

DENSO ROBOT

RC7M

CONTROLLER MANUAL (T03)

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Preface

Thank you for purchasing this high-speed, high-accuracy assembly robot.

This manual describes the RC7M controller configured in the **G-T series robot system. It also covers interfacing required when you integrate your robot system into your facilities, as well as providing the maintenance & inspection procedures.

Before use, read this manual carefully together with related manuals to safely get the maximum benefit from your robot in your assembling operations.

Robot controller covered by this manual

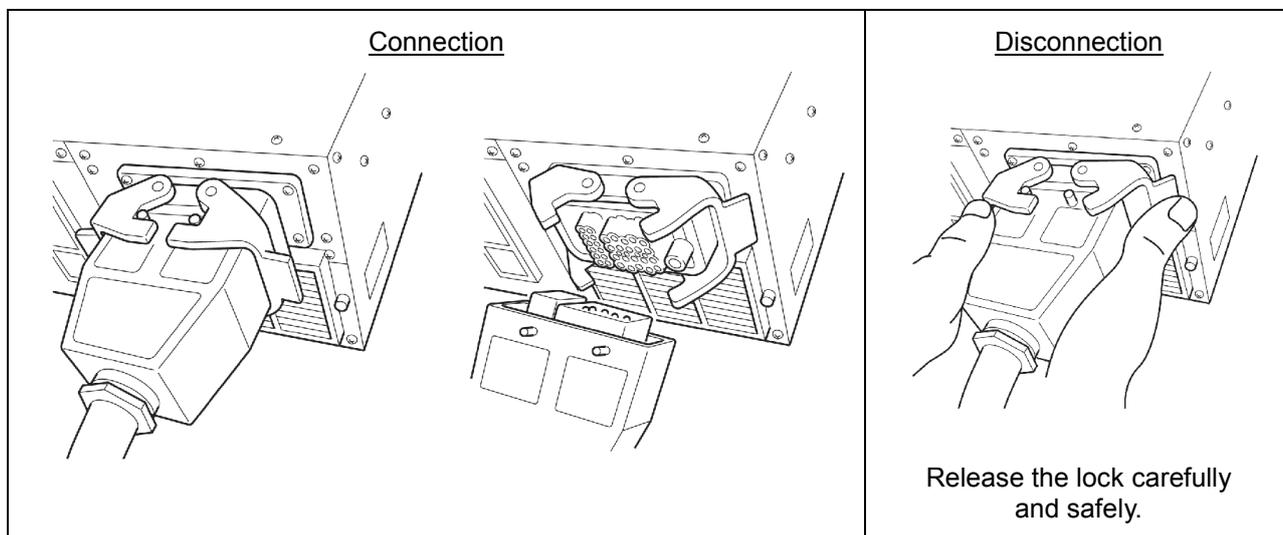
RC7M controller

Caution in connecting/disconnecting the motor & encoder cable

The CN7 (MOTOR) connector for the motor & encoder cable on the RC7M controller uses a rigid structure.

Connection: Lock the connector properly.

Disconnection: Release the lock carefully and safely. It cannot be easily released.



Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS."

How this book is organized

This book is just one part of the robot documentation set.

Chapter 1 Outline of the RC7M Controller

Provides an outline of the RC7M controller. The robot controller is available in several models that will differ in detailed specifications to match robot models to be connected.

Chapter 2 I/O Circuits and Connectors (PNP type)

Describes the I/O circuits and connector pin layout of a PNP I/O board (sink input and source output).

Chapter 3 Installation & Maintenance for the RC7M controller

Provides instructions for installing the robot controller, and maintenance & inspection procedures.

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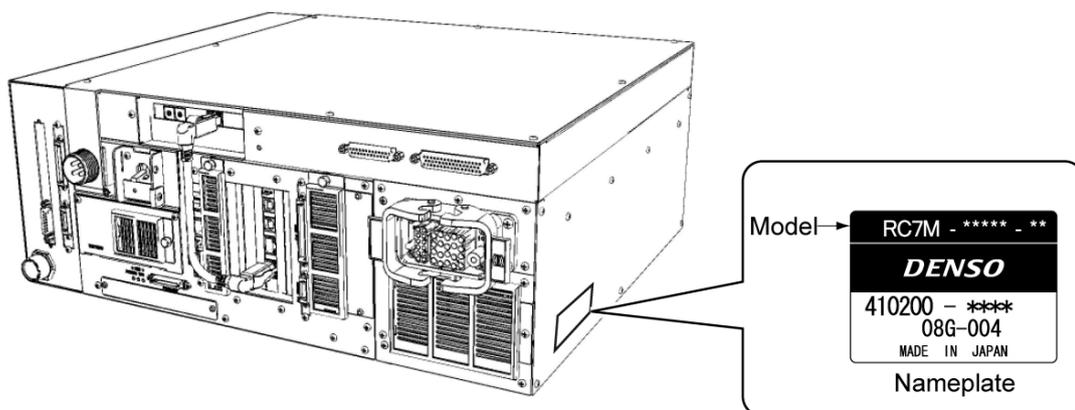
Chapter 1

General Information about RC7M Controller

The RC7M controller is available in several models which differ in detailed specifications to match robot models.

1.1 Controller Model Name on Nameplate

The model name of the controller is printed on the nameplate attached to the rear side of the controller as shown below. The model name is coded as listed below.



Coding of Controller Model Name

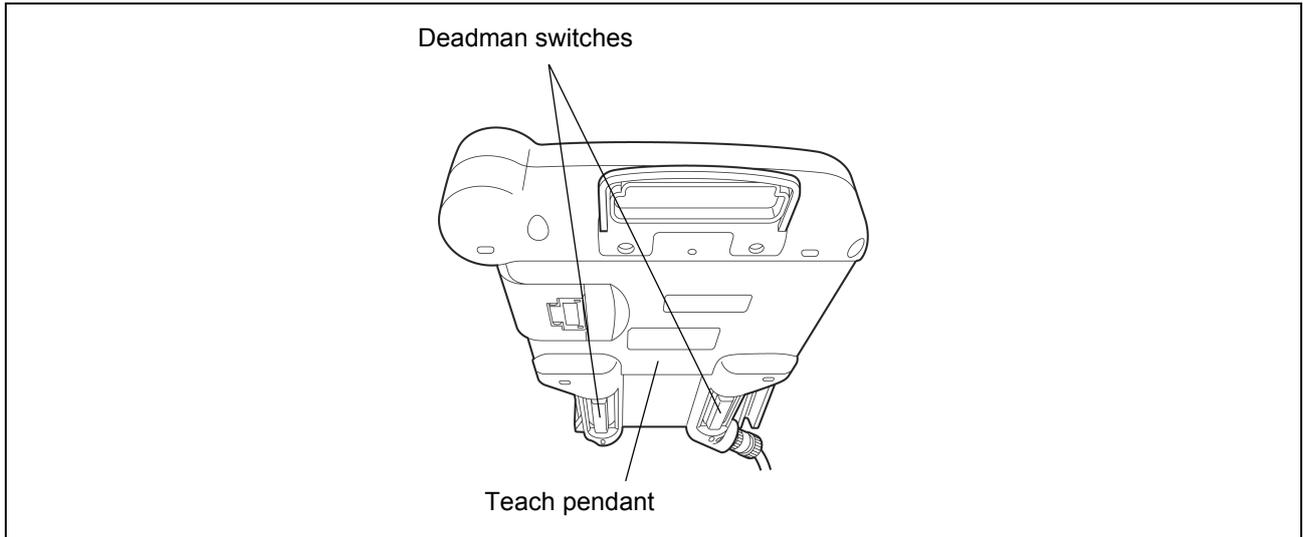
Position	Code sample	Denotes:	Coding
		RC7M - <u>VSG</u> <u>6</u> <u>B</u> <u>A</u> <u> </u> - <u>F</u> <u>P</u> - <u>3AD</u> <u> </u> (a) (b) (c) (d) (e) (f) (g) (h) (i)	
(a)	VSG	Robot model name	VMG: VM-G-T series HMG: HM-G-T series VSG: VS-G-T series HSG: HS-G-T series VPG: VP-G-T series
(b)	6	No. of controllable axes	4: 4 axes, 5/6: 5 or 6 axes, 6: 6 axes
(c)	B	Engineering symbol 1	B: Encoder B C: Encoder C
(d)	A	Engineering symbol 2	A: 24V brake
(e)		Engineering symbol 3	Blank: 200 VAC power
(f)	F	Controller type	F: Robot controller G: Robot controller with motion monitoring option
(g)	P	I/O type	P: PNP I/O
(h)	3AD	Motor type	3AD: A-format compatible
(i)		Extended-joint option	Blank: Without extended-joint option E: With extended-joint option

■ **Deadman switches**

Note the following deadman switch function when operating the robot controller with the teach pendant in the manual or teach mode.

- (1) Unless either one of the deadman switches is held down, you can neither operate the robot nor turn the motor power ON.
- (2) When the robot is in operation, releasing the deadman switch stops not only the robot but also turns the motor power OFF.

Locations of deadman switches on the teach pendant



1.2 Names of the Controller Components

1.2.1 Controller Components

The following figures show the names of the robot controller components.

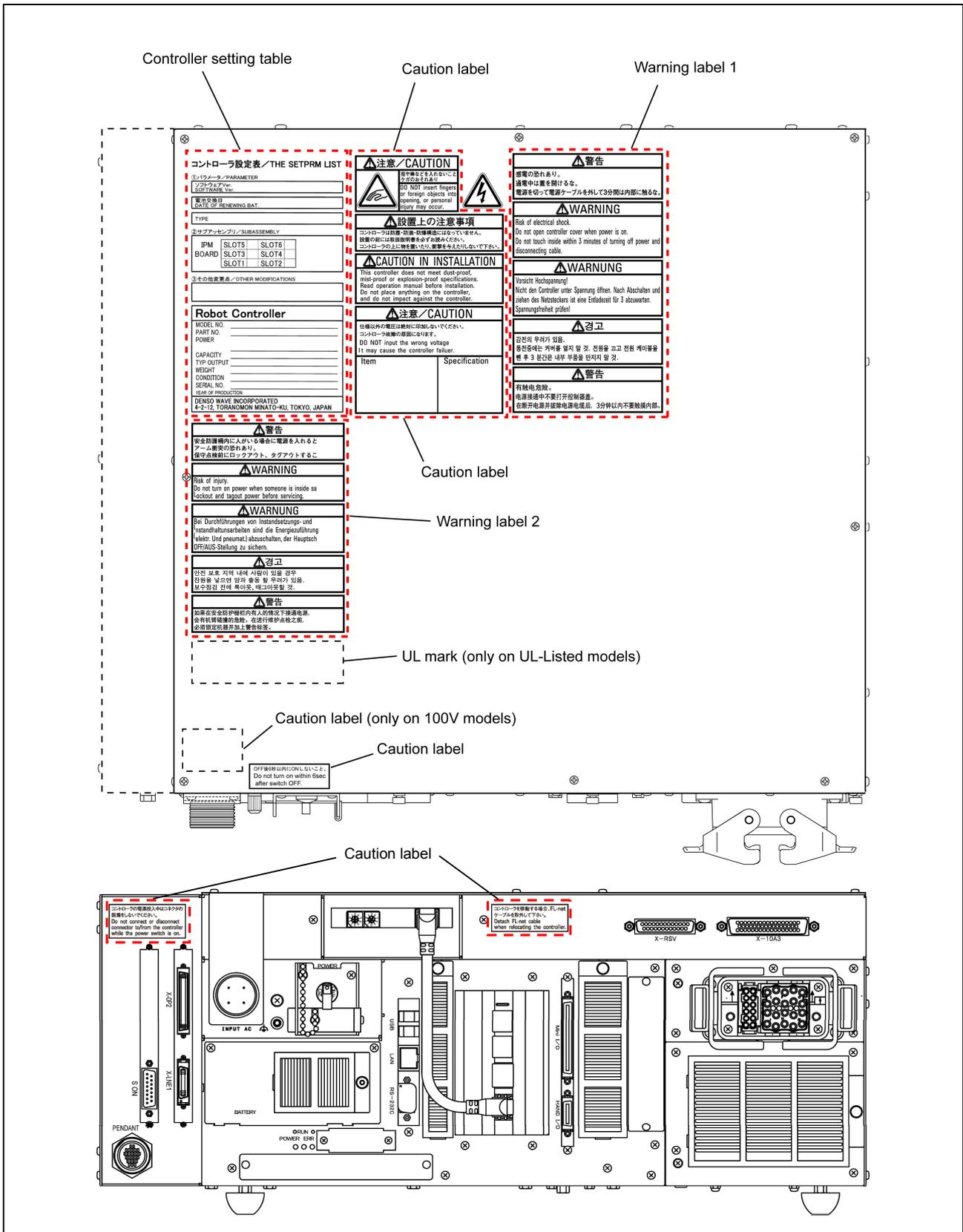
The image contains three diagrams of the RC7M robot controller. The top diagram is a detailed view of the front panel, showing various connectors and components labeled: PENDANT, I/O C, LIBTY, INPUT AC, BATTERY, MOTOR, HAND I/O, X-RSV, and X-10A3. The middle diagram shows the rear panel (air exhaust side) with two large air filters. The bottom-left diagram shows the front panel with labels for the front panel and air intake filters. The bottom-right diagram shows the front panel with labels for the front panel and air intake filters.

Connector No.	Marking	Name
CN1	RS-232C	Serial interface connector
CN2	USB	USB connector (2 lines)
CN4	LAN	Ethernet connector
CN5	Mini I/O	User and system I/O connector
CN6	INPUT AC	Power supply connector
CN7	MOTOR	Motor & encoder connector
CN9	HAND I/O	HAND I/O connector
CN12	—	FL-net connector (X-FL) for line controller
CN13	—	USB connector for PLC
CN14	—	USB connector for PLC
CN16	PENDANT	Teach pendant connector
CN17	S ON	Servo ON output & user power input connector
CN18	X-OP2	Operation panel connector
CN19	X-LNE1	Line controller wiring connector
CN22	X-10A3	User wiring connector for robot unit
CN23	X-RSV	User wiring connector (Reserved.)

Names of RC7M Robot Controller

1.2.2 Warning and Caution Labels

The robot unit has warning and caution labels pasted as shown below. They alert the user to the dangers of the areas on which they are pasted. Be sure to observe the instructions printed on those labels.



Location of Labels on the Controller

Warning and Caution Labels on the Robot Controller

Warning and caution labels on the controller	Contents												
<p>Warning label 1</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">⚠ WARNING</p> <p>Risk of electrical shock. Do not open controller cover when power is on. Do not touch inside within 3 minutes of turning off power and disconnecting cable.</p> </div>	<p>(For maintenance of the controller)</p> <p>Risk of electrical shock. Never open the controller cover when the power is ON. Never touch the inside of the controller for at least 3 minutes even after turning the power OFF and disconnecting the power cable.</p>												
<p>Warning label 2</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">⚠ WARNING</p> <p>Risk of injury. Do not turn on power when someone is inside safety fence. Lockout and tagout power before servicing.</p> </div>	<p>(For controller power switch)</p> <p>Risk of injury. Be sure to perform lockout/tagout before starting servicing. Turning the power ON may move the arm, causing injuries if a person is inside the safety fence.</p>												
<p>Caution label</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">⚠ 注意 / CAUTION</p> <div style="display: flex; align-items: center;"> <div style="font-size: 0.8em;"> <p>指や棒などを入れないこと ケガのおそれあり</p> <p>DO NOT insert fingers or foreign objects into opening, or personal injury may occur.</p> </div> </div> </div>	<p>(For cooling fans)</p> <p>Risk of injury. Do not insert fingers, sticks or other foreign objects through the openings.</p>												
<p>Caution label</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">⚠ 設置上の注意事項</p> <p>コントローラは防塵・防滴・防爆構造にはなっていません。 設置の前には取扱説明書を必ずお読みください。 コントローラの上に物を置いたり、衝撃を与えたりしないで下さい。</p> <hr/> <p style="text-align: center;">⚠ CAUTION IN INSTALLATION</p> <p>This controller does not meet dust-proof, mist-proof or explosion-proof specifications. Read operation manual before installation. Do not place anything on the controller, and do not impact against the controller.</p> </div>	<p>The controller is not designed to be dust-, splash-, or explosion-proof. Before installation, be sure to read the user's manual. Do not put anything on the controller or apply any impact or shock to it.</p>												
<p>Caution label</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">⚠ 注意 / CAUTION</p> <p>仕様以外の電圧は絶対に印加しないでください。 コントローラ故障の原因になります。 DO NOT input the wrong voltage. It may cause the controller failure.</p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.8em;"> <thead> <tr> <th style="text-align: left;">Item</th> <th style="text-align: left;">Specification</th> </tr> </thead> <tbody> <tr> <td>Mini I/O</td> <td>DC21.6V~26.4V</td> </tr> <tr> <td>X-LNE1</td> <td>DC21.6V~26.4V</td> </tr> <tr> <td>X-10A3</td> <td>DC21.6V~26.4V</td> </tr> <tr> <td>X-RSV</td> <td>DC21.6V~26.4V</td> </tr> <tr> <td>S ON</td> <td>DC21.6V~26.4V</td> </tr> </tbody> </table> </div>	Item	Specification	Mini I/O	DC21.6V~26.4V	X-LNE1	DC21.6V~26.4V	X-10A3	DC21.6V~26.4V	X-RSV	DC21.6V~26.4V	S ON	DC21.6V~26.4V	<p>Never apply a voltage not specified. Doing so can result in a controller failure.</p>
Item	Specification												
Mini I/O	DC21.6V~26.4V												
X-LNE1	DC21.6V~26.4V												
X-10A3	DC21.6V~26.4V												
X-RSV	DC21.6V~26.4V												
S ON	DC21.6V~26.4V												
<p>Caution label</p> <div style="border: 1px solid black; padding: 5px;"> <p>OFF後6秒以内にONしないこと。 Do not turn on within 6sec after switch OFF.</p> </div>	<p>After turning the power switch OFF, do not turn it ON for at least six seconds.</p>												
<p>Caution label</p> <div style="border: 1px solid black; padding: 5px;"> <p>コントローラの電源投入中はコネクタの 脱着をしないでください。 Do not connect or disconnect connector to/from the controller while the power switch is on.</p> </div>	<p>Do not connect or disconnect the connector while the power of the controller is turned on. Doing so can result in a malfunction.</p>												
<p>Caution label</p> <div style="border: 1px solid black; padding: 5px;"> <p>コントローラを移動する場合、FL-net ケーブルを取外して下さい。 Detach FL-net cable when relocating the controller.</p> </div>	<p>Remove the FL-net cable when moving or transporting the controller. Doing so can result in a damage or disconnection of the connector.</p>												

1.3 Controller Specifications

[1] Specifications

The table below lists the robot controller specifications.

