

INSTRUCTION MANUAL
SSB-100 MIL
Transmitter

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TABLE OF CONTENTS

SECTION I DESCRIPTION

Paragraph		Page
1.	Introduction	1
2.	Features	1
3.	Specifications	2

SECTION II INSTALLATION

1.	Unpacking	5
2.	Location and Mounting	5
3.	External Connections	5
	a. Antenna	5
	b. Microphone	6
	c. Key	6
	d. Antenna Change-over Relay	6
	e. Receiver Silencing	6
	f. Voice Controlled Break-in	6
	g. Power	6
	h. Ground Connection	6
	i. Terminal	6

SECTION III OPERATION

1.	Controls	7
	a. On-Off Switch	7
	b. Control Switch	7
	c. Operation Switch	7
	d. LSB-USB	7
	e. Audio	7
	f. Carrier	7
	g. Meter Switch	8
	h. Vox	8

Section III - Operation (cont'd)

i.	QT	8
j.	Grid Tuning	8
k.	Plate Tuning	8
l.	Loading	8
m.	Band Change	8
n.	Crystal Switch	9
o.	Frequency Dial	9
p.	Zero Adjust	9
2.	Initial Adjustments	9
a.	Preliminary Control Setting	9
b.	Bias Adjustment	10
c.	Adjustment of Overtone Crystals	10
d.	Transmitter Output Frequency	10
3.	Tuning Procedure	12
a.	CW Operation	12
b.	SSB Operation	13
c.	AM Operation	13

SECTION IV

THEORY OF OPERATION

1.	General	15
2.	Audio & Voice Break-in Circuits	16
3.	Low Frequency Oscillator, Cathode Follower, Balanced Modulator & Crystal Filter	18
4.	Sideband Selector	20
5.	CW & AM Signals	21
6.	Third Mixer & Crystal Oscillator	21
7.	Driver & Power Amplifier	22
8.	Oscilloscope	24
9.	Power Supply	25
10.	Control Circuit	25

SECTION V

MAINTENANCE

1.	Service Adjustment	27
a.	Exciter Chassis	27

Section V - Maintenance (cont'd)

b.	VFO Chassis	28
c.	RF Chassis	29
2.	Trouble Shooting	30
a.	Trouble Shooting Chart	32
b.	Resistance Chart	38
c.	Voltage Chart	39
	PARTS LISTS.	40

LIST OF ILLUSTRATIONS

Figure 1.	Oscilloscope Patterns	14
Figure 2.	Vox Control Circuit	17
Figure 3.	Signal Path Thru Transmitter	19
Figure 4.	Basic Neutralizing Circuit	23
Figure 5.	Basic Neutralization As A Bridge	23
Figure 6.	Neutralizing Circuit of 6360	23
Figure 7.	Driver and P.A.	24
Figure 8.	Chassis Connectors From Inside	30

Appendix -

Figure 9.	Top View-Power Supply Chassis	
Figure 10.	Bottom View - Power Supply Chassis	
Figure 11.	VFO Chassis	
Figure 12.	Exciter Chassis	
Figure 13.	Xtal Oscillator & Oscilloscope Chassis	

SECTION I
DESCRIPTION

1. Introduction

The SSB-100 MIL is a single sideband, medium power, suppressed carrier transmitter designed for simplex telephone or telegraph operation. It may also be operated with carrier to make it compatible with existing amplitude modulated systems. The SSB-100 MIL covers the range from 2.2 to 30 megacycles in 7 bands, selected by a front panel switch. The peak envelope power output is 100 watts. The occupied bandwidth is roughly 3 kc as opposed to 6 kc with a conventional AM transmitter and either sideband is selectable by a switch on the front panel.

2. Features

The SSB-100 MIL has been designed to provide the utmost in flexibility without compromising the performance characteristics up to now available only in highly specialized equipment. Among the features that contribute to the high grade performance of this transmitter are the following:

- a. Highly stable filter type exciter section providing a minimum of 50 db of unwanted sideband and carrier attenuation.
- b. Selectable sideband operation, front panel controlled.
- c. Audio shaping for maximum intelligibility, pleasing quality and conservation of valuable spectrum space.
- d. Voice controlled break-in operation with speaker quieting circuit.
- e. Built-in highly stable variable frequency oscillator.
- f. Inverse RF feed-back for low distortion.
- g. Compact design, completely self-contained including all control circuits for receiver muting and antenna change over.
- h. Built-in one inch oscilloscope for continuous monitoring of the linearity of all mixers and amplifiers between exciter and power output stage.

3. Specifications

Operating Frequency:	2.2 through 30 mc band switching from front panel. Choice of 12 crystal frequencies through operating range plus VFO control plus or minus 100 kc of crystal frequencies.
Type of Transmission:	Single Sideband - Suppressed Carrier; USB or LSB (selectable by front panel control). One sideband with carrier (AM); continuous wave.
Frequency Stability:	Overall frequency stability of better than 500 cycles - 2.2 through 30 mc.
Power Output:	Peak envelope RF power output 100 watts CW output 50 watts AM output (one sideband with carrier) 20 watts
Unwanted Sideband:	Unwanted Sideband Attenuation - 50 db or greater
Carrier Attenuation:	Carrier Attenuation - 50 db or greater
Distortion:	Unwanted Sideband Distortion Products - 35 db or greater down at full output.
Transmitter Band Width:	Band Width 3.3 kc approx. at 6 db points on voice signals.
Transmitter Carrier Injection	Front panel controlled; from 50 db down to full power output, provided for tuning purposes, AM and CW operation.
Audio Input:	High Impedance Crystal or Dynamic microphone (-55 db).
Transmitter Output:	52 ohms - unbalanced.
Voice Control Operation:	Voice control operation and receiver muting provided and selected by front panel controls.

- CW Operation:** Break-in CW operation provided; chirpless and clickless, consistent with modern engineering practice.
- Metering and Monitoring:** Plate circuit meter supplied, switchable to the power amplifier and crystal oscillator circuit for tuning purposes. A one-inch 1CP1 oscilloscope, with associated circuit, is incorporated to provide for constant monitoring of the outgoing signal under all conditions of operation.
- Physical Specifications:** Weight: 65 lbs.
Dimensions: 10-1/2" high x 19" wide
 x 16" deep.
Cabinet: Rack mounted with fully enclosed cabinet. Access through top cover.
Finish: Military Gray.

SECTION II

INSTALLATION

1. Unpacking

Open packing carton carefully to prevent damage to the equipment. Check all the packing material carefully for small packages. Inspect the transmitter for mechanical damage and check the various front panel controls for bent shafts and broken couplings. Any claim for damage must be filed immediately with the transportation company and the original packing material should be preserved.

2. Location and Mounting

The SSB-100 MIL may be used either rack mounted or table top. The location chosen should be as dry and cool as possible. Adequate clearance should be allowed for the connections to the rear and for the proper ventilation of the transmitter. **CAUTION: DO NOT REMOVE THE CABINET FOR RACK MOUNTING.** The dimensions of the transmitter are such that it may be rack mounted with the cabinet. The cabinet is essential for support of the chassis and protects the unit from dust. If necessary, remove rubber feet by unscrewing bottom plate. Put bottom plate back in place after feet are removed.

3. External Connections

- a. **Antenna:** The transmitter is equipped with an 83-1R coaxial receptacle and mating connector on the rear of the chassis for use with 52 ohm coaxial cable output. Balanced feedlines should be connected through an antenna tuner or balun coil, which in turn is fed with coaxial cable from the transmitter for best results. If the feedline shows an appreciable amount of reactance at the transmitter, it may be impossible to load it properly. In that case, changing the length of the feedline a few feet at a time or using an antenna tuner will cure the problem. It is suggested that the operator use a 52 ohm dummy load first to familiarize himself with this equipment. In case a proper dummy load is not available, a 60 or 100 watt, 110 V light-bulb will serve the purpose.

CAUTION: DO NOT OPERATE THIS EQUIPMENT WITHOUT PROPER EXTERNAL LOAD. Excessive RF voltages may develop which might cause breakdown of components.

- b. **Microphone:** A standard microphone connector is provided on the front panel. A high impedance crystal or dynamic microphone (-55 db) may be used.
- c. **Key:** A standard closed circuit jack is provided on the rear of the unit for connection of the key. It should be unplugged except for CW operation.
- d. **Antenna Change-over Relay (not supplied):** It is recommended that a coaxial type relay be used. The coil should be 115 V AC and connected to terminal #4 and 5 on the terminal strip in rear of the transmitter.
- e. **Receiver Silencing:** Terminals #1, 2 and 3 on the terminal board in rear are provided for receiver silencing. 1 and 2 are normally open whereas 2 and 3 are normally closed contacts on relay RLY-1.
- f. **Voice Controlled Break-in with Speaker (QT operation):** Normally, voice controlled break-in operation of the transmitter would be impossible where a speaker is used, because the loud speaker signal would turn on the transmitter. Therefore, a cancellation circuit has been built into the SSB-100 MIL. Part of the received signal is fed from the audio output transformer of the receiver into the transmitter to cancel the signal picked up by the microphone. Terminals #7 and 8 are for 4 ohm output windings and #6 and 8 are used for 500 ohms. CAUTION: Observe correct polarity of leads as terminal #8 on the transmitter is grounded.
- g. **Power:** The transmitter must be powered from a 115 V, 50-60 cps source.
- h. **Ground Connection:** A 1/4" ground bolt is provided at the rear of the transmitter. It should be connected to a good electrical ground with as short and as heavy a lead as possible.
- i. **A 600 ohm unbalanced audio-input terminal is provided through a closed circuit jack at the rear of the unit. It may be used when the transmitter is connected to telephone line or other low impedance source such as recording equipment.**

SECTION III
OPERATION

1. Controls

- a. On-Off Switch: This switch connects primary power to all circuits.

CAUTION: HIGH, MEDIUM AND BIAS VOLTAGES ARE PRESENT ON ALL CIRCUITS AS SOON AS THIS SWITCH IS IN THE "ON" POSITION, REGARDLESS OF WHETHER THE CONTROL SWITCH IS IN THE STANDBY OR "ON" POSITION.

- b. Control Switch: In the STANDBY position, the low voltage is removed from all except the oscillator stages. Blocking bias is applied to the final to provide plate current cut-off. The CALIBRATE position applies B+ to all except the audio stages and also keeps the final cut off. The TRANSMIT position connects all the operating voltages.
- c. Operation Switch: This switch is used to select the desired mode of operation. In the CW position, the audio section of the transmitter is turned off. In the manual position, the transmitter is turned on and off by the control switch (STBY-XMIT). The VOX position makes the voice controlled break-in circuit operative. The QT position connects the speaker cancellation circuit to permit voice break-in with a loud speaker.
- d. LSB-USB: This switch is used to select the desired sideband by changing the injection frequency in the first conversion stage to either 413 kc below or above the first intermediate frequency.
- e. Audio: The audio gain controls should be adjusted for proper scope pattern. Gain increases clockwise.
- f. Carrier: This control feeds carrier around the crystal filter for tuning purposes and operation of the equipment on AM. The carrier injection increases clockwise.

- g. Meter switch: This is a spring return switch normally connecting the meter to the cathode of the final amplifier (Plate position). In the Oscillator Grid position, it measures the grid current of the crystal oscillator V-12 to enable the operator to adjust coils L-18 through L-20 for operation with overtone crystals.
- h. VOX: Adjusts the gain of the voice control amplifier V 5. Increases clockwise.
- i. QT: Adjusts the gain of the cancellation circuit V-5. Increases clockwise.
- j. Grid Tuning: This control tunes the grid of the final and driver stages. The capacity of the tuning condensers increases clockwise.
- k. Plate Tuning: This control resonates the final plate circuit. The capacity of this condenser increases clockwise.
- l. Loading: Adjusts the amount of loading (energy transfer from final to antenna). The capacity increases clockwise.

IMPORTANT: CONTROLS J, K AND L SHOULD ALWAYS BE LOCATED IN THE MAXIMUM CLOCKWISE (MAXIMUM CAPACITY) POSITION WHEN TUNING UP THE TRANSMITTER IN ORDER TO AVOID TUNING TO HARMONICS AND OTHER SPURIOUS OUTPUT FREQUENCIES.

- m. Band Change: The band change switch is used to select the proper coil condenser combination for various output frequencies. The following table should serve as a guide with regard to the frequency coverage of each band:

Band #1	-	21 - 30 mc
Band #2	-	14.5 - 21 mc
Band #3	-	9.7 - 14.5 mc
Band #4	-	6.0 - 9.7 mc
Band #5	-	3.8 - 6.0 mc
Band #6	-	2.8 - 3.8 mc
Band #7	-	2.2 - 2.8 mc

NOTE: Where one of the frequencies falls very close to the edge of the band, it may be advantageous to try the adjoining band also, especially if difficulties in loading should be experienced.

