〈R42－145－0〉

Service Manual

STEREO DISPLAY

SD-1000/FW

PIONEER

〈7I I 02F 2IN〉

CONTENTS

1. SPECIFICATIONS

SEMICONDUCTORS	FETs	9
	Transistors	40
	Diodes	33
Cathode-ray tube	3-inch (75mm) Electrostatic-deflection type	

OSCILLOSCOPE SECTION

Vertical amplifier	Deflection sensitivity:	20mV p-p/cm
	Frequency response:	5Hz – 250kHz (within –3dB)
	Input impedance:	190kΩ
	Input capacitance:	80pF
Horizontal amplifier	Deflection sensitivity:	20mV p-p/cm
	Frequency response:	5Hz – 250kHz (within –3dB)
	Input impedance:	190kΩ
	Input capacitance:	80pF
Sweep frequency range	4 ranges	10Hz – 100kHz
Synchronous circuit	Synchronous level:	More than 3/8" on scope
	Synchronize system:	Internal
Additional circuit	"Spot killer" circuit	

AUDIO OSCILLATOR SECTION

Frequency range	20Hz – 20kHz Automatic sweep, manual sweep ±10% or less
Output level	2V or more, variable continuously
Output stability	20Hz – 20kHz, ±1dB or less
Output impedance	4.7kΩ or less
Distortion	1% or less (at 20Hz – 20kHz)
Sweep time:	25 seconds (from 20Hz to 20kHz)

LEVEL METERS SECTION

Reference level	0dB = 2V (Front), 0dB = 20V (Rear)
Input sensitivity	0dB, –10dB, –20dB
Response time	0.3 second for to 0dB indicate (at 1kHz)
Frequency response	20Hz – 20kHz, ±1dB

INPUT & OUTPUT TERMINALS

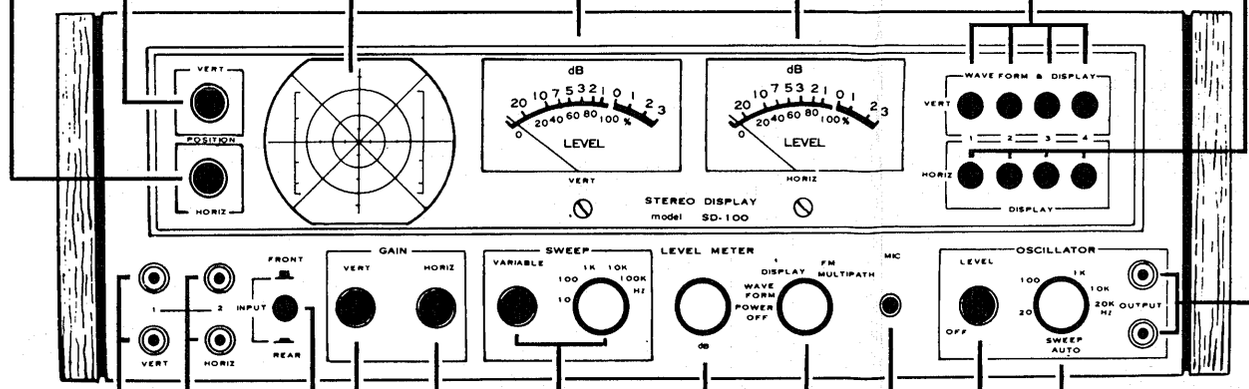
Front panel inputs	INPUT 1 (VERT), INPUT 2 (HORIZ)
	Sensitivity: 20mV p-p/cm (190kΩ)
	MIC (mono): Sensitivity, 0.6mV rms/cm
	Impedance, 50kΩ (1kHz)
Rear panel inputs	INPUT 1, 2, 3 and 4
	Sensitivity: 200mV p-p/cm (190kΩ)
	FM MULTIPATH/VERT
	FM MULTIPATH/HORIZ
	Sensitivity: 20mV p-p/cm
Front panel output	AF OSC OUTPUT 2V or more

POWER SUPPLY SECTION

Power requirements and frequency	110V, 120V, 130V, 220V and 240V, 50 – 60Hz
Power consumption	25W (MAX)
Dimensions	16-15/16(W) x 5-11/16(H) x 13-11/16(D) in.
	[430(W) x 145(H) x 348(D) mm]
Weight	19lb 6oz (8.8kg)
Accessories	Operating instructions 1
	Cords with pin plug 1
	Polishing cloth 1

NOTE: Specifications and the design subject to possible modification due to improvements.

2. FRONT PANEL FACILITIES



CATHODE-RAY TUBE (CRT) SCREEN:

All patterns, waveforms or displays appear on this screen. The signal level can be read on the vertical scale in the center.

VERTICAL POSITION:

Turning the knob clockwise moves the pattern on the screen upward; turning the knob counterclockwise moves the pattern downward.

HORIZONTAL POSITION:

Turning the knob clockwise moves the pattern on the screen to the right; turning the knob counterclockwise moves the pattern to the left.

INPUTS 1 (VERT):

High-sensitivity inputs for vertical amplifier; these terminals are used when observing a low-level input signal. The upper is for the positive (+), the lower is for the negative (–) pole (ground).

INPUTS 2 (HORIZ):

High-sensitivity inputs for horizontal amplifier, other functions are the same as for INPUT 1.

FRONT-REAR SELECTOR:

This push-button switch is set to FRONT when the INPUTS 1 or 2 are used; to REAR when the AUDIO INPUTS on the rear panel are used. If this switch is depressed, it is locked and set to REAR, and depressed once again, it is released and set to FRONT.

VERTICAL GAIN:

Turning this knob clockwise allows vertical amplitude of the waveform on the screen to increase.

LEVEL METERS:

Direct reading of input level in decibel units. If the input signal to be measured is applied through the AUDIO INPUTS on the rear panel, add 20dB to the reading on the scale.

WAVEFORM & DISPLAY SELECTOR SWITCHES (VERT):

Switch numbers 1 to 4 correspond to the input terminal numbers.

SWEEP RANGE AND FREQUENCY VARIABLE CONTROLS:

The right selector switch chooses the sweep frequency range, the left control adjusts the sweep frequency within the pre-selected range.
The selected sweep frequency should be the same as or below the signal frequency to be observed. Identical sweep and signal (VERT input) frequencies mean that one cycle will be displayed on the CRT. Lower sweep frequencies let you display several VERT input cycles.
The controls are only operative when the FUNCTION SWITCH is set to WAVEFORM position.

HORIZONTAL GAIN:

Turning this knob clockwise allows horizontal amplitude of the waveform on the screen to increase.

DISPLAY SWITCHES (HORIZ):

Switch numbers 1 to 4 correspond to the input terminal numbers. To observe a Lissajous pattern on the screen, the switch corresponding to the input terminals used should be depressed.

OSCILLATOR OUTPUTS:

These are output terminals for the built-in audio oscillator. The upper terminal is for the positive (+), the lower terminal is for the negative (–) pole (ground).

OSCILLATOR FREQUENCY CONTROL:

Frequencies in the range from 20Hz to 20kHz can be obtained by means of this control knob.
With the knob set to SWEEP AUTO, the oscillator will continuously sweep frequencies from 20Hz to 20kHz automatically at approx. 25 seconds for one sweep cycle.

OSCILLATOR LEVEL CONTROL:

Turning this knob clockwise increases output of the oscillator. With this knob set to OFF, the oscillator stops operating. Be sure to keep the knob set to OFF when the oscillator is not in use.

MIC JACK:

Waveform of the sound picked up by a microphone can be observed by plugging a dynamic microphone into this JACK. At the time, the LEVEL METER (VERT) will show the sound level. Be sure to disconnect the microphone when it is not used.

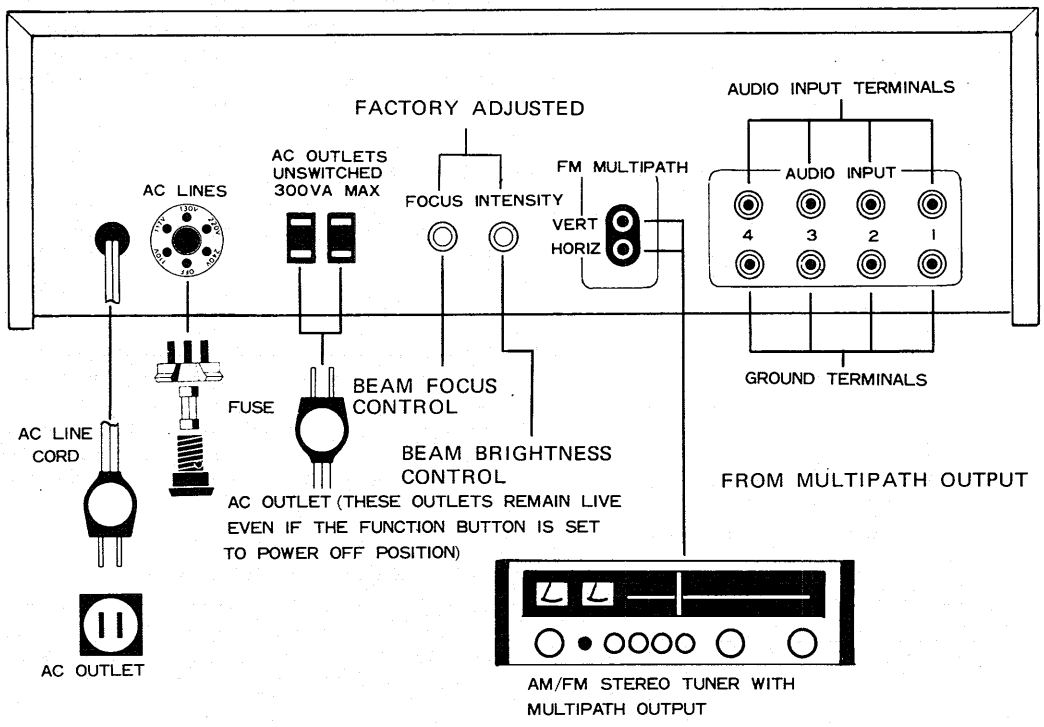
FUNCTION SWITCH:

POWER OFF ····· Turns power off.
WAVEFORM ····· For observing waveforms of signals selected with the WAVEFORM & DISPLAY SELECTOR SWITCHES.
DISPLAY ····· For observing a Lissajous pattern selected with the WAVEFORM & DISPLAY SELECTOR SWITCH and the DISPLAY SWITCH.
FM MULTIPATH ··· For observing multipath conditions of an FM antenna.

LEVEL METER SELECTOR SWITCH:

OFF ····· The LEVEL METERS will not function.
0 ····· When a signal of 2V(rms) is applied to the INPUTS "1" or "2", the LEVEL METER(S) will indicate 0dB.
–10 ····· When a signal of 0.63V (–10dB below 2V) is applied to the INPUTS "1" or "2", the LEVEL METER(S) will indicate 0dB.
–20 ····· When a signal of 0.2V (–20dB below 2V) is applied to the INPUTS "1" or "2", the LEVEL METER(S) will indicate 0dB.

3. CONNECTION DIAGRAM



BEFORE OPERATION

INPUTS

There are two pairs of inputs on the front and four pairs on the rear panels. Please note that the rear panel inputs are always attenuated by −20dB.

SPOT KILLER CIRCUIT

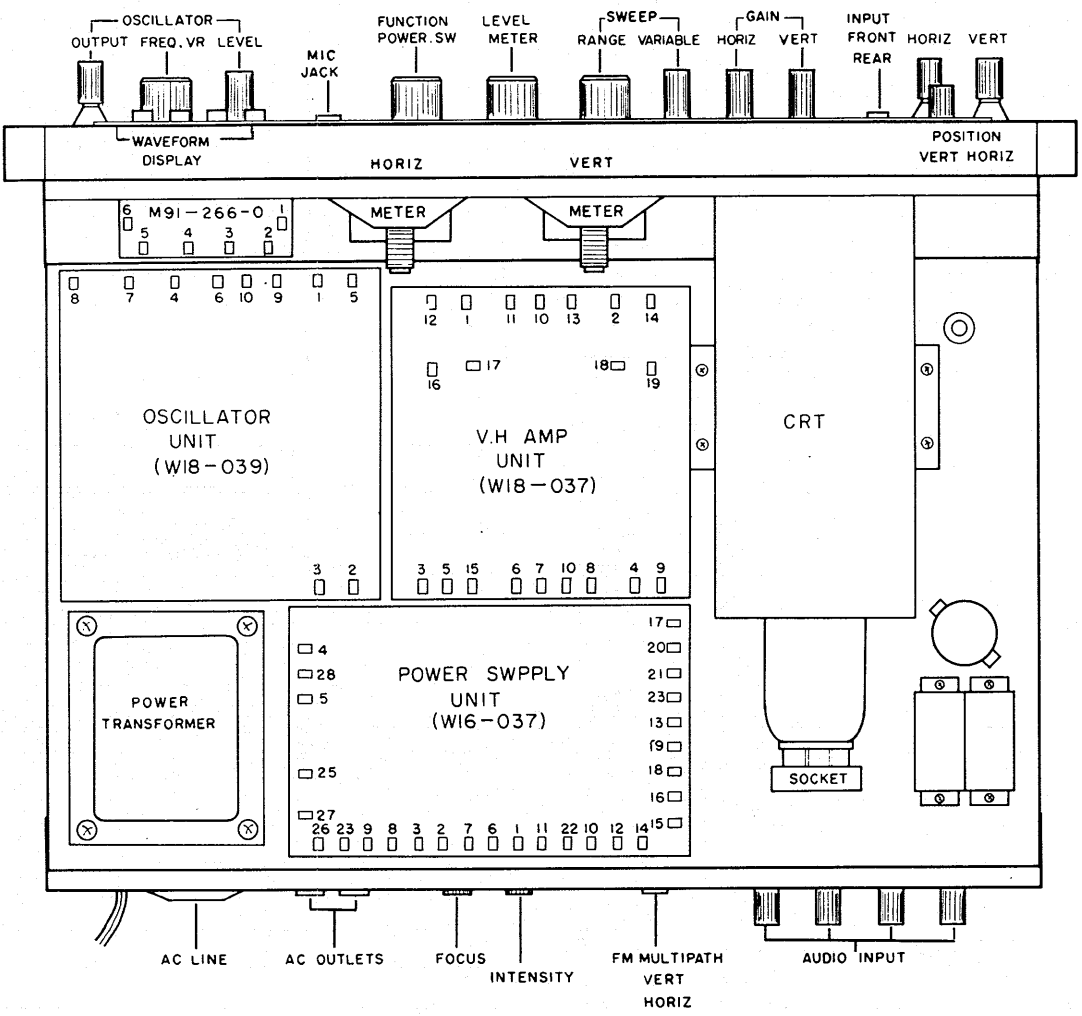
To prevent burning of the CRT phosphorous screen, a "spot killer" circuit is built in which is activated when the deflection amplitude of the beam is less than 10mm. The beam intensity is reduced automatically.
This will happen, for example, when observing the waveform of a very low level audio signal. In extreme cases, the beam will gradually disappear altogether.

LEVEL METERS

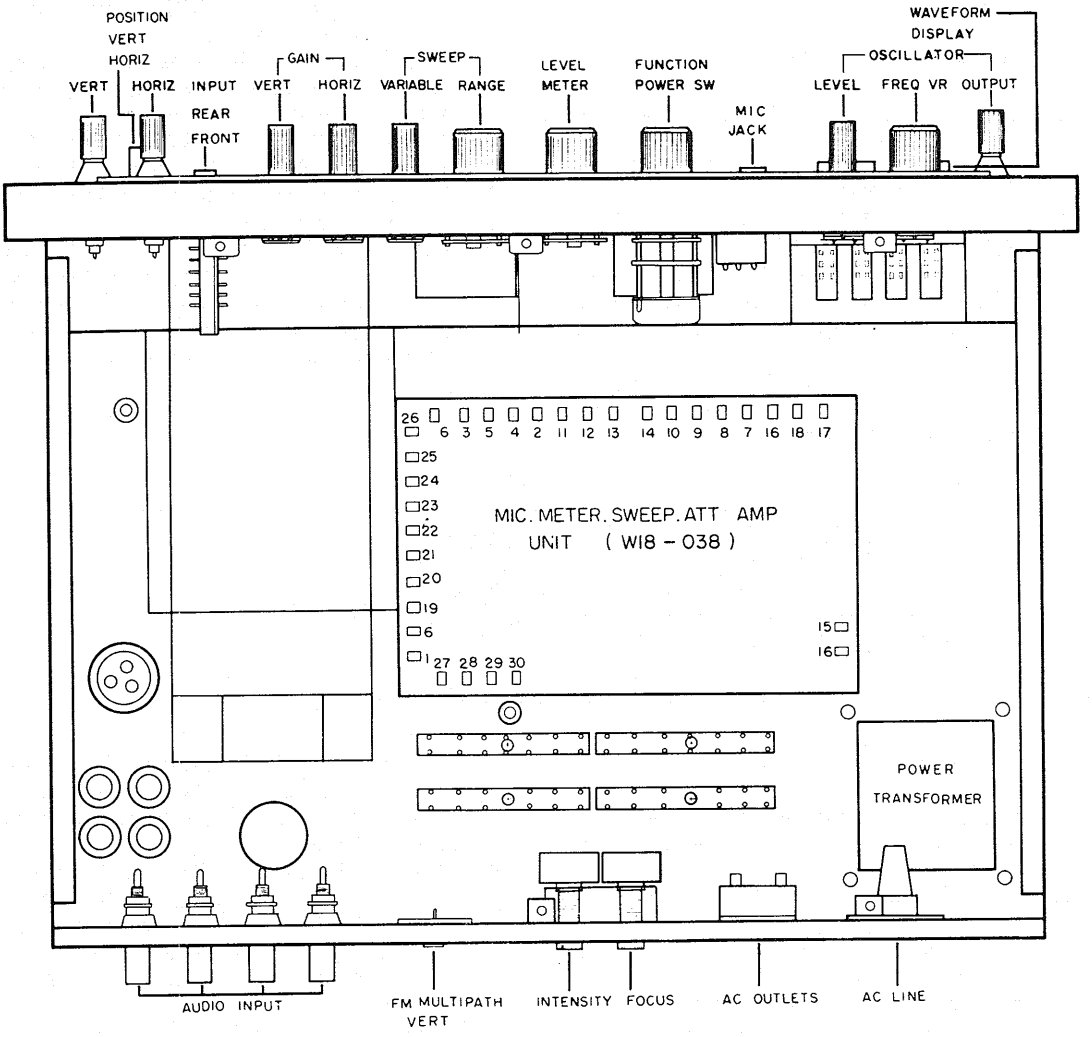
The level meters are calibrated to a reference voltage of 2V = 0dB. Meter sensitivity can be adjusted in 3 steps: 0dB, −10dB and −20dB. −10dB means that the meter sensitivity is increased by 10dB, in other words, that 10dB must be subtracted from the reading to obtain the true value.

