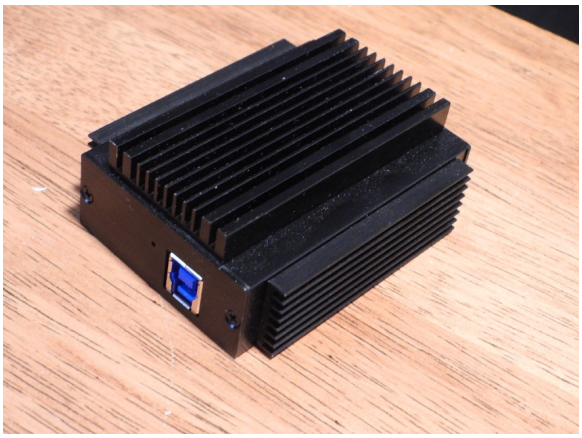
Modification of RX888 v2 for External Clock Input

This is a description of modifications made on RX888 v2 SDRs in order to provide support for external 27 MHz system clock input. This only applies to the second version of the RX888 and as a caveat, there was no schematic of the receiver nor available detail of the inner workings of the Skyworks SI5351A synthesizer that requires clocking. Some of this is a guess from existing documentaion and previous experience with the synthesizer along with measurements of the RX888.

Recognizing that many RX888 owners may want to achieve external clocking with a minimum of soldering and without any surface mount component soldering at all this modification requires only soldering two wires onto a SPST switch and mechanical operations which can be done with only a screwdriver and a hole punch or drill.



RX888 v2 shown with largest heat sink up. This is the top view.

RX888 v2 bottomv view, "RF end" SMA connectors are on the right, USB on the left.

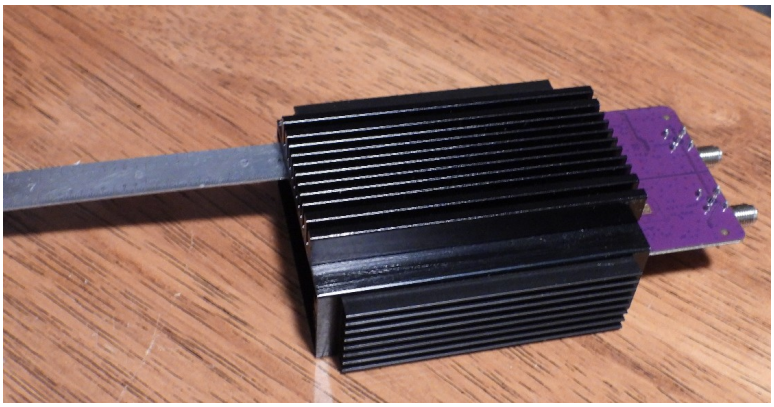
As it ships the RX888 has only an internal clock which appears to be a 27 MHz module possibly trimmed for temperature by an on-board DAC. It actually seems to perform quite well with units showing only a Hertz or two error at 14 MHz. This amounts to .1 ppm accuracy which is better than uncorrected quartz sources can generally provide. Probably there is a thermometer near a tunable

crystal oscillator which is used to adjust for temperature changes and thus creates a TCXO from an XO but this is a guess.

