AN 16-30APA11-3

HANDBOOK OF MAINTENANCE INSTRUCTIONS

for

RADAR INDICATOR ASSEMBLY AN/APA-11

RESTRICTED

(For Official Use Only)

Keller-Crescent Co., Evansville, Ind.—5-30-45—19,400

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Destruction of Abandoned Materiel in the Combat Zone

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:-

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:-

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

★

Unsatisfactory Report

For U. S. Army Air Force Personnel:

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Radio model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

For U. S. Navy Personnel:

Report of failure of any part of this equipment during its guaranteed life shall be made on Form N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the inspector of Naval Materiel (location to be specified) and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:

Form 1022 procedure shall be used when reporting failure of radio equipment.

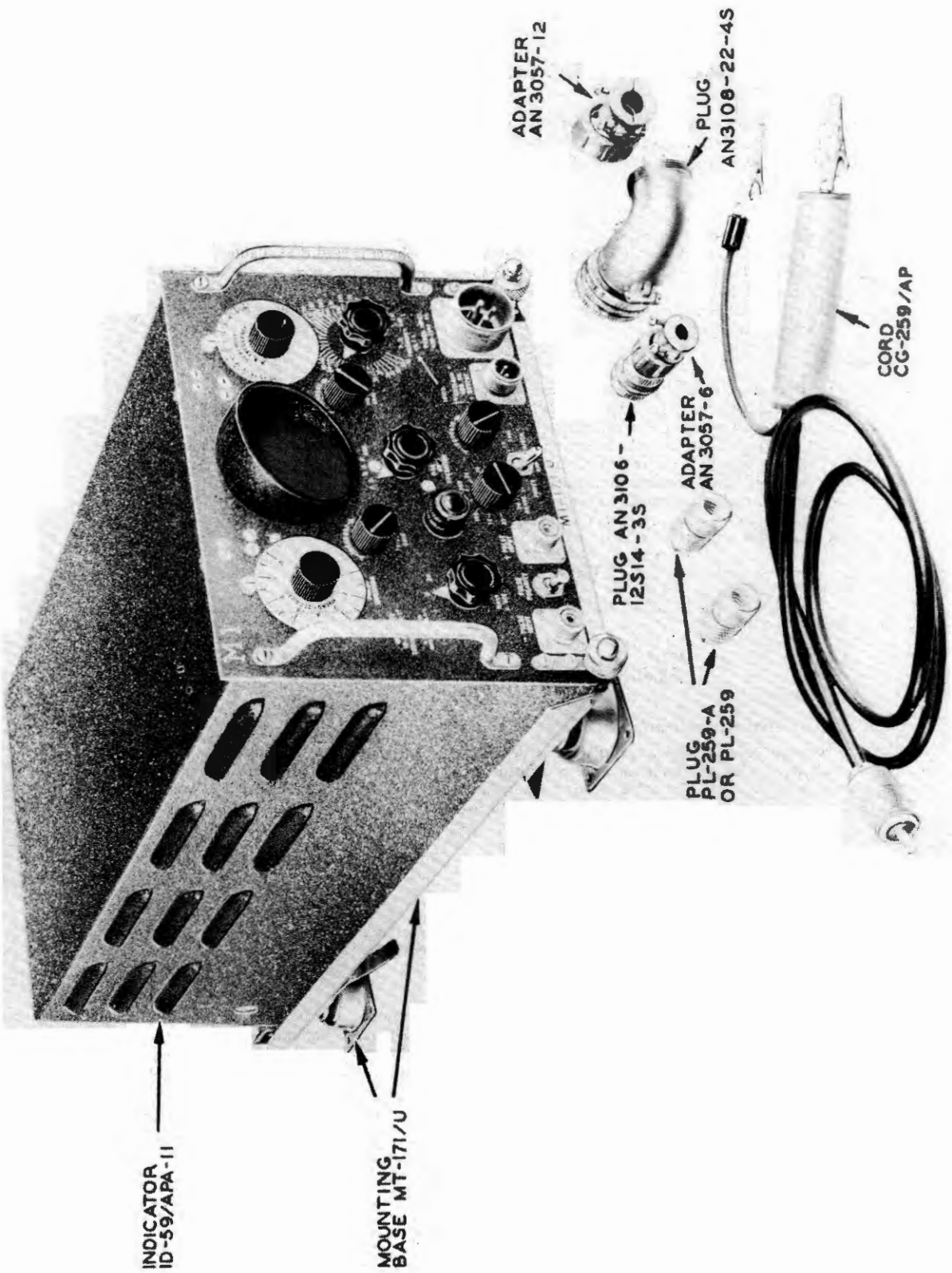


Figure 1-1. Radar Indicator Assembly AN/APA-11—Major Components

SAFETY NOTICE

This equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

SECTION I
GENERAL DESCRIPTION

1. GENERAL.

a. Radar Indicator Assembly AN/APA-11 (see figure 1-1) is designed for airborne use to assist in the identification and location of radar installations which operate on a pulse repetition frequency between 200 and 6000 cycles per second. This equipment operates when supplied with either a positive or a negative pulsed signal. It is used in conjunction with Receiving Equipment AN/APR-1, AN/APR-4, Radio Set SCR-587-A, Photographic Adapter AN/APA-7, or similar equipment. It is a pulse analyzer with three modes of operation. Two modes permit the analyzing and identifying of pulses. The third allows the equipment to be used as an ordinary cathode-ray oscilloscope. The modes of operation are as follows:

(1) Measurement of pulse length or pulse duration time between ½ and 100 microseconds.

(2) Determination of pulse repetition frequency or rate.

(3) As an airborne cathode-ray oscilloscope.

b. This equipment operates satisfactorily from —40°C to +60°C (—40°F to +140°F).

c. The following table lists the power requirement for this equipment:

Volts (Nominal)	*Line Voltage*	*Current Drawn*	*Operating Power*	*Power Factor*	*Frequency*
115.7 or	105 to 125	1.74 amperes	196 watts at 115 volts and 400 cycles per second	0.90	400 to 2600 cycles per second
80.0 See sec. II, par. 1.*a.* (2)	75 to 85	2.45 amperes	196 watts at 80 volts and 400 cycles per second	.90	400 to 2600 cycles per second

2. EQUIPMENT SUPPLIED.

The following equipment is supplied with Radar Indicator Assembly AN/APA-11:

Quantity	*Name of Unit*	*Army Type Designation*	*Navy Type Designation*	*Overall Dimensions (inches)*	*Weight (pounds)*
1	Indicator	ID-59/APA-11	ID-59/APA-11	Complete unit with shock mounts 7⅞ x 10¼ x 21½	46.25
1	Plug	AN3108-22-4S	AN3108-22-4S	3 1/16 x 2 5/16 x 1 9/16	0.25
1	Adapter	AN3057-12	AN3057-12	1½ x 1 9/16	0.06
2	Plug	PL-259-A or PL-259	PL-259-A	¾ x ¾ x 1½	0.05 each
1	Plug	AN-3106-12S14-3S	AN3106-12S14-3S	1 x 1 x 1½	0.06
1	Adapter	AN3057-6	AN3057-6	15/16 x 15/16 x 1	0.06
1	Cord includes:	CG-259/AP	CG-259/AP	36	0.5
1	Plug	PL-259	PL-259-A		0.05
1	Mounting Base	MT-171/U	MT-171/U	2 7/16 x 11 1/16 x 23	2.0

3. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

The following equipment is required but not supplied for complete installation and maintenance of this assembly:

Quantity	*Name of Unit*	*Army Type Designation*	*Navy Type Designation*	*Required Characteristics*
As required	Adapter	M-359		
1	Standard Voltmeter			1,000 ohms per volt
1	Standard Voltmeter			20,000 ohms per volt
1	Test Oscillator	TS-47/APR	TS-47/APR	
1	Jackson Audio Oscillator (or equivalent)	Type 652		20 to 20,000 cycles

4. DESCRIPTION OF MAJOR ASSEMBLIES.

Radar Indicator Assembly AN/APA-11 functions as a device to measure the width and repetition frequency of pulse signals from radar equipment and also as a cathode-ray oscilloscope. It consists of Indicator ID-59/APA-11 which includes a chassis with six separate plug-in units (see figures 1-2 and 1-3), Mounting Base MT-171/U, and accessories.

a. INDICATOR ID-59/APA-11.—This indicator is a chassis and control panel with the following six plug-in units. (See figure 1-3.)

(1) The video amplifier is a three-stage amplifier whose output connects to the vertical plates of the cathode-ray tube. (See figure 1-4.) Connecting plugs are on the bottom.

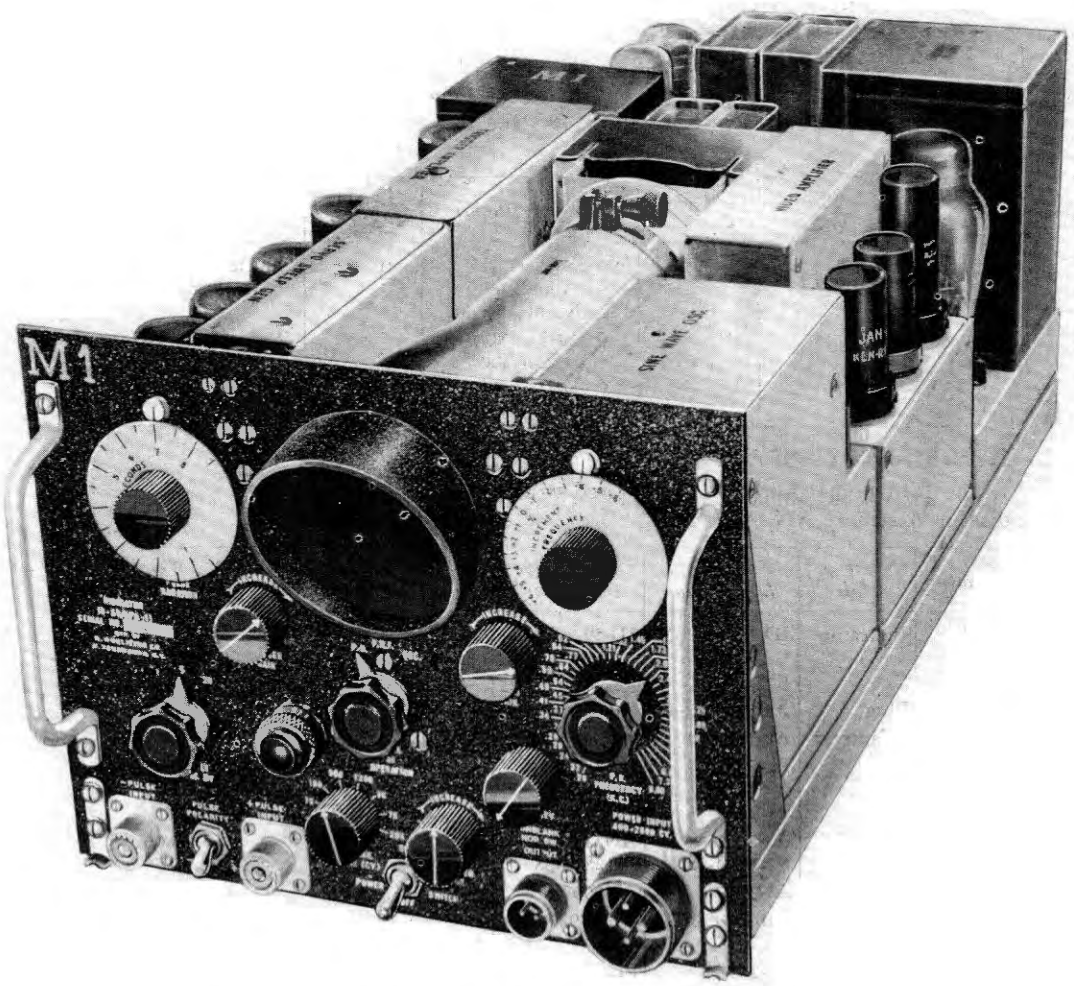


Figure 1-2. Indicator ID-59/APA-11—Dust Cover Removed

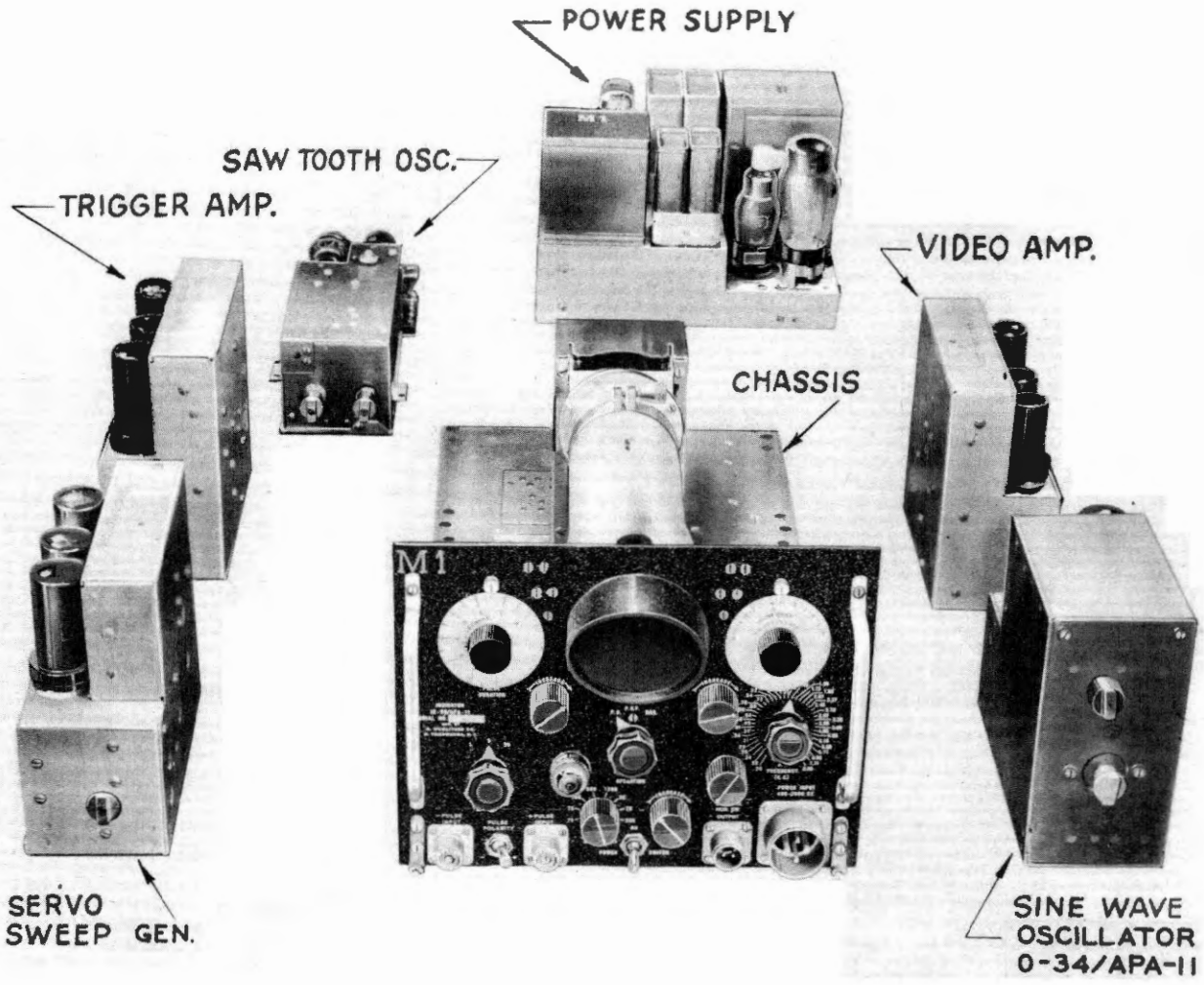


Figure 1-3. Indicator ID-59/APA-11—Units Removed

(2) The trigger amplifier unit contains both the inverter and trigger amplifier, however they are separate and perform separate functions. (See figure 1-5.) Connecting plugs are on the bottom.

(a) The inverter reverses the polarity of negative input signals but it is not used if input signals are positive.

(b) The trigger amplifier is a three-stage amplifier that builds up the input signal to a magnitude sufficient to operate the servo-sweep generator.

(3) The servo-sweep generator is tripped by the amplified signal from the trigger unit and generates a sweep voltage which is applied to the horizontal plates of the cathode-ray tube. (See figure 1-6.) Connecting plugs are on the bottom.

(4) The saw-tooth oscillator provides a sweep voltage for the horizontal plates when Indicator ID-59/APA-11 is used as an oscilloscope. Figure 1-7 shows the location of the controls and one connecting plug.

(5) The sine wave oscillator is a two-tube unit. It provides a means for determining the pulse repetition frequency of radar installations. (See figure 1-8.) Connecting plugs are on the bottom.

(6) The power supply (see figure 1-9), containing four tubes, is the source of filament and d-c voltage. It is connected at the factory for 105- to 125-volt operation at 400- to 2600-cycles per second. A tap for 75- to 85-volt operation is provided. Connecting plugs are on the bottom.

b. MOUNTING BASE MT-171/U.—This is a shock-mount base designed to hold Indicator ID-59/APA-11 in place in the aircraft. (See figure 1-1.)

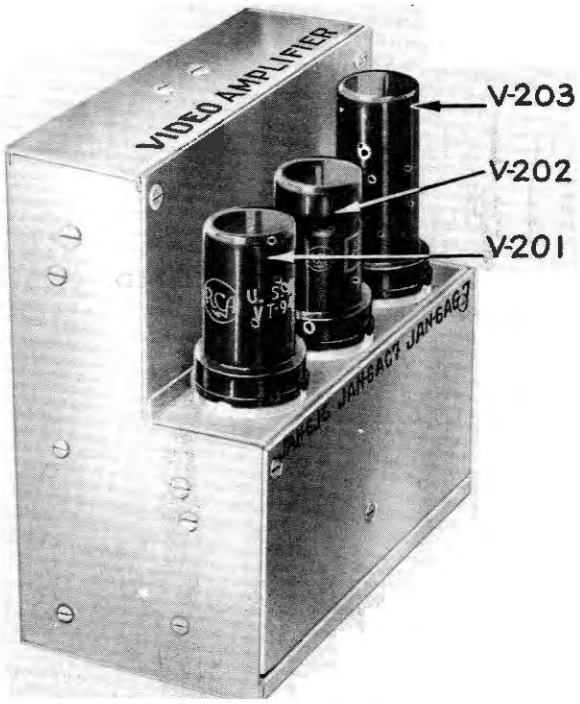


Figure 1-4. Video Amplifier—Outside View

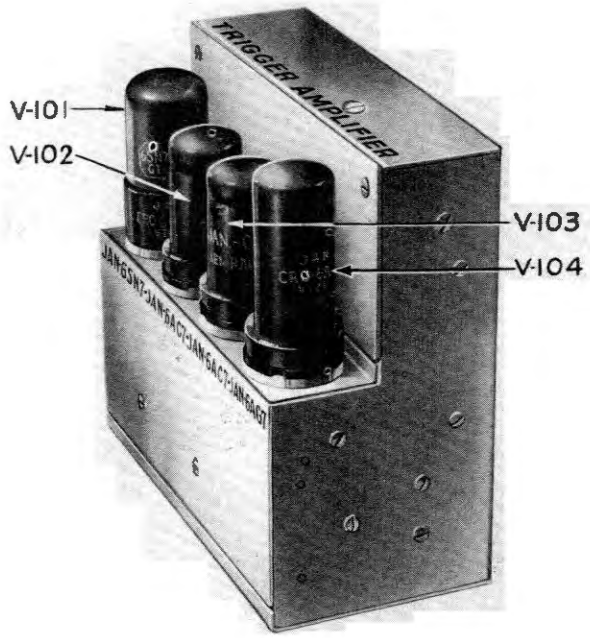


Figure 1-5. Trigger Amplifier—Outside View

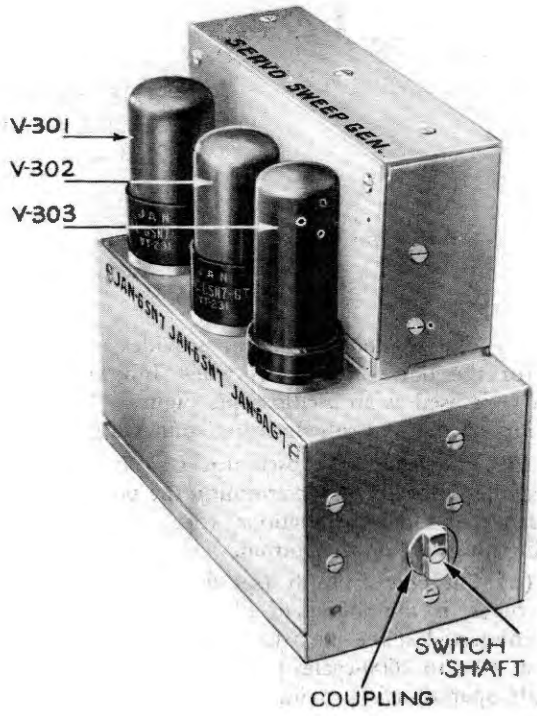


Figure 1-6. Servo-Sweep Generator—Outside View

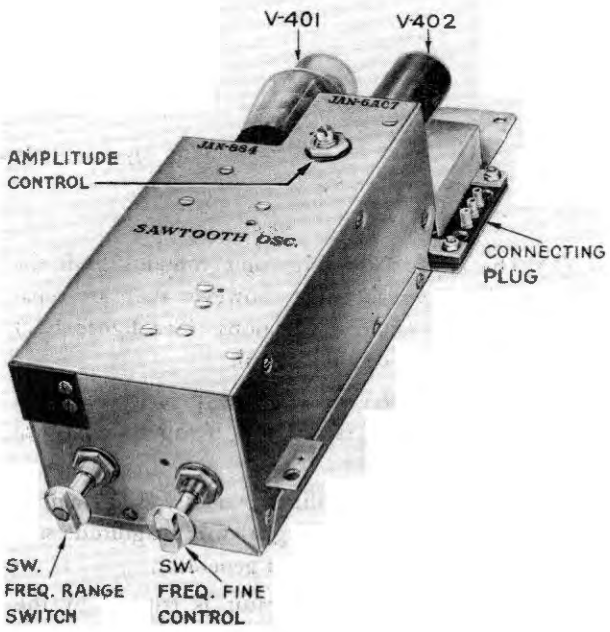


Figure 1-7. Saw-tooth Oscillator—Outside View

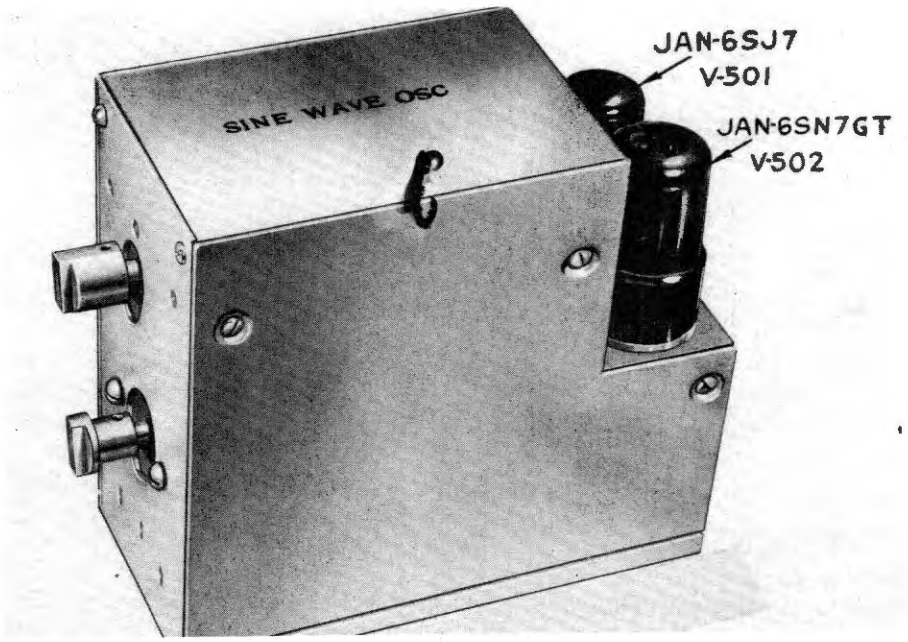


Figure 1-8. Sine Wave Oscillator O-34/APA-11—Outside View

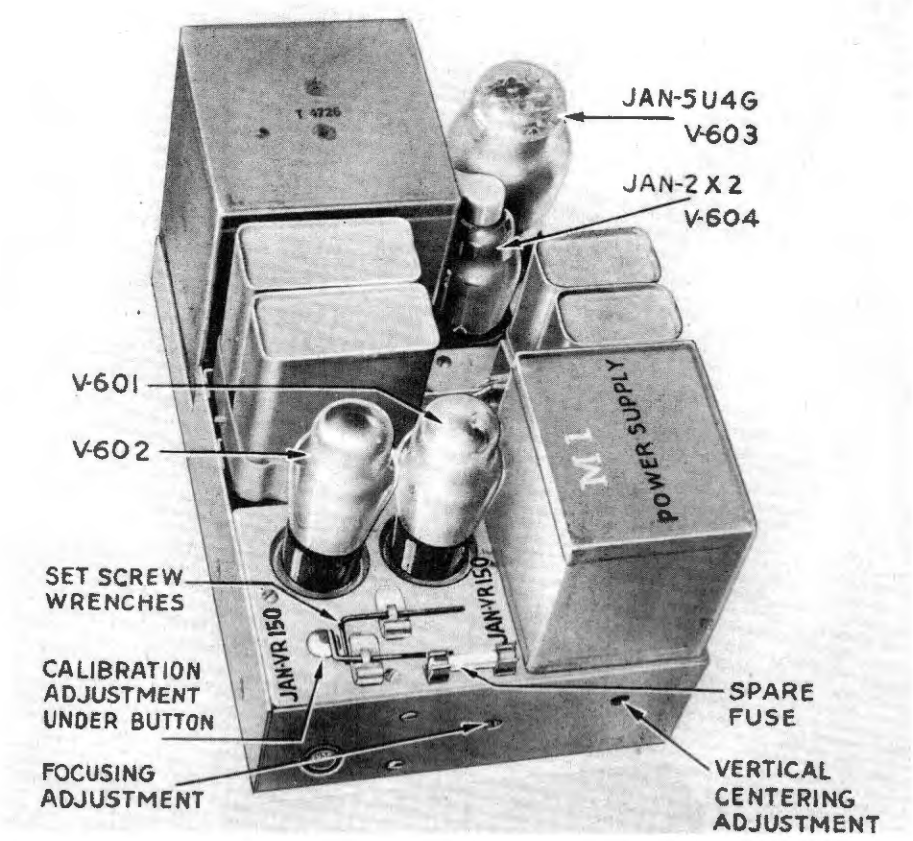


Figure 1-9. Power Supply—Outside View

SECTION II
INSTALLATION AND ADJUSTMENT

WARNING

High voltages are employed in this equipment which may prove fatal if contacted. Extreme caution should be exercised when working with the equipment.

