

XRef-PLL

Icom IC-9100 Installation Notes

1. Overview

Most modern Amateur transceivers now generate their operating frequency from a single internal Reference Oscillator. In many cases, this Reference Oscillator is voltage-controlled, allowing front panel adjustment of the Reference frequency.

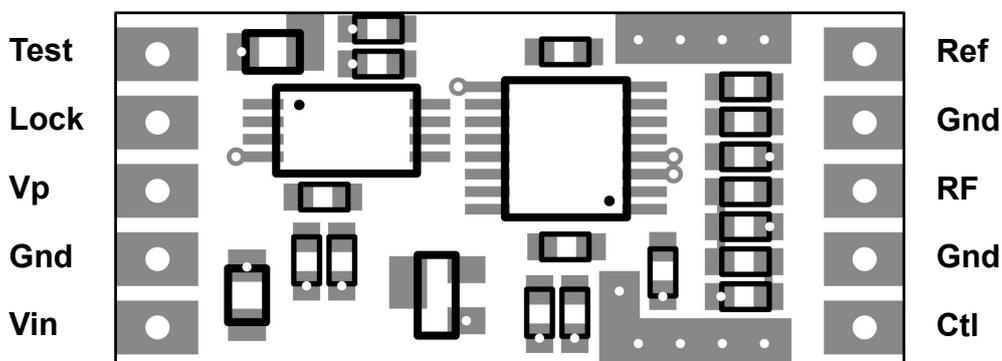
The XRef-PLL locks the radio's Reference Oscillator to an external 10 MHz reference signal from a GPS reference or other high-accuracy source. It intended to be installed internally within the radio. When no 10 MHz reference is connected, the XRef-PLL completely disconnects from the radio, allowing it to operate as from the factory.

In the case of the Icom IC-9100, the Reference frequency is 32.0 MHz.

A Word of Caution: The installation requires a small amount of soldering to very small and fragile SMD components. If you do not have experience with SMD techniques, please seek the assistance of someone who does. We are happy to provide any advice needed, but we cannot take responsibility for any damage to your radio.

2. Technical Specifications

Connections to the board are shown below:



Connection	Description	Specifications
Test	Do Not Connect	
Lock	PLL Lock Indicator	+3.3V (0.1mA max)
Vp	Do Not Connect	
Gnd	Power Ground	
Vin	Supply for XRef	5 to 16 V @ 20 mA
Ref	10 MHz Reference Input	0 to +15 dBm (0.5V to 3.6V p-p)
RF	Reference frequency from Radio.	Radio dependent
Ctl	Control output to Reference VCXO	0 to +3.3V

3. Circuit Modifications

No modifications are required to the standard circuit. The XRef is simply connected to several points on the PLL board. An extract from the circuit diagram in Figure 1 shows where connections are to be made.

