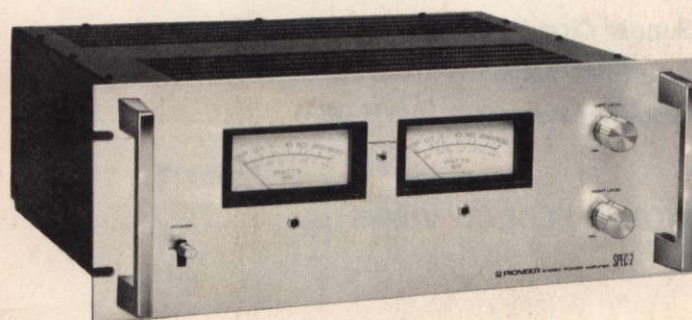


STEREO POWER AMPLIFIER

# SPEC-2

KCU

## *Service Manual*



 PIONEER®

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# 1. SPECIFICATIONS

## Semiconductors

Transistors .....	55
Diodes .....	75

## Power Amplifier

Circuitry .....	Cascaded differential Amplifier, Push-pull drive, Triple push-pull, direct coupled OCL.
Continuous Power Output from 20 Hertz to 20,000 Hertz (Both channels driven) .....	250 watts per channel (8 ohms)
Total Harmonic Distortion at 20 Hertz to 20,000 Hertz (Continuous rated power output) .....	0.1%
(125 watts per channel power output, 8 ohms) .....	0.05%
(1 watt per channel power output, 8 ohms) .....	0.05%
Intermodulation Distortion (Continuous rated power output) .....	0.1%
(125 watts per channel power output, 8 ohms) .....	0.05%
(1 watt per channel power output, 8 ohms) .....	0.05%
Frequency Response .....	5 Hertz to 80,000 Hertz $\pm 1$ dB
Input (Sensitivity/Impedance) .....	2V/50k ohms
Output Speaker .....	4 ohms to 8 ohms
Damping Factor (20 Hertz to 20,000 Hertz, 8 ohms) .....	50
Hum and Noise (IHF, short-circuited, A network) .....	110dB

## Miscellaneous

Power Requirements .....	AC 120V 60 Hertz
Power Consumption .....	500 watts
Dimensions .....	480(W) x 186.5(H) x 445(D) mm 19-5/16 x 7 x 13-3/16 in
Weight: Without Package .....	24.3kg; 54 lb

## Furnished Parts

Connection Cord with Pin Plugs .....	1
Operating Instructions .....	1

### NOTE:

*Specifications and the design subject to possible modification without notice due to improvements.*

## 2. FRONT PANEL FACILITIES

### PEAK LEVEL METERS

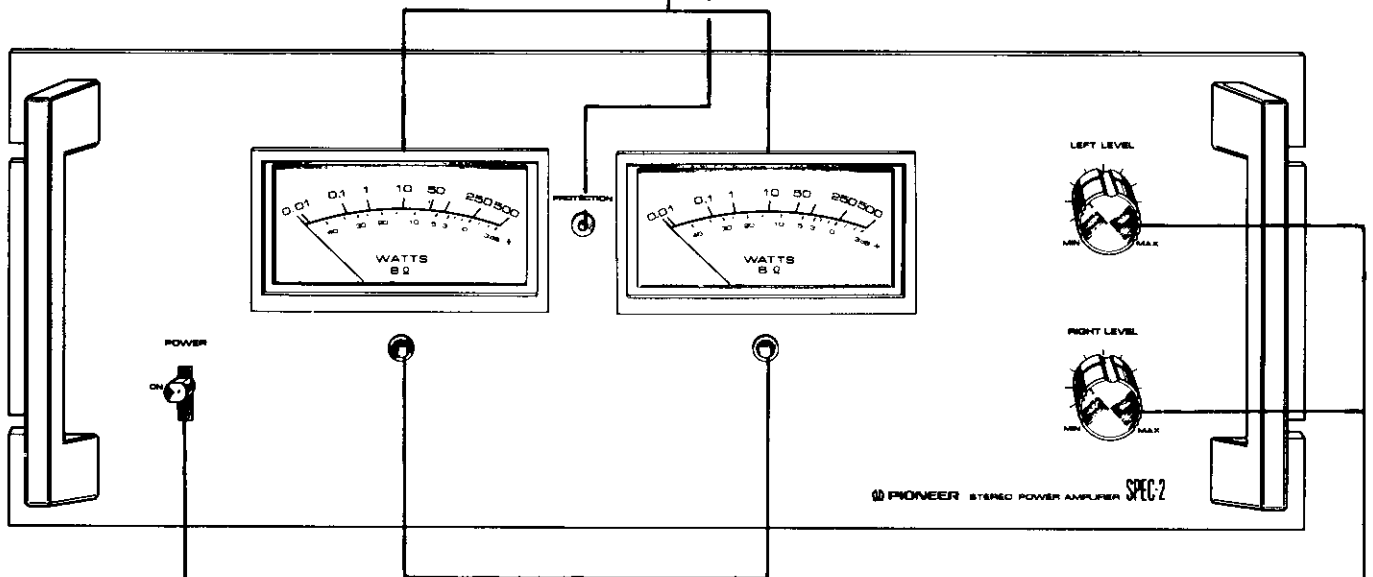
When speaker systems of  $8\Omega$  nominal impedance are connected, these provide direct readout of the output power in Watts.

**NOTE:**

*Speaker system impedance varies according to frequency. To obtain a precise measurement of the output power, remove speaker connections and connect  $8\Omega$  dummy loads across the SPEAKERS terminals.*

### PROTECTION INDICATOR

The lamp lights when the protection circuit functions. If the lamp stays on during operation, turn off the POWER switch and check as described in the section "Protection Circuit Operation". After identifying and correcting the source of difficulty, if the lamp still fails to extinguish, contact a Pioneer Authorized Service Center.



### POWER SWITCH

Set to ON to energize the SPEC-2. Output will not be obtained until the PROTECTION indicator lamp goes out. This effect is due to the internal muting circuit and does not indicate malfunction.

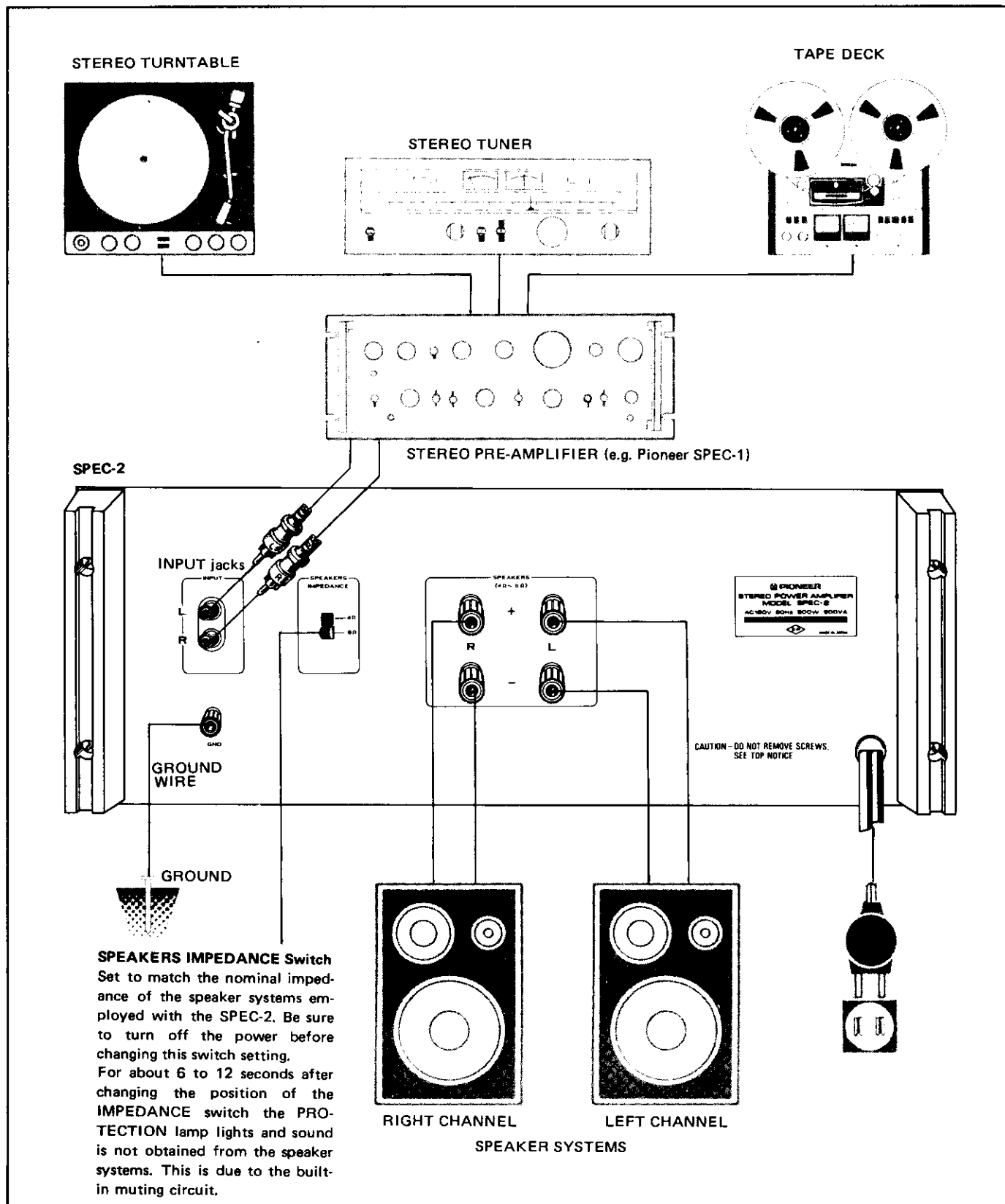
### METER ZERO POINT ADJUSTMENT

### INPUT LEVEL CONTROLS (LEFT & RIGHT)

Adjust LEFT and RIGHT controls according to the output level (voltage) of the pre-amplifier connected to the SPEC-2 INPUT (L & R) jacks. Control positions correspond to 2V at MAX (fully clockwise), 4V at center of rotation, and  $\infty$  at MIN (fully counter-clockwise). Normally set these controls to MAX (2V).

- If the minimum output voltage of the employed pre-amplifier does not reach 2V, set the controls to MAX (2V). In this case the effective output indicated in the specifications will not be obtained (for example 1/4 of the specified output can be attained with a pre-amplifier output voltage of 1V).

### 3. CONNECTION DIAGRAM



# 4. CIRCUIT DESCRIPTION

## 4.1 POWER AMPLIFIER

The SPEC-2 is a high power design, employing a cascoded differential amplifier first stage, push-pull drive, and darlington triple push-pull circuit with all stages direct coupled (OCL).

The circuit diagram is shown in Fig. 2. Q1 and Q2 form the differential amplifier. The input signal is applied to Q1 and NFB from the output stage applied to Q2 base. These two transistors are connected in common base circuits with Q3 and Q4, forming a cascode amplifier. Since the common emitter circuit (Q1 & Q2) load becomes the input of the following common base circuit stage, load impedance is low and stable amplification can be achieved.

Q3 and Q4 outputs drive Q5 and Q6 in opposite phase. The Q5 output via Q7 is applied to the current mirror circuit formed by D2 and Q8, where the phase is again inverted. Q6 and Q8 outputs thus become signals of the same phase and perform a pre-driver function.

The current mirror circuit is depicted in Fig. 1. Current flowing through R2 and Q8 becomes equal to that flowing through R1 and D2. In other words, since R1 and R2 are equal, and the characteristics of D2 and Q8 base-emitter are also equal, the current +B1 reaching point A (in Fig. 1) through R1 and D2 is equal to that reaching the same point through R2 and Q8 base-emitter. This becomes equivalent to having Q5 output directly driving Q8.

By adopting this current mirror circuit, when muting relay RL5 is OFF Q8 is cut off, Q10 – Q20 are switched OFF in succession, and operation stops. The reversed phases of Q8 and Q6 outputs cause them to cancel each other, reducing pop noise and muting relay switching noise.

Q13 and Q14 in the following driver stage drive the power transistors by direct coupling. The final stage is a high output design with three power transistors for each channel coupled in parallel. This parallel coupling permits comparatively large current (Ic) to be employed through each transistor, plus selection of an operating point with good linearity and high amplification (hfe).

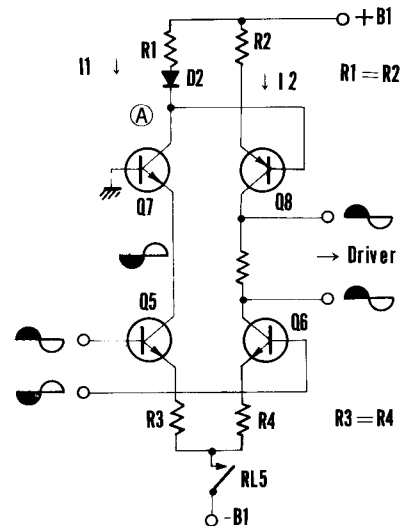


Fig. 1 Current Mirror Circuit

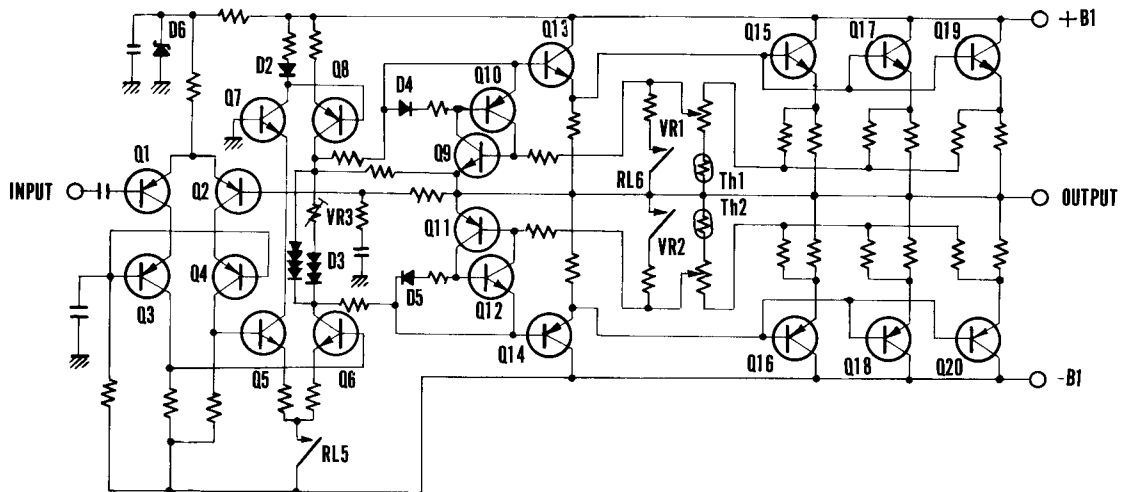


Fig. 2 Power Amplifier Circuit

**Current Limiter Circuit**

The current limiter circuit, shown in Fig. 2, consists of Q9 – Q12. If an overcurrent flows in the power transistors, due to low load (less than 4Ω) or load shorting, this circuit utilizes the voltage drop produced in the power transistor emitter resistance to limit the input voltage. Q9 – Q12 are normally OFF, but if for some reason an overcurrent occurs in the power transistors, the voltage drop component of the power transistor emitter resistance increases. This voltage is divided and used to bias the bases of Q9 and Q11, switching them ON. Q9 and Q11 make Q10 and Q12 conductive, limiting the signal voltages applied to the basis of Q13 and Q14.

VR2 and VR3 in this circuit set the current limiting value, while TH1 and TH2 are for temperature compensation. RL6 is a selector switch for changing the current limiting value at 4Ω load.

**4.2 PEAK LEVEL METER CIRCUIT**

Logarithmic indication is required in order to provide a broad indicating range in a single meter, without the need for range selection by the user. With respect to an 8Ω load, approximately 50dB logarithmic compression is performed to allow meter indication in the range of 0.01 – 500W.

As shown in Fig. 3, the circuit is divided into positive and negative sides. Each side consists of logarithmic compression, peak value holding and voltage to current converter circuits. In addition there is a current resultant circuits, common to both sides. The positive side circuit operation is described here.

A portion of the power amplifier output signal is compressed by the logarithmic compression circuit, which utilizes the exponential function properties of diodes. Figs. 4 and 5 illustrate the operating principle and input-output response. The compressed signal is then rectified and retained for a suitable length of time by the peak holding circuit, which employs a simple diode and capacitor construction. Holding time is determined by the time constant of C1 and R1.

The holding circuit voltage is then applied to the voltage-current converter, where it is converted into a current value and amplified. The current afterwards passes through the current resultant circuit and drives the meter.

The current resultant circuit applies the larger current of the positive and negative sides to the meter for operation.

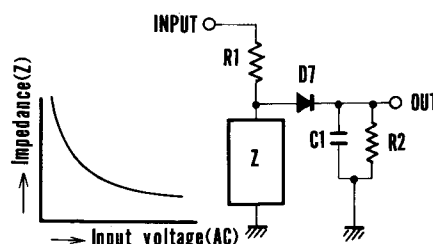


Fig. 4 Equivalent Circuit of the Logarithmic Compression

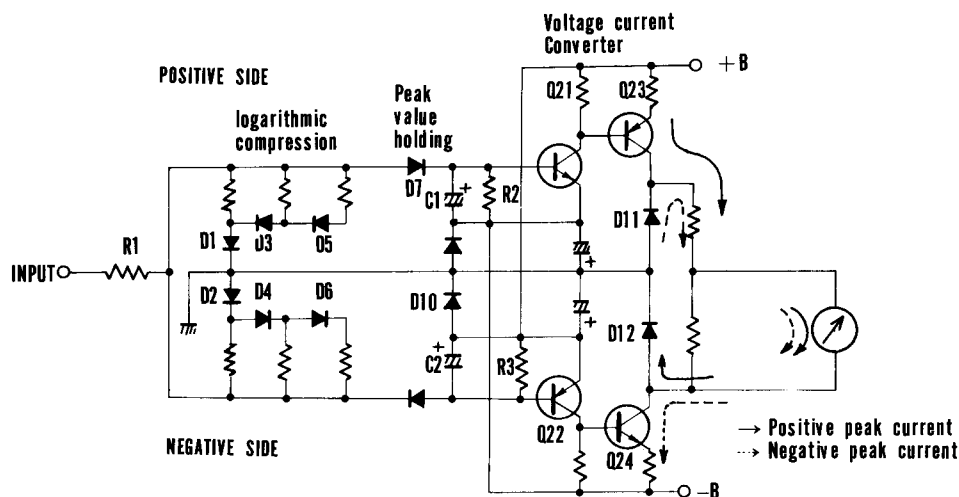


Fig. 3 Peak Level Meter Circuit

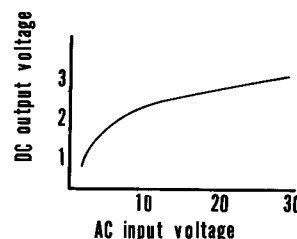


Fig. 5 Input-output Response

### 4.3 PROTECTION CIRCUIT

The main purpose of the protection circuit is to protect the equipment and give an indication in the event of malfunction, incorrect operation, faulty connections, or other causes.

The block diagram of the protection circuit functions is shown in Fig. 6. The following description is in reference to the diagram.

#### Relay and Lamp Drivers

Q27 – Q30 form the relay drive circuit (see Fig. 7). while Q31 drives the lamp. In normal operation, reverse bias is applied to Q27, maintaining it in the cut off state. When an abnormality is detected by the DC balance or temperature detector, current flows through R1. Q27 base potential falls rapidly and it switches ON. This causes forward bias voltage to be applied to Q28, turning Q28 ON. Potential at point B drops, turning off Q29 and Q30. With Q29 OFF, current to relay RL5 is cut off, turning Q31 (lamp drive) ON and lighting the protection lamp. Q30 cuts off the current to RL4 and RL2 (when impedance switch is at  $8\Omega$ ; when at  $4\Omega$ , RL4, RL6 and RL3).

Because of RL4 off, output circuit of the power amplifier becomes open, and the stages beyond the predriver are stopped operation completely by RL5.

RL2, RL3 and RL6 are for changing the transformer secondary taps when the impedance switch is selected and determining the value of the current control circuit in the power amplifier. They are thus not directly related to the protection function.

Zener diodes D2 and D3 fix the operating potentials of Q29 and Q30, and the difference in their starting points prevent misoperation.

#### Power Switch ON Muting

This circuit also includes a delaying function when the power switch is set to ON. The delay time is determined by R8 and C1 in the Q29 and Q30 base circuits.

Immediately after the power switch is turned ON, Q27 and Q28 are reverse biased by  $-B1$  and  $-B2$ , and switched OFF. Point B potential from  $+B3$  passes through R8 and rises as C1 charges. The rise time is determined by the time constant of C1 and R8. When the potential exceeds D3 (zener diode) zener voltage, Q30 is switched ON and current flows in the relay circuit connected to Q30.