Note

All numerical references to controls will be found in figure 2-1.

1. INSTALLATION.

a. PRELIMINARY PROCEDURE.

(1) UNPACKING.—Use care in unpacking the equipment so that nothing is damaged. Then give the equipment a visual check to make sure that everything is in good order. Check against the list in section I, paragraph 2, to make sure that all parts are there (including the six plug-in units).

(2) PRELIMINARY ADJUSTMENT.

(a) Indicator ID-59/APA-11 is connected by the manufacturer to operate on 105 to 125 volts a-c and normally requires no preliminary adjustment. When the equipment is required to operate on 75 to 85 volts a-c the tap on the power transformer must be changed as follows:

Note

Use a 2-ampere fuse on 115-volt operation and a 3-ampere fuse on 85-volt operation.

1. Remove Indicator ID-59/APA-11 from the mounting base by cutting the safety wires holding the knurled clamping nuts and loosening the two knurled clamping nuts in front and swinging them down.

2. Turn the power switch off and start to remove the dust cover by loosening the two airlock fasteners on the back of the dust cover near the bottom. Remove the two nickel-plated binder head screws on the top just back of the control panel and pull the chassis from the dust cover.

3. Then change the transformer tap by cutting the safety wires on the snap slides holding the power supply and releasing the snap slides. Lift the power supply out; remove its bottom and unsolder the lead at terminal 3 and connect it to terminal 2. (See figure 5-15.)

(b) Reassemble Indicator ID-59/APA-11 by using the following procedure:

1. Fasten the bottom on the power supply unit. Pull the snap slides out, plug the power supply unit in and close the snap slides. Put safety wires on the snap slides.

2. Replace the dust cover and then screw two 6-32 $\frac{5}{16}$ inch binder head screws in the top of the dust cover just back of the control panel.

3. Tighten the airlock fasteners on the indicator and fit it on Mounting Base MT-171/U so that the hold-down pins on the base fit into the holes in back.

4. Then swing the front clamping assembly up over the hold-down hooks, tighten the knurled nuts and put safety wires on to hold knurled nuts.

(3) BENCH TEST.

(a) Check the pulse duration time measurements using Test Oscillator TS-47/APR (or equivalent) and Receiving Equipment AN/APR-4 (see section V, paragraph 1.*a.*(2)*(c)1.*)

(b) Check of repetition frequency determination. (See section V, paragraph 1.*a.*(2)*(c)*2.)

(c) Check of oscilloscope operation. (See section V, paragraph 1.*a.*(2)*(c)*3.)

b. INSTALLATION.

(1) MOUNTING BASE MT-171/U.—Bolt the mounting base to a flat horizontal surface using the mounting dimensions given in figure 8-1 to locate the holes for bolting.

(a) Allow sufficient clearance on all sides and on the top for free action of the shockmounts and for removal of Indicator ID-59/APA-11 from the mounting base.

(b) Each of the four ground straps should be attached to a shockmount mounting hole by means of a mounting screw inserted in the lug in the free end of the ground strap. This must be a good ground connection.

(2) CLAMP INDICATOR ID-59/APA-11 TO MOUNTING BASE.

(a) Place Indicator ID-59/APA-11 on mounting base so that hold-down pins on base fit into holes in back.

(b) Swing front clamping assembly up over hold-down hooks and tighten knurled nuts.

(c) Put safety wires on. Wires go through the knurled nuts and adjacent small holes in front of the mounting base (see figure 8-1).

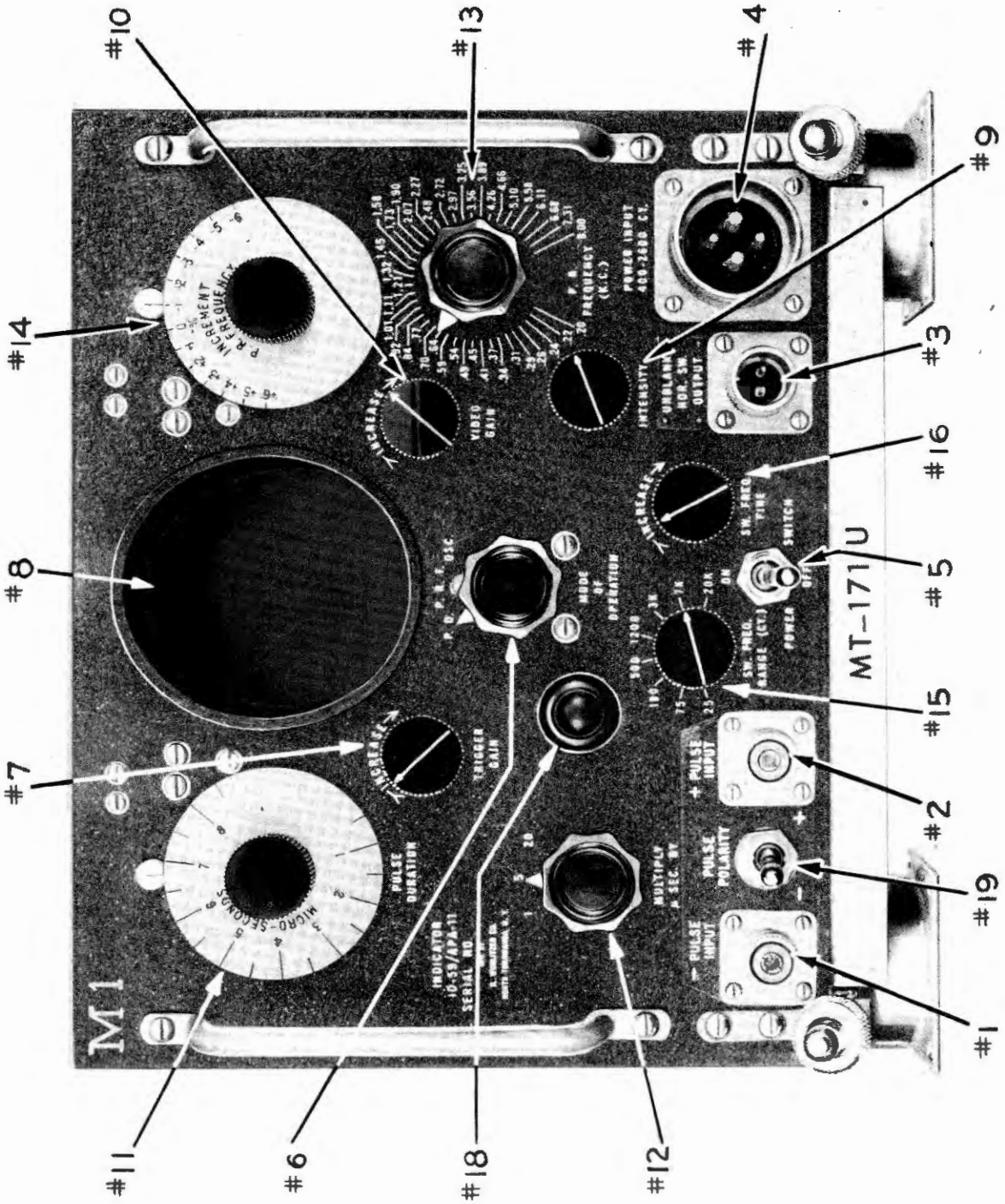


Figure 2-1. Indicator ID-59/APA-11—Control Panel

c. MAKING CABLES.—Installation instructions supplied with Radar Indicator Assembly AN/APA-11 should be followed for making up the cables as requirements differ in various types of aircraft. General instructions follow.

(1) Power cable specifications and wiring connections are found in figure 8-2. Cut a length of cable long enough to permit dressing along the fuselage of the aircraft from "POWER INPUT 400-2600 CY" socket (AN3102-22-4P) to the power source. Connect adapter AN3057-12 and plug AN3108-22-4S to one end of the cord and connect the free end to the power source.

(2) Cut lengths of Radio Frequency Cable RG-8/U long enough to reach from Indicator ID-59/APA-11 to the receiver supplying the signal. Connect plug PL-259-A or PL-259 to the cable end that attaches to the indicator. Attach a plug suitable for connecting to the receiving equipment to the other end of the cable.

d. CABLE CONNECTIONS.

(1) Connect cable from receiving equipment supplying negative pulsed voltage to connector socket SO-239, marked "—PULSE INPUT" (#1). (See figures 2-1 and 8-2.)

(2) Connect cable from receiving equipment supplying positive pulsed voltage to connector socket SO-239, marked "+PULSE INPUT" (#2). (See figures 2-1 and 8-2.)

(3) Connect cable from receiving equipment using horizontal sweep and requiring unblanking pulse to Socket AN-3102-12S-3P, marked "UNBLANK HOR. SW. OUTPUT" (#3). (See figures 2-1 and 8-2.)

(4) Connect cable from power source to connector socket AN3102-22-4P, marked "POWER INPUT 400-2600 CY" (#4). (See figures 2-1 and 8-2.)

2. ADJUSTMENT.

Preliminary adjustment is described in section II, paragraph 1.*a.*(2). No further adjustment of this equipment need be made after installation. If internal adjustments are necessary, see section V, paragraph 6.

3. AFTER-INSTALLATION TEST.

a. Check the equipment and the associated plugs and cables to make sure that they are secure.

b. Check knobs and dials for tightness to shafts.

c. Check Indicator ID-59/APA-11 for proper operation on all modes of operation.

(1) To check the pulse duration time, proceed as follows:

(a) Connect cable from video output on associated receiver to either positive or negative pulse input on Indicator ID-59/APA-11 depending on the polarity of the pulse.

(b) Attempt to tune in a signal on the receiver from some nearby transmitter.

(c) If no signal can be obtained on the associated receiver, it will be necessary to supply a signal from Test Oscillator TS-47/APR. Place the test oscillator in the vicinity of the receiving antenna outside the aircraft, and proceed as follows:

1. Remove the cap from the "ANTENNA" connector on the test oscillator and pull out the center conductor to a length that equals about one-quarter of the wave length of the desired frequency.

2. Connect the test oscillator to the proper voltage source.

Note

The external power source must be of the type and voltage shown on the power source indication on the front of the test oscillator.

3. Set the band selector switch on the test oscillator to correspond with the frequency band to be used.

4. Turn the "OSCILLATOR FREQUENCY" control knob to the desired frequency as indicated by the "MEGACYCLES" dial on the oscillator panel.

5. Place the test oscillator "OUTPUT" switch to the desired signal strength.

6. Place the test oscillator "MODULATION" switch in the "PULSE" position.

7. Turn the test oscillator "POWER-OFF" switch on, and place the "DIAL LIGHT-OFF" switch in the up position.

(d) Start the associated receiver by turning on the power.

(e) Follow the procedure given in section V, paragraph 1.*a.*(2)*(c)1.* for the remainder of the pulse duration time check.

(2) To check the pulse repetition frequency, follow the procedure given in section V, paragraph 1.*a.*(2)*(c)2.*

(3) To check the oscilloscope operation, follow the procedure given in section V, paragraph 1.*a.*(2)*(c)3.*

SECTION III

OPERATION

Note

All numerical references to controls will be found in figure 2-1.

1. STARTING AND STOPPING EQUIPMENT.

a. TO START.—Throw "POWER SWITCH" (see figure 2-1, #5) to "ON" position.

b. TO STOP.—Throw "POWER SWITCH" to "OFF" position.

2. OPERATION.

a. TO MEASURE PULSE DURATION TIME.

(1) Turn "MODE OF OPERATION" switch (figure 2-1, #6) to "P.D."

(2) Adjust associated equipment to supply Indicator ID-59/APA-11 with either (or both) negative or positive pulsed voltage. Throw "PULSE POLARITY" (#19) switch to left or right for required signal.

(3) Adjust "TRIGGER GAIN" (#7) control to obtain a stationary pattern on screen of cathode-ray tube (#8).

(4) Turn "INTENSITY" control (#9) until beam is at suitable brilliancy. Avoid blooming of spot at left edge of trace.

(5) Set "VIDEO GAIN" (#10) to give a convenient vertical deflection between 1/4 and 3/4 inches.

(6) Turn "PULSE DURATION" dial (#11) to set left edge of trace near left side of screen of cathode-ray tube (#8).

(7) Turn "MULTIPLY SEC. BY" switch (#12) to 1, 5, or 20, separate the start and finish of the pulse, keeping each well on the screen.

(8) Using "PULSE DURATION" dial (#11), set point on right side of pulse 3 db down (approximately 30 percent) from peak to vertical index line. Read microsecond setting on this dial.

(9) Using "PULSE DURATION" dial (#11), set point on left side of pulse 3 db down (approximately 30 percent) from peak to vertical index line. Again read the microsecond setting. Difference between readings of (8) and (9) multiplied by indicated multiplying factor of (7) above is the pulse duration time in microseconds.

b. TO DETERMINE REPETITION FREQUENCY. —Adjust the associated equipment to supply Indicator ID-59/APA-11 with either (or both) negative or positive pulsed voltage. Throw the "PULSE POLARITY" (#19) switch to the left or the right for the required signal.

(1) Turn "MODE OF OPERATION" switch (#6) to "P.R.F."

(2) Set "MULTIPLY SEC. BY" (#12) to "5."

(3) Adjust "TRIGGER GAIN" control (#7) to near maximum.

(4) Set "INTENSITY" control (#9) to obtain suitable brilliancy. Avoid too much brilliancy.

(5) Turn "P.R. FREQUENCY (K.C.)" (#13) and "INCREMENT P.R. FREQUENCY" (#14) to ".20 K.C." and "0%" respectively.

(6) Adjust "VIDEO GAIN" control (#10) to separate the multiple traces.

(7) Starting at the extreme counterclockwise positions as mentioned in (5) above, turn "P.R. FREQUENCY (K.C.)" control (#13) step by step to the right and watch pattern of moving horizontal or near horizontal lines on screen. Look for (a) a mass of lines that are nearly indistinguishable from each other; or (b) four, three, two, or one line. In general when condition (a) exists, the equipment is operating near condition (b). Condition (b) gives a close indication of the true pulse repetition frequency.

(8) When a position of the "P.R FREQUENCY (K.C.)" switch (#13) is found giving condition (a), turn "FREQUENCY INCREMENT" dial to the left and to the right slowly enough to bring pattern into a stationary position, if this is possible, and see if pattern fulfills condition (b) of sub-paragraph (7) above. If it does not, continue turning "P.R. FREQUENCY (K.C.)" (#13) switch to right and adjusting "INCREMENT P.R. FREQUENCY" dial (#14) until condition does exist.

(9) The first point at which a single stationary trace may be found, while carefully turning "P.R. FREQUENCY (K.C.)" switch (#13) from extreme left toward the right and at the same time slowly adjusting "INCREMENT P.R. FREQUENCY" dial (#14), is the one indicating the true pulse repetition frequency. Other single stationary traces will be found beyond this point but these may be neglected except as indicated in subparagraph (12) below.

(10) To determine the actual pulse repetition frequency when the correct single trace is found, multiply the frequency indicated at "P.R. FREQUENCY (K.C.)" knob (#13) by 1000 and increase or decrease the resulting number by the percentage indicated by the "INCREMENT P.R. FREQUENCY" dial (#14). Determine the actual pulse repetition frequency as illustrated in the following example.

EXAMPLE

The "P.R. FREQUENCY (K.C.)" knob (#13) points to 1.90 and the "INCREMENT P.R. FREQUENCY" dial (#14) indicates + 2 percent. The correct P.R.F. may be determined as follows: $1.90 \times 1000 = 1900$ pulses per second. 2 percent of 1900 is 38. $1900 + 38 = 1938$ pulses per second which is the correct P.R.F. within plus or minus 5 percent.

(11) The number of stationary traces seen on the screen always has some definite relationship to the P.R.F. However, the usable traces in determining P.R.F. are one, two, three, four. The table below gives the relationship between the stationary lines and the ratio of actual P.R.F. to the indication at the "P.R. FREQUENCY (K.C.)" knob (#13) as well as the number of steps required to reach the actual P.R.F.

Oscilloscopic Pattern Stationary Lines	*Radio Actual P.R.F. to Indication on "P.R. FREQUENCY (KC)" (#13)*	*Turn Switch to Right for One Less Line*	*Turn Switch to Right for P.R.F.**
1	1:1	0	This is P.R.F. except as noted in (12) below.
2	2:1	7 or 8	7 or 8
3	3:1	4 or 5	12 or 13
4	4:1	2 or 3	15 or 16

* The relationships as shown in the two columns to the right are only approximate and adjusting the "Increment P.R. Frequency" dial to actually find the desired trace requires care.

(12) Other single traces may be found when the "P.R. FREQUENCY (K.C.)" knob (#13) is adjusted to the right of the true indicating single trace so that if a single trace is found quickly without going through the sequence of operations outlined in paragraphs (7), (8), (9), (10), and (11) above it will be necessary to make a check to find if it is true or spurious. This check consists of turning the "P.R. FREQUENCY (K.C.)" knob (#13) 7 or 8 steps to the left. If proper adjustment of the "INCREMENT P.R. FREQUENCY" dial (#14) at either of these two steps shows *two* traces then the frequency indicated when the single trace was obtained is the true P.R.F.

(13) The method of checking back 8 or 9 steps from a single trace to a double trace to be sure the single trace is correct may not be applied below a P.R.F. of 400 because of limitations of the indicator. When a single trace appears with "P.R. FREQUENCY (K.C.)" knob (#13) adjusted between ".20" and ".41," it will have to be assumed that this is the true trace and P.R.F. established accordingly.

c. TO OPERATE AS CATHODE-RAY OSCILLOSCOPE.

(1) Attach Cord CG-259/AP to "—PULSE INPUT" (#1). Throw "PULSE POLARITY" switch (#19) to "—" (left position). (See figures 2-1 and 8-2.)

(2) Turn "MODE OF OPERATION" switch (#5) to "OSC."

(3) Turn "TRIGGER GAIN" control to minimum.

(4) Adjust "INTENSITY" control (#9) to obtain required trace brilliance.

(5) Adjust "PULSE DURATION" control (#11) for horizontal centering.

(6) Connect test probe to point where signal is to be checked. Adjust "VIDEO GAIN" control (#10).

(7) Select sweep frequency.

(a) Set "SW. FREQ. RANGE CY" switch (#15) pointer to approximate frequency desired.

(b) Turn "SW. FREQ. FINE" control (#16) to select the frequency required to stabilize the pattern on the screen. (With this control, frequencies above and below that indicated by "SW. FREQ. RANGE (CY)" switch (#15) position may be obtained and overlapping of frequencies between "SW. FREQ. RANGE (CY)" switch (#15) steps is thereby provided.)

d. TO ADJUST PILOT LAMP (#18) BRIGHTNESS.—Use finger to rotate the lens assembly slightly clockwise or counterclockwise to obtain desired brightness.

SECTION IV
THEORY OF OPERATION

1. GENERAL.

a. The purpose of Radar Indicator Assembly AN/APA-11 is to assist in the identification and location of radar installations. It may also be used as a conventional cathode-ray oscilloscope.

b. In order to trace the course of a signal through the equipment, proceed as follows:

(1) With the "MODE OF OPERATION" switch placed on "P.D."

(a) A negative pulsing signal introduced at "—INPUT PULSE" receptacle is fed into both the video amplifier and the trigger amplifier via the inverter when the "PULSE POLARITY" switch is thrown in the direction to complete the proper circuits. A positive pulsing signal introduced at the "+INPUT PULSE" receptacle is also fed to the video and the trigger amplifiers but in this case the inverter is by-passed when the "PULSE POLARITY" switch is in the proper position.

(b) Video amplifier amplifies and delays signal and feeds it to the vertical plates of tube V-1.

(c) Trigger amplifier amplifies the signal and feeds it to servo-sweep generator.

(d) Servo-sweep generator is triggered and supplies horizontal sweep voltage to the horizontal plates of tube V-1 and "HOR. SW. OUTPUT" jack and unblanking voltage to the control grid of tube V-1 and the "UNBLANK OUTPUT" jack. (The slight delay provided by the video unit allows the entire pulse shape to appear on the screen because the pulse arrives at vertical plates just as the horizontal sweep has been started. Pattern of signal is synchronized on the screen because both vertical and horizontal plates are actuated by the same pulse signal.)

(2) With the "MODE OF OPERATION" switch placed on "P.R.F."

(a) Signal at "—PULSE INPUT" or "+PULSE INPUT" goes into trigger amplifier as in paragraph (1)*(a)* above but does not go into video amplifier.

(b) Sine wave oscillator feeds into video amplifier.

(c) Video amplifier amplifies the sine wave signal and applies it to the vertical plates of tube V-1.

(d) Trigger amplifier amplifies the signal and feeds it to the servo-sweep generator.

(e) Servo-sweep generator is triggered and supplies horizontal sweep voltage to the horizontal plates of tube V-1 and "B" terminal of "UNBLANK HOR. SW. OUTPUT" receptacle and an unblanking voltage to the control grid of tube V-1 and "A" terminal of the same receptacle.

(f) Pattern on screen is a horizontal trace or traces.

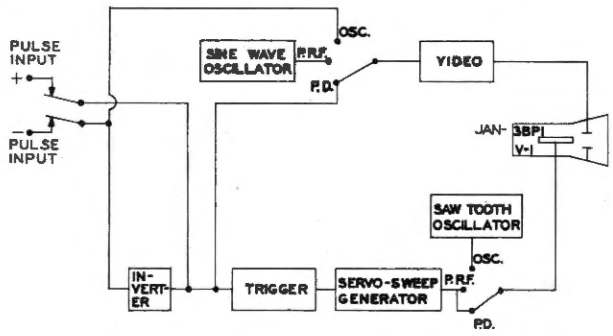


Figure 4-1. Indicator ID-59/APA-11—Functional Block Diagram

(3) With "MODE OF OPERATION" switch placed on "OSC." (cathode-ray oscilloscope operation):

(a) Signal "—PULSE INPUT" is fed directly into the video amplifier which amplifies the signal and applies it to the vertical plates of tube V-1 and to the saw-tooth oscillator for synchronizing.

(b) Saw-tooth oscillator impresses the sweep voltage on the horizontal plates of tube V-1, leaving the pattern on screen in the shape of an input signal.

2. DETAILED FUNCTIONING.

a. VIDEO AMPLIFIER.—This amplifier uses three tubes JAN-6J5, JAN-6AC7, and JAN-6AG7 in cascade. Its output connects the vertical plates of the cathode-ray tube. Its frequency range is from 200 cycles to 4 megacycles. In addition to amplifying the input signal, the video unit introduces in its last stage the slight time delay caused by induction L203 in series with the plate which is necessary to permit the start of an incoming pulse to appear on the screen.

b. TRIGGER AMPLIFIER.—This amplifier uses two tubes JAN-6AC7 and one tube JAN-6AG7 in cascade. An additional tube JAN-6SN7GT is housed in this unit and is used when necessary to change the phase of the input voltage by 180 degrees. The trigger amplifier output connects to the servo-sweep generator supplying the latter with a voltage of sufficient amplitude to "trigger" it.

c. SERVO-SWEEP GENERATOR.—This unit consists of a *flip-flop,* or trigger, using tube JAN-6SN7GT (V-301), a sweep circuit using tube JAN-6AG7 (V-303), and two cathode followers, each using a section of tube JAN-6SN7GT (V-302).

(1) The *flip-flop* is biased so that it is normally at rest with tube JAN-6SN7GT (V-301) section (#4, #5, and #6 socket terminals) drawing current due to a plus-150-volt potential on the grid.

(2) The other section (#1, #2, and #3 socket terminals) is normally biased to cut-off due to a d-c voltage across the bias resistor R-303 and ground potential on the grid.

(3) Tube JAN-6AG7 (V-303) in the sweep circuit has approximately zero bias so that at rest it is drawing current and its plate is at a d-c potential lower than 350 volts due to the voltage drop across R-317, R-316, and R-315 in parallel and L-302.

(4) When a pulse of negative polarity is impressed on the servo-sweep generator input, the trigger or *flip-flop* makes one complete cycle and drives the grid of tube JAN-6AG7 (V-303) to cut-off.

(5) When tube JAN-6AG7 (V-303) is cut off its plate voltage increases, the rate of increase being determined by capacitor C-313, C-314, or C-315, whichever is connected via S301B to the plate. The resulting voltage is impressed on the horizontal plates of the cathode-ray tube and provides a horizontal sweep.

(6) An unblanking voltage is taken off the trigger via coupling capacitor C-309 and put through a cathode-follower section of V-302 from which it is applied to the 3BP1 (V-1) and a jack on the panel.