- n. Crystal Switch: Up to twelve crystals may be selected from the front panel, with the last three (10, 11, 12) positions reserved for third overtone crystals.
- o. Frequency Dial: The frequency dial permits adjustment of the transmitter output frequency over a range of ± 100 kc. At zero frequency, the output frequency is 2.1 mc below the crystal frequency of the crystal oscillator V-12.
- p. Zero Adjust: This control allows adjustment of the VFO over a range of approximately ± 3 kc and is intended to compensate for minor tracking errors in the VFO calibration.

2. Initial Adjustment:

After the transmitter has been installed according to Section II, the front panel controls should be set up according to the following table:

a. Preliminary Control Settings

<u>Control</u>	<u>Position</u>
Toggle Switch	Off
Control Switch	STBY
Operation Switch	MAN
Audio Gain	Fully CCW
VOX Gain	Fully CCW
QT Gain	Fully CCW
Carrier	Fully CCW
Meter	Plate Position
Frequency Dial	Zero
Crystal Switch	Position #1
Band Change	Position #7
Grid Tuning	Fully CW
Plate Tuning	Fully CW
Loading	Fully CW
Sideband Selector	LSB

Now plug the power cord into a line outlet and turn the toggle switch to "ON." Allow a minimum of three minutes for the equipment to warm up.

- b. **Bias Adjustment:** Turn control switch to XMIT and adjust the bias potentiometer on the rear for a static plate current of approximately 40 ma. After this adjustment has been made, return the switch to STBY. Then insert crystals into crystal sockets on the right rear corner of the transmitter, the lowest frequency crystal into the lowest number position and so on.
- c. **Adjustment of Overtone Crystals:** Overtone crystals (crystals above 15 mc) should be used in positions #10, 11 and 12 only. Each coil covers the following approximate range:

#10 - 15-18 mc

#11 - 18-22 mc

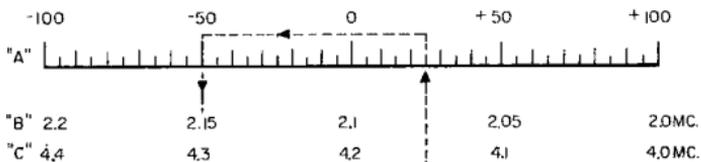
#12 - 22-31 mc

If there are any overtone crystals to be used, plug them into the appropriate socket according to the above table. Start with the slug all the way out, switch meter to oscillator grid and tune the slug. The grid current should slowly increase as the slug is moved into the coil, reach a maximum and then drop down very quickly to zero. If the grid current does not drop to zero after the maximum has been passed, the crystal is not oscillating in the proper mode and the next higher position should be tried. After reaching zero, return the slug to the point where maximum grid current occurs. If there is any doubt whether the crystal oscillates in the proper mode, the following test is suggested: Note the frequency marked on the crystal. Divide that frequency by three and tune the receiver there. Couple some energy to the receiver by bringing a lead connected to the antenna terminal close to the crystal. If any output from the crystal can be heard in that region, then it is not oscillating in the correct mode.

- d. **Transmitter output frequency:** The transmitter output frequency is 2.1 mc below the frequency of Crystal Oscillator V-12. In ranges 1 - 5 it is therefore pos-

sible to tune the transmitter to the crystal oscillator output rather than to mixer output which is 2.1 mc below the oscillator frequency. This can quickly be identified by the fact that the signal level as indicated by the plate meter does not vary with the carrier control if the transmitter is tuned to the crystal oscillator. The correct signal will be found by tuning the grid to a lower frequency (turn grid tuning control clockwise). A few additional precautions are necessary if the transmitter is used for frequencies between 2.2 and 2.25 mc and also between 4 and 4.4 mc. Due to the fact that the transmitter has a variable intermediate frequency of 2 - 2.2 mc, difficulties will be experienced unless the following recommendations are followed:

- (1) Operation between 2.2 and 2.25 mc: Choose your crystal so that required output frequency is reached with the VFO set at +80 rather than zero. This requires the crystal to be 2.020 mc higher than the desired output frequency.
- (2) Operation between 4 and 4.4 mc.



If operation is desired between 4 - 4.4 mc, do not operate within 50 kc on your VFO dial to the frequencies indicated on Line C. To find the required crystal frequency, proceed as follows: Find your assigned operating frequency on Line C. Then go vertically to Line A and move at least 75 kc in the direction of zero. From there move down to Line B and add the figure indicated to the assigned frequency. This new figure will be the required crystal frequency and the correct output frequency will appear with the VFO adjusted to the frequency obtained on Line A.

Example: It is desired to operate at 4.150 mc. Locate 4.150 mc on Line C by interpolation. Locate the corresponding point on Line A and interpolate the correct figure (-25). Move 75 kc to the left to -50. Go from -50 on Line A to 2.150 mc on Line B. Add 2.150 mc to 4.150 mc and find the desired crystal frequency (6.300 mc). With a 6.300 mc crystal, the VFO setting for a desired output of 4.150 mc will be -50 from Line A.

The reason that these steps must be taken is to avoid the second harmonic of the VFO Mixer output. This second harmonic, if too close to the desired signal, may appear in the output as an audible beat note.

3. Tuning Procedure

After the initial adjustments have been carefully made according to the instructions in Paragraph 2 of this Chapter, the transmitter is ready for tune-up.

- a. CW Operation: Turn OPERATION switch into CW position. Select desired crystal and find proper bandswitch position from Paragraph 1-m of this Section. Turn control switch to Transmit, then advance carrier control to about mid-range. A bright spot on the oscilloscope will be visible at this point. Now turn grid tuning from the maximum clockwise position slowly counterclockwise until an increase in plate current is noticed. Now turn the plate tuning condenser until the bright spot on the scope becomes a vertical line. Where the line reaches a maximum, the plate circuit is resonated. Now go back to the grid tuning and carefully adjust for maximum plate current. Then turn the carrier control fully counterclockwise. The plate current should drop down to its initial value of about 40 ma. The carrier control should be advanced slightly until an indication is visible on the scope. Now move the plate tuning control until there is no vertical deflection visible and advance the carrier control until the plate current rises to 150 ma. Then resonate the plate quickly by adjusting the plate tuning for minimum plate current (dip). Then increase the loading by turning the loading control counterclockwise. Every time the loading condenser is moved, the plate tuning has to be re-reso-

nated for minimum plate current. Continue to do this until the plate current minimum reaches 100 ma. Then advance the carrier control until the plate current reads 125 ma and plug key into key jack. The transmitter is now ready for use on CW.

- b. SSB Operation: Tune transmitter exactly as outlined above under Section a. Then turn carrier control fully CCW and switch OPERATION switch to MAN. Adjust audio gain control for proper scope pattern according to Figure 7. Select desired sideband. The transmitter is now ready to use on SSB. If voice controlled break-in is desired, switch OPERATION switch to VOX. Advance VOX gain control to the point where the relay is easily tripped but no further. Then turn OPERATION switch to the QT position and advance QT gain control to the point where speaker signals do not trip the relay.

NOTE: If the transmitter is adjusted properly, the plate current on voice signals should swing to about 100-125 ma before non-linearity becomes apparent on the scope.

- c. AM Operation: Follow procedure outlined under CW operation. Then turn OPERATION switch to MAN and readjust carrier control for a plate current of 100 ma. Then adjust audio gain until the scope picture becomes a triangle on audio peaks. The transmitter is now ready for use on AM. Refer to Figure 1, Page 14.

FIGURE 1.



Unmodulated carrier or single tone.



Modulated pattern when tuned to incorrect signal (i.e., high frequency crystal signal)



AM pattern, about 60% modulation.



AM pattern, 100% modulation, or SSB pattern with correct adjustment.



AM or SSB pattern with improper adjustment; reduce drive and/or change loading.



AM or SSB pattern with excessive bias on 5894 stage.



AM or SSB pattern with the mixer balance control (C-91) out of adjustment.

SECTION IV
THEORY OF OPERATION

.. General

The SSB-100 MIL may be regarded as a triple conversion receiver in reverse. It contains all the circuits and conversion steps essential to a triple conversion receiver, only the signal path follows the circuits in the opposite direction.

The audio signal, after being amplified in the speech amplifier (V-1), is converted to a 413 kc double sideband suppressed carrier signal in the balanced modulator (V-2), the 413 kc carrier being supplied by the carrier oscillator (V-8). The 413 kc double sideband suppressed carrier signal is then passed through a crystal-lattice filter which removes the higher sideband and passes the lower sideband. At the output of the crystal-lattice filter, the single sideband signal is fed into a mixer (V-3). For amplitude modulation, some of the 413 kc carrier which was removed by the balanced modulator is also fed into the mixer at the same time, so that either an SSB signal or an AM signal is fed into the mixer. The signal (SSB) is mixed with a crystal controlled signal.

For lower sideband operation the 413 kc signal is mixed with a 2562 kc signal which gives a 2975 kc lower sideband signal. To obtain an upper sideband signal the 413 kc signal is mixed with a 3388 kc signal which gives a 2975 kc upper sideband signal. A trimmer across the crystal allows the resonant frequency of this crystal to be adjusted in such a manner that the output carrier frequency will be the same in either sideband position. The output of this mixer is fed into an IF transformer which suppresses the unwanted mixer products.

The signal next enters V 4 which is a cathode follower-grounded grid combination. The signal is taken from the common cathode of this tube and fed into the VFO chassis. Part of the signal is amplified in the grounded grid amplifier and fed into V-9.

The signal is detected in V-9 to provide two different types of output. One of these is the envelope of the SSB signal which is taken from pin 2 of V-9 and fed into the 6AU6 horizontal deflection amplifier V-21. The DC component of the signal is recovered at pin #1 of the V-9 and is fed into the grid of the scope to provide automatic beam intensification when signal is present.

(V 20)
The 6AK6 (V-30) circuit is a highly stable variable frequency oscillator operating from 775 to 975 kcs. The corresponding VFO calibrations are - 100 and + 100 kcs, respectively. The output of

this stage is fed thru a low pass filter to provide suppression of the VFO harmonics.

The SSB signal (2975 kcs) is mixed with the VFO signal in a 12AT7 (V-18) balanced mixer. (C-19 serves as a mixer balance adjust). This gives an SSB signal adjustable from 2.2 to 2.0 mcs corresponding to -100 and +100 kc on the VFO scale. The output of this mixer is fed into an IF stage which is adjusted to track with the VFO setting. These circuits deliver their signal into 6C4 (V-19) cathode follower.

The signal enters the final chassis thru an impedance matching network. R-52 serves as a drive adjustment. The signal is delivered into 6X8 (V-17) which is connected as a balanced mixer. The 12AT7 (V-12) crystal oscillator (at 2.1 mc higher than the desired output frequency) has its output coupled into the 6X8 balanced mixer. The mixer feeds the desired signal into the 6360 driver stage and is again amplified into a 5894 final stage.

2. Audio & Voice Break-in Circuits

The speech pre-amplifier is a conventional resistance coupled amplifier and is of usual design.

