MODIFICATIONS TO FEELELEC FY6900

Background

The FY6900 is a very versatile while relatively low-cost function generator. It has two independent signal sources each with a plethora of output waveforms and it also provides a frequency counter facility. The version I bought was specified to 60MHz and the cost was sub GBP100. It has a somewhat clunky user interface with a single-entry knob for settings but this can be supplemented with a USB PC graphical interface. While not the most sexy of instruments I have grown to appreciate it as a really useful cost effective addition to my electronics workshop.

While working on a clock related project, I had the feeling that the FY6900 displayed frequency did not necessarily accurately match other sources. As the unit does not have an input for an external frequency standard this made cross checking analysis difficult.

There is a lot of discussion about the weaknesses of the FY6900 on the EEV blog and an article by PaulV at pauldiyblogs.net. Based on these posts I decided to dive in.

An internal inspection was needed and eventually I got the top cover off the FY6900. A screw hidden under the label on the bottom cover was the solution. Once this is removed the front and rear panel can be sprung off with a fine flat blade screwdriver. The design of the enclosure is quite nice in this respect with just the one retaining screw.

Inspection of the motherboard revealed the processor reference module to be a small surface mount 10MHz TCXO. I reasoned that if I could improve the specification of the reference that the instrument would be more accurate. (Note not all FY6900 units are the same …).

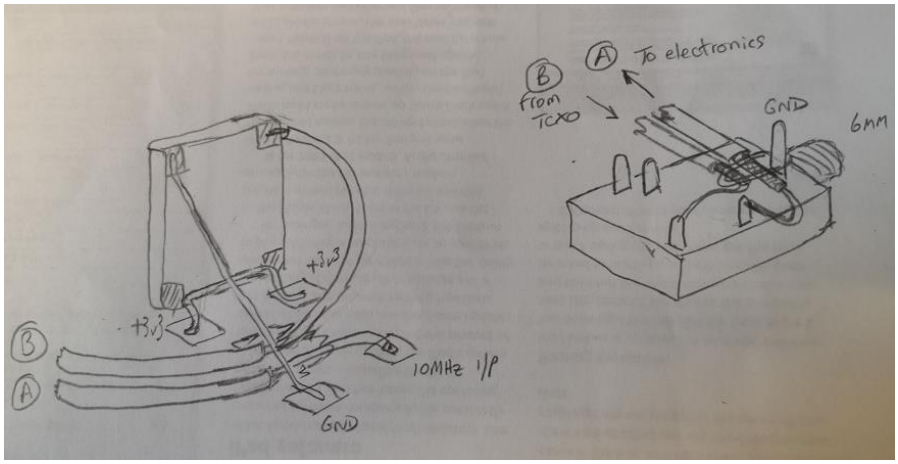
My first plan was to add a remote frequency standard input socket on the rear panel. I wanted to retain the existing TXCO for when I was 'out in the field' and just have the external frequency standard input as a workshop option. Rather than have a switch to do this I opted to use a 3.5mm stereo jack socket with normally closed contacts that would be broken on inserting the mating mono 3.5mm jack plug. The jack socket was mounted on the rear panel and had two miniature coax leads

running to and from the TCXO location. The rear panel is quite thick so I had to counterbore the jack socket mounting hole. The jack socket I used is RS (#913-1030) as shown below.

The TCXO was removed from the PCB using two soldering irons hopping between the four surface mount pads. It is important to mark or take a picture of the orientation of the TCXO before doing this. Once the TCXO was removed, I scraped away the solder resist under where the TCXO had been and then tinned the exposed bare copper.

Some 3D bird's nest mounting of the TCXO is required so that it now sits vertically on the two pads nearest the back panel – these are both 3.3V positive pads. The two pads nearest the front panel are the ground and output pads. To mount the TCXO vertically I made a bridging link of a fine TCW wire (component clipping) across the two positive pads. The TCXO was then soldered to this bridge so it was vertical against this link. A similar wire clipping was then soldered from the ground pad on the board to the pad on the TCXO such that it acts as an angled supporting strut.

This combination gave a rigid mounting for the TCXO. Two miniature coax leads (RG178) are then connected to the TCXO output pad and the frequency reference input pad on the motherboard. The braid on both of the coax leads is soldered to the newly exposed tinned pad. It is important to use coax with a PTFE inner or there will be tears. RG178 is recommended. Here is a rough sketch of my method.



The two coax leads are soldered to the 3.5mm jack on the back panel such that with no mating plug in place, the lead carrying the TCXO output signal is shorted back down the other coax lead to the motherboard. This is normally the 'tip' of the jack plug. A liberal coating of hot glue gives the leads some mechanical strength around the jack socket. This also stops the socket rotating.

Further Mods

The next two modifications were not necessary but the lid was off and they were easy to do.

The mains PSU in the FY6900 did not seem to be respected on the forums so I replaced it with a modular 5V 2A power supply from MakersHut. This was mounted on an aluminium sub plate which in turn had matching holes for the four plastic standoffs on the bottom cover. The connections to the motherboard for the 5V supply are clearly marked as red and black.

Further reading suggested that adding a fan might be a good idea as there was already mounting bosses and grill for this on the back panel. A 5V fan was wired directly into the new modular power

supply. Note that the fan must be a low-profile part (<10mm) or it will clash with the 5V supply plug to the motherboard. My fan was over 10mm and I ended up replacing the motherboard plug and socket with hard wired connections. If the fan is wired directly to the power supply output it will run continuously while the rear panel mains switch is ON. I did not investigate any switched supply derived from the front panel power button.

Result

These mods completed, I reassembled the FY6900 and powered the unit up. I tested the frequency with the original TCXO in circuit and then with an external GPS disciplined oscillator borrowed from a friend. The TCXO was somewhat lacking on the GPS source accuracy.