(7) The other cathode-follower section of tube JAN-6SN7GT (V-302) is coupled to tube JAN-6AG7 (V-303) and supplies a horizontal sweep voltage to the "B" terminal of the "UNBLANK HOR. SW. OUTPUT" jack on the panel.

d. SINE WAVE OSCILLATOR O-34/APA-11.—This unit includes an oscillator section and an output amplifier.

(1) The oscillator section is a two-stage resistance coupled amplifier, using tube JAN-6SJ7 (V-501) and one section of tube JAN-6SN7GT (V-502), over which both positive and negative feedback are applied. The positive feedback is a frequency selective, resistor capacitor combination (resistors are on switches S-501A and S-501B; capacitors are C-501A, C-501B, C-502, C-503, C-504, C-505) which is used to control the frequency of oscillation. Negative feedback is used to stabilize the operation of the circuit. The amount of negative feedback is determined by a resistor network R-501, R-502, I-501, one of which (I-501) is nonlinear. This element controls the amount of feedback in accordance with the amplitude of oscillation and maintains the proper operating point in the system.

(2) The amplifier follows the oscillator section and is coupled to it by C-508. The output of the amplifier is connected to the "MODE OF OPERATION" switch (#6). On "P.R.F." position, the sine wave oscillator signal feeds into the video unit which amplifies it and impresses it on the vertical plates of the cathode-ray tube.

e. SAW-TOOTH OSCILLATOR.—This is substantially a conventional oscillator.

(1) A voltage builds up across a capacitor (C-407 to C-414B) as it charges at a rate determined by R-405, R-406, and the capacitor. When the voltage attains breakdown value, tube JAN-884 (V-401) fires, and the capacitor discharges through it. As soon as the capacitor voltage drops below the ionization potential of the tube, deionization occurs, the discharge current ceases to flow, the grid resumes control, and the capacitor starts to recharge again. The resulting voltage output is similar to a saw tooth, the rising voltage being gradual and the

discharge being abrupt. A single stage amplifier using tube JAN-6AC7 (V-402) follows the JAN-884 and amplifies the saw-tooth voltage.

(2) When the "MODE OF OPERATION" switch (#6) is at the "OSC." position, the saw-tooth oscillator output is used as a sweep and is applied to the horizontal plates of the cathode-ray tube. This provides operation as an oscilloscope.

(3) Tube JAN-884 is supplied with 240 volts which is partially regulated to compensate for the effect of line voltage variations upon sweep amplitude and frequency. A synchronizing voltage from the video amplifier output is applied to the JAN-884 (V-401) grid through R-5 and C-401.

f. POWER SUPPLY.—This is the source of filament and d-c voltages for the equipment.

(1) A JAN-504G (V-603) rectifier tube supplies +350 volts d-c to the various units, to the JAN-OD3/VR-150 regulators (V-601 and V-602), and to the cathode-ray tube JAN-3BP1 (V-1) horizontal and vertical plate circuits.

(2) A JAN-2X2 (V-604) rectifier tube supplies the high potential, —1300 volts, required by the cathode-ray tube. The voltages, measured to ground, supplied to the cathode-ray tube (V-1) electrodes are approximately as follows: Anode 2 +150, grid —1300 (see table 5-17).

g. CORD CG-259/AP.—Use this test probe when the unit functions as a cathode-ray oscilloscope with the "MODE OF OPERATION" switch on "OSC." The signal is fed to the video amplifier of Radar Indicator Assembly AN/APA-11 by means of a shielded cord and passes through capacitor C-7 and resistor R-10. (See figure 4-2.)

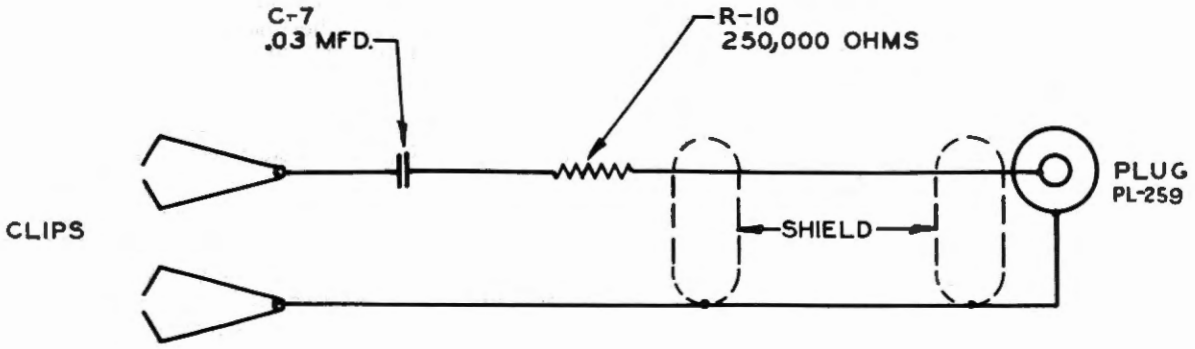


Figure 4-2. Circuit Diagram of Cord CG-259/AP

SECTION V
MAINTENANCE

CAUTION

This equipment employs high voltages which are dangerous and may prove fatal if contacted. Maintenance personnel should use extreme care when working with the equipment.

1. INSPECTION.

IMPORTANT

Periodic inspections prescribed herein represent minimum requirements. If because of local conditions, peculiarities of equipment, or abnormal usage they are found insufficient to assure satisfactory operation of the equipment, local authorities should not hesitate to increase their scope of frequency.

a. PREFLIGHT INSPECTION.

(1) Inspect Form 1-A and correct any defects noted thereon which pertain to Radar Indicator Assembly AN/APA-11.

(2) Make a visual and operating inspection of Radar Indicator Assembly AN/APA-11 equipment to include:

(a) Check for satisfactory securing of equipment and associated plugs and cables.

(b) Check knobs and dials for tightness to shafts.

(c) Check for proper operation of Indicator ID-59/APA-11 on all modes of operation.

1. Check the pulse duration time measurement using Test Oscillator TS-47/APR (or equivalent) and Receiving Equipment AN/APR-4 (or equivalent) to supply pulse to Indicator ID-59/APA-11.

a. Turn "MODE OF OPERATION" switch (#6) to "P.D."

b. Turn on "POWER SWITCH" (#5).

c. Make sure Receiving Equipment AN/APR-4 (or equivalent) and Test Oscillator TS-47/APR (or equivalent) are on the same frequency. (The pulse duration of Test Oscillator TS-47/APR is approximately 70 microseconds.)

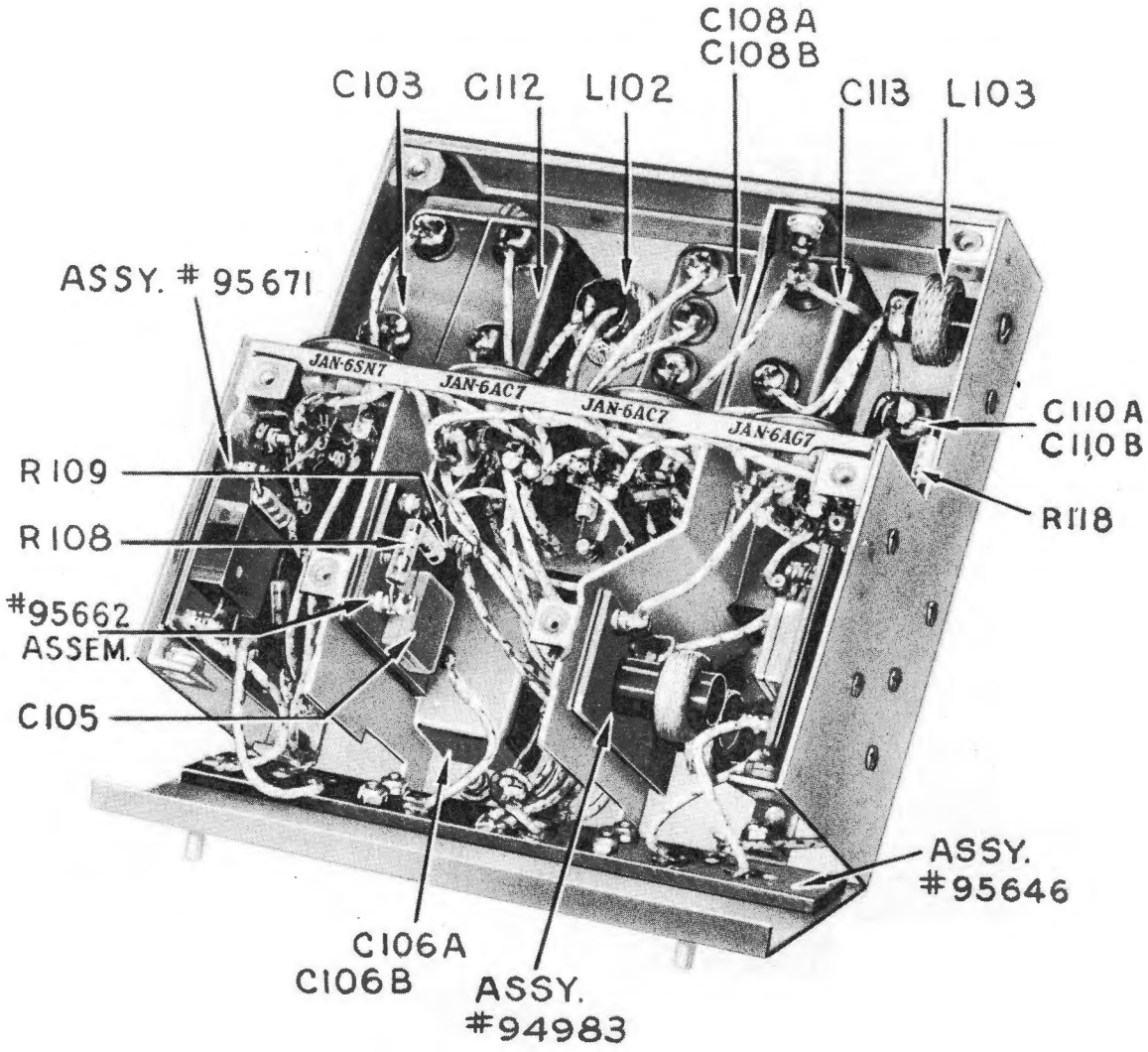


Figure 5-1. Trigger Amplifier, Sides Off and Bottom Loose—Right Diagonal Side View

d. Adjust "TRIGGER GAIN" control (#7) and "INTENSITY" control (#9) to get stationary pattern of suitable brightness on screen. (Avoid too much brightness.)

e. Adjust "VIDEO GAIN" control (#10) for vertical deflection between ½ inch and 1 inch.

f. Adjust "MULTIPLY μ SEC. BY" switch (#12) to "20."

g. By means of "PULSE DURATION" dial (#11) set the leading (left) edge of the pulse trace so that a point 3 db down (approximately $^{7}/_{10}$ of the maximum height) from the peak coincides with the vertical index line visible at the right center of the cathode-ray screen. Note the reading on the "PULSE DURATION" dial and repeat procedure for the trailing (right) edge of the pulse trace. The difference between these two settings of the "PULSE DURATION" dial multiplied by the setting of the "MULTIPLY μ SEC. BY" switch gives the pulse duration time in microseconds within plus or minus 15 percent of the known duration time of the input pulse assuming no error in the calibration of the test oscillator.

2. Check the repetition frequency determination using Test Oscillator TS-47/APR and Receiving Equipment AN/APR-4 (or equivalent) to supply pulse to Indicator ID-59/APA-11.

a. Turn "MODE OF OPERATION" switch (#6) to "P.R.F." and "MULTIPLY μ SEC. BY" switch to "5."

b. Turn on "POWER SWITCH" (#5).

c. Tune Receiving Equipment AN/APR-4 and Test Oscillator TS-47/APR to the same frequency.

d. The pulse repetition rate of Test Oscillator TS-47/APR is approximately 500 pulses per second.

e. Adjust "TRIGGER GAIN" control (#7) to near maximum. (One or more traces should appear on screen.) Adjust "INTENSITY" control (#9) for satisfactory brilliance.

f. Starting with "P.R. FREQUENCY (K.C.)" switch (#13) at ".20" and sweeping "INCREMENT P.R. FREQUENCY" dial (#14) from minus 6% to plus 6% at each "P.R. FREQUENCY (K.C.)" switch position, advance the "P.R. FREQUENCY (K.C.)" switch (#13) step by step until a single horizontal trace is first seen on the screen.

g. When a single trace is first obtained as in "f." the true pulse repetition frequency is indicated. Other single stationary traces will be found at frequencies beyond this point but these frequencies will be spurious since they will be multiples of the true repetition frequency. To check for true or spurious repetition frequency turn the "P.R. FREQUENCY (K.C.)" switch (#13) seven or eight steps to the *left* of the position arrived at in "f." If proper adjustment of the "INCREMENT P.R. FREQUENCY" dial (#14) at either of these two steps shows *two* traces, then the frequency indicated in "f." was the true P.R.F.

h. Check for vertical deflection at each of the 42 "P.R. FREQUENCY (K.C.)" switch (#13) positions. (Pattern seen on screen will generally be a complex one having multiple traces.) Vertical deflection at all switch settings indicates that Indicator ID-59/APA-11 is functioning properly on "P.R.F." position.

3. CHECK OF OSCILLOSCOPE OPERATION.

a. Attach Cord CG-259/AP to "—PULSE INPUT" (#1) and throw "PULSE POLARITY" switch (#19) to "—" (left). (See figure 1-1.)

b. Turn "MODE OF OPERATION" switch to "OSC."

c. Connect clips of Cord CG-259/AP to the output terminals of an audio oscillator (Jackson Type 652 or equivalent).

d. Turn on "POWER SWITCH" (#5).

e. Adjust "INTENSITY" control (#9) to obtain suitable trace brilliance. (Avoid too much brightness.)

f. Adjust the audio oscillator output and "VIDEO GAIN" control to get vertical deflection of approximately ¾ inch.

g. At each "SW. FREQ. RANGE CY" switch (#15) position, adjust audio oscillator frequency to that indicated by range switch pointer and turn "SW. FREQ. FINE" control so as to get one cycle on the screen.

h. Successful completion of g. indicates that the saw-tooth oscillator is functioning properly and that oscilloscope operation is satisfactory.

(3) CHECK DIAL LIGHT.

(a) Turn "POWER SWITCH" on.

(b) With fingers, rotate dial light lens assembly to the right and left to see if brightness is adjustable.

(4) Make entry on Form 1-A of inspection status and any maintenance work performed.

b. AFTER-FLIGHT INSPECTION.

(1) Inspect Form 1-A and correct defects noted thereon which pertain to Radar Indicator Assembly AN/APA-11.

(2) Make entry on Form 1-A of inspection status and any maintenance work performed.

c. DAILY INSPECTION.

(1) Inspect Form 1-A and correct any defects noted thereon which pertain to Radar Indicator Assembly AN/APA-11.

(2) Make a visual and operating inspection of Radar Indicator Assembly AN/APA-11 equipment to include:

(a) Check for satisfactory securing and stowage of Radar Indicator Assembly AN/APA-11.

(b) Carry out procedure as given in paragraph 1.*a.*(2)*(c)* of pre-flight inspection.

(c) Check for mechanical ease of operation and absence of mechanical looseness of all controls on Indicator ID-59/APA-11.

(d) Check for loose grid clips and proper seating of all tubes.

(e) Check for presence of spare fuse. The spare fuse should be located on the power supply unit. (See figure 1-9.)

(f) Check for intermittent operation when equipment is subjected to jarring.

(g) Enter on Form 1-A inspection status and any maintenance work performed.

d. 24-HOUR INSPECTION.—Same as daily inspection but conducted under supervision.

e. 100-HOUR INSPECTION.—Specially trained personnel who have been properly cleared to handle classified equipment should perform inspection.

(1) Inspect Form 1-A and correct any defects noted thereon which pertain to Radar Indicator Assembly AN/APA-11.

(2) Turn off equipment. Then remove dust cover and unplug all six units, and clean and inspect the following:

(a) Check all wiring and connections for satisfactory connections and for absence of corrosion and leakage paths.

(b) Check all switch contacts for cleanliness and tension.

(c) Check all tubes for which testing facilities are available and reinstall serviceable tubes in same sockets from which removed.

(d) Check pilot lamp and fuse and see if spare fuse is in spare fuse holder on power supply unit.

(e) Plug the six units back in, safety wire snap slides, and replace dust cover.

(3) Check for proper functioning on all positions of all controls as in section V, paragraph 1.*a.*(2)*(c)* for pre-flight inspection.

Check for absence of intermittent operation when Indicator ID-59/APA-11 and associated plugs and cordage are subjected to jarring. Do this for all three modes of operation.

(4) Record results of inspection on Form 1-A.

2. TROUBLE SHOOTING INSTALLED EQUIPMENT.

a. GENERAL.—In case of trouble in installed equipment, look for evidence of trouble in the cables used for connecting to associated equipment (see figure 8-2). See if connectors are tight. Note whether pilot lamp (#18) lights. To adjust pilot lamp brightness, use finger to rotate the lens assembly slightly clockwise or counterclockwise to obtain desired brightness. Presence of burned-out parts is often indicated by characteristic odor. Observe glass tubes to see if filaments light. If there are no indications of trouble, use Trouble Location Chart I.

b. TROUBLE LOCATION CHART I.—The purpose of this chart is to aid in quickly restoring the equipment to service by making simple replacements. The first replacements should be tubes, one at a time.

Note

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock. If tube change is not beneficial, reinstall original tube in socket. In each of the tests listed below, adjust "INTENSITY" control (#9) to give desired brightness.

WARNING

Turn "POWER SWITCH" off before removing tubes or units.

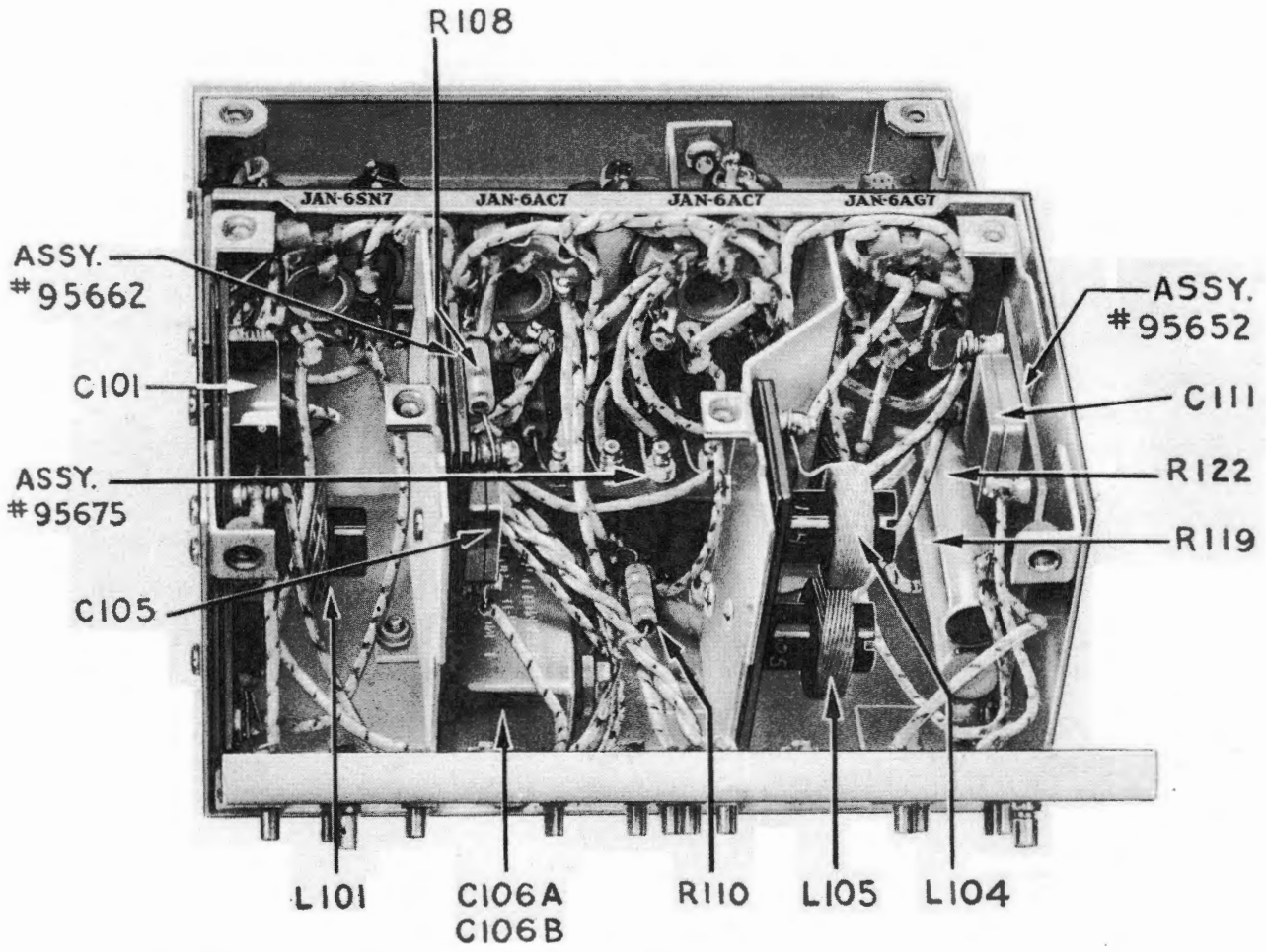


Figure 5-2. Trigger Amplifier, Sides Off and Bottom Loose—Bottom Diagonal View

TABLE 5-1. TROUBLE LOCATION CHART I

Test No.	*Symptom*	*"MODE OF OPERATION" Switch Position*	*Input Signal Required*	*Trouble Location*	*Remedy*
1	No horizontal deflection	"OSC."	no	Saw-tooth oscillator.	1. Replace tubes one at a time. 2. Replace unit.
2	No horizontal deflection	"P.D."	yes	Trigger Amplifier and/or servo-sweep generator.	1. Replace tubes in trigger clipper one at a time. 2. Replace trigger amplifier. 3. Replace tube V-302. 4. Replace tube V-301 and V-303. (Change of either tube may cause 10% difference in pulse duration reading.) 5. Replace entire equipment.
3	No vertical deflection	"OSC."	yes	Video amplifier.	1. Replace tubes one at a time. 2. Replace the video amplifier.
4	No vertical deflection	"P.D."	yes	Video amplifier.	1. Replace tubes one at a time. 2. Replace the video amplifier.
5	No vertical deflection	"P.R.F."	no	Sine wave oscillator and/or video amplifier (if video amplifier is O.K. in Test No. 4, trouble is in sine wave oscillator).	1. Replace tubes one at a time. 2. Replace unit.
6	Rotation of "PULSE DURATION" control (#11) does not shift trace horizontally.	"OSC."	no	Power supply or R-6 on back of control panel.	Replace Indicator ID-59/APA-11.
7	Change of "MULTIPLY μ SEC. BY" switch (#12) does not affect width of pattern or results in no horizontal deflection.	"P.D."	yes	Servo-sweep generator.	1. Look for open connection in the servo-sweep generator at or near switch. 2. If above shows nothing, replace entire Indicator ID-59/APA-11.
8	Increasing "TRIGGER GAIN" (#7) does not produce sweep and decreasing does not stop sweep.	"P.D."	yes	Rear of control panel at R-1.	1. Check connections at R-1. 2. If connections are O.K. replace Indicator ID-59/APA-11.
9	No change of pattern when "SW. FREQ. RANGE (CY)" switch (#15) or "SW. FREQ. FINE" control (#16) are rotated.	"OSC."	yes	Saw-tooth oscillator.	Replace the saw-tooth oscillator.
10	Vertical amplitude not changed by adjustment of "VIDEO GAIN" control (#10).	"P.D."	yes	Main chassis at R-2.	1. Check connections at R-2. 2. If connections are O.K. replace Indicator ID-59/APA-11.
11	Trace out of focus.	"OSC."	yes	Power supply at R-612.	Focus by adjusting R-612 (see figure 1-9).
12	Pattern crowded at ends.	"OSC."	yes	Saw-tooth oscillator.	Reduce saw-tooth oscillator sweep amplitude (see figure 1-7).
13	Vertical centering off.	"OSC."	no	Power supply at R-604	Adjust R-604 (see figure 1-9).
14	"PILOT LAMP" (#18) out.			"FUSE" (#17) or pilot lamp (#18).	Replace fuse or pilot lamp. Section V, paragraph 4.
15	"PILOT LAMP" intensity not adjustable.			Pilot lamp lens assembly.	Replace lens assembly.

Note

In case of replacements being made as a result of test, #2, #5, #6, #7, #8, and #10 during the course of radar identifying and locating work, it will generally be necessary to start at the beginning and collect new data. In any event, data taken before and after a replacement should not be used together.

3. TROUBLE SHOOTING AT REPAIR STATION.

a. PRELIMINARY.—The purpose of Table 5-2 is to aid in the localizing of a source of trouble by means of the operating controls.

TABLE 5-2. TROUBLE LOCATION CHART II

Test No.	*Symptom*	*"MODE OF OPERATION" Switch Position*	*Input Signal Required*	*Indicated Source of Trouble*
1	No vertical deflection.	"OSC." or "P.D."	yes	Video amplifier or R-2 on control panel.
2	No vertical deflection.	"P.R.F."	no	Sine wave oscillator (if Test #1 shows no trouble).
3	No horizontal deflection.	"OSC."	no	Saw-tooth oscillator.
4	No horizontal deflection.	"P.D."	yes	Trigger amplifier and/or servo-sweep generator (see Test #5).
5	"TRIGGER GAIN" (#7) rotation has no effect.	"P.D."	yes	R-1 on control panel (see Test #4, and figure 5-17).
6	"INTENSITY" control (#9) rotation has no effect.	ANY	no	R-9 on control panel (see figure 5-17).
7	"POWER SWITCH" (#5) has no effect.	ANY	no	Fuse or power supply.
8	"PULSE DURATION" control (#11) has no effect.	"OSC."	no	R-6 on control panel (see figure 5-17).
9	SAW-TOOTH OSC. will not stay locked in synchronization.	"OSC."	yes	R-5 on chassis C-401 in saw-tooth oscillator (see figure 5-18).

