



**SINGER**  
INSTRUMENTATION

MAINTENANCE MANUAL  
FOR  
OSCILLOSCOPE AMPLITUDE MODULATION MONITOR

MODEL OAM-1

(For use with Model FM-10 or FM-10C Mainframes)

Manual No. 1-500783-298

(For Use with Serial Numbers 101 and Above)

# WARRANTY

THE SINGER COMPANY, LOS ANGELES OPERATION, (SELLER) warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

TCXO Oscillator ..... 2 Years  
Electrical and Electronic Measuring Instruments..... 1 Year

Repair or replacement (at our option) without charge (F.O B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and RatioTran potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other warranties, express or implied INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, or fitness for a particular purpose. In no event shall the SELLER be liable for INCIDENTAL OR CONSEQUENTIAL damages. The SELLER neither assumes, nor authorizes any person to assume for it, any other liability in connection with sales of instruments manufactured by SELLER.

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**THE SINGER COMPANY, LOS ANGELES OPERATION**  
5340 Alla Road, Los Angeles, California 90066

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## REPAIR AND MAINTENANCE

Instruments should be returned only on prior authorization from the Singer Representative or the factory. You will be advised of detailed shipping instructions at that time. Return the instrument to the factory Prepaid. Validity of warranty will be determined by the factory.

Chargeable repairs: If requested, an estimate of charges will be made prior to repairs. Please provide us with the following information in order to expedite the processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble<sup>(1)</sup>
4. Approximate date instrument was placed in operation.
5. Approximate number of hours in use.
6. Has maintenance action been previously requested.
7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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This manual refers directly to serial numbers suffixed with 04324 and above.

Appendix A, Manual Backdating Information, adapts this manual to serial numbers 101 thru serial numbers suffixed with 04323.

For operating instructions refer to either Model FM-10 Operator's Manual No. 1-500783-286, or Model FM-10C Operator's Manual No. 1-500783-258 (Rev B) or later.

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**INSTRUMENTATION**

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## Section I

### THEORY OF OPERATION

#### 1.1 INTRODUCTION

This section consists of the circuit description of the Model OAM-1 plug-in module. The information is presented to assist the user in the troubleshooting and maintenance of the instrument. Refer to the Detailed Block Diagram, Figure 1-1, and the Schematic Diagram, Figure 4-1.

#### 1.2 GENERAL

The Model OAM-1 plug-in module derives its operating power and signal input from the Mainframe via the rear connector, P1. It contains its own power switch to permit use of the Mainframe while the plug-in module is switched off. High voltages for the CRT are developed within the module by a dc-to-dc inverter operating from the +9 volts dc supplied by the Mainframe. There are four subassemblies in the Model OAM-1: AM detector assembly, A1; high voltage power supply assembly A2; vertical amplifier assembly, A3; and horizontal amplifier assembly, A4. The circuitry contained in the Model OAM-1 may be divided into four major sections: vertical deflection circuitry, horizontal deflection circuitry, internal modulator circuitry and power supply circuitry.

#### 1.3 DETAILED THEORY

##### 1.3.1 Vertical Deflection Circuitry

The 2 MHz IF signal from the Mainframe is applied to a 2 MHz active filter, A1Q601, A1L601, A1L602, A1L603, via connector P1-16. This is followed by a 2 MHz tuned differential amplifier, A1U602, A1L606, and a buffer amplifier, A1Q603. The gain of the differential amplifier is controlled by CARRIER LEVEL control, R1.

The output of buffer amplifier, A1Q603, is applied to operational amplifier, A1Q604, A1Q605, peak detector, A1Q606, and buffer amplifier, A1Q607. The operational amplifier, A1Q604, A1Q605, has 100% feedback so that the loop gain is unity. The RC time constant of A1C628, A1R630 is sufficiently short that the modulation envelope is accurately followed. An AGC loop from the output of buffer amplifier, A1Q607, to differential amplifier, A1U602, provides output stability with fluctuations of 6 dB to 10 dB of IF input signal level.

The output of buffer amplifier A1Q607, is applied to precision voltage divider, A1R656, A1R658, A1R659, and is also applied to recovered audio amplifier, A1Q608. The output of recovered audio amplifier, A1Q608, is applied through buffer amplifier, A1Q609, to the Mainframe via connector, P1-14, and to distortion analyzer output amplifier, A3Q105. This output is connected to DIST ANAL receptacle, J2.

The output of buffer amplifier, A1Q607, is also applied to buffer amplifier, A3Q101, whenever VERT MODE switch, S2, is in either the MEAS AM or the CARR SET position. (In the CARR SET position, capacitor C3 removes the ac component of the modulated signal.) A3Q102 is a constant current source for buffer amplifier, A3Q101, and the output of the buffer amplifier is applied to the high gain,

dc-coupled vertical amplifier consisting of A3U101A/B, A3Q103 and A3Q104. (A3U101C is a constant current source for A3U101A/B.) The vertical amplifier drives the CRT vertical deflection plates and VERT POS control, R6, sets the bias of Q3U101B. When VERT MODE switch, S2, is in the EXT position, an external signal may be applied to VERT IN receptacle, J1, for general oscilloscope use. VERT GAIN control, R3, provides attenuation of this external signal.

##### 1.3.2 Horizontal Deflection Circuitry

The sweep generator contains a current source, A4Q200, and a regenerative trigger, A4Q201, A4Q202. Sweep speed is controlled by SWEEP RANGE switch, S4, and SWEEP SPEED control, R5. The output level is controlled by variable resistor, A4R204. Synchronization is provided by the vertical signal output of A3Q104. The sweep generator output is applied to buffer amplifier, A4Q203, when MOD MODE switch, S6, is in either the INT or EXT position. The output of buffer amplifier, A4Q203, is applied to the dc-coupled horizontal deflection amplifier, A4Q204, A4Q205, having differential outputs which drive the horizontal deflection plates of the CRT. HORIZ POS control, R8, sets the bias of A4Q205. The horizontal amplifier may be driven from an external source connected to the EXT MOD/HORIZ IN receptacle, J4, when the MOD MODE switch, S6, is in the EXT HORIZ position. The Mainframe may be modulated from the EXT MOD/HORIZ IN receptacle, J4, when the MOD MODE switch, S6, is in the EXT position and the RANGE switch, S3, is in the GEN 30% position or MEAS/GEN 100% position via the amplitude modulation amplifier, A1Q616, A1Q617, through connector, P1-11.

##### 1.3.3 Internal Modulator Circuitry

The 400 Hz/1 kHz Wein-bridge oscillator, A1Q610, A1Q611, is buffered by A1Q613 and automatically leveled by level detector, A1CR602, A1CR603, and ALC control, A1Q611. The oscillator frequency is selected by MOD/AUDIO OUT FREQ switch, S5, which selects feedback variable resistors A1R674 and A1R675 and frequency variable resistors A1R671 and A1R673 corresponding to the frequency selected. The output of the oscillator is impressed across INT MOD/AUDIO OUT control, R2, and the wiper of R2 is connected to 400 Hz/1 kHz driver amplifier, A1Q614. The output of A1Q614 is applied to AUDIO OUT receptacle, J3, via buffer amplifier, A1Q615. When the MOD MODE switch, S6, is in the INT position, the output from the Wein-bridge oscillator is first amplified by the 400 Hz/1 kHz driver and buffer, A1Q614, A1Q615, and then by AM modulation amplifier, A1Q616, A1Q617, and applied to the Mainframe through connector, P1-11 when the RANGE switch, S3, is in the GEN 30% or MEAS/GEN 100% position.



### 1.3.4 Power Supply Circuitry

The power supply is a dc-to-dc inverter that converts +9 volts from the Mainframe when the PWR OFF switch, S1, is on, to -1000 volts and +300 volts required by the CRT. The inverter also supplies -15 volts required by the vertical and horizontal deflection amplifiers and the AM detector. 6.3 V rms required by the CRT heater is also supplied. The

inverter consists of a 20 kHz oscillator, Q1, Q2, a power transformer, T401, and three rectifiers, A2CR401, A2CR402; A2CR403, A2CR404; and A2CR405, A2CR406. The astigmatism control, A4R217, utilizes the +300 V dc while the FOCUS and INTENSITY controls, R11 and R13 respectively, require the -1000 V dc.

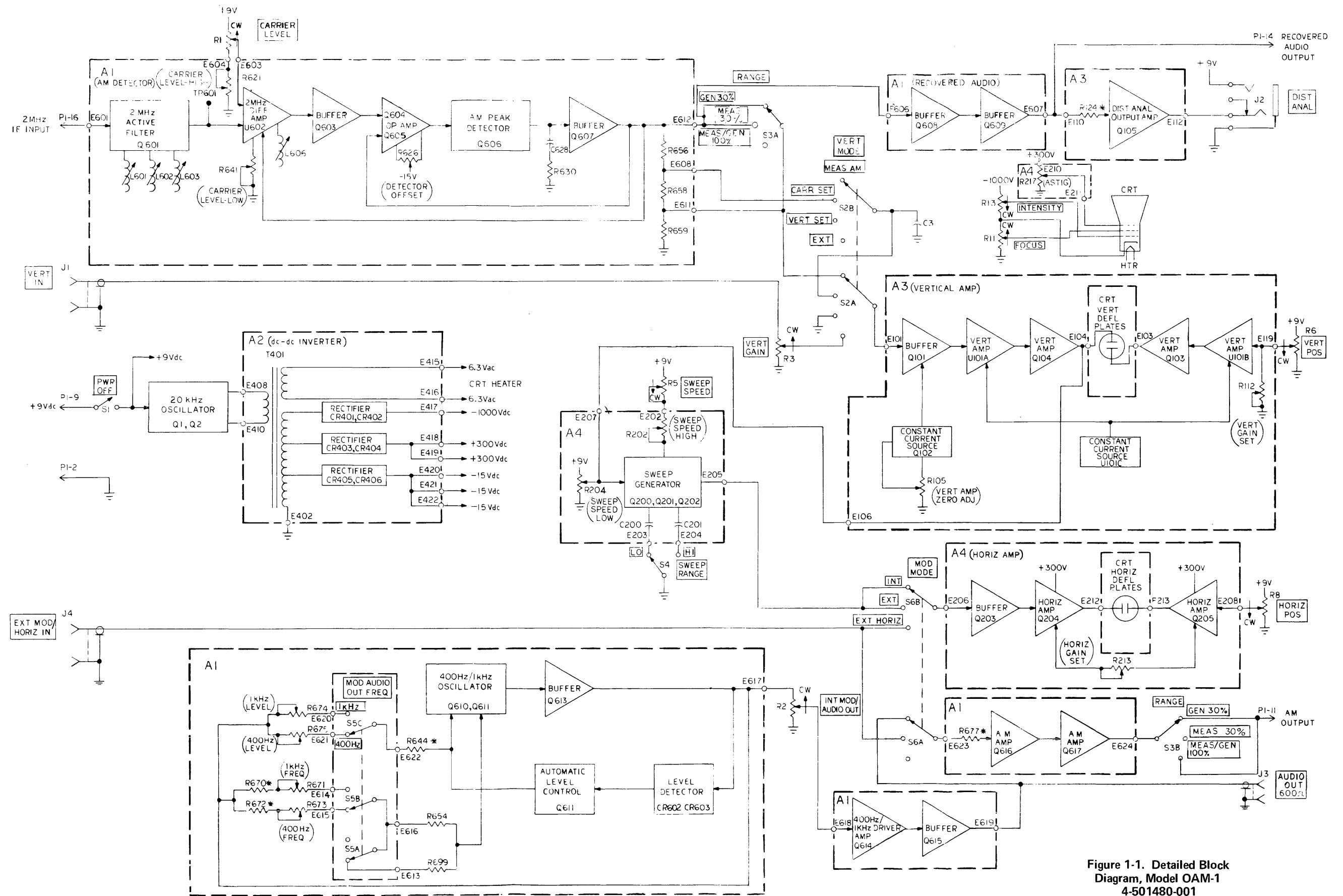


Figure 1-1. Detailed Block Diagram, Model OAM-1  
4-501480-001

## Section II MAINTENANCE

### 2.1 INTRODUCTION

This section contains information for the maintenance of the Model OAM-1. Included are Minimum Performance Procedures, Alignment and Adjustment Procedures, and Fault Isolation Procedures.

All ac and dc voltages displayed without tolerances on the Schematic Diagram in Section IV are typical. The dc voltages may vary widely (+100%, -50%) and the ac voltages may vary widely ( $\pm 6$  dB) due to component tolerances and beta ranges of the transistors. This does not imply that instruments in which measured voltages are at the tolerance extremes will not perform to the specifications, since the instrument has been designed to allow for these tolerances.

#### NOTE

The procedures in this section are related directly for use with the Model FM-10 Mainframe. Where procedures deviate for use with the Model FM-10C Mainframe, the information is provided in brackets.

### 2.2 PRELIMINARY INFORMATION

#### 2.2.1 Alignment Interval

To ensure instrument accuracy check the Model OAM-1 performance using the Minimum Performance Procedures every 1000 hours of operation, or every six months if used occasionally.

#### 2.2.2 Singer Customer Service

Both Factory and Field Centers provide instrument service and repair. Contact your local Singer representative for additional information.

#### 2.2.3 Minimum Performance Procedures Defined

The performance of the instrument can be checked without removing the covers or performing internal adjustments by the use of the Minimum Performance Procedures. Refer to Paragraph 2.4. These procedures do not test every detail of the alignment of the instrument but do check the overall performance for accuracy and correct operation within allowable tolerances.

