

A cheap and good solution for the IC9700 drift problem!

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The Icom IC9700 is a nice radio with many great features.

Like VK7MO already mentioned in his test report:

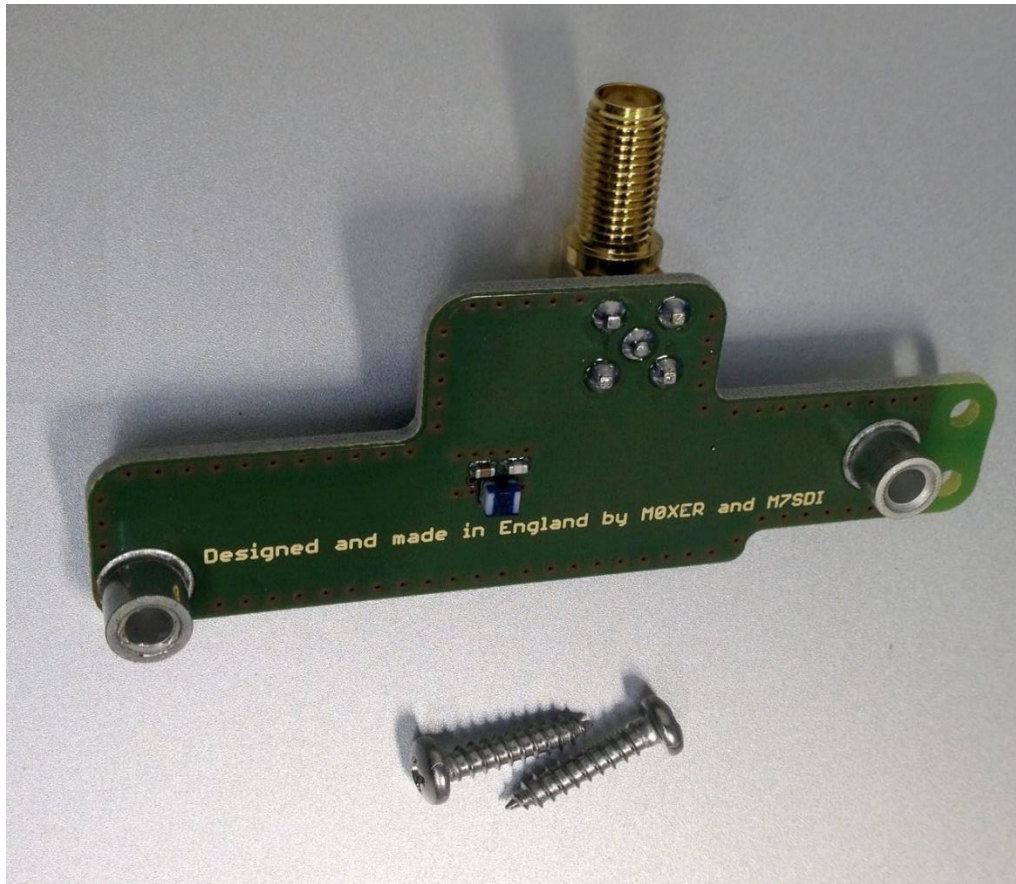
1. An essentially flat passband from 100 Hz to 3000 Hz that is a useful advantage for wide bandwidth digital modes such as MSK144, ISCAT-B and QRA64-E.
2. Internal soundcard, PTT and CAT control all work over a single USB connection which avoids many cables and additional boxes for portable operation, the problem of using modern computers with combo ports (no separate line-in line-out), and reduces hum loops.
3. 1 Hz CAT control stepping for Doppler Correction on EME.
4. A nice feature is the Max power limit which can be set to say 1 watt (or lower) to feed transverters.
5. No ALC overshoot. (Some operators have reported tripping of Solid State PAs - this is not due to overshoot but rather high SWR caused by transmission prior to the antenna relay changing over.
6. A generally very nice radio to use.

But the IC9700 drift a lot and does not really lock on the 10 MHz. REF input. This REF input is used like an old fashioned XTAL calibrator, the way we did in the old days with tube receivers.

