	20V or more	20V or more
Input OFF voltage	6V or less	6V or less
Tolerable chattering time	1ms or less	1ms or less
Input signal hold time	(Note 1)	2ms or more
Machine side contact capacity	+30V or more, 16mA or more	+30V or more, 16mA or more

(Note 1) This will differ according to the PLC program length.

<Output circuit (Y0 to Y7)>

The output is an open collector (sink output).

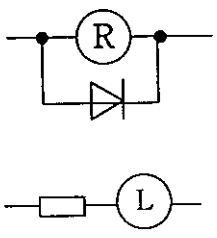
Output circuit (Y0 to Y7)



Output signal conditions

Insulation method	Photocoupler
Rated load voltage	DC+24V
Max. output current	60mA
Output delay time	40μs

When driving a relay coil or lamp, etc., insert a protective resistance clamp diode to prevent rush currents.



1.4 Controller operation control function

1.4.1 Control axis

No. of controllable axes: 1 axis

1.4.2 Command unit (Command and setting unit)

Linear axis : 0.001mm
Rotary axis : 0.001deg.

The command unit is changed with the parameters. (In development)

Type	Linear axis	Rotary axis
A	0.001mm	0.001 deg.
B	0.01mm	0.01 deg.
C	1mm	1 deg.

1.4.3 Command method

The commands are issued with the point table method in which positioning commands can be issued easily. The positioning to the multiple points (movement target values) designated in the point table can be done with the multi-point mode in which positioning is continuously executed from the randomly selected points by the signal input from an external source, or single-point mode in which random points are selected by the input signal from an external source and then positioning is executed.

Point table specifications

Item	Specifications
No. of points	Standard: 8 points, Max. 64 points
Point internal command items	Positioning command, speed command, timer command, M command, acceleration/deceleration time
Position command method	The end position of each point is commanded (absolute value command)
Timer command method	The time is commanded or the deceleration mode is designated
M command method	Direct commanding with M code
Speed command method	Direct commanding of movement speed, or designation with parameter No.
Acceleration/deceleration time	Direct commanding of acceleration/deceleration time

1.4.4 Feed function

[Speed command method]

The speed is commanded as a movement speed to each point in the point program. There are two commanding methods.

Speed command method	Specifications
Linear command	The movement speed is directly set in the point program.
Parameter designation	The speed is commanded with a No. of a parameter where a speed has been preset.

[Feed method]

The axis is fed with the asynchronous feed method in which the feed rate per minute is set.

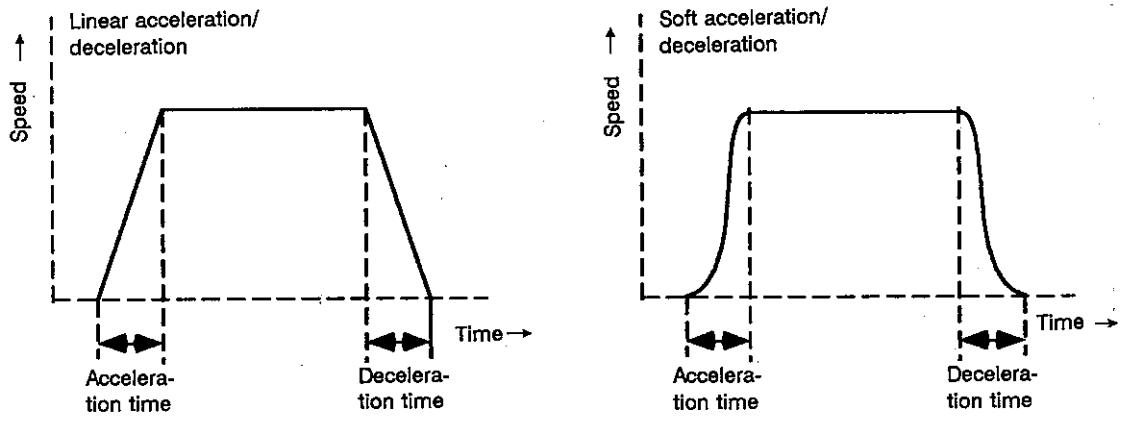
[Command range]

Command unit	A (0.001mm)	B (0.01mm)	C (1mm)
Command mode	Per-minute feed	Per-minute feed	Per-minute feed
Min. command unit	0.001 mm/min.	0.01 mm/min.	1 mm/min.
Command range	0.001 ~ 100000.000	0.01 ~ 100000.00	1 ~ 100000

* The command units B and C are in development.

[Automatic acceleration/deceleration]

The acceleration/deceleration is automatically applied to all commands. The linear acceleration/deceleration or soft acceleration/deceleration pattern can be selected with parameters.
Selection of whether the axis decelerates at each point or continues during continuous operation of the point program is set with the timer in the point table.



[Feedrate override]

An override of 0% to 300% can be applied on the feedrate.

[Feedrate parameter]

The feedrate can be preset in the parameters. There are four parameter stages, and random values can be set in each stage.
The speed set in the first stage is handled as the clamp speed. A speed exceeding this clamp speed cannot be commanded in any case. For example, if speed parameter No. 1 is designated in the point program, the override will be valid only to 100%.
The four stages of speed parameter have the following special meanings.

Speed parameter	Parameter correspondence	Special handling
Stage 1	Equivalent to the point table No. designation –1	Clamp speed, PLC manual speed 1
Stage 2	Equivalent to the point table No. designation –2	Clamp speed, PLC manual speed 2
Stage 3	Equivalent to the point table No. designation –3	
Stage 4	Equivalent to the point table No. designation –4	

1.4.5 Timer

The timer time can be set for each point in the point program. When positioning to that point is completed, the axis will wait at that point for the designated timer time.
The timer time setting range is 0.001 to 99999.999 sec.
The following timer setting values have special meanings.

Timer setting value	Valid special function
0	The completion of positioning is confirmed with the command system, and then execution of the next point data is moved to. (Error detect OFF)
–1	The deceleration and stop for servomotor positioning is confirmed, and then execution of the next point data is moved to. (Error detect ON)
–2	The axis does not deceleration and stop, and instead the execution of the next point data is moved to. However, if a differing speed is designated in the next point data, the axis will accelerate/decelerate to that speed.

1.4.6 M function

The M commands can be set for each point in the point program. The M code and strobe signal will be output simultaneously with the start of movement to that point. A completion sequence is required for the M command. The axis will wait at that point until the completion sequence is completed. The M command is output as a 2-digit BCD.

1.4.7 Coordinate system setting

[Reference point return]

The axis can be returned to the position (reference point) set characteristically for the machine.
Either dog-type reference point return or memory-type reference point return can be used.

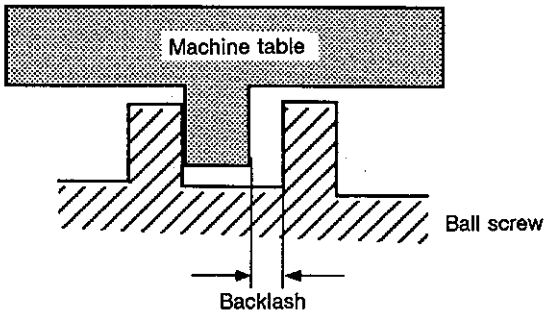
[Coordinate system for rotary axis]

The coordinate system for the rotary axis is between 0° and 360°. Note that the coordinate system display will be from 0 to 359.999. Short cut control is also possible.

1.4.8 Machine error compensation

[Backlash compensation]

The error (backlash) that occurs when the machine system's movement direction is reversed is compensated.
The compensation amount is specified with the feedback pulse unit of the position detector. The setting range is 0 to ±9999 pulses.



1.4.9 Protective functions

[Emergency stop]

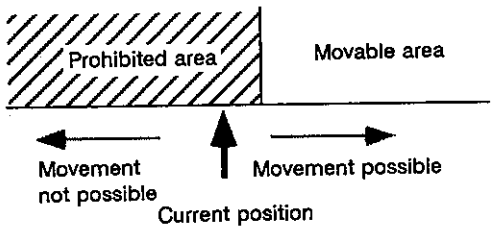
When emergency stop is applied, all commands will be stopped, and the machine movement will be decelerated and stopped.

The movement will also decelerate and stop as with emergency stop when the power is shut off.

[Stroke end]

A limit switch and dog are set in the machine, and when the limit switch kicks the dog, the machine movement will stop. An alarm will simultaneously be output to the machine side.

The stroke end information is retained, and when the axis is escaped from the dog by feeding in the reverse direction in the manual mode, the alarm state will be canceled. If the alarm state is still entered, the program operation will be prohibited, and moving in the first direction will not be possible even with the manual mode.



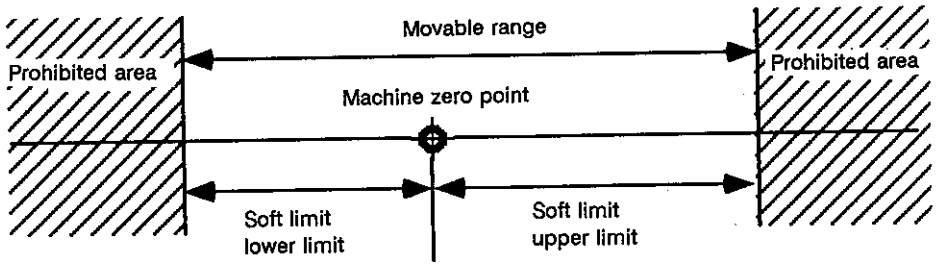
[Soft limit]

This is a memory-type stroke end function. The movable range is set in the parameters with coordinate values. The difference with stroke end is that with soft limit the movement decelerates and stops before the limit point.

There are set maker and user parameters, and the one with the narrower range is valid.

The setting range is –99999.999 to +99999.999mm.

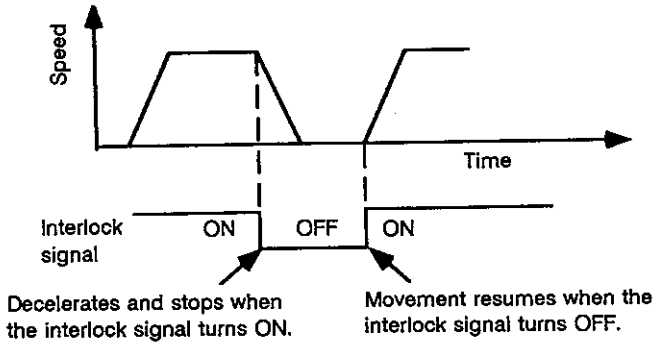
If the same data with signs is set for the max. value and min. value, the soft limit function will be invalidated.



[Interlock]

If the interlock signal is turned OFF with an external input, the machine movement will immediately decelerate and stop. When the signal turns ON again, the movement will resume immediately.

The interlock signals include the manual interlock signal that is valid during manual operation, and the automatic interlock signal that is valid during program operation. The + direction and – direction signals are separate for each signal.



[Edit lock]

The internal data can be protected with the edit lock signal.

Lock signal	Prohibited items
Program lock 1	Writing of point program
Program lock 2	Reading and writing of point program
Parameter lock 1	Changing of parameters for set maker
PLC lock 1	Writing of PLC program
PLC lock 2	Reading and writing of PLC program

1.4.10 Operation mode

[Program operation mode]

This mode automatically operates the point program. Before starting, the No. of the point (0 to 7) where operation is to be started is designated, and the start signal is input. The axis will move to the position commanded by the selected point No.

Whether to continuously execute the next point No. or to stop the operation is controlled with the continuous operation signal. In the multi-point mode, the program will be continuously operated to the last point No. In the single-point mode, the operation will stop when the commands in the designated point No. are completed. To operate the next point No., the point No. designation must be changed, and the start sequence repeated.

[JOG feed]

In the JOG feed mode, the axis can be moved in the manual mode when the movement direction and feedrate are input. When the input of the movement direction is ended, the axis will immediately decelerate and stop.

[Incremental feed]

In the incremental feed mode, the axis will move a set amount when the movement direction, movement scale and feedrate are input. When the movement direction is re-input, the movement will resume.

[Reference point return]

In the reference point return mode, the reference point return (zero point return) can be executed with the same inputs as JOG feed. Whether to use per-time dog-type or memory-type is set with the parameters.

[PLC operation mode]

In this mode, the point program is created with the PLC, and the point program is operated. The point program is created in the file register.

1.4.11 External control

[MC reset]

This resets the controller. When this signal is input, the following reset operations will take place.

1) The axis movement decelerates and stops.
2) The resettable alarms are reset.
3) The M strobe is reset.
4) Program operation stops. Designate the point No. when restarting.
5) The resetting signal is output.

[Operation start]

The program or PLC operation is started. The operation is also removed during automatic off.

[Feed hold]

If this signal is turned OFF during program or PLC operation start, the operation will stop, and the automatic off state will be entered. The operation will not resume even if the signal is turned ON again. The axis will decelerate and stop. When the timer is being executed, the timer count will be held and stopped.

[Continuous operation]

When this signal is turned ON, the next point No. will be continuously executed after the point No. positioning being executed is completed.
When this signal is turned OFF, the program or PLC operation will be stopped and the block stop state will be entered after the point No. positioning being executed is completed.

1.4.12 Status output

[Servo READY]

This signal is output when the servo system enters the operation READY state.

[In-automatic start]

This signal is output when the program operation or PLC operation starts.
This signal will turn OFF during feed hold and block stop. This signal will also turn OFF when execution of the last point No. is completed.

[In-automatic off]

If the feed hold signal turns OFF during program operation or PLC operation, this signal will turn ON. The operation off state will also be entered if the operation mode is changed to the manual mode.

[In-alarm]

This signal turns ON when the controller detects and alarm. The following signals will also be output depending on the alarm type.

1) Servo alarm
2) System alarm
3) Program error
4) Operation error

[Battery alarm]

When the power is turned ON, errors are checked for in the battery. If an error is found, this signal will be output.

[In-reset]

This signal is output when the controller is reset.

[Movement command completion]

This signal will turn ON when the movement command is completed during program operation or PLC operation.

This is used to process the M command after movement is completed.

[Position switch]

A maximum of 8 points can be set in the parameters for the memory-type dog signal. If the machine position is within the setting range, this signal will turn ON. This is used for the area signal.

[Power off movement over]

This signal will be output with an alarm if the machine positions at power off and power on exceed the tolerable error in the absolute position detection system.

1.4.13 Axis control functions

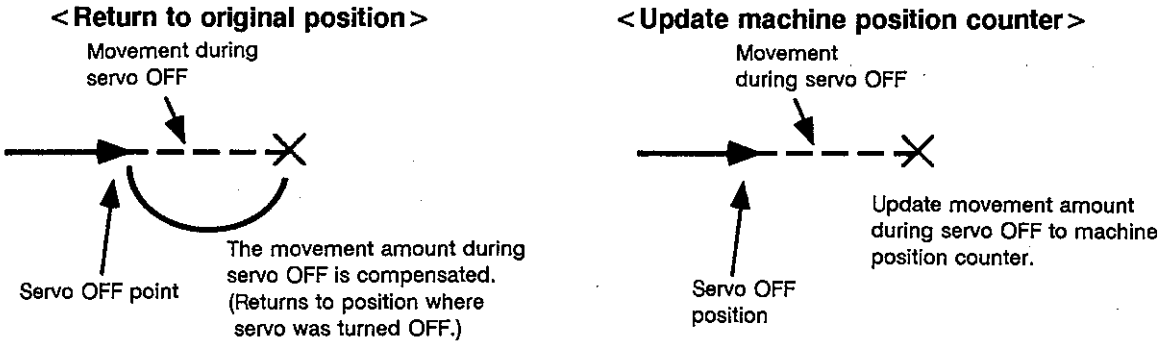
[Servo OFF]

The drive section is turned OFF with the servo OFF input signal.

This function prevents the servomotor from being overload by the clamp force when the movement axis is mechanically clamped.

Whether to compensate (return to original position) the movement amount during servo OFF or to update the machine position when the state is changed from servo OFF to servo ON is selected with parameters.

The axis will be interlocked during servo OFF.



[Follow-up function]

The machine movement during the emergency stop state is monitored, and the machine position is updated. Thus, reference point return does not need to be redone after emergency stop.

[Rotary axis control]

The coordinate system for the rotary axis is handled as 0 to 359.999°. Short cut control in which a short cut direction is selected for the command and moved is selected with parameters.

1.4.14 Data connection

[Serial connection]

A 1-channel serial interface can be used. This teaching box or personal computer can be connected to this channel.

<Serial interface specifications>

Interface : RS-232-C (accordance) 1-channel
RS-422 (accordance) 1-channel
Baud rate : 9600BPS (fixed)
Protocol : 8-bit data + even parity + 1-bit stop (fixed)

[MC link B connection]

Serial connection of the remote I/O unit DX100 (DI: 32-point, DO: 32-point) is possible.

1.5 Servo control function

1.5.1 Smooth high gain control

Using an outstanding response and stable position loop control (SHG control) method, the positioning time and machine vibration during acceleration/deceleration can be reduced, and the tracking can be improved.

1.5.2 Absolute position control

Absolute position detection is possible when using the servomotor with absolute position detector. This motor position is retained even during servo OFF or when the power is turned off.
Either the dog-type or dog-less type (stopper, reference point) can be selected for the zero point initialization method.

1.5.3 Torque limit value changeover

Two preset torque limit values can be changed over with parameters.

1.5.4 Deceleration control during emergency stop

If external emergency stop is input, or if an undervoltage or servo alarm (excluding some) occurs, the motor will be decelerated and stopped according to the set time constant. If the time constant setting is long, stopping with little shock is possible. Note that position loop step stop must be set for the axis with mechanical brake.

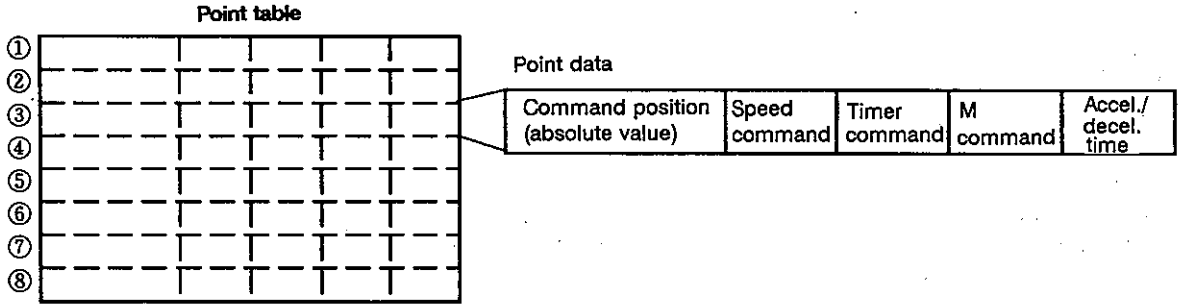
1.5.5 Dynamic braking

The dynamic brake will function when alarm that cannot be controlled with deceleration stop occurs.

