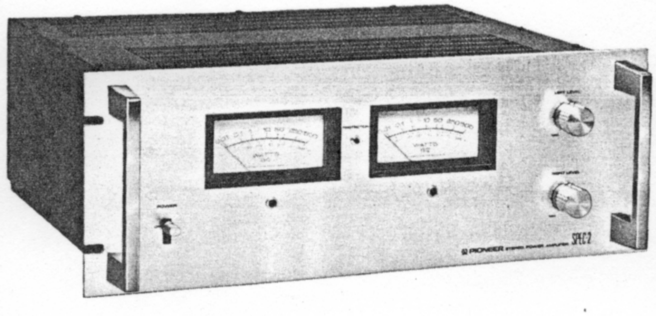
STEREO POWER AMPLIFIER

SPEC-2

KCU

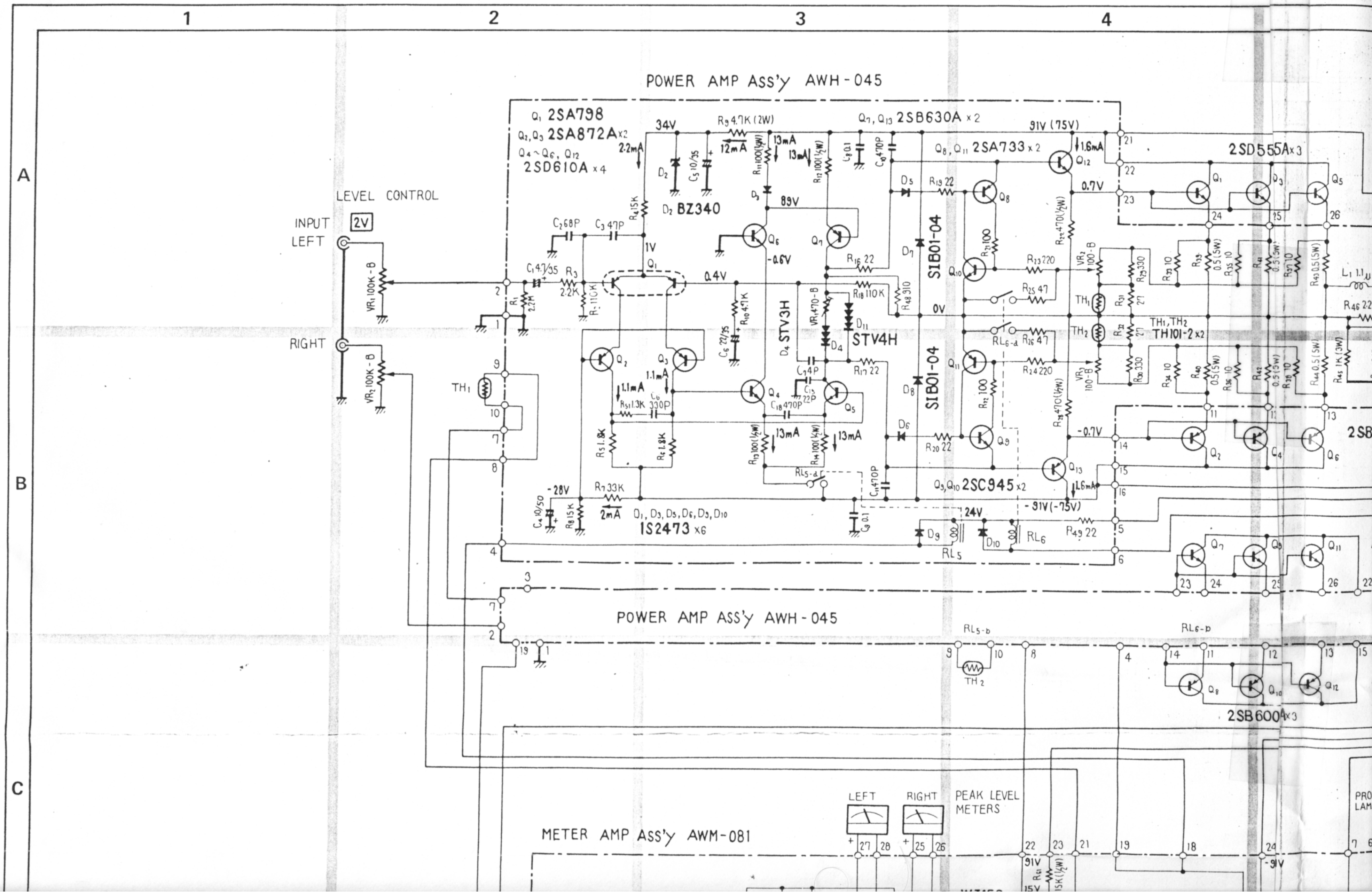
Service Manual

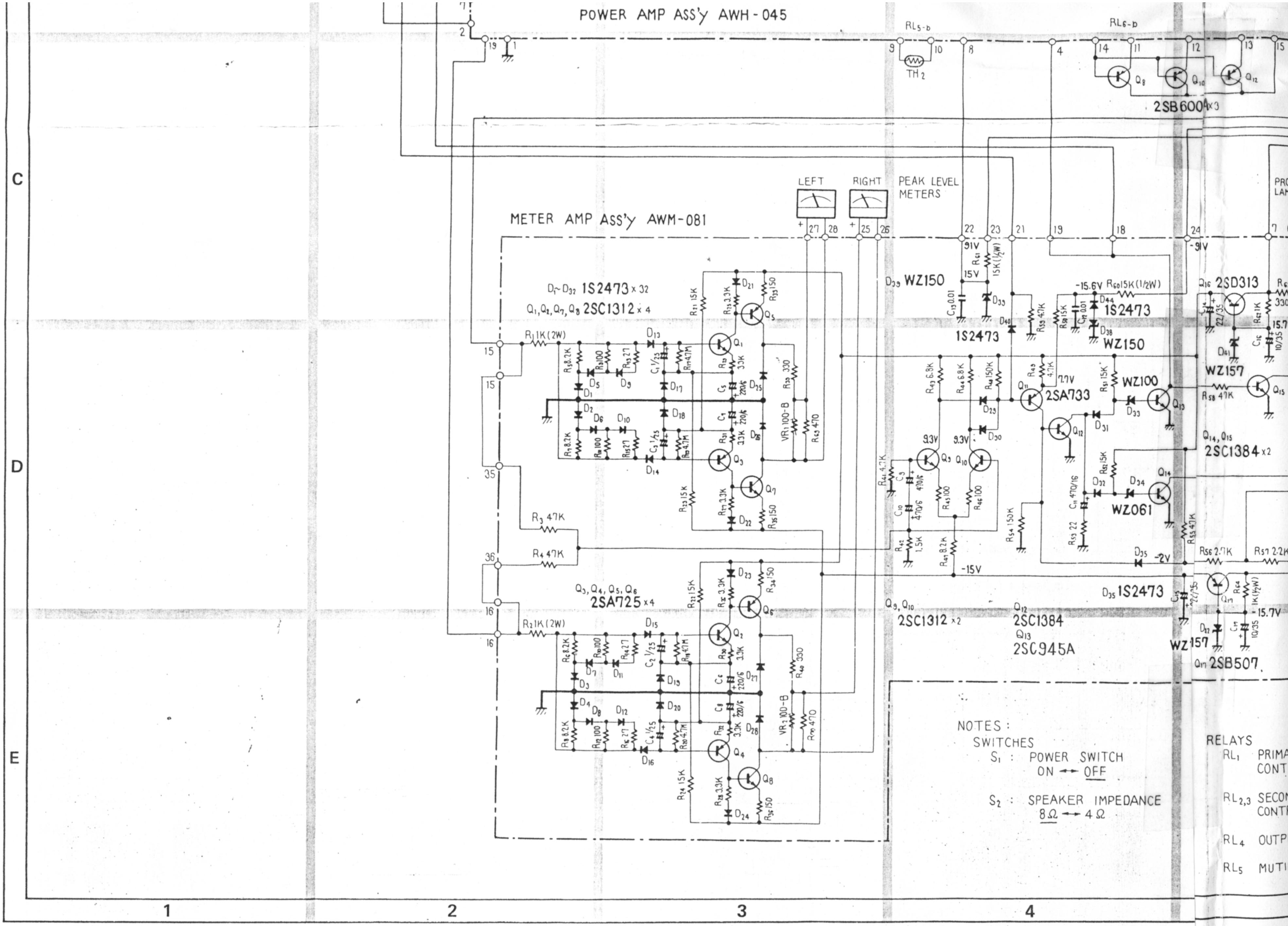


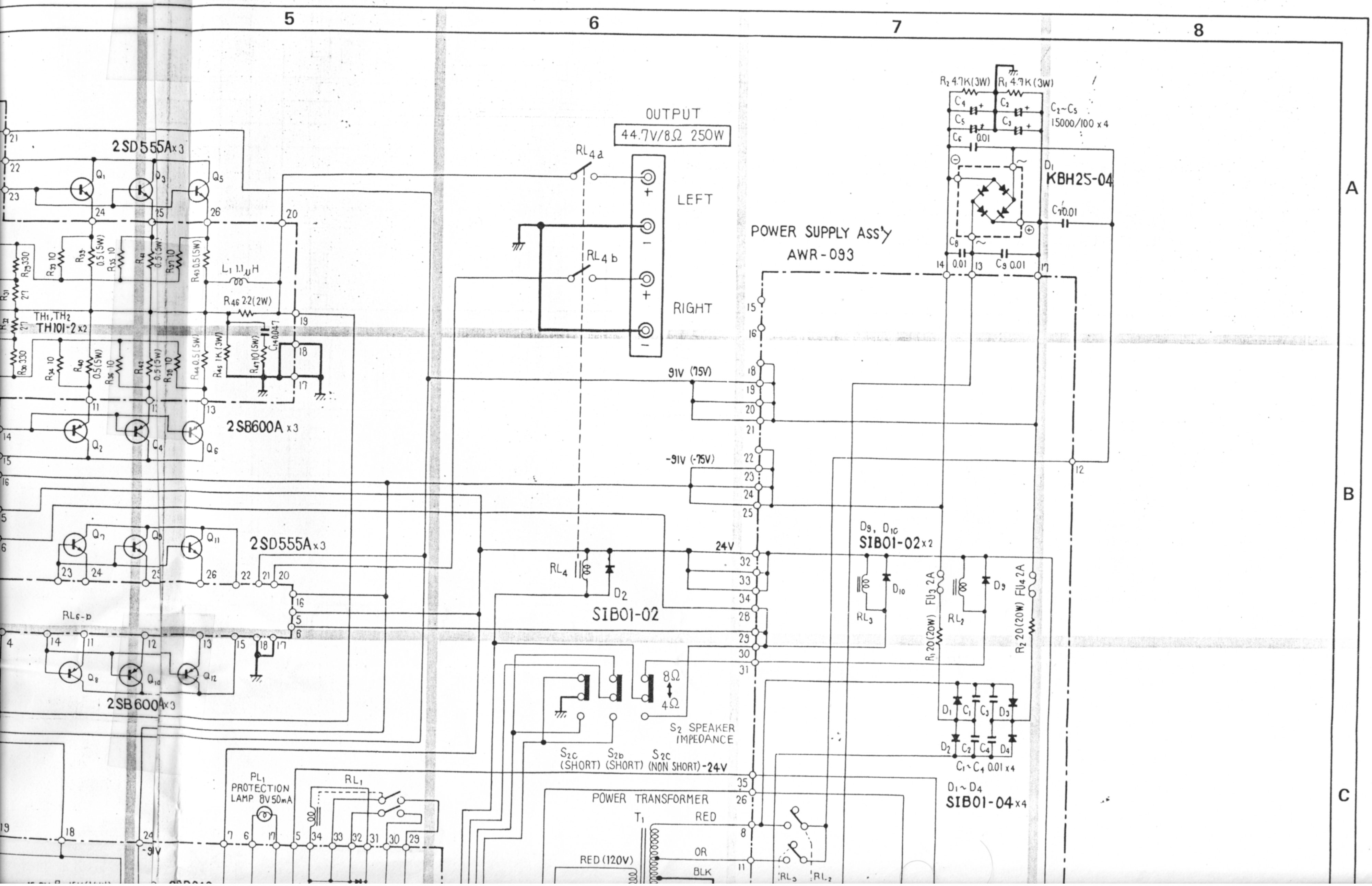
PIONEER®

STEREO POWER AMPLIFIER

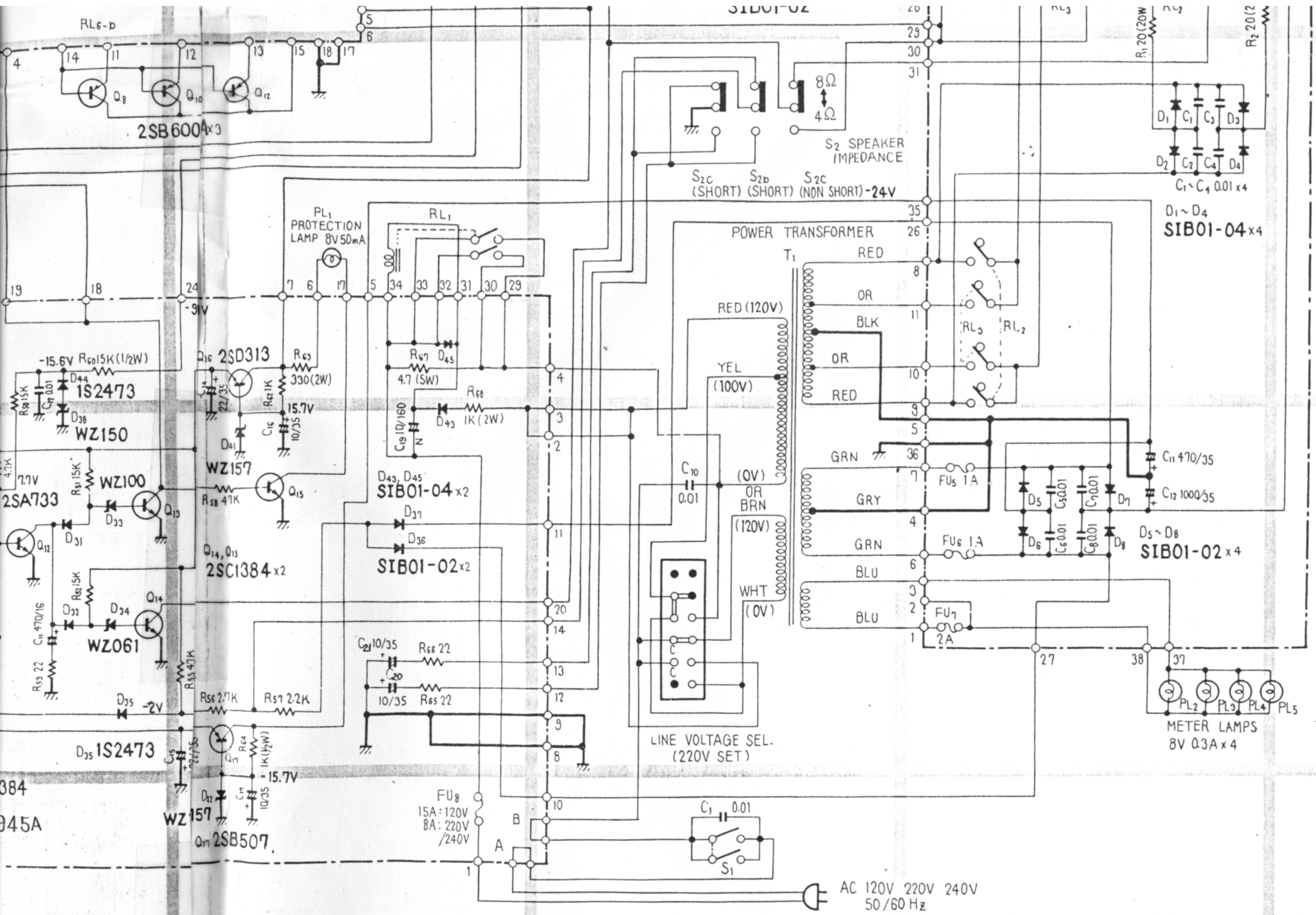
SPEC-2 D




POWER AMP ASS'Y AWH-045
METER AMP ASS'Y AWM-081
LEFT
RIGHT
PEAK LEVEL METERS
D1~D32 1S2473 x 32
Q1, Q2, Q7, Q8 2SC1312 x 4
