TSW Software Operating Manual for the Teensy 4.1 MPU used with the μBITX V6 transceiver from HF Signals (India)

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TSW Teensy 4.1 Raduino Software Splash Screen

V6 uBITX and using TSW's software. (Screen shots in this manual may not be from the latest software but will be totally sufficient to illustrate the item(s) being discussed in the text.

Profound thanks to Mark, N8ME for his generous provision of the special "ScreenDump" Python script and Bill, W3IVD who refined it a bit. This allows me to use actual screens from the operating radio for the illustrations in this (and subsequent) software manuals for the Teensy 4.1.

Introduction:

Shortly after the HF Signals (India) uBITX transceiver Version 6 hit the market, the TSW group produced a Raduino Clone for it that could use an Arduino NANO like the factory version did and operate with the factory's software or, with an adapter also produced by TSW, use a Teensy 4.0 by PJRC in place of the NANO with our own software for much faster display updates, easier calibration and much better Iambic keyer CW operation.

We had good success with the Teensy 4.0 using the adapter, but when we tried to mount the Teensy 4.0 directly on a board, for some reason we could not make it work right so abandoned that project. Fast forward a few months and PRJC has made available a new, larger footprint version of the Teensy called the Teensy 4.1 so we decided to make a limited attempt at using this on a unique Raduino clone that used only the T4.1 mounted directly on the board, no adapter.

We had a very limited run of prototype boards made to test the concept. Much to everyone's delight, it worked very well and seemed to have eliminated most if not all of the noise problems inherent with the Factory (and our older clone) Raduino using the Teensy 4.0 to NANO adapter.

The new TSW Teensy 4.1 Raduino is designed specifically to replace the factory's original V6 Raduino with one that uses a PJRC.com Teensy 4.1 in place of the Arduino NANO but keep the same 2.8" TFT Color Touch Screen for compatibility with the Factory supplied cases and install using the same display mounting holes as the original. We have tried to make the Touch Screen display a bit easier to read and have implemented a comprehensive menu system as well as an improved, easier to use calibration system for the uBITX V6 with this new TSW Raduino.

Because of the additional "Host Mode" features available with the Teensy 4.1, the touch screen control of the Raduino has now been supplemented with both Keyboard AND Mouse control functions that will allow the uBITX to be operated almost completely without ever touching the screen OR the rotary encoder.

The new "Host Mode" will, however, require a modification to the uBITX V6 Factory case (if used) to allow for an additional USB cable connection to be brought out to some accessible point (preferably on the back panel but completely up to the user) if they choose to implement Host Mode use.

During initial testing, we found that a USB hub could be used but there were compatibility problems in mixing wired and wireless keyboards/mice. A wireless mouse didn't always function properly when used with a wired keyboard and vice versa. If both keyboard and mouse were wired and connected via a USB hub, they worked just fine.   Also, wireless keyboard/mouse combinations that use a single USB "dongle" work quite well. At least the versions tested – Cheap "Jelly Comb" brand from Amazon, Microsoft's 2000 series as well as those by Logitech AS LONG AS they use a single USB plug-in to connect BOTH keyboard and mouse.

Mouse control uses the Left Button and the Scroll wheel for operation and this will be explained in detail later in this manual. The mouse "cursor" will appear on the screen as a yellow dot, initially parked in the upper right corner of the display. (See example below.)

The keyboard will perform many control functions such as selecting mode, direct entry of frequency, CW keyer speed, etc. can be done by pressing the correct combination of keys on the keyboard and the functions/keys can be found in an appendix to this manual. Pressing the <ESC> key will activate the keyboard.

Table of contents:

First time use (brand new, unprogrammed Teensy 4.1):

The first time this (or any) TSW software is loaded on the Teensy 4.0, you will need to calibrate the touch screen. The touch screen calibration is fully explained later in this manual but to get started, hold the "Encoder" button in, power up the uBITX and continue holding the button until the Touch Calibration screen appears. There will be a tiny "x" displayed in the upper left corner. Using your stylus or a blunt pencil, touch this "x". Next the "x" will jump to the upper right corner. Touch it again and then the lower left and lower right corners of the screen. Once you touch the last "x" in the lower right corner of the screen the calibration coordinates will be saved in the Teensy 4.1's EEPROM and should not have to be recalibrated unless the display is somehow damaged or replaced.

Once display calibration is done, the main operating screen will appear.

The next things you should do are: first, calibrate the BFO (see the appropriate appendix for complete instructions) and then do the "Master Oscillator" calibration. If you don't do the BFO first, the proper sideband (USB/LSB) may not be correct when selected.

The next thing you should do is go to the "SET" menu and select the IARU region you live in (USA will be Region 2). The initial default is Region 1 and the IARU band frequency limits for that region will be set. G/C (General Coverage) is the ONLY band that has no set limits.

Basic Operation:

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.

Touching the triangle in the center of the MENU bar will cause the bar's display to rotate through the available selections. Touching any selection will cause the proper action for that selection, either executing a command or bringing up another menu with further selections available.

Mode touched – mode select menu bar showing.