1.6 Point table (program)

1.6.1 Configuration of point table

One movement is a point table unit. A maximum of 8 points can be continuously programmed.



1.6.2 Point table creation method

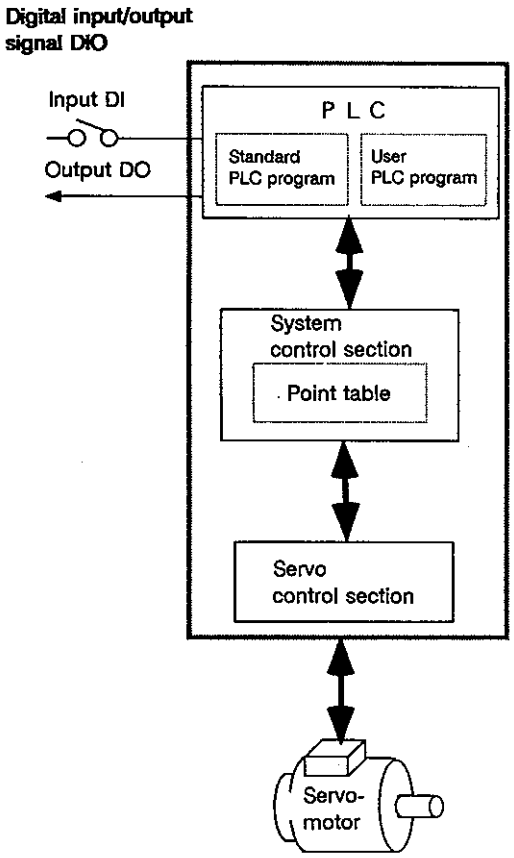
The point program is input to the controller with the teaching box. For PLC operation, the point data with the same configuration is created in the file register, and random movement can be controlled with the PLC. The position to actually move the axis can be input in the point table command position using the teaching box's teaching function.

1.7 Built-in PLC

The Mitsubishi single-axis amplifier built-in controller "Model E" is configured of the control blocks "PLC control section", "System control section" and "Servo control section" as shown on the right. Operations including starting and stopping are started after the PLC analyzes the signal input from the controller and outputs a command to the "System control section".

The "PLC control section" operates according to the "standard PLC program" set as a default, or according to the "user PLC program" created by the user. The "standard PLC program" can be randomly edited, and used as the base for creating the "user PLC program". The default state can be returned to with the touch of a button.

Refer to the separate material "PLC Instruction Manual (BNP-B2072)" for how to create the "user PLC program".



1.7.1 User PLC program

[Specifications]

Language	Ladder language
Program size	500 steps/RAM
Usable No. of commands	20 types of basic commands, 41 types of function commands
D.D.B. interface	Possible

[Development tools]

The following tools can be used for user PLC program development.

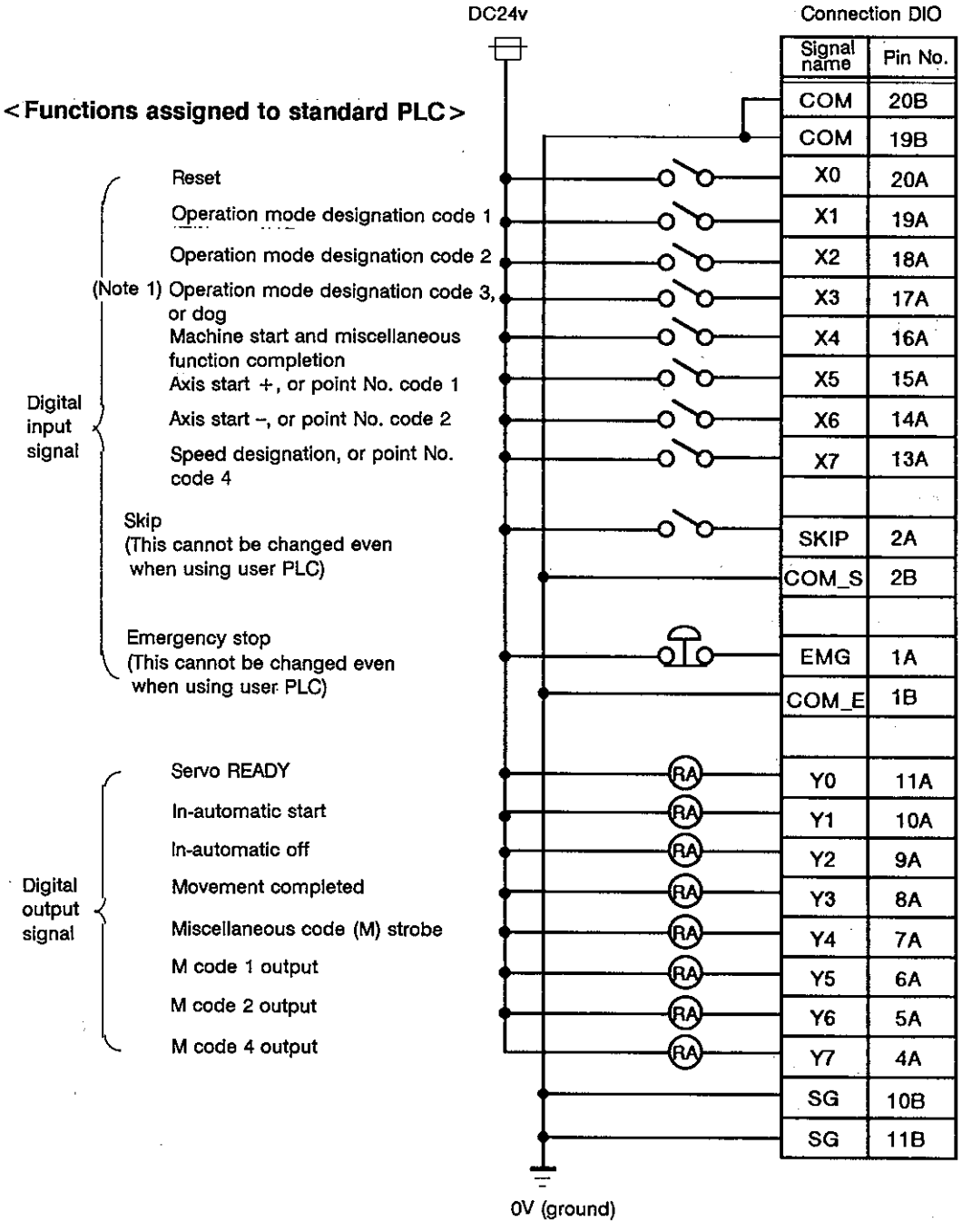
MELSEC development device : A6GPP/A6PHP, A7PHP, A7HGP
Personal computer (PC98)
software for MELSEC development : SW□NX-GPPA

1.7.2 Standard PLC program

The "standard PLC program" is the basic usage method. This program is arranged so that point table operation and manual operation is possible with external input signals.

1.7.3 Digital input interface

The digital input signal interface is used to control the controller operation from an external source, notify the operation state to the external source, or to control the peripheral devices.
For the digital input interface, 8 common input points, 8 common output points, 1 skip signal input point, and 1 emergency stop input point are mounted on the controller unit. When using the "standard PLC program", the following functions are assigned to each point.



(Note 1) The details assigned to X3 to X7 will differ according to the operation mode. Refer to "Appendix 3 Explanation of digital input/output interface during use of standard PLC" for details.

1.7.4 Expansion digital input/output interface

By serially connected (MC link B) the remote I/O unit FCUA-DX100, the interface can be expanded by 32 input points and 32 output points. Refer to "Chapter 7 Remote I/O unit specifications" for details.

1.8 Setting and display functions

[Setting and display unit]

The teaching box CT200 can be connected as a setting and display unit. Refer to "Chapter 5 Teaching box CT200 specifications" for details.

A 2-digit 7-segment LED is mounted on the upper front of the controller, so the operation state and occurrence alarm Nos., etc., can be easily displayed.

1.9 Self-diagnosis

[Self-diagnosis display]

The various alarms detected in the controller are displayed.

The cause of stopping or why starting is not possible is displayed.

During emergency stop, the cause is displayed.

(1) Main unit 7-segment

The state of the alarm occurring is displayed on the 2-digit 7-segment LED on the main unit. The No. of the alarm that is occurring is sequentially displayed.

(2) Setting and displayed unit

The No. of the alarm that is occurring is displayed.

[Servo monitor]

The status of the servomotor such as speed and load current is displayed on the teaching box CT200 monitor.

[Input/output interface]

The status of the digital input/output interface is displayed on the teaching box CT200 monitor.

With forced definition, a random interface can be forced defined.

[History monitor]

The latest 24 alarms that have occurred are saved as alarm history, and can be displayed on the teaching box CT200.

A maximum of 128 points of changes in the input/output interface can be recorded and displayed on the teaching box CT200.

[PLC monitor]

The ladder monitor function can be used by connecting the following MELSEC peripheral devices.

- MELSEC development device A6GPP/A6PHP, A7PHP, A7HGP
- Personal computer (PC98) + personal computer (PC98) software for MELSEC development SW□NX-GPPA

CHAPTER 2 Servomotor Selection

The servomotor capacity, positioning method, and use of reduction gears can be selected according to the application.

Series name	Ultra-low inertia, small capacity HA-ME series	Low-inertia, small capacity HA-FE/FH series		Medium inertia, medium capacity HA-SE/SH series	
Motor type	HA-ME ··	HA-FE ··	HA-FH ··	HA-SE ··	HA-SH ··
Motor capacity	0.05kW ~ 0.75kW	0.05kW ~ 0.6kW		0.5kW ~ 2kW	
Positioning method	Incremental	Incremental	Incremental, absolute value	Incremental	Incremental, absolute value

2.1 Configuration of servomotor name

HA – SH 10 2 B G – Y – K

Symbol	Shaft end
None	Straight shaft, no keyway
T	Taper
	Straight shaft, no keyway

Symbol	Detector
None	Incremental
Y	Absolute position

Symbol	Reduction gears
None	None
G	With

Symbol	Magnetic brakes
None	None
B	With

Symbol	Rated speed
1	1000 r/min.
2	2000 r/min.
3	3000 r/min.

Symbol	Output	Symbol	Output
05	50W	6	600W
1	100W	8	850W
2	200W	10	1000W
3	300W	12	1200W
4	400W	15	1500W
5	500W	20	2000W

AC servomotor
HA-ME series,
HA-FE series,
HA-SE series,
HA-FH series,
HA-SH series

2.2 Servomotor specifications

			HA-ME series				
Features			Ultra-low inertial, small capacity				
Position detection method			Incremental				
Type		HA-	ME053	ME13	ME23	ME43	ME73
Conti-nuous charac-teristics	Rated output	(kW)	0.05	0.1	0.2	0.4	0.75
	Rated torque	(Nm)	0.16	0.32	0.64	1.3	2.4
	Rated torque	(kgf·cm)	1.62	3.25	6.49	13.0	24.4
Rated speed		(r/min.)	3000				
Max. speed		(r/min.)	4500				
Max. torque (Nm)		(kgf·cm)	0.48	0.95	1.9	3.9	7.2
			4.87	9.74	19.5	39.0	73.1
Power rate		(kW/sec.)	12.19	29.25	37.23	93.88	78.24
Moment of inertia	J	($kg \cdot cm^2$)	0.021	0.035	0.11	0.18	0.73
	GD^2	($kgf \cdot cm^2$)	0.084	0.140	0.44	0.72	2.92
Speed/position detector			Encoder 1000P/rev resolution 4000P/rev)				
Mounted parts			Encoder				
Structure			Fully-closed, self-cooling (no frame) JP44				
Ambient temperature			0°C ~ 40°C				
Weight		(kg)	0.4	0.55	1.2	1.8	3.5
Compatible units	MC10-01		■	■			
	MC10-03				■	■	
	MC10-06						■
	MC10-10						
	MC10-20						
Power facility capacity		(kVA)	0.3	0.3	0.7	0.7	1.1

♦ HA-FE/FH series

			HA-FE series						HA-FH series					
Features			Low-inertia, small capacity						Low-inertia, small capacity					
Position detection method			Incremental						Absolute value/incremental					
Type		HA-	FE053	FE13	FE23	FE33	FE43	FE63	FH053	FH13	FH23	FH33	FH43	FE63
Conti-nuous charac-teristics	Rated output	(kW)	0.05	0.1	0.2	0.3	0.4	0.6	0.05	0.1	0.2	0.3	0.4	0.6
	Rated torque	(Nm)	0.16	0.32	0.64	0.95	1.3	1.9	0.16	0.32	0.64	0.95	1.3	1.9
	Rated torque	(kgf•cm)	1.62	3.25	6.5	9.7	13.0	19.5	1.62	3.25	6.5	9.7	13.0	19.3
Rated speed		(r/min.)	3000						3000					
Max. speed		(r/min.)	4000						4000					
Max. torque (Nm)		(kgf•cm)	0.48	0.95	1.9	2.9	3.8	5.7	0.48	0.95	1.9	2.9	3.8	5.7
			4.86	9.74	19.5	29.2	39	58.5	4.86	9.74	19.5	29.2	39	58.5
Power rate		(kW/sec.)	4.0	10.2	11.7	18.1	17.2	30.1	4.0	10.2	11.7	18.1	17.2	30.1
Moment of inertia	J	($kg•cm^2$)	0.063	0.10	0.35	0.50	0.98	1.2	0.063	0.10	0.35	0.50	0.98	1.2
	GD^2	($kgf•cm^2$)	0.25	0.38	1.4	2.0	3.9	4.8	0.25	0.38	1.4	2.0	3.9	4.8
Speed/position detector			Encoder 1000P/rev, resolution 4000P/rev						Encoder 2000P/rev, resolution 8000P/rev					
Mounted parts			Encoder, V-ring						Encoder, V-ring					
Structure			Fully-closed, self-cooling (JP44)						Fully-closed, self-cooling (JP44)					
Ambient temperature			0°C ~ 40°C						0°C ~ 40°C					
Weight		(kg)	1.3	1.5	2.3	2.6	4.2	4.8	1.3	1.5	2.3	2.6	4.2	4.8
Compatible units	MP10-01		▒	▒					▒	▒				
	MP10-03				▒	▒					▒	▒		
	MP10-06						▒	▒					▒	▒
	MP10-10													
	MP10-20													
Power facility capacity		(kVA)	0.3	0.3	0.7	0.7	1.1	1.1	0.3	0.3	0.7	0.7	1.1	1.1

♦ HA-SE/SH series

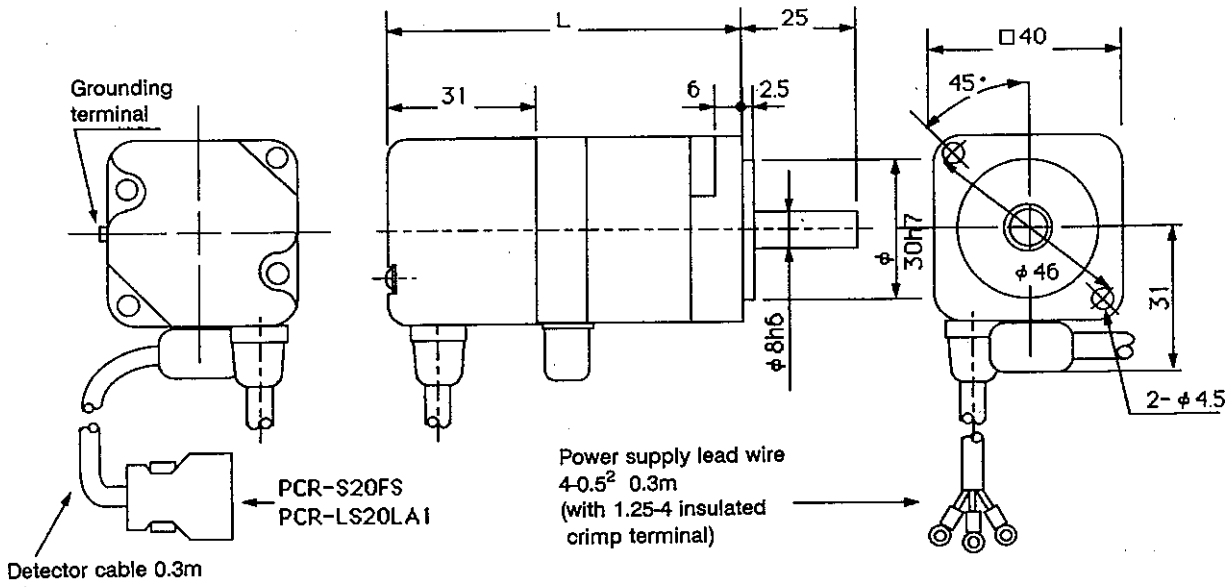
			HA-SE 1000 r/min. series			HA-SE 2000 r/min. series				HA-SE 3000 r/min. series			
Features			Medium inertia, medium capacity										
Position detection method			Incremental										
Type		HA-	SE81	SE121	SE201	SE52	SE102	SE152	SE202	SE53	SE103	SE153	SE203
Continuous characteristics	Rated output	(kW)	0.85	1.2	2.0	0.5	1.0	1.5	2.0	0.5	1.0	1.5	2.0
	Rated torque	(Nm)	8.12	11.5	19.1	2.39	4.78	7.16	9.55	1.59	3.18	4.78	6.35
	Rated torque	(kgf·cm)	82.8	117.0	175.0	24.4	48.7	73.1	97.4	16.2	32.5	48.7	65.0
Rated speed		(r/min.)	1000			2000				3000			
Max. speed		(r/min.)	1200			2300				3000			
Max. torque (Nm)		(kgf·cm)	24.4	34.4	57.3	7.16	14.4	21.6	28.5	4.77	9.55	14.3	19.1
			248.0	351.0	585.0	73.1	146.0	219.0	292.0	48.7	97.4	146.0	195.0
Power rate		(kW/sec.)	22.3	19.3	27.8	5.8	11.8	17.6	13.2	2.6	5.2	7.7	5.9
Moment of inertia	J	($kg \cdot cm^2$)	29.5	68.5	131.0	9.8	19.6	29.5	68.5	9.8	19.6	29.5	68.5
	GD^2	($kgf \cdot cm^2$)	118.0	274.0	525.0	39.2	78.4	118.0	274.0	39.2	78.4	118.0	274.0
Speed/position detector			Encoder 1000P/rev, resolution 4000P/rev										
Mounted parts			Encoder, oil seal										
Structure			Fully-closed, self-cooling JP44										
Ambient temperature			0°C ~ 40°C										
Weight		(kg)	16	21	32	8	12	16	21	8	12	16	21
Compatible units	MP10-01												
	MP10-03												
	MP10-06		▒			▒				▒			
	MP10-10			▒			▒	▒			▒	▒	
	MP10-20				▒				▒				▒
Power facility capacity		(kVA)	1.1	1.7	3.5	1.1	1.7	1.7	3.5	1.1	1.7	1.7	3.5