In the same manner, when the potential at point B exceeds D2 zener voltage, Q29 is switched ON and current flows in RL5. Correct voltage is thus applied to the power amplifier.

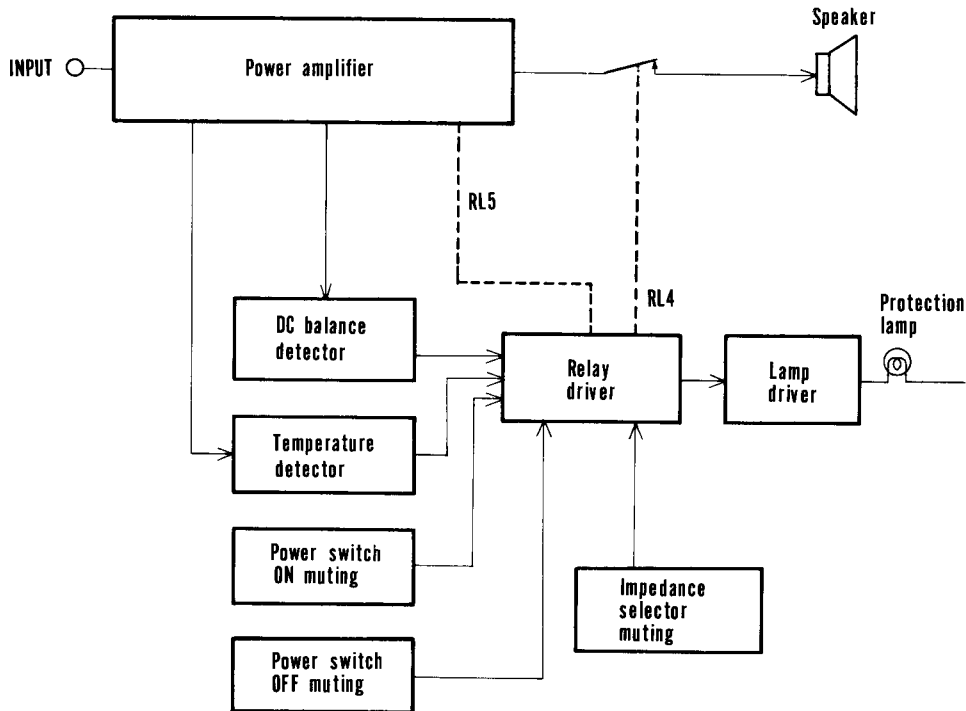


Fig. 6 Block Diagram of the Protection Circuit



**Power Switch OFF Muting**

Since +B3 normally passes from R7 to R6 and flows to -B2, Q28 base is maintained at cut off potential. When the power switch is turned OFF, -B2 immediately ceases, since its time constant is smaller than +B3. Consequently, +B3 passes through D1 and is applied to Q28 base, turning Q28 ON. Point B potential then falls rapidly, turning Q27 and Q30 OFF.

**Impedance Selector Muting**

When the impedance selector switch (S1) is changed from 8Ω to 4Ω, uncharged capacitor C2 is introduced into the -B2 circuit, temporarily reducing -B2 voltage. This causes Q28 to switch ON, C1 to be discharged, and Q29 & Q30 to be switched OFF.

Although Q28 switches OFF again, Q29 and Q30 continue in the OFF condition for several seconds while C1 is charging.

**Temperature Detector**

The temperature detector employs positive coefficient thermistors (posistors). These are temperature sensitive elements possessing a positive temperature response, rapidly increasing in resistance when a certain temperature is exceeded (see Figs. 8 & 9). The posistors (TH3 & TH4) are mounted on the power transistor. If some abnormality increases the temperature to the posistor operating point, their resistance rapidly increases, reducing the potential at point C. This allows D3 to conduct, so that the potential at point D drops and Q27 switches ON.

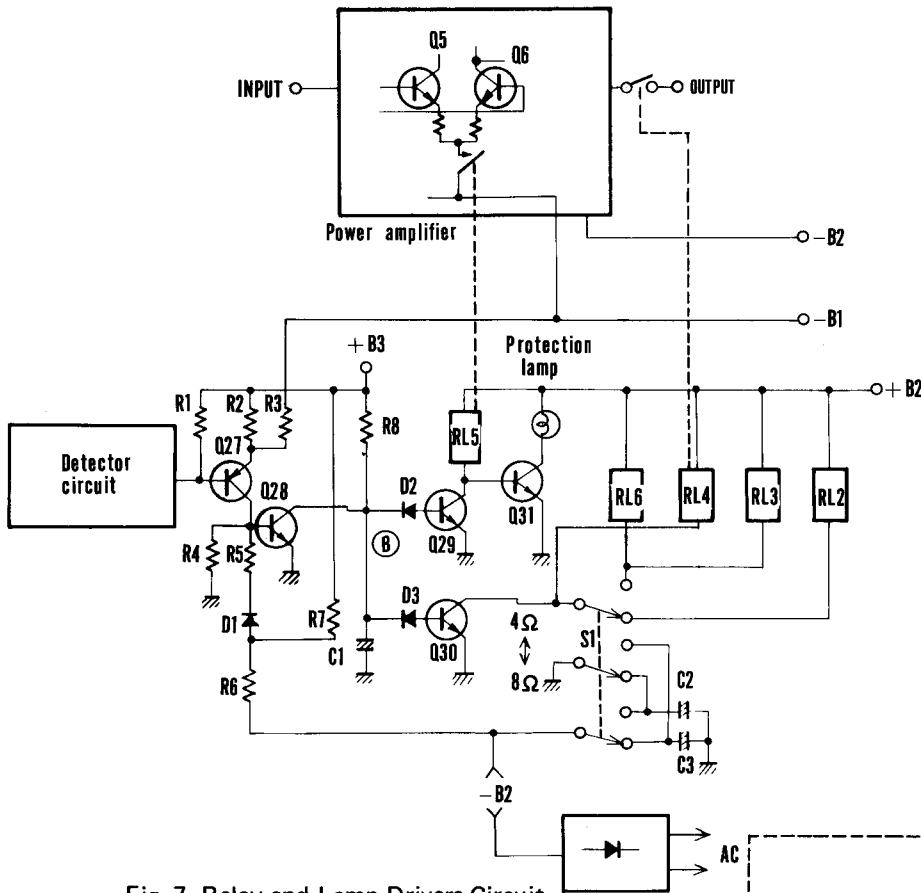


Fig. 7 Relay and Lamp Drivers Circuit

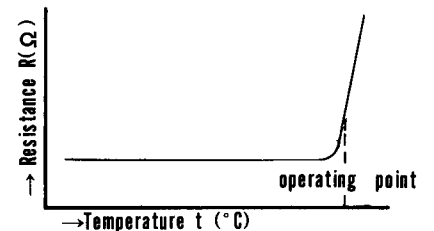


Fig. 8 Posistor-temperature Response

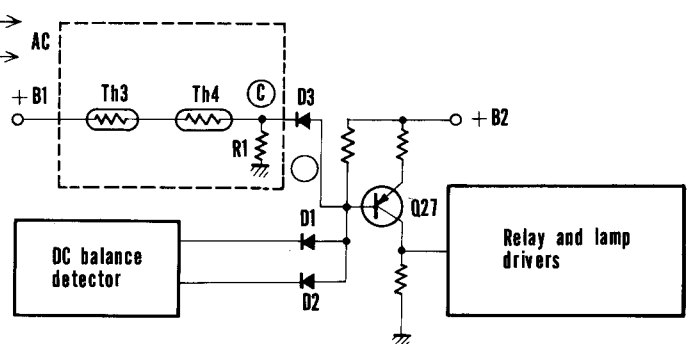


Fig. 9 Temperature Detector Circuit

## DC Balance Detector

Q25 and Q26 make up a differential amplifier, as shown in Fig. 10. The inputs (bases) of these transistors are connected to the left and right power amplifier. If for some reason the DC balance of the power stage is upset, a potential difference arises in the differential amplifier input signal, unbalancing Q25 and Q26 collector currents. When one of the collector potentials becomes lower than Q27 base potential, this base potential is dissipated through D1 or D2, Q27 switches ON, and relay and lamp drives operate.

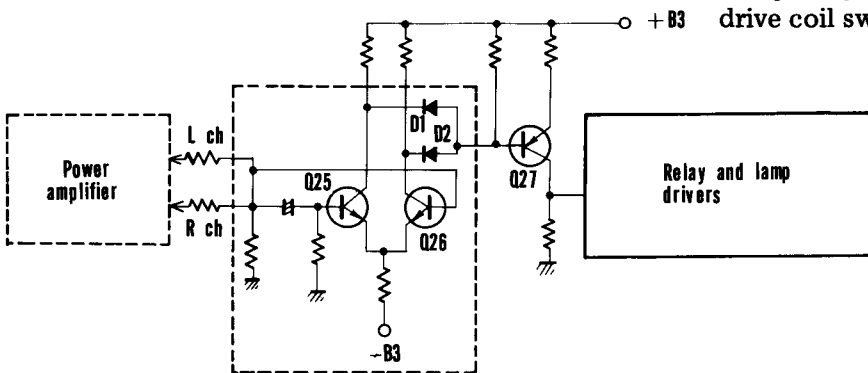


Fig. 10 DC Balance Detector Circuit

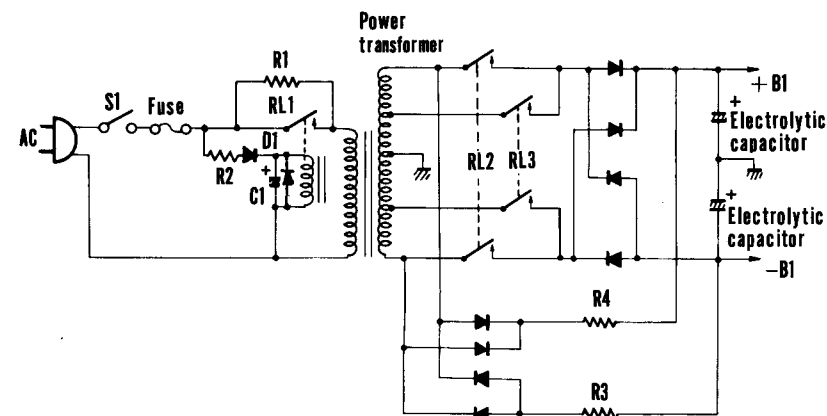


Fig. 11 Surge Current Suppressor Circuit

## 4.4 SURGE CURRENT SUPPRESSOR CIRCUITS

A toroidal core power transformer is used in the SPEC-2, which while possessing compactness and a large handling capacity, also exhibits extremely low internal resistance. In combination with the four 15,000 $\mu$ F electrolytic capacitors forming the power supply, surge current accompanying power switch operation can reach a maximum of 300A. The power supply can therefore be damaged unless protective measures are taken.

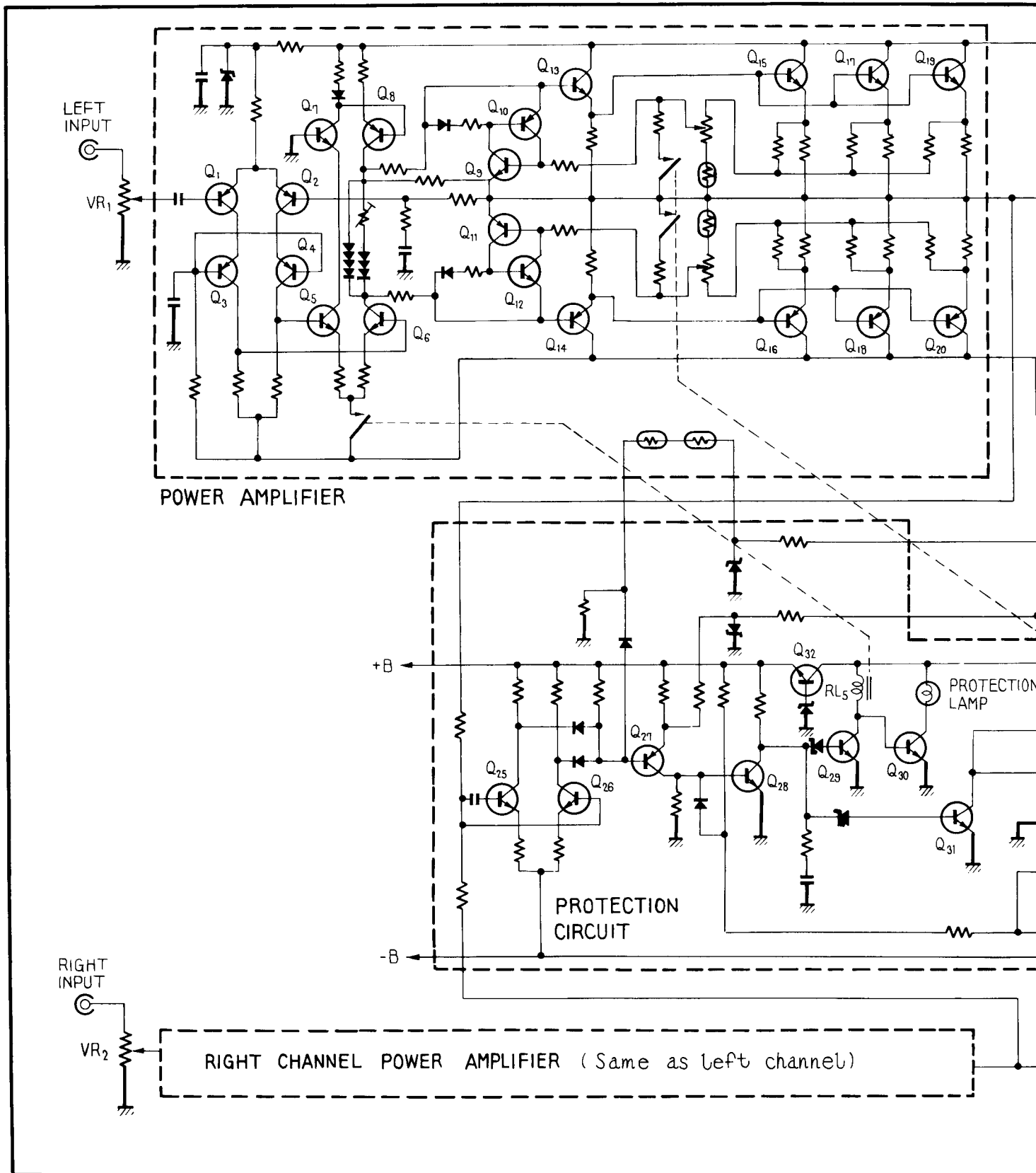
The main sources of surge current generation are power transformer excitation current and power supply electrolytic capacitor charging current.

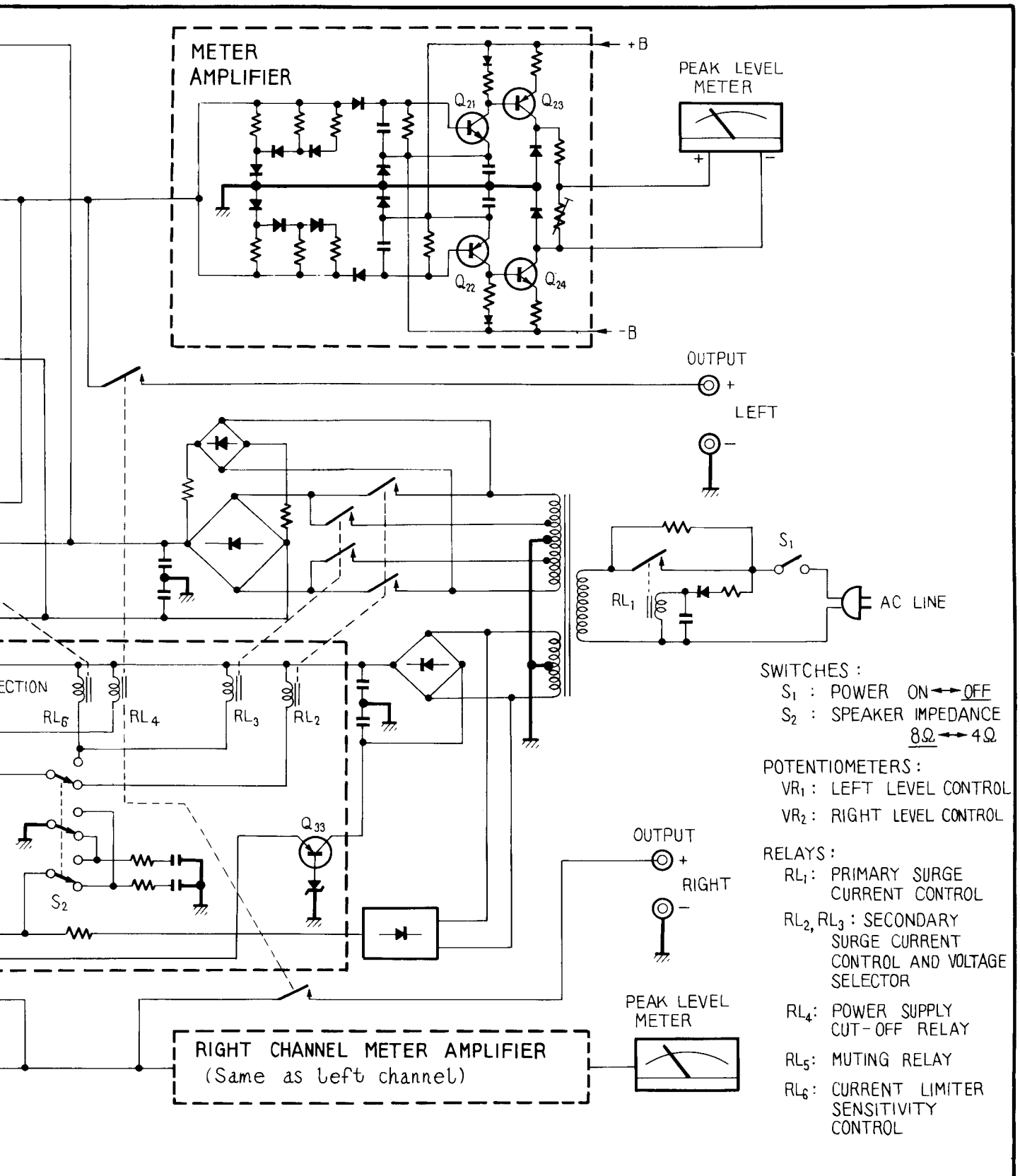
Two surge suppressor circuits are employed in the SPEC-2, one each in the primary and secondary power transformer circuits. These circuits are shown in Fig. 11.

Power transformer excitation current is handled by the relay surge suppressor circuit at the primary side. When the power switch is turned ON, the current passes through R2 & D1 and charges C1, therefore it does not flow through the relay drive coil immediately, and RL1 remains OFF. The transformer excitation current flows through R1 during this interval. After C1 is completely charged, current flows in the RL1 drive coil switching it ON, and R1 is shorted.

The surge suppressor circuit in the secondary side of the power transformer is designed to handle the electrolytic capacitor charging current. When the power switch is turned ON, RL2 and RL3 remain OFF due to protection circuit operation. Consequently, the current passes through R3 and R4, gradually charging the electrolytic capacitors through a bridge type rectifier circuit. RL2 or RL3 is switched ON when charging has been completed, giving the normal operating mode. By employing these circuits, surge current is limited to approximately 40 A.

# 5. BLOCK DIAGRAM





- SWITCHES :
- S<sub>1</sub> : POWER ON ↔ OFF
  - S<sub>2</sub> : SPEAKER IMPEDANCE  
8Ω ↔ 4Ω
- POTENTIOMETERS :
- VR<sub>1</sub> : LEFT LEVEL CONTROL
  - VR<sub>2</sub> : RIGHT LEVEL CONTROL
- RELAYS :
- RL<sub>1</sub> : PRIMARY SURGE CURRENT CONTROL
  - RL<sub>2</sub>, RL<sub>3</sub> : SECONDARY SURGE CURRENT CONTROL AND VOLTAGE SELECTOR
  - RL<sub>4</sub> : POWER SUPPLY CUT-OFF RELAY
  - RL<sub>5</sub> : MUTING RELAY
  - RL<sub>6</sub> : CURRENT LIMITER SENSITIVITY CONTROL

## 6. ADJUSTING PROCEDURES

Since the same configuration is used for both left and right channels of the SPEC-2 power amplifier assembly, the following adjustments apply to both channels.

### 6.1 IDLE CURRENT ADJUSTMENT

- 1) Connect as shown in Fig. 12.
- 2) Set LEFT LEVEL and RIGHT LEVEL controls on the front panel to minimum (fully counter-clockwise).
- 3) Set POWER switch to ON. After 1 or 2 minutes adjust VR1 to give an indication of 30mV on the voltmeter.
- 4) After the power has been ON for 30 minutes, readjust VR1 for 30mV indication on the voltmeter.