4. PARTS LOCATION

TOP VIEW



BOTTOM VIEW


POSITION
VERT
HORIZ
VERT
HORIZ
INPUT
REAR
FRONT
GAIN
VERT
HORIZ
SWEEP
VARIABLE
RANGE
LEVEL
METER
FUNCTION
POWER SW
MIC
JACK
WAVEFORM
DISPLAY
OSCILLATOR
LEVEL
FREQ VR
OUTPUT
MIC. METER. SWEEP. ATT AMP
UNIT (W18 - 038)
POWER
TRANSFORMER
AUDIO INPUT
FM MULTIPATH
VERT
INTENSITY
FOCUS
AC OUTLETS
AC LINE

5. PERFORMANCE CHECKS

5.1 AUDIO FREQUENCY OSCILLATOR (Fig. 1)

1. Connect OSCILLATOR OUTPUT to INPUT 1 (V).
2. Set FUNCTION SWITCH to position WAVEFORM.
3. Set FRONT-REAR SELECTOR to position FRONT.
4. Push WAVEFORM & DISPLAY SELECTOR SWITCH 1.
5. Adjust OSCILLATOR FREQUENCY CONTROL to around 1kHz, turn OSCILLATOR LEVEL CONTROL to middle position.
6. Adjust SWEEP RANGE and FREQUENCY VARIABLE CONTROLS to obtain clear, stable pattern.
7. Vertical and horizontal amplitudes can be controlled with the VERT. and HORIZ. GAIN CONTROLS.
8. Signal level can be read by adjusting LEVEL METER sensitivity to proper value (0, −10, or −20dB).
9. Turn OSCILLATOR LEVEL CONTROL in either direction. Check that level meter (V) and oscilloscope vert. amplitude change accordingly.
10. Turn OSCILLATOR FREQUENCY CONTROL to AUTO SWEEP. Confirm that density of waves on CRT changes accordingly. Note that there is a considerable pause after each sweep cycle.

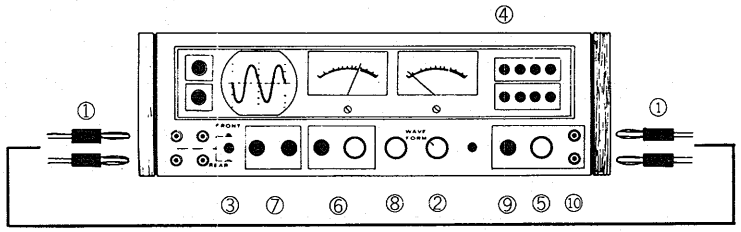


Fig. 1

5.2 LISSAJOUS PATTERNS (Fig. 2)

1. Apply two signals of similar level and frequency to INPUTS 1 and 2, respectively.
2. Turn FUNCTION SWITCH to position DISPLAY.
3. Set FRONT-REAR SELECTOR to position FRONT.
4. Push both No. 1 WAVEFORM and DISPLAY selector switches (VERT and HORIZ).
5. Adjust VERTICAL and HORIZONTAL GAIN controls to obtain a pattern as shown in fig. 3, 0^{o},(45 degree upward slanted line).
6. Push DISPLAY SWITCH No. 2. Pattern will be a Lissajous pattern composed of signals 1 and 2 (1: vertical. 2: horizontal). If both signals have exactly the same frequency, patterns as in fig. 3 can be obtained.
7. Adjust LEVEL METER sensitivity, if necessary. Both vertical and horizontal signal levels can be read.

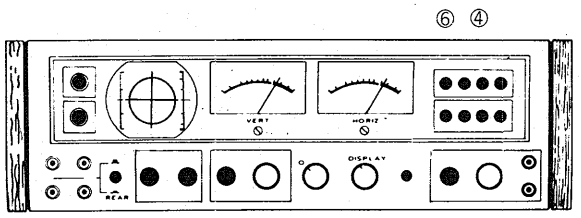


Fig. 2

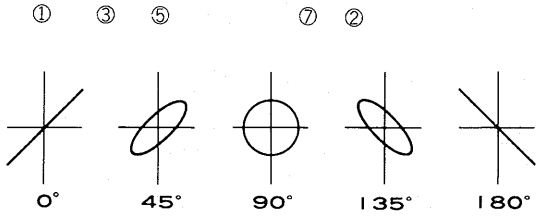


Fig. 3

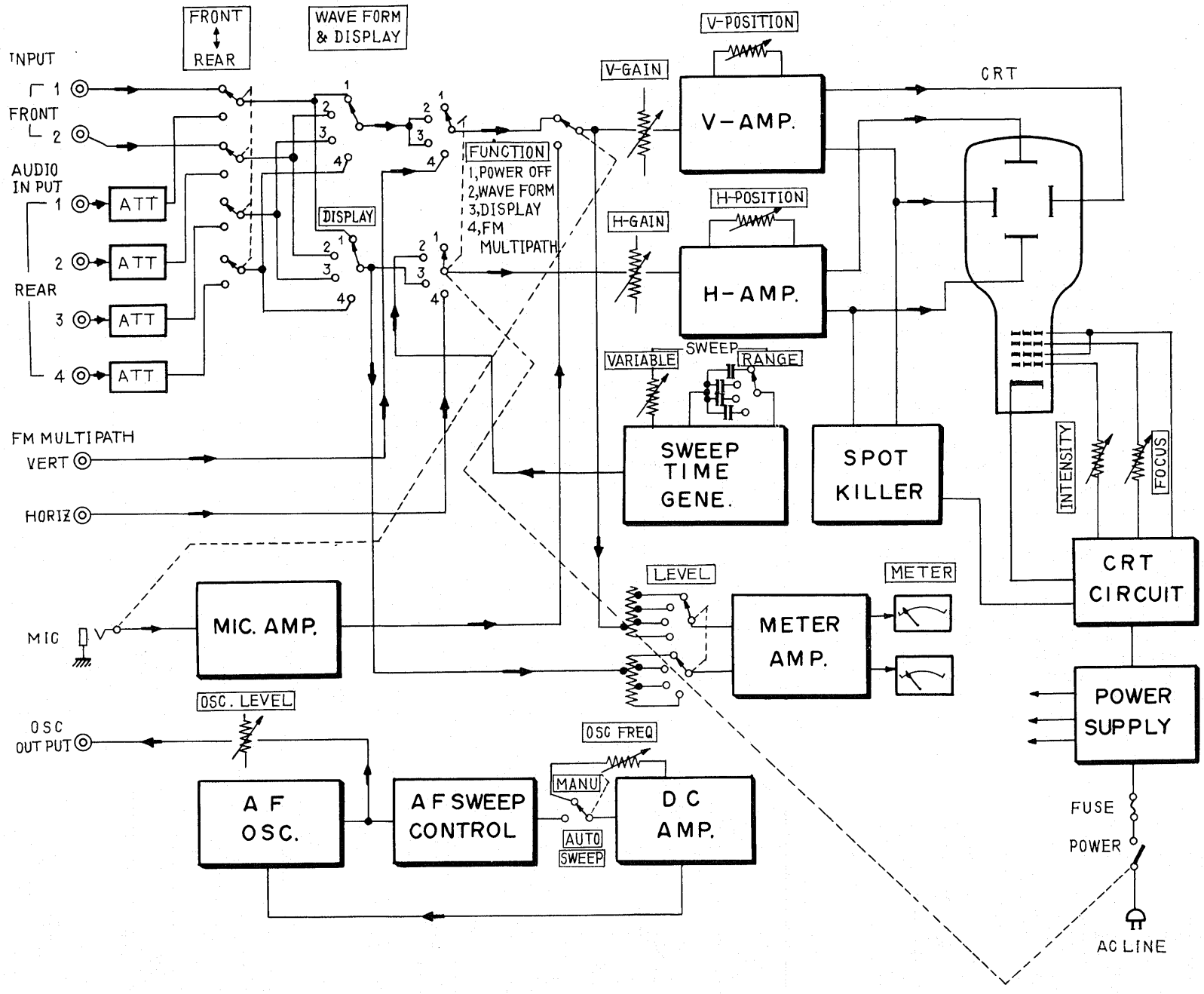
6. CIRCUIT DESCRIPTION

6.1 BLOCK DIAGRAM, CIRCUIT COMPOSITION

The block diagram (right) shows the circuits according to their functions. The circuitry consists of 4 PCBs whose arrangements are as follows:

1. VERTICAL & HORIZONTAL AMPLIFIER.
2. METER AMPLIFIER, INPUT ATTENUATORS, MICROPHONE AMPLIFIER, SWEEP TIME GENERATOR (INTERNAL SAW-TOOTH OSCILLATOR).
3. AF OSCILLATOR, AF SWEEP CONTROL, DC AMPLIFIER.
4. POWER SUPPLY, CRT CIRCUIT, SPOT KILLER CIRCUIT.

The intensity and focus controls shown in the block diagram are semi-fixed controls on the rear panel. All other controls are on the front panel.



6.2 MICROPHONE AMPLIFIER (Fig. 4)

When the microphone is plugged in, an internally linked switch operates to select WAVEFORM function, and the microphone signal is supplied to the vertical amplifier. The frequency response of this amplifier is 12Hz ~ 40kHz (—3dB), as determined by C21 and C24. Gain at 1kHz is approximately 70 (37dB), the input impedance is 50kΩ, which means that optimum matching is obtained with a microphone of about 50kΩ output impedance. R41 and C22 serve to eliminate buzz (TV signal pickup) and prevent operational instabilities caused by negative feedback.

6.3 METER AMPLIFIER (Fig. 5)

This amplifier is based on a direct coupled two transistor design. Negative feedback is applied through the rectifier bridge, R19 and semi-fixed R13. The diode rectifier bridge has the purpose to maintain good linearity between current and voltage.
R13 controls the NFB factor which affects the amplifier's total gain. It is adjusted so that the meter reads 0dB when an input signal of 0.2V is present at the base of Q7 (or Q4) (fig. 5). Meter sensitivity is adjustable by means of the voltage divider circuit. —20dB position means direct signal input to the top transistor, i.e. maximum sensitivity.

6.4 VERT. AND HORIZ. AMPLIFIER CIRCUITS (Figs. 6, 7)

Vertical and horizontal amplifiers are of basically the same design and produce practically the same gain (different by about only 6dB). Inputs to these amplifiers are selected by SW5 (FUNCTION switch).

The input signal, controlled by gain controls VR1 and/or VR2, then enters the gate of Q9 or Q1.
(The following explanations refer to the vertical amplifier; the horizontal amp functions in essentially the same manner.) Figs. 6 and 7 show the vertical amp circuit in detail.
The total circuit consists of 4 differential amplifiers.
The signal obtained from the source of Q9 passes through Q11, and a signal of inverted phase appears at the collector of Q11.
On the other hand, a signal of the same phase as the input appears at the emitter of Q11, it is injected to the emitter of Q12 through R31.
Q12 operates as grounded base amplifier, and therefore the signal amplified in Q12 (emitter-input) maintains its original phase.
The output signals from the Collectors of Q11 and Q12, with opposite phases, are applied to the bases of Q13 and Q14, in push-pull output manner, and in the same way, emitter outputs of opposite phase from Q13 and Q14 are supplied to the bases of Q15 and Q16. Their outputs serve to control CRT deflection.
The DC bias for deflection (position control) can be controlled by the 50kΩ variable resistor, whereby the currents of differential amplifier Q13/Q14 and amplifier Q15/Q16 are changed; consequently, the DC deflection potential changes in see-saw fashion, permitting highly effective control of the pattern position on the CRT. The 50kΩ resistor is adjustable by the VERTICAL POSITION control on the front panel.
R27 has the function of balancing the DC current of differential amplifiers Q9/Q10 and Q11/Q12. R31 controls the injection voltage to Q12, thereby controlling the over-all gain. Both these resistors are semi-fixed and mounted on the PCB.

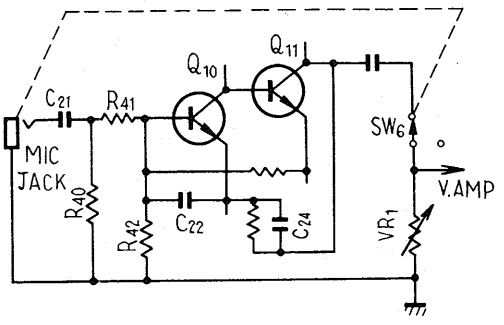


Fig. 4

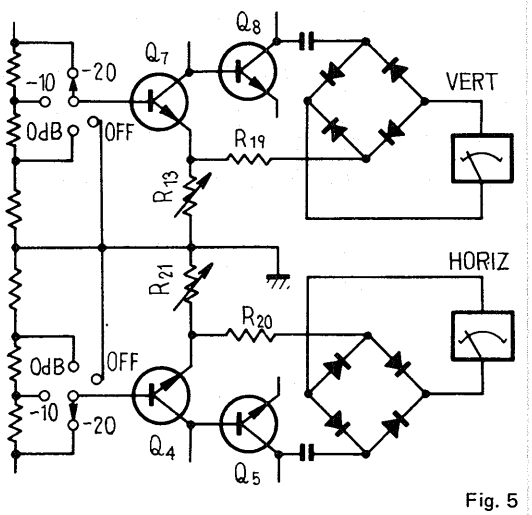


Fig. 5

6.5 SPOT KILLER CIRCUIT (Fig. 8)

The purpose of this circuit is to protect the CRT's fluorescent screen when there is no or almost no deflection, i.e. when the image on the screen is a spot or a straight line. Basically, this is done by a switching transistor inserted in the CRT cathode circuit; switching is performed by the V and/or H input signals to the scope in the following manner.

Fig. 8 shows the simplified circuit diagram. The switching transistor Q2, is connected with its base to both the vertical and horizontal deflection plates through diodes D11, D12, capacitors C8, C9 (which isolate the transistor from the high DC voltage at the deflection plates) and through resistors R14, R15. The deflection input signals which are applied to the deflection plates are rectified by diodes D12, D11 to produce a forward bias for Q2. As long as this signal is sufficiently strong, Q2 remains on. When the deflection signal approaches zero, no bias is supplied to Q2, and Q2 is cut off. This switching operation of Q2 serves to switch the cathode electron emission on and off, thereby regulating the beam intensity in accordance with the level of the deflection signal.

The threshold level of Q2 becoming conductive is factory-adjusted to 1cm deflection on the screen. This adjustment is made by the 500kΩ VR2. VR2 is located on the power supply unit.

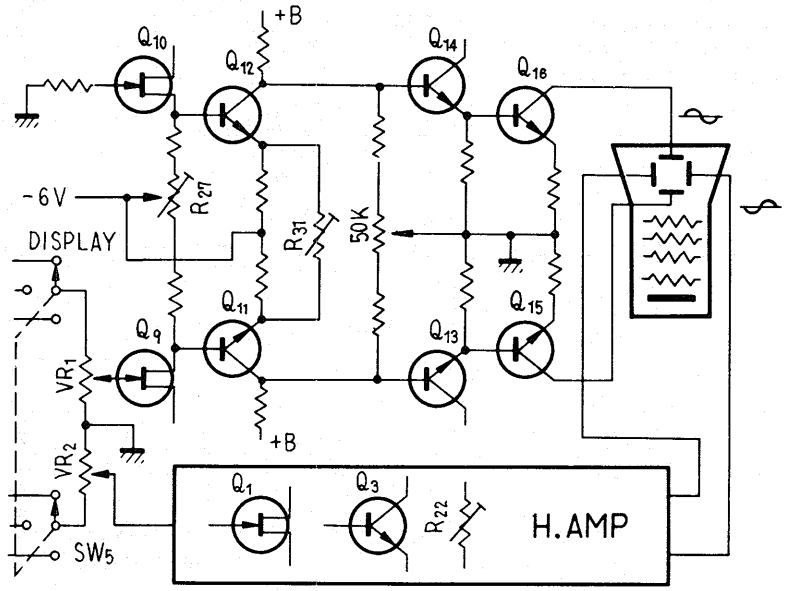


Fig. 6

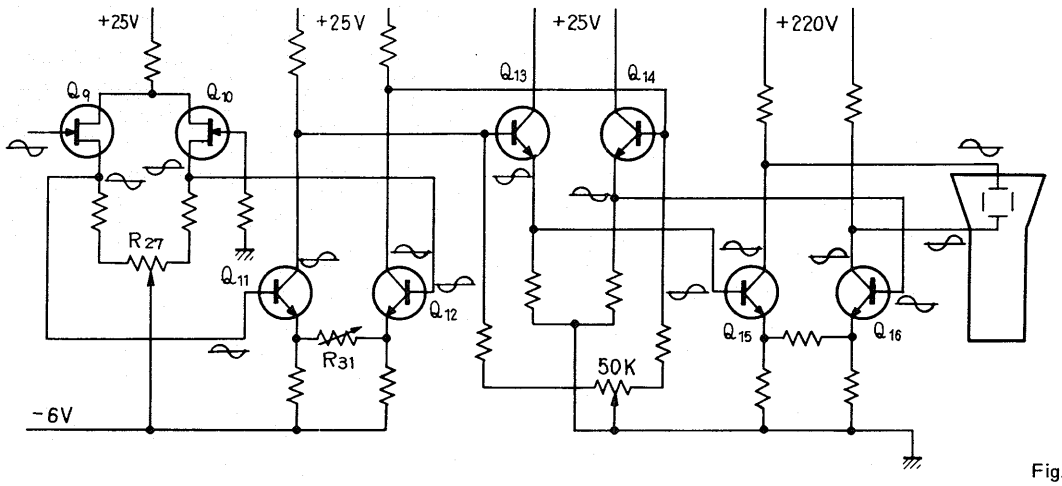


Fig. 7

6.6 SWEEP TIME GENERATOR(Fig. 9)

When the FUNCTION switch is set at position WAVEFORM, this circuit is activated and supplies the required horizontal saw-tooth wave. See fig. 9. The FUNCTION switch controls the power supply (+B, +25V) to Q2 through pin 4 on the PCB. The basic bias for Q1 is set at a value approximating class B operation because the collector current of Q1 drops when there is no input from the V amplifier to the base of Q1.

