

EPSON

ROBOT CONTROLLER

RC520

Rev.9

EM073C1490F

ROBOT CONTROLLER RC520 Rev.9

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RC520

Rev.9

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FOREWORD

Thank you for purchasing our robot products.

This manual contains the information necessary for the correct use of the robot controller.

Please carefully read this manual and other related manuals before installing the robot system.

Keep this manual handy for easy access at all times.

WARRANTY

The robot system and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards.

Product malfunctions resulting from normal handling or operation will be repaired free of charge during the normal warranty period. (Please ask your Regional Sales Office for warranty period information.)

However, customers will be charged for repairs in the following cases (even if they occur during the warranty period):

1. Damage or malfunction caused by improper use which is not described in the manual, or careless use.
2. Malfunctions caused by customers' unauthorized disassembly.
3. Damage due to improper adjustments or unauthorized repair attempts.
4. Damage caused by natural disasters such as earthquake, flood, etc.

Warnings, Cautions, Usage:

1. If the robot system or associated equipment is used outside of the usage conditions and product specifications described in the manuals, this warranty is void.
2. If you do not follow the WARNINGS and CAUTIONS in this manual, we cannot be responsible for any malfunction or accident, even if the result is injury or death.
3. We cannot foresee all possible dangers and consequences. Therefore, this manual cannot warn the user of all possible hazards.

TRADEMARKS

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TRADEMARK NOTATION IN THIS MANUAL

Microsoft® Windows® 2000 Operating system

Microsoft® Windows® XP Operating system

Throughout this manual, Windows 2000, and Windows XP refer to above respective operating systems. In some cases, Windows refers generically to Windows 2000, and Windows XP.

NOTICE

No part of this manual may be copied or reproduced without authorization.

The contents of this manual are subject to change without notice.

Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

INQUIRIES

Contact the following service center for robot repairs, inspections or adjustments.

If service center information is not indicated below, please contact the supplier office for your region.

Please prepare the following items before you contact us.

- Your controller model and its serial number
- Your manipulator model and its serial number
- Software and its version in your robot system
- A description of the problem

SERVICE CENTER

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Before Reading This Manual

This section describes what you should know before reading this manual.

Control System

The RC520 Robot Controller can be used with either the EPSON RC+ or SPEL CT systems. For users of each system, the section or chapter to refer in the related manual is indicated as follows in this manual.

EPSON RC+ : User's Guide

SPEL CT : User's Guide introduction or Setup & Operation

TABLE OF CONTENTS

Before Reading This Manual.....	v
---------------------------------	---

Setup & Operation

1. Safety	3
1.1 Conventions	3
1.2 Safety Precautions	3
1.3 Safety Features	6
2. Part Names and Functions	9
2.1 Model Number	9
2.2 System Configuration	9
2.3 Standard Specifications	11
2.4 Control Unit	13
2.4.1 Control Unit	13
2.4.2 Front Panel	13
2.4.3 Rear Panel	16
2.4.4 Dimensions	18
2.4.5 Control Unit Capability	18
2.5 Four-axis Drive Unit (RC520DU)	19
2.5.1 Four-axis Drive Unit	19
2.5.2 Front Panel	19
2.5.3 Locking out the Four-axis Drive Unit	20
2.5.4 Rear Panel	20
2.5.5 Four-axis Drive Unit - Interior Layout	21
2.5.6 Dimensions	23
2.6 Six-axis Drive Unit (RC520DU6)	24
2.6.1 Six-axis Drive Unit	24
2.6.2 Front Panel	24
2.6.3 Locking out the Six-axis Drive Unit	25
2.6.4 Rear Panel	25
2.6.5 Six-axis Drive Unit - Interior Layout	26
2.6.6 Dimensions	28

6. D-I/O Connector	54
6.1 Input Circuit.....	55
6.2 Output Circuit.....	57
6.3 Pin Assignments.....	59
6.3.1 D-I/O connector - Pin Assignments.....	59
6.3.2 D-I/O connector optional cable - Pin Assignments ...	60
6.3.3 D-I/O connector optional cable for USA Specification - Pin Assignments.....	61
7. Expansion I/O Board - Optional	62
7.1 Expansion I/O Board.....	62
7.2 Protected Expansion I/O Board.....	63
7.2.1 Jumper Settings.....	63
7.2.2 Input Circuit.....	64
7.2.3 Output Circuit.....	66
7.3 Expansion I/O Board.....	68
7.3.1 Jumper Settings.....	68
7.3.2 Input Circuit.....	68
7.3.3 Output Circuit.....	69
7.4 Expansion I/O Board: Pin Assignments.....	71
7.4.1 Pin Assignments (NPN type).....	71
7.4.2 Pin Assignments (PNP type).....	73
7.5 Expansion I/O Connector.....	75
7.5.1 Pin Layout of Expansion I/O Connector.....	75
7.5.2 Expansion I/O Connector Cable.....	75
7.5.3 Expansion I/O Connector Cable - Pin Assignments .	76
8. I/O Remote Settings	80
8.1 Remote I/O Signal Descriptions (EPSON RC+).....	80
8.1.1 Remote Input Signals.....	81
8.1.2 Remote Output Signals.....	83
8.2 Remote I/O Signal Descriptions (SPEL CT).....	84
8.2.1 Remote Input Signals.....	84
8.2.2 Remote Output Signals.....	86
8.3 Timing Specifications (EPSON RC+).....	88
8.3.1 Design Notes for Remote Input Signals.....	88
8.3.2 Timing Diagram for Operation Execution Sequence	88
8.3.3 Timing Diagram for Program Execution Sequence...	89
8.3.4 Timing Diagram for Safety Door Input Sequence	90
8.3.5 Timing Diagram for Emergency Stop Sequence.....	90

8.3.6	Timing Diagram for RECOVER Sequence.....	91
8.4	Timing Specifications (SPEL CT)	93
8.4.1	Design Notes for Remote Input Signal.....	93
8.4.2	Timing Diagram for Operation Execution Sequence	93
8.4.3	Timing Diagram for Program Execution Sequence ..	94
8.4.4	Timing Diagram for Safety Door Input Sequence.....	95
8.4.5	Timing Diagram for Emergency Stop Sequence	96
8.4.6	Timing Diagram for Error Generating Sequence.....	96
8.4.7	Timing Diagram for RECOVER Sequence.....	97

9. RS-232C Settings 99

9.1	RS-232C cable	99
9.1.1	Pin Assignments	99
9.1.2	Connection Example	100
9.2	Preparation for Communication	100

10. Jumper Settings for MIB 101

11. Stand-alone Option for RC520 104

11.1	Stand-alone Option.....	104
11.2	System Configuration	104
11.3	Installation	104
11.4	Power Supply	105
11.5	Emergency Connector Plate Kit.....	105
11.5.1	Appearance of Emergency Connector Plate Kit.....	105
11.5.2	Components of Emergency Connector Plate Kit....	106
11.5.3	Safety Door Switch and Emergency Stop Switch...	106
11.5.4	Pin Assignments	107
11.5.5	Circuit Diagram	108
11.6	MIB.....	110
11.6.1	Board Number.....	110
11.6.2	Jumper Settings	110
11.7	Option.....	110

Maintenance

1. Safety Precautions for Maintenance	113
1.1 Procedure for Lockout.....	115
1.2 Tagout.....	115
2. Regular Maintenance Inspection	116
2.1 Schedule for Maintenance Inspection	116
2.2 Inspection Point	117
2.2.1 Inspection While the Controller is Turned OFF	117
2.2.2 Inspection While the Controller is Turned ON.....	117
2.3 Cleaning the Fan Filter	117
2.4 Replacing a Lithium Battery on the CPU Board	117
2.5 Backup of Data	119
2.5.1 EPSON RC+.....	119
2.5.2 SPEL CT.....	124
3. Hardware Configuration	129
3.1 Control Unit, Drive Unit and Manipulator.....	129
3.2 Optional Boards	130
4. Control Unit	131
4.1 Overview	131
4.2 Replacing the MIB.....	131
4.3 Replacing CPU Board	132
4.4 Replacing an Optional Board	134
4.5 Replacing the System Panel	134
4.5.1 Removal of the System Panel	134
4.5.2 Installation of the System Panel	135
4.6 Cleaning and Replacing the Fan Filter	136
4.7 Replacing the Fan	137
4.8 Replacing the HDD (Hard Disk Drive).....	138
4.9 Replacing the Emergency Connector Plate Kit	138
5. Four-axis Drive Unit (RC520DU)	139
5.1 Overview	139
5.2 Pin Assignments for the System Connectors.....	140
5.2.1 M/C Power.....	140
5.2.2 M/C Signal.....	141
5.2.3 MOTION	142

5.3	Four-axis Drive Unit.....	143
5.3.1	System Configuration of Four-axis Drive Unit	143
5.3.2	Module Functions and Layout	144
5.3.3	Inspecting the Switching Power Supply Module.....	145
5.4	Motor Driver Module	146
5.4.1	Layout and Functions	146
5.4.2	Replacing a Motor Driver Module.....	147
5.5	DPB (Drive Power Board).....	149
5.5.1	Layout and Functions	149
5.5.2	Adjusting Encoder Voltage	151
5.5.3	Adjusting +5V Voltage.....	152
5.6	DMB (Drive Main Board).....	153
5.6.1	Layout and Functions	153
5.6.2	Replacing the DMB	154
5.7	Cooling Fan	157
5.7.1	Layout	157
5.7.2	Inspecting the Fan Filter.....	157
5.7.3	Replacing the Fan	158
5.8	Regeneration Module (For RC520DU)	160
5.8.1	Layout and Function.....	160
5.8.2	Replacing a Regeneration Module (For RC520DU).....	160

6. Six-axis Drive Unit (RC520DU6) 162

6.1	Overview.....	162
6.2	Pin Assignments for the System Connectors	163
6.2.1	M/C Power	163
6.2.2	M/C Signal	164
6.2.3	MOTION.....	164
6.3	Six-axis Drive Unit	165
6.3.1	System Configuration of Six-axis Drive Unit.....	165
6.3.2	Module Functions and Layout	166
6.3.3	Inspecting the Switching Power Supply Module.....	167
6.4	Motor Driver Module	167
6.5	DPB (Drive Power Board).....	167
6.5.1	Layout and Functions	167
6.6	DMB (Drive Main Board).....	169
6.6.1	Layout and Functions	169
6.6.2	Replacing the DMB	169

6.7	Cooling Fan.....	172
6.7.1	Layout.....	172
6.7.2	Inspecting the Fan Filter	172
6.7.3	Replacing the Fan	173
6.8	Regeneration Module (For RC520DU6).....	175
6.8.1	Layout and Function	175
6.8.2	Replacement of Regeneration Module (For RC520DU6)	176
6.9	Over-voltage Detection Module (For RC520DU6).....	180
6.9.1	Layout and Function	180
6.9.2	Over-voltage Detection Module (For RC520DU6) ..	180
7. Verifying Manipulator Operation		183
8. Recovering the HDD		185
8.1	Recovering Windows	186
8.1.1	Recovery Procedure	186
8.1.2	Windows Recovery (With “EasyRestore” License Label)	186
8.1.3	Windows Recovery (Without “EasyRestore” License Label)	189
8.2	Configuring Windows	192
8.3	Setting Up EPSON RC+ (For EPSON RC+ User).....	193
8.3.1	Installing EPSON RC+.....	193
8.3.2	Reserving Address Resources of EPSON RC+ Options	194
8.4	Setting Up SPEL CT (For SPEL CT User)	195
8.4.1	Installing SPEL CT	195
8.4.2	Reserving Address Resources of SPEL CT Options	196
9. Maintenance Parts List		197

Setup & Operation

This manual contains information for setup and operation of the RC520 Robot Controller.

1. Safety

Installation and transportation of robots and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes.

Please read this manual and other related manuals before installing the robot system or before connecting cables. Keep this manual handy for easy access at all times.

Please read the *Safety* chapter in User's Guide to understand safety requirements before installing the robot system.

EPSON RC+ :User's Guide - chapter *Safety*

SPEL CT :User's Guide Introduction

:Safety - 1. *Safety* and 2. *Basic Safety-related Matters*

1.1 Conventions

Important safety considerations are indicated throughout the manual by the following symbols. Be sure to read the descriptions shown with each symbol.

 WARNING	This symbol indicates that a danger of possible serious injury or death exists if the associated instructions are not followed properly.
 WARNING	This symbol indicates that a danger of possible harm to people caused by electric shock exists if the associated instructions are not followed properly.
 CAUTION	This symbol indicates that a danger of possible harm to people or physical damage to equipment and facilities exists if the associated instructions are not followed properly.

1.2 Safety Precautions

Only trained personnel should design and install the robot system.

Trained personnel are defined as those who have taken robot system training classes held by the manufacturer, dealer, or local representative company, or those who understand the manuals thoroughly and have the same knowledge and skill level as those who have completed the training courses.

The following items are safety precautions for qualified design or installation personnel:

 WARNING	<ul style="list-style-type: none"> ■ Personnel who design and/or construct the robot system with this product must read the <i>Safety</i> chapter in User's Guide to understand the safety requirements before designing and/or constructing the robot system. Designing and/or constructing the robot system without understanding the safety requirements is extremely hazardous, may result in serious bodily injury and/or severe equipment damage to the robot system, and may cause serious safety problems.
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 WARNING	<ul style="list-style-type: none"> ■ The Manipulator and the Controller must be used within the environmental conditions described in their respective manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in an environment that exceeds the specified environmental conditions may not only shorten the life cycle of the product but may also cause serious safety problems. ■ The robot system must be used within the installation requirements described in the manuals. Using the robot system outside of the installation requirements may not only shorten the life cycle of the product but also cause serious safety problems. ■ The interlock of the Safety Door must be functioning when the robot system is operated. Do not operate the system under the condition that the switch cannot be turned ON/OFF. (I.E. the condition where the switch is disabled) (Example: Tape is put around the switch to hold it closed.) Operating the robot system when the switch is not functioning properly is extremely hazardous and may cause serious safety problems as the Safety Door input cannot fulfill its intended function. ■ Connect input signal wires for Emergency Stop and Safety Door to the EMERGENCY connector so that the Emergency Stop switch in the operation unit or the ATTEND (TEACH) control device connected to the OPTIONAL DEVICE connector always functions. (Refer to the typical application diagram in the <i>Setup & Operation 5.5 Circuit Diagrams.</i>)
--	---

 WARNING	<ul style="list-style-type: none"> ■ Do not open the cover(s) of the Controller except while maintaining it. Opening the cover(s) of the Controller is extremely hazardous and may result in electric shock even when its main power is OFF because of the high voltage charge inside the Controller. ■ Make sure that the power to the Controller is turned OFF and locked out before connecting or disconnecting any cables. Connecting or disconnecting any cables with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the Controller. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or a contact failure is extremely hazardous and may result in electric shock and/or improper function of the system. ■ If it is necessary to change the plug to fit the outlet in your factory, make sure that it is done by qualified personnel. When changing the plug be sure to connect the earth wire of the AC power cable colored green/yellow on the Controller to the earth terminal of the factory power supply. The equipment must be grounded properly at all times to avoid the risk of electric shock. Always use a power plug and receptacle. Never connect the Controller directly to the factory power supply. (Field wiring)
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 WARNING	<ul style="list-style-type: none"> ■ Do not touch the inside of the AC OUTLET connector. The AC power cable and the AC OUTLET connector on the Drive Unit are directly connected inside the Drive Unit by the cable. The AC200V OUTLET connector on the Drive Unit is constantly ON, whether the Drive Unit power is ON or OFF. Therefore, touching the inside of the AC OUTLET connector is extremely hazardous and may result in electric shock.
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 CAUTION	<ul style="list-style-type: none"> ■ Only install optional hardware specifically designed for the robot system. If any other hardware is installed to the robot system, the robot system may function improperly and also cause safety problems. (For EPSON RC+ Users, only the hardware that has been approved by EPSON can be installed on the robot system.) ■ Do not install any other software in the robot system except for the software that was originally installed at ship time. If any other software is installed, the robot system may function improperly and also cause safety problems. (For EPSON RC+ Users, only the software that has been approved by EPSON can be installed on the robot system.) ■ The serial numbers of the Drive Unit and Manipulator that should be connected are indicated on the Connection Check Label on the Control Unit. Connect the Control Unit, the Drive Unit and the Manipulator correctly. Improper connections between the Drive Unit and the Manipulator and between the Control Unit and the Drive Unit may cause improper function of the robot system and also safety problems. ■ If there is more than one Drive Unit connected to the Control Unit in the robot system, make sure that the DU numbers (DU1 - DU3) indicated above the MIB connector on the Control Unit and the Drive Unit (above the MOTION connector) match. Improper connection between the Control Unit and the Drive Unit may cause malfunction of the robot system and/or safety problems as it may make the Manipulator move abnormally. ■ When using remote I/O, always make sure of the following. Using the robot system under unsatisfactory conditions may cause malfunction of the system and/or safety problems. <ul style="list-style-type: none"> - Assign remote functions to inputs/outputs correctly and wire correctly when setting up remote I/O signals. - Make sure that the functions correspond to the correct input/output signals before turning ON the system. - When verifying the robot system operation, prepare for failures with initial settings or wiring. If the Manipulator functions unusually by the failures with initial settings or wiring, press the Emergency Stop switch immediately to stop the Manipulator.
---	--

The following items are safety precautions for qualified operator personnel:

 WARNING	<ul style="list-style-type: none"> ■ The interlock of the Safety Door must be functioning when the robot system is operated. Do not operate the system under the condition that the switch cannot be turned ON/OFF. (I.E. the condition where the switch is disabled) (Example: Tape is put around the switch to hold it closed.) Operating the robot system when the switch is not functioning properly is extremely hazardous and may cause serious safety problems as the Safety Door input cannot fulfill its intended function.
--	---

 WARNING	<ul style="list-style-type: none"> ■ Do not open the cover(s) of the Controller except while maintaining it. Opening the cover(s) of the Controller is extremely hazardous and may result in electric shock even when its main power is OFF because of the high voltage charge inside the Controller.
--	--

1.3 Safety Features

The RC520 robot control system supports safety features for peripheral equipment and robot system itself as described below. However, the user is recommended to strictly follow the proper usage of the robot system by thoroughly reading the attached manuals before using the system. Failure to read and understand the proper usage of the safety functions is highly dangerous.

Among the following safety features, the Emergency Stop Switch and Safety Door Input are particularly important. Make sure that these and other features function properly before operating the robot system.

Refer to the *Setup & Operation 5.1 Safety Door Switch and Latch Release Switch* and *Setup & Operation 5.2 Emergency Stop Switch* for details.

ATTEND (TEACH) Control Device

To operate the Manipulator at a short distance without any operation unit (option), you must create an ATTEND (TEACH) control device and connect it to the OPTIONAL DEVICE connector on the front of the Control Unit in order to operate the Manipulator at a short distance. The ATTEND (TEACH) control device should consist of the Emergency Stop switch, 3-position enable switch (dead-man switch), and ATTEND (TEACH) control device enable/disable switch.

The name of the control device depends on the software used in your Control Unit as shown below:

- EPSON RC+ : TEACH control device
- SPEL CT : ATTEND control device

Emergency Stop Switch

The ATTEND (TEACH) control device must be equipped with the Emergency Stop switch. The EMERGENCY connector on the Drive Unit has extension Emergency Stop input terminals used for connecting the Emergency Stop switches.

These Emergency Stop inputs are internally connected to the relays for the dynamic brake. Therefore, pressing any Emergency Stop switch can shut off the motor power immediately and the robot system will enter the Emergency Stop condition.

Safety Door Input

In order to activate this feature, make sure that the Safety Door Input switch is connected to the EMERGENCY connector on the Drive Unit.

When the safety door is opened, normally the Manipulator immediately stops the current operation, and the status of Manipulator power is operation-prohibited until the safety door is closed and the latched condition is released. In order to execute the Manipulator operation while the safety door is open, you must change the ATTEND (TEACH) control device enable/disable switch to “enable” or change the mode selector switch on the operation unit to the mode for teaching and then engage the 3-position enable switch. In this case, the Manipulator is operated in low power status.

Lockout

Turn OFF the power supply and use a lockout procedure to prevent anyone from turning ON the power supply by mistake while someone else is in the safeguarded area for maintenance or repairs.

The procedure for lockout is described in the *Maintenance 1. Safety Precautions for Maintenance*.

Low Power Mode

The motor power is reduced in this mode. A shift into restricted status (low power status) can be done through the execution of a power status change instruction, regardless of the safety door or operation mode. This ensures the safety of the operator and reduces the possibility of peripheral equipment being destroyed or damaged as a result of careless operation.

Dynamic Brake

The dynamic brake circuit includes relays that short the motor armatures. When the motor armatures are shorted, the power to the Motor Driver modules is cut off and the reverse EMF caused by the short stops the motors. The dynamic brake circuit is activated when there is an Emergency Stop input or when any of the following errors is detected: encoder cable disconnection, motor overload, irregular motor torque, motor speed error, servo error (positioning or speed overflow), irregular CPU, memory check-sum error and overheat condition inside the Motor Driver Module.

Encoder Cable Disconnection Error Detection

The dynamic brake circuit is activated when the Motor Encoder Signal cable (connecting to the Drive Unit) is disconnected.

Motor Overload Detection

The dynamic brake circuit is activated when the system detects that the load on the motor has exceeded its capacity.

Irregular Motor Torque (out-of-control manipulator) Detection

The dynamic brake circuit is activated when irregularity with motor torque (motor output) is detected (in which case the Manipulator is out of control).

Motor Speed Error Detection

The dynamic brake circuit is activated when the system detects that the motor is running at incorrect speed.

Positioning Overflow - Servo Error - Detection

The dynamic brake circuit is activated when the system detects that the difference between the Manipulator's actual position and commanded position exceeds the margin of error allowed.

Speed Overflow - Servo Error - Detection

The dynamic brake circuit is activated when the system detects that motor speed has overflowed.

CPU Irregularity Detection

Irregularity in the motor controlling CPU is monitored by a watch-dog timer. Also, the system CPU inside the Control Unit and the motor controlling CPU inside the Drive Unit are designed to constantly check each other for any discrepancies between the units. If a discrepancy is detected, the dynamic brake circuit is activated.

Memory Check-sum Error Detection

The dynamic brake circuit is activated when a memory check-sum error is detected.

Overheat Detection at the Motor Driver Module

The dynamic brake circuit is activated when the temperature of the power device inside the Motor Driver module is above the nominal limit.

Over-Voltage Detection

The dynamic brake circuit is activated when the voltage of the Controller is above the normal limit. (When mounting a regeneration module toDU4, or using DU6)

2. Part Names and Functions

2.1 Model Number

The RC520 robot controller consists of one Control Unit and Drive Unit(s). The Controller Unit and Drive Unit have several models depending on the specifications. The following table shows all the combinations of the Control Unit and Drive Unit, and their differences.

The model number is recorded on the signature label of the Control Unit or Drive Unit.

Model Number		Model Differences		
Control Unit	Drive Unit	Controllable Axes	Type of D-I/O	Conformity to Safety Standard
RC520CU-1	RC520DU	4 axes	NPN type	
RC520CU-1	RC520DU/CE	4 axes	PNP type	CE Marking
RC520CU-1-UL	RC520DU-UL	4 axes	PNP type	CE Marking and UL
RC520CU-1	RC520DU6	6 axes	NPN type	
RC520CU-1	RC520DU6/CE	6 axes	PNP type	CE Marking
RC520CU-1-UL	RC520DU6-UL	6 axes	PNP type	CE Marking and UL

2.2 System Configuration

The numbers of controllable motor axes per Drive Unit are as shown below:

Each four-axis Drive Unit (RC520DU) : Up to four axes

Each six-axis Drive Unit (RC520DU6) : Up to six axes

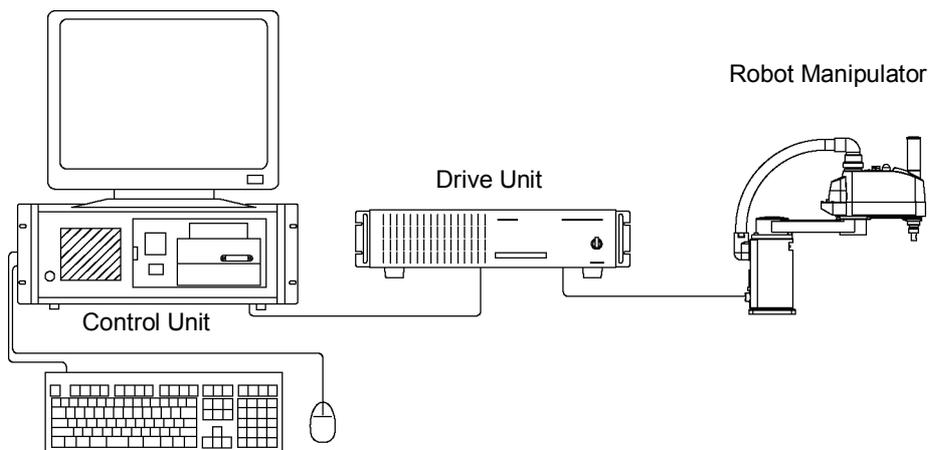
Up to three Drive Units are connected to one Control Unit. The following table shows available connections of the Drive Units per Control Unit.

	Four-axis Drive Units	Six-axis Drive Units
Case 1	3 Drive Units	-
Case 2	2 Drive Units	1 Drive Unit
Case 3	-	2 Drive Units

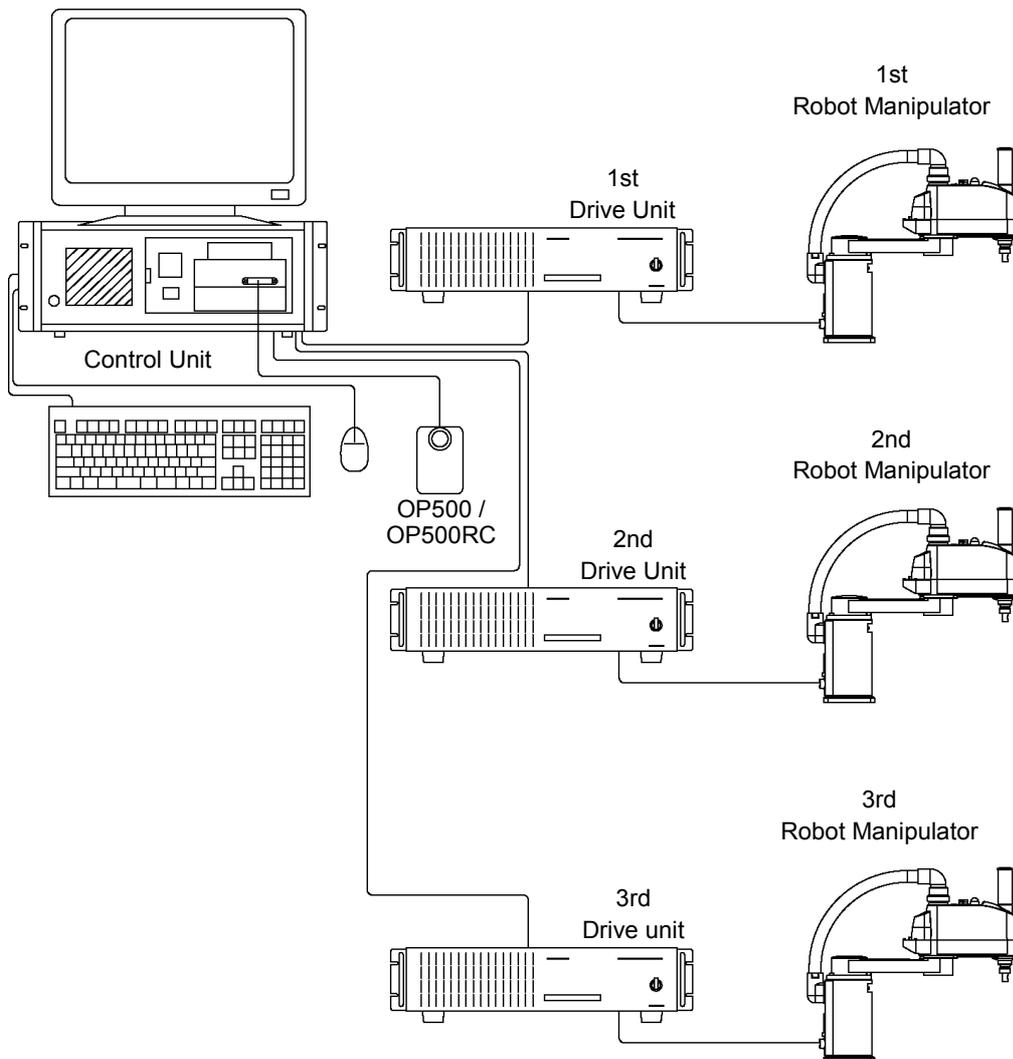
For details on the Control Unit, refer to the *Setup & Operation 2.4 Control Unit (RC520DU)*.

For details on the Drive Unit, refer to the *Setup & Operation 2.5 Four-axis Drive Unit* and the *Setup & Operation 2.6 Six-axis Drive Unit (RC520DU6)*.

Example 1 : One Drive Unit and One Manipulator



Example 2 : Three Drive Units and Three Manipulators



2.3 Standard Specifications

Item	Specification		
Model	RC520		
CPU	PC compatible computer optimized for RC520: CPU : PentiumIII 850MHz or faster HDD : 20GB or more RAM : SPEL CT 128MB or more EPSON RC+ 256MB or more		
Controllable Axes	Max. 16 (For the number of controlled axis, refer to the <i>Setup & Operation 2.4.5 Control Unit Capability.</i>)		
Robot Manipulator Control	Programming Language and Robot Control Software	EPSON RC+ (multi-tasking robot language) SPEL CT (multi-tasking robot language)	
	Joint Control	Simultaneous control over all the six (6) joints Software AC servo control	
	Speed Control	PTP motion : Programmable in the range of 1% to 100% CP motion : Programmable (Actual value to be manually entered.)	
	Acceleration/Deceleration Control	PTP motion : Programmable in the range of 1% to 100%; Automatic CP motion : Programmable (Actual value to be manually entered.)	
Positioning Control	PTP (Pose-To-Pose control)/CP (Continuous Path control)		
Memory Capacity	Programmable Area:	4MB	
	Points Data Area:	EPSON RC+ :Max. 1000 points programmable (per Manipulator)	
	Poses Data Area:	SPEL CT :Max. 2000 poses programmable (per Manipulator)	
Teaching Method	Remote Direct MDI (Manual Data Input)		
External Input/ Output Signals	D-I/O	Input : 16 Output : 16	Remote functions allowed
	Expansion I/O	Input : 32 (per board) Output : 32 (per board)	
Communication Interface	RS-232C : 2 channels (Standard) Ethernet : 1 channel (Standard) USB : 2 channels (Standard)		
Expansion Slots	ISA 7 slots : Primary MIB is installed in ISA slot. PCI 4 slots (The Stand-alone option occupies one expansion slot of either ISA or PCI.)		

Item	Specification
Safety Features	<ul style="list-style-type: none"> - Emergency stop switch - Safety door input - Low power mode - Dynamic brake - Encoder cable disconnection error detection - Motor overload detection - Irregular motor torque (out-of-control Manipulator) detection - Motor speed error detection - Positioning overflow - servo error - detection - Speed overflow - servo error - detection - CPU irregularity detection - Memory check-sum error detection - Overheat detection at the Motor Driver Module - Safety key lock on the ATTEND (TEACH) Control Device for mode switch. - Over-voltage detection (Mounting a regeneration module in DU4 or using DU6) - Lockout
Power Source	Control Unit: AC 100V to AC 120V/AC 200V to AC 240V Single phase 50/60Hz Drive Unit AC 200V to AC 240V Single phase 50/60Hz
Maximum Power Consumption	2000W (Depending on the Manipulator model)
Insulation Resistance	100MΩ or more
Rated Ambient Temperature	5 to 40 deg.C
Rated Relative Humidity	20% to 80% (with no condensation)
Weight	Control Unit : 17 kg * Four-axis Drive Unit : 14 kg * Six-axis Drive Unit : 16 kg *
Size	For the Control Unit, refer to the <i>Setup & Operation 2.4.4 Dimensions</i> . For the Four-axis Drive Unit, refer to the <i>Setup & Operation 2.5.6 Dimensions</i> . For the Six-axis Drive Unit, refer to the <i>Setup & Operation 2.6.6 Dimensions</i> .
Keyboard dimension	W347 × D116 × H18 (mm)

* Weight of the unit is indicated on the Controller Unit and the Drive Unit itself.
 Make sure to check the weight before units transfer or relocation and prevent throwing out your back at holding the unit.
 Also, make sure to keep your hands, fingers, and feet safe from being caught or serious injury.

2.4 Control Unit

2.4.1 Control Unit

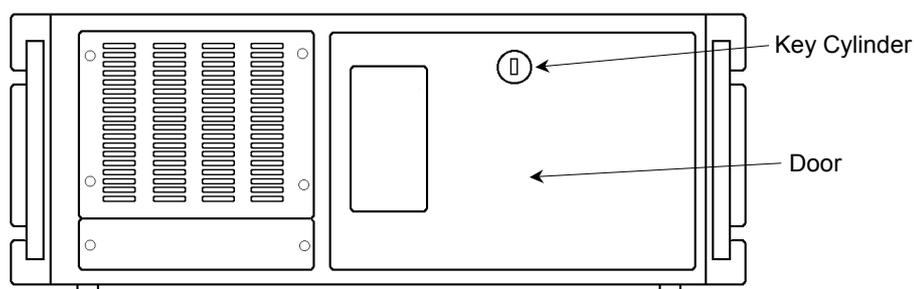
The Control Unit is an FA personal computer that includes an MIB (Motion Interface Board) and a system panel. The Control Unit sends commands to the Drive Unit to control the Manipulator motors. The Control Unit also controls such peripheral devices as I/O and stepper motors.

 CAUTION	<ul style="list-style-type: none"> ■ Only install optional hardware specifically designed for the robot system. If any other hardware is installed to the robot system, the robot system may function improperly and also cause safety problems. (For EPSON RC+ Users, only the hardware that has been approved by EPSON can be installed on the robot system.) ■ Do not install any other software in the robot system except for the software that was originally installed at ship time. If any other software is installed, the robot system may function improperly and also cause safety problems. (For EPSON RC+ Users, only the software that has been approved by EPSON can be installed on the robot system.)
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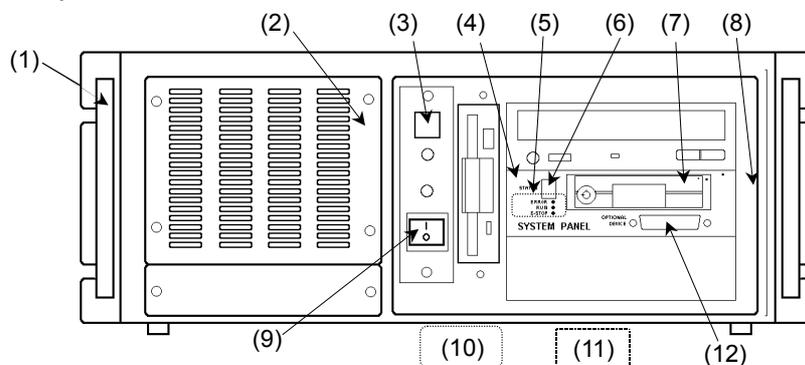
2.4.2 Front Panel

The Control Unit has a door on the front panel, which can be opened/closed by a key supplied with the unit.

Front Panel, Closed



Front Panel, Open



(1) Signature label (This label is attached on the left side of the Control Unit when you face the front panel.)

The serial number of the Control Unit is recorded on the signature label.

(2) Cooling Fan Filter

A protective filter is installed in front of the cooling fan to filter out dust.



Check condition of the filter regularly and clean it as necessary. A dirty filter may result in the malfunction of the robot system as the temperature rises in the Control Unit.

(3) RESET switch

Resets the Control Unit to restart.

(4) SYSTEM PANEL

Special system panel for RC520. This has the connectors for operation units and the LED for indicating the status.

(5) LED

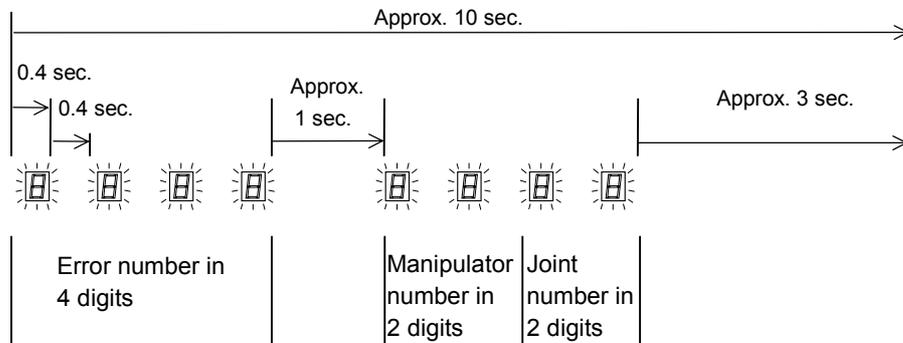
The LEDs indicate the following status when they turn ON:

LED	Color	Description
E-STOP	Red	The computer is in the Emergency Stop condition.
RUN	Green	The computer is operating normally. (When an error occurs, this LED turns OFF.)
ERROR	Red	There is an error.

(6) STATUS

One seven-segment LED displays the error number, Manipulator number and joint number. The numbers will be displayed with the LEDs blinking. Record all the numbers and check the error that has occurred.

Timing of LED Blinking



The cycle above (which lasts approximately 10 seconds) repeats and is displayed until the error is canceled or the power is OFF.

Error Number : Four-digit error numbers are displayed. For details, refer to the following manual.

EPSON RC+ : SPEL⁺ Language Reference
- SPEL⁺ Error Messages

SPEL CT : User's Guide Introduction - Appendix B
SPEL CT Execution Error Messages

Manipulator Number : Two-digit Manipulator numbers are displayed, starting from 01.

Joint Number : Two-digit numbers are display, showing which joint of the Manipulator has an error. The number starts from 01.

When an error occurs that has no relation to a Manipulator or joint, the error number will appear, but the Manipulator number and joint number will both be displayed as 00.

(7) HDD (for the removable HD unit model)

The disk drive is mounted in a removable case. Refer to the *Maintenance 4.8 Replacing the HDD* for details on replacing the HDD.

(8) Windows COA label (This label is attached on the right side of the Control Unit when the front door is open.)

The Product Key that is required when you install Windows is recorded on this label. When using Windows XP, this label is attached below the HDD when the front door is open.

(9) Power switch

Turns ON or OFF the Control Unit.

(10) Connection Check label (This label is attached on the bottom of the inside of front door.)

The details of the Drive Units(s) and Manipulator(s) to be connected are recorded on the label as shown below: The Manipulator model, Manipulator serial number, DU number (ex: DU1) and Drive Unit serial number.

Example:

MANIPULATOR		DRIVE UNIT	
ES551S	00002	DU1	00007

(11) MT label (This label is attached on the bottom of the inside of front door)

The label indicates the specification number for the customized Manipulator or Controller and is attached only to the customized Manipulator. If your Manipulator indicates this label, it may require a specific maintenance procedure. In this case, make sure to contact your dealer before performing any maintenance procedures.

(12) OPTIONAL DEVICE connector

Connects the optional operation unit or ATTEND (TEACH) Control Device.

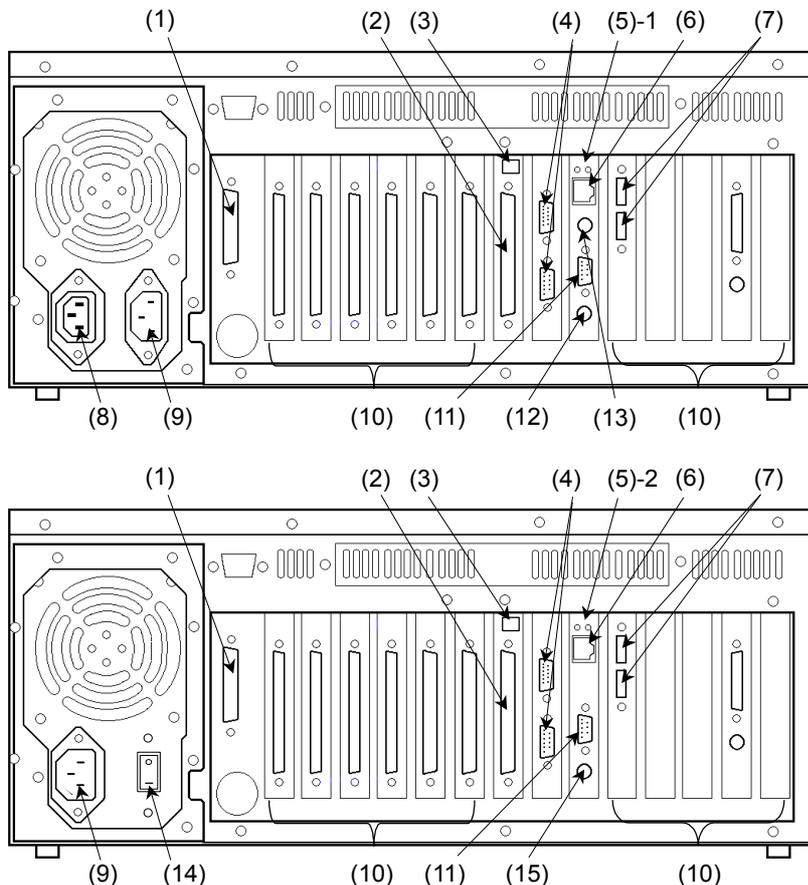
For details, refer to the *Setup & Operation 4. OPTIONAL DEVICE Connector*.

 CAUTION	<p>■ Do not connect the EPSON RC+ software key to the OPTIONAL DEVICE connector. Connecting the EPSON RC+ software key to the OPTIONAL DEVICE connector while the Control Unit is ON may cause damage to the EPSON RC+ software key.</p> <p>Connect the EPSON RC+ software key to the IEEE-1284 (parallel) connector on the rear of the Control Unit.</p>
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2.4.3 Rear Panel

NOTE


The types of power receptacle and CPU board (connectors for mouse and keyboard) are different depending on the shipping date. The Controller in which the parts have been replaced for maintenance can be different from the figures below.



- (1) IEEE-1284 (parallel) connector
 Receptacle for printer cable.
 For EPSON RC+ Users, this connector is for the EPSON RC+ software key.
- (2) MIB (Motion Interface Board)
 This board is used for communication between the Control Unit and the Drive Unit. The Control Unit has one MIB mounted in one of its expansion slots for each Drive Unit connected. The maximum number of MIBs that can be mounted in the Control Unit is three (3).
- (3) DU number label
 This label is attached on the MIB slot to specify which Drive Unit to be connected. You may confirm this number (DU1, DU2 or DU3) also on the Connection Check Label on the front panel where the appropriate DU number for each Drive Unit is indicated.
- (4) Serial connector (RS-232C)
 This connector facilitates data communication and centralized control by connecting peripheral equipment and a host computer.
 For settings, refer to the *Setup & Operation 9. RS-232C Settings*.

(5) CPU Board

For details, refer to the *Setup & Operation 2.3 Standard Specifications*.

The CPU board has different model numbers and appearances depending on the dates of the shipping and the board changeover.

	CPU Board	Connector for Mouse and Keyboard
(5)-1	PC-686BX(PC)-*	Separate connectors
(5)-2	SPI-6941-*	Integrated connector

At one period, the CPU board SPI-6941-EPP (integrated connector) was installed in the Control Unit shown in the upper figure on the previous page instead of the CPU board PC-686BX(PC)-* (separate connectors).

(6) Ethernet connector

This Ethernet connector enables communication via 100BASE-TX / 10BASE-T.

(7) USB connector

Connects the USB-enabled hardware (CD-ROM drive, etc.).

(8) AC OUT

The AC OUT connector outputs the power to the monitor. The power input to the AC IN is output.

(9) AC IN

The Drive Unit outputs from its AC OUT connector AC100V to AC120V or AC200V to AC240V that is input to this connector at the Control Unit.

(10) System Expansion (Optional Board) Slots

Up to 6 ISA slots and 4 PCI slots are available for optional boards such as the Expansion I/O Board. Do not install boards other than the optional boards for the RC520.

(11) VGA connector

Receptacle for VGA monitor cable.

(12) Keyboard connector (CPU board (5)-1)

Receptacle for keyboard cable. To connect a type AT connector keyboard, use the dedicated adapter (AT keyboard adapter) included in the accessories.

(13) Mouse connector (CPU board (5)-1)

Receptacle for mouse cable.

(14) AC power switch

Switch for power input from AC IN.

(15) Mouse / Keyboard connector (CPU board (5)-2)

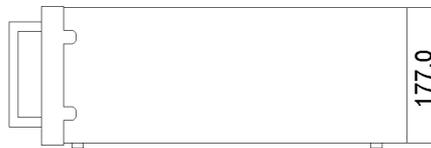
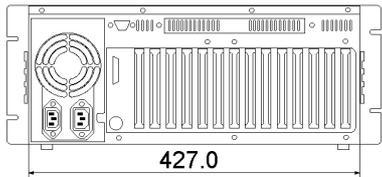
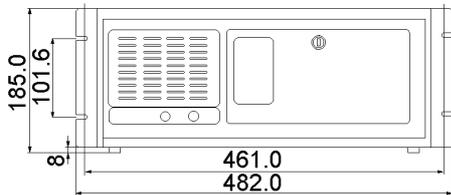
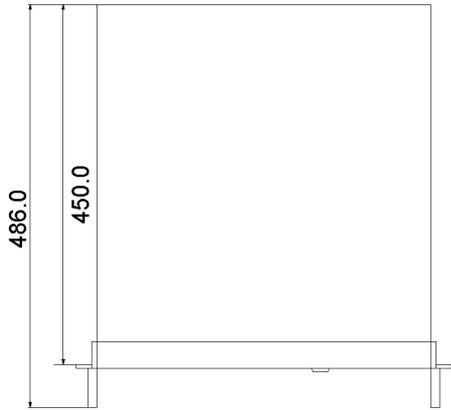
Receptacle for mouse and keyboard cable. Connect the cable to a mouse and a keyboard following the symbols on the cable.

Do not lose a PS/2 exchange cable included in the accessories.



- Connect the mouse and the keyboard properly when the power is OFF. If the mouse or keyboard is connected when the power is ON or connected incorrectly, the robot system cannot function properly.

2.4.4 Dimensions



NOTE



Do not remove any rubber feet of the Control Unit.

[Unit: mm]

2.4.5 Control Unit Capability

The capability of the RC520 Control Unit with regard to the maximum number of controllable Manipulators (= motor axes) is shown in the table below:

Allowable Combination and Number of controllable Motor Axes from the Pulse Generating (P/G) Board

		SCARA type and Cartesian type Manipulators (E2 series, X4 series, etc.)				
		Number	0	1	2	3
Six-Axis Manipulator (PS3 series, etc.)	0	16 PG axes	12 PG axes	8 PG axes	4 PG axis ^{*1}	
	1	10 PG axes	6 PG axes	0 PG axis ^{*2}		
	2	4 PG axis ^{*1}				

*1 : When CP motion is used, one PG axis can be connected to the robot system.

*2 : No PG axis is connected to the robot system in this combination of the Manipulators.

NOTE



The above tables presume the Control Unit is equipped with a PentiumIII 850MHz CPU and RAM 128MB.

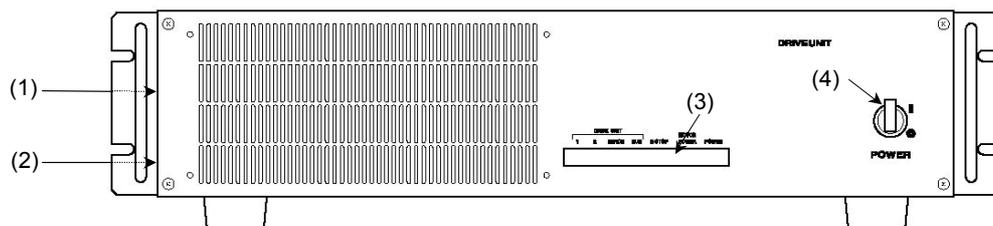
Example: When one E2 series Manipulator (SCARA) and one PS3 series Manipulator (Six-Axis) are connected to the RC520, up to six PG axes can be connected. (This example is for the screened box in the table above.)

2.5 Four-axis Drive Unit (RC520DU)

2.5.1 Four-axis Drive Unit

The four-axis Drive Unit controls the motor/axes as it receives commands from the Control Unit. One four-axis Drive Unit is capable of controlling up to four (4) axes. The number of connectable Drive Units per Control Unit is shown in the *Setup & Operation 2.2 System Configuration*.

2.5.2 Front Panel



(1) Signature label

The Signature Label indicates the four-axis Drive Unit Serial number. It is attached on the left side when facing the front panel.

(2) Connection Check label

This label indicates the serial number of the Manipulator to be connected and is attached on the left side when facing the front panel.

Example)

MANIPULATOR	
ES551S	00002

(3) LED

The LED on the front panel indicates the status of the four-axis Drive Unit during operation as follows:

LED	Description
1	LED "1" indicates that an unresettable error relating to motor control of any of the Manipulator axes occurs.
2	LED "2" indicates that a resettable error relating to motor control of any of the Manipulator axes occurs.
ERROR	Lights when the CPU of the four-axis Drive Unit detects an error.
RUN	Lights while the CPU is operating normally in the four-axis Drive Unit.
E-STOP	Lights when Emergency Stop condition exists.
MOTOR POWER	Lights when the motor power is ON. (Motor Power: The DC power supply that inputs to the Motor Driver module to drive the motor. This DC power is generated by regulating AC200V or the local equivalent power.)
POWER	Lights when the four-axis Drive Unit is turned ON.

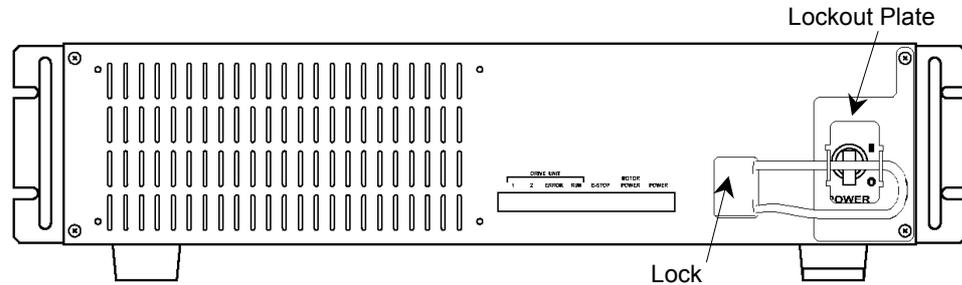
(4) POWER switch

A 15A circuit protector in the four-axis Drive Unit that turns the power to the unit ON and OFF.

2.5.3 Locking out the Four-axis Drive Unit

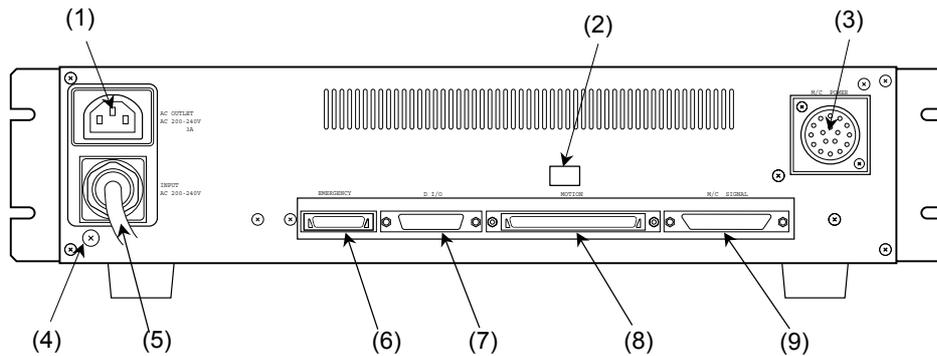
Lock out the robot system to prevent any one from booting the robot system by mistake while someone else is within the safeguarded area for maintenance or repair.

The following shows the four-axis Drive Unit is locked out.



For the procedure, refer to the *Maintenance 1.1 Procedure for Lockout*.

2.5.4 Rear Panel



(1) AC OUTLET

Receptacle for the AC200V (or the local equivalent) power supply to the Control Unit.

The PC power cable included in the accessories should be connected to this AC OUTLET. Note that the power input via an AC Power cable (described in (5) below) is directly output here.

(2) DU number label

The label indicates the Drive Unit number (DU1 through DU3). The same DU number as this one is also indicated at MIB on the rear panel of the Control Unit.

(3) M/C POWER connector

A connector for the Manipulator power source. Connect the dedicated power cable attached to the Manipulator.

(4) ⊕ Protective Earth Terminal

External protective earth terminal

(5) AC Power cable

Cable for the AC200V (or the local equivalent) power input

(6) EMERGENCY connector

This connector is used for input/output from/to Emergency Stop and Safety Door switches. Refer to the *Setup & Operation 5. EMERGENCY Connector* for details.

(7) D-I/O connector

This connector is used for connection with input/output devices. There are 16 inputs and 16 outputs. Refer to the *Setup & Operation 6. D-I/O Connector* for details.

(8) MOTION connector

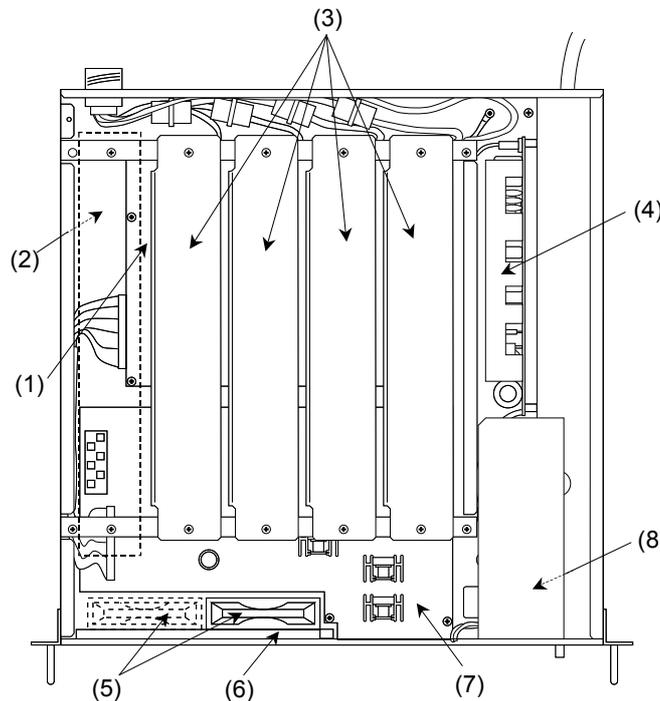
This connector is used to connect with the MIB board in the Control Unit. For the connection, use the Motion cable included in accessories.

(9) M/C SIGNAL connector

This connector is used for control signals such as the Manipulator's motor encoder, origin sensor signals, etc. Connect the Manipulator's dedicated signal cable.

2.5.5 Four-axis Drive Unit – Interior Layout

 WARNING	<p>■ Do not open the cover(s) of the Controller except while maintaining it. Opening the cover(s) of the Controller is extremely hazardous and may result in electric shock even when its main power is OFF because of the high voltage charge inside the Controller.</p>
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(1) DMB (Drive Main Board)

The Drive Main Board receives position references from the Control Unit and thereby drives the motors.

(2) Regeneration module (For RC520DU)

This module protects the circuit from the regenerated electricity when the Manipulator consumes high electric power during operation.

A regeneration module is mounted in the place indicated with a broken line above.

