NAVSHIPS 92251 *(Non-Registered)*

INSTRUCTION BOOK

for

OSCILLOSCOPE
OS-8C/U and OS-8E/U

JETRONIC INDUSTRIES, INC.
PHILADELPHIA, PA.

POLYTRONIC RESEARCH, INC.
ROCKVILLE, MARYLAND

CAROL ELECTRONICS CORP.
MARTINSBURG, WEST VIRGINIA

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

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DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
18 June 1954

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Oscilloscope OS-8C/U, NAVSHIPS 92251

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the Bureau of Ships Journal and in the Index of Bureau of Ships General and Electronics Publications, NAVSHIPS 250-020.

W. D. LEGGETT, JR.
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Standard Navy stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name of part and complete description.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name or part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

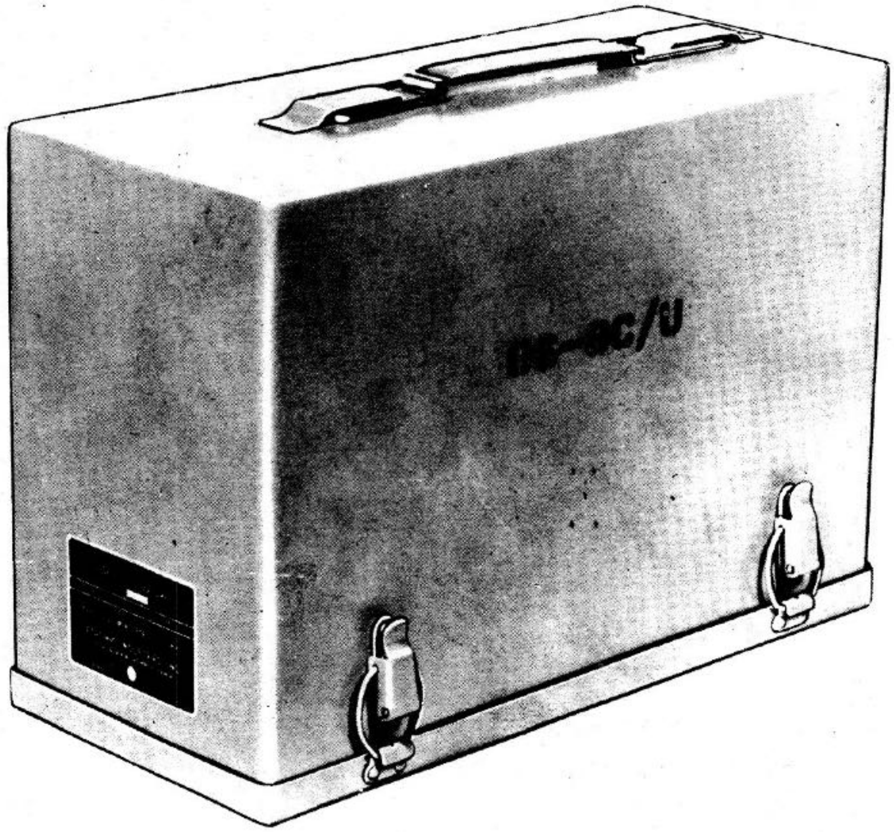


Figure 1-1. Oscilloscope OS-8C/U with Cover in Place

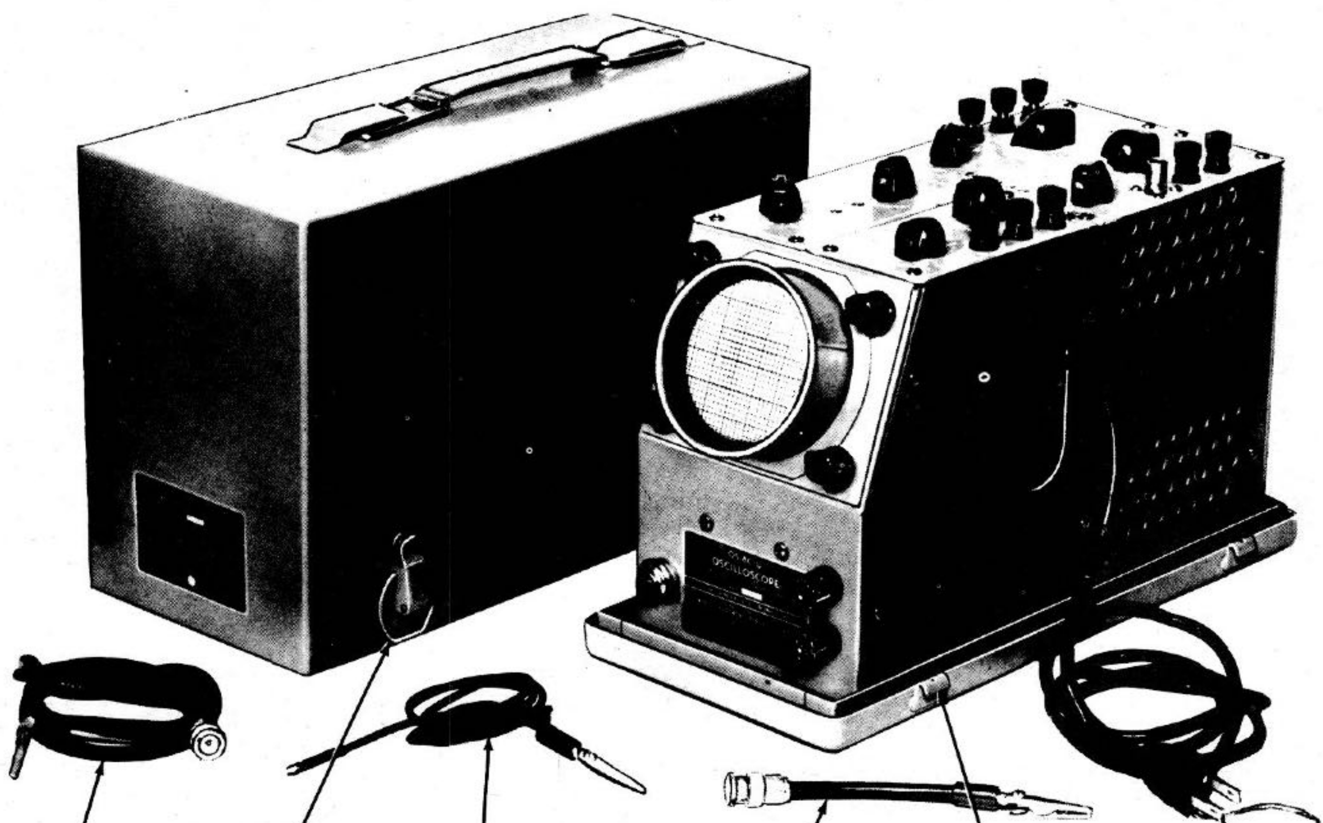


Figure 1-2. Oscilloscope OS-8C/U and Accessories, Cover Removed

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE.

This instruction book describes Oscilloscopes OS-8C/U and OS-8E/U, and includes information concerning the operation and maintenance of the equipment. References and illustrations have been changed throughout the text only to the extent required for clarity. All reference to OS-8C/U applies equally to OS-8E/U, except as specifically indicated.

2. BRIEF DESCRIPTION.

a. GENERAL.—This oscilloscope operates from 115 volts ±10%, 50-1000 cycles a-c, and is designed to be used as a visual testing instrument in all instances where such apparatus can be used to service electronic equipment. It has been designed to be as small and light in weight as possible, consistent with its ability to perform the functions required of it. Some of the characteristics of this oscilloscope which make it a useful instrument are: vertical a-c amplifier operating over a frequency range of 5 cycles to 2 megacycles per second, independent of gain control setting, with a sensitivity of .075 RMS volts per inch; vertical d-c amplifier operating over a frequency range of zero to 2 megacycles per second at full gain control setting; horizontal a-c amplifier operating over a frequency range of one cycle to 500,000 cycles per second, independent of gain control setting, with a sensitivity of .075 RMS volts per inch; horizontal d-c amplifier operating over a frequency range of zero to 500,000 cycles per second at full gain control setting; self-contained sweep circuit oscillator operating through a frequency range of 3 to 50,000 cycles per second with provisions for synchronizing of either positive or negative synchronizing voltages; provisions for beam blanking from either internal or external sources; direct access to both horizontal and vertical deflecting plates; shock mounted within a watertight carrying case; and of unitized construction throughout to allow for versatility and ease of servicing. In regard to this last characteristic, the oscilloscope is made up of seven major assemblies: vertical amplifier, horizontal amplifier, sweep circuit oscillator, sync. circuit, power supply, cathode ray tube assembly, and potentiometer assembly (comprised of vertical positioning, horizontal positioning, intensity and focus controls). Each of these assemblies is interchangeable from one oscilloscope to another, thus allowing for consolidation of working assemblies in case of emergency.

b. APPLICATION.—The portable construction of this oscilloscope makes it convenient to carry to any location where visual servicing is required. This oscilloscope is capable of any number of operations within its ratings, including alignment and testing of electronic and electrical equipment, hum measurements, frequency comparison, observance of complex waveforms, percentage modulation measurements, etc. Operators should familiarize themselves with each control by obtaining a pattern and then rotating the control and noting the effect, except for intensity which should not be allowed to be of extreme brilliance.

3. REFERENCE DATA.

a. Nomenclature: Oscilloscope OS-8C/U or OS-8E/U, for general electronics use.

b. Contract Number: NObsr 75143 and 75682. Date: 26 Feb. 1958 and 23 Jan. 1959.

c. Contractor: Carol Electronics Corp.

d. Cognizant Naval Inspector: Inspector of Naval Material, Baltimore, Md.

e. Number of Packages Involved per Complete Shipment of Equipment: One.

f. Total Cubical Content: Crated: 3,335 cu. in. Uncrated: 730 cu. in.

g. Total Weight: Crated: 34 lbs. Uncrated: 14½ lbs.

h. Frequency Range:
- (1) Vertical Amplifiers:
  - (a) 0-2,000,000 cycles at full gain control setting.
  - (b) 5-2,000,000 cycles, independent of gain control setting.
- (2) Horizontal Amplifiers:
  - (a) 0-500,000 cycles at full gain control setting.
  - (b) 1-500,000 cycles, independent of gain control setting.
- (3) Sweep Circuit Oscillator: 3 to 50,000 cycles.

i. Characteristics of Power Supply Required for Operation: 105-125 volts, 50-1000 cycles, a-c, single phase.

j. Input Impedance:
- (1) Vertical: AC—1.5 megohm shunted by 25 mmf. DC—2 megohms.
- (2) Horizontal: AC—1.5 megohm shunted by 25 mmf. DC—2 megohms
- (3) Vertical Direct: 9 megohms shunted by 11 mmf.
- (4) Horizontal Direct: 9 megohms shunted by 11 mmf.

k. Deflection Sensitivity:
- (1) Vertical: Amplifier—.075 RMS volts/inch. Direct—approximately 17 RMS volts/inch.
- (2) Horizontal: Amplifier—.075 RMS volts/inch. Direct—approximately 25 RMS volts/inch.

l. Power Consumption: 60 watts at 115 volts.

m. Overall Accuracies:
- (1) Vertical Amplifiers:
  - (a) ±3 DB from zero to 2,000,000 cycles at full gain control setting.
  - (b) ±3 DB from 5 to 2,000,000 cycles, independent of gain control setting.
- (2) Horizontal Amplifiers:
  - (a) ±3 DB from zero to 500,000 cycles at full gain control setting.
  - (b) ±3 DB from one to 500,000 cycles, independent of gain control setting.

4. EQUIPMENT DATA.

TABLE 1-1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NOMEN-CLATURE	OVERALL DIMENSIONS A—CRATED B—UNCRATED HEIGHT - WIDTH - DEPTH	VOLUME A—CRATED B—UNCRATED	WEIGHT A—CRATED B—UNCRATED
1	Oscilloscope	OS-8C/U	A: 20¼"x11⅛"x14¾" B: 9" x 6" x 13½"	A: 3,335 cu. in. B: 730 cu. in.	A: 34 lbs. B: 14½ lbs.
1	Case	CY-1300/U	9" x 6" x 13½"		
1	Test Lead	1207/U (3' 0")	3' 0"		
1	Test Lead	1207/U (0' 6")	6"		
1	Ground Lead	W-104	3' 0"		
2	Cathode Ray Tube Screen	O-104	2⅞" dia.		
2	Instruction Book	NAVSHIPS 92251	9" x 11½"		

5. TUBE COMPLEMENT.

TABLE 1-2. TUBE COMPLEMENT

TUBE	TYPE	FUNCTION
V101A-V101B	12AT7WA	Vert. Cathode Follower—Sync. Amplifier
V102A-V102B	12AT7WA	1st Vert. DC Amplifier
V103	6AH6	2nd Vert. DC Amplifier
V104	6AH6	2nd Vert. DC Amplifier
V105A-V105B	12AT7WA	Horiz. Cathode Follower—Intensity Modulation Amp.
V106A-V106B	12AT7WA	1st Horiz. DC Amplifier
V107A-V107B	6J6WA	2nd Horiz. DC Amplifier
V108A-V108B	6J6WA	Sweep Circuit Oscillator
V109	3RP1	Cathode Ray Tube
V110	6X4W	Intermediate Voltage Rectifier
CR101	Selenium	Low Voltage Rectifier
CR102	Selenium	Low Voltage Rectifier
CR103	Selenium	High Voltage Rectifier

SECTION 2
THEORY OF OPERATION

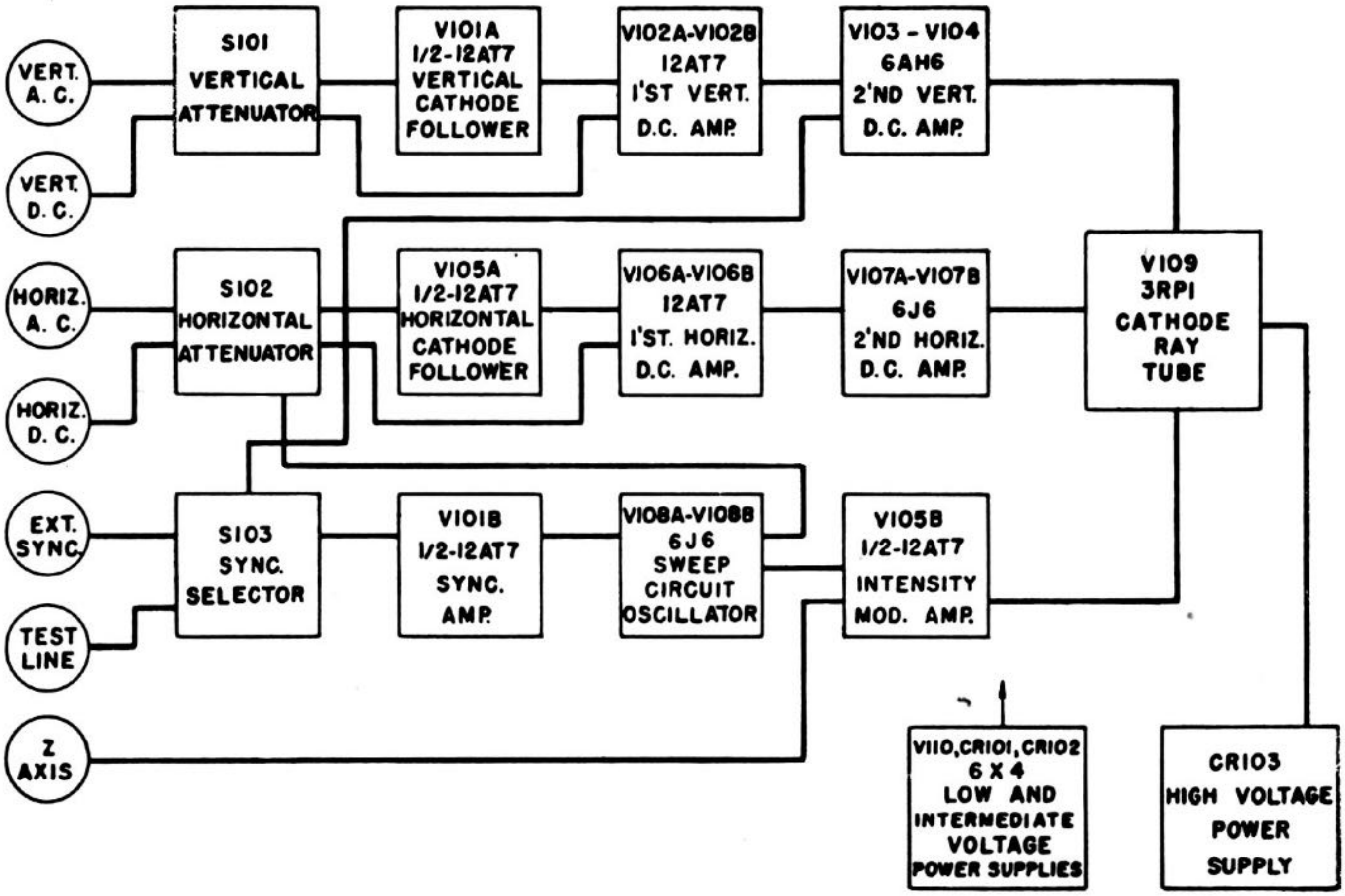


Figure 2-1. Basic Diagram of Operation, Block Form

1. GENERAL.

During the following discussion, reference to the block diagram of the oscilloscope, Figure 2-1, and the schematic wiring diagram, Figure 7-11, will facilitate the understanding of the basic operation of the circuits used in this equipment.

a. VERTICAL.

(1) VERT. ATTEN. AND VERT. GAIN. (See Figure 2-2)

AC voltages applied to the vertical AC input may be attenuated by a factor of 1, 10 or 100 by means of the VERT. ATTEN. control and further controlled by the position of the VERT. GAIN control. With the VERT. ATTEN. in the DC position, DC voltages may be applied to the DC input and may also be controlled by the position of the VERT. GAIN control.

(2) CATHODE FOLLOWER. (See Figure 2-3)

One-half of a type 12AT7 tube, V101A, is used as a cathode follower to provide for high impedance vertical input circuits for AC voltages. The output voltages from this stage are taken from the low impedance cathode circuits and attenuated with a low impedance gain control before being applied to the following DC amplifier stage.

(3) AMPLIFIERS. (See Figure 2-4)

The vertical amplifiers consisting of one 12AT7, V102, and two 6AH6's, V103 and V104, connected in push-pull cascade are of the direct-coupled type and serve for amplification of both AC and DC voltages. The high frequency range of these amplifiers is 2 mc. When amplifying AC voltages, the input is condenser-coupled from the cathode follower, V101A, and gives a low frequency response of 5 cycles. When serving as DC amplifiers, the input is taken directly from the VERT. GAIN control. AC voltages may be applied to the DC input for amplification by the vertical amplifiers; however, the high frequency response will be determined by the setting of the VERT. GAIN control.

b. HORIZONTAL.

(1) HOR. ATTEN. and HOR. GAIN. (See Figure 2-5)

AC voltages applied to the horizontal AC input may be attenuated by a factor of 1, 10 or 100 by means of the HOR. ATTEN. control and further controlled by the position of the HOR. GAIN control. With the HOR. ATTEN. control in the DC position, DC voltages may be applied to the DC input and may also be controlled by the position of the HOR. GAIN control. With the HOR. ATTEN. control in the SWEEP position, the sawtooth output from the sweep circuit oscillator is applied to the horizontal amplifier through the horizontal cathode follower and the sweep width may be controlled by the position of the HOR. GAIN control.

(2) CATHODE FOLLOWER. (See Figure 2-6)

One-half of a type 12AT7 tube, V105A, is used as a cathode follower to provide for high impedance horizontal input circuits for AC voltages. The output voltages from this stage are taken from the low impedance cathode circuits and attenuated with a low impedance gain control before being applied to the following DC amplifier stage.

(3) AMPLIFIERS. (See Figure 2-7)

The horizontal amplifiers consisting of a 12AT7, V106, and a 6J6, V107, connected in push-pull cascade are of the direct-coupled type and serve for the amplification of both AC and DC voltages. The high frequency range of these amplifiers is 500,000 cycles. When amplifying AC voltages, the input is condenser-coupled from the cathode follower, V105A, and gives a low frequency response of one cycle. When serving as DC amplifiers, the input is taken directly from the HOR. GAIN control. AC voltages may be applied to the DC input for amplification by the horizontal amplifiers; however, the high frequency response will be determined by the setting of the HOR. GAIN control. When the horizontal amplifiers are being used to amplify the internal sawtooth they are fed through the cathode follower, V105A, in the same manner as an external AC voltage.

c. SWEEP CIRCUIT OSCILLATOR. (See Figures 2-8 and 2-8A)

A type 6J6 tube, V108, is used in a multivibrator type circuit to generate linear sawtooth voltages for horizontal deflection of the cathode ray tube. Six positions of the COARSE FREQUENCY control are used in conjunction with a two-gang potentiometer, R158A and R158B, to provide control of sawtooth frequencies between 3 and 50,000 cycles.

d. SYNC. SELECTOR-AMPLIFIER. (See Figure 2-9)

A three-position SYNC. SELECTOR switch, S103, is used as a means to provide a selection of EXT., INT. or LINE frequencies to be used in connection with synchronizing the sweep circuit oscillator. Voltages selected by the SYNC. SELECTOR are fed to the control grid of one-half of the 12AT7 tube, V101B. The LOCKING control, R154, is so connected that it permits synchronization of the sweep circuit oscillator

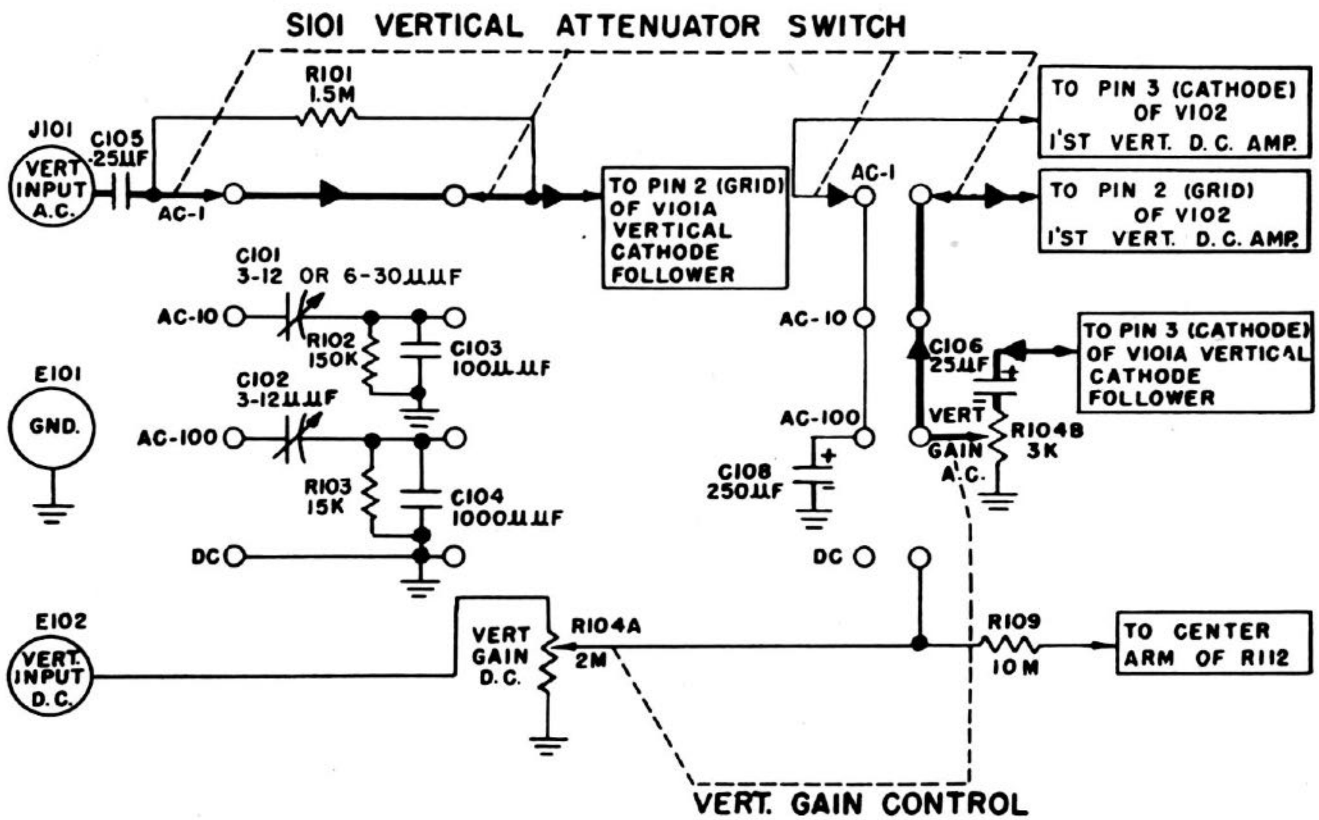


Figure 2-2. Vertical Input Attenuator

on either positive or negative peaks of the selected synchronizing voltage.

e. INTENSITY MODULATION AMPLIFIER. (See Figure 2-10)

One-half of a type 12AT7 tube, V105B, is used as an amplifier whereby external or internal voltages may be amplified to provide for intensity modulation of the beam of the cathode ray tube. By connecting a jumper between BLANKING terminals on terminal board TB105 pulses from the sweep circuit oscillator may be used to blank out the return trace when using horizontal sweep.

f. CATHODE RAY TUBE. (See Figure 2-11)

A type 3RP1 electrostatic deflection cathode ray tube, V109, is used as the indicating medium. Deflection voltages for this tube may be applied from internal circuits, or by rearranging the jumpers on terminal board TB105 external voltages may be directly applied for deflection.

g. POWER SUPPLY. (See Figure 2-12)

A type 6X4 tube, V110, is connected as a full-wave rectifier and supplies DC voltages for operation of the cathode followers, final amplifier stages and sweep circuit oscillator. A pair of selenium rectifiers, CR101 and CR102, are connected as a full-wave rectifier and supply low DC voltages for the operation of all the other circuits except the cathode ray tube. A selenium rectifier, CR103, is connected as a half-wave rectifier to supply the high voltage for the cathode ray tube. Suitable other windings are on the power transformer, T101, to supply the heater voltages for all tubes in the instrument. The transformer is fused by means of fuses F101 and F102 located on the front panel.

2. CIRCUIT ANALYSIS.

a. VERTICAL.

(1) VERTICAL INPUT ATTENUATOR.

An AC voltage impressed between the vertical input (AC) and GND is applied through capacitor C105 to the three-stage vertical attenuator network. This network consists of resistors R102 and R103 shunted by C103 and C104 respectively, and resistor R101 shunted by C101 or C102 depending upon the position of the attenuator switch S101. The network is so designed that it is non-frequency discriminating up to square wave frequencies of 100 kc. On position "1" the voltage impressed is applied to grid pin 2 of the vertical cathode follower, V101A. On position "10" this voltage is reduced by a factor of ten, and on position "100" the voltage is reduced by a factor of 100. When the VERT. ATTEN., S101, is operated to the "DC" position and a DC or AC voltage is impressed between vertical input (DC) and GND, the voltage is controlled by potentiometer R104A, the DC VERT. GAIN control, and applied to grid pin 2 of the first vertical DC amplifier, V102A.

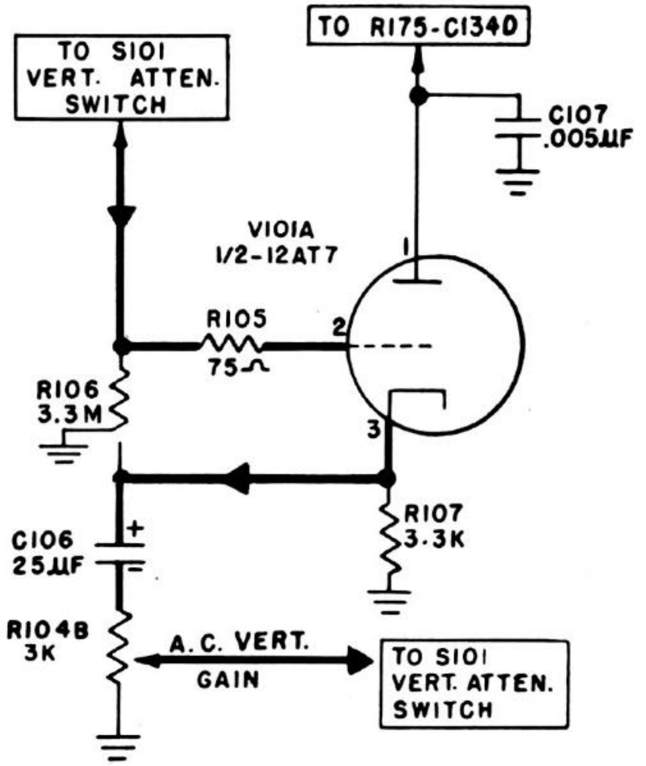


Figure 2-3. Vertical Cathode Follower

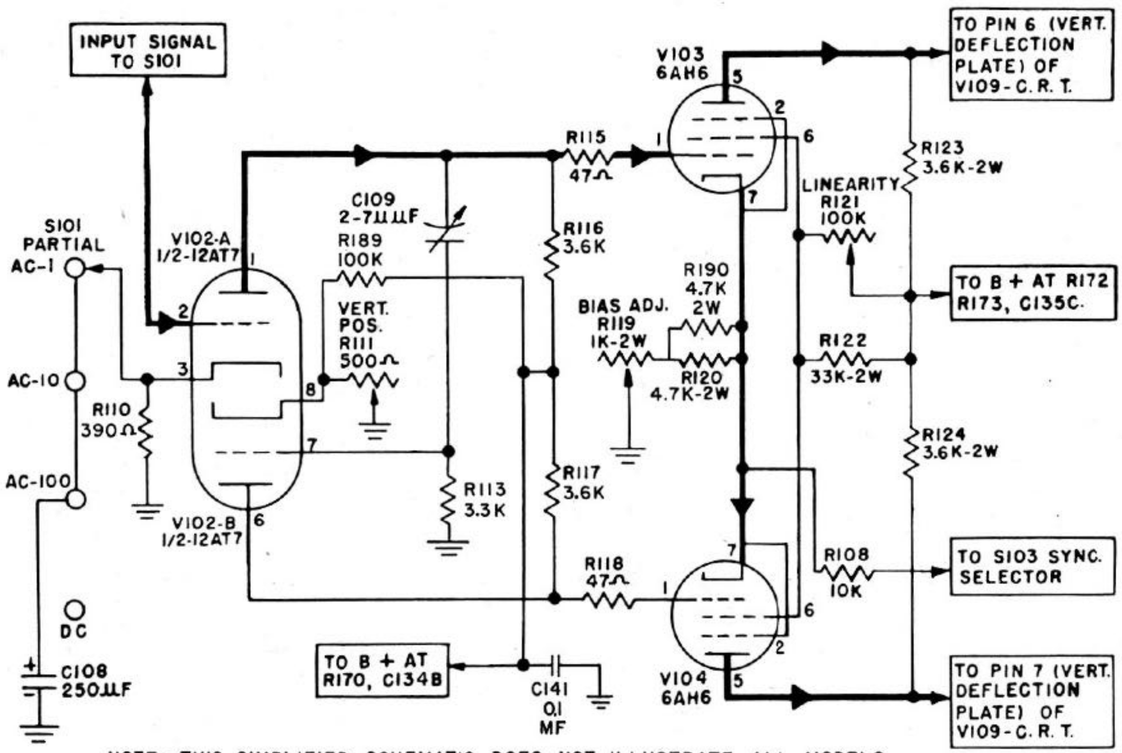
(2) CATHODE FOLLOWER.

One-half of a 12AT7 tube, V101A, is connected in a conventional cathode follower circuit with plate bypassed to ground by C134D and C107. Any voltage applied to the grid will, in the same phase, at a slightly lower potential, appear between the cathode and ground. Between the cathode and ground is a network composed of bias resistor R107, paralleled by C106 and AC VERT. GAIN control R104B in series. By virtue of the fact that R104B and C106 are of low impedance, the circuit capacities will be negligible and frequencies of 5 cycles to 2 mc may be controlled by R104B without frequency discrimination. The output voltage from R104B is taken through the VERT. ATTEN. switch, S101, and applied to the grid, pin 2 of the first vertical DC amplifier, V102A.

(3) VERTICAL AMPLIFIERS.

The vertical amplifiers are of the direct-coupled push-pull type. This allows the amplification of DC as well as AC voltages. The fact that the amplifiers are push-pull affords excellent stability with line voltage variations.

