EPSON

ROBOT CONTROLLER

SRC520

Rev.4   EM015C868F

ROBOT CONTROLLER   SRC520   Rev.4

ROBOT CONTROLLER

SRC520

Rev.4

FOREWORD

Thank you for the purchase of our robot for use in precision construction applications. This manual contains information that you need to know how to use the robot controller correctly. Please thoroughly read this and other related manuals before and while using the equipment.

- Robot controller SRC500/520 (including SRC520CE) is shown as "SRC5**" in relevant manual.

<div style="border:1px solid">

C E   • Only SRC520CE is a robot controller meets to the CE marking.

</div>
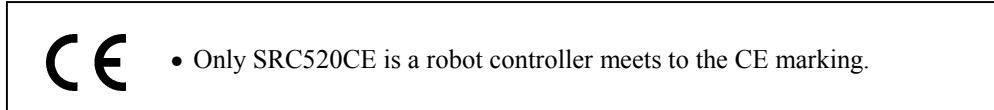
- The following mark is put to the description corresponding to only SRC520CE.

  520CE
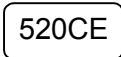
WARRANTY

The robot 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.

1. Warranty Period:	The warranty period is 12 months after delivery.
2. Warranty Coverage:	1) We warrant only the product we delivered.
	2) Product's malfunctions resulting from normal handling and operation will be repaired free of charge within this warranty period. Any other repairs after this warranty period ought to be invoiced.
3. Escape Clause:	Customers will be charged for repairs in the following cases even if it is within 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 customer's unauthorized reconstruction or disassembly.
	3) Damage due to improper adjustments or unauthorized repair attempts.
	4) Damage caused by natural disasters such as earthquake, flood, etc.
4. Caution:	1) If the robot 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) Of course, we cannot foresee all possible dangers and consequences. Therefore, this manual cannot warn the user of all possible hazards.

NOTICE

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

■ The content of this manual is subject to change without notice.

■ We ask that you please notify us if you should find any errors in this manual or if you have any comments regarding its content.

TRADEMARKS

Pentium is a trademark of the Intel Corporation.

Microsoft is a registered trademark and Windows and Windows logo are registered trademarks of the Microsoft Corporation.

Other brand and product names are trademarks or registered trademarks of the respective holders.

Please direct any inquiries about the use of this manual to:

Safety Precautions

Please carefully read this manual and any other manuals before installing this robot system (and definitely before connecting cables).   Keep this manual in a handy location for easy access at all times.

⚠ WARNING	This sign indicates that a danger of serious injury or death will exist if the instructions thereunder are not followed.
⚠ CAUTION	This sign indicates that ignoring the instructions thereunder may cause harm to people or physical damage to equipment and facilities.

⚠ WARNING

- The manufacturer/supplier must design and construct this robot system in accordance with the principles described in the "Safety" section of the SRC5**/SPEL 95 Introduction Manual.   Please read the Introduction Manual first to follow Safety Precautions therein.

- This robot has been designed and manufactured strictly for use in a normal indoor environment.   Do not use the robot in an environment that exceeds the conditions set forth in the manuals for the manipulator and controller.

- Do not use the robot outside of the usage conditions and product specifications described in the manuals.   Doing so will not only adversely affect the life of the product, but may also present a serious safety problem.

- Only trained personnel should be allowed to design, install, operate, perform function testing, and maintain this robot and the robot system.   Trained personnel are those who have taken a robot training course (held by the dealer on a regular basis) or those who have carefully read the manuals and have equivalent knowledge or skill.

Manuals (Relevant documentation)

1. SRC5**/SPEL 95 Introduction Manual
   SRC5**/SPEL 95 User's Guide
   SRC5**/SPEL 95 Appendix

   These manuals that describe the outline of SRC5** controller, manipulator, and SPEL 95 program development software. These manuals include explanations regarding basic operation, teaching, programming, and file management. Read these manuals first and learn the required operations.

2. Manipulator manual

   This manual describes the manipulator, which performs the actual movements.
   It contains requirements and safety-related information that should be read before installation.

3. Robot Controller manual

   This manual describes the controller functions, setup, and peripheral equipment wiring.
   It contains requirements and safety-related information that should be read before installation.
   Controller options:
   ● Multi-Manipulator Manual
   ● Pulse Generating Board Manual
   ● Ethernet Board Manual
   ● Remote I/O Board Manual
   ● Vision Calibration Guide
   ● M300 Micro Image-checker
   ● Custom Manipulator Tuning
   ● Operation Pendant OP500 Manual

Revised Points from SRC500

SRC520 is a succeeding model to SRC500. The function, operation and external dimension have not been changed. The main revised points are as follows:

● The unit for 2.5-inch hard disk drive has been able to be replaced from the front panel.
● The emergency stop circuit has been changed for double structure for safety.
  Therefore, the emergency connector standard has been changed.
  When connecting SRC520 to the emergency stop circuit that used to be connected to SRC500, a converting connector (option) is necessary.

Parts Compatibility between SRC500 and SRC520

The maintenance parts list in the "Maintenance 5. Maintenance Parts List" describes whether the maintenance parts for SRC520 are applicable to SRC500.
For more details, please contact us.

This manual describes about the robot controller SRC520 (including SRC520CE). The controller consists of one Control Unit and Drive Unit(s). You may find the controller model name on the front panels of them.

520CE

The model, SRC520 and SRC520CE, are quite different. Only SRC520CE is in conformity with the following EC directives:

Conformed to:	Applied Standards
Machinery directive	EN775, EN60204-1
EMC directive	EN55011, EN50082-2
Low Voltage directive	EN60950

SRC520CE Drive Unit(s) and SRC520CE Control Unit (with SPEL 95) compose a SRC520CE.

SRC520CE will not meet the above-mentioned Standards when the SRC520CE is remodeled and/or when the SRC520CE is connected with other controller.

SRC520CE provides only PNP-type I/O.
SRC520 provides NPN-type I/O, but PNP-type is prepared as an option.

SERVICE CENTER

Contact the following service center for robot repairs, inspections or adjustments. Please have the model name, the Serial No. of each unit, software version and a description of the problem ready when you call.

MANUFACTURER

SEIKO EPSON CORPORATION
Okaya Plant No. 2
1-16-15, Daiei-cho, Okaya-shi, Nagano-ken, 394-0025, Japan

TEL: 81-266-23-0020 (switchboard)
      81-266-24-2004 (direct)
FAX: 81-266-24-2017

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Maintenance

Function

The manual herein explains in detail the functions of the
robot controller, SRC520.

1. For Safety

1.1 Safety Precautions

⚠ WARNING	This sign indicates that a danger of serious injury or death will exist if instructions there under are not followed.
⚠ CAUTION	This sign indicates that ignoring the instructions there under may cause harm to people or physical damage to equipment and facilities.

⚠ WARNING

■ Do not open the cover(s) of the Control and Drive Units except while maintaining them. Because of the high voltage charger inside the Control Unit and Drive Unit, there is a risk of fatal electrical shock even when its main power is OFF.

■ If it is necessary to change the plug to fit the outlet in your factory, be certain to connect the earth wire of the AC power cable colored green/yellow 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. Never connect the controller directly to the factory power supply.

■ Make sure that the power to the Control Unit and Drive Unit is turned OFF before connecting or disconnecting any cables. Failure to do so may cause electric shock and may damage the units.

■ The interlock of the Safety Door must be functioning when the system is operated. It is dangerous to operate the system unless the Safety Door switch is in a completely functioning condition.

■ Do refer to the typical application diagram in "Function 5.4 Circuit Diagrams" in this manual when wiring to the EMERGENCY connector so that it should not dysfunction the emergency stop input at the Optional Units via the OPTIONAL DEVICE connector.

┌───┐

⚠ CAUTION

■ The power supply voltage switch on the Control Unit must be set and kept at [230] side (AC200V to AC240V) when using the Control Unit with other equipment. If connecting the equipment with AC200V (or the local equivalent) under the condition that the power supply voltage switch is set at [115] side (AC100V to AC120V), the equipment will be damaged seriously.

■ Only install optional hardware specifically designed for the SRC520 in the Control Unit. Do not install any other software than originally installed in the Control Unit at shipping. Otherwise, the warranty is void.

■ Check on the Connection Check Label, DU number (at Control Unit) and Signature Labels (at Drive Unit & Manipulator) when connecting those units. If those units are misconnected, the robot may not function properly or may be damaged.

■ If there are more than one Drive Units connected to the Control Unit, make sure that the DU numbers (DU1 - DU3) indicated at the Control Unit (above the MIB connector) and the Drive Unit (above the MOTION connector) match. It is highly dangerous if those do not match, causing to activate an unintended robot.

■ Ensure all cables are securely connected. Avoid placing anything heavy on the cables, and, do not bend them excessively, because this may damage the cables, preventing the robot from functioning properly.

■ The AC power cable and the AC OUTLET connector on the Drive Unit are directly connected inside the unit. Therefore, no matter if the Drive Unit is ON or OFF, the AC OUTLET connector is constantly outputting AC200V (or the local equivalent) power which requires extra caution.

■ When using I/O at the remote setup, always make sure before allowing current to flow that the cable connection matches to the pin assignments. Failure to do so may cause damage to/by the peripheral equipment.
At performance testing, prepare for some kind of failure with initial settings or cable connection and, therefore, take extra caution.

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1.2 Safety Features

Provided against unexpected contingencies, the robot features the following safety measures.   However, the user is recommended to strictly follow the proper usage of the robot by thoroughly reading the attached manuals at the very beginning.   Skipping the proper steps of usage relying on the featured safety functions is highly dangerous.

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

Emergency Stop Switch:

Optional operation units, JP500 (Jog Pad) and OP500 (Operation Pendant), are equipped with the Emergency Stop Switch that connects to the OPTIONAL DEVICE connector at the Control Unit.   The emergency stop switch can also be provided on an external devices/unit that connects to the EMERGENCY connector at the Drive Unit.

By connecting those switches to the relays in the Motor Driver modules at the Drive Unit, they activate as dynamic braking.   When the switch is pressed, the motor power is shut down right away, and the robot will enter the emergency stop condition.

Safety Door Input:

Opening the Safety Door stops the robot right away for the time being.   In order to activate this feature, make sure that the Safety Door Input switch is connected to the EMERGENCY connector at the Drive Unit.

Low Power Mode:

The motor power is reduced in this mode.   During the ATTEND operation mode to perform teaching, the robot automatically operates with slower speed.   When the Safety Door is open while the robot operates in the NORMAL operation mode, the robot temporarily stops and enters the operation-prohibited status.

Dynamic Brake:

The dynamic brake circuit includes the relays that shorting the motor power cable at the motor module or connecting it to the motor driver module.   When those relays are short, the power to the Motor Driver module is cut off thus stopping the motor.   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 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 load on the motor is detected to exceed its capacity.

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

The dynamic brake circuit is activated when irregularity with the 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 motor is detected running at the speed not as specified.

Positioning Overflow - Servo Error - Detection:

The dynamic brake circuit is activated when the robot's "actual position" is detected to mark an overflow (the actual position is outside the nominal range) error.

Speed Overflow - Servo Error - Detection:

The dynamic brake circuit is activated when the robot's actual speed is detected to mark an overflow (the actual speed is outside the nominal range) error.

CPU Irregularity Detection:

Irregularity at the motor controlling CPU is detected by the 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 against each other for any discrepancies between the units.   If the discrepancy error is detected, the dynamic brake circuit is activated.

Memory Check-sum Error Detection:

The dynamic brake circuit is activated when the check-sum error of memory 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 goes up above the nominal limit.

2. Part Names and Functions

2.1 System Configuration

The SRC520 is consisted of one Control Unit and Drive Unit(s). One Drive Unit enables controlling up to 4 axes/motors at once. Up to three Drive Units can be connected to one Control Unit.

For details of the Control Unit, refer to the "Function 2.3 Control Unit".

For details of the Drive Unit, refer to the "Function 2.4 Drive Unit".

Example 1 : One Drive Unit and One Manipulator
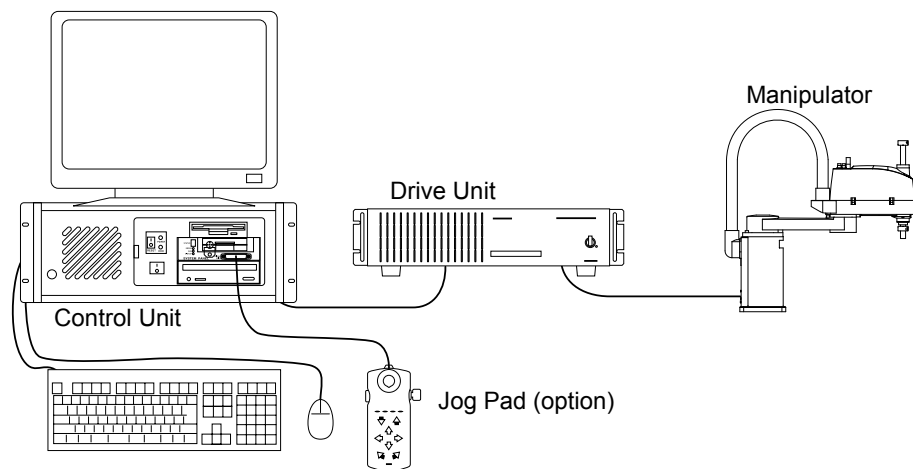
Example 2 ： Three Drive Units and Three Manipulators
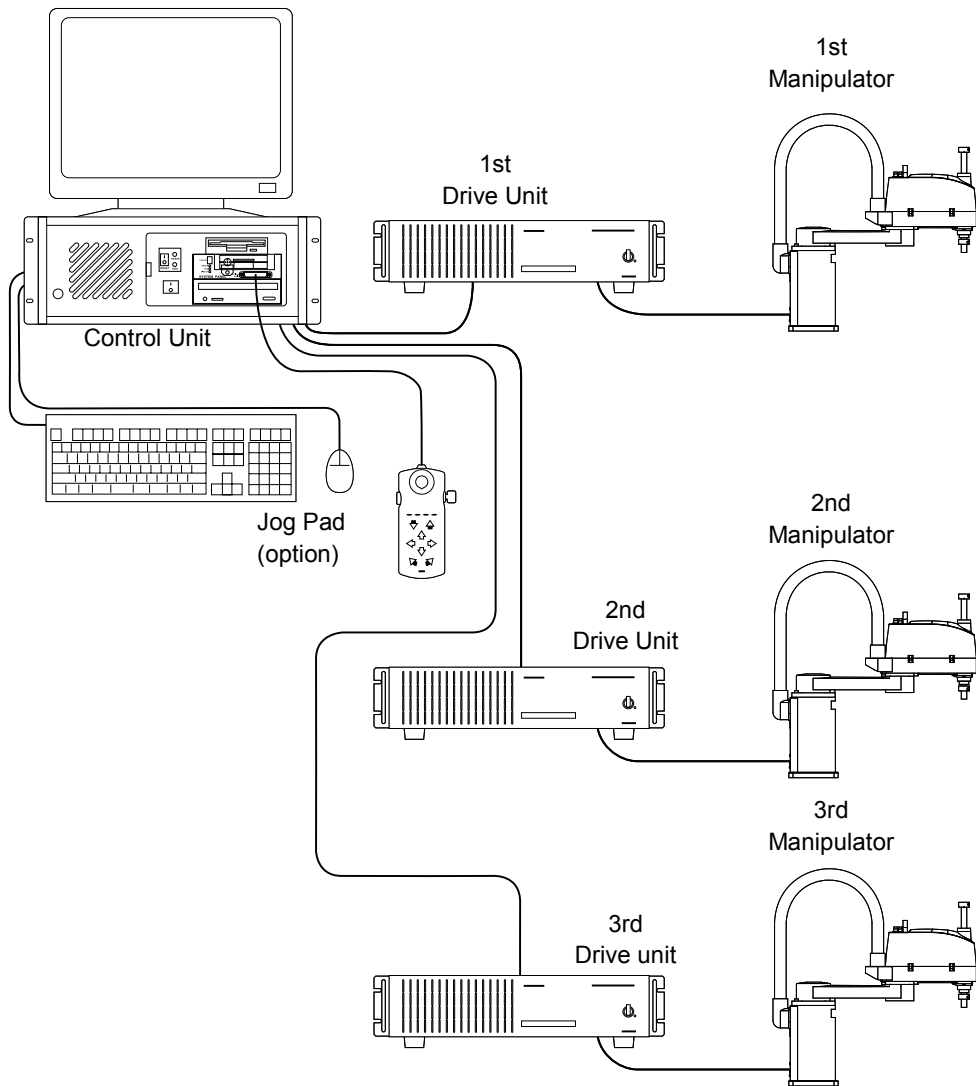
2.2 Standard Specifications

Item	Specification		
Model	SRC520		
Control Unit	PC compatible computer optimized for SRC520: CPU : Pentium 200MHz or faster HD/RAM : 1GB/32MB or more OS : Windows 95		
Drive Unit	Up to four (4) connectable AC Servo Motors		
Controllable Axes	Max. 16 (For the number of controlled axis, refer to the "Function 2.3.5 Control Unit Capability".)		
Robot Manipulator Control	Programming Language and Robot Control Software	SPEL 95 (a multi-task 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 : 2MB Pose Data Area : Max. 2000 poses programmable (per Manipulator)		
Teaching Method	Remote Direct MDI (Manual Data Input)		
External Input/ Output Signals	Standard I/O	input : 16 output : 16	Remote functions allocable
	Extension I/O	input : 32 (per board) output : 32 (per board)	
	Remote I/O	Up to 128 (per board) for both input and output included	
	Total I/O	input : 512 output : 512	
Communication Interface	RS-232C (×2) (standard) Ethernet (option)		

Item	Specification
Safety Features	- 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 Drive Module - Safety key lock on the JP500/OP500 for mode switch (NORMAL/ATTEND).
Option	- Extension I/O Board (Input: 32 Output: 32 / A special optional cable is prepared.) - Pulse Generating Board (4 additional controllable axes/one board / A special optional cable is prepared.) - Remote I/O Board (Input and Output total: 128) - Ethernet Board - Vision Option - Multi-Manipulator Option - Custom Manipulator Option - Conveyor Tracking Option - Jog Pad, JP500 - Operation Pendant, OP500
Power Source	AC 200V to AC 240V / Single phase 50/60Hz *
Power Consumption	Max. 2000W (Depending on the manipulator model) *
Insulation Resistance	100MΩ or more
Rated Ambient Temperature	5 to 40 °C
Rated Relative Humidity	10 to 80 %
Weight	Control Unit :18 kg Drive Unit :14 kg
Size	For the Control Unit, refer to the "Function 2.3.4 Dimensions". For the Drive Unit, refer to the "Function 2.4.5 Dimensions".

* When only using the Control Unit, the specification is different.
  Refer to the "Function 11. Stand-alone Option for SRC520".

520CE

SRC520CE is in conformity with the following EC directives:

Conformed to:	Applied Standards
Machinery directive	EN775, EN60204-1
EMC directive	EN55011, EN50082-2
Low Voltage directive	EN60950

2.3 Control Unit

2.3.1 Control Unit

Control Unit is a FA personal computer that packages a MIB (Motion Interface Board) and a system panel.   The Control Unit sends a command to the Drive Unit to control the motor.   The Control Unit also controls such peripheral devices as I/O and stepping motors.

⚠ CAUTION

■ The power supply voltage switch on the Control Unit must be set and kept at [230] side (AC200V to AC240V) when using the Control Unit with other equipment.   If connecting the equipment with AC200V (or the local equivalent) under the condition that the power supply voltage switch is set at [115] side (AC100V to AC120V), the equipment will be damaged seriously.
As for the power supply when only using the Control Unit, refer to the "11.4 Power Supply" in the "Function 11. Stand-alone Option for SRC520".

■ Only install optional hardware specifically designed for the SRC520 in the Control Unit.   Do not install any other software than originally installed in the Control Unit at shipping.   Otherwise, the warranty is void.

2.3.2 Front Panel

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

Closed

Key Cylinder
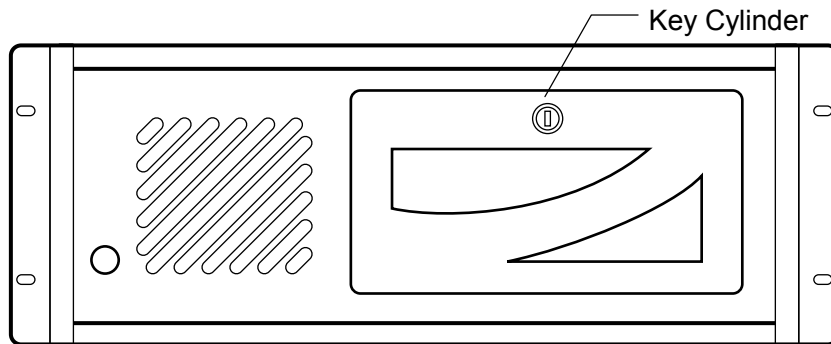
When the door is open, the System Panel appears to enable various operations. (Refer to (1) through (11) on the next page.)

Open

(Certain PC panels may appear differently from the figure.)
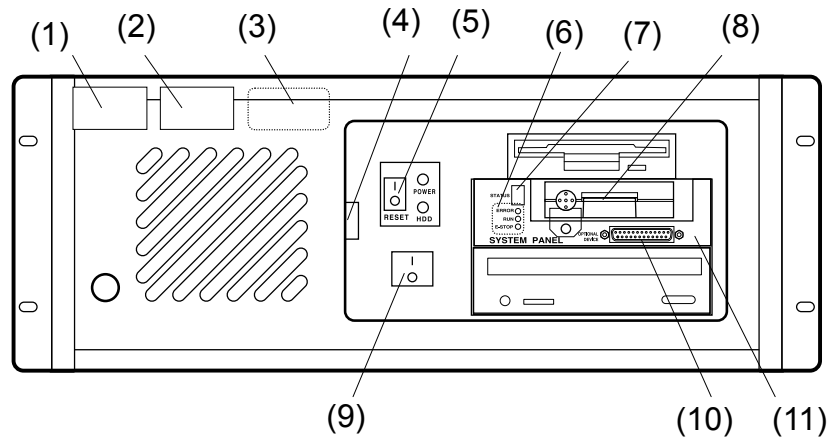
(1) Signature label:
The serial number of the Control Unit is recorded.

(2) Connection Check label:
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

(3) MT label:
The label indicates the specification number for the customized robot and is attached only to the customized robot. If your robot indicates this label, it may require a specific maintenance procedure. For such robot with this label, make sure to contact your dealer before any maintenance procedures.

(4) Cooling Fan Filter:
A filter for a cooling fan.   It can be pulled out to the right by pulling the tab forward. The filter needs regular check-up and cleaning.

(5) RESET switch:
Resets the Control Unit to restart.

(6) LED:
The lamp indicates the following status when it turns ON:

LED	Color	Description
E-STOP	Red	The computer is in the emergency stop condition.
RUN	Green	The computer is operating normally.
ERROR	Red	There is an error.

(7) STATUS:
     Seven-segment LED as one-digit 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
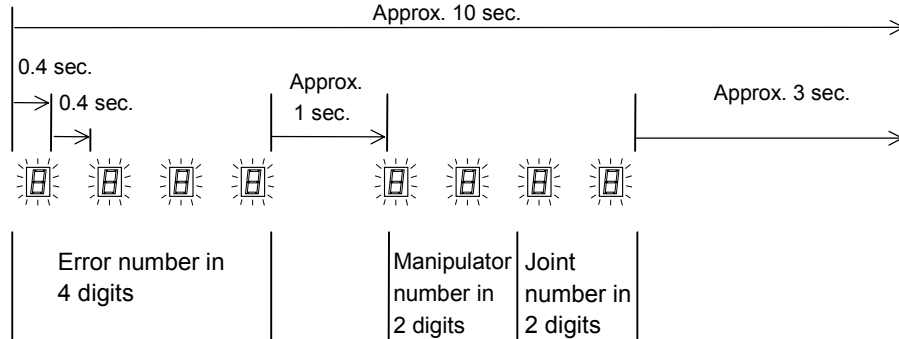
     The above mentioned cycle (which lasts approximately 10 seconds) repeats and is displayed until the error is canceled or the power is OFF.

    Error Number   : Four-digit error numbers are displayed.
                                    For details, refer to the SRC5**/SPEL 95 Appendix manual for the error number table in the "Appendix B".

    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.

(8) HDD (for the removable HD unit model):
     The disk drive is mounted on the removable case.   Refer to the "Maintenance 3.7 Replacing the HDD for Removable HD Unit Model" for the method of replacing HDD.

(9) Power switch:
     Turns ON or OFF the Control Unit.

(10) OPTIONAL DEVICE connector:
     Connects the optional operating unit.
     For details, refer to the "Function 4. OPTIONAL DEVICE Connector".

(11) SYSTEM PANEL:
     Special system panel for SRC520.   This has the connectors for operation units and the LED for indicating the status.

2.3.3 Rear Panel

Name and functions as follows:
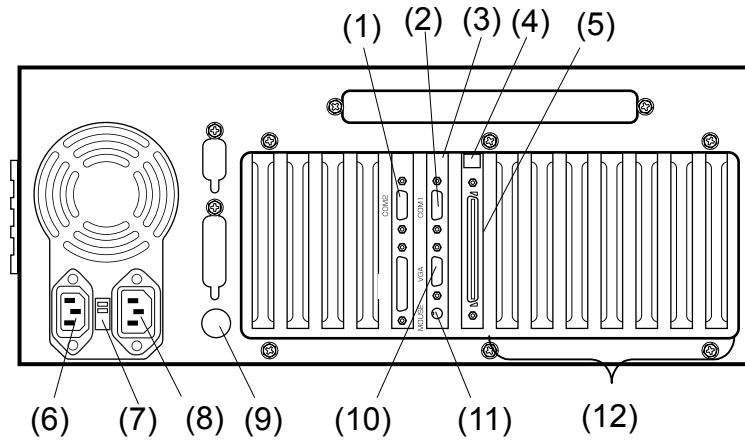
(1) RS-232C connector (COM2):
    This connector facilitates data communication and centralized control by connecting peripheral equipment and the host computer to the Control Unit.
    For details, refer to the "Function 9. RS-232C Settings".

(2) RS-232C connector (COM1):
    This connector facilitates data communication and centralized control by connecting peripheral equipment and the host computer to the Control Unit.
    For details, refer to the "Function 9. RS-232C Settings".

(3) CPU Board:
    The board packages a Pentium CPU.   The standard package includes 32MB memory.

    The jumpers on the type MSC1551 CPU board are originally set as shown in the table.   Normally, the default settings do not need to be changed for regular usage.

Jumper No.	Defines:	Settings	Set for:
JP2	BUS Clock and CPU Type	2-4,3-5	BUS Clock 66MHz Pentium MMX 200MHz
JP4		2-4,3-5	
JP8		7-8	
JP9		5-6,7-8	
JP7	COM2	All open	RS-232C
JP6	Keyboard/Mouse	1-3, 2-4	Mouse
JP12	Unused	1-2	Unused

(4) 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.

(5) MIB (Motion Interface Board):
A board is to allow for communication between the Control Unit and the Drive Unit. The controller has one MIB mounted on its extension slot for each Drive Unit connected.   The maximum number of MIBs that can be mounted in the PC is three (3).

(6) AC IN:
The Drive Unit outputs from its AC OUTLET connector AC200V which is input to this connector at the Control Unit.

(7) Power Supply Voltage Switch:
The power supply voltage switch on the Control Unit must be set and kept at [230] side (AC200V to AC240V) when using the Control Unit with other equipment. When only using the Control Unit, the setting is different.   Refer to the "Function 11. Stand-alone Option for SRC520" for the "11.4 Power Supply".

(8) AC OUT:
The AC OUT connector outputs the power to the monitor.

(9) Keyboard connector:
A socket is to connect with a keyboard.   To connect a type PS/2 connector keyboard, use a dedicated adapter (PS/2 keyboard adapter) included in the accessories.

(10)VGA connector:
A socket is to connect with a VGA monitor.

(11)Mouse connector:
A socket is to connect with a mouse.

(12)System Extension (Optional Board) Slots:
Up to 7 slots are available for optional boards such as the Extension I/O Board or Pulse Generating Board.   Do not mount the boards other than the optional boards of SRC520.

2.3.4 Dimensions
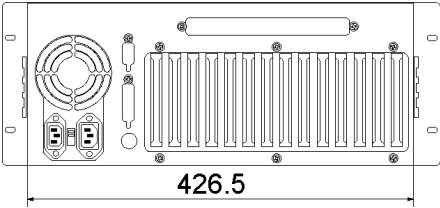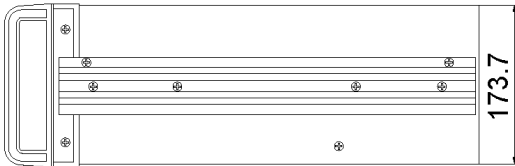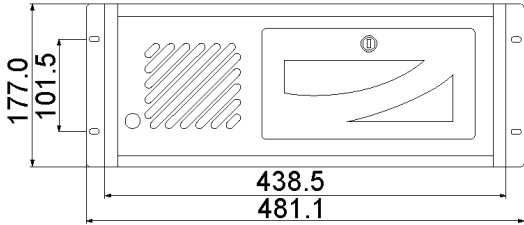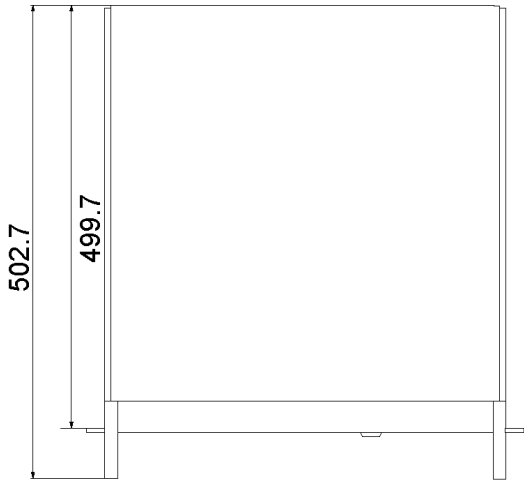
[mm]

2.3.5 Control Unit Capability

The capability of the SRC520 Control Unit with regards to the max. number of controllable manipulators (=motor axes) is as in the table below:

When the CP motion is used:

		0	1	2	3	4	5	6	7	8	9	10	11	12	13-16
		\# of controllable motor axes from the Pulse Generating (P/G) Board(s)													
Number of * Manipulators	0	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	1	O	O	O	O	O	O	O	O	O	O	O	O	O	
	2	O	O	O	O	O	O	O	O	O					
	3	O	O	×	×	×									

When the CP motion is not used:

		0	1	2	3	4	5	6	7	8	9	10	11	12	13-16
		\# of controllable motor axes from the Pulse Generating (P/G) Board(s)													
Number of * Manipulators	0	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	1	O	O	O	O	O	O	O	O	O	O	O	O	O	
	2	O	O	O	O	O	O	O	O	O					
	3	O	O	O	O	O									

* : This "Manipulator" means a manipulator with the SRC520 Drive Unit of 4 motor-axis capabilities.

NOTE

The above tables presume the Control Unit equipped with Pentium MMX 200MHz CPU and RAM 32MB.

The "O" indicates possible combination of the number of motor axes and the Manipulator.

If it is desirable to run a Visual BASIC or Microsoft EXCEL application via OLE I/F to monitor operation, you need to install an additional 32MB RAM (SIMM).

2.4   Drive Unit

2.4.1 Drive Unit

The Drive Unit controls the motor/axes as it receives a command from the Control Unit. One Drive Unit is capable of controlling (a motor with) up to four (4) axes.   Up to three (3) Drive Units are connectable to a Control Unit.

2.4.2   Front Panel
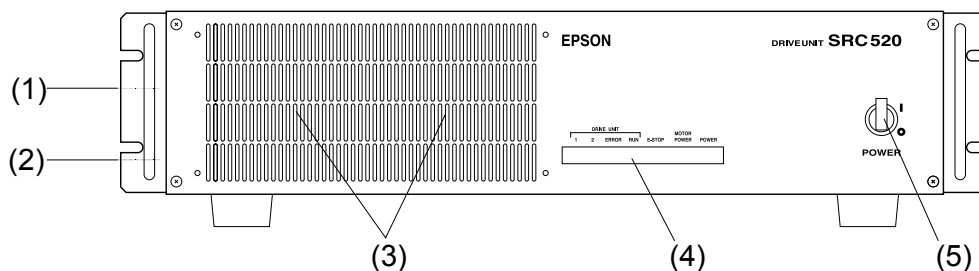
(1) Signature label:
     The Signature Label indicates the Drive Unit Serial No.   It is attached on the left when facing to the front panel.

(2) Connection Check label:
     This label indicates a serial number of the Manipulator to be connected and is attached on the left when facing to the front panel.

Example)

MANIPULATOR	
ES551S	00002

(3) Cooling Fan:
     Either one or two cooling fans are installed behind the front panel.

(4) LED:
     The LED on the front panel indicates the status of the Drive Unit during operation as follows:

LED	Description
1	The number "1" indicates that an unresettable error relating to motor control with/in any of the robot axes occurs.
2	The number "2" indicates that a resettable error relating to motor control with/in any of the robot axes occurs.
ERROR	Lights when the CPU of the Drive Unit detects an error.
RUN	Lights while the CPU is operating normally in the Drive Unit.
E-STOP	Lights when in the emergency stop condition.
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 Drive Unit is turned ON.

(5) POWER switch:
     The rated 15A circuit protector turns ON and OFF the power to the unit.

