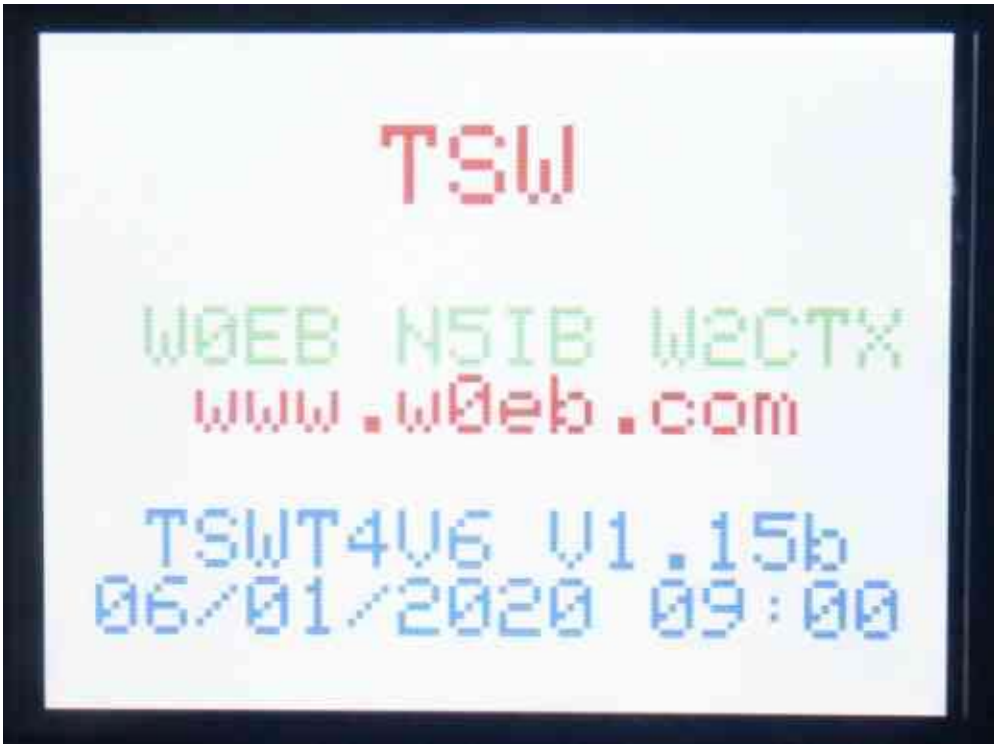
TSW Software V1.15b for the Teensy 4.0 MPU used with the µBITX transceiver from HF Signals (India)

From the Triumvirate Skonk Worx, www.w0eb.com

Manual V1.15b – last update 07/22/2020 @ 13:30 UTC



TSW

W0EB N5IB W2CTX
www.w0eb.com

TSWT4V6 V1.15b
06/01/2020 09:00

TSW_T4_V1.15b Splash Screen

Teensy 4 Adapter running on a V6 uBITX and using TSW's software.

Version numbers will change from release to release but pictures will only be changed where necessary so the version number in the pictures may not always match the Version of the software.

Introduction:

There are many advantages to using a Teensy 4.0 in place of the original NANO. The T4 is MUCH faster, a 32 bit, 600 MHz processor vs. the NANO's 16 Mhz 16 bit. The T4 has 1024k of 32 bit RAM, 2048K of 32 bit flash memory, larger stack area for storing variables & program constants to name just a few. Its clock oscillators operate on different frequencies which get rid of a bunch of "birdies" that plague the NANO MPU Raduino's.

The major operational changes TSW made to the original software were to improve the CW keyer by using separate dot and dash wires, using the "Timer Interrupts" to allow other things to happen in the software while the key paddles are not pressed instead of having to constantly poll the inputs to see if a key press occurred. You ONLY have to add another Key Paddle jack which will connect to pins on the Teensy4.0 to NANO adapter to be able to use the Iambic Keyer. Hand key operation via the Microphone Jack's PTT connection remains the same and NO mods to the uBITX OR Raduino are needed for this.

The new paddle jack connects directly to the A8 and A9 input pads on the end of the adapter board by the Teensy's USB connector. A8 gets wired to the "TIP" connection of the new jack and becomes the Paddle DOT connection. A9 gets wired to the "Ring" connection and becomes the Paddle DASH connection. The jack's ground connection connects to the ground pin on that header.

We also greatly improved the calibration routines for both the Master Oscillator and BFO to make them much simpler and more intuitive to use, something that has been needed for the μBITX practically from day one.

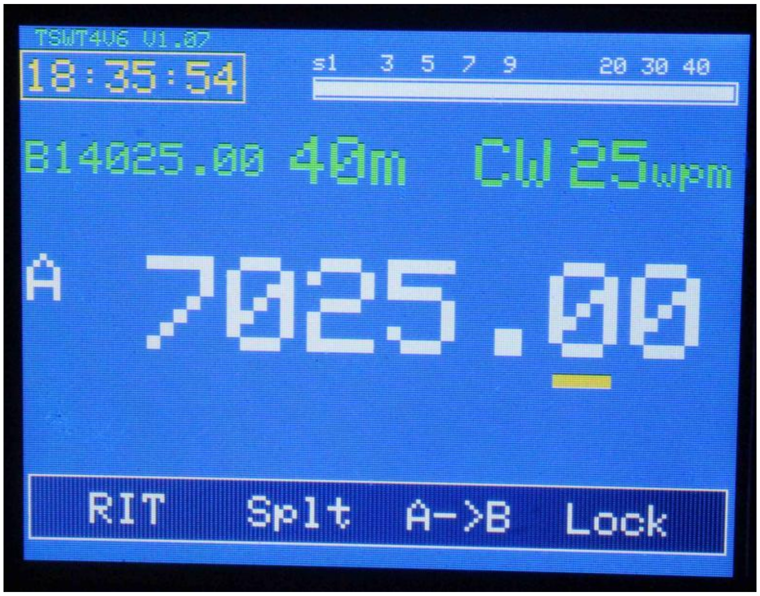
NOTE: For CW, the hand key will still operate normally as long as you plug it into the microphone connector because, just like the Factory V6 uBITX (and Raduino), the PTT line is used for hand key operation, independent of the Iambic Keyer. The hand key MUST connect between the “RING” (PTT) and “SLEEVE” (Ground) connections of a 3.5mm stereo plug in order to be able to plug it into the Microphone Jack and use it for CW, but NO mods have to be made to the uBITX or Raduino itself. You can also connect an external keyer in the same manner if you like.

TSW’s keyer routine is “interrupt” driven and we’ve given the Hand Key priority in the interrupt hierarchy so if you key via Hand Key (or mic PTT button), until the uBITX returns to receive, the Paddles will be locked out.

How to wire the hand key properly is listed in the highlighted paragraph above. Please pay close attention to this and it will work great.

All Menu operations are now done by touching the items on the color touch screen with your finger or a blunt plastic stylus. In a previous version, a 10 channel frequency/mode memory was added along with its corresponding “MEM” button and also in response to a request we added another mode called “CWP” (CW Practice). Usage of these selections will be fully explained in Appendix B to this manual but noted here, CWP operates just like CW except during all CW keying the transmitter output is inhibited so NO RF is output. All calibration functions, (Touch Screen, Master Oscillator and BFO) are explained fully in Appendix C.

A bit of information on the selected VFO (shown in large text close to the middle of the display), there is a cursor that can be placed under any digit in the display (except the left most digit when the frequency is 10 MHz or higher) and moved to any selectable digit just by touching that digit. Tuning will be from that digit and all digits to its left will stay what they are until the cursor is moved under one of them or further to the right. This makes rapid QSY within a given band much more convenient.

