NIDEK

CO_2 SURGICAL LASER

COL-1040

SERVICE MANUAL

NIDEK CO., LTD.

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* Specifications are subject to change without notice for improvement.

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§1 SAFETY

1.1 Introduction

This service manual contains service instructions for the NIDEK CO_2 SURGICAL LASER, COL-1040.

For correct service, thorough understanding of the contents of this manual is required prior to the service.

The specifications and design of this instrument are subject to change without notice for improvement. In the case of major changes, refer to the corresponding TECHNICAL BULLETIN issued on each occasion.

If the instrument cannot be repaired by the repaire operations in accordance with this Servece Manual, please inform NIDEK of the Serial Number of the instrument, and details of the symptom.

* This manual is for the 5-digit Serial Number model (CC-1A). For the 7-digit Serial Number model (CC-1), refer to the COL-1040 Service Manual: JHX005B.

1.2 Precautions in Using the Manual

1. This manual is intended for personnel that have been trained by NIDEK or NIDEK Inc. and have familiarity with the instrument. Other persons should not perform the maintenance.

2. This manual does not include information as to the operation of the instrument.
   Read the Operator's Manual thoroughly before you use this manual.

3. The contents of this manual are subject to change without notice for improvement of the instrument. Check the latest information according to your need.

1.3 Maintenance Precautions

Precautions in the maintenance are listed below.
The COL-1040 emits high-power CO_2 laser. Therefore service personnel are always exposed to serious danger such as burns.
In addition, the power source of the laser is high-voltage, and there is also the possibility of electric shock that may lead to death.
Items of high importance appear at the appropriate points in the manual to make service personnel heedful. Do not miss them.

1. Perform the maintenance in accordance with the manual, following the correct procedures.
   Negligence in following the instructions in this manual may cause unexpected and incidental accidents.

2. When performing the maintenance work, disconnect the power cord from the wall outlet unless the power needs to be ON.
   The maintenance work with bare hands with the power ON involves danger of damaging the parts and electric shock.

3. If the instrument malfunctions, check the symptom, and turn OFF the instrument immediately.
   Leaving the power ON may make the problem worse.

4. Perform the conduction check and voltage measurement described in "§3 TROUBLEHOOTING" refering to "WIRING DIAGRAM".
   Turn the power OFF for the conduction check. Turn the power ON for the voltage measurement.

5. Prepare containers for removed screws and parts not to lose them or drop them inside the instrument.
   For reassemblage and avoidance of mixing and loss of screws and parts, it is convenient to screw the removed screws loosely where they were fixed or put them in proper bags and stick them near the place they were fixed without obstructing the work.

6. Be careful not to pinch the cables when fixing the cover after the maintenance.

7. In some areas, regulations oblige service personnel to put safety shoes on when carrying heavy objects and to wear gloves in fear of electric shock or injury. Abide by those regulations.

8. The primary connections of the transformers differ according to the input voltage (AC100V, 115V, 200V, 215V, or 230V). Check it before the work. Incorrect connections may cause damage to and malfunction of the instrument.

9. The main fuse varies according to the systems: 100V system (including 115V), 200V system (including 215V), and 230V system. Be careful when you replace the parts or move the instrument to areas where the voltage differs.

10. The reflective mirrors on the optical rail and the articulated arm consist of precisely adjusted parts. Therefore they are susceptible to damage from impacts. Handle them with care during the service.

11. The CO_2 laser is an invisible light laser with wavelength of 10.6µm.
    While the instrument operates, all the persons in the room need to protect their eyes with laser goggles or the equivalent of them.

12. Do not let the CO_2 laser or the diode laser for the aiming (including the reflections of them) beam into your eyes.
    If you do, even laser goggles may not protect your eyes.

13. The HVPS is a power source used to oscillate the CO_2 laser, and generates high voltage enough to kill a person. Even when the power is OFF, high voltage may be in the condensers and connectors. Handle it with care.

§2 OVERVIEW OF THE INSTRUMENT

2.1 Introduction

The instrument emits two types of coaxial laser beams to affected parts of patients.

Visible low-power diode laser ..... for aiming
Invisible high-power CO_2 laser ..... for sugical operations

The instrument consists of the following six main systems:

Control panel
Laser optical system
Articulated arm
Cooling system
Power Supply
Scanner.

2.2 Control Panel

The control panel controls the entire instrument, and provides the operator with various information (CO_2 laser output, emission time, modes, and others) during the operation.
The control panel is positioned on the top of the instrument. It is designed to move front and back, and turn left and right so that the operators can look at it wherever they stand.
Concerning the switches on the panel, and displays, refer to the Operator's Manual.

2.3 Laser Optical System

The laser optical system sends two types of coaxial laser beams to the articulated arm and the handpiece.
This system consists of the following optical components, and incorporates the mechanism that adjusts the output and direction of the laser beams.

- Aiming beam
- Aiming beam reflective mirrors
- Aiming beam attenuator
- CO_2 laser tube
- CO_2 laser reflective mirror
- Shutter unit
- Power meter
- Beam combiner

The CO_2 laser tube is complex and fragile, and requires careful handling.
The tube is a triple-fold glass tube. The central and the outermost tubes are filled with CO_2 gas, and the in-between one with cooling liquid.

The laser oscillation happens in the central tube.
Both ends of the laser tube are connected to the power supply and the cooling system.
Mirrors are set at both ends of the tube. They are precisely adjusted to be vertical to the center of the tube and parallel with each other.
The output of the CO_2 laser reduces 10-20% in the course from the tube to the handpiece.

2.4 Articulated Arm

The articulated arm incorporates mirrors that carry two types of coaxial lasers beam to the tip of the arm.
The handpiece that is at the end of the arm, through the condensing lens inside, supplies the laser beam with a specific diameter to affected areas.

2.5 Cooling System

The cooling system radiates the heat that generates in the CO_2 laser tube.
This system consists of a pump, a reservoir, a radiator, a radiator fan, a temperature sensor, and a flow sensor.
If the cooling system malfunctions, stop the laser emission immediately. An error message should be displayed on the control panel.

2.6 Power Supply

The power source consists of the LVPS (Low Voltage Power Supply) for system operation and the HVPS (High Voltage Power Supply) for the CO_2 laser.

2.7 Scanner

By scanning of the laser beam, the scanner forms beam patterns of various shapes and sizes on affected areas.
This system consists of a scanner head, a scanner control box, and a display for the scanner.
The scanner is not necessarily come with the instrument.

§3 TROUBLESHOOTING

Connect the power cord to the main body and the wall outlet.
Connect the footswitch and the short plug (remote interlock connector) to the connector panel on the rear of the main body.
Turn ON the master switch on the rear of the main body.
Be sure to wear goggles before starting the operation below.

Does the power ON lamp light?

NO → See "4.1 Power ON Lamp does not Light".

YES

Turn the key switch to ON and then to START.
Does the instrument start and the display on the operation panel indicate "SYSTEM CHECK" ?
As for the starting of the instrument, see *1 on the last page of this section.

NO → See "4.2 The Pump and the Fan do not Operate".

NO → See "4.3 Though the Pump and the Fan Operate, there is no Indication on the Operation Panel".

NO → One of the following error messages is indicated:
- ADC CHECK ERR
- FLOW SWITCH ERR (☆)
- REMOTE INTLK ERR (☆)
- TEMP SWITCH ERR (☆)
- FOOT SW MISSING (☆)
- SHUTTER ERR (☆)

The messages with ☆ can be indicated also during the operation.

See "§9. ERROR MESSAGE LIST".

YES

Turn ON the air purge switch on the rear of the main body.
Does the air blow from the tip of the handpiece?

NO → See "4.4 The Air does not Blow from the Tip of the Handpiece".

YES ↓

Release the articulated arm from the holder. Manipulate the handpiece and place it on a steady table.
Then fix a tongue depressor (jig) on the handpiece about 300 mm from the tip of it.

↓

Set the aiming beam to MED, and adjust the position of the tongue depressor so that the aiming beam falls on it.
Is the aiming beam emitted from the handpiece?

NO → See "4.5 The Aiming Beam is not Emitted".

YES ↓

Turn ON the READY/STANDBY switch. When the word "READY" on the operation panel lights, on the panel, set the emission condition of the laser as follows:

Mode: CW mode/SINGLE
POWER: 10W
ON TIME: 1 sec

NO → The instrument does not show reaction when you press the switches on the operation panel. The LED, value indicator, and LCD have light failure or chips.

↓

Replace the control panel board (See 6.4.2).

Is the setting completed?
When the POWER value is changed in the "READY" state, the instrument enters the calibration mode to correct the difference between the actual power value and the displayed one. During the calibration, "CALIBRATIION" is indicated on the display, and no other operation is possible.

→ After the calibration "POWER HIGH ERR" is indicated.

↓

See "§9. ERROR MESSAGE LIST".

→ After the calibration, "POWER LOW ERR" is indicated momentarily followed by "SYSTEM CHECK ⇒ STANDBY".

↓

See "4.6 "POWER LOW ERR" is Displayed".

YES ↓

When you confirm that the aiming beam is on the center of the tongue depressor, emit the laser by pressing the footswitch.
Is the laser emitted to form a burn pattern?

NO → The laser is not emitted, nor is the error message indicated.

↓

When you disconnect the connector P107 from the BA01 board and press the footswitch, is there conduction between 2 and 6, and 5 and 8?

YES ↓ Replace the footswitch.

NO ↓ See "6.4.1 Replacing the Master Board ASSY".

YES ↓

One of the following messages is indicated:

LASER POWER ERR
FOOT SWITCH MISSING
TIMING ERR
SHUTTER ERR.

↓

See "§9. ERROR MESSAGE LIST".

Does the aiming beam on the tongue depressor coincide with the center of the burn pattern formed by the CO_2 laser?
The overlapped area of 50% or more is acceptable.

NO → See "8.1.1 Coaxial Test and Adjustment of the CO_2 Laser and the Aiming Beam".

↓

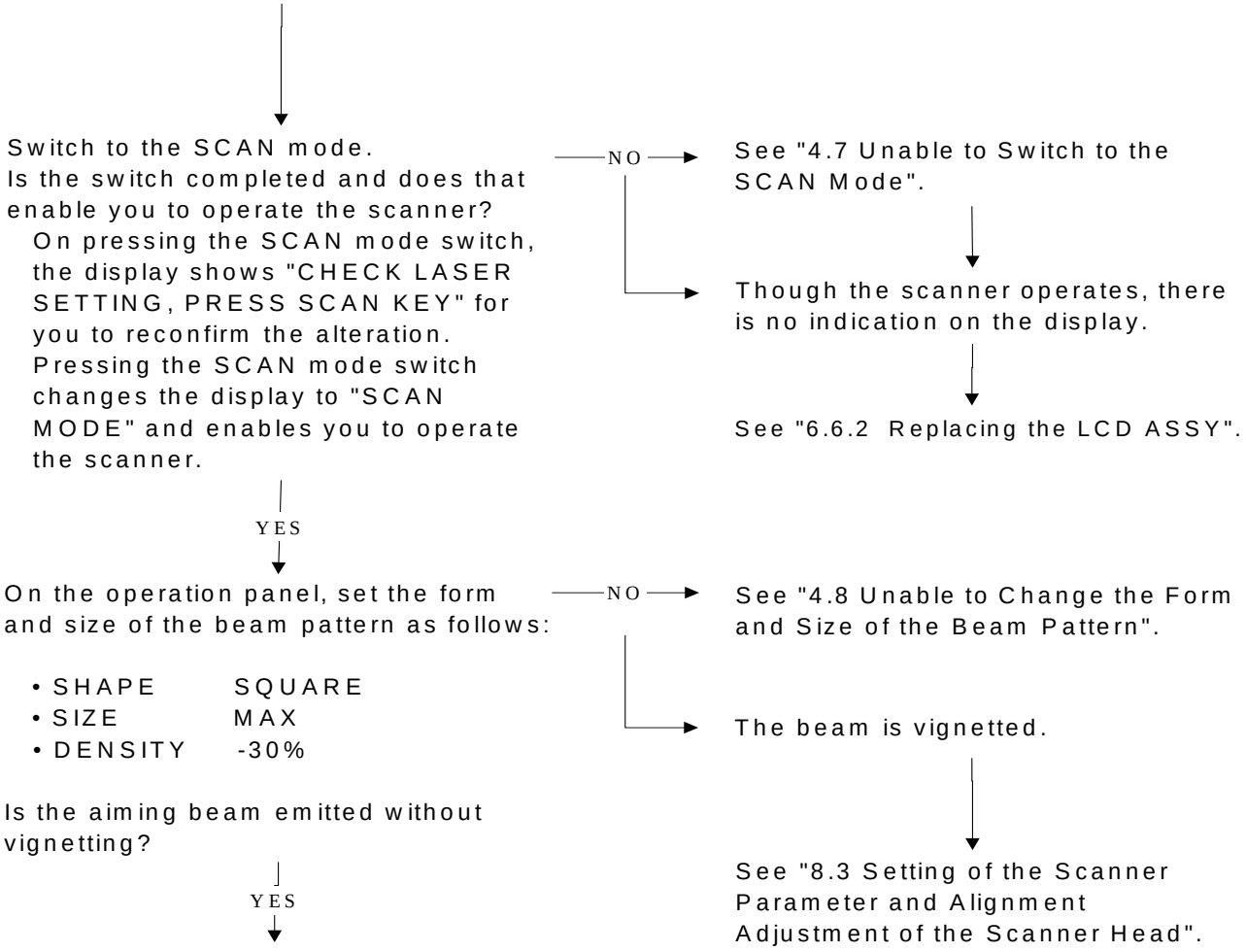
See "8.1.2 Coaxial Test and Adjustment of the Arm and the Aiming Beam".

YES ↓

By changin the settings on the operation panel, try various modes and emission conditions of the laser as shown below, and check the operations (see the Operator's Mannual).
If malfunctions occur, solve them according to the troubleshooting on previous pages.

- CW or UNIPULSE
- CONT, SINGLE or REPEAT
- POWER
- ON TIME (SINGLE or REPEAT mode only)
- OFF TIME (REPEAT mode only)
- COAG: I - CUT: V (UNIPULSE mode only)

* As for more detailed operation tests of, for example, laser emission time, repeat interval time, and UNIPULSE mode, see "§8. System Test and Adjustment".



On the operation panel, set the form and size of the beam pattern as follows: —NO→ Check the symptom and contact us.

- Mode SINGLE
- POWER 10W

After confirming the word "READY" on the operation panel lights and that the aiming beam is on the tongue depressor, emit the laser by pressing the footswitch.
Is the laser emitted to form a burn pattern?

YES ↓

Press the emergency STOP button. —NO→ See "6.8.2 Replacing the Key Switch and the Emergency STOP Button".
Is the power turned OFF to stop the instrument?

YES ↓

The troubleshooting is finished.

The system starts in the following order:

- The power is supplied to the secondary side of the transformer. Then the radiator and the pump start. Turning ON the air purge switch on the rear panel of the main body starts the operation of the air purge pump. The power is supplied to LVPS and HVPS.

- Next the CPU starts, the EMISSION indicator (LASER EMISSION) on the operation panel lights, and the system starts self-check of the instrument.
  During the self-check, the indication “SYSTEM CHECK” is displayed on the operation panel, and “POWER ON SELF TEST” on the display for the scanner.
  The objects of the self-check are as follows:

  Operations of the converters for CPU, ROM, RAM, and A/D•D/A.
  Operation of the shutter
  Connection of the footswtich
  State of the remote interlock
  Operation of the pump and the amount of flowing cooling fluid in contrast with the set value
  Temperature of the cooling fluid in contrast with the set value.

- If the instrument does not have any problem, it lets you know by the indication “STAND BY” on the operation panel and “NIDEK SCANNER” on the display for the scanner that you can use it . If the instrument has one or more problems, the display shows error messages corresponding to the symptoms. For the meaning of the error messages and counter measures for errors, see “§9. ERROR MESSAGE LIST”.

4.1 Power ON Lamp does not Light

Is the power supply voltage within ±10% of the regulation voltage?
—NO→ Use another outlet or a voltage stabilizer.

↓ YES

Are the fuses (F1, F2) blown?
—YES→ See "6.7 Replacing the Fuses".

↓ NO

Is the output from the POWER INLET AS (EA02) within ±10% of the regulation voltage?
Measure the voltage between the terminals TB1-1(WHT) and 7(BLK).
—NO→ Replace the POWER INLET AS (EA02).

↓ YES

Is the output of the transformer within AC115V±10%?
Measure the voltage at the following transformer output terminals:
7: 115V(BLK)
8: 0V(WHT)
—NO→ Is the wiring of the transformer's primary side normal?
(See "12.6.2 Transformer Wiring Diagram".)

↓ YES

See "6.8.1 Replacing the Power ON Lamp".

↓ Correct the wiring.

See "6.5.4 Replacing the Transformer".

4.2 The Pump and the Fan do not Operate

Is the emergency STOP button OFF? —NO→ Set the emergency STOP button OFF.

↓ YES

Is the fuse (F3) blown? —YES→ See "6.7 Replacing the Fuses".

↓ NO

Is the key switch normanl? —NO→ See "6.8.2 Replacing the Key Switch and the Emergency STOP Button".

If it is, its operates as follows:

- ON: conduction between 1 and 2
- START: conduction between 1 and 2, and 3 and 4

↓ YES

Is the output (between 4-8) from the relay (RY1) within AC115V±10%? —NO→ See "6.5.3 Replacing the Relay".

↓ YES

Replace the noise filter.

4.3 Though the Pump and the Fan Operates, there is no Indication on the Operation Panel

Is the fuse (F8) blown? —YES→ See "6.7 Replacing the Fuses".

NO ↓

Is the supply of power from the LVPS board (PS1) to the BA01 board normal? —NO→ See "6.5.2 Replacing the LVPS".

Check the voltages of the following connectors on the BA01 board:

- J101 1(BRN): DC+5V
  2(RED): DC+5V
  3(BLK): GND
  4(BLK): GND
- J102 1(ORN): DC+15V
  2(BLK): GND
  3(YEL): DC-15V

YES ↓

Does replacing of the master board ASSY solve the problem? (See 6.4.1.) —YES→ The troubleshooting is finished.

YES ↓

Is the flat cable (EA45) that connects the BA01 board and the BA02 board broken? —YES→ See "6.8.3 Replacing the Control Panel Cable".

NO ↓

See "6.4.2 Replacing the Control Panel Board".

4.4 The Air does not Blow from the Tip of the Handpiece

Remove the tube from the air outlet of the main body.
Can you confirm that the air blows from the outlet?

—YES→ Is the tube between the main body and the handpiece pressed by the fix band of the arm?

YES ↓ Loosen the fix band so it does no press the tube.

NO ↓ Foreign substances may be stuffing the passage of air inside the handpiece.
Clean the hole of the handpiece.

NO ↓

Open the cover on the main body.
Can you confirm that the air purge pump is operating?

—YES→ Check if the tube between the pump and the air outlet of the main body is in place.

NO ↓

Is the fuse (F11) blown?

—YES→ See "6.8.3 Replacing the Control Panel Cable".

NO ↓

Is the air purge switch broken?

—YES→ Replace the air purge switch.

Turn OFF the power of the main body.
Turn the air purge switch ON and check the conduction between 1 and 1a, and between 2 and 2a.

NO ↓

Replace the air purge pump.

4.5 The Aiming Beam cannot be Emitted

Open the cover on the main body.
Can you confirm that the aiming beam is emitted from the laser diode?

—YES→ Is the problem solved by the coaxial test and adjustment of the CO_2 laser and the aiming beam (See 8.1.1), and the coaxial test and adjustment of the arm and the aiming beam (See 8.1.2)?

YES → The troubleshooting is completed.

NO → See "6.1 Replacing the Articulated Arm".

NO ↓

Is the output from the connector P123 on the LD SWITCH ASSY (EA38) normal?

—YES→ See "6.2.4 Replacing the LD ASSY".

•P123 1(BRN) :DC+5V
2(RED) :GND

NO ↓

Disconnect the connector P104 from BA01.
Is there conduction between 3 and 4 of P104 when the aiming is ON?

—NO→ Replace the microswitch (EA38) of the laser diode.

YES ↓

See "6.4.1 Replacing the Master Board ASSY".

4.6 “POWER LOW ERR” is Displayed

Is the laser lit?
Remove the rear cover on the main body and check that.
—YES→ (A)

YES ↓

Calibrate the power meter.
Is the output at the tip of the handpiece 40W or more (37W or more in the case of a scanner type)?
(See 8.2.)
—NO→ Perform the power MAX test and adjustment of the CO_2 laser tube.
(See 8.1.3)
Is the problem solved?

YES ↓ The troubleshooting is completed.

NO ↓ See "6.2.3 Replacing the CO_2 Laser Tube".

YES ↓

Make an adjustment to the master board.
Is the problem solved?
(See 8.2)
—YES→ The troubleshooting is completed.

NO ↓

Does replacing the power meter sensor ASSY (EA41) solve the problem?
(See 6.2.6.)
—YES→

NO ↓

Does replacing the power meter board ASSY (BA03) solve the problem?
(See 6.2.5.)
—YES→ The troubleshooting is completed.

YES ↓

See "6.4.1 Replacing the Master Board ASSY (EA90)".

A

Is the voltage between 1 and 2 of the connector J404 on the HVPS board AC110V?

NO → Replace the fuse (F9). (See 6.7.)

YES

Is the output signal transmitted from the BA01 board to the HVPS by pressing the footswitch?

NO → See "6.4.1 Replacing the Master Board ASSY".

P103	2(CONTROL):	0 - +5.25V
	3(A.GND):	0V
	4(GATE):	+15V
	5(D.GND):	0V

YES

Does replacing the HVPS (E406) solve the problem?
(See 6.5.1.)

NO → See "6.2.3 Replacing the CO_2 Laser Tube".

YES

The troubleshooting is completed.

4.7 Unable to Switch to the SCAN Mode

Is the subD connector J421 for the scanner connected to the main body?
—NO→ Connect it to the main body.

↓ YES

Is the input voltage of the scanner control box AC115V?
Measure the voltage between 1 and 2 of the connector J1 on the control box E450.
—NO→ (B)

↓ YES

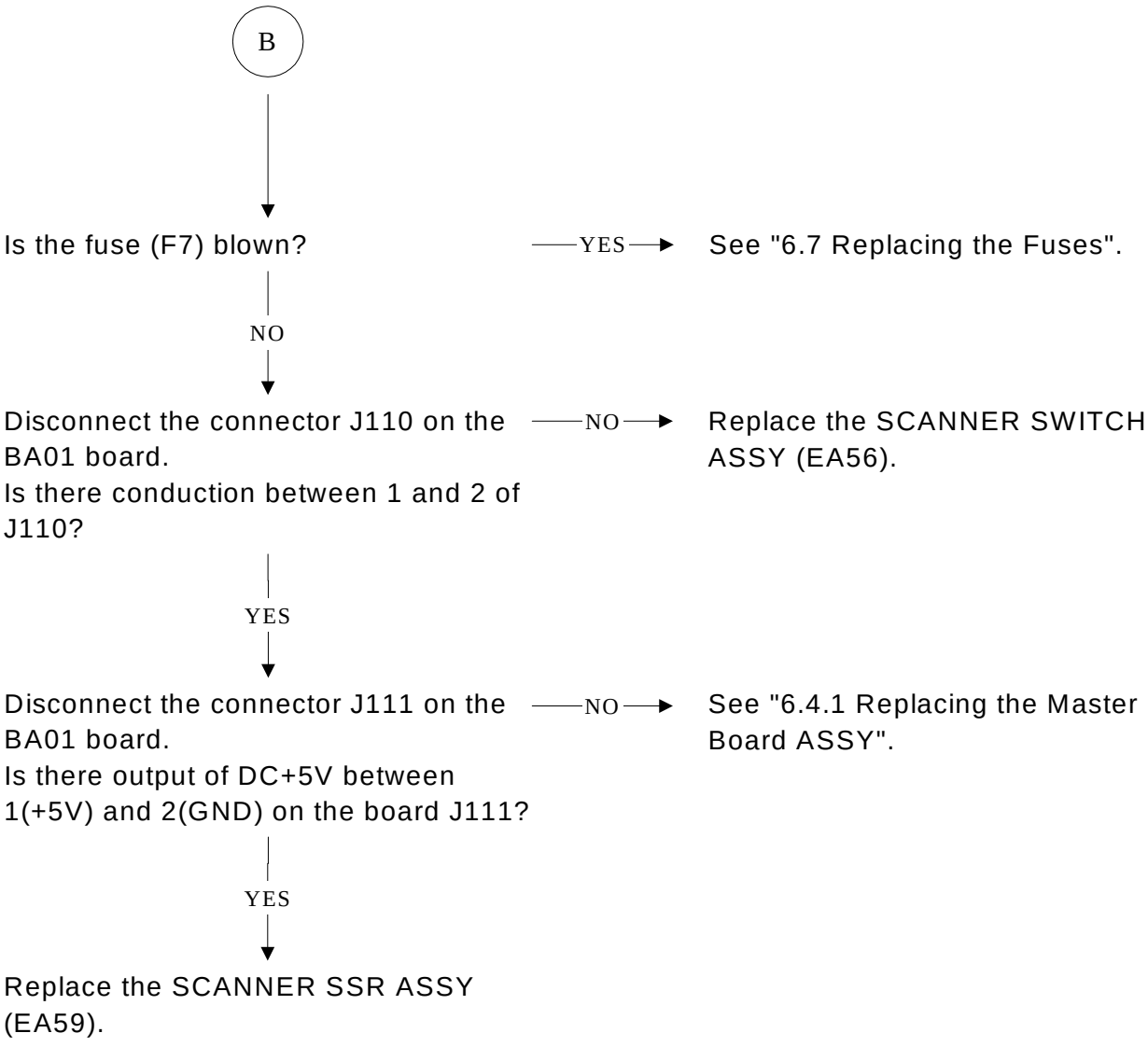
Is the scanner flat cable EA55 broken?
—YES→ See "6.8.4 Replacing the Scanner Cable 2 ASSY".