			HA-SH 1000 r/min. series			HA-SH 2000 r/min. series				HA-SH 3000 r/min. series			
Features			Medium inertia, medium capacity										
Position detection method			Absolute value/incremental										
Type		HA	SH81	SH121	SH201	SH52	SH102	SH152	SH202	SH53	SH103	SH153	SH203
Continuous characteristics	Rated output	(kg)	0.85	1.2	2.0	0.5	1.0	1.5	2.0	0.5	1.0	1.5	2.0
	Rated torque	(Nm)	8.12	11.5	19.1	2.39	4.78	7.16	9.55	1.59	3.18	4.78	6.35
	Rated torque	(kgf·cm)	82.8	117.0	175.0	24.4	48.7	73.1	97.4	16.2	32.5	48.7	65.0
Rated speed		(r/min.)	1000			2000				3000			
Max. speed		(r/min.)	1200			2300				3000			
Max. torque (Nm)		(kgf·cm)	24.4	34.4	57.3	7.16	14.4	21.6	28.5	4.77	9.55	14.3	19.1
			248.0	351.0	585.0	73.1	146.0	219.0	292.0	48.7	97.4	146.0	195.0
Power rate		(kW/sec.)	22.3	19.3	27.8	5.8	11.8	17.6	13.2	2.6	5.2	7.7	5.9
Moment of inertia	J	($kg \cdot cm^2$)	29.5	68.5	131.0	9.8	19.6	29.5	68.5	9.8	19.6	29.5	68.5
	GD^2	($kgf \cdot cm^2$)	118.0	274.0	525.0	39.2	78.4	118.0	274.0	39.2	78.4	118.0	274.0
Speed/position detector			Encoder 4000P/rev, resolution 16000P/rev										
Mounted parts			Encoder, oil seal										
Structure			Fully-closed, self-cooling JP44										
Ambient temperature			0°C ~ 40°C										
Weight		(kg)	16	21	32	8	12	16	21	8	12	16	21
Compatible units	MC10-01												
	MC10-03												
	MC10-06		▒			▒				▒			
	MC10-10			▒			▒	▒			▒	▒	
	MC10-20				▒				▒				▒
Power facility capacity		(kVA)	1.1	1.7	3.5	1.1	1.7	1.7	3.5	1.1	1.7	1.7	3.5

2.3 Outline of servomotor

HA-ME053, HA-ME13

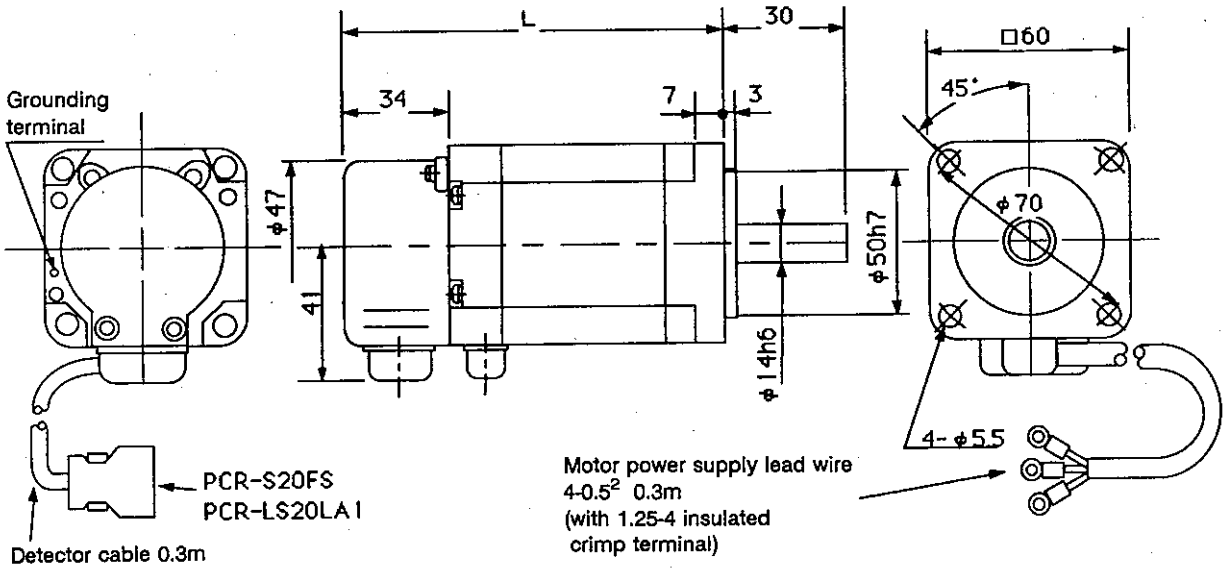
Unit: mm



Changed dimensions / Type	L
HA-ME053	76.5
HA-ME13	94.5

HA-ME23, HA-ME43

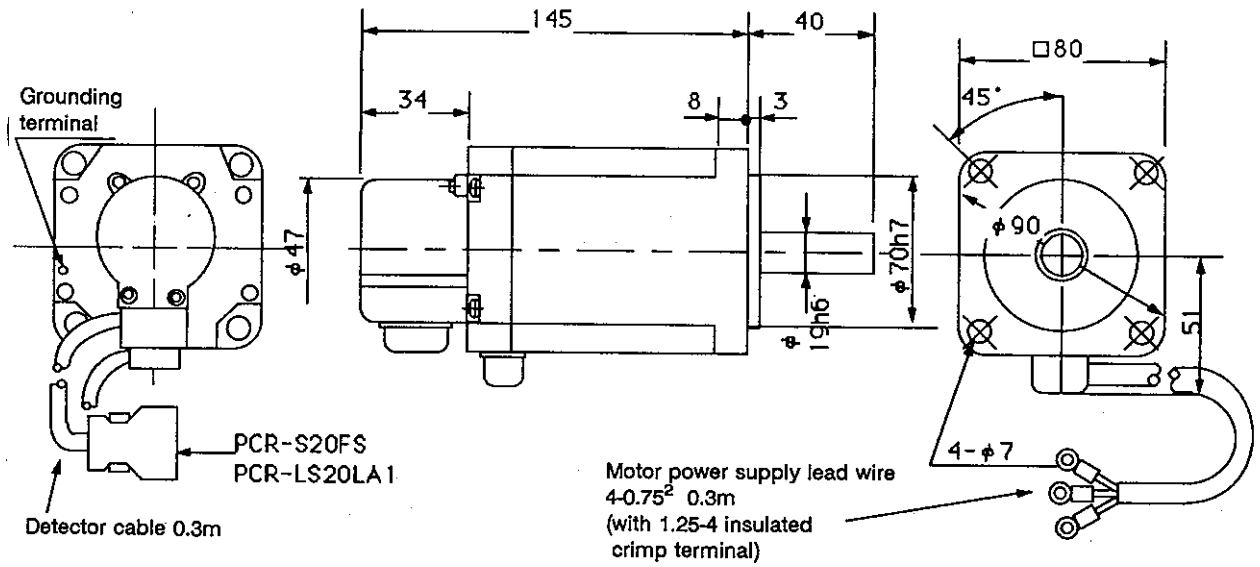
Unit: mm



Changed dimensions / Type	L
HA-ME23	96.5
HA-ME43	124.5

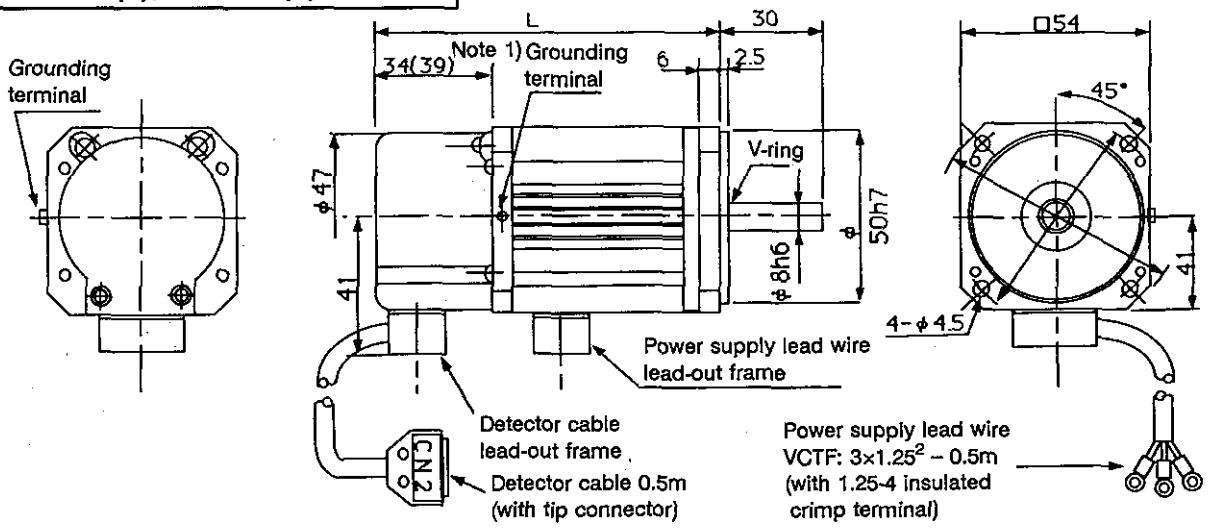
HA-ME73

Unit: mm



HA-FE053(B), HA-FH053(B)-Y
HA-FE13(B), HA-FH13(B)-Y

Unit: mm



- **With incremental detector**

Type \ Changed dimensions	L Note 2)
HA-FE053(B)	101 (136)
HA-FE13(B)	118 (153)

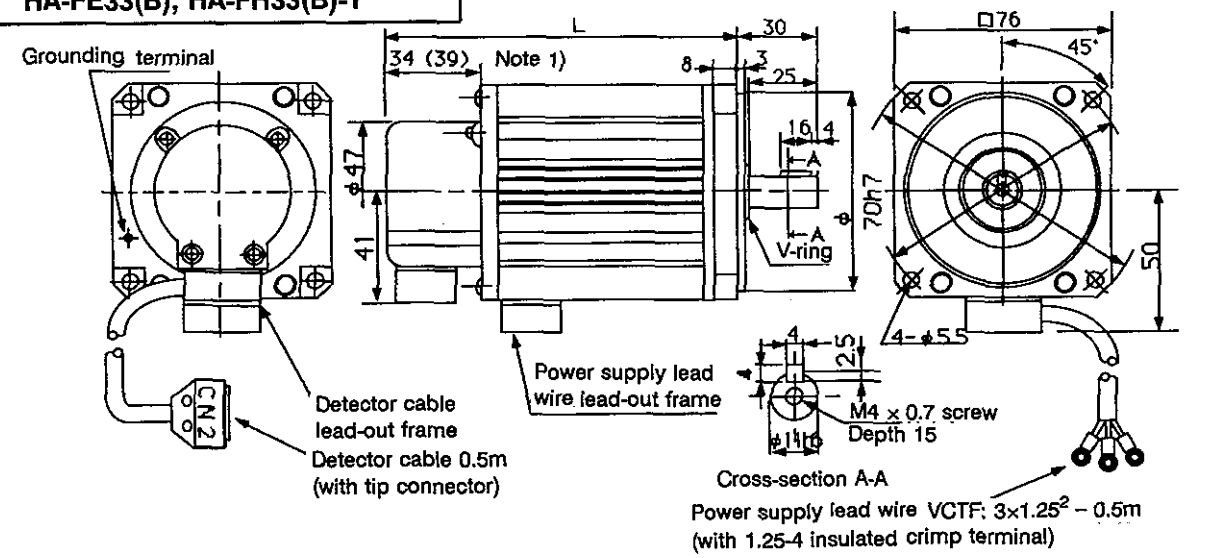
- **With absolute position detector**

Type \ Changed dimensions	L
HA-FH053(B)-Y	106 (141)
HA-FH13(B)-Y	123 (158)

Note 1) *Dimensions shown in parentheses are for the absolute position detector.*
Note 2) Dimensions shown in parentheses are for the motor with magnetic brakes.

HA-FE23(B), HA-FH23(B)-Y
HA-FE33(B), HA-FH33(B)-Y

Unit: mm



- **With incremental detector**

Type \ Changed dimensions	L Note 2)
HA-FE23(B)	126 (163)
HA-FE33(B)	143 (181)

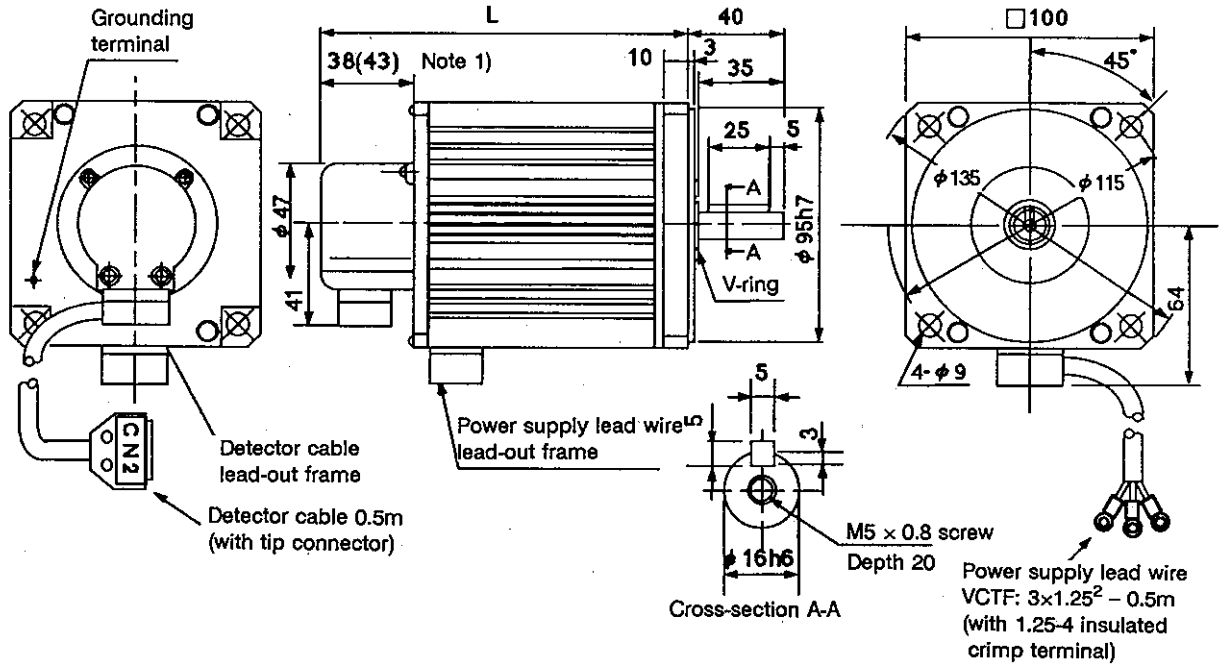
- **With absolute position detector**

Type \ Changed dimensions	L
HA-FH23(B)-Y	131 (168)
HA-FH33(B)-Y	148 (186)

Note 1) Dimensions shown in parentheses are for the absolute position detector.
Note 2) Dimensions shown in parentheses are for the motor with magnetic brakes.

HA-FE43(B), HA-FH43(B)-Y
HA-FE63(B), HA-FH63(B)-Y

Unit: mm



• **With incremental detector**

Changed dimensions / Type	L Note 2)
HA-FE43(B)	150 (187)
HA-FE63(B)	165 (202)

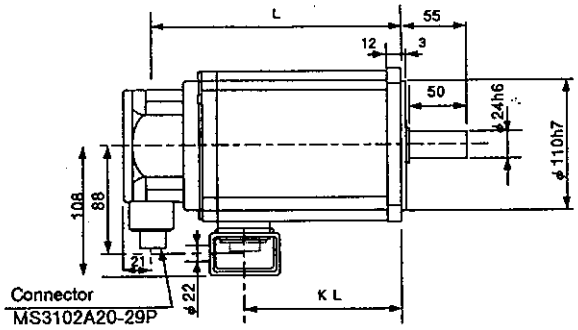
• **With absolute position detector**

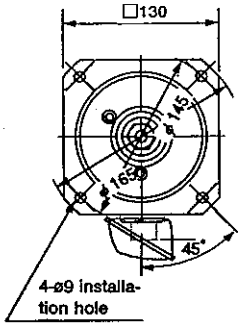
Changed dimensions / Type	L
HA-FH43(B)-Y	155 (192)
HA-FH63(B)-Y	170 (207)

Note 1) Dimensions shown in parentheses are for the absolute position detector.
Note 2) Dimensions shown in parentheses are for the motor with magnetic brakes.

HA-SE81(B) **HA-SH81(B)**
HA-SE52(B)~HA-SE152(B) **HA-SH52(B)~HA-SH152(B)**
HA-SE53(B)~HA-SE153(B) **HA-SH53(B)~HA-SH153(B)**

Unit: mm



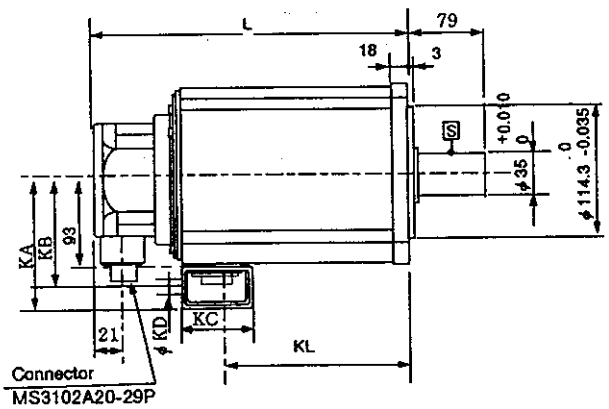


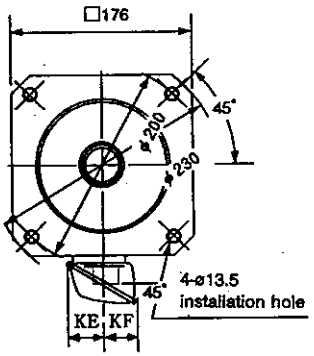
Motor type			Changed dimensions	L	KL
1000 r/min. series	2000 r/min. series	3000 r/min. series	SE motor	SH motor	
	HA-SE52(B), HA-SH52(B)	HA-SE53(B), HA-SH53(B)	223(273)	214(264)	124
	HA-SE102(B), HA-SH102(B)	HA-SE103(B), HA-SH103(B)	263(313)	254(304)	164
HA-SE81(B), HS-SH81(B)	HA-SE152(B), HA-SH152(B)	HA-SE153(B), HA-SH153(B)	303(353)	294(344)	204

Note 1) Dimensions shown in parentheses are for the motor with magnetic brakes.
Note 2) There are no changes in the dimensions for the incremental specifications and absolute value specifications.