2.4.3 Rear Panel
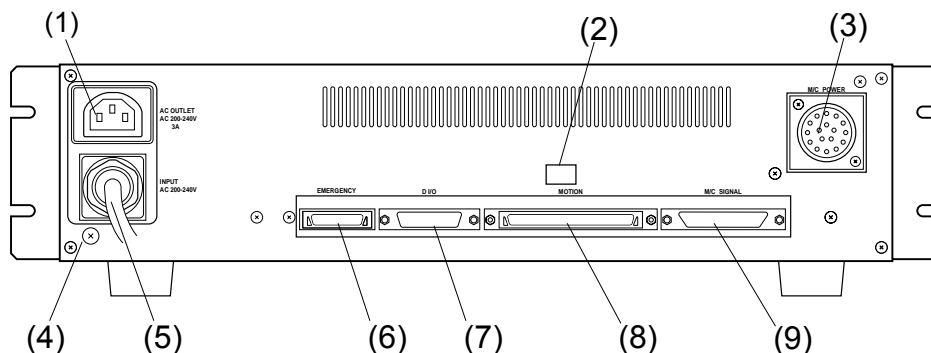
(1) **AC OUTLET:**
   Socket for the AC200V (or the local equivalent) power supply to the Control Unit.
   The PC power cable included in the accessories should be connected to this AC
   OUTLET.   Note that the power input via an AC Power cable (described in (5)
   below) is directly output here.

(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 robot power source.   Connect the dedicated power cable
   attached to the Manipulator.

(4) **PE Terminal:**
   External protective conductor terminal

(5) **AC Power cable:**
   Cable for the AC200V (or the local equivalent) power input

(6) **EMERGENCY connector:**
   The connector is used for input/output from/to Emergency Stop and Safety Door
   switches.   Refer to the "Function 5. EMERGENCY Connector" for details.

(7) **D-I/O connector:**
   The connector is used for connection with input/output devices.   There are 16
   circuits each for input and output.   Refer to the "Function 6. D-I/O Connector" for
   details.

(8) **MOTION connector:**
   This connector is to connect with the MIB board in the Control Unit.   For the
   connection, use the Motion Interface cable included in accessories.

(9) **M/C SIGNAL connector:**
   This connector is used for the signals such as the robot's motor encoder or the origin
   sensor signals etc.   Connect the Manipulator's dedicated signal cable.

2.4.4 Drive Unit – Interior Layout

⚠ WARNING	■ Do not open the cover(s) of the Control and Drive Units except while maintaining them. Because of the high voltage charger inside the Control and Drive Units, there is a risk of fatal electrical shock even when its main power is OFF.

The figure below shows the interior of a Drive Unit.
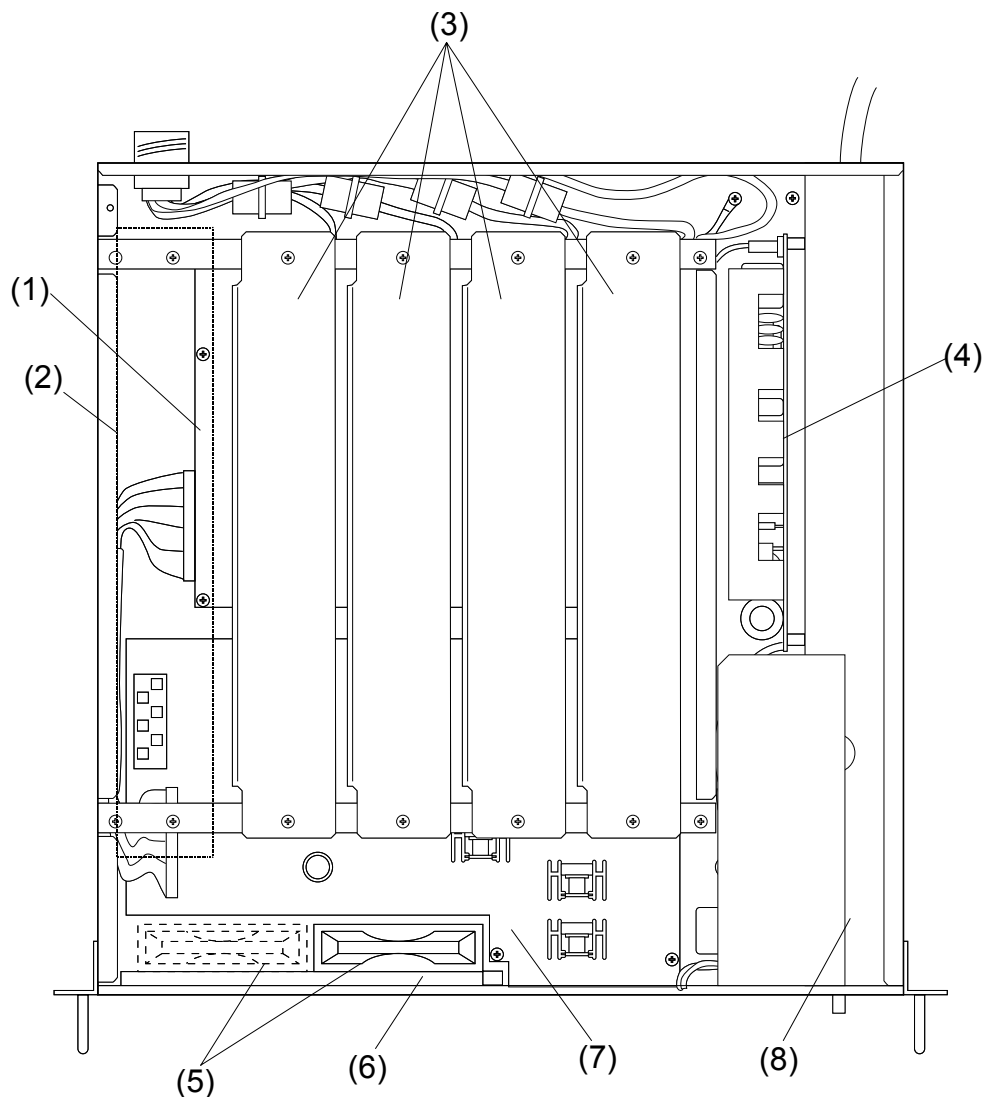
(1) DMB (Drive Main Board):
   The Drive Main Board receives a position reference from the Control Unit and thereby drives the motor.

(2) Regeneration module:
   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.

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(3) Motor Driver module:

The Motor Driver module receives a reference from DMB, and, outputs the three-phase current to supply power to the motor.   (The figure in the previous page shows a sample of Drive Unit for a 4-axes robot.   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 DC24V.

(5) Cooling Fan:

A standard model comes with one suction fan for cooling.   For the 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 screen dust.

NOTE ☞   Check condition of the filter regularly and clean it as necessary.   A dirty filter can cause the temperature inside the controller to rise, which might cause the robot to malfunction.

(7) DPB (Drive Power Board):

The Drive Power Board is consisted of two circuits: one is to generate the DC24V into several power sources and another is to distribute the main power source to each motor driver that drives the axes.

(8) Motor Power module:

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

2.4.5 Dimensions
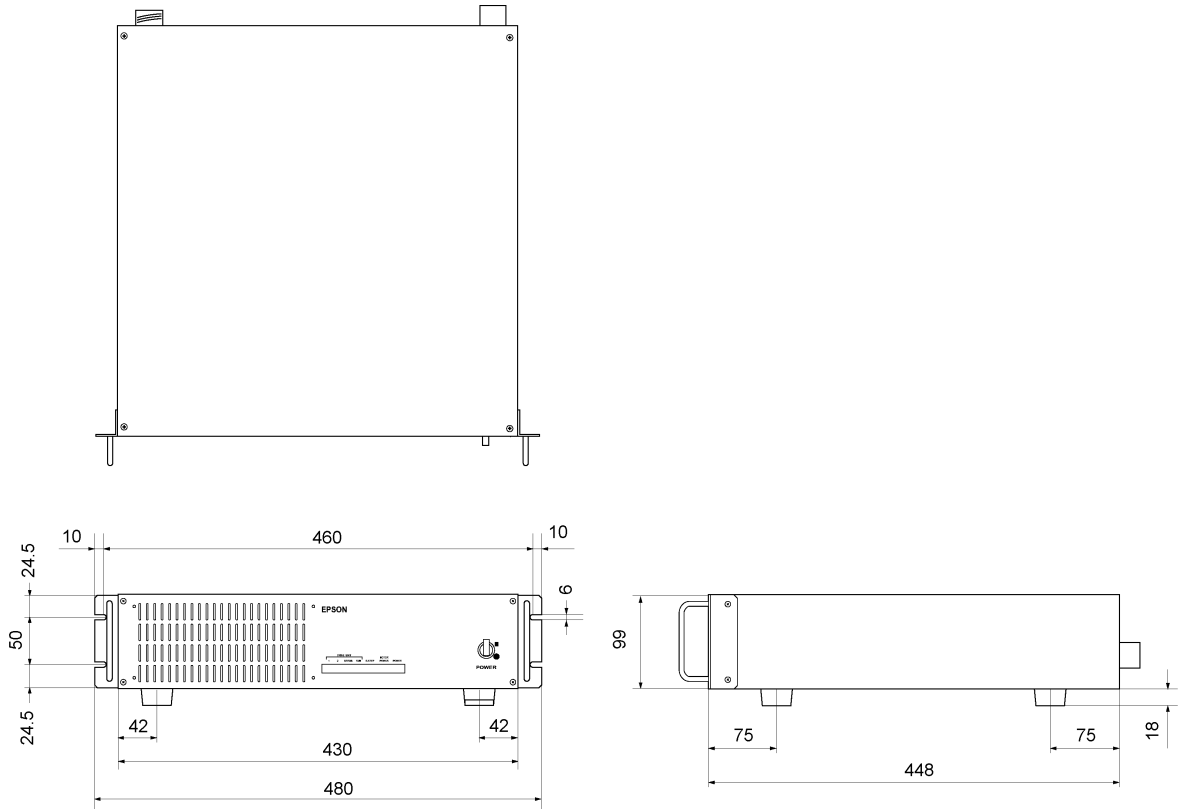
[mm]

3. Installation

NOTE
☞
The controller is not designed for clean-room specification.   If it must be installed in a clean room, make sure to cover it with a box with either ventilation or cooling mechanism.

3.1 Box Contents

Control Unit

Item	Quantity	Note
Control Unit	1 unit	(The option boards packaged in the Control Unit depend on the option.)
Windows 95	1 set	CD-ROM
Start-up Disk	1 set	CD-ROM
SPEL 95	1 set	Floppy disk
PC Power Cable	1 piece	Length：1.5m
OPTIONAL DEVICE Port Short Connector	1 set	D_sub 25-pin (with short-circuit connector)
Video Driver	1 set	FD (This program has already been installed in a Controller.)
Metal Fitting and Angles	1 set	
PS/2 Keyboard Adapter	1 piece	
Board affixing screws and accessories	1 set	

Drive Unit

Item	Quantity	Note
Drive Unit	1 unit	
EMERGENCY Connector	1 piece	Square half-pitch 20-pin
D-I/O Connector	1 piece	Square half-pitch 50-pin
Motion Interface Cable	1 piece	Length：70 cm

NOTE
☞
The manipulator Power cable and Signal cable are packed with the Manipulator.

Manuals

Manual	Quantity	Note
SRC5**/SPEL 95 Introduction Manual	1 book	
SRC5**/SPEL 95 User's Guide	1 book	
SRC5**/SPEL 95 Appendix	1 book	
Robot Controller SRC520 manual	1 book	
Manipulator manual	1 book/model	
Robot controller option manual	Depends on the option	Pulse Generating Board Remote I/O Board Ethernet Board Multi-Manipulator etc.

3.2 Environmental Requirements

In order to safety optimize the controller's performance; the controller must be placed in an environment which satisfies the following conditions.

Item	Condition
Ambient temperature	5 to 40°C (with minimal variation)
Ambient relative humidity	20 to 80 % (with no condensation)
First transient burst noise	Less than 2kV (without mouse and keyboard)
Electrostatic noise	Less than 6kV (without mouse and keyboard)
Environment	- Install indoors only. - Place in a well-ventilated area. - Keep away from direct sunlight. - Keep away from dust, oil, 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. If the controller must be used in an environment that does not fulfill the conditions mentioned above, take adequate countermeasure. For example, the controller may be covered with a box having a cooling mechanism. The controller is not designed for clean-room specification. If it is to be installed in a clean room, it needs to be covered with a box with either ventilation or cooling mechanism.
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	- 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.

NOTE

The controller must be normally placed horizontally.

3.3 Power Supply

3.3.1 Specifications

Ensure that the available power meets the following specifications.

Item	Specification
Voltage	AC 200V to AC 240V
Phase	Single phase
Frequency	50/60Hz
Momentary Power Interrupt	Less than 10msec.
Power Consumption	Drive Unit itself consumes a maximum of approximately 200W, but actual consumption depends on the rated capacity of the motor and controller unit. Please refer to manipulator power consumption in the manipulator manual and use the following equation to determine total consumption: Rated consumption $= 200W + $ Control Unit (300W) consumption $+ $ total manipulator consumption (rated) $\times 1.2$
Peak Current	When power is turned ON: approximately 50A (2msec.) When motor is ON: approximately 150A (5msec.)
Leakage Current	6mA (TYP)
Ground Resistance	Less than 100Ω

If you are to connect an earth leakage circuit breaker in the AC power cable line (for the Drive Unit), make sure to use an inverter type that does not induce a leakage current of more than 10kHz.   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.

The socket-outlet shall be installed near the equipment and shall be easily accessible.

NOTE
☞

The power supply specification is different from the one shown above when only using the Control Unit.
Refer to the "11.4 Power Supply" in the "Function 11. Stand-alone Option for SRC520".

3.3.2 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 outlet in your area.   If not, replace the attached plug with the one that is suitable in your area.

⚠ WARNING

■ If it is necessary to change the plug to fit the outlet in your factory, be certain to connect the protective earth wire of the AC power cable, colored yellow/green, to the earth terminal of the factory power supply.   The equipment must be protective earth wire properly at all times to avoid the risk of electric shock. Always use the power plug.   Never connect the controller directly to the factory power supply

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

3.4 Cable Connection

	■ Make sure that the power to the Control Unit and the Drive Unit is turned OFF before connecting or disconnecting any cables. Failure to do so may cause electric shock and may damage the units.

⚠ WARNING

⚠ CAUTION

■ Check on the Connection Check Label and DU number (at Control Unit) and Signature Labels (at Drive Unit & Manipulator) when connecting those units. If those units are misconnected, the robot may not function properly or may be damaged.

■ If there are more than one Drive Units connected to a Control Unit, make sure that the DU numbers (DU1 - DU3) indicated at the Control Unit (above the MIB connector) and the Drive Unit (above the MOTION connector) match.   It is highly dangerous if those do not match, causing to activate an unintended robot.

■ Ensure all cables are securely connected.   Avoid placing anything heavy on the cables, and, do not bend them excessively, because this may damage the cables, preventing the robot from functioning properly.

3.4.1 Typical Cable Connection (Single Manipulator)

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

Drive Unit

M/C POWER	(1) M/C Power Cable	Manipulator
M/C SIGNAL	(2) M/C Signal Cable	
MOTION	(3) Motion Interface Cable	
D-I/O(Standard)	(4) D-I/O	Input/output unit
EMERGENCY	(5) EMERGENCY	E-STOP switch Safety Door switch
AC OUTLET	(6) PC Power Cable	
INPUT	(7) AC Power Cable	AC200V power
PE	(8) PE	Protective earth

Control Unit

MOTION	
Extension I/O (option)	Input/output unit
MONITOR	Monitor
MOUSE	Mouse
KEYBOARD	Keyboard
ACIN	
(9) OPTIONAL DEVICE	Operation unit or Port Short Connector

(1) M/C Power cable:
   Cable, round connectors with 17-pins on both ends.   Connect the female connector to the POWER connector at the Manipulator and the male connector to the M/C POWER connector at the Drive Unit.   Insert the connectors and rotate clockwise until you hear a "click".

(2) M/C Signal cable:
   Cable, square connectors with 68-pins on both ends.   Connect the signal cable to the manipulator SIGNAL connector and the controller M/C SIGNAL connector of a drive unit.

(3) Motion Interface cable:
   Cable, square connectors with 100-pins on both ends.   This cable connects the MOTION connectors of Control Unit and the Drive Unit.   If you are connecting more than one Drive Unit to your Control Unit, make sure that the MOTION connectors connecting each Drive Unit to the Control Unit goes into the specified terminal on the Control Unit: ex: DU1 - DU1, DU2 - DU2, DU3 - DU3.   Failure to do so causes unintended activation of a robot, which can be highly dangerous.

(4) D-I/O connector:
   A connector is to connect with the user's input/output device.   If you have input/output units, connect them to this connector.   For details about D-I/O, refer to the "Function 6. D-I/O Connector".

(5) EMERGENCY connector:
   The EMERGENCY connector has inputs to connect the emergency stop switch and the safeguard switch.   For safety reasons, connect proper switches for these input devices.   For details, refer to the "Function 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 Unit supplies the power to the Control Unit.

⚠ CAUTION

■ The power supply voltage switch on the Control Unit must be set and kept at [230] side (AC200V to AC240V) when using the Control Unit with other equipment.   If connecting the equipment with AC200V (or the local equivalent) under the condition that the power supply voltage switch is set at [115] side (AC100V to AC120V), the equipment will be damaged seriously.
As for the power supply when only using the Control Unit, refer to the "11.4 Power Supply" in the "Function 11. Stand-alone Option for SRC520".

(7) AC Power cable:
Cables for AC200V (or the local equivalent) power supply to the Drive Unit.

⚠ CAUTION

■ The AC power cable and the AC OUTLET connector on the Drive Unit are directly connected inside the unit.   Therefore, no matter if the Drive Unit's switch is ON or OFF, the AC OUTLET connector is constantly outputting AC200V (or the local equivalent) power which requires extra caution.

(8) PE Terminal connector:
The PE terminal connects to the Protective earth wire.   The PE terminal is better to be connected when several robots 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 PE terminal.

(9) OPTIONAL DEVICE:
Connects either optional operation units or the Port Short connector to this connector. (There are two optional operation units, Jog Pad JP500 and Operation Pendant OP500.)   If neither is connected, the robot will be in the Emergency Stop condition and will not function.   For details, refer to the "Function 4. OPTIONAL DEVICE Connector".

3.4.2 Connecting Drive Unit and Control Unit

The setup data for the Drive Unit is stored in the Control Unit.   When connecting those units, it is crucial that the Drive Unit must be itself specified on the Connection Check Label on the front panel of the Control Unit be connected.   The connection check label on the Control Unit indicates the serial No. of the Control Unit to be connected and Drive Unit's No. (See the picture in the next page.)   Connect the appropriate Drive Unit.

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

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

■ Make sure that the power to the Control Unit and the Drive Unit is turned OFF before connecting or disconnecting any cables.   Failure to do so may cause electric shock and may damage the units.

⚠ CAUTION

■ Check on the Connection Check Label, DU number (at Control Unit) and Signature Labels (at Drive Unit & Manipulator) when connecting those units. If those units are misconnected, the robot may not function properly or may be damaged.

■ If there are more than one Drive Units connected to the Control Unit, make sure that the DU numbers (DU1 - DU3) indicated at the Control Unit (above the MIB connector) and the Drive Unit (above the MOTION connector) match.   It is highly dangerous if those do not match, causing to activate an unintended robot.

■ Ensure all cables are securely connected.   Avoid placing anything heavy on the cables, and, do not bend them excessively, because this may damage the cables, preventing the robot from functioning properly.

Connection Check label(s) at the front of Control Unit:

NOTE
☞

There are same numbers of this label as the number of Drive Units.   The label is put on the front panel of the Control Unit.
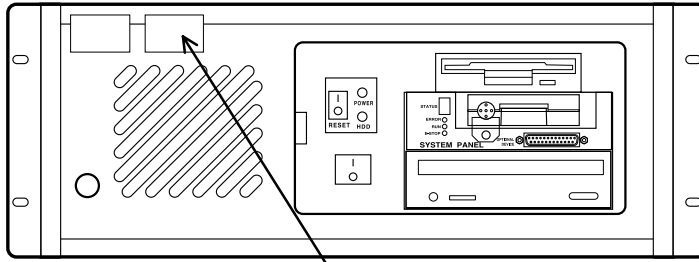
MANIPULATOR		DRIVE UNIT	
ES551S	00002	DU1	00007

Manipulator model

Manipulator serial number

Drive Unit serial number

DU number

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

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

DU1
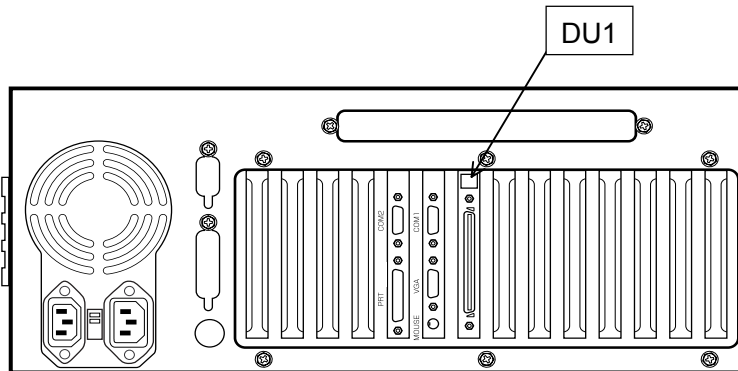
DU number label(s) at the back of Control Unit: Drive Unit serial number - Identifying proper unit:

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

MODEL   :SRC520
                 DRIVE UNIT
SERIAL NO.   :00006

Drive Unit serial number
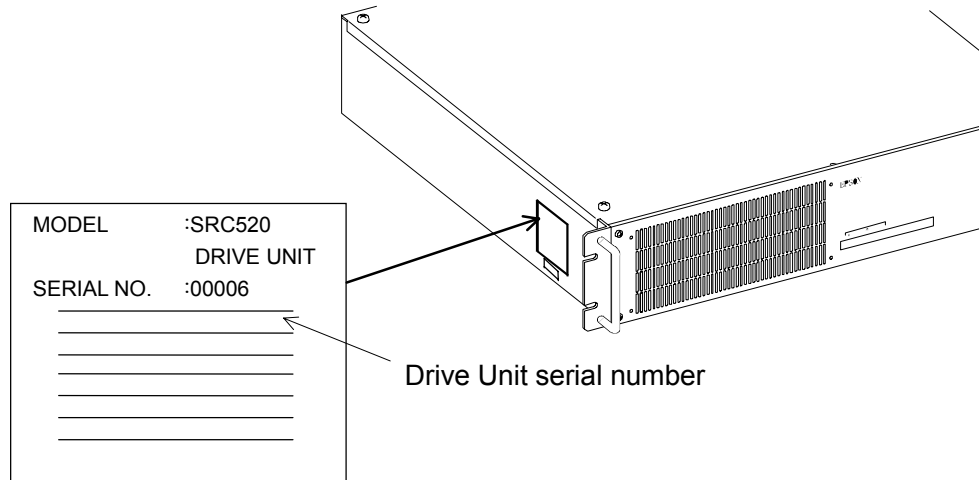
3.4.3 Connecting a Drive Unit to the Manipulator

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

M/C power cable   : M/C Power cable has round connectors with 17-pins on both ends. Connect the female connector to the POWER connector at the Manipulator and the male connector to the M/C POWER connector at the Drive Unit.   Insert the connectors and rotate clockwise until you hear a "click".

M/C Signal cable   : M/C Signal cable has square connectors with 68-pins on both ends. Connect the signal cable to the SIGNAL connector at the Manipulator and the M/C SIGNAL connector at the Drive Unit.

⚠ WARNING

■ Make sure that the power to the Control Unit and the Drive Unit is turned OFF before connecting or disconnecting any cables.   Failure to do so may cause electric shock and may damage the units.

⚠ CAUTION

■ Check on the Connection Check Label, DU number (at Control Unit) and Signature Labels (at Drive Unit & Manipulator) when connecting those units. If those units are misconnected, the robot may not function properly or may be damaged.

■ Ensure all cables are securely connected.   Avoid placing anything heavy on the cables, and, do not bend them excessively, because this may damage the cables, preventing the robot from functioning properly.

The setting data for the manipulator and manipulator model are stored in the Control Unit. Therefore, it is crucial that the manipulator has to be itself specified on the Connection Check label on the front panel of the Control Unit (see previous figures) be connected. You may also find the proper Manipulator's serial No. on your left hand side facing the Drive Unit.

MANIPULATOR

| ES551S | 00002 | → Manipulator serial number
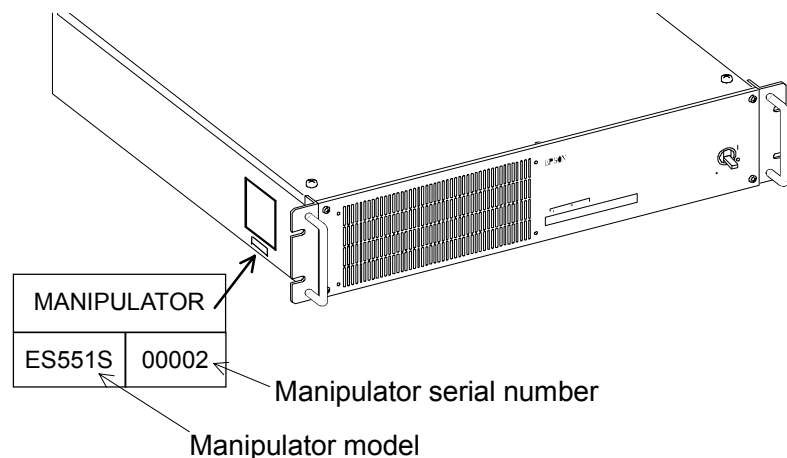
Manipulator model

NOTE

☞   The Manipulator's serial No. is indicated on the signature label on the back of the Manipulator.

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3.5 Noise Countermeasures

The followings must be observed in the system's cable wiring:

・ The earth wire of the power supply should be grounded. (Ground resistance: less than 100Ω)
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 "Function 3.3.2 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 of 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:

AC Line duct

200 mm or more

DC line duct
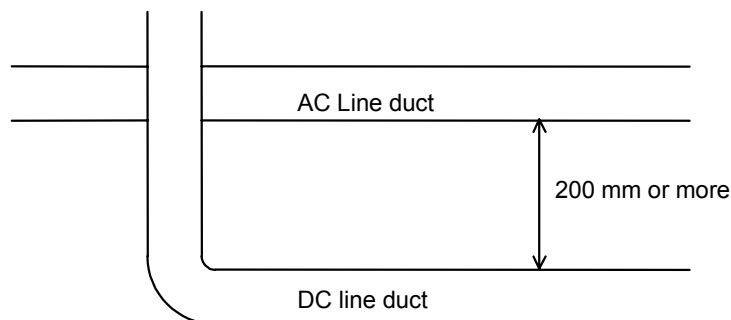
・ For I/O lines, wire it as short as possible and use a shielded wire and clamp the shield to the attached I/O connector interior.

・ Use a shielded wire 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 be 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 take 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 (spark killer) between the wires.   The spark suppressor is more effective when placed closer to the motor.

NOTE

☞

・ As they are easily influenced by static electricity or the noise from power source, keep the mouse and keyboard away from peripheral noise sources.   It is sometimes effective in suppressing such noise to wind the keyboard or mouse cables around the ferrite core several times.

4. OPTIONAL DEVICE Connector

4.1 OPTIONAL DEVICE Connector

This is the connector for JP500 (Jog Pad) or OP500 (Operation Pendant) as an optional operation unit.

The "Port Short Connector," an accessory that comes with the Control Unit, must be connected to this connector if an operation unit is not used.   The robot will be in the emergency stop condition when this connector is left unconnected.

4.2 Operation Unit (JP500/OP500)

There are two kinds of Operation Units: JP500 (Jog Pad), OP500 (Operation Pendant).
JP500/OP500 is used for the "teaching".
For details of each operation unit, refer to the following manuals.
 JP500 : SRC5**/SPEL 95 User's Guide for "2.8 Operation by JP (Jog Pad)."
 OP500 : Operation Pendant OP500 manual.

4.3 OPTIONAL DEVICE Port Short Connector

The OPTIONAL DEVICE Port Short connector is to connect with OPTIONAL DEVICE connector when an operation unit is not used.

The emergency stop input terminals of this connector has a short-circuit to prevent the robot from entering the emergency stop condition.
The operation mode (NORMAL/ATTEND) is preset and fixed at NORMAL operation mode by wiring.

OPTIONAL DEVICE   OPTIONAL DEVICE
Connector   Port Short connector

E_SW11	6	
E_SW21	9	
E_SW12	10	
E_SW22	11	
SG	13	
ENABLE	14	
SG	15	
KEY2	19	

39
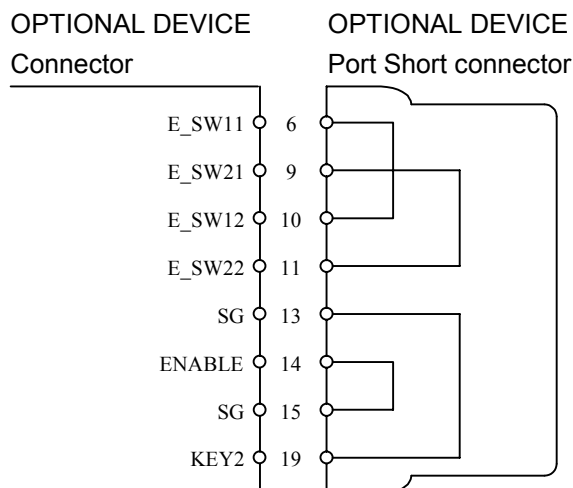
4.4 Pin Assignments

In case you wish to connect your own mode-switching switch to the OPTIONAL DEVICE Port Short connector, refer to the following pin assignments.

Pin number	Signal name	Pin number	Signal name
1	FG	14	ENABLE
2	SD	15	SG
3	RD	16	-
4	RS	17	-
5	CS	18	KEY1
6	E_SW11	19	KEY2
7	SG	20	ER
8	CD	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 Mode	KEY1	KEY2
ATTEND	Connect to SG (13 pin)	Open
NORMAL	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 at the Drive Unit.

5. EMERGENCY Connector

NOTE
☞

For safety, refer to the SRC5**/SPEL 95 Introduction manual for "1. Safety".

NOTE
☞

When the system is "Multi-Manipulator" to control two or more manipulators with one Control Unit, refer to the Multi-Manipulator manual for the "1.3 Safety" in "1. Hardware Setup".

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.

5.1.1 Safety Door Switch

⚠ WARNING

■ The interlock of the Safety Door must be functioning when the system is operated. It is dangerous to operate the system unless the Safety Door switch is in a completely functioning condition.

In order to maintain a safe working zone, a safety enclosure must be erected around the manipulator.   The enclosure must have "a door with an interlock switch" (=Safety Door) that is connected to the "Safety Door input terminal" on the EMERGENCY connector.
By connecting the two, safety features such as temporary hold-up of the program or the operation-prohibited status is 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 of which connect opens compulsively 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 to two contact points.   If the values entered at the two points differ by two seconds or more, the system recognizes it to be an error.   Therefore, make sure that the Safety Door switch has 2-contact points and that each connects to the specified pins (re: section 4.2 herein) at the EMERGENCY connector at the Drive Unit.

- The Safety Door must be designed and installed so that it does not close accidentally.

5.1.2 Latch Release Switch

Software latches the following conditions:

- The safety door is open.
- The operation mode is "ATTEND".

The EMERGEMCY 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 and the operation mode is ATTEND.

Closed : The latch release switch releases the latched conditions.

NOTE

☞

In case that the latched ATTEND mode is released while the safety door is open, the operation mode turns to NORMAL.   At that time, the status of manipulator power is operation-prohibited because the safety door is open.

To execute an automatic operation, close the safety door, and then close the latch release input.

5.1.3 Checking the Functions of Latch Release Switch

Once connecting the safety door switch and latch release switch with the EMERGENCY connector, be sure to check the switch functions for safety by following the procedures described below before operating the robot.

(1)   Turn ON the Control and Drive Units while the safety door is open in order to boot the SPEL 95.

(2)   Make sure that "Safety Door" 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 Door" is disappeared from 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.

The latch release input also functions when the operation mode is changed from ATTEND to NORMAL.
In order to change the operation mode from ATTEND to NORMAL, turn the 2Mode Selector Switch with Key" on the jog pad or operation pendant to the "NORMAL" side.
Then, close the latch release input.

5.2 Emergency Stop Switch

⚠ WARNING

■ Do refer to the typical application diagram in the "Function 5.4 Circuit Diagrams" when wiring to the EMERGENCY connector so that it should not dysfunction the emergency stop input at the Control Unit via the OPTIONAL DEVICE connector.

5.2.1 Emergency Stop Switch

If it is desired to create an external Emergency Stop switch(es) in addition to the Emergency Stop that an operation unit (JP500/OP500) provides, make sure to connect such Emergency Stop switch(es) to the proper pins at 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 input with two circuits.

If the values entered at the two circuits differ by two seconds or more, the system recognizes it as an error.   Therefore, make sure that the Emergency Stop switch has a double contact and that each connects to the specified pins at the EMERGENCY connector at the Drive Unit.   Refer to the "Function 5.4 Circuit Diagrams".

5.2.2 Checking the Functions of Emergency Stop Switch

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 robot must not be powered ON until the following test is completed.

(1) Turn ON the Control Unit and the Drive Unit to launch the SPEL 95 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 RESET command.

(6) Make sure that "E-STOP" LED is turned OFF and the "Emergency Stop" is disappeared from the status bar.

