

Digital Display Guide for Transceivers by Chuck Adams, K7QO

The QRPGuys digital display and frequency counter is a very nice display for use in QRP transceiver kits that do not have a digital display or for use in home brew projects on the workbench. It has a multitude of uses. This document will cover how to use it for some common transceiver kits.

I assume that you have read the assembly manual and the instructions on how to use the command button on the unit. I will explain here the steps, but knowing the instructions in the manual will speed things up for you.

The digital display is based upon the design of DL4YLF. It is a simple hardware design and even made more simple by using the five digit display so that you do not have to have the complex board layout for five individual seven segment LED digit displays.

A pre-amp provides a high impedance interface and amplification of the input RF signal to give you a high impedance input. This allows you to measure small RF signal levels, as we will see in the first transceiver installation, and to minimize the effect of having the display attached to the VFO section of the receiver or transceiver.

THEORY

The digital display has only one signal input. This signal is usually provided from the local VFO or VXO of the project. For a super heterodyne receiver or for a transmitter the VFO is combined with another frequency, using a procedure called mixing, for the purpose of obtaining the desired frequency output in the case of the transmitter and for the purpose of getting the signal to be received in the receiver.

If you have two frequencies, VFO for the frequency of the VFO and IF for the intermediate frequency of the receiver, the mixing will give you the desired frequency by either addition or subtraction. $VFO + IF$ gives you the desired frequency for addition. $VFO - IF$ or $IF - VFO$ for subtraction to get the desired frequency.

Let's take the One Watter, 1W, from KitsAndParts.com, transceiver for 20 meters as an example. The VXO is at 8.059 MHz and the IF is at 6.000 MHz for operation at 14.059 MHz in the 20 meter band.

This requires addition of the two frequencies $8.059 + 6.000$ to get 14.059.

1W TRANSCEIVER INSTALLATION

To use the digital display in the currently popular 1W from Diz, W8DIZ, at kitsAndParts.com, you need to take the VXO signal and measure it and then add the IF frequency to the number and then display that result. You must be very carefully when having an operating transceiver (one that is powered up) and measuring signals and voltages internally. Any conducting object dropped or placed in the wrong place will result in destruction of a lot of work. So, be very careful.

The first thing we want to do is measure and store the IF frequency into the internal memory of the microprocessor of the digital display.

Do the following with the power off.

Since the spacing on the IC chips is 2.54mm, you need to be extra careful not to short things out. I use a 10cm length of INSULATED 24 AWG solid wire. Remove 1mm of insulation from one end and tack solder it to pin 7 of U5, the NE602A mixer, in the receiver section of the transceiver.

Temporarily attach this wire to the input of the digital display. Attach the ground input of the display, via a small wire, to one of the ground mounting points on the PCB of the transceiver. Again, using insulated wire.

Now power up both the display and the transceiver. The display should be displaying a value of 5.9994 MHz or so. Rarely will you ever get 6.0000 MHz, as the oscillator in the NE602A will cause oscillations slightly below the marked frequency on the crystal case.

Now, using the function or command button on the display, step to the ADD function. Now, hold the button down until the display starts flashing and then release the button.

Now the display should be showing twice the value. This is because you have now programmed the display to take the input signal and add to it the stored value that you just placed in memory.

That is all there is to it. Proceed with installing both the display and the transceiver in your selected enclosure. After removed the temporary wire at pin 7 of U5 and the ground connection, if you did this with everything out of the enclosure and on the workbench.

For use with the 1W, there is a capacitor Cs which the builder installs and is not provided in the kit. This is because the value varies depending up on the display used. For the QRPGuys display start with about 10pF. Just friction fit a cap in place WITHOUT shorting to ground and see if you get a steady reading on the display. Tune the VXO from one end to the other to see what the range is and to see if you get a steady reading for all frequencies. If there is a fluctuation in the reading then increase the cap value and try again until you get steady readings. That's all there is to it.

The display will give you readings to the nearest 1KHz. See next section if you just gotta read to the nearest 100Hz.

ADVANCED INSTALLATION PROCEDURE

As mentioned in the last section, the display is normally set up to display the operating frequency to the nearest 1 KHz value when measuring over 10MHz. Ken called me on the phone wanting to get 100Hz resolution over 10MHz. He wanted to subtract 10.000MHz from what would be displayed, but that is impossible to do with the display as it operates. Here is a way to get to the same desired result, but using a different technique.

This requires that you have a signal generator of some type that generates an RF signal somewhere between 1 and 30 MHz. Can be analog or digital.

Some theory required here. Using the 1W on 20m as an example, the VXO is generating 8.059MHz to get to 14.059MHz after the mixing in the mixer U2 in the transmitter section. Again, because of the 6.000MHz IF frequency used at X6 and here at X2. We want the digital display to show only the 4 in the 14. This will give us 4 additional digits available in the display for the remainder of the frequency and thus giving us the 100 Hz value for display.

So, what we do is, from the 8.059 MHz, we SUBTRACT 4.000MHz!! This will allow the digital display to shift the decimal point in the display one to the left and give us the last digit for the 100Hz value.

In order to do this, we power up the display and feed it a 4.000MHz signal from a stable signal generator and go through the programming stage again, but this time use the SUB function to subtract the input frequency for storage (4.000MHz).

Now the display will show 4.0593 MHz for operation at 14.0593 MHz with the least significant digit being dropped. Some people have to record on their QSL cards the frequency down to the 100Hz reading. I am not one of those, but to each his own. The capability to get more precision in the display is needed for operation near band edges.

CALIBRATION

Let's talk about accuracy. I showed you how to improve the precision in the display by allowing the display of the 100Hz value. You now have 6 digits of precision for the frequency being read by not having to display the leading number 1. We have yet to determine the accuracy of the display. For this we need more equipment.

Firstly, you need a 10 000 000 Hz signal source calibrated against WWV or other frequency standard. Use it with zero offset in the display to set the trimmer cap to get the display to read 10.000MHz.

This will allow to be comfortable with the frequency readings and as to their accuracy.

I have the trimmer cap and the function/command button on the back of the display for adjustments when the display is mounted in an enclosure with a transceiver.

I know that you will enjoy having the luxury of a digital display on any receiver or transceiver for frequency readout.

The procedure outlined in this write up is apropos to use with any other receiver or transceiver. You will have to experiment on coupling capacitor values and where to tie them into the circuit. Send me a schematic of the rig and I can help, if you need it.

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