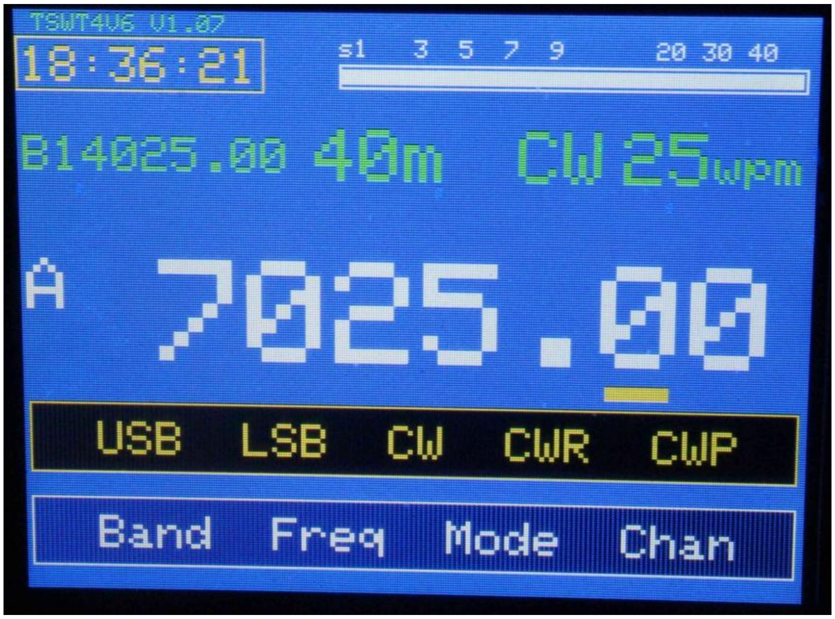


Example showing rig in CW mode on 40 meters, 7025.00 KHz.

The yellow cursor under the 0 can be moved to any digit just by touching the desired digit and this will allow the encoder to begin tuning from that digit and allow for very rapid QSY within a given band. VFO B now is capable of being on another band and mode completely from VFO A and switching between them allows for quick QSY to another frequency and mode if desired. These selections area also now saved during a power cycle as long as they both have been on screen for at least 5 seconds.

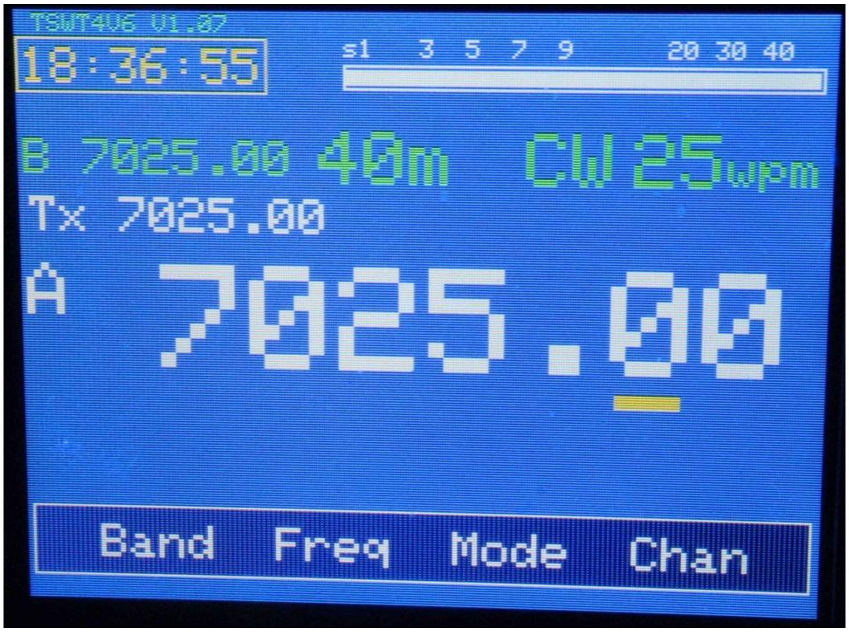
Pressing and holding the encoder button or touching and holding ANYWHERE on the menu bar will scroll the bar to the next available set of menus. While a given set of menus is on the screen, tapping one of the selections (don't press & hold it) will switch to that menu. Also touching the displayed MODE (in this case CW) will also bring up the MODE menu. Tapping on the desired mode will select it and close the mode menu.

There is another display for MODE on the screen and that may be ERR. If ERR shows up, simply touch it, select a proper mode from the menu and that will cure it. ERR means a mode has not yet been selected (initialized) for that VFO. Once one has been established, ERR won't appear again.



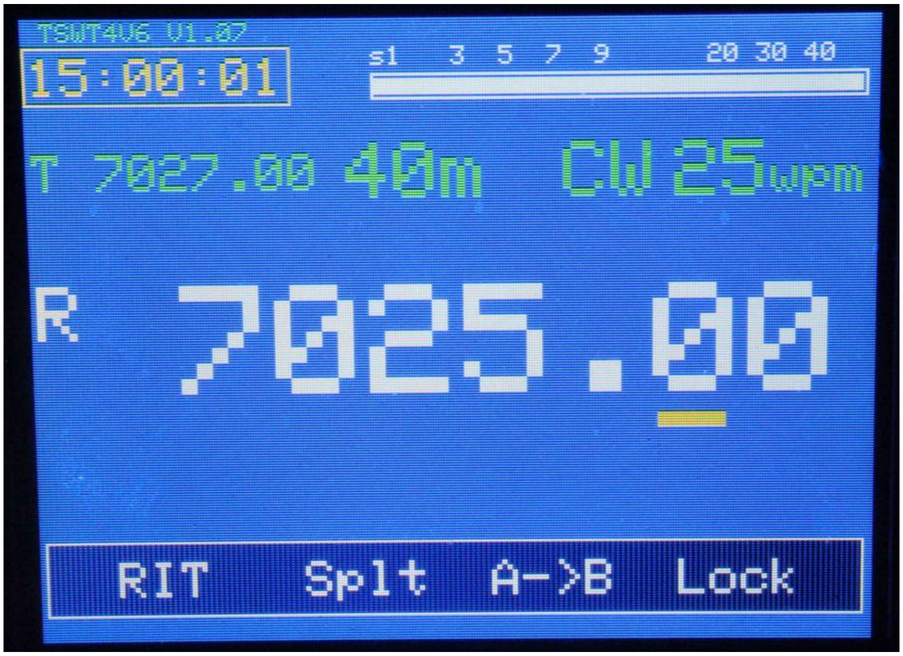
Mode touched – mode select menu bar showing.

Touching RIT will turn on the Receiver Incremental Tuning (RIT) and the transmit frequency will be locked. TX frequency will appear above and to the left of the VFO A display. If RIT is selected, the "SPL" (split) function is locked out as only the receiver is being tuned in this mode anyway.



Example of RIT display

- An A>B button has been added that, when touched, makes the frequency in VFO B equal to the frequency in VFO A which makes preparing for SPLIT a bit less painful. Now, touching SPL will put the rig into SPLIT frequency operation where VFO A will be receive and VFO B will be the transmit frequency. This will also lock out the RIT function for as long as split is being used.



TSWT4V6 V1.07

15:00:01

T 7027.00 40m CW 25wpm

R 7025.00

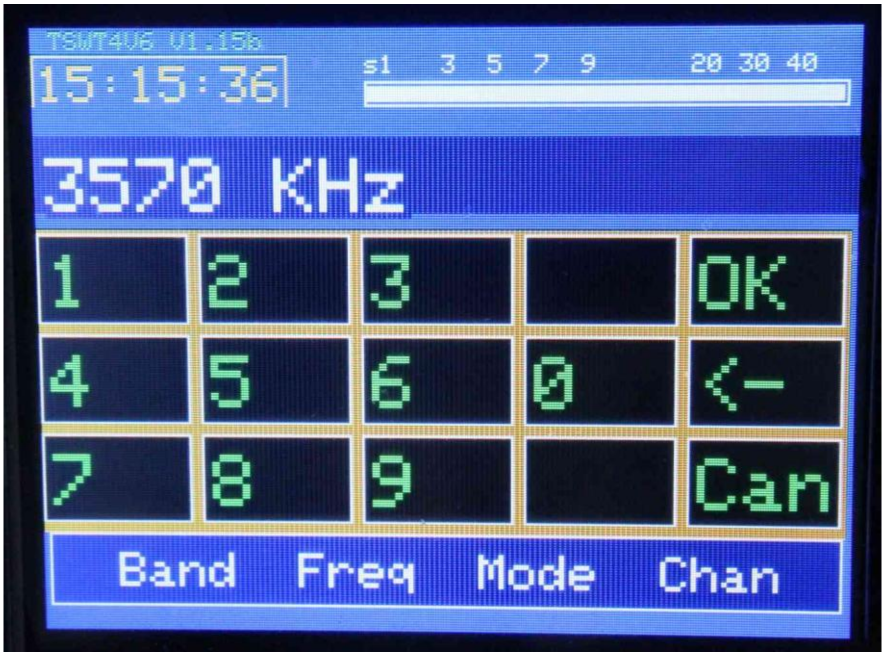
Split example screen

To change your transmit frequency, click on the VFO B frequency. It will change to indicate “R” and be the highlighted window. Since the law in most countries requires you to listen on your transmit frequency, B will now be the receive frequency until you select VFO A again after setting your TX frequency using VFO B (you automatically listen on B while you are tuning it and the receiver switches back to A when you click on the VFO A frequency. The selected VFO is always shown on the top line in larger size text.

