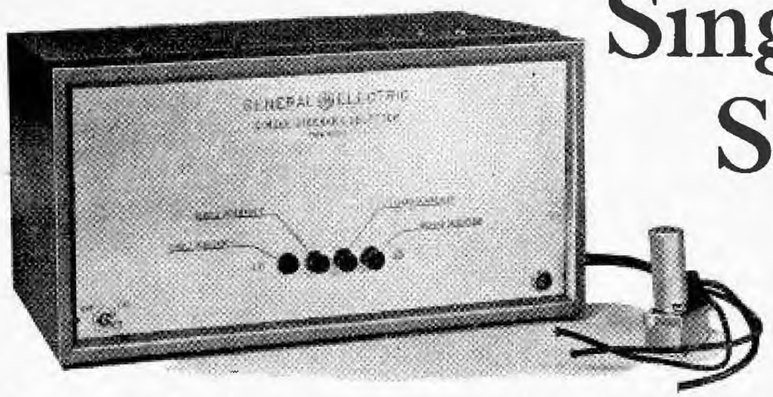


Single Sideband Selector

Unit for Attachment to Communications Receivers

By A. DINSDALE

A SINGLE-SIDEBAND selector unit for attachment to communications receivers having an intermediate frequency of approximately 455 kc/s has been developed by the General Electric Company of America. When properly connected and aligned, this new unit permits single-sideband reception of either modulated or unmodulated (C.W.) signals.

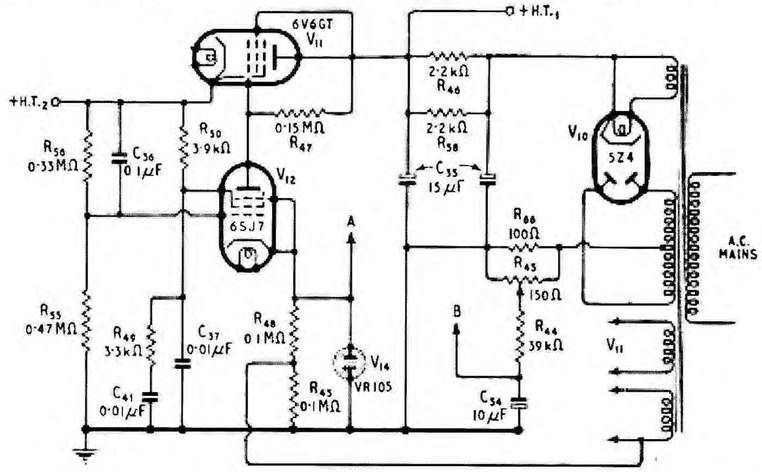
In a crowded frequency band, heterodyne or sideband interference frequently affects only one sideband of the desired signal. By merely punching up push buttons on the front panel of the new unit, each sideband can be explored separately, the noisy one rejected, and the undisturbed one accepted.

By punching up a third button, double-sideband reception is achieved with a locally-reinforced carrier. This reduces distortion caused by selective fading. A fourth button disconnects the single-sideband selector unit and returns the system to normal reception.

