P & H ELECTRONICS

BUILDERS OF FINE ELECTRONIC EQUIPMENT

424 COLUMBIA STREET · PHONE 2-0361

LAFAYETTE, INDIANA

RF DISTORTION INDICATOR
MODEL DI-1

Application

The Model DI-1 oscilloscope was specifically designed to meet the needs of the single sideband enthusiast who uses an accessory with his S.S.B. exciter, such as a linear amplifier or transmitting converter. The DI-1 takes the guesswork out of tuning and adjusting these accessories for best linearity consistent with maximum efficiency under actual operating conditions regardless of voice characteristics. It may also be used as a % modulation indicator for AM transmitters or for carrier and sideband suppression adjustments of single sideband exciters.

The trapezoid pattern display is used for most applications; however, a 60 cycle sweep is provided for an envelope display if it should be desired. When using the trapezoid mode of application, the oscilloscope beam is cut off when no RF is present at the high level connectors of the oscilloscope. This prevents burning a spot on the face of the cathode ray tube during standby periods.

By studying the interconnecting diagrams you will be able to select the method of application desired for your particular requirement.

Description

The DI-1 is a 3" oscilloscope supplied with a green filter and sealed bezel to provide a clean, clear display in an average bright operating area. It is enclosed in a dark grey, durable steel cabinet of modern styling with rubber feet. The low and high voltage, hum-free power supply is built in. Connections are provided at the rear of the scope for all functions.

An accessory socket, below the chassis, accommodates a plug-in two-tone oscillator, Model TT-1, when it is required. The output from the two-tone oscillator is connected to the exciter microphone input connector. See Fig. 3, Page 7. The size of the vertical display is controlled by the 6-step vertical attenuator. Steps 1, 2, or 3 are used for higher powered transmitters while the remaining steps provide increasing sensitivity for the lower powered transmitters. The horizontal size knob controls the gain of the horizontal amplifier which provides control over the width of the display in either the trapezoid or envelope functions.

The centering of the display is controlled by the vertical and horizontal centering controls, while intensity and focus provide the control over the brilliance and clarity of the display. The AC power for the scope and the DC power for the two-tone oscillator (when installed) are controlled by a rotary switch. A pilot lamp, when lit, indicates that the power is on.

WARNING!

Whenever the oscilloscope is removed from the cabinet, exercise extreme care to avoid serious electrical shock. The potentiometers behind the panel next to the cathode ray tube face are at 1000VDC potential with respect to the chassis. Remove the line plug from the power source before removing or installing the cabinet.

Specifications

Dimensions:	9" high x 6¼" wide x 14¼" deep
Screen Size:	3"
Tubes & Rectifiers. .	1 ea. 3AP1 cathode ray tube
	1 ea. 6BW4 rectifier tube
	1 ea. 12AT7 dual triode tube
	1 ea. 6AL5 dual diode tube
	1 ea. #51 pilot lamp
	1 ea. 1N34 diode
	1 ea. V50HP high voltage selenium
Power Required: . . .	117V AC 60 watts (with TT-1)
Inpedance:	50 to 70 for both low and high level RF connectors
Freq. Coverage: . . .	160 through 6 meters
Power Limits:	5W to 2KW input
Audio Output:	1000 cy or 1000 cy and 2000 cy approximately, to match high impedance microphone input of exciter (with TT-1)
Shipping weight: . .	14½ lbs.

Operating Instructions

I General

1. Select the desired interconnecting diagram from page 7 for the desired application.

2. Connect exciter and linear amplifier or transmitting converter (160 thru 6 meters) in accordance with diagram.

3. Connect the output from the two-tone oscillator where applicable or connect a microphone to the mic connector on the exciter. Use shielded mike cable.

4. Plug DI-1 into any convenient 110-117 VAC 50-60 cycle source and apply power to the scope.

5. After one minute warm-up, place envelope-trapezoid switch in envelope position.

6. Adjust intensity, focus, vertical and horizontal centering, and horizontal gain controls for a sharp line of desired brilliance across center of the screen.

7. Place envelope-trapezoid switch in trapezoid position; trace should then be blanked.

II For Trapezoid Display

A. For use as % modulation indicator on AM transmitter or for making sideband suppression adjustments on phasing type SSB exciter. See Fig. 1, Page 7.

1. Connect RF output from AM transmitter or SSB exciter to either one of the low level RF connectors on the DI-1.

2. Connect a short length of coax from the remaining low level connector to one of the high level connectors.

3. Connect the remaining high level connector to an antenna for % modulation indicator or to a dummy load for SSB exciter suppression adjustment.

4. Proceed with Steps 3 through 7 under General Instructions.

5. Set vertical attenuator to Position 1.

6. Turn on transmitter or exciter (carrier only).

7. Adjust transmitter for normal operation and adjust vertical attenuator for about 1" high display of vertical scan (straight vertical line).