Tapping BAND when displayed on the menu bar will bring up a separate menu showing 80, 40, 30, 20, 17, 15 and 10 plus G/C. When one of the displayed bands is touched will switch the rig to a frequency within that band and that will be set in the main VFO A display, center screen.

You can set your own frequency on each band by first selecting that band and either tuning to it with the encoder or using the Frq button to select the desired frequency on that band. Once you have to a given frequency, if that frequency remains unchanged for 5 seconds or more or you change bands, it will be saved and that same band/frequency will be recalled when you turn the radio off and back on again.

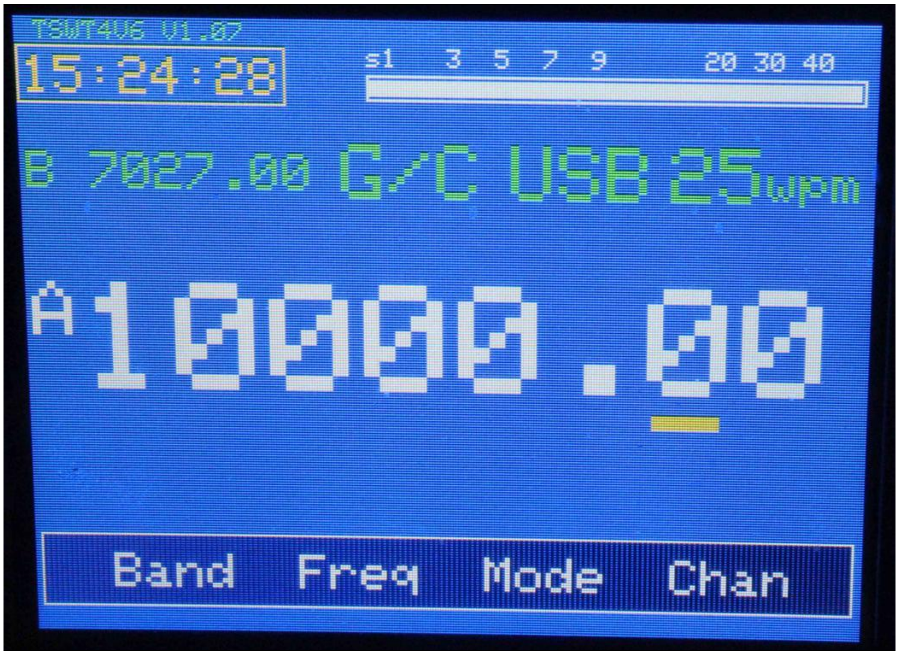
Tapping Freq on the menu bar will allow direct frequency entry using an on screen keypad.



Example of the display after Freq and the digits 3,5,7,0 have been touched.

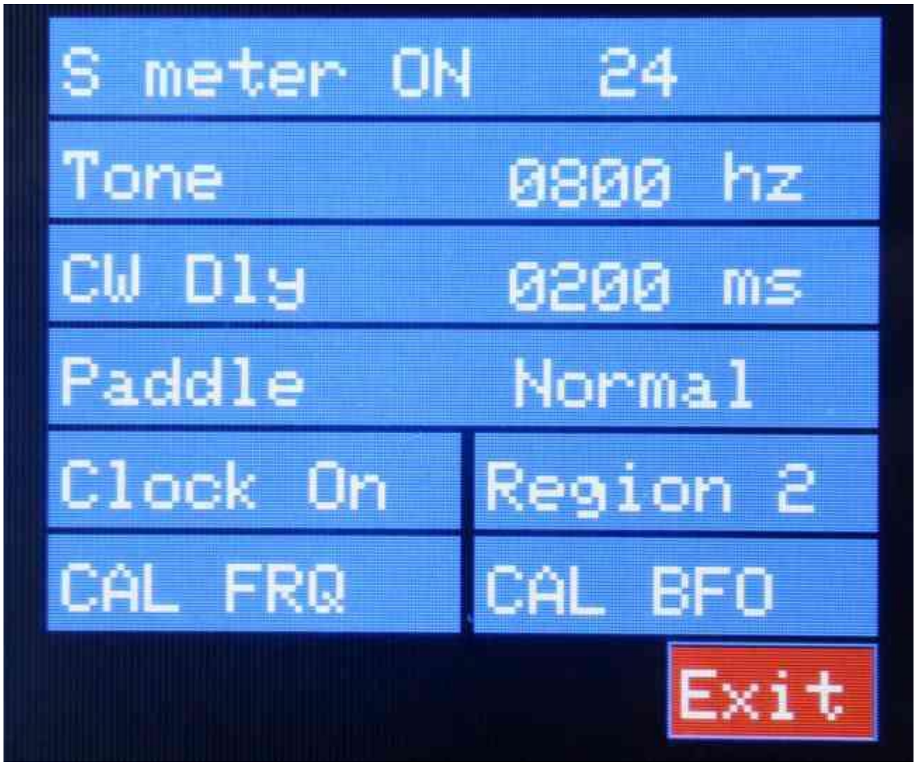
Using the Freq menu is really simple. For example to set 3570.00 as the desired 80 meter frequency, touch Freq which will bring up the above menu. On this menu you would touch 3, 5, 7 and 0 in that order and then touch the on screen OK button. This will save that frequency to the 80 meter band. Works the same way for all bands and if you are trying to do a quick QSY within a band, the Freq menu will most likely be quicker than tuning with the encoder, especially for a long QSY to SSB from CW or vice versa. The other buttons on the Freq display are <- which is the digit erase button to wipe out a wrong number press one at a time. The Can button is

"CANCEL" and will drop out of this menu back to the main screen without making any changes. NOTE: If the Freq menu is used, and you have one of the ham bands selected, Freq will allow only frequency entries WITHIN that band. To enter frequencies outside of the ham bands, select the "G/C" (General Coverage) item on the appropriate menu bar. This will allow tuning outside of the ham bands and anywhere the radio is capable of tuning.



Example with General Coverage (GC) selected and 10000.00 MHz tuned in

G/C means "General Coverage" and was added to simplify extended tuning beyond the ham bands. With G/C selected, you can tune any frequency the μBITX is capable of tuning. With one of the ham bands selected, you can tune only within that particular ham band. This keeps out of band frequencies from being accidentally saved to that band selection. Could get very confusing otherwise.



S meter ON 24

Tone 0800 hz

CW Dly 0200 ms

Paddle Normal

Clock On

Region 2

CAL FRQ

CAL BFO

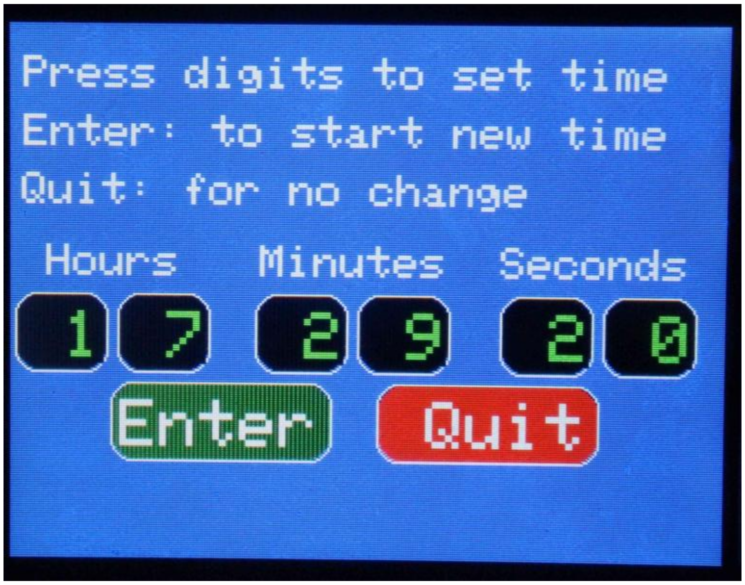
Exit

The Set menu

Set menu: In this menu you have 8 selections and an Exit selection. The first 4 selections operate on this screen for “S” meter on/off (when set to on, there is a number to the right of the word ON. This is a calibration value and may allow one to set the sensitivity of the S meter display), Sidetone Frequency, CW delay (between TX/RX) and paddle swap for the keyer. In the other four, Clock On toggles the RTC On/Off, Region toggles between IARU Region 1, 2 and 3, CAL Freq and CAL BFO each take you to a special sub-menu for calibrating either the Master Oscillator (CAL Freq) or the BFO (CAL BFO) Exit will take you back to the main screen either immediately or after using one of the selections. There are more explicit instructions for calibrating the uBITX as used with the TSW software in Appendix B: of this manual.

