

Xref Versatile

Kenwood TS-2000 Installation Sheet

1. Overview

The XRef Versatile is a replacement Reference Oscillator for a variety of amateur transceivers, intended to be installed internally within the radio.

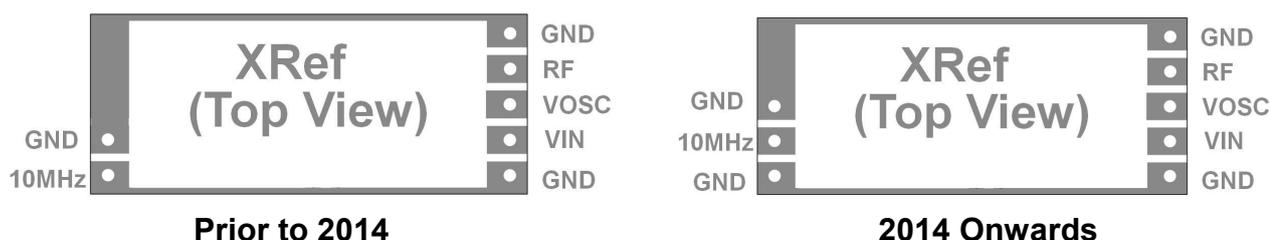
The board takes a 10 MHz reference signal from a GPS reference or other high-accuracy source and generates a precision reference for the radio. It also provides a backup in the case where a 10 MHz source is not available.

In the case of the Kenwood TS-2000, the Reference Frequency is 15.6 MHz.

The version of the XRef that should be used with the TS-2000 is the Xref-VS with onboard power switching. This switches on the radio's own reference when the external 10 MHz reference is not connected.

2. Technical Specifications

At the start of 2014, a new version of the board was produced with different connections for the 10MHz Reference Input as shown below:



Connection	Description	Specifications
VIN	Supply for XRef and, for VS version, passed through to Radio's Reference	5 to 16 V 20 mA for XRef
VOSC	(VS version only) Voltage to Radio's Reference	5 to 16 V 500 mA max
RF	Reference frequency out to Radio.	Radio dependent
10 MHz	10 MHz Reference Input	0 to +15 dBm (0.5V to 3.6V p-p)

3. Circuit Modifications

Circuit modifications involve cutting the power to the internal reference oscillator and injecting a reference signal from the XRef board. The extract from the circuit diagram in Figure 1 shows where modifications are to be made.

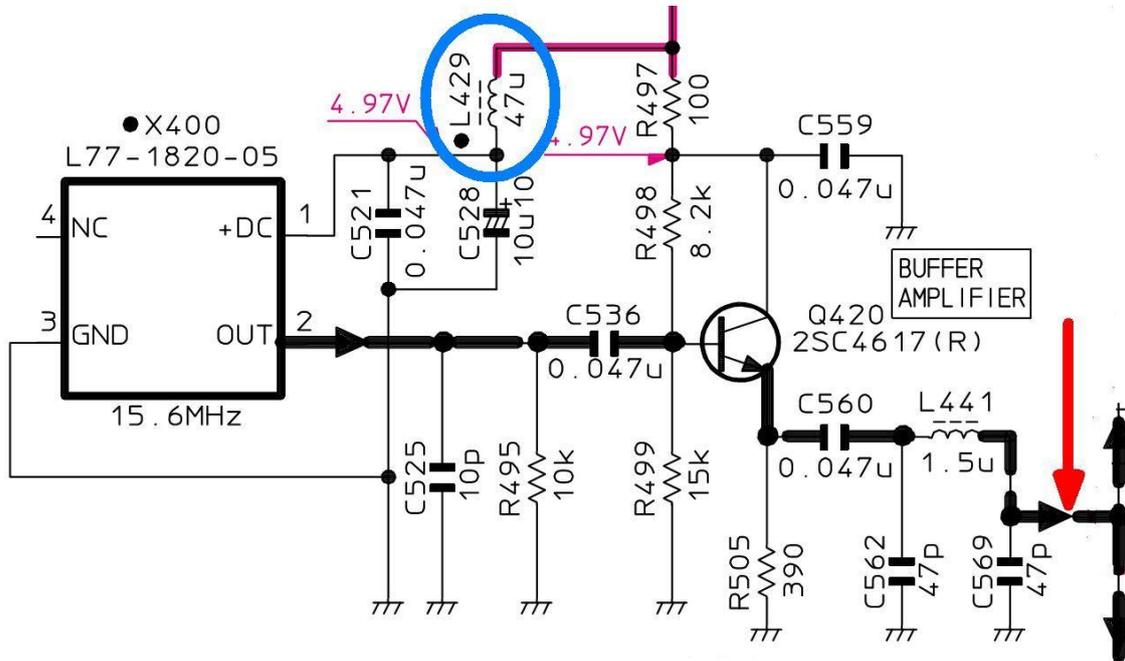


Figure 1. - Kenwood TS-2000 Reference Oscillator Circuit

The blue circle shows where inductor L429 is removed to break +5V power to the standard oscillator. Connections are made to both sides of the break to allow the XRef to control power to the oscillator. The output of the Xref is coupled into the radio where the red arrow points.