(3) Motor Driver module

The Motor Driver module receives a reference from the DMB, and, outputs three-phase current to supply power to the motor. (The figure in the previous page shows a sample of Drive Unit for a 4-axis Manipulator. From left to right: Axis 1 through 4.)

(4) Switching Power Supply

The supplied AC200V (or the local equivalent) power is regulated here and is output as +24V.

(5) Cooling Fan

A standard model comes with one cooling fan in the four-axis Drive Unit. For the four-axis Drive Unit equipped with the Regeneration module that generates more heat, an additional cooling fan is packaged.

(6) Filter

A protective filter is installed in front of the fan to filter out dust.



Check condition of the filter regularly and clean it as necessary. A dirty filter may result in the malfunction of the robot system as the temperature rises in the Drive Unit.

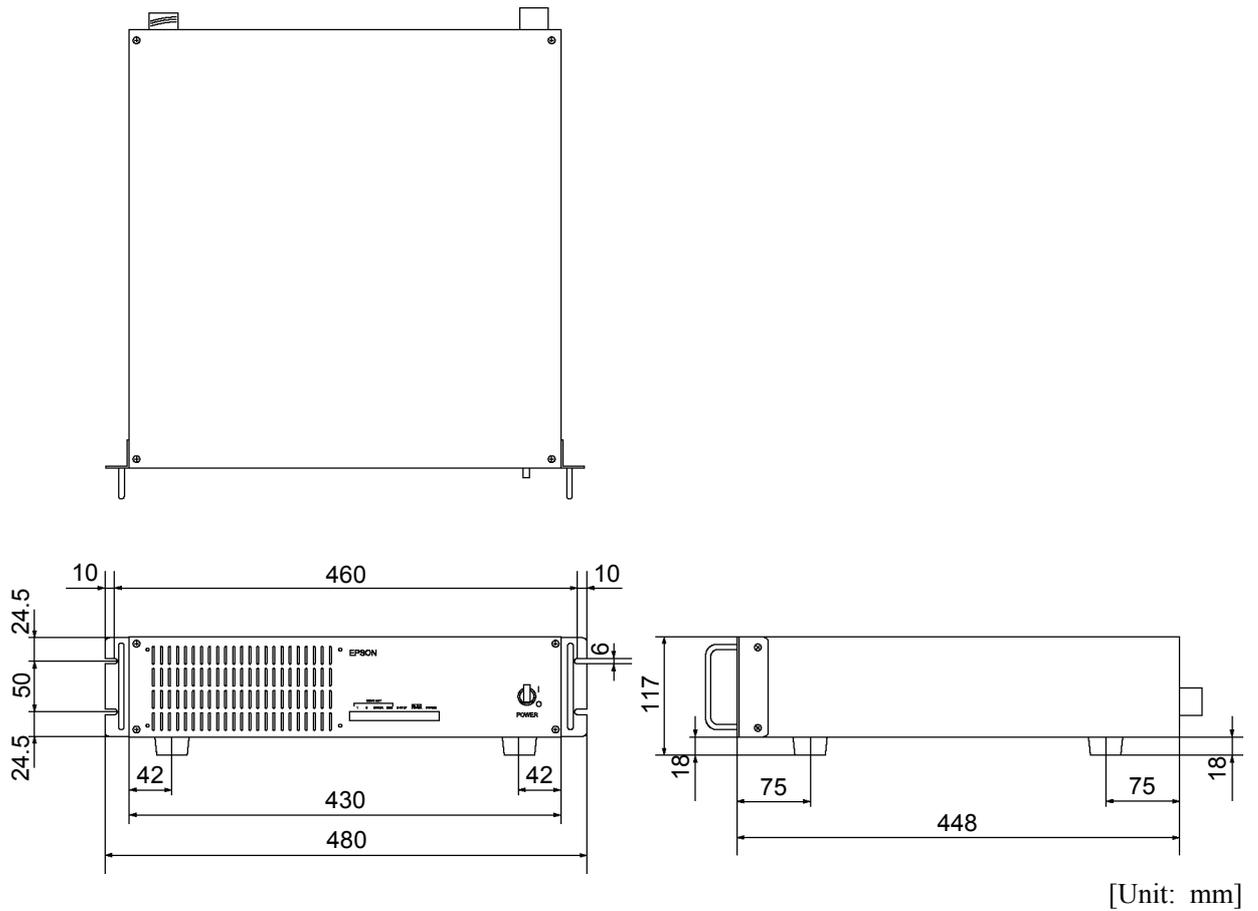
(7) DPB (Drive Power Board)

The Drive Power Board consists of two circuits: one generates +24V control power and the other distributes the main power source to each motor driver that drives the axes.

(8) Motor Power module

This module rectifies AC200V (or the local equivalent) power to output power for the motor.

2.5.6 Dimensions



[Unit: mm]

NOTE



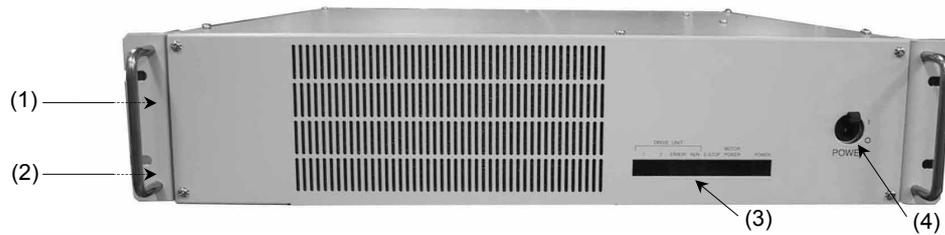
Do not remove any feet of the four-axis Drive Unit.

2.6 Six-axis Drive Unit (RC520DU6)

2.6.1 Six-axis Drive Unit

The six-axis Drive Unit controls the motor/axes as it receives commands from the Control Unit. One six-axis Drive Unit is capable of controlling up to six (6) axes. The number of connectable Drive Units per Control Unit is shown in the *Setup & Operation 2.2 System Configuration*.

2.6.2 Front Panel



(1) Signature label

The Signature Label indicates the six-axis Drive Unit Serial number. It is attached on the left side when facing the front panel.

(2) Connection Check label

This label indicates the serial number of the Manipulator to be connected and is attached on the left side when facing the front panel.

Example)

MANIPULATOR	
PS3-AS00	00002

(3) LED

The LED on the front panel indicates the status of the six-axis Drive Unit during operation as follows:

LED	Description
1	LED “1” indicates that an unresettable error relating to motor control of any of the Manipulator axes occurs.
2	LED “2” indicates that a resettable error relating to motor control of any of the Manipulator axes occurs.
ERROR	Lights when the CPU of the six-axis Drive Unit detects an error.
RUN	Lights while the CPU is operating normally in the six-axis Drive Unit.
E-STOP	Lights when Emergency Stop condition exists.
MOTOR POWER	Lights when the motor power is ON. (Motor Power: The DC power supply that inputs to the Motor Driver module to drive the motor. This DC power is generated by regulating AC200V or the local equivalent power.)
POWER	Lights when the six-axis Drive Unit is turned ON.

(4) POWER switch

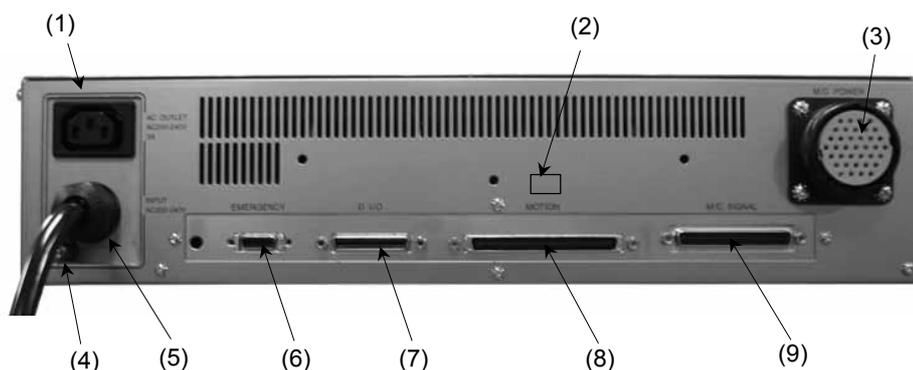
A 15A circuit protector in the six-axis Drive Unit that turns the power to the unit ON and OFF.

2.6.3 Locking out the Six-axis Drive Unit

Lock out the robot system to prevent any one from booting the robot system by mistake while someone else is within the safeguarded area for maintenance or repair.

For the procedure and the figure of the locked out Drive Unit, refer to the *Maintenance 1.1 Procedure for Lockout*.

2.6.4 Rear Panel



(1) AC OUTLET

Receptacle for the AC200V (or the local equivalent) power supply to the Control Unit.

The PC power cable included in the accessories should be connected to this AC OUTLET. Note that the power input via an AC Power cable (described in (5) below) is directly output here.

(2) DU number label

The label indicates the Drive Unit number (DU1 through DU3). The same DU number as this one is also indicated at MIB on the rear panel of the Control Unit.

(3) M/C POWER connector

A connector for the Manipulator power source. Connect the dedicated power cable attached to the Manipulator.

(4) \oplus Protective Earth Terminal

External protective earth terminal

(5) AC Power cable

Cable for the AC200V (or the local equivalent) power input

(6) EMERGENCY connector

This connector is used for input/output from/to Emergency Stop and Safety Door switches. Refer to the *Setup & Operation 5. EMERGENCY Connector* for details.

(7) D-I/O connector

This connector is used for connection with input/output devices. There are 16 inputs and 16 outputs. Refer to the *Setup & Operation 6. D-I/O Connector* for details.

(8) MOTION connector

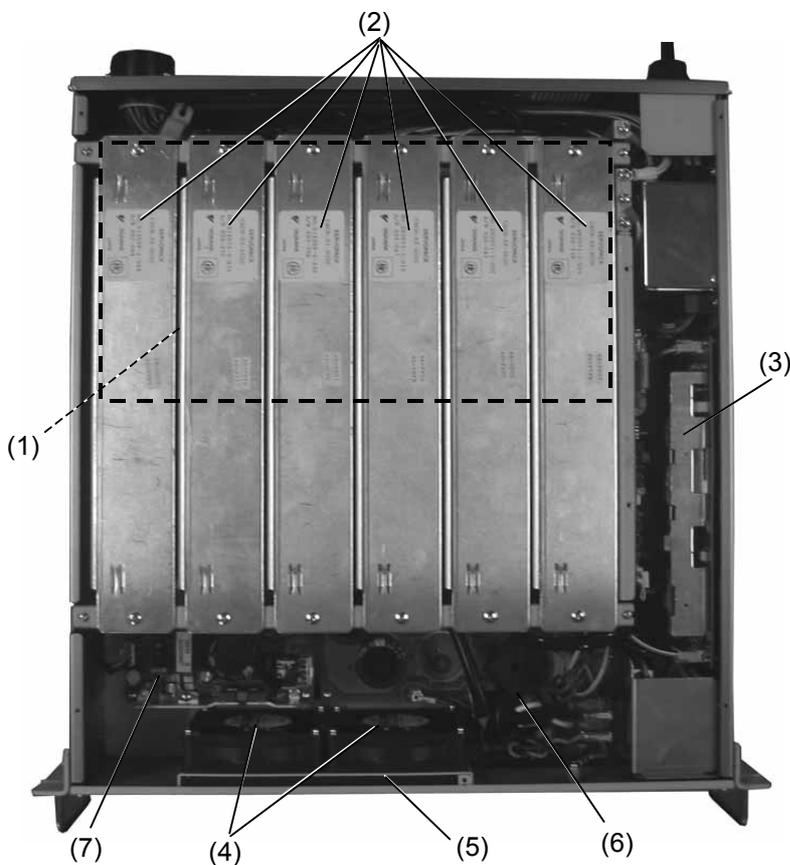
This connector is used to connect with the MIB board in the Control Unit. For the connection, use the Motion cable included in accessories.

(9) M/C SIGNAL connector

This connector is used for controlling signals of the Manipulator’s motor encoder. Connect the Manipulator’s dedicated signal cable.

2.6.5 Six-axis Drive Unit – Interior Layout

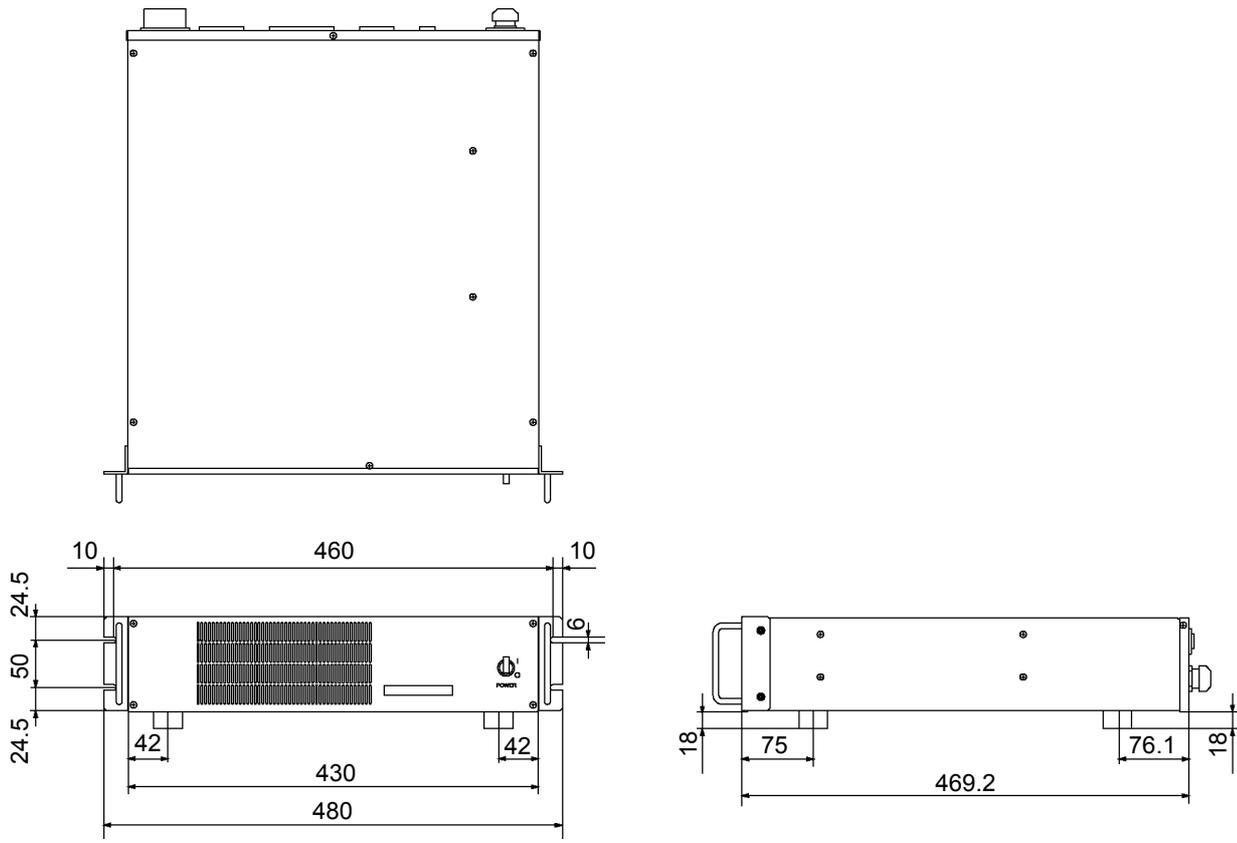
 WARNING	<ul style="list-style-type: none"> Do not open the cover(s) of the Controller except while maintaining it. Opening the cover(s) of the Controller is extremely hazardous and may result in electric shock even when its main power is OFF because of the high voltage charge inside the Controller.
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- (1) **DMB (Drive Main Board)**
The Drive Main Board receives position references from the Control Unit and thereby drives the motors.
 - (2) **Motor Driver module**
The Motor Driver module receives a reference from the DMB, and, outputs three-phase current to supply power to the motor. (The photo shows a sample of Drive Unit for a 6-axis Manipulator. From left to right: Axis 1 through 6.)
 - (3) **Switching Power Supply (+24V)**
The supplied AC200V (or the local equivalent) power is regulated here and is output as +24V.
 - (4) **Cooling Fan**
A standard model comes with two cooling fans in the six-axis Drive Unit.
 - (5) **Filter**
A protective filter is installed in front of the fan to filter out dust.
- NOTE**
 Check condition of the filter regularly and clean it as necessary. A dirty filter may result in the malfunction of the robot system as the temperature rises in the Drive Unit.
- (6) **DPB (Drive Power Board)**
The Drive Power Board consists of two circuits: one rectifies AC200V (or the local equivalent) and distributes the main power source to each motor driver that drives the axes, and the other is an interface circuit of the LED on the front.
 - (7) **Switching Power Supply (+5V)**
The supplied AC200V (or the local equivalent) power is regulated here and is output as +5V.
 - (8) **Over-voltage Detection Module or Regeneration Module (For RC520DU6)**
The installed module is different depending on the Manipulator models.

Module	Manipulator
Over-voltage Detection Module	PS3
Regeneration Module (For RC520DU6)	PS3L PS3LP PS5

2.6.6 Dimensions



[Unit: mm]



NOTE Do not remove any feet of the six-axis Drive Unit.

3. Installation

3.1 Environmental Requirements



- The Manipulator and the Controller must be used within the environmental conditions described in their manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in the environment that exceeds the conditions may not only shorten the life cycle of the product but also cause serious safety problems.

In order to optimize the robot system's performance for safety, the Controller must be placed in an environment that satisfies the following conditions:



The Controller is not designed for cleanroom specification. If it must be installed in a clean room, make sure to install it in the proper enclosure with adequate ventilation and cooling.

Item	Condition
Ambient temperature	5 to 40 deg.C (with minimal variation)
Ambient relative humidity	20% to 80% (with no condensation)
First transient burst noise	2kV or less (without mouse and keyboard)
Electrostatic noise	6kV or less (without mouse and keyboard)
Environment	<ul style="list-style-type: none"> - Install indoors only. - Place in a well-ventilated area. - Keep away from direct sunlight. - Keep away from dust, oily smoke, oily mist, salinity, metal powder or other contaminants. - Keep away from flammable or corrosive liquid and gas. - Keep away from water. - Keep away from shocks or vibrations. - Keep away from sources of electronic noise. <p>If the Controller must be used in an environment that does not fulfill the conditions mentioned above, take adequate countermeasures. For example, the Controller may be enclosed in a cabinet with adequate ventilation and cooling.</p>
Base table	Use a base table that is at least 100 mm off the floor. Placing the Controller directly on the floor could allow dust penetration leading to malfunction.
Space	<ul style="list-style-type: none"> - Allow at least 50 mm on each side. - There must be room in front of the Controller so that the entire Controller can be pulled outward. - There must also be room behind the Controller so that one can attach and remove cables and boards. - Do not block airflow to or from the fan.



The RC520 Controller must be normally placed horizontally.
Do not remove any rubber feet of the Control Unit.

3.2 Power Supply

3.2.1 Specifications

Ensure that the available power meets the following specifications.

Item	Specification
Voltage	Control Unit: AC 100V to AC 120V/AC 200V to AC 240V Drive Unit: AC 200V to AC 240V
Phase	Single phase
Frequency	50/60Hz
Momentary Power Interrupt	10msec. or less
Power Consumption	Each Drive Unit consumes a maximum 200W, but actual consumption depends on the rated capacity of the motor and Control Unit. Maximum Power Consumption for Control Unit: 300W Please refer to Manipulator power consumption in the Manipulator manual and use the following equation to determine total consumption: Rated consumption = 200W + 300W + total Manipulator consumption (rated) × 1.2
Peak Current	When power is turned ON: approximately 50A (2msec.) When motor is ON: approximately 150A (5msec.)
Leakage Current	Max.3.5mA
Ground Resistance	100Ω or less

NOTE



Install an earth leakage circuit breaker or a circuit breaker in the AC power cable line (for the Drive Unit) at 20A or less rated electric current. Both should be a two-pole disconnect type. If you install an earth leakage circuit breaker, make sure to use an inverter type that does not operate by induction of a 10kHz or more leakage current. If you install a circuit breaker, please select one that will handle the above mentioned “peak current”.

If the Drive Unit is connected to the IT power supply system, install an earth leakage circuit breaker between the Drive Unit and the power supply.

 WARNING	<ul style="list-style-type: none"> When connecting a manipulator with protection specification to the RC520 controller, use an earth leakage breaker between the RC520 controller and the power supply to avoid the electric shock and circuit breakdown caused by an unexpected water leak.
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The power receptacle shall be installed near the equipment and shall be easily accessible.

3.2.2 Power Plug

The AC power cable of the Drive Unit is equipped with a power plug. Make sure that the plug is compatible with the power receptacle in your area. If not, replace the attached plug with the one that is suitable in your area.

 WARNING	<ul style="list-style-type: none"> ■ If it is necessary to change the plug to fit the outlet in your factory, make sure that it is done by qualified personnel. When changing the plug, be sure to connect the earth wire of the AC power cable colored green/yellow on the Controller to the earth terminal of the factory power supply. The equipment must be grounded properly at all times to avoid the risk of electric shock. Always use a power plug and receptacle. Never connect the Controller directly to the factory power supply. (Field wiring)
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Plug Specification:

Terminal	Description	Color
X terminal	AC power	Brown
Y terminal	Open	–
Z terminal	AC power	Blue
W terminal	Protective earth wire	Green/Yellow

The Drive Unit's AC power cable is specified as follows:

Item	Specification
Conductor	Structure : 41 lines/0.26 mm (AWG#14) Diameter : 1.9 mm (TYP)
Insulator	Color : Brown, Blue (for AC Power Source) Green/Yellow (for Protective Earth) Diameter : 3.5 mm (TYP) UL. Style No. 1015
Braided Shield	Braid Density : 70%
Sheath	Color : Black Diameter : 10.5 mm (TYP)
Cable	Length : 3.5 m

3.3 Cable Connection

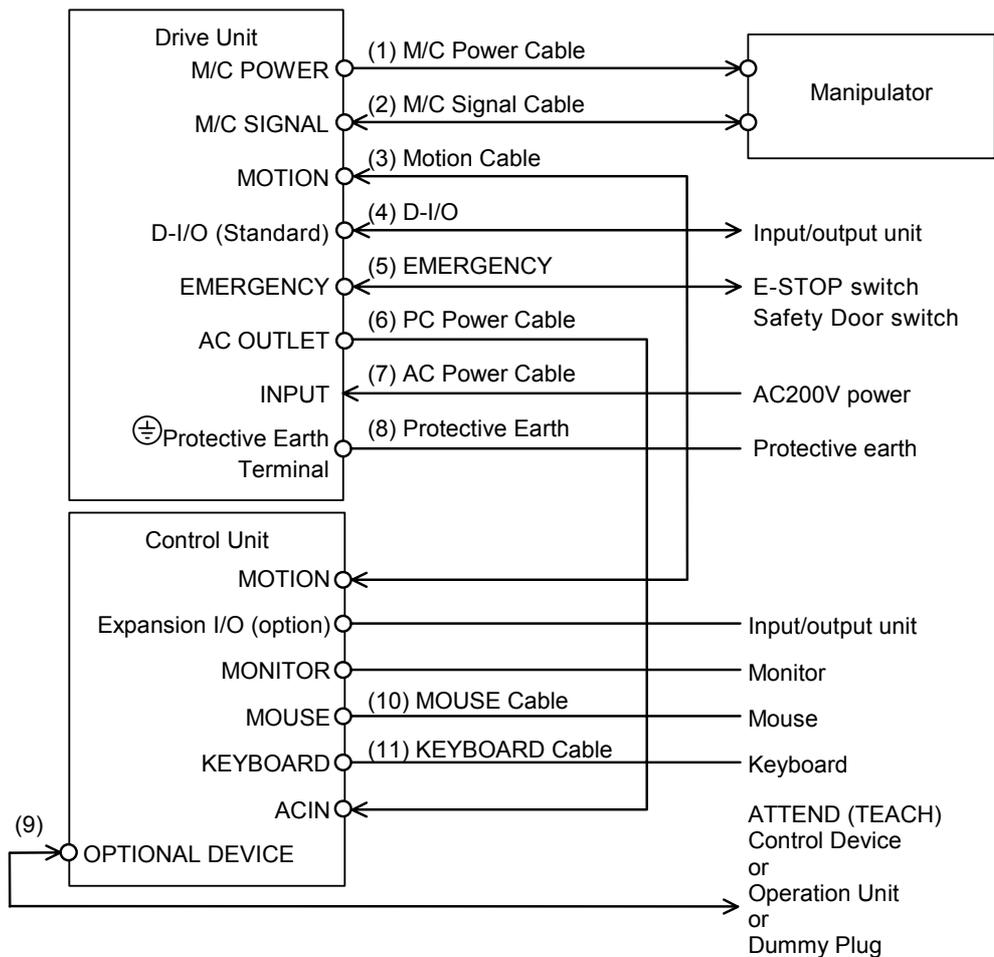
 WARNING	<ul style="list-style-type: none"> ■ If there is more than one Drive Unit connected to the Control Unit in the robot system, make sure that the DU numbers (DU1 - DU3) indicated above the MIB connector on the Control Unit and the Drive Unit (above the MOTION connector) match. Improper connection between the Control Unit and the Drive Unit may cause malfunction of the robot system and/or safety problems as it may make the Manipulator move abnormally.
 WARNING	<ul style="list-style-type: none"> ■ Make sure that the power to the Controller is turned OFF and locked out before connecting or disconnecting any cables. Connecting or disconnecting any cables with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the Controller. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or a contact failure is extremely hazardous and may result in electric shock and/or improper function of the system.
 CAUTION	<ul style="list-style-type: none"> ■ The serial numbers of the Drive Unit and Manipulator that should be connected are indicated on the Connection Check Label on the Control Unit. Connect the Control Unit, the Drive Unit and the Manipulator correctly. Improper connections between the Drive Unit and the Manipulator and between the Control Unit and the Drive Unit may cause improper function of the robot system and also safety problems.

3.3.1 Typical Cable Connections (Single Manipulator)

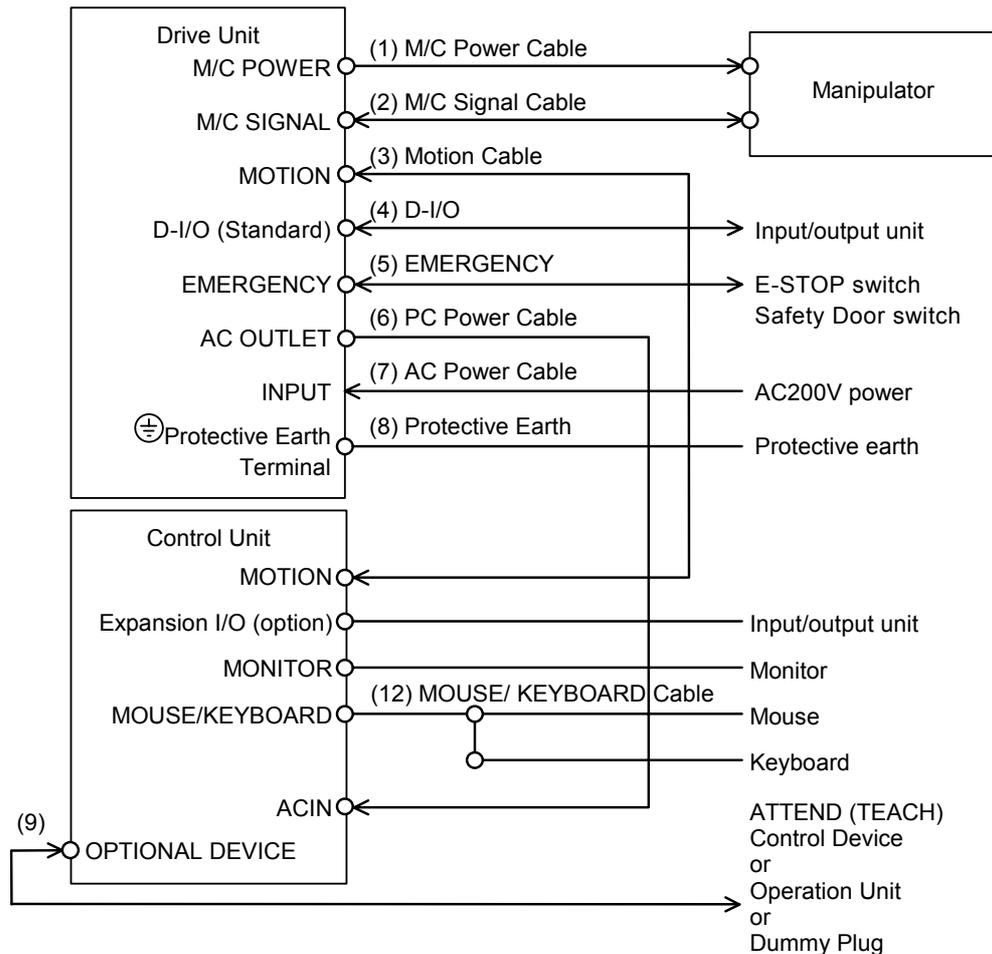
The Manipulator must be connected as follows in order to operate properly. The diagram below indicates a standard cable connection for a single Manipulator configuration.

Connection appearances of the mouse and the keyboard are different depending on the dates of the shipping and the board changeover.

Separate connectors for mouse and keyboard



Integrated connector for mouse and keyboard



(1) M/C Power cable

For the four-axis Drive Unit:

This cable has round connectors with 17 pins on both ends. Connect the female connector to the POWER connector on the Manipulator and the male connector to the M/C POWER connector on the Drive Unit. Insert the connectors and rotate clockwise until you hear a “click” to secure the connection.

For the six-axis Drive Unit:

This cable has a round connector with 37 pins on the controller-side and a rectangular connector with 36 pins on the Manipulator-side. Connect the round connector to the M/C POWER connector on the Drive Unit and the rectangular connector to the POWER connector on the Manipulator.

(2) M/C Signal cable

For the four-axis Drive Unit, the M/C Signal cable has rectangular connectors with 68 pins on both ends.

For the six-axis Drive Unit, the cable has a D-sub connector with 37 pins on the Controller-side end and a rectangular connector with 40 pins on the Manipulator-side end. Connect the signal cable to the Manipulator SIGNAL connector and the Controller M/C SIGNAL connector of the Drive Unit.

(3) Motion Interface cable

This cable has rectangular connectors with 100 pins on both ends. This cable connects the MOTION connectors of Control Unit and the Drive Unit. The DU numbers (DU1-DU3) are assigned to the MOTION connectors.

 WARNING	<ul style="list-style-type: none"> ■ If there is more than one Drive Unit connected to the Control Unit in the robot system, make sure that the DU numbers (DU1 - DU3) indicated above the MIB connector on the Control Unit and the Drive Unit (above the MOTION connector) match. Improper connection between the Control Unit and the Drive Unit may cause malfunction of the robot system and/or serious safety problems as it may make the Manipulator move abnormally.
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(4) D-I/O connector

This connector is for the user's input/output devices. For details about D-I/O, refer to the *Setup & Operation 6. D-I/O Connector*.

(5) EMERGENCY connector

The EMERGENCY connector has inputs to connect the Emergency Stop switch and the Safety Door switch. For safety reasons, connect proper switches for these input devices. For details, refer to the *Setup & Operation 5. EMERGENCY Connector*.

(6) PC Power cable

The AC200V (or the local equivalent) power input to the Drive Unit is supplied to the Control Unit via this cable. When two or more Drive Units are connected with the Control Unit, one of the Drive Units supplies the power to the Control Unit.

(7) AC Power cable

Cables for AC200V (or the local equivalent) power supply to the Drive Unit.

 WARNING	<ul style="list-style-type: none"> ■ Do not touch the inside of the AC OUTLET connector. The AC power cable and the AC OUTLET connector on the Drive Unit are directly connected inside the Drive Unit by the cable. The AC200V OUTLET connector on the Drive Unit is constantly ON, whether the Drive Unit power is ON or OFF. Therefore, touching the inside of the AC OUTLET connector is extremely hazardous and may result in electric shock.
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(8)  Protective Earth Terminal connector

The Protective Earth terminal connects to the earth ground wire. The Protective Earth terminal is better to be connected when several Manipulators are used in a line, or, when a peripheral control unit such as a sequencer is used in the system. Use a cable of size equal to or greater than AWG #16 for the Protective Earth terminal.

(9) OPTIONAL DEVICE

Connect to an optional operation unit, ATTEND (TEACH) Control Device, or Optional Device Dummy Plug. If neither is connected, the Manipulator will be in the Emergency Stop condition and will not function. For details, refer to the *Setup & Operation 4. OPTIONAL DEVICE Connector*.

(10) Mouse cable (Separate connectors)

Cable for a mouse.

(11) Keyboard cable (Separate connectors)

Cable for a keyboard.

(12) Mouse / Keyboard cable (Integrated connector)

Branch cable for a mouse and a keyboard. Connect the cable to a mouse and a keyboard following the symbols on the cable.

 CAUTION	<ul style="list-style-type: none"> ■ Connect the mouse and the keyboard properly when the power is OFF. If the mouse or keyboard is connected when the power is ON or connected incorrectly, the robot system cannot function properly.
--	--

3.3.2 Connecting Drive Unit and Control Unit

The configuration data for the Drive Unit is stored in the Control Unit. When connecting these units, it is crucial that the Drive Unit must be connected to the specified Control Unit. The Connection Check label on the front door of the Control Unit indicates the serial number of the Drive Unit to be connected and the DU (Drive Unit) number. (See the picture in the next page.) Connect the appropriate Drive Unit.

Connect the Drive Unit and the Control Unit by using Motion cable. The Motion Interface cable has a rectangular, 100-pin connector on both ends, which must go into the MOTION connectors on both the Control Unit and the Drive Unit.

Connect the AC OUTLET connector of the Drive Unit to the AC IN connector of the Control Unit with the Power cable to supply AC200V power to the Control Unit from via the Drive Unit.

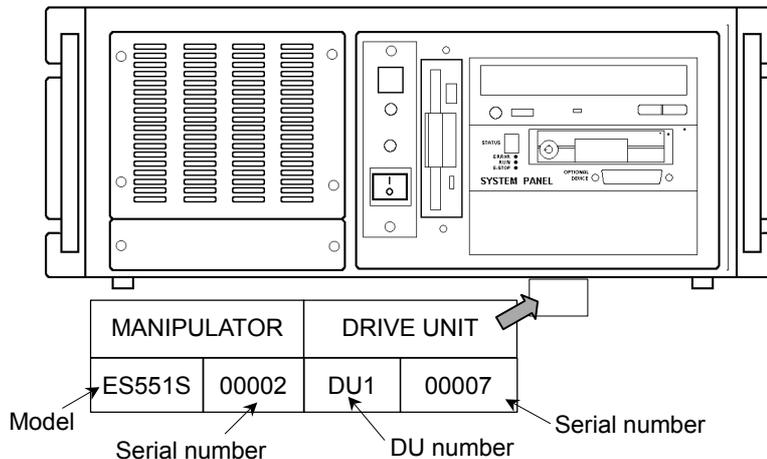
 WARNING	<ul style="list-style-type: none"> ■ Make sure that the power to the Controller is turned OFF and locked out before connecting or disconnecting any cables. Connecting or disconnecting any cables with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the Controller. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or a contact failure is extremely hazardous and may result in electric shock and/or improper function of the system.
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 CAUTION	<ul style="list-style-type: none"> ■ The serial numbers of the Drive Unit and Manipulator that should be connected are indicated on the Connection Check Label on the Control Unit. Connect the Control Unit, the Drive Unit and the Manipulator correctly. Improper connections between the Drive Unit and the Manipulator and between the Control Unit and the Drive Unit may cause improper function of the robot system and also serious safety problems. ■ If there is more than one Drive Unit connected to the Control Unit in the robot system, make sure that the DU numbers (DU1 - DU3) indicated above the MIB connector on the Control Unit and the Drive Unit (above the MOTION connector) match. Improper connection between the Control Unit and the Drive Unit may cause malfunction of the robot system and/or serious safety problems as it may make the Manipulator move abnormally.
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Connection Check label(s) at the front of Control Unit:

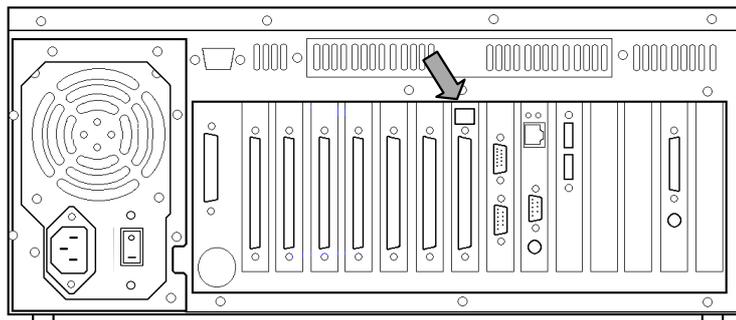
NOTE


There is a Connection Check label for each Drive Unit. The same number of labels as Drive Units used in the robot system is attached on the bottom of the inside of the front door.



DU number label(s) at the back of Control Unit:

Drive Unit's No. is indicated on the label as shown below.



Drive Unit serial number - Identifying proper unit:

Drive Unit's serial number is indicated on the label as shown below.
 (The following photo is the six-axis Drive Unit.)



MODEL	:RC520DU6
	DRIVE UNIT
SERIAL NO.	:00006

3.3.3 Connecting a Drive Unit to the Manipulator

Connect a Drive Unit to the Manipulator by using M/C Power cable and M/C Signal cable.

M/C power cable : For the four-axis Drive Unit:

The M/C power cable has round connectors with 17 pins on both ends. Connect the female connector to the POWER connector on the Manipulator and the male connector to the M/C POWER connector on the Drive Unit. Insert the connectors and rotate clockwise until you hear a “click” to secure the connection.

For the six-axis Drive Unit:

This cable has a round connector with 37 pins on the controller-side and a rectangular connector with 36 pins on the Manipulator-side. Connect the round connector to the M/C POWER connector on the Drive Unit and the rectangular connector to the POWER connector on the Manipulator.

M/C Signal cable : For the four-axis Drive Unit, the M/C Signal cable has rectangular connectors with 68 pins on both ends.

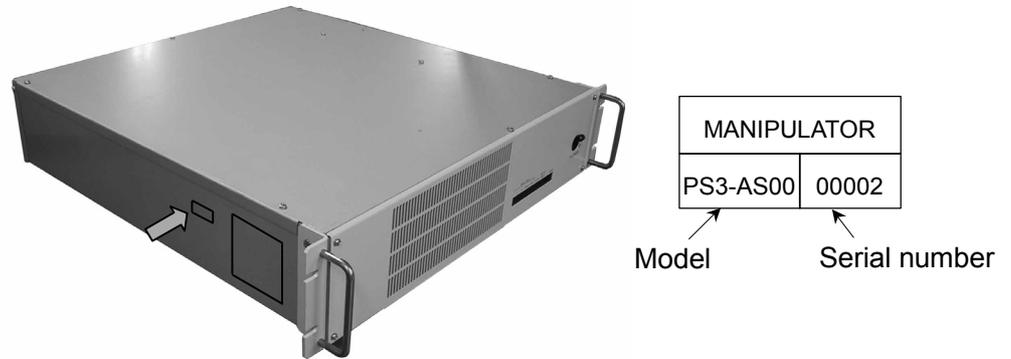
For the six-axis Drive Unit, the cable has a D-sub connector with 37 pins on the Controller-side end and a rectangular connector with 40 pins on the Manipulator-side end.

Connect the signal cable to the SIGNAL connector on the Manipulator and the M/C SIGNAL connector on the Drive Unit.

 WARNING	<ul style="list-style-type: none"> ■ Make sure that the power to the Controller is turned OFF and locked out before connecting or disconnecting any cables. Connecting or disconnecting any cables with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the Controller. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or a contact failure is extremely hazardous and may result in electric shock and/or improper function of the system.
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 CAUTION	<ul style="list-style-type: none"> ■ The serial numbers of the Drive Unit and Manipulator that should be connected are indicated on the Connection Check Label on the Control Unit. Connect the Control Unit, the Drive Unit and the Manipulator correctly. Improper connections between the Drive Unit and the Manipulator and between the Control Unit and the Drive Unit may cause improper function of the robot system and also serious safety problems.
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You can find the serial number of the Manipulator that should be connected to the Drive Unit on your left hand side facing the Drive Unit. The Manipulator's serial number is indicated on the signature label of the Manipulator. (The following photo is the six-axis Drive Unit.)



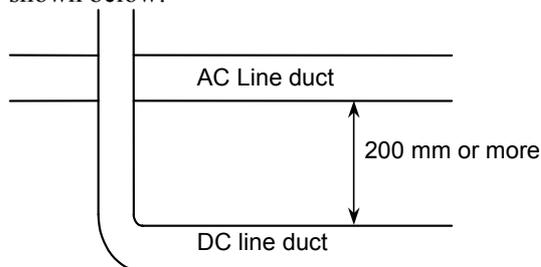
3.4 Noise Countermeasures

To minimize electrical noise conditions, the following items must be observed in the system's cable wiring:

- The earth wire of the power supply should be grounded. (Ground resistance: 100Ω or less)

It is important to ground the frame of Drive Unit not only for prevention from electric shock, but also for reducing the influence of electric noise around the Drive Unit. Therefore, be sure to connect the earth wire (yellow/green) of the Drive Unit's power cable to the ground terminal of the factory power supply. For details about the plug and AC power cable, refer to the *Setup & Operation 3.2.2 Power Plug*.

- Do not tap power from a power line that connects to any equipment which may cause noise.
- When you tap power for the controller and the single-phase AC motor from the same power line, change the phase of one or the other. Ensure that they will not be the same phase.
- Use a twisted pair motor power line.
- Do not run AC power lines and DC power lines in the same wiring duct, and separate them by at least 200 mm. For example, separate the AC motor power line and the controller power line by at least 200 mm from the sensor or valve I/O lines; and do not bundle both sets of wiring with the same cable tie. If more than one duct/cable must cross each other, they should cross perpendicularly. The preferable example is shown below:



- For I/O lines, wire as short as possible and use a shielded cable and clamp the shield to the attached D-I/O connector interior.
- Use a shielded cable for the EMERGENCY connector and clamp the shield to the interior of the connector.
- Make sure that the induction elements used to connect to the Controller's I/O (such as relays and solenoid valves) have surge suppressors. If an induction element without surge suppressor has been used, make sure to connect a rectifying diode right in front of the induction element. In selecting a rectifying diode, make sure that it can handle the voltage and current incurred by the induction load.

- To start and change revolutions of the conveyer's (or the like's) AC motor (ex: an induction motor or three-phase induction motor) regularly or abruptly, make sure to install a spark suppressor between the wires. The spark suppressor is more effective when placed close to the motor.
- As they are easily influenced by static electricity or the noise from power source, keep the mouse and keyboard away from peripheral noise sources.

NOTE



It is sometimes effective in suppressing such noise to wind the keyboard or mouse cables around a ferrite core several times.

4. OPTIONAL DEVICE Connector

The details of safety requirements for this section are described in the *Safety* chapter in User's Guide. Please refer to them to keep the robot system safe.

EPSON RC+ :User's Guide - chapter *Safety*

SPEL CT :User's Guide Introduction

Safety - 1. *Safety* and 2. *Basic Safety-related Matters*

4.1 OPTIONAL DEVICE Connector



CAUTION

- The front door of the Control Unit cannot be closed when an operation unit or ATTEND (TEACH) control device is connected to the OPTIONAL DEVICE connector since there is a cable of the operation unit or ATTEND (TEACH) control device. When operating the Manipulator with an operation unit or ATTEND (TEACH) control device that is connected to the OPTIONAL DEVICE connector, be careful not to hit your leg or foot against the front door.
- Do not connect the EPSON RC+ software key to the OPTIONAL DEVICE connector. Connecting the EPSON RC+ software key to the OPTIONAL DEVICE connector while the Control Unit is ON may cause damage to the EPSON RC+ software key.
Connect the EPSON RC+ software key to the IEEE-1284 (parallel) connector on the rear of the Control Unit.

The Optional Device connector is used for an optional operation unit, ATTEND (TEACH) control device or OPTIONAL DEVICE Dummy Plug.

The "Optional Device Dummy Plug," an accessory that comes with the Control Unit, must be connected to this connector if an operation unit or ATTEND (TEACH) control device is not used. The robot system will be in the Emergency Stop condition when this connector is left unconnected.

4.2 ATTEND (TEACH) Control Device

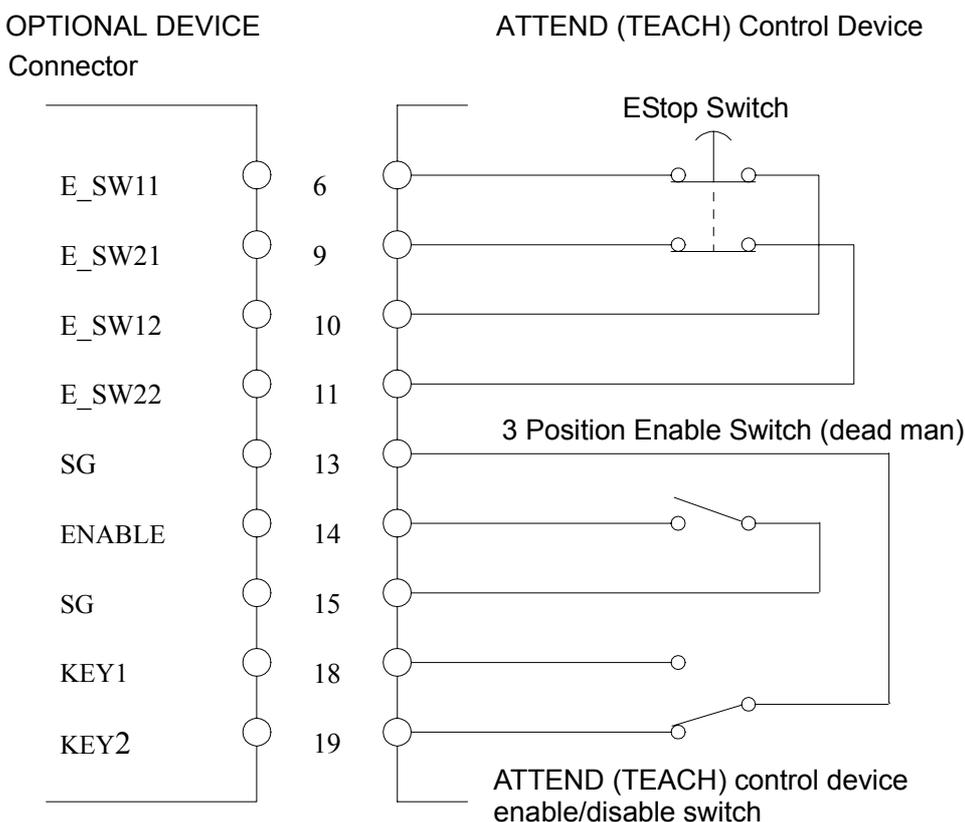
The name of the control device depends on the software used in your Control Unit as shown below:

- EPSON RC+ : TEACH control device
- SPEL CT : ATTEND control device

To operate the Manipulator at a short distance without any operation unit (option), you should use the ATTEND (TEACH) control device. Create the ATTEND (TEACH) control device that consists of the following switches and connect it to the OPTIONAL DEVICE connector.

- Emergency Stop switch
- 3 position enable switch (dead-man switch)
- ATTEND (TEACH) control device enable/disable switch

Refer to the following figure for the internal circuit and refer to the *Setup & Operation 4.4 Pin Assignments* for the signal descriptions.



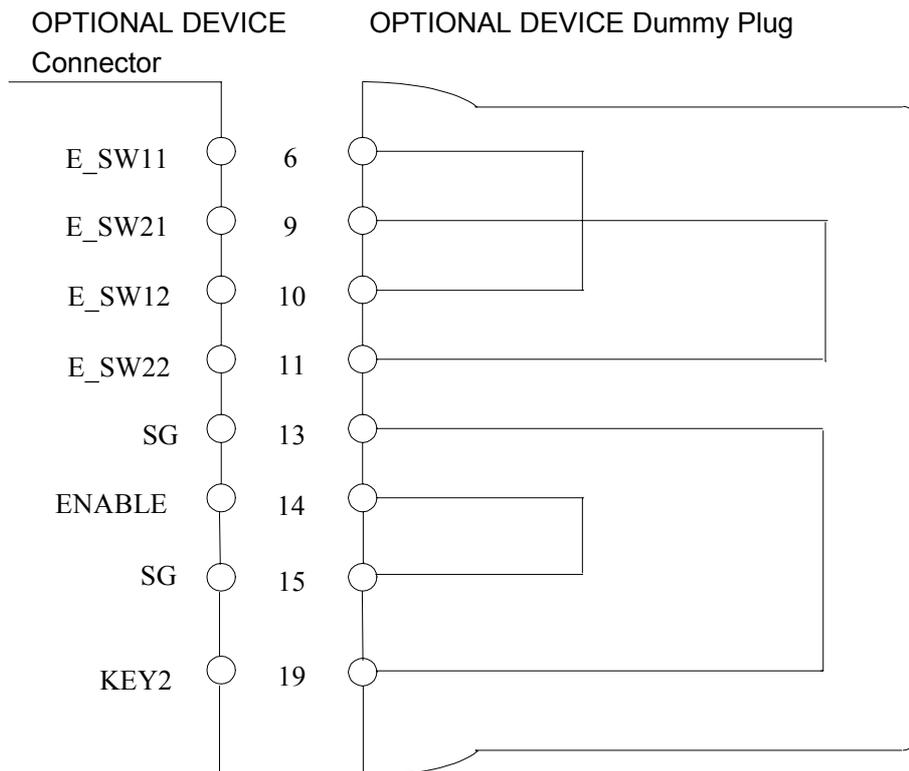
NOTE The 3-position enable switch is available when the ATTEND (TEACH) control device is enabled. The Emergency Stop switch is always available whether the ATTEND (TEACH) control device is enabled or disabled.

4.3 OPTIONAL DEVICE Dummy Plug

The OPTIONAL DEVICE Dummy Plug is connected to the OPTIONAL DEVICE connector when an operation unit or ATTEND (TEACH) control device is not used.

When manufacturing robotic systems without using the optional unit or ATTEND (TEACH) control device, you can use the dummy plug, as shown below, to disable the Emergency Stop input for the OPTIONAL DEVICE port, and the ATTEND (TEACH) control device enable/disable input.

In this case, however, you cannot operate the Manipulator while the safety door is open.



Plug	Standard
OPTIONAL DEVICE Dummy Plug	D-sub 25 pin #4-40 screw

4.4 Pin Assignments

In case you wish to connect the ATTEND (TEACH) control device enable/disable switch to the OPTIONAL DEVICE connector, refer to the following pin assignments.

Pin number	Signal name	Pin number	Signal name
1	FG	14	ENABLE
2	Not to be used.	15	SG
3	Not to be used.	16	–
4	Not to be used.	17	–
5	Not to be used.	18	KEY1
6	E_SW11	19	KEY2
7	SG	20	Not to be used.
8	Not to be used.	21	–
9	E_SW21	22	–
10	E_SW12	23	–
11	E_SW22	24	–
12	–	25	+12V
13	SG		

Each mode is dictated by the signals at KEY1 and KEY2 as follows:

Operation Condition		KEY1	KEY2
The ATTEND (TEACH) control device	Enabled	Connect to SG (#13 pin)	Open
	Disabled	Open	Connect to SG (#13 pin)

Use pins #13, #18 and #19 only.

If you are connecting an Emergency Stop switch, connect it to the EMERGENCY connector on the Drive Unit.



Names of each operation mode when ATTEND (TEACH) control device is enabled or disabled are defined as shown below in EPSON RC+ and SPEL CT. For details on the operation mode, refer to each User's Guide.

	ATTEND (TEACH) Control Device	
	Enabled	Disabled
EPSON RC+	TEACH mode	AUTO mode
SPEL CT	ATTEND mode	NORMAL mode

5. EMERGENCY Connector

NOTE



The details of safety requirements for this section are described in the *Safety* chapter in User's Guide. Please refer to them to keep the robot system safe.

EPSON RC+ :User's Guide - chapter *Safety*

SPEL CT :User's Guide Introduction

Safety - 1. Safety and 2. Basic Safety-related Matters

5.1 Safety Door Switch and Latch Release Switch

The EMERGENCY connector has input terminals for the Safety Door switch and the Emergency Stop switch. Be sure to use these input terminals to keep the system safe. Use only the connector that comes as a standard accessory.

Connector	Standard
EMERGENCY Connector	Rectangular half-pitch 20-pin M2.6 screw

5.1.1 Safety Door Switch

In order to maintain a safe working zone, a safeguard must be erected around the Manipulator. The safeguard must have an interlock switch at the entrance to the working zone. The Safety Door that is described in this manual is one of the safeguards and an interlock of the Safety Door is called a Safety Door switch. Connect the Safety Door switch to the Safety Door input terminal on the EMERGENCY connector.

The Safety Door switch has safety features such as temporary hold-up of the program or the operation-prohibited status that are activated whenever the Safety Door is opened.

Observe the following in designing the Safety Door switch and the Safety Door.

- For the Safety Door switch, select a switch that opens as the Safety Door opens and not by the spring of the switch itself.
- The signal from the Safety Door (Safety Door input) is designed to input two redundant signals. If the signals at the two inputs differ by two seconds or more, the system recognizes it to be a critical error. Therefore, make sure that the Safety Door switch has two separate redundant circuits and that each connects to the specified pins at the EMERGENCY connector on the Drive Unit.
- The Safety Door must be designed and installed so that it does not close accidentally.

5.1.2 Latch Release Switch

The controller software latches the following conditions:

- The safety door is open.
- The operation mode is for teaching.

The EMERGENCY connector has an input terminal for a latch release switch that cancels the latched conditions.

Open : The latch release switch latches conditions that the safety door is open or the operation mode is for teaching.

Closed : The latch release switch releases the latched conditions.

NOTE



When the latched operation mode for teaching is released while the safety door is open, the status of Manipulator power is operation-prohibited because the safety door is open at that time.

To execute a Manipulator operation, close the safety door again, and then close the latch release input.

5.1.3 Checking Latch Release Switch Operation

After connecting the safety door switch and latch release switch to the EMERGENCY connector, be sure to check the switch operation for safety by following the procedures described below before operating the Manipulator.

- (1) Turn ON the Control Unit and Drive Unit while the safety door is open in order to boot the Controller.
- (2) Make sure that “Safety” (EPSON RC+) or “Safety Door” (SPEL CT) is displayed on the status bar on monitor window.
- (3) Close the safety door, and turn ON the switch connecting to the latch release input. Make sure that the “Safety” or “Safety Door” is no longer visible (or dimmed) on the status bar.

The information that the safety door is open can be latched by software based on the latch release input condition.

Open : The latch release switch latches condition that the safety door is open.

To cancel the condition, close the safety door, and then close the safety door latch release input.

Closed : The latch release switch does not latch the condition that the safety door is open.

NOTE



The latch release input also functions to acknowledge the change of operation mode for teaching.

In order to change the latched condition of the operation mode for teaching, turn the mode selector switch on the operation unit to the mode for normal or turn the ATTEND (TEACH) control device enable/disable switch to “disable”. Then, close the latch release input.

5.2 Emergency Stop Switch



WARNING

- Connect input signal wires for Emergency Stop and Safety Door to the EMERGENCY connector so that the Emergency Stop switch in the operation unit or the ATTEND (TEACH) control device connected to the OPTIONAL DEVICE connector always functions. (Refer to the typical application diagram in the *Setup & Operation 5.5 Circuit Diagrams*.)

