Phase locked External Reference for 10GHz Satellite LNB's

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With the new geostationary satellite Es'Hail Sat 2, many Hams are making efforts to become ready to access the satellite ham transponders.

The Es'Hail Sat2 has the downlink on 10Ghz band and several hams are looking forward to use cheap TVSAT-LNB (Low Noise Block-converters) to start monitoring the satellite downlink. Since the dish size requirements are quite modest the use of small TVRO dishes and modified LNB's might be a very popular way to build up a receiving station.

Fig 1 EK LNB 21 – twin output TVSAT-LNB

Nowadays TVSAT-LNB's have good noise figures and lots of conversion gain and some of them have their local oscillator internally locked to a crystal reference. These particular types are the ones we are interested.

Recent LNB's no longer employ DROs (dielectric Resonator Oscillator) they use instead a single chip PLL with integrated VCO and reference oscillator. The low cost xtal and an uncompensated oscillator configuration used is not good enough to provide stability that allows the use of narrow band amateur modes. In fact the LNB without modifications is quite sensitive to temperature variations, even a soft breeze can make the final LO frequency drift a few kHz, as shown on Fig 2.
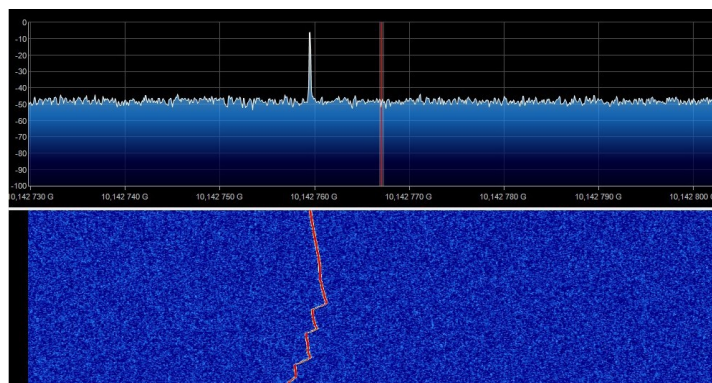

Fig 2 - 10GHz signal received with the unmodified LNB

I have found that LNB's based on the Rafael RT320M chips (and similar) are quite easy to lock to an external 25MHz reference. (There are also other models that use 27MHz as the reference oscillator).

In Fig 3, we show a 10GHz signal being received with the LNB modified to accept an external reference signal.
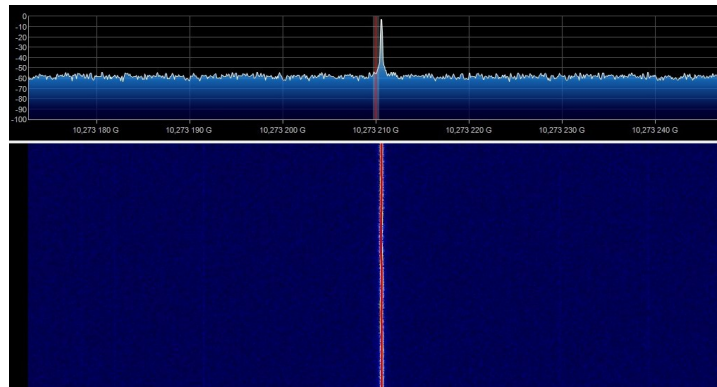

Fig 3 - 10GHz signal received with a modified LNB receiving an external 25MHz reference.

The Es' Hail Sat 2 downlink will be on 10,490GHz, as TVSAT LNB's LO is usually at 9,750GHz the resulting IF is on 740MHz.

We offer the EK-LBB21 (RL320M based) because it has dual output which results quite convenient mechanically as we can use one of the F connections as the 25MHz reference input.
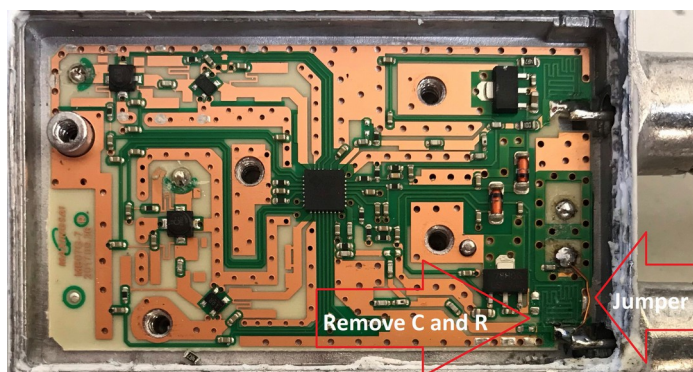

Fig 4 LNB modification, Reference and signal connections

The modification consists of injecting the reference directly into the LO chip directly into the 25MHz xtal circuit terminals.