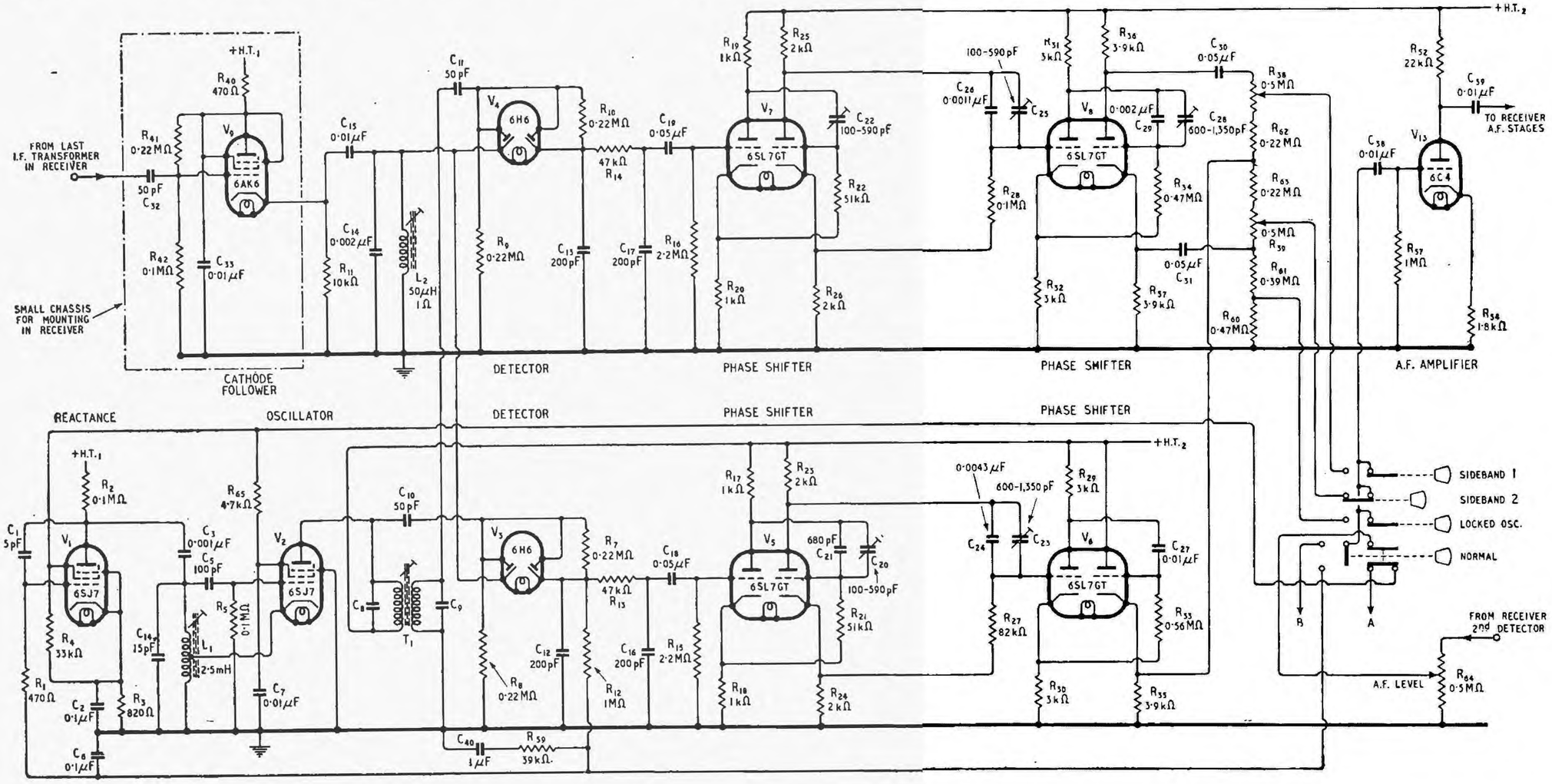
The unit is illustrated in the accompanying photographs, and the circuit diagram supplies much technical information. As indicated in the circuit diagram, there are 14 valves, but essentially the unit comprises an oscillator, two detectors with accompanying phase-shifter circuits, and a single stage of A.F. amplification.

Briefly, signal voltage from the last I.F. stage of the receiver is fed into the selector unit, where detection and phase-shifting take place, and the resultant audio voltage is then fed back into the input of the receiver's audio system.

Detailed installation instructions



(Above) The stabilized power supply unit. (Left) The cathode-follower input stage is mounted in the receiver and feeds the I.F. signal to the detectors V_3 and V_4 through a low-impedance cable of 450pF capacitance. The oscillator V_2 operates at the receiver intermediate frequency and is controlled within limits by the reactance valve V_1; it is coupled to the detectors by T_1 which is adjusted to give a 90-degree phase difference between its primary and secondary voltages. The detector outputs are passed through the phase-shifters which introduce a difference of phase between the signals of some 90 degrees over the range 70-7,000 c/s.



The Single-Sideband Selector unit functions as a complete second detector and beat-frequency oscillator. Therefore, these circuits in the receiver are not used when the unit is employed in the 'Sideband' and 'Locked Oscillator' positions. Since the B.F.O. of the receiver is normally turned on and off from the front panel, it is not necessary to make changes in this circuit.

Although the receiver's second detector is not called upon to deliver audio voltage when the unit is used in the 'Sideband' or 'Locked Oscillator' positions, in some cases it does supply receiver

are supplied by the manufacturer for various makes of commercial communications receivers. Minor wiring changes must be made in most types of receiver, but these do not impair the normal operation or efficiency of the receiver.

Single Sideband Selector—

A.V.C. voltage and operate the S-meter, and these functions are not disturbed when the unit is connected.

In the 'Normal' position, the output of the receiver's second detector passes through one stage of A.F. amplification in the selector unit and is then fed back into the audio stages of the receiver. The connection between the receiver's second detector and audio system must therefore be broken; otherwise, audio output from the second detector will feed into the audio system at all times and render the selector unit useless.

