

# **μBITX Mini Manual**

*A small booklet aiming to help new bitx users!*

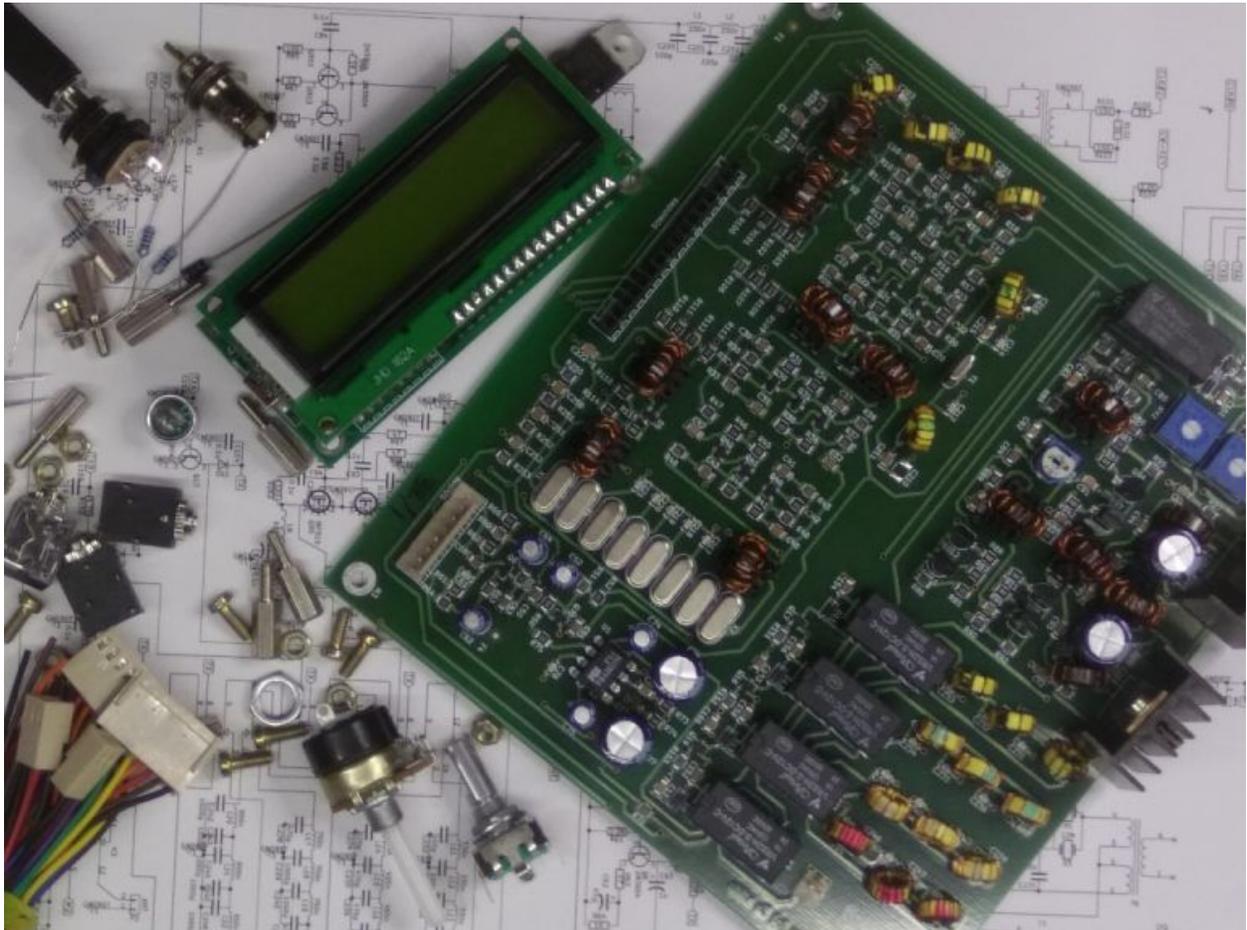
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Ver 0.1

## Welcome to your new BitX!

The  $\mu$ BITX is an HF SSB/CW QRP transceiver kit that is easy for first time kit builders to assemble and get on the air with. IT is designed to be open source and easily modified and extended right on the workbench of your radio shack. The rig's motherboard is built around pretty easy to follow schematic blocks. The BitX covers from 3 to 30MHz, with a respectable ten watts output for SSB and CW use.



