POWER SUPPLY UNIT FOR REFLECTED LIGHT FLUORESCENCE

MODEL BH2-RFL-T3

REPAIR MANUAL

OLYMPUS
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1. NAME AND SYMBOL IN OLYMPUS

<table>
<thead>
<tr>
<th>Name</th>
<th>POWER SUPPLY UNIT FOR MERCURY BURNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE in OLYMPUS</td>
<td>BH2-RFL-T3</td>
</tr>
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</table>

2. OUTLINE OF MERCHANDISE

This is a power supply designed to be combined with BH2-LSRF-2 FLUORESCENCE ILLUMINATOR for lighting a 100W MERCURY BURNER to be used for fluorescence observation with a REFLECTED LIGHT FLUORESCENCE MICROSCOPE.

3. FEATURES

1) Compact and light weight using a switching system.

<table>
<thead>
<tr>
<th></th>
<th>BH2-RFL-T2</th>
<th>BH2-RFL-T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>240mm</td>
<td>120mm</td>
</tr>
<tr>
<td>Depth</td>
<td>355mm</td>
<td>290mm</td>
</tr>
<tr>
<td>Height</td>
<td>175mm</td>
<td>180mm</td>
</tr>
<tr>
<td>Weight</td>
<td>18.5kg</td>
<td>Approx. 4kg</td>
</tr>
</tbody>
</table>

2) Life meter indicates the lamp life (200 hours in average).

* When the power switch is turned on and the lamp is lit, the meter counts up 0.1 and thereafter counting up 0.1 at every 6 minutes while the lamp is lighting.

3) When the power switch is turned on, the ignition is automatically operated and the lamp can be lit.

4) The circuit system is not influenced by an input power supply, eliminating the necessity of switching power supply frequency (50/60Hz) and voltage (100V/110V/120V or 220V/240V).

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>100V type</td>
<td>100 ~ 120V ±10%</td>
<td>50/60Hz</td>
</tr>
<tr>
<td>200V type</td>
<td>220 ~ 240V ±10%</td>
<td>50/60Hz</td>
</tr>
</tbody>
</table>

4. RESTRICTED CONDITIONS

1) USHIO USH-102D mercury lamp is only applicable.

2) Wait at least 3 minutes before lighting again the lamp again once turning it off.

3) Avoid turning off the lamp for about 15 minutes after lighting up.

* Conditions 2) and 3) are not caused by the power supply. It is the problem of the mercury lamp itself. The lamp life may be reduced or the lamp may become difficult to light up again.

4) AC plug socket capacity should be 5A or larger. (Do not put many loads on one electrical outlet.)

5) The unit is compact and air cooled. Do not block the slit for cooling.

* It is desirable to have a 10cm space around the unit when installing it. If the unit is overheated, the protector functions and the power supply unit stops operation.
BH2-RFL-T3

A. OUTLINE OF PRODUCT

6) High voltage part is included inside. Protect the unit from being condensation and splashed with water.
   - Operating temperature: 0 ~ 40°C
   - Operating humidity: 30 ~ 80% (No condensation)
   - Storing temperature: -25 ~ +75°C
   - Storing humidity: 20 ~ 80% (No condensation)

7) Replacement of the fuse by the user is prohibited for safety.
   * The fuse is located on the PCB in the unit.
   A high voltage generating part is included, and dangerous. Disassembly and repairs except by a qualified serviceman is prohibited.

8) Use a 3-core cord for power supply, and make grounding for safety.

5. SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Input power supply voltage</td>
<td>100V type: 100 ~ 120V continuous</td>
<td>Commercial power supply (AC)</td>
</tr>
<tr>
<td></td>
<td>200V type: 220 ~ 240V continuous</td>
<td></td>
</tr>
<tr>
<td>2 Input current</td>
<td>100V type: 2.8A max. (AC100V)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>200V type: 1.8A max. (AC220V)</td>
<td></td>
</tr>
<tr>
<td>3 Power supply frequency</td>
<td>50 ~ 60Hz continuous</td>
<td></td>
</tr>
<tr>
<td>4 Connecting device</td>
<td>Power supply input connector (3-core)</td>
<td>Compatible with BH2-RFL-T2</td>
</tr>
<tr>
<td></td>
<td>Lamp house connection connector (5-core)</td>
<td></td>
</tr>
<tr>
<td>5 Lamp life judgment</td>
<td>Life meter with reset function</td>
<td>4-digit display (000.0 ~ 999.9) Min. digit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1 = 6 min.</td>
</tr>
<tr>
<td>6 Applicable mercury lamp</td>
<td>USHIO-USH-102D</td>
<td></td>
</tr>
<tr>
<td>7 Power switch</td>
<td>OMURON</td>
<td>Seesaw type</td>
</tr>
<tr>
<td></td>
<td>A8A-213-1 (100V)</td>
<td>Green cap</td>
</tr>
<tr>
<td></td>
<td>A8A-223-1 (200V)</td>
<td>Neon illumination type</td>
</tr>
<tr>
<td>8 Dimensions</td>
<td>Width: 120mm</td>
<td>Projections not included</td>
</tr>
<tr>
<td></td>
<td>Depth: 290mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Height: 170mm</td>
<td></td>
</tr>
<tr>
<td>9 Weight</td>
<td>100V type: 3.8kg ± 10%</td>
<td>Except 0.9kg ± 0% of packing material</td>
</tr>
<tr>
<td></td>
<td>200V type: 3.9kg ± 10%</td>
<td></td>
</tr>
</tbody>
</table>
6. FRONT PANEL DISPLAY

