

RCA

STEREO FM SIGNAL SIMULATOR

Type WR-51A



- Operation
- Applications
- Specifications
- Maintenance



RADIO CORPORATION of AMERICA

ELECTRONIC COMPONENTS AND DEVICES

ELECTRONIC INSTRUMENTS

HARRISON, NEW JERSEY

Safety Precautions

The metal case of this instrument is connected to the ground of the internal circuit. For proper operation, the ground lead of the instrument should always be connected to the ground of the equipment under test. The output cable has a shield throughout its entire length which is connected to the instrument ground and case. It is always best to handle the cable by the insulation.

An important point to remember is that there is always danger inherent in testing electrical equipment which operates at hazardous voltages. Therefore, the operator should thoroughly familiarize himself with the equipment under test before working on it, bearing in mind that high voltages may appear at unexpected points in defective equipment. Additional precautions which experience in the industry has shown to be important are listed below.

1. It is good practice to remove power before connecting test leads to high-voltage points. If this is impractical, be especially careful to avoid accidental contact with equipment racks and other objects which can provide a ground. Working with one hand in your pocket and standing on a prop-

erly insulated floor lessens the danger of shock.

2. Filter capacitors may store a charge large enough to be hazardous. Therefore, discharge filter capacitors before attaching test leads.

3. Remember that leads with broken insulation provide the additional hazard of high voltages appearing at exposed points along the leads. Check test leads for frayed or broken insulation before working with them.

4. To lessen the danger of accidental shock, disconnect test leads immediately after test is completed.

5. Remember that the risk of severe shock is only one of the possible hazards. Even a minor shock can place the operator in hazard of more serious risks such as a bad fall or contact with a source of higher voltage.

6. The experienced operator continuously guards against injury and does not work on hazardous circuits unless another person is available to assist in case of accident.

Items Supplied with WR-51A

1 Instruction Booklet
 1 Registration Card
 1 RF Output Cable (terminated)
 1 Direct Output Cable

Balance Meter Cables
 Left and Right Input
 (permanently wired-in)
 1 Cable-holding Bracket

Description

The RCA WR-51A Stereo FM Signal Simulator is a compact, lightweight instrument designed to generate the signals necessary for complete service and maintenance of multiplex adaptors or Stereo FM receivers.

Signals available from the WR-51A include:

- Composite stereo output signal for either left or right channel, and a special "Phase Test" signal (L + R in phase) for accurate phase adjustment of subcarrier transformers. These signals can be modulated with 400 cps, 1000 cps, or 5000 cps frequencies, as desired.
- A variable-level 19 Kcs (± 2 cps) crystal controlled subcarrier signal for checking the lock-in range of stereo receivers.

- Four additional sine-wave signals, 28 Kc, 38 Kc, 48 Kc, and 67 Kc for adjusting the bandpass networks in multiplex adaptors or stereo receivers.
- 100 Mc carrier signal, adjustable ± 0.8 Mc to permit selection of a quiet point in the fm band. This signal may be frequency modulated with the above composite stereo or monaural information, with adjustable deviation from 0 to 75 Kc.
- 100 Mc sweep with an adjustable range of from 0 to 750 Kc at a 60 cps rate, permitting over-all rf/lf alignment checks.
- Crystal-controlled 5.35 Mc signal to provide a 10.7 Mc if marker, and harmonic markers at 90.95 Mc, 96.30 Mc, 101.65 Mc, and 107 Mc for rf alignment check of the receiver.

RCA Stereo FM Signal Simulator

The Simulator has a 60 db, 3-step attenuator for the rf output signals.

A zero-center meter is provided for checking the balance of a stereo amplifier audio output. Two cables (left and right) are permanently wired into the rear of the instrument for connection to an amplifier voice-coil output.

The WR-51A Stereo FM Simulator comes complete with two connecting cables. A direct, un-terminated cable is provided for use with the

COMP/SIG AUDIO output and for IF MARKER output, and a terminated cable for use with the RF OUT connection to a 75 ohm or 300 ohm receiver antenna input.

The instrument is readily portable, weighing only 14 pounds, and measuring 13½ inches x 10 inches x 8 inches. A cable holding bracket is provided that may be mounted on the back of the case. The WR-51A is attractively styled, with a blue-gray hammeroid case and brushed aluminum panel.

Specifications

Note: Performance figures are for a line voltage of 120 volts, 60 cps.

Electrical

RF Signal Output	
Carrier	100 Mc
	Center frequency adjustable ± 300 Kc
Subcarrier	19 Kc*
FM Modulation	Left stereo signal
	Right stereo signal
	Special phase test (L + R subcarrier modulation)
	Monaural FM
Deviation	Adjustable 0 to 75 Kc †
Sweep Signal	
Center Frequency	100 Mc
Rate	60 cps
Sweep width	adjustable 0 to 750 Kc
RF Output Voltage	approx. 0.1 volts, RMS
RF Attenuator Range	60 db, in 3 steps
Crystal-Controlled Markers	
(at "IF Marker" jack)	10.7 Mc
	90.95 Mc
	96.30 Mc
	101.65 Mc
	107.00 Mc
Composite Signal	
Composite Signal Output (0 to 3 V P-P)	Left stereo signal
	Right stereo signal
	Special phase test (L + R subcarrier modulation)
Audio Output (0 to 2 V P-P)	} 400 cps, 1 Kc, 5 Kc, 19 Kc,*
	} 28 Kc, 38 Kc, 48 Kc, 67 Kc
Percent distortion of 400 cps, 1 Kc, and 5 Kc Frequencies	less than 2%
Balance Meter	Approx. ± 1.4 V RMS from Zero Center
(for connection to voice coils of stereo amplifier)	
Power Supply	
Voltage	115 to 125 volts, 60 CPS
Power Consumption	40 watts

† Applies only to stereo FM signals (Phase Test, Left, and Right).

* 19 Kc signal is crystal-controlled. Accuracy within ± 2 cps.

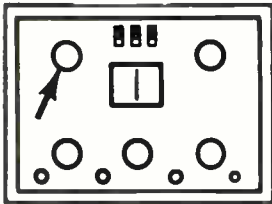
Tube and Crystal Complement

1 RCA 6AN8A	1 Crystal, 19 Kc
1 RCA 6AU8A	1 Crystal, 5.35 Mc
2 RCA 6CG7	3 Crystal Diodes, 1N192
1 RCA 12AT7	1 Silicon Rectifier, 1N1764
1 RCA 12AU7A	

Mechanical

Dimensions:	Weight:
Width	Unpacked
13½ inches	14 lbs.
Height	Packed
10 inches	18 lbs.
Depth	
8 inches	
Finish	} blue-gray Hammeroid case
	} brushed Aluminum Panel

Functions of Controls and Terminals



RF DEVIATION/
SWEEP WIDTH
AUDIO LEVEL/
COMP SIG LEVEL

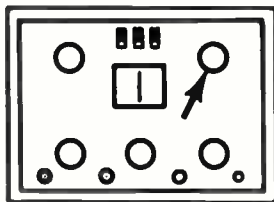
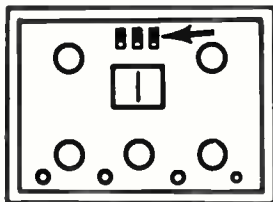
RF Deviation — Adjusts the FM deviation of the 100 Mc RF oscillator.

Sweep Width—(Applies only when Function Switch is set to the “RF Sweep & IF Marker” position.) Adjusts the sweep width of the 100 MC RF sweep signal from 0 to 750 Kc.

Audio Level—(Applies only when the Function Switch is set to the “Audio & Mono FM” position.) Adjusts the level of the audio signal obtained from the COMP SIG/AUDIO Connector.

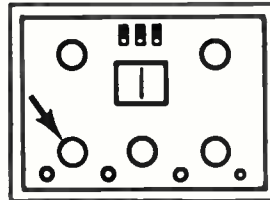
Comp. Sig. Level — (Applies only when the Function Switch is set to one of the three Stereo positions.) Adjusts the level of the composite stereo signal obtained from the COMP SIG/AUDIO Connector.

RF ATTENUATOR — Provides 60 db RF attenuation in three 20 db steps.



19KC SUBCARRIER LEVEL — Applies power to the instrument when turned clockwise from POWER OFF

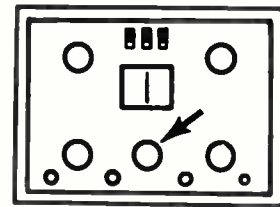
position. Adjusts the level of the 19 Kc subcarrier applied to the composite stereo signal from 0 to 10%.



FREQUENCY — Selects the various frequencies available from the internal audio oscillator. These eight sine-

wave frequencies can be used to modulate the FM signal, or can be obtained separately from the COMP SIG/AUDIO connector. Note: When switching from one frequency to another, it is normal for a slight delay to occur before the signal reaches full amplitude.

5. **FUNCTION** — Selects the internal signals available at the output connectors as described below:



RF Sweep & IF Marker—Provides RF Sweep at RF OUT connector. Sweep width is adjustable from 0 to 750 Kc.

Provides crystal controlled 10.7 IF marker at “IF Marker” output connector. Also, four additional RF markers in the 88-108 Mc FM range.