RC7M Robot Controller Specifications (1)

Item		Specifications				
Robot series		Medium-sized, vertical articulated (VM-G-T series)	Small-sized, vertical articulated (VS-G-T series)	Mini-sized, vertical articulated (VP-G-T series)	Medium-sized, horizontal articulated (HM-G-T series)	Small-sized, horizontal articulated (HS-G-T series)
Model		RC7M-VMG6BA-FP	RC7M-VSG6BA-FP	RC7M-VPG5/6CA-FP	RC7M-HMG4BA-FP	RC7M-HSG4BA-FP
Controllable axes		6 axes		5 or 6 axes	4 axes	
Control system		PTP, CP 3-dimensional linear, 3-dimensional circular				
Drive system		All axes: Full-digital AC servo				
Language used		TOYOTA robot language DENSO robot language PAC (conforming to SLIM)				
Memory capacity		3.25 MB (equivalent to 10,000 steps, 30,000 points)				
Teaching system		1) Remote teaching 2) Numerical input (MDI)			1) Direct teaching 2) Remote teaching 3) Numerical input (MDI)	
External signals (I/O)	Standard I/O	Mini I/O	Input: 8 user open points Output: 8 user open points			
		HAND I/O	Input: 8 user open points Output: 8 fixed system points			
	PLC	PLC I/O	Available with FL remote I/O			
		DLNK-M2	Available with extension unit			
		FL-net	Built in TOYOPUC PC10P			
	CMP-LNK	Available with extension unit				
External communication		RS-232C: 1 line Ethernet: 1 line USB: 2 lines (Supporting flash memory)				
Extension slots		1 (Two out of three extension slots have been occupied)				
Self-diagnosis function		Overrun, servo error, memory error, input error, etc.				
Timer function		0.02 to 10 sec. (in units of 1/60 sec.)				
Error display		Error codes will be outputted on the external I/O. Error messages will be displayed in English on the teach pendant.				
Cables	Robot control cable (option)	2 m, 4 m, 6 m, 12 m, 20 m (Splash-proof type)		2 m, 4 m, 6 m, 12 m, 20 m (Standard type)	2 m, 4 m, 6 m, 12 m, 20 m (Splash-proof type)	
	I/O cable (option)	8 m, 15 m (For Mini I/O, HAND I/O, X-LNE1, S ON, and X-10A3)				
	Power cable	5 m				

RC7M Robot Controller Specifications (2)

Item	Specifications
Environmental conditions (in operation)	Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed) Altitude: 1,000m or less
Power source	Medium-sized, vertical articulated (VM-G-T series) Three-phase, 200 VAC -10% to 230 VAC +10%, 50/60 Hz, 3.3 kVA
	Small-sized, vertical articulated (VS-G-T series) Three-phase, 200 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.9 kVA Single-phase, 230 VAC ±10%, 50/60 Hz, 1.9 kVA
	Mini-sized, vertical articulated (VP-G-T series) Three-phase, 200 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.0 kVA Single-phase, 230 VAC ±10%, 50/60 Hz, 1.0 kVA
	Medium-sized, horizontal articulated (HM-G-T series) Three-phase, 200 VAC -10% to 230 VAC +10%, 50/60 Hz, 2.5 kVA Single-phase, 230 VAC ±10%, 50/60 Hz, 2.5 kVA
	Small-sized, horizontal articulated (HS-G-T series) Three-phase, 200 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.9 kVA Single-phase, 230 VAC ±10%, 50/60 Hz, 1.9 kVA
I/O power source	External power source to be used Supply 24 DVC ±10% power externally
Rated output current	VM-G-T series: Approx. 20 A , VS-G-T series: Approx. 11 A , VP-G-T series: Approx. 5 A , HM-G-T series: Approx. 19 A , HS-G-T series: Approx. 14 A
Degree of protection	IP20
Weight (Mass)	VM/VS/VP-G-T series: Approx. 26 kg (57 lbs) HM/HS-G-T series: Approx. 25 kg (55 lbs)

Note: When handling the controller, be sure to observe the following.

⚠ WARNING

- **DO NOT touch fins. Their hot surfaces may cause severe burns.**
- **DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.**
- **Before opening the controller cover and accessing the inside of the controller for maintenance and inspection, be sure to turn off the power switch, disconnect the power cable, and then wait at least 3 minutes. This is for protecting you from electric shock.**
- **DO NOT connect or disconnect connectors to/from the controller when the AC power or the 24 VDC power for I/O is being supplied. Doing so may cause electric shock or controller failure.**

⚠ CAUTION IN INSTALLATION

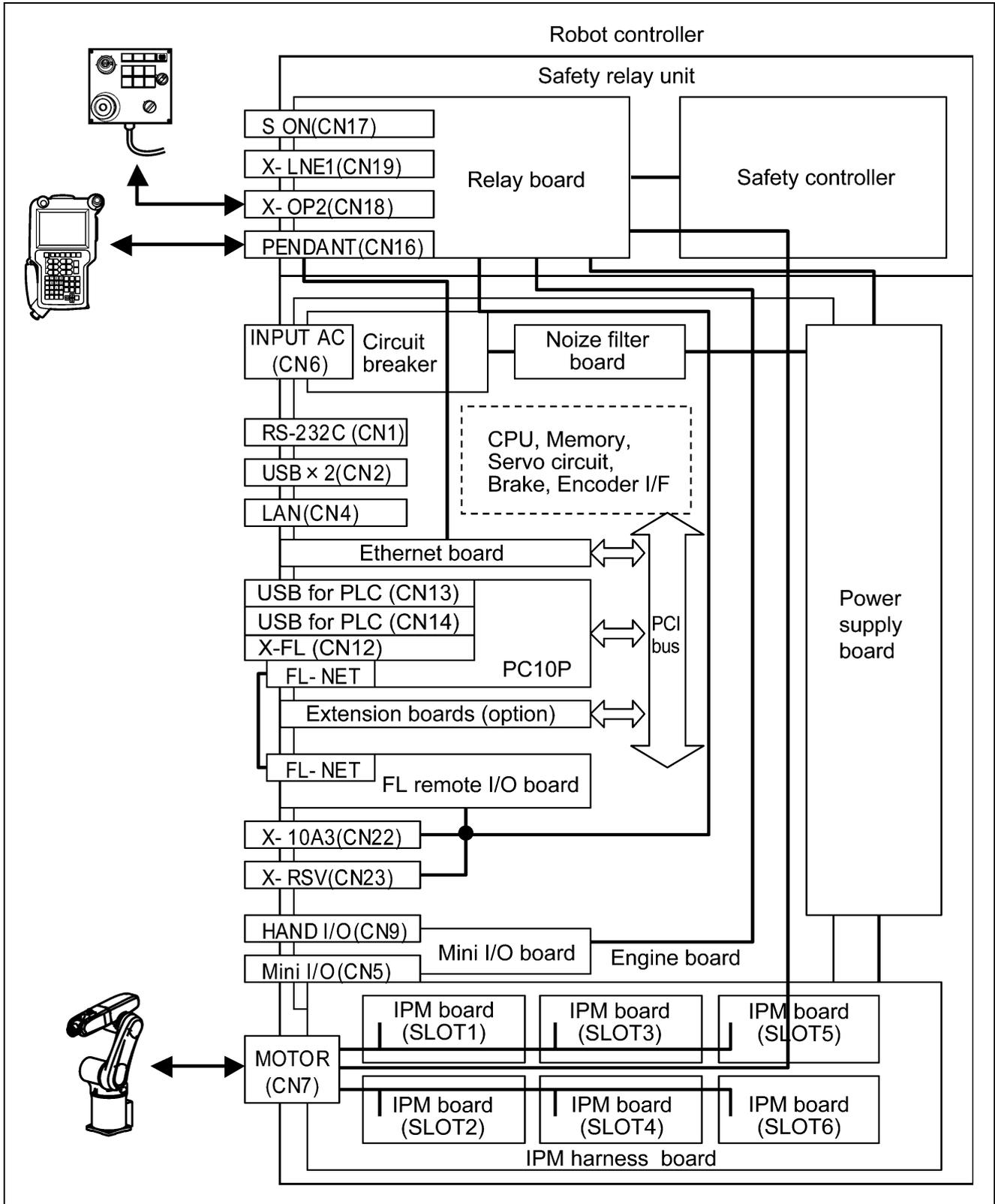
- **This controller is not designed to be dust-, splash-, or explosion-proof.**
- **Read operation manuals before installation.**
- **Do not place anything on the controller or apply an impact or shock to the controller.**
- **Avoid mounting the controller in an environment where excessive vibration is applied to the controller.**

⚠ CAUTION: The robot controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error. Be sure to turn the robot controller OFF before connecting/ disconnecting the power connector or motor connector. Otherwise, the internal circuits of the robot controller may be damaged.

1.4 Controller System Configuration

1.4.1 Internal Circuits of the RC7M Controller (Typical configuration)

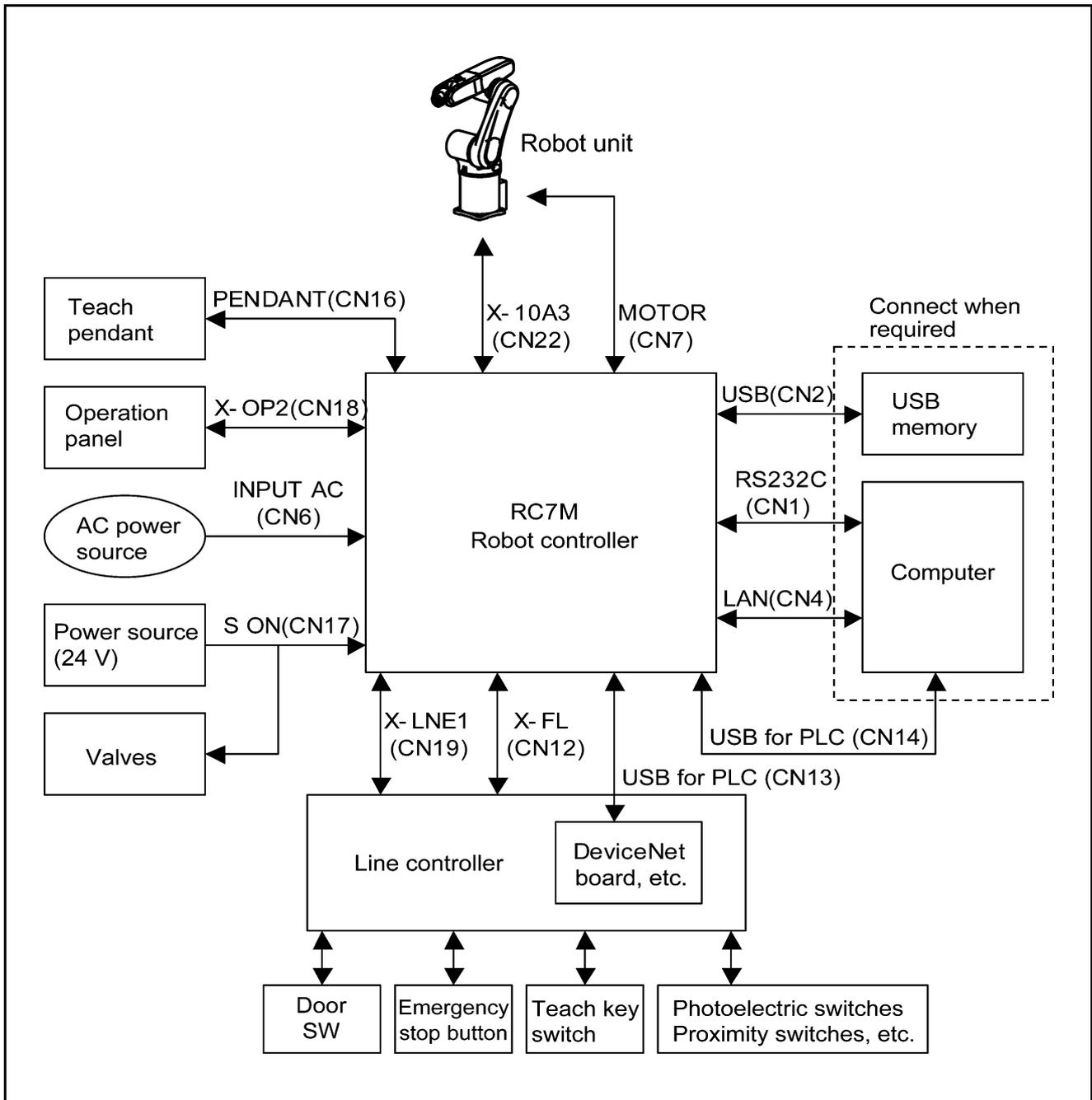
The block diagram below shows the internal circuits of the RC7M controller designed for a 6-joint robot as a typical example.



Block Diagram of the RC7M Controller

1.4.2 Typical Robot System Configuration

The block diagram below shows a typical robot system configuration.



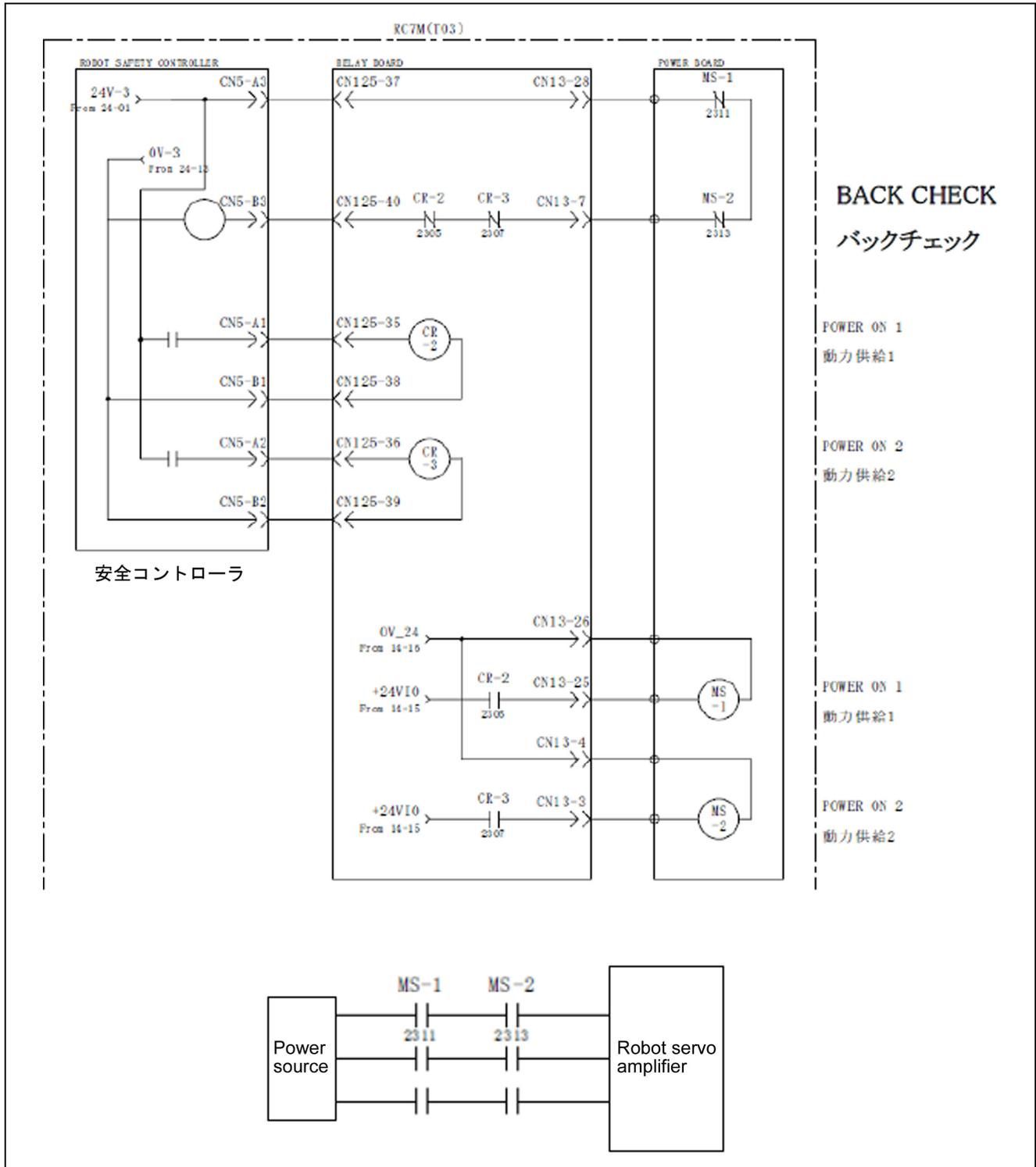
Robot System Configuration

1.4.3 Motor Power Shutdown Confirmation Circuit

The figure below shows the RC7M controller power shutdown circuit that is monitored by the safety controller.

The safety controller confirms that the contacts of the final switches (MS-1 and MS-2) are not melted down to the danger side when the motor power is off, which is the drive start condition.

Whether the safety controller normally operates is checked with the stand-alone function inspection of the safety controller, the continuity/short-circuit inspection of the harnesses and printed circuit boards, and the after-assembly ON/OFF inspection of the switches, all of which are conducted at the shipment of the controller.



