

# Xref Versatile

## Icom IC-910H 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 Icom IC-910H, the Reference Frequency is 30.2 MHz.

There are two versions of the Xref:

- the Xref-VT with onboard TCXO. This completely replaces the radio's own reference oscillator with the TCXO being used when the external 10 MHz reference is not connected.
- the Xref-VS with onboard power switching. This is used when the radio's own reference is to be used when the external 10 MHz reference is not connected.

### 2. Technical Specifications

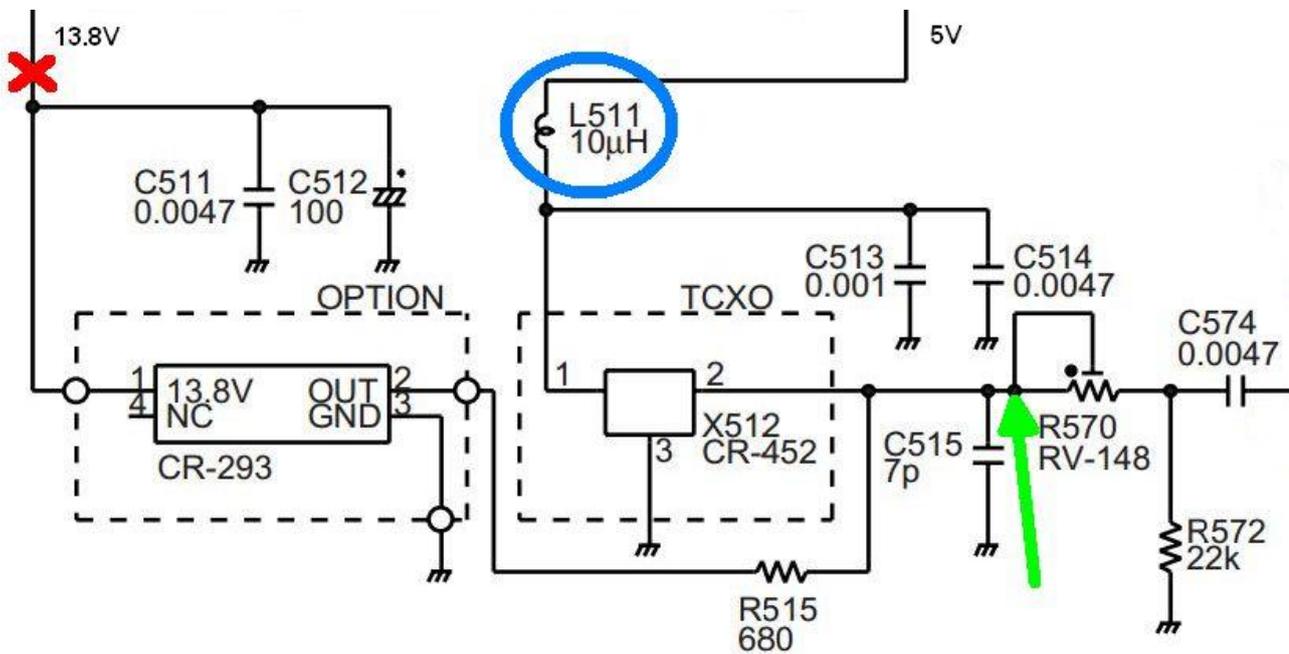
At the start of 2014, a new version of the board was produced with different connections for the 10MHz Reference Input as shown below:



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. - ICom IC-910H Reference Oscillator Circuit**

The power modification is different for the standard oscillator and for the the CR-293 Hi-Stab option. The blue circle shows where inductor L511 is removed to cut +5V power to the standard oscillator. For the Hi-Stab option, a track is cut in the 13.8V feed where the red cross is shown. For the XRef-VS (switched) version, 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 green arrow points.

#### 4. Installation

Remove the 4 screws on the side and 5 on the bottom of the radio's case and then remove the bottom cover.

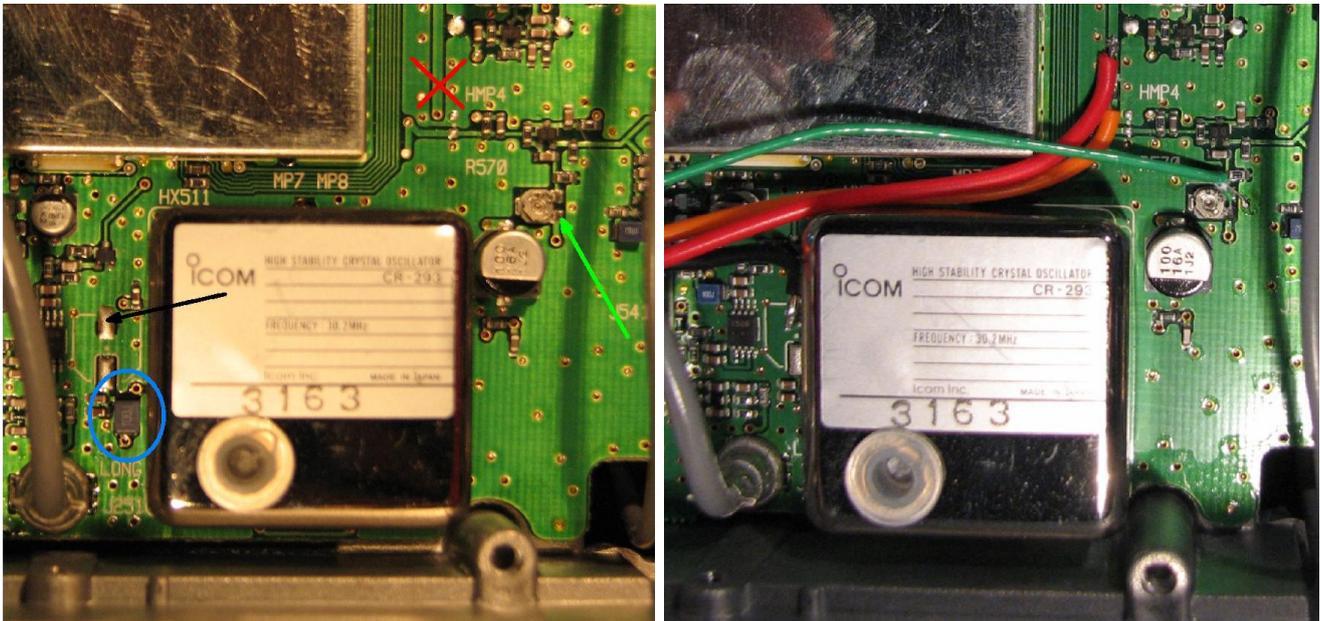
If you have the UX-910 23cm option installed, remove the 4 screws holding it down. Unplug the coax cable coming out the side of the UX-910 from the connector in the PLL board (under the tin shield). Move UX-910 out of the way to give clear access to the shield over the PLL board.

