

CTR2-Mini

Operation Manual

v1.14.03



CTR2-Mini



CTR2-Mini+

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Updated to firmware v1.14.03

Revised sections for this version are highlighted in yellow

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Introduction

Welcome to the operation manual for CTR2-Mini and CTR2-Mini+. I'll refer to CTR2-Mini and CTR2-Mini+ as simply 'the Mini' in this manual because they both run the same firmware.

My original intent was to document the Mini's features and operation on my blog (<https://ctr2.lynovation.com>) and YouTube channel (<https://youtube.com/lynovation>) but after further consideration I decided that an actual document with an active Table of Contents would be better. You can, and should, use my blog and YouTube channel for additional information as many features may be better understood using those mediums.

Manuals for other CTR2-Mini products can be found on the Lynovation blog at <https://ctr2.lynovation.com/category/download>

How to use this manual

Originally this manual was designed as a reference manual. An expanded Help system if you will. Items in the Table of Contents link to their write up in the manual. The main categories have short write ups describing the functions available in that section.

Users have asked for a 'Mini 101' section to help you learn about setting up various functions in the program. This section has been added at the top of the manual, right after the [Quick Start Guide](#).

A [FAQ and Troubleshooting](#) section has also been added to address common questions and failure modes.

As this document evolves, sections that have changed since the last update will be highlighted in yellow.

The version number of this manual will follow the latest released version number of the firmware.

Feel free to contact me if you have question about a certain feature or have ideas for future improvements. I love to get feedback on my work. My email address is good on QRZ.com.

Version Changes

The latest changes to the firmware are listed in this section. When a new update is created this section will be updated and this information will be moved to [Appendix I](#).

v1.14.xx Changes

1. Added a new [Range Tuning](#) mode to the [VFO](#) and [B] button menus
2. Added a new [Scan](#) mode to the [VFO](#), [C] button, and Function Button menus
3. Pressing the blue 5-way switch in the Home page shifts the Function Buttons to their secondary functions and displays the [Secondary Function Button Help](#) page. The default F5 function has been changed from SHIFT to open the [Radio](#) menu. You no longer need to assign SHIFT to a primary function button.
4. Added the ability to use the blue 5-way switch *Up* and *Down* buttons to switch modes in [Radio](#) menu
5. Refined Icom CAT commands to work with IC-9700 and added the ability to set Icom address in [ICOM Radio](#) menu
6. Improved the functionality of the VFO modes and debugged memory load/save issues
7. Added '!' to character list – mostly for password entry – Morse is 'KW'

v1.14.01 Changes

8. Blocked '#' from being used as the first character in a memory label – '#' is used to mark a comment line in the file
9. Preload tuning range so there's something in it on first use

v1.14.02 Changes

10. Minor tweaks to paddle debouncing algorithm
11. Fixed bug that prevented updating scan range when selecting or updating a memory slot
12. Reset selected memory slot when changing bands

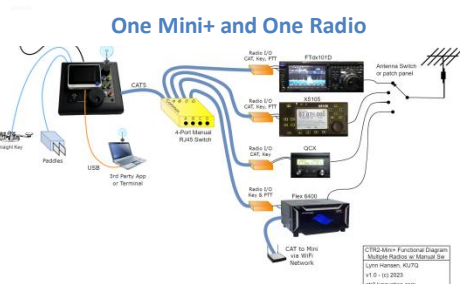
v1.14.03 Changes

13. Added code to detect a faulty input on the RMT PTT/KEY INPUT
14. Moved the Function Button Recalibration function from the [Config->Function Btms](#) menu to the [Config->Calibrations](#) menu

What's a CTR2-Mini?

The first question I'm asked when posting anything about the Mini on social media is "What's a CTR2-Mini?" That's a fair question. At first glance the Mini looks like a run of the mill remote tuning knob with a built-in contest keyer for your radio. But the Mini is much more than a tuning knob or keyer. Much, much more!

The Mini is a small radio controller based on the [Seed Studios Wio Terminal](#). It can control one or more radios.



Being small, it can find a place on even a crowded operating desk.

Unlike other remote control options like PC programs and steam deck controllers the Mini **does not** require a PC or external program to be running in order to control your radio.

This is true even for the Flex Signature radio series. The Mini can control the Flex, including PTT and Key, as a GUI client over the network without SmartSDR [One Mini+ controlling multiple radios](#) running. In GUI mode a small panadapter can be displayed.

The following is a brief summary of the Mini's capabilities.

- The Mini is completely self contained – no other programs or a PC are required to control your radio
 - Connects as a GUI or non-GUI client to Flex radios – *SmartSDR is not required*
- The Mini keeps you informed of the status of your radio by displaying frequency, band, mode, RIT, and other useful information
- Stores up to 16 radio profiles
 - Use a manual RJ45 switch to select one of many radios as shown above
 - An optional [I/O Multiplexer](#) is available that replaces the manual RJ45 switch above. It automatically connects the selected radio to the Mini.
 - [Multiple profiles](#) can be used with one radio to increase the number of saved frequencies
- [Enhanced Tuning](#)
 - Turning the encoder changes the frequency on the radio based on the selected tuning step
 - Tune your radio with its tuning step and use another tuning step on the Mini
 - The tuning step can be easily changed by pressing and holding the encoder while turning
 - Half digit steps such as 5, 50, 500 Hz, etc. are supported
 - Manages two VFOs (A and B) and memory tuning using *only VFO-A on the radio*
 - This leaves VFO-B on the radio free for other uses
 - Split mode operation separate from the radio's split mode
 - Ability to set a tuning range in any band. This is useful for staying within a contest's frequency range or when tuning linear transponders on satellites.
 - Scan mode sweeps the radio's frequency through the band or through a selected tuning range. The encoder is used to switch directions.
 - Can zero digits below the tuning digit to tune to set a precise frequency
 - Remembers the last 14 frequency/mode pairs tuned so you can easily return to them
 - Saves up to 200 frequencies and their modes (100 for each VFO)
 - Frequency list can be assigned to one radio profile or shared with all profiles
 - Define a tuning range by saving the start frequency in VFO-A and the stop frequency in VFO-B
- [Contest Keyer](#)
 - 14 memory buffers, 5 to 99 wpm
 - Straight, Passthru, Iambic-A and B, Ultimatic, and Bug modes
 - Passthru allows you to key your radio's keyer or an external keyer using paddles connected to the Mini
 - Radio's keyer speed is synchronized with the Mini's keyer speed

- Keyboard keying using a PC terminal program connected to the Mini's USB serial port
- Prosigns are based on the K1EL WinKey 3.0 standard
- Use special prosigns to send your call ("^"), contest SN ("#"), contest exchange ("%"), or increase speed 50% ("*")
- Connect your contest logging software to the **PTT/Key In** jack to key the selected radio
- [Practice mode](#) generates fixed or random length words based on characters you select
- Practice mode can be used for on-air practice for club session or one-to-one sessions
- For radios with two receivers like the Yaesu FTdx101, Icom IC-7610, and Elecraft K3/K4 the Mini allows you to tune and control each receiver independently.
- [Meter mode](#) turns the Mini into a remote meter panel displaying the S-meter, Power Out, SWR, Compression, and ALC meters
- [External Tuner mode](#) automatically sets your radio to a carrier mode (CW, AM, or FM) and reduces power for tuning an external tuner. Settings are returned to normal when you exit this mode.
- Link to the [CTR2-Antenna Switch Controller](#) to select antennas directly from the Mini
- [Link](#) two Mini's to control two radios simultaneously for receiver diversity and/or SO2R operation
- Function buttons and the blue 5-way switch on the Wio can be [mapped](#) to functions like [RIT](#), [Zero Digits](#), [keyer speed](#), [External Tuner mode](#), [Meter mode](#), [Scan](#), [Toggle Database](#), radio specific functions, etc.
- [Terminal mode](#) allows you to control the Mini from a terminal program connected to the USB port
- [Emulates a Kenwood TS-2000](#) on the Wio's USB serial port for 3rd party applications
- The Mini is easy to build or I can provide fully assembled and tested units for less than the cost of other control knobs or stream deck solutions

Quick Start Guide

This section describes how to setup the Mini and get it connected to your radio. The [Mini 101](#) section provides easy to follow lessons to help you learn about the Mini's user interface.

Step 1: Powering the Mini

Original Mini

The original Mini obtains power through the USB-C port on the bottom of the Wio Terminal. Connect this port to either a USB port on your PC or to a 5 VDC phone charger. The 5 volt supply should be able to provide at least 500 mA of current. If you plug it into a USB hub that hub should be a powered hub.

Mini+

The Mini+ has a built-in 12 VDC power supply that can be connected to your station 12 volt system, a 12 volt 'wall wart', or other 12 volt power source. It can also be powered through the USB-C port on the Wio, like the original Mini. The power connector on the Mini+ is a 2.1x5.5 mm coaxial plug with the center pin connected to +. When powered from a 12 volt supply use the on/off switch on the Mini+ volume control to turn the Mini on. For your convenience a power cord is supplied with assembled Minis. Connect your 12 volt power supply to this cord with the + on the RED wire.

NOTE: In all cases the power switch on the Wio Terminal must be in the **On** (center) position.

Step 2: Connect to the CAT port on your radio

If you are setting up a Flex radio there is no hardware CAT connection so skip to step 3b below.

All other radios use serial CAT (Computer Aided Transceiver) commands. The Mini supports most of the newer radios that utilize the Icom, Kenwood, or Yaesu protocols.

The Mini uses a 1/8" (3.5mm) stereo phone jack for its CAT I/O port. The Mini+ has this port built in while the original Mini requires an external Radio I/O module connected to the Mini with a CAT5 cable to provide this connection. The Mini+ can also use the external Radio I/O module if you plan on controlling two or more radios as shown [here](#).

You'll need to either build a CAT cable for your radio or order one from me. [Appendix B](#) provides the schematics for various radios and their part #s if you want to order them.

Once you have the CAT cable you need to set the CAT polarity using the configuration header in the [radio I/O module](#) or [inside the Mini+](#).

There are three options:

- 1) Normal provides non-inverted TTL level CAT signals
- 2) Inverted provides inverted TTL level CAT signal – usually used with RS-232 ports
- 3) Normal + CI-V provides non-inverted TTL CAT signals on a two-wire line for Icom radios

NOTE: The Mini does not support USB CAT ports.

Step 3a: Select your radio's CAT protocol and baud rate

The Mini normally boots into its Home page. To access the Mini's menu system press the encoder for less than 1 second. Once the menu opens navigate to a menu item by turning the encoder. Press the encoder again to select that option.

To tell the Mini which radio you have open the Mini's **Radio CAT** menu in the **Config** menu. Scroll down the list of radio protocols and select the one that matches your radio.

The protocol will load using the default baud rate specified by the manufacturer. To verify the Mini's baud matches your radio's baud, open the **CAT Connection** menu in the **Config** menu. Select the baud that matches your radio's setting. The baud rates are the first eight options on this menu.

If you are connecting to a Flex radio continue on with step 3b otherwise you're ready to start using your Mini!

Step 3b: Connecting to a Flex radio

The Flex radio is controlled over WiFi instead of through a serial connection. To connect to your Flex radio, follow these steps.

1. Select the **Flex** protocol as described in step 3a above. Once selected a **Flex 6000** menu will appear on the main menu at the bottom of the second column.
2. Open the main menu and select the **Config->CAT Connection** menu.
3. Within this menu navigate to the **IP Adrs** option to set the radio's IP address.
 - a. Use the encoder to select the character for each digit in the [text editor](#). Press and hold the encoder then turn it to advance to the next character. Once you've entered your radio's IP address click the encoder to exit the text editor.

NOTE: The radio's IP address can be found in SmartSDR under the **Settings -> Radio Setup -> Network** tab.
4. On the **Config->CAT Connection** menu, set the **TCP Port** to **4992**, the default port the Flex uses for API control.
5. Next, setup your credentials to access your WiFi network. To do this, open the main menu and select **WiFi**. Enter your router's **SSID** and **PW** (password or passkey) the same way you edited the radio's IP address.
6. After you've entered the SSID and password click the **Connect to WiFi** item at the top of the **WiFi** menu. The Mini should connect to your network and then to your radio.

NOTE: By default the Mini will connect to the A slice and uses the existing panadapter (or creates one if one doesn't exist). You can choose to open another slice or create a panadapter in the **Flex 6000** menu.

If everything is connected properly you should be able to control your radio with the Mini. You should also see changes on the Mini if you manually change your radio's frequency, mode, or other supported setting in the **Radio** menu.

Now that you have the Mini connected to your radio visit the [Hardware Tour](#) section to become familiar with the control locations then visit [Appendix A – Mini 101 Basic Training](#) to get comfortable with using your Mini.

Mini vs Mini+

Two models of the Mini are available. The original Mini, mounted in a custom acrylic stand is shown throughout this manual. The newest model is the Mini+ shown here. It includes several standard features that are either optional or not available on the original Mini.

- An integrated 12 VDC power supply allows you to power the Mini+ from your station's 12 VDC power supply instead of through the USB-C connector on the Wio Terminal. **This is a standard 2.1x5.5mm coaxial power plug with (+) on the center pin.**
- An improved sidetone amplifier with a volume control and front facing speaker for louder sidetone audio.
- An on/off switch on the volume control.
- A center mounted encoder eliminates the need for a



Mini+

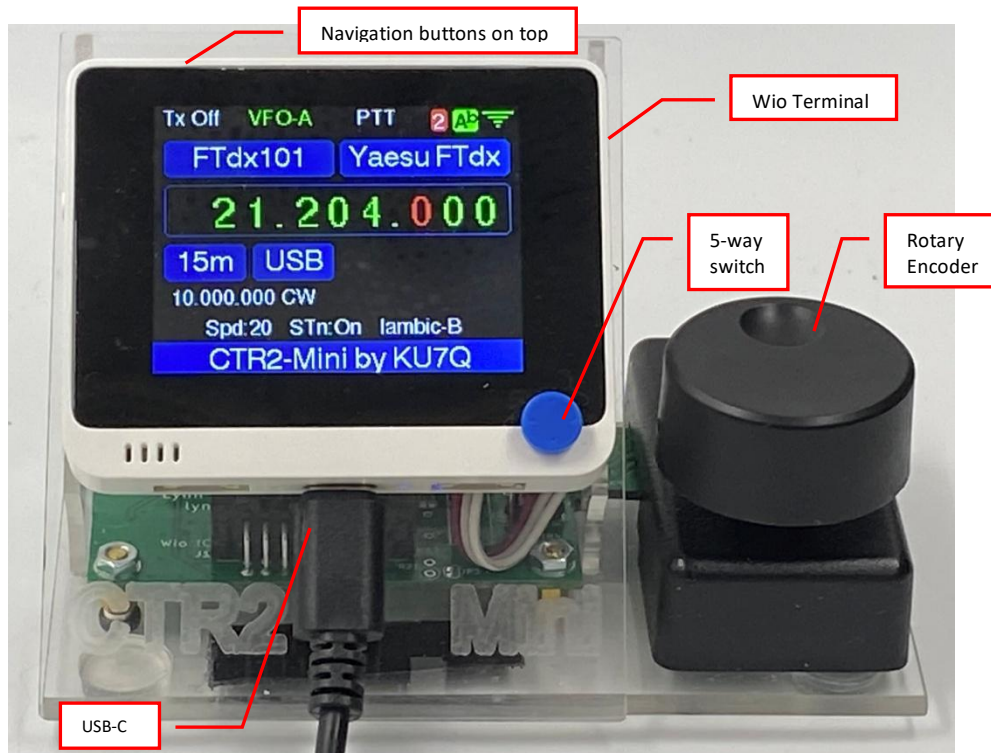
right and left-handed version.