Motor Power Shutdown Confirmation Circuit

Chapter 2

Connector Pin Assignment and I/O Circuits (PNP type)

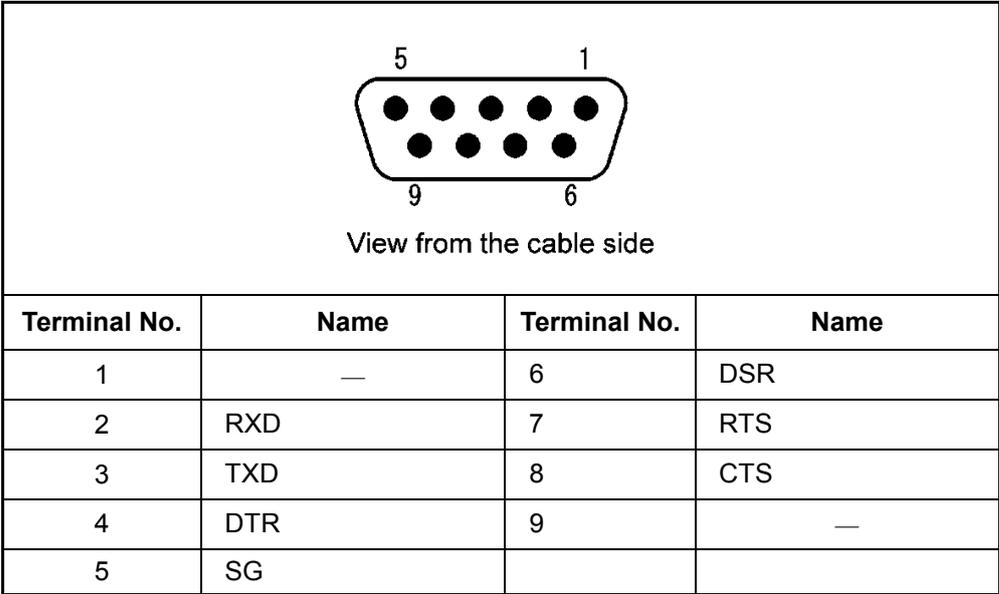
This chapter explains the connector pin assignment and circuits of PNP type (sink input and source output) on an I/O board.

2.1 Connector Pin Assignment (PNP type)

This section describes the pin assignment of I/O connectors on the robot controller.

2.1.1 RS-232C (CN1): RS-232C connector

RS-232C (CN1) Pin Assignment



2.1.2 HAND I/O (CN9)

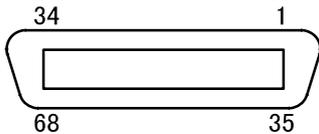
HAND I/O (CN9) Pin Assignment (PNP type)

Terminal No.	Name	Port No.	Wire color	Terminal No.	Name	Port No.	Wire color
1	User output	64	Black	11	User input	50	Pink
2	User output	65	Brown	12	User input	51	Pink
3	User output	66	Black	13	User input	52	White
4	User output	67	Brown	14	User input	53	White
5	User output	68	Red	15	User input	54	White
6	User output	69	Orange	16	User input	55	White
7	User output	70	Yellow	17	Internal power source output (0V)	—	White
8	User output	71	Green	18	Internal power source output (+24V)	—	White
9	User input	48	Blue	19	NC	—	White
10	User input	49	Violet	20	NC	—	White

Note: The optional I/O cable for the above connector consists of twisted pair wires--pairs of #1 and #11, #2 and #12, #10 and #20.

2.1.3 Mini I/O (CN5)

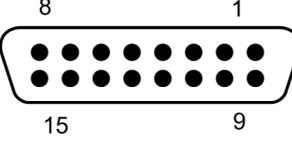
Mini I/O (CN5) Pin Assignment

 <p style="text-align: center;">View from the cable side</p>							
Terminal No.	Signal name	Port No.	Wire color	Terminal No.	Signal name	Port No.	Wire color
1	Reserved.	—	Black	35	Reserved.	—	Pink
2	Reserved.	—	Brown	36	Reserved.	—	Pink
3	Reserved.	—	Red	37	Reserved.	—	Pink
4	Reserved.	—	Orange	38	Reserved.	—	Pink
5	Reserved.	—	Yellow	39	Reserved.	—	Pink
6	Reserved.	—	Black	40	Reserved.	—	White
7	Reserved.	—	Brown	41	Reserved.	—	White
8	Reserved.	—	Red	42	Reserved.	—	White
9	Reserved.	—	Orange	43	Reserved.	—	White
10	—	—	Yellow	44	—	—	White
11	Reserved.	—	Green	45	Reserved.	—	White
12	Reserved.	—	Blue	46	Reserved.	—	White
13	Reserved.	—	Violet	47	Reserved.	—	White
14	Reserved.	—	Gray	48	Reserved.	—	White
15	Reserved.	—	Pink	49	Reserved.	—	White
16	Reserved.	—	Black	50	Reserved.	—	Gray
17	Reserved.	—	Black	51	Reserved.	—	Violet
18	Reserved.	—	Brown	52	Reserved.	—	Violet
19	User input	8	Red	53	User output	24	Violet
20	User input	9	Orange	54	User output	25	Violet
21	User input	10	Yellow	55	User output	26	Violet
22	User input	11	Green	56	User output	27	Violet
23	User input	12	Blue	57	User output	28	Violet
24	User input	13	Gray	58	User output	29	Violet
25	User input	14	Pink	59	User output	30	Violet
26	User input (<i>Interruption Skip</i>)	15	Brown	60	User output	31	Gray
27	—	—	Red	61	—	—	Gray
28	Reserved.	—	Orange	62	Reserved.	—	Gray
29	Reserved.	—	Yellow	63	Reserved.	—	Gray
30	Reserved.	—	Green	64	Reserved.	—	Gray
31	—	—	Blue	65	—	—	Gray
32	+24 VDC power source input	—	Pink	66	0 VDC power source input	—	Gray
33		—	Black	67		—	Blue
34		—	Brown	68		—	Blue

Note: The optional I/O cable for the above connector consists of twisted pair wires--pairs of #1 and #35, #2 and #36, #34 and #68.

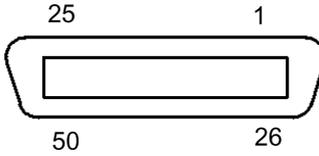
2.1.4 S ON (CN17)

S ON (CN17) Pin Assignment

					
Terminal No.	Signal name	Wire color	Terminal No.	Signal name	Wire color
1	+24 VDC power source input	Blue	9	<i>Servo On Monitor</i> output	Pink
2	—	Red	10	—	—
3	0 VDC power source input	Violet	11	—	—
4	<i>Contact</i> <i>Contact Monitor</i> output 1	White	12	—	—
5	<i>Contact</i> <i>Contact Monitor</i> output 1	Brown	13	—	—
6	<i>Contact</i> <i>Contact Monitor</i> output 2	Black	14	—	—
7	<i>Contact</i> <i>Contact Monitor</i> output 2	Gray	15	—	—
8	<i>Servo On Monitor</i> output	Light blue			

2.1.5 X-OP2 (CN18)

X-OP2 (CN18) Pin Assignment

			
Terminal No.	Signal name	Terminal No.	Signal name
1	—	26	MOTOR POWER lamp (-)
2	CUT OFF (+)	27	CONTROL POWER lamp (-)
3	CUT OFF (-)	28	FAULT lamp (-)
4	—	29	BUZZER (-)
5	TEACH 1 (-)	30	FAULT lamp, BUZZER (+)
6	MAN. 1 (-)	31	—
7	AUTO 1 (-)	32	—
8	TEACH 2 (-)	33	—
9	MAN. 2 (-)	34	—
10	AUTO 2 (-)	35	—
11	START lamp (-)	36	Emergency Stop lamp (-)
12	START lamp (+)	37	Emergency Stop lamp (+)
13	START key (-)	38	Robot Emergency Stop 11 (-)
14	START key (+)	39	Robot Emergency Stop 21 (-)
15	MASTER ON lamp (-)	40	Robot Emergency Stop 22 (+)
16	MASTER ON key 1 (-)	41	Robot Emergency Stop 12 (+)
17	MASTER ON key 2 (-)	42	CONTROL POWER lamp, TEACHING READY, MASTER ON, AUTO, MAN., TEACH (+)
18	HOLD/RUN (-)	43	—
19	HOLD/RUN (+)	44	—
20	TEACH READY 2 (-)	345	—
21	TEACH READY 1 (-)	46	—
22	BUZZER OFF (-)	47	—
23	FAULT RESET (-)	48	—
24	—	49	—
25	BUZZER OFF, FAULT RESET, MOTOR POWER lamp (+)	50	—

Recommended connector for X-OP2 cable

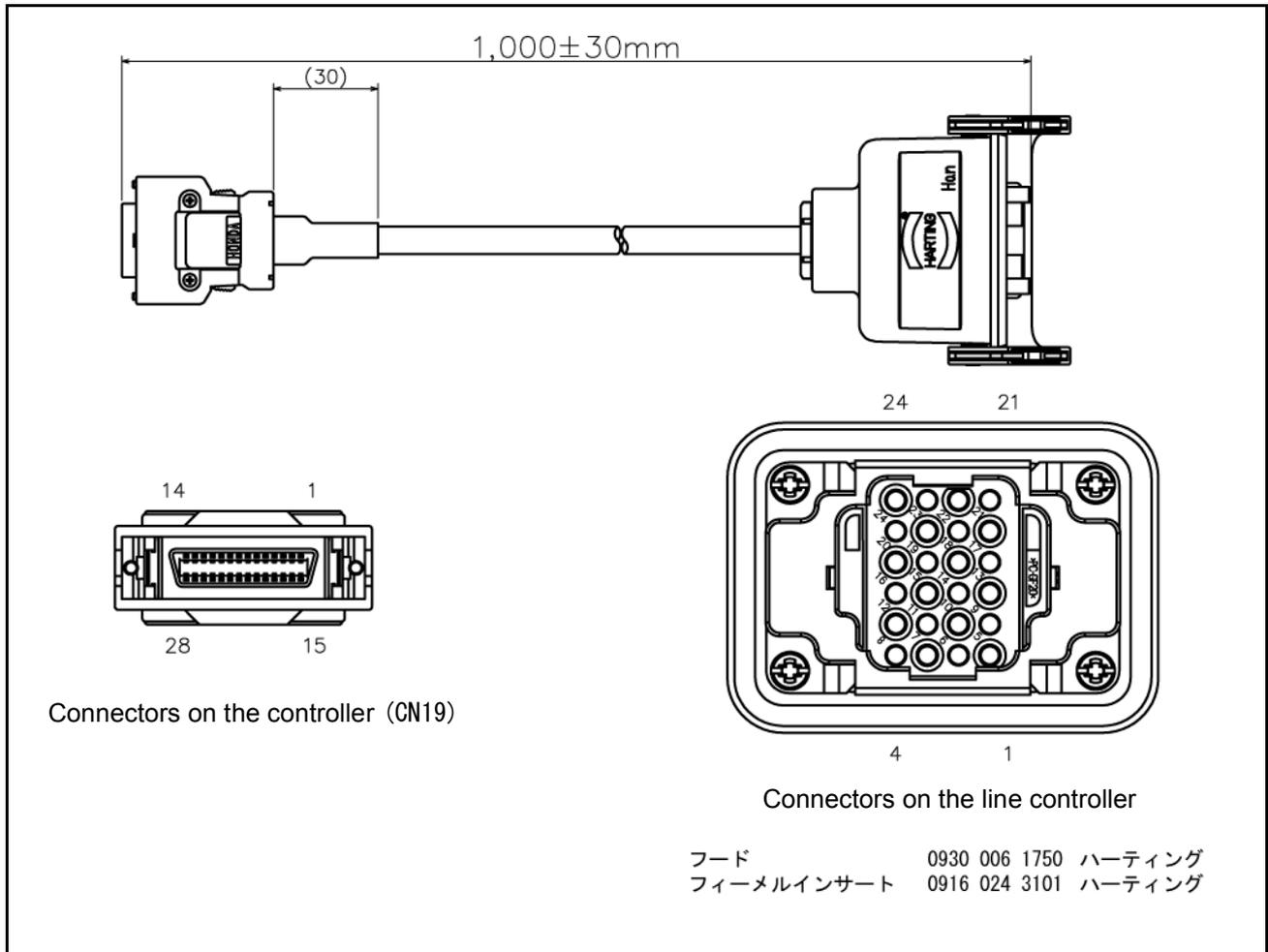
Manufacturer: HONDA TSUSHIN KOGYO Co., LTD

Model: PCR-E50FS+ (Connector)
PCS-E50LKPA (Case)

Cable standards: UL2464 shielded, equivalent to AWG28x35P

2.1.6 X-LNE1 (CN19)

Line controller conversion cable(T03) and Pin Assignment



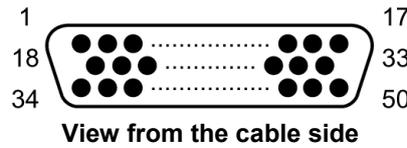
View from the cable side

Terminal No.	Signal name	Terminal No.	Signal name
1	Robot Emergency Stop 1	13	Line Emergency Stop 1
2	Robot Cut OFF	14	Line Emergency Stop 1 common
3	Robot Home Position	15	Line Emergency Stop 2
4	Motor Power OFF 1	16	Line Emergency Stop 2 common
5	Robot Emergency Stop 1 common	17	Teach Plug
6	Robot Emergency Stop 2	18	Teach OK
7	Robot Emergency Stop 2 common	19	Common (For Master On Command, Teach Plug, Teach OK)
8	Protective Stop 1	20	Protective Stop 2
9	Protective Stop 1 common	21	Protective Stop 2 common
10	Master On Command	22	Motor Power OFF 1 common
11	Motor Power OFF 2	23	(-)
12	Motor Power OFF 2 common	24	(+)

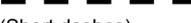
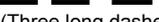
2.1.7 X-10A3 (CN22)

X-10A3 (CN22) Pin Assignment

Terminal No.	Signal name	Terminal No.	Signal name	Terminal No.	Signal name
1	U24V	18	Y59	35	X1C
2	U24V	19	Y58	36	X1B
3	U24V	20	PWR_Y58-5F	37	X1A
4	U24V_S ON	21	PWR_Y50-57	38	X19
5	U24V_S ON	22	COM_Y50-57	39	X18
6	U24V_S ON	23	COM_Y50-57	40	COM_X18-1F
7	U0V	24	Y57	41	COM_X18-1F
8	U0V	25	Y56	42	X17
9	U0V	26	Y55	43	X16
10	COM_Y58-5F	27	Y54	44	X15
11	COM_Y58-5F	28	Y53	45	X14
12	Y5F	29	Y52	46	X13
13	Y5E	30	Y51	47	X12
14	Y5D	31	Y50	48	X11
15	Y5C	32	X1F	49	X10
16	Y5B	33	X1E	50	COM_X10-17
17	Y5A	34	X1D		

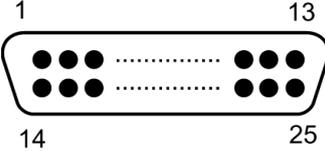


Wire ID Marking

Terminal No.	Wire color	Printed mark	Marking color	Terminal No.	Wire color	Printed mark	Marking color
1	Light green	None	—	27	Light blue	 (Short dashes)	Red
2	White	 (Three long dashes)	Black	28	Gray		Black
3	Pink	None	—	29	Light green		Red
4	Light blue	 (Three long dashes)	Black	30	White		Black
5	White	None	—	31	Pink	 (Four long dashes)	Red
6	Light blue	 (Three long dashes)	Black	32	Light green		Black
7	Gray	None	—	33	White		Red
8	Pink	 (Three long dashes)	Black	34	Pink		Black
9	Light green	 (Continuous line)	Red	35	Gray	 (Four long dashes)	Red
10	White		Black	36	Light blue		Black
11	White		Red	37	Gray		Red
12	Pink		Black	38	Light green		Black
13	Light blue	 (Short dashes)	Red	39	White	 (Four short dashes)	Red
14	Gray		Black	40	Pink		Black
15	Light green		Red	41	Light blue		Red
16	Light blue		Black	42	Gray		Black
17	White	 (Short dashes)	Red	43	White	 (Four short dashes)	Red
18	Pink		Black	44	Light blue		Black
19	Light green		Red	45	Gray		Red
20	White		Black	46	Light blue		Black
21	Light green	 (Short dashes)	Red	47	Gray	 (Four short dashes)	Red
22	White		Black	48	Light blue		Black
23	Light blue		Red	49	Gray		Red
24	Gray		Black	50	Light blue		Black
25	Light green	 (Short dashes)	Red				Red
26	Pink		Black				Black

2.1.8 X-RSV (CN23)

X-RSV (CN23) Pin Assignment

			
Terminal No.	Signal name	Terminal No.	Signal name
1	U24V	14	Y61
2	U24V_S ON	15	Y60
3	U0V	16	X27
4	PWR_Y60-67	17	X26
5	PWR_Y60-67	18	X25
6	COM_Y60-67	19	X24
7	COM_Y60-67	20	X23
8	Y67	21	X22
9	Y66	22	X21
10	Y65	23	X20
11	Y64	24	COM_X20-27
12	Y63	25	COM_X20-27
13	Y62	—	—

Connectors on the controller side

Manufacturer: Japan Aviation Electronics Industry, Ltd. (JAE)

Model: DBU-25SF-F0 (Connector)

D*C-20-24S, Socket (Contactor)

Screw type: #4-40

Recommended connectors for X-RSV cable

Manufacturer: Japan Aviation Electronics Industry, Ltd.