When amplifying AC voltages, the signal is applied to grid pin 2 of V102A from the center arm of the low impedance gain control, R104B, through switch S101. The resistance of R104B is low enough so as to afford no frequency discrimination and therefore the position of the gain control has no effect on the band width when in the "A.C." attenuator positions. When amplifying DC voltages, the signal is applied



NOTE: THIS SIMPLIFIED SCHEMATIC DOES NOT ILLUSTRATE ALL MODELS. REFER TO OVERALL SCHEMATIC DRAWING.

Figure 2-4. Vertical Amplifiers

to grid pin 2 of V102A from the center arm of the high impedance gain control, R104A, through switch S101. The resistance of R104A is high and therefore when the attenuator is in the "D.C." position the gain control acts as a frequency sensitive voltage divider varying the band width as in Table 2-1. When the

TABLE 2-1. Effect of Vertical Gain Control Setting on Bandwidth for Vertical "D.C." Input.

Gain Control Setting	Approximate Band Width
100	2,000,000 cps
75	300,000 cps
50	2,000,000 cps
25	3,000,000 cps

VERT. ATTEN., S101, is on the "D.C." position, there is a slight negative contact potential developed on grid pin 2 because of the high impedance in that circuit. This voltage is cancelled out by a B+ voltage applied through R109. The bias for V102A is supplied by cathode resistor R110. When amplifying AC voltages the cathode is bypassed through C108 to eliminate degeneration; however, when amplifying DC voltages this cathode is left unbypassed to eliminate low frequency discrimination. The B+ voltage is supplied to the plate of this amplifier through plate load resistor R116 which is balanced with plate load resistor R117 of the other portion (V102B) of the first push-pull amplifier. Grid pin 7 of V102B is held at a low impedance to ground through R113. This grid carries no signal except at high frequencies as will be explained later. The bias for V102B is supplied by the cathode resistance of the VERT. POS. control, R111.

The output from this first push-pull amplifier is applied between the grids, pins 1 of V103 and V104, which comprise the second push-pull amplifier, through resistors R115 and R118. These resistors act to suppress any tendency for spurious oscillation. The cathodes of V103 and V104 are tied together and biased to ground through resistor R120, R190 and BIAS ADJUST, R119. Since the grids of V103 and V104 are approximately 80 volts above ground, because of the direct connection from the previous stage, the cathode must develop a voltage slightly higher than this to supply sufficient operating bias. The B+ voltage is supplied to the plates, pins 5 of V103 and V104, through plate load resistors R123 and R124. The screen grids, pins 6 of V103 and 104, are tied together and supplied with voltage through a common screen dropping resistor, R122, shunted by LINEARITY control, R121. Since these tubes are operating in push-pull, there is no need for bypass on these screens. The suppressor grids, pins 2 of V103 and V104, are tied to the cathode as in normal pentode connection when the cathode is operated above ground. The signal is directly coupled from the plates, pin 5, of the final push-pull amplifier stage, to the deflection plates of the cathode ray tube through terminal board TB105.

Since the circuit is designed in push-pull, any B+ variation caused by fluctuating line voltages has essentially no effect on the centering of the beam of the cathode ray tube, as a voltage change on one plate is accompanied by an equal voltage change on the other plate. The path of the signal is through one side of the first push-pull amplifier, V102A, and on to the grid, pin 1, of V103. It is then transferred to V104 through the common cathode resistance R120, R190 and BIAS ADJUST R119 in series. The action is as follows. As a positive signal appears on grid pin 1 of V103 this tube draws more current. As the current increases the voltage at cathode pin 7 will rise. This rise is carried to cathode pin 7 of V104 by virtue of the common cathode connection. Since grid pin 1 of V104 is at a stationary potential as far as the signal is concerned, the rising cathode voltage causes this tube to draw less current, accomplishing a push-pull double-ended output between the plates, pins 5, of V103 and V104.

At high frequencies a portion of the signal on the plate of V102A is fed to grid pin 7 of V102B through trimmer condenser C109. This high frequency signal is transferred from the plate of V102B to the grid of V104 and boosts the high frequency output. Trimmer condenser C109 is adjusted to give the amplifier sufficiently high frequency response. Resistors R189 and R111 together form a voltage dividing network that balances both triodes of V102 for proper vertical centering. BIAS ADJUST R119 is provided so that tolerances in resistors and electron tubes may be accounted for in providing the proper bias on the final stage. A LINEARITY adjustment, R121, is incorporated in the circuit to adjust the voltage on the screens of the final push-pull stage (V103 and V104) in order to accomplish maximum linearity with changes in tubes. Normally, these controls will not have to be adjusted unless tubes V102, V103 and V104 are changed, in which case the adjustments will be minor.

b. HORIZONTAL.

(1) HORIZONTAL INPUT ATTENUATOR.

An AC voltage impressed between the horizontal input (AC) and GND is applied through capacitor C110 to the three-stage horizontal attenuator network. This network consists of resistors R126 and R127 shunted by C114 and C115 respectively, and resistor R128 shunted by C111 or C112 depending upon the position of the attenuator switch S102. The network is so designed that it is non-frequency discriminating up to the square wave frequency of 25 kc. On position "1" the voltage impressed is applied directly to grid pin 2 of the horizontal cathode follower, V105A. On position "10" this voltage is reduced by a factor of ten, and on position "100" the voltage is reduced by a factor of 100. When the HOR. ATTEN., S102, is operated to the "DC" position and a DC or AC voltage is impressed between the horizontal input (DC) and GND, the voltage is controlled by potentiometer R129A, the DC HOR. GAIN control, and applied to grid pin 2 of the first horizontal DC amplifier, V106A. When the HOR. ATTEN., S102, is operated to the "SWEEP" position the internal sawtooth voltage is fed to grid pin 2 of the horizontal cathode follower, V105A, shunted by the resistor-capacitor combination R125 and C113.

(2) HORIZONTAL CATHODE FOLLOWER.

One-half of a 12AT7 tube, V105A, is connected in the conventional cathode follower circuit with plate

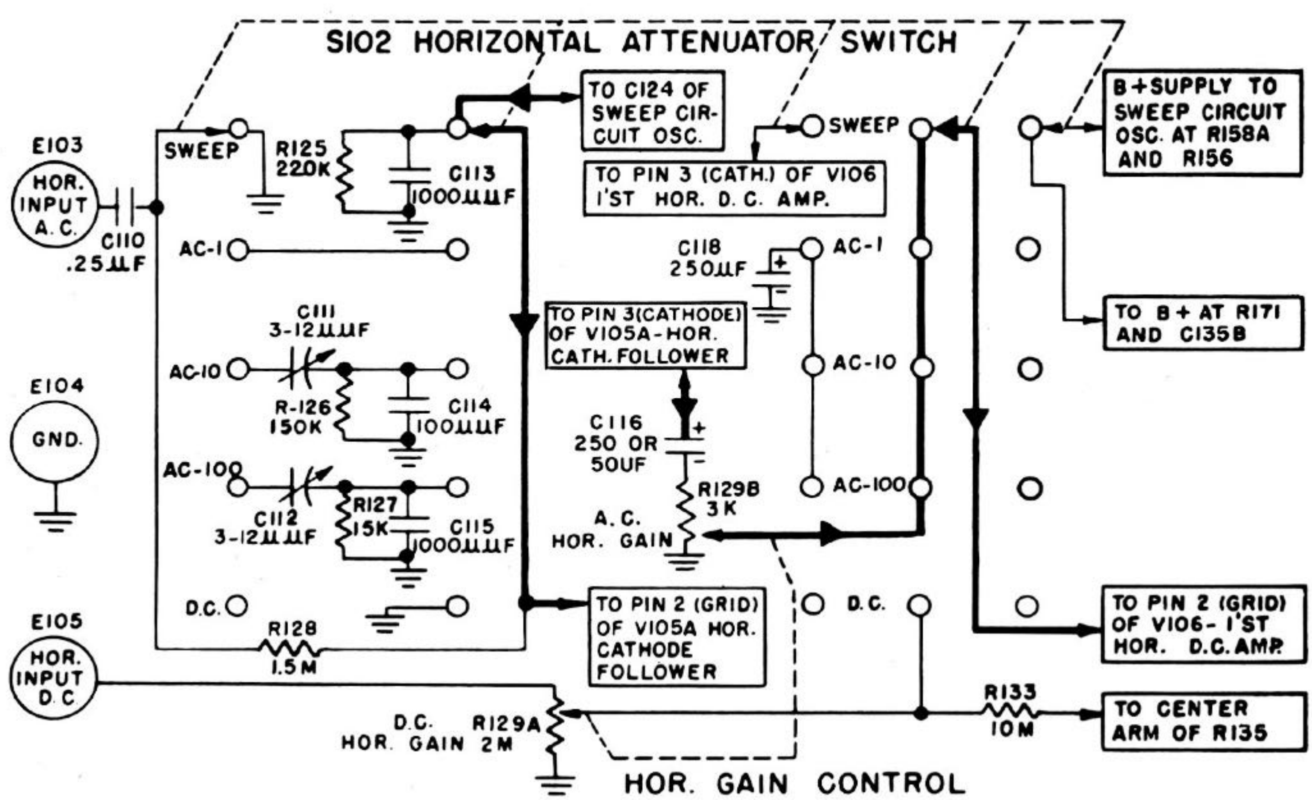


Figure 2-5. Horizontal Input Attenuator

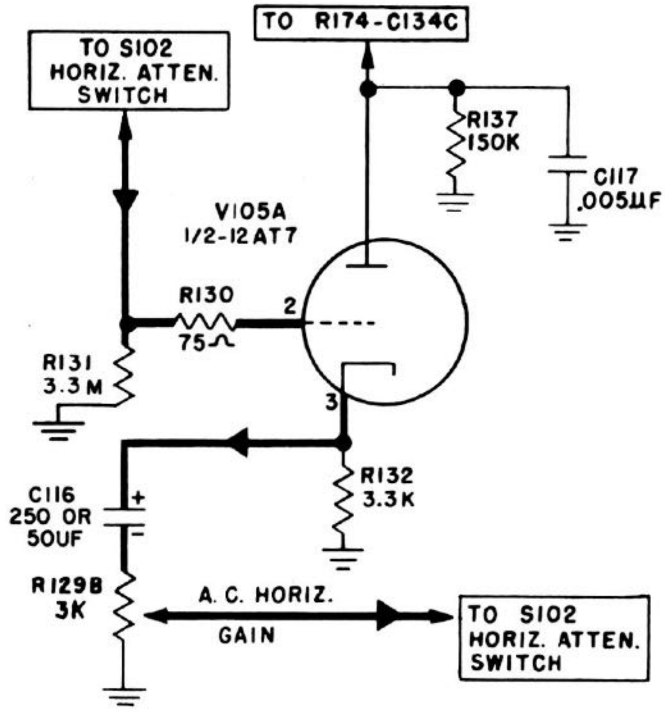


Figure 2-6. Horizontal Cathode Follower

bypassed to ground by C134C and C117. Any voltage applied to the grid will, in the same phase, at a slightly lower potential, appear between the cathode and ground. Between the cathode and ground is a network composed of bias resistor R132, paralleled by C116, and the AC HOR. GAIN control, R129B, in series. By virtue of the fact that R129B and C116 are of low impedance, the circuit capacities will be negligible and frequencies of one cycle to 500 kc may be controlled by R129B without frequency discrimination. The output voltage of R129B is taken through the HOR. ATTEN., S102, and applied to grid pin 2 of the first horizontal DC amplifier, V106A.

(3) HORIZONTAL AMPLIFIERS.

The horizontal amplifiers are of the direct-coupled push-pull type. This allows the amplification of DC as well as AC voltages. The fact that the amplifiers are push-pull affords excellent stability with line voltage variations. When amplifying AC voltages or the internal sawtooth, the signal is applied to grid pin 2 of V106A from the center arm of the low impedance gain control, R129B, through switch S102. When amplifying DC voltages, the signal is applied to grid pin 2 of V106A from the center arm of the high impedance gain control, R129A, through S102. When HOR. ATTEN., S102, is on the "DC" position, there is a slight negative contact potential developed on grid pin 2 of V106A because of the high impedance in that circuit. This voltage is cancelled out by a B voltage through R133. The bias for V106A is supplied by cathode resistor R134. When amplifying AC voltages the cathode is bypassed through C118 to eliminate degeneration; however, when amplifying DC voltages this cathode is left unbypassed to eliminate low frequency discrimination. The B+ voltage is supplied to the plate of this amplifier through plate load resistor R139 which is balanced with plate load resistor

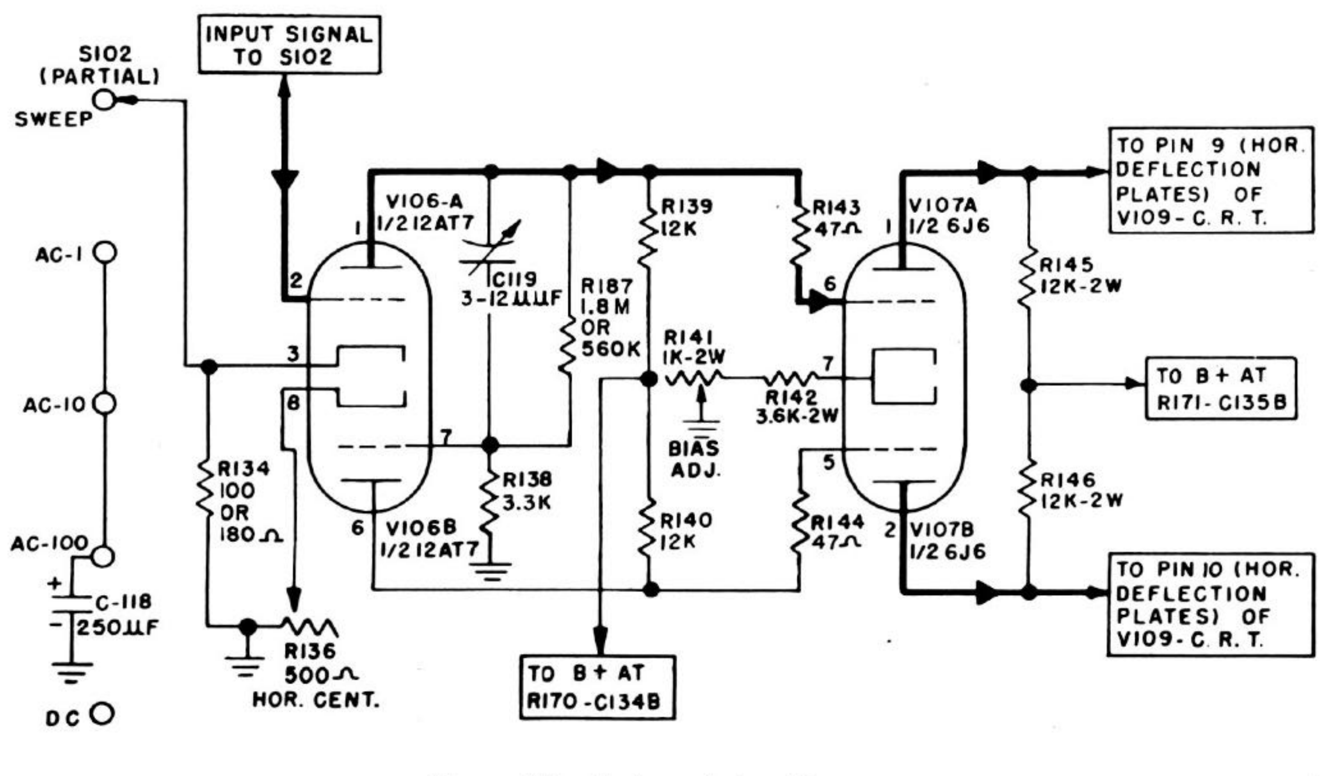


Figure 2-7. Horizontal Amplifiers

R140 of the other portion (V106B) of the first push-pull amplifier. Grid pin 7 of V106B is held at a low impedance to ground through R138. This grid carries no signal except at high frequencies as will be explained later. The bias for V106B is supplied by the cathode resistance of the HOR. POS. control, R136.

The output from this first push-pull amplifier is applied between the grids, pins 5 and 6 of V107, which comprises the second push-pull amplifier, through resistors R143 and R144. These resistors act to suppress any tendency for spurious oscillation. The cathode of V107 is biased to ground through resistor R142 and BIAS ADJUST, R141. Since the grids of V107 are approximately 60 volts above ground, because of the direct connection from the previous stage, the cathode must develop a voltage slightly higher than this to supply sufficient operating bias. The B+ voltage is supplied to the plates, pins 1 and 2 of V107, through plate load resistors R145 and R146. The signal is directly coupled from these to the deflection plates of the cathode ray tube through terminal board TB105.

Since the circuit is designed in push-pull, any B+ variation caused by fluctuating line voltage has essentially no effect on the center of the beam of the cathode ray tube, as a voltage change on one plate is accompanied by an equal voltage change on the other plate. The path of the signal is through one side of the first push-pull amplifier, V106A, and on to the grid, pin 6 of V107A. It is then transferred to V107B through the common cathode resistance R142 and BIAS ADJUST R141 in series. The action is as follows: As a positive signal appears on grid pin 6 of V107A this tube draws more current. As the current increases the voltage at cathode pin 7 will rise. Since grid pin 5 of V107B is at a stationary potential as far as the signal is concerned, the rising cathode voltage causes V107B to draw less current, accomplishing a push-pull double-ended output between the plates, pins 1 and 2, of V107

At high frequencies a portion of the signal on the plate of V106A is fed to grid pin 7 of V106B through trimmer condenser C119. This high frequency signal is transferred from the plate of V106B to the grid of V107B and boosts the high frequency output. Trimmer condenser C119 is adjusted to give the amplifier sufficiently high frequency response. Resistors R187 and R138 together form a voltage dividing network that balances both triodes of V102 for proper horizon-

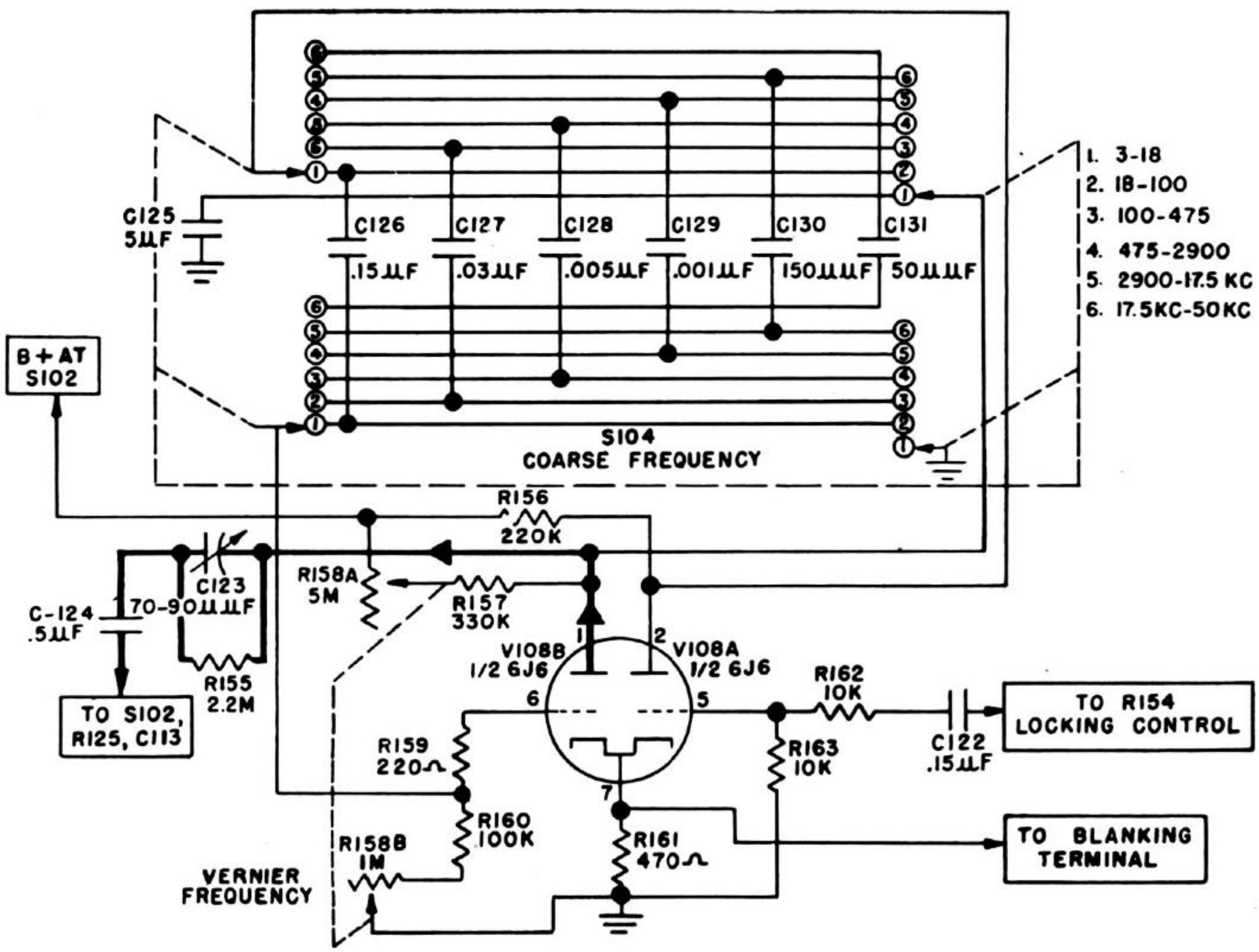


Figure 2-8. Sweep Circuit Oscillator

tal centering. BIAS ADJUST R141 is provided so that tolerances in resistors and electron tubes may be accounted for in providing the proper bias on the final stage. Normally, these controls will not have to be adjusted unless tubes V106 and V107 are changed, in which case the adjustments will be minor.

c. SWEEP CIRCUIT OSCILLATOR.

A cathode coupled, multivibrator circuit utilizing a type 6J6 tube, V108, is used as the horizontal sawtooth oscillator and operated over a frequency range from 3 to 50,000 cycles per second. This range of frequencies is controlled by the COARSE FREQUENCY switch, S104, utilizing capacitors C125 through C131. These capacitors act alternately and respectively as sawtooth generating capacitors for the second triode section, V108B, and as coupling capacitors for the first triode section, V108A, to the second triode section of the multivibrator. In the position shown in Figure 2-8, C125 is used as a sawtooth capacitor while C126 is the coupling capacitor.

Fine frequency control is accomplished by means of the dual VERNIER FREQUENCY potentiometer, R158A and R158B, in the plate circuit and in the grid of the second triode section of the multivibrator. Both potentiometers are on the same shaft and operated by the VERNIER FREQUENCY control on the SWEEP CIRCUIT OSCILLATOR panel.

The sawtooth output is taken from plate pin 1 of V108B through the frequency compensated voltage divider consisting of R155 shunted by C123 (Fig. 2-8) and R125 shunted by C113 (Fig. 2-5), and decoupled by capacitor C124. This sawtooth signal is applied to the horizontal cathode follower through HOR. ATTEN. S102 when set to the "SWEEP" position. The high frequency linearity of the sawtooth may be adjusted with capacitor C123 in the frequency compensated dividing network.

Bias for the multivibrator is supplied by cathode resistor R161. The wave form at the cathode consists of sharp pulses of the exact width of the retrace time and in the proper phase. These pulses may be jumpered at terminal board TB105 to the input of the intensity modulation amplifier and thus provide return trace elimination when using the sweep circuit oscillator. The synchronizing signal from the LOCKING control, R154, is applied to grid pin 5 of V108A through isolation resistor R162. This causes the frequency of the multivibrator to lock in at the frequency of the synchronizing signal or some submultiple thereof.

d. SYNC. SELECTOR—AMPLIFIER.

The purpose of the SYNC. SELECTOR switch, S103, and amplifier is to provide a means of synchronizing the sweep circuit oscillator from either

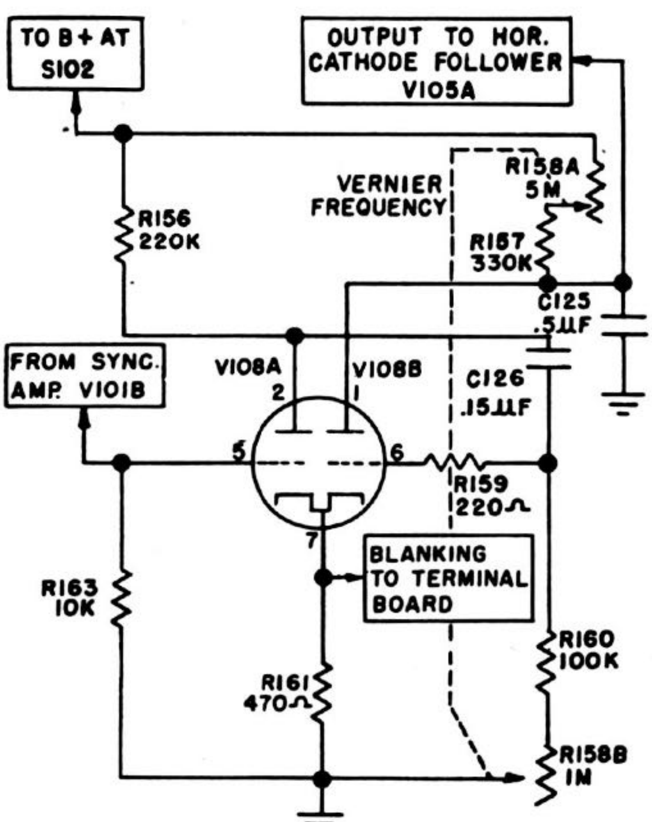


Figure 2-8A. Sweep Circuit Oscillator, Simplified

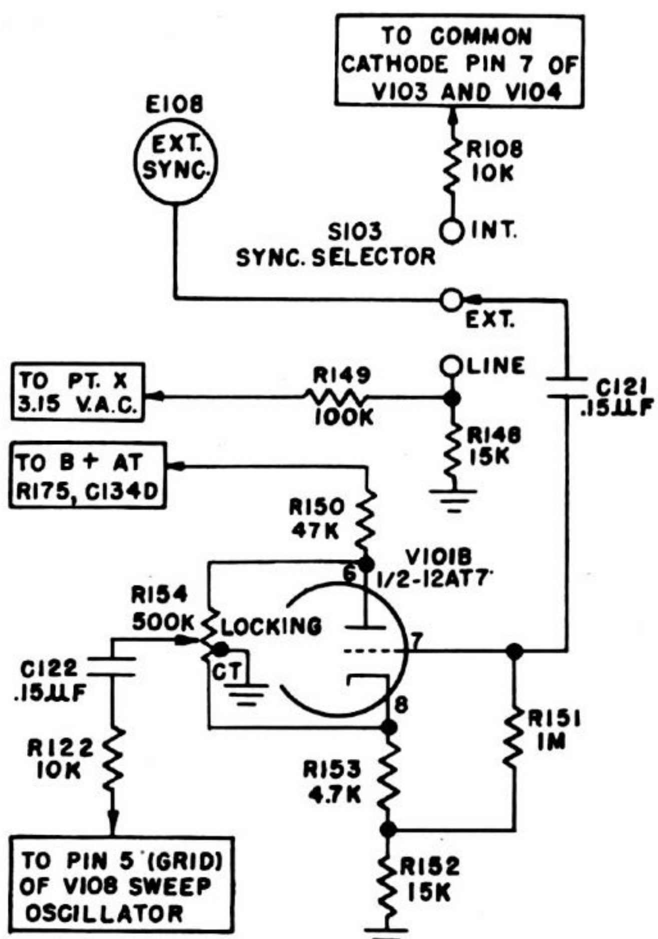


Figure 2-9. Sync. Selector—Amplifier

EXT., INT. or LINE frequency voltages and to permit the synchronization of the sweep circuit oscillator from either positive or negative peaks of the applied synchronizing voltage. The output from the SYNC. SELECTOR is fed through capacitor C121 to grid pin 7 of V101B and selects either:

(1) line frequency voltage supplied from the filament winding through a voltage divider consisting of R149 and R148,

(2) external frequency voltage applied to binding post E108, or

(3) internal frequency voltage supplied from the low impedance cathode of the 2nd vertical d-c amplifier (V103 and V104), through decoupling resistor, R108. The grid of the sync. amplifier, V101-B, is returned to the junction of R153 and R152 through resistor R151 to provide sufficient bias for operation of the amplifier.

An analysis of the circuits between the plate of V101B and ground will show that with a signal applied to the control grid, the high end of the LOCKING control, R154, will be electrically receiving signals developed at the plate of this tube; and the low end of the LOCKING control will be receiving signals from the cathode. When this control is at approximately the center of its rotation there is no signal since the center of the control is grounded. If this control is operated toward the plate side of R154 a locking voltage would be obtained which would be out of phase with the signal applied to the grid and consequently, tend to lock the sweep circuit oscillator at a polarity with respect to the negative peaks of the synchronizing signal. If the LOCKING control is advanced toward the cathode side of R154 the locking voltage applied to the sweep circuit oscillator would be in positive phase relation to the synchronizing signal. As a result of this circuit, the sweep circuit oscillator may be locked in with respect to incoming synchronizing signals, either in phase or out of phase with these voltages.

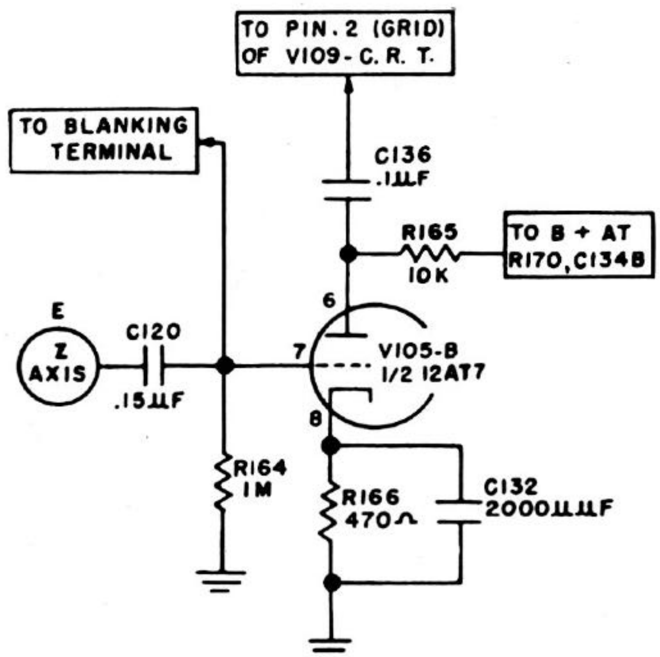


Figure 2-10. Intensity Modulation Amplifier

e. INTENSITY MODULATION AMPLIFIER.

In cathode ray oscilloscope nomenclature a modulation of the intensity of the cathode ray tube beam is known as Z AXIS modulation. Such modulation is often useful to establish a time base for the horizontal deflection of the cathode ray tube beam. As an example, the beam might be modulated by a 1000 cycle source which would cause it to increase in brilliance and decrease each one-thousandth of a second, or each one-thousand microseconds. With this intensity modulation superimposed upon an observed wave form its duration could be calculated.

One-half of a type 12AT7 tube, V105B, is utilized as an amplifier to provide intensity modulation for the cathode ray tube beam. Voltages to actuate this amplifier may be taken from the Z AXIS input, or by means of a jumper on the rear terminal board TB105, pulses may be taken from the sweep circuit oscillator to provide beam banking during the return trace when using the sweep circuit oscillator for horizontal deflection. If the voltage is taken from the Z AXIS input it is applied to grid pin 7 of V105B through capacitor C120. However, if the pulses from the sweep circuit oscillator are used for internal beam blanking the signal is directly coupled to the grid from the cathode of the sweep circuit oscillator to eliminate low frequency discrimination. Resistor R164 acts as a grid return to ground. Bias for this amplifier is provided in the cathode circuit by resistor R166 shunted by capacitor C132. This resistor-capacitor combination provides compensation for improving the high frequency response of this amplifier. The B+ is supplied to the plate through resistor R165 and the output is taken from the plate through capacitor C136 and applied directly to the control grid of the cathode ray tube, V109. Positive voltages applied to the Z AXIS input will cause blanking action of the cathode ray tube beam.

f. CATHODE RAY TUBE.

