NAVSHIPS 0967-871-4 040

TECHNICAL MANUAL

for

HIGH GAIN - WIDE BAND

PREAMPLIFIER

AM-3568A/USM

DEPARTMENT OF THE NAVY
NAVAL ELECTRONIC SYSTEMS COMMAND

Approved: 28 January 1969

LIST OF EFFECTIVE PAGES

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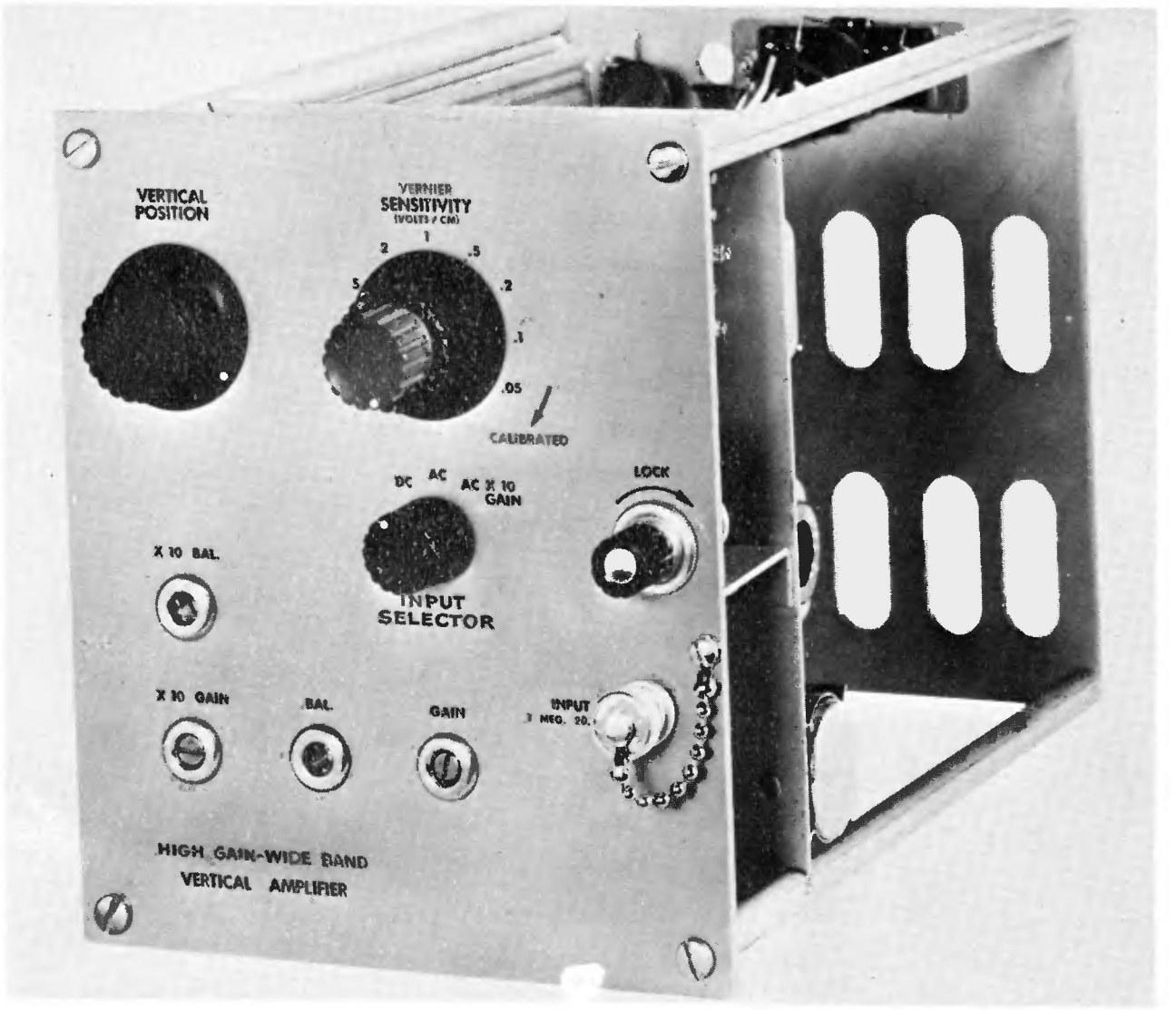


FIGURE 1-1. PREAMPLIFIER, AM-3568A/USM

SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

The AM-3568A/USM High Gain-Wide Band Preamplifier is a plug-in unit designed for use with the AN/USM-105 and AN/USM-140 series Oscilloscopes. It is used for viewing low level, high frequency waveforms on the oscilloscope.

Complete operational information for the preamplifier is given in section 3 of this manual.

1-2. CHANGES.

At the time of publication no field changes have been made or authorized affecting the equipment covered by this manual.

1-3. QUICK REFERENCE DATA.

a. TEMPERATURE AND HUMIDITY.

This equipment is designed to operate within the accuracies specified herein over the entire temperature range from minus 28°C to plus 50°C, with a relative humidity of 99 percent.

When reference is made to temperature and humidity ranges of this paragraph, the following shall apply: Range I shall be from 15°C to plus 35°C with a relative humidity not greater than 75 percent; Range II shall be from 0°C to plus 50°C with a relative humidity not greater than 90 percent; Range III shall be from minus 28°C to plus 50°C with a relative humidity of not greater than 99 percent.

b. COMPOSITION.

The AM-3568A contains calibrated attenuators, amplifiers, and vertical positioning circuits.

c. SENSITIVITY.

The sensitivity of the Model AM-3568A is from 0.005 volts/cm to 50 volts/cm for ac coupling, and 0.05 to 50 volts/cm for dc coupling.

A combined ac and dc voltage up to 600 volts will not damage the equipment.

d. INPUT IMPEDANCE.

1 Megohm ±10% shunted by 20 picofarads on all sensitivity ranges.

e. ATTENUATORS.

Nine calibrated ranges in 1-2-5-10 sequence from 0.05 volts/cm to 20 volts/cm (0.005 to 2 volts/cm with AC-DC switch on AC X10 position) and a continuous uncalibrated vernier adjustment between ranges and to at least 40 volts/cm minimum sensitivity.

f. VERTICAL POSITIONING.

A vertical positioning control is provided for the vertical positioning of any signal within the working range of the equipment at any point within the workable area of the cathode ray tube.

g. VOLTAGE ACCURACY AND LINEARITY.

With the attenuator controls set for maximum sensitivity with either ac or dc coupling, the accuracy on all other calibrated ranges for any trace deflection within the working area of the crt face is 3 percent or better except that the accuracy over temperature and humidity Range III of paragraph 1-3a is 5 percent or better.

h. GENERAL.

Power - Supplied by oscilloscope.
Weight - 4 pounds, 10 ounces.
Dimensions - 11-1/4"L x 7"H x 6"W

TABLE 1-1. BANDWIDTH, SQUARE WAVE RESPONSE AND RISE TIME SPECIFICATIONS

FUNCTION	AN/USM-105A SENSITIVITY RANGE		AN/USM-140A SENSITIVITY RANGE	
	0.05 v/cm to 50 v/cm	0.005 v/cm to 0.02 v/cm	0.05 v/cm to 50 v/cm	0.005 v/cm to 0.02 v/cm
BANDWIDTH DC	dc to 15 MC (3 db)		dc to 30 MC (3 db)	
AC	2 cps to 15 MC (3 db)	10 cps to 15 MC (3 db)	2 cps to 30 MC (3 db)	10 cps to 24 MC (3 db)
SQUARE WAVE RESPONSE	Permits faithful reproduction of square waves having a 0.02 usec rise time over a frequency range of 1 cps to 1 mc.			
RISE TIME	23 nsec		12 nsec	14 nsec

TABLE 1-2. LIST OF EQUIPMENT SUPPLIED

QTY PER EQUIP.	NOMENCLATURE	MODEL NO. OR PART NO.	HEIGHT (INCHES)	WIDTH (INCHES)	DEPTH (INCHES)	VOLUME (CU.INCHES)	WEIGHT (LBS. & OZ.)
1	High-Gain - Wide Band Preamplifier	AN-3568A/USM	7	6	11-1/4	470	4 lbs., 10 oz.
2	Technical Manual	Navships 0967-871-4040	11-1/2	8			

SECTION 2
INSTALLATION

2-1. POWER REQUIREMENTS.

All operating voltages required by the Preamplifier are supplied by the associated oscilloscope with which it is used.

2-2. INSTALLATION.

To install the preamplifier in the oscilloscope, slide it into the front-panel opening of the oscilloscope in the right-hand corner of the front panel. Seat the unit securely and lock it in place to assure good electrical connection.

2-3. INSPECTION AND ADJUSTMENT.

Before placing the preamplifier in operation, visually inspect it for any physical damage such as broken or loose knobs, loose tube retainers, cracked or broken vacuum tubes, etc.

Install the AM-3568A/USM in an oscilloscope and turn the oscilloscope power on. All adjustments have been made and preset at the factory, so no preoperational calibration should be necessary. If, however, it is determined that adjustment is required refer to Section 6 of this manual for proper adjustment and recalibration procedures.

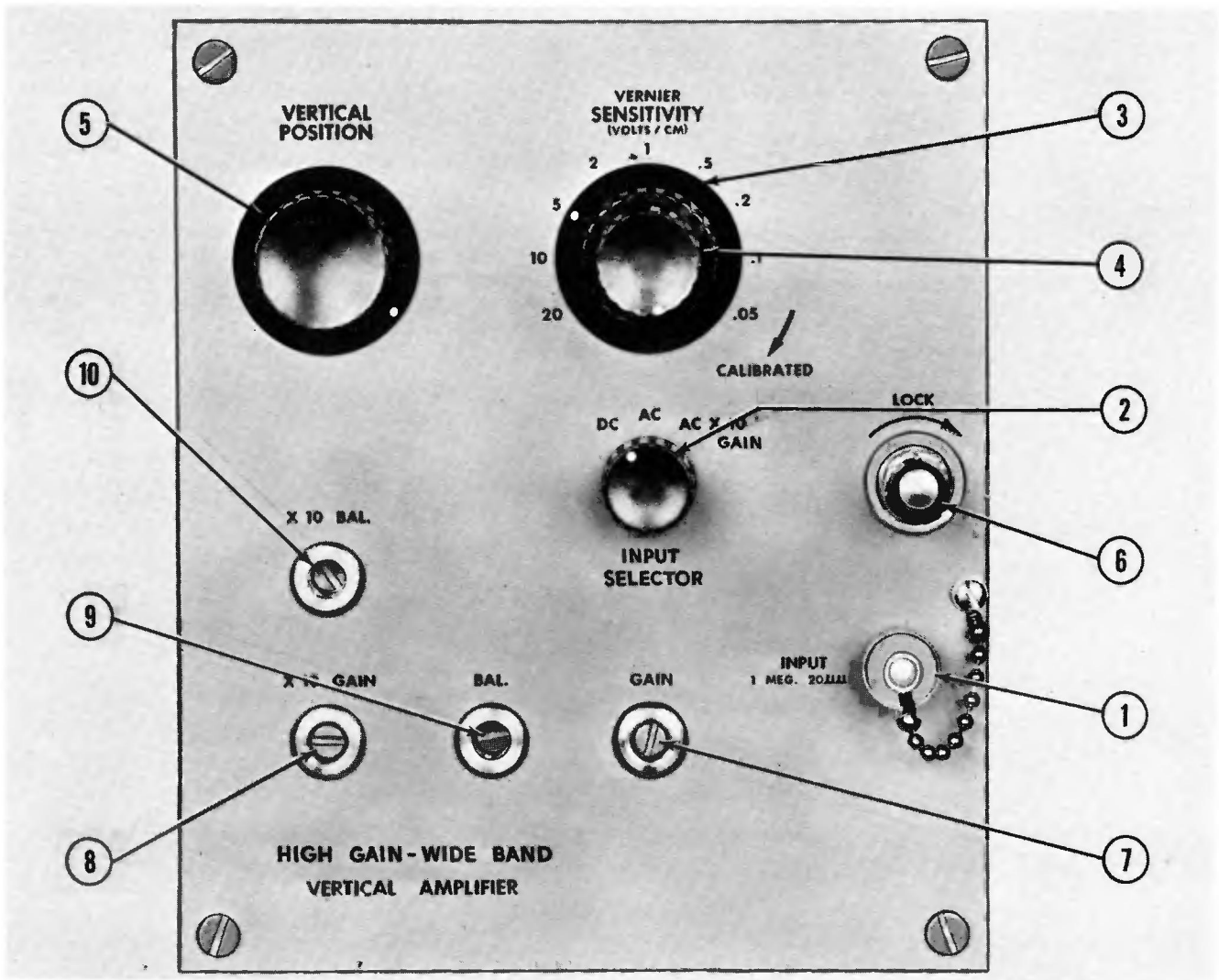


Figure 3-1. Description of Front Panel Controls and Connectors

SECTION 3

OPERATING INSTRUCTIONS

3-1. FUNCTIONAL DESCRIPTION.

The sensitivity switch of the AM-3568A provides calibrated vertical deflection from 0.005 to 20 volts/cm. A variable vernier control provides uncalibrated deflection up to 50 volts/cm. With the Input Selector in the AC or DC position the vertical deflection is as indicated by the setting of the SENSITIVITY switch. When the Input Selector is in the AC X10 GAIN position the amplifier gain is increased by a factor of ten and the deflection sensitivity is the setting of the SENSITIVITY switch divided by ten.

The DC position of the Input Selector should be used for viewing long pulses and square waves below 100 cps, since signals of this type are distorted by the time constant of the ac coupling circuit. Also dc coupling should be used when the dc component is an important part of the signal.

The basic pass-band of the AM-3568A is greater than 60 mc. When used with the AN/USM-105 series the overall pass-band is 15 mc, and when used with the AN/USM-140 series the pass-band is 30 mc for sensitivity ranges from 0.05 to 50 volts/cm and 24 mc for 0.005 to 0.02 v/cm sensitivity ranges.

3-2. DESCRIPTION OF FRONT PANEL CONTROLS AND CONNECTORS.

Figure 3-1 illustrates the front panel controls and connectors of the preamplifier. The following is a description of these controls and connectors:

① INPUT connector. BNC connector for input of waveforms to be displayed on oscilloscope cathode ray tube.

② INPUT SELECTOR. Provides for AC or DC coupled input. It also provides AC X10 gain.

③ SENSITIVITY (Volts/Cm) switch. Selects calibrated vertical deflection sensitivities when the VERNIER control is set at the CALIBRATED position (fully clockwise).

