OPERATING INSTRUCTIONS

FOR

GENERAL ELECTRIC SINGLE SIDEBAND SELECTOR

TYPE YRS-1

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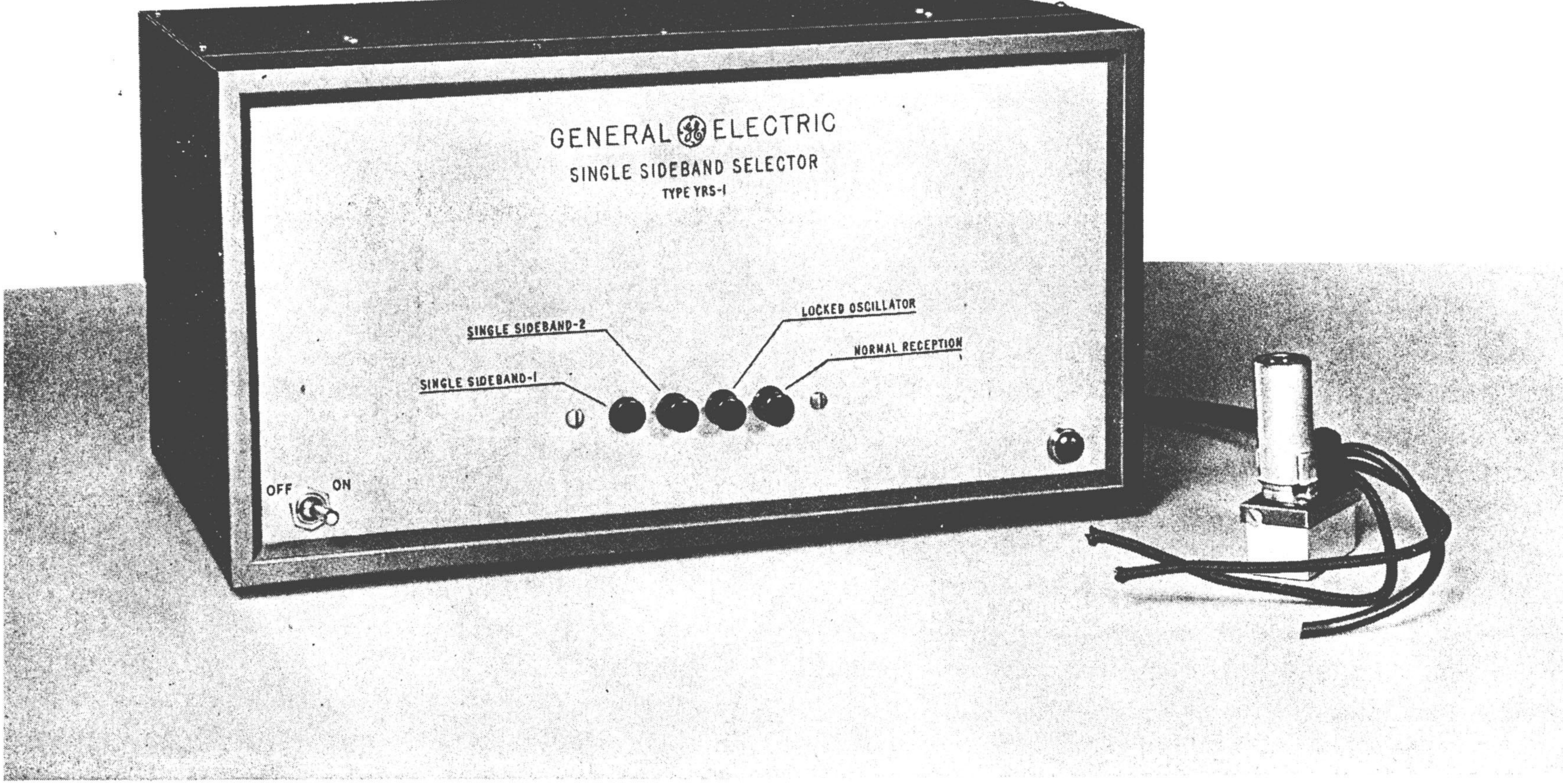
GENERAL ELECTRIC COMPANY

ELECTRONICS DEPARTMENT

SPECIALTY DIVISION

SYRACUSE, NEW YORK

ESD-151



SINGLE SIDEBAND SELECTOR Type YRS-1

CONTENTS

GENERAL SPECIFICATIONS

Power Requirements:

105-125 volts, 50-60 cycle commercial AC. Power consumption 60 watts.

Operating Range:

Can be used with any receiver having an intermediate frequency of approximately 455 KC.

Physical Specifications:

Width - 14 1/2"

Height - 7 3/4"

Depth - 8 1/2 "

Weight - 15 1/2 lbs.

SERVICE PARTS AND ACCESSORIES

TUBES:

Symbol	Function	Type
V1	Reactance Tube	6SJ7
V2	Oscillator	6SJ7
V3	Detector	6H6
V4	Detector	6H6
V5	Phase Shifter	6SL7GT
V6	Phase Shifter	6SL7GT
V7	Phase Shifter	6SL7GT
V8	Phase Shifter	6SL7GT
V9	High Impedance Input Stage	6AK6
V10	Rectifier	5Z4
V11	DC Valve	6V6GT
V12	Voltage Regulator Amplifier	6SJ7
V13	Audio Amplifier	6C4
V14	Voltage Regulator	VR-105

LAMP:

I1	G. E. Type #51, 6-8V.

OPERATING INSTRUCTIONS

FOR

GENERAL ELECTRIC SINGLE SIDEBAND SELECTOR

TYPE YRS-1

GENERAL DESCRIPTION

The General Electric Single Sideband Selector, Type YRS-1, when properly connected and aligned to a superheterodyne receiver having an intermediate frequency of approximately 455 kilocycles, permits single sideband reception of either modulated or unmodulated signals. Either sideband can be accepted or rejected to cope with existing interference conditions, this selection being made manually by means of push buttons which are centrally located on the front panel of the unit. The YRS-1 can also be used for carrier-reinforced double sideband reception, a condition which reduces distortion caused by selective fading. A fourth operating condition permits the receiving system to function in the normal manner.

Once connected and aligned, the YRS-1 requires no further attention or tuning other than the selection of the desired mode of operation. No additional power is drawn from the receiving equipment to which the YRS-1 is connected.

Although rejection of an undesired sideband range is accomplished by a system which provides the effect of extreme selectivity, the quality of modulation contained in the accepted sideband is not impaired in any manner and is generally restricted only by the I. F. pass-band of the particular receiver in use. This is because the audio frequency response of the YRS-1 is in excess of 70 to 7000 cycles per second, whereas the overall frequency response of the average communications receiver falls off considerably above approximately 5000 cycles per second due to sideband cutting in the intermediate frequency amplifiers.

To illustrate the operation of the YRS-1, consider an amplitude modulated signal as shown in simple form in Figure 1, page 5. The modulation process creates two sidebands, A and B, which are symetrically located on either side of the carrier and represent the modulating component. If an interfering carrier of almost the same carrier frequency is superimposed as shown in Figure 2, page 5, the result will be a heterodyne whose frequency will be equal to the difference frequency of the two carriers. Normally, if the amplitudes of the two carriers are approximately equal, the resulting heterodyne will be of sufficient amplitude to partially or completely mask the intelligence contained in both sidebands of the desired carrier because conventional communications receivers cannot discriminate between the two carriers and may demodulate sidebands A and B against the interfering carrier. This is illustrated in Figure 3, page 5, where a typical selectivity

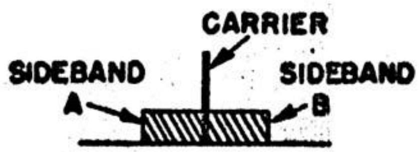


FIG. 1

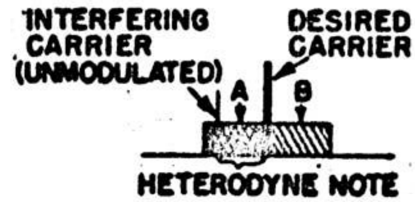


FIG. 2

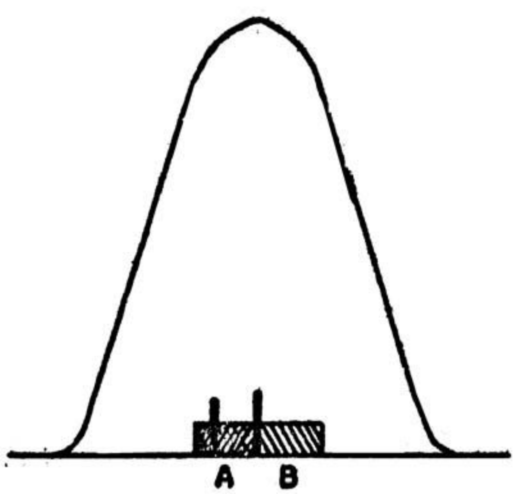


FIG. 3

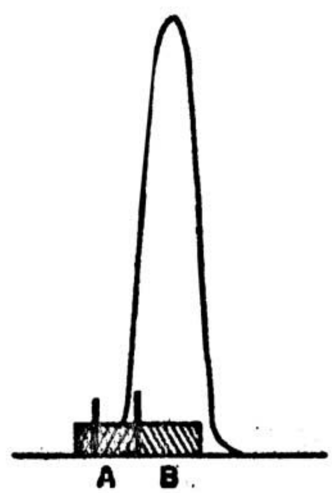


FIG. 4

curve has been imposed on the heterodyned signal of Figure 2, page 5. Observe that the curve is sufficiently broad to encompass both sidebands. Even if the receiver is tuned slightly off the carrier in an attempt to discriminate against the heterodyne, the flaring of the skirts of the curve indicate that an appreciable portion of the heterodyne will still be passed.

If the receiver possessed an extremely sharp, essentially straight sided response curve as shown in Figure 4, page 5, fairly good separation of the sidebands would be possible. Such selectivity, while desirable from the standpoint of communications, might seriously restrict the audio fidelity because the higher and lower audio frequencies would be clipped off along with the heterodyne. This is the reason signals lose intelligibility when the crystal filter is switched into the I. F. amplifiers of a communications receiver.

The YRS-1 Single Sideband Selector combines the advantages of the broad response curve for audio fidelity, and the sharp response curve for selectivity, without the disadvantages of either. This is accomplished by special detector circuits which split the received signal into two components, which when shifted in phase and added or subtracted, reject undesired interference in one sideband or the other. This makes possible the reception of signals which normally would be unreadable because of heterodyne interference.

The only additional controls introduced into the receiving system are four push buttons which permit selection of: (1) Sideband 1; (2) Sideband 2; (3) Locked Oscillator; (4) Normal.

When the YRS-1 is set to the "Locked Oscillator" position, an unmodulated I. F. voltage of considerable potential is injected into the detector circuits together with the I. F. voltage developed by the incoming signal. The result is to reduce distortion on signals which are received under selective fading conditions in which the normal ratio of carrier level to sideband level to sideband level is disturbed. Both sidebands are received in this operating position. In the "Normal" position, the YRS-1 phasing and oscillator circuits are disconnected and the receiver is restored to normal operation.

Once connected, the YSR-1 must be energized whenever the receiver is used, because regardless of the mode of operation, the detected signal passes through one stage of audio amplification in the YRS-1 before being fed into the receiver's audio system.

<u>INSTALLATION</u>

It is necessary to make minor wiring changes in most types of receiving equipment with which the Single Sideband Selector is to be used. These changes will not impair the normal operation or efficiency of the receiver but eliminates the necessity for the beat frequency oscillator for code reception when the YRS-1 is used in other than the "Normal" positions.

Although detailed installation instructions for various makes of commercial communications receivers are given below, the following general outline of required changes will acquaint the user with the operation of the YRS-1 and will serve as a guide for installations in receivers not detailed in the following pages.