Q3, Q4, Q5, Q6 2SA725 x 4
Q9, Q10 2SC1312 x 2
Q12 2SC1384
Q13 2SC945A
Q14, Q15 2SC1384 x2
Q16 2SD313
Q17 2SB507
2SB600 x3
2SA733
D39 WZ150
D35 1S2473
WZ100
WZ061
WZ157
NOTES:
SWITCHES
S1 : POWER SWITCH ON ↔ OFF
S2 : SPEAKER IMPEDANCE 8Ω ↔ 4Ω
RELAYS
RL1 PRIMA CONT
RL2,3 SECON CONT
RL4 OUTP
RL5 MUTI
C
D
E
1
2
3
4



5
6
7
8
A
B
C
2SD555A x3
2SB600A x3
2SD555A x3
2SB600A x3
R_{33} 10
R_{39} 0.5(5W)
R_{35} 10
R_{41} 0.5(5W)
R_{37} 10
R_{43} 0.5(5W)
R_{34} 10
R_{40} 0.5(5W)
R_{36} 10
R_{42} 0.5(5W)
R_{38} 10
R_{44} 0.5(5W)
R_{29} 330
R_{30} 330
R_{31} 27
R_{32} 27
TH1, TH2
TH101-2 x2
L_1 1.1μH
R_{46} 22(2W)
R_{45} 1K(3W)
R_{47} 10(5W)
C_{14} 0.047
RL6-D
OUTPUT
44.7V/8Ω 250W
LEFT
RIGHT
RL4 a
RL4 b
RL4
D2
SIB01-02
POWER SUPPLY ASS'Y
AWR-093
91V (75V)
-91V (-75V)
24V
-24V
8Ω
4Ω
S2 SPEAKER
IMPEDANCE
S2C (SHORT)
S2D (SHORT)
S2C (NON SHORT)
PL1
PROTECTION
LAMP 8V50mA
RL1
POWER TRANSFORMER
T1
RED
OR
BLK
RED (120V)
RL3
RL2
D9, D10
SIB01-02 x2
FU3 2A
FU4 2A
R1 20(20W)
R2 20(20W)
D1 ~ D4
SIB01-04 x4
C1 ~ C4 0.01 x4
R2 4.7K(3W)
R1 4.7K(3W)
C2 ~ C5
15000/100 x4
C6 0.01
C8 0.01
C9 0.01
C7 0.01
D1
KBH25-04



RELAYS
RL1 PRIMARY SURGE CURRENT CONTROL RELAY
RL2,3 SECONDARY SURGE CURRENT CONTROL AND VOLTAGE SELECTOR RELAYS
RL4 OUTPUT CUT-OFF RELAY
RL5 MUTING RELAY
RL6 CURRENT LIMITER 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.

