

Low cost TVSat LNB disciplined to 10MHz reference

Using commercial TVSat LNBs to receive signals in the 10GHz radioamateur segment is nothing new. Since new PLL based LNBs were launched to market to fit the HD needs for better stability they proved to be useful for Rx of narrow signals like CW and SSB. Size, price and sensibility of these devices are unbeatable.

But one problem is that they use a simple quartz crystal as internal PLL reference, so the long term stability is poor. Temperature variations when operating outdoors make it drift slowly and constantly. One never knows exactly which is the frequency tuned in a received signal.

Finally we can say that this problem has an easy and economic fix. Solution is a 27MHz PLL disciplined with a 10MHz reference. Stability and precision will be as good as the 10MHz reference used.



How to get this ?

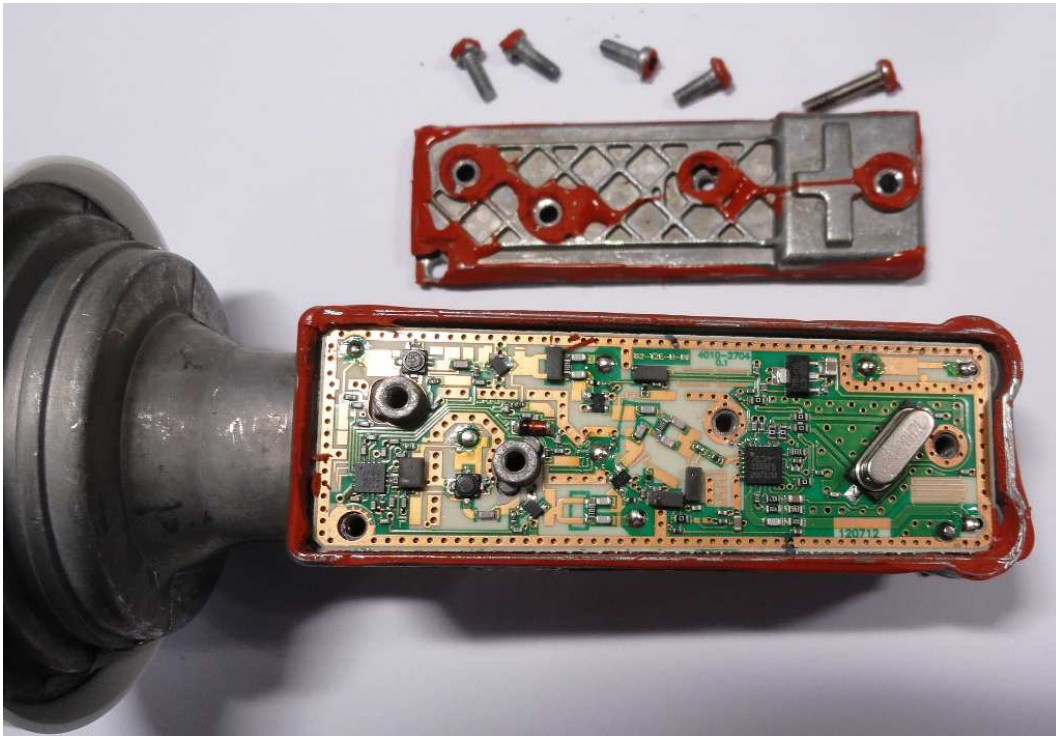
For the LNB we need a dual output (twin) model using an internal 27MHz crystal. Any of this kind will do. We have located in the market the model shown in picture under the brand MICROELECTRONICS TECHNOLOGY INC.

But the LNB business market changes models and availability quite fast. It is hard to get the same models and brands available for long time. New models may be cheaper and it is worth to try and see if they use a 27MHz crystal. With a price well under 10€ it is no such a high risk.