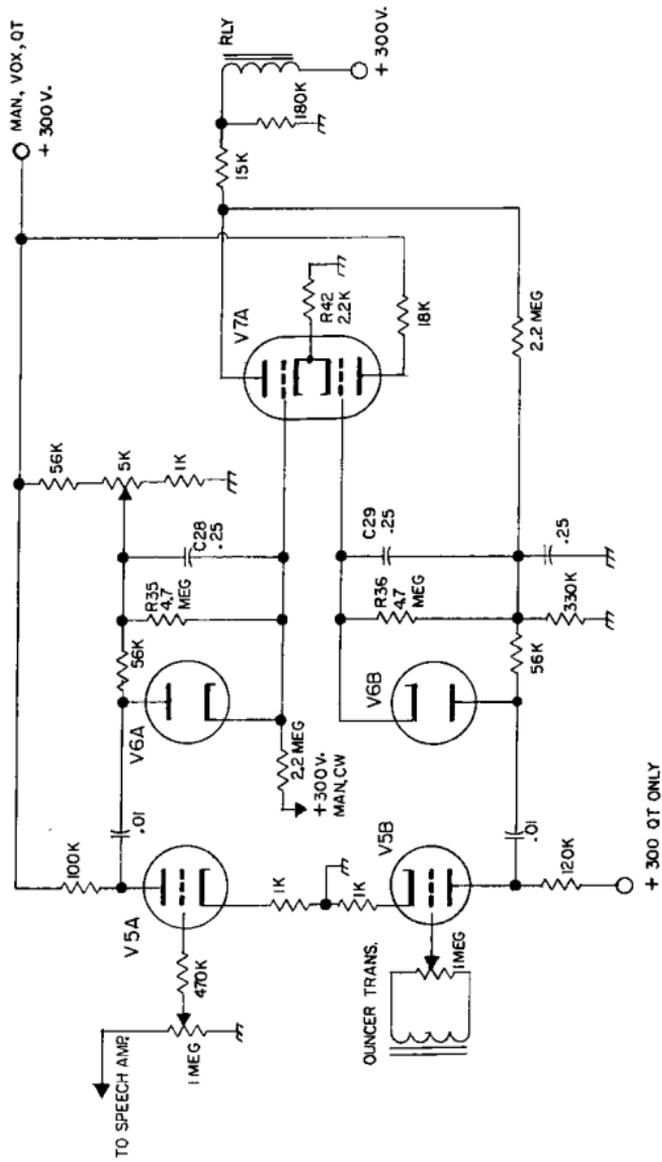
The output of the speech pre-amplifier is fed into the balanced mixer. Part of the audio signal is also fed into the voice control system. (See Figure 2).

The speech is amplified in V-5A and from there it is rectified by V-6A. The resulting DC voltage is applied to the grid of the V-7A which drives it into high conduction, causing the relay to close. The relay applies the proper operating voltages to all the stages. V-7A remains in high conduction until after the speech ceases and C-28 discharges through R-35. The action of V-7A is very much like that of a one-shot multivibrator.

When operating QT, the receiver audio is fed into V-5B and through the audio channel via loudspeaker and microphone. The audio entering the tubes V-5A, V-6A and V-7A tends to trip the relay. However, the audio in V-5B (from the receiver) is rectified by V-6B and fed into V-7B, which causes it to conduct heavily. This causes a large voltage to appear across R-42 which in turn prevents V-7A from conducting heavily.

When a voice signal appears at the microphone or low impedance input, the signal levels in the two audio control channels are unbalanced causing the relay control to operate.

When the operation control is in the Man, Vox or QT position, B+ is applied to V-5A, V-6A and V-7A. When the control is in QT, the B+ is applied to V-5B.



VOX CONTROL CIRCUITS

FIG. 2

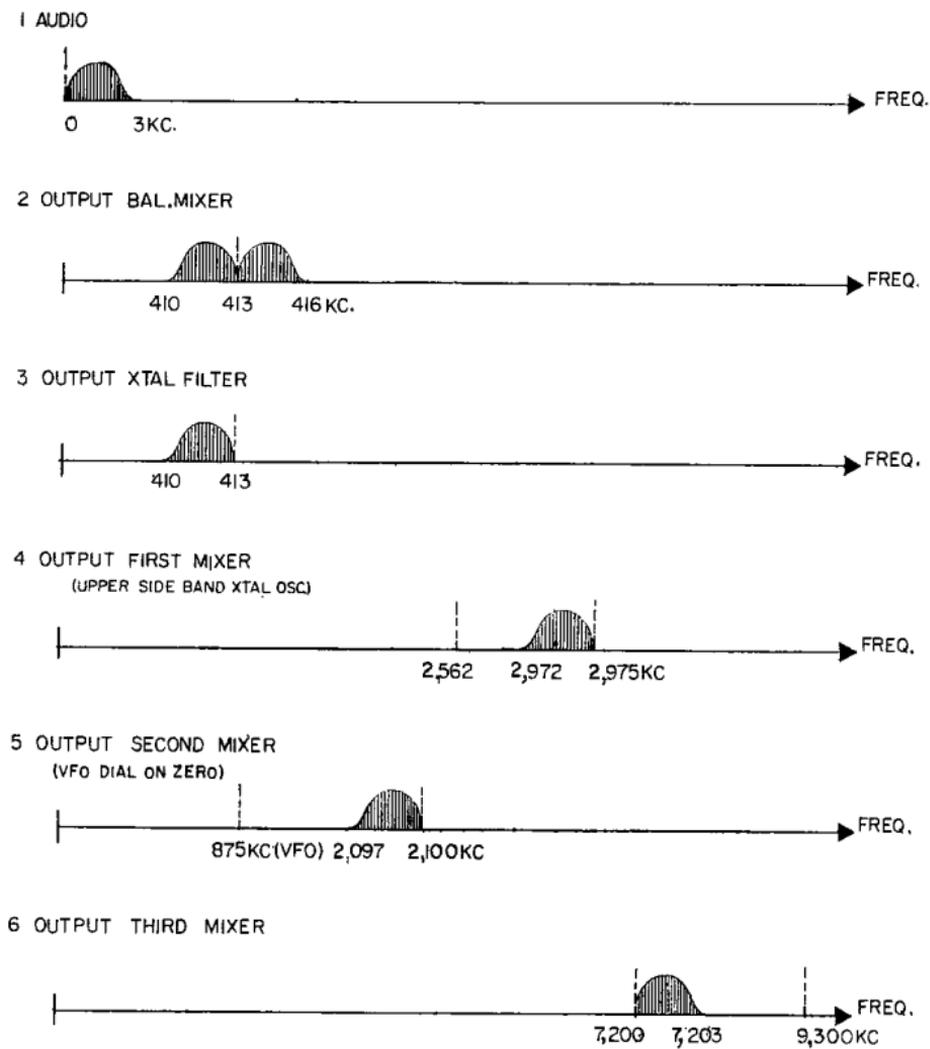
3. Low Frequency Oscillator, Cathode Follower, Balanced Modulator and Crystal Filter

The 12AT7 (V-8) is a crystal oscillator-cathode follower combination. The crystal is connected between pin 1 and 2 and forms a parallel resonant circuit at 413 mc. The capacitance divider across the crystal consists of C-31 and C-34 (their mid-point is grounded), which in combination with the crystal forms the oscillator circuit. R-49 plays an important part in the operation of this circuit by providing a plate load for the tube.

The cathode follower section serves two purposes. One is to isolate the LFO from the modulator circuit. It does this by the inherent high input impedance of a cathode follower. The output from the cathode is injected into the common cathodes of the balanced modulator. In order to reinsert carrier without disturbing the crystal filter, the cathode resistor of the cathode follower is made variable to tap off the correct amount of carrier voltage and to reinject it beyond the crystal filter.

The balanced modulator is in reality a balanced mixer. The carrier is fed into the cathodes driving the 12AT7 (V-2) in push-push. The plate circuit is connected in push-pull and is tuned to 413 kcs. With this connection, provided that tube gains, voltages, etc., are properly matched, the carrier voltage can be adjusted to be 50 db or more down. The audio is applied in a push-pull manner to the grid, heterodyning against the carrier producing sum and difference frequencies between audio and carrier. (The balanced modulator also performs the function of an audio phase inverter). The phase relationships are such that these mixer products appear in the proper phase to cause signal voltages to appear in the plate circuit of the 12AT7 (V-2). The result of all this is that the mixer products (sidebands) appear in the plate circuit while leaving the carrier suppressed.

The crystal filter is a more elaborate version of the kind found in most communications receivers. The crystals are used to provide steep skirts to the selectivity curve while maintaining a relatively flat top. (NO READJUSTMENT OF THIS FILTER SHOULD BE ATTEMPTED. THE CRYSTALS SHOULD NOT BE REMOVED OR REPLACED. ANY ATTEMPTED ADJUSTMENTS ARE CERTAIN TO RESULT IN SERIOUSLY DEGRADED PERFORMANCE.) The crystals at the output of the filter serve as series resonant traps to increase sideband and carrier attenuation. The passband of this filter is approximately 3 kc. The resulting single sideband signal is fed into the 6BA7 (V-3) mixer. (See Figure 3.)



SIGNAL PATH THRU TRANSMITTER

FIG. 3

4. Sideband Selection

The function of the 6BA7 is to provide selection of either upper or lower sideband. This is accomplished by mixing the signal with either of two crystal controlled signals. One crystal is at 3388 kc and the other is at 2562 kc. These signals, when mixed with the 413 kc signal provide output at 2975 kc. The output of the crystal filter is an SSB signal (lower sideband) extending from 410 to 413 kc. When added to the 2562 kc signal, it produces a signal extending from 2972 to 2975 kc (lower sideband). This signal is later inverted to upper sideband. When the 410 to 413 kc signal is heterodyned against the 3388 kc signal, the output is 2975 to 2978 kc signal (upper sideband). Later this signal is inverted to produce a lower sideband signal at the output. Reference to Figure 3 will show the path and resultant mixer products that provide the required signals.

The output circuit of the 6BA7 mixer is a tuned transformer with adequate selectivity to provide adequate rejection of unwanted mixer products, and is tuned to 2975 kcs. The transformer feeds into a 12AT7 (V-4) cathode follower which feeds its output into the VFO chassis via a coaxial cable. The other half of V-4 is a grounded grid amplifier that feeds the signal into a 6AL5 envelope detector. The output of the detector is fed into a 6AU6 (V-12) horizontal scope amplifier. The second half of the 6AL5 provides scope intensification.

The variable frequency oscillator is an inductance tuned, modified colpitts oscillator. It is temperature-compensated to provide high stability in excess of the usual requirements for single sideband operation. The low mass in the VFO assures adequate mechanical stability, even if the unit is used in a moving vehicle. The VFO is operated as an electron-coupled oscillator and its output is inserted into a low pass filter. The function of the filter is to attenuate sharply any harmonics of the VFO. The frequency range of the VFO is from 775 to 975 kc.

The VFO signal, having progressed through the low pass filter, next enters a 12AT7 (V-18) balanced mixer where it is mixed with the signal from the exciter. The output of this mixer is fed into two tuned circuits that have been adjusted to track with the oscillator. The output of the mixer is variable from 2.0 to 2.2 mc.

The result of the mixing, filtering, etc., up to this part of the circuit provides a variable selectable single sideband signal. The remaining problem, that of getting the signal to the operating frequency, is solved by heterodyning the signal once more to the operating frequency.

The output of the VFO is derived from the 6C4 (V-19) cathode follower, and in turn is delivered to the final chassis via a coaxial cable.

5. CW and AM Signals

CW and AM signals are produced in the following manner. Carrier is reinserted into the signal channel. This is added to the previously formed single sideband signal, producing single sideband with carrier which can be received on receivers in the ordinary manner. For all practical purposes, this signal is almost identical with an ordinary AM signal.

For CW signals (with operation switch in CW position) the first speech amplifier is disabled. The carrier is reinserted with the carrier reinsertion control (R-51) to obtain the proper level. Keying is accomplished by grid block keying applied to V-4, V-10 and V-18.

6. Third Mixer & Crystal Oscillator

The SSB signal leaves the cathode follower on the VFO chassis and traveling via a coaxial cable, it enters the power supply and power amplifier chassis. First, it passes through a potentiometer which is used to adjust the RF level of the incoming signal to provide just sufficient drive to insure proper operation regardless of the band or crystal used. C-38, C-39 and L-4A provide an impedance match to the grid of the triode section of the 6X8 (V-17). This circuit is in effect a reversed pi-network and actually steps up the incoming voltage from R-52. This circuit helps suppress spurious signals (unwanted mixer products, harmonics, etc.). The oscillator signal is injected via C-40 into the grid of the pentode section of the 6X8. Note that the plates and cathodes of the 6X8 are tied in parallel to provide mixer action. The cathode resistor is lightly by-passed with a 10 mmfd capacitor to provide increased gain. The tuned plate circuit of the mixer forms the grid circuit of the 6360 driver.

V-12 (12AT7) is a crystal oscillator operating at 3.1 mc higher than the desired output frequency. (Note that this makes the final inversion of the sideband to produce upper or lower sideband output). The operation of the oscillator, in crystal positions 1-9, is identical with that of the carrier oscillator. When operating as an overtone oscillator (crystal positions 10, 11 and 12) the circuit is that of a TGTP oscillator. The coils L-18, L-19 and L-20 are ad-

justed to be self-resonant at the desired harmonic of the crystal frequency. (Note: See operation instructions when operating in the 4 - 4.4 mc region).