Model: DDU-25PF-F0 (Connector)

D*C-20-24P (Contactor)

DB-C4-J11-S1 (Case)

Cable standards: UL2464 shielded, equivalent to AWG26x25P

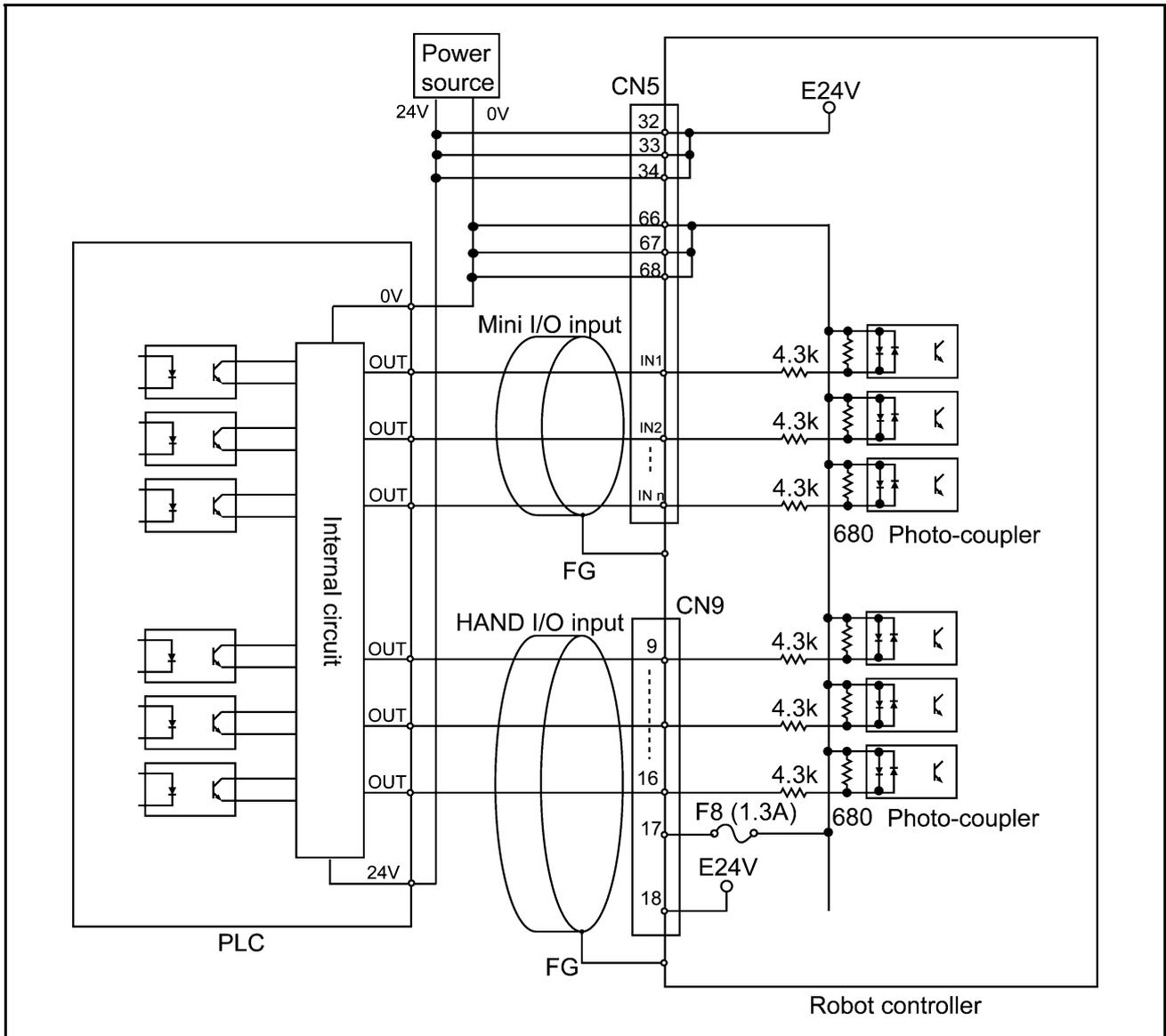
2.2 Hand I/O (CN9) and Mini I/O (CN5) Circuits (PNP type)

2.2.1 User-Input Circuits (PNP type)

The figure below shows the circuit configuration of user-inputs on Hand I/O (CN9) and Mini I/O (CN5) and its connection example.

Notes

- (1) In addition to PLCs, proximity switches and relay contacts can be directly connected to the input terminals of the robot controller. Note that the leakage current from the proximity switches should be 1 mA or below.
- (2) Use multi-core shielding cables for protecting the controller from external noise and ground them at the controller side.



User-Input Circuits (PNP type)

2.2.2 User-Output Circuits (PNP type)

The figures on the next page shows the circuit configuration of user-outputs on Hand I/O (CN9) and Mini I/O (CN5) and its connection example.

(1) The User-Output circuit is an open collector output circuit.

(2) The maximum allowable source current is 70 mA.

Keep the current consumption of a device to be connected to the Robot Controller, such as a PLC and a relay coil, below the allowable current.

(3) Select an induction load, such as a relay coil, which has a built-in diode (for absorbing inverse electromotive force).

To use an induction load without a built-in diode, add a diode equivalent to the 1S1888 (Toshiba) in close vicinity to the coil.

 **Caution:** When externally attaching a diode, connect it with correct polarity. Incorrect polarity may damage the output circuit.

(4) Connecting a lamp requires a circuit through which dark current flows and use a lamp whose rating is 0.5W or less.

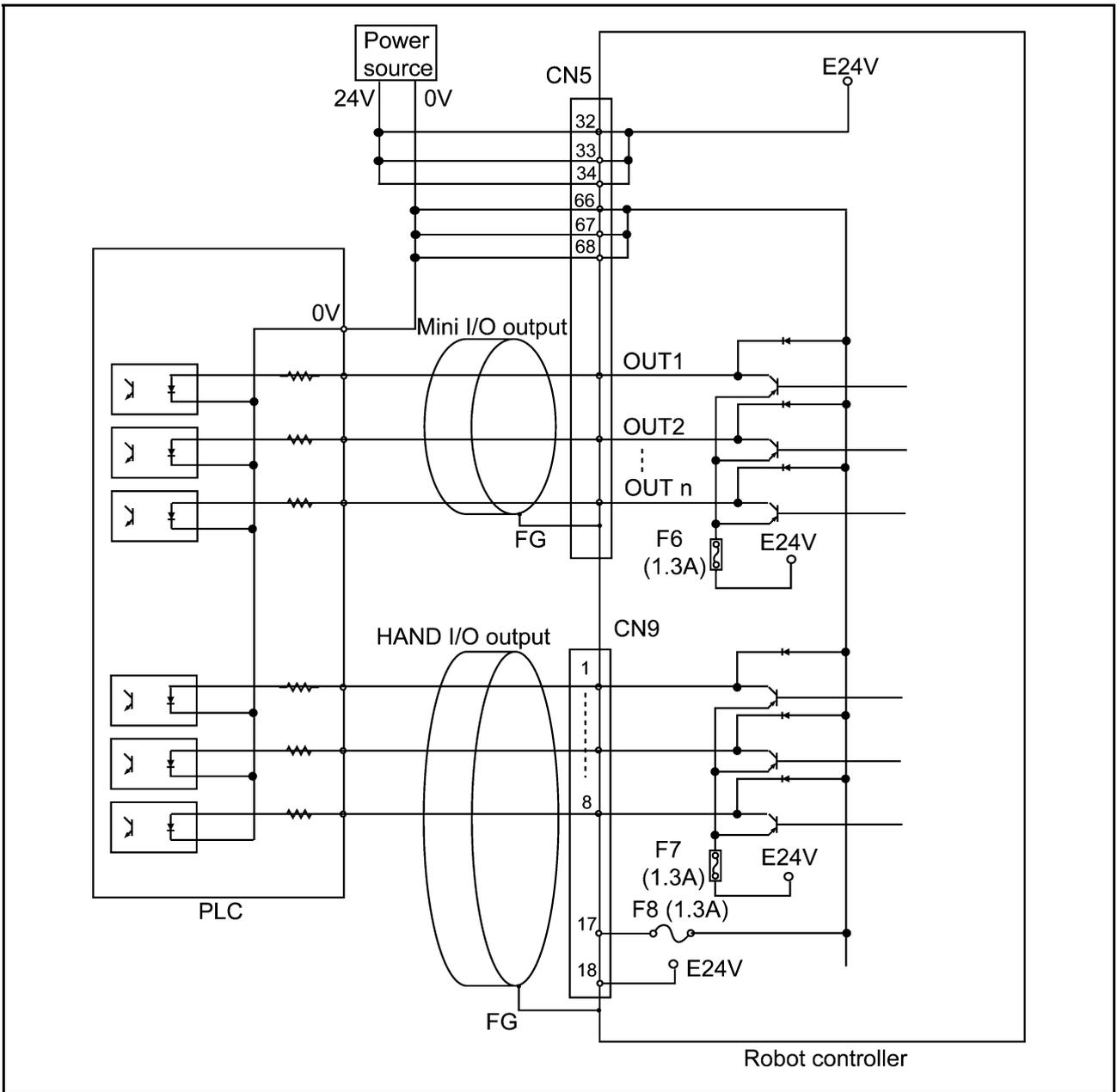
 **Caution:** Since the initial resistance of a lamp is small, the output circuit may be damaged by rush current that flows when the lamp lights. To reduce rush current, select and connect a resistor R that allows dark current 1/3 or less of the rated current to flow when the lamp goes OFF. Refer to the next page.

(5) Use a multi-core shielding cable for the purpose of protecting the devices from external noise. Ground it to the robot controller.

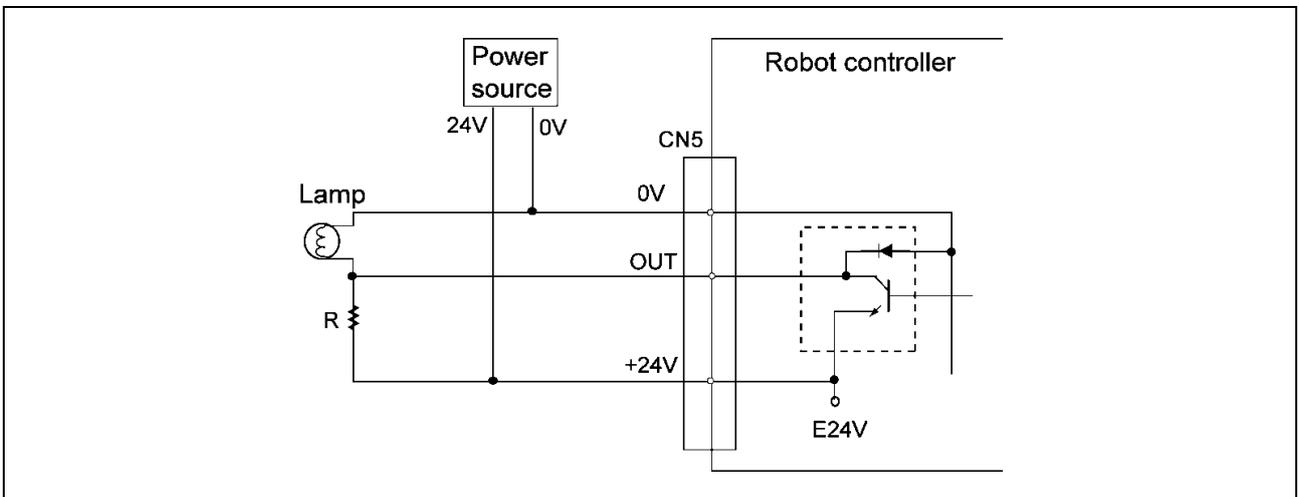
(6) +24V internal power source of the robot controller must not be grounded.

 **Caution:** If the output terminal +24V of internal power source is grounded, there may be a case where the controller is damaged.

(7) For three seconds after the controller power is turned ON, the I/O board will be in a transient state and its outputs may accidentally go ON, so do not use them as valid signals.



User-Output Circuits (PNP type)



Example of Circuit with Lamp (PNP type)

2.3 Wiring Notes for Controller I/O Connectors (PNP type)

After the wiring of the controller's I/O connectors is completed, check the following before turning ON the power:

Check point (1)

Using a circuit tester, check across the "+24V terminal" and "0V terminal" of each connector and across the "E24V terminal" and the "E0V terminal" to see that there is no continuity.

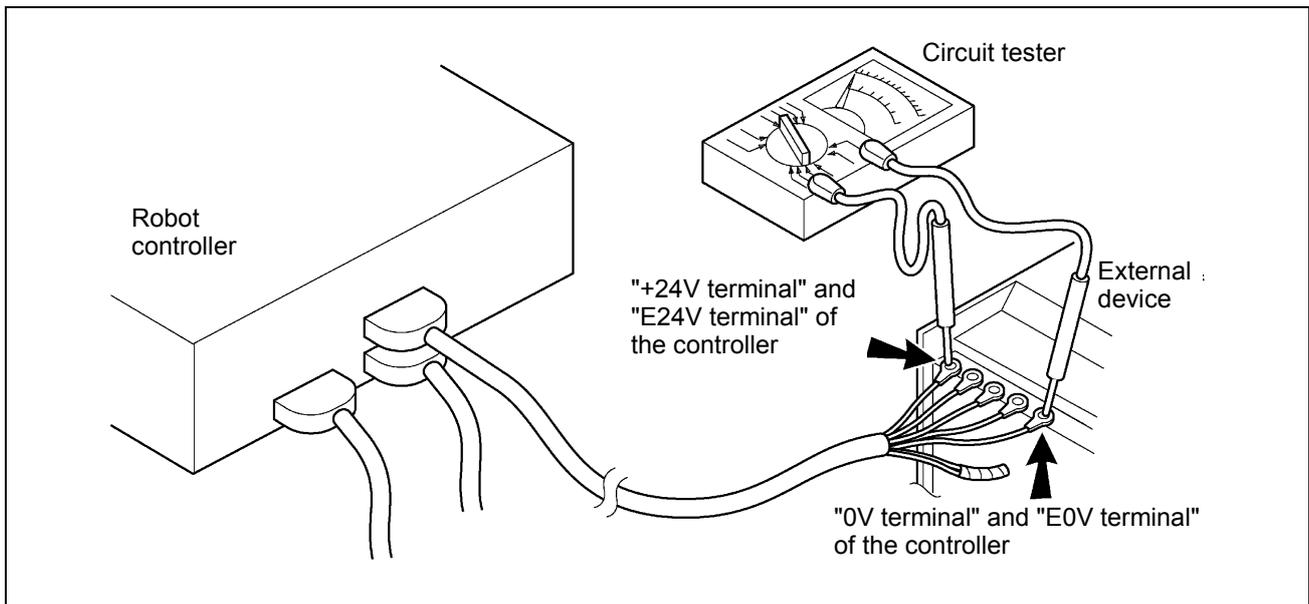
⚠ Caution: If the connector wiring between the Robot Controller's "+24V terminal" and "0V terminal" and between the "E24V terminal" and the "E0V terminal" is shorted, damage to the power circuit of the Robot Controller will result.

Check point (2)

Using a tester, check across "each signal output terminal" and "+24V terminal" or "E24V terminal" of each connector to see that there is no continuity.

⚠ Caution: If the wiring between "each signal output terminal" and "+24V terminal" or "E24V terminal" of each connector is shorted, damage to the Output circuit and power circuit of the Robot Controller will result.

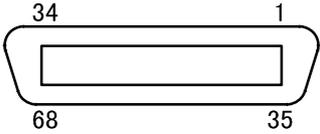
⚠ Caution: Wind adhesive vinyl tape around all ends of the unconnected wiring of each connector to prevent them from contacting other wiring and parts, which results in shorting.



Checking Example

Connector Terminals to Be Checked (PNP type I/O)

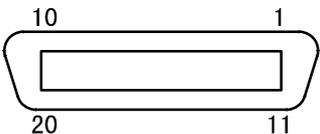
Mini I/O connector (CN5)



View from the cable side

Terminal number	Name	Meaning	Check point
32 to 34	+24 VDC power source output	24 VDC power output	(1)
53 to 60	Signal output terminal	+24 V at output	(2)
66 to 68	0 VDC power source output	DC power output (GND)	(1)

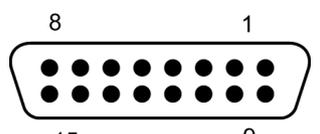
HAND I/O connector (CN9)



View from the cable side

Terminal number	Name	Meaning	Check point
1 to 8	User output terminal	+24V at output	(2)
17	Internal power source output (0V)	DC power output (GND)	(1)
18	Internal power source output (+24V)	24 VDC power output	(1)

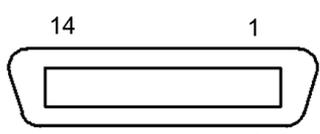
S ON connector (CN17)



View from the cable side

Terminal number	Name	Meaning	Check point
1	+24 VDC power source input	24 VDC power input	(1)
3	0 VDC power source input	DC power input (GND)	(1)

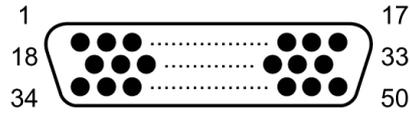
X-LNE1 connector (CN19)



View from the cable side

Terminal number	Name	Meaning	Check point
23	(-)	0 VDC power input	(1)
24	(+)	+24 VDC power input	(1)

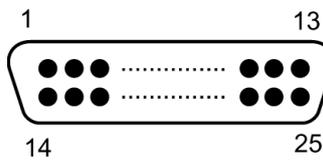
X-10A3 connector (CN22)



View from the cable side

Terminal number	Name	Meaning	Check point
1 to 6	U24V	+24 VDC power input	(1)
7 to 9	U0V	0 VDC power input	(1)
12 to 19	Signal output terminal	24V at output	(2)
24 to 31	Signal output terminal	24V at output	(2)

X-RSV connector (CN23)



View from the cable side

Terminal number	Name	Meaning	Check point
1 and 2	U24V	+24 VDC power input	(1)
3	U0V	0 VDC power input	(1)
8 to 15	Signal output terminal	24V at output	(2)

Chapter 3 Installation and Maintenance of the RC7M Controller

This chapter describes installation and maintenance jobs required for the RC7M controller. For jobs required for each robot type, refer to the "INSTALLATION & MAINTENANCE GUIDE" for each robot type.

3.1 Supplies for the Controller

The table below lists the supplies for the RC7M controller.

⚠ Caution (1) The battery used in this device may present a risk of fire or chemical burn if mistreated. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate.
(2) Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.

