SINGLE SIDEBAND RECEPTION

To permit a logical discussion of the techniques and circuits required to process a single-sideband-suppressed-carrier signal through the Swan Model 600-R Receiver, it is important to understand the generation of a voice modulated radio frequency signal.

SIDEBAND GENERATION:

When a modulated audio frequency, such as one produced by a human voice, is heterodyned with an RF carrier frequency, sideband frequencies are generated which are the sum of, and the difference between, the two heterodyned frequencies. To many, these sideband frequencies are thought of as having only a single frequency with a very small bandwidth. In fact, however, these sidebands are separated from the RF carrier frequency by the sum and difference of the audio frequency. For example, a typical intelligible voice signal contains audio frequencies in the frequency range of 300 to 3000 cycles. If this modulating audio frequency is heterodyned with an RF carrier frequency of 5,500,000 cycles, the resultant sum frequencies cover the frequency range of 5,500,300 cycles to 5,503,000 cycles, and these are called the upper sideband. Likewise, the difference frequencies cover the frequency range of 5,499,700 cycles to 5,499,700 cycles, and are called the lower sideband. From the above information, it is apparent that each of the sidebands occupy a bandwidth of approximately 2,700 cycles.

Since the sideband frequencies carry all the audio intelligence that is impressed on the RF carrier frequency, and the intelligence contained in one of the sidebands is exactly duplicated in the other sideband, only one of the sidebands needs to be transmitted. The other sideband and carrier can be suppressed. It should be remembered that in the single-sideband-suppressed-carrier mode of transmission, the unwanted sideband and carrier are greatly suppressed, but not entirely eliminated. It should also be noted that Swan Transmitters and Receivers normally employ a 5500 kc upper sideband I.F. system. Normal operation on 80 and 40 meters is lower sideband, while on 20, 15, and 10 meters, normal operation is upper sideband.

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It is important to keep in mind that the sideband that is being received is actually a band of frequencies approximately 2.7 kc wide. Since the normal I.F. of the Swan Model 600-R Receiver is a 5500 kc USB I.F. system, those RF frequencies which are LSB must be inverted to USB before detection and recovery of the audio intelligence. On 80 and 40 meters, the normal LSB RF operating frequency is subtractively heterodyned with the receiver VFO injection frequency in the Mixer circuit, and the resultant difference frequency selected at the output of the mixer is the USB I.F. For example, if a LSB RF operating frequency of 3899.7 kc to 3897.0 kc is subtractively heterodyned with the receiver VFO injection frequency of 9400.0 kc, the resultant output of the mixer circuit is the 5500.3 kc to 5503.0 kc USB I.F. In other words, the LSB RF operating frequency has been inverted to a USB I.F. signal by the subtractive heterodyning process.

On 20, 15, and 10 meters, the receiver VFO injection frequency is also subtractively heterodyned with the normal USB RF operating frequency in the Mixer circuit, and the resultant difference frequency selected at the output of the mixer is the USB I.F. For example, if the receiver VFO injection frequency of 8700.0 kc is subtractively heterodyned with the normal USB RF operating frequency of 14200.3 kc to 14203.0 kc, the resultant output of the mixer circuit is the 5500.3 to 5503.0 kc USB I.F. Note that on these bands, the inversion process does not take place.

When operation is desired on the opposite sideband, that is, USB on 80 and 40 meters, or LSB on 20, 15, and 10 meters, the I.F. system is changed to a LSB I.F. system. On 80 and 40 meters, the USB RF operating frequency is heterodyned with the receiver VFO injection frequency, and the resultant difference frequency selected at the output of the mixer circuit is the LSB I.F. On 20, 15, and 10 meters, the LSB RF operating frequency is heterodyned with the receiver VFO injection frequency, and the resultant difference frequency selected at the output of the mixer circuit is the LSB I.F.

In order to detect and reproduce the audio intelligence contained in the USB or LSB I.F. signal, the carrier frequency must be reinserted before the audio stages of the receiver. In the Swan 600-R, this reinsertion takes place at the Product Detector stage in the following manner.

The normal USB I.F. of 5500.3 kc to 5503.0 kc is subtractively heterodyned with the carrier frequency of 5500 kc, and results in a difference audio frequency of 300 to 3000 cycles at the output of the Product Detector. When the I.F. of the receiver is the LSB I.F., the Opposite carrier crystal frequency of 5503.3 kc is switched into the circuit and subtractively heterodyned with the LSB I.F. of 5503.0 to 5500.3 kc, and results in a difference audio frequency of 300 to 3000 cycles.