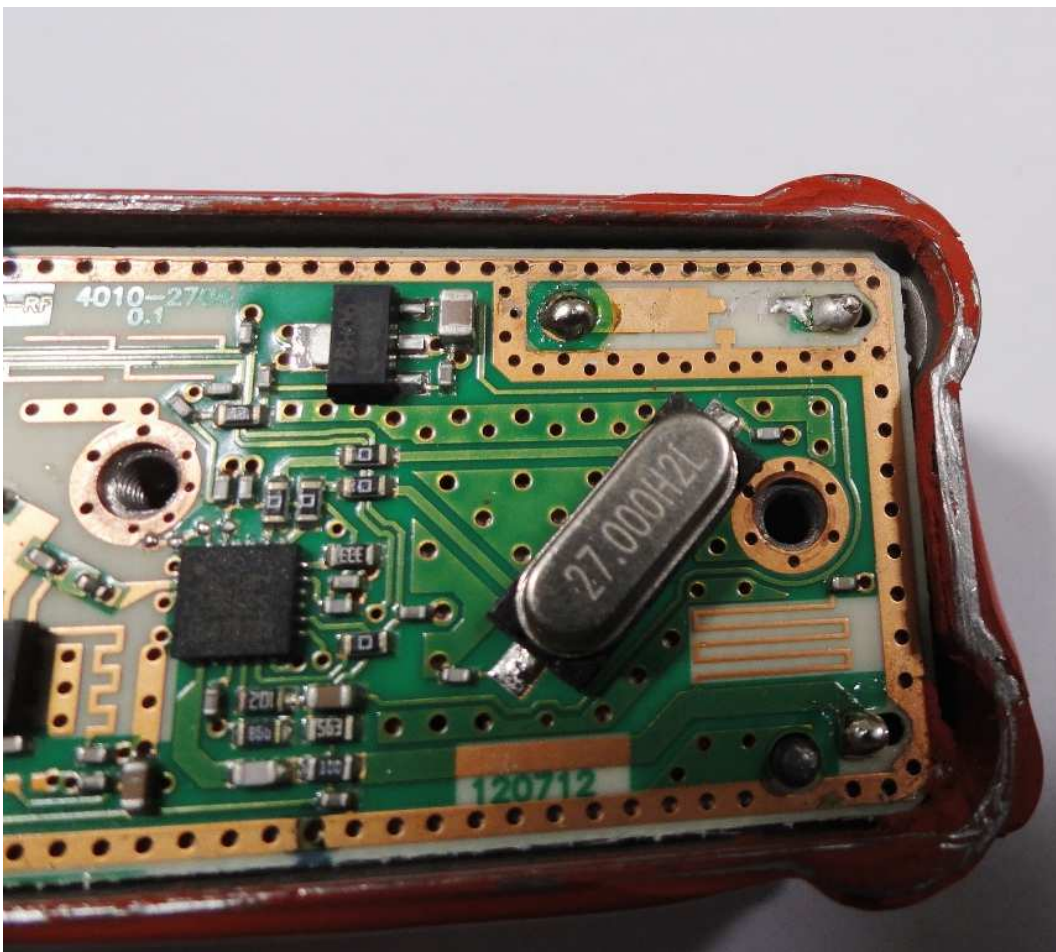
I'll describe the process to modify this LNB, which will be very similar for many others. Differences should be mechanical and related to component position in PCB, than electrical.

First of all the external plastic cover must be removed. It is formed by two shells locked with plastic locks that easily break. Beware to break many of them.