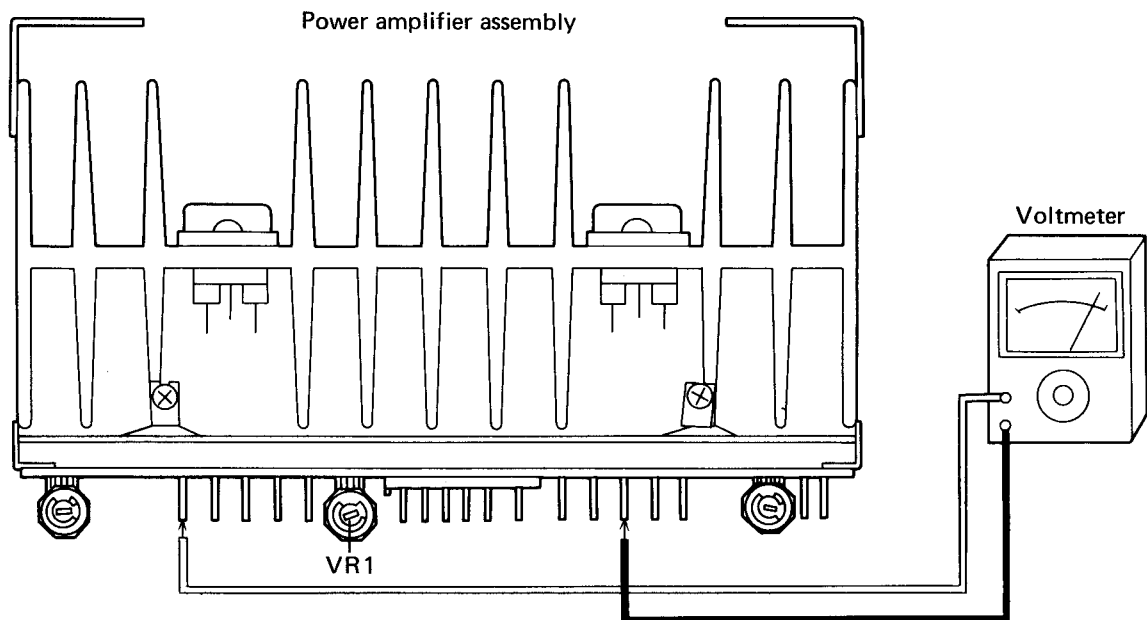


Fig. 12 Connection Diagram for Idle Current Adjustment

## 6.2 CURRENT LIMITER SENSITIVITY ADJUSTMENT

Note:

The high output power of the SPEC-2 requires a dummy load of  $4\Omega$  and more than 200W. If a 200W dummy load is not available, connect two  $8\Omega$ , 100W loads in parallel.

- 1) Connect as shown in Fig. 14.
  - 2) Set SPEC-2 impedance selector switch to  $8\Omega$  (even though a  $4\Omega$  dummy load is used).
  - 3) While the voltmeter indicated  $30V/(4\Omega)$ , adjust VR2 to just distorted point the upper half of the waveform.
- In the same manner, adjust VR3 to just distorted point the lower half with  $28.3V/(4\Omega)$ .

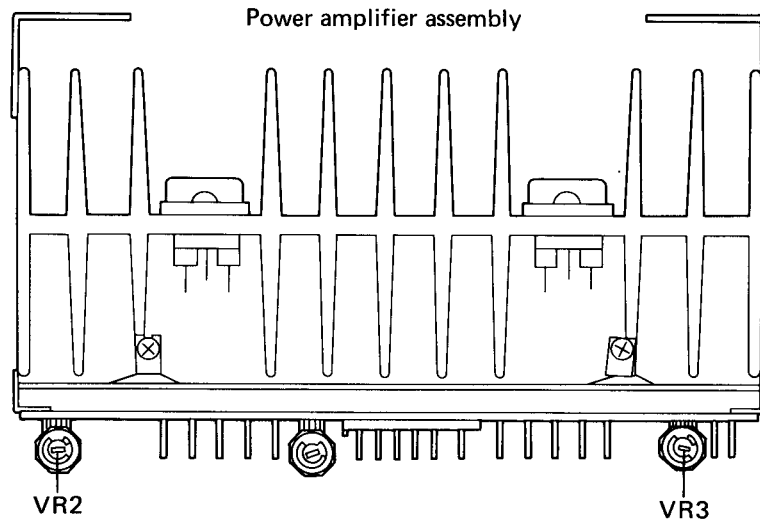


Fig. 13 The Position of VR2 and VR3

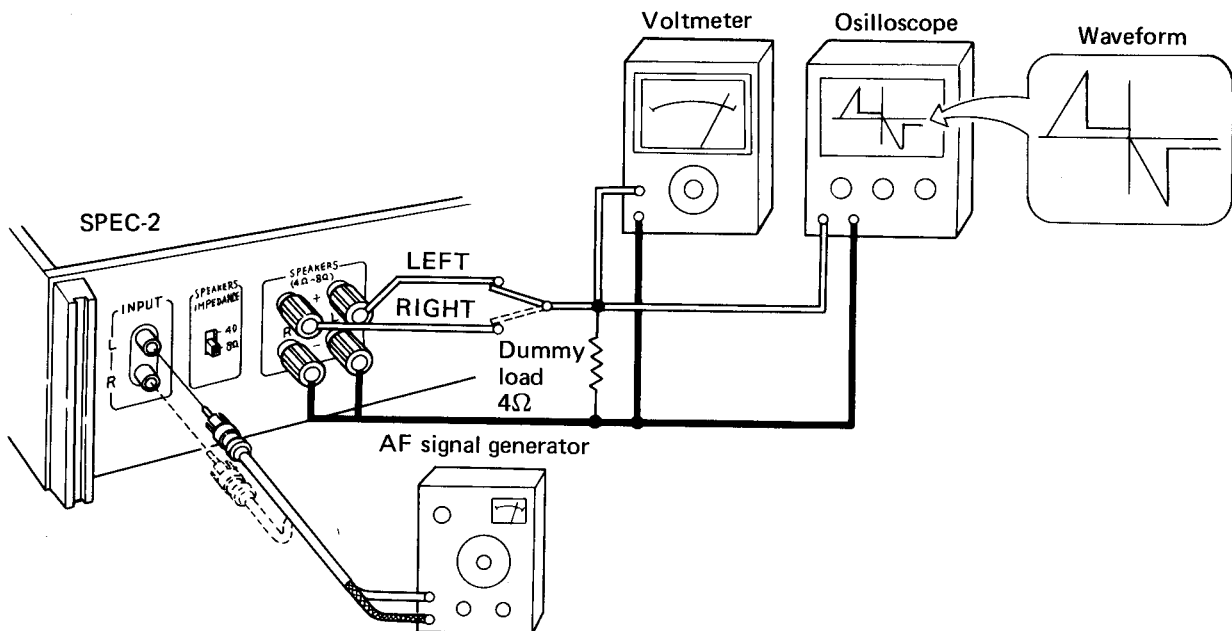


Fig. 14 Connection Diagram for Current Limiter Sensitivity Adjustment

### 6.3 METER AMPLIFIER ADJUSTMENT

- 1) Connect as shown in Fig. 16.
- 2) Adjust input level to give an indication of 44.7V on the voltmeter.
- 3) At this time, adjust VR1 (left channel; VR2 is for right channel) for 0dB (250W) indication on the LEVEL meter.

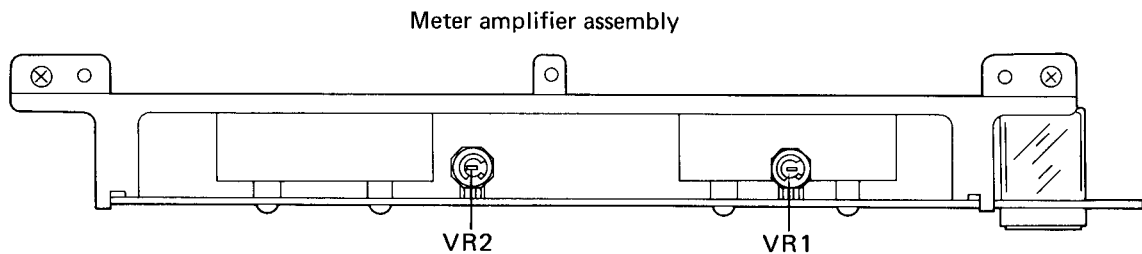


Fig. 15 The Position of VR1 and VR2

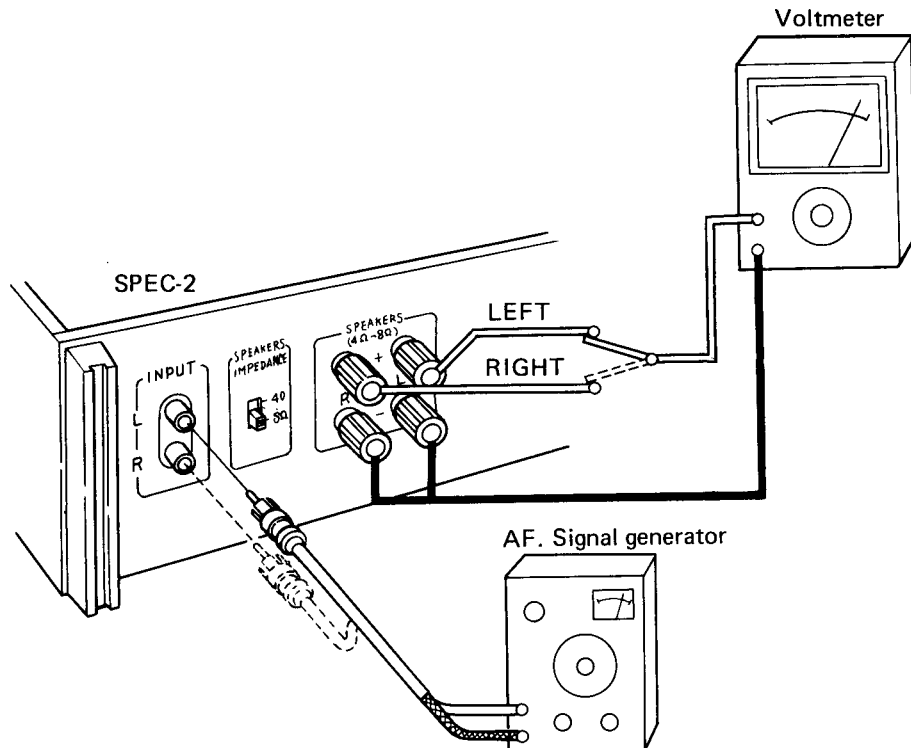
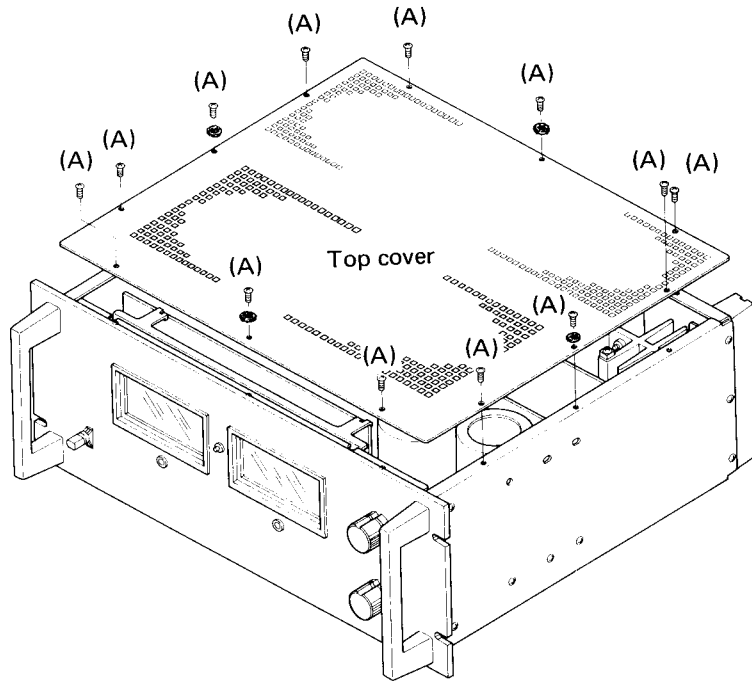


Fig. 16 Connection Diagram for Meter Amplifier Adjustment

# 7. DISASSEMBLY

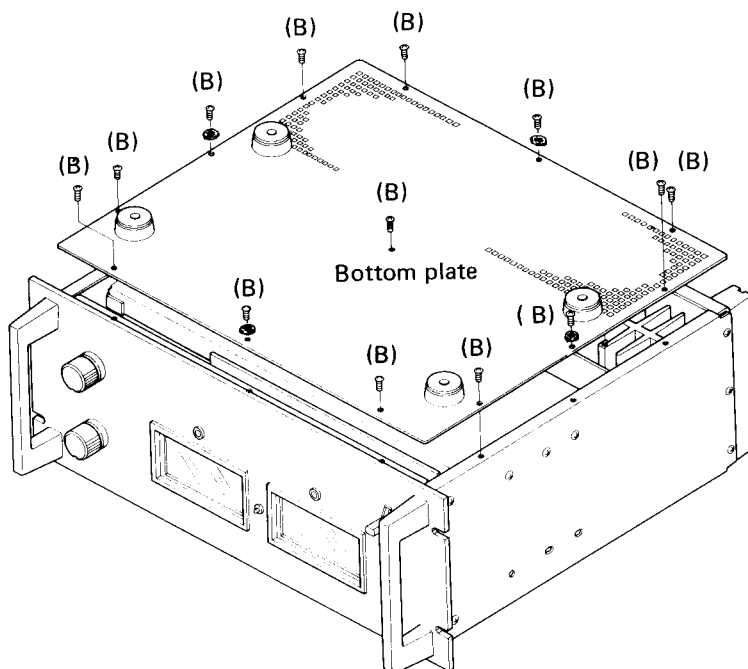
## 1. Removing the Top Cover

Remove the 12 screws (A) to detach the top cover.



## 2. Removing the Bottom Plate

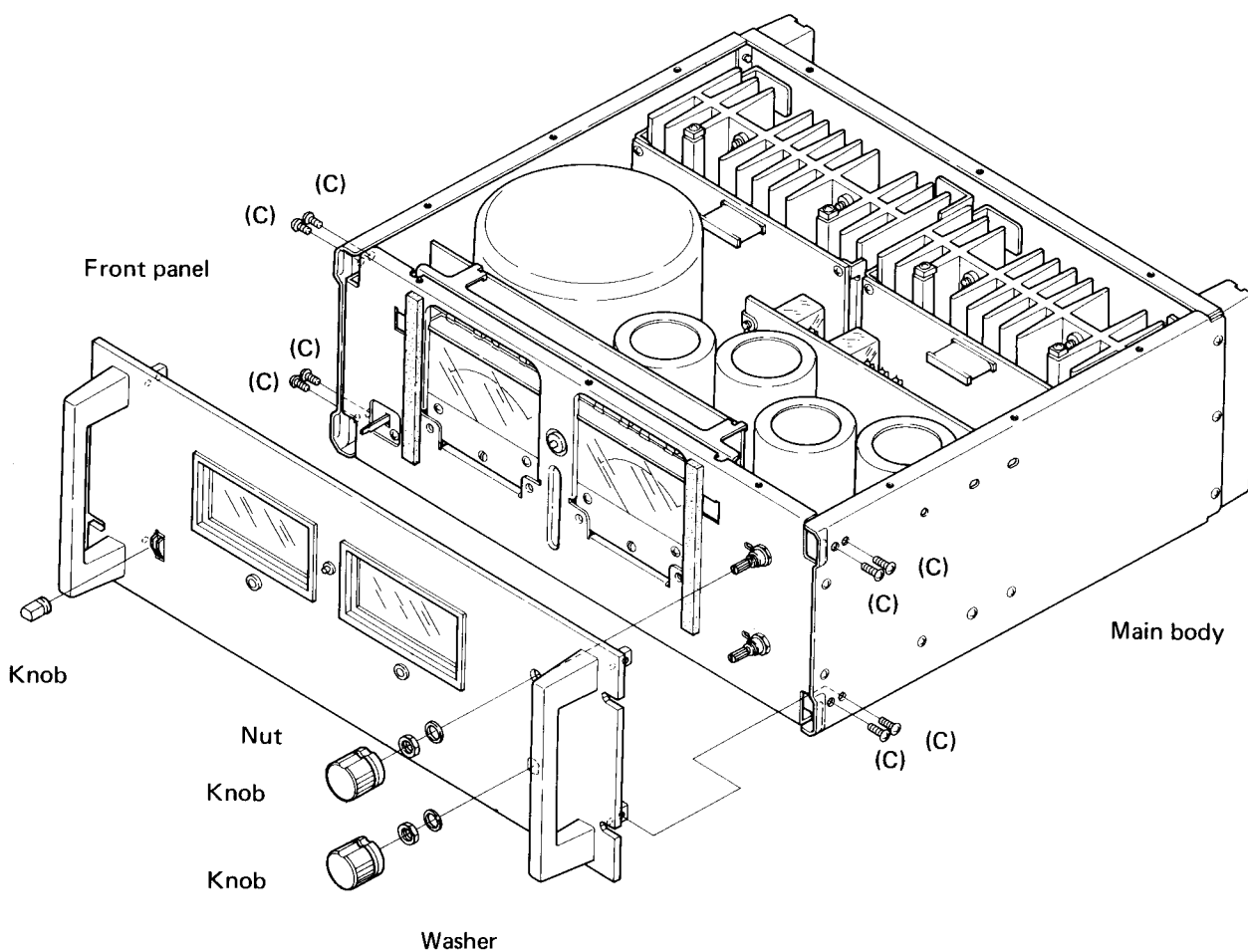
Remove the 13 screws (B) to detach the bottom plate.





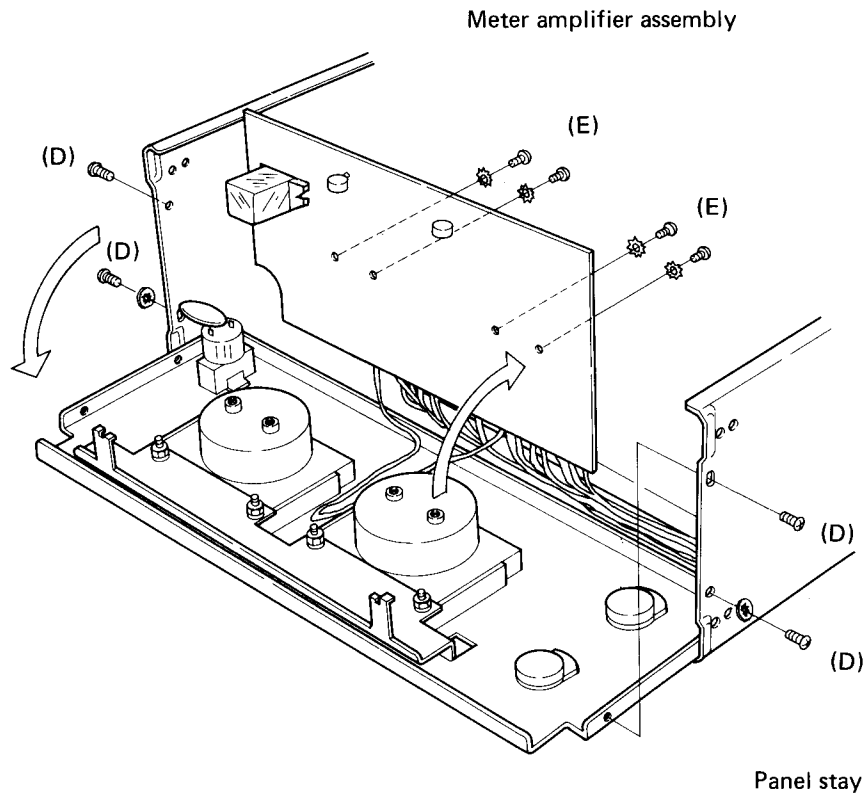
**3. Removing the Front Panel**

- (1) Remove all control knobs by pulling them out.
- (2) Remove the LEFT LEVEL and RIGHT LEVEL shaft nuts and washers.
- (3) Remove the 4 screws (C) on each side of the main body. The front panel is ready for removal.