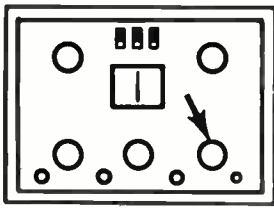
Audio & Mono FM—Provides sine-wave signal at selected frequency at the “COMP SIG/AUDIO” output connector. Also provides Monaural FM at the RF OUT connector.

Phase Test—Composite stereo (L+R) signal with 19 Kc subcarrier balanced to provide zero phase reference for adjustment of demodulation transformers.

Left—Standard stereo “left” composite signal.

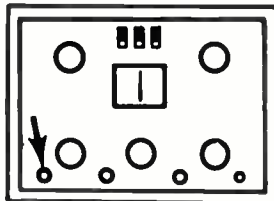
Right—Standard stereo “right” composite signal.

STEREO



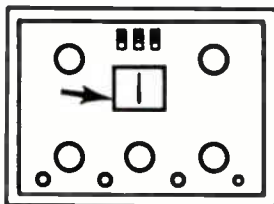
CENTER RF FREQ ADJ — Permits center frequency adjustment of the 100 Mc oscillator signal ± 0.8 Mc so that

a “quiet point” can be located on the FM band.

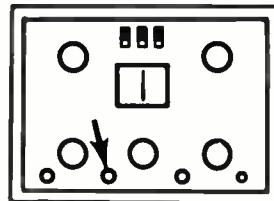


COMP SIG/AUDIO OUTPUT CONNECTOR—Provides composite signal output when the FUNCTION Switch is set to any of the three Stereo positions. Provides sine wave output when FUNCTION Switch is set to the “Audio & Mono FM” position. Use the direct, unterminated cable, at this connector.

is set to any of the three Stereo positions. Provides sine wave output when FUNCTION Switch is set to the “Audio & Mono FM” position. Use the direct, unterminated cable, at this connector.

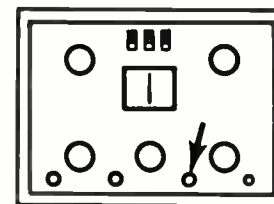


ZERO-CENTER BALANCE METER—Indicates balance of stereo amplifier output. Left and Right input cables are provided on the rear of the instrument for connection to the voice-coil output of a stereo amplifier.



RF OUT Connector —Provides signal output for RF sweep, and stereo or monaural FM. Use the terminated cable for

connection to 75 ohm or 300 ohm receiver antenna terminals.



IF MARKER Connector — Provides crystal-controlled marker output. Use the direct cable at this connector.

Cable-Holding Bracket Installation

A cable-holding bracket is supplied separately with each WR-51A. If desired, this bracket can be mounted on the rear of the instrument, as shown in the photograph.

Loosen the two screws indicated by arrows in Figure 1. Pass the power cord through the hole provided in the bracket, then position the bracket as shown, with the mounting slots in the bracket under the heads of the two screws. Tighten these screws securely.



Figure 1. Rear View of WR-51A Showing Cable-Holding Bracket

Aligning Stereo FM Multiplex Circuits With The WR-51A

Many different types of stereo FM receiver circuits are used by various manufacturers. For this reason, it is not practical to give a complete alignment procedure that will apply to all receivers. In each case, the manufacturer's service information should be followed, using the RCA Stereo FM Simulator as a source of the required signals.

Basically, the alignment procedure of any FM stereo circuit consists of adjusting the amplitude and phase of the 19 Kc pilot signal and the 38 Kc signal, adjusting the SCA trap for minimum response, and setting the internal stereo balance control.

The following example is provided as an aid in understanding the use of the Simulator in checking the tuner and aligning the multiplex circuit of a stereo FM receiver. The multiplex alignment procedure given is for one particular receiver. The schematic diagram for the IF limiter and discriminator stages is shown in Figure 3, and the multiplex circuitry is shown in Figure 8. Although this example deals with a complete stereo FM receiver, the same procedure would apply in general for a separate multiplex adaptor used with an FM tuner.

An oscilloscope, such as the RCA WO-33A or WO-91A, equipped with a low-capacitance probe, is required in the alignment procedure.

Checking the "Tuner" Portion of the Receiver

The RF, IF, limiter, and detector stages of the stereo FM receiver should be serviced according to the manufacturer's instructions, and using the test equipment specified in the instructions. However, the Simulator can be used to check the overall performance of these stages, and to determine whether alignment or service is needed.

1. Remove the antenna from the receiver, and connect the terminated cable from the RF OUTPUT connector of the Simulator to the antenna terminals.

2. Adjust the Simulator controls as follows:

FUNCTION	"RF SWEEP AND IF MARKER"
SWEEP WIDTH	"6" (equivalent to 600 Kc)
RF ATTENUATOR	-40 db (two switches down)
CENTER RF FREQ ADJ	"O"
19 KC SUBCARRIER LEVEL	"O"
FREQUENCY	any position

3. Tune the receiver to 100 Mc to pick up the Simulator signal. Note: If station interference is encountered at that point on the dial, adjust the CENTER RF FREQ ADJ to either side of "O" (100 Mc carrier) as necessary to find a quiet point in the FM band. Loosely couple the Direct cable from the IF Marker connector to the 1st IF of the receiver to produce a 10.7 Mc marker.

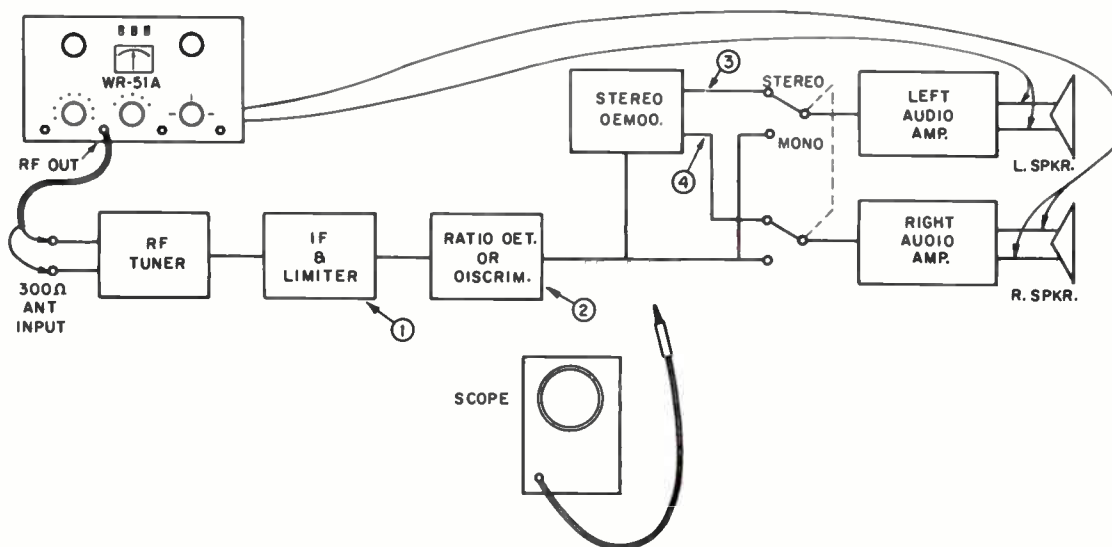
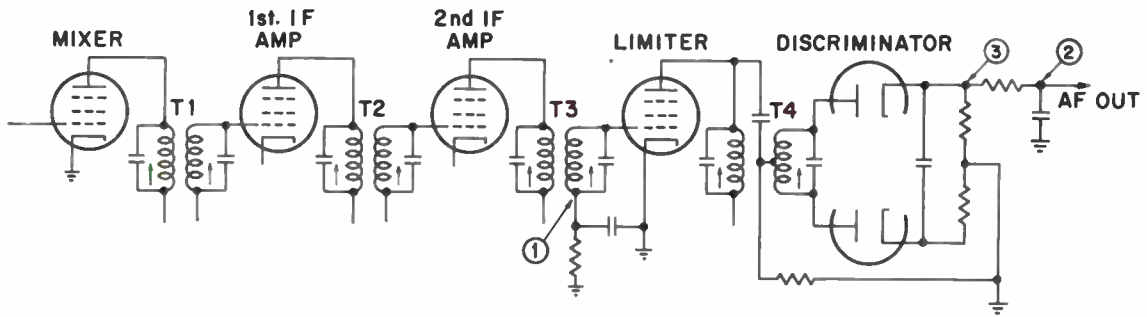


Figure 2. Stereo FM Receiver Block Diagram



DETAIL A

Note: Use this schematic to locate test point if receiver uses a ratio detector.

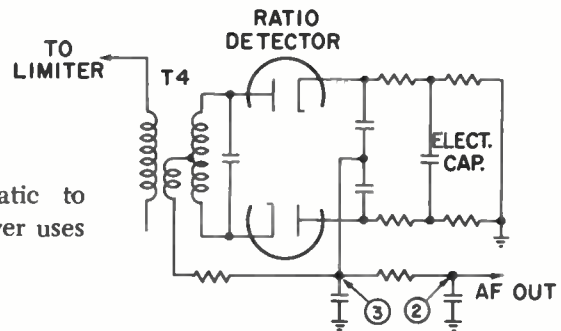


Figure 3. Limiter and Detector Test Points

4. Connect the vertical input probe of the oscilloscope to test point 1, shown in Figure 3, the Limiter grid circuit. Set the oscilloscope H Selector switch to "Line", and adjust the phase control for a single trace. If the receiver is operating properly, and the IF transformers are correctly aligned, the trace should appear similar to that in Figure 4, below.