5.2.1 Emergency Stop Switch

If it is desired to create an external Emergency Stop switch in addition to the Emergency Stop that an operation unit or ATTEND (TEACH) control device provides, make sure to connect such Emergency Stop switches to the proper pins on the EMERGENCY connector.

The Emergency Stop switch connected must comply with the following:

- It must be a push button switch that is “normally closed.”
- A button that does not automatically return or resume.
- The button must be mushroom-shaped and red.
- The button must have a double contact that is “normally closed.”

NOTE



The signal from the Emergency Stop switch is designed to use two redundant circuits. If the signals at the two circuits differ by two seconds or more, the system recognizes it as a critical error. Therefore, make sure that the Emergency Stop switch has double contacts and that each circuit connects to the specified pins on the EMERGENCY connector at the Drive Unit. Refer to the *Setup & Operation 5.5 Circuit Diagrams*.

5.2.2 Checking Emergency Stop Switch Operation

Once the Emergency Stop switch is connected to the EMERGENCY connector, continue the following procedure to make sure that the switch functions properly. For the safety of the operator, the Manipulator must not be powered ON until the following test is completed.

- (1) Turn ON the Control Unit and the Drive Unit to boot the Controller while pressing the Emergency Stop switch.
- (2) Make sure that both the “E-STOP” LEDs on the Control Unit’s system panel and the Drive Unit’s front panel are ON.
- (3) Make sure that “Emergency Stop” is displayed on the status bar on the monitor window.
- (4) Release the Emergency Stop Switch.
- (5) Execute the RESET command.
- (6) Make sure that “E-STOP” LEDs are turned OFF and the “Emergency Stop” is no longer visible (or dimmed) from the status bar.

NOTE



For the Emergency Stop condition to work with the peripheral equipment at the input of the Emergency Stop at the Drive Unit via the EMERGENCY connector, make sure that the desired equipment is connected to the Emergency Stop output terminals. The relay contacts at the EMERGENCY connector (#5 & #6) (normally closed) will open at the input of Emergency Stop state.

5.3 E. STOP Box



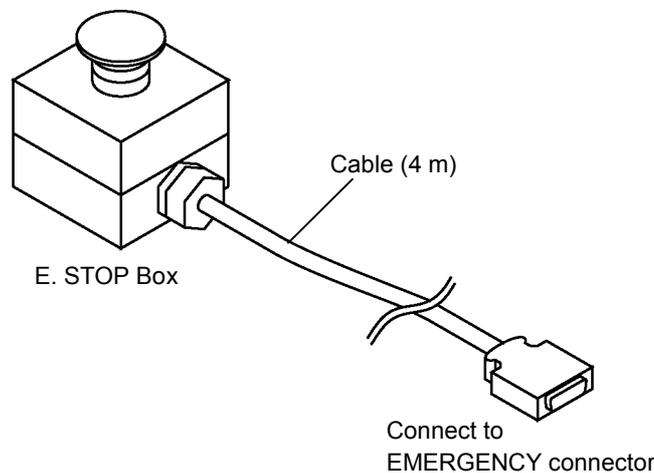
- The E. STOP box is a temporary method until the safeguard, safety door, and emergency stop devices are installed in the robot system. The E. STOP box cannot thoroughly keep the robot system safe by itself. Therefore, be sure to install proper safeguard, safety door, and emergency stop devices in the robot system.

5.3.1 E. STOP Box

The E. STOP box is a unit for performing an emergency stop. When using the E. STOP box, connect it to the EMERGENCY connector.

The E. STOP box is provided with the Controller as a standard accessory when the Controller you purchased is UL specifications.

When connecting the Safety Door switch or Emergency Stop switch to the EMERGENCY connector, remove the E. STOP box from the connector.



5.3.2 Checking E. STOP Box Operation

Once the E. STOP box is connected to the EMERGENCY connector, continue the following procedure to make sure that the E. STOP box functions properly. For the safety of the operator, the Manipulator must not be powered ON until the following test is completed.

- (1) Turn ON the Control Unit and the Drive Unit to boot the Controller while pressing the E. STOP box switch.
- (2) Make sure that the “E-STOP” LEDs on the Control Unit’s system panel and the Drive Unit’s front panel are ON.
- (3) Make sure that “Emergency Stop” is displayed on the status bar on the monitor window.
- (4) Release the E. STOP box switch.
- (5) Execute the RESET command.
- (6) Make sure that “E-STOP” LEDs are turned OFF and the “Emergency Stop” is no longer visible (or dimmed) from the status bar.

5.4 Pin Assignments

The EMERGENCY connector pin assignments are as follows:

Pin No.	Signal	Function
1	E_SW11	Emergency Stop switch output (1) *3
2	E_SW12	
3	E.STOP1+	Emergency Stop input 1 (+)
4	E.STOP1-	Emergency Stop input 1 (-)
5	E.STOP OUT	Emergency Stop condition output (Relay contact) *1
6	E.STOP OUT	
7	GUARD11	Safety Door input (1) *2
8	GUARD12	
9	+24V	+24V output
10	+24VGND	+24V GND output
11	E_SW21	Emergency Stop switch output (2) *3
12	E_SW22	
13	E.STOP2+	Emergency Stop input 2 (+)
14	E.STOP2-	Emergency Stop input 2 (-)
15	RELEASE	Latch Release input
16	RELEASE	
17	GUARD21	Safety Door input (2) *2
18	GUARD22	
19	+24V	+24V output
20	+24VGND	+24V GND output

*1 The Emergency Stop condition is output via relay contact when it is open (it is normally closed).

*2 A critical error occurs if the input values from Safety Door 1 and Safety Door 2 are different for two or more seconds. They must be connected to the same switch with two sets of contacts.

*3 The signal from the Emergency Stop switch is designed to use two redundant circuits. An error occurs if the statuses of the two redundant circuits are different for two or more seconds. They must be connected to the same switch with two sets of contacts.

Emergency Stop switch output rated load	+30V 1A or under	1-2, 11-12 pin
Emergency Stop rated input voltage range Emergency Stop rated input current	+24V $\pm 10\%$ 10mA/24V input	3-4, 13-14 pin
Safety Door rated input voltage range Safety Door rated input current	+12V to +24V $\pm 10\%$ 10mA/24V input	7-8, 17-18 pin
Latch Release rated input voltage range Latch Release rated input current	+12V to +24V $\pm 10\%$ 10mA/24V input	15-16 pin
Emergency Stop output relay contact rated load	+30V 0.5A or under	5-6 pin

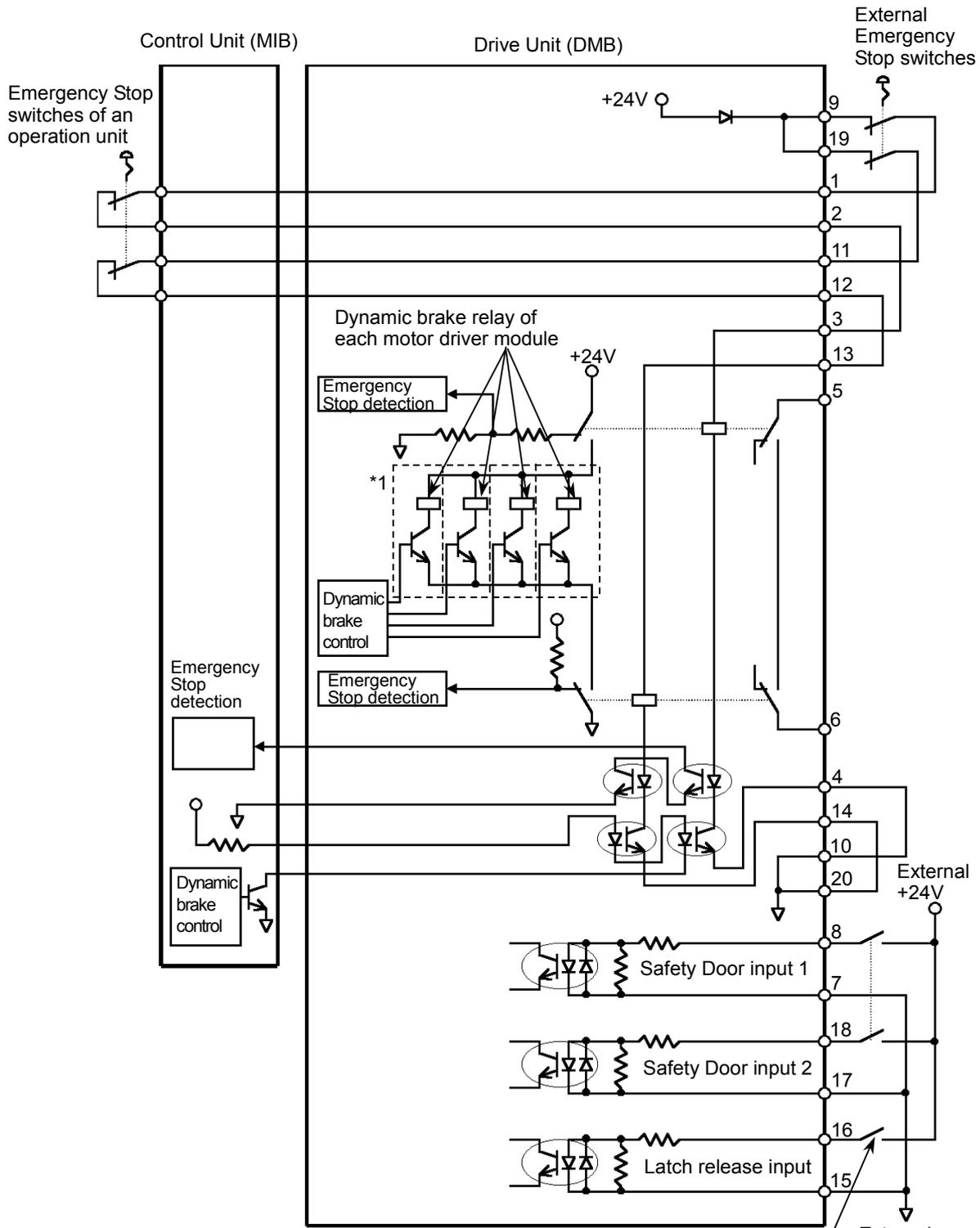
NOTE



The total electrical resistance of the Emergency Stop switches and their circuit should be 1 Ω or less.

5.5 Circuit Diagrams

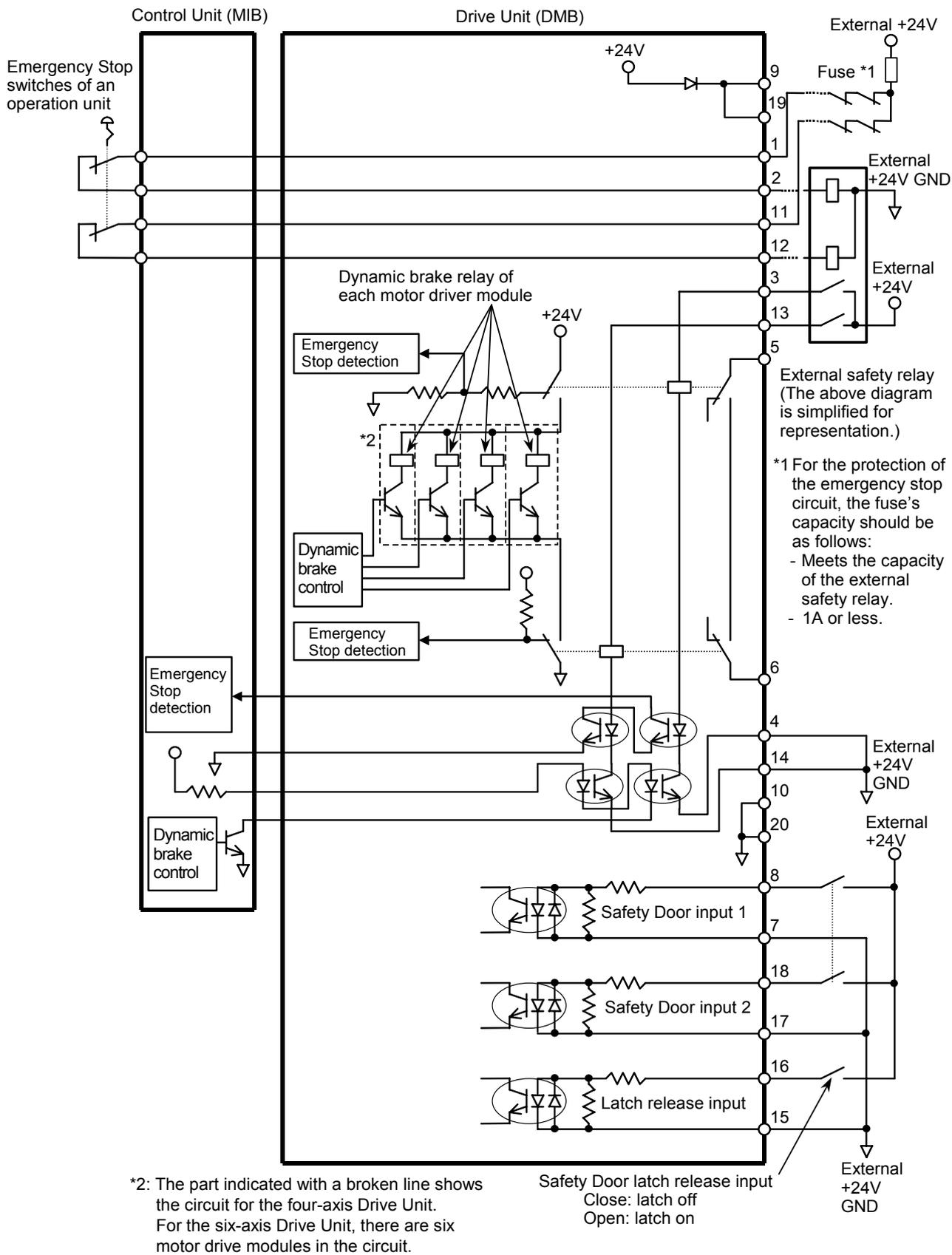
5.5.1 Example 1: External emergency stop switch typical application



*1: The part indicated with a broken line shows the circuit for the four-axis Drive Unit. For the six-axis Drive Unit, there are six motor driver modules in the circuit.

Latch release input
Close: latch off
Open: latch on

5.5.2 Example 2: External safety relay typical application



6. D-I/O Connector

The D-I/O connector is for connecting your input/output equipment to the system. A standard controller model has one D-I/O port on the rear panel of the Drive Unit. It has pins for 16 inputs and 16 outputs.

The following table shows the applicable Drive Unit for the input/output bit numbers.

Input bit number	Output bit number	Applicable Hardware
0 to 15	0 to 15	Standard Drive Unit (DU1)
16 to 31	16 to 31	Additional Drive Unit (DU2)
32 to 47	32 to 47	Additional Drive Unit (DU3)

Refer to the *Setup & Operation 7. Expansion I/O Board - Optional* for the specified model of an expansion I/O Board.

For cable wiring, refer to the *Setup & Operation 3.4 Noise Countermeasures* in order to prevent noise.

6.1 Input Circuit

Input Voltage Range	: +12 V to +24 V \pm 10%
ON Voltage	: +10.8 V (min.)
OFF Voltage	: +5 V (max.)
Input Current	: 10 mA (TYP) at +24 V input

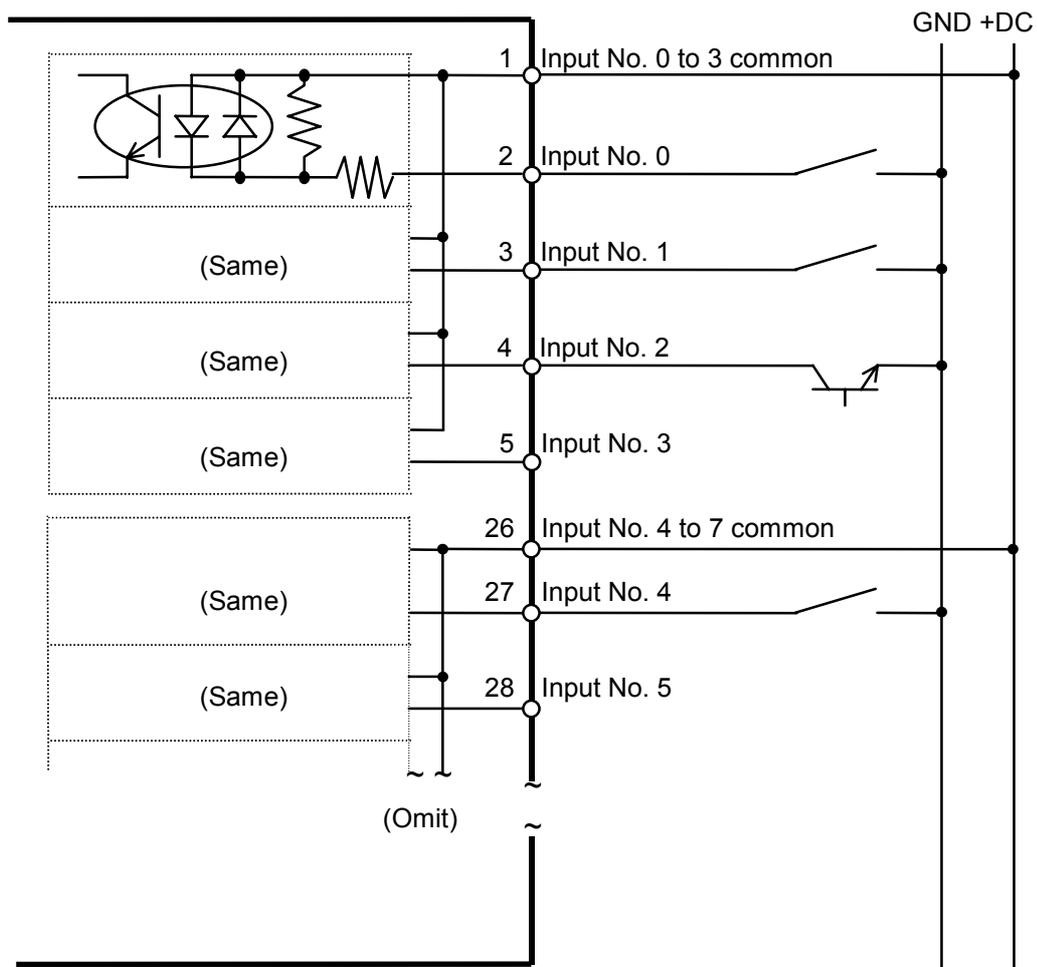
NOTE



The input bit numbers in the following diagrams are for the standard Drive Unit (DU1).

 CAUTION	<ul style="list-style-type: none"> ■ Use the PNP-type wiring diagram for CE conformance. Be sure to wire correctly. Improper wiring may cause safety problems as it may make the Manipulator move unusually. ■ When the wiring for PNP or NPN type is changed, the jumper settings for the input circuit don't require changing.
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Typical Input Circuit Application 1: NPN type



6.2 Output Circuit

- Rated Output Voltage : +12 V to +24 V \pm 10%
- Maximum Output Current : TYP 100 mA/1 output
- Output Driver : Photo coupler
- Saturation Voltage : 1.6 V or under

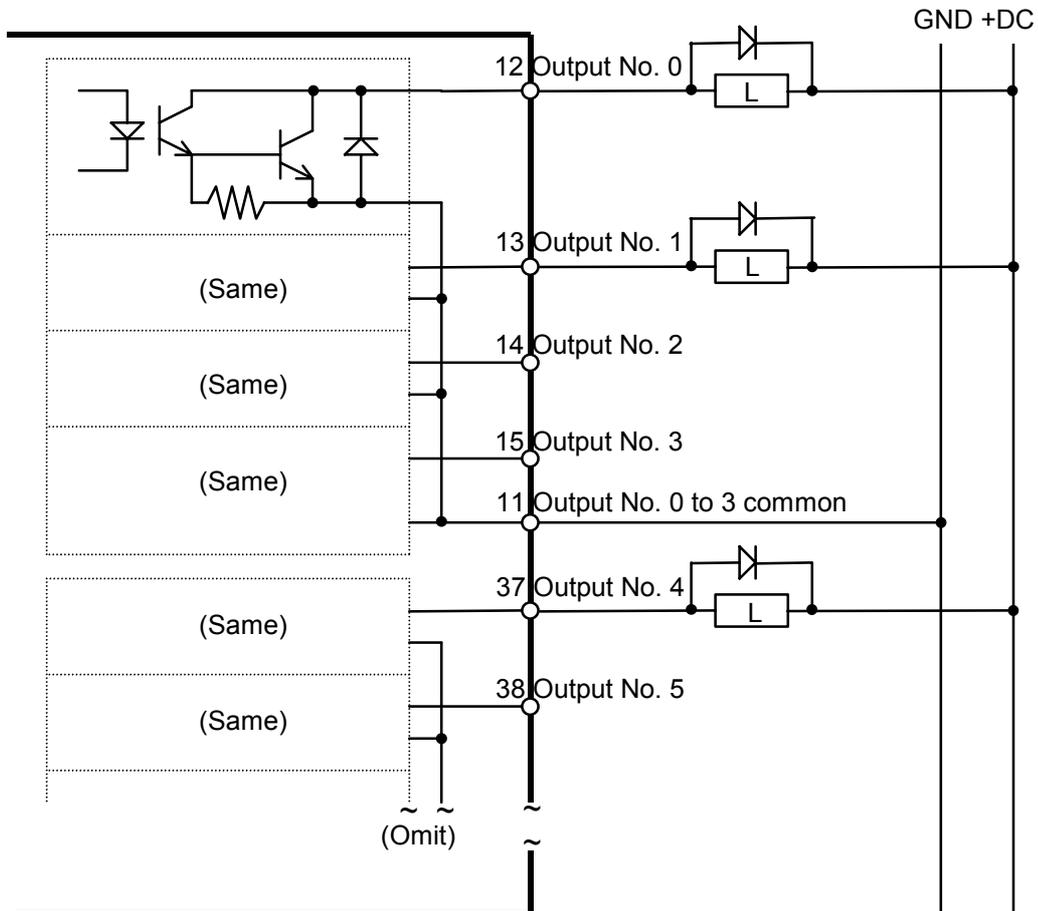
The input bit numbers in the following diagrams are for the standard Drive Unit (DU1).



CAUTION

- Use the PNP-type wiring diagram for CE conformance. Be sure to wire correctly. Improper wiring may cause safety problems as it may make the Manipulator move unusually.
- Be sure to wire the output circuit properly because it has no protection circuitry for short-circuit and reverse-connection. Improper wiring may cause malfunction of the parts on the board and then improper function of the robot system.

Typical Output Circuit Application 1: NPN type



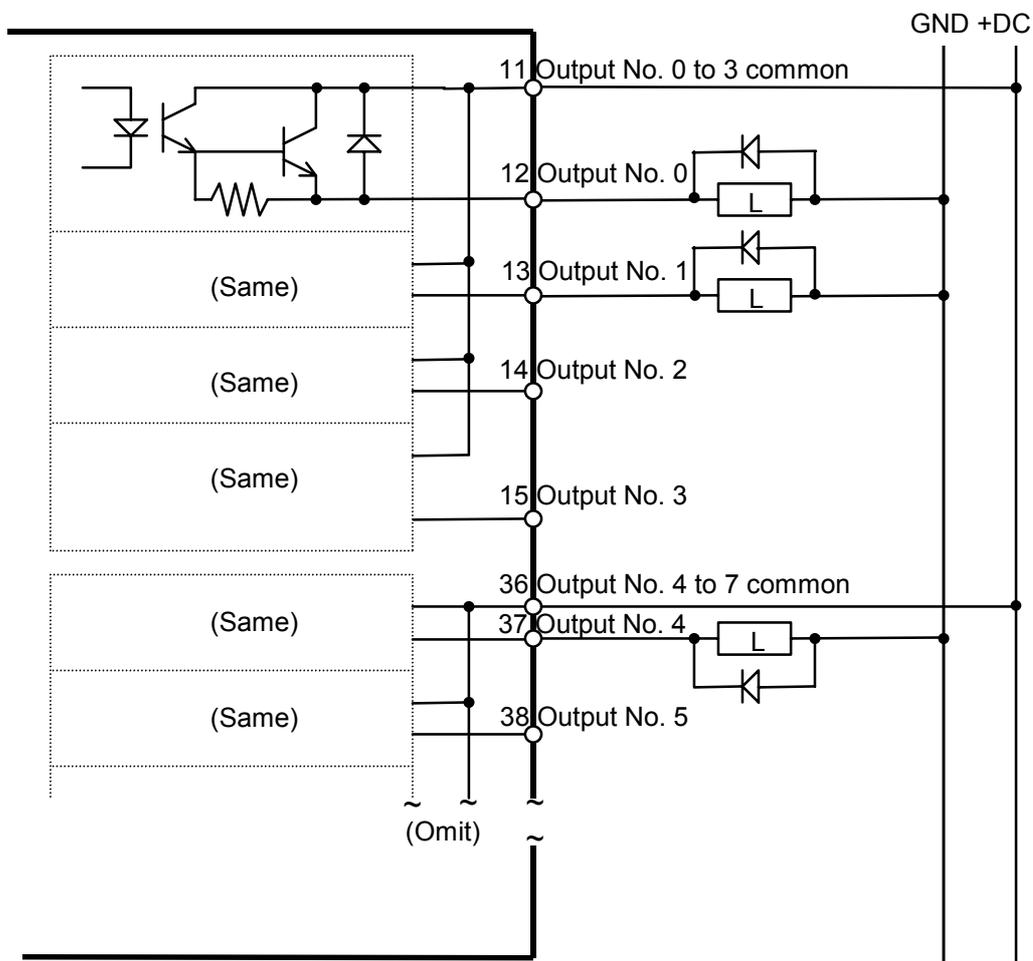
Jumper Settings for the NPN-type Output

Jumper No.	Setting
JP4, 5, 9, 10, 14, 15, 19, 20, 24, 25	1-3, 2-4, 5-6
JP6, 11, 16, 21, 26	Open
JP7, 12, 17, 22, 27	Short
JP8, 13, 18, 23, 28	2-3

(For RC520DU6, the jumpers 24, 25, 26, 27, and 28 do not exist. Their settings are not required.)

Typical Output Circuit Application 2: PNP type

 CAUTION	<p>■ Be sure to wire the output circuit properly because it has no protection circuitry for short-circuit and reverse-connection. Improper wiring may cause malfunction of the parts on the board and then improper function of the robot system.</p>
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Jumper Settings for the PNP-type Output

Jumper No.	Setting
JP4, 5, 9, 10, 14, 15, 19, 20, 24, 25	1-2, 3-5, 4-6
JP6, 11, 16, 21, 26	Short
JP7, 12, 17, 22, 27	Open
JP8, 13, 18, 23, 28	1-2

(For RC520DU6, the jumpers 24, 25, 26, 27, and 28 do not exist. Their settings are not required.)

6.3 Pin Assignments

The internal power supply does not connect to the D-I/O connector. Make sure that the power is supplied by an external power source.

6.3.1 D-I/O connector – Pin Assignments

The input/output bit numbers shown below are for the standard Drive Unit (DU1).

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common No. 0 to 3	26	Input common No. 4 to 7
2	Input No. 0	27	Input No. 4
3	Input No. 1	28	Input No. 5
4	Input No. 2	29	Input No. 6
5	Input No. 3	30	Input No. 7
6	Input common No. 8 to 11	31	Input common No. 12 to 15
7	Input No. 8	32	Input No. 12
8	Input No. 9	33	Input No. 13
9	Input No. 10	34	Input No. 14
10	Input No. 11	35	Input No. 15
11	Output common No. 0 to 3	36	Output common No. 4 to 7
12	Output No. 0	37	Output No. 4
13	Output No. 1	38	Output No. 5
14	Output No. 2	39	Output No. 6
15	Output No. 3	40	Output No. 7
16	Output common No. 8 to 11	41	Output common No. 12 to 15
17	Output No. 8	42	Output No. 12
18	Output No. 9	43	Output No. 13
19	Output No. 10	44	Output No. 14
20	Output No. 11	45	Output No. 15
21	Not to be used.	46	Not to be used.
22	Not to be used.	47	Not to be used.
23	Not to be used.	48	GND
24	Not to be used.	49	GND
25	Not to be used.	50	GND

Connector	Standard
D-I/O connector	Rectangular half-pitch 50-pin M3 screw

6.3.2 D-I/O connector optional cable – Pin Assignments

The D-I/O connector cable is an optional part.

If your D-I/O connector optional cable is USA specification, refer to the pin assignments table in the next section 6.3.3.

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common No. 0 to 3	26	NC
2	NC	27	Output common No. 0 to 3
3	Input No.0	28	Output No.0
4	Input No.1	29	Output No.1
5	Input No.2	30	Output No.2
6	Input No.3	31	Output No.3
7	Input common No. 4 to 7	32	NC
8	NC	33	Output common No. 4 to 7
9	Input No.4	34	Output No.4
10	Input No.5	35	Output No.5
11	Input No.6	36	Output No.6
12	Input No.7	37	Output No.7
13	Input common No. 8 to 11	38	NC
14	NC	39	Output common No. 8 to 11
15	Input No.8	40	Output No.8
16	Input No.9	41	Output No.9
17	Input No.10	42	Output No.10
18	Input No.11	43	Output No.11
19	Input common No. 12 to 15	44	NC
20	NC	45	Output common No. 12 to 15
21	Input No.12	46	Output No.12
22	Input No.13	47	Output No.13
23	Input No.14	48	Output No.14
24	Input No.15	49	Output No.15
25	FG	50	FG

6.3.3 D-I/O connector optional cable for USA Specification - Pin Assignments

The following pin assignments table is for USA specification.

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common No. 0 to 3	26	Input common No. 4 to 7
2	Input No. 0	27	Input No. 4
3	Input No. 1	28	Input No. 5
4	Input No. 2	29	Input No. 6
5	Input No. 3	30	Input No. 7
6	Input common No. 8 to 11	31	Input common No. 12 to 15
7	Input No. 8	32	Input No. 12
8	Input No. 9	33	Input No. 13
9	Input No. 10	34	Input No. 14
10	Input No. 11	35	Input No. 15
11	Output common No. 0 to 3	36	Output common No. 4 to 7
12	Output No. 0	37	Output No. 4
13	Output No. 1	38	Output No. 5
14	Output No. 2	39	Output No. 6
15	Output No. 3	40	Output No. 7
16	Output common No. 8 to 11	41	Output common No. 12 to 15
17	Output No. 8	42	Output No. 12
18	Output No. 9	43	Output No. 13
19	Output No. 10	44	Output No. 14
20	Output No. 11	45	Output No. 15
21	Not to be used.	46	Not to be used.
22	Not to be used.	47	Not to be used.
23	Not to be used.	48	GND
24	Not to be used.	49	GND
25	Not to be used.	50	GND

7. Expansion I/O Board - Optional

7.1 Expansion I/O Board

Install an expansion I/O board in an ISA slot in the Control Unit when extra inputs and/or outputs are desired.

Each additional I/O board provides 32 inputs and 32 outputs. The number of I/Os that can be expanded is subject to the number of ISA slots available in the type of Control Unit used.

The I/O bit numbers #0 through #47 are reserved for the three Drive Units, DU1 through DU3.

The input and output bit #s are assigned as follows. For the Expansion I/O boards, the I/O Bit #s start with #48.

Input Bit #	Output Bit #	Applicable Hardware
0 to 15	0 to 15	Standard drive unit (DU1)
16 to 31	16 to 31	Additional drive unit (DU2)
32 to 47	32 to 47	Additional drive unit (DU3)
48 to 79	48 to 79	The 1st expansion I/O board
80 to 111	80 to 111	The 2nd expansion I/O board
⋮	⋮	⋮

The types of the optional expansion I/O board are listed below.

Name	Input/Output Type	Output Circuit	Overcurrent Protection
Protected Expansion I/O board	NPN	Hybrid IC SEP007	Available
Protected Expansion I/O board	PNP	Hybrid IC SEP008	Available
Expansion I/O board	NPN	Transistor array and photo coupler	Not Available



CAUTION

- Use the PNP-type of protected Expansion I/O Board for CE conformance. Be sure to wire correctly. Improper wiring may cause serious safety problems as it may make the Manipulator move unusually.
- Be sure to wire the output circuit properly. Especially the expansion I/O board has no protection circuitry for short-circuit and reverse-connection. Improper wiring may cause malfunction of the parts on the board and then improper function of the robot system.

7.2 Protected Expansion I/O Board

7.2.1 Protected Expansion I/O Board : Jumper Settings

The I/O board address is defined by the jumpers JP1, JP2, and JP3.

JP1, JP2

The table below shows the settings for JP1 and JP2 on each board. The table is oriented the same way that the jumpers are on the board (address bit increases from left to right).

Board #	Address	JP 2					JP 1								
		1-2 A3	3-4 A4	5-6 A5	7-8 A6	9-10 A7	1-2 A8	3-4 A9	5-6 A10	7-8 A11	9-10 A12	11-12 A13	13-14 A14	15-16 A15	
1	700	Short	Short	Short	Short	Short				Short	Short	Short	Short	Short	
2	710	Short		Short	Short	Short				Short	Short	Short	Short	Short	
3	720	Short	Short		Short	Short				Short	Short	Short	Short	Short	
4	730	Short			Short	Short				Short	Short	Short	Short	Short	
5	740	Short	Short	Short		Short				Short	Short	Short	Short	Short	
6	750	Short		Short		Short				Short	Short	Short	Short	Short	
7	760	Short	Short			Short				Short	Short	Short	Short	Short	
8	770	Short				Short				Short	Short	Short	Short	Short	
9	780	Short	Short	Short	Short					Short	Short	Short	Short	Short	
10	790	Short		Short	Short					Short	Short	Short	Short	Short	

Short: Short-circuit, Blank: Open

When assigning the I/O boards to 0700H to 0707H, set them as follows:

Input: 0700H to 0703H (four ports) Output: 0704H to 0707H (four ports)

JP3

Short-circuit between 1-2, 4-5, 7-8 and 10-11.

JP4, 5, 6

Normally open.

When the Expansion I/O Board is used, the appropriate software settings must be done in addition to the jumper settings. For details about software settings, refer to the following manual.

EPSON RC+ : User's Guide - the section *ISA I/O Board Software Configuration*
in the chapter *I/O Systems*

SPEL CT : User's Guide Setup & Operation - the section 11.3.3 *I/O Board*

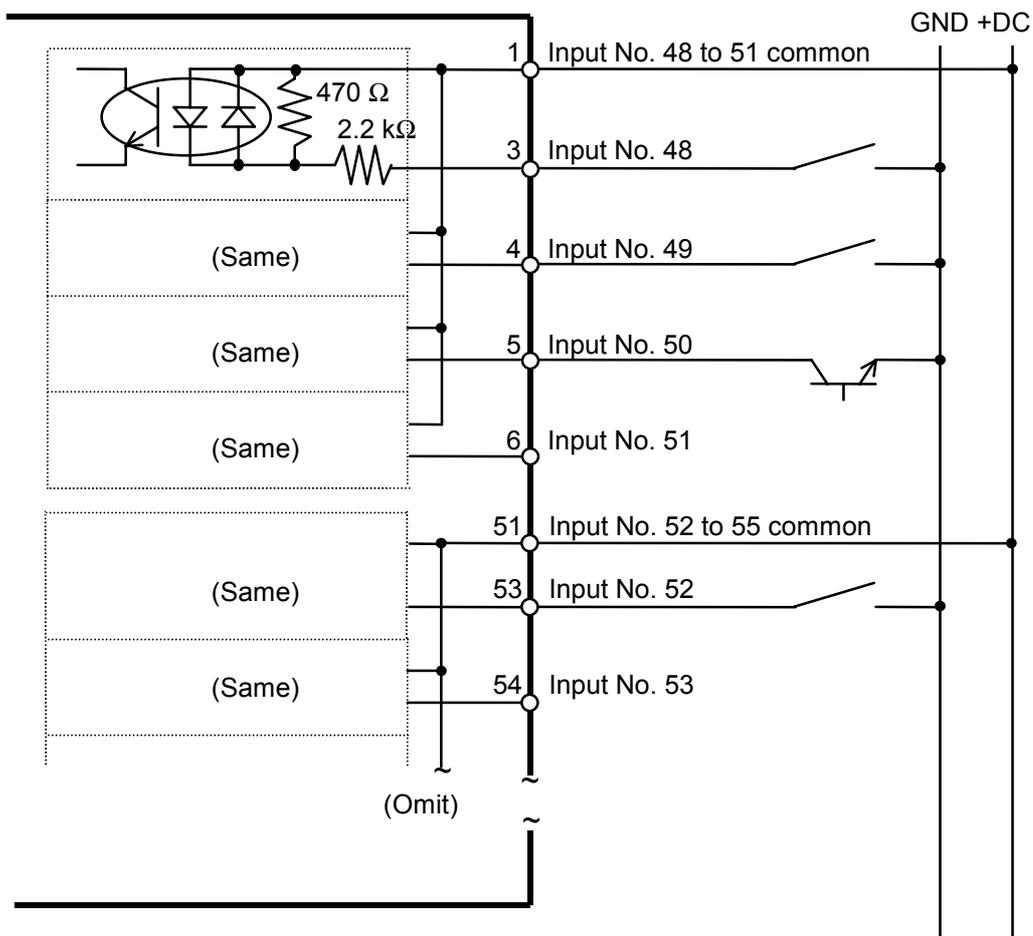
7.2.2 Protected Expansion I/O Board : Input Circuit

The following diagrams illustrate cases where #48 through #79 are assigned to the Expansion I/O's inputs and outputs. The I/O number assignment depends on the software settings.

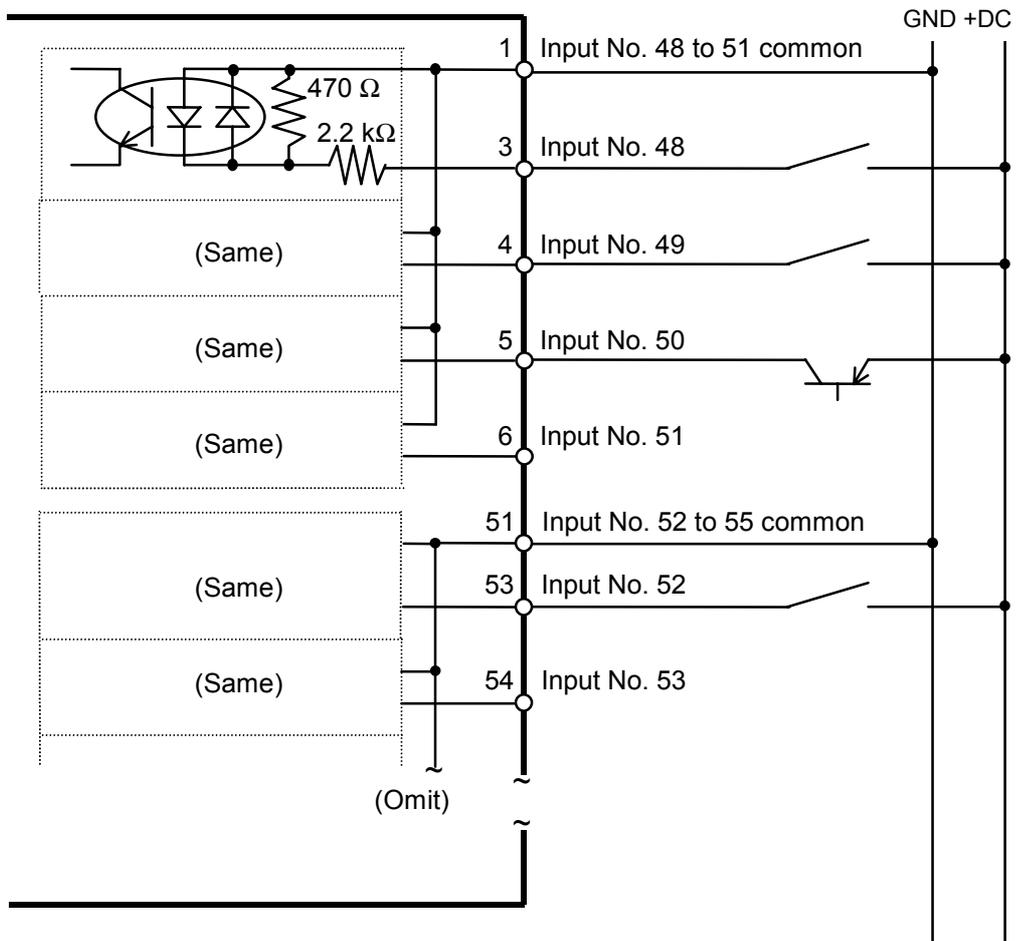
- Input Voltage Range : +12 V to +24 V ±10%
- ON Voltage : +10.8 V (Min.)
- OFF Voltage : +5 V (Max.)
- Input Current : 10 mA (TYP) at +24 V input

 CAUTION	<ul style="list-style-type: none"> ■ Use the PNP-type of wiring diagram for CE conformance. Be sure to wire correctly. Improper wiring may cause safety problems as it may make the Manipulator move unusually.
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Protected Expansion I/O Board
 Typical Input Circuit Application 1: NPN type



Protected Expansion I/O Board
 Typical Input Circuit Application 2: PNP type:

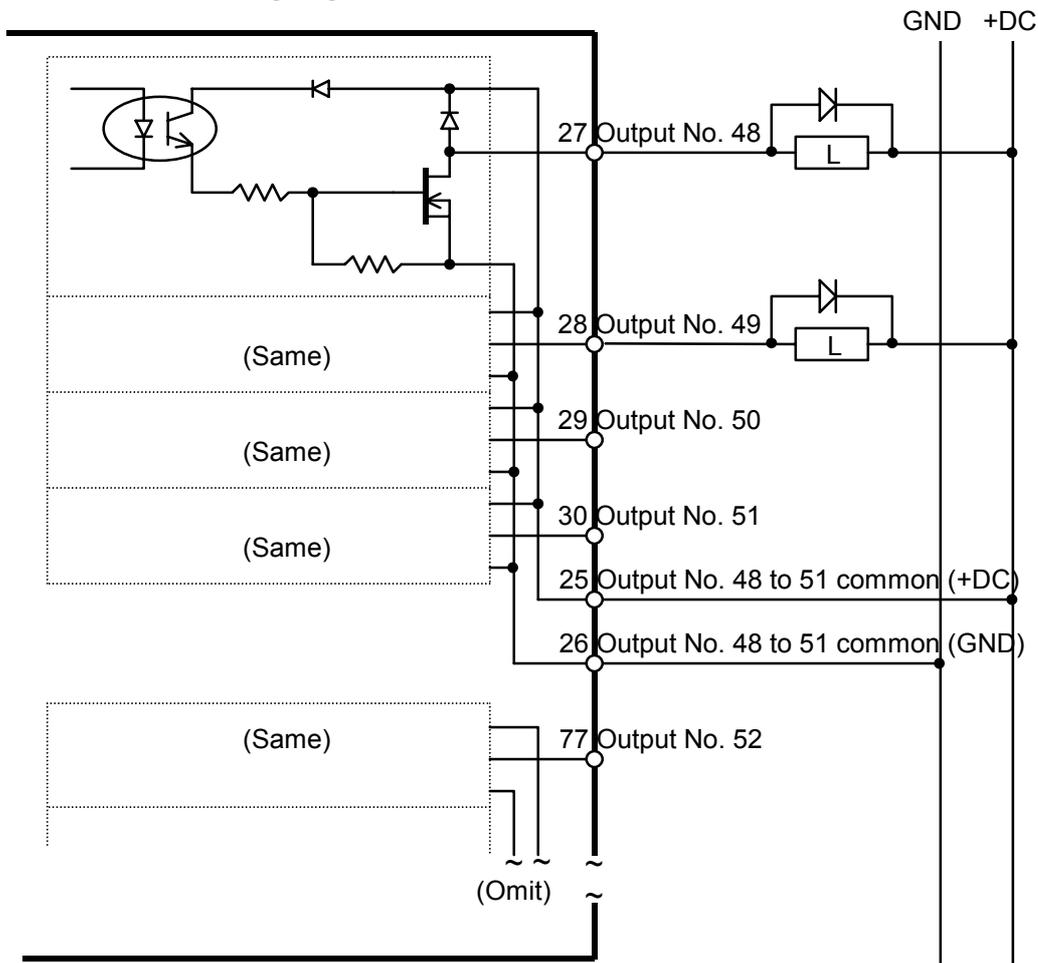


7.2.3 Protected Expansion I/O Board : Output Circuit

The following diagrams illustrate cases where #48 through #79 are assigned to the Expansion I/O's inputs and outputs. The I/O number assignment depends on the software settings.

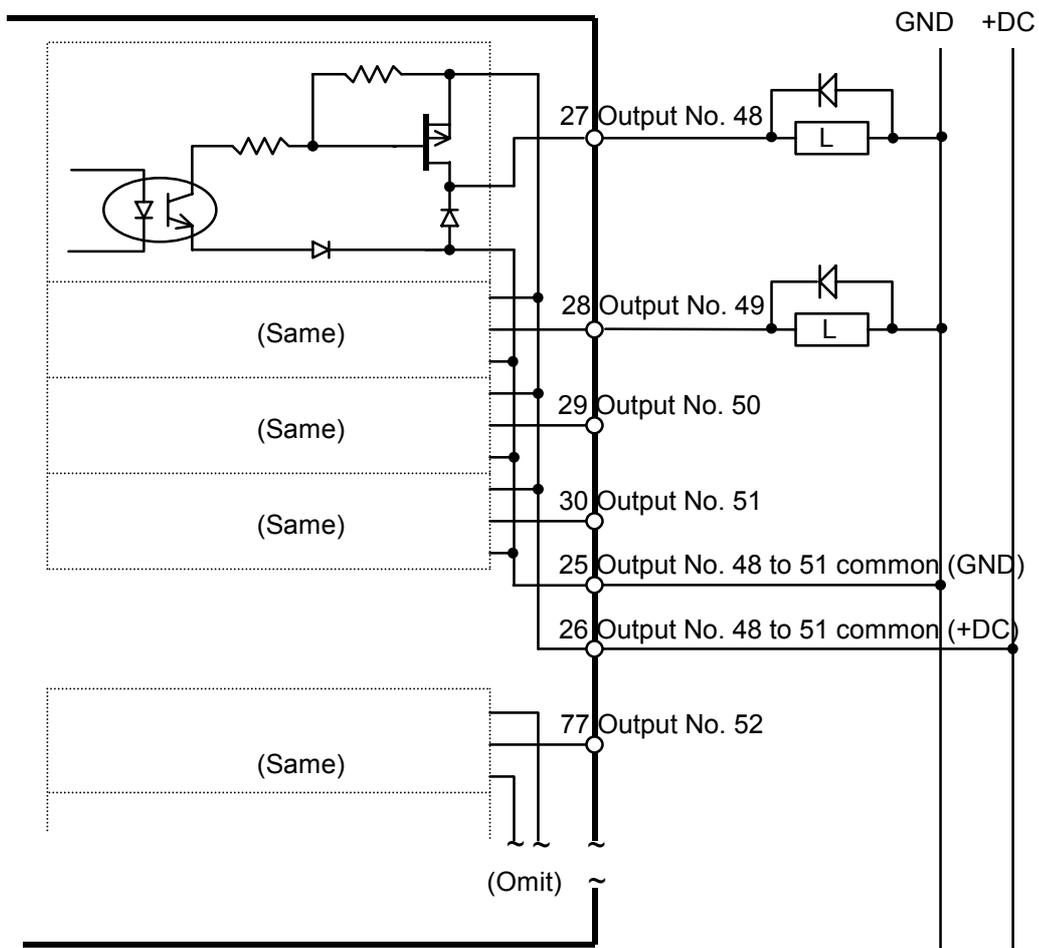
 CAUTION	<p>■ Use the PNP-type of wiring diagram for CE conformance. Be sure to wire correctly. Improper wiring may cause safety problems as it may make the Manipulator move unusually.</p>
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Protected Expansion I/O Board
 Typical Output Circuit Application 1: NPN type
 Wire as the following diagram shows.



- Rated Output Voltage : +12 V to +24 V ±10%
- Maximum Output current : 250 mA/1 output
- Output Driver : N channel power MOS FET
- Saturation Voltage : 1.0 V or under

Protected Expansion I/O Board
 Typical Output Circuit Application 2: PNP type
 Wire as the following diagram shows.



Rated Output Voltage : +12 V to +24 V $\pm 10\%$
 Maximum Output current : 250 mA/1 output
 Output Driver : P channel power MOS FET
 Saturation Voltage : 1.0 V or under

7.3 Expansion I/O Board

7.3.1 Expansion I/O Board : Jumper Settings

The I/O board address is defined by the jumpers JP1, JP2, and JP3.

JP1, JP2

The table below shows the settings for JP1 and JP2 on each board. The table is oriented the same way that the jumpers are on the board (address bit increases from left to right).

Board #	Address	JP 2					JP 1							
		1-2 A3	3-4 A4	5-6 A5	7-8 A6	9-10 A7	1-2 A8	3-4 A9	5-6 A10	7-8 A11	9-10 A12	11-12 A13	13-14 A14	15-16 A15
1	700	Short	Short	Short	Short	Short				Short	Short	Short	Short	Short
2	710	Short		Short	Short	Short				Short	Short	Short	Short	Short
3	720	Short	Short		Short	Short				Short	Short	Short	Short	Short
4	730	Short			Short	Short				Short	Short	Short	Short	Short
5	740	Short	Short	Short		Short				Short	Short	Short	Short	Short
6	750	Short		Short		Short				Short	Short	Short	Short	Short
7	760	Short	Short			Short				Short	Short	Short	Short	Short
8	770	Short				Short				Short	Short	Short	Short	Short
9	780	Short	Short	Short	Short					Short	Short	Short	Short	Short
10	790	Short		Short	Short					Short	Short	Short	Short	Short

Short: Short-circuit, Blank: Open

When assigning the I/O boards to 0700H to 0707H, set them as follows:

Input: 0700H to 0703H (four ports) Output: 0704H to 0707H (four ports)

JP3

Short-circuit between 1-2, 4-5, 7-8 and 10-11.

JP4, 5, 6

Normally open.

When the Expansion I/O Board is used, the appropriate software settings must be done in addition to the jumper settings. For details about software settings, refer to the following manual.

EPSON RC+ :User's Guide - the section *ISA I/O Board Software Configuration*
in the chapter *I/O Systems*

SPEL CT :User's Guide Setup & Operation - the section 11.3.3 *I/O Board*

7.3.2 Expansion I/O Board : Input Circuit

The input circuit is the same as the NPN type of the protected expansion I/O board.

Refer to the *Setup & Operation 7.2.2 Protected Expansion I/O board: Input Circuit* for details.

7.3.3 Expansion I/O Board : Output Circuit

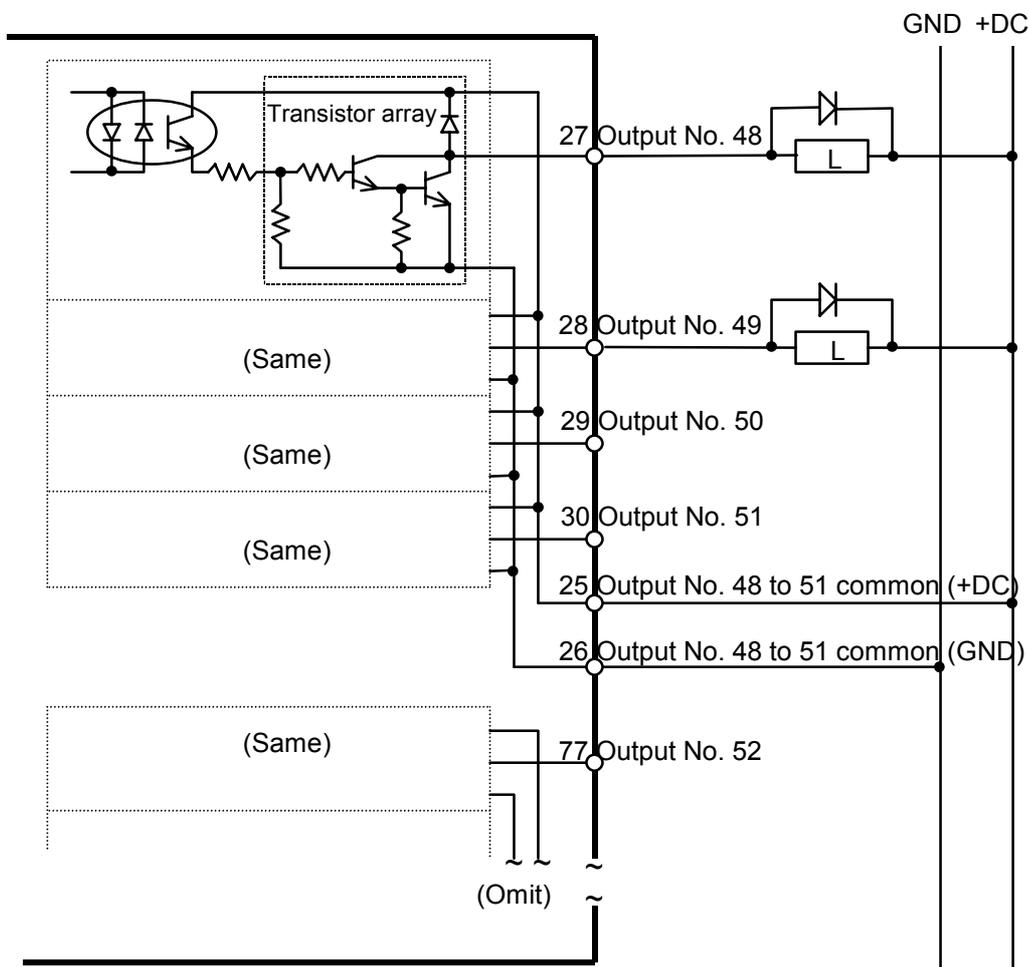
The following diagrams illustrate cases where #48 through #79 are assigned to the Expansion I/O's inputs and outputs. The I/O number assignment depends on the EPSON RC+ settings.

Expansion I/O Board

I/O Typical Output Circuit Application 1 :

Output #48 to #55 (Eight low numbers among thirty-two bit numbers existing in one board are output.)