- A built-in Radio I/O module. If you only need to control one radio the Mini+ can be connected directly to your radio's CAT, PTT, and KEY inputs without using a separate Radio I/O module.
- It provides an RJ45 Radio I/O jack like the Mini in case you want to control more than one radio with your Mini+. You'll need a Radio I/O module for every radio you want to control and a manual RJ45 switch as shown [here](#).
- The rear panel is silkscreened to show each jack's function.
- It is enclosed in a PacTec KEU-5 sloped enclosure providing a rugged enclosure for portable/mobile use or you can mount the front panel in a rack panel and the base PCB on the back if your station uses rack panels.
- 25mm standoffs are provided to provide additional tilt to the display. These standoff have adjustment screws under their rubber feet that can be used to level the Mini+ on an uneven surface.
- For users with a discriminating ear, or use [iCW](#) for Internet CW operations the Mini+ v1.3 hardware (units built from June 2023 on) include an option that allows you to install a [Hi-Per-Mite](#) audio filter on the sidetone output. I don't build the filters because of the time involved. If you want one installed on an assembled Mini+ you can purchase the filter, assemble it, and send it to me to be installed in your unit when I build it. Units with a Hi-Per-Mite filter must be powered by +12 VDC to power the filter.

Hardware Tour

This section describes the controls and interface ports on the Mini and Mini+.

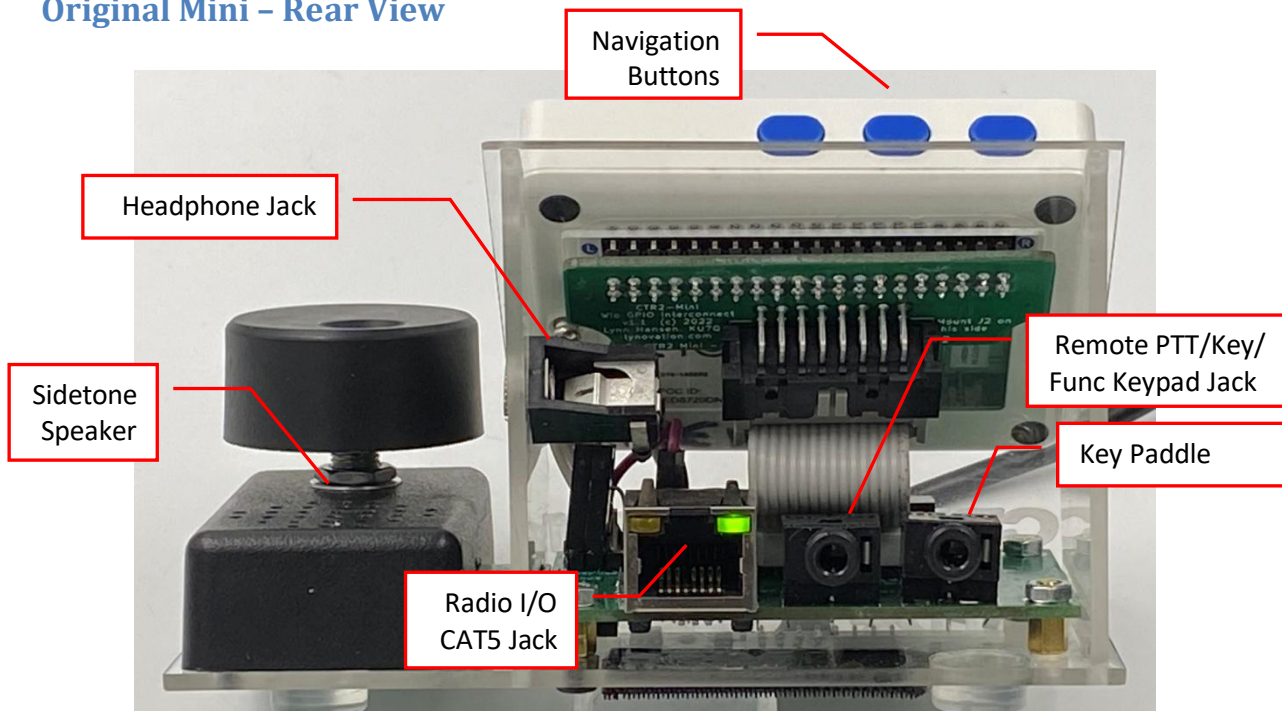
Original Mini - Front View



To power the original Mini connect the USB-C port on the Wio Terminal to a USB port on your PC or to a 5 VDC power supply using the supplied USB-C cable. You may need a USB extension cable since the supplied cable is short. I use a 6' cable with a 90 degree USB-C connector for my systems.

There are three navigation buttons on the top of the Wio Terminal. These are referred to as Button [A], [B], and [C] and run left to right. The labels on the display directly below the buttons identify their function. The 5-way switch can be mapped to functions such as Band Up/Down, Mode Up/Down, etc. **Select the Config->Function Btns menu to configure them.**

Original Mini - Rear View



On the rear of the original Mini you'll find the I/O jacks. Due to the lack of space back here there are no labels on the jacks.

The optional mono headphone jack allows you to listen to the sidetone using headphones. You can cut a trace on the PCB and install a potentiometer in line with the speaker output to reduce the volume for headphones. The sidetone speaker is mounted in the encoder enclosure.

NOTE: To connect the headphone output to a powered speaker you must add an inline 600/600 ohm isolation transformer.

The RJ45 (CAT5) Radio I/O jack is on the left side of the control board in the photo above. This jack is used to connect your Mini to the [Radio I/O](#) module or manual RJ45 switch using standard CAT5 (or better) cable. The green light indicates that this port is supplying power to the **Radio I/O**. A similar light on the **Radio I/O** module lights up when it's receiving power.

NOTE: The RJ45/CAT5 signals in the Mini ARE NOT ETHERNET COMPATIBLE. DO NOT connect these ports to an Ethernet connection on your router or your PC! The Mini puts 5 VDC on its RJ45 connector and this could damage an Ethernet port.

The Remote PTT/Key/Function Keypad input jack is the 1/8" (3.5mm) stereo jack next to the RJ45 jack. You can connect a remote PTT switch (foot switch, hand switch, etc.) or a straight key here. A [Function Keypad](#) with integrated PTT switch can also be connected here. This keypad gives you a PTT switch and five programmable function buttons. Remote PTT and function buttons cannot be used when this jack is configured for a straight key in the [Keyer->Rmt](#) menu. Always use shielded cable for this connection.

The Paddle input jack is the 1/8" (3.5mm) stereo jack on the far right in the photo above. Connect your paddles here with Dit on the Tip, Dah on the Ring, and ground on the Sleeve. Dit/Dah paddles can be reversed in the [Keyer](#) menu so wiring isn't critical. Always use shielded cable for this connection.

Mini+ Hardware

The Mini+ has all the features of the Mini and then some. One of the biggest differences is the form factor. Instead being mounted in a custom acrylic stand, the Mini+ is installed in a PacTec KEU-5 sloped equipment cabinet. This enclosure is about 5-1/4" (135mm) square. This gives the Mini+ a more professional look that will be right at home in any ham shack. It's also more rugged so it can be easily taken with you when you travel.

The front panel is shown below.



Front View of CTR2-Mini+

The back panel of the Mini+ has the same **PADDLE IN**, **PTT/KEY IN**, and **RADIO I/O** jacks as the Mini. In addition it includes a **PTT/KEY OUT**, **CAT I/O**, and **12VDC** jacks as shown below. **The center pin of the 12VDC jack is (+).**

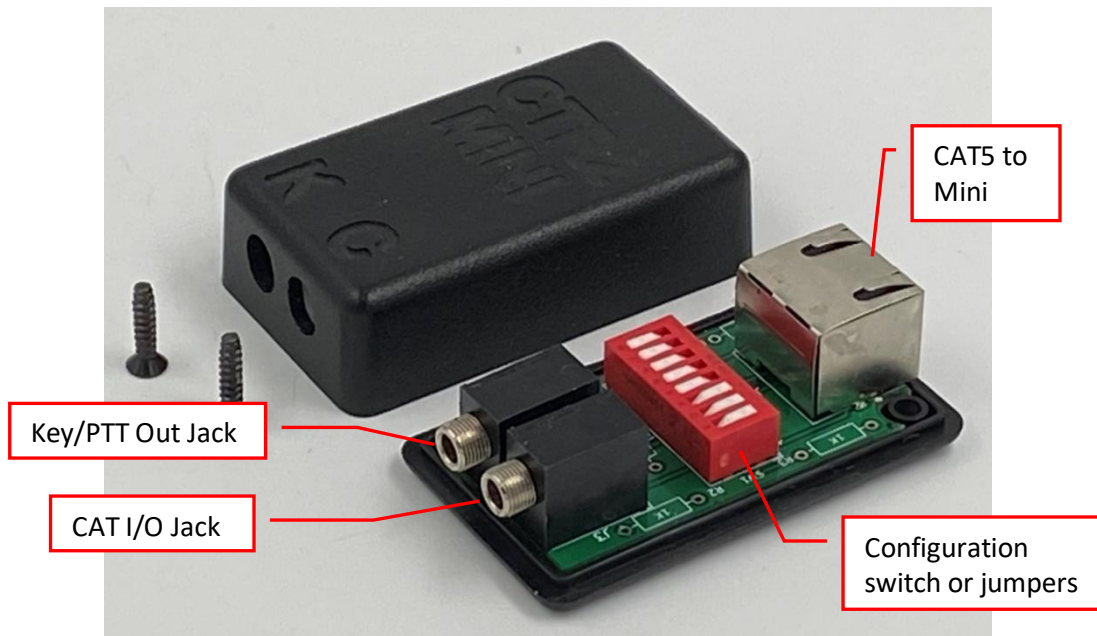
The **PTT/KEY OUT** and **CAT I/O** jacks are used to connect the Mini+ to a single radio. They replace the **Radio I/O** module required for the **Mini**. The CAT polarity jumpers for the internal **CAT I/O** port are inside.

Use the **RADIO I/O** RJ45 jack to connect the Mini+ to a manual RJ45 switch to control multiple radios. When using this jack open all of the internal CAT polarity jumpers and set the CAT polarity jumpers on each **Radio I/O** module for the radio they are connected to.



Back Panel of CTR2-Mini

Radio I/O Module



The Radio I/O module interfaces the radio's CAT, Key, and PTT signals to the Mini. It connects to the Mini with CAT5 cable. One Radio I/O module is required per radio when controlling multiple radios using a manual RJ45 switch as shown [here](#).

The Key/PTT jack ('K') has the **Key Output on the Tip** and the **PTT Output on the Ring** of the 1/8" stereo jack.

CAT signals are available on the CAT jack ('C'). The **Tip is wired to CAT TX** (towards the radio) and the **Ring is wired to CAT RX** (from the radio). Radio interface cable schematics can be found in [Appendix B](#).

The 8-pole configuration switch/header is used to change to CAT mode for normal TTL, inverted TTL (RS232 ports), and CI-V (Icom).

NOTE: Newer versions of the Radio I/O module use a dual row, 8 pin header and jumpers instead of the DIP switch but the strapping positions are the same.

Mini+ Built-in Radio I/O

The Mini+ has a radio I/O circuit built in so it can control *one radio* without an external Radio I/O module as shown in the first drawing shown [here](#). It has a dual-row 8-pin header on the base PCB like the newer Radio I/O modules to configure the CAT polarity. Open these jumpers to use external Radio I/O modules if you plan on controlling two or more radios. When controlling two or more radios each radio requires an external Radio I/O module (unless you are controlling a Flex radio using network PTT and/or CW).

Table 1 shows the CAT configuration switch/jumper positions for each mode. O=Open C=Closed

Mode	S1	S2	S3	S4	S5	S6	S7	S8
Normal	C	C	C	O	O	O	O	O
Inverted (RS232)	O	O	O	C	C	C	C	O
Icom CI-V	C	C	C	O	O	O	O	C

Table 1

Navigation Controls

This Mini has a simple user interface with only a few controls. In order to make full use of these controls most of them have multiple functions. This is not unlike most modern radios that incorporate ‘long press’ functions for their buttons. Button functions are intuitive and easy to remember.

Each control has a short-press and long-press function. A **Short-press** action occurs when a control is pressed and released in less than 1 second. A **Long-press** action occurs when the control is *pressed and held* longer than 1 second.

Encoder Functions

The encoder is the main navigation control. It has multiple actions depending on the mode of the program. Table 2 describes the encoder action for each mode.

Encoder Action	Home	Meter	Menu Press & hold button [A] to exit	Text Editor Press & hold button [A] to exit	Value Editor Press & hold button [A] to exit
Turn Left	Dec freq tuning digit	Temporarily exit to the Home page	Move selection up	Next character	Dec value
Turn Right	Inc freq tuning digit	Same as Turn Left	Move selection down	Previous character	Inc value
Short-press	Open main menu	Open main menu	Open selected option	Accept and close	Accept return to Home
Short-press + turn Left	Move freq tuning digit to the left	Same as Turn Left	Same as long-press	Move selected digit to the left	Accept and return to menu
Short-press + turn Right	Move freq tuning digit to the right	Same as Turn Left	Same as short-press	Move selected digit to the right	Accept and return to menu
Long-press	Open the function btn help window	Same as Turn Left	Return to Home page	Escape and return to main menu	Toggle between 0 and current value
Long-press + turn Left	Cancel function btn help window	Same as Turn Left	Return to previous menu	Same as long-press	Accept and return to menu
Long-press + turn Right	Cancel function btn help window	Same as Turn Left	Same as short-press	Same as long-press	Accept and return to menu

Table 2

[A], [B], and [C] Button Functions

The [A], [B], and [C] buttons on the top of the Wio Terminal also have short-press and long-press functions. These are described in Table 3.

Program Mode	Button [A]	Button [B]	Button [C]
Home			
Short-press	Toggle Tx Enable Interlock On/Off	Step through VFO options	Execute user [C] button function
Long-press	Open Meter mode	Toggle LOCK On/Off <i>except</i> in VFO Memory mode. Long-press here moves Memory frequency and mode to VFO-A.	Open [C] button menu
Menu			
Short-press	[Esc] – Return to calling menu	[^] – Move selection up	[v] – Move selection down
Long-press	[Esc] – Return Home	[<] – Return to previous menu	[?] – Open Help page, release btn to close Help
Meter Mode			
Press	Toggle Tx Enable On/Off	Key radio (if in CW mode)	[Esc] – exit this mode
External Tuner			
Press	Toggle Tx Enable On/Off	Key radio carrier in CW mode	[Esc] – exit this mode
Text Editor			
Short-press	[Esc] – Return to calling menu	[^] – Next character	[v] – Previous character
Long-press	[Esc] – Return Home	[<] – Return to calling menu	[<] – Return to calling menu
Value Editor			
Short-press	Esc] – Return to calling menu	[^] – Increment value	[v] – Decrement value
Long-press	[Esc] – Return Home	[<] – Return to calling menu	[<] – Return to calling menu

Table 3

5-Way Switch Functions

The small blue 5-way on the Wio Terminal can be assigned several functions, just like the built-in function key pad on the Mini+.