A type 3RP1 cathode ray tube, V109, is used as the indicating medium in the oscilloscope. This tube utilizes electrostatic deflection and has four free deflecting plates. Voltage for the operation of this tube is obtained from the high voltage section of the power supply, the negative side of which is filtered and applied through R179 to the control grid, pin 2 of V109. Intensity (INT.) control, R176, is connected directly from the negative side of the high voltage power supply to R177, the FOCUS control. Cathode pin 3 of V109 is connected to the center arm of INTENSITY control R176 through resistor R180. As the INT. control is operated, it varies the potential difference between the cathode of V109 and the control grid, thereby controlling the intensity of the beam. FOCUS control, R177, is returned to ground through R178 and serves to focus the cathode ray tube beam. Anode #2 and grid #2, pin 8 of V109, are supplied with B+

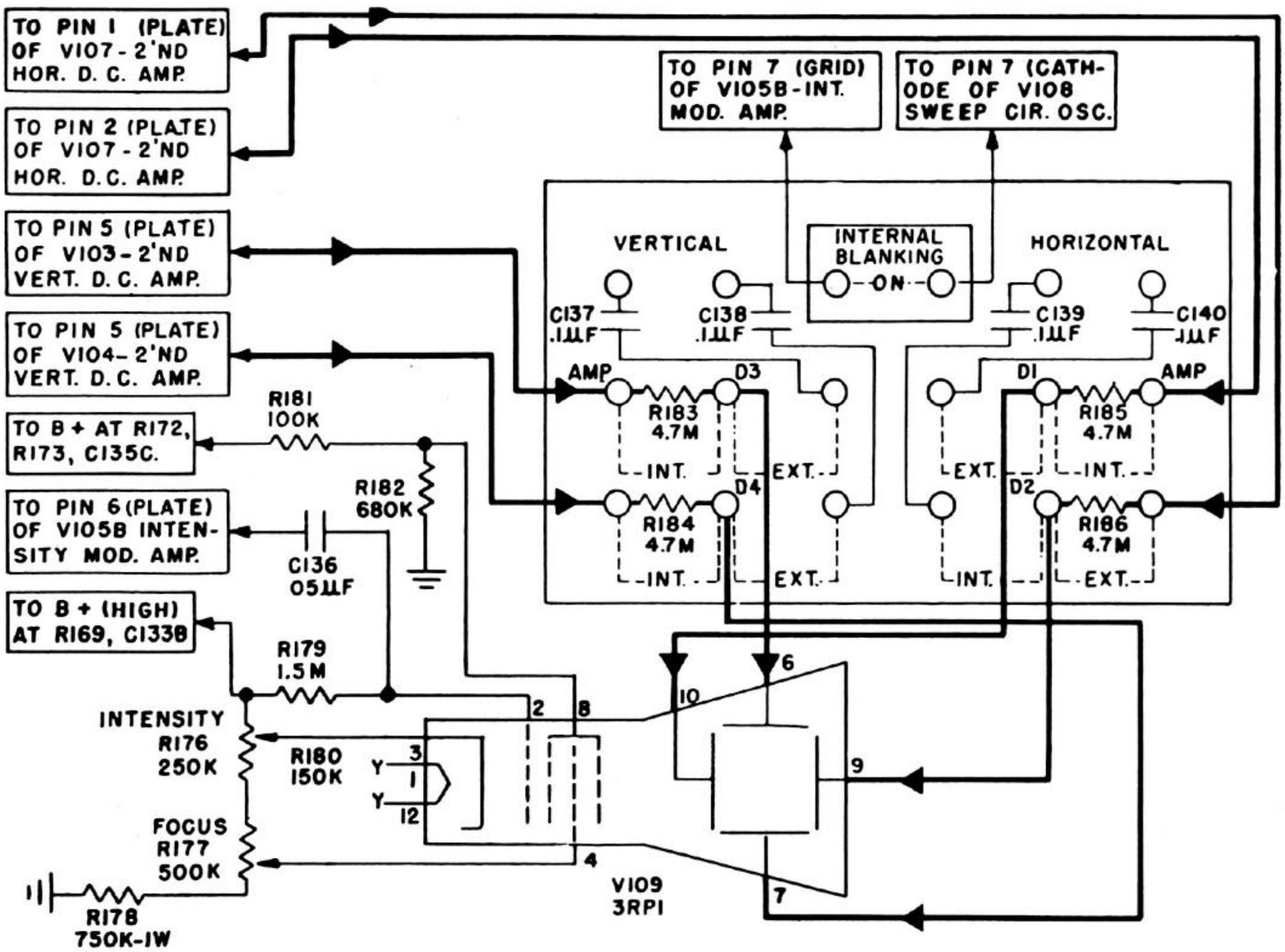


Figure 2-11. Cathode Ray Tube

through the voltage divider consisting of resistors R181 and R182. The voltage at the output of this divider determines the astigmatic focus and is designed to be equal to the nominal DC voltage of the deflection plates, pins 6, 7, 9, and 10 of V109.

The vertical and horizontal deflection plates, pins 6, 7, 9 and 10 respectively, are directly connected to terminal board TB105. When the jumpers on this terminal board are arranged for internal connection the output leads from the vertical and horizontal amplifiers are connected directly to the deflection plates. When the jumpers are arranged for external connection, the output leads from the vertical and horizontal amplifiers are connected to the deflection plates through resistors R183 to R186 inclusive. These resistors provide the DC voltage and centering that was present with the internal connection; however, no signal is carried to the deflection plates. With this connection, an external signal may be applied to the deflection plates through capacitors C137 to C140 inclusive by connecting the external signal to the terminals marked EXT. INPUT. If it is desired to use an external capacitor to couple the signal directly to the deflection plates, this capacitor may be connected to the terminals marked D1 through D4 on the terminal board TB105.

g. POWER SUPPLY.

All voltages for operation of the oscilloscope are obtained from the power supply utilizing transformer T101. The primary of this transformer is connected to the permanent AC power cable W103. Fuses F101 and F102 are used between the input and the primary. The POWER OFF-ON switch, S105, is connected in series with one fuse and one side of the primary. There are basically four secondary windings on the transformer. One of these is center-tapped to ground and provides two full-wave voltages, approximately 90 and 325 volts, on each side of the center tap. The 325 volt winding is connected to the plates, pins 1 and 6, of the intermediate voltage rectifier, V110. The output is taken from cathode pin 7 of this rectifier and suitably filtered by means of capacitors C135A and C135B in conjunction with resistor R171 to provide B+ voltage for the final stages of the horizontal amplifier. This output is also decoupled by means of resistors R172 and R173 and capacitor C135C, and acts to supply the B+ voltage for the final stages of the vertical amplifiers. The B+ voltages for the vertical and horizontal cathode followers are provided by the decoupling networks consisting of R175 and C134D, and R174 and C134C respectively.

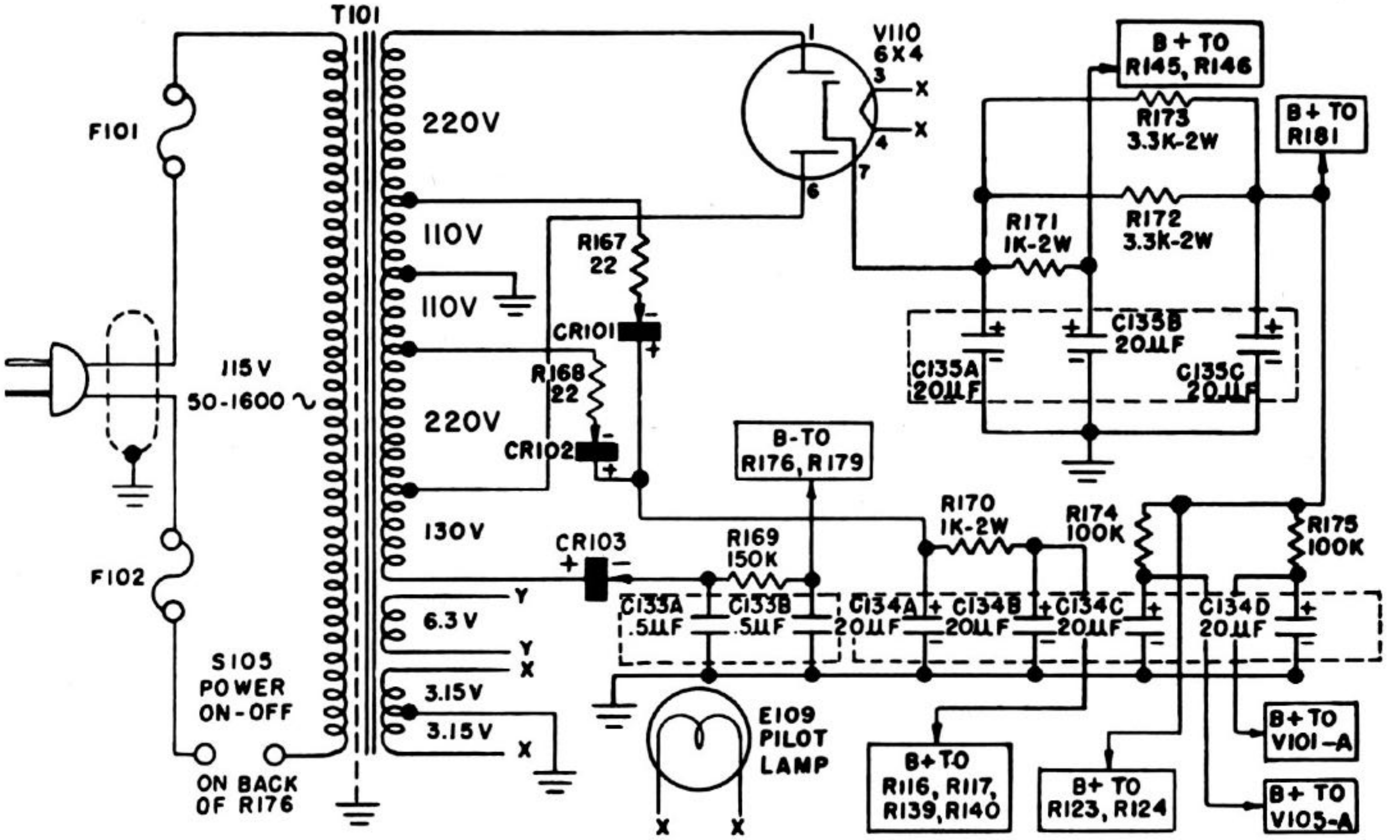


Figure 2-12. Power Supply

The 90 volt winding is connected to the plates of CR101 and CR102 through protective resistors R167 and R168. The output from these selenium rectifiers is filtered by C134A and C134B in conjunction with R170 to provide low voltage B+ supply for the first push-pull horizontal and vertical amplifier stages.

Another secondary winding has its low voltage side tied to one side of the 325 volt winding and its high voltage side tied to the cathode of selenium rectifier CR103. The output from this rectifier is filtered by C133A and C133B in conjunction with R169 and provides a high negative voltage for operation of the cathode ray tube.

A separate 6.3 volt winding is used to supply the heater of the cathode ray tube, V109. Another 6.3 volt winding, center-tapped to ground, is used to supply the heaters of all other tubes in the equipment.

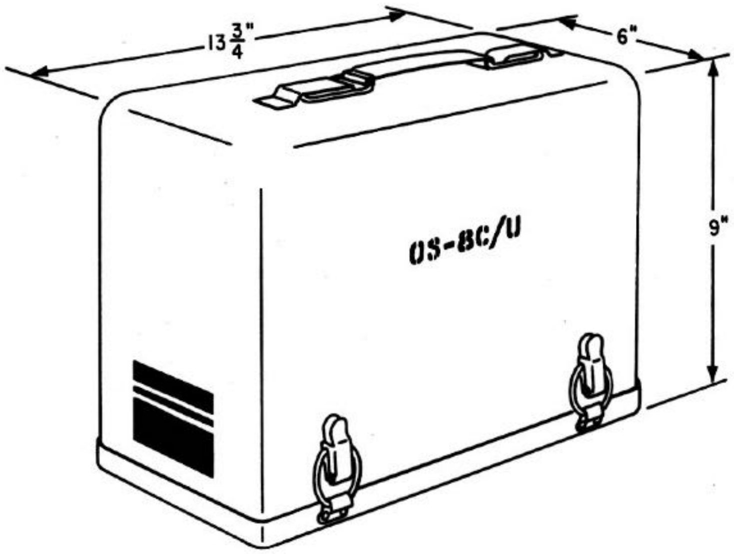


Figure 3-1. Overall Outline Dimensions of Oscilloscope OS-8C/U

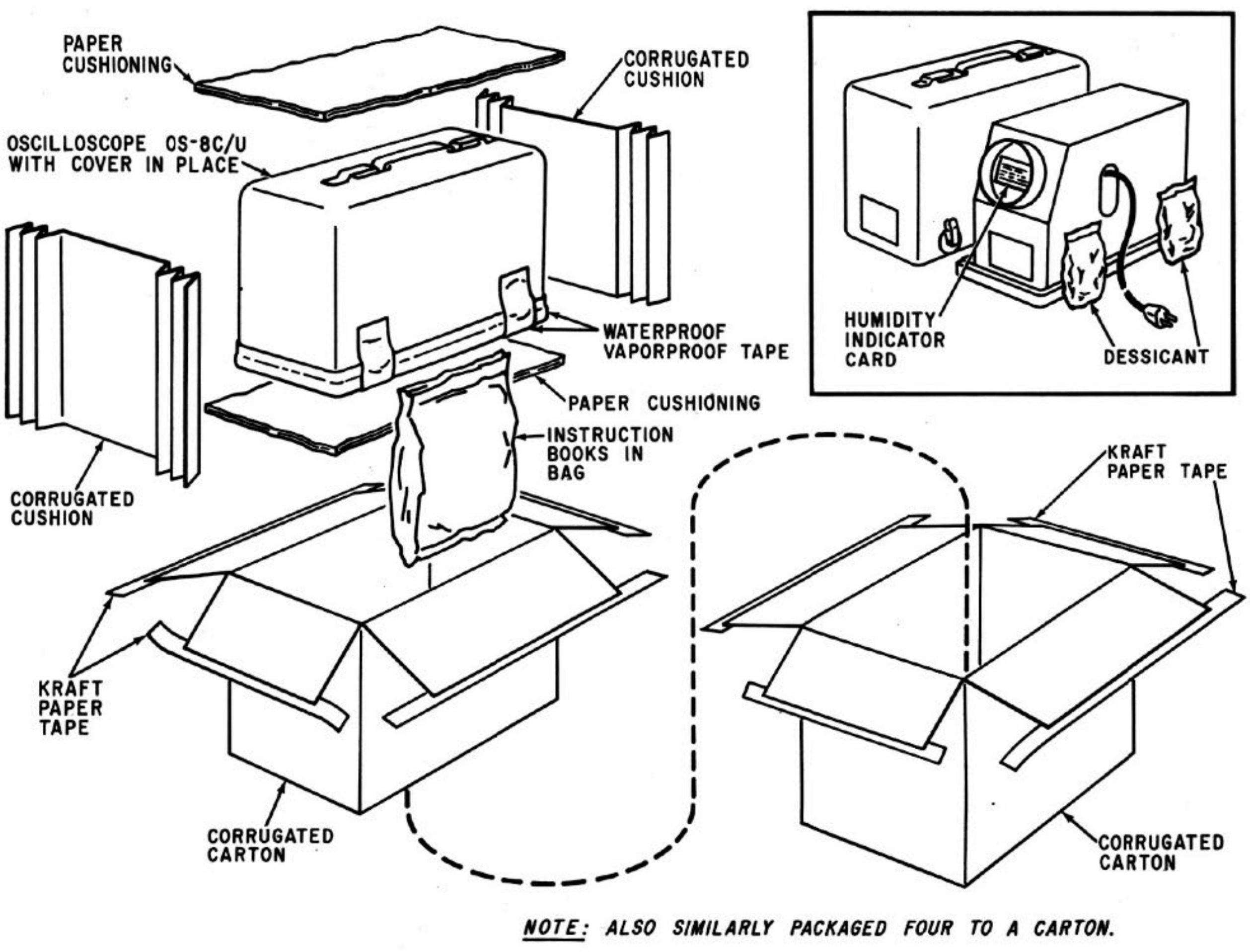


Figure 3-2. Cutaway View of Export Packaging

SECTION 3

INSTALLATION AND INITIAL ADJUSTMENT

1. INSTALLATION.

a. HOUSING.—Oscilloscope OS-8C/U, together with all accessories except the instruction book, is housed in a water-tight metal case consisting of a bottom section in which the unit is secured by four shock mounts, and an upper cover which is secured to the lower case by four drawbolts. The upper cover is sealed to the lower case by means of a rubber gasket making the instrument water-tight when the upper cover is in place.

A compartment is provided in the right side panel of the main unit for storing the line cord (See Figure 3-4). The test leads are stored in the front corner of the case.

b. UNPACKING.—When opening the packing case and removing the equipment (See Figure 3-2), care should be taken not to dent or otherwise damage the metal housing of the equipment in order to preserve its water-tightness.

c. OPERATING LOCATION.—In general, with very few exceptions, any location where suitable AC input power is available will be a satisfactory operating location for the equipment. However, it should NOT be operated adjacent to or in the vicinity or large electrical generating equipment or in close proximity to other apparatus which might be generating large stray magnetic fields, as this will tend to distort the patterns displayed on the screen of the cathode ray tube.

Note

The equipment has been designed to operate equally well in any convenient operating position.

d. OPERATING CABLES.

(1) AC LINE CORD.—A 5-foot AC line cord (W103) will be found in the accessory compartment on the right side of each equipment. This cord is permanently connected to the oscilloscope on one end and is fitted on the other end with a standard 2-prong male AC line plug. The shield of the power cord is terminated in a lug suitable for retention by an 8-32 roundhead machine screw on the end having the 2-prong male plug.

(2) TEST CABLES.—Supplied as accessories to each equipment are one 36-inch shielded coaxial cable (W101) and one 6-inch shielded coaxial cable (W102) for use in connection with the vertical input circuits. A 3-foot unshielded test lead (W104) is supplied to be used for connection between the chassis of the OS-8C/U or OS-8E/U oscilloscope and ground side of the voltage to be observed.

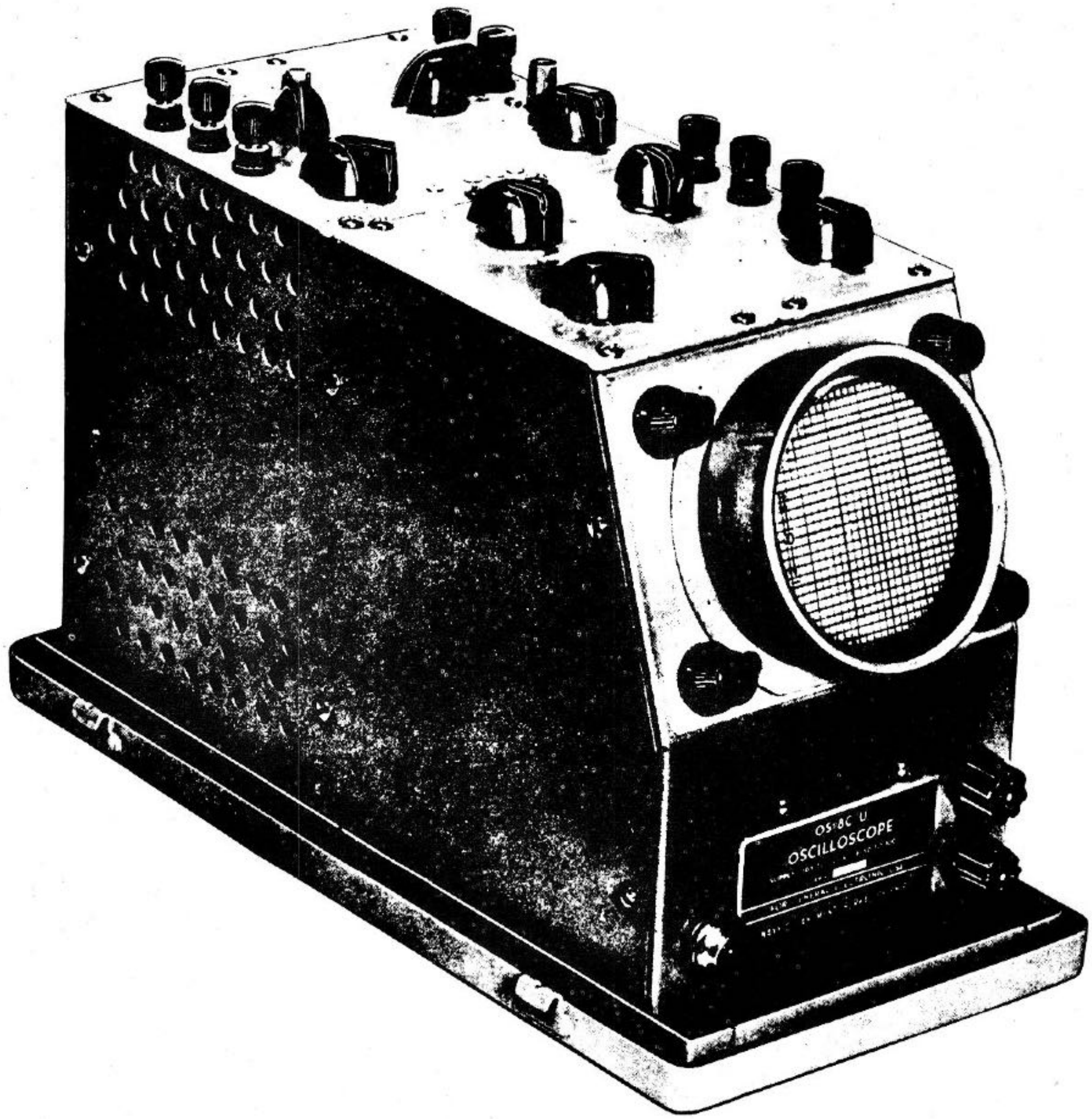


Figure 3-3. Oscilloscope OS-8C/U Front Oblique View

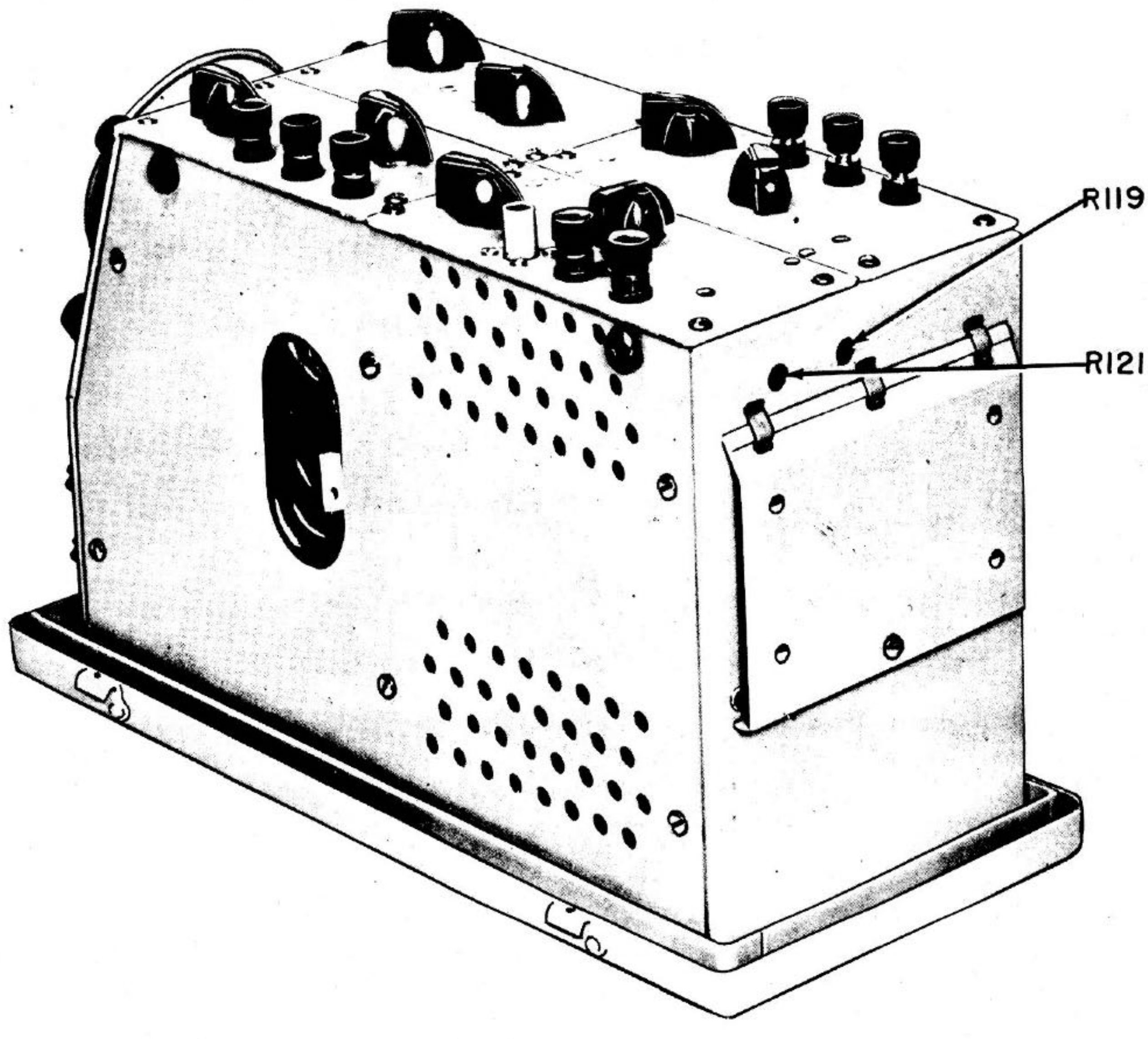


Figure 3-4. Oscilloscope OS8-C/U Right Cable Compartment and Terminal Board, Rear Oblique View

2. ADJUSTMENT.

WARNING

THE VOLTAGES WHICH ARE UTILIZED IN THIS EQUIPMENT ARE DANGEROUS TO HUMAN LIFE. BEFORE REMOVING THE EQUIPMENT FROM ITS CASE FOR INSPECTION, THE AC LINE PLUG WHICH FITS INTO THE POWER RECEPTACLE SHOULD BE COMPLETELY REMOVED. SHOULD IT BE NECESSARY TO TAKE VOLTAGE READINGS WITHIN THE INSTRUMENT, MAKE SURE HANDS ARE DRY, USE TEST PRODS INSULATED FOR AT LEAST 2500 VOLTS, AND IN ALL POSSIBLE CASES MAKE ALL READINGS AND ADJUSTMENTS WITH ONE HAND IN A POCKET.

a. INSPECTION.—Before applying AC power to this equipment for the first time, inspect the entire equipment as follows:

(1) Make certain that there are three test leads in addition to the AC line cord in the accessory compartments, and check carefully for mechanical damage to connectors or cables.

(2) Loosen the six screws securing each side panel to the main unit and inspect chassis to make certain that all tubes are undamaged and in their proper sockets.

(3) Give the entire equipment a careful mechanical inspection to make certain there are no damaged components.

(4) Replace side panels.

b. TESTS PRECEDING OPERATION.—The following measurements should be made prior to placing the equipment in operation:

(1) With a continuity tester, check the test cables for open or short circuits.

(2) With the AC line cord disconnected from the power supply, but with the INT. control rotated a sufficient distance to place the AC line switch in the "ON" position, check with an ohmmeter the DC resistance between the two prongs of the male AC line plug. This resistance should be about 8 ohms. If it should vary substantially from this value, or show no continuity at all, inspect fuses, AC line switch on the INT. control, and all wiring, for cause of trouble.

c. INITIATING OPERATION.—With the AC line cord inserted into any convenient source of 115 volts ±10%, 50 to 1000 cycles AC, the equipment is set in operation by rotating the INT. control in a clockwise direction away from the position marked "OFF". Operation will be indicated by the glow of the pilot light E109 near the bottom of the front panel. Within approximately one minute, the beam should appear on the cathode ray tube screen.

d. CHECKING OPERATION.—Check operation of the positioning (POS.), FOCUS and intensity (INT.) controls. By turning the COARSE FREQUENCY switch through all positions, with the HOR. ATTEN. switch in the "SWEEP" position and advancing the HOR. GAIN control, proper operation of the sweep circuit oscillator will be indicated by horizontal deflection of the beam.

Note

In order to prevent burning the screen of the cathode ray tube, always set the INT. control at the point which will give a trace no brighter than that which can be conveniently seen with the light shield extended.

SECTION 4
OPERATION

1. FUNCTION OF EQUIPMENT.

Since Oscilloscope OS-8C/U is operated in a conventional manner, only a basic knowledge of cathode ray oscilloscopes is required for its application and operation. Therefore, this section will be concerned with the specific controls of the equipment and their functions.

2. CONTROLS AND THEIR FUNCTIONS.

The front panel views illustrated in Figures 4-1 and 4-2 show the location of all operating controls.

a. INT.-OFF (R176, S105).—Operating the intensity control clockwise turns the power on to the instrument and the pilot light E109 will indicate that the instrument is on. As this control is operated further clockwise, it controls the intensity of the pattern on the cathode ray tube. When moved to full clockwise position, the pattern is at maximum brilliancy.

b. FOCUS (R177).—This control adjusts the focus, or sharpness, of the trace on the screen of the cathode ray tube.

c. POS. (LEFT-RIGHT (R136), DOWN-UP (R111)).—The purpose of the positioning controls is to adjust the position of the trace on the screen, either horizontally or vertically.

d. VERT. ATTEN. (S101).

Important Note

Always operate the VERT. ATTEN. switch to the highest attenuator position in which suitable vertical deflection can be obtained. If this is not done, overloading of the cathode follower will generally result. Overloading can be detected by a clipping or squashing of the pattern.

This control attenuates the signal fed in at the vertical input (AC) connector by a factor of 1, 10 or 100. When turned to the "DC" position, it permits the DC voltages fed in between the DC input and GND to be amplified by the vertical amplifier. Positive DC voltages will cause the beam to move up on the screen.

e. VERT. GAIN (R104).—This control is used as a vernier in connection with the VERT. ATTEN. to control the height of the pattern on the screen in the case of AC voltages; and in the case of DC voltages, the extent of deflection, either up or down, of the beam. The position of the gain control has no effect on band width when the attenuator is in the "AC" positions; however, in the "DC" position the gain control affects the band width as indicated in Table 2-1.

f. HOR. ATTEN. (S102).

Important Note

Always operate the HOR. ATTEN. switch to the highest attenuator position in which suitable horizontal deflection can be obtained. If this is not done, overloading of the cathode follower will generally result. Overloading can be detected by a clipping or squashing of the pattern.

This control attenuates the signal fed in at the horizontal input (AC) connector by a factor of 1, 10 and 100. When turned to the "DC" position, it permits the DC voltages fed in between the DC input and GND to be amplified by the horizontal amplifier. Positive DC voltages will cause the beam to move to the right on the screen. This control, when turned to the "SWEEP" position, permits the sawtooth from the sweep circuit oscillator to be amplified by the horizontal amplifier, thus providing horizontal deflection.

g. HOR. GAIN (R129).—This control is used as a vernier in connection with the HOR. ATTEN. to control the width of the pattern on the screen in the case of external AC voltages; and in the case of DC voltages, the extent of deflection, either left or right, of the beam. When the HOR. ATTEN. is in the "SWEEP" position, the HOR. GAIN controls the width of the sweep.

h. COARSE FREQUENCY (S104).—This control selects the range of frequencies of the internal sweep circuit oscillator which may operate between the limits of 3 and 50,000 cycles. Although the frequency ranges are marked on the panel for convenience of the operator, these frequencies are only approximate and, in general, the actual frequency range will be much greater so that two consecutive frequency ranges will exhibit a sizeable overlap.

i. VERNIER-FREQUENCY (R158).—This control serves as a vernier on the frequency being generated by the sweep circuit oscillator in any one of the six positions of the COARSE FREQUENCY control.

j. SYNC. SELECTOR (S103).—This control selects synchronizing voltage for application to the sweep circuit oscillator. These synchronizing voltages may be selected either from an external source, internal source which is the voltages being applied to the vertical amplifiers, or from an internal source of line frequency voltage.

k. LOCKING (R154).—This control permits selection of either positive or negative peaks of synchronizing voltages and, in addition, controls the extent of locking voltage applied to the sweep circuit oscillator.

l. TERMINALS.

VERTICAL INPUT (AC) (J101).—Input for AC voltages deflecting the beam vertically on the cathode ray tube screen.

VERTICAL INPUT (DC) (E102).—Input for DC voltages applied to the vertical amplifiers.

HORIZONTAL INPUT (AC) (E103).—Input for AC voltages deflecting the beam horizontally on the cathode ray tube screen.