#### 2.2.4 Alignment and Adjustment Procedures Defined

The completion of each step of the Alignment and Adjustment procedure (refer to Paragraph 2.5) ensures that the instrument meets the electrical specifications provided in Section II of the Operator's Manual. For best overall instrument performance when performing a complete Alignment and Adjustment Procedure, adjust each trimmer as close as possible to the exact figure, even though the Minimum Performance Procedures indicate that the operation is within the allowable tolerance.

### 2.3 TEST EQUIPMENT REQUIRED

The test equipment required for minimum performance, alignment, calibration, and troubleshooting is listed in Table 2-1. Use the recommended type or equivalent.

### 2.4 MINIMUM PERFORMANCE PROCEDURES

#### NOTE

The equipment should be checked at a temperature of  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for best overall performance.

#### 2.4.1 Evaluation of Focus and Intensity

- a. Install the Model OAM-1 into the right-hand compartment of the Mainframe.
- b. Set PWR OFF switch on.
- c. Set INTENSITY control fully cw.
- d. Set FOCUS control to mid-range.
- e. Set VERT MODE switch to VERT SET position.
- f. Set MOD MODE switch to INT position.
- g. Allow 5 to 10 seconds for the CRT filament to warm up.
- h. Vary VERT POS and HORIZ POS controls until CRT trace is centered.
- i. Vary FOCUS and INTENSITY controls for sharp-est trace with adequate intensity.
- j. Verify that the CRT trace is bright enough to be visible in normally-lit room. Verify that FOCUS, VERT POS, and HORIZ POS controls are approximately at mid-range.

#### 2.4.2 Evaluation of Vertical and Horizontal Position Control Range

- a. Rotate VERT POS control from fully cw to fully ccw.
- b. Verify that CRT trace deflects off the calibrated portion of the graticule vertically when VERT POS control is at its extreme positions.
- c. Return VERT POS control to mid-range.
- d. Rotate HORIZ POS control from fully cw to fully ccw.
- e. Verify that ends of trace deflect horizontally to at least mid-screen when HORIZ POS control is at its extreme positions.
- f. Return HORIZ POS control to mid-range.
- g. Verify that trace is centered on CRT with controls set at approximately mid-range.

#### 2.4.3 Evaluation of Sweep Range

- a. Rotate VERT GAIN control fully cw.
- b. Set VERT MODE switch to EXT.
- c. Connect audio oscillator and ac voltmeter to VERT IN receptacle.
- d. Set audio oscillator frequency to 50 Hz and set ac voltmeter to 300 mV scale.

**Table 2-1. Test Equipment Requirements**

Instrument	Minimum Specifications	Recommended		Use*
		Manufacturer	Model	
Audio oscillator	Frequency range: 45 Hz to 30 kHz Output level: 100 mV rms to 3 V rms	Hewlett-Packard	200CD	A,M
Ac voltmeter	Frequency response: 50 Hz to 2 MHz Input level: 2 mV to 400 mV rms Input resistance: 1 megohm minimum Input capacitance: 35 pF maximum	Hewlett-Packard	400E	A,M
Signal generator	Frequency range: 2 MHz, 25 MHz Output level: 6 mV rms to 20 mV rms Stability: $\pm 0.0004\%$ /5 minutes maximum Leveling: $\pm 1$ dB Output impedance: 50 ohm nominal	Singer	FM-2748	A,M
Oscilloscope with 1X probe	Frequency response: 2 MHz Vertical sensitivity: 5 mV/cm	Tektronix	531 with 53/54B plug-in	A
Distortion analyzer	Frequency response: 400 Hz to 1 kHz Input level: 1 V rms Accuracy: $\pm 0.1\%$	Hewlett-Packard	333A	A,M
Frequency counter	Frequency response: 400 Hz to 1 kHz Input level: 1 V rms	Hewlett-Packard	5512A	A,M
Dc power supply	Output level: 9 V dc at 1 A	Hewlett-Packard	6214A	A
VOM	Input level: 0 V dc to 1100 V dc	Simpson	269	A
Dc digital voltmeter	Input level: 10 V to 1000 V dc Accuracy: $\pm 0.1\%$ of indication	Hewlett-Packard	3440A	A
Mainframe	Required for testing Model OAM-1 module	Singer	FM10 Mainframe or FM-10C Mainframe with RFM and FIM modules	A,M
Extender cable	Required for testing the Model OAM-1	Singer	PC-2653	A
Connector	16 pin	Amphenol	26-190-16	A
Resistors	62 ohm, 180 ohm, 240 ohm, 510 ohm, 510 ohm, 560 ohm (all $\pm 5\%$ , 1/4 watt)	Not applicable		A,M

\*A = Alignment and Adjustment and Fault Isolation

M = Minimum Performance

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>e. Rotate SWEEP SPEED control fully ccw.</li> <li>f. Set SWEEP RANGE switch to LO position.</li> <li>g. Increase audio oscillator output level until sine wave deflection on CRT is full-scale. Vary audio oscillator frequency for a stationary, one-cycle sine wave on CRT.</li> <li>h. Verify that audio oscillator frequency is less than 50 Hz (approximately 45 Hz).</li> <li>i. Rotate SWEEP SPEED control fully cw.</li> <li>j. Set SWEEP RANGE switch to HI position.</li> <li>k. Vary audio oscillator frequency for a stationary, one-cycle sine wave on CRT.</li> </ul> | <ul style="list-style-type: none"> <li>l. Verify that audio oscillator frequency is greater than 5 kilohertz and is spread out across entire CRT.</li> <li>m. Rotate SWEEP SPEED control fully ccw.</li> <li>n. Vary audio oscillator frequency for a stationary, one-cycle sine wave on CRT.</li> <li>o. Verify that audio oscillator frequency is less than 500 Hz (approximately 450 Hz).</li> <li>p. Set SWEEP RANGE switch to LO position.</li> <li>q. Rotate SWEEP SPEED control fully cw.</li> <li>r. Vary audio oscillator frequency for a stationary, one-cycle sine waveform.</li> </ul> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- s. Verify that audio oscillator frequency is greater than 500 Hz (approximately 550 Hz).
- 2.4.4 Evaluation of Vertical Sensitivity**
- a. Set audio oscillator frequency to 1.0 kHz.
  - b. Set SWEEP RANGE switch and vary SWEEP SPEED control for a stationary pattern on CRT.
  - c. Vary output level of audio oscillator for full-scale deflection on CRT.
  - d. Verify that output level of audio oscillator is 106 mV rms  $\pm$ 11 mV rms (95 mV to 117 mV).
- 2.4.5 Evaluation of Vertical Amplifier Frequency Response**
- a. Vary audio oscillator output to obtain exactly full-scale deflection on CRT at 1.0 kHz frequency.
  - b. Increase audio oscillator frequency to 30 kHz and note p-p deflection on CRT.
  - c. Decrease audio oscillator frequency to 50 Hz and note p-p deflection on CRT.
  - d. Verify that signal on CRT did not change greater than 3 dB (less than 7 divisions p-p) from 50 Hz to 30 kHz.
- 2.4.6 Evaluation of Carrier Level Control**
- a. Connect signal generator to left-hand module MEASURE INPUT receptacle [With Model RFM-10B or RFM-10D in Model FM-10C Mainframe insert a 20 dB pad, Model RFA-20, between the generator and the MEASURE INPUT receptacle].
  - b. Set Model FM-10 Mainframe Frequency switches to 27.000 MHz, 10 MHz switch to OUT, and AUDIO switch to OUT. [Set Model FM-10C Mainframe Frequency switches to 25.0000 MHz, MODE switch to MEAS, and GENERATOR MODULATION switch to OFF (out)].
  - c. Set signal generator frequency to exactly 25 MHz, cw [With Model FM-10C Mainframe and Model RFM-10A, 10B, 10D or 11A left-hand module, set the signal generator output level to 6 mV rms and vary the SENSITIVITY controls to obtain a sensitivity threshold position where the OPERATE indicator lamp in the FIM module just lights].
  - d. Set the signal generator output level to 10 mV rms.
  - e. Set VERT MODE switch to VERT SET position.
  - f. Vary VERT POS control so that CRT trace is exactly on VERTICAL SET line of the graticule.
  - g. Set VERT MODE switch to CARR SET position.
  - h. Vary CARRIER LEVEL control so that CRT trace is exactly on CARRIER SET line of the graticule.
  - i. Decrease signal generator output level 3 dB from 10 mV rms (7.07 mV rms).
  - j. Vary CARRIER LEVEL control until CRT trace is exactly on CARRIER SET line.
  - k. Verify that CARRIER LEVEL control has sufficient range to set CRT trace on CARRIER SET line of the graticule  $\pm$ 1/2 division.
  - l. Increase signal generator output level 6 dB (14.1 mV rms).
  - m. Vary CARRIER LEVEL control until CRT trace is exactly on CARRIER SET line.
  - n. Verify that CARRIER LEVEL control has sufficient range to set CRT trace on CARRIER SET line of the graticule  $\pm$ 1/2 division.
  - o. Recalibrate VERT SET and CARR SET (Steps d. thru h.).
  - p. Set VERT MODE switch to MEAS AM position.
  - q. Verify that CRT trace is on the 0 center line of graticule. (A slight amount of noise on the trace is normal.)
- 2.4.7 Evaluation of Modulation Measurement Accuracy**
- a. Recalibrate as specified in Paragraph 2.4.6-d thru h., if necessary.
  - b. Set signal generator modulation mode switch to external position.
  - c. Connect audio oscillator to external modulation receptacle of signal generator and also external horizontal receptacle of oscilloscope.
  - d. Set audio oscillator frequency to 1.0 kHz and output level to approximately 8 V p-p.
  - e. Set Model OAM-1 RANGE switch to MEAS 30%.
  - f. Vary modulation amplitude control on signal generator to obtain full-scale deflection (30%) on the Model OAM-1 CRT.
  - g. Remove signal generator cable from the left-hand module MEASURE INPUT receptacle and connect it to vertical input receptacle of oscilloscope.
  - h. On oscilloscope, set horizontal display switch to external; vary external horizontal attenuator control for approximately 5 cm horizontal deflection. Set time/divisions switch to 2 seconds, and vary vertical sensitivity to obtain exactly 4 cm vertical deflection for E max on trapezoid pattern.
  - i. Verify that E min on trapezoid pattern on oscilloscope is between 2.3 cm and 2.0 cm (27% to 33% modulation).
  - j. Remove signal generator cable from vertical input receptacle on oscilloscope and reconnect it to left-hand module MEASURE INPUT receptacle.
  - k. Set RANGE switch to MEAS/GEN 100%.
  - l. Vary signal generator modulation amplitude control to obtain 9.5 divisions (95% modulation) deflection on the CRT graticule.
  - m. Verify that sine wave pattern on CRT is symmetrical about the 0 center line of graticule and that no clipping of the peaks is present.
  - n. Reconnect signal generator cable to the vertical input receptacle of oscilloscope.
  - o. Vary vertical sensitivity to obtain 4 cm vertical deflection for E max on trapezoid pattern.
  - p. Verify that E min on trapezoid pattern on oscilloscope is approximately 0.1 cm (95% modulation).

#### 2.4.8 Evaluation of Mainframe (Internal) Modulation Capability and Recovered Audio Distortion

- a. Set Model FM-10 Mainframe 10 MHz switch to IN and Frequency switches to 12 MHz [Set Model FM-10C Mainframe MODE switch to GEN MOD CAL and GENERATOR MODULATION switch to IN-ON].
- b. Set VERT MODE switch to VERT SET.
- c. Position CRT trace on VERTICAL SET line of the graticule with VERT POS control.
- d. Set VERT MODE switch to CARR SET. Position CRT trace on CARRIER SET line of the graticule with CARRIER LEVEL control.
- e. Set RANGE switch to GEN 30%.
- f. Set MOD/AUDIO OUT FREQ switch to either 1 kHz or 400 Hz.
- g. Set INT MOD/AUDIO OUT control fully cw.
- h. Set VERT MODE switch to MEAS AM.
- i. Verify that recovered audio on CRT is greater than full-scale deflection.
- j. Rotate INT MOD/AUDIO OUT control for exactly full-scale deflection.
- k. Connect distortion analyzer to DIST ANAL receptacle and calibrate it to modulating frequency.
- l. Verify that measured distortion is less than 3% at 30% modulation.
- m. Set RANGE switch to MEAS/GEN 100%.
- n. Rotate INT MOD/AUDIO OUT control for indication of exactly 9.5 divisions (95% modulation).
- o. Verify that measured distortion is less than 10% at 95% modulation.

#### 2.4.9 Evaluation of External Modulation Capability, Frequency Response, and Recovered Audio Distortion

- a. Connect audio oscillator and ac voltmeter to EXT MOD/HORIZ IN receptacle.
- b. Set audio oscillator frequency to 1.0 kHz and its output level to approximately 500 mV rms.
- c. Set MOD MODE switch to EXT and set the RANGE switch to GEN 30%.
- d. Recalibrate VERT SET and CARR SET and set VERT MODE switch to MEAS AM.
- e. Vary audio oscillator output level to obtain full-scale deflection (30% modulation) on CRT.
- f. Note ac voltmeter indication.
- g. Verify that external signal level required to produce 30% modulation is 500 mV rms  $\pm 20\%$ .
- h. Set RANGE switch to MEAS/GEN 100%.
- i. Verify that increasing audio input (to approximately 1.7 V rms) will produce full-scale deflection (100% modulation).
- j. Calibrate distortion analyzer at 1.0 kHz.
- k. Vary audio oscillator frequency between 50 Hz and 3 kHz.