Note

Trouble in the sine wave oscillator is indicated when, with "MODE OF OPERATION" switch on "P.R.F." and the "INTENSITY" control turned up so that trace appears on screen, the vertical amplitude rises and falls periodically when the "P.R. FREQUENCY (K.C.)" switch position is changed. This rising and falling may persist or may damp out slowly (fast damping out is normal and does not indicate trouble). Trouble is also indicated if change of "P.R. FREQUENCY (K.C.)" switch position causes vertical deflection to stop. Replace sine wave oscillator or readjust (see section V, paragraph 6.*b.*)

b. DETAILED PROCEDURE.

(1) Use Tables 5-1 and 5-2 and/or VOLTAGE CHARTS to determine source of trouble, then:

(a) Turn "POWER SWITCH" off.

(b) One by one replace tubes of faulty unit.

Note

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock.

(c) Turn "POWER SWITCH" on and try equipment after each tube change.

(d) If the tube change is not beneficial, locate the fault and make the necessary repairs.

(2) To locate the fault in any unit, or on main chassis or control panel:

(a) Turn "POWER SWITCH" off.

(b) With volt-ohmmeter, check all components in the particular unit or circuit by the resistance charts and/or schematic diagram. If the trouble is in a unit, remove it from the main chassis to make resistance check.

(c) Check the voltages in a unit against the voltage chart.

(3) When the part causing trouble has been found, it should be replaced by an identical or equivalent part. For example: The resistance, watt rating, and tolerance of a resistor or the capacity, voltage rating, and tolerance of a capacitor replacing a defective part should correspond to that of the defective part.

(4) Use the pictorial illustrations to determine the location of a defective part. Illustrations follow the resistance and voltage charts for each unit. Subassembly photographs show resistors, capacitors and coils not visible in the views of the complete unit.

Note

Resistance chart measurements are made with the unit removed from the main chassis and with the tubes out. Voltage chart measurements are made from socket-terminals-to-ground and with the tubes in socket, unless otherwise stated. (See Table 5-6.) Line voltage is 115 volts no signal applied. Values given are d-c unless otherwise indicated. For access to socket terminals, remove the sides of trigger amplifier, servo-sweep generator, video amplifier, sine wave oscillator and bottom of saw-tooth oscillator.

TABLE 5-3. TRIGGER AMPLIFIER RESISTANCE CHART

Test No.	*From*	*To*	*Ohmmeter Scale*	*Approximate Resistance (ohms)*	*Probable Cause of Incorrect Reading*
1	V-101, #4	gnd	1000	1 meg.	open R101
2	V-101, #5	gnd	1000	open	shorted C103
3	V-101, #5	V-101, #1	1000	open	shorted C102
4	V-101, #1	gnd	1000	570 M	open R103, R105, R106
5	V-101, #3	gnd	1000	11250	open R104, R105, R106
6	V-101, #7	gnd	1000	open	short in heater circuit
7	P-101-A	V-101, #4	1000	open	shorted C101
8	P-101-C	gnd	1000	10000	open R106
9	P-101-D	V-102, #4	1000	open	shorted C105
10	P-101-G	gnd	1000	open	shorted C103, C106-B, C108-B
11	P-101-H	gnd	1000	open	short in heater circuit
12	P-101-J	gnd	1000	open	shorted C112, C113
13	P-101-L	V-104, #8	1000	open	shorted C111
14	V-102, #2	gnd	1000	open	short in heater circuit
15	V-102, #4	gnd	1000	270 M	open R109
16	V-102, #6	P-101-G	1000	100 M	open R111
17	V-102, #8	P-101-J	1000	6350	open R123, R112, L102
18	V-102, #8	V-103, #4	1000	open	shorted C107
19	V-103, #2	gnd	1000	open	short in heater circuit
20	V-103, #4	gnd	1000	270 M	open R113
21	V-103, #6	P-101-G	1000	10 M	open R115
22	V-103, #8	P-101-J	1000	6750	open R116, R123, L103
23	V-103, #8	V-104, #4	1000	open	shorted C109
24	V-104, #2	gnd	1000	open	short in heater circuit
25	V-104, #4	gnd	1000	680 M	open R117
26	V-104, #6	P-101-J	1000	22 M	open R119
27	V-104, #6	gnd	1000	open	shorted C-110B
28	V-101, #5	P-101-G	100	4200	open R107, R102, L101
29	V-101, #2	P-101-G	100	1500	open R107
30	V-101, #3	P-101-C	100	1250	shorted C104
31	V-104, #8	P-101-J	100	3000	open R122, L105, L104
32	V-101, #6	gnd	direct	0	open connection
33	V-101, #8	gnd	direct	0	open connection
34	P-101-B	gnd	direct	0	open connection
35	P-101-E	gnd	direct	0	open connection
36	P-101-F	gnd	direct	0	open connection
37	P-101-K	gnd	direct	0	open connection
38	V-102, #1	gnd	direct	0	open connection
39	V-102, #3	gnd	direct	0	open connection
40	V-102, #5	gnd	direct	150	open R110, shorted C106-A
41	V-102, #7	gnd	direct	0	open connection
42	V-103, #1	gnd	direct	0	open connection
43	V-103, #3	gnd	direct	0	open connection
44	V-103, #5	gnd	direct	150	open R114, shorted C108-A
45	V-103, #7	gnd	direct	0	open connection
46	V-104, #1	gnd	direct	0	open connection
47	V-104, #3	gnd	direct	0	open connection
48	V-104, #5	gnd	direct	56	shorted C110-A, open R118
49	V-104, #7	gnd	direct	0	open connection

Note

For direct continuity test on R108 or any other resistors or coils separately, see figures 5-1, 5-2 and 5-3 which show locations. Check with resistance values given on schematic diagram, figure 8-3.

TABLE 5-4. TRIGGER AMPLIFIER VOLTAGE CHART

Meter Ohms Per Volt	*Tube Symbol*	*Tube Type*		*Socket Terminals*							
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1000	V-101	JAN-6SN7GT	Voltage	0	128	6.7	*	100	0	6.3 a-c	0
			Meter Scale		500	10		500		10 a-c	
1000	V-102	JAN-6AC7	Voltage	0	6.3 a-c	0	0	.8	48	0	265
			Meter Scale		10 a-c			10	500		500
1000	V-103	JAN-6AC7	Voltage	0	6.3 a-c	0	0	1.55	128	0	257
			Meter Scale		10 a-c			10	500		500
1000	V-104	JAN-6AG7	Voltage	0	6.3 a-c	0	0	2.55	137	0	247
			Meter Scale		10 a-c			10	500		500
20000	V-101	JAN-6SN7GT	Voltage	.65	128	6.8	*	100	0	6.3 a-c	0
			Meter Scale	10	250	10		250		10 a-c	
20000	V-102	JAN-6AC7	Voltage	0	6.3 a-c	0	0	.77	60	0	265
			Meter Scale		10 a-c			10	250		1000
20000	V-103	JAN-6AC7	Voltage	0	6.3 a-c	0	0	1.5	130	0	260
			Meter Scale		10 a-c			10	250		1000
20000	V-104	JAN-6AG7	Voltage	0	6.3 a-c	0	0	2.55	142	0	250
			Meter Scale		10 a-c			10	250		250

*Slight Neg. Deflection.

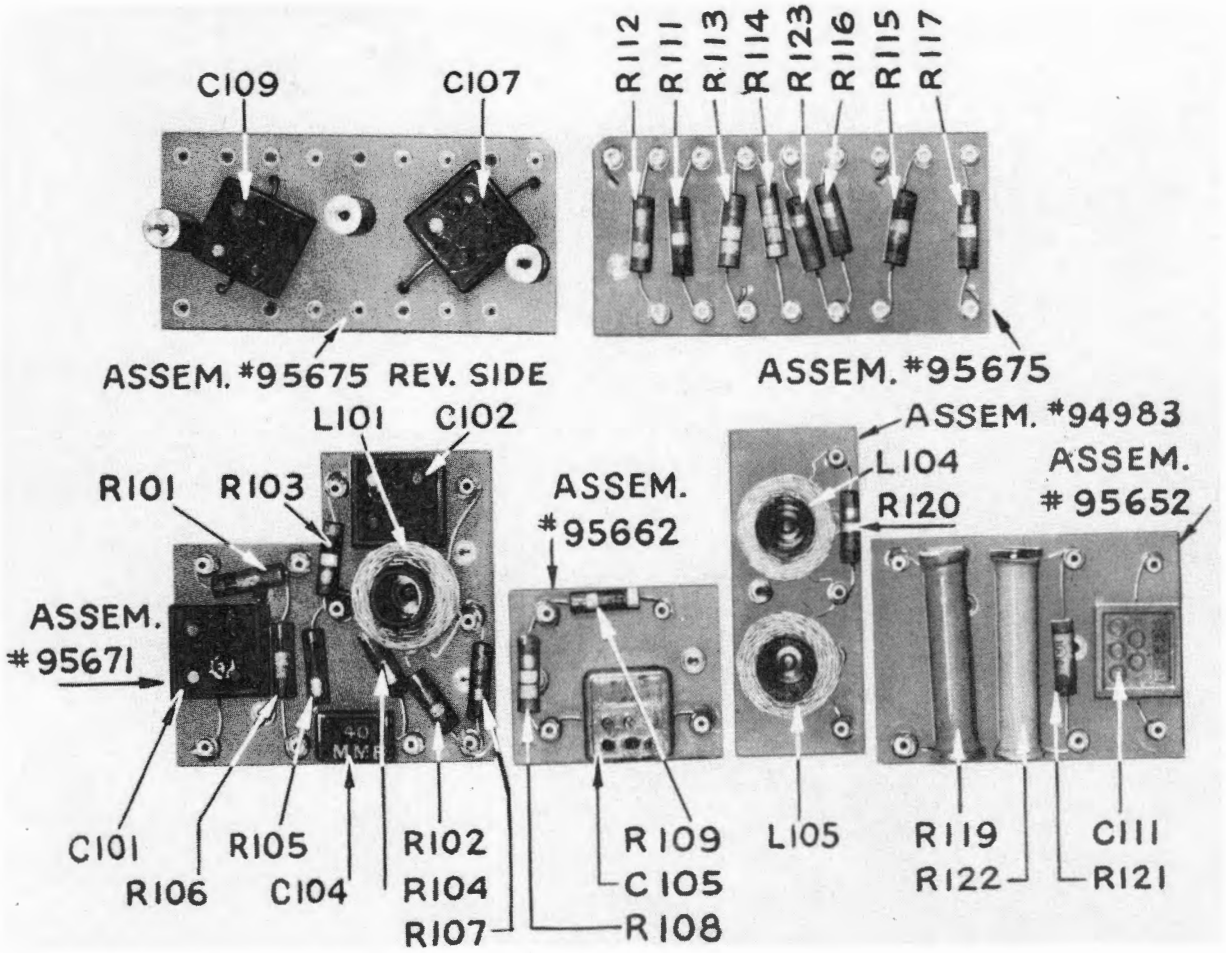


Figure 5-3. Trigger Amplifier—Subassemblies

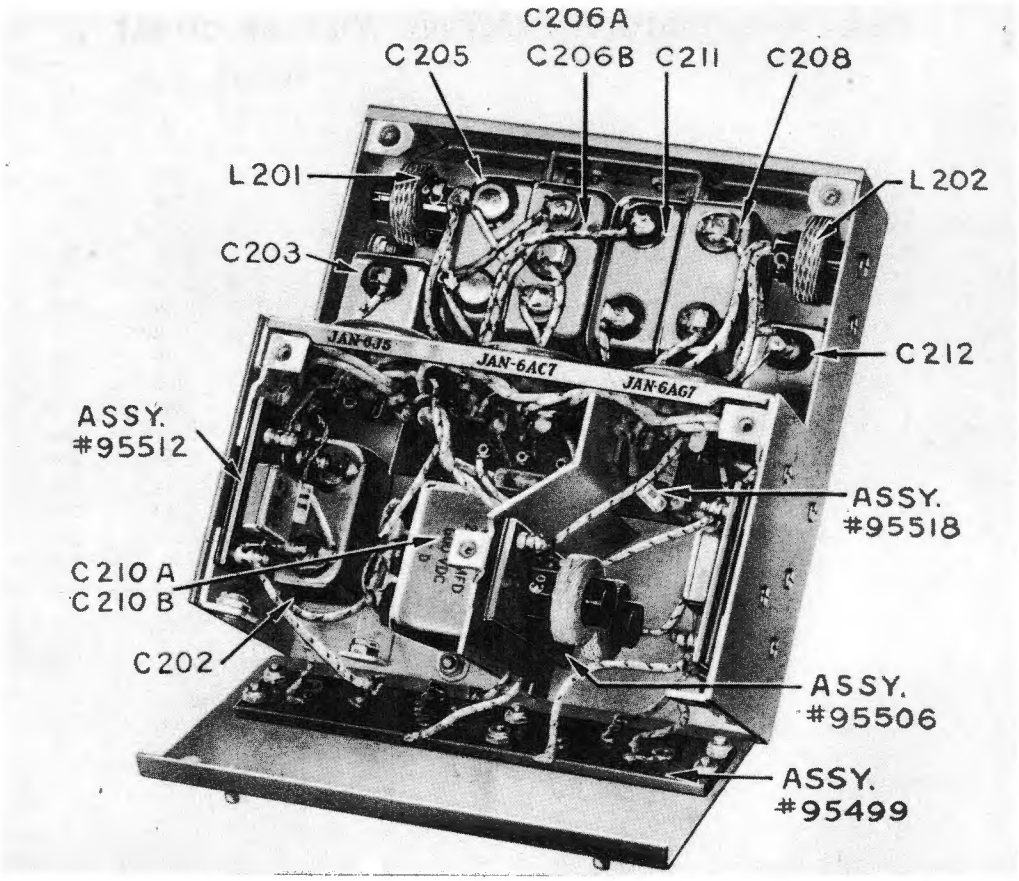


Figure 5-4. Video Amplifier, Sides Off and Bottom Loose—Right Diagonal Side View

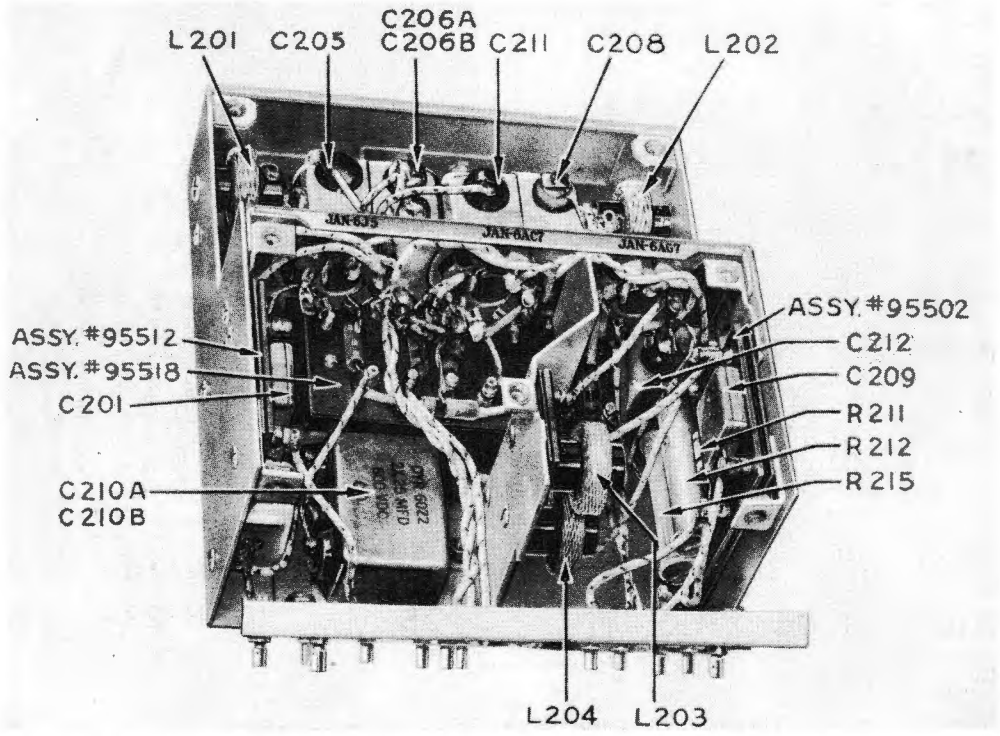


Figure 5-5. Video Amplifier, Sides Off and Bottom Loose—Left Diagonal Side View

TABLE 5-5. VIDEO AMPLIFIER RESISTANCE CHART

Test No.	*From*	*To*	*Ohmmeter Scale*	*Approximate Resistance (ohms)*	*Probable Cause of Incorrect Reading*
1	V-201, #2	gnd	1000	open	short in heater circuit
2	V-201, #3	P-201-F	1000	27,000	open R214, R213, R202, L-201
3	V-201, #5	gnd	1000	270 M	open R201
4	V-201, #3	V-202, #4	1000	open	shorted C204
5	V-202, #2	gnd	1000	open	short in heater circuit
6	V-202, #4	gnd	1000	270 M	open R204 or open 56 ohm grid series resistor
7	V-202, #6	P-201-D	1000	5600	open R207
8	V-202, #8	P-201-F	1000	7300	open R206, R214, L202
9	V-202, #8	V-203, #4	1000	open	shorted C207
10	V-203, #2	gnd	1000	open	short in heater circuit
11	V-203, #4	gnd	1000	680 M	open R208 or open 56 ohm grid series resistor
12	V-203, #6	P-201-F	1000	22 M	open R215
13	V-203, #8	P-201-H	1000	open	shorted C209
14	P-201-B	V-201, #5	1000	open	shorted C201
15	P-201-D	gnd	1000	open	shorted C206-B
16	P-201-F	gnd	1000	open	shorted C212, C211, C210-B, C210-A, C208, C204 (See also No. 4)
17	P-201-E	gnd	1000	open	short in heater circuit
18	V-201, #8	gnd	100	910	open R202, shorted C202, C203
19	V-203, #8	P-201-F	100	2500	open L204, R212, L203
20	V-202, #5	gnd	10	150	open R205, shorted C205, C206-A
21	V-201, #1	gnd	direct	0	open connection
22	V-201, #7	gnd	direct	0	open connection
23	V-202, #1	gnd	direct	0	open connection
24	V-202, #3	gnd	direct	0	open connection
25	V-202, #7	gnd	direct	0	open connection
26	V-203, #1	gnd	direct	0	open connection
27	V-203, #3	gnd	direct	0	open connection
28	V-203, #5	gnd	direct	91	open R209
29	V-203, #7	gnd	direct	0	open connection
30	P-201-A, C, and G.	gnd	direct	0	open connection

Note

For direct continuity tests on coils or any resistors separately, see figures 5-4, 5-5, and 5-6 which show locations. Check with resistor values given on schematic (figure 8-3).

TABLE 5-6. VIDEO AMPLIFIER VOLTAGE CHART

Meter Ohms Per Volt	*Tube Symbol*	*Tube Type*		*Socket Terminals*							
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1000	V-201	JAN-6J5	Voltage	0	6.3 a-c	155	—	0	—	0	4.5
			Meter Scale		10 a-c	500					10
1000	V-202	JAN-6AC7	Voltage	0	6.3 a-c	0	0	1.95	135	0	242
			Meter Scale		10 a-c			10	500		500
1000	V-203	JAN-6AG7	Voltage	0	6.3 a-c	0	0	3.5	165	0	265
			Meter Scale		10 a-c			10	500		500
20000	V-201	JAN-6J5	Voltage	0	6.3 a-c	160	—	0	—	0	4.7
			Meter Scale		10 a-c	250					10
20000	V-202	JAN-6AC7	Voltage	0	6.3 a-c	0	0	2.1	137	0	250
			Meter Scale		10 a-c			10	250		250
20000	V-203	JAN-6AG7	Voltage	0	6.3 a-c	0	0	3.6	171	0	265
			Meter Scale		10 a-c			10	250		1000

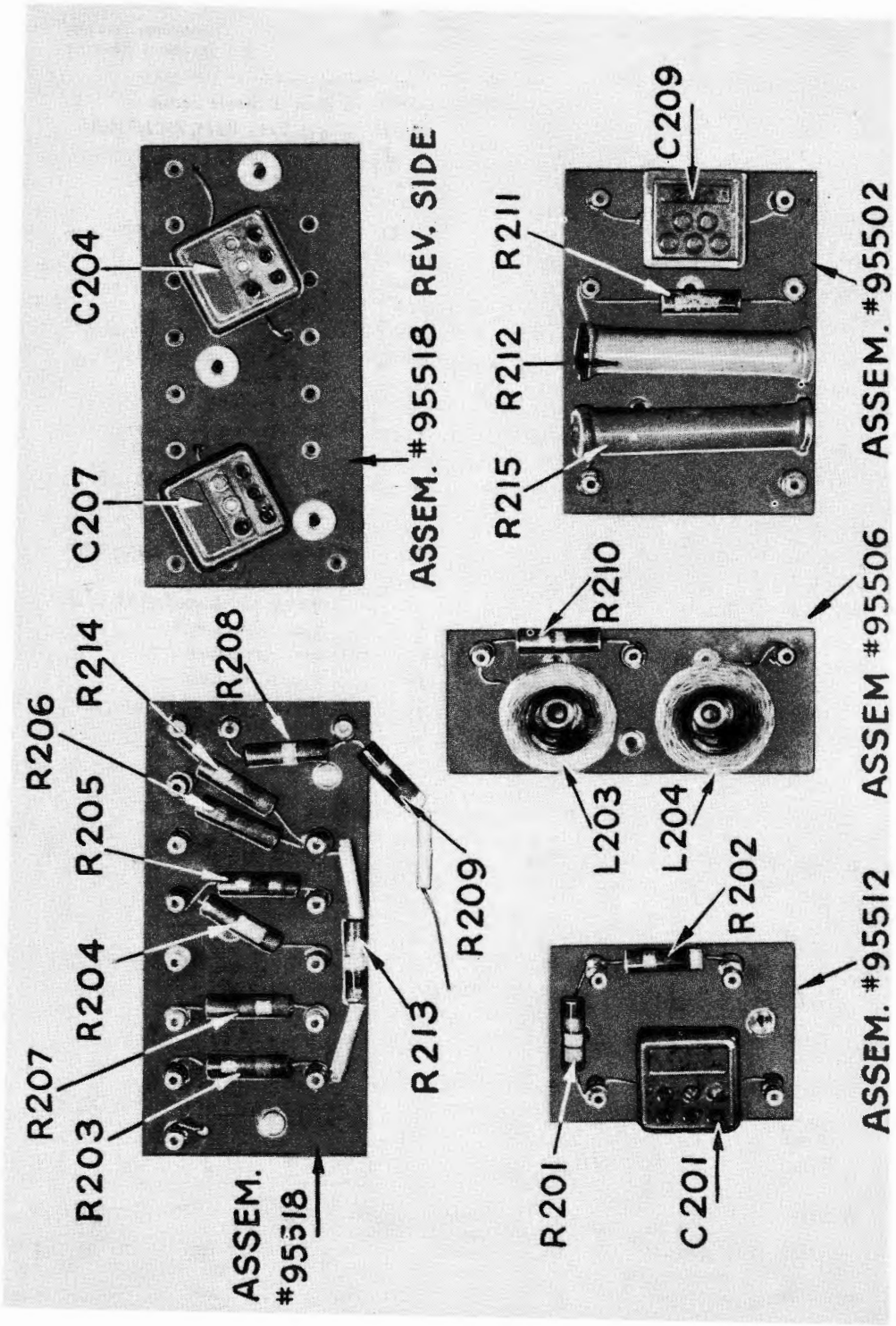


Figure 5-6. Video Amplifier—Subassemblies

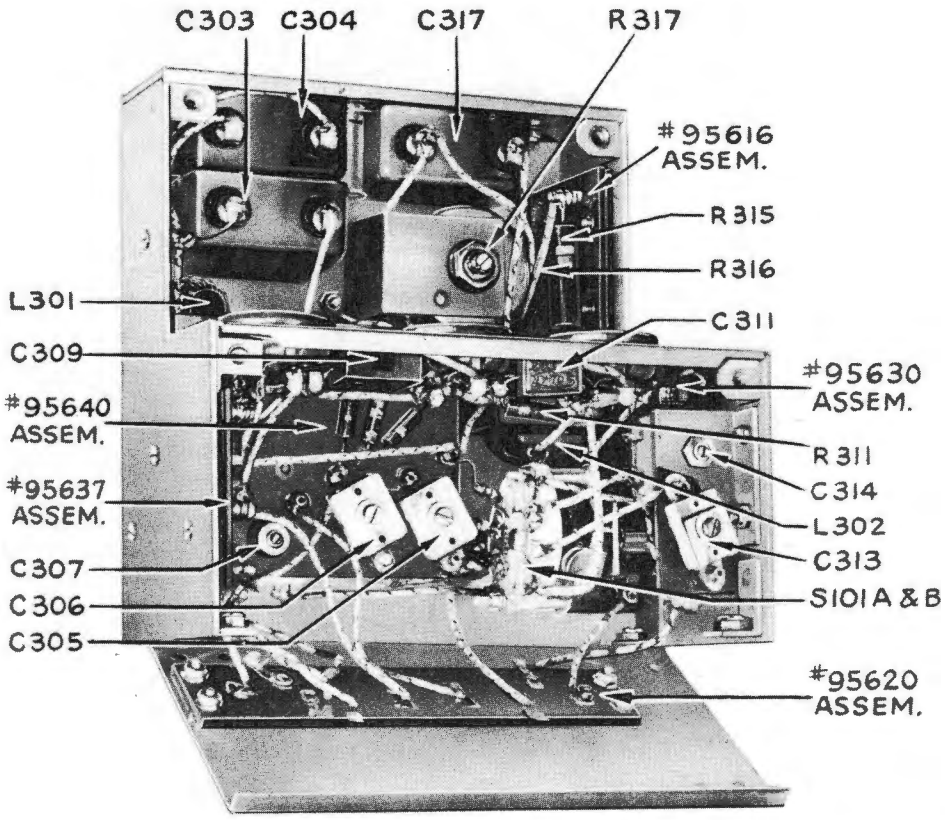


Figure 5-7. Servo-Sweep Generator, Sides Off and Bottom Loose—Left Diagonal View

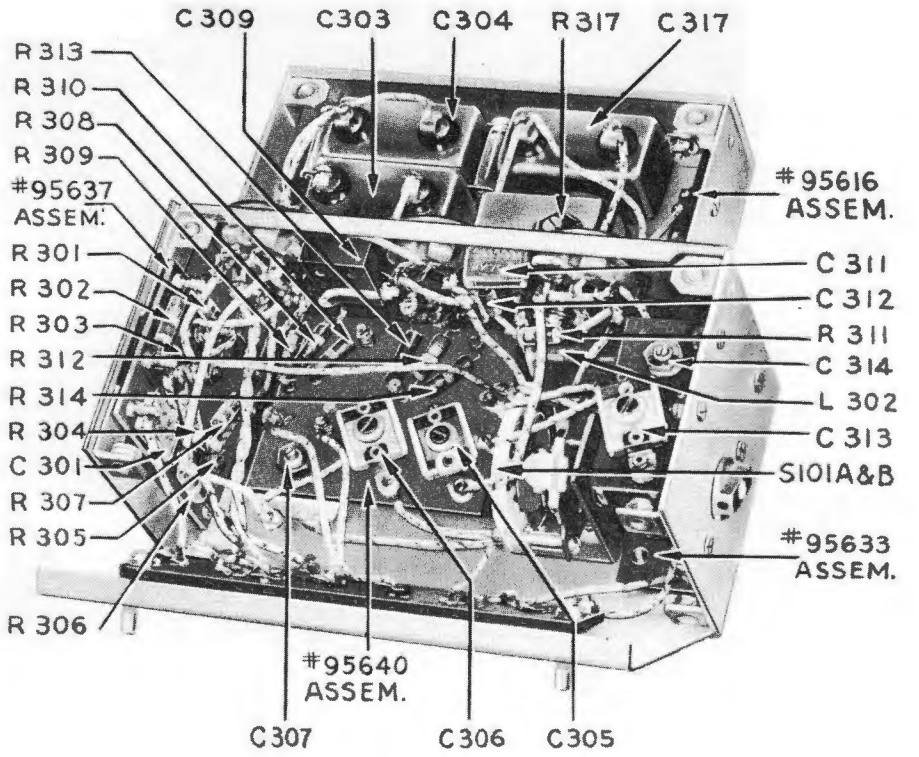


Figure 5-8. Servo-Sweep Generator, Sides Off and Bottom Loose—Right Diagonal Side View