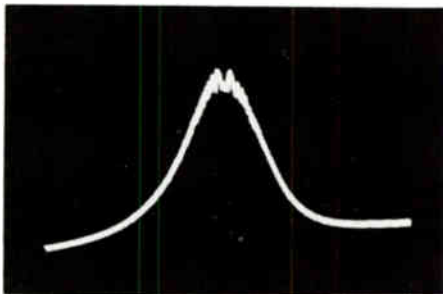


Figure 4. Trace Obtained at Limiter Grid Circuit

5. Connect the probe of the oscilloscope to the output of the detector, test point 2. Connect the Direct cable from the COMP SIG/AUDIO connector on the Simulator to the horizontal input of the oscilloscope. Set the oscilloscope H Selector switch to H input. Set the Simulator SWEEP WIDTH controls to "8" (approximately 750 Kc).

NOTE: The detector used in Figure 2 is a discriminator type. For circuits using a ratio detector, refer to the circuit shown in Detail A. It will be

necessary to disconnect the electrolytic capacitor to obtain the illustrated trace.

A properly aligned detector will result in a symmetrical trace as shown in Figure 5.

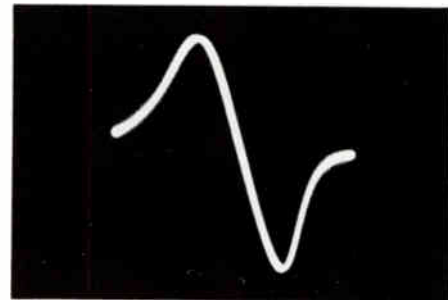


Figure 5. Trace Obtained at Output of Properly Aligned Discriminator

Checking Demodulated Stereo Output Signal From Tuner

Connect the low-capacitance probe of the oscilloscope to the output of the detector. Test Point 3 in Figure 3. Set the oscilloscope H Selector switch to "Int".

6. Set the Simulator controls as shown below:
- | | |
|------------------------|--------------|
| RF DEVIATION | "75 Kc" |
| FUNCTION | "PHASE TEST" |
| RF ATTENUATOR | "OUT" |
| 19 KC SUBCARRIER LEVEL | "10" |
| FREQUENCY | "1 Kc" |
| CENTER RF FREQ ADJ | "0" |

7. Adjust the oscilloscope controls to obtain a trace similar to that shown in Figure 6. Rotate the RF DEVIATION control throughout its range, noting the waveform on the oscilloscope. The 1000 cps signal will vary in amplitude, but should retain its waveform regardless of the setting of the control. Flattening of the sine-wave peaks, or "break-up", is an indication of probable poor alignment or insufficient bandwidth in the tuner. (Figure 7 shows an example of the waveform obtained from a poorly aligned tuner.) Note the peak-to-peak signal amplitude of the oscilloscope trace. This

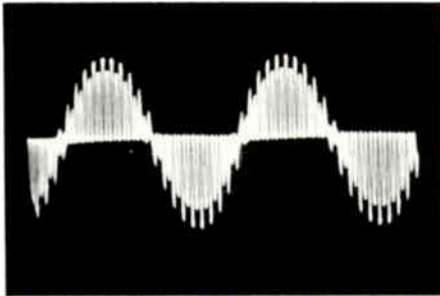


Figure 6. Demodulated Stereo Output from Properly Aligned Tuner

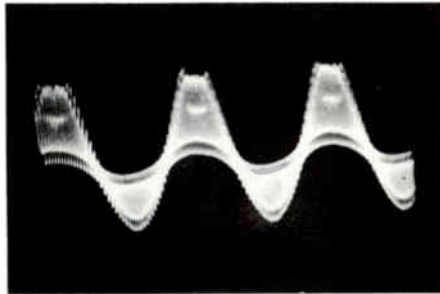


Figure 7. Demodulated Stereo Output from Poorly Aligned Tuner

will be the reference level for the composite stereo signal fed to the multiplex input. Remove the terminated cable from the antenna terminals of the receiver.

Multiplex Circuit Alignment

Connect the oscilloscope low-capacitance probe to the Direct cable from the COMP SIG/AUDIO output connector of the Simulator. Adjust the COMP SIG LEVEL control to obtain a signal level on the oscilloscope which is the same as the output level obtained from the tuner in step 7 of the preceding section. Connect the Direct cable from the COMP SIG/AUDIO connector to the input of the multiplex circuit. Set the remaining Simulator controls as follows:

- 19 KC SUBCARRIER LEVEL "0"
- FUNCTION "AUDIO & MONO FM"
- FREQUENCY "19 Kc"

The RF ATTENUATOR and CENTER RF FREQ ADJ controls do not affect the composite stereo signal.

Refer to the multiplex circuit schematic diagram shown in Figure 8

1. Connect the low-capacitance oscilloscope probe to pin #6 of the 6CL8A 19 Kc Amplifier. Align the primary of T-1 for maximum response on the oscilloscope.
2. Connect the oscilloscope probe to the junction of CR-1 and CR-2. Align the T-1 secondary for maximum response. (Note that the frequency has been doubled in the network CR-1 and CR-2.)

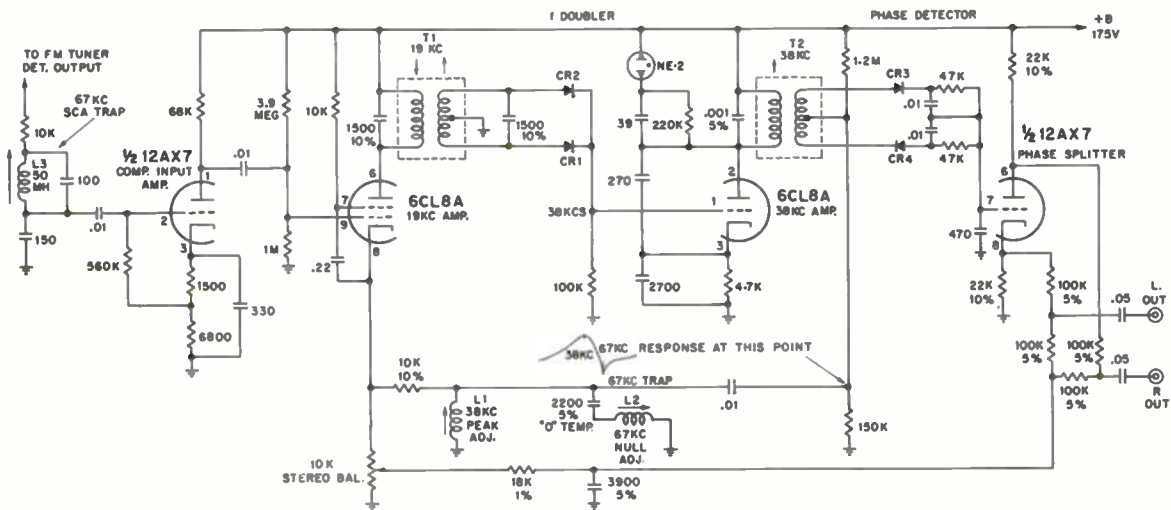


Figure 8. Multiplex Circuit Schematic

3. Connect the oscilloscope probe to pin #2 of the 6CL8A 38 Kc amplifier. Align T-2 for maximum response.

4. Set the FREQUENCY switch to 38 Kc and connect the oscilloscope probe to the center tap of T-2. Align L-1 for maximum response.

5. Set the FREQUENCY switch to 67 Kc and adjust L-2 for *minimum* response.

6. Set the FREQUENCY switch to 38 Kc and recheck alignment of L-1 as in step 4.

7. Again set the FREQUENCY switch to 67 Kc. Short out the 2200 mmf capacitor in series with L-2. Adjust L-3, the 67 Kc SCA trap for minimum response. Remove the short across the 2200 mmf capacitor.

8. Set the Simulator FUNCTION switch to "LEFT" and the FREQUENCY switch to "1 Kc". Connect the oscilloscope probe to the left output of the multiplex circuit. Set the 10 K Stereo Balance potentiometer of the multiplex circuit to approximately mid-range. Note the waveform and amplitude of the signal. Carefully retune the primary of T-1 for maximum output and best sine waveform of the 1000 cps signal as noted on the oscilloscope. The trace should appear as shown in Figure 9A. Turn the FUNCTION switch of the

Simulator to "RIGHT". Adjust the 10 K Stereo Balance potentiometer for minimum response. The trace should appear as shown in Figure 9B.

9. Connect the oscilloscope probe to the right output of the multiplex circuit with the FUNCTION switch still set to "RIGHT". The amplitude and waveform should be about the same as that obtained in the previous step at the left output with the FUNCTION switch set to "LEFT" (Figure 9A). Set the Simulator FUNCTION switch to "LEFT". The signal from the right output should then drop to about the same level as was noted at the left output with the FUNCTION Switch set to "RIGHT". Remove the Direct cable from the input to the multiplex circuit.

