Hear SSB amateurs on your shortwave receiver

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Since most amateurs switched from AM to single sideband more than 40 years ago, it hasn't been possible to receive them with an unaided shortwave receiver. All you'd hear is garbled 'duck talk'. Here's the solution. It's a one-transistor beat frequency oscillator that makes 3.5 and 7 MHz amateur SSB signals intelligble on a cheap receiver.

It is an ideal project for the aspiring amateur, as it allows them to monitor amateur activity. Its usefulness, low cost, and ease of construction would make it a good group project for schools, radio clubs or amateur theory classes.

The BFO is a miniature transmitter. It provides a steady carrier signal to the receiver to replace that suppressed within the transmitter (refer to any radio theory book for a more detailed explanation). It is the ultimate in simplicity, employing but eight components. The unit costs

approximately ten dollars to build from all-new parts, and requires no alignment or connections to the receiver. Anyone with basic soldering skills can construct this project, and have it working first time.

Though receivers covering the short wave bands are no longer in every home, suitable sets can still be picked up cheaply at garage sales and swap meets. Tuning the medium wave and one or two short wave bands, their performance is lacking in many respects. Nevertheless, they work better than might be expected when used with this circuit. The reasons for this are given later.

Circuit Description

This unit is a one transistor 3.5 MHz RF oscillator whose frequency can be varied. As mentioned before, it replaces the carrier in the receiver that was suppressed during the transmitter's SSB generation process.

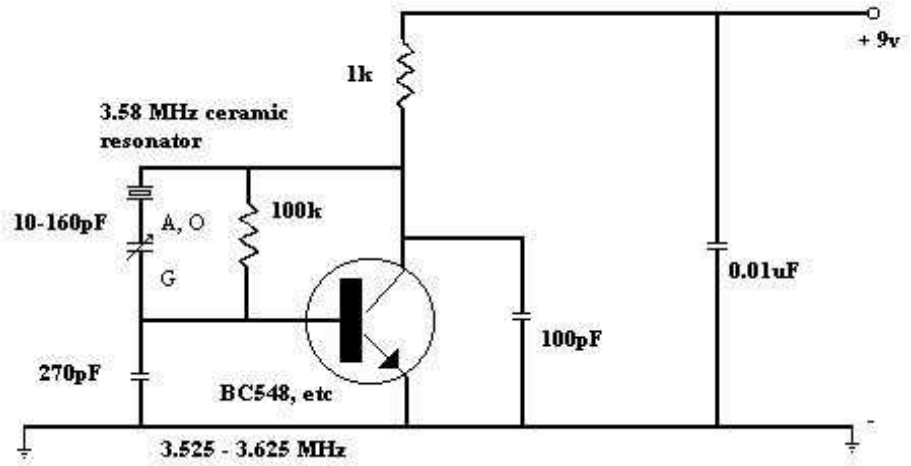
A 3.58 MHz ceramic resonator sets the oscillator frequency. This two-dollar component is similar to a crystal. Its main advantage is that it can be shifted over a 100 kHz frequency range by connecting a variable capacitor in series with it. While the frequency stability is somewhat inferior to that of a crystal, it is still acceptable for stable SSB reception.

Because the BFO operates directly on the received frequency, many of the limitations of low cost AM receivers (such as frequency drift, coarse frequency readout, hand-capacity and difficulty of tuning) are either eliminated or made less apparent.

This is because the tuning in of SSB transmissions is effectively performed by a stable, easy to tune BFO, rather than the unstable free-running coarse-tuning local oscillator within the receiver. The latter would have been the case had a conventional 455kHz fixed-frequency BFO been employed.

The circuit shown (see below) covers the popular 3.525 - 3.625 MHz frequency range. This permits reception of CW and SSB activity, WIA Divisional Broadcasts and some club nets. The second harmonic of this range covers the busy 7.050 to 7.250 MHz segment of forty metres, while the fourth might be useable for twenty metre reception.

Signal Frequency Beat Frequency Oscillator



Notes

1. Different brands of ceramic resonators have different characteristics. If there is poor high-end frequency coverage, reduce the 270pF capacitor. As low as 15pF may sometimes be required.

2. On most variable capacitors the middle (and sometimes longer) connection (G) is common or ground. The two either side (A and G) are wired together to increase maximum capacitance to 160pF.

3. Move the BFO nearer the receiver for stronger SSB signals and further for weaker signals.

Construction

Virtually any construction method may be used to assemble the BFO. However, large stray capacitances must be avoided if the full tuning coverage is to be obtained. Several prototypes were built. Almost any construction technique can be used.

Full frequency coverage will only be obtained if leads are kept short. Those to the ceramic resonator and variable capacitor are particularly critical. Whereas most RF projects are built in metal cases to provide shielding, the BFO's operation depends on there being a lack of shielding between it and the receiver. Thus either a plastic or wooden box is recommended.

Testing/Operation

To verify BFO operation, your AM short wave set is required. Position the receiver near the BFO, and tune it across the 3.5 - 4 or 7 - 8 MHz frequency range. At a certain point on the dial, the receiver will go quiet; all normal background noise will be silenced. Switching off the BFO will restore the normal band noise, while adjusting the BFO's 'Tune' Control will move the 'silence' to a different frequency. If the BFO passes these two checks, you know that it works.

Now switch off the BFO, attach a piece of wire (preferably outdoors) to the receiver's telescopic antenna, and tune in a strong SSB signal for maximum volume. Assuming the

received signal is within the BFO's tuning range, it will be possible to resolve the signal by correctly adjusting the BFO.

Place the BFO near the receiver, and adjust the BFO's tune control until the receiver quietens. Move the BFO away from the set, and adjust it *carefully* until the SSB signal is intelligible. Note that this setting is critical; the BFO's frequency must be equal to that of the transmitter's suppressed carrier.

While at first this process is somewhat fiddly, it becomes easier with practice. For optimum results, experiment with the physical distance between the BFO and the receiver; weaker signals require less signal from the BFO (ie a greater separation). However, it should be possible to find a compromise position for the BFO where reception from all stations is satisfactory.

A demonstration of the BFO in use appears at http://www.youtube.com/vk3ye

Conclusion

A novel device to allow the reception of amateur signals on domestic AM-only short wave receivers has been described. It is cheap, very simple to build, and can be expected to work first time. It fills a definite need amongst potential amateurs, and has the advantage of being expandable to a direct conversion receiver or CW/DSB transmitter or transceiver as interest develops.

Notes

This article is an abridged version of a full-length article that appeared in *Amateur Radio,* October 1997.

For more radio articles and demonstrations, or to contact the author, visit http://www.vk3ye.com and http://youtube.com/vk3ye