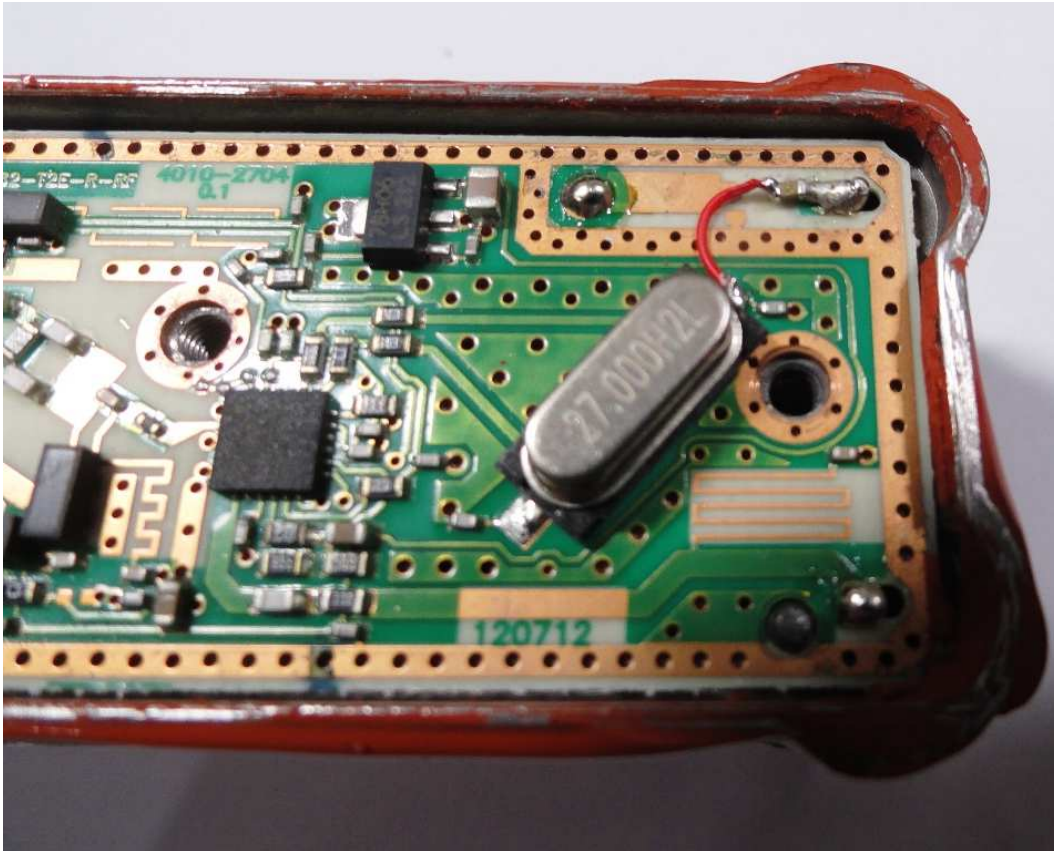
Then we will see to the LNB metal body. The access top lid and screws are sealed to avoid water inlets. Screws are usually TORX N-9 models, not Philips nor Allen. It is recommended to use a proper screwdriver. Once removed all screws (beware some are hidden by the sealant) and gently levering the top lid, it can be opened and there is access to the circuit.



On the right side there is clearly the 27Mhz crystal and the two IF outputs. We will keep the main output as IF which is located down on the right side. The other output (up on right side) will be modified to inject our 27Mhz disciplined reference. First step is cutting the track of this secondary IF output