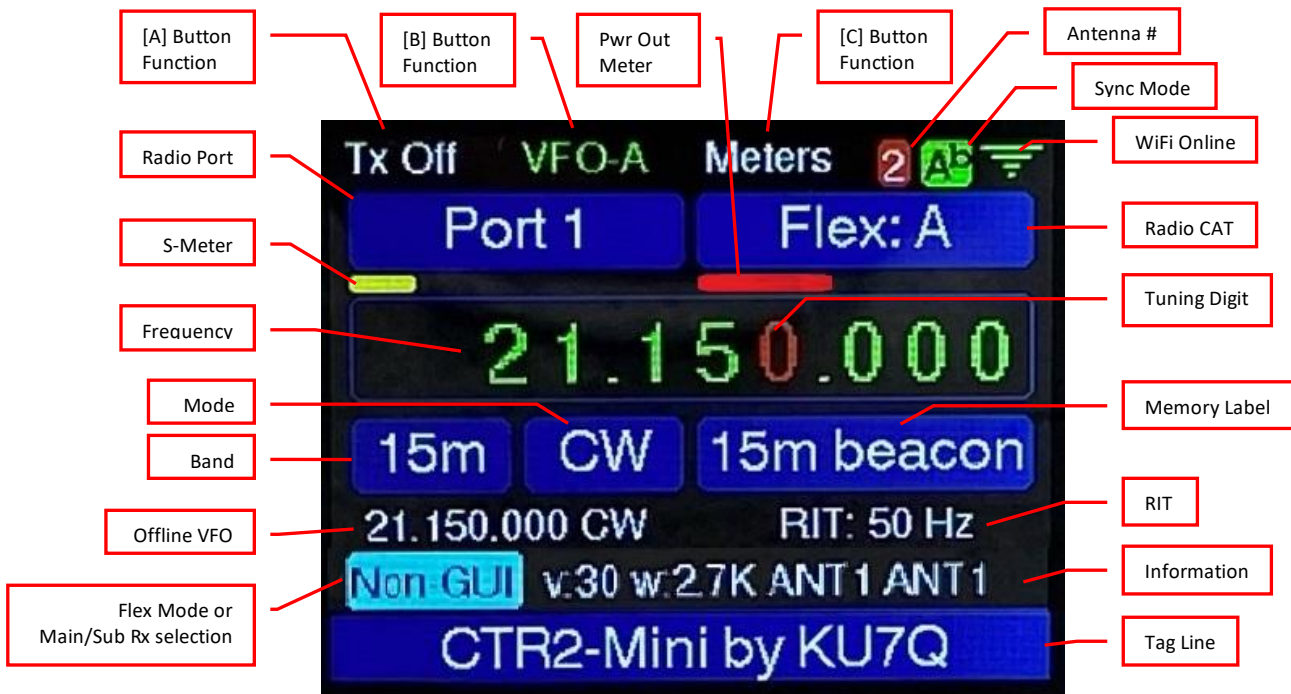
In the **Home** page pressing the 5-way switch shifts the function buttons and displays the [Secondary Function Button Help](#) page for 7 seconds. During this time, pressing any button executes it's secondary function. The Up, Down, Left, and Right switches can be assigned primary and secondary (shift) functions using the [Config->Function Button](#) menu. Outside of the Home page these switches are used for navigation.

For more information on programming user functions to these switches see the [Config: Function Button Assignment](#) section.

In other modes the 5-way switch mimics the encoder.

Home Page

The Home page is the default display on the Mini. It displays the information the user needs at all times when operating their radio.



The various fields on the Home page are identified above.

Wio's Top Buttons

The functions of the three buttons on the top of the Wio Terminal are shown at the top of the display. In the **Home** page these buttons have the following functions:

- Button [A] toggles the *Tx Enable* interlock. When it is set to **Tx Off** the Mini cannot put the radio into transmit mode. **The radio's controls will still control the radio** (i.e. the Mic PTT still works). Press the [A] button to toggle the interlock to **TxEnab** if you want the Mini to control the transmitter. Long-press [A] to open the Meter page.
- Button [B] steps through the four VFO options, *VFO-A*, *VFO-B*, *Split*, and *Memory*.
NOTE: The Mini always uses VFO-A on the radio so you can switch your radio's VFO to B if you want to operate the radio on that frequency without the Mini controlling the radio's frequency.
- Button [C] is a user programmable button. To change its function long-press button [C] for > 2 seconds or open the [Config-\[C\] Btn](#) menu.

WiFi Online Icon

The WiFi Online (antenna) icon provides an RSSI (Received Signal Strength Indication). One bar means the WiFi signal is below -75 dBm. Two bars mean it's between -65 and -75 dBm. Three bars mean it's between -55 and -65 dBm, and four bars mean it's above -55 dBm. The more bars the better. The Mini may have reliability issues with signal strengths of two bars or less.

Encoder Functions

The rotary encoder provides frequency control and a navigation tool for the Mini. In the Home page, turning the encoder increases or decreases the radio's frequency by the selected tuning step digit (the red frequency digit). Press and hold the encoder then turn it to change the tuning step digit. Every other tuning step is a 'half step' meaning that tuning will be 5 times the red digit. The digit to the left of the tuning step digit will be violet in half step mode. The tuning step in the photo on the right is set to 500 Hz. Tuning step increments are 1, 5, 10, 50, 100, 500, 1k, 5k, 10k, 50k, 100k, 500k, 1m, 5m, 10m, 50m, and 100m.



Short pressing the encoder (less than 2 seconds) opens the [main menu](#). From here you can navigate the menus with the encoder. Once the menu opens, short press the encoder again to select a menu. Press and turn the encoder left to back up one menu level.

Long pressing the encoder in the **Home** page opens the [Function Button](#) help window. This allows you to see the primary functions are assigned to the function buttons and 5-way switch. A similar help window opens for the [shifted functions](#) when the function button assigned to the SHIFT function is pressed.

Meters

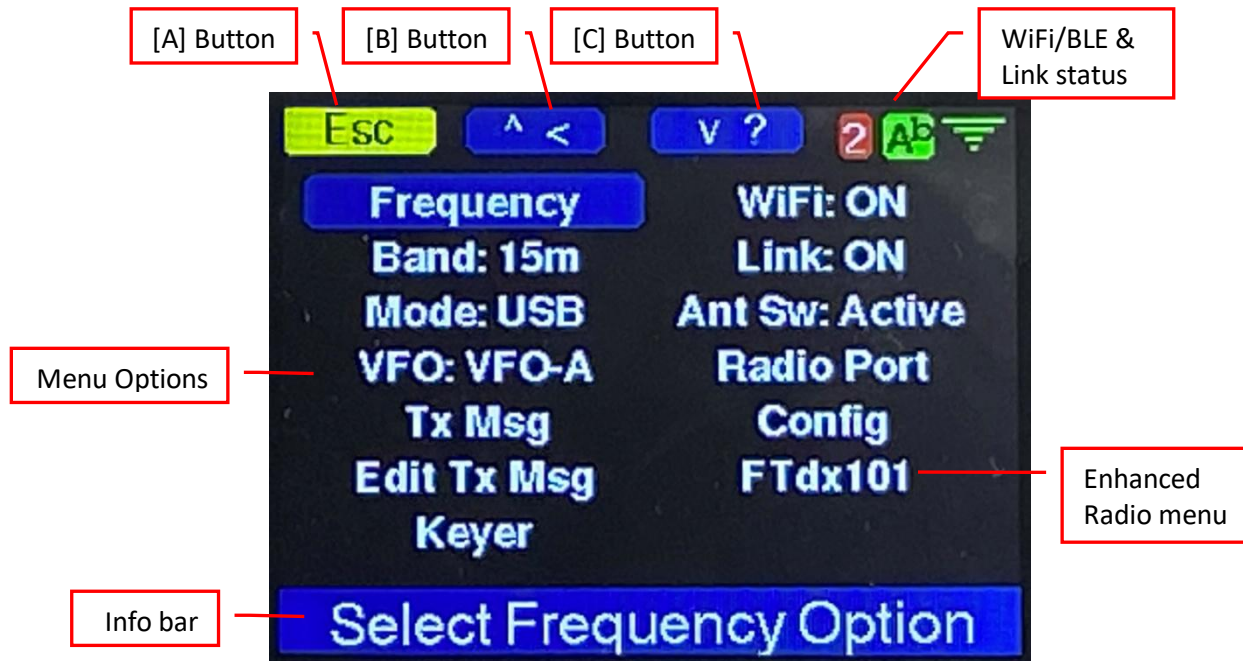
Two small bar graphs display the current values of the S-meter and Tx Output Power meters. These meters appear just below the [A]-[B]-[C] button labels at the top of the display. The power meter is only visible during transmit. For a full screen meter display, press and hold the [A] button for longer than 2 seconds, or select [Mode->Meter Mode](#). Meter mode can also be assigned to a function button or to the [C] button on the Home page.

Display Fields

Not every field on the display is always visible. For example:

- The *Antenna #* icon that shows which antenna is connected to this Mini's radio is only displayed when the Mini is linked to the CTR2-Mini Antenna Switch Controller
- The *Sync Mode* icon is only visible when this Mini is linked to another Mini. In this example this unit is Mini-A and it's in Basic Sync mode [A^b]. The other Mini will display [B^b]. This icon will be blue if we're linked with Bluetooth instead of WiFi.
- The *WiFi* icon is only visible when WiFi is connected. It's always green.
- The *Memory Label* is only visible when we're tuned to a frequency in the current memory list
- The *RIT Offset* is only visible when RIT is enabled (RIT is not available on all radios)
- The *Tag Line* can be changed in the [Config->Tag Line](#) menu

Menu Page



Short pressing the encoder on the Home page opens the Main menu shown above.

Turn the encoder or press the [B] or [C] buttons on top of the Wio Terminal to move to the desired option then press the [A] button to return to the Home page or press the encoder to select that option.

Pressing and turning the encoder LEFT will close the menu or return to the previous menu if you're in a sub menu or back to the Home page if you're in the Main menu. Pressing and turning the encoder RIGHT will open the selected sub menu (same as pressing the encoder).

The [B] and [C] buttons have two functions. Normally they move the menu selection up or down (^ and v). Long-pressing the [B] button (<) returns you to the previous menu, or Home page if on the Main menu. Pressing and holding the [C] button (?) opens a help screen for the selected item. Release the [C] button to close the help screen.

Not all menus are available all the time. For example:

- The *Ant Switch* menu is only available when the Mini is linked to the CTR2-Mini Antenna Switch Controller.
- If the radio has expanded CAT support a **Radio** menu will be displayed at the bottom of the second column in the main menu. Currently only the *Icom*, *Yaesu FTdx*, *Flex 6000*, *Kenwood*, and *Icom PCR1000* radios have expanded support.

System Connections

The basic Mini system is very easy to set up. The drawings [here](#) show the basic connections. The [Quick Start Guide](#) section gives you the basics. This section gives more details on the complete setup.

1. Power the Mini:
 - a. On the original Mini connect the USB-C port on the Wio Terminal to a USB port on your PC or to an external 5 VDC cell phone adapter. If you use a USB hub make sure it's a powered hub. The Wio Terminal on the Mini comes with a short USB-C to USB-A cable. You'll probably need a USB cable extender. I opted to purchase a 6' USB cable with a 90 degree USB-C connector on it so the cable routes around the side of the Mini. These are available at various online stores.
 - b. The Mini+ can be powered from the Wio's USB port like the original Mini or it can be powered directly from your station's 12 VDC supply. Use a 2.1x5.5mm coaxial power plug with +9 to +14 VDC on the center pin. The Mini+ is reverse-polarity protected.
2. Connect the Mini to the [Radio I/O](#) module using a standard CAT5 cable. **If using a Mini+ with one radio you can skip this step.**
3. Connect the CAT and Key/PTT ports on the Radio I/O module (or Mini+) to your radio. [Appendix B](#) includes the schematics for adapter cables for various radios. I can supply these cables. If your radio isn't shown here send me the information for it and I'll create a schematic and update [Appendix B](#).
4. Connect your paddles or a straight key to the Mini's [Paddle In](#) jack and select the keyer type in the [Keyer](#) menu. You should be able to hear your keying though the sidetone speaker on the Mini. You can turn the sidetone off in the [Keyer](#) menu. **On the Mini+ you can just turn down the volume.**
5. Open the [Config->Radio CAT](#) menu and select the CAT protocol for your radio. Note that many radios use CAT protocols from other manufacturers. Your manual should indicate which protocol it uses. For instance the Yaesu FTdx101 uses a derivative of the Kenwood1 protocol, as does the QRP Labs QCX. The Xiegu radios use a subset of the Icom protocol.
6. Press the [A] button to enable the Mini to control the transmit output signals (PTT and Key). Button [A]'s label will change to *Tx Enab*. This enables [Key Output](#) on the Radio I/O. Pressing your paddle should key your radio.

NOTE: The transmit enable interlock only blocks the outputs from the Mini. The radio is still fully functional and can transmit if you press the PTT on its microphone.

That's all there is to it. The Mini should now be able to control the frequency and mode of your radio and the keyer and Remote PTT should key your radio.

The Mini can do a lot of different things. I invite you to scan through the Table of Contents at the top of this manual and investigate the various features I've included in its design. I think you'll be impressed.

The menu system will be described in the next section.

Menu System

The [Menu Display](#) section explains how you navigate the menu system using the controls on the Mini. Menu items may behave differently depending on the option they control.

The [A] (Esc) button has two functions in the menu system. Short-pressing it will return you to the previous menu. Long-pressing it will return you to the Home page.

Toggle Options

Many options just toggle a setting. These options use lower case for the default state of the option and CAPITALIZE the off-normal state when enabled. Click the encoder to toggle these options.

Value Editor

Some options allow you to adjust their value in real time such as keyer speed or RIT offset. Selecting these options opens the *Value Editor* window shown to the right. Adjust the value with the encoder or buttons [B] and [C]. Press the encoder or button [A] (Esc) to close the window.

NOTE: Values will remain open until you click the encoder or press button [A]. On some menus you can long-press the encoder (> 1 second) to quickly toggle the value between the current setting and 0.

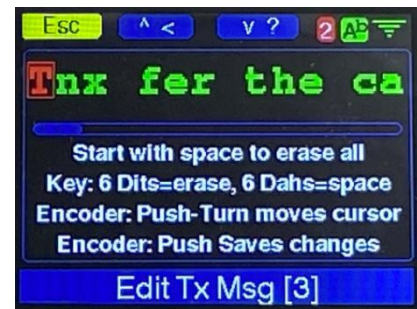


Value Editor

NOTE: Some values may be rounded to fit the protocol of the selected radio so the value you set may change slightly when read back from the radio.

Text Editor

Options that require text entry, such as editing the CW buffers, open the *Text Editor*. In this mode, the character being edited is red and surrounded by a red box. To change the character turn the encoder or press button [B] or [C]. Pressing and turning the encoder moves to the next character. Press the encoder to accept the text and close the window, or press button [A] (Esc) to exit without updating the text.



Text Editor

To erase the entire entry set the first character to a space (the space character is next to the small 'a' when rotating the encoder) and click the encoder.

NOTE: You can use the paddles to enter characters. Key in 6 to 8 DITs to erase the current character and go back one space. Key in 6 to 8 DAHs to add a space and move forward one character. Leave at least a word space between characters as you key them in. You can also use the *Terminal* mode to quickly edit text data. This mode will be described in the [Terminal Mode](#) section.