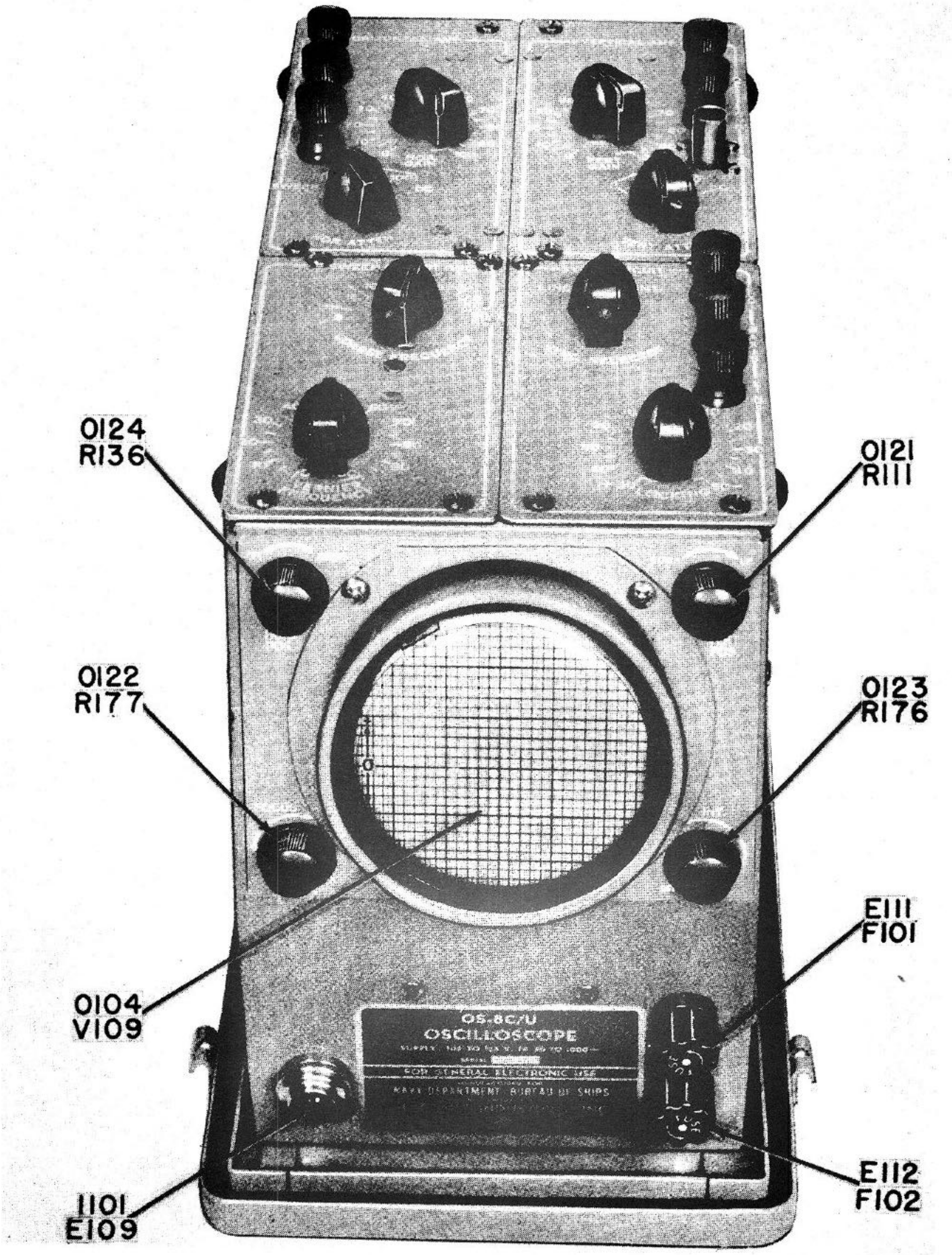


Figure 4-1. Panel Connectors and Controls, Front View

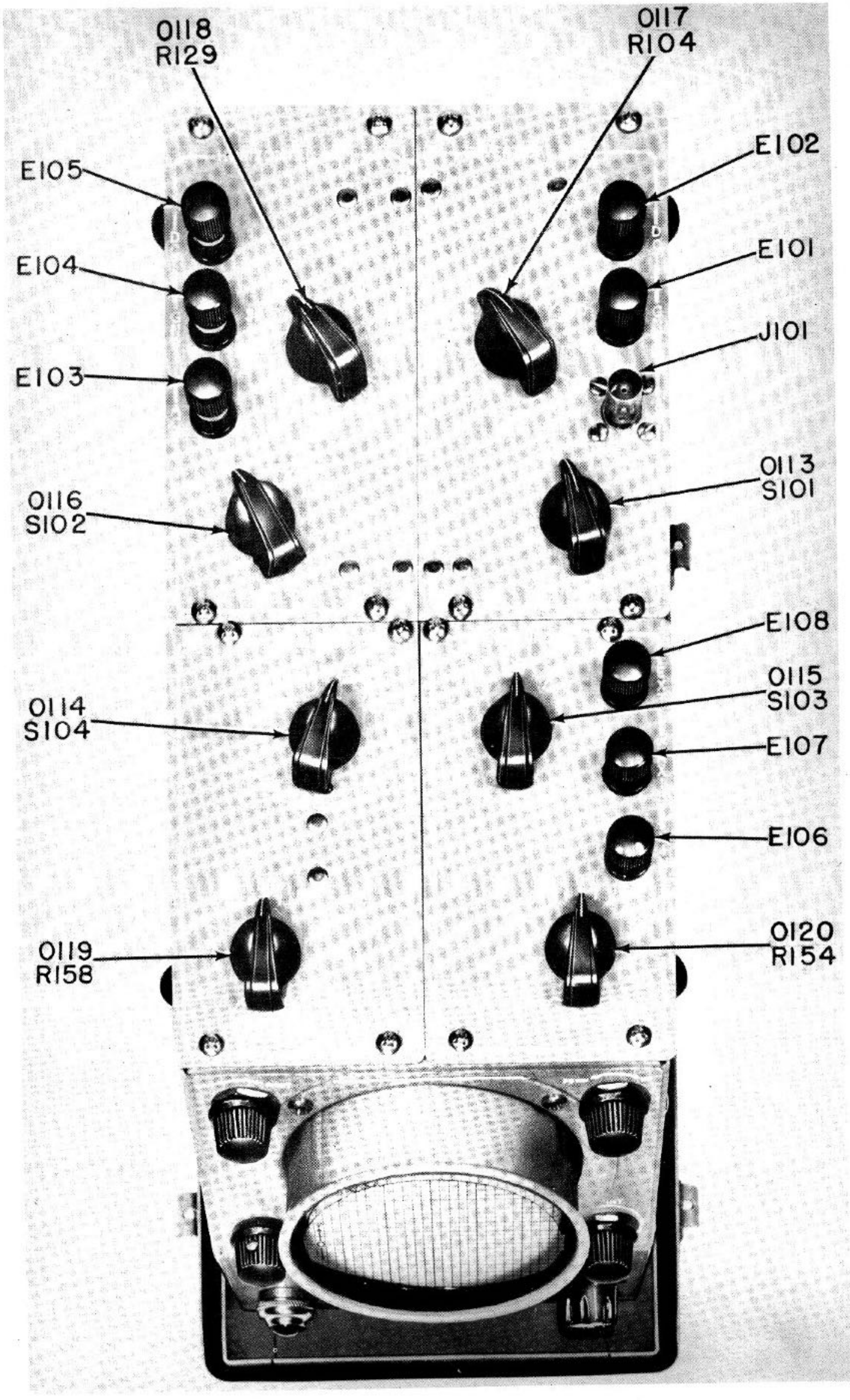


Figure 4-2. Panel Connectors and Controls, Top View

HORIZONTAL INPUT (DC) (E105).—Input for DC voltages applied to the horizontal amplifiers.

GND (2) (E101, E104).—Direct connection to chassis of equipment and to one side of all other externally applied voltages.

EXT. (E108).—Input for external synchronizing voltages to be used in synchronizing the sweep circuit oscillator.

LINE (E106).—A source of line supply frequency to be used either in causing deflection for horizontal or vertical inputs, or as a source of line frequency for any other use to which it might be put.

Z AXIS (E107).—Connection for an external voltage to be used in intensity modulating the cathode ray tube beam.

TERMINAL BOARD (TB105)–Permits direct connection to either horizontal or vertical deflection plates and provides means of beam blanking from internal sweep circuit oscillator.

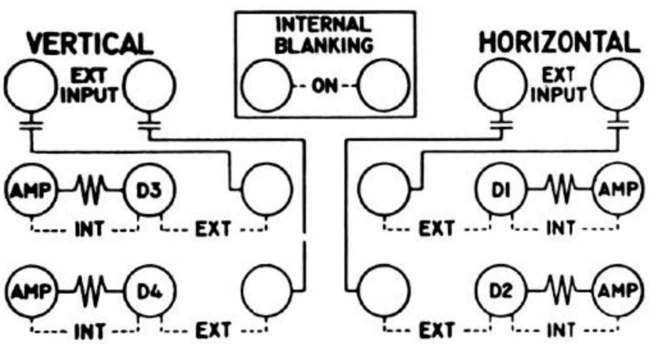


Figure 4-3. Rear Terminal Board **TB105**

3. OPERATION.

a. OBSERVING WAVE FORMS USING INTERNAL SWEEP AND SYNC.

Connect the source of alternating voltage to be observed to the vertical input (AC) and GND connections. Set the COARSE FREQUENCY control, S104, to the slowest sweep frequency, position "3-18". The SYNC. SELECTOR, S103, should be turned to "INT", while the LOCKING control, R154, is turned to the zero position. Adjust VERT. GAIN R104 and VERT. ATTEN. S101 for suitable vertical deflection. Adjust HOR. GAIN R129 until the pattern is of the desired width. When the pattern first appears it will usually show many cycles as the picture of the sine wave under observation in Figure 4-4. Slowly rotate the VERNIER-FREQUENCY, R158, until the number of cycles decreases to the desired number. If the number is still greater than convenient, then COARSE FREQUENCY S104 should be rotated to the next clockwise position and fewer cycles will appear as shown in Figure 4-5. When the desired number of cycles are obtained, the trace can be locked in by rotating the LOCKING control, R154, either clockwise or counter-clockwise, depending upon whether it is desired to lock in positive or negative synchronizing pulses.

b. OBSERVING WAVE FORMS USING INTERNAL SWEEP AND EXT. SYNC.

Follow all steps outlined in paragraph 3(a) with the following exception:

SYNC. SELECTOR S103 is turned to "EXT" rather than "INT", and the source of synchronizing voltage is applied between the EXT. binding post and GND.

c. OBSERVING WAVE FORMS USING INTERNAL SWEEP WITH LINE FREQUENCY SYNCHRONIZING VOLTAGES.

Follow all steps outlined in paragraph 3(a) with the following exception:

When the sweep circuit is to be locked in at line frequency, SYNC. SELECTOR S103 is turned to "LINE".

d. OBSERVING WAVE FORMS USING INTERNAL SINE WAVE LINE FREQUENCY SWEEP.

Connect the source of alternating voltage to be observed between the vertical input (AC) and GND. Set the HOR. ATTEN., S102, to the AC divided by 10 position. Make an electrical connection between the LINE binding post and the horizontal input (AC) binding post. Operate the HOR. GAIN and VERT. GAIN controls to give the desired size of pattern. LOCKING, VERNIER-FREQUENCY and SYNC. SELECTOR controls have no effect upon the operation.

e. OBSERVING PATTERNS WITH SINE WAVE VOLTAGES IN BOTH HORIZONTAL AND VERTICAL INPUTS.

Connect the two voltages for comparison to the oscilloscope, one on the horizontal input (AC) and one on the vertical input (AC). Adjust the HOR. ATTEN., S102, and VERT. ATTEN., S101, to the highest attenuation position that will give suitable deflection in both directions. Adjust the HOR. GAIN and VERT. GAIN controls until the pattern is of the desired size. With the above controls so adjusted, as the two frequencies become exact ratios of one another definite patterns, as illustrated in Figures 4-6 and 4-7, will appear on the screen.

The rule for determining ratios is to count the number of times the pattern touches one axis and then the number of times it touches the other. The ratio between the two is the ratio of the two frequencies. If the beam touches the horizontal axis more often than the vertical axis, then the beam must be moving more slowly in the horizontal direction than it is in the vertical direction. This being the case, the slowest frequency is being fed into the horizontal amplifier.

f. VERTICAL DEFLECTION WITH DC INPUT.

Operate the VERT. ATTEN., S101, to the "DC" position. Apply DC voltage to the (DC) vertical input connection, E102, and adjust VERT. GAIN R104 to give the desired deflection sensitivity.

g. HORIZONTAL DEFLECTION WITH DC INPUT.

Operate HOR. ATTEN. S102 to the "DC" position. Apply DC voltages to the (DC) horizontal input connection, E105, and adjust HOR. GAIN R129 to give the desired deflection sensitivity.

h. APPLYING VOLTAGE DIRECTLY TO DEFLECTION PLATES. (See Figure 4-3)

WARNING

The voltages that appear on the bottom two rows of terminals on TERMINAL BOARD TB105 are by necessity high and dangerous to human life. Before changing any jumper connections on these terminals, de-energize the oscilloscope.

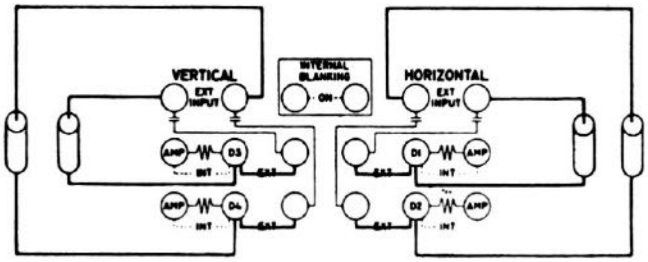


Figure 4-3A—Rear Terminal Board* TB105 *showing the addition of larger external capacitors.

(1) VERTICAL PLATES.—To apply voltages directly to the vertical deflection plates, change the jumpers on the vertical side of the board from "INT" to "EXT" connection as indicated by the dotted lines on the diagram appearing on the cover of TERMINAL BOARD TB105. The deflecting voltages may then be applied to the two terminals marked "EXT. INPUT". These terminals are isolated from the voltage on the deflection plates through capacitors C137 and C138. In observing very low frequency wave forms, the time constant of this input circuit may become objectionable. In this case, larger external capacitors may be connected between the terminals marked "EXT. INPUT" and the terminals marked D3 and D4 (See Figure 4-3A).

(2) HORIZONTAL PLATES.—To apply voltages directly to the horizontal deflection plates, change the jumpers on the horizontal side of the board from "INT" to "EXT" connection as indicated by the dotted lines on the diagram appearing on the cover of TERMINAL BOARD TB105. The deflecting voltages may then be applied to the two terminals marked "EXT. INPUT". These terminals are isolated from the voltage on the deflection plates through capacitors C139 and C140. In observing very low frequency wave forms, the time constant of this input circuit may become objectionable. In this case larger external capacitors may be connected between the terminals marked "EXT. INPUT" and the terminals marked D1 and D2 (See Figure 4-3A).

i. RETURN TRACE ELIMINATION. (See Figure 4-3)

When using the sweep circuit oscillator for horizontal deflection, should it be desired to blank the beam out on the return trace, a jumper should be installed between the two INTERNAL BLANKING terminals on the TERMINAL BOARD TB105. With these terminals connected together voltage should not be fed in at the Z AXIS binding post, E107, on the main panel to avoid distorting the saw tooth output of the sweep circuit oscillator.

j. OTHER APPLICATIONS OF THE OSCILLOSCOPE.

In addition to using the OS-8C/U for observation of wave forms as outlined in paragraphs 3(a) through 3(i), the oscilloscope may find use in many other applications such as:

(1) Alignment of tuned R.F. and I.F. stages and video circuits,

(2) Alignment of F.M. discriminator stages,

(3) Observation of irregular wave shapes, pulses, etc.,

(4) Approximate measurements of percent distortion,

(5) Detection and identification of hum in power supplies, and

(6) Determination of percent modulation in transmitters.

(7) Due to the wide frequency response of the vertical amplifiers, being from zero cycles on DC to 2 mc AC, the instrument will find extremely wide uses in connection with measurements and observation of wave forms from very low frequencies on up into the high frequency ranges.

(8) If suitable calibrating potentials are available it may be used as an electronic voltmeter. As an example, if it is desired to determine the voltage of an unknown signal being applied, the VERT. GAIN controls may be adjusted to give a deflection such as 15 small squares, or one and one-half inches. By substituting for the unknown voltage a known voltage of given magnitude, the ratio of the number of divisions of deflection of the unknown voltage would be proportional to that voltage as the number of divisions of deflection of the unknown voltage is to that unknown voltage. As a concrete example, if, with a given setting of the gain controls, the unknown voltage produced 15 divisions and a known voltage of 5 volts produced 5 divisions, the unknown voltage is to 15 as the known voltage (5) is to 5 divisions, or unknown voltage equals 15 volts.

If either of the VERT. GAIN controls are changed, recalibration should be effected unless notations of the exact control settings have been made and recorded for future use. Such recorded calibrations should be accurate for relatively long periods of time as they would be affected only by the operator's ability to reset accurately and the potential loss of mutual conductance with age of the vertical amplifier tubes.

(9) If using the DC vertical amplifier section with unshielded leads, caution should be taken as these unshielded leads might pick up stray fields and distort the wave shape being observed. Such precautions consist of using as short leads as possible and orienting the leads so that they do not come close to a source of AC fields such as transformers or alternating-current-carrying wires.

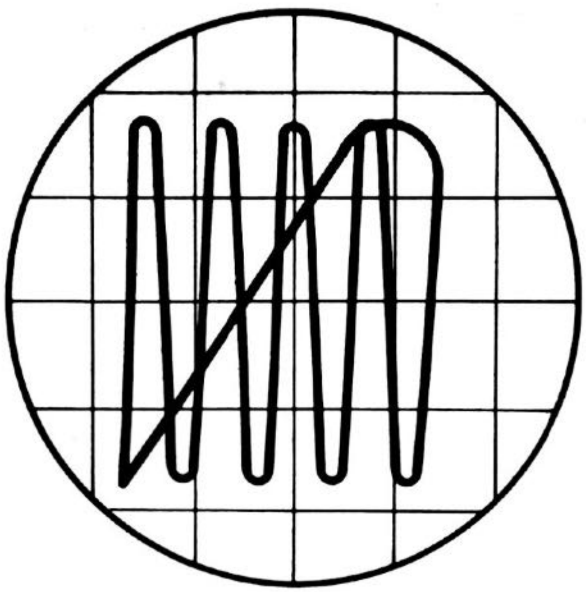


Figure 4-4

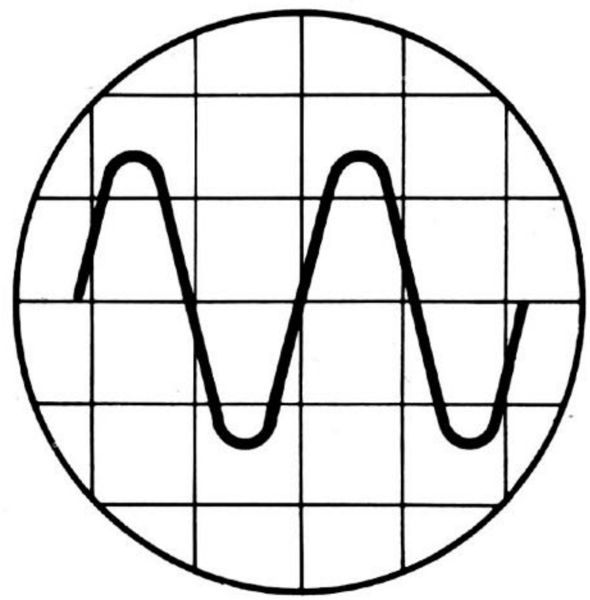


Figure 4-5

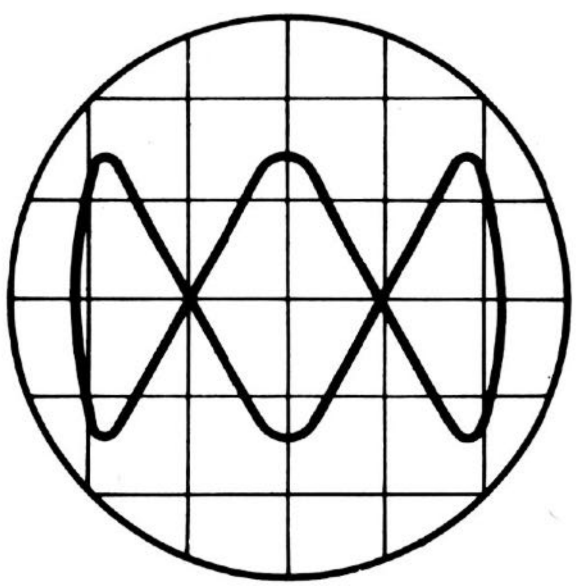


Figure 4-6

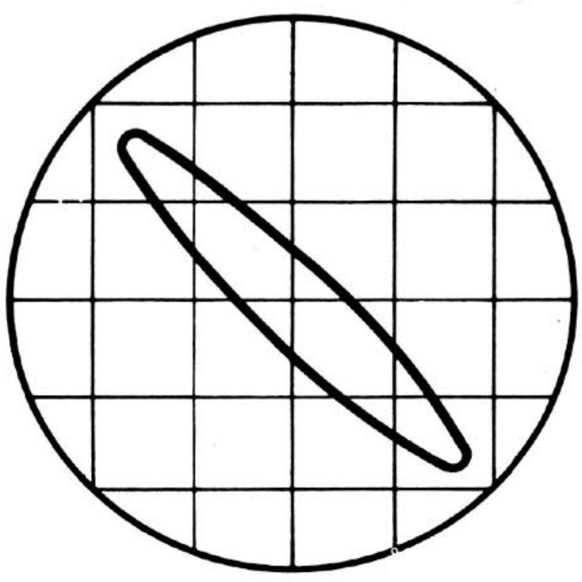


Figure 4-7

Wave Forms

SECTION 5
OPERATOR'S MAINTENANCE

1. PILOT LIGHT AND FUSES.

Connect power cord of Oscilloscope OS-8C/U to an outlet supplying 115V $\pm 10\%$, 50 to 1000 cycles AC. When the oscilloscope is energized, the pilot light should glow.

If the pilot light does not light, disconnect unit from power source and check fuses. This may be done by grasping the fuse holder finger grip cap and pressing it while making a slight turn to the left then pulling out. Check continuity of the fuse element with an ohmmeter.

If the fuse is found satisfactory, replace, and check the pilot light. Grasp pilot light jewel by the knurled portion and unscrew, then press in on lamp, twist to the left and pull out. Check lamp element for continuity with an ohmmeter.

2. EMERGENCY MAINTENANCE.

a. OPERATORS' NOTICE.

Operators should not perform any of the emergency maintenance procedures without proper authorization. Whenever tubes are replaced, realignment is necessary and table 7-2, the Alignment Chart, must be followed.

b. REPLACEMENT OF TUBES.

To replace tubes, remove sides, six screws per side. Tubes V101, V102, V103 and V104 are found on terminal board TB102 attached to the vertical amplifier panel (see fig. 7-3). Tubes V105, V106 and V107 are found on terminal board TB101 attached to the horizontal amplifier panel (see fig. 7-2). Tube V108 is mounted on the bracket attached to the sweep circuit oscillator panel (see fig. 7-2). Tube V110 is mounted on top of the power supply chassis (see fig. 7-3). Replacement of cathode ray tube may be accomplished by following procedure given in paragraph 1b, section 7.

SECTION 6
PREVENTIVE MAINTENANCE

1. GENERAL.

Preventive maintenance is the removing of possible trouble which might later cause the equipment to become inoperative. Primarily, this includes periodic inspection, checking, cleaning and tightening of contacts and components. Certain suggestions can be made for such a program, but local conditions will largely determine the exact details.

The guide to the program will be found in Table 6-1 ROUTINE MAINTENANCE CHART. By carefully following this chart, troubles can be detected and remedied before causing actual breakdown of the equipment.

2. LUBRICATION.

No lubrication is required.

3. CLEANING.

WARNING

Disconnect power cord.

a. GENERAL.—The chassis is best blown out with dry compressed air free of oil vapor, or cleaned with a dry cloth and a soft dry paint brush of suitable size. It may be necessary to use dry cleaning solvent, 140-F FED P-S-661 Type II (SNSN G51-S-4718-10 for a 5 gallon can), on a cloth to clean ceramic high voltage insulators. On chassis surfaces, however, this solvent should not be used as there is danger of softening the tropicalizing paint which covers them. Dust should be cleaned off thoroughly, both inside and outside the case.

Inspection should be combined with cleaning, since every part of the equipment can be observed at that time, and cleaning may inadvertently break or loosen a connection.

All exposed lug and screw connections, plug and socket connections, and electron tube pins should be checked for tightness. Cable ends should be properly dressed to prevent short circuits or strain on wires and lugs.

Caution

Faulty electrical contacts can cause equipment failure at a critical time. Evidences of heating or breakdown such as carbonized surfaces, overheated resistors with discolored surfaces, and discolored metal parts should be noted. Though there may be no damage, potential trouble is indicated.

TABLE 6-1. ROUTINE MAINTENANCE CHART

ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO REQUIREMENTS OF CHAPTER 67 OF THE "BUREAU OF SHIPS MANUAL" OF THE LATEST ISSUE.

The following Table is given as a basis for a routine maintenance schedule.

WARNING

Before removing the case, remove the power cable. After removal of the case, discharge any capacitors in the power supply.

MONTHLY

a. Remove fuses one at a time. Clean and burnish ends and clips as needed.

b. Check tube pins and socket contacts for corrosion. Clean as needed.

c. Check all tubes in a tube tester. Replace weak tubes.

d. Replace any tubes missing from tested emergency spares after first testing in proper socket.

e. Check operation of all panel controls.

f. Blow out dust with dry compressed air.

g. Check for rust and corrosion. Clean and touch up with paint as needed.

All knobs should be checked for looseness and tightened if necessary. Occasionally knobs become loose and fail to rotate their controls; thus, a loose knob may give the impression of fault in a variable circuit.

Rough handling of the oscilloscope will sometimes jar parts or wires out of position or abrade them; such damage should be repaired. Rust or corrosion on painted surfaces should be cleaned and sanded smooth, and the spot covered with touchup paint. Unpainted surfaces will not ordinarily corrode unless exposed to salt water or some other corrosive agent. Should corrosion occur, it should be cleaned off thoroughly, taking care not to let the scrapings fall into the unit, and the spot touched up with clear varnish or tropicalizing paint. Paint or varnish should not be used too close to switch or tube socket contacts.

b. TUBES.

Compressed air free of oil vapor or a brush will usually suffice to remove dust from the tubes. Be careful to clean tubes that operate at a high temperature, as a layer of dust would interfere with heat radiation and raise the operating temperature. After cleaning, make sure that all tubes are properly seated in their sockets, and all tube clamps locked.

The plate connectors used on high voltage rectifier tubes may lose their spring tension as a result of overheating. The tension should be increased when necessary.

c. FUSES.

Fuses should be removed and checked for corrosion and looseness, either of which can cause eventual trouble. A clean cloth moistened with dry cleaning solvent, 140-F FED P-S-661 Type II (SNSN G51-S-4718-10 for a 5 gallon can), will usually suffice for cleaning the fuses and clips, but in some cases it may be necessary to use crocus cloth or fine sandpaper. When repiacing, make sure that the fuses are tight in their clips.

d. HIGH-VOLTAGE INSULATORS.

Ceramic and other insulators for voltages under 600 volts are usually tropicalized. They should be kept clean, but care should be taken not to remove the special paint. The use of solvents is not recommended.

Ceramic insulators for voltages greater than 600 volts are not tropicalized. They should be kept clean to prevent the possibility of arc-overs. It may be necessary to use a cloth moistened with dry cleaning solvent, 140-F FED P-S-661 Type II (SNSN G51-S-4718-10 for a 5 gallon can), or some other solvent.

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NAVGEH 1025 which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from the nearest District Printing and Publication Office.

SECTION 7
CORRECTIVE MAINTENANCE

1. GENERAL.

Components in oscilloscope OS-8C/U can, in general, be replaced with equivalent components without the necessity of any further adjustment except where specifically mentioned. Most of the components may be replaced in the scope generally serviced by merely removing the side panels, six screws per panel; however, it will be found much more convenient when attempting any major repair to remove the sub-assembly involved as indicated below.

a. REMOVING SUB-ASSEMBLIES

(1) VERTICAL AMPLIFIER.

(a) Remove the right side panel.

(b) Unsolder the two leads from the vertical amplifier assembly at terminal board TB105 in the rear of the scope.

(c) Remove the four screws holding the vertical amplifier assembly to the top of the chassis.

(d) Remove the assembly from the chassis by giving it a slight counter-clockwise turn and pulling straight out.

(e) The vertical amplifier assembly may then be swung down and laid on the bench next to the oscilloscope, and the two leads from the amplifiers reconnected to the terminal board with short jumpers. The oscilloscope may now be operated in its normal manner with this circuit completely exposed.

(2) HORIZONTAL AMPLIFIER.

(a) Remove the left side panel.

(b) Unsolder the two leads from the horizontal amplifier assembly at terminal board TB105 in the rear of the scope.

(c) Remove the four screws holding the horizontal amplifier panel to the top of the chassis.

(d) Remove the assembly from the chassis by giving it a slight clockwise turn and pulling straight out.

(e) The horizontal amplifier assembly may then be swung down and laid on the bench next to the oscilloscope, and the two leads from the amplifiers reconnected to the terminal board with short jumpers. The oscilloscope may now be operated in its normal manner with this circuit completely exposed.

(3) SWEEP CIRCUIT OSCILLATOR.

(a) Remove the left side panel.

(b) Remove the four screws holding the sweep circuit oscillator panel to the top of the chassis.

(c) Remove the assembly from the chassis by pulling straight out.

(d) The sweep circuit oscillator may then be swung down and laid on the bench beside the oscilloscope and the scope operated in the normal manner with this circuit completely exposed.

(4) SYNC. CIRCUIT.

(a) Remove the right side panel.

(b) Remove the four screws holding the sync. circuit panel to the top of the chassis.

(c) Remove the assembly from the chassis by applying a slight clockwise twist and pulling straight out.

(d) The sync. circuit assembly may then be swung down and laid on the bench next to the scope and the scope operated in the normal manner with this circuit completely exposed.

(5) POWER SUPPLY.

(a) Disengage the bottom pan from the chassis by removing the four water-tight screws from the shock mounts.

(b) Remove both side panels.

(c) Unsolder the shield of the power cord from its lug on the power supply assembly.

(d) Unsolder wire on rear terminal of lower fuse holder and the longer wire on the a-c switch located on the back of the intensity control.

(e) Remove the four screws holding the power supply assembly to the chassis. Two of these screws are located on the front of the chassis and the other two on the bottom.

(f) The assembly may then be removed by pulling it through the opening on the right side of the chassis and turning it slightly counter-clockwise. There is sufficient slack in the cabling to permit this removal.

(g) After reconnecting the two wires by means of jumpers, the oscilloscope may be operated in the normal manner with this assembly completely exposed.

Important Note

IN CASE OF EMERGENCY, WHEN REPLACEMENT PARTS ARE NOT AVAILABLE, THESE ASSEMBLIES MAY BE COMPLETELY DETACHED FROM THE OSCILLOSCOPE BY UNSOLDERING THE CABLES FROM DISTRIBUTION BOARD AND A CONSOLIDATION OF WORKABLE ASSEMBLIES MAY BE ACCOMPLISHED SINCE EACH ASSEMBLY IS INTERCHANGEABLE FROM ONE OSCILLOSCOPE TO ANOTHER.