4. Installation

Turn the radio upside down and remove the bottom cover. The top cover does not need to be removed. The Reference Oscillator is under the area circled in green in Figure 2 below.

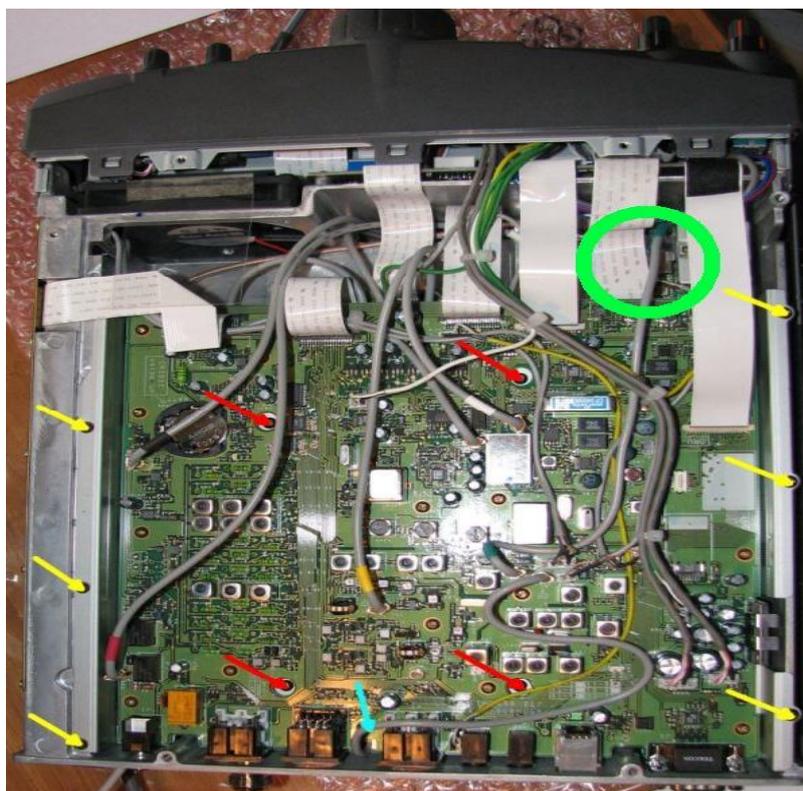


Figure 2. - Location of Screws and Cable

Referring to Figure 2, remove the subchassis:

- Remove the 6 screws (3 along each edge of the main chassis) holding the sub-chassis in place (Yellow arrows).
- Remove the 4 screws that are visible through circular cutouts in the circuit board (Red arrows).
- Unplug the shielded cable that goes over the rear edge of the board (Blue arrow).
- Manoeuvre the subchassis so that the rear panel sockets clear the rear panel, tip it over forwards and lay it flat out over the front of the rig. It may be useful to put some books or a box of suitable thickness under it to support the board.

Most of the ribbon cables can remain connected apart from two which block access to the reference oscillator area. Pull to disconnect them. Tape a strip of cardboard over all the ribbon cables to protect them from an errant soldering iron.

The TCXO, power feed inductor and output are shown in Figure 4 below.