TABLE 5-7. SERVO-SWEEP GENERATOR RESISTANCE CHART

Test No.	*From*	*To*	*Ohmmeter Scale*	*Approximate Resistance (ohms)*	*Probable Cause of Incorrect Reading*
1	V-301, #1	gnd	1000	560 M	open R302
2	V-301, #2	P-301-D	1000	9200	open R304, R305
3	V-301, #4	P-301-D	1000	910 M	open R306
4	V-301, #5	P-301-D	1000	7800	open R307, R305, L301
5	V-301, #7	gnd	1000	open	short in heater circuit
6	V-301, #2	V-301, #4	1000	920 M	shorted C305, C306, C307 open R304, R305, R306
7	V-301, #5	V-301, #1	1000	open	shorted C302
8	V-301, #2	V-303, #4	1000	open	shorted C308
9	V-301, #5	V-302, #1	1000	open	shorted C309
10	V-302, #1	gnd	1000	565 M	open R308, R310
11	V-302, #3	gnd	1000	6400	open R309, R310
12	V-302, #4	gnd	1000	920 M	open R312, R314
13	V-302, #6	gnd	1000	10800	open R313, R314
14	V-302, #7	gnd	1000	open	short in heater circuit
15	V-303, #2	gnd	1000	open	short in heater circuit
16	V-303, #4	gnd	1000	1.5 meg	open R311
17	V-303, #6	P-301-H	1000	20 M to 37 M	open L302, R316, R317
18	V-303, #8	P-301-H	1000	20 M to 37 M	open L302, R316, R317
19	V-303, #8	P-301-K	1000	open	shorted C319, C318
20	P-301-A	V-301, #4	1000	open	shorted C301
21	P-301-F	V-302, #3	1000	open	shorted C310
22	P-301-G	V-302, #6	1000	open	shorted C316
23	P-301-H	gnd	1000	open	shorted C317, C313, C314, C315
24	P-301-D	gnd	1000	open	shorted C304
25	V-303, #8	V-302, #4	1000	open	shorted C311
26	V-301, #3	gnd	100	3000	open R303, shorted C303
27	V-301, #6	gnd	100	3000	open R303
28	V-302, #2	P-301-H	direct	0	open connection
29	V-302, #5	P-301-H	direct	0	open connection
30	V-303, #1	gnd	direct	0	open connection
31	V-303, #3	gnd	direct	0	open connection
32	V-303, #5	gnd	direct	0	open connection
33	P-301-B, J	gnd	direct	0	open connection

Note

For direct continuity tests on R301 or on any other resistors or coils separately, see figures 5-7, 5-8, and 5-9 which show locations. Check with resistor values given in figure 8-3. Resistance of L-302 is 500 ohms.

TABLE 5-8. SERVO-SWEEP GENERATOR VOLTAGE CHART

Meter Ohms Per Volt	*Tube Symbol*	*Tube Type*		*Socket Terminals*							
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1000	V-301	JAN-6SN7GT	Voltage	0	140	17	23	90	17	6.3 a-c	0
			Meter Scale		500	25	500	500	25	10 a-c	
1000	V-302	JAN-6SN7GT	Voltage	1.0	335	65	10	335	93	6.3 a-c	0
			Meter Scale	500	500	500	500	500	500	10 a-c	
1000	V-303	JAN-6AG7	Voltage	0	6.3 a-c	0	#	0	50*	0	50*
			Meter Scale		10 a-c				500		500
20000	V-301	JAN-6SN7GT	Voltage	0	143	23	23	93	23	6.3 a-c	0
			Meter Scale		250	50	50	250	50	10 a-c	
20000	V-302	JAN-6SN7GT	Voltage	41	330	68	43	330	90	6.3 a-c	0
			Meter Scale	250	1000	250	250	1000	250	10 a-c	
20000	V-303	JAN-6AG7	Voltage	0	6.3 a-c	0	#	0	50*	0	50*
			Meter Scale		10 a-c				250		250

*Varies with R316.
#Slight Neg. Deflections.

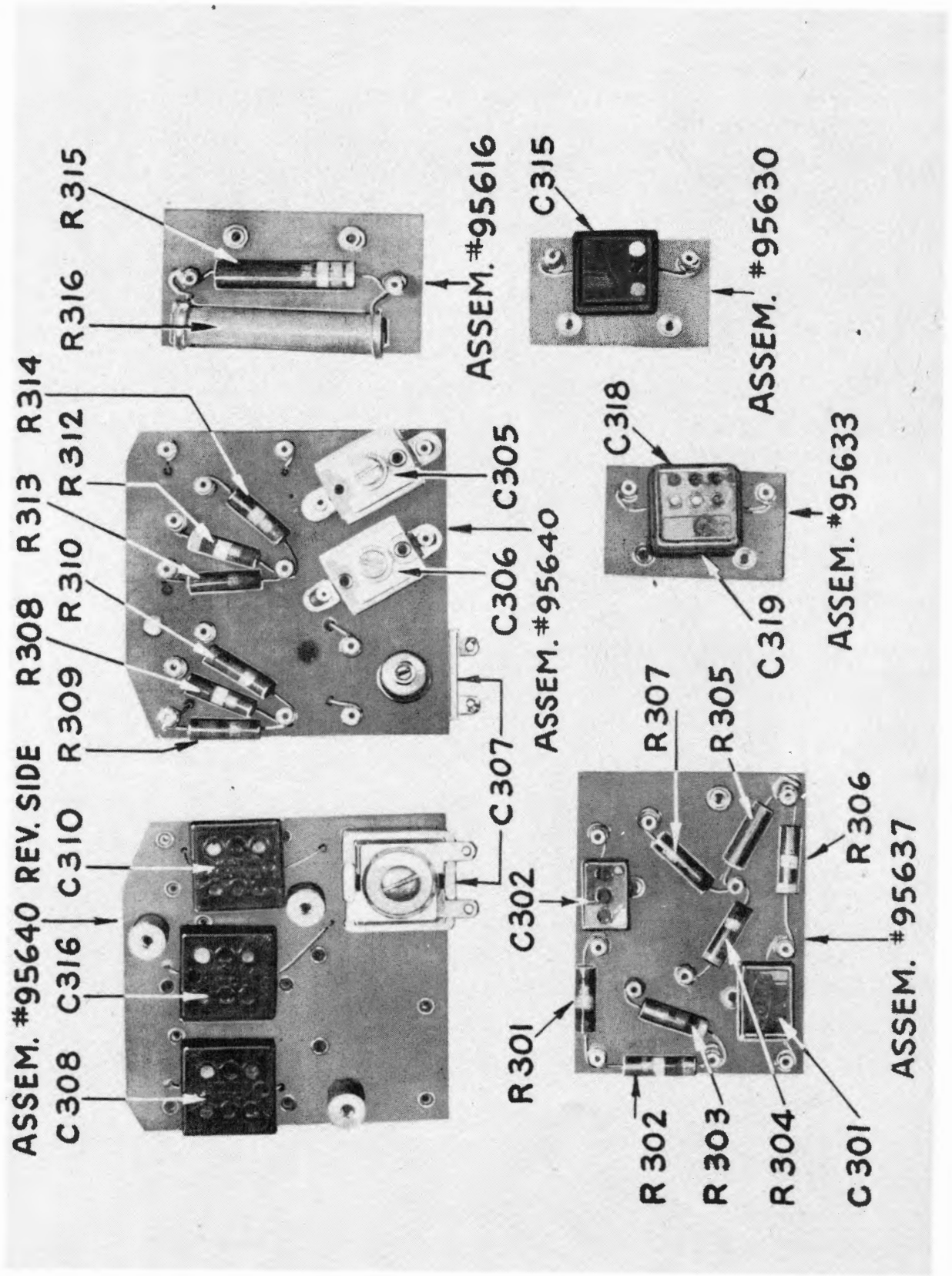


Figure 5-9. Servo-Sweep Generator—Subassemblies

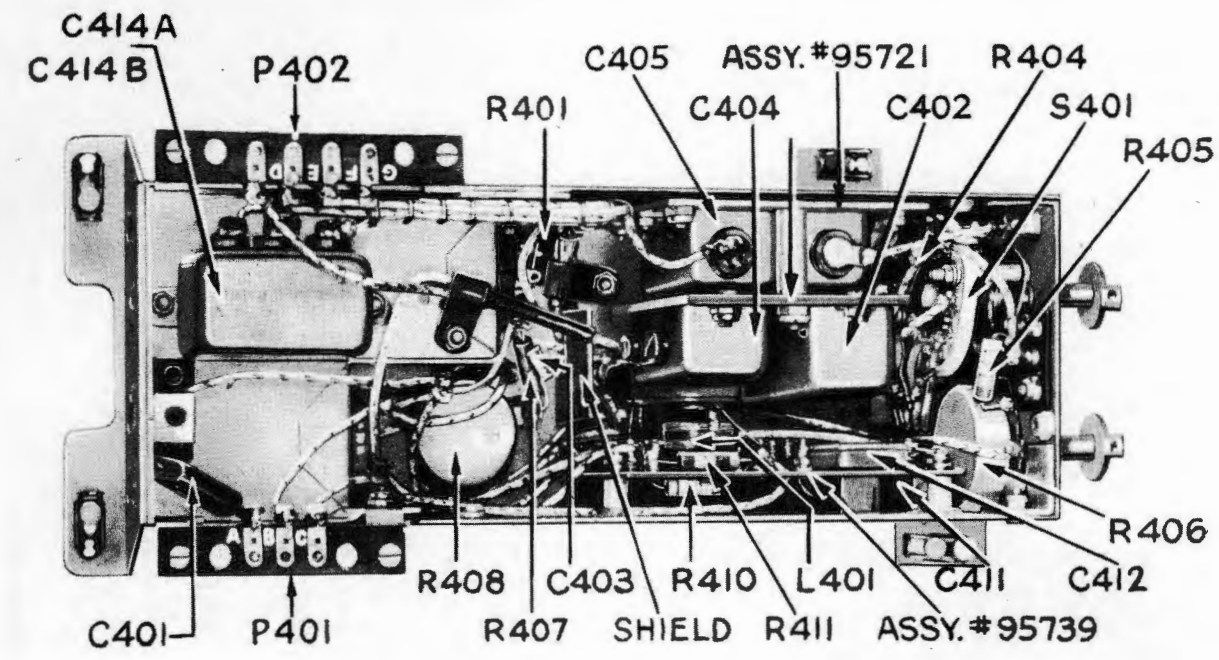


Figure 5-10. Saw-tooth Oscillator—Bottom Off

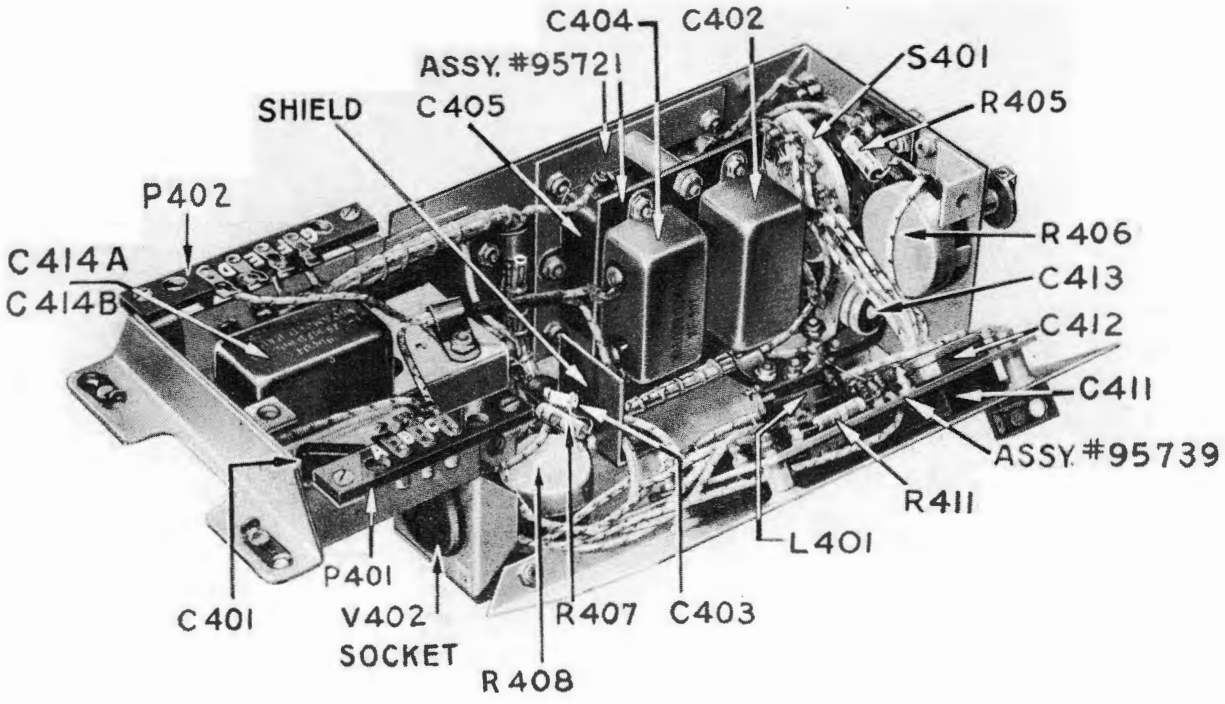


Figure 5-11. Saw-tooth Oscillator—Bottom Off and Side Loose

TABLE 5-9. SAW-TOOTH OSCILLATOR RESISTANCE CHART

Test No.	*From*	*To*	*Ohmmeter Scale*	*Approximate Resistance (ohms)*	*Probable Cause of Incorrect Reading*
1	V-401, #3	gnd	1000	470 M to 2½ meg	R404, R405, R406, R402, R403 open; C407 to C414-B shorted
2	V-401, #5	gnd	1000	30 M	R401 open
3	P-401-A	gnd	1000	open	C401 shorted
4	P-401-C	gnd	1000	open	short in heater circuit
5	P-402-D	V-402, #8	1000	open	shorted C404
6	P-402-E	V-402, #8	1000	50 M	open R411, L401
7	P-402-E	V-402, #6	1000	390 M	open R410
8	P-402-F	gnd	1000	33900	open R403, R402
9	P-402-F	V-401, #3	1000	470 M to 2½ meg	open R404, R405, R406; shorted C407 to C414-B
10	V-402, #4	gnd	1000	0 to 500 M	open R408
11	V-402, #7	gnd	1000	open	short in heater circuit
12	V-402, #4	V-401, #6	1000	1.5 meg to 2 meg	open R407, or R408; shorted C403
13	V-401, #6	V-401, #3	1000	2 to 4 meg	shorted C402
14	P-402-E	gnd	1000	open	shorted C405
15	V-401, #8	gnd	100	910	R403 open
16	V-401, #2	gnd	direct	0	open fil. or gnd. conn.
17	V-401, #7	gnd	direct	open	short in heater circuit
18	P-401-B	gnd	direct	0	open connection
19	V-402, #3	gnd	direct	0	open connection
20	V-402, #5	gnd	direct	500	open R409, shorted C406
21	V-402, #2	gnd	direct	0	open connection

Note

For direct continuity tests on coil or any resistors separately, see figures 5-10, 5-11, and 5-12 which show location. Make test and check with values given in figure 8-3. Resistance of L-401 is 160 ohms.

TABLE 5-10. SAW-TOOTH OSCILLATOR VOLTAGE CHART

Meter Ohms Per Volt	*Tube Symbol*	*Tube Type*		*Socket Terminals*							
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1000	V-401	JAN-884	Voltage	—	0	43*	—	0	0	6.3 a-c	5.85
			Meter Scale			500			d-c	10 a-c	10
1000	V-402	JAN-6AC7	Voltage	0	0	0	0	1.65	73	6.3 a-c	175
			Meter Scale				d-c	10	500	10 a-c	500
20000	V-401	JAN-884	Voltage	—	0	38	—	0	0	6.3 a-c	6.5
			Meter Scale			250			d-c	10 a-c	10
20000	V-402	JAN-6AC7	Voltage	0	0	0	0	1.7	83	6.3 a-c	193
			Meter Scale				d-c	10	250	10 a-c	250

*Fine Freq. Control Counterclockwise.

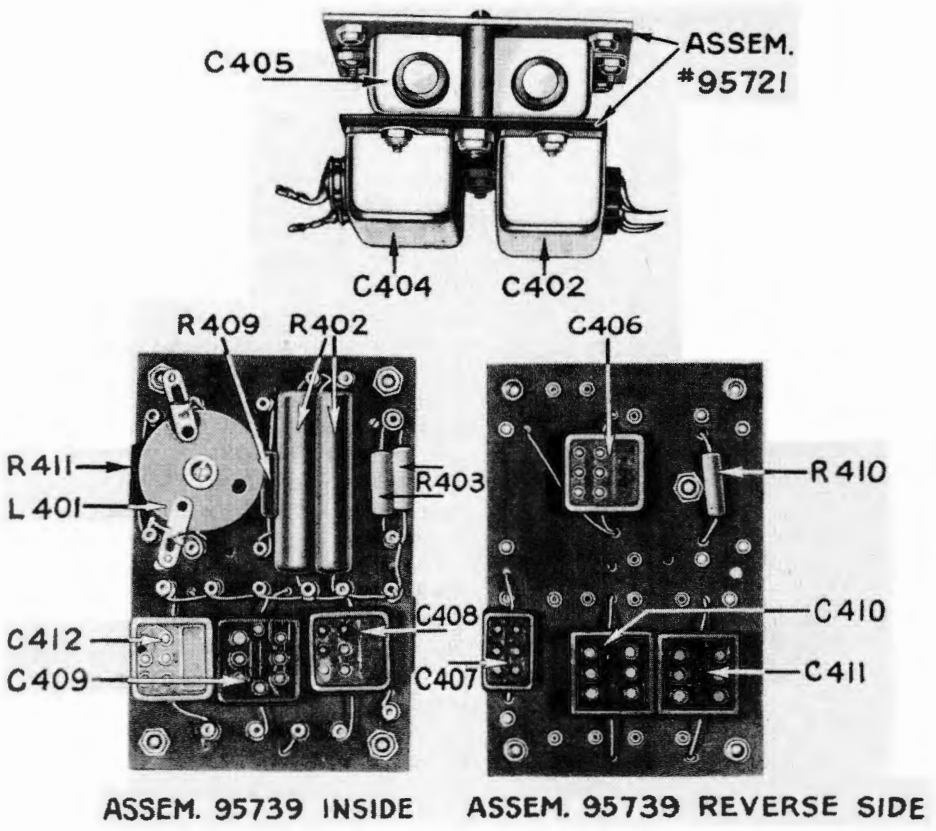


Figure 5-12. Saw-tooth Oscillator—Subassemblie:

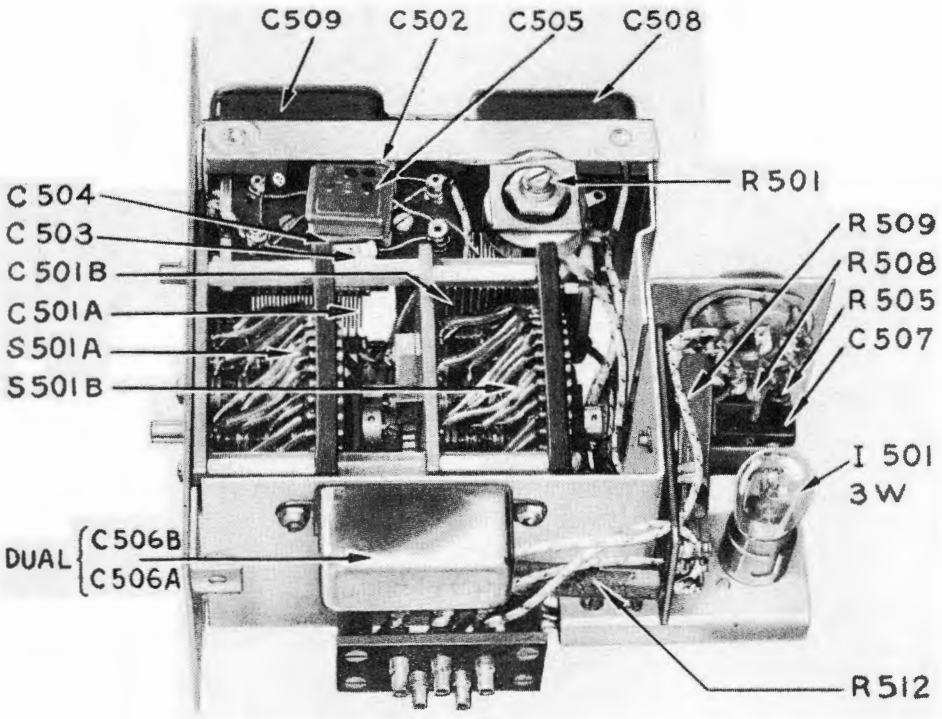


Figure 5-13. Sine Wave Oscillator O-34/APA-11—Side and Case Off

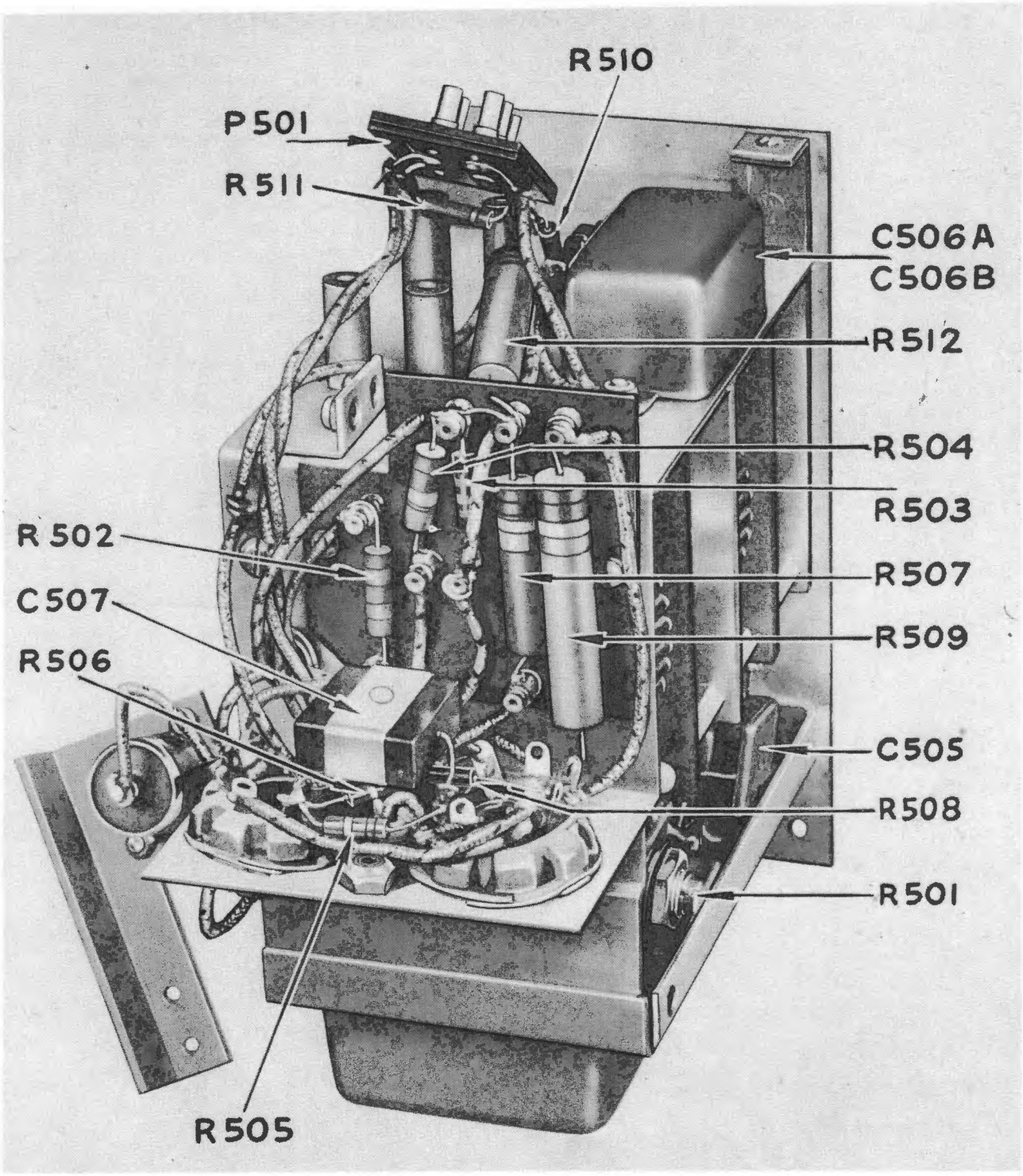


Figure 5-14. Sine Wave Oscillator O-34/APA-11—Bracket and Terminal Board Loose to Show Resistors