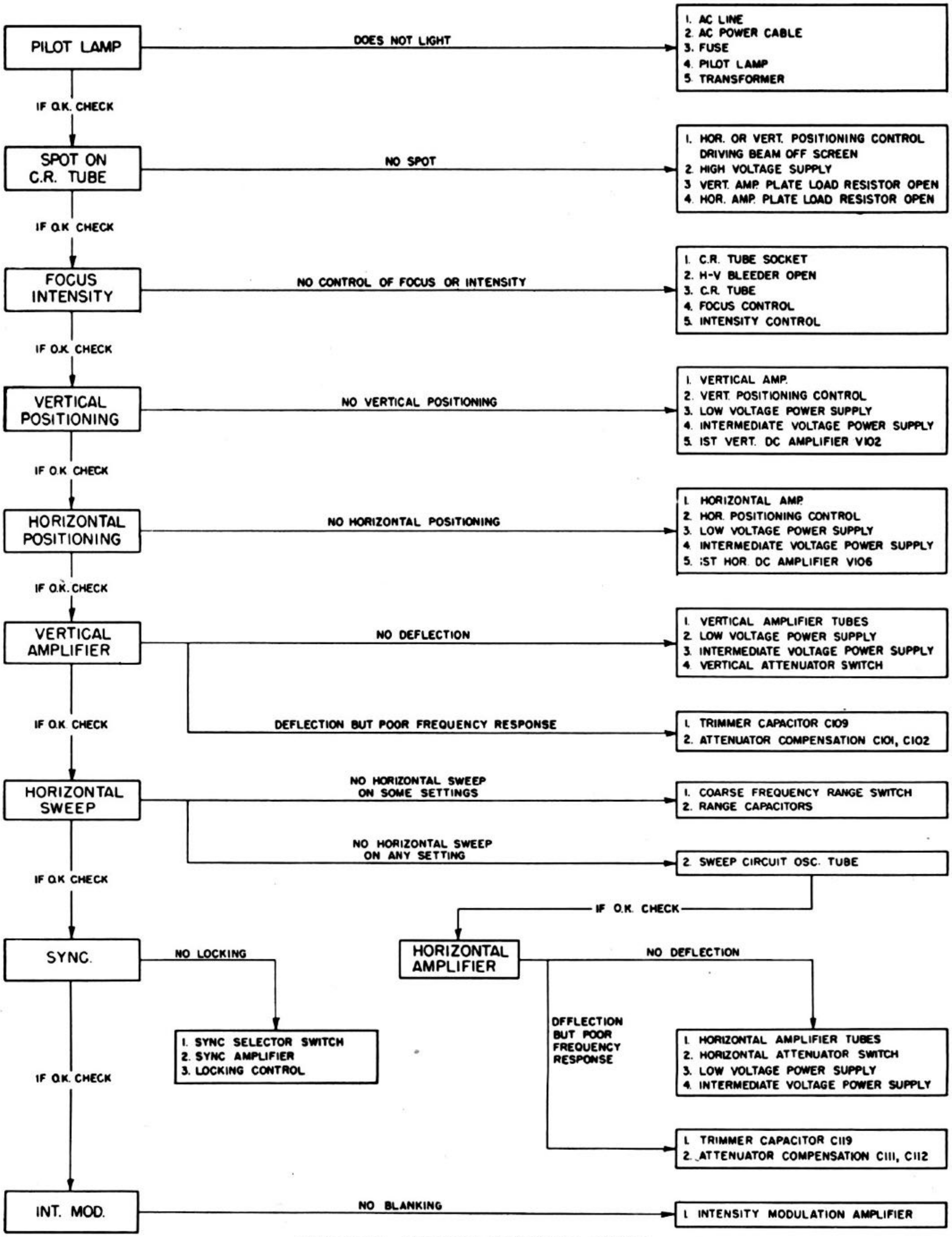


TABLE 7-1. TROUBLE SHOOTING CHART

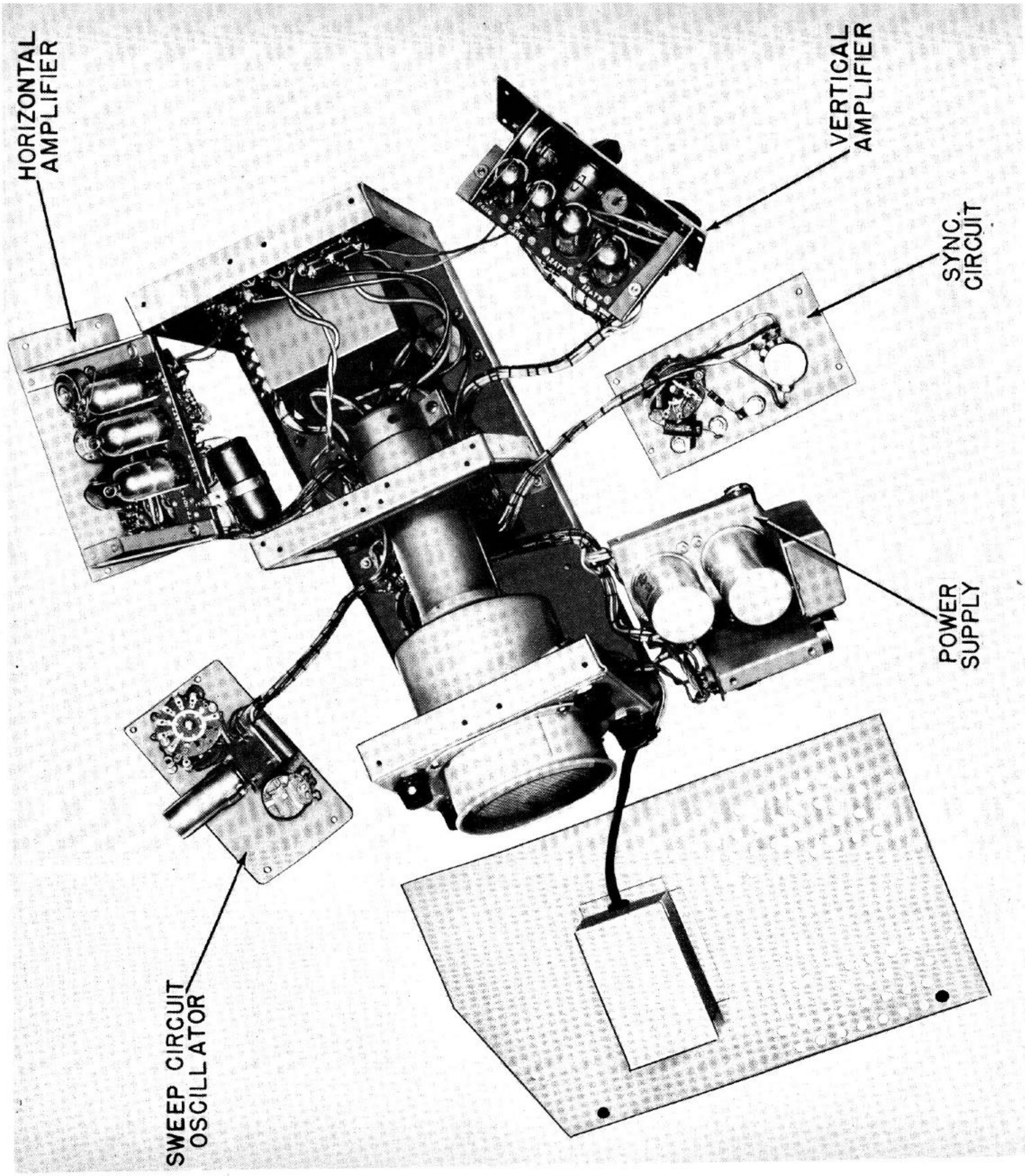


Figure 7-1. Oscilloscope OS8-C/U, Sub-Assemblies Removed

b. REPLACING CATHODE RAY TUBE.

Caution

HANDLE WITH CARE. Breakage of this tube, which contains a high vacuum, may result in injury from flying glass. Do not strike or scratch the tube. Never subject to more than moderate pressure when installing in or removing from equipment.

Should it be necessary to replace the cathode ray tube, the following procedure should be followed:

(1) Remove the right side panel.

(2) Loosen the cathode ray tube clamp (See Figure 7-2).

(3) The cathode ray tube may then be removed by disengaging the socket and pulling forward and out with the tube visor.

c. REPLACING THE TRANSFORMER (See Figure 7-3).

Should it become necessary to replace transformer T101, the following procedure should be followed:

(1) Disengage the bottom pan from the chassis by removing the four water-tight screws from the shock mounts.

(2) Remove both side panels.

(3) Unsolder all leads from the transformer terminals, being sure to identify them so that they can be correctly replaced.

(4) Remove the cathode ray tube as outlined above.

(5) Remove the four screws securing the transformer to the main chassis. These screws are located on the bottom of the chassis.

(6) The transformer may then be removed through the right side of the chassis and the replacement made.

d. ALIGNMENT OF DC AMPLIFIERS (HORIZONTAL AND VERTICAL).

The amplifiers used in the vertical and horizontal deflection circuits are of the direct-coupled type which depend upon proper adjustment for best operation. Although these adjustments are made in the factory, it is possible that after replacement of major components, readjustment may be required for optimum performance. Some of the symptoms of maladjustment and the methods for correcting them are listed below, as well as in Table 7-2.

(1) LACK OF SENSITIVITY, INSUFFICIENT POSITIONING, CROWDING, OR POOR FOCUS (ASTIGMATIC CONDITION)—If any one or more of these conditions exist in the vertical or horizontal amplifiers, readjustment of BIAS controls R119 and R141 respectively would be advisable. For the vertical amplifier, adjust BIAS ADJ. R119 (See Figure 3-4) until the voltage drop across plate load resistor R123 or R124 (See Figure 7-10 is 45 volts with the beam vertically centered on the cathode ray tube. For the horizontal amplifier, BIAS ADJ. R141 (See Figure 7-3) should be adjusted until the voltage drop across plate load resistor R145 or R146 (See Figure 7-10) is 90 volts when the beam is horizontally centered on the cathode ray tube.

If, after the bias adjustment indicated above, the vertical amplifier still exhibits excessive crowding, readjustment of LINEARITY control R121 would be advisable. Crowding is the term used for non-linearity of the pattern height with changes in positioning. For example, a one-half inch pattern obtained in the center of the screen may be appreciably less than one-half inch when positioned to the top or bottom of the screen. To readjust LINEARITY control R121, feed a test signal into the vertical amplifier and adjust the trace until it is approximately one-half inch high and positioned to the top or bottom of the cathode ray tube. Adjust R121 (See Figure 3-4) for maximum deflection.

(2) SHIFTING OF THE BEAM WITH GAIN CONTROL SETTINGS ON DC ATTENUATOR POSITION—When the vertical or horizontal attenuators are in the DC position and no signal is being fed into the DC input, the beam should not shift appreciably when the GAIN control is rotated. If the beam shifts vertically or horizontally it would be advisable to readjust potentiometers R112 (See Figure 7-2) or R135 (See Figure 7-3) respectively. The easiest way to accomplish this is to center the beam with the POSITIONING control while the GAIN control is in its extreme counter-clockwise position, with no signal applied to the amplifier, and with the intensity reduced so as not to burn a hole in the cathode ray tube screen. Then, turn the GAIN control to its extreme clockwise position and re-center the beam with potentiometer R112 (vertical) or R135 (horizontal), depending upon whether the beam moves vertically or horizontally. This process may have to be repeated more than once.

(3) POSITIONING CONTROLS INCAPABLE OF SWINGING THE BEAM OFF SCREEN IN ONE DIRECTION—If replacement tubes used in the horizontal DC amplifier are badly unbalanced, a condition might result in which the POSITIONING control is not capable of positioning the beam off screen in one direction. If this condition arises, the unbalanced tube should be replaced. In an emergency, resistor R187 (See Figure 7-10) (horizontal) may be changed in value until the beam will swing off screen in both directions. This resistor is 560K, 10%, ½ watt, carbon, as originally supplied in the oscilloscope and any replacement should be the same type (carbon) but could range in value anywhere from 330K to 4.7 megohm.

(4) LACK OF FREQUENCY RESPONSE, SQUARE WAVE ROUNDING, OR EXCESSIVE SQUARE WAVE OVERSHOOT (See Figures 7-4, 7-5 and 7-6)—In making any adjustments of the frequency characteristics of the amplifiers or the compensation of the attenuators, it is important that a good quality square wave generator be used in order to insure good pulse response.

With a 100 kc square wave on the vertical amplifier, and the attenuator in the AC divide by 1 (AC-1) position, the trace should exhibit a fast rise time and about

TABLE 7-2. Alignment Chart for Major Component Replacement.

COMPONENT REPLACED	SYMPTOMS SHOWING NEED FOR ALIGNMENT	PART TO BE ALIGNED	ALIGNMENT PROCEDURE
V102, V103 or V104	Lack of Sensitivity, Insufficient Positioning, Crowding, or Poor Focus (Astigmatic Condition) on Vertical Amplifier.	Bias. Adj. R119	Adjust R119 until drop across plate load resistor R123 or R124 is 45 volts with the beam vertically centered on the cathode ray tube.
	Crowding after the bias adjustment indicated above.	Linearity Control R121	Feed a test signal into the vertical amplifier and adjust the trace until it is approximately one-half inch high and positioned to the top or bottom of the cathode ray tube. Adjust R121 for maximum deflection.
V106 or V107	Lack of Sensitivity, Insufficient Positioning, Crowding, or Poor Focus (Astigmatic Condition) on Horizontal Amplifier.	Bias Adj. R141	Adjust R141 until drop across plate load resistor R145 or R146 is 90 volts when the beam is horizontally centered on the cathode ray tube.
V102 or V106	Shifting of the Beam with Gain Control Settings on DC Attenuator Position.	R112 (Vertical) R135 (Horizontal)	With the gain control counter-clockwise, center the beam wth positioning control. Then run the gain control clockwise and re-center the beam with R112 (Vertical) or R135 (Horizontal).
V102, V106 or V107	Positioning Controls Incapable of Swinging Beam off Screen in One Direction.		Replace unbalanced tube or in case of emergency change resistors R114 (Vertical) or R187 (Horizontal).
V102, V103, V104, V106 or V107	Lack of Frequency response, square wave rounding, or excessive square wave overshoot in the AC divide by 1 (AC-1) attenuator position.	C109 (Vertical) or C119 (Horizontal)	With 100KC square wave, adjust C109 (Vertical) for 3% overshoot. With 25KC 3 square wave, adjust C119 (Horizontal) for 3% overshoot.
Any Attenuator Components	Square wave rounding or excessive square wave overshoot in the (AC-10) or (AC-100) attenuator positions.	C101 (Vertical AC-10) C102 (Vertical AC-100) C111 (Horizontal AC-10) C112 (Horizontal AC-100)	With square wave, adjust attenuator trimmer condensers until the trace appears normal.

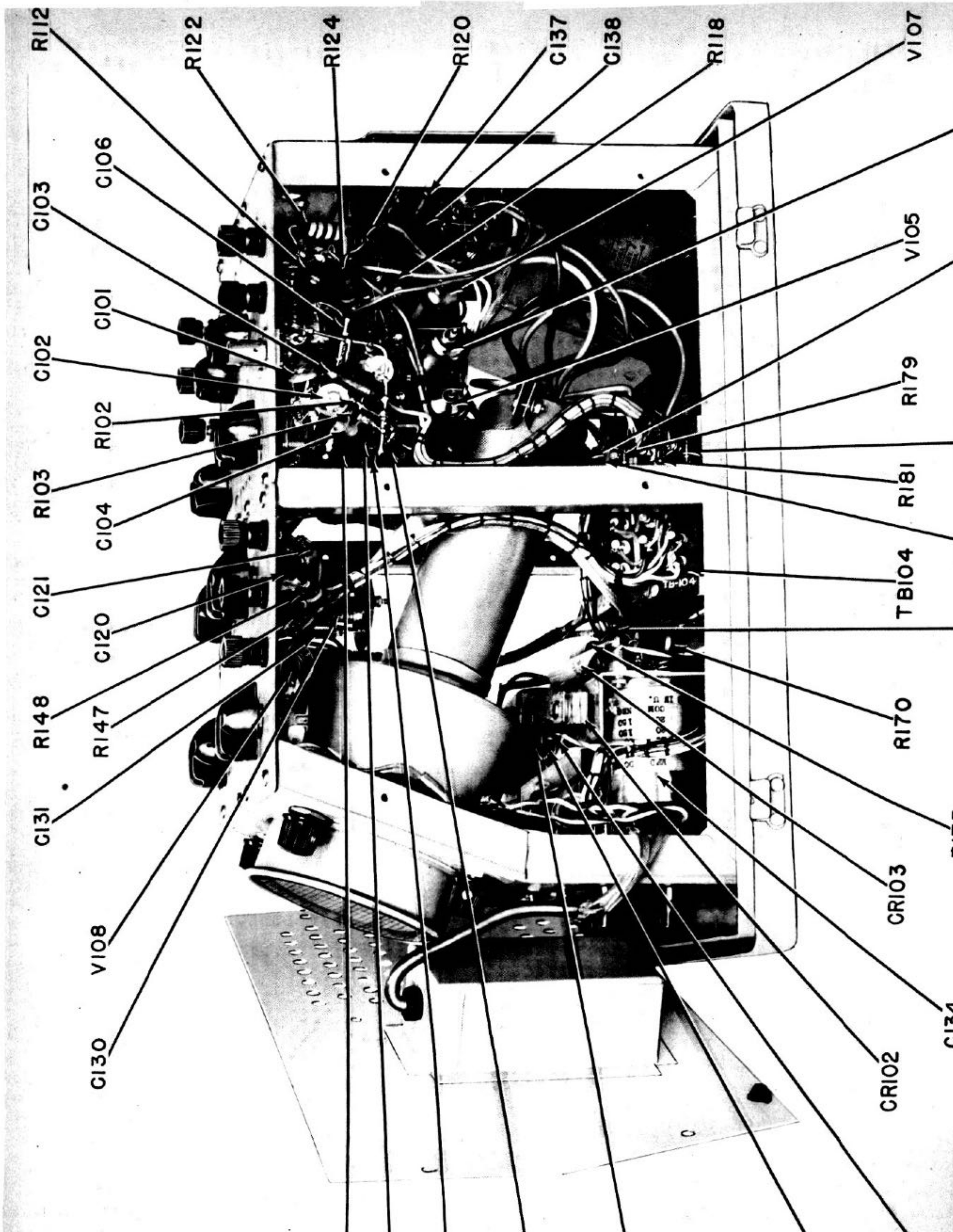


Figure 7-2. OS-8C/U, Right Side View, Cover and Side Panel Removed

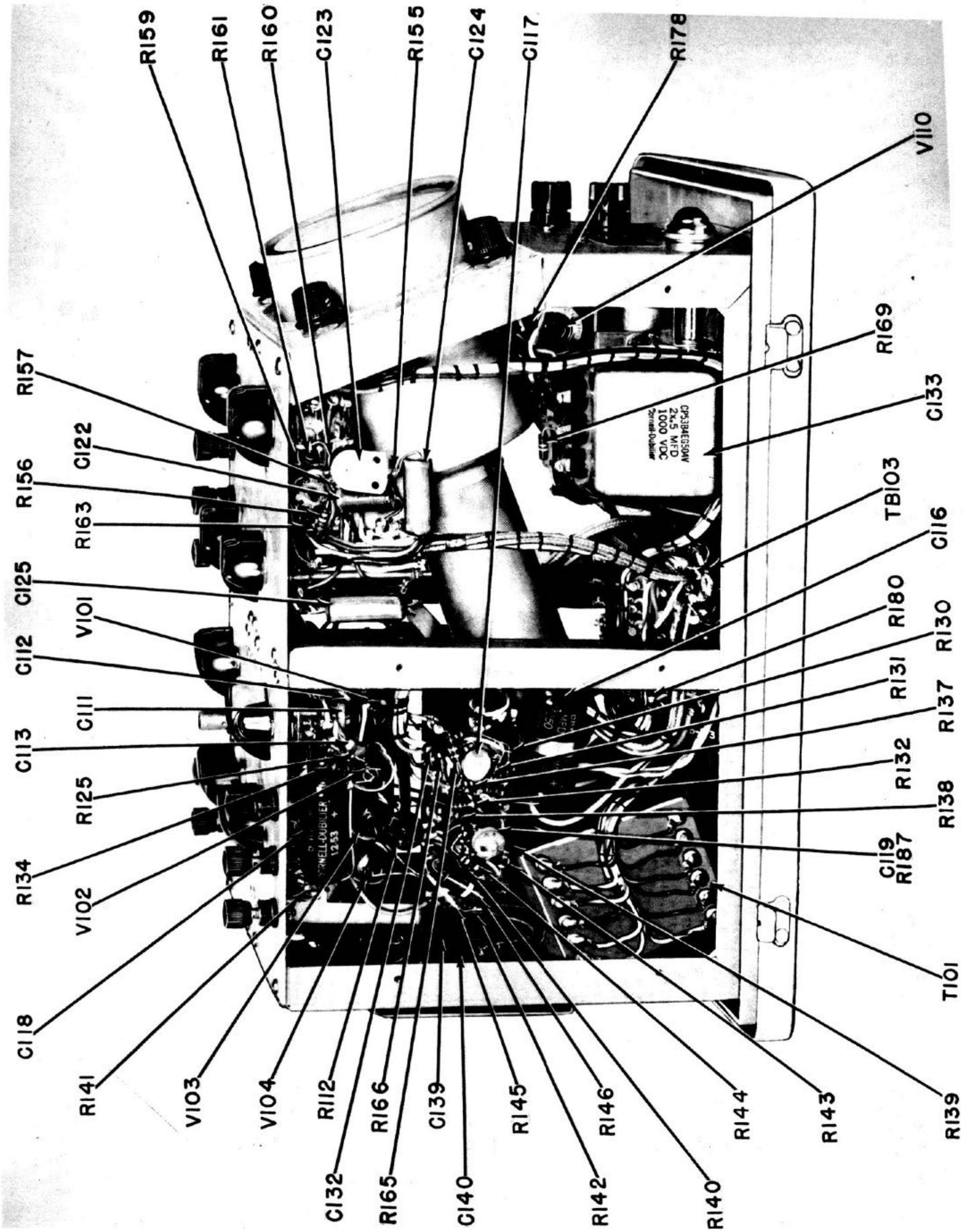


Figure 7-3. OS-8C/U, Left Side View, Cover and Side Panel Removed

3% overshoot as indicated in Figure 7-6. If the trace exhibits rounding as in Figure 7-4, or excessive overshoot as in Figure 7-5, readjustment of trimmer condenser C109 (See Figure 7-2) would be advisable. If, after the adjustment indicated above, the square wave trace appears distorted on the AC divide by 10 (AC-10) position, adjust trimmer condenser C101 (See Figure 7-2) until the trace appears normal as in Figure 7-6. If the distortion appears on the AC divide by 100 (AC-100) position, adjust C102 (See Figure 7-2) as above.

With the vertical amplifier driven by a sawtooth from an external source to provide a vertical sweep, the horizontal attenuator in the AC divide by 1 (AC-1) position, and a 25 kc square wave on the horizontal amplifier, the trace should exhibit a fast rise time and about 3% overshoot as indicated in Figure 7-6. If the trace exhibits rounding as in Figure 7-4, or excessive overshoot as in Figure 7-5, readjustment of trimmer condenser C119 (See Figure 7-3) would be advisable. If, after the adjustment indicated above, the square wave trace appears distorted on the AC divide by 10 (AC-10) position, adjust trimmer condenser C111 (See Figure 7-3) until the trace looks normal as in Figure 7-6. If the distortion appears on the AC divide by 100 (AC-100) position, adjust trimmer C112 (See Figure 7-3) as above.

c. MAKING REPLACEMENTS WITH COMPONENT PARTS OTHER THAN THOSE CALLED FOR IN THE PARTS LIST.

(1) E101 may be made from Standard Navy Stock Number N17-P-69135-8011 by cutting off the excessive stud length.

(2) X101 and X103 may be made from Standard Navy Stock numbers N16-S-64063-6717 and N16-S-62063-6693 respectively by cutting off the ground ears and removing the center shield.

(3) When replacing X109 socket, check the color coding on replacement socket and make any necessary notes as to changes before removing the old socket.

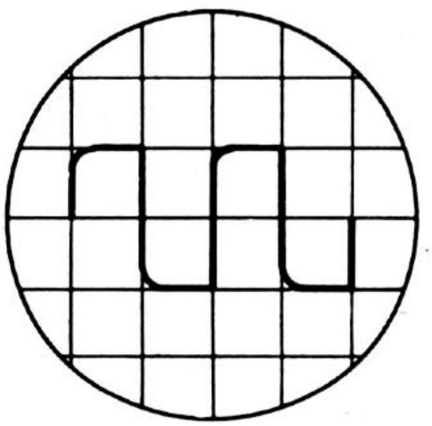


Figure 7-4

Square wave exhibiting excessive rounding. UNDER-COMPENSATED

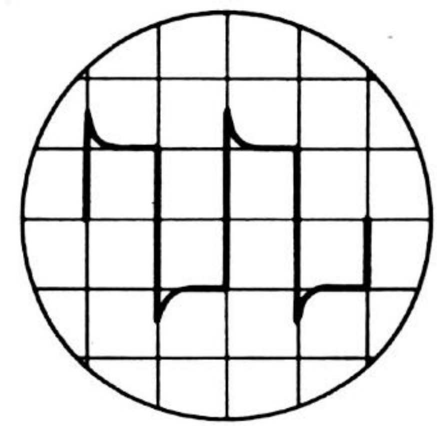


Figure 7-5

Square wave exhibiting excessive overshoot. OVER-COMPENSATED

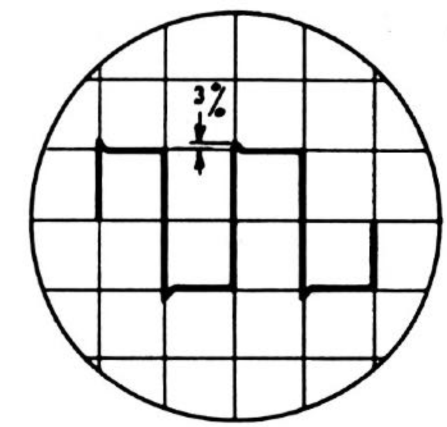
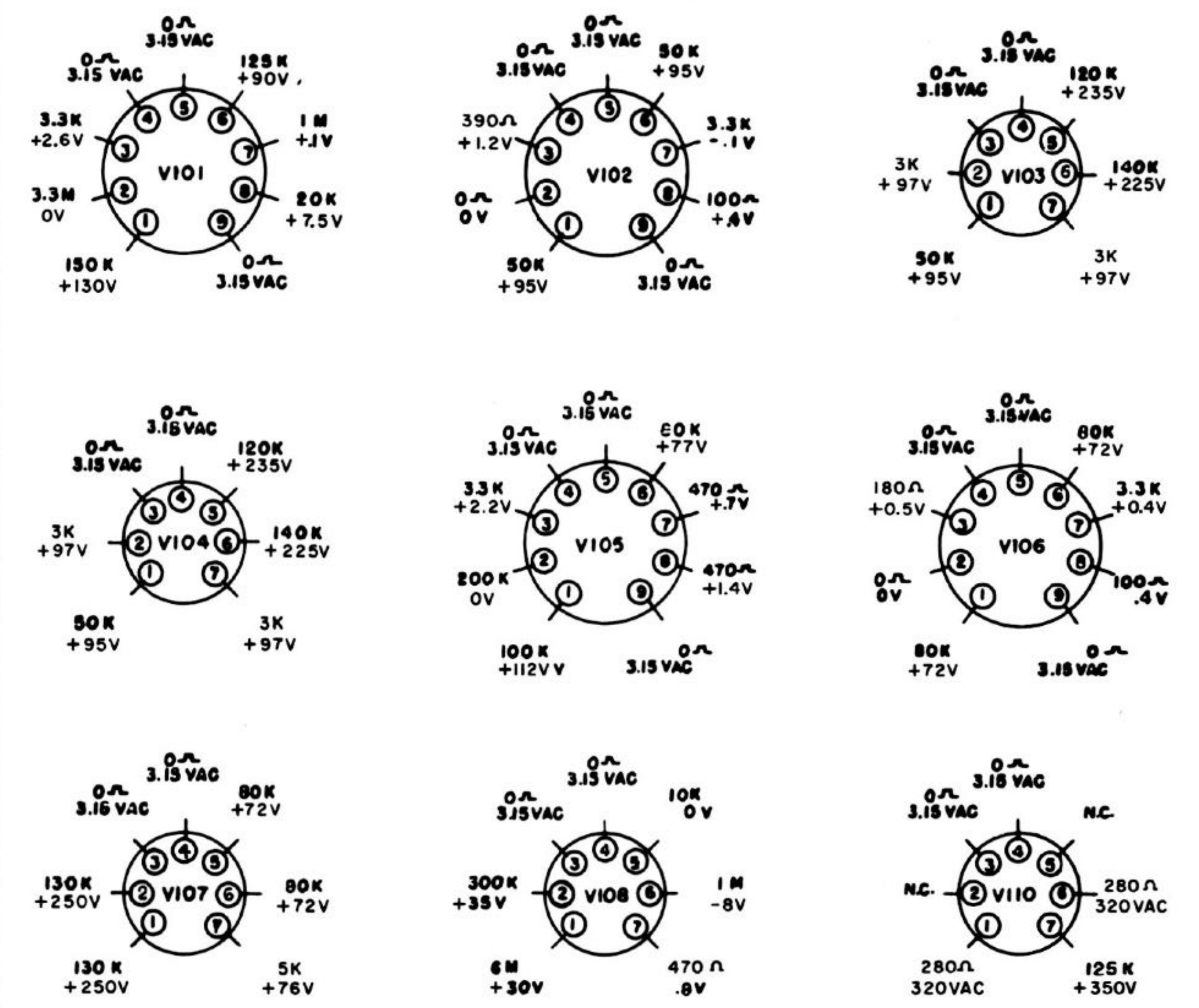


Figure 7-6

Square wave exhibiting 3% overshoot. CORRECT ADJUSTMENT



* VOLTAGE MEASUREMENTS TAKEN WITH CONTROLS IN FOLLOWING POSITIONS:-

——VERT. AMP.——

GAIN SET AT O, ATTENUATOR SET AT AC X 1.

——HOR. AMP.——

GAIN SET AT O, ATTENUATOR SET AT SWEEP.

——SYNC. CIRCUIT——

SELECTOR SET AT INTERNAL LOCKING SET AT +50.

—SWEEP CIRCUIT OSC.—

COARSE FREQUENCY SET AT 100-475, VERNIER FREQUENCY SET AT O.

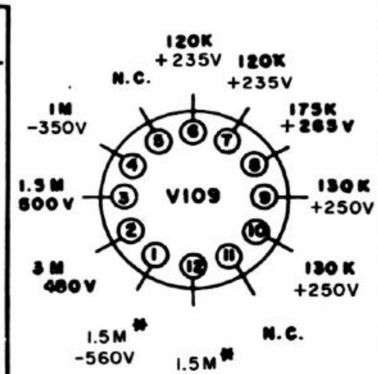
FRONT PANEL CONTROLS SET FOR LOW INTENSITY FOCUSED SPOT IN CENTER OF SCREEN.

D.C.V. READINGS WERE TAKEN WITH A 20,000-Ω PER VOLT METER.

A.C.V. READINGS WERE TAKEN WITH A 1,000-Ω PER VOLT METER.

ALL TEST LEADS DISCONNECTED.

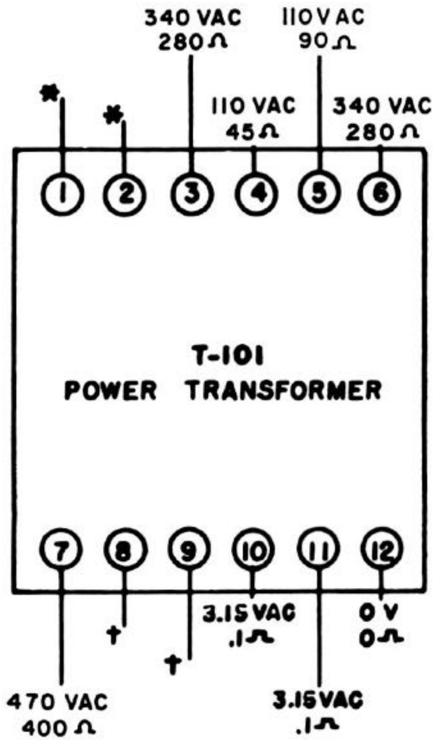
RESISTANCE MEASUREMENTS TAKEN WITH CONTROLS IN POSITION FOR VOLTAGE MEASUREMENTS BUT WITH LINE POWER CORD REMOVED.



*VOLTAGES BETWEEN THESE POINTS ARE 6.3 VAC.

ALL OTHER VOLTAGES AND RESISTANCE READINGS MADE TO GROUND.

Figure 7-7. Tube Socket Voltage and Resistance Measurements



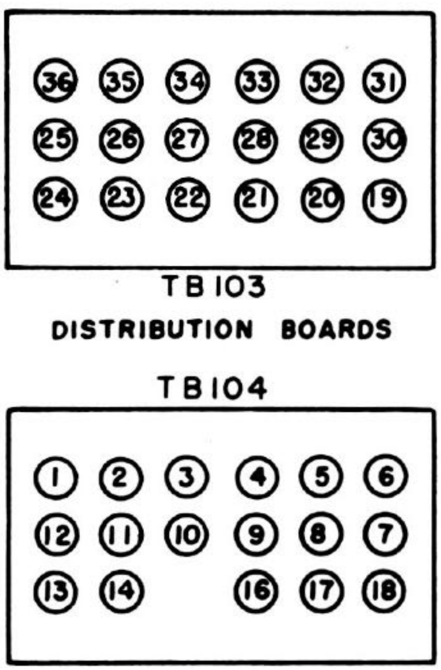
*BETWEEN PINS 1+2 115 VAC, 7Ω

†BETWEEN PINS 8+9 6.3 VAC, 0.4Ω

READING ON ALL OTHER TEMINALS TO GND.