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### Operational Features In A Small Package

The BitX is very simple to wire up and even simpler to get on the air with. With automatic sideband selection while tuning the VFO, RIT, CW Speed settings all easily access from the menu using the tuning knob encoder.

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## Kit Components and Specifications

The BitX is delivered as a complete-it-yourself kit with the following components included in its shipping package:

1 x BitX Motherboard		1 x Raduino		1 x Detent-free Encoder
3 x Audio Sockets		1 x BNC Connector		1 x Power Connector
1 x Power Jack		8 x Brass Standoffs		2 x CW Key Resistors
1 x Reverse Protect Diode		1 x Electret Mic		1 x Miniature PTT Button
1 x Volume Control with On/Off Switch				

BitX Specifications:

### Receiver:

- Sensitivity: a 0.2uv signal is clearly audible
- Selectivity: 2.4 KHz, low ripple SSB filter with 8 crystals
- RIT (Receiver Incremental Tuning)
- Continuous coverage from 500 KHz to 30 MHz
- Sideband selection
- Detent-less encoder tuning. Tunes with larger step rates when tuned quickly

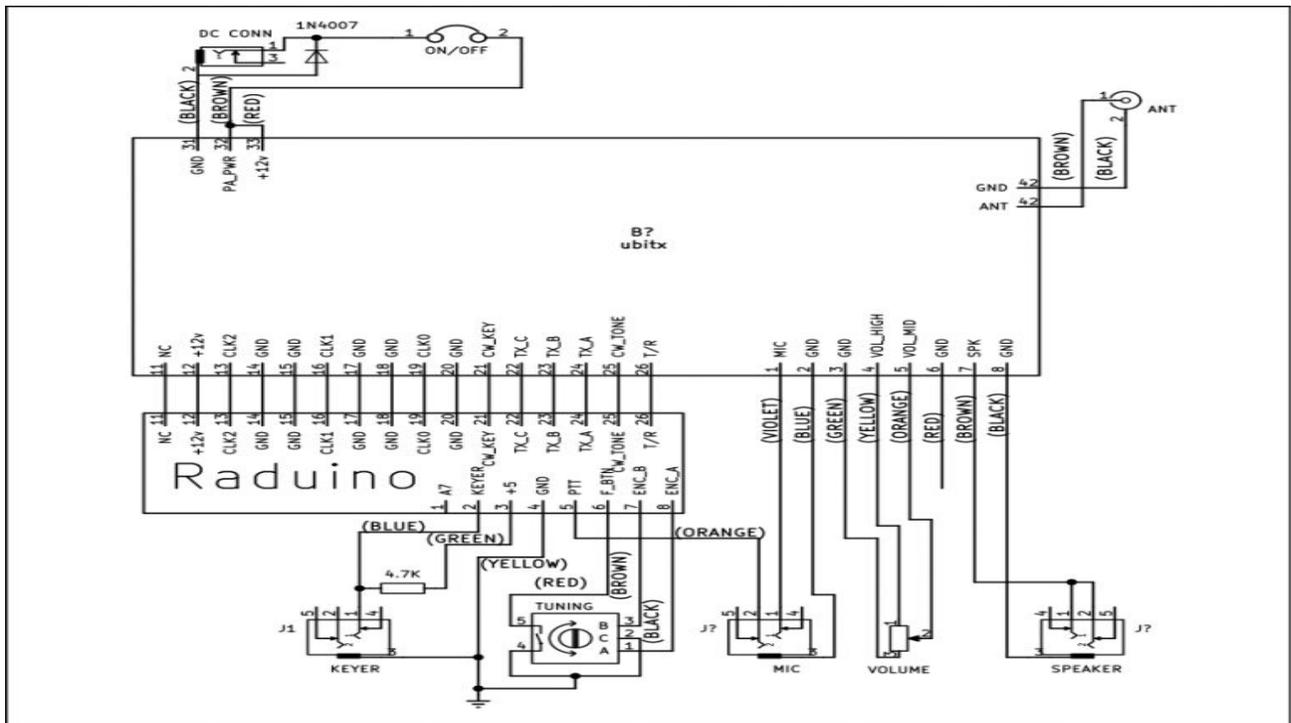
### Transmitter:

- More than 10 watts up to 10 MHz, 7 watts up to 21 MHz, 2 watts on 28 MHz
- CW transmit with the built-in keyer
- Uses IRF510s x 2 as PA and 2N3904 x 4 drivers in push-pull mode for low distortion transmission.

