

MAINTENANCE MANUAL
FOR
COMMUNICATIONS SERVICE MONITOR
MODEL FM-10CS

(For use with serial numbers 701 and above)

This document should be inserted into the front of the Model FM-10C
Maintenance Manual No. 1-500783-260.

This document refers directly to instrument serial numbers
suffixed with 04155 and above. The included backdating information
adapts this document to instrument serial numbers 701 thru
those suffixed with 04154.

REVISED (A) FORM 3-19-74 (B) FORM 6-20-74 (C) FORM 8-7-74
FORM 10-24-8

The Singer Company, Los Angeles Operation
3211 South La Cienega Blvd.,
Los Angeles, Ca. 90016

TITLE DIFFERENCE DATA SHEET
MODEL FM-10CS

DWG NO.
I- 410262-001
SHEET 1

The Model FM-10CS is identical to the Model FM-10C with the following exception: The instrument has internal sweep capability for both "generate" and "measure" modes. This instrument also has the capability of providing internal or external amplitude modulation of the mainframe carrier up to 100% modulation when used with the Model OAM-1 plug-in module.

The Model FM-10C Maintenance Manual may be converted into a Model FM-10CS Maintenance Manual by making the following changes:

Page 3-4: Paragraph 3.2.9, Amplitude Modulation Circuitry.

Line 4 and 5, Delete: ... amplitude modulator, A7CR1 and A7CR2...

In its place, add: 100% AM MODULATOR

Line 8, Delete: amplitude modulator modulates the synthesizer frequency...

In its place, add: 100% AM MODULATOR modulates the synthesizer signal...

3.2.12 Sweep Circuitry (Refer to block diagram corrections, Figure 1, attached.)

SWEEP RATE potentiometer, R11, controls the duration of the sweep oscillator, A25Q1. The sweep output of buffer, A25Q2, is applied to the SWEEP WIDTH control, R12, and amplified by A25Q4. It is then applied to the VCO on A2 via the SWEEP switch and relay A25K1. The sweep output of buffer, A25Q2, is also applied to the HORIZONTAL SIZE control, R13, and then to the HORIZONTAL OUTPUT receptacle, J10.

The RF detector, A26, is accessible from the front panel by the DETECTOR INPUT receptacle, J11, and the VERTICAL OUTPUT receptacle, J12.

Page 3-9: Paragraph 3.7.5 Internal Modulator Circuitry

Last sentence, Was: ..., S3, is in the GEN 30% position.

Is: ..., S3, is in either the GEN 30% or MEAS/GEN 100% position

Page 3-23/3-24: Figure 3-6. Detailed Block Diagram Model OAM-1

Delete: R14 and replace it with a straight line.

Add: A line (jumper) from S3B GEN 30% to S3B MEAS/GEN 100%

Change S3B 30% to MEAS 30%.

Page 4-1, Table 4-1. Test Equipment Requirements for Mainframe Frequency Counter.

Change recommended model to Hewlett-Packard Model 5532A.

Add: Amplitude Measurement range: 27% to 100% Singer Model 2748/OAM-1
Modulation
Meter

Page 4-3, Paragraph 4.3.1. Tone Generator Mode Check.

Step a, Add: Set the SWEEP switch to the OFF position.

Page 4-5, Add Paragraph 4.3.10 as follows:

4.3.10 Sweep Range Check

- a. Set the mainframe Frequency switches to 151.000 MHz, 0-100 Hz control to 5, MODE switch to MEAS, MEASURE MODE AUDIO OUTPUT switch to RECOVERED AUDIO (OUT). Set the left hand module MEASURE SENSITIVITY switch and control to HIGH and 2 mV. Set the center module RANGE switch to ZERO. Set the right hand module INT MOD/AUDIO OUT control to fully ccw (not off).

- b. Connect the signal generator to the MEASURE INPUT receptacle.
- c. Set the signal generator to 151 MHz at a level of -41 dBm.
- d. Set the mainframe SWEEP RATE control to the fully ccw position (not off).
- e. Rotate the mainframe SWEEP WIDTH control cw until pulse tone is heard approximately every 1/10 second as the frequency of the mainframe coincides with 151 MHz from the signal generator.
- f. Set the signal generator to 152 MHz.
- g. Rotate the mainframe SWEEP WIDTH control if necessary until a pulse tone is heard as in Step e except at 152 MHz.

