

A. CIRCUIT THEORY

GENERAL DISCUSSION

The Swan 500CX transceiver provides single sideband, suppressed carrier transceive operation, and generates the single sideband signal by means of a crystal lattice filter. To permit a logical discussion of this mode of operation, certain definitions are necessary. In a normal AM signal, (double sideband with carrier), a radio frequency signal is modulated with an audio frequency signal. This is considered by many to be merely a case of varying the amplitude of the carrier at an audio rate. In fact, however, there are actually sideband frequencies generated, which are the results of mixing the RF and the AF signals. These sidebands are the sum of, and the difference between the two heterodyned signals. In the detection of this conventional AM signal, the two sidebands are mixed with the carrier to recover and reproduce the audio intelligence. This is an inefficient means of transmission, because only 25 percent of the transmitted power is used to transmit intelligence. There are other attendant drawbacks, also. The bandwidth of AM voice transmission is approximately 6 kc, while the actual demodulated audio is only approximately 3 kc. The result is inefficient use of the frequency band, and over half of the allotted band is unusable due to heterodynes, interference, and congestion.

In the single sideband, suppressed carrier mode of transmission, only one of the sideband signals is transmitted. The other sideband and the carrier are suppressed to negligible level. In addition to increasing the transmission efficiency by a factor of four, single sideband effectively doubles the number of stations or channels which can be used in a given band of frequencies.

It should be remembered that in the single sideband, suppressed carrier mode of transmitting, the unwanted sideband and carrier are only suppressed, not entirely eliminated. Thus, with a transmitted signal from a transmitter with 50 db sideband suppression, the other or unwanted sideband will be present, and will be transmitted, but its level will be 50 db below the wanted sideband. When this signal is received at a level of 20 db over S9, the unwanted sideband will be present at a level of approximately S5. The same is true of carrier suppression. With carrier suppression of 60 db, and a signal level of 20 db over S9, carrier will be present at a level of approximately S3 to S4.

In the Model 500CX transceiver, the single sideband suppressed carrier signal is generated by the crystal lattice filter method. For details, refer to the schematic diagram, and to Figures 1, 2, and 3.

SIGNAL GENERATION

When the push-to-talk switch on the microphone is pressed, the transmitter portion of the transceiver is activated, and it generates a single sideband, suppressed

carrier signal in the following manner. Carrier is generated by a crystal oscillator using transistor, Q3. This stage operates in both the transmit and receive modes. When transmitting, the RF output of the oscillator is injected into the control grid of the Balanced Modulator, V13. This balanced modulator is a beam deflection tube, and operates similar to a cathode ray tube in that the electron beam from the cathode is deflected to one output plate or the other by the charge appearing on the deflection plate. The carrier signal fed to the control grid of the balanced modulator appears on both plates of the output. The two plates are connected to Transformer T1301 in push-pull, so the carrier signal cancels itself out in T1301. The deflection plate DC voltages are adjusted by means of the carrier balance control so that the RF being fed to the output plates will cancel out, and the output from T1301 will be zero. Audio signals from the Microphone Amplifier, V15, are applied as a modulating voltage to one deflection plate, and the two sidebands resulting from the sum and difference frequencies of the audio and carrier signals appear in the output of transformer T1301. Carrier suppression is approximately 60 db.

The double sideband, suppressed carrier signal is then coupled from the secondary winding of T1301 to the crystal filter, which suppresses the lower sideband, and permits only the upper sideband to be fed to the First IF Amplifier, V8. The carrier frequency is generated at approximately 5500.0 kc, normal sideband. With the opposite sideband crystal, the carrier crystal frequency will be 5503.3 kc, and this positions the double sideband signal on the other side of the filter response curve, attenuating the upper sideband by at least 50 db. In the single conversion mixing process, these sidebands become inverted on 80 and 40 meters. Thus the Swan-500CX normally operates on lower sideband on 80 and 40, while on 20, 15, and 10 meters normal operation is on upper sideband.

Q1, the VFO 2N706 Oscillator, operates in the common base configuration as a colpitts oscillator. Q2, The Emitter Follower is used for isolation. The extremely good regulation achieved through using the Zener diode regulator D1801 across the bias supply voltage, also contributes to the stability. Bandswitching is accomplished by changing the tank circuit coil. The VFO in the Model 500CX exhibits extremely good stability after the initial warm-up period. Drift from a cold start will be less than 1 kc for the first hour on 80, 40, and 20-meter bands, and less than 20 kc on 10 and 15 meters. After the initial warm-up period, drift will be negligible.

The single sideband, suppressed carrier signal from the first IF Amplifier is fed to the Transmitter.