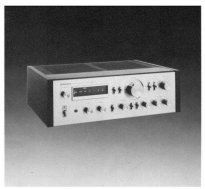

Service Manual

STEREO AMPLIFIER

SA-8800

PIONEER

MODEL SA-8800 COMES IN FIVE VERSIONS DISTINGUISHED AS FOLLOWS:

Type	Voltage	Remarks
K U	120V only	U.S.A. model
K C	120V only	Canada model
H E	220V and 240V (Switchable)	Europe or Oceania model
S/S	110V, 120V, 220V and 240V (Switchable)	U.S. Military model
S	110V, 120V, 220V and 240V (Switchable)	General export model

The variation in safety standards in different countries has also necessitated variations in power supply and circuit component specifications.

This service manual is applicable to the KU type. For servicing of the other types please refer to the additional service manuals.

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1. SPECIFICATIONS

Semiconductors

IC 3
FET 1
Transistors 53
Diodes 49
Others 2

Power Amplifier Section

Continuous Power Output is 60watts* per channel, min., at 8 ohms from 10 Hertz to 20,000 Hertz with no more than 0.005% total harmonic distortion, or 80 watts* per channel at 4 ohms from 10 Hertz to 20,000 Hertz with no more than 0.005% total harmonic distortion.

Continuous Power Output
50Hz to 10,000Hz: 80W + 80W [T.H.D. 0.01%, 8 ohms]
100W + 100W [T.H.D. 0.02%, 4 ohms]
Total Harmonic Distortion (20 Hertz to 20,000 Hertz)
continuous rated power output
. . . . . No more than 0.005%
40 watts per channel power output,
8 ohms . . . . . No more than 0.004%
1 watt per channel power output,
8 ohms . . . . . No more than 0.004%
Intermodulation Distortion (60 Hertz : 7,000 Hertz = 4 : 1)
continuous rated power output
. . . . . No more than 0.002%
40 watts per channel power output,
8 ohms . . . . . No more than 0.002%
1 watt per channel power output,
8 ohms . . . . . No more than 0.002%
Frequency Response . . . . . 5 to 300,000 Hertz ±2 dB
[POWER AMP Int]
Input Sensitivity/Impedance . . . . . 1V/50 kilohms
[POWER AMP Int]

Output
Speaker . . . . . A, B, A+B
Impedance . . . . . Low impedance
Damping Factor
[20 Hertz to 20,000 Hertz, 8 ohms] 55
Hum and Noise
[SHF, short-circuited, A network] 110dB

Preamplifier Section

Input Sensitivity/Impedance
PHONO 1 . . . . . 2.5 mV/50
PHONO 2 . . . . . 2.5 mV/50
CARTRIDGE LOAD . . . . . Both Phono 1 and 2
100, 50k, 25k, 50k, 100k ohms
AUX . . . . . 150mV/50 kilohms
TUNER . . . . . 150mV/50 kilohms
AUX . . . . . 150mV/50 kilohms
TAPE PLAY 1 . . . . . 150mV/50 kilohms
TAPE PLAY 2 . . . . . 150mV/50 kilohms
Maximum Input Level [T.H.D. 0.003%, 1 kHz]
PHONO 1, 2 . . . . . 250mV
Output [Level/Impedance]
TAPE REC 1 . . . . . 150mV
TAPE REC 2 . . . . . 150mV
Tape Monitor . . . . . 7V/5000 ohms, 3V/500 ohms [min.]
Total Harmonic Distortion
(20 to 20,000 Hertz, 1V output) : No more than 0.008%
Frequency Response
PHONO [RIAA Equalization]
. . . . . 20Hz to 20,000Hz ±0.2dB
TUNER, AUX, TAPE PLAY : 5Hz to 100,000Hz ±2 dB
Tone Control
BASS . . . . . +10dB, -10dB [100Hz]
TREBLE . . . . . +10dB, -10dB [10kHz]
Filter SUBSONIC . . . . . 15Hz [6dB/oct]
HIGH . . . . . 8kHz [6dB/oct]
Hum and Noise [SHF, short-circuited, A network]
PHONO 95dB
TUNER, AUX, TAPE PLAY 110dB
Muting . . . . . -20dB
Loudness Contour [Volume control set at -40dB position]
. . . . . +6dB [100Hz], +3dB [10kHz]