List of Supplies for the RC7M Controller

No.	Name	Part Number	Remarks
1	Air inlet filter set	410053-0100	For standard type (FS-1705W)
		410053-0110	For global type (FS-1705)
2	Memory backup battery	410076-0261	For backup of the controller memory
3	Fuse (1.3A)	410054-0230	Fuse (LM13) for controller I/O
4	IC for output (NPN)	410077-0010	IC (M54522P) for controller output
5	IC for output (PNP)	410077-0020	IC (M54564P) for controller output
6	PC10P Backup Battery	prepared by customer	Lithium rechargeable battery (JTEKT Corporation : TIP-5426)

3.2 Mounting the Controller

3.2.1 Installation Requirements for the Controller

The table below lists the installation requirements for the RC7M controller.

Installation Requirements for the RC7M Controller

Item	Environmental Requirements
Installation type	Stand-alone and Wall-mount
Ambient temperature	In operation: 0 to 40°C In storage or during transportation: -10 to 60°C
Humidity	In operation: 90% or less (No dew condensation is allowed.) In storage or during transportation: 75% or less (No dew condensation is allowed.)
Safe installation environment	The robot should not be installed in an environment where: <ul style="list-style-type: none"> • there are flammable gases or liquids, • there are any acidic, alkaline or other corrosive material, • there is a mist, or • there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.
Working space	Sufficient service space must be available for inspection and disassembly.
Grounding conditions	Grounding resistance (protective ground): 100Ω or less

3.2.2 Mounting the Robot Controller

Before mounting the robot controller to the target position, you need to secure the robot controller to the controller mounting panel.

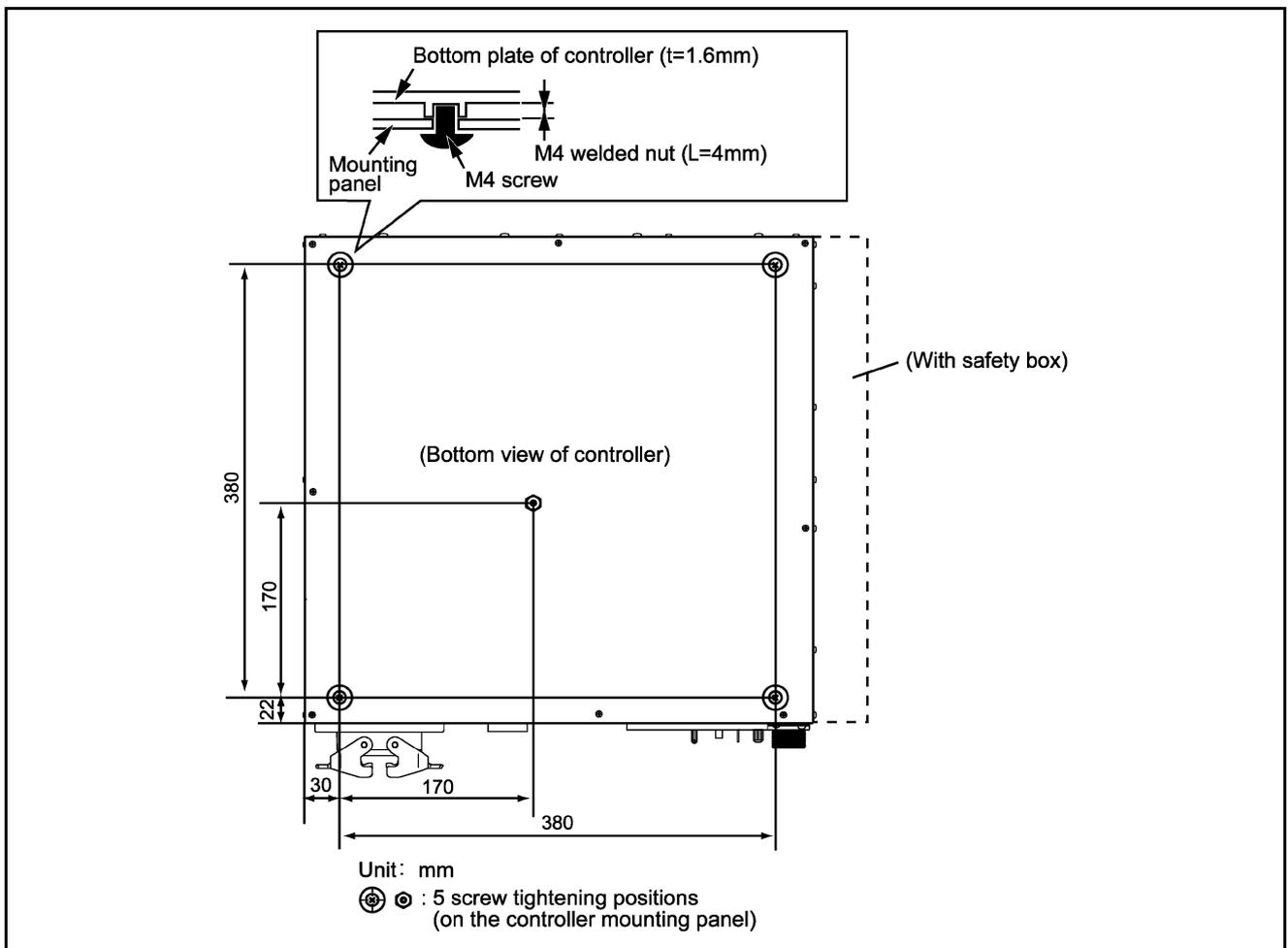
The robot controller supported by the mounting panel may be either stand-alone or wall-mounted.

⚠ Caution When using the robot controller in any environment where there is mist, put the controller in an optional robot controller protective box. The robot controller is not dust-proof, splash-proof, or explosion-proof. Set up the controller at the place where it is easy to replace the memory backup battery and air filters.

[1] Securing the Robot Controller to the Controller Mounting Panel

- (1) The figure below shows the bottom view of the robot controller. Five M4-nut welded holes may be used for securing the robot controller to the mounting panel.
- (2) Prepare a mounting panel large enough for mounting the robot controller and secure the robot controller onto the mounting panel using five screws.

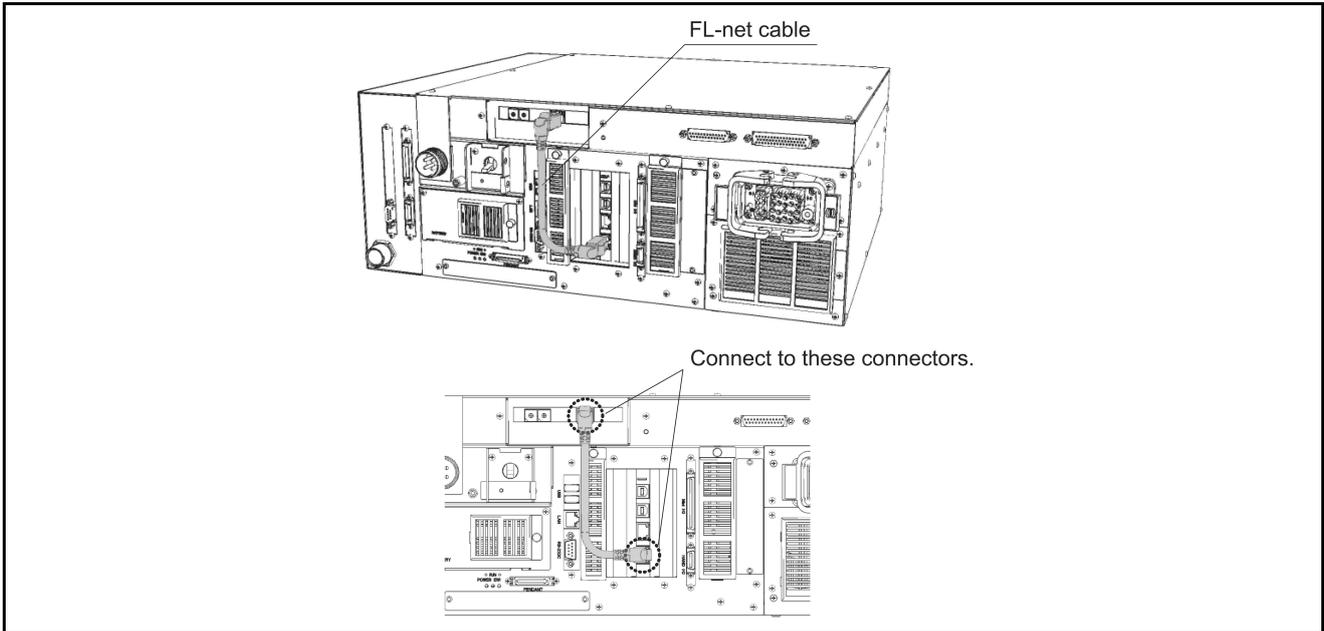
⚠ Caution (1) The controller mounting screws must not be more than the thickness of the mounting panel plus 4 mm in length. If their length is out of the specified range, the nut welded holes may be damaged.
 (2) Fix the robot controller at all of the five nut-welded holes.



Location of Mounting Screw Holes (on the bottom of the robot controller)

[2] Notes for transport

Before transporting the robot controller, be sure to disconnect the FL-net cable. After installation, connect it correctly.

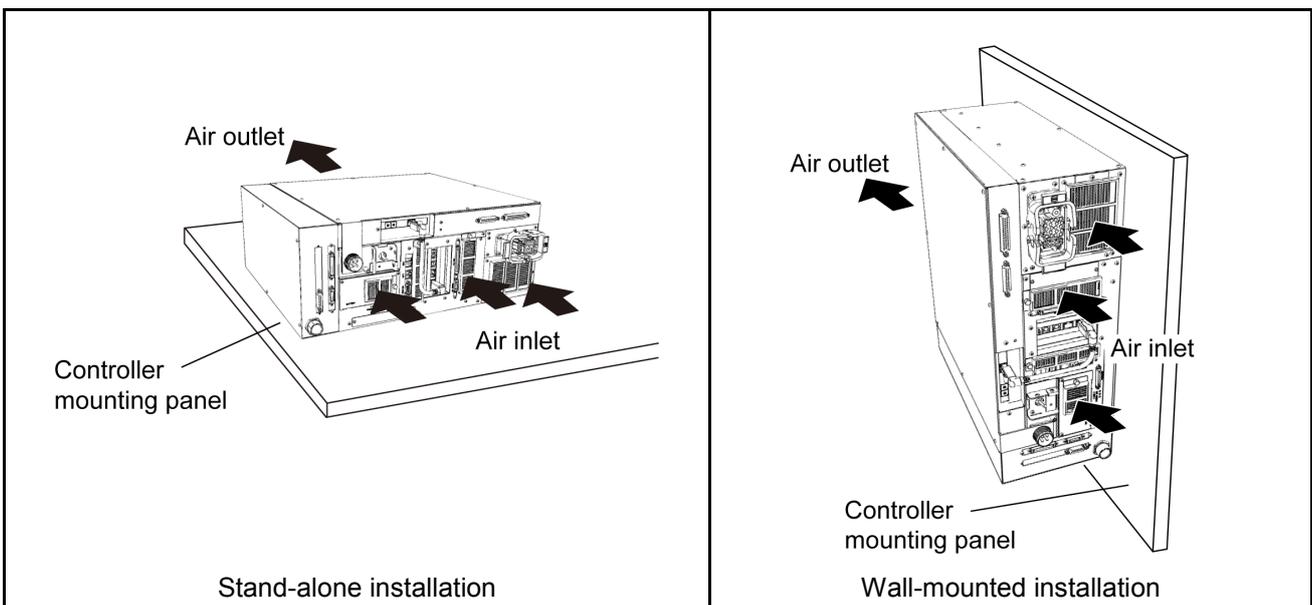


[3] Installing the Robot Controller

The robot controller can be installed stand-alone or on the wall.

Set up the robot controller as shown in the figure below.

- ⚠ Caution** Do not place anything within 200 mm from the air inlet and outlet of the robot controller.
- ⚠ Caution** The robot controller has no air filter on the air outlet side. In wall-mounted installation, therefore, to prevent free-fall dust or dirt from getting into the controller, set up the controller with the air outlet side not facing upward as shown below.



Setting up the Robot Controller

3.3 I/O and AC Input Wiring

3.3.1 Multi-core Cables with Connectors

Multi-core cables with connectors to be used for the I/O wiring of the Robot Controller are options. Select an appropriate cable from the table given below if necessary.

I/O Cables (Options)

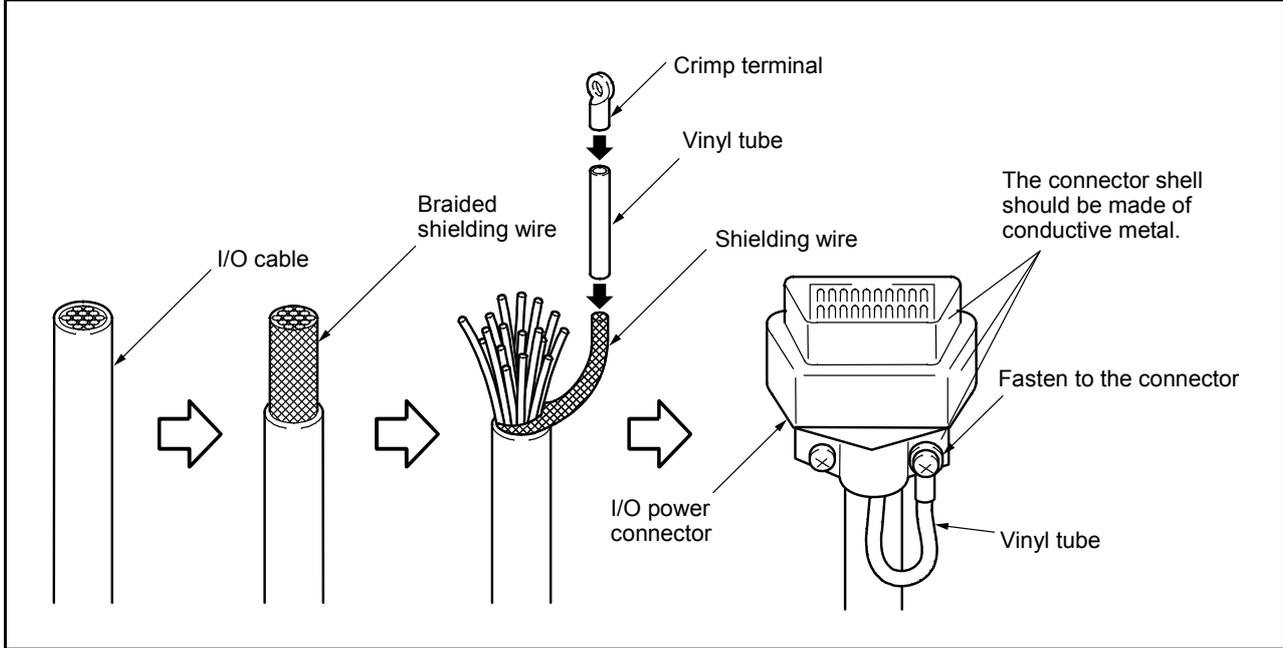
No.	Name	Part Number	Remarks
1	Standard I/O cable set	410149-0940	(8 m) Including Nos. 1-1 and 1-2
		410149-0950	(15 m) Including Nos. 1-1 and 1-2
1-1	Mini I/O cable (68 pins)	410141-2700	(8 m)
		410141-2710	(15 m)
1-2	Hand I/O cable (20 pins)	410141-1740	(8 m)
		410141-1750	(15 m)
2	X-LNE1 cable (T03) (28 pins) (Cable dia. 8 mm)	410141-4210	(8 m)
		410141-4220	(15 m)
3	S ON cable (T03) (15 pins) (Cable dia. 9.4 mm)	410141-4260	(8 m)
		410141-4270	(15 m)
4	X-10A3 cable (T03) (50 pins) (Cable dia. 15 mm)	410141-4240	(8 m)
		410141-4250	(15 m)
5	Line controller conversion cable (T03)	410141-4200	(1 m)

If you do not use optional cables listed above, use the recommended connectors and cables listed on the next page.

Cable diameters in the above table apply to Denso genuine cables.

Recommended Connectors for I/O Cables and Cable Standards

Connector name	Connector model/manufacturer	Cable Standards	Remarks
Mini I/O	PCR-E68FS connector PCS-E68LPA-1E cover (HONDA TSUSHIN KOGYO Co., LTD)	UL2789 - With shield Equivalent to AWG28x34P	Caution: Be sure to modify the shielding wire at the end of the cable to be used, as shown below. Without this modification, the robot may malfunction due to noise.
HAND I/O	PCR-E20FS connector PCS-E20LA cover (HONDA TSUSHIN KOGYO Co., LTD)	UL2789 - With shield Equivalent to AWG28x20P	



Modifying the Shielding Wire (Example)

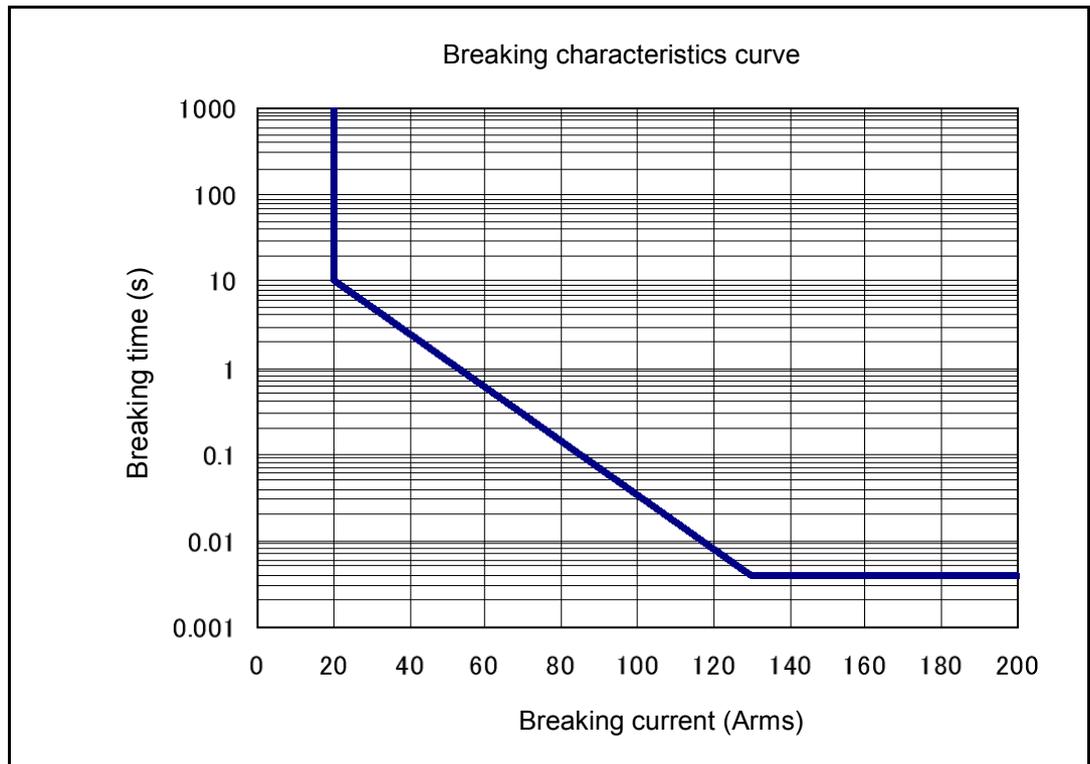
3.3.2 Wiring of Primary Power Source

Observe the following precautions when wiring the primary power source of the robot controller:

- (1) Connect the robot power cable to a power source separate from the welder power source.
- (2) Ground the protective grounding wire (green) of the robot power cable.
- (3) Ground the functional grounding terminal of the robot controller using a wire of 1.25 mm² or more in size.
- (4) For the robot power supply, use a protective grounding wire with grounding resistance of 100Ω or less.
- (5) If the supply power source for the robot controller requires a leakage breaker, use a high frequency-proof leakage breaker for inverters.
- (6) When inserting a circuit breaker between the robot and the AC input power supply, select the circuit breaker with breaking capacity higher than the following specification.