There are many test reports on the internet and they all explain the need for a real lock on the REF input. Up until now Icom did not solve the problem. VK1XX published a hardware solution and soon LeoBodnar and MiniKits came on the market with GPS locked references for the IC9700. They all work the same way and inject a strong 49,152 MHz signal in the oscillator circuit of the IC9700. Up until now the VK1XX board is not on the market yet. The other two solutions are proven methods, already used with the IC706 many years ago. The Leo Bodnar device has a disadvantage. It needs a dedicated GPS antenna and receiver system.

Most of the hams needing ultra-stable equipment have a 10 MHz house reference already. Often a GPSDO with 10 MHz output. So do I. And I don't want an extra GPS antenna nor receiver. Time to look for another solution.

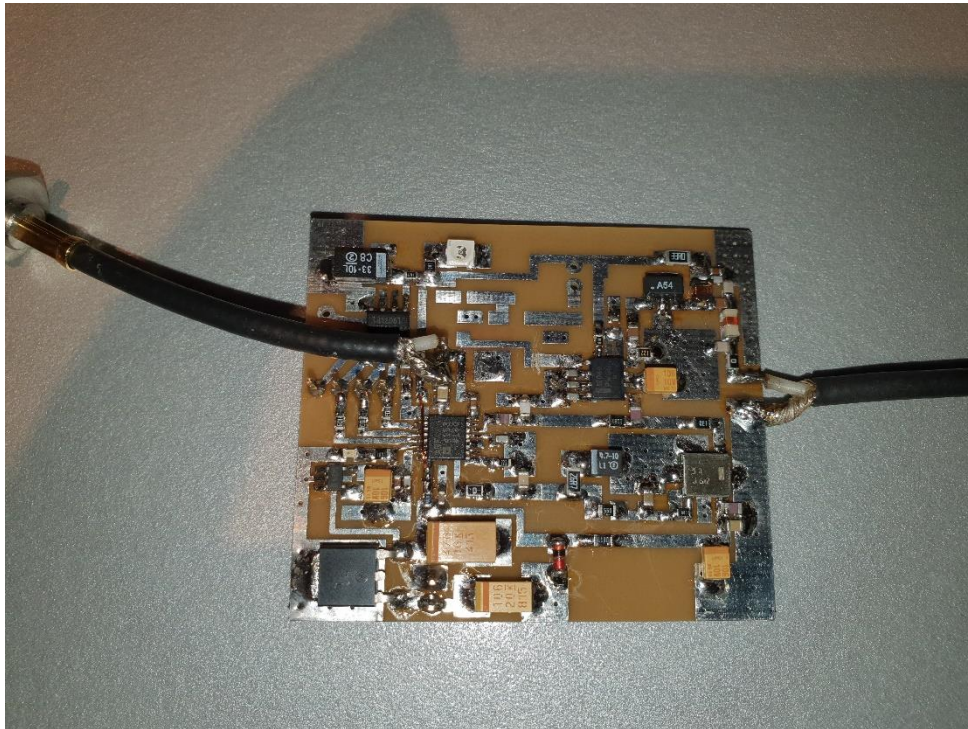
Leo Bodnar in the UK sells injection boards on his web shop. When one feeds a 49.152 MHz. reference signal into this board the IC9700 will lock on it. Have a look on the picture here below.



There is a fine description on the Leo Bodnar web site:

www.leobodnar.com/shop/index.php?main_page=product_info&cPath=107&products_id=352

Dieter DF9NP made me some nice PLL oscillators in the past for GHZ equipment. I contacted him and described my demand for the IC9700. And he confirmed he can make me a 49.152 MHz PLL locked on a 10 MHz reference. Soon the prototype was tested and worked very well with 15 dBm output. Have a look on the picture of the board here below..



