Calibration Procedure for TSW_T4_V1.00 and later versions of the Teensy 4.0 firmware used in the HF Signals uBITX Version 6 transceiver

Manual version 1.3 dated January 24, 2020

INTRODUCTION:

Starting with TSW_T4_V1.00, the Triumvirate Skonk Works programmer, W2CTX has included in the firmware's "SET" menu a reasonably simple, easy to use set of calibration routines for calibrating the uBITX Version 6 Raduino when used with either a TSW Teensy4 to NANO adapter on a factory V6 Raduino, a TSW V6 Raduino Clone or our forthcoming stand alone Teensy4 Raduino Clone (projected availability late February/early March 2020).

This manual is intended to provide the user with an easy to follow set of instructions to use these routines in achieving accurate "master oscillator" and "BFO" calibration for the HF Signals uBITX Version 6 transceiver that is using a TSW Teensy 4 to NANO adapter in an HF Signals V6 Raduino, in A TSW V6 Raduino Clone with the adapter or an a Raduino Clone that has been designed specifically to use only the Teensy 4.0 MPU and still plug into the uBITX Version 6 main board.

Also included are the instructions for calibrating the "Touch Screen" which should be done initially on a new radio or when the Teensy 4.0 is first used as the MPU to insure all of the on screen "Touch" buttons work properly. Once completed, this calibration should be stable and should not need to be frequently updated.

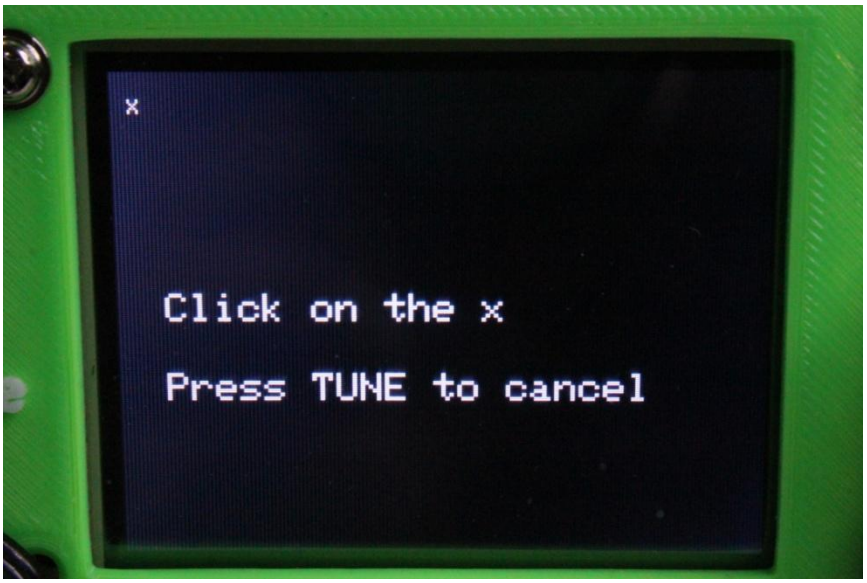
Calibrating your uBITX with the TSW_T4_V1.00d and later firmware:

With the uBITX V6 transceiver powered up, tune the radio to the 10000.00 MHz frequency of a standard time/frequency station OR if one cannot be heard where the user is located, an accurate signal generator on ANY known frequency. 10000.00 MHz will be used in the example given here but any accurately known frequency may be used. Just tune the uBITX to that frequency prior to entering the calibration routine.

Calibrating the "Touch" screen:

The first item that needs calibrating on the uBITX when a new Raduino or MPU (be it a new NANO or Teensy 4.0) has been installed is the "Touch Screen" so the software knows the coordinates of all the "Buttons" on the screen.