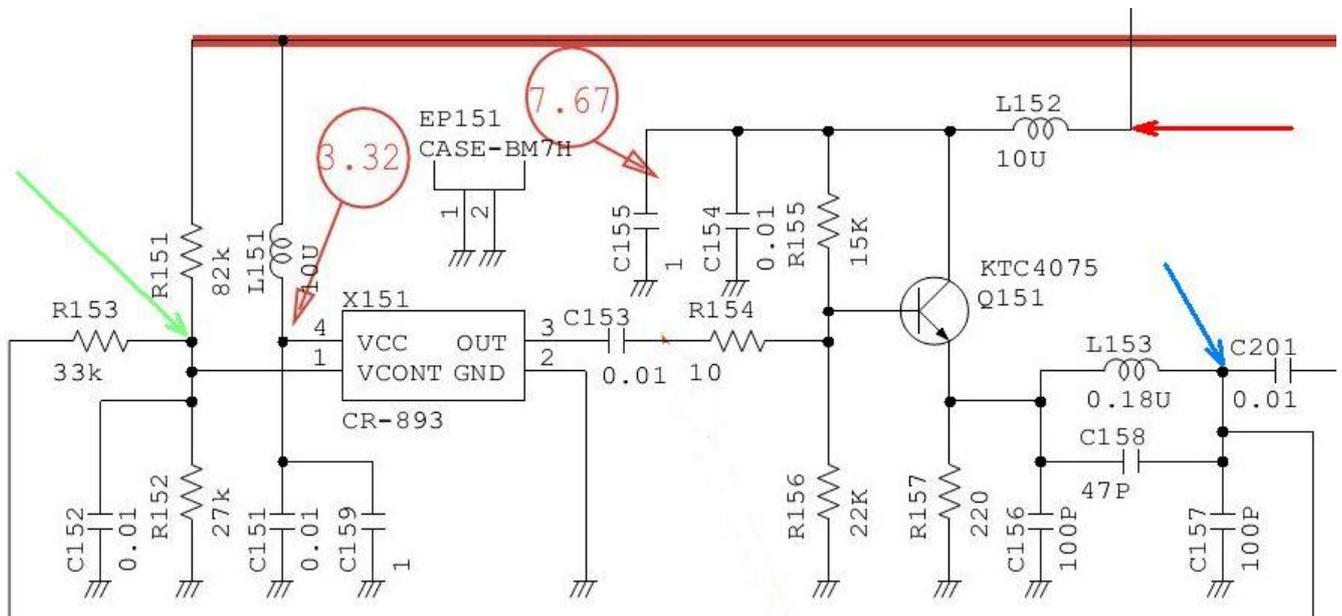


Figure 1. – Icom IC-9100 Reference Oscillator Circuit

- The **Blue** arrow indicates where the output of the Reference Oscillator is sampled.
- The **Green** arrow indicates where the control voltage is fed back to the Reference Oscillator.
- The **Red** arrow indicates where +8V is taken to power the XRef.

4. Installation

For this installation, you will need about 300mm of very thin coax - say RG178B or RG316 and a socket to suit. You will also need some short lengths of very fine gauge hookup wire and a small piece of double-sided foam adhesive tape.

Loosen the two screws holding the handle and remove the bottom cover of the radio.

If you have the optional UX-9100 1200 MHz module, remove it by unscrewing the 4 screws at the corners, and unplugging the leads (see the IC-9100 Instruction Manual for more details). The ribbon cable will pull out of the socket on the IF Unit board. When reassembling, push the ribbon cable squarely back into the socket and be careful not to crimp or bend it. Unscrew the IF Unit board and flip it forwards out of the way. You shouldn't need to disconnect the cables. Put a piece of paper/cloth under it to protect the front panel of the radio. I used some tape to hold it out of the way.

Unscrew and remove the cover over the PLL board.

A photo of the PLL board, taken from the Service Manual, is shown in Figure 2. Locate the Reference Oscillator area on the right side of the PLL board, surrounded by a red rectangle.