↓ NO

Does replacing the master board ASSY solve the problem? (See 6.4.1.)
—YES→ See "6.6.1 Replacing the Scanner Control Box and the Scanner Head".

↓ YES

The troubleshooting is completed.


B
Is the fuse (F7) blown?
YES
See "6.7 Replacing the Fuses".
NO
Disconnect the connector J110 on the BA01 board.
Is there conduction between 1 and 2 of J110?
NO
Replace the SCANNER SWITCH ASSY (EA56).
YES
Disconnect the connector J111 on the BA01 board.
Is there output of DC+5V between 1(+5V) and 2(GND) on the board J111?
NO
See "6.4.1 Replacing the Master Board ASSY".
YES
Replace the SCANNER SSR ASSY (EA59).

4.8 Unable to Change the Form and Size of the Beam Pattern

Is the flat cable EA55 broken? —YES→ See "6.8.4 Replacing the Scanner Cable 2 ASSY".

NO ↓

Is the SCANNER CABLE 5 ASSY (EA58) broken? —YES→ Replace the SCANNER CABLE 5 ASSY (EA58).

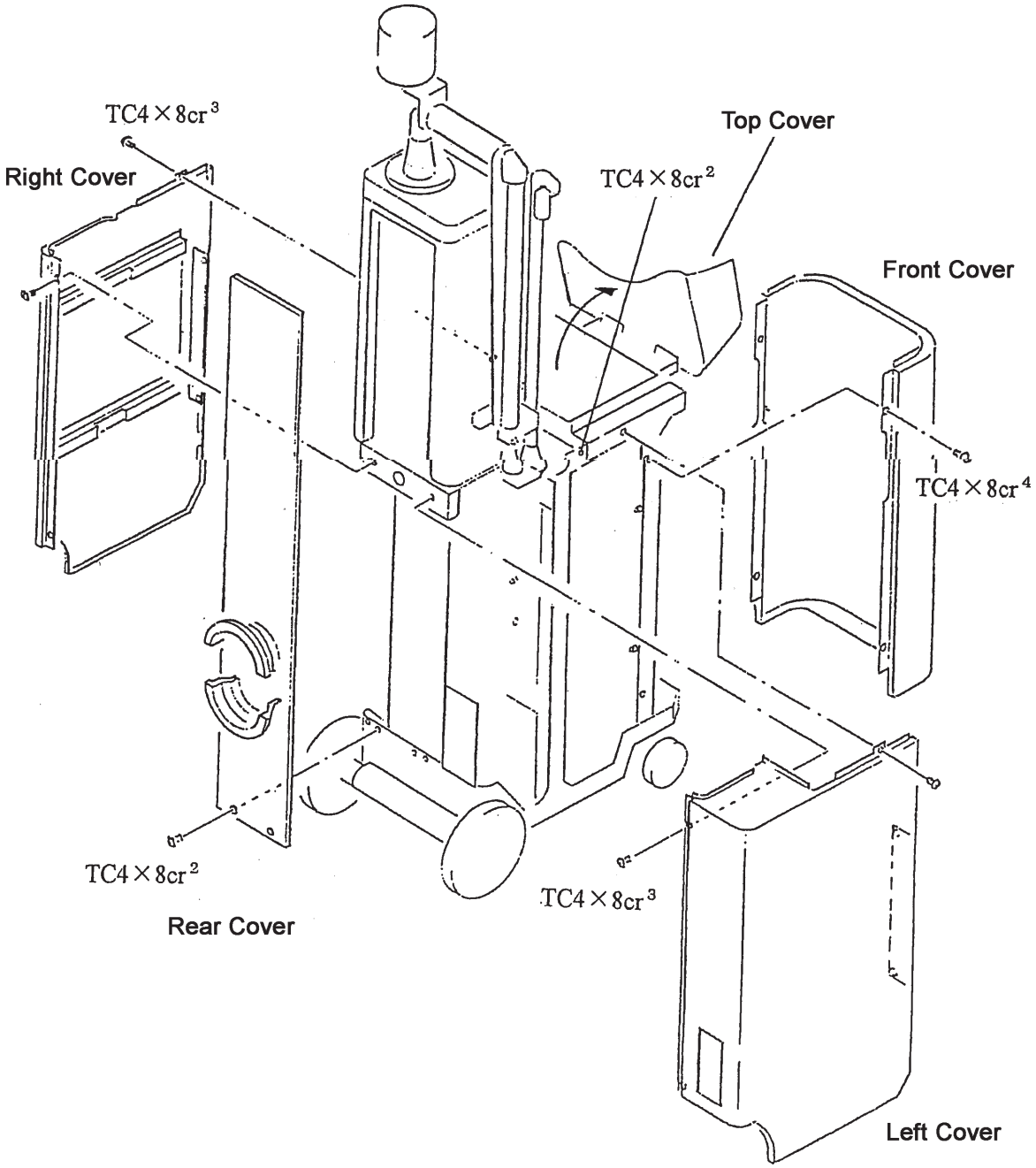
NO ↓

See "6.6.1 Replacing the Scanner Control Box and the Scanner Head".

5.1 Removal of the Covers: Top, Front, Rear, Left and Right

Remove the covers by the following procedure.

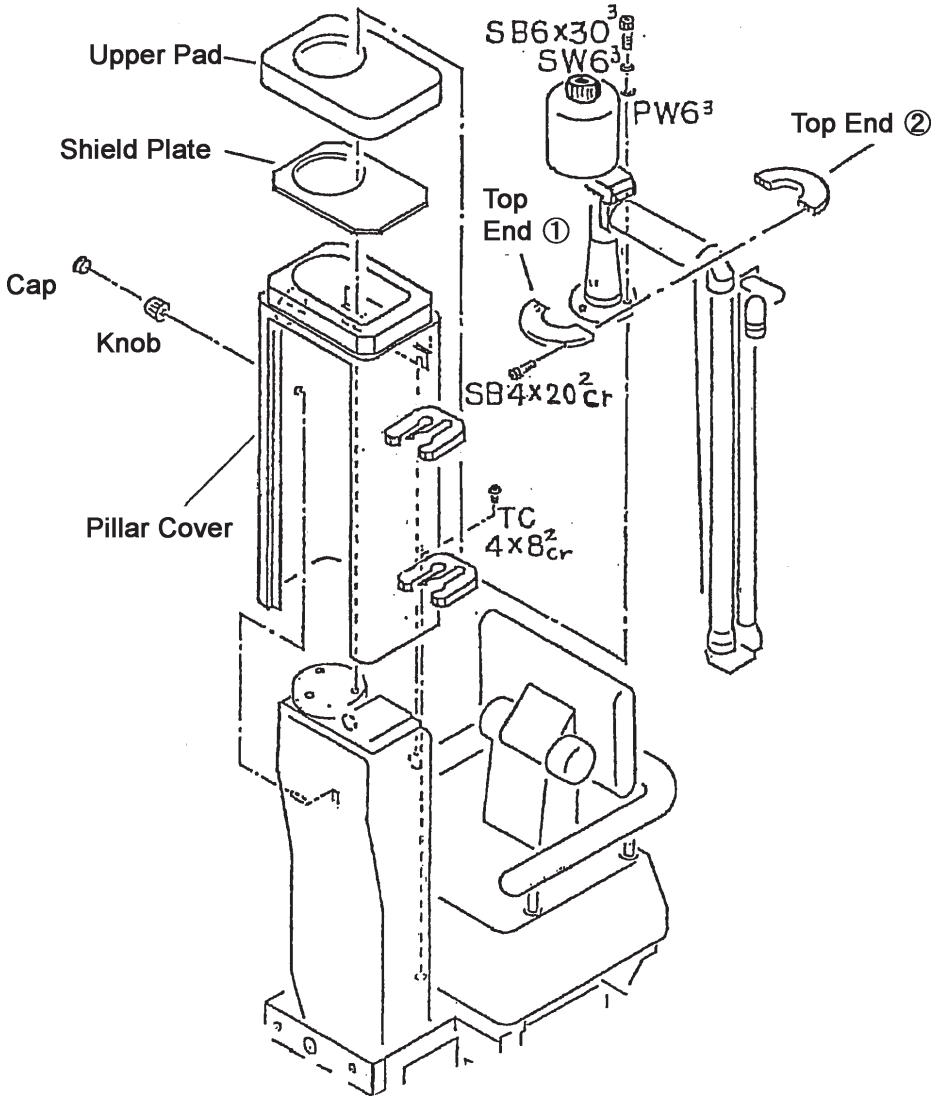
1) Loosen the screws (TC4×8cr^2). Pull the top cover toward you.
2) Unscrew the screws (TC4×8cr^2). Slide the rear cover upward and remove it.
3) Unscrew the screws (TC4×8cr^3). Slide the left and right cover backward and remove them.
   * Remove the short plug (remote interlock connector) and the foot switch before removing the left cover.
4) Unscrew the screws (TC4×8cr^4). Remove the front cover.



5.2 Removal of the Pillar Cover

Remove the cover by the following procedure.

1) Loosen the screws (TC4×8cr²). Pull the top cover toward you (See 5.1).
2) Unscrew the screws (SB4×20cr²). Remove the top ends (1) and (2).
3) Remove the upper pad and the shield plate.
4) Unscrew the screws (SB6×30³). Remove the articulated arm.
5) Remove the cap and knob for the aiming beam intensity adjustment.
6) Unscrew the screws (TC4×8cr²). Remove the pillar cover.
   * The pillar cover need not be removed except when you remove the mirror mount on the optical rail.



6.1 Replacing the Articulated Arm

Part to replace: 60001-M009

* The parts that comprise the arm are precisely adjusted that it is impossible to make adjustments to them at the location. If the arm malfunctions, replace it with a new one. Send the old arm to the factory.

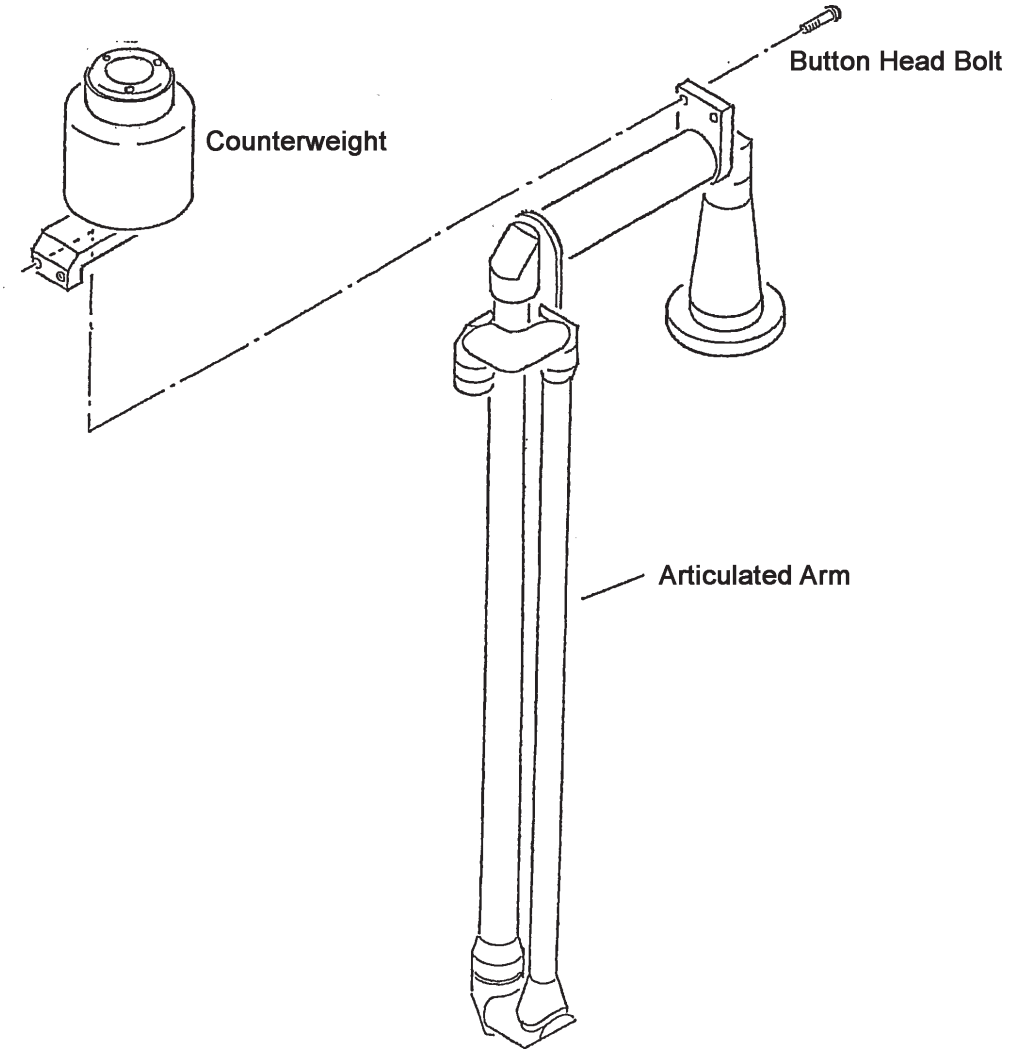
1) Put the arm in place. Unscrew two button head bolts that fix the counter weight to remove it.

2) Remove the top ends (1) and (2) (See 5.2).

3) Dismount the arm and replace it with a new one (See 5.2).

4) Reassemble the removed parts in the reverse order.

5) Perform the coaxial adjustment of the arm and the aiming beam (See 8.1.2).



6.2 Replacing the Laser Optical System

6.2.1 Replacing the Shutter ASSY

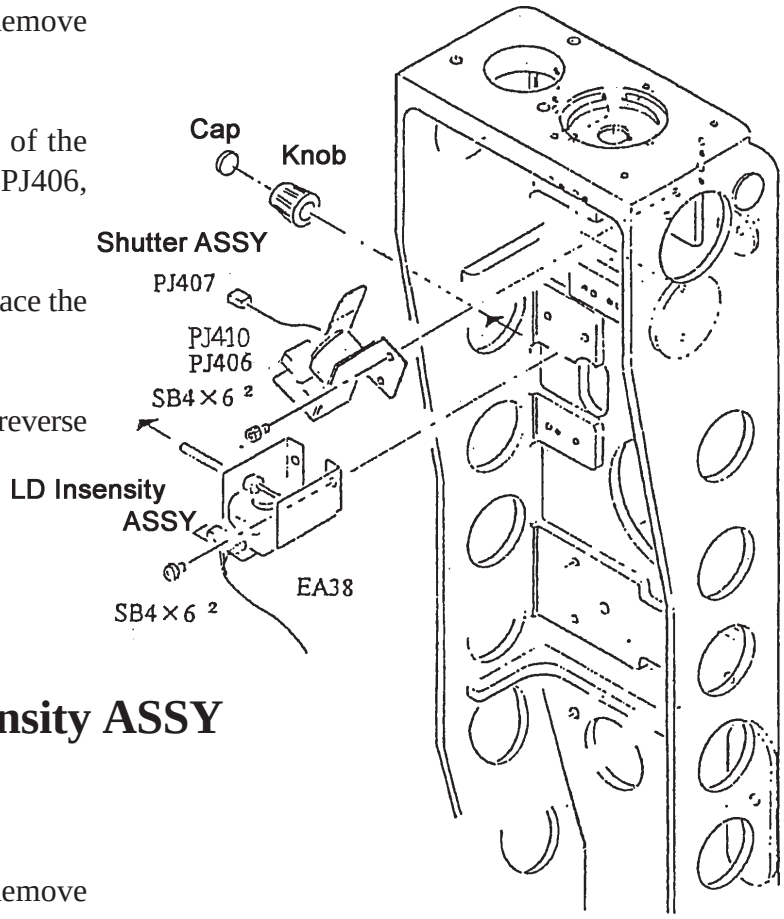
Part to replace: 60011-3100

1) Unscrew the screws (TC4×8cr²). Remove the rear cover (See 5.1).

2) Disconnect the connector (PJ407) of the shutter solenoid and the connector (PJ406, PJ410) of the shutter sensor.

3) Unscrew the screws (SB4×6²). Replace the shutter ASSY.

4) Reassemble the removed parts in the reverse order.



6.2.2 Replacing the LD Intensity ASSY

Part to replace: 60011-3500

1) Unscrew the screws (TC4×8cr²). Remove the rear cover (See 5.1).

2) Disconnect the connector (PJ104) on the master board (BA01) and the connector (PJ123) on the LD ASSY.

3) On the optical rail, a metal clamp fixes the cable (EA38) that connect the LD intensity ASSY and the BA01 board. Unfix the clamp.

4) Remove the cap and knob for the aiming beam intensity adjustment and the screw (SB4×6²). Replace the LD intensity ASSY.

5) Reassemble the removed parts in the reverse order.

6.2.3 Replacing the CO_2 Laser Tube

Parts to replace	:	60001-7000	(CO_2 Laser Tube)
	:	60001-M304 (n=2)	(Lower Tube Support)
	:	60001-M305 (n=2)	(Upper Tube Support)
	:	60001-M381 (n=2)	(Nylon Clamp)
	:	82001-RG034 (n=2)	(O-Ring)
	:	60001-EA19	(CO_2 Cable 1 ASSY)
	:	60001-EA20	(CO_2 Cable 2 ASSY)
	:	60011-EA75	(Ground Cable 5 ASSY)

The parts above are incorporated into a unit.

1) Unscrew the screws (TC4×8cr^2). Remove the rear cover (See 5.1).

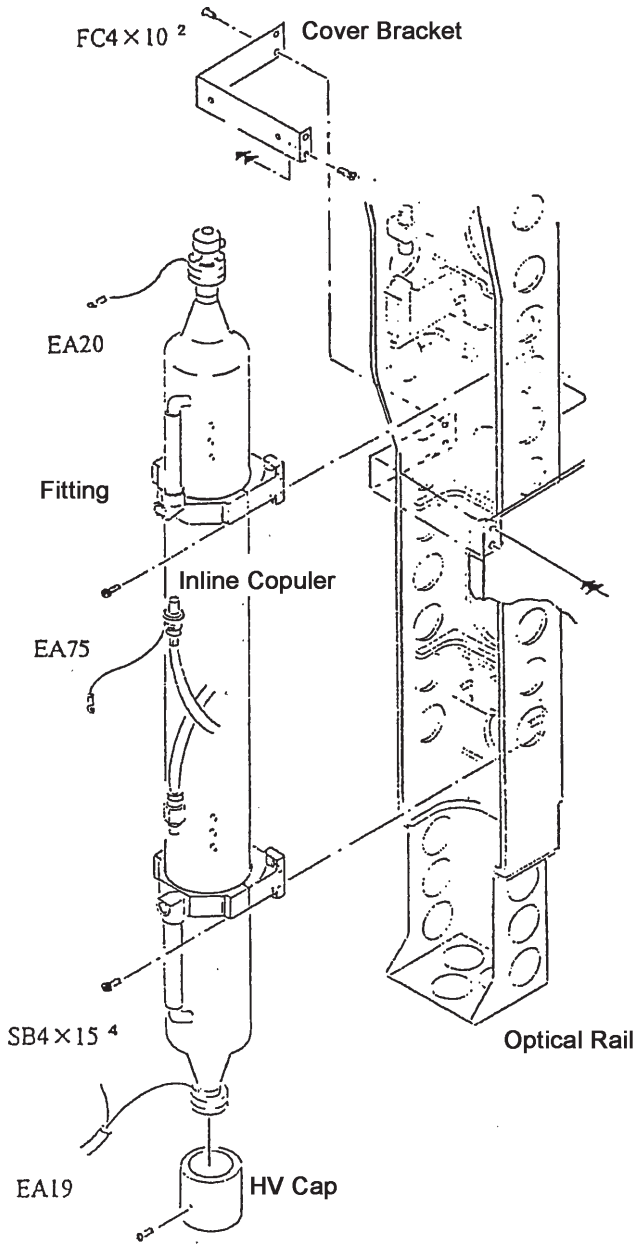
2) Unscrew the screws (FC4×10^2). Remove the cover bracket.

3) Press the fitting on the inline copuler. Remove the upper and lower tubes from the laser tube.
On the removal of the hoses, there should be a little leakage of the cooling fluid. Cover the tip of the tubes with a cotton cloth or its equivalent.

4) Remove the three types of cables that are connected to the CO_2 laser tube.
EA19 (between the tube and the HVPS)
→Pull off the connector on the HVPS.
EA20 (between the tube and the terminal on 5 of TB6.)
→Remove the terminal on 5 of TB6.
EA75 (between the inline copuler of the tube and the rail)
→Remove the terminal on the optical rail.

5) Unscrew the screws (SB4×15^4). Remove the laser tube from the optical rail.
The while, hold the tube firmly with a hand not to let it drop.

6) Tilt the tip of the tube. Remove the tube quietly without letting it interfere with the environment.



7) Loosen the screw and remove the HV cap.

8) Replace the CO_2 laser tube with a new one.

9) Reassemble the removed parts in the reverse order.

6.2.4 Replacing the LD ASSY

Part to replace: 60011-EA22

1) Unscrew the screws (TC4×8cr^2). Remove the rear cover (See 5.1).

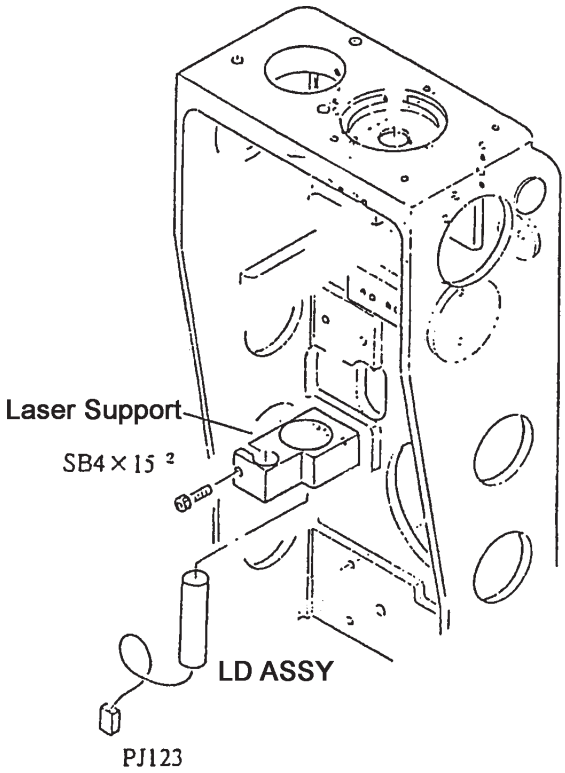
2) Disconnect the LD ASSY connector (PJ123).

3) Loosen the screws (SB4×15^2). Remove the LD ASSY from the laser support.

4) Attach a new LD ASSY to the laser support and connect the connector to it.

5) Perform the coaxial adjustment of the arm and the aiming beam (See 8.1.2).

6) Reassemble the removed parts in the reverse order.



6.2.5 Replace the Power Meter Board

Part to replace: 60001-BA03

1) Unscrew the screws (SB4×20cr²). Remove the top end (See 5.2).

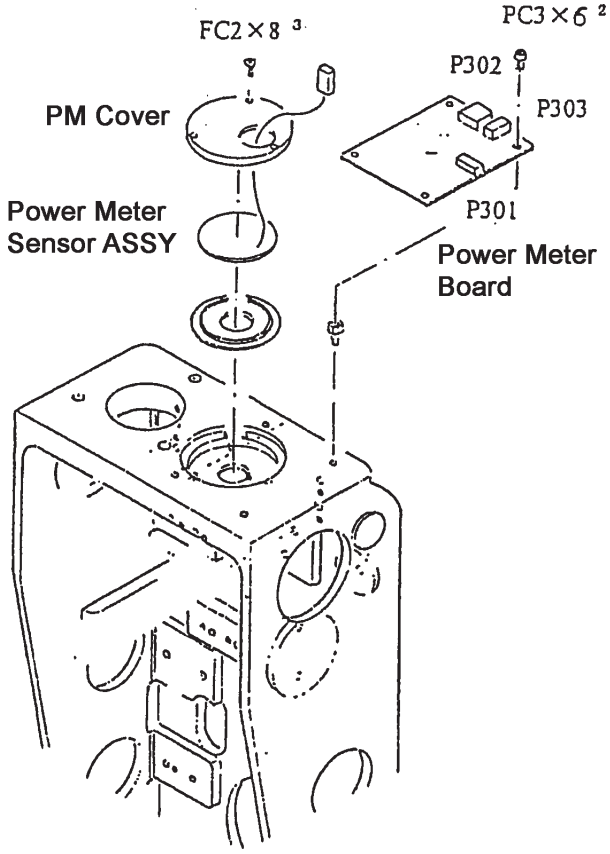
2) Remove the upper pad and the shield plate (See 5.2).

3) Disconnect the connectors (P301, P302, P303) from the board.

4) Unscrew the screws (PC3×6²). Replace the power meter board.

5) Connect the connector of the power meter board. Then calibrate the power meter (See 8.2).