Page 4-5, Paragraph 4.4.2. 10 MHz Amplifier Adjustment

Step a, Add the following: Set the SWEEP switch to the OFF position.

Page 4-35, Paragraph 4.4.34. Amplitude Modulation Adjustment.

Delete steps a through e and replace with the following:

- a. Install the Model AFM-2 in the right-hand compartment of the Model FM-10CS.
- b. Connect one end of a BNC coaxial cable to the audio output receptacle of the audio oscillator and set the output frequency to 1 kHz.
- c. Using a BNC-T connector, connect the other end of the cable and the distortion analyzer input to the Model AFM-2 AM MOD receptacle.
- d. Set the Model FM-10CS switches and controls as follows:

| | |
|-------------------------|---|
| 1) POWER | ON |
| 2) MODE | GEN |
| 3) Frequency | 003.0000 MHz |
| 4) 0-100 Hz | OUT |
| 5) GENERATOR MODULATION | IN-ON |
| 6) RF OUTPUT | -27 dBm (If the left-hand module does not have -27 dBm output level, the broadband amplifier must be used to obtain -27 dBm level.) |
- e. Connect a BNC coaxial cable from the Model FM-10CS RF OUTPUT receptacle to the measure input receptacle of the amplitude modulation meter.
- f. Set the distortion analyzer to the voltmeter mode.
- g. Adjust the audio oscillator to obtain 75 mV rms on the distortion analyzer.
- h. Unsolder the 60 MHz to 150 MHz input cable at A27-4 and connect it to the RF voltmeter with the 50 ohm load. The power level should be $-4 \text{ dBm} \pm 1 \text{ dB}$. Rotate the 10 MHz frequency switch from 0 thru 9. If the output level varies greater than

± 1 dB, refer to 60-150 MHz alignment procedures, Paragraph 4.4.20 thru 4.4.30, and readjust as necessary.

- i. Resolder the cable to A27-4. Disconnect the BNC connector at mixer Z2-X and connect the RF voltmeter with 50 ohm load to the cable.
- j. Adjust A27R1 for an output level of -15 dBm. Disconnect the RF voltmeter and reconnect the cable to Z2-X.
- k. Set the AM meter to 30% AM.
- l. If necessary, adjust A27R1 to obtain 30% modulation on the AM meter.
- m. Change the 10 MHz Frequency switch on the mainframe from 0 thru 9. (Recalibrate the AM meter before each step.)
- n. The modulation should be 27% to 33% at each step. If the modulation is not within these limits, select the value of A27C4. (May be omitted.)
- o. Disconnect the distortion analyzer from the Model AFM-2 and connect it to the distortion analyzer receptacle of the AM meter.
- p. Check that the distortion is less than 3%.
- q. Disconnect the distortion analyzer from the AM meter and reconnect it to the Model AFM-2 AM MOD receptacle.
- r. Set the distortion analyzer to the voltmeter mode.
- s. Vary the audio oscillator for an output level of 225 mV \pm 22.5 mV (202.5 mV to 247.5 mV).
- t. Check the AM meter for an indication of 86% to 100% modulation.
- u. Disconnect the distortion analyzer from the Model AFM-2 and connect it to the distortion analyzer receptacle of the AM meter.
- v. Check that the distortion is less than 10%.

Page 4-37: Paragraph 4.4.39 AM Distortion

- h, Delete the period and add: ...for up to 30% modulation or set it to "MEAS/GEN 100%" for greater than 30% modulation.
- m, Delete the period and add: ...or less than 10% at 95% modulation.
- n, Delete the entire step.

Page 4-37, Add the following:

4.4.41 Internal Sweep Adjustments

- a. Connect the frequency counter input to the mainframe HORIZONTAL OUTPUT receptacle with a BNC coaxial cable.