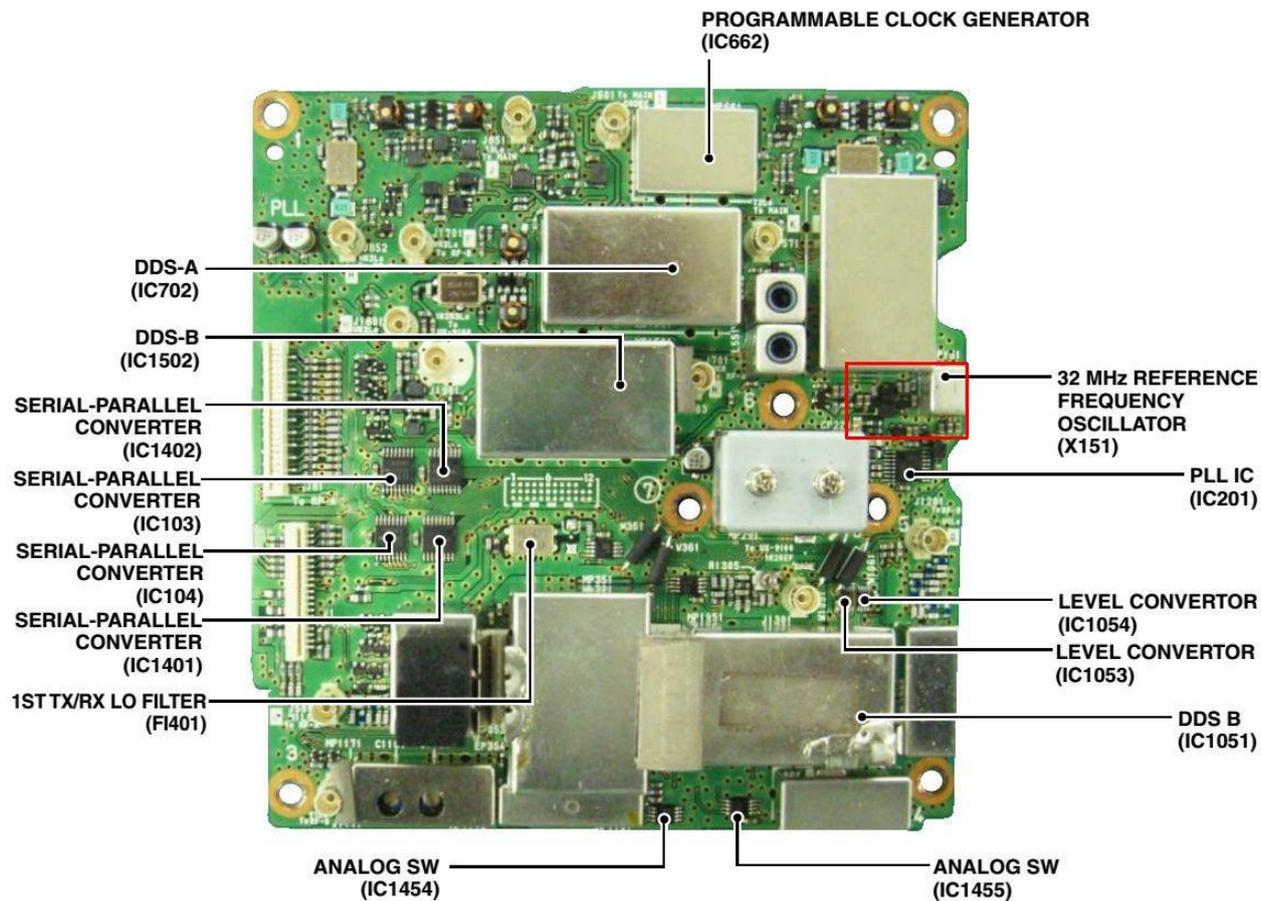


Figure 2. – PLL Board

The connection points in the red rectangular area are shown in Figure 3.