6) Reassemble the removed parts in the reverse order.



6.2.6 Replacing the Power Meter Sensor ASSY

Part to replace:60011-EA41

1) Unscrew the screws (SB4×20cr²). Remove the top end (See 5.2).

2) Remove the upper pad and the shield plate (See 5.2).

3) Disconnect the connectors (P301, P302, P303) from the board.

4) Unscrew the screws (PC3×6²). Remove the power meter board.

5) Unscrew the screws (PC2×8³). Remove the PM cover.

6) Replace the power meter sensor ASSY.

7) Attach the PM cover and the power meter board.

8) Connect the connectors to the power meter board. Calibrate the power meter. (See 8.2).

9) Reassemble the removed parts in the reverse order.

6.3 Replacing the Cooling System

6.3.1 Replacing the Cooling Fluid

Part to replace: 60001-M159 Jigs: 60001-M153 (Inline Copuler (female))
60001-M155 (Inline Copuler (male))
60001-M166 (Vinyl Tube)

*1) The cooling fluid needs to be replaced once a year.
Check the amount of the fluid every six months. Replace the fluid if it is less than it should be.

*2) Be sure to use the fluid that is designated by NIDEK. The concentration of the chemicals that conprise the cooling fluid is very important that the fluid should be replaced wholly without replenishment.

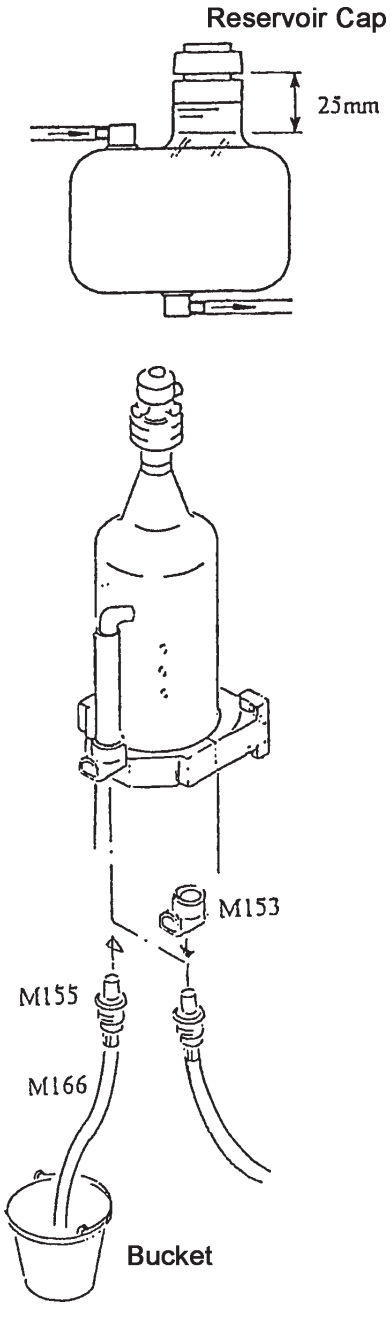
1) Remove all the covers (See 5.1).

2) Check the level of the cooling fluid. If it is under the line of 25mm from the reservoir cap, replace the liquid.
If the level of the fluid is below the top of the reservoir, bubbles mingle in the fluid, and that decreases the cooilng effect.

3) Remove the inline copulers on the fluid outlet of the CO_2 laser. Cennect the male copuler (M155) and the tube of 1m (M166) to the CO_2 laser side, and the female copuler (M153) on the tube side.
Each copuler has a valve to prevent leakage. That makes drainage of the fluid impossible unless the male and female copulers are interchanged.

4) Prepare a container such as a bucket. Put the tip of the tube attached to the outlet of the CO_2 laser into it.

5) Power ON the main body. Turn ON the key switch.
Then the pump operates and the cooling fluid is drained.
When the drainage is finished, turn OFF the key switch and reattach the inline copluers back to their original positions.



6) Remove the cap on the reservoir, and pour the cooling fluid into the tank.
When the fluid level reaches 25mm under the cap or higher, reattach the cap.

7) Turn ON the key switch again.
When the fluid circulates, the fluid level lowers. Add the fluid so that its level reaches the height indicated above.

8) Reassemble the removed parts in the reverse order.

6.3.2 Replacing the Radiator Fan

Part to replace: 60001-E411 (Radiator Fan)

1) Remove all the covers (See 5.1).

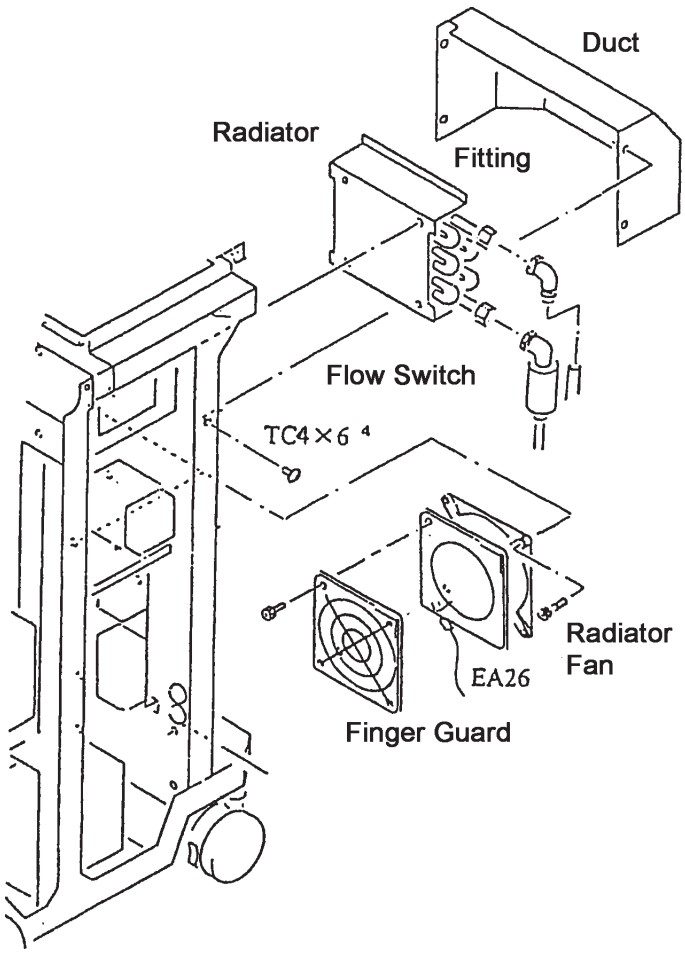
2) Unscrew the screws (TC4×6[4]) and remove the duct.

3) Remove the cable (EA26) and the finger guard from the fan.

4) Insert the hexagonal wrench into the holes on the finger guard, and remove the fan and the radiator.
The fan and the radiator are bound together with allen screws (inch screw thread) with the sub-frame between them.

5) Replace the fan.

6) Reassemble the removed parts in the reverse order.



6.3.3 Replacing the Radiator

Part to replace: 60001-E411 (Radiator)

1) Remove all the covers (See 5.1).

2) Unscrew the screws (TC4×6[4]) and remove the duct.

3) Remove the two fittings that connect the flow switch and the reservoir to the radiator.

4) Remove the cable (EA26) and the finger guard from the fan.

5) Insert the hexagonal wrench into the holes on the finger guard, and remove the fan and the radiator.
The fan and the radiator are bound together with allen screws (inch screw thread) with the sub-frame bwtween them.

6) Replace the radiator.

7) Reassemble the removed parts in the reverse order.

6.3.4 Replacing the Reservoir

Parts to replace: 60001-M151

1) Remove all the covers (See 5.1).

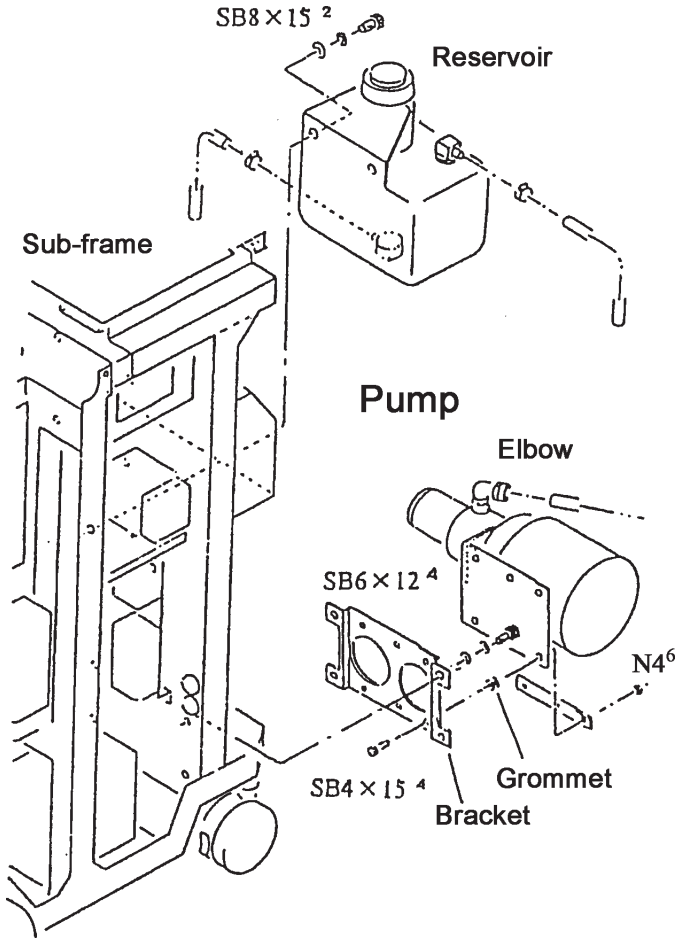
2) Drain the cooling fluid (See 6.3.1).

3) Remove the tubes that are connected to the elbows on the top and bottom of the reservoir.

4) Unscrew the screws (SB8×15[2]). Replace the reservoir.

5) Pour the drained cooling fluid into the new reservoir.

6) Reassemble the removed parts in the reverse order.



6.3.5 Replacing the Pump

Parts to replace: 60001-EA24 (Pump ASSY)
60001-M162 (n=2) (Elbow)

The parts above are incorporated into a unit.

1) Remove all the covers (See 5.1).

2) Detach the two lead wires (ORN and YEL) and a GND wire that stretch from the pump.
   ORN : TB4-4
   YEL : TB5-6
   GRN/YEL : GND/TB1-4

3) Lay a towel or the equivalent under the pump.

4) While holding the two tubes that stretch from the pump firmly, remove them from the elbows. Then Cover the tip of the tubes with a cotton cloth or the equivalent.

5) Unscrew the screws (SB6×12[4]). Remove the pump from the sub-frame.

6) Unscrew the screws (SB4×15[4]). Remove the bracket, the grommet, and the plate nut. Then replace the pump.

7) Reassemble them in the reverse order.

6.3.6 Replacing the Flow Switch and the Temperature Switch

Parts to replace : 60011-EA30 (Flow switch)
: 60011-EA31 (Temperature switch)
: 60001-M160 (Temperature switch elbow)
: 60001-M164 (Fitting: Heat exchanger side)
: 60001-M165 (Fitting: Tube side)

The parts above are incorporated into a unit.

1) Remove all the covers (See 5.1).

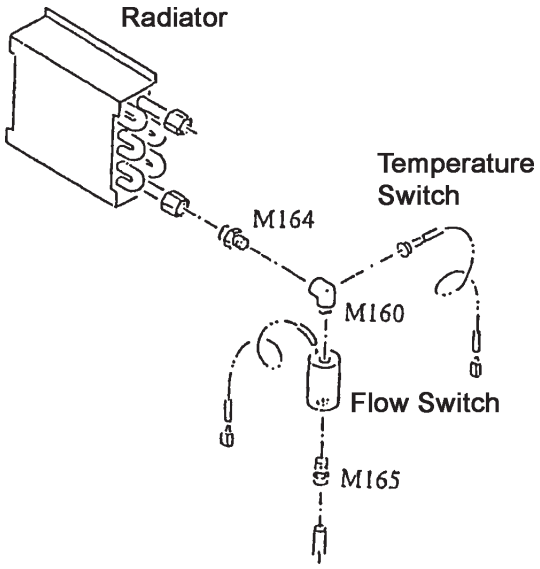
2) Unscrew the screws (TC4×6[4]) and remove the duct (See 6.3.2).

3) Disconnet the connectors that connect the flow switch and the temperature switch to the master board (BA01).
Flow switch : PJ118
Temperature : PJ117

4) Remove the hoses that stretch from the flow switch and cover the tip of the hoses with a cotton cloth or the equivalent.

5) Remove the fitting on the lower side of the radiator. Then replace the flow switch and the temperature switch as a unit.
The flow switch and the temperature switch are firmly connected with the surrounding parts and seal tapes. Replace them simultaneously.

6) Reassemble the removed parts in the reverse order.



6.4 Replacing the Master Board ASSY and the Control Panel Board

6.4.1 Replacing the Master Board ASSY

Part to replace: 60011-EA90

1) Remove the Top cover (See 5.1).

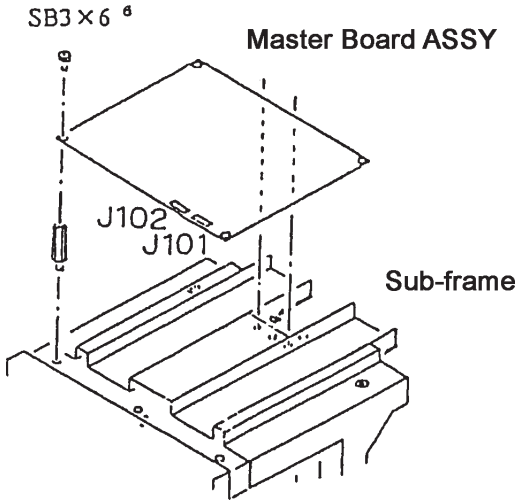
2) Remove all the connectors from the board.

3) Unscrew the screw (SB3×6[6]). Remove the Master Board ASSY from the sub-frame.

4) Replace the Master Board ASSY.

5) Reassemble the removed parts in the reverse order.

6) Adjust the Master Board (See 8.2).



6.4.2 Replacing the Control Panel Board

Part to replace: 60011-BA02

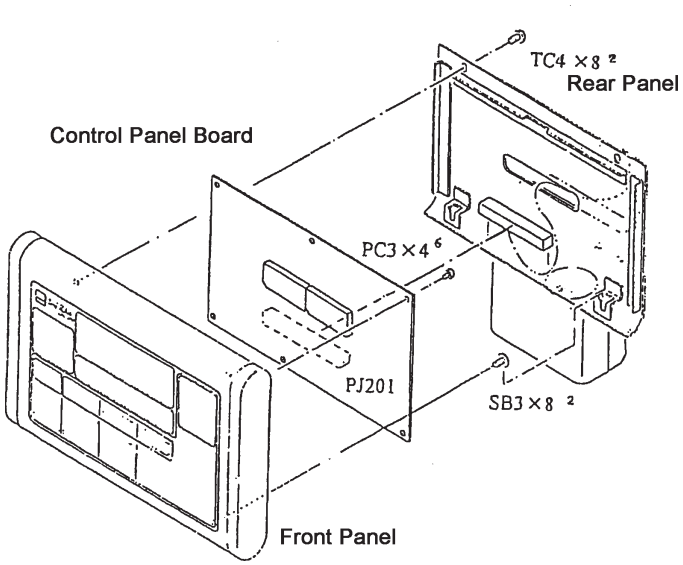
1) Insert a hexagonal wrench into the holes on the lower side of the rear of the control panel. Then loosen the screws (SB3×8[2]).

2) Unscrew the screws (TC4×8[2]) on the upper side of the rear of the control panel. Then remove the front panel from the rear panel.

3) Disconnect the connector P201 from the control panel board.

4) Unscrew the screws (PC3×4[6]). Replace the control panel board.

5) Reassemble the removed parts in the reverse



6.5 Replacing the Parts Around the Power Supply

6.5.1 Replacing the HVPS

Part to replace: 60001-E406 (High Voltage Power Supply)

* The HVPS is the power supply for oscillation of the CO_2 laser, and generates enough high voltage to kill a person.
Even when the power supply is OFF, take enough caution in handling the HVPS because high voltage may remain in the condenser or connector. Discharge the following method.

1. Pull out the cable (pink) of the CO_2 laser tube from the transformer of the HVPS.
   * Since there is fear of an electric shock, when pulling out the cable, do not touch a tip (50mm from the tip) of the cable.
2. Contact the tip (metal part) of the cable (pink) of the CO_2 laser tube to the frame of the main body.
   * There is a sputtering sound for electric discharge at this time.
3. Insert the cable (pink) of the CO_2 laser tube into the transformer of the HVPS again.
   * Insert the cable as far as it goes.
4. Repeat steps 1 to 3 until the sputtering sound is gone. (two or three times)
   * If there is no longer the sputtering sound, electric discharge of the HVPS and the CO_2 laser tube will be completed.

In addition, confirm that the connector is inserted as far as it goes. If the contact is poor, that may damage the power supply.

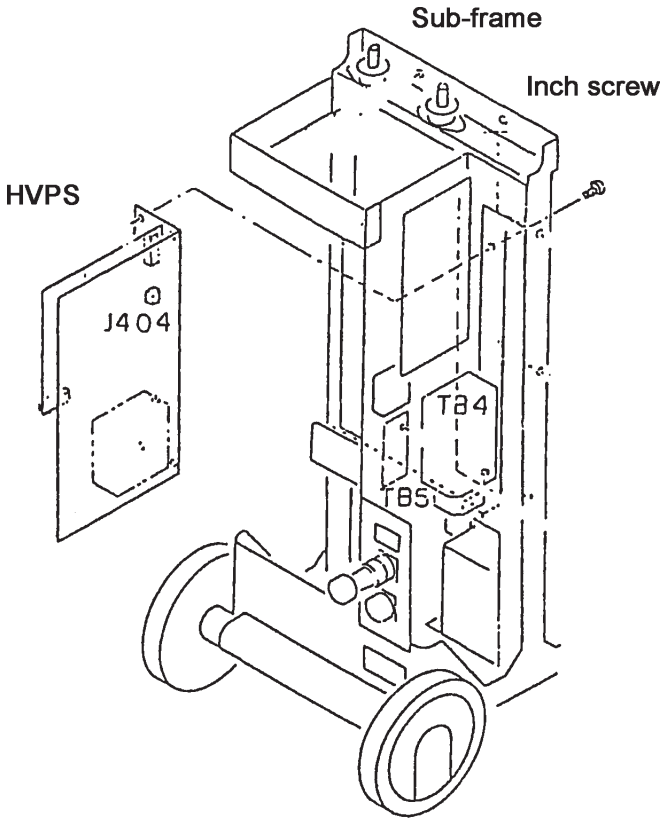
1) Make sure that the power supply cord is thoroughly extracted from the outlet.

2) Remove all the covers (See 5.1).

3) Disconnect all the connectors and the leads from the board.
   J404 : Connector P404 (Power Supply for the HVPS)
   P2-5 : Lead BRN (HVPS RETURN)
   OUT : Lead RED (HVPS OUTPUT)

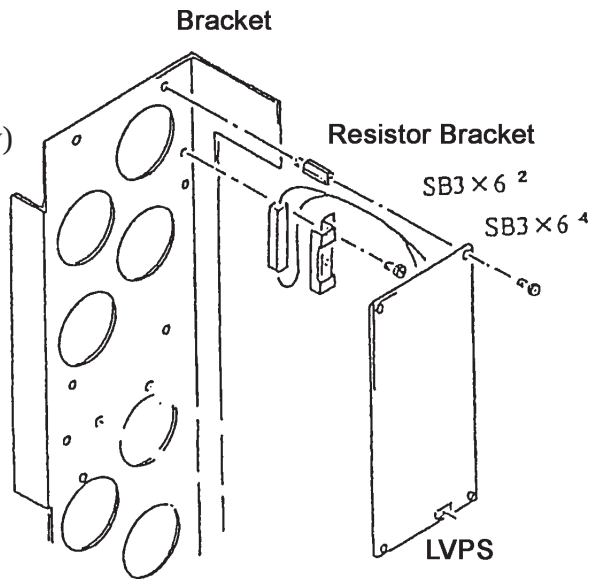
4) Unscrew the inch screw while holding the HVPS tightly. Then remove the HVPS from the sub-frame.

5) After replacing the HVPS, reassemble the removed parts in the reverse order.



6.5.2 Replacing the LVPS

Part to replace: 60001-EA97
(Low Voltage Power Supply)



1) Remove all the covers (See 5.1).

2) Remove all the connectors (PJ402 and PJ403) from the board.

3) Unscrwe the screws (SB3×6[4]). Take the LVPS off the bracket.

4) Unscrew the screws (SB3×6[2]). Take rhe resistor bracket off the bracket.

5) After replacing the LVPS, reassemble the removed parts in the reverse order.

6.5.3 Replacing the Relay

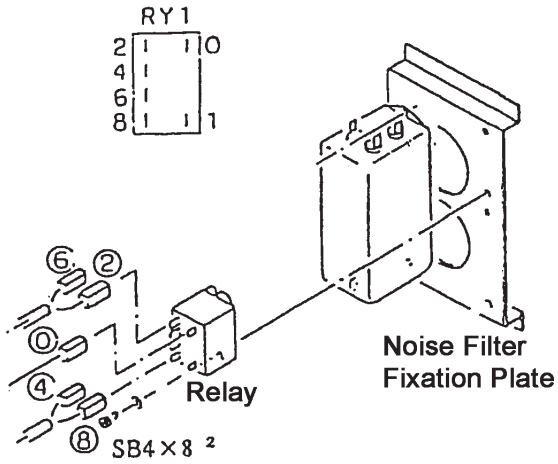
Part to replace: 60001-E403

1) Remove the top, rear, and left covers (See 5.1).

2) Disconnect all the connectors (No.0,1,2,4,6,8) from the relay .

3) Unscrew the screws (SB4×8[2]). Then remove the relay from the noise filter fixation plate.

4) After replacing the relay, reassemble the removed parts in the reverse order.



6.5.4 Replacing the Transformer

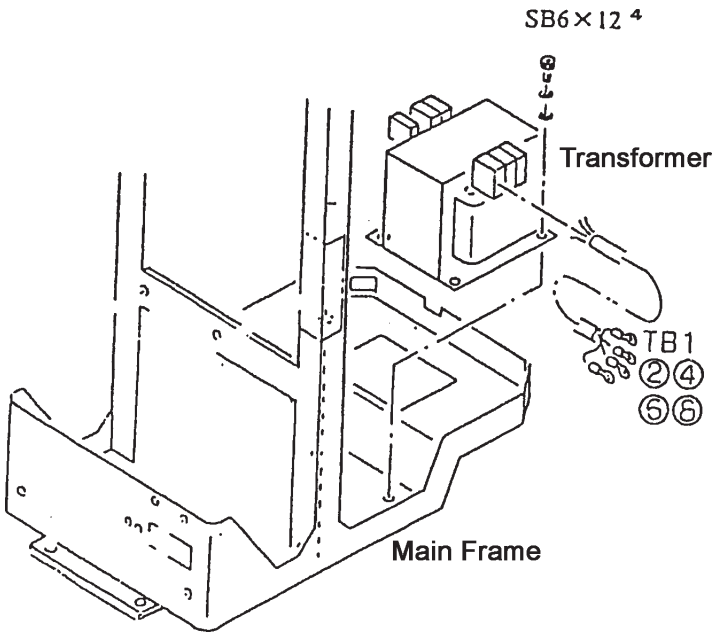
Part to replace: 60001-E401

1) Remove the top, rear, and left covers (See 5.1).

2) Disconnect all the leads from the transformer.
Taking notes of the colors of connectors and the wires makes rewiring them easier. Wiring of the primary side differs according to the destinations. Perform the wiring according to the wiring diagram not to make errors.

3) Unscrew the screws (SB6×12[4]). Remove the transformer from the main frame.
The transformer is heavy. Perform the removal holing it firmly with hands.

4) After replacing the transformer, reassemble the removed parts in the reverse order.



6.6 Replacing the Scanner

6.6.1 Replacing the Scanner Control Box and the Scanner Head

Parts to replace : 60001-E450 (Scanner Control Box)
: 60001-E451 (Scanner Head)

* Replace the Scanner Control Box and the Scanner Head as a unit.

Replacing the Scanner Control Box

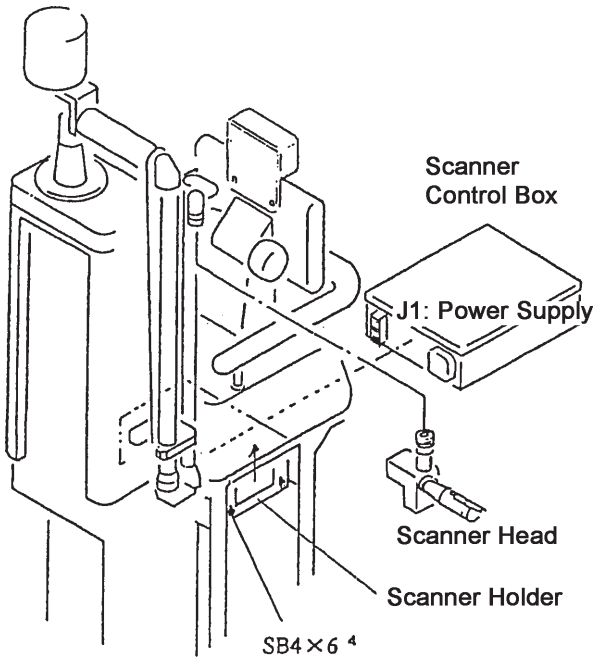
1) Remove all the covers (See 5.1).