④ VERNIER control. (Red inner knob). Provides uncalibrated variable deflection sensitivities between settings of the SENSITIVITY switch when turned counter-clockwise. (Up to 50 volts/cm for SENSITIVITY switch setting of 20).

⑤ VERTICAL POSITION control. Positions the trace vertically on the cathode ray tube.

⑥ LOCK. Secure the unit in place.

3-3. DESCRIPTION OF FRONT PANEL CALIBRATION CONTROLS.

⑦ GAIN adjustment. Screwdriver adjustment to set proper amount of vertical deflection indicated by the setting of the SENSITIVITY switch.

⑧ X10 GAIN. Screwdriver adjustment to set proper amount of vertical deflection as indicated by the setting of the SENSITIVITY switch with the Input Selector set to AC X10.

⑨ BAL. Screwdriver adjustments to set amplifier balance so that the trace does not shift vertically as the VERNIER control is rotated when the Input Selector is in either the AC or DC position.

⑩ X10 BAL. Screwdriver adjustment to set amplifier balance so that the trace does not shift vertically as the VERNIER control is rotated when the Input Selector is in the AC X10 position.

3-4. DEFLECTION FACTOR.

To assure the correct deflection factor as indicated by the setting of the SENSITIVITY control, the VERNIER control must be turned fully clockwise to the CALIBRATED position.

3-5. INPUT COUPLING.

When the Input Selector is in the AC position, a capacitor is placed in series with the input connector to block the DC component of the displayed waveform. This is done when the Input Selector is in either the AC or the AC X10 position.

3-6. ADJUSTMENT OF PROBE.

Probe compensation is a function of the input capacitance of the preamplifier. If the compensation is incorrect, frequency response will be affected.

To compensate for various input capacitances from one instrument to another, a trimmer adjustment is provided in the probe. To make this adjustment, set the calibrator controls of the oscilloscope to display several cycles of the waveform at a suitable amplitude when the probe tip is touched to the calibrator connector. Adjust the probe capacitor to obtain a flat top on the square wave as shown in figure 3-2. Instructions for probe adjustment are given in the oscilloscope instruction manual.

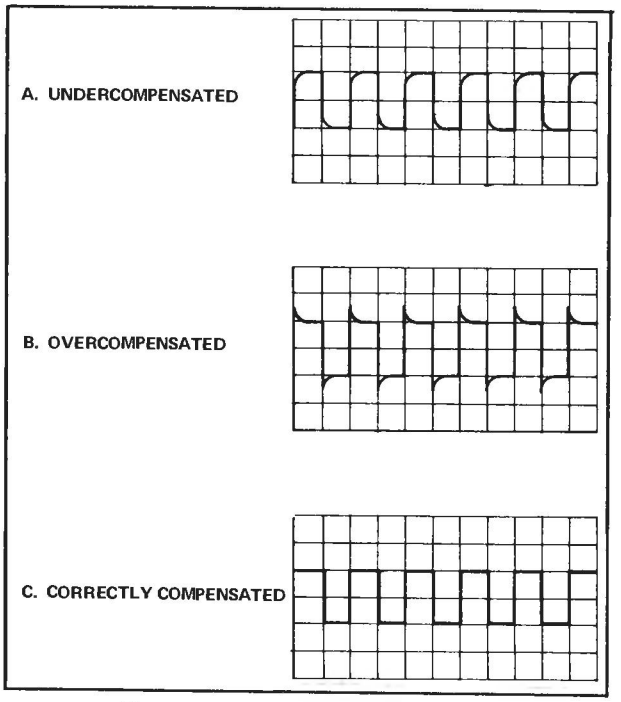


Figure 3-2. Adjustment of Probe

3-7. OPERATOR'S MAINTENANCE.

a. OPERATING CHECKS AND ADJUSTMENTS. The calibration of the four front panel calibration controls should be checked periodically by the operator. The function of these four controls is explained in paragraph 3-3. The following is the procedure for determining if these controls are in need of adjustment, and the adjustment procedure:

(1) BAL. adjustment - Need for recalibration of the BAL. adjustment is indicated when the trace shifts vertically as the VARIABLE control is rotated when the Input Selector is in either the AC or DC position. BAL. adjustment is accomplished in the following manner:

Free run sweep.

Set Input Selector to AC.

Rotate the VARIABLE control back and forth and adjust the BAL. adjustment until the trace does not shift with the rotation of the VARIABLE control.

(2) X10 BAL. adjustment - Need for recalibration of the X10 BAL. adjustment is indicated when the trace shifts vertically as the VARIABLE control is rotated when the Input Selector is in the AC X10 position. X10 BAL. adjustment is accomplished in the following manner:

Free run sweep.

Set Input Selector to AC X10.

Rotate the VARIABLE control back and forth and adjust the X10 BAL. adjustment until the trace does not shift with rotation of the VARIABLE control.

(3) GAIN adjustment - Need for recalibration of the GAIN adjustment is indicated when the vertical deflection in volts/cm (or mv/cm) does not agree with the value of a known input with the Input Selector in the AC or DC position. GAIN adjustment is accomplished in the following manner:

Set Input Selector to DC.

Set SENSITIVITY control to 0.05 (VARIABLE control fully CW).

Connect a 200 millivolt square wave from the calibrator and adjust GAIN adjustment for exactly 4 cm of vertical deflection.

(4) X10 GAIN adjustment - Need for recalibration of the X10 GAIN adjustment is indicated when the vertical deflection in volts/cm (or mv/cm) does not agree with the value of a know input with the Input Selector in the AC X10 position. X10 GAIN adjustment is accomplished in the following manner:

Set the Input Selector to AC X10.

Set SENSITIVITY control to 0.05 (VARIABLE control fully CW).

Connect a 20 millivolt square wave from the calibrator and adjust X10 GAIN adjustment for exactly 4 cm of deflection.

b. EMERGENCY MAINTENANCE. In an emergency, operating personnel can replace tubes listed in Table 3-1. Overall operation of the preamplifier will not be seriously degraded, however, a technician should check the indicated adjustment as soon as possible thereafter.

TABLE 3-1. REQUIRED ADJUSTMENTS FOLLOWING VACUUM TUBE REPLACEMENT

VACUUM TUBE	FUNCTION	ADJUSTMENT
V801	"A" section-Input Cathode Follower	Input Capacitance per paragraph 6-12.
		Bal. Adjustment per paragraph 3-7a(1)
	"B" section-X10 Amplifier	High Frequency Response per paragraph 6-15.
		X10 Gain per paragraph 3-7a(4).
V802	"A" section-X10 Amplifier	X10 High Frequency Compensation per paragraph 6-15.
		X10 Gain per paragraph 3-7a(4).
	"B" section-X10 Cathode Follower	X10 Bal. Adjustment per paragraph 3-7a(2).
V803	Input Amplifier	High Frequency Compensation per paragraph 6-14.
		Gain Adjustment per paragraph 3-7a(3).
		Bal. Adjustment per paragraph 3-7a(1).
		X10 Bal. Adjustment per paragraph 3-7a(2).
V804	Constant Current Generator	Low Frequency Response per paragraph 6-13.
V805	Output Cathode Follower	High Frequency Compensation per paragraph 6-14.
		Bal. Adjustment per paragraph 3-7a(1).
		X10 Bal. Adjustment per paragraph 3-7a(2).

SECTION 4
PRINCIPLES OF OPERATION

4-1. OVERHAUL FUNCTIONAL DESCRIPTION.

The AM-3568A/USM is a preamplifier designed specifically for use with the AN/USM-140 and AN/USM-105 series oscilloscopes. The wide pass-band and high gain of this preamplifier enables the user to view high frequency waveforms of very low amplitude.

The functional block diagram, Figure 4-1, shows the major circuit configuration of the equipment.

An input signal is applied to the Input Cathode Follower (V801A) through a compensated attenuator network, the attenuation ratio of which is selected by the setting of the SENSITIVITY switch.

This attenuated signal is then applied to the Amplifier/Phase Inverter stage (V803) either directly when the Input Selector is in the AC or DC position, or througn an amplifier with a fixed gain of ten (10) when the Input Selector is in the AC X10 position. The signal is then applied to the input of the oscilloscope vertical amplifier from the Output Cathode Follower.

4-2. ATTENUATOR NETWORK.

Figure 4-2 is a partial functional schematic of the attenuator network. Two attenuator legs are shown in this illustration, Figure 4-2(A) is the attenuation leg when the SENSITIVITY switch is in the .05 V/CM position and Figure 4-2(B) is a generalized schematic of any of the other legs. The circuit inside the broken line comprises the attenuator network.

Figure 4-2(A) illustrates the most sensitive position of the SENSITIVITY switch. There is, for all practical purposes, no attenuation of the input signal in this position. Capacitor C819 is adjusted for an input Capacitance of 20 pf with the SENSITIVITY switch in the .05V/CM position.

The attenuator Input Capacitance adjustment and the attenuator Frequency Compensation adjustment are called out in Figure 4-2(B). These are adjusted in each attenuator leg for proper compensation of capacitance and frequency. C_X and R_X are the attenuator components that determine the attenuation ratio of each leg of the network from .1 V/CM to 20 V/CM.

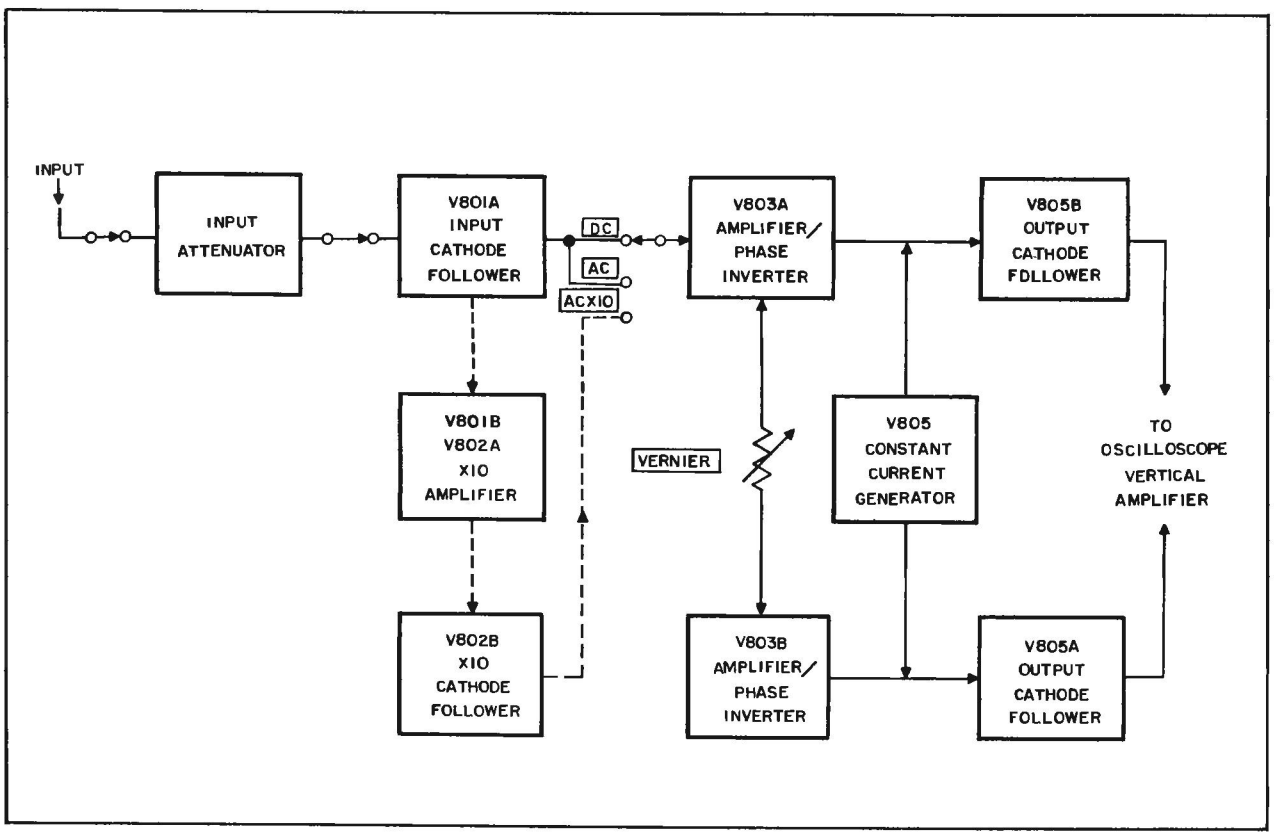


FIGURE 4-1. FUNCTIONAL BLOCK DIAGRAM

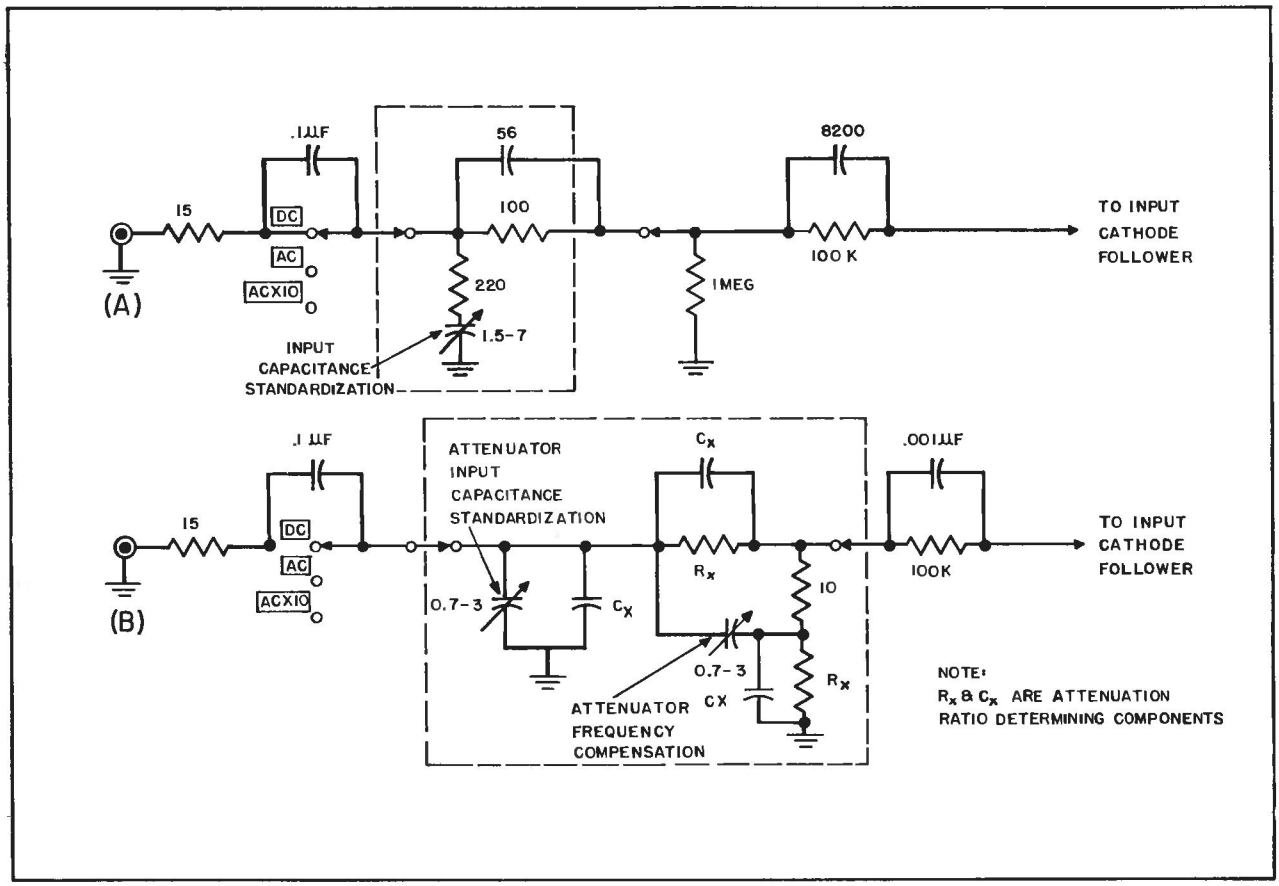


Figure 4-2. Attenuator Network Functional Schematic Diagram, AM-3568A/USM

4-3. INPUT CATHODE FOLLOWER AND X10 AMPLIFIER.