Available modes are: USB, LSB, CW, CWR (opposite sideband) and CWP (CW Practice – TX is inhibited in this mode but the receiver remains on.)

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 "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 Split 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.

Split example screen

To change your transmit frequency, touch on the T 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 center line in larger size text. In normal operation you can easily switch between the A and B VFO's by touching the A (or B) letter displayed to the left of the main frequency, or clicking on it with your mouse if it is installed.

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.

Band Display menu

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 menu has been selected

Using the Freq menu is really simple. For example to set 7025.00 as the desired 40 meter frequency, touch Freq which will bring up the above menu. On this menu you would touch 7, 0, 2 and 5 in that order and then touch the on screen OK button. This will save that frequency to the 40 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 of Frequency entered – touching OK enters into selected VFO.

Example with General Coverage (GC) selected and 10000.00 MHz LSB 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.

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 are 2 numbers to the right of the word ON. The first is a calibration value and may allow one to set the sensitivity of the S meter display. The second one (A07 or A17) allows you to select which input pin to the Teensy needs to be connected to the AGC's "S meter" voltage output.

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.

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 (you must touch or click right in the center of the word OFF or ON). 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 or A17 input. A17 is the old "SPARE" pin on the Encoder connector P1 and A7 is marked on the 12 pin I/O header P5, which is located to the right of the Encoder connector, P1. 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. Caution: If you have the AGC connected to one of the two S meter pins, do not use the other one for anything or some weird display problems may surface. This should not

create too big a problem as there are MANY other I/O pins available on various headers all over the reverse side of the PC Board.

"S" meter display example – receiving an S9+.signal.

Tone: This item works is for setting the sidetone frequency to your comfortable listening frequency. Default is 800 Hz. Touch the center of the number in 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 center of the item again after setting the frequency to save the new value.

Set Menu Tone (sidetone) selection example. Here set to 860 Hz

Set Menu CW Dly selection after being adjusted to 500 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 4.1, 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 and even the Teensy 4.0 with the adapter 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 4.1 MPU. We also found when we fixed the encoder routine to read every pulse from the encoder that most of the rest of the tuning noise also disappeared. Sometimes you just get lucky.

Appendix A: Memory Channel operation & Status Screen:

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 or 4.1 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 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 or CW/CWR in CW) 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.

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).

Stat Screen: Shows the currently installed firmware version, date/time created and the latest fixes or additions.

Stat Screen for firmware version 1.60

CW Practice Mode, CWP:

Also a CWP (CW Practice) 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".

Appendix B:

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 Teensy4.1 Raduino Clone.

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 the Raduino Clone that has been designed specifically to use only the newer Teensy 4.1 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 or 4.1 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, Teensy 4.0 or 4.1) has been installed is the "Touch Screen" so the software knows the coordinates of all the "Buttons" on the screen.
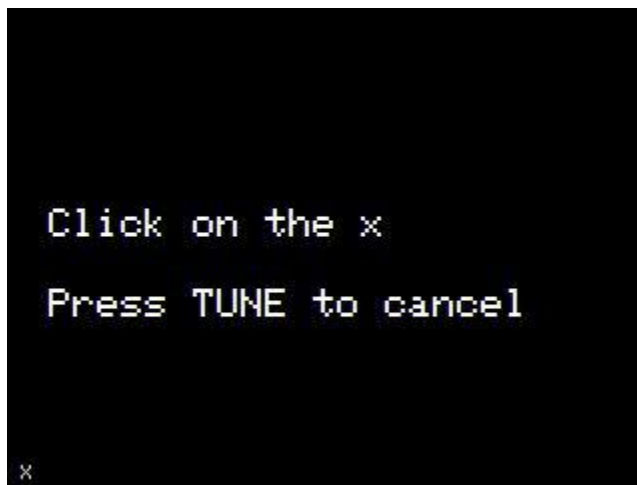
This is accomplished by holding down the encoder button and then while still holding the button, power up the uBITX. After the initial startup of the firmware, keep holding the button until the Touch calibration screen appears. It will look similar to the following:
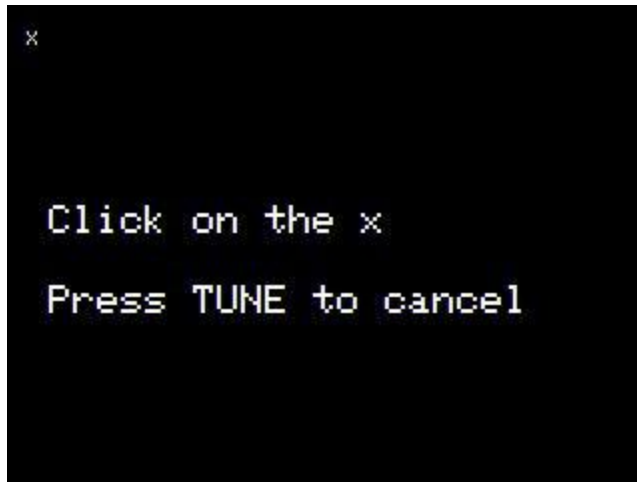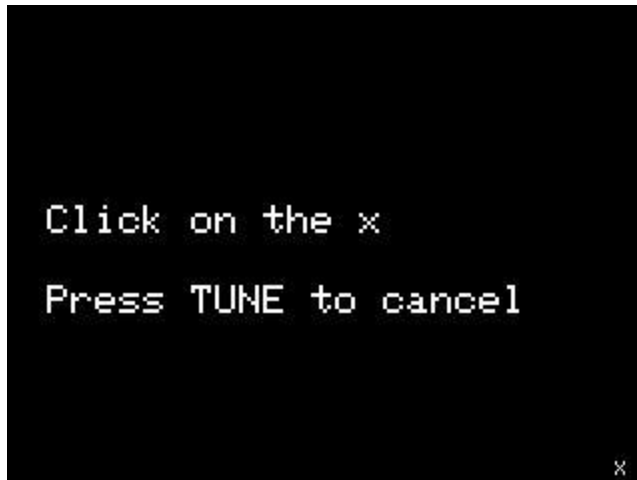
Example: Step 1; touch the "X" in the upper left
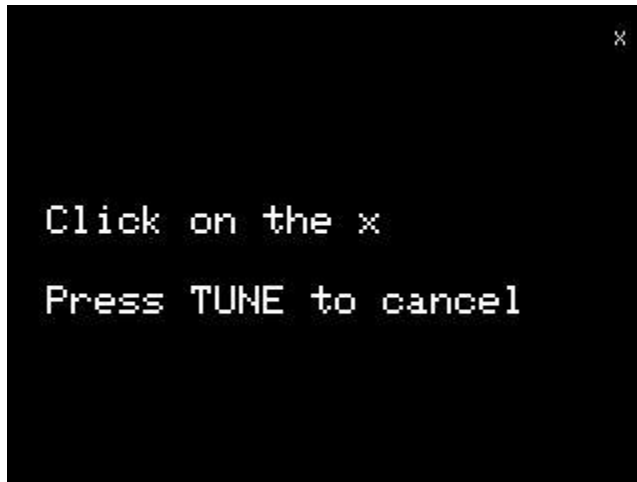
Step 2; touch the "X" in the upper right