7. Driver & Power Amplifier

The driver and power amplifier consist of a 6360 and a 5894 respectively. Each tube is a dual beam tetrode and in each case the two sections are connected in parallel. They operate in Class A and AB1 respectively. This allows linear operation without excessive distortion. In previous stages, the signal level was kept low to avoid excessive distortion. Now the function of these stages is to generate a high level signal. Previous to this point, neutralization was not required because the output of the various stages was not tuned to the same frequency, or the gain of a particular stage was low, or the stage was inherently stable. These final stages require neutralization because the gain is high and the input and output circuits are always tuned to the same frequency. Since the type of operation is Class A or AB1 (as opposed to Class C), it is inherently one of very high power gain. Therefore, these stages are much more sensitive to feed-back via the grid-plate capacity.

If you will look at Figure 4, you will see the basic configuration of the neutralizing circuit. You will see the tube capacitances, C_{gp} (grid-plate capacity) and C_{gk} (grid-cathode capacity), indicated by dotted lines. While these capacitances are not apparent on the circuit diagram, they come "built-in" and are unavoidable. When the plate circuit is tuned to a higher frequency and if the tube is unneutralized, the tube will no longer be an amplifier, but an oscillator. To avoid this, neutralization is employed. The heavy line in Figure 3 shows how an extra capacitance is added from the plate to the opposite end of the grid coil to balance out the voltage coupled into the grid tank via the grid-plate capacitance.

To see how this works, look at Figure 5, which shows the circuit of the 5894 redrawn as a bridge. Assume the plate is going positive and the voltage at the grid (via C_{gp}) is positive. The voltage through C_n tends to make the other end of the grid tank positive. This voltage in turn becomes negative at the other side of the grid tank, thereby cancelling out the feed-back voltages. Figure 6 shows the neutralizing circuit used in the 6360 stage and it is essentially the same as the previous circuit in operation.

To assure adequate linearity, inverse RF feed-back is employed to reduce as far as possible amplitude distortion of the emitted wave. This "Hi-Fi" technique is required for optimum operation.

BASIC NEUTRALIZING CIRCUIT

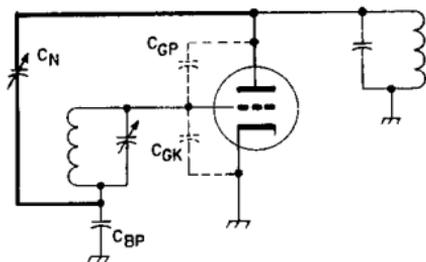


FIG. 4

BASIC NEUTRALIZATION CIRCUIT REDRAWN AS A BRIDGE

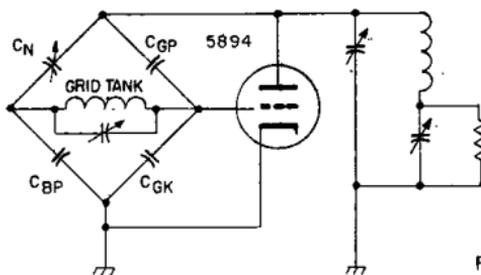


FIG. 5

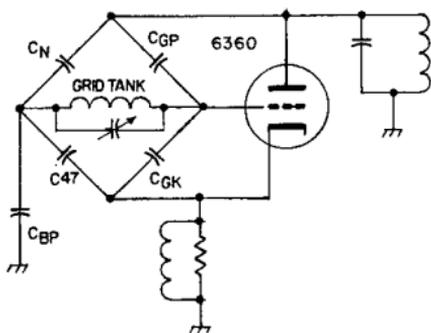
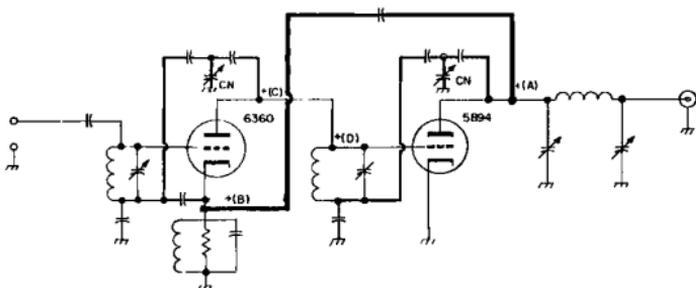


FIG. 6

Some of the RF is coupled through a small capacitor from the plate of the 5894 back to the cathode of the driver. Look at Figure 7 showing the feed-back path. At point (a), assume the voltage is going positive, which is the cathode of the 6360 stage. Consequently, the plate of the 6360 is going positive. This, in turn, drives the grid of the 5894 positive and this tends to drive the plate of the 5894 negative. Remembering that the plate was originally assumed to be going positive, it can be seen that the feed-back is negative in character because it tends to reduce the output slightly. The degree of feed-back depends on the value of the feed-back capacitor and associated components.



DRIVER AND PA, SHOWING NEUTRALIZATION AND R.F. FEEDBACK PATHS.

FIG. 7

8. The Oscilloscope

The oscilloscope provides comparison with the envelope of the low level single sideband signal and the RF voltage present at the plate of the final stage. This is accomplished by first detecting the signal coming from V-4 (pin 6) and obtaining the detected signal from the junction of R-23 and R-24. From there, the signal progresses to the grid of V-21. It is amplified in this tube and coupled into the horizontal deflection plates of V-22. The RF signal at the plate is picked up via a special coupling capacitor (C-105) from the plate of the final amplifier to the vertical deflection plate of V-22. To provide automatic beam intensification, the DC component of the signal is rectified in V-5 and the resulting positive voltage is tapped

from the junction of R-25 and R-26 and applied to the control grid of the oscilloscope. The scope intensity potentiometer (R-98) should be adjusted so the beam is blanked out when the carrier and audio level controls are at zero and with the operation switch in the manual position, and the control switch to transmit.

9. Power Supply

The Power Supply is designed to give three basic voltages: A high voltage for the final stage and oscilloscope; a medium voltage supply supplies the required voltage for all the low level stages and the screen of the power amplifier stage; the bias supply delivers a negative voltage (keyed by a relay to give operating and blocking bias) to the power amplifier. When operated in CW, there is a negative voltage applied to the mixer on the VFO chassis (V-18). This voltage is keyed at the key jack providing grid block keying. The voltages at the output of the various output filter capacitors are: 750 volts for the high voltage supply; 300 for the medium voltage supply and -75 volts for the bias supply. The voltage to ignite the VR tubes is derived from the medium voltage supply. The regulated voltage (150 V) is supplied to the screen grids of the driver (V-10) and the screen grid of the VFO (V-20), the plate of the 413 kc oscillator (V-8), the screen grid of the 6BA7 mixer (V-3), and the plate of the final crystal oscillator (V-12).

10. Control Circuits

a. The control circuits provide four basic types of operation; CW, MAN, VOX and QT. These types of operation are obtained by switching to the appropriate position on the Operation switch. When in the CW position (Control switch in XMIT position) B+ is removed from the first audio stage (V-1) and operating bias is applied to all stages, except V-4, V-10 and V-18, via R-85. When the key is depressed, this bias is removed, allowing the carrier to come through (when the carrier control knob is set to the proper level.) The screen voltage to the 5894 (V-11) is reduced via R-111 to prevent excessive screen dissipation. The vox relay is held in via a positive bias applied to the grid (pin 7 of V-7.) The transmitter is keyed by grid-block keying V-4 and V-18.

When in the MAN position (and Control switch in XMIT), all operating voltages are applied. The unit can then be used for AM and SSB. The vox relay is held in by positive bias applied to pin 7 of V-7.

When in the VOX position (and Control switch in XMIT), all voltages are applied. When the operator's voice signal enters the grid of V-5A, it is amplified, then rectified at the cathode of V-6A.

This rectified positive voltage is applied to the grid of V-7A and causes an increase in the plate current which makes the relaytrip. This removes the blocking bias from the grids of V-11.

The final position of the Control switch is "QT" which allows voice controlled operation with the loudspeaker of the receiver on. The way this is accomplished is to allow some audio from the loudspeaker (fed into 6, 7 and 8 on rear terminal strip). This audio signal is fed into the grid of V-5B and amplified. The signal enters the plate of V-6B and is rectified. The resulting positive signal enters the grid of V-7B causing the cathode of V-7 to go positive. This positive voltage prevents the plate of V-7A from drawing very much current, even when the grid of V-7A is being driven positive by the signal being picked up from the loudspeaker through the microphone. When an external noise, (e.g. the operator's voice) is picked up, the additional signal will unbalance this circuit and the plate of V-7A will draw more current, tripping the relay. This balancing circuit only works in this position because B+ is applied to the plate of V-5B via R-31 only in this control position.

b. Control Switch: The control switch has three positions. When in standby position, voltage is applied to the various oscillators, thus assuring their stability. When in the transmit position, the voltages are distributed according to the position of the control switch as described previously. In the calibrate position, voltages are applied to all stages except the first speech stage and the power amplifier is cut off. When the carrier knob is used to provide carrier reinsertion in this position, the carrier becomes audible to any nearby receiver, thus enabling the operator to adjust his transmitter to any desired frequency.

SECTION V
MAINTENANCE

Generally, little maintenance should be required, provided the equipment is kept clean and dry. It should be placed in such a position that cool air is free to circulate through the equipment.

1. Service Adjustments

a. Exciter chassis:

WARNING: No attempt should be made to adjust the crystal filter. (Subchassis between V-2 and V-3). Any attempt to do so will seriously degrade the performance of the unit. It has been factory adjusted with special equipment to give the optimum compromise between insertion loss, flatness in the pass band, skirt slope and spurious response in the filter. It is strongly advised that the unit be returned to the factory for service if the crystal filter is out of alignment. The component parts have been matched and completely tested to keep the RF losses at a minimum value. Therefore, it is inadvisable to attempt repairs.

The performance of the filter can be checked with an audio generator that puts out a pure, undistorted audiotone. Connect this to the audio input of the transmitter. Set the control to XMIT & MAN. Set the audio frequency to about 1000 cycles per second. Adjust the transmitter according to tuning procedure. Adjust audio level until the plate current is about 85 ma. With the carrier suppressed, the scope pattern should be a clean, thin vertical line, provided the rest of the unit is in good operating condition.

A further check is to tune in this signal with a good receiver set in its sharpest position. Next, slowly tune across the signal; there should be only one strong signal. Be extremely careful to avoid overloading the receiver, because a strong signal will cause spurious signals to appear in the receiver. Merely reducing the RF gain is not sufficient to prevent this from occurring. In all cases, keep the RF gain at normal levels and adjust the pick-up of the receiver by using a short antenna (12 inches or so) on the receiver. In extreme cases, it may be necessary to disconnect the antenna lead from the input to the receiver and put a short, heavy lead from the antenna terminal to a ground on the receiver cabinet.

To check the linearity of the amplifiers, use the audio tone and carrier reinsertion. When adjusted properly, a perfect triangle should be seen. If the linearity of the amplifier is poor, the previous tests for filter performance will not be valid.

To check the carrier balance, set up the receiver as in the previous test and tune in the carrier. The RF and AF gains should be set to normal level without overloading the receiver. With the proper adjustment, the receiver should not be overloaded. Turn off AVC and turn on the BFO. Now turn the transmitter carrier control knob completely counterclockwise. Do not readjust the receiver. The remaining carrier should be almost inaudible. If the carrier is plainly audible, the carrier balance potentiometer will have to be readjusted. If the balanced modulator tube is replaced, a tube will have to be selected to give optimum balance. To adjust the control, the following is recommended. Tune up the exciter and load it into a dummy load. Next, tune the receiver to the output frequency. With the transmitter set to MAN & XMIT and the audio and carrier knobs set to the maximum counterclockwise position, the carrier balance control should be adjusted for minimum carrier.

To readjust the Vox threshold control, set the transmitter to VOX & XMIT. Turn the vox threshold fully clockwise. The relay should be energized and hold in. Next, back off the control until the relay de-energizes. Now turn the vox control clockwise while speaking into the microphone. The relay should be energized at the beginning of a word and hold in for about one half second. If the relay holds in longer than this, turn the vox threshold control slightly counterclockwise to reduce the hold-in time to a suitable value.

To adjust the transmitter sideband frequency, tune in the signal on a receiver. Insert a slight amount of carrier and adjust the frequency until it is precisely zero beat with the BFO in the receiver. Next, switch the sideband selector switch. The carrier frequency should remain at exact zero beat. If not, put the transmitter in the LSB position and adjust transmitter frequency for exact zero beat. Switch to USB and adjust trimmer adjacent to Xtal 1.

b. VFO Chassis:

There is one service adjust on the VFO chassis. It should only be adjusted if the 12AT7 (V-18) on the VFO has to be changed.