Figure 4-3 is a simplified schematic diagram of the Input Cathode Follower V801A, the X10 Amplifier consisting of V801B, V802A and its associated cathode follower V802B.

The attenuated input signal is applied to the grid of V801A, and the resultant signal at the cathode is applied to the Amplifier/Phase Inverter stage through the Input Selector. When the Input Selector is in the AC X10 position, the signal is applied to the X10 Amplifier, V801B and V802A. This signal is then amplified and fed through the X10 Amplifier Cathode Follower V802B to the input of the Amplifier/Phase Inverter stage through the AC X10 position of the Input Selector.

4-4. AMPLIFIER/PHASE INVERTER.

V803 and its associated components form an Amplifier/Phase Inverter stage which provides a signal at the plate of V803A which is 180° out of phase with the incoming signal, and a signal at the plate of V803B which is in phase with the incoming signal. (Refer to Figure 4-4).

4-5. CONSTANT CURRENT GENERATOR AND OUTPUT CATHODE FOLLOWER.

Because of the small plate load resistors of V803 (refer to Figure 4-4) the signal at the plates is at a very high dc level (approximately +105 volts). V804 is used as a Constant Current Generator to reduce this dc level.

A negative feedback current is developed through the large cathode resistors of V804 causing a constant current through the 200K plate load resistors of V804. This constant current produces the desired voltage drop across these resistors and the resultant dc level at the grids of the Ouput Cathode Follower is approximately -5 volts.

The output signal is applied to the oscilloscope vertical amplifier through the Output Cathode Follower V805.

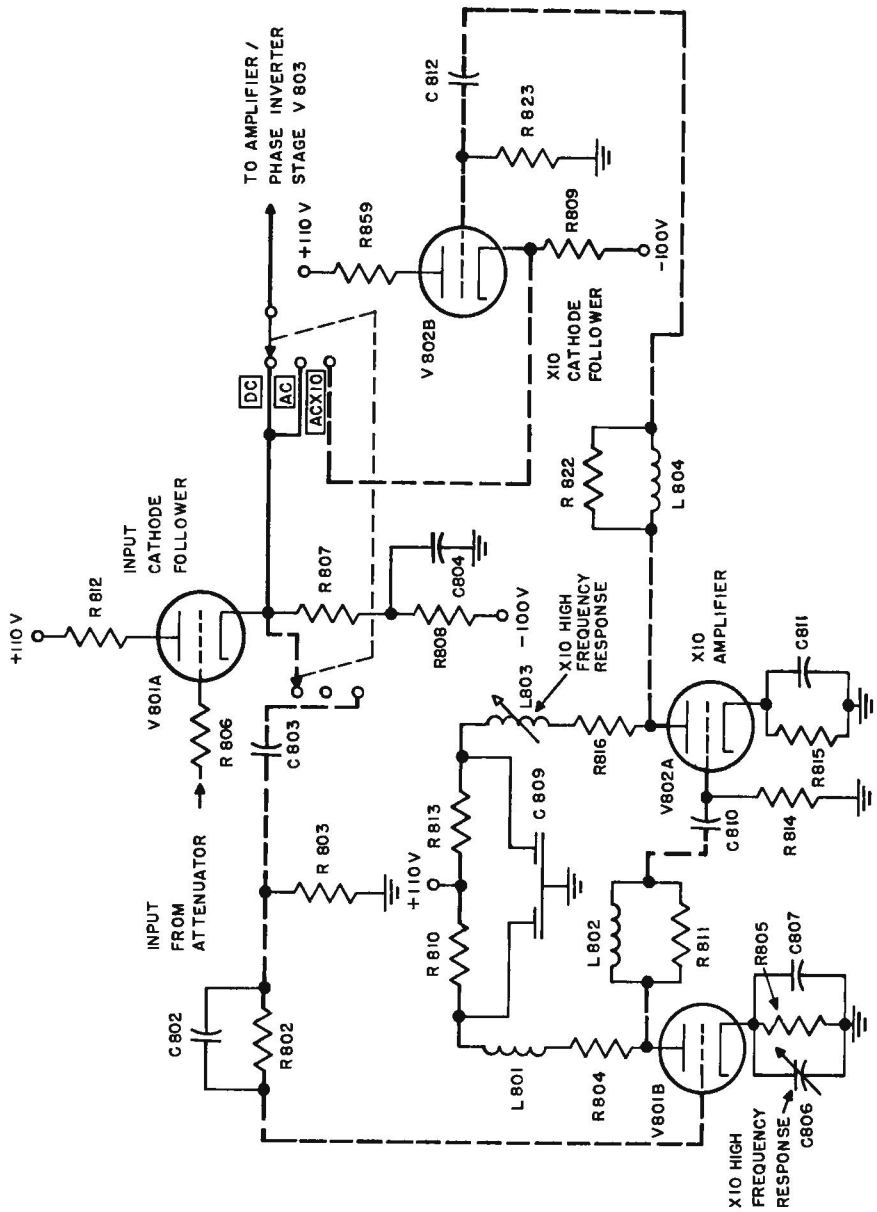


Figure 4-3. Input Cathode Follower and X10 Amplifier, AM-3568A/USM

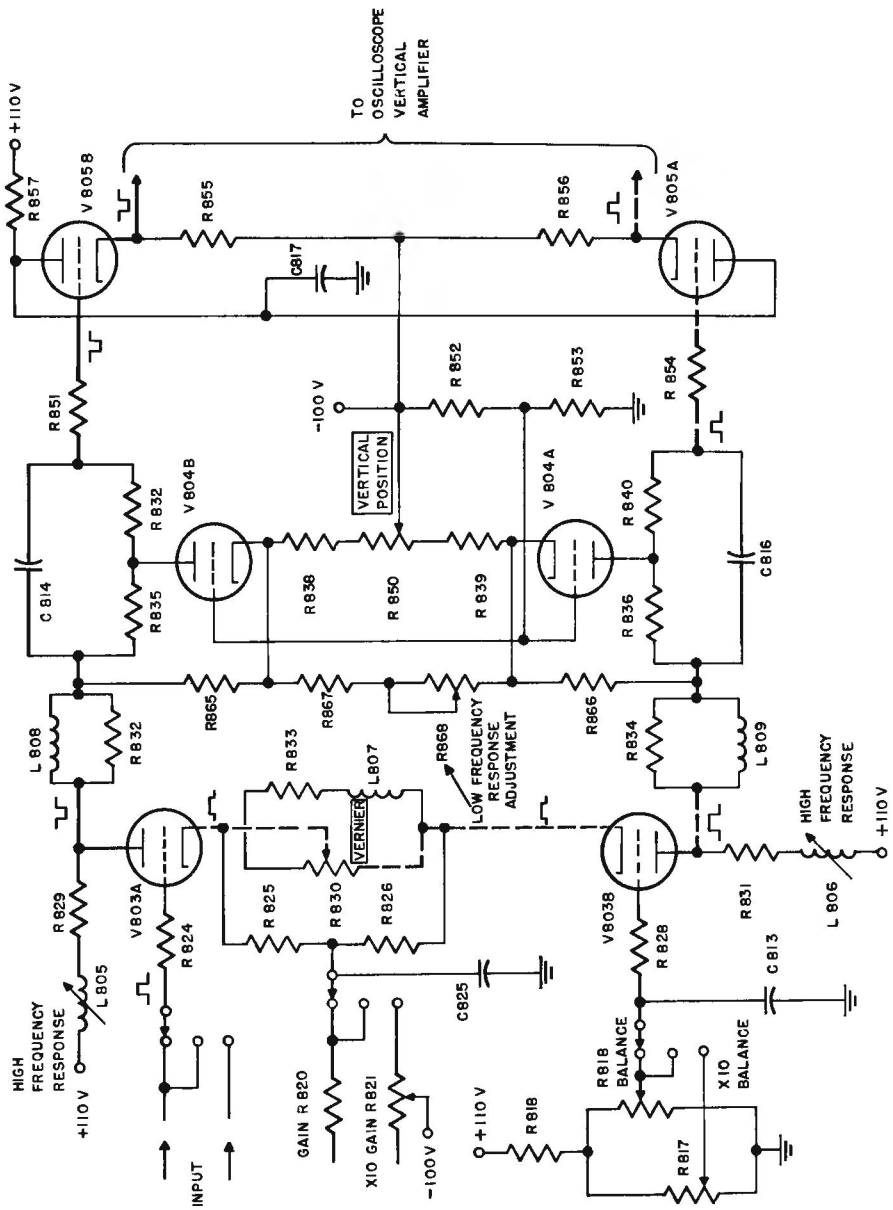


Figure 4-4. Amplifier/Phase Inverter Simplified Schematic Diagram, AM-3568A/USM

SECTION 5
TROUBLE SHOOTING

A thorough understanding of the circuits in this instrument is a valuable aid in trouble shooting. Study SECTION 4, PRINCIPLES OF OPERATION, before starting with the trouble shooting or repair procedures.

TABLE 5-1. LIST OF TEST EQUIPMENT AND SPECIAL TOOLS

TYPE INSTRUMENT	REQUIRED CHARACTERISTICS	APPLICATION	SUGGESTED INSTRUMENT
VOM	1. Voltage Range: 1 to 400 volts 2. Accuracy: 1% 3. Resistance Range: 100 megohms 4. Input Resistance: 20, 000 Ohms/ Volt DC	Voltage and Resistance Measurements	AN/PSM-4C
Oscilloscope	1. Calibrated vertical and horizontal deflection. 2. Input Impedance: 1 megohm/30 pf.	Visual waveform measurement	AN/USM-105A AN/USM-140C
Vertical Plug-in Extender	See Figure 5-1.	Operation of preamplifier outside of oscilloscope.	See Figure 5-1.

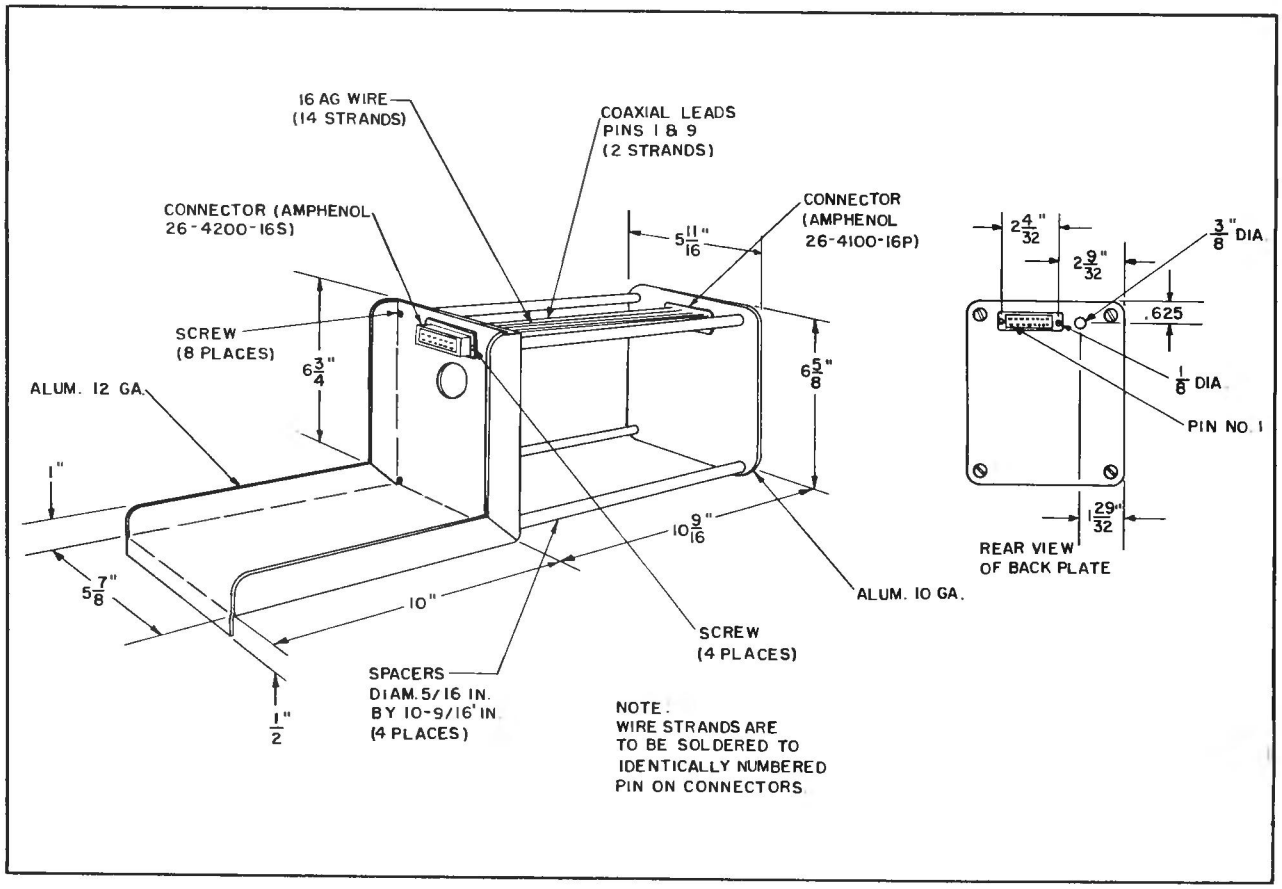


Figure 5-1. Vertical Plug-in Extender

5-1. INTRODUCTION.

