

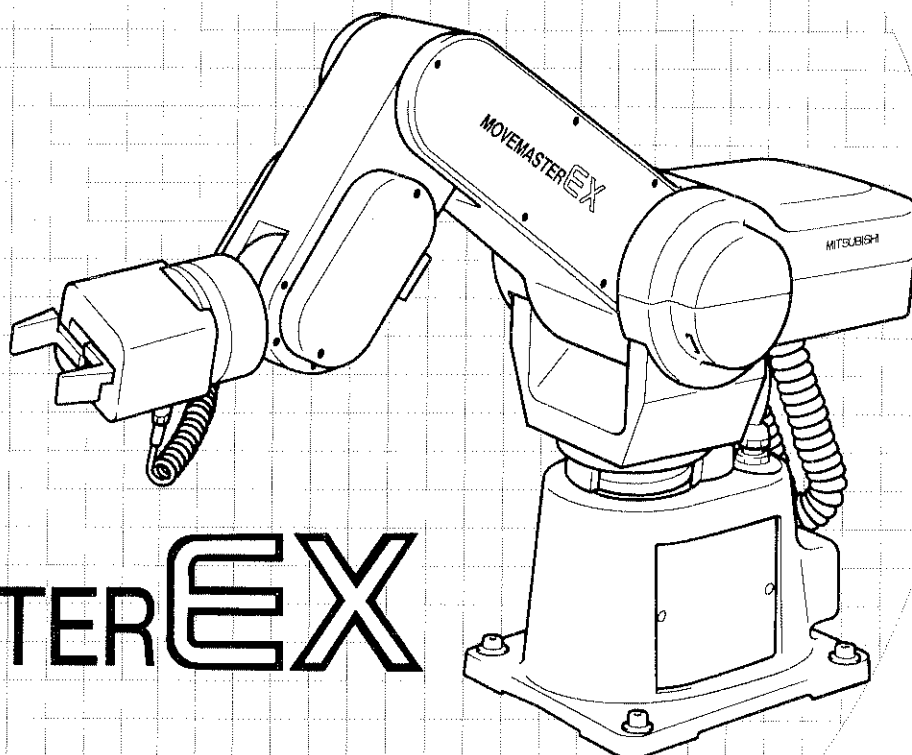


INDUSTRIAL MICRO-ROBOT SYSTEM

Model

RV-M1

SERVICE MANUAL



MOVEMASTER EX

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1. POWER CANNOT BE SWITCHED ON.

No.	Trouble	Cause	Remedy
	Power cannot be switched on.	1) Fuse blown.	Change the fuse.
		2) Input power supply fault.	220V AC $\pm 10\%$ 50/60 Hz

2. ERROR MODE I OCCURS AT POWER ON.

No.	Trouble	Cause	Remedy
	<p>Error mode I occurs at power on. Open the drive unit side door and check the LED lit.</p>	<p>1) LED1 See section 4.</p>	<p>Same as left.</p>
	<p>LED1.....On indicates excessive servo system errors.</p> <p>LED2.....On indicates open or disconnected signal cable between the robot and drive unit.</p>	<p>2) LED2 Motor signal cable connected incorrectly.</p>	<p>Check the cable connectors. Check the cable for continuity.</p>
	<p>LED3.....On indicates drive unit emergency stop input (drive unit front panel and rear panel emergency stop input terminal).</p> <p>LED4.....On indicates teaching box emergency stop input.</p> <p>LED5.....On indicates backup battery fault.</p>	<p>3) LED3 1. The emergency stop switch on the drive unit front panel has been pressed. 2. The drive unit rear panel emergency stop input terminal is open, or the external emergency stop switch is connected incorrectly.</p>	<p>1. Reset the emergency stop switch. 2. Check connection between the rear panel emergency stop terminal and the external switch.</p>
		<p>4) LED4 The teaching box connector is connected incorrectly. See section 5.</p>	<p>Check the teaching box connector at the drive unit rear panel. Same as left.</p>
		<p>5) LED5 1. Wrong setting 2. Incorrect battery connection or battery connector contact fault. 3. Battery expired.</p>	<p>1. Switch power on and set bit2 of SW1 in the drive unit side door to the upper position. 2 Check that the battery is connected correctly. 3. Change the battery.</p>

3. ERROR MODE I OCCURS AT POWER ON.

No.	Trouble	Cause	Remedy
	Error mode I occurs at power on.	1) Drive unit card contact fault.	Push the center of each card in the drive unit to fully insert it.

4. ROBOT OPERATES UNPREDICTABLY AS SOON AS POWER IS SWITCHED ON.

No.	Trouble	Cause	Remedy
	Robot operates unpredictably as soon as the power is switched on. (Examine the cause of misoperating axis.)	1) Fault of the power transistor 2SD1297 (2SD1296) on the heat sink.	See Information 2.
2) Fault of the motor drive direction switching transistor 2SB791, 2SD970 (on MCU card)		See Information 3.	
3) Encoder fault.		Change the motor. For the changing procedure, see the MAINTENANCE AND INSPECTION section of the Instruction Manual.	
4) Encoder signal cable fault.		See Information 4.	

5. ANY TEACHING BOX KEY INVALID.

No.	Trouble	Cause	Remedy
	Any teaching box key is invalid and the display indicates an incorrect value.	1) Connector contact fault.	Check the teaching box connector in the drive unit rear part.
		2) Cable wire breakage	Check the teaching box cable for continuity.
		3) Contact fault of the connector in the teaching box.	Check the connector in the teaching box.
		4) I/O card error.	Change the I/O card.

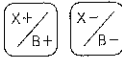
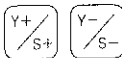
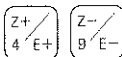
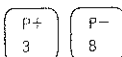

6. ROBOT OPERATES UNPREDICTABLY WHEN JOG OPERATION IS PERFORMED FROM TEACHING BOX.

No.	Trouble	Cause	Remedy
	<p>The robot is normal at power on but misoperates when jog operation is performed from the teaching box.</p> <p> Waist axis Shoulder axis Elbow axis Wrist pitch axis Wrist roll axis </p> <p>(Examine the cause of misoperating axis.)</p>	<p>1) Connector contact fault.</p> <p>2) Encoder fault.</p> <p>3) Encoder signal cable fault.</p>	<p>Check the drive unit-robot cable connectors and teaching box connector.</p> <p>Change the motor. For the changing procedure, see the MAINTENANCE AND INSPECTION section of the Instruction Manual.</p> <p>See Information 4.</p>

7. JOG OPERATION DISABLED IN ORIGIN SETTING DIRECTION.

No.	Trouble	Cause	Remedy
	<p>Jog operation from the teaching box is disabled in the origin setting direction, the teaching box gives the following display, and the buzzer beeps while any key is pressed.</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> </div> <div style="margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 10px;"> $\frac{X+}{B+}$ </div>Waist axis </div> <div style="margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 10px;"> $\frac{Y+}{S+}$ </div>Shoulder axis </div> <div style="margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 10px;"> $\frac{Z+}{4 E+}$ </div>Elbow axis </div> <div style="margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 10px;"> $\frac{P-}{8}$ </div>Wrist pitch axis </div> <div style="margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 5px;"> $\frac{R+}{2}$ </div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 10px;"> $\frac{R-}{7}$ </div>Wrist roll axis </div>		

8. JOG OPERATION INVALID FROM TEACHING BOX.

No.	Trouble	Cause	Remedy
	<p>Jog operation is invalid from the teaching box. Error mode I (excessive error; LED-1 lit) occurs if the key is kept pressed.</p> <p> Waist axis Shoulder axis Elbow axis Wrist pitch axis Wrist roll axis </p> <p>(Examine the cause of the faulty axis.)</p>	<p>1) Motor burn-out</p> <p>2) Motor power cable open.</p> <p>3) Connector contact fault.</p> <p>4) Fault of the power transistor 2SD1297 (2SD1296) on the heat sink.</p> <p>5) Fault of the motor drive direction switching transistor 2SB791, 2SD970 (MCU card.)</p>	<p>Change the motor.</p> <p>Check the cable for continuity. See Information 4.</p> <p>Check the drive unit-robot cable connectors.</p> <p>See Information 2.</p> <p>See Information 3.</p>