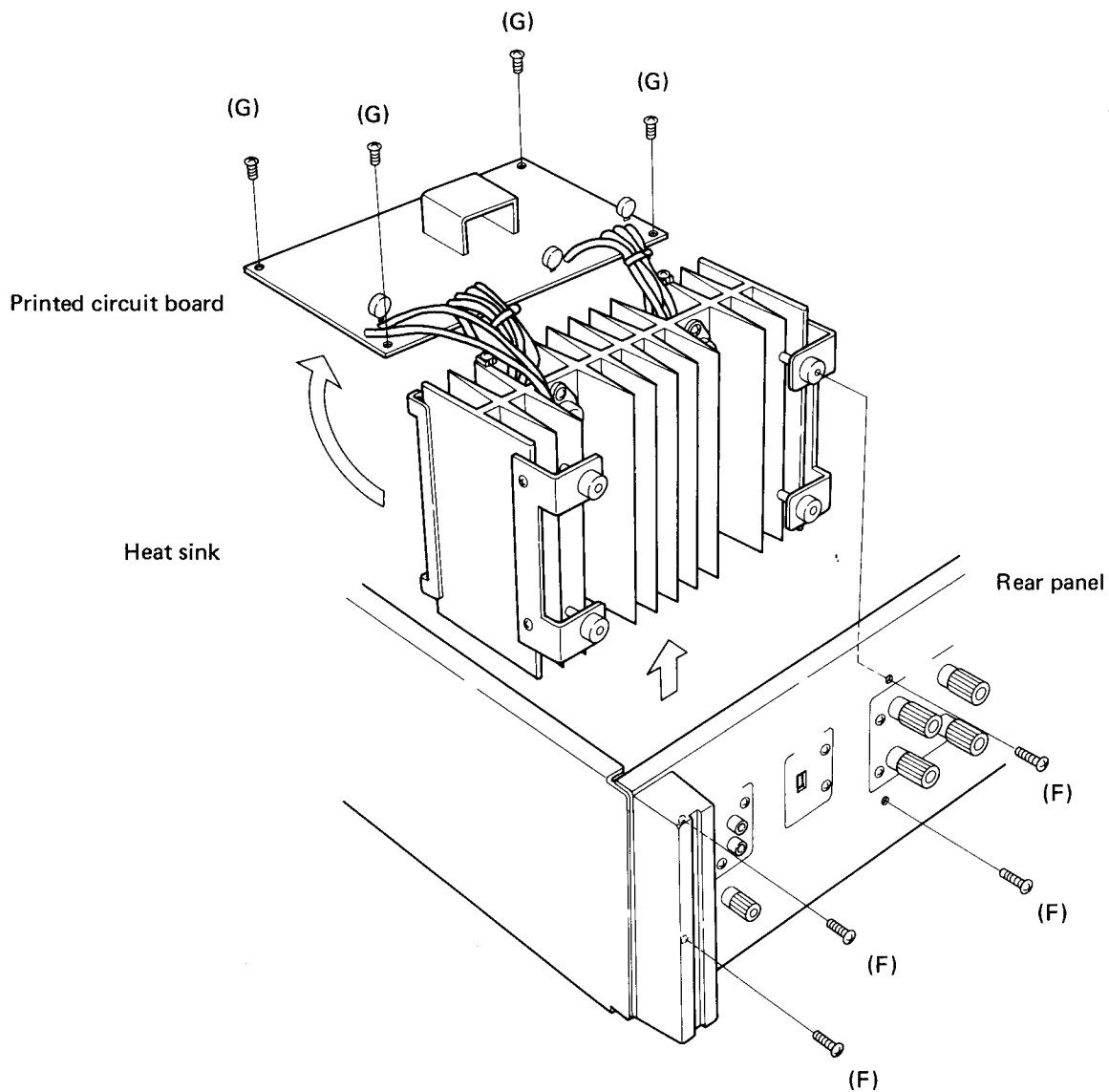
#### 4. Removing the Meter Amplifier Assembly

- (1) Remove the top cover, bottom plate and front panel.
- (2) Unscrew the 4 screws (D). Remove the panel stay.
- (3) Unscrew the 4 screws (E) which mount the printed circuit board on peak level meter.  
This allows the printed circuit board to be moved, though the distance is limited by the length of its lead wire.



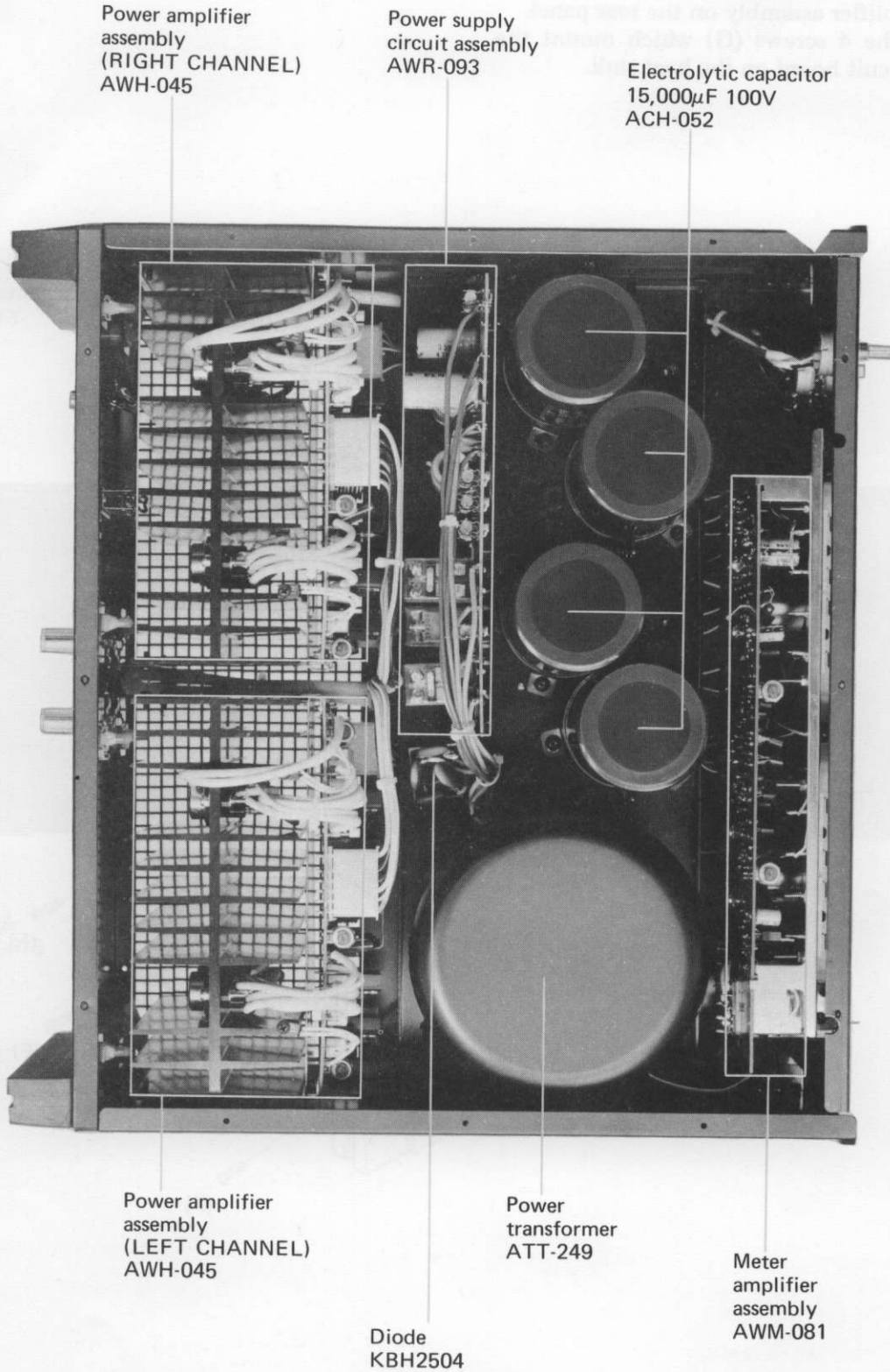
**5. Removing the Power Amplifier Assembly**

- (1) Remove the top cover and bottom plate.
- (2) Unscrew the 4 screws (F) which mount the power amplifier assembly on the rear panel.
- (3) Unscrew the 4 screws (G) which mount the printed circuit board on the heat sink.

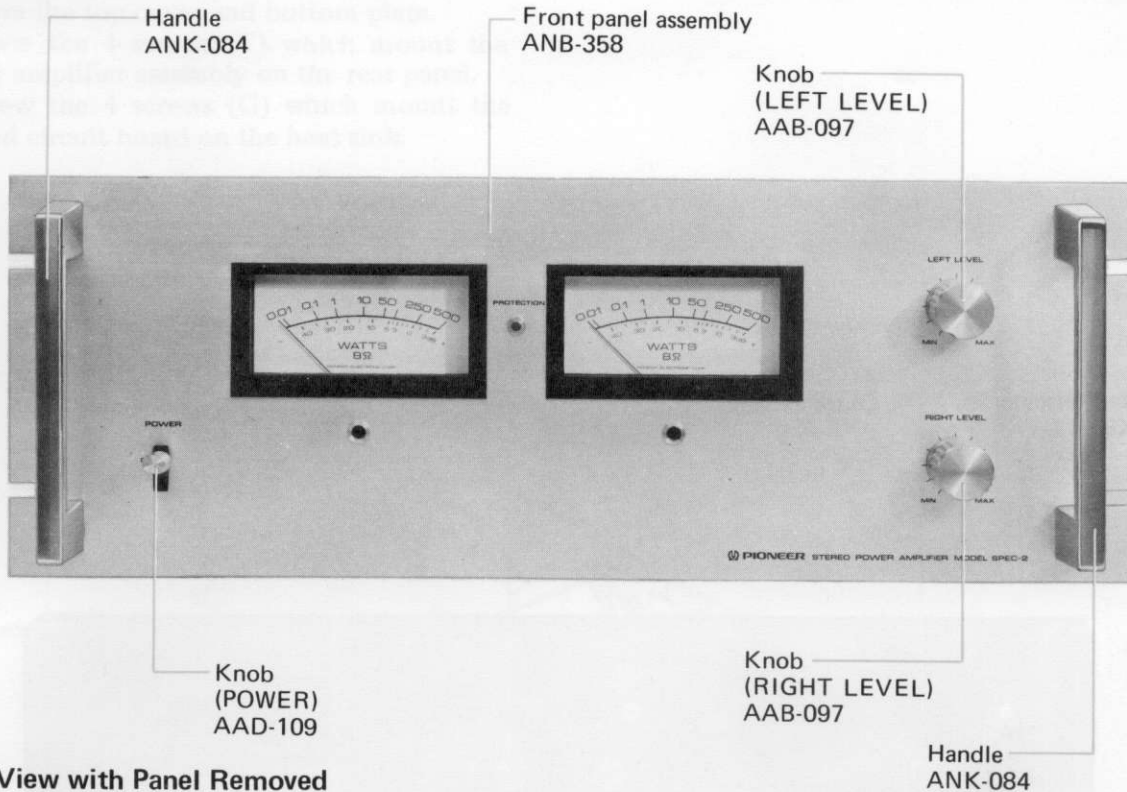


# 8. PARTS LOCATIONS

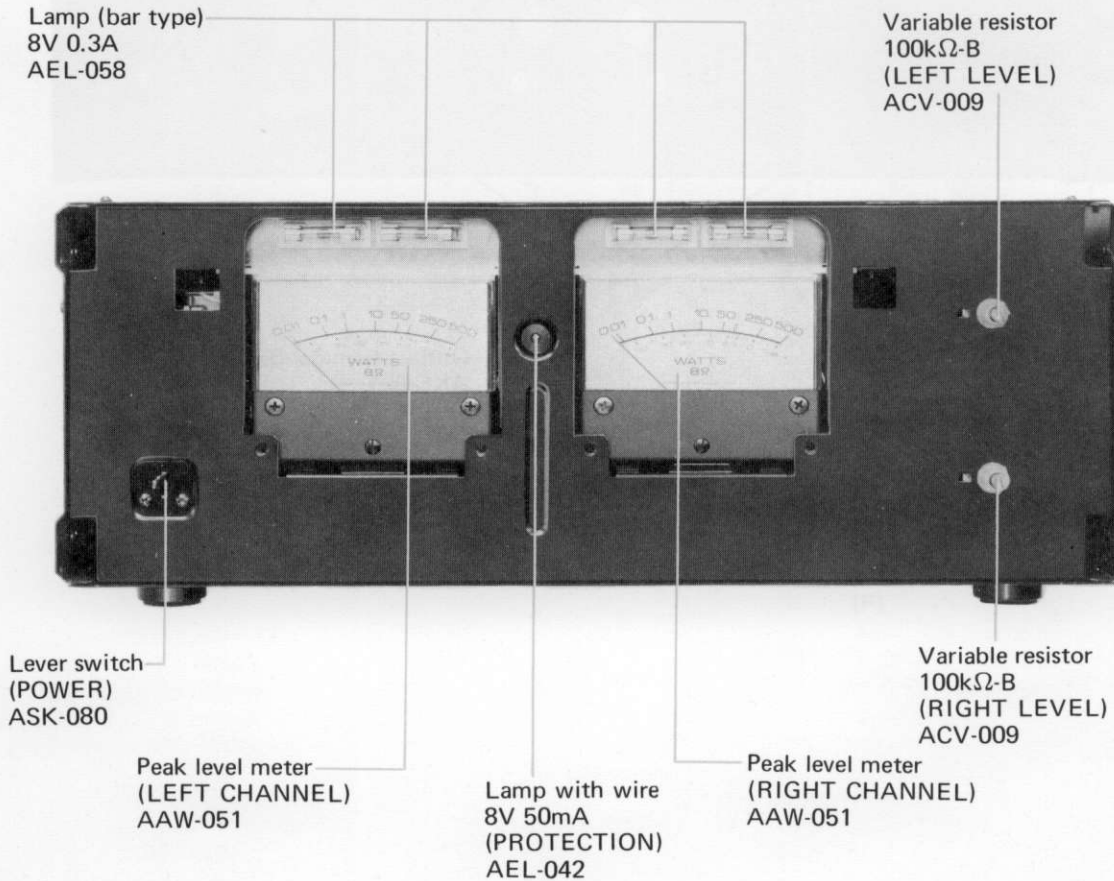
## 1. Top View



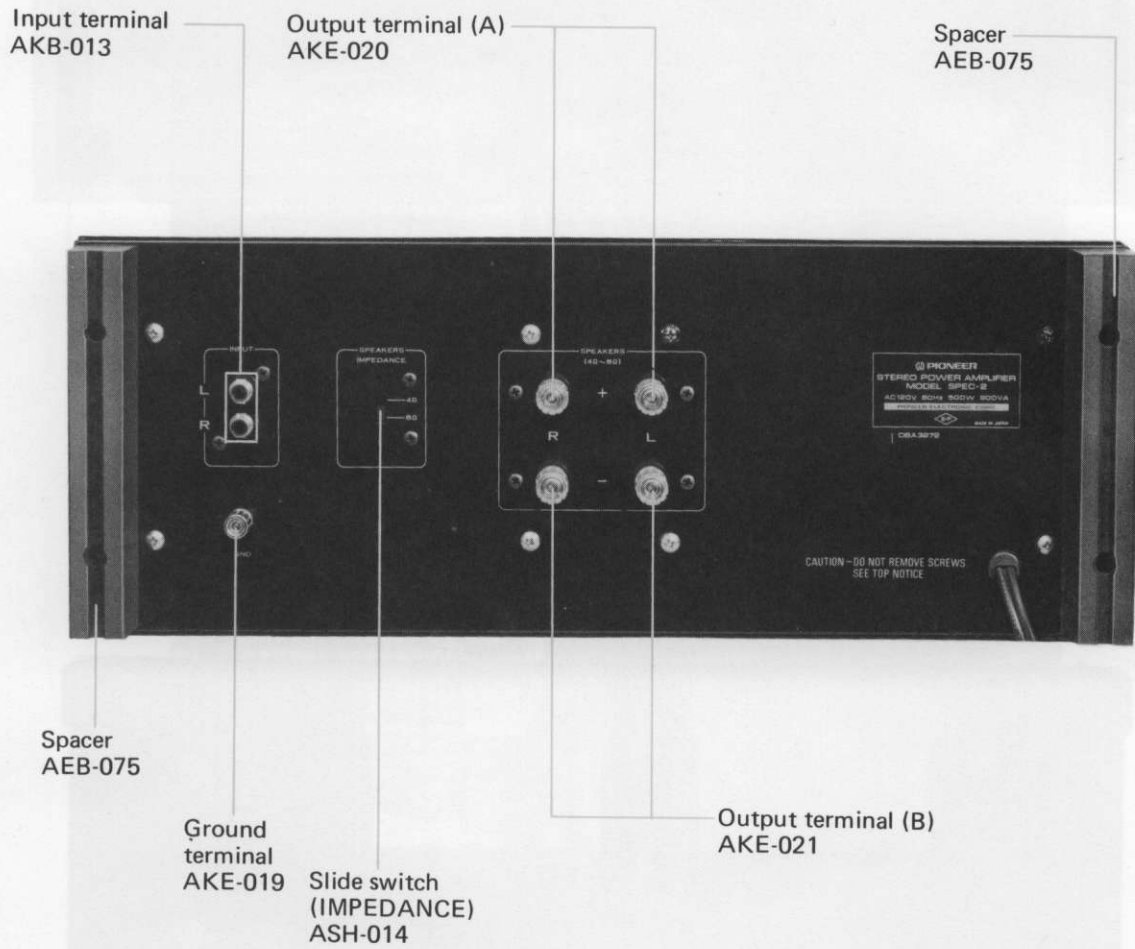
**2. Front Panel View**



**3. Front View with Panel Removed**

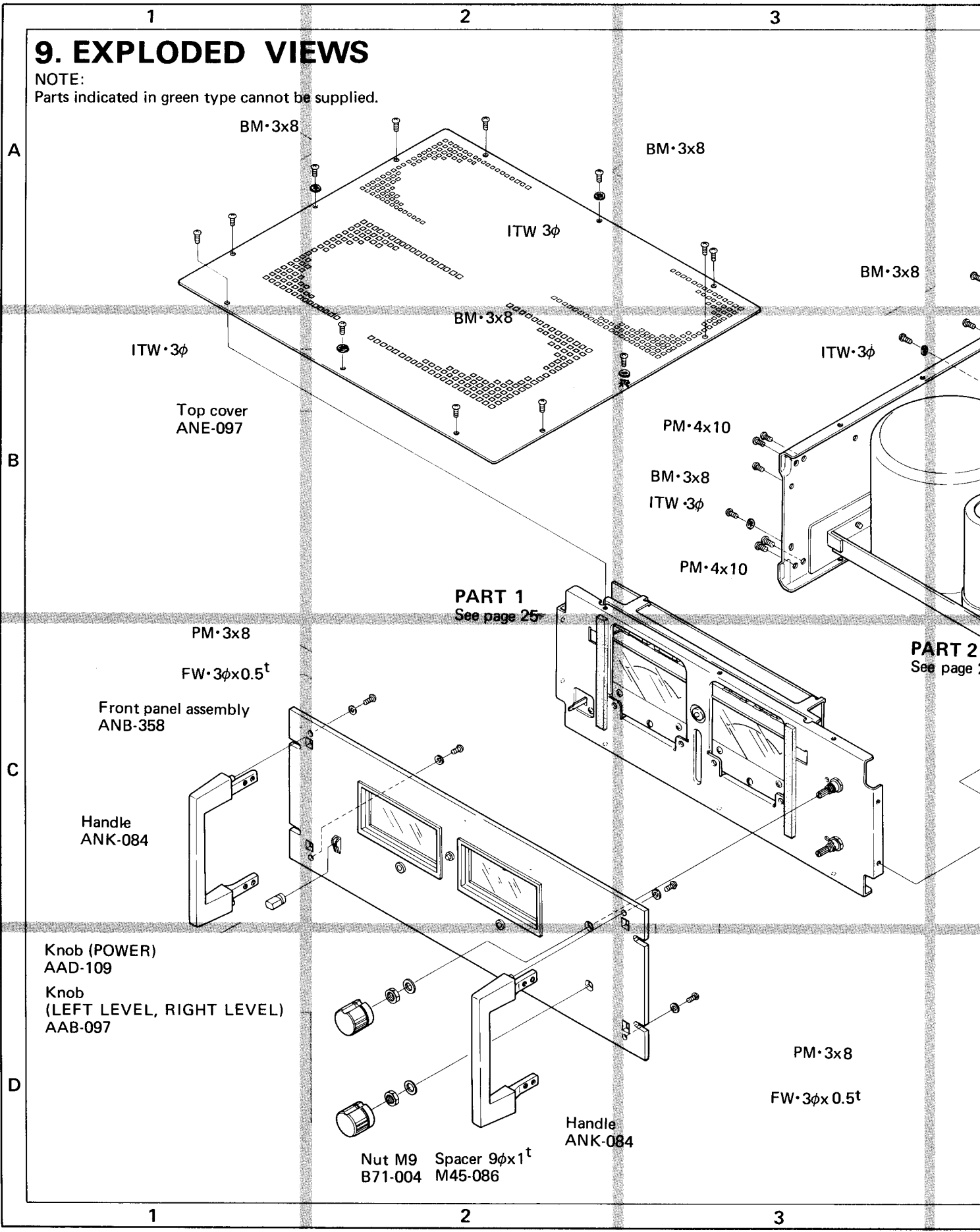


4. Rear View



# 9. EXPLODED VIEWS

NOTE:  
Parts indicated in green type cannot be supplied.