### Architecture:

The  $\mu$ BITX uses upconversion to the first IF of 45 MHz. This eliminates the need for a large number of band pass filters, keeping the design simple and virtually image free. The roofing filter at 45 MHz is 15 KHz wide. The signal is then down-converted to 12 MHz where a low ripple SSB filter with 8 crystals is used to provide a sparkling audio.

## Assembly Instructions



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As you can see above, the wiring of the BitX is really straight forward and can be done up just a few hours. All you should need to wire up and assemble your kit is some basic power tools, an enclosure of your choice, a solder iron and solder.

Remember the following while assembly your kit:

- **The CW keyer has to be wired even if you don't intend to use CW. Yes, the 4.7K resistor to 5v is a must.**
- *The Raduino board plugs into the  $\mu$ BITX board. You can unplug the LCD from the Raduino and install it separately on the front-panel with wires from the Raduino.*
- *Keep the wires to the antenna connector as short as you can manage.*

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**Digital Logic Plug (found on Raduino / CONTROLS):**

| Blue: Keyer | Green: +5VDC | Yellow: Ground | Orange: PTT | Red: Encoder Button |  
| Brown: Encoder B | Black: Encoder A |

**BitX Motherboard Plug (found on BitX / AUDIO1):**

| Violet: Mic | Blue: Ground | Green: Ground | Yellow: Vol\_High | Orange: Vol\_Mid |  
| Red: Ground | Brown: Speaker | Black: Ground |

**Choose an Enclosure:**

The BitX can be enclosed into just about any enclosure that you may have on hand, given that it has room for the motherboard and raduino. While we would recommend that you enclose your BitX into a metal cabinet of some form for shielding, an alternative approach may be to 3D print a plastic enclosure using STL files from places such as Thingiverse or similar places on the web. Just ensure the enclosure of choice will house and protect your radio's circuitry.



**WARNING :** The heatsink of the  $\mu$ BITX carries the DC positive voltage of the power amplifier final MOSFETs. These means that the heatsinks should never come into contact with any other metallic surface that could possibly have reference to ground!



**WARNING:** When assembling your  $\mu$ BITX, you may wish to include a two amp fuse inline with the power amplifier's DC input. This fuse may serve to protect the finals and the traces of your  $\mu$ BITX's motherboard in the event of a MOSFET failure or high SWR condition.



**Editor's Thought:** If you are assembling your  $\mu$ BITX for purely digital work, it may not be a bad idea to place a 600 ohm audio transformer inline between each audio jack and the  $\mu$ BITX's motherboard. This will help isolate your audio stages from your PC or tablet device.

The  $\mu$ BITX kit comes with three audio sockets. These are meant for the mic, headphones and CW key connections. Each socket's sleeve tab should be connected to the ground. This happens automatically if you are using an all metal box for this radio.