2) Remove all the connectors (J2, 3, 4, and 5) from the front of the Scanner Control Box.

3) Loosen the screws (SB4×6[4]), raise the Scanner Holder, and pull out the Control Box.

4) Disconnect all the crimp contacts (J1: power supply) from the rear of the Control Box. Then replace the Control Box.

5) Reassemble the removed parts in the reverse order.



Replacing, adjusting, and parameter setting of the Scanner Head

6) Disconnect the connector J421 (subD) from the rear of the pillar of the main body.

7) Loosen the knurled holder on the handpiece. Then replace the Scanner Head.

8) Perform the setting of the scanner parameter and the alignment of the Scanner Head (See 8.3).

6.6.2 Replacing the LCD ASSY

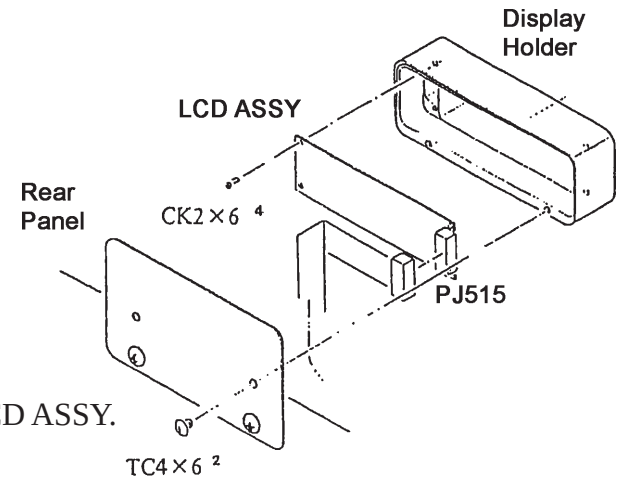
Part to replace: 60001-EA46

1) Unscrew the screws (TC4×6[2]). Then remove the display holder from the rear panel.

2) Remove the connector (PJ515) from the LCD.

3) Unscrew the screws (CK2×6[4]). Then replace the LCD ASSY.

4) Reassmble the removed parts in the reverse order.



6.7 Replacing the Fuses

Parts to replace

Unit	Symbol	Parts No. (Capacity)	Object
EA81	F1, F2	80402-02094 (250V, 10A)	Primary side in 100 or 115V areas
EA83	F1, F2	80402-02091 (250V, 6.25A)	Primary side in 200 or 215V areas
EA85	F1, F2	80402-02090 (250, 5A)	Primary side in 230V areas
EA86	F3	80402-02084 (250V, 0.5A)	Secondary side
	F4	80402-02087 (250V, 2A)	Pump
	F5	80402-02084 (250V, 0.5A)	Radiator Fan
	F7	80402-02087 (250V, 2A)	Scanner Control Box
	F8	80402-02090 (250V, 5A)	LVPS
	F9	80402-02090 (250V, 5A)	HVPS
	F11	80402-02083 (250V, 0.25A)	Airpurge Pump

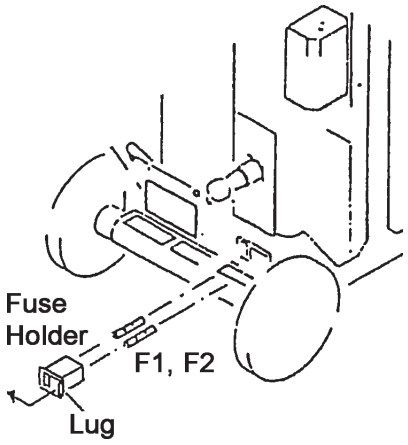
* F1-F11 are used one piece per instrument.
F1 and F2 are at the right of the inlet on the rear of the main body. F3-F11 are inside the terminal TB4 in the main body.

Replacing F1 and F2

1) Pull out the fuse holder while pushing the lug of it to the left.

2) Replace the fuses F1 and F2.

3) Insert the fuse holder into the main body.

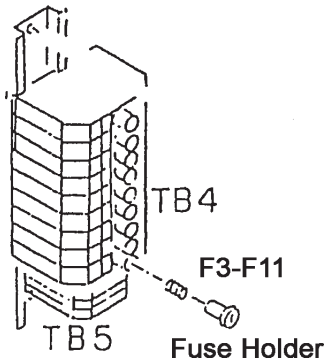


Replacing F3-F11

1) Remove the covers in order of the top, rear, and left (See 5.1).

2) Extract the fuse holders from the terminal TB4, and replace the fuse.
The capacities of each fuse holders are indicated on the pillar of the main body.
Take cautions not to make an error.

3) Reassemble the removed parts in the reverse order.



6.8 Replacing the Parts Around the Front Panel

6.8.1 Replacing the Power ON Lamp

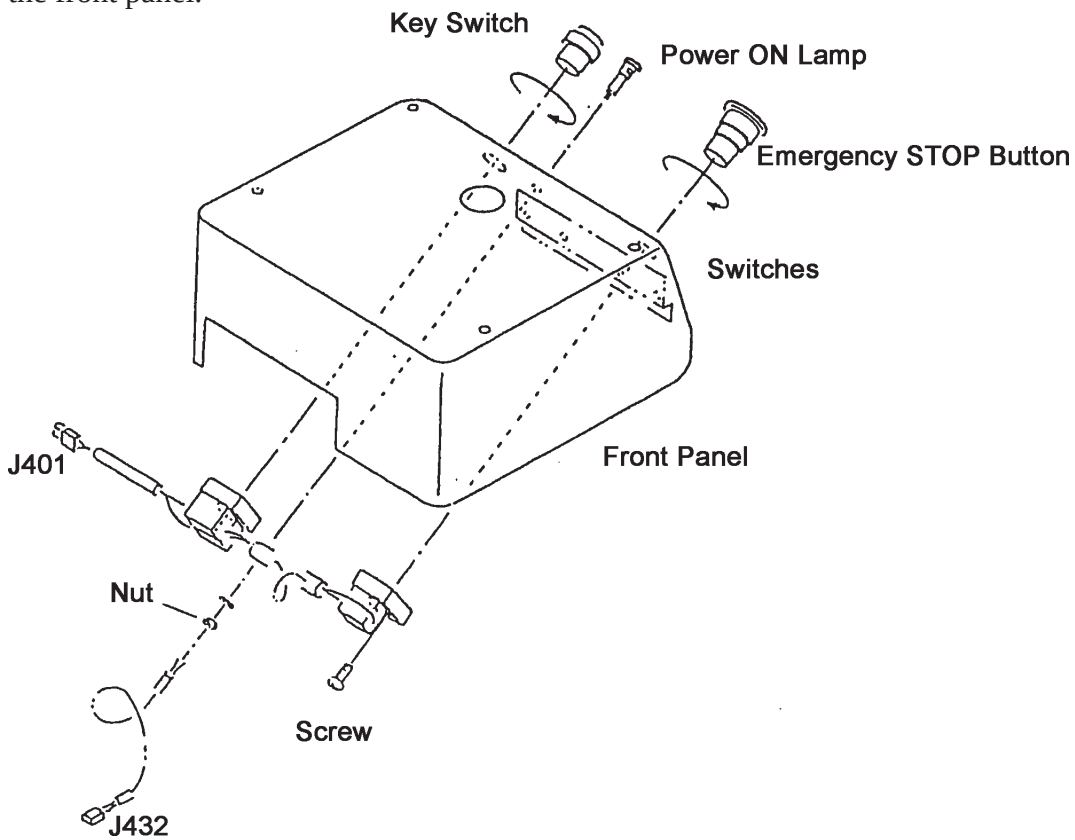
Part to replace: 60011-EA06

1) Pull the front cover toward you (See 5.1).
2) Cut the cable of the Power On Lamp around the connector.
3) Remove the nut attached to the lamp. Then remove the Power ON Lamp from the front panel.
4) Mount a new lamp.

6.8.2 Replacing the Key Switch and the Emergency STOP Button

Part to replace: 60001-EA12 (Switch ASSY)

1) Pull the front cover toward you (See 5.1).
2) Remove the screw attached to the switch.
3) Turn the key switch and the emergency STOP button counterclockwise and remove them from the front panel.



6.8.3 Replacing the Control Panel Cable

Part to replace: 60001-EA45

1) Unscrew the screws (SB4×8[4] and SB3×6[2]). Then remove the rear pillar and the cable holder.

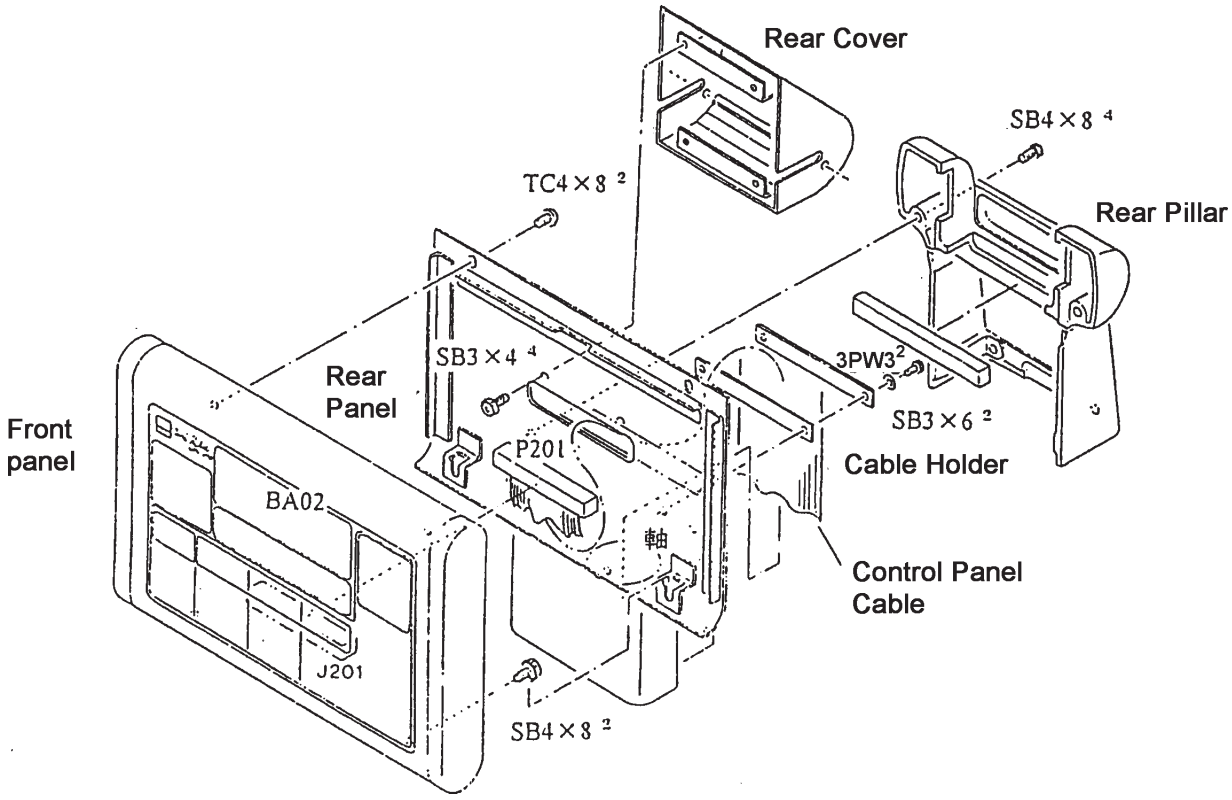
2) Unscrew the screws (TC4×8[2] and SC4×8[2]) and remove the front panel.
Then remove the connector P201 from the control panel board BA02.

3) Unscrew the screws (SB3×4[4]) and remove the rear cover.

4) Pull the front cover toward you. Then remove the connector P105 from the master board BA01 (See 5.1).

5) Pass the control panel cable through in the order of the rear panel, the rear cover, and the shaft. Then replace the cable.

6) Reassemble the removed parts in the reverse order.



6.8.4 Replacing the Scanner Cable 2 ASSY

Part to replace: 60001-EA55

1) Unscrew the screws (SB4×8[4] and SB3×6[2]). Remove the rear pillar and the cable holder.

2) Unscrew the screws (TC4×8[2] and SB4×8[2]). Remove the front panel.

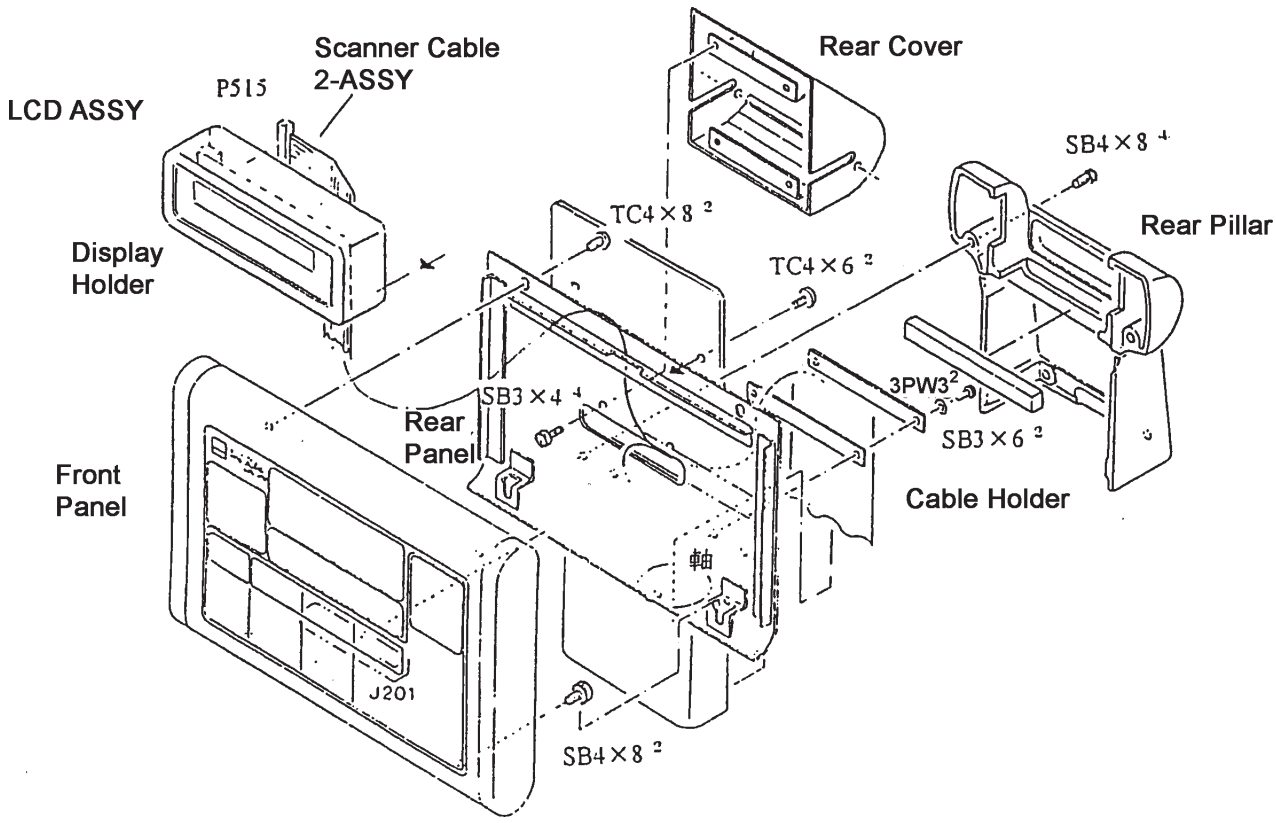
3) Unscrew the screws (SB3×4[4]). Remove the rear cover.

4) Unscrew the screws (TC4×6[2]). Remove the display holder.
Disconnect the connector P515 from the LCD ASSY.

5) Remove all the covers. Then disconnect the connector P114 from the master board BA01, and the connector P5 from the scanner control box (See 5.1).

6) Pass the scanner cable 2 ASSY through in the order of the rear panel, the rear cover, and the shaft. Then replace the cable.

7) Reassemble the removed parts in the reverse order.



§7 CLEANING THE OPTICAL SYSTEM

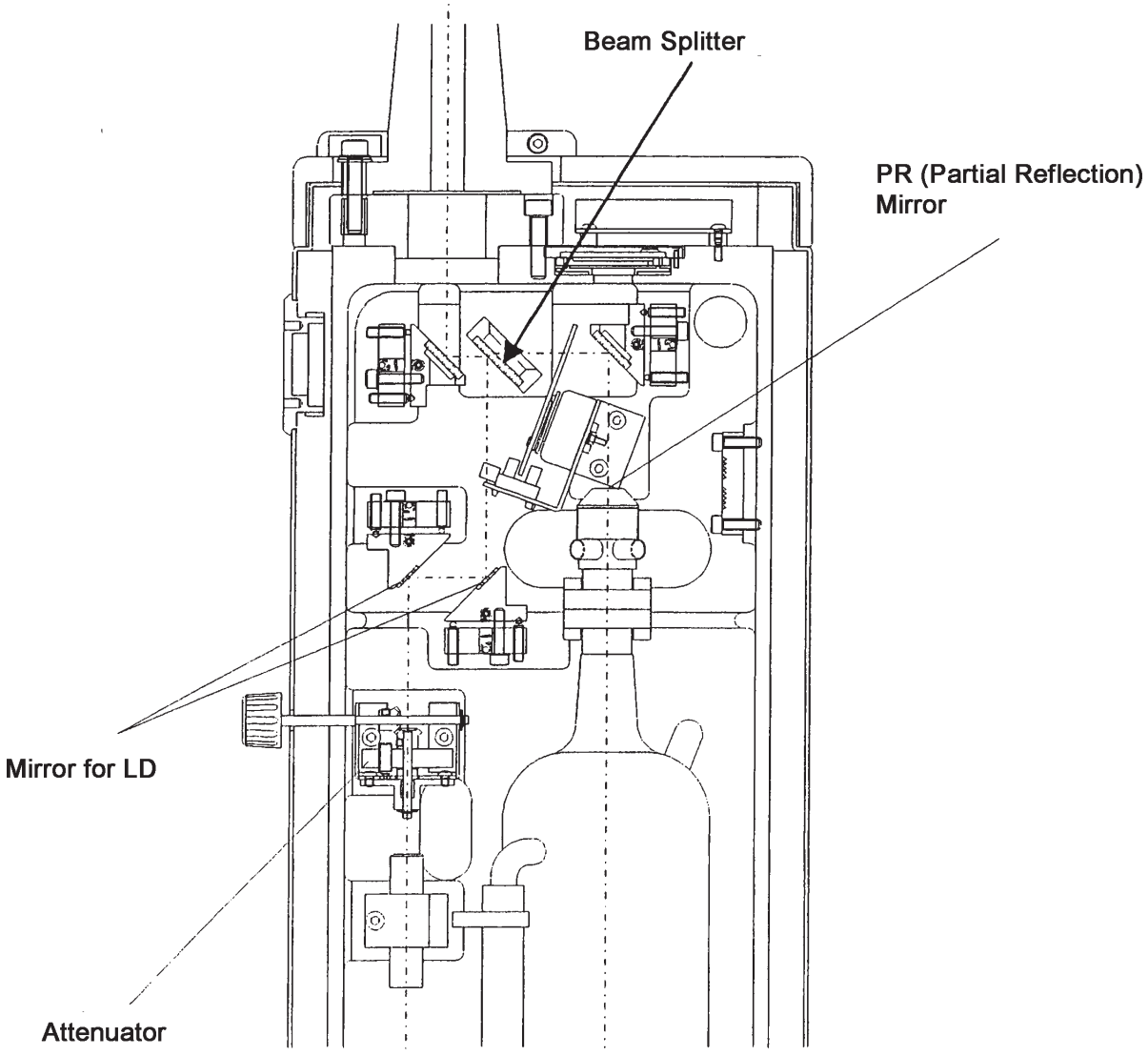
The optical system is concentrated in the optical rail on the rear of the main body.
The cleaning is done to the mirrors that are on the path of CO_2 laser and LD: the PR (Partial Reflection) mirror for CO_2 laser, the mirror for LD, the attenuator for LD, and others.
The mirrors inside the articulated arm are not cleaned basically.

1) Open the rear cover of the main body (See 5.1).

2) Clean the surface of the mirrors with a blower.
If that does not clean the mirrors enough, pick a sheet of cleaning paper, dip it in methanol, and wipe the mirrors with it.
Take enough caution not to damage the surface of the mirrors.

- Stains on the mirrors that are on the path of the CO_2 laser can hinder the full performance of the instrument. In the case of LD, stains disperse the aiming light.

* To clean the beam splitter, wipe it using aceton. Do not use alcohol solvents because of the danger that the beam splitter and the solvent cause a chemical reaction and generate poisonous gas.



8.1 Test and Adjustment of the Optical System

8.1.1 Coaxial Test and Adjustment of the CO_2 Laser and the Aiming Beam

Jigs: power meter
tongue depressor
mirror holder, jig for the reflective mirrors (used only in adjustment)

* When the optical axis of the CO_2 laser deviates widely, that may damage the inner wall of the articulated arm and the optical devices.

Coaxial Test of the CO_2 Laser and the Aiming Beam

1) Release the articulated arm from the holder. Manipulate the handpiece and place it on a steady table.
   Prepare a tongue depressor (jig) and set it about 300mm from the handpiece.

2) Turn the key switch to ON and then to START.
   Never fail to wear CO_2 laser goggles.

3) Set the aiming beam to MED. Adjust the position of the aiming beam so that it is on the tongue depressor.

4) On the operation panel, set the emission conditions of the laser as follows:

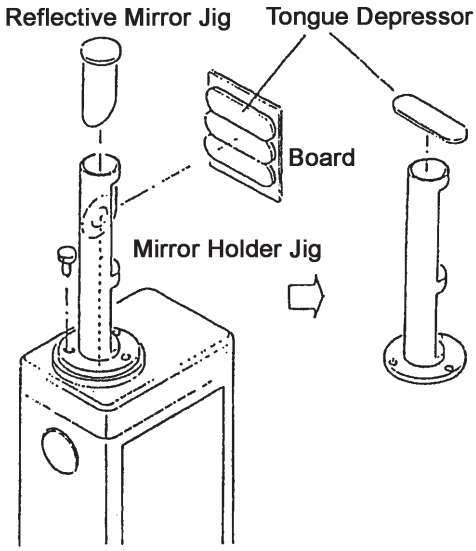
Mode	CW mode / SINGLE
POWER	10W
ON TIME	1sec

5) Turn ON the READY/STANDBY switch.
   When the word “READY” on the operation panel lights, press the footswitch to emit the laser.

6) Confirm that the center of the aiming beam on the tongue depressor coincides with the burn pattern formed by the CO_2 laser.
   The overlapped area of 50% or more is accaptable.
   If the overlapped area is smaller than the standard, perform the coaxial adjustment of the CO_2 laser and the aiming beam.

7) Turn OFF the key switch.

Coaxial Adjustment of the CO_2 Laser and the Aiming Beam



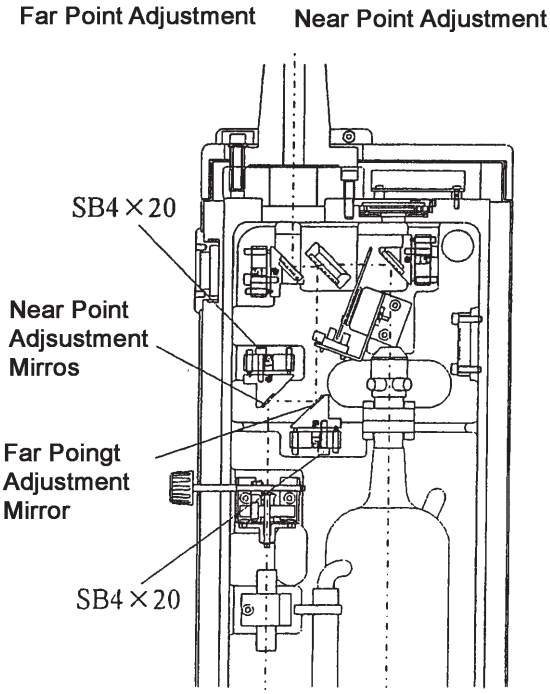
1) Remove the rear panel (See 5.1).

2) Dismount the articulated arm (See 6.1).

3) Mount the mirror holder jig and place a tongue depressor on the holder so that it comes to the center of it.

4) Turn the key switch to ON and then to START. Make sure that all the personnel in the room wear CO_2 laser goggles.

5) Set the aiming beam to MED so that it is on the center of the tongue depressor.



6) Set the emission conditions of the laser as follows:

Mode	CW mode / SINGLE
POWER	10W
ON TIME	1sec

7) Turn ON the READY/STANDBY switch. Then emit the laser.

8) Adjust the near point adjustment mirror so that the center of the aiming beam on the tongue depressor coincides with the burn pattern formed by the CO_2 laser.
..... Near point adjustment
After the adjustment, tighten SB4×20.

9) Remove the tongue depressor from the mirror holder jig. Mount the reflection mirror jig instead. Then project the aiming beam on the wall (2 or 3m apart from the instrument). Tape a board around the place the beam hits to stop the CO_2 laser. On the board, paste about four tongue depressors side by side.

10) Emit the laser again. Adjust the aiming far point adjustment mirror so that the center of the aiming beam on the tongue depressor coincides with the burn pattern formed by the CO_2 laser.
.....Far point adjustment
After the adjustment, tighten SB4×20.