9. ROBOT VIBRATES WHEN JOG OPERATION IS PERFORMED FROM TEACHING BOX.

No.	Trouble	Cause	Remedy
	<p>The robot vibrates when jog operation is performed from the teaching box.</p> <p> </p> <p>(Examine the cause of the faulty axis.)</p>	<p>1) Harmonic drive damage.</p> <p>2) Encoder waveform error.</p> <p>3) Brake fault. (Shoulder and/or elbow axis only)</p> <p>4) Timing belt tension inappropriate. (Sholder, elbow and/or wrist pitch axis only)</p> <p>5) Motor burn-out</p> <p>6) Loose screws in the drive transmission area. Disassemble, check, and re-tighten the screws.</p>	<p>Change the harmonic drive.</p> <p>Change the motor.</p> <p>Check whether the brake is applied and released. Adjust the gap to 0.1mm. See the MAINTENANCE AND INSPECTION section.</p> <p>Adjust the timing belt tension. See the MAINTENANCE AND INSPECTION section.</p> <p>Change the motor. See the MAINTENANCE AND INSPECTION section.</p>

10. LOOSENESS PRODUCED WHEN ROBOT IS STOPPED WHILE POWER IS ON.

No.	Trouble	Cause	Remedy
	<p>Looseness is produced when the robot is stopped while power is on. (Examine the cause of faulty axis.)</p>	<p>1) Harmonic drive wear.</p>	<p>Change the harmonic drive.</p>
<p>2) Timing belt tension insufficient. (Shoulder, elbow and/or wrist pitch axis only)</p>		<p>Adjust the timing belt tension. See the MAINTENANCE AND INSPECTION section.</p>	
<p>3) Loose screws in the drive transmission area.</p>		<p>Disassemble, check, and re-tighten the screws.</p>	
<p>4) Servo gain voltage low.</p>		<p>Adjust the servo gain voltage. See Information 5.</p>	

11. ROBOT VIBRATES WHEN STOPPED WHILE POWER IS ON.

No.	Trouble	Cause	Remedy
	<p>The robot vibrates when it is stopped while power is on.</p>	<p>1) Servo gain voltage high.</p>	<p>Adjust the servo gain voltage. See Information 5.</p>
		<p>2) Fault of the power transistor 2SD1297 (2SD1296) on the heat sink. *This applies to the case where the robot vibrates violently as at power on.</p>	<p>Change the transistor. See Information 2.</p>

12. ERROR MODE I OCCURS DURING ORIGIN SETTING.

No.	Trouble	Cause	Remedy
	<p>Jog operation from the teaching box is performed without fault, but error mode I (excessive error; LED-1 lit) occurs during nesting.</p>	<p>1) Limit switch damage.</p>	<p>Check and change the limit switch.</p>
<p>2) Limit switch and dog positions inappropriate.</p>		<p>Adjust the limit switch and dog positions.</p>	
<p>3) Connector contact fault</p>		<p>Check the drive unit-robot cable connectors.</p>	
<p>4) Limit switch signal cable fault.</p>		<p>Check the cable for continuity. Check the connectors in the robot. See Information 4.</p>	

13. ORIGIN SETTING CANNOT BE COMPLETED.

No.	Trouble	Cause	Remedy
	<p>Jog operation from the teaching box is performed without fault, but nesting is repeated and cannot be completed.</p>	<p>1) Encoder fault.</p>	<p>Change the motor.</p>
<p>2) Limit switch and encoder phase Z positions inappropriate.</p>		<p>Shift the limit switch ON/OFF position.</p>	
<p>3) Encoder signal cable fault.</p>		<p>Check the cable for continuity. See Information 4.</p>	
<p>4) Connector contact fault</p>		<p>Check the drive unit-robot cable connectors.</p>	

14. ERROR MODE I OCCURS DURING AUTOMATIC OPERATION.

No.	Trouble	Cause	Remedy
	Nesting from the teaching box is performed without fault, but error mode I (excessive error; LED-1 lit) occurs during automatic operation.	1) Encoder signal cable fault.	Check the cable for continuity. See Information 4.
2) Encoder fault.		Change the motor.	
3) Connector contact fault.		Check the drive unit-robot cable connectors.	
4) Motor power cable fault.		Check the cable for continuity.	
5) Motor burn-out (demagnetized).		Change the motor.	
6) Harmonic drive damage.		Change the harmonic drive.	
7) Weight capacity exceeded.		Reduce the load.	

15. ERROR MODE I OCCURS AFTER AUTOMATIC OPERATION IS STARTED.

No.	Trouble	Cause	Remedy
	Error mode I occurs after automatic operation is started.	1) Programming error.	Check and correct the program.
		2) Inoperable area specified.	Check and correct the program.



16. POSITION SHIFTED BY ORIGIN SETTING.

No.	Trouble	Cause	Remedy
	Position is shifted by origin setting.	1) Encoder fault.	Change the motor.
2) Limit switch and encoder phase Z positions in appropriate.		Check and readjust the limit pulse. See Information 7.	
3) Loose screws in the limit switch and dog.		Check the limit switch and dog. Retighten the screws.	

17. POSITION SHIFTED DURING AUTOMATIC OPERATION.

No.	Trouble	Cause	Remedy
	Position is shifted during automatic operation.	1) Noise.	Remove the source of noise. Ground securely.
2) Robot installation bolts loose.		Securely fix the robot.	
3) Primary (input) line voltage variations.		Stabilize the primary line voltage.	
4) Encoder fault.		Change the motor.	
5) Encoder signal cable fault.		Check the cable for continuity. See Information 4.	
6) Timing belt tension insufficient. (Shoulder, elbow and/or wrist pitch axis only)		Adjust the timing belt tension.	
7) Loose screws in the drive transmission area.		Retighten the screws.	

18. DC HAND UNABLE TO OPEN/CLOSE.

No.	Trouble	Cause	Remedy
	<p>The DC hand is unable to open and close.</p> <p>◦ Hold down the hand opening/closing key  /  on the teaching box and measure the voltage of the robot forearm hand connector.</p> <p>(1) Examine causes 1) to 3) when repeating + 24V and - 24V.</p> <p>(2) Examine causes 4) to 8) if the voltage is not developed or $\pm 24V$ is only developed.</p>	<p>1) Hand curl cable open.</p> <p>2) Hand opening/closing drive fault.</p> <p>3) Hand motor fault.</p> <p>4) Open hand cable in the robot.</p> <p>5) Fault of the hand motor driver direction switching transistor 2SB791, 2SD970 (mother card).</p> <p>6) Hand output transistor 2SD1297 (2SD1296) fault (heat sink).</p> <p>7) IC TL094 fault (mother card).</p> <p>8) AC/DC select switch in incorrect position.</p>	<p>Check the cable for continuity. Change the cable if it is open.</p> <p>Remove the hand cover and hand-turn the timing pulley to check whether it rotates smoothly. The hand must be changed if it does not turn smoothly (service life expired-unreparable).</p> <p>Remove the hand cover and disconnect the timing belt. In this state, connect to the robot and open/close the hand. Change the motor if it does not rotate.</p> <p>Check the hand cable for continuity. See Information 4.</p> <p>See Information 3.</p> <p>See Information 2.</p> <p>See Information 1. Change the IC.</p> <p>Check the setting at the drive unit rear part.</p>

19. AC HAND UNABLE TO OPEN/CLOSE.

No.	Trouble	Cause	Remedy
	The AC hand cannot be opened and closed.	1) AC/DC select switch in incorrect position.	Check the setting at the drive unit rear part.
2) Hand fuse blown (mother card).		Check and change the fuse. See Information 1.	