- b. Set the mainframe HORIZONTAL SIZE control to the fully cw position.
- c. Set the frequency counter to measure "period" and set the mainframe SWEEP switch to the ON position. Set the SWEEP RATE control to fully cw. The counter should indicate less than 10 ms. If the sweep rate is 10 ms or greater, decrease the value of A25R1 until the sweep rate is less than 10 ms.
- d. Set the mainframe SWEEP RATE control to fully ccw. The counter should indicate greater than 100 ms. If the sweep rate is 100 ms or less, select the value of A25R1 so that the SWEEP RATE control has a range of 100 ms to 10 ms (10 Hz to 100 Hz). If this range cannot be obtained by selecting A25R1, A25C1 may be out of tolerance. Replace A25C1 if necessary and repeat steps c and d.
- e. Connect the oscilloscope 10 X probe to A25-8. Set the mainframe SWEEP RATE control to fully cw (100 Hz) and set the SWEEP WIDTH control to fully cw.
- f. The waveform on the oscilloscope should be a sawtooth with an amplitude of approximately 8.5 V p-p with no compression at the negative peak (flattened out). If the sawtooth is compressed, select the value of A25R7 to obtain a noncompressed sawtooth waveform on the oscilloscope.
- g. If the sawtooth waveform amplitude is less than 9 V p-p, decrease the value of A25R9 until the amplitude is greater than 8 V p-p.
- h. Disconnect the frequency counter and oscilloscope 10 X probe from the unit.

Page 4-65: Paragraph 4.23.9 Modulation Measurement Accuracy Check
 m, Was: 8 division (80% modulation). Is: 9.5 divisions (95% modulation).
 r, Was: between 0.70 and 0.21 cm (70% to 90% modulation).
 Is: approximately 0.1 cm (95% modulation)

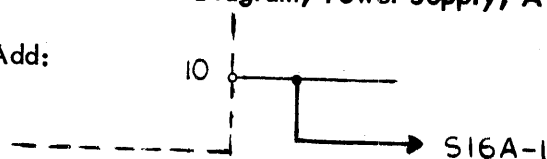
Paragraph 4.23.10-f
 Delete the period and add: for up to 30% modulation or set it to "MEAS/GEN 100%" for greater than 30% modulation.

Page 4-66: Paragraph 4.23.10-n.
 Delete the period and add: or less than 10% at 95% modulation

Paragraph 4.23.11
 c, Delete period and add: and set RANGE switch to GEN 30%.
 Add: d. Switch RANGE switch to MEAS/GEN 100%. Verify that increasing audio oscillator input (to approximately 1.7 V rms) will produce full-scale deflection (100% modulation).

Page 5-5/5-6, Figure 5-2. Schematic Diagram, Power Supply, A1A3

Pin 10, Add:



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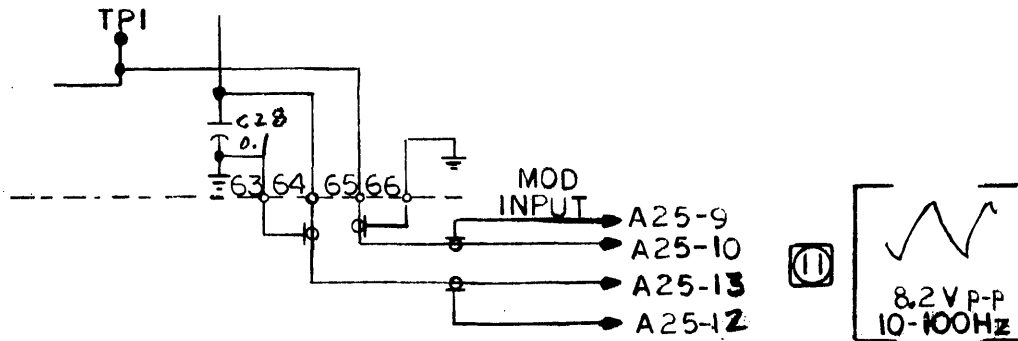
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Page 5-11/5-12, Figure 5-5. Schematic Diagram, VCO, 6, 9 MHz Board, A2

Delete R39 and add the following:



⑪ Levels present when SWEEP switch, S16, is ON.