8. Apply modulation.

   a. For AM transmitter use a single tone or speak into microphone. Adjust horizontal size for correct width of trapezoid. A complete triangle pattern indicates 100% modulation. Width is correct when, with 100% modulation, an equilateral triangle is developed.

   b. For phasing type SSB exciter, remove carrier and apply a single tone (approx. 1000cy.) to microphone input. Do not

overdrive exciter, set drive for maximum output then reduce to 70% or so of maximum to insure linearity of exciter. If suppression is satisfactory only a straight vertical line will appear. When making suppression adjustments advance horizontal size to expand the trapezoid display. Adjust suppression adjustments so as to minimize the width of the trapezoid (% ripple modulation of envelope).

c. For carrier suppression adjustment on all SSB exciters adjust carrier suppression control (carrier balance) for minimum RF envelope with envelope trapezoid switch in envelope position and vertical attenuator in position 6.

B. For use as a distortion indicator with any SSB or AM exciter and a linear amplifier or transmitting converter (160 to 6 meters). See Page 7, Fig. 3.

1. Connect RF output from exciter to either one of the low level RF connectors on the DI-1 using coaxial cable.

2. Connect the remaining low level connector to the input of the linear or transmitting converter with coaxial cable.

3. Connect the output of the linear amplifier or transmitting converter to either one of the high level RF connectors on the DI-1 using coaxial cable.

4. Connect the remaining high level connector to the antenna or dummy load.

5. Proceed with Steps 3 through 7 in General Instructions.

6. Apply two-tone signal from TT-1 to exciter or talk into microphone starting with exciter audio gain low. Tune and load linear or transmitting converter for best linearity and maximum amplitude (output).

7. Adjust vertical attenuator and horizontal size for desired size of display.

8. If the vertical stripping at the wide end of the trapezoid increases in intensity on peaks, the exciter is being overdriven. Reduce exciter audio gain.

9. See sample trapezoid pattern for analysis of your signal.

III For Envelope Display

A. For use in carrier and modulation analysis of AM transmitters or for analysis of envelope display of SSB transmitters. See Page 7, Fig. 2.

1. Connect exciter RF output to either one of the high level connectors on the DI-1 using coaxial cable.

2. Connect the remaining high level connector to the antenna or dummy load.

3. Proceed with Steps 4 through 7 in General Instructions.

4. Set envelope-trapezoid switch to envelope position.

5. Set vertical attenuator to Position 1.

6. Turn on transmitter and adjust vertical attenuator and horizontal size for desired pattern.

7. See sample envelope patterns for analysis of display.

8. If a variable audio oscillator is available it may be used to obtain a modulated envelope pattern, with the fixed 60 cycle sweep provided in the scope, by slowly changing the frequency until the audio frequency is a multiple of the sweep frequency (60 cy.). See Page 7, Fig. 4.

   Phasing type single sideband exciters may then be adjusted in the usual method described by texts and manuals using the envelope pattern with 60 cycle sweep.

TWO-TONE OSCILLATOR

The two-tone oscillator Model TT-1 was designed so that any SSB exciter can produce the two-tone test signal required for adjustment and evaluation of SSB equipment. One of these tones is near 1000 cycles while the other of the tones is near 2000 cycles. These are combined and applied to the exciter. A standard RCA type phono jack on the back of the DI-1 provides the source for this signal when the Model TT-1 is inserted beneath the chassis of the DI-1 in the accessory socket.

The only adjustment required for the TT-1 is the balance of the amplitude of the two signals to produce a triangle pattern on the screen of the scope. It will be noted that a single tone will produce a straight vertical line on the scope in the trapezoid mode while a two-tone test signal or multiple tones (voice frequencies) will produce a trapezoid pattern.

Trapezoid Pattern

In order to produce a trapezoid pattern on the DI-1, the RF envelope must contain more than one frequency. This may be accomplished in several ways with various types of exciters as follows:

1. Any exciter, when modulated with voice frequencies, produces the desired effect.

2. Using a carrier as one tone, and a single audio tone at the microphone, input produces a two-tone signal. However, some SSB exciters have no means of inserting carrier.

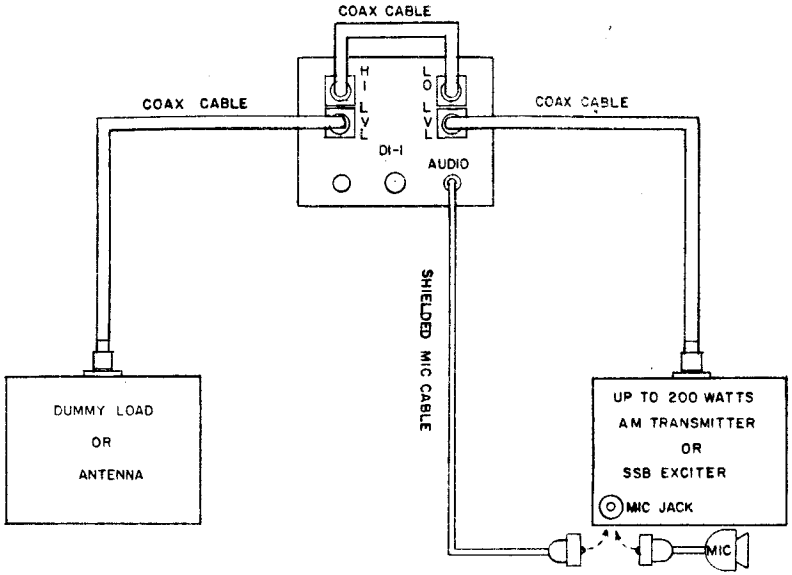
3. Using double sideband with reduced carrier and a single audio tone at the microphone input on the exciter will produce a two-tone signal. Again, however, some SSB exciters provide no means of operating DSB reduced carrier.