 CAUTION	<p>■ Be sure to wire the output circuit properly. Especially the expansion I/O board has no protection circuitry for short-circuit and reverse-connection. Improper wiring may cause malfunction of the parts on the board and then improper function of the robot system.</p>
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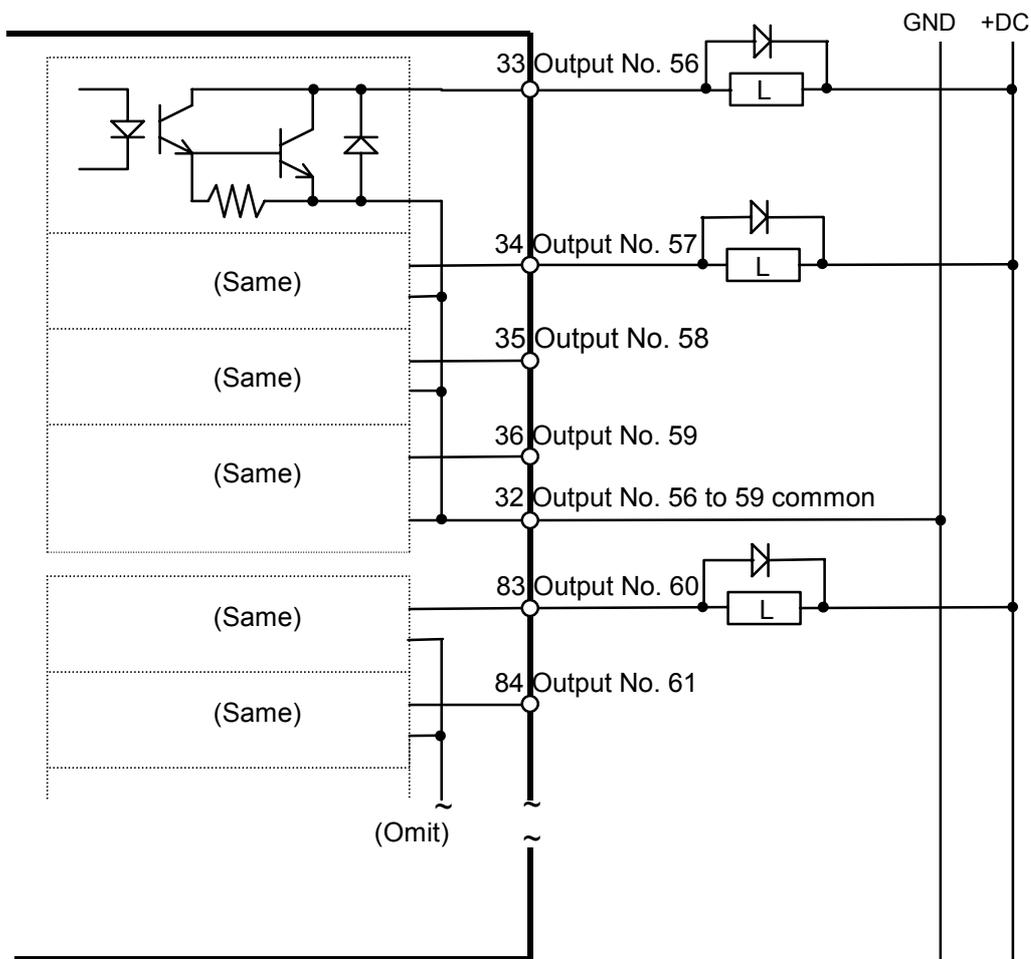


- Rated Output Voltage : +12 V to +24 V ±10%
- Maximum Output current : 250 mA/1 output
- Output Driver : Transistor array
- Saturation Voltage : 1.6 V or under

Expansion I/O Board
 Typical Output Circuit Application 2 : Output #56 to #79



■ Be sure to wire the output circuit properly. Especially the expansion I/O board has no protection circuitry for short-circuit and reverse-connection. Improper wiring may cause malfunction of the parts on the board and then improper function of the robot system.



Rated Output Voltage : +12 V to +24 V $\pm 10\%$
 Maximum Output Current : 100 mA/1 output
 Output Driver : Photo coupler
 Saturation Voltage : 1.6 V or under

7.4 Expansion I/O Board : Pin Assignments

7.4.1 Expansion I/O Board : Pin Assignments (NPN type)

NPN: Pin No. 1-50

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common A (No. 48 to 51)	26	Output common A (GND: No. 48 to 51)
2	NC	27	Output No.48
3	Input No.48	28	Output No.49
4	Input No.49	29	Output No.50
5	Input No.50	30	Output No.51
6	Input No.51	31	Output common C (+DC: No. 56 to 59)
7	Input common C (No. 56 to 59)	32	Output common C (GND: No. 56 to 59)
8	NC	33	Output No.56
9	Input No.56	34	Output No.57
10	Input No.57	35	Output No.58
11	Input No.58	36	Output No.59
12	Input No.59	37	Output common E (+DC: No. 64 to 67)
13	Input common E (No. 64 to 67)	38	Output common E (GND: No. 64 to 67)
14	NC	39	Output No.64
15	Input No.64	40	Output No.65
16	Input No.65	41	Output No.66
17	Input No.66	42	Output No.67
18	Input No.67	43	Output common G (+DC: No. 72 to 75)
19	Input common G (No. 72 to 75)	44	Output common G (GND: No. 72 to 75)
20	NC	45	Output No.72
21	Input No.72	46	Output No.73
22	Input No.73	47	Output No.74
23	Input No.74	48	Output No.75
24	Input No.75	49	FG
25	Output common A (+DC: No. 48 to 51)	50	FG

NPN: Pin No. 51-100

Pin No.	Signal Name	Pin No.	Signal Name
51	Input common B (No. 52 to 55)	76	Output common B (GND: No. 52 to 55)
52	NC	77	Output No.52
53	Input No.52	78	Output No.53
54	Input No.53	79	Output No.54
55	Input No.54	80	Output No.55
56	Input No.55	81	Output common D (+DC: No. 60 to 63)
57	Input common D (No. 60 to 63)	82	Output common D (GND: No. 60 to 63)
58	NC	83	Output No.60
59	Input No.60	84	Output No.61
60	Input No.61	85	Output No.62
61	Input No.62	86	Output No.63
62	Input No.63	87	Output common F (+DC: No. 68 to 71)
63	Input common F (No. 68 to 71)	88	Output common F (GND: No. 68 to 71)
64	NC	89	Output No.68
65	Input No.68	90	Output No.69
66	Input No.69	91	Output No.70
67	Input No.70	92	Output No.71
68	Input No.71	93	Output common H (+DC: No. 76 to 79)
69	Input common H (No. 76 to 79)	94	Output common H (GND: No. 76 to 79)
70	NC	95	Output No.76
71	Input No.76	96	Output No.77
72	Input No.77	97	Output No.78
73	Input No.78	98	Output No.79
74	Input No.79	99	FG
75	Output common B (+DC: No. 52 to 55)	100	FG

7.4.2 Expansion I/O Board : Pin Assignments (PNP type)

PNP: Pin No. 1-50

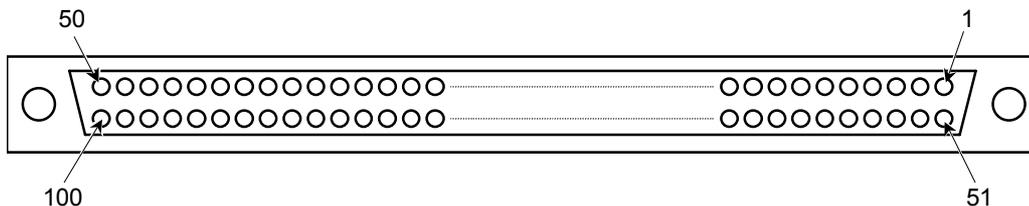
Pin No.	Signal Name	Pin No.	Signal Name
1	Input common A (No. 48 to 51)	26	Output common A (+DC: No. 48 to 51)
2	NC	27	Output No.48
3	Input No.48	28	Output No.49
4	Input No.49	29	Output No.50
5	Input No.50	30	Output No.51
6	Input No.51	31	Output common C (GND: No. 56 to 59)
7	Input common C (No. 56 to 59)	32	Output common C (+DC: No. 56 to 59)
8	NC	33	Output No.56
9	Input No.56	34	Output No.57
10	Input No.57	35	Output No.58
11	Input No.58	36	Output No.59
12	Input No.59	37	Output common E (GND: No. 64 to 67)
13	Input common E (No. 64 to 67)	38	Output common E (+DC: No. 64 to 67)
14	NC	39	Output No.64
15	Input No.64	40	Output No.65
16	Input No.65	41	Output No.66
17	Input No.66	42	Output No.67
18	Input No.67	43	Output common G (GND: No. 72 to 75)
19	Input common G (No. 72 to 75)	44	Output common G (+DC: No. 72 to 75)
20	NC	45	Output No.72
21	Input No.72	46	Output No.73
22	Input No.73	47	Output No.74
23	Input No.74	48	Output No.75
24	Input No.75	49	FG
25	Output common A (GND: No. 48 to 51)	50	FG

PNP: Pin No. 51-100

Pin No.	Signal Name	Pin No.	Signal Name
51	Input common B (No. 52 to 55)	76	Output common B (+DC: No. 52 to 55)
52	NC	77	Output No.52
53	Input No.52	78	Output No.53
54	Input No.53	79	Output No.54
55	Input No.54	80	Output No.55
56	Input No.55	81	Output common D (GND: No. 60 to 63)
57	Input common D (No. 60 to 63)	82	Output common D (+DC: No. 60 to 63)
58	NC	83	Output No.60
59	Input No.60	84	Output No.61
60	Input No.61	85	Output No.62
61	Input No.62	86	Output No.63
62	Input No.63	87	Output common F (GND: No. 68 to 71)
63	Input common F (No. 68 to 71)	88	Output common F (+DC: No. 68 to 71)
64	NC	89	Output No.68
65	Input No.68	90	Output No.69
66	Input No.69	91	Output No.70
67	Input No.70	92	Output No.71
68	Input No.71	93	Output common H (GND: No. 76 to 79)
69	Input common H (No. 76 to 79)	94	Output common H (+DC: No. 76 to 79)
70	NC	95	Output No.76
71	Input No.76	96	Output No.77
72	Input No.77	97	Output No.78
73	Input No.78	98	Output No.79
74	Input No.79	99	FG
75	Output common B (GND: No. 52 to 55)	100	FG

7.5 Expansion I/O Connector

7.5.1 Pin Layout of Expansion I/O Connector

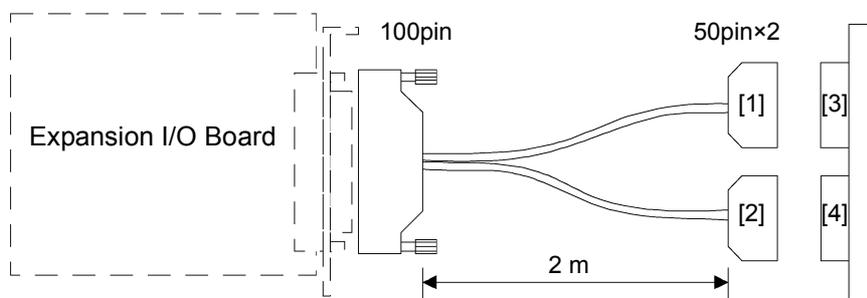


NOTE


Internal power is not connected to the Expansion I/O connector. Therefore, an external power source must be supplied.

7.5.2 Expansion I/O Connector Cable

The Expansion I/O connector cable is an optional part. It has a 100-pin connector on one end and two 50-pin connectors on the other end.



7.5.3 Expansion I/O Connector Cable – Pin Assignments

Expansion I/O connector cable - Pin Assignments: NPN type

Connector on the cable side [1]

Pin No.	Signal Name	Pin No.	Signal Name
1 (1)	Input common A (No. 48 to 51)	26 (25)	Output common A (+DC: No. 48 to 51)
2 (2)	NC	27 (26)	Output common A (GND: No. 48 to 51)
3 (3)	Input No.48	28 (27)	Output No.48
4 (4)	Input No.49	29 (28)	Output No.49
5 (5)	Input No.50	30 (29)	Output No.50
6 (6)	Input No.51	31 (30)	Output No.51
7 (51)	Input common B (No. 52 to 55)	32 (75)	Output common B (+DC: No. 52 to 55)
8 (52)	NC	33 (76)	Output common B (GND: No. 52 to 55)
9 (53)	Input No.52	34 (77)	Output No.52
10 (54)	Input No.53	35 (78)	Output No.53
11 (55)	Input No.54	36 (79)	Output No.54
12 (56)	Input No.55	37 (80)	Output No.55
13 (7)	Input common C (No. 56 to 59)	38 (31)	Output common C (+DC: No. 56 to 59)
14 (8)	NC	39 (32)	Output common C (GND: No. 56 to 59)
15 (9)	Input No.56	40 (33)	Output No.56
16 (10)	Input No.57	41 (34)	Output No.57
17 (11)	Input No.58	42 (35)	Output No.58
18 (12)	Input No.59	43 (36)	Output No.59
19 (57)	Input common D (No. 60 to 63)	44 (81)	Output common D (+DC: No. 60 to 63)
20 (58)	NC	45 (82)	Output common D (GND: No. 60 to 63)
21 (59)	Input No.60	46 (83)	Output No.60
22 (60)	Input No.61	47 (84)	Output No.61
23 (61)	Input No.62	48 (85)	Output No.62
24 (62)	Input No.63	49 (86)	Output No.63
25 (49)	FG	50 (50)	FG

The number in parentheses in the Pin No. above means the corresponding pin number on the 100-pin connector.

Expansion I/O connector cable - Pin Assignments: NPN type

Connector on the cable side [2]

Pin No.	Signal Name	Pin No.	Signal Name
1 (13)	Input common E (No. 64 to 67)	26 (37)	Output common E (+DC: No. 64 to 67)
2 (14)	NC	27 (38)	Output common E (GND: No. 64 to 67)
3 (15)	Input No.64	28 (39)	Output No.64
4 (16)	Input No.65	29 (40)	Output No.65
5 (17)	Input No.66	30 (41)	Output No.66
6 (18)	Input No.67	31 (42)	Output No.67
7 (63)	Input common F (No. 68 to 71)	32 (87)	Output common F (+DC: No. 68 to 71)
8 (64)	NC	33 (88)	Output common F (GND: No. 68 to 71)
9 (65)	Input No.68	34 (89)	Output No.68
10 (66)	Input No.69	35 (90)	Output No.69
11 (67)	Input No.70	36 (91)	Output No.70
12 (68)	Input No.71	37 (92)	Output No.71
13 (19)	Input common G (No. 72 to 75)	38 (43)	Output common G (+DC: No. 72 to 75)
14 (20)	NC	39 (44)	Output common G (GND: No. 72 to 75)
15 (21)	Input No.72	40 (45)	Output No.72
16 (22)	Input No.73	41 (46)	Output No.73
17 (23)	Input No.74	42 (47)	Output No.74
18 (24)	Input No.75	43 (48)	Output No.75
19 (69)	Input common H (No. 76 to 79)	44 (93)	Output common H (+DC: No. 76 to 79)
20 (70)	NC	45 (94)	Output common H (GND: No. 76 to 79)
21 (71)	Input No.76	46 (95)	Output No.76
22 (72)	Input No.77	47 (96)	Output No.77
23 (73)	Input No.78	48 (97)	Output No.78
24 (74)	Input No.79	49 (98)	Output No.79
25 (99)	FG	50 (100)	FG

The number in parentheses in the Pin No. above means the corresponding pin number on the 100-pin connector.

Expansion I/O connector cable – Pin Assignments: PNP type

Connector on the cable side [1]

Pin No.	Signal Name	Pin No.	Signal Name
1 (1)	Input common A (No. 48 to 51)	26 (25)	Output common A (GND: No. 48 to 51)
2 (2)	NC	27 (26)	Output common A (+DC: No. 48 to 51)
3 (3)	Input No.48	28 (27)	Output No.48
4 (4)	Input No.49	29 (28)	Output No.49
5 (5)	Input No.50	30 (29)	Output No.50
6 (6)	Input No.51	31 (30)	Output No.51
7 (51)	Input common B (No. 52 to 55)	32 (75)	Output common B (GND: No. 52 to 55)
8 (52)	NC	33 (76)	Output common B (+DC: No. 52 to 55)
9 (53)	Input No.52	34 (77)	Output No.52
10 (54)	Input No.53	35 (78)	Output No.53
11 (55)	Input No.54	36 (79)	Output No.54
12 (56)	Input No.55	37 (80)	Output No.55
13 (7)	Input common C (No. 56 to 59)	38 (31)	Output common C (GND: No. 56 to 59)
14 (8)	NC	39 (32)	Output common C (+DC: No. 56 to 59)
15 (9)	Input No.56	40 (33)	Output No.56
16 (10)	Input No.57	41 (34)	Output No.57
17 (11)	Input No.58	42 (35)	Output No.58
18 (12)	Input No.59	43 (36)	Output No.59
19 (57)	Input common D (No. 60 to 63)	44 (81)	Output common D (GND: No. 60 to 63)
20 (58)	NC	45 (82)	Output common D (+DC: No. 60 to 63)
21 (59)	Input No.60	46 (83)	Output No.60
22 (60)	Input No.61	47 (84)	Output No.61
23 (61)	Input No.62	48 (85)	Output No.62
24 (62)	Input No.63	49 (86)	Output No.63
25 (49)	FG	50 (50)	FG

The number in parentheses in the Pin No. above means the corresponding pin number on the 100-pin connector.

Expansion I/O connector cable – Pin Assignments: PNP type

Connector on the cable side [2]

Pin No.	Signal Name	Pin No.	Signal Name
1 (13)	Input common E (No. 64 to 67)	26 (37)	Output common E (GND: No. 64 to 67)
2 (14)	NC	27 (38)	Output common E (+DC: No. 64 to 67)
3 (15)	Input No.64	28 (39)	Output No.64
4 (16)	Input No.65	29 (40)	Output No.65
5 (17)	Input No.66	30 (41)	Output No.66
6 (18)	Input No.67	31 (42)	Output No.67
7 (63)	Input common F (No. 68 to 71)	32 (87)	Output common F (GND: No. 68 to 71)
8 (64)	NC	33 (88)	Output common F (+DC: No. 68 to 71)
9 (65)	Input No.68	34 (89)	Output No.68
10 (66)	Input No.69	35 (90)	Output No.69
11 (67)	Input No.70	36 (91)	Output No.70
12 (68)	Input No.71	37 (92)	Output No.71
13 (19)	Input common G (No. 72 to 75)	38 (43)	Output common G (GND: No. 72 to 75)
14 (20)	NC	39 (44)	Output common G (+DC: No. 72 to 75)
15 (21)	Input No.72	40 (45)	Output No.72
16 (22)	Input No.73	41 (46)	Output No.73
17 (23)	Input No.74	42 (47)	Output No.74
18 (24)	Input No.75	43 (48)	Output No.75
19 (69)	Input common H (No. 76 to 79)	44 (93)	Output common H (GND: No. 76 to 79)
20 (70)	NC	45 (94)	Output common H (+DC: No. 76 to 79)
21 (71)	Input No.76	46 (95)	Output No.76
22 (72)	Input No.77	47 (96)	Output No.77
23 (73)	Input No.78	48 (97)	Output No.78
24 (74)	Input No.79	49 (98)	Output No.79
25 (99)	FG	50 (100)	FG

The number in parentheses in the Pin No. above means the corresponding pin number on the 100-pin connector.

8. I/O Remote Settings

This section describes the functions and timings of the remote input and output signals.

The remote functions may be assigned to your standard or expansion I/O board(s) to enhance robot control - either from an operation unit of your choice or a sequencer.

The user defines the I/O number that a remote function is assigned to using software configuration. For further details, refer to the following manual.

EPSON RC+ : User's Guide - the section *Remote Control Software Configuration* in the chapter *Remote Control*

SPEL CT : User's Guide Setup & Operation - the section *11.2.2 Remote*

For details about communication with external equipment, refer to the following manual.

EPSON RC+ : User's Guide - the section *Remote Control Software Configuration* in the chapter *Remote Control*

SPEL CT : User's Guide Setup & Operation - the section *7.3 Remote Setting*

For details about I/O cable connection, refer to the sections *Setup & Operation 6. D- I/O Connector* and *Setup & Operation 7. Expansion I/O Board - Optional* in this manual.



CAUTION

- When using remote I/O, always make sure of the following. Using the robot system under unsatisfactory conditions may cause malfunction of the system and/or safety problems.
 - Assign remote functions to inputs/outputs correctly and wire correctly when setting up remote I/O signals.
 - Make sure that the functions are corresponded to the correct input/output signals before turning ON the system.
 - When verifying the robot system operation, prepare for failures with initial settings or wiring. If the Manipulator functions unusually by the failures with initial settings or wiring, press the Emergency Stop switch immediately to stop the Manipulator.

8.1 Remote I/O Signal Descriptions (EPSON RC+)

You may use either Standard I/O or Expansion I/O for remote control. To use all signals, you will need to add Expansion I/O.



NOTE

When an error occurs, you must execute a Reset to clear the error condition before any more remote input commands can be executed. Therefore, it is recommended that the remote equipment uses the Error output and Reset input to monitor and clear error conditions.

8.1.1 Remote Input Signals

Remote inputs are used to control the Manipulators and start programs. Certain conditions must be met before inputs are enabled, as shown in the table below.

The remote input signals for EPSON RC+ are as follows:

Name	Description
MotorOn	Turns motors on for the current robot. The MotorOff input must be off. Disabled when tasks are running.
MotorOff	Turns motors off for the current robot and disables MotorOn. Disabled when tasks are running.
PowerHigh	Sets high motor power mode for the current robot. The motors must be on and the PowerLow input must be off. Disabled when tasks are running.
PowerLow	Turns off high power mode for the current robot and disables PowerHigh. Disabled when tasks are running.
Mcal	Executes MCal command. Disabled when tasks are running.
Home	Executes Home command. Disabled when tasks are running.
Start	Starts the current program group. Disabled when tasks are running. (*2)
Pause	Pauses all tasks that are configured to pause. Enabled only when tasks are running.
Cont	Continues tasks that have been paused. Enabled only when tasks are running.
AbortAll	Aborts all tasks or the current command.
Reset	Resets the Controller and error condition. This is the only command accepted when the Error output is turned on.
SelRobot	Selects the current robot for robot commands, according to the 4 inputs SelRobot0 to SelRobot3. The robot number is 0 based, with 0 corresponding to Robot 1 (default). (*1)
SelRobot0	Robot Bit 0, weight 1. (*3)
SelRobot1	Robot Bit 1, weight 2. (*3)
SelRobot2	Robot Bit 2, weight 4. (*3)
SelRobot3	Robot Bit 3, weight 8. (*3)
SelGroup	Selects the current program group to be started with the Start input according to the 4 inputs SelGroup0 to SelGroup3.
SelGroup0	Group Bit 0, weight 1. (*4)
SelGroup1	Group Bit 1, weight 2. (*4)
SelGroup2	Group Bit 2, weight 4. (*4)
SelGroup3	Group Bit 3, weight 8. (*4)
Recover *	Initiates a position recovery after the safeguard has been closed.
Shutdown *	Shuts down the Controller. Disabled when tasks are running.
Reboot *	Reboots the Controller. Disabled when tasks are running.

* The Recover has been supported since EPSON RC+ Ver.4.0

The Shutdown and Reboot have been supported since EPSON RC+ Ver.4.1.

- (*1) The SelRobot input is used to select the Manipulator for executing Motor Mode, Power Mode, MCALComplete, AtHOME, the output of CurrRobot0 to 3 for remote output and Motor ON, Motor OFF, Mcal, Home for remote input.
- (*2) The Start input is enabled for the group number specified with SelGroup0-3 bits.
- (*3) Specify the Manipulator number with SelRobot0 - 3 as shown in the table below.

Specified Manipulator	SelRobot0	SelRobot1	SelRobot2	SelRobot3
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

0 : OFF, 1 : ON

- (*4) Specify the group number with SelGroup0 - 3 bits as shown in the table below.

Specified Group No.	SelGroup0	SelGroup1	SelGroup2	SelGroup3
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

0 : OFF, 1 : ON

8.1.2 Remote Output Signals

Remote outputs provide status for the current Manipulator and Controller.

The remote output signals for EPSON RC+ are as follows:

Function	Description
MotorOn	Indicates that motors are on for the current robot.
PowerHigh	Indicates that motor power is set to high for the current robot.
McalComplete	Indicates that MCal has been completed for the current robot. If the robot uses absolute encoders, then this output will always be on.
AtHome	Indicates that the current robot is at its home position.
CmdRunning	Indicates that a remote input command is in cycle.
TasksRunning	Indicates that tasks are running in the Controller.
Paused	Indicates that tasks have been paused.
Safeguard	Indicates that the safeguard circuit is open.
EstopOn	Indicates that emergency stop has occurred.
Error	Indicates that an error had occurred. You must execute a Reset input to clear the error condition.
AUTOMode	Indicates that remote input commands will be accepted.
TeachMode	Indicates that the system is in Teach mode.
EnableOn	Indicates that the enable switch (dead man) is on during Teach mode.
CurrRbor0	Robot Bit 0, weight 1. (*3)
CurrRobot1	Robot Bit 1, weight 2. (*3)
CurrRobot2	Robot Bit 2, weight 4. (*3)
CurrRobot3	Robot Bit 3, weight 8. (*3)
CurrGroup0	Group Bit 0, weight 1. (*4)
CurrGroup1	Group Bit 1, weight 2. (*4)
CurrGroup2	Group Bit 2, weight 4. (*4)
CurrGroup3	Group Bit 3, weight 8. (*4)
MotorMode	Indicates the current motor setting. Sometimes the motors are turned off by the system, such as when the safeguard is opened. But MotorMode signals the current user setting.
PowerMode	Indicates the current power setting. Sometimes the power is set to low by the system. But PowerMode signals the current user setting.
RecoverReqd *	Indicates that a recover position can be executed after the safeguard has been closed.
RecoverInCycle *	Indicates that recover position is in cycle.

* The RecoverReqd and RecoverInCycle have been supported since EPSON RC+ Ver.4.0.

(*3) (*4): Refer to the tables in the *Setup & Operation 8.1.1 Remote Input Signals*.

8.2 Remote I/O Signal Descriptions (SPEL CT)

You may use either Standard I/O or Expansion I/O for remote control. To use all signals, you will need to add Expansion I/O.

8.2.1 Remote Input Signals

Remote inputs are used to control the Manipulators and start programs. Certain conditions must be met before inputs are enabled, as shown in the table below.

The remote input signals for SPEL CT are as follows:

Name	Description
Motor ON	Motor power ON input
Motor OFF	Motor power OFF input
MCAL	Execute MCAL (initializes a Manipulator to the mechanical origin position) input
HOME	Execute HOME (move to home position) input
Mnp.No.0	Inputs the Manipulator number as determined by Sel Mnp signal. (*3)
Mnp.No.1	
Mnp.No.2	
Mnp.No.3	
Sel Mnp	The Manipulator number changing input. (*1)
START	Input for executing a task (main function) or for continuous execution of all tasks. (*2)
PAUSE	Input for pausing the Controller
RESET	Input for releasing the Emergency Stops, and errors, and for interrupting all tasks including background tasks
Grp No.0	Specifies the group number of the project for enabling START input. (*4)
Grp No.1	
Grp No.2	
Grp No.3	
RECOVER	Input for canceling the Emergency Stop status and for returning all Manipulators to the status before Emergency Stop
RESTART	Input for terminating tasks being executed and restarting the background and main functions
ABORT ALL	Input for terminating ordinary tasks except for background tasks
READY	Input for terminating all tasks except for Emergency Stop cancellation, error cancellation and background tasks
SHUTDOWN *	Shuts down the Controller. Disabled when tasks are running.

* The SHUTDOWN has been supported since SPEL CT Ver.3.1.

(*1) Sel Mnp input is used to define the Manipulator for executing Motor Mode, Motor Status, Power Mode, Power Status, MCALed, HOME, the output of Mnp.No.0 to 3 for remote output and Motor ON, Motor OFF, MCAL, HOME for remote input.

(*2) START input is enabled for the function registered in the group of the number specified with Grp. No.0-3/4bit.

(*3) Specify the Manipulator number with Mnp.No.0-3/4 bit referring to the table below.

Specified Manipulator	Mnp. No.0	Mnp. No.1	Mnp. No. 2	Mnp. No.3
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

0 : OFF, 1 : ON

(*4) Specify the group number with Grp. No.0-3/4 bit referring to the table below.

Specified Group No.	Grp No.0	Grp No.1	Grp No. 2	Grp No.3
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

0 : OFF, 1 : ON

8.2.2 Remote Output Signals

Remote outputs provide status for the current Manipulator and Controller.

The remote output signals for SPEL CT are as follows:

Function	Description
Motor Mode	Outputs the motor mode status (Motor mode ON: ON). Outputs the motor mode of the Manipulators as determined by input of the Sel Mnp signal.
Motor Status	Outputs the motor status (Motor status ON: ON). Outputs the motor status of the Manipulators as determined by input of the Sel Mnp signal.
Power Mode	Outputs the power mode status (High power mode: ON). Outputs the power mode of the Manipulators as determined by input of the Sel Mnp signal.
Power Status	Outputs the power status (High power status: ON). Outputs the power status of the Manipulators as determined by input of the Sel Mnp signal.
MCALed	Outputs the MCAL (initializing a Manipulator to the mechanical origin position) status (Executed: ON). Outputs the status of the Manipulators as determined by input of the Sel Mnp signal.
HOME	Outputs the home position status. Outputs the status of the Manipulators as determined by input of the Sel Mnp signal.
Mnp.No.0	Outputs the Manipulator number. (*3) Outputs the Manipulator No. as determined by input of the Sel Mnp signal with these bit.
Mnp.No.1	
Mnp.No.2	
Mnp.No.3	
START monitor	Outputs the Controller START status
In PAUSE	Outputs the Controller PAUSE status
RESET	Outputs the Controller RESET status
Safety Door	Outputs the safety door status (When the safety door is open: ON)
Enable	Outputs the enable switch status of the operation unit
E-Stop	Outputs the Emergency Stop status of the Controller
Error	Outputs the error status of the Controller
Grp No.0	Outputs the group number in the project. (*4) Outputs the current selected group number with these bit.
Grp No.1	
Grp No.2	
Grp No.3	

Function	Description
AUTO mode	Outputs the working mode status. ON in the AUTO mode (OFF in the PROGRAMMING mode).
ATTEND mode	Outputs the operation mode status. ON in the ATTEND operation mode (OFF in the NORMAL operation mode).
READY	Outputs the READY status of the Controller (ON in the READY and RESET status).
WAIT RECOVER	Outputs the WAIT RECOVER status of the Controller.
RECOVER	Outputs the RECOVER status of the Controller.

(*3) (*4): Refer to the tables in the *Setup & Operation 8.2.1 Remote Input Signals*.

8.3 Timing Specifications (EPSON RC+)

8.3.1 Design Notes for Remote Input Signals

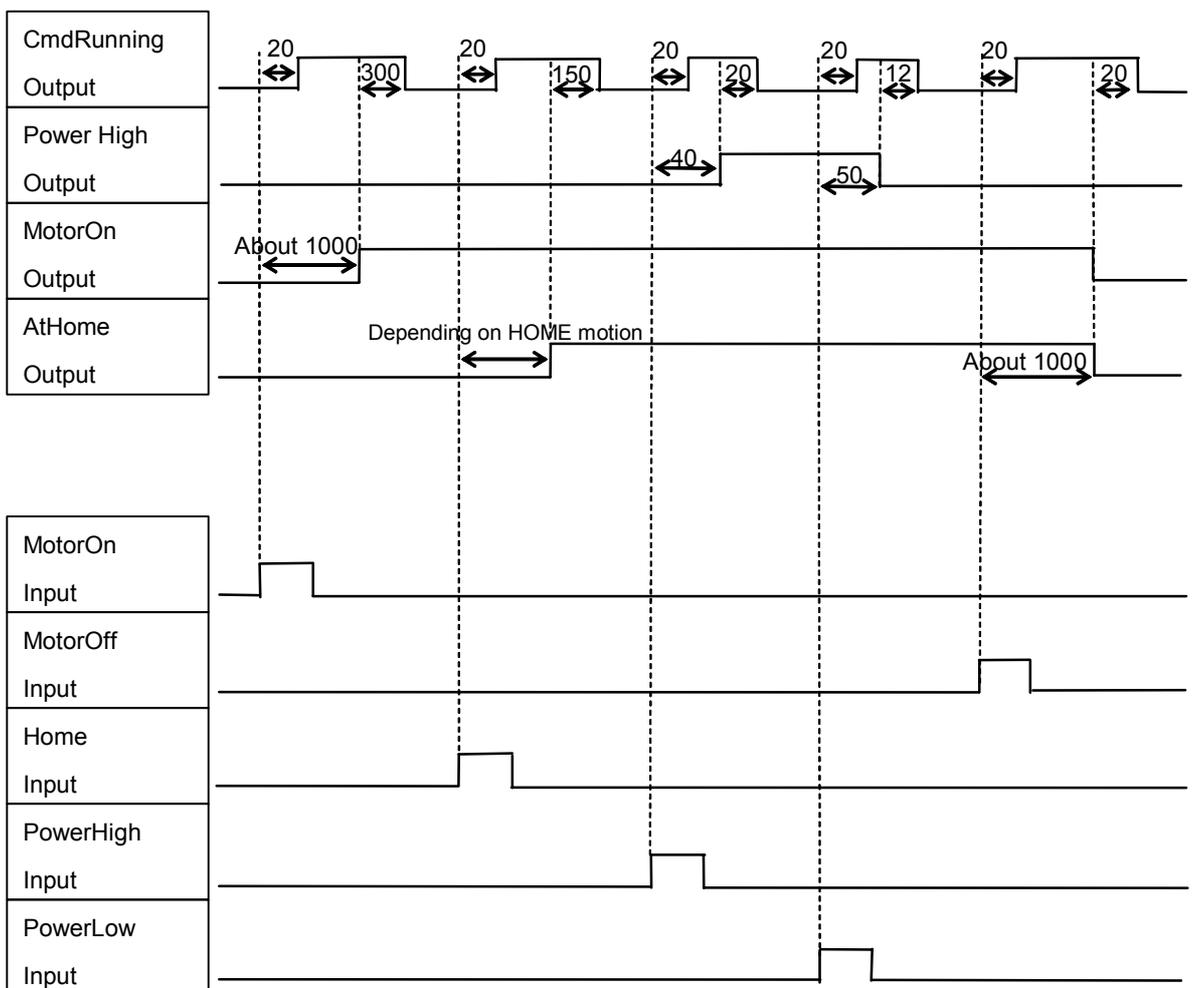
The following charts indicate timing sequences for the primary operations of the Controller.

The indicated time lapses (time durations) should be referred to only as reference values since the actual timing values may vary depending on the number of Manipulators and the number of tasks running, as well as CPU speed of the Controller. Check carefully and refer to the following charts for the timing interrelation when you enter an input signal.

During system design, make sure that you actuate only one remote input operation at a time, otherwise an error will occur.

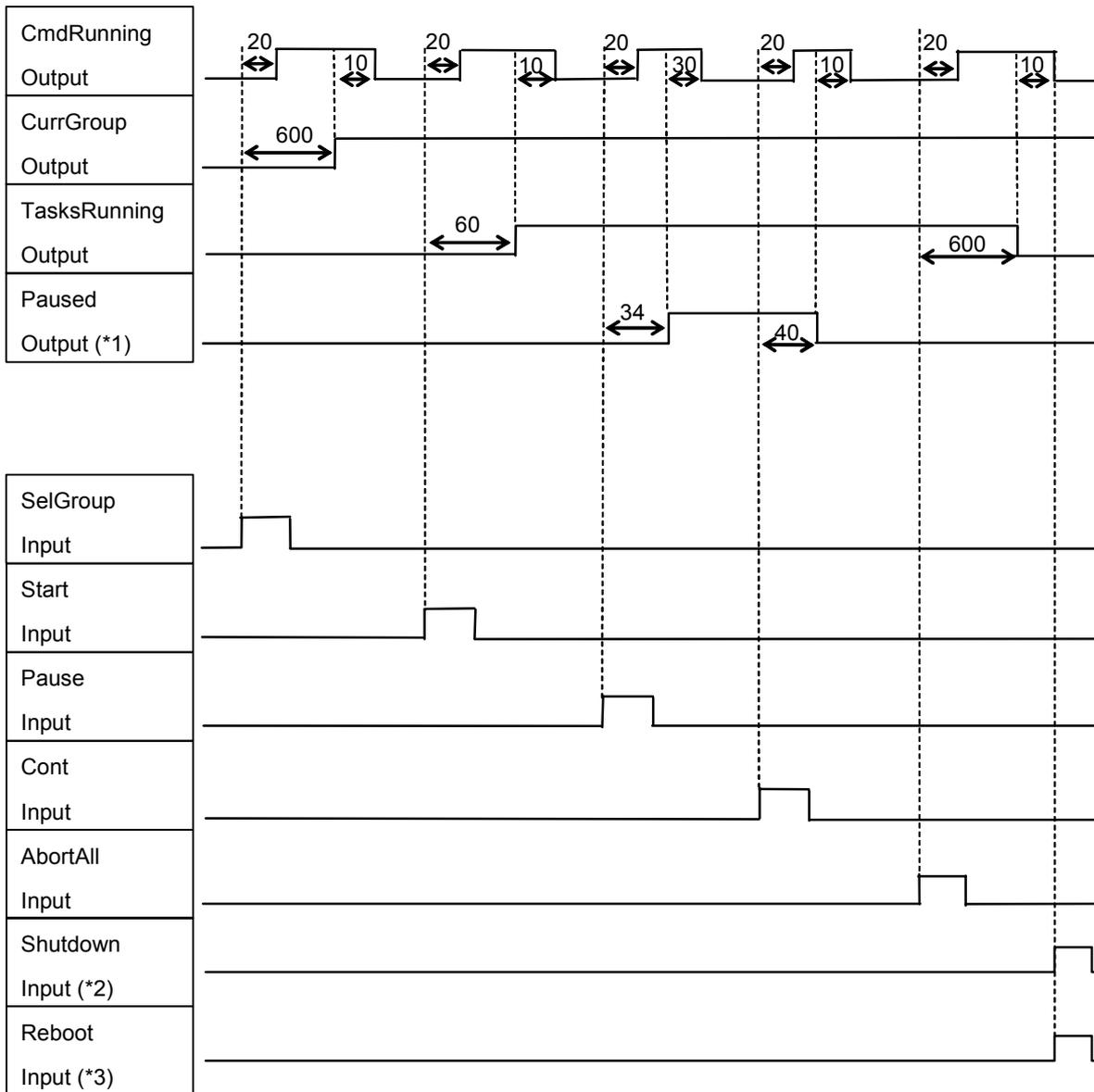
The pulse width of an input signal must be 25 or more milliseconds to be detected.

8.3.2 Timing Diagram for Operation Execution Sequence



[Unit: msec]

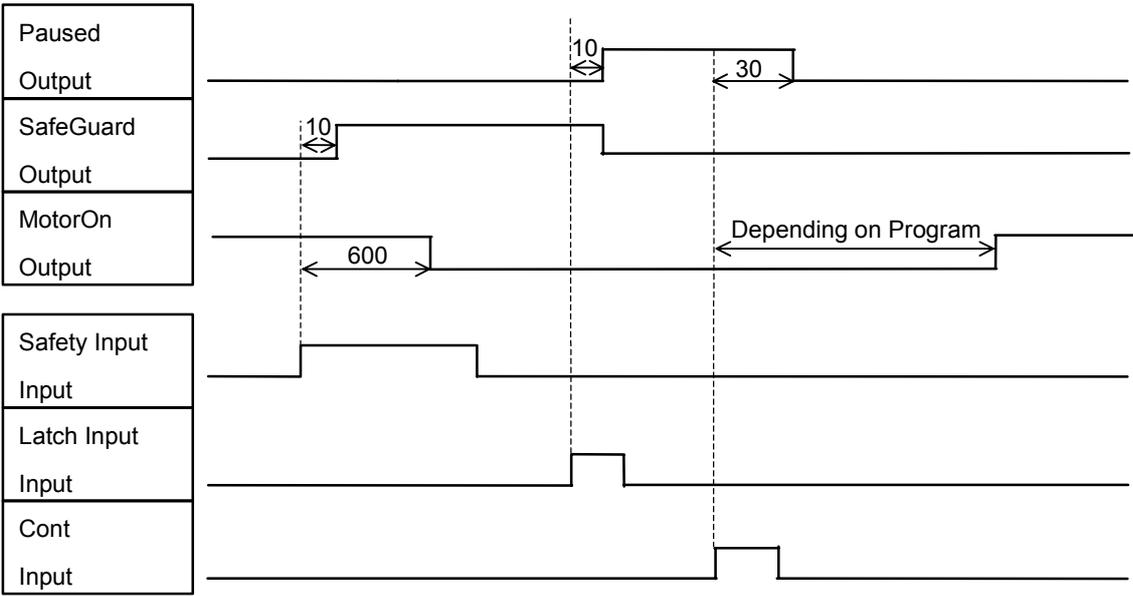
8.3.3 Timing Diagram for Program Execution Sequence



[Unit: msec]

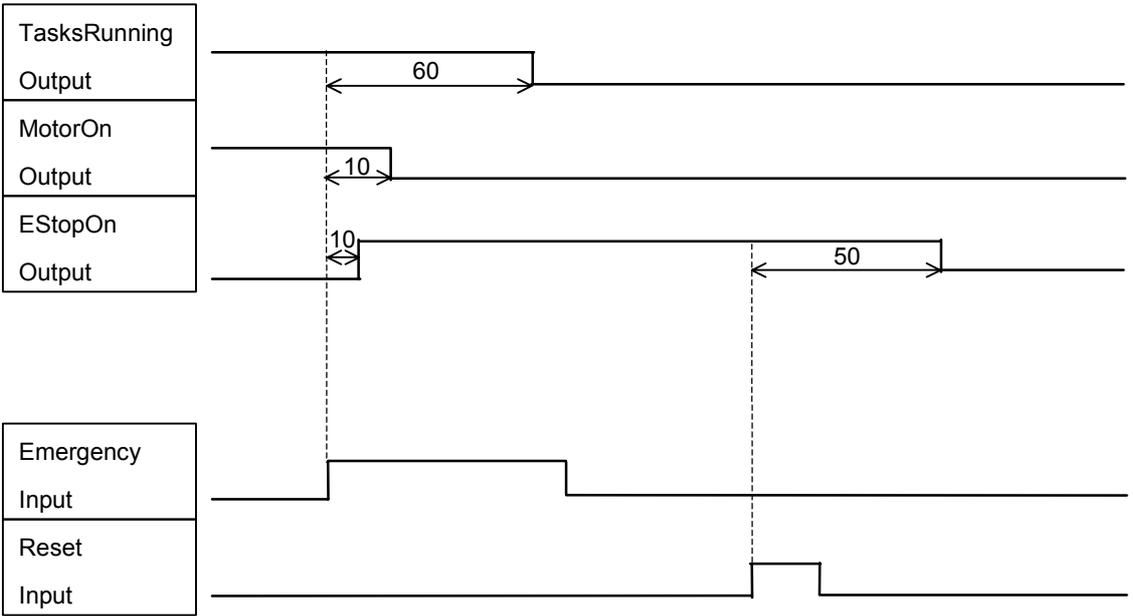
- *1: The duration varies depending on the Quick Pause (QP) setting and the program's operating status at the time of Pause input.
- *2: The Shutdown input is acceptable after the TasksRunning and CmdRunning outputs are OFF.
- *3: The Reboot input is acceptable after the TasksRunning and CmdRunning outputs are OFF.

8.3.4 Timing Diagram for Safety Door Input Sequence



[Unit: msec]

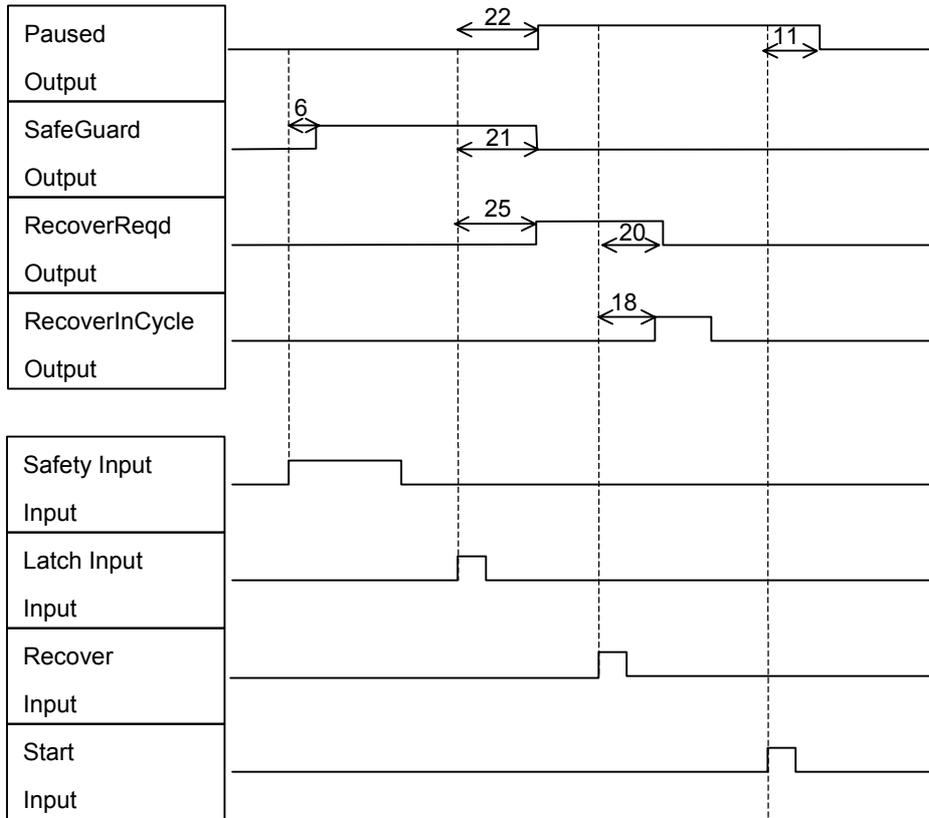
8.3.5 Timing Diagram for Emergency Stop Sequence



[Unit: msec]

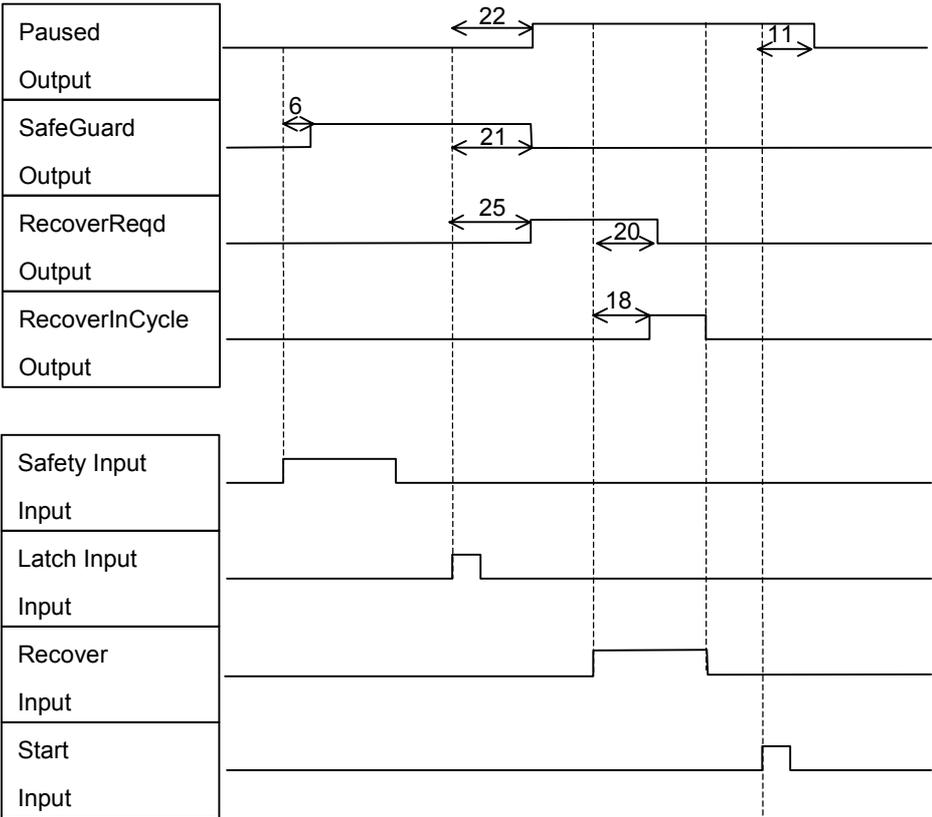
8.3.6 Timing Diagram for RECOVER Sequence (EPSON RC+)

Remote Auto Recover



[Unit: msec]

Remote Manual Recover



[Unit: msec]

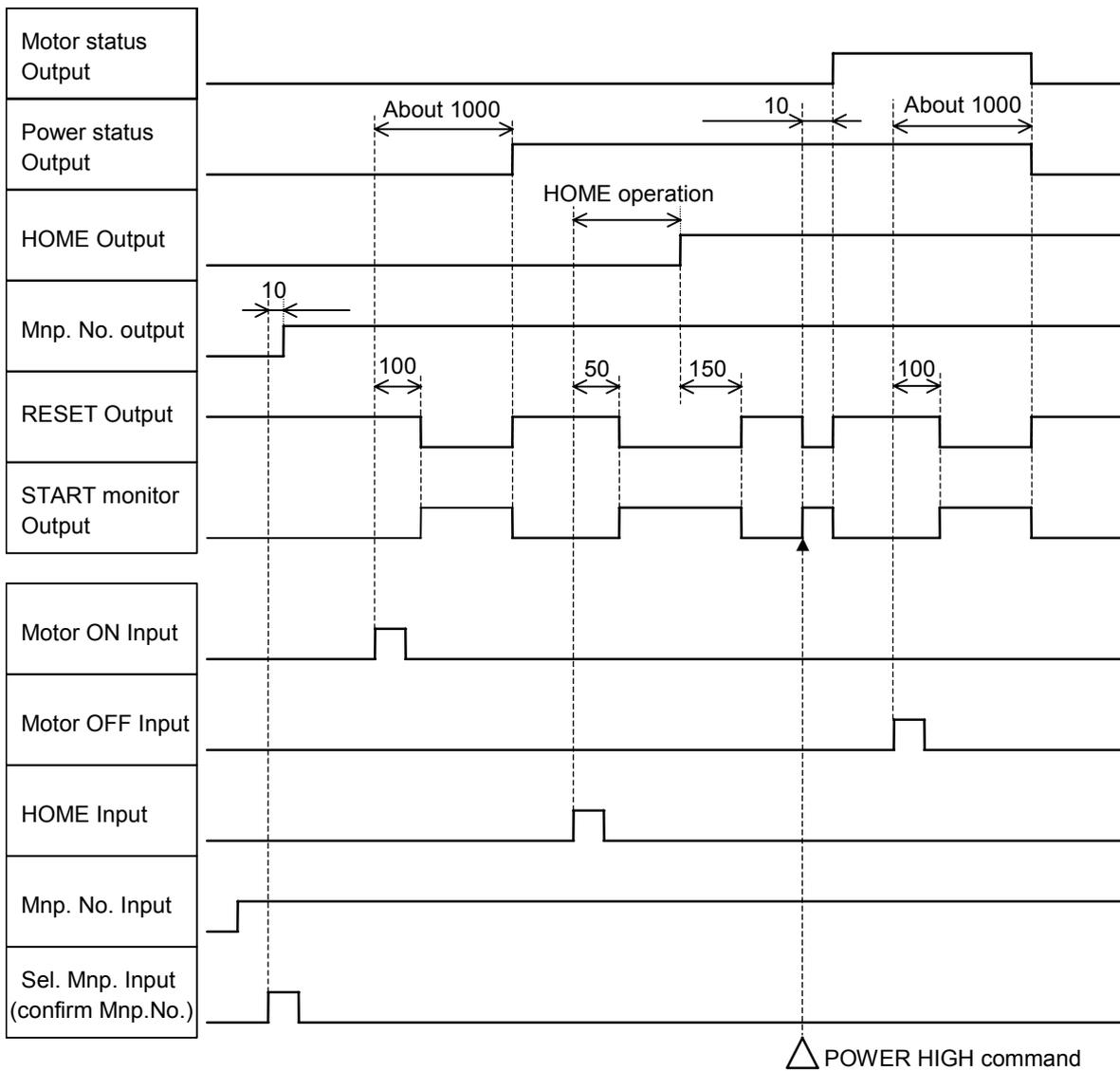
8.4 Timing Specifications (SPEL CT)

8.4.1 Design Notes for Input Signal

The following charts indicate timing sequences for the primary operations of the RC520. The indicated time lapses (time durations) should be referred to only as reference values since the actual timing values may vary depending on the number of Manipulators and the number of tasks running, as well as CPU speed of the Control Unit. Check carefully and refer to the following charts for the timing interrelation when you enter an input signal. During system design, make sure that you actuate only one remote input operation at a time, otherwise an error will occur.

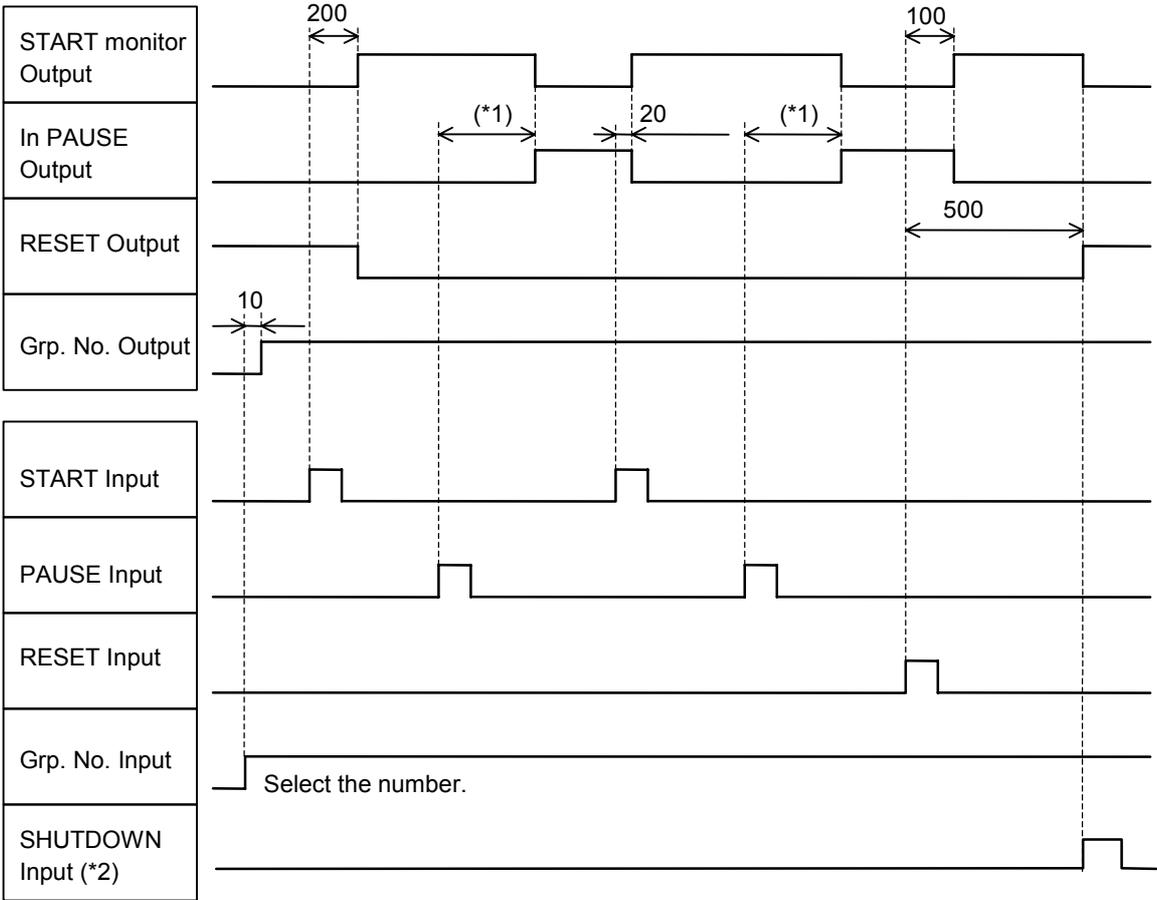
The pulse width of an input signal must be 10 or more milliseconds to be detected.