Over-all Check of FM Stereo Receiver/Amplifier

10. Connect the terminated cable from the RF OUTPUT Connector of the Simulator to the antenna terminals of the receiver. Connect the balance meter cables from the rear of the Simulator to the speaker voice-coil terminals of the stereo amplifier. (The speakers or an equivalent load must be connected to the amplifier output. The sensitivity of the Simulator metering circuit is approximately 1.42 volts RMS full scale, and could be damaged by connection to an open voice-coil circuit.)

11. Adjust the Simulator controls as follows:

RF DEVIATION	"75 Kc"
RF ATTENUATOR	-40 db (two switches down)
19 KC SUBCARRIER LEVEL	"10"
FREQUENCY	"1 Kc"
FUNCTION	"AUDIO & MONO FM"
CENTER RF FREQUENCY ADJ	"O"

12. Tune the receiver to 100 Mc to pick up the Simulator RF signal. Adjust the amplifier controls so that the 1000 cps signal comes from only one audio output, and registers a full-scale reading (either side) on the meter of the Simulator.

13. Adjust the amplifier gain control of the other channel so that the Balance meter on the Simulator reads "O", indicating that the signal level from both channels is the same.

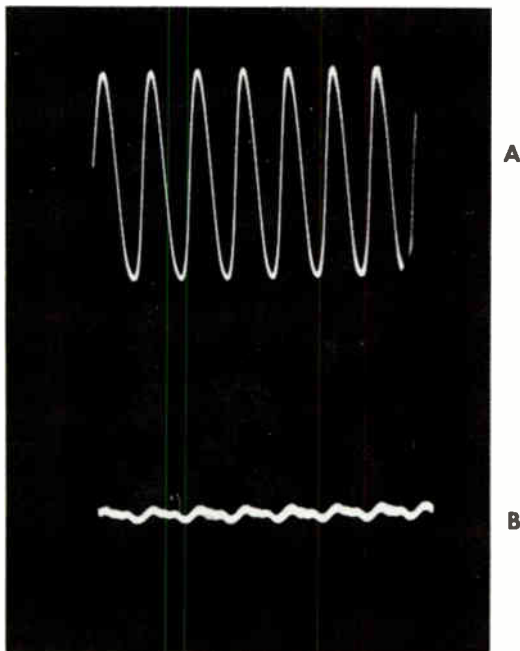


Figure 9

14. Adjust the receiver controls for stereo operation. Turn the FUNCTION switch of the Simulator to the "PHASE TEST" position. The Balance Meter should remain at "O", or very close to it. A wide variation of the meter in this test position indicates a phase shift in the system. This can usually be corrected by slightly readjusting the T-1 primary in the multiplex adaptor so that the output of the two channels is equal, as indicated by a "O" reading on the Balance Meter.

15. Turn the Simulator FUNCTION switch to

"LEFT" and note that the Balance Meter deflects to the left.

16. Turn the FUNCTION switch to "RIGHT", and note that Balance Meter indicates a deflection to the right, approximately the same amount as in step 15 above.

Note: If desired, the amount of channel separation can be determined in decibels by measuring the output of each channel with a meter equipped with a db scale, such as the RCA WV-76A AC VTVM or WV-38A VOM.

Circuit Description

The circuit of the RCA WR-51A Stereo FM Signal Simulator incorporates six tubes and five diodes. A block diagram of the instrument is shown in Figure 10, and a complete schematic diagram is on page 17.

An audio oscillator, V-1A, provides eight frequencies, selected by the FREQUENCY switch, S-3. This audio output is amplified by V-1B, and is available through the COMP SIG/AUDIO connector on the front panel of the instrument. This audio signal is also applied to the 38 Kc balanced modulator through the V-3A audio cathode follower.

The output of the 19 Kc crystal oscillator, V-2A, is fed to a buffer stage, V-4A. The output from this buffer stage is then sent through a phase shift network. By the particular setting of the FUNCTION switch, S-1, a resulting change is made in the phase relationship of the 19 Kc signal to provide the selected stereo output.

The 19 Kc output of V-2A is also coupled to a doubler stage, V-2B, which produces a 38 Kc signal. This 38 Kc output is amplified by V-4B, then fed to the 38 Kc balanced modulator. The 38 Kc carrier and the audio signal are combined to produce the main audio modulation, along with 38 Kc subcarrier AM sidebands. The balanced modulation suppresses the 38 Kc carrier.

A low-pass type filter (L-5, L-6, and L-7) is used to filter all upper order harmonics of the 38 Kc signal. This filter is specifically designed to main-

tain the amplitude and proper phase relationships of the composite signal.

Both the 19 Kc pilot signal and the composite stereo signal are amplified by V-5A, then brought to the COMP SIG/AUDIO connector on the front panel as composite output for use in servicing multiplex circuits apart from the tuner.

The amplified audio output signal from V-5A is also connected to the reactance modulator, V-6B, which determines the deviation (up to 75 Kc) of the 100 Mc oscillator, V-6A. By adjusting the front panel RF DEVIATION control, R-44, the amplitude of this modulating signal can be varied, causing the reactance modulator to vary the frequency of the 100 Mc oscillator. (Note that in frequency modulation, the *amplitude* of the modulating frequency determines the output *frequency swing* of the oscillator.) The center frequency of the 100 Mc carrier can be varied ± 800 Kc with C-16, the CENTER RF FREQUENCY ADJUSTMENT on the front panel. The 100 Mc RF signal (about 0.1 volt) is fed through a 3-step 60 db attenuator to the RF OUTPUT connector on the panel.

The output of the 5.35 Mc crystal oscillator, V-5B, is doubled to 10.7 Mc to serve as an IF Marker. Harmonics of the 5.35 signal also provide markers in the 88-108 RF tuning range of the FM receiver.

A balance meter with external left and right input cables is provided for checking the output balance of stereo amplifiers.

Maintenance

General

The performance of the RCA WR-51A depends on the high quality of the components employed. If it becomes necessary to replace any of the component parts, only RCA replacement parts or their equivalents should be used. When ordering replacement parts for the instrument, consult the Replacement Parts List on page 18.

Since the internal adjustments of the Stereo FM Signal Simulator requires the use of laboratory-type test equipment, it is recommended that the instrument be serviced only by authorized RCA Electronic Instrument Service Depots. For the name and address of the Depot nearest you, contact the RCA Electronic Instrument Distributor in your area, or write to RCA Electronic Instruments, 19th and Federal Streets, Camden, New Jersey.

To remove the instrument from the case, take out the two screws from the under side of the front bezel and remove the bezel from the case. Remove the screws from the front panel, and from the rear of the case. Slide the instrument out through the front of the case.

Equipment Required

Oscilloscope, with low-capacitance probe RCA WO-91A, or equivalent.*
 R.F. Crystal Calibrated Marker Generator, such as the RCA WR-99A
 67 Kc (± 10 cps) signal source
 19 Kc (± 1 cps) signal source

Before making any adjustments, turn on all equipment including the WR-51A, and allow 15 minutes for warm-up.

19 Kc Oscillator Adjustment

1. Connect the output of the 19 Kc (± 1 cps) signal source to the "H Input" terminal of the oscilloscope. Set the oscilloscope selector switch to the "H Input" position, and adjust the horizontal gain for approximately a 3-inch horizontal trace.

2. Set the FUNCTION switch of the WR-51A to "AUDIO & MONO FM," and the FREQUENCY switch to 19 Kc. Connect the vertical input direct cable and ground of the oscilloscope to the COMP/SIG/AUDIO output cable of the Simulator. Adjust the vertical gain of the oscilloscope for a vertical trace of approximately 3-inches.

* The frequency compensating adjustments in the input of the oscilloscope must be properly set prior to using the instrument in the following procedure.