- l. Verify that measured distortion is less than 3% at 30% modulation and that recovered audio level on CRT does not change more than 3 dB throughout the frequency range of 50 Hz to 3 kHz.

#### 2.4.10 Evaluation of External Horizontal Sweep Capability

- a. Set MOD MODE switch to EXT HORIZ.
- b. Set audio oscillator frequency to 1.0 kHz.
- c. Apply output of audio oscillator to EXT MOD/HORIZ IN receptacle.
- d. Vary output level of audio oscillator until trace is full-scale deflection.
- e. Verify that level required for full-scale deflection is 600 mV rms maximum.

#### 2.4.11 Evaluation of Audio Output Frequency, Level, and Distortion

- a. Connect ac voltmeter and frequency counter to AUDIO OUT 600  $\Omega$  receptacle.
- b. Connect a 600 ohm resistive load across the ac voltmeter terminals.
- c. Set MOD/AUDIO OUT FREQ switch to 1.0 kHz.
- d. Rotate INT MOD/AUDIO OUT control fully cw.
- e. Note indications on ac voltmeter and frequency counter.
- f. Verify that frequency is 1.0 kHz  $\pm 5\%$ . The level should be 1.0 V rms minimum into 600 ohms.
- g. Disconnect frequency counter from AUDIO OUT 600  $\Omega$  receptacle and connect distortion analyzer. Set INT MOD/AUDIO OUT control for 1.0 V rms output level into 600 ohm load.
- h. Calibrate distortion analyzer at 1.0 kHz and note the distortion. Distortion should be less than 1.0%.
- i. Disconnect distortion analyzer and reconnect frequency counter to AUDIO OUT 600  $\Omega$  receptacle.
- j. Set MOD/AUDIO OUT FREQ switch to 400 Hz.
- k. Note indications on ac voltmeter and frequency counter.
- l. Verify that frequency is 400 Hz  $\pm 5\%$ . The level should be 1.0 V rms minimum into 600 ohms.
- m. Disconnect frequency counter and connect distortion analyzer.
- n. Calibrate distortion analyzer at 400 Hz and note the distortion. Distortion should be less than 1.0%.

## 2.5 ALIGNMENT AND ADJUSTMENT PROCEDURE

### NOTE

The Alignment and Adjustment Procedure is performed with the Model OAM-1 disconnected from the Mainframe so that any problem in the Mainframe will not affect the alignment of the Model OAM-1. Remove the five screws in the back panel of the Model OAM-1 and slide the cover off the back.

**WARNING**

High voltages are present throughout the instrument and appropriate precautions should be taken while operating the instrument with the cover removed.

**NOTE**

The equipment should be aligned at a temperature of 25°C ±5°C for best overall performance.

**2.5.1 Test Connector Wiring**

- a. See Figure 2-1 for schematic diagram of test connector wiring.

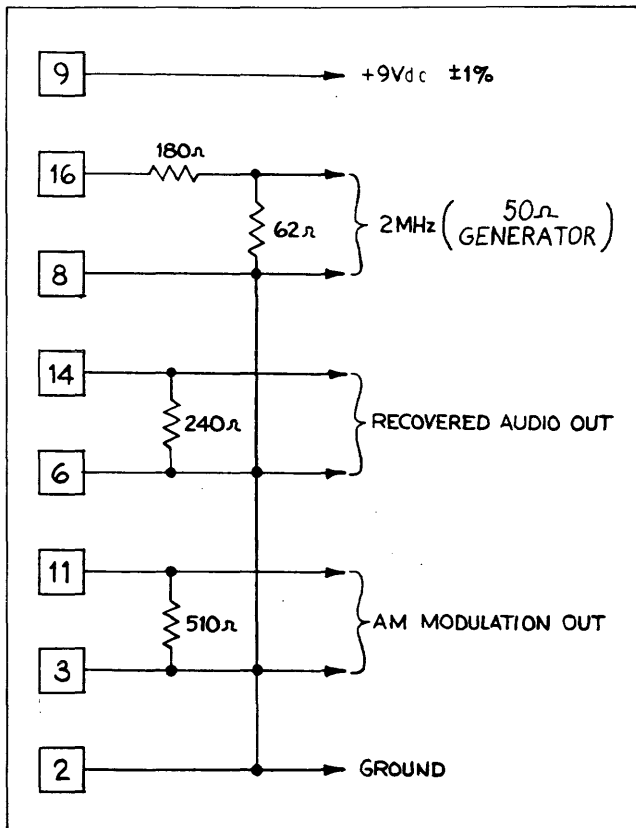


Figure 2-1. Test Connector Schematic Diagram

**2.5.2 Location and Adjustment of Trace**

- a. Connect the test connector to the Model OAM-1 and set the Model OAM-1 controls as follows:

INTENSITY	Fully cw
VERT POS	Mid-range
VERT MODE	VERT SET
MOD MODE	INT
HORIZ POS	Mid-range

- b. Connect the VOM between pins A3E103 and A3E104 (See Figure 2-2).
- c. Adjust A3R105 for 0 V dc on the VOM.
- d. The trace should be visible. If so, set the SWEEP RANGE control to LO and the SWEEP SPEED control fully ccw.

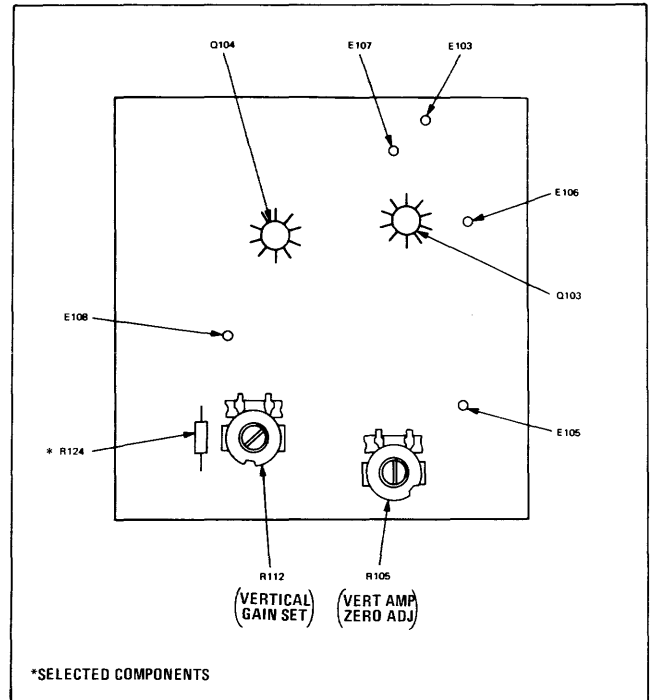


Figure 2-2. Trimmer Locations, Vertical Amplifier Assembly, A3

- e. If the trace is not visible, connect the VOM between A4E212 and A4E213 (See Figure 2-3). Vary the HORIZ POS control for 0 V dc on the VOM.

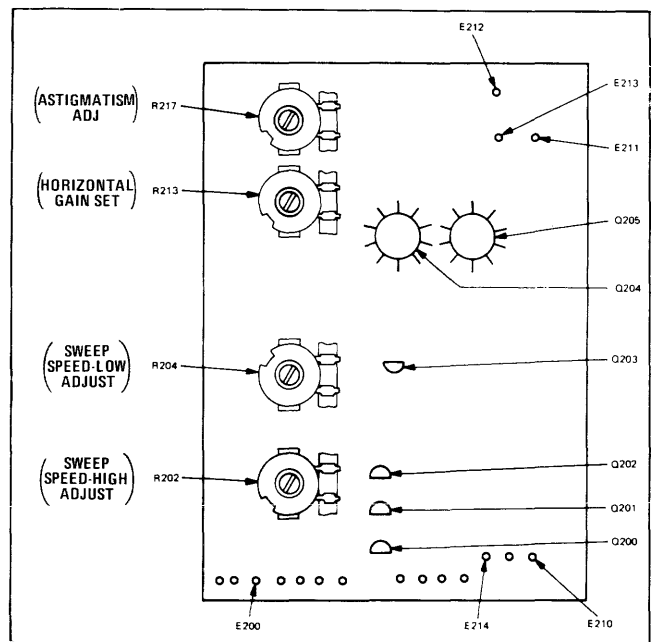


Figure 2-3. Trimmer Locations, Horizontal Amplifier Assembly, A4

- f. The trace should now be visible. If not, connect the digital voltmeter to A4E211 and ground. Adjust A4R217 (astigmatism) for approximately +150 V dc on the digital voltmeter.
- g. Once trace is visible, return to Step d.

### 2.5.3 Trace Alignment and Focus

- Loosen the CRT clamp screw and set the trace on the 0 center line of the graticule with the VERT POS control.
- Grasp the large end of the CRT (away from the high voltage) and rotate it until the trace is parallel to the 0 center line, then rotate it so that the right end of the trace is 1/3 division high. This is to compensate for the cw rotation of the CRT when the clamp screw is tightened. Tighten the clamp screw.
- Repeat Step b. as necessary to align trace exactly parallel to the 0 center line.
- Set the FOCUS control to mid-range and adjust A4R217 (astigmatism) for the sharpest trace.

### 2.5.4 Vertical Gain Adjustment

- Set the Model OAM-1 controls as follows:
 

VERT MODE	EXT
VERT GAIN	Fully cw
VERT POS	Trace on 0 center line
- Connect the ac voltmeter and the audio oscillator to the VERT IN receptacle.
- Set the audio oscillator frequency to 1.0 kHz and output level to 110 mV rms.
- Adjust A3R112 for exactly full-scale deflection on the CRT graticule.

### 2.5.5 Sweep Range Adjustment

- Set the Model OAM-1 controls as follows:
 

VERT POS	Trace on 0 center line
HORIZ POS	Trace centered on CRT
SWEEP RANGE	LO
SWEEP SPEED	Fully ccw
- Set the audio oscillator frequency to 45 Hz and its output level for full-scale deflection on the CRT.
- Adjust A4R204 for a one-cycle stationary display on the CRT.
- Set the audio oscillator frequency to 5.2 kHz. Set the SWEEP RANGE switch to HI and the SWEEP SPEED control to fully cw.
- Adjust A4R202 for a one-cycle stationary display on the CRT.
- Repeat Steps f. thru e.
- Set the SWEEP RANGE switch to HI and the SWEEP SPEED control to fully ccw. Adjust the audio oscillator frequency to produce a one-cycle stationary display.
- The audio oscillator frequency should now be less than 500 Hz.
- Set the SWEEP RANGE switch to LO and the SWEEP SPEED control to fully ccw.
- Vary the audio oscillator frequency to produce a one-cycle stationary display.
- The audio oscillator frequency should now be greater than 500 Hz.

- Set the SWEEP RANGE switch to HI and the SWEEP SPEED control to fully cw. Set the audio oscillator frequency to 1.0 kHz.
- Adjust A4R213 until the trace extends slightly beyond the edges of the CRT.

### 2.5.6 2 MHz IF Amplifier Alignment

- Connect the 2 MHz signal generator to the test connector (See Figure 2-1). Connect the ac voltmeter between A1E601 and ground (See Figure 2-4). Vary the 2 MHz signal generator output level for 2.5 mV rms on the ac voltmeter.

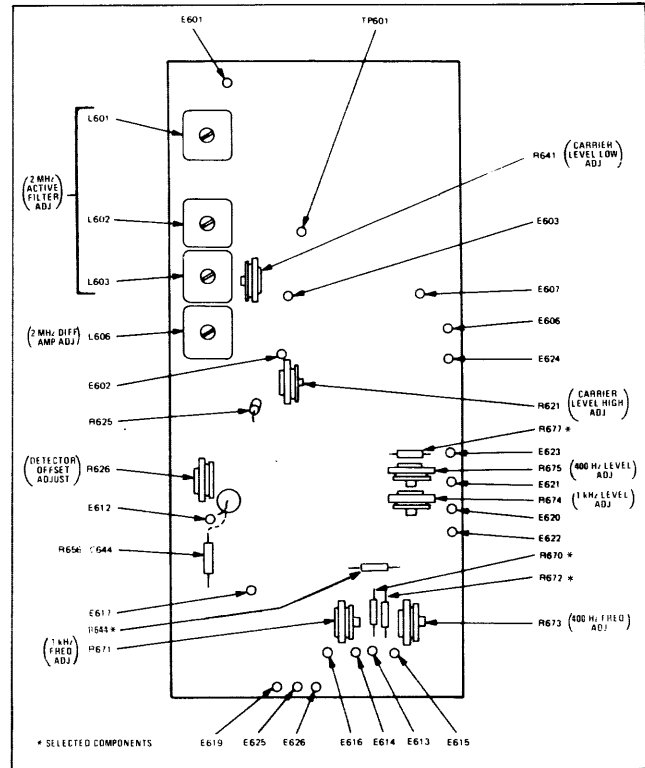


Figure 2-4. Trimmer Locations, AM Detector Assembly, A1

- Connect the oscilloscope probe to A1TP601.
- Adjust A1L601, A1L602 and A1L603 for maximum amplitude on the oscilloscope. The voltage should be approximately 30 mV to 40 mV p-p.
- Connect the oscilloscope probe across A1R625.
- Adjust A1L606 for maximum amplitude and re-adjust A1L601, A1L602 and A1L603. Disconnect the oscilloscope probe.

### 2.5.7 Detector Offset Adjustment

- Disconnect the 2 MHz signal generator and short circuit A1E601 to ground.
- Set the Model OAM-1 VERT MODE switch to VERT SET and vary the VERT POS control so that the trace is exactly on the VERTICAL SET line of the CRT graticule.
- Set the VERT MODE switch to CARR SET and adjust A1R626 so that the trace is exactly on the VERTICAL SET line.
- Repeat Steps b. and c.