As shown in block form in Figure 5, page 9, the Single Sideband Selector functions as a complete second detector and beat frequency oscillator and these circuits are, therefore, not used in the receiver when the YRS-1, is used in the Sideband and Locked Oscillator positions. Since the receiver's BFO is normally turned on and off from the front panel, it is not necessary to make changes in this circuit. I. F. voltage from the last I. F. stage in the receiver is fed into the YRS-1, where detection and phase shifting takes place, and the resultant audio voltage is then fed back into the input of the receiver's audio system. Although the receiver's second detector is not called upon to deliver audio voltage when the YRS-1 is used in the Sideband and Locked Oscillator positions, in some cases it does supply receiver AVC voltage and operate the "S" meter, and these functions are not disturbed when the YRS-1 is fed back into the audio stages

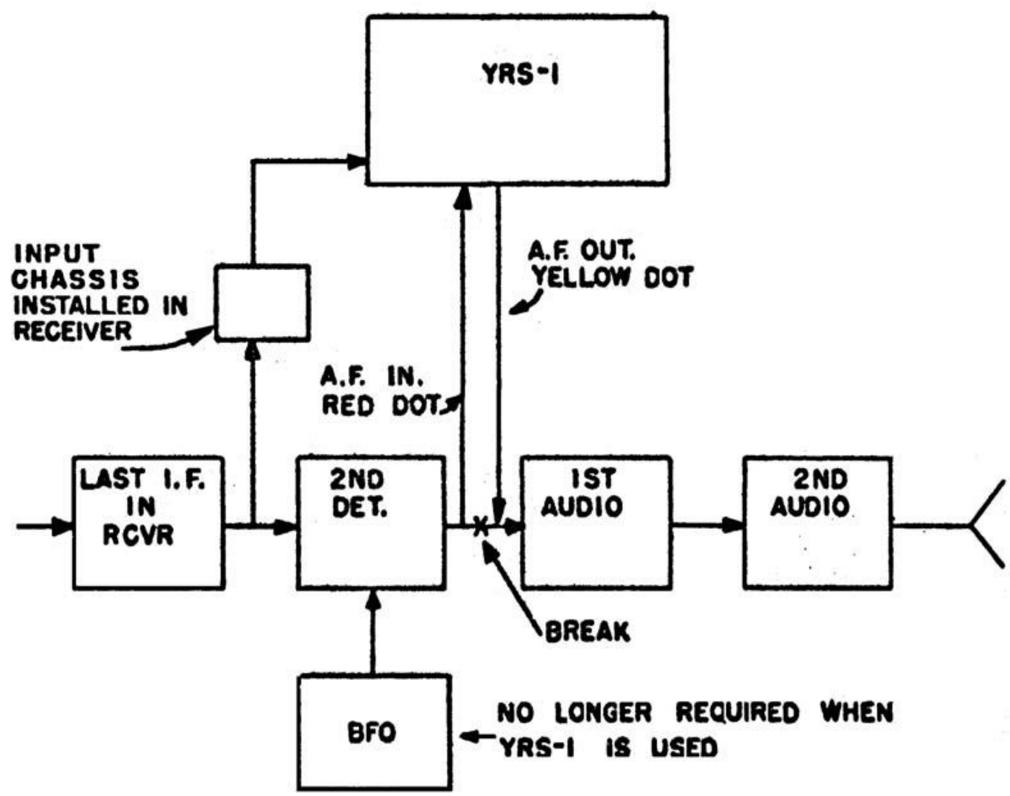

YRS-1
INPUT CHASSIS INSTALLED IN RECEIVER
A.F. OUT. YELLOW DOT
A.F. IN. RED DOT
LAST I.F. IN RCVR
2ND DET.
1ST AUDIO
2ND AUDIO
BREAK
BFO
NO LONGER REQUIRED WHEN YRS-1 IS USED

FIG. 5

in the receiver. The connection between the receiver's second detector and audio system must be broken, as shown in Figure 5, page 9; otherwise, audio output from the second detector will feed into the audio system at all times and render the YRS-1 useless.

To minimize circuit loading of the last I. F. stage in the receiver, a small chassis containing a high impedance input stage for the YRS-1 is installed in the receiver at a convenient location which results in minimum lead length to the I. F. voltage point. This input chassis employs a miniature tube and is quite small, so no great difficulty should be experienced in finding a suitable installation point. Regardless of the location of the input chassis in the receiver, the coaxial lead connection to the I. F. voltage point should be cut as short as possible to minimize capacitive loading of the I. F. transformer secondary.

I. F. voltage for the input stage can usually be picked off most conveniently from the diode plate of the second detector and in most cases this connection can be made from the top of the receiver chassis by means of a small lug attached to the proper pin of the second detector tube. The connection between the receiver's second detector and audio system can usually be broken most conveniently at the audio volume control. In each connection, the shielded outer braid on the cables should be grounded to the receiver chassis to prevent hum pickup. The length of these audio leads is not critical.

It should be pointed out that the efficiency of the YRS-1 in rejecting unwanted sidebands and in passing desired sidebands depends, to a great extent, upon correct alignment of the I. F. channel in the receiver. If the alignment of the I. F. channel is questionable, it is recommended that these stages be carefully realigned so that the full capabilities of the Single Sideband Selector will be realized. In any event, it is necessary to check the tuning of the secondary of the last I. F. transformer and compensate, if necessary, for any additional capacity introduced by the input stage. Some receivers such as the Hammarlund Sp400x employ fixed-tuned secondaries and in such cases no adjustment is possible or required. If a complete I. F. alignment is attempted, visual alignment employing an oscilloscope and a sweep frequency generator is preferred. If such instruments are not available, alignment can be carried out with the conventional amplitude modulated signal generator and output meter. Some types of receivers employ variable bandwidth I. F. channels which, in the "BROAD" or high fidelity position, yield a double-humped and sometimes unsymmetrical response curve. I. F. alignment should not be carried out at this bandwidth setting. Whenever possible, the manufacturer's service notes on the receiver should be adhered to in order to take advantage of the designer's experience with specific peculiarities of the design.

Satisfactory operation can be obtained with the YRS-1 only when the receiver to which it is attached is stable in its operating characteristics. The most troublesome source of instability in many receivers is the tunable oscillator which heterodynes the incoming signals to the intermediate frequency. Instability of this oscillator may fall into one or more of the following classifications:

1. Moderately slow drift in frequency, usually stabilizing within two hours of operation. This drift is caused by temperature readjustment as the receiver reaches a stable operating temperature.
2. Erratic jumps in frequency. This may be caused by line voltage changes, sudden release of stress due to thermal changes as the receiver warms up, poor sliding contacts on the oscillator tuning capacitor, or poor voltage regulation in the plate power supply. Poor voltage regulation may cause the frequency of the oscillator to change with the setting of the manual (RF) gain control or with AVC action.
3. Frequency modulation of the oscillator at power line frequency or harmonics.

It should be remembered that certain amounts of all three types of oscillator instability exist in the very best equipment, and that the YRS-1 will work satisfactoryily with all well engineered receivers. In some instances, however, one or more of the three oscillator defects listed above causes normal operation of the receiver to be difficult, operation with the YRS-1 will also be seriously impaired. The owner is quite probably already aware of their presence if any of the effects mentioned are serious.

Even though the receiver itself has excellent stability, satisfactory operation may not be obtained when receiving certain stations whose frequency control systems suffer from excessive instability of the types listed above.

Under any circumstances it is a good policy to correct the receiver defects if they are of sufficient magnitude to interfere with the operation of the YRS-1.

<u>Input Chassis Installation</u>

1. Select a location on the receiver chassis for the input chassis which will result in the shortest possible lead length to the specified pin of the receiver's second detector tube.

2. Remove the cover from the input chassis and use this as a template to mark two mounting holes on the receiver chassis.

3. Screw the cover to the receiver chassis and reassemble the input chassis.

4. Cut the coaxial cable to the shortest length which will just reach the correct pin on the second detector tube. <u>There should be very little slack in this lead.</u>

5. Strip back the outer insulation jacket and braided shield of the coaxial cable and solder the inner conductor

of the cable to the small lug supplied.

6. Solder the lug to the specified pin of the second detector tube. Be sure the outer braided shield does not short against any of the tube pins. (A spring-grip lug may be used if preferred to the soldered type.)

<u>Installation in Hammarlund SP400X (BC779B, BC794B, BC1004C)</u>

Refer to Figure 6, page 15.

1. Select location for input chassis and follow installation procedure described in preceding section.

2. Connect the inner conductor of the coaxial lead from the input chassis to pin 3 or 5 of the 6H6 second detector tube (point B).

3. Disconnect the lead running from the junction of the diode load resistors (75,000 ohms ½w. and 50,000 ohms ½w.) to the volume control.

4. Connect shielded lead color coded with red dot to the junction of the two diode load resistors described in Step 3. (point A)

5. Connect shielded lead color coded with yellow dot to the "top" of the audio volume control. (Point C)

6. Strip back and unravel the outer braided shield of the two cables. Twist the loose, unraveled stands together tightly and solder to the nearest ground lug on the receiver chassis.

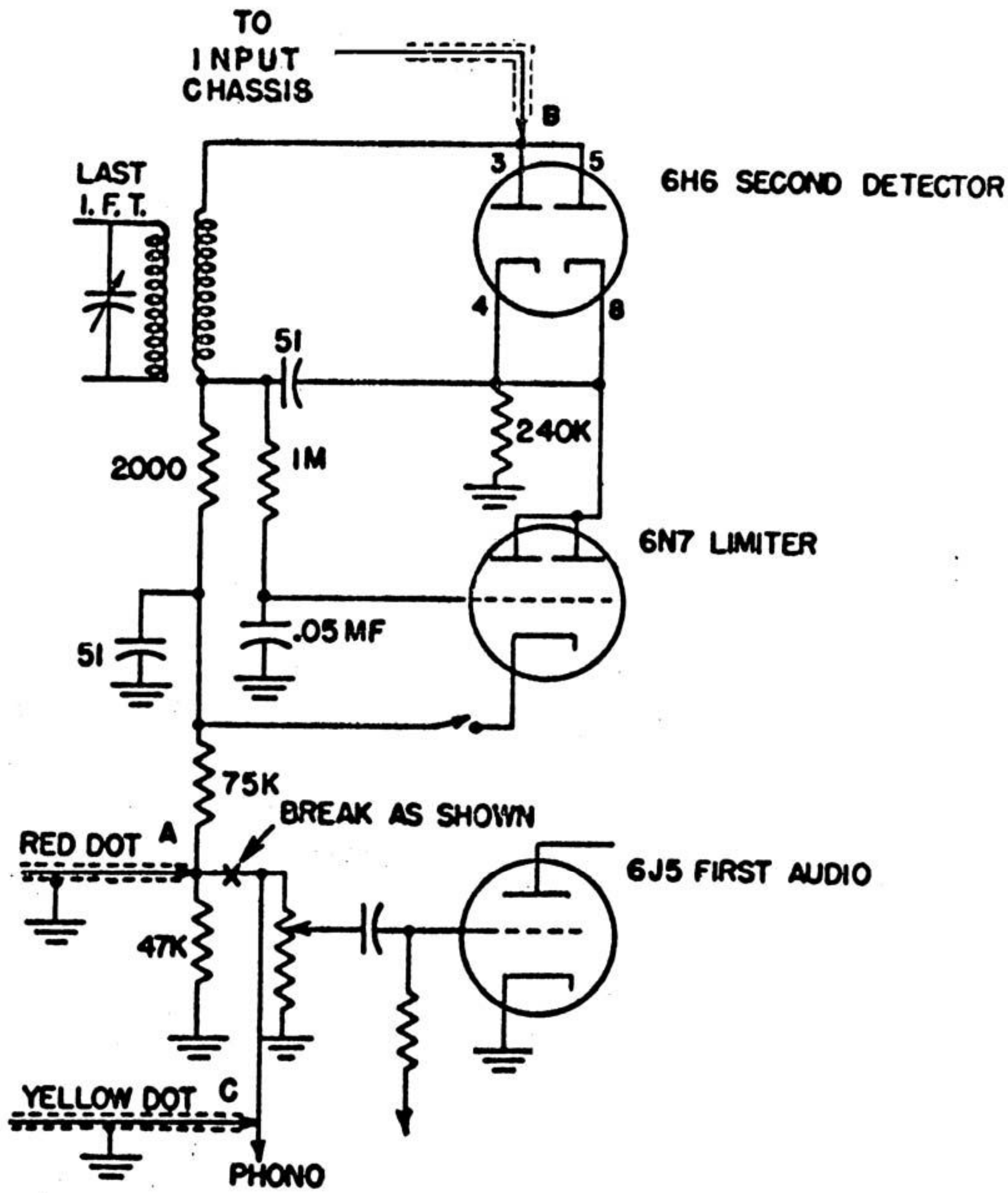

TO
INPUT
CHASSIS
B
3
5
6H6 SECOND DETECTOR
LAST
I. F. T.
4
8
51
240K
2000
IM
6N7 LIMITER
51
.05 MF
75K
BREAK AS SHOWN
RED DOT
A
6J5 FIRST AUDIO
47K
YELLOW DOT
C
PHONO

FIG. 6

Installation in Hallicrafter's SX28A

Refer to Figure 7, page 17.