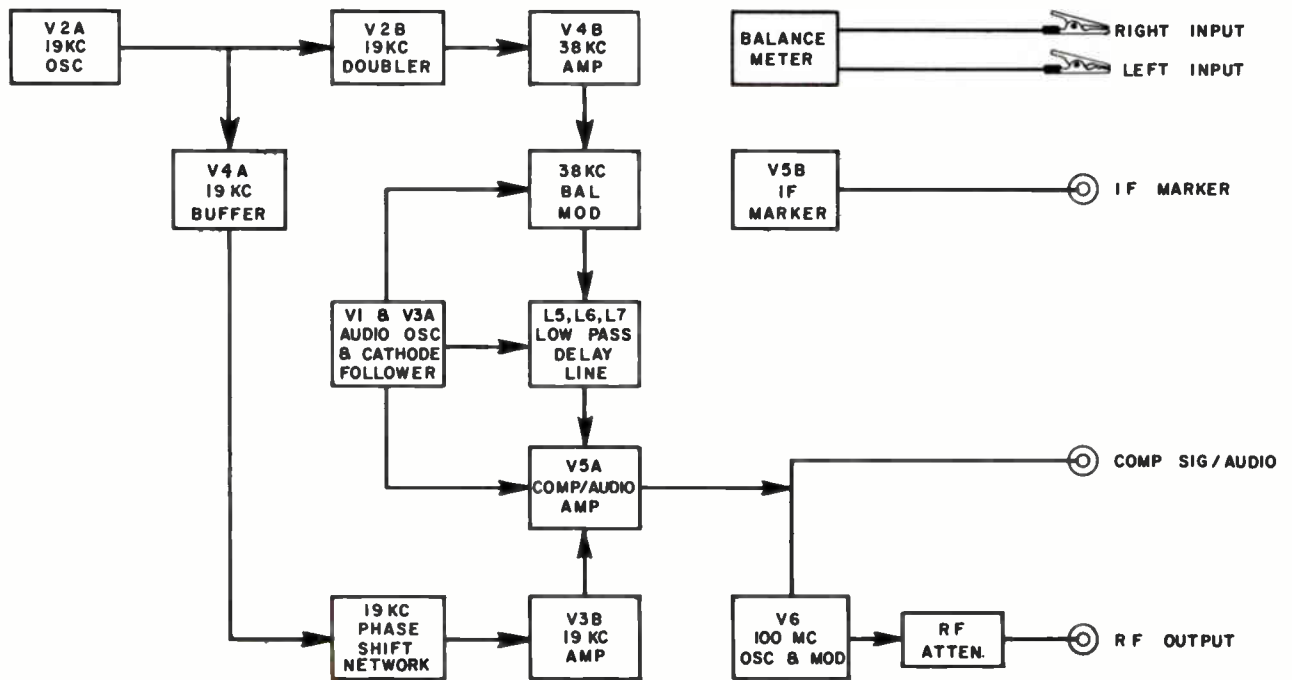


Figure 10. WR-51A Block Diagram

3. Adjust the core of L-1 so that the oscilloscope trace becomes either a circle, or a Lissajous figure indicating a beat of 1 cps or less between the two oscillator frequencies.

4. Switch the Simulator power switch (located on the 19 Kc Subcarrier Level control) on and off several times to be sure that the 19 Kc oscillator starts each time. Failure of the 19 Kc oscillator to start each time, and be within ± 2 cps of the 19 Kc standard indicates that the 19 Kc crystal is defective and should be replaced.

RC Oscillator Adjustment

1. Switch the oscilloscope probe to the low-capacitance position, and connect it to pin #3 of V-1. Set the FREQUENCY switch of the Simulator to "5 Kc".

2. Adjust R-17 so that approximately 1.6 volt P-P is indicated on the oscilloscope. Observe the waveform of the trace when the FUNCTION switch is set to the remaining frequencies, 400 cps, 1000 cps, 19 Kc, 28 Kc, 38 Kc, 48 Kc, and 67 Kc. The waveform and amplitude of these other frequencies should be equivalent to that of the 5 Kc signal.

NOTE: As the FREQUENCY switch is set from one position to another, it is normal for a brief delay to occur before the trace appears due to the interruption in the oscillator circuit.

Frequency Calibration

1. With the oscilloscope low-capacitance probe connected to pin #3 of V-1, connect the output of the 67 Kc (± 10 cps) signal source to the "H Input" terminals of the oscilloscope. Set the oscilloscope selector switch to "H Input." Adjust C-44 for a circular pattern.

2. Remove the 67 Kc signal from the horizontal input of the oscilloscope. Connect the vertical probe (in direct position) to the COMP/SIG/AUDIO output cable, and set the oscilloscope selector switch to internal sync. Set the FREQUENCY switch to the "5 Kc" position. Adjust the "RF DEVIATION/SWEEP WIDTH/AUDIO LEVEL/COMP SIG LEVEL" control so that the oscilloscope trace indicates approximately 2.0 volts P-P.

3. Connect a lead from pin #1 of V-2 to the "H Input" terminal of the oscilloscope. Set the oscilloscope selector switch to "H Input." Adjust

the horizontal gain for approximately 2 inches of horizontal deflection. Set the FREQUENCY switch of the Simulator to "38 Kc." Adjust C-46 so that the 38 Kc signal from the output cable synchronizes with the 19 Kc signal from V-2, pin #1. See Figure 11. Make this adjustment so that C-46 is at the least amount of capacity needed to solidly lock the 38 Kc signal. Excess capacity will cause the 38 Kc amplitude to change.

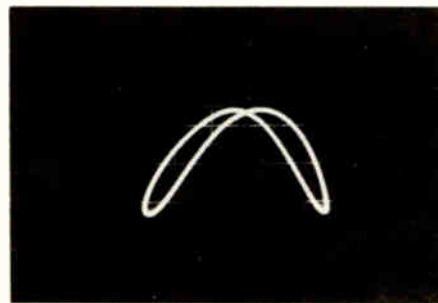


Figure 11. Proper Adjustment of C-46 Showing Synchronized 19 Kc and 38 Kc Signals

Amplitude Check

1. Remove the connection from pin #1 of V-2 to the H Input of the oscilloscope, and set the selector switch of the oscilloscope to internal sync. Leave the oscilloscope probe connected to the COMP SIG/AUDIO cable. Set the FREQUENCY switch to the 400 cps, 1000 cps, 5 Kc, 28 Kc, 38 Kc, 48 Kc, and 67 Kc and observe the waveform and amplitude of each frequency. The amplitude of all the frequencies (other than 19 Kc) should be within $\pm 5\%$ of the amplitude of the 5 Kc signal. A slight readjustment of R-17 may be required to bring these amplitudes within $\pm 5\%$ of the 5 Kc amplitude.

2. Set the FREQUENCY switch to 19 Kc and note the amplitude of the trace. This amplitude should be within $\pm 20\%$ of the 5 Kc signal.

38 Kc Balanced Modulator Adjustment

1. Set the WR-51A RF DEVIATION/SWEEP WIDTH/AUDIO LEVEL/COMP SIG LEVEL control maximum clockwise, the FUNCTION switch to PHASE TEST, and the 19 Kc SUBCARRIER LEVEL control at minimum. Remove V1, 6CG7 from its socket. Connect the oscilloscope low-capacitance probe to pin #7 of V-4. Set the sweep selector of the oscilloscope to "Line", and adjust for a "band-type" of trace approximately one inch high. Adjust coils L-2 and L-3 for maximum amplitude of the trace.

2. Connect the low-capacitance probe to the COMP SIG/AUDIO output cable. As a preliminary adjustment, turn the cores of T-2 and T-3 so that approximately three-eighths inch of the adjustment stud is above the mounting clip. Note the trace on the oscilloscope, and adjust R-41 for minimum amplitude of the trace. Increase the vertical gain of the oscilloscope as necessary. Alternately adjust R-41 and T-3 until a point is reached where the signal is at a minimum.

Low-Pass Delay Line Filter Adjustment

1. Replace V-1. Set the Simulator FREQUENCY switch to 1000 cps with the oscilloscope direct probe connected to the COMP SIG/AUDIO output cable, and set the oscilloscope to internal sync. Adjust the oscilloscope to provide 2 or 3 sine waveforms of the composite signal.

2. Adjust the trimmer capacitor C-10 for minimum capacity (maximum counterclockwise). Adjust L-5, L-6, and L-7 to obtain a waveform as shown in Figure 12. Figure 13 is shown as an example of *misadjustment* of these coils.

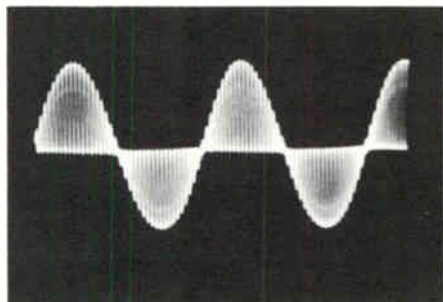


Figure 12. Trace Obtained at Output Cable with L5, L6, and L7 Properly Adjusted

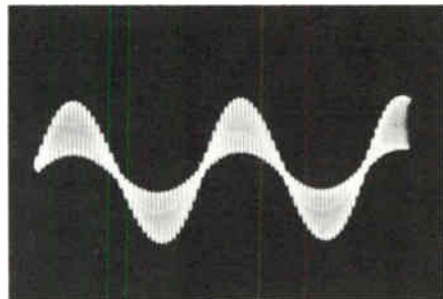


Figure 13. Trace Showing *Improper* of L5, L6, and L7

19 Kc Subcarrier Level Adjustment

1. Connect the oscilloscope to pin #6 of V-5, using the direct probe. Set the 19 Kc SUBCARRIER LEVEL control to "10". Adjust L-4 to

obtain minimum 19 Kc signal in the center of the trace. See Figure 14.

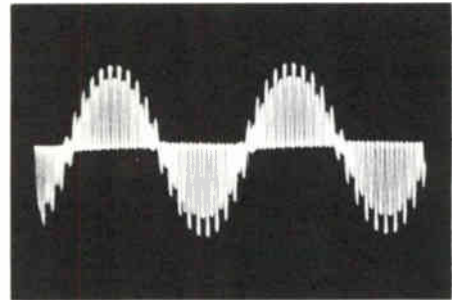


Figure 14. Trace Obtained at Pin #6 of V-5, with L-4 Adjusted for Minimum 19 Kc Signal

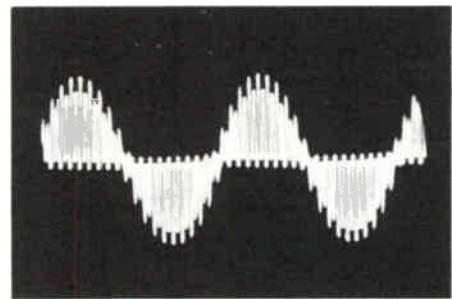


Figure 15. Trace Obtained at Pin #6 of V-5, with L-4 Improperly Adjusted

2. Set the FUNCTION switch to "LEFT", and adjust C-10 to obtain a 19 Kc signal level that is 10% of the entire composite signal as shown in Figure 16.