NOTE

☞

For the emergency condition to be related timely to the peripheral equipment at the input of the Emergency Stop at Drive Unit via the EMERGENCY connector, make sure that the desired equipment be 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 Pin Assignments

The EMERGENCY connector pin assignments are as follows:

Pin No.	Signal	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
6	E.STOP OUT	(Relay contact) [1]
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)
12	E_SW22	
13	E.STOP2+	Emergency Stop input 2 (+)
14	E.STOP2-	Emergency Stop input 2 (-)
15	RELEACE	Latch Release input
16	RELEACE	
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] 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	DC30V 1A or under	1-2, 11-12 pin
Emergency Stop rated input voltage range Emergency Stop rated input current	DC24V ±10% 10mA/24V input	3-4, 13-14 pin
Safety Door rated input voltage range Safety Door rated input current	DC12 to 24V ±10% 10mA/24V input	7-8, 17-18 pin
Latch Release rated input voltage range Latch Release rated input current	DC12 to 24V ±10% 10mA/24V input	15-16 pin
Emergency Stop output relay contact rated load	DC30V 0.5A or under	5-6 pin

NOTE

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

5.4 Circuit Diagrams

5.4.1 Example 1: External emergency stop switch typical application

Control Unit (MIB)   Drive Unit (DMB)   External Emergency Stop switch (es)

Emergency Stop switches of an operating unit

+24V

Dynamic brake relay of motor driver

+24V

Emergency Stop detection

Dynamic brake control

Emergency Stop detection

Emergency Stop detection

Dynamic brake control

External +24V

2.2 kΩ   Safety Door input 1

2.2 kΩ   Safety Door input 2

2.2 kΩ   Latch release input

*1 : Connect the external + 24V GND of the secondary circuit to the protective bonding circuit.

Latch release input
Close: latch off
Open: latch on

External +24V GND

45

5.4.2 Example 2: External safety relay typical application

Control Unit (MIB)

Drive Unit (MIB)

External +24V

Emergency Stop switches of an operating unit

Fuse *2

+24V

9

19

1

2

11

12

External +24V GND

*1

3

13

External +24V

5 External safety relay (the above diagram is simplified for representation)

Dynamic brake relay of motor driver

+24V

Emergency Stop detection

Dynamic brake control

Emergency Stop detection

Emergency stop detection

Dynamic brake control

6

4

14

10

20

8

2.2kΩ

Safety Door input 1

7

2.2kΩ

Safety Door input 2

18

17

2.2kΩ

Latch release input

16

15

External +24V

*1

External +24V

*2 For the protection of the emergency stop circuit, the fuse's capacity should be as follows:

· Meets the capacity of the external safety relay.

· 1A or less.

*1

External +24V GND

Safety Door latch release input
Close: latch off
Open: latch on

*1: Connect the external +24V GND of the secondary circuit to the protective bonding circuit.

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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 at the rear panel.   It has 16 pins each for input and output respectively.

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 "Function 7. Extension I/O Board - Optional" for the specified model of an extension I/O Board.
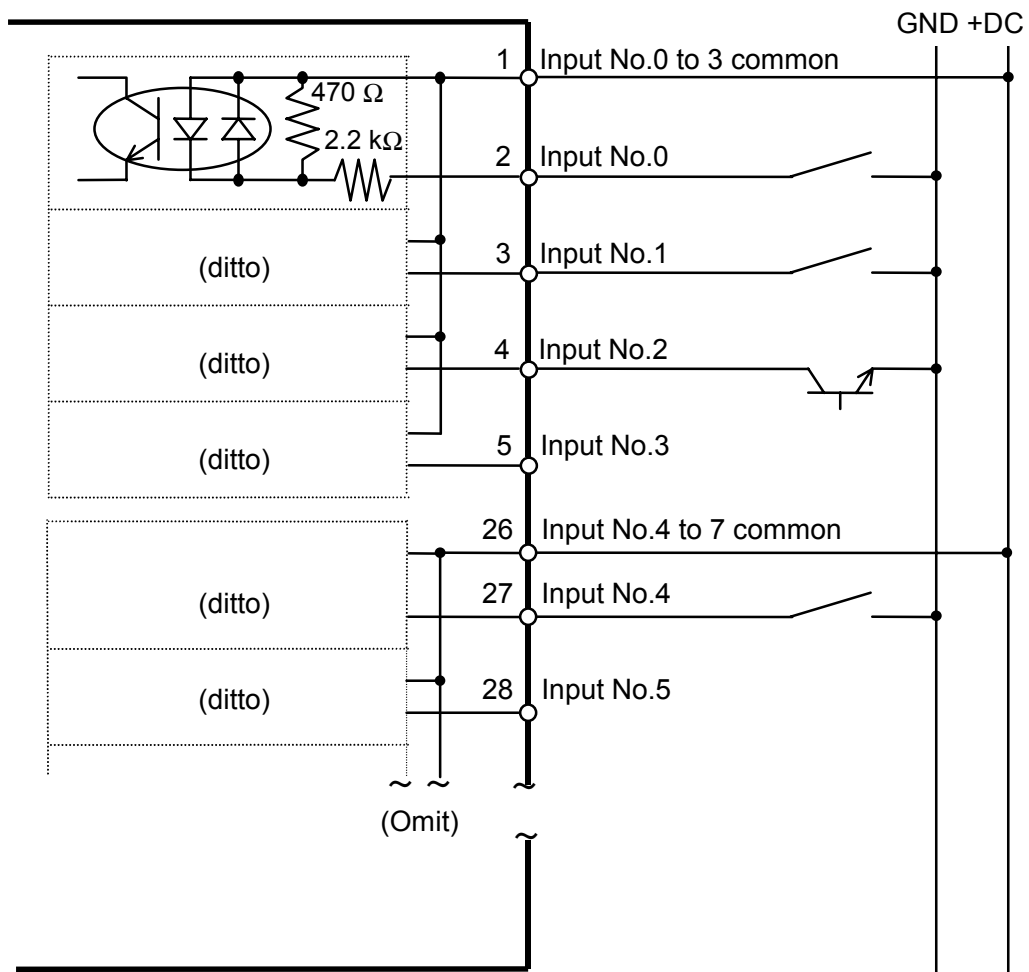
For cable wiring, refer to the "Function 3.5 Noise Countermeasures" in order to prevent noise.
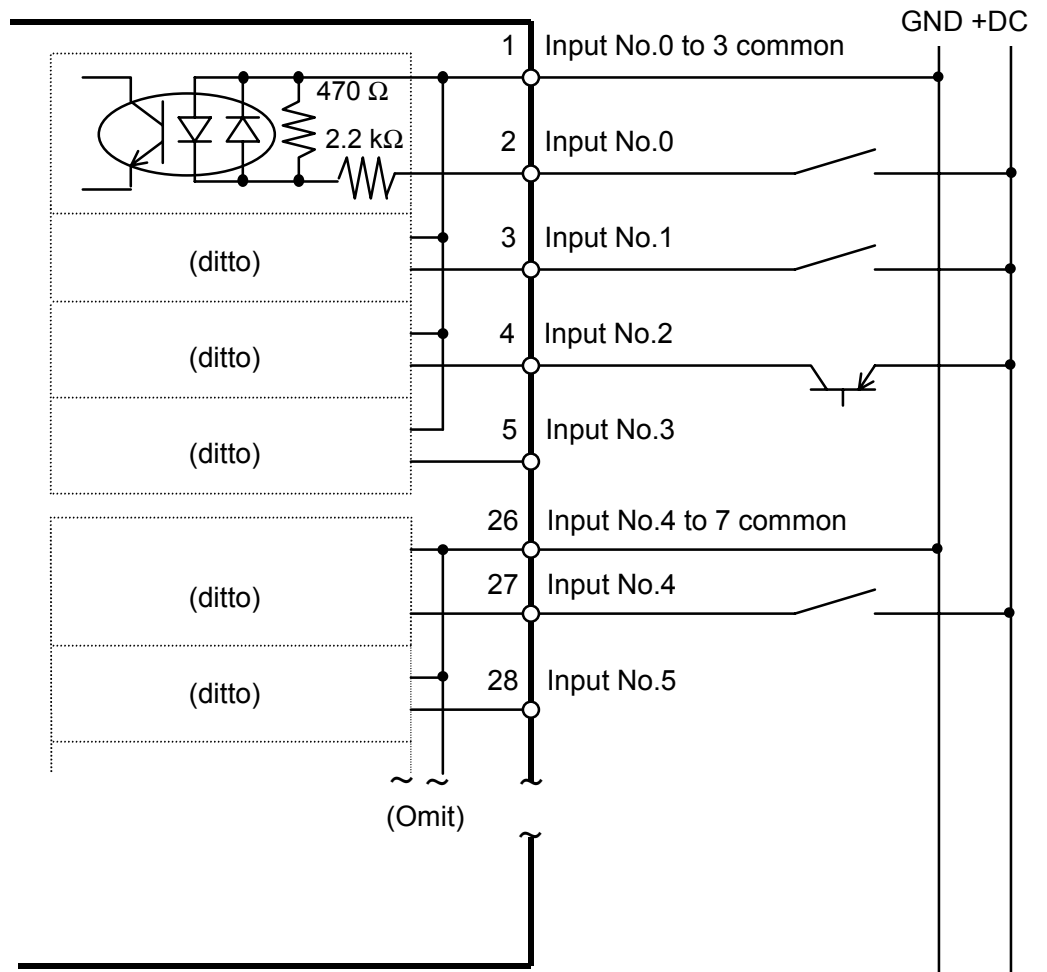
6.1 Input Circuit

Input Voltage Range : DC12 to 24V ±10%

On Voltage : DC10.8V (min.)

Off Voltage : DC5V (max.)

Input Current : 10mA (TYP) at DC24V input

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

Typical Input Circuit Application 1 : NPN type (the standard for the regions outside Europe)

GND +DC	
1	Input No.0 to 3 common
	470 Ω
	2.2 kΩ
2	Input No.0
(ditto)	
3	Input No.1
(ditto)	
4	Input No.2
(ditto)	
5	Input No.3
26	Input No.4 to 7 common
(ditto)	27	Input No.4
(ditto)	28	Input No.5

(Omit)

Typical Input Circuit Application 2 : PNP type (the European standard)

6.2 Output Circuit

|	
Rated Output Voltage	: DC12V to 24V ±10%
Maximum Output Current	: TYP 100mA/1 output
Output Driver	: Photo coupler
Saturation Voltage	: 1.6V or under

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

Typical Output Circuit Application 1 : NPN type (the standard for the regions outside Europe)

⚠ CAUTION ■ Be careful not to misconnect the output circuit because it has no protection circuit which protects the circuit from short-circuit and reverse-connection.
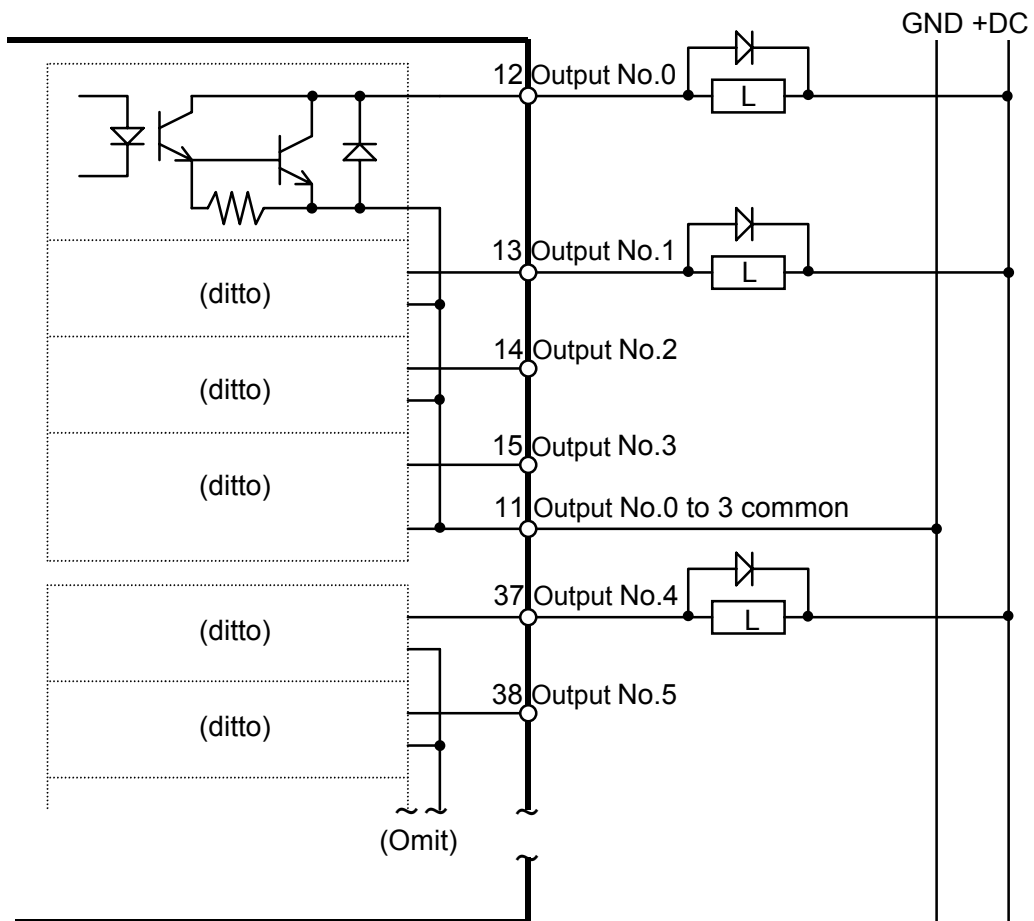
Jumper Settings for the NPN-type Output

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

Typical Output Circuit Application 2 : PNP type (the European standard)

⚠️ CAUTION ∣ ■ Be careful not to misconnect the output circuit because it has no protection circuit which protects the circuit from short-circuit and reverse-connection.
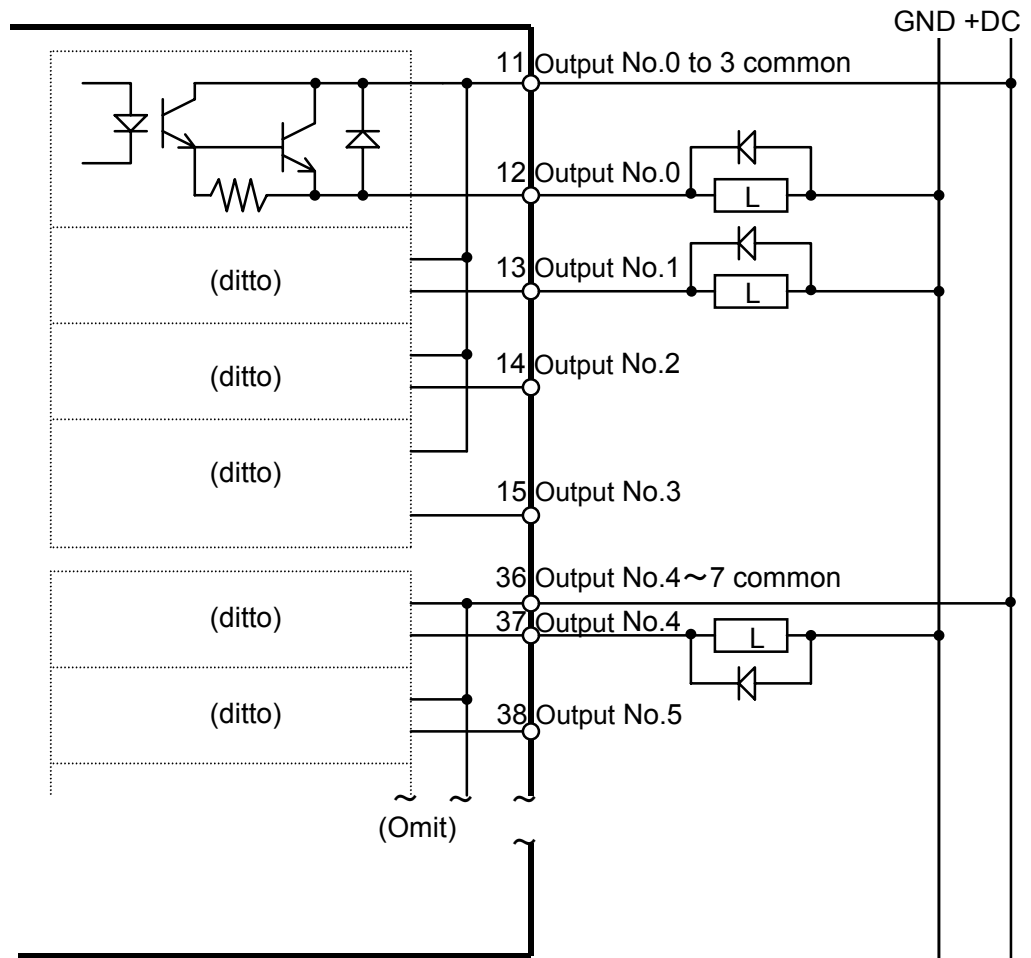

Jumper Settings for the PNP-type Output

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

6.3 Pin Assignments

The internal power supply does not output 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 presume a standard Drive Unit (DU1).

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common 0 to 3	26	Input common 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 8 to 11	31	Input common 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 0 to 3	36	Output common 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 8 to 11	41	Output common 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

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

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

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common 0 to 3	26	NC
2	NC	27	Output common 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 4 to 7	32	NC
8	NC	33	Output common 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 8 to 11	38	NC
14	NC	39	Output common 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 12 to 15	44	NC
20	NC	45	Output common 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

7. Extension I/O Board - Optional

7.1 Extension I/O Board

Mount the extension I/O board on the ISA slot in the Control Unit when extra I/Os are desired.

One additional I/O board extends by 32 pins each for input and output.   The I/Os can be extended up to 464 each for input and output respectively (including those for Remote I/O).   However, this number is subject to the number of ISA slots available on a type of PC used as control unit

The I/O #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 Extension 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 extension I/O board
80 to 111	80 to 111	The 2nd extension I/O board
⋮	⋮	⋮

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

Name	Input/Output Type	Output Circuit	The standard for:
Protected Extension I/O board	NPN	Hybrid IC SEP007	–
Protected Extension I/O board	PNP	Hybrid IC SEP008	Europe
Extension I/O board	NPN	Transistor array and photo coupler	the regions outside Europe

7.2 Protected Extension I/O Board

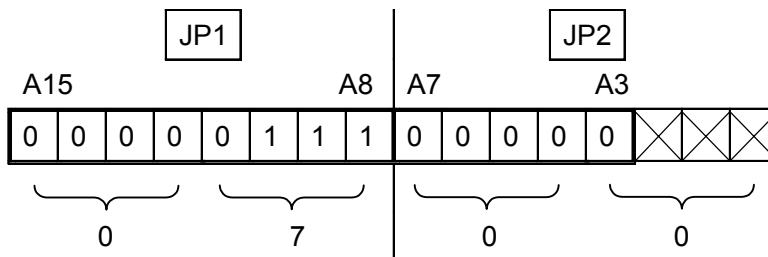### 7.2.1 Protected Extension I/O Board : Jumper Settings

The I/O board address is defined by the jumpers JP1, 2, and 3.

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

JP1 : Short-circuit 16-15, 14-13, 12-11, 10-9 and 8-7.

JP2 : Short-circuit 10-9, 8-7, 6-5, 4-3 and 2-1.

Short : 0, Open : 1

When the Extension I/O Board is extended, an appropriate software settings must be done in addition to the below jumper settings.   For details about software settings, refer to the SRC5**/SPEL 95 User's Guide for a section, "11.3.3 I/O Board" in the "Function 11 Setup".

JP1

JP1 assigns I/O addresses A15 through A8.

16-15	14-13	12-11	10-9	8-7	6-5	4-3	2-1
A15	A14	A13	A12	A11	A10	A9	A8

Short : 0, Open : 1

JP2

JP2 assigns I/O addresses A7 through A3.

| 10-9	8-7	6-5	4-3	2-1
A7	A6	A5	A4	A3

Short : 0, Open : 1

JP3

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

7.2.2 Protected Extension I/O Board : Input Circuit

The following diagrams illustrate cases where #48 through #79 are assigned to the Extension I/O's inputs and outputs.   The I/O number assignment depends on the SPEL 95 settings.
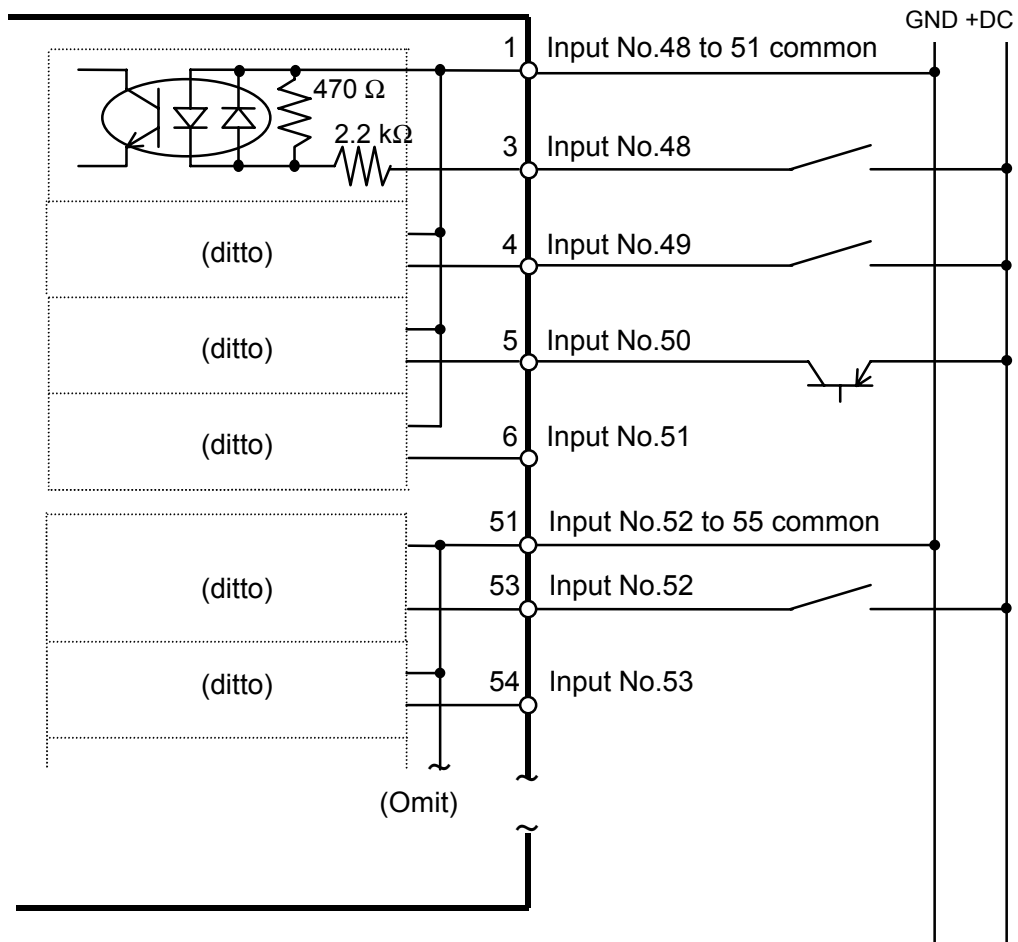
Input Voltage Range	: DC12 to 24V ±10%
On Voltage	: DC 10.8V (MIN.)
Off Voltage	: DC 5V (MAX.)
Input Current	: 10mA (TYP) at DC24V input

Protected Extension I/O Board
Typical Input Circuit Application 1 : NPN type
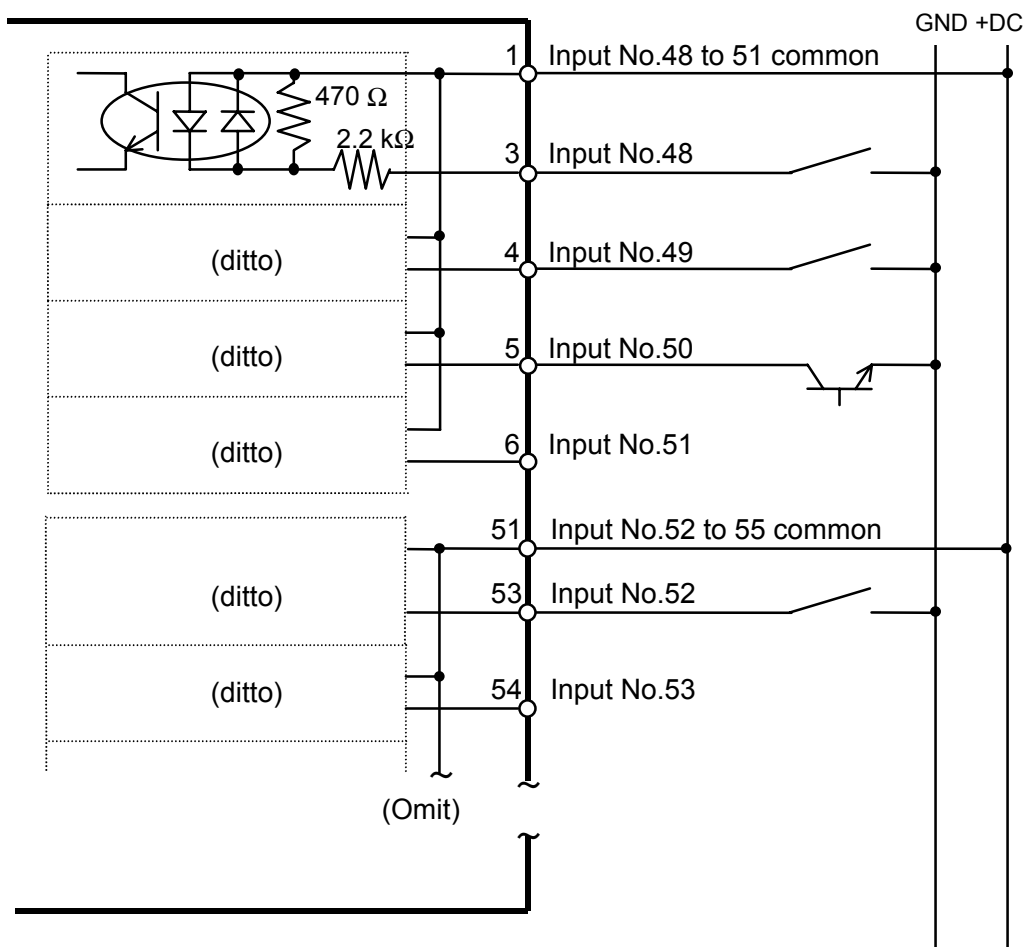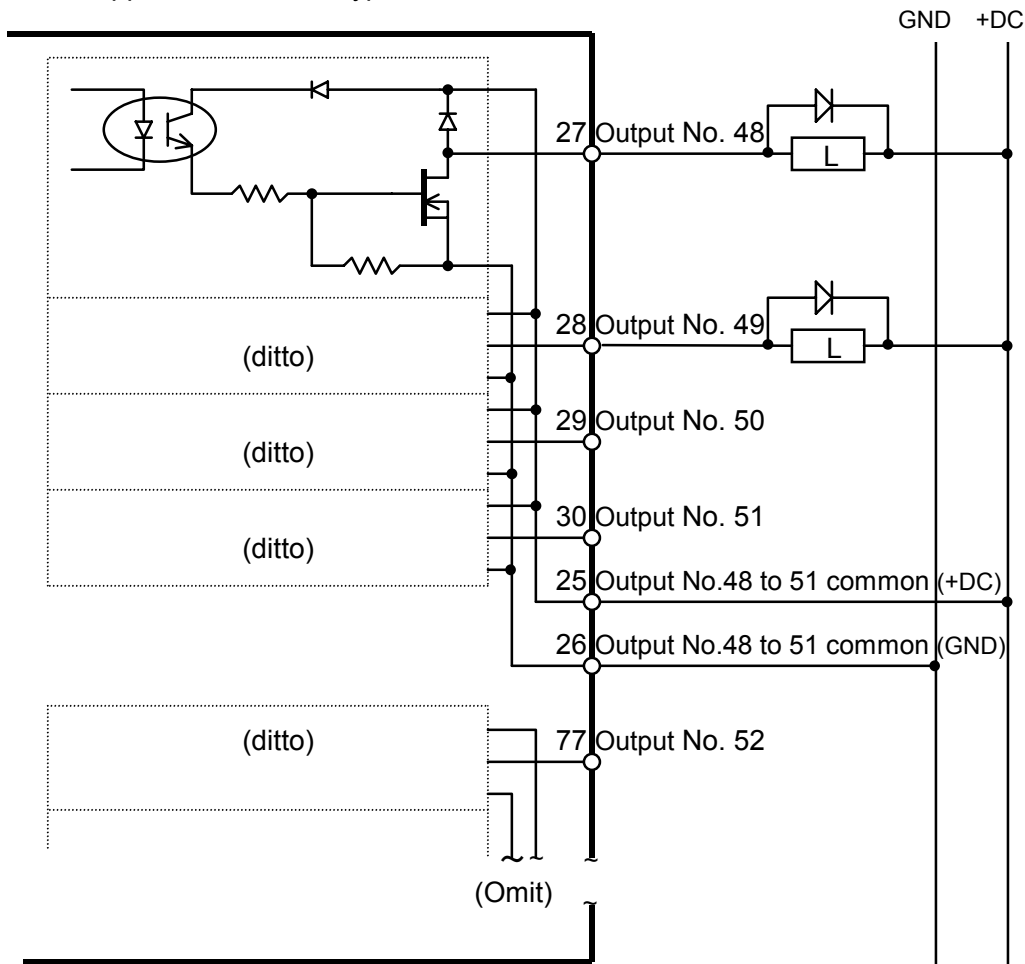
Protected Extension I/O Board
Typical Input Circuit Application 2 : PNP type (the European standard):

GND +DC

1	Input No.48 to 51 common
3	Input No.48
4	Input No.49
5	Input No.50
6	Input No.51
51	Input No.52 to 55 common
53	Input No.52
54	Input No.53

470 Ω
2.2 kΩ

(ditto)
(ditto)
(ditto)
(ditto)
(ditto)

(Omit)

### 7.2.3 Protected Extension I/O Board : Output Circuit

The following diagrams illustrate cases where #48 through #79 are assigned to the Extension I/O's inputs and outputs.   The I/O number assignment depends on the SPEL 95 settings.

Protected Extension I/O Board
Typical Output Circuit Application 1 : NPN type

Rated Output Voltage	: DC12V to 24V ±10%
Maximum Output current	: 250mA/1 output
Output Driver	: N channel power MOS FET
Saturation Voltage	: 1.0V or under

Protected Extension I/O Board
Typical Output Circuit Application 2 : PNP type (the European standard)
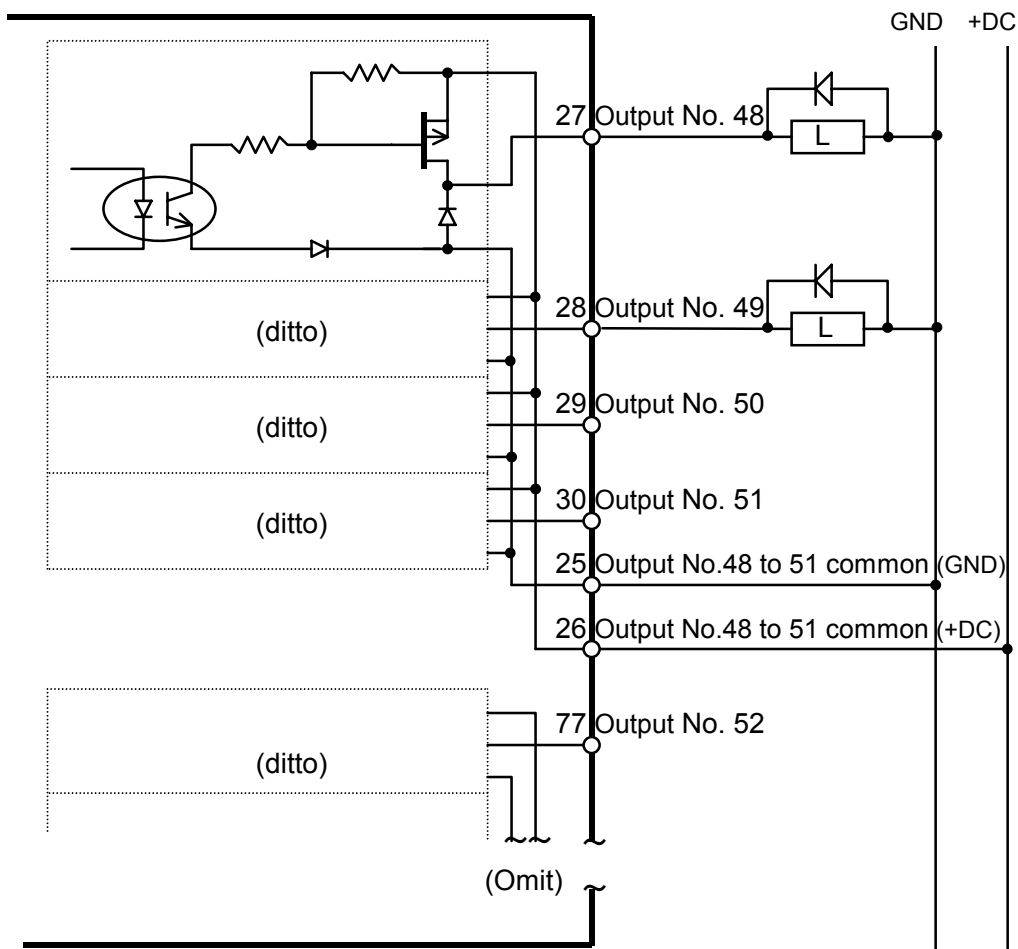
Rated Output Voltage	: DC12V to 24V ±10%
Maximum Output current	: 250mA/1 output
Output Driver	: P channel power MOS FET
Saturation Voltage	: 1.0V or under

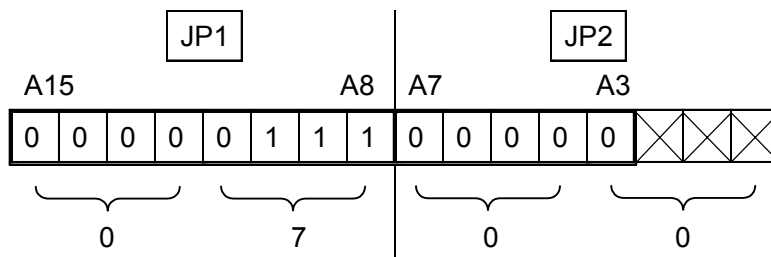## 7.3 Extension I/O Board (the standard for the regions outside Europe)

7.3.1 Extension I/O Board : Jumper Settings

The I/O board address is defined by the jumpers JP1, 2, and 3.