ACV READ WITH 1000Ω PER VOLT METER, LINE VOLTAGE 115 V., CONTROLS SET AS IN FIG. 7-7.

Figure 7-8. Power Transformer Voltage and Resistance Measurements



NO.	Ω	V.
1	0-500	1.2
2	0	3.15 AC
3	0	3.15 AC
4	50K	107
5	1.5M	-560
6	3M	-500
†7	—	-560
8	80K	+280
†9	—	-560
10	150K	+130
11	12K	+97
12	1M	+0.4
13	20K	+7.5
14	125K	+90
16	470	.8
17	0	0
18	175K	235

NO.	Ω	V.
19	80K	+80
20	1.5M	-560
21	50K	+107
22	0	3.15 AC
23	0	3.15 AC
24	0-500	+1.2
25	0-500	+1.0
26	220K	0
27	90K	+320
28	100K	+120
29	1.4M	-510
30	1.5M	-510
31	1M	-340
32	470	+.7
33	470	+.7
34	100K	+340
35	0	0
36	20K	+8

†BETWEEN PINS 7+9 6.3 VAC., .8Ω.

ALL OTHER VOLTAGES AND RESISTANCES TO GND.

ACV READ WITH 1000Ω PER VOLT METER,
DCV READ WITH 20,000Ω PER VOLT METER,
LINE VOLTAGE 115 V., CONTROLS SET AS IN FIG. 7-7.

Figure 7-9. Distribution Board Voltage and Resistance Measurements

NAVSHIPS 92251
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Section 7

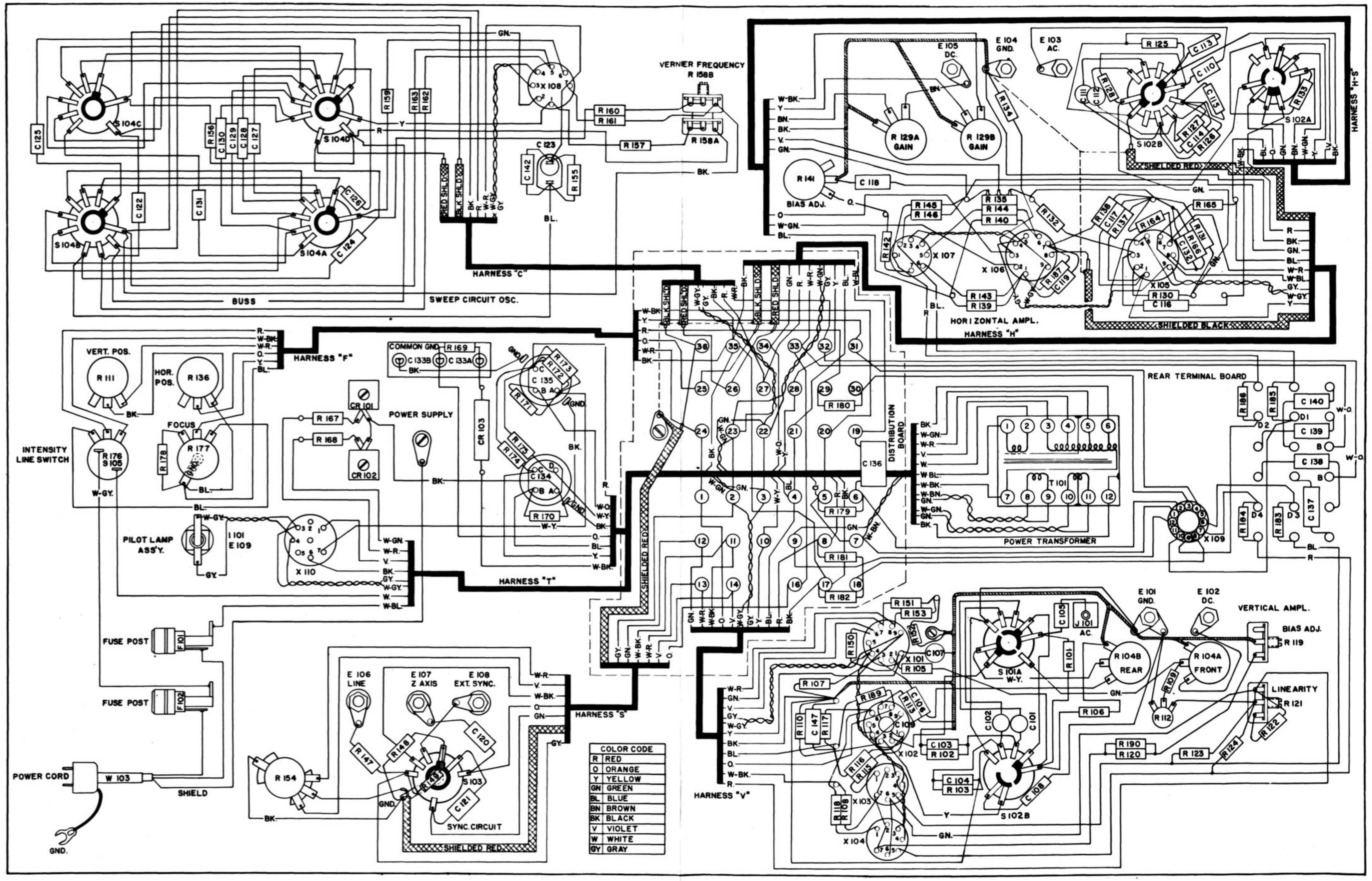


Figure 7-10. Pictorial Wiring Diagram

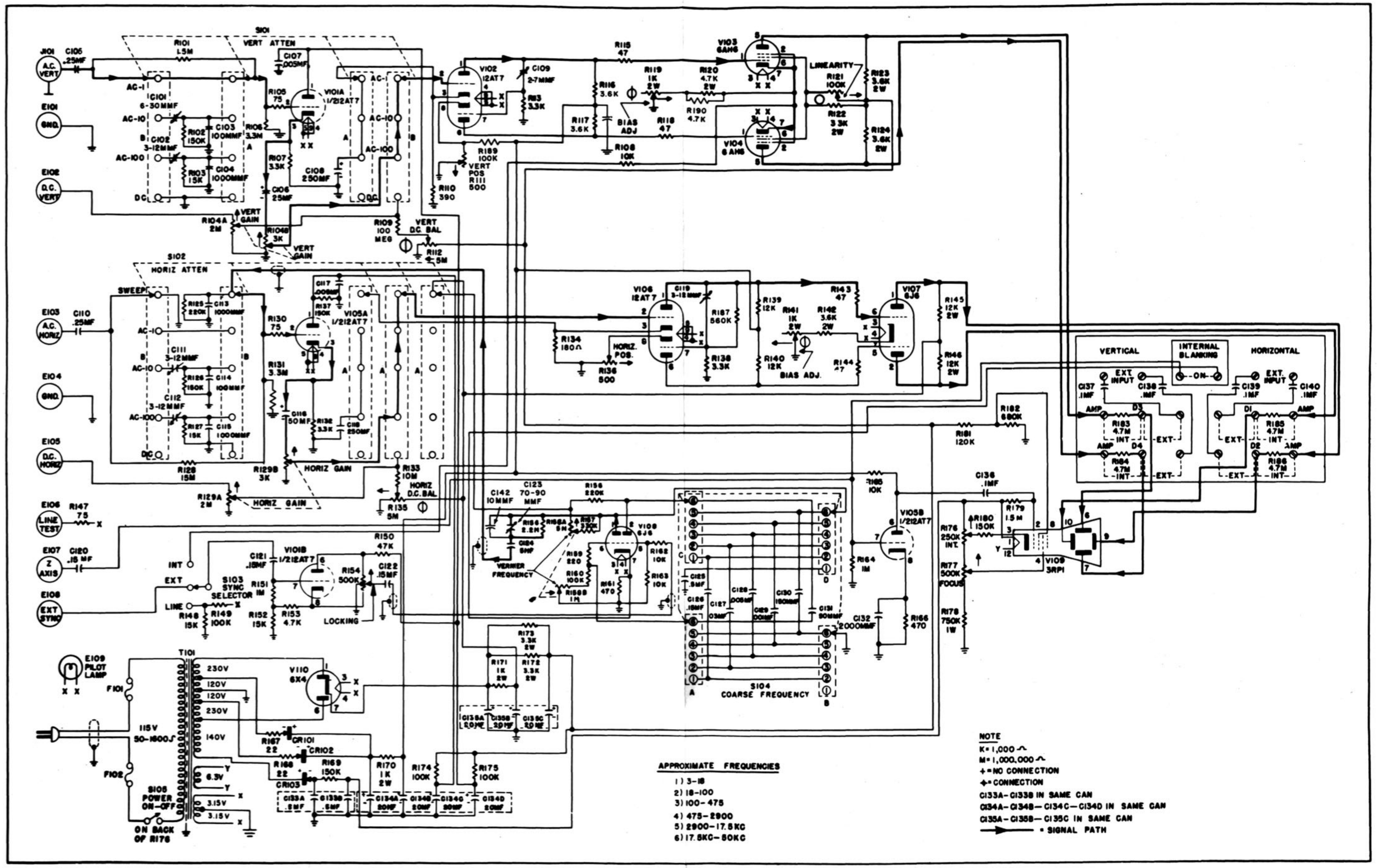


Figure 7-11. Oscilloscope OS-8C/U — Schematic Wiring Diagram

SECTION 8
PARTS LISTS

1. SUPPLEMENTARY TABLE.

Part numbers in the parts list section have been corrected and deletions have been made by means of Supplementary Tables 8-1A and 8-1B below. Always refer to Supplementary Tables 8-1A and 8-1B for the part number for a given item as it completely supersedes any corresponding part number in the basic Table of Replaceable Parts. If no part number is shown for a given item, refer to the basic table for the part number.

2. STOCK NUMBERS.

The stock numbers and support information that appear in this section have been revised. For Federal Stock Numbers and Source Maintenance and Recoverability Codes refer to the appropriate Stock Number Identification Table issued by the Electronics Supply Office. The SNIT, rather than this publication, shall govern if there is any conflict in stock numbers and support information.

TABLE 8-1. LIST OF MAJOR UNITS

SYMBOL GROUP	QUANTITY	NAME OF MAJOR UNIT	DESIGNATION
100	1	Oscilloscope	OS-8C/U

SUPPLEMENTARY TABLE 8-1A. CHANGE DATA FOR TABLE OF REPLACEABLE PARTS*

REF. DESIG.	NEW PART NUMBER†	REF. DESIG.	NEW PART NUMBER†	REF. DESIG.	NEW PART NUMBER†	REF. DESIG.	NEW PART NUMBER†
A-101	C644-13	O-101	A644-45	S-103	A644-24	TB-105	A644-33
A-102	E644-87	O-102	B644-74	S-104	A644-21	TB-106	A644-106
A-121	Delete	O-103	C644-86	T-101	C644-84	W-101	A644-54
A-124	Delete	O-104	A644-46	TB-101	A644-48	W-102	A644-54
E-110	Delete	O-105	Delete	TB-102	A644-47	W-103	A644-43
E-113 thru E-122	Delete	S-101	A644-22	TB-103	A644-49	W-104	A644-91
H-101	A644-44	S-102	A644-23	TB-104	A644-50		

*The data in this table apply only to Oscilloscopes OS-8C/U with serial numbers 8,633 through 10,210 and 14,163 through 14,249, manufactured by Polytronic Research, Inc. 7326 Westmore Road, Rockville, Md.

†In the "New Part Number" column, all part numbers are those of Polytronic Research, Inc. The word "Delete" indicates that the part is not used in the equipment covered by this Change.

SUPPLEMENTARY TABLE 8-1B. CHANGE DATA FOR TABLE OF REPLACEABLE PARTS*

REF. DESIG.	NAME OF PART AND DESCRIPTION
A-101	Size 13-3/4-in. lg., 6-15/16-in. wide, 9-in. high overall . . . Carol 32-2150.
A-102	CHASSIS, . . . secured by 6-32 x 3/8 pan-hd screws. Carol 32-3054.
A-103	Carol 32-640-1.
A105	Carol 32-640-2.
A121	Carol 32-546.
A-124	Carol 32-545.
C-101	6-30 uuf capacity; Centralab part no. 821-AN-2.
C-102	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; rotary type, 3-12 uuf capacity, Centralab part no. DA-821-013.
C-103	100 uuf ± 2%; MIL Spec C-20, type CC32CG101E.
C-104	CAPACITOR, FIXED, MICA DIELETRIC; 1000 uuf ± 10%; 300 V DCW, CM20B102K per MIL-C-5.
C-105	CAPACITOR, FIXED, PLASTIC DIELECTRIC, 1 section, 250,000 uuf, +20%; 400 V DCW; plastic case; 0.675 dia. x 1-1/2-in. lg., Pyramid type 107.
C-106	Sprague part no. M17998.
C-107	4700 uuf; CK62Y472Z per MIL-C-11015A.
C-111	Same as C102.
C-112	Same as C102.
C-116	50 uf; 6V DCW; Cornell-Dubilier part no. BBR-50-6.
C-119	Same as C102.
C-120	CP05A1EC154K per MIL-C-25A.
C-122	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 1 section, 0.453 dia. x 7/8-in. lg., 150,000 uuf ± 20%; 200 VDCW; Pyramid type 167.
C-124	CAPACITOR, FIXED, PLASTIC DIELECTRIC, 1 section; 500,000 uuf ± 10%; 200V DCW; 0.609. dia. x 1-3/8-in. lg., Pyramid type 107.
C-126	Same as C122.
C-127	CAPACITOR, FIXED, PLASTIC DIELECTRIC; 1 section; 30,000 uuf ± 20%; 200V DCW, low-loss plastic case; 1/4-in. dia. x 3/4-in. lg.; Pyramid type 107.
C-128	CAPACITOR, FIXED, MICA DIELECTRIC; 5100 uuf ± 10%; 300V DCW; CM35D513J per MIL-C-5.
C-130	150 uuf ± 2%; CC35CG151G per MIL-C-20B.
C-131	51 uuf ± 2%, CC25CH510G per MIL-C-20B.
C-132	Electra Mfg. Co., No. 12E202MA5.
C-136	100,000 uuf ± 20%.
C-137	CAPACITOR, FIXED, PLASTIC DIELECTRIC, 100,000 uuf ± 20%; 400V DCW; 0.421-dia. x 1-in. lg.; Pyramid type 107.
C-141	Same as C-137.
C-142	CAPACITOR, FIXED, MICA DIELECTRIC; 25 uuf ± 10%; 500V DCW; CM15B250K per MIL-C-54.
CR-101	3/4-in. lg. x 3/4-in. wide; International Rectifier No. 59-0718.
CR-103	International Rectifier No. 61-4325.
E-111	FHN20G per MIL-F-19207.
E-113 through	E-122—Deleted
E-123	TS102U02 per JAN-S-28A.
E-124	TS102U03 per JAN-S-28A.
F-101	2 amp.; MIL F20D2ROOB.
H-101	Carol no. 32-554.
I-101	LAMP, INCANDESCENT; 6-8 volts, 0.15 amps, MS-15571-2.
O-101	Carol no. 32-555.
O-102	Carol no. 32-1246.
O-103	Carol no. 32-2134.
O-104	Butyrate acetate scale; Carol no. 32-557.
O-105	Carol no. 32-577.
O-106	3/8-in. height of head.

* Data in this table apply to Oscilloscopes OS-8E/U manufactured by Carol Electronics Corp., 35 West Stephen Street, Martinsburg, W. Va., under Contracts NObsr 75143 and 75682.

SUPPLEMENTARY TABLE 8-1B. CHANGE DATA FOR TABLE OF REPLACEABLE PARTS*

REF. DESIG.	NAME OF PART AND DESCRIPTION
O-113	Kurz-Kasch part no. S-202-32, w/2 set screws.
O-117	Same as O-113.
O-118	Same as O-113.
O-119	Same as O-113.
O-120	Same as O-113.
O-125	Carol no. 32-622.
R-104	Carol no. 32-703.
R-109	100 megohms ± 10%; RC20GF107K per MIL-R-11B.
R-110	390 ohms ± 5%; RC20GF391J per MIL-R-11B.
R-111	Carol no. 32-710.
R-114	Deleted.
R-116	3,600 ohms ± 5%; RC20GF362J per MIL-R-11B.
R-119	Carol no. 32-714.
R-120	4700 ohms ± 10%; RC20GF472K per MIL-R-11B.
R-121	Carol no. 32-713.
R-133	RESISTOR, FIXED, COMPOSITION; 10 megohms ± 10%; 1/2 W; RC20GF106K per MIL-R-11B.
R-154	Carol no. 32-710.
R-166	Same as R-151.
R-176	Carol no. 32-712.
R-177	Carol no. 32-710-3.
R-181	RESISTOR, FIXED, COMPOSITION; 120,000 ohms, ± 10%; 1/2 W; RC20GF124K per MIL-R-11B.
R-187	560,000 ohms ± 10%; RC20GF564K per MIL-R-11B.
R-189	Same as R-149.
R-190	Same as R-120.
S-101	Carol no. 32-501.
S-102	Carol no. 32-502.
S-103	Carol no. 32-503.
S-104	Carol no. 32-500.
	TRANSFORMER, POWER, STEP DOWN AND STEP UP: Hermetically sealed, fully enclosed metal case; primary winding (term. 1 to 2) 115 v, 50 to 1000 cycles, single phase; secondary winding no. 1 (term. 3 to 4) 220 v, 60 ma; no. 2 (term. 4, 12, 5) 220 v, 76 ma centertapped; no. 3 (term. 5 to 6) 220 v, 60 ma; no. 4 (term. 6 to 7) 140 v, 0.5 ma; no. 5 (term. 10 to 11) 6.3 v, 3.75 amp. centertapped; No. 6 (term. 8 to 9) 6.3 v, 0.6 amp; 2000 volt insulation, asphalt-filled; dimensions excluding terminals and mfg. brackets 3 in. lg. x 2-15/32 in. wide x 2-27/32 in. high; 2-3/8 in. shortest mfg. dim.; 3-1/4 in. longest mfg. dim.; 12 insulated solder lug terminals; four no. 6.32 mfg. bushings on 3-1/4 in. by 2-3/8 in. mtg. centers; TFIRYO3YY dwg. no. 32-2115B Carol Electronics Part no. CA1104-1.
TB-101	Carol no. 32-579.
TB-102	Carol no. 32-578.
TB-103	Carol no. 32-580.
TB-104	Carol no. 32-581.
TB-105	Carol no. 32-531.
TB-106	Carol no. 32-701.
V-101	Type 12AT7WA.
V-103	Type 6AH6.
V-107	Type 6J6WA.
V-109	Type 3RP1.
V-110	Type 6X4W.
W-101	Carol no. 32-622-601.
W-102	Carol no. 32-622-602.
W-103	Carol no. 32-553.
W-104	Carol no. 32-632.
X-101	TS103PO2 per JAN-S-28A.
X-103	TS103PO3 per JAN-S-28A.
X-108	TS103PO1 per JAN-S-28A.
X-109	Carol no. 32-474.

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
	OSCILLOSCOPE; 3 in. screen; sweep circuit incl., 3 to 50,000 cycle per sec. freq. range; .075 RMS V/in. horizontal, .075 RMS V/in. vertical rated deflection sensitivity through amplifier; 25 RMS V/in. horizontal, 17 RMS V/in. vertical deflection sensitivity or direct connection to plates; 0 cycles per sec. to 2 mc per sec. on X-axis, 5 cycles per sec. to 2 mc per sec. on Y-axis rated freq. response; 1.5 meg on X-axis, 1.5 meg on Y-axis, input impedance rating; single phase, 115 V AC 50-1000 CPS operating power requirements;13-1/2 in. lg., 6 in. wide, 9 in. high, over-all; portable type; accessories, 1 Test Lead (3'0"), 1 Test Lead (6"), 1 Ground Lead (3'0"), 1 Oscilloscope Case, 1 Cathode Fay Tube Scale, 1 Instruction Book; MIL Spec O-15525D, type OS-8C/U.	3F3665-8 F16-Q-192563-200 (with spares) F-16-Q192563-100 (without spares)	
A-101	CASE, OSCILLOSCOPE; aluminum; gray enamel finish; 13-1/2 in. lg., 6 in. wide, 9 in. high over-all; 1 handle located on top; four latch fasteners to secure cover to bottom; water seal between cover and bottom. Consists of A-101A, A-101B, A-101C, A-101D. Jetronic part no. A-525.	6F209-9 Low failure item — if required req. from ESO ref. NavShips 900,180A	Protective carrying case.
A-101A	COVER, OSCILLOSCOPE; part of A-101.	3F30850-15	
A-101B	BASE, OSCILLOSCOPE; part of A-101.	3F1774B-7	
A-101C	LATCH, FASTENER; part of A-101A.		
A-101D	CATCH, FASTENER; part of A-101B.		
A-102	CABINET, ELECTRICAL EQUIPMENT; aluminum; gray enamel finish; 11-15/16 in. lg., 5-1/4 in. wide, 7-3/8 in. high over-all; upper section of front slopes 20° for cathode ray tube; single compartment; mtg. holes for components of equipment; removable side panels secured by 6-32 x 3/8 BHMS. Jetronic part no. E-3054.	6F207-114 Low failure item — if required req. from ESO ref. NavShips 900-180A	Structural housing and chassis.

A-103	BUMPER, RUBBER; molded in steel plate; attaches to equipment by four .141 in. dia. mtg. holes spaced 1 in. c to c, attaches supporting base by one 8-32 screw; for 4.5 lb. load. Lord part no. J-5695-1.	2Z6820.519 N17-M-74978-7591	Rear shock cushion between case and structural housing.
A-104	BUMPER, RUBBER; Same as A-103.		
A-105	BUMPER, RUBBER; molded in steel plate; attaches to equipment by four .141 in. dia. mtg. holes spaced 1 in. c to c, attaches to supporting base by one 8-32 screw; for 2 lb. load. Lord part no. J-5695-2.	2Z6820.518 N17-M-74937-9501	Front shock cushion between case and structural housing.
A-106	BUMPER, RUBBER; Same as A-105.		
A-121	HOLDER, CAPACITOR; 1/4 in. wide x 1 in lg. over-all; attaches to distribution board bracket by one .1495 in. dia. mtg. hole; .025 in. thk. phosphor bronze, nickel plated. Jetronic part no. A-546.	2Z2646.221 N17-C-789978-708	Secures capacitor C-136.
A-124	SPRING, TERMINAL COVER; 7/32 in. wide x 1 in. lg. over-all; attaches to rear of cabinet housing A-102 by single .1495 in. dia. mtg. hole; .025 tempered spring steel, nickel plated. Jetronic part no. A-545.	2Z2646.220	Rear terminal board cover spring.
C-101	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; rotary type, single section 3-12 mmf capacity; 500V DCW; 11/32 in. dia., 9/32 in. thick; two solder lug terminals on bottom; mtd. by means of solder lugs; screw driver adjustment; ceramic base; zero temp. coefficient, power factor less than 0.2% at 1 megacycle; Centralab part no. DA-821-013.	3D9012V-28 For replacement use SNSN N16-C-63934-8109	Adjustable freq. compensating cap. for AC-10 position of VERT. ATTEN.
C-102	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; Same as C-101.		Adjustable freq. compensating cap. for AC-100 position of VERT. ATTEN.
C-103	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 100 mmf ±10%; 500V DCW; zero temp. coef; insulated; approx. .885 in. lg. x .255 in. dia.; two radial wire leads. Centralab part no. DA-315-108B. JAN spec C-20A, type CC32CH-101K.	3D9100-241 For replacement use SNSN N16-C-17073-3195	Fixed freq. compensating cap. for AC-10 position of VERT. ATTEN.
C-104	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 1000 mmf, ± 20%; 600V DCW; zero temp. coef; insulated, lacquer coating; .25 in. dia. x .50 in. lg.; two wire leads; Centralab part no. DA-517-036B.	3DA1-251 For replacement use SNSN N-16-C-18659-7736	Fixed freq. compensating cap. for AC-100 position of VERT. ATTEN.
C-105	CAPACITOR, FIXED, PAPER DIELECTRIC; 1 section; 250,000 mmf, —10% + 20%; 600V DCW; paper case; 5/8 in. dia. x 1-5/32 in. lg.; 2 wire leads; mineral wax impregnated; Aerovox type P92ZN.	3DA250-621 N16-C-46371-9834	Blocking cap. for vertical AC input.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS.	SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
C-106	CAPACITOR, FIXED, ELECTROLYTIC; 25 mfd — 10% + 75%; 25V DCW; insulated, vinyl sleeve; 3/8 in. dia. x 1-1/8 in. lg.; 2 wire leads; Sprague part no. D17997.	3DB25-136 N16-C-19781-4701 055725092		Blocking cap. cathode V-101A.
C-107	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 5000 mmf GMV; 500V DCW; insulated, phenolic jacket; 3/8 in. dia. x 5/32 in. thick; 2 wire leads; Centralab part no. DA-048-001B.	3DA5-229 N16-C-19011-7701		By-pass cap. plate V-101A.
C-108	CAPACITOR, FIXED, ELECTROLYTIC; 1 section; 250 mfds; 6V DCW tubular metal case, hermetically sealed; 5/8 in. dia. x 1-7/16 in. lg.; 2 wire leads located on ends; Cornell-Dubilier type BRV-6025-1.	3DB250-8 N16-C-20503-1450		Cathode by-pass capacitor for first vert. DC amp V-102.
C-109	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; rotary type, 1 section, zero temp. coef; 2.5 mmf min, 7 mmf max capacity; 600V DCW; 17/32 in. dia. x 9/32 in. thick; 2 solder lug terminals located on bottom; mtd. through solder lugs; screwdriver slot adjustment; ceramic base; Centralab type no. DA-821-019.	3D9007V-25 N16-C-63918-8658		Adjustable freq. compensating cap. for first vert. DC amp V-102.
C-110	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-105.			Blocking cap. for horizontal AC input.
C-111	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; Same as C-101.			Adjustable freq. compensating cap. for AC-10 position HOR. ATTEN.
C-112	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; Same as C-101.			Adjustable freq. compensating cap, for AC-100 position HOR. ATTEN.
C-113	CAPACITOR, FIXED, CERAMIC DIELECTRIC; Same as C-104.			Fixed freq. compensating cap. for sweep cidcuit osc. V-108 decoupling network.
C-114	CAPACITOR, FIXED, CERAMIC DIELECTRIC; Same as C-103.			Fixed freq. compensating cap. for AC-10 position HOR. ATTEN.
C-115	CAPACITOR, FIXED, CERAMIC DIELECTRIC; Same as C-104.			Fixed freq. compensating cap, for AC-100 position HOR. ATTEN.
C-116	CAPACITOR, FIXED, ELECTROLYTIC; 1 section; 250 mfds; 25V DCW; tubular metal case, hermetically sealed; dimensions 7/8 in. dia. x 1-11/16 in. lg.; 2 wire leads located on ends; metal mtg. strap, one 5/32 in. dia. hole in mtg. strap end; Cornell-Dubilier part no. BRV-2525-2.	3DB250 N16-C-20506-5841		Blocking cap. cathode V-105A horizontal cathode follower.

C-117	CAPACITOR, FIXED, CERAMIC DIELECTRIC; Same as C-107.		High freq. by-pass cap. plate V-105A horizontal cathode follower.
C-118	CAPACITOR, FIXED, ELECTROLYTIC; Same as C-108.		Cathode by-pass cap. for V-106 first horizontal DC amp.
C-119	CAPACITOR, FIXED, CERAMIC DIELECTRIC; Same as C-101.		Adjustable freq. compensating cap. for V-106 first horizontal DC amp.
C-120	CAPACITOR, FIXED, PAPER DIELECTRIC; 1 section; 150,000 mmf ±10%; 200V DCW; paper case; dimensions 9/32 in. dia. x 7/32 in. lg.; 2 wire leads located on ends; mineral wax impregnated; wax filled; no internal ground connection; Aerovox type P92ZN.	3DA150-28 N16-C-45959-9598	Blocking cap. for Z axis input.
C-121	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-120.		Blocking cap. for sync. amp V-101B input.
C-122	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-120.		Blocking cap. from locking control R-154 to sync. grid of sweep circuit osc. V-108.
C-123	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC; rotary type; 1 section; 70 mmf min, 90 mmf max. capacity; 500V DCW; 5/8 in. lg., 7/8 in. wide, 1/4 in. thick over-all; 2 solder lugs located on back; two .120 in. dia. mtg. holes spaced 3/8 in. c to c; screwdriver slot adjustment; ceramic base; Centralab part no. DA-820-701.	3D9125V For replacement use SNSN N16-C-64214-8975	Adjustable freq. compensating cap. for sweep circuit osc. V-108 decoupling network.
C-124	CAPACITOR, FIXED, PAPER DIELECTRIC; 1 section; 500,000 mmf ±10%; 200V DCW; tubular paper case; 11/32 in. dia. x 1-5/32 in. lg.; 2 wire leads located on ends; mineral wax impregnated; wax filled; no internal ground connections; Aerovox type P92-ZN.	3DA500-707 N16-C-47290-1507	Blocking capacitor from sweep circuit osc. V-108 to horizontal cathode follower V-105A.
C-125	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-124.		Sweep circuit osc. V-108 plate discharge on 3-18 range.
C-126	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-120.		Sweep circuit osc. V-108 plate discharge cap. on 18-100 range and grid coupling cap. on 3-18 range.
C-127	CAPACITOR, FIXED, PAPER DIELECTRIC; 1 section; 30,000 mmf ±20%; 200V DCW; tubular paper case; 1/4 in. dia. x 11/16 in. lg.; 2 wire leads located on ends; mineral wax impregnated; wax filled; no internal gnd. connections; Aerovox type P92ZN.	3DA30-101 N16-C-43523-2851	Sweep circuit osc. V-108 plate discharge cap. on 100-475 range and grid coupling cap. on 18-100 range.
C-128	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 5000 mmf ±20%; 500V DCW; insulated; phenolic coating; .255 in. dia. x .885 in. lg.; 2 wire leads; Centralab part no. DA-560-008B.	3DA5-248 N16-C-19011-7769	Sweep circuit osc. V-108 plate discharge cap. on 475-2900 range and grid coupling cap. on 100-475 range.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
C-129	CAPACITOR, FIXED, CERAMIC DIELECTRIC; Same as C-104.		Sweep circuit osc. V-108 plate discharge cap. on 2900-17.5 KC range and grid coupling cap. on 475-2900 range.
C-130	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 150 mmf, ±10%; 500V DCW; zero temp. coef; insulated; phenolic coating; .310 in. dia. x 1.180 in. lg.; 2 wire leads; Centralab part no. DA-360-022.	3D9150-104 N16-C-17402-6097 ———	Sweep circuit osc. V-108 plate discharge cap. on 17.5-50KC range and grid coupling capacitor on 2900-17.5KC range.
C-131	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 50 mmf ±10%; 500V DCW; zero temp. coefficient; insulated; phenolic coating; .230 in. dia. x .750 in. lg.; 2 wire leads; Centralab part no. DA-340-014.	3D9050-184 For replacement use SNSN N16-C-16570-4284 ———	Sweep circuit osc. V-108 grid coupling cap. on 17.5-50KC range.
C-132	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 2000 mmf ±20%; 500V DCW; insulated, phenolic coating; .230 in. dia. x .750 in. lg.; 2 wire leads; Centralab part no. DA-516-055B.	3DA2-204 N16-C-18883-8854 ———	Z axis amp V-105B cathode by-pass for high frequency compensation.
C-133	CAPACITOR, FIXED, PAPER DIELECTRIC; 2 sections; 500,000 mmf +20% —10% each section; 1000V DCW; metal case, hermetically sealed; dimensions 2 in. wide, 2 in. deep, 1-18 in. high, 2-3/8 mtg. centers; 3 solder stud terminals 3/8 in. high located on side, spaced 17/32 in. c to c on ceramic insulated base; mineral oil impregnated and filled; no internal ground connection; Cornell-Dubilier JAN type CP53B4EG504V. JAN spec C-25.	3DA500-584 N16-C-53697-7565 ———	Two section filter for high voltage rectifier CR-103.
C-133A	CAPACITOR, FIXED, PAPER DIELECTRIC; Part of C-133.		
C-133B	CAPACITOR, FIXED, PAPER DIELECTRIC; Part of C-133.		
C-134	CAPACITOR, FIXED, ELECTROLYTIC; 4 sections; 20 mfd per section; 150V DCW each section; tubular metal case; dimensions 1-3/8 in. dia., 2-1/16 in. lg.; 4 solder lug terminals, 5/8 in. high located on bottom, 90 deg. spacing on 11/32 in. radius; negative terminal connected to case internally; twist lug mtg.; sprayed with moisture and fungus proofing lacquer; Aerovox part no. AHF 150/20-20-20-20.	3DB20-160 For replacement use SNSN N16-C-23048-2274 ———	