Together with the Leo Bodnar injection board it will be possible to lock the IC9700 on the 10 MHz reference. This is a cheap solution. All together around €90.- depending on shipping costs. Dieter DF9NP will sell his PLL board for around €40,00. Ask Dieter for a quote. His site: <http://www.df9np.de/index.html>

Using the board it also means that one need a 10 MHz reference. Without the 10 MHz reference the rig will not operate correct because the PLL will generate noise and spikes. If one will use the IC9700 without the 10 MHz reference the 12 Volt supply need to be switched off the board.

You may also decide to use the PLL board outside the IC9700 and use the REF input SMA on the IC9700 for the 49,152 MHz signal that will be supplied direct to the injection board. Without the external 49 MHz reference the rig will work on its own internal (drifting) oscillator.

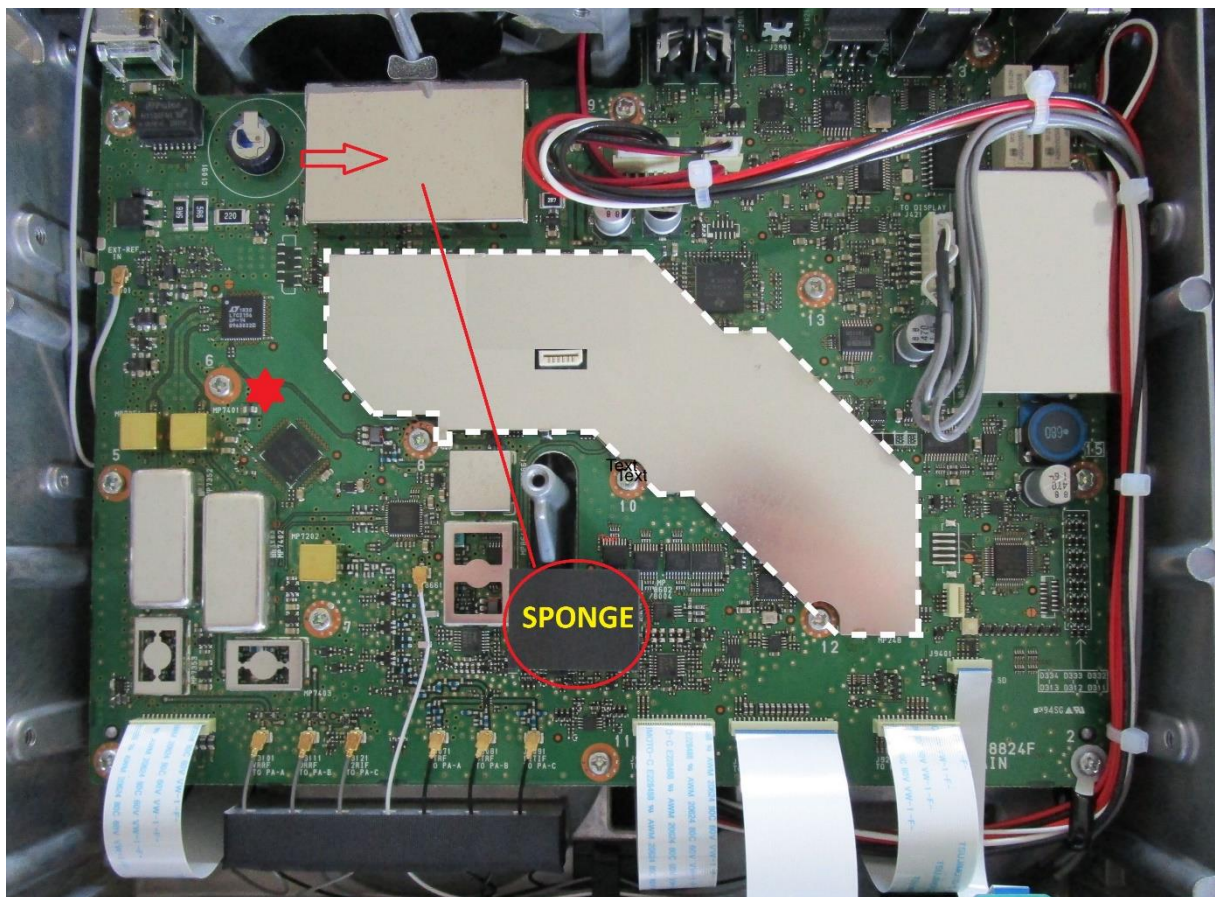
All tests confirmed the stability is within 0,1 Hz with the new PLL on it. A great step forward making the IC9700 a world class radio. It can be used for all demanding digital modes like JT65 for moonbounce.