- **LAMP-ON INDICATOR**
- **POWER SWITCH**
- **LIFE TIME COUNTER**
  - **CHANGE BURNER AFTER 200 hrs.**
  - **1000.0 hrs.**

**OLYMPUS** TRADEMARK
7. REAR PANEL DISPLAY

INPUT TERMINAL

AC INLET

100W HIGH PRESSURE MERCURY BURNER
USHIO USH-102D

TO LAMP HOUSE

output connector to lamp house

CAUTION
HIGH VOLTAGE — DO NOT REMOVE COVER.
KEEP SERVICING TO QUALIFIED SERVICE PERSONNEL

CAUTION
(Japanese)

CAUTION
(English)

SPECIFICATIONS PLATE
(100V system)

MODEL BH2-RFL-T3
No.
100-120V ～ 2.8A 50-60Hz
OLYMPUS OPTICAL CO., LTD.
MADE IN JAPAN
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1. DISASSEMBLY OF INLET-ASS'Y

1-1 Remove the cover.

SCREW(1) CTK3x6SA 10 pcs.

1-2 Disconnect the CONNECTOR (CNA) (1) from the POWER-PCB (2), and disconnect the EARTH-CABLE by removing the SCREW (3) from the bottom.
B. DISASSEMBLY PROCEDURE

1-3 Remove the INLET-ASS'Y.

SCREW ② INLET-ASS'Y (for 100V) =
CTK3x6SA 2 pcs.
INLET-ASS'Y (for 200V) =
CQK3x8SA 2 pcs.

2. DISASSEMBLY OF POWER-PCB

2-1 Remove the CONNECTOR ③ (CNB, CND, CNE, CNF) and the SCREWS ④ and ⑤ of TERMINAL-BLOCKS TL1 and TL2 from the PCB.

2-2 Remove the POWER-PCB.

SCREW ① - ⑤ CUKSK3x20SA 5 pcs.
⑥ - ⑦ CUKSB3x6SA 2 pcs.
3. DISASSEMBLY OF CONTROL-PCB

3-1 Disconnect the CONNECTOR① (7 pcs.) from the PCB as listed below.

```
   CNA       CNE
CNC        CNF
CND       CNB
            CNG
```

3-2 Remove the CONTROL-PCB.

SCREW② CUXSx3x20USA 4 pcs.

4. DISASSEMBLY OF IGNITION-PCB

4-1 Remove the CONNECTOR③ (UNH, UNA) and the SCREW④ of TLI TERMINAL-BLOCK from the PCB.

Disconnect the EARTH-CABLE⑤ extending from the PCB.
4-2 Remove the IGNITION-PCB①.

SCREW② CUKS③×20SA 3 pcs.

5. DISASSEMBLY OF OUTLET-ASS'Y

5-1 Disconnect the CORD④ (1 orange and 2 red cords) from the DIODE 3.

SCREW⑤ CUKS③×6SA 2 pcs.

5-2 Remove the SCREW⑥ on the bottom, and disconnect the EARTH-CABLE.
5-3 Remove the OUTLET-ASS'Y①.
SCREW② CTK3x6SA 4 pcs.

6. DISASSEMBLY OF LED-ASS'Y

6-1 Remove the NUT③ and take off the LED-ASS'Y④.

7. DISASSEMBLY OF COUNTER-ASS'Y

7-1 Remove the SPRING⑤ fastening the counter.
B. DISASSEMBLY PROCEDURE

7-2 Remove the COUNTER-ASS'Y ①.

8. DISASSEMBLY OF MAIN-SW

8-1 Push the CLAW ③ (4 locations) of the MAIN-SW ②, and remove the MAIN-SW ② from the front panel.
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7. ASSEMBLY OF POWER-PCB .............................. C-4
8. ASSEMBLY OF INLET-ASS'Y ............................ C-5

* FOR SAFETY PURPOSE, BE SURE TO USE THE SPECIFIED PART WHEN REPLACING EACH ELECTRICAL PART.
1. ASSEMBLY OF MAIN-SW

1-1 Insert the MAIN-SW① into the front panel in position.

2. ASSEMBLY OF COUNTER-ASS'Y

2-1 Insert the COUNTER-ASS'Y② and fasten it with the SPRING③.

3. ASSEMBLY OF LED-ASS'Y

3-1 Insert the LED ASS'Y④ and fasten it with the NUT⑤.
4. ASSEMBLY OF OUTLET-ASS'Y

4-1 Attach the OUTLET-ASS'Y 1.

SCREW 2 CTK3x66A 4 pcs.

4-2 Fasten the EARTH-CABLE to the bottom with the SCREW 3.

SCREW CUKSB4x16BN 1 pc.

4-3 Connect the cord (1 orange cord 4 and 2 red cords 5) to the DIODE 6.

SCREW 7 CUKSB 4x8BN 2 pcs.
5. ASSEMBLY OF IGNITION-PCB

5-1 Mount the IGNITION-PCB.

SCREW CUJK 3x20 SA 3 pcs.