The collector current from Q1 produces a voltage across R4; in other words, the base voltage of Q2 is determined by the Q1 input. When this input is zero, the Q2 base voltage approaches +B and Q2 is kept in conductive condition.

Capacitors C16 ~ C19 are selected by the SWEEP RANGE switch SW7 and charged by the Q2 emitter voltage, whereby the voltage across the capacitor rises in accordance with its time constant. This charging voltage is applied to the collector of Q3. As soon as its value reaches the point where Q3 becomes conductive, the capacitor is drained immediately.

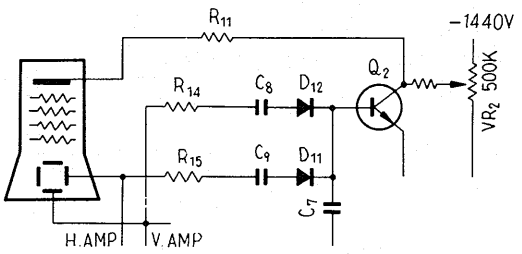


Fig. 8

This saw-tooth signal is fed to the emitter-follower circuit of Q6 through C4. The output from Q6, having very low impedance because of the emitter-follower design, is supplied to the H amplifier.

Synchronizing between V and H sweep frequencies is determined by Q1 by the following operation.

Q1 operates in a mode close to class B. Therefore, the positive half cycle of the input for Q1, which is identical with the output from the V amplifier, makes Q1 conductive. Thereby the collector current of Q1 becomes quite large, and a large voltage drop appears across R4, which causes Q2 to be turned off and the charging circuit for the timing capacitor (C16 ~ C19) to be opened.

On the other hand, the negative half cycle of the input turns Q1 off completely; Q2 becomes conductive, and charging of the timing capacitor begins as explained above.

In this operation, synchronizing is obtained by coupling the negative half cycle of the V signal to the saw-tooth oscillator. The sweep range is determined by the selection of timing capacitors by SW7, where as the SWEEP VARIABLE control varies the time constant by means of the variable resistor R9 in the timing charge circuit. C3 is called a "speed-up capacitor," its function is to obtain stability and high-speed response between Q1 and Q2 without causing a miss in synchronization.

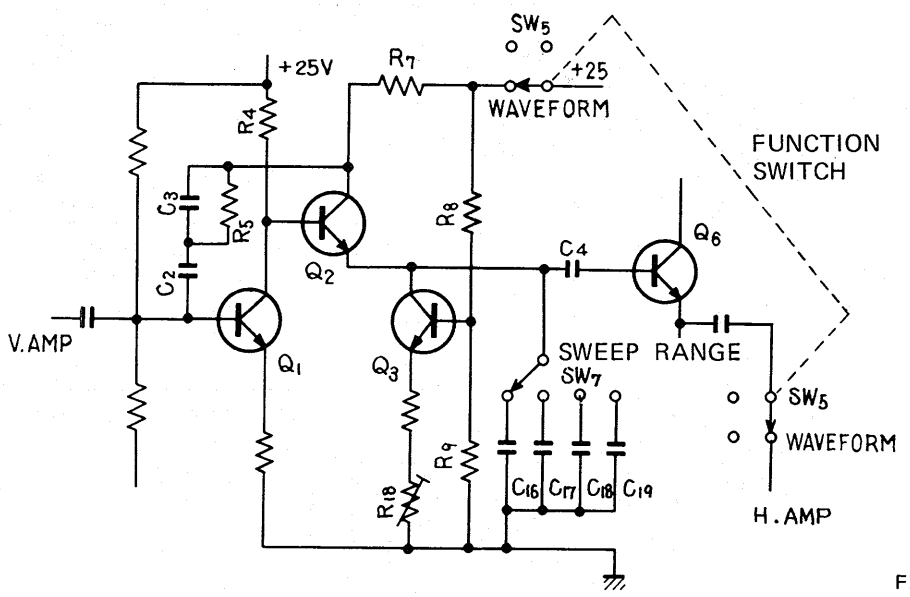


Fig. 9

6.7 AUDIO SWEEP GENERATOR

Figs. 10 and 11 show simplified circuit diagrams of the audio sweep generator. The oscillator circuits are designed as typical CR-type Wien bridge generator. Fig. 12 (A) shows the operation of the Wien bridge oscillator.
This circuit consists of a basic amplifier with positive and negative feedback loops. The oscillation frequency is determined by the CR networks in the positive feedback loop, and a change of either the resistance or capacitance values causes a variation in frequency.
Actually, the SD-1000 uses CdS elements instead of resistors in the CR networks, and the resistance values of these CdS elements are obtained by illuminating them with a pilot lamp. The DC amplifier in fig. 11 produces a varying DC current as power source for the pilot lamp. This current is also controlled by the CR charge-discharge circuits (C21, D6 and resistor elements).

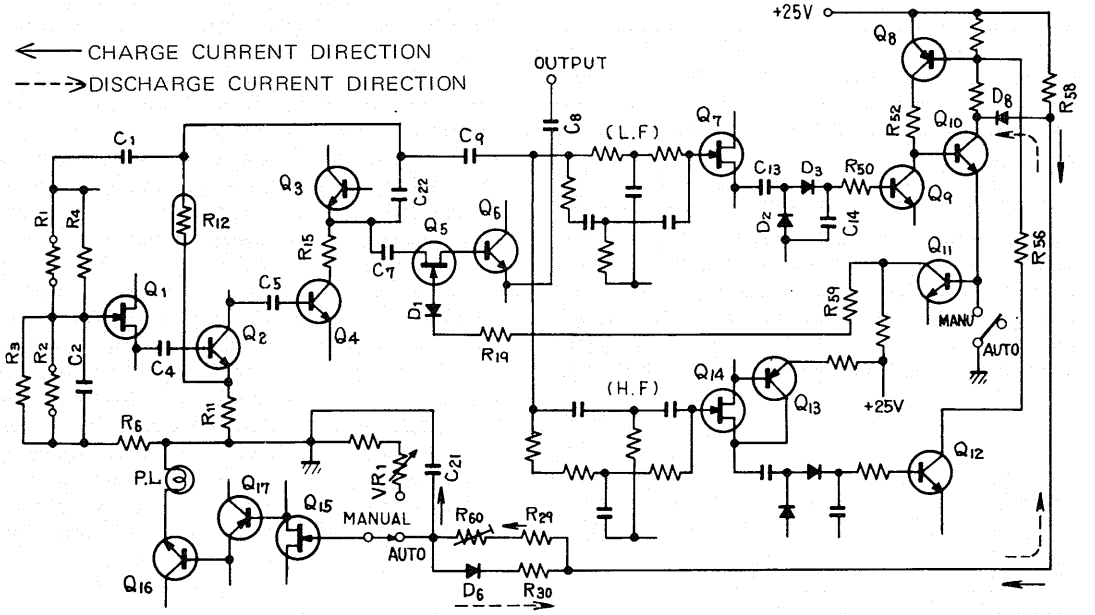


Fig. 10

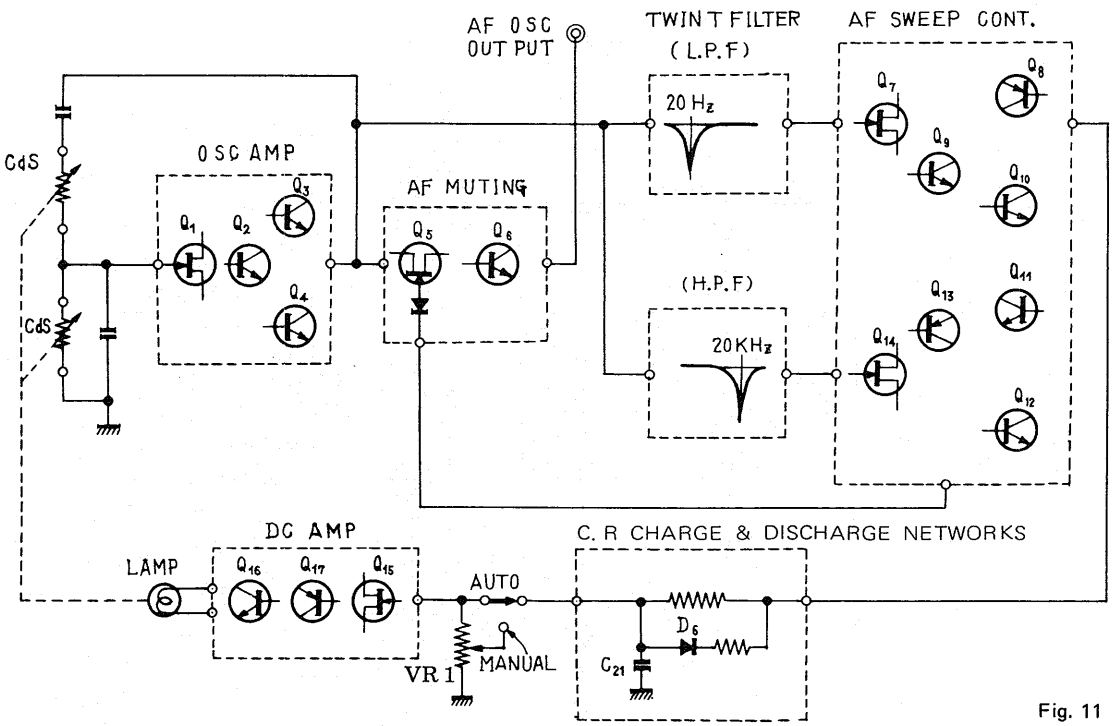


Fig. 11

When the OSCILLATOR FREQUENCY CONTROL is set at a position other than SWEEP AUTO, VR1 effects a frequency change. In position AUTO, the CR circuits perform continuous charge-discharge operation.

As the CR circuits have saw-tooth wave form characteristics, the power source for the pilot lamp and thereby the light value also change in continuous saw-tooth wave fashion. When the pilot lamp is dimmed because of low current, the oscillating frequency is low. High current and the resulting bright light of the lamp produce a high oscillating frequency.

Twin-T filters put in the gates of FETs Q7 and Q14 determine the oscillator's sweep bandwidth. When the frequency reaches 20Hz, the signal passes through the tuned 20Hz filter as a momentary pulse which passes through Q7 and D3 and applies a forward bias to Q9. In this way, Q1 and Q8 are switched off.

From this moment, the +25V +B voltage is added to C21 through R60 and R29 as shown by the solid line in fig. 13.

As the charge voltage of C21 rises, the oscillator frequency climbs to 20kHz. At the moment of 20kHz, D4 and Q12 receive a 20kHz pulse signal and Q12 is turned on. Q8 and Q10 are also on, therefore D8 and D6 become conductive. (The diodes become conductive because the collector potential of Q10 drops down.)

Thereby, a discharge circuit for C21 is formed, and one saw-tooth wave cycle is over.

Fig. 13 shows the charging path and discharging path of C21 in relation to the saw-tooth wave form.

Q11 is a kind of trigger for the output muting circuit. During charging time, Q11 is off, and the output signal is available through Q5 and Q6. During discharge, however, Q11 becomes conductive, whereby Q5 and Q6 are shut off, and no signal appears at the output. Refer to figs. 10 and 13.

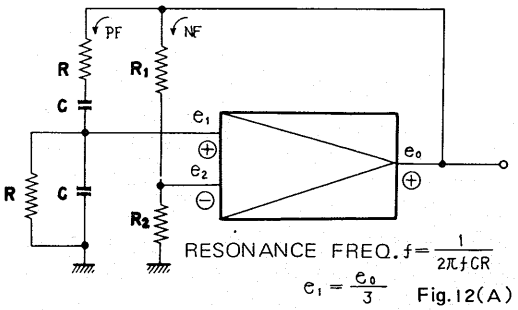


Fig.12(A)

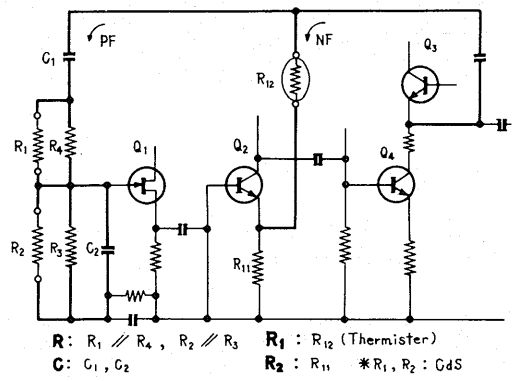


Fig.12(B)

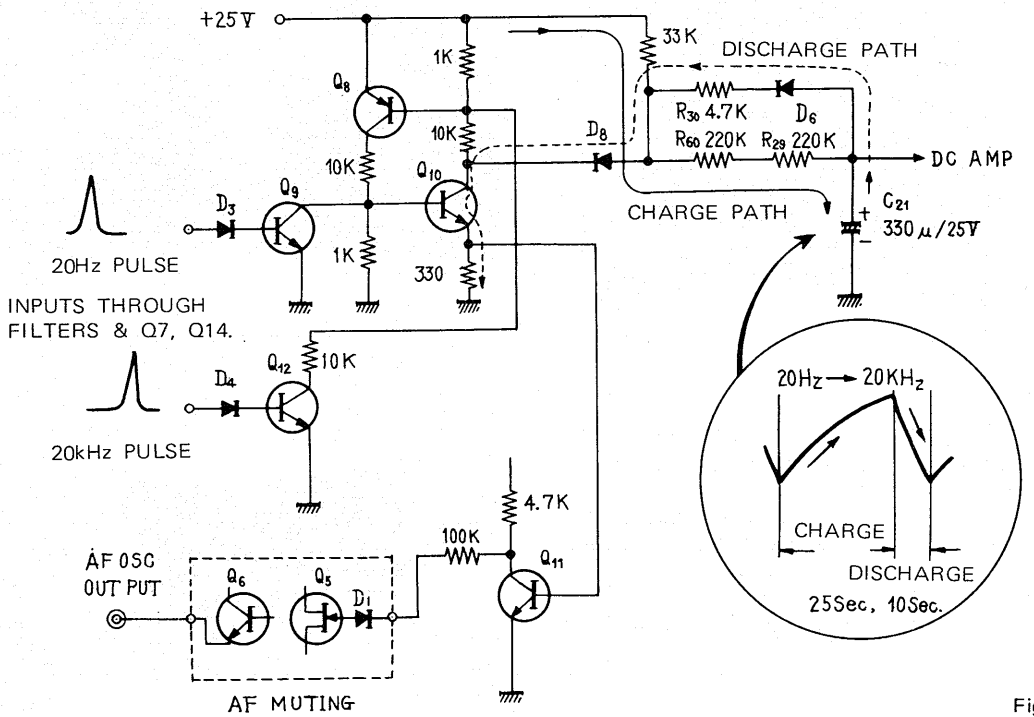


Fig. 13

7. DISASSEMBLY

7.1 WOODEN CASE

Remove the four screws from the sides of the cabinet and pull the wooden case backward and up (Photo 1).

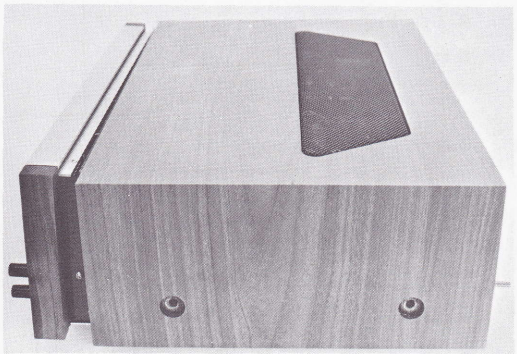


Photo 1

7.2 BOTTOM PLATE

Remove the seven screws and pull the bottom plate backward to remove it (Photo 2).

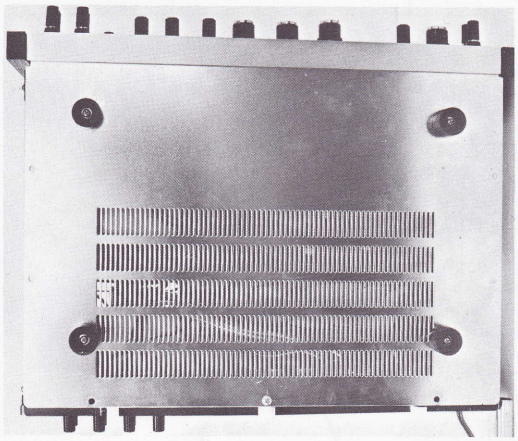


Photo 2

7.3 CRT

Hold the CRT neck firmly with one hand, then carefully disconnect the large connector from the CRT neck (Photo 3).
Remove the four screws from the sides of the shield case (Photo 4). Remove the shield case and the CRT together (Photo 5).
Loosen the CRT fastening screw and pull the CRT out of the shield case (Photos 6, 7).