Miscellaneous

Power Requirements 120V, 60Hz
Power Consumption . . . . . 260W [U.S.], 300VA [CSA]
Dimensions . . . . . 433(W) x 137(H) x 425(D) mm
17-1/16(W) x 5-13/16 x 16-3/4(D) in
Weight . Without package . . . . . 13.6kg [30 lb 6 oz]

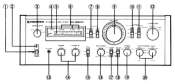
Furnished Parts

Operating instructions 1

* *Measured pursuant to Federal Trade Commission's Trade Regulation rule on Power Output Claims for Amplifier.*

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

2. FRONT PANEL FACILITIES



① **POWER SWITCH**

Set this switch to ON to supply power to the amplifier. There is a short delay when it is set to ON. This is because the muting circuit has been activated to suppress the unpleasant noise that is sometimes generated when the power is on and off.

② **POWER INDICATOR**

When the power switch is set to ON this lamp lights up, indicating the amplifier is turned on.

③ **SPEAKER SELECTOR**

Use this selector to select the speaker system.

A: Sound obtained from speaker connected to the A speaker terminals.

B: Sound obtained from speakers connected to the B speaker terminals.

A+B: Sound obtained from speakers connected to both A and B speaker terminals.

④ **TAPE MONITOR INDICATOR**

The TAPE lamp light up when the tape monitor switch is set to either position "1" or "2".

⑤ **POWER METER**

This meter allows you to read out the rated power level on the fluorescent display tube when speakers with a nominal impedance of 8 ohms are connected to the amplifier's speaker terminals.

⑥ **FUNCTION INDICATORS**

The PHONO, TUNER, AUX function indicators light up in accordance with the position of the function selector.

NOTE

The function indicator will not go off when the tape monitor switch is set to position "1" or "2". This indicates a program of the recording source and during the monitoring of a recording.

⑦ **SUBSONIC FILTER SWITCH**

When this switch is set to the 15Hz position, the subsonic filter with a cut-off frequency of 15Hz is activated. The subsonic filter serves to attenuate frequencies lower than 15Hz in a 6dB/oct slope. It is therefore effective in suppressing ultra-low-frequency noise from warped records, turntable rump and other causes. You cannot actually hear this noise but it is a factor in the generation of intermodulation distortion and it may damage your speaker system. Set this switch to the 15Hz position during record play for the best effect.

⑧ **HIGH FILTER SWITCH**

The high filter with a cut-off frequency of 8kHz is actuated when this switch is set to the 8kHz position.

The high filter serves to attenuate frequencies higher than 8kHz in a 6dB/oct slope. This is why it is effective in suppressing high-frequency noise or noise from scratches on records being played.

⑨ **VOLUME CONTROL**

Use this control to adjust the output level to the speakers connected to the amplifier. Turn clockwise to increase the output level. No sound will be heard if you set it to ∞. The scale is graduated in dB which indicate the attenuation when the max imum output level is 0dB.

⑩ TAPE DUPLICATE SWITCH

Use this switch when employing two tape decks for tape duplicating (dubbing). Set this switch is otherwise kept at the OFF position.

1➡2: When playing back the tape on a deck connected to the TAPE 1 jacks and recording (duplicating) on a deck connected to the TAPE 2 jacks.

OFF: Set to this position when not duplicating.

2➡1: When playing back the tape on a deck connected to the TAPE 2 jacks and recording (duplicating) on a deck connected to the TAPE 1 jacks.

⑪ TAPE MONITOR SWITCH

Use this switch to select the program source which is being reproduced.

1: Set here to monitor a recording or a tape being played back on a tape deck which is connected to the TAPE 1 jacks.

OFF: Set here whenever you are not playing back a tape or monitoring a recording (i.e. when PHONO 1, PHONO 2, TUNER, or AUX for an alternative program source).

2: Set here to monitor a recording or a tape being played back on a tape deck which is connected to the TAPE 2 jacks.

⑫ FUNCTION SELECTOR

Use this control to select the program source. When set, the function indicator above the meter panel corresponding to the position of the function selector will light up.

PHONO 2: Set here when playing records on a turntable connected to the PHONO 2 jacks. (The PHONO function indicator lights up.)

PHONO 1: Set here when playing records on a turntable connected to the PHONO 1 jacks. (The PHONO function indicator lights up.)