HA-SE121(B)~HA-SE201(B) **HA-SH121(B)~HA-SH201(B)**
HA-SE202(B) **HA-SH202(B)**
HA-SE203(B) **HA-SH203(B)**

Unit: mm





Motor type			Changed dimensions	L	KA	KB	KC	KD	KE	KF	KL
1000 r/min. series	2000 r/min. series	3000 r/min. series	SE motor	SH motor							
HA-SE121(B) HS-SH121(B)	HA-SE202(B) HA-SH202(B)	HA-SE203(B) HA-SH203(B)	271(338)	262(329)	135	115	80	22	39	39	168
HA-SE201(B) HS-SH201(B)	———	———	339(406)	330(397)	135	115	80	22	39	39	236

Note 1) Dimensions shown in parentheses are for the motor with magnetic brakes.
Note 2) There are no changes in the dimensions for the incremental specifications and absolute value specifications.

CHAPTER 3 Peripheral Device Selection

3.1 Main circuit related

3.1.1 Selection of power capacity, non-fuse breaker, magnetic contactor

Controller	Power facility capacity (kVA)	Non-fuse breaker	Magnetic contactor
FCUA-MP10-01	0.3	NF30 type 5A	S-K10
FCUA-MP10-03	0.7	NF30 type 10A	
FCUA-MP10-06	1.1	NF30 type 10A	
FCUA-MP10-10	1.7	NF30 type 15A	
FCUA-MP10-20	3.5	NF30 type 20A	S-K18

3.1.2 *Wire size selection*

Controller	Wire (mm^2)				Terminal block
	R, S, T	U, V, W	P, C	Magnetic brake	Screw size
FCUA-MP10-01	2	2	2	1.25	M3.5 D ≤ 7
FCUA-MP10-03	2	2	2		
FCUA-MP10-06	2	2	2		
FCUA-MP10-10	2	2	2		
FCUA-MP10-20	3.5	3.5	2		

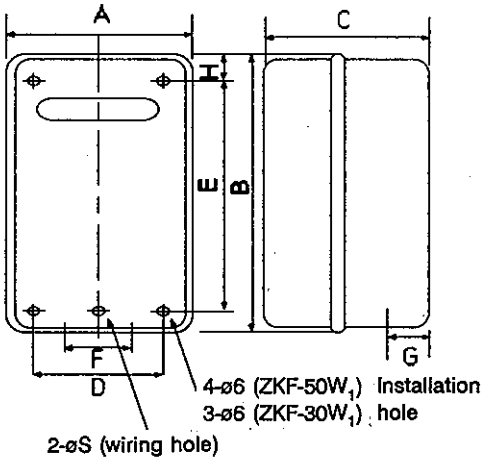
3.2 Magnetic brake related

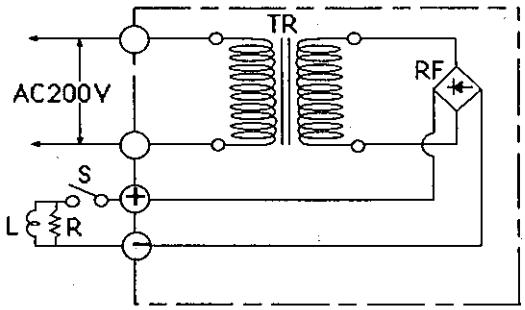
3.2.1 Power supply for magnetic brake

Refer to the following table and select the exciting DC24V for the magnetic brakes.

Motor		Power supply		
HA-FE/FH series	HA-SE/SH series	Output voltage DC (V)	Output current DC (A)	Reference example
50W ~ 100W	50W ~ 100W	24	0.5A or more	ZKF-30W$_1$
200W ~ 300W	200W ~ 300W		0.7A or more	
	500W ~ 1kW		0.9A or more	
	2kW		1.5A or more	ZKF-50W$_1$

(Reference example) The ZKF-□W$_1$ type power supply unit which generates the exciting power supply DC24V for the magnetic brakes from AC200V is given as the example.





TR : Transformer
RF : Rectifier
R : Protective resistor or varistor
L : Exciting coil for brakes
S : Switch

ZKF-W$_1$ type power supply unit outline dimension drawing

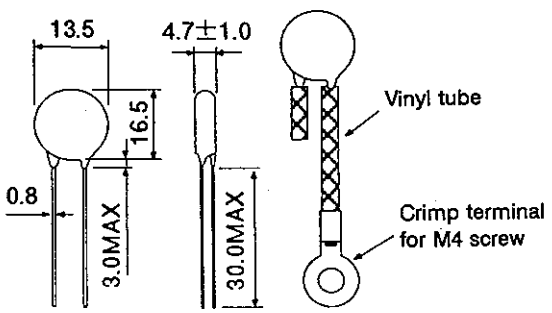
ZKF-W$_1$ type power supply unit outline dimensions

Type	Power voltage AC (V)	Output voltage DC (V)	Output current (A)	A	B	C	D	E	F	G	H	S	Weight (kg)
ZKF-30W$_1$	200	24	0.9	104	170	110	76	140	50	30	15	22	2.6
ZKF-50W$_1$			1.8	135	225	130	95	165	50	45	30	28	3.8

3.2.2 Surge absorber

Always use a surge absorber to cut the DC for the magnetic brake power supply.

Outline dimension drawing (mm)



3.2.3 Magnetic brake characteristics

The characteristics for the magnetic brake used for holding in the motor with magnetic brakes are listed below. When used for the vertical axis feed, the brake prevents the axis from falling when the power is turned OFF, and also prevents collisions to provide a double safety means for the dynamic brakes during emergency stop. Do not use these brakes for braking other than stopping or emergency stop, or else the life will drop remarkably.

Item		HA-F□ series			HA-S□ series	
		FE/FH053 FE/FH13	FE/FH23 FE/FH33	FE/FH43 HFE/FH63	SE/SH52~152 SE/SH53~153 SE/SH81	SE/SH121, 201 SE/SH202 SE/SH203
Type (Note 2)		Spring braking type safety brakes				
Rated voltage		DC24V			DC24V	
Exciting coil resistance	When cold (20°C)	111	78	52	38	23
	When hot (95°C)	144	101	67	49	30
Capacity (W)		7	7.4	11	15	25
Attraction current (A)		0.15	0.2	0.3	0.25	0.4
Drop current (A)		0.06	0.06	0.1	0.14	0.2
Static frictional torque (N・m{kgf・m})		0.39 (4)	1.18 (12)	2.3 (23.5)	7.84 (80)	29.4 (300)
Moment of inertia (Note 3) J (kg・cm^2 {kgf・cm^2})		0.02 (0.07)	0.13 (0.53)	0.34 (1.4)	0.68 (2.7)	4.25 (17)
Release delay time (Note 4) (s)		0.03	0.03	0.03	0.07	0.10
Braking delay time (s) (Note 4)	AC OFF (Fig. a)	0.08	0.10	0.12	0.12	0.12
	DC OFF (Figs. b, c)	0.01	0.03	0.03	0.03	0.03
Tolerable braking work amount (N・m {kgf・m})	Per braking (E1)	3.9 (0.4)	18 (1.8)	46 (4.7)	390 (40)	4400 (450)
	Per hour (E2)	3.9 (0.4)	180 (18)	460 (47)	3900 (400)	44000 (4500)
Brake play at motor shaft (deg.)		0.3 ~ 3.5	0.2 ~ 2.0	0.2 ~ 1.3	0.2 ~ 0.6	
Brake life (Note 1)		30,000 times with braking amount of 4 (N・m) per braking	30,000 times with braking amount of 18 (N・m) per braking	30,000 times with braking amount of 47 (N・m) per braking	20,000 times with braking amount of 200 (N・m) per braking	20,000 times with braking amount of 2000 (N・m) per braking

Note 1. The braking gap will widen because of the brake lining wear caused by braking, but the gap cannot be adjusted. Thus, the life of the brake is up when adjustment is required. The 20,000 time life is equivalent to 5 times/day for 10 years, and the life is inversely proportional to the work amount per braking.

2. The motor does not have a manual release mechanism. If handling is required during alignment of the machine etc., prepare a separate DC24V power supply, and electrically release the brakes.
3. For the motor with magnetic brakes, this is the value loaded on the motor without brakes.
4. This is the value at 20°C for the initial attraction gap.
5. The braking work amount (E1) of the brakes is indicated with the following expression.
   (Work amount = 0.041 × (motor GD^2 + load GD^2) × (rapid traverse motor speed)^2 × 10^{-6}
   The work amount (E2) per hour is calculated by multiplying the work amount (E1) per braking with the No. of braking times per hour.
6. Always prepare a separate power supplies for the machine interface DIO signal and magnetic brake.

3.2.4 Example of connecting power supply for magnetic brake

- Examples of connecting the brake exciting power supply are shown in Figs. a to c. a is for the AC OFF, and b and c are for the DC OFF.
- The braking delay time will be shorted with DC OFF, but a surge absorber must be installed on the brake terminal.

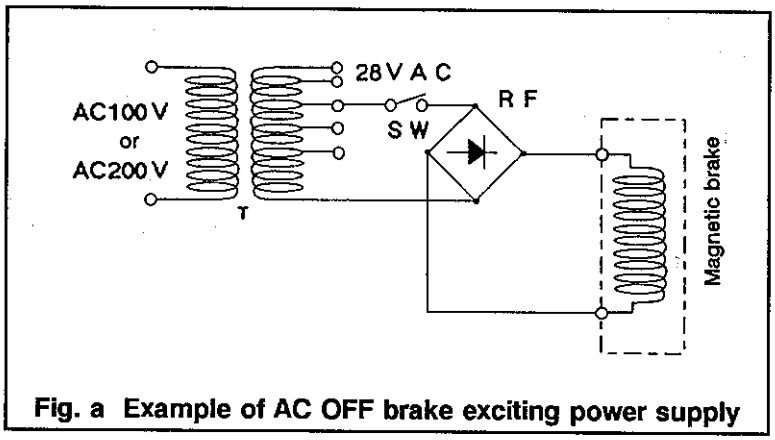


Fig. a Example of AC OFF brake exciting power supply

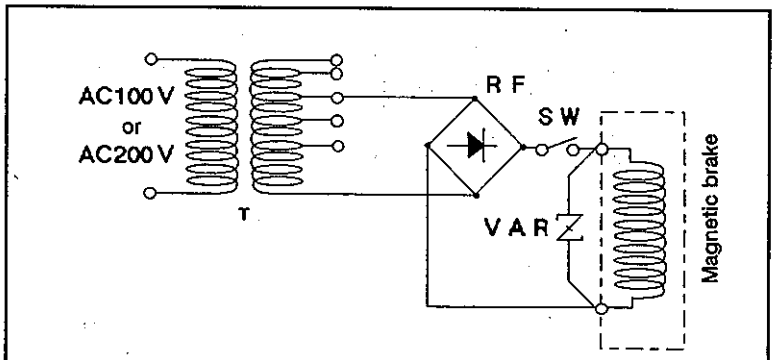


Fig. b Example of DC OFF brake exciting power supply

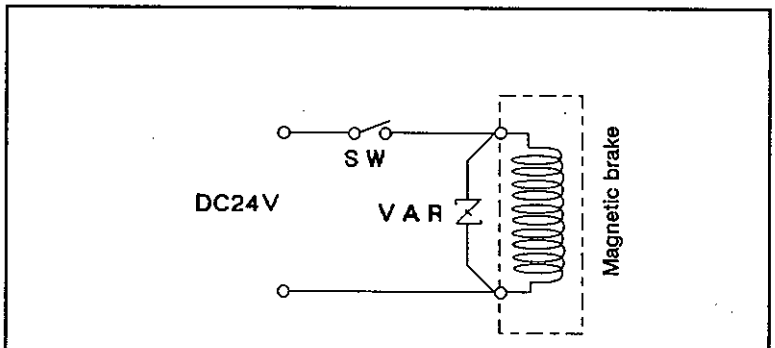


Fig. c Using stabilizing power supply

T : Transformer
RF : Rectifier
VAR: Surge absorber

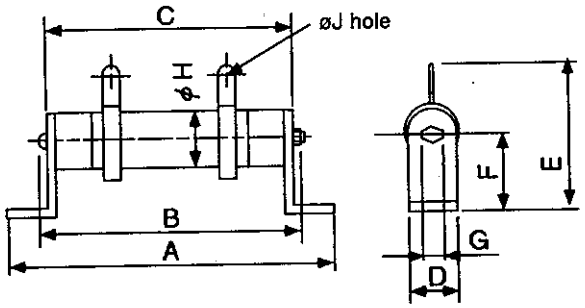
3.3 Regenerative resistor related

3.3.1 Selection of regenerative resistor

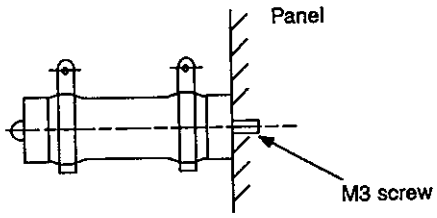
The controller does not have a regenerative resistor, so one of the following must be used. Refer to the next section "Regenerative brake characteristics" to select the regenerative resistor.

Controller	Regenerative resistor type	Tolerable power	Changed dimensions (mm)								
			A	B	C	D	E	F	G	H	J
FCUA-MP10-03,06	MR-RB013	10W	110	101	85	18	35	16	4.5	18	3.2
FCUA-MP10-10,20	MR-RB033	30W	192	173	152	26	54	22	6	26	3.2

Exterior installation of a regenerative resistor is required for the FCUA-MP10-03 (300W) W or more. Always prepare a regenerative resistor.



If the installation fitting is removed for the MR-RB013, installation as shown on the right will be possible.



<Precautions for use>

- Always use a twisted wire for the regenerative resistor, and keep the length as short as possible (5m or less).
- The regenerative resistor will radiate a heat of approx. 100 deg. so do not directly install it on a wall susceptible to heat. Either use a non-combustible wire, or enforce non-combustible treatment (silicon tube, etc.) to prevent contact with the regenerative resistor.

3.3.2 Regenerative brake characteristics

The regenerative energy generated during deceleration is absorbed by the capacitor in the controller or radiated and consumed by the regenerative resistor. The regeneration method for each controller capacity is shown below.

Controller	Regeneration method	Standard		Option	
		Resistor type	Tolerable regeneration frequency	Resistor type	Tolerable regeneration frequency
FUUA-MP10-01	Capacitor regeneration		No limit		No limit
FUUA-MP10-03	Regenerative resistor	MR-RB013	150	MR-RB033	450
FUUA-MP10-06			70		200
FUUA-MP10-10		Two MR-RB033 units connected in parallel.	64		
FUUA-MP10-20			25		

Note) The tolerable regeneration frequency refers the tolerable frequency (times/min.) in one minute to stop from the rated speed.

[Selection of regenerative resistor]

Use the following as a guideline to determine whether the optional regenerative resistor is required.

(a) For horizontal axis

N : No. of positioning times in machine side specifications (times/min.)
m : Load inertia/motor moment of inertia
n : Operation speed/rated speed
D1 : Tolerable regeneration frequency for standard specifications (times/min.)
D2 : Tolerable regeneration frequency for standard specifications (times/min.)

Standard specifications when $N < \frac{D_1}{m+1} \times [\frac{1}{n}]^2$

Standard specifications when $N > \frac{D_1}{m+1} \times [\frac{1}{n}]^2$

(b) In the following cases, obtain the regenerative power during operation, and use so that the tolerable heating value is not exceeded.

- When the operation speed frequently changes
- When a constant regenerative state is entered such as during vertical feed

Controller	Standard	Option
FUUA-MP10-03	10W	30W
FUUA-MP10-06	10W	30W
FUUA-MP10-10	60W	
FUUA-MP10-20	60W	

[Calculation of regenerative power]

The regenerative energy when a vertical-moving axis lowers can be calculated with the following expression.

E	: Regenerative energy	(W)
J	: Motor shaft conversion inertia	($kg \cdot cm^2$)
N_0	: Rapid traverse motor speed	(r/min.)
W	: Unbalance weight	(kg)
h	: Vertical axis full stroke	(mm)
g	: 9.8	(m/sec^2)

$$E = \frac{1}{2} \cdot J \cdot \left[\frac{2\pi N_0}{60}\right]^2 \cdot 10^{-4} + W \cdot g \cdot \frac{h}{1000} \cdot 0.8$$

If the vertical frictional force is large during lowering, subtract the frictional force from the unbalance weight, and use the result as the unbalance weight.
The tolerable repeatable positioning frequency D_3 can be expressed with the following expression using the calculated regenerative energy E and the regenerative resistor's tolerable heating value Wr. Compare this with the actual operation pattern, and select the regenerative resistor.

$D_3 = 60 \times Wr/E$ (times/min.)

CHAPTER 4 Installation

4.1 Installation conditions of controller

The controller and remote I/O are designed to be installed in a fully-closed cabinet. When installing in the cabinet, observe the following items.

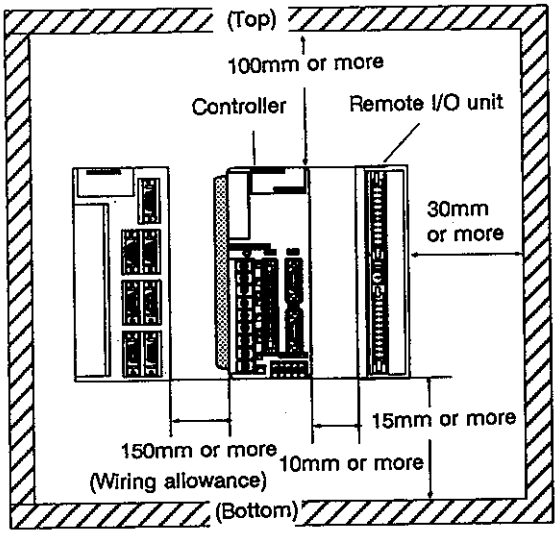
4.1.1 Working environment conditions

- Ambient temperature : 0 to 55°C (with no freezing) <Note>
- Ambient humidity : 90%RH or less (with no dew condensation)
- Vibration : 5.9m/s^2 {0.6G} or less

<**Note**> Inner panel temperature specifications. To ensure the servo drive's life and reliability, the average inner panel temperature should be 40°C or less.

4.1.2 Installation direction and clearance

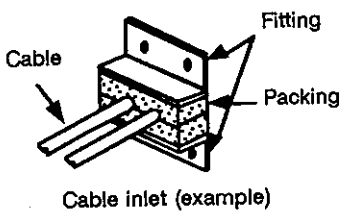
Install each unit so that the front can be seen.
Refer to the drawing on the right, and secure ventilation space around each unit for heat radiation and wiring.