TABLE 5-11. SINE WAVE OSCILLATOR O-34/APA-11 RESISTANCE CHART

Test No.	*From*	*To*	*Ohmmeter Scale*	*Approximate Resistance*	*Probable Cause of Incorrect Reading*
1	V-501, #2	gnd	1000	open	short in heater wiring
2	V-501, #4	gnd	1000	18500 to 800 M	open res. on S502B, shorted C501-A, C501-B, C503, C505
3	V-501, #6	P-501-A	1000	575 M	open R503, R512
4	V-501, #6	gnd	1000	open	shorted C506-A, C509
5	V-510, #8	P-501-A	1000	115 M	open R504, R512
6	V-501, #8	V-502, #1	1000	open	shorted C507
7	V-502, #1	gnd	1000	1 meg	open R505
8	V-502, #2	P-501-A	1000	25 M	open R507, R512
9	V-502, #2	V-502, #4	1000	open	shorted C508
10	V-502, #5	P-501-A	1000	10 M	open R509
11	V-502, #7	gnd	1000	open	short in heater circuit
12	V-502, #5	P-501-C	1000	open	shorted C506-B
13	P-501-B	gnd	1000	open	short in heater circuit
14	V-501, #3	gnd	1000	700 to 1500	open I501
15	V-501, #5	gnd	100	700 to 1500	open I501
16	V-502, #3	gnd	100	1000	open R506
17	V-502, #4	gnd	100	1600 to 1500	open R501, R502, I501
18	V-502, #6	gnd	100	1000	open R508
19	P-501-C	gnd	100	2000	open R511
20	V-501, #1	gnd	direct	0	open connection
21	V-501, #7	gnd	direct	0	open connection
22	V-502, #8	gnd	direct	0	open connection
23	P-501-D	gnd	direct	0	open connection
24	P-501-E	gnd	direct	0	open connection

Note

For direct continuity tests on R510 or on any other resistors separately, see figures 5-13 and 5-14 which show locations. Check with resistance values given in figure 8-3.

TABLE 5-12. SINE WAVE OSCILLATOR O-34/APA-11 VOLTAGE CHART

Meter Ohms Per Volt	*Tube Symbol*	*Tube Type*		*Socket Terminals*							
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1000	V-501	JAN-6SJ7	Voltage	0	6.3 a-c	1.40	0	1.4	33	0	100
			Meter Scale		10 a-c	10		10	500		500
1000	V-502	JAN-6SN7GT	Voltage	0	173	5.35	1.1	255	8.55	6.3 a-c	0
			Meter Scale		500	10	10	500	10	10 a-c	
20000	V-501	JAN-6SJ7	Voltage	0	6.3 a-c	1.4	0	1.4	43	0	121
			Meter Scale		10 a-c	10		10	250		250
20000	V-502	JAN-6SN7GT	Voltage	0	176	5.7	1.4	260	8.95	6.3 a-c	0
			Meter Scale		250	10	10	1000	10	10 a-c	

TABLE 5-13. POWER SUPPLY RESISTANCE CHART

Test No.	*From*	*To*	*Ohmmeter Scale*	*Approximate Resistance (ohms)*	*Probable Cause of Incorrect Reading*
1	P-601-D	P-601-H	1000	6000	open R609, R610
2	P-601-D	P-610-C	1000	12 M to 27 M	open R601, R602
3	P-601-D	P-601-P	1000	62 M	open R605, R606, R603, R604
4	P-601-D	P-601-K	1000	35 M to 65 M	open R603, R604
5	P-601-D	P-610-J	1000	35 M to 65 M	open R603, R604
6	P-601-D	gnd	1000	63 M	shorted C601, C602, open R603, R604, R605, R606
7	P-601-T	gnd	1000	1 meg	shorted C603, C604, open R614, R615, R616
8	P-601-T	V-604 Grid cap	1000	45 M	open R617, R618
9	P-601-P	gnd	1000	58 M	open R606, R605, R604, R603
10	P-601-R	gnd	1000	1.3 meg	open R611, R612, R613
11	P-601-S	P-601-R	1000	100 M to 600 M	open R611, R612
12	P-601-A	P-601-B	100	3000	open R608
13	P-601-A	P-601-D	100	3000	open R607
14	V-604, #1 or #4	gnd	100	680	open H.V. Sec.
15	P-601-D	#11 on Power Trans.	direct	65	open L601
16	V-604, #1	V-604, #4	direct	0.08	open in trans. sec.
17	V-603, #2	V-603, #8	direct	0.05	open in rect. fil. winding
18	V-603, #4 or #6	gnd	direct	43	open in trans. sec.
19	P-601-L	P-601-E	direct	01.0	open trans. primary or open fuse
20	P-601-U	P-601-V	direct	0.15	open filament winding
21	V-601, #2	gnd	direct	0	open connection
22	V-602, #2	gnd	direct	0	open connection

Note

For direct continuity tests on resistors separately, see figures 5-15 and 5-16 which show locations. Check with resistor values given in figure 8-3 (where parallel circuits exist as with R603, R604, R605 and R606, it will be necessary to unsolder one end of resistor).

TABLE 5-14. INDUCTANCE AND D-C RESISTANCE OF TRANSFORMERS AND AUDIO CHOKES

Part No.	*Reference Symbol*	*Terminals*	*Res. in Ohms*	*Inductance*
95995	L601		65	4.1 hy. plus or minus 15% measured at 35 volts, 60 cycles, with 225 ma. direct current.
96106	L302		500	7 hy. plus or minus 25% measured at 10 volts, 60 cycles, with 15 ma. direct current.
95536	L401		100	30 millihenries plus or minus 10%.
96063	T601	1 to 3	1.0	
	T601	1 to 2	0.5	
	T601	2 to 3	0.5	
	T601	6 to 7	0.15	
	T601	10 to 11	0.05	
	T601	4 to 5	0.04	
	T601	12 to 13	41.0	
	T601	13 to 14	43.0	
	T601	12 to 14	84.0	
	T601	14 to 15	630	
	T601	12 to 15	714	
	T601	8 to 9	0.08	

TABLE 5-15. POWER SUPPLY VOLTAGE CHART

Meter Ohms Per Volt	Tube Symbol	Tube Type		Socket Terminals 1	2	3	4	5	6	7	8	Cap
1000	V-601	JAN-OD3/VR-150	Voltage	—	—	—	—	150	—	—	—	—
			Meter Scale					500				
1000	V-602	JAN-OD3/VR-150	Voltage	—	—	—	—	150	—	—	—	—
			Meter Scale					500				
1000	V-603	JAN-5U4G	Voltage	—	350	—	—	—	—	—	—	—
			Meter Scale		500							
1000	V-604	JAN-2X2	Voltage	—	—	—	—	—	—	—	—	—1340
			Meter Scale									1000 x 2
20000	V-601	JAN-OD3/VR-150	Voltage	—	—	—	—	150	—	—	—	—
			Meter Scale					250				
20000	V-602	JAN-OD3/VR-150	Voltage	—	—	—	—	150	—	—	—	—
			Meter Scale					250				
20000	V-603	JAN-5U4G	Voltage	—	350	—	—	—	—	—	—	—
			Meter Scale		1000							
20000	V-604	JAN-2X2	Voltage	—	—	—	—	—	—	—	—	—1400
			Meter Scale									1000 x 2

JAN-5U4G fil. 5 V. a-c. JAN-2X2 fil. 2.5 V. a-c. *Use Weston Model 666 Socket Selector Unit.

TABLE 5-16. PANEL AND CHASSIS RESISTANCE CHART

Note

Tests 1 to 7 inclusive may be made without removing the units, tubes, or cathode-ray tube.

For tests 4 to 7, turn mode of operation switch to "OSC." For test number 2, turn mode of operation switch to "P.D."

Test No.	From	To	Ohmmeter Scale	Approximate Resistance (ohms)	Probable Cause of Incorrect Reading
1	J-201-H	J-601-J	1000	1 meg	open R3
2	J-301-K	J-601-C	1000	1 meg	open R4, R6
3	J-201-H	J-401-A	1000	10 meg	open R5
4	J-201-B	gnd	100	2000 with "VIDEO GAIN" control (#10) clockwise	open R2
5	J-101-A	gnd	100	2000	open R2, switch connection
6	J-101-C	gnd	direct	500	open R1
7	J-101-D	gnd	direct	500 with "TRIGGER GAIN" control (#7) clockwise	open R1

Note

Tests 8 to 16 inclusive may be made with cathode-ray tube only removed.

8	V-1, #3	J-601-T	1000	1 meg	open R7
9	J-601-T	J-601-R	1000	280 M	open H8, R9
10	J-301-F	V-1, #3	1000	open	shorted C1
11	V-1, #2	J-601-R	1000	0 to 260 M	open R9
12	J-601-L or J-601-E	gnd	1000	open	shorted section of C5
13	J-601-J	gnd	1000	20 M with R604 set about midway	shorted C2 open R604
14	J-601-K	gnd	1000	20 M with R604 set about midway	shorted C6 open R604
15	V-1, #5	J-601-S	direct	0	open connection
16	V-1, #9	J-601-P	direct	0	open connection

Note

Tests 17 to 20 inclusive may be made with power supply unit removed.

17	J-601-J	gnd	1000	open	shorted C2
18	J-601-K	gnd	1000	open	shorted C6
19	V-1, #7	J-601-C	1000	25 M "PULSE DURATION" (#11) control clockwise	open R6
20	V-1, #7	gnd	1000	25 M "PULSE DURATION" (#11) control clockwise	shorted C3, C4 open R6

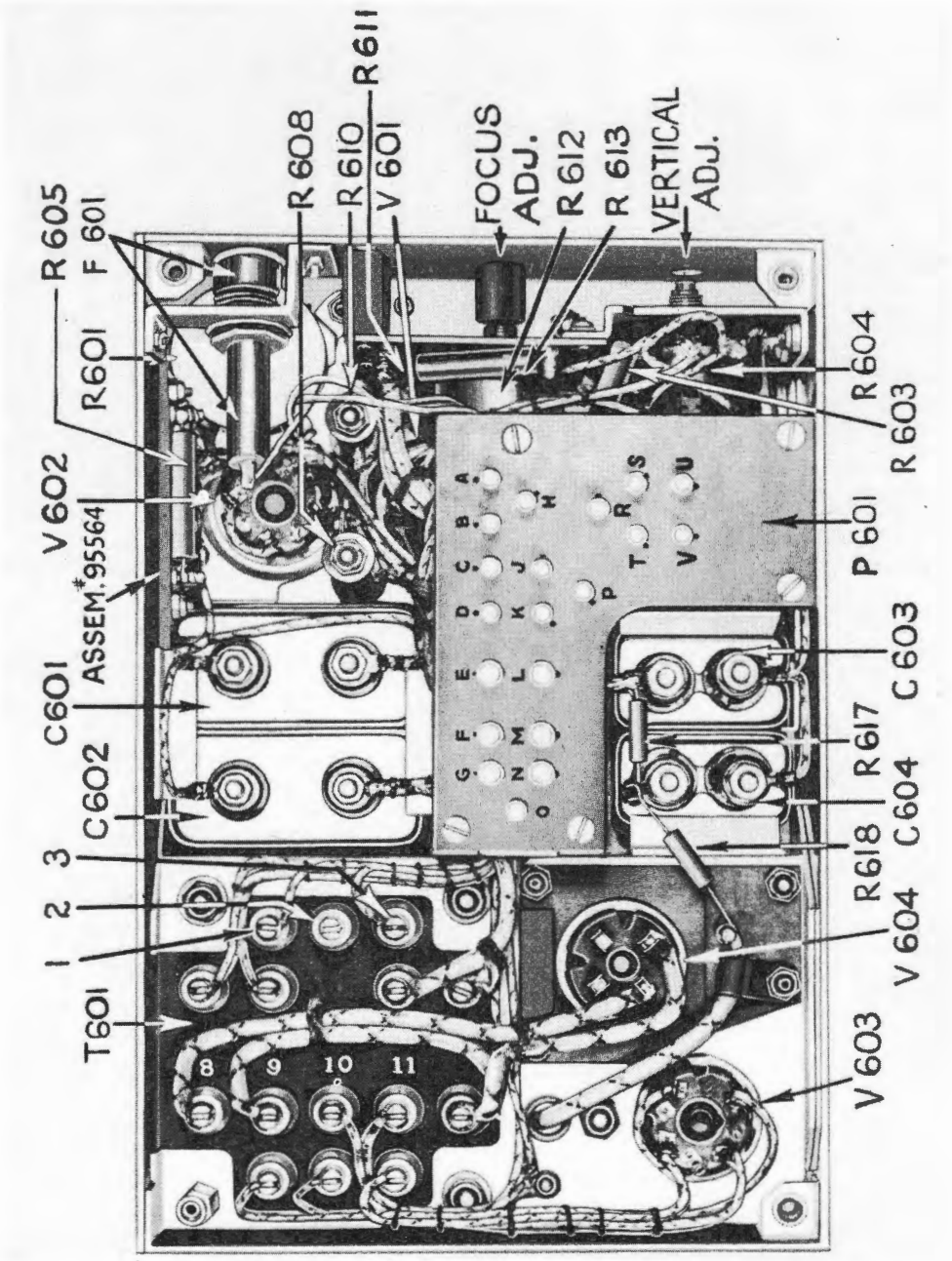


Figure 5-15. Power Supply—Bottom Off

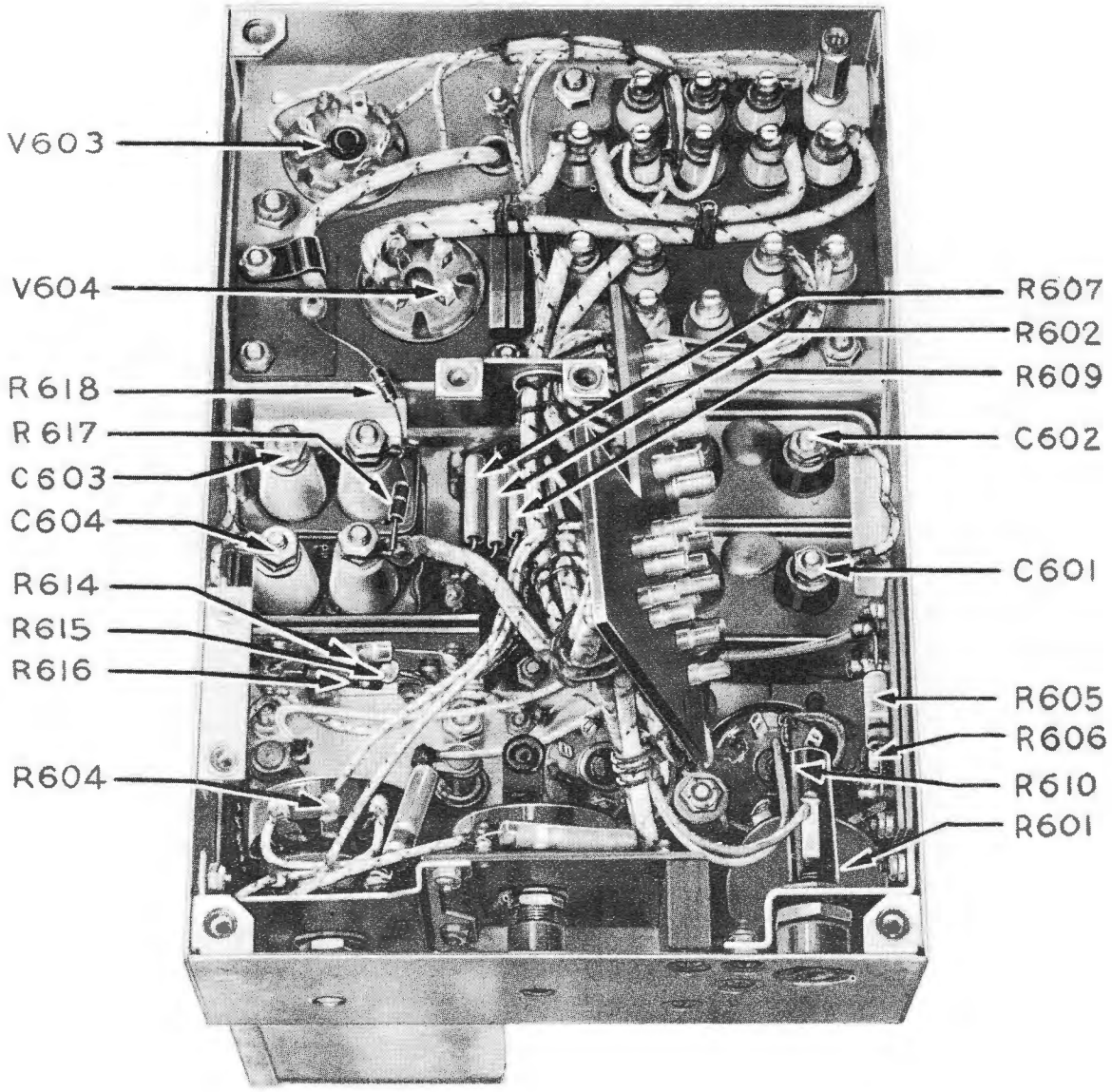


Figure 5-16. Power Supply—Bottom Terminal Board Loose

TABLE 5-17. TERMINAL BLOCK VOLTAGE CHART

Voltage from terminals on bottom of Indicator ID-59/APA-11 to ground—all units plugged in.

Meter Ohms Per Volt	*Terminal Block*		*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	*M*	*N*	*O*	*P*	*R*	*S*	*T*	*U*	*V*
1000	J-101	Voltage	0	0	1.50	0	0	0	155	6.3 a-c	330	0	0	—	—	—	—	—	—	—	—	—
		Meter Scale			10				500	10 a-c	500											
20000	J-101	Voltage	0	0	1.5	0	0	0	150	6.3 a-c	340	0	0	—	—	—	—	—	—	—	—	—
		Meter Scale			10				250	10 a-c	1000											
1000	J-201	Voltage	0	0	0	155	6.3 a-c	333	0	20	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale				500	10 a-c	500		500												
20000	J-201	Voltage	0	0	0	150	6.3 a-c	340	0	65	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale				250	10 a-c	1000		250												
1000	J-301	Voltage	0	0	0	155	6.3 a-c	0	0	333	0	0	—	—	—	—	—	—	—	—	—	—
		Meter Scale				500	10 a-c			500												
20000	J-301	Voltage	0	0	0	150	6.3 a-c	0	0	340	0	0	—	—	—	—	—	—	—	—	—	—
		Meter Scale				250	10 a-c			1000												
1000	J-401	Voltage	5	0	6.3 a-c	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale	500		10 a-c																	
20000	J-401	Voltage	25	0	6.3 a-c	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale	250		10 a-c																	
1000	J-402	Voltage	—	—	—	0	335	230	0	—	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale				500	500	500														
20000	J-402	Voltage	—	—	—	0	340	230	0	—	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale				250	1000	250														
1000	J-501	Voltage	332	6.3 a-c	.9 a-c	0	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale	500	10 a-c	10 a-c																	
20000	J-501	Voltage	340	6.3 a-c	.9 a-c	0	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Meter Scale	1000	10 a-c	10 a-c																	
1000	J-601	Voltage	227	155	195#	332	PR1	0	0	150	65#	73#	PR1	6.3 a-c	6.3 a-c	0	155	—805	—595#	—1230	*	*
		Meter Scale	500	500	500	500				500	500	500		10 a-c	10 a-c		500	1000	1000	1000 x 2		
20000	J-601	Voltage	234	150	197#	340	PR1	0	0	150	70#	77#	PR1	6.3 a-c	6.3 a-c	0	165	—1080	—850#	—1300	*	*
		Meter Scale	250	250	250	1000				250	250	250		10 a-c	10 a-c		250	1000	1000	1000 x 2		

*V-1 Fil. 6.3 V. a-c.
#Voltages at J-601 J, J-601 S, J-601 C and J-201 H change with control settings.