TUNER: Set here when listening to a program source which is connected to the TUNER jacks. (The TUNER function indicator lights up.)

AUX: Set here when listening to a program source which is connected to the AUX jacks. (The AUX function indicator lights up.)

⑬ HEADPHONE JACK

Plug the headphones into this jack when you want to listen through your stereo headphones.

NOTE:
Set the speaker selector to OFF when listening only with headphones.

⑭ BASS AND TREBLE CONTROLS

Use these controls to adjust the bass and the treble. If you set the tone switch to ON and turn the bass control to right from its center position, you will be able to emphasize the sound in the low-frequency range. Conversely, if you turn the bass control to the left from the center position, you will attenuate the sound.
You can use the treble control to adjust the sound in the high-frequency range.

⑮ TONE SWITCH

Set this switch to ON when adjusting the bass and treble controls. When set to OFF, the tone control circuits are disengaged and frequency response is flat. This is useful for accurately checking phono cartridge and speaker tone quality and listening room acoustics.

⑯ BALANCE CONTROL

Use this control to balance the volume of the left and right channels. Fast, however, set the mode selector to mono (L+R, L, or R), and adjust so that the sound from the two speakers sounds equally between the two speakers. If the sound appears to be louder on the right, it means that the volume of the right channel is higher. Turn the balance control to the left and adjust.
Conversely, if the sound appears to be louder on the left, it means that the volume of the left channel is higher. Therefore, turn the balance control to the right and adjust. After adjusting, return the mode selector to STEREO.

⑰ LOUDNESS SWITCH

When listening to a performance with the volume control turned down, set this switch to ON and the bass and treble will be accentuated.
The human ear is less sensitive and finds it harder to hear the bass and treble than when the volume is high. The loudness switch is thus designed to compensate for this deficiency. By setting it to ON, the bass and treble come through much more strongly and the sound takes on a punch even when the volume control is turned down.

⑰ MUTING SWITCH

Set this switch to –20dB to attenuate the audio output by approximately 20 dB when turning the switch. There is no need to adjust the volume control if you use this switch when turning down the audio output temporarily and when changing over records or tapes.

⑱ MODE SELECTOR

Use this selector for selecting the performances.

REV: Reverse channel signal is reproduced from signals and reproduces from stereophonic signal.

STEREO: Set to this position for normal stereo reproduction.

L+R: Left and right channel signals and reproduces from monophonically.

L: Left channels signal is reproduced monophonically from both speaker.

R: Right channel signal is reproduced monophonically from both speaker.

⑲ CARTRIDGE LOAD SELECTORS

⑳ CAPACITANCE

These selectors allow you to select the input resistance and input capacitance in line with the rated load impedance and load capacitance of a moving magnet (MM) cartridge for record play.

Use these two switches to produce the sound quality of your preference or the ideal conditions for your cartridge.

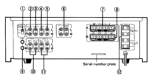
VOLUME CONTROL AND MUTING SWITCH

The volume control can be adjusted from the minimum to ±0. By adjusting it in combination with the muting switch, it is possible to adjust the attenuation more finely across a very wide range. The attenuation (volume) is equal to the volume control indication minus 20dB.

- There will be no need to adjust the volume control every time you change over a tape or record if you set the switch to –20dB position for reducing the volume temporarily during listening.
- You will not be able to finely adjust the volume if the volume control is near the – position when listening to a program at a low sound level at night, for example. In such cases, set the muting switch to –20dB and you will then be able to adjust the sound with the volume control to more fine steps.

NOTE:
Always turn the volume control right down when returning the muting switch to OFF during a performance when the sound is set to a high level with the volume control.

3. REAR PANEL FACILITIES



① **PHONO INTERFERENCE FILTER SWITCH**

This is used to attenuate radio-frequency interference from external electronic or electrical appliances or products during record play.

When the switch is set to the position, record play with the cartridge load resistance switch is at 100Ω position, the sound volume will be reduced.

② **PHONO 1 JACKS**

Connect the turntable output cords to these jacks.

③ **PHONO 2 JACKS**

Connect your second turntable output cords to these jacks.

④ **TUNER JACKS**

Connect the tuner cords to these jacks.

⑤ **AUX JACKS**

These are auxiliary input jacks. Connect a TV tuner or cartridge tape player to them.