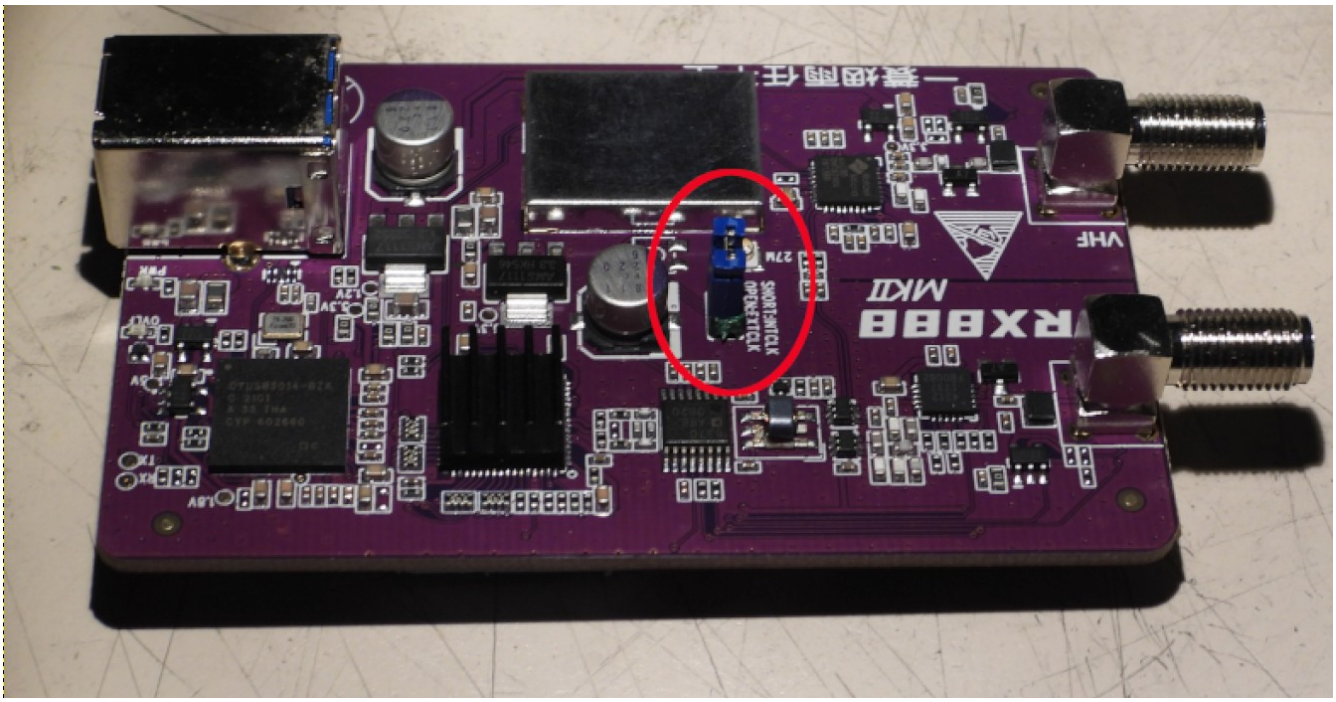
The modification essentially consists of adding a u.fl <==> SMA cable and a SPST switch and mounting them on holes punched or drilled in the USB end panel of the receiver. The u.fl connector is plugged into an existing surface mount connector on the receiver PCB and the SPST switch is wired to a two pin connector that plugs into a two pin strip, replacing a shorting jumper. This jumper appears to apply 3.3V Vcc to the on-board oscillator. Silk screen on the board says to remove it for external clocking. The SPST switch performs this disconnection when external clocking is provided on the SMA connector.

To disassemble the receiver remove the end panels by removing mounting screws for the SMA connectors and the panel.

A metal rule can be inserted between the ADC heatsink pad and the case to easily slide the PCB out from the enclosure.



Metal rule inserted between the ADC thermal padding and case makes removing the PCB much easier.

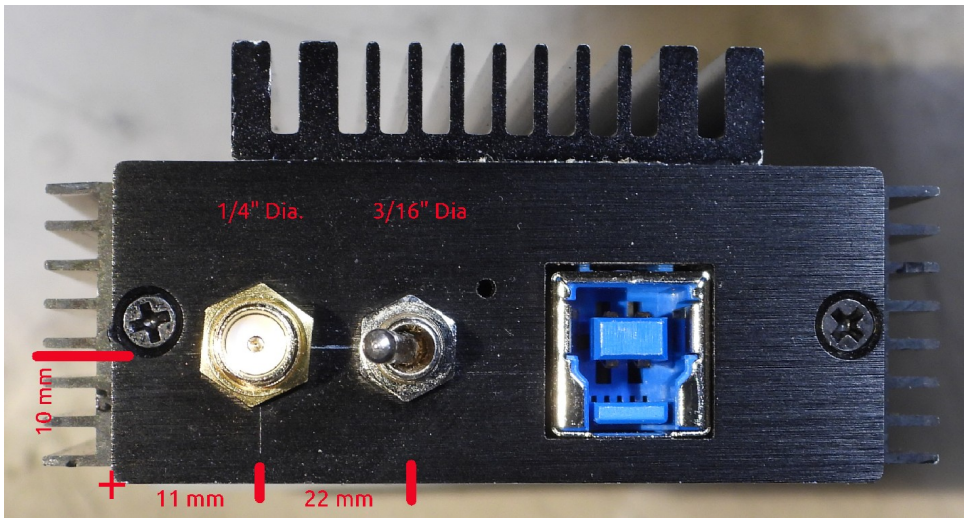


RX888 v2 PCB with region of the two pin external clock jumper and the u.fl connector highlighted

To modify the receiver a sub-miniature SPST toggle switch, that size requiring a .207” mounting hole rather than a more common .25” one. This was done to fit the available space inside the RX888. For connection a pre-made 3 conductor radio controlled servo connector cable similar to This One is wired to the switch. After removing sockets from one end remove the third conductor entirely, cut the free end contacts shorter and soldered them to the switch terminals. Polarity doesn’t matter here although the end of the header nearest the u.fl connector is the Vcc connection.