Step 3; touch the "X" in the lower left

Step 4, and finally 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.

The screen shot above is only an example, the band, frequency, mode, etc. may not be the same as the one shown above.

MASTER OSCILLATOR AND BFO CALIBRATION:

<mark>To get to the Master Oscillator and BFO CAL routines, **FIRST** select mode LSB or 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.</mark>

uBITX main screen shown with "GC", "LSB" and 10000.00 KHz selected.

Next, tap the "triangle" in the menu bar several times to scroll the items until Set appears. Tapping "Set" will switch the display to a set of menu selection items as shown in the next picture.

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.

After first calibrating the "Touch" screen and when calibrating your uBITX with the Teensy 4.0 or 4.1 for the first time, the BFO frequency SHOULD be set 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 an 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 but if it is NOT, touch the "FACTORY RESET" button and that will initialize the BFO frequency properly.==

The calibration procedure for the BFO is best done with the antenna connected, the frequency set to one with no signal and the volume control turned up so you can hear the background noise very well.

Tune the encoder knob 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, turn up the volume if you need to), 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 (remember the filter is actually an upper sideband 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 or 4.1's EEPROM and drop back to the SET menu. Loading a new version of TSW's software later will NOT change the calibrated value so you should not have to re-calibrate the VFO for a given radio even if you upgrade the software.

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 needed when installing a brand new Teensy 4.1 and later only 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 changed 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, either USB or LSB. Do NOT use CW or your final calibrated frequency will be off by the value of the sidetone freq.

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: (The numbers shown below will NOT necessarily be the ones shown for your radio.)

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. This procedure is called "Zero Beating" the received calibration signal for those of you who have not heard the term before.

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 and 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.

Appendix C:

Keyboard and Mouse Operation: First off, to be able to use a keyboard and/or a mouse with your TSW Teensy 4.1 Raduino, you will need to connect a USB Host mode cable (available from PJRC at the same time you order your Teensy 4.1 to use with the TSW Raduino) to the USB host mode 5 pin header on the Teensy 4.1 and bring it out the rear of your uBITX V6. You will most likely have to carefully cut a hole for its mounting in the back panel of the radio for best operation.

USB Host Mode connector cable from PJRC.com

The female DuPont connector hooks to the 5 pin HOST header on the back side of the Teensy 4.1. Looking at the Teensy's back side, this header is at the lower right of the MPU. The two black "ground" pins on the DuPont connector got to the two "ground" pins on the Teensy's header and are the two left most pins as viewed from the back of the Teensy. The back panel of the Factory case needs a rectangular cutout and screw holes to match the pattern of the USB "A" connector to be usable.