⑥ **PREAMPLIFIER/POWER AMPLIFIER CONNECTOR BAR**

When this connector bar is disconnected from the jacks, you can separate the SA-8900's preamplifier and power amplifier. For normal use, however, it is connected.

NOTE:
If this bar is not connected properly, you will not hear any sound from the speakers connected to the SPEAKERS terminals.

⑦ **SPEAKERS TERMINALS A**

Connect your first pair of speakers to these terminals.

⑧ **SPEAKERS TERMINALS B**

Connect your second pair of speakers to these terminals.

⑨ **GND TERMINALS**

These are the ground terminals. Connect the ground wire of the turntable, etc. to these terminals.

⑩ **TAPE 1 JACKS**

Connect the tape deck cords to these jacks. Connect the REC (recording) jacks to the INPUT jacks on the tape deck, and the PLAY (playback) jacks to the OUTPUT jacks.

⑪ **TAPE 2 JACKS**

Connect your second tape deck cords to these jacks. Connect the REC (recording) jacks to the INPUT jacks on the tape deck, and the PLAY (playback) jacks to the OUTPUT jacks.

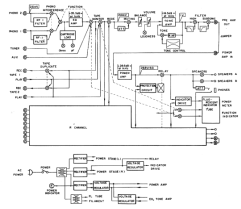
⑫ **AC OUTLETS**

These are spare power outlets. Insert the power plug on the stereo components (turntable, tuner, tape deck, etc.) into these outlets.

SWITCHED: The power supplied through these outlets is coupled to the operation of the amplifier's power switch. The maximum power capacity which may be connected to the SWITCHED outlets is 300W (For the Canadian model, the maximum power capacity is 100VA).

UNSWITCHED: The power is always supplied through these two outlets regardless of the position of the power switch. The maximum power capacity which may be connected to these two outlets is 200W (For the Canadian model, the maximum power capacity is 100 VA).

4. BLOCK DIAGRAM



5. CIRCUIT DESCRIPTIONS

5.1 PRE-AMPLIFIER SECTION

Cartridge Load Selectors

The input resistance and input capacitance of the PHONO input may be varied. The EQ amplifier input resistance is set to 100kΩ, and the input capacitance to 100pF. By operation of the CARTRIDGE LOAD selectors, different resistors and capacitors are added to the EQ amplifier input circuit. Five different input resistance levels (100Ω, 10kΩ, 30kΩ, 50kΩ and 100kΩ) and five different input capacitance levels (100pF, 200pF, 300pF, 400pF and 500pF) are available, permitting the user to select optimum load conditions for the phono cartridge being employed in the turntable connected to the PHONO terminals.

Phono Interference Filter

Because of the high sensitivity of the phono input circuits, a certain amount of radio frequency interference may be picked up. This can be avoided simply turning the rear panel PHONO INTERFERENCE FILTER on (thereby connecting a resistor in series with the phono input circuits).

EQ Amplifier

Fig. 5-1 shows the basic configuration of the circuit. The EQ amplifier is a completely symmetrical DC-coupled 3-stage amplifier, the first stage of which employs newly developed ultra-low-noise twin FET transistors.

The output stage is a symmetrical complementary SEPP Class A configuration. The output current is of the same order of magnitude as that of a small power amplifier, and is sufficient to cope with low-impedance loads.

The S/N ratio of the EQ amplifier is 90dBs, and the equalizer deviation is ±0.5dB (20Hz to 20,000Hz).

Tone Controls

Fig. 5-2 shows the basic tone control circuit. The tone amplifier is a 3-stage DC-coupled amplifier, the first stage is a differential amplifier consisting of a ultra-low-noise twin FET. The second stage is a differential amplifier using a silicon epitaxitic transistor, and the output impedance lowered by using an emitter follower at the output stage.

Tone control (BASS, TREBLE) is accomplished by providing the tone amplifier NFB circuit with a frequency selective characteristic. The NFB circuit is changed so a flat frequency characteristic when the TONE switch is in the OFF position.

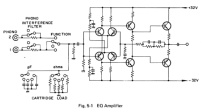


Fig. 5-1 EQ Amplifier

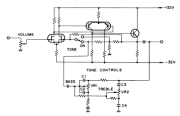


Fig. 5-2 Tone Control Circuit

5.2 POWER AMPLIFIER SECTION

Amplifier Circuit

The basic circuit arrangement of the power amplifier is shown in Fig. 5-3. The first stage is a differential amplifier comprising PNP twin transistor (Q_2), the load circuit of which is a current mirror employing an NPN twin transistor (Q_3). The current mirror provides push-pull operation in this stage, which serves to cancel even harmonics and further increase gain.