5 6 7 8

C D E

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 differntial 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).

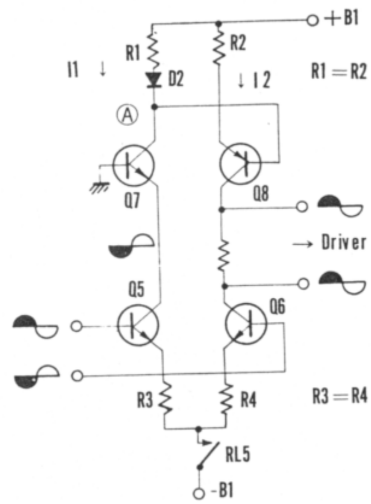


Fig. 1 Current Mirror Circuit

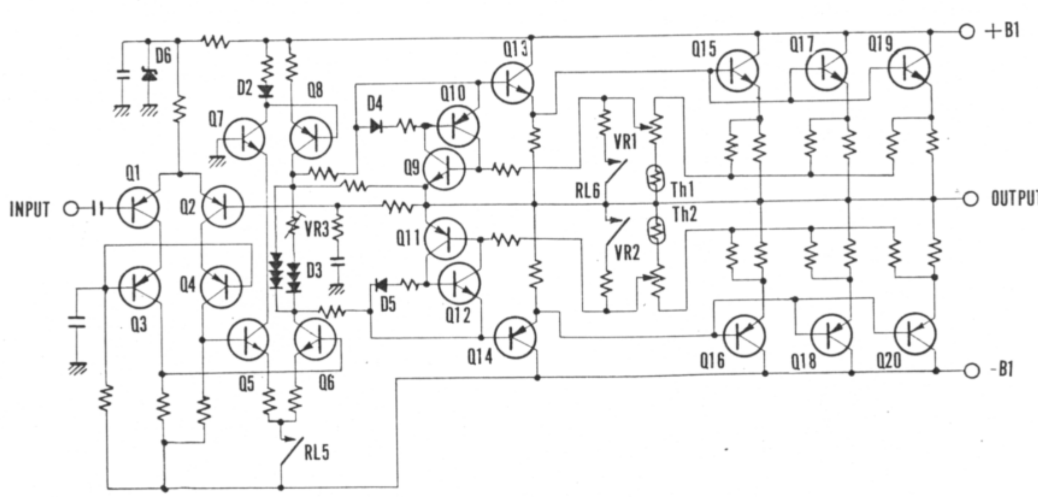


Fig. 2 Power Amplifier Circuit

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.

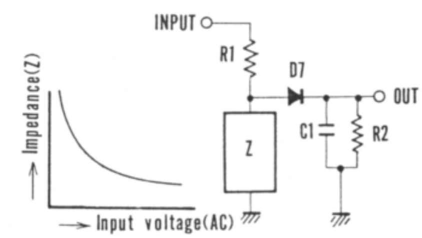


Fig. 4 Equivalent Circuit of the Logarithmic Compression

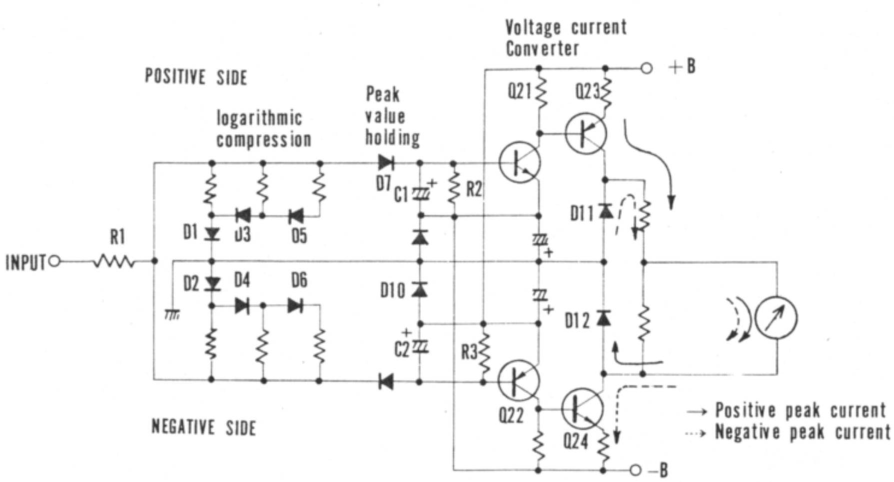


Fig. 3 Peak Level Meter Circuit

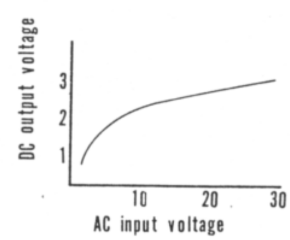


Fig. 5 Input-output Response

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 8Ω; when at 4Ω, 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.