20. EXTERNAL INPUT DISABLED.

No.	Trouble	Cause	Remedy
	External input is disabled.	1) Wrong connection for external input.	See APP-14 to APP-28 in the Instruction Manual and check the connection.
2) Programming error.		Check and correct the program.	
3) External I/O connector contact fault.		Check the external I/O connector at the drive unit rear part.	
4) IC M54563P fault. (I/O card IC 1D)		Change the IC. See Information 1.	
5) Specifications		Check APP-14 to APP-28 in the Instruction Manual.	

21. EXTERNAL OUTPUT DISABLED.

No.	Trouble	Cause	Remedy
	External output is disabled.	1) Wrong connection for external output.	See APP-14 to APP-28 in the Instruction Manual and check the connection.
2) Programming error.		Check and correct the program.	
3) External I/O connector contact fault.		Check the external I/O connector at the drive unit rear part.	
4) IC M54563P fault. (I/O card 1A, 1B, 1C)		Change the IC. See Information 1.	
5) Fault of capacitor (C24, C25) on the I/O card.		Change the capacitor C24, C25 0.1 μ F. See Information 1.	
6) Specifications		Check APP-14 to APP-28 in the Instruction Manual.	

22. ROM DATA TRANSFER DISABLED.

No.	Trouble	Cause	Remedy
	ROM data cannot be transferred. Automatic operation cannot be performed.	1) ROM installation fault.	Check the direction of user ROM installation. Check for pin breakage and bend.
2) ROM data error due to ROM fault during storage.		Check the ROM storage status.	
3) Setting error in drive unit mode or personal computer mode.		See page 2-37 in the Instruction Manual.	
4) Robot is in external signal operation mode.		See page 2-39 in the Instruction Manual.	

23. DATA WRITE TO ROM DISABLED.

No.	Trouble	Cause	Remedy
	Data cannot be written to ROM.	1) ROM installation fault.	Check the direction of user ROM installation. Check for pin breakage and bend.
		2) ROM not yet erased.	Use the ROM after it is erased by ultraviolet ray.
		3) Different ROM used.	Use M27256K.
		4) ROM write voltage error.	See Information 6.

24. NO COMMUNICATION VIA CENTRONICS INTERFACE.

No.	Trouble	Cause	Remedy
	Communication cannot be made via the Centronics interface.	1) Wrong setting.	See APP-1 to APP-4 in the Instruction Manual.
2) Wrong cable used.		See APP-1 to APP-4 in the Instruction Manual.	
3) Connector contact fault.		Check the drive unit-personal computer cable connectors.	

25. NO COMMUNICATION VIA RS-232C INTERFACE.

No.	Trouble	Cause	Remedy
	Communication cannot be made via the RS-232C interface.	1) Wrong setting.	See APP-5 to APP-13 in the Instruction Manual.
2) Wrong cable used.		See APP-5 to APP-13 in the Instruction Manual.	
3) Connector contact fault.		Check the drive unit-personal computer cable connectors.	

26. COMMUNICATION DISABLED VIA PERSONAL COMPUTER INTERFACE.

No.	Trouble	Cause	Remedy
	<p>Communication being made via the personal computer interface was disabled after automatic operation was started.</p>	<p>1) The reset switch was not pressed after stopping automatic operation.</p>	<p>Press the reset switch.</p>
		<p>2) Personal computer mode, drive unit mode setting error.</p>	<p>Set to personal computer mode.</p>
		<p>3) The teaching box is on.</p>	<p>Switch off the teaching box.</p>

27. POSITION SETTING DISABLED.

No.	Trouble	Cause	Remedy
	Position cannot be set.	1) Any of the robot axes is located near its operation limit.	Move the corresponding axis away from the limit.
		2) The reference position in the cartesian coordinate system is not as specified in APP-29 of the Instruction Manual.	Set the robot to the reference position in APP-29.
		3) Origin setting (nesting) is not yet executed.	Execute origin setting.

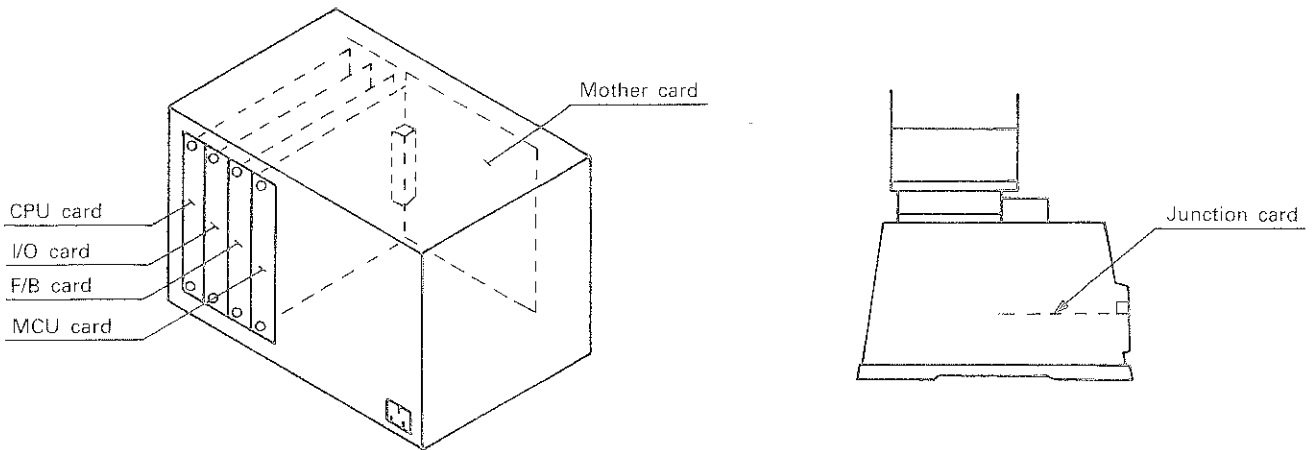
28. DATA NOT BATTERY BACKED.

No.	Trouble	Cause	Remedy
	Data cannot be battery backed. Data is cleared when the power is switched off.	1) The battery is not present.	Open the drive unit side door and check whether the battery is on the drive unit.
2) Battery connector contact fault.		Check the battery connector.	
3) Battery expired.		Change the battery.	
4) Setting error.		See pages 2-10 and 2-11 in the Instruction Manual.	