Installing both boards in the IC9700 is easy.

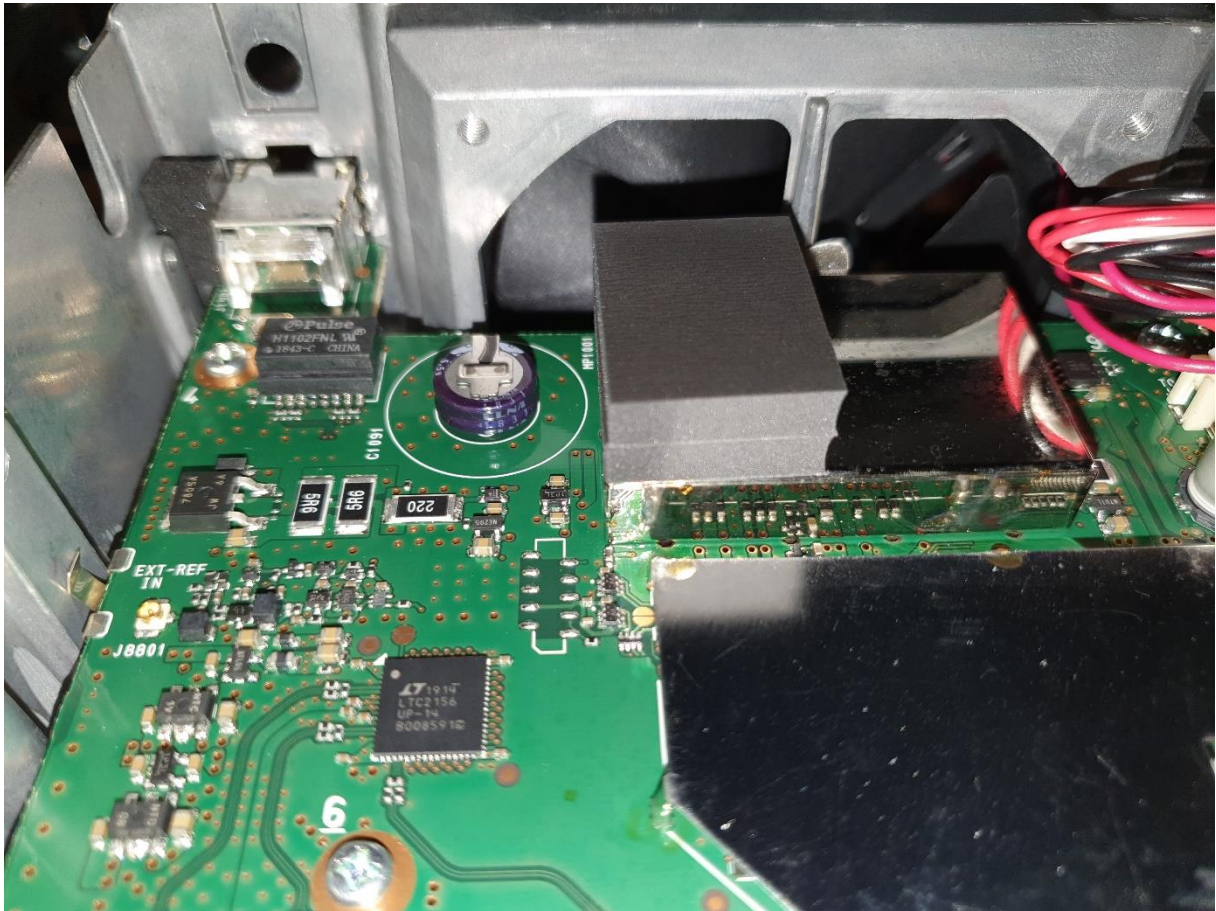
Start to install the injection board as described on the Leo Bodnar website:

- Disconnect all external cables and wires connected to the IC-9700
- Place a soft cloth or clean towel on your working surface to avoid scratching your ICOM IC-9700
- Remove 12 cross-head screws holding the bottom cover - three on each side and six on the bottom. Use the correct screwdriver to avoid stripping screw heads
- Turn IC-9700 upside down, remove the bottom cover and put it aside
- Unscrew the nut holding SMA connector on the back marked "REF IN 10MHZ". Disconnect small U.FL connector, remove and save the cable. *Alternatively*, leave U.FL side connected, place SMA connector, nut and washer into a small plastic bag and securely tape it inside the IC-9700
- Remove black airflow protection sponge and stick it elsewhere inside the IC-9700
- Remove two screws on the main PCB, marked "10" and "11". Put them aside
- Install injection board using two supplied longer screws
- Place old screws into two holes on the injection board for storage

Now put that black airflow protection sponge to the place marked with the arrow on the picture here below. That will be the place for the PLL board.



Also notice the red star on the picture. This will become the DC ground point for the PLL board.



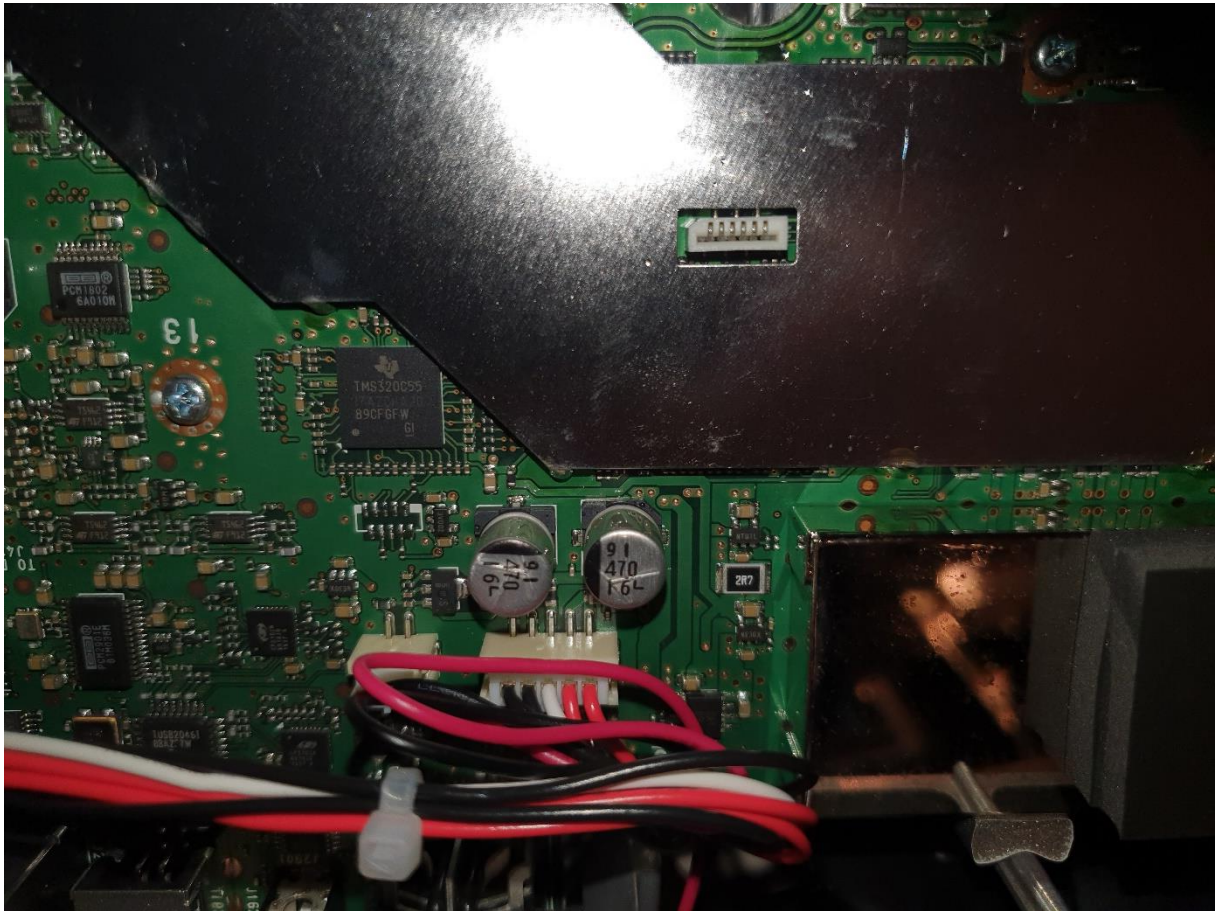
New position for the “sponge”