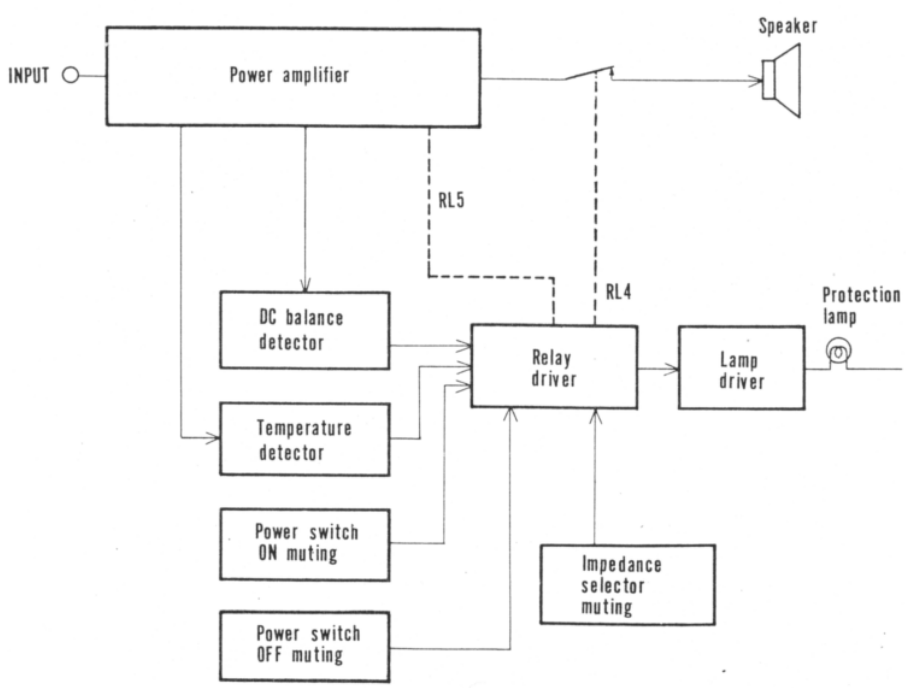


Fig. 6 Block Diagram of the Protection Circuit

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.