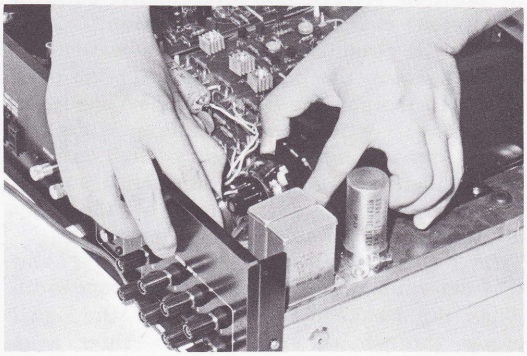


Photo 3

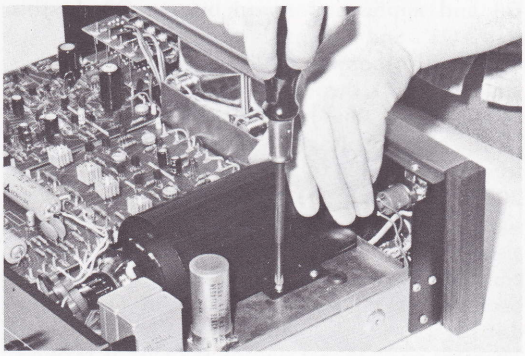


Photo 4

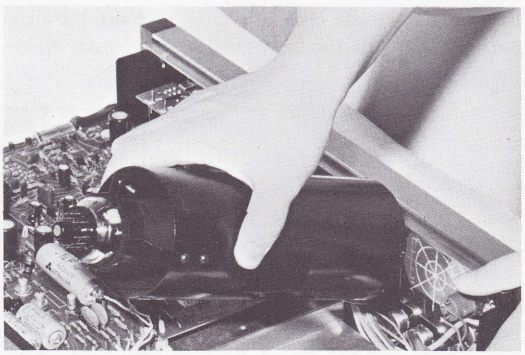


Photo 5

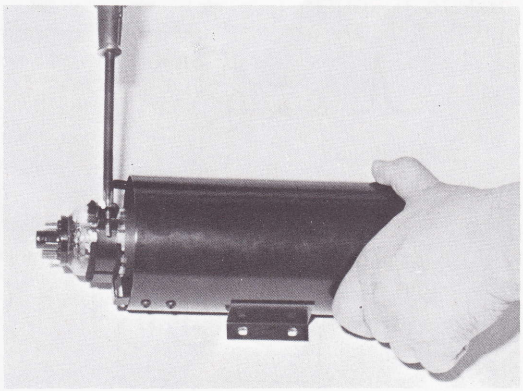


Photo 6

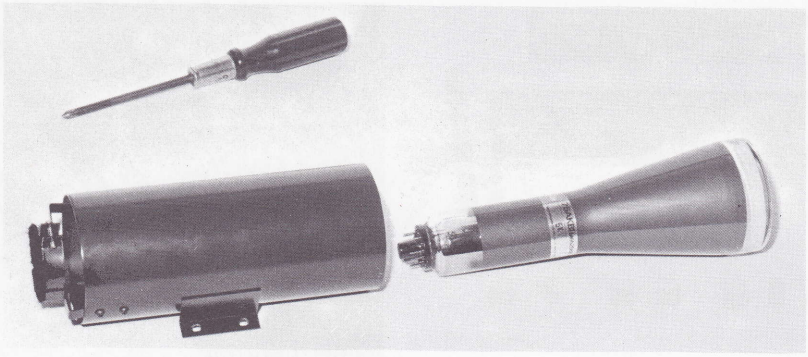


Photo 7

7.4 RE-ASSEMBLY OF CRT

When re-installing the CRT in the shield case, do not tighten the fastening screw too firmly. Then re-connect the cluster connector to the CRT neck, and finally install the shield case and tube in the chassis (Photo 8).
Turn the POWER SWITCH on. Turn the CRT so that it aligns perfectly with the axis of the scale screen (Photo 9).
Then tighten the fastening screw holding the CRT in the shield case.

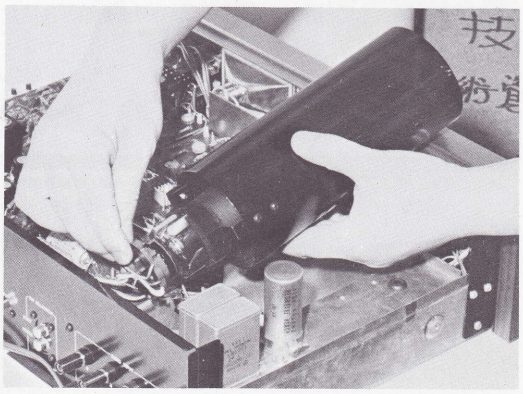


Photo 8

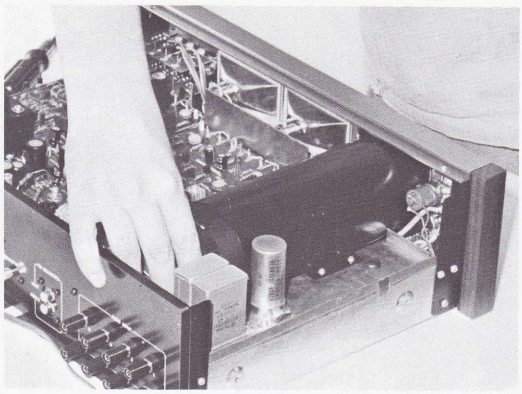


Photo 9

CAUTION: DON'T TOUCH THE CRT SOCKET PIN.
Be careful when turning the CRT; voltages as high as 1,500 volts are present.

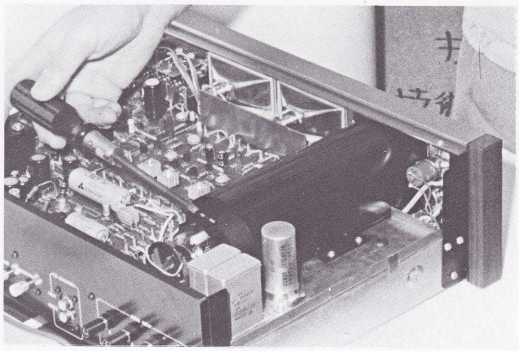


Photo 10

7.5 FRONT PANEL

A soldering iron is required. Unsolder leads from OSC OUT, INPUT 1 & 2 terminals (Photo 11).
Remove all knobs by pulling them off their shafts.
Remove the nuts from the control knob shafts.
Remove the two screws in the front corners (Photo 12). The front panel can now be taken off (Photo 14).
Photo 15 shows the inner side of the front panel.

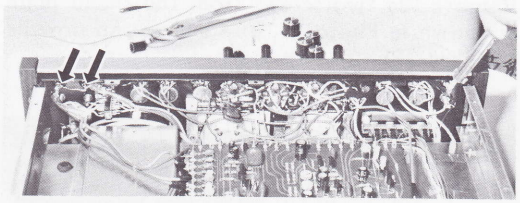


Photo 11

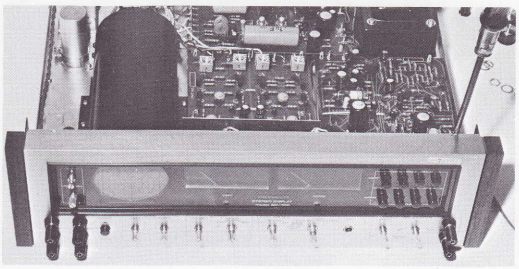


Photo 12

Photo 13

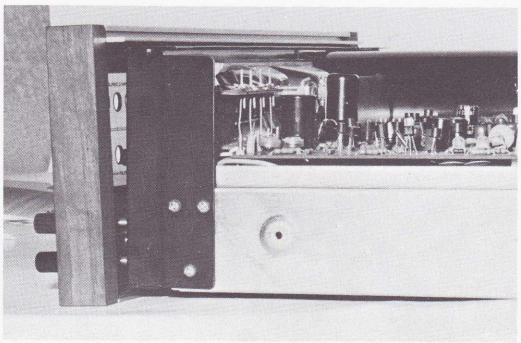


Photo 14

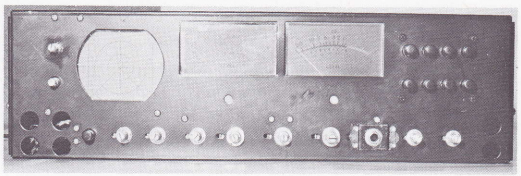


Photo 15

7.6 LEVEL METERS

Remove the front panel as explained above. Remove two screws as shown in Photo 16. Remove the two screws from the shield plate as shown in Photo 17. The meters can now be removed (Photo 18).

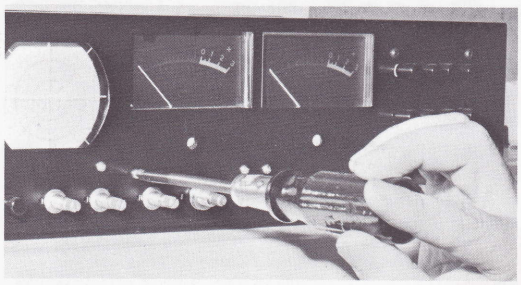


Photo 16

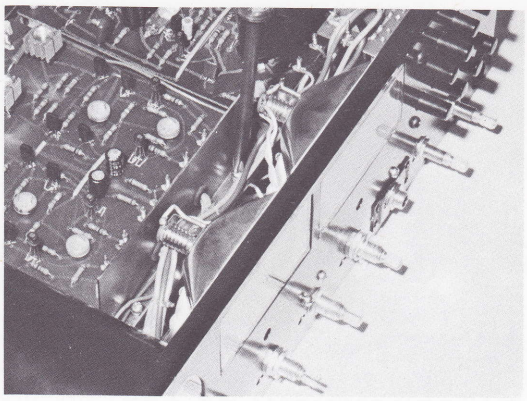


Photo 17

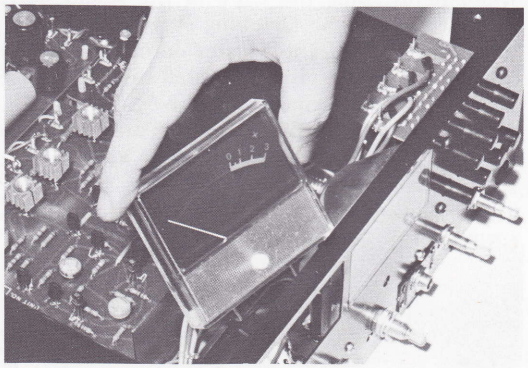


Photo 18

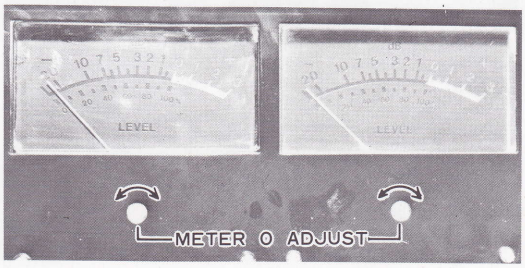


Photo 19

8. ALIGNMENT PROCEDURE

8.1 ZERO AXIS POSITION

1. Set both VERT. and HORIZ. POSITION controls to center position.
2. Adjust R27 on V amp PCB to obtain 0V between terminals 8 and 9 (Photo 20).
3. Turn R21 on H amplifier PCB to obtain 0V between terminals 5 and 6.

8.2 AMPLITUDE SENSITIVITY ADJUSTMENT (Photo 20)

V. AMPLIFIER

1. Apply a 28mV rms 1kHz sine wave signal to INPUT 1 (marked VERTICAL) on front panel.
2. Turn VERTICAL GAIN control to maximum, HORIZONTAL GAIN control to minimum.
3. Adjust R31 on V amp PCB to obtain a straight line of 40mm length.
4. Adjust R21 (horizontal position) and R27 (vertical position) so that line is centered as shown in fig. 14.

H. AMPLIFIER

1. Apply same input signal as described in "V. AMPLIFIER"to INPUT 2 (marked HORIZONTAL) on front panel.
2. Turn VERTICAL GAIN control to minimum, HORIZONTAL GAIN control to maximum.
3. Adjust R22 to obtain a 40mm long line.
4. Adjust R21 and R27 so that line is centered as shown in fig. 15.

FINAL CHECKS

1. Apply input signal as mentioned above to INPUT 2. Turn both HORIZONTAL and VERTICAL GAIN controls to maximum.
2. Line should be as shown in fig. 16.
3. If necessary, adjust R31 and R22 to obtain line as shown.

8.3 METER CALIBRATION (Photo 21)

1. Apply a 1kHz 2V (rms) signal to INPUTS 1 and 2 (on front panel).
2. Set LEVEL METER switch at position 0dB.
3. Adjust R13 (vert.) and R22 (horiz.) so that both meters indicate 0dB.

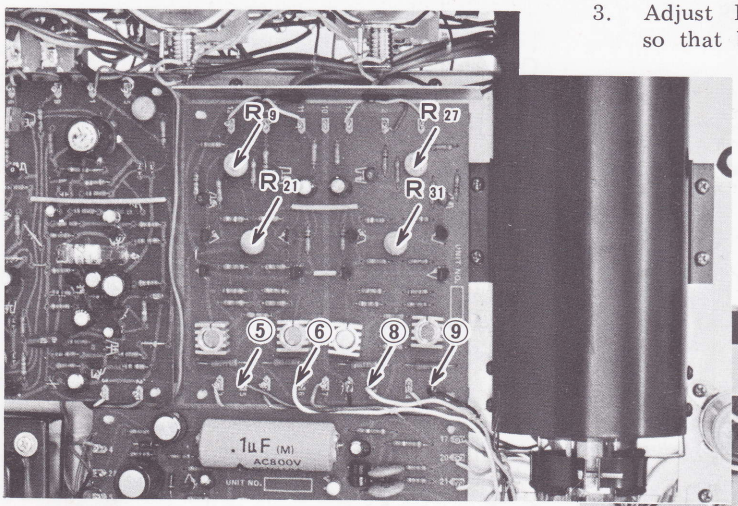


Photo 20

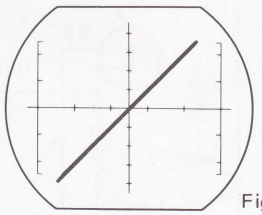


Fig. 16

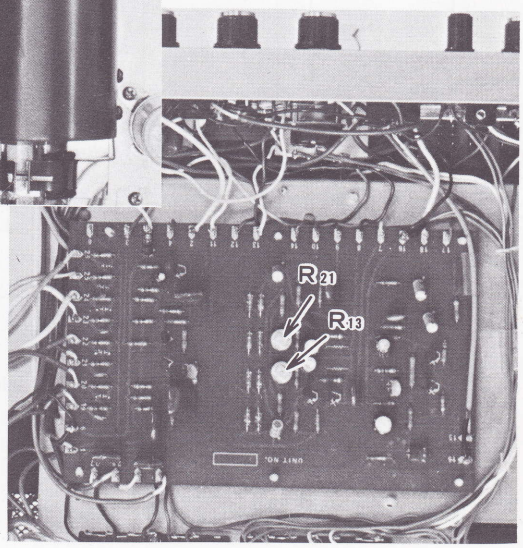


Photo 21

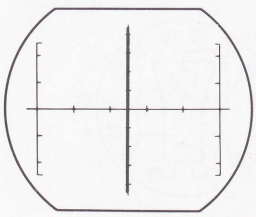


Fig. 14

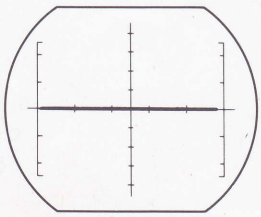
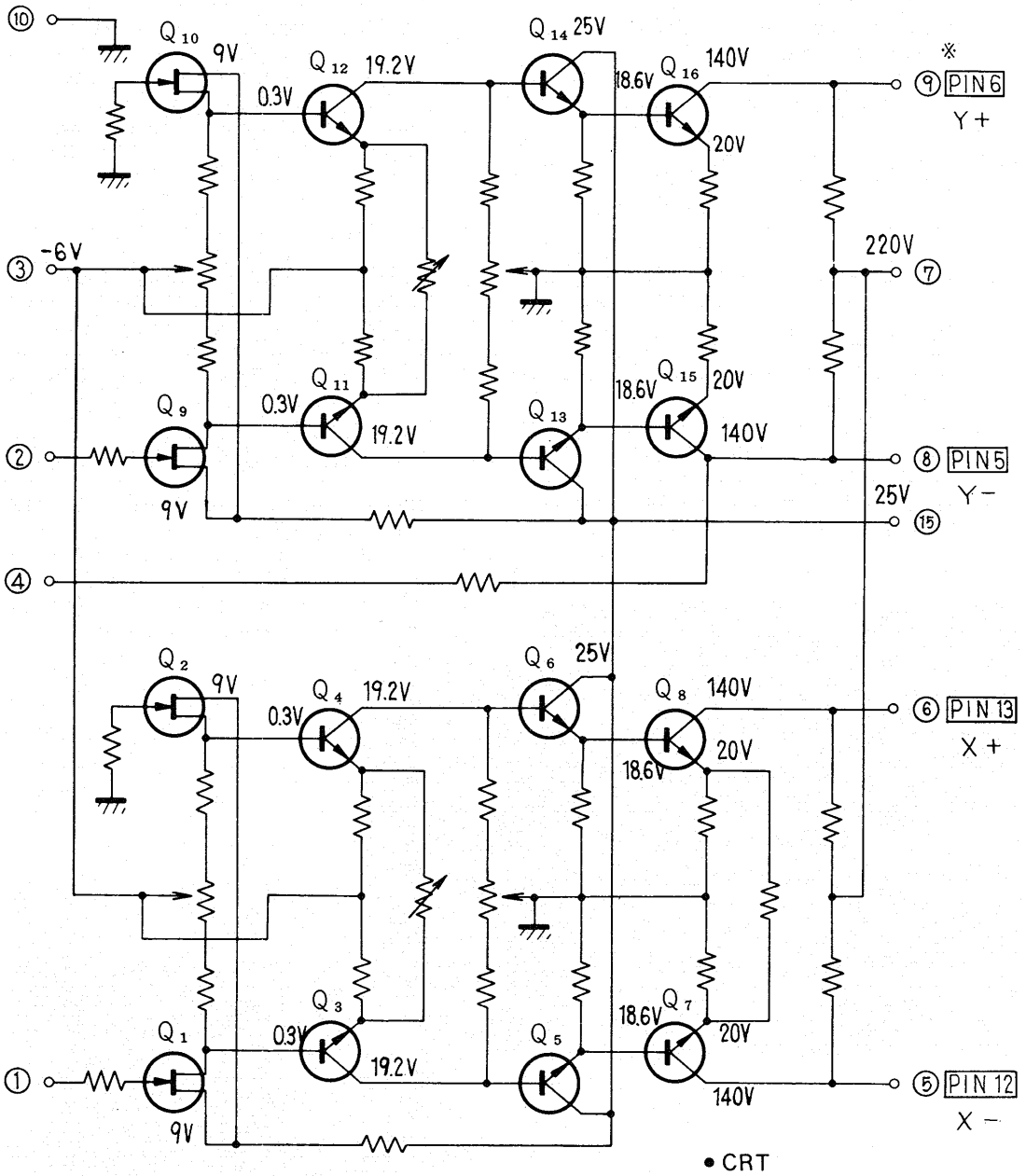