5-2 Insert the CONNECTOR (CNA, CNB) into the PCB, and fasten the cord to TLL TERMINAL-BLOCK with a SCREW.

SCREW CUJK 3x6 BN 1 pc.

Connect the EARTH-CABLE extending from the PCB.

SCREW CUJK 3x6 BN 1 pc.

6. ASSEMBLY OF CONTROL-PCB

6-1 Mount the CONTROL-PCB.

SCREW CUJK 3x20 SA 4 pcs.
6-2 Insert the CONNECTOR\( \mathbf{1} \) (7 pcs.) into the PCB.

7. ASSEMBLY OF POWER-PCB

7-1 Mount the POWER-PCB.

SCREW \( \mathbf{1} \) - \( \mathbf{5} \) CUKS3x20SA 5 pcs.
SCREW \( \mathbf{6} \) - \( \mathbf{7} \) CUKS3x6SA 2 pcs.

7-2 Insert the CONNECTOR\( \mathbf{3} \) (4 pcs.) into the PCB, and fasten the cord to TL1 and TL2 terminal blocks\( \mathbf{4} \) and \( \mathbf{5} \) with a SCREW.

SCREW CUKS3x6BN
8. ASSEMBLY OF INLET-ASS'Y

8-1 Attach the INLET-ASS'Y(1).

SCREW(2) INLET-ASS'Y (for 100V) = CTK3x6SA 2 pcs.
INLET-ASS'Y (for 200V) = CQK3x8SA 2 pcs.

8-2 Insert the CONNECTOR (CNA)(3) into the power PCB, and fasten the EARTH-CABLE to the bottom with the SCREW(4).

SCREW(4) CUKSB4x16BN 1 pc.

8-3 Attach the COVER.

SCREW(5) CTK3x6SA 10 pcs.
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1. OUTLINE

This is a power supply to light up the 100W MERCURY-BURNER. It has a built-in DC-IGNITION. Artificial CONSTANT-VOLTAGE DRIVE is employed to drive a lamp. An external interlock is provided.

2. CIRCUIT DESCRIPTION

This power supply employs the PULSE-DURATION-CONTROL HALF BRIDGE INVERTER SYSTEM that contributes to compactness, light weight and high efficiency. Fig. 17 shows the overall view of the circuit. Fig.18 ~ Fig.20 show the printed circuit boards PBl, PB2 and PB3. The power supply consists of the functional blocks shown in Fig. 21. The blocks are explained according to the circuit diagrams of Fig.1 ~ Fig.16.

PBl = POWER PCB
PB2 = CONTROL PCB
PB3 = IGNITION PCB

* The circuit diagram of BH2-RFL-T3-200 (for 200V) is shown below in explanation of the blocks. The circuit diagram of BH2-RFL-T3-100 (for 100V) is omitted, because it is the same as the circuit diagram of BH2-RFL-T3-200 except the parts (jumper pin, fuse, etc.).
1. INPUT-FUSE (Fig. 1)

F1 and F2 of PB1 are the input fuses. A 3.15A slow-blow miniature type fuse is used. F2 is not mounted for 100V. Input current is about 2.8A for 100V and 1.6A for 200V.

2. NOISE-FILTER (Fig. 1)

This is a circuit comprising L2 - L4, C1, C2, R26 and R27 of PB1, which minimize a surge of the power supply and prevent a switching noise generated inside from being leaked to the outside. It is effective as a filter for the noises in both common mode and normal mode. (L2 is a choke in the common mode, and L3, L4 are the chokes in the normal mode.) C2 contains three condensers molded inside. R26 and R27 are the resistors to quickly discharge the condenser.

---

Fig. 1 Input fuse and noise filter
3 PRIMARY RECTIFIER & SMOOTHING CIRCUIT (Fig. 2)

This is a circuit comprising D1, C7, C8, R4, R24, R5 and R25 of PBl, which rectifies AC input and outputs as positive and negative DC current. C6 is a pass condenser to escape a noise to the body. D1 rectifies AC input, and C7, C8 ELECTROLYTIC-CONDENSERS smooth it to output as DC current. Jumper is mounted for 100V. This circuit functions as a voltage doubler rectifier, and about DC150V is supplied at both ends of C7, C8 in either type for 100V or 200V.

R4, R24, R5 and R25 are resistors to balance the DC voltage of C7, C8 ELECTROLYTIC-CONDENSERS connected in series and discharge them quickly at power off.

4 RUSH CURRENT LIMITATION CIRCUIT (Fig. 2)

This is a circuit comprising R1 and Q1 of PBl. Q1 is a triac. It limits rush current generated at power on for charging the C7, C8 ELECTROLYTIC-CONDENSERS in the PRIMARY RECTIFIER & SMOOTHING CIRCUIT. When the rush current is limited (to approx. 20A or lower) by R1 (10 ohm) and the condensers C7 and C8 are charged, R1 is shorted by oscillation of T1 (see Fig. 3) and turning on of Q1. At this time, secondary rush current flows. (Approx. 35A)

The current flows through R1 for 50 - 70msec.

R1 contains a THERMAL-FUSE (130°C). If Q1 should not be turned on, R1 temperature increases suddenly and the THERMAL-FUSE is blown to stop the power supply operation.