Q_1 in the input circuit absorbs outflow of base current from Q_2, and prevents the generation of a DC voltage. Because Q_1 follows any temperature drift in Q_2, temperature drift of the center point voltage is prevented.

The pre-drive stage (Q_4, Q_5) is a Darlington arrangement, the load circuit of which employs a constant-current source (D_1, Q_6) resulting a high voltage gain.

The power stage bias voltage is supplied by the NSA circuit. The NSA circuit provides non-switching operation in the power stage (refer to "NSA Circuit").

The power stage ($Q_7 - Q_{12}$) is a 2-stage Darlington arrangement, the last stage is parallel SEPP circuit employing an SL RET (Super Linearity Ring Emitter Transistor). The RET is a kind of IC consisting of a number of small transistors on a single chip, with each transistor being connected in parallel via an emitter resistor. This provides excellent high frequency characteristics comparable to those of a small-signal transistor. Furthermore, because there is no time constant in the NFB circuit in the low-frequency region, amplification is possible down to DC (DC inputs will be cut off, however, by the input coupling capacitor).

The circuit features described above provide an extremely wide power frequency range (80W + 80W, 10Hz to 20kHz, THD 0.005%, 8Ω).

Power Limiter

The power limiter is a high-speed protection circuit which operates to protect the power transistors from overcurrent conditions caused by load shorts, etc.

The circuit (Fig. 5-4), constitutes a Wheatstone bridge (Fig. 5-5), one arm of which is the load (R_L), which is arranged so that Q_1 (Q_2) is biased by the potential difference between the opposite corners of the bridge. As the value of R_L decreases, Q_1 (Q_2) start to conduct, thus holding down the drive voltage and controlling the magnitude of the current flowing in to the power transistors. Q_3 (Q_4) is link connected to Q_1 (Q_2) which provides sharp clipping characteristics.

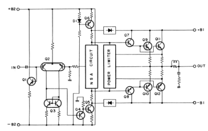


Fig. 5-3 Power amplifier circuit

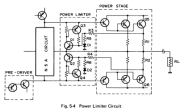


Fig. 5-4 Power Limiter Circuit

Fig. 5-5 Bridge Circuit

NSA (Non-Switching Amplifier) Circuit

By operating the power stage only within the active region (no possible cut-off) and with minimal time delay (zero), the NSA circuit prevents the generation of switching distortion and reduces heat loss.

Operating Principle

Since idle current flows through normal class B (SEPP power stages (see Fig. 5-6) when no signal is applied, the DC level is shifted by D and VR by a fixed amount (with the voltage across points P and Q and points R and S at this time will be equal). When the positive portion of a signal is applied to this circuit, the power stage current on the NPN side is increased resulting in the voltage across points P and Q also being increased. However, since the voltage across points P and R is practically constant (see note), the voltage across points P and R (PNP power stage bias) will be decreased, resulting in the PNP power stage being cut off.

Fig. 5-6 Normal Power Stage

The NSA circuit increases the voltage across points P and Q, thereby cancelling the voltage increase across points P and Q, thereby cancelling the voltage decrease across points Q and R, and preventing the PNP power stage from being cut off.

This NSA circuit is outlined in Fig. 5-7. When there is no signal applied to the circuit, Q_1 and Q_2 are cut-off, and thus Q_3 and Q_4 are cut-off. The voltage across the collector and base of both of these transistors (Q_3 and Q_4) at this time may be disregarded. Consequently, with the power stage transistors (Q_5 and Q_6) PNP junctions formed by Q_3, D_1, and Q_4, and VR_1, this is equivalent to the previous circuit shown in Fig. 5-6.

With R_1 and D_1 ensuring a constant flow of current, the base of Q_5 and point Q may be DC-tight to the Earth level (see Fig. 5-8). Point P, however, is not Earth-level (due to the signal) by a simple shift in DC level. Furthermore, Q_7 may be considered emitter-follower with R_1 as the emitter resistance.