### 2.5.8 IF Dynamic Range Adjustment



- a. Reconnect the 2 MHz signal generator and set its output level, at A1E601, to 3 mV rms on the ac voltmeter.
- b. Set the Model OAM-1 VERT MODE switch to VERT SET and vary the VERT POS control so that the trace is exactly on the VERTICAL SET line. Set the CARRIER LEVEL control fully cw.
- c. Set the VERT MODE switch to CARR SET and adjust A1R641 so that the trace is exactly on the CARRIER SET line of the CRT graticule.
- d. Set the 2 MHz signal generator output level at A1E601, to 6 mV rms as indicated by the ac voltmeter. Set the CARRIER LEVEL control to fully ccw.
- e. Adjust A1R621 so that the trace is exactly on the CARRIER SET line.
- f. Repeat Steps a. thru e.
- g. Set the VERT MODE switch to MEAS AM. The trace should be exactly on the 0 center line of the CRT graticule. If it is not, repeat Paragraphs 2.5.7 and 2.5.8.

#### 2.5.9 Distortion Analyzer Amplifier Adjustment

- a. Connect the digital voltmeter to pin 2 of the DIST ANAL receptacle and verify that +9 V dc  $\pm 1.0\%$  is present.
- b. Connect the ac voltmeter to pin 1 of the DIST ANAL receptacle. The voltage should be between 270 mV and 330 mV rms. If it is not within this range, select the value of A3R124 to obtain 300 mV rms.

#### 2.5.10 Modulation Oscillator Adjustment

- a. Connect the ac voltmeter (with 560 ohm resistor across terminals), frequency counter and the distortion analyzer to the Model OAM-1 AUDIO OUT 600  $\Omega$  receptacle.
- b. Set the Model OAM-1 INT MOD/AUDIO OUT control to fully cw and the MOD/AUDIO OUT FREQ switch to 1 kHz.
- c. Adjust A1R674 for 1.15 V rms on the ac voltmeter.
- d. Adjust A1R671 for 1.0 kHz  $\pm 1$  Hz on the frequency counter. Readjust A1R674 for 1.15 V rms if necessary. If unable to obtain 1.0 kHz, set A1R671 to mid-range and select the value of A1R670 to obtain 1.0 kHz  $\pm 25$  Hz. (Increase A1R670 to reduce frequency.)
- e. Vary the INT MOD/AUDIO OUT control to obtain 1.0 V rms on the ac voltmeter. Calibrate the distortion analyzer at 1.0 kHz and measure the distortion. It should be less than 1.0% and decrease as the audio output level is decreased.
- f. Set the MOD/AUDIO OUT FREQ switch to 400 Hz and set the INT MOD/AUDIO OUT control to fully cw.
- g. Adjust A1R675 for 1.15 V rms on the ac voltmeter.
- h. Adjust A1R673 for 400 Hz  $\pm 1$  Hz on the frequency counter. Readjust A1R675 for 1.15 V rms if necessary. If unable to obtain 400 Hz, set

A1R673 to mid-range and select the value of A1R672 to obtain 400 Hz  $\pm 10$  Hz. (Increase A1R672 to reduce frequency.)

- i. Vary the INT MOD/AUDIO OUT control to obtain 1.0 V rms on the ac voltmeter. Calibrate the distortion analyzer at 400 Hz and measure the distortion. It should be less than 1.0% and decrease as the audio output level is decreased.

#### 2.5.11 Modulation Amplifier Adjustment

- a. Connect the audio oscillator and ac voltmeter to the Model OAM-1 EXT MOD/HORIZ IN receptacle. Set the audio oscillator frequency to 1.0 kHz and output level to 500 mV rms.
- b. Set the Model OAM-1 MOD MODE switch to EXT and connect the ac voltmeter across the 510 ohm resistor on the test connector.
- c. The ac voltmeter should indicate 75 mV rms  $\pm 5\%$ . If the level is not 75 mV rms  $\pm 5\%$ , select the value of A1R677 to obtain 75 mV rms  $\pm 5\%$ . (Reduce A1R677 to increase level.)
- d. Connect the ac voltmeter and the 560 ohm load resistor across the AUDIO OUT 600  $\Omega$  receptacle.
- e. Set the MOD MODE switch to INT and vary the INT MOD/AUDIO OUT control for 1.0 V rms on the ac voltmeter. Disconnect the ac voltmeter, but leave the 560 ohm load resistor across the AUDIO OUT 600  $\Omega$  receptacle.
- f. Connect the ac voltmeter across the 510 ohm resistor on the test connector. The ac voltmeter should indicate greater than 80 mV rms.

### 2.6 FAULT ISOLATION PROCEDURES

Fault Isolation Procedures are presented to provide a guide in servicing the Model OAM-1. The procedures follow the sequence of the Minimum Performance Procedures, Paragraph 2.4, with each subsection keyed to the step in Paragraph 2.4 that first indicates a fault. When a fault is noted during Model OAM-1 operation, proceed as follows:

- a. Perform the Minimum Performance Procedures in Paragraph 2.4.
- b. Start Fault Isolation Procedures at the point where minimum performance cannot be satisfied.
- c. When the fault is isolated to a circuit, refer to the alignment procedure for that circuit in Paragraph 2.5 and check alignment of that circuit before proceeding with fault isolation.
- d. After a fault is repaired, complete the Minimum Performance Procedure to determine if further alignment is necessary.

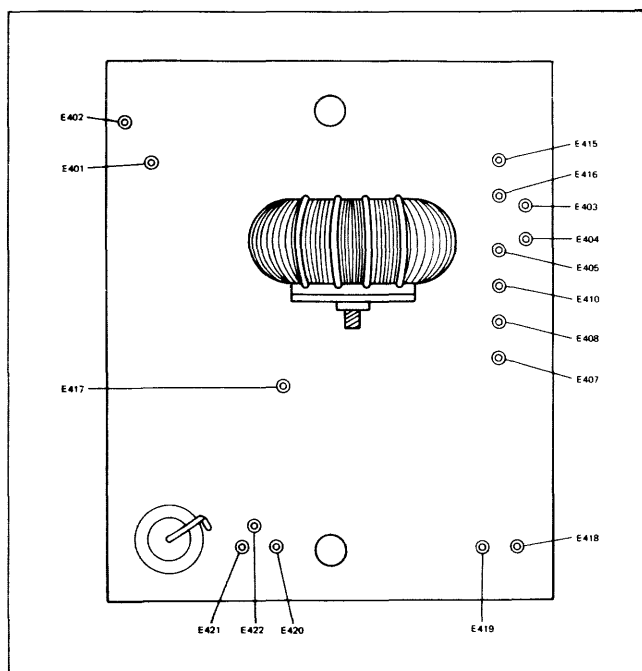
#### WARNING

High voltages are present throughout the instrument. Appropriate precautions should be taken while operating the instrument with the cover removed.

#### 2.6.1 No Trace (2.4.1-h)

- a. Remove socket from V1 (CRT) and check V1 voltage displayed on Figure 4-1.
- b. If voltages are within tolerance, replace V1.

- c. If any voltage is absent or out of tolerance, check voltage source on assembly A2, A3 or A4 output terminals. (See Figure 2-5)



**Figure 2-5. Trimmer Locations, Power Supply Assembly, A2**

### 2.6.2 Vertical Centering Defective (2.4.1-h)

- a. Check voltages at pins 9 and 10 of V1. Voltage should vary over an 80 V minimum span within the range of +95 V dc to +235 V dc as the VERT POS control is rotated throughout its range.
- b. If voltages are within tolerance, replace V1.
- c. If voltages are not within tolerance, check voltage at A3E119. This voltage should vary from less than +0.1 V dc to greater than +2.3 V dc as the VERT POS control is rotated throughout its range.
- d. If voltage at A3E119 is within tolerance, use voltages and waveforms on Figure 4-1 to isolate fault on assembly A3.
- e. If voltage at A3E119 is not within tolerance, check R6, R7 and associated wiring.

### 2.6.3 Horizontal Centering Defective (2.4.1-h)

- a. Check voltages at pins 6 and 7 of V1. Voltages should vary over a 240 V minimum span within the range of 0 V dc to +330 V dc as the HORIZ POS control is rotated throughout its range.
- b. If voltages are within tolerance, replace V1.
- c. If voltages are not within tolerance, check voltage at A4E208. This voltage should vary from 0 V dc to +4.8 V dc nominal as HORIZ POS control, R8, is rotated throughout its range.
- d. If voltage at A4E208 is not within tolerance, check voltage at A4E209. Voltage should be +4.3 V dc to +5.3 V dc.
- e. If voltage at E208 is within tolerance, use voltages and waveforms on Figure 4-1 to isolate fault on assembly A4.

### 2.6.4 Focus Defective (2.4.1-i)

- a. Check voltage on pin 5 of V1. Voltage should vary over at least a 100 volt span within -650 V dc and -920 V dc as FOCUS control, R11, is varied throughout its range.
- b. If voltage is within tolerance, replace V1.
- c. If voltage is not within tolerance, check for -1000 V dc  $\pm 10\%$ , A2E417.
- d. If voltage is within tolerance at A2E417, check wiring and neon indicator, DS1.
- e. If voltage at A2E417 is out of tolerance, use Figure 4-1 voltages and waveforms to isolate fault on assembly A2.

### 2.6.5 Intensity Defective (2.4.1-i)

#### NOTE

The Model OAM-1 operates in a Main-frame designed for 12 V dc operation. The normal maximum intensity is not as high as that of oscilloscopes designed for 115 V ac operation because a lower power CRT is used to conserve current drain during battery operation.

- a. Check voltage on pin 3 of V1 and determine if the voltage varies over a 50 volt span within the range of -850 V dc to -1100 V dc as INTENSITY control, R13, is rotated throughout its range.
- b. If voltage is within tolerance, replace V1.
- c. If voltage is out of tolerance, check voltage at A2E417.
- d. If voltage is within tolerance at A2E417, check associated wiring and INTENSITY control, R13.
- e. If voltage at A2E417 is out of tolerance, use Figure 4-1 voltages and waveforms to isolate fault in assembly A2.

### 2.6.6 Insufficient Range of Vertical Position Control (2.4.2-b)

- a. Perform procedures of Paragraph 2.6.2.

### 2.6.7 Insufficient Range of Horizontal Position Control (2.4.2-d)

- a. Perform procedures of Paragraph 2.6.3.
- b. Perform procedures of Paragraph 2.6.21.

### 2.6.8 Sweep Speed Cannot Adjust Below 50 Hz on Low Range (2.4.3-h)

- a. Check resistance of A4E203 to ground. If resistance is greater than 10 ohms, check wiring of SWEEP RANGE switch, S4.
- b. If A4E203 is grounded, check voltage at A4E203 to determine if the voltage varies over a span of at least 0.6 V dc within the range of +7.4 V dc to +9.9 V dc.
- c. If voltage is within tolerance, use voltages and waveforms on Figure 4-1 to isolate fault on assembly A4.