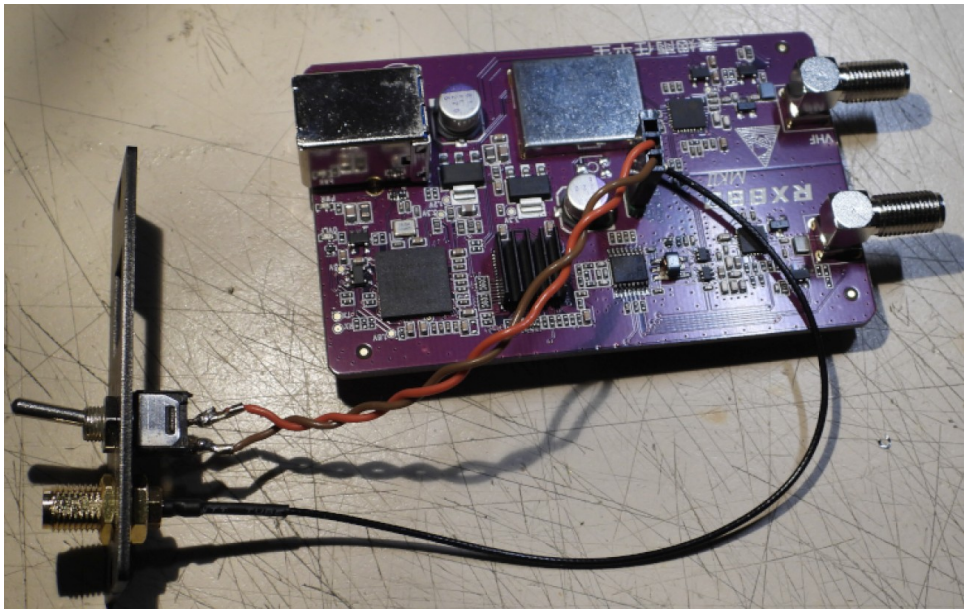
The u.fl <==> SMA cable is available from Amazon and cost a little over US$1 each. The switch is a common variety and small enough that its body size fits between the PCB and the enclosure when assembled. From what I can tell This Switch from Digikey will work, though the one shown is from the local junk box.

The centers for the and SMA and switch holes are as shown.



SMA and SPST switch hole placement in the USB-end panel

After punching holes in the panel mount the SPST switch and the SMA and then connect the two pin header and the u.fl. The switch is oriented so that in the open condition the bat handle is toward the SMA connector. This has the handle ‘pointing’ towards either the SMA or USB connector indicating the clock source being used. The u.fl is small and needs to carefully aligned with its mate on the PCB. Getting this done right is perhaps the hardest part of the whole modification. It seems that u.fl connectors are very small and fragile. Try to arrange to only connect them once and not require a disconnection later.


Mounted and fully connected modification.

With the switch in internal position Vcc is applied to the internal oscillator and there must be no external input supplied to the SMA connector. The internal clock frequency may be measured in this condition. When the switch is changed to the external/SMA position an external clock of at least 400 mV peak-peak should be applied. Because the RX888 external input is high impedance a good way to

provide this may be by placing a 10 dB attenuator on the SMA and driving it throgh a 50 ohm cable. This won't create a perfect match but it will be better than connecting to what looks pretty much like a 10 pF capacitor and so a high impedance at 27 MHz. Probably neither this match nor the level will matter for single RX888 operation where driving the RX888 directly from a +12 dBm source such as a Bodnar or N6GN Reference will likely be fine but may become an issue when more than one RX888 is driven from the same external source and total phase shift needs to remain highly stable.

Although this description is only concerned with clocking a single RX888 externally from typical external GNSS or other accurately disciplined source, a future topic may be about ways of combining multiple RX888s so that together they act like a multi-ADC system: one that is fully frequency, phase and possibly amplitude synchronous. This sort of system may have very interesting uses within amateur radio but will likely require very high stability of any external clocking circuits. Whether the single-receiver modification described here will be adequate for good perfomance of this sort of system is still TBD.

n6gn July 2023