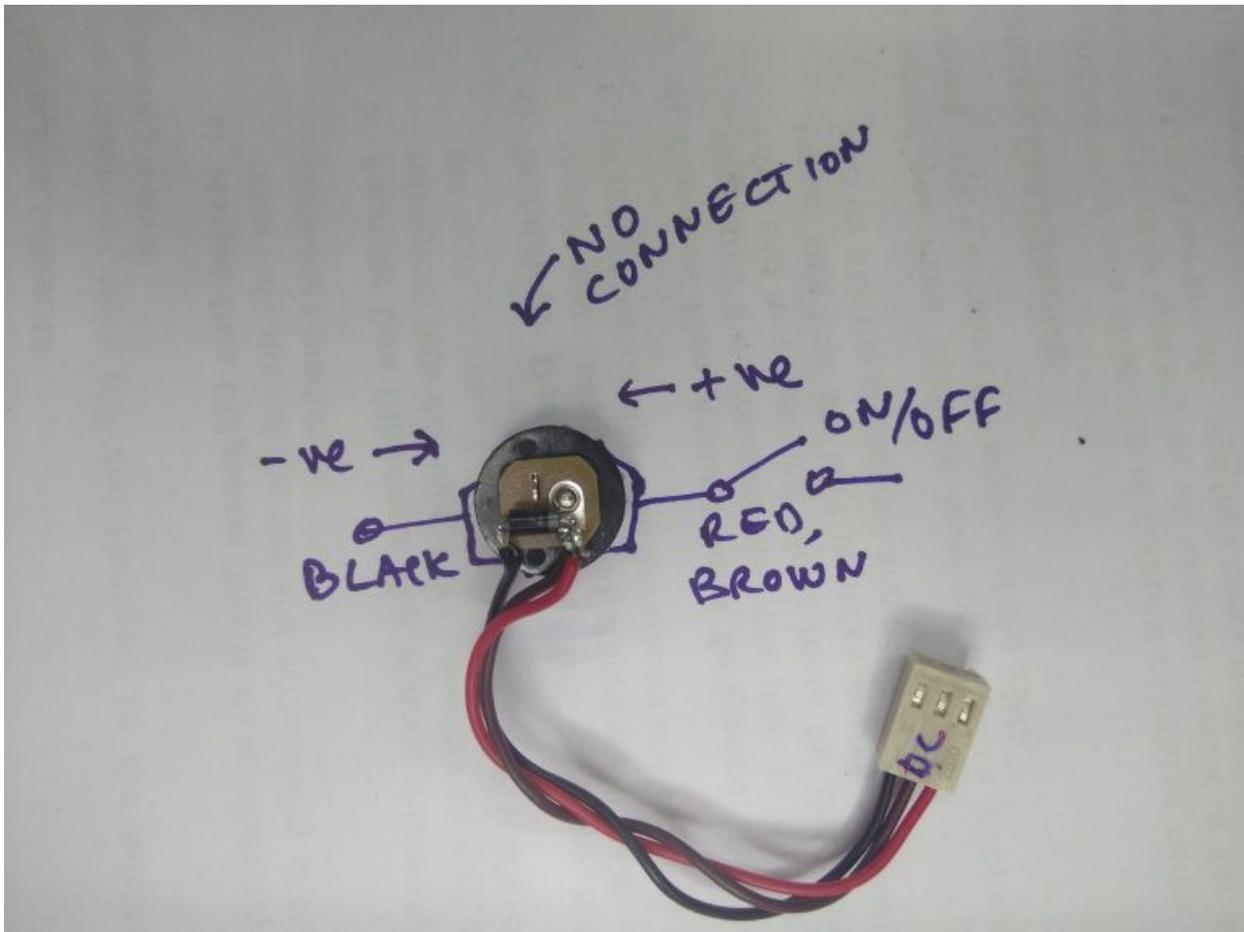
If you are using a non-metallic box, solder wires between the ground lug of each of the sockets and connect it to the DC ground. The DC ground is available on the Yellow wire connected to the encoder or at the DC socket. To avoid making mistakes, it is better to write the name of the socket against it, inside the chassis. See the picture below.



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Pick up the 3-pin DC connector with cables and the 1N4007 silicon diode. The 1N4007 has to be installed with reverse polarity. Its purpose is to conduct if you have supplied reverse voltage to the radio and burn itself out, and thus blowing the fuse if you decided to include the use of one, instead of damaging the radio.

- Solder the 1N4007 diode across the DC connector. The ring of the diode should go to the positive tab of the DC connector, the other side of the diode goes to the ground tab. (See the picture below)
- Solder the DC cable's red and brown wires together to the positive lug of the DC connector
- Solder the black wire to the ground.



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Now, plug this into the main board's DC connector. Switch on the power and measure the current. It should be between 90ma and 110 ma.