### 2.6.9 Sweep Speed Cannot Adjust Above 5000 Hz on High Range (2.4.3-l)

- a. Check resistance of A4E203 to ground. If resistance is less than 100 kilohms, check wiring of SWEEP RANGE switch, S4.
  - b. If resistance is greater than 100 kilohms, check voltage at A4E202 to determine if the voltage varies over a span of at least 0.6 V dc within the range of +7.4 V dc to +9.9 V dc.
- 2.6.10 Sweep Speed Cannot Adjust Below 500 Hz on High Range (2.4.3-o)**
- a. Perform procedures of Paragraph 2.6.9.
- 2.6.11 Sweep Speed Cannot Adjust Above 500 Hz on Low Range (2.4.3-l)**
- a. Perform procedures of Paragraph 2.6.8.
- 2.6.12 External Vertical Input Sensitivity Out of Specification (2.4.4-d)**
- a. Apply a 1.0 kHz signal at a level of 106 mV rms to VERT IN receptacle and check voltage with an oscilloscope at A3E101. Voltage should be 300 mV p-p.
  - b. If voltage is not 300 mV p-p, check VERT GAIN control, R3, R4, and associated wiring.
  - c. If voltage is 300 mV p-p, use voltages and waveforms on Figure 4-1 to isolate fault.
- 2.6.13 Cannot Adjust Trace to Vert Set Line (2.4.6-f)**
- a. Perform procedures of Paragraph 2.6.2.
- 2.6.14 Cannot Set Trace to Carrier Level Set Line (2.4.6-h, j, m)**
- a. Check signal level at A1E601. If level is not 11 mV p-p  $\pm 10\%$ , fault is in Mainframe; refer to Mainframe Maintenance Manual.
  - b. If signal level is correct, check dc voltage at A1E603. Voltage should vary over a span of at least 1 V within the range of 0 V dc to +2.0 V dc as CARRIER LEVEL control, R1, is rotated throughout its range.
  - c. If voltage at A1E603 is not within tolerance, check R1 and associated wiring. Also, check voltages on A1E602 and A1E604 to verify that levels are within tolerances specified on Figure 4-1.
  - d. If voltage at A1E603 is within tolerance, check dc voltage at A3E101. Voltage should be +0.3 V dc  $\pm 10\%$ .
  - e. If voltage at A3E101 is within tolerance, use Figure 4-1 voltages and waveforms to isolate fault on assembly A3.
  - f. If voltage is not within tolerance at A3E101, check voltage at A1E608.
  - g. If voltage at A1E608 differs from voltage at A3E101, check S2, S3, and associated wiring.
  - h. If voltage at A1E608 is the same as that at A3E101, use Figure 4-1 voltages and waveforms to locate fault on assembly A1.
- 2.6.15 Trace Not on CRT Centerline When Measuring Unmodulated Signal (2.4.6-r)**
- a. Measure dc voltage at A3E101. Voltage should be between +0.13 V dc and +0.17 V dc.
  - b. If voltage is within tolerance, use Figure 4-1 voltages and waveforms to isolate fault on assembly A3.
  - c. If voltage is not within tolerance, check voltage at A1E611. If this voltage differs from voltage at A3E101, check S2, S3, and associated wiring.
  - d. If voltage at A1E611 is the same as voltage at A3E101 and not between +0.13 V dc and +0.17 V dc, use Figure 4-1 voltages and waveforms to isolate fault on assembly A1.
- 2.6.16 AM Does Not Measure Within Specified Accuracy (2.4.7-i, p)**
- a. Check waveform at A3E101 with oscilloscope. Level should be between 270 mV and 330 mV p-p. If not, use Figure 4-1 voltages and waveforms to isolate fault on assembly A-3.
  - b. If voltage at A3E101 is not within above tolerance, check signal at A1E611. If level at A1E611 differs from signal at A3E101, check S2, S3, and associated wiring.
  - c. If signal at A1E611 is the same as signal at A3E101 and not between 270 mV and 330 mV p-p, use Figure 4-1 voltages and waveforms to isolate fault on assembly.
- 2.6.17 Trace Cannot Set on CRT Carrier Set Line (Mainframe in Cal Mode) (2.4.5-d)**
- If procedures of Paragraph 2.4.6 can be accomplished and those of Step 2.4.5-d. cannot, the problem is in the Mainframe. Refer to Mainframe Maintenance Manual.
- 2.6.18 Insufficient Modulation Using Internal Source (2.4.5-i)**
- a. Check signal level at P1-11 with oscilloscope. Level should be greater than 300 mV p-p. If it is, fault is in Mainframe. Refer to Mainframe Maintenance Manual.
  - b. If level at P1-11 is less than 300 mV p-p, check level at A1E624. If level at A1E624 differs from level at P1-11, check S3 and associated wiring.
  - c. If signal at A1E624 is the same as signal at P1-11 and over 300 mV p-p, check signal at A1E628. This signal should be greater than 1.2 V p-p. If it is, fault is in buffer stages A1Q616 and A1Q617.
  - d. If level is less than 1.2 V p-p at A1E623, check level at A1E614. If level at A1E614 differs from level at A1E623, check AUDIO OUT control, R2, S6, and associated wiring.
  - e. If level at A1E614 is the same as at A1E623 and less than 1.2 V p-p, use Figure 4-1 voltages and waveforms to isolate fault on assembly A1.
- 2.6.19 Modulation Distortion Exceeds 3% at 30% Modulation (2.4.5-l)**
- a. Adjust INT MOD/AUDIO OUT control for 1.0 V rms out of AUDIO OUT receptacle into a 600 ohm load.
  - b. Connect distortion analyzer input across 600 ohm load and measure distortion.
  - c. Distortion should be less than 1.0%. If it is, the fault is in the Mainframe. Refer to Mainframe Maintenance Manual.

- d. If distortion is greater than 1.0 % at AUDIO OUT 600  $\Omega$  receptacle, check distortion at A1E617. If distortion at A1E617 is less than 1.0%, fault is in stages A1Q614 and A1Q615.
- e. If distortion at A1E617 exceeds 1.0%, use Figure 4-1 voltages and waveforms to isolate fault on assembly A1.

**2.6.20 External Modulation Sensitivity Not Within Specification (2.4.6-g)**

- a. Set external modulation input level to exactly 500 mV rms and measure level at A1E623.
- b. If level at A1E623 is not 500 mV rms, check S6 and associated wiring.
- c. If level at A1E623 is 500 mV rms, check level at A1E624. Level at A1E624 should be between 60 mV rms and 90 mV rms. If not, fault is in stages A1Q616 and A1Q617.

**2.6.21 External Horizontal Input Sensitivity Not Within Specification (2.4.7-c)**

- a. Set audio oscillator output level to exactly 600 mV rms and check level at A4E206. If level is not equal to input level, check S6 and associated wiring.
- b. If level at A4E206 is equal to input, use Figure 4-1 voltages and waveform to isolate fault on assembly A4.

**2.6.22 Frequency of Internal 1 kHz Tone Not Within Specification (2.4.8-f)**

Use Figure 4-1 voltages and waveforms to isolate fault on assembly A1.

**2.6.23 Audio Output Less Than 1 V rms into 600 Ohm Load at 1 kHz (2.4.8-f)**

- a. Check level at A1E618. Level should be greater than 1.2 V p-p. If it is, fault is in stages A1Q614 and A1Q615. Use Figure 4-1 voltages to further isolate fault.
- b. If level at A1E618 is within tolerance, check level at A1E617. If level at A1E617 differs from level at A1E618, check R2, S6, and associated wiring.
- c. If level at A1E617 is equal to level at A1E618 and is less than 1.2 V p-p, use Figure 4-1 voltages and waveforms to isolate fault on assembly A1.

**2.6.24 Audio Distortion Greater Than 1% at 1 kHz (2.4.8-h)**

Perform Steps d. and e. of Paragraph 2.6.19.

**2.6.25 Internal 400 Hz Frequency Not Within Specification (2.4.8-l)**

Use Figure 4-1 voltages and waveforms to isolate fault on assembly A1.

**2.6.26 Audio Output Less Than 1 V rms Into 600 ohm Load at 1 kHz (2.4.8-m)**

Perform procedures of Paragraph 2.6.23.

**2.6.27 Audio Distortion Greater Than 1% at 400 Hz (2.4.8-n)**

Perform Steps d. and e. of Paragraph 2.6.19.

## Section III REPLACEABLE PARTS

### 3.1 INTRODUCTION

This section contains information for ordering replacement parts. Tables 3-1 thru 3-5 list the parts according to their functional groupings. Parts are listed in alpha-numerical order of their reference designators and indicate the

description, the Singer part number, typical manufacturer of the part in a five-digit code, and the manufacturer's part number. Table 3-6 lists the typical manufacturers in numerical code number order.

Table 3-1. Parts List for Main Assemblies and Chassis

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
A1	Assembly, AM Detector	4-004369-005	88869	
A2	Assembly, High Voltage Power Supply	4-003202-005	88869	
A3	Assembly, Vertical Amplifier	4-003204-009	88869	
A4	Assembly, Horizontal Amplifier	5-003217-005	88869	
C1	Capacitor, fixed, plastic, 0.47 uF, ±20%, 250 V dc	1-900001-021	73445	C280AE,0.47uF
C2	Not used			
C3	Capacitor, fixed, electrolytic, 2 uF, +75% 10%, 25 V dc	1-900023-016	56289	TE1201
C4	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 1000 V dc	1-900012-012	56289	5QA-S20
DS1	Lamp, indicator, neon	1-925008-011	24446	NE86
J1	Connector, jack, BNC	1-910132-001	11636	UG1094A/U
J2	Connector, jack, phone	1-910152-001	82389	S13B
J3	Connector, jack, BNC	1-910132-001	11636	UG1094A/U
J4	Connector, jack, BNC	1-910132-001	11636	UG1094A/U
P1	Connector, plug, rectangular, 16 pins	1-910071-001	02660	26-159-16
Q1	Transistor, silicon, NPN	1-958001-004	04713	MJE521
Q2	Transistor, silicon, NPN	1-958001-004	04713	MJE521
R1	Resistor, variable, composition, 1.0 kilohm, ±30%, 1/2 W (part of S3)			
R2	Resistor, variable, composition, 1.0 kilohm, ±30%, 1/2 W (part of S1)			
R3	Resistor, variable, composition, 100 kilohm, ±30%, 1/3 W (part of S2)			
R4	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R5	Resistor, variable, composition, 500 kilohm, ±30%, 1/2 W (part of S4)			
R6/R13	Resistor/variable, assembly (R6) 1.0 kilohm, ±30%, 1/2 W	1-003215-002	88869	
R7	Resistor, fixed, composition, 2.2 kilohm, ±10%, 1/4 W	1-945000-041	01121	CB2221
R8/R11	Resistor/variable, assembly (R8) 5 kilohm, ±30%, 1/2 W	1-003215-001	88869	
R9	Resistor, fixed, composition, 470 kilohm, ±10%, 1/4 W	1-945000-069	01121	CB4741
R10	Resistor, fixed, composition, 4.7 megohm, ±10%, 2 W	1-945003-081	01121	HB4751
R11	Resistor, variable, composition, 500 kilohm, ±30%, 1/4 W (part of R8/R11)			
R12	Resistor, fixed, composition, 560 kilohm, ±5%, 1/2 W	1-945001-228	01121	EB5645
R13	Resistor, variable, composition, 1.0 megohm, ±30% (part of R6/R13)			

Table 3-1. Parts List for Main Assemblies and Chassis (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
S1/S6/R2	Switch/variable resistor assembly (S1) switch, rotary, 1 pole, 1 position	1-003407-003	88869	
S2/R3	Switch/variable resistor assembly (S2) switch, rotary, 4 poles, 4 positions	1-003407-001	88869	
S3/R1	Switch/variable resistor assembly (S3) switch, rotary, 2 poles, 3 positions	1-003210-003	88869	
S4/R5	Switch/variable resistor assembly (S4) switch, rotary, 1 pole, 2 positions	1-003210-002	88869	
S5	Switch, rotary, 3 poles, 2 positions	1-003214-003	88869	
S6	Switch, rotary, 2 poles, 3 positions (part of S1/S6/R2)			
V1	Electron Tube, cathode ray	1-917000-001	24972	D7-166J
XVI	Socket, CRT	1-950003-001	24972	30232

Table 3-2. Parts List for AM Detector Assembly, A1

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C601	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
C602	Capacitor, fixed, mica, 1200 pF, ±5%, 100 V dc	1-900003-057	72136	DM15F122J
C603	Capacitor, fixed, mica, 1200 pF, ±5%, 100 V dc	1-900003-057	72136	DM15F122J
C604	Capacitor, fixed, mica, 150 pF, ±5%, 500 V dc	1-900003-034	72136	DM15F151J
C605	Capacitor, fixed, mica, 150 pF, ±5%, 500 V dc	1-900003-034	72136	DM15F151J
C606	Capacitor, fixed, mica, 3 pF, ±0.5 pF, 500 V dc	1-900003-003	72136	DM15C030
C607	Not used			
C608	Capacitor, fixed, mica, 150 pF, ±5%, 500 V dc	1-900003-034	72136	DM15F151J
C609	Capacitor, fixed, mica, 1200 pF, ±5%, 100 V dc	1-900003-057	72136	DM15F122J
C610	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C611	Not used			
C612	Not used			
C613	Not used			
C614	Not used			
C615	Not used			
C616	Not used			
C617	Not used			
C618	Not used			
C619	Not used			
C620	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C621	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C622	Capacitor, fixed, electrolytic, 10 uF, +75% 10%, 25 V dc	1-900023-017	56289	TE1204
C623	Capacitor, fixed, mica, 150 pF, ±5%, 500 V dc	1-900003-034	72136	DM15F151J
C624	Capacitor, fixed, mica, 1000 pF, ±5%, 100 V dc	1-900003-056	72136	DM15F102J
C625	Not used			
C626	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C627	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C628	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF



Table 3-2. Parts List for AM Detector Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C629	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C630	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C631	Capacitor, fixed, plastic, 0.022 uF, ±20%, 250 V dc	1-900001-005	73445	C280AE,0.022uF
C632	Capacitor, fixed, electrolytic, 2 uF, +75% -10%, 25 V dc	1-900023-016	56289	TE1201
C633	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C634	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C635	Not used			
C636	Capacitor, fixed, electrolytic, 200 uF, +75% -10%, 15 V dc	1-900039-002	72699	984-1733
C637	Capacitor, fixed, mica, 100 pF, ±5%, 500 V dc	1-900003-030	72136	DM15F101J
C638	Capacitor, fixed, electrolytic, 2 uF, +75% -10%, 25 V dc	1-900023-016	56289	TE1201
C639	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C640	Capacitor, fixed, electrolytic, 2 uF, +75% -10%, 25 V dc	1-900023-016	56289	TE1201
C641	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C642	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C643	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C644	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C645	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C646	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C647	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72599	984-2203
C648	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C649	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C650	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C651	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C652	Capacitor, fixed, electrolytic, 200 uF, +75% -10%, 15 V dc	1-900039-002	72699	984-1733
CR601	Diode, silicon, zener, 4.7 V, ±5%, 1 W	1-913004-005	04713	JZ4.7B