TSW V6 T4.1 software, Keyboard Commands:

Depressing any key but Esc will display "Esc -> keyboard"

To start a keyboard command, depress Esc ("Kcmd> (h-help)" will be displayed)
followed by depressing one of the following commands:
(all command letters are lower case)

b - Band. Command format: b enters BAND change then u for up and d for down
"u" and "d" keep cycling each time they are pressed until <ESC> is pressed.

c - Enter keyboard CW mode (use Esc to exit this mode).
uBITX Must be in CW or CWR mode. (Special keys shown below)

The keyboard buffer is a 255 character, circular buffer. Backspace allows for
correction of mistyped words and as a safety factor, <ESC> will immediately clear
the buffer and terminate any CW Keyboard operation.

f - New frequency (you must enter full 8 digit frequency with no decimal point,
i.e. 14060000. Below 10 MHz, a leading 0 must be entered, i.e. 07025000.) Direct
entry works only for frequencies within the current band.

l - lock (toggles)

m - mode (repeats cycle by hitting 'm', exit by pressing any key but 'm')

r - RIT (toggles)

s - SPLT (toggles)

t - CW Tone (100 - 2000)

v - VFO (toggles)

w - CW speed (5 - 50)

h - Help will cycle through the valid commands every 2 seconds.
 (Exit "help" by pressing any key but "h").
==

CW Keyboard special keys:

<ESC> immediately stops sending, clears the buffer and exits KB CW keyer.

<- (backspace) clears the last character(s) typed into the buffer as long as the buffer is not empty to allow corrections for typographical errors.

= sends BT

> sends SK

/ sends DN (slash bar)

; sends KR (formal semicolon)

@ sends AC (Current symbol for the @ sign)

! sends KR (Exclamation Point)

(sends KN (Formal Open Parentheses - seldom used)

$ sends VU (Dollar sign)

) sends KK (Open/Close Parentheses)

" sends AF (Quotation mark)

- sends DU (formal dash sign)

' sends WG (Apostrophe)

_ sends UK (underline - seldom used)

: sends OS (formal colon)

+ sends AR

Spacebar inserts a word space (7 dit delay) into the send buffer for those speedy typists.

Mouse Operation:

Once the mouse has been connected, the mouse cursor (yellow dot) will appear on screen. This will then allow you to select any item in a menu, tune each digit of the frequency with the scroll wheel (assuming the mouse has one), set mode with a click, or even placing the cursor over the MODE indicator on the screen and rolling the scroll wheel.

You can tune the main frequency very easily by placing the cursor on which digit you would like to change and using the scroll wheel, roll it forward to increase the frequency or backward to decrease.

The same method will work with the MODE, CW Speed (click on the speed# and roll the wheel forward to increase 1 wpm at a time or backward to decrease by the same amount.

You can place the mouse cursor on the center of the "Triangle" in the MENU bar and use the scroll wheel to move the selection through the available selections. Clicking any selection on the bar will enter that menu where the mouse will still be fully active.

Mouse operation will allow you to completely control your uBITX fitted with TSW's Teensy 4.1 Raduino with a mouse and never have to touch the screen though the touch function will remain completely active for use if desired.

Appendix D:

<mark>CW Message entering/editing and CW message sending. To use this feature requires that the modifications to the V6 uBITX be made to allow for keyboard and mouse operation. At least the keyboard must be connected for these features to be used. Also software version 1.45 is the first version this is fully functional in.</mark>

Five CW messages have been provided for. To enter your custom message, first click on the triangle, bottom center screen, several times until the Smsg and Emsg items appear on the lower right of the screen and click on or touch Emsg. The following screen will then appear. (Message one will be blank the first time you do this.)
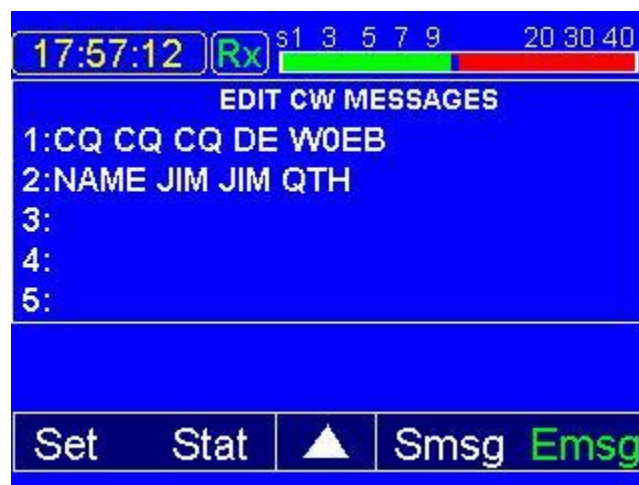

Emsg (Edit/Enter) message screen.