C-134A	CAPACITOR. FIXED, ELECTROLYTIC; Part of C-134.		Filter cap. for low voltage power supply.
C-134B	CAPACITOR. FIXED, ELECTROLYTIC; Part of C-134.		Filter cap. for low voltage power supply.
C-134C	CAPACITOR. FIXED, ELECTROLYTIC; Part of C-134.		Decoupling cap. for horizontal cathode follower V-105A.
C-134D	CAPACITOR, FIXED, ELECTROLYTIC; Part of C-134.		Decoupling cap. for horizontal cathode follower V-101A.
C-135	CAPACITOR, FIXED, ELECTROLYTIC; 3 sections; 20 mfd per section; 450V DCW; tubular metal case; dimensions 1-3/8 in. dia., 2-7/16 in. lg.; 3 solder lug terminals, 5/8 in. high, located on bottom, 90 degree spacing on 11/32 in. radius; twist lug mounting; sprayed with moisture and fungus proofing lacquer; Aerovox part no. AHF 450/20-20-20.	3DB20-161 N16-C-22643-2777	3 section filter cap. for intermediate power supply.
C-135A	CAPACITOR. FIXED, ELECTROLYTIC; Part of C-135.		
C-135B	CAPACITOR. FIXED, ELECTROLYTIC; Part of C-135.		
C-135C	CAPACITOR. FIXED, ELECTROLYTIC; Part of C-135.		
C-136	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 100,000 mmf GMV ;600V DCW; insulated; phenolic dip; 1-9/32 in. lg., 1/8 in. thick, 27/32 in. wide; 2 wire lead terminals, Centralab part no. DA-938-001H.	3DA100-1110 N16-C-19143-7811	Blocking cap. for cathode ray tube grid pin 2 of V-109.
C-137	CAPACITOR, FIXED, PAPER DIELECTRIC; 100,000 mmf ±20%; 400V DCW; paper case, durez sealed ends; 3/8 in. dia., 1-5/32 in. lg.; 2 wire lead terminals located on ends; wax impregnated; plastic filled; Aerovox part no. P92ZN.	3DA100-1142 N16-C-45805-4437	Decoupling cap. for external connection to deflection plate D-3 pin 6 of cathode ray tube V-109.
C-138	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-137.		Decoupling cap. for external connection to deflection plate D-4 pin 7 of cathode ray tube V-109.
C-139	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-137.		Decoupling cap. for external connection to deflection plate D-2 pin 9 of cathode ray tube V-109.
C-140	CAPACITOR, FIXED, PAPER DIELECTRIC; Same as C-137.		Decoupling cap. for external connection to deflection plate D-1 pin 10 of cathode ray tube V-109.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
CR-101	RECTIFIER, METALLIC; selenium; single phase, halfwave circuit; single phase 130V AC RMS max. input; halfwave 125V DC 20ma max. output; 1/2 in. lg., 1/2 in. wide, 9/16 in. high over-all; center mtg. hole for 6-32 screw; 2 solder lug terminals; Radio Receptor type type "Selectron 8Y1".	3H4860-229 N17-R-51401-8431 688000-1265	Low voltage rectifier.
CR-102	RECTIFIER, METALLIC; Same as CR-101.		Low voltage rectifier.
CR-103	RECTIFIER, METALLIC; selenium; single phase, half-wave; single phase 1650V AC input; 800V DC 1.5 ma max. output; 2-1/4 in. lg., .250 dia. over-all; 2 wire lead terminals; Conant part no SEIH45-TUA.	3H4860-230 N17-R-51557-1075 688000-1215	High voltage rectifier.
E-101	POST, BINDING; phenolic, natural finish; 7/8 in. over-all height of post above mtg. surface (fully extended), 1/2 in. OD of post; 5/16 in. lg., 6-32 mtg. stud; 3/32 in. max. dia. of wire hole; Eby type "Ensign" no. 7695 w/5/16 in. stud.	3Z737-25.3 N17-P-69142-3661	Vertical amp GND connection.
E-102	POST, BINDING; Same as E-101.		Vertical amp DC input connection.
E-103	POST, BINDING; Same as E-101.		Horizontal amp AC input connection.
E-104	POST, BINDING; Same as E-101.		Horizontal amp GND connection.
E-105	POST, BINDING; Same as E-101.		Horizontal amp DC input connection.
E-106	POST, BINDING; Same as E-101.		Line test output connection.
E-107	POST, BINDING; Same as E-101.		Z AXIS input connection.
E-108	POST, BINDING; Same as E-101.		EXT sync. connection.
E-109	LAMP, INCANDESCENT; 6 to 8 volts, .15 amp; miniature bayonet base; T-3-1/4 clear bulb, white, 1 tungsten C-2 filament; 1-1/8 in. max. over-all height; 25 hr. rated life; any burning position; GE type 47F.	2Z5952 G17-L-6297	Pilot lamp.
E-110	TERMINAL, STUD; 3500V AC RMS; solder connection; brass, cadmium plated; 29/64 in. lg., 5/32 in. hex. base, over-all; mts by threaded shank 2-56 thd, 7/32 in. lg.; Garde Type M3550-1.	3Z12101-43.2 Low failure item — if required req. from ESO ref. NavShips 900,180A	Insulated terminal for components junction

E-111	FUSE HOLDER; extractor post type; 250V, 15 amp; accommodates 1 cartridge type fuse, 1-1/4 in. lg., 1/4 in. dia.; molded black phenolic body; clip type beryllium copper contact, natural finish; over-all dim. 1-41/64 in. lg., 11/16 in. dia.; 2 solder lug terminals; mounts in single 1/2 in. dia. hole; Littlefuse Type A-342003.	3Z3282-11.19 N17-F-74266-9053	Holds fuse F-101.
E-112	FUSE HOLDER; Same as E-111.		Holds fuse F-102.
E-113	TERMINAL STUD; 5000V max electrical rating; solder connection; brass, cadmium plate finish; 13/16 in. lg., 5/16 in. hex. base, over-all dim.; mts by threaded shank 6-32, 1/4 in. lg.; Precision Metal Type 5000.	3Z12101-65 N17-T-28214-4116	Insulated terminal for mtg. CR-103.
E-114	TERMINAL, STUD; Same as E-113.		Insulated terminal for mtg. CR-103.
E-115 through E-122	TERMINAL, STUD; Same as E-110.		Insulated terminal for components junction.
E-123	SHIELD, ELECTRON TUBE; accommodates RMA envelope type T-5-1/2, straight cylinder shape with flared end, open top; brass; 1-3/4 in. lg., 3/4 in. dia.; mts. on shock shield base; 2 spring shields; Eby part no. 9701-20.	2Z8304-270 N16-S-34557-8351 774000-1955	Shield for V-108.
E-124	SHIELD, ELECTRON TUBE; accommodates RMA envelope type T-5-1/2, straight cylinder shape with flared end, open top; brass; 2-1/4 in. lg., 3/4 in. dia.; mts. on shock shield base; 2 spring shields; Eby part no. 9702-11.	2Z8340.277 N16-S-34607-6039 774000-1975	Shield for V-110.
F-101	FUSE, CARTRIDGE; 3/4 amp, 250 volts: time decay, blowing time 1 hr. at 135% rated load, 60 seconds max. for 200% load; ferrule type terminals, 1/4 in. dia. x 1/4 in. lg.; glass body, enclosed type; one time; over-all dim. 1-1/4 in. lg. x 1/4 in. dia.; Littlefuse part no. 313.750.	3Z2600A7.3 N17-F-14310-370	Overload protection.
F-102	FUSE, CARTRIDGE; Same as F-101.		Overload protection.
F-103	FUSE, CARTRIDGE; Same as F-101.		Spare fuse.
F-104	FUSE, CARTRIDGE; Same as F-101.		Spare fuse.
H-101	RETAINER, ELECTRON TUBE; no. 15 gauge stainless steel music wire; over-all dim. 1-27/32 in. lg., approx. 2-1/8 in. wide, approx. 1-3/16 in. high; retained item dim. 2-1/8 in. lg. x 13/16 in. dia. over-all; mtd. by .136 in. dia. hole formed by end of retainer; Jetronic part no. A-554.	2Z7780-242 N16-R-503580-280	Retainer for V-101.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
H-102	RETAINER, ELECTRON TUBE; Same as H-101.		Retainer for V-102.
H-103	RETAINER, ELECTRON TUBE; Same as H-101.		Retainer for V-103.
H-104	RETAINER, ELECTRON TUBE; Same as H-101.		Retainer for V-104.
H-105	RETAINER, ELECTRON TUBE; Same as H-101.		Retainer for V-105.
H-106	RETAINER, ELECTRON TUBE; Same as H-101.		Retainer for V-106.
H-107	RETAINER, ELECTRON TUBE; Same as H-101.		Retainer for V-107.
I-101	LIGHT, INDICATOR; supplied w/lens 1/2 in. dia., red, smooth face, frosted back; friction mtd. lens holder; 1 T-3-1/4 lamp, miniature bayonet base; brass frame, nickel plated; over-all dim. 2-5/32 in. lg., 15/16 in. dia.; mtd. through 11/16 in. dia. panel hole, 1/4 in. max. panel thickness; lamp replaceable from front; 2 solder lug terminals located on lampholder, both insulated from frame; Drake type no. 80-MIL Ruby.	2ZK5991-7 N17-L-76854-4041 ———	Indicates power on.
I-101A	SOCKET; Part of I-101.		
I-101B	LENS; Part of I-101.		
J-101	CONNECTOR, RECEPTACLE; 1 rd female contact; not polarized or grounded; straight type; .712 in. lg., 11/16 in. wide, 11/16 in. high over-all, excluding protruding contacts and terminals; cylindrical body, brass, silver plated, locking type; molded polystyrene insert; Waltham part no. UG-290A/U.	2Z7390-290 N17-C-73108-1253 ———	Vert. amp AC input connection.
O-101	CLAMP, ELECTRICAL; steel, cadmium plated; 1 bolt type fastening device; 2-1/2 in. lg., 5/8 in. wide, 2 in. high over-all; mounted by 2 .1495 in. dia. holes in ends of band; designed to hold material 1-7/8 in. max. dia. and 1-9/16 in. min. dia.; Jetronic part no. A-555.	2Z2642.882 N17-C-789978-709 ———	Tension clamp for cathode ray tube V-109

O-102	VISOR, CATHODE RAY TUBE; aluminum; light gray enamel finish; 3-1/4 in. dia. attachment end inside dim., 3-1/4 in. dia. viewing end inside dim.; 3-3/8 in. lg. over-all; slip fit into 2.75 in. lg. by 3.312 in. dia. shield; Jetronic part no. B-1246.	2ZA951-60	Improve visibility for cathode ray tube V-109.
O-103	SHIELD, ELECTRON TUBE; aluminum with MU metal insert sleeve; gray enamel finish; 4-1/8 in. dia. x 8.035 in. lg. approx. over-all; four .1562 in. mtg. holes in flange located on 1.937 in. radius 90° apart; Jetronic part no. C-2134.	N16-S-34961-1477	Shielded housing for cathode ray tube V-109.
O-103A	SHIELD, ELECTRON TUBE; aluminum housing. Part of O-103.	2Z8304.496	Machined mtg. for O-103B, O-102 and cathode ray tube V-109.
O-103B	SHIELD, ELECTRON TUBE; MU metal insert sleeve. Part of O-103.	2Z8304.497	Isolates cathode ray tube V-109 from stray magnetic fields.
O-104	SCALE, CATHODE RAY TUBE; 29 horizontal and 29 vertical scale graduations; graduated in units of 0.1 in., range approx. 0 to 2-7/8 in.; black scaling, clear background; mts. by three integral radial mtg. tabs spaced 120 degrees apart; cellulose acetate scale; 3/4 in. lg., 2-7/8 in. dia. over-all; Jetronic part no. A-557.	2Z8076-122 Low failure item — if required req. from ESO ref. NavShips 900,180A	Aid in evaluation of deflection and waveforms.
O-105	WASHER, FLAT; rd, fibre; rd hole, .1495 in. dia.; outside dimensions .437 in. dia., .062 in. thk; Jetronic Part no. A-577.	6L50522-66 N33-G-9998-1475	Insulating washer for binding posts.
O-106	BUMPER, RUBBER; synthetic; black; 9/32 in. over-all height; 5/32 in. height of head; 1/8 in. lgth. of shank, 3/16 in. dia. of shank; 5/16 in. dia. of head; Canfield part no. 4104.	6Z1650-50 N33-B-1225-30	Mounted in holes of CR tube clamp O-101; Keep CR tube from turning.
O-107	BUMPER, RUBBER; Same as O-106.		
O-108	BUMPER, RUBBER; Same as O-106.		
O-109	BUMPER, RUBBER; synthetic; black; 13/32 in. over-all height; 11/64 in. height of head; 3/16 in. length of shank, 3/16 in. dia. of shank small end), 5/16 in. dia. of shank (large end); 1/4 in. dia. of groove; 1/2 in. dia. of head; 3/64 in. width of groove; Canfield part no. 4762.	6Z1650-51 N33-B-1225-45	Protection for side panel when mtg. cover.
O-110	BUMPER, RUBBER; Same as O-109.		
O-111	BUMPER, RUBBER; Same as O-109.		
O-112	BUMPER, RUBBER; Same as O-109.		

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
O-113	KNOB; black phenolic, w/single pointer; plain gripping surface; 1-1/4 in. lg., 3/4 in. wide, 5/8 in. thk over-all; white depressed radial line marking; Kurz-Kasch part no. S-292-3L, W/1 set screw.	2Z5822-13.1 N16-K-700065-545 292221362	VERT. ATTEN. switch knob.
O-114	KNOB; Same as O-113.		COARSE FREQUENCY switch knob.
O-115	KNOB; Same as O-113.		SYNC. SELECTOR switch knob.
O-116	KNOB; Same as O-113.		HOR. ATTEN. switch knob.
O-117	KNOB; black phenolic w/single pointer; plain gripping surface; 1-1/4 in. lg., 3/4 in. wide, 5/8 in. thk. over-all; 2 set screw holes 8-32; white depressed radial line marking; Kurz-Kasch part no. S-292-3L, W/2 set screws.	2Z5822-13.1 For replacement use SNSN N16-K-700065-545 ———	VERT. GAIN control knob.
O-118	KNOB; Same as O-117.		HOR. GAIN control knob.
O-119	KNOB; Same as O-117.		VERNIER FREQUENCY control knob.
O-120	KNOB; Same as O-117.		LOCKING control knob.
O-121	KNOB; black phenolic; positive gripping surface; 9/16 in. lg. over-all; 41/64 in. max. outside dia.; accommodates unthreaded shaft, 1/4 in. dia.; w/brass insert; two 8-32 set screws; Kurz-Kasch part no. S-230-64, W/2 set screws.	2Z5842-12 N16-K-700277-371 292241494	VERT. POS. control knob.
O-122	KNOB; Same as O-121.		FOCUS control knob.
O-123	KNOB; Same as O-121.		INT. control knob.
O-124	KNOB; Same as O-121.		HOR. POS. control knob.
O-125	CLIP, ELECTRICAL; alligator type; steel; cad. plated; 2-11/32 in. lg., 3/8 in. wide, 5/16 in. high over-all; red phenolic insulation; 5/16 in. max. jaw opening; Mueller part no. 60-HS-Red (MOD) per Jetronic dwg. A-622.	3Z1087-8 N17-C-802585-161 ———	Part of test lead W-101.
O-126	CLIP, ELECTRICAL; Same as O-125.		Part of test lead W-102.

O-127	CLIP, ELECTRICAL; alligator type; steel; cad. plated; 2-11/32 in. lg., 3/8 in. wide, 5/16 in. wide, 5/16 in. high; black phenolic insulation; 5/16 in .max. jaw opening; Mueller part no. 60-HS-Black.	3Z1087-8.1 N17-C-802584-284	Part of test lead W-104.
O-128	TERMINAL, LUG; rd. tongue end; brass; tinned finish; 21/32 in. lg., 3/8 in. wide, .020 in. thk; no. 10 stud; Zierick part no. 221-no, 10.	3Z12073-44.40 For replacement use SNSN G17-T-5114	Part of test lead W-104.
P-101	CONNECTOR, PLUG; 1 round male contact; straight type; 31/32 in. lg., 9/16 in. dia.; cylindrical body, brass silver-plated, locking type; 1/4 in. dia. max. cable opening; Waltham type UG-260 B/U.	2Z7390-260B N17-C-71408-9285	Part of test lead W-101.
P-102	CONNECTOR, PLUG; Same as P-101.		Part of test lead W-102.
R-101	RESISTOR, FIXED, COMPOSITION; 1.5 megohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia.; 1-1/2 in. lead length; insulated, resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1555.	3RC20BF155J N16-R-51019-431	Part of voltage divider network for input of vertical cathode follower V-101A.
R-102	RESISTOR, FIXED, COMPOSITION; 150,000 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated, resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1545.	3RC20BF154J N16-R-50677-431	Part of voltage divider network for input of vertical cathode follower V-101A.
R-103	RESISTOR, FIXED, COMPOSITION; 15,000 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated, resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1535.	3RC20BF153J N16-R-50335-431	Part of voltage divider network for input of vertical cathode follower V-101A.
R-104	RESISTOR, VARIABLE; composition; 2 sections; 1st section 2 megohms ±20% second section 3000 ohms ±20%; both sections 1/2W; 3 solder lug terminals each section; metal inclosed case, 15/16 in. dia. x 1 in. deep; single rd. metal shaft 1/4 in. dia., 5/8 in. lg. from mtg. surface; normal torque; insulated contact arm; no "off" position; mtg. bushing 3/8 in. dia., 32 thds/in., 1/4 in. lg.; Mallory Dual type per Jet dwg. B-1184.	3Z7499-2.56 N16-R-89250-7579	Vertical gain control.
R-104A	RESISTOR, VARIABLE. Part of R-104.	Listed for reference only.	Vertical gain control for DC signals.
R-104B	RESISTOR, VARIABLE. Part of R-104.	Listed for reference only.	Vertical gain control for AC signals.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS.	SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
R-105	RESISTOR, FIXED, COMPOSITION; 75 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1°2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-7505.	3RC20BF750J N16-R-49516-431		Parasitic suppression pin 2 V-101A.
R-106	RESISTOR, FIXED, COMPOSITION; 3.3 megohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-3351.	3RC20BF335K N16-R-51109-431		Grid return pin 2 V-101A.
R-107	RESISTOR, FIXED, COMPOSITION; 3300 ohms ±10%; 1/2 W rated at 70 deg. C ambient salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-3321.	3RC20BF332K N16-R-50066-811		Cathode load resistor pin 3 of V-101A.
R-108	RESISTOR, FIXED, COMPOSITION; 10,000 ohms ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1031.	3RC20BF103K N16-R-50281-431		Isolation resistor for internal sync signal.
R-109	RESISTOR, FIXED, COMPOSITION; 10 megohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1061.	3RC20BF106K N16-R-51326-811		Isolation and voltage dropping resistor for cancellation of contact potential at R-104A.
R-110	RESISTOR, FIXED, COMPOSITION; 100 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1015.	3RC20BF101J N16-R-49579-431		Cathode bias resistor pin 3 of V-102.
R-111	RESISTOR, VARIABLE; composition; 1 section, 500 ohms ±20%; 1/2W; 3 solder lug terminals, metal inclosed case 15/16 in. dia., 15/32 in. deep; single rd. metal shaft 1/4 in. dia., 5/8 in. lg. from mtg. surface; normal torgue; insulated; no "off" position; mtg. bushing 3/8-32, 1/4 in. lg.; Allen-Bradley JAN type RV3ATRD501B. JAN spec R-94.	3RV25028 N16-R-87191-9330		Adjustable cathode bias resistor pin 8 of V-102. Vertical centering control.

R-112	RESISTOR, VARIABLE; composition; 1 section, 5 megohms ±20%; 1/10W; 3 solder lug terminals; open phenolic body 5/8 in. dia., .170 in. deep max.; single rd., slotted, metal shaft, 5/32 in. dia.; normal torgue; insulated contact arm; no "off" position; mts. by soldering of terminals; Centralab part no. BA001-208.	3Z7499-5.27 N16-R-88510-8001	Adjustable calibration potentiometer for cancellation of contact potential at R-104A.
R-113	RESISTOR, FIXED, COMPOSITION; Same as R-107.		Grid return pin 7 of V-102.
R-114	RESISTOR, FIXED, COMPOSITION; 560,000 ohms ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-5641.	3RC20BF564K N16-R-50858-811	Voltage divider with R-113.
R-115	RESISTOR, FIXED, COMPOSITION; 47 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-4701.	3RC20BF470K N16-R-49427-811	Parasitic suppression resistcr pin 1 of V-103.
R-116	RESISTOR, FIXED, COMPOSITION; 2700 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-2725.	3RC20BF272J N16-R-50038-431	Plate load resistor pin 1 of V-102.
R-117	RESISTOR, FIXED, COMPOSITION; Same as R-116.		Plate load resistor pin 6 of V-102.
R-118	RESISTOR, FIXED, COMPOSITION; Same as R-115.		Parasitic suppression resistor pin 1 of V-104.
R-119	RESISTOR, VARIABLE; wire-wound; 1 section; 1000 ohms ± 20%; 2W; 2 solder lug terminals; open metal case 1-3/64 in. dia., 7/16 in. deep; single rd. metal slotted shaft; 1/4 in. dia., 3/8 in. lg. FMS; normal torque; contact arm grounded to case; no "off" position; mtg. bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; Allen-Bradley JAN type RA15AISA102AK. JAN spec. R-19.	3Z7310-122 N16-R-90764-9340 844500-3991	Adjustable cathode bias resistor of V-103 and V-104. In series with R-120.
R-120	RESISTOR, FIXED, COMPOSITION; 2200 ohms ±10%; 2W rated at 70 deg. C ambient temp.; .688 in. lg., .312 in. dia.; 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. HB-2221.	3RC41BF222K For replacement use SNSN N16-R-50013-461	Fixed cathode bias resister of V-103 and V-104. In series with R-119.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS.	SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
R-121	RESISTOR, VARIABLE; composition; 1 section; 100,000 ohms ±20%; 1/2W; three solder lug terminals; metal inclosed case; 15/16 in. dia., 17/32 in. deep; single rd. metal slotted shaft, 1/4 in. dia.; 3/8 in. lg. FMS; normal torque; insulated; no "off" position; mtg. bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; Allen-Bradley JAN type RV3ATSA104B. JAN spec. R-94.	3RV51071 For replacement use SNSN N16-R-88011-9300		Screen grid voltage adjustment pin 6 of V-103 and V-104 for amplifier linearity.
R-122	RESISTOR, FIXED, COMPOSITION; 33,000 ohms ±10%; 2W rated at 70 deg. C ambient temp.; .688 in. lg., .312 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. HB-3331.	3RC41BF333K For replacement use SNSN N16-R-50418-726		In parallel with R-121 as part of screen dropping resistor.
R-123	RESISTOR, FIXED, COMPOSITION; 3600 ohms ±5%; 2W rated at 70 deg. C ambient temp.; .688 in. lg., .312 in. dia., 1-1/2 in. lead length; insulated; resistant to humdity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. HB-3625.	3RC41BF362J For replacement use SNSN N16-R-50084-346		Plate load resistor pin 5 of V-103.
R-124	RESISTOR, FIXED, COMPOSITION; Same as R-123.			Plate load resistor pin 5 of V-104.
R-125	RESISTOR, FIXED, COMPOSITION; 220,000 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-2241.	3RC20BF224K N16-R-50714-811		Part of sweep circuit csc. V-108 decoupling network.
R-126	RESISTOR, FIXED, COMPOSITION; Same as R-102.			Part of voltage divider network for input of horizontal cathode follower.
R-127	RESISTOR, FIXED, COMPOSITION; Same as R-103.			Part of voltage divider network for input of horizontal cathode follower.
R-128	RESISTOR, FIXED, COMPOSITION; Same as R-101.			Part of voltage divider network for input of horizontal cathode follower.
R-129	RESISTOR, VARIABLE; Same as R-104.			Horizontal gain control.
R-129A	RESISTOR, VARIABLE; Part of R-129.	Listed for reference only		Horizontal gain control for AC signals.
R-129B	RESISTOR, VARIABLE; Part of R-129.	Listed for reference only		Horizontal gain control for DC signals.

R-130	RESISTOR, FIXED, COMPOSITION; Same as R-105.		Parasitic suppression pin 2 of V-105A.
R-131	RESISTOR, FIXED, COMPOSITION; Same as R-106.		Grid return pin 2 of V-105A.
R-132	RESISTOR, FIXED, COMPOSITION; Same as R-107.		Cathode load resistor pin 3 of V-105A.
R-133	RESISTOR, FIXED, COMPOSITION; Same as R-109.		Isolation and voltage dropping resistor for cancellation of contact potential at R129A.
R-134	RESISTOR, FIXED, COMPOSITION; 180 ohms ±5%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1815.	3RC20BF181J N16-R-49642-431	Cathcde bias pin 3 of V-106.
R-135	RESISTOR, VARIABLE; Same as R-112.		Adjustable calibration potentiometer for cancellation of contact potential at R-129A.
R-136	RESISTOR, VARIABLE; Same as R-111.		Adjustable cathode bias resistor pin 8 of V-106. Horizontal centering contrcl.
R-137	RESISTOR, FIXED COMPOSITION; 150,000 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part now. EB-1541.	3RC20BF154K N16-R-50678-811	Bleeder resistor for horizontal cathode follower V-105A decoupling network.
R-138	RESISTOR, FIXED, COMPOSITION; Same R-107.		Grid return pin 7 of V-106.
R-139	RESISTOR, FIXED, COMPOSITION; 12,000 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1231.	3RC20BF123K N16-R-50309-811	Plate load resistor pin 1 of V-106.
R-140	RESISTOR, FIXED, COMPOSITION; Same as R-139.		Plate load resistor pin 6 of V-106.
R-141	RESISTOR, VARIABLE; Same as R-119.		Adjustable cathode bias resistor of V-107. In series with R142.
R-142	RESISTOR, FIXED, COMPOSITION; Same as R-123.		Fixed cathode bias resistor. In series with R-141.
R-143	RESISTOR, FIXED, COMPOSITION; Same as R-115.		Parasitic suppression pin 6 V-107.
R-144	RESISTOR, FIXED, COMPOSITION; Same as R-115.		Parasitic suppression pin 5 V-107.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
R-145	RESISTOR, FIXED, COMPOSITION; 12,000 ohms ±5%; 2W rated at 70 deg. C ambient temp.; .688 in. lg., .312 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. HB-1235.	3RC41BF123J For replacement use SNSN N16-R-50308-945	Plate load pin 1 V-107.
R-146	RESISTOR, FIXED, COMPOSITION; Same as R-145.		Plate load pin 2 V-107.
R-147	RESISTOR, FIXED, COMPOSITION; Same as R-105.		Series load fcr line test voltage.
R-148	RESISTOR, FIXED, COMPOSITION; 15,000 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1531.	3RC20BF153K N16-R-50336-811	Part of AC voltage dividing network to provide line sync.
R-149	RESISTOR, FIXED, COMPOSITION; 100,000 ohms ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1041.	3RC20BF104K N16-R-50633-811	Part of AC voltage dividing network to provide line sync.
R-150	RESISTOR, FIXED, COMPOSITION; 47,000 ohms ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-4731.	3RC20BF473K N16-R-50480-811	Plate load pin 6 V-101B.
R-151	RESISTOR, FIXED, COMPOSITION; 1 megohm ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1051.	3RC20BF105K N16-R-50975-811	Grid return pin 7 V-101B.
R-152	RESISTOR, FIXED, COMPOSITION; Same as R-148.		Part of cathode load of V-101B in series with R-153.
R-153	RESISTOR, FIXED, COMPOSITION; 4700 ohms ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-4721.	3RC20BF472K N16-R-50129-811	Part of cathode load of V-101B in series with R-152.

R-154	RESISTOR, VARIABLE; composition; 1 section, 500,000 ohms ±20%; 1/2W; one center tap; 4 solder lug terminals; inclosed metal case 15/16 in. dia. x 17/32 in. deep; single rd. metal shaft 1/4 in. dia., 5/8 in. lg. FMS; normal torque; insulated; no "off" position; mtg bushing 3/8 in. dia. 32 thd/in., 1/4 in. lg., Mallory, per Jetronic dwg. no. B-1181.	3Z7498-50.202 N16-R-88181-8531	Sync. amp locking control.
R-155	RESISTOR, FIXED, COMPOSITION; 2.2 megohm ±10%; 1/2 W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-2251.	3RC20BF225K N16-R-51065-811	Part of sweep circuit osc. V-108 decoupling network.
R-156	RESISTOR, FIXED, COMPOSITION; Same as R-125.		Plate load pin 2 of V-108.
R-157	RESISTOR, FIXED, COMPOSITION; 330,000 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-3341.	3RC20BF334K N16-R-50759-811	Part of plate load pin 1 of V-108. In series with R-158A.
R-158	RESISTOR, VARIABLE; COMPOSITION; 2 sections; 1 megohm first section, 5 megohms rear section, ±20%, 1/2W both sections; 3 solder lug terminals each section; inclosed metal case 15/16 in. dia., 1 in. deep; single rd. metal shaft 1/4 in. dia., 5/8 in. lg. FMS; normal torque; insulated; no "off" position: mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; Mallory Midgetrol type, per Jetronic dwg. B-1185.	3Z7499-5.23 N16-R-89232-1586	Vernier freq. control.
R-158A	RESISTOR, VARIABLE, COMPOSITION; Part of R-158.	Listed for reference only	5 meg. section in series with R-157 as part of plate load pin 1 V-108.
R-158B	RESISTOR, VARIABLE, COMPOSITION; Part of R-158.	Listed for reference only	1 meg. section in series with R-160 as part of grid return pin 6 V-108.
R-159	RESISTOR, FIXED, COMPOSITION; 220 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-2211.	3RC20BF221K N16-R-49661-811	Part of grid return pin 6 V-108. In series with R-160.
R-160	RESISTOR, FIXED, COMPOSITION; Same as R-149.		Part of grid return pin 6 V-108. In series with R-159 and R-158A.
R-161	RESISTOR, FIXED, COMPOSITION; 470 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-4711.	3RC20BF471K N16-R-49769-811	Cathode bias resistor pin 7 V-108.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
R-162	RESISTOR, FIXED, COMPOSITION; Same as R-108.		Isolation for sync. grid pin 6 of V-108.
R-163	RESISTOR, FIXED, COMPOSITION; Same as R-108.		Grid return pin 6 V-108.
R-164	RESISTOR, FIXED, COMPOSITION; Same as R-151.		Grid return pin 7 V-105B.
R-165	RESISTOR, FIXED, COMPOSITION; Same as R-108.		Plate load pin 6 V-105B.
R-166	RESISTOR, FIXED, COMPOSITION; Same as R-161.		Cathode bias resistor pin 8 of V-105B.
R-167	RESISTOR, FIXED, COMPOSITION; 22 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-2201.	3RC20BF220K N16-R-49319-811	Surge suppression on input to CR-101.
R-168	RESISTOR, FIXED, COMPOSITION; Same as R-167.		Surge suppression on input to CR-102.
R-169	RESISTOR, FIXED, COMPOSITION; Same as R-137.		Filter resistor for high voltage power supply.
R-170	RESISTOR, FIXED, COMPOSITION; 1000 ohms ±10%; 2W rated at 70 deg. C ambient temp.; .688 in. lg., .312 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. HB-1021.	3RC41BF102K For replacement use SNSN N16-R-49923-531	Filter resistor for low voltage power supply.
R-171	RESISTOR, FIXED, COMPOSITION; Same as R-170.		Filter resistor for intermediate voltage power supply. Horizontal amp.
R-172	RESISTOR ,FIXED, COMPOSITION; 3300 ohms ±10%; 2W rated at 70 deg. C ambient temp.; .688 in. lg., .312 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. HB-3321.	3RC41BF332K For replacement use SNSN N16-R-50067-501	Part of filter for intermediate voltage power supply. Vertical amp. In parallel with R-173.
R-173	RESISTOR, FIXED, COMPOSITION; Same as R-172.		Part of filter for intermediate voltage power supply. Vertical amp. In parallel with R-172.