Table 3-2. Parts List for AM Detector Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
CR602	Diode, germanium, Vr=30 V, If=100 mA	1-913005-001	03877	1N273
CR603	Diode, germanium, Vr=30 V, If=100 mA	1-913005-001	03877	1N273
CR604	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	24446	1N4148
L601	Inductor, variable, 30 uH to 60 uH	1-906006-003	88869	
L602	Inductor, variable, 30 uH to 60 uH	1-906006-003	88869	
L603	Inductor, variable, 30 uH to 60 uH	1-906006-003	88869	
L604	Not used			
L605	Not used			
L606	Inductor, variable, 30 uH to 60 uH	1-906006-003	88869	
Q601	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q602	Not used			
Q603	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q604	Transistor, silicon, NPN	1-948000-001	04713	2N3904-5
Q605	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q606	Transistor, silicon, PNP	1-958000-002	04713	2N3906-5
Q607	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q608	Transistor, N-channel, J-FET	1-958031-003	17856	E102
Q609	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q610	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q611	Transistor, N-channel, J-FET	1-958044-003	04713	MFE2006
Q612	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q613	Transistor, silicon, PNP	1-958000-002	04713	2N3906-5
Q614	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q615	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q616	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q617	Transistor, silicon, PNP	1-958000-002	04713	2N3906-5
R601	Resistor, fixed, composition, 470 ohm, ±10%, 1/4 W	1-945000-033	01121	CB4711
R602	Resistor, fixed, composition, 6.8 kilohm, ±10%, 1/4 W	1-945000-047	01121	CB6821
R603	Resistor, fixed, composition, 56 ohm, ±10%, 1/4 W	1-945000-022	01121	CB5601
R604	Resistor, fixed, composition, 2.2 kilohm, ±10%, 1/4 W	1-945000-041	01121	CB2221
R605	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R606	Resistor, fixed, composition, 680 ohm, ±10%, 1/4 W	1-945000-035	01121	CB6811

Table 3-2. Parts List for AM Detector Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R607	Not used			
R608	Not used			
R609	Not used			
R610	Not used			
R611	Not used			
R612	Not used			
R613	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R614	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R615	Not used			
R616	Not used			
R617	Not used			
R618	Not used			
R619	Not used			
R620	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R621	Resistor, variable, composition, 500 ohm, $\pm 30\%$ , 1/4 W	1-945007-003	71450	X201
R622	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R623	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R624	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R625	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R626	Resistor, variable, composition, 500 ohm, $\pm 30\%$ , 1/4 W	1-945007-003	71450	X201
R627	Resistor, fixed, composition, 4.7 kilohm, $\pm 10\%$ , 1/4 W	1-945000-045	01121	CB4721
R628	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R629	Resistor, fixed, composition, 12 kilohm, $\pm 10\%$ , 1/4 W	1-945000-050	01121	CB1231
R630	Resistor, fixed, composition, 18 ohm, $\pm 10\%$ , 1/4 W	1-945000-016	01121	CB1801
R631	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R632	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R633	Resistor, fixed, composition, 470 ohm, $\pm 10\%$ , 1/4 W	1-945000-033	01121	CB4711
R634	Resistor, fixed, composition, 10 ohm, $\pm 10\%$ , 1/4 W	1-945000-013	01121	CB1001
R635	Resistor, fixed, composition, 10 ohm, $\pm 10\%$ , 1/4 W	1-945000-013	01121	CB1001

Table 3-2. Parts List for AM Detector Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R636	Resistor, fixed, composition, 2.7 megohm, $\pm 10\%$ , 1/4 W	1-945000-078	01121	CB2751
R637	Resistor, fixed, composition, 1.0 megohm, $\pm 10\%$ , 1/4 W	1-945000-073	01121	CB1051
R638	Resistor, fixed, composition, 330 ohm, $\pm 10\%$ , 1/4 W	1-945000-031	01121	CB3311
R639	Resistor, fixed, composition, 10 ohm, $\pm 10\%$ , 1/4 W	1-945000-013	01121	CB1001
R640	Not used			
R641	Resistor, variable, composition, 100 ohm, $\pm 30\%$ , 1/4 W	1-945007-001	71450	X201
R642	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R643	Resistor, fixed, composition, 2.2 kilohm, $\pm 10\%$ , 1/4 W	1-945000-041	01121	CB2221
R644	Resistor, fixed, composition, selected, 100 ohm nominal, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R645	Resistor, fixed, composition, 3.3 kilohm, $\pm 10\%$ , 1/4 W	1-945000-043	01121	CB3321
R646	Thermistor, 300 ohm, $\pm 2\%$	1-945070-001	14674	C20
R647	Resistor, fixed, composition, 39 ohm, $\pm 5\%$ , 1/4 W	1-945000-128	01121	CB3905
R648	Resistor, fixed, composition, 2.2 kilohm, $\pm 10\%$ , 1/4 W	1-945000-041	01121	CB2221
R649	Resistor, fixed, composition, 2.2 kilohm, $\pm 10\%$ , 1/4 W	1-945000-041	01121	CB2221
R650	Resistor, fixed, composition, 680 ohm, $\pm 10\%$ , 1/4 W	1-945000-035	01121	CB6811
R651	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1/4 W	1-945000-057	01121	CB4731
R652	Resistor, fixed, composition, 56 ohm, $\pm 10\%$ , 1/4 W	1-945000-022	01121	CB5601
R653	Resistor, fixed, composition, 180 ohm, $\pm 10\%$ , 1/4 W	1-945000-028	01121	CB1811
R654	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1/4 W	1-945000-057	01121	CB4731
R655	Not used			
R656	Resistor, fixed, film, 4.02 kilohm, $\pm 1\%$ , 1/4 W	1-945016-251	72982	RN60D4021F
R657	Resistor, fixed, composition, 56 kilohm, $\pm 10\%$ , 1/4 W	1-945000-058	01121	CB5631
R658	Resistor, fixed, film, 3.01 kilohm, $\pm 1\%$ , 1/4 W	1-945016-239	72982	RN60D3011F
R659	Resistor, fixed, film, 3.01 kilohm, $\pm 1\%$ , 1/4 W	1-945016-239	72982	RN60D3011F
R660	Resistor, fixed, composition, 820 ohm, $\pm 10\%$ , 1/4 W	1-945000-039	01121	CB8211

Table 3-2. Parts List for AM Detector Assembly, A1 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R661	Resistor, fixed, composition, 10 ohm, $\pm 10\%$ , 1/4 W	1-945000-013	01121	CB1001
R662	Resistor, fixed, composition, 680 ohm, $\pm 10\%$ , 1/4 W	1-945000-035	01121	CB6811
R663	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R664	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R665	Resistor, fixed, composition, 18 kilohm, $\pm 10\%$ , 1/4 W	1-945000-053	01121	CB1831
R666	Resistor, fixed, composition, 330 ohm, $\pm 10\%$ , 1/4 W	1-945000-031	01121	CB3311
R667	Resistor, fixed, composition, 560 ohm, $\pm 10\%$ , 1/4 W	1-945000-034	01121	CB5611
R668	Resistor, fixed, composition, 6.8 kilohm, $\pm 10\%$ , 1/4 W	1-945000-047	01121	CB6821
R669	Resistor, fixed, composition, 27 kilohm, $\pm 10\%$ , 1/4 W	1-945000-054	01121	CB2731
R670	Resistor, fixed, composition, selected, 10 kilohm nominal, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R671	Resistor, variable, composition, 5 kilohm, $\pm 30\%$ , 1/4 W	1-945007-006	71450	X201
R672	Resistor, fixed, composition, selected, 27 kilohm nominal, $\pm 10\%$ , 1/4 W	1-945000-054	01121	CB2731
R673	Resistor, variable, composition, 10 kilohm, $\pm 30\%$ , 1/4 W	1-945007-007	71450	X201
R674	Resistor, variable, composition, 100 ohm, $\pm 30\%$ , 1/4 W	1-945007-001	71450	X201
R675	Resistor, variable, composition, 100 ohm, $\pm 30\%$ , 1/4 W	1-945007-001	71450	X201
R676	Resistor, fixed, composition, 10 ohm, $\pm 10\%$ , 1/4 W	1-945000-013	01121	CB1001
R677	Resistor, fixed, composition, selected, 39 kilohm nominal, $\pm 10\%$ , 1/4 W	1-945000-056	01121	CB3931
R678	Resistor, fixed, composition, 22 kilohm, $\pm 10\%$ , 1/4 W	1-945000-053	01121	CB2231
R679	Not used			
R680	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R681	Resistor, fixed, composition, 330 ohm, $\pm 10\%$ , 1/4 W	1-945000-031	01121	CB3311
U601	Not used			
U602	Integrated circuit, differential/cascade amplifier	1-926005-001	02735	CA3028A

Table 3-3. Parts List for High Voltage Power Supply Assembly, A2

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C401	Capacitor, fixed, plastic, 0.047 uF, $\pm 20\%$ , 250 V dc	1-900001-009	73445	C280AE,0.047uF
C402	Capacitor, fixed, electrolytic, 200 uF, +75% -10%, 15 V dc	1-900039-002	72699	984-1733
C403	Capacitor, fixed, plastic, 0.47 uF, $\pm 20\%$ , 250 V dc	1-900001-021	73445	C280AE,0.47uF
C404	Capacitor, fixed, ceramic, 0.02 uF, $\pm 20\%$ , 1000 V dc	1-900012-012	56289	5GA520
C405	Capacitor, fixed, ceramic, 0.02 uF, $\pm 20\%$ , 1000 V dc	1-900012-012	56289	5GA520
C406	Capacitor, fixed, ceramic, 0.02 uF, $\pm 20\%$ , 1000 V dc	1-900012-012	56289	5GA520
C407	Capacitor, fixed, electrolytic, 4 uF, +100% -10%, 350 V dc	1-900011-001	14665	BR350
C408	Capacitor, fixed, electrolytic, 4 uF, +100% -10%, 350 V dc	1-900011-001	14665	BR4-350
C409	Capacitor, fixed, electrolytic, 25 uF, +75% -10%, 25 V dc	1-900039-001	72699	984-2203
C410	Capacitor, fixed, electrolytic, 100 uF, +75% -10%, 25 V dc	1-900039-004	72699	984-1653
C411	Capacitor, fixed, plastic, 0.1 uF, $\pm 10\%$ , 250 V dc	1-900001-113	73445	C280AE,0.1uF
C412	Capacitor, fixed, ceramic, 0.02 uF, $\pm 20\%$ , 1000 V dc	1-900012-012	56289	5GA520
CR401	Diode, silicon, $V_r=2000$ V, $I_f=50$ mA	1-913087-001	83003	VG2X
CR402	Diode, silicon, $V_r=2000$ V, $I_f=50$ mA	1-913087-001	83003	VG2X
CR403	Diode, silicon, $V_r=400$ V, $I_f=1$ A	1-913088-002	04713	1N4936
CR404	Diode, silicon, $V_r=400$ V, $I_f=1$ A	1-913088-002	04713	1N4936
CR405	Diode, silicon, $V_r=50$ V, $I_f=1$ A	1-913088-001	04713	1N4933
CR406	Diode, silicon, $V_r=50$ V, $I_f=1$ A	1-913088-001	04713	1N4933
CR407	Diode, silicon, zener, 15 V, $\pm 10\%$ , 1 W	1-913004-017	04713	MZ100-17
L401	Inductor, fixed, 20 uH minimum	1-003213-001	88869	
R401	Resistor, fixed, composition, 68 ohm, $\pm 10\%$ , 1/4 W	1-945000-023	01121	CB6801
R402	Resistor, fixed, composition, 680 ohm, $\pm 10\%$ , 1/4 W	1-945000-035	01121	CB6811
R403	Resistor, fixed, composition, 10 kilohm, $\pm 10\%$ , 1/4 W	1-945000-049	01121	CB1031
R404	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
T401	Transformer, power	1-003206-001	88869	

Table 3-4. Parts List for Vertical Amplifier Assembly, A3

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C101	Capacitor, fixed, electrolytic, 25 uF, +75% 10%, 25 V dc	1-900039-001	72699	984-2203
C102	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE,0.01uF
C103	Capacitor, fixed, electrolytic, 25 uF, +75% 10%, 25 V dc	1-900039-001	72699	984-2203
C104	Capacitor, fixed, ceramic, 0.001 uF, +100% 10%, 500 V dc	1-900012-002	72982	861Z50102P
C105	Capacitor, fixed, plastic, 0.1 uF, ±10%, 400 V dc	1-900005-115	90201	PVC401
C106	Capacitor, fixed, ceramic, 0.001 uF, +100% 0%, 500 V dc	1-900012-002	72982	861Z50102P
C107	Not used			
C108	Capacitor, fixed, electrolytic, 25 uF, +75% 10%, 25 V dc	1-900039-001	72699	984-2203
CR101	Not used			
CR102	Diode, silicon, $V_r=75$ V, $I_f=10$ mA	1-913007-001	24446	1N4148
CR103	Diode, silicon, $V_r=75$ V, $I_f=10$ mA	1-913007-001	24446	1N4148
Q101	Transistor, N-channel, J-FET	1-958002-002	04713	2N5458
Q102	Transistor, N-channel, J-FET	1-958002-002	04713	2N5458
Q103	Transistor, silicon, NPN	1-958004-001	02735	40327
Q104	Transistor, silicon, NPN	1-958004-001	02735	40327
Q105	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
R101	Resistor, fixed, composition, 10 ohm, ±10%, 1/4 W	1-945000-013	01121	CB1001
R102	Resistor, fixed, composition, 10 megohm, ±10%, 1/4 W	1-945000-085	01121	CB1061
R103	Resistor, fixed, composition, 100 ohm, ±10%, 1/4 W	1-945000-025	01121	CB1011
R104	Resistor, fixed, composition, 1.0 megohm, ±10%, 1/4 W	1-945000-073	01121	CB1051
R105	Resistor, variable, composition, 100 kilohm, ±30%, 1/4 W	1-945010-010	71450	U201
R106	Resistor, fixed, composition, 560 ohm, ±10%, 1/4 W	1-945000-034	01121	CB5611
R107	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R108	Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-037	01121	CB1021
R109	Resistor, fixed, composition, 470 ohm, ±10%, 1/4 W	1-945000-033	01121	CB4711
R110	Resistor, fixed, composition, 1.0 megohm, ±10%, 1/4 W	1-945000-073	01121	CB1051
R111	Resistor, fixed, composition, 1.0 megohm, ±10%, 1/4 W	1-945000-073	01121	CB1051

Table 3-4. Parts List for Vertical Amplifier Assembly, A3 (Cont.)

