Modifying the Yaesu FT-817
External 10 MHz Reference Input

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Introduction

This document describes the modification of an FT-817 to lock it to an external 10 MHz source.

So, why do this modification? Weak-signal experiments require a rig that is both stable and accurately on-frequency. The FT-817 derives its internal mixing frequencies from a single 22.625 MHz Reference oscillator whose frequency is effectively multiplied 20 times for the 70 cm band. The standard oscillator does not use any special techniques to enhance frequency stability (temperature control etc.) and so the rig can drift considerably as temperature changes during transmission. A TCXO option is available, but this only provides better stability, not absolute frequency accuracy. A stable external Reference oscillator (e.g. GPS-locked) will improve performance significantly.

Description of Internal Reference Oscillator

An extract from the Yaesu FT-817 Technical Supplement showing the internal Reference oscillator circuit is given in Figure 1.

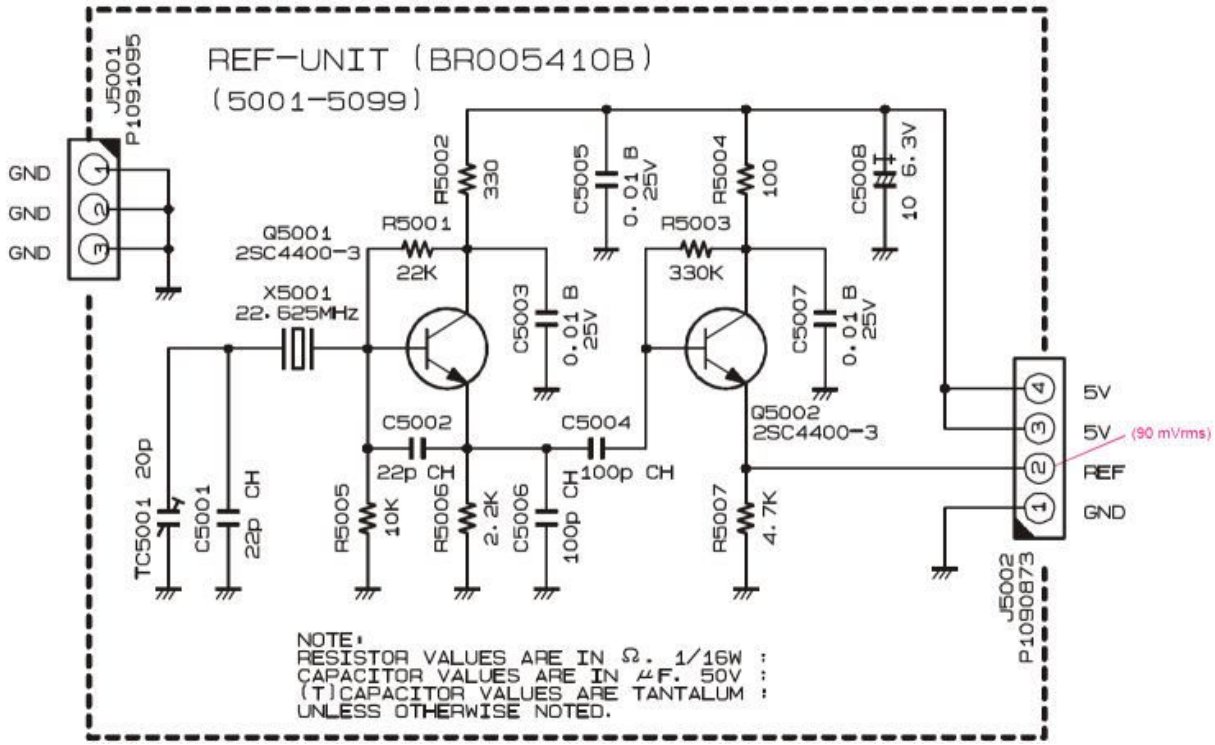

Figure 1 – Reference Oscillator Circuit Diagram

The Reference Oscillator is constructed on a small board as pictured in Figure 2.