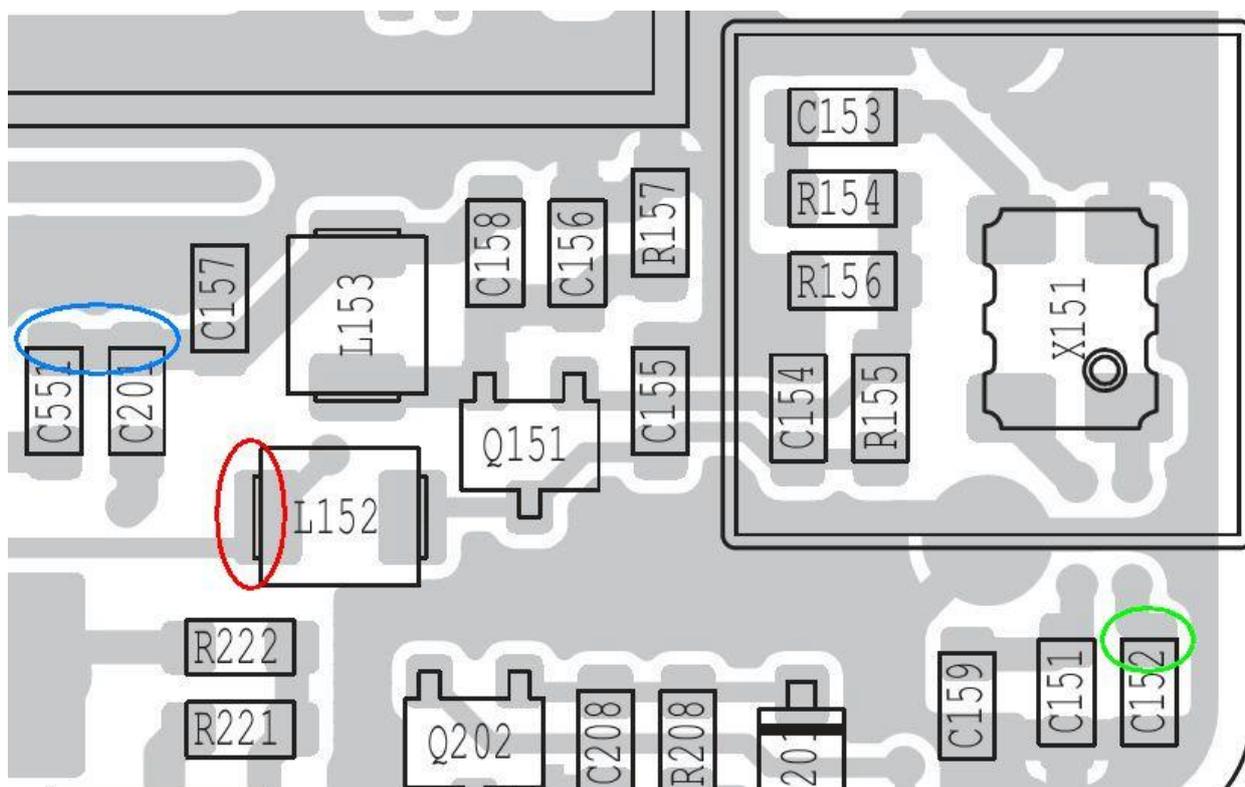


Figure 3. – PLL Board Reference Oscillator Area

Using thick double-sided foam adhesive tape, mount the XRef board on top of the shielded box at the upper right of the PLL board in Figure 2. Mount the board with the Ref/RF/Ctl connections closest to the Reference Oscillator area. The XRef connection pads are double-sided, so check that the underside pads aren't shorting to the shielded box.

The next step involves soldering three short lengths of fine hookup wire to each of the connection points circled in Figure 3. With a very fine tip soldering iron, it is possible to do this with difficulty with the board in place. However, it is recommended that the PLL board be removed from the radio. Whatever you do, be very careful not to overheat the components as they can be easily damaged. I normally apply a small blob of "normal" (i.e. not lead-free) solder to the connection point first, and then attach the already-tinned wire.

Attach the wires to the XRef as follows:

- **Blue** connection to RF pin.
- **Green** connection to Ctl pin.
- **Red** connection to Vin pin.

Also connect a wire from the XRef Gnd pin to a nearby earth connection. I used the tin shield. See figure 4 below for the connection points.