BM·3x8

BM·3x8

BM·3x8

ITW 3φ

BM·3x8

ITW·3φ

Top cover  
ANE-097

PM·4x10

BM·3x8

ITW·3φ

PM·4x10

**PART 1**  
See page 25

**PART 2**  
See page 2

PM·3x8

FW·3φx0.5<sup>t</sup>

Front panel assembly  
ANB-358

Handle  
ANK-084

Knob (POWER)  
AAD-109

Knob  
(LEFT LEVEL, RIGHT LEVEL)  
AAB-097

PM·3x8

FW·3φx0.5<sup>t</sup>

Handle  
ANK-084

Nut M9    Spacer 9φx1<sup>t</sup>  
B71-004    M45-086

4

5

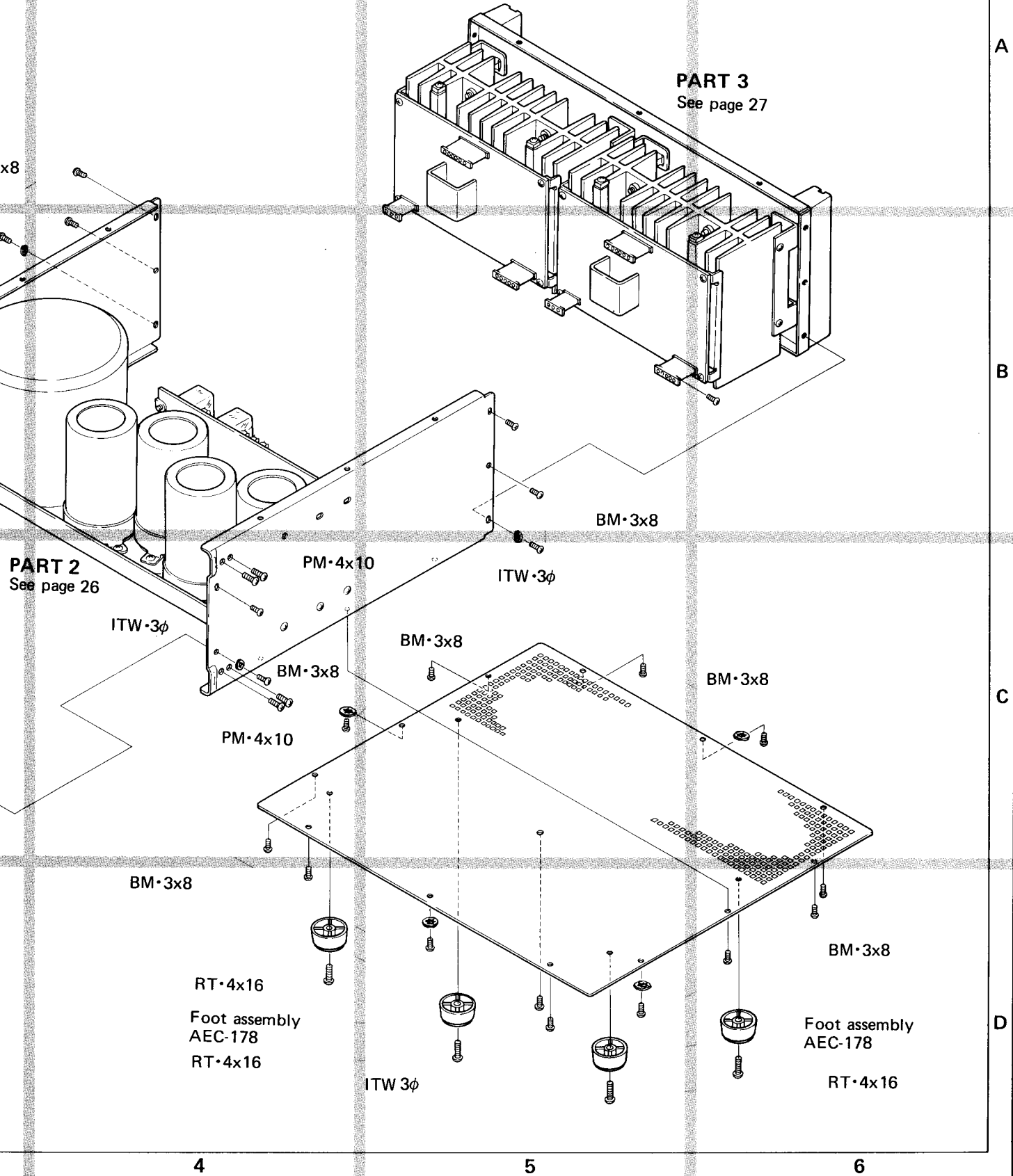
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A

B

C

D

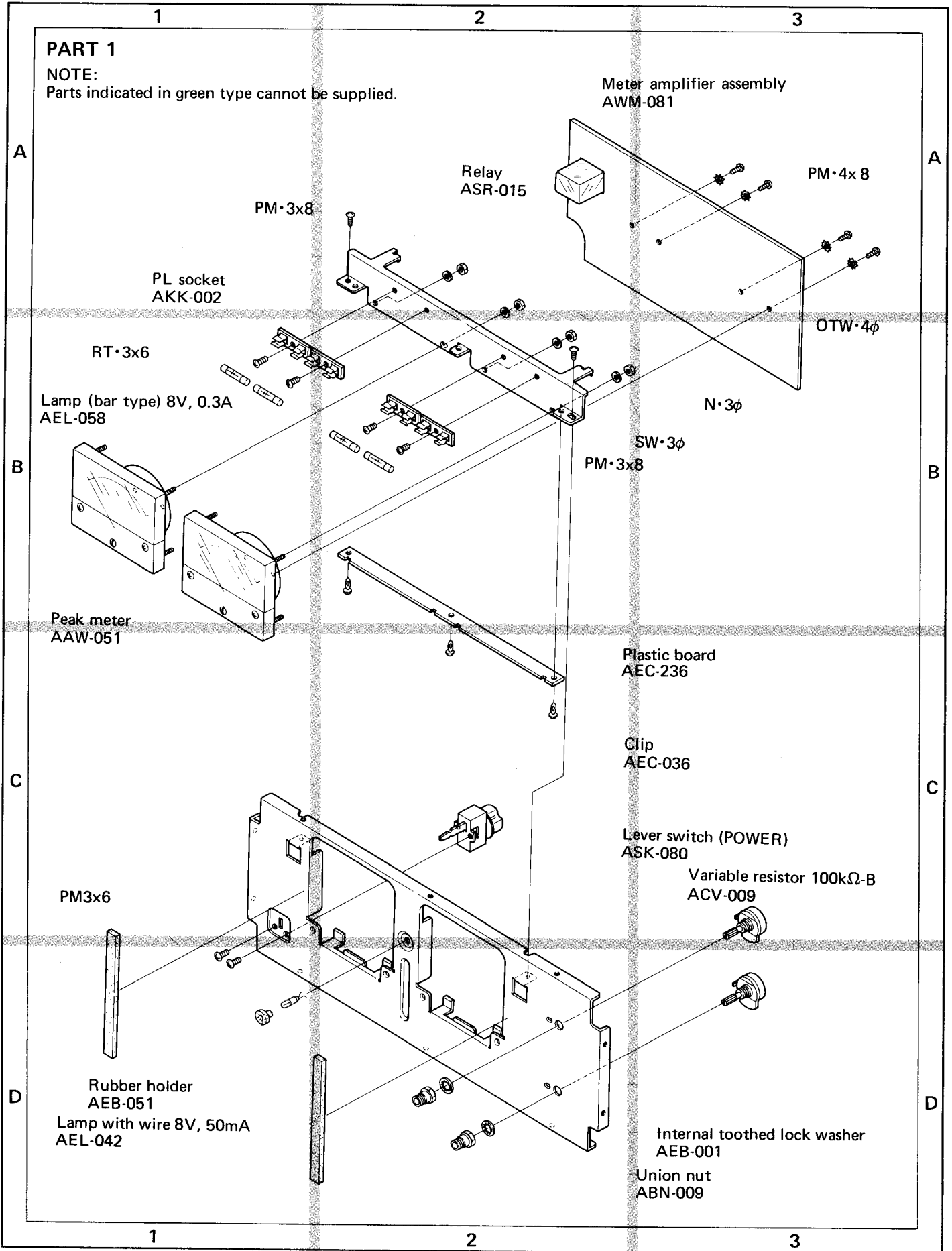


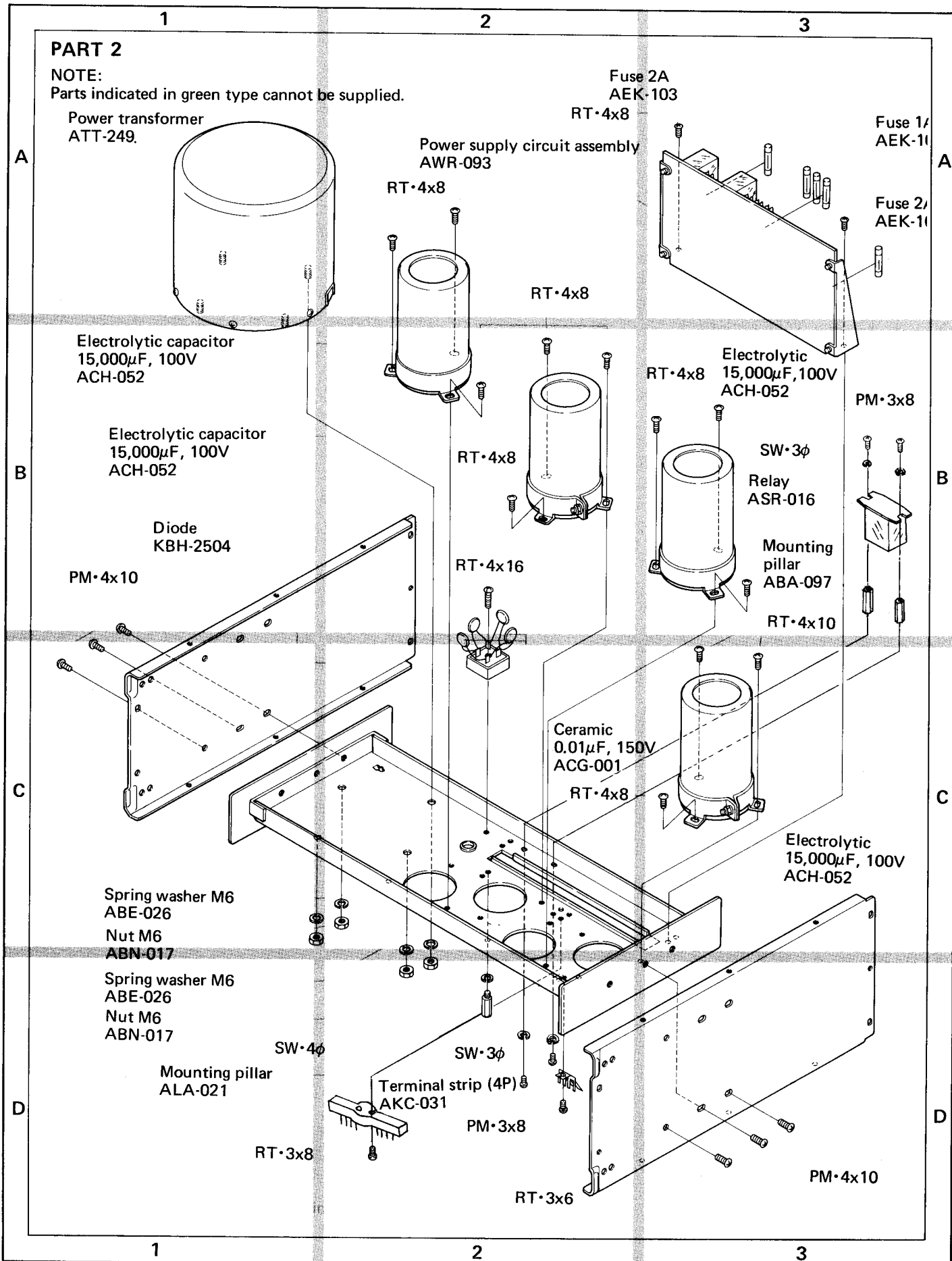
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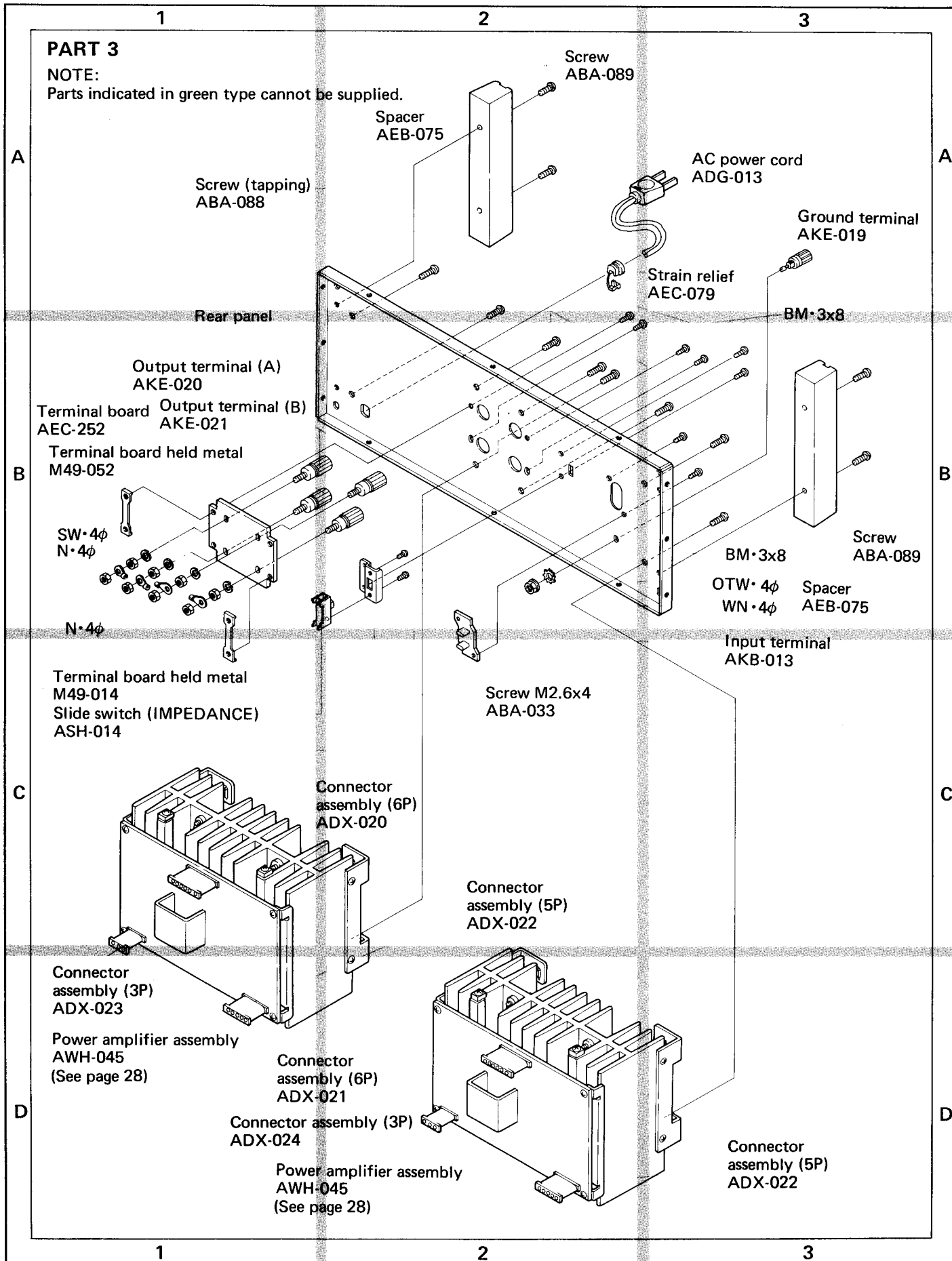
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6









1

2

3

# POWER AMPLIFIER ASSEMBLY

NOTE:  
Parts indicated in green type cannot be supplied.

A

A

B

B

C

C

D

D

BM·3x10

Toggle nut  
AEC-225

Insulating wafer  
AEC-076

Power transistor  
2SC1586

Power transistor  
2SA909

PM·3x16

RT·3x8

Varistor  
STV4H

BM·3x8

PM·3x16

Insulating wafer  
AEC-076

Transistor socket  
AKH-001

BM·3x8

Contact strip (3P)  
AKM-018

Contact strip (6P)  
AKM-020

BM·3x8

BM·3x8

Contact strip (5P)  
AKM-019

Toggle nut  
AEC-225

1

2

3

**NOMENCLATURE OF SCREWS, WASHERS AND NUTS**

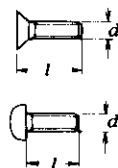
The following symbols stand for screws, washers and nuts as shown in exploded view.

Symbol	Description	Shape
RT	Brazier head tapping screw	
PT	Pan head tapping screw	
BT	Binding head tapping screw	
CT	Countersunk head tapping screw	
TT	Truss head tapping screw	
OCT	Oval countersunk head tapping screw	
PM	Pan head machine screw	
CM	Countersunk head machine screw	
OCM	Oval countersunk head machine screw	
TM	Truss head machine screw	
BM	Binding head machine screw	
PSA	Pan head screw with spring lock washer	
PSB	Pan head screw with spring lock washer and flat washer	
PSF	Pan head screw with flat washer	

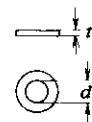
Symbol	Description	Shape
EW	E type washer	
FW	Flat washer	
SW	Spring lock washer	
N	Nut	
WN	Washer faced nut	
ITW	Internal toothed lock washer	
OTW	Outernal toothed lock washer	
SC	Slotted set screw (Cone point)	
SF	Slotted set screw (Flat point)	
HS	Hexagon socket headless set screw	
OCW	Oval countersunk head wood screw	
CW	Countersunk head wood screw	
RW	Round head wood screw	

**EXAMPLE**

PM - 3x8  
 length in mm (*l*)  
 diameter in mm (*d*)  
 Symbol



FW - 9φ x 1<sup>t</sup>  
 thickness in mm (*t*)  
 diameter in mm (*d*)  
 Symbol



# 10. SCHEMATIC DIAGRAMS, P.C. BOARD PATTERNS AND PARTS LIST

## 10.1 SCHEMATIC DIAGRAM AND MISCELLANEOUS PARTS

### Miscellaneous Parts List

#### CAPACITORS

Symbol	Description	Part No.
C1	Ceramic 0.01 150V	ACG-003
C2	Electrolytic 15,000 100V	ACH-052
C3	Electrolytic 15,000 100V	ACH-052
C4	Electrolytic 15,000 100V	ACH-052
C5	Electrolytic 15,000 100V	ACH-052
C6	Ceramic 0.01 150V	ACG-001
C7	Ceramic 0.01 150V	ACG-001
C8	Ceramic 0.01 150V	ACG-001
C9	Ceramic 0.01 150V	ACG-001
C10	Ceramic 0.01 150V	ACG-003

#### RESISTORS AND POTENTIOMETERS

Symbol	Description	Part No.
R1	Metal oxide 4.7k 3W	RS3P 472K
R2	Metal oxide 4.7k 3W	RS3P 472K
VR1	Variable resistor 100k-B (LEFT LEVEL)	ACV-009
VR2	Variable resistor 100k-B (RIGHT LEVEL)	ACV-009

#### SWITCHES

Symbol	Description	Part No.
S1	Lever switch (POWER)	ASK-080
S2	Slide switch (IMPEDANCE)	ASH-014

#### NOTE:

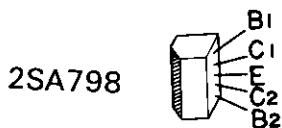
- Capacitors: in  $\mu F$  unless otherwise noted p:pF
- Resistors: in  $\Omega$ ,  $\frac{1}{4}W$  unless otherwise noted k:k $\Omega$ , M:M $\Omega$

#### FUSES

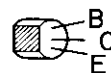
Symbol	Description	Part No.
FU1	.....	.....
FU2	.....	.....
FU3	Fuse 2A (Secondary)	AEK-103
FU4	Fuse 2A (Secondary)	AEK-103
FU5	Fuse 1A (Secondary)	AEK-106
FU6	Fuse 1A (Secondary)	AEK-106
FU7	Fuse 2A (Secondary)	AEK-103
FU8	Fuse 12A (Primary)	AEK-301

#### OTHERS

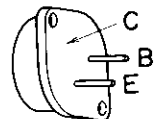
Symbol	Description	Part No.
T1	Power transformer	ATT-249
PL1	Lamp with wire 8V, 50mA	AEL-042
PL2	Lamp (bar type) 8V, 0.3A	AEL-058
PL3	Lamp (bar type) 8V, 0.3A	AEL-058
PL4	Lamp (bar type) 8V, 0.3A	AEL-058
PL5	Lamp (bar type) 8V, 0.3A	AEL-058
RL1	Relay	ASR-015
RL4	Relay	ASR-016
D1	Diode	KBH-2504
D2	Diode	SIB01-02



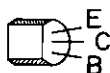
2SA733  
2SA872A  
2SC945



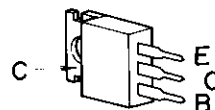
2SA909  
(2SB600A)  
2SC1586  
(2SD555A)