The AM-3568A/USM Preamplifier forms an integral part of the oscilloscope with which it is used. All vertical input signals are first applied to the Preamplifier and then to the associated oscilloscope, therefore particular attention should be given to the control settings of both the Preamplifier and the oscilloscope.

This manual outlines shooting procedures for the Preamplifier only. For trouble shooting procedures for the oscilloscope with which the Preamplifier is to be used, refer to the trouble shooting section of the oscilloscope instruction manual.

5-2. OVERALL TROUBLE SHOOTING.

Before proceeding with any trouble shooting procedures for the AM-3568A/USM, ascertain that the oscilloscope is in good working condition. Check oscilloscope operating voltages and Reference Standards as outlined in the oscilloscope instruction manual. When it has been determined that the operation of the oscilloscope is satisfactory visually inspect the Preamplifier for any obvious defects, such as unseated vacuum tubes, loose wires etc.

Table 5-2 lists some of the most common troubles that may occur in the AM-3568A/USM. This chart is merely a guide to finding the section or specific part of the circuit that is not functioning properly. When the trouble has been pin-pointed to a specific circuit or section of a circuit the schematic diagram should be used as a trouble shooting guide. Voltage and resistance measurements and waveform measurements are shown on the schematic and should be used to determine the specific component or components that are at fault.

TABLE 5-2. TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of Trace	Improper Vertical Positioning Control Adjustment. Improper Vertical Positioning voltages. (Voltage on pins 1 and 9 of the innerconnecting plug must be essentially equal).	Adjust Vertical Positioning Control until trace appears on the CRT. Defective tubes. Check V803, V804, and V805 and replace if necessary.
Inability to position trace	Improper vertical positioning voltages. Defective Vertical Positioning control.	Defective tubes. Check V803, V804, and V805 and replace if necessary. Measure for open or short and replace if necessary.
Horizontal trace present but not waveform displayed in AC X10 position.	Defective component in X10 Amplifier section.	Check for defective tubes, open coils, shorted or open capacitor. Replace faulty component. eg: Open coil L801 will open plate line of V801B.
Horizontal trace present but no waveform displayed in any position of the Input Selector (AC X10, AC or DC)	Defective component in Amplifier/Phase Inverter stage or Output stage.	If trace can be moved vertically with the vertical position control, check components of the Amplifier/Phase Inverter stage (V803). If trace cannot be moved vertically with the vertical position control, check components of the Output stage (V805). Replace faulty component.
Low Vertical Gain	Gain components out of calibration. Defective tube in Preamplifier or Amplifier/Phase Inverter Stage.	Recalibrate as per calibration instructions. See Paragraph 3-7a(3) and 3-7a(4). Check and replace faulty tube.
Low frequency waveform distortion.	Low Frequency Compensation maladjusted. Improperly adjusted probe.	Recalibrate as per calibration instructions. See Paragraph 6-12. Readjust probe as per instructions.

TABLE 5-2. TROUBLE SHOOTING CHART (CONTINUED)

TROUBLE	PROBABLE CAUSE	REMEDY
High frequency waveform distortion	High frequency peaking coils misadjusted (L805 and L806).	Recalibrate as per calibration instructions. See Paragraph 6-14.
	Shorted or partially shorted peaking coils (L805 and L806).	Check and replace if necessary.
	L807 Defective.	Check and replace if necessary.

5-3. TROUBLE SHOOTING PROCEDURES.

With the signal disconnected, make successive dc measurements. (The dc voltages are shown in the schematic diagram with respect to ground unless otherwise indicated.) If the dc measurement does not agree with the reference on the schematic diagram, the fault or defect lies at this point. Check for defective tube, resistor, capacitor, switch, poor solder joint or loose wire connection. After repair, the waveforms should be as indicated on the schematic.

Using the test oscilloscope, check circuit operation by comparing waveforms, voltage measurements, and resistance measurements obtained with those on the schematic diagram.

Waveforms and voltage measurements called out on the schematic diagram are typical measurements. A slight deviation from these measurements should not be interpreted as a malfunction. Any major deviation from these measurements should be checked and corrected before proceeding with the trouble shooting procedure.

WARNING

TURN INSTRUMENT OFF BEFORE FOLLOWING ANY INSTRUCTION (CALLING FOR DISCONNECTION OF LEADS, REMOVAL OF TUBES, ETC.) WHICH MAY CAUSE CONTACT WITH OFF-GROUND POTENTIALS.

In many cases, instrument failure is caused by faulty vacuum tubes. The best method of determining if a tube is faulty is to replace it with a known good tube of the same type.

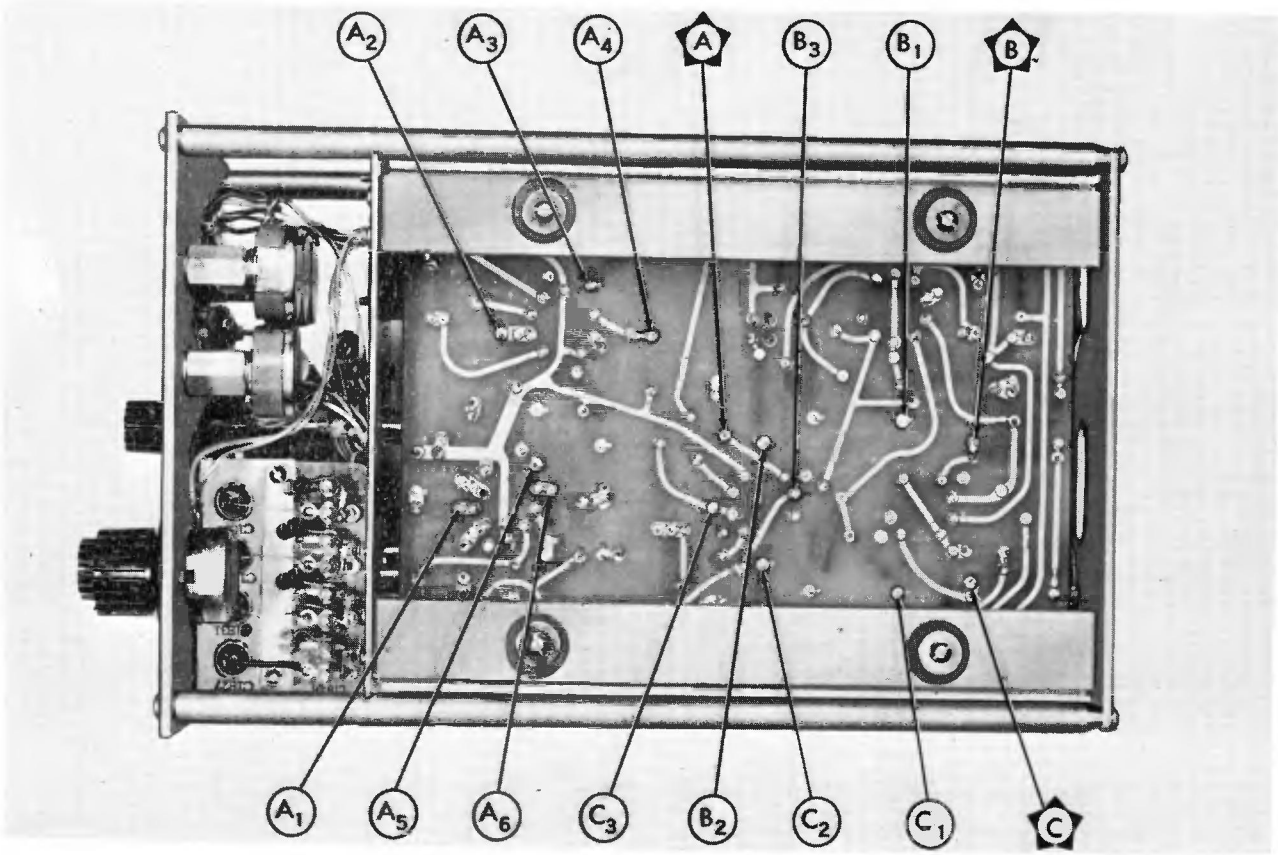


Figure 5-2. Location of Test Points, AM-3568A/USM

SECTION 6
SERVICE, REPAIR AND RECALIBRATION

6A PREVENTATIVE MAINTENANCE

6-1. INTRODUCTION.

Preventative maintenance for the AM-3568A/USM Preamplifier consists mainly of visual inspection for potential sources of trouble. General good-housekeeping techniques such as periodic visual inspection for loose switch knobs, unseated vacuum tubes, loose or frayed wire, etc., will assure long trouble-free operation of the Preamplifier.

The power supply voltages of the oscilloscope should be checked periodically to assure that the power supply voltages are operating within their rated accuracy.

6B REFERENCE STANDARDS

6-2. GENERAL.

Reference Standards are included in this manual so that they may be used as guides to determine that the instrument is operating at specified accuracies (para. 1-3). After repair of the instrument the repaired circuit or circuits should be recalibrated per the applicable portion of the Adjustment and Recalibration procedures outlined in paragraph 6-4. After recalibration, instrument performance should be checked by the procedures outlined in this section.

6-3. TEST EQUIPMENT.

Test equipment required for service and repair of AM-3568A/USM is listed in Table 6-1. Other test equipment having the same characteristics may be substituted for the models listed. All tests are to be performed using an Oscilloscope of the AN/USM-140 series.

TABLE 6-1. TEST EQUIPMENT REQUIRED FOR SERVICE AND REPAIR

EQUIPMENT	REQUIRED CHARACTERISTICS	TO BE USED FOR	MODEL
Square Wave Generator	Output: 1 cps to 1 mc, 75 ohm and 600 ohm output.	Low Frequency Response Check	HP 211A
Fast Rise Time Square Wave Generator	Output: 0.4 mc to 1.0 mc. Risetime: 3.0 nanosec.	High Frequency Compensation Check	Tektronix Model 107.
Constant Amplitude Signal Generator	Range: 0.35 to 50 mc. Constant Amplitude Voltage: 1-10 volts peak-to-peak.	Frequency Response Check	Tektronix Model 190A.
20 pf Capacitance Standardizer		Input Capacitance Standardization	Tektronix Model 011-022. (CS20)
10:1 Attenuation "T" Pad	Attenuation Ratio: 10:1 Impedance: 52 ohms.	Frequency Response Check	Tektronix Model B52 T10.
Voltmeter Calibration Generator	Output Voltage: 0.01 to 50 volts @400 cps. Accuracy: ± 0.25%.	Attenuator Calibration	Hewlett-Packard Model 738AR.
Vertical Plug-in Extender	See Figure 5-1.	Operation of Preamplifier outside of oscilloscope	See Figure 5-1.
Tube Tester		Checking Vacuum Tubes	AN/USM-118A or AN/USM-118B

6-4. PERFORMANCE TESTS.

Performance tests for the AM-3568A/USM are described in paragraphs 6-5 through 6-9.

6-5. ATTENUATOR CALIBRATION.

The calibration of the input attenuators of the Preamplifier is measured in the following manner:

a. Connect the output of the Voltmeter Calibration Generator to the INPUT connector of the AM-3568A/USM with a BNC-GR cable. Set the FUNCTION switch of the Voltmeter Calibration Generator to 400 cycles peak-to-peak.

b. Set the oscilloscope SWEEP TIME to 1 ms/cm. Set the GAIN adjustment of the Preamplifier so that 0.2 volts from the Voltmeter Calibration Generator gives exactly 4 centimeters of vertical deflection with the SENSITIVITY switch set to 0.05 V/CM.

c. Set the output of the Voltmeter Calibration Generator to the following settings for the sensitivity to be checked. The vertical deflection should be within the indicated values:

SENSITIVITY	VOLTMETER CALIBRATION GENERATOR	VERTICAL DEFLECTION
0.05	0.2	4.00
0.10	0.3	2.91 to 3.09
0.20	0.5	2.42 to 2.58
0.50	1.0	1.94 to 2.06
1.00	3.0	2.91 to 3.09
2.00	5.0	2.42 to 2.58
5.00	10.0	1.94 to 2.06
10.00	30.0	2.91 to 3.09
20.00	50.0	2.42 to 2.58

d. Set the SENSITIVITY switch of the Preamplifier to 0.05 V/CM and turn the VERNIER control fully counterclockwise. Set the Voltmeter Calibration Generator to 0.05 volts. The deflection should be less than 4 centimeters.

e. Set the Voltmeter Calibration Generator to the following settings. Set the Input Selector AM-3568A/USM to AC X10. The vertical deflection should be within the values listed.

SENSITIVITY	VOLTMETER CALIBRATION GENERATOR	VERTICAL DEFLECTION
0.005	0.01	1.94 to 2.06
0.010	0.03	2.91 to 3.09
0.020	0.05	2.42 to 2.58

6-6. SENSITIVITY, VOLTAGE ACCURACY, AND LINEARITY.

The dc sensitivity, voltage accuracy, and linearity of the cathode ray tube is measured with the same test equipment setup as in paragraph 6-5 (Attenuator Calibration) except that the Voltmeter Calibration Generator shall be set to dc+ and the input of the AM-3568A/USM shall be set on dc coupling.

a. Set the oscilloscope SWEEP MODE control to FREE RUN to obtain a base line reference trace.

b. Set the Voltmeter Calibration Generator to zero output and position the oscilloscope trace on the lowest graticule line.

c. Set the Preamplifier SENSITIVITY switch and the Voltmeter Calibration Generator output switch as shown below. The trace should be displaced upward the indicated number of centimeters.