29. INFORMATION 1

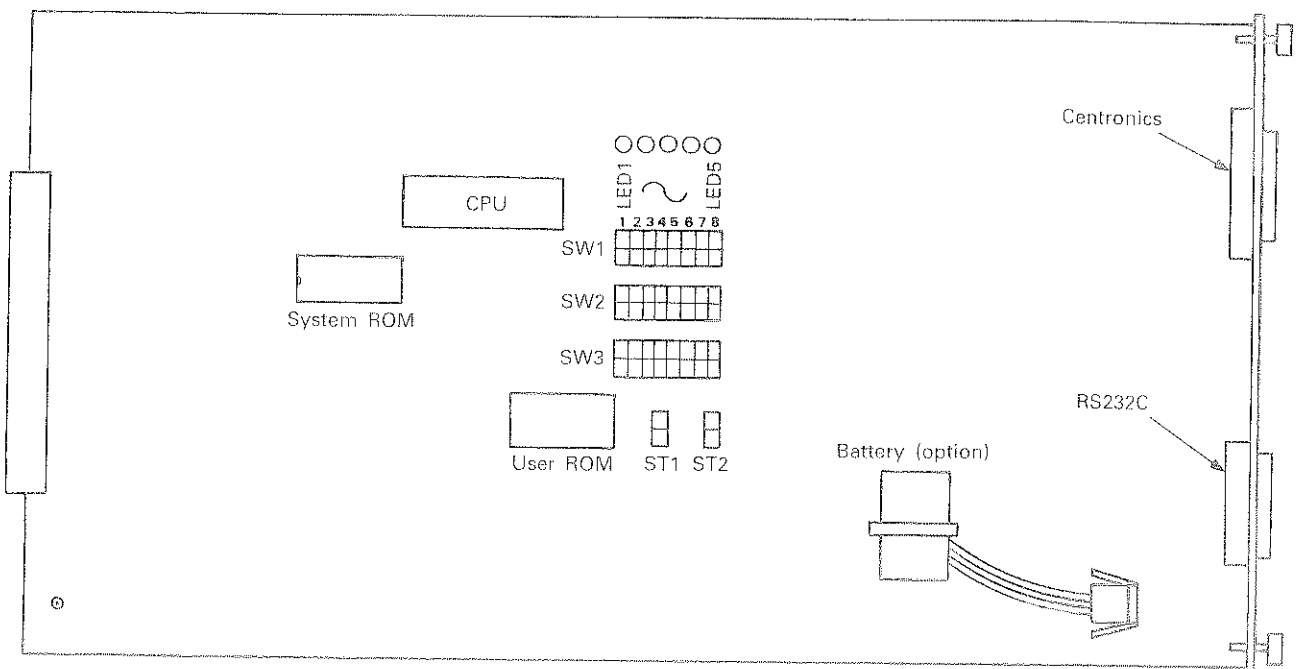
Card Layout Diagram and Card Schematics

1. Card Layout Diagram

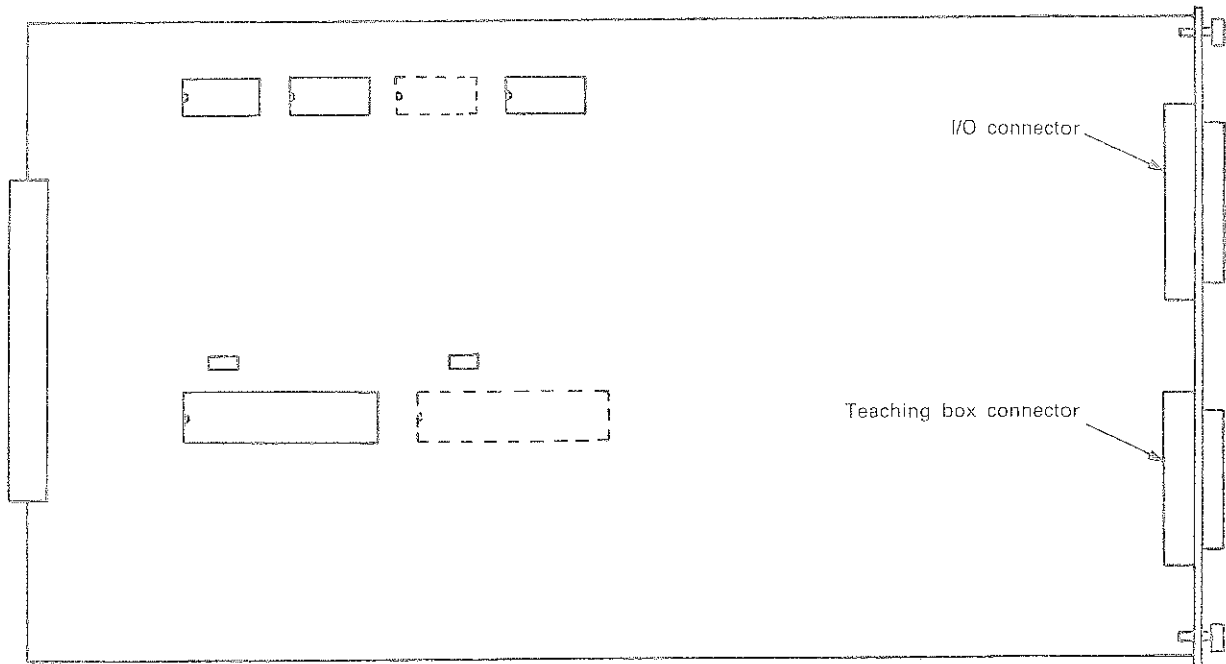



2. Card Schematics

2.1 CPU card

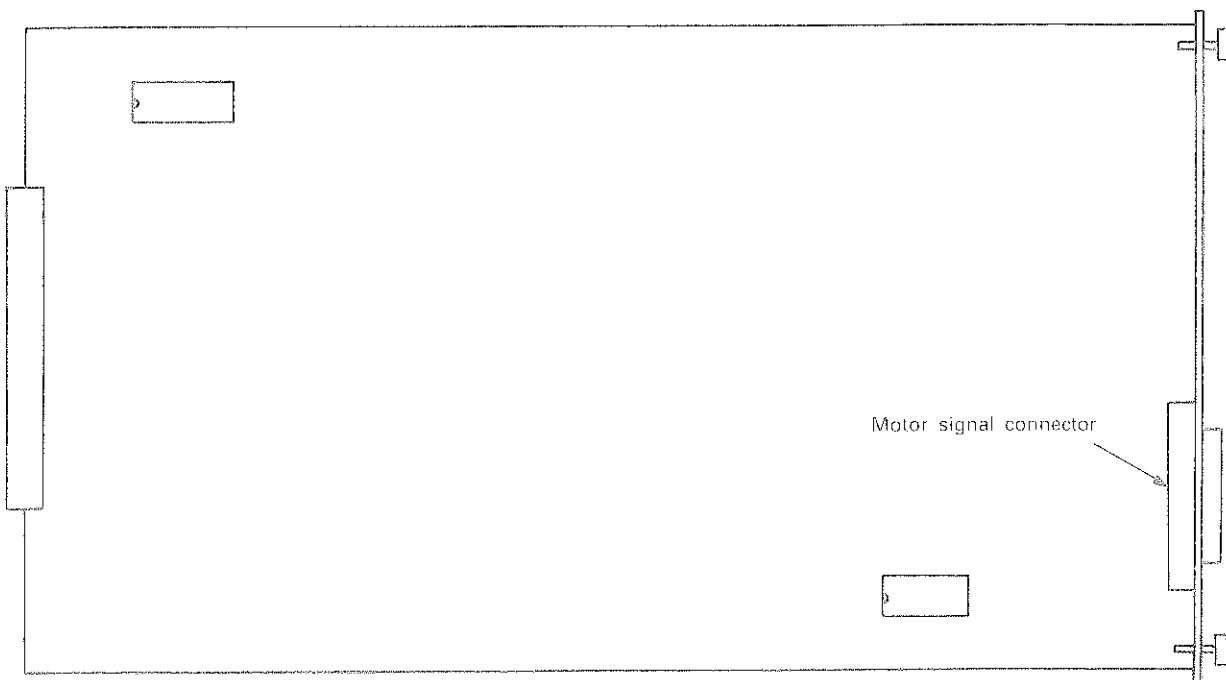


2.2 I/O card

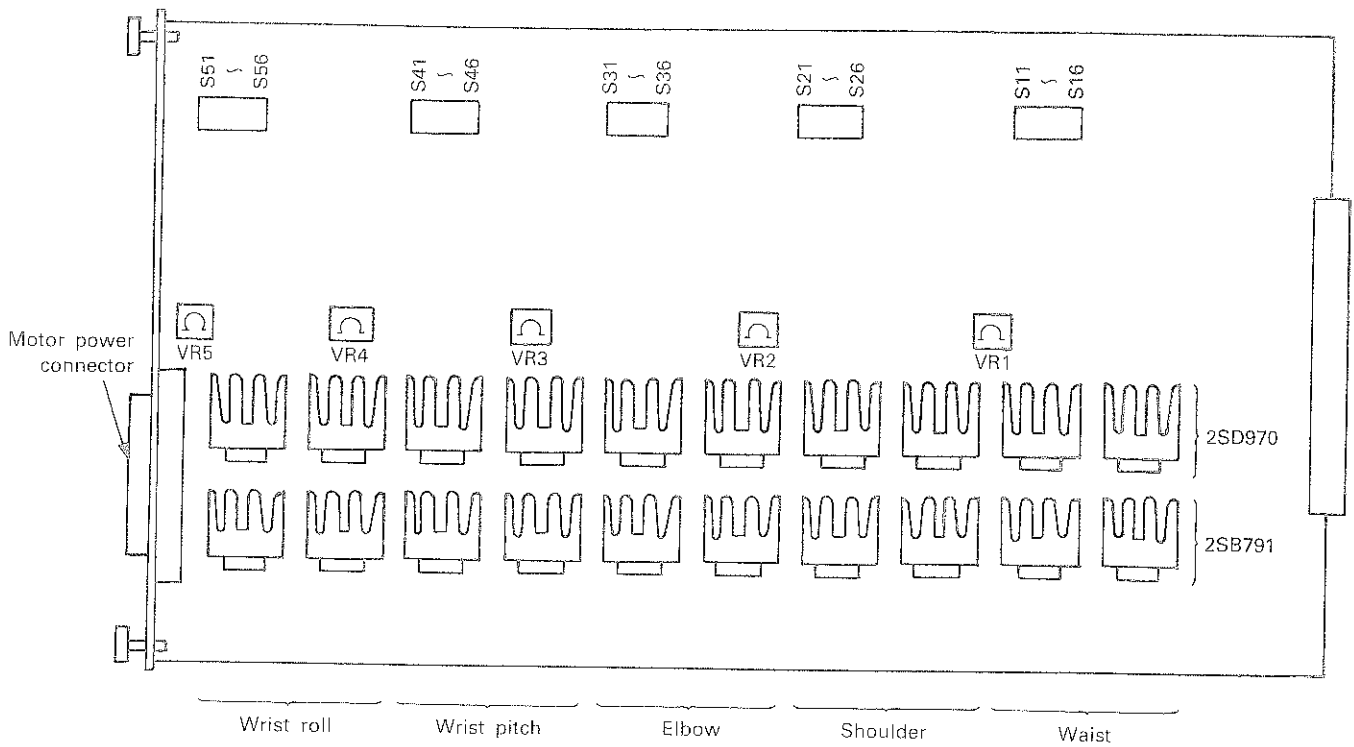


*The ICs marked  do not exist on the 8-point card.

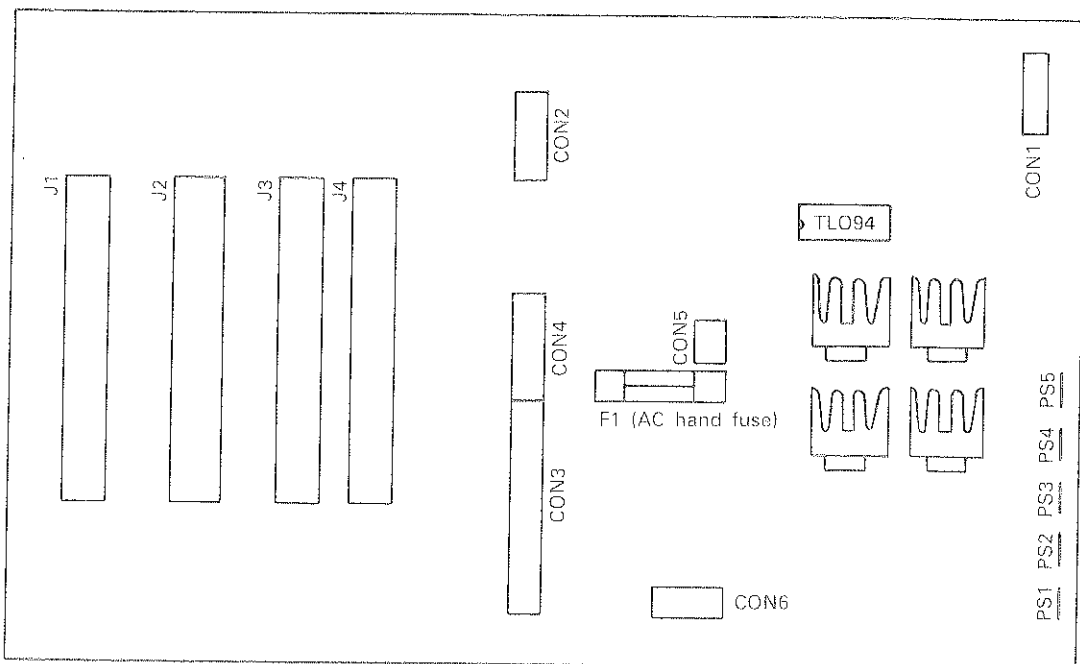
2.3 F/B card



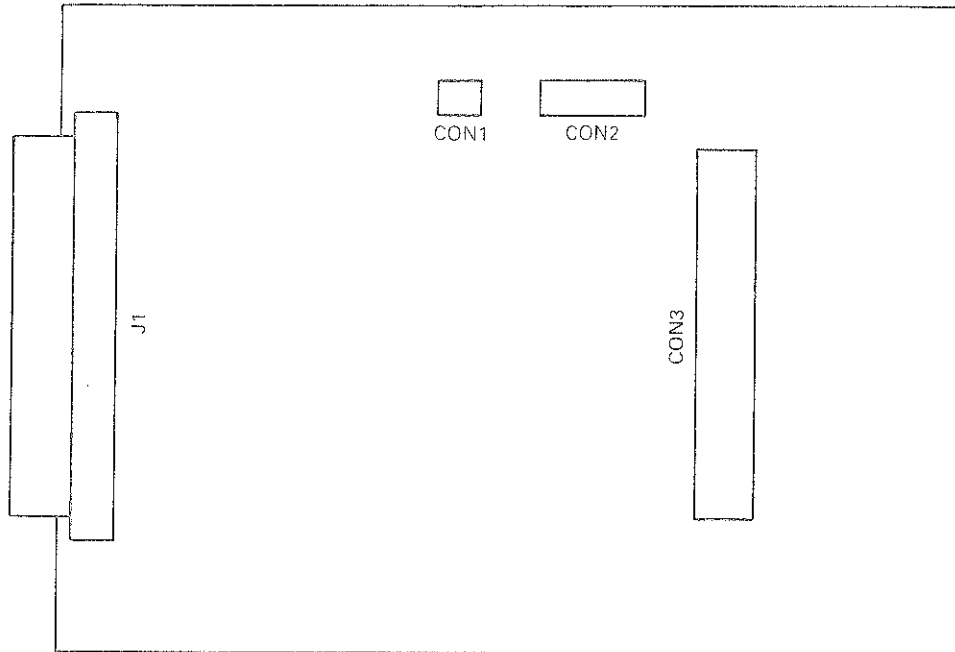
2.4 MCU card



2.5 Mother card



2.6 Junction card



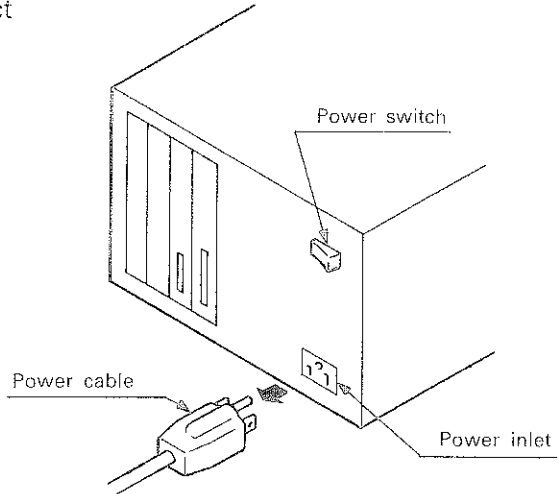
3. Card Functions

Card	Description	Loading Position	Function	Remarks
RM01	CPU card	Drive unit 1	Main CPU card having the personal computer interface, memory and ROM writer functions.	
RM03 RM103 RM13 RM113	I/O card	Drive unit 2	I/O interface card having user available I/O and teaching box interface functions.	Japan: 8 I/O points 16 I/O points Foreign countries: 8 I/O points 16 I/O points
RM06	Feedback card	Drive unit 3	Card for processing encoder feedback signal.	
RM10	Mother card	Within drive unit	Mother card for each drive unit card. Has the hand amplifier circuit and control voltage stabilizing circuit.	
RM18	Junction card	Within robot base	Junction card for encoder and limit switch signals.	
RM31	MCU card	Drive unit 4	Motor output amplifier card	