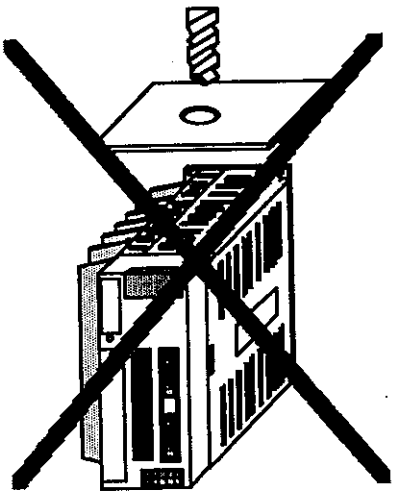
4.1.3 Prevention of foreign matter entry

Enforce the following measures on the cabinet.

- Dust proof and oil proof the cable inlets with packing, etc.
- Take care so that the outdoor air does not enter the inside the unit from the heat radiation holes, etc.
- Block all clearances.
- Securely install the door packing.
- If there is a rear cover, always attach packing.
- Oil will easily accumulate on the top, and may enter the cabinet from the screw holes, so take special measures such as oil proofing packing.
- After installing each unit, avoid machining in the peripheral area. The cutting chips, etc., may adhere to the electronic parts and lead to faults.



Cable inlet (example)



4.2 Heat radiation measures

(1) The average temperature in the cabinet should be 55°C or less to ensure the reliability and life of each unit.

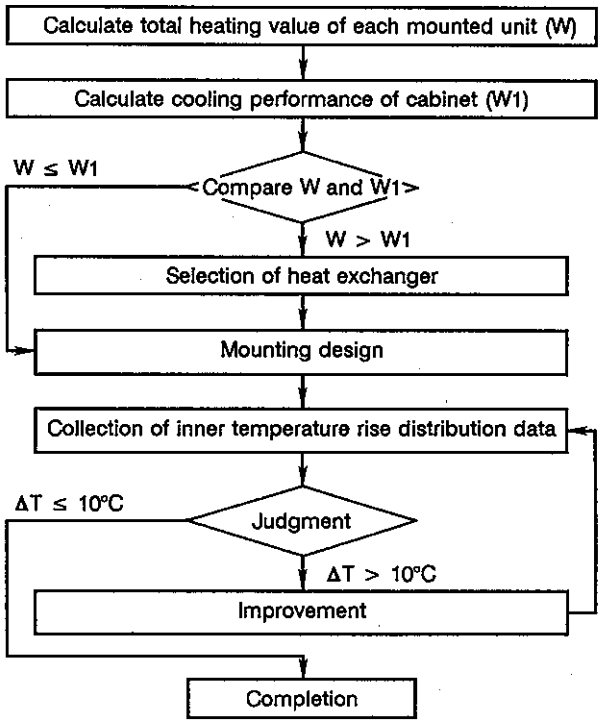
(2) Mix the air in the cabinet with a fan if the heat tends to accumulate at the top.

Example of heat radiation measures

<Assumed conditions>

(1) In-panel average temperature : $T \leq 55°C$
(2) Panel ambient temperature : $Ta \leq 0°C \sim 45°C$
(3) Internal temperature rise value : $\Delta T = T - Ta\ (max) = 10°C$

Procedure for heat design to verification



<Supplement>

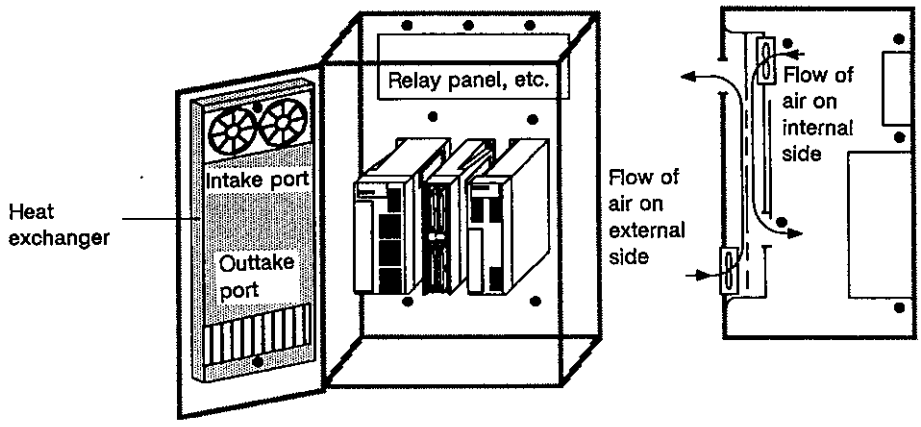
(1) Expression for calculating cooling performance of sealed cabinet (sheet steel)
$W1 = U \times A \times \Delta T$
ΔT: Internal temperature rise value (10°C)
U : 6W/ × °C ..... With internal mixing fan
$4W/m^2 \times °C$ ... Without internal mixing fan
A : Valid heat radiation area m^2
(Area in which cabinet heat can be radiated)
<Note> When calculating the valid heat radiation area, do not include the sections that contact with other items.

(2) Precautions for heat radiation measures during mounting design
* Consideration of cabinet convection (elimination of heat spots)
* Collect high temperature air to panel intake port on heat exchanger

(3) Judgment criteria for internal temperature rise distribution data
ΔT (average value) ≤ 10°C
ΔT max (max. value) ≤ 15°C
R (inconsistency $\Delta Tmax - \Delta Tmin$) ≤ 6°C
(Judgment of existence of heat spots)

Example of mounting and introduction to temperature (ΔT) measurement positions (Reference)

● : Temperature rise measurement point (example)



4.3 Controller heating amount

The loss generated during a rated load of the controller is shown below. Use the values below during the heat design of the fully-closed control panel, taking the worst conditions into consideration. In the actual machine, the heating amount will be the value between the rated operation and zero torque according to the duty during operation. If the motor is not used at the max. speed, the nominal output of the motor will drop. The power capacity will also drop from the values in the table, but the heating amount of the servo driver will not change.

Controller	Controller heating amount		Area required for heat radiation	Approximately dimension of fully-closed box
Type	During rated output (W)	During zero torque (W)	(m^2)	(mm)
FCUA-MP10-01	25	15	0.5	280W x 300D x 300H
FCUA-MP10-03	35	15	0.7	350W x 400D x 300H
FCUA-MP10-06	40	15	0.8	400W x 400D x 300H
FCUA-MP10-10	50	15	1.0	400W x 400D x 500H
FCUA-MP10-20	90	20	1.8	400W x 400D x 1000H

<Note> The heat radiated during regeneration is not included in the controller's heating amount. The heating amount of the brake resistance is shown with an approximate expression below, so if the starting frequency is high and the controller's heating amount cannot be ignored, secure a heat radiation area that includes the following value.

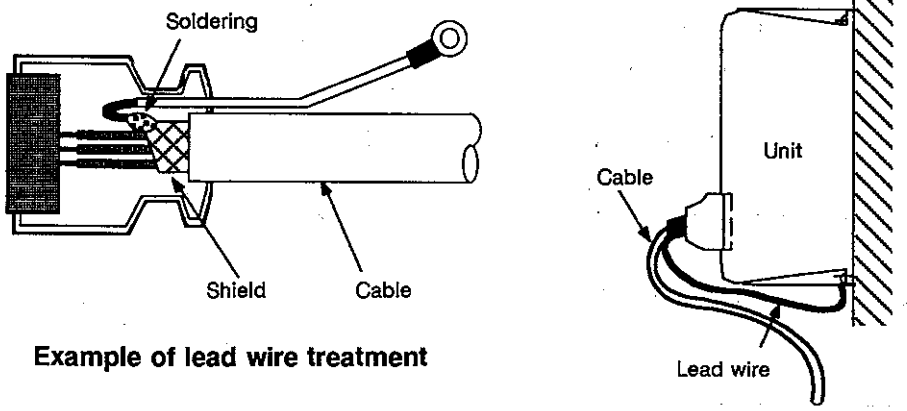
$$P_{RS} = \frac{(GD_M^2 + GD_L^2) \times N^2 \times f_s}{5.48 \times 10^4} \text{ [W]}$$

GD_L^2 : Motor shaft conversion load moment of inertia [kgf·cm^3]
GD_M^2 : Moment of inertia of motor itself [kgf·cm^3]
N : Motor speed [r/min.]
f_s : No. of decelerations [times/min.]

4.4 Grounding measures and grounding treatment

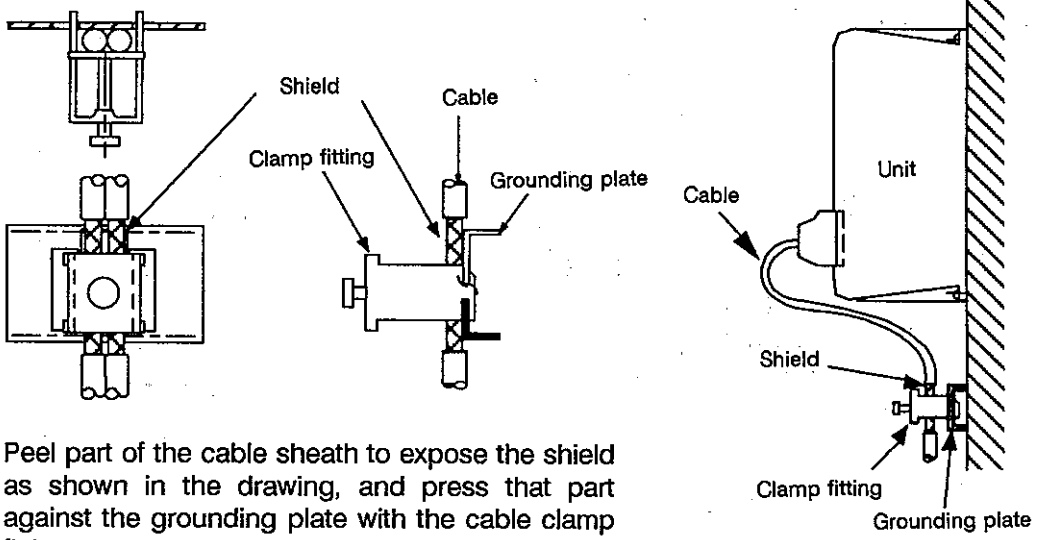
The shield of the shield cable connected to the controller must always be connected to the grounding to prevent malfunctioning by noise and to stabilize the system operation.
The shield can be connected to the grounding with either a lead wire or a clamp fitting. Treat the shield cable referring to the following drawings.

Example of connection with lead wire



Example of lead wire treatment

Example of connection with clamp fitting

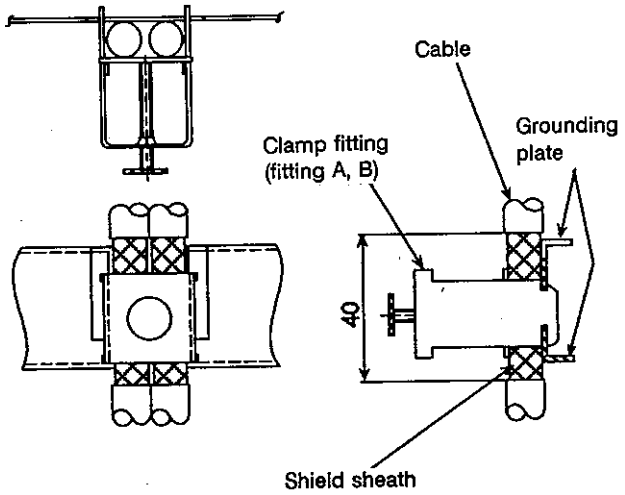


(1) Peel part of the cable sheath to expose the shield as shown in the drawing, and press that part against the grounding plate with the cable clamp fitting.
(2) If the cable is thin, bundle several together and clamp.
(3) Take care to not damage the wire when tightening the cable, and tighten with an appropriate strength.
(4) Connect each grounding plate and ground to one point.

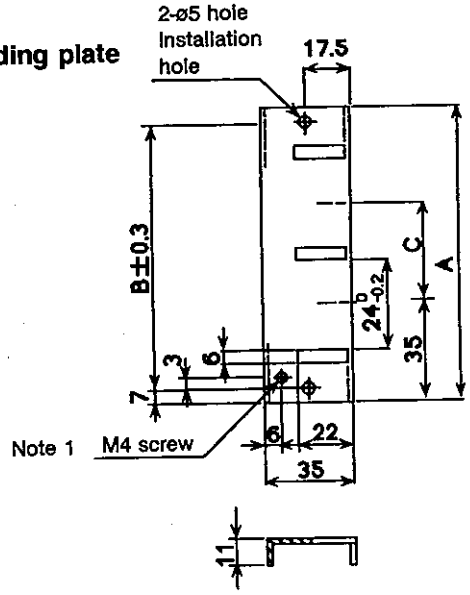
When manufacturing the clamp fitting and grounding plate, refer to the "Clamp fitting outline and dimension drawings" on the next page. These parts can also be ordered from Mitsubishi.

Normally, the shield wire only needs to be connected to the case frame of the connector. However, the effect can be enhanced by directly connecting it to the grounding plate as shown on the right. Install a grounding plate near each unit, peel part of the cable sheath to expose the shield, and press that part against the grounding plate with a clamp fitting, as shown on the right. If the cable is thin, bundle several together and clamp. Directly install the grounding plate to the cabinet or connect with a grounding wire so that a sufficient frame grounding can be achieved.
Contact Mitsubishi when the grounding plate and clamp fitting set AERSBAN-□SET is required.

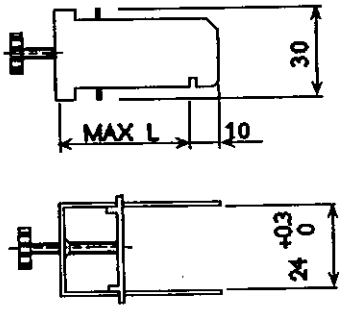
Outline of clamp fitting



Grounding plate



Clamp fitting



Note 1) Screw hole for wiring to cabinet grounding plate
Note 2) The grounding plate thickness is 1.6mm

	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Two clamp fittings A
AERSBAN-ESET	70	56	—	One clamp fitting B

	L
Clamp fitting A	70
Clamp fitting B	45

CHAPTER 5 Teaching Box CT200 Specifications

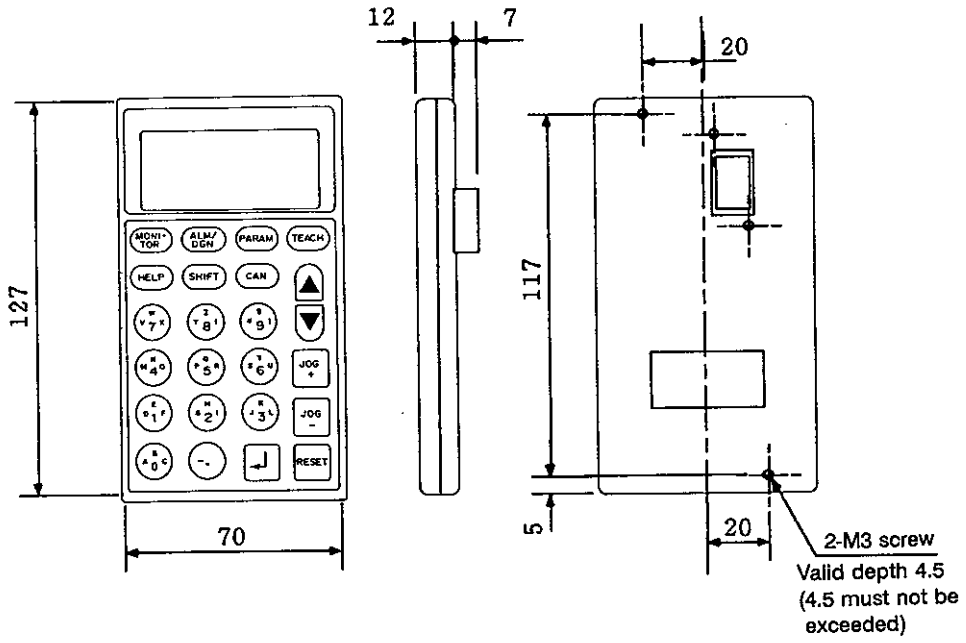
The teaching box CT200 is a man-machine interface used to set the parameters and point data, etc., in the controller and to view the operation status of the controller.

5.1 General specifications

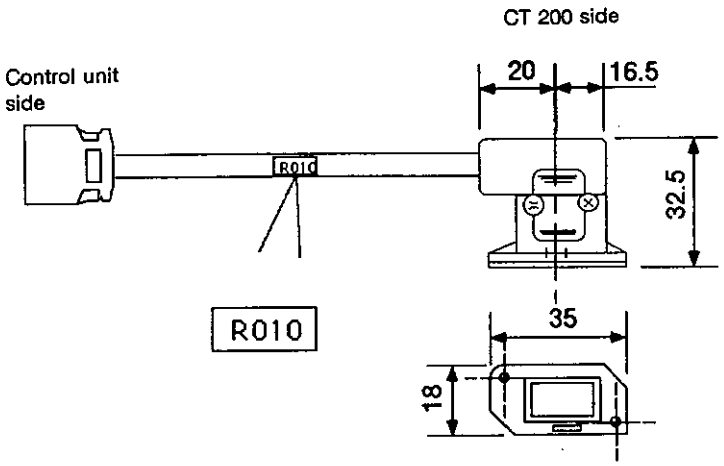
Environment	Ambient temperature	0 to +45°C (no freezing), storage –20 to +65°C
	Ambient humidity	90%RH or less (no dew condensation)
	Atmosphere	No corrosive gases or dust
	Altitude	1000m or less
	Vibration	5.9m/s^2 (0.6G) or less
Structure		Fully-closed

<**Note**> The power is supplied from the controller unit.