Clock On (or Off): This button toggles the RTC (Real Time Clock) display on or off. The clock displays whatever time you have set in the upper left corner of the main screen. You will have to set the clock each time you turn the uBITX on unless you connect a 3 volt backup battery between the “Vbat” pad on the Teensy 4 itself and ground.

To set the clock, you touch on its display which brings up the following, self explanatory menu.



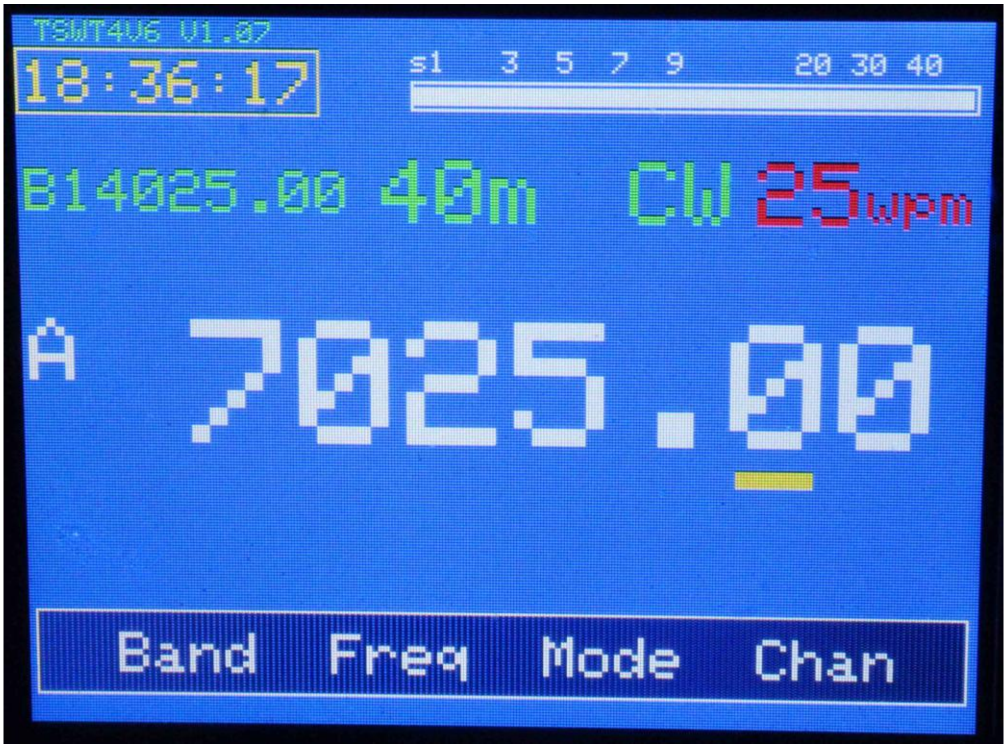
Press digits to set time
Enter: to start new time
Quit: for no change

Hours 1 7
Minutes 2 9
Seconds 2 0

Clock set menu.

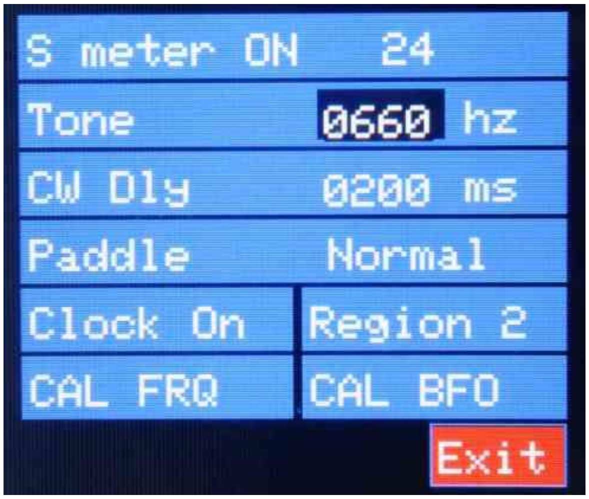
The menu items may be selected either by touching them with your stylus or finger,

S meter: The default is “Off” but you can turn it on by touching on the item. If you have an AGC (automatic gain control) board installed in your μBITX that has an “S-meter” output, as long as the maximum DC supplied by that output is LESS than 3.3 volts, you can connect it to the A7 input on the Raduino which has been listed as a “Spare” in the factory documentation. Assuming the AGC is operating correctly and the “S-meter” voltage varies between zero and about 3 volts, the S-meter should give you a relative reading. Right now it's only calibrated for the N8DAH AGC board. But if the AGC output voltage is adjustable the user can use the adjustment to calibrate the S meter to S9 with a 50 microvolt input signal AT THE ANTENNA of the transceiver.



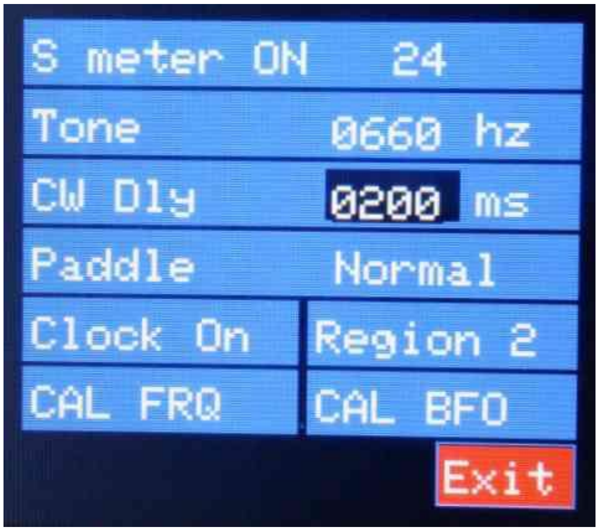
"S" meter display example – receiving background noise (no signal).

Tone: This item works is for setting the sidetone frequency to your comfortable listening frequency. Default is 800 Hz. Touch the item and a black box will appear with the tone highlighted in white and the sidetone sounding in the speaker/headphones. You can set it using the encoder knob to any desired tone frequency from 100 Hz on the low end to well over 1000 Hz on the high end. Touch on the item again after setting the frequency to save the new value.



S meter ON 24
Tone 0660 hz
CW Dly 0200 ms
Paddle Normal
Clock On
Region 2
CAL FRQ
CAL BFO
Exit

Set Menu Tone (sidetone) selection example. Here set to 660 Hz



S meter ON 24
Tone 0660 hz
CW Dly 0200 ms
Paddle Normal
Clock On
Region 2
CAL FRQ
CAL BFO
Exit

Set Menu CW Dly selection example, adjusted to 200 milliseconds.

CW Delay: Sets the number of milliseconds after the last paddle or hand key press before the uBITX switches from Transmit back to Receive. Menu item works exactly the same as the Tone selection. On initial startup with a new Teensy 4, this could accidentally contain a negative number. If that occurs, before transmitting set this to a positive number greater than zero or the rig will stay in transmit until you turn it off and then back on again.

Paddle, “Normal” or “Reverse”: This gives you the option of reversing your dot/dash paddle levers (Reverse is for left handed persons or those who have their paddles wired backward from the conventional TIP=DOT, RING=DASH setup.) Click on the item and the on-screen value is swapped to its opposite (Normal or Reverse).

CAL Freq is used to calibrate the Master Oscillator frequency. See Appendix B to this manual for detailed instructions on using this menu item.

CAL BFO is for setting the BFO frequency to the right point on the crystal filter's passband. See Appendix B to this manual for detailed instructions on using this menu item.