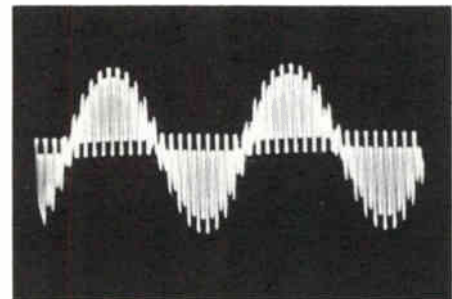


Figure 16. Proper Adjustment of C-10. 19 Kc Signal is 10% of Entire Composite Signal

3. Reset the FUNCTION switch to "PHASE TEST" and recheck the adjustment of L-4 for minimum 19 Kc signal as in step 1, above.

4. Set the FUNCTION switch to "LEFT" again, and note the 10% ratio of 19 Kc signal to composite signal. Then, turn the FUNCTION switch to RIGHT and note that the 19 Kc signal has the same ratio (10%) to the composite signal.

5. Repeat steps 1 through 4 if necessary to obtain results as shown in Figure 14 and Figure 16.

Phasing Check

1. Set the Simulator FUNCTION switch to the PHASE TEST position. Connect a lead from pin #1 of V-2 to the Sync input of the oscilloscope. Connect another lead from the oscilloscope ground to the chassis of the WR-51A. Set the oscilloscope horizontal selector switch to external sync, (and the sweep rate to the "10K-100K" range.) Adjust the horizontal gain for approximately a 3-inch horizontal trace. Set the vertical gain and sweep control to obtain a trace as shown in Figure 17.

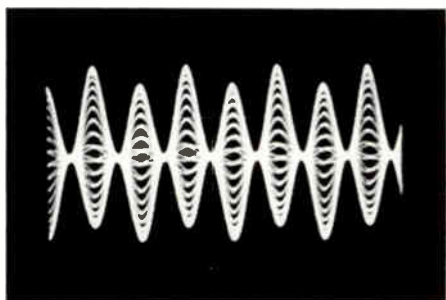


Figure 17. Pattern Obtained with FUNCTION Switch in "PHASE TEST" Position

2. Turn the FUNCTION switch first to "LEFT" and then to "RIGHT" and compare these traces with Figure 17, Figure 18, and Figure 19. These traces indicate proper operation of the balanced modulator and proper signal phasing in the "LEFT", "RIGHT", and "PHASE TEST" function of the instrument.

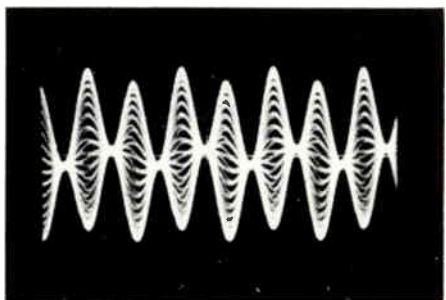


Figure 18. Pattern Obtained with FUNCTION Switch in "LEFT" Position

RF DEVIATION/SWEEP WIDTH/AUDIO LEVEL/COMP SIG LEVEL Control (R-44) Adjustment

1. Turn the RF DEVIATION/SWEEP WIDTH /AUDIO LEVEL/COMP SIG LEVEL control to

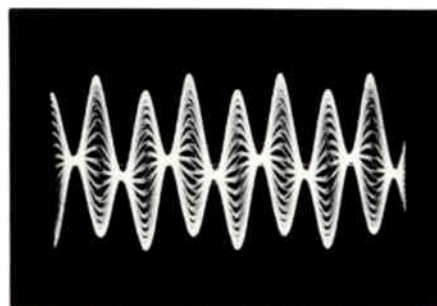


Figure 19. Pattern Obtained with FUNCTION Switch in "RIGHT" Position

maximum (fully clockwise). Connect the oscilloscope direct probe to the COMP SIG/AUDIO output cable. Adjust the vertical gain for a trace 3-inches in vertical height.

2. Remove the knob from R-44 and loosen the nut fastening the control to the panel. Temporarily replace the knob, and adjust the control so that the trace is reduced to 1½ inches in height. Mechanically rotate the entire control slightly so that the knob pointer is aligned with the "5" mark on the 0 to 10 scale. Carefully remove the knob and tighten the control. Replace the knob.

19 Kc Subcarrier Level Control (R-25) Adjustment

1. Remove V-1 from its socket. With the oscilloscope connected to the COMP SIG/AUDIO output cable, turn the 19 Kc SUBCARRIER LEVEL control fully clockwise, and adjust the oscilloscope so that a trace with 3-inches of vertical amplitude is obtained. Note that the residual signal is 19 Kc only.

2. As in the adjustment of R-44 above, adjust R-25 so that a trace of 1½ inches is obtained, then position the potentiometer so that the knob pointer indicates exactly "5".

Replace the tube, V-1.

Modulator Adjustment

1. Set the FUNCTION control to "AUDIO" & "MONO FM". Adjust R-45 (10K) for minimum modulation (full counter-clockwise) viewed from the top of the chassis. Connect the RF OUT cable from the WR-51A to the RF IN and GND inputs of an RCA WR-99A Crystal-Calibrated Marker Generator. Calibrate the WR-99A to 100 Mc using the internal 10 Mc crystal. Turn the

CAL/MOD switch of the WR-99A to OFF, and the AF GAIN to maximum. Set the RF ATTENUATOR switches of the Simulator to "OUT".

2. Adjust the CENTER RF FREQUENCY ADJ control of the WR-51A to "O". Carefully adjust the core of L-8 for zero beat with the WR-99A oscillator.

3. Set the RF switch of the WR-99A to OFF, and the CAL/MOD switch to "10 Mc CAL". Note that the 100 Mc signal from the WR-51A will still be heard as a beat against the 10th harmonic of the 10 Mc signal of the WR-99A. It may be weaker than the 100 Mc RF signal from the calibrator, but will be more stable.

4. Slightly detune the WR-51A CENTER RF FREQUENCY ADJUSTMENT control to obtain a beat note in the order of 1000 to 3000 cps. Adjust the RF DEVIATION/SWEEP WIDTH/AUDIO LEVEL/COMP SIG LEVEL Control to a position equivalent to 67 Kc on the 0 to 75 Kc panel scale. Set the FREQUENCY control to 28 Kc. Noting the audible beat in the WR-99A, adjust R-45 to a point where the beat is at a minimum. The adjustment of R-45 will cause the carrier beat in the WR-99A to each point where it almost disappears. This point corresponds to approximately 2.4×28 Kc or 67.2 Kc deviation of the RF signal.

5. Recheck the center frequency "O" setting of the CENTER RF FREQUENCY ADJUSTMENT using the WR-99A 100 Mc signal. Connect the V input probe of the oscilloscope to the center lug

of R-45, and note the P-P voltage. Set the FUNCTION switch of the Simulator to the "PHASE TEST" position, and the FREQUENCY control to 1 Kc. Readjust R-45 so that the oscilloscope trace has the same P-P amplitude noted above.

IF Marker Check

1. Connect the cable from the IF MARKER CONNECTOR to the WR-99A "RF IN" and "GND" input jacks. Set the FUNCTION switch to "RF SWEEP & IF MARKER". Tune and calibrate the WR-99A to 21.4 Mc, then to 26.75 Mc, and note the beats from the WR-51A crystal oscillator. The crystal in the instrument is 5.35 Mc, therefore harmonics should be detectable with the WR-99A in the range 19-28 Mc.

Balance Meter Adjustment

1. Apply a 1.3 volt rms, 60 cps signal to the left input cable clips (yellow boot) and note that meter deflects to the left. (If the meter deflects to the right, reverse CR-5.)

2. Connect the 60 cps signal to the right input cable clips and note the meter deflection to the right. If the meter should deflect to the left, reverse CR-4.