1. Select location for input chassis and follow installation procedure described in preceding section.

2. Connect the inner conductor of the coaxial lead from the input chassis to pin 4 or 5 of the 6B8 second detector and "S" meter amplifier tube. (Point B)

3. Disconnect the .02 mfd. coupling capacitor at the "phono" jack.

4. Connect shielded lead color coded with red dot to the .02 mfd. capacitor lead which connects to the termination of the two 470 k and one 100 k resistors. (Point A)

5. Connect shielded lead color coded with yellow dot to empty lug at point C on "phono" jack.

6. Strip back and unravel the outer braided shield on the two cables. Twist the loose, unraveled ends together tightly and solder to the nearest ground lug on the receiver chassis.

Installation in RME 45

Refer to Figure 8, page 18.

1. Select location for input chassis and follow installation procedure described in preceding section.

2. Connect the inner conductor of the coaxial lead from the input chassis to pin 5 or 6 of the 7B6 second detector and BFO tube. (Point B)

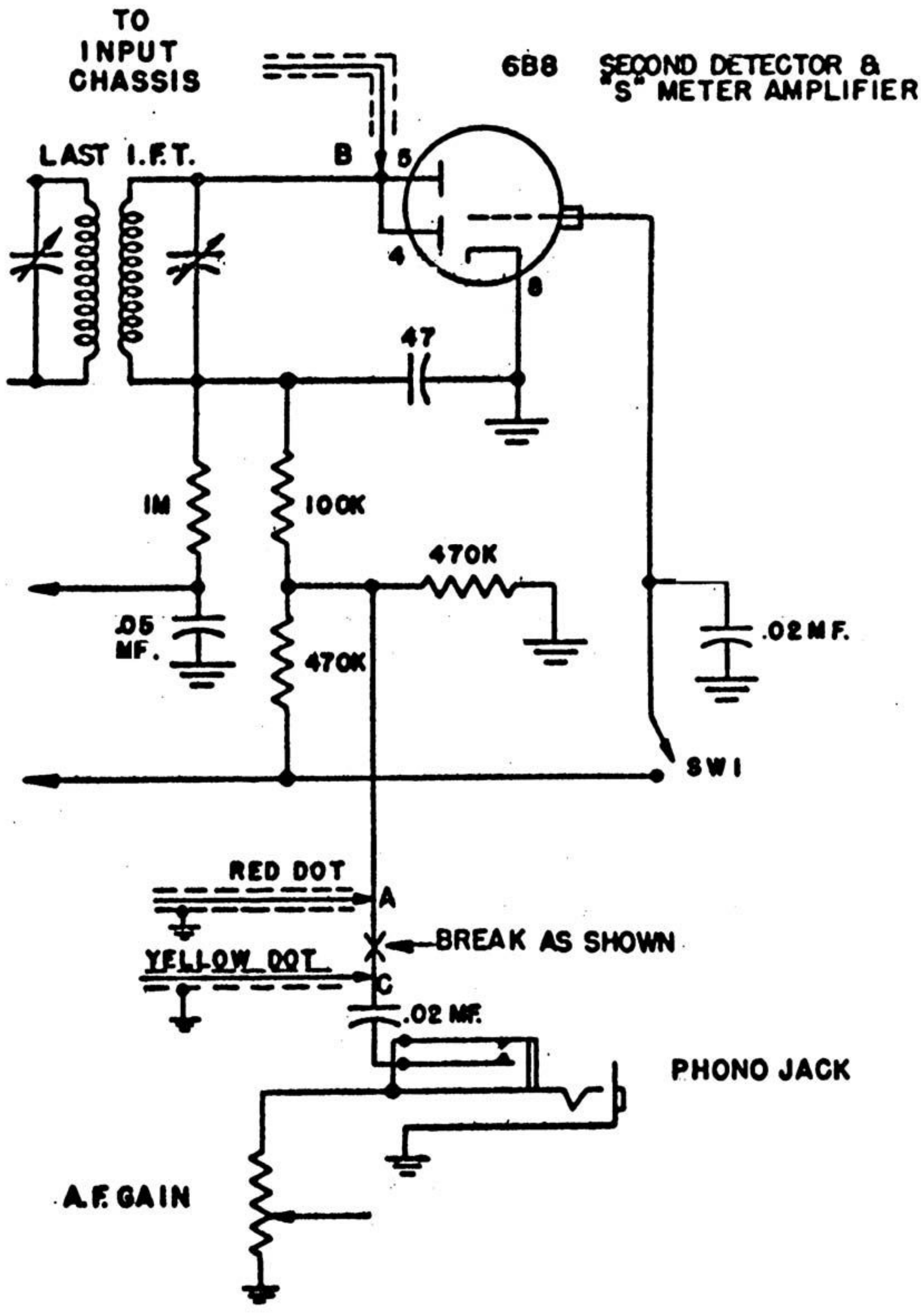
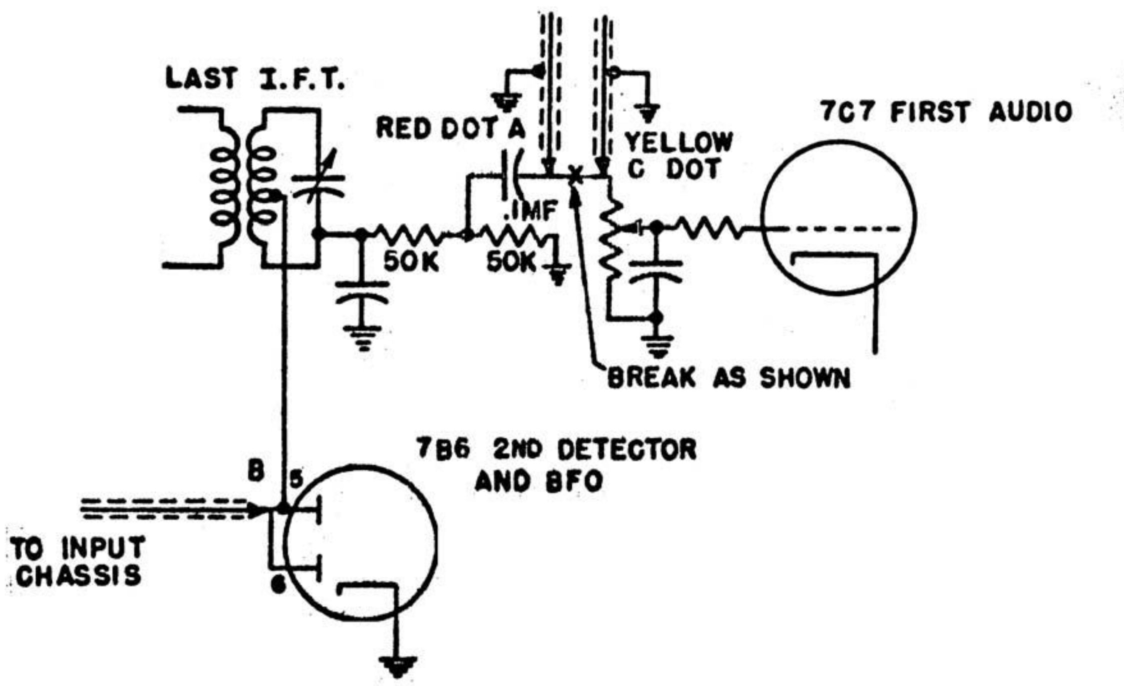

TO
INPUT
CHASSIS
6B8 SECOND DETECTOR &
"S" METER AMPLIFIER
LAST I.F.T.
B
5
4
8
47
1M
100K
470K
.05
MF.
470K
.02 MF.
SW1
RED DOT
A
BREAK AS SHOWN
YELLOW DOT
C
.02 MF.
PHONO JACK
A.F. GAIN

FIG 7.



LAST I.F.T.
RED DOT A
.1MF
50K
50K
YELLOW
C DOT
7C7 FIRST AUDIO
BREAK AS SHOWN
7B6 2ND DETECTOR
AND BFO
B
5
6
TO INPUT
CHASSIS

FIG. 8

3. Disconnect the lead running from the .1 mfd. audio coupling capacitor to the audio volume control.

4. Connect shielded lead color coded with red dot to the loose end of the .1 mfd. coupling capacitor. (Point A)

5. Connect shielded lead color coded with yellow dot to the "top" lug of the audio volume control. (Point C)

6. Strip back and unravel the outer braided shield on the two cables. Twist the loose unraveled strands together tightly and solder to the nearest ground lug on the receiver chassis.

<u>Installation in Hammarlund HQ 129X</u>

Refer to Figure 9, page 20.

1. Select location for input chassis and follow installation procedure described in preceding section.

2. Connect the inner conductor of the coaxial lead from the input chassis to pin 3 of the 6H6 second detector and noise limiter tube. (Point B)

3. Disconnect the .02 mfd. audio coupling capacitor from the audio volume control.

4. Connect shielded lead color coded with red dot to loose end of .02 mfd. audio coupling capacitor. (Point A)

5. Connect shielded lead color coded with yellow dot to "top" of volume control. (Point C)

6. Strip back and unravel the outer braid shield on the two cables. Twist the loose, unraveled strands together

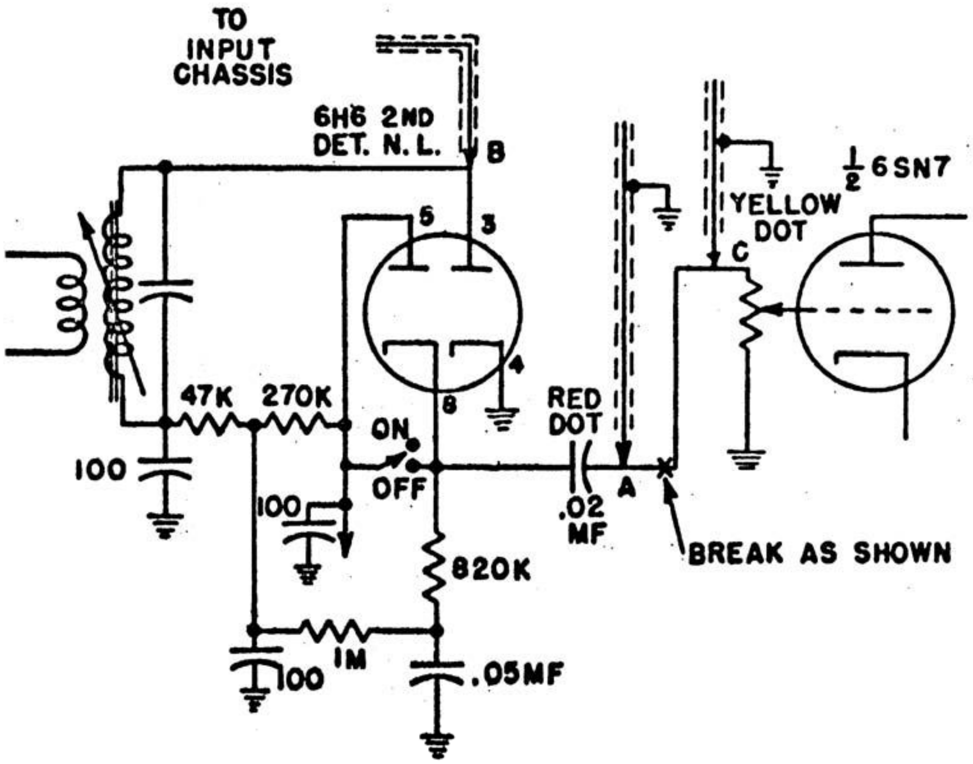

TO
INPUT
CHASSIS
6H6 2ND
DET. N. L.
B
5
3
4
8
1/2 6SN7
YELLOW
DOT
C
47K
270K
ON
OFF
100
100
RED
DOT
.02
MF
A
BREAK AS SHOWN
820K
1M
100
.05MF

FIG. 9

tightly and solder to the nearest ground lug on the receiver chassis.