---

Fig. 2 PRIMARY RECTIFIER & SMOOTHING CIRCUIT and RUSH CURRENT LIMITATION CIRCUIT
5) INVERTER-CIRCUIT (Fig. 3)

This is a circuit comprising Q2, Q3, T1, C9, R6, C10 and R7 of PBl. HIGH FREQUENCY & RECTANGLE WAVE VOLTAGE of 40kHz can be obtained by turning on and off Q2 and Q3 alternately by the driver circuit described later. MOS-FET is used for Q2 and Q3. C10 and R7 make a circuit to absorb spike voltage caused by leakage inductance of the PRIMARY-COIL of the main transformer T1. (SNUBBER-CIRCUIT)

C11 stabilize potential of the HEAT SINK with Q1, Q3 mounted and prevents generation of noise. About 300V is supplied to both ends of Q2 and Q3.

6) MAIN-TRANSFORMER (Fig. 3)

This comprises T1 of PBl, and converts the high frequency & rectangle wave voltage of 40kHz/150V obtained by the inverter circuit into about 40V rectangle wave voltage. A ferrite core is used for MAIN-TRANSFORMER T1. The COIL shown on P2 is to control triac Q1.

Fig. 3 Inverter circuit and main transformer
7) SUPERIMPOSED-CIRCUIT (Fig. 4)

This is a circuit comprising R18, D8, R19 and D9 of PBl, which changes the output voltage to about 85V just before lighting on a lamp.

The voltage generated from S3 and S4 coils of T1 is current limited by R18, R19 and half-wave rectified by D8 and D9. This voltage is fluctuated by input voltage and input voltage waveform.

8) SECONDARY RECTIFIER & SMOOTHING CIRCUIT (Fig. 4)

This is a circuit comprising D11, D10, R20, C14, R21, C15, R23, C17 and L5 of PBl. D11 and D10 full-wave rectifies about 40V rectangle wave voltage induced in the secondary coil (S1, S2) of the main transformer T1, and L5 of PBl and C3 of PB2 smooth the voltage to provide DC output voltage. R23 and C17 are surge absorbers to prevent the spike voltage generated in the secondary coil from being returned to the primary side. R20, C14, R21 and C15 are surge absorbers to prevent breakage of D11 and D10.

C13 stabilizes potential of the heat sink with D11 and D10 mounted and prevents generation of noise.

Fig. 4 Superimposing circuit and secondary rectifier & smoothing circuit
D. DESCRIPTION OF MECHANISM

9) OUTPUT CURRENT DETECTOR (Fig. 5)

This circuit comprises R2 and R3 of PB2, and feeds the voltage generated at both ends of these resistors back to the PWM driver as an output current signal.

10) CIRCUIT for LAMP DAMAGE PREVENTION and IGNITION ABILITY (Fig. 5)

This circuit comprises L1, R1, C1, D1, and R4 of PB2, and prevents damage of a lamp at lighting and improves ignition ability. Lamp voltage of the mercury burner 100W is 20V at stabilized. But, high DC voltage of about 1.6kV is required at ignition to break down the lamp electrodes. Besides, it is necessary to charge the electrolytic condenser C1 to DC85±10V for improving ignition ability. C1 has been charged to DC85±10V by the superimposed circuit, and will be discharged with strong flashing of the lamp when the lamp electrodes are broken down by the ignition. R1 limits the peak value of rush current to the lamp at this time. (Without R1, the peak value of the rush current from C1 to the lamp is high and the current wave duration becomes small.) L1 prolongs the discharging time and suppress the rush current to the lamp at ignition. This minimizes wear of the lamp electrodes, and prolongs the lamp life. R4 quickness rising of current immediately after break down of the lamp. D1 is used to prevent drop of the lamp current caused by resonance of L1 and C3.

11) OUTPUT FILTER CIRCUIT (Fig. 5)

This circuit comprises C4 of PB2 and L1, C1-C3, R1, and V1 of PB3, and prevents a noise at actuation of the ignition. R1 and V1 let the current run in the body when the line is electrically floated from the body by the ignition.

Fig. 5 OUTPUT CURRENT DETECTOR, circuit for lamp damage prevention and ignition ability and output filter circuit
T4 of PB1 is an auxiliary transformer, which supplies 12V to the driver of PB2. For 100V, a transformer which outputs about AC16V for AC100V input is mounted.

R22 and C16 of PB1 absorb abnormal voltage generated at turning on/off the power switch. Output voltage of T4 is full-wave rectified by D8 of PB2 and stabilized to +12V by C23, C24, C25, and IV7.

D9 protects IC7 when reverse voltage is generated.

Fig. 6 Auxiliary transformer and rectifier circuit
PWM DRIVER (PB2) (Figs. 7, 8 and 9)

Stable constant-current and constant-power driving with IC1 and IC2.
(Constant-current driving when the output voltage is low immediately after ignition of the lamp, and constant-power driving when the output voltage is increased over 16V.) IC2 is an INTEGRATED-CIRCUIT exclusive to PWM switching regulator.

Block diagram and terminal connection diagram of IC2 are shown below.