When assigning the I/O boards to 0700H to 0707H, set them as follows:
JP1 : Short-circuit 16-15, 14-13, 12-11, 10-9 and 8-7.

JP2 : Short-circuit 10-9, 8-7, 6-5, 4-3 and 2-1.

When the Extension I/O Board is extended, an appropriate software settings must be done in addition to the below jumper settings.   For details about software settings, refer to the SRC5**/SPEL 95 User's Guide for the section, "11.2.2 Remote" in the "Function 11. Setup".

JP1

JP1 assigns I/O addresses A15 through A8.

16-15	14-13	12-11	10-9	8-7	6-5	4-3	2-1
A15	A14	A13	A12	A11	A10	A9	A8

Short : 0, Open : 1

JP2

JP2 assigns I/O addresses A7 to A3.

10-9	8-7	6-5	4-3	2-1
A7	A6	A5	A4	A3

Short : 0, Open : 1

JP3

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

JP4, 5, 6

Normally open.

7.3.2 Extension I/O Board : Input Circuit

The input circuit is the same as the NPN type of the protected extension I/O board.
Refer to the "Function 7.2.2 Protected Extension I/O board : Input Circuit" for details.

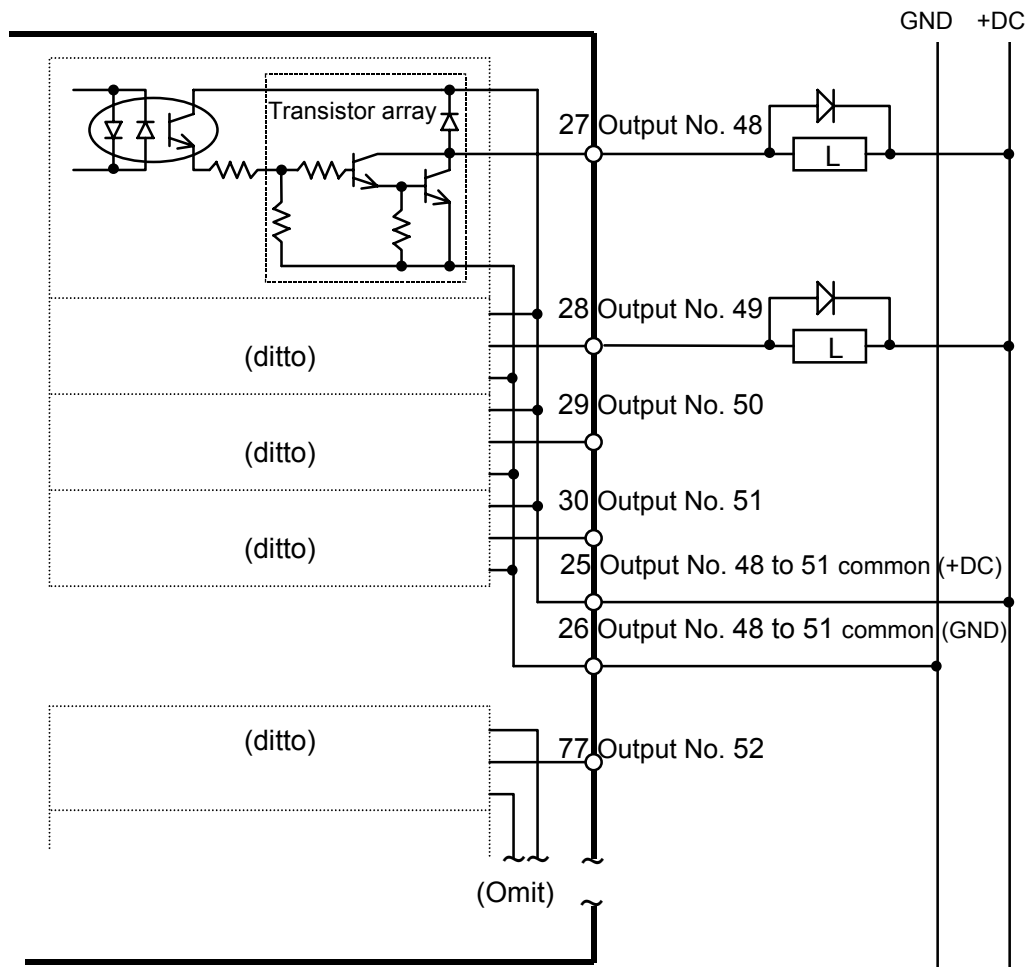### 7.3.3 Extension I/O Board : Output Circuit

The following diagrams illustrate cases where #48 through #55 are assigned to the Extension I/O's inputs and outputs.   The I/O number assignment depends on the SPEL 95 settings.

Extension 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**   ■ Be careful not to misconnect the output circuit because it has no protection circuit which protects the circuit from short-circuit and reverse-connection.
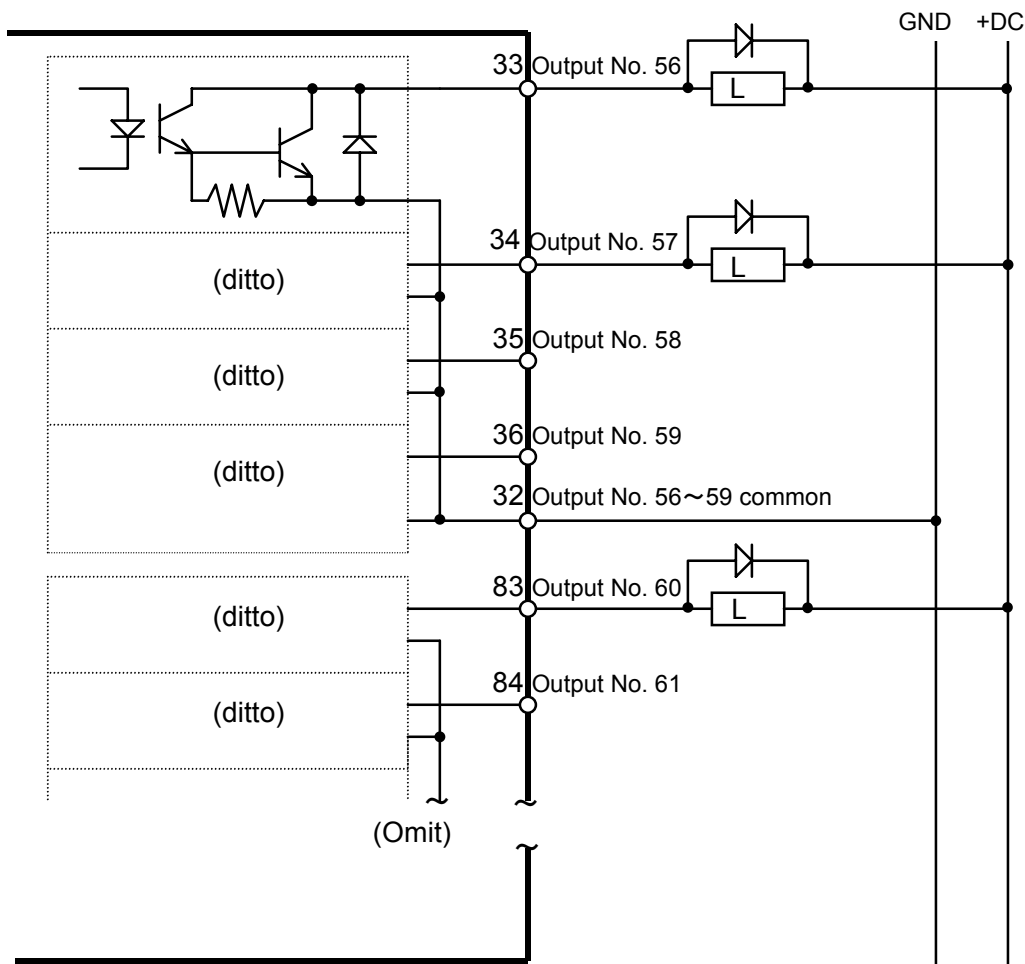

Rated Output Voltage	: DC12V to 24V ±10%
Maximum Output current	: 250mA/1 output
Output Driver	: Transistor array
Saturation Voltage	: 1.6V or under

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

⚠ CAUTION | ■ Be careful not to misconnect the output circuit because it has no protection circuit which protects the circuit from short-circuit and reverse-connection.

Rated Output Voltage : DC12V to 24V ±10%

Maximum Output Current : 100mA/1 output

Output Driver : Photo coupler

Saturation Voltage : 1.6V or under

7.4 Extension I/O Board : Pin Assignments

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

NPN：Pin No. 1-50

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common A (48 to 51)	26	Output common A (GND: 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: 56 to 59)
7	Input common C (56 to 59)	32	Output common C (GND: 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: 64 to 67)
13	Input common E (64 to 67)	38	Output common E (GND: 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: 72 to 75)
19	Input common G (72 to 75)	44	Output common G (GND: 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：48 to 51)	50	FG

NPN：Pin No. 51-100

Pin No.	Signal Name	Pin No.	Signal Name
51	Input common B (52 to 55)	76	Output common B (GND: 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: 60 to 63)
57	Input common D (60 to 63)	82	Output common D (GND: 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: 68 to 71)
63	Input common F (68 to 71)	88	Output common F (GND: 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: 76 to 79)
69	Input common H (76 to 79)	94	Output common H (GND: 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: 52 to 55)	100	FG

7.4.2 Extension I/O Board : Pin Assignments (PNP type)
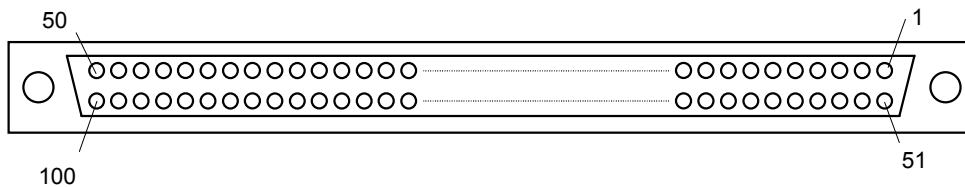
PNP：Pin No. 1-50

Pin No.	Signal Name	Pin No.	Signal Name
1	Input common A (48 to 51)	26	Output common A (+DC: 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: 56 to 59)
7	Input common C (56 to 59)	32	Output common C (+DC: 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: 64 to 67)
13	Input common E (64 to 67)	38	Output common E (+DC: 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: 72 to 75)
19	Input common G (72 to 75)	44	Output common G (+DC: 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: 48 to 51)	50	FG

PNP Pin No. 51-100

Pin No.	Signal Name	Pin No.	Signal Name
51	Input common B (52 to 55)	76	Output common B (+DC: 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: 60 to 63)
57	Input common D (60 to 63)	82	Output common D (+DC: 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: 68 to 71)
63	Input common F (68 to 71)	88	Output common F (+DC: 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: 76 to 79)
69	Input common H (76 to 79)	94	Output common H (+DC: 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: 52 to 55)	100	FG

7.5 Extension I/O Connector

7.5.1 Pin Layout of Extension I/O Connector

An internal power is not supplied to the Extension I/O connector.   Therefore, an external power source must be supplied.

7.5.2 Extension I/O Connector Cable

The Extension 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.
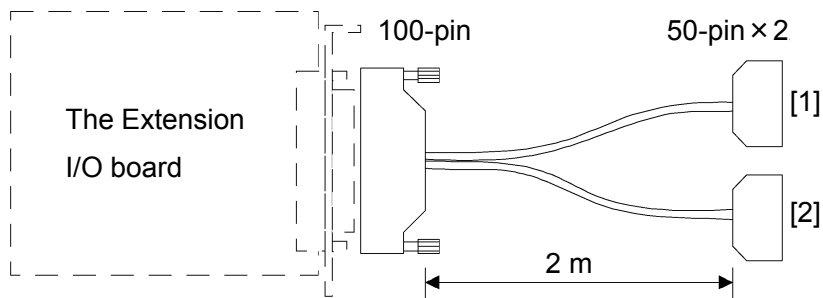
7.5.3 Extension I/O Connector Cable – Pin Assignment

Extension I/O connector cable - Pin Assignment : NPN type

[1]

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

[2]

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

Extension I/O connector cable – Pin Assignment : PNP type

[1]

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

[2]

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

8. I/O Remote Settings

This section describes functions and timing of input/output signals.

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

The user defines the I/O number that a remote function is assigned to.   For further details, refer to the SRC5**/SPEL 95 User's Guide for a section, "11.2.2 Remote" in the "11. Setup".

For details about I/O cable connection, refer to sections on "Function 6. D-I/O Connector" and "Function 7. Extension I/O Board - Optional" in this manual.

For details about communication with external equipment, refer to the SRC5**/SPEL 95 User's Guide for a section "7.3 Remote Setting" in the "7. Communication with External Equipment".

⚠ CAUTION

■ When using I/O at the remote setup, always make sure before allowing current to flow that the cable connections match to the pin assignments.   Failure to do so may cause damage to/by the peripheral equipment.   At performance testing, you should expect some kind of failure with initial settings or cable connection and therefore take extra caution.

NOTE

☞ If you set up an I/O remote function, please either keep a written record of the function settings or make sure to store the data in a file.

8.1 I/O Signal Description

A standard I/O input and output is 16 points each.   Extension I/O board(s) is necessary for input/output of all the functions.

8.1.1 Input Signal

Remote input is a function in which operation of the manipulators or Controller is enabled by input of a signal when the fixed conditions for each function are fulfilled.

The items that can be set 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

(*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

8.1.2 Output Signal

Remote output is a function to output the status of the manipulators, the status of the Controller and operating mode and so on, externally to the Controller.

The items that can be set 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	
Mnp.No.1	Outputs the Manipulator number. (*3) Outputs the Manipulator No. as determined by input of the Sel Mnp signal with these bit.
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 Jog Pad
E-Stop	Outputs the emergency stop status of the Controller
Error	Outputs the error status of the Controller
Grp No.0	
Grp No.1	Outputs the group number in the project. (*4) Outputs the current selected group number with these bit.
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).

(*3) (*4) : Refer to the tables in the ''Function 8.1.1 Input Signal''.

8.2 Timing Specifications

8.2.1 Design Notes for Input Signal

The following charts indicate timing sequence of the primary operations of the SRC520. The indicated lapse (time duration) should be referred to only as reference value since the actual timing value varies depending on the number of manipulators and running tasks as well as CPU speed of the control unit PC.   Check carefully and refer to the following charts for the timing interrelation when you enter an input signal.

In designing, avoid simultaneous entries as much as possible to prevent errors since the remote signal value is entered in pulse.

The pulse width of an input signal must be 10 or more millisecond to avoid chattering.

8.2.2 Timing Diagram for Operation Execution Sequence
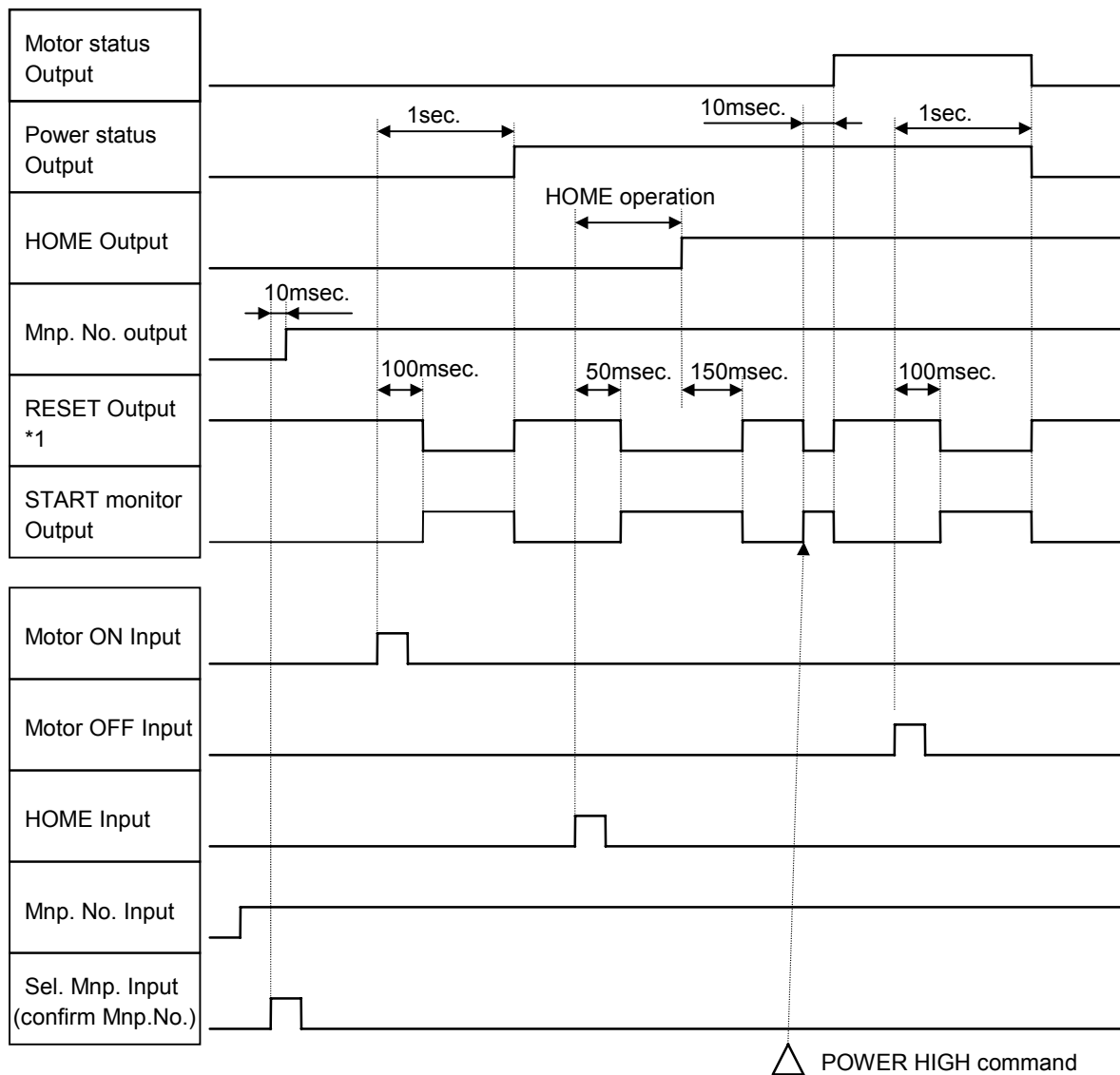
*1: It is the timing of READY output when using the background task.

8.2.3 Timing Diagram for Program Execution Sequence
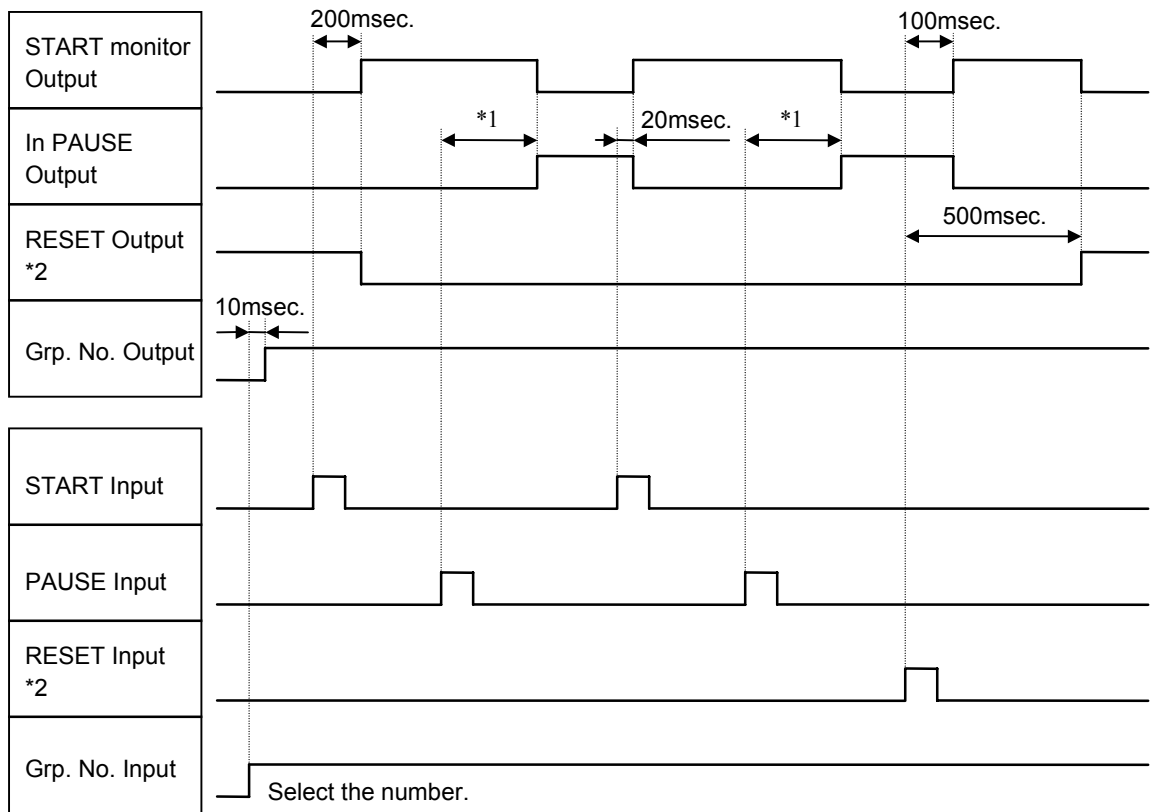
*1: The duration varies depending on the Quick Pause (QP) setting and the program's operating status at the time of Pause input.

*2: It is the timing of READY output/input when using the background task.

8.2.4 Timing Diagram for Safety Door Input Sequence
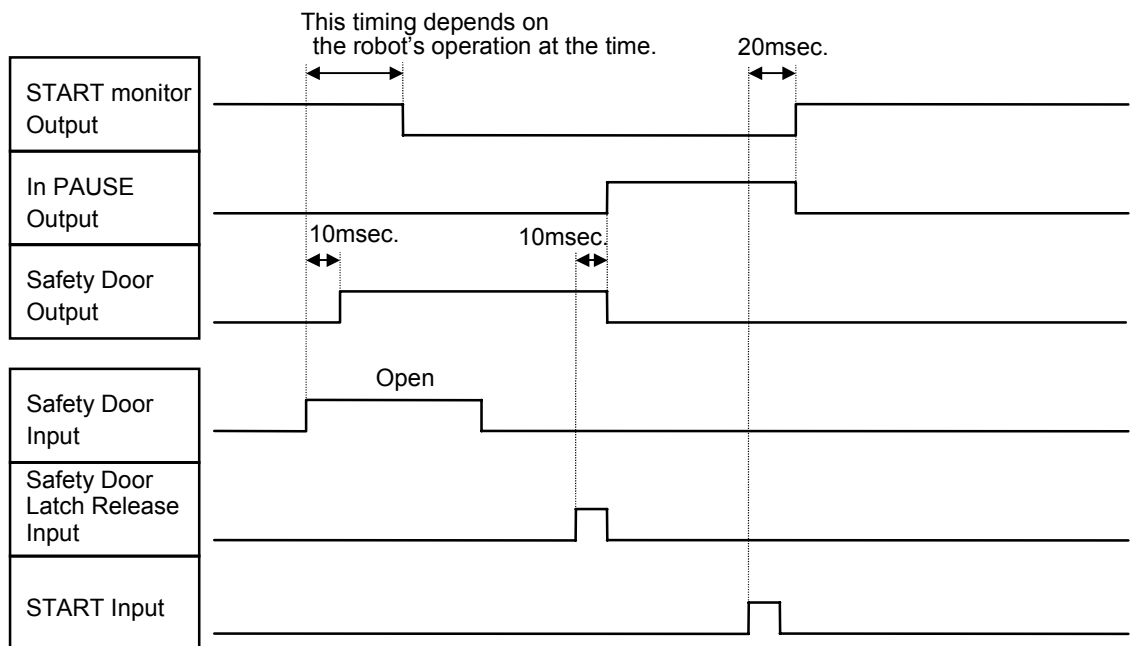
8.2.5 Timing Diagram for Emergency Stop Sequence

Power status Output	
START monitor Output	10msec.
RESET Output *1	500msec.
Emergency Stop Output	20msec.
RESET Input *1	
Emergency Stop Input	
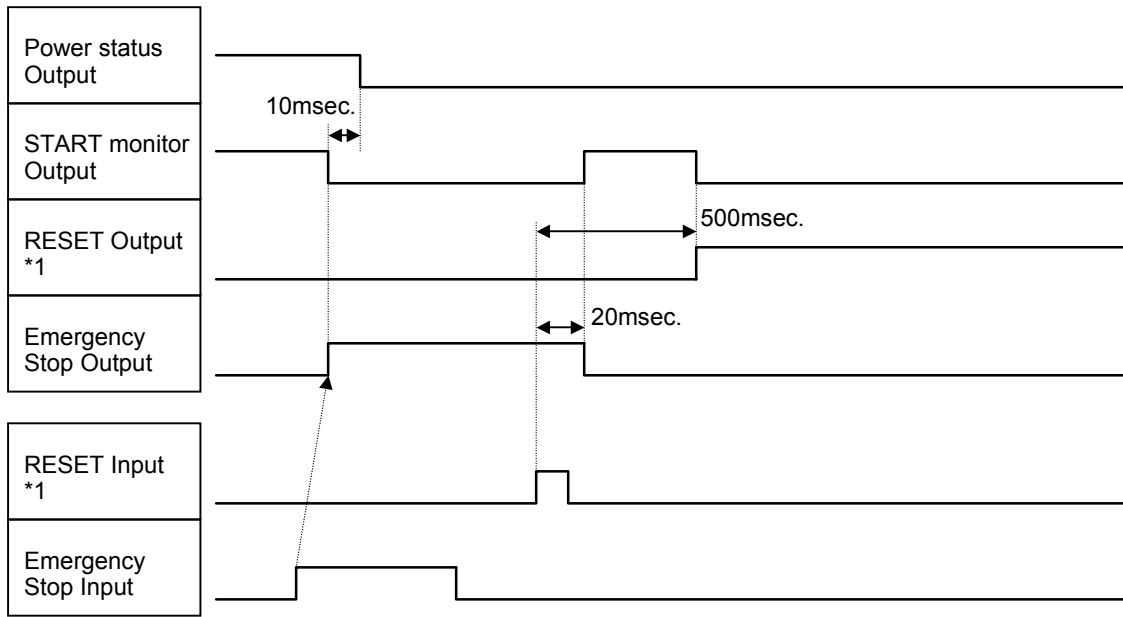
*1: It is the timing of READY output/input when using the background task.

8.2.6 Timing Diagram for Error Generating Sequence

START monitor Output	
RESET Output *1	500msec.
Error Output	30msec.
RESET Input *1	

△ Error occurs.
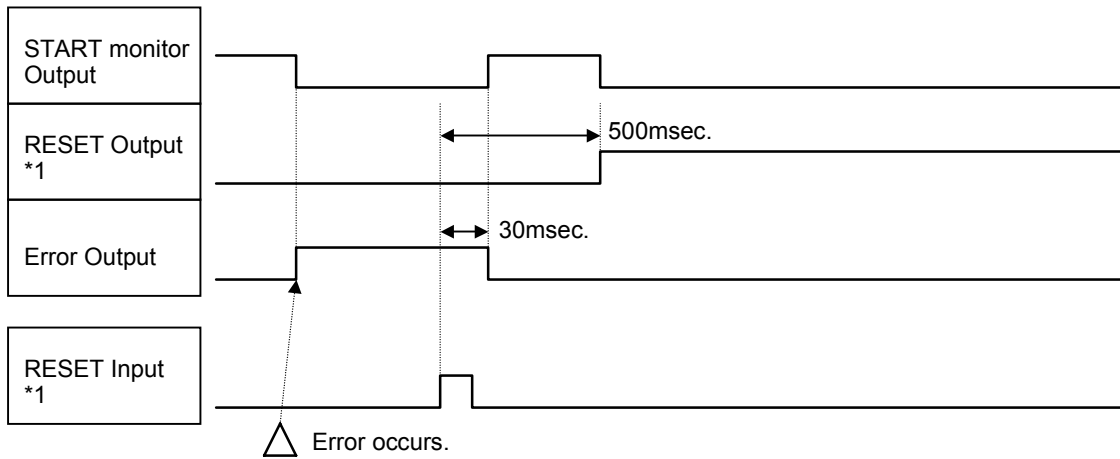
*1: It is the timing of READY output/input when using the background task.

9. RS-232C Settings

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

9.1 RS-232C cable

The RS-232C cable is not included in the standard SRC520 model.   Prepare them as necessary.

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

9.1.1 Pin Assignments

Pin assignments for RS-232C connector 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

[Control Unit]   [Peripheral equipment]

Signal Name	Pin No.			Pin No.	Signal Name
SD	3			2	SD
RD	2			3	RD
SG	5			7	SG
RS	7			4	RS
CS	8			5	CS
DR	6			6	DR
CD	1			8	CD
ER	4			20	ER
Clamp Hood				1	FG
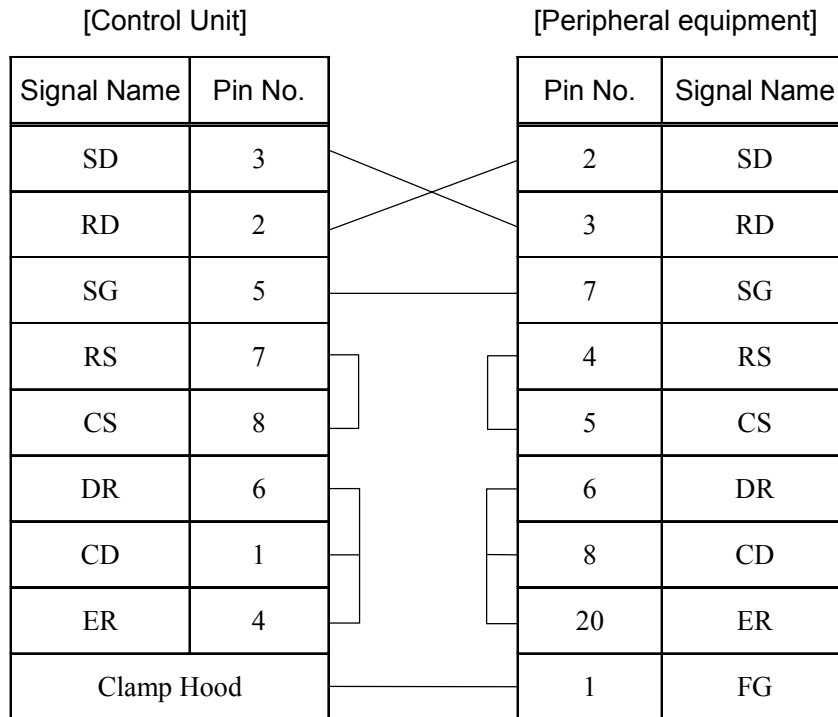
Example 2: H/W Flow Control

[Control Unit]   [Peripheral equipment]

Signal Name	Pin No.			Pin No.	Signal Name
SD	3			2	SD
RD	2			3	RD
SG	5			7	SG
RS	7			4	RS
CS	8			5	CS
DR	6			6	DR
CD	1			8	CD
ER	4			20	ER
Clamp Hood				1	FG
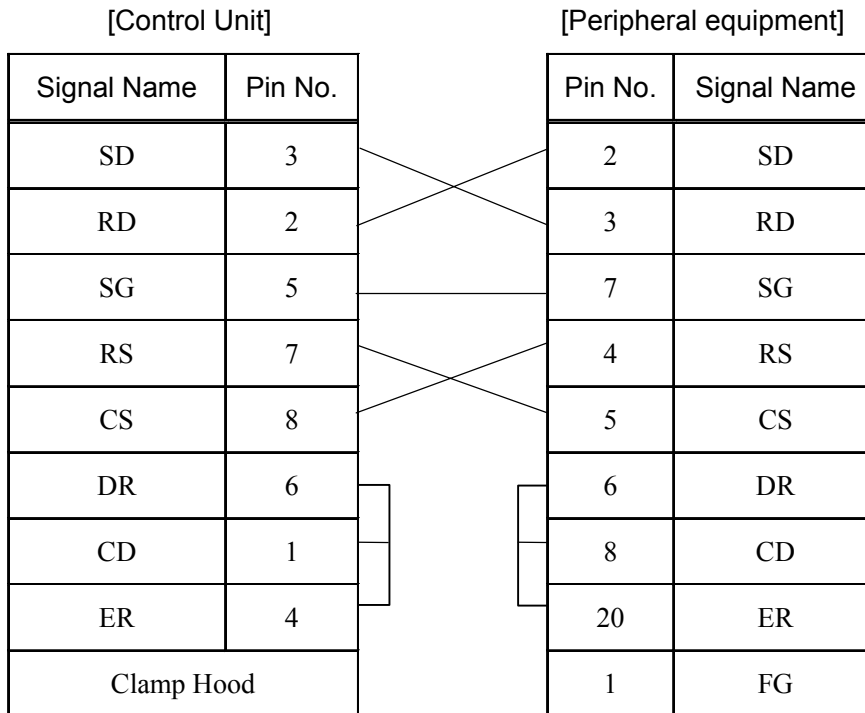
9.2 Preparation for Communication

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.   You may use either SETCOM command or go to [Setting of a Robot Controller] - [COM Port] to set up the following parameters:

    - Port #
    - Baud Rate
    - Data Bit Length
    - Stop Bit
    - Parity
    - Terminator
    - H/W Flow Control
    - S/W Flow Control

    - Timeout [sec.]