When the voltage across points P and Q is increased by the positive portion of the signal applied to this circuit, it becomes the input signal of this emitter-follower (Q_7). Since the emitter-follower voltage gain is practically 1, a voltage more or less equal to that of the input signal (that is, the positive portion of the signal) will be produced at R_1. And the R_1 voltage is the voltage applied across the base and collector of Q_7 which forms part of the power stage bias circuit. So the bias voltage applied to Q_7 will be in excess by the positive portion of the signal. Consequently, when Q is increased (by positive portion of the signal) above the voltage level when no signal is being applied. Consequently, the increase in voltage across points P and Q cancels the decrease in voltage across points P and Q. So Q_5 can maintain the idle current without cutting the PNP power stage off (noting that there actually is a slight decrease in current). For the negative portions of the signal, Q_1 and Q_2 are operated in the same manner, thus preventing the NPN power stage from being cut-off.

In other words, the NSA circuit acts to prevent any "power stage cut-off" signals from being applied to the power stage (see Fig. 5-9).

Note:
The quiescent current actually decreases when the positive portion of the signal is applied, resulting in a decrease in the voltage across points P and Q.

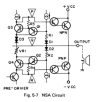


Fig. 5-7 NSA Circuit

Fig. 5-8 NSA Circuit

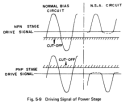


Fig. 5-9 Driving Signal of Power Stage

5.3 INDICATOR CIRCUIT

The SA-8600 output power and function indicator is a fluorescent display tube. When a voltage is fed to this tube, thermionic emissions from the cathode are accelerated into the fluorescent substance of the segmental anodes, resulting in the emission of light. This tube is used to indicate output power and the selected function.

An outline of the FL tube drive circuit is shown in Fig. 5-10. The output-circuit signal is first passed through a low-pass filter and a compressor circuit before being applied to pin no.8 (41) of the IC (HA12010). The IC compresses the input signal by of the non-linearity of the rising portion of the diode's Vd – Id characteristics to contract the signal dynamic range by 20dB. The IC contains a detector circuit, compressor (40dB), and peak hold circuit for both left and right channels. The dynamic range of the signal is thus contracted by 60dB to obtain a "peak hold" DC voltage.

The output power indicator segments of the FL tube are driven by the HA12010 ICs (one for each channel) equipped with 12 pairs of differential amplifiers. These amplifiers are biased at increasing levels so that the output power indicator segments separately as the input level increases. And since these amplifiers apply the voltages to the output power indicator segments, each successive segment will light up in turn as the input level rises.

The output power indicator tube is the result of a voltage being applied to the corresponding function indicator segment according to the selected positions of the FUNCTION and TAPE MONITOR switches.

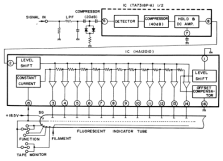


Fig. 5-10 Indicator Circuit

5.4 PROTECTION CIRCUIT

The purpose of this circuit is to protect the speakers. The relay in the output circuit is automatically energized when the power is turned on.

1. During the "transient operations" when the power supply is turned on and off.
2. Upon detection of a DC voltage in the output circuit, caused by component failure or accident.

Muting Operation when Power Supply is Turned On and Off

With reference to Fig. 5-11 when the power supply is turned on, the time constant of $+B_1$ (the time constant of the $-B_1$ circuit is very small). If there is no input (DC) on Q_1 and Q_2, they will be off, and the timing capacitor C_{10} charges up through R_1 and R_{11}, and thus Q_3 turns on. When the relay is energized, the output circuit of the output section of the power amplifier will be removed.

When the power supply is turned off, $-B_1$ will abruptly decay, and Q_3 will conduct owing to the residual component of $+B_1$. As a result, C_{10} will rapidly discharge, Q_3 will cease to conduct, whereupon the relay will become de-energized and restore muting.

DC Voltage Detector

The DC voltage detector is connected to the Q_1 emitter and Q_2 base via a low-pass filter (R_{12}, C_{11}). Any DC voltages appearing the output circuit of the power amplifier, it will be applied to the Q_1 emitter and the Q_2 base. If the voltage is positive, Q_1 turns on. C_{11} will rapidly discharge. If the voltage is positive, Q_2 turns on. C_{11} will rapidly discharge. In either case, Q_3 will cut off, and the relay will become de-energized, thus causing the output circuit to open.

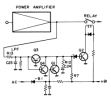


Fig. 5-11 Protection Circuit