4. Using AM, a carrier modulated with a single tone applied to the microphone input of a SSB exciter or an AM transmitter, will produce a trapezoid. However, some SSB exciters will not operate AM.

5. The use of the two-tone oscillator Model TT-1 provides the complex audio signal to produce the trapezoid pattern for any SSB exciter. By switching off one of the two-tone signals, a single tone is available for other requirements.

TRAPEZOID PATTERN

USED FOR: CHECKING MODULATION PERCENTAGE OF AM TRANSMISSIONS, SIDEBAND SUPPRESSION ADJUSTMENTS FOR PHASING EXCITERS, BALANCE ADJUSTMENT OF MODEL TT-1 TWO-TONE OSCILLATOR.



DOES NOT CHECK LINEARITY

FIG 1.

ENVELOPE PATTERN

USED FOR; ANALYSIS OF MODULATED RF ENVELOPE OF AM SIGNAL OR SSB ENVELOPE DISPLAY, USING 60 CYCLE SWEEP.

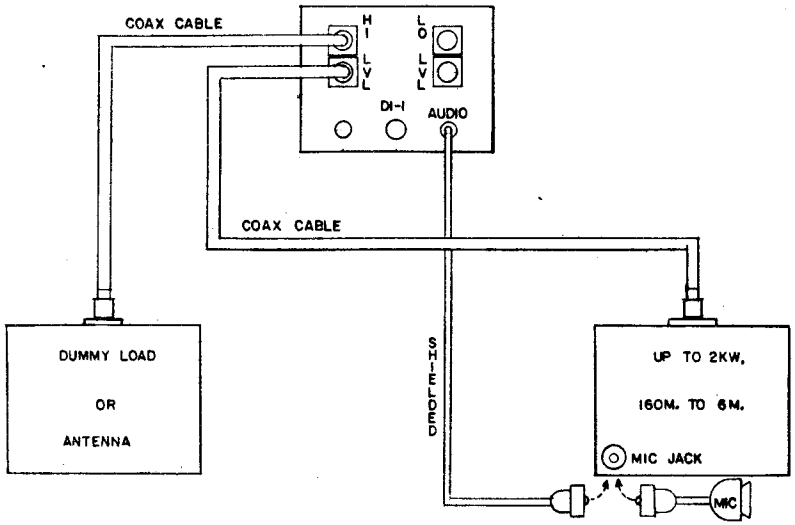


FIG 2.

TRAPEZOID PATTERN

USED FOR: CHECKING DISTORTION DUE TO NON-LINEARITY OF LINEAR AMPLIFIER OR TRANSMITTING CONVERTER. THE RF ENVELOPE MUST CONTAIN MORE THAN ONE FREQUENCY.

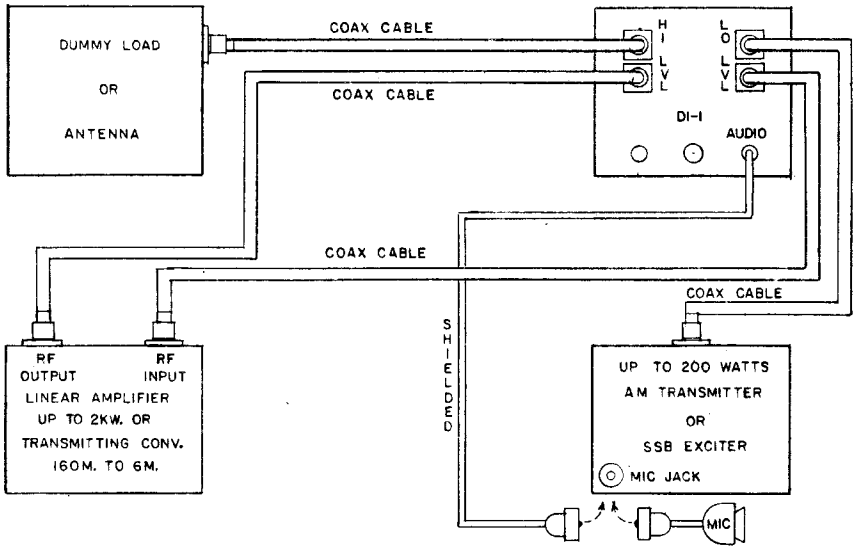


FIG 3.