For details on the set-up procedure and communication commands, refer to the SRC5**/SPEL 95 User's Guide for "7. Communication with External Equipment".

10. Jumper Settings for MIB (Motion Interface Board)

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

The tables below show the MIB jumper settings.   The shadowed indicates the default at shipping.   Usually, the default settings do not need to be changed.

Each time an additional MIB is installed, the software needs to be re-setup accordingly in addition to the jumper settings.   For further details, refer to the SRC5**/SPEL 95 User's Guide for a section, "11.3 Setting Up the Hardware" in the "11. Setup".

JP1   factory-set and fixed

1-2	3-4	5-6
○	○	

○: Short

JP2

Set up the Periodic Interrupt Level for the first MIB only.   This setting is not necessary for the 2nd or the 3rd MIB.

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

○: Short

JP3

Set up the RS-232C Interrupt Level for the first MIB only.   This setting is not necessary for the 2nd or the 3rd MIB

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

○: Short

JP4   Setup the memory address for MIB on the PC.

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

○: Short

JP5   Setup the I/O address for the MIB on the PC.

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

○: Short

JP6, JP7   factory-set and fixed

1-2	3-4
○	

○: Short

JP8   When the manipulator's axes configuration is such as to require 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)	○		
Master (XF signal)		○	
Slave			○

○: Short

JP9, JP10   Setup the type of Drive Unit connected with the MIB.

Setting	1-2	2-3
Drive Unit for SRC520	○	
Drive Unit for SRC500		○

○: Short

JP11   The normal settings are open.

11. Stand-alone Option for SRC520

This section describes a Stand-alone Option that allows you to use the SRC520'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 Extension Emergency Connector Unit to the Control Unit.

NOTE

☞ The Stand-alone Option has been available from SPEL95 Ver2.5.

If necessary, refer to the "Function 2.3 Control Unit" for functions of the Control Unit.

11.2 System Configuration

OP500

Camera

Sensor

Solenoid Valve

SRC520
Control Unit

Driver   Motor
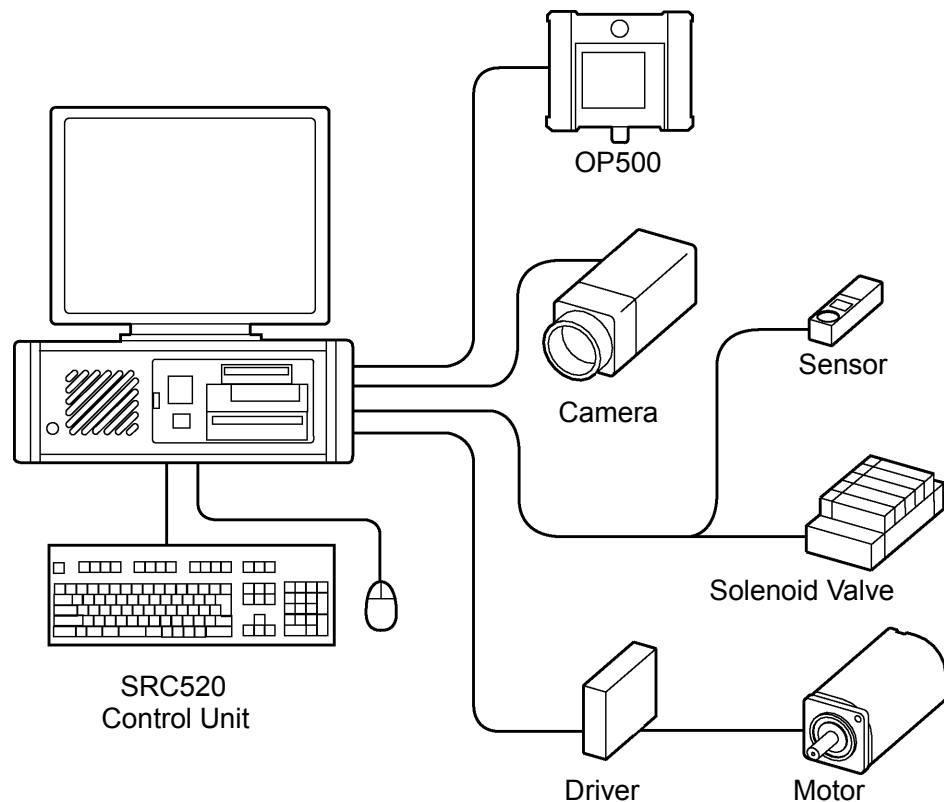
11.3 Installation

When installing the Control Unit, it must be placed in the proper environment.
For details, refer to the "Function 3. Installation".

11.4 Power Supply

⚠ CAUTION

■ PC power cable for power source supply from the Drive Unit can not be used when using the Control Unit only. Use the proper PC power cable conforming to the specification of the connecting power source.

■ A power supply voltage switch at the rear panel of the Control Unit must be set at the connecting voltage. Failure to do so will cause serious damage to the equipment.

Ensure that AC power source of the Control Unit meets the following specifications.

Item	Specification
Voltage	When the power supply voltage switch is set at [115] side : AC100V to AC120V When the power supply voltage switch is set at [230] side : 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 Extension Emergency Connector Unit

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

11.5.1 Appearance of Extension Emergency Connector Unit

The Extension Emergency Connector Unit is connected with MIB as shown below.

MIB

Extension Emergency Connector Junction Cable

Extension Emergency Connector Board
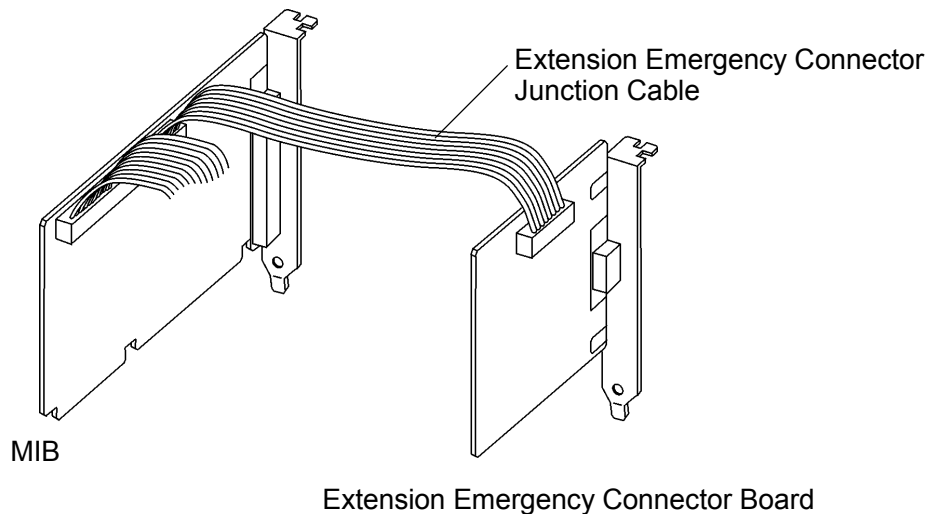
11.5.2 Components of Extension Emergency Connector Unit

The Extension Emergency Connector Unit consists of the following parts.

Extension Emergency Connector Board

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

Extension Emergency Connector Junction Cable

: Connects an extension 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.

 "Function 5.1 Safety Door Switch and Latch Release Switch"
 "Function 5.2 Emergency Stop Switch"

11.5.4 Pin Assignments

Pin assignments of the Extension Emergency Connector 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	RELEACE	Latch Release input
16	RELEACE	
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	DC 30V 1A or under	1–2, 11–12 pin
Emergency Stop rated input voltage range Emergency Stop rated input current	DC 12V to 24V±10% 10mA/24V input	3–4, 13–14 pin
Safety Door rated input voltage range Safety Door rated input current	DC 12V to 24V±10% 10mA/24V input	7–8, 17–18 pin
Latch Release rated input voltage range Latch Release rated input current	DC 12V to 24V±10% 10mA/24V input	15–16 pin
Emergency Stop output relay contact rated load	DC 30V 0.5A or under	5–6 pin

NOTE

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

11.5.5 Circuit Diagram

Example 1 : External emergency stop switch typical application
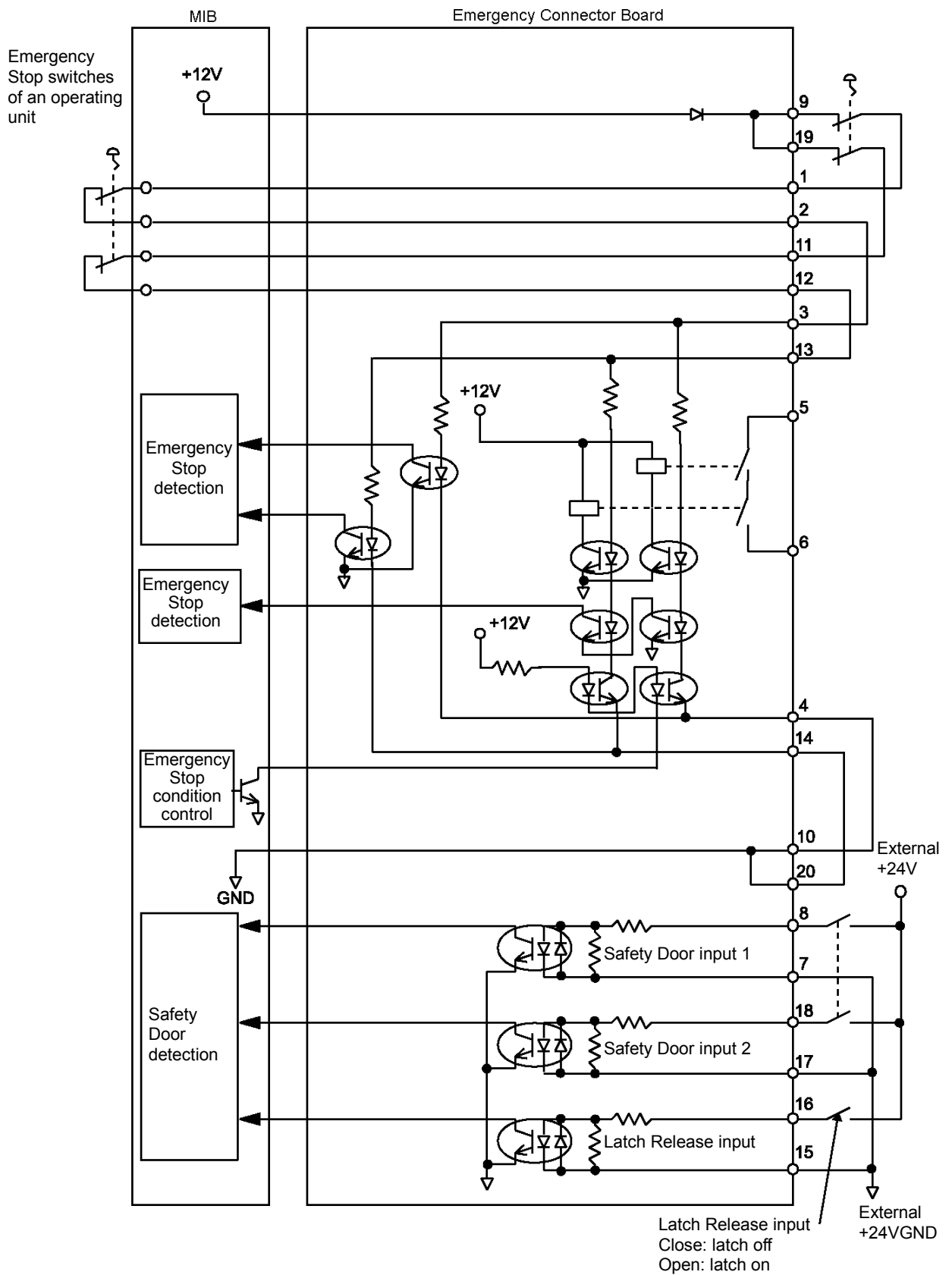
Example 2: External safety relay typical application
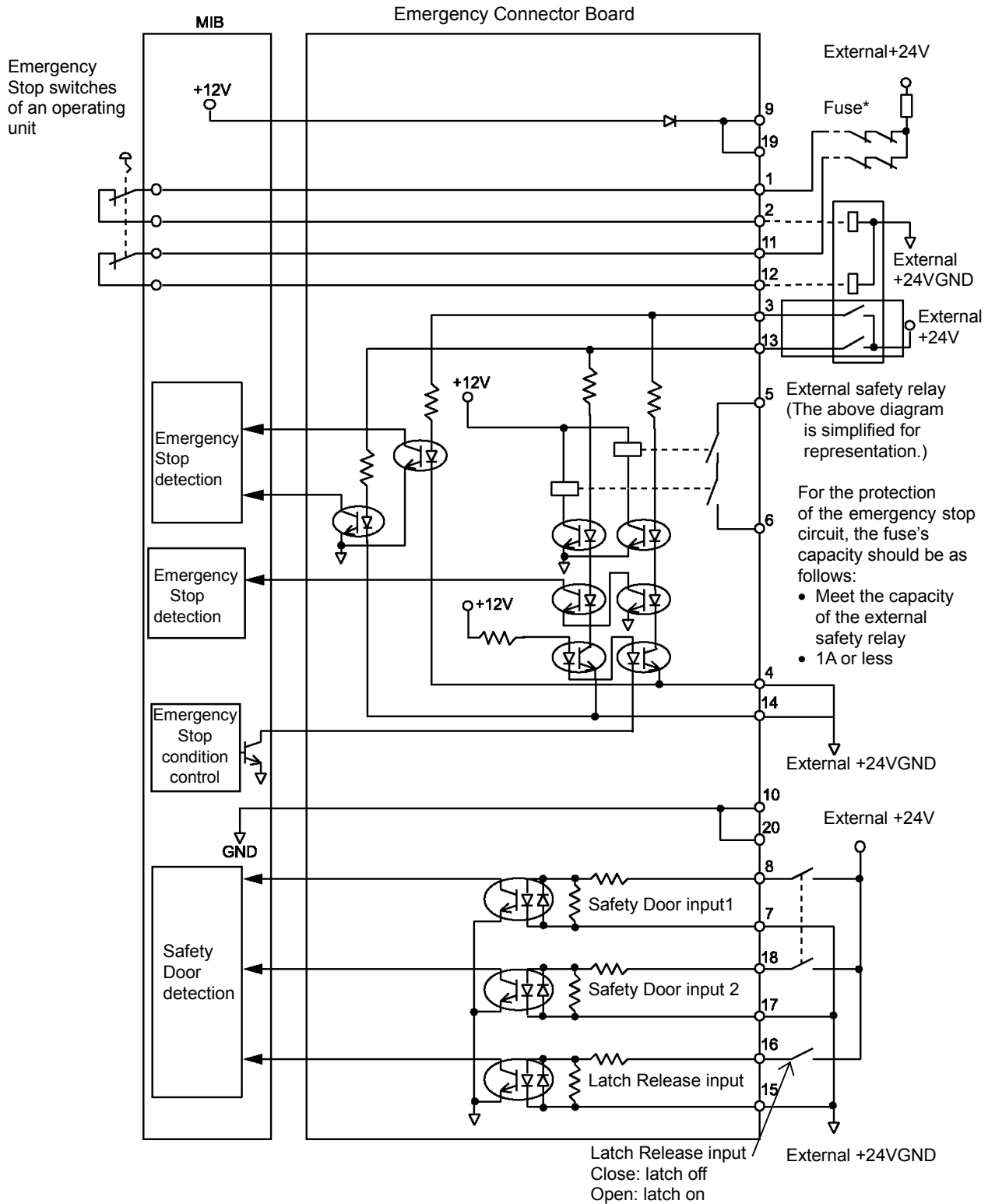
11.6 MIB

11.6.1 Board Number

When using the Control Unit only, use the MIB with the following board number.
・SKP372-1 Dr-01
・SKP372-2 Dr-01
・SKP372-3 or newer

11.6.2 Jumper Settings

Set the MIB jumper referring to the table below.

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 "Function 10. Jumper Settings for MIB (Motion Interface Board)".

11.7 Option

The options for SRC520, such as the Operation Units (JP500 and OP500), Extension 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

The manual herein explains the maintenance procedure for each unit in the robot controller, SRC 520.

1. Safety Precautions on Maintenance

⚠	WARNING	This sign indicates that a danger of serious injury or death will exist if the instructions thereunder are not followed.
⚠	CAUTION	This sign indicates that ignoring the instructions thereunder may cause serious harm to people or physical damage to equipment and facilities.

⚠ **WARNING**

- Only trained personnel should be allowed to operate, test and maintain this robot and the robot system. Trained personnel are those who are certified trainees of the government sponsored training courses for safety operation of industry robots or those who have completed the manufacturer or dealer's introductory and maintenance training courses (held on a regular basis).

- Always make sure before performing any maintenance procedure that the main power is turned OFF and that the high voltage charged area is completely discharged.

- Make sure to use only dedicated/specified maintenance parts especially for the MIB and optional boards or any other units in the Control Unit to be replaced. Using non-specified parts may cause serious damage to the equipment or the robot's overrun that can be highly dangerous.

```
┌──────────────────────────────────────────────────────────────────────────┐
│                          ⚠  CAUTION                                        │
│                                                                            │
│   ■ It is possible that the Motor Driver modules both in the Drive Unit    │
│     and the Switching Power Supply can become very hot.  If you maintain   │
│     these units, examine the surface temperature, and wear protective      │
│     gloves if necessary.                                                   │
│                                                                            │
│   ■ Do not remove any parts that are not covered in this manual.  Follow   │
│     the maintenance procedure strictly as described in this manual.  When  │
│     you do replace a part or maintain the equipment, do not proceed in any │
│     other ways than described in this manual.                             │
│                                                                            │
│   ■ Do not shock, shake or drop the HDD, FDD and CD-ROM drive.  When these │
│     disk drives are shocked physically, it may damage the contained data.  │
│                                                                            │
│   ■ Make sure that the wattage of the new Motor Drive module is correct.   │
│     When the inappropriate wattage module is connected with the Drive      │
│     Unit, the robot may not function properly or may be damaged.           │
│                                                                            │
│   ■ Check on the Connection Check Label, DU number (at Control Unit) and   │
│     Signature Labels (at Drive Unit & Manipulator) when connecting those   │
│     units.  If those units are misconnected, the robot may not function    │
│     properly or may be damaged.                                            │
│                                                                            │
│   ■ If there are more than one Drive Units connected to the Control Unit,  │
│     make sure that the DU numbers (DU1−DU3) indicated at the Control Unit  │
│     (above the MIB connector) and the Drive Unit (above the MOTION         │
│     connector) match.  It is highly dangerous if those do not match,       │
│     causing to activate an unintended robot.                               │
│                                                                            │
└──────────────────────────────────────────────────────────────────────────┘
```

NOTE

☞   Before performing maintenance on the controller, all the data must be copied as a backup.

2. Hardware Configuration

2.1 Control Unit, Drive Unit and Manipulator

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

	Electric Power	Encoder Voltage	SPEL 95
Control Unit — Computer — MIB / MIB / MIB			Setting data (Manipulator & hardware)
MOTION Interface Cable — DU1 / DU2 / DU3			Jumper settings of MIB (Memory & I/O address)
Drive Unit (×3) — DPB Encoder Voltage		Output voltage	Drive Unit No.
Cooling Fan	1 or 2		
Regeneration Module	Mount or Unmount		
Motor driver (×4 per Drive Unit)	Motor driver wattage		CTGAIN, CTOFFSET, Motor driver wattage
M/C SIGNAL Cable		Cable length	
Manipulator — Motor / Encoder	Motor wattage		Encoder type (ABS/INC)
			Manipulator's axes configuration

(Mnp1) (Mnp2) (Mnp3) (Mnp4) (Mnp5)(Mnp6)

(Manipulator numbers in sample configuration)

2.2 Optional Boards

Control Unit


```
┌─────────────────────────────────────────────────────────────────────┐
│                                                                       │
│  ┌──────────────┐                                                     │
│  │  Computer    │              Optional Boards                        │
│  └──────────────┘                                                     │
│                                                                       │
│  ┌─────┐  ┌─────┐  ┌─────┐                                           │
│  │ MIB │  │ MIB │  │ MIB │                                           │
│  └─────┘  └─────┘  └─────┘                                           │
│                                                                       │
│        ┌──────────────┐  ┌──────────────┐  ┌──────────────┐          │
│        │    Pulse     │  │ Extension I/O│  │  Remote I/O  │          │
│        │  Generating  │  │    Board     │  │    Board     │          │
│        │   Board*     │  │              │  │              │          │
│        │              │  │(Set the jumper│ │(Set the jumper│         │
│        │(Set the jumper│ │ for I/O      │  │ for I/O      │          │
│        │ for I/O      │  │ address)     │  │ address and  │          │
│        │ address)     │  │              │  │ the number of│          │
│        │              │  │              │  │ I/O)         │          │
│        └──────────────┘  └──────────────┘  └──────────────┘          │
│                                                                       │
└─────────────────────────────────────────────────────────────────────┘
```

Drivers

Motors of manipulator (s)

Input/output Equipment
Input   :32
Output :32

Input/output Equipment Total
(input/output included): 128
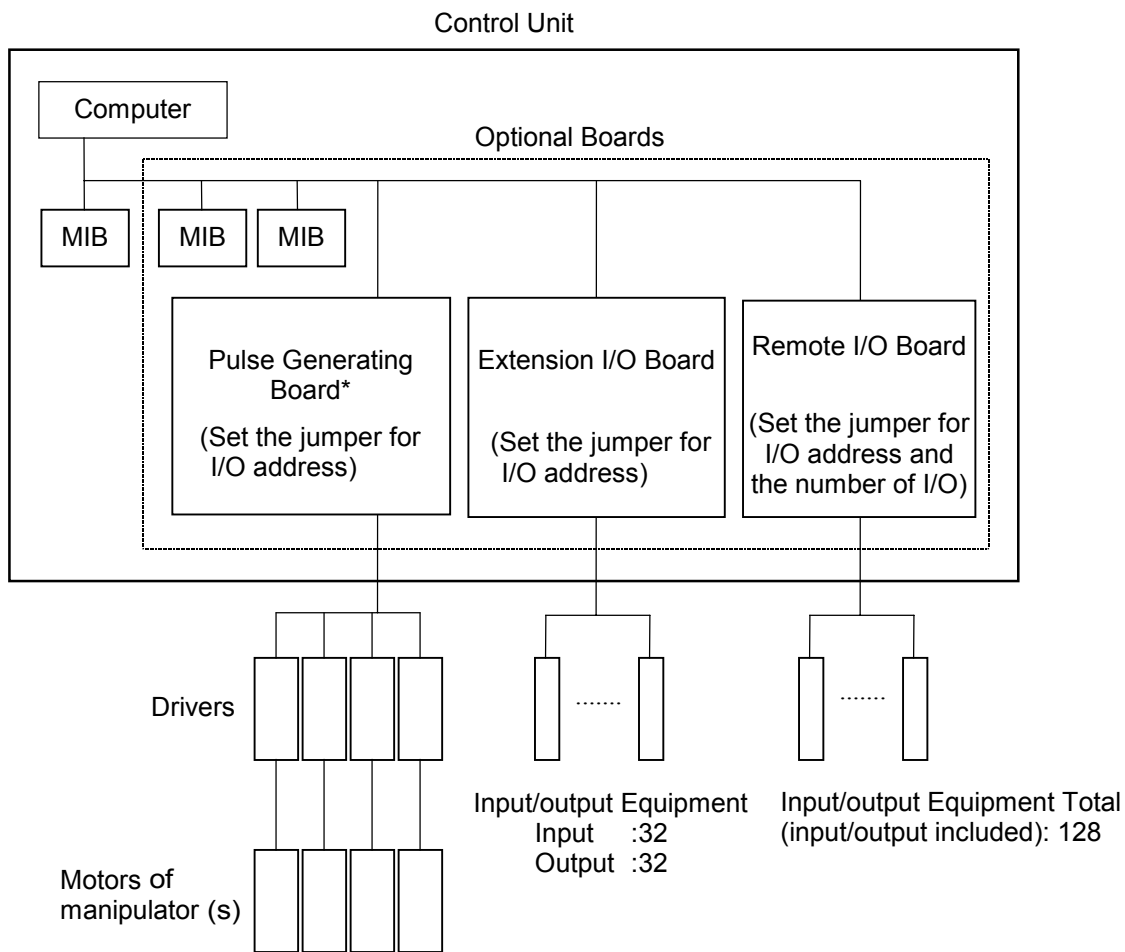
* One Pulse Generating Board increases the number of controllable axes by four (4) at maximum.

For details about jumper and data settings of the boards, refer to the manual attached to each board.

3. Control Unit

3.1 Overview

The Control Unit internal layout:

MIB CPU board

Switching Power Supply

CD-ROM Drive

FDD : upper

HDD : lower

Drive Bay Unit

Fan   Filter   System Panel
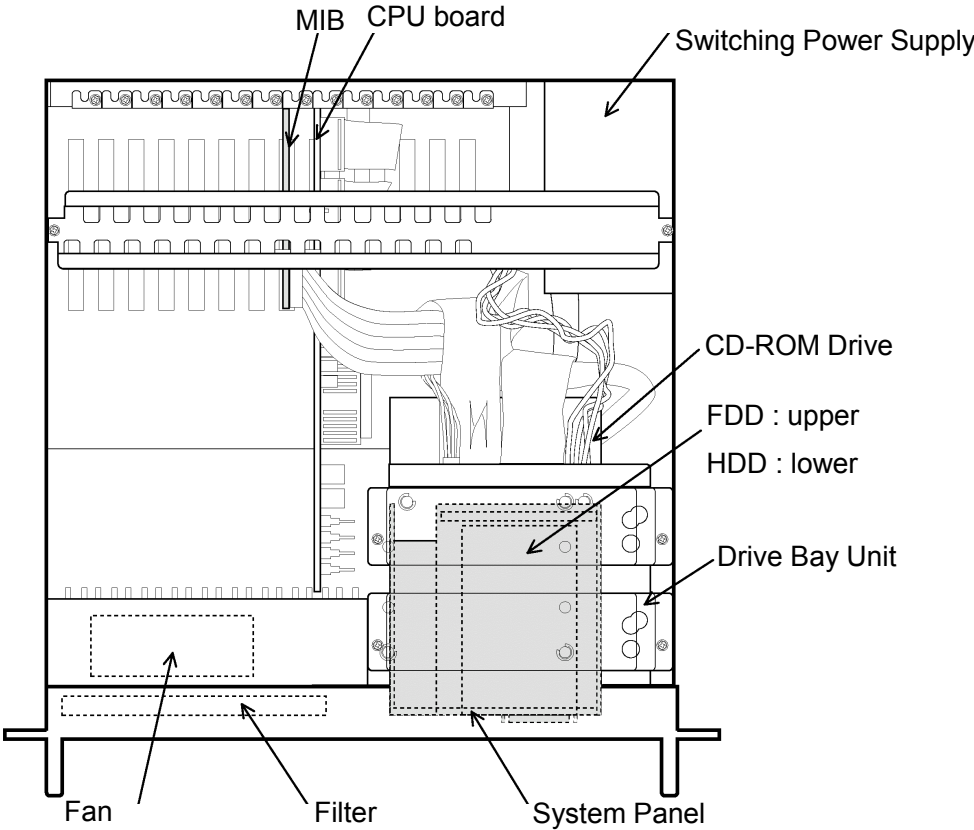
3.2 Replacing the MIB

When MIB is suspected to be defective, replace the board by following the steps below:

(1) Shut down Windows 95.   Turn OFF the Control and Drive Units.

(2) Disconnect the Motion Interface cable.
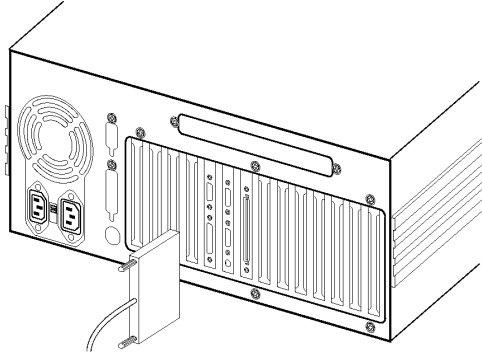
(3) Remove the four screws on both sides of the Control Unit.
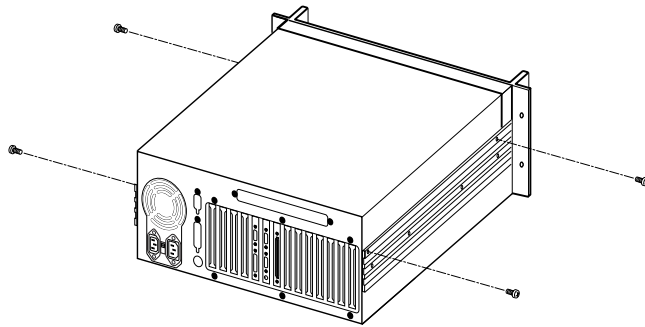
(4) Remove the Upper Cover from the Control Unit.
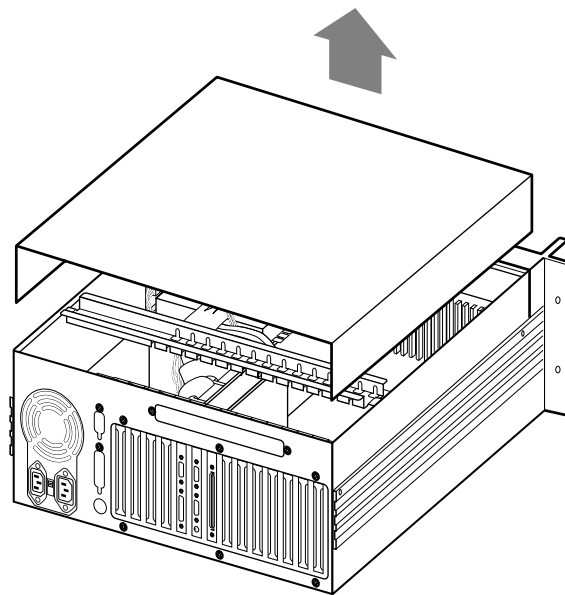
(5) Remove two affixing screws, and then take the metal fitting off from the board.