OPERATING ADJUSTMENTS

CAUTION: THIS EQUIPMENT WILL OPERATE ON 105 TO 125 VOLTS, 50/60 CYCLE AC ONLY. DO NOT ATTEMPT TO OPERATE ON DC.

THE FOLLOWING ADJUSTMENTS MUST BE MADE BEFORE THE YRS-1 WILL OPERATE PROPERLY. RECEIVER I. F. ALIGNMENT MUST BE CORRECT.

General

For best results, adjustments should be made with a signal generator capable of unmodulated and modulated output. If a signal generator is not available, a stable signal such as a local broadcast station whose carrier level remains constant can be used. In all cases, R. F. input to the receiver should be kept as low as possible consistent with accurate indications.

CAUTION: ADJUST ONLY THE CONTROLS SPECIFIED IN THE STEPS BELOW. THE REMAINING CONTROLS HAVE BEEN ADJUSTED AT THE FACTORY AND WILL NOT REQUIRE RESETTING UNDER NORMAL CONDITIONS.

Keep the receiver input circuit and signal generator leads well separated from the YRS-1 chassis so that oscillator voltage from the YRS-1 will no be fed into the front end of the receiver. Normally the R. F. sensitivity of the receiver is sufficient to reject a low level signal of I. F. Frequency which may appear at the antenna terminals. The I. F. voltage developed by the YRS-1 is of the order of 40 to 80 volts. Although good shielding is provided, care must be taken to prevent even a

small amount of this voltage from being introduced into the I. F. channel of the receiver through the front end, while adjustments are being made. Under no condition should the receiver be removed from its cabinet or left in an unshielded condition while adjustments are being made on the YRS-1.

1. Apply power to the receiver and the YRS-1. Depress the "Normal" button on the YRS-1 and permit the equipment to warm up for ten or fifteen minutes until normal operating stability is reached.

2. Adjust R64 (located on rear apron of chassis) to full clockwise position.

3. Turn receiver BFO off and AVC on. Set the signal generator to produce an unmodulated signal and tune it in on the receiver. The exact frequency used is unimportant provided it is free from interference.

4. If a trimmer adjustment is available on the secondary of the last I. F. transformer, adjust it for maximum "S" meter reading.

5. Switch the receiver to the "medium crystal" position and carefully tune the signal for maximum indication on the "S" meter. Adjust the RF gain control on the receiver to insure that the receiver and the YRS-1 are not overloaded.

6. Depress the "Locked Oscillator" button on the YRS-1. Adjust L1, the slotted head bolt on the YRS-1 chassis until a beat note is heard. Progressively reduce the RF gain and

increase the AF gain and adjust L1 for exact zero beat. It is important that the RF gain control on the receiver be kept as low as possible to avoid "Lock-in" and consequent tuning error. IMPORTANT: SEE FOOTNOTE IF RECEIVER I. F. IS OTHER THAN 455 KCS.

7. Adjust L2, the slotted head bolt on the YRS-1 chassis for maximum output. This adjustment is not critical and it will be found that tuning is quite broad.

8. Detune the signal generator until a beat note of approximately 1100 cycles is obtained. Depress either Side-band button and keep depressed the one which results in lower output.

FOOTNOTE:

If the frequency of the receiver's I. F. channel is not 455 kcs., it will be necessary to tune both the primary and secondary of T1 to approximately the correct frequency before adjustments on R38 and R39 are made. The primary of T1 is reached from the bottom of the chassis and the YRS-1 must be removed from its cabinet to permit access to the iron core tuning adjustment.

Following step 6, connect an a-c vacuum tube voltmeter between pin 5 of V-4 and ground. Adjust the iron tuning adjustment in the bottom and top of T1 for maximum reading on the VTVM. Then proceed to step 7.

9. In this step, adjust R38 if Sideband 1 button is depressed and R39 if Sideband button 2 is depressed. R38 and R39 are the "balancing controls". Using a broad-bladed trimming tool or screwdriver, adjust the for iron tuning disc at the top of T1 and simultaneously rock the appropriate balancing control for minimum output. If considerable tuning of T1 is required, the beat note may change slightly and this should be ignored for the moment. Advance the audio gain control on the receiver if necessary, to obtain good indications.

10. Retune the signal generator to give the same frequency beat note on the other side of zero beat and depress the other sideband button. Adjust only the appropriate balancing control (R38 or R39, depending upon which Sideband button is depressed) for minimum output.

11. Retune the signal generator to its original frequency and adjust L1 for zero beat as described in Step 6. Repeat Steps 8, 9, and 10 but this time use an audio signal generator, if available, to check the 1100 cycle beat note. (If a piano is available, the note 2 octaves above middle C is approximately 1100 cps. Use this to determine beat note frequency.) These steps should be carried out carefully if best results are to be obtained.

When L1, T1, R38, and R39 have been properly adjusted, it should be possible to obtain approximately the same attenuation

of either side band by tuning the receiver (or signal generator) to either side of zero beat and depressing the appropriate side-band button on the YRS-1. This attenuation should run from 20 to 40 dB.

12. Tune in a broadcast station and depress the "Locked Oscillator" button. Tune the signal to zero beat. Advance RF gain control until locking action is definite. Do not over-load receiver or YRS-1.

13. Depress the "Normal" button, observe the output level and the depress the "Locked Oscillator" button. If there is a difference in output level between the two positions, adjust R64 (located on rear apron of chassis) with the "Normal" button depressed until the output level is the same in either position.

Bias Adjustment

Incorrect bias voltage on the reactance tube will cause a beat note which will rapidly drop in frequency and finally fall to zero beat as operation is changed from "Normal" to any other position. This shifting beat note should not be confused with the steady beat note which occurs when a steady carrier is slightly detuned with the YRS-1 in any position other than "Normal". If the bias voltage is correct, switching back and forth between "Normal" and any other position will not result in a shifting beat note, provided the signal has been tuned in correctly in the "Locked Oscillator" position.

The Following procedure should be used to adjust the bias

voltage to the proper potential.

Set the YRS-1 to "Locked Oscillator" and tune in a steady, unmodulated carrier from a signal generator or VFO. Tune the receiver to produce a beat note, and progressively increase the audio gain while decreasing the RF gain. Reduce the RF gain as low as possible consistent with an audible signal and then tune the signal to zero beat. While switching back and forth between "Normal" and "Locked Oscillator", adjust potentiometer R45 (located on rear apron of chassis) in small steps until the shift of the beat note is minimum.

OPERATION

Important: Maintain the RF gain control on the receiver as low as possible consistent with the readability of the received signal to prevent overloading the receiver and the YRS-1. The lower the signal input to the YRS-1, the better the sideband rejection.

Amplitude Modulated Reception

When the YRS-1 is used in any position other than "Normal", a beat note will generally be heard as a signal is tuned in on the receiver. This beat is produced by the incoming carrier beating against the local oscillator of the YRS-1. For reception of amplitude modulated signals, the receiver should be tuned to zero-beat with the desired carrier. In general, the mode of operation (i.e. Sideband 1, Sideband 2, Locked Oscillator, or Normal) best suited to tuning a band of frequencies will depend to a great extent upon the degree of interference encountered over that portion of the spectrum which must be covered.

When heterodyne interference is encountered on both sides of the desired carrier, the receiver's normal crystal filter phasing adjustment can be used to minimize the disturbance on a strong heterodyne within the single sideband accepted for reception. This generally reduces the audio fidelity, just as in normal receiver use.

Since the receiver's second detector circuits are by-passed when the YRS-1 is operated in either Sideband or "Locked Oscillator" positions, the usual type of series noise limiter circuit incorporated in the receiver's second detector circuit is no longer operative. This is a condition which must be accepted when the YRS-1 is used in any position other than "Normal". In the "Normal" position, the receiver circuits are used and the series noise limiter functions in the normal manner. Receivers equipped with I. F. noise silencing circuits are not subject to this limitation and the effect of the noise limiter circuits is unchanged, regardless of the mode of operation used on the YRS-1.

Reception of Single Sideband Transmissions

Reception of single sideband, suppressed carrier signals is, of course, perfectly feasible with the YRS-1. If the carrier is totally suppressed, the local oscillator in the YRS-1 will have no incoming voltage on which to lock but will operate to provide single sideband reception. With transmitter carrier attenuation of, say 20 dB, however, sufficient carrier voltage will be fed into the YRS-1 to enable the local oscillator to lock-in automatically at the correct frequency.

When receiving a single sideband transmission, the operator should make certain that the YRS-1 is set to receive the sideband being transmitted. The AVC control on the receiver should be off for this type of operation.

<u>CW Reception</u>

For CW reception, the receiver's BFO should be turned off when the YRS-1 is used in the Sideband or Locked Oscillator positions. The necessary beat note is produced by the incoming signal beating with the local oscillator in the YRS-1. When the YRS-1 is switched to "Normal", however, the local oscillator is de-energized and the receiver BFO must be turned on to provide normal CW reception. With the YRS-1 set to "Locked Oscillator", the beat notes on each side of zero beat will be of equal strength, provided the receiver's I. F. pass band is symmetrical, and it will be found that there is no operational difference between CW reception in this position, and CW reception with the receiver's BFO on and the YRS-1 in the "Normal" position.

The mode of operation of the YRS-1 for general CW tuning depends again upon interference conditions in the spectrum to be covered and also upon the operator's personal preferences. It has generally been found satisfactory to tune for signals with the YSR-1 in the "Locked Oscillator" position and then, when the signal has been located, to switch to the appropriate sideband. If interference develops, retune the receiver to the other side of zero beat and depress the other sideband button. The advantage of the YRS-1 over the crystal filter is that an entire sideband spectrum of interference is removed, rather than a small "notch", and furthermore, removal of such interference is automatic because critical phasing controls are not involved. "Chirpy: CW signals can be copied on the YRS-1 whereas the crystal filter makes this difficult and sometimes impossible.

CW reception should not be attempted with the receiver set to the sharp crystal position and the YRS-1 set to one sideband. Since the receiver must be detuned to produce an audio beat note, the incoming signal will likewise be detuned off the peak of the crystal filter response curve and hence the signal will be greatly attenuated.

Determination of Sidebands

By definition, the lower sideband is always on the low frequency side of the transmitted carrier and the upper sideband is always on the high frequency side of the transmitted carrier. Since it is often desirable to be able to determine on which side of the carrier frequency interference exists, simple tests can be made to ascertain whether "Sideband 1" corresponds to the upper of lower frequency sideband of the received signal. These tests should be made on each receiver band on which operation is contemplated because the sideband positions in the I. F. channel depend on whether the local oscillator in the receiver operates on the low or high side of the incoming signal frequency.