R-174	RESISTOR, FIXED, COMPOSITION; Same as R-149.		Decoupling resistor for horizontal cathode follower V-105A.
R-175	RESISTOR, FIXED, COMPOSITION; Same as R-149.		Decoupling resistor for horizontal cathode follower V-101A.
R-176	RESISTOR, VARIABLE; composition; 1 section, 250,000 ohms ±20%; 1/2W; three solder lug terminals; metal and phenolic inclosed case, 15/16 in. dia., 15/16 in. lg.; single rd. metal shaft 1/4 in. dia., 5/8 in. lg. FMS; normal torque; insulated; "off" position at CCW end of rotation; mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; SPST switch, 5 amp., 125V, normally open, operates at start of rotation, 2 solder lug terminals; Allen-Bradley JAN type RV3BTRD254B. JAN spec. R-94.	3RV52565 N16-R-88081-9268	Intensity control. Part of high voltage network.
R-177	RESISTOR, VARIABLE; composition; 1 section, 500,000 ohms ±20%; 1/2W; three solder lug terminals; metal inclosed case 15/16 in. dia., 17/32 in. deep; single rd. metal shaft, 1/4 in. dia., 5/8 in. lg. FMS; normal torque; insulated no "off" position; mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; Allen-Bradley Jan type RV3ATRD504B. JAN spec. R-94.	3RV55104 N16-R-88181-9438	Focus control. Part of high voltage network.
R-178	RESISTOR, FIXED, COMPOSITION; 750,000 ohms ±5%; 1W rated at 70 deg. C ambient temp.; .562 in. lg., .225 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. GB-7545.	3RC30BF754J N16-R-49642-431	Part cf high voltage dividing network.
R-179	RESISTOR, FIXED, COMPOSITION; 1.5 megohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1551.	3RC20BF155K N16-R-51020-811	Intensity grid return to high voltage B. Pin 2 of V-109.
R-180	RESISTOR, FIXED, COMPOSITION; Same as R-137.		Current limiting cathode resistor pin 3 V-109.
R-181	RESISTOR, FIXED, COMPOSITION; Same as R-149.		Part of astigmatic voltage dividing network.
R-182	RESISTOR, FIXED, COMPOSITION; 680,000 ohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 n. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-6841.	3RC20BF684K N16-R-50894-811	Part of estigmatic voltage dividing network.
R-183	RESISTOR, FIXED, COMPOSITION; 4.7 megohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 n. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-4751.	3RC20BF475K N16-R-51173-811	Return path for difference plate D3 pin 6 of V-109.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
R-184	RESISTOR, FIXED, COMPOSITION; Same as R-183.		Return path for deflectien plate D4 pin 7 of V-109.
R-185	RESISTOR, FIXED, COMPOSITION; Same as R-183.		Return path for deflection plate D1 pin 10 of V-109.
R-186	RESISTOR, FIXED, COMPOSITION; Same as R-183.		Return path for deflection plate D2 pin 9 of V-109.
R-187	RESISTOR, FIXED, COMPOSITION; 1.8 megohms ±10%; 1/2W rated at 70 deg. C ambient temp.; .375 in. lg., .140 in. dia., 1-1/2 in. lead length; insulated; resistant to humidity and salt-water-immersion; 2 wire lead terminals; Allen-Bradley part no. EB-1851.	3RC20F185K N16-R-51083-811	Voltage divider with R-138 pin 7 V-106.
S-101	SWITCH, ROTARY; 1 section; 4 positions, max. no. of switching positions possible; "non-pile-up" type, 4 moving contacts, 15 fixed contacts; 4 poles, 4 throws; non-shorting, brass, silver-plated contacts; bakelite insulation; 5/8 in. lg., 1-13/32 in. wide, 1-17/32 in. high; mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; flatted shaft 5/8 in. lg., FMS, 1/4 in. dia.; solder lug terminals; Oak type J, per Jetronic dwg. A-501.	3Z9825-62.736 N17-S-59360-9983	Vertical attenuator switch.
S-102	SWITCH, ROTARY; 1 section; 5 positions, max. no. of switching positions possible; "non-pile-up" type, 5 moving contacts, 18 fixed contacts; 2 dummy terminals, 5 poles, 5 throws; non-shorting brass, silver-plated contacts, bakelite insulation; 5/8 in. lg., 1-13/32 in. wide, 1-17/32 in. high; mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; flatted shaft 5/8 in. lg. x 1/4 in. dia.; solder lug terminals; Oak type J, per Jetronic dwg. A-502.	3Z9825-62.737 N17-S-59387-1060	Horizontal attenuator switch.
S-103	SWITCH, ROTARY; 1 section; 3 positions; "non-pile-up" type, 1 moving contact, 4 fixed contacts; 3 dummy terminals, one pole, 3 throws; non-shorting, brass, silver-plated contacts; bakelite insulation; 5/8 in. lg., 1-13/32 in. wide, 1-17/32 in. high; mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; flatted shaft 5/8 in. lg., 1/4 in. dia.; solder lug terminals; Oak type N, per Jetronic dwg. A-503.	3Z9825-62.735 N17-S-59931-7430	Sync. selector switch.

S-104	SWITCH, ROTARY; two sections; 6 positions, max. no. of switching positions possible; "non-pile-up" type, 4 moving contacts; 28 fixed contacts, 1 dummy contact, 4 poles, 6 throws, non-shorting, brass, silver plated contacts; bakelite insulation; 2-1/4 in. lg., 1-13/32 in. wide, 1-17/32 in. high; mtg bushing 3/8 in. dia., 32 thd/in., 1/4 in. lg.; flatted shaft 5/8 in. lg., 1/4 in. dia.; solder lug terminals: Oak type N, per Jetronic dwg. A-500.	3Z9825-171 N17-S-65080-1501	Course frequency switch.
S-105	SWITCH. ROTARY; SPST; mounted on and actuated by R176.	Listed for reference only	Power switch.
T-101	TRANSFORMER, POWER, STEP-DOWN AND STEP UP; hermetically sealed, fully inclsed metal case; 115V AC, 50-1000 cycles, single phase primary winding; secondary windings, No. 1 235V, 50 ma; No. 2 180V 65 ma center tapped; No. 3 235V 50 ma; No. 4 130V 0.5 ma; No. 5 6.3V 3.75 amps center tapped; No. 6 6.3V 0.6 amp; 2000V insulation; oil-cooled and oil-filled; dimensions excluding terminals and mtg brackets 3 in. lg. x 2-15/32 in. wide x 2-27/32 in. high; 2-5/8 in. shortest mtg dim., 3-1/4 in. longest mtg dim., 12 insulated solder lug terminals; four no. 6-32 mtg bushings on 3-1/4 in. by 2-3/8 in. mtg. centers; Ind. Trans. per Jetronic dwg. C-2115.	2Z9621-521 N17-T-74279-7589	Power transformer.
TB-101	TERMINAL BOARD; phenolic board; 8 rivet type terminals; 4-17/32 in. lg., 1-3/8 in. wide, 1/8 in. thick excluding terminals; two .1495 in. dia. holes spaced 4-1/32 in. c to c; Jetronic part no. A-579.	3Z770-8.202 Shop manufacture	Tube and component mtg.
TB-102	TERMINAL BOARD; phenolic board; 5 rivet type terminals; 4-17/32 in. lg., 1-3/8 in. wide, 1/8 in. thick over-all excluding terminals; two .1495 in. dia. holes spaced 4-1/8 in. c to c; Jetronic part no. A-578.	3Z770-5.140 Shop manufacture	Tube and component mtg.
TB-103	TERMINAL BOARD; phenolic board; 18 terminals; 9 single and 9 double rivet type; 3 in. lg., 1-1/2 in. wide, 3/32 in. thick over-all excluding terminals; two .1495 in. dia. holes spaced 2-11/16 in. c to c; Jetronic part no. A-580.	3Z770-18.129 Shop manufacture	Distribution board left side.
TB-104	TERMINAL BOARD; phenolic board; 17 terminals, 6 single, 11 double rivet type; 3 in. lg., 1-1/2 in. wide, 3/32 in. thick; two .1495 in. dia. holes spaced 2-11/16 in. c to c; Jetronic part no. A581.	3Z770-17.47 Shop manufacture	Distrbution board right side.
TB-105	TERMINAL BOARD; phenolic board; 18 screw type terminals; 4-1/2 in. lg., 3 in. wide, 3/32 n. thick over-all excluding terminals; 5 .1495 in. dia. mtg. holes, 3 on 1-3/4 in. horizontal centers, 2 on 4-1/4 in. horizontal centers; Jetronic part no. A-531.	3Z770-18.122 Shop manufacture	External connection to CRT V-109 deflection plates.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
V-101	ELECTRON TUBE; glass envelope; amplifier; GE type JG-12AT7WA.	2J12AT7WA N16-T-58240-14	Vertical cathode follower and sync. amp.
V-102	ELECTRON TUBE; Same as V-101.		First vertical DC amp.
V-103	ELECTRON TUBE; glass envelope; receiving type; Raytheon type JRP-6AH6.	2J6AH6 N16-T-56185	Part of second vertical DC amp.
V-104	ELECTRON TUBE; Same as V-103.		Part of second vertical DC amp.
V-105	ELECTRON TUBE; Same as V-101.		Horizontal cathode follower and Z axis amp
V-106	ELECTRON TUBE; Same as V-101.		First horizontal DC amp.
V-107	ELECTRON TUBE; glass envelope; receiving type; RCA type JRC-6J6.	2J6J6 N16-T-56360	Second horizontal DC amp.
V-108	ELECTRON TUBE; Same as V-107.		Sweep circuit osc.
V-109	ELECTRON TUBE; glass envelope; kinescpe; RCA type CRC-3RP1.	2J3RP1 N16-T-53860	CR tube.
V-110	ELECTRON TUBE; glass envelope; rectifier; GE type JG-6X4.	2J6X4 N16-T-56840	Intermediate voltage rectifier.
W-101	LEAD TEST; 1 solid copper conductor no. 22 AWG; black; insulation materials from bare conductor out: polyethelene, copper braid, vinyl jacket; 3 ft. lg.; 750V max. rated working voltage, Jan type UG-260B/U plug connector on one end; Mueller part no. 60HS (red) alligator clip on other end; Jetronic part no. A-622-601.	3E4017.27 N17-L-63284-1726	Connector for vertical amp.
W-102	LEAD, TEST; solid copper conductor no. 22 AWG; black; insulation materials from bare conductor out: polyethelene, copper braid, vinyl jacket; 750V max. rated working voltage, 6 in. lg.; Jan type UG-260B/U plug connector on one end; Mueller part no. 60HS (red) alligator clip on other end; Jetronic part no. A-622-602.	3E4017.28 N17-L-63284-7781	Connector for vertical amp.

W-103	CABLE ASSEMBLY, POWER, ELECTRICAL; 2 stranded no. 28AWG conductors, polyethylene insulation; materials from insulated conductors out: tinned copper shield, vinyl jacket; 5 ft. 6 in. lg.; plug and ground lead on one end; conductors second end extend 3-1/2 in. beyond end of jacket, conductors stripped and tinned 1/2 in.; Jetronic part no. A-553.	3E4000.344 N17-C-48238-8111	Power cable.
W-104	LEAD TEST; 1 stranded, black, copper conductor no. 18AWG; insulation materials from bare conductor out: cotton wrap, rubber insulation; 36 in. lg., 5000V max. rated working voltage; Mueller no. 60HS (black) alligator clip on one end; Zierick part no. 221- no. 10 lug terminal on other end; Jetronic part no. A-632.	3E4017.26 For replacement use SNSN N17-L-63455-7490	Ground lead.
W-105	CABLE, RADIO FREQUENCY; coaxial; 93 ohms nom impedance, 13.5 mmf nom capacity per ft.; 750V RMS max. operating voltage; solid, copperweld inner conductor no. 22AWG; outer conductor braid, copper, tinned finish, polyethylene dielectric; vinyl jacket; .242 in. dia. over-all; Fed. Telephone & Radio type RG-62A/U.	1F425-62A N15-C-12161-555	Cable for test leads W-101 and W-102.
W-106	WIRE, ELECTRICAL; stranded, rd. black conductor no. 18AWG, 65 strands, 36AWG; .140 in. OD incl. insulation; copper, tinned finish conductor; 5000V max. rated working voltage; insulation from bare conductor out: cotton wrap, rubber insulation; moisture and oil resistant; Belden type 8899-Black.	1B1018 N15-W-2195-5100	Wire for test lead W-104.
X-101	SOCKET, ELECTRON TUBE; 9 contacts, phosphor bronze, silver-plated; miniature; no shock or center shield; 1-13/32 in. lg., 15/16 in. wide, 11/32 in. high over-all, excluding terminals; mica filled phenolic body; one piece saddle, mtg.; 3/4 in. dia. chassis hole required, two .125 in. dia. mtg. holes spaced 1-1/8 in. c to c; Elco part no. 277PH-SPTD.	2Z8679.46 For replacement use SNSN N16-S-64063-6233	Socket for V-101.
X-102	SOCKET, ELECTRON TUBE; Same as X-101.		Socket for V-102.
X-103	SOCKET, ELECTRON TUBE; 7 contacts, phosphor bronze, silver-plated finish; miniature; no metal shock or center shield; 1-3/32 in. lg., 51/64 in. wide, 11/32 in. high over-all, excluding terminals; mica filled phenolic body; one piece saddle mounting, 5/8 in. dia. chassis hole required, 2 mtg. holes, .125 in. dia., spaced .875 in. c to c; Elco Corp. part no. 116PH-SPTD.	2Z8677.202 For replacement use SNSN N16-S-62603-6912	Socket for V-103.
X-104	SOCKET, ELECTRON TUBE; Same as X-103.		Socket for V-104.

TABLE 8-2. TABLE OF REPLACEABLE PARTS (Cont'd)

REF. DESIG.	NAME OF PART AND DESCRIPTION	STOCK NOS. SIG. CORPS STD. NAVY AIR CORPS	LOCATING FUNCTIONS
X-105	SOCKET, ELECTRON TUBE; Same as X-101.		Sccket for V-105.
X-106	SOCKET, ELECTRON TUBE; Same as X-101.		Socket for V-106.
X-107	SOCKET, ELECTRON TUBE; Same as X-103.		Socket for V-107.
X-108	SOCKET, ELECTRON TUBE; 7 contacts, berryllium copper, silver-plated finish; miniature; 13/16 in. dia., 1/2 in. high incl. metal shock shield; center shield incl.; 1-3/32 in. lg., 13/16 in. dia., 29/32 in. high over-all, excluding terminals; low loss phenolic body; one piece saddle mtg., 5/8 in. dia. chassis hole required, 2 mtg. holes .125 in. dia. spaced 7/8 in. c to c; Eby part no. 9735-11.	2Z8677.94 For replacement use SNSN N16-S-62603-6702	Socket for V-108.
X-109	SOCKET, ELECTRON TUBE; 12 contacts; spring brass, solder dipped finish; contacts no. 5 and 11 missing; miniature duo decal; 1-3/8 in. dia., 1/2 in. high over-all, excluding terminals; phenolic body; direct mtg. to contacts of cathode ray tube; Alden part no. 212MINC.	2Z8682.24 N16-S-64286-3985	Socket for V-109.
X-110	SOCKET, ELECTRON TUBE; Same as X-108.		Socket for V-110.

TABLE 8-3. MAINTENANCE PARTS KIT LIST

KEY DESIGNATION	QUANTITY	KEY DESIGNATION	QUANTITY
C-105	1	C-132	1
C-109	1	C-137	1
C-116	1	J-101	1
C-120	1	P-101	1
C-124	1	R-111	1
C-127	1	R-176	1
C-128	1	R-177	1
C-130	1	S-104	1

TABLE 8-4. CROSS REFERENCE PARTS LIST

JAN (or AWS) DESIGNATION	KEY SYMBOL
12AT7WA	V-101
3RP1	V-109
6J6	V-107
6X4	V-110
CC25CH500K	V-131
CC35CH151K	C-130
CG1207/U(0' 6")	W-101
CG1207/U(3' 0")	W-102
CP53B4E6504V	C-133
JRP6AH6	V-103
RA15A1SA102AK	R-199
RC20BF101J	R-110
RC20BF103K	R-108
RC20BF104K	R-149
RC20BF105K	R-151
RC20BF106K	R-109
RC20BF123K	R-139
RC20BF153J	R-103
RC20BF153K	R-148
RC20BF154J	R-102
RC20BF154K	R-137
RC20BF155J	R-101
RC20BF155K	R-179
RC20BF181J	R-134
RC20BF185K	R-187
RC20BF220K	R-167
RC20BF221K	R-159
RC20BF224K	R-125
RC20BF225K	R-155
RC20BF272J	R-116
RC20BF332K	R-107
RC20BF334K	R-157
RC20BF335K	R-106
RC20BF470K	R-115
RC20BF471K	R-161
RC20BF473K	R-153
RC20BF472K	R-150
RC20BF475K	R-183
RC20BF564K	R-114
RC20BF684K	R-182
RC20BF750J	R-105
RC30BF754J	R-178
RC41BF102J	R-170
RC41BF123J	R-145
RC41BF222K	R-120
RC41BF332K	R-172
RC41BF333K	R-122
RC41BF362K	R-123
RV3ATRD501B	R-111
RV3ATRD504B	R-177
RV3ATSA104B	R-121
RV3BTRD254B	R-176
RG-62A/U	W-105
TS102P01	X-108
TS102U02	E-123

JAN (or AWS) DESIGNATION	KEY SYMBOL
TS102U03	E-124
UG260B/U	P-101
UG290A/U	J-101

STD. NAVY STOCK NO.	KEY SYMBOL
F16-Q-192563-100	OS-8 C/U (W/O Spares)
F16-Q-192563-200	OS-8 C/U (W Spares)
G17-L-6297	E-109
G17-T-5114	O-128
N16-C-12161-555	W-105
N16-W-2195-5100	W-106
N16-C-16570-4284	C-131
N16-C-17073-3195	C-103
N16-C-17402-6097	C-130
N16-C-18659-7736	C-104
N16-C-1883-8854	C-132
N16-C-19011-7701	C-107
N16-C-19143-7811	C-136
N16-C-19781-4701	C-106
N16-C-20503-1450	C-108
N16-C-20506-5841	C-116
N16-C-22643-2777	C-135
N16-C-23048-2274	C-134
N16-C-43523-2851	C-127
N16-C-45805-4431	C-137
N16-C-45949-9598	C-120
N16-C-46371-9834	C-105
N16-C-47290-1507	C-124
N16-C-53697-7565	C-133
N16-C-64214-8975	C-123
N16-K-700065-545	O-113
N16-K-700277-371	O-121
N16-R-49319-811	R-170
N16-R-49427-811	R-115
N16-R-49516-43	R-105
N16-R-49579-431	R-110
N16-R-49642-431	R-134
N16-R-49769-811	R-167
N16-R-49923-531	R-172
N16-R-50013-461	R-120
N16-R-50038-431	R-116
N16-R-50066-811	R-107
N16-R-50067-501	R-176
N16-R-50129-811	R-153
N16-R-50281-431	R-108
N16-R-50308-945	R-145
N16-R-50309-811	R-139
N16-R-50335-431	R-103
N16-R-50336-811	R-148
N16-R-503580-200	H-101
N16-R-50418-726	R-122

STD. NAVY STOCK NO.	KEY SYMBOL
N16-R-50480-811	R-150
N16-R-50633-811	R-149
N16-R-50677-431	R-102
N16-R-50678-811	R-137
N16-R-50714-811	R-125
N16-R-50759-811	R-157
N16-R-50858-811	R-114
N16-R-50894-811	R-182
N16-R-50911-751	R-178
N16-R-51019-431	R-101
N16-R-51020-811	R-179
N16-R-51065-811	R-155
N16-R-51083-811	R-187
N16-R-51109-431	R-106
N16-R-51173-811	R-183
N16-R-51326-811	R-109
N16-R-88011-4300	R-121
N16-R-88081-9268	R-176
N16-R-88181-8531	R-153
N16-R-88181-9438	R-177
N16-R-88510-8001	R-112
N16-R-89232-1586	R-159
N16-R-89250-7579	R-104
N16-R-90764-9340	R-119
N16-S-34557-8351	E-123
N16-S-34607-6039	E-124
N16-S-34961-1477	O-103
N16-S-62603-6702	X-108
N16-S-62603-6912	X-103
N16-S-64286-3985	X-109
N16-T-53860	V-109
N16-T-56185	V-103
N16-T-56360	V-107
N16-T-56840	V-110
N16-T-58240-14	V-101
N17-C-48238-811	W-103
N17-C-71408-9285	P-101
N17-C-73108-1253	J-101
N17-C-789978-708	A-121
N17-C-789978-709	O-101
N17-C-802584-284	O-127
N17-F-14310-370	F-101
N17-F-74266-9053	E-111
N17-L-63284-1726	W-101
N17-L-63284-7781	W-102
N17-L-63455-7490	W-104
N17-L-76854-4041	I-101
N17-M-74937-9501	A-105
N17-M-74978-7591	A-103
N17-P-69142-3661	E-101
N17-R-51401-8431	CR-101
N17-R-51557-1075	CR-103
N17-S-59360-9983	S-101
N17-S-59387-1060	S-102
N17-S-59931-7430	S-103
N17-S-65080-1501	S-104

TABLE 8-4. CROSS REFERENCE PARTS LIST (Cont'd)

STD. NAVY STOCK NO.	KEY SYMBOL
N17-T-28214-4116	F-113
N17-T-74279-7589	T-101
N33-B-1225-30	O-106
N33-B-1225-45	O-109
SNSN-S-64063-6233	X-101

SIGNAL CORPS STOCK NO.	KEY SYMBOL
1B1018	W-106
1F425-62A	W-105
2J12AT7WA	V-101
2J3RP1	V-109
2J6AH6	V-103
2J6J6	V-107
2J6X4	V-110
2ZA951-60	O-102
2ZK5991-7	I-101
2Z2642.882	O-101
2Z2646.221	A-121
2Z5288-13.1	O-113
2Z5842-12	O-121
2Z5952	E-109
2Z6820-518	A-105
2Z6820-519	A-103
2Z7390-260B	P-101
2Z7780-242	I-101
2Z8304-270	E-123
2Z8304-277	E-124
2Z8304.496	O-103A
2Z8304.497	O-103B
2Z8677.202	X-103
2Z8677-94	X-108
2Z8679.46	X-101
2Z8682-24	X-109
2Z87390-290	J-101
2Z9621-521	T-101
3DA1-251	C-104
3DA-100-1110	C-136
3DA-100-1142	C-137
3DA-150-28	C-120
3DA2-204	C-132
3DA250-621	C-105
3DA30-101	C-127
3DA5-229	C-107
3DA5-248	C-128
3DA500-584	C-133
3DA500-707	C-124
3DB20-160	C-134
3DB20-161	C-135
3DB25-136	C-106
3DB250	C-116
3DB250-8	C-108
3D9007V-25	C-109

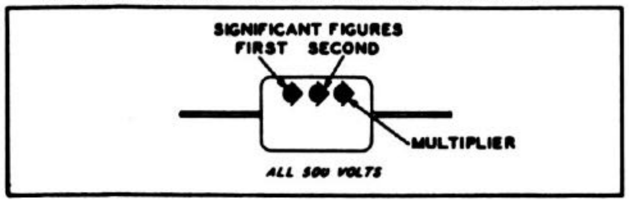
SIGNAL CORPS STOCK NO.	KEY SYMBOL
3D9050-185	C-131
3D9100-241	C-103
3D9125V	C-123
3E4000.344	W-103
3E4017.26	W-104
3E4017.27	W-101
3E4017.28	W-102
3F17774B-7	A-101B
3F30850-15	A-101A
3F3665-8	OS-8 C/U
3H4860-229	CR-101
3H4860-230	CR-103
309012V-28	C-101
3RC20BF101J	R-110
3RC20BF103K	R-108
3RC20BF104K	R-149
3RC20BF106K	R-109
3RC20BF153J	R-103
3RC20BF153K	R-148
3RC20BF154J	R-102
3RC20BF154K	R-137
3RC20BF154K	R-139
3RC20BF155J	R-103
3RC20BF155K	R-179
3RC20BF181J	R-134
3RC20BF185K	R-187
3RC20BF220K	R-167
3RC20BF221K	R-159
3RC20BF224K	R-125
3RC20BF225K	R-155
3RC20BF272J	R-116
3RC20BF332K	R-107
3RC20BF334K	R-157
3RC20BF335K	R-106
3RC20BF470K	R-115
3RC20BF471K	R-161
3RC20BF472K	R-153
3RC20BF473K	R-150
3RC20BF475K	R-183
3RC20BF564K	R-114
3RC20BF684K	R-182
3RC20BF750J	R-105
3RC30BF754J	R-178
3RC41BF102K	R-170
3RC41BF123J	R-145
3RC41B222K	R-120
3RC41BF332K	R-172
3RC41BF333K	R-122
3RC41BF362K	R-123
3RV25028	R-111
3RV51071	R-121
3RV52565	R-176
3RV55104	R-177
3Z1087-8	O-125
3Z1087-8.1	O-127

SIGNAL CORPS STOCK NO.	KEY SYMBOL
3Z12073-44.40	O-128
3Z12101-43.2	E-110
3Z12101-65	E-113
3Z2600A-7.3	F-101
3Z3282-11.19	E-111
3Z7310-122	R-119
3Z737-25.3	E-101
3Z7498-50.202	R-154
3Z7499-2.56	R-104
3Z7499-5.23	R-158
3Z7499-5.27	R-112
3Z770-17.47	TB-104
3Z770-18.122	TB-105
3Z770-18.123	TB-103
3Z770-5.140	TB-102
3Z770-8.202	TB-101
3Z9825-62.735	S-103
3Z9825-62.736	S-101
3Z9825-62.737	S-102
6F207-114	A-102
6F209-9	A-101
6Z1650-50	O-106
6Z1650-51	O-109

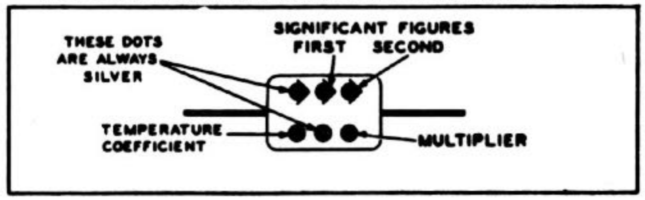
AIR FORCE STOCK NO.	KEY SYMBOL
055725092	C-106
292221362	O-113
292241494	CR-103
688000-1215	CR-101
688000-1265	O-121
774000-1955	E-123
774000-1975	E-124
844500-3991	R-119

CAPACITOR COLOR CODES

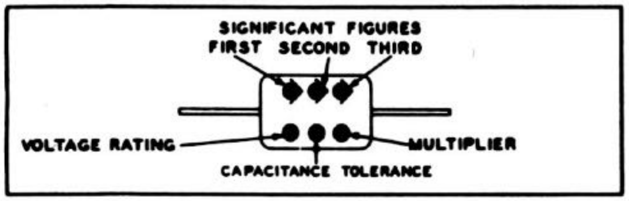
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



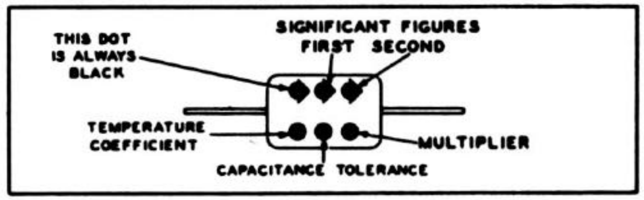
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



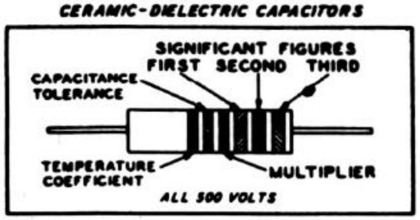
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

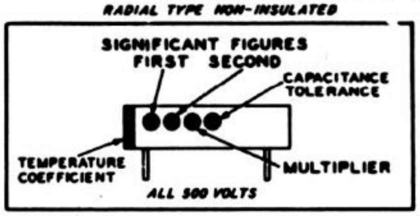


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

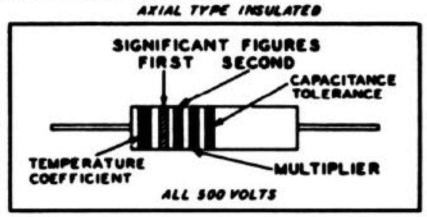


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

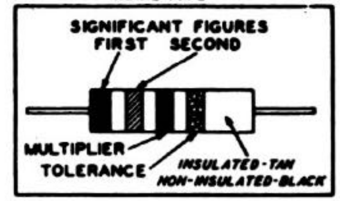
RESISTORS		CAPACITORS						
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

TABLE 8-5. APPLICABLE COLOR CODES

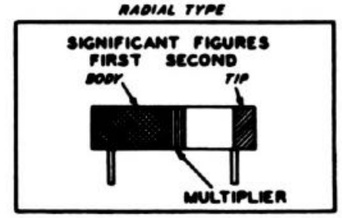
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

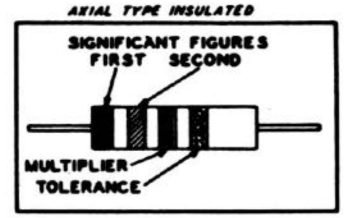


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

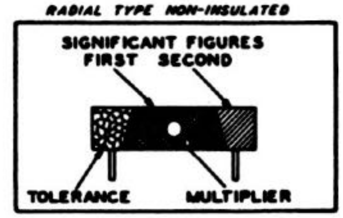


TABLE 8-6. LIST OF MANUFACTURERS

ABBREVIATION	PREFIX	NAME	ADDRESS
Aerovox	CAW	Aerovox Corporation	742 Belleville Ave., New Bedford, Mass.
Allen-Bradley	CBZ	Allen-Bradley Co.	118 W. Greenfield Ave., Milwaukee, Wis.
Alden	CYA	Alden Products Co.	117 N. Main Street, Brockton, Mass.
Belden	CQG	Belden Mfg. Co.	P. O. Box 5070A, Chicago, Ill.
Canfield		Canfield Rubber Co.	Bridgeport, Conn.
Centralab	CBN	Centralab Division, Globe-Union	900 E. Keefe Ave., Milwaukee, Wis.
Cornell-Dubilier	CD	Cornell-Dubilier Corp.	1000 Hamilton Blvd., So. Plainfield, N.J.
Conant	CAZO	Conant Electrical Labs	6500 "O" Street, Lincoln, Nebraska
Drake	CAYS	Drake Mfg. Co.	1713 W. Hubbard St., Chicago, Ill.
Eby	CEB	Hugh H. Eby	4700 Stenton Ave., Philadelphia, Pa.
Elco		Elco Mfg. Co.	Philadelphia, Pa.
Fed. Telephone & Radio		Federal Telephone & Radio	East Newark, N.J.
Garde		Garde Mfg. Co.	588 Eddy Street, Providence, R.I.
GE	CG	General Electric Co.	1 River Road, Schenectady, N.Y.
Heyman		Heyman Mfg. Co.	Kenilworth, N.J.
Ind. Trans.	INTR	Industrial Transformer Corp.	Gouldsboro, Penna.
Jetronic	CBUA	Jetronic Industries, Inc.	Main and Cotton Sts., Phila., Pa.
Kurz-Kasch	CAUP	Kurz-Kasch, Inc.	1421 So. Broadway, Dayton, Ohio
Lord	CAXP	Lord Mfg. Co.	1639 W. 12th St., Erie, Pa.
Littlefuse	CLF	Littlefuse, Inc.	4765 Ravenswood Ave., Chicago, Ill.
Mallory	CMA	P. R. Mallory Co., Inc.	1941 Thomas St., Indianapolis, Ind.
Mueller	CBIT	Mueller Electric Co.	1597 E. 31st St., Cleveland, Ohio
Oak	COC	Oak Mfg. Co.	1200 N. Clybourne Ave., Chicago, Ill.
Precision Metal		Precision Metal Products Co.	Stoneham, Mass.
RCA	CRC	Radio Corp. of America	Harrison, N.J.
Radio Receptor	CAFQ	Radio Recepter Co., Inc.	251 W. 19th St., New York, N.Y.
Raytheon		Raytheon Mfg. Co.	Waltham, Mass.
Sprague	CFS	Sprague Specialties Co.	North Adams, Mass.
Waltham		Waltham Horological Corp.	Waltham, Mass.
Zierick		Zierick Mfg. Co.	New Rochelle, N.Y.