This is accomplished by holding down the encoder button and then while still holding the button, power up the uBITX. After the initial startup of the firmware, keep holding the button until the Touch calibration screen appears. It will look similar to the following:



Follow the directions on the screen – touch your stylus (or finger) to the "x" in the upper left. When you release it, the x will move to the upper right. Touch it again

and it will move to the lower left. Touch it again and it goes to the lower right. Once you touch the x in the lower right of the screen, it will calculate the coordinates for every pixel on the screen and save that value so the program will be able to decipher which button has been pressed during subsequent operation of the uBITX and bring up the following “Main” operating screen.

To get to the Master Oscillator and BFO CAL routines, first touch the “Set” button the uBITX main operating screen shown in the photo below.

uBITX main screen shown on W0EB’s test set.

Touching the “Set” button will switch the display to a set of menu selection items as shown in the next picture.

There are 6 items on this menu screen plus an EXIT button which will bring you back to the uBITX main operating screen. For now, we are only going to explain how to first calibrate the Raduino's BFO and then the Master Oscillator. The other menu items are explained in the Software Operating Manual for the version being used.

The best sequence to use (After first calibrating the "Touch" screen) for calibrating your uBITX with the Teensy 4 for the first time is to set the BFO frequency first.

This needs to be done properly to insure that the USB/LSB selection is correct. The uBITX Version 5 and later use an 11.059 MHz IF frequency and the crystal filter is actually a USB (Upper Sideband) filter but due to the conversion scheme used with the first mixer the rig thinks it is a LSB (Lower Sideband) filter.

A bit confusing, but since it is actually designed as a USB filter, we need to set the BFO to the right point on the skirt of that filter to help suppress the carrier for SSB and to ensure that USB and LSB can be properly selected with the buttons on the main screen. Our default BFO frequency winds up being 11.055.0 MHz but this will only get you close. The following procedure will help you fine tune this to the point you should have no trouble selecting USB or LSB and having the uBITX receive on the proper sideband in SSB mode and CW operation.

BFO Calibration Procedure:

Calibrate BFO screen

To calibrate the BFO, touch the “CAL BFO” button on the SET menu shown on page 3 above and you will enter the screen shown above. If you entered this screen accidentally, touch the “USER EXIT” button and it will take you back to the SET menu without changing anything. If this is the first time you are using the screen the frequency in the window should be as shown.

The calibration procedure for the BFO is a bit more tricky than for the Master Oscillator, but isn’t really difficult. Best to do this one with the antenna connected and the frequency set to one with no signal, the volume control turned up about halfway, or at least so you can hear the background noise fairly well.

Tune the encoder knob (the frequency will display backward from the tuning knob’s direction of rotation) for the loudest background noise first. Write this frequency on a piece of paper. Keep tuning in the same direction until the noise just starts to diminish. Write this frequency on the paper. Now, tune in the opposite direction, through the peak of maximum noise (it may be pretty subtle

so listen carefully) and continue until it just starts to diminish again and also write this frequency down.

Look at the 3 frequencies you have written. One of the two diminished noise frequencies should be up around 11.057-11.059 and the other one should be down around 11.053-11.055 or so. (Due to individual crystal and other component differences, this will vary from uBITX radio to radio.) You want to set the BFO to the LOWER of those two frequencies. This places the BFO oscillator on the lower edge of the filter's steep skirt and all the upper sideband energy should be in the middle area of the filter. Do NOT set it to the higher of the frequencies or your USB/LSB buttons will be reversed and cause you a lot of confusion when trying to tune in an SSB signal.