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R112	Resistor, variable, composition, 5 kilohm, $\pm 30\%$ 1/4 W	1-945010-006	71450	U201
R113	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1 W	1-945002-057	01121	GB4731
R114	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R115	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1 W	1-945002-057	01121	GB4731
R116	Resistor, fixed, composition, 1.0 megohm, $\pm 10\%$ , 1/4 W	1-945000-073	01121	CB1051
R117	Resistor, fixed, composition, 820 ohm, $\pm 10\%$ , 1/4 W	1-945000-036	01121	CB8211
R118	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R119	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R120	Resistor, fixed, composition, 10 kilohm, $\pm 5\%$ , 1/4 W	1-945000-186	01121	CB1035
R121	Resistor, fixed, composition, 1.0 kilohm, $\pm 5\%$ , 1/4 W	1-945000-162	01121	CB1025
R122	Resistor, fixed, composition, 150 ohm, $\pm 5\%$ , 1/4 W	1-945000-142	01121	CB1515
R123	Not used			
R124	Resistor, fixed, composition, selected, 91 ohm nominal, $\pm 10\%$ , 1/4 W	1-945000-137	01121	CB9101
R125	Not used			
R126	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R127	Resistor, fixed, composition, 1.0 megohm, $\pm 10\%$ , 1/4 W	1-945000-073	01121	CB1051
R128	Resistor, fixed, composition, 22 kilohm, $\pm 10\%$ , 1/4 W	1-945000-053	01121	CB2231
U101	Integrated circuit, differential/cascade amplifier	1-926005-001	02735	CA3028A



Table 3-5. Parts List for Horizontal Amplifier Assembly, A4

Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
C200	Capacitor, fixed, plastic, 0.0022 uF, $\pm 10\%$ , 600 V dc	1-900005-101	90201	PVC6222
C201	Capacitor, fixed, plastic, 0.022 uF, $\pm 10\%$ , 200 V dc	1-900005-004	90201	PVC2122
C202	Capacitor, fixed, plastic, 0.1 uF, $\pm 20\%$ , 250 V dc	1-900001-013	73445	C280AE,0.1uF
C203	Not used			
C204	Capacitor, fixed, electrolytic, 25 uF, $+75\%$ -10%, 25 V dc	1-900039-001	72699	984-2203
C205	Capacitor, fixed, electrolytic, 25 uF, $+75\%$ -10%, 25 V dc	1-900039-001	72699	984-2203
Q200	Transistor, silicon, PNP	1-958000-002	04713	2N3906-5
Q201	Transistor, silicon, PNP	1-958000-002	04713	2N3906-5
Q202	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q203	Transistor, N-channel, J-FET	1-958002-002	04713	2N5458
Q204	Transistor, silicon, NPN	1-958004-001	02735	40327
Q205	Transistor, silicon, NPN	1-958004-001	02735	40327
R200	Resistor, fixed, composition, 2.2 kilohm, $\pm 10\%$ , 1/4 W	1-945000-041	01121	CB2221
R201	Resistor, fixed, composition, 15 kilohm, $\pm 10\%$ , 1/4 W	1-945000-051	01121	CB1531
R202	Resistor, variable, composition, 100 kilohm, $\pm 30\%$ , 1/4 W	1-945010-010	71450	U201
R203	Resistor, fixed, composition, 1.2 kilohm, $\pm 10\%$ , 1/4 W	1-945000-038	01121	CB1221
R204	Resistor, variable, composition, 10 kilohm, $\pm 30\%$ , 1/4 W	1-945010-007	71450	U201
R205	Resistor, fixed, composition, 10 megohm, $\pm 10\%$ , 1/4 W	1-945000-085	01121	CB1061
R206	Not used			
R207	Not used			
R208	Resistor, fixed, composition, 22 kilohm, $\pm 10\%$ , 1/4 W	1-945000-053	01121	CB2231
R209	Resistor, fixed, composition, 1.0 kilohm, $\pm 10\%$ , 1/4 W	1-945000-037	01121	CB1021
R210	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1 W	1-945002-057	01121	GB4731
R211	Resistor, fixed, composition, 5.6 kilohm, $\pm 10\%$ , 1/4 W	1-945000-046	01121	CB5621
R212	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R213	Resistor, variable, composition, 1.0 kilohm, $\pm 30\%$ , 1/4 W	1-945010-004	71450	U201
R214	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1 W	1-945002-057	01121	GB4731
R215	Resistor, fixed, composition, 5.6 kilohm, $\pm 10\%$ , 1/4 W	1-945000-046	01121	CB5621

**Table 3-5. Parts List for Horizontal Amplifier Assembly, A4 (Cont.)**

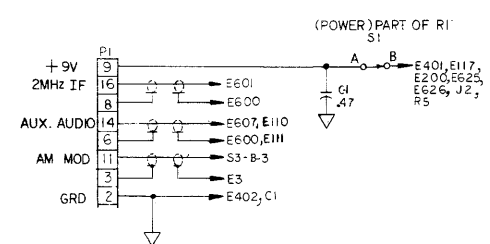
Ref. Desig.	Description	Singer Part No.	Mfr. Code No.	Mfr. Part No.
R216	Resistor, fixed, composition, 3.9 kilohm, ±10%, 1/4 W	1-945000-044	01121	CB3921
R217	Resistor, variable, composition, 1.0 megohm, ±30%, 1/4 W	1-945010-013	71450	U201

**Table 3-6. Code List of Manufacturers**

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-2.

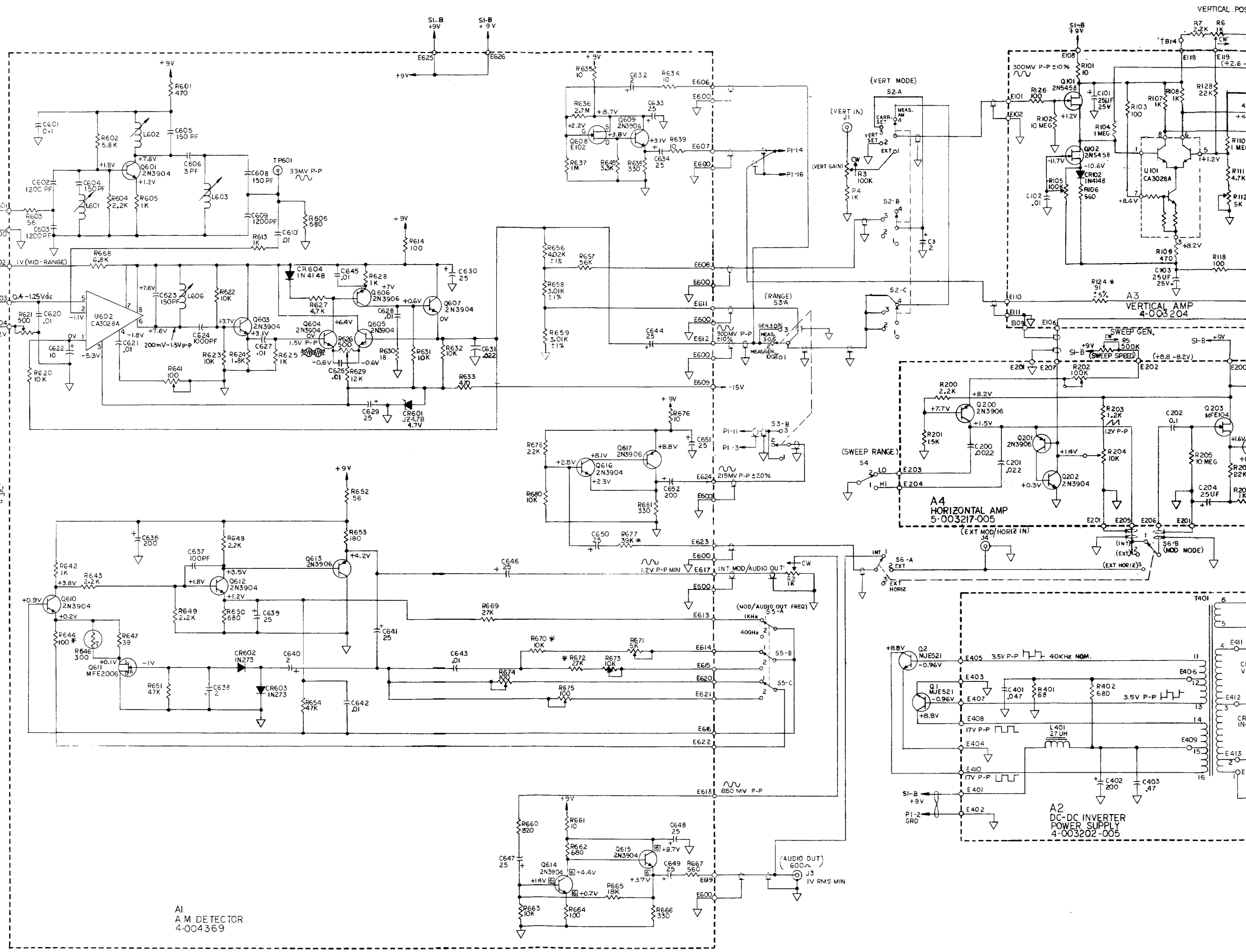
Code No.	Manufacturer	Address
01121	Allen-Bradley Co.	Milwaukee, Wis.
02660	Amphenol-Bunker Ramo Corp., Connector Div.	Broadview, Ill.
02735	RCA Semiconductor and Materials Div.	Sommerville, N.J.
03877	Transitron Electronic Corp.	Wakefield, Mass.
04713	Motorola Inc.	Phoenix, Ariz.
11636	Kings Electronics Co.	Pasadena, Calif.
14655	Cornell-Dubilier Elect. Corp.	Newark, N.J.
14674	Corning Glass Works, Electronic Components Dept.	Corning, N.Y.
17856	Siliconix, Inc.	Santa Clara, Calif.
24446	G. E. Corp.	Schenectady, N.Y.
24972	Telefunken Sales Corp.	Long Island, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
71450	CTS Corp.	Elkhart, Ind.
72136	Electro Motive Mfg. Co.	Willimantic, Conn.
72699	General Instrument Corp.	Newark, N.J.
72982	Erie Technological Products Inc.	Erie, Pa.
73445	Amperex Electronics Co.	Hicksville, N.Y.
88869	Singer Instrumentation	Los Angeles, Calif.
90201	Mallory Capacitor Co.	Indianapolis, Ind.

**Section V**  
**SCHEMATIC DIAGRAMS**



- 1. RMS VOLTAGE MEASURED WITH VOM BETWEEN PIN 2415 AND E416. CAUTION! VOLTMETER MUST HAVE FLOATING INPUTS AS E415 AND E416 MAY BE AT A HIGH DC POTENTIAL.
  - 2. VOLTAGES TAKEN WITH INT MOD/AUDIO OUT POT (R2) IN THE FULL CCW POSITION.
  - 3. VOLTAGES WITHOUT TOLERANCE ARE FOR REFERENCE ONLY.
  - 4. VOLTAGES REFERENCED TO GROUND WHILE MEASURING A SIGNAL WITH 30% MODULATION @ 1KHz.
  - 5. \* INDICATES SELECTED VALUES.
  - 6. ALL RESISTORS ARE IN OHMS, ±10%, 1/4W
  - 7. CAPACITORS ARE IN MICROFARADS.
- NOTES: UNLESS OTHERWISE SPECIFIED

**A1  
A M DETECTOR  
4-004369**





**APPENDIX A  
BACKDATING INFORMATION  
For Model OAM-1**

**Serial Numbers 101 thru Serial Numbers suffixed with 04323**

This manual refers directly to serial numbers suffixed with 04324 and above. The following information is provided to adapt this manual for serial numbers 101 thru serial numbers suffixed with 04323. Perform the following changes to the manual down to the effective serial number of your instrument.

**Effective serial number:** 101 thru Serial numbers suffixed with 04324

Page 3-8: Table 3-2. Parts List For AM Detector Assembly, A1

Change R647 to:

Resistor, fixed, composition, 56 ohm, ±10%, 1/4 W	1-945000-022	01121	CB5601
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Change R652 to:

Resistor, fixed, composition, 100 ohm, ±10%, 1/4 W	1-945000-025	01121	CB1011
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Change R653 to:

Resistor, fixed, composition, 270 ohm, ±10%, 1/4 W	1-945000-030	01121	CB2711
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Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1

Change R647 to 56

Change R652 to 100

Change R653 to 270

**Effective serial number:** 101 thru Serial numbers suffixed with 04295

Page 3-10: Table 3-3. Parts List For High Voltage Power Supply Assembly, A2

Change CR401, CR402 to:

Diode, silicon	1-913043-002	04713	MR991A
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Change CR403, CR404 to:

Diode, silicon	1-913001-004	04713	1N4004
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Change CR405, CR406 to:

Diode, silicon	1-913001-002	04713	1N4002
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Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1

Change CR401, CR402 to MR991A

Change CR403, CR404 to 1N4004

Change CR405, CR406 to E1

**Effective serial numbers:** 101 thru 565

Page 1-1: Paragraph 1.3.3 Internal Modulator Circuitry

Last sentence, Delete: The words "or MEAS/GEN 100%"

Page 1-3/1-4: Figure 1-1. Detailed Block Diagram, Model OAM-1

Change RANGE switch S3A and S3B,

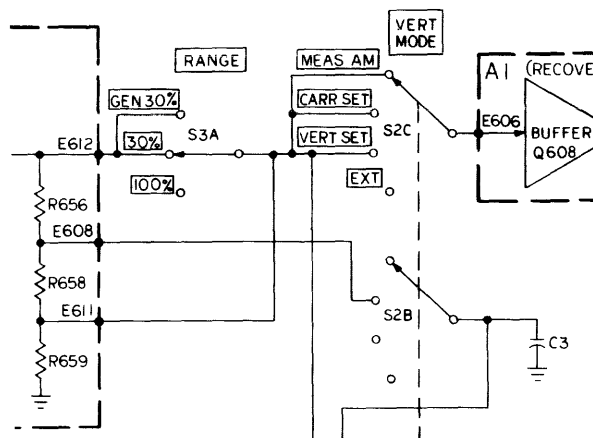
From: MEAS 30% and MEAS/GEN 100%

To: 30% and 100% respectively.