### Step 3: Prepare the Digital connector

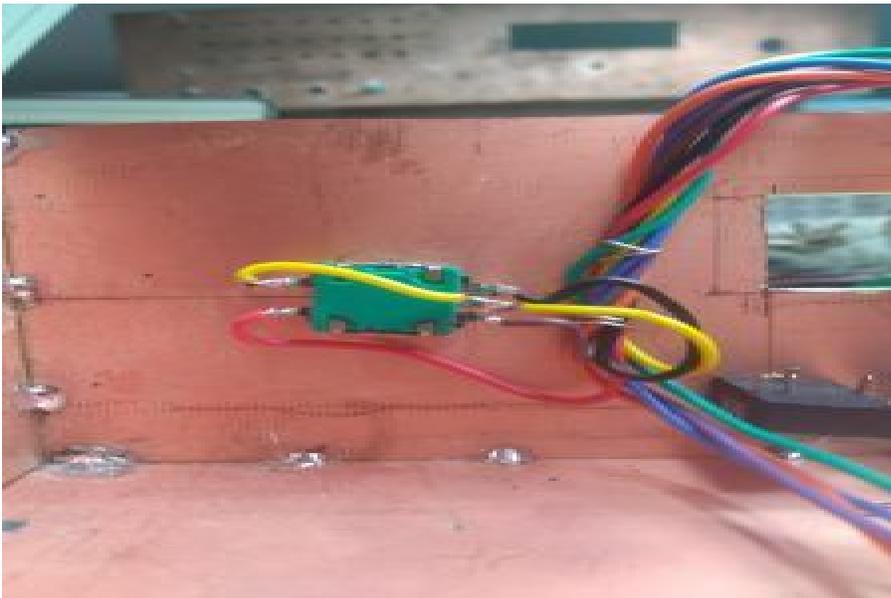
The digital connector is an 8-bit connector that wires the Raduino board to the front panel. Take one of the two 8-pin connectors, write 'DIGITAL' on top of it. Twist its wires together so that they stick together. You might want to apply some insulation tape to keep them together. The digital connector's wires length must be just enough to be routed to the front-panel, excess should be cut out. Leaving the wires coiled or looped around can increase the digital noise.

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### Step 3.1 : Wiring the up Encoder

The encoder has three tabs on one side that correspond to Encoder's A, ground and B tabs. On the other side is the push switch. It has to be wired as follows:

- Black of the Digital connector to Encoder's A tab (this is A0 from the Raduino board)
- Brown of the Digital connector to Encoder's B tab (this is the A1 from the Raduino board)
- Red of the Digital connectorto Encoder's switch (this is A2 from the Raduino board)
- Yellow of the Digital connector to Encoder's middle tab (this is the Ground line from the Raduino board)
- The solder the remaining tab of the push switch to the digital connector's yellow wire (it has to go to ground as well)



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### Step 3.2: Wiring up the PTT from the digital connector (not the mic, yet)

Connect the orange wire from the Digital connector to the mic socket's left most tab (as seen from behind). When we wire the microphone's line to the Audio connector, it will provide common ground for the PTT as well.

 Check that the mic's ground lug is showing connectivity with the chassis ground.

### Step 3.3: Wiring up the CW Key

The CW key needs a pull-up resistor of 4.7 K from 5 volts to the key socket's tip. The green wire from the digital connector carries 5v. The blue wire of the digital connector is the keyer line (A6 of Raduino).

- Solder the digital connector's blue wire to the tip tab of the CW key socket
- Solder the 4.7K resistor to the CW key socket's tip.
- Solder the digital connector's green wire from the digital connector to the other side of the 4.7 K resistor.

 **DANGER** : If you power up the  $\mu$ BITX without the pull-up resistor the  $\mu$ BITX can randomly go into CW transmit and if this happens without a dummy load or suitable antenna connected to the radio, damage to the MOSFET finals can occur!



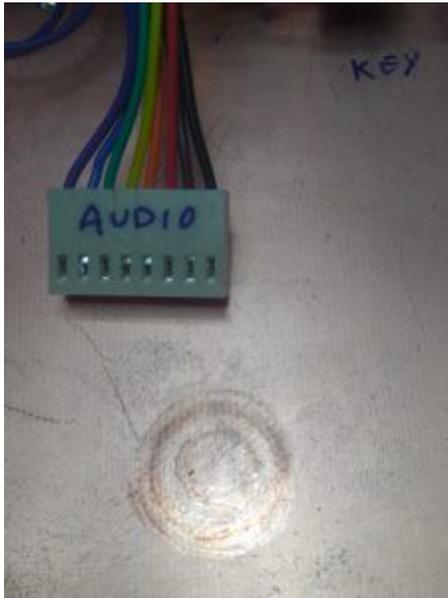
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Leave the violet wire (The A7). Keep it coiled. It is not used in the  $\mu$ BITX , thus if you can hack your way around the  $\mu$ BITX , find some use for it.