Page 5-17/5-18, Figure 5-8, Schematic Diagram, 10 MHz Decade Switching, A4B

Change Pin 41 information as follows: Is: A27-4,5 Was: Z2-1

Page 5-25/5-26, Figure 5-12, Schematic Diagram, 10 MHz Decade Assembly, A8

Change Z2-X information as follows: Is: A27-6,7 Was: A4B-41,42
 [60-150MHz] (60-150 MHz) IN
 INPUT [0dBm]

Change Z2-L information as follows: Is: [600 - 700MHz] Was: (600-700 MHz) OUT
 OUTPUT [-8dBm]
 [-21dBm]

Page 5-39, 5-40, Figure 5-19, Switching Diagram

Replace with attached Figure 5-19.

Page 5-59/5-60: Figure 5-29. Schematic Diagram Model OAM-1

Delete: R14* 47k and replace with a straight line.

Delete: The line from E606 to S2C - common and replace with a line from E606 to S3A-2.

Add: A line from S3B-1 to S3B-3.

R120, Was: 6.8 k Is: 10 k

Page 5-69 through 5-72. Change Figure 5-34 as on the attached Figure 1.

After Page 5-71/5-72 add the following attached schematic diagrams.

Page 5-73/5-74, Figure 5-35, Schematic Diagram, Sweep Generator Board, A25

Page 5-75/5-76, Figure 5-36, Schematic Diagram Detector, A26

Page 5-77/5-78, Figure 5-37, Schematic Diagram AM Modulator Board, A27

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Page 6-4. Table 6-2. Parts List for FM-10C

A2,

Was: VCO/6 and 9 MHz Generator Circuit Board Assembly 5-003082-006
 Is: VCO/6 and 9 MHz Generator Circuit Board Assembly 5-003082-007 88869

A4B,

Was: 10 MHz Programming Circuit Board Assembly 4-004235-006
 Is: 10 MHz Programming Circuit Board Assembly 4-004235-008 88869

A5,

Was: 1200 MHz Decade Assembly 4-004243-001
 Is: 1200 MHz Decade Assembly 1-004334-002 88869

A7,

Was: Gain Control Amp/Amplitude Modulator Assembly 4-003086-002
 Is: Gain Control Amp/Amplitude Modulator Assembly 4-003086-003 88869

A8

Was: 10 MHz Decade Assembly 4-003085-002
 Is: 10 MHz Decade Assembly 4-003085-004 88869

Page 6-5. Table 6-2

After A24, Add:

A25 Sweep Generator Assembly 1-004877-001 88869
 A26 Detector Assembly 1-004887-001 88869
 A27 AM Modulator Assembly 1-004805-001 88869

Page 6-7, Table 6-2, After J9, Add:

J10 Connector, jack, bulkhead, BNC 1-910043-001 11636 KC19-68

After R10, Add:

R11 Resistor, variable, composition, 50 kilohm,
 ±30%, 1/2 W (Part of S16/R11/R12)

R12 Resistor, variable, composition, 5 kilohm,
 ±30%, 1/2 W (Part of S16/R11/R12)

R13 Resistor, variable, composition, 1 kilohm,
 ±30%, 1/2 W 1-403633-001 88869

Page 6-8, Table 6-2, After S15, Add:

S16/
 R11/ Switch/variable resistor assembly
 R12 (S16) Switch, rotary, 2 pole, 1 position 1-403632-001 88869

After W1, Add:

W2 Cable assembly, 6 in., BNC to BNC 1-003159-002 88869
 W3 Cable assembly, 6 in., BNC to BNC 1-003159-002 88869

Page 6-26, Table 6-2,
 R39

Was: Resistor, fixed, composition, 47 k Ω ,
 $\pm 10\%$, 1/4 W 1-945000-057 01121 CB4731

Is: Not Used

Page 6-37, Table 6-2,

Delete C40 through C42 and all information
 Delete CR1 and CR2 and all information

Page 6-38, Table 6-2,
 R22

Was: Resistor, fixed, composition, selected,
 100 ohm nominal, $\pm 10\%$, 1/4 W 1-945000-025 01121 CB1011

Is: Not Used

Page 6-61, After A21, add the following:

Table 6-2. Parts List for Model FM-10CS

A25 - Sweep Generator Assembly

| Ref Desig | Description | Singer Part No. | Mfg. Code No. | Mfr. Part No. |
|-----------|---|-----------------|---------------|--------------------|
| C1 | Capacitor, fixed, electrolytic, 2.2 μ F, $\pm 10\%$, 20 Vdc | 1-900057-111 | 56289 | 150D225X90 20A2 |
| C2 | Capacitor, fixed, electrolytic, 120 μ F, $\pm 20\%$, 15 Vdc | 1-900115-001 | 12954 | D120GS D15M |

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Table 6-2, Parts List for Model FM-10 CS (Continued)

A25 Sweep generator Assembly

| Ref Design | Description | Singer Part No. | Mfg. Code No. | Mfg. Part No. |
|------------|--|-----------------|---------------|----------------|
| C3 | Capacitor, fixed, electrolytic, 50 uF, ±30%, 15 Vdc | 1-900060-001 | 76433 | 904-GNO6 31 |
| C4 | Capacitor, fixed, electrolytic, 50 uF, ±30%, 15 Vdc | 1-900060-001 | 76433 | 904-GNO6 31 |
| C5 | Capacitor, fixed, electrolytic, 200 uF, -10% +75%, 15 Vdc | 1-900039-002 | 76433 | 984-1733 |
| CR1 | Diode, Zener, 11 V ±5%, 1W | 1-913004-014 | 81483 | 1ZS11A |
| J1 | Connector, jack, BNC (part of A26) | | | |
| J2 | Connector, jack, BNC (part of A26) | | | |
| K1 | Relay, reed, miniature, SPST, Coil: 12 Vdc 1000 Ω | 1-942014-004 | 0000G | 1A12AH |
| Q1 | Transistor, UJT, 2N2646 | 1-958050-001 | 03508 | 2N2646 |
| Q2 | Transistor, FET, 2N5458 | 1-958002-002 | 04713 | 2N5458 |
| Q3 | Transistor, silicon, NPN, 2N3904 | 1-958000-001 | 04713 | 2N3904-5 |
| Q4 | Transistor, silicon, NPN, 2N3904 | 1-958000-001 | 04713 | 2N3904-5 |
| Q5 | Transistor, silicon, NPN, 2N3904 | 1-958000-001 | 04713 | 2N3904-5 |
| R1 | Resistor, fixed, composition, selected, 4.3 kilohm nominal, ±5%, 1/4 W | 1-945000-177 | 01121 | CB4325 |
| R2 | Resistor, fixed, composition, 240 ohm, ±5%, 1/4 W | 1-945000-147 | 01121 | CB2415 |
| R3 | Resistor, fixed, composition, 5.1 ohm, ±5%, 1/4 W | 1-945000-107 | 01121 | CB51G5 |
| R4 | Resistor, fixed, composition, 10 kilohm ±5%, 1/4 W | 1-945000-186 | 01121 | CB1035 |
| R5 | Resistor, fixed, composition, 470 ohm, ±5%, 1/4 W | 1-945000-154 | 01121 | CB4715 |
| R6 | Resistor, fixed, composition, 27 kilohm, ±5%, 1/4 W | 1-945000-196 | 01121 | CB2735 |

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Table 6-2, Parts List for Model FM-10CS, (Continued)

A25 Sweep generator Assembly

| Re Design | Description | Singer Part No. | Mfg. Code No. | Mfg Part No. |
|-----------|---|-----------------|---------------|--------------|
| R7 | Resistor, fixed, composition, selected, 3.9 kilohm nominal, $\pm 5\%$, 1/4 W | 1-945000-176 | 01121 | CB3925 |
| R8 | Resistor, fixed, composition, 1 kilohm, $\pm 5\%$, 1/4 W | 1-945000-162 | 01121 | CB1025 |
| R9 | Resistor, fixed, composition, selected, 91 ohm nominal, $\pm 5\%$, 1/4 W | 1-945000-137 | 01121 | CB9105 |
| R10 | Resistor, fixed, composition, 470 ohm, $\pm 5\%$, 1/4 W | 1-945000-154 | 01121 | CB4715 |
| R11 | Resistor, fixed, composition, 30 ohm, 5%, 1/4 W | 1-945000-128 | 01121 | CB3905 |
| R12 | Resistor, fixed, composition, 47 kilohm, 5%, 1/4 W | 1-945000-202 | 01121 | CB4735 |
| R13 | Resistor, fixed, composition, 3 kilohm, 5%, 1/4 W | 1-945000-173 | 01121 | CB3025 |