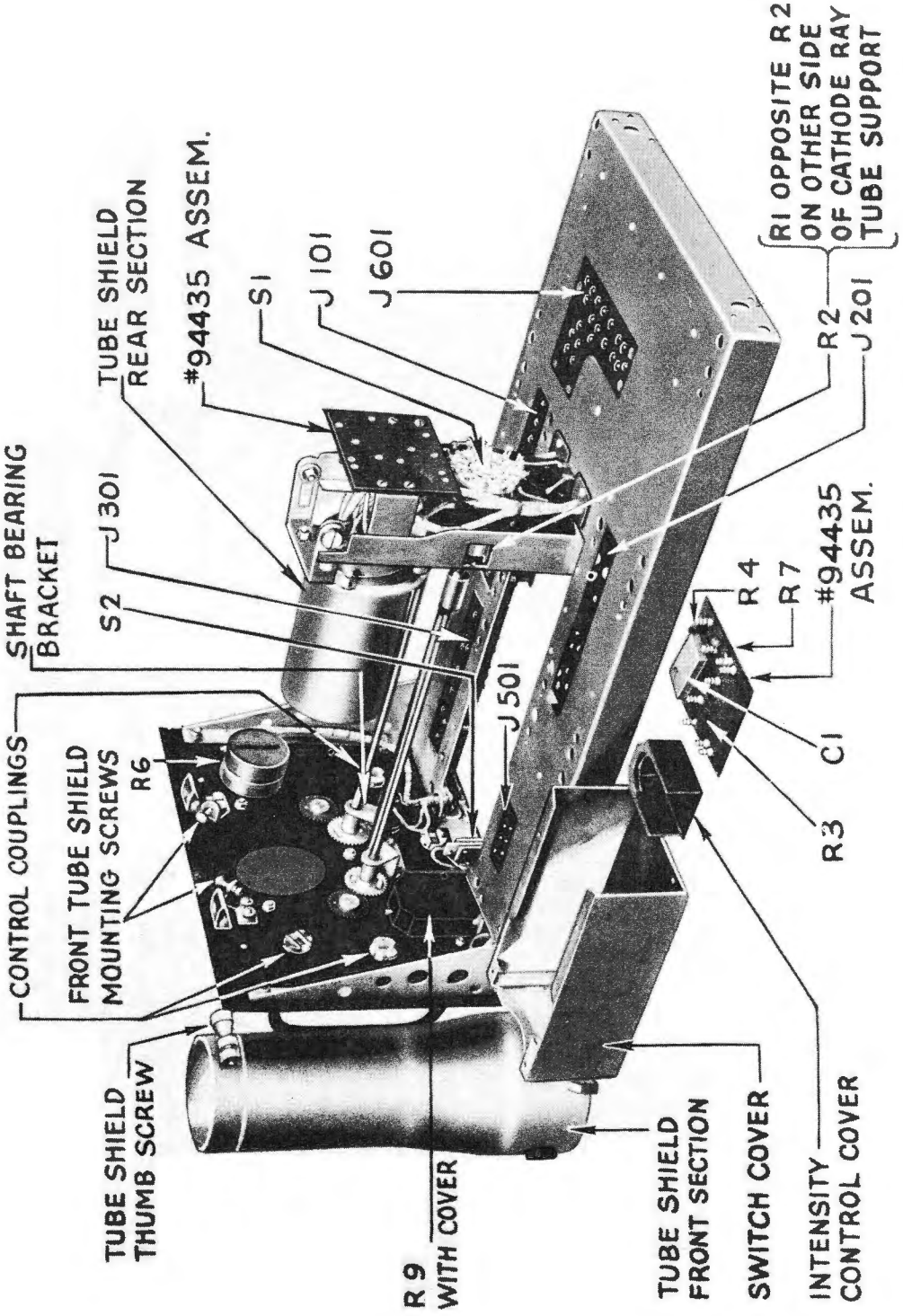


Figure 5-17. Chassis and Control Panel—Rear View

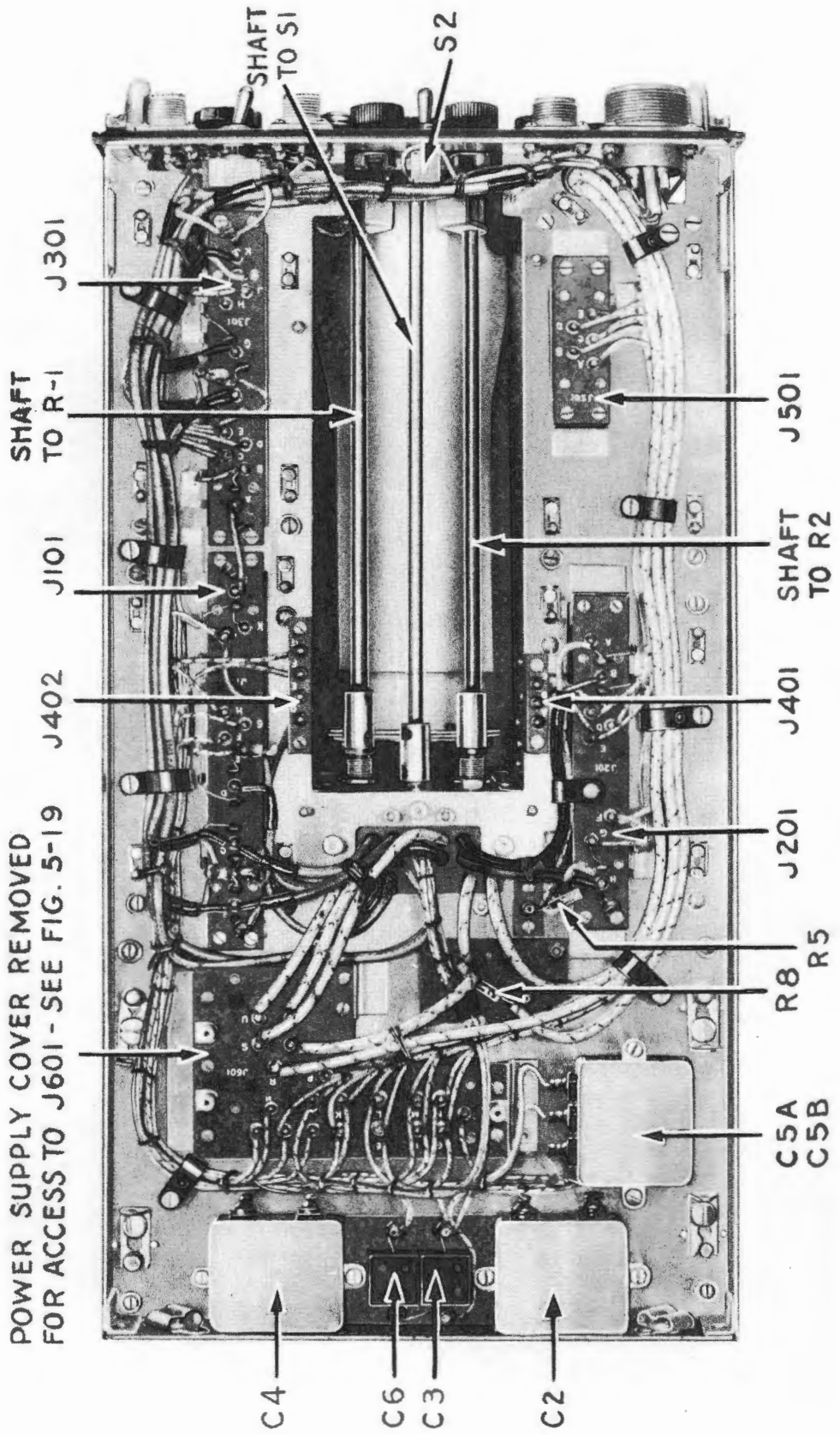


Figure 5-18. Bottom View of Chassis—Saw-tooth Oscillator Removed

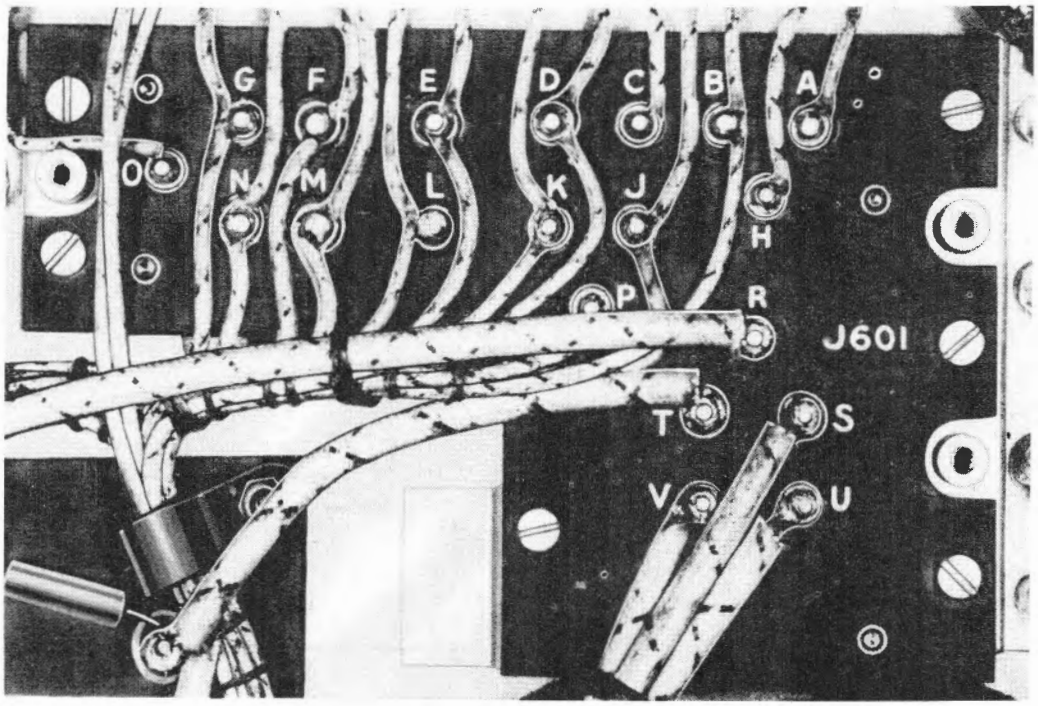


Figure 5-19. Power Supply Connector Board

4. REPLACEMENT OF FUSE AND LAMPS.

a. INSTRUCTIONS FOR FUSE REPLACEMENT.

(1) Look for fuse and spare fuse on power supply (see figure 1-9) and in spare parts box.

(2) With a screw driver or a thin coin turn red end of "FUSE" (see figure 5-16) to left about 60° and pull out.

(3) Remove fuse cartridge.

(4) Insert new 2-ampere fuse cartridge into clip on removed end.

(5) Put back into holder. Turn to right about 60° to lock into position.

b. INSTRUCTIONS FOR PILOT LAMP REPLACEMENT.

(1) Locate spares in spare parts box, then unscrew with fingers knurled end of pilot lamp (figure 2-1, #18) lens assembly.

(2) Push lamp in slightly and twist to left to release and remove.

(3) Put in new #96173 (GE 44, or equivalent) lamp and lock it into position by pushing in slightly and twisting to right until stop is reached.

(4) Screw lens assembly back into place.

c. REPLACEMENT OF SINE WAVE OSCILLATOR CONTROL LAMP (I-501).

(1) Look for spares in spare parts box, then turn "POWER SWITCH" off.

(2) Remove dust cover according to directions given in paragraph 5.*a.* below.

(3) Remove detachable side of sine wave oscillator.

(4) Lamp is under the tube sockets. Push lamp in slightly and twist to left to release and remove.

(5) Replace with GE MAZDA 3W S6 code 3S6 S. C. Base 120-volt lamp, Part No. 96194. Lock it in place by pushing it in slightly and twisting it to the right until a stop is reached.

(6) Make adjustment of sine wave oscillator control (R-501) as described in paragraph 6.*b.*, this section.

(7) Replace detachable side and dust cover.

5. SPECIAL MAINTENANCE INSTRUCTIONS.

a. INSTRUCTIONS FOR REMOVING AND REPLACING THE DUST COVER.

(1) TO REMOVE.

(a) Turn "POWER SWITCH" off.

(b) Loosen two knurled clamping nuts in front which hold Indicator ID-59/APA-11 to mounting base and swing them down.

(c) Slide Indicator ID-59/APA-11 forward and remove from mounting base.

(d) Loosen two airloc fasteners on back of dust cover near bottom by turning counterclockwise about one-half turn.

(e) Remove two nickeled binder head screws on top just back of control panel.

(f) Slide chassis assembly out of dust cover.

(2) TO REPLACE DUST COVER.

(a) Turn "POWER SWITCH" off.

(b) Slide chassis assembly into dust cover.

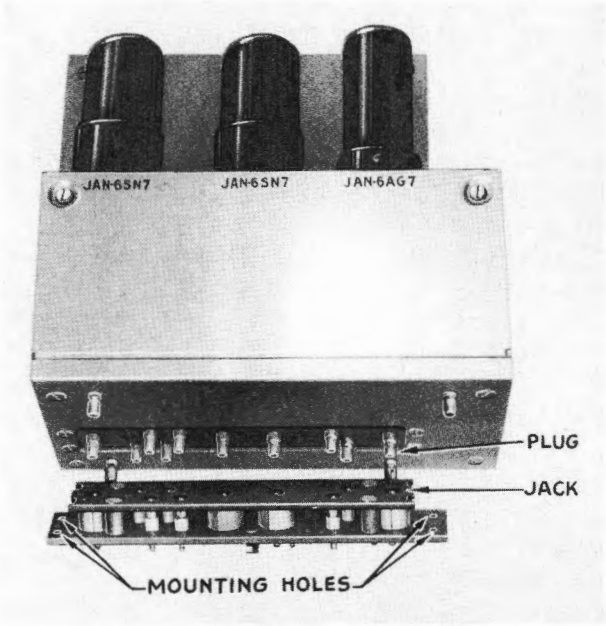


Figure 5-20. Unit Plug and Jack Connectors—Jack Removed from Chassis

(c) Put two 6-32 $\frac{5}{16}$" binder head screws in top just back of control panel.

(d) Tighten two airloc fasteners on back of dust cover near bottom by turning clockwise.

(e) Place Indicator ID-59/APA-11 on mounting base so that hold-down pins on base fit into holes in back.

(f) Swing front clamping assembly up over the hold-down hooks and tighten knurled nuts.

b. INSTRUCTIONS FOR REMOVING AND INSTALLING THE UNITS.—The six detachable units of Indicator ID-59/APA-11 make electrical connection with the main chassis through plugs on the bottom of the units and jacks on the chassis. Figure 5-20 shows a plug connector on the bottom of a unit and a jack connector into which the unit plugs. Except for the saw-tooth oscillator all units plug in from the top of the chassis; the saw-tooth oscillator plugs in from the bottom. The jack connector shown in figure 5-20 is removed from the chassis in order to show its mounting holes. If required, when installing a replacement unit, the pack connector may be shifted about slightly when the mounting screws are loosened. Procedure is to loosen mounting screws to plug unit in carefully shifting jack so that mounting studs center in mounting holes and to tighten the jack mounting screws. Generally this adjustment will not be necessary.

Note

All snap slides are underneath the main chassis. In all cases when removing a unit, pull as nearly straight upward as possible with a slight back and forth rocking motion. (See paragraph 5.*a.* above.)

(1) VIDEO UNIT.

(a) TO REMOVE.

1. Turn "POWER SWITCH" (#5) off (see figure 2-1).

2. Cut safety wires and release snap slides for video unit.

3. Pull unit out.

(b) TO INSTALL.

1. Open snap slides.

2. Plug unit in.

3. Close snap slides and put on new safety wires.

(2) POWER SUPPLY.

(a) TO REMOVE.

1. Turn "POWER SWITCH" (#5) off.

2. Cut safety wires and release snap slides for power supply.

3. Pull unit out.

(b) TO INSTALL.

1. Open snap slides.

2. Plug unit in.

3. Close snap slides and put on new safety wires.

(3) INVERTER AND TRIGGER UNIT.

(a) TO REMOVE.

1. Turn "POWER SWITCH" (#5) off.

2. Cut safety wires and release snap slides for trigger amplifier.

3. Pull unit out.

(b) TO INSTALL.

1. Open snap slides.

2. Plug unit in.

3. Close snap slides and put on new safety wires.

(4) SAW-TOOTH OSCILLATOR.

(a) TO REMOVE.

1. Turn "POWER SWITCH" (#5) off.

2. Turn "SW. FREQ. RANGE CY" switch (#15) to "500."

3. Turn "SW. FREQ. FINE" control (#16) pointer vertical.

4. Cut safety wires and release snap slides for saw-tooth oscillator.

5. Remove unit from bottom, terminal end first.

(b) TO INSTALL. (See paragraph 5, this section.)

1. Open snap slides.

2. Turn "SW. FREQ. RANGE CY" switch (#15) to "500."

3. Turn "SW. FREQ. FINE" control (#16) pointer vertical.

4. Turn couplings on both shafts so that set screws are in vertical position.

5. Move saw-tooth oscillator into position from bottom, shaft end first, so that couplings mesh.

6. When shaft is started properly, push terminals into place.

7. Close snap slides and put on new safety wires.

(5) SERVO-SWEEP GENERATOR.

(a) TO REMOVE.

1. Turn "POWER SWITCH" off.

2. First remove trigger amplifier (see paragraph 5.*b.*(3), this section).

3. Cut safety wires and release snap slides for servo-sweep generator.

4. Pull unit out.

(b) TO INSTALL. (See paragraph 5.*g.*, this section.)

1. First remove trigger amplifier (see paragraph 5.*b.*(3), this section).

2. Open snap slides.

3. Turn "MULTIPLY μ SEC. BY" switch to "5."

4. Turn shaft coupling on unit so that set screw is down (90° from horizontal).

5. Plug in servo-sweep generator, first making sure that couplings mesh.

6. Close snap slides and put on new safety wires.

7. Install trigger amplifier (see paragraph 5.*b.*(3), this section).

(6) SINE WAVE OSCILLATOR.

(a) TO REMOVE.

1. Turn "POWER SWITCH" off.

2. Set "P. R. FREQUENCY (K. C.)" switch (#13) between 1.32 and 1.21 (see figure 2-1).

3. Set "INCREMENT P. R. FREQUENCY" control (#14) to 0.

4. Cut safety wires and release snap slides for sine wave oscillator.

5. Pull out sine wave oscillator unit.

(b) TO INSTALL. (See paragraph 5.*g.*, this section.)

1. Open snap slides.

2. Set "P. R. FREQUENCY (K. C.)" switch (#13) between 1.32 and 1.21 (see figure 2-1).

3. Set "INCREMENT P. R. FREQUENCY" control (#14) to 0.

4. Turn shaft couplings on unit so that set screws are down (90° from horizontal).

5. Plug sine wave oscillator in, first making sure that couplings mesh.

6. Close snap slides and put on new safety wires.

c. INSTRUCTIONS FOR CATHODE-RAY TUBE.

(1) TO REMOVE CATHODE-RAY TUBE. (See paragraph 5.*a.*, this section.)

(a) Turn "POWER SWITCH" off.

(b) Loosen two front screws and thumb screw on cathode-ray tube shield.

(c) Slide tube shield back to allow access to cathode-ray tube.

(d) Lift front end of tube shield to elevate screen end of cathode-ray tube.

(e) Pull cathode-ray tube out.

(2) TO INSTALL CATHODE-RAY TUBE.

(a) Loosen two front screws and thumb screw on cathode-ray tube shield.

(b) Slide both sections of tube shield back and lift front end.

(c) Put cathode-ray tube into socket. Do not force. See that the pins do not catch on springs.

(d) Slide both sections of tube shield forward to observe fit of tube in the three rubber grommets on the shield. If tube does not fit snugly make the following adjustments:

1. If fit is too loose turn one or more rubber grommets over so that the thick flanges are inside the shield and the thin flanges are outside.

2. If fit is too tight turn one or more rubber grommets over so that the thin flanges are inside and the thick flanges are outside the shield.

(e) When tube fits properly slide both sections of shield back.

(f) Lower tube and shield and slide shield forward into position.

(g) Tighten the two front screws.

(h) Slide the rear shield section forward until screen of tube just touches green plastic front panel screen and then back off to allow $\frac{1}{32}$-inch clearance.

(i) Tighten thumb screw on rear shield section.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Observe all safety regulations at all times.

(3) ADJUSTMENT OF CATHODE-RAY TUBE TO GET HORIZONTAL TRACE.

(a) Turn "MODE OF OPERATION" switch (6) to "OSC."

(b) Loosen two front screws and thumb screw on cathode-ray tube shield.

(c) Lift front end of tube shield to elevate screen end of tube.

(d) Loosen four screws at rear section of the tube shield.

(e) Slide tube shield back to allow access to cathode-ray tube and turn "POWER SWITCH" on.

(f) Turn front end of tube as desired to get trace level or horizontal and then turn "POWER SWITCH" off.

(g) Tighten four screws at rear section of tube shield. (Be careful not to rotate tube.)

(h) Slide shield forward and lower into position.

(i) Tighten two front screws and thumb screw.

(4) TO REMOVE SHIELD OF CATHODE-RAY TUBE.

(a) Turn "POWER SWITCH" off, then loosen two front screws and the thumb screw on cathode-ray tube shield.

(b) Slide both sections of tube shield back to allow access to cathode-ray tube.

(c) Lift front end of tube shield to elevate screen end of tube.

(d) Pull cathode-ray tube out.

(e) Remove four screws at rear section of tube shield and lift shield off.

d. "INTENSITY" CONTROL REPLACEMENT.—This control is insulated from the control panel. (See figure 2-1, #9.) In case control is to be replaced note arrangement of bakelite parts during removal of faulty control. To install new control:

(1) From front of panel push threaded bakelite bushing into hole for intensity control.

(2) From back of panel, put bakelite shaft coupling into bakelite bushing so that shaft extends through to front.

(3) Put helical spring in bakelite bushing just back of bakelite shaft coupling.

(4) From back of panel, put bakelite disc and then bakelite collar on bakelite bushing. Pin the collar fits into holes in disc and in control panel. The tapped screw hole in collar should be up.

(5) Thread control into bakelite bushing until control shaft seats in coupling slot.

(6) Turn control so that locating pin will go into notch in collar when bushing is tightened.

(7) Use wrench to tighten bushing. Do not strip threads.

(8) Put molded cover over the intensity control on back of the control panel. (This must be on to prevent breakdown at high altitude.)

(9) Fasten molded cover on with screw through top of it into tapped hole in collar.

e. MECHANICAL ADJUSTMENT OF SHAFTS FOR PROPER ALIGNMENT.

(1) Do not bend shafts to get alignment. Bent shafts should be replaced. (See paragraph *f.* below for assembly procedure.)

(2) Alignment depends on bearing in bearing bracket on back of front panel.

(3) Shaft may be considered in alignment when wobble at free end (with coupling slide forward) makes a circle about the center of the control shaft. To check this:

(a) Loosen shaft coupling sleeve and slide it forward.

(b) Grasp free end of shaft with two fingers and move it around in a circle. The looser the fit of shaft in bearing the greater the circle diameter will be.

(c) Having described a circle as in *(b)* above note the approximate center. This should be the same as the control shaft center.

(d) Rotate the shaft 180° by means of the front panel knob and repeat *(b)* and *(c)* above. If centers are in alignment throughout *(b)*, *(c)*, and *(d)*, the shaft is true and in alignment.

(e) If shaft appears in alignment in *(b)* and *(c)* but not in *(d)* or vice versa, shaft is bent and should be replaced.

(f) If shaft appears out of alignment in the same direction and to the same extent in *(b)*, *(c)*, and *(d)* shaft is true but bearing is out of alignment.

(4) To obtain alignment when shaft is true.

(a) Try shifting heavy bracket in front and the controls.

(b) If *(a)* does not get sufficient alignment, bend heavy bracket as required.

f. PROCEDURE FOR ASSEMBLY OF SHAFTS, GEARS, AND KNOBS USED WITH "VIDEO GAIN" AND "TRIGGER GAIN" CONTROLS.

(1) Screw shaft bearing bracket to back of control panel. (See figure 5-17.)

(2) Put oil (AAF Specification 3582A) on end of shaft having the smaller diameter. (Oil goes on the large diameter adjacent to the small diameter not on the small diameter.)

(3) Put coupling sleeves on opposite end of shaft (large diameter end).

(4) Insert small diameter end into bracket bushing.

(5) Place anti-backlash gear between panel and bracket bushing with gear and bushing hole centers in line and with hub of gear toward the bushing.

(6) Push small diameter of shaft through anti-backlash gear hole.

(7) Line up set screw in gear hub with flat on shaft.

(8) Make sure that gear hub is against shaft shoulder.

(9) Tighten set screw in gear hub.

(10) Line up in same plane the flats on shaft of control and large diameter end of shaft.

(11) Line up coupling sleeve set screws with flats.

(12) Slide coupling sleeve so that it is about equally spaced over flats of shafts. (Sleeve should not rub on control bushing or extend over coil spring on control shaft.)

(13) Tighten set screw on control unit end of coupling sleeve.

(14) Get .005" to .020" end play in shaft between hub of anti-backlash gear and bracket bushing.

(15) Tighten coupling sleeve set screw on shaft flat.

(16) Oil and insert shaft of fibre gear into panel bushing. (Use AAF Specification 3582A oil.)

(17) Line up positioning marks on back of fibre gear and anti-backlash gear and put gears in mesh. Positioning marks should meet when gears are rotated.

(18) Hold bakelite gear against bushing in front panel.

(19) Put flat spring washer on bakelite gear assembly shaft protruding through front panel.

(20) Put on knob by lining up set screw with flat on gear shaft, pushing knob against flat spring washer slightly and tightening set screw.

(21) If shaft, gears, and knob are lined up correctly, at half rotation of control the arrow will be pointing up vertically. Apply glyptol to all set screws.

g. INSTALLATION OF SINE WAVE OSCILLATOR O-34/APA-11, SAW-TOOTH OSCILLATOR, AND SERVO-SWEEP GENERATOR REPLACEMENT UNITS.—When a replacement is necessary for sine wave oscillator, saw-tooth oscillator, or servo-sweep generator, the directions under paragraph 5.*b.*, this section, are to be supplemented with the following:

(1) SINE WAVE OSCILLATOR O-34/APA-11.

(a) Plug in unit. (Refer to paragraph 5.*b.*(6) *(b) 1* to *5* inclusive, this section.)

(b) Observe engagement distance of panel coupling tongue in the unit shaft coupling groove (should be about 1/8 inch).

(c) If distance in *(b)* is not approximately 1/8 inch:

1. Note the amount of shifting required.

2. Remove unit.

3. Loosen set screws and shift couplings endwise on shaft as required in *1* above.

4. Tighten set screw and reinstall unit. (Do not force or cracking may occur.)

(d) If distance in *(b)* is approx. 1/8 inch, apply glyptol to set screws, close snap slides and put on new safety wires.

(2) SAW-TOOTH OSCILLATOR.

(a) Plug in unit. (Refer to paragraph 5.*b.*(4)*(b) 1* to *6* inclusive, this section.)

(b) Observe engagement distance of panel coupling tongues in unit shaft coupling grooves (should be approximately 1/8 inch).

(c) If distance in *(b)* above is not approximately 1/8 inch:

1. Note the amount of shifting required.

2. Loosen set screws and shift couplings endwise on shaft as required in *1*, above.

3. Tighten set screw (do not force).

(d) If distance in *(b)* above is approximately 1/8 inch, apply glyptol to set screws, close snap slides and put on new safety wires.

(3) SERVO-SWEEP GENERATOR.

(a) Observe position of shaft coupling. Skirt of coupling should just clear case without scraping.

(b) If clearance of coupling skirt is too great or if skirt rubs against case:

1. Loosen set screw and shift coupling endwise so that it just clears case.

2. Tighten set screw (do not force).

(c) If endwise position of shaft coupling is as required in *(a)*, apply glyptol to set screw, plug unit in (refer to paragraph 5.*b.*(5)*(b)*., this section).

h. LUBRICATION. — Moving parts may require lubrication with low temperature oil (AAF Specification 3582A) every two to six months depending upon the amount of usage. When necessary, lubricate at the following places:

(1) Saw-tooth oscillator "SW. FREQ. RANGE CY" switch bearing.

(2) Sine wave oscillator "P. R. FREQUENCY (K. C.)" switch bearings.

(3) "MODE OF OPERATION" switch and extension shaft bearings.

(4) Servo-sweep generator "MULTIPLY μ SECONDS BY" switch bearing.

(5) Bearings and gears at panel end of "TRIGGER GAIN" and "VIDEO GAIN" extension shafts.

(6) All control panel coupling shafts except "INTENSITY" control and "PULSE DURATION" control.

WARNING

This equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

6. ADJUSTMENT OF INTERNAL CONTROLS.

a. TO ADJUST SAW-TOOTH OSCILLATOR SWEEP AMPLITUDE.

(1) Throw "POWER SWITCH" off.

(2) Remove dust cover (refer to paragraph 5.*a.*, this section).

(3) Throw "POWER SWITCH" on.

(4) Turn "MODE OF OPERATION" switch to "OSC."

(5) Turn "INTENSITY" control clockwise until trace can be seen.

(6) Turn "SW. FREQ. RANGE CY." switch to "7K."

(7) Turn "SW. FREQ. FINE" control counterclockwise.

(8) Turn slotted shaft of saw-tooth oscillator amplitude control on top of saw-tooth oscillator unit (R-408 on schematic) to obtain a suitable horizontal deflection (usually about 1 3/4 to 2 1/4 inches with no signal on vertical plates).

Note

A change of JAN-884 tube or JAN-6AC7 (V-402) may make the sweep amplitude adjustment necessary.

b. TO ADJUST SINE WAVE OSCILLATOR O-34/APA-11 NEGATIVE FEEDBACK OR DEGENERATION CONTROL.