11) Repeat 8)-10) until the center of the aiming beam on the tongue depressor coincides with the burn pattern formed by the CO_2 laser at the near point, and the gap between their centers becomes within 3mm at the far point.

12) Turn OFF the key swith.

8.1.2 Coaxial Test and Adjsutment of the Arm and the Aiming Beam

Jig: Target (Arm Optical Axis Adjustment Jig) CC1DJ-M101

* Confirm that the CO_2 laser and the aiming beam are coaxial before you start the coaxial adjustment of the arm and the aiming beam.
If the CO_2 laser and the aiming beam are not coaxial, the adjustment loses effect.

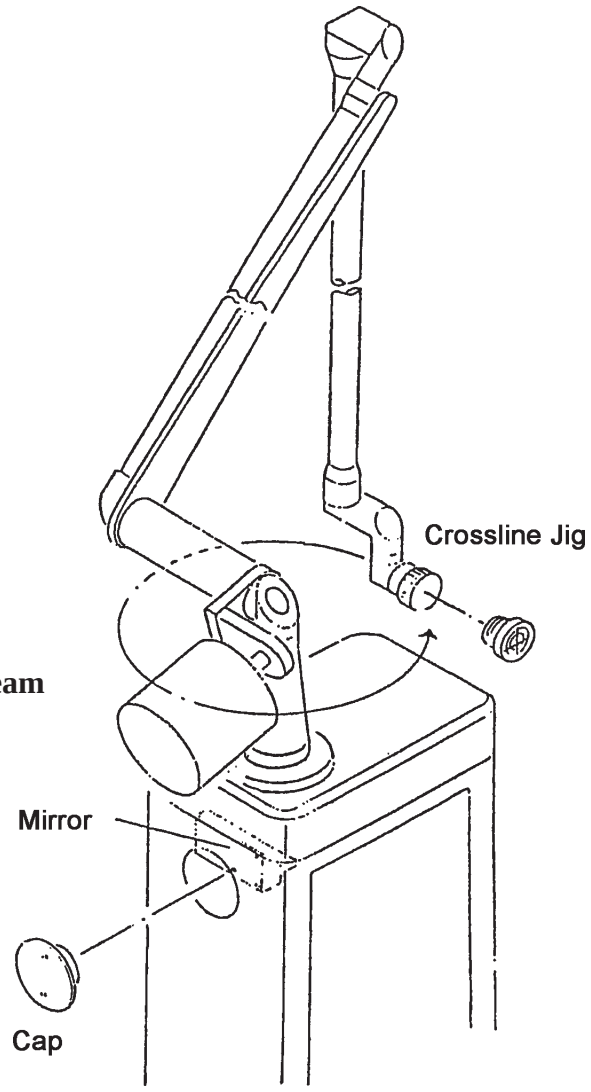
1) Set the target on the tip of the arm.

2) Turn the key switch to ON and then to START.
Be sure to wear CO_2 laser goggles.

3) Set the aiming beam to MED. Confirm that the aiming beam is on the target.

4) Hold the tip of the arm and turn it around the main body once.
If the aiming beam is within 2 mm in radius from the center of the target, that is acceptable. Turn OFF the key switch.

If the result of the test is not within the acceptable starndard, perform the coaxial adjustment below.



Coaxial Adjustment of the Arm and the Aimng Beam

5) Remove the cap (white) by turning it counterclockwise.

6) If the adjustment is not correct, the aiming beam draws a circle on the target while the arm turns.
Adjust the inclination of the mirror so that the beam comes to the center of the circle.

7) Repeat 4) and 6) until the result meets the standard.
When repeated adjustment does not bring the beam to the center, the problem may lie in the articulated arm.
In that case, contact us.

8) Turn OFF the key switch.

8.1.3 Power MAX Test and Adjustment of the CO_2 Laser Tube

Jig: Power Meter

There are mirrors on both ends of the CO_2 laser. The upper mirror is called PR (Partial Reflection) mirror, and the lower one TR (Total Reflection) mirror.
If the two mirrors are not parallel, enough output is not obtained, and can cause errors such as "PWR LOW ERR".
In that case, power MAX test and adjustment of the CO_2 laser tube need to be done.
The TR mirror is immovable. Adjust only the upper PR mirror.

* The test and adjustment are performed near the outlet of the CO_2 laser.
  The CO_2 laser is invisible and high power.
  Lack of caution can cause serious burns. Never place your body parts in the optical path.
  In addition, metal objects like tools are reflective and can cause unexpected accidents.
  Never leave them close to the optical path.

* The power MAX test and adjustment are possible in normal operation, when "PWR LOW ERR" is not displayed. If it is on the display, laser emission is impossible.
  In that case, perform the adjustment in the service mode as described in the next page.

In the case "PWR LOW ERR" is not displayed

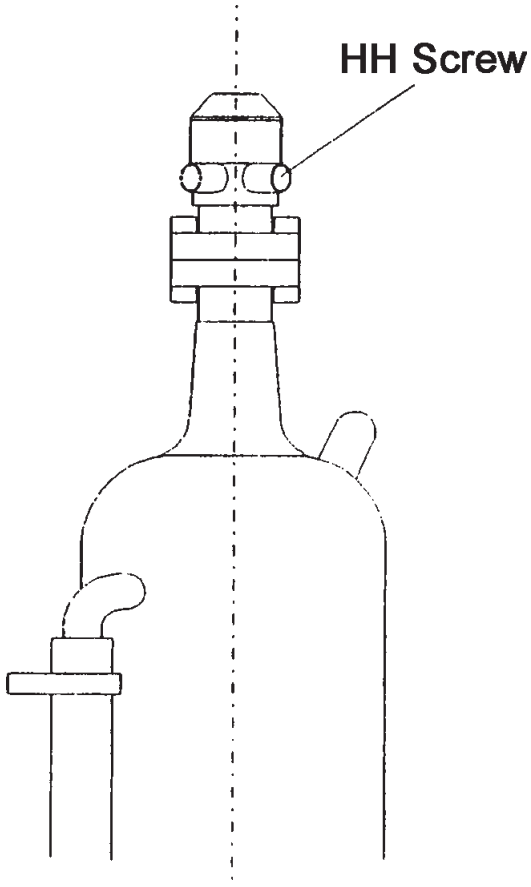
1) Release the articulated arm from the holder.
   Manipulate the handpiece and fix it on a steady table.
   Then prepare a power meter, and fix the light-receptive part at about 100mm from the tip of the handpiece.

2) Remove the rear cover (See 5.1).

3) Turn the key switch to ON and then to START.
   Wear CO_2 laser goggles.
   * Before preceeding to the power MAX test, maintain the STANDBY state for at least ten minutes to stabilize the laser output.

4) Set the emission conditions as follows:

Mode	CW mode / CONT
POWER	10W



5) Set the aiming beam to MED. Confirm that the aiming beam is on the light-receptive part.

6) Turn ON the READY/STANDBY switch.
Confirm that nothing is on the optical path. Then emit the laser.

7) Push the upper part of the CO_2 laser (around the three HH screws) with a tongue depressor to the vertical position to the optical path.

8) If pushing the laser from any circumferential directions tends to decrease the power, the adjustment is correct. If the power increases when the laser is pushed from some directions, tighten the screws on these directions.
If excessive tightening of screws leads to total power reduction, do not loosen them, but tighen the screw on the other side to find the point where the power is maximized.

9) Turn OFF the key switch.

In the case "PWR LOW ERR" is displayed

1) Release the articulated arm from the holder. Manipulate the handpiece and fix it on a steady table.
Then prepare a power meter, and fix the light-receptive part on the handpieceat about 100mm from the tip of it.

2) Remove the top, rear, and right covers (See 5.1).

3) Turn the key switch to ON and then to START". Set the emission condition to CW mode / CONT.
Set the aiming beam to MED, and confirm that the aiming beam is on the light-receptive part.

4) Press SW1 on BA01 and confirm that "SERVICE MODE" is displayed and the instrument is in the service mode.

5) Emit the laser by pressing the footswitch and confirm that the value on the power meter shows 10W. If the value is not 10W, press the POWER △ ▽ buttons to set it to 10W.
   • If 10W cannot be reached, raise the power as possible.

6) Perform the power MAX test in the same manner as 7)-8) of the procedure in the case "PWR LOW ERR" is not displayed.

7) Turn OFF the power of the main body.

8.2 Calibration of the Power Meter and Adjustment of the Master Board

Jigs: Power Meter
Multitester (used only in calibration of the power meter)

Calibration of the Power Meter

Calibration of the power meter is done by adjustment of BA03.

* Confirm that the CO_2 laser and the aiming beam, and the arm and the aiming beam are coaxial before you start the calibration of the power meter.

1) Remove the top, rear, and right covers (See 5.1).

2) Unscrew the screws (SB4×18[2]) and remove the topend (1) and (2) (See 5.2).

3) Remove the upper pad (See 5.1).

4) Set the tester to the voltage range (DC). Connect the gauge head to TP-6 of the power meter board.

5) Release the articulated arm from the holder. Manipulate the handpiece and fix it on a steady table. Then prepare a power meter and fix its light-receptive part at about 100mm from the tip of the handpiece (HP:120mm) or the scanner.

6) Initialize the variable resister (VR1, VR2, and VR3) of the power meter board at the following positions:

VR1(GAIN ADJ)	Center
VR2(OVERSHOOT ADJ)	Fully counterclockwise (CCW)
VR3(OFFSET ADJ)	Center

7) Turn the key switch to ON and then to START. Set the aiming beam to MED, and confirm that the aiming beam is on the light-receptive part.

8) Press SW1 on BA01 and confirm that "SERVICE MODE" is displayed and the instrument is in the service mode.

9) Turn VR3 on BA03 to adjust the voltage of TP–6 to –15mV±5mV.

10) Emit the laser by pressing the footswitch and confirm that the value on the power meter shows 40W. If the value is not 40W, press the POWER △ ▽ buttons to set it to 40W.

11) Read the voltage of TP–6 when the value of the power meter is 40W. Turn VR1 on BA03 to adjust the voltage to DC+4V.

Condition of adjustment: Power meter value × 4V/40W = 4V±0.05V

To convert that, the voltage at TP–6 is DC+1V and the power of the laser is 10W.

* For the scanner type, perform the adjustment at 37W.

Condition of adjustment: Power meter value × 4V/37W = 4V±0.05V

12) Turn OFF the power of the main body.
That completes the calibration of the power meter. Proceed to the adjustment of the master board.

Adjustment of the Master Board

The adjustment of the master board is done at BA01.

13) Initialize the variable resister (VR1, VR2) of BA01 at the following positions:
VR1 (PWR REF) Fully Clockwise (CW)
VR2 (HV CNT) Position of 3 in a clock

14) Turn the key switch to ON and then to START. Set the emission conditions as follows:
Mode CW mode / CONT
POWER 40W

15) Set the aiming beam to MED. Confirm that the aiming beam is on the light-receptive part. Turn ON the READY/STANDBY switch. Then emit the laser.

16) Measure the voltages (DC) of TP11, TP13, and TP15 with a tester. Turn the variable resister (VR1, VR2, and VR3) on BA01 to adjust the voltages as follows:
TP11 (PWR REF) : –5.20V±0.05V → VR1
TP13 (PWR CONT) : –5.50V±0.05V → VR2
TP15 (LASER CUR) : Power meter value×2.5V/40W = 2.5±0.1V → VR3
*Perform the adjustment at 37W for the scanner type.
TP15 Conditions for adjustment: Power meter value×2.5V/37W = 2.5±0.05V

17) When the adjustment is completed, turn OFF the key switch.

8.3 Setting of the Scanner Parameter and Alignment Adjustment of the Scanner Head

* After the replacement of the Scanner Control Box and the Scanner Head, you need to perform setting of the Scanner Parameter and alignment adjustment of the Scanner Head.

Setting of the Scanner Parameter

1) Turn the key switch to ON and then to START" and the mode to CW.

2) Press the DOWN switches of SHAPE, SIZE, and DENSITY simultaneously.
Press the DOWN switches of SHAPE and SIZE alternately as SHAPE → SIZE → SHAPE → SIZE.
Then the system enters the service mode, and on the operation display is "SCANNER SERVICE" and on the scanner display "VARIABLE ADJUST".

3) Press the UP switch of SIZE, and the first parameter "SPOTSIZE" appears on the display. Press the DENSITY switch and set the value at 1.02mm.

4) Press the UP siwthc of SIZE to display other parameters.
As in the case of SPOTSIZE, press the DENSITY switch to set the parameters as shown below. Ignore the value of X and Y offset.

Ftswdly	Refer to right figure.
freqdly	1/3333.00μs
shutter Dly	0.00ms

Set value changes with version of the main body ROM.

Main body ROM	Ftswdly set value
Ver 1.09 or before	107ms
Ver 1.12 or after	140ms

Alignment Adjustment of the Scanner Head

5) Set the mode to SCAN. Adjust the setting as follows:

SHAPE	SQUARE
SIZE	18.9×18.4
DENSITY	0%

6) Adhere a semi-transparent tape on the tip of the scanner head.

7) Set the aiming beam to MED.

8) Manipulate the SCANNER ALIGNMENT switches (up, down, left and right) so that the center of the outlet of the scanner head coincides with the center of the scanner pattern (square).

8.4 Operation Tests

* The three types of operation tests (emission time test, repeat mode operation test, and UNIPULSE mode operation test) are simple means using tongue depressors to check the operation of the system at the location of the installation.
  They are different from the detailed operation check that is done at the factory on the shipment.

8.4.1 Emission Time Test

1) Release the articulated arm from the holder. Manipulate the handpiece and fix it on a steady table.
   Then put a tongue depressor on another and fix them at about 300mm from the tip of the handpiece.
   Two tongue depressors are used not to allow the CO_2 laser pass through them.

2) Turn the key switch to ON and then to START.
   Wear CO_2 laser goggles.

3) Set the aiming beam at MED. Adjust the position of the aiming beam so that it lights the target.

4) On the operation panel, set the emission conditions of the laser as follows:

Mode	CW mode / SINGLE
POWER	40W
ON TIME	0.8 sec

5) Turn ON the READY/STANDBY switch.
   When the “READY” letters on the operation panel lights, press the footswitch and emit the laser.

6) Move the tongue depressors so that the emission position of the CO_2 laser do not overlap with the former one.

7) Change the emission conditions of the laser as shown below. After that press the footswitch again and emit the laser.

ON TIME	0.4 sec

8) Move the tongue depressors again.

9) Change the emission conditions of the laser as shown below. After that press the footswitch again and emit the laser.

ON TIME	0.2 sec

10) Press the READY/STANDBY switch to set the instrument to the “STANDBY” state.

11) Confirm that the size of burned area is decreasing.

12) Turn OFF the key switch.

8.4.2 Repeat Mode Operation Test

1) Release the articulated arm from the holder. Manipulate the handpiece and place it on a steady table.
   Then put a tongue depressor on another and fix them on the handpiece about 300mm from its tip.
   Two tongue depressors are used not to allow the CO_2 laser pass through them.

2) Turn the key switch to ON and then to START.
   Wear CO_2 laser goggles.

3) Set the aiming beam at MED. Adjust the position of the aiming beam so that it lights the target.

4) On the operation panel, set the emission conditions of the laser as follows:

Mode	CW mode / REPEAT
POWER	40W
ON TIME	0.1 sec
OFF TIME	0.1 sec

5) Turn ON the READY/STANDBY switch.
   When the “READY” letters on the operation panel lights, press the footswitch and emit the laser.
   The number of the laser emissions is as follows:
   Laser emissions 10 pulses

6) Move the tongue depressors so that the emission position of the CO_2 laser do not overlap with following ones.

7) Change the number of the laser emissions as shown below. After that press the footswitch again and emit the laser.
   Laser emissions 5 pulses

8) Move the tongue depressors again.

9) Change the number of the laser emissions as shown below. After that press the footswitch again and emit the laser.
   Laser emissions 1 pulse

10) Press the READY/STANDBY switch to set the instrument to the “STANDBY” state.

11) Confirm that the sizes of the cauterization area are decreasing and the depths are becoming shallower gradually.

12) Turn OFF the key switch.

8.4.3 UNIPULSE Mode Operation Test

1) Release the articulated arm from the holder. Manipulate the handpiece and place it on a steady table.
   Then prepare a power meter and fix its light-receptive part on the handpiece about 100mm from its tip.

2) Turn the key switch to ON and then to START.
   Wear CO_2 laser goggles.

3) Set the aiming beam at MED. Adjust the position of the aiming beam so that it lights the target.

4) On the operation panel, set the emission conditions of the laser as follows:
   Mode UNIPULSE mode / CONT
   COAG/CUT I (COAG)
   POWER 5W

5) Turn ON the READY/STANDBY switch.
   When the “READY” letters on the operation panel lights, press the footswitch and emit the laser.
   At this time, confirm that the power meter value is 5W±20%.

6) Change the emission condition of the laser as shown below. After that press the footswitch again and emit the laser.
   COAG/CUT III
   At this time, as in 5), confirm that the power meter value is 5W±20%.

7) Change the emission condition of the laser as shown below. After that press the footswitch again and emit the laser.
   COAG/CUT V (CUT)
   At this time, as in 5), confirm that the power meter value is 5W±20%.

8) Turn OFF the key switch.

§9 ERROR MESSAGE LIST

This section describes the meanings of the error messages and the counter measures against the errors.
In the case that there are multiple actions in the “CHECK / MEASURES” section, start with the item with the smallest number.
Except for when you check the cause of the error messages, turn the power switch of the main body OFF.
If the power is left ON, that may deteriorate the condition.

1. On the Status Display

ERROR MESSAGES	MEANING	CHECK / MEASURES
FOOT SW MISSING	The connector of the footswitch is off.	Connect the connector of the footswitch.
REMOTE INTLK ERR	The remote interlock connector is off.	Connect the remote interlock connector.
FLOW SWITCH ERR	The flow switch has detected a malfuntion.	1. Check if the pump is operating. 2. Check if the amount of the cooling liquid is enough. 3. Replace the footswitch. 4. Replace EA90.
TEMP SWITCH ERR	The TEMP switch has detected a malfunction.	1. Check if the fan is operating. 2. Replace the temperature switch. 3. Replace EA90.
SHUTTER ERR	The safety shutter did not operate normally.	1. Check if the shutter is in its place and has nothing caught in it. 2. Check the solenoid or the wiring of the shutter sensor for breaks or bad crimps. 3. Replace EA90. 4. Replace the shutter unit.
LASER POWER ERR	The laser has been emitted with an output over the standard value.	1. Adjust BA01 and BA03. 2. Replace the power meter. 3. Replace BA03 4. Replace EA90.
POWER LOW ERR	The laser has been emitted with an output under the set value.	See “4.6 Troubleshooting”.
TIMING ERR	The timing of the safety shutter and the laser control cannot be synchronized.	Replace EA90.
SCANNER MISSING	The scanner connector was disconnected when the scanner was being used.	Connect the scanner connector.
ADC CHECK ERR	The input value to the A/D converter is not normal.	Please contact us.
SCANNER ERROR	The scanner has detected an error.	1. Check the operation of the scanner. 2. Replace the scanner (CC1SM-1). 3. Replace 60003-CA43.

2. On the Scanner Display

ERROR MESSAGES	MEANING	CHECK / MEASURES
The message is out. (Only the backlight is on.)	Problem is on the part of the main body.	1. Check the CC-1A main body for errors. 2. Replace 60003-CA43.
SCANNER ERROR	The scanner did not operate normally.	1. Check the operation of the scanner. 2. Replace the scanner (CC1SM-1).
SCANNER ERROR X	The scanner of the X axis system did not operate normally.	1. Check the operation of the X Galvanometer. 2. Replace and adjust the X Galvanometer.
SCANNER ERROR Y	The scanner of the Y axis system did not operate normally.	1. Check the operation of the Y Galvanometer. 2. Replace and adjust the Y Galvanometer.
+15 and –15V ERROR	Lack of power supply voltage.	1. Check ±15V of the scanner (CC1SM-1). 2. Replace the LVPS BOARD of the scanner (CC1SM-1).
PATTERN TOO SMALL	The shutter delay value is longer than the specified pattern emission time.	Check the setting of the parameter in the ADJUST MODE of CC1SM-1.

§10 CONNECTOR TABLE

This section is a description of the details and functions of the connector table on the board.

BA01

Connector No.	Pin No.	IN/OUT	Type	Level	Signal Name	Function
J101 (LVPS)	1	INPUT	Digital	+5V	+5V	+5V power supply
	2	INPUT	Digital	+5V	+5V	+5V power supply
	3	GROUND	Digital	0V	D.GND	Digital Ground
	4	GROUND	Digital	0V	D.GND	Digital Ground
J102 (LVPS)	1	INPUT	Analog	+15V	+15V	+15V power supply
	2	GROUND	Analog	0V	A.GND	Analog Ground
	3	INPUT	Analog	–5V	–15V	–15V power supply
J103 (HVPS)	1	(OUTPUT)	(Digital)	(+5V)	(+5V)	Not used
	2	OUTPUT	Analog	0 - +5.25V	HVPS CONTROL	Laser output control signal
	3	GROUND	Analog	0V	A.GND	Analog Ground
	4	OUTPUT	Analog	+15V	HVPS GATE	HVPS ON signal
	5	GROUND	Digital	0V	D.GND	Digital Ground
	6				NC	
	7				NC	
	8	INPUT	Analog	0 - +5V	LASER CUR	Electricity to the laser tube
	9	(INPUT)	(Analog)	(–15V)	(–15V)	Not used
	10	(INPUT)	(Analog)	(+15V)	(+15V)	Not used
J104 (LD)	1	OUTPUT	Digital	+5V	+5V	+5V power supply
	2	OUTPUT	Digital	0 - +5V	LD ON	LD ON signal (Active L)
	3	INPUT	Digital	0 - +5V	LD SW	LD SW ON signal (Active L)
	4	INPUT	Ground	+5.25V	D.GND	Digital Ground
J105 (BA02)	A1	OUTPUT	Digital	+5V	+5V	+5V power supply
	B1	OUTPUT	Digital	+5V	+5V	+5V power supply
	A2	OUTPUT	Digital	+5V	+5V	+5V power supply
	B2	OUTPUT	Digital	+5V	+5V	+5V power supply
	A3	GROUND	Digital	0V	D.GND	Digital Ground
	B3	GROUND	Digital	0V	D.GND	Digital Ground

Connector No.	Pin No.	IN/OUT	Type	Level	Signal Name	Function
J105 (BA02)	A4	INPUT	Digital	0 -+5V	DISPLAY STUS	Not connected to BA02 when the signal level is H
	B4	GROUND	Digital	0V	D.GND	Digital Ground
	A5	OUTPUT	Digital	0 - +5V	BEEP	BEEP (BA02 SP1) is ON when the signal level is L
	B5	GROUND	Digital	0V	D.GND	Digital Ground
	A6	OUTPUT	Digital	0 - +5V	CS7218A1	IC1 Chip Select
	B6	OUTPUT	Digital	0V	CS7218A2	IC2 Chip Select
	A7	OUTPUT	Digital	0V	CS7218A3	IC3 Chip Select
	B7	GROUND	Digital	0V	D.GND	Digital Ground
	A8	GROUND	Digital	0V	D.GND	Digital Ground
	B8	OUTPUT	Digital	0 - +5V	CE1	D28 Chip Enable
	A9	OUTPUT	Digital	0 - +5V	CE2	D29 Chip Enable
	B9	GROUND	Digital	0V	D.GND	Digital Ground
	A10	OUTPUT	Digital	0 - +5V	MODE	IC 1, 2, 3 Decode (Active L)
	B10	GROUND	Digital	0V	D.GND	Digital Ground
	A11	OUTPUT	Digital	0 - +5V	BWR	Write (Active L)
	B11	OUTPUT	Digital	0 - +5V	RESET	System Reset (Active L)
	A12	OUTPUT	Digital	0 - +5V	CS SW1	IC4 Chip Select (Active L)
	B12	OUTPUT	Digital	0 - +5V	CS SW2	IC5 Chip Select (Active L)
	A13	OUTPUT	Digital	0 - +5V	CS SW3	IC6 Chip Select (Active L)
	B13	OUTPUT	Digital	0 - +5V	CS SW4	IC7 Chip Select (Active L)
	A14-B15	GROUND	Digital	0V	D.GND	Digital Ground
	A16	OUTPUT	Digital	0 - +5V	A5	D28, D29 Address Sig.
	B16	OUTPUT	Digital	0 - +5V	A4	D28, D29 Address Sig.
	A17	OUTPUT	Digital	0 -+5V	A3	D28, D29 Address Sig.
	B17	OUTPUT	Digital	0 - +5V	A2	D28, D29 Address Sig.
	A18	OUTPUT	Digital	0 - +5V	A1	D28, D29 Address Sig.
	B18	OUTPUT	Digital	0 - +5V	A0	D28, D29 Address Sig.
	A19	GROUND	Digital	0V	D.GND	Digital Ground
	B19	GROUND	Digital	0V	D.GND	Digital Ground