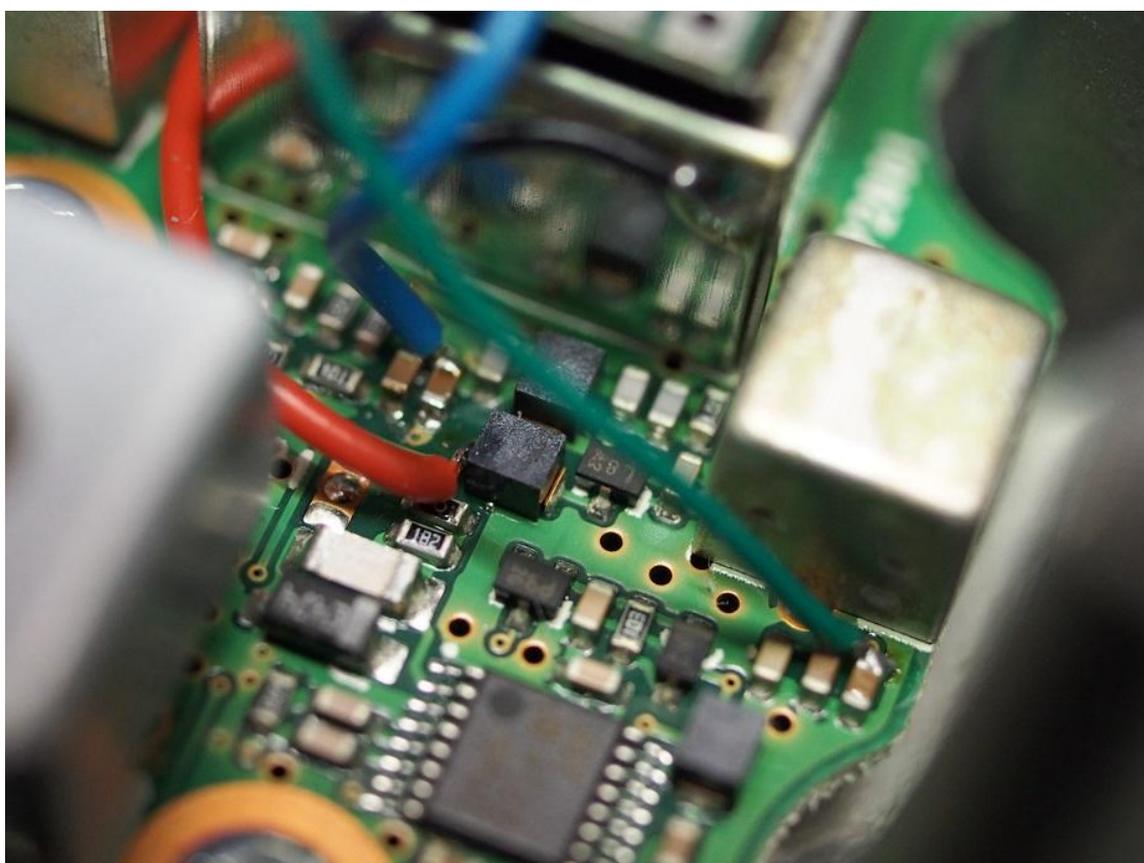


Figure 4. – XRef Connection Points

A picture of an installation is shown in Figure 5 below.

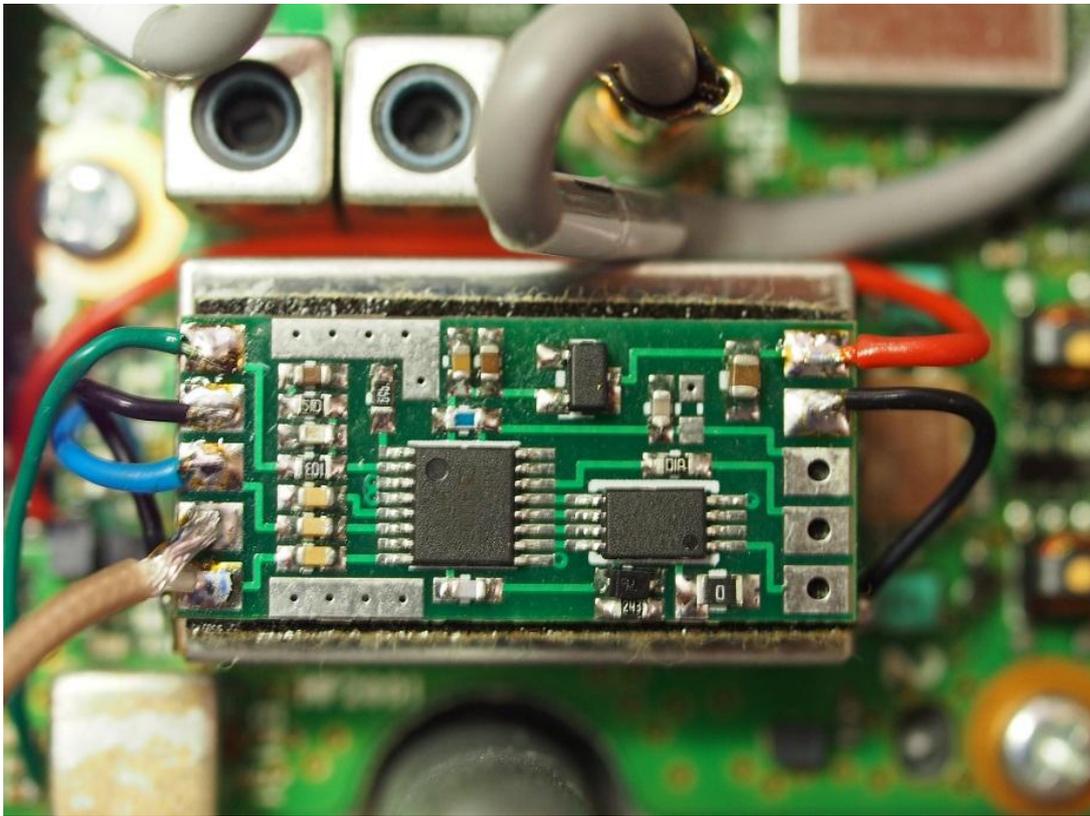


Figure 5. – XRef PLL Installation

Finally, we need to bring 10 MHz in to the XRef. There are several options for this:

- If you don't have the UX-9100 1200 MHz module option, you could mount a BNC socket on the blanking plate that covers the hole for the 1200 MHz antenna connector.
- A socket can be mounted on the back panel near the UX-9100 as shown in Figure 6 below.



