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Monday, 25 May 2009 02:44 -

Modifications

First off, a modification to the crystal frequency. Though the can says 10.140, it's actually nearly 10.144. There is a 30W propagation station DK0WCY on 10.144 which makes reception of the QRSS signal difficult for people who can't turn off the AGC in their receiver.

I started removing the can using wire snippers as described on my penning page . This harsh method is required on most modern crystals because the can is resistance welded to the base and therefore cannot be easily removed with a soldering iron. I found snipping the corners first was Ok as the crystals I had opened were round, so the corner space was empty.

Right after the first snip was started, I had second thoughts. This is not a standard off-the-shelf crystal, probably at some point it was part of a small batch made to order. Therefore I thought I'd try the desoldering technique and sure enough, the "weld" wasn't a weld it was ordinary solder. Then I was faced with the difficult decision to either use the tried and tested cutting method, or try desoldering which I had never done before. Having its own risks of damage, for example I didn't know whether or not the crystal would overheat and crack. In the end I weighed the risks and decided on the desoldering, which turned out to be surprisingly easy once the pins were soldered to an old PCB as an anchor.

Very lucky that I made that decision! This crystal is not round, it is square: my cutting method would have destroyed the crystal. The picture (below left) shows the crystal with can removed, and its legs soldered to a scrap of unetched PCB. In the background you can see the changes to the front panel of the beacon, most noticeably the installation of a thumbwheel switch having 8 positions labelled 0 to 7, and perfect for selecting 1 of 8 messages that can be stored in the 8K EEPROM.

The picture (below middle) shows the bare crystal installed temporarily in the beacon. Behind the beacon you can see the VFO compartment of the 30m Direct Conversion receiver , and behind that my usual HF Receiver with its frequency counter and audio sections connected to the 30m receiver. Note that the frequency reading on the counter is wrong by a factor of about 1.0001081, a little of 1KHz too low at this frequency.

Frequency of the crystal was measured by zero beating the signal in the receiver and measuring the receiver's VFO frequency (though I could also have measured the crystal oscillator output directly).

The crystal has a small dot of ink from a felt tip pen on it. This tiny dot was enough to move the frequency down to below 10,140,000! My target was 10,142,500 (away from DK0WCY but above the harmonics of the TV timebase that are in some QTH's audible nearer to 10,140,000). The application of a little nail varnish remover using a cotton bud removes enough of the ink to bring the frequency back up. Achieving an exact frequency is very difficult, particularly when the crystal seems so easy to pull (compared to my 80m crystal before). A tiny amount of ink moves it a long way. Also putting the case back on changes the frequency. My end result is 10,141,952 Hz, once again measured by reference to Russia's RWM station on 9,996 KHz.

The 2nd modification was to use a separate 5V voltage regulator to power the crystal oscillator, in an attempt to remove the frequency wobble effect (see above). I realised that the voltage to the "digital-to-analogue" converter for applying the shift (for creating staircases etc) may also vary depending on the current load and that this could also create an unwanted shift. So installed an additional 74LS08 quad-AND gate chip to buffer the 4 frequency control signals before feeding the resistor network. The 74LS08 is also powered from the separate 5V regulator.

The third and final modification was to drive the A10, A11 and A12 address lines from the 8-way thumbwheel selector switch, which conveniently has a binary output. In the controller circuit diagram these 3 pins are grounded, but a previous modification added the "PGM A or B" switch to the front panel allowing selection of two 1024 byte messages via A10. This switch now has a different meaning. In "A" mode, A10 runs to the address counter instead of the thumbwheel selector. This means that it is possible to use double length messages occupying 2048 bytes!

In these conditions it is necessary to disable the end-stop comparator which is only connected to A0 - A9. Really I *should* have connected the comparator properly to A10 etc., but that would have meant removing the circuit board and a lot more work, which I did not have time to do. Instead I connected one of the A10'th comparator input to the binary "1" output of the thumbwheel switch. Therefore the end stop comparator is disabled whenever an odd numbered message is selected i.e. 1, 3, 5, 7. If an end stop is needed on a "normal" 1024 byte message it must be in bank 0, 2, 4 or 6. For a long 2048 byte message, the end stop must be disabled so the message setting must be 1, 3, 5 or 7.

As long as I remember all of this I won't have any difficulty operating the beacon correctly.

This picture (below right) shows the right hand compartment of the beacon after all modifications to date. Note that the "CAUTION" label on the thumbwheel switch is just a warning about using only Isopropyl Alcohol to clean the switch! The voltage regulator is bolted to the back panel. The new 74LS08 is fixed on the controller side of the dividing wall, next to the resistor ladder (digital to analogue converter). Not shown, is an additional LED to display the state of A10 labelled "1024" on the left of the front panel.

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