Fig. 15

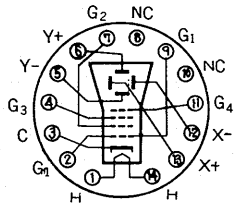
9. DC VOLTAGE CHARTS

9.1 V & H AMPLIFIERS

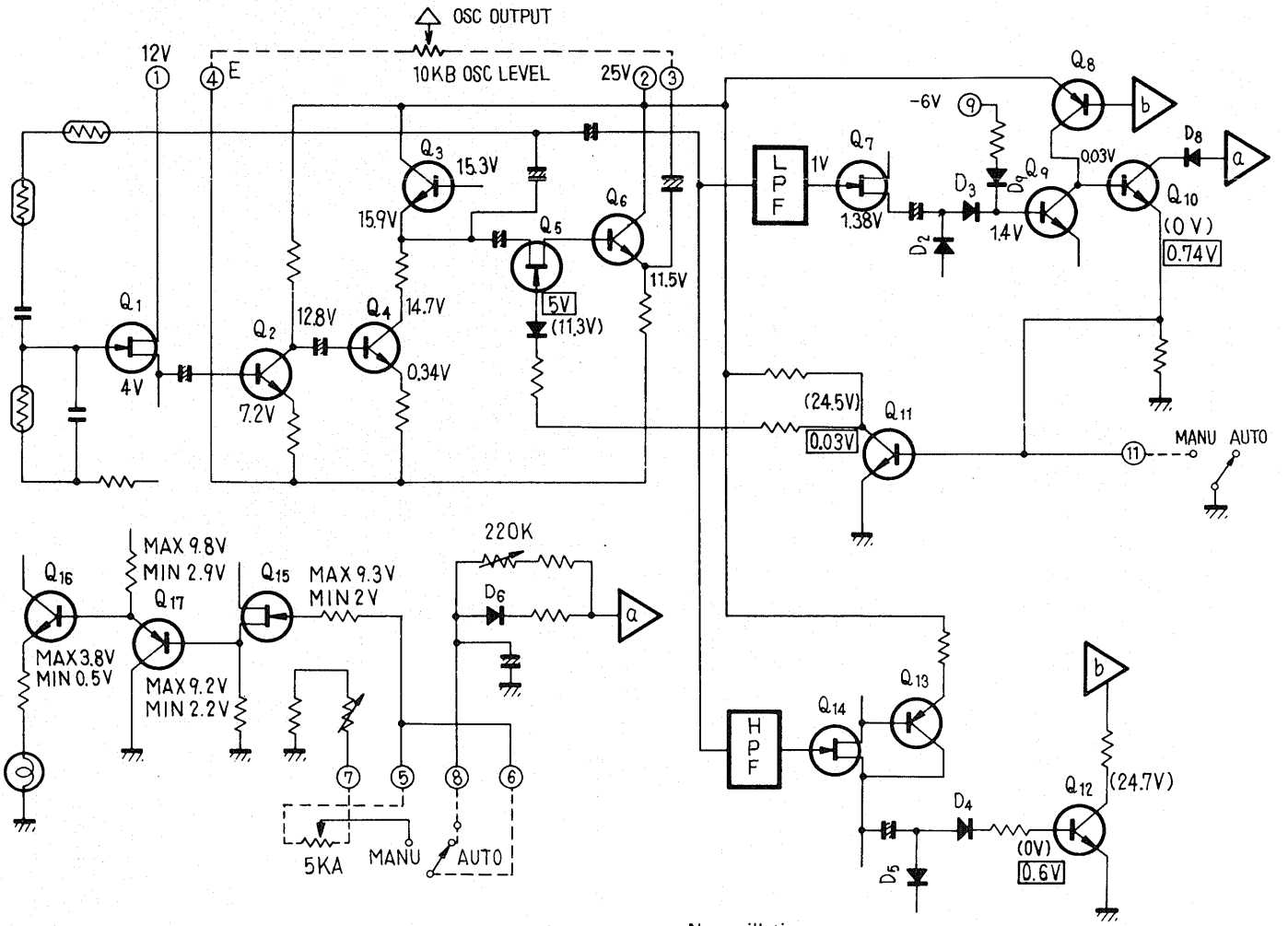


※ Figures in ▭ indicate number of CRT pin.

• CRT



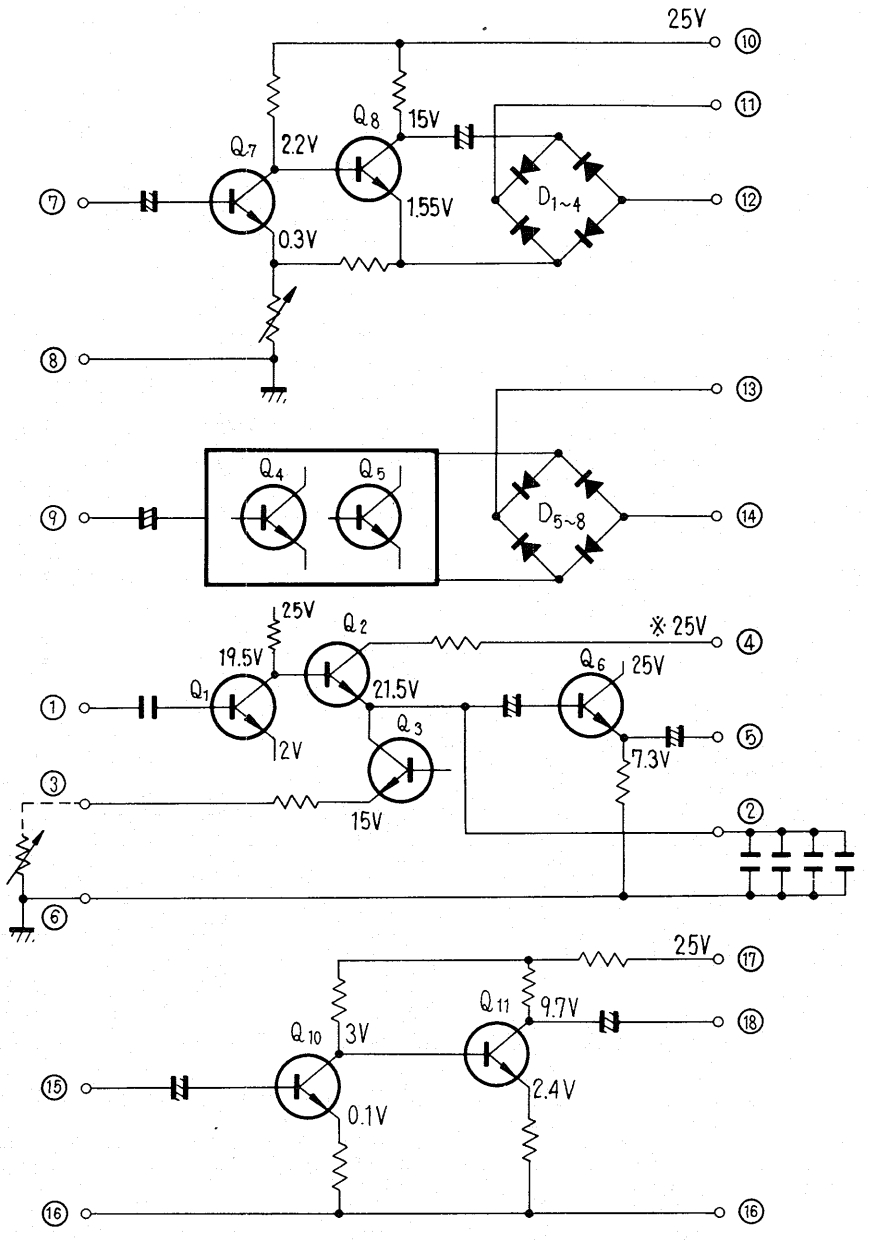
M6525BIB



NOTES: Max. values apply to highest frequency oscillation.
Min. values apply to lowest frequency oscillation.

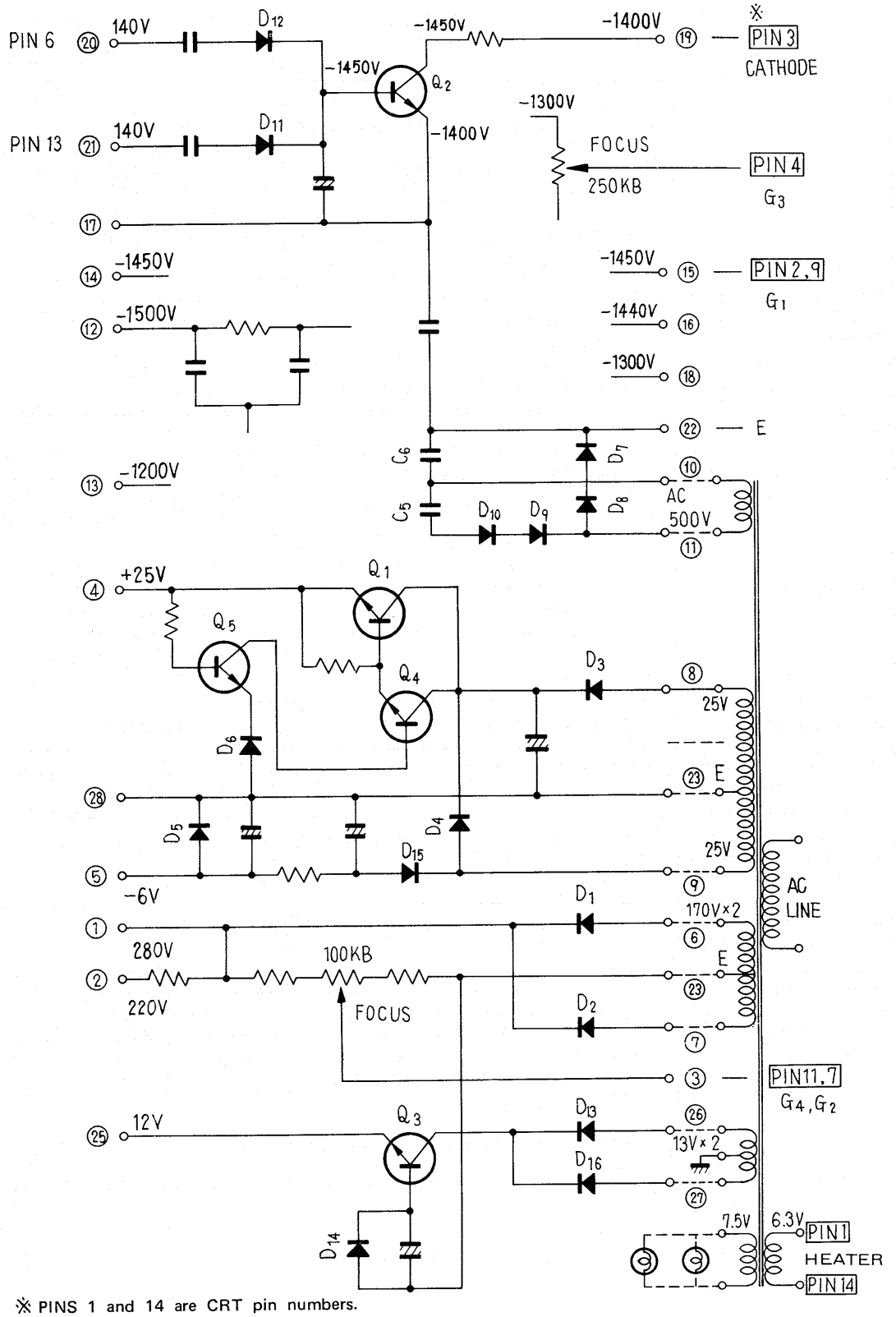
No oscillation
Irrespective of operation mode
( ) Oscillation

9.3 METER AMPLIFIER



※ This voltage appears only when the FUNCTION SELECTOR is in position WAVEFORM. Other voltages may differ considerably.

9.4 POWER SUPPLY



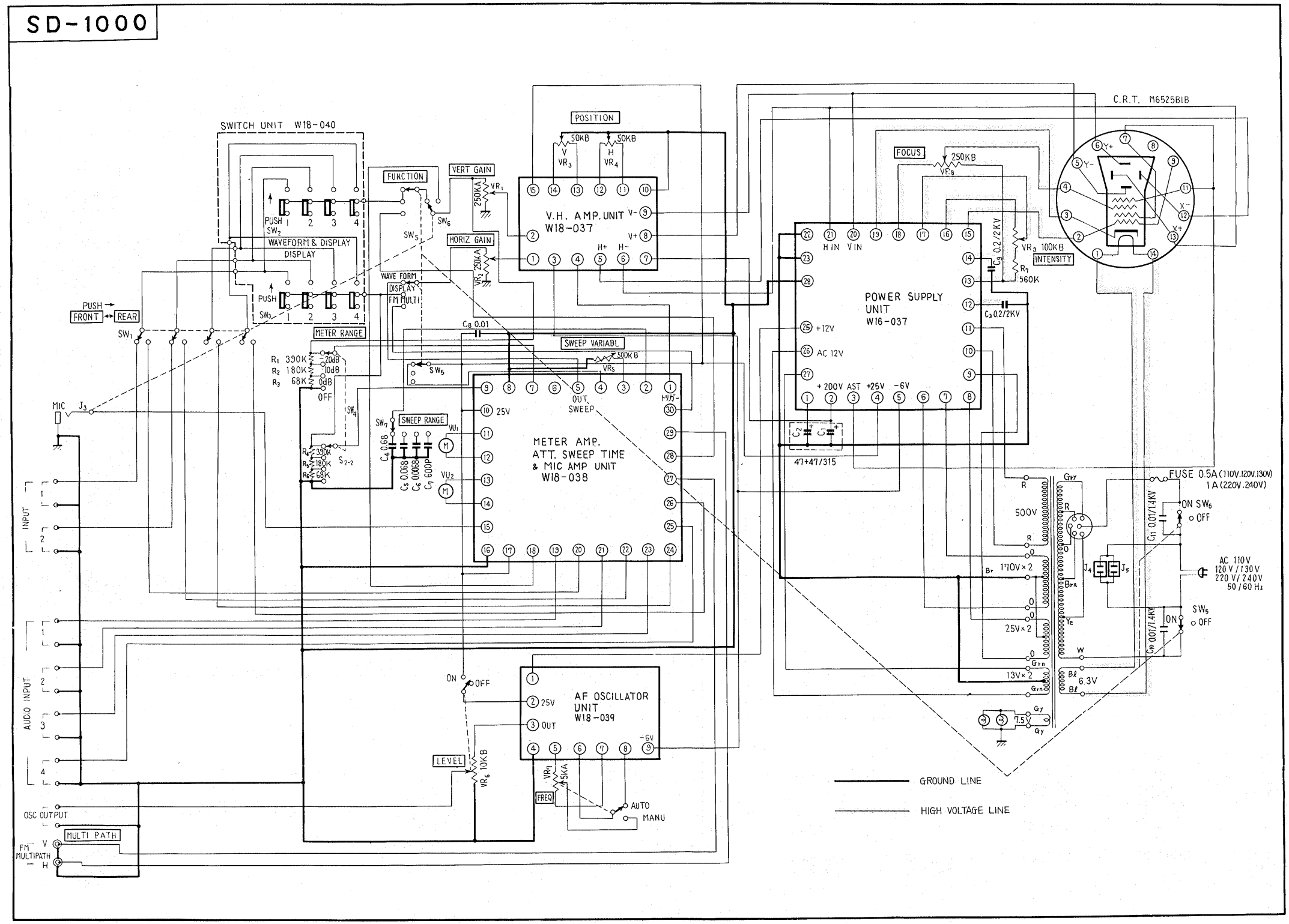
※ PINS 1 and 14 are CRT pin numbers.