- Pins 1, 2, 15 and 16 of IC2 are the input of the ERROR-AMPLIFIER, forming a feedback loop so that the output current signals obtained from the CURRENT-DETECTING-RESISTORS R2 and R3 coincide with the reference signal supplied to IC2, PIN 2.
- IC2, PIN 4 is a terminal to set a pause duration to prevent simultaneous turning on of Q2 and Q3 of PB1 (inverter circuit). VR3 and R37 set a pause duration to about 2 sec. IC2, PIN 4 is used also for soft start, and the output pulse duration is increased gradually from 0 in the period from power on to the end of charging C15. About 1 ~ 1.5 second is required to run completely after power on. IC2, PIN 4 is also used for interlock. When PC1 or PC3 turns on, a reference voltage (5V) is supplied to IC2, PIN 4 and the pause duration is prolonged with stop of oscillation.
- IC2, PINS 5 and 6 are the terminals to connect R36 resistor and C13 condenser to determine the high frequency inverter's operating frequency.
- IC2, PIN 8 and 11 generate PWM output signals displaced 180° in phase to each other.
- IC2, PIN 12 is a power supply input terminal. C12 and R41 are inserted to prevent a malfunction of IC caused by a noise.
- IC2, PIN 14 generates a reference voltage, 5V stabilized by the circuit in IC. This reference voltage is used for soft start and as a driving reference signal for output current and output voltage.
D. DESCRIPTION OF MECHANISM

Fig. 9 PWM driver

D-9
### D. DESCRIPTION OF MECHANISM

#### (14) CONSTANT-POWER DRIVER (Figs. 10 and 11)

Constant-current driver when the output voltage is low, and constant-power driver when the output voltage is increased. Output voltage signal and output current signal are supplied to ICl, PIN 1 through R6 and R8. Reference voltage determined by R9, R10 and VRl is supplied to ICl, PIN 2. Difference between the reference voltage and (output voltage signal + output current signal) is supplied to ICl, PIN 1 as a gain determined by R12. Signal of ICl, PIN 1 is inverted by Q1 and applied to IC2, PIN 2. The signal is driven so that it coincides with the output current signal. Artificial constant-power driving is made in such a circuit. Exact constant-power driving is made in the form of (output voltage signal × output current signal), but even (output voltage signal + output current signal) can be regarded constant-power as shown below.

![Output current vs. Output voltage graph](image)

Output voltage signal is set by the resistance ration between R6 and R8, so that it becomes about 1/100 of actual lamp voltage. Reference voltage of VRl is variable in 0.1 ~ 0.6V. VRl is actually adjusted so that the output current of 5A can be obtained when the output voltage is 20VA. Maximum value of output voltage is restricted by the constant-current driver described later.

#### (15) Constant-current driver (PB2) (Fig. 11)

When the output voltage signal is low, (output voltage signal + output current signal) is lower than the reference voltage determined by R9, R10 and VRl and the output at ICl, PIN 1 is OV and Q1 turns off. At this time the voltage determined by R15, R16 and VR2 is applied to IC2, PIN 2 to be controlled so that this voltage becomes equal to the output current signal. Adjustment range of VR2 is 0A ~ 9A equivalent to output current. For actual adjustment, connect a dummy resistor of 1 ~ 1.5 ohm to the unit output so that the output current becomes about 6A. (Because the voltage immediately after ignition of a lamp is considered 5 ~ 10V.)
Output current signal is used also for light-on detection. The voltage at IC1, PIN 6 determines the light-on detection level, and set to about 0.09V by R22 and R23.

When an output current signal exceeds this voltage, IC1, PIN 7 becomes HIGH. As an output current signal is 0.05 time of output current, IC1, PIN 7 becomes HIGH when an output current exceeds 1.8A. After IC1, PIN 7 becomes HIGH and the time determined by R26, C9 and D2 passes, Q2 turns on. Q2 has two functions. One is to turn on the lighting counter driving circuit and count it up one. The other function is to improve the lamp's lighting ability.

Before Q2 turns on, +12V is supplied to IC1, PIN 2 through D3 and the constant power driver reference voltage becomes 12V. This means that the constant-power driver is restricted and constant-current driver functions instead before Q2 turns on. The lamp voltage may increase immediately after ignition. Constant-power driver decrease the output current as the lamp voltage rises, increasing the lamp voltage as a result. To prevent it, only the constant-current-driver is operated for about one second (time determined by R26, C9 and D2) after detection of the lamp light-on.

Fig. 11 Constant-power driver, constant-current driver and light-on detector
IGNITION-TIMER (PB2) (Fig. 12)

This stops the ignition high voltage for safety when a lamp fails to light on for a long time. When the power switch is turned on and 12V is supplied to the driver, Q3 turns on after the time (approx. 11 seconds) determined by R32, C10 and D5 and PC3 is turned on accordingly. With PC3 turned on, as above described, oscillation of IC2 stops and the power supply fail to function and the ignition stops, too. (The ignition function will be described later.) If Q4 turns on before Q3, the charging current to C10 flows in Q4 and this timer is reset. Q4 turns on simultaneously with detection of light-on, and the timer is reset simultaneously with lighting on of a lamp.

![Fig. 12 IGNITION-TIMER](image-url)
INTERLOCK (PB2) (Fig. 13)

UNV: PIN 1 and PIN 3 of PB2 can be used as an interlock. When these PINs are shorted, no current flows in PC1 and PC2. When these PINs are opened, current flows in PC1 and PC2. When PC1 turns on, IC2 stops oscillation. When PC2 turns on, the ignition timer is reset. (Otherwise, if the PINs 1 and 3 are opened for over 11 seconds, the power supply fails to functions even if the pins are shorted thereafter.) When the PINs are shorted again, the power supply functions and lights up again a lamp.