Connector No.	Pin No.	IN/OUT	Type	Level	Signal Name	Function
J105 (BA02)	A20	OUTPUT	Digital	0 - +5V	D7	Date Sig.
	B20	OUTPUT	Digital	0 - +5V	D6	Data Sig.
	A21	OUTPUT	Digital	0 - +5V	D5	Date Sig.
	B21	OUTPUT	Digital	0 - +5V	D4	Data Sig.
	A22	OUTPUT	Digital	0 - +5V	D3	Date Sig.
	B22	OUTPUT	Digital	0 - +5V	D2	Data Sig.
	A23	OUTPUT	Digital	0 - +5V	D1	Date Sig.
	B23	OUTPUT	Digital	0 - +5V	D0	Data Sig.
	A24-B25	GROUND	Digital	0V	D.GND	Digital Ground
J106 (Shutter)	1	INPUT	Digital	0 - +5V	SHUTTER SENSE	SHUTTER OPEN when the signal level is H
	2	GROUND	Digital	0V	D.GND	Digital Ground
	3	OUTPUT	Digital	+5V	SHUTTER LED	Photointerrupter LED power supply
	4	OUTPUT	Analog	0 - +15V	SHUTTER SOL	SHUTTER OPEN at +15V
	5	GROUND	Analog	0V	A.GND	Analog Ground
J107 (FOOT SW)	1	GROUND	Digital	0V	D.GND	Digital Ground
	2	GROUND	Digital	0V	D.GND	Digital Ground
	3	INPUT	Digital	0 - +5V	FOOT SW INT	FOOT SW disconnected when the signal level is H
	4	INPUT	Digital	0 - +5V	OFF	FOOT SW OFF when the signal level is L
	5	GROUND	Digital	0V	D.GND	Digital Ground
	6	INPUT	Digital	0 - +5V	ON	FOOT SW ON when the signal level is L
	7	GROUND	Digital	0V	F.GND	Digital Ground
	8	INPUT	Digital	0 - +5V	FOOT SW	FOOT SW and SCANNER ON when the signal level is L
J108 (FOOT SW1)	1	GROUND	Digital	0V	D.GND	Digital Ground
	2	GROUND	Digital	0V	D.GND	Digital Ground
	3	OUTPUT	Digital	0 - +5V	FOOT SW INT 1	FOOT SW disconnected when the signal level is H
	4	OUTPUT	Digital	0 - +5V	OFF 1	FOOT SW ON when the signal level is L
	5	GROUND	Digital	0V	D.GND	Digital Ground
	6	OUTPUT	Digital	0 - +5V	ON 1	FOOT SW ON when the signal level is L
	7	GROUND	Digital	0V	F.GND	Digital Ground
	8	OUTPUT	Digital	0 - +5V	FOOT SW 1	FOOT SW and SCANNER ON when the signal level is L
	9	INPUT	Digital	0 - +5V	TG	Laser output forbidden when the signal level is H

Connector No.	Pin No.	IN/OUT	Type	Level	Signal Name	Function
J109 (FOOT SW2)	1	GROUND	Digital	0V	D.GND	Digital Ground
	2	GROUND	Digital	0V	D.GND	Digital Ground
	3	INPUT	Digital	0 - +5V	FOOTSW INT2	FOOT SW disconnected when the signal level is H
	4	INPUT	Digital	0 - +5V	OFF 2	FOOT SW OFF when the signal level is L
	5	GROUND	Digital	0V	D.GND	Digital Ground
	6	INPUT	Digital	0 - +5V	ON 2	FOOT SW ON when the signal level is L
	7	GROUND	Digital	0V	F.GND	Digital Ground
	8	INPUT	Digital	0 - +5V	FOOTSW 2	FOOT SW and SCANNER ON when the signal level is L
J110 (HEAD SW)	1	INPUT	Digital	0 - +5V	NO HEAD	SCANNER HEAD disconnected when the signal power is H
	2	GROUND	Digital	0V	D.GND	Digital Ground
	3				NC	
J111 (SCAN ON)	1	OUTPUT	Digital	+5V	+5V	+5V power supply
	2	OUTPUT	Digital	0 - +5V	SCANNER ON	SCANNER SSR ON→Power Supply ON when the signal level is L
J112 (POWER METER)	1	OUTPUT	Analog	+15V	+15V	+15V power supply (for BA03)
	2	GROUND	Analog	0V	A.GND	Analog Ground
	3	OUTPUT	Analog	–15V	–15V	–15V power supply (for BA03)
	4	GROUND	Analog	0V	A.GND	Analog Ground
	5	GROUND	Analog	0V	SHIELD	Analog Ground
	6	INPUT	Analog	0 - +5V	POWER OUT	Power meter input 1V/10W
	7	GROUND	Analog	0V	A.GND	Analog Ground
J114 (SCANNER)	1	OUTPUT	Digital	0 - +5V	SCAN SW1	SW1 Sig.
	2	GROUND	Digital	0 - +5V	SCAN SW2	SW2 Sig.
	3	OUTPUT	Digital	0 - +5V	SCAN SW3	SW3 Sig.
	4	OUTPUT	Digital	0 - +5V	SCAN SW4	SW4 Sig.
	5	GROUND	Digital	0 - +5V	SCAN SW5	SW5 Sig.
	6	OUTPUT	Digital	0 - +5V	SCAN SW6	SW6 Sig.
	7	INPUT	Digital	0 - +5V	SCAN COM1	COM1 Sig.
	8	INPUT	Digital	0 - +5V	SCAN COM2	COM2 Sig.
	9				NC	

Connecttor No.	Pin No.	IN/OUT	Type	Level	Signal Name	Function
J117	1	GROUND	Digital	0V	D.GND	Digital Ground
(TEMP)	2	INPUT	Digital	0 - +5V	TEMP INT	TEMP ERR when the signal level is H
J118	1	GROUND	Digital	0V	D.GND	Digital Ground
(FLOW)	2	INPUT	Digital	0 - +5V	FLOW INT	FLOW ERR when the signal level is H
	3				NC	
J119	1	GROUND	Digital	0V	D.GND	Digital Ground
(REMOTE)	2	INPUT	Digital	0 - +5V	INTLK	RMT INTLK when thesignal level is H
	3				NC	
J120	1				NC	
(PRINTER)	2	OUTPUT	Digital	0 - +5V	TXD	TXD signal
	3	INPUT	Digital	0 - +5V	RXD	RXD signal
	4-6				NC	
	7	GROUND	Digital	0V	D.GND	Digital Ground
	8-25				NC	

BA02

As for BA02 • J201, see the connector table BA01 • J105. However , IN/OUT of BA02 • J201 are reverse to those of BA01 • J105.

Connector No.	Pin No.	IN/OUT	Type	Level	Signal Name	Function
J301	1	INPUT	Analog	0 - +4mV	SENSOR IN	Power meter input signal
(POWER IN)	2	GROUND	Analog	0V	A.GND	Analog Ground
J302	1	OUTPUT	Analog	+15V	+15V	+15V power supply (for BA03)
	2	GROUND	Analog	0V	A.GND	Analog Ground
	3	OUTPUT	Analog	–15V	–15V	–15V power supply (for BA03)
	4	GROUND	Analog	0V	A.GND	Analog Ground
J303	1	GROUND	Analog	0V	A.GND	Analog Ground
(POWER	2	OUTPUT	Analog	0 - +15V	POWER OUT	Power meter output 1V/10W
OUT)	3	GROUND	Analog	0V	A.GND	Analog Ground

§11 TEST POINTS LIST

This section is a description of the details of the main test points on the board.

BA01

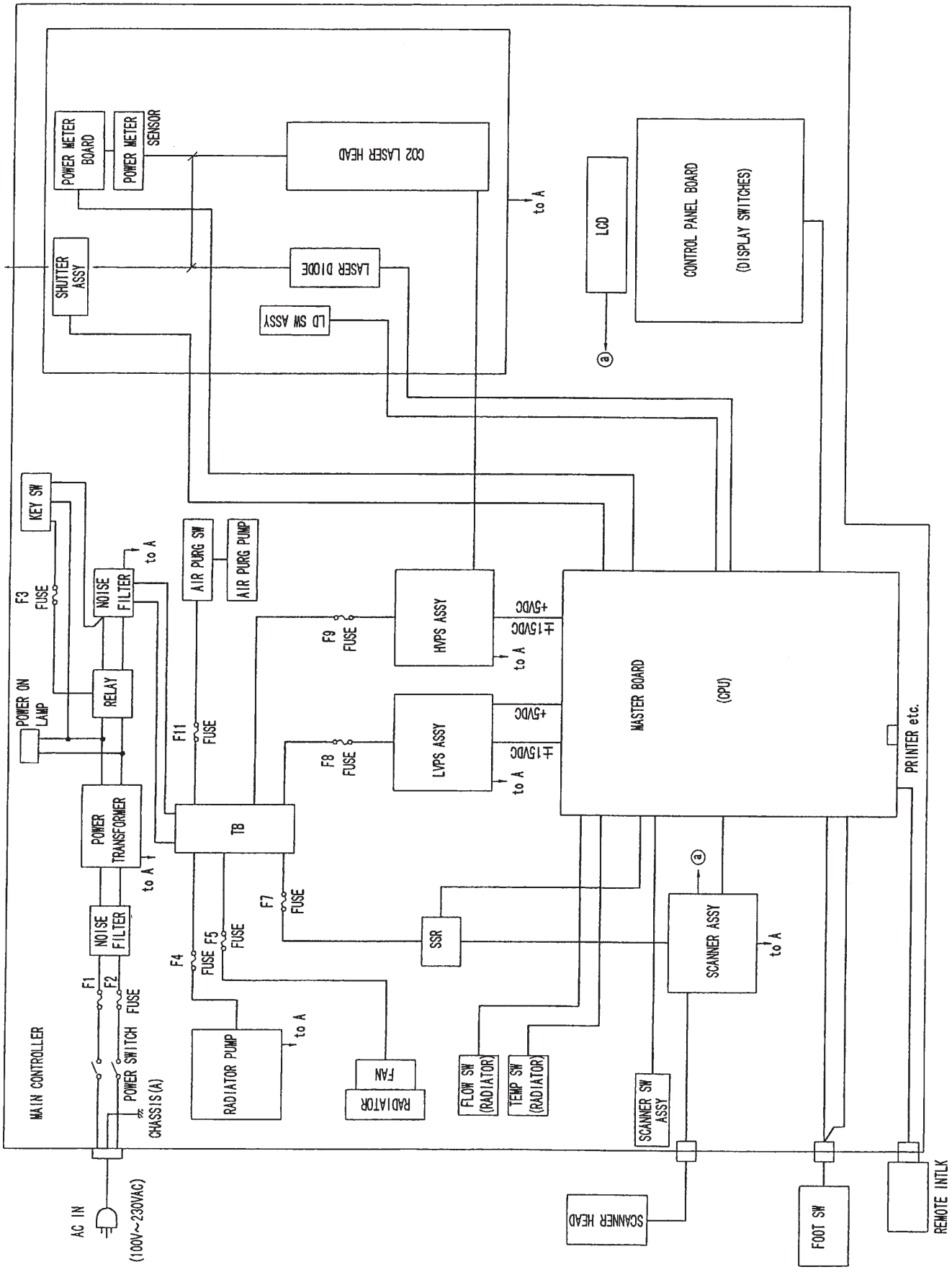
TP No.	Type	Level	Signal Name	Function	Corresponding Volume No.
1	Digital	0 -+5V	RESET/	System reset when the signal level is L	
2	Digital	0 - +5V	RESET/	Hardware reset when the signal level is L	
3	Digital	0 - +5V	RESET	CPU reset when the signal level is H	
4	Digital	0 - +5V	Shutter Solenoid	Shutter OPEN when the signal level is H	
8	Digital	0 - +5V	SCAN REPEAT	Scan Repeat OFF when the signal level is H	
9	Digital	0 - +5V	CAL	Calibration when the signal level is H	
10	Analog	0 - +5.2V (±0.05V)	PWR REF	Laser over power voltage	
11	Analog	–7.5V - 0V (Adjust it to -5.2±0.05V)	(PWR REF)	Standard value of laser over power voltage	VR1
12	Analog	0 - +5.5V (±0.05V)	HV CNT	Laser over power voltage	
13	Analog	–7.5V - 0V (Adjust it to -5.5±0.05V)	(HV CNT)	Standard value of laser over power voltage	VR2
15	Analog	0 - +5V	LASER CUR	Monitor value of laser tube current	VR3
16	Analog	0 - +5V	AIN	Output signal from IC21 (Multiplexer)	
18	Digital	0 - +5V	POWER OVER	Laser over power when the signal level is H	
21	Digital	0 - +5V	HV CNTR	HVPS ON when the signal level is H	
22	Digital	0 - +5V	TG	Laser output forbidden when the signal level is H (during the operation of the galvanometer)	
31	Digital	0 - +5V	SHUTTER SOL	Shutter OPEN when the signal level is H	
32	Digital	0 - +5V	HV G/	HVPS ON when the signal level is L	

BA03

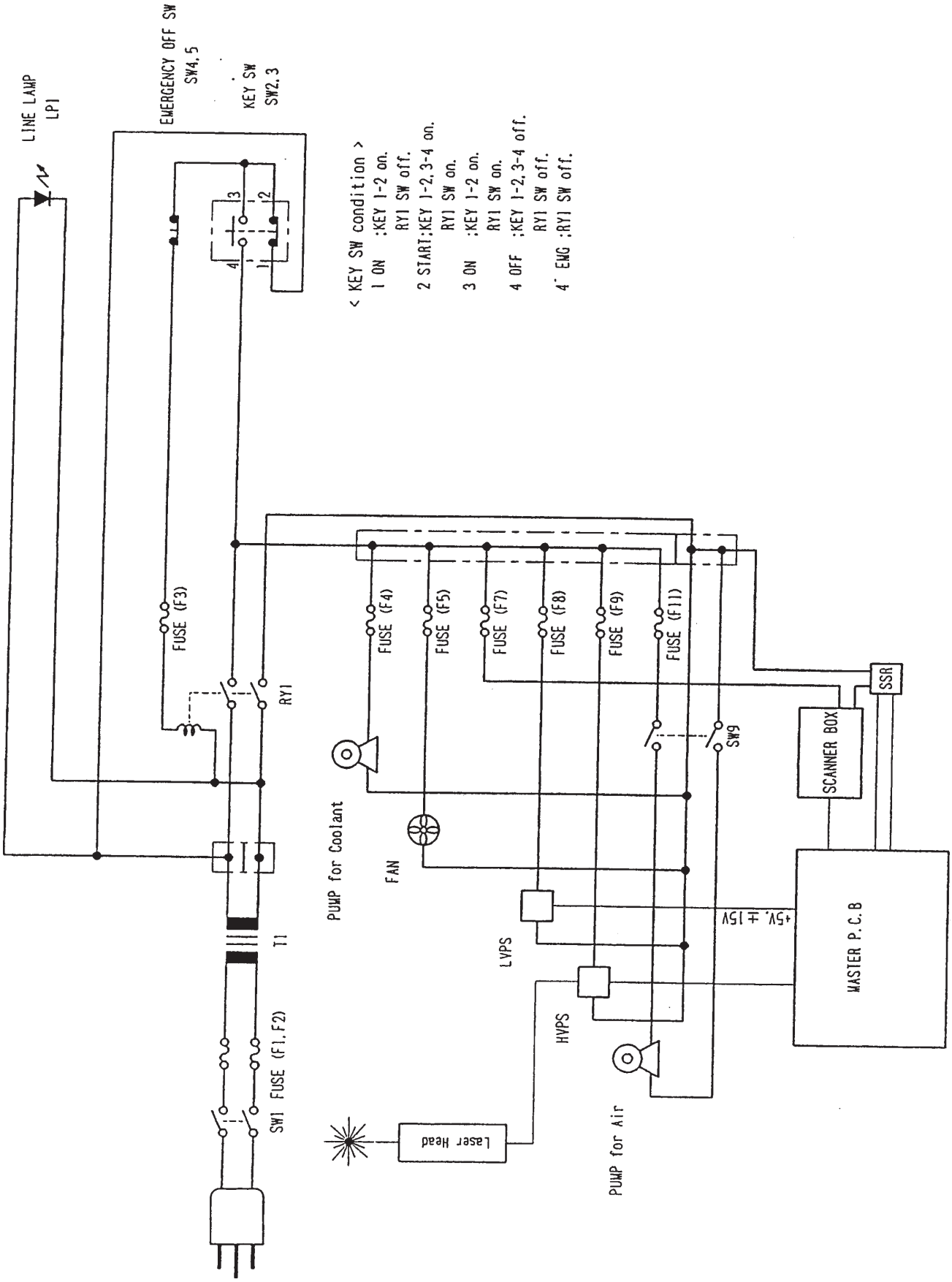
TP No.	Type	Level	Signal Name	Function	Corresponding Volume No.
1	Analog	+15V	+15V	Power supply	
2	Analog	–15V	–15V	Power supply	
3	Analog	0-+1V		First AMP output signal from the power meter sensor	
4	Analog	0 - +11V	GAIN	AMP output signal (1-11 times as much) GAIN adjustment	VR1
5	Analog	–0.44 - +0.44V	OFFSET	OFFSET adjustment	VR3
6	Analog	–0.22 - +5.72V	OVER SHOOT	OVER SHOOT adjustment	VR2

§12 WIRING DIAGRAM

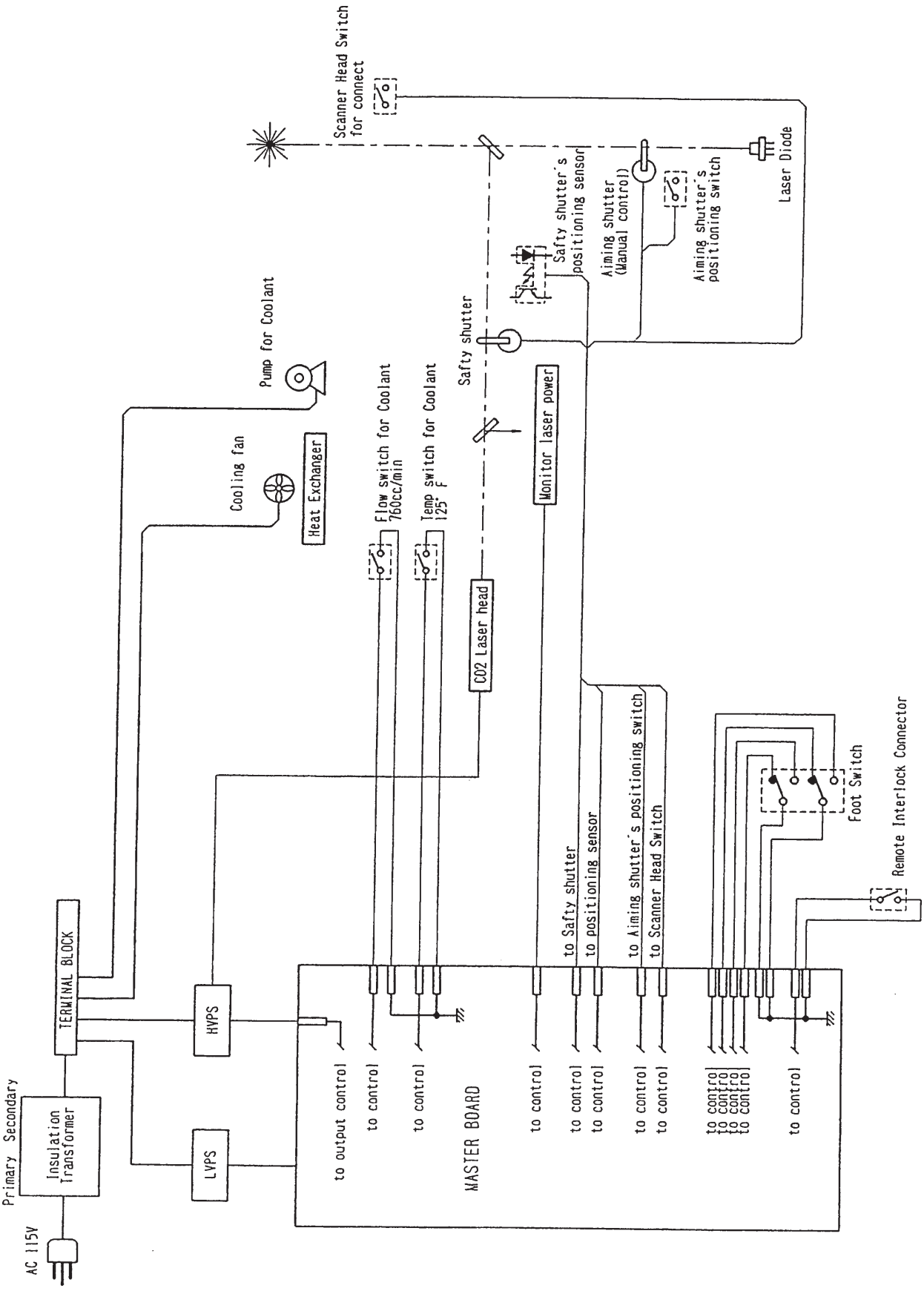
12.1 System Block Diagram

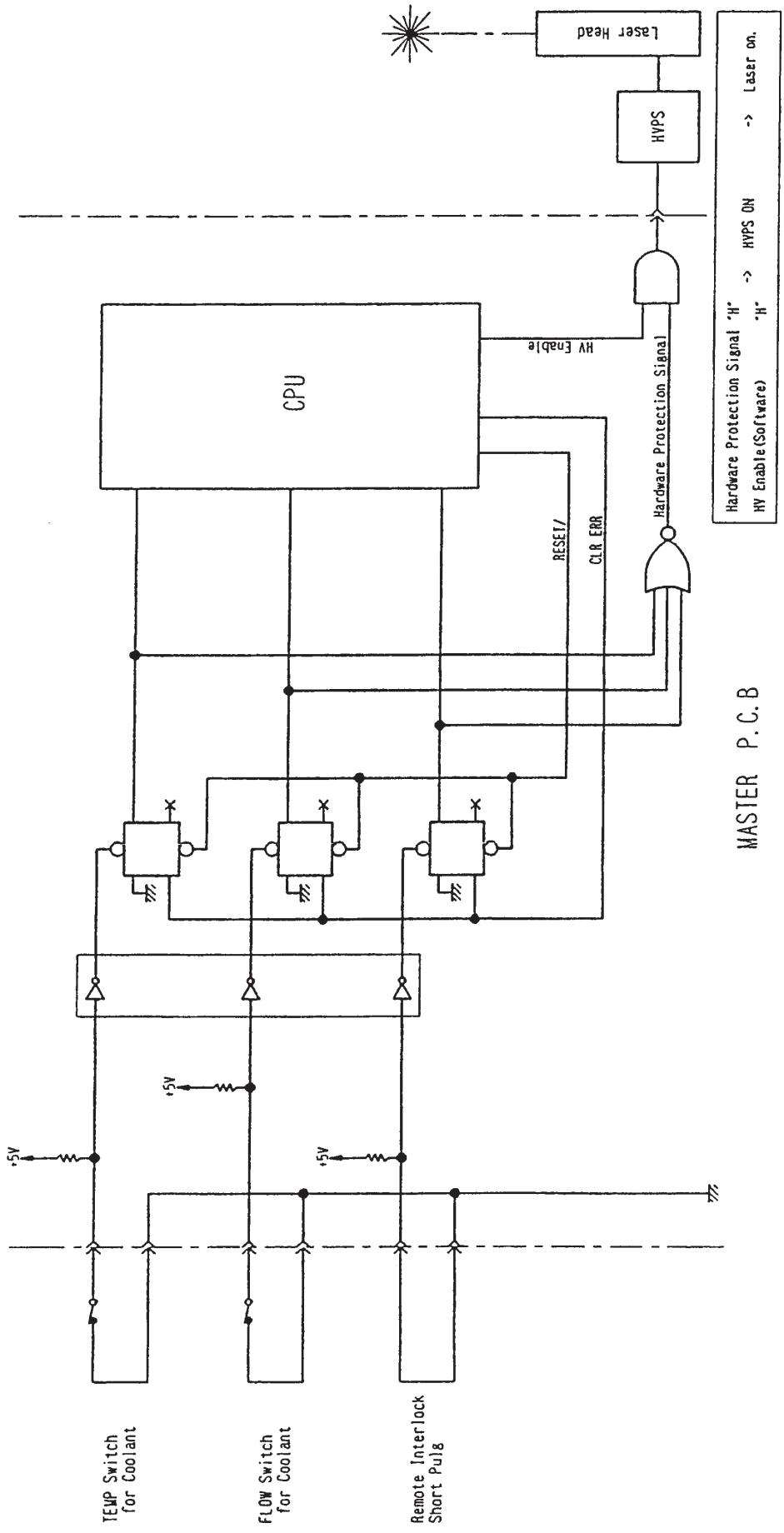


12.2 Power Sequence Block Diagram



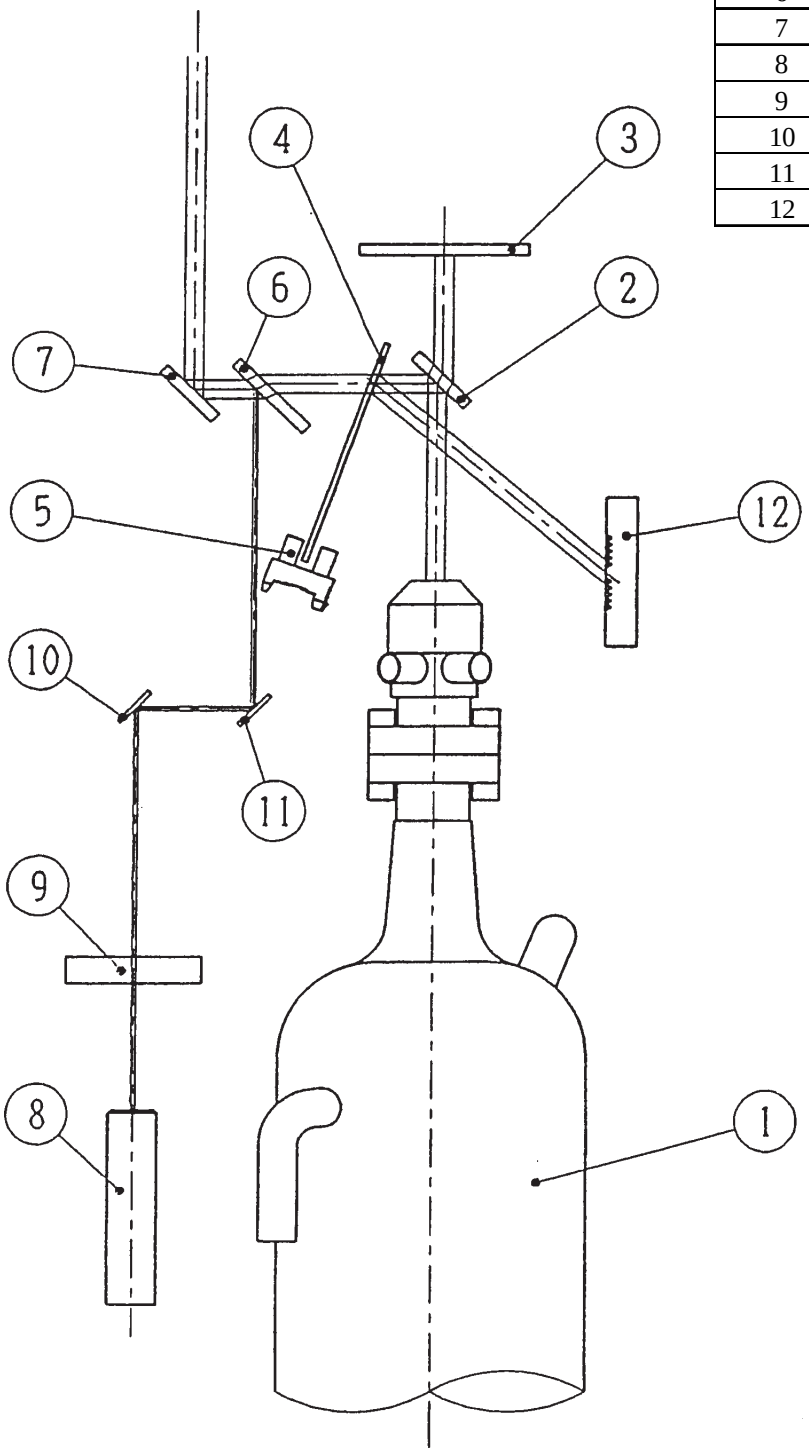
12.3 Interlock Chain Block Diagram




Laser Head
HVPS
Hardware Protection Signal "H" -> HVPS ON -> Laser on.
HV Enable(Software) "H"
CPU
HV Enable
Hardware Protection Signal
RESET/
CLR ERR
MASTER P.C.B
+5V
+5V
+5V
TEMP Switch for Coolant
FLOW Switch for Coolant
Remote Interlock Short Pulg