This is the mixer balance adjustment, and is located just forward and to the left of the 6C4 (V-19). It is accessible from the top of the chassis of the VFO. To adjust the trimmer, set the output frequency for about 7 mc. Adjust the VFO setting slightly to the right of +100, then put in carrier and a pure audio tone. If the scope pattern is examined and the adjustment is incorrect, the sloping edges will have a slight amount of fuzziness. This is due to unwanted mixer products. The trimmer should be adjusted for a minimum amount of these products.

c. RF Chassis:

There are three adjustments on the RF chassis. They are the RF level adjust, the bias adjust and the neutralizing adjust.

The RF level control is set as follows: Set the transmitter on the highest band in use. Insert full carrier. Then adjust the RF level control, located adjacent to the bleeder resistor, for full rated input as indicated on the plate meter. Recheck on all other bands and if there is insufficient drive on any of the other bands, readjust the RF level control. If insufficient drive persists, the crystal, located in the crystal box on the RF chassis, may have poor activity or the corresponding grid coils may be misaligned. These coils should very rarely need realignment because they have been given optimum adjustment for full coverage on all bands.

The bias adjustment should be set as follows: Set the transmitter to XMIT & MAN with the audio and carrier controls set fully counterclockwise. Check the plate milliammeter. It should read 40 milliamperes. If it does not, adjust the bias control on the back of the cabinet until this requirement is met.

Neutralization: First tune up the transmitter for maximum performance with just the carrier operating at the rated level into a dummy load. Switch to standby. Next attach an RF voltmeter to the ungrounded side of C-68. A lead from this condenser passes close to a ventilating hole on the side of the cabinet and is a convenient point to attach the RF voltmeter or probe. (A circuit of a suitable RF probe is included at the end of the manual). Remove V-16 from its socket. Turn the carrier control to minimum. Set the control switch to XMIT. Insert carrier until the RF meter gives a

fairly strong indication on the meter. Then adjust C-32 for a minimum. Switch the control switch to standby and replace V-16. Then switch to calibrate and adjust the carrier level until the RF probe gives an indication. Then adjust C-33 for a dip on the probe. This adjustment should only be made if the driver or PA are changed.

It may be necessary to make the neutralization twice -- first on Band 4 and then on Band 1. Lack of neutralization is indicated when maximum power output does not occur at the dip.

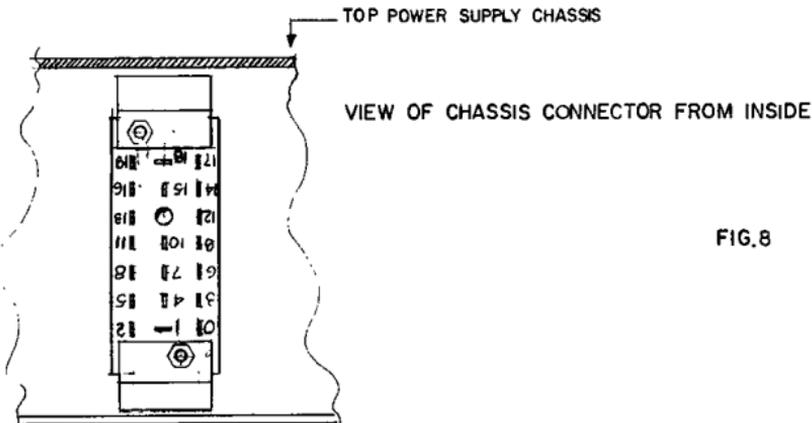


FIG.8

2. Trouble Shooting

The following tables should help to locate trouble. Defects in many of the stages will produce similar symptoms. Therefore, a careful check of the signal path should be made to determine where the trouble is occurring before any attempt is made to repair the equipment.

ATTENTION: Removal of V-11 (5894) final amplifier necessitates removal of the right side panel of the transmitter for access to the tube. For removal of V-22 (1CP1) scope tube, the scope bracket retaining screws on the right side panel should be removed and the hold-down screws on the scope bezel should be removed. To remove the tube, spring the scope bracket back and remove the tube with the scope shield.

NOTE:

All requests for maintenance beyond the capabilities of using unit should be referred to higher headquarters.

TROUBLE SHOOTING CHART

Symptoms	Defect in tube or its associated circuitry
Tubes do not light. No response at all	
Operates on CW. No output on phone. VOX & QT does not operate. Scope operates on CW.	V-1
Carrier cannot be balanced out. Low output may be present. Scope operates.	V-2
Low output on phone. Reports of poor quality and inadequate sideband suppression. Operates on CW, VOX & QT. Oscilloscope indicates good linearity	Xtal Filter
Sideband selector, oscilloscope works in one position and not in the other, (on CW works only in one sideband position), OR No output at all. No indication on scope.	V-3
VOX & QT circuits operate. No output. No indication on scope (remains dark)	V-4
Automatic scope intensification does not work and/or no horizontal sweep. Distorted pattern. Transmitter operates normally VOX & QT operate.	V-9
No output. No scope pattern. VOX & QT operate.	V-8

Check to verify the approximate location of the trouble

Procedure

Insert audio signal to wiper to audio gain control Transmitter should now operate normally.

Replace Fuse

Replace tubes. Make voltage and resistance checks.

Perform tests specified in the chapter on service adjustments.

Replace tubes. Make voltage and resistance checks.

Remove tube shield from V-3. Bring antenna lead from receiver near tube. Turn up the carrier knob. A signal at 2975 kcs should be audible in both side-band positions if V-3 is operating properly.

If Xtal filter is defective, return to factory.

Pull out cable from VFO (marked input) and bring free end to receiver tuned to 2975 kcs. If stage operates, signal will be audible.

Make voltage and resistance checks. Replace tubes. Check crystals.

Insert audio between R-23 and R-24. If horizontal sweep appears, trouble is indicated in V-9. Insert audio between R-25 and R-26. If scope pattern brightens, trouble is indicated in V-9.

Replace tubes. Make voltage and resistance checks.

Carrier oscillator defective. Insert signal generator to pin 8 of V-8. Set generator to 413 kcs. If transmitter seems to operate, trouble in V-8 is indicated.

Make voltage and resistance checks. Replace V-9.

Make voltage and resistance checks. Replace V-8. If crystal is defective, a replacement crystal should be obtained from the manufacturer.

TROUBLE SHOOTING CHART (cont'd)

No output, no vertical deflection. Horizontal sweep present. VOX & QT operate	V-20
No output, no vertical deflection. Horizontal sweep present. VOX & QT operate.	V-18
No output, no vertical deflection. Horizontal sweep present. VOX & QT operate.	V-19
No output, no vertical deflection. Horizontal sweep present. VOX & QT operate. This may occur only on one band.	V-12
No output, no vertical deflection. Horizontal sweep present VOX & QT operate. This may occur only on one band.	V-17
No output, no vertical deflection. Horizontal sweep present. VOX & QT operate. This may occur only on one band.	V-10
No output, no vertical deflection. Horizontal sweep present. VOX & QT operate. This may occur only on one band.	V-11

Remove tube shield of V-20. Set VFO to zero. Couple antenna to V-20. Signal should be present at 875 kcs if oscillator is functioning.

Replace V-20. Make voltage and resistance checks.

Remove key from key jack. An unclosed key will prevent operation. Remove tube shield. Couple antenna of receiver near tube. Insert carrier. Set VFO to zero. A signal should be heard at 2.1 mc if mixer is functioning.

Replace V-18. If transmitter functions normally, make service adjustment described previously. Make voltage and resistance checks.

Remove cable from jack labeled input adjacent to bleeder. Put a 500 ohm resistor across the inner and outer conductor. Couple a receiver antenna near center conductor. Insert carrier. Set VFO to zero. If V-19 is operating, a signal will be heard at 2.1 mc.

Replace V-19. Make voltage and resistance checks.

Switch meter to oscillator grid position. Meter should indicate at about 1/4 scale if stage is operating.

Replace V-12. Make voltage and resistance checks.

Use RF probe to see if RF drive is being applied to control grid of 6360. If not, V-17 or previous stage is at fault.

Replace V-17. Make voltage and resistance checks.

Use RF probe to see if RF drive is being applied to control grid of V-11. If not, V-10 or previous stage is at fault.

Replace V-10. Make voltage and resistance checks.

Check to see if RF drive is being applied to grids of V-11. If not, check previous stages.

Replace V-11. Make voltage and resistance checks.

TROUBLE SHOOTING CHART (cont'd)

No horizontal deflection. Transmitter functions normally otherwise.	V-21
No scope pattern even with intensity control fully clockwise.	V-22
VOX and/or QT does not operate. Possibly no output on SSB or AM.	V-5, V-6, V-7

Connect audio generator to pin 1 of V-21 through .05 or .1 condenser. If horizontal deflection does not occur, trouble is indicated in V-21

Replace V-21. Make voltage and resistance checks.

Replace V-22. Make voltage and resistance checks.

Replace tubes. Make voltage and resistance checks.

RESISTANCE

TUBE & TYPE	Pin #1	Pin #2	Pin #3	Pin #4	Pin #5	Pin #6	Pin #7	Pin #8	Pin #9	
V-1	12AT7	280K	1 meg	680	0+	0+	92K	1 meg	1800	0
V-2	12AT7	33K	120K	2400	0+	0+	33K	130K	2400	0
V-3	6BA7	38K	47K	40	0	0+	0	470K	0	30K
V-4	12AT7	33K	120K	470	0+	0+	30K	0	470	0
V-5	12AT7	150K	850K	1K	0+	0+	160K	240K	1K	0
V-6	6AL5	5 meg	57K	0	0+	5 meg	Inf.	330K	--	--
V-7	12AT7	65K	5 meg	2200	0+	0+	65K	5 meg	2200	0
V-8	12AT7	180K	470K	0	0+	0+	33K	100K	1K	0
V-9	6AL5	950K	110K	0	0+	0	Inf.	0	--	--
V-10	6360	63K	38K	63K	0+	0+	30K	33K	30K	0
V-11	5894	0+	12K	50K	10	0	12K	0+	--	--
V-12	12AT7	42K	32K	220	0+	0+	42K	35K	220	0
V-13	5R4	Inf.	25K	Inf.	100	Inf.	100	Inf.	25K	--
V-14	5U4	Inf.	33K	Inf.	26	Inf.	27	Inf.	33K	--
V-15	OA2	Inf.	Inf.	Inf.	Inf.	33K	Inf.	0	--	--
V-16	OA2	33K	Inf.	Inf.	Inf.	33K	Inf.	0	--	--
V-17	6X8	0	120K	33K	0+	0	0	120K	200K	33K
V-18	12AT7	30K	150K	220	0+	0+	30K	48K	240	0
V-19	6C4	30K	Inf.	0+	0	30K	47	1K	--	--
V-20	6AK6	470K	0	0	0+	33K	30K	5100	--	--
V-21	6AU6	470K	0	0	0+	180K	470K	1200	--	--
V-22	1CP1	0+	1 meg	3.2 meg	3.2 meg	920K	3.3 meg	100K	0	--

All measurements with V. T. V. M.,
with zero signal in. at 117V AC input

Carrier set at zero

Sideband Selector at LSB

Audio Gain set at zero

Operation set at MAN

Vox set at half

QT set at half

Control at Transmit

Band Change at Band 1

Xtal at Xtal 12

VFO set at zero

Plate Meter at 50 ma.

Transmitter loaded into Dummy
Load 60 watt bulb

Power Switch "ON"*

* For Resistance Measurements - set power switch at "OFF" position.