To provide a good 25MHz reference that could even be locked to an external 10MHz I have developed the solution I present below.
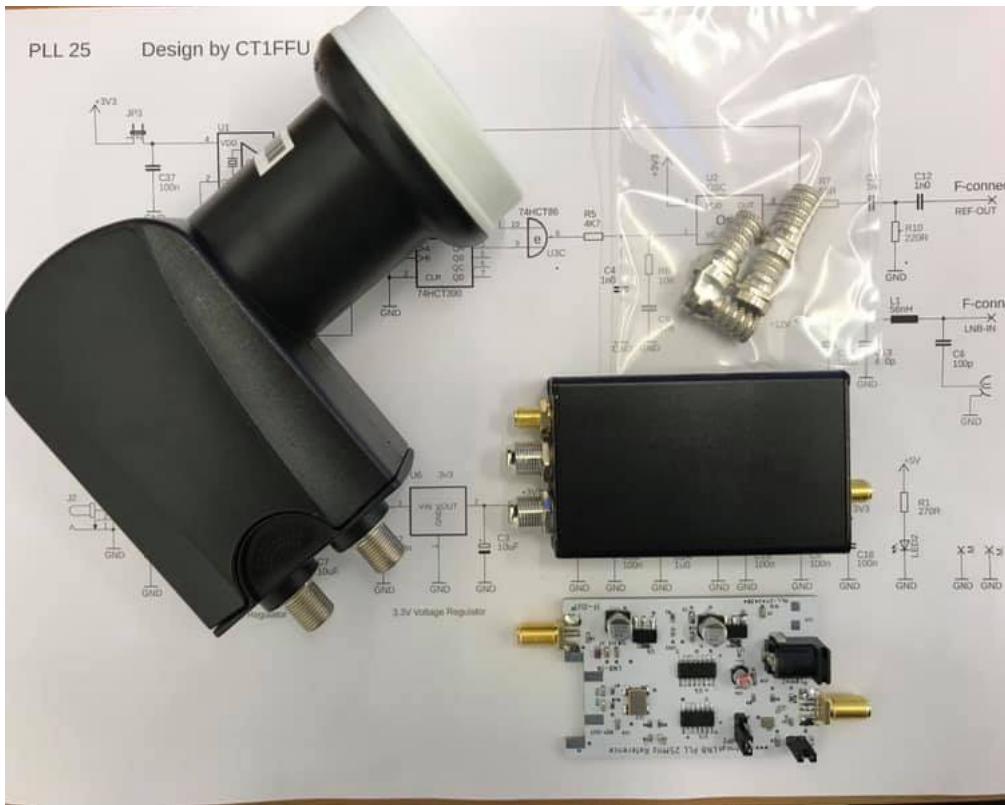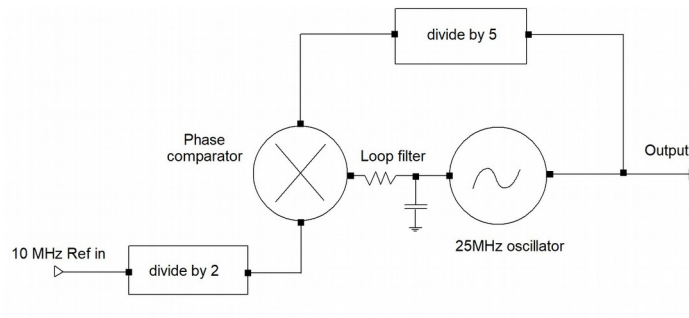
Fig 5 Set Up