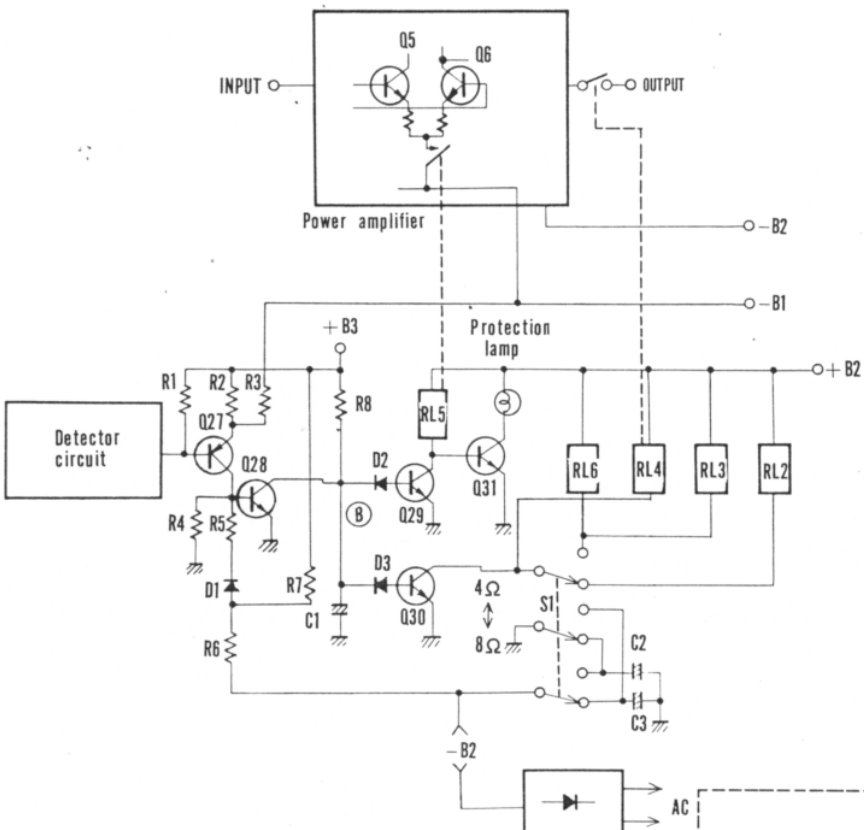


Fig. 7 Relay and Lamp Drivers Circuit

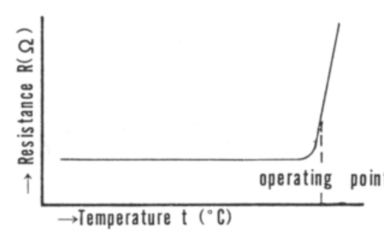


Fig. 8 Posistor-temperature Response

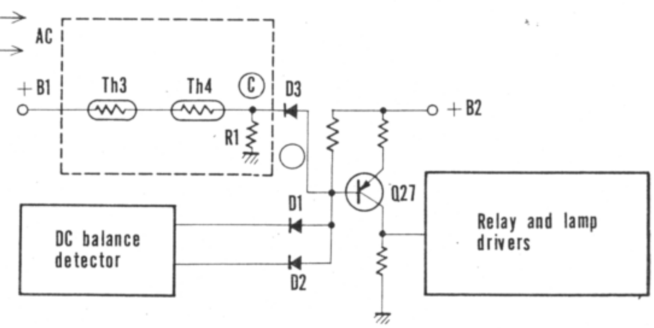


Fig. 9 Temperature Detector Circuit

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.

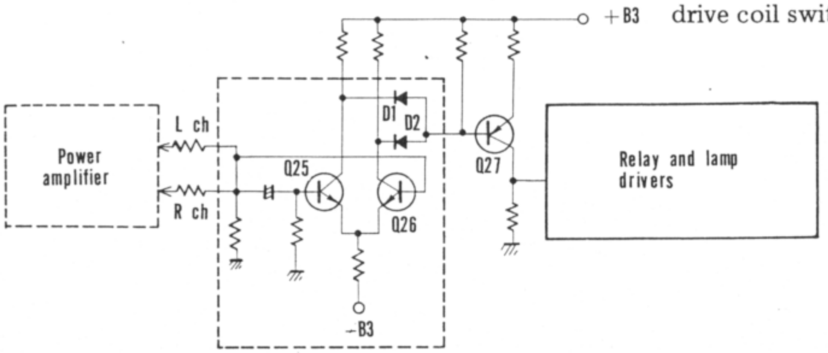


Fig. 10 DC Balance Detector Circuit

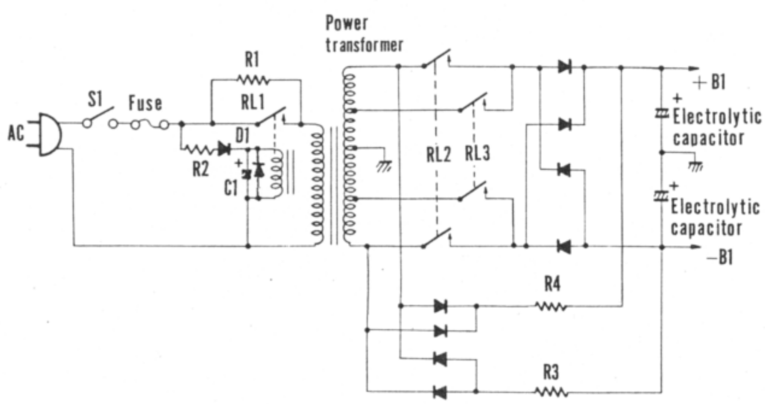


Fig. 11 Surge Current Suppressor Circuit

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 15,000μF 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.