VOLTAGE

TUBE & TYPE	Pin #1	Pin #2	Pin #3	Pin #4	Pin #5	Pin #6	Pin #7	Pin #8	Pin #9	
V-1	12AT7	57	0	0.65	6AC	6AC	185	7	2.8	0
V-2	12AT7	240	0.3	7.6	6AC	6AC	240	52	7.6	0
V-3	6BA7	100	-7.2	.47	6AC	6AC	0	-2	0	265
V-4	12AT7	260	0	4.2	6AC	6AC	265	0	4.2	0
V-5	12AT7	100	0	1.5	6AC	6AC	0.8	0.6	0	0
V-6	6AL5	11.6	14.6	0	6AC	2.3	0	11.2	--	--
V-7	12AT7	260	11.4	20.3	6AC	6AC	96	20.3	20.3	0
V-8	12AT7	250	0.45	7.8	6AC	6AC	250	0.7	7.8	0
V-9	6AL5	0.5	0.3	0	6AC	0	0	0	--	--
V-10	6360	-7.8	2.6	2.45	6AC	6AC	280	142	280	0
V-11	5894	6AC	-100	280	0.8	0	-100	6AC	--	--
V-12	12AT7	110	-3.8	1.1	6AC	6AC	110	-3.8	1.1	0
V-13	5R4	0	780	0	840AC	0	840AC	0	780	--
V-14	5U4	0	350	0	280AC	0	280AC	0	350	--
V-15	OA2	0	0	0	0	150	0	0	--	--
V-16	OA2	150	0	0	0	150	0	0	--	--
V-17	6X8	0	250	6	0	0	5	-1.2	138	240
V-18	12AT7	320	0	4	6AC	6AC	320	0.4	4	6AC
V-19	6C4	320	0	6AC	0	320	0	25	--	--
V-20	6AK6	2.6	0	6AC	0	270	160	7	--	--
V-21	6AU6	0	0	0	6AC	110	80	1.7	--	--
V-22	1CP1	6AC	620	520	520	0.57	520	23	0	--

All measurements with V. T. V. M.,
with zero signal in. at 117V AC input

Carrier set at zero

Sideband Selector at LSB

Audio Gain set at zero

Operation set at MAN

Vox set at half

QT set at half

Control at Transmit

Band Change at Band 1

Xtal at Xtal 12

VFO set at zero

Plate Meter at 50 ma.

Transmitter loaded into Dummy
Load 50 watt bulb

Power Switch "ON"

PARTS LIST

Part No.	Mfg. No.	Description	Application
R-1	AB EB	Resistor, carbon, 47K 1/2 w 10%	RF-Filter V-1a
R-2	AB EB	Resistor, carbon, 1 meg 1/2 w 10%	V-1a Grid
R-3	AB EB	Resistor, carbon, 220K 1/2 w 10%	V-1a Plate
R-4	AB EB	Resistor, carbon, 80 1/2 w 10%	V-1a Cathode
R-5	AB EB	Resistor, carbon, 1 meg 1/2 w 10%	V-1b Grid
R-6	AB EB	Resistor, carbon, 47K 1/2 w 10%	V-1b Plate
R-7	AB EB	Resistor, carbon, 1.8K 1/2 w 10%	V-1b Cathode
R-8	CL	Potentiometer, carbon, 1 meg 20% Log taper	Audio Gain Control
R-9	AB EB	Resistor, carbon, 1K 1/2 w 10%	RF Filter, V-2 Grid
R-10	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-2 Grid
R-11	AB EB	Resistor, carbon, 270 1/2 w 10%	Part of Carrier Balance Network
R-12	AB EB	Resistor, carbon, 2.2K 1/2 w 10%	V-2 Cathode
R-13	AB Type J U taper	Resistor, Pot. carbon, 500 2 w	Carrier Balance Control
R-14	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-2 Grid
R-15	AB EB	Resistor, carbon, 270 1/2 w 10%	Part of Carrier Balance Control
R-16	AB EB	Resistor, carbon, 470K 1/2 w 10%	Isolating Resistor
R-17	AB EB	Resistor, carbon, 220K 1/2 w 10%	V-3 Grid
R-18	AB EB	Resistor, carbon, 47K 1/2 w 10%	V-3 Grid
R-19	AB EB	Resistor, carbon, 4.7K 1 w 10%	V-3 Screen
R-20	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-4a Grid
R-21	AB EB	Resistor, carbon, 2.2K 1/2 w 10%	V-4a Plate
R-22	AB EB	Resistor, carbon, 470 1/2 w 10%	V-4 Cathode
R-23	AB EB	Resistor, carbon, 100K 1/2 w 10%	V-9a Load
R-24	AB EB	Resistor, carbon, 2.2K 1/2 w 10%	V-9a Load
R-25	AB EB	Resistor, carbon, 10K 1/2 w 10%	V-9b Load
R-26	AB EB	Resistor, carbon, 1 meg 1/2 w 10%	V-9b Load
R-27	AB EB	Resistor, carbon, 470 1/2 w 10%	V-5a Grid
R-28	AB EB	Resistor, carbon, 100K 1/2 w 10%	V-5a Plate
R-29	AB EB	Resistor, carbon, 1K 1/2 w 10%	V-5a Cathode
R-30	AB EB	Resistor, carbon, 1K 1/2 w 10%	V-5b Cathode
R-31	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-5b Plate
R-32	AB EB	Resistor, carbon, 2.2 meg 1/2 w 10%	B+ Return
R-33	AB EB	Resistor, carbon, 56K 1/2 w 10%	V-6a Load
R-34	AB EB	Resistor, carbon, 56K 1/2 w 10%	V-6b Load
R-35	AB EB	Resistor, carbon, 4.7 meg 1/2 w 10%	V-6a Load
R-36	AB EB	Resistor, carbon, 4.7 meg 1/2 w 10%	V-6b Load

Part No.	M fg. No.	Description	Application
R-37	AB EB	Resistor, carbon, 330K 1/2 w 10%	DC Return
R-38	AB GB	Resistor, carbon, 56K 1/2 w 10%	Voltage Divider
R-39	CL ^{CM18876} N/P	Resistor, W. W. P. T. 5K	Voltage Divider
R-40	AB GB	Resistor, carbon, 1K 1w 10%	Voltage Divider
R-41	AB EB	Resistor, carbon, 2.2meg 1/2 w 10%	Clamping
R-42	AB EB	Resistor, carbon, 3,3K 1/2 w 10%	V-7 Cathode
R-43	AB GB	Resistor, carbon, 18K 1 w 10%	V-7b Plate
R-44	AB GB	Resistor, carbon, 15K 1 w 10%	V-7a Plate
R-45	AB GB	Resistor, carbon, 180K 1 w 10%	DC Return
R-46	AB EB	Resistor, carbon, 100K 1/2 w 10%	V-8a Grid
R-47	AB EB	Resistor, carbon, 470K 1/2 w 10%	V-8a Grid
R-48	AB EB	Resistor, carbon, 1K 1/2 w 10%	V-8a Decoupling
R-49	AB EB	Resistor, carbon, 150K 1/2 w 10%	V-8a Plate
R-50	AB EB	Resistor, carbon, 2.2K 1/2 w 10%	V-8a Plate
R-51	AB ^{Type J} S taper	Resistor, carbon, Pot. 1K 2 w	Carrier Level
R-52	AB ^{Type J} U taper	Resistor, carbon, Pot. 500 2 w	RF Level
R-53	AB EB	Resistor, carbon, 4.7K 1/2 w 10%	Broad Banding
R-54	AB EB	Resistor, carbon, 47 1/2 w 10%	Stabilizing
R-55	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-17 Grid
R-56	AB EB	Resistor, carbon, 560 1/2 w 10%	V-17 Cathode
R-57	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-17 Grid
R-58	AB EB	Resistor, carbon, 180K 1/2 w 10%	V-17 Screen
R-59	AB GB	Resistor, carbon, 3.9K 1 w 10%	RF Isolation
R-60	AB EB	Resistor, carbon, 8.2K 1/2 w 10%	V-12 Plate
R-61	AB EB	Resistor, carbon, 120K 1/2 w 10%	V-10 Grid
R-62	AB EB	Resistor, carbon, 10K 1/2 w 10%	V-10 Grid
R-63	AB EB	Resistor, carbon, 47 1/2 w 10%	Parasitic Suppressor
R-64	AB EB	Resistor, carbon, 1K 1/2 w 10%	V-10 Cathode
R-65	AB EB	Resistor, carbon, 1K 1/2 w 10%	RF Isolation
R-66	AB EB	Resistor, carbon, 4.7K 1/2 w 10%	RF Isolation
R-67	AB EB	Resistor, carbon, 47 1/2 w 10%	Parasitic Suppressor
R-68	AB GB	Resistor, carbon, 10 1 w 10%	V-11 Cathode
R-69	AB EB	Resistor, carbon, 2.2K 1/2 w 10%	Metering
R-70	S 5NIT	Resistor, W. W. Non-Ind. 50 5 w 20%	Parasitic Suppressor
R-71	AB EB	Resistor, carbon, 47 1/2 w 10%	V-11 Screen
R-72	CL ^{P25K-} 3000	Resistor, W. W. 3K 25w 20%	V-15, 16 Dropping
R-73	AB GB	Resistor, carbon, 470 1 w 10%	V-15 Dropping
R-74	AB GB	Resistor, carbon, 470 1 w 10%	V-16 Dropping

Parts No.	Mfg. No.	Description	Application
R-75	AB EB	Resistor, carbon, 22K 1/2 w 10%	V-12 Grid
R-76	AB EB	Resistor, carbon, 4.7K 1/2 w 10%	Metering
R-77	AB EB	Resistor, carbon, 10K 1/2 w 10%	V-12 Grid
R-78	AB EB	Resistor, carbon, 220 1/2 w 10%	V-12 Cathode
R-79	AB EB	Resistor, carbon, 470K 1/2 w 10%	V-20 Grid
R-80	AB EB	Resistor, carbon, 47 1/2 w 10%	V-20 Screen
R-81	AB GB	Resistor, carbon, 470 1 w 10%	V-20 Cathode
R-82	AB HB	Resistor, carbon, 4.7K 2 w 10%	RF Filtering
R-83	AB EB	Resistor, carbon, 47K 1/2 w 10%	V-18 Grid
R-84	AB EB	Resistor, carbon, 220 1/2 w 10%	V-18 Cathode
R-85	AB EB	Resistor, carbon, 47 1/2 w 10%	Parasitic Suppressor
R-86	AB EB	Resistor, carbon, 47K 1/2 w 10%	RF Filtering
R-87	AB EB	Resistor, carbon, 220K 1/2 w 10%	RF Filtering
R-88	AB EB	Resistor, carbon, 47 1/2 w 10%	Parasitic Suppressor
R-89	AB EB	Resistor, carbon, 470K 1/2 w 10%	V-21 Screen
R-90	AB EB	Resistor, carbon, 470K 1/2 w 10%	V-21 Grid
R-91	AB EB	Resistor, carbon, 120 1/2 w 10%	V-21 Cathode
R-92	AB EB	Resistor, carbon, 1K 1/2 w 10%	V-21 Cathode
R-93	AB EB	Resistor, carbon, 150K 1/2 w 10%	V-21 Plate
R-94	AB GB	Resistor, carbon, 1 meg 1 w 10%	Voltage Divider
R-95	AB EB	Resistor, carbon, 2.2 meg 1/2 w 10%	V-22 Load
R-96	AB EB	Resistor, carbon, 2.2 meg 1/2 w 10%	V-22 Load
R-97	AB EB	Resistor, carbon, 2.2 meg 1/2 w 10%	V-22 Load
R-98	AB ^{Type J} S taper	Resistor, carbon, Pot. 100K 2 w	V-22 Intensity
R-99	CL C4GJ	Resistor, W. W. 2K 5 w	Filter
R-100	O 0420	Resistor, W. W. 25K 50 w	H. V. Bleeder
R-101	O 0219	Resistor, W. W. 33K 25 w	L. V. Bleeder
R-102	AB HM	Resistor, carbon, 470K 5 w 10%	H. V. Bleeder
R-103	AB EB	Resistor, carbon, 1 meg 1/2 w 10%	RF Isolation
R-104	CL ^{CM18877} N/P	Potentiometer, 1 meg 2 w linear	QT Sensitivity
R-105	AB EB	Resistor, carbon, 2.2 meg 1/2 w 10%	V-11 Grid Return
R-106	AB EB	Resistor, carbon, 470K 1/2 w 10%	Voltage Divider
R-107	CL ^{CM18875} N/P	Resistor, W. W., Pot. 10K 4 w	Bias Adjust
R-108	AB GB	Resistor, carbon, 56K 1 w 10%	Voltage Divider
R-109	AB EB	Resistor, carbon, 120K 1/2 w 10%	Voltage Divider
R-110	AB EB	Resistor, carbon, 82K 1/2 w 10%	Voltage Divider
R-111	AB HB	Resistor, carbon, 10K 2 w 10%	V-11 Screen
R-112	AB HB	Resistor, carbon, 1.2K 2 w 10%	Decoupling
R-113	CL ^{CM18877} N/P	Resistor, carbon, Pot. 1 meg 2 w	Vox Sensitivity