Click on the number of the message you wish to enter (or edit) and the enter/edit window will open. An example allowing edit (or entry) of message number 1 is shown below. INSERT is shown in green and is the active screen edit mode.
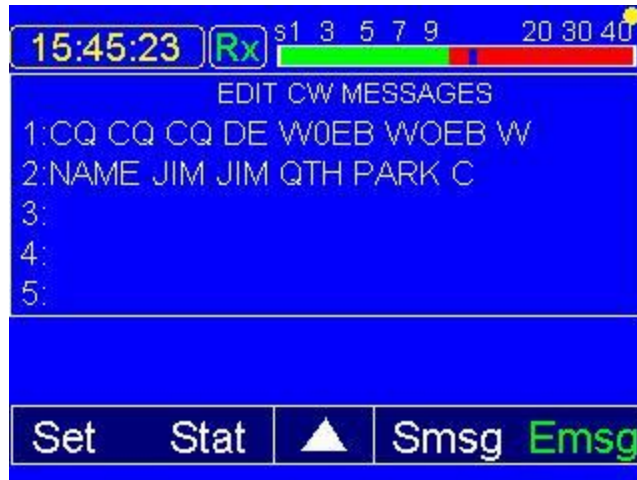
You may now use the normal keyboard editing keys to make any changes or additions to the message you would like.   When finished, touch or click the mouse on SAVE if you are satisfied or CANCEL if you wish to exit. Either way, you will be returned to the main operating screen. If you clicked SAVE, the message will be saved or edited as appears on the screen. If you clicked CLEAR with a message selected, the selected message will be erased. If you clicked CANCEL the original message will remain unchanged (or blank if no message had been entered),

Once you have at least one of the 5 messages saved to a message slot, to send that message, you must be in one of the CW modes (CW, CWR or CWP). Click or touch on the triangle again until Smsg shows on the screen, click Smsg and you will see the SEND CW MESSAGES screen shown below.
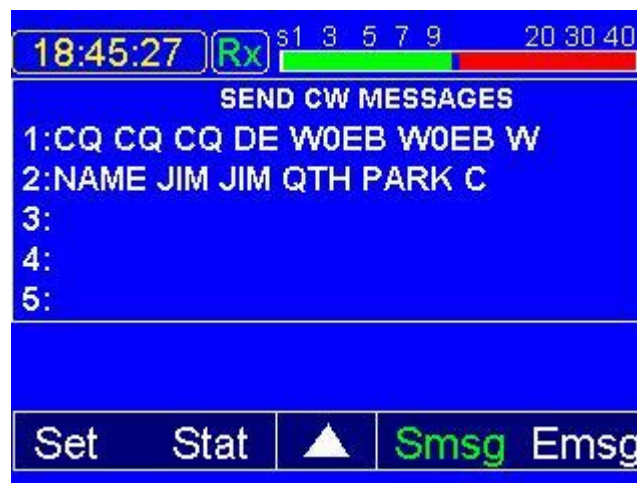
To send the desired message, touch or click on the number of the message to send and it will be sent. To stop the sending immediately, press the <ESC> key on the keyboard and the message being sent will be aborted. To send it again, just click or touch on the message number again. To return to the main operating screen just click or touch on the Green Smsg. The main screen will appear and both Smsg and Emsg will be white in color instead of green.

If you are using the Keyboard CW keyer, you may send messages 1 through 5 by pressing the F1-F5 keys on the keyboard. While the canned message is being sent, you may also use the backspace key to remove characters not yet sent and type new characters which will be added to the end of the message. This will make it convenient for you to modify a "Canned" message on the fly as it's being sent (assuming you can type fast enough or are sending slow enough to do this.

Appendix E:

Band Scanner: Optional – REQUIRES AGC with 3V max to S meter input (A7)

TSW's master programmer W2CTX has created a rudimentary band scanner routine that will scan the entire active amateur band and give a low resolution graphic picture of where the signals are on the band. It also displays a red line cursor showing the frequency the uBITX is tuned to and shows the bottom and top end frequencies of the scan. Scan is activated when the S meter is turned on (Via the SET menu) and though it will scan without an AGC present, the display will be meaningless as there will be no signal information available to the routine since the S meter input is essentially "floating" with no valid input. If the S meter is NOT turned on, the Scan selection will not appear on the first menu bar and the scan routine will be deactivated.

"Scan" (when the S meter is active) replaces "Freq"(manual frequency entry) on the first menu bar as shown below. Freq is moved to the last menu bar and is still available for frequency entry if desired. When the S meter is turned off via the SET menu, Scan disappears from Menu bar 1 and Freq resumes it's place right after "Band".

"Scan" selection shown on the first Menu bar.

Touching or clicking on Scan will cause the active band to be scanned once, the red bar cursor to be activated (allowing fast tuning through the band) and the graphical scan to be displayed. To re-scan without leaving the bandscan screen

simply touch or click on the "Rescan" button. Touch or click anywhere else to exit and return to the main screen. Whatever frequency the red line cursor is pointing to will be loaded into the active VFO and the receiver tuned to that frequeny upon exiting the band scan screen.


Band scan of 20 meters during the February 2021 ARRL CW DX contest.

To reiterate, this optional mode operates ONLY if an AGC board is installed and an S meter voltage that varies between 0 and 3 volts maximum (all the Teensy will safely take on any input) is connected to the A7 or A17 (analog) input of the teensy. A7 is available on the 12 pin DuPont header P5 and A17 is connected to the old "Spare" pin on the right hand side of P1, the encoder connector.

Appendix F:

Special Mods for CW: To use the Teensy 4.1 system's CW keyer, the connections to the front panel "KEY" jack either need to be modified (it is NOT connected to the Teensy 4.1 Raduino card in any way in the factor configuration of the main uBITX V6 board) so unless modified, the front panel key jack is not usable.