8.4.2 Timing Diagram for Operation Execution Sequence



[Unit: msec]

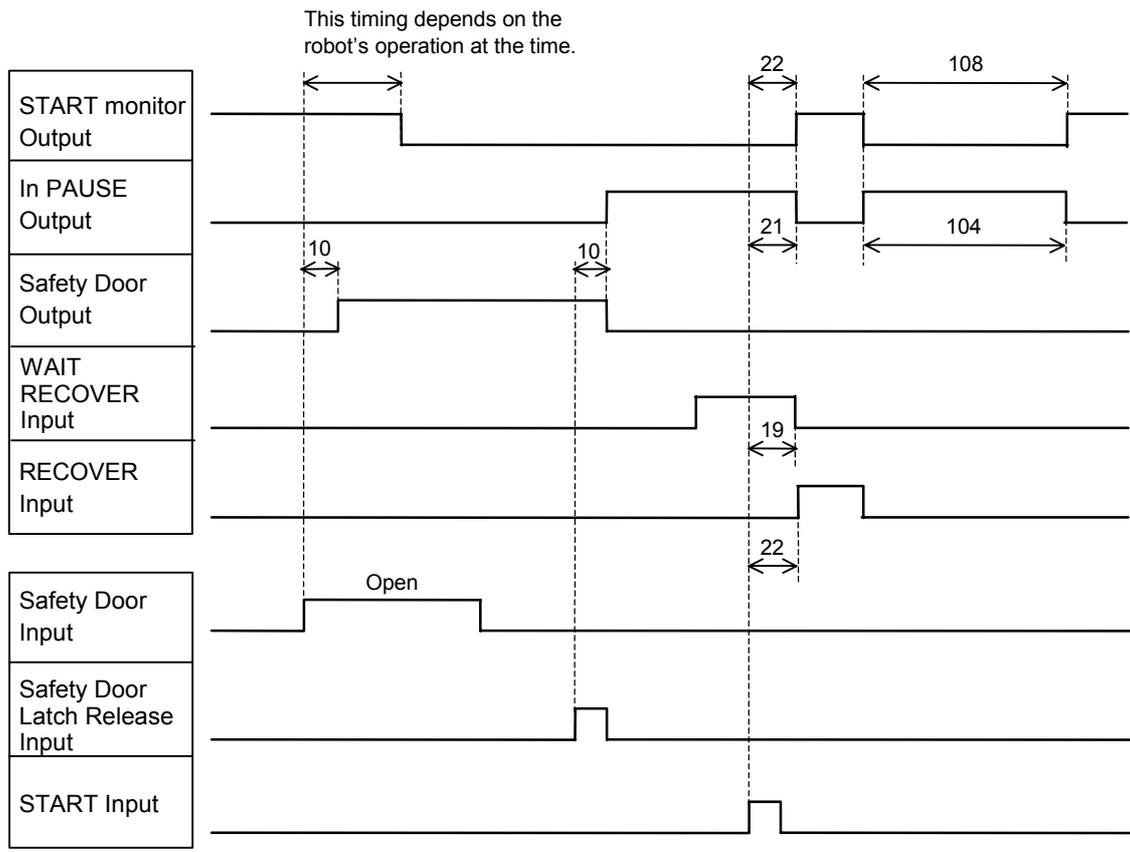
8.4.3 Timing Diagram for Program Execution Sequence



[Unit: msec]

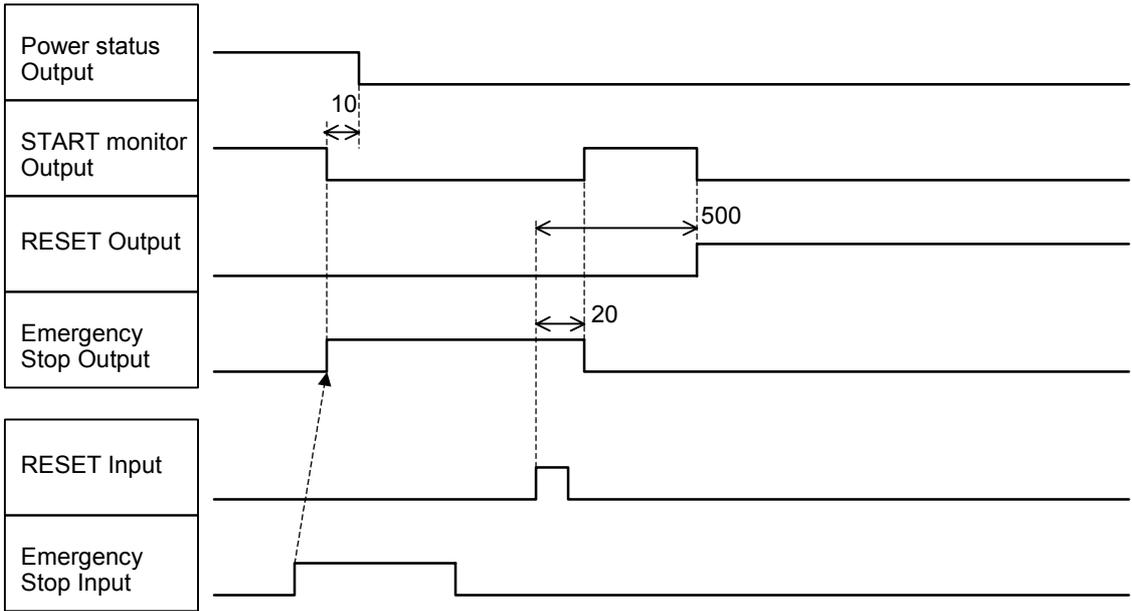
- *1: The duration varies depending on the Quick Pause (QP) setting and the program's operating status at the time of Pause input.
- *2: The SHUTDOWN input is acceptable after the RESET output is ON.

8.4.4 Timing Diagram for Safety Door Input Sequence



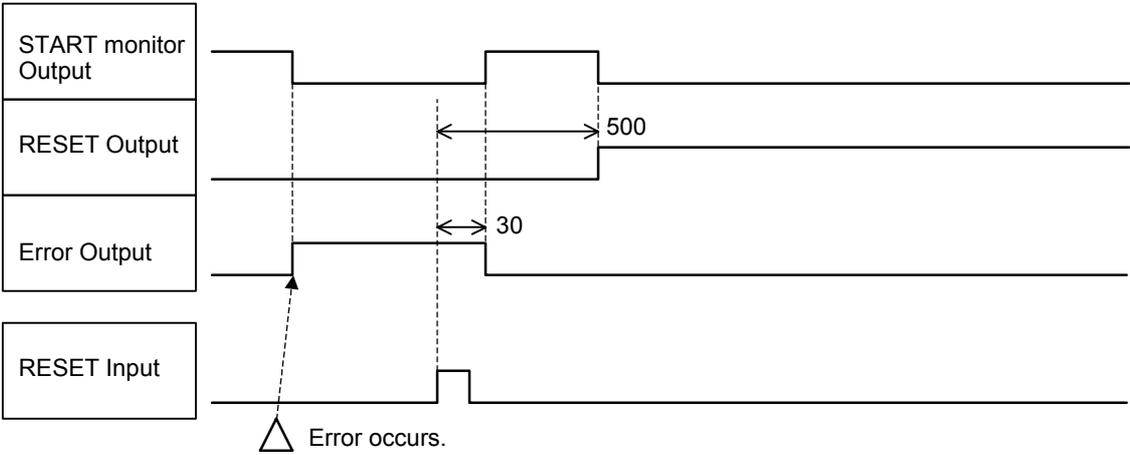
[Unit: msec]

8.4.5 Timing Diagram for Emergency Stop Sequence



[Unit: msec]

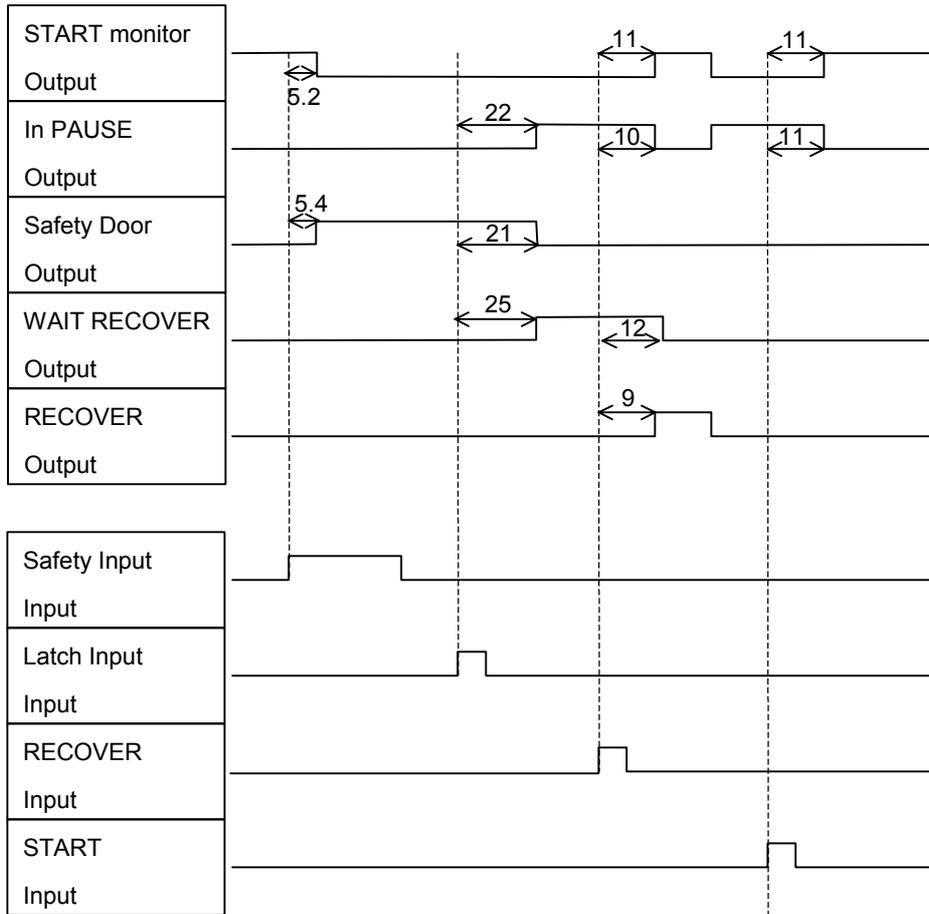
8.4.6 Timing Diagram for Error Generating Sequence



[Unit: msec]

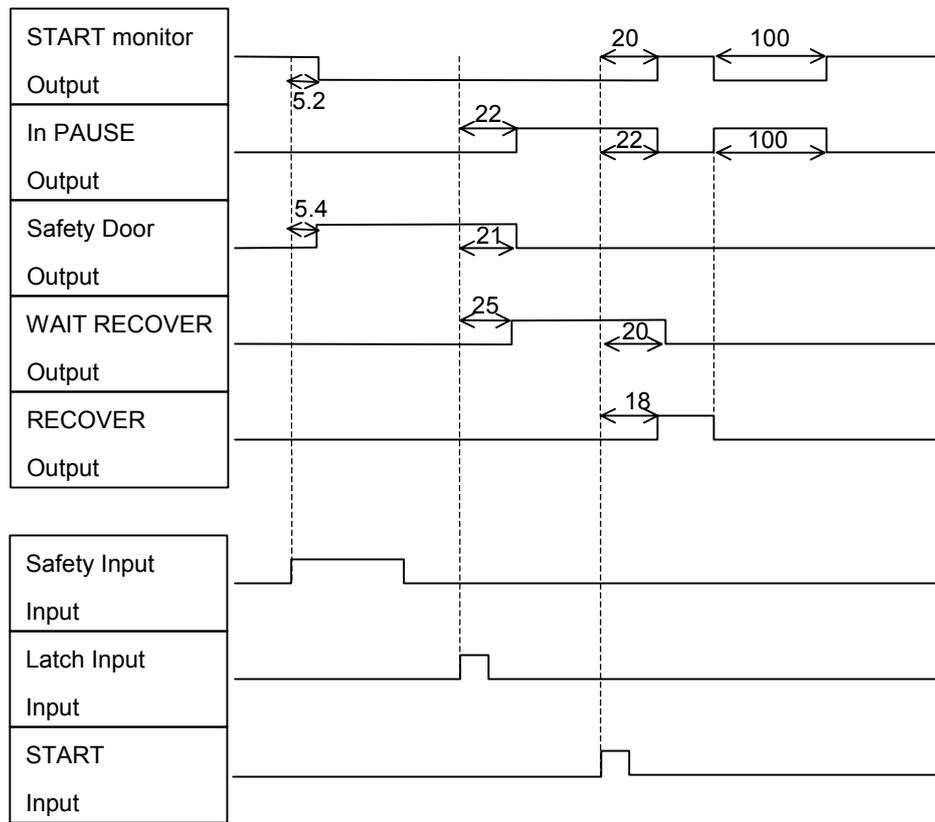
8.4.7 Timing Diagram for RECOVER Sequence (SPEL CT)

When the RECOVER is input in WAIT RECOVER status:



[Unit: msec]

When the START (Continue) is input in WAIT RECOVER status:



[Unit: msec]

9. RS-232C Settings

The Standard RC520 Control Unit comes with two RS-232C channels to facilitate controlling of the data communication among the host computer and peripheral equipment.

9.1 RS-232C cable

RS-232C cables are not included with the standard RC520 Controller. The user must prepare them as necessary.

Connector	Standard
Communication Connector	D-sub 9 pin #4-40 screw

The cable must be shielded twisted pair. Clamp the shield to the connector hood to prevent noise.

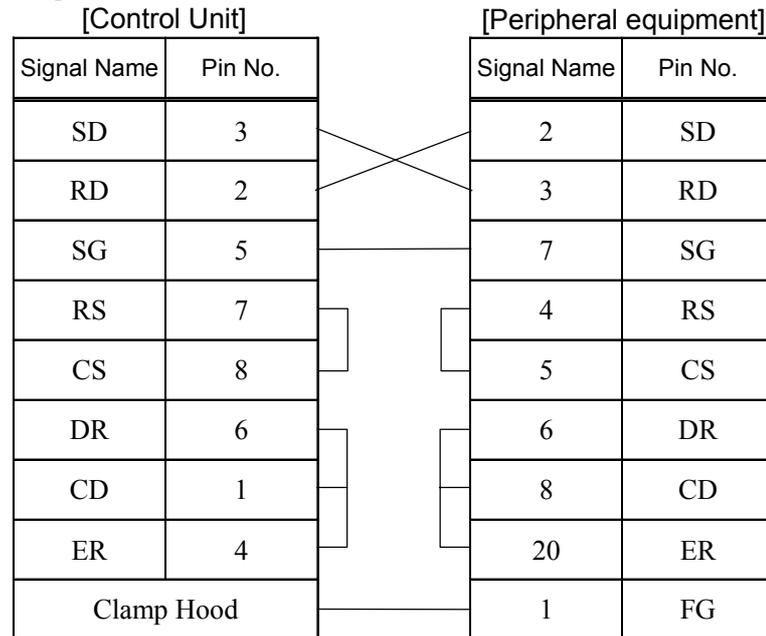
9.1.1 Pin Assignments

Pin assignments for RS-232C connectors are as follows:

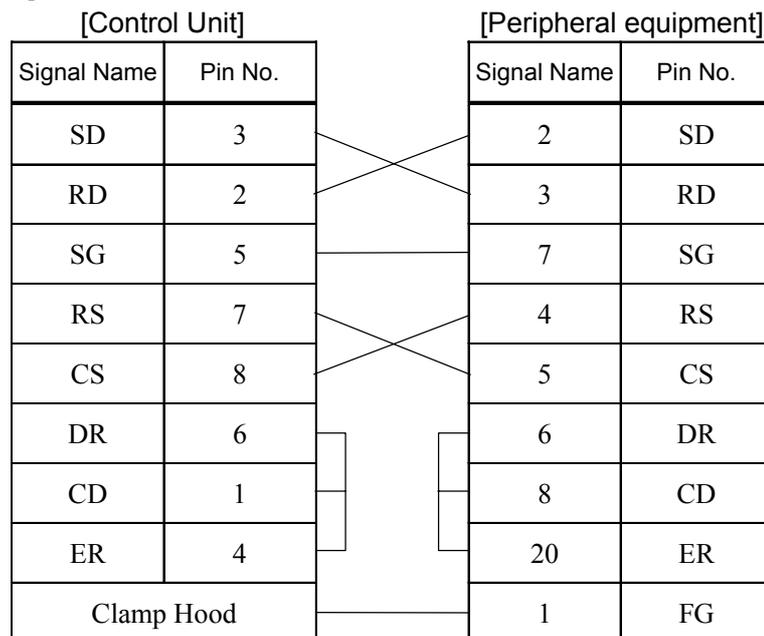
Pin No.	(Abbr.)	Signal Name	Signal Direction
1	CD	Data carrier detect	Input
2	RD	Receive data	Input
3	SD	Send data	Output
4	ER	Terminal ready	Output
5	SG	Signal ground	–
6	DR	Data set ready	Input
7	RS	Request to send	Output
8	CS	Clear to send	Input
9	RI	Ring indicator	Input

9.1.2 Connection Example

Example 1: Standard



Example 2: H/W Flow Control



9.2 Preparation for Communication

For communication via RS-232C between the Control Unit and peripheral equipment to work, the port configuration on both units must be the same. Make sure that the settings on the following parameters on both units match.

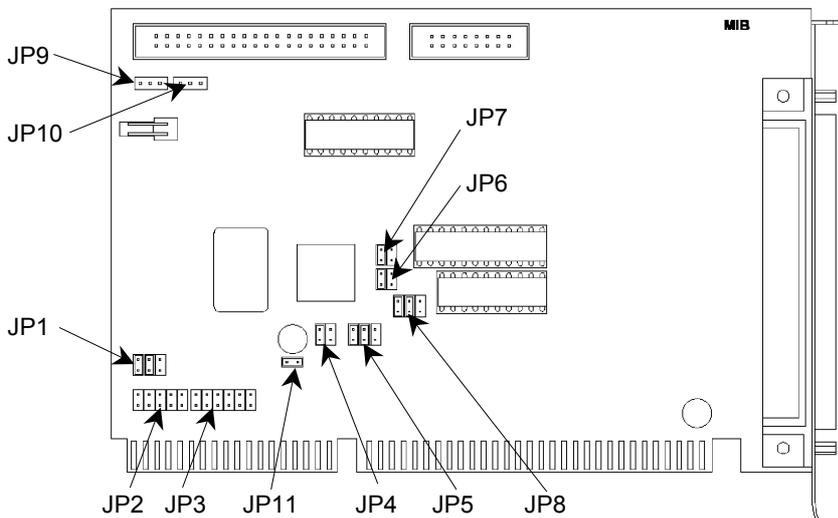
For details on the set-up procedure and communication commands, refer to the following manual.

EPSON RC+ : User's Guide - the section *RS-232 Software Configuration*
in the chapter *RS-232 Communications*

SPEL CT : User's Guide Setup & Operation - chapter 7. *Communication with External Equipment*

10. Jumper Settings for MIB (Motion Interface Board)

The Motion Interface Board (MIB) is installed in the Control Unit. It enables communication between the Control Unit and Drive Unit. The maximum number of MIBs that can be installed in one Control Unit is three (3).



The tables below show the MIB jumper settings. The settings shown in gray are the default settings at ship time. Usually, the default settings do not need to be changed.

Each time an additional MIB is installed, the software needs to be configured accordingly in addition to the jumper settings. For further details, refer to the following manual.

EPSON RC+ : User's Guide - the section *RC520 Drive Unit Software Configuration* in the chapter *Motion Systems*

SPEL CT : User's Guide Setup & Operation - *11.3 Setting Up the Hardware*

JP1

Factory-set and fixed

1-2	3-4	5-6
Short	Short	

Short: Short-circuit

When the board number is SKP372-3 or later, this jumper does not exist on the board.

JP2

Set up the Periodic Interrupt Level for the first MIB only. For the 2nd or the 3rd MIB, all settings are open.

Interrupt Level	1-2	3-4	5-6	7-8	9-10
IRQ5	Short				
IRQ10		Short			
IRQ11			Short		
IRQ12				Short	
IRQ15					Short

Short: Short-circuit

JP3

Set up the RS-232C Interrupt Level for the first MIB only. For the 2nd or the 3rd MIB, all settings are open.

Interrupt Level	1-2	3-4	5-6	7-8	9-10	11-12
IRQ4						Short
IRQ5	Short					
IRQ10		Short				
IRQ11			Short			
IRQ12				Short		
IRQ15					Short	

Short: Short-circuit

JP4

Setup the memory address for MIB on the Controller.

Memory address	1-2	3-4	MIB
C0000-C7FFF	Short	Short	
C8000-CFFFF		Short	For the third MIB
D0000-D7FFF	Short		For the second MIB
D8000-DFFFF			For the first MIB

Short: Short-circuit

JP5

Setup the I/O address for the MIB on the Controller.

I/O address	1-2	3-4	5-6	MIB
300-31F	Short	Short	Short	For the first MIB
320-33F		Short	Short	For the second MIB
340-35F	Short		Short	For the third MIB
360-37F			Short	
380-39F	Short	Short		
3A0-3BF		Short		
3C0-3DF	Short			
3E0-3FF				

Short: Short-circuit

JP6, JP7

Factory -set and fixed

1-2	3-4
Short	

Short: Short-circuit

When the board number is SKP372-3 or later, these jumpers do not exist on the board.

JP8

When the Manipulator's axes configuration requires two or more Drive Units, these Drive Units need to be defined as either master or slave. The normal settings are open for all of them.

Setting	1-2	3-4	5-6
Master (1ms signal)	Short		
Master (XF signal)		Short	
Slave			Short

Short: Short-circuit

JP9, JP10

Factory -set and fixed

1-2	2-3
Short	

Short: Short-circuit

JP11

The normal settings are open.

11. Stand-alone Option for RC520

This section describes a Stand-alone Option that allows you to use the RC520's Control Unit only.

11.1 Stand-alone Option

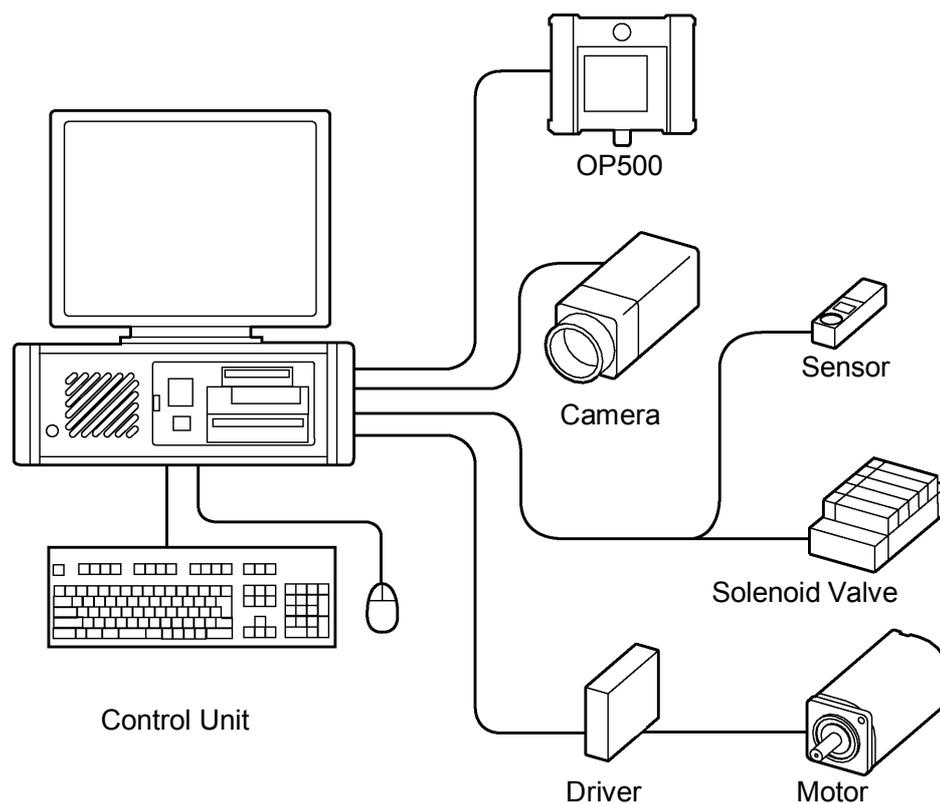
A Stand-alone Option allows forming the Control Unit own system including the Emergency Stop input and Safety Door input by connecting an Emergency Connector Plate Kit to the Control Unit.



The Stand-alone Option is available in SPEL CT or higher and EPSON RC+ Ver.3.6 or higher.

If necessary, refer to the *Setup & Operation 2.4 Control Unit* for functions of the Control Unit.

11.2 System Configuration



11.3 Installation

When installing the Control Unit, it must be placed in the proper environment. For details, refer to the *Setup & Operation 3. Installation*.

11.4 Power Supply

 CAUTION	<ul style="list-style-type: none"> PC power cable for power source supply from the Drive Unit cannot be used when using the Control Unit only. Use the proper PC power cable conforming to the specification of the connecting power source.
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Ensure that AC power source of the Control Unit meets the following specifications.

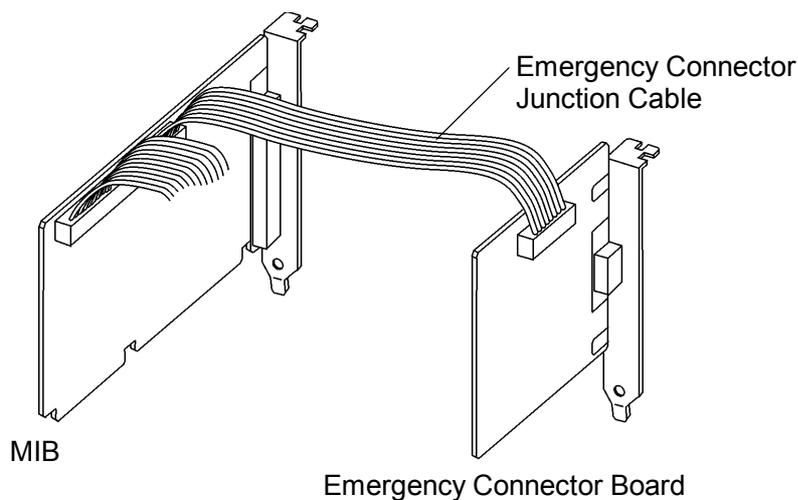
Item	Specification
Voltage	: AC100V to AC120V : AC200V to AC240V
Frequency	50/60Hz
Momentary Power Interrupt	Less than 10msec.
Power Consumption	300W (The monitor is not connected.)
Peak Current	Approximately 40A (at AC200V)
Leakage Current	3.5mA max.

11.5 Emergency Connector Plate Kit

An Emergency Connector Plate Kit is to provide the same function as the emergency connector of the Drive Unit for the Control Unit.

11.5.1 Appearance of Emergency Connector Plate Kit

The Emergency Connector Plate Kit is connected with MIB as shown below.



The emergency connector board occupies one expansion slot in the Control Unit.

11.5.2 Components of Emergency Connector Plate Kit

The Emergency Connector Plate Kit consists of the following parts.

Emergency Connector Board

: Provides the emergency connector function of the Drive Unit for the Control Unit.

Emergency Connector Junction Cable

: Connects an emergency connector board with the MIB.

Motion Connector Cover

: Prevents the use of a MIB motion connector.

When using the Control Unit only, be sure to place this Motion Connector Cover to avoid connecting with the Drive Unit.

11.5.3 Safety Door Switch and Emergency Stop Switch

For details about functions and connection of the Safety Door switch, Emergency Stop switch and Latch Release switch, refer to the proper section shown below.

Setup & Operation 5.1 Safety Door Switch and Latch Release Switch

Setup & Operation 5.2 Emergency Stop Switch

11.5.4 Pin Assignments

Pin assignments of the Emergency Connector (Stand-alone option) are as follows:

Pin No.	Signal Name	Function
1	E_SW11	Emergency Stop switch output (1)
2	E_SW12	
3	E.STOP1+	Emergency Stop input 1 (+)
4	E.STOP1-	Emergency Stop input 1 (-)
5	E.STOP OUT	Emergency Stop condition output (Relay contact) *1
6	E.STOP OUT	
7	GUARD11	Safety Door input (1) *2
8	GUARD12	
9	+12V	+12V output
10	+12VGND	+12VGND output
11	E_SW21	Emergency Stop switch output (2)
12	E_SW22	
13	E.STOP2+	Emergency Stop input 2(+)
14	E.STOP2-	Emergency Stop input 2(-)
15	RELEASE	Latch Release input
16	RELEASE	
17	GUARD21	Safety Door input (2) *2
18	GUARD22	
19	+12V	+12V output
20	+12VGND	+12VGND output

*1 The Emergency Stop condition is output via relay contact when it is open (it is normally closed).

*2 It becomes an error if the input values from the Safety Door 1 and Safety Door 2 are apart by two or more seconds. They must be connected to the same switch with two contacts.

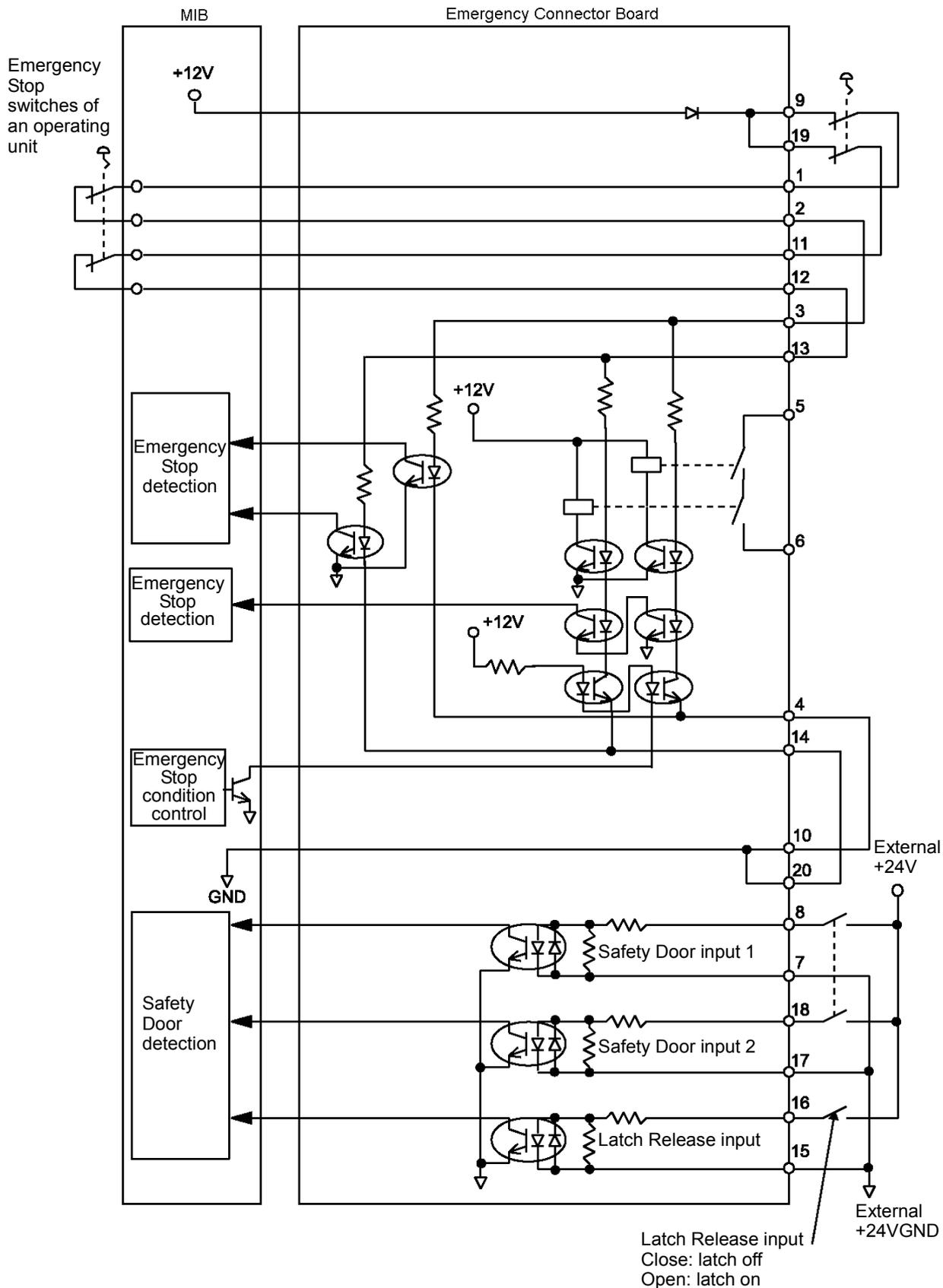
Emergency Stop switch output rated load	+30 V 1 A or under	1-2, 11-12 pin
Emergency Stop rated input voltage range Emergency Stop rated input current	+12 V to +24 V $\pm 10\%$ 10 mA/24 V input	3-4, 13-14 pin
Safety Door rated input voltage range Safety Door rated input current	+12 V to +24 V $\pm 10\%$ 10 mA/24V input	7-8, 17-18 pin
Latch Release rated input voltage range Latch Release rated input current	+12 V to +24 V $\pm 10\%$ 10 mA/24 V input	15-16 pin
Emergency Stop output relay contact rated load	+30 V 0.5 A or under	5-6 pin



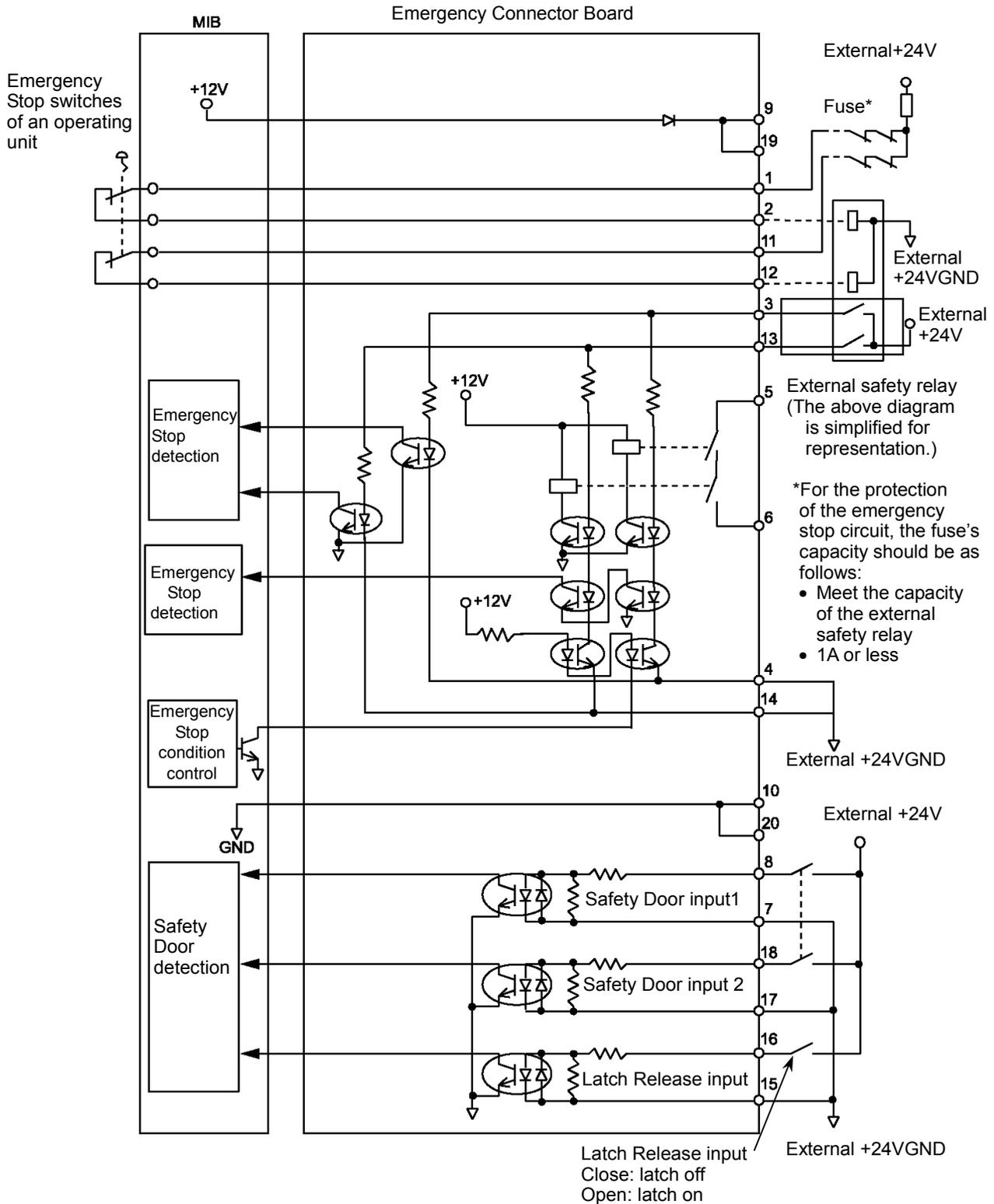
The total electrical resistance of the Emergency Stop switches and their circuit should be 1 Ω or less.

11.5.5 Circuit Diagram

Example 1: External emergency stop switch typical application



Example 2: External safety relay typical application



11.6 MIB

11.6.1 Board Number

When using the Control Unit only, use the MIB with the following board number.

SKP372-1 Dr-04

SKP372-2 Dr-04

SKP372-3 or later

11.6.2 Jumper Settings

Set the MIB jumper referring to the table below.

When the board number is SKP372-3 or later, JP1, JP6, and JP7 do not exist on the board.

Jumper	Setting	Note
JP1	1-2, 3-4 short	
JP2	3-4 short	Interrupt level: IRQ10
JP3	1-2 short	Interrupt level: IRQ5
JP4	All open	Memory address: D8000-DFFF
JP5	1-2, 3-4, 5-6 short	I/O address: 300-31F
JP6	1-2 short	
JP7	1-2 short	
JP8	All open	
JP9	1-2 short	
JP10	1-2 short	
JP11	All open	

For jumper functions, refer to the *Setup & Operation 10. Jumper Settings for MIB*.

11.7 Option

The options for RC520, such as the Operation Units (JP500 and OP500), Expansion I/O Board and Pulse Generating Board, are available to use even in the Control Unit system only.

For details, refer to the proper section in this manual or the manual for each option.

Maintenance

This manual contains maintenance procedures for the Robot Controller.

1. Safety Precautions for Maintenance



WARNING

- Only qualified personnel who have taken the safety training should be allowed to maintain the robot system. The safety training is the program for industrial robot operator that follows the laws and regulations of each nation. The personnel who have taken the safety training acquire knowledge of industrial robots (operations, teaching, etc.), knowledge of inspections, and knowledge of related rules/regulations. The personnel who have completed the robot system-training and maintenance-training classes held by the manufacturer, dealer, or locally-incorporated company are allowed to maintain the robot system.
- Make sure to use only dedicated/specified maintenance parts especially for the optional boards or any other parts in the Controller to be replaced. Using non-specified parts may cause serious damage to the robot system and/or serious safety problems.
- Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual. Do not proceed using any methods other than described in this manual when you do replace a part or maintain the equipment. Improper removal of parts or improper maintenance may cause not only improper function of the robot system but also serious safety problems.
- The interlock of the Safety Door must be functioning when the robot system is operated. Do not operate the system under the condition that the switch cannot be turned ON/OFF. (I.E. the condition where the switch is disabled) (Example: Tape is put around the switch to hold it closed.) Operating the robot system when the switch is not functioning properly is extremely hazardous and may cause serious safety problems as the Safety Door input cannot fulfill its intended function.



WARNING

- Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.



CAUTION

- Do not touch directly the Motor Driver modules and the Switching Power Supply in the Controller. The Motor Driver modules and the Switching Power Supply can become very hot and may result in a burn. If you maintain them, examine the surface temperatures and wear protective gloves if necessary.
- Do not shock, shake, or drop any parts during maintenance. When the parts related with data (the CD-ROM drive, FDD, HDD, etc.) are shocked physically, they may be damaged and may also cause data loss during data loading/saving.

 <p>CAUTION</p>	<ul style="list-style-type: none">■ Do not lose the screws removed at maintenance. When the screw is dropped into the Control Unit or Drive Unit, be sure to take it out. Leaving the screw in the Control Unit or Drive Unit may cause short circuit and may result in equipment damage to the parts and/or robot system.■ Make sure that the power rating (wattage) of a new Motor Driver module is correct. Using a Motor Driver module with improper power rating (wattage) in the Drive Unit may not only cause improper function of the robot system but also damage to the system.■ The serial numbers of the Drive Unit and Manipulator that should be connected are indicated on the Connection Check Label on the Control Unit. Connect the Control Unit, the Drive Unit and the Manipulator correctly. Improper connections between the Drive Unit and the Manipulator and between the Control Unit and the Drive Unit may cause improper function of the robot system and also safety problems.■ If there is more than one Drive Unit connected to the Control Unit in the robot system, make sure that the DU numbers (DU1 - DU3) indicated above the MIB connector on the Control Unit and the Drive Unit (above the MOTION connector) match. Improper connection between the Control Unit and the Drive Unit may cause malfunction of the robot system and/or safety problems as it may make the Manipulator move abnormally.
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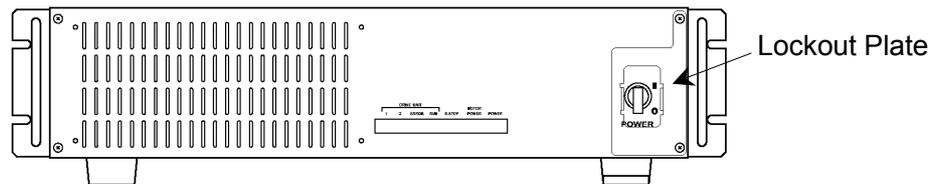
NOTE

Before performing maintenance on the Controller, all the data must be copied as a backup. Refer to the *Maintenance 2.5 Backup of Data* for details.

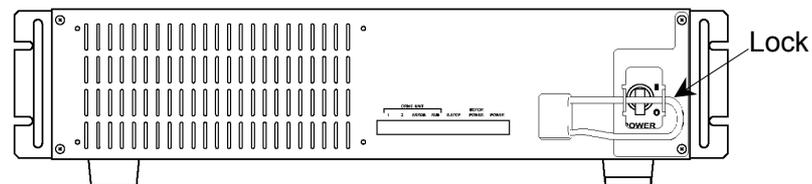
1.1 Procedure for Lockout

The lockout is a method to prevent any one from turning ON the robot system by mistake while someone else is within the safeguarded area for maintenance or repair. When the robot system is locked out, the POWER switch of the Drive Unit is locked in the OFF position. The procedure for lockout is described as follows. (The following figures of the Drive Unit are for four-axis, but the procedure for lockout of the six-axis Drive Unit is the same with the four-axis.)

- (1) Turn OFF the Drive Unit.
- (2) Attach the lockout plate on the Drive Unit as shown below. Then, secure the plate with screws.



- (3) Insert the lock in the loops of the lockout plate as shown below.



1.2 Tagout

The tagout method is attaching a tag or sign plate to the Power switch to prevent any one from turning ON the robot system by mistake while someone else is within the safeguarded area for maintenance or repair.

2. Regular Maintenance Inspection

Performing the inspection steps properly is essential to preventing trouble and maintaining safety. This chapter describes schedule for maintenance inspection and the procedures.

Be sure to perform the maintenance inspection in accordance with the schedule.

2.1 Schedule for Maintenance Inspection

Inspection points are divided into five stages: daily, monthly, quarterly, biannual, and annual. The inspection points are added every stage.

If the robot system is operated for 250 hours or longer per month, the inspection points must be added every 250 hours, 750 hours, 1500 hours, and 3000 hours operation.

	Inspection Point				
	Daily inspection	Monthly inspection	Quarterly inspection	Biannual inspection	Annual inspection
1 month (250 h)	Inspect every day	✓			
2 months (500 h)		✓			
3 months (750 h)		✓	✓		
4 months (1000 h)		✓			
5 months (1250 h)		✓			
6 months (1500 h)		✓	✓	✓	
7 months (1750 h)		✓			
8 months (2000 h)		✓			
9 months (2250 h)		✓	✓		
10 months (2500 h)		✓			
11 months (2750 h)		✓			
12 months (3000 h)		✓	✓	✓	✓
13 months (3250 h)		✓			
⋮	⋮	⋮	⋮	⋮	⋮

h = hour

2.2 Inspection Point

2.2.1 Inspection While the Controller is Turned OFF

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Visually check for external defects. Clean up if necessary.	External appearance of Control Unit and Drive Unit	✓	✓	✓	✓	✓
Cleaning of the fan filter	Fan filter on the Control Unit and Drive Unit		✓	✓	✓	✓
Battery Replacement on the CPU Board	CPU Board	Ever 5 years				

2.2.2 Inspection While the Controller is Turned ON

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check whether unusual sound or vibration occurs.	Whole of the Controller	✓	✓	✓	✓	✓
Make a backup of data.	Project and system data	Whenever data are changed.				

2.3 Cleaning the Fan Filter



Check condition of the filter regularly and clean it as necessary. A dirty filter may result in the malfunction of the robot system as the temperature rises in the Control Unit or Drive Unit.

Refer to the following sections for details on cleaning the fan filter.

Maintenance 4.6 Cleaning and Replacing the Fan Filter (Control Unit)

Maintenance 5.7.2 Inspecting the Fan Filter (Four-axis Drive Unit)

Maintenance 6.7.2 Inspecting the Fan Filter (Six-axis Drive Unit)

2.4 Replacing a Lithium Battery on the CPU Board

The button type lithium battery is mounted on the CPU board for backup of BIOS settings. The battery life is five years. Replace the battery every five years.



CAUTION

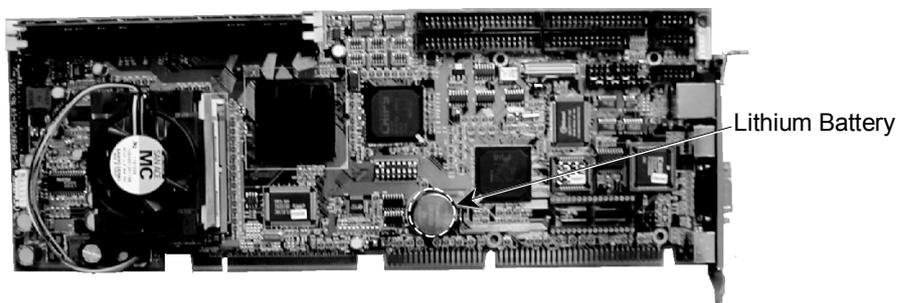
- Lithium batteries contain flammable materials such as lithium, organic solvents, etc. If misused, batteries may generate heat, explode or catch fire. Observe the following precautions for safe use of lithium batteries.
 - Use the specified type of battery or equivalent. CR2032 (Panasonic)
 - Connect the positive (+) and negative (-) electrodes correctly.
 - Do not allow the positive (+) and negative (-) electrodes to short circuit at maintenance.
 - Do not throw batteries into fire or heat them to high temperature.
 - Do not disassemble or alter batteries.
 - When discarding batteries, insulate the terminals by wrapping them with tape, etc.

- (1) Remove the CPU board from the Control Unit. Refer to the *Maintenance 4.3 Replacing CPU Board* for details.
- (2) Replace the lithium battery with new one.

CPU Board: SPI-6941-EPP



CPU Board: PC686BX(PC)-EPP850



- (3) After replacing the lithium battery, set up the BIOS.
 - 3-1. Turn ON the Control Unit while pressing the <Delete> key on the keyboard. The [BIOS] dialog will appear.
 - 3-2. Select the “Standard COMS Features” and press the <Enter> key.
 - 3-3. Set the “Date” and “Time” to current date and time. (Use the <Page Up> key for changing the setting items and the arrow keys <↑> <↓> <→> <←> for moving a cursor.)
 - 3-4. Press the <Esc> key. The [BIOS] dialog will appear.
 - 3-5. Select the “PnP/PCI Configurations” and press the <Enter> key.
 - 3-6. Select the “IRQ Resources [Press Enter]” and press the <Enter> key.
 - 3-7. Set the “IRQ-5” and “IRQ-10” to the “Legacy ISA”. (Use the <Page Up> key for changing the setting items and the arrow keys <↑> <↓> <→> <←> for moving a cursor.)
 - 3-8. Press the <Esc> key twice. The [BIOS] dialog will appear.
 - 3-9. Press the <F10> key. The message “SAVE to COMS and EXIT (Y/N)?” will appear.
 - 3-10. Press the <Y> key and then <Enter> key. The system will be automatically restarted.

2.5 Backup of Data



CAUTION

- Save a backup data of your project and system settings in a floppy disk while the Control Unit operates properly. Then, keep the floppy disk in case of damage to the data in HDD. Be sure to back up the latest data whenever you change the project and system settings.

If the latest data is not backed up, it takes a lot of time to restore the robot system data once the robot system has a trouble. The robot system data after the trouble may fail to be backed up. Even if the robot system data is backed up successfully, the backed up data is unreliable and the robot system data cannot be restored completely with it.

2.5.1 EPSON RC+

The system hardware and manipulator configuration data are saved in a backup file that can be used to restore the whole system.



CAUTION

- Do not restore the backup data in any other system. The data includes the original configuration of the system. If the data is restored in the other system, the system may function improperly or EPSON RC+ may fail to start up. If EPSON RC+ is downgraded and its version is different even though the backup data is for the same system, an error may occur and the data may fail to be restored.

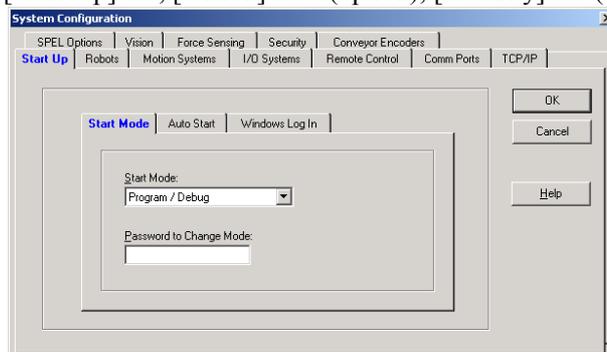
For EPSON RC+, you can save and restore the system configuration using the MKVER and SETVER commands. Before servicing the system, you should execute MKVER and store the system configuration on a floppy disk. If required, you can use SETVER to restore previously stored data.

NOTE



When you attempt to make backup copies of the system configurations using the MKVER and SETVER commands, the configuration data in the following tabs cannot be backed up. Record such configurations data displaying the [System Configuration] dialog. (Select the [System Configuration] in the [Setup] menu to display the [System Configuration] dialog.)

[Start Up] tab, [Vision] tab* (option), [Security] tab (option)



* [Vision] tab (option)

: If your EPSON RC+ is 4.1.0 or higher, recording the items on the [Vision] is not necessary.

After restoring the backup data, configure the settings for the recorded items in the respective tabs.

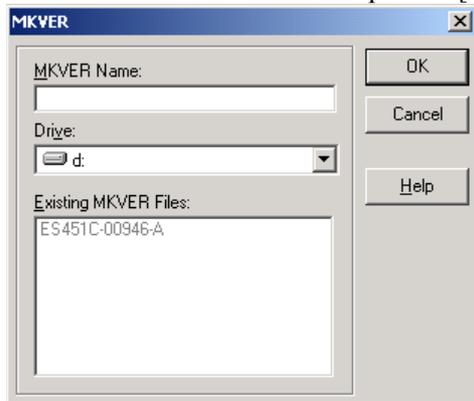
Back up system configurations

MKVER: Backs up (saves) system configurations.

- (1) Select either one of the following to open the [Maintenance] dialog.
 - 1. Select the [Maintenance] in the [Tools] menu.
 - 2. Click the  icon.



- (2) Click the <MKVER> button to open the [MKVER] dialog.



- (3) Type in a unique name to identify the system in the [MKVER Name] text box.
- (4) Select the disk drive where you want to save the information in the [Drive] box. (You can select any drive except for C drive.)
- (5) Click the <OK> button to save the system configuration.

Restore system configurations

SETVER: Restores system configurations.

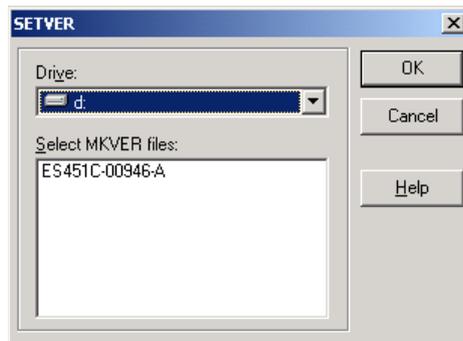
(1) Select either one of the following to open the [Maintenance] dialog.

1. Select the [Maintenance] in the [Tools] menu.

2. Click the  icon.



(2) Click the <SETVER> button to open the [SETVER] dialog.



(3) Select the drive where the backed-up information is stored in the [Drive] box.

(4) Select the system configuration from the [Select MKVER files] list box.

(5) Click the <OK> button to restore the system configuration.

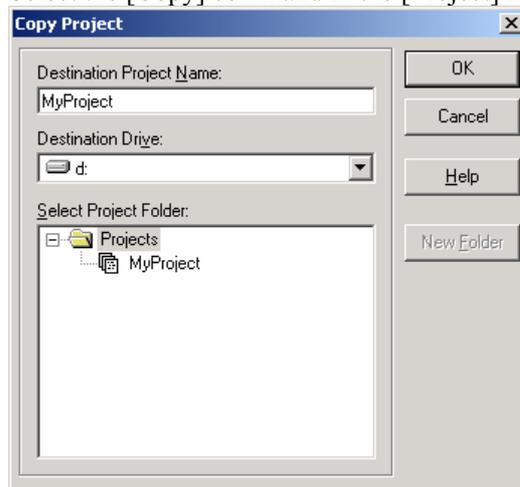
Backing up / Restoring a Project

You can back up the whole of stored project and restore it. You can also move your developing EPSON RC+ applications into another system.

Back up a project

Follow the steps below to make a backup copy of the current project.

- (1) Select the [Copy] command in the [Project] menu to open the [Copy Project] dialog.



- (2) Select the drive where a backup copy will be made in the [Destination Drive] box.
- (3) Enter the current project name for the [Destination Project Name] box.
- (4) Click the <OK> button.

NOTE



The currently open project is the original project stored in the C drive, not a backed-up project stored in the destination drive specified in step (2).

NOTE

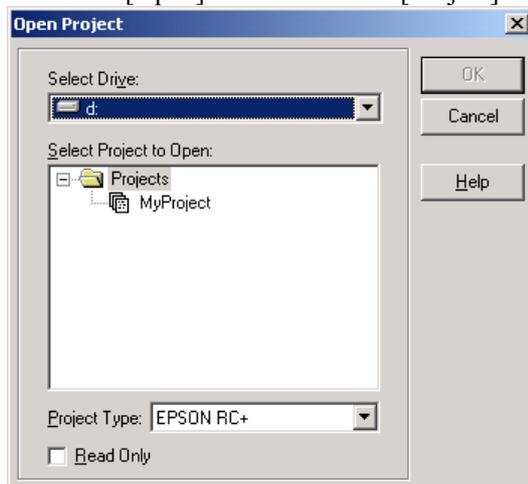


If there is more than one project, back up every project separately.

Restore a project

Follow the steps below to restore the backed-up project.

- (1) Select the [Open] command in the [Project] menu to open the [Open Project] dialog.