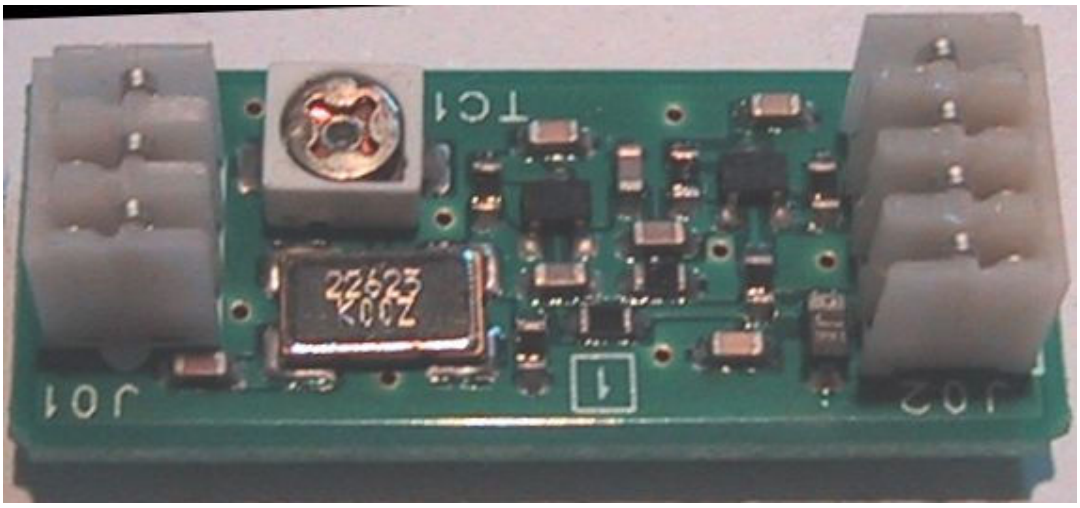

Figure 2 – Reference Oscillator

This board can be unplugged from the FT-817 mainboard so that the TCXO option can be installed in its place.

Modifications

It was decided to remove the internal reference oscillator and build in a PLL oscillator locked to an external 10 MHz reference source. As the FT-817 is never used on batteries, the battery holder was removed and the PLL Oscillator built into the space.

The PLL Oscillator circuit is shown in Figure 3.

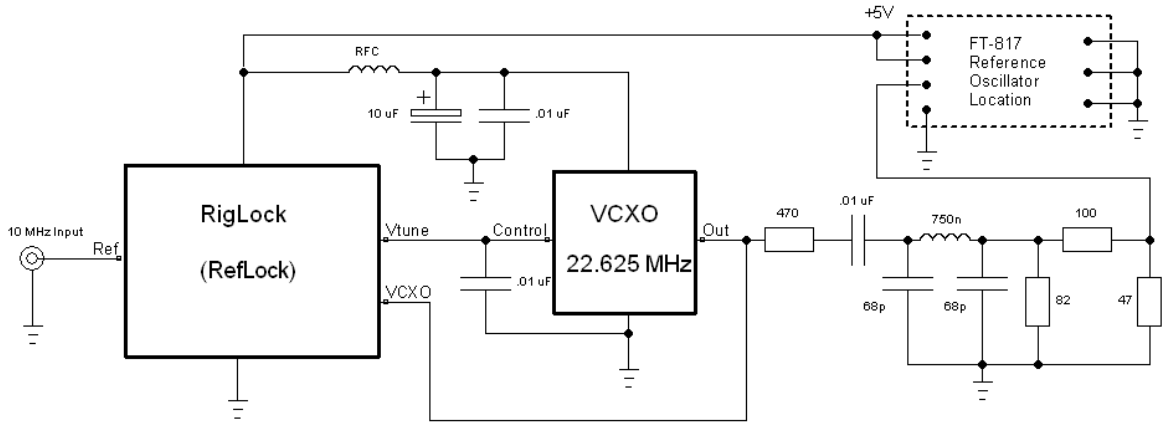

Figure 3 – PLL Oscillator Circuit

The PLL is a CT1DMK Reflock 1 board onto which I have installed my own firmware ("Riglock"). The Riglock firmware has several link-selectable fixed divider configurations suitable for locking an FT-817/847/857/897 (22.625 MHz), TS-2000(X) (15.6 MHz) or IC-910H (30.2 MHz) to a 10 MHz reference. The VCXO and PLL is shown in Figure 4.