C27, L2 and C26 are noise filters to prevent ingress of noise from CNC to the driver.

In addition to an external interlock, a thermal switch interlock is provided.

The thermal switch is fixed to the heat sink on which D10 and D11 of PB1 are mounted.

The thermal switch (TH1 of PB1) should function at 90° and used as a B-contact.

The signal from the thermal switch is applied to CNB PIN 5 and PIN 6 of PB2.

When the thermal switch does not function (contact ON), no current flows in PB2 and PC3.

When the thermal switch functions (contact OFF), current flows in PC3 of PB2 and PC3 turns on to stop oscillation of IC2. When the thermal switch functions, it is better to stop the power supply function completely. So the ignition timer is not reset then.

Fig. 13 INTERLOCK
This comprises the parts shown in PB1, and amplifies the PWM drive signal from the PWM driver and drives MOS-FET of the inverter circuit. Q6 and Q7 amplify the PWM drive signal. T2 insulates primary and secondary coils. As backward bias is effected by utilizing the back electromotive force generated by the exciting voltage, a gap is provided in the core. D6 resets the energy stored in the leakage inductance of the primary side coil.

R14 prevents ringing generated by L-component of the secondary side coil of T2 and the input capacity component of Q2. Q4 is a circuit to pull out quickly the electric charges stored in the input capacity component of Q2.
The circuit comprising IC3 - IC6 of PB2 is a life meter. IC3 is set by VR so that it usually oscillates at about 36ms cycle. Set VR4 by monitoring the voltage cycle of TP4 (check pin). VR4 setting range is 25 50ms.

IC4 and IC5 are dividers, which divide to 1/100. As 1/36ms = 27.777...Hz, it is divided into 0.0027...Hz by IC4 and IC5. IC6 is a one-shot vibrator, which receives an output signal from IC5 and generates a pulse of about 50ms. (PIN 10) This pulse is amplified by Q5 and Q6 to count up the meter on the panel by one.

When the lamp is not lit, Q4 light-on detector turns off and IC4 and IC5 are inhibited (PINS 7, 13 of IC4 and IC5 and PIN 9 of IC6) and the meter does not function.

When Q4 turns on, IC4 and IC5 are released from the inhibit state and start dividing.

As described in 16 Light-on detector, when Q2 turns on after detection, Q7 turns off and IC6 is triggered (IC6, PIN 8) and the meter is counted up one.

---

D-15
IGNITION (PB3) (Fig. 16)

When no-load open voltage (about 85V) is applied, C4 is charged through R2. When the C4 voltage reaches about 60V, Q1 cdac turns on (at 60V) to discharge the electric charge stored in C4 to the primary side of T1 pulse transformer.

T1 is used as a flyback transformer, transfers the energy stored in the primary side coil of T1 to the secondary side immediately after the end of discharging C4, charging C5 through D1. As T1 is designed to increase the secondary turn ratio to the primary, DC high voltage is stored in C5. C5 voltage is clamped to about 1600V by variable resistors V2 and V3. R3 is a resistor to discharge C5 at power off.

When the voltage at both ends of C5 exceeds the breakdown voltage, C5 charges are supplied to the lamp through R4. R4 is a resistor to suppress the peak value of the current supplied from C5 to the lamp to enlarge duration.

A high-voltage blocking diode is provided to prevent the high voltage generated from the ignition from being applied to the main circuit. All the current supplied from the main circuit flows through the high-voltage blocking diode.
D. DESCRIPTION OF MECHANISM

BH2-RPL-T3

4. Circuit Diagram

1. Overall wiring diagram

Fig. 17 Overall wiring diagram
"A" indicates a leading line in T1.
D. DESCRIPTION OF MECHANISM

"A" indicates a leading line in T1.

Fig. 19 POWER-PCB Circuit Diagram (For 200V)
D. DESCRIPTION OF MECHANISM

Fig. 20 Control-PCB CIRCUIT DIAGRAM
D. DESCRIPTION OF MECHANISM

4 FUNCTION-BLOCK DIAGRAM

INPUT

- NOISE FILTER
- PRIMARY RECTIFIER & SMOOTHING CIRCUIT
- RUSH CURRENT LIMITATION CIRCUIT
- INVERTER CIRCUIT
- MAIN TRANSFORMER
- SECONDARY RECTIFIER & SMOOTHING CIRCUIT
- OUTPUT CURRENT DETECTOR
- CIRCUIT FOR LAMP DAMAGE PREVENTION AND IGNITION ABILITY
- OUTPUT FILTER CIRCUIT
- IGNITION CIRCUIT

OUTPUT

- AUXILIARY TRANSFORMER AND RECTIFIER & SMOOTHING CIRCUIT
- INTERLOCK
- DRIVER CIRCUIT
- PWM DRIVER
- CONSTANT-POWER CIRCUIT
- CONSTANT-CURRENT CIRCUIT
- LIGHT-ON DETECTOR
- LIFE METER
- IGNITION TIMER

Fig. 21 FUNCTION-BLOCK-DIAGRAM
CONTENTS

1. GUIDE TO USE ............................................. E-1

2. LAMP
   2-1 LAMP IS NOT LIT ................................. E-2
   2-2 LAMP IS TOO DARK .............................. E-7

3. DISPLAY
   3-1 LIFE METER DOES NOT FUNCTION ............. E-9
   3-2 BURNER ON LED IS NOT LIT ................. E-10
   3-3 POWER LED IS NOT LIT ....................... E-12
1. GUIDE TO USE

- The troubleshooting is written in the flowchart form. You can find a defective part by following the arrows.