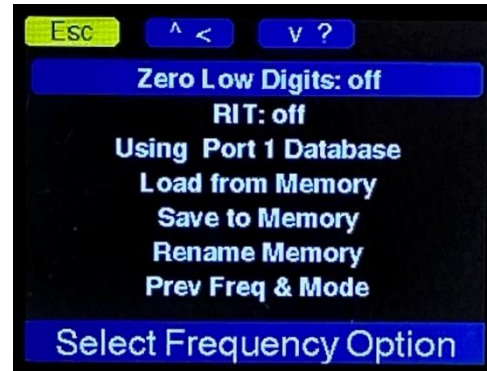
Frequency Menu

The *Frequency* menu contains functions related to controlling the radio's frequency with the Mini.

Zero Low Digits

This option zeros the digits below the *tuning digit* (the red digit on the frequency display).

This is handy when you want to tune in exact increments.



RIT

This option enables or disables *Receiver Incremental Tuning* (also call *Clarifier* by Yaesu) on your radio. When RIT is selected the current value appears in a *Value Edit* window. Use the encoder to tune the receiver up or down up to 9999 Hz from your transmit frequency.

The *Value Window* will remain open until you click the encoder to close it.

Long-pressing the encoder will zero RIT, turning it off. Long-press the encoder again to restore the previous offset. Changing the radio's frequency with the Mini or the radio's tuning knob cancels RIT.

NOTE: Not all radios support RIT control in their CAT protocol. If you have one of these radios this option doesn't do anything.

Database Selection

The Mini can manage up to 16 radio profiles, called [Radio Ports](#). Each profile contains the settings associated with one radio. Multiple radio profiles are useful when using a manual RJ45 switch to select from several radios as shown [here](#). Each radio profile contains settings such as the CAT protocol, CAT baud rate, keyer settings, and the favorite frequency list for that port. Each entry in the frequency list contains settings for the Mini's A and B VFO frequencies and modes. This gives you a total of 200 favorite frequencies. In addition, a common favorite frequency list and Tx Message buffers are also available to every radio port. Use the shared list as your 'golden list' with your most used favorites.

This option is a toggle option. Click the encoder to switch between the current radio port settings and the common settings.

NOTE: The [Radio Port](#) name will be prefaced with a "*" when the shared database is enabled for that port.

Load from Memory

Open this menu to load the VFOs from a memory slot. Selecting one of the entries loads both the A and B VFOs. The frequencies displayed on the list depend on which VFO is active at the time. You can step through the VFO options using the [B] button in the Home page or you can specify the active VFO in the [VFO](#) menu.

NOTE: VFO-A and VFO-B are internal to the Mini. The Mini always controls the A VFO on the radio. Switching to your radio's B VFO will disable Mini frequency control.

NOTE: If Memory-A's frequency is less than Memory-B the Mini will use these frequencies as the tuning range when [Range Tuning](#) is enabled. To set the tuning range for the entire band select an open memory slot or select another band.

Save to Memory

This option allows you to save the current frequencies and modes of both VFOs to one of the memory slots. Turn the encoder to select the slot then press it to save. You will be able to edit the label associated with this memory slot after it's saved. This label appears in the *Memory Label* location on the Home page.

NOTE: VFO-A and VFO-B are internal to the Mini. The Mini always controls the A VFO on the radio.

NOTE: To define a tuning range for [Range Tuning](#) set VFO-A to the start of the range and VFO-B to the end of the range then save these settings to a memory slot.

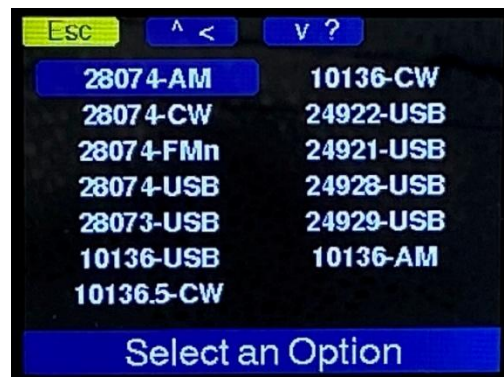
Rename/Erase Memory

As its name implies, this option allows you to rename or erase a memory slot. To erase all data in a memory slot change the first character in a memory slot's name to *space* (" ").

Previous Freq/Mode

The *Prev Freq/Mode* menu tracks the last 13 frequency/mode combination that you have tuned the radio to. The first frequency/mode pair in this menu is the current frequency/mode. Use the encoder to select any pair from the list to tune the radio back to that frequency/mode.

Only frequencies that you stay on longer than 10 seconds will be saved to this list. This prevents saving the incremental tuning steps as you scan through a band.



This feature can be assigned to the [C] button or to a function button if you find you use it often.

Band Menu

The *Band* option allows you to quickly move to a band. Just pick the new band and click the encoder.

Your current frequency and mode are saved when you move away from a band and will be restored when you use the *Band* menu to return to it (i.e. band stacking registers).

Mode Menu

The *Mode* menu allows you to change operating modes of the radio and select special modes on the Mini.

Radio Modes

Radio modes set the operating mode of your radio. Options are **CW**, **CWr (reverse)**, **LSB**, **USB**, **FMn (narrow)**, **FMw (wide)**, **AM**, **DigL**, and **DigH**. When --- is displayed the user has selected an unsupported mode on the radio.

NOTE: The **DigL** and **DigH** modes are translated to the closest mode your radio supports (i.e. RTTY Low, RTTY High, among others).

Toggle Tx Enable

This option toggles the transmit interlock, just like the [A] button does on the [Home page](#). It was added to this menu so you can control the interlock when in [Terminal mode](#).

Meter Mode

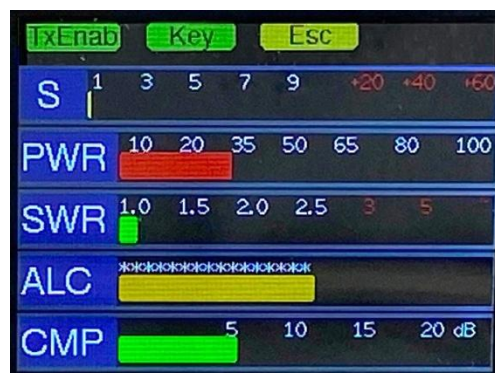
S-meter and Power Output bar graphs are displayed on the Home page. **Meter Mode** opens a full screen meter view and displays all five meters that are monitored by the Mini. This mode allows you to use the Mini as a remote, always on, meter.

During receive mode only the S-meter will be active as shown in the left photo below. While the transmitter is transmitting the S-meter will be inactive and the Power, SWR, ALC, and Compression meters will be active. This is shown in the right photo below transmit power is about 30 watts and the SWR is around 1.1. In this example the radio was keyed with the PTT directly wired to the radio instead of the Mini so the Tx Enable and Key button labels are green instead of red.

Because of slow polling rate (about every 600 milliseconds) the transmit meters will jump around quite a bit especially in voice modes.



Meters while Receiving



Meters while Transmitting

NOTE: While I have attempted to match the Mini's meter readings to those shown on the radio they're not always in sync. Radios vary on how they send meter data over CAT so a [Calibrations](#) menu has been added to the [Config](#) menu to allow you to fine-tune these indications.

Sticky Meter Mode

Meter mode is a "sticky mode", similar to the value settings screens. Once it is enabled it will remain open, even through a power cycle, until you close it. Press the [C] button (Esc) to close **Meter** mode and return to the Home page.

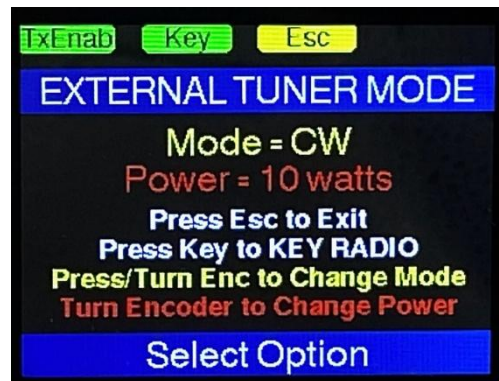
Turning the encoder *slightly* will return you to the Home page where you can tune to another frequency, change modes, or do other housekeeping chores. After 10 seconds of inactivity **Meter** mode will resume. This allows you to keep the meters visible while operating.

Pressing the encoder will open the main menu. The program will return to **Meter** mode after 10 seconds of inactivity.

NOTE: If you turn the Mini off while in **Meter** mode it will return to **Meter** mode the next time you turn it back on. This allows you to use the Mini primarily as a remote meter display. Press [C] to disable Meter mode and return to the Home page.

External Tuner Mode

External Tuner opens the **External Tuner Mode** page. On this page you can easily tune an external tuner. The Mini automatically sets the radio's mode to your preferred tuning mode (CW, AM, or FM) and sets the tune power you specify. To change the mode, press and hold the encoder then turn it. To change the power, just turn the encoder. By default the power is set to 15 watts. You can adjust it from 5 to 100 watts. If you go above 15 watts the Power indication turns red as shown here. This is just to remind you that you are above normal tuning power.



External Tuner Mode

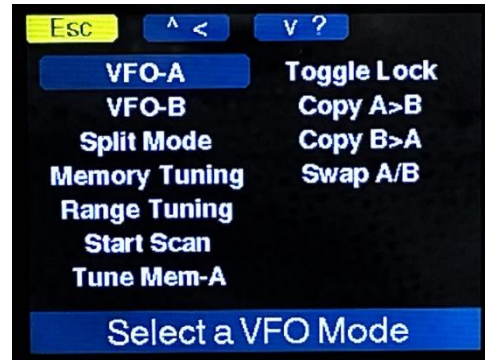
Use the [A] button to toggle the Tx interlock and the [B] button to activate KEY OUT on the Mini to key the radio. Push the [B] button again to unkey the radio. You can also momentarily key the radio by pressing PTT on the function button keypad or use your foot switch if you have one plugged into the PTT/Key In jack of the Mini.

Radio settings are returned to normal when you exit this mode by pressing the [C] button (Esc) or long-pressing the encoder (>1 second).

NOTE: Power is only changed on radios that support Tx power control via CAT. If your radio doesn't support CAT Tx power control you'll need to adjust it manually.

VFO Menu

The *VFO* menu contains many options to help you manage the VFOs maintained by the Mini. As noted earlier, the VFOs in the Mini are internally managed. On dual receiver radios such as the FTdx101 and Elecraft K4 the Mini can tune either receiver. The active receiver is selected in the **Radio** menu. The Mini's A and B VFO can be used on either receiver. On single receiver radios the Mini only controls the A VFO. This in effect gives you three VFOs to operate with as you can select either VFO in the Mini or the B VFO on your radio and use it without affecting the Mini's VFOs.



VFO Menu

Use the [B] button on top of the Wio Terminal to step through *VFO-A*, *VFO-B*, *Split Mode*, *Memory Tuning*, and *Range Tuning*. Long-pressing the [B] button toggles **Lock** mode. When locked, short-press [B] again to unlock.

VFO-A

Select *VFO-A* to enable it. *VFO-B* will be disabled and its frequency and mode will be displayed in the *Offline VFO* box on the [Home page](#).

VFO-B

Select *VFO-B* to enable it. *VFO-A* will be disabled and its frequency and mode will be displayed in the *Offline VFO* box on the [Home page](#).

Split Mode

Split Mode mimics split mode on your radio. In this mode the Mini uses its VFO-A for receive then switches the radio to the Mini's VFO-B when you transmit. The radio always stays on its VFO-A, the Mini manages the split frequencies.

NOTE: On radios that have dual receivers Split mode works best if the transmitter and receiver are set to the same VFO in the Radio menu (i.e. RX-A and TX-A, RX-SUB and TX-SUB, etc.)

Memory Tuning

Memory Tuning switches the Mini from VFO tuning to memory tuning. As you turn the encoder the Mini will tune the radio using the frequencies and modes saved in your favorite frequency list. You can choose to tune with either VFO-A or VFO-B memories by toggling the [Tune Memory A/B](#) option that will be described below.

NOTE: Memory tuning starts at the currently selected memory slot and skips empty slots.

NOTE: When controlling an Icom IC-9700 memory tuning skips over frequencies not supported by the currently selected receiver. This is because the IC-9700 will not move to a frequency outside the selected receiver's range. Memory tuning only stops on frequencies supported by the current receiver.

Range Tuning

Range Tuning was introduced in v1.14.00. By default the selected band is used as the start and end frequencies of the tuning range. This mode keeps you in the same band while tuning.

Pressing the [B] button toggles through the VFO mode. **RANGE** is the last VFO mode. In this mode the title for button [B] will be set to **RANGE** and the frequency digits will be displayed in violet as shown in this photo. The [C] button defaults to **Scan**. Pressing [B] will cycle the Mini back to **VFO-A** mode and pressing [C] will start and stop range scanning.



Range Tune Mode

Defining Tuning Range

You can define a frequency range by setting VFO-A to the start frequency and VFO-B to the end frequency then saving these VFOs to a memory slot.

The space under the band and radio mode that normally displays the off-line VFO displays either **Scan: Band**, or in this case **Scan: 40M-QRP**. The line just above the bottom status bar displays the frequency range.

In this example, VFO-A has been set to 7.05 MHz and VFO-B has been set to 7.06 MHz. These were [saved in memory slot #1](#) and titled *40M-QRP*. Loading this memory slot sets the tuning range so you can't inadvertently tune outside of this range using the encoder. You can tune outside using the radio's tuning control.

Pressing [C] (**Scan**) will start scanning based on the currently selected tuning digit. In this case it's 1 KHz. To change the scan direction move the encode left or right. The **Scan** label for the [C] button shows the scan direction while scanning. In this case we're scanning up the band (**Scan>**). Moving the encoder either direction changes the scan direction.

To turn scanning off press the [C] button or the encoder.

To reset the tuning range to the entire band, reselect the band in the [Band](#) menu or load an open memory slot in the [Frequency->Load from Memory](#) menu.

Start Scanning

Select this option to start scanning in any VFO mode. This function can be assigned to the [\[C\] button](#) or to one of the [function buttons](#).

When scanning is active the [C] button's function will be set to **Scan** and the scan direction will be shown. To stop scanning, press the [C] button or the encoder.

Tune Memory A/B

This option toggles whether VFO Memory-A or VFO Memory-B settings in the favorite frequency list are used for [Memory Tuning](#).

Toggle Lock

Lock mode operates similar to the Lock button on your radio. It blocks you from inadvertently changing the frequency and mode on the Mini. You can still use your radio's controls to change these settings.

You can toggle *Lock* mode by long-pressing the [B] button on top of the Wio Terminal while in the Home page.

NOTE: Frequency and mode changes on the Mini are automatically blocked during key-down transmit (active key or PTT).

Copy A>B

This option allows you to copy the frequency and mode in VFO-A to VFO-B.

Copy B>A

Similar to *Copy A>B* this option allows you to copy the frequency and mode in VFO-B to VFO-A.

Swap A/B

As its name implies, *Swap A/B* swaps the settings of the VFOs moving A to B and B to A.

Push to A/B

This option is only available when two Minis are linked together in [Basic Sync](#) mode, typically when operating SO2R. It allows you to push the frequency and mode on this Mini to the radio on the other Mini.

On Mini-A this option is titled **Push to B**. On Mini-B this option is titled **Push to A**.

This option can be assigned to the [C] button or to a function button.

Pull from A/B

This option is only available when two Minis are linked together in [Basic Sync](#) mode, typically when operating SO2R. It allows you to pull the frequency and mode from the other Mini to this Mini.