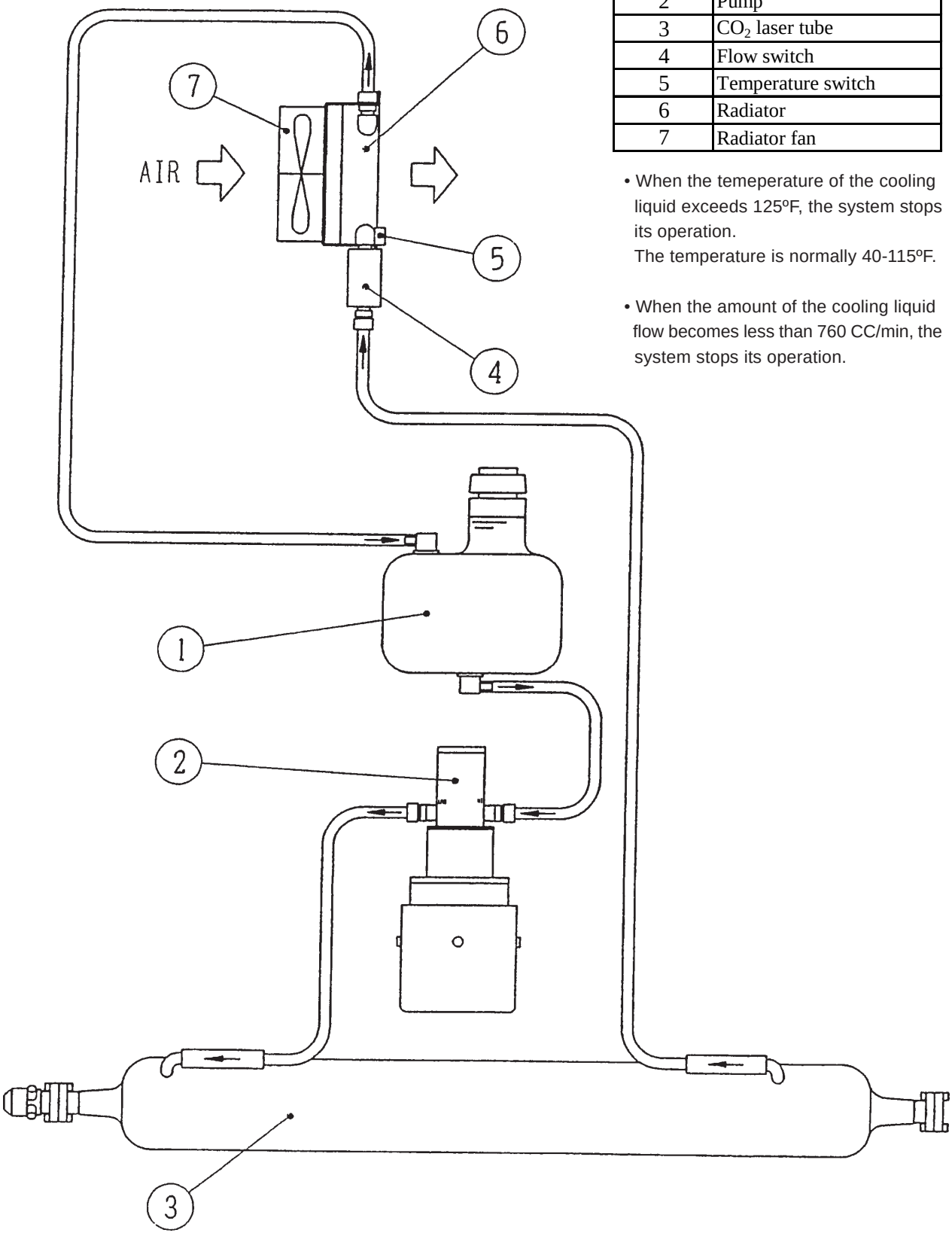
12.4 Optical System Block Diagram

No.	Parts Name
1	CO_2 laser tube
2	Beam splitter
3	Power meter
4	Shutter plate
5	Shutter sensor
6	Dichroic mirror
7	Mirror
8	Diode laser
9	Attenuator & shutter
10	Mirror
11	Mirror
12	Absorption plate



12.5 Cooling System Block Diagram

No.	Parts Name
1	Reservoir
2	Pump
3	CO_2 laser tube
4	Flow switch
5	Temperature switch
6	Radiator
7	Radiator fan

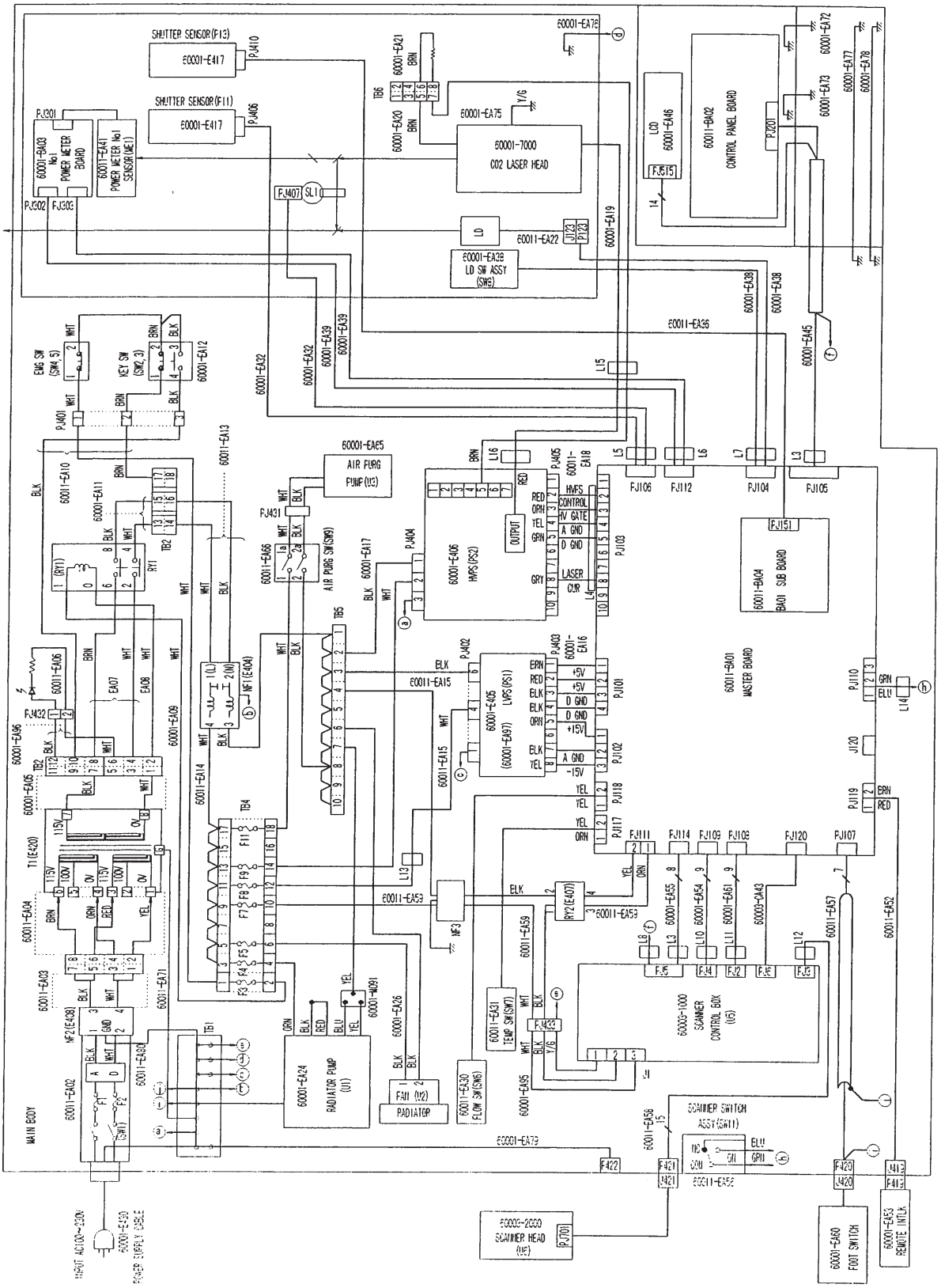


- When the temeperature of the cooling liquid exceeds 125ºF, the system stops its operation.
  The temperature is normally 40-115ºF.

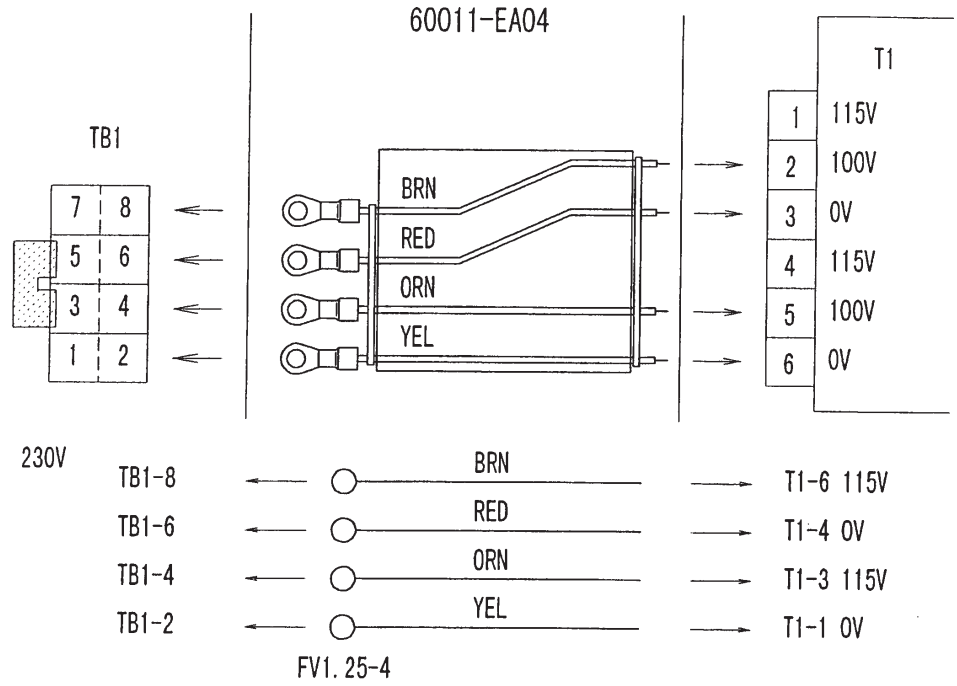
- When the amount of the cooling liquid flow becomes less than 760 CC/min, the system stops its operation.

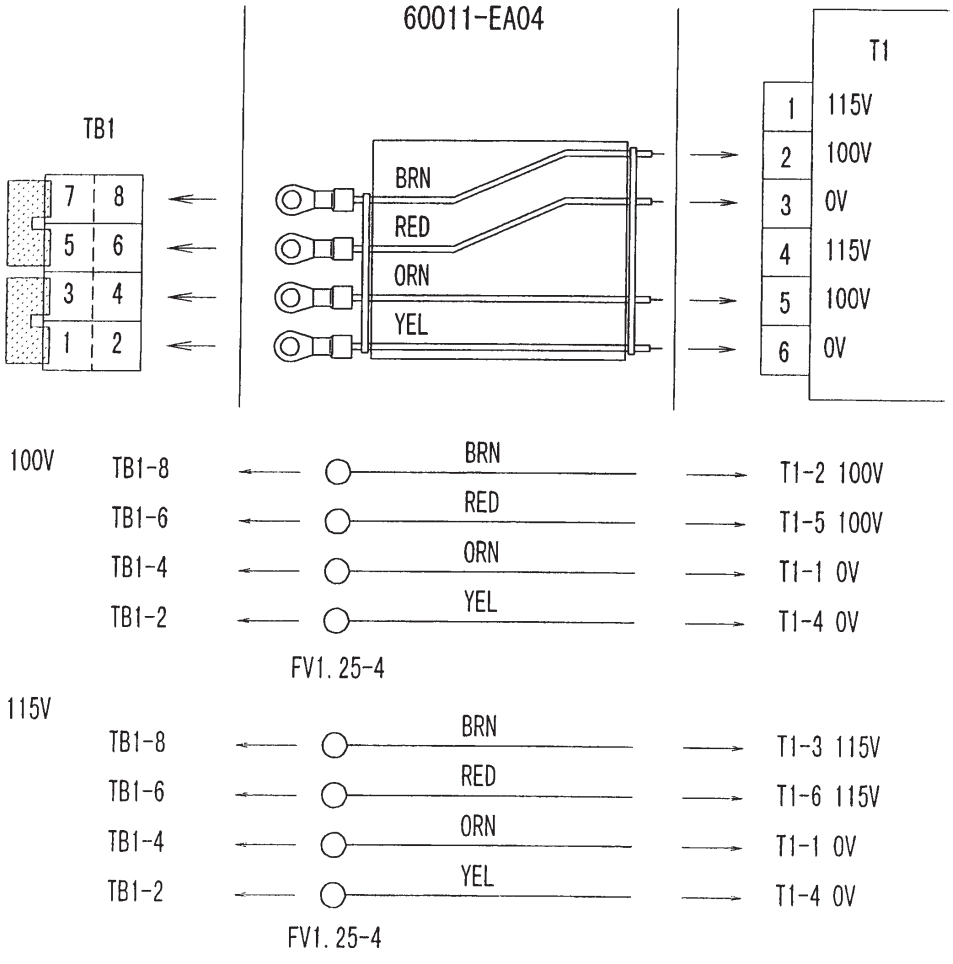
12.6 Wiring Diagram

12.6.1 System Wiring Diagram

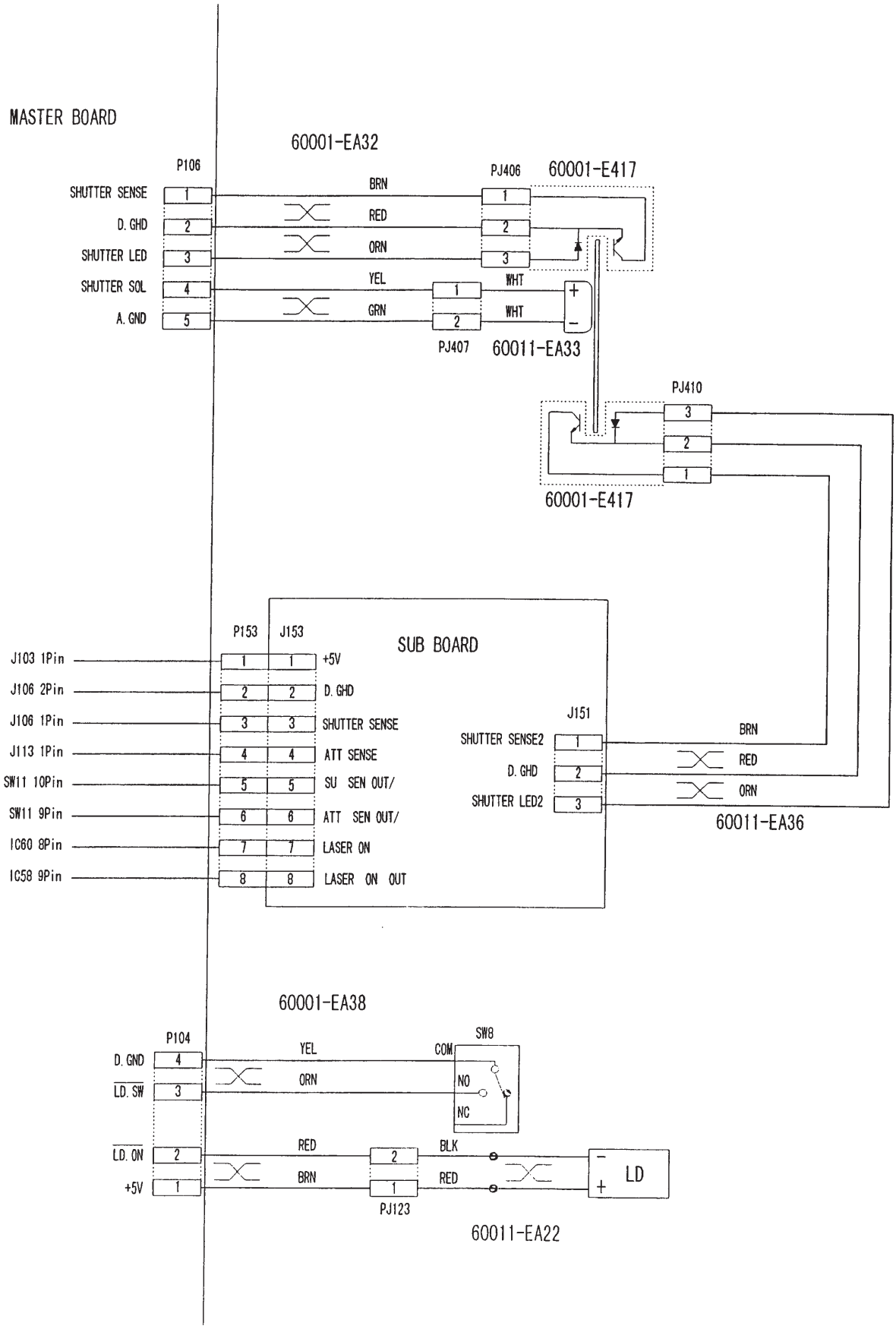


12.6.2 Transformer Wiring Diagram

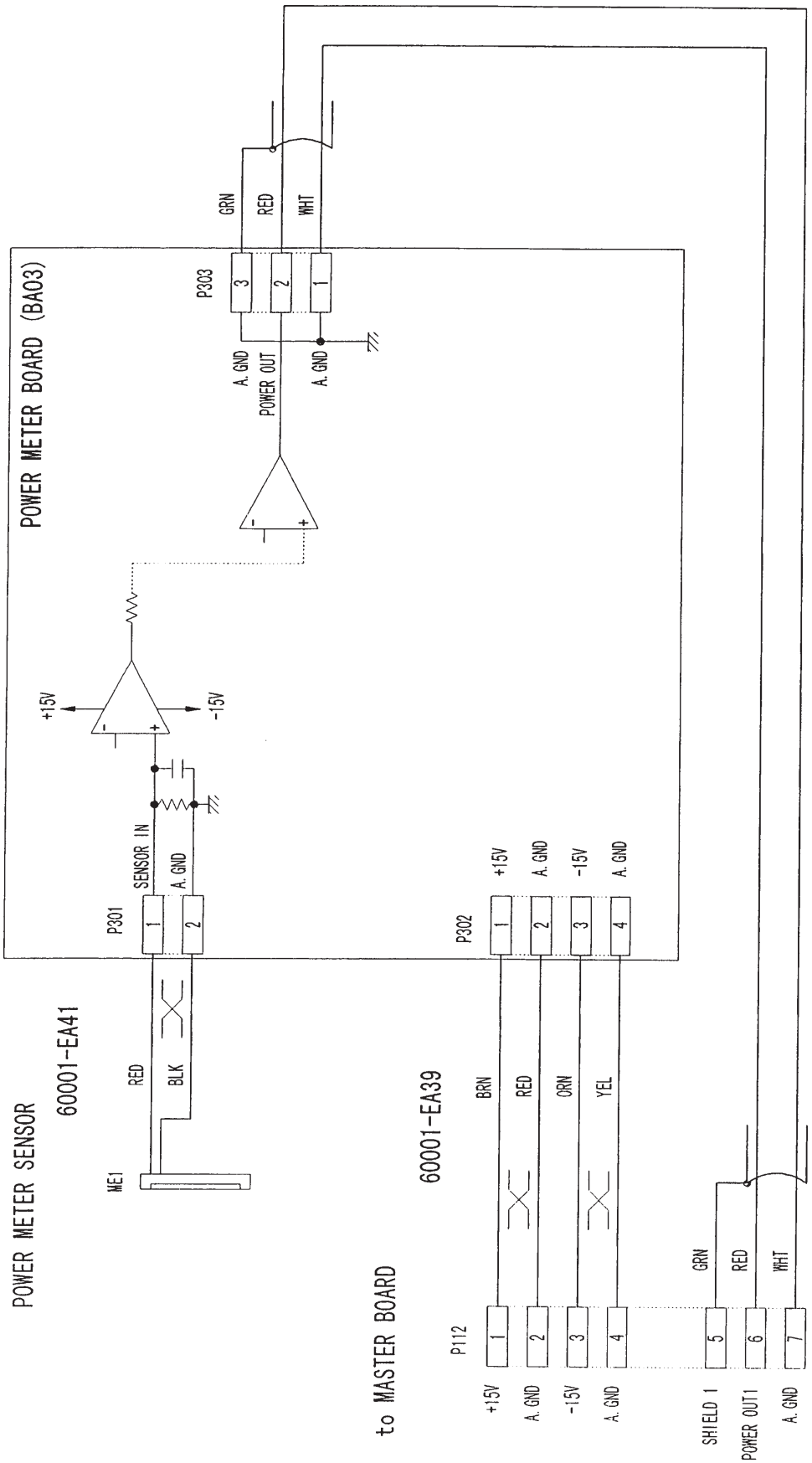




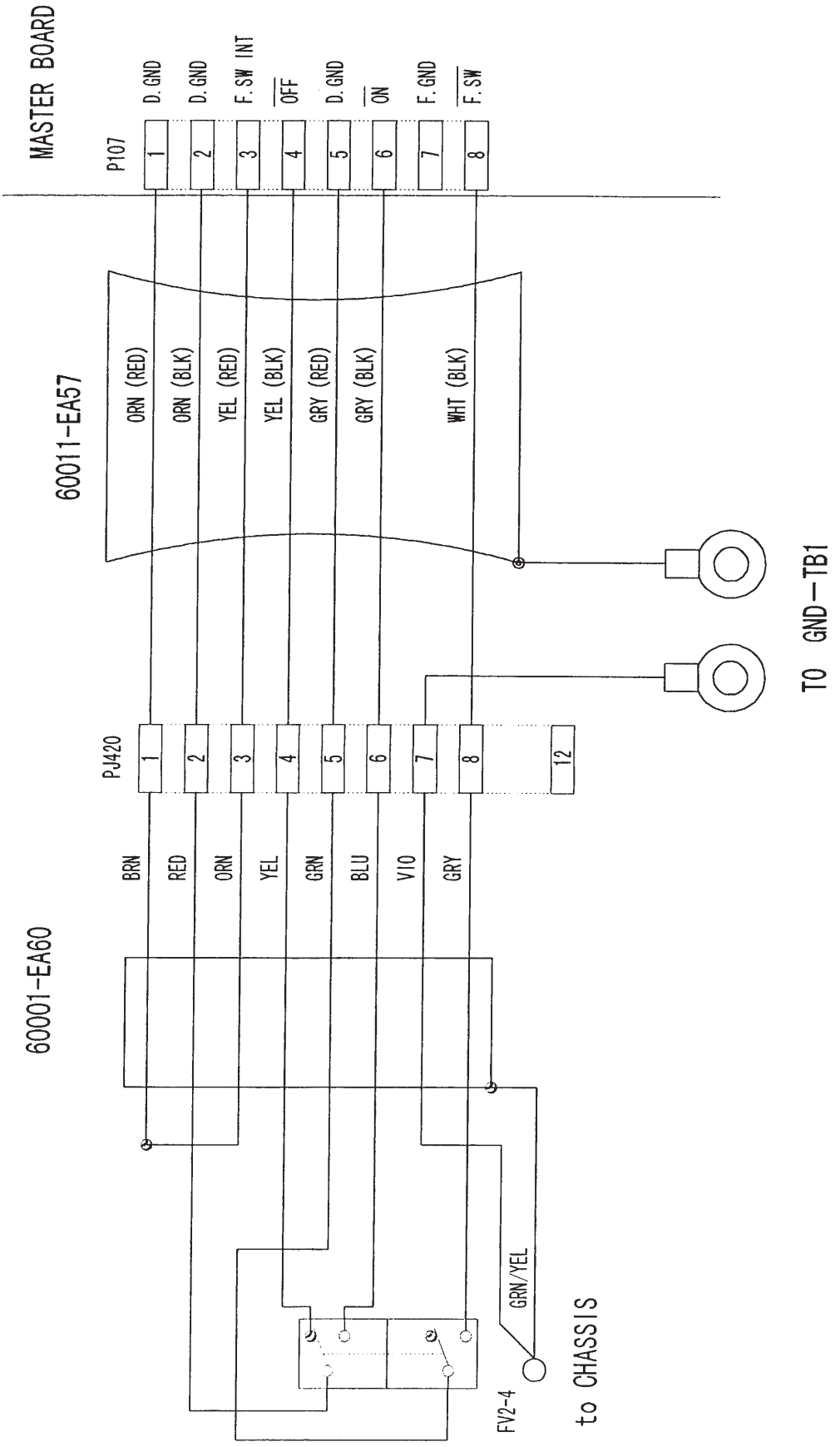
12.6.3 Shutter and LD Periphery Wiring Diagram