3. Apply the 60 cps signal to both leads in parallel. Adjust R-62 so that the meter indicates "O".

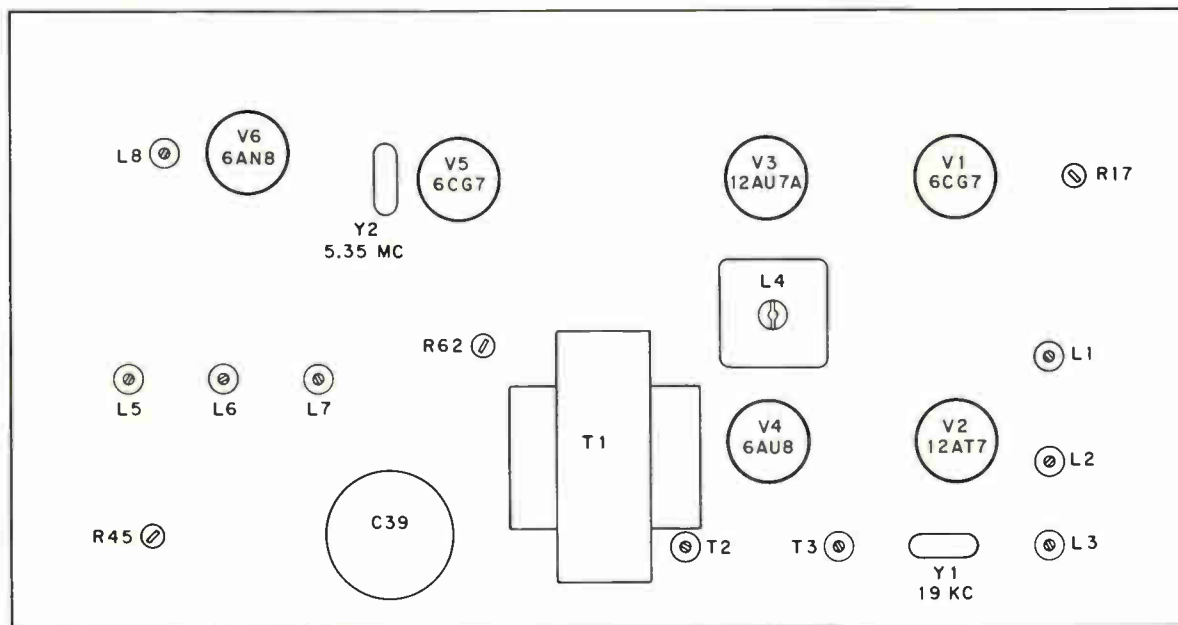


Figure 20. Chassis Layout, Top View

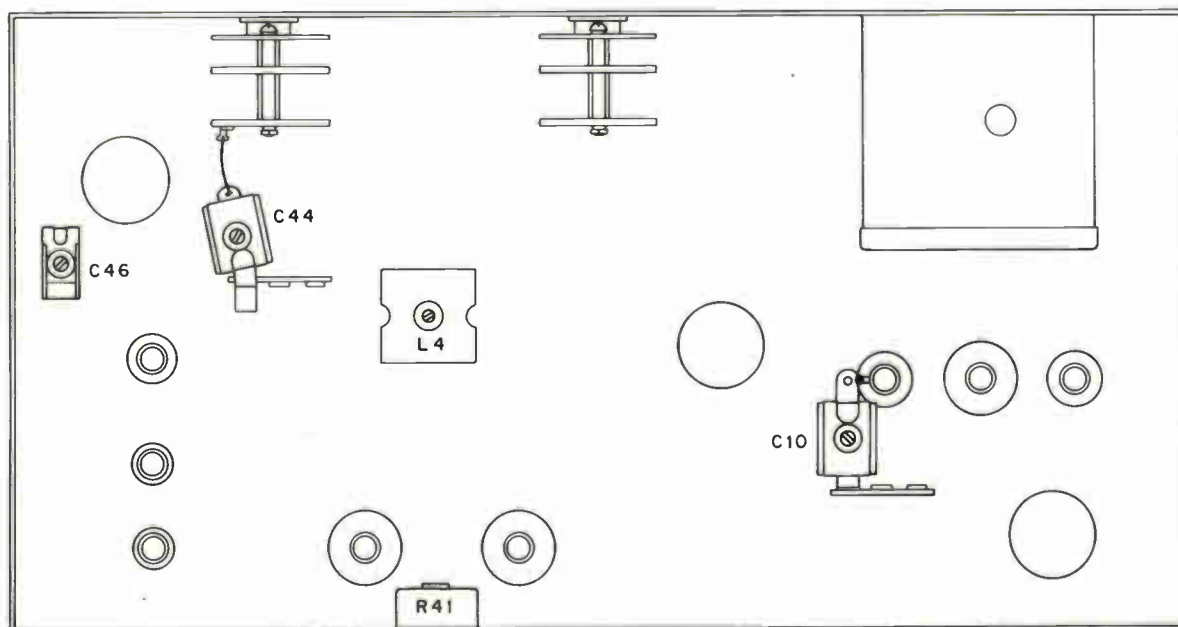


Figure 21. Adjustments on Underside of Chassis

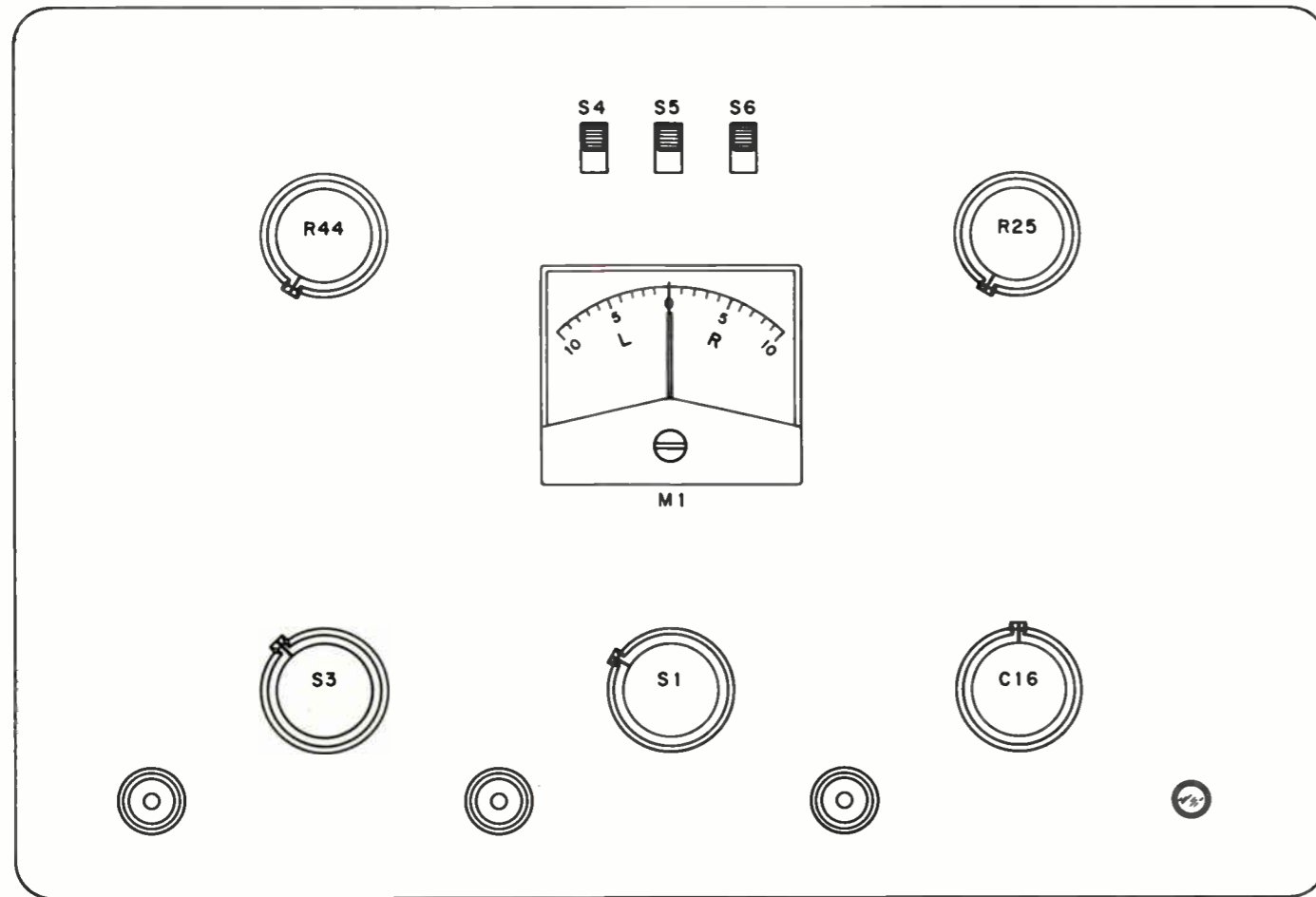
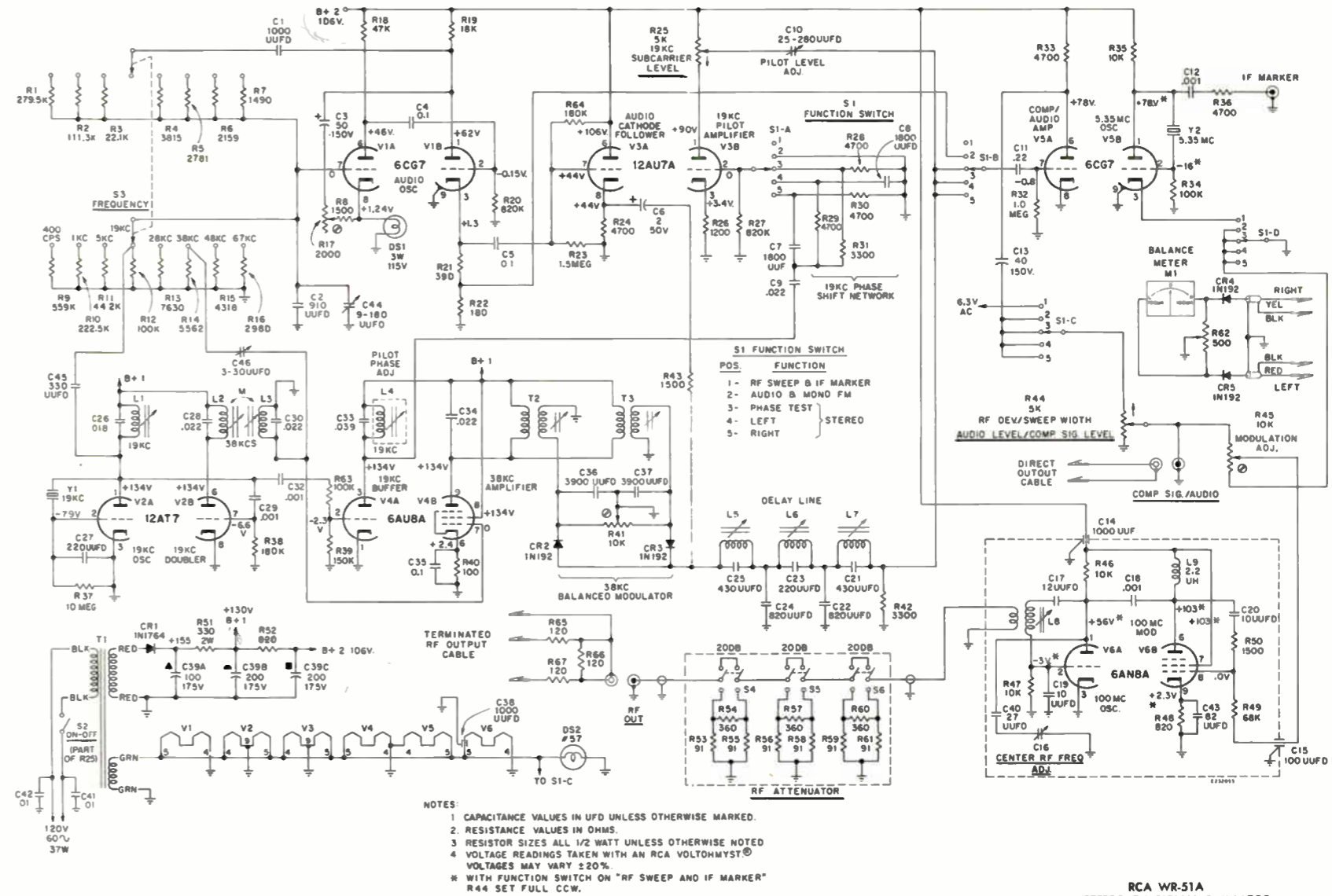