ENVELOPE PATTERN

USED FOR: SIDEBAND SUPPRESSION ADJUSTMENTS FOR PHASING TYPE SSB EXCITERS USING VARIABLE FREQ. AUDIO OSCILLATOR AND 60 CY. INTERNAL SWEEP.

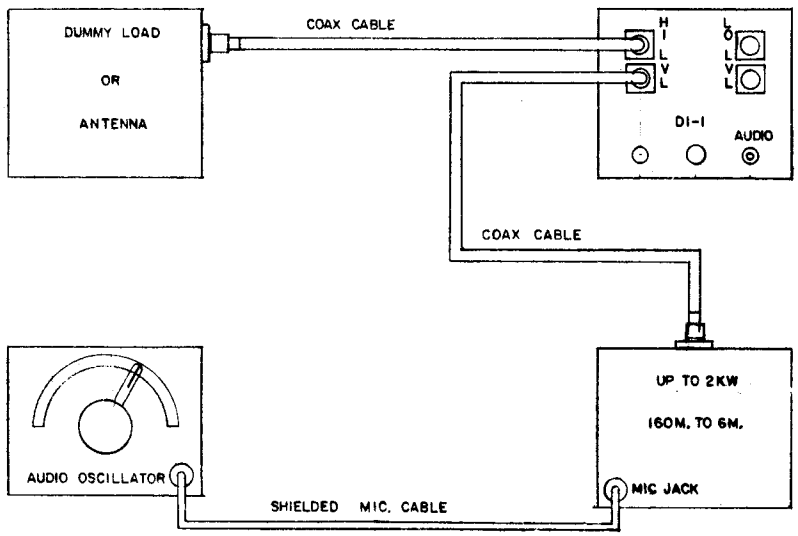


FIG 4.

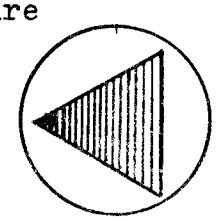
TRAPEZOID PATTERNS

For Interconnecting diagrams Fig. 1 and Fig. 3, Page 7

Figure

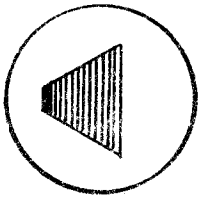
RF trapezoid, desirable linearity, 100% modulation SSB voice or two tone, AM linear 100% modulation normal excitation. Two-tone oscillator balanced. No distortion.

1



RF trapezoid, desirable linearity, SSB two-tone oscillator unbalanced, AM less than 100% modulation SSB with strong carrier leakage.

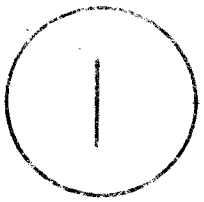
2



Carrier with no modulation, single tone SSB signal with good sideband suppression. May also occur when:

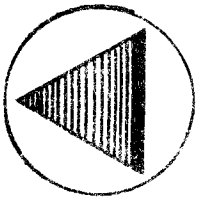
a. Two-tone oscillator not operative
b. No signal at horizontal deflection plate
c. Horizontal size control not adjusted
d. Audio failure in transmitter or cables

3



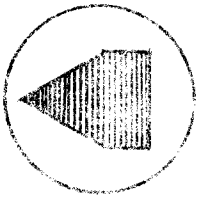
Exciter distortion due to overdrive and flatopping--good linearity of amplifier. Note the density of the striping at right side (wide end) of the pattern is greater than the adjacent area.

4



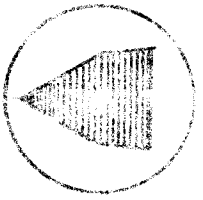
Class AB or AB_2 amplifier grounded cathode. More severe distortion due to overdrive, insufficient antenna loading or unstable grid voltage.

5



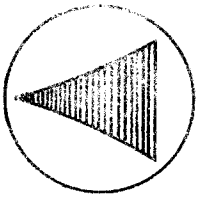
Class B grounded grid amplifier distortion caused by insufficient antenna loading, or in any amplifier poor bias regulations.

6



Distortion due to regeneration or excessive grid bias.

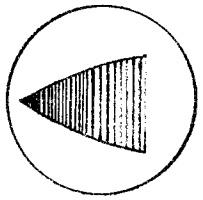
7



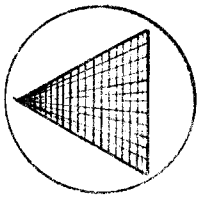
TRAPEZOID PATTERNS (CONT.)