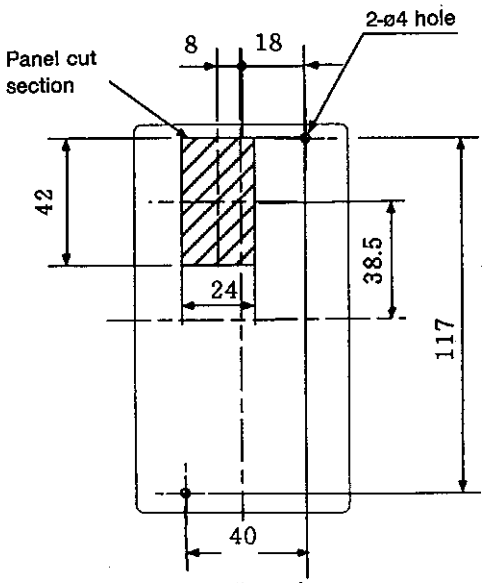
5.2 Outline dimensions of teaching box CT200



Outline drawing of CT200 cable

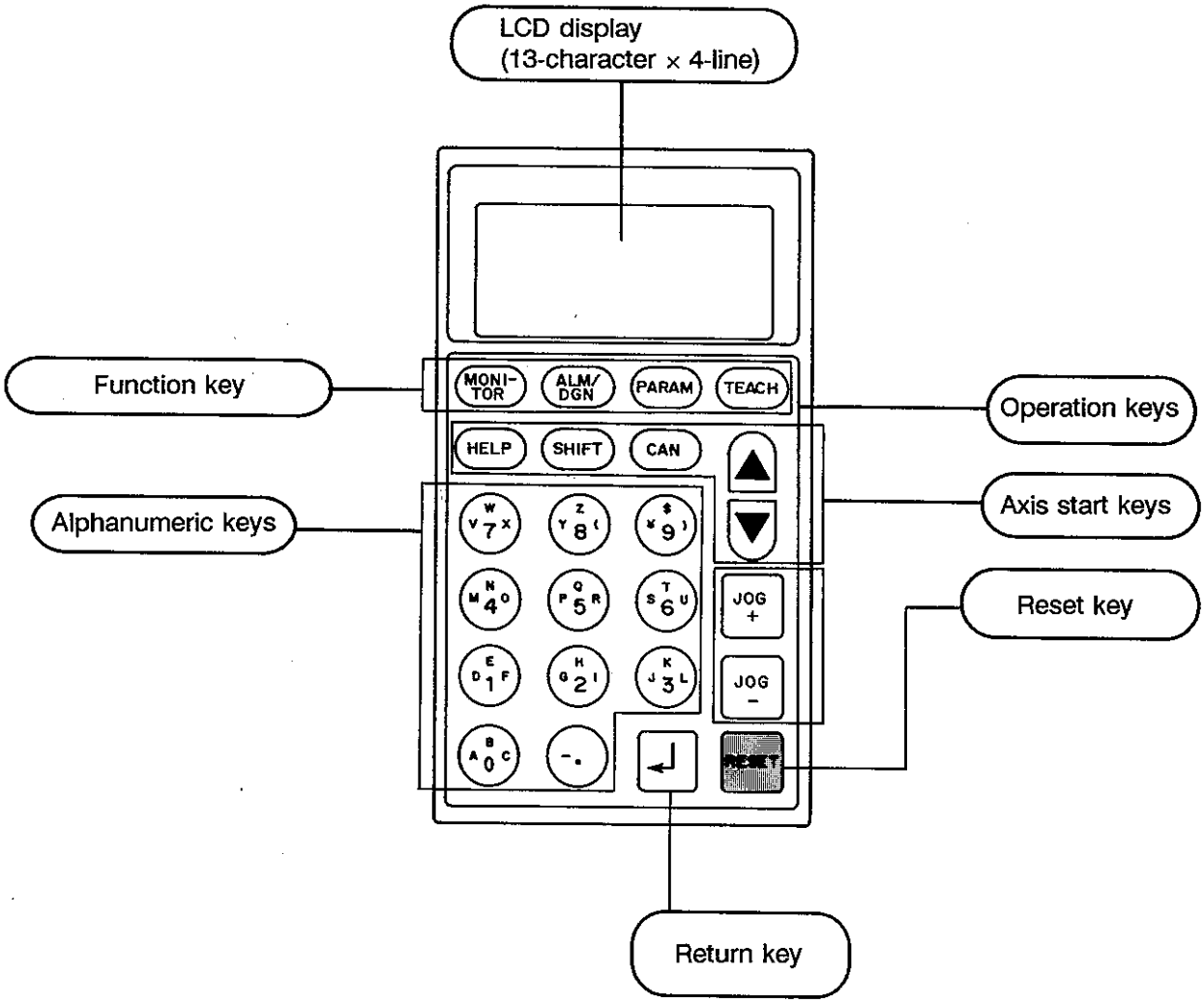


Cut dimension when installing on panel



5.3 Functions of teaching box CT200

Item	Details
Parameter	Setting, display and saving of parameters
Point table	Creation, editing and teaching of point table
Monitor	Machine position, servo status
Self-diagnosis	Alarm display, operation stop/emergency stop cause display, servo monitor, input/output interface diagnosis, history monitor



[Memo]

CHAPTER 6 Remote I/O FCUA-DX100 Specifications

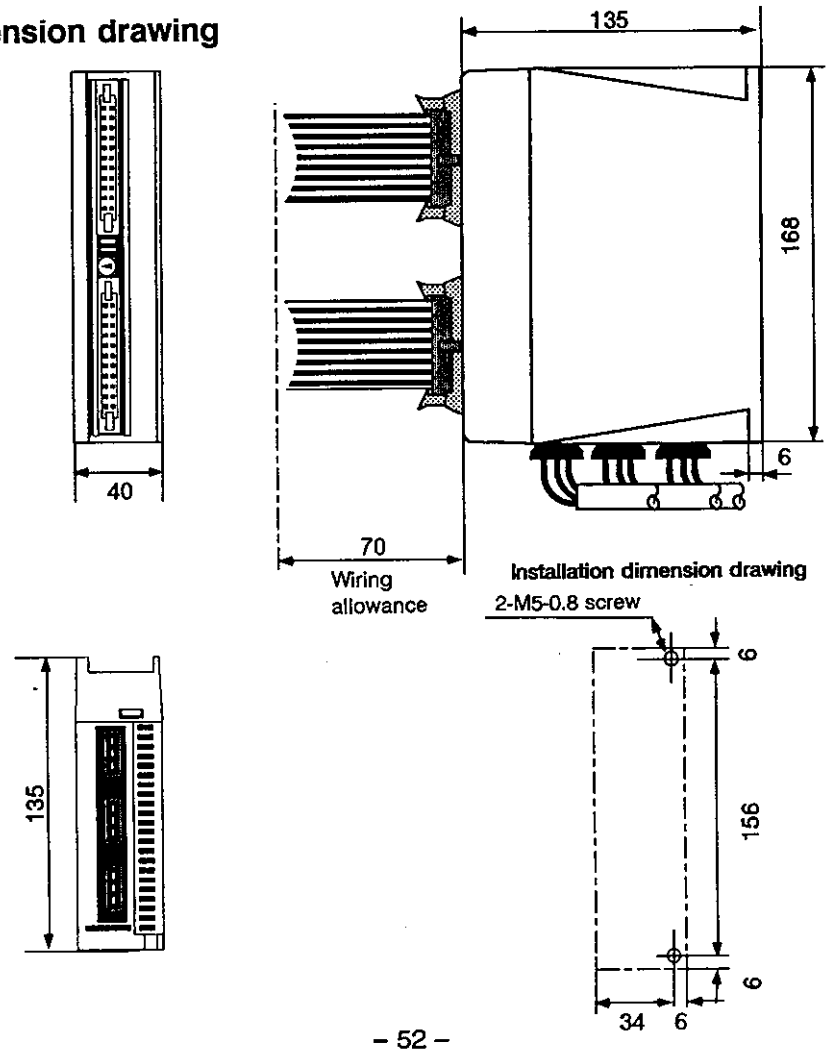
The remote I/O FCUA-DX100 is a unit used to expand the machine input/output signals (DIO).
An MC link B exclusive serial connection is used to connect with the controller.

6.1 General specifications

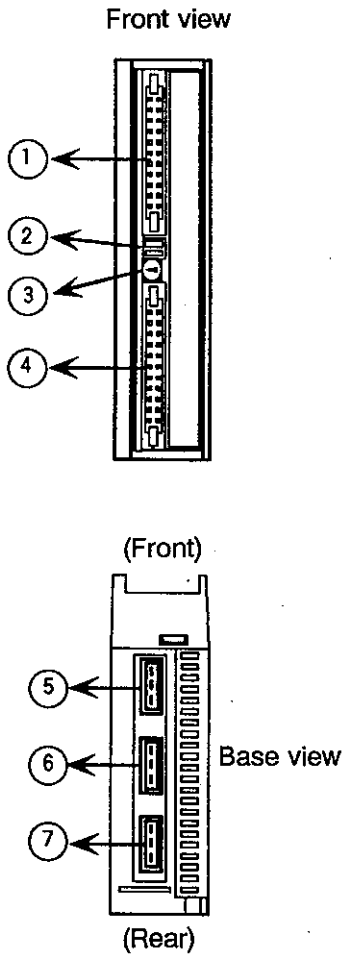
Working ambient temperature	0 to 55°C
Storage ambient temperature	–20 to 65°C
Working ambient temperature	40 to 75%RH (with no dew condensation)
Storage ambient temperature	40 to 90%RH (with no dew condensation)
Vibration resistance	0.5G or less (during operation)
Impact resistance	3.0G or less (during operation)/ 10G or less (during transportation)
Working atmosphere	No corrosive gases or dust
Power static	1kV (P – P)
Power voltage	DC24V ± 5% Ripple ±5% (P – P)
Tolerable momentary power failure time	———
Consumed power <Note 1>	24V 0.7A

<Note 1> Only control circuit consumption amount.
<Note 2> During operation of all points in machine input/output interface circuit.

6.2 Outline dimension drawing

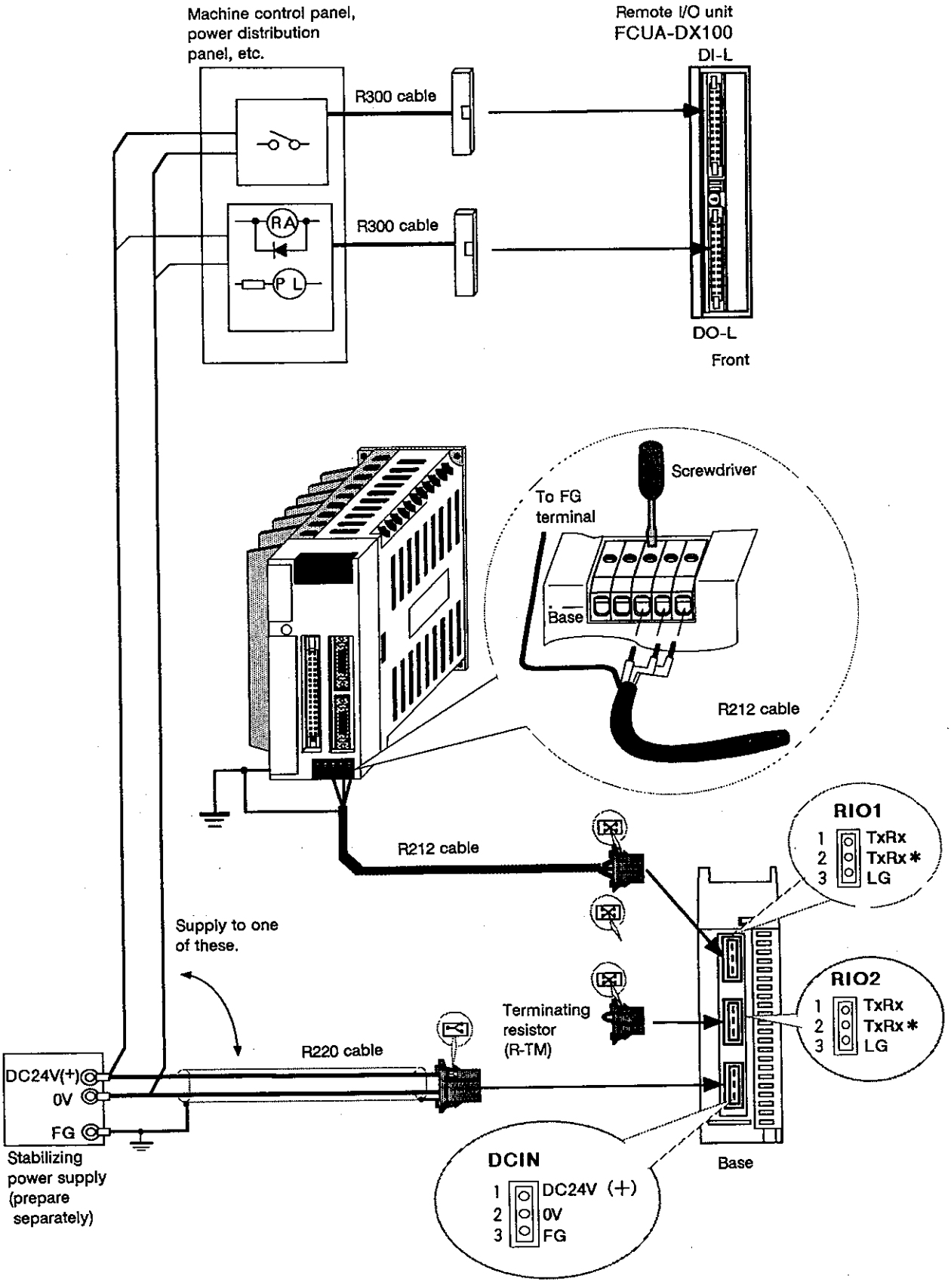


6.3 Connector layout and functions

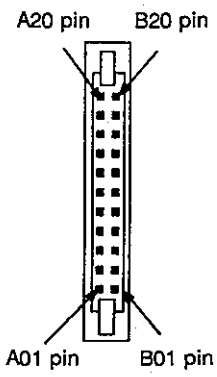


① DI-L (Machine input signal connector)
② DS1 (Baud rate changeover switch)
③ CS1 (Channel changeover switch)
④ DO-L (Machine output signal connector)
⑤ RIO1 (Serial connection connector #1)
⑥ RIO2 (Serial connection connector #2)
⑦ DCIN (DC24V power input connector)

6.4 Connection

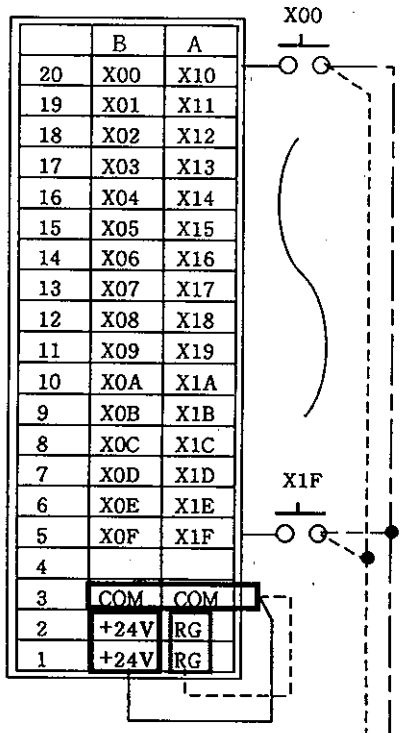


Input (DI) connector
DI-L

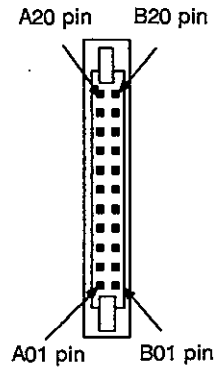


Connector type : Flat 40-pin
Cable connector: 7940-6500SC
(batch caulking 3M)

	B	A
20	X00	X10
19	X01	X11
18	X02	X12
17	X03	X13
16	X04	X14
15	X05	X15
14	X06	X16
13	X07	X17
12	X08	X18
11	X09	X19
10	X0A	X1A
9	X0B	X1B
8	X0C	X1C
7	X0D	X1D
6	X0E	X1E
5	X0F	X1F
4		
3	COM	COM
2	+24V	RG
1	+24V	RG

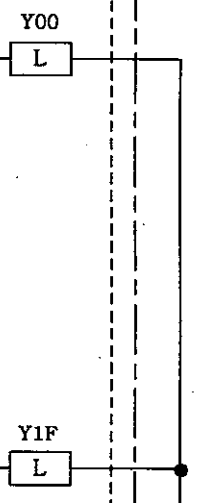


Contact output (DO) connector
DO-L



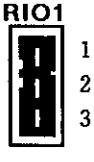
Connector type : Flat 40-pin
Cable connector: 7940-6500SC
(batch caulking 3M)

		A
20	Y00	Y10
19	Y01	Y11
18	Y02	Y12
17	Y03	Y13
16	Y04	Y14
15	Y05	Y15
14	Y06	Y16
13	Y07	Y17
12	Y08	Y18
11	Y09	Y19
10	Y0A	Y1A
9	Y0B	Y1B
8	Y0C	Y1C
7	Y0D	Y1D
6	Y0E	Y1E
5	Y0F	Y1F
4		
3		
2	+24V	RG
1	+24V	RG



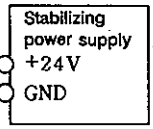
DC24V power supply
input connector

RIO1



Connector : D3100S (Japan AMP)
Cable connector: 2-178288-3 (Japan AMP)

Pin No.	Signal
1	DC+24V IN
2	RG
3	FG



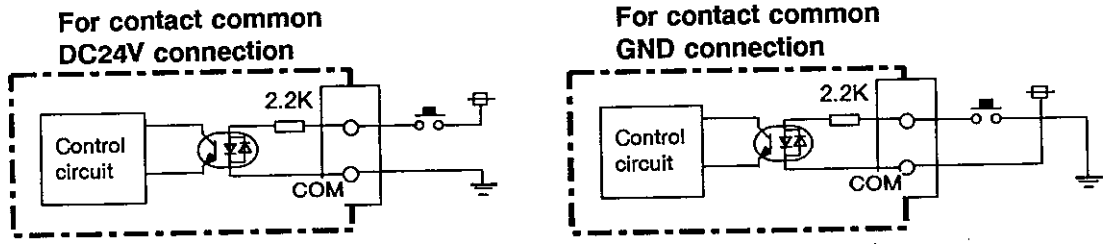
Connection for
contact common = GND

Connection for
contact common = DC+24V

6.5 Digital signal input circuit

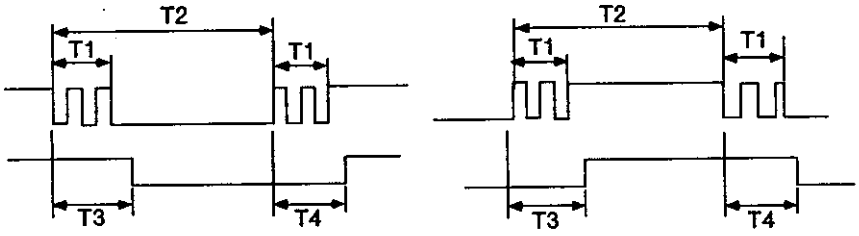
[Input circuit]

Either "contact common DC24V connection" or "contact common GND connection" can be used for the input circuit.