Metal Fitting
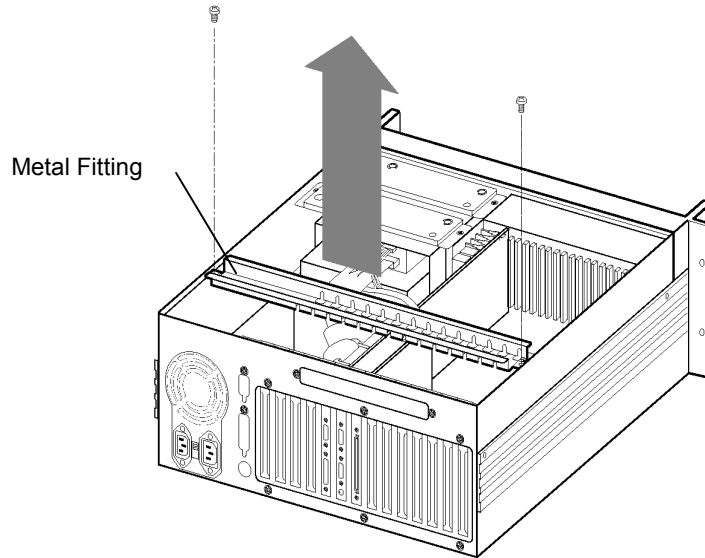
(6) Remove the affixing screw from MIB and remove the MIB out of the slot in the
Control Unit.
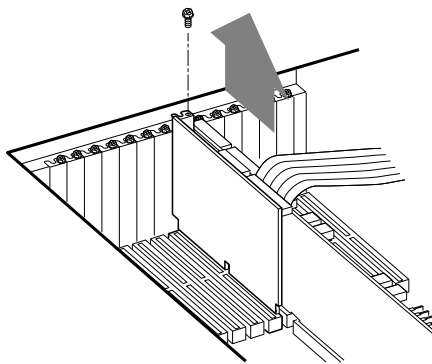
(7) Disconnect the cable from MIB by releasing the connector lock as shown below.
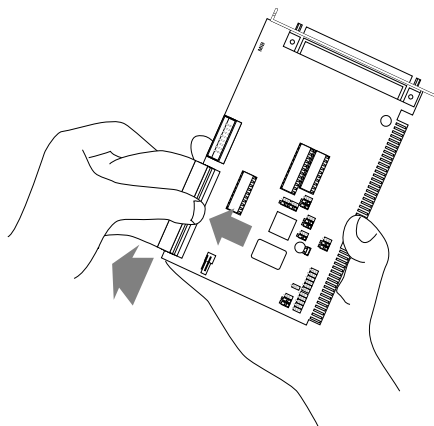
(8) Set the jumpers on the new MIB exactly the same as on the old board.
Refer to the "Function 10. Jumper Settings for MIB (Motion Interface Board)" for details of the jumper functions.
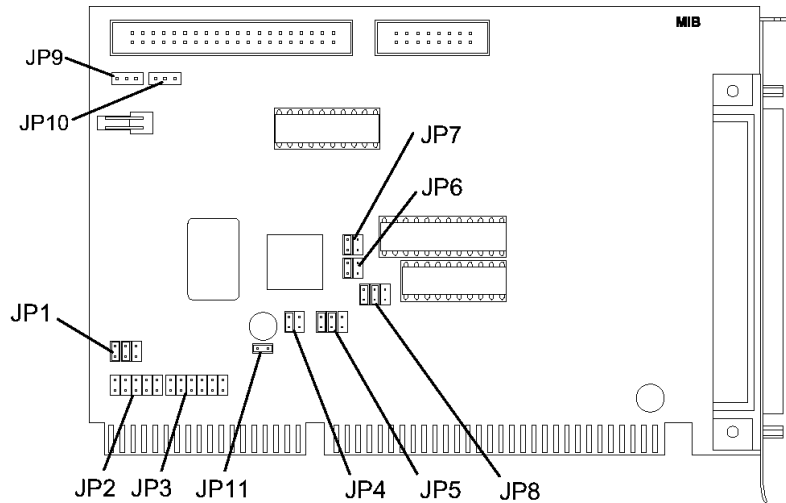
(9) Connect the cable from the System panel to the new MIB.
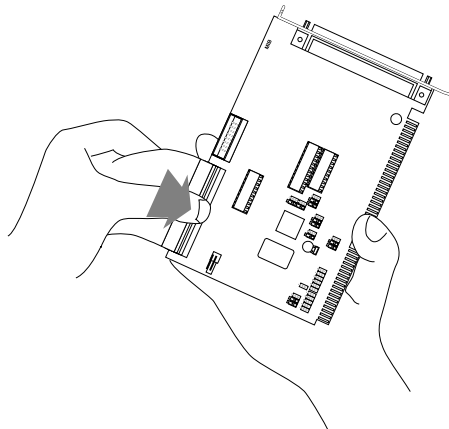
(10) Mount the new MIB onto the option slot in the Control Unit and fasten the screw to secure the new board.
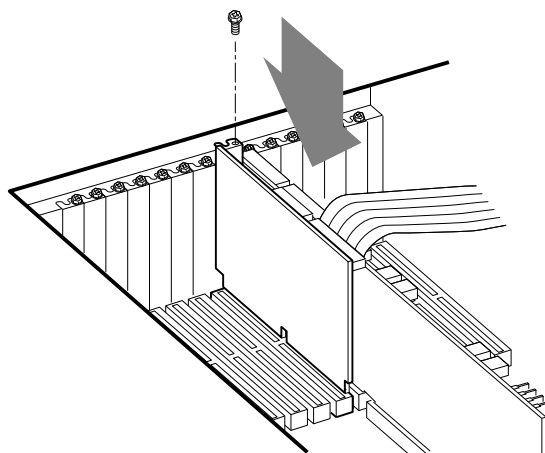
(11) Loosen the screws that are holding the angles on the metal fitting.
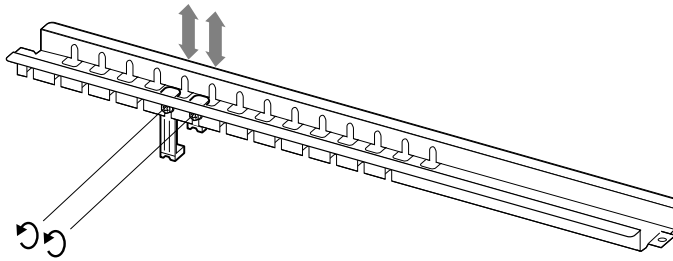
The angle comes in three different sizes to accommodate different board sizes.
Select the one that fits.
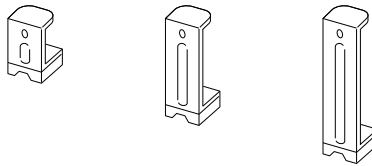
(12) Affix the metal fitting to the Control Unit.
(13) Adjust the angle and fix it inside the unit using screws.   The angle must be adjusted
to hold down the board not too tightly.
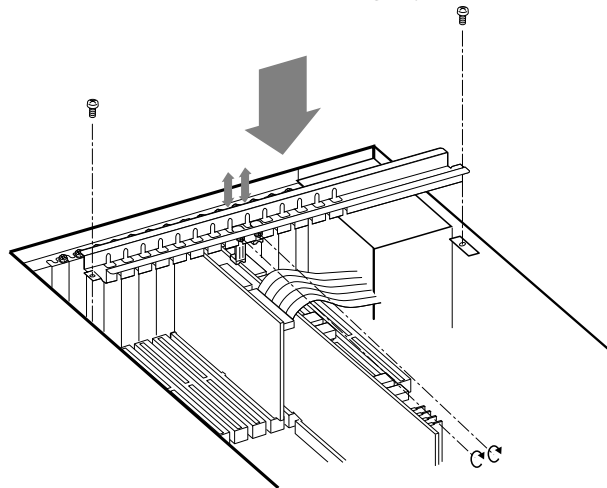
(14) Place the Upper Cover of the Control Unit back on and secure it with the screws.
(15) Connect the Motion Interface cable.
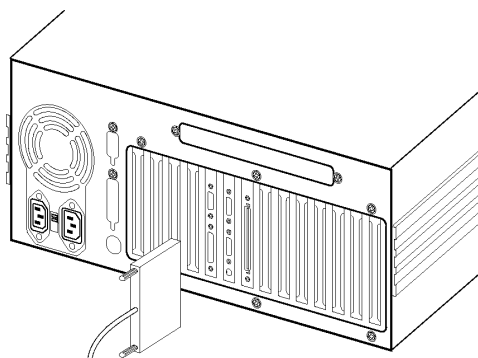
3.3 Replacing the Extension Emergency Connector Unit

When replacing the Extension Emergency Connector Unit that allows you to use the Control Unit only, follow the steps below:

(1)   Shut down Windows 95.   Turn OFF the Control and Drive Units.

(2)   Disconnect the Motion Interface cable.
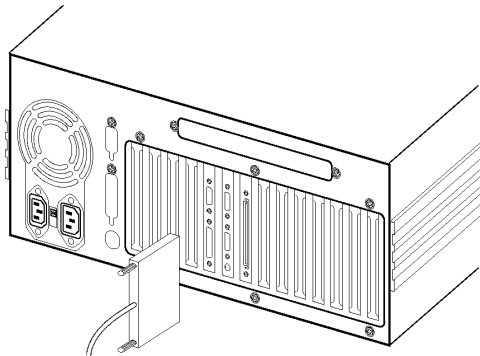
(3)   Remove the four screws on both sides of the Control Unit.
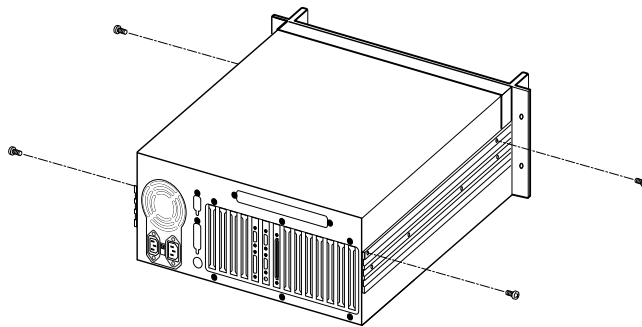
(4)   Remove the Upper Cover from the Control Unit.
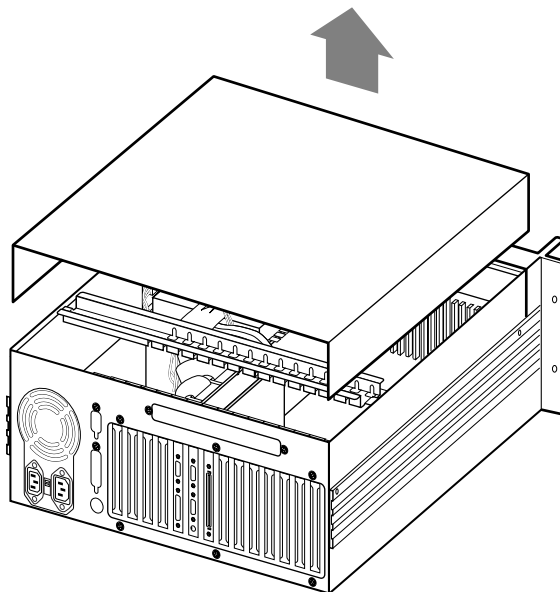
(5) Remove two affixing screws, and then take the metal fitting off from the board.
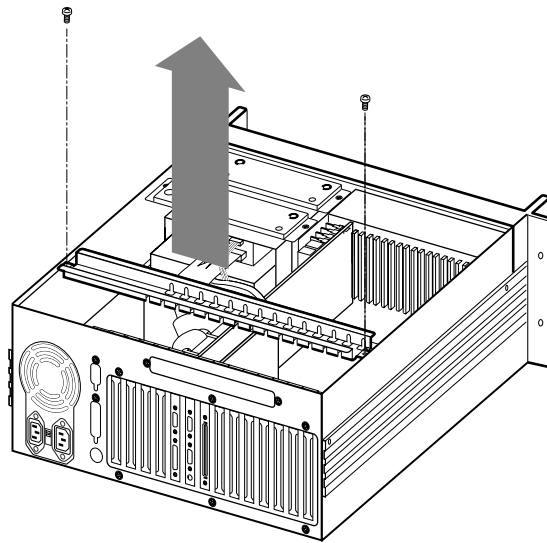
(6) Disconnect the cable connecting between the MIB and Extension Emergency Connector Board.
(7) Unfasten an affixing screw from the Extension Emergency Connector Board and remove the Board.
(8) Mount a new Extension Emergency Connector Board onto the slot and fasten the screw to secure the new board.
(9) Connect the MIB to the Extension Emergency Connector Board with a cable.
(10) Loosen the screws that are holding the angles on the metal fitting.
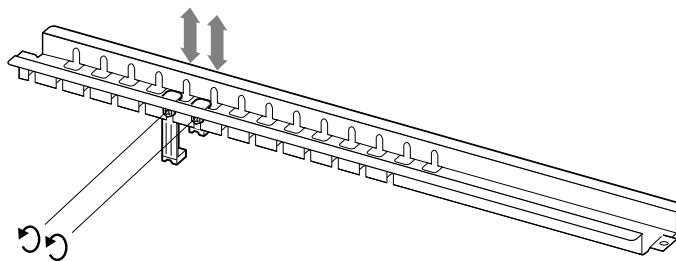
(11) Affix the metal fitting to the Control Unit.
(12) Adjust the angle and fix it inside the unit using screws.   The angle must be adjusted to hold down the board not too tightly.
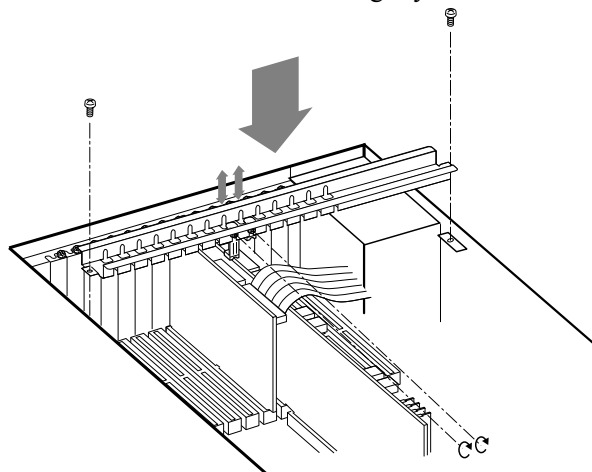
(13) Place the Control Unit Cover back on and secure it with the screws.

(14) Connect the Motion Interface cable.
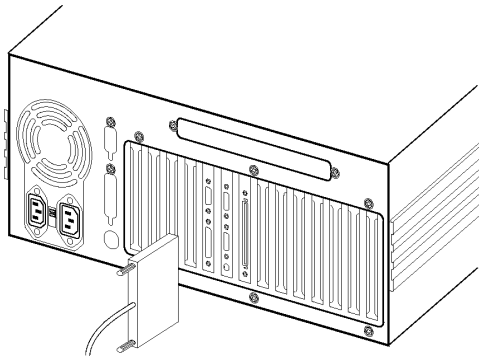
3.4 Replacing an Optional Board

When replacing an optional board(s), refer to the "Maintenance 3.2 Replacing the MIB" and follow the 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.

3.5 Replacing the System Panel

If the System Panel is suspected to be defective, replace the System Panel by following the steps described in the section, "3.5.1" and 3.5.2", as follows:

3.5.1 Removable HD Unit Model

Removal

(1) Shut down Windows 95, and then turn OFF the power on both the Control and Drive Units.

(2) Disconnect the Operation Unit or Port Short connector from the OPTIONAL DEVICE connector.
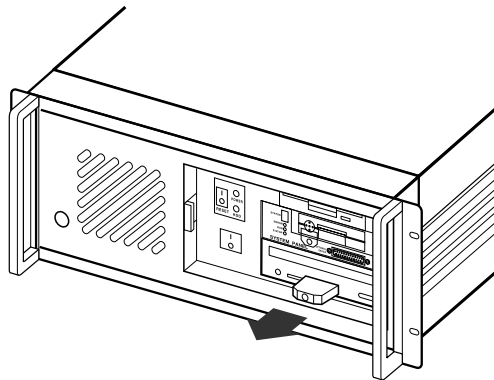
(3) Remove the HDD.   For the procedure, refer to the "Maintenance 3.7 Replacing the HDD for Removable HD Unit Model".

(4) Remove the four screws on both sides of the Control Unit.
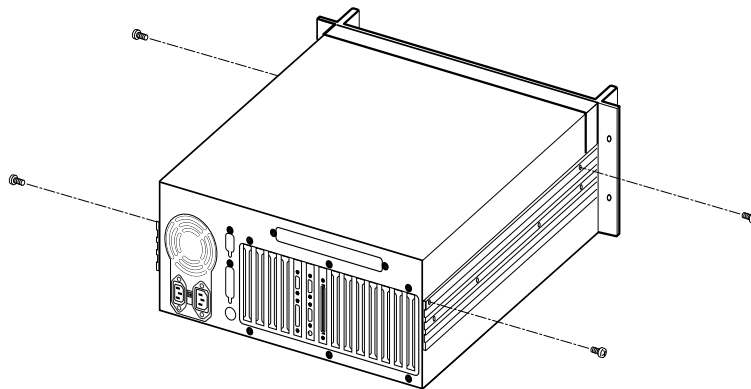
(5) Remove the Upper Cover from the Control Unit.

(6) Remove an affixing screw from MIB and remove the MIB out of the slot in the Control Unit.

(7) Disconnect the cable from MIB by releasing the connector lock as shown below.
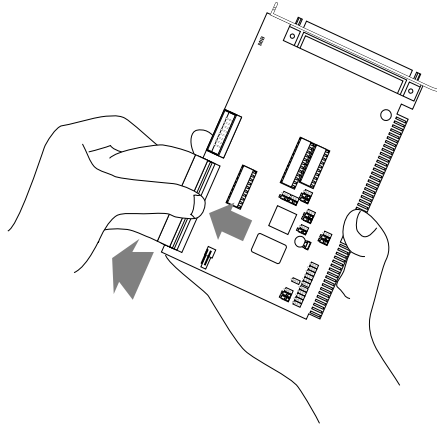
(8) Disconnect any cables that are connected to the Drive Bay Unit (DC-ROM drive, FDD and HDD mounting case).

⚠ CAUTION | ■ Do not shock, shake or drop the HDD, FDD and CD-ROM drive.
When these disk drives are shocked physically, it may damage the contained data.

(9) Unscrew all the mounting screws on the Drive Bay Unit to remove the unit.

Drive Bay Unit

FDD

HDD mounting case

CD-ROM drive

111
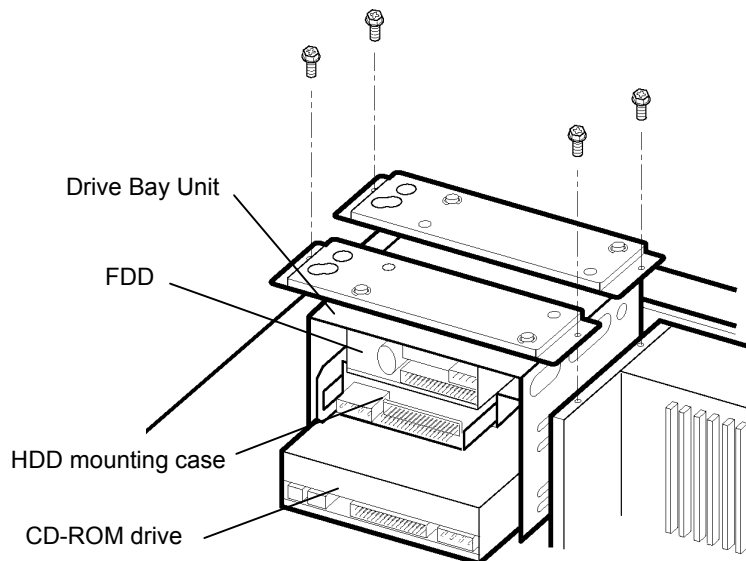
(10) Unscrew the mounting screws on the System Panel and remove it from the Drive Bay Unit.
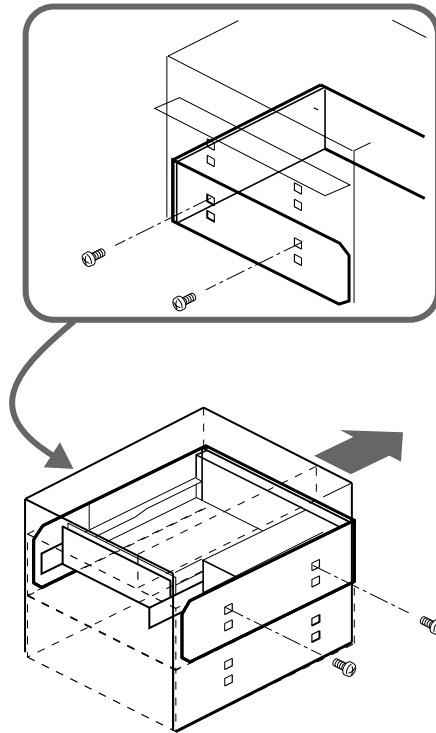
(11) Remove the two screws on the HDD mounting case and remove it from the System Panel.

Screw

Screw
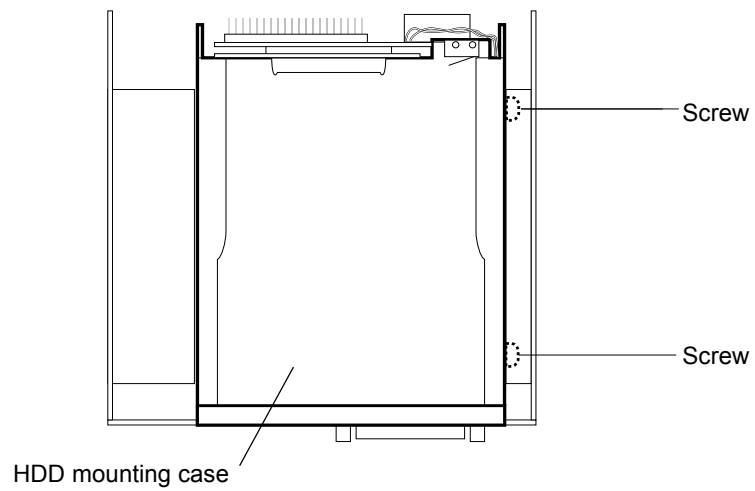
HDD mounting case

Installation

(1) Attach the HDD mounting case to a new system panel with the four screws.
Match the faces of the case and the system panel to flatten.

Screw

Screw

Face of the system panel   Face of the HDD mounting case
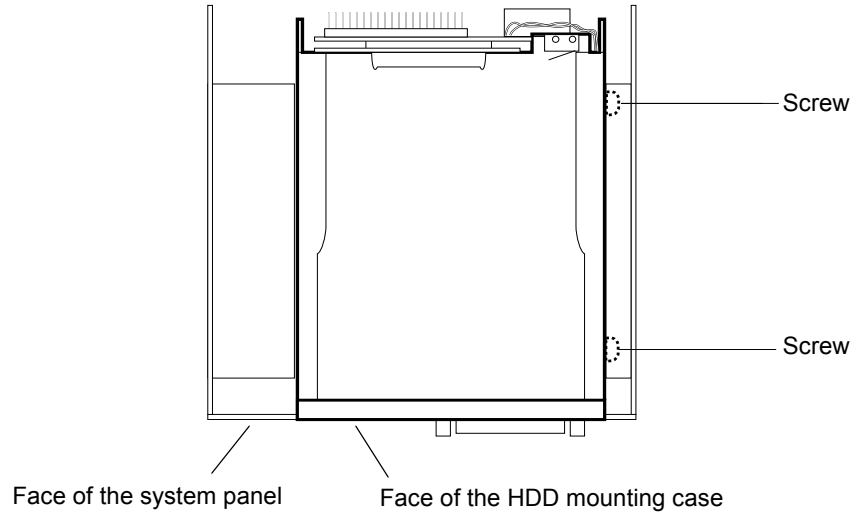
(2) Install the System Panel in the Drive Bay Unit and secure it with the screws.
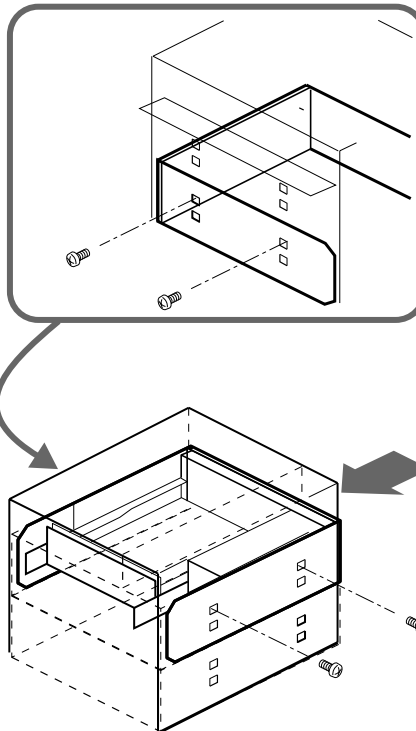
(3) Install the Drive Bay Unit and fix it with the screws.
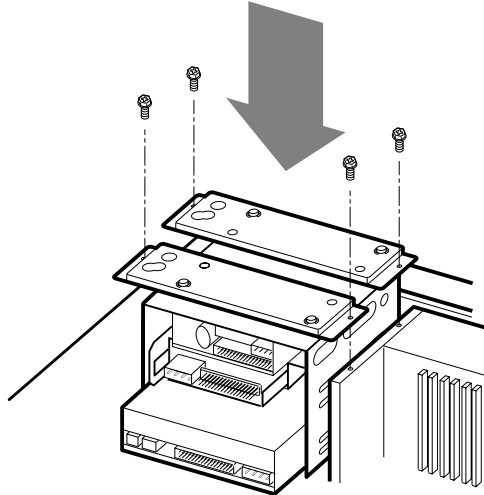
(4) Connect the cables for the Drive Bay Unit (HDD mounting case, CD-ROM drive and FDD) back.

(5) Connect the cable from the System Panel to the MIB.
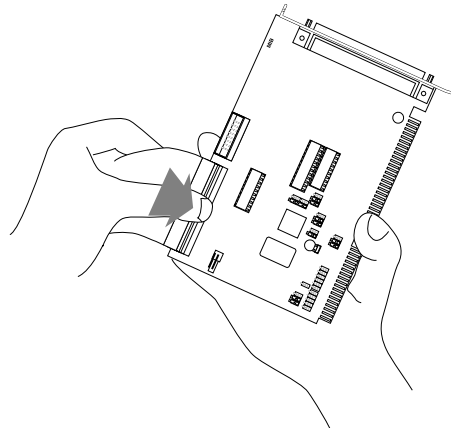
(6) Attach the MIB on the option slot in the Control Unit and fix it with the screw.
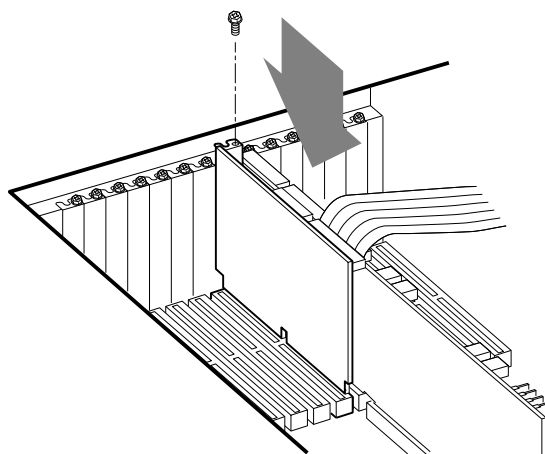
(7) Loosen the screws that are holding the angles on the metal fitting.
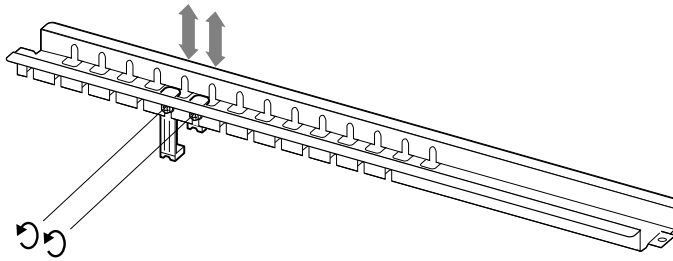
(8) Affix the metal fitting to the Control Unit.

(9) Adjust the angle and fix it inside the unit using screws.   The angle must be adjusted to hold down the board not too tightly.
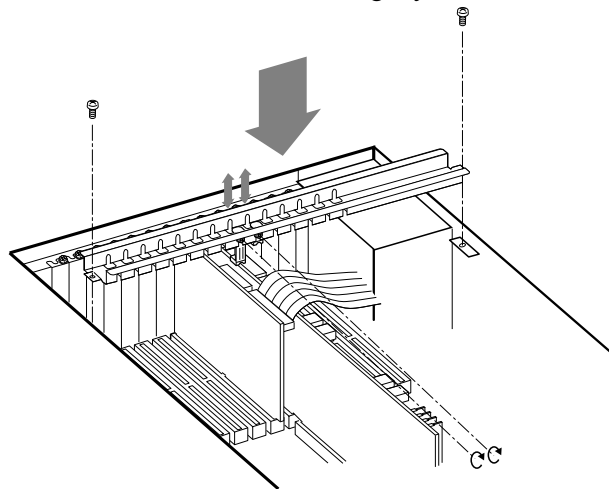
(10) Place the Upper Cover of the Control Unit back on and fix it with screws.

(11) Install the HDD back in, and fix it with the switch fixing plate.
    For details, refer to the "Maintenance 3.7 Replacing the HDD for Removable HD Unit Model".

(12) Connect the Operation Unit or Port Short connector that has been removed back to the OPTIONAL DEVICE connector.

3.5.2 Built-in HDD Model

Removal

(1) Shut down Windows 95, and then turn OFF the power on both the Control and Drive Units.

(2) Disconnect the Operation Unit or Port Short connector from the OPTIONAL DEVICE connector.
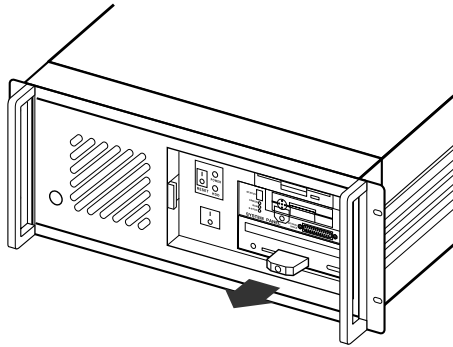
(3) Remove the four screws on both sides of the Control Unit.
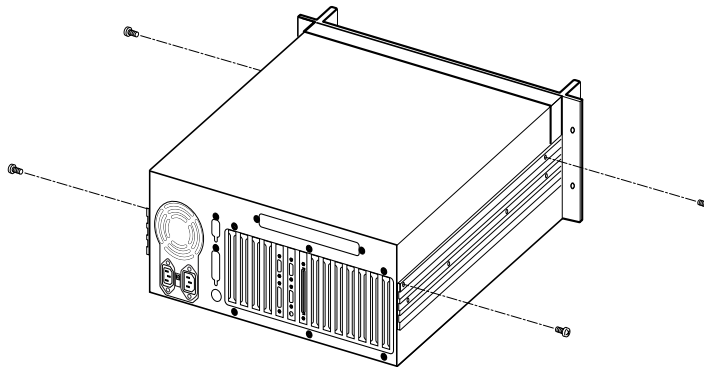
(4) Remove the Upper Cover from the Control Unit.
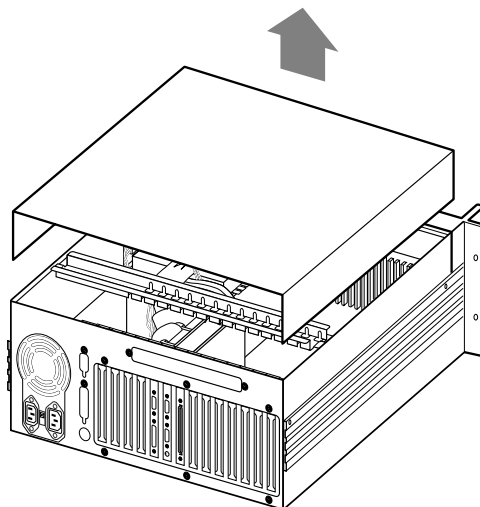
(5) Disconnect any cables that are connected to the Drive Bay Unit (HDD, CD-ROM drive and FDD).   Unscrew all the mounting screws on the Drive Bay Unit to remove the unit.
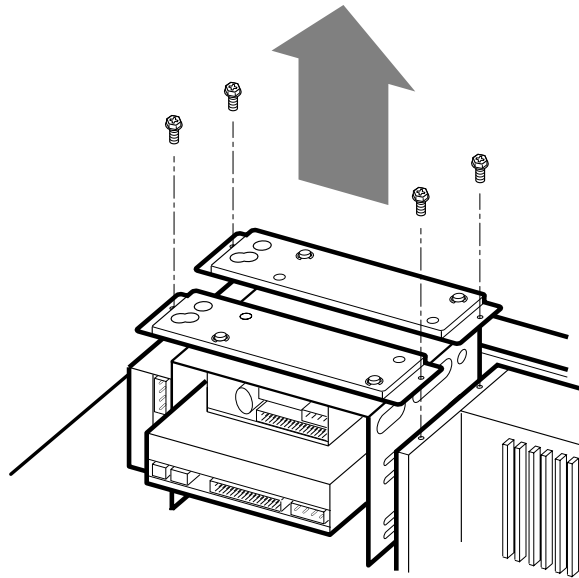
(6) Unscrew the mounting screws on the HDD and remove the HDD from the Drive Bay Unit.
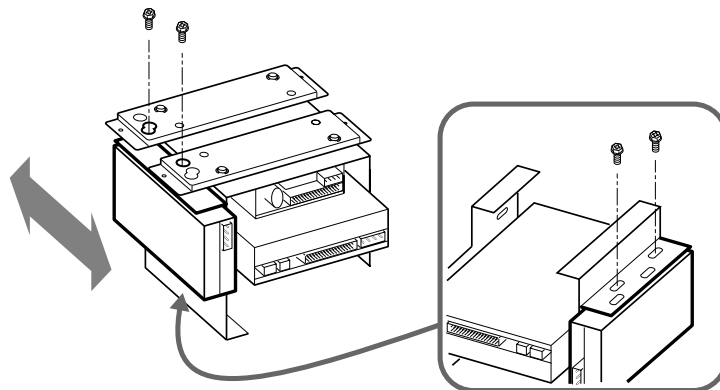
⚠ CAUTION   ■ Do not shock, shake or drop the HDD, FDD and CD-ROM drive.
When these disk drives are shocked physically, it may damage the contained data.