An unmodulated signal from a signal generator or VFO can be used for these tests. Set the YRS-1 to "Sideband 1". Starting at a frequency lower than the receiver frequency, slowly tune the signal source through the receiver frequency. Two beat notes, one much stronger than the other, will be heard. If the first beat note is stronger, "Sideband 1" corresponds to the low frequency sideband and "Sideband 2" corresponds to the high frequency sideband. If the second beat note is stronger, this relationship will be reversed, "Sideband 1" then corresponding to the upper sideband. This information can be recorded for each band for future operating convenience.

THEORY OF OPERATION

If a carrier frequency, F, is amplitude modulated by a single audio frequency, M, an upper and a lower sideband will be produced. These two sideband frequencies are (F+M) for the upper sideband, and (F-M) for the lower sideband. The conventional AM receiver, of course, incorporates a detector which, when delivered such a signal, demodulates it to restore the original intelligence frequency M. In so doing, both sidebands are utilized and necessary. The YRS-1 likewise incorporates a detector, but in this case of novel design, which when used in conjunction with phase shift networks, results in a system capable of reproducing separately, the intelligence in the upper sideband and the intelligence in the lower sideband.

Figure 10, page 32, shows in block form the circuit arrangement of the YRS-1 upon which the following explanation is based. Two detectors are shown. Each is supplied with the amplitude modulated I. F. output of the receiver, and each receives a strong signal from the locked oscillator shown as source 2. However, the phase of the locked oscillator voltage fed to detector 2 differs by 90 degrees from that fed to detector 1. Because of this, the demodulated outputs from these detectors differ in phase by 90 degrees. Assume now that network A introduces a phase shift of X degrees and that the phase shift in network B is smaller by 90 degrees. Thus, considering the (F-M) sideband only, and assuming the amplitude to be 1 volt, the output from the two networks can be tabulated as follows:

NETWORK A

Amplitude	Freq.	Input Phase	Output Phase
1 unit	M cps	0°	$0^\circ + X^\circ$

NETWORK B

Amplitude	Freq.	Input Phase	Output Phase
1 unit	M cps	0°	$90^\circ + (X^\circ - 90^\circ) = 0^\circ + X^\circ$

When the outputs of networks A and B are added or subtracted, the mixed signals combine as follows:

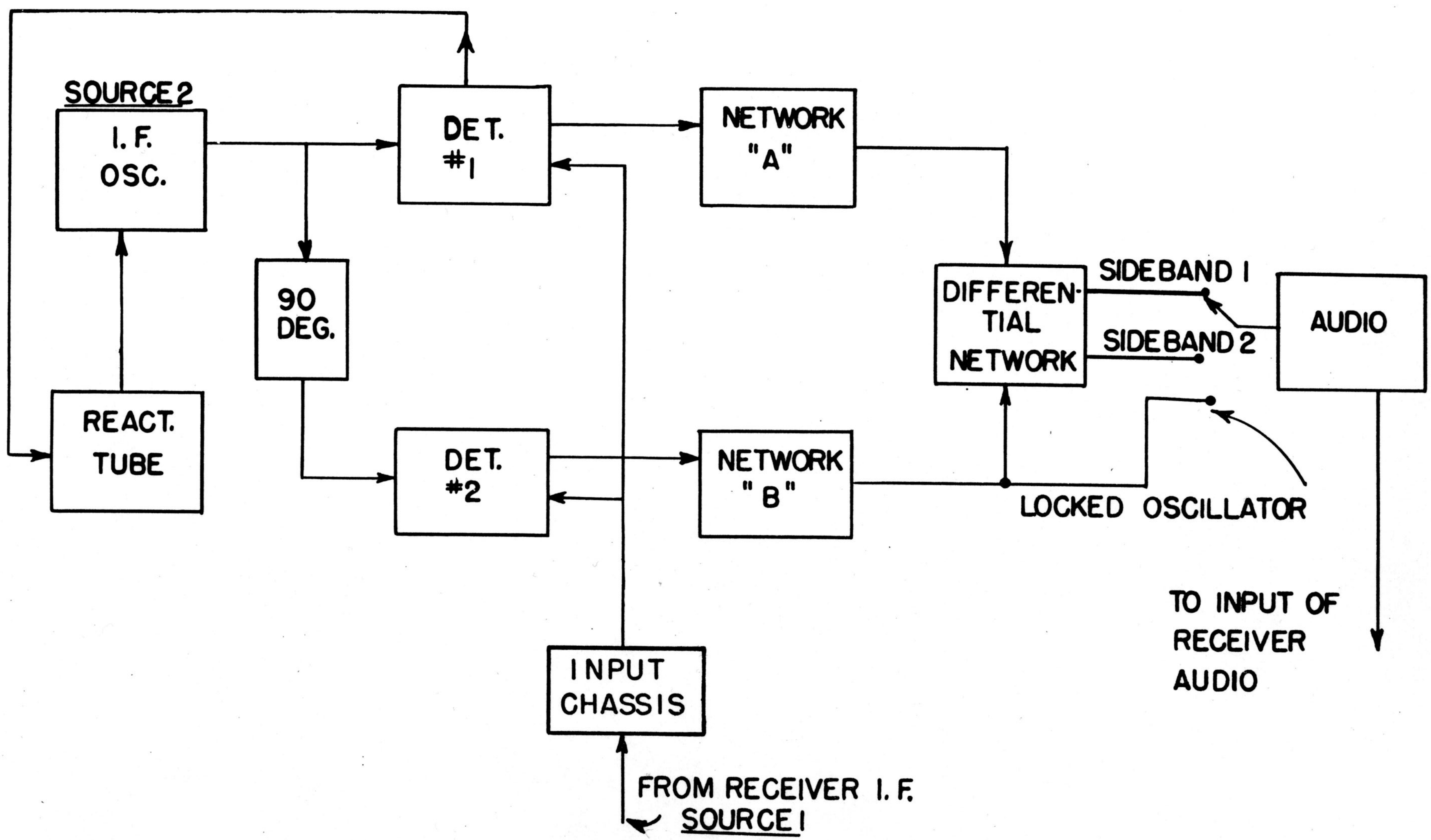

SOURCE 2
I. F.
OSC.
DET.
#1
NETWORK
"A"
90
DEG.
REACT.
TUBE
DET.
#2
NETWORK
"B"
DIFFEREN-
TIAL
NETWORK
SIDEBAND 1
SIDEBAND 2
AUDIO
LOCKED OSCILLATOR
TO INPUT OF
RECEIVER
AUDIO
INPUT
CHASSIS
FROM RECEIVER I. F.
SOURCE 1

FIG. 10

	FREQUENCY	OUTPUT PHASE	AMPLITUDE
NETWORK A	M cps	$0^\circ + X^\circ$	1 unit
NETWORK B	M cps	$0^\circ + X^\circ$	1 unit
SUM	M cps	X°	2 units
DIFFERENCE	M cps	---	0 units

Thus, the audio output for a radio frequency signal (F-M) will be M cycles per second with a phase delay of X degrees and a strength of 2 units when the sum is taken, and will be zero amplitude when the difference is taken. (Figure 11, A, B, Page 34)

The same treatment, with minor variations, can be applied when only the upper sideband (F+M) is present. Whereas in the previous case, for the lower sideband, the demodulated output from detector 2 led that from detector 1 by 90 degrees, in this case it lags by 90 degrees. Hence, the following summation applies to the output for the two networks:

NETWORK A

Amplitude	Freq.	Input Phase	Output Phase
1 unit	M cps	0°	$0^\circ + X^\circ$

NETWORK B

Amplitude	Freq.	Input Phase	Output Phase
1 unit	M cps	-90°	$-90^\circ + (X^\circ - 90^\circ) =$ *$X^\circ - 180^\circ$

*- Which is equal to a negative signal of phase X°.

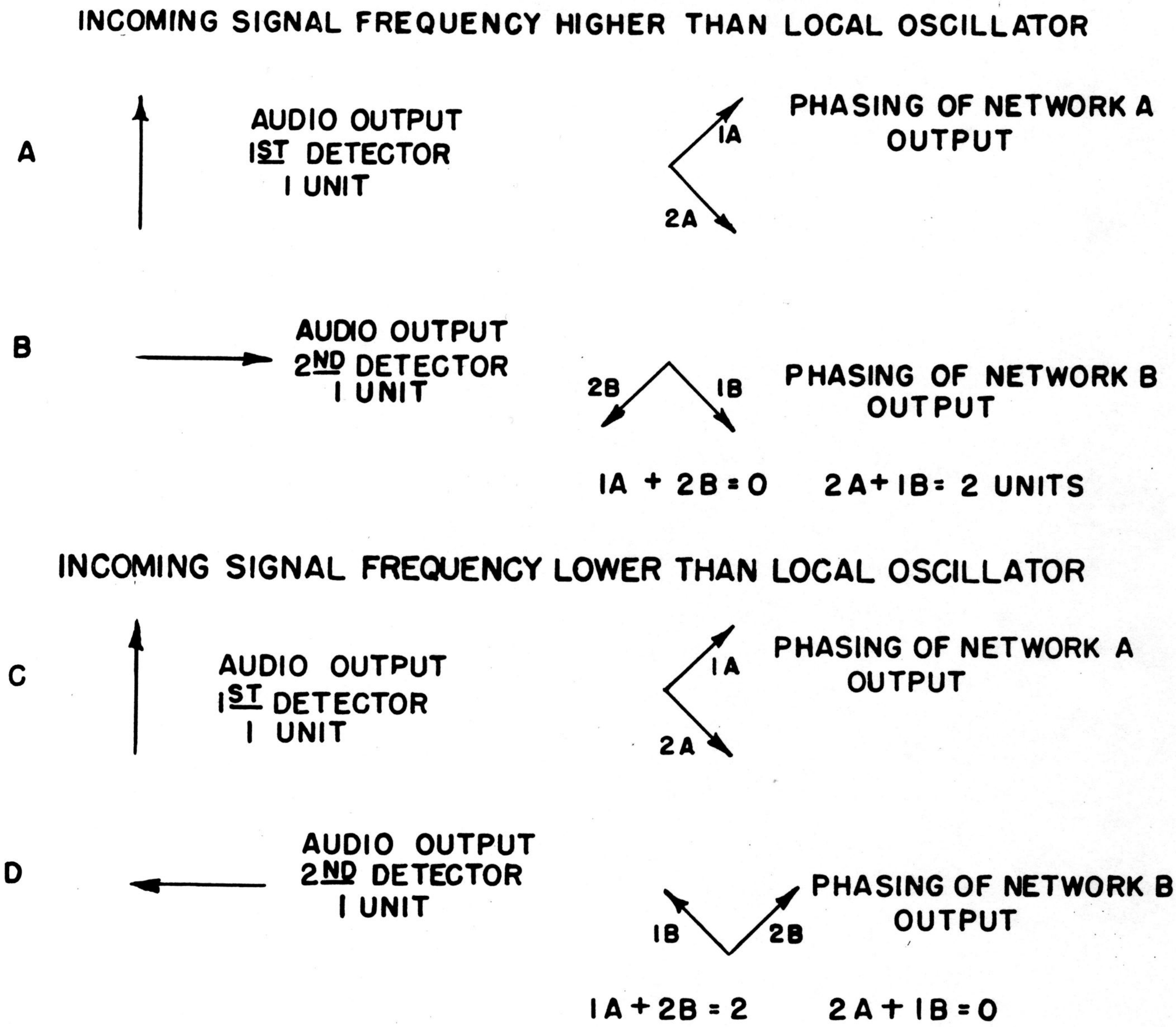


FIG.-11- VECTOR DIAGRAMS OF DETECTOR OUTPUTS

When the outputs of networks A and B are added or subtracted, the mixed signals combine as follows:

	FREQUENCY	OUTPUT PHASE	AMPLITUDE
NETWORK A	M cps	$0^\circ + X^\circ$	1 unit
NETWORK B	M cps	X°	- 1 unit
SUM	M cps	---	0 units
DIFFERENCE	M cps	X°	2 units

This time, the audio output for a radio frequency signal (F+M) will be <u>zero</u> when the sum is taken, and will be M cycles per second with a phase delay of X degrees and a strength of 2 units when the <u>difference</u> is taken. (Figure 11C,D, page 34)

When both sidebands (F-M) and (F+M) are impressed simultaneously, such as in conventional AM reception, the net result will be a superposition of the above two cases. Thus, 2 units of lower sideband information and zero of upper will be delivered in the lower sideband position, while 2 units of upper sideband information and none of lower will be delivered in the upper sideband position.