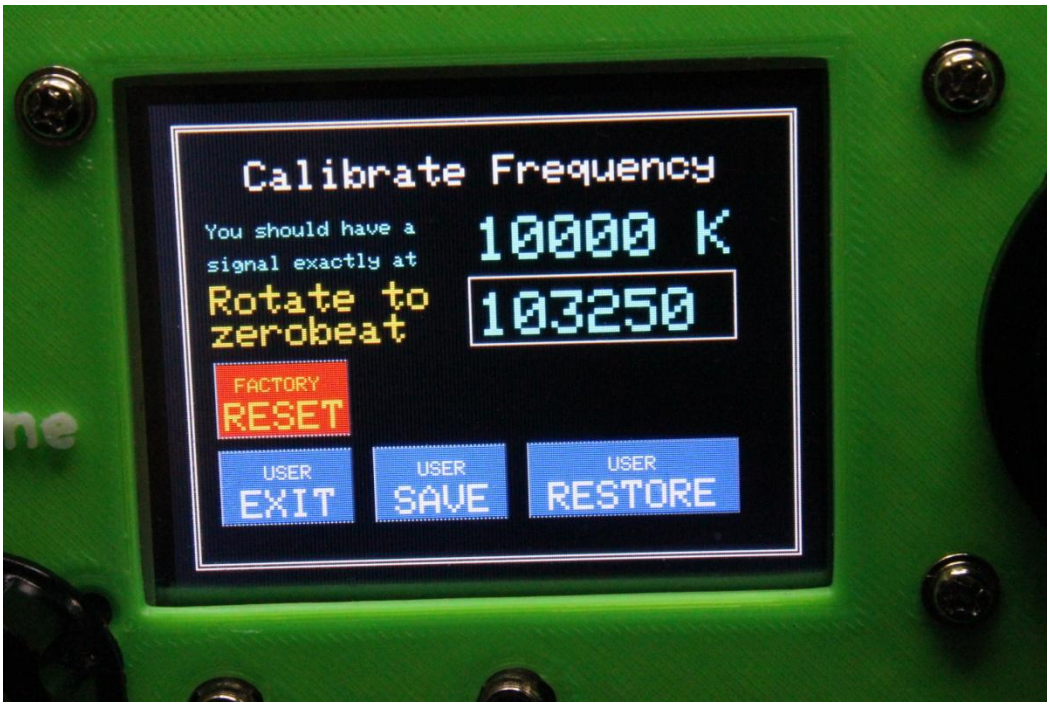
Once you are satisfied you have the right frequency showing on the screen, press the "USER SAVE" button. This will save your now calibrated BFO frequency to the Teensy 4.0's EEPROM and drop back to the SET menu.

A word about the other "on screen" options; there are several touch buttons and they are "FACTORY RESET" this recalls the TSW default frequency of 11.055.0 and should only be used if absolutely necessary. "USER EXIT" gets you out of this screen without changing anything. "USER SAVE" is used to save your selected frequency and exit the screen. Finally, if you accidentally change something but didn't save it, you can use the "USER RESTORE" button to get back to your last saved BFO frequency.

This completes your BFO calibration.

Master Oscillator Calibration:

If this is the first time calibrating your uBITX, you should now touch the item labeled CAL Freq on SET menu and it will bring you to the following screen:



Master Oscillator calibration screen.

Referring to this “Calibrate Frequency” screen, you have several options.

If you have a 10000.00 MHz signal tuned in and can hear a tone, turn the encoder knob until the tone decreases in frequency and finally goes to zero. Keep tuning and if the tone appears again, tune in the opposite direction until the tone again goes to zero. If you are using a time/frequency standard station you should now hear the time ticks or beeps clearly. If you are using a signal generator or some other 10000.00 frequency standard oscillator you should hear only background hiss and no tone, not even a very low frequency one for best accuracy.

Once you have achieved this, you can either press the encoder button (not recommended because it is very easy to accidentally rotate it slightly, throwing the calibration off by a few Hz or more), or better, being careful not to move the

encoder knob, touch the blue “USER SAVE “ button on the screen. This will save the calibration value in the Teensy’s EEPROM and return to the SET Menu screen.

You can now touch the “Exit” button and return to the main operating screen with your master oscillator calibrated for normal operation.

After the first time calibrating your uBITX ,if you need to touch up or recalibrate either the Master Oscillator or the BFO, it doesn’t matter which sequence you do them in as they both will be close to correct.

Credits:

Author/photographer, Jim Sheldon, W0EB Email: w0eb@cox.net

TSW Master programmer, Ron Pfeiffer, W2CTX

TSW Website: http://www.w0eb.com

Manual version 1.3 dated January 25, 2020,