Fig 6 Block Diagram of PLL
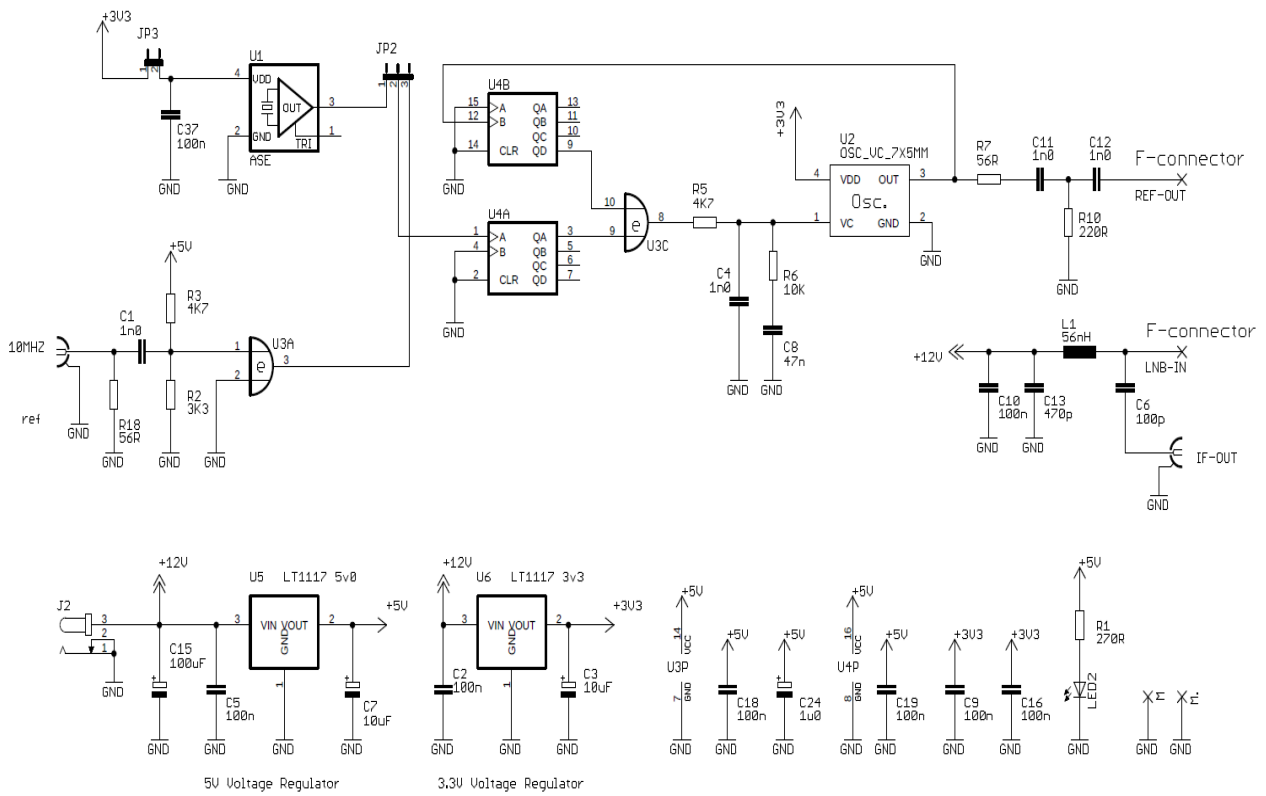