(7) Unscrew the mounting screws on the System Panel and remove it from the Drive Bay Unit.
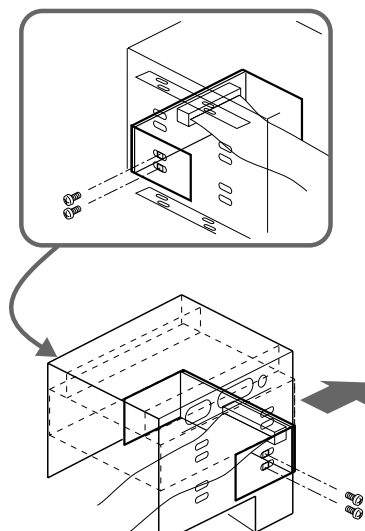
(8) Remove the flat cable connecting to the MIB.
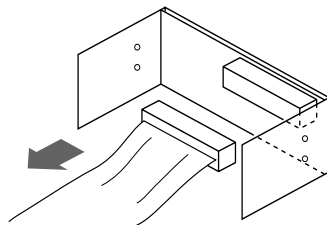
Installation

(1) Connect the flat cable of the new System to the MIB.
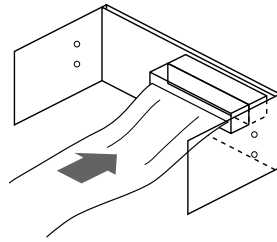
(2) Install the System Panel in the Drive Bay Unit and secure it with the screws.
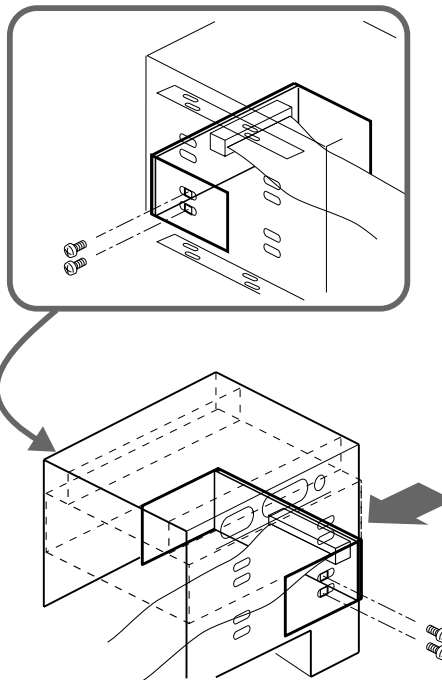
(3) Affix the four mounting screws on the HDD temporarily.   Match the screws on the upper two through holes and fasten to secure the HDD position.   Tighten the remaining two screws.
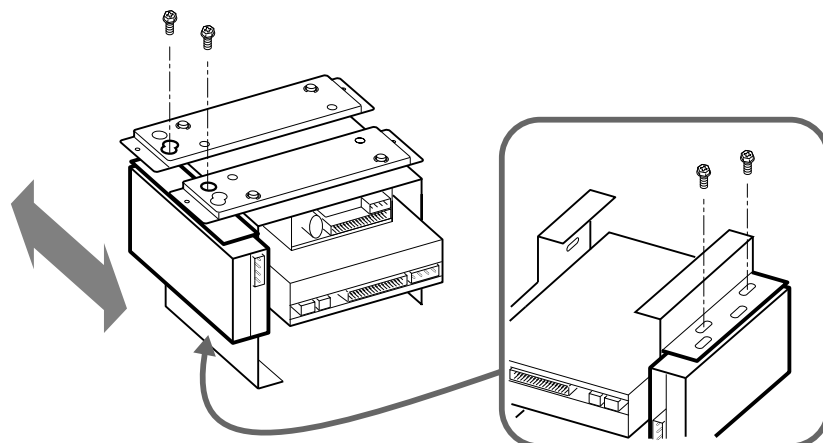
(4) Install the Drive Bay Unit and fix it with the screws.
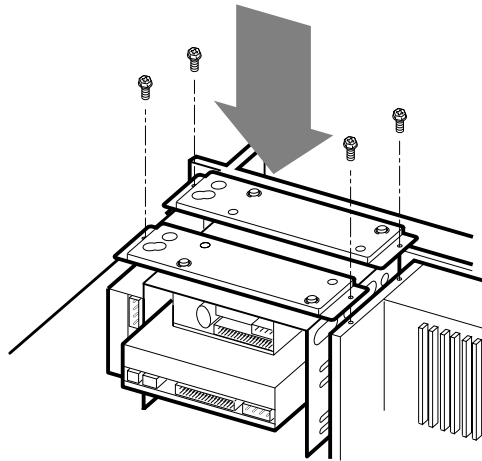
(5) Connect the cables for the Drive Bay Unit (HDD, CD-ROM drive and FDD) back.

(6) Place the Upper Cover of the Control Unit back on and fix it with the screws.
Connect the Motion Interface cable, PC Power cable and Monitor cable.
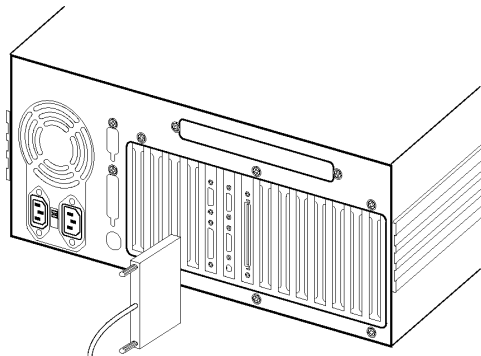
(7) Connect the Operation Unit or Port Short connector that has been removed back to the
OPTIONAL DEVICE connector.
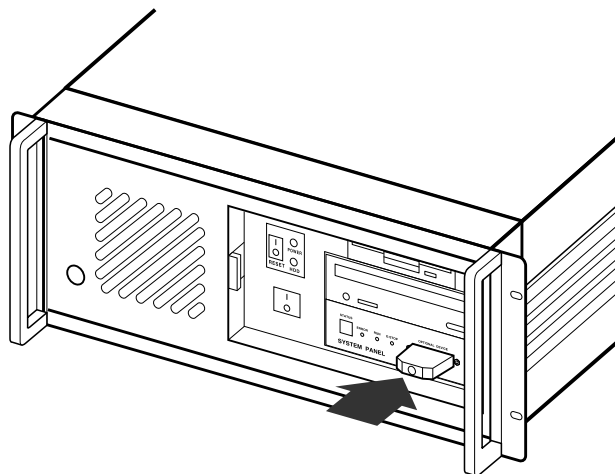
3.6 Cleaning and Replacing the Fan Filter

When you clean and replace the Fan Filter, follow the procedure below:

(1) Close down Windows 95.   Then, turn OFF the power on both the Control and Drive Units.

(2) Open the front panel door.

(3) Pull the Fan Filter case frontward by holding its tab while sliding it to the right.
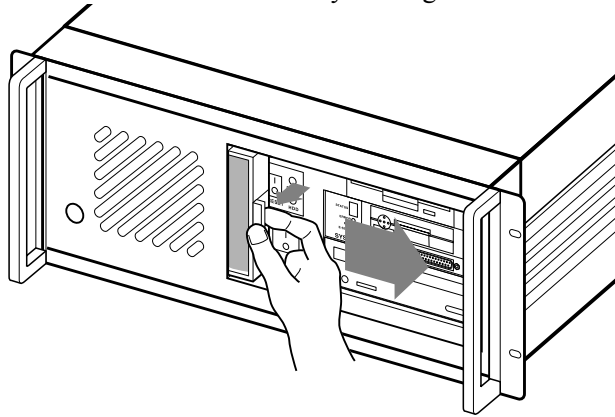
(4) Remove the filter from the filter case.
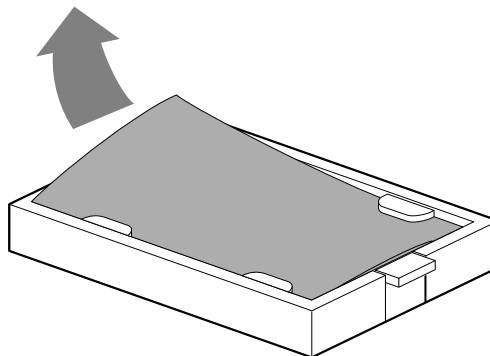
(5) Clean or replace the filter.   When you clean the filter, vacuum the dust with a vacuum cleaner.

(6) Place the clean filter back in the filter case.   The filter must be securely place under the four hooks on the edges of the casing.

Hooks
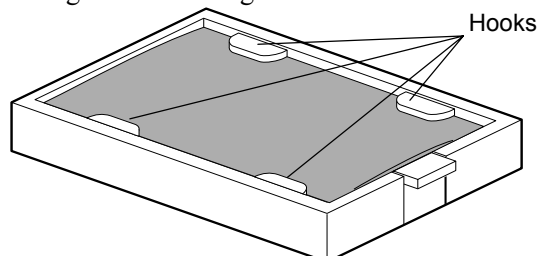
(7) Place the filter case back on.

## 3.7 Replacing the HDD for Removable HD Unit Model

⚠ CAUTION
  ■ Do not shock, shake or drop the HDD, FDD and CD-ROM drive.
   When these disk drives are shocked physically, it may damage the contained data.

NOTE
☞ For the previous model with a built-in HDD, refer to the "3.5.2 Built-in HDD Model" in the "Maintenance 3.5 Replacing the System Panel".
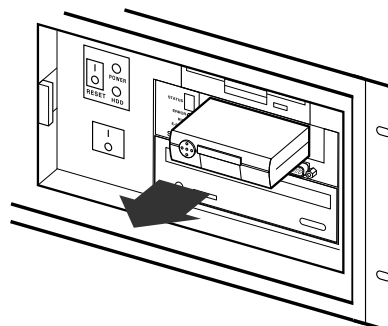
(1) Shut down Windows 95.   Turn OFF the power on both the Control and Drive Units.
(2) Open the front panel door.
(3) Loosen the screw on the switch fixing plate and remove the plate from the HDD.

Switch fixing plate

Screw
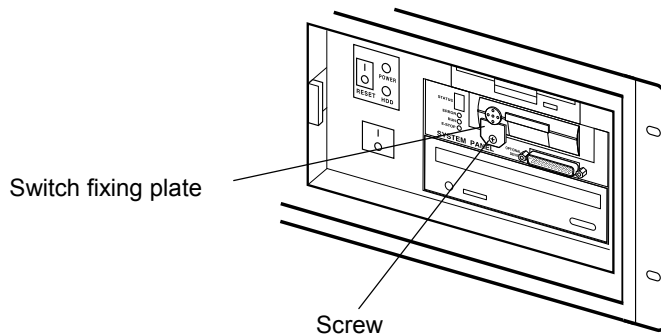
(4) Move the lock switch right.

Lock switch
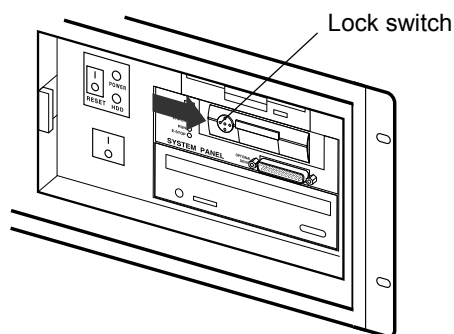
(5) Pull out the HDD forward.

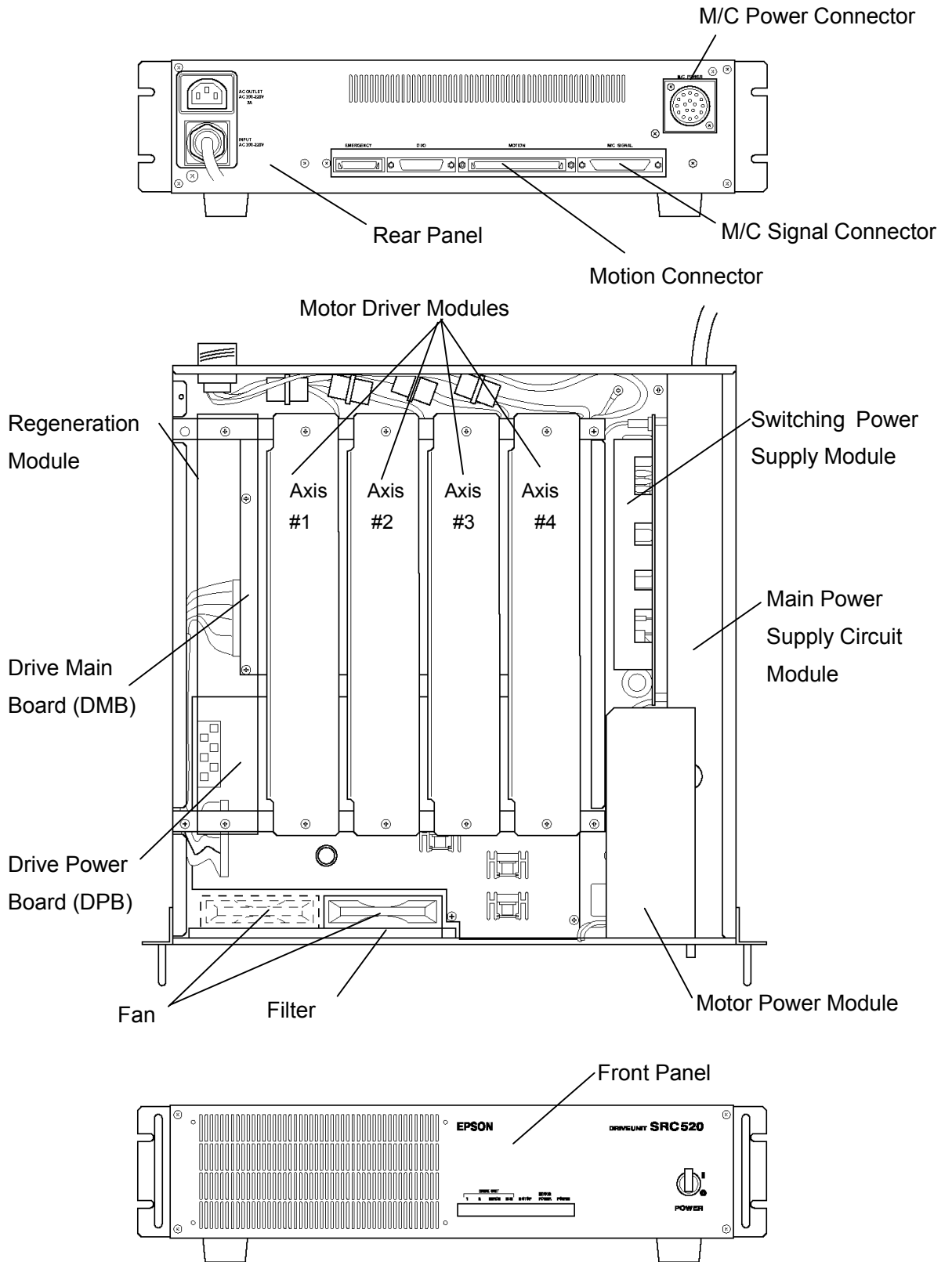(6) Install a new HDD and fix it with the switch fixing plate.

NOTE
☞ Refer to the explanation appended to the new HDD for a new hard disk setting.

4. Drive Unit

4.1 Overview

M/C Power Connector

Rear Panel

M/C Signal Connector

Motion Connector

Motor Driver Modules

Regeneration Module

Switching Power Supply Module

Axis #1   Axis #2   Axis #3   Axis #4

Drive Main Board (DMB)

Main Power Supply Circuit Module

Drive Power Board (DPB)

Fan   Filter

Motor Power Module

Front Panel

EPSON   DRIVEUNIT SRC520   POWER

4.2 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 function volume in this manual.

4.2.1 M/C Power

Pin No.	Signal	Pin No.	Signal
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

4.2.2 M/C Signal

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

NOTE

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

4.2.3 MOTION

| Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
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-		

4.3 Drive Unit

4.3.1 System Configuration
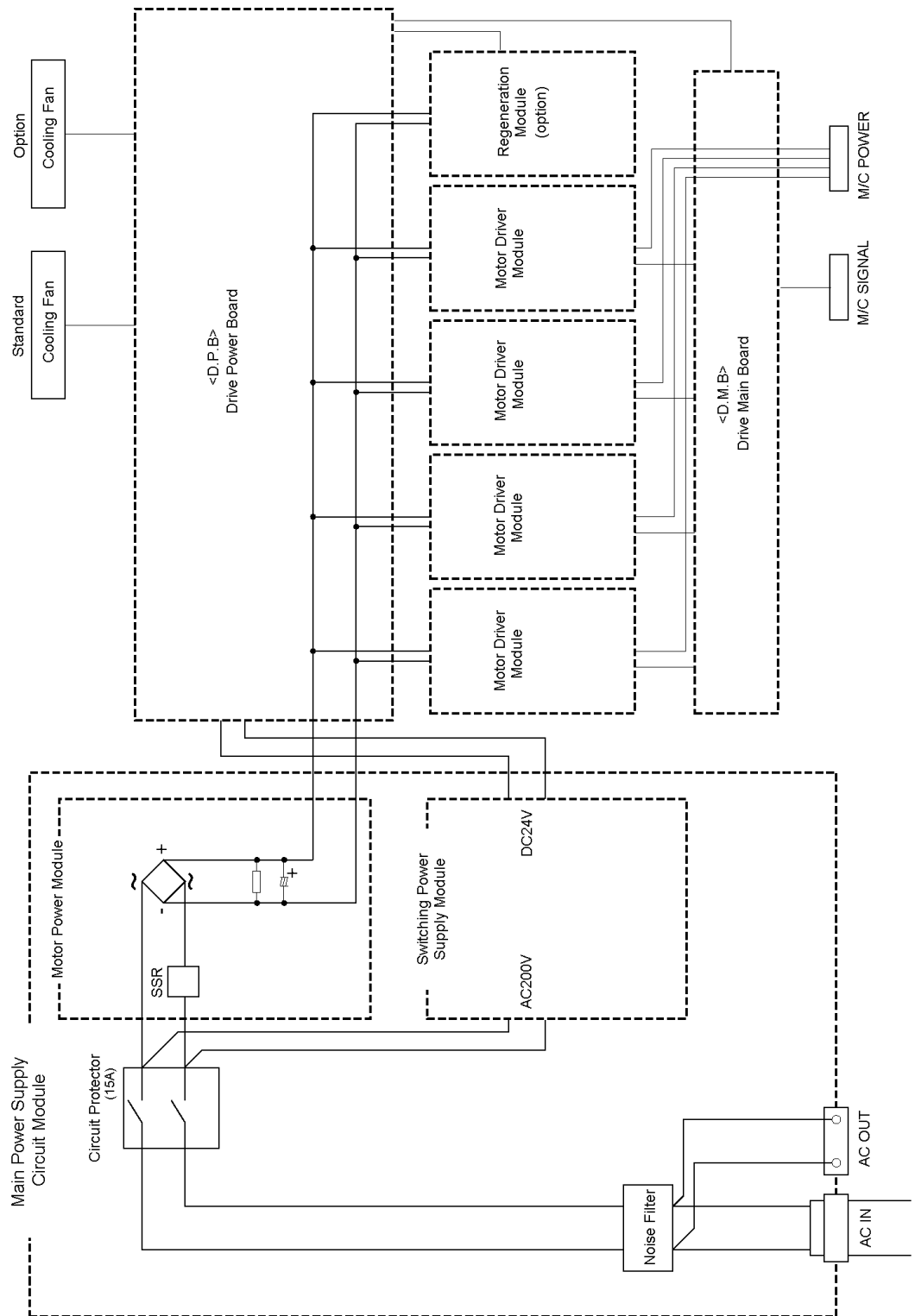
4.3.2 Module Functions and Layout

The 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 positions in the Drive Unit for each module to be installed.

Module	Description
Main Power Supply Circuit	The module incorporates the following modules: the AC Power Input, Motor Power and Switching Power Supply.
Motor Power	The module rectifies AC200V (or the local equivalent) and outputs the DC power to the motor.
Switching Power Supply	This module outputs DC24V rectified from AC200V (or the local equivalent) as the control power source.

Main Power Supply Circuit Module

Switching Power Supply Module

Motor Power Module
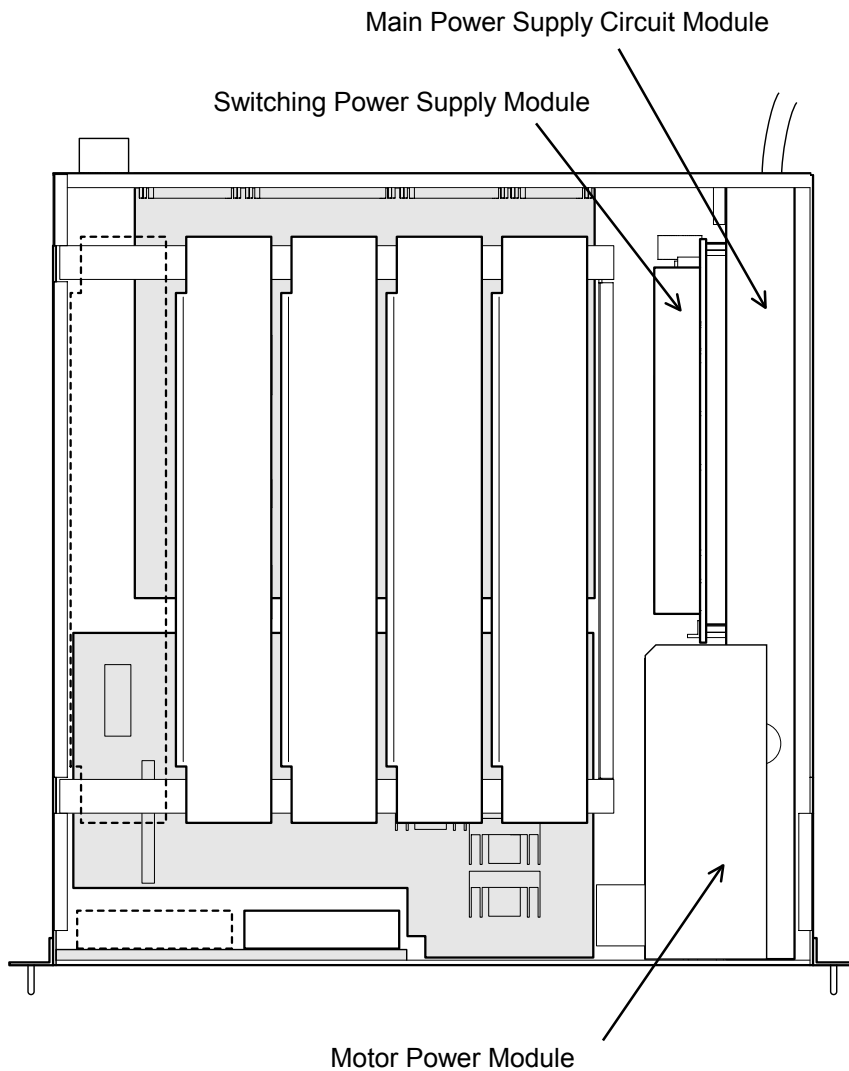
4.3.3 Inspecting a Switching Power Supply Module

The Switching Power Supply module rectifies AC200V (or the local equivalent) and outputs DC24V.   The DC24V 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 Drive Unit(s).

(2) Check on the Drive Unit's front panel if the POWER LED (green) is ON.
     If this lamp is either OFF or dim, suspect that the +24V power output is not normal.

(3) Check on the Drive Unit's front panel to make sure that the LED (green) on the left of and behind the ERROR LED (red) is ON.   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.
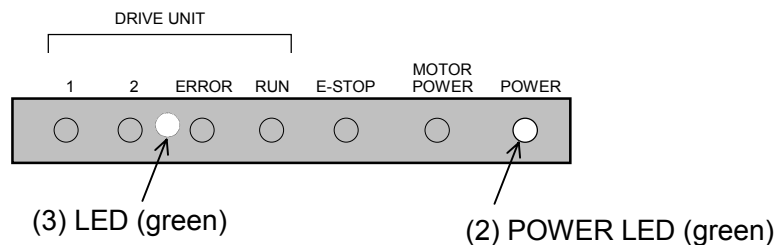
4.4 Motor Driver Module

4.4.1 Layout and Functions

Layout
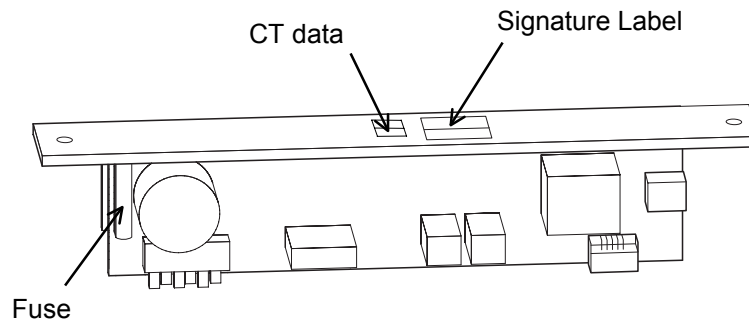
Signature Label

The Signature Label on the radiator (heat slinger) indicates capacity in wattage for each Motor Driver module.

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

The wattage of the mounted Motor Driver module depends on the wattage of the motor. For details of the wattage of the motor, refer to the "Maintenance Replacing the Motors" 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-**** : display the information on "CT OFFSET".

4D-**** : display the information on "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.

NOTE
The CT data to be entered in the Control Unit must be recorded before placing the Upper Cover back on the Drive Unit.   For details, refer to the "Maintenance 4.4.3 Setting up the new CT data on the SPEL 95".

4.4.2 Replacing a Motor Driver Module

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

⚠️ CAUTION

■ Make sure that the wattage of the new Motor Driver module is correct. When the inappropriate wattage module is connected with the Drive Unit, the robot may not function properly or may be damaged.

(1) Shut down Windows 95, and turn OFF the control and Drive Units.
(2) Disconnect all the cables from the back of the Drive Unit.
(3) Wait for about 1 minute until the high voltage is completely discharge.
   Remove the Upper Cover by unscrewing the eight set screws as in the figure below.

M3 crown washer screws
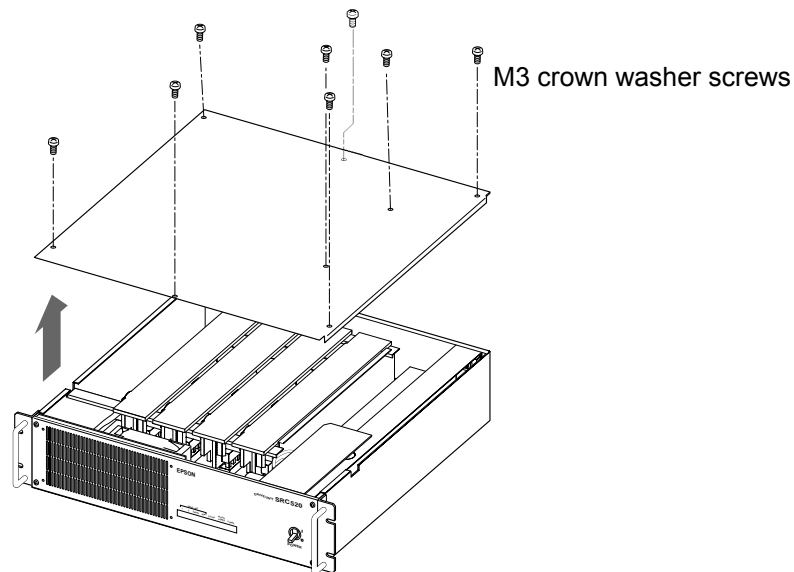
(4) Check to make sure that the LED #9 (orange) on the DPB is OFF. Wait until the light is OFF because the condenser is not completely discharged if this LED #9 is ON.
(5) Remove the two set screws from the Motor Driver module.
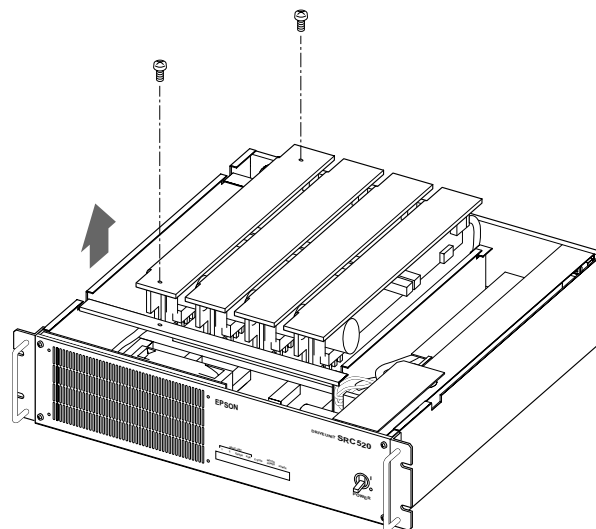
(6) Lift up the Motor Driver module so that the cable connected on the back can be disconnected. Compress projections on both sides of the connector to disconnect the cable smoothly.

2) Pull out

1) Compress
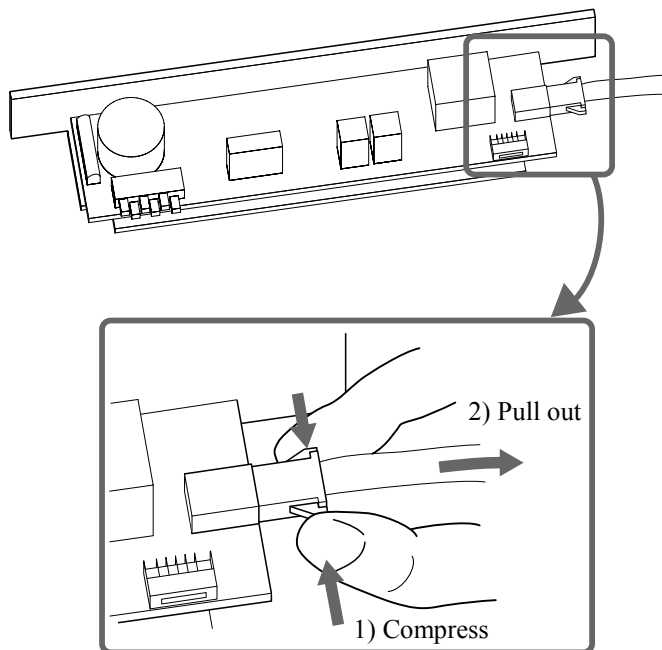
(7) Connect the cable to a new Motor Driver module.

(8) Press down the module carefully and gradually to match the connectors on DPB and DMB.

(9) M4 screws

(8) DPB connector   (8) DMB connector
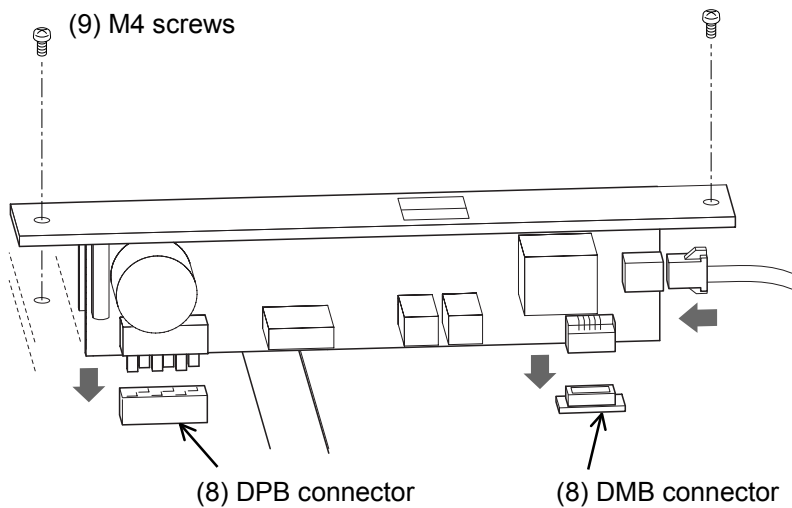
(9) Secure the new Motor Driver module and fix the Upper Cover with two screws.

### 4.4.3 Setting Up the New CT Data on the SPEL 95

After a Motor Driver module is replaced, set up the CT data in the Control Unit by following the steps below.

For details of CT data, refer to the "CT data" in the "Maintenance 4.4.1 Layout and Functions".

(1) Make sure that the cables are connected correctly.

(2) Turn ON the Control and Drive Units and start up Windows 95 and SPEL 95.

(3) Execute [Setup]-[Hardware Setting] from menu bar to display [SPEL 95 Hardware Settings] dialog.
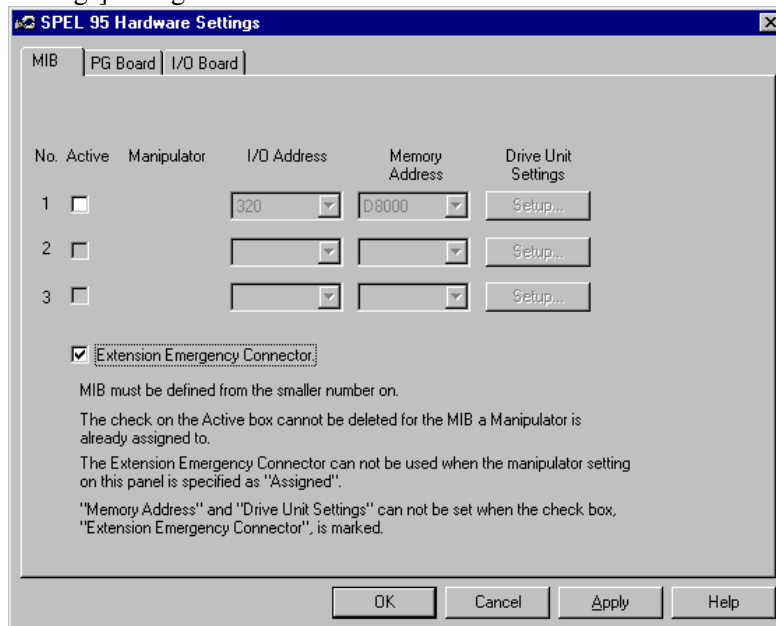
(4) Select [MIB] tab to show the [MIB] panel.

(5) Click the <Setup...> button for the appropriate Drive Unit to show [Drive Unit Settings] dialog.
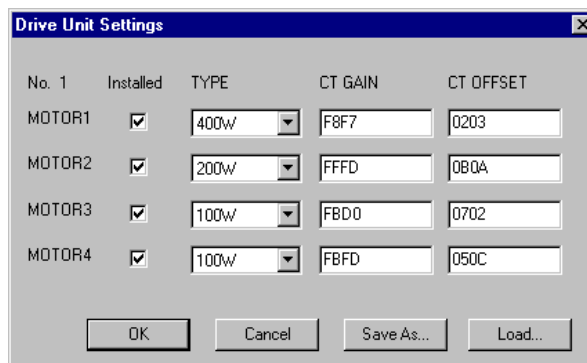
(6) Enter the [CT GAIN] and [CT OFFSET] values for the new Motor Driver module.

(7) After completing the Drive Unit settings, click the <OK> button.
     The setting is effective when rebooting SPEL 95.