Figure

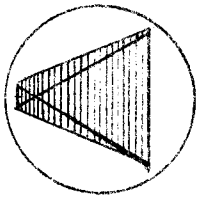
Distortion caused by regeneration or bias instability. Indicates small grid bias required with zero screen voltage when operating Class B grounded grid triode connected tetrodes. 8



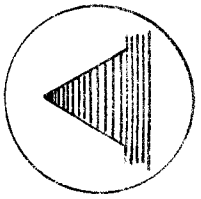
High distortion product content, low tank circuit 'Q'. Lines change position when plate capacitor is varied. 9



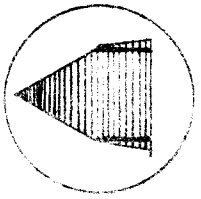
Linear amplifier hum in bias supply. 10



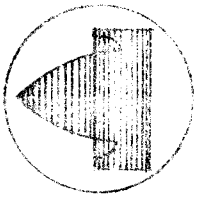
Positive peak parasites. 11



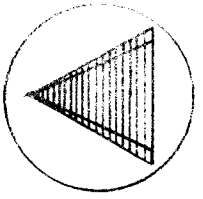
Improper loading of Class B amplifier with harmonic distortion. 12



Severe parasitic oscillation and amplifier not neutralized. 13



Spurious radiation down about 20 DB. 14

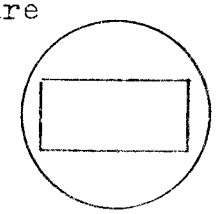


ENVELOPE PATTERNS

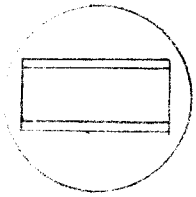
For interconnecting diagrams Figures 2 and 4, Page 7

Figure

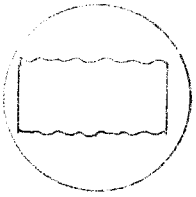
Pure RF carrier or SSB single tone with too much drive causing flatening of normal slight ripple. See fig. 3, this page. 1



RF carrier with spurious radiation down 20DB. 2



SSB single tone using variable oscillator. See page 7, figure 4. 3



SSB two-tone test signal or DSB reduced carrier. 4

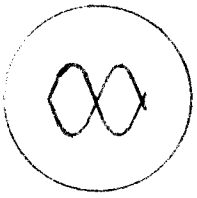
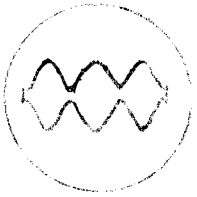
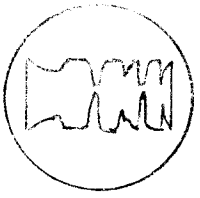


Plate modulated AM single tone input. 100% modulation or DSB with carrier inserted. 5