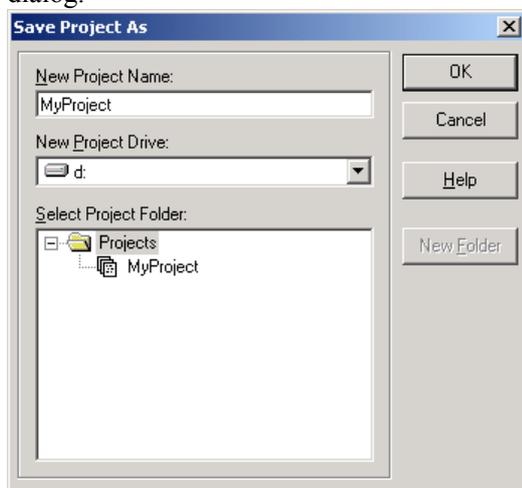


- (2) Select the drive where the backed-up project is stored in the [Select Drive] box and open the backed-up project.

NOTE


The currently open project is the backed-up project stored in the drive you select in the [Select Drive] box.

- (3) Select the [Save As] command in the [Project] menu to open the [Save Project As] dialog.



- (4) Select the "C drive" in the [New Project Drive] box.
- (5) Enter a project name for the [New Project Name] box.
- (6) Click the <OK> button.

NOTE


The currently open project is the project stored in the C drive.

2.5.2 SPEL CT

Backing up/Restoring the Hardware & Manipulator Settings

The system hardware and manipulator configuration data are saved in a backup file that can be used to restore the whole system.



CAUTION

- Do not restore the backup data in any other system. The data includes the original configuration of the system. If the data is restored in the other system, the system may function improperly or SPEL CT may fail to start up. If SPLE CT is downgraded and its version is different even though the backup data is for the same system, an error may occur and the data may fail to be restored.

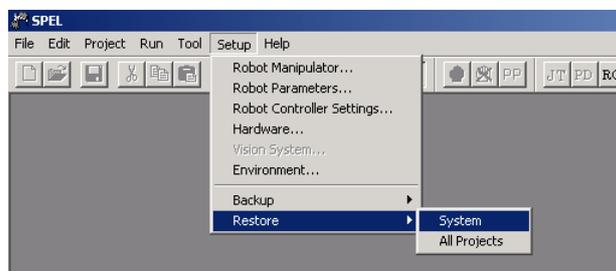
Backing up the Hardware & Manipulator Settings

- Specify the location, either FD or folder, to back up. Also, be sure that the folder for the backup file to be saved in is empty since saving a backup of Hardware & Manipulator settings will delete the other files in the same folder.

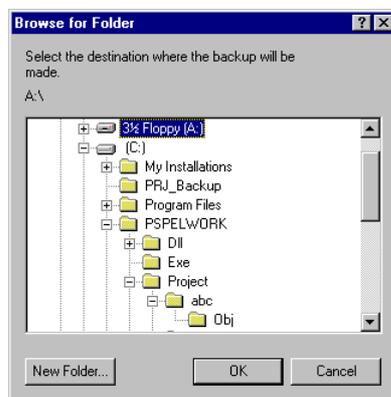
If a backup file is to be saved on a floppy disk, be sure that the disk:

- has been formatted;
- is not write-protected;
- is not a system disk.

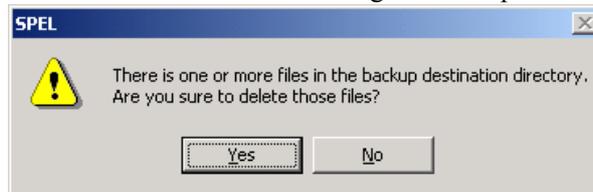
- Close the project.
- Select the [Setup] - [Backup] - [System] commands.



- Select the folder to backup. Click the <OK> button. Click the <New Folder> button when you make a new folder.



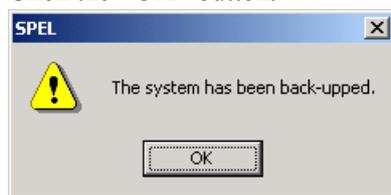
If there are any other files found in the specified folder, the following message dialog will appear. Click the <Yes> button if it is okay to delete the existing file. Click the <No> button to cancel saving the backup.



The status bar will indicate the system's status while a backup file is being saved.



- (5) The following message dialog will appear when the data is completely backed up. Click the <OK> button.

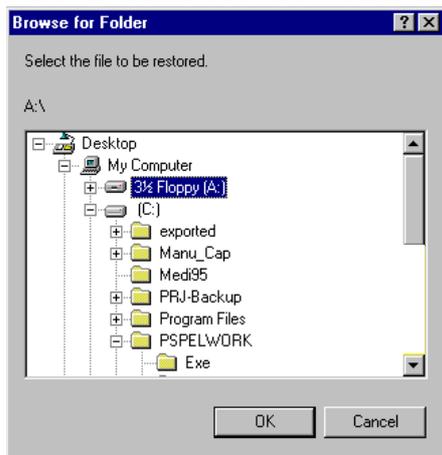


Restoring the Hardware & Manipulator Backup File

- (1) If a project backup file must be restored as well as the system's hardware or manipulator settings backup file, restore the project file first. Refer to the "Restoring Projects" in the later part of this section.
- (2) Be sure of the folder/disk to restore.
- (3) Close all projects that are open.
- (4) Select the [Setup] - [Restore] - [System] commands.



- (5) Select the folder to restore. Click the <OK> button.



- (6) Restart SPEL CT when the file has been restored. Click the <OK> button in the following message dialog.



The system's configuration will be restored when SPEL CT is restarted.

Backing up/Restoring a Project

A backup of an added project can be made and restored. By using this backup/restore feature, a SPEL CT application developed can be imported as a whole in another system environment.

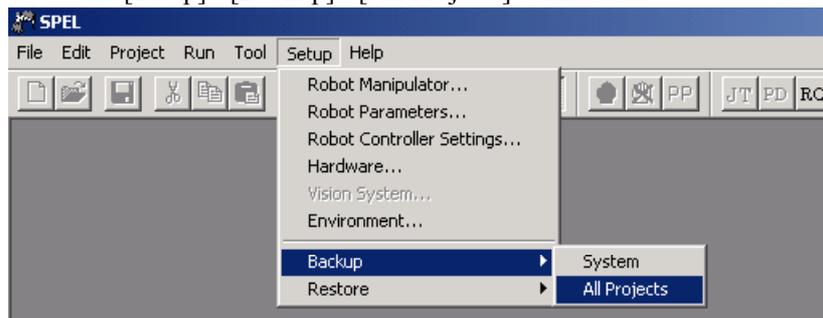
Backing up a Project

- (1) Create a folder to save the backup file. Also, be sure that the folder for the backup file to be saved in is empty since a back-up file may overwrite the existing file in the same folder.

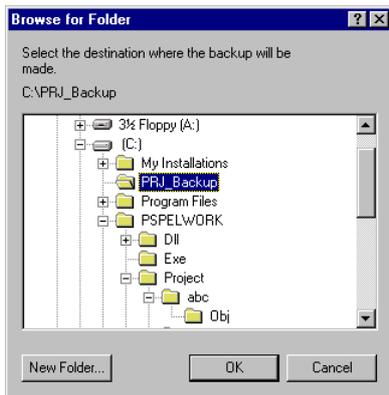
If a backup file is to be saved on a floppy disk, be sure that the disk:

- has been formatted;
- is not write-protected;
- is not a system disk.

- (2) Select the [Setup] - [Backup] - [All Projects] commands.



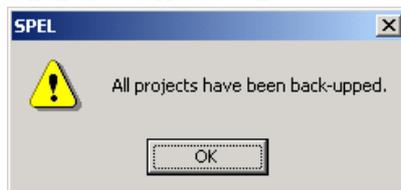
- (3) Select the folder to save the backup file in. Click the <OK> button.
Click the <New Folder> button when you make a new folder.



The status bar will indicate the project name and progress situation under backup.

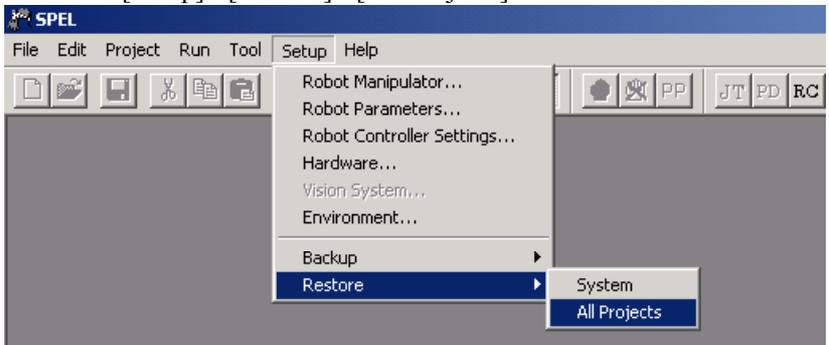


- (4) The following message dialog will appear when backing up the project is completed.
Click the <OK> button.

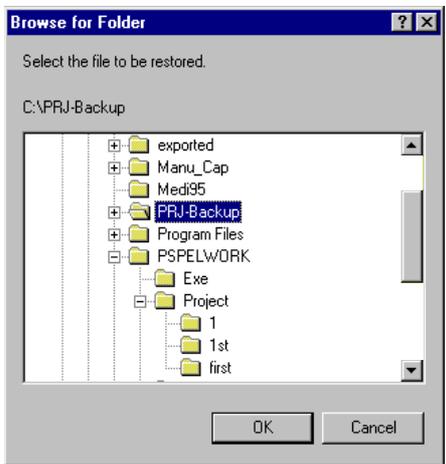


Restoring a Project

- (1) Be sure of the folder or disk to restore.
- (2) Close a project that is open.
- (3) Select the [Setup] - [Restore] - [All Projects] commands.



- (4) Select the folder to restore. Click the <OK> button.



- (5) The following message dialog will appear when the file has been restored. Click the <OK> button.



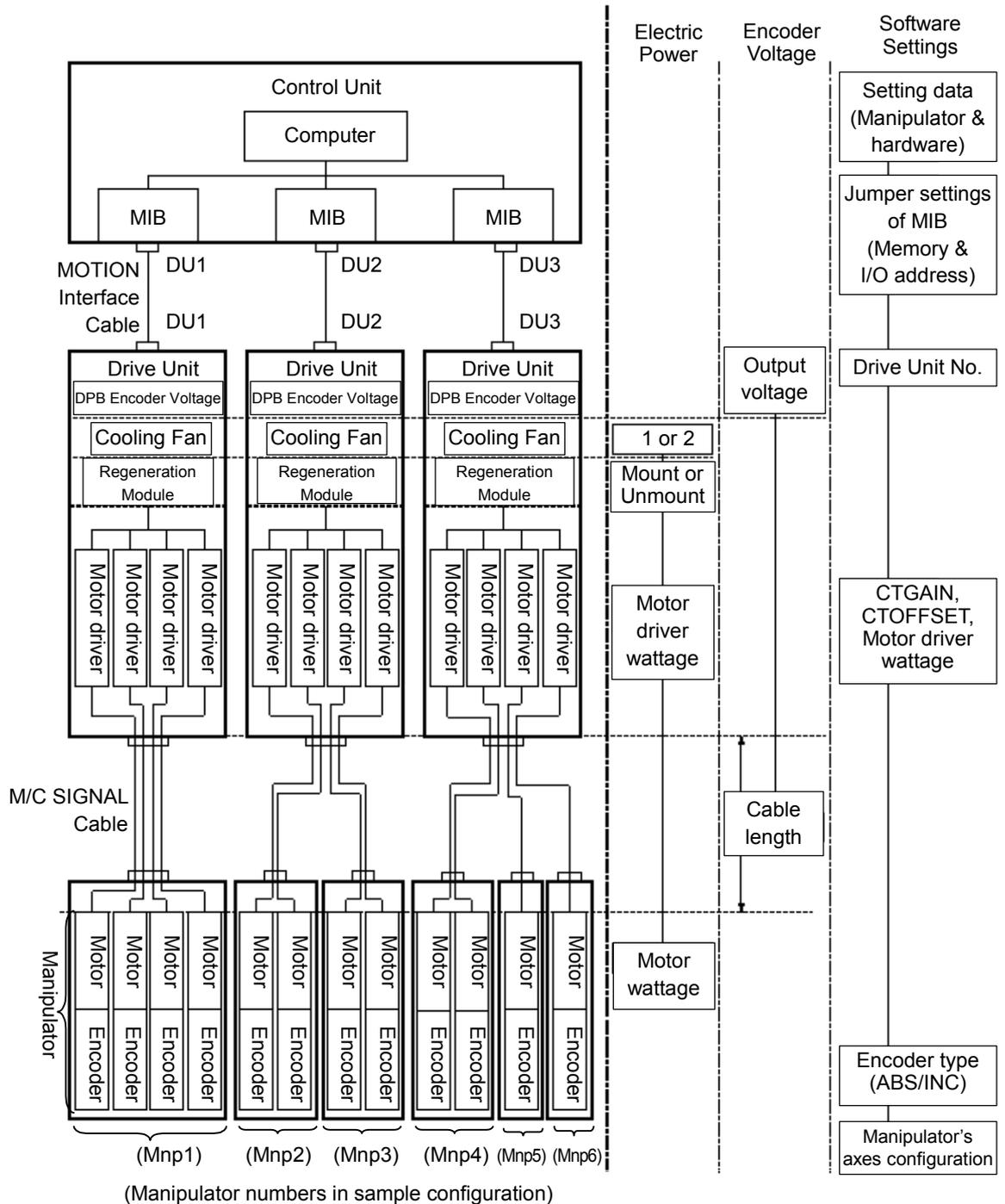
The project has been restored.

3. Hardware Configuration

3.1 Control Unit, Drive Unit and Manipulator

The figure below illustrates the hardware (Control Unit, Drive Units and Manipulators) layout. When exchanging a module in any of the units, refer to the appropriate section in this manual. Make sure you follow the instructions and the setting recommendations.

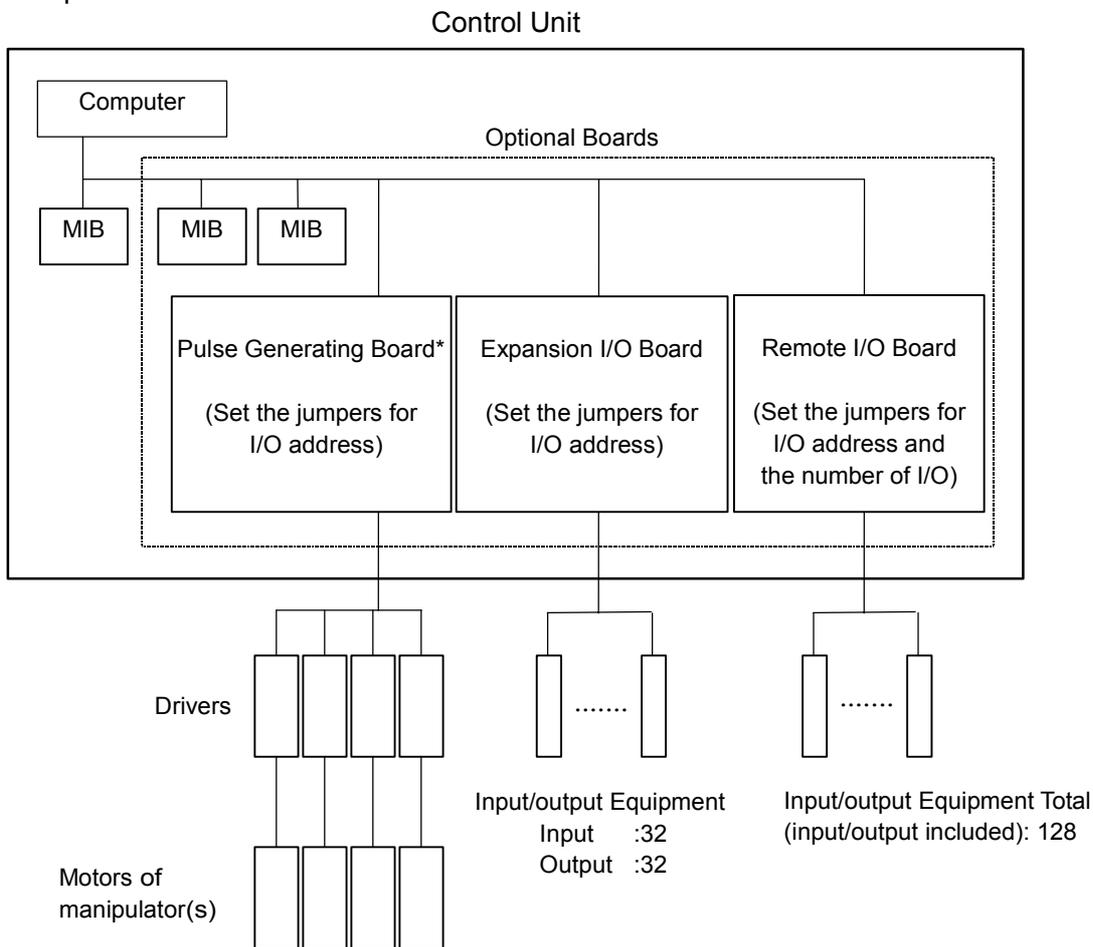
Example: Four-axis Drive Unit



3.2 Optional Boards

Available option boards depend on your system.

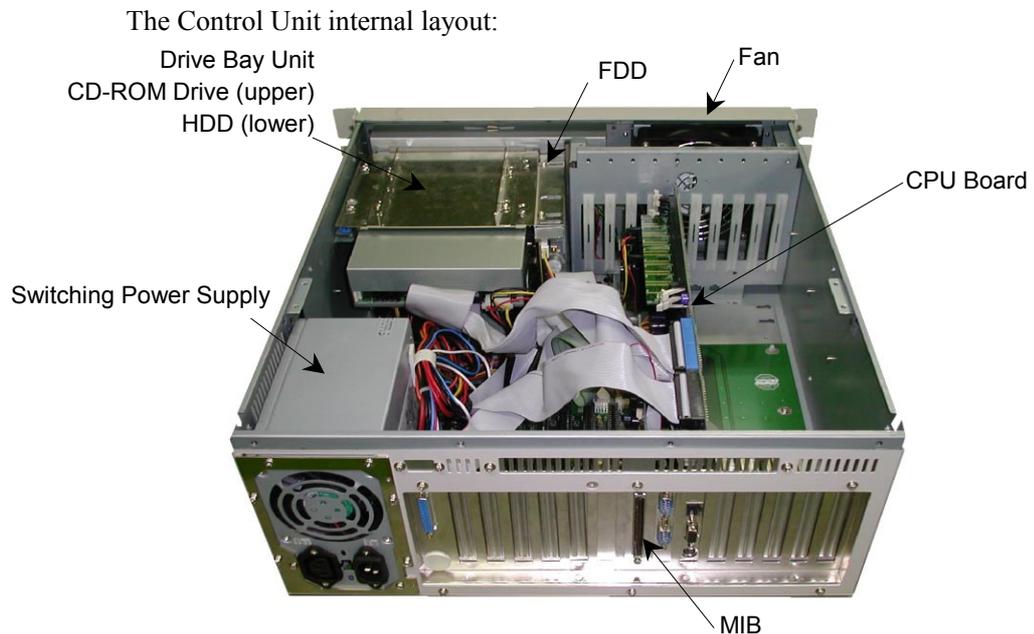
Example: SPEL CT



* One Pulse Generating Board increases the number of controllable axes by four (4) at maximum.

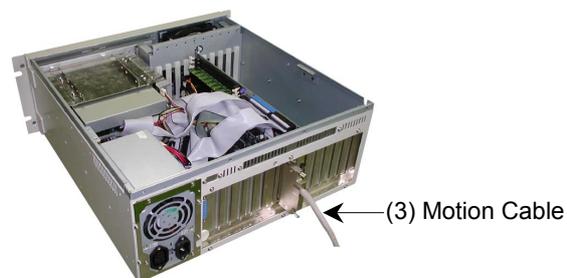
4. Control Unit

4.1 Overview

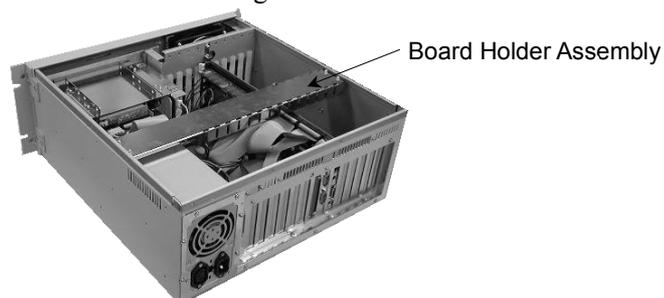


4.2 Replacing the MIB

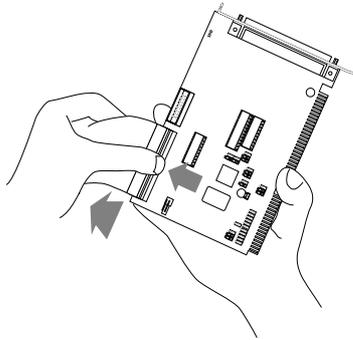
- (1) Shut down Windows. Turn OFF the Control Unit and Drive Unit.
- (2) Remove four Top Cover screws on the back of the Control Unit.
- (3) Disconnect the motion cable from the MIB.



- (4) Remove the Top Cover from the Control Unit.
- (5) Remove four mounting screws for the board holder assembly, then remove it.



- (6) Disconnect the flat cable from the CPU board.
- (7) Remove the mounting screw for the MIB and remove the MIB from the slot in the Control Unit.
- (8) Disconnect the cable from the MIB while releasing the connector lock as shown below.

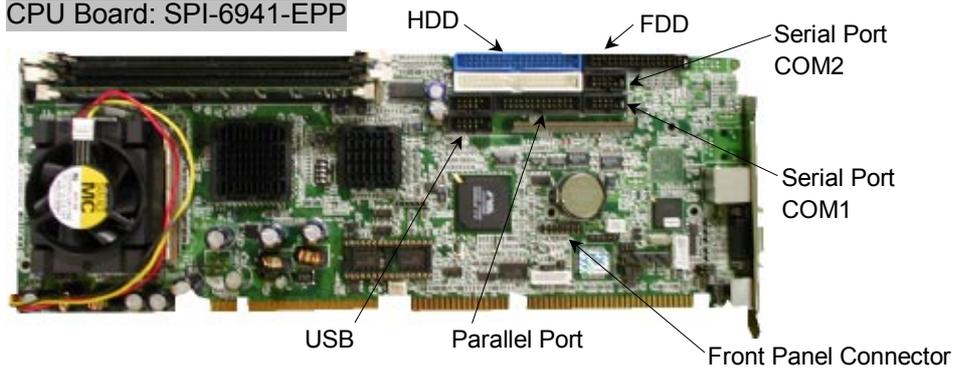


- (9) Set the jumpers on the new MIB exactly the same as on the old board.
Refer to the *Setup & Operation 10. Jumper Settings for MIB (Motion Interface Board)* for details on the jumper settings.
- (10) Connect the cable from the system panel to the new MIB.
- (11) Mount the new MIB into the same option slot in the Control Unit and fasten the mounting screw to secure the new board.
- (12) Connect the flat cable that was disconnected from the CPU board in step (6). For the cable connection, refer to the *Maintenance 4.3 Replacing CPU Board*.
- (13) Mount the board holder assembly to the Control Unit.
- (14) Place the Top Cover of the Control Unit back on and secure it with four screws.
- (15) Connect the motion cable to the MIB.

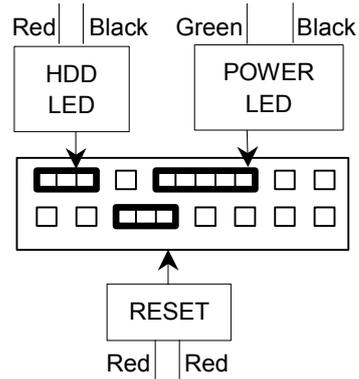
4.3 Replacing CPU Board

- (1) Shut down Windows. Turn OFF the Control Unit and Drive Unit.
- (2) Disconnect the cables of the CPU board from the back of the Control Unit.
- (3) Remove four Top Cover screws on the back of the Control Unit.
- (4) Remove the Top Cover from the Control Unit.
- (5) Remove the four mounting screws for the board holder assembly and remove it.
- (6) Disconnect seven cables from the CPU board. (HDD, FDD, Parallel Port, COM1, COM2, USB and Front Panel)

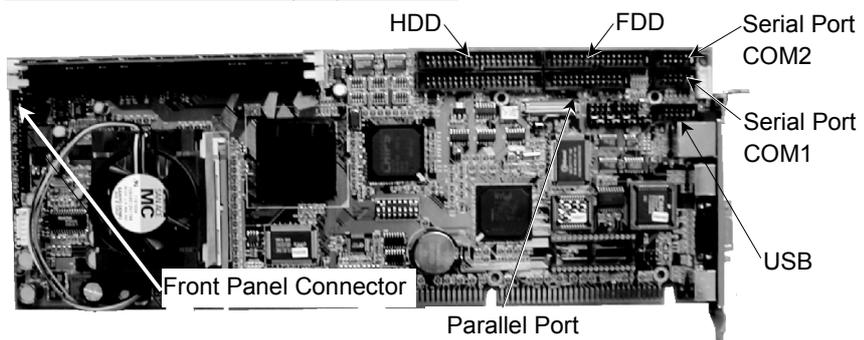
CPU Board: SPI-6941-EPP



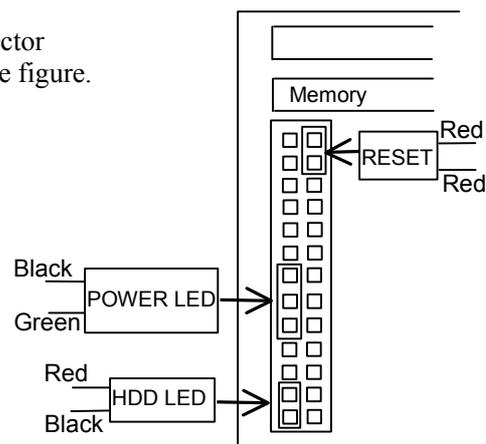
The Front Panel connector details are shown in the figure.



CPU Board: PC686BX(PC)-EPP850



The Front Panel connector details are shown in the figure.



- (7) Remove the mounting screw for the CPU board on the rear side of the Control Unit and remove the CPU board from the slot.
- (8) Install the new CPU board in the slot. Then, mount the board with the mounting screw.

- (9) Connect the cables to the CPU board.
- (10) Mount the board holder assembly in the Control Unit.
- (11) Mount the Top Cover to the Control Unit.
- (12) Connect the cables that have been disconnected before the board replacement to the back of the Control Unit.

4.4 Replacing an Optional Board

When replacing an optional board(s), refer to the *Maintenance 4.2 Replacing the MIB* and follow the same procedure. If there is any jumper set on the old board, it must be set on the new board exactly the same as on the old board.

4.5 Replacing the System Panel

4.5.1 Removal of the System Panel

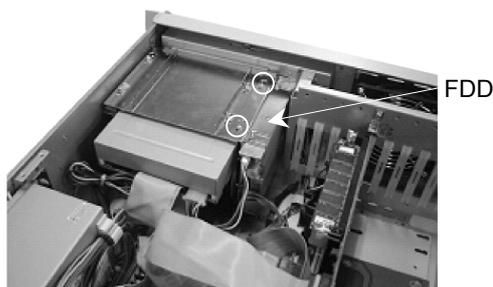
- (1) Shut down Windows, and then turn OFF the power on both the Control Unit and Drive Unit.
- (2) Disconnect the Operation Unit, ATTEND (TEACH) Control Device, or OPTIONAL DEVICE Dummy Plug from the OPTIONAL DEVICE connector.
- (3) Remove the HDD. For the procedure, refer to the *Maintenance 4.8 Replacing the HDD (Hard Disk Drive)*.
- (4) Remove four Top Cover screws on the back of the Control Unit.
- (5) Remove the Top Cover from the Control Unit.
- (6) Remove the board holder assembly from the Control Unit.
- (7) Disconnect the cable from the MIB while releasing the connector.
- (8) Disconnect any cables that are connected to the CD-ROM drive, HDD, and FDD.
(If you cannot disconnect the cable from the HDD at this step, disconnect the cable from the HDD at Step (10) while the Drive Bay Unit is pulled up.)



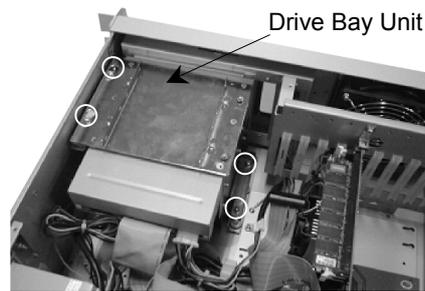
CAUTION

- Do not shock, shake, or drop any parts during maintenance. When the parts related with data (the CD-ROM drive, FDD, HDD, etc.) are shocked physically, they may be damaged and may also cause data loss during data loading/saving.

- (9) Remove the two FDD mounting screws and remove the FDD.



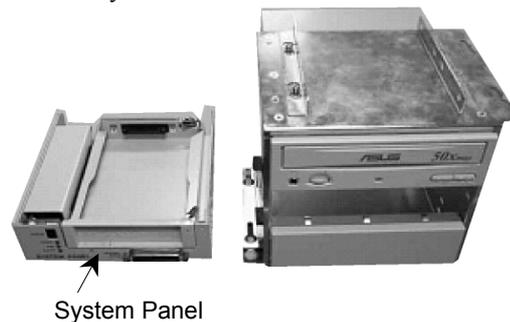
- (10) Remove four mounting screws on the Drive Bay Unit, and remove the Drive Bay Unit.



- (11) Remove four mounting screws on the both sides of the Drive Bay Unit.

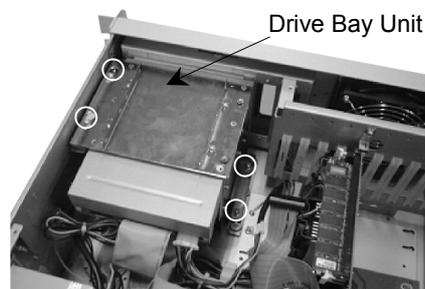


- (12) Pull the System Panel forward to remove it from the Drive Bay Unit.



4.5.2 Installation of the System Panel

- (1) Install a new System Panel in the Drive Bay Unit and secure it with the screws.
- (2) Install the Drive Bay Unit in the Control Unit and mount it with screws.



- (3) Install the FDD in the Control Unit.
- (4) Connect the cables for the FDD, HDD, and CD-ROM drive.
- (5) Connect the cable from the System Panel to the MIB.
- (6) Mount the board holder assembly to the Control Unit.
- (7) Place the Top Cover of the Control Unit back on and mount it with four screws.

- (8) Install the HDD and secure it.
For details, refer to the *Maintenance 4.8 Replacing the HDD (Hard Disk Drive)*.
- (9) Connect the Operation Unit, ATTEND (TEACH) Control Device, or OPTIONAL DEVICE Dummy Plug that has been previously removed to the OPTIONAL DEVICE connector.

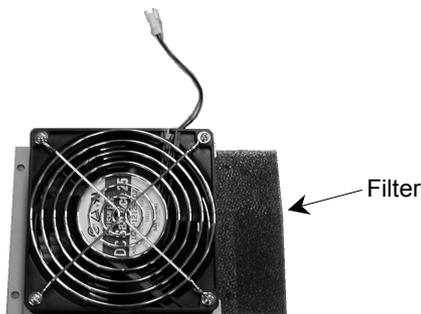
4.6 Cleaning and Replacing the Fan Filter

To clean and replace the Fan Filter, follow the procedure below:

- (1) Shut down Windows. Then, turn OFF the power on both the Control Unit and Drive Unit.
- (2) Remove four screws from the front panel of the Control Unit and remove the fan.



- (3) Pull out the filter from the filter case of the fan.



- (4) Clean or replace the filter. When you clean the filter, vacuum the dust with a vacuum cleaner.
- (5) Place the clean filter back in the filter case.
- (6) Secure the fan to the Control Unit.

4.7 Replacing the Fan

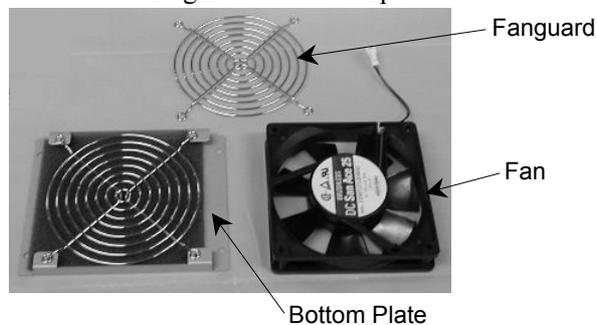
- (1) Shut down Windows. Then, turn OFF the power on both the Control Unit and Drive Unit.
- (2) Remove four screws from the front panel of the Control Unit and remove the fan.



- (3) Remove four screws from the fan.



- (4) Remove the fan guard from the top of the fan.



- (5) Replace the fan with a new one.
- (6) Place the new fan and fan guard on the bottom plate. Then, secure them with the screws.
- (7) Secure the fan to the Control Unit.

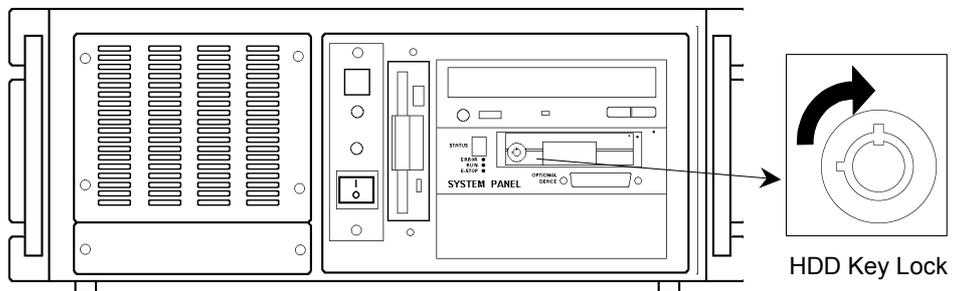
4.8 Replacing the HDD (Hard Disk Drive)

 CAUTION	<ul style="list-style-type: none"> Do not shock, shake, or drop any parts during maintenance. When the parts related with data (the CD-ROM drive, FDD, HDD, etc.) are shocked physically, they may be damaged and may also cause data loss during data loading/saving.
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NOTE  Back up the necessary data of the project and system before replacing the HDD. Then, restore the data of the project and system after the replacement.

Refer to the *Maintenance 2.5 Backup of Data* for details of data backup/restore.

- (1) Shut down Windows. Turn OFF the power on both the Control and Drive Units.
- (2) Open the front door of the Control Unit.
- (3) Insert the key to the HDD key lock and turn the key to the right.

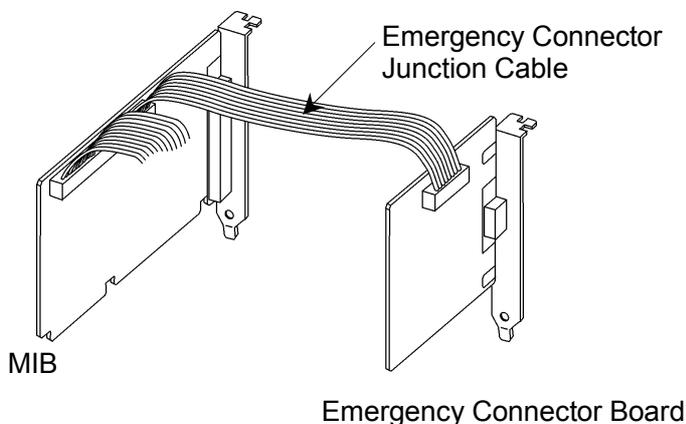


- (4) Pull out the HDD.
- (5) Install a new HDD. Insert the key to the HDD key lock and turn the key to the left.

NOTE  Refer to the instructions supplied with the new HDD for new hard disk settings.

4.9 Replacing the Emergency Connector Plate Kit

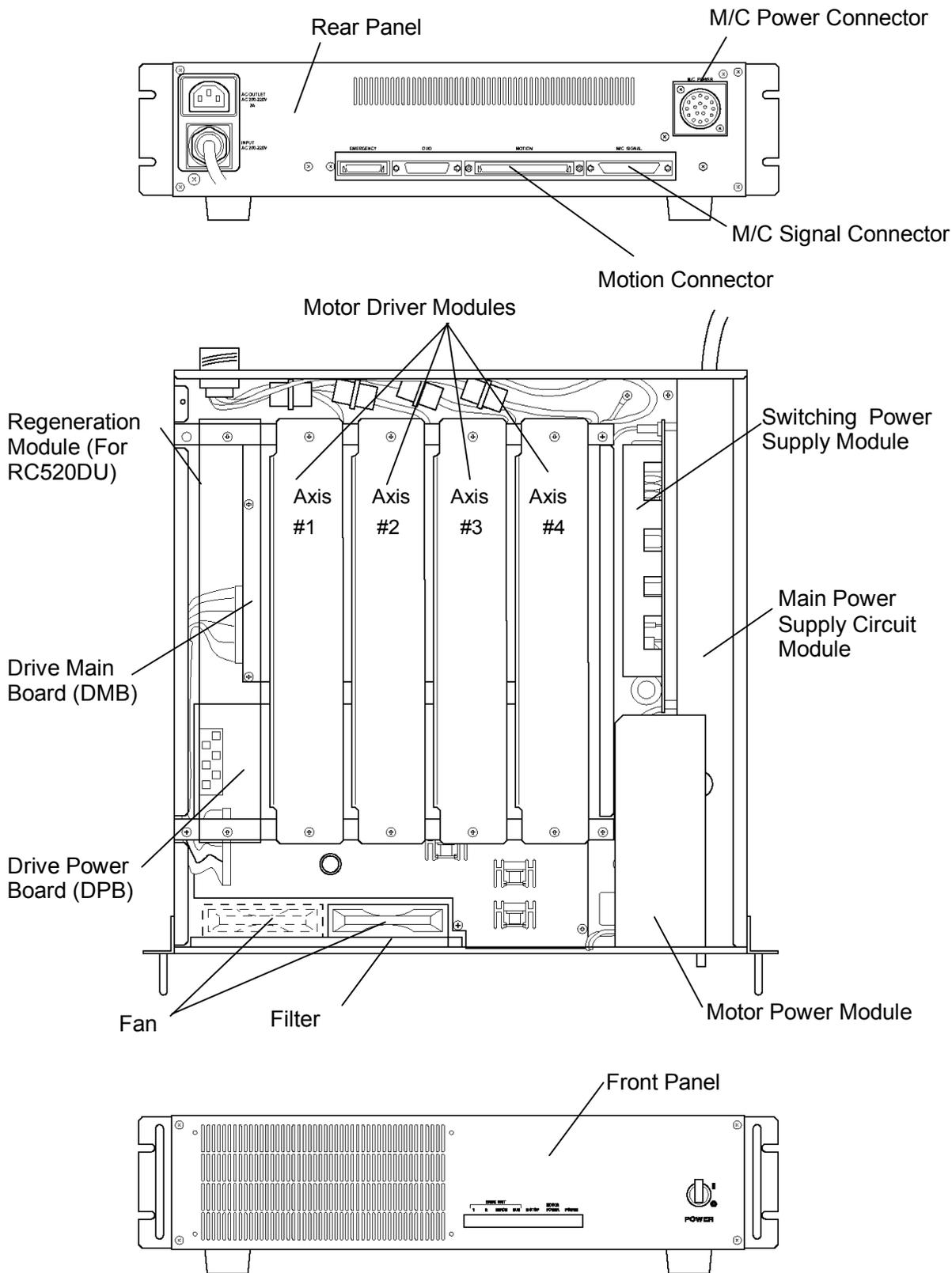
When replacing an Emergency Connector Plate Kit, refer to the *Maintenance 4.2 Replacing the MIB* and follow the same procedure. Refer to the figure below and connect the MIB and emergency connector board with the cable.



5. Four-axis Drive Unit (RC520DU)

5.1 Overview

The figures below show the rear, top, and front views of the RC520 four-axis Drive Unit.



5.2 Pin Assignments for the System Connectors

The following tables show the pin assignments for the M/C power connector, M/C signal connector and Motion connector respectively. As for the pin assignments of the connectors not covered in this section, refer to the *Setup & Operation*.

5.2.1 M/C Power

Pin No.	Signal Name	Pin No.	Signal Name
1	1U	9	3W
2	4V	10	2U
3	1V	11	NC
4	4U	12	NC
5	SHIELD	13	3V
6	1W	14	2V
7	4W	15	3U
8	NC	16	2W
		⊕	FGND

5.2.2 M/C Signal

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	EG	26	1S	51	$\bar{2}B$
2	4A	27	1HOME	52	$\bar{2}Z$
3	4B	28	ENC+5V	53	$\bar{2}S$
4	4Z	29	NC	54	NC
5	4S	30	NC	55	ENC+5V
6	4HOME	31	NC	56	EG
7	ENC+5V	32	EMB1	57	$\bar{1}A$
8	EG	33	+24V	58	$\bar{1}B$
9	3A	34	RG	59	$\bar{1}Z$
10	3B	35	EG	60	$\bar{1}S$
11	3Z	36	$\bar{4}A$	61	HCOM
12	3S	37	$\bar{4}B$	62	ENC+5V
13	3HOME	38	$\bar{4}Z$	63	NC
14	ENC+5V	39	$\bar{4}S$	64	NC
15	EG	40	NC	65	NC
16	2A	41	ENC+5V	66	EMB2
17	2B	42	EG	67	+24V
18	2Z	43	$\bar{3}A$	68	RG
19	2S	44	$\bar{3}B$		
20	2HOME	45	$\bar{3}Z$		
21	ENC+5V	46	$\bar{3}S$		
22	EG	47	NC		
23	1A	48	ENC+5V		
24	1B	49	EG		
25	1Z	50	$\bar{2}A$		



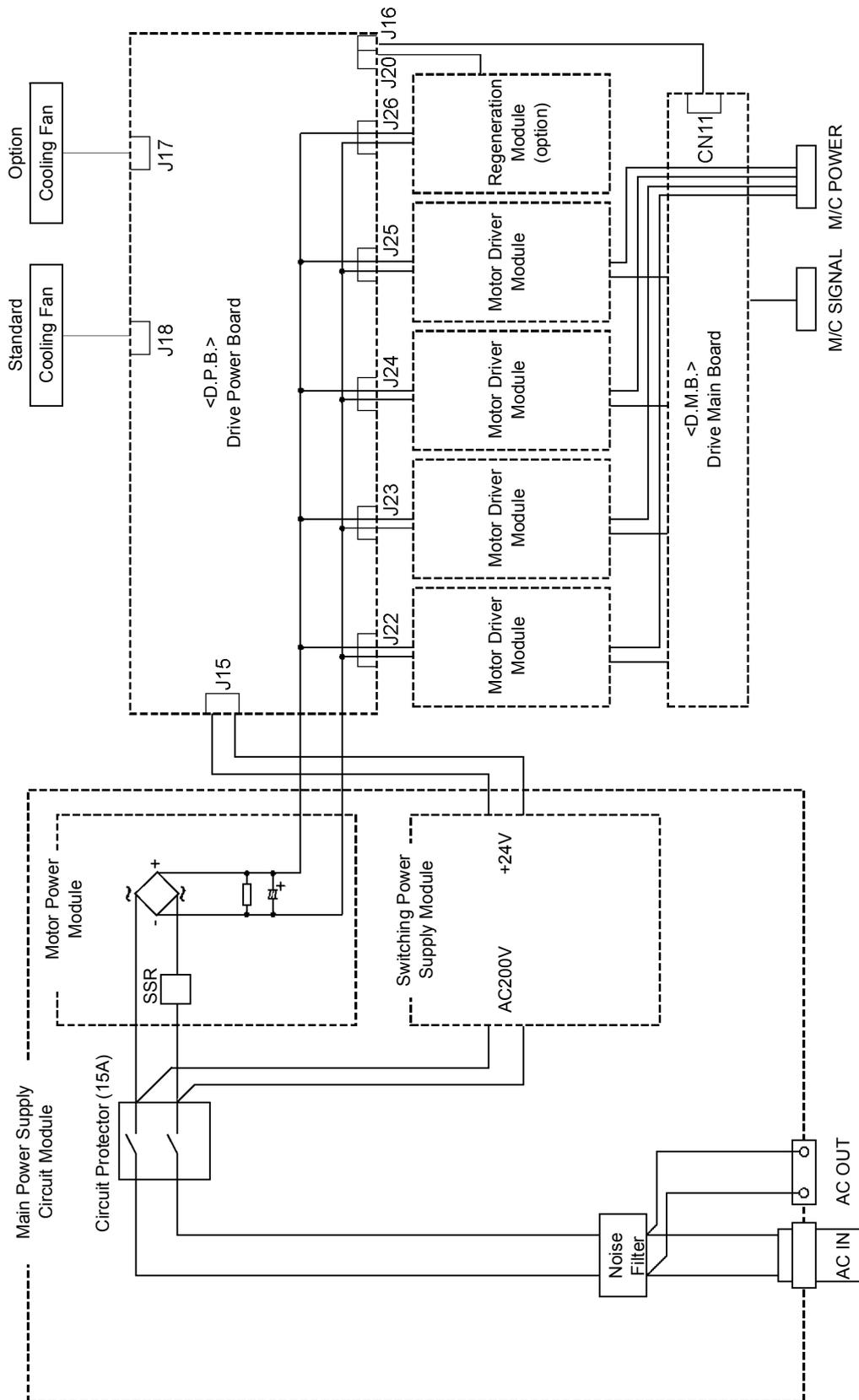
The Drive Unit and Manipulator's pin numbering layouts differ: one is lined horizontally and the other is lined vertically.

5.2.3 MOTION

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	+5V	41	XF+	81	ED4+
2	(NC)	42	XF-	82	ED4-
3	RAS+	43	RESMIB+	83	ED2+
4	RAS-	44	RESMIB-	84	ED2-
5	EA13+	45	E_STOP001	85	ED0+
6	EA13-	46	E_STOP002	86	ED0-
7	EA11+	47	E_SW21	87	RDEN+
8	EA11-	48	(NC)	88	RDEN-
9	EA9+	49	GND	89	INT4+
10	EA9-	50	GND	90	INT4-
11	EA7+	51	E_SW11	91	READY+
12	EA7-	52	GND	92	READY-
13	EA5+	53	EA14+	93	E_STOP003
14	EA5-	54	EA14-	94	E_STOP004
15	EA3+	55	EA12+	95	NC
16	EA3-	56	EA12-	96	NC
17	EA1+	57	EA10+	97	NC
18	EA1-	58	EA10-	98	E_SW22
19	BANK2+	59	EA8+	99	GND
20	BANK2-	60	EA8-	100	E_SW12
21	BANK0+	61	EA6+		
22	BANK0-	62	EA6-		
23	GND	63	EA4+		
24	GND	64	EA4-		
25	MRD+	65	EA2+		
26	MRD-	66	EA2-		
27	EIOR+	67	EA0+		
28	EIOR-	68	EA0-		
29	ED7+	69	BANK1+		
30	ED7-	70	BANK1-		
31	ED5+	71	RESET+		
32	ED5-	72	RESET-		
33	ED3+	73	GND		
34	ED3-	74	GND		
35	ED1+	75	MWR+		
36	ED1-	76	MWR-		
37	SDEN+	77	EIOW+		
38	SDEN-	78	EIOW-		
39	BIO+	79	ED6+		
40	BIO-	80	ED6-		

5.3 Four-axis Drive Unit

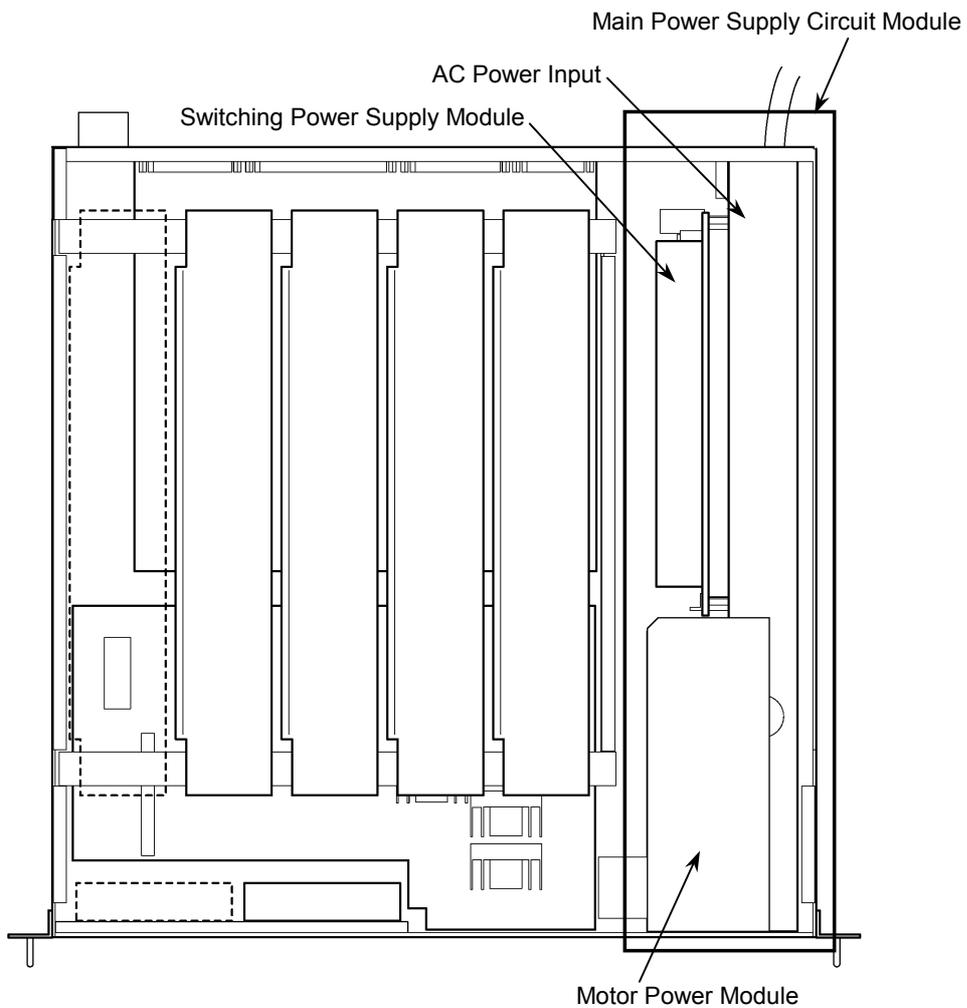
5.3.1 System Configuration of Four-axis Drive Unit



5.3.2 Module Functions and Layout

The four-axis Drive Unit consists of Main Power Supply Circuit module, Motor Power module and Switching Power Supply module. The functions of each module are described in the table below. The following figure illustrates the locations in the Drive Unit for each module to be installed.

Module	Description
Main Power Supply Circuit	This module incorporates the following modules: the AC Power Input, Motor Power and Switching Power Supply.
Motor Power	This module rectifies AC200V (or the local equivalent) and outputs the DC power to the motor.
Switching Power Supply	This module outputs +24V rectified from AC200V (or the local equivalent) as the control power source.



5.3.3 Inspecting the Switching Power Supply Module

The Switching Power Supply module rectifies AC200V (or the local equivalent) and outputs +24V. The +24V is converted by the DPB to supply power to: VCC (+5V), the motor driver ($\pm 5V$) and the encoder (5V).

Inspect the Switching Power Supply module by following the steps as described below:

(1) Turn ON the four-axis Drive Unit(s).

(2) Check that the four-axis Drive Unit's front panel POWER LED (green) is ON.

NOTE



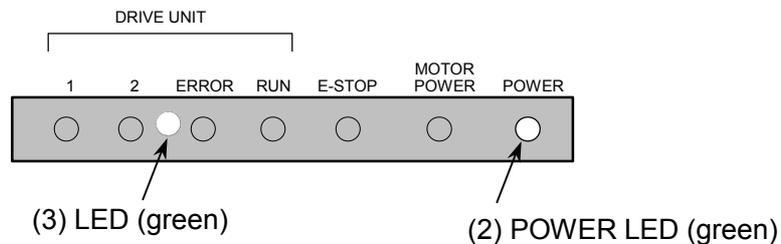
If this LED is either OFF or dim, suspect that the +24V power output is not normal.

(3) Check on the four-axis Drive Unit's front panel to make sure that the LED (green) on the left of and behind the ERROR LED (red) is ON.

NOTE

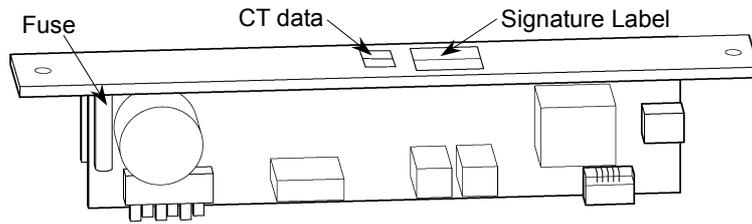


When this lamp is OFF, either the +24V or +5V power output may not be normal, or the +24V power voltage may be too low.



5.4 Motor Driver Module

5.4.1 Layout and Functions



Signature Label

The Signature Label on the heat sink indicates capacity in wattage for each Motor Driver module.

Model	Capacity (W)
CACR-A5-SU3C	50W
CACR-01-SU3C	100W
CACR-02-SU3CY1	200W
CACR-04-SU3C	400W
CACR-08-SU3C	750W

The power rating (wattage) of the mounted Motor Driver module corresponds to the wattage of its driving motor. However, a 150W motor requires either a 100W or 200W Motor Drive module depending on the Manipulator models. For details, refer to the maintenance parts list in the Manipulator manual.

CT data

The CT data beside the Signature label indicates specific information to each Motor Driver module. In order to optimize the Control Unit's control over the Manipulator, the exact same values as indicated here must be set up in the Control Unit after the motor Driver module is replaced.

There are two kinds of CT data as follows:

4B-**** : "CT OFFSET".

4D-**** : "CTGAIN".

The mark, "*", on the CT data is indicated with "0" to "9" and "A" to "F".

The indication is different depending on the Driver module.



Record the CT data to be entered in the Control Unit before placing the Top Cover back on the four-axis Drive Unit when replacing the Motor Driver module. After the replacement, refer to User's Guide and set up the CT data.

5.4.2 Replacing a Motor Driver Module

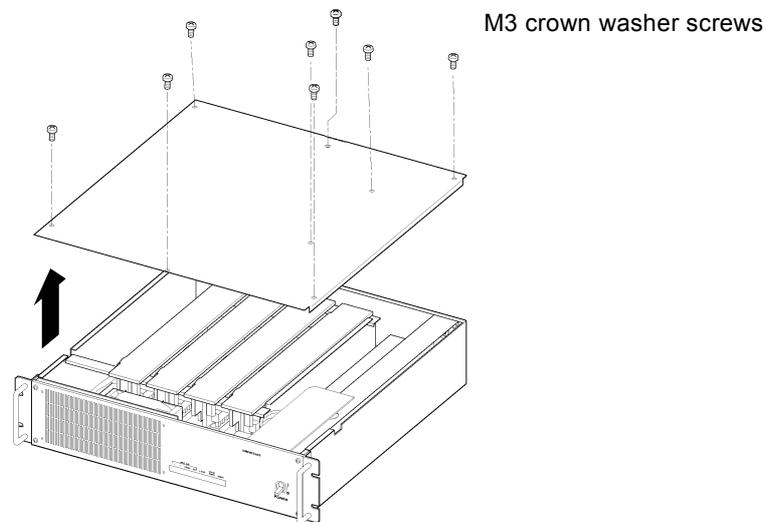
Replace a Motor Driver module by following the steps described below.