SENSITIVITY	VOLTMETER CALIBRATION GENERATOR	VERTICAL DEFLECTION
0.05	0.10	1.94 to 2.06
0.10	0.30	2.91 to 3.09
0.20	0.50	2.42 to 2.58
0.50	0.50	0.97 to 1.03
0.50	1.00	1.94 to 2.06
0.50	2.00	3.88 to 4.12
1.00	3.00	2.91 to 3.09
2.00	5.00	2.42 to 2.58
5.00	10.00	1.94 to 2.06
10.00	30.00	2.91 to 3.09
20.00	50.00	2.42 to 2.58

d. Rotate the VERNIER control for minimum sensitivity (full CCW). With the calibrator voltage of 100.0 volts, the vertical deflection should be 2 centimeters or less.

6-7. SQUARE WAVE RESPONSE.

The square wave response of the AM-3568A/USM preamplifier is checked in the following manner:

a. Set the SENSITIVITY switch to 0.05 V/CM and the Input Selector to DC. Connect the 52 ohm output of the Fast Rise Time Square Wave Generator to the INPUT connector of the AM-3568A/USM with a 52 ohm BNC-BNC cable and a 52 ohm feed-thru termination. Set the frequency of the Fast Rise Time Square Wave Generator to 1 megacycle.

b. Set the oscilloscope SWEEP TIME switch to INTERNAL SWEEP MAGNIFIER X5. Adjust oscilloscope sweep controls to obtain a stable display.

c. Set the amplitude control of the Fast Rise Time Square Wave Generator to give 4 centimeters of vertical deflection. Measure the 10 to 90 percent rise time of the displayed square wave. Since the Fast Rise Time Square Wave Generator has a rise time of about 3 nanoseconds, the measured rise time should not exceed 0.0124 usec.

d. Switch the Preamplifier Input Selector to AC X10. Connect the 52 ohm "T" attenuator to the 52 ohm output of the Fast Rise Time Square Wave Generator and set the amplitude control of the generator to give 4 centimeters of vertical deflection. The 10 to 90 percent risetime of the square wave should not exceed 0.015 usec.

e. Set the oscilloscope HORIZONTAL DISPLAY switch to X1 and the SWEEP TIME switch to 0.5 usec/cm. Adjust the oscilloscope sweep controls to obtain a stable display.

f. Observe the quality of the resultant waveform. There should be no noticeable ringing, oscillations, slope, or spurious responses. For the purpose of precise measurement any effect greater than 2 percent will be considered noticeable.

g. Adjust the oscilloscope TRIGGER LEVEL control as far negative as possible and still maintain stable triggering. (Use of the SWEEP MODE control may be necessary). The leading edge of the square wave shall be visible.

h. Connect the Square Wave Generator 600 ohm output to the INPUT connector of the AM-3568A/USM and the 75 ohm output to the EXT. SYNC. connector of the oscilloscope. Set the oscilloscope SWEEP TIME switch to 50 usec/cm. Set the frequency of the Square Wave Generator to 5kc. Set the 75 ohm output to maximum and adjust the 600 ohm output to give approximately 4 centimeters of vertical deflection of the displayed square wave.

i. Adjust the Preamplifier SENSITIVITY switch to successive steps of less sensitivity and increase the 600 ohm output of the Square Wave Generator simultaneously to maintain approximately constant vertical deflection.

j. Observe the quality of the waveform. There should be no noticeable ringing, oscillations, slope droop, or spurious responses. Check each position of the SENSITIVITY switch. For the purpose of precise measurement any effect greater than 2 percent will be considered noticeable.

k. Set the SWEEP TIME switch to 2 MILLISECONDS/CM. Set the Square Wave Generator frequency to 100 cps and adjust the 600 ohm output and the Preamplifier SENSITIVITY switch for 4 centimeters of vertical deflection.

l. Observe the quality of the waveform. There should be no noticeable droop or rise in the flat top of the square wave.

6-8. FREQUENCY RESPONSE.

The frequency response of the AM-3568A/USM measured in the following manner:

a. Set the SENSITIVITY switch to 0.05 V/CM and the Input Selector to AC. Connect the output of the Constant Amplitude Signal Generator to the AM-3568A/USM INPUT connector.

b. Adjust the oscilloscope sweep controls for a free-running display. Adjust the output amplitude of the Constant Amplitude Signal Generator for exactly 4 centimeters of vertical deflection at 50kc.

c. Change the frequency of the Constant Amplitude Signal Generator to 30 megacyles. The vertical deflection of the 30 megacycle sine wave should be at least 2.8 centimeters.

d. Set the Preamplifier Input Selector to AC X10. Connect the 10:1 "T" attenuator between the output of the Constant Amplitude Signal Generator and the Preamplifier INPUT connector. Adjust the output amplitude of the Constant Amplitude Signal Generator for exactly 4 centimeters of vertical deflection at 50 KC.

e. Change the frequency of the Constant Amplitude Signal Generator to 24 megacycles. The vertical deflection of the 24 megacycle sine wave should be at least 2.8 centimeters.

6-9. VERTICAL POSITION RANGE.

The vertical position range of the AM-3568A/USM is checked with the same equipment setup as that for paragraph 6-5 (Attenuator Calibration).

Set the output of the Voltmeter Calibration Generator to 0.5 volts. Set the Preamplifier SENSITIVITY switch to 0.05 V/CM. Adjust the VERTICAL POSITION control from one extreme to the other. The signal should move beyond the uppermost and the lowest graticule marking in both the upward and downward direction.

6C MAINTENANCE REPAIR

Complete adjustment and recalibration of the Preamplifier is described in the following paragraphs. Table 3-1 lists the required adjustments after the replacement of vacuum tubes. Table 6-1 lists the test equipment required for complete recalibration of the instrument.

6-10. PREAMPLIFIER INPUT CAPACITANCE ADJUSTMENT.

Set the controls of the AM-3568A/USM as follows:
INPUT SELECTOR. . . . . DC

SENSITIVITY . . . . . 0.05 V/CM

Apply a 0.2 volt square wave from the oscilloscope square wave calibrator through the 20 pf Capacitance Standardizer to the INPUT connector of the AM-3568A/USM. Adjust the oscilloscope sweep controls for a stable display of a few cycles of the square wave. Adjust C819 for a flat top of the displayed square wave.

6-11. ATTENUATOR COMPENSATION ADJUSTMENT.

Using the output from the oscilloscope square wave calibrator (be sure to remove 20 pf capacitance standardizer) adjust the Attenuator Compensation Capacitors (see Figure 6-1) according to the following settings to remove the spike from the leading edge of the displayed square wave.

OSCILLOSCOPE CALIBRATOR SETTING	SENSITIVITY SWITCH SETTING	ADJUST ATTEN. COMP. CAPACITOR
0.2V	0.1 V/CM	C1805
0.5V	0.2 V/CM	C1809
1.0V	0.5 V/CM	C1814
2.0V	1.0 V/CM	C1818
5.0V	2.0 V/CM	C1826
10.0V	5.0 V/CM	C1830
20.0V	10.0 V/CM	C1834
50.0V	20.0 V/CM	C1838

6-12. ATTENUTATOR INPUT CAPACITANCE ADJUSTMENT.

Using the output from the oscilloscope square wave calibrator through the 20 pf capacitance standardizer adjust the Attenuator Input Capacitance capacitors according to the following settings for a flat top on the displayed square wave.

OSCILLOSCOPE CALIBRATOR SETTING	SENSITIVITY SWITCH SETTING	ADJUST INPUT CAPACITOR
0.5V	0.1 V/CM	C1803
1.0V	0.2 V/CM	C1807
2.0V	0.5 V/CM	C1812
5.0V	1.0 V/CM	C1817
10.0V	2.0 V/CM	C1825
20.0V	5.0 V/CM	C1829
50.0V	10.0 V/CM	C1833
100.0V	20.0 V/CM	C1837

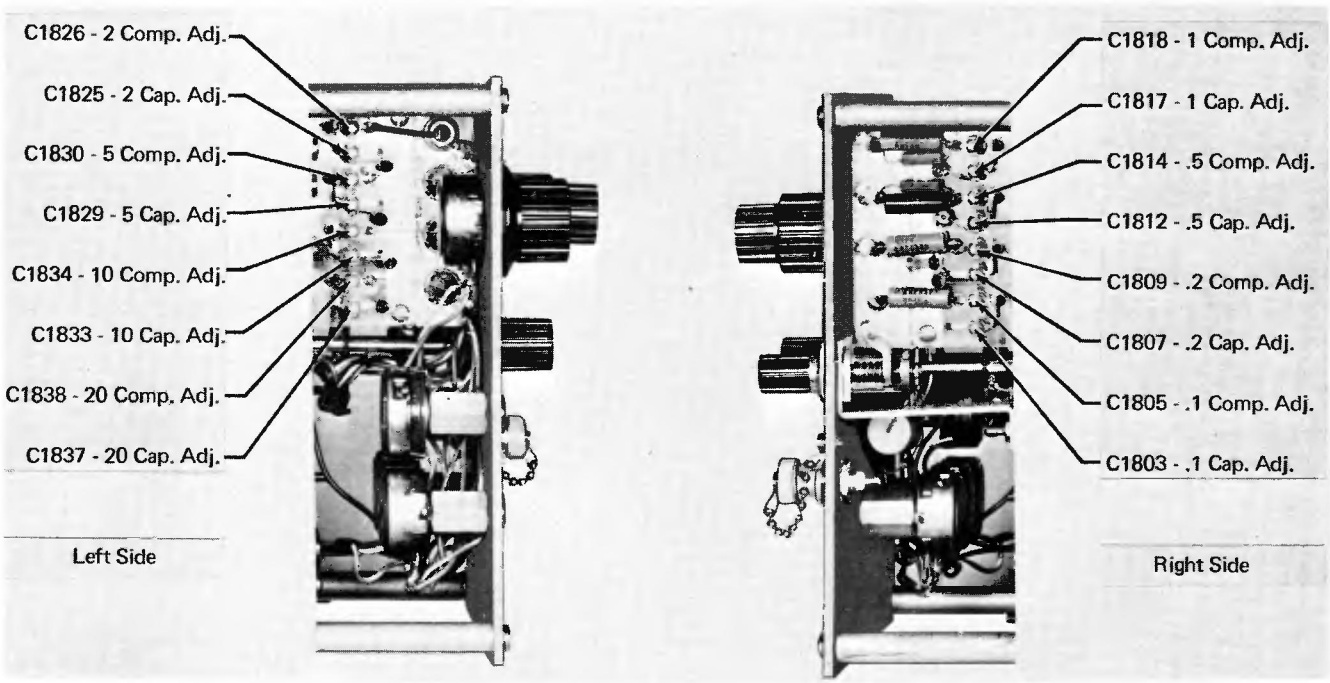


FIGURE 6-1. LOCATION OF ATTENUATOR ADJUSTMENTS

6-13. LOW FREQUENCY COMPENSATION.

a. Set the controls of the Preamplifier as follows:

INPUT SELECTOR . . . . . DC

SENSITIVITY 0.05V/CM

b. Apply a square wave from the 75 ohm output of the H.P. 211A Square Wave Generator to the AM-3568A/USM Preamplifier INPUT connector, set frequency to 100 cps, the 75 ohm attenuator to 20 db, and amplitude for 4 cm deflection. Adjust R868 for a flat top on the displayed square wave.

6-14. HIGH FREQUENCY COMPENSATION.

Set the controls of the AM-3568A/USM as follows:

INPUT SELECTOR . . . . . AC

SENSITIVITY 0.05V/CM

Connect the output of the Fast Rise Time Square Wave Generator to the INPUT connector of the AM-3568A/USM.

Adjust the frequency of the Fast Rise Time Square Wave Generator to approximately 500kc and adjust the oscilloscope sweep controls for a stable display of a few cycles of the square wave.

Adjust the amplitude of the Fast Rise Time Square Wave Generator for approximately 3 centimeters of vertical deflection of the displayed square wave.

Adjust L805 and L806 for a slight peak on the leading edge of the displayed 500kc square wave.

6-15. X10 HIGH FREQUENCY COMPENSATION.

Set the controls of the AM-3568A/USM as follows:

INPUT SELECTOR . . . . . AC X10

SENSITIVITY 0.05V/CM

Connect the output of the Fast Rise Time Square Wave Generator through the 10:1 attenuator pad to the INPUT connector of the AM-3568A/USM.

Adjust the frequency of the Fast Rise Time Square Wave Generator to approximately 500kc and adjust the oscilloscope sweep controls for a stable display of a few cycles of the square wave.

Adjust the amplitude of the Fast Rise Time Square Wave Generator for approximately 3 centimeters of vertical deflection of the displayed square wave.

Adjust C806 for a flat top on the displayed square wave.

Adjust L803 for a slight peak on the leading edge of the displayed square wave.