A26 Detector Assembly

| | | | | |
|-----|--|--------------|-------|-----------|
| C1 | Capacitor, fixed, plastic, 0.1 uF, $\pm 20\%$, 250 Vdc | 1-900001-013 | 73445 | C280AE |
| C2 | Capacitor, fixed, plastic, 0.1 uF, $\pm 20\%$, 250 Vdc | 1-900001-013 | 73445 | C280AE |
| C3 | Capacitor, fixed, standoff, 0.001 uF, 0% +100%, 500 Vdc | 1-900044-002 | 01121 | SS5D-102W |
| CR1 | Diode, germanium, 1N273 | 1-913005-001 | 03877 | 1N273 |
| J1 | Connector, jack, BNC | 1-910005-001 | 11636 | UG-911/U |
| J2 | Connector, jack, BNC | 1-910005-001 | 11636 | UG-911/U |
| R1 | Resistor, fixed, composition, 620 ohm, $\pm 5\%$, 1/4 W | 1-945000-157 | 01121 | CB6215 |
| R2 | Resistor, fixed, composition, 100 kilohm, $\pm 10\%$, 1/4 W | 1-945000-061 | 01121 | CB1041 |

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Table 6-2. Parts List for Model FM-10CS (Continued)

A27 - AM Modulator Assembly

| Ref Desig | Description | Singer Part No. | Mfg. Code No. | Mfg. Part No. |
|-----------|---|-----------------|---------------|---------------|
| A1 | Modulator, AM | 1-403717-001 | 05375 | SS-44 |
| C1 | Capacitor, fixed, electrolytic, 100 uF, -10% +75%, 25 Vdc | 1-900039-004 | 76433 | 984-1653 |
| C2 | Capacitor, fixed, mica, 250 pF, ±5%, 500 Vdc | 1-900003-040 | 72136 | DM15 |
| C3 | Capacitor, fixed, plastic, 1000 pF, ±5%, 500 Vdc | 1-900003-056 | 72136 | DM15 |
| C4 | Capacitor, fixed, mica, selected, 22 pF nominal, ±5%, 500 Vdc | 1-900003-013 | 72136 | DM15 |
| R1 | Resistor, variable, ceramic, 20 kilohm, ±10%, 1/2 W | 1-945082-001 | 71450 | 190PC 203A |
| R2 | Resistor, fixed, composition, 4.7 kilohm, ±10%, 1/4 W | 1-945000-045 | 01121 | CB4721 |
| R3 | Resistor, fixed, composition, 510 ohm, ±5%, 1/4 W | 1-945000-155 | 01121 | CB5115 |
| R4 | Resistor, fixed, composition, 47 ohm, ±10%, 1/4 W | 1-945000-021 | 01121 | CB4701 |

Page 6-99: MAIN ASSEMBLIES AND CHASSIS PARTS

R14, Was: Resistor, fixed, composition, selected, 68 k ohm nominal, ±10%, 1/4 W 1-945000-059 01121 CB6831
 Is: Not used.

Page 6-111: A3-VERTICAL AMPLIFIER BOARD ASSEMBLY

R120, Was: Resistor, fixed, composition, 6.8 k ohm, ±5%, 1/4 W 1-945000-182 01121 CB6825
 Is: Resistor, fixed, composition, 10 k ohm, ±5%, 1/4 W 1-945000-186 01121 CB1035