When finished with any item in the Set menu and not intending to use another, touch the red Exit bar and you will be back at the main screen again.

During testing, it was noted the annoying "Tuning Clicks" and many of the internal "Birdies" that had been caused by using a NANO for the main processor were either gone completely or reduced to a level where any atmospheric noise in the receiver covered them to the point they were not noticeable. This is one of the advantages of using the Teensy 4.0 MPU.

Appendix A:

How to install the TSW µBITX Software onto the Teensy 4.0

By Jim Smith, KK0U, used with permission.

Overview

The Triumvirate Skonk Worx (TSW) has provided an enhanced operating sketch for the µBITX V6 radio project. This enhanced sketch takes advantage of the PJRC Teensy 4.0 board (available for purchase here: (https://www.pjrc.com/store/teensy40.html), which supports a 600 MHz processor, 1024k RAM and 2048 bytes of Flash memory – well beyond the capabilities of the Arduino NANO board the µBITX is based on. This guide will show you how to compile the software and upload that software to the Teensy 4.0. For instructions on how to purchase and build the TSW Teensy 4.0 to NANO plug-in adapter board, see the TSW website http://www.w0eb.com .

Installing the Arduino IDE

First the Arduino Integrated Development Environment (IDE) must be installed on your computer. The latest version (as of this writing) is Ver. 1.8.10. The software is available here: (https://www.arduino.cc/en/main/software) and versions for Linux, MacOSX and Windows are available. Follow the installation instructions on the Arduino website (https://www.arduino.cc/en/guide/HomePage) for your particular OS.

NOTE: Install the Arduino IDE. Now ONLY repeat ONLY if you are planning to compile TSW's older firmware for the 2 and 4 line LCD character type displays, before doing anything else, go into the Libraries directory for the basic IDE and DELETE the LiquidCrystal directory completely. Again, this step is ONLY needed for the 2 and 4 line character display type software. The V6 programs do not use this library so it is not necessary to remove it if you are compiling for the V6 uBITX.

Installing Teensyduino

Next, go to the PJRC website and download the Teensyduino installer found here: (https://www.pjrc.com/teensy/td_download.html). Again, versions for Linux, MacOSX and Windows are available. Save the file to a directory on your hard drive and follow the directions on the PJRC website to run the installer – when it asks you for the directory to install it in, point the installer to the directory in which you installed your Arduino IDE and Teensyduino will be installed and integrated into the Arduino IDE's environment.

NOTE: Do NOT delete the LiquidCrystal directory under "Hardware – Teensy – Libraries" though as this is the one that is needed to compile the software.

Getting the needed AdaFruitILI9341 libraries

Now run the Arduino IDE by clicking on it. From the initial panel, click on the "sketch" dropdown menu, click on "Include Libraries" (alternatively, you can press CTRL-SHIFT-I on your keyboard which will bring up the "Manage Libraries" window). In the "Filter Your Search" section, type "ILI9341" and wait for the IDE to present library options. Hover over "AdaFruit ILI9341" with your mouse and click on "Install". The program will ask you some additional dependencies, click on "Install all". Once this completes, you are ready to download the latest TSW Sketch.

Downloading, compiling and installing the TSW Sketch

Go to the TSW website http://www.w0eb.com/TSW_uBITX_VERSION6_NEW_SOFTWARE/ directory and download the latest (by date/time) version of the TSW software for the Teensy 4.0. Usually there will be only 1 zip file in that directory but at times there may be earlier versions left for experimentation. You should normally download the latest version. Save this file to a separate directory on your hard drive and unpack (unzip) it. You will then have a directory containing all the program files for compile. Copy or move this unzipped directory into the same directory where your Arduino IDE files are.

Next plug your Teensy 4.0 board into a USB port on your computer, using an appropriate cable. Note that many cell phone charger cables are ***not*** wired for data transfer, only power. Be sure to use a USB cable that can transfer data.

With a brand new Teensy, the factory will have loaded a test program that causes the orange (or red) LED to blink once a second. This blinking will start as soon as the Teensy 4.0 is powered up by the +5 volts supplied through the USB programming cable. This is normal. If it doesn't blink, you may have a bad board or a bad cable. If the blinking LED's color is green or blue you most likely have a counterfeit board – you should have bought it direct from PJRC as the counterfeit ones may or may not work – "Caveat Emptor" (let the buyer beware).

Now, run the Arduino IDE. Once the main compiler window comes up, click on the "Tools" dropdown, hover over the "Board" line which will bring up another drop down giving a huge list of different boards that can be used with the IDE. You should see a faint "Teensyduino" at the top of this list and directly under that "Teensy 4.0". Click on Teensy 4.0. That will set the proper board for the IDE's compiler. Click on the "Tools" menu again set USB to "Serial" if it isn't already, Set CPU Speed to 600 MHz, Set "Optimize" to "Faster" Hover your mouse over

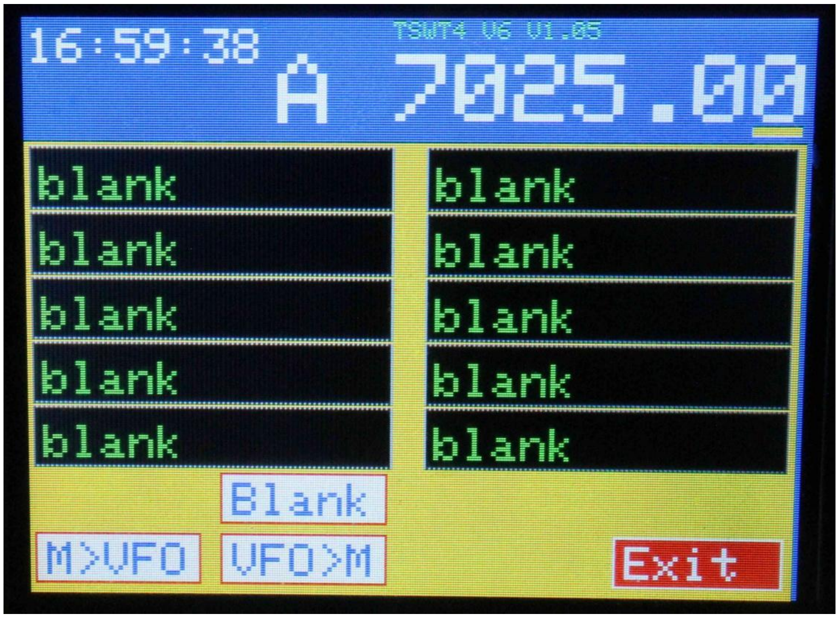
“Port” and with your Teensy plugged into the USB cable select the serial COM Port that is indicated for the Teensy 4.

Now you have the IDE environment set properly for the Teensy 4.0 board, click on “File”, “Open” and find your TSW sketch file in the list of file directories that are shown. Double click on that directory which will bring up another list of actual files. Find the one that has the file extension “.ino” and double click on that one. The compiler window will now open with that .ino file loaded. Click on the “UPLOAD” Icon which is a right pointing arrow inside a green circle. This will compile the software and run the Teensyduino loader once it’s finished compiling. If everything is okay, the compiled program will be installed in the Teensy. If the Teensyduino loader asks you, you may have to press the tiny button on the Teensy 4 at which time it will load the program onto the Teensy – this may or may not be necessary as the loader should be set for “Auto” upload as it comes from the PJRC download of Teensyduino.

Appendix B: Memory Channel operation:

By popular request, TSW has added a set of 10 memory channels to the software. We've tried to make this intuitive and easy to use.

When you first load the software and open the "Channel" menu by touching the "Chan" selection on the menu bar, You should get a screen with all locations containing the word "blank" as shown in the next picture, or you may have random, invalid frequencies in them if your Teensy 4 had been used before with other version(s) of software. If that occurs, you should delete the data in each channel before continuing. There are several function (Touch buttons) on the screen and one is labeled "Blank". First select the memory to be deleted, (A white highlight box will appear around it when selected) then touch the "Blank" button. The contents will be erased and the word "blank" will replace the frequency until a valid frequency, sideband and mode in loaded into that memory.