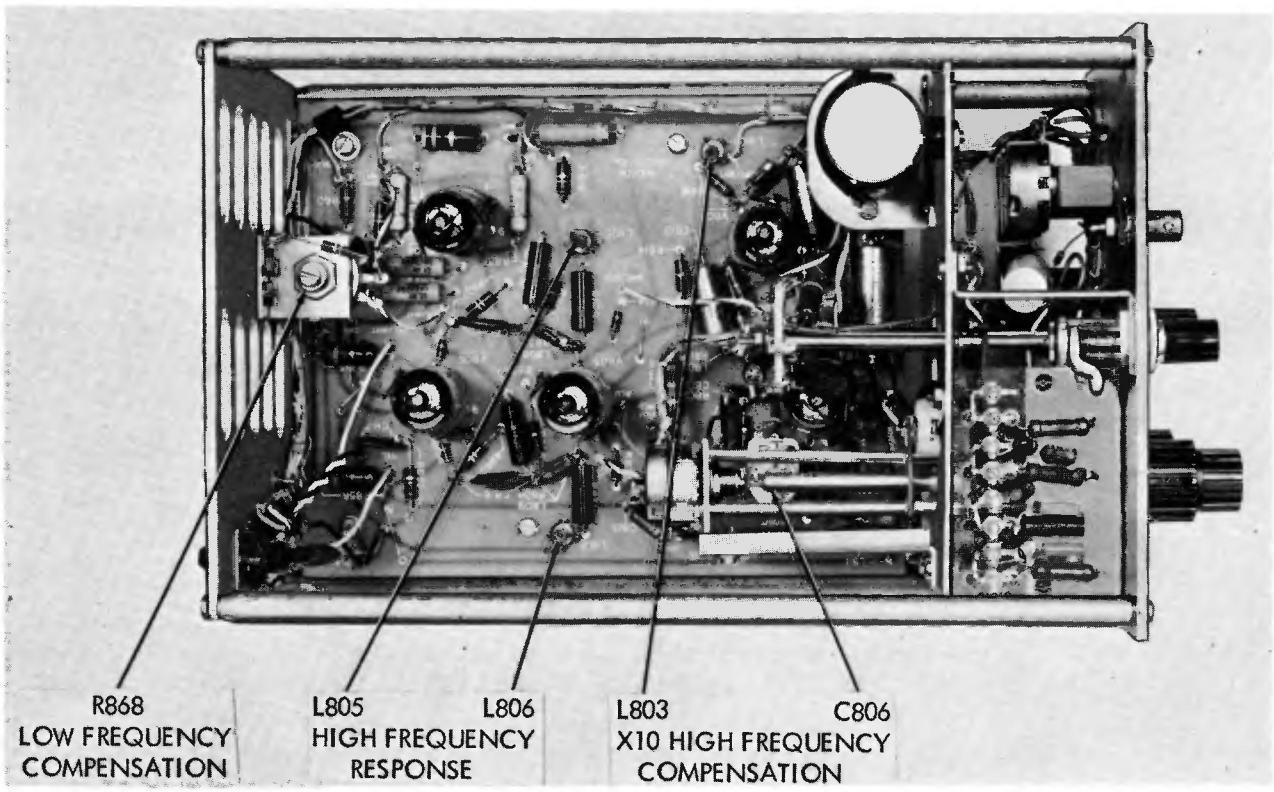


Figure 6-2. Location of Adjustments, AM-3568A/USM

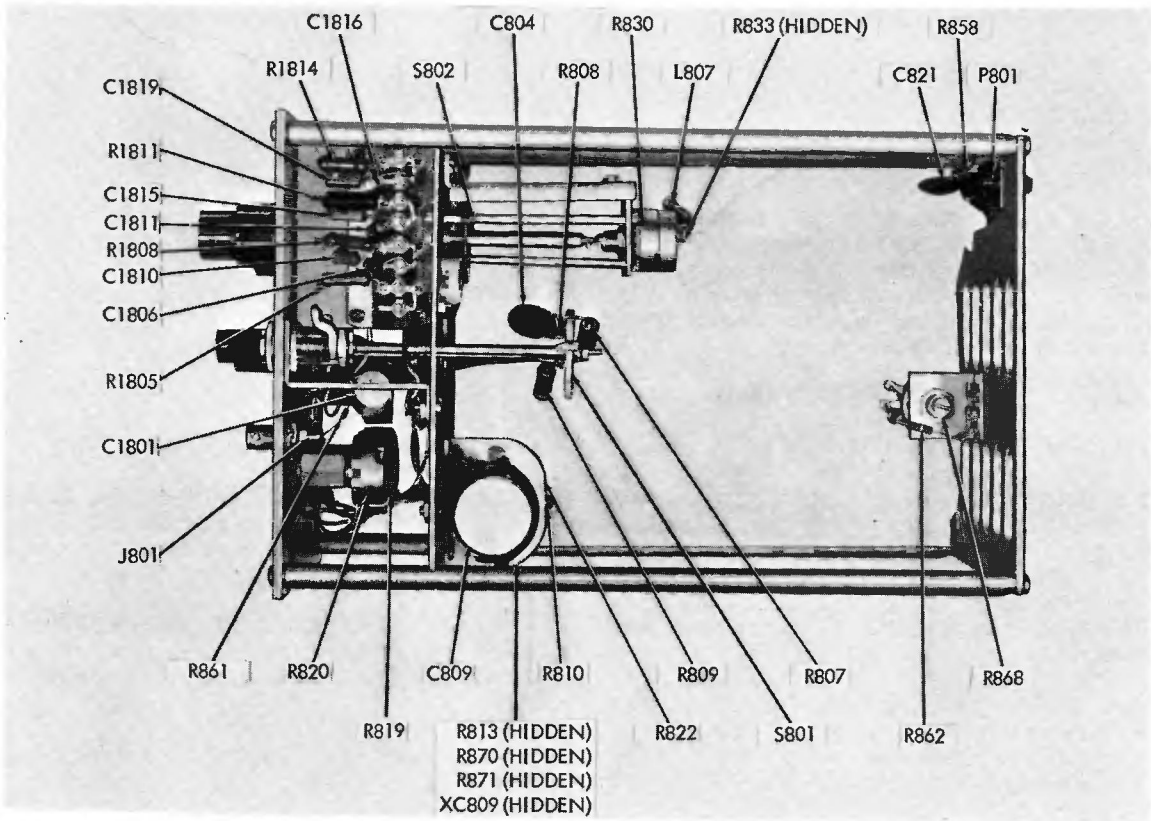


Figure 6-3. Location of parts, Right Side, AM-3568A/USM

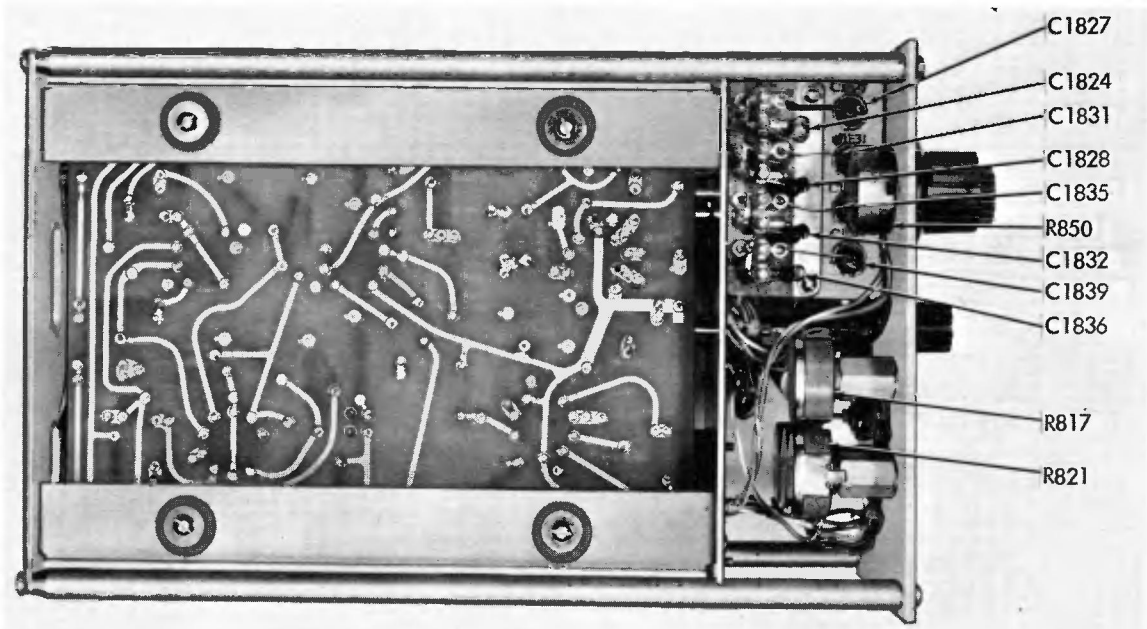


Figure 6-4. Location of Parts, Left Side, AM-3568A/USM

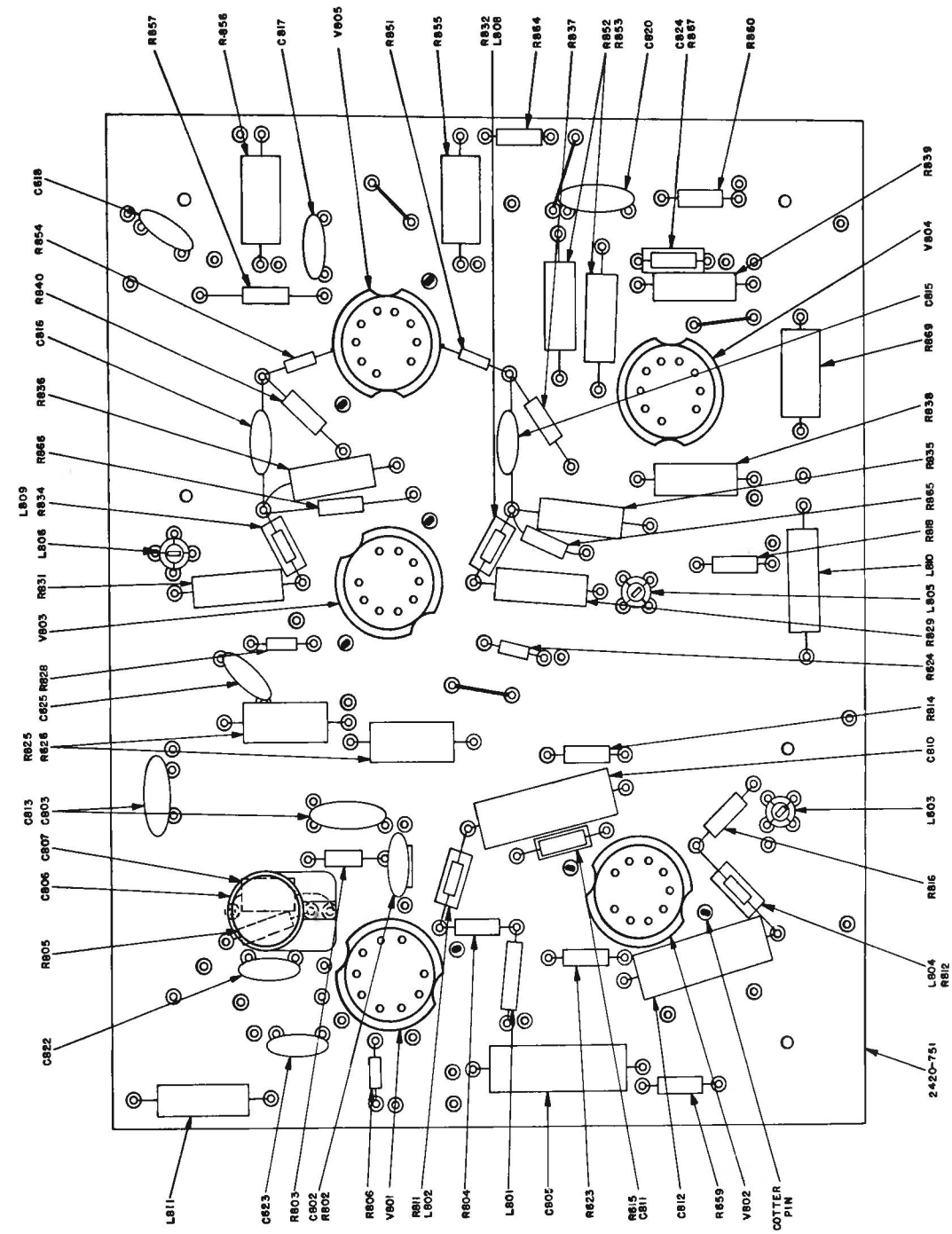


Figure 6-5. Location of Parts, Circuit Board A801, AM-3568A/USM

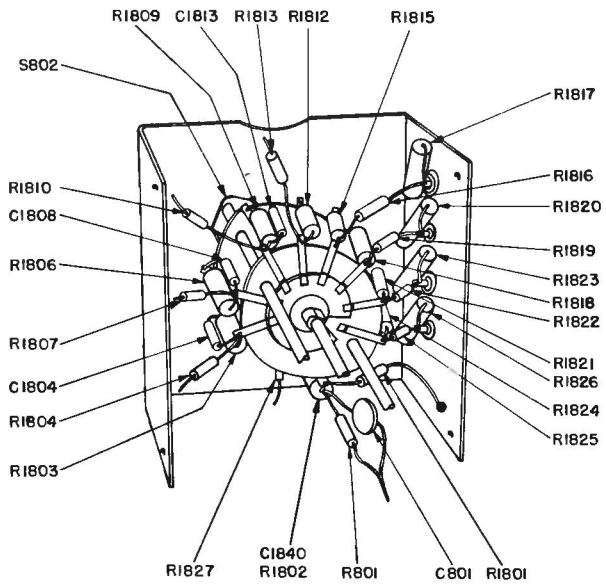
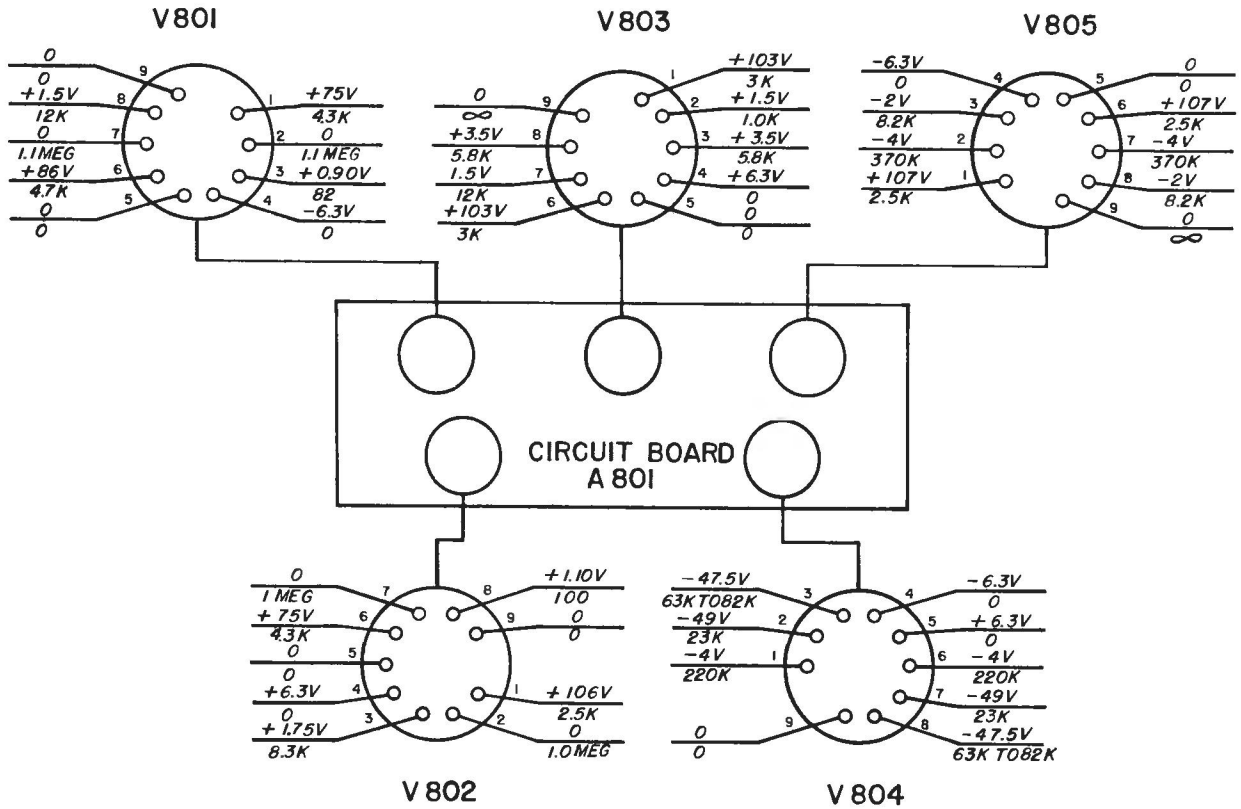