Put a piece of good quality double-sided tape on the sponge which is on the new place just beside the battery. Now put the PLL board on top of the sponge, it will kept in position with the tape. Now prepare the coax with the SMA socket (female) and mount it on the board and the back side of the IC9700. Make another coax with a SMA male, solder it on the board and connect it on the injection board. I used pieces I had in the junk box. It is not critical but make it as short as possible. Have a look on the picture here below.

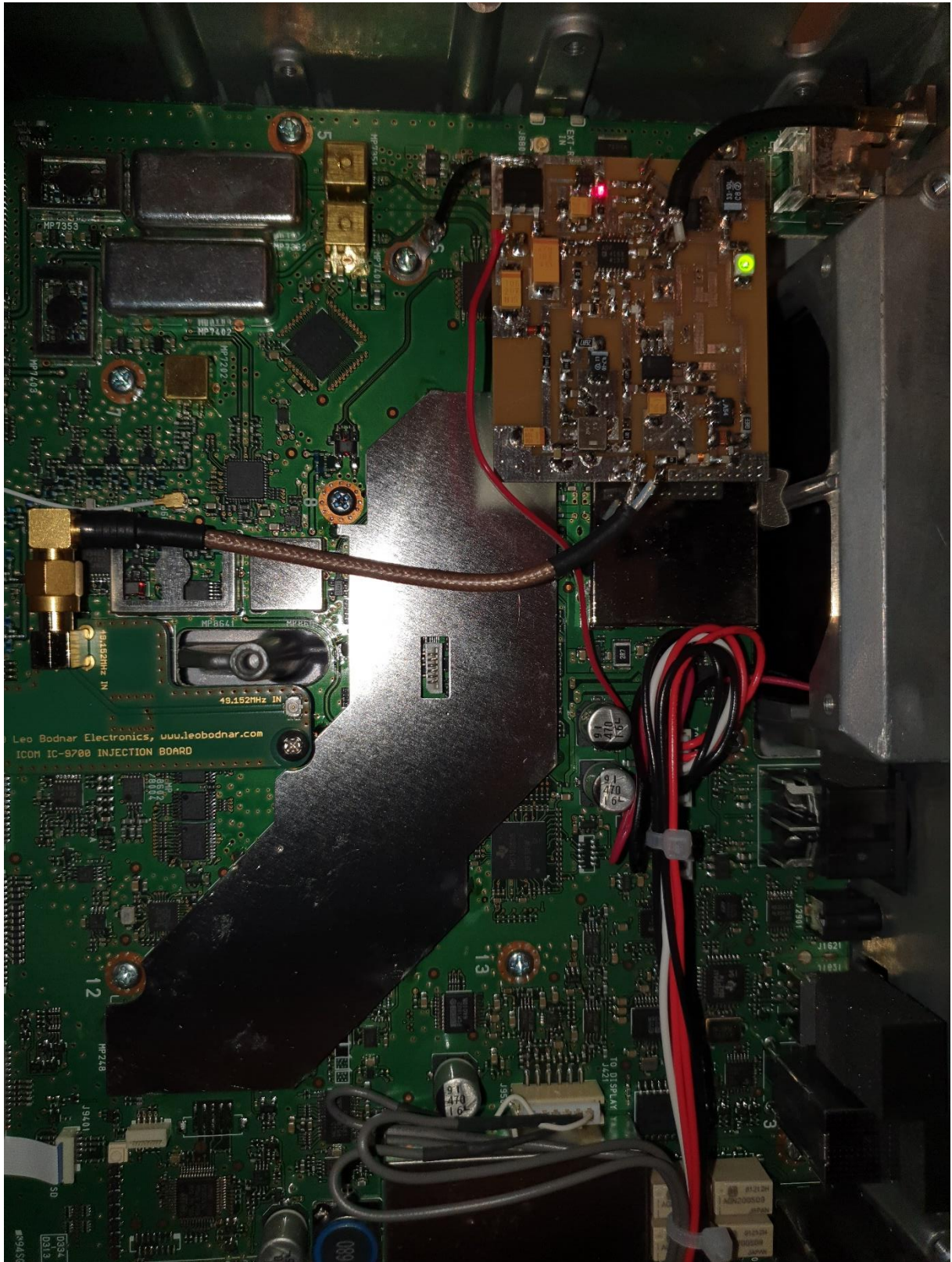


The PLL board need 12 Volt supply. The main board get it on the white plastic connector from the power distribution inside the rig. I soldered a thin red wire on the paths just near the white connector. This is the 12 Volt connection. It correspond with the two red wires on the connector.

If you don't want to solder on the board you might prepare on of the two red wires to take 12 Volt from there. Have a look on the photo here below.



Now you need to create a DC ground for the PLL. I used a lip that I put underneath the screw marked with the red star on the first picture. Use a thick wire for this, it will also act as a extra support for the PLL board and keeps it on the sponge.



Fully functional PLL board in the IC9700

Your IC9700 is ready and you can switch it on. Do not close the rig yet! You need to see the two LED's on the PLL board. When you switch it on the green LED will go on. Now connect a good 10 MHz reference to the back of the IC9700 on the SMA called REF. As soon the 10 MHz reference is connected, the red LED will go on and showing the PLL is locked. If none of the LED's will go on check if there is 12 Volt on the board.