- [A] or [B] indicates a connector No. or a pin No. TP indicates a check pin. TPl means a check pin 1.

- Only a multimeter should be used in this troubleshooting.

- "Measure the voltage between TPl and Tp2" means "Apply HOT to TPl and GND to Tp2 for measuring the voltage".

  GND → Reference potential in an electronic circuit, 0V.
  HOT → Supply voltage line is called "HOT" against "GND".


- [A] or [B] means "Check method is given in [A] or [B] in the same item, and follow the method".

- For the replacement method, refer to "C. ASSEMBLY AND ADJUSTMENT PROCEDURES".
2-1 LAMP is not lit

CAUSE

1. Defective lamp
2. Ambient temperature too high
3. Defective fuse F1 (100V) or F2 (200V)
4. Defective door switch
5. Defective MAIN-SW
6. Blocked slit for cooling
7. Defective INLET 100/200 ASS'Y
8. Defective OUTLET 100/200 ASS'Y
9. Defective HARNESS 1
10. Defective HARNESS 2
11. Defective POWER-PCB (PB1)
12. Defective CONTROL-PCB (PB2)
13. Defective IGNITION-PCB (PB3)
E. TROUBLESHOOTING

D. Is the lamp flashing. (Lights up once, but goes off in 0.5 second.)

- **YES**
  - Replace the CONTROL-PCB (P2).

- **NO**
  - Replace the POWER-SUPPLY-PCB (PB1).

C. Is the RADIATION-HOLE blocked?

- **YES**
  - Remove the obstacle.

- **NO**
  - Do not place a thing within 10cm around the power supply.

B. Is DC31V or lower voltage supplied between TP6 and TP1 in the CONTROL-PCB (PB2)?

- **YES**
  - Replace the lamp.

- **NO**
  - Replace the POWER-SUPPLY PCB (PB1).

A. Is DC250 ~ 380V supplied between D (drain) and TP3 of Q2 in the power supply PCB (PB1) after the lamp goes off?

- **YES**
  - Light up the lamp and wait until it goes off. Measure the voltage just before turning off of the lamp.
  - Replace the POWER-SUPPLY PCB (PB1).

- **NO**
  - Replace the INLET-ASS'Y.

E. Is DC7 ~ 5V supplied between M10 (anode side) and TP1 in the CONTROL-PCB (PB2) after the lamp goes off?

- **YES**
  - Replace the POWER-SUPPLY-PCB (PB1).

- **NO**
  - Replace the CONTROL-PCB (PB2).

F. Is AC100V (100V) or AC220V (200V) supplied between M4 and 1 in the POWER-SUPPLY-PCB (PB1) (connector plug side)?

- **YES**
  - Remove the AC INLET and CNA of the power supply PCB (PB1). Insert the AC INLET, and measure the voltage.

- **NO**
  - Replace the INLET-ASS'Y.
**E. TROUBLESHOOTING**

1. **Is the main SWITCH LED lit?**
   - NO → Replace the fuse Fl (100V) and Fl/F2 (200V).
   - YES → Is the lamp lit normally?
     - NO → Replace the door SWITCH.
     - YES → Is the lamp still off even after the MAIN-SWITCH is turned ON?
       - NO → Replace the POWER-PCB (PB1).
       - YES → Is DC70V or high voltage supplied between TP6 and TP1 in the control PCB (PB2)?
         - NO → Replace the ignition PCB (PB3).
         - YES →

2. **Does the lamp flicker intermittently?**
   - NO → Replace the control PCB (PB2).
   - YES →

**Switch**

<table>
<thead>
<tr>
<th>Switch</th>
<th>C (Yellow) - NO (White)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>O</td>
</tr>
<tr>
<td>OFF</td>
<td>X</td>
</tr>
</tbody>
</table>

O: Conducting  X: Open
Is AC100V (100V) or AC220V (220V) supplied between CNB 1 and 3 in the POWER-SUPPLY-PCB (PB1) (connector's receptacle side)?

- **NO**: Replace the MAIN-SW.
- **YES**: Remove the AC INLET and CNA of the power supply PCB (PB1). Insert the AC INLET, and measure the voltage.

**(ii)**

Is about AC15V supplied between TP1 and TP2 in the POWER-SUPPLY-PCB (PB1)?

- **NO**: Is the voltage measured in (ii) about AC 1~10V?
  - **NO**: Replace the POWER-SUPPLY-PCB (PB1).
  - **YES**: Replace the POWER-SUPPLY-PCB (PB1) and CONTROL-PCB (PB2).

- **YES**: Is DC12V supplied between TP7 and TP1 in the CONTROL-PCB (PB2)?
  - **NO**: Replace the POWER-SUPPLY-PCB (PB1) and CONTROL-PCB (PB2).
  - **YES**: Replace the CONTROL-PCB (PB2).

Is DC250~380V supplied between D (drain) of Q2 and TP3 in the POWER-SUPPLY-PCB (PB1)?