Recommended circuit breaker example: CP33V/20 (Fuji Electric FA Components & Systems Co., Ltd.)

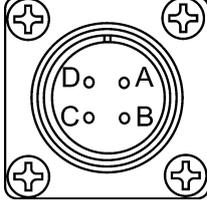
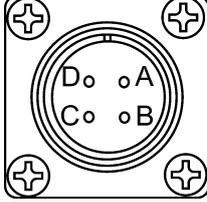
Caution: Using a circuit breaker with breaking capacity lower than the following specification may cause the circuit breaker to be shut down due to robot operation.



Circuit Breaker Characteristics

- (7) Prepare wires of an appropriate capacity for the 200/100 VAC main line and other cables according to the tables given below.

Robot Controller Power Supply Specifications

Item		Specifications	Pin assignment on power connector (CN6) (View from the pin face of cable)		
Power supply	Three-phase, 200 VAC	Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz		A: 200 VAC, phase R	
	Power supply capacity	VMG6BA: 3.3 kVA		VSG6BA: 1.85 kVA	B: 200 VAC, phase S
		VPG5/6CA: 1 kVA		HMG4BA: 2.45 kVA	C: 200 VAC, phase T
		HSG4BA: 1.8 kVA			D: Protective Ground
Single-phase, 200 VAC	Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz		A: 200 VAC, phase R		
Power supply capacity	VSG6BA: 1.85 kVA		VPG5/6CA: 1 kVA	B: 200 VAC, phase S	
	HMG4BA: 2.45 kVA		HSG4BA: 1.8 kVA	D: Protective Ground	
Max. rush current when the power is turned ON		40 A (for 1/50 or 1/60 second)			

Caution: If ERROR6102 (power voltage drop) occurs when the robot is in operation, then it may be due to an insufficient capacity of the primary power source.

- (8) Do not bundle the teach pendant cables, I/O cables or motor cables together with high power lines such as 200 VAC lines and peripheral device cables, or route the motor cables near high power devices (motor, welder, parts feeder, etc.).
- (9) Do not route any additional cables or air tubes of end-effectors through the robot unit. Doing so will result in broken cables or tubes.
- (10) Be sure to use the power supply conforming to the controller power specifications.

Disconnecting the Robot from the Power Source

If you need to cut off the power supply from the robot unit for maintenance or transportation purpose, follow the steps below for safety.

1. Turn OFF the power switch of the robot controller.
2. Check that the motor ON lamp is OFF.
3. Disconnect the power cable from connector CN6 on the robot controller.

3.4 Cleaning the Air Intake Filters

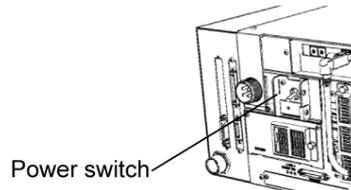
The robot controller has three air intake filters.

If those filters are clogged, the robot controller becomes insufficiently ventilated so that the internal electronic devices may be damaged due to heat.

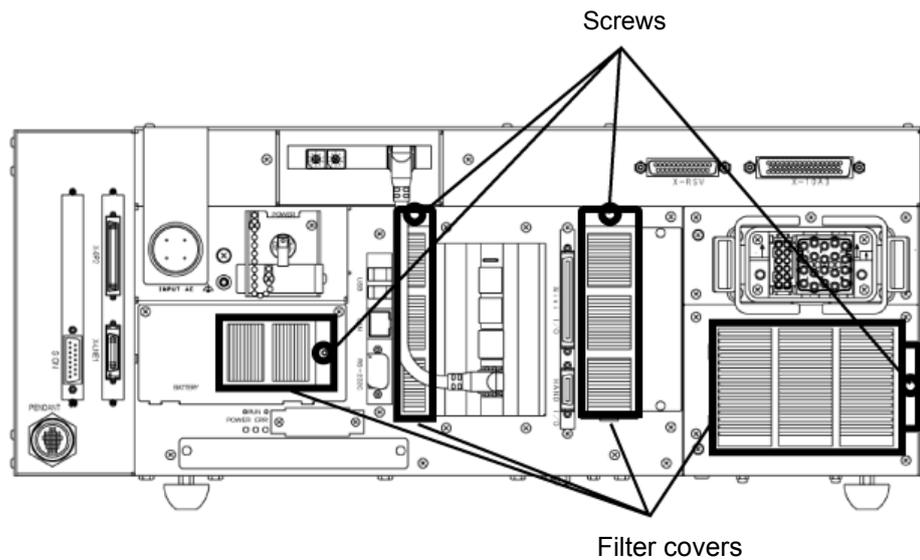
If a power module error appears, it may be caused by clogged filter, so clean the filter.

<Cleaning Procedures>

Step 1 Turn the controller power OFF.

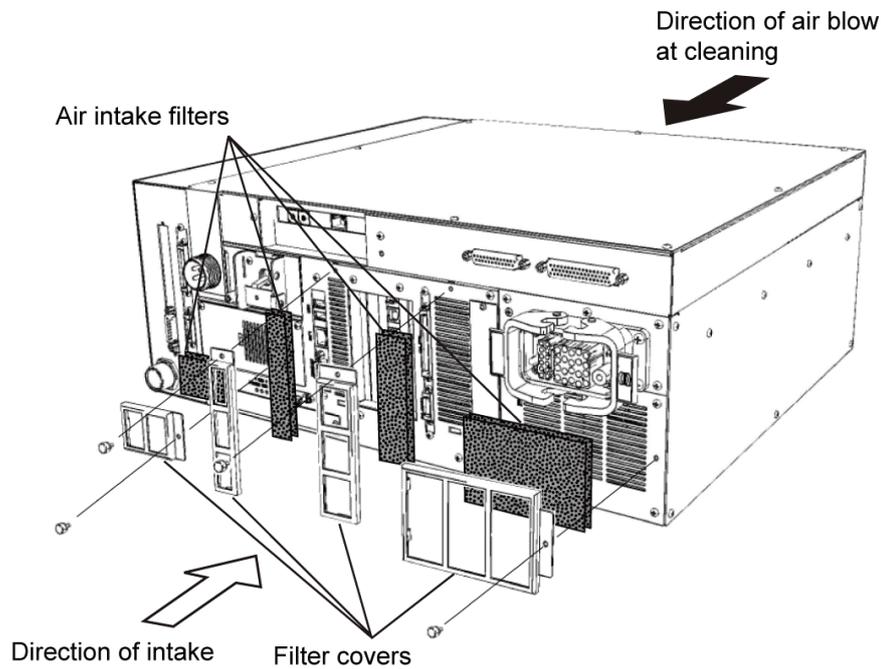


Step 2 Remove the four filter covers from the front panel by loosening the screw each.



Step 3 Blow compressed air to the filter in the direction opposite to the regular air- flow.

Note: Use dehumidified, oil-free, pure compressed air for cleaning.



If the filter is excessively dirty, wash it with water or warm water (40°C or lower). A neutral detergent is most effective.

Notes (1) Dry the washed filter completely before mounting it.
(2) If the filter is still dirty after air blowing or washing, replace it with new one.

Step 4 Set the filters back into place in the reverse order of removal.

3.5 Replacing the Memory Backup Battery

Programs, parameters, CAL data, etc. are stored in the internal memory of the robot controller.

The memory backup battery retains the above data while the power to the robot controller is turned OFF. However, the battery has a limited lifetime and must, therefore, be replaced regularly.

Note: If two years elapse from replacement of backup battery, the "Time to change controller backup battery" message will appear on the teach pendant.

⚠ Caution: Without replacing the memory backup battery, important robot-specific data held in the memory will be lost.

This caution applies **ONLY** in CALIFORNIA, USA.
Perchlorate Material – special handling may apply,
See www.dtsc.ca.gov/hazardouswaste/perchlorate

3.5.1 Replacement Procedure

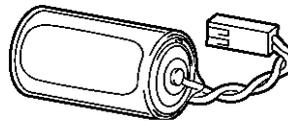
This section gives an example of replacing the memory backup battery.

Caution: Before replacing the memory backup battery, be sure to save the memory data in the robot controller to the PC using WINCAPSIII.

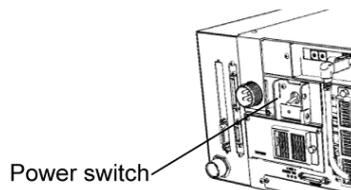
⚠ Caution (1) The battery used in this device may present a risk of fire or chemical burn if mistreated. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate.
(2) Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.

Step 1 Save the memory data held in the controller to the PC.

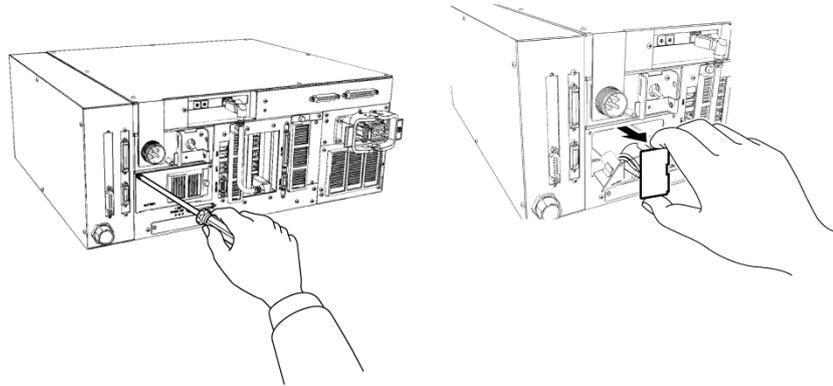
Step 2 Make a new memory backup battery ready for use.



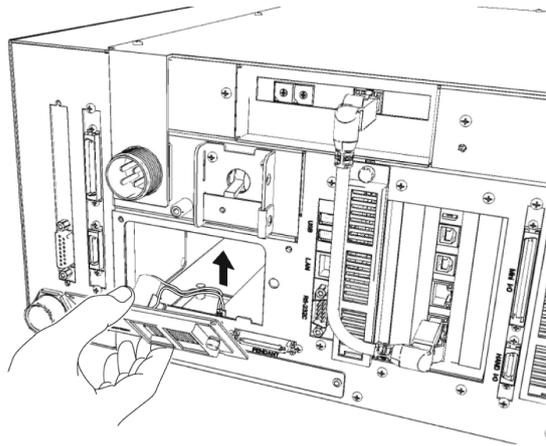
Step 3 Turn the controller power ON, wait at least one minute, and then turn it OFF again.



Step 4 Remove the two screws from the battery cover and pull out the cover together with the backup battery.

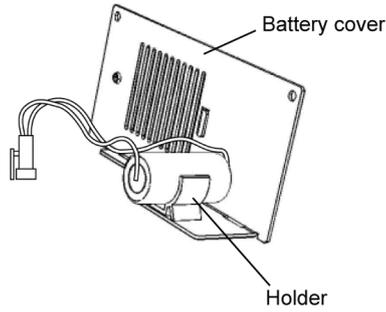


Step 5 Disconnect the backup battery harness.

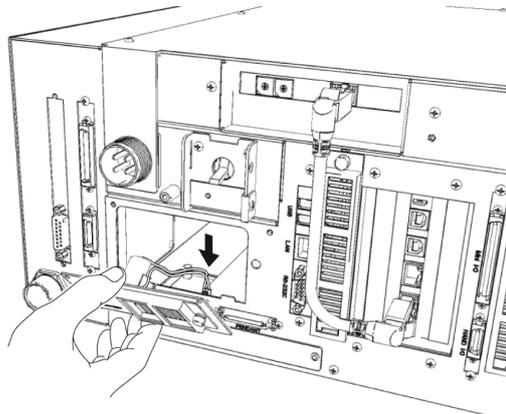


⚠ Caution Complete Steps 5 through 7 within three minutes. Taking more time will lose the memory data.

Step 6 Set the new memory backup battery ready for use in Step 2 in the holder of battery cover.



Step 7 Connect the backup battery harness to the controller.



Step 8 Mount the battery cover with the new backup battery into the controller and secure the cover with the screw.

⚠ Caution Take care not to pinch the battery lead wires between covers or internal parts. Shorting may occur, resulting in an unexpected failure.

3.5.2 Setting the Next Battery Replacement Date

After replacing the memory backup battery, set the next battery replacement date from the teach pendant, according to the following procedure.

Note: Check that the system clock of the robot controller shows the correct date beforehand. If it is incorrect, the next replacement date will also become incorrect.

Step 1 | **On the extended screen of the teach pendant, press [Set].**
The Settings (Main) window appears.

Step 2 | **Press [Maint.] in the Settings (Main) window.**
The Maintenance menu appears.

Step 3 | **Press [Battery] in the Maintenance menu.**
The Next Battery Replacement Date window appears.
In the top of the window, the current setting is displayed.
The date entry areas show the default replacement date that is two years later the current data at which you open this window, assuming that the battery service life is two years.

Step 4 | **Press OK.**
Note: If you do not want to change the replacement date, press Cancel.
The message "Are you sure you want to set the next battery replacement date?" appears.

Step 5 | **Press OK.**
The screen returns to the Settings (Main) window.

3.6 Replacing the PC10P Backup Battery

3.6.1 About Lithium Rechargeable Battery (JTEKT TIP-5426)

The PC10P board has a dedicated lithium rechargeable battery.

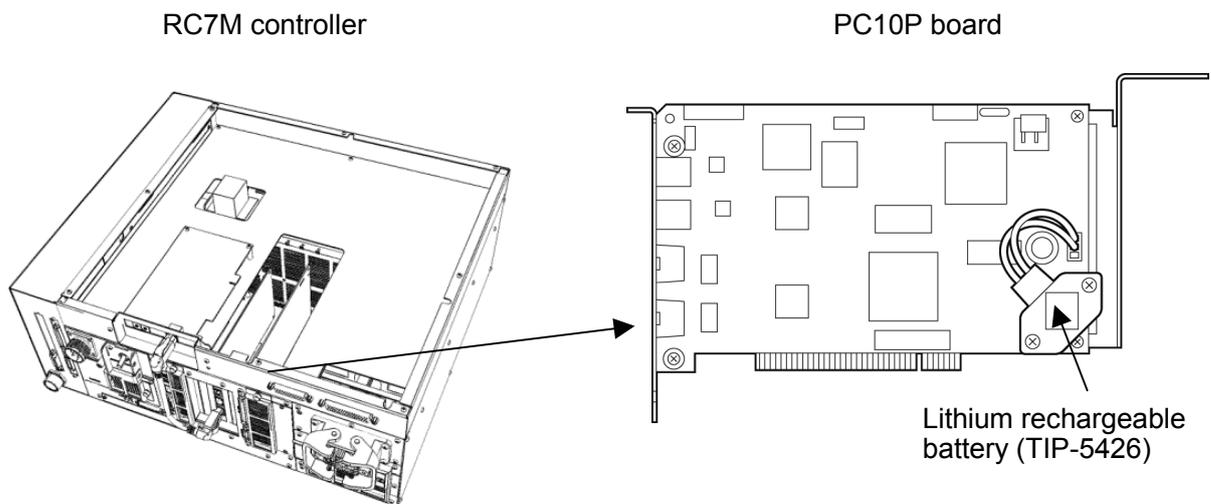
Keeping the controller power ON for about four hours a day fully charges the battery. In case of power failure, the fully charged battery can back up the data memory (data areas such as latching relays and data registers) as well as the built-in clock on the PC10P board for more than one year at room temperature (25°C). Note that the guaranteed backup period is six months at room temperature (25°C).

If a battery alarm issued due to a voltage drop persists or if a battery alarm is issued soon even after recharging, the battery service life may be coming to the end. The battery should be replaced with a new one dedicated for the PC10P board (TIP-5426 manufactured by JTEKT Corporation) by qualified service personnel.

The battery service life is five years as a rough guide, which varies depending on the use conditions.

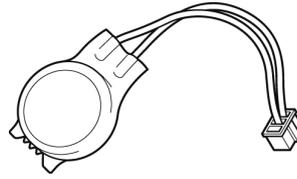
Caution: If the content of the data memory is lost, the PC10P board can restore it.

User programs (sequence programs and parameters) and equipment information (such as comments) will not be lost in case of power failure since they are stored in the flash memory.