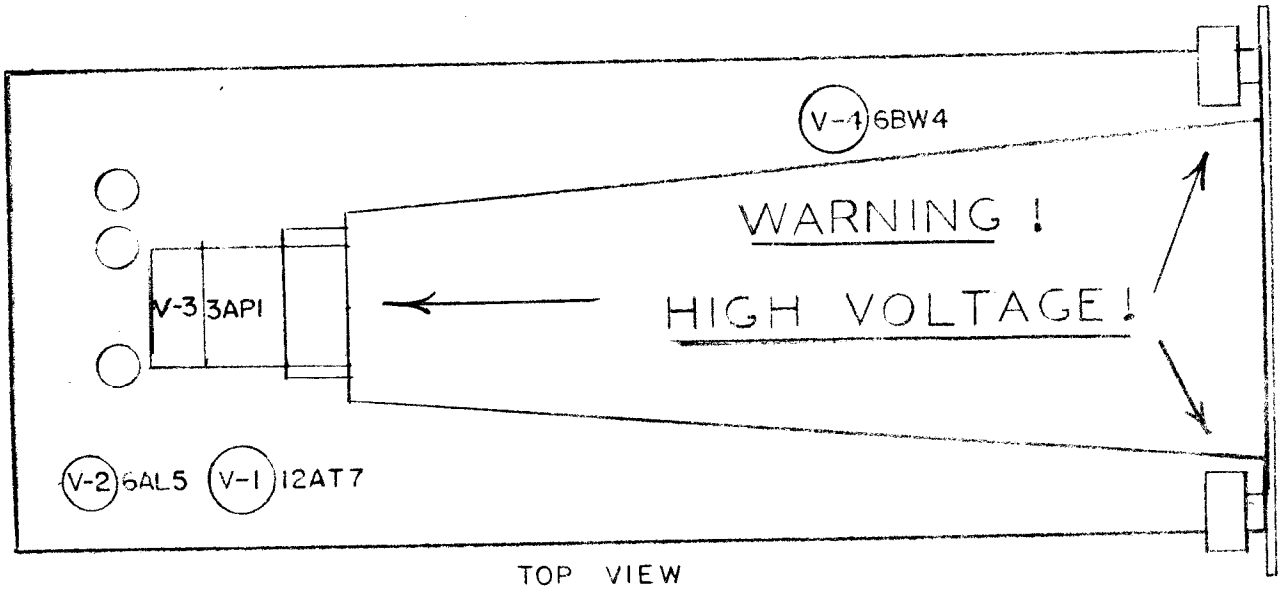


Voice envelope pattern SSB with 60 cycle internal sweep, normal audio level. 6

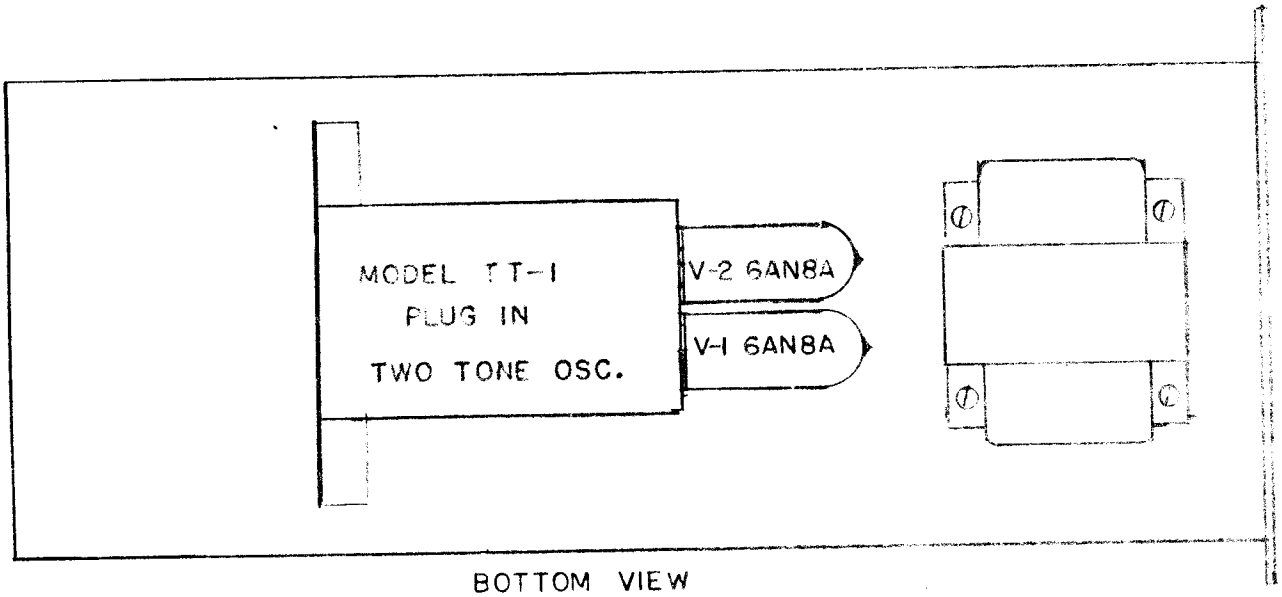
Voice envelope pattern SSB with distortion due to audio input level set too high using 60 cycle sweep. 7