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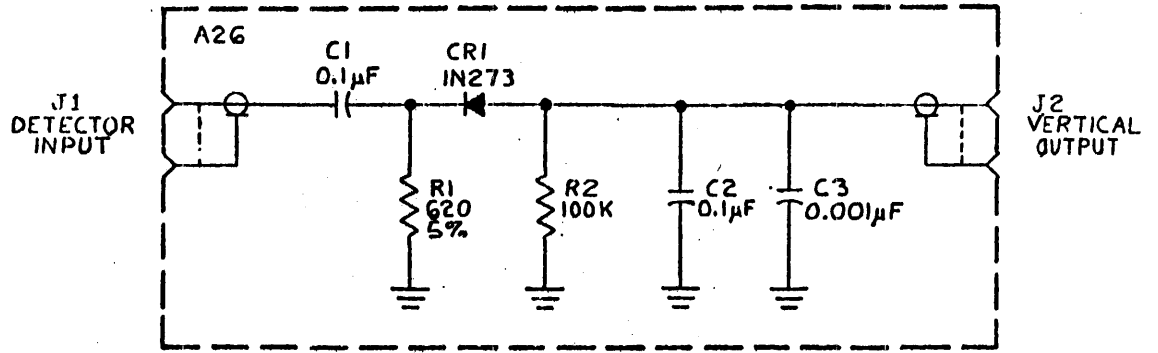
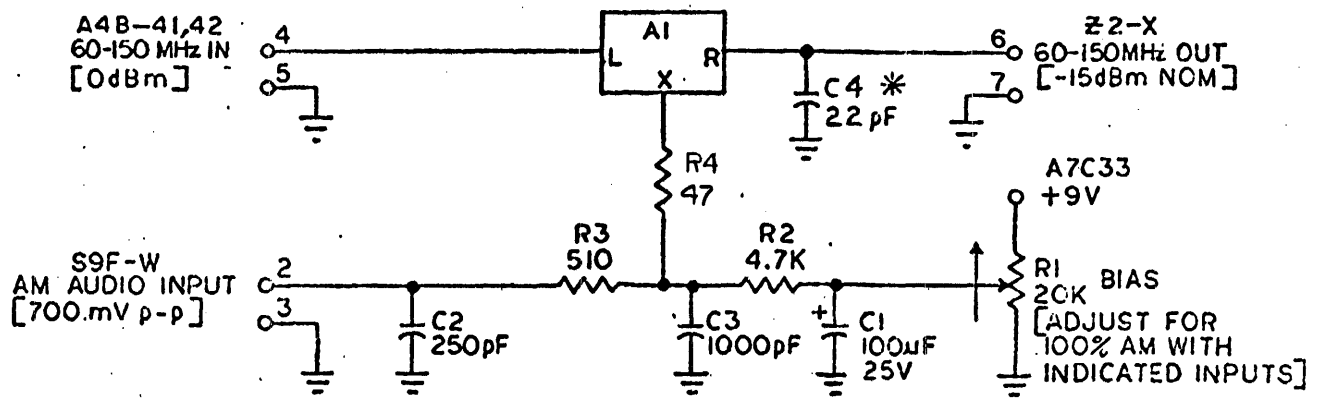


Figure 5-36, Schematic Diagram,
 Detector, A26
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C.R.B. 10-10-73



1. * INDICATES SELECTED VALUE

Figure 5-37. Schematic Diagram
AM Modulator Board, A27

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APPENDIX A
BACKDATING INFORMATION
FOR MODEL FM-10CS

Serial Numbers 701 thru instrument serial numbers suffixed with 04154

This document refers directly to instrument serial numbers suffixed with 04155 and above. The following information is provided to adapt this document for serial numbers 701 thru instruments serial numbers suffixed with 04154.

Perform the following changes to the manual, down to the effective serial number of your instrument.

Effective serial number: 701 thru instrument serial numbers suffixed with 04154.

Page 4-35: Paragraph 4.4.34 Amplitude Modulation Adjustment
Step h., line 2, should be: $-1 \text{ dBm} \pm 1 \text{ dB}$
Step n., Delete: (May be omitted.)

Pages 5-69 thru 5-72: Figure 5-34. Detailed Block Diagram
Remove FL2 from A7-4 (input) and replace with a straight line.
Add: FL2 between A7-6 and Z1-L

Page 5-77/5-78: Figure 5-37. Schematic Diagram AM Modulator Board, A27
Delete: R4, 47, and replace with a straight line.

Page 6-61: A27, AM Modulator Assembly
Delete: R4 and all information.