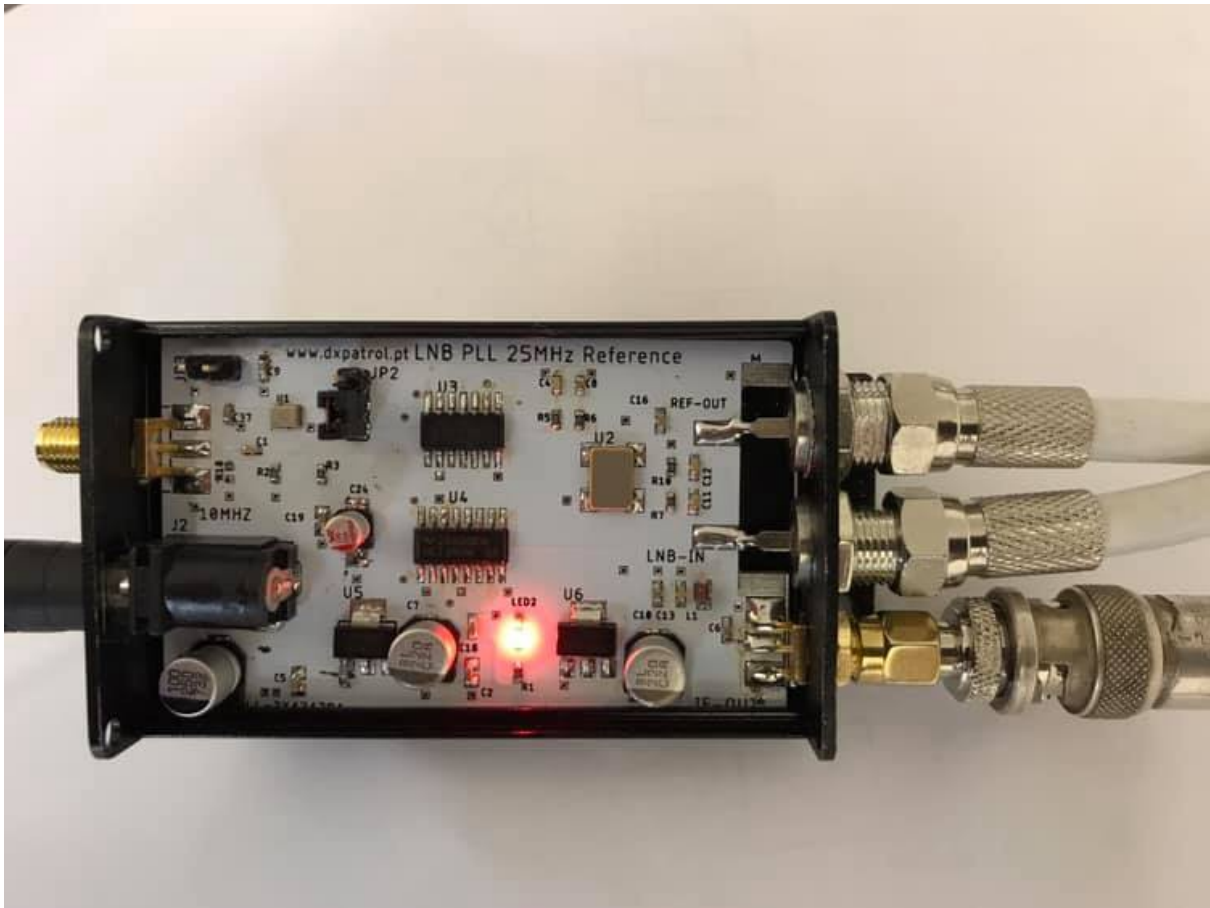
PLL 25   Design by CT1FFU