TUBE LAYOUT DIAGRAM



TOP VIEW

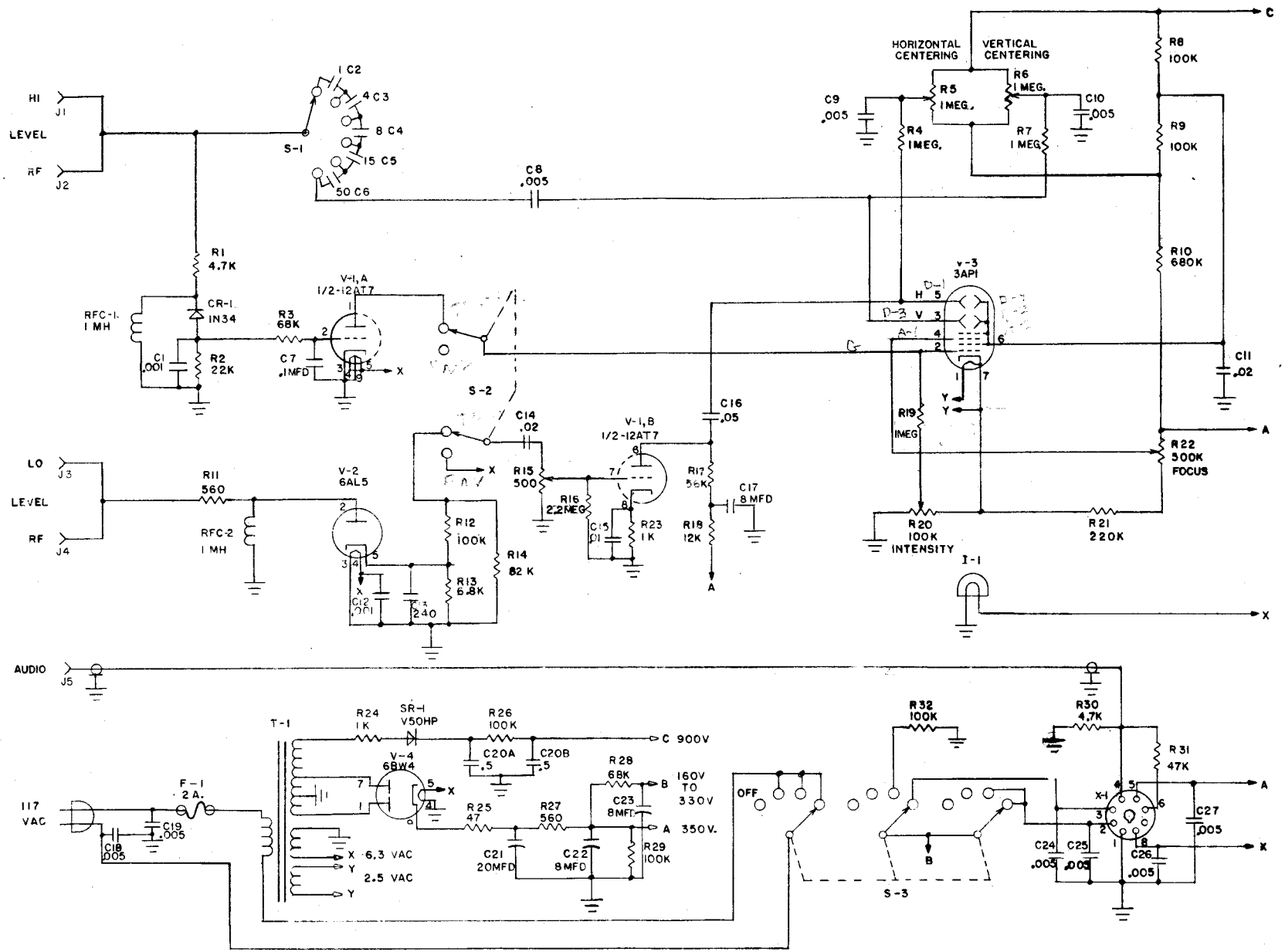


BOTTOM VIEW

TWO-TONE OSCILLATOR
Model TT-1

PARTS LIST

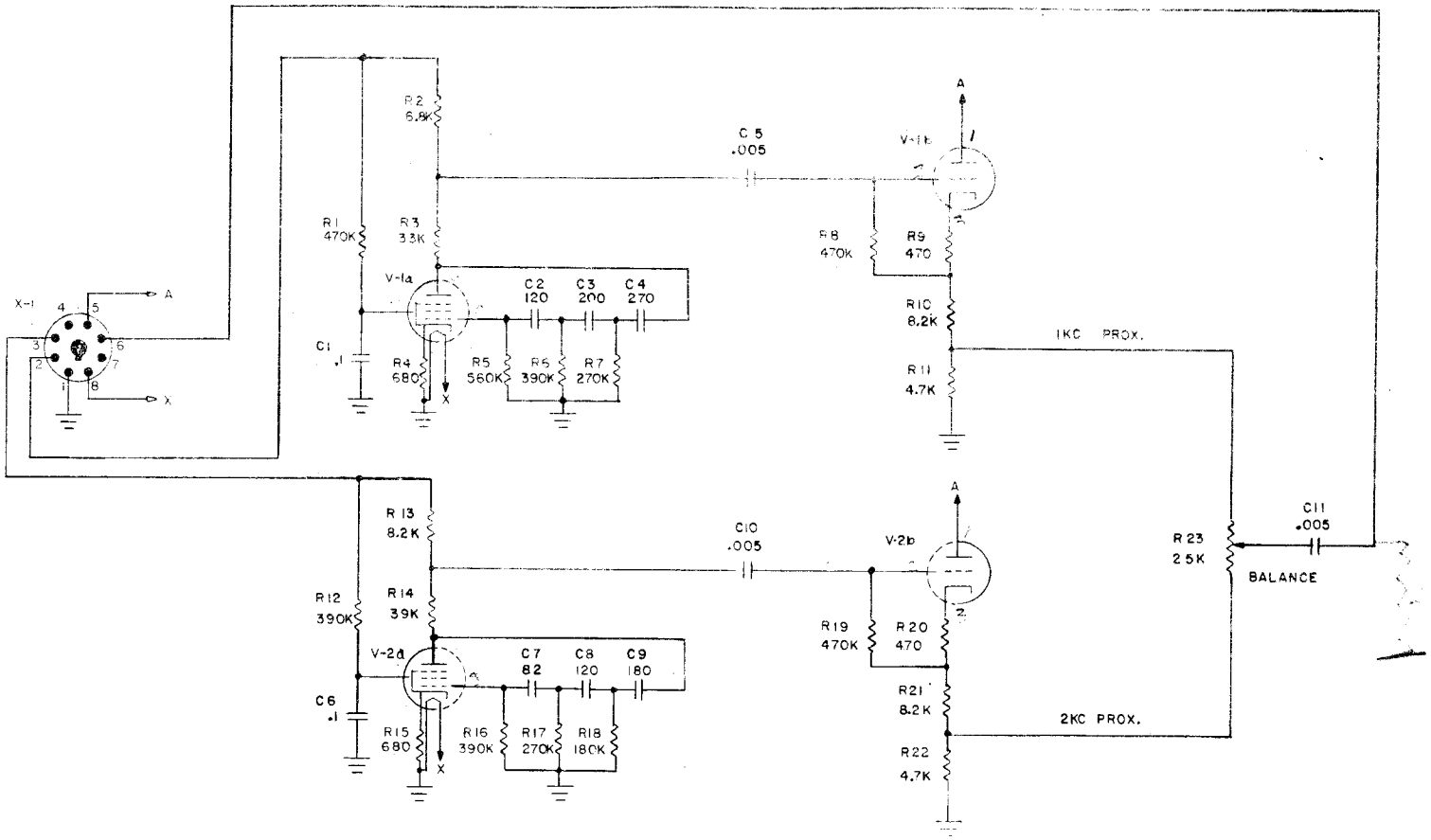
PART NO.	PART DESCRIPTION
V1,2	6AN8A tube
X1	octal 8 pin plug
X2,3	9 pin tube socket
CH1	TT-1 chassis assembly
TA1	9 plug terminal strip
TA2	5 plug terminal strip
C1,6	.1 paper 200V
C2,8	120 ceramic
C3	200 ceramic
C4	270 ceramic
C5,10,11	.005 disc ceramic
C7	82 ceramic
C9	180 ceramic
R1,8,19	470K ½ watt resistor
R2	6.8 K ½ watt resistor
R3	33K ½ watt resistor
R4,15	680 ½ watt resistor
R5	560K ½ watt resistor
R6,12,16	390K ½ watt resistor
R7,17	270K ½ watt resistor
R9,20	470 ½ watt resistor
R10,13,21	8.2K ½ watt resistor
R11,22	4.7K ½ watt resistor
R14	39K ½ watt resistor
R18	180K ½ watt resistor
R23	25K potentiometer