Figure 6-6. Location of Parts, Attenuator Switch, AM-3568A/USM


V801
0
0
+1.5V
12K
0
1.1MEG
+86V
4.7K
0
0
+75V
4.3K
0
1.1MEG
+0.90V
82
-6.3V
0
V803
0
∞
+3.5V
5.8K
1.5V
12K
+103V
3K
+103V
3K
+1.5V
1.0K
+3.5V
5.8K
+6.3V
0
0
0
V805
-6.3V
0
-2V
8.2K
-4V
370K
+107V
2.5K
0
0
+107V
2.5K
-4V
370K
-2V
8.2K
0
∞
INPUT J801
CIRCUIT BOARD
A 801
V802
0
1 MEG
+75V
4.3K
0
0
+6.3V
0
+1.75V
8.3K
+1.10V
100
0
0
+106V
2.5K
0
1.0MEG
V804
-47.5V
63K TO 82K
-49V
23K
-4V
220K
0
0
-6.3V
0
+6.3V
0
-4V
220K
-49V
23K
-47.5V
63K TO 82K

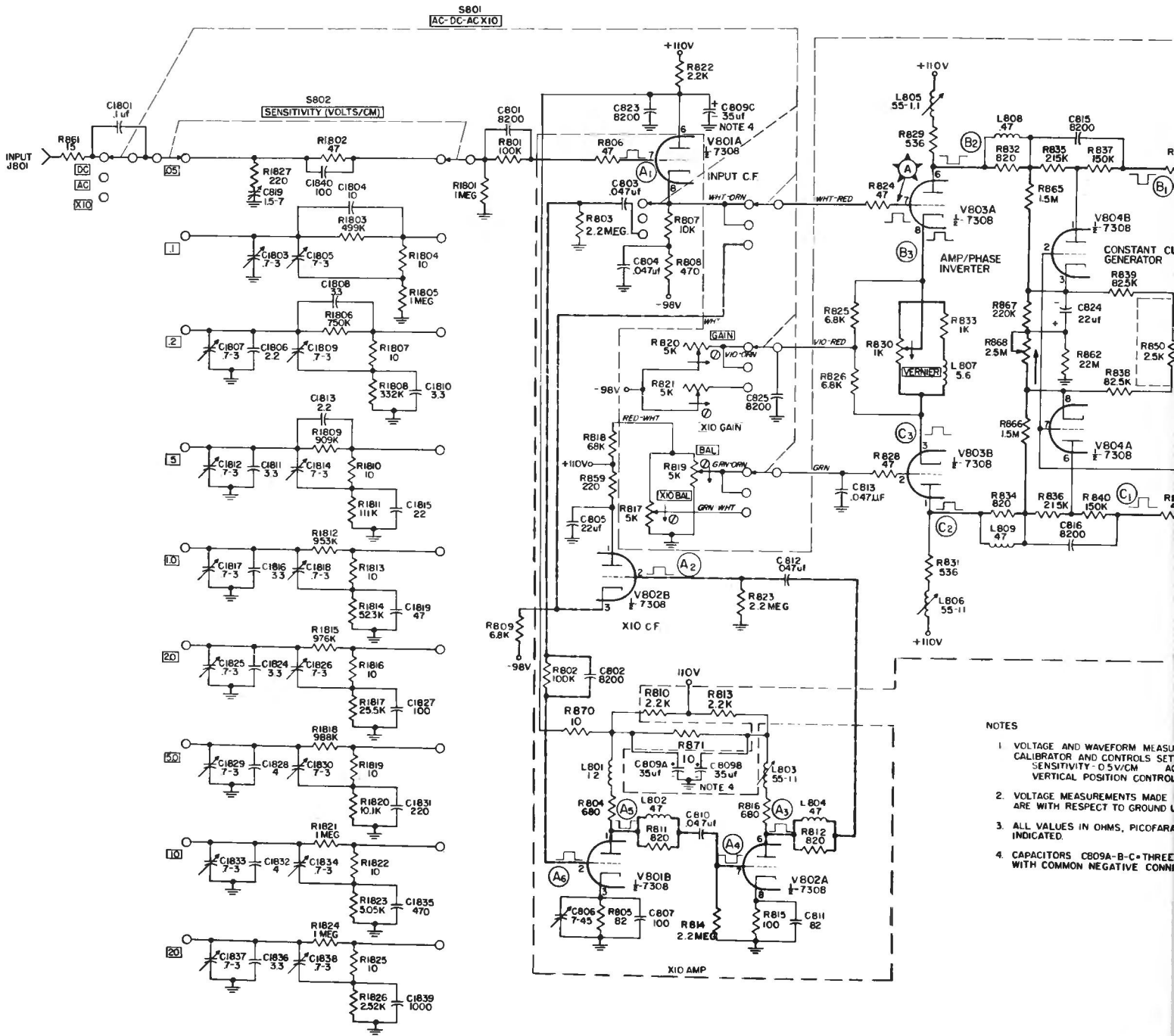
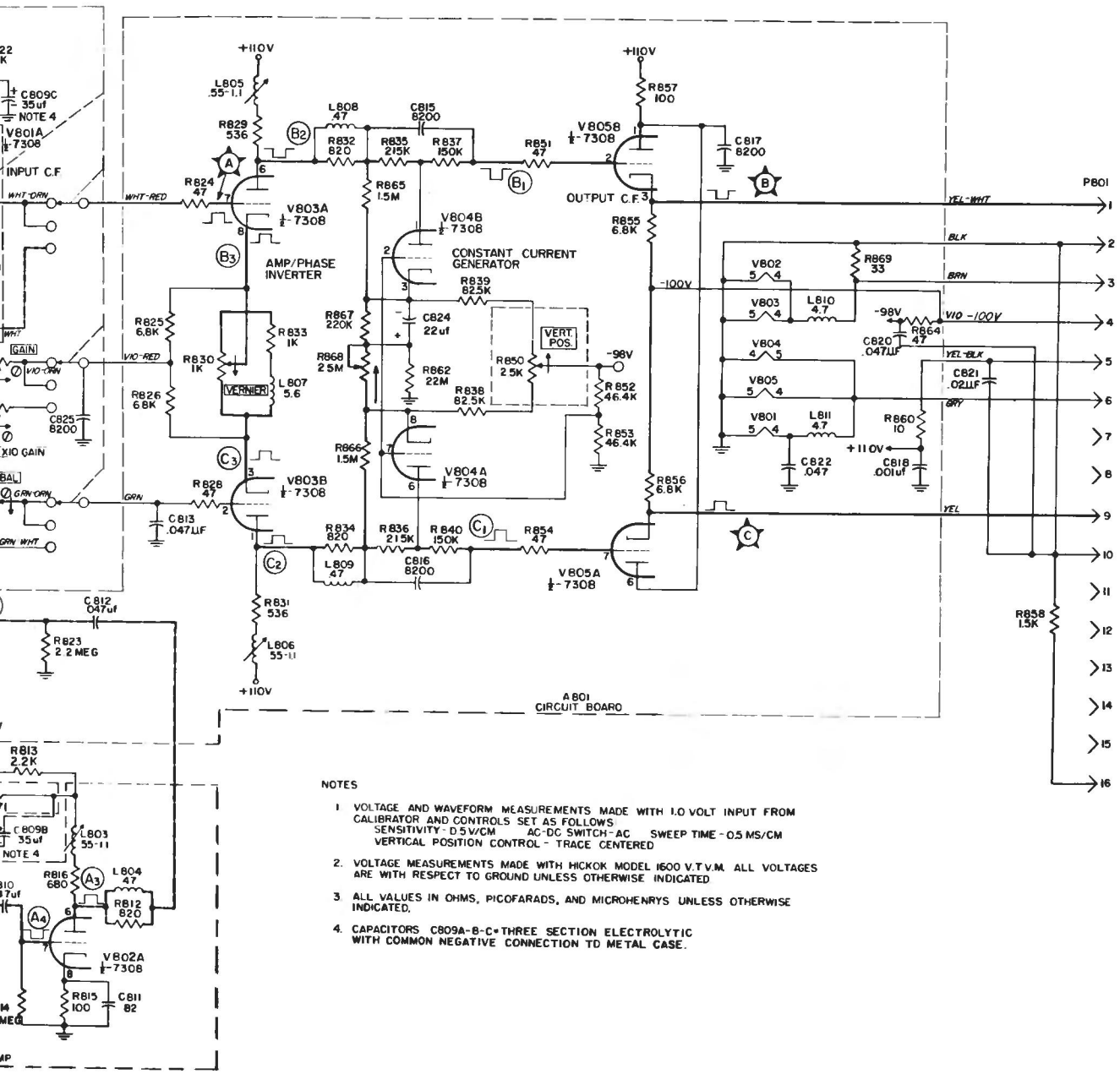


Figure 6-7. Schematic Diagram of AM-3568A/USM Preamplifier



NOTES

1. VOLTAGE AND WAVEFORM MEASUREMENTS MADE WITH 1.0 VOLT INPUT FROM CALIBRATOR AND CONTROLS SET AS FOLLOWS:
   SENSITIVITY - 0.5 V/CM AC-DC SWITCH - AC SWEEP TIME - 0.5 MS/CM
   VERTICAL POSITION CONTROL - TRACE CENTERED
2. VOLTAGE MEASUREMENTS MADE WITH HICKOK MODEL 1600 V.T.V.M. ALL VOLTAGES ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.
3. ALL VALUES IN OHMS, PICOFARADS, AND MICROHENRYS UNLESS OTHERWISE INDICATED.
4. CAPACITORS C809A-B-C THREE SECTION ELECTROLYTIC WITH COMMON NEGATIVE CONNECTION TO METAL CASE.

hematic Diagram of AM-3568A/USM Preamplifier

SECTION 7
PARTS LIST

7-1. INTRODUCTION.

Reference designations have been assigned to all maintenance parts of the equipment. They are used on drawings, diagrams and illustrations to identify and locate the various parts. When practical the reference designations are marked on the chassis or terminal boards adjacent to the parts they identify. The letters of a reference designation indicate the kind of part (generic group), such as resistor, capacitor, electron tube, etc. The number differentiates between parts of the same group. Sockets associated with a particular plug-in device such as an electron tube, lamp or plug-in capacitor are identified by a reference designation which includes the designation of the plug-in device. For example, the socket for an electron tube V101 is designated XV101 and the socket for plug-in capacitor C101 is XC101.

7-2. MAINTENANCE PARTS LIST.

Table 7-1 lists all maintenance parts for the equipment. Column 1 lists the reference designations in alpha-numeric sequence. Column 2 provides references to explanatory notes which may appear in paragraph 7-5. Column 3 gives the name and a brief description of the part. Column 4 identifies the illustration which pictorially locates the part.

7-3. LIST OF MANUFACTURERS.

Table 7-2 lists the manufacturers of parts used in the equipment. The first column lists the manufacturer's code used in table 7-1 to identify the manufacturers.

7-4. STOCK NUMBER IDENTIFICATION.

Allowance Parts Lists (APL) issued by the Electronics Supply Office (ESO) include Federal Stock Numbers and Source Maintenance and Recoverability Codes. Therefore, reference should be made to the APL prepared for the equipment for stock numbering information.

7-5. NOTES.

The following note provides information as referenced in table 7-1.

A. MIL type CE58C350J may be substituted for replacement.

TABLE 7-1. MAINTENANCE PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
A801		BOARD, ETCHED CIRCUIT; includes: C802, C803, C805, C806, C807, C810, C811, C812, C813, C815, C816, C817, C818, C820, C822, C823, C824, C825, L801, L802, L803, L804, L805, L806, L808, L809, L810, L811, R802, R803, R804, R805, R806, R811, R812, R814, R815, R816, R818, R823, R824, R825, R826, R828, R829, R831, R832, R834, R835, R836, R837, R838, R839, R840, R851, R852, R853, R854, R855, R856, R857, R859, R860, R864, R865, R866, R867, R869, V801, V802, V803, V804, V805, XV801, XV802, XV803, XV804, XV805, (mfr 28569 p/n 2420-761)	6-5
A802		SWITCH ASSEMBLY, DC-AC-ACX10, includes: C804, C1801, R807, R808, R809, S801; (mfr 28569 p/n 19915-686)	6-3
A1801		ATTENUATOR ASSEMBLY, includes: A1802, A1803, R1801, R1804, R1807, R1810, R1813, R1816, R1819, R1822, R1825; (mfr 28569 p/n 1920-31)	6-6
A1802		CAPACITOR BRACKET ASSEMBLY, includes: C1810, C1815, C1819, C1827, C1831, C1835, C1839, R1804, R1805, R1811, R1814, R1817, R1820, R1823, R1826: (mfr 28569 p/n 2661-171)	6-3, 6-4

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
A1803		SWITCH ASSEMBLY, V/CM, includes: C801, C1804, C1808, C1813, C1840, L807, R801, R830, R833, R1802, R1803, R1806, R1809, R1812, R1815, R1818, R1821, R1824, R1827, S802; (mfr 28569 p/n 19915-685)	6-6
C801		CAPACITOR, FIXED, CERAMIC: 8200 pf, ±20%, 500V; MIL type CK62AW822M	6-6
C802		Same as C801	6-5
C803		CAPACITOR, FIXED, CERAMIC: .047 uf, ±20%, 200V; (mfr 72982 p/n 825-030X5V0473M)	6-5
C804		Same as C803	6-3
C805		CAPACITOR, FIXED, PAPER: .22 uf ±10%, 500V; MIL type CP09A1KC224K3.	6-5
C806		CAPACITOR, VARIABLE: 7-45 pf, 500V; MIL type CV11C450.	6-5
C807		CAPACITOR, FIXED, MICA: 82 pf, ±5%, 500V; MIL type CM15CD820JN3.	6-5
C808		Not Assigned	
C809A, B, C	A	CAPACITOR, FIXED, ELECTROLYTIC: 3X 35 uf, 150V; MIL type CE53C350J.	6-3
C810		CAPACITOR, FIXED, PAPER: .047 uf, ±10%, 200V; MIL type CP09A1KC473K3.	6-5
C811		Same as C807	6-5
C812		Same as C810	6-5
C813		Same as C803	6-5
C814		Not Assigned	
C815		Same as C801	6-5
C816		Same as C801	6-5
C817		Same as C801	6-5
C818		CAPACITOR, FIXED, CERAMIC: 1000 pf, ±10%, 500V; MIL type CK62BX102K.	6-5
C819		CAPACITOR, VARIABLE: 1.5-7 pf 500V; MIL type CV11A070.	6-2
C820		Same as C803	6-5
C821		CAPACITOR, FIXED, CERAMIC: .02 uf, ±20%, 500V; (mfr 72982 p/n 841-000Z5U0203M).	6-3
C822		Same as C803	6-5
C823		Same as C801	6-5