Fig 6 circuit diagram

Fig 7 First prototype of the external reference circuit. It uses two 75 Ohms cables with F-connectors to the LNB and provides an SMA connector to the IF receiver at 740MHz.
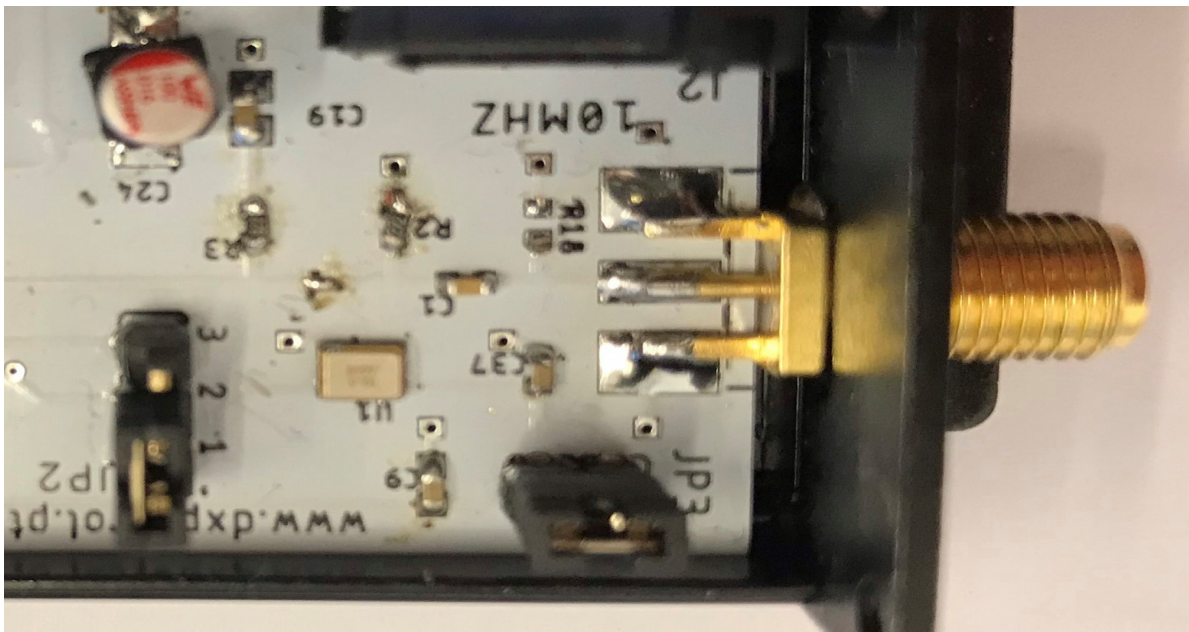

Fig 8 10MHz reference selection:

Internal = JP3 ON and JP2 between pin 1 and 2.
External= JP3 OFF and JP2 between pin 2 and 3

The circuit has a PCB Size of 70mm x 40mm, requires an input Voltage of 12V to 15V DC and consumes about 40mA (75 to 100 mA with LNB connected depending on LNB type). The 25MHz reference amplitude is about 2 Vpp.
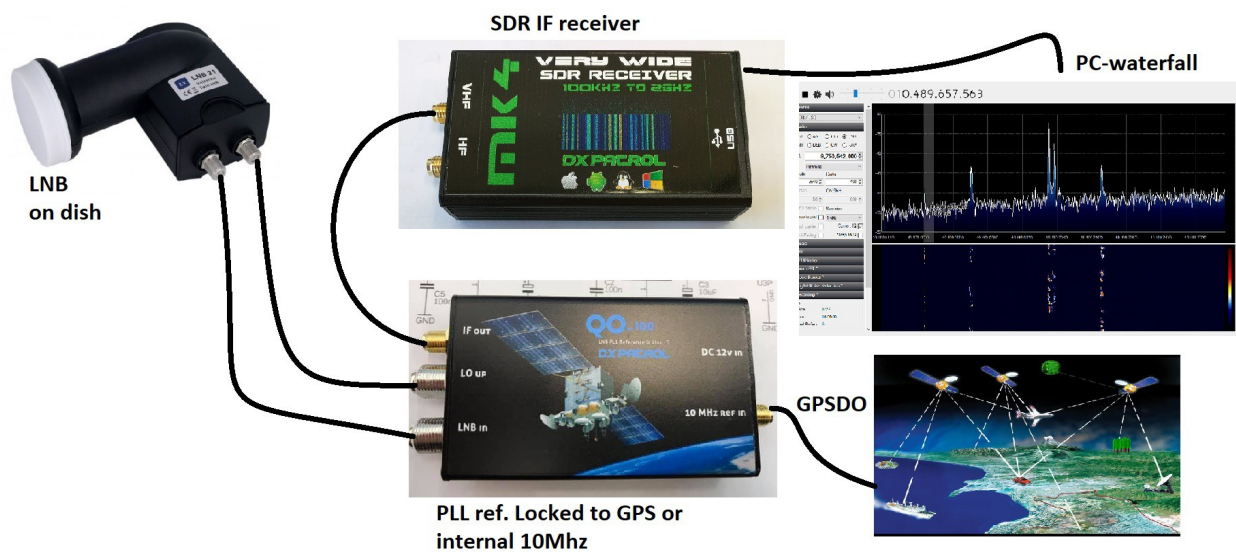

Fig 9 assembling schematic

Conclusion.
In this setup we describe an easy and cheap way to improve the stability of a TVSAT LNB for the reception of Es´s Hail Sat 2.