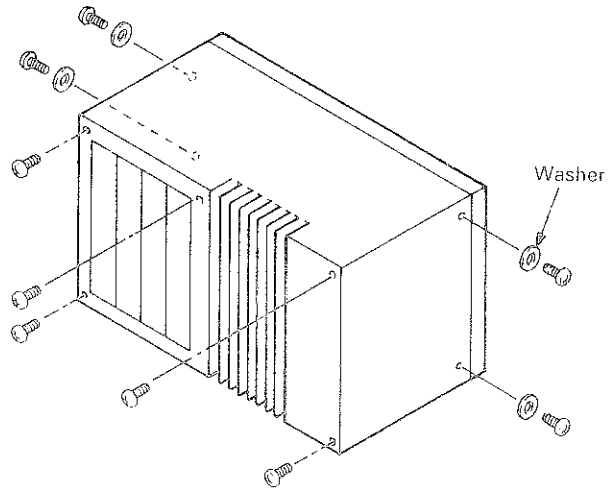
30. INFORMATION 2

Checking the Power Transistor 2SD1297 (2SD1296) on the Heat Sink

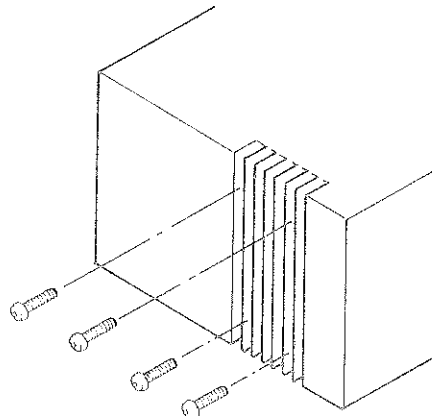
- Measure the transistor impedances.
 - (1) Turn off the power switch and disconnect the power cable from the power inlet.



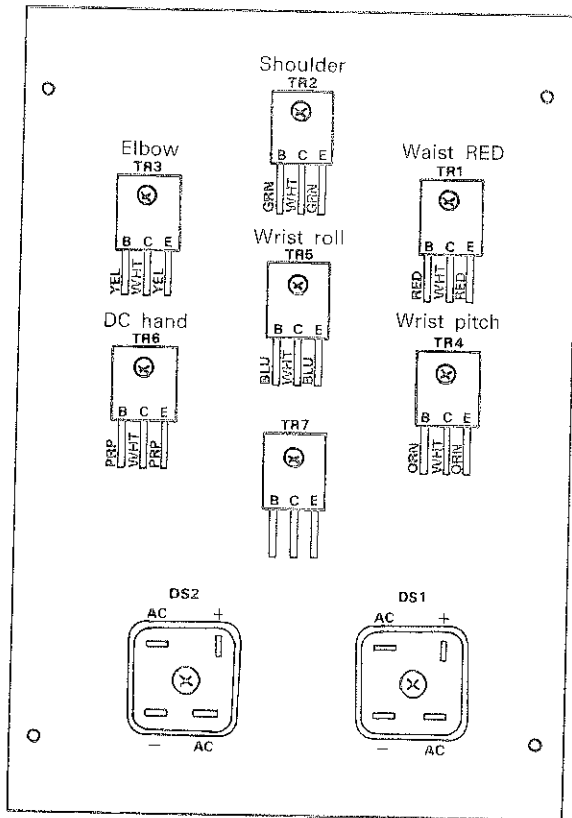
- (2) Remove the cover from the drive unit (nine screws).



- (3) Unscrew the heat sink installation screws and remove the heat sink (four screws).



(4) Measure impedances across B and C, C and E, and B and E of each transistor.



- TR1 Waist
- TR2 Shoulder
- TR3 Elbow
- TR4 Wrist pitch
- TR5 Wrist roll
- TR6 DC hand

	2SD1296	2SD1297
Across B and C:	∞	∞
Across C and E:	Approx. 5k Ω	Approx. 5k Ω
Across B and E:	Approx. 1k Ω	Approx. 1k Ω



Test terminals (multimeter range $\times 1000$)

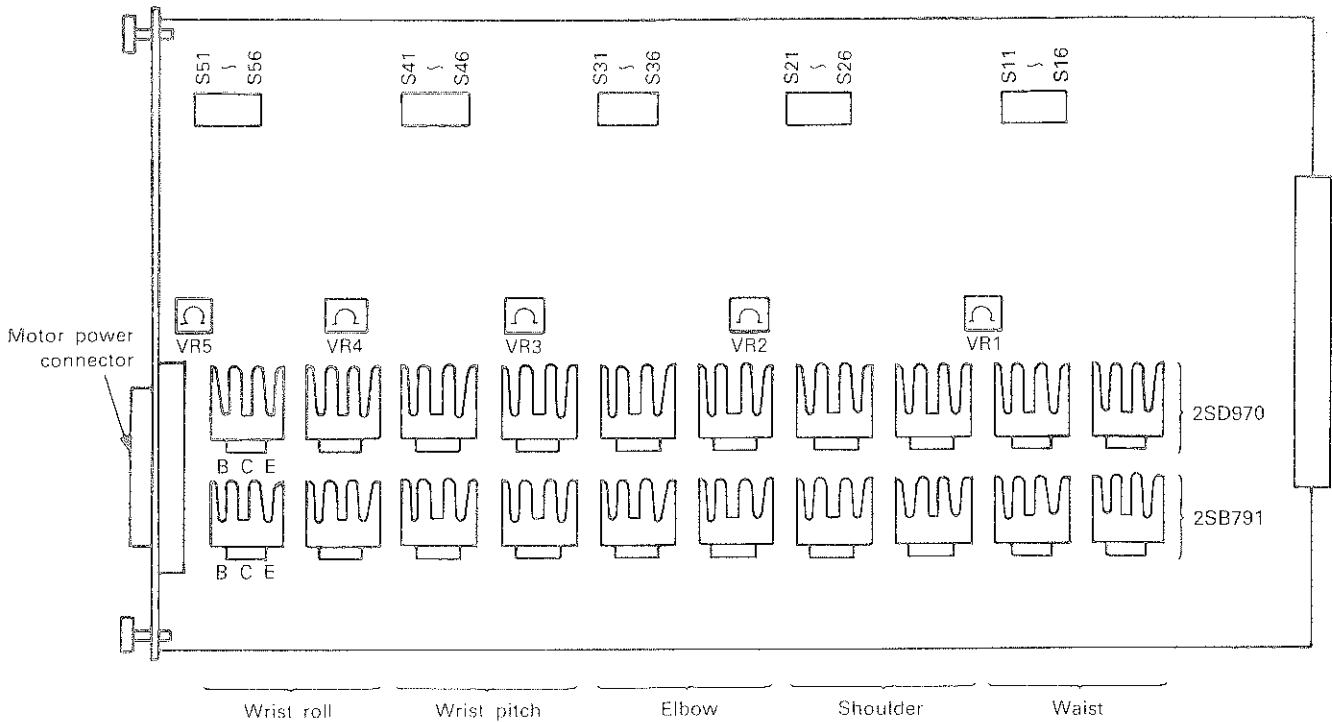
(5) Change the corresponding transistor if any impedance is not as specified above.

31. INFORMATION 3


Checking the Motor Drive Direction Switching Transistors 2SB791 and 2SD970

● Measure the transistor impedances.

(1) Unload the MCU card. (Waist, shoulder, elbow, wrist roll, wrist pitch)



(2) Measure impedances across B and C, C and E, and B and E of each transistor using a multimeter.

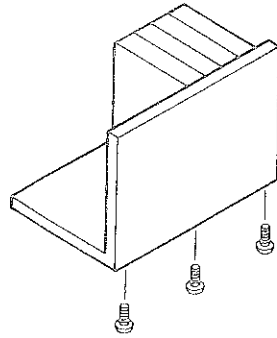
	2SB791	2SD970
Across B and C	Approx. 7kΩ	∞
Across C and E	∞	Approx. 6kΩ
Across B and E	Approx. 4kΩ	Approx. 3kΩ
 Multimeter terminals × 1000 range		

Symbols B, C and E are printed in the card.