This is useful when operating SO2R with a spotting receiver. To work a station on the spotting receiver just pull it's frequency and mode to the operating transceiver.

On Mini-A this option is titled **Pull from B**. On Mini-B this option is titled **Pull from A**. This option can be assigned to the [C] button or to a function button.

Swap VFOs

This option is only available when two Minis are linked together in [Basic Sync](#) mode, typically when operating SO2R. It allows you to swap the frequencies and modes on the two Minis and their radios, similar to **Swap A/B** above.

Tx Msg Menu

The *Tx Msg* menu allows you to choose from 14 pre-programmed CW message buffers. Each buffer can contain up to 75 characters. Only the first 13 characters of each buffer are displayed on the menu due to display limitations.

NOTE: The first message buffer is used as a *repeat* buffer. It always holds the last buffer sent (not the last characters sent with the paddles). This allows you to repeat a contest exchange without incrementing the [contact serial number](#).

When the [A] button is set to *Tx Off* on the Home page selecting a buffer will just send it to the sidetone for code practice. You'll be able to see the buffer being sent on the tag line at the bottom of the display.

When the [A] button is set to *Tx Enab* the buffer will be sent to the [Key Output](#) of the Radio I/O and on to the radio, transmitting the message.

While the buffer is running the [A] button changes to *Stop*. Pressing the [A] button will immediately stop the transmission and delete the rest of the buffer.

While the buffer is running the [B] button changes to *Pause*. Pressing the [B] button will pause the transmission of the buffer allowing you to inject additional code with the paddles or straight key, such as an RST report. Pressing the [B] button again, (now called *Start*), resumes sending the buffer at the place it was paused.

Edit Tx Msg Menu

This option allows you to edit the CW message buffers. Select the buffer to edit from the menu.

Prosigns follow the K1EL keyer standard and can be embedded in each message buffer. There are four special prosigns that send your call [^], Contact Serial Number [#], Contest Exchange [%], and increase/decrease sending speed by 150% [*]. Your [call](#), [contact SN](#), and [exchange](#) can be edited in the [Keyer](#) menu. Table 4 contains the available prosigns and their Morse equivalents.

Prosign	Morse	Prosign	Morse	Prosign	Morse	Prosign	Morse
^	Ur Call	:	KN	(KN	@	AC
#	Serial#	\$	SX	= or _	BT	-	DN
%	Exchange	;	AA)	KK	[AS
*	Speed	'	WG	>	SK	/	DN
"	RR	<	AR	+	AR]	KN

Keyer Menu

The *Keyer* menu contains the various settings available to control the contest keyer built into the Mini.

Speed

The *Speed* option brings up a [Value Editor](#) window that allows you to set the keyer speed. Speed range is 5 to 99 WPM. This window will remain open until you click the encoder or the [A] button (Ok) to close it. This allows you to keep it open during a QSO so you can easily change your speed when needed. This option can be assigned to the [C] button or a function button.

Changing Speed during a message or QSO

You can change turn the encoder to change the keyer speed while a CW message is playing or when sending CW (the [A] button shows [TX CW]).

NOTE: On radios with expanded CAT functions adjusting the Mini's keyer speed will automatically adjust the keyer speed in the radio. This allows you to use the Mini to control your radio's keyer speed even when you're not using the Mini's keyer. *Manually adjusting the radio's keyer speed does not change the Mini's keyer speed.*

Farnsworth Spacing

Farnsworth Spacing allows you to change the spacing between characters. This can be helpful when learning the code as it's easier to 'hear' the character if it's sent above 15 WPM. *Farnsworth Spacing* gives you more time to write down the character before the next one is sent.

This setting is only used when transmitting CW message buffers as character spacing is not enforced when keying with the paddles or a straight key.

Sidetone Frequency

Adjust the frequency of the Mini's keyer sidetone with this option. The range is 120 Hz to 1200 Hz. Operators typically prefer sidetone frequencies between 500 Hz and 700 Hz.

Adjusting the frequency below 120 Hz sets it to 0 Hz, effectively turning the sidetone off.

Keyer Type

The *Keyer Type* menu allows you to choose from five traditional keyers, and one special keyer that only the Mini provides (as far as I know).

- *None* – The keyer in the Mini is not used
- *Straight* – Connect the Tip pin on the [Paddle Jack](#) to a conventional straight key. No timing is applied – you're on your own!
- *Passthru* – This is a special Mini keyer mode. In this mode the Tip of the *Paddle In Jack* controls the [Key Output](#) on the Radio I/O module, just like in Straight Key mode. The Ring of the *Paddle In Jack* controls the [PTT Output](#) on the Radio I/O module (or *PTT/K*

Out on the Mini+). When these two signals are wired to your radio's paddle input jack or to an external keyer the Mini will key those devices instead using the Mini's keyer. Since you'll be using the *PTT Output* for CW you can't use the PTT options built into the Mini. **NOTE: The PTTKEY6 and PTTKEYFLEX6 cables I supply are not compatible with Passthru mode. For Passthru mode use a standard 1/8" (3.5mm) to 1/8" stereo cable to connect the PTT/K Out jack on the Mini+ (K jack on the Radio I/O) to your radio's Key In jack.**

- *Iambic A* and *Iambic B* – These modes are the most common. They allow you to use dual paddles to key DIT and DAH and when you squeeze them at the same time the DITs and DAHs alternate. *Iambic B* adds a slight timing adjustment to the release of both paddles that's not there in *Iambic A* so use the one you're comfortable with. If you use a single paddle key there is no difference in these modes.
- *Ultimatic* – is a deviation from the Iambic modes. In this mode when the two paddles are squeezed the keyer generates a constant string of DITs or DAH depending on last paddle squeezed. I've never gotten use to it but it is here if you want to try it (or really like it). Again, if you use a single paddle key this mode makes no difference.
- *Bug* – what would a keyer be without *Bug* mode? In this mode the DIT paddle generates a constant string of DITs and the DAH paddle acts like a straight key just like the old mechanical bug keys.

NOTE: On Flex radios, selecting any keyer type besides **None** or **Passthru** will automatically disable the radio's Iambic keyer. If you plan to use the radio's keyer turn off the Mini's keyer by selecting **None** or **Passthru**.

Paddles (Pdls)

The *Pdls* option allows you to reverse the DIT/DAH orientation of your paddles... in case you wired it backwards☺. The options are *Pdls: Norm* and *Pdls: REV*.

Remote (Rmt)

This menu option defines the operation of the [PTT/Key In](#) jack.

The functions that are available with this option can be confusing. Please read the following descriptions carefully!

There are three settings for *Rmt* mode:

- *PTT* – In this mode an external foot switch or hand switch can be connected to the **PTT/Key In** jack of the Mini to control PTT on your radio.

On the original Mini you can also connect a [Function Keypad](#) in parallel to your PTT switch. The function keypad is standard on the Mini+. This keypad contains six pushbutton switches, five of which are wired to a resistance ladder. Each button provides a different resistance to ground. In PTT mode the input is read by an analog/digital converter (ADC) so the Mini can determine which switch is pressed by the

voltage on its input. Five buttons are programmable in the [Function Buttons](#) menu. The sixth button is always a PTT switch.

- *PTT Latch* – This mode is the same as *PTT* with the exception that the *PTT Output* on the Radio I/O module latches ON and OFF with each press of the PTT button. This allows you to control PTT on your radio with either a switch wired to the **PTT/Key In** jack or the [C] button on the Wio Terminal. Assign *PTT* to the [C] button when operating a Flex radio using the Flex 6000->Network PTT option.
- *KEY* – This operation mode is different from the first two. In this mode allows you to connect a straight key to the **PTT/Key In** jack and use it along with your paddles. This is a great option for CW operators that use both types of keys.

KEY mode can be used to connect a third-party application such as a logging program or an external keyer to the Mini. Logging programs generally key RTS or DTR on a USB port. To access this signal you'll need to use a USB to Serial converter and build an inverter circuit to convert the RS232 signal levels to 3.3 VDC TTL levels. A simple 2N2222 transistor with a 10K resistor on its base is all you need. [N1AV has an excellent web page](#) that shows how this is done.

NOTE: Function key F1 and F2 are not available when **KEY** is selected because they appear like key inputs to the Mini.

Call

The *Call* option in the *Keyer* menu allows you to save your call sign in the Mini. Your call is substituted when the ^ prosign is embedded in a CW message buffer. This along with the [Contact SN](#) and [Contest Exchange](#) prosigns allow you to easily construct a contest exchange message.

(Contact) SN

The *Contact SN* is the second parameter required for a contest keyer. It is sent by embedding the SN prosign, #, into a CW message buffer. The Mini automatically increments the contact serial number after the CW buffer containing the # prosign completes. This allows you to use it multiple times in a buffer if needed without incrementing the SN.

This option allows you to edit the *Contact SN* if it gets out of sync or when starting a new contest.

NOTE: If you need to repeat a contest exchange without incrementing the *Contact SN* send the #1 CW message buffer. This buffer always holds the last message transmitted and the Mini will not increment the *Contact SN* when it is sent from this buffer.

Exchange

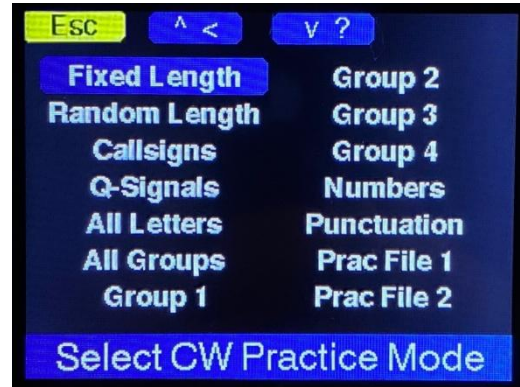
The *Contest Exchange* is the third parameter required for a contest keyer. It is sent by embedding the % prosign in the contest message.

Generally this field contains a specific text string such as a grid # or state ID required for the contest exchange. It doesn't usually change during the contest. This option allows you to edit it.

CW Practice Menu

The *Practice* option opens the **CW Practice** menu. This menu gives you a list of practice modes and *character pools* to select from. The first three *practice* modes draw random characters from the selected *character pool*.

NOTE: If the [Tx Enable](#) interlock is enabled the practice code will be transmitted over the air. This allows you conduct on-air practice sessions.



Code Practice Menu

You can select from several practice modes:

- *Fixed Length* sends random five character words using the characters in the character pool (i.e. defined in the group, numbers, or punctuation options).
- *Random Length* sends random length random words using characters in the character pool.
- *Callsigns* sends randomly generated callsigns in the 1x1, 1x2, 1x3, 2x1, 2x2, and 2x3 formats. It uses characters in the character pool and random numbers for the 'x' character in the call whether you have numbers in the character pool or not.
- *Q-Signals* sends random Q-signals from a list of real Q-signals in common use. Q-signals are not part of the character pool.
- *Prac File1* and *Prac File2* send pre-loaded text files. These text files are stored in the /MISC/ folder as PRAC1.TXT and PRAC2.TXT on the micro-SD card. You must remove the SD card and edit those files in a [text editor](#) on your PC if you want to change the content of the files. The characters in these files are not added to the character pool.

Preset Character Pools

The following table lists the characters that will be placed in the character pool for each option. These characters will be the characters currently in the pool.

Option	Character Set
All Letters	A through Z
All Groups	Group 1, 2, 3, 4, Numbers, Punctuation
Group 1	E I S H T M O
Group 2	A R U V N D B
Group 3	W J P K G
Group 4	L F Y C Q X Z
Numbers	1 2 3 4 5 6 7 8 9 0
Punctuation	. , ? ' / : ; + - =

Table 5

Editing the Character Pool

The *Fixed Length*, *Random Length*, and *Callsign* practice modes draw characters randomly from the character pool. Select one of the character pools above or press the [B] button to edit the pool to create your own set.

While in the practice window, **Start** and **Stop** practice mode by pressing the encoder. Turn the encoder to change the speed and press and hold the encoder then turn it to change character spacing. The text will scroll off the display once it fills or you can press the [C] button to clear the display.

The Koch Method of Learning CW

The Koch method of learning CW suggests starting with two characters and practicing them until you achieve 90% accuracy. Then you add another character to the pool and continue again until you reach 90% accuracy. Then add another character, and so on. Koch also recommends a minimum character speed of 15 wpm. This causes you to learn a character's sound instead of counting the Dits and Dahs that make up the character. There are many articles on the Internet about learning code using the Koch method.

While *Practice Mode* includes pre-canned *character pools* I recommend you create your own pool using the Koch method. In the end, use whatever method that works for you.

WiFi Menu

The *WiFi* menu allows you to configure and connect to a WiFi network. The Mini requires a DHCP server on the LAN to assign its IP address. Once the Mini is connected to your network your *Station Address* will be displayed in this menu. You will need to know the Mini's IP address when setting up [Linking](#) to another Mini or when linking this Mini to the [CTR2-Mini Antenna Switch Controller](#).

Connect to WiFi

Select this option to initiate a WiFi connection or disconnect the current connection. After the connection process completes the *Station Address (Sta Adrs)* will be filled in at the bottom of the menu.

The Mini will attempt to connect to your router five times before it gives up. The attempt number will be displayed in the top-right corner of the display, where the WiFi signal icon is normally displayed. If it fails to connect after 5 tries that usually means something is wrong with your credentials. Check the SSID and password and try again.

NOTE: The Mini can connect to either the 2.5 and 5 GHz radio on your router however it seems to have problems connecting *if both radios share the same SSID*. Some routers also have an **Auto Connect** feature that automatically selects the band to use. The Mini doesn't seem to like this feature either. ***I recommend that you use different SSIDs for each radio on your route and disable the Auto Connect featurer.***

Reset IP Connection

Executing this option will reset the IP connection to the radio without disconnecting WiFi from the router. On the Flex this allows you to switch GUI client mode or temporarily disconnect the Mini from the radio so you can connect SmartSDR to the radio if running Flex v2.xx SmartSDR and the Mini was connected as a GUI client.

SSID

Enter the SSID of your WiFi router here. Proper capitalization of the SSID is required.

Password

Enter the password, or pass key, for your WiFi router. The password is not displayed in this menu but it is displayed on the [Text Editor](#) screen. The password must be exactly the same as the router expects or the connection will fail.

NOTE: If a character you use in the SSID or Password of your router is not available on the Mini you can connect to your Mini with the [Terminal](#) and use your regular keyboard to input these characters.

Auto Connect

Toggle *Auto Connect* ON to have the Mini automatically connect to your WiFi network when you first power it on.

NOTE: *WiFi Auto Connect* is automatically enabled if you enable *Auto Connect* in the *Link* menu when WiFi linking is used.