10. TROUBLESHOOTING CHART

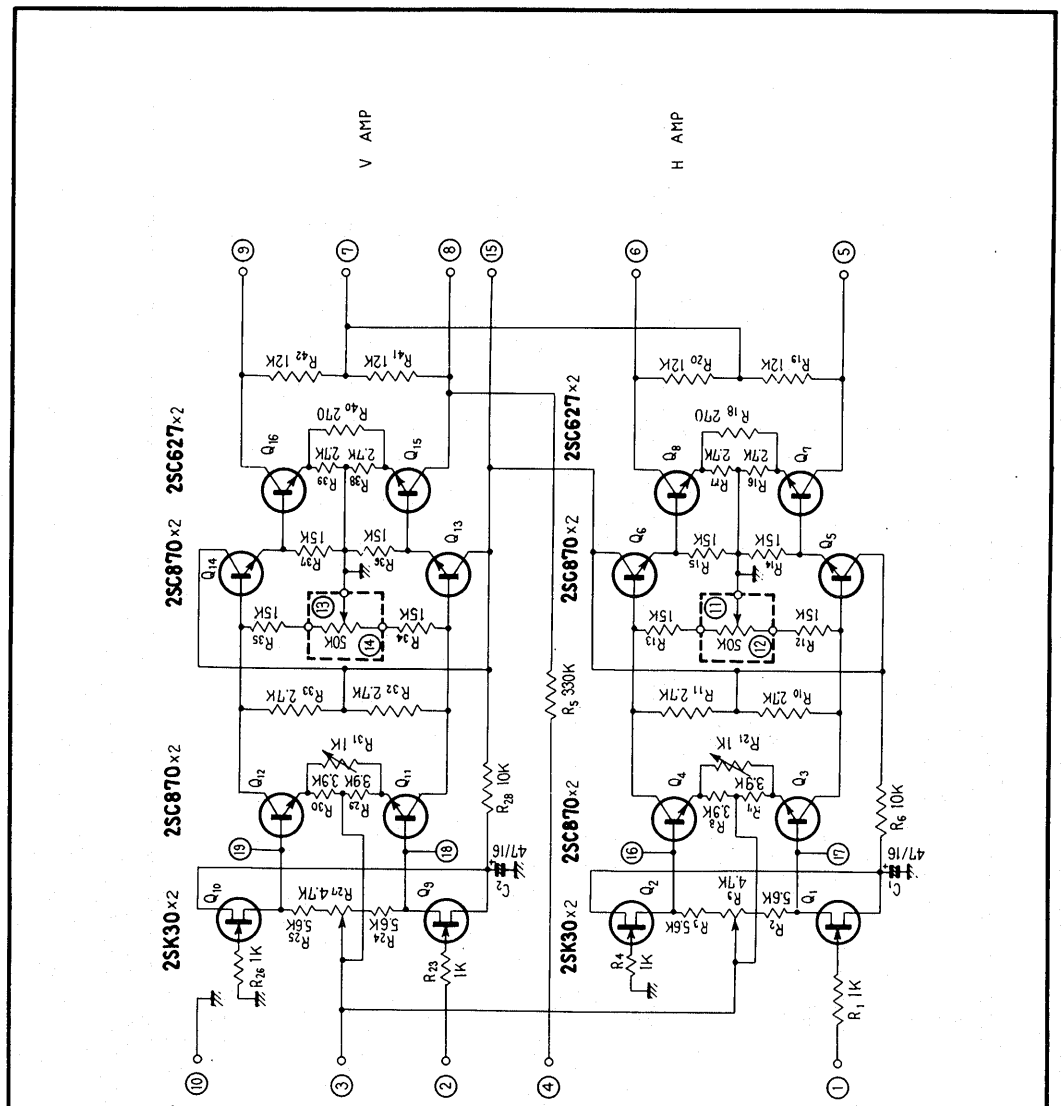
Trouble	Suspected cause	Remedy
No oscilloscope beam line.	a. Faulty setting of vertical, horizontal position knobs. b. Intensity control (on rear panel) set to MIN. c. Defective transistors in V-H-amplifiers. d. Misalignment of R21, R27 in V-H-amplifiers. e. Saw-tooth oscillator for horiz. sweep not operating.	a. Set at approx. center. b. Turn up. c. Replace transistors. Replace HFE and IDSS in pairs. d. Re-align, calibrate. e. Check saw-tooth wave oscillator with scope.
No beam line at a certain scope sweep frequency setting.	a. Defective charging capacitor in that switch position. b. Poor switch contact.	a. Replace capacitor. b. Replace switch.
No spot pattern.	a. Intensity control set to minimum. b. Faulty threshold level of spot killer.	a. Turn up. b. Re-adjust VR2 in power supply unit.
Spots of under 10mm height appear.	a. Spot killer ineffective. b. Q2 in power supply unit defective.	a. Re-adjust VR2 in power supply unit. b. Replace Q2, then re-adjust VR2.
Not in focus.	a. VR1 in power supply unit misadjusted. b. Poor contact at CRT socket. c. Intensity control turned up too far.	a. Re-adjust VR1. b. Check and secure CRT socket connection. c. Turn down as far as necessary.
Slanted beam line.	CRT twisted out of position.	Re-adjust CRT position.
Distorted pattern from clean sine wave input.	Excessive input to vert. amp.	a. Try input on rear panel. b. Reduce input level.
Unstable pattern when observing audio sweep oscillation.	Defective CdS element in AF oscillator unit.	Replace.
Varying sweep times in AUTO SWEEP operation.	R60 in AF oscillator circuit misaligned.	Re-adjust R60.
AF oscillator does not cover 20~20,000Hz band.	a. If lower end does not reach 20Hz, R28 in AF oscillator unit is misadjusted. b. If high end does not reach 20kHz, R63 in AF oscillator unit is misadjusted. c. Defective CdS element in AF oscillator unit.	a. Re-adjust R28. b. Re-adjust R63 to 1.2~1.8k c. Replace.

11. SCHEMATIC DIAGRAMS AND PCB PATTERNS

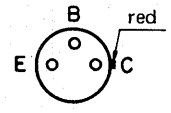
11.1 UNIT CONNECTION DIAGRAM



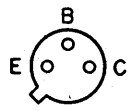
11.2 V & H AMPLIFIER UNIT (W18-037)