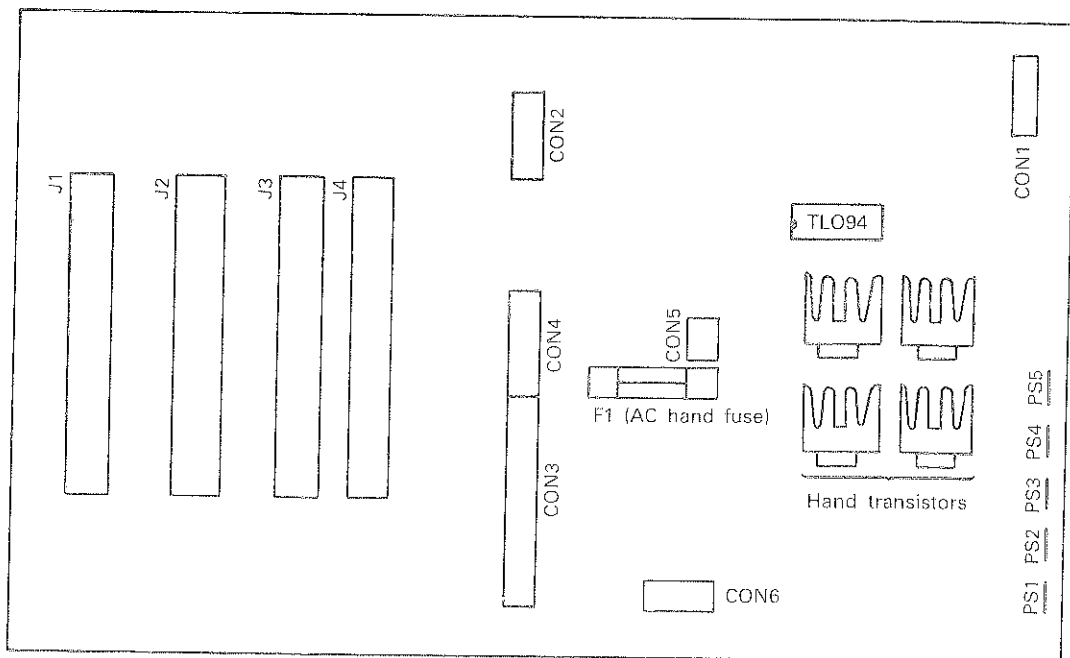
(3) Change the corresponding transistor if any impedance is not as specified in (2).

(4) Check the mother card (hand switching transistors).

- 1) Remove the drive unit cover. See Information 2.
- 2) Remove the front panel (three screws).



(5) Measure the impedances of transistors 2SB791 and 2SD970.



(6) Change the corresponding transistor if any impedance is not as specified in (2).

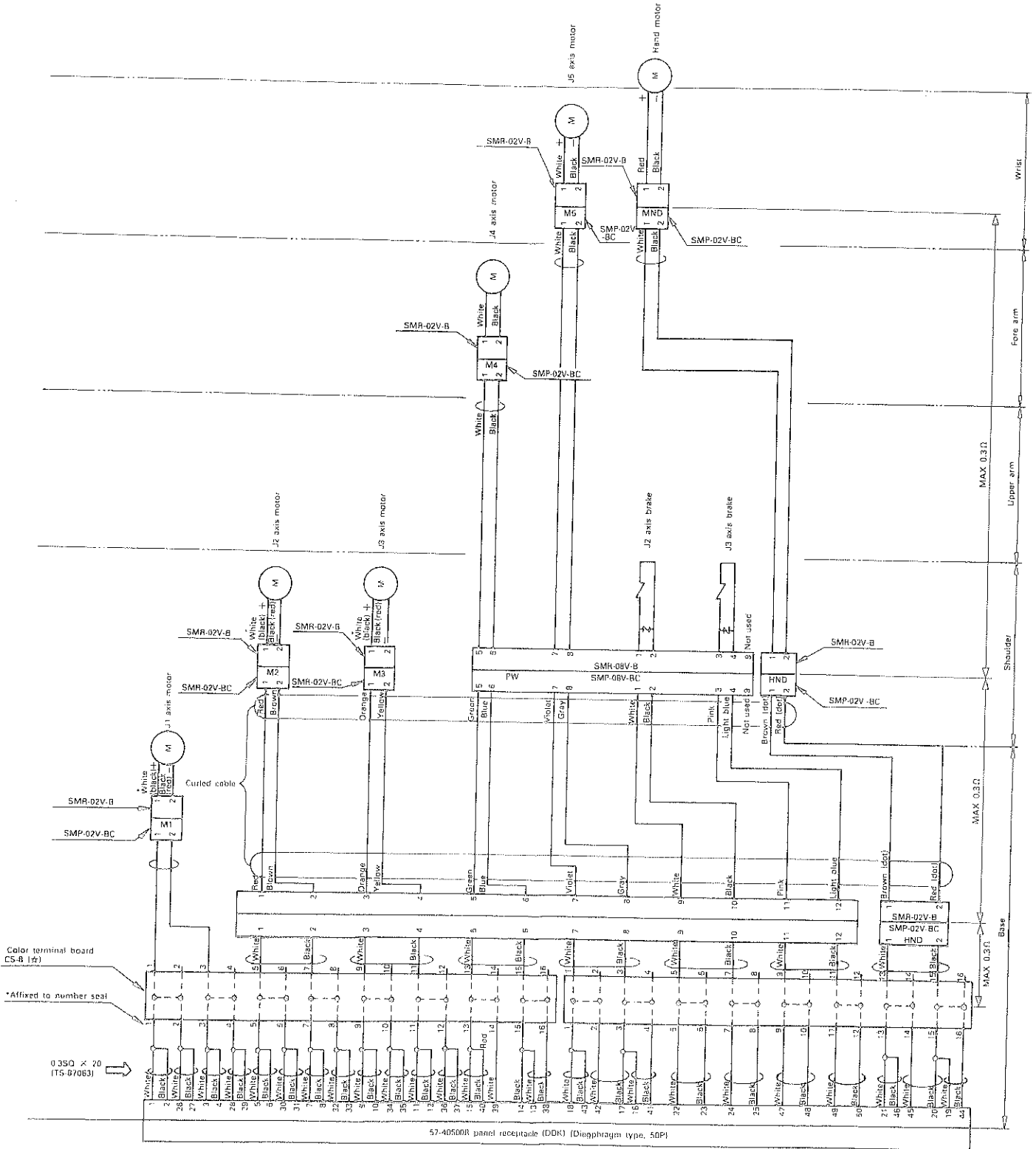
32. INFORMATION 4

Checking the Cable in the Robot for Continuity

1. Measure impedances across the cable connectors in the robot. See the next page.
 - (1) Encoder signal cable fault Measure the motor signal circuit impedance.
 - (2) Limit switch cable fault Measure the motor signal circuit impedance.
 - (3) Motor power cable wire breakage Measure the motor power circuit impedance.
 - (4) Brake fault Measure the motor power circuit impedance.
 - (5) Hand cable fault Measure the motor power circuit impedance.

2. Wire breakage may have occurred in the corresponding cable if any measured value exceeds its impedance shown in the wiring diagram on the next page. In this case, change the cable.