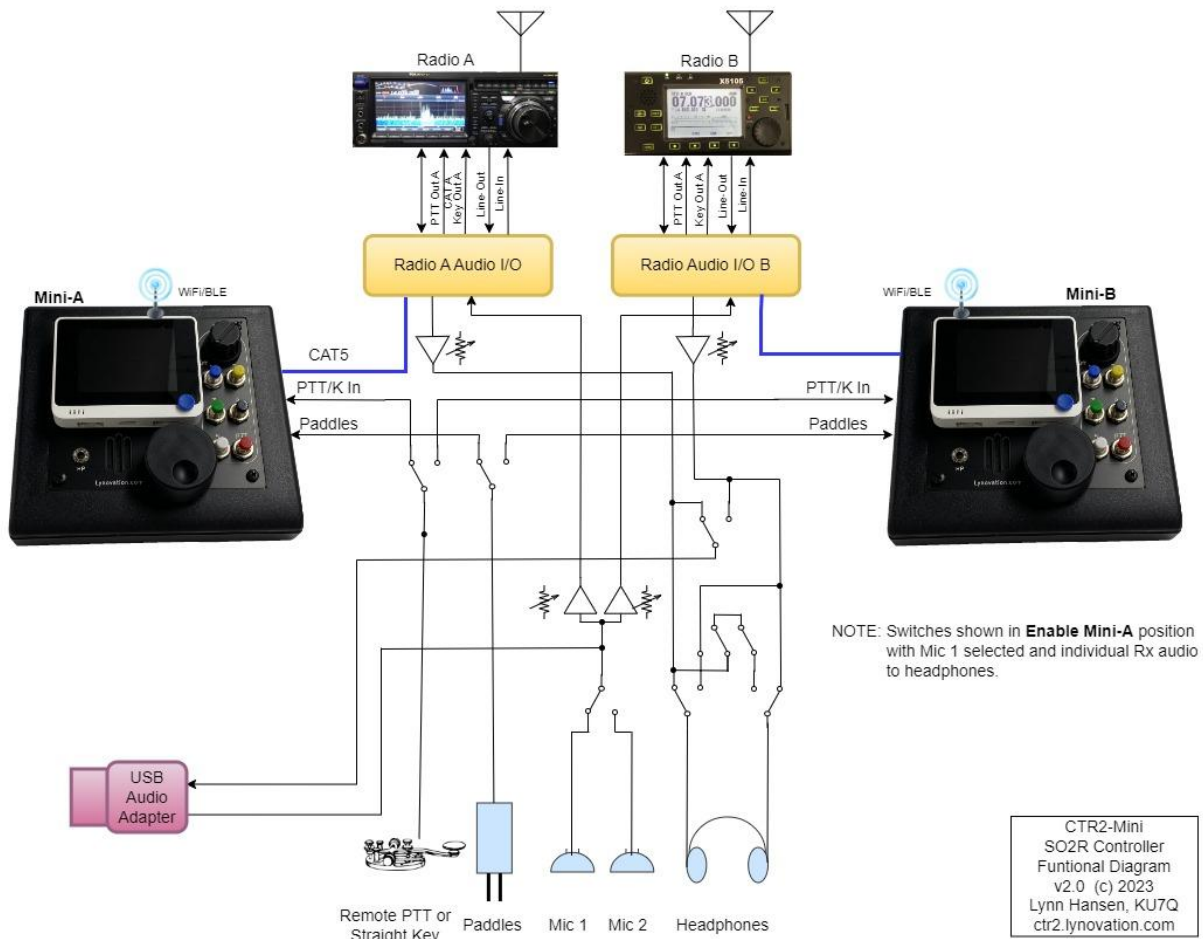
IP Station Address (Sta Adrs)

This field displays the IP address assigned to the Mini by your WiFi router and is not editable. You will need to know this when [linking](#) it to another Mini or to the [CTR2-Mini Antenna Switch Controller](#).

Link Menu

The **Link** menu allows you to create a link between two Minis and/or the [CTR2-Mini Antenna Switch Controller](#). Linking two Minis allows them to share common settings. **Link Modes** allow the Minis and their radios to share frequency and mode settings in different ways. When linked to the [CTR2-Mini Antenna Switch Controller](#) you can select antennas, enable/disable the switch, edit the antenna labels, and automatically switch antennas based on operating band from the Mini.

You generally link two Mini's and their radios together when operating in SO2R (Single Operator Two Radios) mode. However the **Remote** link mode can be used to connect two Mini's together for remote operation. A diagram of two radios and two Minis connected for SO2R operation is shown below. A new **CTR2-Mini SO2R Controller** will soon be available that provides the connections shown in the diagram. For more information on several new products planned for Spring 2023 see this post in my blog: <https://ctr2.lynovation.com/new-products-2023>



The link between two Minis can be done with either WiFi or Bluetooth LE (BLE). You must use WiFi if you also want to connect to the [CTR2-Mini Antenna Switch Controller](#).

Connect Link

Click this option to connect or disconnect the link. When using WiFi, the WiFi connection will be connected if it isn't already online. Disconnecting an active link will not disconnect the WiFi connection.

Selected Mini

A link must have a *server* (Mini-A) and a *client* (Mini-B). This option allows you to assign each Mini to one of these modes. You must have one Mini-A and one Mini-B to form a link.

Mini-A can be thought of as the link master. It provides (serves) information to Mini-B (the client). The amount of data shared between Minis varies depending on the [Sync Mode](#) selected. Basic data like keyer settings and the *Tx Enable* interlock status (only one Mini can have its transmitter enabled at any one time) are always shared. In *Basic Settings* mode you can push or pull frequency and mode settings from one Mini to the other. *Basic+Freq* and *Basic+Tracking Sync Modes* share real-time frequency and mode information.

When linking to the [CTR2-Mini Antenna Switch Controller](#), Mini-A connects to the antenna switch controller and shares this connection with Mini-B. Either Mini can send antenna control commands back to the antenna switch controller but for Mini-B to 'see' the antenna switch controller Mini-A must have links established to Mini-B and the antenna controller.

Sync Modes

The **Sync** menu option allows you to choose the **Sync Mode** used by the link. There are four **Sync Modes**.

NOTE: Sync Mode can only be changed on Mini-A. Mini-B follows the mode selected on Mini-A.

- **Basic Settings**

This mode allows two Minis to share basic information such as keyer settings and *Tx Enable* interlock status. When using two Minis and two radios this allows the keyer to be set the same for both radios and allows only one Mini and its radio to be actively transmitting at any time. The [CTR2-Mini SO2R Controller](#) takes advantage of this mode by allowing a single set of paddles, mics (up to 2), and headphones to be shared between both Minis.

This mode also allows frequency and mode [Push](#), [Pull](#), and [Swap VFOs](#) between the two Minis. This allows you to use one radio as a 'spotter' receiver then push or pull the spotter's frequency and mode to the main radio.

The Link icon next to the WiFi icon will display the Mini's function (**A** for server, **B** for client) plus a superscript **b**. Examples: **A^b** or **B^b**.

- **Basic + Frequency**

This mode shares the basic information above plus it locks both Minis (and their radios) to the same frequency, but it does not sync the modes. This allows you to use two radios on separate antennas in full diversity mode. Tuning either Mini or either radio

moves the frequency on both Minis and both radios. When used with the [CTR2-Mini SO2R Controller](#) you can choose to listen to each receiver in separate headphone speakers, listen to just one receiver in both speakers, or combine the audio from both receivers in both speakers.

The Link icon next to the WiFi icon will display the Mini's function (**A** for server, **B** for client) plus a superscript **f**. Examples: **A^f** or **B^f** unless **Rx-B Zero Beat** is enabled. In this case the client Mini will display **B^f** if the B radio's frequency is tuned below the A radio, or **B[>]** if the B radio's frequency is tuned above the A radio.

Rx-B Zero Beat

When operating in *Basic + Frequency* mode the *Link* menu on Mini-B has a special *Rx-B Zero Beat* option that allows you to change the receive frequency on the B receiver (+/- 9999 Hz) to match the exact frequency of the A receiver. This is best done while listening to a constant carrier (like WWV) on both receivers and adjusting this setting until the audio tone from the B receiver matches the audio tone from the A receiver. The tone will 'wobble' when the frequencies are close and may cancel out if they are exactly on frequency but 180 degrees out of phase. You may wish to operate the B radio slightly above or below the A radio to eliminate the wobble.

When **Zero Beat** is turned on the Link icon will display **B^f** if the B radio's frequency is tuned below the A radio, or **B[>]** if the B radio's frequency is tuned above the A radio.

NOTE: Only the frequency on the B receiver will show the zero beat frequency offset. The frequency on Mini-B will be the exact same frequency as shown on Mini-A and its radio.

Basic + Tracking

This mode allows you to set Mini-A and its radio to one frequency and Mini-B and its radio to another frequency (usually another band) and have both Minis and their radios track each other as any of them are tuned. This allows you to effectively work two bands at the same time. As you tune you'll hear Mini-A's receiver in your left headphone and Mini-B's in your right. When you find a station to work simply enable the transmitter on that Mini and work the station. Like the *Basic + Frequency* mode, this mode works best with the [CTR2-Mini SO2R Controller](#).

The Link icon next to the WiFi icon will display the Mini's function (**A** for server, **B** for client) plus a superscript **t**. Examples: **A^t** or **B^t**.

- ***Remote Controller***

This mode allows Mini-A to remote control Mini-B and its radio. You can locate Mini-A in another area of your house or anywhere on the Internet and control the radio in your shack remotely. Just connect your radio to an audio server such as [SonoBus](#) or [Mumble](#) to carry the audio from your radio to your tablet or cell phone. Remote PTT is supported but CW keying is not supported in this mode.

The Link icon next to the WiFi icon will display the Mini's function (**A** for server, **B** for client) with a superscript **r** (remote) or **l** (local) denoting that Mini's location. Examples: **A^r** or **B^l**.

NOTE: Remote Controller mode is not fully functional on all radios and probably never will be. This mode will probably be depreciated in the near future.

Link with WiFi/BLE

This menu option allows you to choose between using WiFi or Bluetooth LE for the link. Bluetooth LE can be used to link two Minis but it cannot link the [CTR2-Mini Antenna Switch Controller](#). The advantage of Bluetooth LE is that no other hardware is required. WiFi of course must have access to a WiFi network which most shacks have now days. WiFi also allows multiple connections between devices so Mini-A can be linked to Mini-B and to the [CTR2-Mini Antenna Switch Controller](#) at that same time.

NOTE: You must use WiFi for Link if you are controlling a network base radio like a Flex or Elecraft K4. The Wio Terminal does not support concurrent WiFi and Bluetooth connections.

Auto Connect

The *Auto Connect* option works the same as *WiFi Auto Connect* in that it automatically establishes the link you need when you power up the CTR2-Mini system. Enabling *Link Auto Connect* automatically enables *WiFi Auto Connect* if you've selected WiFi as the link medium or *BLE Auto Connect* if you've selected Bluetooth LE as the link medium.

Mini A/B IP Address

When using WiFi for linking, enter the IP address of the other Mini you want to link to in this field. The IP address of that Mini can be found in the [Station Address](#) field in its *WiFi* menu after that Mini has been connected to the WiFi network.

Antenna Switch IP

Enter the address of the [CTR2-Mini Antenna Switch Controller](#) in this field. Mini-A polls the switch controller and shares its status with Mini-B when the two Minis are linked together. Each Mini sends commands to the antenna switch independently. If you only have one Mini it must be assigned as Mini-A in the [Selected Mini](#) menu in order to link to the antenna switch controller.

Ant Switch Menu

The *Antenna Switch* menu only appears on the main menu when the Mini is linked to the [CTR2-Mini Antenna Switch Controller](#). When linked to the antenna switch controller the current [Antenna #](#) appears in the top-right corner of the Mini's display. The items in this menu allow you to control the switch controller from this Mini. To link to the antenna switch define the switch's IP address in the [Antenna Switch IP](#) field on Mini-A. Mini-B will be updated from Mini-A. If you're just using one Mini make sure it's defined as Mini-A in the [Selected Mini](#) field in the [Link](#) menu.

Port A Antenna

This option opens a menu that allows you to select an antenna for the A radio port on the switch. On single-port switches this is the common port.

NOTE: On dual-port antenna switches the antenna(s) connected to the B radio port are not displayed on this menu. This is an interlock that prevents the same antenna from being selected for both radios.

Port B Antenna

This option is available on dual-port antenna switches. This menu allows you to select an antenna for the B radio port on the switch.

As with the Port A menu, the antenna(s) connected to the A radio port are not shown in this menu to prevent the same antenna from being selected for both radios.

Swap A/B Antennas

This option allows you to instantly swap the antennas on the A and B radio ports. This gives you an easy way to find out which antenna has the best signal.

Operation Mode

This option allows you to toggle the *Operation Mode* of the antenna switch controller between *Ready* and *Locked*. In *Ready* mode you can control the antenna switch locally or from a linked Mini. When *Locked* the switch is active but you can't change its settings.

Switch Mode

This option allows you to toggle the *Switch Mode* of the antenna switch controller between *Active* and *OFF*. When *Active* the switch controller supplies power to the remote antenna switch to operate the antenna relays. Turning the *Switch Mode* to *OFF* removes the power from the remote antenna switch and the antenna connections open to the radio port(s).

Edit Antenna Labels

This option opens the list of antennas on the switch controller. Select one and push the encoder to edit the label associated with it.

Send Band Data

Turning *Send Band Data* to *ON* will cause the Mini to send its current band to the [CTR2-Mini Antenna Switch Controller](#). The switch controller will use this information to automatically select an antenna if an antenna has been assigned to that band in the switch controller. The band to antenna assignment must be done on the switch controller itself.

If a band does not have an antenna assigned to it in the switch controller, or if the controller is set up to control a dual port antenna switch and the band antenna is already in use by the other Mini no switching action occurs.

NOTE: This option is not available in the *Basic + Frequency Sync Mode* because both Minis and radios will be operating on the same band all the time.

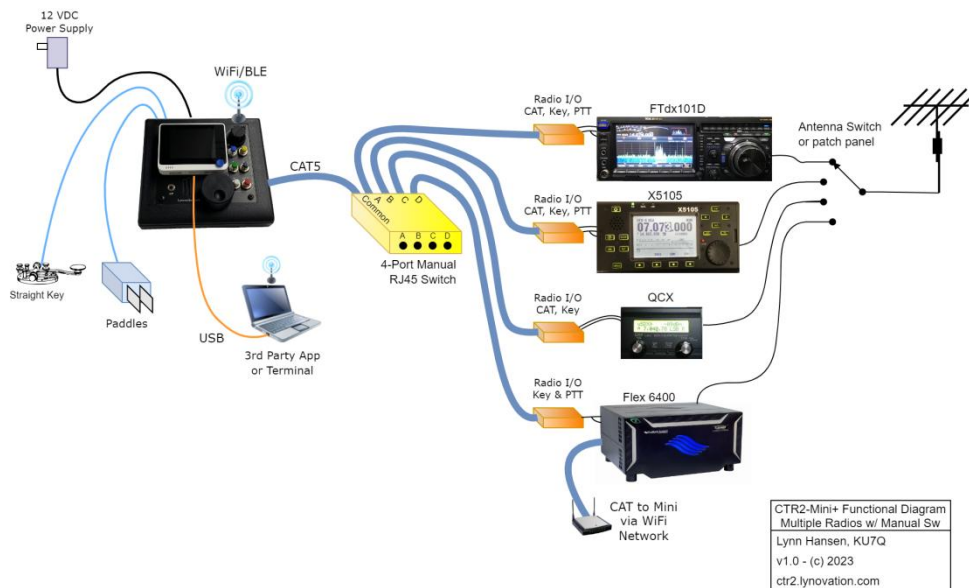
Radio Port Menu

The Mini has the ability to store up to 16 radio profiles. Each radio profile stores the radio CAT, CAT connection method (baud rate or IP address/port), keyer settings, and the favorite frequency list. There's no reason you can't have the same radio CAT (i.e. radio) assigned to multiple *Radio Ports* with each port managing a separate favorite frequency list. This would allow you to store up to 3400 individual frequency/mode pairs in the 16 *Radio Ports* (200 frequency/mode pairs per port and 200 more in the common frequency list).