Part No.	Mfg. No.	Description	Application
R-114	AB EB	Resistor, carbon, 4.7K 1/2 w 10%	Filter Decoupling
R-115	AB EB	Resistor, carbon, 1K 1/2 w 10%	Decoupling
R-116	AB GB	Resistor, carbon, 470 1 w 10%	VFO Decoupling
R-117	AB EB	Resistor, carbon, 470 1/2 w 10%	V-7 DC Return
R-118	AB EB	Resistor, carbon, 47 1/2 w 10%	V-8 Parasitic Suppressor
R-119	AB HB	Resistor, carbon, 47K 2 w 10%	V-7 Voltage Divider
R-120	AB EB	Resistor, carbon, 1K 1/2 w 10%	Carrier Level Padding
C-1	GE 23F115	Capacitor, oil filled, 1 mf 500 VW	Audio coupling
C-2	GA D	Capacitor, disc, 330 mmf GMV 600VW	RF filter V-1a
C-3	GA D	Capacitor, disc, .01 mf GMV 600 VW	V-1a coupling
C-4	GA D	Capacitor, disc, .01 mf GMV 600 VW	V-1b coupling
C-5	GA D	Capacitor, disc, .01 mf GMV 600 VW	V-2 Grid coupling
C-6	GA D	Capacitor, disc, .001 mf GMV 600 VW	V-2 Grid RF bypass
C-7	GA D	Capacitor, disc, .005 mf GMV 600 VW	V-2 Cathode coupling
C-8	GA D	Capacitor, disc, .025 mfd GMV 600VW	RF By-pass
C-9	GA D	Capacitor, disc, .001 mfd GMV 600 VW	V-2 Grid RF By-pass
C-10	GA D	Capacitor, disc, .025 mfd GMV 600 VW	RF By-pass
C-11	CRL TCZ	Capacitor, ceramic tubular, 10mmfd 300 VW 10%	V-3 Grid
C-12	EM DM-15	Capacitor, mica, 250 mmfd 10% 300 VW	V-3 Grid
C-13	GA D	Capacitor, disc, .025 mfd GMV 600 VW	V-3 By-pass
C-14	CRL TCZ	Capacitor, ceramic tubular, 10 mmfd 10% 300 VW	V-3 Padding
C-15	J 160-110	Capacitor, variable, 5-20 mmfd	V-3 Trimmer
C-16	EM DM-15	Capacitor, mica, 100 mmfd 10% 300 VW	V-3 Tuning
C-17	EM DM-15	Capacitor, mica, 100 mmfd 10% 300 VW	V-4 Tuning
C-18	GA D	Capacitor, disc, .01 mfd GMV 600VW	V-3 RF By-pass
C-19	GA D	Capacitor, disc, .01 mfd GMV 600VW	V-4 RF By-pass
C-20	GA D	Capacitor, disc, .01 mfd GMV 600VW	V-4 Plate By-pass
C-21	EM DM-15	Capacitor, mica, 100 mmfd 10% 300 VW	V-4 Plate Tuning
C-22	GA D	Capacitor, disc, .01 mfd GMV 600VW	V-4 By-pass
C-23	CRL BC20A	Capacitor, ceramic tubular, 100 mmfd 10% 300 VW	V-9 Coupling
C-24	CRL BC20A	Capacitor, ceramic tubular, 100 mmfd 10% 300 VW	V-9 Coupling
C-25	GA D	Capacitor, disc, .025 mfd GMV 600VW	V-9 Filter

Part No.	Mfg. No.	Description	Application
C-26	GA D	Capacitor, disc, .01 mfd GMV 600VW	V-5a A. F. Coupling
C-27	GA D	Capacitor, disc, .01 mfd GMV 600VW	V-5b A. F. Coupling
C-28	M 345	Capacitor, molded paper, .25 mfd 200 VW	V-7a Filter
C-29	M 345	Capacitor, molded paper, .25 mfd 200 VW	V-7b Filter
C-30	M 345	Capacitor, molded paper, .25 mfd 200 VW	V-6b By-pass
C-31	CRL TCZ	Capacitor, ceramic tubular, 15 mfd 10% 300 VW	V-8 By-pass
C-32	CRL 827C	Capacitor, variable, 5-30 mmfd	V-10 Neutralizing
C-33	CRL 827C	Capacitor, variable, 5-30 mmfd	V-11 Neutralizing
C-34	EM DM-15	Capacitor, mica, 39 mmfd 10% 300KW	V-8a Grid
C-35		Not used	
C-36	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-8 RF Coupling
C-37	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-11 RF Coupling
C-38	EM DM-20	Capacitor, mica, 680 mmfd 10% 300 VW	V-11 Part of Pi-network
C-39	EM DM-20	Capacitor, mica, 200 mmfd 10% 300 VW	V-11 Part of Pi-network
C-40	CRL BC20A	Capacitor, ceramic tubular, 100 mmfd 10% 300 VW	V-12 RF Coupling
C-41	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-17 RF By-pass
C-42	EM DM-15	Capacitor, mica, 200 mmfd 10% 300 VW	V-10 RF By-pass
C-43	CRL TCZ	Capacitor, ceramic tubular, 15 mmfd 10% 300 VW	V-10 Padder
C-44	CRL BC20A	Capacitor, ceramic tubular, 100 mmfd 10% 300 VW	V-10 Coupling
C-45	CRL TCZ	Capacitor, ceramic tubular, 15 mmfd 10% 300 VW	V-10 Neutralizing
C-46	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-18 Feed-back
C-47	CRL TCZ	Capacitor, ceramic tubular, 50 mmfd 10% 300 VW	V-10 Feed-back
C-48	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-10 By-pass
C-49	CRL TCZ	Capacitor, ceramic tubular, 10 mmfd 10% 300 VW	V-10 Neutralizing
C-50	CRL FT1000	Capacitor, feed thru, .001 mfd	V-10 By-pass
C-51	GA D	Capacitor, disc, .001 mfd GMV 600 VW	V-10 Screen By pass
C-52	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-10 By-pass

Part No.	Mfg. No.	Description	Application
C-53	H HED50	Capacitor, variable, 50mmfd/sec	V-11 Grid
C-54	EM DM-15	Capacitor, mica, 200 mmfd 10% 300 VW	V-11 By-pass
C-55	CRL TCZ	Capacitor, ceramic tubular, 10 mmfd 10% 300 VW	V-11 Neutralizing
C-56	GA D	Capacitor, disc, .025 mfd GMV 600 VW	V-8 By-pass
C-57	CRL TCZ	Capacitor, ceramic tubular, 18 mmfd 10% 300 VW	V-11 Padder
C-58	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-11 By-pass
C-59	CRL BC20A	Capacitor, ceramic tubular, 100 mmfd 10% 300 VW	V-11 Coupling
C-60	CRL TCZ	Capacitor, ceramic tubular, 10 mmfd 10% 300 VW	V-17 By-pass
C-61	CRL TCZ	Capacitor, ceramic tubular, 3 mmfd 300 VW	V-11 Neutralization
C-62	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-11 By-pass
C-63	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-11 By-pass
C-64	CRL 3-501	Capacitor, 500 mmfd, 12.5KV	V-11 Coupling
C-65	GA G	Capacitor, disc, .003 mfd GMV 2KV	V-11 By-pass
C-66	CRL TCZ	Capacitor, ceramic tubular, 1 mmfd 300 VW	V-11 Feed-back
C-67	CRL 858- S500	Capacitor, ceramic button, 500 mmfd	V-11 Tuning
C-68	H MC200S	Capacitor, variable, 200 mmfd	V-11 Tuning
C-69	CRL 850- S-252	Capacitor, ceramic button, 25 mmfd	V-11 Tuning
C-70	CRL 850- S-252	Capacitor, ceramic button, 25 mmfd	V-11 Tuning
C-71	CRL 850- S-502	Capacitor, ceramic button, 50 mmfd	V-11 Tuning
C-72	CRL 850- S-502	Capacitor, ceramic button, 50 mmfd	V-11 Tuning
C-73	RC #273	Capacitor, variable, 3X450 mmfd	V-11 Loading
C-74	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-12 By-pass
C-75	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-12 By-pass
C-76	GA D	Capacitor, disc, .001 mfd GMV 600 VW	V-12 Coupling
C-77	H HFD50	Capacitor, variable, 50 mmfd/sec	V-10 Tuning Padding & Temp. Comp.
C-78	EM DM-15	Capacitor, mica, added in test	Temp. Comp. Padding & Temp. Comp.
C-79	EM DM-20	Capacitor, mica, added in test	Temp. Comp. VFO zero
C-80	J 160-110	Capacitor, variable, 5-20 mmfd	

Part No.	Mfg. No.	Description	Application
C-81	CD CM25-751	Capacitor, silver mica, 750 mmfd 10% 500 VW	V-20 Grid
C-82	CD CM25-102	Capacitor, silver mica, .001 mfd 10% 500 VW	V-20 Grid
C-83	CD CM25-102	Capacitor, silver mica, .001 mfd 10% 500 VW	V-20 Cathode
C-84	GA D	Capacitor, disc, .025 mfd GMV 600 VW	V-20 By-pass
C-85	GA D	Capacitor, disc, .001 mfd GMV 600 VW	V-20 Coupling
C-86	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-20 By-pass
C-87	GA D	Capacitor, disc, .001 mfd GMV 600 VW	V-18 Coupling
C-88	GA D	Capacitor, disc, .001 mfd GMV 600 VW	V-18 Coupling
C-89	CRL TCZ	Capacitor, ceramic tubular, 50 mmfd 10% 300 VW	V-18 Padder
C-90	CRL TCZ	Capacitor, ceramic tubular, 33 mmfd 10% 300 VW	V-18 Padder
C-91	E TS2A-7	Capacitor, ceramic trimmer, 5-25 mmfd	V-18 Balance
C-92	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-18 By-pass
C-93	B LC1662	Capacitor, variable, 50 mmfd/sec	V-18, 19 Tracking
C-94	EM DM-15	Capacitor, mica, 150 mmfd 10% 300 VW	V-18 Tuning
C-95	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-18 By-pass
C-96	EM DM-15	Capacitor, mica, 150 mmfd 10% 300 VW	V-19 Tuning
C-97	CRL TCZ	Capacitor, ceramic tubular, 15 mmfd 10% 300 VW	V-19 Tuning
C-98	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-19 By-pass
C-99	GE 23F-115	Capacitor, oil, 1 mfd 500 VW	V-21 By-pass
C-100	A BT 50	Capacitor, bathtub, 50 mfd 50 WVDC	V-21 By-pass
C-101	GA D	Capacitor, disc, .025 mfd GMV 600 VW	V-21 Coupling
C-102	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-22 By-pass
C-103	GA G	Capacitor, disc, .003 mfd GMV 2 KV	V-22 By-pass
C-104	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-22 By-pass

Part No.	Mfg. No.	Description	Application
C-105	Eldico	Capacitor, 'scope coupling	V-22 Coupling
C-106	GA G	Capacitor, disc, .003 mfd GMV 2 KV	Line By-pass
C-107	GA G	Capacitor, disc, .003 mfd GMV 2 KV	Line By-pass
C-108	Astron MM16- 450	Capacitor, electrolytic, 16 mfd 450 WVDC	Bias Filter
C-109	CD TJH10- 100	Capacitor, oil, 10 mfd, 1 KV	H. V. Filter
C-110	M 927- 1030	Capacitor, electrolytic, 450V dual	L. V. Filter
C-111	M 927- 1030	Capacitor, electrolytic, 450V dual	L. V. Filter
C-112	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-10 Fil. By-pass
C-113	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-17 Fil. By-pass
C-114	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-12 Fil. By-pass
C-115	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-11 Fil. By-pass
C-116	CD 428928	Capacitor, bathtub, 15 mfd 150WVDC	Bias Filter
C-117	S 33201	Capacitor, paper tubular, .5 mfd 100 WVDC	By-pass
C-118	GA D	Capacitor, disc, .005 mfd GMV 600 VW	By-pass
C-119	Astron MM16- 450	Capacitor, electrolytic, 16 mfd 450 WVDC	QT By-pass
C-120	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-18 Fil. By-pass
C-121	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-19 Fil. By-pass
C-122	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-20 Fil. By-pass
C-123	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-1 Fil. By-pass
C-124	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-2 Fil. By-pass
C-125	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-3 Fil. By-pass
C-126	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-4 Fil. By-pass
C-127	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-5 Fil. By-pass
C-128	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-6 Fil. By-pass
C-129	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-7 Fil. By-pass