Actual connection between the receiver and the selector unit is made by means of a tiny chassis containing a cathode-follower input stage, using a miniature valve. This chassis is installed in the receiver at a place convenient to the I.F. voltage point, so that the connecting co-axial lead can be cut as short as possible. Connection is made in this manner in order to minimize capacitive loading on the I.F. transformer secondary.

I.F. voltage for the cathode follower can usually be picked off most conveniently from the diode anode 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 valve. The connection between the receiver's second detector and audio system can usually be broken most conveniently at the A.F. volume control. The length of the audio leads is not critical. In the case of both connections, the braided shields of the cables should be grounded to the receiver chassis.

The manufacturer points out that the efficiency of the unit in rejecting unwanted sidebands and passing desired sidebands depends to a great extent upon the correct alignment of the I.F. circuits in the receiver. Therefore, if the alignment is doubtful, it is recommended that it be checked up. In any event, it is necessary to check the tuning of the secondary of the last I.F. transformer and compensate, if necessary, for the additional capacitance introduced by the cathode-follower input stage.

It is also pointed out that satisfactory operation can be obtained only when the receiver to which the unit 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 in 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 warms up to 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 anode power supply. Poor voltage regulation may cause the frequency of the oscillator to change with the setting of the manual R.F. gain control, or with A.V.C. action.

(3) Frequency modulation of the oscillator at mains frequency or harmonics.

Certain amounts of all three types of oscillator instability exist in the very best of equipment, but the manufacturer claims that this unit will work satisfactory with most receivers. In some instances, however, one or more of the three oscillator defects may be so severe as to render the unit useless for many purposes.

If the receiver itself is satisfactory, good operation may not be obtained when receiving certain stations whose frequency control systems suffer from excessive instability of the types listed above.

After the unit has been connected up to the receiver, the manufacturer's instructions list 14 steps which must be taken to complete the proper adjustments so that the unit will work properly with the particular receiver to which it is connected.

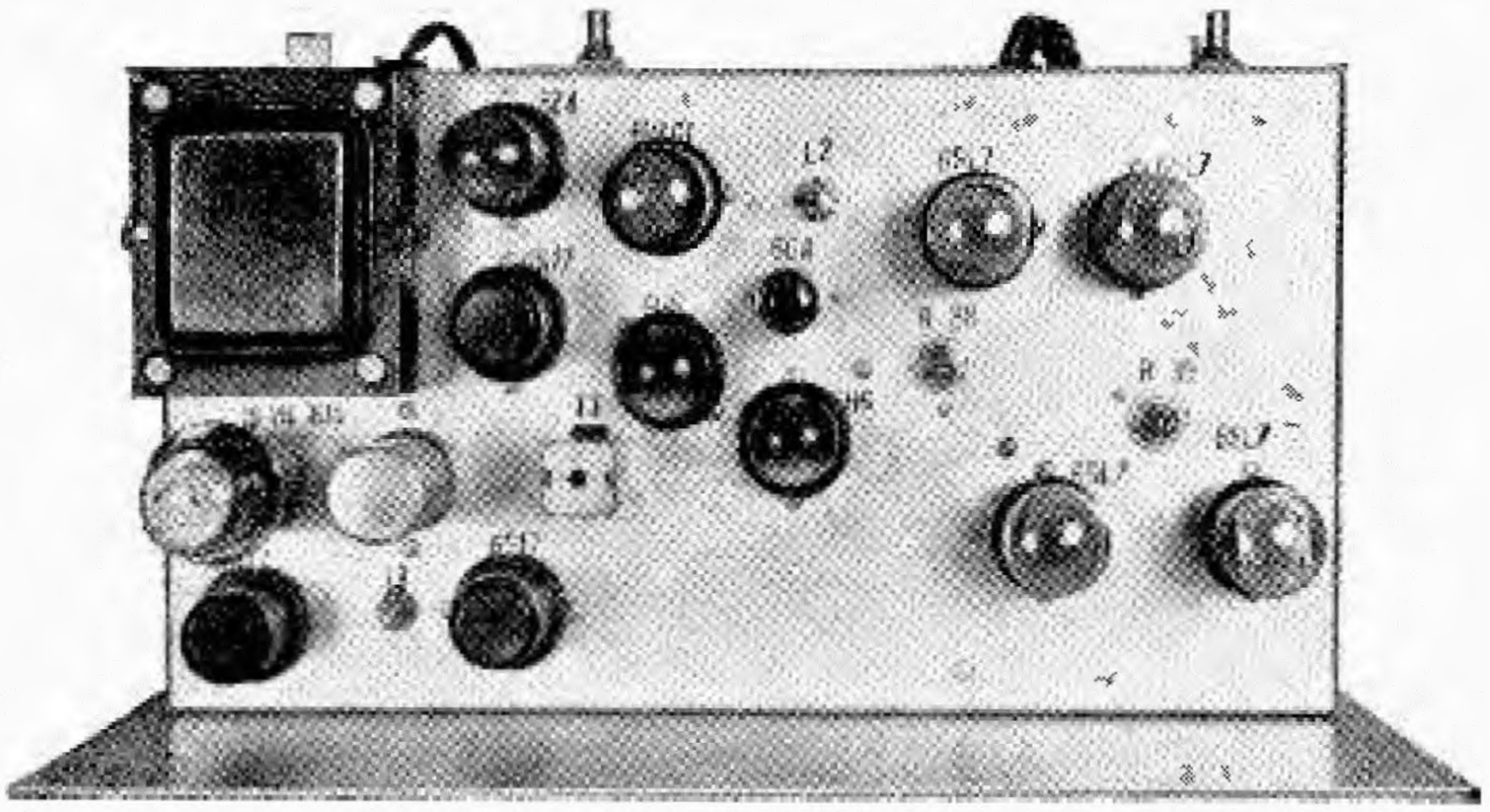
When the unit is used in any position other than 'Normal', a beat note will generally be heard as a signal is tuned in on the receiver. This beat is produced by the incoming carrier beating against the local oscillator in the unit. For A.M. reception, the receiver is tuned to zero beat.