It is possible to pick off an audio voltage produced by both sidebands by connecting to the output of network B ahead of the differential network. The only difference between this type of reception and that afforded by a conventional receiver is that the incoming carrier is built up or "exalted" by the local oscillator in the YRS-1. "Exalted" reception ("Locked

Oscillator" reception as it is termed in the case of the YRS-1) reduces distortion effects which are brought about by selective fading conditions on high frequencies or by severe heterodyne interference. Under such conditions, only a small segment of the frequency spectrum occupied by the transmitted signal fades, leaving the remaining portion of the spectrum at the original level. Figures 12-A, page 37, shows the normal relationship between carrier and sideband amplitude. If, under selective fading conditions, only the segment of the frequency spectrum occupied by the carrier faded, the resulting signal would look something like Figure 12-B, page 37, and as far as the receiver detector is concerned, overmodulation with accompanying distortion has taken place. If the carrier is "exalted" by inserting an unmodulated signal of the same frequency and phase into the detectors, the signal appearing at the detector would then appear as in Figure 12-C, page 37, wherein the effective percentage of modulation is greatly reduced. Fading of the exalted carrier as shown in Figure 12-D, page 37, will then only slightly increase the effective depth of modulation, since, in most cases, the amplitude of the local occillator is ten to thirty times as great as the amplitude of the received carrier.

OUTLINE OF COMPONENT FUNCTIONS

V9 - High Impedance input stage. Picks up I. F. voltage from receiver and delivers it at low impedance to

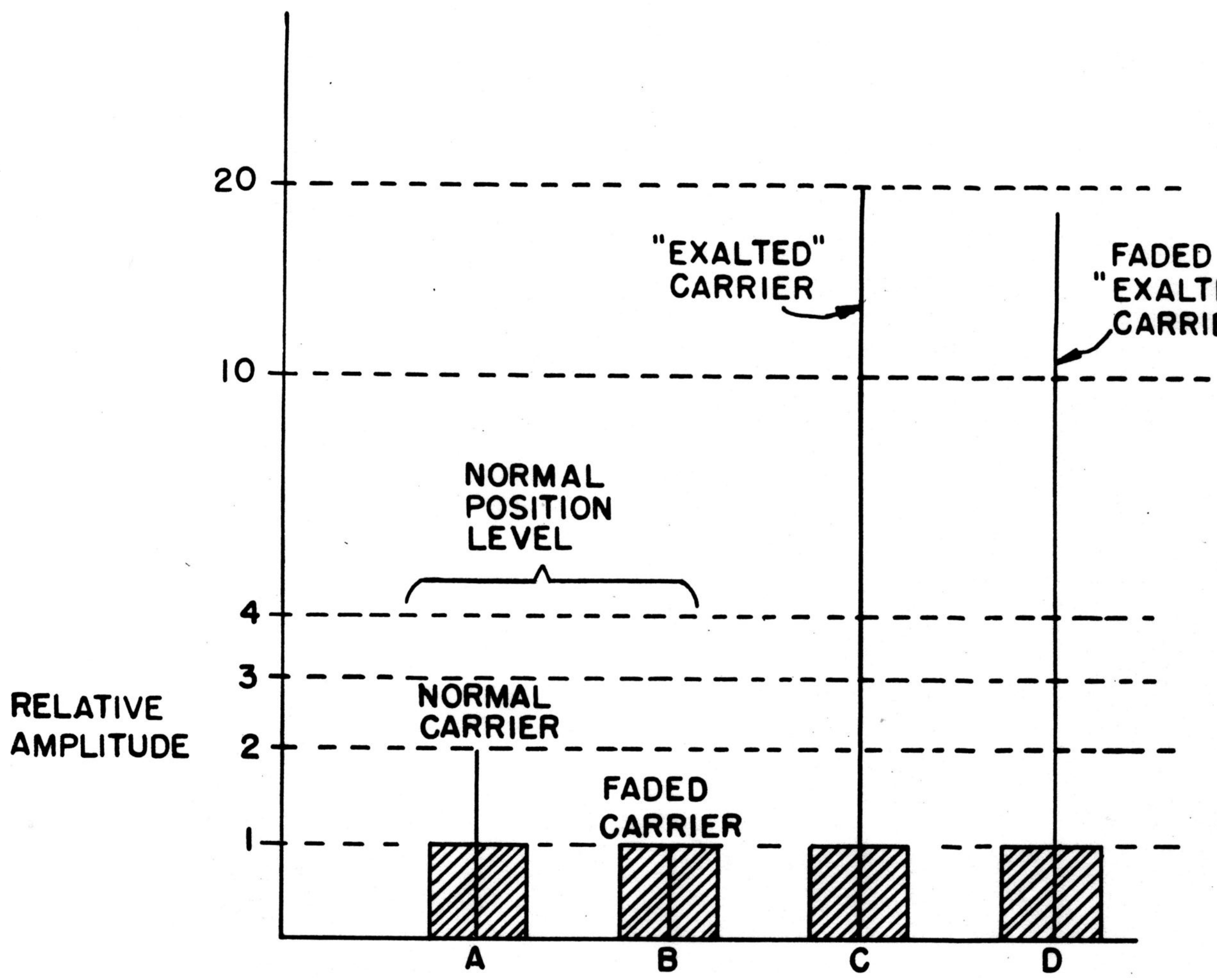

20
10
4
3
2
1
RELATIVE AMPLITUDE
"EXALTED" CARRIER
FADED "EXALTED" CARRIER
NORMAL POSITION LEVEL
NORMAL CARRIER
FADED CARRIER
A
B
C
D

FIG. 12

detectors V3 and V4.

V2 - Electron coupled oscillator. Adjusted to receiver I. F. by means of inductive tuning slug in L1.

V1 - Reactance tube. Controls frequency of oscillator V2 within certain limits.

V3, V4 - Detectors. Recover sideband intelligence with phase relationships described in theory of operation. In addition, V3 provides a d-c control voltage dependent upon the frequency difference between oscillator V2 and signal delivered by receiver.

Reactance tube V1, oscillator V2 and detector V3 are all part of a feedback loop. Should a frequency difference exist between oscillator V2 and the signal delivered by receiver, the d-c output of detector V3 will change. This voltage change, applied to reactance tube V1, shifts the frequency of oscillator V2 to bring it into synchronism with the signal delivered by the receiver.

T1 - Double tuned transformer adjusted to receiver I. F. When properly tuned, T1 introduces 90 degree phase difference between the signals applied to detectors V3 and V4.

V5, V6 - V7, V8 Wide band phase shift networks. The phase difference between the two networks remains approximately 90 degrees over an audio frequency range of roughly

70 to 7000 cycles, provided the R-C circuits are set to the designated frequencies.

R38,R29 - Differential network controls. These controls are adjusted initially to properly add and subtract the voltages delivered by networks A and B. The sum and difference voltages are then selected by push-button switch S2.

V13 - Resistance coupled audio frequency amplifier. This circuit amplifies the signal selected by push-button switch S2, which can be Sideband 1, Sideband 2, Locked Oscillator, or Normal.

V10,V11 - V12,V14 Rectifier and control tubes for voltage regulated power supply.

MAINTENANCE

Vacuum Tube Replacement

The most probable cause of improper operation is defective vacuum tubes, and these should be checked before any other adjustments are made.

Hum modulation of the oscillator signal can be caused by excessive heater-cathode leakage in oscillator tube V2 or reactance tube V1. Replacement of V1 or V2 may require adjustment of L1 and R45. These adjustments are described in the Adjustment section.

Alignment of A and B Networks

Under normal operating conditions, the R-C circuits in networks A and B will remain in adjustment over long periods of time and will not be affected by tube replacements. These networks are adjusted by trimmer capacitors which are accessible at the side apron of the chassis when the unit is withdrawn from the case. The figures specified on each trimmer correspond to the audio frequencies to which the respective circuits are tuned.

ADJUSTMENT OF THESE TRIMMERS SHOULD NOT BE ATTEMPTED UNLESS IT HAS POSITIVELY BEEN ASCERTAINED THAT MISALIGNMENT OF THE RC CIRCUITS IS RESPONSIBLE FOR IMPROPER OPERATION. CHECK THE ADJUSTMENT OF EACH R-C CIRCUIT BEFORE ATTEMPTING ALIGNMENT.

An oscilloscope and an accurate audio oscillator with a frequency range of 25 to 13000 cycles are required for checking or alignment of the R-C circuits. These circuits are adjusted individually by feeding the correct audio frequency voltage into the grid of the tube preceding the circuit and connecting the vertical amplifier of the oscilloscope to the cathode of the tube following the tuned circuit. Voltage from the audio oscillator is also applied to the horizontal amplifier of the oscilloscope*. These connections are shown in Figure 13, page 41. Under theses conditions, an almost perfect circle can be obtained on the screen of the oscilloscope when the R-C circuit is properly

* The phase characteristics of the oscilloscope must be checked and adjusted before it is used.