(1) Turn off "POWER SWITCH."

(2) Remove dust cover. (Refer to paragraph 5.*a.*, this section.)

(3) Remove the detachable side of the sine wave oscillator.

(4) Read the warning at the end of paragraph 5.

(5) Turn "MODE OF OPERATION" switch to "P. R. F."

(6) Turn "POWER SWITCH" on.

(7) Adjust "INTENSITY" control until beam appears.

(8) Turn "VIDEO GAIN" clockwise.

(9) Turn slotted shaft of degeneration control, R-501 (on right side near top) counterclockwise. (See figure 5-13.)

(10) Slowly turn degeneration control clockwise until vertical displacement of beam is first observed and note control position.

(11) Rotate control 90° clockwise from position in (10) above.

(12) Check for operation at all settings of "P. R. FREQUENCY (K. C.)" switch.

(13) In case vertical deflection stops or shows tendency to fluctuate periodically during (12), increase rotation of (11) beyond 90° sufficiently to obtain steady vertical deflection on all "P. R. FREQUENCY (K. C.)" switch settings.

(14) Turn off "POWER SWITCH," reassemble, and repeat (12) for recheck.

c. FOCUSING SIGNAL ON SCREEN.

(1) Turn off "POWER SWITCH" and remove dust cover. (Refer to paragraph 5, this section.)

(2) Turn "MODE OF OPERATION" switch to "OSC."

Note

If pulse generator is available, turn to "P. D." and get pulse pattern on screen.

(3) Turn "POWER SWITCH" on.

(4) Turn up "INTENSITY" control on front panel to get trace on screen.

(5) Adjust for best focus with control (R-612 on schematic) on power supply. (See figure 1-9.)

d. VERTICAL CENTERING SIGNAL ON SCREEN.

WARNING

This equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

(1) Turn off "POWER SWITCH" and remove dust cover (refer to paragraph 5.*a.*(1), this section).

(2) Turn "MODE OF OPERATION" switch to "OSC."

(3) Turn "POWER SWITCH" on.

(4) Turn up "INTENSITY" control (see figure 2-1, #9) to get a trace on screen.

(5) Adjust centering control (R-604) on schematic) on power supply (see figure 1-9).

e. CALIBRATION OF "PULSE DURATION" DIAL.

(1) Turn off "POWER SWITCH."

(2) Remove dust cover. (Refer to paragraph 5.*a.*, this section.)

(3) Turn the "MODE OF OPERATION" switch to "P. D."

(4) Remove snap button on the POWER SUPPLY covering calibration adjustment. (See figure 1-9.)

(5) Turn "POWER SWITCH" on.

(6) Turn up "INTENSITY" control until spot just appears on screen of cathode-ray tube. Keep brilliance as low as possible to prevent damage to screen.

(7) By means of "PULSE DURATION" control (see figure 2-1, #11) set spot $\frac{1}{8}$ inch from right edge of screen and observe microsecond reading on dial.

(8) By means of "PULSE DURATION" control (figure 2-1, #11) move spot to left $2\frac{3}{8}$ inches from setting in (7) and observe microsecond reading on dial.

(9) The difference in readings obtained in (7) and (8) should be five microseconds. For example, if reading in (7) was two microseconds the reading in (8) should be seven microseconds.

(10) If difference in (9) was greater than five microseconds, rotate calibration adjustment in the power supply slightly clockwise. Conversely, if difference in (9) was less than five microseconds, rotation should be counterclockwise.

(11) Repeat (7), (8), and (10) until five microsecond difference is obtained.

(12) Turn "POWER SWITCH" off.

(13) Replace snap-button and dust cover.

Note

Calibration of "PULSE DURATION" dial is required if power supply replacement is made.

f. ADJUSTMENT OF SERVO-SWEEP GENERATOR.

(1) Turn off "POWER SWITCH."

(2) Remove dust cover. (Refer to paragraph 5.*a.*, this section.)

(3) Take off both removable side plates of servo-sweep generator. (Figure 5-7 shows sides removed.) Do not open bottom, however, and do not unplug servo-sweep generator from chassis.

(4) Turn "MODE OF OPERATION" switch to "P. D."

(5) To "PULSE INPUT" apply a signal which will operate the servo-sweep generator by using Test Oscillator TS-47/APR.

(a) Turn "MULTIPLY μ SEC. BY" switch to "20."

1. Adjust "TRIGGER GAIN" and "INTENSITY" controls of Indicator ID-59/APA-11 and the output control of pulse generator to get pulse pattern on screen.

2. Set left edge of pulse (if edges are not vertical take a point 3 db down (approximately 30 percent) from peak on left edge of the pulse) to index line on screen by means of "PULSE DURATION" control and observe "PULSE DURATION" dial reading in microseconds.

3. Turn "PULSE DURATION" control counterclockwise sufficiently to increase the microsecond reading on the dial by two microseconds. For example, if reading obtained in subparagraph *4* above was three microseconds the dial should now be set to read five microseconds.

4. By means of resistor R-317 (see figure 5-7) set right edge of the pulse (if edges are not vertical take point 3 db down (approximately 30 percent) from peak on right edge of pulse) to the index line.

5. Check back by repeating *4*, *5*, and *6* above to get closer adjustment.

6. Set left end of the complete trace about 1/8 inch from left side of screen.

7. Adjust capacitor C-307 (see figure 5-7) to obtain a total horizontal trace length of about 2 1/4 to 2 1/2 inches.

SECTION VI

SUPPLEMENTARY DATA

1. FREQUENCY STABILITY OF SINE WAVE OSCILLATOR O-34/APA-11.

The precision of the pulse repetition frequency determination is dependent upon the frequency stability of the sine wave oscillator. It should be possible to reproduce a frequency setting within plus or minus 0.4 percent during a fifteen minute period when the change of temperature is not more than 18° F (10° C) and the change of line voltage is not more than plus or minus 3 percent.

2. POWER SUPPLY.

a. 105 to 125 volts a.c. (Tap for 75 to 85 volts.)
b. 400 to 2600 cycles per second.
c. Power factor 0.98.

3. CURRENT REQUIRED.

Total current drawn is 1.74 amperes at 115 volts, 400 cycles.

4. TUBE COMPLEMENT.

Unit	*Quantity*	*Tube JAN-Designation*	*Tube VT-Designation*
Power Supply	2	JAN-OD3/VR-150	VT-139
	1	JAN-5U4G	VT-244
	1	JAN-2X2	VT-119
Video amplifier	1	JAN-6J5	VT-94
	1	JAN-6AC7	VT-112
	1	JAN-6AG7	VT-247
Trigger amplifier	1	JAN-6SN7GT	VT-231
	2	JAN-6AC7	VT-112
	1	JAN-6AG7	VT-247
Servo-sweep generator	2	JAN-6SN7GT	VT-231
	1	JAN-6AG7	VT-247
Sine wave oscillator	1	JAN-6SJ7	VT-116
	1	JAN-6SN7GT	VT-231
Saw-tooth oscillator	1	JAN-884	VT-231
	1	JAN-6AC7	VT-112
Panel and chassis	1	JAN-3BP1	

5. LIST OF PANEL CONTROLS.

The controls are located on the panel of Indicator ID-59/APA-11. (See figure 2-1.)

a. "POWER SWITCH."

b. "MODE OF OPERATION." This switch permits selection of type of operation required.

c. "TRIGGER GAIN" control. It controls amplitude of the triggering signal.

d. "INTENSITY." Trace brightness may be regulated by this control.

e. "VIDEO GAIN." This control is for adjusting the amplitude of vertical deflection.

f. "PULSE DURATION." This control is used for horizontal shifting of pattern.

g. "MULTIPLY μ SEC. BY" switch. It controls spread of pulse pattern.

h. "P. R. FREQUENCY (K. C.)" (pulse rate frequency kilocycles). This control is used for adjusting frequency in determining repetition frequency.

i. "INCREMENT P. R. FREQUENCY" (increment pulse rate frequency).

j. "SW FREQ. RANGE (CY)" (sweep frequency range cycles). This control is used for adjusting frequency of saw-tooth oscillator.

k. "SW. FREQ. FINE" (sweep frequency, fine).

l. "PULSE POLARITY." (This switch changes the operation condition of the equipment from — to + polarity pulses.)

SECTION VII
PARTS CATALOG

Introduction

Table of Parts

The parts listed in this table do not constitute a complete electrical and mechanical breakdown of the equipment. The table lists all electrical parts together with such operative mechanical parts as are subject to loss or failure, with the exception of structural and minor parts such as standard bolts, screws, nuts, and the like. In some instances individual detail parts of a sub-assembly may not be listed as separate items, since replacement of such items is impractical.

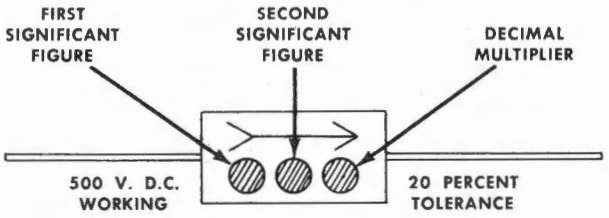
Ordering of Spare Parts

Each Service using this list has established certain depots and service groups for the storage and issue of spare parts to its organizations requiring them. The regulations of each Service should be studied to determine the method and source for requisitioning spare parts. The information in this list, as to manufacturer's or contractor's name, type, model, or drawing number, is not to be interpreted as authorization to field agencies to attempt to purchase identical or comparable spare parts directly from the manufacturer or a wholesale or retail store except under emergency conditions as covered by existing regulations of the Service concerned.

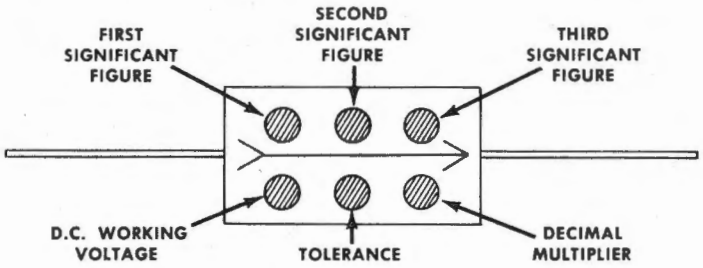
U. S. Army Personnel: This table is for information *only* and is not to be used as a basis for requisitioning parts. Authorities for obtaining maintenance items are as follows: 1. For using organizations: applicable Service publications of the 00-30 series of AAF Technical Orders. 2. For higher maintenance and supply echelons: applicable Service publications of the 08-55 series of AAF Technical Orders.

RMA COLOR CODES

CAPACITORS (MMFD)



COLOR	NUMERAL	VOLTS	MULTIPLIER	TOLERANCE
BLACK	0		1	
BROWN	1	100	10	1%
RED	2	200	100	2%
ORANGE	3	300	1,000	3%
YELLOW	4	400	10,000	4%
GREEN	5	500	100,000	5%
BLUE	6	600	1,000,000	6%
VIOLET	7	700	10,000,000	7%
GRAY	8	800	100,000,000	8%
WHITE	9	900	1,000,000,000	9%
GOLD		1000	0.1	5%
SILVER		2000	0.01	10%
NO COLOR		500		20%

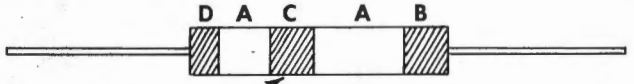


RESISTORS (OHMS)

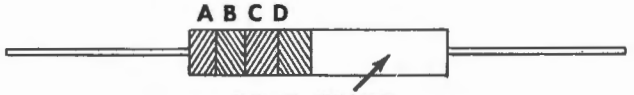
COLOR	A 1ST DIGIT	B 2ND DIGIT	C MULTIPLIER
SILVER			0.01
GOLD			0.1
BLACK		0	1.0
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
PURPLE	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	

D - TOLERANCE CODE:

GOLD = 5% SILVER = 10% NO COLOR = 20%



OLD COLOR ARRANGEMENT



NEW COLOR ARRANGEMENT

BODY COLOR (NEW COLOR ARRANGEMENT ONLY) INDICATES TYPE OF RESISTOR, AS FOLLOWS:

BLACK - COMPOSITION, NON-INSULATED
TAN, OLIVE OR WHITE - COMPOSITION, INSULATED
DARK BROWN - WIRE-WOUND, INSULATED

SECTION VIII

DRAWINGS

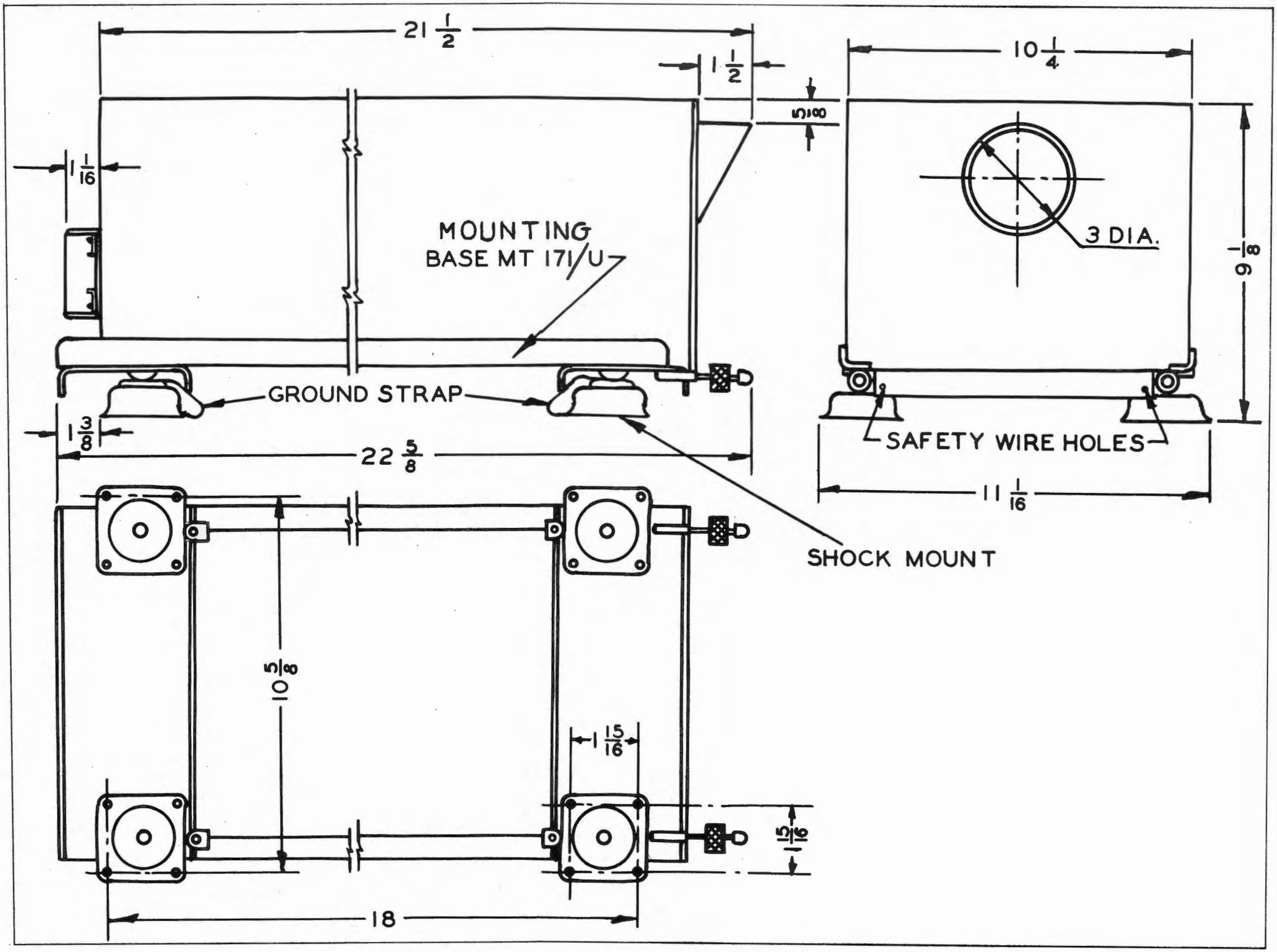


Figure 8-1. Indicator ID-59/APA-11—Mounting Dimensions

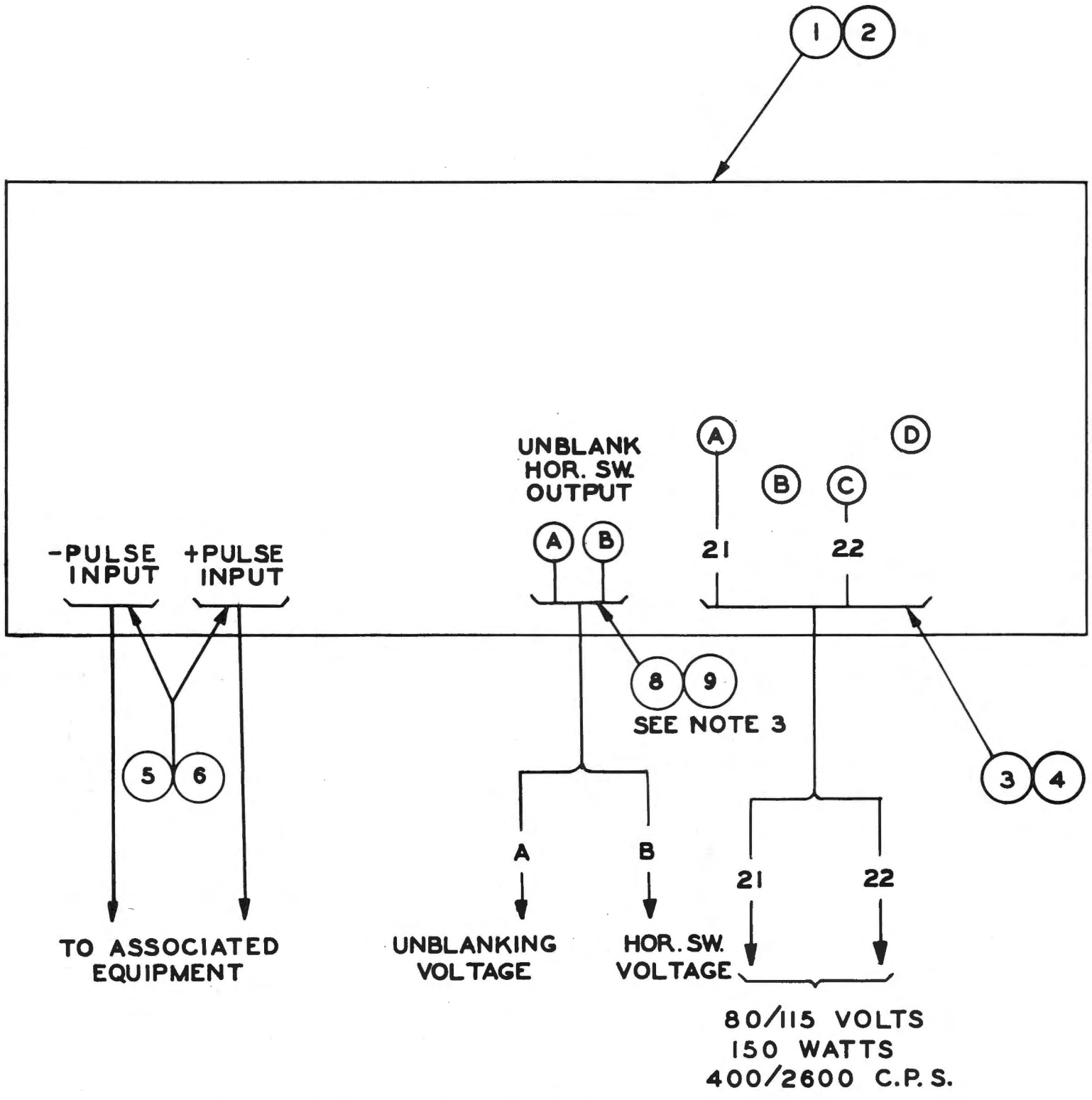


Figure 8-2. Radar Indicator Assembly AN/APA-11—Cording Diagram

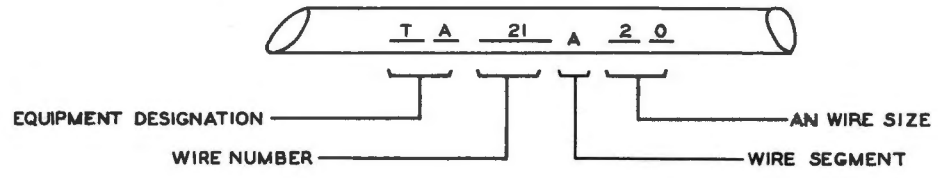
WIRE TABLE

All wires to be aircraft cable per Spec. AN-J-C-48, unless otherwise specified.

All terminal strips required in the installation of the wiring shall be made of suitable insulating material, and with terminal spacing, to prevent voltage breakdown.

Wires for this equipment shall be identified in the airplane wiring diagram and shall be labeled on the airplane wiring in accordance with Spec. AN-W-14.

(Example of the first wire in the table below)



NOTES:

+ Indicates wires to be individually shielded per Spec. 95-27273.

△ Maximum allowable voltage drop in this or these wires shall be in accordance with paragraph C-3a of Spec. AN-W-14.

Ref. Note	*Wire No.*	*Maximum Operating Voltage*	*Max Allowable Resistance In OHMS (71°C)*	*Minimum Cable Size Permitted*
△	21	115 AC	.65	AN-20
△	22	115 AC	.65	AN-20

COMPONENT TABLE

Item	*Quan. Req'd*	*Equipment Description*	*Nomenclature Type No.*	*Spec. or Installation Drawing*
*1	1	Indicator	ID-59/APA-11	
*2	1	Mounting Base	MT-171/U	H44G3448
*3	1	Plug	AN3108-22-4S	AN9534
*4	1	Adapter	AN3057-12	AN3057
*5	2	Plug	PL-259-A or PL-259	H43G11747
*6	As Req'd	Adapter	M-359	H43G11747
*7	1	Cord (see note 4)	CG-259/AP	
*8	1	Plug	AN3106-12S14-3S	
*9	1	Adapter	AN3057-6	AN3057

*Indicates Government Furnished Equipment.

NOTES:

1. When this equipment is installed on a rack assembly, the power cord may be already installed on the rack and connected to power terminal box J-491A.
2. The maximum current carrying capacity of the fuse for this equipment is 5 amperes.
3. Plug AN3106-12S14-3S is used with Radio Frequency Cable RG-22/U when unblanking voltage and/or horizontal sweep voltage is to be supplied to the associated equipment.
4. Cord CG-259/AP is used by connecting it to the "-PULSE INPUT" socket when the indicator is to be used as an oscilloscope.
5. The minimum bending radius of Radio Frequency Cable RG-8/U is 5 inches.

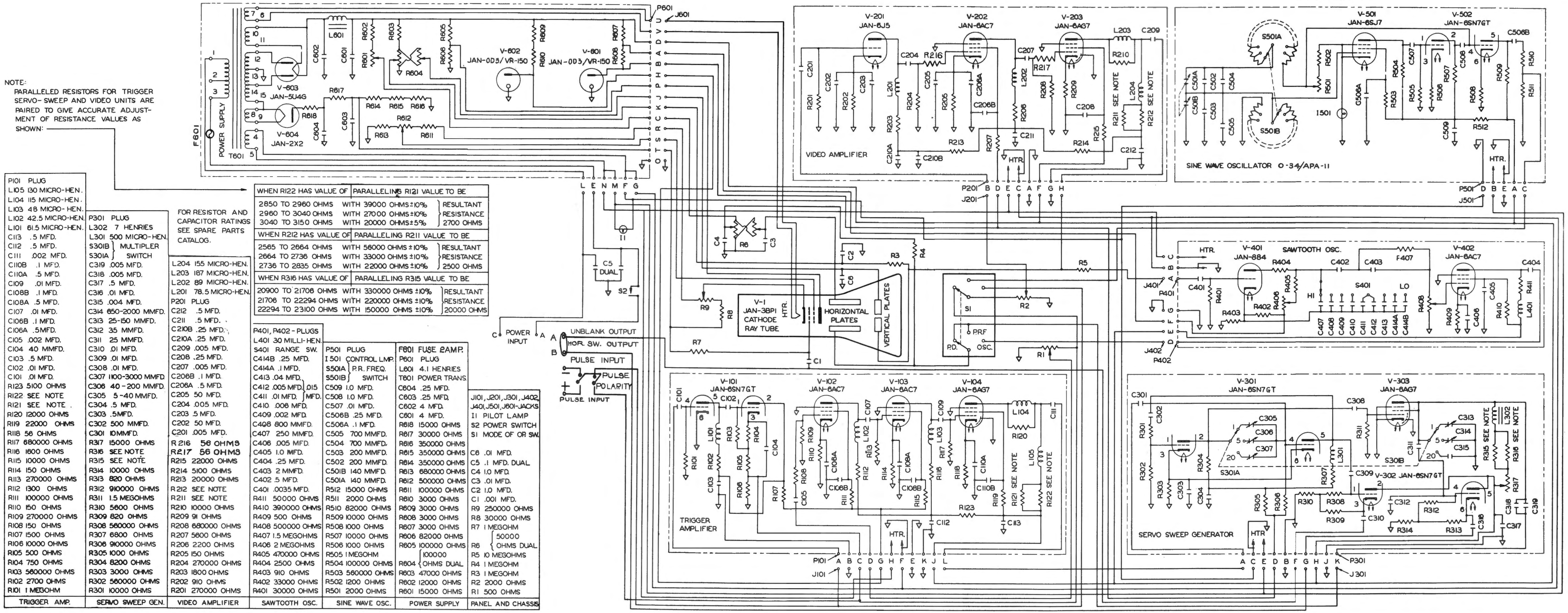


Figure 8-3. Indicator ID-59/APA-11—Schematic—Wiring Diagram