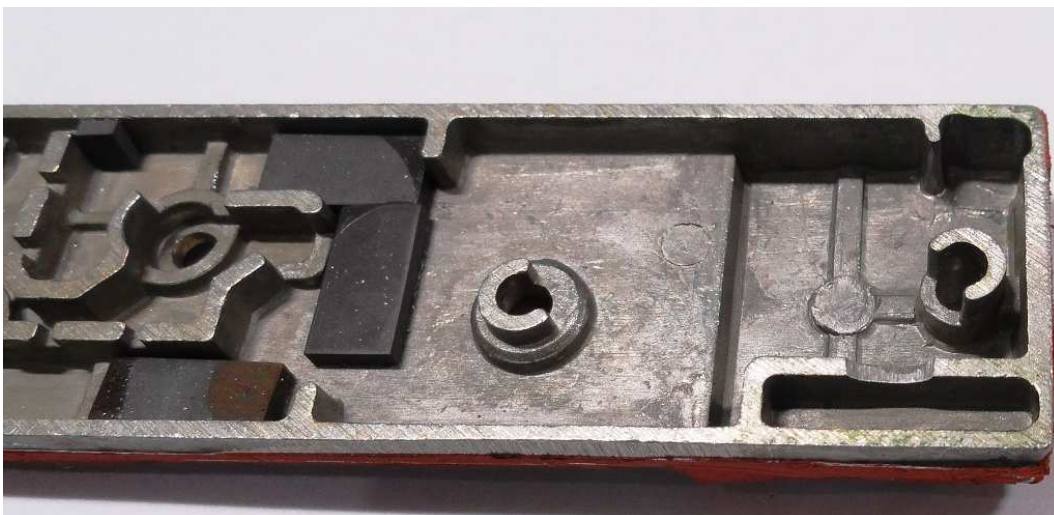


At this point we install an small SMD 0603 1nF ceramic capacitor which will be in serial with the signal to block any incoming DC. The other side of capacitor will link to the closest pin of the quartz crystal using an small wrapping wire



And it is almost done

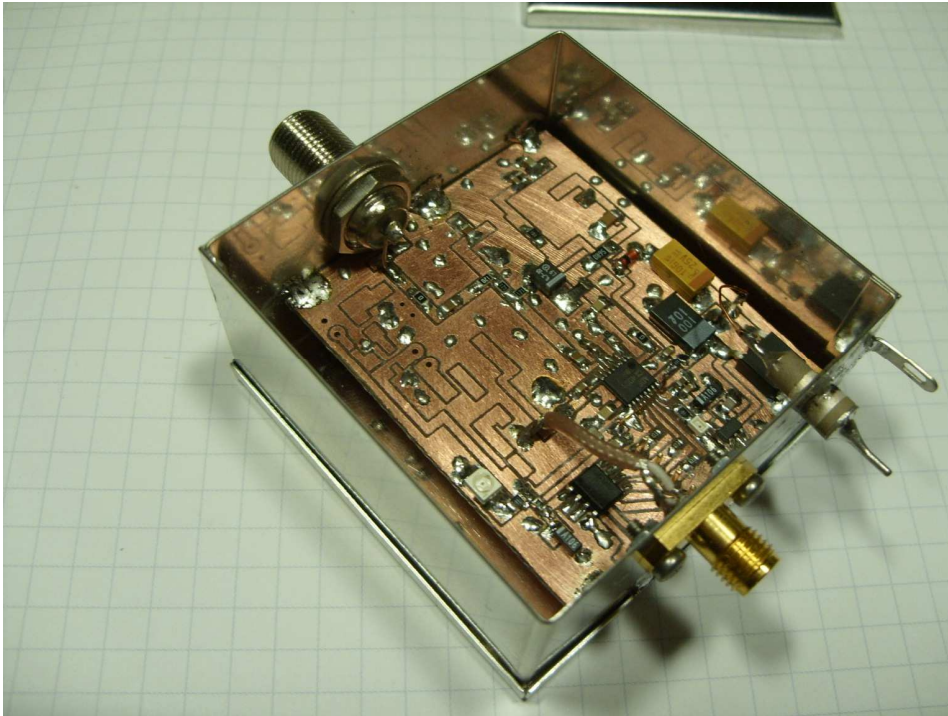
Just need to make a small notch in the metal of the LNB cover, just to avoid the wire shorted or cutted when we get it firmly closed. A little file or Dremel work and it will be ready



Fix the metal lid with the screws again and test the LNB. Check if it work ok. With the modification you can expect some more frequency variation. But this will be corrected when applying the external reference A new sealing with proper sealant will be needed to guarantee outdoor weather resistance

As external reference a 27MHz VCXO is used. This outputs a clean enough signal and its frequency can be trimmed with voltage control

Dieter DF9NP, very famous for his range of PLLs designed a proper PLL to keep this VCXO locked to an external 10MHz standard with minimum phase noise. The PLL is assembled in a metal box with an F output connector which can be easily wired to the LNB using cheap TV cable. The 10Mhz input uses SMA