Unless you plan on someday reverting to the Factory Raduino and configuration (not likely once you use the CW keyer in TSW's program with the T4.1 Raduino card), we advise the following modifications.
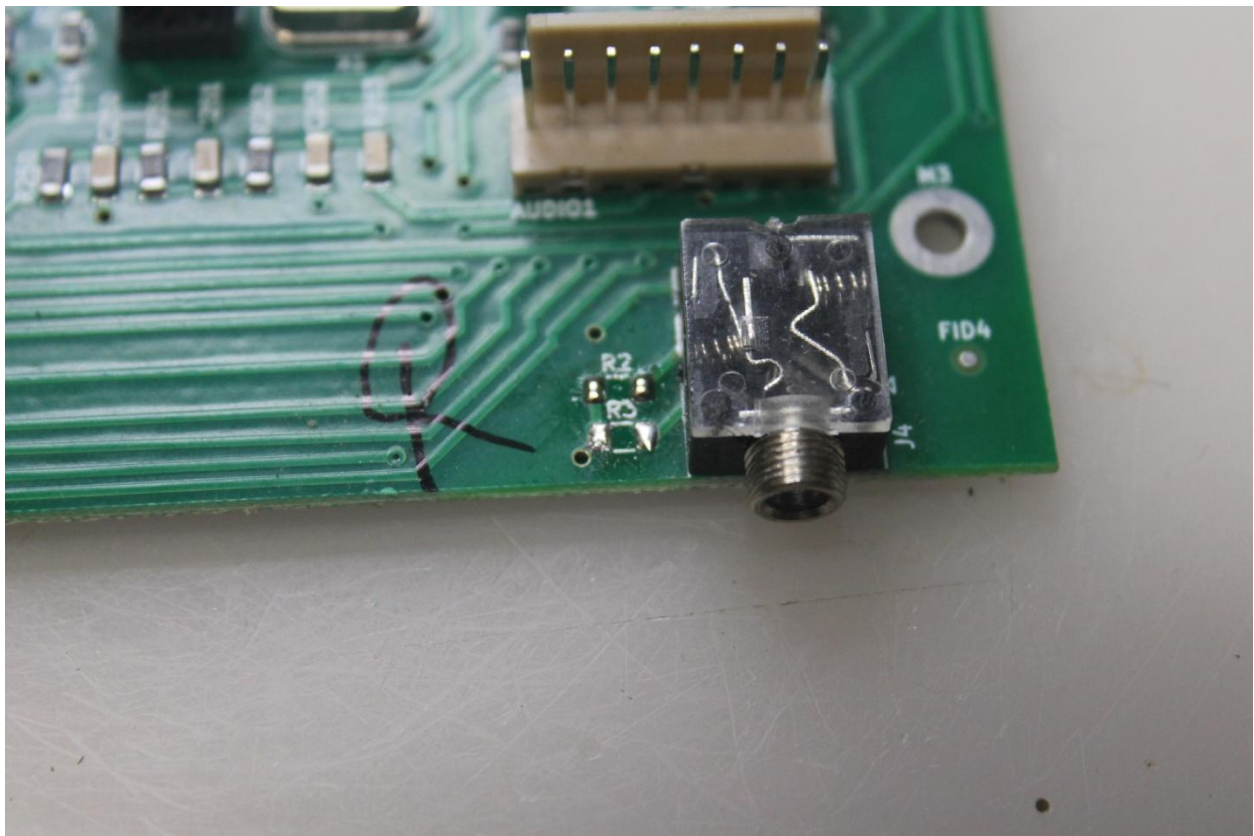
uBITX V6 Main Board, Front Panel CW Jack with R2 and R3 removed