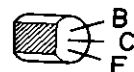
2SA725  
2SC1312



2SB507  
2SB630A  
2SD313  
2SD610A



2SC1384



# Schematic Diagram

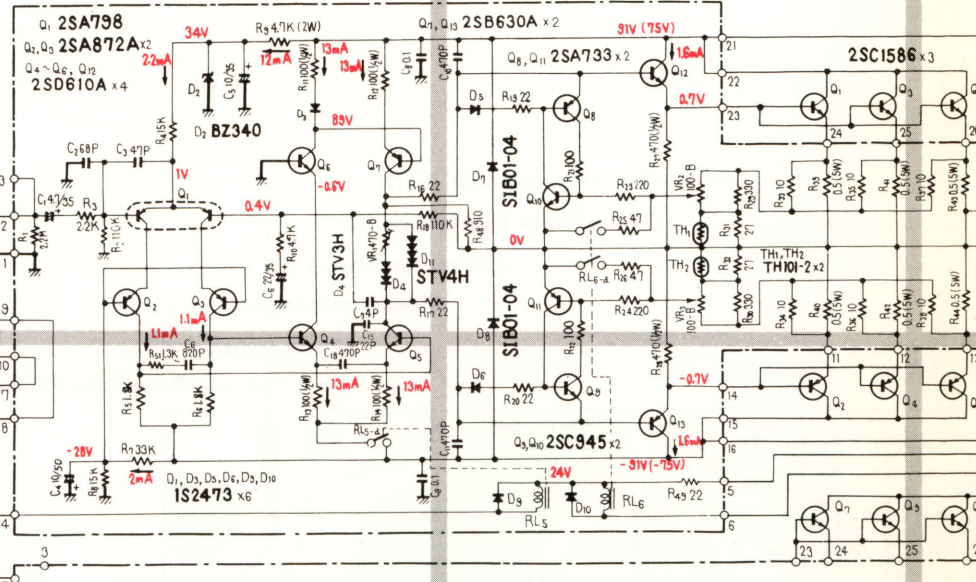
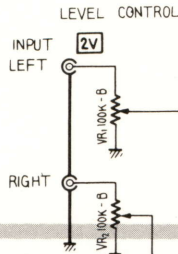
## POWER AMP ASSY AWH-045

A

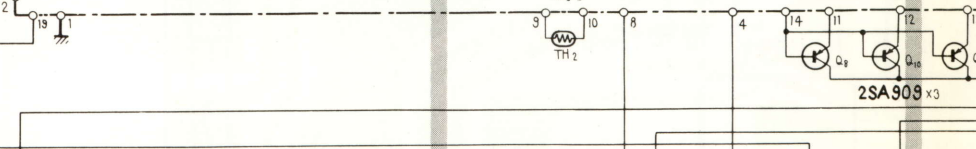
B

C

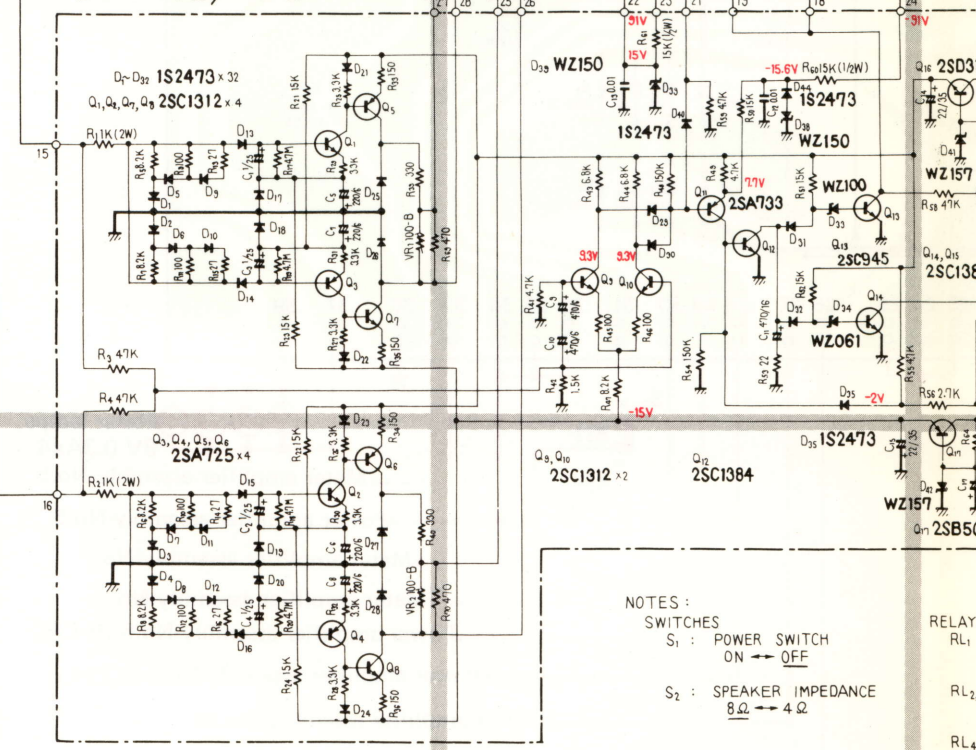
D



## POWER AMP ASSY AWH-045

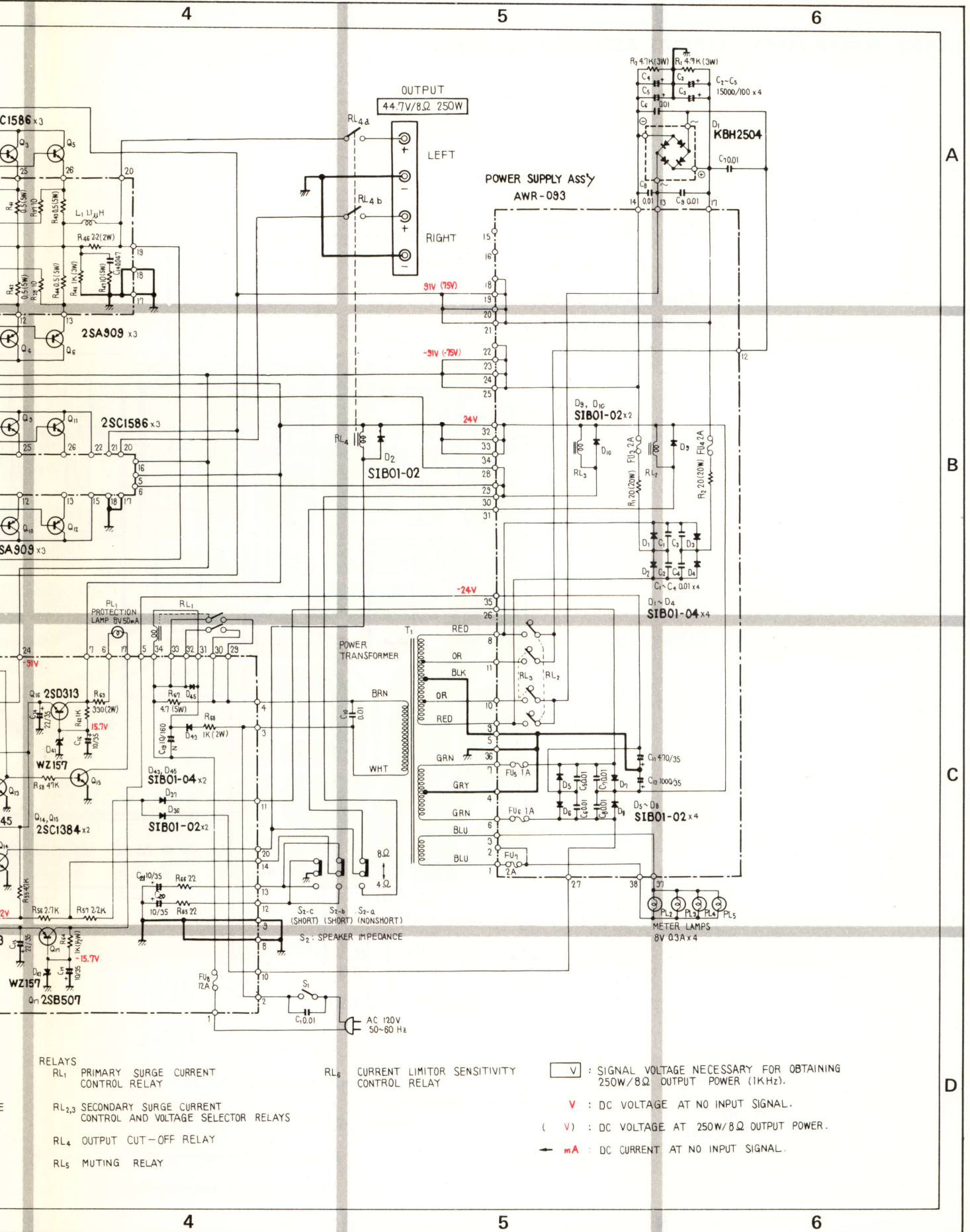


## METER AMP ASSY AWM-081



NOTES:  
SWITCHES  
S<sub>1</sub>: POWER SWITCH  
ON ↔ OFF  
S<sub>2</sub>: SPEAKER IMPEDANCE  
8Ω ↔ 4Ω

RELAYS  
RL<sub>1</sub>  
RL<sub>2</sub>  
RL<sub>3</sub>  
RL<sub>4</sub>  
RL<sub>5</sub>



- RELAYS
- RL<sub>1</sub> PRIMARY SURGE CURRENT CONTROL RELAY
  - RL<sub>2,3</sub> SECONDARY SURGE CURRENT CONTROL AND VOLTAGE SELECTOR RELAYS
  - RL<sub>4</sub> OUTPUT CUT-OFF RELAY
  - RL<sub>5</sub> MUTING RELAY

RL<sub>5</sub> CURRENT LIMITOR SENSITIVITY CONTROL RELAY

V : SIGNAL VOLTAGE NECESSARY FOR OBTAINING 250W/8Ω OUTPUT POWER (1KHz).  
**V** : DC VOLTAGE AT NO INPUT SIGNAL.  
 ( **V** ) : DC VOLTAGE AT 250W/8Ω OUTPUT POWER.  
**mA** : DC CURRENT AT NO INPUT SIGNAL.

A  
B  
C  
D

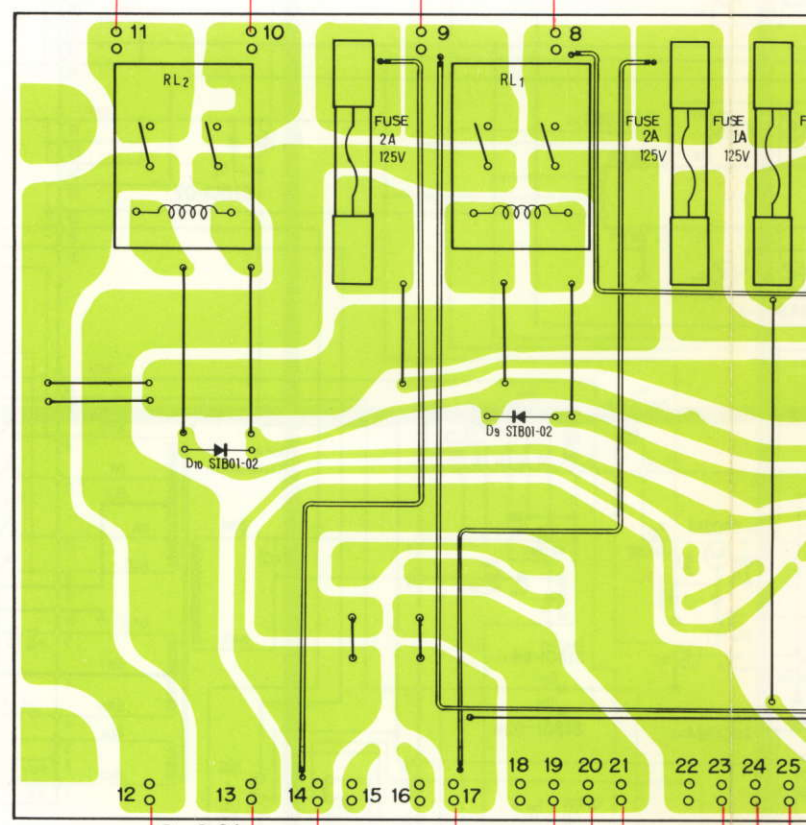


10.2 POWER SUPPLY CIRCUIT ASSEMBLY (AWR-093)

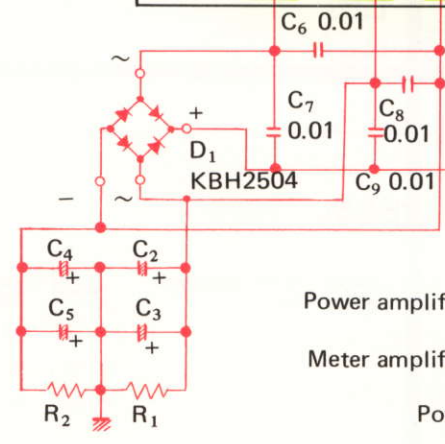
A  
B  
C  
D

1 2 3

Power transformer (RED)  
Power transformer (RED)  
Power transformer (OR)  
Power transformer (OR)

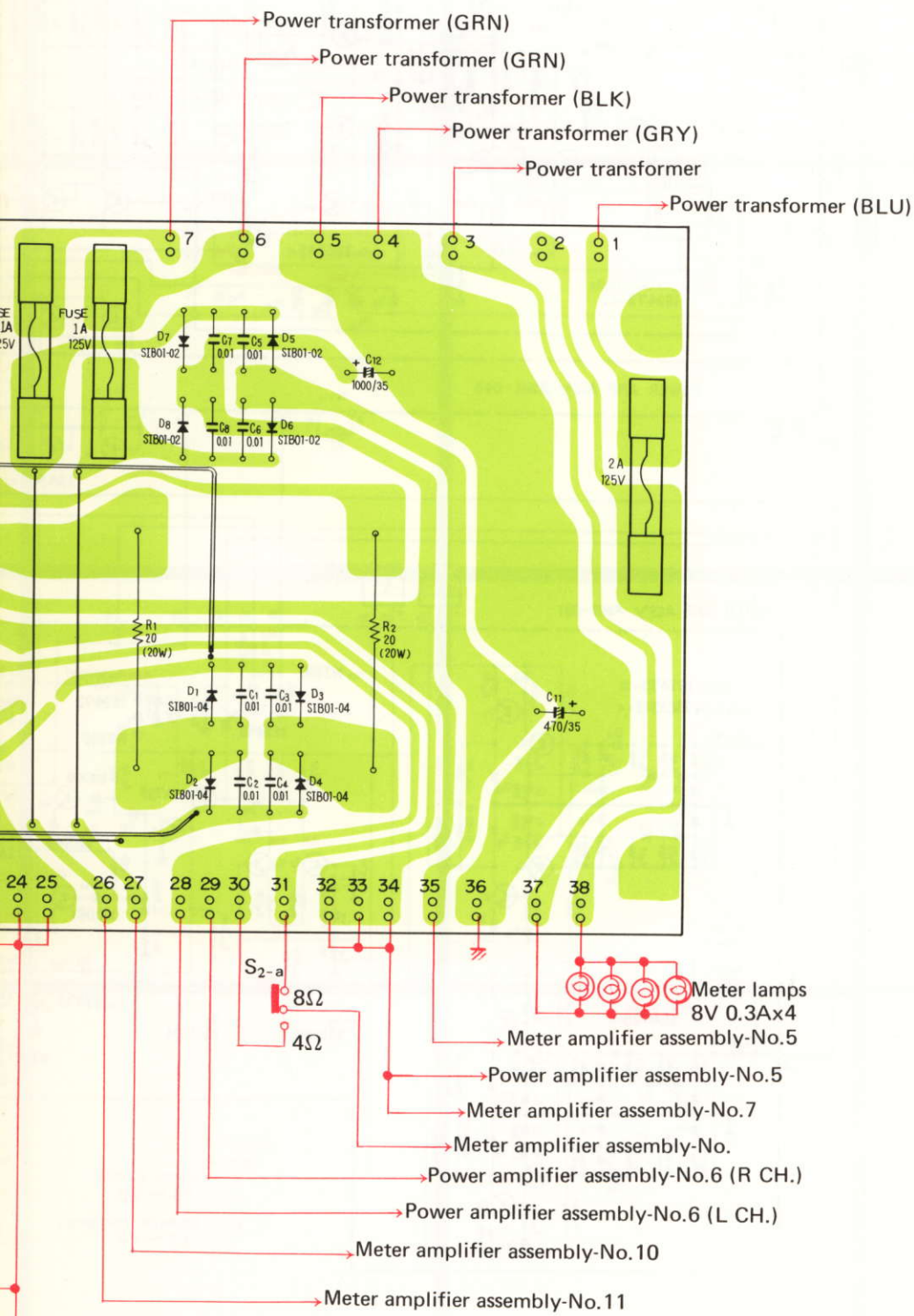


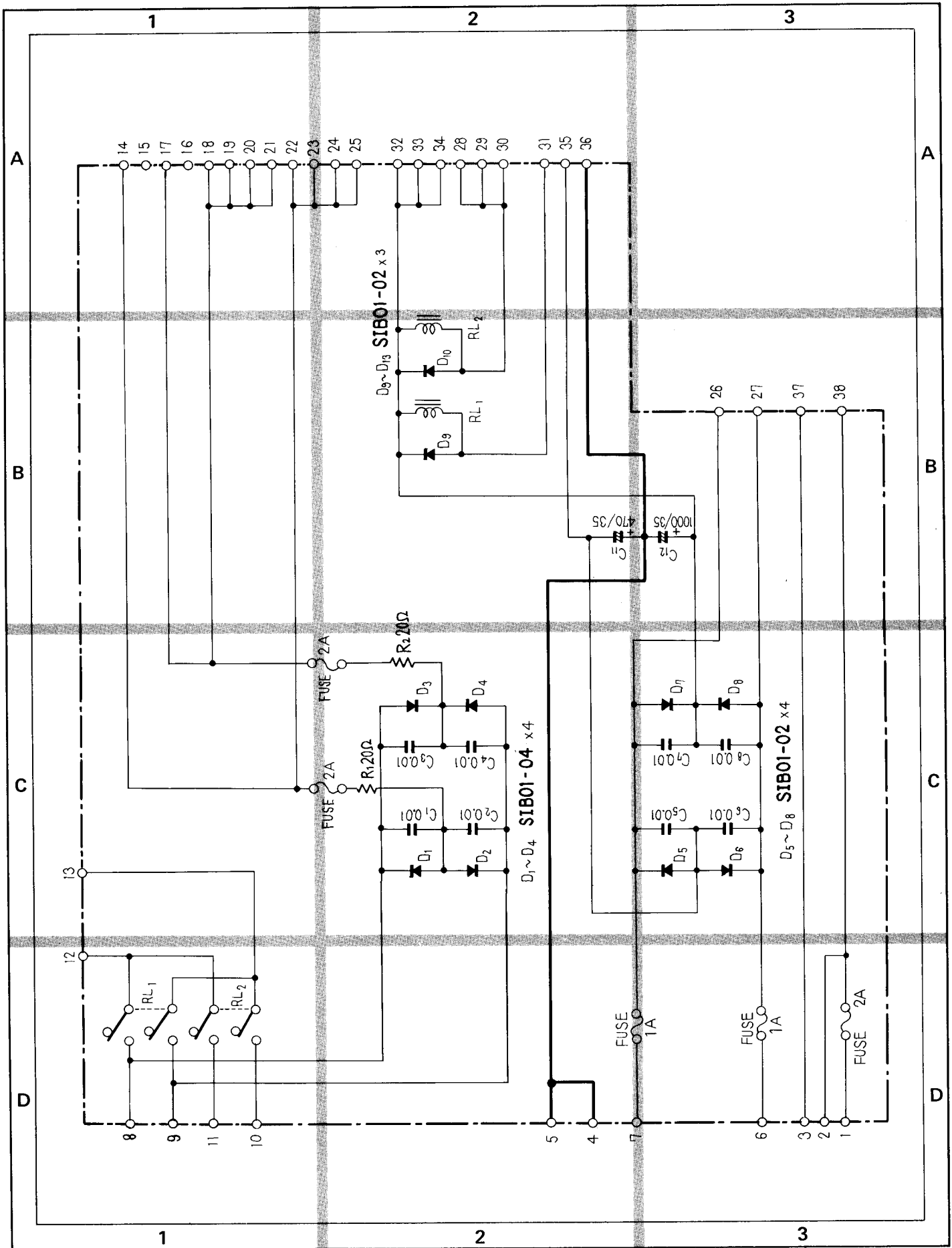
$C_2 \sim C_5$   
15,000/100x4  
 $R_1, R_2$   
4.7k $\Omega$ (3W)



Power amplifier assembly-No.21  
Meter amplifier assembly-No.23  
Power amplifier assembly-No.5  
Meter amplifier assembly-No.7