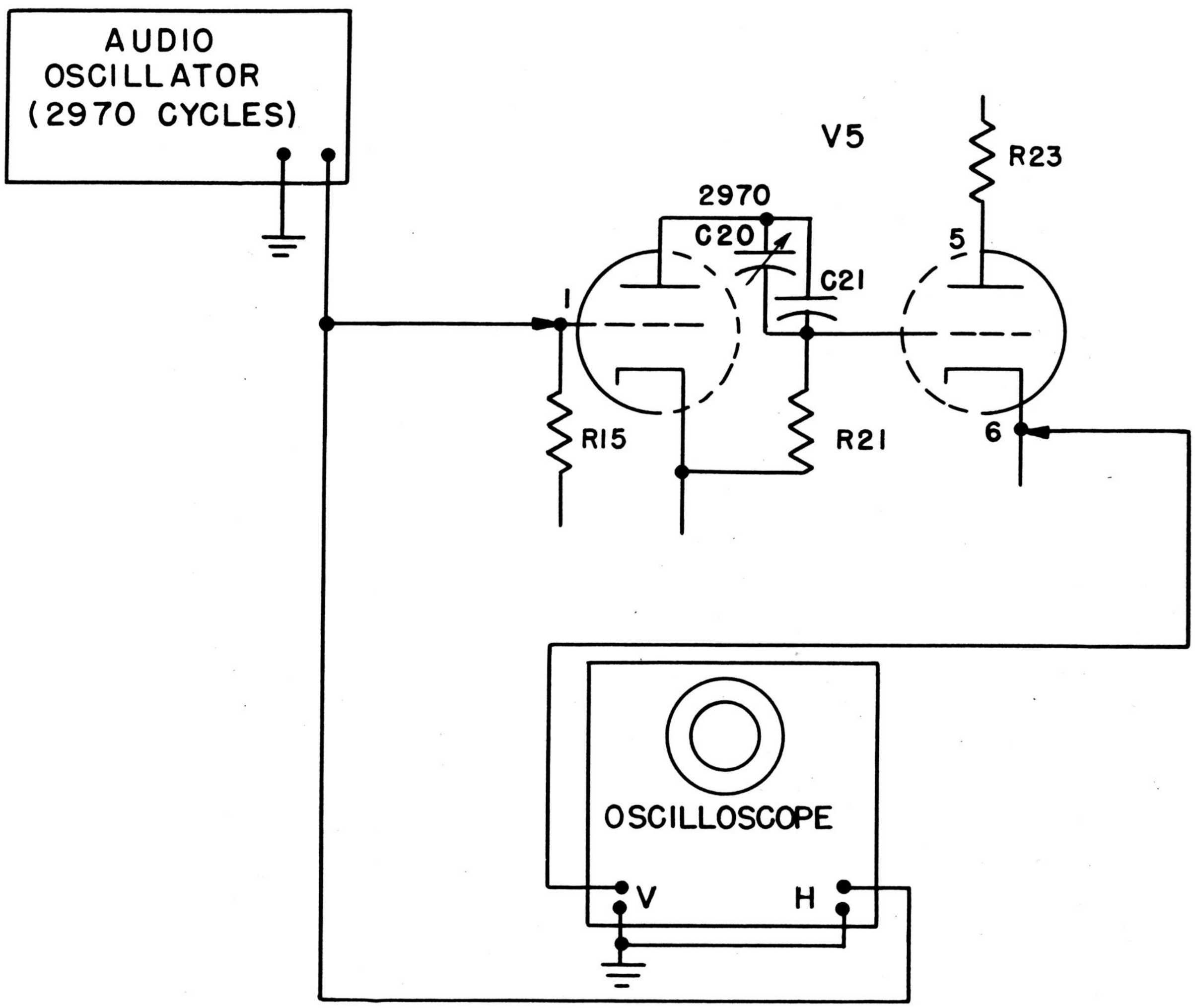

AUDIO
OSCILLATOR
(2970 CYCLES)
V5
R23
2970
C20
C21
5
1
R15
R21
6
OSCILLOSCOPE
V
H

FIG. 13

adjusted. Adjustment of the appropriate trimmer capacitor will shift the phase between the two voltages applied to the oscilloscope and improper adjustment will cause the circular pattern on the oscilloscope to tilt slightly and assume an elliptical shape. The trimmer capacitor associated with the circuit should be adjusted to produce a circular pattern, as shown in Figure 14, page 43. Audio oscillator and oscilloscope connections to the pins of the 6SL7 tubes are listed below, together with the correct alignment frequency to be used for each connection. Tuning adjustments are not provided on the 28 cycle circuit which is factory-adjusted.

Audio Oscillator to Pin #	Vertical Amp. of Oscilloscope to Pin #	Audio Oscillator Frequency - **
1 on V6	6 on V6	28 cycles
4 on V5	3 on V6	354 cycles
1 on V5	6 on V5	2970 cycles
1 on V8	6 on V8	121 cycles
4 on V7	3 on V8	1000 cycles
1 on V7	6 on V7	12800 cycles

This instruction manual is intended to furnish information for the use of the General Electric Single Sideband Selector, Type YRS-1. It does not attempt to furnish all details or variations in equipment, nor to provide for every possible contingency to be met in connection with the installation,

** Must be accurate within ± 1%.

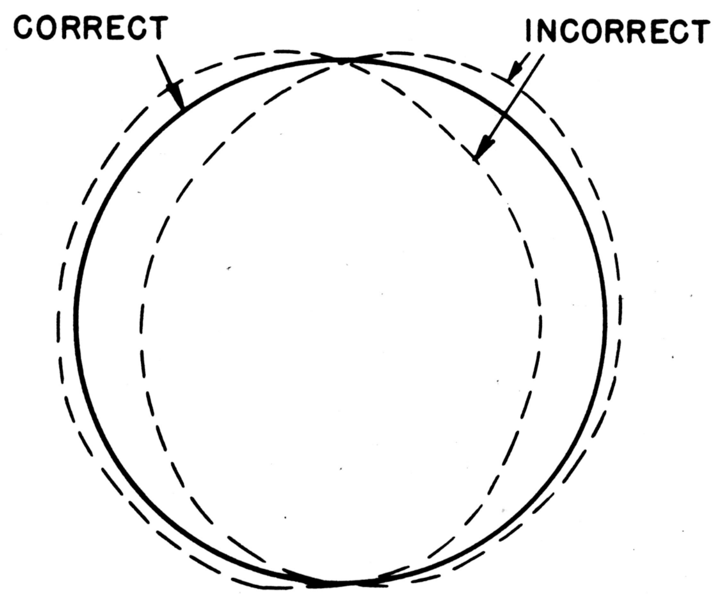


FIG. 14

operation, or maintenance of the instrument. Should further information be desired or should particular problems arise which are not covered sufficiently by this manual the matter should be referred to the General Electric Company, Specialty Division, Syracuse, New York.

USER WARRENTY

The General Electric Company warrents to the purchaser of of this new General Electric Single Sideband Selector, Type YRS-1, that any part thereof(except electronic tubes incorporated therein, which are covered by the Company's standard tube warrenties) which proves to be defective in material or workmanship within ninety (90) days from the date of original purchase for use will be repaired or replaced. Any defect in said Single Sideband Selector, Type YRS-1, should be brought to the attention of the General Electric dealer from whom it was purchased, who will be authorized to furnish or arrange for repairs or replacements within the terms of this warrenty.

The foregoing is in lieu of all other warrenties, expressed or implied, and the General Electric Company neither assumes, nor authorizes any person to assume for it, any other obligation or liability in connection with said Single Sideband Selector, Type YRS-1.

TABLE OF SOCKET VOLTAGES

Voltage measurements are made with 20,000 ohm/volt meter to chassis for DC, AC with 1000 ohm per voltmeter between pins marked.

"Locked Oscillator" button depressed with no signal input. Voltages hould hold within ± 20% when power line voltage is 117 V. RMS.

Pin	V1	V2	V5	V6
1	0	0	--	--
2	6.3 VAC*	6.3 VAC*	175	175
3	4	--	1.25	4
4	--	--	--	--
5	4	--	175	175
6	105	100	2.8	5
7	6.3 VAC*	6.3 VAC*	6.3 VAC*	6.3 VAC*
8	175	165	6.3 VAC*	6.3 VAC*

Pin	V7	V8	V9	V10
1	--	--	96	--
2	175	175	260	380, 5 VAC*
3	1.5	4.4	6.3 VAC*	--
4	--	--	6.3 VAC*	640 AC*
5	175	175	260	--
6	3	6	260	640 AC*
7	6.3 VAC*	6.3 VAC*	115	--
8	6.3 VAC*	6.3 VAC*		380, 5 VAC*

Pin	V11	V12	V13	V14
1	0	0	--	--
2	6.3 VAC*	6.3 VAC*	--	0
3	325	105	6.3 VAC*	--
4	325	104.5	6.3 VAC*	--
5	170	105	115	105
6	TP-325	135	0	--
7	6.3 VAC*	6.3 VAC*	4.4	--
8	175	170		--

REPLACEMENT PARTS LIST

PART	DESCRIPTION	CAT. NO.
C1	Capacitor, ceramic, 5 mmf., 500v., 10%	*
C2	Capacitor, paper, .1 mf., 200v.	*
C3	Capacitor, paper, .001 mf., 600v.	*
C4	Capacitor, ceramic, 15 mmf., 500v., 10%	*
C5	Capacitor, ceramic, 100 mmf., 500v., 20%	*
C6	Capacitor, paper, .1 mf., 200v.	*
C7	Capacitor, paper, .01 mf., 600v.	*
C10,C11	Capacitor, ceramic, 50 mmf., 500v., 10%	*
C12,C13	Capacitor, ceramic, 200 mmf., 500v., 10%	*
C14	Capacitor, mica, 2000 mmf., 500v., 5%	*
C15	Capacitor, paper, .01 mf., 600v.	*
C16,C17	Capacitor, ceramic, 200 mmf, 500v., 10%	*
C18,C19	Capacitor, paper, .05 mf., 200v.	*
C20	Capacitor, trimmer, 100-590 mmf.	SCY-008
C21	Capacitor, mica, 680 mmf., 500v., 10%	*
C22	Capacitor, trimmer, 100-590 mmf.	SCY-008
C23	Capacitor, trimmer, 600-1350 mmf.	SCY-009
C24	Capacitor, mica, 4300 mmf., 500v., 5%	*
C25	Capacitor, trimmer, 100-590 mmf.	SCY-008
C26	Capacitor, mica, 1100 mmf., 500v., 5%	*
C27	Capacitor, mica, 10000 mmf., 300v., 5%	*
C28	Capacitor, trimmer, 600-1350 mmf.	SCY-009
C29	Capacitor, mica, 2000 mmf., 500v., 5%	*

REPLACEMENT PARTS LIST

PART	DESCRIPTION	CAT. NO.
C30	Capacitor, paper, .05 mf., 600v.	*
C31	Capacitor, paper, .05 mf., 200v.	*
C34	Capacitor, electrolytic, 10 mf., +100%, -10%, 25 WVDC	Sprague Type DEE
C35	Capacitor, electrolytic, 15 mf., +100% -10%, 450 WVDC	Sprague DFP-15
C36	Capacitor, paper, .1 mf., 200v.	*
C37,38,39	Capacitor, paper, .01 mf., 600v.	*
C40	Capacitor, paper, 1. mf., 200v.	*
C41	Capacitor, paper, .01 mf., 600v.	*
I1	Lamp, GE51 6-8v., .2 amp.	*
L1	Coil, oscillator	SLC-020
L2	Coil, choke	SLF-017
R1	Resistor, carbon, 470 ohms, ½w., 10%	*
R2	Resistor, carbon, 100K, ½w., 20%	*
R3	Resistor, carbon, 820 ohms, ½w., 10%	*
R4	Resistor, carbon, 33K, ½w., 10%	*
R5	Resistor, carbon, 100K, ½w., 20%	*
R7,8,9,10	Resistor, carbon, 220K, ½w., 20%	*
R11	Resistor, carbon, 10K, ½w., 20%	*
R12	Resistor, carbon, 3.3 meg., ½w., 20%	*
R13,14	Resistor, carbon, 47K, ½w., 20%	*
R15,16	Resistor, carbon, 2.2 meg., ½w., 20%	*

REPLACEMENT PARTS LIST

PART	DESCRIPTION	CAT. NO.
R17,18,19,20	Resistor, precision, 1000 ohms, ½w., 1%	Continental Type X or equiv.
R21,22	Resistor, precision, 51K, ½w., 1%	Continental Type X or equiv.
R23,24,25,26	Resistor, precision, 2000 ohms, ½w., 1%	Continental Type X or equiv.
R27	Resistor, precision, 82K, ½w., 5%	Continental Type X or equiv.
R28	Resistor, precision, 100K, ½w., 5%	Continental Type X or equiv.
R29,30,31,32	Resistor, precision, 3000 ohms, ½w., 1%	Continental Type X or equiv.
R33	Resistor, precision, 560K, ½w., 5%	Continental Type X or equiv.
R34	Resistor, precision, 470K, ½w., 5%	Continental Type X or equiv.
R35,36,37	Resistor, carbon, 3900 ohms, ½w., 5%	*
R38,39	Potentiometer , carbon, 500K ½w., 20%	*
R40	Resistor, carbon, 470 ohms, ½w., 10%	*
R43	Resistor, carbon, 100K, ½w., 20%	*
R44	Resistor, carbon, 39K, ½w., 10%	*
R45	Potentiometer, carbon, 150 ohms	*
R46	Resistor, carbon, 2200 ohms, 2w., 10%	*
R47	Resistor, carbon, 150K, ½w., 10%	*
R48	Resistor, carbon, 100K, ½w., 20%	*
R49	Resistor, carbon, 3300 ohms, 2w., 20%	*
R50	Resistor, carbon, 3900 ohms, 2w., 10%	*

REPLACEMENT PARTS LIST

PART	DESCRIPTION	CAT. NO.
R52	Resistor, carbon, 22K, $\frac{1}{2}$w., 10%	*
R53	Resistor, carbon, 100 ohms, $\frac{1}{2}$w., 20%	*
R54	Resistor, carbon, 1800 ohms, $\frac{1}{2}$w., 10%	*
R55	Resistor, carbon, 470K, $\frac{1}{2}$w., 10%	*
R56	Resistor, carbon, 330K, $\frac{1}{2}$w., 10%	*
R57	Resistor, carbon, 1 meg., $\frac{1}{2}$w., 20%	*
R58	Resistor, carbon, 2200 ohms, 2w., 10%	*
R59	Resistor, carbon, 10K, $\frac{1}{2}$w., 20%	*
R60	Resistor, carbon, 470K, $\frac{1}{2}$w., 10%	*
R61	Resistor, carbon, 390K, $\frac{1}{2}$w., 10%	*
R62,63	Resistor, carbon, 220K, $\frac{1}{2}$w., 20%	*
R64	Potentiometer, carbon, 500K, $\frac{1}{2}$w., 20%	*
R65	Resistor, carbon, 4700 ohms, $\frac{1}{2}$w., 20%	*
R66	Resistor, carbon, 100 ohms, $\frac{1}{2}$w., 20%	*
S1	Switch, toggle, SPST	SSS-006
S2	Switch, pushbuttom	SSP-006
T1	Transformer, I. F., with trimmer capacitors, 455Kc	STL-021
T2	Transformer, power	STP-009

*Universal obtainable from any radio parts jobber.