First, carefully remove the two surface mount resistors to the left of the front panel key jack. This will ensure that no improper signal voltage can be applied to the jack from the V6's original on-board wiring. Next, on the underside of the board, connect a wire from the TIP (DOT) connection of the key jack to the RING (PTT) connection on the microphone connector. This will make the front panel jack into your "Hand Key" jack.
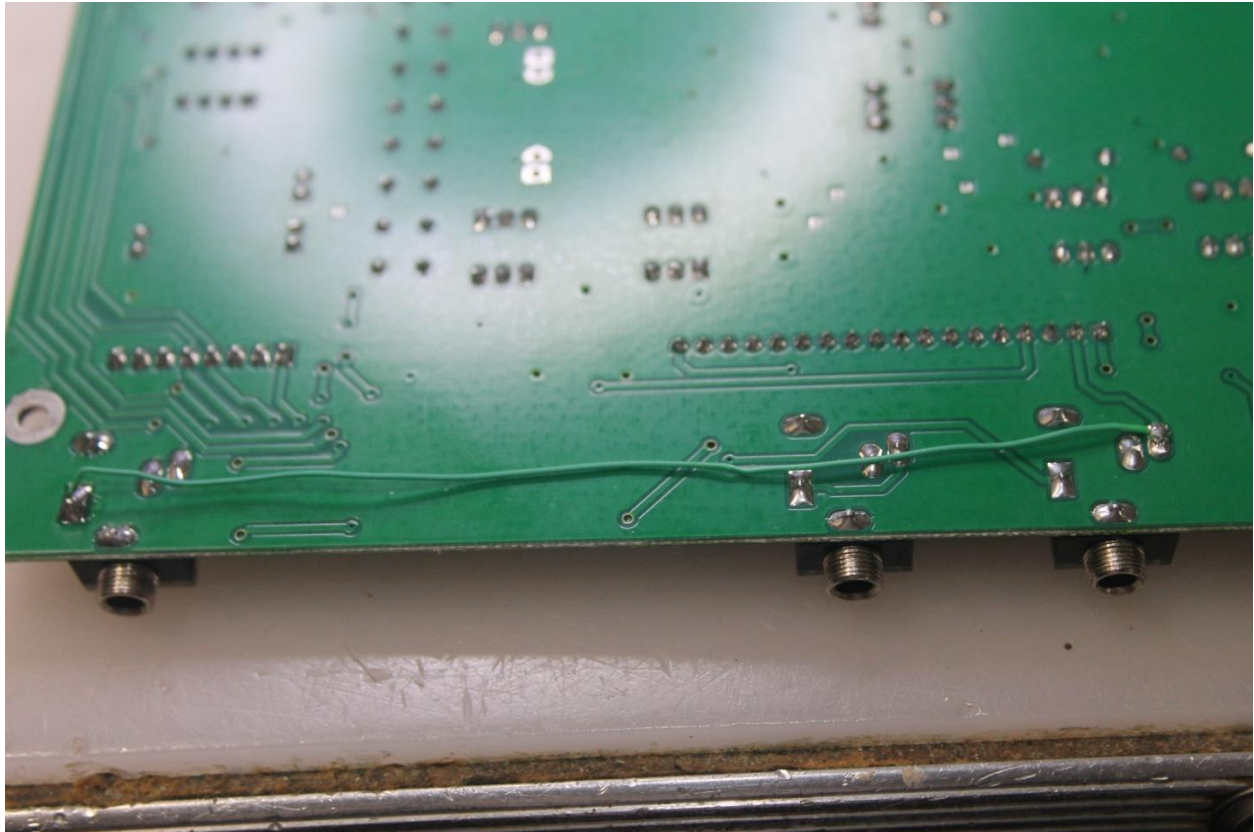
Wire connected between front panel KEY jack "TIP" and Microphone jack "RING" (PTT)

Re-assemble the V6 uBITX and this completes your CW "Hand Key" modification.

CW Iambic Paddle Keyer: First, you need to make up a 3 wire cable (3 conductors twisted together is fine) with the wires running from a "stereo" jack mounted through a drilled hole on the back panel. This jack can be either 1/4 inch or 1/8 inch stereo jack depending on the user's preference.
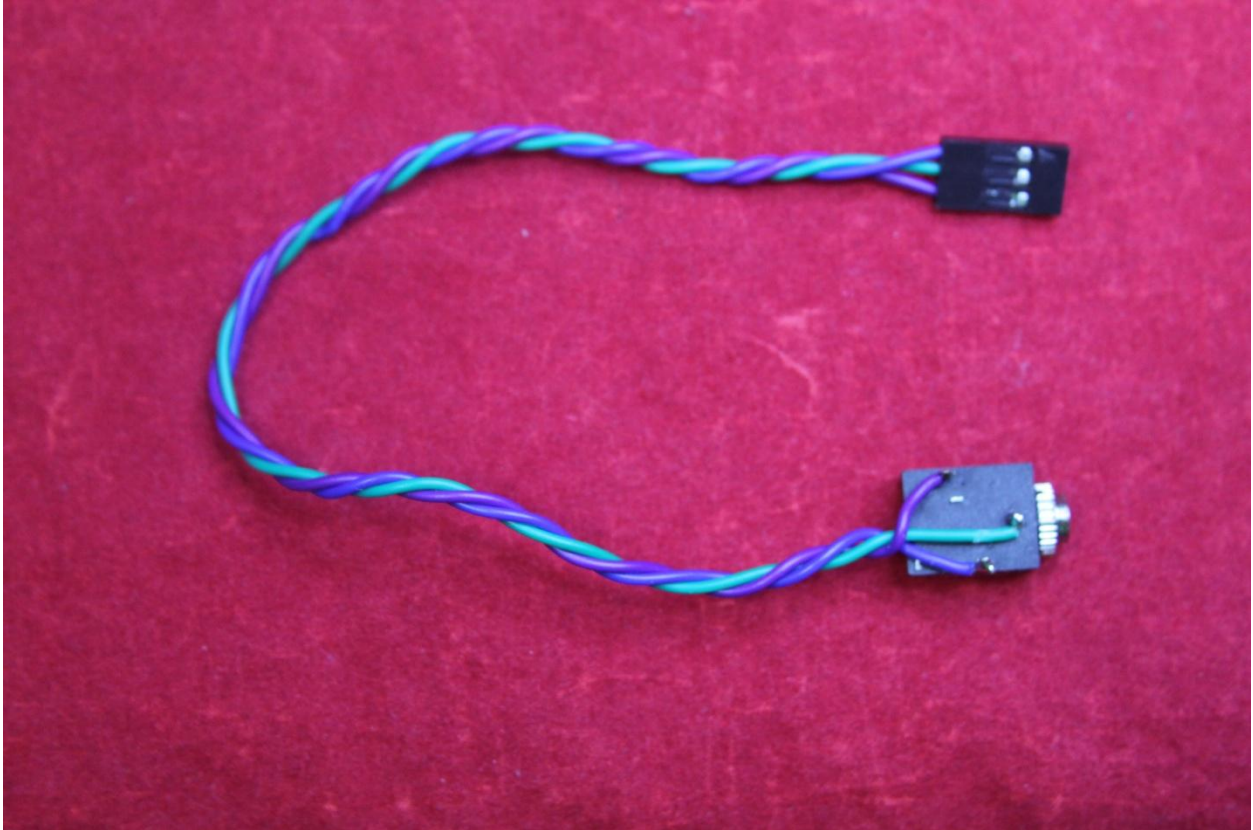
Assembled Paddle Jack & cable using a 1/8 inch stereo jack