In general, the mode of operation (i.e., Sideband 1, Sideband 2, Locked Oscillator or Normal) best suited to the occasion will depend to a great extent upon the degree of interference encountered.

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 a strong heterodyne within the single sideband accepted for reception. This generally reduces audio fidelity, just as in normal receiver use.

It is recommended that the R.F. gain control on the receiver be kept as low as possible consistent with readability, to prevent overloading the receiver and the Selector Unit. The lower the signal input to the unit, the better the sideband rejection.

Reception of single-sideband suppressed carrier signals is per-



The interior of the Sideband Selector unit. The cathode-follower input stage is a separate unit fitted to the main receiver.

fectly feasible with this unit. If the carrier is totally suppressed, the local oscillator of the Selector Unit has no incoming voltage on which to lock, but it will operate to provide good single-sideband reception. With a transmitter carrier attenuation of, say, 20 db, however, sufficient carrier voltage will be fed into the unit to enable the local oscillator to lock-in automatically at the correct frequency.

When receiving single-sideband transmissions, the operator is warned to make certain that the unit is set to receive the sideband being transmitted. The A.V.C. switch of the receiver should be off for this type of reception.

For C.W. reception, the receiver B.F.O. should be switched off when the Selector Unit is used in the 'Sideband' or 'Locked Oscillator' positions. The local oscillator in the unit serves as a B.F.O. But if the unit is switched to 'Normal' the local oscillator is switched off, and the receiver B.F.O. must be switched on.

As in the case of A.M. signals, the method of operation for C.W. will depend upon conditions. If interference is encountered, try one sideband or the other. The advantage of this unit over a crystal filter is that an entire sideband of interference is eliminated, rather than a small 'notch.' Furthermore, removal of such interference is automatic because critical phasing controls are not involved. 'Chirpy' C.W. signals can be copied on this unit, whereas the crystal filter makes this difficult or impossible.

Incidentally, C.W. reception should not be attempted with the receiver set to the 'sharp' crystal position, and the Selector Unit set to one sideband. Since the receiver must be detuned to produce an audible 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.

In the 'Locked Oscillator' position, 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 Selector Unit. 'Exalted' or 'Locked Oscillator' reception reduces distortion effects brought about by selective fading on high frequencies, or by severe heterodyne interference. By thus building up the carrier locally, fading will then only slightly increase the effective depth of modulation, since, in most cases, the amplitude of the local oscillator is ten to thirty times as great as the amplitude of the received carrier.

As at present designed, the Single-Sideband Selector unit is intended for the use of military services, communication companies, and amateurs. The engineers who developed the unit feel that eventually the principles involved will be incorporated in future communications receivers. It is possible, also, that some modification may be developed for use in broadcast receivers in regions where station separation is inadequate.