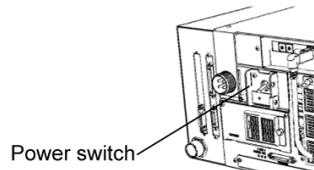


3.6.2 Replacement Procedure

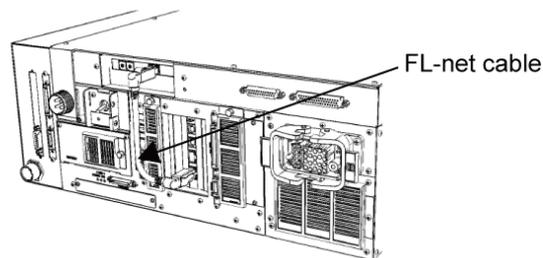
Step 1 Make a new lithium rechargeable battery ready for use.



Step 2 Turn the controller power OFF.



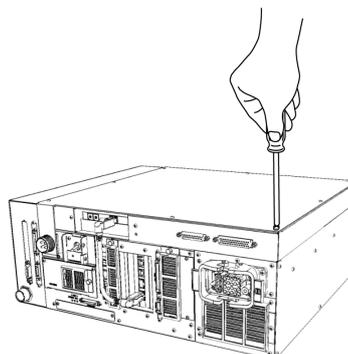
Step 3 Disconnect the FL-net cable.



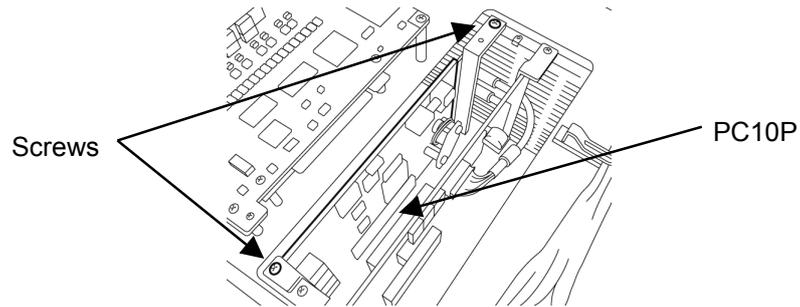
Step 4 Remove the controller upper cover by removing eight screws.

⚠Warning Before removing the controller upper cover for maintenance and inspection or other purposes, be sure to turn the controller power OFF, disconnect the power supply connector (CN6), and then wait at least three minutes. Otherwise, electric shock may occur.

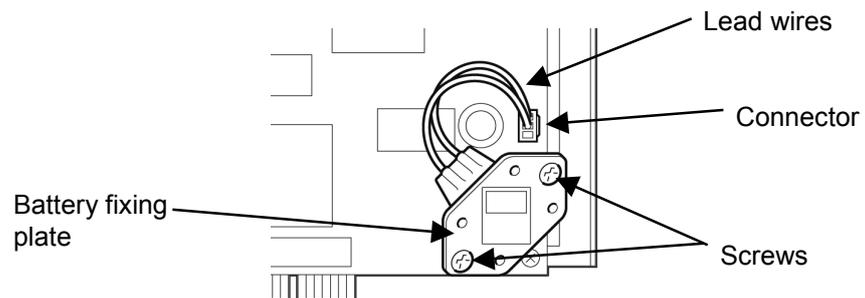
As long as the power supply connector (CN6) is connected, the power is supplied to the circuit protector via fuses even if the power switch is OFF. Touching the fuses may cause electric shock.



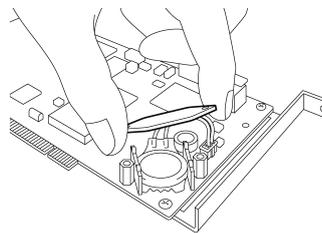
Step 5 Remove the PC10P board by removing two screws.



Step 6 Remove the two screws from the battery fixing plate.



Step 7 Remove the battery fixing plate.



Step 8 Disconnect the battery connector.

Caution: Do not pull the lead wires. Doing so may break wires.

Step 9 Set the new battery in the reverse order of removal.

Caution: When connecting the battery connector, be careful with the direction. Also take care not to let the lead wires protrude from the PC10P board.

Step 10 Turn the controller power ON and check that the battery alarm is OFF with a peripheral device.

Step 11 Turn the controller power OFF.
Make a note of the current date on the battery replacement label.

Caution: Complete the battery replacement procedure within five minutes after turning the controller power OFF in step 2. Within the period, the large-capacitance capacity backs up the data memory (data areas such as latching relays and data registers) as well as the built-in clock on the PC10P board.

User programs (sequence programs and parameters) and equipment information (such as comments) will not be lost even if the battery is removed since they are stored in the flash memory.

3.6.3 **WARNING: Handling lithium rechargeable batteries**

Replace the lithium rechargeable battery properly, referring to the battery instruction manual.

The lithium rechargeable battery is safe as long as it is normally mounted in the robot controller. In storing it as a spare part or disposing of the used one, wrong handling may cause battery fluid leakage, heat, fire, or burst, resulting in a damage to the surrounding equipment or bodily injuries.

To prevent potential accidents, observe the following:

- (1) Do not throw the battery into fire.
- (2) Keep the battery away from water.
- (3) Do not directly solder any part to the battery.
- (4) Do not heat the battery.
- (5) Do not disassemble the battery.
- (6) Do not short-circuit the battery terminals (+) and (-).
- (7) Do not apply pressure to the battery or deform it.
- (8) Do not forcibly discharge the battery.
- (9) Do not recharge the battery not mounted the PC10P board, with any charger.
- (10) Do not use the batteries being connected in series or in parallel.
- (11) Avoid storing the battery in an environment with high temperature or high humidity, and avoid dew condensation.

When disposing of the battery, observe the following in addition to the above instructions. The battery should be disposed of as a nonflammable garbage according to the local regulations.

- (1) Do not gather batteries together; wrap each battery in a vinyl bag to prevent short-circuit.
- (2) For storing used batteries, use a container made of nonconductive material.
- (3) Do not mix the battery with other metallic materials such as nails or wires.
- (4) Do not expose the battery to rain or water.
- (5) Do not mix the battery with hazardous materials designated by the local fire protection law or bring the battery close to those materials.
- (6) Do not put the battery in a place close to fire or with high temperature.

3.7 Replacing Fuses and Output ICs

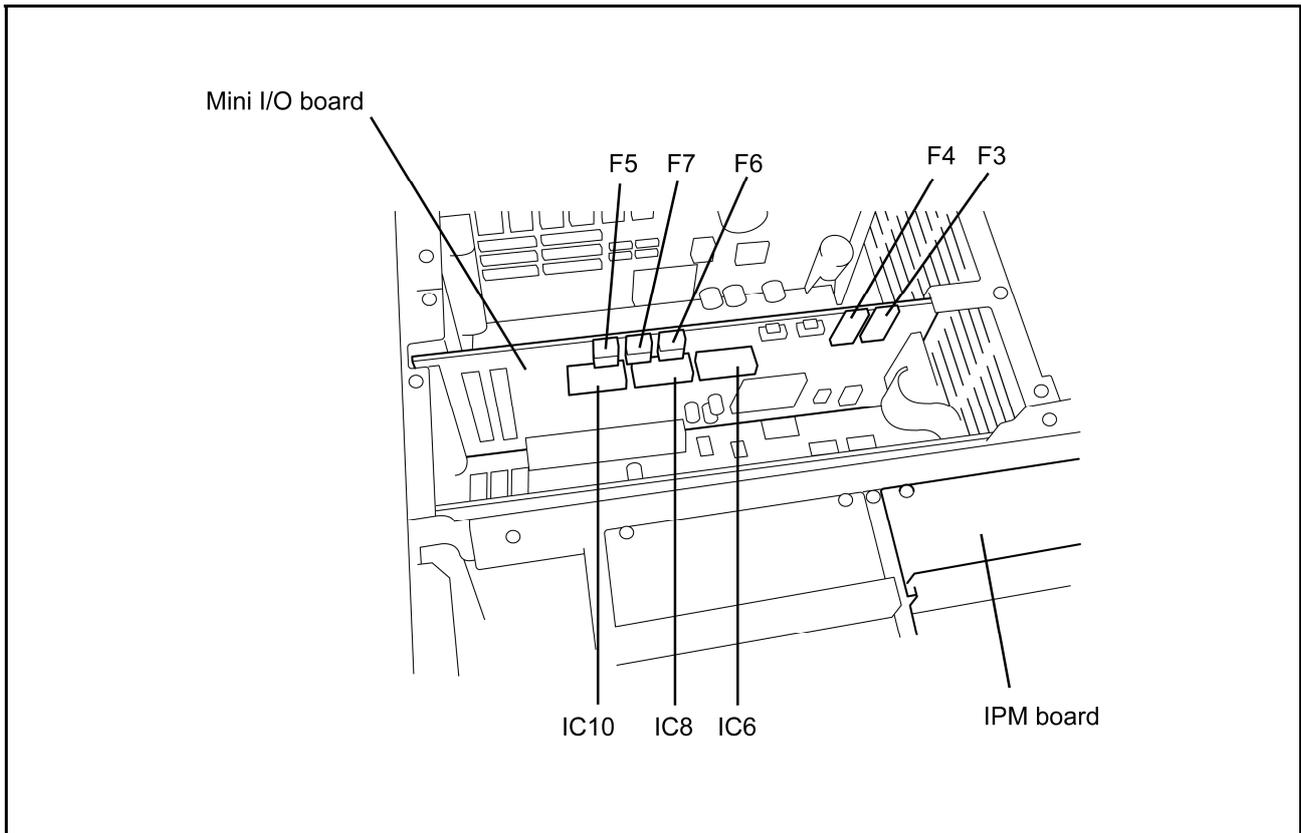
3.7.1 Positions of Fuses and Output ICs

The robot controller is equipped with fuses to protect it from external wiring shorted.

If any fuse is blown, replace it according to the following procedure.

If an output signal error persists even after replacement of the output fuse, the related output IC needs to be replaced.

Fuses and output ICs are located in the robot controller as shown in the figure below.



Positions of Fuses (with the controller top cover removed)

Fuse	Capacity	Corresponding output connector and terminal No.	Signal name	I/O port No.
F3	1.3 A	Mini I/O, terminals 32 to 34	DC power input +24V (E24V)	---
F4	1.3 A	Mini I/O, terminals 66 to 68	DC power input 0V (E0V)	---
F5	1.3 A	Mini I/O, terminals 1 and 35	Power supply for <i>Enable auto</i> (Internal +24V)	---
		Mini I/O, terminals 2 and 36	<i>External emergency stop 1b-1</i> (Internal +24V)	---
		Mini I/O, terminals 3 and 37	<i>External emergency stop 2b-1</i> (Internal +24V)	---
F6	1.3 A	Mini I/O, terminals 45 to 60	System output/User output	16 to 31
F7	1.3 A	Hand I/O, terminals 1 to 8	Hand output	64 to 71

The table below lists the output ICs and fuses for the Mini I/O (CN5) and HAND I/O (CN9). If an output signal error occurs, check the corresponding fuse.

Note: The Emergency Stop and Deadman output circuits use PolySwitches (resettable fuses) that trip in an overcurrent condition to open the circuits. If a PolySwitch trips, turn the power off and check the related circuit. (As long as the power is on, a PolySwitch keeps tripping. After checking, therefore, turn the controller power off and on, then check the circuit again.

Output ICs and Fuses

Connector Name	Application	Pin No.	I/O Port No.	Output IC	Fuse		
HAND I/O CN9	For output	1	64	IC10	F7 (1.3A)		
		2	65				
		3	66				
		4	67				
		5	68				
		6	69				
		7	70				
		8	71				
Mini I/O CN5	For output	45	16	IC6	F6 (1.3A)		
		46	17				
		47	18				
		48	19				
		49	20				
		50	21				
		51	22				
		52	23				
		53	24	IC8			
		54	25				
		55	26				
		56	27				
		57	28				
		58	29				
	59	30					
	60	31					
	For 24 VDC					External power supply	Internal power supply
			32	–	–	–	F3 (1.3A)
			33	–	–	–	
			34	–	–	–	
		66	–	–	–	F4 (1.3A)	
		67	–	–	–		
		68	–	–	–		
		1, 35	–	–	–	F5 (1.3A)	
	2, 36	–	–	–			
	3, 37	–	–	–			
Reference: PolySwitch on Mini I/O (CN5)	Emergency stop and Deadman output	6, 40	–	–	PS5 (0.15A)		
		7, 41	–	–	PS6 (0.15A)		
		8, 42	–	–	PS3 (0.15A)		
		9, 43	–	–	PS4 (0.15A)		

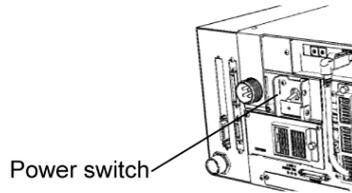
3.7.2 Replacement Procedure

Replace fuses and output ICs according to the following procedure:

- ⚠Caution** (1) Wear a wristband and connect its terminal to a grounded portion before starting work.
(2) Do not touch electronic devices or their terminals on any printed circuit board with bare hand. Electronic devices could be destroyed by static electricity.

<Replacing fuses>

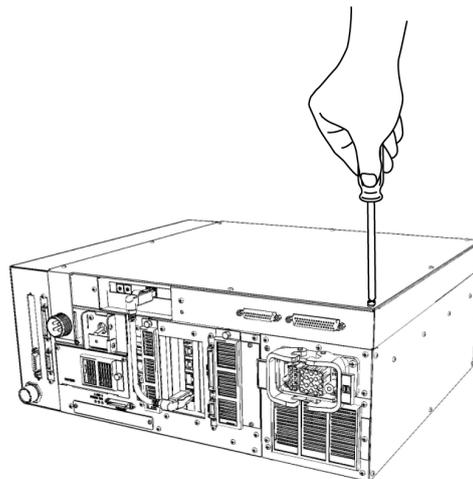
Step 1 Turn the controller power OFF.



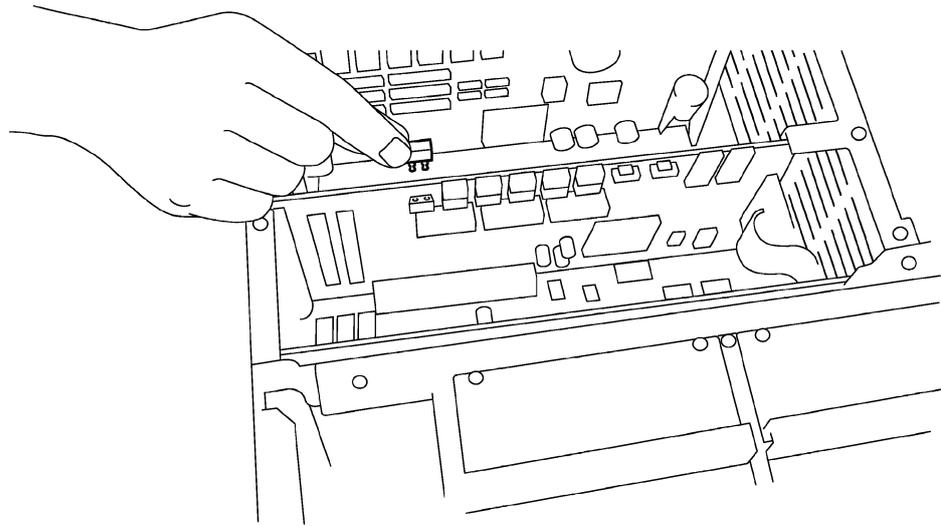
Step 2 Remove the controller upper cover by unscrewing eight screws.

⚠Warning Before removing the controller upper cover for maintenance and inspection or other purposes, be sure to turn the controller power OFF, disconnect the power supply connector (CN6), and then wait at least three minutes. Otherwise, electric shock may occur.

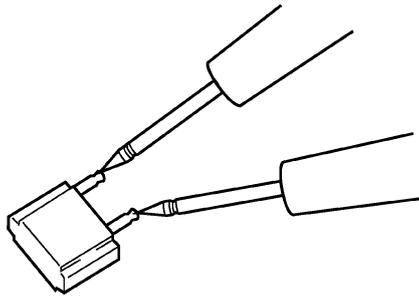
As long as the power supply connector (CN6) is connected, the power is supplied to the circuit protector via fuses even if the power switch is OFF. Touching the fuses may cause electric shock.



Step 3 Pull out the fuse to check.



Step 4 Using a circuit tester, check the removed fuse for continuity.



Step 5 If no continuity is observed with the fuse in Step 4:

- (1) Check the wiring of the corresponding output connector and remove the cause of the blown fuse.
- (2) Insert a new fuse into place in the controller.

If continuity is observed with the fuse in Step 4, set the removed fuse back into place in the controller.

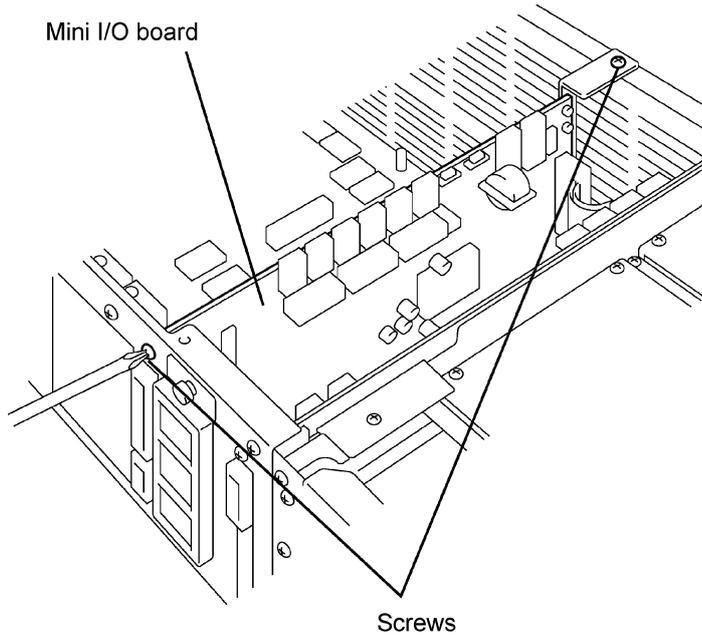
Step 6 Set the controller upper cover back into place and restart the controller in the reverse order of Steps 1 through 3.