NOTE:
→ INDICATES SOURCE
→ TO SOURCE

MODEL DI-1 SCHEMATIC	
DATE 21-3-61 REV. 18-9-61	
DRAWN BY	R.L.P.
CKD. BY	R.L.W.
SCALE	2:1
ENGR.	R.L.P.

P & H ELECTRONICS
LAFAYETTE, INDIANA



TUBES – 2EA. 6AN8A – V-1, V-2

NOTES:
→ INDICATES SOURCE
← TO SOURCE

MODEL TT-1 SCHEMATIC	
DATE 25-9-61 REV.	
DRAWN BY RAP	
CKD. BY R.L.W.	
SCALE 2:1	
ENGR. GLG	
P&H ELECTRONICS LAFAYETTE, INDIANA	

R. F. DISTORTION INDICATOR
Model DI-1

PARTS LIST

PART NO.	PART DESCRIPTION
C1,12	.001 Mfd. disc ceramic
C2	1 mmfd. ceramic
C3	4 mmfd. ceramic
C4	8 mmfd. ceramic
C5	15 mmfd. ceramic
C6	50 mmfd. ceramic
C7	.1 Mfd. paper
C8,9,10,18,19	.005 Mfd. disc ceramic 2KV
C11	.02 disc ceramic 1600V
C13	240 mmfd. mica
C14	.02 disc ceramic
C15	.01 paper
C16	.05 paper 1600V
C17,22,23	8 Mfd. electrolytic 450V
C20	2 x .5 Mfd. Bathtub 1000V
C21	20 Mfd. electrolytic 450V
C24,25,26,27	.005 disc ceramic 600V
R1	4.7K ½ watt resistor
R2	22K ½ watt resistor
R3	68K ½ watt resistor
R4,7,19	1 Meg. ½ watt resistor
R8,9,12	100K ½ watt resistor
R10	680K ½ watt resistor
R13	6.8K ½ watt resistor
R14	82K ½ watt resistor
R16	2.2 Meg. ½ watt resistor
R17	56K ½ watt resistor
R18	12K ½ watt resistor
R21	220K ½ watt resistor
R23	1K ½ watt resistor
R30	4.7K ½ watt resistor
R31	47K ½ watt resistor
R11,27	560 1 watt resistor
R25	47 ohm 1 watt resistor
R28	68K 2 watt resistor
R24	1K 2 watt resistor
R26,29,32	100K 2 watt resistor
R5,6	1 Meg. potentiometer
R15,22	500K potentiometer
R20	100K potentiometer

MODEL DI-1 PARTS LIST (CONT.)

PART NO.	PART DESCRIPTION
J1,2,3,4	SO239 coax connector
J5	RCA phono jack
RFC-1,-2	1 MH RF choke
V1	12AT7 tube
V2	6AL5 tube
V3	3AP1 CR tube
I1	Pilot light assembly
S1	6 pan 1 pole switch
S2	DPDT switch
S3	3 pole 4 psn. switch
T1	BE8788 power transformer
F1	2A fuse
CR1	1N34 diode
SR1	V50HP selenium rectifier
CH1	DI-1 chassis
BK1	DI-1 bracket
PL1	DI-1 panel
CA1	DI-1 cabinet with feet
X1	Octal socket
X2	7 pin miniature tube socket
X3	7 pin large tube socket
X4,5	9 pin miniature tube socket
TA1,4	3 term lug
TA2	2 term lug
TA3	6 term lug
TA5,6	5 term lug
TA7	4 term lug