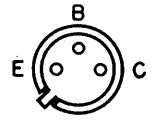
• TRANSISTOR



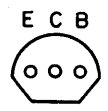
2SC281
2SC284



2SC627

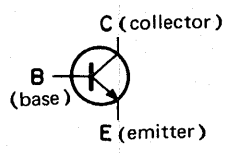


2SC627



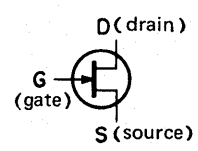
2SC870
2SC871

2SA561P
2SC734

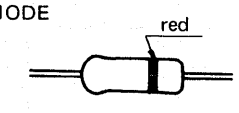


• FET

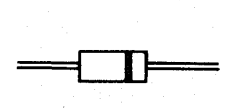
2SK30



• DIODE

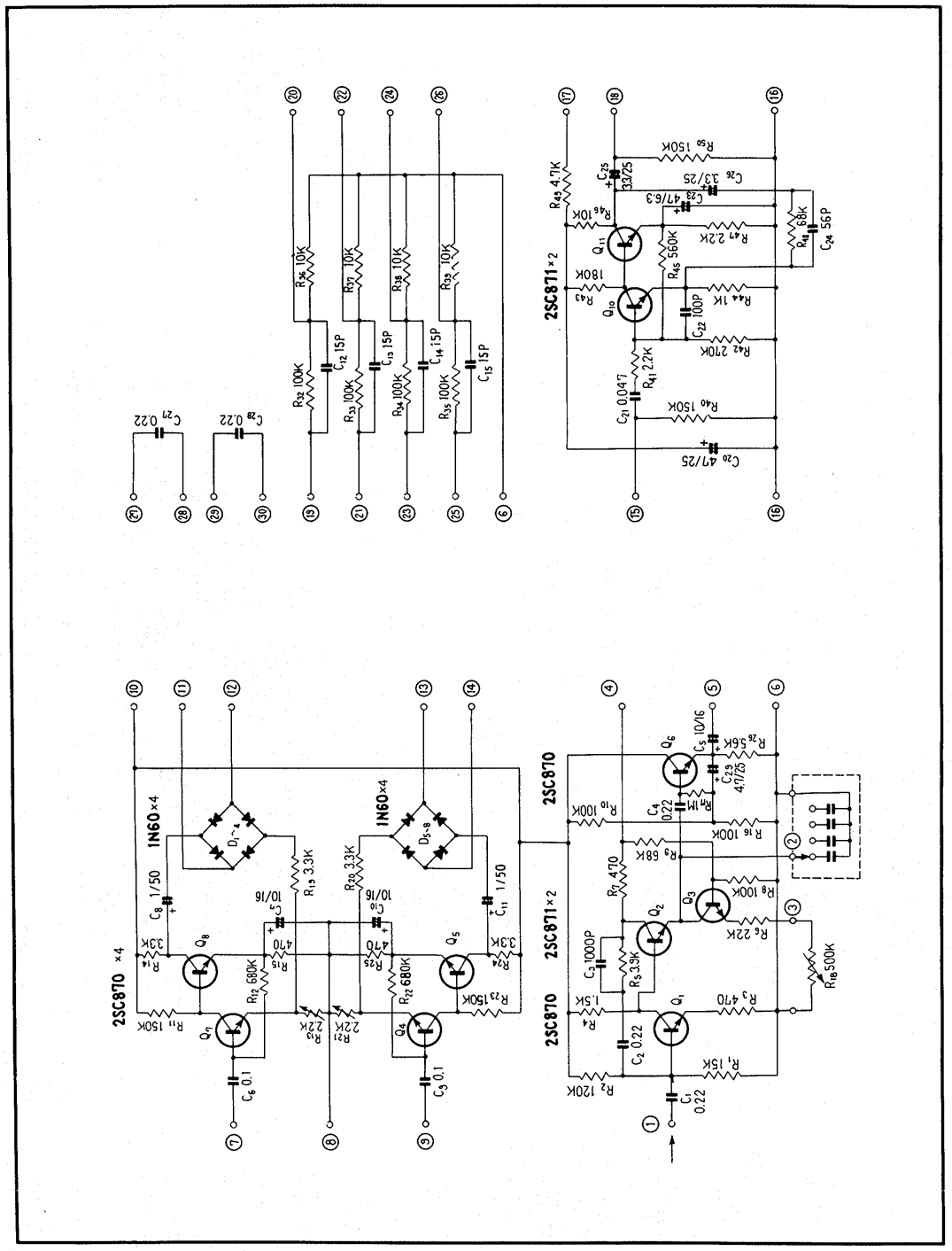


IN60

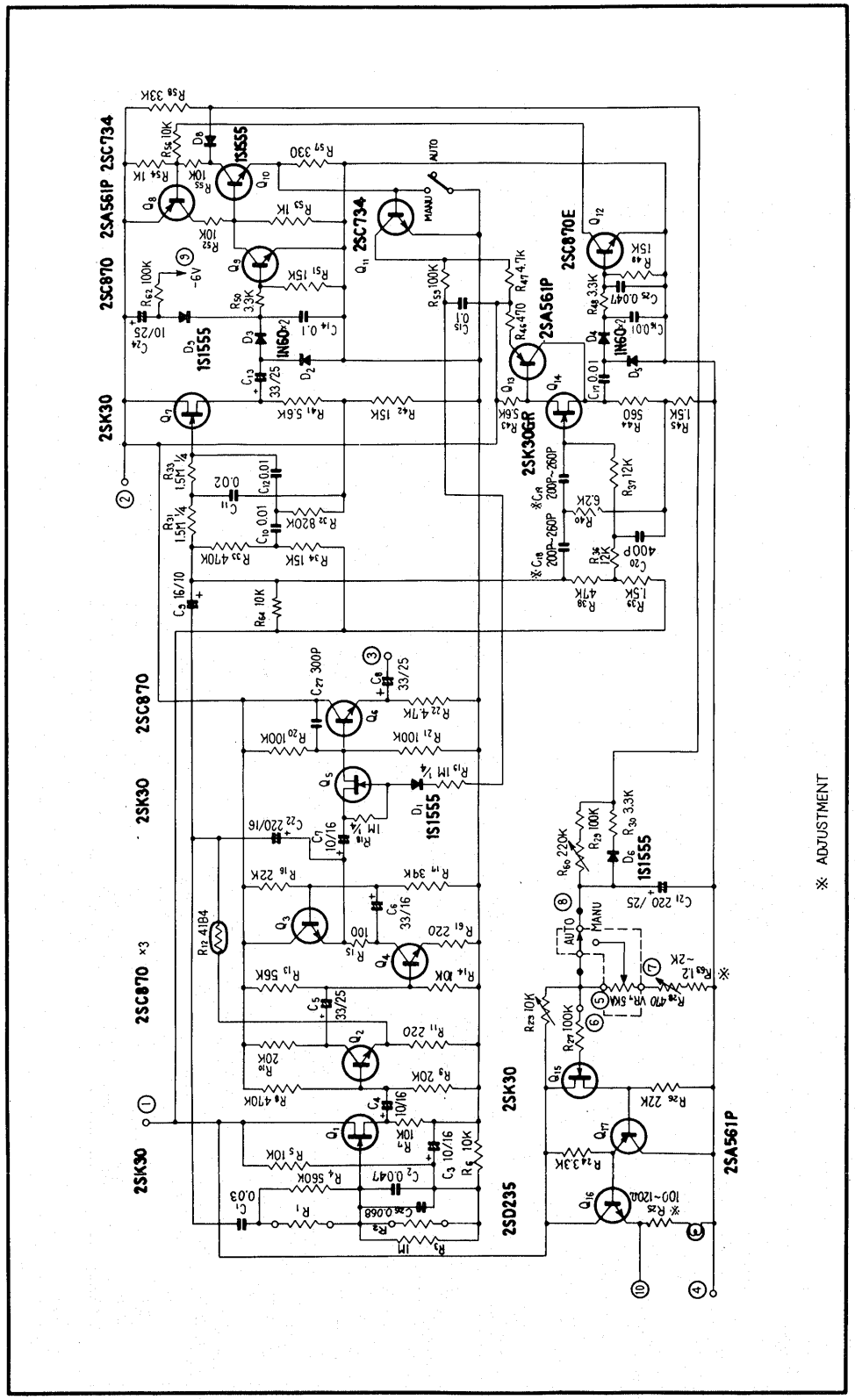


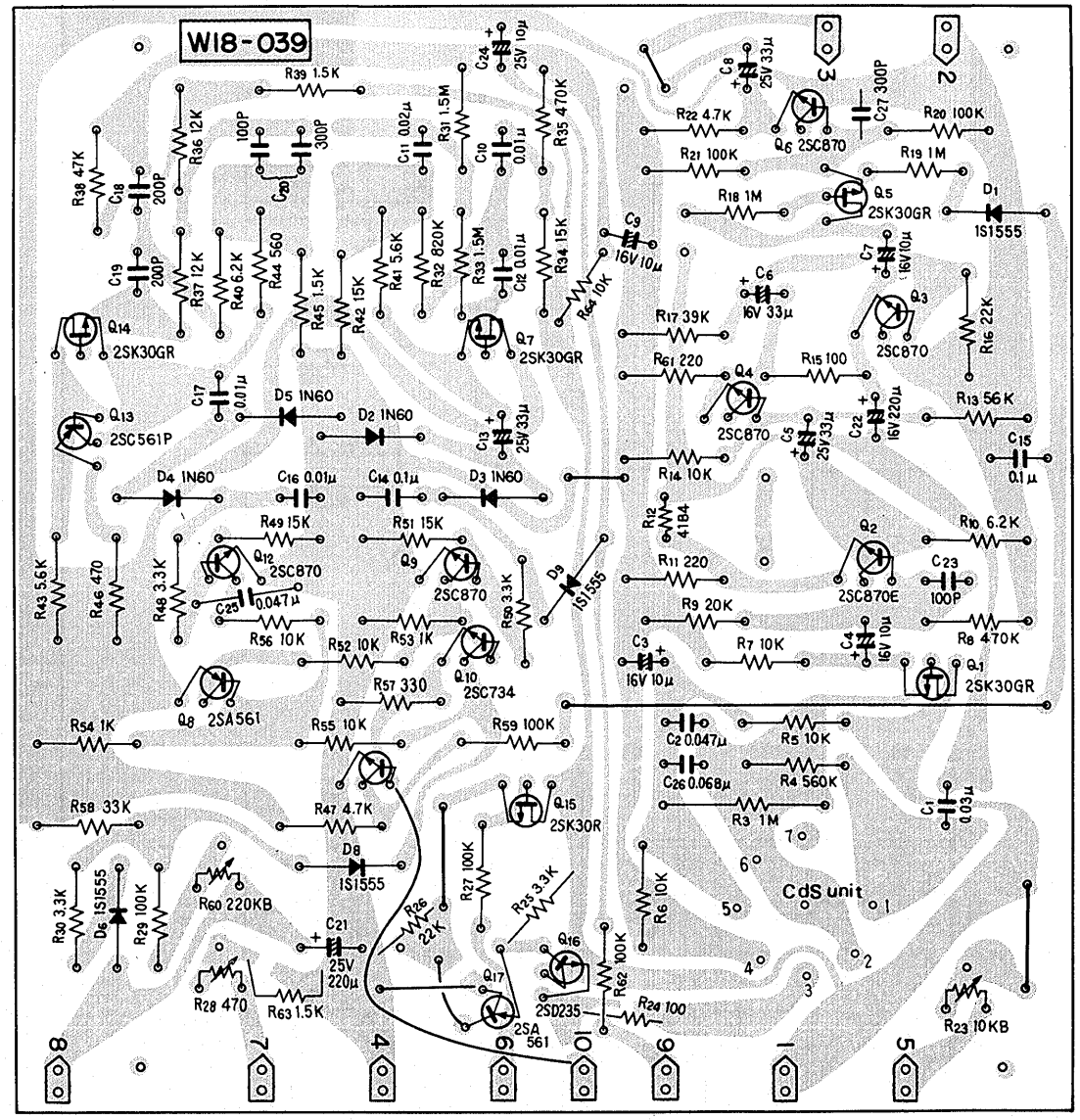
1S1555

11.3 METER & MICROPHONE AMPLIFIER UNIT (W18-038)

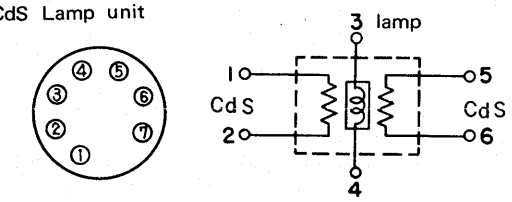


11.4 AUDIO SWEEP GENERATOR UNIT (W18-039)



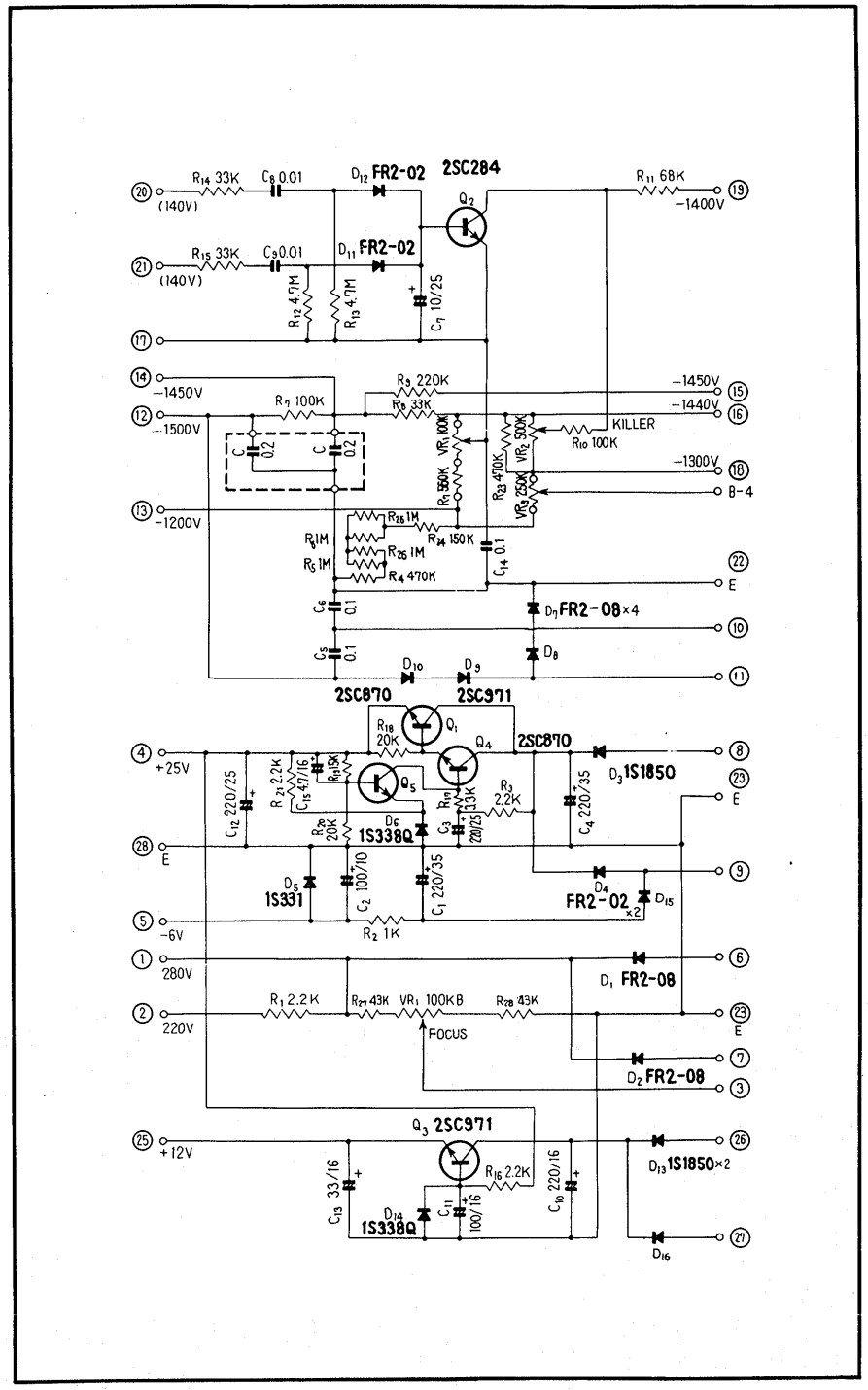


• CdS Lamp unit



• Voltage for lamp DC 5V
• Current for lamp DC 60mA ± 10mA

11.5 POWER SUPPLY UNIT (W16-037)



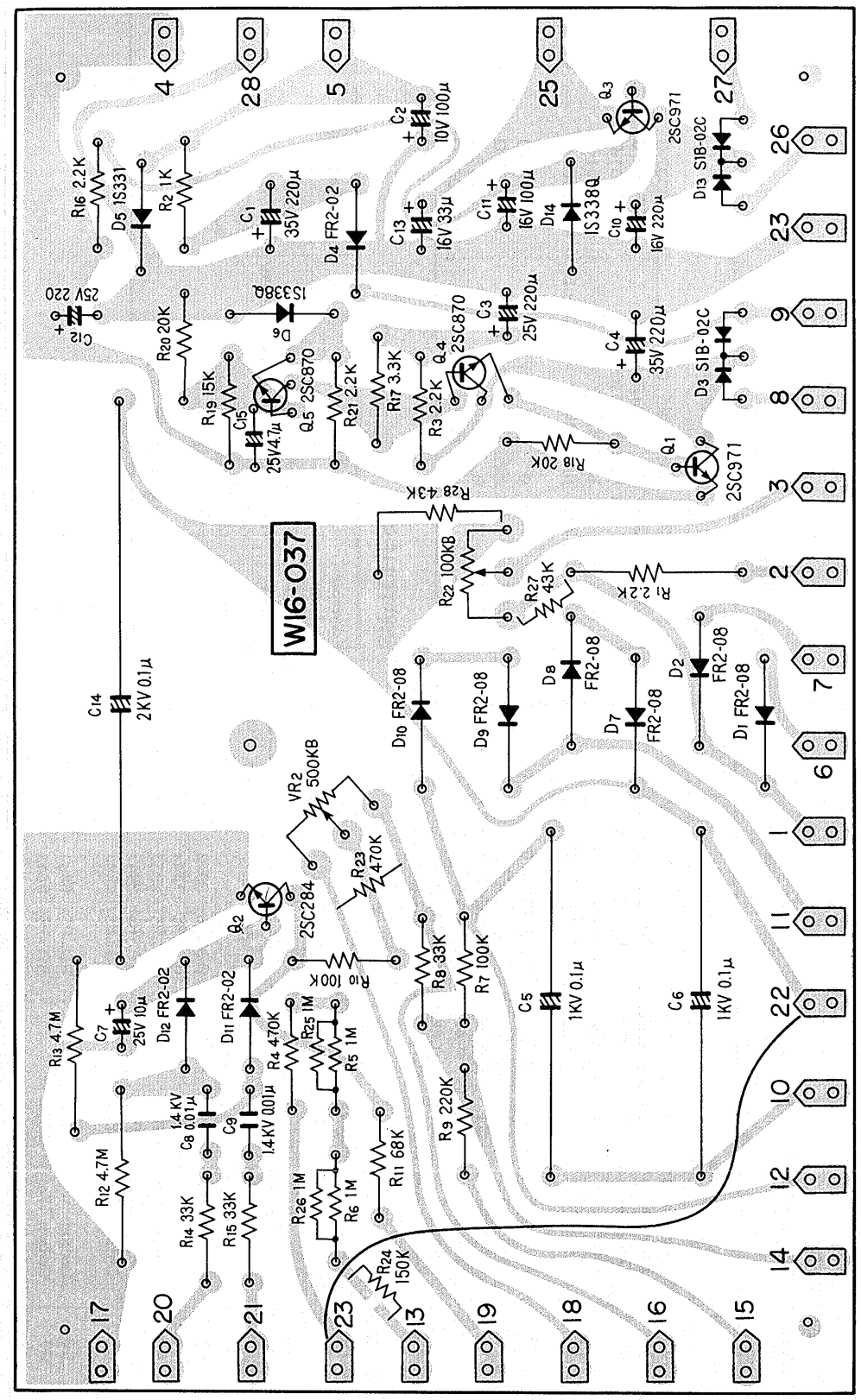
white

1S338Q · 1S331

red

FR—2

1S1850



12. PARTS LIST

12.1 MISCELLANEOUS PARTS

CAPACITORS

IN μF, UNLESS OTHERWISE NOTED p: μμF

Symbol	Description	Part No.	
C1	Electrolytic 40 + 40 315V	CMLG 40 + 40MF 315V	
C2	Electrolytic 40 + 40 315V	CMLG 40 + 40MF 315V	
C3	Oil paper 0.2 1.5kV	CPB 204M 1500	
C4	Mylar 0.68 50V	CQMA684K 50	
C5	Mylar 0.068 50V	CQMA683K 50	
C6	Mylar 0.0068 50V	CQMA682K 50	
C7	Ceramic 600p 50V	CKDYB601K50	
C9	Oil paper 0.2 1.5kV	CPB 204M 1500	
C10	Ceramic 0.01 1.4kV	C43-003-O	
C11	Ceramic 0.01 1.4kV	C43-003-O	

RESISTORS

IN OHM ¼W UNLESS OTHERWISE NOTED
k: kΩ, M: MΩ

Symbol	Description	Part No.	
R1	Carbon film 390k	RD¼PS 394J	
R2	Carbon film 180k	RD¼PS 184J	
R3	Carbon film 68k	RD¼PS 683J	
R4	Carbon film 390k	RD¼PS 394J	
R5	Carbon film 180k	RD¼PS 184J	
R6	Carbon film 68k	RD¼PS 683J	
R7	Carbon film 560k	RD¼PS 564J	

POTENTIOMETERS

Symbol	Description	Part No.	
VR1	250k A2, VERT GAIN	ACT-002-O	
VR2	250k A2, HORIZ GAIN	ACT-002-O	
VR3	50k B, POSITION	ACT-001-O	
VR4	50k B, POSITION	ACT-001-O	
VR5	500k B, SWEEP VARIABLE	ACT-003-O	
VR6	10k B, OSC LEVEL	ACT-502-O	
VR7	5k A2, FREQUENCY	ACT-501-O	
VR8	250k B, FOCUS	ACV-003-O	
VR9	1M B, INTENSITY	ACV-002-O	

SWITCHES

Symbol	Description	Part No.	
SW1	FRONT-REAR Selector	ASG-001-O	
SW2	WAVEFORM & DISPLAY selector	ASG-002-O	
SW3	DISPLAY switch	ASG-002-O	
SW4	METER RANGE selector	ASC-004-O	
SW5	FUNCTION Switch	ASA-004-O	
SW7	SWEEP RANGE selector	ASC-004-O	

OTHERS

Symbol	Description	Part No.	
	Wooden case	M52-139-O	
	Front panel Ass'y	ANB-049-O	
	Foot	M61-017-O	
	Level meter	A91-019-O	
	Knob (without marking)	A12-204-A	
	Knob (small, with marking)	A12-237-A	
	Knob (large, with marking)	A12-631-O	
	Knob (push switch)	A19-077-O	
	Dial scale	AAG-018-O	
	Pin jack (2P)	K21-009-O	
	Ganged AC outlets	K82-014-O	
	Fuse holder	K91-009-A	
	Line voltage selector	S11-018-O	
	Power transformer	ATT-008-A	
	Power cord W. UL plug	D11-003-B	
	Terminal A	AKE-002-O	
	Terminal B	AKE-003-O	
J3, SW6	Mic jack	K72-020-O	
	Socket (CRT)	AKG-001-O	
	Socket (pilot lamp)	K41-002-B	
	Fuse, 1A	E21-004-O	
	CRT	M6525-B1B	
	Pilot lamp (screwed), 8V 150mA	E22-002-O	
	Fuse 1A	E21-004-A	
	Fuse 0.5A	E21-007-O	
	Cord W. pin plug (Red)	D51-004-B	
	Cord W. pin plug (White)	D51-003-B	
	Cord W. plug	ADE-001-O	
	Vinyl bag	E11-034-A	
	Operating instructions	ARB-001-O	
	V & H amplifier unit	W18-037-O	
	Meter & Mic amplifier unit	W18-038-A	
	Audio sweep unit	W18-039-O	
	Power supply unit	W16-037-O	
	Switch unit	W18-040-O	

12.2 V & H AMPLIFIER UNIT (W18-037)

SEMICONDUCTORS & CAPACITORS

Symbol	Description			Part No.				
Q1	FET	2SK30GR						
Q2	FET	2SK30GR						
Q3	Transistor	2SC870E						
Q4	Transistor	2SC870E						
Q5	Transistor	2SC870E						
Q6	Transistor	2SC870E						
Q7	Transistor	2SC627-2						
Q8	Transistor	2SC627-2						
Q9	FET	2SK30GR						
Q10	FET	2SK30GR						
Q11	Transistor	2SC870E						
Q12	Transistor	2SC870E						
Q13	Transistor	2SC870E						
Q14	Transistor	2SC870E						
Q15	Transistor	2SC627-2						
Q16	Transistor	2SC627-2						
C1	Electrolytic	47	16V	CEA	470P	16		
C2	Electrolytic	47	16V	CEA	470P	16		

RESISTORS

Symbol	Description	Part No.	
R1	Carbon film 1k ±5%	RD¼PS 102J	
R2	Carbon film 5.6k ±5%	RD¼PS 562J	
R3	Carbon film 5.6k ±5%	RD¼PS 562J	
R4	Carbon film 1k ±5%	RD¼PS 102J	
R5	Carbon film 330k ±5%	RD¼PS 334J	
R6	Carbon film 10k ±5%	RD¼PS 103J	
R7	Carbon film 3.9k ±5%	RD¼PS 392J	
R8	Carbon film 3.9k ±5%	RD¼PS 392J	
R9	Semi-fixed 4.7k	SR19R 4.7K	
R10	Carbon film 2.7k ±5%	RD¼PS 272J	
R11	Carbon film 2.7k ±5%	RD¼PS 272J	
R12	Carbon film 15k ±5%	RD¼PS 153J	
R13	Carbon film 15k ±5%	RD¼PS 153J	
R14	Carbon film 15k ±5%	RD¼PS 153J	
R15	Carbon film 15k ±5%	RD¼PS 153J	
R16	Carbon film 2.7k ±5%	RD¼PS 272J	
R17	Carbon film 2.7k ±5%	RD¼PS 272J	
R18	Carbon film 270 ±5%	RD¼PS 271J	
R19	Carbon film 12k 1W ±5%	RS1P 123J	
R20	Carbon film 12k 1W ±5%	RS1P 123J	
R21	Semi-fixed 1k	SR19R 1K	
R23	Carbon film 1k ±5%	RD¼PS 102J	
R24	Carbon film 5.6k ±5%	RD¼PS 562J	
R25	Carbon film 5.6k ±5%	RD¼PS 562J	
R26	Carbon film 1k ±5%	RD¼PS 102J	
R27	Semi-fixed 4.7k	SR19R 4.7K	
R28	Carbon film 10k ±5%	RD¼PS 103J	
R29	Carbon film 3.9k ±5%	RD¼PS 392J	
R30	Carbon film 3.9k ±5%	RD¼PS 392J	
R31	Semi-fixed 1k	SR19R 1K	

Symbol	Description	Part No.	
R32	Carbon film 2.7k ±5%	RD¼PS 272J	
R33	Carbon film 2.7k ±5%	RD¼PS 272J	
R34	Carbon film 15k ±5%	RD¼PS 153J	
R35	Carbon film 15k ±5%	RD¼PS 153J	
R36	Carbon film 15k ±5%	RD¼PS 153J	
R37	Carbon film 15k ±5%	RD¼PS 153J	
R38	Carbon film 2.7k ±5%	RD¼PS 272J	
R39	Carbon film 2.7k ±5%	RD¼PS 272J	
R40	Carbon film 270 ±5%	RD¼PS 271J	
R41	Carbon film 12k 1W ±5%	RS1P 123J	
R42	Carbon film 12k 1W ±5%	RS1P 123J	

12.3 METER & MIC AMPLIFIER UNIT (W18-038)

SEMICONDUCTORS

Symbol	Description		Part No.	
Q1	Transistor	2SC870E		
Q2	Transistor	2SC871E		
Q3	Transistor	2SC871E		
Q4	Transistor	2SC870E		
Q5	Transistor	2SC870E		
Q6	Transistor	2SC870E		
Q7	Transistor	2SC870E		
Q8	Transistor	2SC870E		
Q9				
Q10	Transistor	2SC871E		
Q11	Transistor	2SC871E		
D1	Diode	1N60		
D2	Diode	1N60		
D3	Diode	1N60		
D4	Diode	1N60		
D5	Diode	1N60		
D6	Diode	1N60		
D7	Diode	1N60		
D8	Diode	1N60		

CAPACITORS

Symbol	Description			Part No.	
C1	Mylar	0.22	50V	CQMA 224K 50	
C2	Mylar	0.22	50V	CQMA 224K 50	
C3	Ceramic	1000p	50V	CKDYB102K 50	
C4	Mylar	0.22	50V	CQMA 224K 50	
C5	Electrolytic	10	16V	CEA 100P 16	
C6	Mylar	0.1	50V	CQMA 104K 50	
C7	Electrolytic	10	16V	CEA 100P 16	
C8	Electrolytic	1	50V	CEA 010P 50	
C9	Mylar	0.1	50V	CQMA 104K 50	
C10	Electrolytic	10	16V	CEA 100P 16	
C11	Electrolytic	1	50V	CEA 010P 50	
C12	Ceramic	15p	50V	CCDSL 150K 50	
C13	Ceramic	15p	50V	CCDSL 150K 50	
C14	Ceramic	15p	50V	CCDSL 150K 50	
C15	Ceramic	15p	50V	CCDSL 150K 50	
C20	Electrolytic	47	25V	CEA 470P 25	
C21	Mylar	0.047	50V	CQMA 473K 50	
C22	Ceramic	100p	50V	CCDSL 101K 50	
C23	Electrolytic	47	6.3V	CEA 470P 6R3	
C24	Ceramic	56p	50V	CCDSL 560K 50	
C25	Electrolytic	1	50V	CEA 010P 50	
C26	Electrolytic	1	50V	CEA 010P 50	
C27	Mylar	0.22	50V	CQMA 224K 50	
C28	Mylar	0.22	50V	CQMA 224K 50	
C29	Electrolytic	4.7	25V	CEA 4R7P 25	