- **NO**: Replace the POWER-SUPPLY-PCB (PB1).
- **YES**: Anode

Is DC 0V supplied between D10 (anode side) and TP1 in the CONTROL-PCB (PB2)?

- **NO**: Replace the POWER-SUPPLY-PCB (PB1).
- **YES**: Is DC 0V supplied between PCl 1 and TP1 in the CONTROL-PCB (PB2)?
  - **NO**: Replace the HARNESS-ASS' Y.
  - **YES**: Replace the POWER-SUPPLY-PCB (PB1).
E. TROUBLESHOOTING

1. Disconnect CNF in the POWER-SUPPLY-PCB (PB1), and check.

2. Disconnect the TO LAMPHOUSE connector, and check.

Replace the OUTLET-ASS'Y.

Is the circuit between 3 and 2 of the connector's plug (CN2) side conducting?

NO YES

Is the output cable conducting?

YES NO

Replace the output cable.

Replace the door switch.

Is the HARNESS-ASS'Y conducting?

YES NO

Replace the HARNESS-ASS'Y.

Replace the CONTROL-PCB (PB2).

Is the resistor in the CONTROL-PCB (PB2) normal?

YES NO

Replace the POWER-SUPPLY-PCB (PB1) and CONTROL-PCB (PB2).

E-6

Replace the CONTROL-PCB (PB2).

Remove AC INLET. Normal; if the resistance value is as shown in the table below. Defective; otherwise.

<table>
<thead>
<tr>
<th>IC2 1 - TP1</th>
<th>Resistance value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ~ 3 kΩ</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IC2 2 - TP1</th>
<th>Resistance value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ~ 6 kΩ</td>
<td></td>
</tr>
</tbody>
</table>
2-2 Lamp is too dark.

Is DC30V or higher voltage supplied between TP6 and TP1 in the CONTROL-PCB (PB2)?

Light up the lamp with a multimeter lead applied to TP6 and TP1 in the CONTROL-PCB (PB2), and measure the voltage after 10 minutes.

Check the load resistor according to 10-4 and 10-5 of "C. ASSEMBLY AND ADJUSTMENT PROCEDURES" No. C-7.

Replace the lamp.

CAUSE

1. Defective lamp
2. Defective CONTROL-PCB (PB2)
E. TROUBLESHOOTING

Replace the lamp.

Replace the CONTROL-PCB (PB2).
3-1 Life meter does not function.

* Counter operation

1. The counter (Life Meter) clicks about 0.5 ~ 1 second after the lamp is lit, and counts up one at every 6 minutes. If the counter functions immediately after the lamp is lit, and fails after about 6 minutes, replace the CONTROL-PCB (PB2). If the counter function but the operation time is extremely short or long, replace the CONTROL-PCB (PB2).

2. If the counter reset button is pressed insufficiently, the counter character plate is caught causing failure in counting. In this case, press the reset button deeply to reset the counter display to "000.0".
3-2 BURNER ON LED is not lit.

![Diagram of electrical circuit with labels CN, PB1, PB2, PB3, SW1, D1, D2, TL1, TL2, and connections]

**CAUSE**

1. Defective LED-ASS'Y
2. Defective CONTROL-PCB (PB2)
3. Defective lamp

* LED operation

1. BURNER ON LED is lit simultaneously with the lamp, and lighting continuously while the lamp is lighting. When the LED is too dark, replace the LED-ASS'Y.

* Caution

1. Before touching the power supply inside or replacing the fuse, be sure to disconnect the AC INLET as well as turning off the power switch. Even with the main switch turned off, the supply voltage is supplied to the fuse.
2. The ignition (PB3) generates high voltage (approx. 2kV) only when the lamp is lit. When the lamp is completely lit, the ignition stops automatically.

3. Pull out the connectors connected to the PCB by hand and verify that they are not loose or not disconnected.

Is the lamp lit?

- NO: Proceed the check according to "2-1 Lamp is not lit."
- YES: Replace the LED-ASS'Y.

Is the lamp lit normally?

- YES: END
- NO: Return the LED ASS'Y to the original position, and replace the CONTROL-PCB (PB2).
3-3 POWER LED is not lit.

**CAUSE**

1. Defective main SW100 (100V) or SW200 (200V)
2. Defective power supply PCB (PBl)
3. Defective lamp

*POWER switch

1. This switch turns on and off the input voltage to the power supply unit. The switch LED is lit when the power is supplied. Main SW ass'y is available for 100V and 200V. Use a correct one at replacement. If a wrong one is used, the switch LED is heated or dimmed. (Main SW100 for 100V and SW200 for 200V)

*Caution

1. Before touching the power supply inside or replacing the fuse, be sure to disconnect the AC INLET as well as turning off the power switch. Even with the main switch turned off, the supply voltage is applied to the fuse.
2. The ignition (PB3) generates high voltage (approx. 2kV) only when the lamp is lit. When the lamp is completely lit, the ignition stops automatically.

3. Pull out the connectors connected to the PCB by hand and verify that they are not loose or not disconnected.

---

**Is the lamp lit?**

- **YES**
  - Replace the MAIN-SW.

- **NO**
  - **Is the fuse F1 (100V) or F1/2 (200V) in the POWER-SUPPLY-PCB (PBl) conducting?**
    - **YES**
      - x
    - **NO**
      - Proceed the check according to "2-1 Lamp is not lit."