Figure 6. – Possible 10MHz Input Socket Location

- There is plenty of blank space in the middle of the back panel where the Icom sticker is normally placed. A socket can be mounted here. Be careful to avoid the strengthening ribs inside the back panel.
- The least-preferred option is to run a flying lead through one of the holes in the back panel. Be aware that you could potentially have RF feedback problems if the coax is not earthed where it exits the radio.

Solder the 10 MHz input coax to the Ref pin on the XRef board. Route the coax taking into account the PLL cover plate and (if fitted) the UX-9100 module which still have to be re-fitted (see Figure 7).

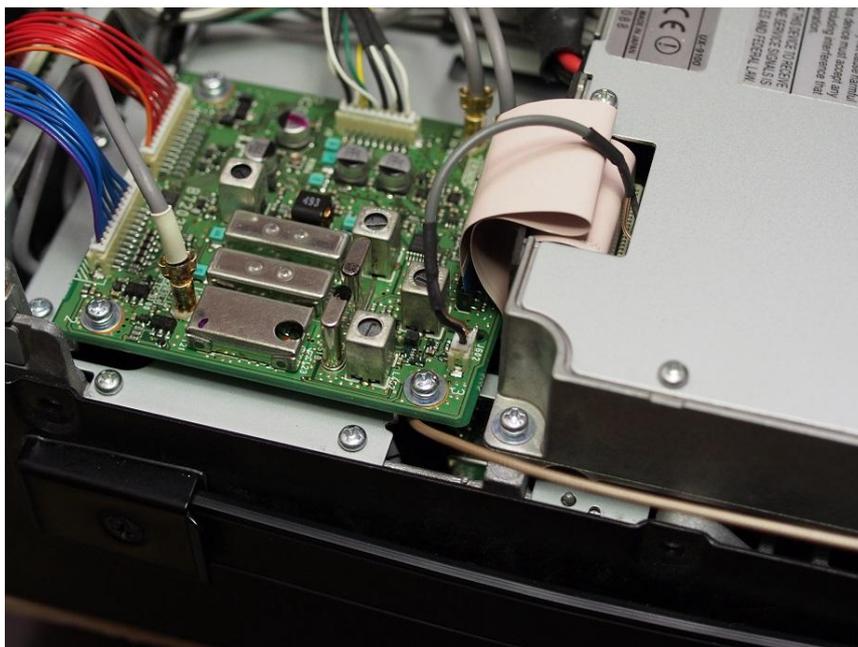


Figure 7. – Example 10 MHz Input Coax Routing

Optionally, the XRef Lock output can be used to drive a transistor switching an LED to indicate when the radio is locked to 10 MHz. Maximum current from the Lock output is 0.1 mA. The LED could be mounted next to the connector on the back panel.

Before putting everything back together, carry out some basic tests.

- With 10 MHz NOT connected, turn the radio on, select SSB mode and a higher band, and tune to a beacon or carrier.
- Enter Menu #69 – Ref Adjust. Adjust the setting up and down and you should hear the beacon tone change indicating the Reference Frequency is changing.
- With Ref Adjust set to say 75%, connect 10 MHz and you should hear the beacon tone jump slightly. Alter the Ref Adjust setting and the beacon tone frequency should now not change except possibly at the extremes of adjustment.
- Bring the Ref Adjust setting back to 50% and exit the menu.

Finally, re-assemble the radio in the reverse order (i.e. replace PLL cover, reinstall the UX-9100 if fitted and replace the bottom cover) and enjoy your new frequency accuracy and stability!

5. Operation

The board continually tests for the presence of the external reference. If 10 MHz is removed, the XRef-PLL will automatically disconnect from the radio, leaving the radio to operate as standard.

If you notice a warble on the signal indicating a marginal PLL lock, try altering the Ref Adjust setting so that there is very little change in the radio's frequency with 10 MHz connected or not.

The 10 MHz source can be a sine or square wave, but it is important that it is clean. The board is, in effect, adjusting the radio's Reference in step with the incoming 10 MHz, including whatever imperfections there may be. The old adage *garbage-in, garbage-out* applies here.

If the radio seems to occasionally go dead, the 10 MHz level is probably too low.

6. Support

If you have any difficulties, you can contact David Smith VK3HZ by email : xref@vk3hz.net