All percentages shown are plus and minus.

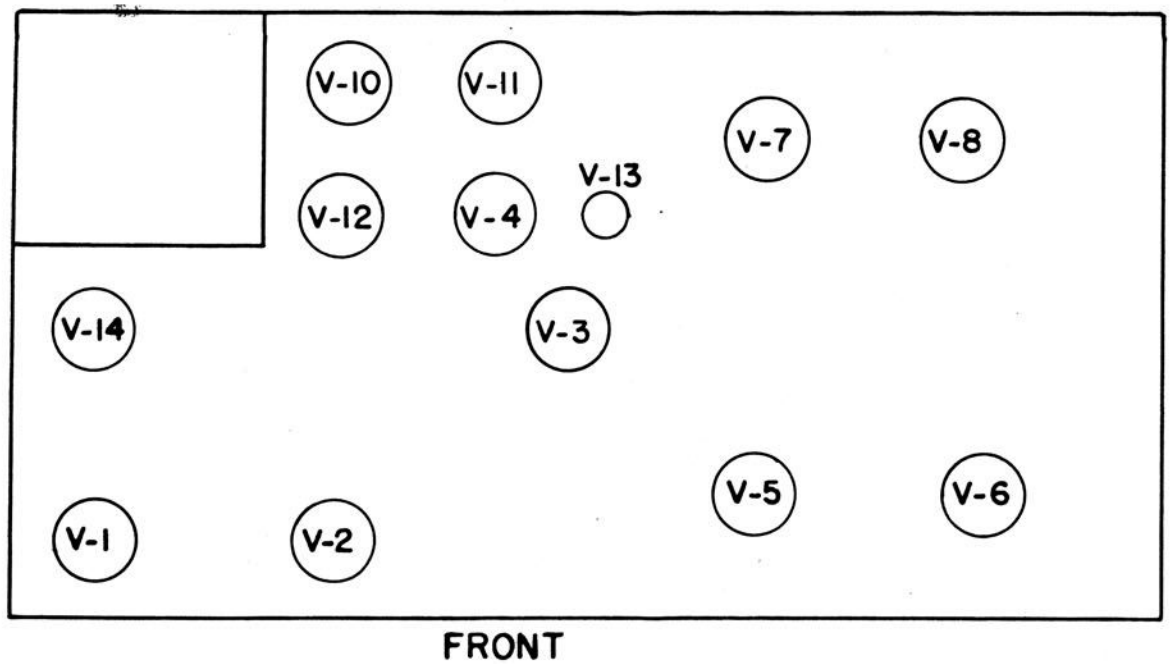
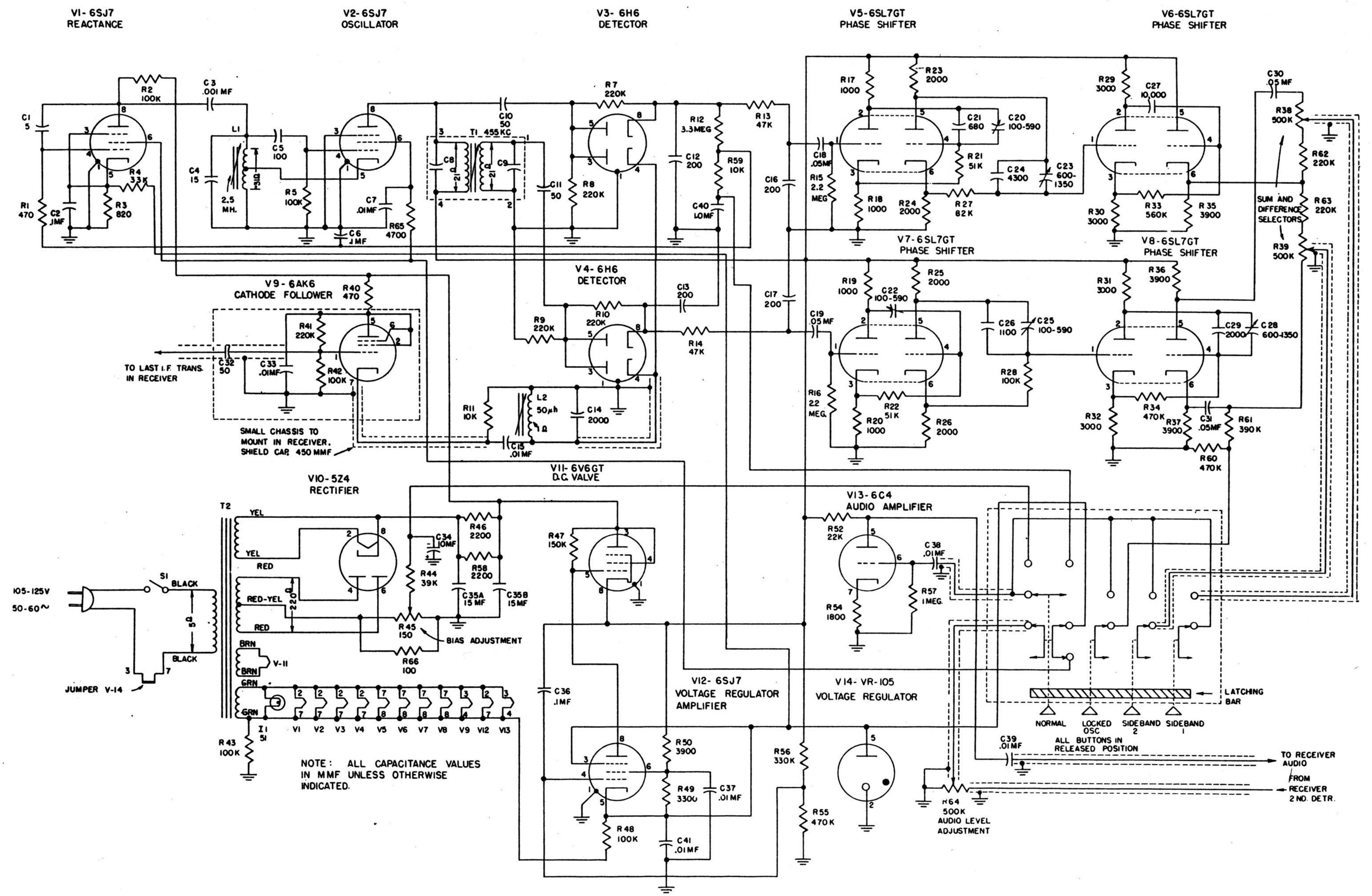
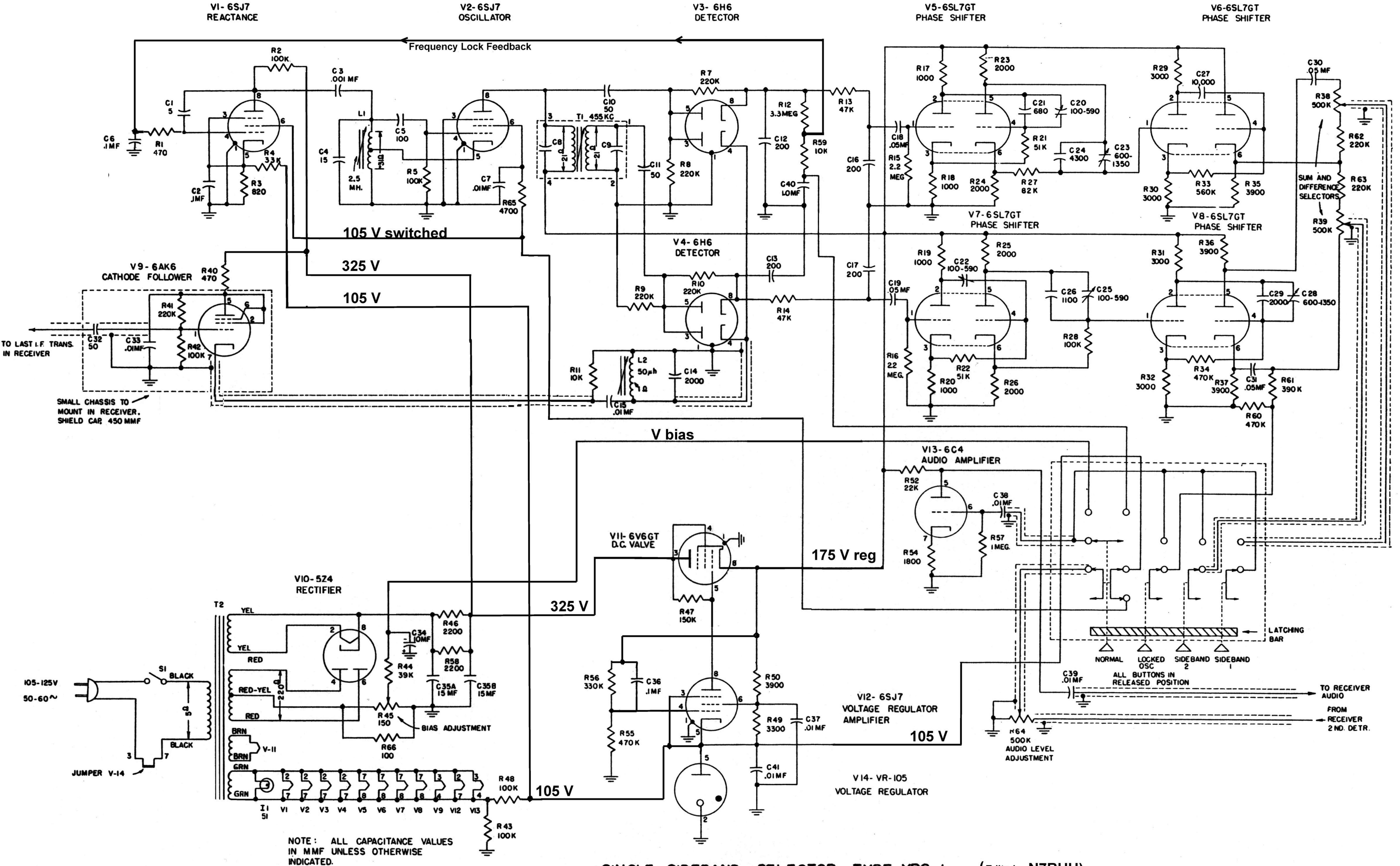


FIG. 15



SINGLE SIDEBAND SELECTOR TYPE YRS-1



SINGLE SIDEBAND SELECTOR TYPE YRS-1 (Edited, N7RHU)