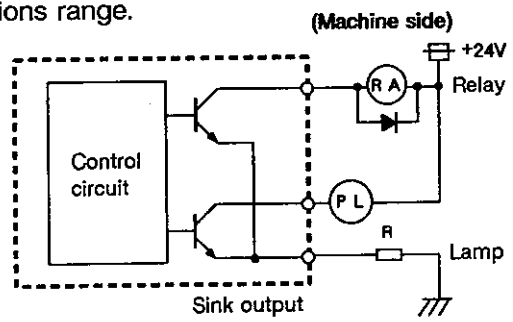
Input signal conditions

Input voltage during external contact ON	6V or less
Input current during external contact ON	9mA or more
Input voltage during external contact OFF	20V or more
Input current during external contact OFF	2mA or less
Tolerable chattering time	3ms or less (refer to T1 in following figure)
Input signal hold time	40ms or more (refer to T2 in following figure)
Input circuit operation delay time	3ms ≤ T3 ≒ T4 ≤ 20ms
Machine side contact capacity	+30V or more, 16mA or more



[Output circuit]

The digital signal output circuit is an all-point sink (open collector) output. Use within the following specifications range.



Output conditions

Insulation method	Non-insulated
Rated load voltage	DC+24V
Max. output current	60mA
Output delay time	40μs

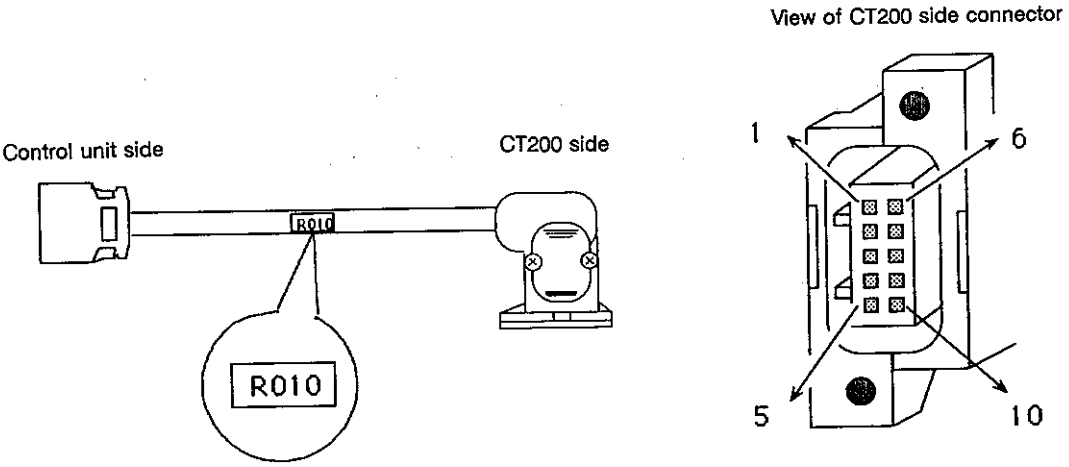
<Note>
- When using an inductive load such as a relay, always connect a diode (withstand voltage 100V or more, 100mA or more) in parallel with that load.
- When using a capacitance load such as a lamp, connect a protective resistor (R=150Ω) in serial with the load to limit rush currents. (Make sure that the current, including the instantaneous current, is less than the above tolerable current.)

Appendix 1 Peripheral Device Cable Manufacturing Drawings

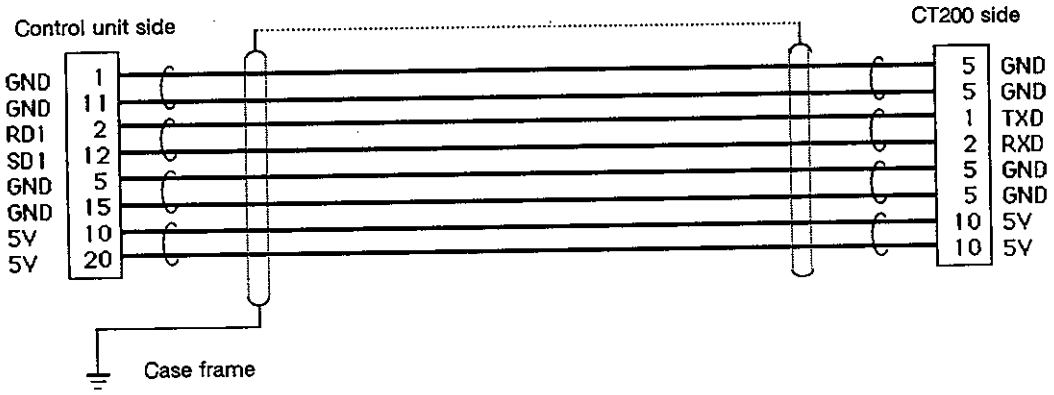
Reference drawings for FCUA-R010 cable manufacturing

Application: Cable between controller and teaching box CT200

Assembly drawing



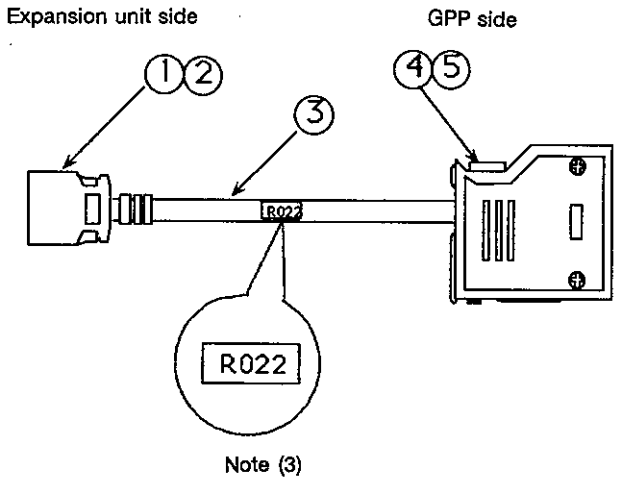
Connection drawing



Reference drawing for FCUA-R022 cable manufacturing

Application: Cable between controller and GPP

Assembly drawing

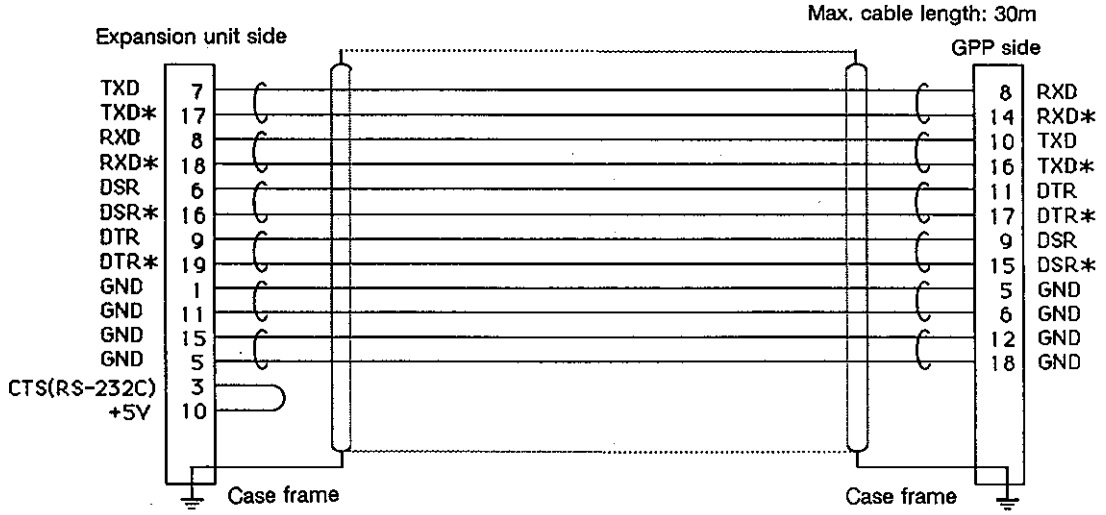


Option (compatible connector set)
FCUA-CS022

List of parts

No.	Part name/type	Maker	Qty.
1	Connector 10120-6000EL	Sumitomo 3M	1
2	Connector case 10320-3210-000	Sumitomo 3M	1
3	Wire UL20276 AWG28×10P	Note (1)	(1)
4	Connector S-1620A (09)	Hirose	1
5	Connector case P-1620A-CA (20)	Hirose	1

Connection drawing



Notes for manufacturing

(1) For the wire, use a 10-pair twisted strand equivalent to the UL20276 standard AWG28 (0.08mm^2) covered with a shield.
(2) The above parts are the recommended parts. Equivalent parts may be used if the specifications are compatible.
(3) Attach the nameplate with protective cover, on which the cable name is stamped, at the position specified in the assembly drawing.
(4) Fold the wire, shield back over the sheath, and wrap copper foil tape around it. Then, clamp with the connector case frame.
(5) The part 1 connector and part 2 connector case are pressure welded types. If soldered types are preferred, use the connector 10120-3000VE and connector case 10320-52F0-008 (both made by Sumitomo 3M).

Reference drawing for FCUA-R300 cable manufacturing

Application: Cable between controller and machine distribution panel

Assembly drawing

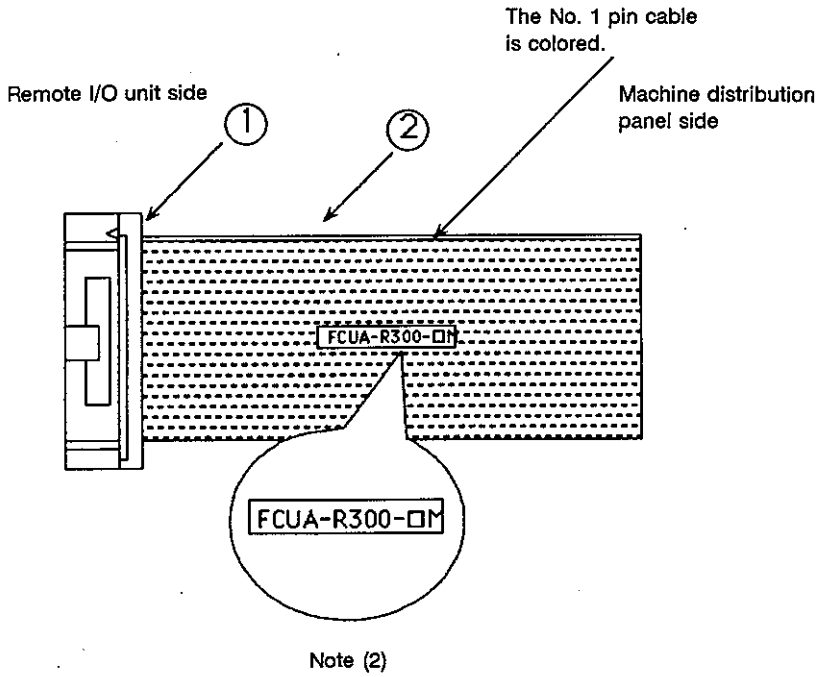
Option (compatible connector set)
FCUA-CN300 (Note that only the remote I/O unit side connector is compatible)

List of parts

No.	Part name/type	Maker	Qty.
1	Connector 7940-6500SC	Sumitomo 3M	1
2	Wire B40-S	Note (1)	(1)

Connection drawing

Max. cable length: 50m



Note (2)

Notes for manufacturing

(1) The above parts are the recommended parts. Equivalent parts may be used if the specifications are compatible.
(2) Attach the nameplate, on which the cable name is stamped, at the position specified in the assembly drawing.

Reference drawing for FCUA-R301 cable manufacturing

Application: Cable between controller and recommended terminal block

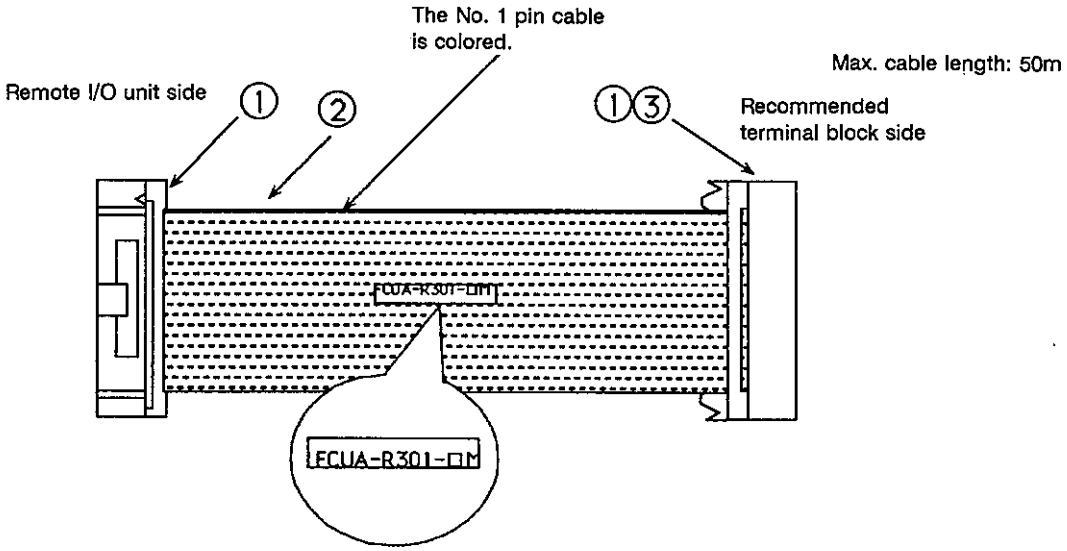
Assembly drawing

Option (compatible connector set)
FCUA-CS301 (Note that only the remote I/O unit side connector is compatible)

List of parts

No.	Part name/type	Maker	Qty.
1	Connector 7940-6500SC	Sumitomo 3M	2
2	Wire B40-S	Note (1)	(1)
3	Strain relief 3448-7940	Sumitomo 3M	1

Connection drawing



Note (2)

Notes for manufacturing

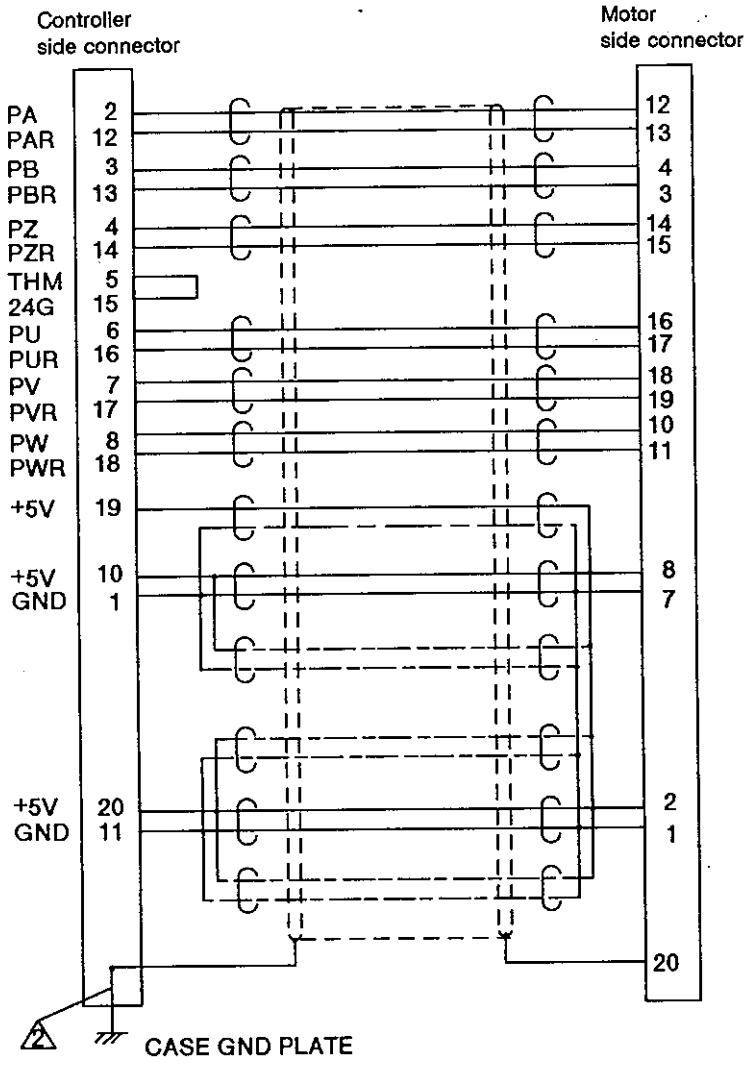
(1) The above parts are the recommended parts. Equivalent parts may be used if the specifications are compatible.
(2) Attach the nameplate, on which the cable name is stamped, at the position specified in the assembly drawing.
(3) The recommended terminal block is I/O terminal BX1F-T40 (Izumi Denki).

[Memo]

Appendix 2 Motor End Detector Cable

Reference drawing for FCUA-R060 cable manufacturing

Applicable motor: HA-FE series



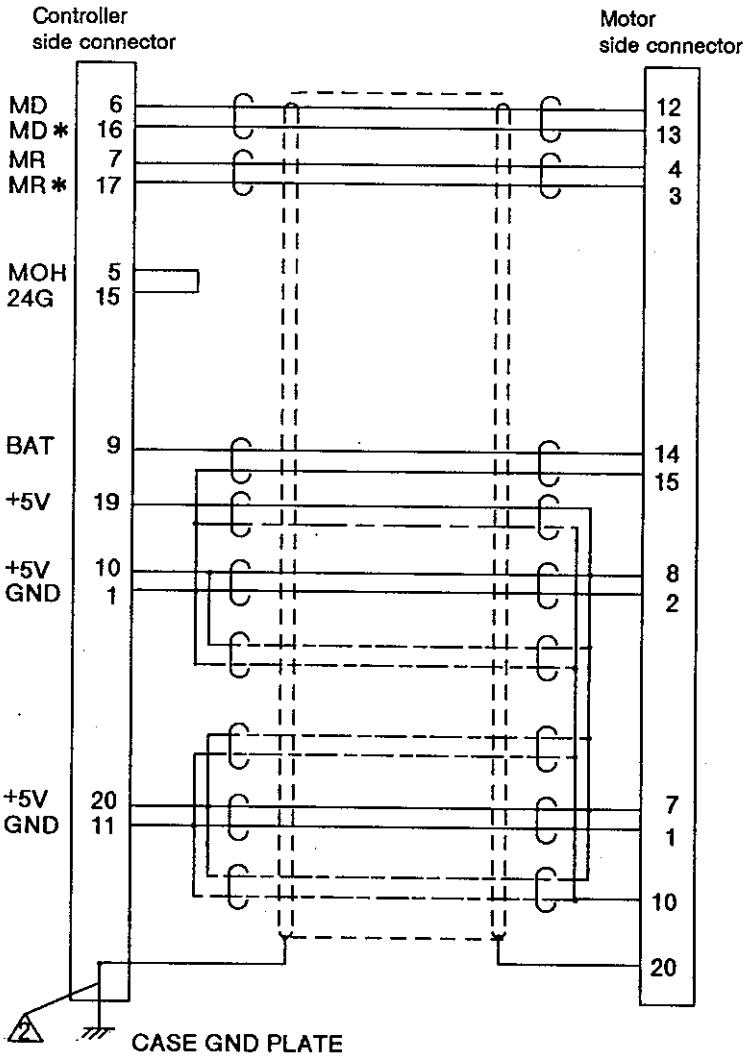
Note 1) If the cable length is 10m or more and 30m or less, connect +5V/GND in parallel as shown with ——— – – ——— in the drawing.