#### Step 4: Wiring up the Audio connector

The audio connector is another 8-pin connector. It connects to the main board of the  $\mu$ BITX and ties in the mic, headphones and the volume control to the board. Write 'Audio' on the top of the connector to prevent swapping it with the digital connector.

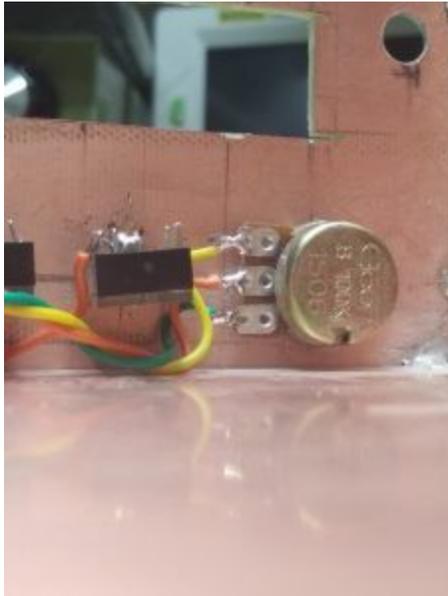


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### Step 4.1: Wiring up the Volume Control

The green, orange and yellow wires from the Audio connector are soldered to the volume control.



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- Connect the green wire to the ground tab of the volume control
- Connect the yellow wire to the hot end of the volume control
- Connect the orange wire to the wiper (middle lug) of the volume control

### Step 4.2: Wiring up the Microphone

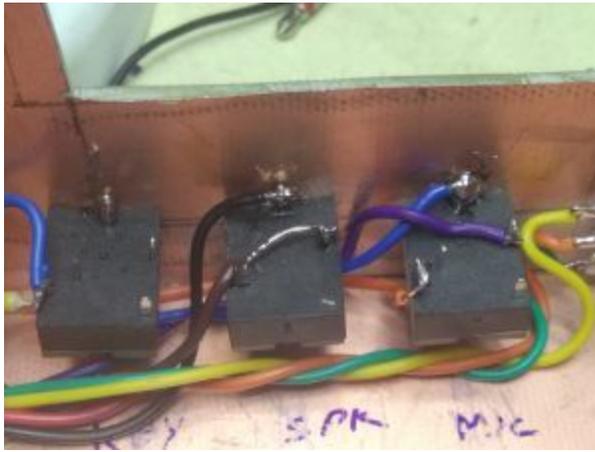
The audio connector's blue and purple wires connect to the microphone.

- The blue wire is soldered to the ground lug of the microphone socket
- The purple wire connects to the the tip of the microphone socket

### Step 4.3: Wiring up the Headphones

The brown and black wires from the audio connectors carry the speaker out.

- The Brown wire is speaker output
- The Black wire is speaker ground
- The brown wire has to be connected to the (both) the tip and the ring of the headphone socket.



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*Tip: You can connect a speaker by connecting an internal speaker to the ground lug and any of the two unconnected lugs of the headphone socket.*

### Step 5: Wiring up the Antenna socket

The BNC antenna socket should be mounted close to the antenna connector on the main board. Connect the 2-pin wire connector to the antenna socket on the board. Cut the wire to the shortest length that will take it to the antenna socket. While mounting the BNC antenna socket to the box, be sure to slip the soldering lug over the BNC socket from inside the box (between the nut and the wall of the radio box).

- Connect the black wire of the antenna connector to the lug of the BNC socket.
- Connect the brown wire of the antenna connector to the center pin of the BNC socket.

## Step 6: Plugging in



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- Install the  $\mu$ BITX board
- Insert the Raduino board into the  $\mu$ BITX . Be careful, it is easy to wrongly install the board by skipping a pin.
- Connect the Audio connector to the  $\mu$ BITX board
- Connect the Digital connector to the Raduino board
- Connect the antenna and power connectors

## Step 7: Check Out

- Plug-in a Mic (tip is Mic, ring is the PTT) and a speaker.
- Attach a low SWR antenna
- Plug-in clean 12 VDC power supply capable of at least 3 Amps.