1 2 3





**Parts List of Power Supply Circuit Assembly (AWR-093)**

**CAPACITORS**

Symbol	Description			Part No.
C1	Ceramic	0.01	150V	ACG-004-0
C2	Ceramic	0.01	150V	ACG-004-0
C3	Ceramic	0.01	150V	ACG-004-0
C4	Ceramic	0.01	150V	ACG-004-0
C5	Ceramic	0.01	150V	ACG-004-0
C6	Ceramic	0.01	150V	ACG-004-0
C7	Ceramic	0.01	150V	ACG-004-0
C8	Ceramic	0.01	150V	ACG-004-0
C9	.....			.....
C10	.....			.....
C11	Electrolytic	470	35V	CEA 471P35-85C
C12	Electrolytic	1000	35V	CEA 102P35-85C

**RESISTORS**

Symbol	Description			Part No.
R1	Wire wound	20	20W	ACN-005-0
R2	Wire wound	20	20W	ACN-005-0

**SEMICONDUCTORS**

Symbol	Description			Part No.
D1	Diode			SIB01-04
D2	Diode			SIB01-04
D3	Diode			SIB01-04
D4	Diode			SIB01-04
D5	Diode			SIB01-02
D6	Diode			SIB01-02
D7	Diode			SIB01-02
D8	Diode			SIB01-02
D9	Diode			SIB01-02
D10	Diode			SIB01-02

**OTHERS**

Symbol	Description			Part No.
RL1	Relay			ASR-013-0
RL2	Relay			ASR-013-0

### 10.3 POWER AMPLIFIER ASSEMBLY (AWH-045)

A

B

C

D

1

2

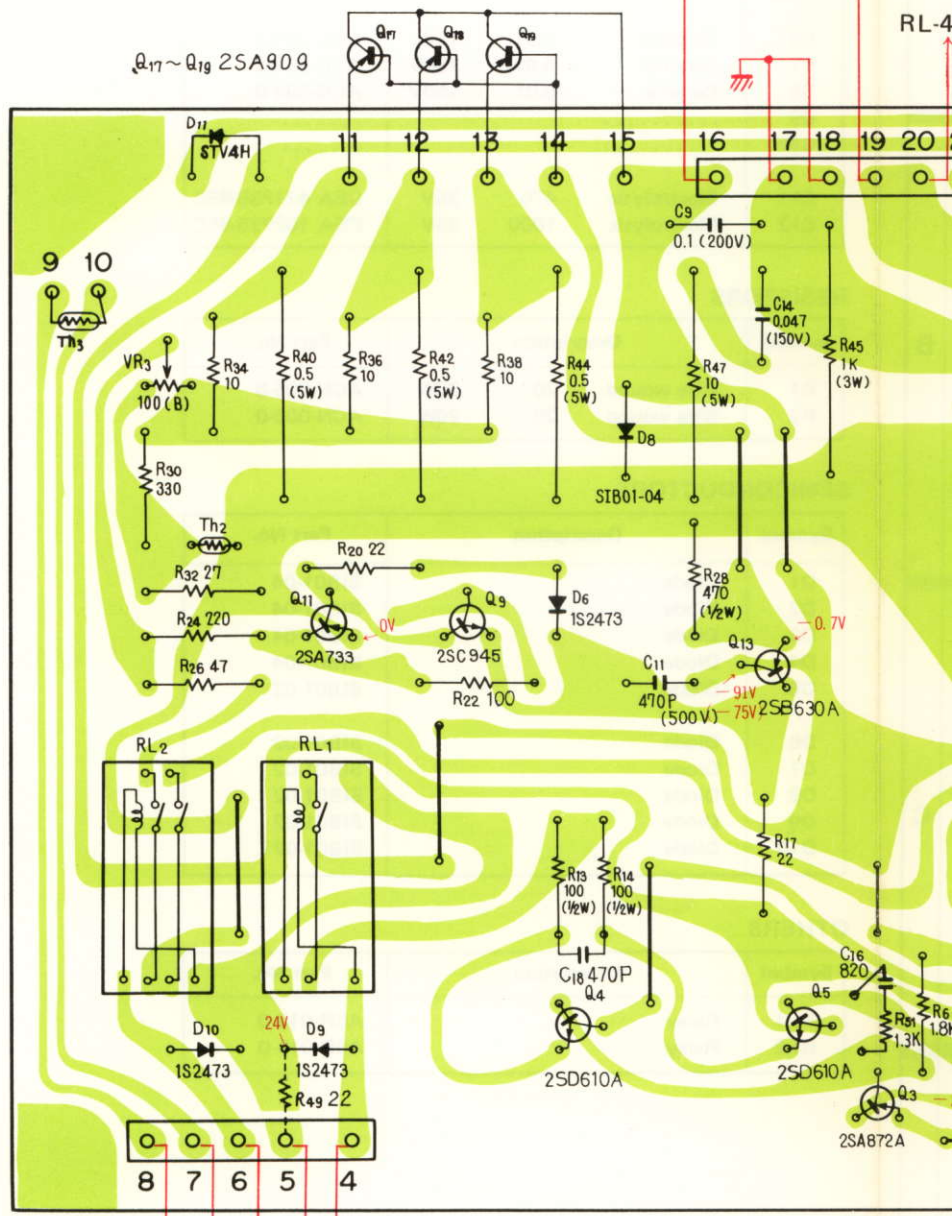
3

1

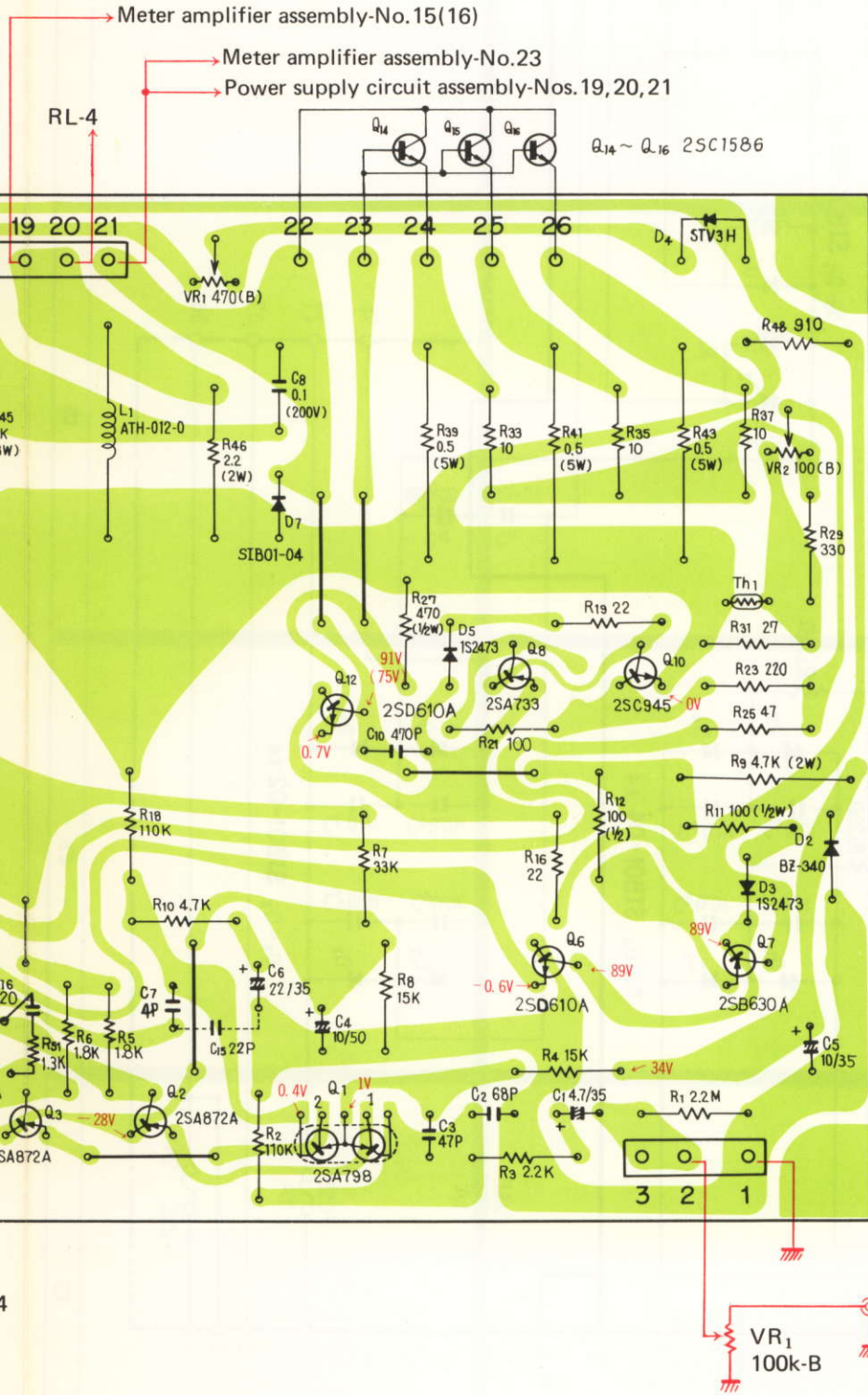
2

3

Meter amplifier assembly-No.24 ←  
 Power supply circuit assembly-Nos. 23,24,25 ←



Meter amplifier assembly-No.21 (22) ←  
 Power amplifier assembly-No.7 (R CH.) ←  
 Meter amplifier assembly-No.18 (19) ←  
 Power supply circuit assembly-Nos. 32, 33, 34 ←  
 Meter amplifier assembly-No.7 ←  
 Power supply circuit assembly-No.28 ←





## Parts List of Power Amplifier Assembly (AWH-045)

### CAPACITORS

Symbol	Description			Part No.
C1	Electrolytic	4.7	35V	CSZA 4R7M 35
C2	Ceramic	68p	50V	CCDSL 680K 50
C3	Ceramic	47p	50V	CCDSL 470K 50
C4	Electrolytic	10	35V	CEA 100P 50
C5	Electrolytic	10	35V	CEA 100P 35
C6	Electrolytic	22	35V	CEA 220P 35
C7	Ceramic	4p	50V	CCDSL 040K 50
C8	Mylar	0.1	200V	CQMA 104K 200
C9	Mylar	0.1	200V	CQMA 104K 200
C10	Ceramic	470p	500V	CKDYB 471K 500
C11	Ceramic	470p	500V	CKDYB 471K 500
C12	.....			.....
C13	.....			.....
C14	Ceramic	0.047	150V	ACG-009-0
C15	Ceramic	22p	50V	CKDYB 220 50
C16	Ceramic	820p	50V	CKDYB 821K 50
C18	Ceramic	470p	50	CKDYB 471K 50

### RESISTORS AND POTENTIOMETERS

Symbol	Description			Part No.
R1	Carbon film	2.2M		RD½PS 225J
R2	Carbon film	110k		RD½PS 114J
R3	Carbon film	2.2k		RD½PS 222J
R4	Carbon film	15k		RD½PS 153J
R5	Carbon film	1.8k		RD½PSF 122J
R6	Carbon film	1.8k		RD½PSF 122J
R7	Carbon film	33k		RD½PS 333J
R8	Carbon film	15k		RD½PS 153J
R9	Metal oxide	4.7k	2W	RS2P 472K
R10	Carbon film	4.7k		RD½PS 472J
R11	Carbon film	100	½W	RD½PMF 101J
R12	Carbon film	100	½W	RD½PMF 101J
R13	Carbon film	100	½W	RD½PMF 101J
R14	Carbon film	100	½W	RD½PMF 101J
R15	.....			.....
R16	Carbon film	22		RD½PSF 220J
R17	Carbon film	22		RD½PSF 220J
R18	Carbon film	110k		RD½PSF 114J
R19	Carbon film	22		RD½PSF 220J
R20	Carbon film	22		RD½PSF 220J
R21	Carbon film	100k		RD½PS 101J
R22	Carbon film	100k		RD½PS 101J
R23	Carbon film	220k		RD½PSF 221J
R24	Carbon film	220k		RD½PSF 221
R25	Carbon film	47		RD½PS 470J
R26	Carbon film	47		RD½PS 470J
R27	Carbon film	470	½W	RD½PMF 471J
R28	Carbon film	470	½W	RD½PMF 471J
R29	Carbon film	330		RD½PS 331J
R30	Carbon film	330		RD½PS 331J

Symbol	Description			Part No.
R31	Carbon film	27		RD½PS 270J
R32	Carbon film	27		RD½PS 270J
R33	Carbon film	10		RD½PS 100J
R34	Carbon film	10		RD½PS 100J
R35	Carbon film	10		RD½PS 100J
R36	Carbon film	10		RD½PS 100J
R37	Carbon film	10		RD½PS 100J
R38	Carbon film	10		RD½PS 100J
R39	Wire wound	0.5	5W	RT5B 0R5K
R40	Wire wound	0.5	5W	RT5B 0R5K
R41	Wire wound	0.5	5W	RT5B 0R5K
R42	Wire wound	0.5	5W	RT5B 0R5K
R43	Wire wound	0.5	5W	RT5B 0R5K
R44	Wire wound	0.5	5W	RT5B 0R5K
R45	Metal oxide	1k	3W	RS3P 102K
R46	Wire wound	2.2	2W	RT2B 2R2K
R47	Wire wound	10	5W	RT5B 100K
R48	Carbon film	910		RD½PS 911J
R51	Carbon film	1.3k		RD½PS 132J
VR1	Semi-fixed	470-B		ACP-051-0
VR2	Semi-fixed	100-B		ACP-050-0
VR3	Semi-fixed	100-B		ACP-050-0

### SEMICONDUCTORS

Symbol	Description			Part No.
Q1	Transistor			2SA798-G or F
Q2	Transistor			2SA872A-D or E
Q3	Transistor			2SA872A-D or E
Q4	Transistor			2SD610A-R or S, Q
Q5	Transistor			2SD610A-R or S, Q
Q6	Transistor			2SD610A-R or S, Q
Q7	Transistor			2SB630A-R or S, Q
Q8	Transistor			2SA733-R
Q9	Transistor			2SC945-R
Q10	Transistor			2SC945-R
Q11	Transistor			2SA733-R
Q12	Transistor			2SD610A-R or S, Q
Q13	Transistor			2SB630A-R or S, Q
Q14	Transistor			2SC1586-O or R
Q15	Transistor			2SD555A-R or S
				2SC1586-O or R
				2SD555A-R or S
Q16	Transistor			2SC1586-O or R
				2SD555A-R or S
Q17	Transistor			2SA909-O or R
				2SB600A-R or S
Q18	Transistor			2SA909-O or R
				2SB600A-R or S
Q19	Transistor			2SA909-O or R
				2SB600A-R or S

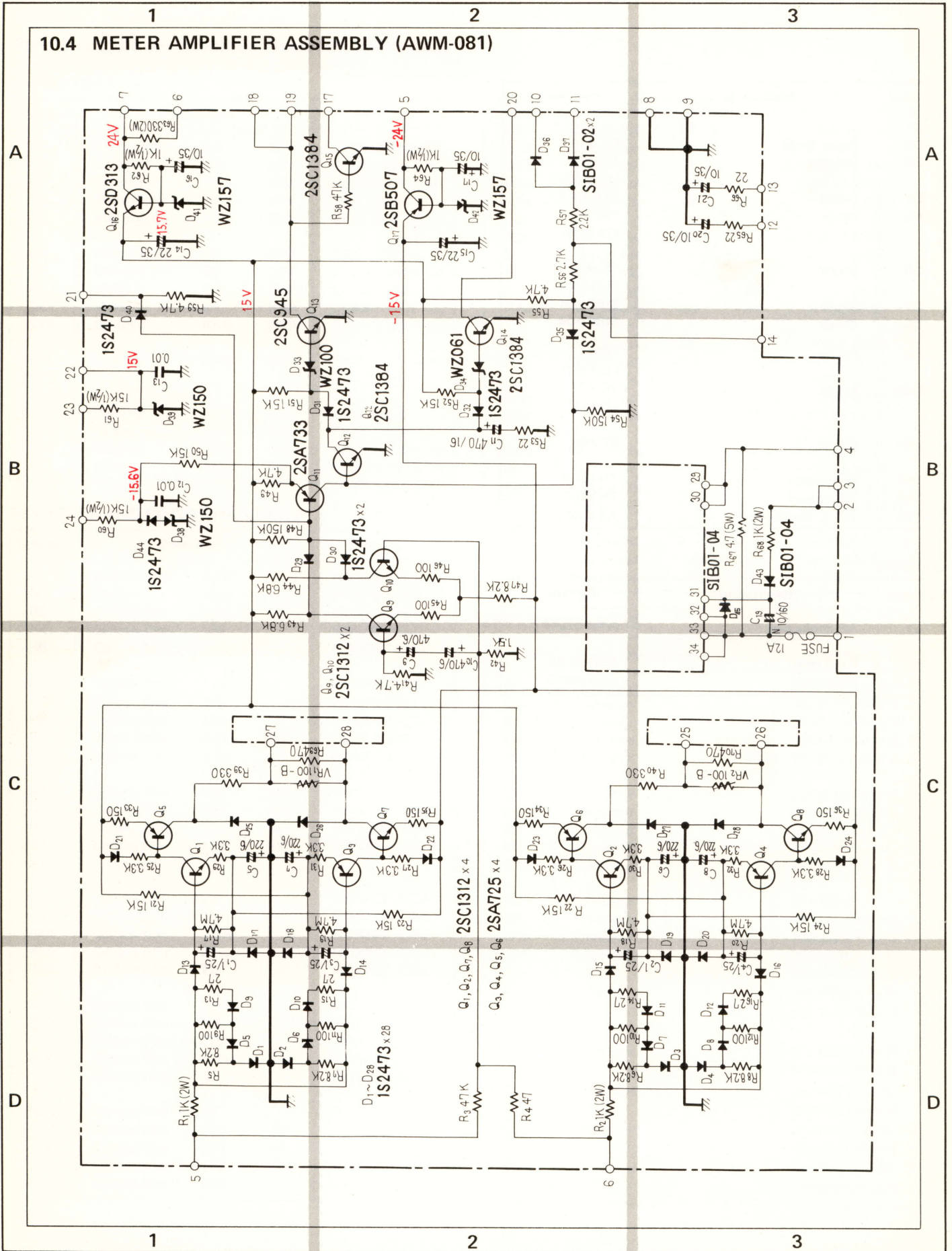


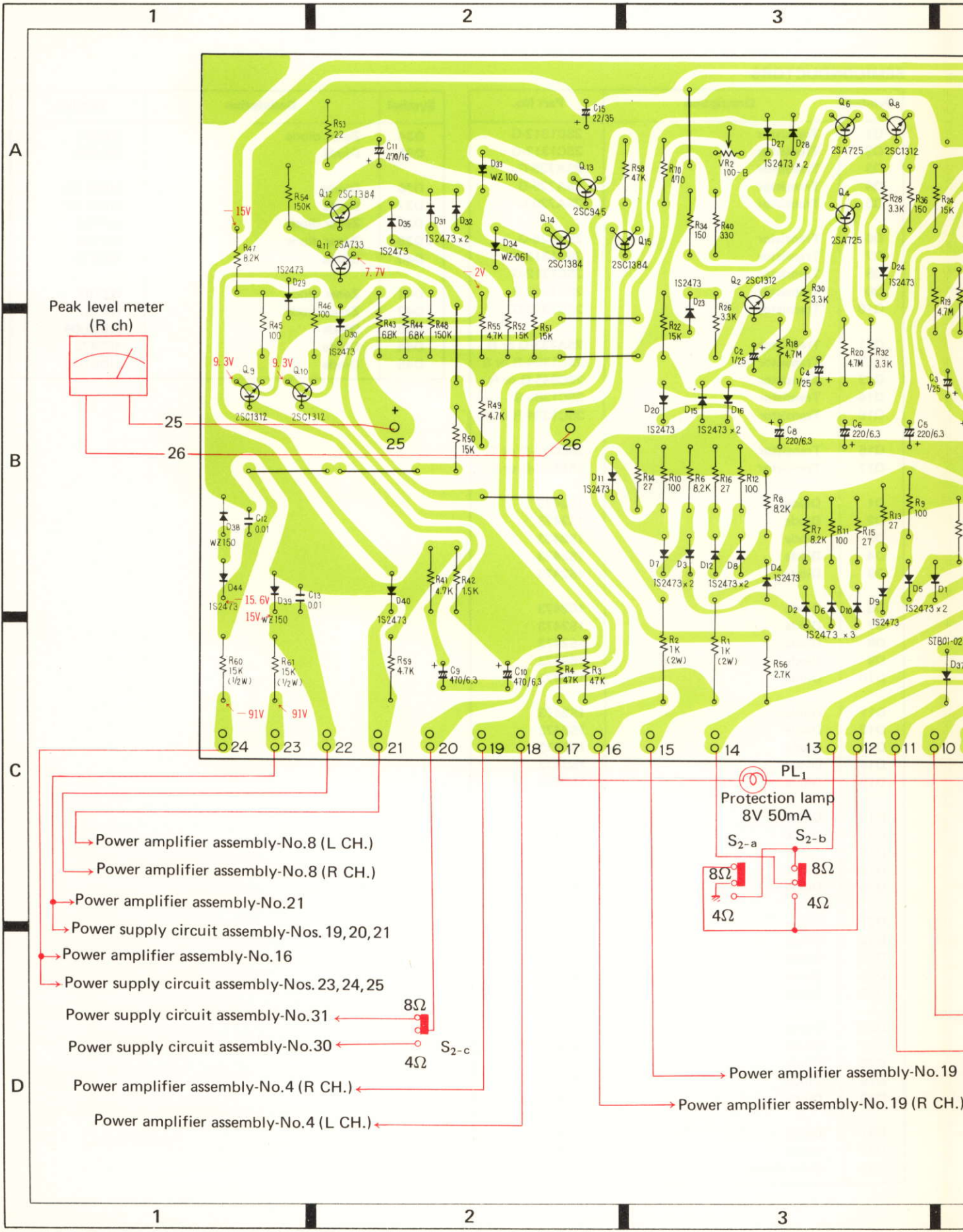
Symbol	Description	Part No.
D1	.....	
D2	Zener diode	BZ 340
D3	Diode	1S2473 (1S1555)
D4	Diode	STV3H-Y
D5	Diode	1S2473 (1S1555)
D6	Diode	1S2473 (1S1555)
D7	Diode	SIB01-04
D8	Diode	SIB01-04
D9	Diode	1S2473 (1S1555)
D10	Diode	1S2473 (1S1555)
D11	Diode	STV4H
Th1	Thermistor	TH101-2
Th2	Thermistor	TH101-2
Th3	P.T.C. thermistor	AEX-044