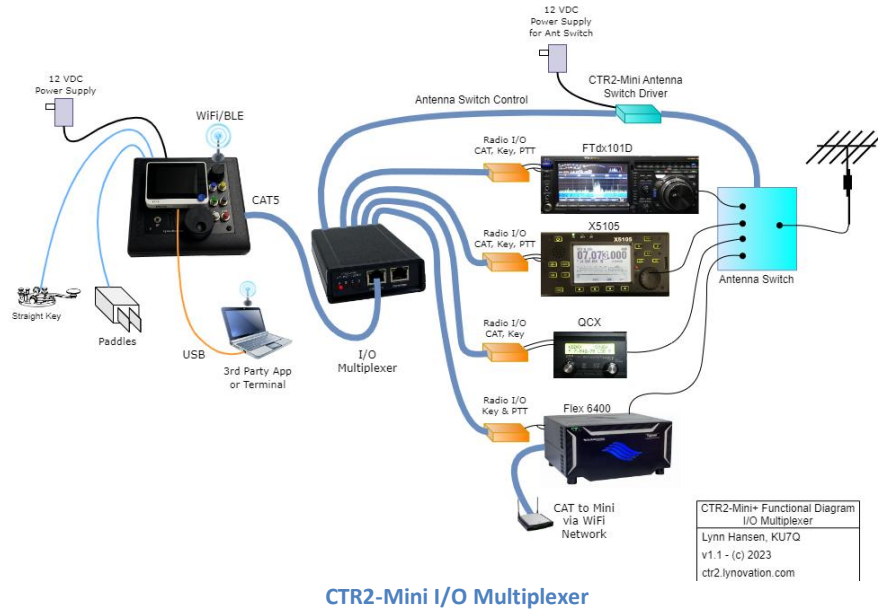
Manual RJ45 Switch

You can use a manual RJ45 switch to select between several radios as shown in the diagram below. Just select the radio on the switch and the **Radio Port** on the Mini. Make the antenna connection and you're ready to go.



I/O Multiplexer

The new **CTR2-Mini I/O Multiplexer** replaces the manual RJ45 switch. It automatically routes the I/O from the selected radio when you select it in the **Radio Port** menu. The multiplexer can also activate an external antenna switch to route the antenna to the selected radio. The diagram below shows this configuration.



Select Port 1 to 16

Select from one of the 16 ports (profiles) listed. Each port can have a unique 10 character name assigned to it. Use the *Rename* menu option to rename the active port.

Copy Port

Copy Port is used to copy the settings and frequency list from the *active port* to another port. Once you copy the settings, select the new port and use the *Rename* menu option to set its name.

Rename Port

This option allows you to change the 10 character name assigned to the *active Radio Port*. To change another port's name you must select it first.

Erase Port

This option allows you to erase the settings and favorite frequency list on the *active Radio Port*.

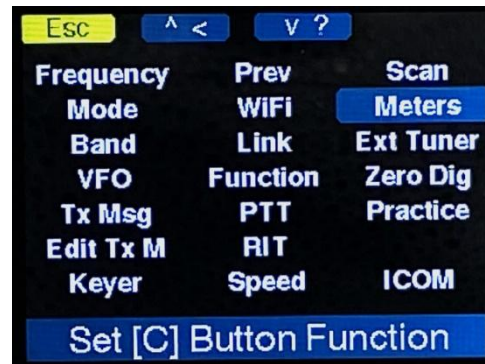
Config Menu

The *Config* menu contains the general configuration settings for the Mini. Many settings are saved in the *Init.txt* file in the root folder of the micro-SD card plugged into the Wio Terminal. *Radio Port* specific settings are saved in the */RADIO/* folder on the SD card. Radio files use the *RADIO_x.INI* naming convention where x= the Hex value of the *Radio Port* (numbered 0 to F).

[C] Button Menu

The *[C] Btn* menu allows you to select from a list of menus and functions that can be assigned to the [C] button (the right button on the top of the Wio Terminal). This gives you quick access to the selected menu or feature.

You can also long-press (> 1 second) the [C] button to instantly open this menu and change its function on the fly.



[C] Button Menu

Function Btns Menu

This option opens the **Function Button** menu where you can select from a list of menus and functions that can be assigned to each function button on the [Function Button Keypad](#) or on the Wio Terminal's small blue 5-way switch. Programming function buttons is covered in detail in [Appendix D](#). For the purpose of this discussion I'll refer to 5-way switches as buttons.

The original Mini requires an [optional keypad](#) that plugs into the [PTT/Key In](#) jack on the back of the Mini. The keypad is built into the Mini+.

The keypad has six pushbuttons. Function button #6 (F6) is permanently wired as a PTT switch. The [Keyer->Rmt](#) option controls the operation of this switch. The other five use a resistance ladder to present different voltages to the Mini. The Mini uses this voltage to determine which *Function Button* has been pressed. Each button can be assigned to open a menu or execute a function.

SHIFT Functions

Each button can be programmed with both a *primary* and *secondary* function. The *primary* function is activated when you press that button. To access the *secondary* function you must program one of the *primary* function buttons as a **SHIFT** button. Default settings use button #5 for **SHIFT**. Pressing this button shifts the functions on all buttons from their *primary* function to their *secondary* function (including the button assigned to the **SHIFT** function). When the **SHIFT** mode is activated a window opens that displays the shifted function of each button. Pressing one of the buttons activates its **SHIFT** function and turns off **SHIFT** mode. **SHIFT** mode automatically deactivates if no button is pressed within 4 seconds.

NOTE: To view a window that displays the *primary* button functions, *long-press and hold* the encoder in the **Home page**.

Function Button Lockout Reset

This menu option appears when the function buttons have been locked out due to a button being pressed longer than 10 seconds, or a failure in the function button voltage detection circuit. If this occurs try resetting the lockout using this option.

Theme

The *Theme* option allows you to choose from seven color themes for this Mini. This is handy when using two linked Minis side by side. Each Mini can be assigned a different theme color to make it easier to identify.

Tag Line

This option allows you to change the default text that appears in the [Tag Line](#) at the bottom of the display. Feel free to change it to anything you want.

Radio CAT

Select the CAT protocol for your specific radio here. This selection will be saved in the **Radio Port** profile and be used when this **Radio Port** is selected. You must also set the [configuration switches](#) on the [Radio I/O module](#) or inside the Mini+ to match to CAT signal's polarity to match the radio's CAT port. You may also need to change the [Radio Baud](#) if your radio isn't using the default for that protocol.

NOTE: Many radio manufacturers use radio CAT protocols from other manufacturers so even if your radio isn't listed here the Mini still might be able to control it. For instance the QRP Labs QCX and UCX radios use the *Kenwood1* protocol, as do several others. Check the manual for your radio to see which protocol it uses. Let me know if your radio isn't listed. I can add additional protocols to the Mini as needed.

CAT Connection

This menu allows you to define how you want to connect to your radio.

Most radios support a serial CAT port. The first 8 entries on this menu allow you to set the baud rate that the Mini uses on this port. The Mini's baud rate must match the baud rate set on the radio.

The polarity of the physical signaling is defined by hardware jumpers or switch settings on either the internal radio I/O configuration header in the Mini+ or on the external Radio I/O module. You can choose between normal TTL levels, inverted (RS232) levels, or Icom CI-V 2-wire bus.

Newer radios such as the Flex 6000 series, the Elecraft K4, and others supporting the Hamlib rigCtld library (such as the Xiegu X6100 running the [Armbian build](#)) allow you to connect to your radio's CAT port over a network connection. You can assign the **IP Address** and **TCP Port** for this connection using this menu. You can also use an inexpensive [serial terminal server](#) (or [serial terminal server software](#)) to connect to any radio's serial CAT port across the network.

NOTE: The **TCP Port #** must be above 1000.

NOTE: When an **IP Address** is selected the Mini's serial port is disabled.

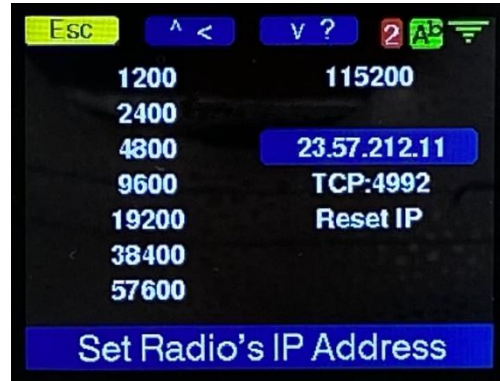
The **Reset IP** menu item on this menu and on the **WiFi** menu in the main menu allows you to reset this connection if you change the address or TCP port #.

Flex Radio IP Address and TCP Port Settings

To connect to a Flex 6000 series radio you must first enter the radio's IP address into the **IP Adrs** field. You can find this address in SmartSDR under the *Settings->Radio Setup...Network* tab. Enter the radio's IP address here and set the **TCP Port** to **4992** then [Connect WiFi](#) to connect the Mini to your radio.

By default the Flex uses TCP port 4992 to communicate with local clients. You can change the default port here if you are going to run the Mini on the Internet and want to connect to a Flex radio behind your station router. Forwarding IP ports on your router is dangerous and beyond the scope of this manual. I highly recommend using a VPN like [TailScale](#) for remote access. Google is your friend here.

WARNING! NEVER, EVER FORWARD PORT 4992 THROUGH YOUR ROUTER TO THE OUTSIDE WORLD. THIS PORT IS COMPLETELY OPEN AND HAS NO PROTECTION AGAINST BAD ACTORS.



Hamlib rigCtld TCP Port

The Mini supports the Hamlib rigCtld network CAT protocol. If your radio supports this protocol just select **NET rigCtld** in the [Config->Radio CAT](#) menu and set the **TCP Port** to **4532** in the [Config->CAT Connection](#) menu then connect to WiFi.

Elecraft K4 TCP Port

The K4 supports network CAT control along with USB and RS-232. To connect to your K4 over WiFi just enter the radio's **IP Address** and **TCP Port 9200** in this menu and connect to your WiFi network.

UDP Port

The Mini opens **UDP Port 42022** to receive meter and panadapter UDP packets from the Flex radio and data shared between two Minis and to the CTR2-Mini Antenna Switch Controller in **Link** mode.

NOTE: If you decide to operate your Flex remotely using port forwarding (against better judgment) you'll need to forward UDP port 42022 along with TCP port 4992. I haven't had a lot of success forwarding UDP ports through my router so your mileage may vary.

Calibration Menu

With the variety of radios the Mini's meter indications don't always match up with the radio's indications. This menu allows you to add a calibration factor to each meter. 1.0 is the default. 1.5 increases the Mini's meter reading by 50%, and 2.0 increases it 100%. You can enter any range between .01 and 9999. The indication from the radio is multiplied by the calibration factor to get the Mini's meters close to the radio's own meter indications. It may take several tries to get what you want.

S-meter Calibration

Many radios change the S-meter indication when the RF Gain is turned down. This makes it easy to calibrate the Mini's S-meter. You can also tune a steady carrier like WWV to set the S-meter calibration factor.

Power Meter Calibration

To calibrate the power meter set the radio to CW and key up into a dummy load. Adjust the Tx Power meter's calibration factor so the Mini's Power meter matches your radio's power.

SWR Meter Calibration

To calibrate the SWR meter, key into a mismatched antenna.

ALC and Compression Meter Calibration

ALC and Compression calibrations are a little more subjective. I've found it's easiest to use WSJT-X in **Tune** mode (into a dummy load of course) to put the transmitter into known ALC and compression levels then calibrate to that.

Saving the Calibrations

Calibrations are saved in the radio file associated with the selected **Radio Port**. These settings will be restored when you reboot the Mini. However, if you change the **Radio CAT** on this **Radio Port** these settings will be reset to their default values. If you have more than one radio you want to control with the Mini, save each radio's configuration in a separate **Radio Port**. It's also a good idea to save your meter calibration factors in a document separate from the Mini.

Function Button Recalibration

This option allows you to recalibrate the resistance ladder used by the [Function Button Keypad](#). This allows you to fine-tune the resistor ladder if you use resistors that are 'close' to the suggested values in the keypad schematic. It also provides a means to calibrate the Mini to work with the [CTR2-Mini SO2R Controller](#). The SO2R controller loads the voltages from the resistance ladder enough to require recalibration.

Encoder Mode

The **Encoder Mode** setting has been moved to this menu. Many users prefer a smooth encoder over an encoder with detents. Smooth encoders are more natural for tuning but they can be frustrating when trying to select menus and menu options. With a highly sensitive encoder just pressing the encoder to select a menu option can change the selection. Because of this, I've always recommended a detent encoder even though I prefer a smooth encoder.

For my own sanity I added an encoder mode option in v1.07.00 firmware. This option allows you to choose between *Fast* and *Slow* encoder sensitivity. The *Slow* mode desensitizes the encoder when a menu is open so more encoder movement is required to change the menu selection. This reduces the chances of selecting the wrong menu when using a smooth encoder (although it will still happen occasionally).

Amplifier Sequencing

This is a rather odd (and probably never used) option that allows you to specify the PTT key-down and key-up sequences needed on older linear amplifiers. When this feature is turned on keying the PTT on the Mini causes the following sequence to occur:

- The Mini immediately closes *PTT Out* on the [Radio I/O](#) module. Wire this output to the **amplifier's** PTT input.
- After the *PTT->Key Pickup Delay* time (in milliseconds) the Mini closes the *Key Output* on the [Radio I/O](#) module. Wire this output to the **transmitter's** PTT or Key input.
- When PTT is released on the Mini it immediately opens the *Key Output* on the *Radio I/O* module, dropping the transmit carrier.
- After the *Key->PTT Release Delay* time (in milliseconds) the Mini opens the *PTT Output* on the *Radio I/O* module, dropping PTT to the amplifier.

Radio Menu (Expanded Options)

The Mini currently offers expanded control for several radios. Others may be added in the future as time and need dictate. I'll update this manual as changes are made.

When selecting one of the *Radio CAT* protocols listed below a menu for that radio appears as the last item on the Main menu. Opening this menu gives you access to the various functions I've included for these radios.

This menu will remain active until you press button [A] (Esc), press and turn the encoder LEFT, or long-press the encoder to exit it.

As of v1.14.00 all **Radio** menus include the ability to change the radio's mode using the Blue navigation 5-way Up and Down switches.

Flex 6000 Menu

The **Flex 6000** menu is visible in the main menu when you select the **Flex Radio Protocol**. This menu gives you control over enough of the features of this radio that you can operate it without the SmartSDR software. You may want to do this if you're monitoring a band for activity and don't want or need SmartSDR running. Or maybe you just want to operate your Flex as a P.O.R. (Plain Old Radio).



Flex 6000 Menu

But even with SmartSDR running the Mini adds significantly to the operation of this radio by providing a smart tuning knob for the radio and function button access to the features you use the most. Two or more Minis can be connected to the radio simultaneously with each controlling a different slice. The [Link](#) options can also be used to synchronize two slices as needed.

You have the option of connecting to your Flex as a **GUI client** or **non-GUI client** (third menu item on the right column). The GUI client allows you to display the mini-panadapter in the Mini. If you're running v1.xx or v2.xx of SmartSDR you won't be able to connect to your radio as a GUI client if SmartSDR is running because older versions of SmartSDR don't support multiple clients. The connection type is shown in the text box on the bottom-left.



If you connect to your radio as a GUI client then decide to switch to a non-GUI client, use the **Reset IP Connection** command on the **WiFi** menu to release the connection and reconnect as a non-GUI client. If you're running SmartSDR 3.xx there's no worries because it supports multiple GUI clients.