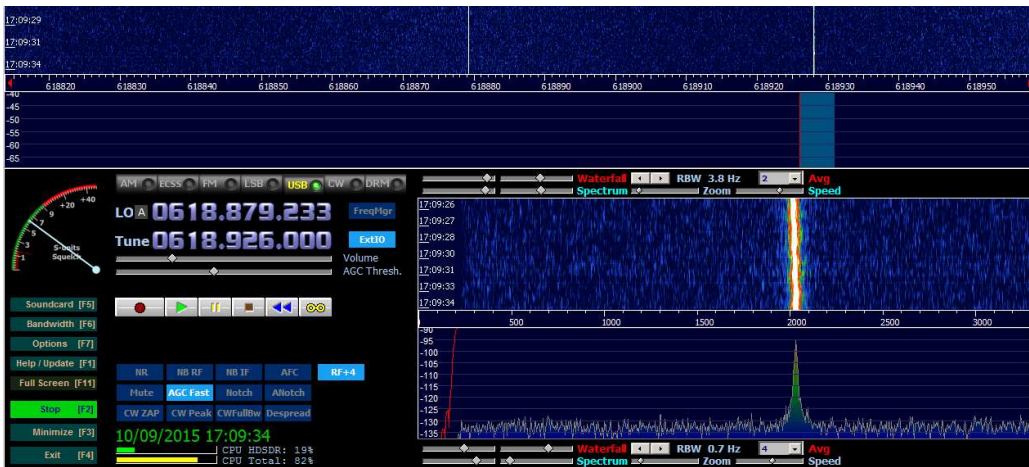
This is the schematic of Dieters PLL

http://microbandas.es/lib/exe/fetch.php?media=microperlas:accesorios:lnb_disciplinado:pll_27mhz_schematic.pdf

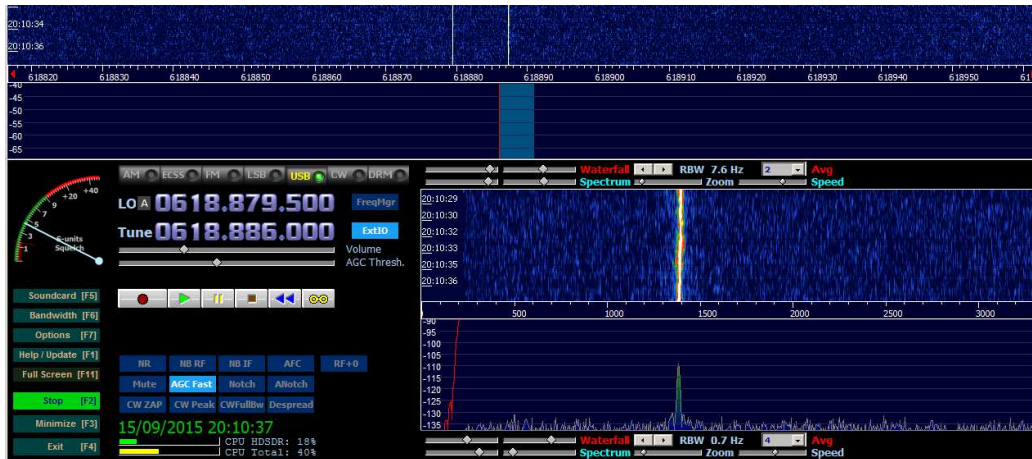
Normally the PLL will be located in the shack close to the 10Mhz reference and the 27Mhz standard will be feed to the LNB using a dedicated cheap TV cable. Of course you can also mix it with the IF and use a single cable. But take care with integrity of the 27Mhz signal. Any noise picked by the LNB PLL will greatly degrade the phase noise of the LNB



I have tested the performance of the LNB using a reference signal generated by a cheap Baofeng UV-3R and this is how this signal looks in the SDR when using the LNB with the original crystal (no ext. reference)



And then the same signal when the external 27Mhz reference is used



Added phasenoise due to the 27MHz PLL is really minimum. You can hardly notice by ear a significant difference when using the LNB crystal or the external reference

The LNB with 27MHz PLL reference and 10Mhz OCXO is already working at Alicante 10GHz WebSDR at: <http://maxiplaya.dyndns.org:8901/>

In a near future will be also installed in Madrid 10GHz WebSDR at <http://matlab.idr.upm.es:8901/>

What is more. The price of the PLL is really affordable. It only needs an external 10MHz reference which can be an OCXO, Rubidium or GPSDO

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