RESISTORS

Symbol	Description	Part No.	
R1	Carbon film 15k ±5%	RD¼PS 153J	
R2	Carbon film 120k ±5%	RD¼PS 124J	
R3	Carbon film 470 ±5%	RD¼PS 471J	
R4	Carbon film 1.5k ±5%	RD¼PS 152J	
R5	Carbon film 3.9k ±5%	RD¼PS 392J	
R6	Carbon film 27k ±5%	RD¼PS 273J	
R7	Carbon film 470 ±5%	RD¼PS 471J	
R8	Carbon film 100k ±5%	RD¼PS 104J	
R9	Carbon film 68k ±5%	RD¼PS 683J	
R10	Carbon film 100k ±5%	RD¼PS 104J	
R11	Carbon film 150k ±5%	RD¼PS 154J	
R12	Carbon film 680k ±5%	RD¼PS 684J	
R13	Semi-fixed 2.2k B	SR19R2.2KB	
R14	Carbon film 3.3k ±5%	RD¼PS 332J	
R15	Carbon film 470 ±5%	RD¼PS 471J	
R16	Carbon film 100k ±5%	RD¼PS 104J	
R17	Carbon film 1M ±5%	RD¼PS 105J	
R18			
R19	Carbon film 3.3k ±5%	RD¼PS 332J	
R20	Carbon film 3.3k ±5%	RD¼PS 332J	
R21	Semi-fixed 2.2k B	SR19R 2.2KB	
R22	Carbon film 680K ±5%	RD¼PS 684J	
R23	Carbon film 150k ±5%	RD¼PS 154J	
R24	Carbon film 3.3k ±5%	RD¼PS 332J	
R25	Carbon film 470 ±5%	RD¼PS 471J	
R26	Carbon film 5.6k ±5%	RD¼PS 562J	
R27			
R28			
R29			
R30			

Symbol	Description	Part No.	
R31			
R32	Carbon film 100k ±5%	RD¼PS 104J	
R33	Carbon film 100k ±5%	RD¼PS 104J	
R34	Carbon film 100k ±5%	RD¼PS 104J	
R35	Carbon film 100k ±5%	RD¼PS 104J	
R36	Carbon film 10k ±5%	RD¼PS 103J	
R37	Carbon film 10k ±5%	RD¼PS 103J	
R38	Carbon film 10k ±5%	RD¼PS 103J	
R39	Carbon film 10k ±5%	RD¼PS 103J	
R40	Carbon film 150k ±5%	RD¼PS 154J	
R41	Carbon film 2.2k ±5%	RD¼PS 222J	
R42	Carbon film 270k ±5%	RD¼PS 274J	
R43	Carbon film 180k ±5%	RD¼PS 184J	
R44	Carbon film 1k ±5%	RD¼PS 102J	
R45	Carbon film 560k ±5%	RD¼PS 564J	
R46	Carbon film 10k ±5%	RD¼PS 103J	
R47	Carbon film 2.2k ±5%	RD¼PS 222J	
R48	Carbon film 68k ±5%	RD¼PS 683J	
R49	Carbon film 4.7k ±5%	RD¼PS 472J	
R50	Carbon film 150k ±5%	RD¼PS 154J	
R51	Carbon film 1k ±5%	RD¼PS 102J	

12.4 AUDIO SWEEP UNIT (W18-039)

SEMICONDUCTORS

Symbol	Description		Part No.	
Q1	FET	2SK30GR		
Q2	Transistor	2SC870E		
Q3	Transistor	2SC870E		
Q4	Transistor	2SC870E		
Q5	FET	2SK30GR		
Q6	Transistor	2SC870E		
Q7	FET	2SK30GR		
Q8	Transistor	2SA561P		
Q9	Transistor	2SC870E		
Q10	Transistor	2SC734P		
Q11	Transistor	2SC734P		
Q12	Transistor	2SC870E		
Q13	Transistor	2SA561P		
Q14	FET	2SK30GR		
Q15	FET	2SK30R		
Q16	Transistor	2SA561P		
Q17	Transistor	2SD235		
D1	Diode	1S1555		
D2	Diode	1N60		
D3	Diode	1N60		
D4	Diode	1N60		
D5	Diode	1N60		
D6	Diode	1S1555		
D7				
D8	Diode	1S1555		
D9	Diode	1S1555		

CAPACITORS

Symbol	Description			Part No.			
C1	Mylar	0.03	50V	CQMA	303K	50	
C2	Mylar	0.047	50V	CQMA	473K	50	
C3	Electrolytic	10	16V	CEA	100P	16	
C4	Electrolytic	10	16V	CEA	101P	16	
C5	Electrolytic	33	25V	CEA	330P	25	
C6	Electrolytic	33	16V	CEA	330P	16	
C7	Electrolytic	10	16V	CEA	100P	16	
C8	Electrolytic	33	25V	CEA	330P	25	
C9	Electrolytic	10	16V	CEA	100P	16	
C10	Mylar	0.01	50V	CQMA	103J	50	
C11	Mylar	0.02	50V	CQMA	203J	50	
C12	Mylar	0.01	50V	CQMA	103J	50	
C13	Electrolytic	33	25V	CEA	330P	25	
C14	Mylar	0.1	50V	CQMA	104K	50	
C15	Mylar	0.1	50V	CQMA	104K	50	
C16	Mylar	0.01	50V	CQMA	103K	50	
C17	Mylar	0.01	50V	CQMA	103K	50	
C18	Ceramic	200P	50V	CCDSL	201K	50	
C19	Ceramic	200P	50V	CCDSL	201K	50	
C20	Ceramic	400P	50V	CCDSL	401K	50	
C21	Electrolytic	220	25V	CEA	221P	25	
C22	Electrolytic	220	16V	CEA	221P	16	
C23	Ceramic	100P	50V	CCDSL	101K	50	
C24	Electrolytic	10	25V	CEA	100P	25	
C25	Mylar	0.047	50V	CQMA	473K	50	
C26	Mylar	0.068	50V	CQMA	683K	50	
C27	Ceramic	300P	50V	CKDYB	301K	50	

RESISTORS

Symbol	Description			Part No.	
R1, R2	CdS unit			W58-001-O	
R3	Carbon film	1M	±5%	RD¼PS 105J	
R4	Carbon film	560k	±5%	RD¼PS 564J	
R5	Carbon film	10k	±5%	RD¼PS 103J	
R6	Carbon film	10k	±5%	RD¼PS 103J	
R7	Carbon film	10k	±5%	RD¼PS 103J	
R8	Carbon film	470k	±5%	RD¼PS 474J	
R9	Carbon film	20k	±5%	RD¼PS 203J	
R10	Carbon film	6.2k	±5%	RD¼PS 622J	
R11	Carbon film	220	±5%	RD¼PS 221J	
R12	Thermistor	41B4			
R13	Carbon film	56k	±5%	RD¼PS 563J	
R14	Carbon film	10k	±5%	RD¼PS 103J	
R15	Carbon film	100	±5%	RD¼PS 101J	
R16	Carbon film	22k	±5%	RD¼PS 223J	
R17	Carbon film	39k	±5%	RD¼PS 393J	
R18	Carbon film	1M	±5%	RD¼PS 105J	
R19	Carbon film	1M	±5%	RD¼PS 105J	
R20	Carbon film	100k	±5%	RD¼PS 104J	
R21	Carbon film	100k	±5%	RD¼PS 104J	
R22	Carbon film	4.7k	±5%	RD¼PS 472J	
R23	Semi-fixed	10k	B	SR19R 10KB	
R24	Carbon film	100	±5%	RD¼PS 101J	
R25	Carbon film	3.3k	±5%	RD¼PS 332J	
R26	Carbon film	22k	±5%	RD¼PS 223J	
R27	Carbon film	100k	±5%	RD¼PS 104J	
R28	Semi-fixed	470	B	SR19R 470B	
R29	Carbon film	100k	±5%	RD¼PS 104J	
R30	Carbon film	3.3k	±5%	RD¼PS 332J	

Symbol	Description			Part No.	
R31	Carbon film	1.5M	±5%	RD¼PS 155J	
R32	Carbon film	820k	±5%	RD¼PS 824J	
R33	Carbon film	1.5M	±5%	RD¼PS 155J	
R34	Carbon film	15k	±5%	RD¼PS 153J	
R35	Carbon film	470k	±5%	RD¼PS 474J	
R36	Carbon film	12k	±5%	RD¼PS 123J	
R37	Carbon film	12k	±5%	RD¼PS 123J	
R38	Carbon film	47k	±5%	RD¼PS 473J	
R39	Carbon film	1.5k	±5%	RD¼PS 152J	
R40	Carbon film	6.2k	±5%	RD¼PS 622J	
R41	Carbon film	5.6k	±5%	RD¼PS 562J	
R42	Carbon film	15k	±5%	RD¼PS 153J	
R43	Carbon film	5.6k	±5%	RD¼PS 562J	
R44	Carbon film	560	±5%	RD¼PS 561J	
R45	Carbon film	1.5k	±5%	RD¼PS 152J	
R46	Carbon film	470	±5%	RD¼PS 471J	
R47	Carbon film	4.7k	±5%	RD¼PS 472J	
R48	Carbon film	3.3k	±5%	RD¼PS 332J	
R49	Carbon film	15k	±5%	RD¼PS 153J	
R50	Carbon film	3.3k	±5%	RD¼PS 332J	
R51	Carbon film	15k	±5%	RD¼PS 153J	
R52	Carbon film	10k	±5%	RD¼PS 103J	
R53	Carbon film	1k	±5%	RD¼PS 102J	
R54	Carbon film	1k	±5%	RD¼PS 102J	
R55	Carbon film	10k	±5%	RD¼PS 103J	
R56	Carbon film	10k	±5%	RD¼PS 103J	
R57	Carbon film	330	±5%	RD¼PS 331J	
R58	Carbon film	33k	±5%	RD¼PS 333J	
R59	Carbon film	100k	±5%	RD¼PS 104J	
R60	Semi-fixed	220k	B	SR19R 220KB	

Symbol	Description			Part No.		
R61	Carbon film	220	±5%	RD¼PS	221J	
R62	Carbon film	100k	±5%	RD¼PS	104J	
R63	Carbon film	1.5k	±5%	RD¼PS	152J	
R64	Carbon film	10k	±5%	RD¼PS	103J	

12.5 POWER SUPPLY UNIT (W16-037)

SEMICONDUCTORS

Symbol	Description		Part No.	
Q1	Transistor	2SC971-2		
Q2	Transistor	2SC284		
Q3	Transistor	2SC971-2		
Q4	Transistor	2SC870E		
Q5	Transistor	2SC870E		
D1	Diode	FR2-08		
D2	Diode	FR2-08		
D3	Diode	1S1850		
D4	Diode	FR2-02		
D5	Zener diode	1S331		
D6	Zener diode	1S338Q		
D7	Diode	FR2-08		
D8	Diode	FR2-08		
D9	Diode	FR2-08		
D10	Diode	FR2-08		
D11	Diode	FR2-02		
D12	Diode	FR2-02		
D13	Diode	1S1850		
D14	Zener diode	1S338Q		
D15	Diode	FR2-02		
D16	Diode	1S1850		

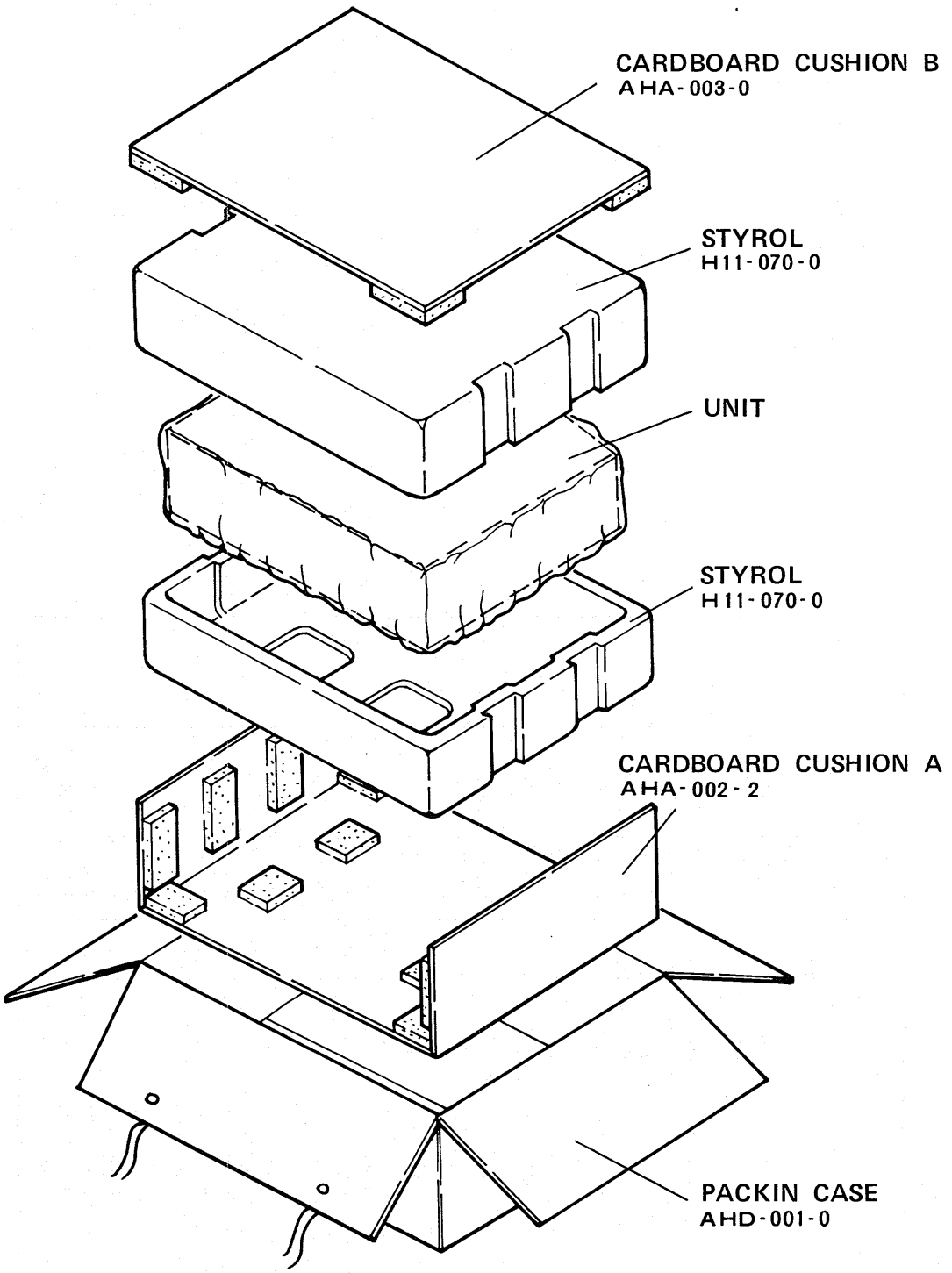
CAPACITORS

Symbol	Description			Part No.	
C1	Electrolytic	220	35V	CEA 221P 35	
C2	Electrolytic	100	10V	CEA 101P 10	
C3	Electrolytic	220	25V	CEA 221P 25	
C4	Electrolytic	220	35V	CEA 221P 35	
C5	Oil paper	0.1	1kV	CPB 104M1000	
C6	Oil paper	0.1	1kV	CPB 104M1000	
C7	Electrolytic	10	25V	CEA 100P 25	
C8	Ceramic	0.01	1.4kV	C43-003-O	
C9	Ceramic	0.01	1.4kV	C43-003-O	
C10	Electrolytic	220	16V	CEA 221P 16	
C11	Electrolytic	100	16V	CEA 101P 16	
C12	Electrolytic	220	25V	CEA 221P 25	
C13	Electrolytic	33	16V	CEA 330P 16	
C14	Oil paper	0.1	1.5kV	CPB 104M1500	
C15	Electrolytic	4.7	16V	CEA 4R7P16	

RESISTORS

Symbol	Description	Part No.	
R1	Carbon film 2.2k 2W ±5%	RS2P 222J	
R2	Carbon film 1k ±5%	RD¼PS 102J	
R3	Carbon film 2.2k ±5%	RD¼PS 222J	
R4	Carbon film 470k ±5%	RD¼PS 474J	
R5	Carbon film 1M ±5%	RD¼PS 105J	
R6	Carbon film 1M ±5%	RD¼PS 105J	
R7	Carbon film 100k ±5%	RD¼PS 104J	
R8	Carbon film 33k ±5%	RD¼PS 333J	
R9	Carbon film 220k ±5%	RD¼PS 224J	
R10	Carbon film 100k ±5%	RD¼PS 104J	
R11	Carbon film 68k ±5%	RD¼PS 683J	
R12	Carbon film 4.7M ±5%	RD¼PS 475J	
R13	Carbon film 4.7M ±5%	RD¼PS 475J	
R14	Carbon film 33k ±5%	RD¼PS 333J	
R15	Carbon film 33k ±5%	RD¼PS 333J	
R16	Carbon film 2.2k ±5%	RD¼PS 222J	
R17	Carbon film 3.3M ±5%	RD¼PS 332J	
R18	Carbon film 20k ±5%	RD¼PS 203J	
R19	Carbon film 15k ±5%	RD¼PS 153J	
R20	Carbon film 20k ±5%	RD¼PS 203J	
R21	Carbon film 2.2k ±5%	RD¼PS 222J	
R22	Semi-fixed 100k B	U16L2N 100KB	
R23	Carbon film 470k ±5%	RD¼PS 474J	
R24	Carbon film 150k ±5%	RD¼PS 154J	
R25	Carbon film 1M ±5%	RD¼PS 105J	
R26	Carbon film 1M ±5%	RD¼PS 105J	
R27	Carbon film 43k ±5%	RD¼PS 433J	
R28	Carbon film 43k ±5%	RD¼PS 433J	
R29	Carbon film 560k ±5%	RD¼PS 564J	
VR2	Semi-fixed 500k B	U16L2N 500KB	

13. PACKING METHOD



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