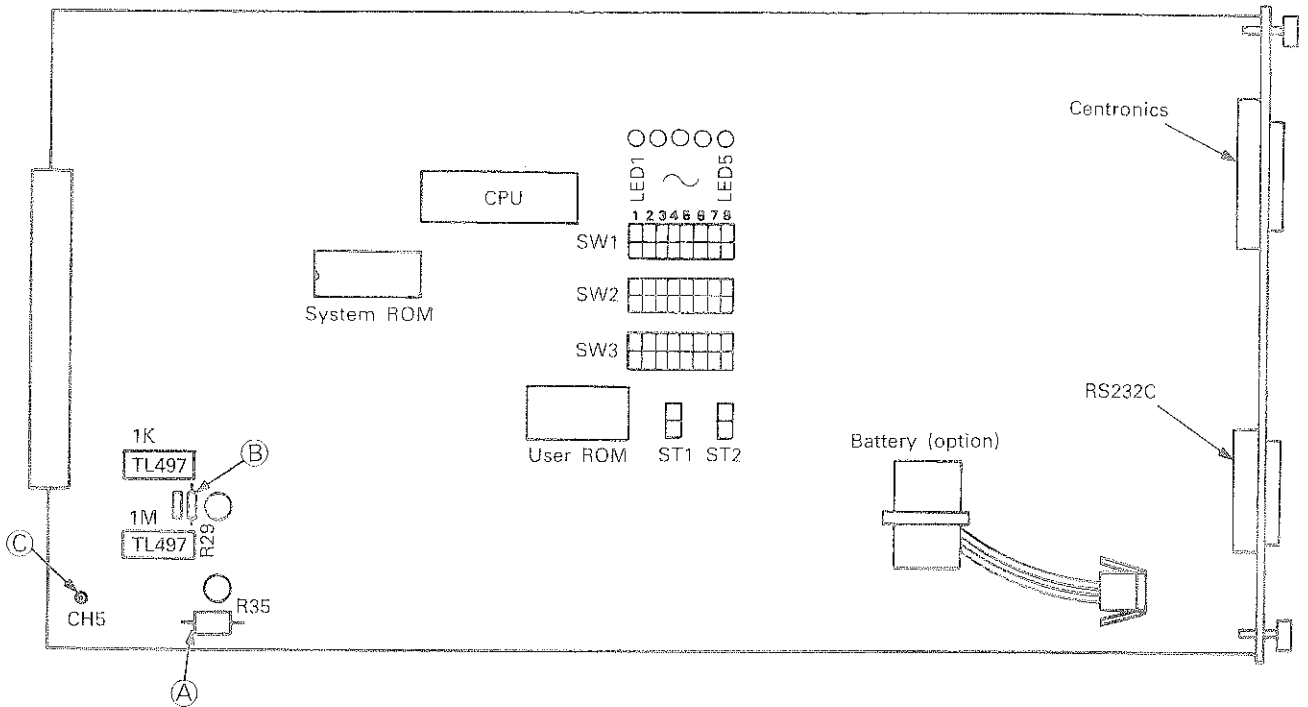
Motor Power Circuit



34. INFORMATION 6

Checking the ROM Write Voltage

1. If data cannot be written to ROM, check the write voltage.
 - (1) Switch power off and disconnect the power cable.
 - (2) Open the drive unit cover.
 - (3) Switch power on and measure the voltage. 6V DC, 12.5V DC on the CPU card



CPU card

- Ⓐ R35 left 6V DC
- Ⓑ R24 top 12.5V DC
- Ⓒ CH5 GND

(4)

Measuring Point	Write Voltage Range	Outside Write Voltage Range
Across Ⓐ and Ⓒ	6V DC $\pm 0.5V$	Change the IC 1M TL497.
Across Ⓑ and Ⓒ	12.5V DC $\pm 0.5V$	Change the IC 1K TL497.

35. INFORMATION 7

Checking the Limit Pulses

After origin setting, check the limit pulses (the number of pulses generated between the limit switch off and the first phase Z detected) by the teaching box.

1. Press the following teaching box keys:



2. Criteria

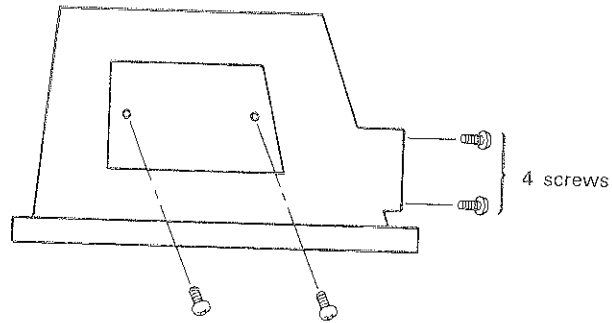
Parameter	Axis	Number of Pulses per Motor Rotation	Display Range	Standard Value	Adjustment
1	Waist	200	0 to 199	30 to 170	Adjust the limit switch installation position.
2	Shoulder	200	0 to 199	30 to 170	Reduce the timing belt tension to skip teeth.
3	Elbow	200	0 to 95	30 to 170	Reduce the timing belt tension to skip teeth.
4	Wrist pitch	96	0 to 95	20 to 75	Reduce the timing belt tension to skip teeth.
5	Wrist roll	96	0 to 95	20 to 75	Adjust the limit switch installation position.

- (1) The number of pulses displayed must be within the standard value range.
- (2) Adjustment must be made to keep the number of pulses displayed within the standard range. If the number of pulses indicated is outside the standard range, the position may shift by the length equivalent to one motor rotation during origin setting.

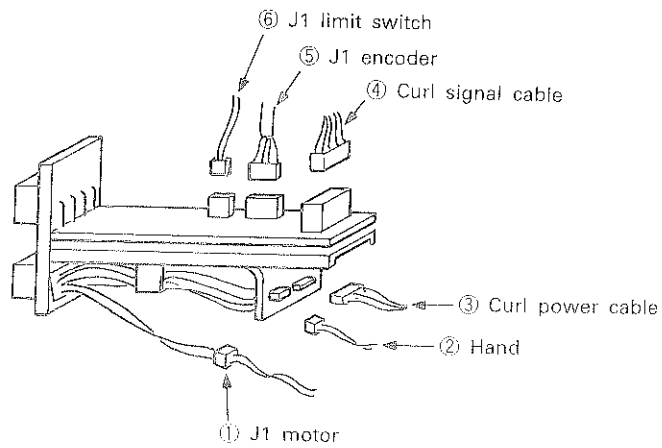
36. INFORMATION 8

Removing the Junction Card

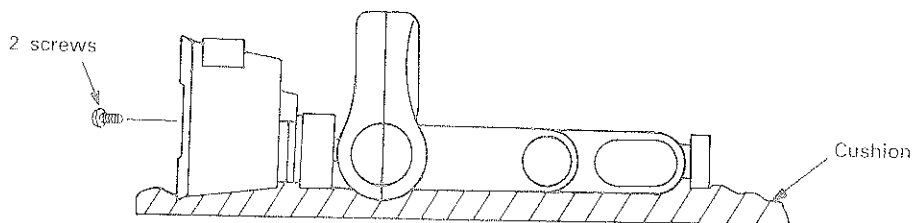
1. Remove the two base covers and junction card installation screws.



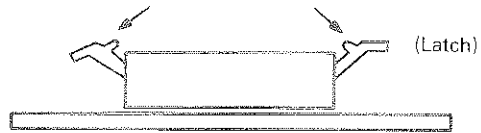
2. Disconnect six junction card connectors using long-nose pliers.



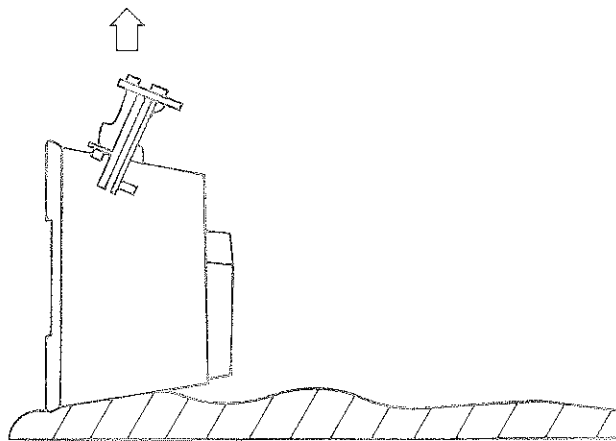
3. Place a cushion and slowly tilt the robot forward. Remove the base bottom cover.



4. Reach from the base bottom for the curl signal cable connector on the junction card and push the latches open.



5. Slowly pull out the opened latches.





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