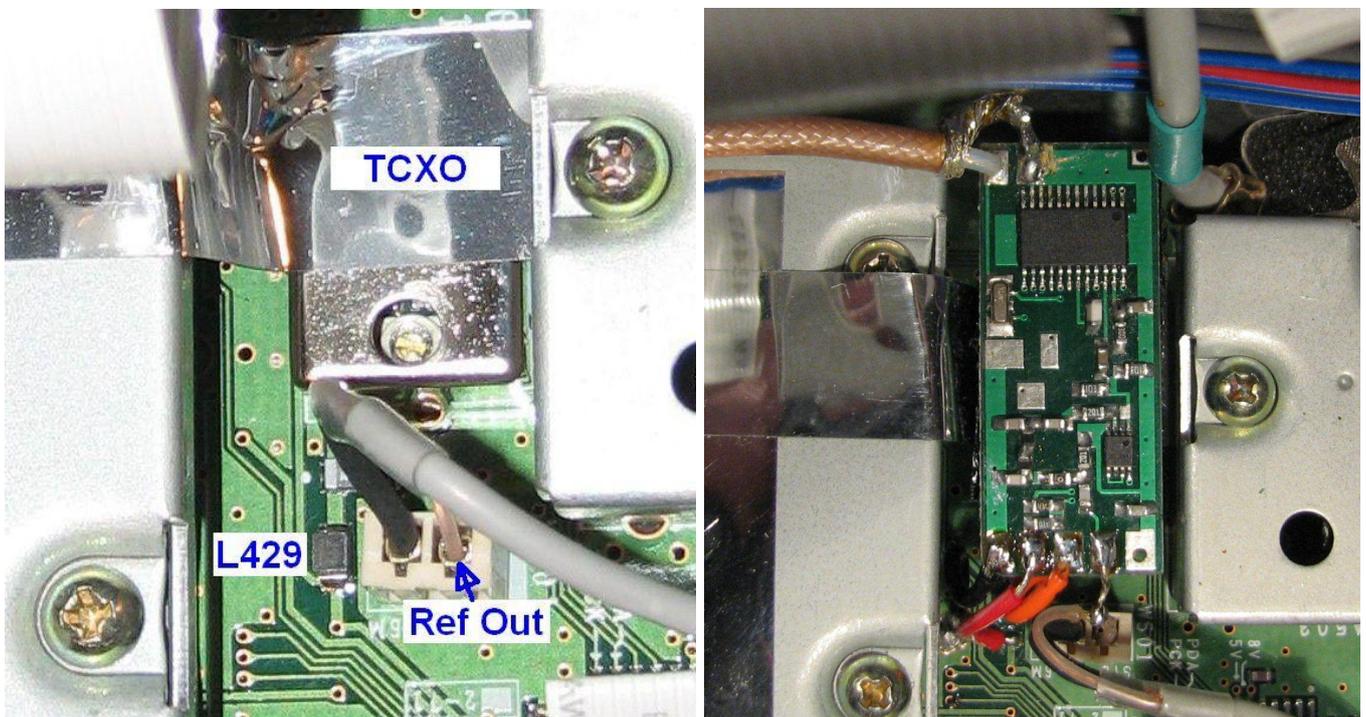


Figure 4. – TCXO Area Before and After XRef Installation

Power (+5V) is fed to the TCXO through L429. Remove it from the board, then solder it in, standing vertically, with one end soldered to the TCXO end of the existing pads (top pad in Figure 3). Solder an orange wire to the upper end of the inductor. Solder a red wire to the lower pad (+5V supply). Solder a black wire to a suitable earth point on the PCB.

The XRef output is injected into the cable labelled "Ref Out" in figure 4. With the soldering iron, carefully melt away a short length of the insulation to expose a section of the inner of the Ref Out shielded cable.

There is some space at the front of the rig, but I mounted the XRef on top of the TCXO using adhesive Velcro. Leave the TCXO tuning hole clear of the Velcro, but the XRef itself sits across the hole and can be removed if the TCXO needs alignment. I soldered a short length of wire directly from the XRef output to the exposed Ref Out cable in the radio.

To feed the 10 MHz in, I used a 4-hole SMA socket bolted diagonally through the ventilation slot near the DC connector. A length of coaxial cable is routed along the edge of the 70cm PA board to the front of the rig, across the front and to the XRef. See Figure 5.



Figure 5. – 10 MHz Input

Solder all wires to the XRef board. See page 1 for connection details. Then mount the XRef in place.

Re-attach the ribbon cables (carefully) and check that all others are properly seated in their sockets. Replace the main board sub-chassis.

Before putting everything back together, you might want to do some preliminary testing. Connect a 10 MHz source to the rear panel connector and check that the radio is working correctly. Turn the radio off, disconnect the 10 MHz source, turn the radio on again and check that it is still working.

Finally, re-assemble the radio and enjoy your new level of frequency accuracy and stability!

5. Operation

The board only tests for the presence of the external reference when power is first applied. Therefore, if you plug/unplug the 10 MHz lead during operation, you must cycle power to the radio for it to operate correctly.

It is important that a clean source of 10 MHz be used as a reference. The board is, in effect, converting the signal you are supplying to the reference frequency of the rig, including whatever imperfections there may be. The old adage *garbage-in, garbage-out* applies here.

It is also important that the 10 MHz reference is stable in frequency before the radio is powered up. The synthesiser chip used in the XRef does a self-calibration when powered up based on the actual output frequency. If the reference frequency is varying, this calibration can fail. If using a GPSDO or Rubidium reference, wait for it to lock before switching on the radio.

6. Support

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