Part No.	Mfg. No.	Description	Application
C-130	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-8 Fil. By-pass
C-131	GA D	Capacitor, disc, .005 mfd GMV 600 VW	V-9 Fil. By-pass
C-132	CRL TCZ	Capacitor, ceramic tubular, 1 mmfd 300 VW	V-19 Coupling
C-133	GA D	Capacitor, disc, .025 mfd GMV 600 VW	Intensity By-pass
C-134	CRL BC20	Capacitor, ceramic tubular, 80 mmfd, 10% 300 VW	L-12 Padder
C-135	CRL BC20	Capacitor, ceramic tubular, 80 mmfd, 10% 300 VW	L-11 Padder
C-136	CRL BC20	Capacitor, ceramic tubular, 80 mmfd, 10% 300 VW	L-5 Padder
C-137	CRL BC20	Capacitor, ceramic tubular, 80 mmfd 10% 300 VW	L-4 Padder
C-138	GA D	Capacitor, disc, .005 mfd GMV 600 VW	Phone Patch By-pass
C-139	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-21 By-pass
C-140	E 532-08- 0R5	Capacitor, piston, variable, .5-5 mfd	V-17 Trimmer
C-141	GA D	Capacitor, disc, .01 mfd GMV 600 VW	V-12 By-pass
L-1	Eldico	Coil, RF, single layer	VFO Main Tuning
L-2		Not used	
L-3	Eldico	Coil, RF, single layer	V-17 Grid coil
L-4	Eldico	Coil, RF, single layer	V-10 Grid coil Band #7
L-5	Eldico	Coil, RF, single layer	V-10 Grid coil Band #6
L-6	Eldico	Coil, RF, single layer	V-10 Grid coil Band #5
L-7	Eldico	Coil, RF, single layer	V-10 Grid coil Band #4
L-8	Eldico	Coil, RF, single layer	V-10 Grid coil Band #3
L-9	Eldico	Coil, RF, single layer	V-10 Grid coil Band #2
L-10	Eldico	Coil, RF, single layer	V-10 Grid coil Band #1
L-11	Eldico	Coil, RF, single layer	V-11 Grid coil Band #7
L-12	Eldico	Coil, RF, single layer	V-11 Grid coil Band #6

Part No.	Mfg. No.	Description	Application
L-13	Eldico	Coil, RF, single layer	V-11 Grid coil Band #5
L-14	Eldico	Coil, RF, single layer	V-11 Grid coil Band #4
L-15	Eldico	Coil, RF, single layer	V-11 Grid coil Band #3
L-16	Eldico	Coil, RF, single layer	V-11 Grid coil Band #2
L-17	Eldico	Coil, RF, single layer	V-11 Grid coil Band #1
L-18	Eldico	Coil, RF, single layer	V-12 Plate Tuning Pos. #12
L-19	Eldico	Coil, RF, single layer	V-12 Plate Tuning Pos. #11
L-20	Eldico	Coil, RF, single layer	V-12 Plate Tuning Pos. #10
L-21	Eldico	Coil, RF, single layer	V-4b Plate Tuning
L-22	Eldico	Coil, RF, single pi	V-18a Plate Tuning
L-23	Eldico	Coil, RF, single pi	V-19 Grid Tuning
L-24	Eldico	Coil, RF, single layer	V-20 Padding
L-25	Eldico	Coil, RF, single layer - Assy.	V-11 Plate Tuning
L-26	Eldico	Coil, RF, single layer	
IFT-1	Eldico	Transformer, IF 2,975 KC	V-3 Tuning
T-1	Eldico ET-318	Power transformer	Power supply
T-2	Eldico ET-328	AF transformer	QT Transformer
CH-1	Eldico EC-315	Swinging choke	H. V. Filter
CH-2	Eldico EC-329	Smoothing choke	L. V. Filter
PS-1	Eldico	Parasitic suppressor	V-10 Grid
PS-2	Eldico	Parasitic suppressor	V-11 Grid
PS-3	Eldico	Parasitic suppressor	V011 Plate
RFC-1	Eldico	RF choke, 3 mh	V-3 Cathode

Part No.	Mfg. No.	Description	Application
RFC-2	Eldico	RF choke, 3 mh	V-20 Plate
RFC-3	Eldico	RF choke, 3 mh	V-20 Cathode
RFC-4	Eldico	Not used	V-18b Plate
RFC-5	Eldico	RF choke, 3 mh	V-10 Cathode
RFC-6	Eldico	RF choke, 3 mh	V-10 Plate
RFC-7	Eldico	RF choke, 3 mh	V-11 Grid
RFC-8	Eldico	RF choke, 5 mh	V-11 Plate
RFC-9	Eldico	RF choke, 3 mh	V-8
RFC-10	Eldico	RF choke, 3 mh	V-17 Plate
RY-1	Automatic Ele. R-45L	Relay	Vox Control
M-1	Hoyt 635 Scale print A 2477	0-200 ma Meter	
SR1-2	RR 8J1	Selenium Rectifier	Bias Supply
V-1	RCA	12AT7	Speech Amplifier
V-2	RCA	12AT7	Balanced Modulator
V-3	RCA	6BA7	Mixer
V-4	RCA	12AT7	2975 kc Amplifier
V-5	RCA	12AT7	Vox & QT Amplifier
V-6	RCA	6AL5	Vox & QT Rectifier
V-7	RCA	12AT7	Vox & QT Control Tube
V-8	RCA	12AT7	413 kc Carrier Oscillator
V-9	RCA	6AL5	Envelope Detector
V-10	Amperex	6360	Driver Stage
V-11	Amperex	5894	Power Amplifier
V-12	RCA	12AT7	High Freq. Xtal Oscillator
V-13	RCA	5R4	High Voltage Rectifier
V-14	RCA	5U4	Low Voltage Rectifier
V-15	RCA	OA2	Voltage Regulator
V-16	RCA	OA2	Voltage Regulator
V-17	RCA	6X8	High Freq. Balanced Mixer
V-18	RCA	12AT7	VFO Balanced Mixer
V-19	RCA	6C4	Cathode Follower

Part No.	Mfg. No.	Description	Application
V-20	RCA	6AK6	Variable Freq. Oscillator
V-21	RCA	6AU6	Horizontal Amplifier
V-22	Cossor	1CP1	Oscilloscope
SW-1	CRL PA-0	Sideband selector	V-3 Xtal Selector
SW-2a	CRL PA-0	Xtal selector	V-12 Xtal Selector
SW-2b	CRL PA-0	Xtal selector	V-12 Xtal Selector
SW-3a	CRL GD	Band selector	V-10 Grid
SW-3b	CRL GD	Band selector	V-11 Grid
SW-3c	CRL PISD	Band selector	V-11 Plate coil
SW-3d	CRL PISD	Band selector	V-11 Plate load
SW-4a	H&H GC 1338	Line switch	
SW-5	CRL RRD	Meter switch	
SW-6a	CRL PA-3		Control Switch
SW-6b	CRL PA-3		Control Switch
SW-7a	CRL PA-3		Operation Switch
SW-7b	CRL PA-3		Operation Switch
SW-7c	CRL PA-12		Operation Switch
XF-1	Eldico ^{KF410-} 413	Passband crystal filter	Sideband filter
LPF	Eldico ^{LPF} 775-975	Low Pass filter	VFO harmonic filter
F-1	Littlefuse 311005		Line fuse

LEGEND

A. . . .	Aerovox	GA . . .	Good All
AB. . .	Allen Bradley	GE . . .	General Electric
AH&H. .	Arrow, Hart & Hegeman	H. . . .	Hammarlund
B. . . .	Bud	J. . . .	E. F. Johnson
CD. . . .	Cornell Dubilier	M. . . .	Micamold
CL. . . .	Clarostat	O. . . .	Ohmite
CRL. . .	Centralab	RR. . . .	Radio Receptor
E. . . .	Erie	S. . . .	Sangamo
EM. . .	ElMenco		

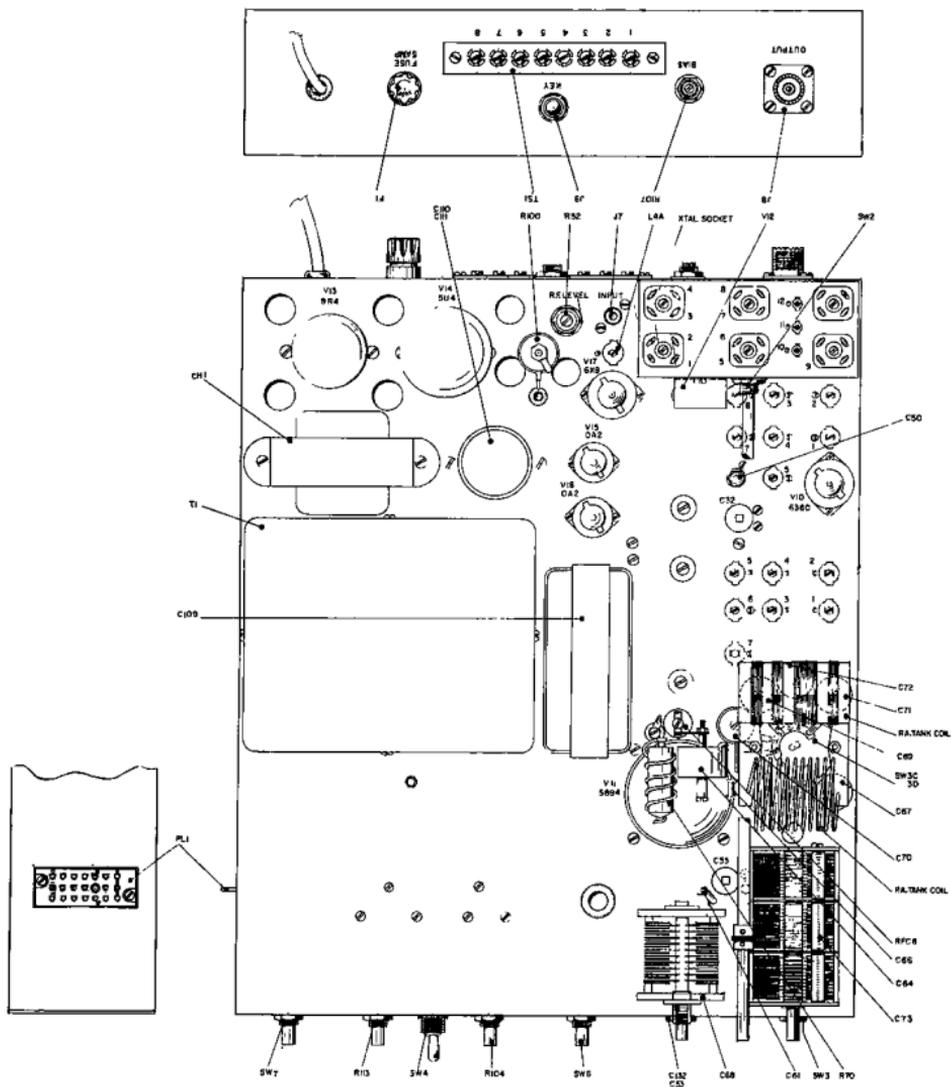


FIG 9

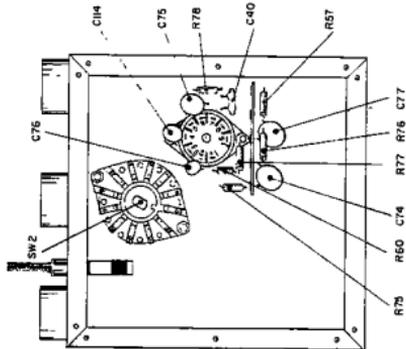
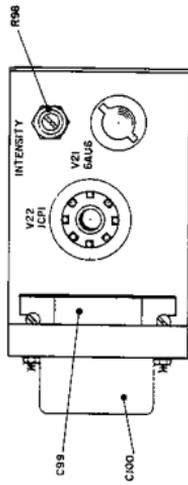
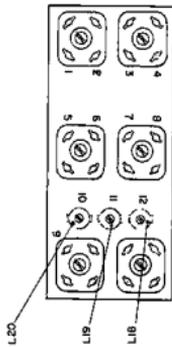
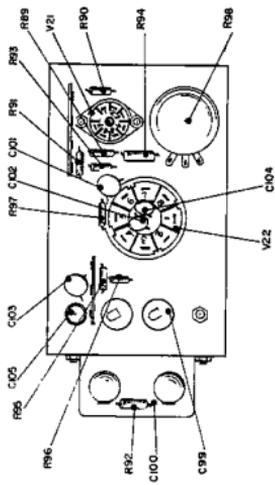
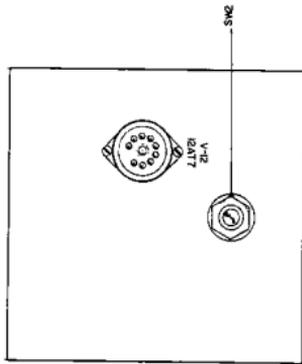


FIG.13