Proceed to the following steps when replacing output ICs

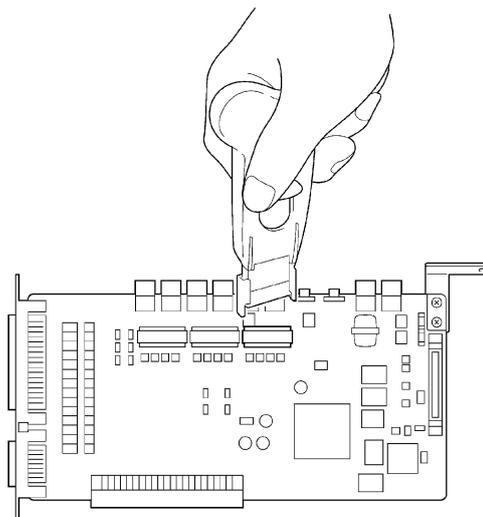
Step 7 If an output signal error persists even after replacement of the output fuse, the related output IC needs to be replaced.

⚠ Caution (1) When replacing a damaged output IC, fix the cause that damages the IC before replacement.
(2) Do not directly touch the electronic devices and their terminals on printed circuit boards by hand.

Remove the three screws and take the Mini I/O board out of the controller.

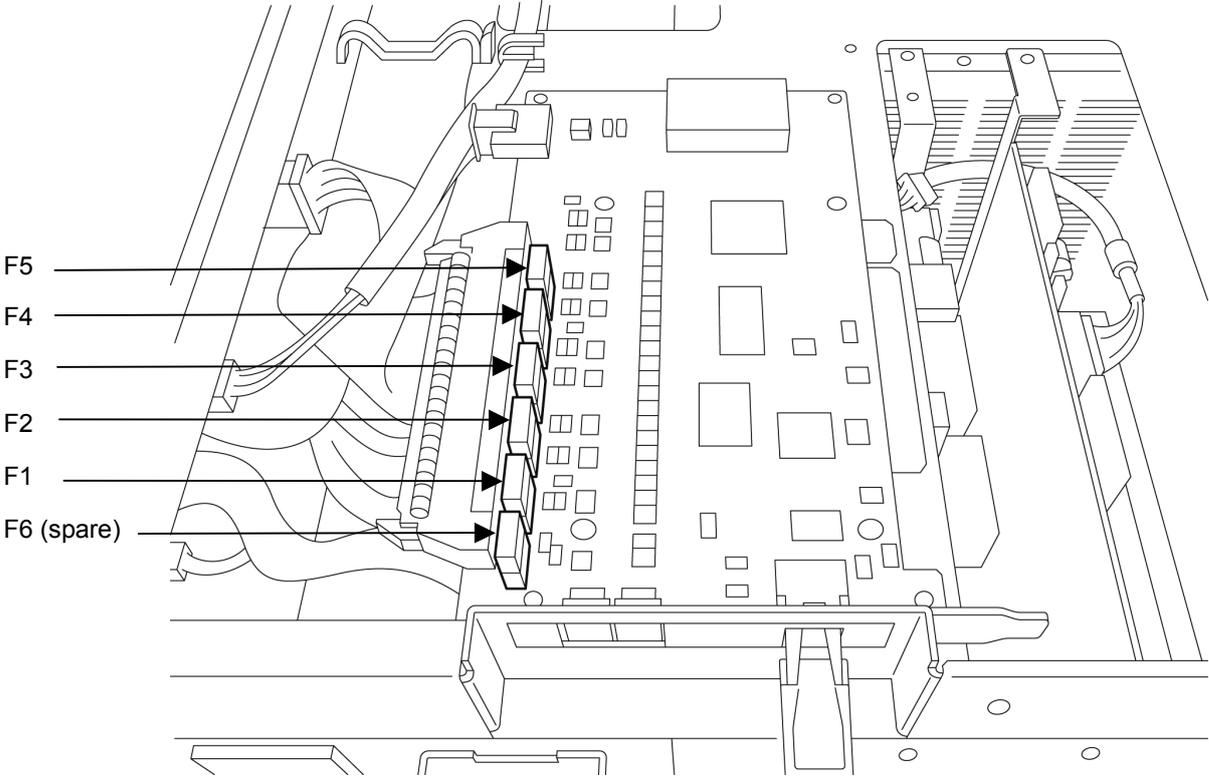


Step 8 Check the IC No. on the printed circuit board and pull out the target output IC with an IC pull-out jig. Mount a new output IC.



3.7.3 Replacing Fuses on FL Remote I/O Board

The figure below shows the fuse mounting positions.



**Names and Mounting Positions of Fuses
(with the controller upper cover removed)**

<Replacing fuses>

Outputs Y040 to Y067 (common, 40 points) have fuses as listed below.

Which one out of these five fuses is blown can be checked with X028 to X02C.

Output				
Address	COM	Fuse	Blown fuse alarm address	PWR
Y040 to Y047	COM8	F1	X028	PWR0
Y048 to Y04F	COM9	F2	X029	
Y050 to Y057	COMA	F3	X02A	PWR1
Y058 to Y05F	COMB	F4	X02B	
Y060 to Y067	COMC	F5	X02C	PWR2

Fuse model name: LM32 (Daito Communication Apparatus Co., Ltd.)

After removing the cause of the fuse blowout, replace the fuse with F6 fuse (spare). Fuses may not protect the output electronic devices from some causes (e.g. a current flow exceeding the rated level but not blowing out the fuse). The fuse capacity is 3.2 A.

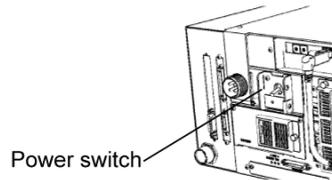
⚠Warning Before removing the controller upper cover for maintenance and inspection or other purposes, be sure to turn the controller power OFF, disconnect the power supply connector (CN6), and then wait at least three minutes. Otherwise, electric shock may occur.

As long as the power supply connector (CN6) is connected, the power is supplied to the circuit protector via fuses even if the power switch is OFF. Touching the fuses may cause electric shock.

⚠Caution (1) Wear a wristband and connect its terminal to a grounded portion before starting work.
(2) Do not touch electronic devices or their terminals on any printed circuit board with bare hand. Electronic devices could be destroyed by static electricity.

<Replacement procedure>

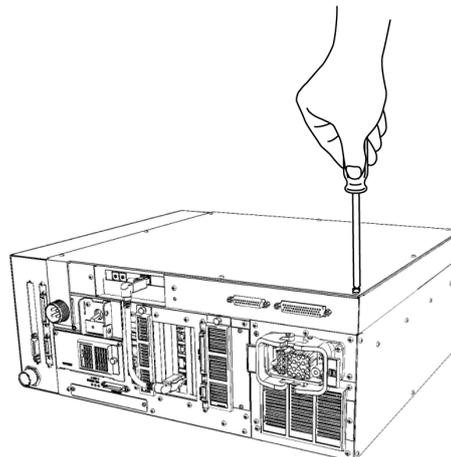
Step 1 Turn the controller power OFF.



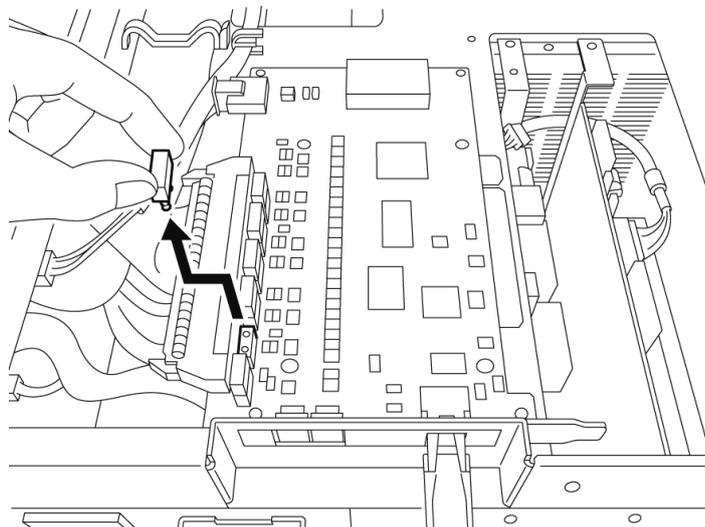
Step 2 Remove the controller upper cover by unscrewing eight screws.

⚠Warning Before removing the controller upper cover for maintenance and inspection or other purposes, be sure to turn the controller power OFF, disconnect the power supply connector (CN6), and then wait at least three minutes. Otherwise, electric shock may occur.

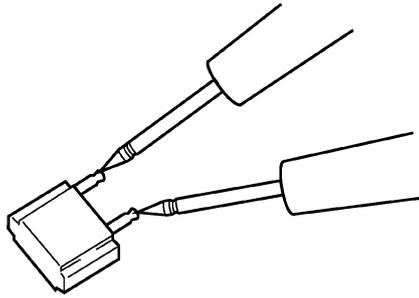
As long as the power supply connector (CN6) is connected, the power is supplied to the circuit protector via fuses even if the power switch is OFF. Touching the fuses may cause electric shock.



Step 3 Pull out the fuse to check.



Step 4 Using a circuit tester, check the removed fuse for continuity.



Step 5 If no continuity is observed with the fuse in Step 4:

- (1) Check the wiring of the corresponding output connector and remove the cause of the blown fuse.
- (2) Insert a new fuse into place in the controller.

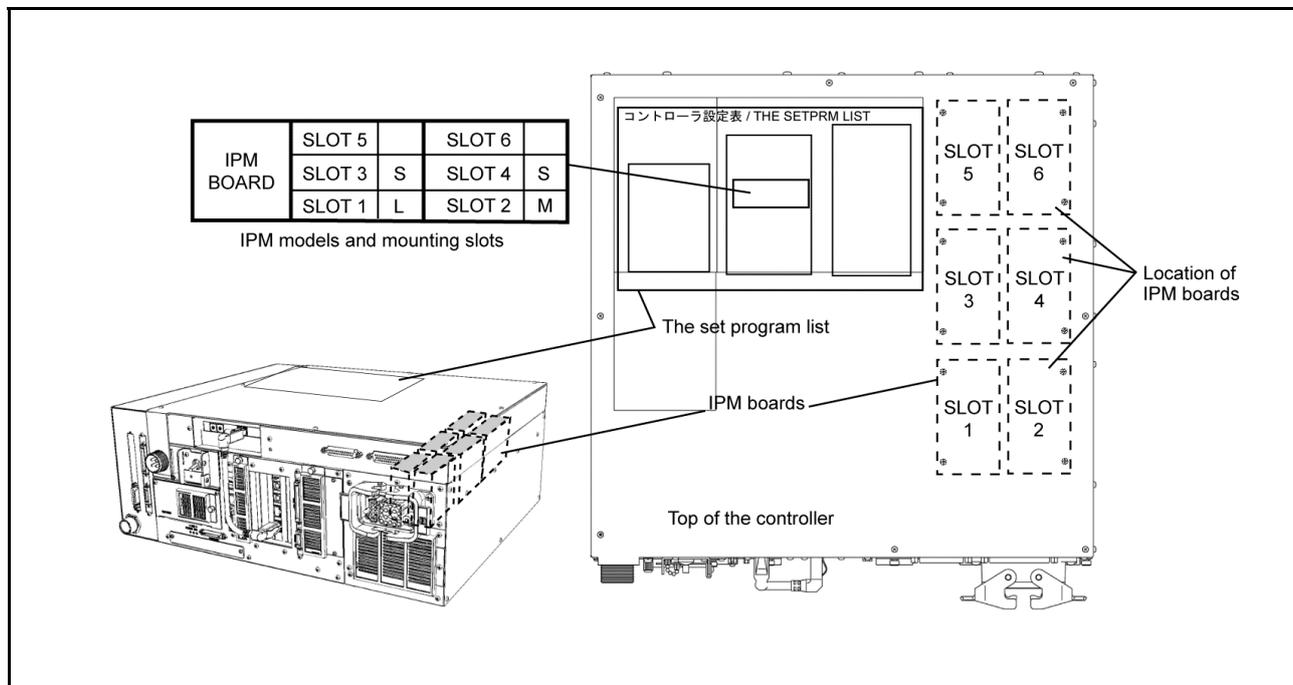
If continuity is observed with the fuse in Step 4, set the removed fuse back into place in the controller.

Step 6 Set the controller upper cover back into place and restart the controller in the reverse order of Steps 1 through 3.

3.8 Replacing IPM Boards

3.8.1 Location of IPM Boards

The IPM boards are located in the robot controller as shown below.



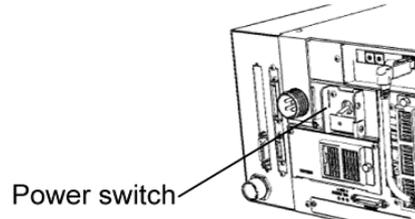
Robot series	SLOT	SLOT 6	SLOT 5	SLOT 4	SLOT 3	SLOT 2	SLOT 1
		Joint #	6	5	4	3	1
VM-G-T	IPM model	SS	SS	SS	S	L	M
	Motor capacity (W)	100	200	200	400	1500	750
VS-G-T	Joint #	6	5	4	3	2	1
	IPM model	SS	SS	SS	S	S	M
VP-G-T	Motor capacity (W)	50	80	100	200	400	750
	Joint #	6	5	4	3	2	1
HM-G-T	IPM model	SS	SS	SS	SS	SS	SS
	Motor capacity (W)	30	30	30	50	80	80
HS-G-T	Joint #	--	--	4	3	2	1
	IPM model	--	--	M	M	L	LL
HS-G-T	Motor capacity (W)	--	--	300	300	600	1000
	Joint #	--	--	4	3	2	1
HS-G-T	IPM model	--	--	S	S	M	L
	Motor capacity (W)	--	--	150	200	400	750

Note: The "--" in the above table denotes no board installed.

3.8.2 Replacing the IPM Board

Replace the IPM board with the procedure below.

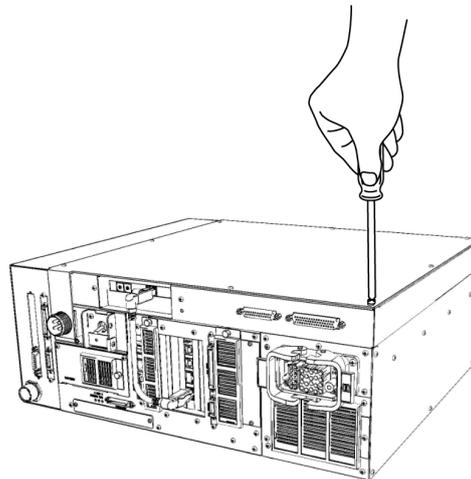
Step 1 Turn the controller power OFF.



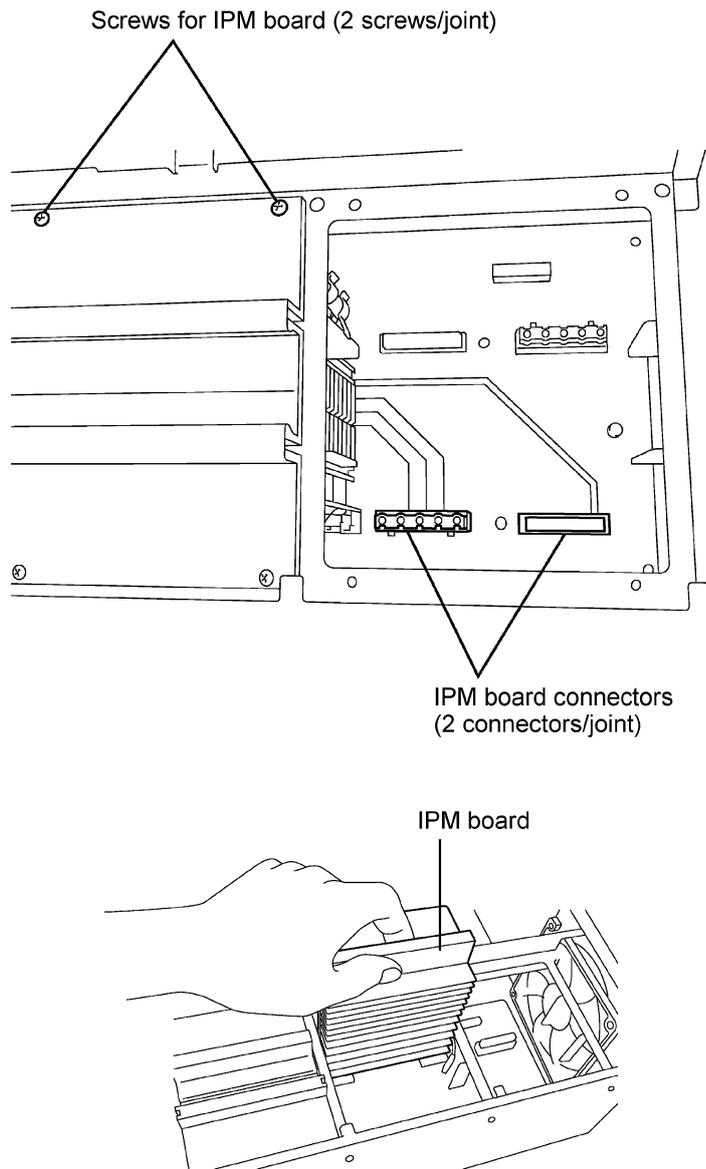
Step 2 Remove the controller upper cover by removing eight screws.

⚠Warning Before removing the controller upper cover for maintenance and inspection or other reasons, be sure to turn the controller power OFF, disconnect the power supply connector (CN6), and then wait at least three minutes. Otherwise, electric shock may occur.

As long as the power supply connector (CN6) is connected, the power is supplied to the circuit protector via fuses even if the power switch is OFF. Touching the fuses may cause electric shock.



Step 3 Remove the two screws from the IPM board to be replaced. Disconnect the board from its two connectors and connect a new one.



Step 4 Secure the controller upper cover with eight screws.
Tightening torque: 1.35 to 1.45 Nm

RC7M

CONTROLLER MANUAL (T03)

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The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.