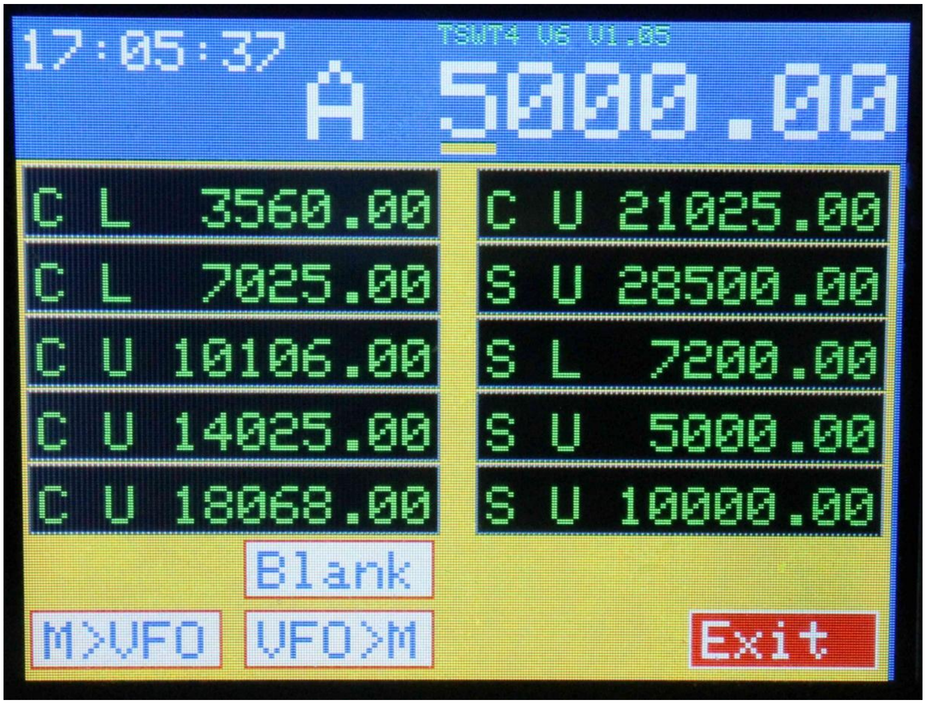


Initial Chan screen (older rev but same basic sceen) showing all channels empty (blank).

Besides the Blank button, there are 3 more function buttons along the bottom of the screen. The red Exit button should be self explanatory. Touching it will take you back to the main screen either after setting one or more memories or if you entered the screen but want to leave it without changing anything.

To store a particular channel, on the main screen first tune to the desired frequency (you can use either VFO A or VFO B), set the desired mode (SSB or CW) and the desired sideband (USB or LSB) before touching the Mem button.

In the Mem menu above, touch the desired memory channel (it will be highlighted with a white box after touching) and then touch the VFO>M (VFO Contents TO memory) button. The Mode, Sideband and Frequency will then be stored in the selected channel. See the next picture for several examples of stored frequency/mode channels.



17:05:37

TSWT4 V6 V1.05

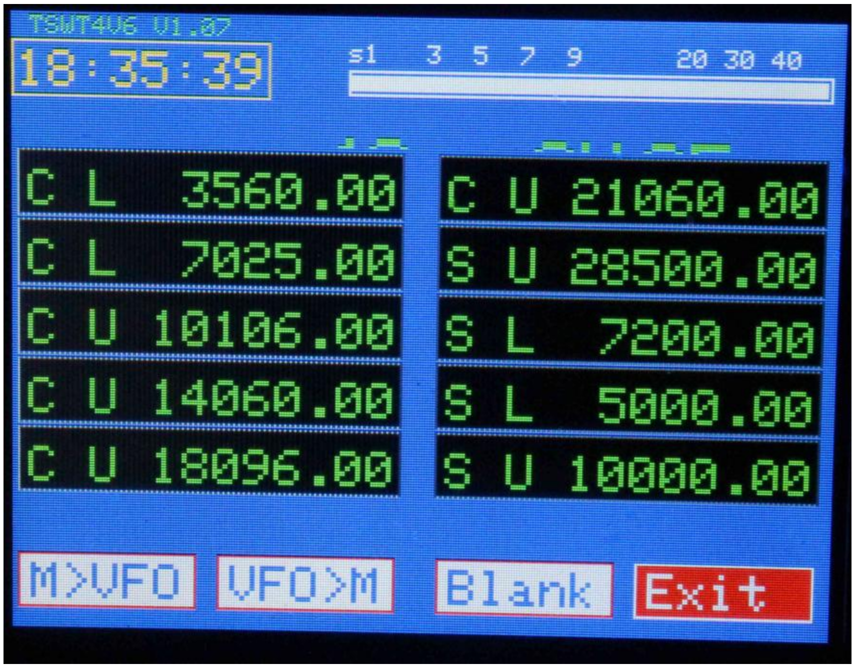
A 5000.00

C L 3560.00	C U 21025.00
C L 7025.00	S U 28500.00
C U 10106.00	S L 7200.00
C U 14025.00	S U 5000.00
C U 18068.00	S U 10000.00

Example with Mode/Sideband/Frequencies stored in the memory channels.

Once a frequency has been stored in any memory channel, to change it there is no need to blank the channel first, simply select frequency/mode/sideband on the main operating screen, touch Mem to enter the above menu, select the memory you'd like to change and use the VFO>M button to replace that memory's contents with your new data.

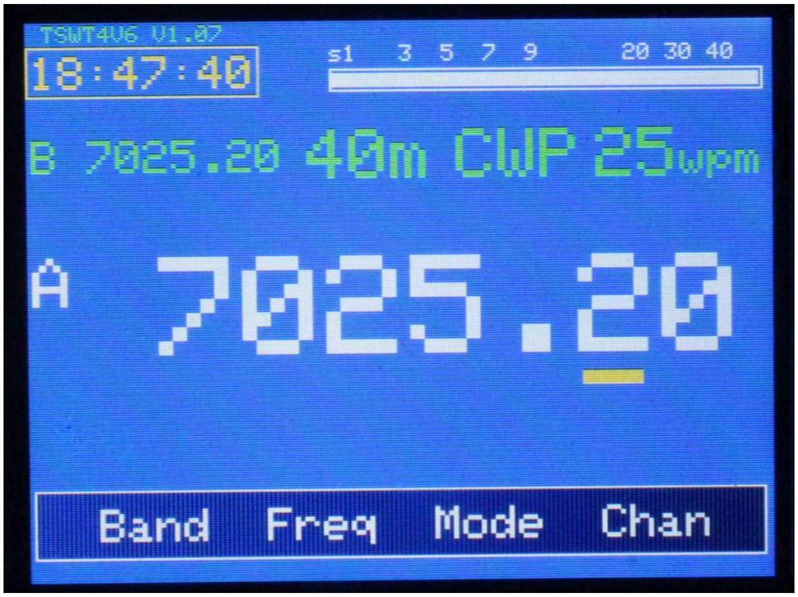
To recall a particular memory as in a favorite frequency, first select the VFO (A or B) you would like tuned to that frequency, go to the "Mem" menu, select the memory you want to recall, touch the M>VFO button (Memory to VFO) and that frequency (with its proper band selected automatically) will be entered into the selected VFO (A or B).



C L 3560.00
C L 7025.00
C U 10106.00
C U 14060.00
C U 18096.00
C U 21060.00
S U 28500.00
S L 7200.00
S L 5000.00
S U 10000.00

Channel screen from version V1.07. Only slight differences from the previous versions. Operation is identical.

Finally, the new CWP function has been added to the mode selection. It is selected simply by bringing up the Mode menu bar and tapping CWP. All CW functions (Hand Key and Iambic Keyer and Keyer Speed set) operate in this mode except for the fact the transceiver stays in receive mode and outputs NO RF during CW Practice. This allows the user to test keys and key paddles as well as practice their CW sending with either a hand key, external keyer or the internal Iambic Keyer. The receiver remains active so the user can use an external Morse training unit (user supplied) to provide code practice under interference conditions without causing any interference to other stations.



Example showing SSB/CW/CWP set to “CWP”.

In the latest version (1.Ø8R) the CAT (FT-817) commands have been corrected and tested to operate with WSJT and several other digital programs via the USB port. Digital mode audio I/O still needs to be via earphone/speaker and microphone jacks.

Appendix C:

Calibration Procedure for TSW_T4_V1.00 and later firmware.

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).