Figure 22. Front Panel Controls



RCA WR-51A
STEREO FM SIGNAL SIMULATOR

Replacement Parts List

WR-51A

When ordering replacement parts, include serial number and code number of instrument.

Order parts by stock number, through a local RCA Distributor.

Symbol No.	Description	Stock No.	Symbol No.	Description	Stock No.
Capacitors					
C1	Mica, 1000 mmf, 2%, 100V	219195	R6	Composition, 2159 ohm, ½W, 1%	228019
C2	Mica, 910 mmf, 2%, 100V	260053	R7	Composition, 1490 ohm, ½W, 1%	228020
C3	Molded, 50 mfd, 150V, Elec.	109227	R8	Composition, 1500 ohm, ½W, 10%	
C4, C5	Molded, .1 mfd, 200V	228040	R9	Composition, 559K, ½W, 1%	228022
C6	Molded, 2 mfd, 50V, Elec.	79181	R10	Composition, 222.5K, ½W, 1%	228023
C7, C8	Mica, 1800 mmf, 5%, 500V	215380	R11	Composition, 44.2K, ½W, 1%	228024
C9, C34	Molded, .022 mfd, 600V	228042	R12	Composition, 100K, ½W, 10%	
C10	Trimmer, 25-280 mmf	228036	R13	Composition, 7630 ohm, ½W, 1%	228026
C11	Ceramic Disc., .22 mfd, 10V	218461	R14	Composition, 5562 ohm, ½W, 1%	228027
C12, C18, C29, C32	Ceramic Disc., .001 mfd, 500V	112660	R15	Composition, 4318 ohm, ½W, 1%	228028
C13	Molded, 40 mfd, 150V	228035	R16	Composition, 2980 ohm, ½W, 1%	228029
C14, C38	Ceramic "feed-thru", 1000 mmf, 500V	225758	R17	Variable, 2K	228033
C15	Ceramic "feed-thru", 100 mmf, 500V	228041	R18	Composition, 47K, ½W, 10%	
C16	Variable, 3.3-7.9 mfd	228044	R19	Composition, 18K, ½W, 10%	
C17	Ceramic Disc., 12 mmf, ±2%, 600V	206226	R20	Composition, 820K, ½W, 20%	
C19, C20	Ceramic Disc., 10 mmf, 600V	33098	R21	Composition, 390 ohm, ½W, 10%	
C21, C25	Mica, 430 mmf, 500V	106944	R22	Composition, 180 ohm, ½W, 10%	
C22, C24	Mica, 820 mmf, ±10%, 500V	219743	R23	Composition, 1.5 Meg, ½W, 10%	
C23	Mica, 220 mmf, 500V	300187	R24	Composition, 4700 ohm, ½W, 10%	
C26	Tubular, .018 mfd, 600V	228045	R25	Variable, 5K, W/S-2 ON/OFF	228032
C27	Ceramic Disc., 220 mmf, ±10%, 1000V	228037	R26	Composition, 1200 ohm, ½W, 10%	
C28, C30, C34	Tubular, .022 mfd, 400V, ±10%	228034	R27	Composition, 820K, ½W, 20%	
C33	Tubular, .039 mfd, 600V, ±10%	228039	R28, R29, R30	Composition, 4700 ohm, ½W, 5%	502247
C35	Ceramic Disc., .1 mfd, 10V, -80%, +20%	218457	R31	Composition, 3300 ohm, ½W, 5%	502233
C36, C37	Mica, 3900 mmf, 5%, 500V	921796	R32	Composition, 1 Meg, ½W, 20%	
C39	Electrolytic, 100/200/200 mfd, 175V	228043	R33, R36	Composition, 4700 ohm, ½W, 10%	
C40	Ceramic, 27 mmf		R34	Composition, 100K, ½W, 10%	
C41, C42	Ceramic Disc., .01 mfd, GMV, 1400V DC	220880	R35, R46, R47	Composition, 10K, ½W, 10%	
C43	Ceramic Disc., 82 mmf, 10%, 500V	105246	R37	Composition, 10 Meg, ½W, 20%	
C44	Trimmer, 9-180 mmf	210133	R38, R64	Composition, 180K, ½W, 10%	
C45	Ceramic Disc., 330 mmf		R39	Composition, 150K, ½W, 10%	
C46	Trimmer, 3-30 mmf		R40	Composition, 100 ohm, ½W, 10%	
Resistors					
R1	Composition, 279.5K, ½W, 1%	228015	R41	Variable, 10K	228031
R2	Composition, 111.3K, ½W, 1%	228016	R42	Composition, 3300 ohm, ½W, 10%	
R3	Composition, 22.1K, ½W, 1%	921331	R43, R50	Composition, 1500 ohm, ½W, 10%	
R4	Composition, 3815 ohm, ½W, 1%	228017	R44	Variable, 5K	228423
R5	Composition, 2781 ohm, ½W, 1%	228018	R45	Variable, 10K	228030
			R48, R52	Composition, 820 ohm, ½W, 10%	
			R49	Composition, 68K, ½W, 10%	
			R51	Composition, 330 ohm, 2W, 10%	
			R53, R55, R56	} Composition, 91 ohm, ½W, 5%	502091
			R58, R59, R61		
			R54, R57, R60		

Replacement Parts List (Continued)

Symbol No.	Description	Stock No.
R62	Variable, 500 ohm.....	228424
R63	Composition, 100K, ½W, 10% ..	
R65, R66 R67	Composition, 120 ohm, ½W, 10%	
Switches		
S1	Function Switch, 5-position	228046
S2	Part of R-25 Power Switch	
S3	Frequency Switch, 8-position	228047
S4, S5, S6	Slide Switch, SPST	46760
Coils		
L1	Coil, 8 mh, adj.	228053
L2, L3	Coil, 800 uh, adj.	228054
L4	Coil, 2.6 mh, adj.	228055
L5, L7	Coil, 4-30 mh, adj.	228056
L6	Coil	228057
L8	Coil, rf	228058
L9	Coil, 2.2 uh	228425

Symbol No.	Description	Stock No.
Miscellaneous		
M1	Meter	228052
T1	Transformer, power	228059
T2, T3	Transformer, w/slug	228060
CR1	Silicon Diode, 1N1764	106379
CR2, CR3		
CR4, CR5	Crystal Diode, 1N192	228050
Y1	Crystal, 19 Kc	228048
Y2	Crystal, 5.35 Mc	228049
DS1	Lamp, 3W, 115V, type 3S6	51462
	Base, for 3S6 Lamp	
DS2	Pilot Lamp, #57	228051
	Pilot Lamp Bracket Assembly ...	
	Clip alligator, miniature	
	Insulator, red rubber	
	Insulator, black rubber	
	Insulator, yellow rubber	
	Knob, blue plastic	211953
	Shell, for output cables	219486
	Output cable, direct	228426
	Output cable, terminated (for RF)	228427
	Handle	211885



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