Improving Crystal Oscillator Signal Purity

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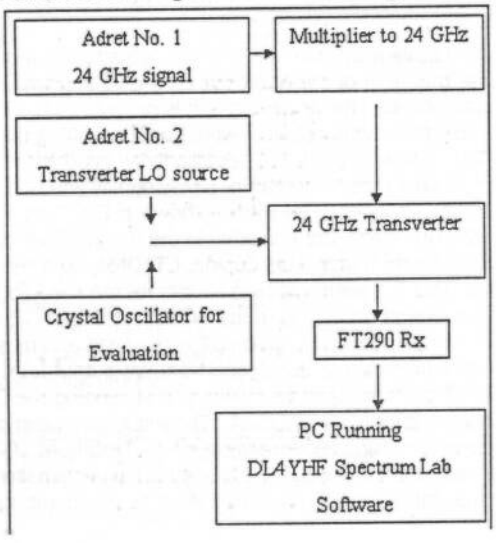
Many microwavers purchase low cost crystals from providers such as QuartSlab, Klove and Eisch. At 24GHz and above it sometimes happens that the received signal using a new low cost crystal can sound full of LF jitter or perturbations. This makes copying of weaker SSB signals quite difficult.

The blame for this effect can be laid directly at the door of the crystal itself. I have been pursuing a cure for this problem for some time, it being quite difficult to get suppliers to discuss the problem and therefore track down a solution. The crystal blank quality on low cost crystals appears to drop to very poor quality at times, possibly quality that is adequate only for computer crystals. Both G4BRK and myself purchased 100.2 MHz crystals from Klove recently and both these showed large amounts of jitter. Other crystals purchased at the same time from Klove are perfectly good but because the frequency was different they where almost certainly made from different quartz blanks of better quality. So the first unknown is the **crystal blank quality**. It seems likely that once a bad quality crystal frequency appears its likely to persist until all that stock of blanks is exhausted.

Additionally there appears to be a likely hood that variable stresses are contained in the bond wires, the crystal element within the can adding to this jitter problem. QuartSlab suggested some time ago that holding a crystal vertically and using a soldering iron to heat the lead out wire for ten seconds to allow the heat to travel up inside the unit would reduce the jitter. This was tried and an improvement in the amplitude of the jitter of perhaps 2:1 was obtained. I also understood that professional users often store new crystals at around 80° C until they are required. I had kept some crystals under the jacket of my hot water cylinder for several years but on finally using these the jitter was no different to a new crystal. This warm storage may help with ageing though I have no measurements to support this aspect. Another crystal supplier then suggested cycling the troublesome crystals between around +80° C and -10° C for one hour at each temperature for 48 hours.

A simple arrangement to do this cycling was to use my OCXO[1] unit itself to do the crystal heating. A resistor of 4K7 was added from TP1 on the circuit diagram to the +10.5v regulated supply. This allows the upper oven temperature range to be extended. Additionally if the heating is done using the complete OCXO it is important that high temperature Epoxy was used to bond the heater plate to the PCB board. For the low temperature simply placing the bare OCXO module in the freezer was the simplest solution. Only the crystal itself needs to be cycled so if you have a means then it can be done outside the OCXO.

An evaluation method needed to be established to verify any improvements that might be made. The **system diagram** (seen here to the right) shows the arrangement employed. Two Adret 5104 synthesizer units are employed to establish a reasonable quality reference. The Adrets themselves will not be perfect but the results show them to be considerably better than a 'bad' crystal.



The IF output from the transverter is