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4.5 DPB (Drive Power Board)

4.5.1 Layout and Functions
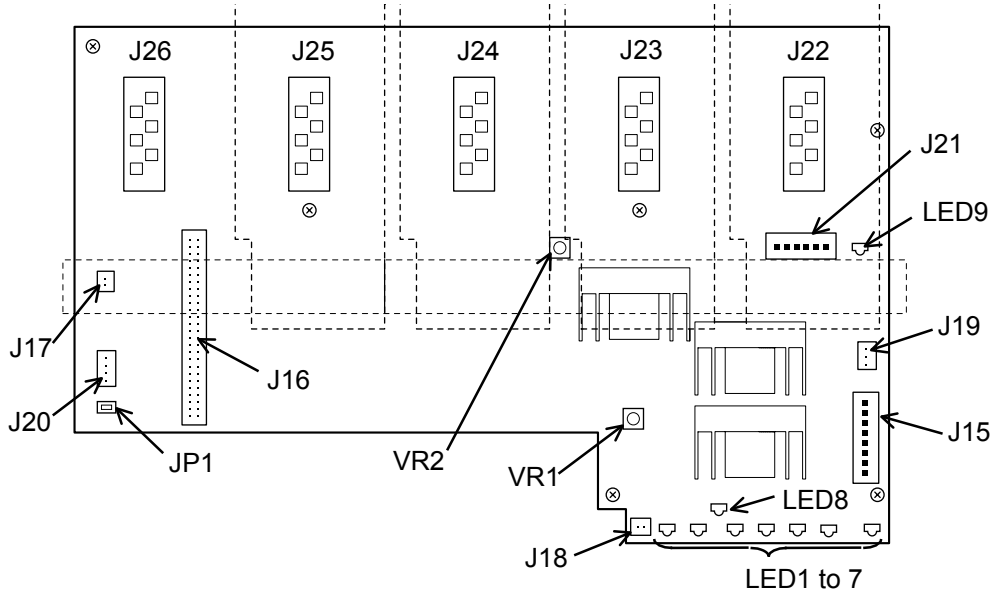
Connector

Connector No.	Function
J15	The connector to input the DC24V to the Switching Power Supply module.
J16	The connector to connect the DMB interface cable.
J17	The connector to connect the optional Cooling Fan.
J18	The connector to connect the standard Cooling Fan.
J19	The connector for the SSR (Solid State Relay) Control Signal.
J20	The connector to connect the Signal cable of the Regeneration module.
J21	The connector to connect 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.

Volume

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

Jumper（JP1）

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

LED

| LED No.		Function
LED1	1	The number "1" indicates that an unresettable error relating to motor control with/in any of the robot axes occurs.
LED2	2	The number "2" indicates that a resettable error relating to motor control with/in any of the robot axes occurs.
LED3	ERROR	Lights when the CPU of the Drive Unit detects an error.
LED4	RUN	Lights while the CPU of the 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 Drive Unit is turned ON.
LED8		This lamp turns OFF when the +24V voltage drops.
LED9		This lamp indicates the charge status of the condenser.

4.5.2 Adjusting Encoder Voltage

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

(1) Turn ON the Drive and Control Units, and boot SPEL 95. The Robot must be put into the emergency stop condition for safety. At this time, make sure that the encoder power is being supplied by checking on the LED1 on the Manipulator's relay board. (The lamp 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 measure, refer to the Manipulator manual.)

(3) If the encoder voltage is not within the range of 4.9V to 5.2V, adjust it as follows:

(4) Remove the Upper Cover of the Drive Unit by taking out the eight screws.

(5) If the measured voltage is lower than 4.9V, turn the VR1 on DPB knob "+" direction by 1/2 track to increase the voltage. If the measure voltage is higher than 5.2V, turn the VR1 knob "-" direction by 1/2 track to lower the voltage.
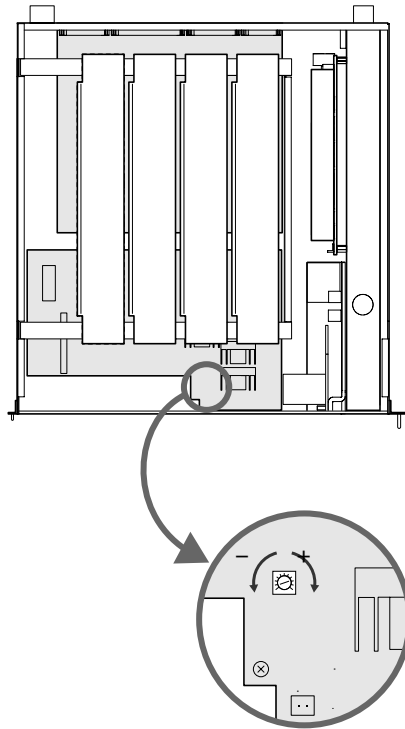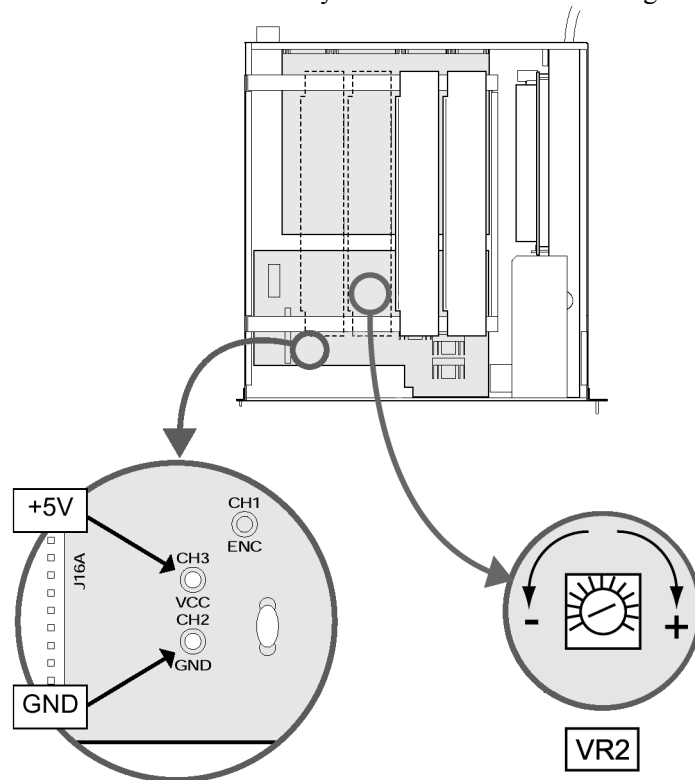

(6) Repeat the step (2) to ensure that the voltage is between "4.9V and 5.2V".

(7) If necessary, repeat the steps (5) and (6) until the voltage is within the range of "4.9V to 5.2V".

(8) When the adjustment is completed, place the Upper Cover back on.

4.5.3 Adjusting +5V Voltage

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

(1) Shut down Windows 95, and turn OFF the Control and Drive Units.

(2) Remove the Upper Cover of the Drive Unit by unscrewing the eight set screws.

(3) Remove the Motor Driver module by unscrewing the two set screws.

(4) Turn ON the Drive Unit.

(5) Measure the voltage between the through-holes marked as VCC and GND near J16 connector on the DPB.

(6) If the +5V voltage is not within the range of 4.9V to 5.2V, adjust the voltage as follows:

(7) If the measured voltage is lower than 4.9V, turn the VR2 on DPB knob "+" direction by 1/2 track to increase the voltage.   If the measure voltage is higher than 5.2V, turn the VR2 knob "-" direction by 1/2 track to lower the voltage

(8) Repeat the step (5) to ensure that the voltage is between "4.9V and 5.2V".

(9) If necessary, repeat the steps (7) and (8) until the voltage is within the range of "4.9V to 5.2V".

(10) After the adjustment, place the Motor Driver module back on.

(11) Turn OFF the Drive Unit and place the Upper Cover back on.

4.6 DMB (Drive Main Board)

4.6.1 Layout and Functions

The through-holes (test pins) for voltage check
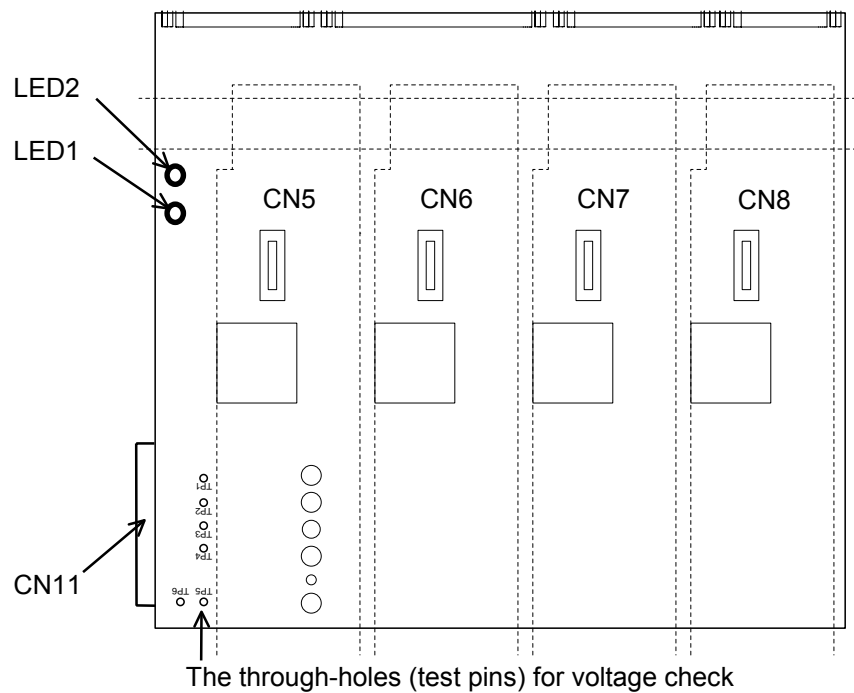
The through-holes (test pins) for voltage check

| No.	Through-hole	Description
TP1	+5V	+5V voltage for DMB
TP2	+5VA	+5V voltage for the Motor Driver module
TP3	−5V	−5V voltage for the Motor Driver module
TP4	+24V	+24V output voltage of the Switching Power Supply module
TP5	+5.6V	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.

4.6.2 Replacing DMB

Replace DMB by following the steps described below.

(1) Shut down Windows 95, and turn OFF the Control and Drive Units.

(2) Disconnect cables connected at the back of the Drive Unit.

(3) Wait for about 1 minute until the high voltage is discharged.   Remove the Upper Cover by unscrewing the eight set screws.

(4) Remove the two DMB set screws on the back of the Drive Unit as shown below.


M3 crown washer screws
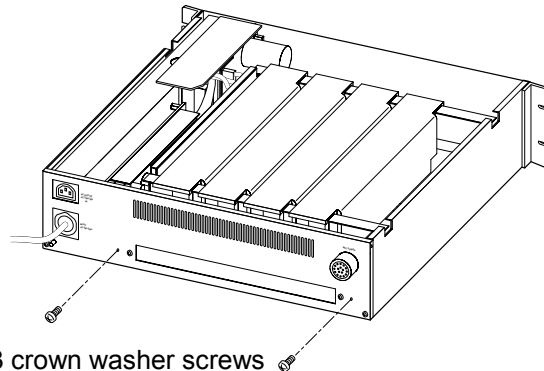
(5) Make sure that the LED 9 (orange) on the DPB is OFF.   The condenser is not completely discharged while this lamp is ON.   Make sure to wait until the lamp turns OFF.

(6) As shown below, remove the set screws on the motor drivers for four axes in the Drive Unit.
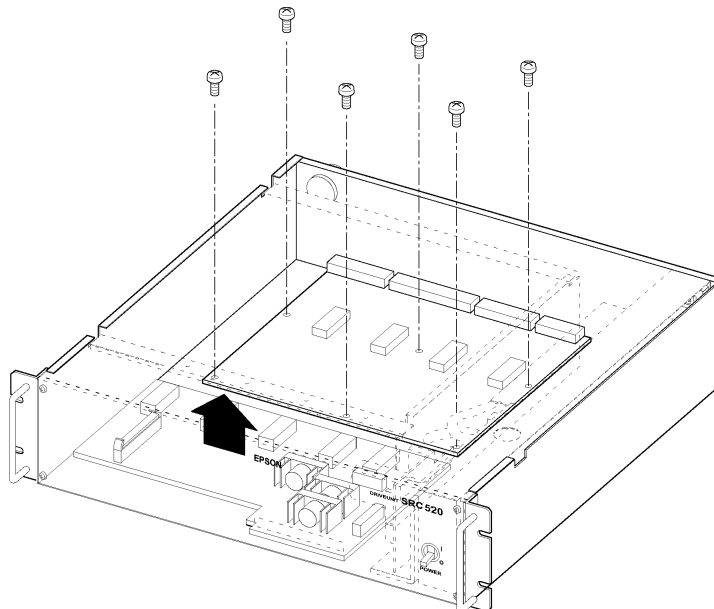

M4 screws
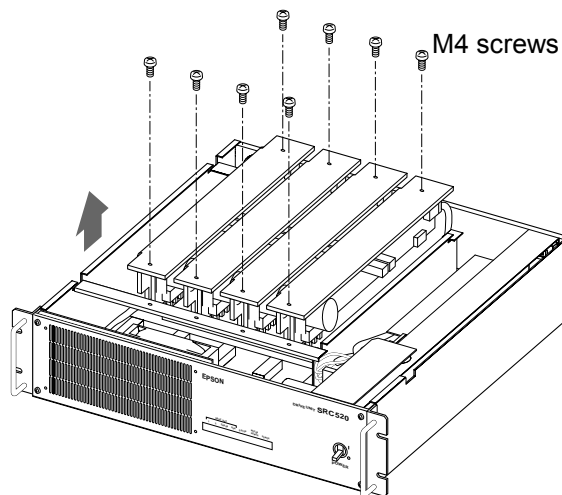
(7) If a Regeneration module is connected, remove it by following the steps, (5) and (6), in the "Maintenance 4.8.2 Replacing a Regeneration Module".

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

2) Pull out

1) Compress
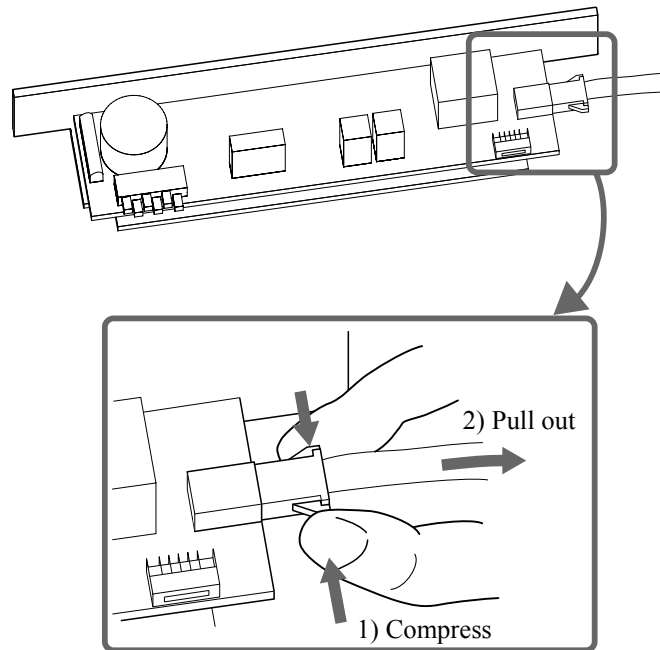
(9) Keep a written record of the corresponding axis number, CT data and the wattage so that the settings for the Motor Driver module remain the same.

(10) Disconnect the flat cable CN11 that connects to DPB.

(11) Disconnect all cables connected to the DMB from the back of the Drive Unit.

(12) Remove six set screws securing DMB in the Drive Unit.

(13) Replace the DMB by a new one.

(14) Fit in the new DMB and fix it with six set screws loose enough so that it can still be moved around a little for positioning.

(15) Fit in the Motor Drivers for axis #1 and axis #3 just to position the DMB.
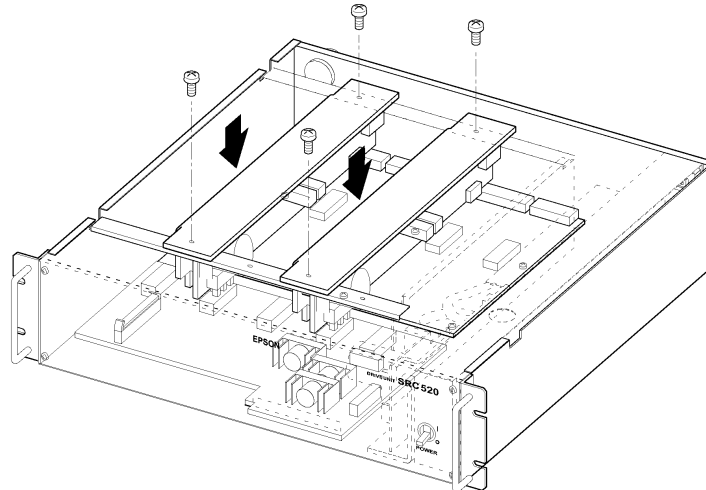
(16) Tighten the six set screws that are still loose in the step (14).

(17) Connect the flat cable CN11.

(18) If the Regeneration module has been removed in the step (7), reattach it with referring the steps (6) and (7) described in the "Maintenance 4.8.2 Replacing a Regeneration Module".

(19) Place the Motor Drivers and the Upper Cover back on.

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4.7 Cooling Fan

4.7.1 Layout

Cooling Fan (option)   Cooling Fan (standard)
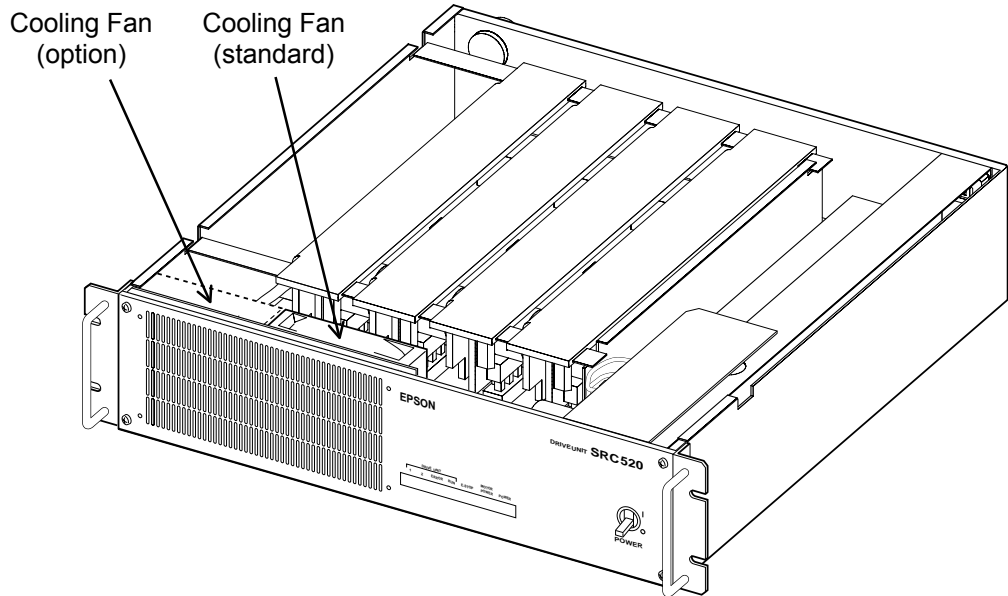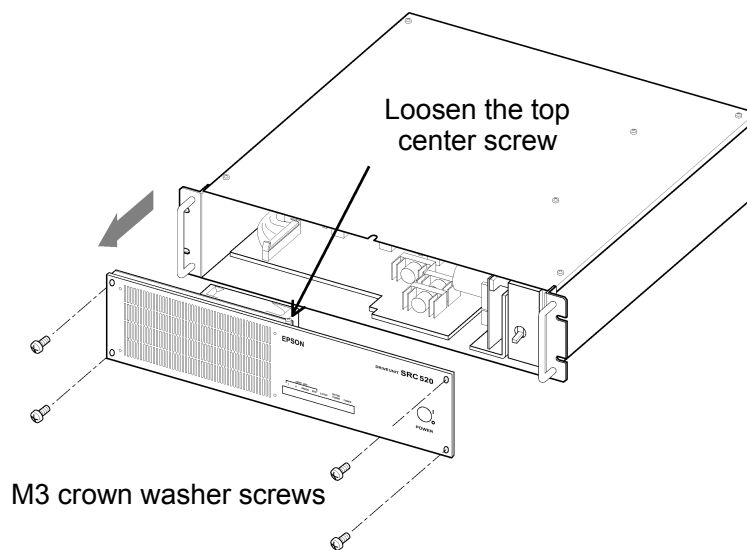
4.7.2 Inspecting the Fan Filter

When you inspect the fan and clean the filter, follow the steps described below.

(1) Shut down Windows 95, and turn OFF the Control and Drive Units.

(2) Wait for about 1 minute until the high voltage is discharged.   Then, remove the Front Panel as shown below.   Regarding the top center screw, the panel can be removed by just loosening it.

NOTE   Be careful not to pull the Front Panel too tightly because the power cable of the fan is connected to DPB.

Loosen the top center screw

M3 crown washer screws

(3) Pull down the filter for cleaning.

Filter

(4) It may be cleaned either by vacuuming the dust or rinsing in water.   (The filter must be thoroughly dray before being reinstalled.)

(5) Reinstall the filter to its original positions.

(6) Reattach the Front Panel to the Drive Unit.

(7) Turn On the Drive Unit and make sure that the Fan operates normally.

4.7.3 Replacing the Fan
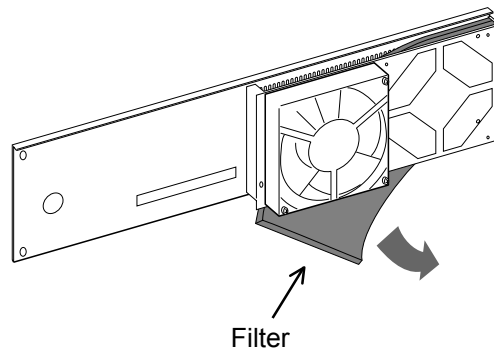
Replace the fan by following the steps described below.

(1) Shut down Windows 95, and turn OFF the Control and Drive Units.

(2) Wait for about 1 minute until the high voltage is discharged.   Then, remove the Front Panel as shown below.   Regarding the top center screw, the panel can be removed by just loosing it.

NOTE
☞   Be careful not to pull the Front Panel too tightly because the power cable of the fan is connected to DPB.

Loosen the top center screw

M3 crown washer screws

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

(4) Remove the four set screws that hold the Cooling Fan in place.
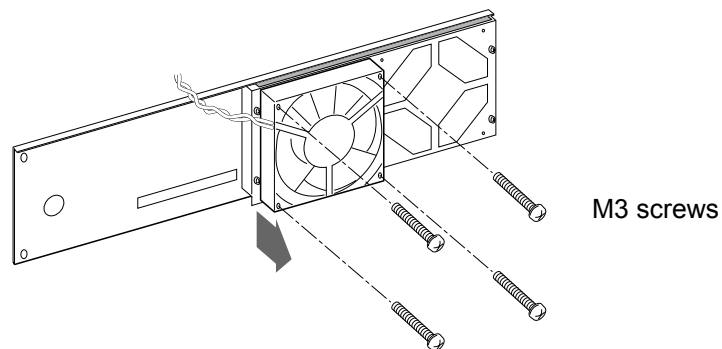
(5) Install a new Cooling Fan, and connect the cable of the fan to the connector on the DPB.

(6) Reattach the Front Panel.

(7) Turn ON the Drive Unit and make sure that the new Cooling Fan runs properly.

4.8 Regeneration Module
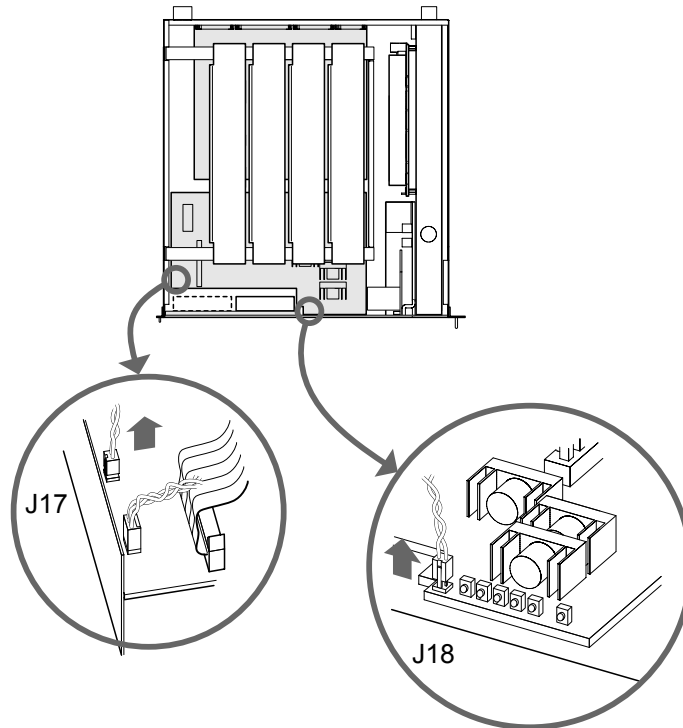
4.8.1 Layout and Function

LED2 (red)   LED3 (green)   LED1 (orange)

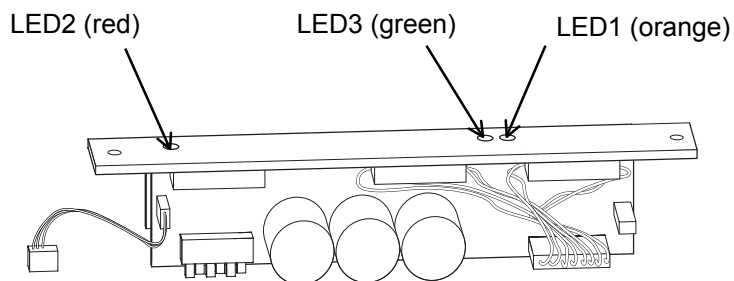| LED No.	Lamp Color	Description
LED1	Orange	The lamp is ON when the system is in a regenerative process. (This process is to reduce the regenerated electricity by using resistors when the motor is decelerating so that the circuit can be protected.)
LED2	Red	The lamp is ON when the system is in the process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

NOTE
☞
If a Regeneration module is installed, the JP1 on the DPB (Drive Power Board) must be "open".

4.8.2 Replacing a Regeneration Module

Replace the Regeneration module by following the steps described below.

(1) Shut down Windows 95, and turn OFF the Control and Drive Units.

(2) Disconnect all the cables from the back of the Drive Unit.

(3) Wait for about 1 minute until the high voltage is completely discharged.
     Then, remove the Upper Cover by unscrewing the eight set screws.

(4) Make sure that the LED #9 (orange) on the DPB is OFF.   The condenser is not completely discharged while this lamp is ON.   Wait until the lamp turns OFF.

(5) Remove the two set screws of the Regeneration module.

(6) Lift up the Regeneration module carefully, and disconnect the connector J20 from the DPB.

J20   J26
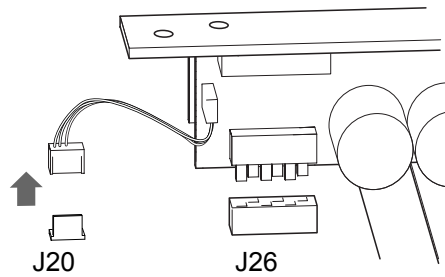
(7) Connect the J20 connector of a new Regeneration module to DPB.

(8) The new Regeneration module must be pushed in carefully, while making it sure that the J26 connector engages properly.

J20   J26
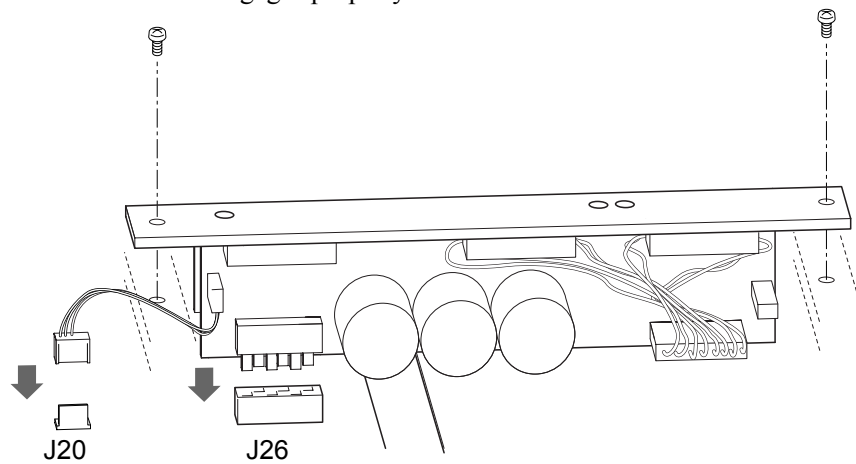
(9) Affix the Regeneration module securely.   Place the Upper Cover back on.

5. Check List for the Manipulator Operation

When either 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.

⚠ CAUTION

■ Check on the Connection Check Label, DU number (at Control Unit) and Signature Labels (at Drive Unit & Manipulator) when connecting those units.   If those units are misconnected, the robot may not function properly or may be damaged.

■ If there are more than one Drive Units connected to the Control Unit, make sure that the DU numbers (DU1 to DU3) indicated at the Control Unit (above the MIB connector) and the Drive Unit (above the MOTION connector) match.   It is highly dangerous if those do not match, causing to activate an unintended robot.

(2) Turn ON both the Drive Unit and Control Unit.   Launch SPEL 95.   During this process, watch and monitor the LED status against the following list:

Drive Unit – Front Panel LED

	From power-on to SPEL 95 launch	While running the SPEL 95
POWER LED	The lamp must be ON if the system is operating properly. When the light is OFF, suspect either the input/output failure with the Switching Power Supply module or the wiring failure in the Control Power Supply circuit.	
MOTOR POWER	The lamp must be OFF.	The lamp must be OFF when the motor is turned off.
E-STOP	The lamp must turn ON when the system is in E-STOP condition. This lamp 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 lamp must be blinking.	The lamp must be ON.
ERROR	The lamp must be blinking.	The lamp must be OFF under normal conditions. The lamp must turn ON when there is a system error.
1	The lamp must be OFF.	The lamp must turn ON when there is an unresettable error on the motor control.
2	The lamp must be OFF.	The lamp turns ON when there is a resettable error on the motor control.

Control Unit – System Panel LED

	From power-on to SPEL 95 launch	While running the SPEL 95
E-STOP	When the main power is turned ON, the light 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 light must stay ON. This lamp 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 lamp must be blinking.	The lamp must be ON.
ERROR	The lamp must be blinking.	The lamp 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 SPEL 95 launch.	The lamp 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 "Appendix B" in the SRC5**/SPEL 95 Appendix manual.)

(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 robot must operate accordingly and normally without vibration or abnormal sounds.

6. Maintenance Part List

Old Code	New Code	Name	Specification	Qty.	Applies to SRC:		
					520 CE	520	500
SR520DRU001	R12R520DRU001	Drive Unit for PNP type	SRC520	1	○	*5	/
SR520DRU012	R12R520DRU012	Drive Unit for NPN type	SRC520	1	/	○	*3
SR520DRU002	R12R520DRU002	DMB (Drive Main Board) for PNP type	Board No.SKP373	1	○	*5	/
SR520DRU011	R12R520DRU011	DMB (Drive Main Board) for NPN type	Board No.SKP373	1	/	○	/
SR520DRU003	R12R520DRU003	Motor Driver – 50W	CACR-A5-SU3C	1	○	○	○
SR520DRU004	R12R520DRU004	Motor Driver – 100W	CACR-01-SU3C	1	○	○	○
SR520DRU005	R12R520DRU005	Motor Driver – 200W	CACR-02-SU3C	1	○	○	○
SR520DRU006	R12R520DRU006	Motor Driver – 400W	CACR-04-SU3C	1	○	○	○
SR520DRU007	R12R520DRU007	Motor Driver – 750W	CACR-08-SU3C	1	○	○	○
SR520DRU008	R12R520DRU008	Regeneration Module	Board No.SKP375	1	○	○	○
SR500DRU011	R13R500DRU011	Cooling Fan	109P0924H402 DC24V	1	○	○	○
SR500DRU012	R13R500DRU012	Fan Filter for Drive Unit		1	○	○	○
SR500CUP012	R12R500CUP012	Fan Filter for Control Unit		1	○	○	○
SR520CUP001	R12R520CUP001	MIB (Motion Interface Board)	Board No.SKP372	1	○	○	*1
-	R220500010020	MIB (Motion Interface Board) *6 for Emergency Connector Unit	Board No.SKP372	1	○	○	*1
SR520CUP002	R12R520CUP002	System Panel for built-in HDD model	Board No.SKP371	1	*6	/	○
SR520CUP004	R13R520CUP004	System Panel for removable HD unit model (with HDD mounting case)	Board No. SKP384/385	1	○	○	○
SR520CUP005	R12E520CUP005	HDD		1	*2	○	*2
SR520CUF313	R12R520CUF313	Control Unit (English version of Windows 95/SPEL 95 installed)	FA type (MMX200MHz)	1	○	○	*3
SR500OPU001	R13R500OPU001	Jog Pad JP500		1	○	○	○

Old Code	New Code	Name	Specification	Qty.	Applies to SRC:		
					520 CE	520	500
SR500OPU011	R12R500OPU011	Operation Pendant OP500		1	*4	*4	*4
SR520DIO001	R12R520DIO001	Protected Extension I/O Board for PNP type	Board No.SKP376	1	○	*5	*5
SR520DIO002	R12R520DIO002	Protected Extension I/O Board for NPN type	Board No.SKP376	1	/	*5	*5
SR500DIO003	R13R500DIO003	Extension I/O Board	Board No.SKP349	1	/	○	○
SR500PLS003	R13R500PLS003	Pulse Generating Board	C-863	1	○	○	○
SR500RIO001	R13R500RIO001	Remote I/O Board	SL-PCAT	1	○	○	○
SR500NET001	R13R500NET001	Ethernet Board	3C509B-TPO	1	○	○	○
-	R220500010010	Emergency Connector Unit *6	Board No.SKP393	1	○	○	/

*1: It will be available according to the jumper settings.

*2: It is available to a Control Unit with a system panel for removable HD unit model.

*3: Please contact us.

*4: It is available for a Control Unit with SPEL 95 Ver.2.3 or newer.

*5: Can be selected.

*6: When using an Emergency Connector Unit, use the MIB (Motion Interface Board), "R220500010020".