Phase 2

The same friend offered me a 10MHz ISOTEMP Oven Controlled Crystal Oscillator (143 Series). There are similar surplus devices on EBay. They offer stability specs measured in parts per billion. This is not quite up to the same spec as the GPSDO but more than good enough for what I needed and a big step up on the internally fitted TXCO.

The OCXO had five connections, +5V, Ground, 10MHz output, internal stabilised voltage source and voltage adjust pin. I used an adjustment feed from a 10k multiturn pot across the stabilised source to ground. I was a bit worried about powering the OCXO directly from the newly installed 5V power supply module but after an extensive soak test it did not seem to induce anything weird into the OCXO.

I hacked (Dremel) a small single sided PCB to mount the OCXO with the multiturn adjuster trim pot. By chance there was just enough space to mount this board on the aluminium sub plate alongside the power supply module. The signal output coax connection I had so carefully crafted onto the TCXO was now unsoldered and routed to the OCXO output. The 3.5mm jack remained on the rear panel so a GPSDO could still be used as an external standard. The onboard TCXO was now redundant.

This secondary modification was now complete. The unit was powered up and left to soak while the oven in the OCXO settled. I fed the 10MHz output from the GPSDO into the counter input on the FY6900 and adjusted the trimpot to bring the counter in the FY6900 onto frequency.

There some images on the last page to help your understanding.

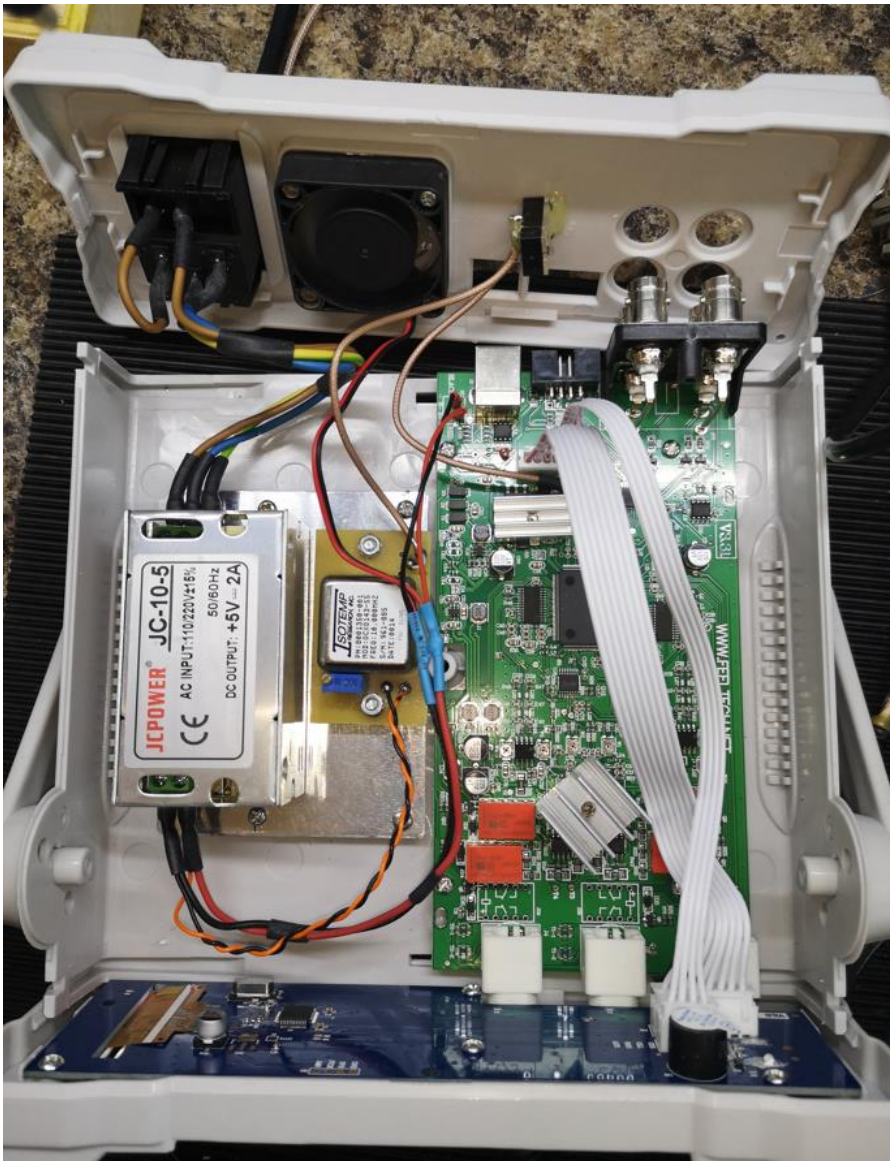
Result 2

If I swap between the new internal 10MHz OCXO and the external 10MHz GPSDO there is very little difference in the readings on the FY6900 counter readout. If I reverse this and use the FY6900 set to 60MHz and measure this on my lab counter with the GPSDO as its reference the results match.

Conclusion

The modification to the reference standard is well worth doing. Once you fit an OCXO it is debateable whether it is now justified to have the external reference standard socket as the OCXO is so good. But there will always be the slight doubt that the OCXO might have drifted …….. so having the socket for a quick test might not be a bad thing,

A word of warning - these mods clearly are contra to any FeelElec warranty terms and conditions. If the mods are not undertaken carefully, you could write off your FY6900. There is also some forum discussion that running the FY6900 without any frequency reference serving the processor might cause all sorts of damage to the firmware. Proceed with caution and at your own risk.


JCPOWER JC-10-5
AC INPUT:110/220V±15%
50/60Hz
DC OUTPUT: +5V 2A


U18