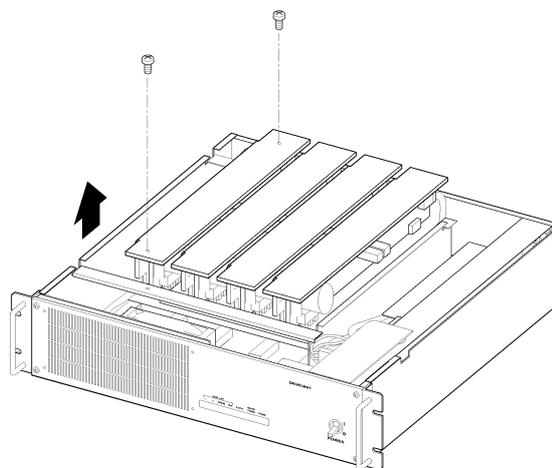
- Make sure that the power rating (wattage) of a new Motor Driver module is correct. Using a Motor Driver module with improper power rating (wattage) in the Drive Unit may not only cause improper function of the robot system but also damage to the system.

- (1) Shut down Windows, and turn OFF the Control Unit and four-axis Drive Unit.
- (2) Disconnect all the cables from the back of the four-axis Drive Unit.
- (3) Wait for about 1 minute until the high voltage is completely discharge.

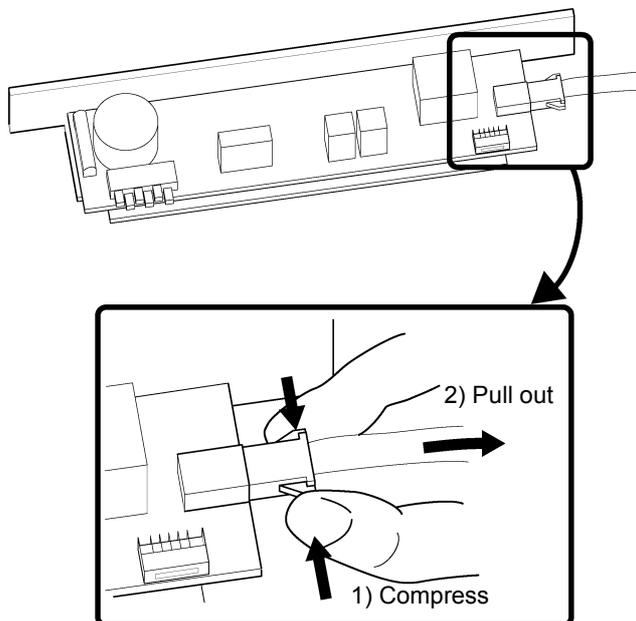
Remove the Top Cover by removing the eight screws as shown in the figure below.



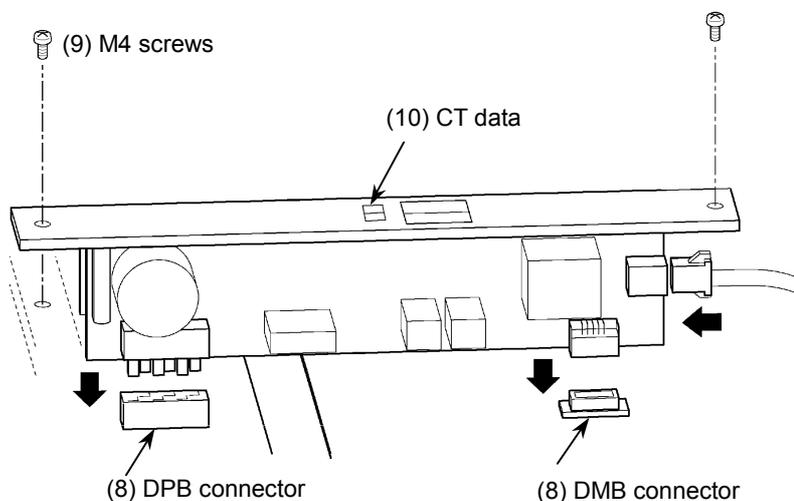
- (4) Check to make sure that LED #9 (orange) on the DPB is OFF. Wait until the LED is OFF because the capacitors are not completely discharged if LED #9 is ON.
- (5) Remove the two screws from the Motor Driver module as shown below.



- (6) Lift up the Motor Driver module so that the cable connected on the back can be disconnected. Compress the projections on both sides of the connector to disconnect the cable.



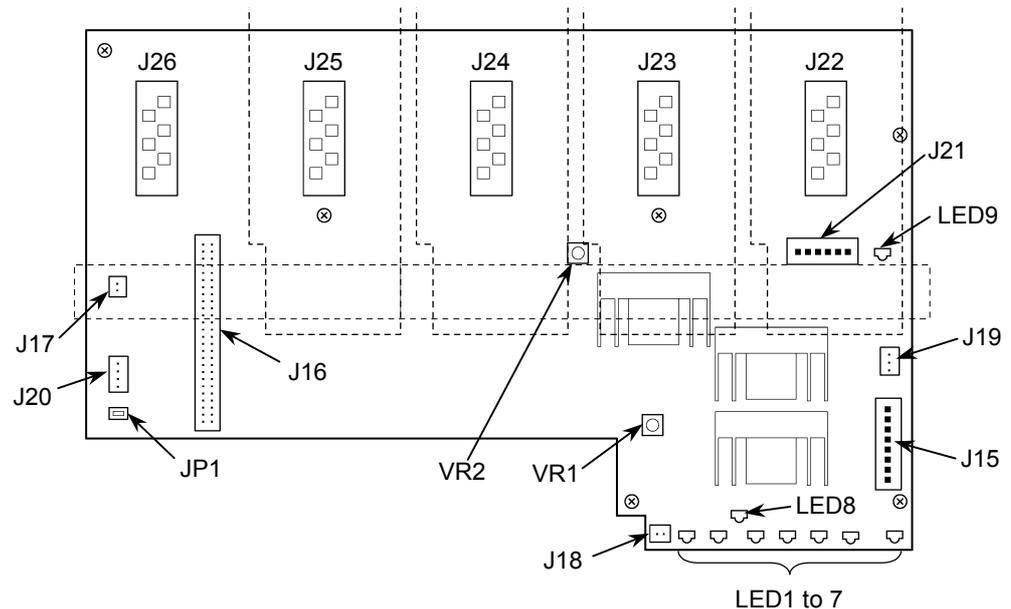
- (7) Connect the cable to a new Motor Driver module.
 (8) Press down the module carefully and gradually to match the connectors on DPB and DMB.



- (9) Secure the new Motor Driver module with two screws.
 (10) Record the CT data.
 (11) Secure the Top Cover with the eight screws.
 (12) Set up the CT data. For details, refer to the following manuals.
 EPSON RC+ : User's Guide - the section *RC520 Drive Unit Software Configuration* in the chapter *Motion Systems*
 SPEL CT : User's Guide Setup & Operation - the section *11.3 Setting Up the Hardware*

5.5 DPB (Drive Power Board)

5.5.1 Layout and Functions



Connector

Connector No.	Function
J15	The connector to input the +24V to the Switching Power Supply module
J16	The connector for the DMB interface cable
J17	The connector for the optional Cooling Fan
J18	The connector for the standard Cooling Fan
J19	The connector for the SSR (Solid State Relay) Control Signal
J20	The connector for the Signal cable of the Regeneration module (For RC520DU)
J21	The connector for the Power Supply cable from the Motor Power module
J22 to 25	The connectors to supply motor power to the Motor Driver module
J26	The connector to supply motor power to the Regeneration module (For RC520DU)

Variable Resistors

VR No.	Function
VR1	The control to adjust the Encoder Power Supply voltage
VR2	The control to adjust the +5V voltage (VCC)

Jumper (JP1)

Condition	Description
JP1 short	If the regeneration module is not installed.
JP1 open	If the regeneration module is installed.

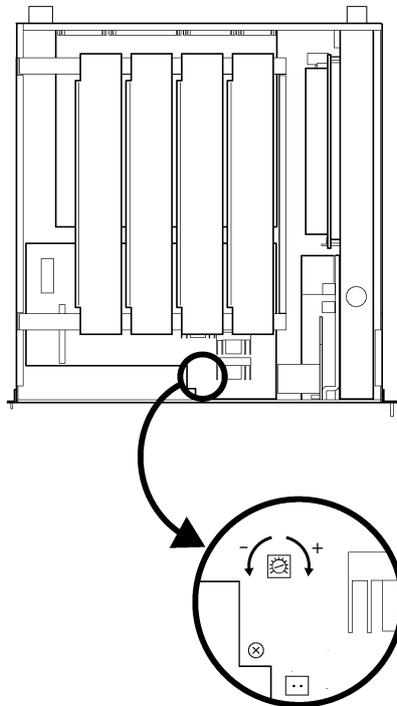
LED

LED No.	Function	
LED1	1	LED "1" indicates that an unresettable error relating to motor control with/in any of the Manipulator axes occurs.
LED2	2	LED "2" indicates that a resettable error relating to motor control with/in any of the Manipulator axes occurs.
LED3	ERROR	Lights when the CPU of the four-axis Drive Unit detects an error.
LED4	RUN	Lights while the CPU of the four-axis Drive Unit is operating normally.
LED5	E-STOP	Lights when in the emergency stop condition.
LED6	MOTOR POWER	Lights when the motor power is ON. (Motor Power: The DC power supply that inputs to the Motor Driver module to drive the motor. This DC power is generated by regulating AC200V or the local equivalent power.)
LED7	POWER	Lights when the four-axis Drive Unit is turned ON.
LED8	This LED turns OFF when the +24V voltage drops.	
LED9	This LED indicates the charge status of the condenser.	

5.5.2 Adjusting Encoder Voltage

You may adjust the Encoder Power Supply voltage using control VR1 as follows:

- (1) Turn ON the Drive Unit and Control Unit to boot the Controller while pressing the Emergency Stop switch. Make sure that the encoder power is being supplied by checking LED1 on the Manipulator's relay board. (The LED must be ON.)
- (2) Measure the voltage between the encoder +5V and the GND pin on the Encoder Signal connector of the longest motor cable in the Manipulator. (As for which pins to use, refer to the Manipulator manual.) If the encoder voltage is not within the range of 4.9V to 5.2V, adjust it as follows:
- (3) Remove the Top Cover of the four-axis Drive Unit by taking out the eight screws.
- (4) If the measured voltage is lower than 4.9V, turn VR1 on the DPB in the "+" direction by 1/2 turn to increase the voltage. If the measure voltage is higher than 5.2V, turn VR1 in the "-" direction by 1/2 turn to lower the voltage.

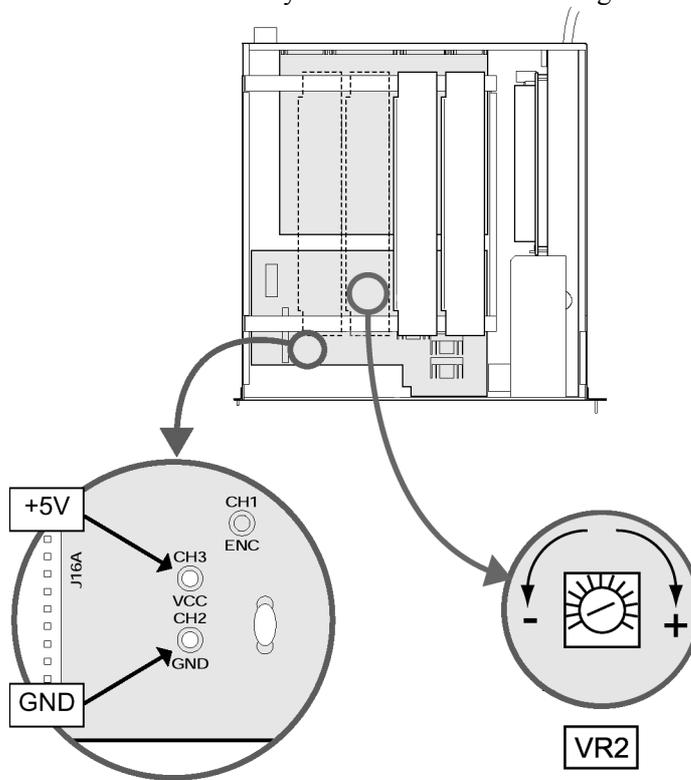


- (5) Repeat step (2) to ensure that the voltage is between 4.9V and 5.2V.
- (6) If necessary, repeat steps (4) and (5) until the voltage is within the range of 4.9V to 5.2V.
- (7) When the adjustment has been completed, place the Top Cover back on.

5.5.3 Adjusting +5V Voltage

You may adjust the +5V voltage for the DMB control circuit using a control VR2, as follows:

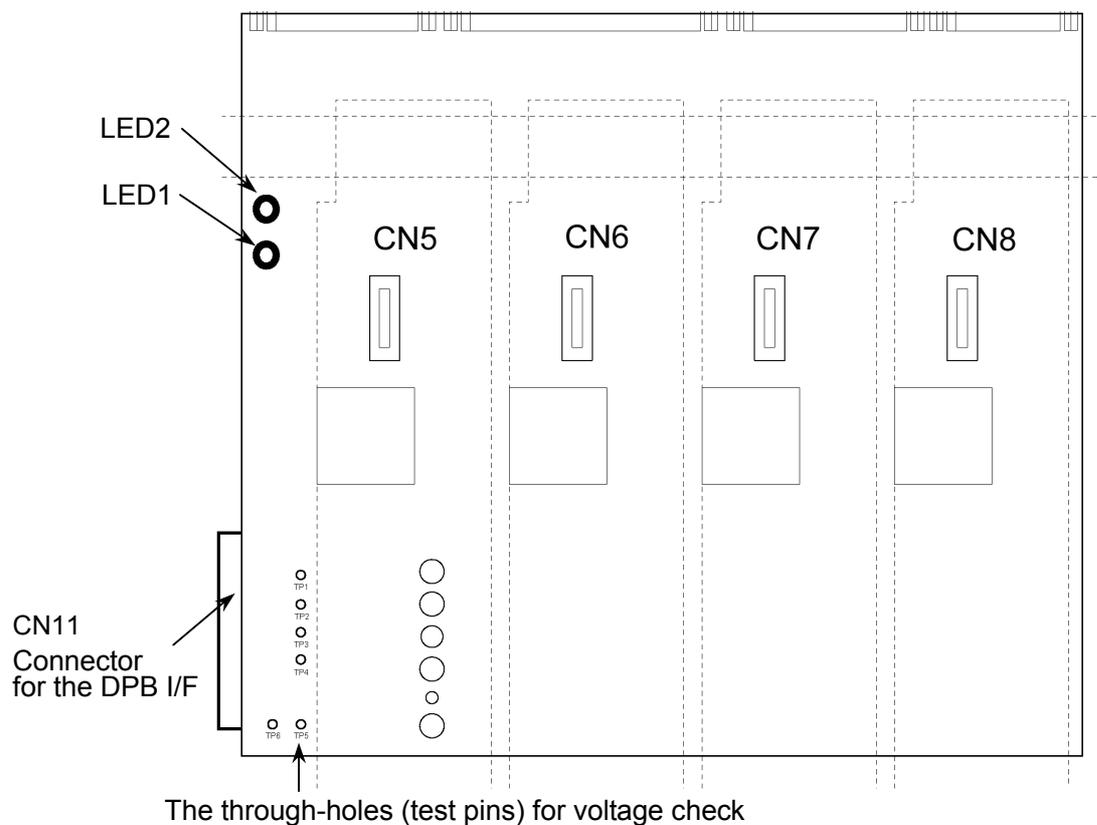
- (1) Shut down Windows, and turn OFF the Control Unit and four-axis Drive Unit.
- (2) Remove the Top Cover of the four-axis Drive Unit by removing the eight screws.
- (3) Remove the Motor Driver module by removing the two mounting screws.
- (4) Turn ON the four-axis Drive Unit.
- (5) Measure the voltage between the through-holes marked as VCC and GND near the J16 connector on the DPB. If the +5V voltage is not within the range of 4.9V to 5.2V, adjust the voltage as follows:
- (6) If the measured voltage is lower than 4.9V, turn VR2 on the DPB in the “+” direction by 1/2 turn to increase the voltage. If the measured voltage is higher than 5.2V, turn VR2 in the “-” direction by 1/2 turn to lower the voltage.



- (7) Repeat step (5) to ensure that the voltage is between 4.9V and 5.2V.
- (8) If necessary, repeat steps (7) and (8) until the voltage is within the range of 4.9V to 5.2V.
- (9) After the adjustment, re-install the Motor Driver module in.
- (10) Turn OFF the Drive Unit and re-install the Top Cover.

5.6 DMB (Drive Main Board)

5.6.1 Layout and Functions



The through-holes (test pins) for voltage check

No.	Through-hole	Description
TP1	+5 V	+5 V voltage for DMB
TP2	+5 VA	+5 V voltage for the Motor Driver module
TP3	-5 V	-5 V voltage for the Motor Driver module
TP4	+24 V	+24 V output voltage of the Switching Power Supply module
TP5	+5.6 V	Encoder power supply voltage
TP6	GND	GND for TP1 through TP5

LED

No.	Description
1	ON while the power for Encoder is output.
2	ON while the Manipulator's electromagnetic brake is released.

5.6.2 Replacing the DMB

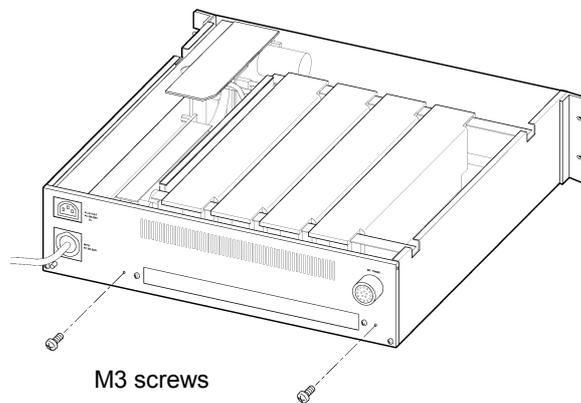


WARNING

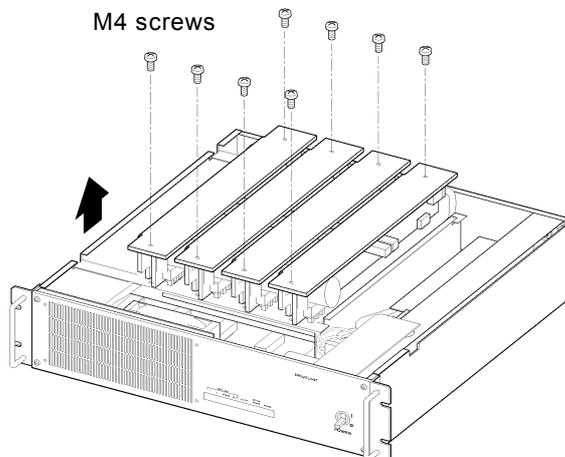
- Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.

Replace the DMB by following the steps described below.

- (1) Shut down Windows, and turn OFF the Control Unit and four-axis Drive Unit.
- (2) Disconnect cables connected at the back of the four-axis Drive Unit.
- (3) Wait for about 1 minute until the high voltage is discharged.
- (4) Remove the Top Cover by removing the eight screws.
- (5) Remove the two DMB mounting screws on the back of the four-axis Drive Unit as shown below.

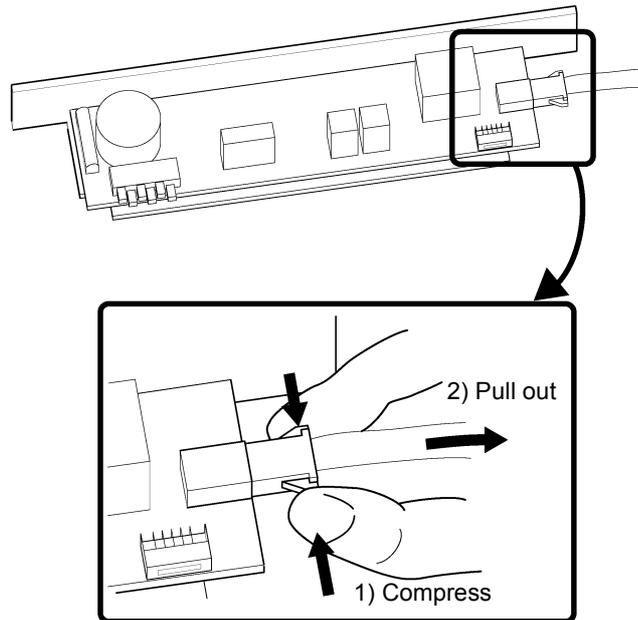


- (6) Make sure that the LED 9 (orange) on the DPB is OFF. The capacitors have not completely discharged if this LED is ON. Make sure to wait until the LED goes OFF.
- (7) As shown below, remove the mounting screws on the motor drivers for four axes in the Drive Unit.

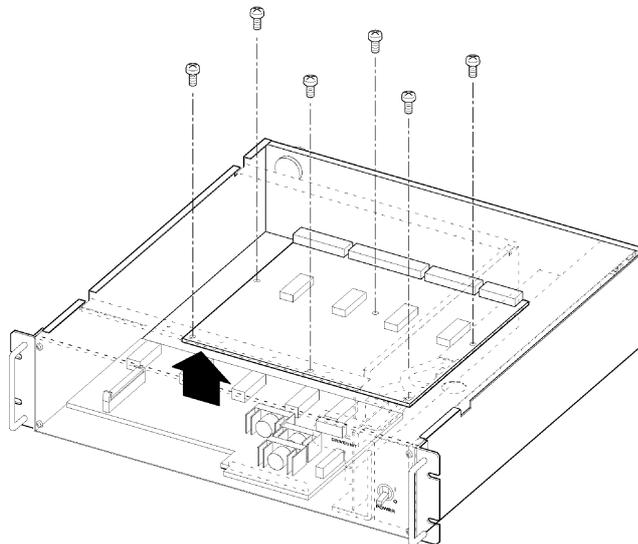


- (8) If a Regeneration module is connected, remove it by following the steps, (5) and (6), in the *Maintenance 5.8.2 Replacing a Regeneration Module (For RC520DU)*.

- (9) Lift up the Motor Driver module and disconnect cables from the back.
Compress the projections on both sides of the connector to disconnect the cable.

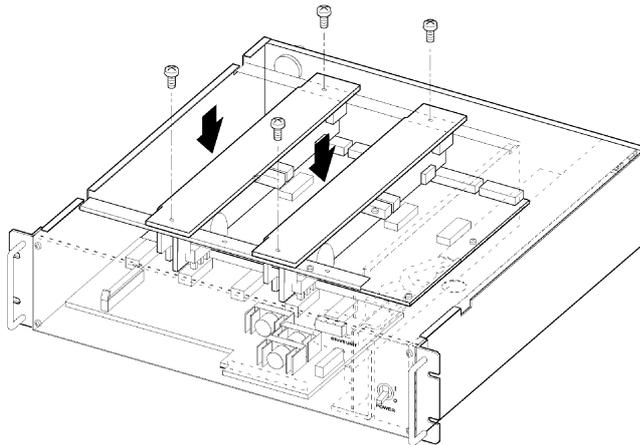


- (10) Keep a written record of the corresponding axis number, CT data and the wattage so that the settings for the Motor Driver module remain the same.
- (11) Disconnect the flat cable CN11 that connects to the DPB.
- (12) Remove six mounting screws securing the DMB in the four-axis Drive Unit.



- (13) Remove the old DMB.
- (14) Install the new DMB and mount it with eight mounting screws loose enough so that it can still be moved around a little for positioning.

(15) Install the Motor Drivers for axis #1 and axis #3 just to position the DMB.



(16) Tighten the eight mounting screws that are still loose from step (14).

(17) Connect the flat cable CN11.

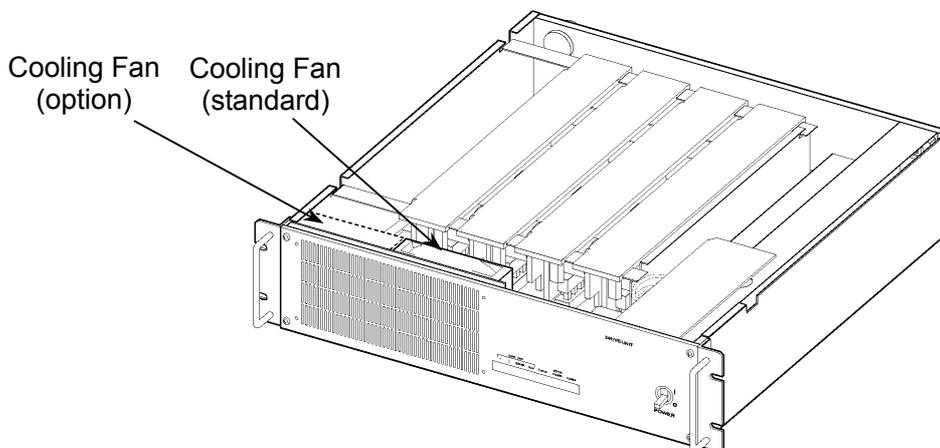
(18) If the Regeneration module has been removed in step (7), re-install it. Refer to steps (7) and (8) described in the *Maintenance 5.8.2 Replacing a Regeneration Module (For RC520DU)*.

(19) Re-install the Motor Drivers and Top Cover.

(20) Connect the cables that have been disconnected before the DMB replacement to the back of the four-axis Drive Unit.

5.7 Cooling Fan

5.7.1 Layout



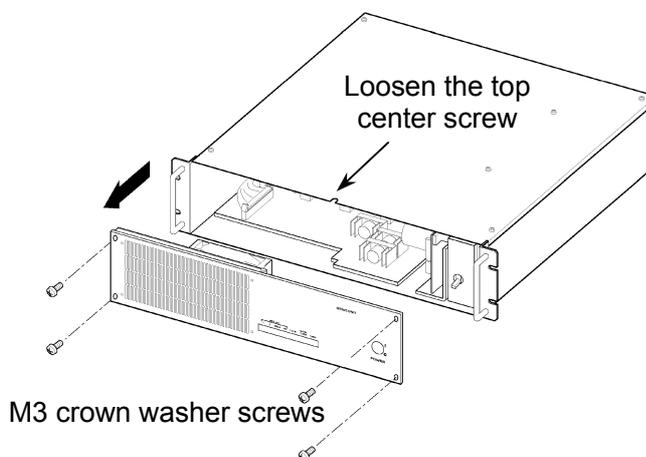
5.7.2 Inspecting the Fan Filter

 WARNING	<ul style="list-style-type: none"> Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.
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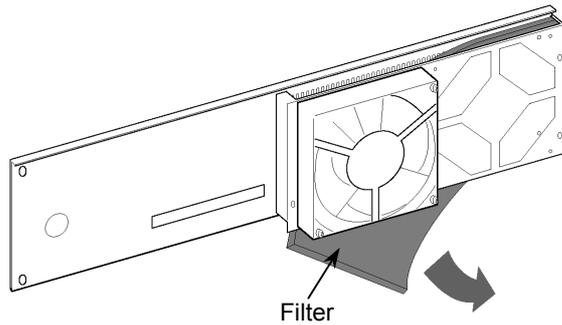
When you inspect the fan and clean the filter, follow the steps described below.

- (1) Shut down Windows, and turn OFF the Control Unit and four-axis Drive Unit.
- (2) Wait for about 1 minute until the high voltage is discharged. Then, loosen five screws and remove the front panel as shown below. The top center screw only needs to be loosened to remove the panel.

NOTE Be careful not to pull out the front panel too far because the power cable of the fan is still connected to the DPB.



(3) Pull out the filter for cleaning as shown below.



- (4) The filter may be cleaned either by vacuuming the dust or rinsing in water. (The filter must be thoroughly dry before being reinstalled.)
- (5) Reinstall the filter to its original location.
- (6) Reattach the front panel to the Drive Unit.
- (7) Turn ON the four-axis Drive Unit and make sure that the fan operates normally.

5.7.3 Replacing the Fan



WARNING

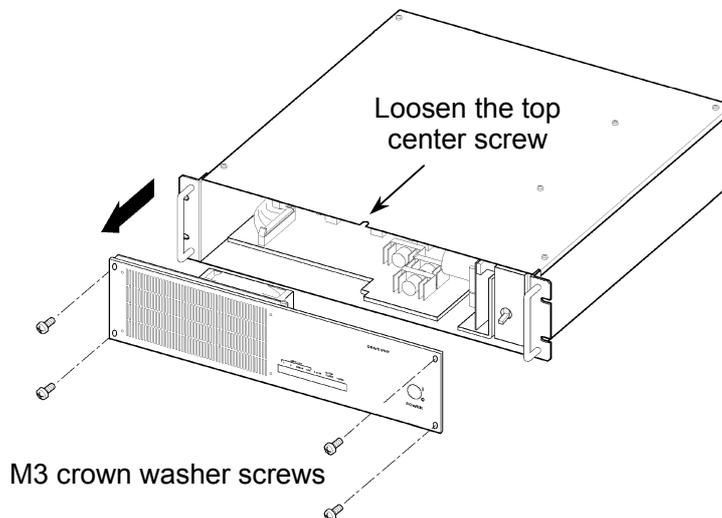
- Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.

Replace the fan by following the steps described below.

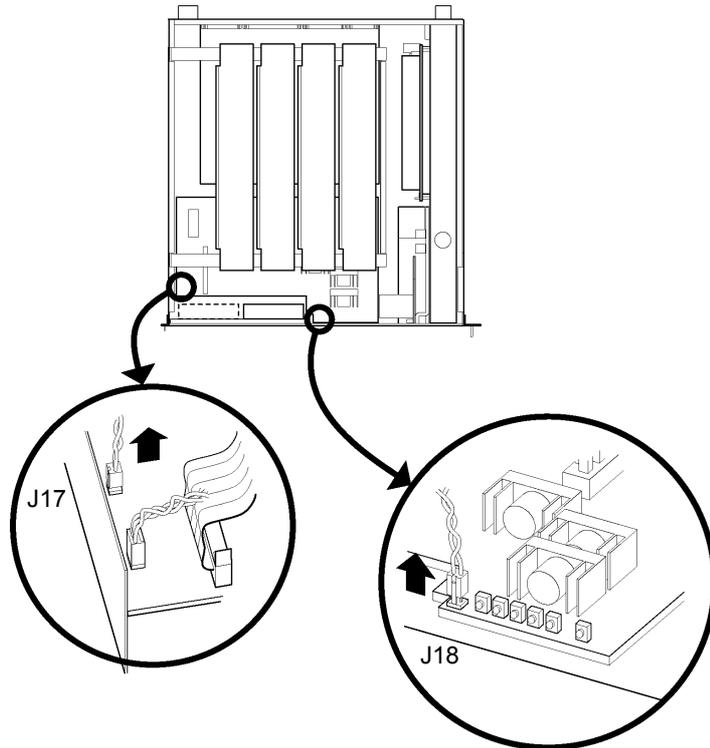
- (1) Shut down Windows, and turn OFF the Control Unit and four-axis Drive Unit.
- (2) Wait for about 1 minute until the high voltage is discharged. Then, loosen five screws and remove the front panel as shown below. The top center screw only needs to be loosened to remove the panel.



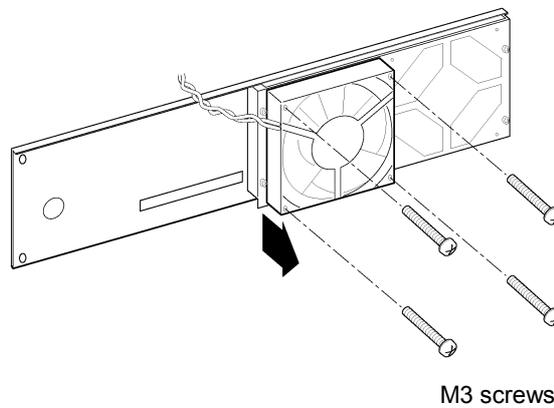
NOTE Be careful not to pull out the front panel too far because the power cable of the fan is still connected to the DPB.



- (3) Disconnect the cable for the Cooling Fan from the connector (J18 for the standard fan; J17 for the optional fan) on the DPB.



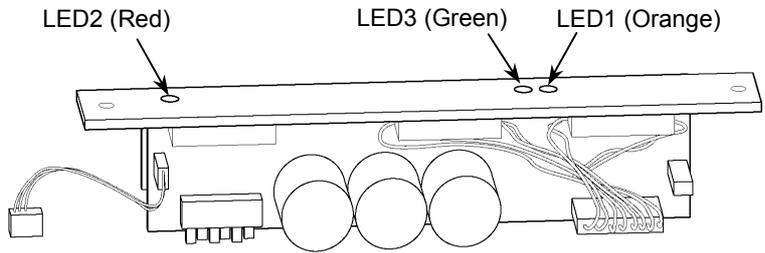
- (4) Remove the four mounting screws that hold the Cooling Fan in place.



- (5) Install a new Cooling Fan, and connect the cable of the fan to the connector on the DPB.
- (6) Reattach the front panel.
- (7) Turn ON the four-axis Drive Unit and make sure that the new Cooling Fan runs properly.

5.8 Regeneration Module (For RC520DU)

5.8.1 Layout and Function



LED No.	LED Color	Description
LED1	Orange	This LED is ON when the system is in the regenerative process. (This process is to reduce the regenerated electricity by using resistors when the motor is decelerating so that the circuit can be protected.)
LED2	Red	This LED is ON when the system is detecting over-voltage.
LED3	Green	This LED is ON when the motor power is ON. (It may flicker while the Manipulator(s) is/are operating.)

NOTE


If a Regeneration module (for RC520DU) is installed, JP1 on the DPB (Drive Power Board) must be “open”.

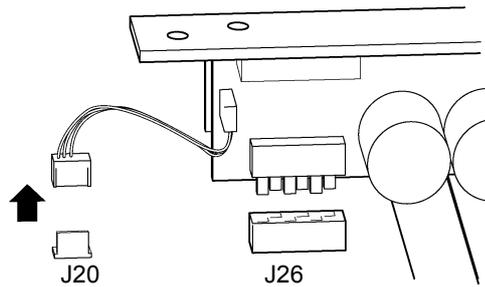
5.8.2 Replacing a Regeneration Module (For RC520DU)

 WARNING	<ul style="list-style-type: none"> Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.
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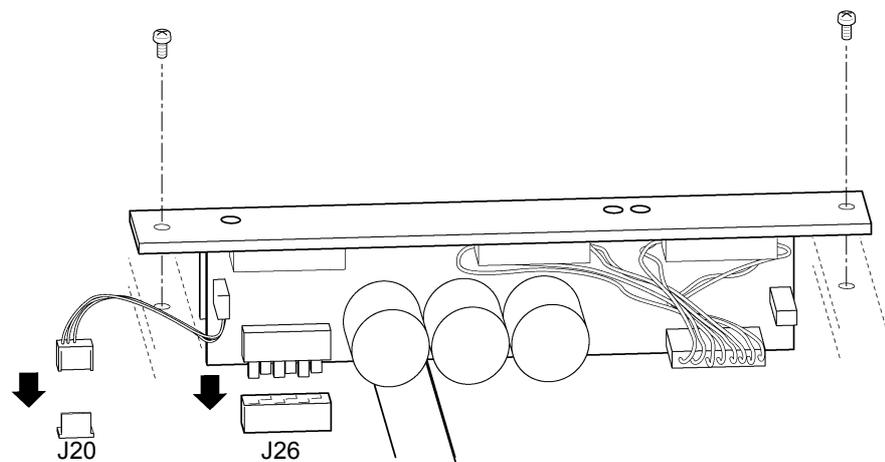
Replace the Regeneration module by following the steps described below.

- (1) Shut down Windows.
- (2) Turn OFF the Control Unit and four-axis Drive Unit.
- (3) Disconnect all the cables from the back of the four-axis Drive Unit.
- (4) Wait for about 1 minute until the high voltage is completely discharged.
- (5) Remove the Top Cover by removing the eight mounting screws.
- (6) Make sure that LED #9 (orange) on the DPB is OFF. The capacitors are not completely discharged if this LED is ON. Wait until the LED goes OFF.
- (7) Remove the two mounting screws for the Regeneration module (for RC520DU).

- (8) Lift up the Regeneration module (for RC520DU) carefully, and disconnect the connector J20 from the DPB.



- (9) Connect the J20 connector of a new Regeneration module (for RC520DU) to the DPB.
- (10) The new Regeneration module (for RC520DU) must be pushed in carefully, while making sure that the J26 connector engages properly.

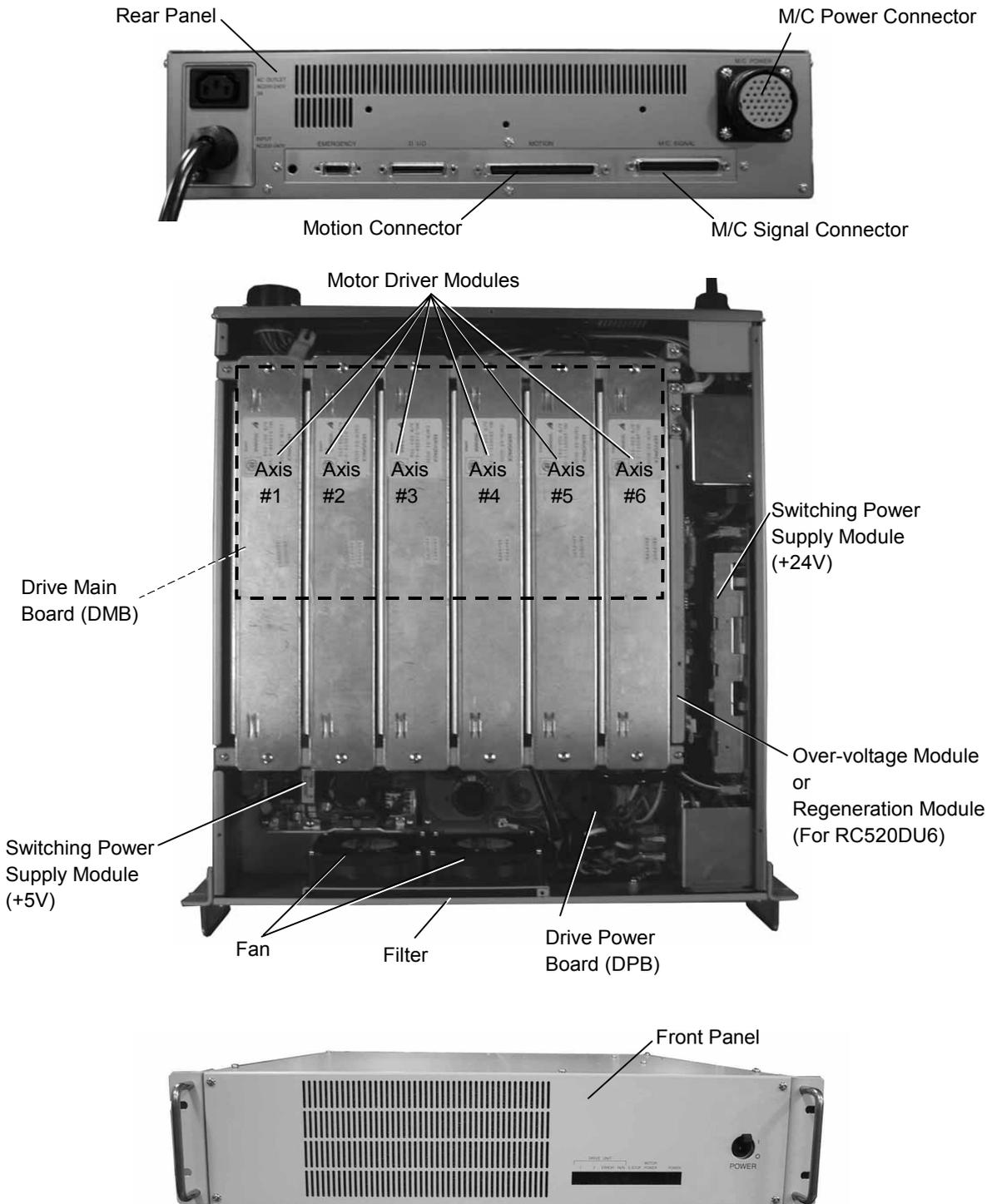


- (11) Secure the Regeneration module (for RC520DU) with two mounting screws securely.
- (12) Secure the Top Cover with four mounting screws.
- (13) Connect cables connected at the back of the four-axis Drive Unit that was removed in procedure (3).

6. Six-axis Drive Unit (RC520DU6)

6.1 Overview

The figures below show the rear, top, and front views of the RC520 six-axis Drive Unit.



6.2 Pin Assignments for the System Connectors

The following tables show the pin assignments for the M/C power connector, M/C signal connector and Motion connector respectively. As for the pin assignments of the connectors not covered in this section, refer to the *Setup & Operation*.

6.2.1 M/C Power

Pin No.	Signal Name	Pin No.	Signal Name
1	1U	19	5V
2	2U	20	6V
3	2W	21	6W
4	3U	22	–
5	1V	23	FGND
6	1W	24	FGND
7	2V	25	FGND
8	3V	26	FGND
9	3W	27	FGND
10	–	28	FGND
11	4U	29	EMBGND
12	5U	30	6EMB
13	5W	31	5EMB
14	6U	32	4EMB
15	–	33	EMBGND
16	–	34	3EMB
17	4V	35	2EMB
18	4W	36	1EMB
		37	FGND

6.2.2 M/C Signal

Pin No.	Signal Name	Pin No.	Signal Name
1	+24V	20	1S
2	GND	21	$\overline{1S}$
3	+24V	22	2S
4	GND	23	$\overline{2S}$
5	+24V	24	3S
6	GND	25	$\overline{3S}$
7	+24V	26	4S
8	GND	27	$\overline{4S}$
9	+24V	28	5S
10	GND	29	$\overline{5S}$
11	+24V	30	6S
12	GND	31	$\overline{6S}$
13	–	32	–
14	–	33	–
15	–	34	–
16	–	35	–
17	–	36	+24V
18	+24V	37	GND
19	POWER LED		



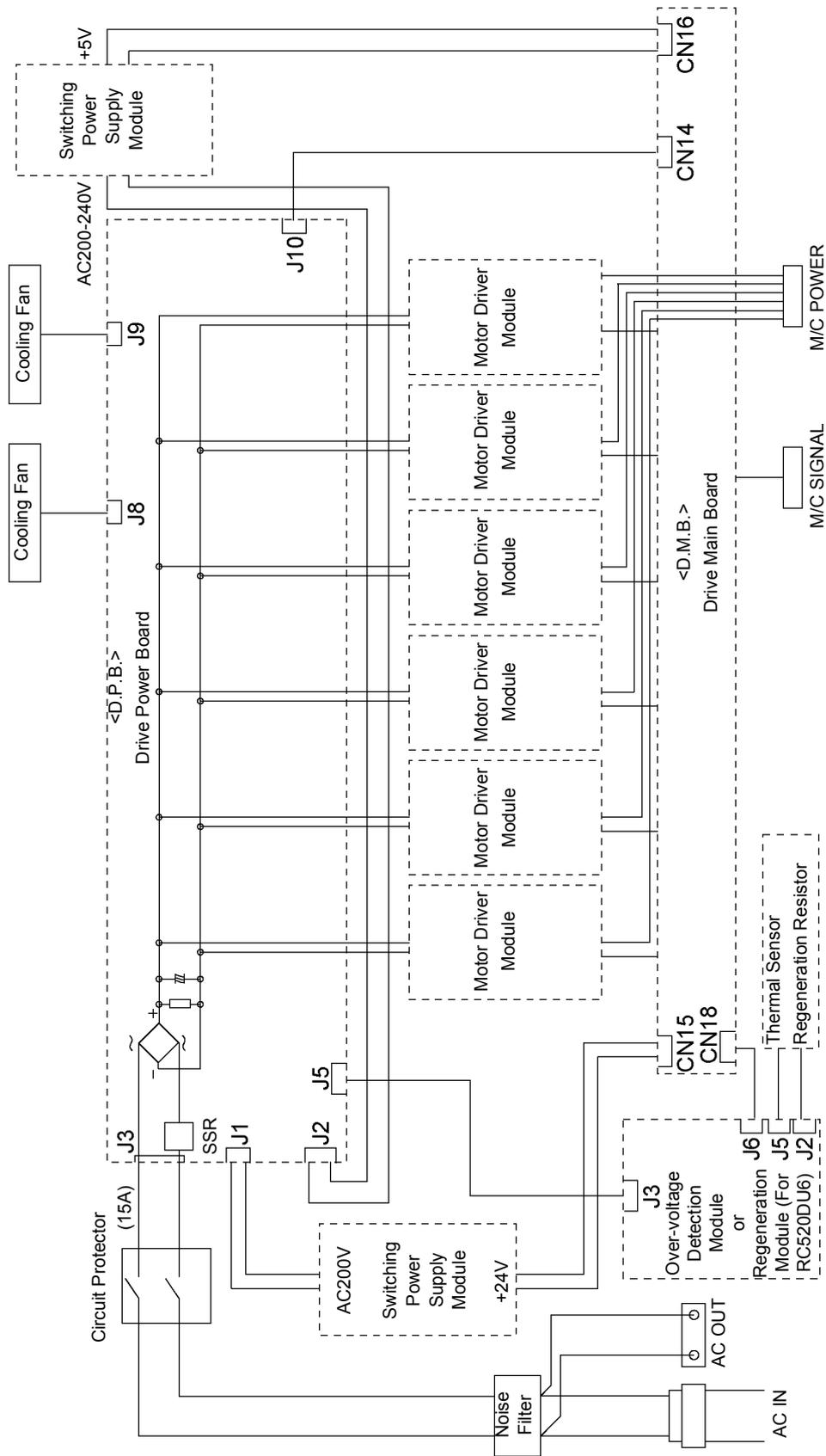
The Drive Unit and Manipulator's pin numbering layouts differ: one is lined horizontally and the other is lined vertically.

6.2.3 MOTION

The pin assignments of the MOTION connector for the six-axis Drive Unit are in common with ones for the four-axis Drive Unit. Refer to the Maintenance 5.2.3 *MOTION*.

6.3 Six-axis Drive Unit

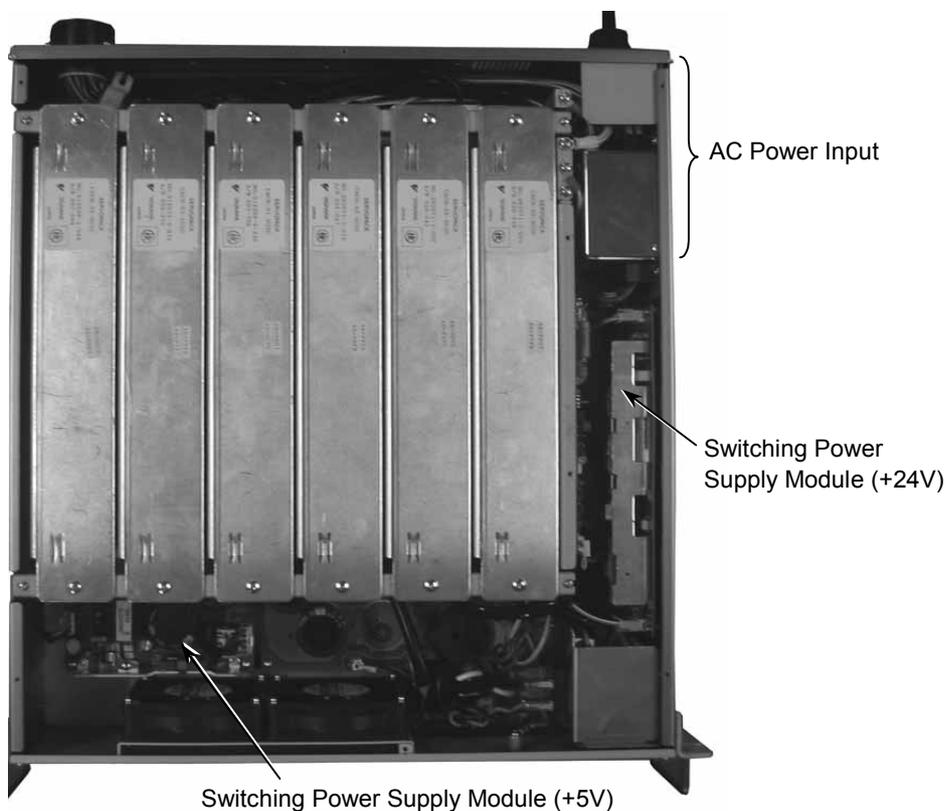
6.3.1 System Configuration of Six-axis Drive Unit



6.3.2 Module Functions and Layout

The six-axis Drive Unit consists of AC Power Input and Switching Power Supply modules. The functions of each module are described in the table below. The following figure illustrates the locations in the Drive Unit for each module to be installed.

Module	Description
AC Power Input	AC200 V (or the local equivalent) is input in this module. The noise filter, surge protector, and so on are installed in this module.
Switching Power Supply (+5 V)	This module outputs +5 V rectified from AC200 V (or the local equivalent) as the control power source.
Switching Power Supply (+24 V)	This module outputs +24 V rectified from AC200 V (or the local equivalent) as the control power source.



6.3.3 Inspecting the Switching Power Supply Module

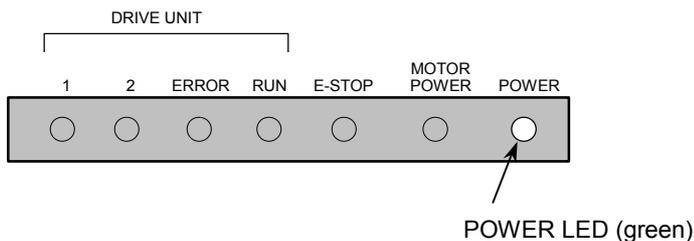
The Switching Power Supply module rectifies AC200 V (or the local equivalent) and outputs +24 V and +5 V.

Inspect the Switching Power Supply module by following the steps as described below:

- (1) Turn ON the six-axis Drive Unit(s).
- (2) Check that the six-axis Drive Unit's front panel POWER LED (green) is ON.



If this LED is either OFF or dim, suspect that the +24 V power output is not normal.

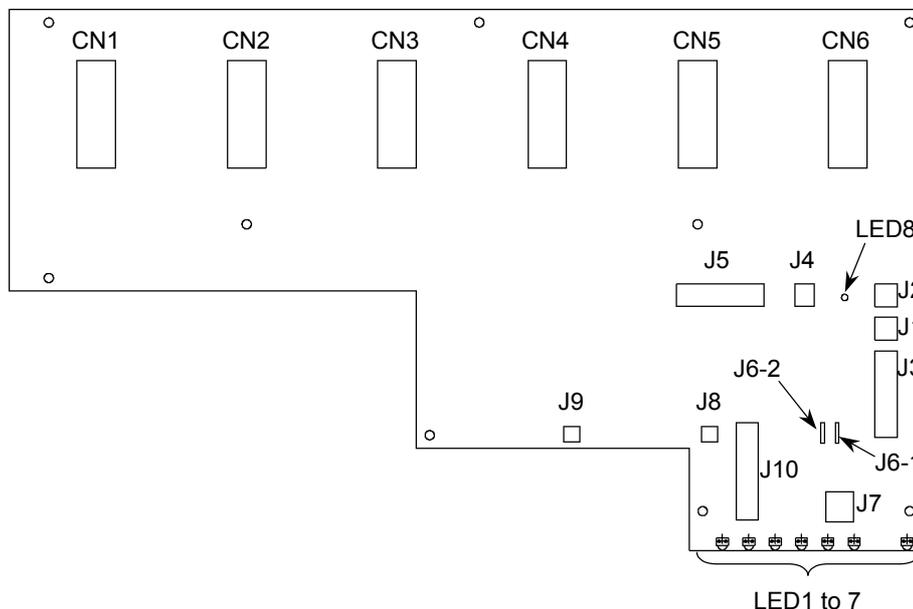


6.4 Motor Driver Module

The motor driver module for the six-axis Drive Unit is in common with the one for the four-axis Drive Unit. Refer to the Maintenance 5.4 Motor Driver Module.

6.5 DPB (Drive Power Board)

6.5.1 Layout and Functions



Connector

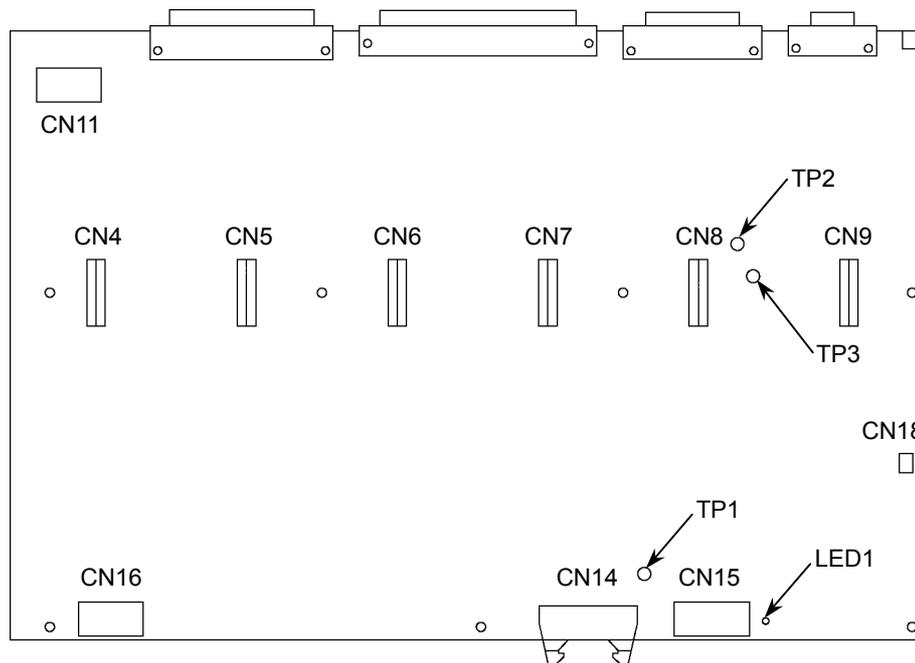
Connector No.	Function						
J1	The connector to output AC200 V (or the local equivalent) power to the Switching Power Supply module +24 V						
J2	The connector to output AC200 V (or the local equivalent) power to the Switching Power Supply module +5 V						
J3	The connector to input the AC200 V (or the local equivalent) power						
J4	The connector for the discharging resistor						
J5	The installed module is different depending on the Manipulator modes.						
	<table border="1"> <thead> <tr> <th>Module</th> <th>Manipulator</th> </tr> </thead> <tbody> <tr> <td>Over-voltage Detection Module</td> <td>PS3</td> </tr> <tr> <td>Regeneration Module (For RC520DU6)</td> <td>PS3L PS3LP PS5</td> </tr> </tbody> </table>	Module	Manipulator	Over-voltage Detection Module	PS3	Regeneration Module (For RC520DU6)	PS3L PS3LP PS5
	Module	Manipulator					
Over-voltage Detection Module	PS3						
Regeneration Module (For RC520DU6)	PS3L PS3LP PS5						
J6_1, 2	The connector for the SSR (Solid State Relay)						
J7	The connector for the SSR (Solid State Relay)						
J8, J9	The connectors for the Cooling Fans						
J10	The connector for the interface cable to the DMB						
CN1 through 6	The connectors to output motor power to the Motor Driver module						

LED

LED No.	Function		
LED1	<table border="1"> <tr> <td>MOTOR POWER</td> <td>Lights when the motor power is ON. (Motor Power: The DC power supply that inputs to the Motor Driver module to drive the motor. This DC power is generated by regulating AC200 V or the local equivalent power.)</td> </tr> </table>	MOTOR POWER	Lights when the motor power is ON. (Motor Power: The DC power supply that inputs to the Motor Driver module to drive the motor. This DC power is generated by regulating AC200 V or the local equivalent power.)
MOTOR POWER	Lights when the motor power is ON. (Motor Power: The DC power supply that inputs to the Motor Driver module to drive the motor. This DC power is generated by regulating AC200 V or the local equivalent power.)		
LED2	<table border="1"> <tr> <td>1</td> <td>LED “1” indicates that an unresettable error relating to motor control with/in any of the Manipulator axes occurs.</td> </tr> </table>	1	LED “1” indicates that an unresettable error relating to motor control with/in any of the Manipulator axes occurs.
1	LED “1” indicates that an unresettable error relating to motor control with/in any of the Manipulator axes occurs.		
LED3	<table border="1"> <tr> <td>2</td> <td>LED “2” indicates that a resettable error relating to motor control with/in any of the Manipulator axes occurs.</td> </tr> </table>	2	LED “2” indicates that a resettable error relating to motor control with/in any of the Manipulator axes occurs.
2	LED “2” indicates that a resettable error relating to motor control with/in any of the Manipulator axes occurs.		
LED4	<table border="1"> <tr> <td>ERROR</td> <td>Lights when the CPU of the six-axis Drive Unit detects an error.</td> </tr> </table>	ERROR	Lights when the CPU of the six-axis Drive Unit detects an error.
ERROR	Lights when the CPU of the six-axis Drive Unit detects an error.		
LED5	<table border="1"> <tr> <td>RUN</td> <td>Lights while the CPU of the six-axis Drive Unit is operating normally.</td> </tr> </table>	RUN	Lights while the CPU of the six-axis Drive Unit is operating normally.
RUN	Lights while the CPU of the six-axis Drive Unit is operating normally.		
LED6	<table border="1"> <tr> <td>E-STOP</td> <td>Lights when in the emergency stop condition.</td> </tr> </table>	E-STOP	Lights when in the emergency stop condition.
E-STOP	Lights when in the emergency stop condition.		
LED7	<table border="1"> <tr> <td>POWER</td> <td>Lights when the six-axis Drive Unit is turned ON.</td> </tr> </table>	POWER	Lights when the six-axis Drive Unit is turned ON.
POWER	Lights when the six-axis Drive Unit is turned ON.		
LED8	This LED indicates the charge status of the electrolytic capacitor.		