You still, here? Go and operate! Or follow on to the pages following assembly for more information about the kit!

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## Tune-up Procedure

The  $\mu$ BITX comes pre-aligned. You should do this only if you really think it is out of alignment. However, there are three things to be tuned up to ensure things are operating as intended.

### 1. PA BIAS

- Switch off the rig
- Locate the two PA bias presets (the blue square ones)
- Set both the presets to fully clockwise position, gently.
- Attach a dummy load or a low SWR antenna and switch the rig on
- Attach a current meter to the power supply so you can monitor the current draw
- Switch the radio on
- Press the PTT without speaking ( no modulation)
- The current draw should be between 470mA and 500mA
- Slowly increase one of the two presets until the current increases by 100mA
- Do the same for the other preset (the total current should have increased by 200mA now)
- Now, blow a loud HALLLOWWW into the mic.

Does the current suddenly jump up? If so, congrats, you're done with PA Bias!

### 2. Aligning the master clock

All the frequencies of the  $\mu$ BITX are derived by multiplying/dividing to the required frequency from a single 25 MHz crystal. This crystal is rarely at exactly 25 MHz. We have to calibrate this clock to the exact frequency. Here is how it is done

- Click on the encoder button to display the menu, rotate it to the "Setup On?" and click on to confirm it. This enables the setup options.
- Tune to an AM broadcast signal with known frequency.
- Set the dial of the  $\mu$ BITX to read the exact given carrier frequency of the station. If your calibration is out, this will NOT be zero-beat.
- Click on the encoder button again to display menu and this time it will show up a new option 'Set Calibration?'. Click to enter this option
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- 
- Now zero-beat to this signal (the frequency display of  $\mu$ BITX will remain the same)
  - Press PTT to save the calibration.

### 3. Setting the BFO

- Click on the encoder button to display the menu, rotate it to the "Setup On?" and click on to confirm it
- Tune to an clean and preferably weak SSB signal to its loudest (not the clearest)
- Click on the encoder button again to display menu and choose the option 'Set the BFO'. Click to enter this option
- Now tune with the encoder for the best sounding audio
- Press PTT to save the calibration.

You are now done with alignment of the radio.

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## Firmware Functions

The stock firmware includes a simple to use menu system that can be fully utilized by the encoder. To access the radio's menu, simply push the encoder knob in to activate its built in function button.

### **Band Select:**

This menu item allows you to quickly select the band you wish to operate.

### **RIT:**

Enables or disables the radio's RIT function.

### **VFO A / VFO B:**

This menu item allows you to toggle between VFOs.

### **LSB / USB:**

This menu item allows you to override the automatic sideband selection.

### **CW:**

This menu item allows you to select your CW speed.

### **Exit Menu:**

Does just that, exits the menu.

### **Setup On / Setup Off:**

Enables or Disables the alignment/calibration menu options.



**WARNING:** Do not mess with the alignment unless you know what you are doing and you are sure the radio is out of alignment. The BitX comes aligned from HFSignals.



**NOTICE:** There may be some menu options missing from this mini manual. The editor has not had a BitX in his shack in a few months. If anything is missing, feel free to let the editor know.

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## Obtaining Support

At the time this document was composed, HFSignals does not appear to provide support directly for this kit. However, kit builders are actively encouraged to head over to <https://groups.io/g/BITX20> and join the community to obtain support by asking questions and reading previously posted messages.

## Various Firmware Repos

The BitX and its accompanying software are open source. You can easily get the source code for the stock firmware or even change what firmware you use on your radio. Here are a few firmware repos to get you started.



**WARNING:** Flashing a different firmware than stock can make your BitX function different or possibly incorrectly. It may be as simple as flashing back to the stock firmware to fix, or it may require recalibrating the radio under the new firmware.

Ashhar Farhan, Stock uBitX v4 Firmware: <https://github.com/afarhan/ubitx4/>

KD8CEC, Aftermarket Firmware (v3): <https://github.com/phdlee/ubitx>

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## Credits

Ashhar Farhan (hfsignals), ubitx design and production

<http://www.hfsignals.com>: imagery and information used in document

BitX20 group on <http://groups.io>: various bits of information used in document

Ghericoan\_Eckly (N5WLF): Composure of document

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