With the board working well you need to setup the IC9700. If you had the rig before installing the PLL board working on a 10 MHz reference it will give an error message telling that it is missing the 10 MHz. Just confirm that and go on. It will not show up anymore.

ICOM IC-9700 Setup Instruction

- Turn IC-9700 on and let it warm up for 5-10 minutes
- Switch to a SSB mode and tune to a reasonably stable CW signal you can hear and see on the waterfall
- Press **MENU** button then tap **(1), SET, Function, REF Adjust**
- Turn on and off external reference and observe CW signal frequency shift. Adjust sliders so that frequency shift is within 10Hz on 2m band (30Hz on 70cm band or 100Hz on 1200MHz band.)
- Exit the menu and test IC-9700 operation.

Troubleshooting - if IC-9700 does not lock

- Make sure external reference is switched on and LED's are on on the board.
- Verify that REF Adjust is set correctly. Coarse scale should be roughly in 40-50% range. Follow fine adjustment procedure above.
- Lock range for proper set up is wider than 100Hz (2m band), 300Hz (70cm band), 800Hz (1200MHz band) in both direction. This is about two times wider than extreme excursion during continuous transmit and receive periods.

Put back the enclosure and all screws. It is all done and you are the owner of a reliable state of the art transceiver. Good luck with it and see you of the moon.

73, Peter Gouweleeuw PA2V

References:

Leo Bodnar

http://www.leobodnar.com/shop/index.php?main_page=product_info&cPath=107&products_id=352&zenid=78ac348b21e00ab507ac21ab57e93b47

DF9NP

<http://www.df9np.de/>

MiniKits

<https://www.minikits.com.au/gps9700>

VK1XX

<http://www.cortexrf.com.au/IC9700lock.html>