6.6 DMB (Drive Main Board)

6.6.1 Layout and Functions



The test pins for voltage check

No.	Description
TP1	GND
TP2	-5V voltage for the Motor Driver module
TP3	GND

LED

No.	Description
1	ON while the power for Encoder is output.

6.6.2 Replacing the DMB

 WARNING	<ul style="list-style-type: none"> Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.
---	---

Replace the DMB by following the steps described below.

- (1) Shut down Windows.
- (2) Turn OFF the Control Unit and six-axis Drive Unit.
- (3) Disconnect cables connected at the back of the six-axis Drive Unit.
- (4) Wait for about one minute until the high voltage is discharged.
- (5) Remove the Top Cover by removing the eight screws.

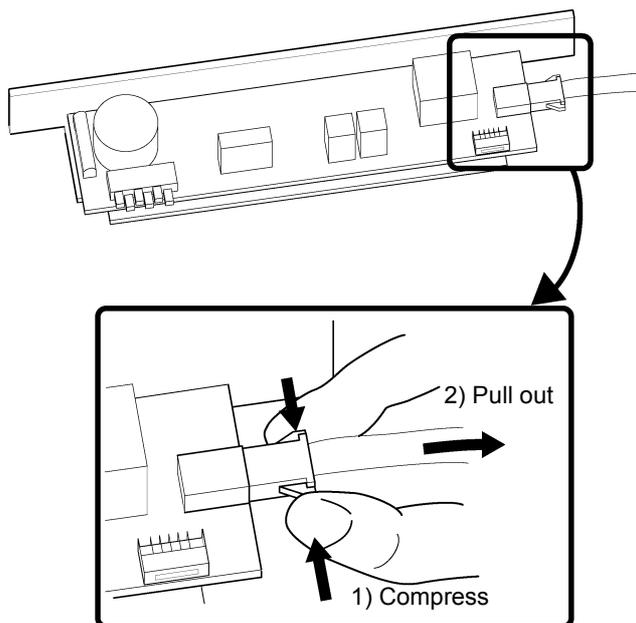
- (6) Remove the four DMB mounting screws on the back of the six-axis Drive Unit as shown below.



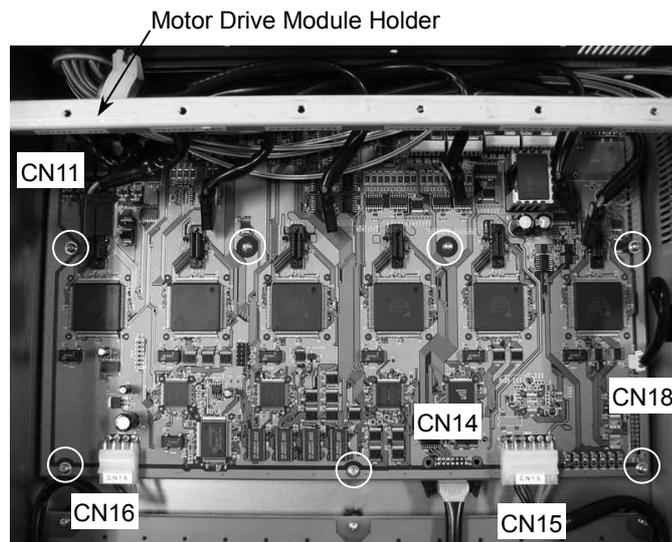
- (7) Make sure that the LED 8 (orange) on the DPB is OFF. The capacitors have not completely discharged if this LED is ON. Make sure to wait until the LED goes OFF.
- (8) As shown below, remove twelve M4 mounting screws on the motor drivers for six axes in the Drive Unit.



- (9) Lift up the Motor Driver module and disconnect cables from the back. Compress the projections on both sides of the connector to disconnect the cable.



- (10) Keep a written record of the corresponding axis number, CT data and the wattage so that the settings for the Motor Driver module remain the same.
- (11) Remove two screws from the motor driver module holder. Then remove the motor driver module holder.
- (12) Disconnect the connectors (CN11, 14, 15, 16, and 18).
- (13) Remove seven mounting screws securing the DMB in the six-axis Drive Unit.



- (14) Remove the old DMB.
- (15) Install the new DMB and secure it with seven mounting screws.
- (16) Connect the connectors (CN11, 14, 15, 16, and 18).
- (17) Mount the motor driver module holder on the six-axis Drive Unit.
- (18) Re-install the Motor Drivers and Top Cover.
- (19) Connect the cables that have been disconnected before the DMB replacement to the back of the six-axis Drive Unit.

6.7 Cooling Fan

6.7.1 Layout



Cooling Fan

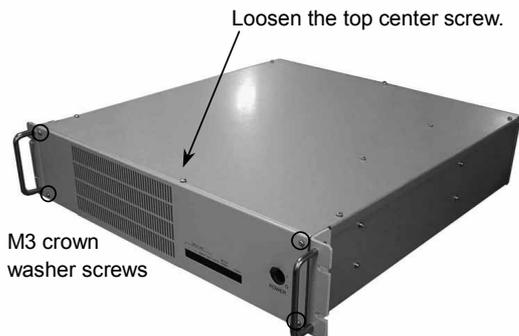
6.7.2 Inspecting the Fan Filter

 <p>WARNING</p>	<ul style="list-style-type: none">■ Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.
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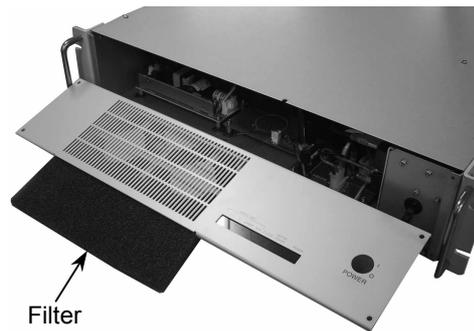
When you inspect the fan and clean the filter, follow the steps described below.

- (1) Shut down Windows.
- (2) Turn OFF the Control Unit and the six-axis Drive Unit.
- (3) Wait for about one minute until the high voltage is discharged.
- (4) Loosen five screws and remove the front panel as shown below.
The top center screw only needs to be loosened to remove the panel.

NOTE  Be careful not to pull out the front panel too far because the power cable of the fan is still connected to the DPB.



- (5) Pull out the filter for cleaning as shown below.



- (6) The filter may be cleaned either by vacuuming the dust or rinsing in water. (The filter must be thoroughly dry before being reinstalled.)
- (7) Reinstall the filter to its original location.
- (8) Reattach the front panel to the Drive Unit.
- (9) Turn ON the six-axis Drive Unit and make sure that the fan operates normally.

6.7.3 Replacing the Fan

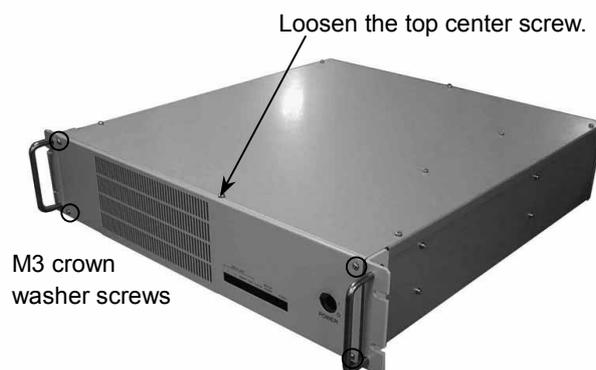
 WARNING	<ul style="list-style-type: none"> ■ Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.
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Replace the fan by following the steps described below.

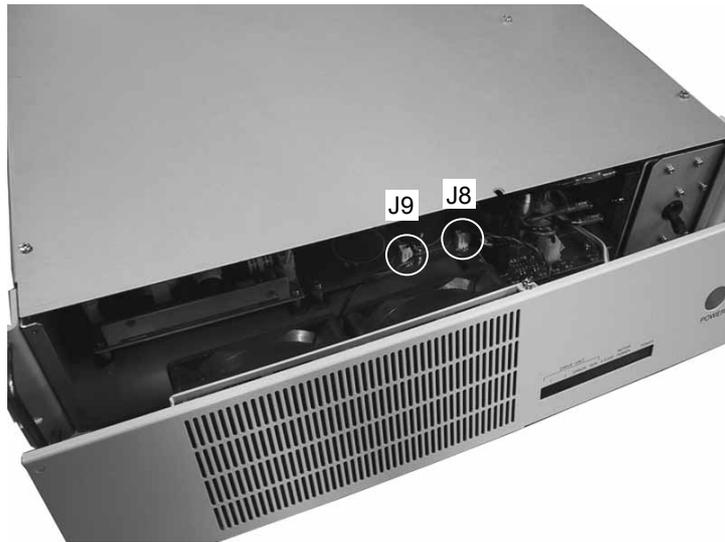
- (1) Shut down Windows.
- (2) Turn OFF the Control Unit and the six-axis Drive Unit.
- (3) Wait for about one minute until the high voltage is discharged.
- (4) Loosen five screws and remove the front panel as shown below. The top center screw only needs to be loosened to remove the panel.



NOTE Be careful not to pull out the front panel too far because the power cable of the fan is still connected to the DPB.



- (5) Disconnect the cables for the Cooling Fan from the connectors (J8 and J9) on the DPB.



- (6) Remove the eight mounting screws that hold the Cooling Fan in place.



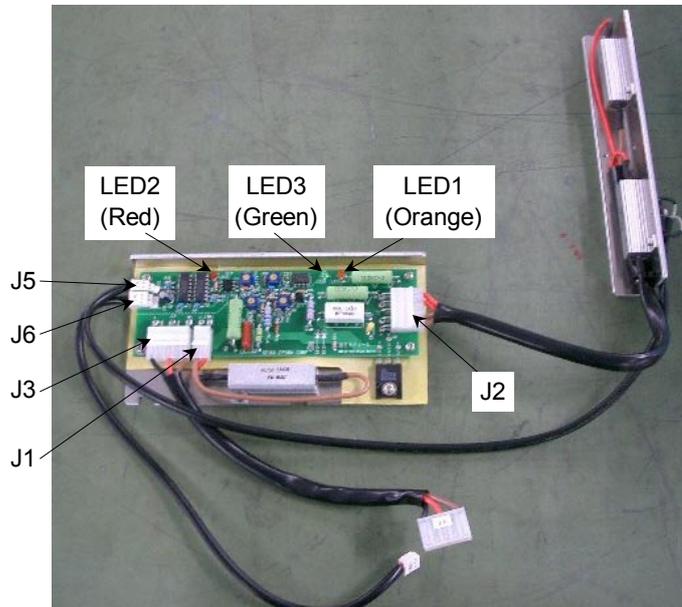
- (7) Install a new Cooling Fan, and connect the cable of the fan to the connector on the DPB.
- (8) Reattach the front panel.
- (9) Turn ON the six-axis Drive Unit and make sure that the new Cooling Fan runs properly.

6.8 Regeneration Module (For RC520DU6)

6.8.1 Layout and Functions

When the Manipulator connected to the RC520 is PS3L, PS3LP, or PS5, the regeneration module is installed in the Drive Unit.

When the Manipulator connected to the RC520 is PS3, refer to *Maintenance 6.9 Over-voltage Detection Module (For RC520DU6)*.



LED

LED No.	LED Color	Description
LED1	Orange	This LED is ON when the system is in the regenerative process. (This process is to reduce the regenerated electricity by using resistors when the motor is decelerating so that the circuit can be protected.)
LED2	Red	This LED is ON when the system is detecting over-voltage.
LED3	Green	This LED is ON when the motor power is ON. (It may flicker while the Manipulator(s) is/are operating.)

Connector

Connector No.	Connected To	Connector No.	Connected To
J1	Winding Resistor	J5	Thermal Sensor
J2	Regeneration Resistor Unit	J6	D.M.B - CN18
J3	D.P.B - J5		

Regeneration module consists of regeneration board unit and regeneration resistor unit.



Regeneration Board Unit



Regeneration Resistor Unit

6.8.2 Replacing the Regeneration Module (For RC520DU6)



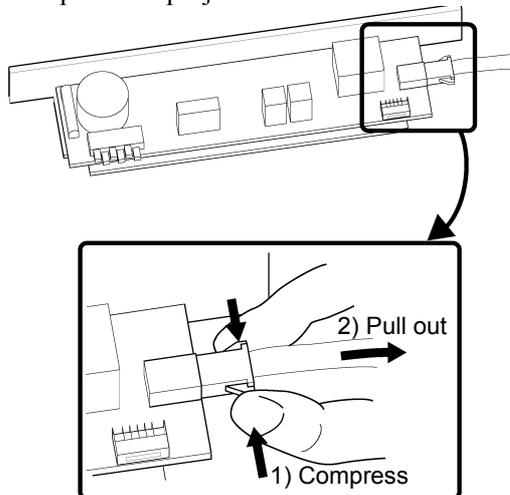
WARNING

- Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.

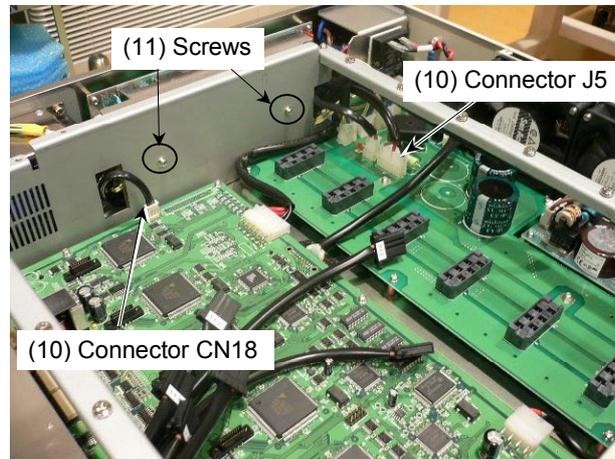
- (1) Shut down Windows.
- (2) Turn OFF the Control Unit and the six-axis Drive Unit.
- (3) Disconnect cables connected at the back of the six-axis Drive Unit.
- (4) Wait for about one minute until the high voltage is discharged.
- (5) Remove the Top Cover by removing the eight screws.
- (6) Make sure the LED8 (Orange) on the DMB is OFF.
The capacitors have not completely discharged if this LED is ON. Make sure to wait until the LED goes OFF.
- (7) As shown below, remove the twelve M4 mounting screws on the motor driver for six axes in the Drive Unit.



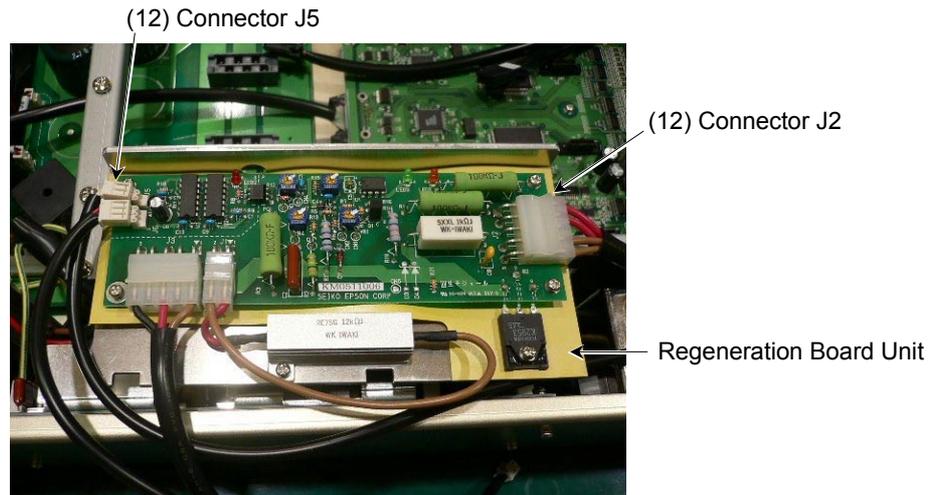
- (8) Lift up the Motor Driver module and disconnect cables from the back.
Compress the projections on both sides of the connector to disconnect the cable.



- (9) Keep a written record of the corresponding axis number, CT data, and wattage so that the setting for the Motor Driver module remains the same.
- (10) Disconnect the connector CN18 to the DMB side and the connector J5 to the DPB side.



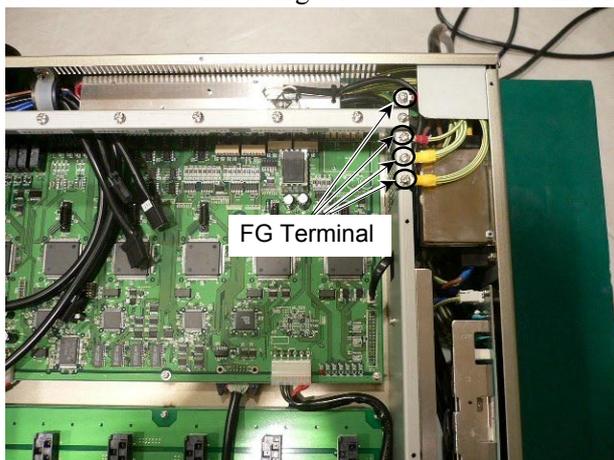
- (11) Remove the two mounting screws on the regeneration board unit.
- (12) Lift up the regeneration board unit carefully, and disconnect the connector J2 and J5 from the regeneration board unit.



- (13) Replace the regeneration board unit.
- (14) Remove the three mounting screws on the regeneration resistor unit.



(15) Remove the four mounting screws on the FG terminal.



(16) Replace the regeneration resistor unit.

(17) Install the new regeneration resistor unit and secure it with three mounting screws.



(18) Connect the connectors (J2 and J5) of the new regeneration resistor unit and the new regeneration board unit.

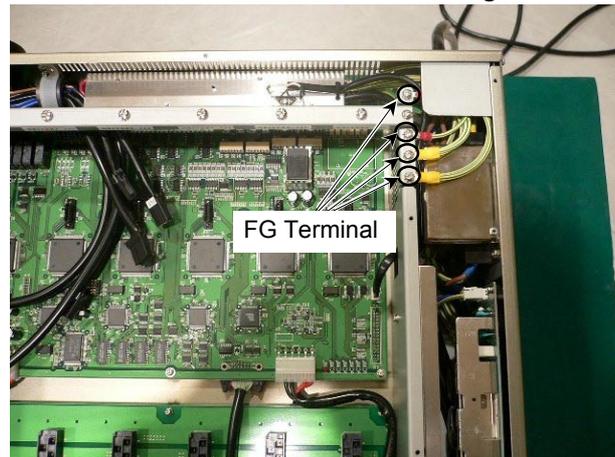
(18) Connector J5



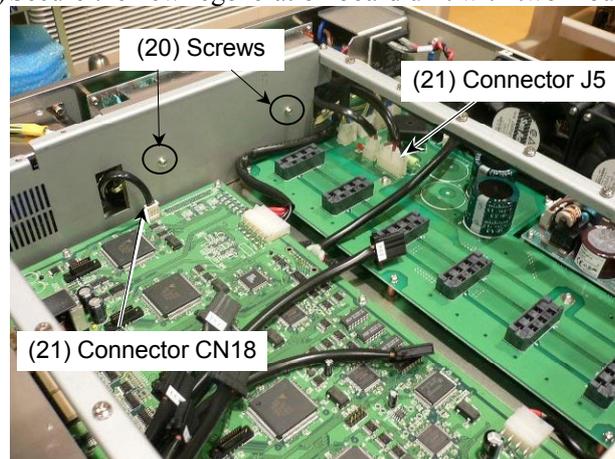
(18) Connector J2

Regeneration Board Unit

(19) Secure the FG terminal with four mounting screws.



(20) Secure the new regeneration board unit with two mounting screws.



(21) Connect the connector CN18 to the DMB and the connector J5 to the DPB.

(22) Secure the Motor Driver with twelve mounting screws.

(23) Reattach the Top Cover by securing it with eight screws.

(24) Connect cables connected at the back of the six-axis Drive Unit that was removed in procedure (3).

6.9 Over-voltage Detection Module (For RC520DU6)

6.9.1 Layout and Functions

When the Manipulator connected to the RC520 is PS3, the over-voltage detection module is installed in the Drive Unit.

When the Manipulator connected to the RC520 is PS3L, PS3LP, or PS5, refer to *Maintenance 6.8 Regeneration Module (For RC520DU6)*.

The LED and connectors are located at the same position as the regeneration module.



LED

LED No.	LED Color	Description
LED2	Red	This LED is ON when the system is detecting over-voltage.

Connector

Connector No.	Connected To
J3	D.P.B - J5
J5	Thermal Sensor
J6	D.M.B - CN18

6.9.2 Replacing the Over-voltage Detection Module (For RC520DU6)

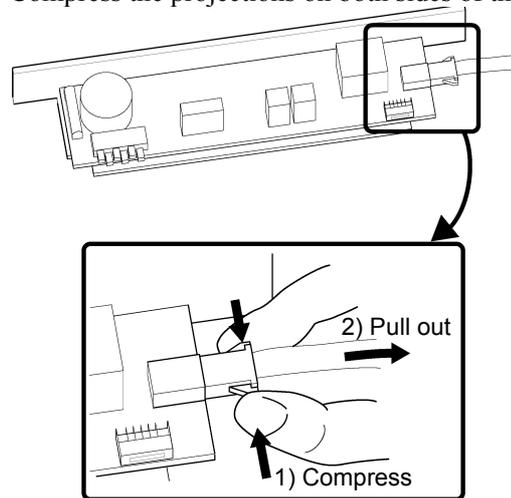
 WARNING	<ul style="list-style-type: none"> ■ Before performing any maintenance procedure, always make sure that the main power of the Controller is turned OFF and that the high voltage charged area is completely discharged. Performing any maintenance procedure while the main power is ON or the high voltage charged area isn't discharged completely is extremely hazardous and may result in electric shock and/or cause serious safety problems.
---	---

- (1) Shut down Windows.
- (2) Turn OFF the Control Unit and the six-axis Drive Unit.
- (3) Disconnect cables connected at the back of the six-axis Drive Unit.
- (4) Wait for about one minute until the high voltage is discharged.
- (5) Remove the Top Cover by removing the eight screws.
- (6) Make sure the LED8 (Orange) on the DMB is OFF.
 The capacitors have not completely discharged if this LED is ON. Make sure to wait until the LED goes OFF.

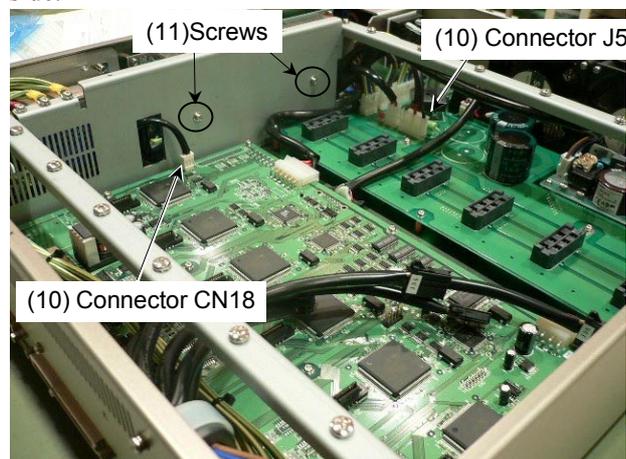
- (7) As shown below, remove the twelve M4 mounting screws on the motor driver for six axes in the Drive Unit.



- (8) Lift up the Motor Driver module and disconnect cables from the back. Compress the projections on both sides of the connector to disconnect the cable.

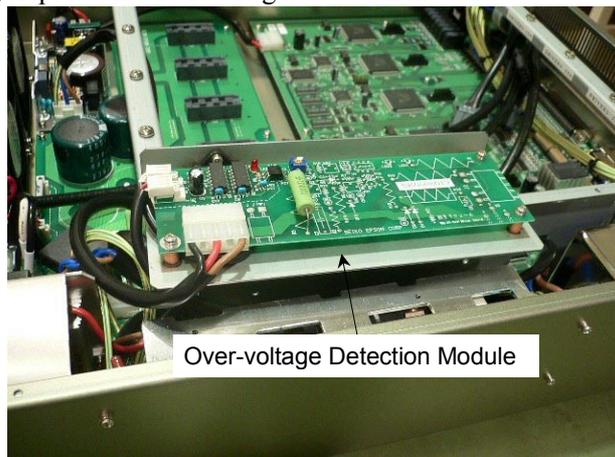


- (9) Keep a written record of the corresponding axis number, CT data, and wattage so that the setting for the Motor Driver module remains the same.
- (10) Disconnect the connector CN18 at the DMB side and the connector J5 at the DPB side.

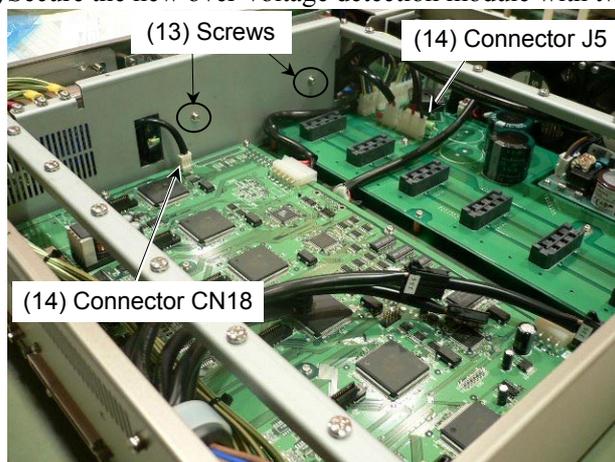


- (11) Remove the two mounting screws securing the over-voltage detection module.

(12) Replace the over-voltage detection module.



(13) Secure the new over-voltage detection module with two mounting screws.



(14) Connect the connector CN18 to the DMB, and the connector J5 to the DPB.

(15) Secure the Motor Driver with twelve mounting screws.

(16) Secure the Top Cover with eight mounting screws.

(17) Connect cables connected at the back of the six-axis Drive Unit that was removed in procedure (3).

7. Verifying Manipulator Operation

When the Manipulator(s), Control Unit or Drive Unit(s) has been maintained or, when any parts were replaced in those units, it must be checked according to the procedure in this section to ensure that the new setting(s) operates normally.

When only using the Control Unit, check the LED status on the system panel in the step, (2) described below.

(1) Completely connect all the necessary cables for the system.

 WARNING	<ul style="list-style-type: none"> ■ When verifying the robot system operation, prepare for failures with initial settings or wiring. If the Manipulator operates unusually by the failures with initial settings or wiring, press the Emergency Stop switch immediately to stop the Manipulator. Verify the robot system operation in the restricted (low speeds and low power) status. Verifying the robot system operation at high speeds may damage the robot system and/or cause serious safety problems as the Manipulator cannot stop operating immediately in case of abnormal operation of the Manipulator.
 CAUTION	<ul style="list-style-type: none"> ■ The serial number of the Manipulator that should be connected is indicated on the Connection Check Label on the Controller. Connect the Controller and the Manipulator correctly. Improper connection between the Controller and the Manipulator may cause improper function of the robot system and also safety problems. ■ If there is more than one Drive Unit connected to the Control Unit in the robot system, make sure that the DU numbers (DU1 - DU3) indicated above the MIB connector on the Control Unit and the Drive Unit (above the MOTION connector) match. Improper connection between the Control Unit and the Drive Unit may cause malfunction of the robot system and/or safety problems as it may make the Manipulator move abnormally.

(2) Turn ON both the Drive Unit and Control Unit. Boot the Controller. During this process, watch and monitor the LED status as described in the following list:

Drive Unit – Front Panel LEDs

	From power-on to boot	While running
POWER LED	The LED will be ON if the system is operating properly. When the LED is OFF, suspect that either there is an input/output failure in the Switching Power Supply module or a wiring failure in the Control Power Supply circuit.	
MOTOR POWER	The LED must be OFF.	The LED must be OFF when the motor is turned off.
E-STOP	The LED must be ON when the system is in E-STOP condition. This LED turns ON when there is an EMERGENCY STOP input to the Control Unit's OPTIONAL DEVICE connector and the Drive Unit's EMERGENCY connector.	
RUN	The LED must be blinking.	The LED must be ON.
ERROR	The LED must be blinking.	The LED must be OFF under normal conditions. The LED must turn ON when there is a system error.
1	The LED must be OFF.	The LED must turn ON when there is an unresettable error on the motor control.
2	The LED must be OFF.	The LED turns ON when there is a resettable error on the motor control.

Control Unit – System Panel LEDs

	From power-on to boot	While running
E-STOP	When the main power is turned ON, the LED must turn ON momentarily and must go OFF unless there is an emergency stop input. If there is an emergency stop input at this time, the LED must stay ON. This LED turns ON when there is an EMERGENCY STOP input to the Control Unit's OPTIONAL DEVICE connector and the Drive Unit's EMERGENCY connector.	
RUN	The LED must be blinking.	The LED must be ON.
ERROR	The LED must be blinking.	The LED is OFF under normal conditions. It must turn ON when there is a system error.
7 segment	When the main power is turned ON, "8" lights up momentarily and goes OFF. The displayed data must change from "0" in order to indicate the system condition that is checked at the beginning of the Controller.	The LED is OFF under normal conditions. In case of system error, it must display the status of the error by the designated number. (For details, refer to the following manual.) EPSON RC+ : SPEL+ Language Reference - <i>SPEL+ Error Messages</i> SPEL CT : User's Guide Introduction Appendix - <i>Appendix B SPEL CT Execution Error Messages</i>

- (3) Execute MOTOR ON and check the followings:
 - No error displayed.
 - The MOTOR POWER LED on the Drive Unit's Front Panel turns ON.
 - The Manipulator operates normally, and there is excitation.
- (4) Execute various motion commands (such as JUMP, etc.). The Manipulator must operate accordingly and normally without vibration or unusual sounds.

8. Recovering the HDD

This chapter describes the procedure for recovering the current HDD in the RC520 Embedded OS is installed in.

Follow the procedure below to recover the HDD.

Recovery Procedure		Reference
1	Backing Up the Current Data Settings	<i>Maintenance 2.5 Backup of Data</i>
2	Recovering Windows	<i>Maintenance 8.1 Recovering Windows</i>
3	Configuring Windows	<i>Maintenance 8.2 Configuring Windows.</i>
4	Setting Up EPSON RC+	<i>Maintenance 8.3 Setting Up EPSON RC+</i>
	Setting Up SPEL CT	<i>Maintenance 8.4 Setting Up SPEL CT</i>
5	Restoring the Backup Data	<i>Maintenance 2.5 Backup of Data</i>

Please prepare the parts below.

Parts	Note
Recovery CD	Attachment to RC520
EPSON RC+ setup CD-ROM or SPEL CT setup disks	
PS/2 keyboard	Only USB keyboard users
PS/2 mouse	Only USB mouse users



USB keyboard and USB mouse cannot be used for Windows recovery. Be sure to use PS/2 keyboard and PS/2 mouse.



HDD for RC520 that installs Windows XP does not support recovery. Contact us when recovery is necessary.

8.1 Recovering Windows



CAUTION

- When the Windows is recovered, all the data in the HDD will be erased. Make sure to make a back up of data before recovering Windows. The procedure for backup is described in *Maintenance 2.5 Backup of Data*.
- When the Windows is recovered, all the partition including the created partition in the HDD will be erased and only the C drive will remain. All the data in the HDD will be erased. Make sure to make a back up of data before the recovery. The procedure for backup is described in *Maintenance 2.5 Backup of Data*.

8.1.1 Recovery Procedure

There are Robot Controllers with “EasyRestore” license label (following label) and without the label for RC520 (Embedded OS).



The recovery procedure for each Controller (with and without label) is different. Check which type your product is and follow the relevant recovery procedure.

NOTE


When “EasyRestore” license label is labeled on the RC520.

Refer to *8.1.2 Windows Recovery (With “EasyRestore” License Label)*.

NOTE


When “EasyRestore” license label is NOT labeled on the RC520.

Refer to *8.1.3 Windows Recovery (Without “EasyRestore” License Label)*.

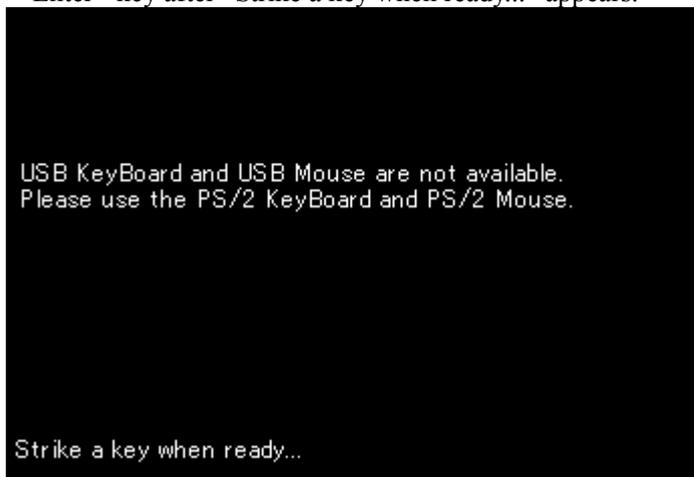
8.1.2 Windows Recovery (With “EasyRestore” License Label)

NOTE


When you accidentally turn ON the RC520 with the recovery CD in its CD-ROM drive, the RC520 will start from the recovery CD. In this case, turn OFF the Controller before the restore begins. The restore will not begin until you click the <Yes> button in the following procedure (9).

- (1) Connect the PS/2 keyboard and the PS/2 mouse. (The USB keyboard and the USB mouse cannot be used in Windows recovery.)
- (2) Turn ON the RC520.
- (3) Set the recovery CD to the CD-ROM drive.

- (4) The message “USB Key Board and USB Mouse are not available. Please use the PS/2 Key Board and PS/2 Mouse.” appears. Read the message and press the <Enter> key after “Strike a key when ready...” appears.



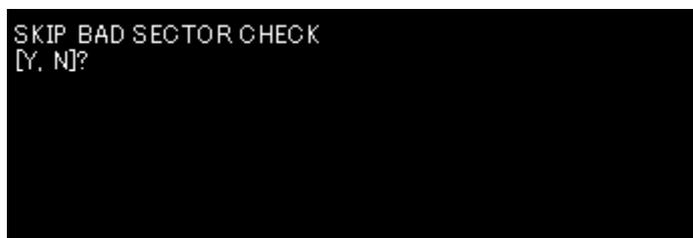
NOTE


- (5) After “SKIP BAD SECTOR CHECK [Y, N]” appears, press the <Y> or the <N> key. The time required will change by the key selection since the process changes. The required is only a measure.

Key	Descriptions	Time Required
Y	Skip the bad sector check	About 4 minutes
N	Do not skip the bad sector check	About 20 minutes

NOTE


When the replaced HDD is a new purchased one, there are no problems by selecting “Y”. For the recovery of the HDD that has been used in the RC520, selecting “N” is recommended.



- (6) Terms of use appears. Follow the procedure and press the <Enter> key three times.
- (7) Easy Restore starts.



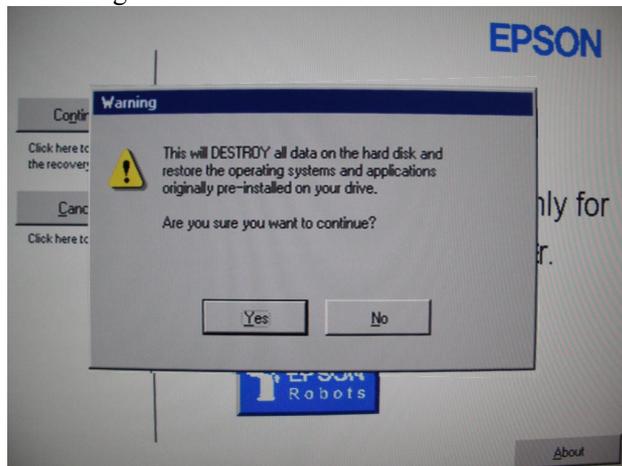
NOTE


- (8) Click the <Continue> button. If you click the <Cancel> button, the Easy Restore ends. When you accidentally turned ON the RC520 with the recovery CD in its CD drive, click the <Cancel> button in this window.

(9) Check the contents of the [Warning] dialog and click the <Yes> button.

NOTE

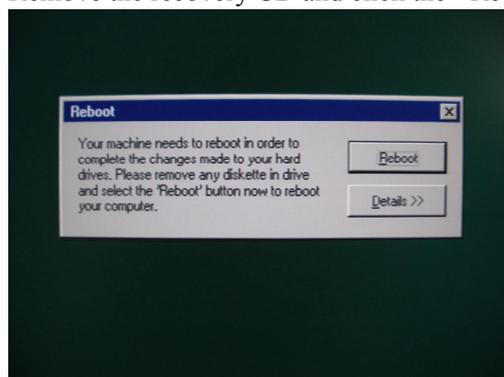

If clicking the <No> button, the Easy Restore ends. When you accidentally turned ON the RC520 with the recovery CD in its CD-ROM drive, click the <No> button in this dialog.



(10) The restore starts.



(11) After completing the restore, the [Reboot] dialog appears. Remove the recovery CD and click the <Reboot> button.



(12) Select the <Agree> option button in the License Agreement window and click the <Next> button.

(13) Enter the "Product Key" recorded on the COA label attached on the right side of the Control Unit (inside the front door) in the [Product Key] dialog and click the <Next> button.

- (14) Input the serial number (01-*****) of the RC520UC-1 to the [Computer Name] box in the [Computer Name and Administrator Password] dialog and click the <Next> button.
- (15) After rebooting, click the <OK> button in the [Windows Login] dialog.
- (16) Windows starts.



If the EPSON RC+ or the SPEL CT is not installed, the [Install the Robot Control Software] dialog appears when the Controller is started. Make sure to install the EPSON RC+ or the SPEL CT. If it is not installed, Windows will automatically shutdown in 30 minutes.

8.1.3 Windows Recovery (Without “EasyRestore” License Label)



When you accidentally turn ON the RC520 with the recovery CD in its CD-ROM drive, the RC520 will start from the recovery CD. In this case, turn OFF the Controller before the restore begins. The restore will not begin until you click the <Y> key in the following procedure (7).

- (1) Connect the PS/2 keyboard and the PS/2 mouse. (The USB keyboard and the USB mouse cannot be used in Windows recovery.)
- (2) Turn ON the RC520.
- (3) Set the recovery CD to the CD-ROM drive.
- (4) The message “USB Key Board and USB Mouse are not available. Please use the PS/2 Key Board and PS/2 Mouse.” appears. Read the message and press the <Enter> key after “Strike a key when ready...” appears.



- (5) After “SKIP BAD SECTOR CHECK?” appears, press the <Y> or the <N> key. The time required will change by the key selection since the process changes. The required is only a measure.

Key	Descriptions	Time Required
Y	Skip the bad sector check	About 7 minutes
N	Do not skip the bad sector check	About 80 minutes



When the replaced HDD is a new purchased one, there are no problems by selecting “Y”. For the recovery of the HDD that has been used in the RC520, selecting “N” is recommended.



- (6) The message “Select “CONTINUE” to Start the Recovery process. Select “CANCEL” to exit.” Appears. Read the message and press the <Y> key.



If you press the <N> key, Windows recovery will not be executed. When you accidentally turned ON the RC520 with the recovery CD in its CD drive, click the <Cancel> button in this window.



When you press the <Y> key, “BAD SECTOR TEST WILL BE SKIPPED” appears on the left top.

When you press the <N> key, “BAD SECTOR TEST WILL BE EXECUTED” appears on the left top.

- (7) If you press the <Y> key, recovery starts and deletes all the data in the HDD. Press the <Y> key to start the recovery.



If you press the <N> key, Windows recovery will not be executed. If you click the <Cancel> button, the Easy Restore ends. When you accidentally turned ON the RC520 with the recovery CD in its CD drive, click the <N> key in this window.

```
+ BAD SECTOR TEST WILL BE SKIPPED +

** WARNING! ** -----
+
+ - Recovery disk for EPSON ROBOT CONTROLLER RC520/RC420 - +
+
+ ** WARNING! ** +
+ This will be DESTROY all data on the hard disk and +
+ restore the operating systems and applications +
+ originally pre-installed on your drive. +
+
+ Are you sure want to continue? +
+
+ YES(Y) NO(N) +
+
-----
Enter selection: _
```

- (8) The restore starts.

```
Please wait...

PQIDePLOY DOS
Copyright (C) 1994-2004 Symantec Corporation
Build 170 on Nov 04, 2004 14:57:48

0:00 Entire Progress:10% Delete all:100%
0:37 Entire Progress:22% Restore:14% Copying data:19%
```

- (9) After the restore is completed, “A:\>” appears.

Remove the recovery startup disk and reboot the RC520.

```
Please wait...

PQIDePLOY DOS
Copyright (C) 1994-2004 Symantec Corporation
Build 170 on Nov 04, 2004 14:57:48

0:00 Entire Progress:10% Delete all:100%
5:58 Entire Progress:100% Restore:100%
5:58 Entire Progress:100%

The operation completed successfully.

Warning: Reboot machine before accessing modified partitions!
A:\>_
```

- (10) Select the <Agree> option button in the License Agreement window and click the <Next> button.

- (11) Enter the “Product Key” recorded on the COA label attached on the right side of the Control Unit (inside the front door) in the [Product Key] dialog and click the <Next> button.
- (12) Input the serial number (01-*****) of the RC520UC-1 to the [Computer Name] box in the [Computer Name and Administrator Password] dialog and click the <Next> button.
- (13) After rebooting, click the <OK> button in the [Windows Login] dialog.
- (14) Windows starts.



If the EPSON RC+ or the SPEL CT is not installed, the [Install the Robot Control Software] dialog appears when the Controller is started. Make sure to install the EPSON RC+ or the SPEL CT. If it is not installed, Windows will automatically shutdown in 30 minutes.

8.2 Configuring Windows

Disabling the Automatic Restart at System Error

- (1) Double-click the <My Computer> - <Control Panel> - <System> icons.
- (2) Select the [Advanced] tab in the [System Properties] dialog, and click the <Startup and Recovery> button.
- (3) Uncheck the [Automatically reboot] check box in the [System Failure] group box in the [Startup and Recovery] dialog. Then, click the <OK> button.
- (4) Another dialog appears. Click the <OK> button.
- (5) Click the <OK> button in the [System Properties] dialog.
- (6) Click the <No> button in the [System Settings Change] dialog.



Following items are set up by Windows recovery.

- Change the display configurations
- Power configurations
- Setting the Network to disabled
- Disabling the Check Disk during Windows start
- Changing the Communication Port COM3 configuration
- Disabling the automatic update

8.3 Setting Up EPSON RC+ (For EPSON RC+ User)

8.3.1 Installing EPSON RC+

- (1) Set the EPSON RC+ Setup CD-ROM in the CD-ROM drive.
- (2) The [EPSON RC+ Setup] dialog is automatically opened. (When the dialog is not automatically opened, select the [Run] from the [Start] menu and enter “d:\epsonrc\setup.exe” in the [Open] box. Then, click the <OK> button.)
- (3) Click the <Next> button in the [Welcome to the EPSON RC+ Installation] dialog.
- (4) Confirm that the Name is “EPSON RC User” and the Organization is “SEIKO EPSON CORP” in the [Customer Information] dialog. Then, click the <Next> button.
- (5) Confirm that the destination location drive is “C” in the [Choose Destination Location] dialog. Then, click the <Next> button.
- (6) Check the check box for the option you want to use in the [Select Options] dialog. Then, click the <Next> button.
- (7) When you checked the [Install Vision Guide] check box in the [Select Options] dialog, the [Select Vision System Type] dialog appears. Select the type you want to use and click the <Next> button.
- (8) Click the <Next> button in the [Start Copying Files] dialog.
- (9) The [Information] dialog appears. Click the <OK> button.
- (10) Click the <Next> button in the [Acrobat Reader Setup] dialog.
- (11) Click the <Next> button in the [Choose Destination Location] dialog.
- (12) The [Information] dialog appears. Click the <OK> button.
- (13) After the [InstallShield Wizard Complete] dialog appears, remove the EPSON RC+ Setup CD-ROM from the CD-ROM drive.
- (14) Select the <Yes, I want to restart my computer now.> option button in the dialog. Then, click the <Finish> button.

8.3.2 Reserving Address Resources of EPSON RC+ Options

To use the EPSON RC+ options “Expansion I/O Board”, “PG (Pulse Generating) Board”, and “Multi-Manipulator”, reserve address resources of each option.

- (1) Double-click the <My computer> - <Control Panel> - <System> icons.
- (2) Select the [Hardware] tab in the [System Properties] dialog and click the <Hardware Wizard> button.
- (3) Click the <Next> button in the [Welcome to the Add/Remove Hardware Wizard] dialog.
- (4) Select the <Add/Troubleshoot a device> option button in the [Choose a Hardware Task] dialog. Click the <Next> button.
- (5) Select the “Add a new device” in the [Choose a Hardware Device] dialog. Click the <Next> button.
- (6) Select the <No, I want to select the hardware from a list> option button in the [Find New Hardware] dialog. Click the <Next> button.
- (7) Select the “SPEL RESOURCE Drivers” in the [Hardware Type] dialog. Click the <Next> button.
- (8) Select the applicable Models for each option in the [Select a Device Driver] dialog. Click the <Next> button.

Expansion I/O Board	:	SPEL RESOURCE IO	*
PG (Pulse Generating) Board	:	SPEL RESOURCE PG	*
Multi-Manipulator	:	SPEL RESOURCE MIB	*

(The asterisk * indicates each board number.)
- (9) Another dialog appears. Click the <OK> button.
- (10) Click the <OK> button in the [Add New Hardware Wizard Properties] dialog.
- (11) Click the <Yes> button in the [Creating a Forced Configuration] dialog.
- (12) Click the <Next> button in the [Start Hardware installation] dialog.
- (13) Click the <Finish> button in the [Completing the Add/Remove Hardware Wizard] dialog.
- (14) When you continue reserving address resources of the EPSON RC+ options, click the <No> button in the [System Setting Change] dialog and repeat the same steps from (2) for each option.
When you finish reserving address resources of the EPSON RC+ options, click the <Yes> button in the [System Setting Change] dialog and restart Windows.



After setting up EPSON RC+, restore the backed-up data. For details, refer to the *Maintenance 2.5 Backup of Data*.

8.4 Setting Up SPEL CT (For SPEL CT User)

8.4.1 Installing SPEL CT

- (1) Set the first disk of the SPEL CT Setup Disks in the FDD.
- (2) Select the [Run] from the [Start] menu.
- (3) Enter “a:\setup” in the [Open] box in the [Run] dialog. Then, click the <OK> button.
- (4) Click the <Next> button in the [Welcome to the InstallShield Wizard for SPEL] dialog.
- (5) Confirm that the destination folder is “c:\PSPELWORK\” in the [Choose Destination Location] dialog. Then, click the <Next> button.
- (6) Select the “Install to Control Unit” in the [Setup Type] dialog. Then, click the <Next> button.
- (7) Check the [Help] and [Spel other Modules] check boxes in the [Setup Type / Select Install Modules] dialog, and click the <Next> button.
- (8) Select the <850MHz> option button in the [Setup Type / Select CPU clock of Control Unit] dialog. Click the <Next> button.
- (9) Check the [Add SPEL into StartUp] and [Add SPEL into Start Menu] check boxes in the [Setup Type / Select install options] dialog. Then, click the <Next> button.
- (10) Click the <Next> button in the [Start Copying Files] dialog.
- (11) When the [Setup Needs The Next Disk] dialog appears, set the required disk in the FDD and click the <OK> button. (Repeat this step for all the SPEL CT Setup Disks.)
- (12) Set each item in the [MIB] panel in the [SPEL Hardware Settings] dialog as shown below. Then, click the <OK> button.

No.	Current	Manipulator	I/O Address	Memory Address
1	Checked	Not Assigned	300	D8000
- (13) After the [Install Wizard Complete] dialog appears, remove the SPEL CT Setup Disk from the FDD.
- (14) Select the <Yes, I want to restart my computer now.> option button in the dialog. Then, click the <Finish> button.

8.4.2 Reserving Address Resources of SPEL CT Options

To use the SPEL CT options “Expansion I/O Board”, “Remote I/O Board”, “Pulse Generating Board”, and “Multi-Manipulator”, reserve address resources of each option.

- (1) Double-click the <My computer> - <Control Panel> - <System> icons.
- (2) Select the [Hardware] tab in the [System Properties] dialog. Click the <Hardware Wizard> button.
- (3) Click the <Next> button in the [Welcome to the Add/Remove Hardware Wizard] dialog.
- (4) Select the <Add/Troubleshoot a device> option button in the [Choose a Hardware Task] dialog. Then, click the <Next> button.
- (5) Select the “Add a new device” in the [Choose a Hardware Device] dialog, and click the <Next> button.
- (6) Select the <No, I want to select the hardware from a list> option button in the [Find New Hardware] dialog, and click the <Next> button.
- (7) Select the “SPEL RESOURCE Drivers” in the [Hardware Type] dialog, and click the <Next> button.

- (8) Select the applicable Models for each option in the [Select a Device Driver] dialog. Click the <Next> button.

Expansion I/O Board : SPEL RESOURCE IO *

Remote I/O Board : SPEL RESOURCE RIO *

Pulse Generating Board : SPEL RESOURCE PG *

Multi-Manipulator : SPEL RESOURCE MIB *

(The asterisk * indicates each board number.)

- (9) Another dialog appears. Click the <OK> button.
- (10) Click the <OK> button in the [Add New Hardware Wizard Properties] dialog.
- (11) Click the <Yes> button in the [Creating a Forced Configuration] dialog.
- (12) Click the <Next> button in the [Start Hardware installation] dialog.
- (13) Click the <Finish> button in the [Completing the Add/Remove Hardware Wizard] dialog.
- (14) When you continue reserving address resources of the SPEL CT options, click the <No> button in the [System Setting Change] dialog and repeat the same steps from (2) for each option.

When you finish reserving address resources of the SPEL CT options, click the <Yes> button in the [System Setting Change] dialog and restart Windows.



After setting up SPEL CT, restore the backed-up data. For details, refer to the *Maintenance 2.5 Backup of Data*.

9. Maintenance Parts List

Name		Code	Note	
MIB (Motion Interface board)		R12R520CUP001	SKP372-3	
System Panel II		R13R520CUP004	SKP 384/385	
Fan Filter for RC520CU-1		R13A060500600		
Cooling Fan for RC520CU-1		R13A060500500		
PC Power Cable		R12R500CUP013		
OPTIONAL DEVICE Dummy Plug		R12R500CUP018		
Software Options Key		R13A090300700	For EPSON RC+ Ver. 3.4 or 3.5	
		R13A090301300	For EPSON RC+ Ver. 3.6 or higher	
Protected Expansion I/O Board	PNP type	R12R520DIO001	SKP376	
	NPN type	R12R520DIO002	SKP376	
Expansion I/O Board		R13R500DIO003	SKP349	
Expansion I/O Cable		R12R500DIO004		
Terminal Block		R12R500DIO005		
Expansion I/O Connector		R12R500DIO006		
Motor Driver	50W	R12R520DRU003	CACR-A5-SU3C	
	100W	R12R520DRU004	CACR-01-SU3C	
	200W	R12R520DRU005	CACR-02-SU3CY1	
	400W	R12R520DRU006	CACR-04-SU3C	
	750W	R12R520DRU007	CACR-08-SU3C	
DMB	RC520DU	NPN Type	R12R520DRU011	SKP373
		PNP Type	R12R520DRU002	SKP373
	RC520DU6	NPN Type	R13B040201	
		PNP Type	R13B040202	
Fan Filter for Drive Unit		R13R500DRU012		
Cooling Fan for Drive Unit		R13R500DRU011		
Regeneration Module (For RC520DU)		R12R520DRU008	SKP375	
EMERGENCY Connector		R13R520DRU014		
Motion Cable		R13R500DRU013		
D-I/O Connector		R12R500DIO008		
D-I/O Cable		R12R500DIO007		
EMERGENCY Connector Plate Kit		R220500010010	SKP393	
MIB (for EMERGENCY Connector Plate Kit)		R220500010020	SKP372	
E. STOP Box		R12B020201	Standard accessory for UL specifications	
DIO Cable for RC520 (3 m)		R12B020203	For USA specification	
DIO Cable for RC520 (6 m)		R12B020204	For USA specification	
Terminal Block (USA specification)		R12B061001	For USA specification	

Name	Serial Number	Language	Code
2.5" HDD	-	-	R13A110401000
2.5" HDD with Windows XP Installation	S/N 01-30001 or later	Japanese	R13B110413
		English	R13B110414
Recovery HDD for RC520	From S/N 01-20001 to S/N 01-30000	Japanese	R13B110409
		English	R13B110410

Name	CPU board	Serial Number	Language	Code
2.5" HDD with Windows 2000 Installation	PC-686BX(PC)-* Separate Connectors for Mouse and Keyboard	From S/N 01-00001 to S/N 01-10000	Japanese	R13A110401100
			English	R13A110401200
	SPI-6941-* Integrated Connector for Mouse and Keyboard	From S/N 01-10001 to S/N 01-20000	Japanese	R13B110401
			English	R13B110402

The code of the 2.5" HDD installing Windows 2000 varies depending on the type of CPU board in the Controller.

Name	Connector for Mouse and Keyboard	Model Number	Serial Number	Code
CPU Board	Separate Connectors	PC-686BX(PC)-EPP850	From S/N 01-00001 to S/N 01-10000	R13A040000100
	Integrated Connector	SPI-6941EPP	S/N 01-10001 or later	R13B040001

The CPU board type has different model numbers and appearances depending on the dates of the shipping and the board changeover.

When the CPU board has been replaced for maintenance, the type of CPU board cannot be distinguished only by serial number. In such a case, see the type of connector for mouse and keyboard or the model number printed on the CPU board to distinguish the CPU board type.