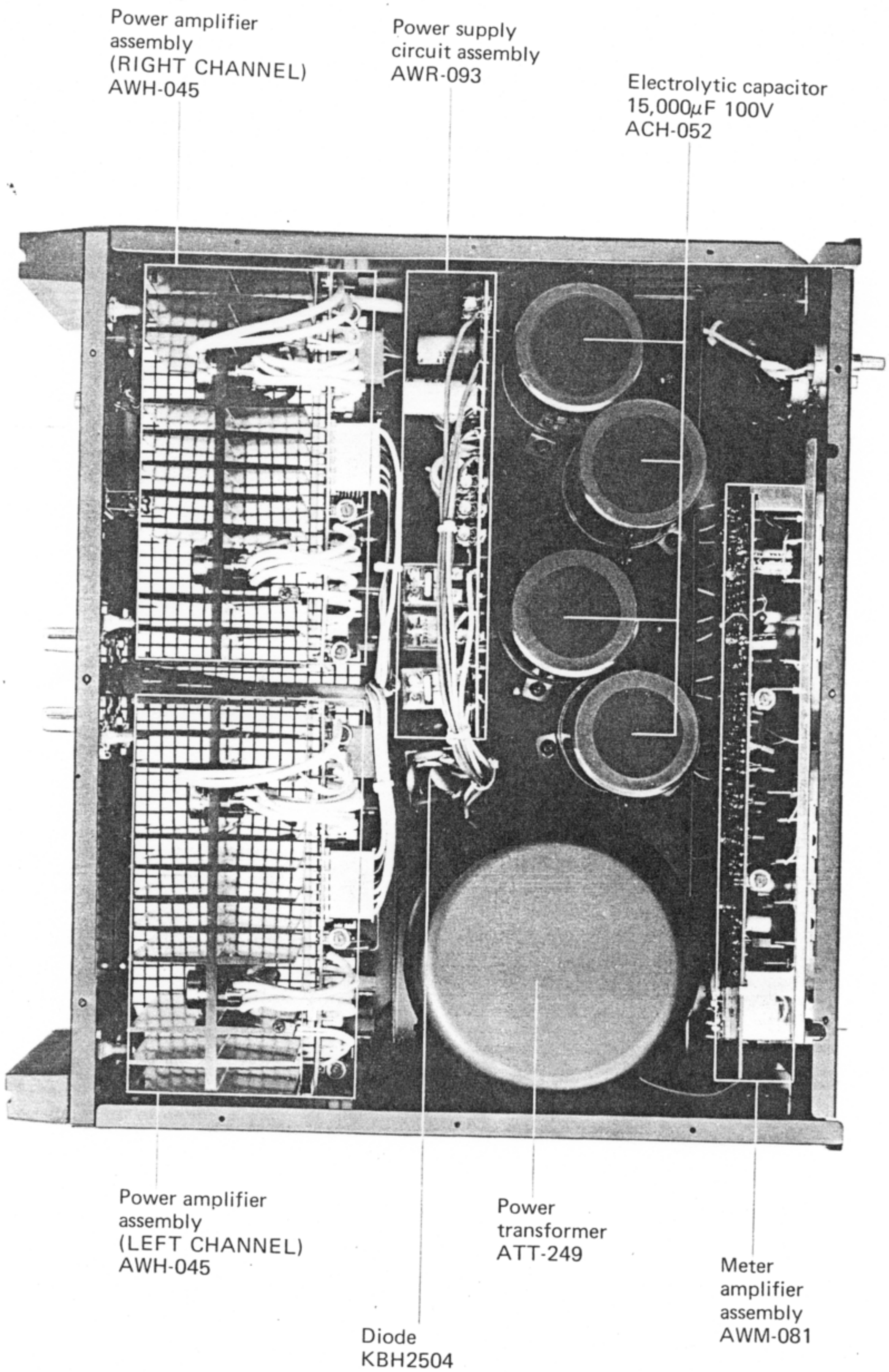
The surge suppressor circuit in the secondary side of the power transformer is designed to handle the electrolytic capacitor charging current. When the power switch is turned ON, RL2 and RL3 remain OFF due to protection circuit operation. Consequently, the current passes through R3 and R4, gradually 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.

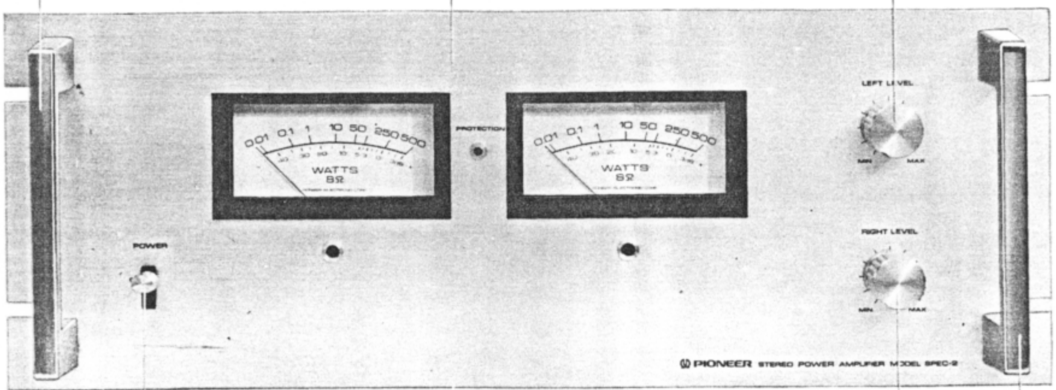
TRi-COMP

8. PARTS LOCATIONS

1. Top View



2. Front Panel View



3. Front View with Panel Removed