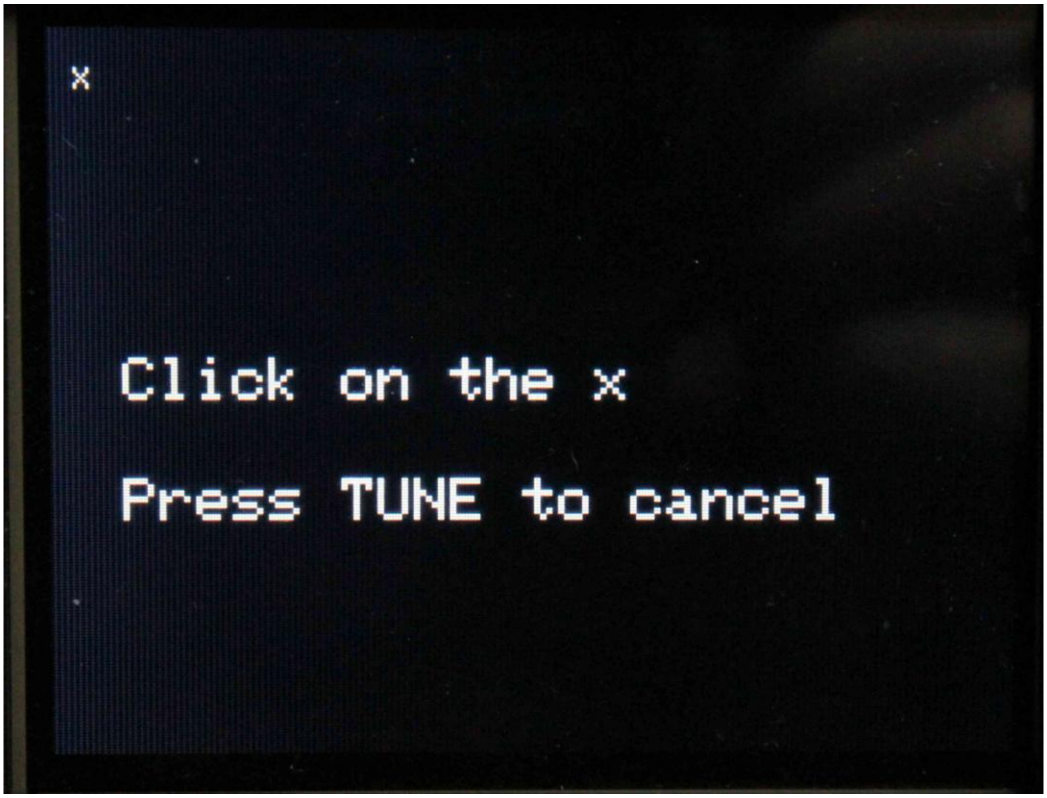
This manual is intended to provide the user with an easy to follow set of instructions to use these routines in achieving accurate "master oscillator" and "BFO" calibration for the HF Signals uBITX Version 6 transceiver that is using a TSW Teensy 4 to NANO adapter in an HF Signals V6 Raduino, in A TSW 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 the entire on screen "Touch" buttons work properly. This calibration should be stable and should not need to be frequently updated.

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.

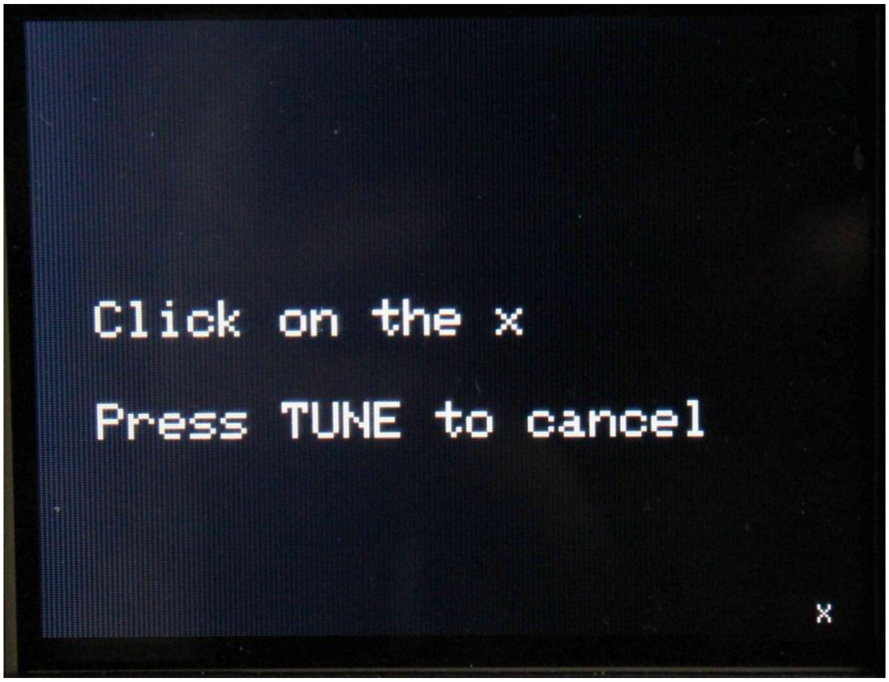
This is accomplished by holding down the encoder button and then while still holding the button, power up the uBITX. After the initial startup of the firmware, keep holding the button until the Touch calibration screen appears. It will look similar to the following:



Click on the x

Press TUNE to cancel

Example: Step 1, touch the "X" in the upper left



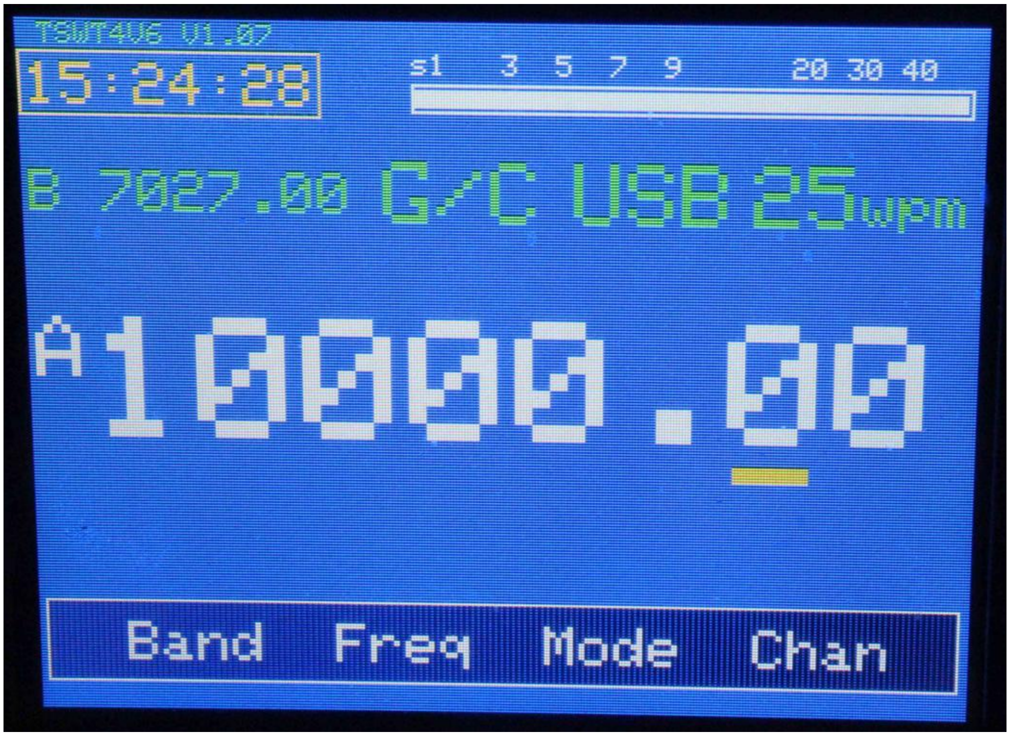
Click on the x

Press TUNE to cancel

Step 4, touch the "X" in the lower right to save and exit

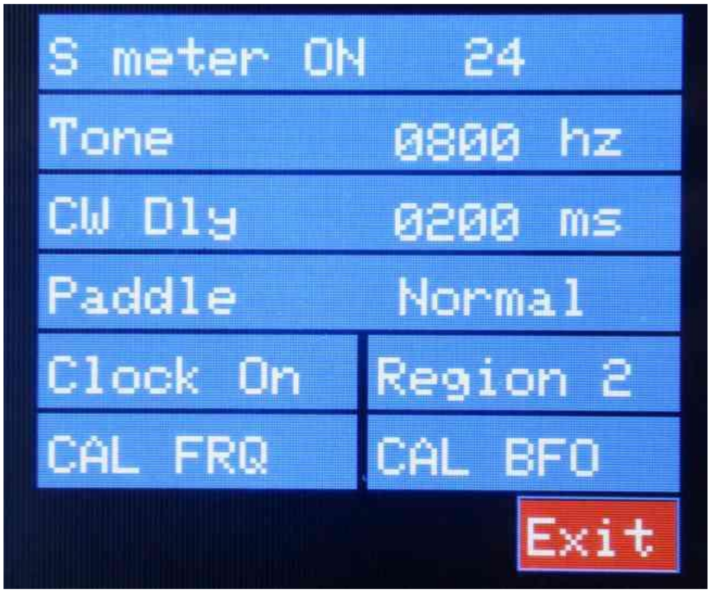
Follow the directions on the screen – touch your stylus (or finger) to the "x" in the upper left. When you release it, the x will move to the upper right. Touch it again and it will move to the lower left. Touch it again and it goes to the lower right. Once you touch the x in the lower right of the screen, 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 select mode USB, band G/C and set VFO A to the frequency of the desired calibration signal (10000.00 KHz) for example on the uBITX main operating screen shown in the photo below.



uBITX main screen with “GC” and 10000.00 KHz shown on W0EB’s test set.

Press and hold the menu bar to scroll the items until Set appears (may take several “Press and Hold” operations.) Tapping “Set” button will switch the display to a set of menu selection items as shown in the next picture.



S meter ON 24

Tone 0800 hz

CW Dly 0200 ms

Paddle Normal

Clock On

Region 2

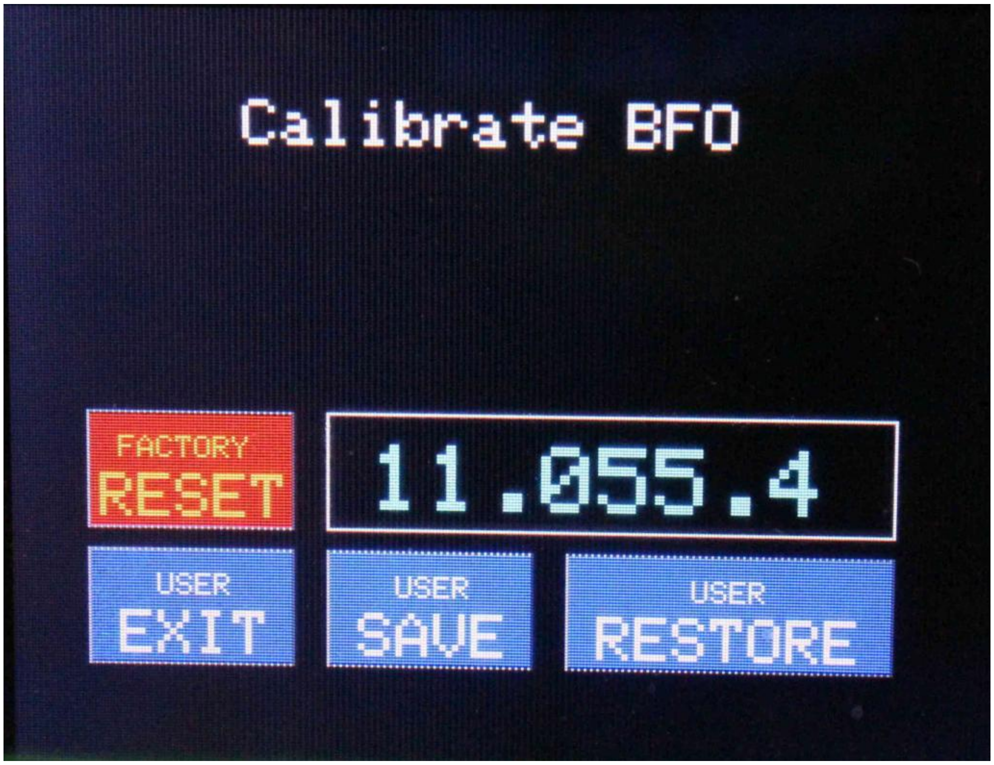
There are 8 items on this menu screen plus an EXIT button which will bring you back to the uBITX main operating screen. For now, we are only going to explain how to first calibrate the Raduino's BFO and then the Master Oscillator. The other menu items are explained in the main body of the manual for 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

11.055.4

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.

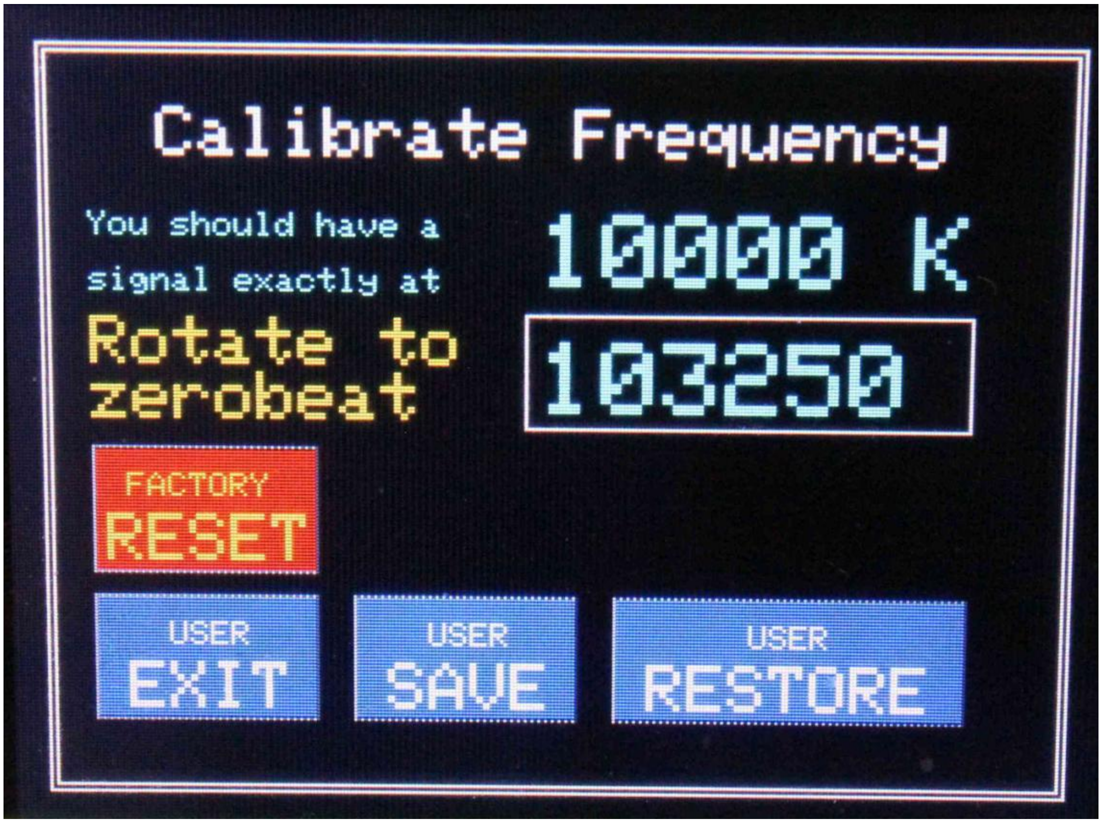
A word about the other "on screen" options; there are several touch buttons and they are "FACTORY RESET" this recalls the TSW default frequency of 11.055.0 and should only be used if absolutely necessary. "USER EXIT" gets you out of this screen without changing anything. "USER SAVE" is used to save your 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:

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. Set the mode to SSB.

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:



Calibrate Frequency

You should have a signal exactly at

10000 K

Rotate to zerobeat

103250

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 will both be correct.

W0EB's new V6 μBITX "Full Kit" using TSW's Teensy 4 to NANO adapter and running TSW_T4_V1.15b software, listening on 40 meters.

Credits:

Jim Sheldon, W0EB. TSW Project Coordinator and Webmaster for theTSW website, www.w0eb.com

Ron Pfeiffer, W2CTX, TSW Master Programmer

Jim Giammanco, N5IB, TSW Engineer/PC Layout Specialist

Jim Smith, KK0U author of Appendix A to this manual.

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