Note 2) Treat the driver side connector shield to the case grounding plate.

	Controller side connector	Motor side connector	Cable specifications
Connector	10120-3000VE	MR-20RF	Use a 0.2SQ twisted pair shield wire.
Case	10320-52F0-008	MR-20LK2	
Manufacturer	Sumitomo 3M	Honda Tsushin	
Both connectors can be supplied with option CS060.			

Reference drawing for FCUA-R061 cable manufacturing

Applicable motor: HA-FH series



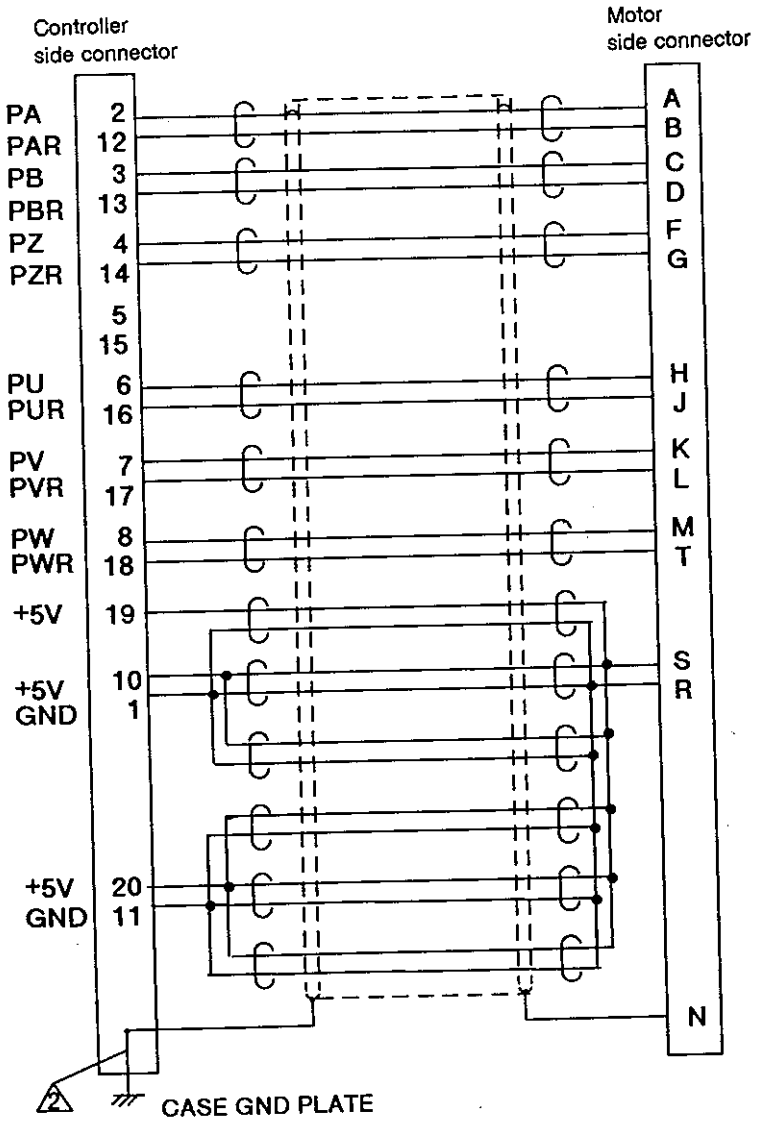
Note 1) If the cable length is 10m or more and 30m or less, connect +5V/GND in parallel as shown with ——— — ——— in the drawing.

Note 2) Treat the driver side connector shield to the case grounding plate.

	Controller side connector	Motor side connector	Cable specifications
Connector	10120-3000VE	PCR-E20PMRS-SL	Use a 0.2SQ twisted pair shield wire.
Case	10320-52F0-008	PCR-S20PMLA2	
Manufacturer	Sumitomo 3M	Honda Tsushin	
Both connectors can be supplied with option CS061.			

Reference drawing for FCUA-R074 cable manufacturing

Applicable motor: HA-SE series

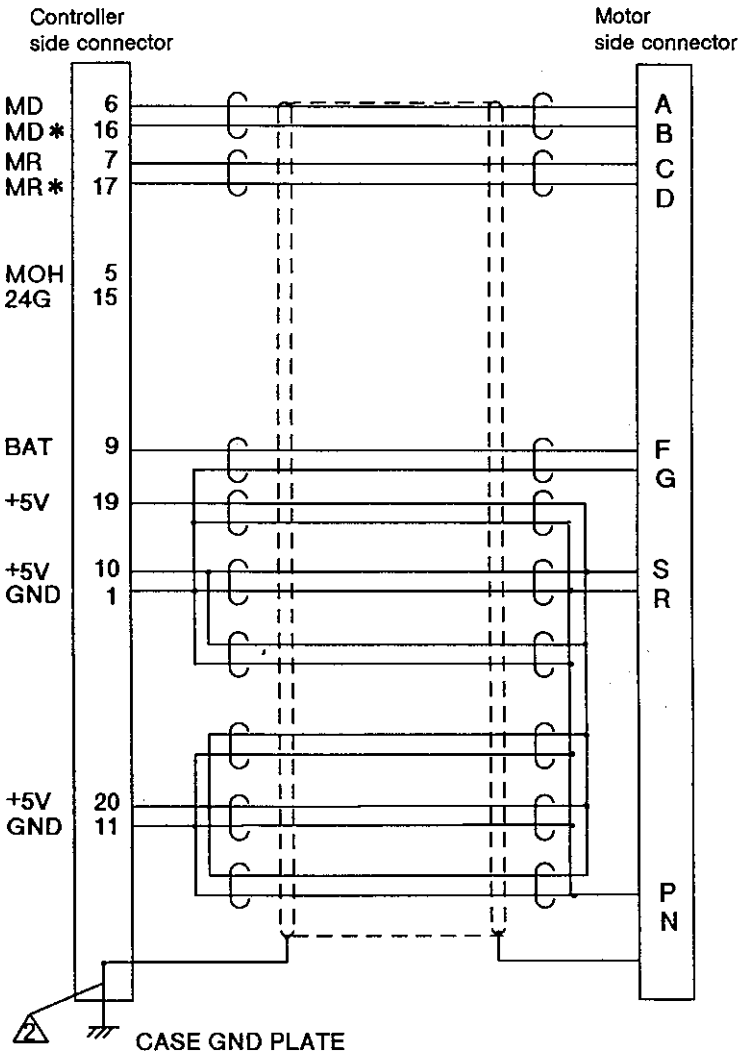


Note 1) Treat the driver side connector shield to the case grounding plate.

	Controller side connector	Motor side connector	Cable specifications
Connector	10120-3000VE	MS-3057-12A	Use a 0.2SQ twisted pair shield wire.
Case	10320-52F0-008	MS3108B20-29S	
Manufacturer	Sumitomo 3M	ITT CANON	
Both connectors can be supplied with options CS054, CS050.			

Reference drawing for FCUA-R075 cable manufacturing

Applicable motor: HA-SH series

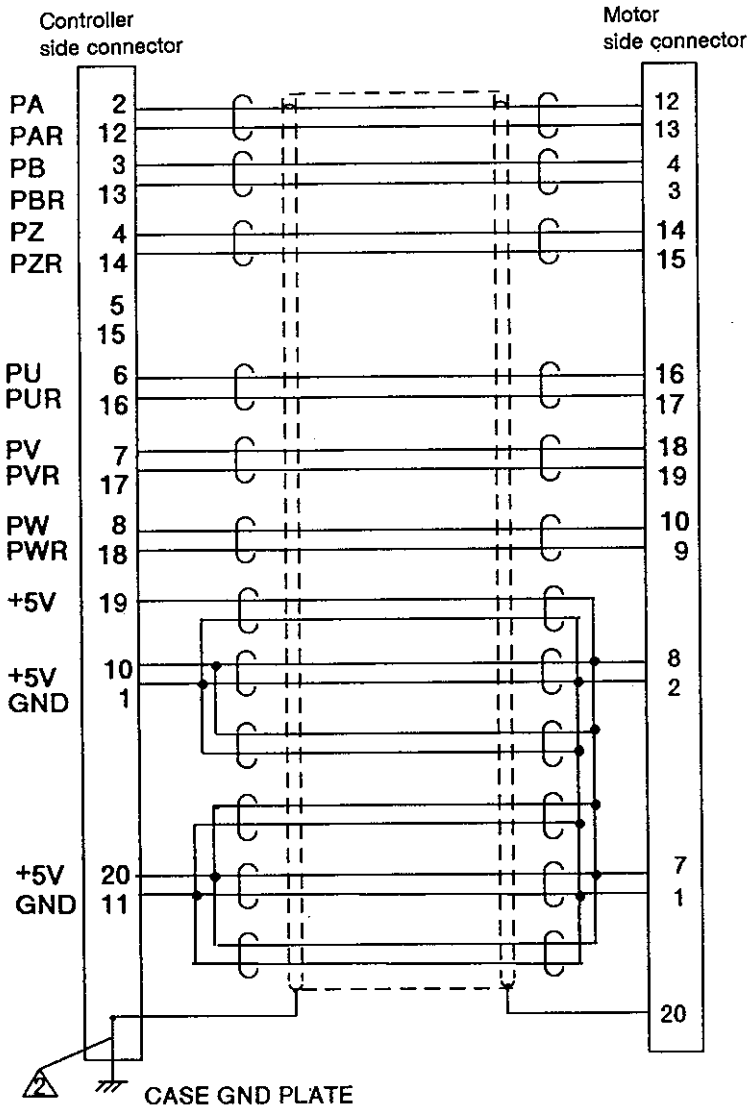


Note 1) Treat the driver side connector shield to the case grounding plate.

	Controller side connector	Motor side connector	Cable specifications
Connector	10120-3000VE	MS-3057-12A	Use a 0.2SQ twisted pair shield wire.
Case	10320-52F0-008	MS3108B20-29S	
Manufacturer	Sumitomo 3M	ITT CANON	
Both connectors can be supplied with options CS054, CS050.			

Reference drawing for FCUA-R062 cable manufacturing

Applicable motor: HA-ME series



Note 1) Treat the driver side connector shield to the case grounding plate.

	Controller side connector	Motor side connector	Cable specifications
Connector	10120-3000VE	MR-20RF	Use a 0.2SQ twisted pair shield wire.
Case	10320-52F0-008	MR-20LK2	
Manufacturer	Sumitomo 3M	Honda Tsushin	
Both connectors can be supplied with options CS054, CS050.			

Appendix 3 Explanation of Digital Input/output Interface during Use of Standard PLC

Appendix 3 Explanation of Digital Input/output Interface during Use of Standard PLC

[Outline]

The standard PLC is the PLC program stored beforehand in the control software.
At shipment from the factory, the standard PLC is already registered in the PLC memory. The standard PLC can be easily read into the PLC memory from the control software at any time, and can also be revised. The standard PLC is modified so that program operation and manual operation can be done with basic operation method. The digital input/output interface is as described below.

[Digital input/output interface assignment table]

Input signals

Device	Abbr.	Signal name	Connector pin No.
X0	RST	Reset	DIO-20A
X1	MD1	Operation mode 1	19A
X2	MD2	Operation mode 2	18A
X3	MD4 (*DOG)	Operation mode 3 (or reference near-point detection)	17A
X4	ST	Program operation start and miscellaneous function completion	16A
X5	P1	Differs according to operation mode	15A
X6	P2		14A
X7	P4 (*OT +/–)	Differs according to operation mode (or stroke end)	13A
X8	SKIP	Skip input	2A
X9	*EMG	Emergency stop	1A

* 1. Signals with an asterisk are handled as B (back) contacts.
  2. If reference near-point detection or the stoke end signals are not required, each of these can be used as the MD4 and P4 signal. Use the parameters to set which signal is used.
  3. The details of the P1 to P4 signals differ according to the selected operation mode.

Output signals

Device	Abbr.	Signal name	Connector pin No.
Y0	SA	Servo READY	DIO-11A
Y1	STL	In-automatic operation	10A
Y2	SPL	In-automatic off	9A
Y3	DEN	Movement completed	8A
Y4	MF	Miscellaneous function (M strobe)	7A
Y5	M1	M code output	6A
Y6	M2		5A
Y7	M4		4A

[Detailed explanation of signals]

<Input signals>

(1) X0 (RST)

The reset state will be entered when this signal is input.
The following reset operations will take place during resetting.

- The axis movement decelerates and stops.
- The resettable alarms are canceled.
- The miscellaneous function strobe is reset.
- The program operation stops, and a point No. is designated for restarting.

(2) X1 to X3 (MD1 to MD4)

The operation modes are as follows according to the X1 to X3 combinations (ON/OFF).
When using X3 as the reference near-point detection signal (*DOG), the operation modes will be those possible with the X1 and X2 combinations.

Device	Signal name
X1	MD1
X2	MD2
X3	(MD4)

Combination			Operation mode
X3	X2	X1	
OFF	OFF	OFF	Single-point operation
OFF	OFF	ON	Multi-point operation
OFF	ON	OFF	Reference point return
OFF	ON	ON	JOG
ON	OFF	OFF	Incremental
ON	OFF	ON	Automatic initialization setting
ON	ON	OFF	
ON	ON	ON	

(3) X4 (ST)

This functions as both the program start signal and miscellaneous function completion signal.

Program operation signal : The point program operation is started.

Miscellaneous function completion signal: This signal notifies the machine controller that the miscellaneous function (M) has been commanded, received by the PLC, and the designated operation completed by the PLC.

(4) X5 to X7 (P1 to P4)

X5 to X7 have the following meanings depending on the operation mode.

— For program operation (single-point operation, multi-point operation) mode —

If the single-point operation or multi-point operation is selected for the operation mode, the No. of the point to be started is designated with the combination of X5 to X7 (ON/OFF). In this case, the selection is set before the input of the start signal.

For multi-point operation, the operation will start and continue from the designated point No.

When X7 is used as the stroke end signal (*OT+/–), the point No. designation possible will be that with the combination of X5 and X6.

Device	Signal name
X5	P1
X6	P2
X7	(P4)

Combination			Designated point No.
X7	X6	X6	
OFF	OFF	OFF	Point No. 1
OFF	OFF	ON	Point No. 2
OFF	ON	OFF	Point No. 3
OFF	ON	ON	Point No. 4
ON	OFF	OFF	Point No. 5
ON	OFF	ON	Point No. 6
ON	ON	OFF	Point No. 7
ON	ON	ON	Point No. 8

— For manual operation (reference point return, JOG, incremental) mode —

If the manual mode (zero point return, JOG, step) is selected for the operation mode, the combinations will have the following meanings.

When X7 is used as the stroke end signal (*OT.+/–), the "speed parameter 1 selection" and "feed scale × 100" settings will be fixed.

Combination / Operation mode	X5	X6	X7	
	ON	ON	OFF	ON
Reference point return	Axis start +	Axis start –	Speed parameter 1 selection	Speed parameter 2 selection m
JOG				
Incremental			Feed scale × 100	Feed scale × 10

[Output signals]

(1) Y0 (SA)

This signal notifies that the servo system can be normally operated. If this signal is not ON, it means that the servo (position control) is not functioning.

(2) Y1 (STL)

This signal notifies that the machine controller has been started by the program operation start, and that a movement command or miscellaneous function (M) command is being executed.

(3) Y2 (SPL)

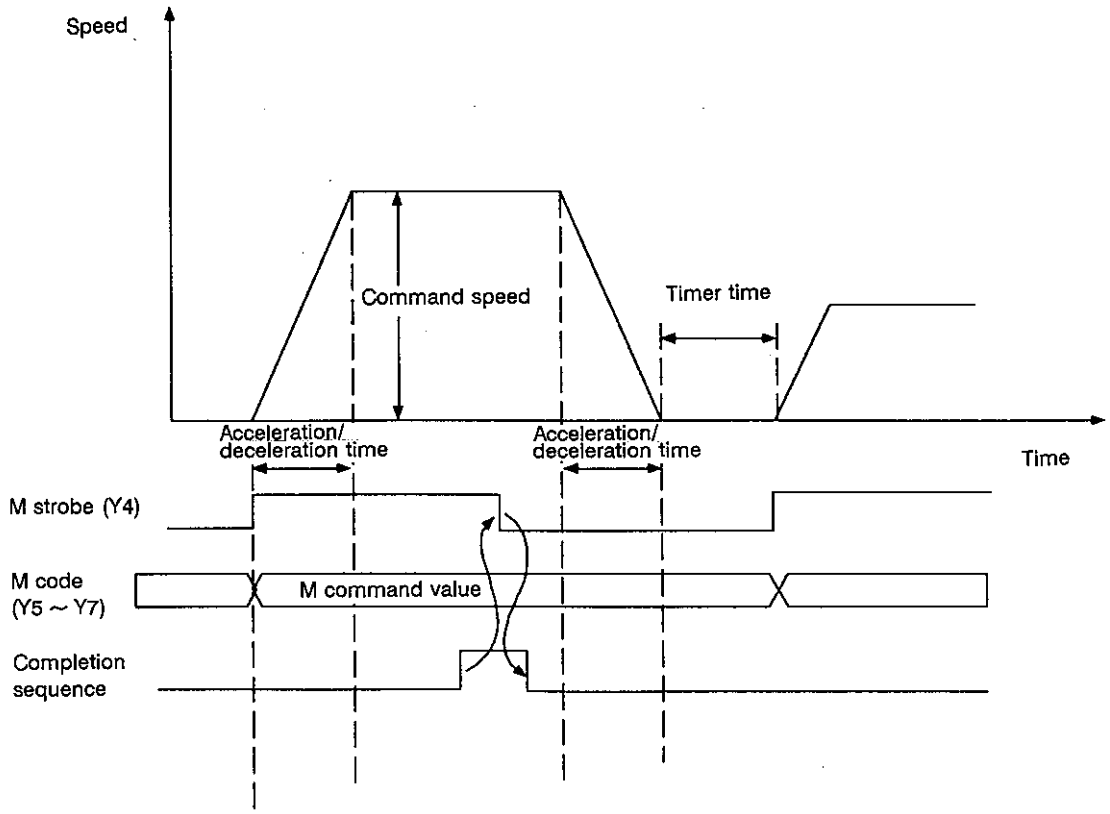
This signal notifies that the machine controller has been started by the program operation start, and has been interrupted by a program stop signal, etc., during execution of a movement command or miscellaneous function (M) command.

(4) Y3 (DEN)

This signal notifies that the machine controller has completed the axis movement command. This is used to process a miscellaneous function (M) command after movement is completed during program operation or PLC operation.

(5) Y4 (MF), Y5 to Y7 (M1 to M4)

This is the miscellaneous function (M) strobe and M code output signal. The timing of each is as follows.



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