At the junction of E619 and S6A, Add: A resistor, R14\*

Delete: The line connecting S3B- "GEN 30%" to S3B-"100%"

Delete the line connecting E612 to E606 and, Add: Switch S2C as follows:



Page 2-3: Paragraph 2.4.7. Evaluation of Modulation Measurement Accuracy

Change Step l.

From: 9.5 divisions (95% modulation) To: "8 divisions (80% modulation)"

Change Step p,

From: "approximately 0.1 cm (95% modulation)" To: "between 0.70 and 0.21 cm (70% to 90% modulation)"

Page 2-4: Paragraph 2.4.8. Evaluation of Mainframe (Internal) . . . Audio Distortion

Change Step e to the following:

Set RANGE switch to GEN 30%.

Delete Steps m, n, and o.

Paragraph 2.4.9. Evaluation of External Modulation . . . Audio Distortion

Delete Steps h and i.

Page 3-2: Table 3-1. Parts List for Main Assemblies and Chassis (Cont.)

Below R13, Add:

R14	Resistor, fixed, composition, selected, 47 kilohm nominal, ±10%, 1/4 W	1-945000-057	01121	CB4731
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Page 3-12: Table 3-4. Parts List for Vertical Amplifier Assembly, A3

Change R120 to:

	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4 W	1-945000-182	01121	CB6825
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Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1

Add: A resistor, R14\* 47 K between J3 and S6A-1

Delete: The line connecting S3B-1 to S3B-3.

Change the line,

From: E606 to S3A-2 To: E606 to S2C-common

Change R120, to: 6.8 K

**Effective serial numbers:** 101 thru 515

Page 3-2: Table 3-1. Parts List for Main Assemblies and Chassis

Change C2, to:

	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE,0.1uF
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Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1

Between J1 and R3,

Add: A capacitor, C2, 0.1, with the curved side to R3.

**Effective serial numbers:** 101 thru 465

Page 3-10: Table 3-3. Parts List for High Voltage Power Supply Assembly, A2

Change C411, to:

Capacitor, fixed, ceramic, 0.1 uF, +80% -20%, 500 V dc	1-900012-005	56289	41C92
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**Effective serial numbers:** 101 thru 364

Page 3-2: Table 3-1. Parts List for Main Assemblies and Chassis

Change R14, to:

Resistor, fixed, composition, selected, 68 kilohm nominal, ±10%, 1/4 W	1-945000-059	01121	CB6831
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Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1

Change R14, to: \*68 K

**Effective serial numbers:** 101 thru 300

Page 3-2: Table 3-1. Parts List for Main Assemblies and Chassis

Change A3, part number, to 5-003204-006

Pages 3-5 thru 3-9: Table 3-2. Parts List for AM Detector Assembly, A1

Change C635, to:

Capacitor, fixed, electrolytic, 2 uF, +75% -10%, 25 V dc	1-900023-016	56289	TE1201
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Change CR601, to:

Diode, zener, 5.1 V, ±5%, 400 mV	1-913003-009	04713	MZ500-9
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Change R624, to:

Resistor, fixed, composition, 1.8 kilohm, ±10%, 1/4 W	1-945000-040	01121	CB1821
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Change R634, to:

Resistor, fixed, composition, 1.0 megohm, ±10%, 1/4 W	1-945000-073	01121	CB1051
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Change R639, to:

Resistor, fixed, composition, 100 ohm, ±10%, 1/4 W	1-945000-025	01121	CB1011
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Change R655, to:

Resistor, fixed, composition, 10 kilohm, ±10%, 1/4 W	1-945000-049	01121	CB1031
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Change R662, to:

Resistor, fixed, composition, 1.0 kilohm, ±10%, 1/4 W	1-945000-035	01121	CB1021
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Pages 3-11 and 3-12: Table 3-4. Vertical Amplifier Assembly, A3

Delete: The entire table and replace with the following:

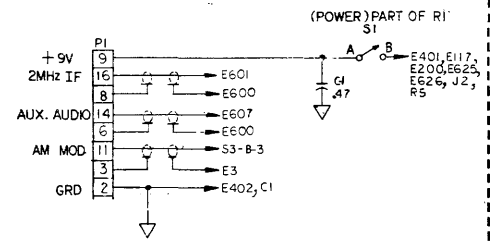
C101	Not used			
C102	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 V dc	1-900001-001	73445	C280AE.0.01uF
C103	Not used			
C104	Capacitor, fixed, plastic, 0.47 uF, ±20%, 250 V dc	1-900001-021	73445	C280AE.0.47uF
C105	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE.0.1uF
C106	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 V dc	1-900001-013	73445	C280AE.0.1uF
C107	Capacitor, fixed, electrolytic, 2 uF, +75% -10%, 25 V dc	1-900023-016	73445	TE1201



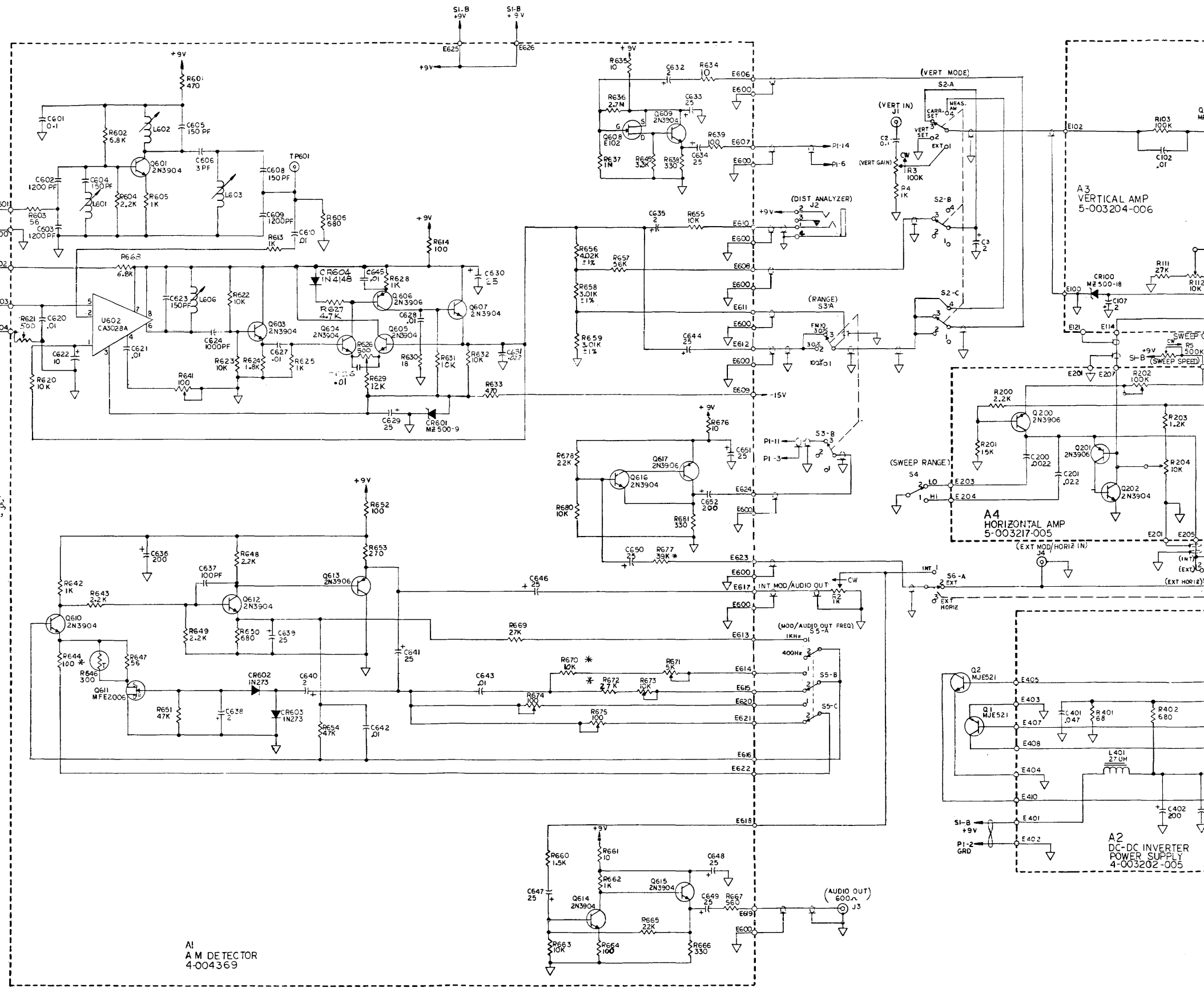
CR100	Diode, zener, 12 V, $\pm 5\%$ , 400 mW	1-913003-020	04713	MZ500-18
Q100	Transistor, N-channel, J-FET	1-958002-002	04713	MPF104-5
Q101	Not used			
Q102	Not used			
Q103	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q104	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q105	Transistor, silicon, NPN	1-958000-001	04713	2N3904-5
Q106	Transistor, silicon, NPN	1-958004-001	02735	40327
Q107	Transistor, silicon, NPN	1-958004-001	02735	40327
R100	Not used			
R101	Not used			
R102	Not used			
R103	Resistor, fixed, composition, 100 kilohm, $\pm 10\%$ , 1/4 W	1-945000-061	01121	CB1041
R104	Not used			
R105	Not used			
R106	Not used			
R107	Not used			
R108	Not used			
R109	Not used			
R110	Not used			
R111	Resistor, fixed, composition, 27 kilohm, $\pm 10\%$ , 1/4 W	1-945000-054	01121	CB2731
R112	Resistor, variable, composition, 10 kilohm, $\pm 30\%$ , 1/4 W	1-945010-007	71450	U201
R113	Resistor, fixed, composition, 4.7 kilohm, $\pm 10\%$ , 1/4 W	1-945000-045	01121	CB4721
R114	Resistor, fixed, composition, 3.3 kilohm, $\pm 10\%$ , 1/4 W	1-945000-043	01121	CB3321
R115	Resistor, fixed, composition, 330 ohm, $\pm 10\%$ , 1/4 W	1-945000-031	01121	CB3311
R116	Resistor, fixed, composition, 27 kilohm, $\pm 10\%$ , 1/4 W	1-945000-054	01121	CB2731
R117	Resistor, fixed, composition, 470 ohm, $\pm 10\%$ , 1/4 W	1-945000-033	01121	CB4711
R118	Resistor, fixed, composition, 1.0 megohm, $\pm 10\%$ , 1/4 W	1-945000-073	01121	CB1051
R119	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1 W	1-945002-057	01121	GB4731
R120	Resistor, fixed, composition, 5.6 kilohm, $\pm 10\%$ , 1/4 W	1-945000-046	01121	CB5621
R121	Resistor, fixed, composition, 100 ohm, $\pm 10\%$ , 1/4 W	1-945000-025	01121	CB1011
R122	Resistor, variable, composition, 500 ohm, $\pm 30\%$ , 1/5 W	1-945010-003	71450	U201
R123	Resistor, fixed, composition, 47 kilohm, $\pm 10\%$ , 1 W	1-945002-057	01121	GB4731
R124	Resistor, fixed, composition, 5.6 kilohm, $\pm 10\%$ , 1/4 W	1-945000-046	01121	CB5621

Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1

Replace with the attached Figure 4-1.



4. FOR USE ON SER. NOS. 150 & BELOW  
 3 \* INDICATES SELECTED VALUES.  
 2. ALL RESISTORS ARE IN OHMS,  $\pm 10\%$ ,  $1/4W$   
 1. CAPACITORS ARE IN MICROFARADS.  
 \*TES: UNLESS OTHERWISE SPECIFIED





ADDENDUM  
for  
Manual No. 1-500783-298  
Model No. OAM-1

ERRATA

Correct the following errors in the above manual:

Page 3-11: Table 3-4. Parts List for Vertical Amplifier Assembly, A3  
Q103, Q104, Mfr. Part No., Was: 40327 Is: 40327-66031

Page 3-13: Table 3-5. Parts List for Horizontal Amplifier Assembly, A4  
Q204, Q205, Mfr. Part No., Was: 40327 Is: 40327-66031

Page 4-3/4-4: Figure 4-1. Schematic Diagram, Model OAM-1  
CR401, CR402, Was: MR991A Is: VG2X  
CR403, CR404, Was: 1N4004 Is: 1N4936  
CR405, CR406, Was: E1 Is: 1N4933  
Add: A line connecting S3A-wiper to S2C-2

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B	
A	
Revision	↑ Initials
Approved	9-30-75 ↑ Date

CLASS CODE

THE SINGER COMPANY  
LOS ANGELES OPERATION  
LOS ANGELES, CALIF.

TITLE    **ADDENDUM**  
          **Model OAM-1**

DWG. NO.  
**1-500783-298**  
SHEET **1.1**

