A low cost DSB/CW Transceiver for 80m

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Question. How do you make a phone/CW HF transceiver for less than £50 complete? The answer is to use direct conversion with a single band, QRP design. By definition, the technique results in double sideband rather than single sideband emissions. However, once the receiving station has tuned to the correct sideband, the signal from this set is indistinguishable from normal SSB.

One may consider that the transmission of an extra sideband is wasteful of spectrum space. Yes, but it must be kept in context. We intended this design for two specific applications. The basic rig is for 80m only (although it is easy to adapt to other bands). During the day the band is relatively dead and good for local chit-chat only. Apart from the various old groaners' nets on a Sunday morning and television line timebase whistles for the rest of the daylight hours, there's plenty of room available for everyone including those with an extra sideband. After dark, you would never stand a chance running QRP phone on 80m so the question of two sidebands doesn't apply. However nightime QRP CW operation is a distinct and interesting possibility and our design is excellent in this mode.

Multimode operation

The transceiver is cheap and simple although the performance is out of all proportion to the cost. The transmitted audio has a clarity exceeding that of most commercial rigs, possibily because there are so few audio stages to distort — there is just one transistor before the double balanced mixer — and also because the TX uses a power MOSFET output stage which, at the 4W PEP level of this design, is exceedingly linear.

The receiver is as sensitive as any commercial unit and, due to the direct conversion DBM technique without RF amplification, the strong signal performance possibly better. There are two inescapable drawbacks though. The reception bandwidth is defined by the bandwidth of the audio amplifier, a parameter which can never be as closely defined as is possible with a crystal filter arrangement. Furthermore it is sensitive to both upper and lower sidbands. This means that the reception bandwidth is at least double that of a conventional SSB receiver. As designed, the same bandwidth also applies in the CW mode. However it would be quite feasible to add narrow bandwidth AF filtering at a later stage. The other disadvantage is that it is almost impossible to add AGC to a direct conversion set.

To make the transceiver easier to operate in CW mode, an incremental tune feature shifts the TX frequency about 800Hz LF of the RX frequency making operation of this direct conversion design compatible with conventional equipment. Direct conversion requires a frequency difference between the VFO/local oscillator and received signal. However the VFO/LO is the transmit frequency and the normal receiving station will be tuned to this, transmitting the same frequency on return. This would produce no output in a normal direct conversion set. However this design adds a few exra pF on the VFO in the transmit mode so that the return transmission will be correctly placed in the receiver passband.

Direct conversion

In its most basic form, a standard receiver or transceiver mixes a VFO output with the incoming (or outgoing) signal to produce a difference frequency, the IF signal. This is typically 9MHz or 10.7MHz. All subsequent signal processing or amplification is carried out a this one frequency. Eventually it will be remixed with a carrier signal in a product detector to produce an output at AF.

Conversely, in the transmit mode, AF is mixed with an IF CW frequency to produce SSB (or DSB). This is remixed with the VFO/LO to produce the output signal frequency. In a direct conversion set, the IF stage is left out. AF is produced directly by mixing the incoming signal with a VFO/LO running at the signal carrier frequency. The result is an IF of zero, ie the AF modulation frequency. The reverse occurs in transmit. AF mixes with the VFO/LO to produce a DSB RF signal. In the normal case all the amplification would be done at IF. In the direct conversion set, all the