**OTHERS**

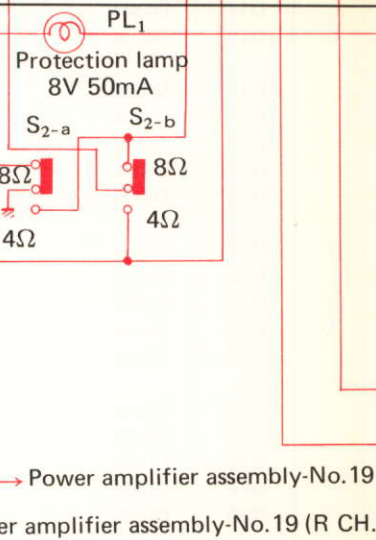
Symbol	Description	Part No.
L1	AF choke coil	ATH-012-0
RL1	Reed relay	ASR-017-0
RL2	Reed relay	ASR-005-C

# 10.4 METER AMPLIFIER ASSEMBLY (AWM-081)

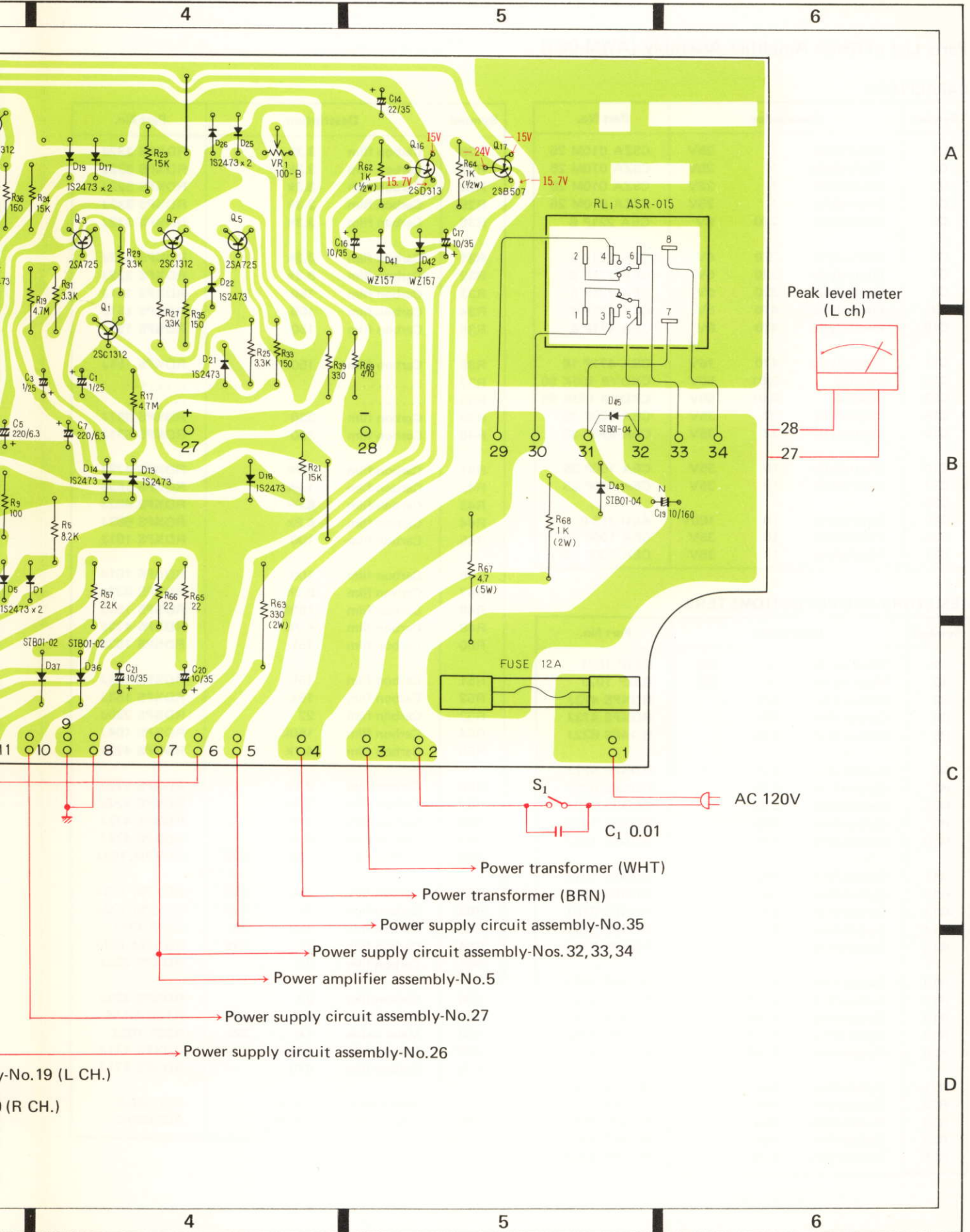




Peak level meter  
(R ch)



- Power amplifier assembly-No.8 (L CH.)
- Power amplifier assembly-No.8 (R CH.)
- Power amplifier assembly-No.21
- Power supply circuit assembly-Nos. 19, 20, 21
- Power amplifier assembly-No.16
- Power supply circuit assembly-Nos. 23, 24, 25
- Power supply circuit assembly-No.31 ← 8Ω
- Power supply circuit assembly-No.30 ← 4Ω
- Power amplifier assembly-No.4 (R CH.) ← S2-c
- Power amplifier assembly-No.4 (L CH.)



-No.19 (L CH.)

(R CH.)

A

B

C

D

## Parts List of Meter Amplifier Assembly (AWM-081)

### CAPACITORS

Symbol	Description			Part No.
C1	Electrolytic	1	25V	CSZA 010M 25
C2	Electrolytic	1	25V	CSZA 010M 25
C3	Electrolytic	1	25V	CSZA 010M 25
C4	Electrolytic	1	25V	CSZA 010M 25
C5	Electrolytic	220	6V	CEA 221P 6
C6	Electrolytic	220	6V	CEA 221P 6
C7	Electrolytic	220	6V	CEA 221P 6
C8	Electrolytic	220	6V	CEA 221P 6
C9	Electrolytic	470	6V	CEA 471P 6
C10	Electrolytic	470	6V	CEA 471P 6
C11	Electrolytic	470	16V	CEA 471P 16
C12	Ceramic	0.01	50V	CKDYB 103K 50
C13	Ceramic	0.01	50V	CKDYB 103K 50
C14	Electrolytic	22	35V	CEA 220P 35
C15	Electrolytic	22	35V	CEA 220P 35
C16	Electrolytic	10	35V	CEA 100P 35
C17	Electrolytic	10	35V	CEA 100P 35
C18	.....			.....
C19	Electrolytic	10	160V	ACH-313-0
C20	Electrolytic	10	35V	CEA 100P 35
C21	Electrolytic	10	35V	CEA 100P 35

### RESISTORS AND POTENTIOMETERS

Symbol	Description			Part No.
R1	Metal oxide	1k	2W	RS2P 102J
R2	Metal oxide	1k	2W	RS2P 102J
R3	Carbon film	47k		RD½PS 473J
R4	Carbon film	47k		RD½PS 473J
R5	Carbon film	8.2k		RD½PS 822J
R6	Carbon film	8.2k		RD½PS 822J
R7	Carbon film	8.2k		RD½PS 822J
R8	Carbon film	8.2k		RD½PS 822J
R9	Carbon film	100		RD½PS 101J
R10	Carbon film	100		RD½PS 101J
R11	Carbon film	100		RD½PS 101J
R12	Carbon film	100		RD½PS 101J
R13	Carbon film	27		RD½PS 270J
R14	Carbon film	27		RD½PS 270J
R15	Carbon film	27		RD½PS 270J
R16	Carbon film	27		RD½PS 270J
R17	Carbon film	4.7M		RD½PS 475J
R18	Carbon film	4.7M		RD½PS 475J
R19	Carbon film	4.7M		RD½PS 475J
R20	Carbon film	4.7M		RD½PS 475J
R21	Carbon film	15k		RD½PS 153J
R22	Carbon film	15k		RD½PS 153J
R23	Carbon film	15k		RD½PS 153J
R24	Carbon film	15k		RD½PS 153J
R25	Carbon film	3.3k		RD½PS 332J

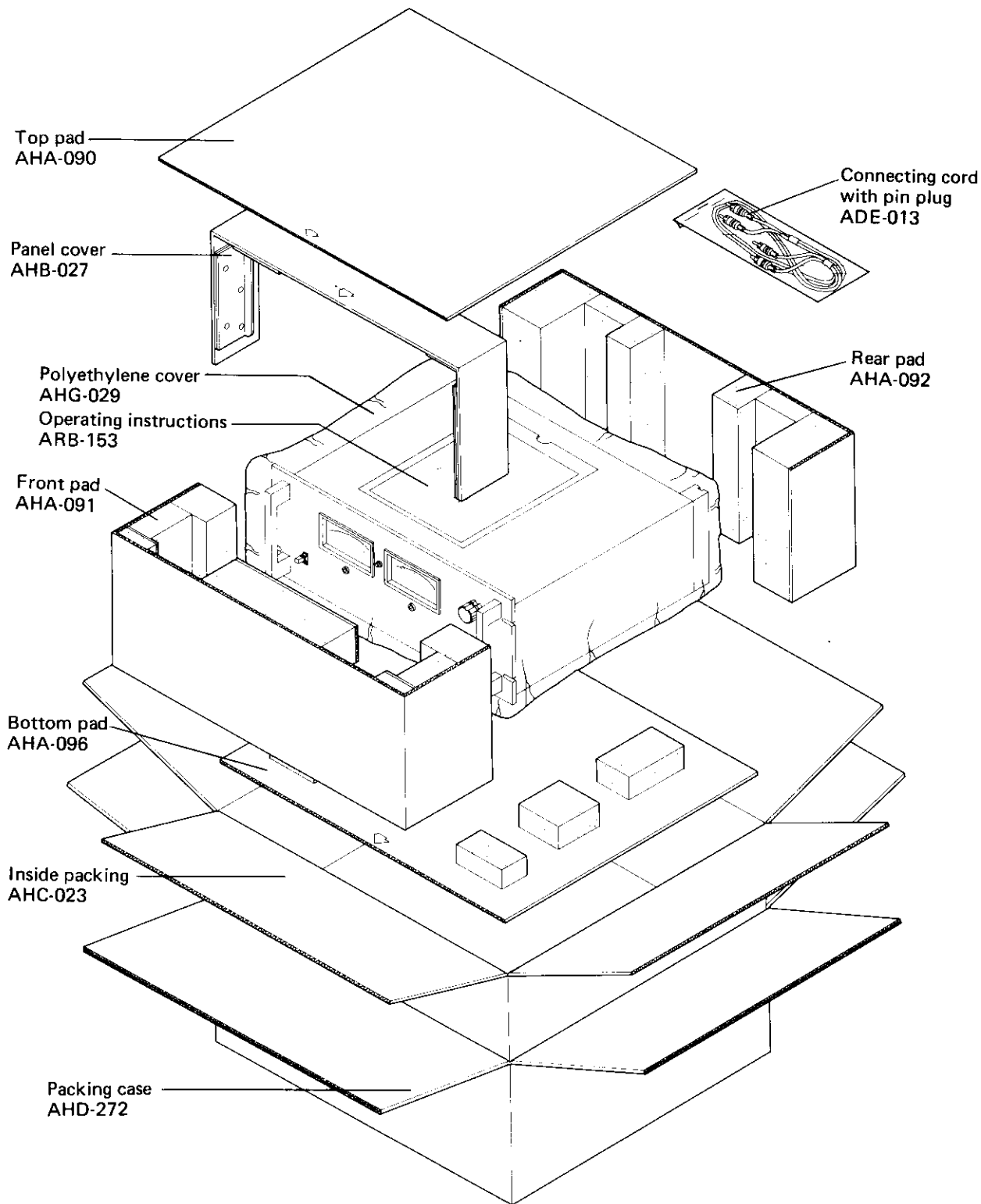
Symbol	Description			Part No.
R26	Carbon film	3.3k		RD½PS 332J
R27	Carbon film	3.3k		RD½PS 332J
R28	Carbon film	3.3k		RD½PS 332J
R29	Carbon film	3.3k		RD½PS 332J
R30	Carbon film	3.3k		RD½PS 332J
R31	Carbon film	3.3k		RD½PS 332J
R32	Carbon film	3.3k		RD½PS 332J
R33	Carbon film	150		RD½PS 151J
R34	Carbon film	150		RD½PS 151J
R35	Carbon film	150		RD½PS 151J
R36	Carbon film	150		RD½PS 151J
R37	.....			.....
R38	.....			.....
R39	Carbon film	330		RD½PS 331J
R40	Carbon film	330		RD½PS 331J
R41	Carbon film	4.7k		RD½PS 472J
R42	Carbon film	1.5k		RD½PS 152J
R43	Carbon film	6.8k		RD½PS 682J
R44	Carbon film	6.8k		RD½PS 682J
R45	Carbon film	100		RD½PS 101J
R46	Carbon film	100		RD½PS 101J
R47	Carbon film	8.2k		RD½PS 822J
R48	Carbon film	150k		RD½PS 154J
R49	Carbon film	4.7k		RD½PS 472J
R50	Carbon film	15k		RD½PS 153J
R51	Carbon film	15k		RD½PS 153J
R52	Carbon film	15k		RD½PS 153J
R53	Carbon film	22		RD½PS 220J
R54	Carbon film	150k		RD½PS 154J
R55	Carbon film	4.7k		RD½PS 472J
R56	Carbon film	2.7k		RD½PS 272J
R57	Carbon film	2.2k		RD½PS 222J
R58	Carbon film	47k		RD½PS 473J
R59	Carbon film	4.7k		RD½PS 472J
R60	Carbon film	15k	½W	RD½PM 153J
R61	Carbon film	15k	½W	RD½PM 153J
R62	Carbon film	1k	½W	RD½PM 102J
R63	Metal oxide	330	2W	RS2P 331J
R64	Carbon film	1k	½W	RD½PM 102J
R65	Carbon film	22		RD½PS 220J
R66	Carbon film	22		RD½PS 220J
R67	Wire wound	4.7	5W	RT5B 4R7K
R68	Metal oxide	1k	2W	RS2P 102J
R69	Carbon film	470		RD½PS 471J
R70	Carbon film	470		RD½PS 471J
VR1	Semi-fixed	100-B		ACP-050-0
VR2	Semi-fixed	100-B		ACP-050-0

## SEMICONDUCTORS

Symbol	Description	Part No.
Q1	Transistor	2SC1312-G
Q2	Transistor	2SC1312-G
Q3	Transistor	2SA725-G
Q4	Transistor	2SA725-G
Q5	Transistor	2SA725-G
Q6	Transistor	2SA725-G
Q7	Transistor	2SC1312-G
Q8	Transistor	2SC1312-G
Q9	Transistor	2SC1312-G
Q10	Transistor	2SC1312-G
Q11	Transistor	2SA733-Q or R
Q12	Transistor	2SC1384-R or S
Q13	Transistor	2SC945-Q or R
Q14	Transistor	2SC1384-S
Q15	Transistor	2SC1384-R or S
Q16	Transistor	2SD313-D or E
Q17	Transistor	2SB507-D or E
D1	Diode	1S2473
D2	Diode	1S2473
D3	Diode	1S2473
D4	Diode	1S2473
D5	Diode	1S2473
D6	Diode	1S2473
D7	Diode	1S2473
D8	Diode	1S2473
D9	Diode	1S2473
D10	Diode	1S2473
D11	Diode	1S2473
D12	Diode	1S2473
D13	Diode	1S2473
D14	Diode	1S2473
D15	Diode	1S2473
D16	Diode	1S2473
D17	Diode	1S2473
D18	Diode	1S2473
D19	Diode	1S2473
D20	Diode	1S2473
D21	Diode	1S2473
D22	Diode	1S2473
D23	Diode	1S2473
D24	Diode	1S2473
D25	Diode	1S2473
D26	Diode	1S2473
D27	Diode	1S2473
D28	Diode	1S2473
D29	Diode	1S2473
D30	Diode	1S2473
D31	Diode	1S2473
D32	Diode	1S2473
D33	Zener diode	WZ100

Symbol	Description	Part No.
D34	Zener diode	WZ061
D35	Diode	1S2473
D36	Diode	SIB01-02
D37	Diode	SIB01-02
D38	Zener diode	WZ150
D39	Zener diode	WZ150
D40	Diode	1S2473
D41	Zener diode	WZ157
D42	Zener diode	WZ157
D43	Diode	SIB01-04
D44	Diode	1S2473
D45	Diode	SIB01-04

# 11. PACKING



## 12. PARTS LIST OF EXPLODED VIEWS

Parts No.	Parts Name
AAB-097	Knob
AAD-109	Knob
AAW-051	Peak Level Meter
ABA-033	Screw M2.6x4
ABA-088	Screw
ABA-089	Screw
ABA-090	Screw M4x8
ABA-097	Mounting Pillar
ABE-026	Spring Washer M6
ABN-009	Union Nut
ABN-017	Nut M6
ACG-001	Ceramic Capacitor
ACH-052	Ele, Capacitor
ACV-009	Variable Resistor
ADE-013	Connection Cord (with Pin Plug)
ADG-013	AC Power Cord
ADX-020	Connector Ass. (6P)
ADX-021	Connector Ass. (6P)
ADX-022	Connector Ass. (5P)
ADX-023	Connector Ass. (3P)
ADX-024	Connector Ass. (3P)
AEB-001	Washer (Internal Toothed Lock)
AEB-051	Rubber Holder
AEB-075	Spacer
AEC-036	Clip
AEC-076	Insulating Wafer
AEC-079	Strain Relief
AEC-178	Foot Ass.
AEC-222	Terminal Board
AEC-225	Toggle Nut
AEC-236	Plastic Board
AEK-103	Fuse 2A
AEK-106	Fuse 1A
AEL-042	Lamp with Wire (8V 50mA)
AEL-058	Lamp 8V 0.3A
AHA-090	Top Pad
AHA-091	Front Pad
AHA-092	Rear Pad
AHA-096	Bottom Pad
AHB-027	Panel Cover
AHC-023	Inside Packing
AHD-272	Packing Case
AHG-029	Polyethylene Cover
AKB-013	Input Terminal
AKC-031	Terminal strip (4P)
AKE-019	Ground Terminal
AKE-020	Output Terminal A
AKE-021	Output Terminal B
AKH-001	Transistor Socket
AKK-002	PL Socket

Parts No.	Parts Name
AKM-018	Contact Strip (3P)
AKM-019	Contact Strip (5P)
AKM-020	Contact Strip (6P)
ALA-021	Chassis Mounting Pillar
ANB-358	Front Panel Ass.
ANE-097	Top Cover
ANK-084	Handle
ARB-153	Operating Instruction
ASH-014	Slide Switch
ASK-080	Lever Switch
ASR-015	Relay
ASR-016	Relay
ATT-249	Power Transformer
AWH-045	Power Amp Ass.
AWM-081	Meter Amp Ass.
AWR-093	Power Supply Ass.
B71-004	Nut M9
M45-086	Spacer 9mmx1t
M49-014	Terminal Board Held Metal
M49-052	Terminal Board Held Metal
2SA909	Power Transistor
2SB1586	Power Transistor
KBH2504	Diode
STV4H	Varistor



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