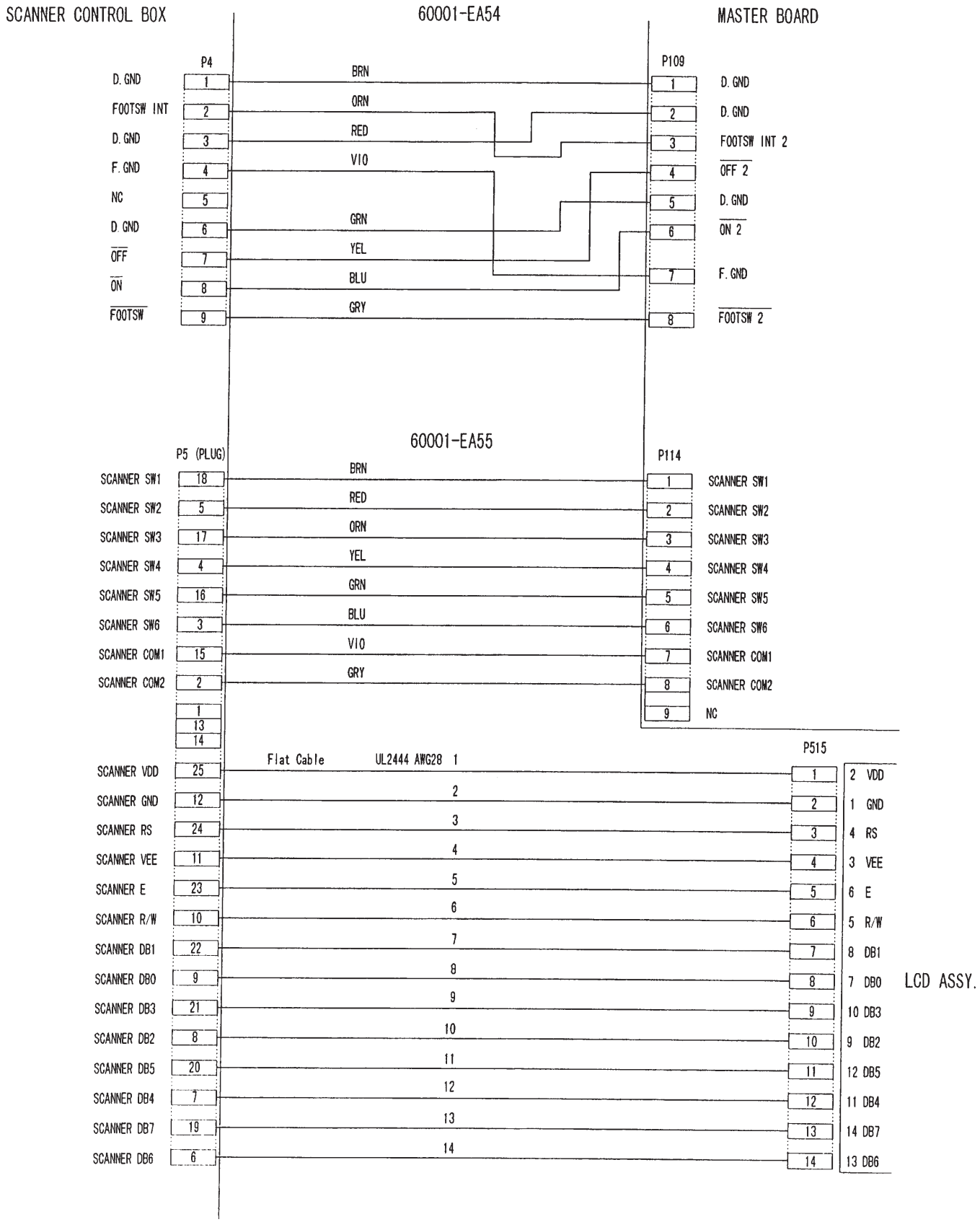
12.6.4 Power Meter Sensor Periphery Wiring Diagram

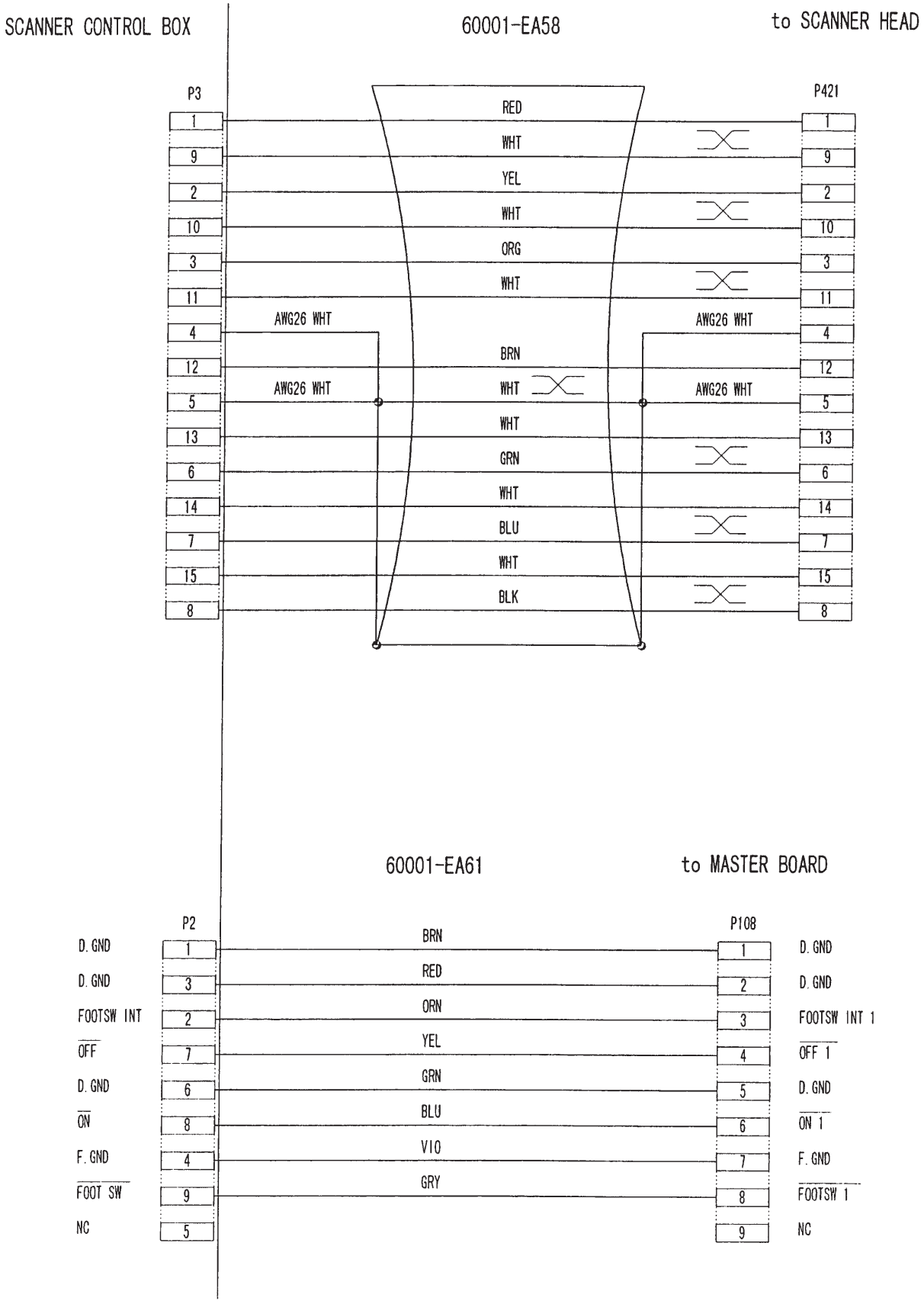


12.6.5 Foot Switch Periphery Wiring Diagram



12.6.6 Scanner Periphery Wiring Diagram

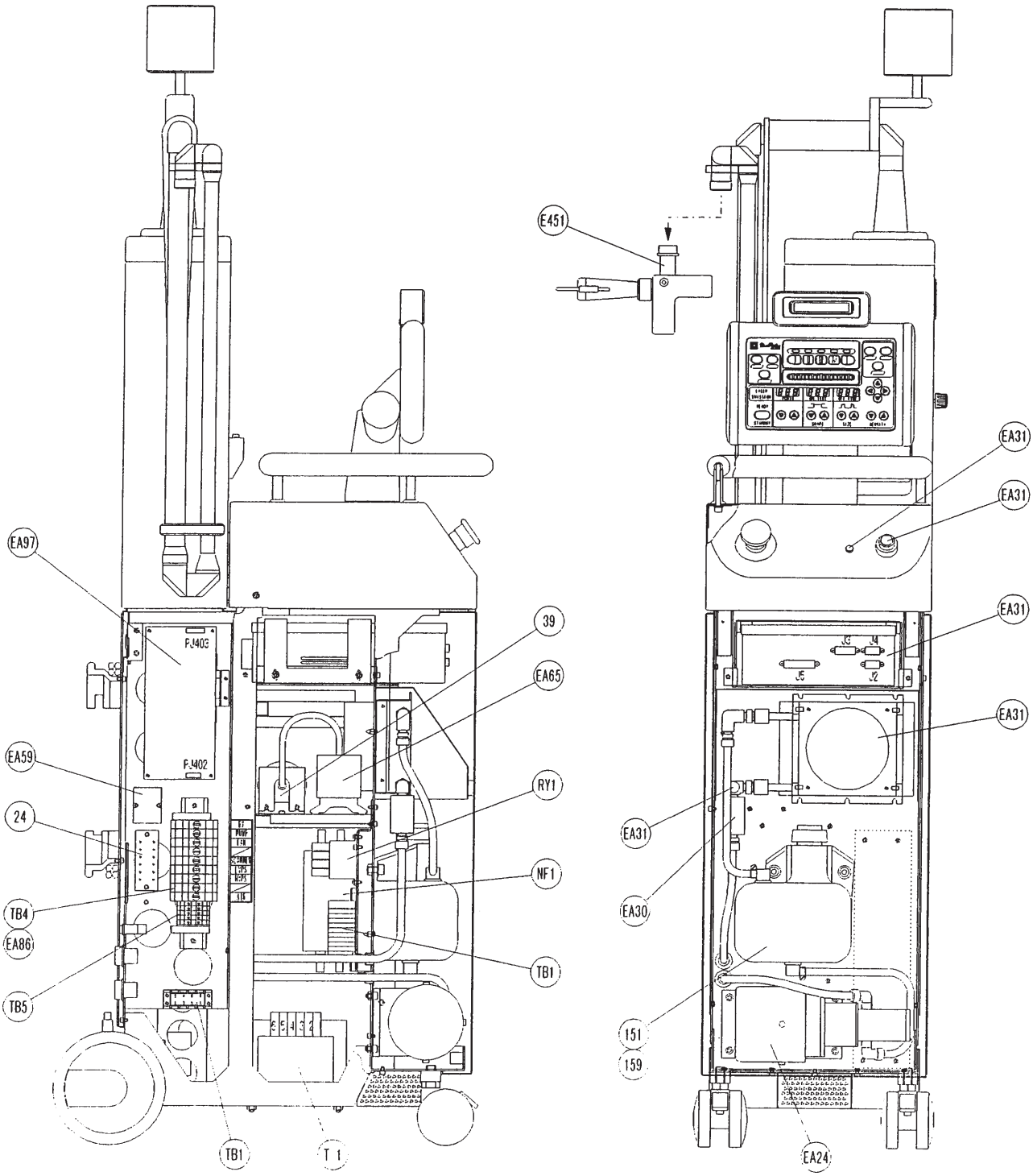



SCANNER CONTROL BOX
60001-EA58
to SCANNER HEAD
P3
P421
1
9
2
10
3
11
4
12
5
13
6
14
7
15
8
RED
WHT
YEL
WHT
ORG
WHT
AWG26 WHT
BRN
AWG26 WHT
WHT
WHT
GRN
WHT
BLU
WHT
BLK
60001-EA61
to MASTER BOARD
P2
P108
D. GND
D. GND
FOOTSW INT
OFF
D. GND
ON
F. GND
FOOT SW
NC
BRN
RED
ORN
YEL
GRN
BLU
VIO
GRY
D. GND
D. GND
FOOTSW INT 1
OFF 1
D. GND
ON 1
F. GND
FOOTSW 1
NC

12.7 Internal View

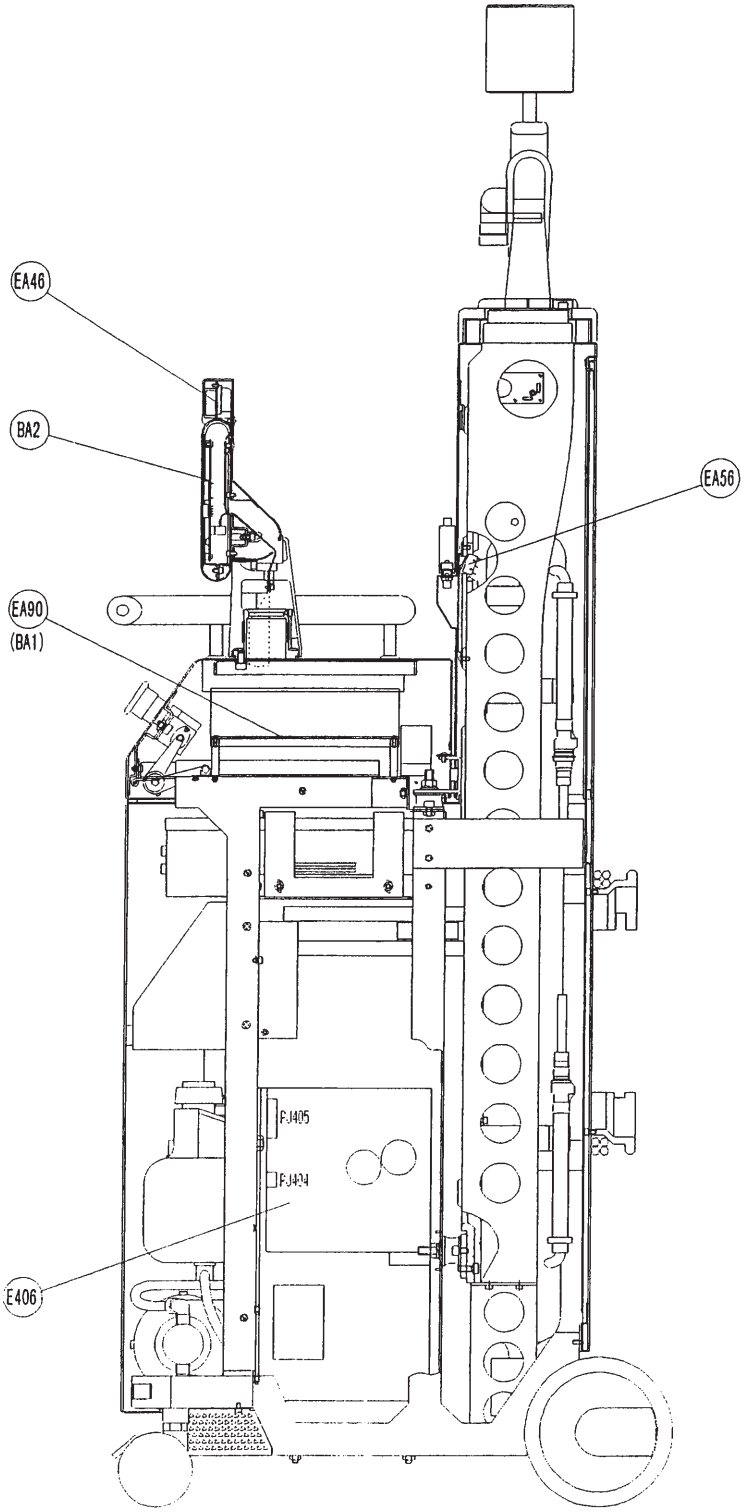
SYM.	Parts Name
24	GND terminal
39	Filter unit
151	Reservoir
159	Cooling water
NF 1	Noise Filter
RY 1	Relay
T 1	Transformer
TB 1	Terminal block No.1
TB 2	Terminal block No.2
TB 4	Terminal block No.3
TB 5	Terminal block No.4
U 2	Radiator

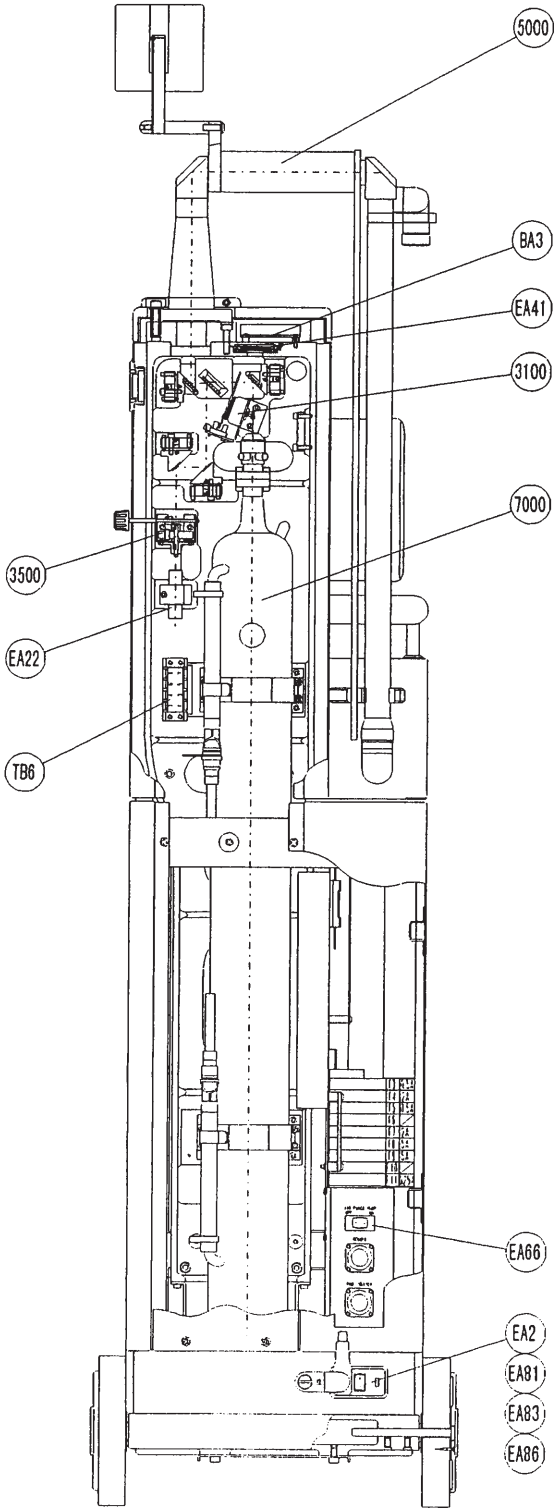
SYM.	Parts Name
E451	Scanner Head
E450	Scanner Control Box
EA 6	Power ON Lamp
EA12	Switch ASSY
EA24	Cooling pump
EA30	Flow switch
EA31	Temperature switch
EA59	Scanner SSR ASSY
EA65	Air purge pump
EA86	Fuse
EA97	LVPS



SYM.	Parts Name
3100	Shutter ASSY
3500	LD intensity ASSY
5000	Articulated arm ASSY
TB6	Terminal block No.6
E406	HVPS
EA 2	Power inlet
EA22	Laser diode
EA41	Power meter
EA46	LCD ASSY
EA56	Scanner switch

SYM.	Parts Name
EA66	Air purge switch
EA81	Fuse (100V)
EA83	Fuse (200V)
EA85	Fuse (230V)
EA90	Master board ASSY
BA 1	Master board
BA 2	Control panel board
BA 3	Power meter board
7000	CO_2 laser tube





§13 REPLACEMENT PARTS LIST

Item	Parts Name	Parts No.	Remarks
Arm Laser optical system	Articulated arm	60011-5000	
	Shutter ASSY	60011-3100	
	LD intensityASSY	60011-3500	
	CO_2 laser tube	60001-7000 60001-M304 (n=2) 60001-M305 (n=2) 60001-M381 (n=2) 82001-RG034 (n=2) 60001-EA22 60001-EA20 60011-EA75	These parts are assembled into a unit.
	LD ASSY	60011-EA22	
	Power meter board	60001-BA03	
	Power meter sensor ASSY	60011-EA41	
Cooling system	Cooling fluid	60001-M159	
	Radiator fan	60001-E411	Radiator fan part
	Radiator	60001-E411	Radiator part
	Reservoir	60001-M151	
	Pump	60001-EA24 60001-M162 (n=3)	These parts are assembled into a unit.
	Flow switch and Temperature switch	60011-EA30 60011-EA31 60001-M160 60001-M164 60001-M165	These parts are assembled into a unit.
Air purge system	Air purge pump	60001-EA65	
	Air purge switch	60011-EA66	
	Filter unit	60001-M039	
Circuit board periphery	Master board ASSY	60011-EA90	
	Control panel board	60011-BA02	
Power supply periphery	HVPS	60001-E406	
	LVPS	60001-EA97	
	Relay	60001-E403	
	Noise filter	60001-E404	
	Transformer	60001-E420	
	Scanner SSR ASSY	60011-EA59	
Scanner	Scanner control box and Scanner head	60001-E450 60001-E451	Replace them together
	LCD ASSY	60001-EA46	

Item	Parts Name	Parts No.	Remarks
Fuse	F1, F2	80402-02094	(250V, 10A) primary side in 100, 115V areas
		80402-02091	(250V, 6.25A) primary side in 200, 215V areas
		80402-02090	(250V, 5A) primary side in 230V areas
	F8, F9	80402-02090	(250V, 5A) LVPS and HVPS
	F4, F7	80402-02087	(250V, 2A) Pump and Scanner control box
	F3, F5	80402-02084	(250V, 0.5A) Secondary side and Radiator fan
	F11	80402-02083	(250V, 0.25A) Air purge pump
Front panel periphery	Power ON lamp	60011-EA06	
	Key switch and Emergency STOP button	60001-EA12	Replace them together
	Control panel cable	60001-EA45	
	Scanner cable 2 • ASSY	60001-EA55	

§14 REFERENCE FOR THE MAINTENANCE

14.1 Tools and Consumables

- Philips screwdriver set
- Flatblade screwdriver set
- Precision screwdriver set
- Flatblade screwdriver
- Hexagonal wrench set (in millimeters and inches)
- Monkey wrench
- Long-nose pliers
- Nippers
- Wire stripper
- Tweezers
- Threadlocking adhesive

- Soldering iron (20-30W)
- Solder
- Cleaner for soldering iron tip

- Blower brush
- Clamps
- Cleaning paper
- Mixed solvent (50% ethyl alcohol and 50% ethanol)
- Methanol (90%)
- Acetone
- Lens tissue (Kimberly-Clerk Corporation's Wiper S-200)

14.2 Jigs and Measuring Instruments

- Tongue depressor
- Mirror holder and reflective mirror jig
- Crossline jig
- Tester (or Multimeter)
- Power meter
- Jigs for Cooling liquid drainage

60001-M153 (Inline copuler (female))	1 pc.
60001-M155 (Inline copuler (male))	1 pc.
60001-M166 (Vinyl tube)	1m