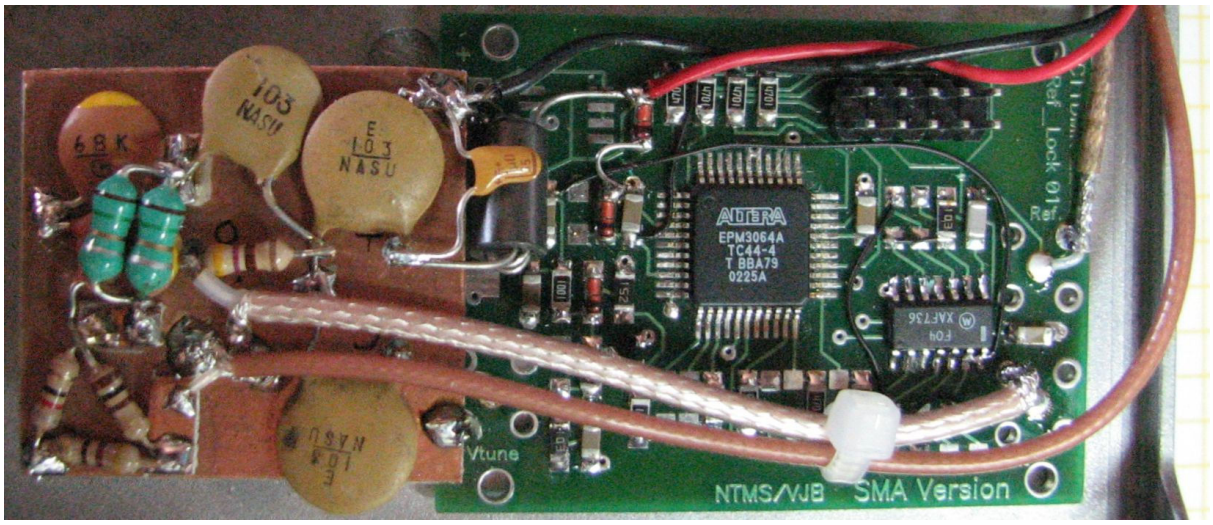

Figure 4 – VCXO and PLL

The Reflock board was modified to fix a bug with the programming voltage, and to substantially reduce current drain. Most of the 74F04 gates were disabled (inputs to +5V). Only one gate is used in the VCXO path to clean up the signal, and two in the Reference path. Pullup resistors for any inputs that are wired low were removed. The load resistor on the 3.3V rail was also not needed. The modified Reflock and PLL run from the FT-817 internal +5V supply without any problems.

An alternative to the Reflock might be the VE1ALQ Versatile PLL. I have not investigated whether the PCB will fit in the available space, or if the current drain would be excessive.

The VCXO can is mounted under the PCB with pins through holes in the board. The components are wired point-to-point with several small pads of PCB used as connection points. Note that the .01uF capacitor connected directly from the VCXO control pin to ground replaces the loop timing capacitor on output of the Reflock board, which must be removed. The capacitor is mounted at the VCXO to minimise earth loop noise.

The VCXO and PLL boards were fastened to the FT-817 chassis using double-sided foam tape.

The installation can be seen in Figure 5.

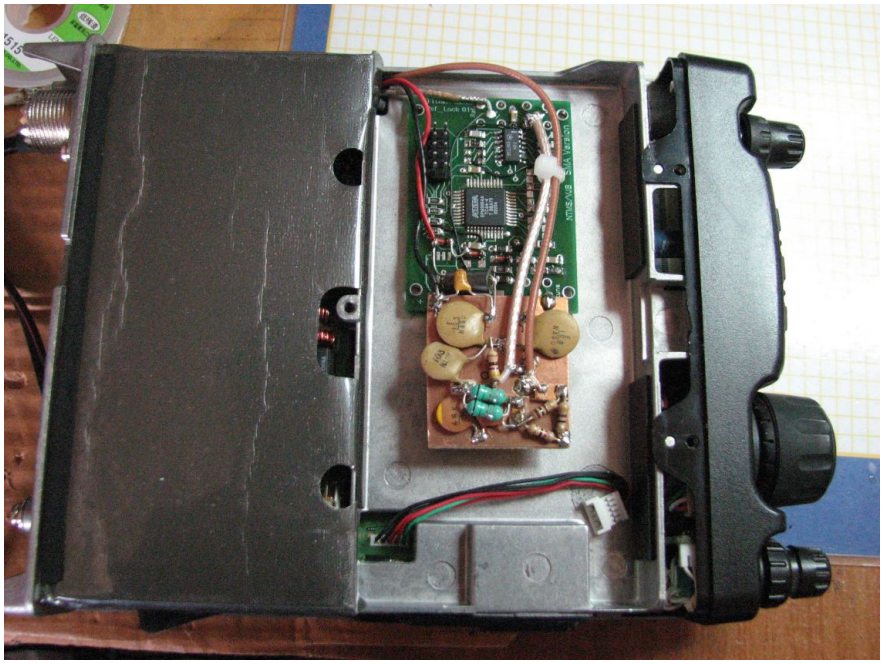

Figure 5 – VCXO and PLL Installation

The cables to connect to the Reference oscillator mounting pins were routed through a slot in the chassis. The Reference oscillator connections are shown in Figure 6.

Figure 6 – Reference Oscillator Connections

An old PC ribbon cable connector (crimp) was sawn into short pieces to form connectors (3-pin and 4-pin) – pin spacing is 2mm.

A hole was carefully drilled and an SMB socket was mounted on the back panel for the 10 MHz input.

Testing

With nothing connected to the 10MHz input, the rig should function correctly. The actual frequency will depend on the TCXO. With no 10MHz, the PLL output voltage will sit at mid-point, setting the TCXO frequency accordingly.

While listening to a CW signal on one of the VHF/UHF bands, connect a clean, stable 10 MHz source to the rig. Level should be around 1 – 2 V. If all is working OK, there will probably be a slight jump in frequency. There should be no change in signal quality.