If there are DSP units installed on the PLL shield, move them out of the way.

Remove the 6 screws from the PLL shield cover, then remove the PLL shield cover.

Identify which Reference Oscillator is in your radio. The oscillator is near the outside edge of the board towards the rear. The High Stability CR-293 unit is large and has a label identifying it. If there is only a small crystal oscillator, then you have the standard reference. The following photos are of a radio fitted with the CR-293 Hi-Stab option.

Referring to Figure 2, we now need to sort out the power supply, which is different for the two oscillators.



**Figure 2. - Reference Oscillator Area - Before and After (VS and Hi-Stab)**

### **For the standard oscillator**

Supply is +5V fed to it via the inductor circled in blue to the left of the "before" photo. Carefully remove this inductor. Solder a red wire to the lower pad (+5V supply). If you are installing the XRef-VS (no TCXO), then solder one end of the inductor to the upper pad so that the inductor is sticking straight up from the board and solder an orange wire to the upper end of the inductor.

### **For the CR-293 High Stability oscillator**

Supply is +13.8V fed to it via the PCB track with the red X in the upper right of the "before" photo. Carefully cut this track about 1cm up from the lower end. Attach a red wire to the upper section of track (+13.8V supply). If you are installing the XRef-VS (no TCXO), then solder an orange wire to the lower section of cut track.

Solder a black wire to a convenient earth point. I used the vacant pad to the left of the oscillator module, pointed to by the black arrow in the "before" photo.

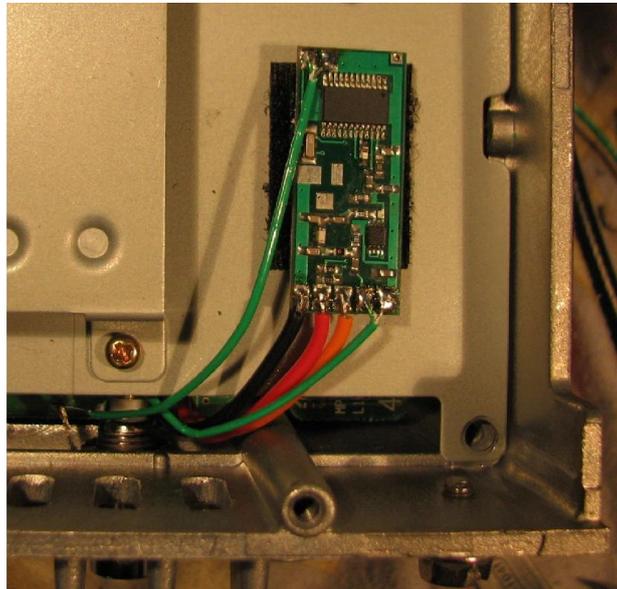
The XRef output is injected into the track pointed to by the green arrow in the "before" photo. Solder the inner of the coax (supplied) to the lower leg of the trimpot. Solder the braid to the earth Via immediately to the right of the trimpot.

Carefully drill a hole in the small blanking plate in the back panel for your connector. I use a cordless drill at very low speed, with the radio inverted to avoid getting metal filings into the radio. Mount the connector.

Put the PLL shield cover back in place, running the wires through the gap between the cover and the rear panel of the radio.

I mounted the XRef on the PLL shield cover using adhesive Velcro to hold the board in place (see Figure 3). Solder all wires to the XRef board. See page 1 for connection details.

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.



**Figure 3. - XRef Installation**

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.

If you have the XRef-VT (TCXO) version, the onboard TCXO was set to the correct frequency during testing. However, the TCXO may drift due to aging during early days of operation. The TCXO frequency is set by the multi-turn trimpot on the XRef board.

If you have the XRef-VS (Switched) version and there is a substantial difference in receive noise level when operating with and without 10 MHz connected, then the XRef output level may need adjustment. This can be done by changing the value of the output coupling capacitor on the XRef board. The standard capacitor is 0603 SMD 15 pF. Increase/reduce this value to increase/reduce the noise level when running on external 10 MHz. A larger SMD package size (or even a small disc ceramic) should also fit.

## 6. Support

If you have any difficulties, you can contact David Smith VK3HZ either:

- by email : [xref@vk3hz.net](mailto:xref@vk3hz.net)

- by telephone : (+613)/(03) 9013 1919