Cable wiring & connections: The ground (sleeve) connection goes to the center pin (GROUND) of the 3 pin KEYER PADDLES header (P9) on the rear of the T4.1 Raduino card (just below the Teensy MPU and about center on the PC board. The Dot connection (usually the TIP) goes to the left most pin of P9 and the Dash (usually the RING) goes to the right most pin of the 3. Use either a 3 pin Female DuPont connector on that end of the cable or use 3 single wires with single DuPont Females on one end. Make sure they are long enough to have a bit of slack when connected between the Pack Panel Jack and that they are twisted together to minimize RF pickup from proximity to the main board circuitry.

In the above photograph, the Green wire is GROUND, the Blue wire is TIP (DOT) and the Purple wire is the RING (DASH) connection on the jack. Connect the DuPont female to the appropriately marked (Dit, Ground, Dah) pins on header P9 and mount the jack on the back panel to complete the Keyer Paddle Jack mod.

Back Panel of the V6 uBITX showing an 1/8" jack for the keyer paddles and the mounting hole for the Host Mode connector. Done carefully, this can be very neat.

No other modifications need be done to the case or main board to use the T4.1 Raduino Clone system – Enjoy the much smoother operation of your radio.

Appendix G: CW Decode (CWD) and Spot (Zero Beat) additions added in V1.61

In Version 1.61 of the software, a CW Decoding routine was added. This DOES require the addition of an audio tone decoder to provide the analog to digital information necessary for the MPU to process & decode the incoming CW signals and also the sidetone audio when using CW Practice Mode (CWP) with the CWD routine.

The SET menu has an additional entry that allows the tone decoder installation to be indicated. When not installed (or deliberately disabled) No CW HW will be shown as in the image below.

No Tone Decoder selected

Tone Decoder installed & Selected

In order to use the CW decoder function, CW HW must be selected AND the tone decoder board must be installed. The tone decoder construction & alignment is contained in a separate manual that comes with the kit of parts and is also included with the program file & software manual for Version 1.61 and later so the user can build his/her own decoder board without purchasing the TSW kit if they so desire.

The CW decode routine CWD will not be active nor will the zero-beat "Spot" button be displayed on the menu line if the tone decoder is disabled or not installed.

Screen shot showing both CWD and Spot buttons.

These items, when active can be selected by touching them on the screen, or using the Mouse to select them. Provision has not yet been made to add Keyboard commands for these selections.

When CWD is active, CWD will change color to green on the main display. When a signal is heard while tuning, as long as it is the only signal audible, touch or click the mouse on "Spot" and the radio will do a quick search +/- around the signal and tune the radio so that the incoming CW tone matches the sidetone frequency as indicated in the SET menu. Once zero-beat has been achieved, the triangle (menu page selector button) will change from white to red and stay red as long as a tone is present. It switch between white & red along following the CW signal and produce a steady red when a continuous tone is matching the sidetone freq.

CWD Active and decoding a signal at zero-beat

The screen shot above shows the CW decoder copying an off the air signal on 14029.85 with an S9+ signal strength after having been zero-beat with the "Spot" button. The red triangle indicates either a dot or dash being received and fed to the decoder logic. The CW decoder will follow CW signal speeds automatically from around 10 wpm up to over 50 wpm.

In CW Practice mode, sending with the hand key, paddles or keyboard, speed is limited to a maximum of approximately 40 wpm due to the processor's multi-tasking overhead requirements.

The CWD routine is NOT intended for use in contests as that is generally against contest rules anyway and it doesn't take much background QRN or interference from a close-in signal to cause character decoding errors. This must be kept in mind when using CWD and is not something that can be corrected due to the nature of CW in relation to noise/QRM even when copying by ear.

NOTE: we had originally not intended to add this capability but there was enough requests for it and we found an excellent, open source decoder program by K4ICY and our master programmer was able to incorporate it into the existing program once the tone decoder circuit was provided.

Miscellaneous:

Photo of W0EB's μBITX using TSW's Teensy 4.1 Raduino & V1.58 software.

Credits:

Jim Sheldon, W0EB, Manual Author, 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

Manual date 12/24/2021