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C824		CAPACITOR, FIXED, TANTALUM: 22 uf, ±10%, 15V; MIL type CSR13D226KL.	6-5
C825		Same as C801	6-5
C1801		CAPACITOR, FIXED, PLASTIC: .1 uf, ±20%, 600V; (mfr 56289 p/n S92684)	6-3
C1802		Not Assigned	
C1803		CAPACITOR, VARIABLE: 0.7-3 pf, 350V; (mfr 72982 p/n 535-034-4R)	6-1
C1804		CAPACITOR, FIXED, CERAMIC: 10pf, ±.25 pf, 500V; MIL type CC20CH100C.	6-6
C1805		Same as C1803	6-1
C1806		CAPACITOR, FIXED, CERAMIC: 2.2 pf, ±.25 pf, 500V; MIL type CC22CK2R2C.	6-3
C1807		Same as C1803	6-1
C1808		CAPACITOR, FIXED, CERAMIC: 3.3 pf, ±.25 pf, 500V; MIL type CC22CJ3R3C.	6-6
C1809		Same as C1803	6-1
C1810		Same as C1808	6-3
C1811		Same as C1806	6-3
C1812		Same as C1803	6-1
C1813		Same as C1806	6-6
C1814		Same as C1803	6-1
C1815		CAPACITOR, FIXED, MICA: 22 pf, ±5% 500V; MIL type CM15CD220JN3.	6-3
C1816		Same as C1808	6-3
C1817		Same as C1803	6-1
C1818		Same as C1803	6-1
C1819		CAPACITOR, FIXED, MICA: 47 pf, ±5%, 500V; MIL type CM15CD470JN3.	6-3
C1820 thru C1823		Not Assigned	
C1824		Same as C1808	6-4
C1825		Same as C1803	6-1
C1826		Same as C1803	6-1

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C1827		CAPACITOR, FIXED, MICA: 100 pf, ±5%, 300V; MIL type CB11RD101J.	6-4
C1828		CAPACITOR, FIXED, CERAMIC: 4.0 pf, ±.25 pf, 500V; MIL type CC22CH040C.	6-4
C1829		Same as C1803	6-1
C1830		Same as C1803	6-1
C1831		CAPACITOR, FIXED, MICA: 220 pf, ±5%, 300V; MIL type CB11RD221J.	6-4
C1832		Same as C1828	6-4
C1833		Same as C1803	6-1
C1834		Same as C1803	6-1
C1835		CAPACITOR, FIXED, MICA: 470 pf, ±5%, 300V; MIL type CB11RD471J.	6-4
C1836		Same as C1808	6-4
C1837		Same as C1803	6-1
C1838		Same as C1803	6-1
C1839		CAPACITOR, FIXED, MICA: 1000 pf, ±5%, 300V; MIL type CB11RD102J.	6-4
C1840		CAPACITOR, FIXED, MICA: 1000 pf, ±5%, 500V; MIL type CM15CD101JN3.	6-6
E801		COVER, CONNECTOR: MIL type CW-123A/U, BNC.	3-1 (1)
J801		CONNECTOR, RECEPTACLE: MIL panel type UG-625B/U, BNC.	6-3
L801		COIL, RF: 1.2 uh, ±10%, 785 ma, 400 ohm dc res; MIL type MS75008-29.	6-5
L802		COIL, RF: .47 uh, ±20%; MIL type MS75008-24.	6-5
L803		COIL, RF: 0.55-1.1 uh ±5%; (mfr 28569 p/n 3320-294)	6-5
L804		Same as L802	6-5
L805		Same as L803	6-5
L806		Same as L803	6-2, 6-5
L807		COIL, RF: 5.60 uh ±10%; MIL type MS75008-37.	6-3
L808		Same as L802	6-5
L809		Same as L802	6-5

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
L810		COIL, RF: 4.7 uh, ±10%, 1200 ma, .6 ohm res; MIL type MS16221-7.	6-5
L811		Same as L810	6-5
L812		Not Assigned	
MP801		LATCH: pawl fastener, 1/4 turn, right hand lock; (mfr 94222 p/n 48-10-101-10)	3-1 ⑥
MP802		KNOB: black, shaft hole size .253 dia; (mfr 28569 p/n 11505-87) (Input Selector)	3-1 ②
MP803		KNOB: black, shaft hole size .253 dia drill thru; (mfr 28569 p/n 11505-90) (Sensitivity)	3-1 ③
MP804		KNOB: black, large, shaft hole size .253 dia; (mfr 28569 p/n 11505-91) (Vert. Position)	3-1 ⑤
MP805		KNOB: red, shaft hole size .128 dia; (mfr 28569 p/n 11505-94) (Vernier)	3-1 ④
P801		CONNECTOR, PLUG: 16 contact; (mfr 02660 p/n 26-4100-16P)	6-3
R801		RESISTOR, FIXED, COMPOSITION: 100K ohms, ±10%, 1/4 watt; MIL type RC07GF104K.	6-6
R802		Same as R801	6-5
R803		RESISTOR, FIXED, COMPOSITION: 2.2 megohms, ±10%, 1/2 watt; MIL type RC20GF225K.	6-5
R804		RESISTOR, FIXED, FILM: 680 ohms, ±5%, 1/2 watt; MIL type RL20S681J.	6-5
R805		RESISTOR, FIXED, FILM: 100 ohms, ±5%, 1/2 watt; MIL type RL20S101J.	6-5
R806		RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%, 1/4 watt; MIL type RC07GF470K.	6-5
R807		RESISTOR, FIXED, FILM: 10K ohms, ±5%, 2 watt; MIL type RL42S103J.	6-3
R808		RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%, 1/2 watt; MIL type RC20GF471K.	6-3
R809		RESISTOR, FIXED, FILM: 6800 ohms, ±5%, 2 watt; MIL type RL42S682J.	6-3
R810		RESISTOR, FIXED, COMPOSITION: 2.2K ohms, ±10%, 2 watt; MIL type RC42GF222K.	6-3
R811		RESISTOR, FIXED, FILM: 820 ohms, ±5%, 1/4 watt; MIL type RL07S821J.	6-5
R812		Same as R811	6-5

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R813		Same as R810	6-3
R814		Same as R803	6-5
R815		RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%, 1/2 watt; MIL type RC20GF101J.	6-5
R816		Same as R804	6-5
R817		RESISTOR, VARIABLE: composition, 5000 ohms, ±10%, 2 watt; MIL type RV4NAYSD502A.	6-4
R818		RESISTOR, FIXED, COMPOSITION: 68K ohms, ±10%, 1/2 watt; MIL type RC20GF683K.	6-5
R819		Same as R817	6-3
R820		Same as R817	6-3
R821		Same as R817	6-4
R822		Same as R810	6-3
R823		Same as R803	6-5
R824		Same as R806	6-5
R825		Same as R809	6-5
R826		Same as R809	6-5
R827		Not Assigned	
R828		Same as R806	6-5
R829		RESISTOR, FIXED, FILM: 536 ohms, ±1%, 1/2 watt; MIL type RN70D5360F.	6-5
R830		RESISTOR, VARIABLE: 1000 ohms, ±10%, 1 watt, w/spst switch; (mfr 28569 p/n 16925-455)	6-3
R831		Same as R829	6-5
R832		Same as R811	6-5
R833		RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±10%, 1/2 watt; MIL type RC20GF102K.	6-3
R834		Same as R811	6-5
R835		RESISTOR, FIXED, FILM: 215K ohms, ±1%, 1/2 watt; MIL type RN70D2153F.	6-5
R836		Same as R835	6-5
R837		RESISTOR, FIXED, COMPOSITION: 150K ohms, ±10%, 1/2 watt; MIL type RC20GF154K.	6-5
R838		RESISTOR, FIXED, FILM: 82.5K ohms, ±1%, 1/2 watt; MIL type RN70D8252F.	6-5

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R839		Same as R838	6-5
R840		Same as R837	6-5
R841 thru R849		Not Assigned	
R850		RESISTOR, VARIABLE: 2500 ohms, ±10%, 2 watt; MIL type RV4NAYSD252A.	6-4
R851		Same as R806	6-5
R852		RESISTOR, FIXED, FILM: 46,400 ohms, ±1%, 1/2 watt; MIL type RN70D4642F.	6-5
R853		Same as R852	6-5
R854		Same as R806	6-5
R855		Same as R809	6-5
R856		Same as R809	6-5
R857		Same as R815	6-5
R858		RESISTOR, FIXED, COMPOSITION: 1500 ohms, ±10%, 1/2 watt; MIL type RC20GF152K.	6-3
R859		RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%, 1/2 watt; MIL type RC20GF221K.	6-5
R860		RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%, 1/2 watt; MIL type RC20GF100K.	6-5
R861		RESISTOR, FIXED, COMPOSITION: 15 ohms, ±10%, 1/4 watt; MIL type RC07GF150K.	6-3
R862		RESISTOR, FIXED, COMPOSITION: 22 megohms, ±10%, 1/2 watt; MIL type RC20GF226K.	6-3
R863		Not Assigned	
R864		RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%, 1/2 watt; MIL type RC20GF470K.	6-5
R865		RESISTOR, FIXED, COMPOSITION: 1.5 megohms, ±5%, 1/2 watt; MIL type RC20GF155J.	6-5
R866		Same as R865	6-5
R867		RESISTOR, FIXED, COMPOSITION: 220K ohms, ±5%, 1/2 watt; MIL type RC20GF224J.	6-5
R868		RESISTOR, VARIABLE, COMPOSITION: 2.5 megohms, ±10%, 2 watt; MIL type RV4NAYSD255C.	6-3
R869		RESISTOR, FIXED, COMPOSITION: 33 ohms, ±10%, 2 watt; MIL type RC42GF330K.	6-5

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R870		Same as R860	6-3
R871		Same as R860	6-3
R1801		RESISTOR, FIXED, FILM: 1 megohm, ±1%, 1/2 watt; MIL type RN70D1004F.	6-6
R1802		Same as R806	6-6
R1803		RESISTOR, FIXED, FILM: 499K ohms, ±1%, 1/2 watt; MIL type RN70D4993F.	6-6
R1804		Same as R860	6-6
R1805		Same as R1801	6-3
R1806		RESISTOR, FIXED, FILM: 750K ohms, ±1%, 1/2 watt; MIL type RN70D7503F.	6-6
R1807		Same as R860	6-6
R1808		RESISTOR, FIXED, FILM: 332K ohms, ±1%, 1/2 watt; MIL type RN70D3323F.	6-3
R1809		RESISTOR, FIXED, FILM: 909K ohms, ±1%, 1/2 watt; MIL type RN70D9093F.	6-6
R1810		Same as R860	6-6
R1811		RESISTOR, FIXED, FILM: 111K ohms, ±1/2%, 1/2 watt; MIL type RN70C1113D.	6-3
R1812		RESISTOR, FIXED, FILM: 953K ohms, ±1%, 1/2 watt; MIL type RN70D9533F.	6-6
R1813		Same as R860	6-6
R1814		RESISTOR, FIXED, FILM: 52.3K ohms, ±1%, 1/2 watt; MIL type RN70D5232F.	6-3
R1815		RESISTOR, FIXED, FILM: 976K ohms, ±1%, 1/2 watt; MIL type RN70D9763F.	6-6
R1816		Same as R860	6-6
R1817		RESISTOR, FIXED, FILM: 25,500 ohms, ±1%, 1/4 watt; MIL type RN65D2552F.	6-6
R1818		RESISTOR, FIXED, FILM: 988K ohms, ±1/2%, 1/2 watt; MIL type RN70C9883D.	6-6
R1819		Same as R860	6-6
R1820		RESISTOR, FIXED, FILM: 10,100 ohms, ±1/2%, 1/4 watt; MIL type RN65C1012D.	6-6
R1821		Same as R1801	6-6
R1822		Same as R860	6-6

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R1823		RESISTOR, FIXED, FILM: 5050 ohms, ±1/2%, 1/4 watt; MIL type RN65C5051D.	6-6
R1824		Same as R1801	6-6
R1825		Same as R860	6-6
R1826		RESISTOR, FIXED, FILM: 2520 ohms, ±1/2%, 1/4 watt; MIL type RN65C2521D.	6-6
R1827		Same as R859	6-6
S801		SWITCH, ROTARY: 3 section, 3 position (AC-DC-X10) (mfr 28569 p/n 19912-581)	6-3
S802		SWITCH, ROTARY: 3 section, 9 position (V/CM) (mfr 28569 p/n 19912-577)	6-3, 6-6
V801		ELECTRON TUBE: MIL type JAN 7308	6-5
V802		Same as V801	6-5
V803		Same as V801	6-5
V804		Same as V801	6-5
V805		Same as V801	6-5
XC809		SOCKET, TUBE: 8 pin octal; MIL type TS101P02.	
XV801		SOCKET, TUBE: 9 pin, noval, UHF, printed circuit type (mfr 91662 p/n 3901PHSPTD)	
XV802		Same as XV801	
XV803		Same as XV801	
XV804		Same as XV801	
XV805		Same as XV801	

TABLE 7-2. LIST OF MANUFACTURERS

CODE	MANUFACTURERS NAME AND ADDRESS
28569	Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, Ohio 44108
56289	Sprague Electric Co., 481 Marshall St., North Adams, Mass. 01247
72982	Erie Technological Products Inc., 644 W. 12th St., Erie, Pa. 16512
91662	Elco Corp., Maryland Road and Computer Ave., Willo Grove, Pa. 19090
94222	South Chester Corp., Chester, Pa.