NOTE: If a GUI client connection attempt fails the Mini will connect as a non-GUI client.

Frequency, band, Mode, and RIT on the slice are set just like any other radio. This menu gives you access to additional features on the radio.

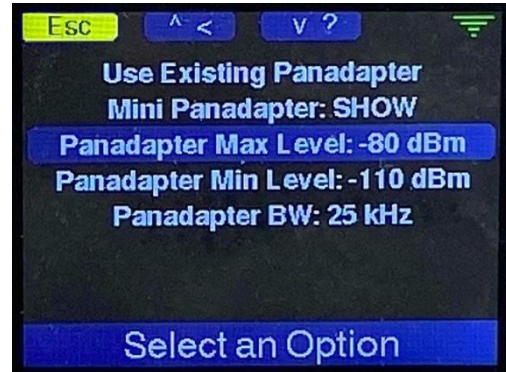
Pan Menu

The *Panadapter Menu* has several options.

Use Existing Panadapter

The first option allows you to specify if you want to create a new panadapter when you connect to the radio with the selected *Slice*. This might be advisable if you're connecting two Minis to your radio and don't want the second Mini to control the mini-panadapter on GUI client Mini.

NOTE: *Create New Panadapter* option must be selected before connecting to the radio.



Panadapter Menu

The mini-panadapter is only available in **GUI client** mode. The radio doesn't send panadapter information in non-GUI client.

Mini Panadapter: Show/Hide/off

This option allows you to show or hide the mini panadapter. The panadapter is shown at the bottom of the Home page. Max and Min levels are shown on the left and bandwidth is shown on the right. The receiver's audio bandwidth is highlighted in green as seen here.

If the panadapter is not supported (non-GUI mode) this option will be **off**.



Mini Flex Panadapter

Panadapter Max Level

This option allows you to set the highest level shown in the mini panadapter. Options are -50, -60, -70, -80, -90, and -100 dBm. Press the encoder to step through the options.

Panadapter Min Level

This option allows you to set the lowest signal level shown in the mini panadapter. Options are -100, -110, -120, -130 dBm. Press the encoder to step through the options.

Panadapter Bandwidth

This option allows you to set the bandwidth shown on the mini panadapter. Options are 500 kHz, 200 kHz, 100 kHz, 50 kHz, 25 kHz, and 10 kHz. Press the encoder to step through the options. As seen on the panadapter photo above the receive bandwidth is shaded in green to give you a visual indication of what you are listening to.

NOTE: When using two or more Mini's connected to your radio the FFT data shown on the mini-panadapter on the Mini running in GUI client mode may be for the Mini that last tuned its slice, not the slice on the GUI client. To make sure you are looking at the proper spectrum toggle the Mini's Tx Enable ([A] button) to make that Mini's slice the active slice.

Slice

The *Slice* allows you to specify which slice you want to connect this Mini to on the radio. You can specify slice A through H depending on your radio. In theory you can have up to eight Minis connected to one radio, each controlling one slice. I don't have a Flex 6600 or 6700 so I've never tried it!

While it is possible to connect two Minis to the same slice I highly recommend against it! The Minis will fight each other and the radio as soon as you try to change the tuning on any of the devices.

NOTE: Changing the slice when the Mini is connected as a GUI client removes the current slice and panadapter and restarts them for the new slice.

Rx (Antenna)

This option allows you to select ANT1, ANT2, RX A, RX B, or XVTA for this slice.

Tx (Antenna)

This option allows you to select ANT1, ANT2, or XVTA for the transmitter.

Power Out (PO)

Set the transmitter power output using the *PO* option. The Tx power is common to all slices.

Tune Power Out (TO)

Set the tuning power level using the *TO* option.

ATU (Tuner)

This option shows the status of the built-in antenna tuner if it's installed. To start the antenna tuning sequence, select this option and press the encoder.

Volume

This option allows you to control the volume on the slice this Mini is controlling. A quick way to mute this slice is to long-press the encoder (>1 second). This sets the volume to 0. Long-pressing the encoder again returns you to the original setting.

Bandwidth (BW)

The **Bandwidth** option allows you to step through the available bandwidths for the current mode. Bandwidth decreases with each click of this control until you reach the lowest bandwidth setting. Clicking this control again starts over at the widest bandwidth.

Filters (WNB, NB, NR, ANF/APF)

The various filters on the radio can be adjusted using these options. Setting a filter to 0 disables that filter. A quick way to toggle a filter on and off is to long-press (> 1 second) the encoder.

RF Gain (RFGn)

This control allows you to select the gain applied in the slice's RF section. The available gain settings depend on the model of the radio. Older 6300 and 6500 radios offer -10, 0, 10, and 20 dB of gain. Newer 6400, 6600, and 6700 radios offer -8, 0, 8, 16, 24, and 32 dB of gain.

NOTE: Gain selection is numbered -1 to 2 for older radios and -1 to 4 for newer radios. This correlates to the gain positions. The actual gain will be shown at the bottom of the window.

AGC

This control allows you to step through the **AGC** settings on this slice. Options are **Fast**, **Med**, **Slow**, and **Off**.

AGC-T (Threshold)

This control allows you to adjust the **AGC-Threshold** level. Flex recommends setting this level after you have set the **Mode**, **RF Gain**, and **AGC**. Tune to a quiet spot on the band then lower the **AGC-T** control until you hear the noise level decrease slightly. This is the 'knee' of the control and means the **AGC** is not applying gain to the noise but signals you want to hear will be amplified. More information on this control can be found [here](#).

PTT

This option allows you to select between *Hardware* and *Network* control of the radio's PTT. Use the *Hardware* option if you've wired *PTT Output* on the *Radio I/O* (or the Mini+'s *PTT/K Out*) to the radio's PTT input on the DB15 connector (or to the RCA PTT connector) on the back of the radio. Use the *Network* option to key the radio over the WiFi connection.

If you use *Network PTT* you may want to set the [Remote PTT \(Rmt\)](#) option on the [Keyer](#) menu for [Latching PTT](#) so you can just click it on then click it off.

Key

Like the *PTT* option above this option allows you to specify *Hardware* or *Network* control of the radio's *Key* input. Use the *Hardware* setting if you have wired the *Key Output* on the *Radio I/O* module (or Mini+'s *PTT/K Out*) to the *Key Input* on the radio. Use the *Network* setting to send the Mini's keyer output over the WiFi network to the radio. This allows you to operate real CW when you're operating your radio remotely.

If you have selected any of the Mini's [Keyer Types](#) with the exception of **None** or **Passthru** the Mini will automatically select *Breakin* on the *P/CW* window and disable the Iambic keyer in the radio when you enable the Tx interlock on the Mini (button [A] on the Home page). If you're using the network for CW keying you'll need to enable sidetone on the Mini so you can hear the Mini's key output. The radio doesn't generate sidetone when keyed from the network.

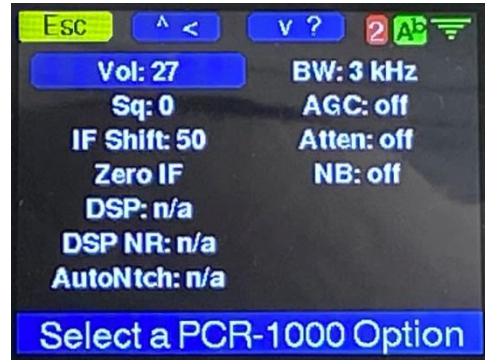
CW Delay

The final option on the *Flex 6000* menu is the *CW Delay*. You'll need to adjust this value to compensate for network latency when using *Network Keying*. Depending on your network's latency you may need 100 to 250 milliseconds of delay to get good code across the network.

Icom PCR1000 Menu

I created a special menu for the Icom PCR1000 radio mostly because I had one gathering dust. It's not the best radio by today's standards but it is wideband and still has value in my shack. At least one Mini user uses his PCR1000 to monitor for 1296 MHz beacons in his area.

The main difference between the PCR1000 implementation and all the other radios is that the PCR1000 uses the [A] button on the Wio Terminal to control the power to the radio instead of *Tx Enable*.



PCR-1000 Menu

The menu for the PCR1000 is shown here. The controls are pretty straight forward so I won't go into detail on each one.

Frequency, band, and mode are set by the Mini just as they are on any other radio. This menu gives you control over the other parameters on the radio.

One thing to be aware of is that DSP is always allowed even if the radio doesn't have the DSP module. The radio will just ignore it if there's no DSP board in it.

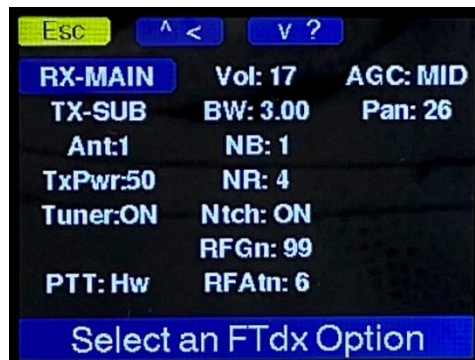
The *Bandwidth (BW)* control cycles through the available bandwidths. Different modes have different bandwidths available. For instance CW, LSB, and USB are restricted to 3 and 6 kHz. Wideband FM can use 15, 150, and 230 kHz bandwidths.

Yaesu FTdx Menu

The Yaesu FTdx menu has been redesigned again in v1.13 and provides quite a bit of control over this radio. Note that this menu can be used with most FTdx models however not all radio support all of these options (i.e. the FTdx10 only has one Rx so Sub Rx options don't work).

RX MAIN / RX SUB

When your radio has two receivers use this option to select the active receiver. The other receiver controls on this menu update to show the selected receiver's settings.



Yaesu FTdx Menu

TX MAIN / TX SUB

This menu option toggles the transmitter between the MAIN and SUB VFO.

Antenna (Ant)

Each receiver can operate on either antenna port 1, 2, or 3. This allows you to easily setup a receiver diversity system. These menu options allow you to choose the antenna for each receiver. Not all antenna ports are available on all radios.

Tx Power

This menu item allows you to set the output power of the transmitter.

Tuner

This menu item opens the *Tuner* menu where you can turn the internal tuner *ON* and *OFF*. When the tuner is *ON* you can *START* and *STOP* it from this menu.

PTT (Hw/CAT)

The FTdx radio has the ability to have PTT keyed either by a normal hardware connection or by a CAT command (**TXn**). Keying the radio using the CAT command eliminates the requirement of connecting a custom cable from the Mini to your Radio's PTT input. It also allows you to control the radio remotely if you connect it to a serial terminal server.

Volume

This control brings up a [Value Edit](#) display where you can adjust the selected receiver's volume. This display will stay open until you press the encoder to close it. You can also long-press (> 1 second) the encoder to 0. Long-pressing the encoder again restores the volume to its previous value.

Bandwidth (BW)

This control allows you to adjust the audio filter on the selected receiver.

Noise Blanker Level (NB Lev)

This control allows you to enable the noise blanker and set its level. To disable the noise blanker set the level to 0.

Noise Reduction Level (NR Lev)

This control allows you to enable DSP noise reduction and set its level. To disable noise reduction set the level to 0.

Auto Notch (Notch)

Click this control to toggle the auto notch filter on and off.

RF Gain

Use this control to adjust the RF gain on the selected receiver.

RF Attenuation (RF Attn)

Click the encoder to step through the RF attenuator settings on the radio. These include **OFF**, **6 dB**, **12 dB**, and **18 dB**.

AGC

Click the encoder to step through the AGC settings on the selected receiver. Options are **OFF**, **FAST**, **MID**, **SLOW**, and **AUTO**.

NOTE: When the AGC is turned **OFF** the receiver's audio is not limited. Loud signals can be hazardous to your ear's health!

Panadapter Reference

This control allows you to adjust the reference level on the active receiver's panadapter.

Icom Menu

The Icom menu is a recent addition to the Mini. While it has been vetted through beta testing all of the functions may not work on all radios. I used the IC-7610 and IC-9700 protocol documents to create this menu. Let me know if you find anything odd while using it on your radio.

The functions on this menu follow the layout of the Yaesu FTdx menu and operate similar to those described above. The Icom menu doesn't support antenna selection or panadapter scope levels since those aren't documented in the Icom CAT protocol document. I'll add them if and when I find the CAT descriptions for them.



Icom Menu

Frequency, band, mode, and RIT are set by the Mini just as they are on any other radio.

RX:

To switch to the Sub receiver on a dual-receiver radios (7610 or 9700), select **RX: A** and press the encoder. The settings on this page will update to show the **B** receiver's settings.

TX:

To use the **B** receiver's VFO for transmit on the 7610 select **TX: A** and press the encoder to toggle to **TX: B**. In this mode the radio goes into Split mode where the radio's B VFO is used to control the transmit frequency and mode.

PTT:

Select this option to toggle PTT between Hardware and CAT control.

Adrs:

This option allows you to change the CI-V address assigned to this radio. Initially the address is set to 00 and the Mini determines the radio's address when it replies to the first command. For this to happen the CAT mode in the radio must be set to **Transceiver** mode. You can manually enter this address.

WARNING: The Mini uses the default radio addresses to determine the radio model it is connected to. If you change the CI-V address the Mini may not function properly with your radio.

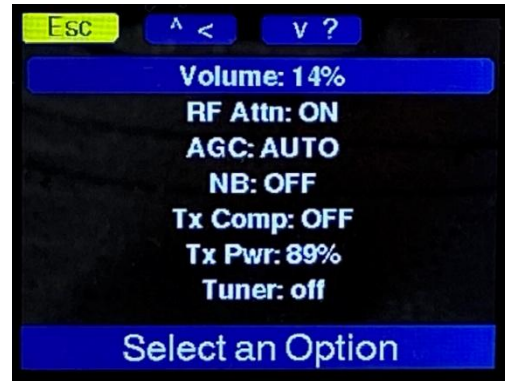
NOTES on the IC-9700

The IC-9700 has separate receivers for each band. This means that you can't tune outside of the selected band and you can't have the same band selected for both receivers.

Xiegu Menu

While the Icom protocol does work (sort of) with the Xiegu radios I decided that there were enough differences between the 'pure Icom' and 'Xiegu' implementations that there needed to be a separate Xiegu radio menu. This menu was added to the Mini in v1.12.02.

The Xiegu radio, according to the [G90 spec published by RadioOddity](#) supports only a small subset of the Icom CAT controls. These are shown on the menu to the right.



Xiegu Menu

With the exception of the volume and Tx power, these controls are toggled by selecting them and pressing the encoder.

NOTE: These CAT controls work on the G90 but only the volume and AGC controls work on the G106. I don't have an X5105 to try so I'm unsure on what works and what doesn't work on that radio. The X6100 isn't supported at the present time by the Mini.

NOTE: The radio's display doesn't update when you change many of these settings with the Mini. This is a Xiegu bug.

Elecraft Menu

The Elecraft menu is also styled after the functional layout used in the [FTdx menu](#) described above. Refer to that [section](#) for detailed explanations of each function.

In v1.13.04 I added the **Comp** control. It allows you to adjust the Speech Compressor on the transmitter. K3 radios have a 0 to 40 dB range where K4 radios have a 0 to 30 dB range.

In v1.13.07 I refined the protocol to better support the K2, KX2, K3, and KX3 radios. The protocol for these radios don't support all of the options shown on the K4 menu, specifically the Tuner (Tun:), Noise Reduction (NR:), and Panadapter level (Pan:) so these options are not displayed.



Elecraft Menu

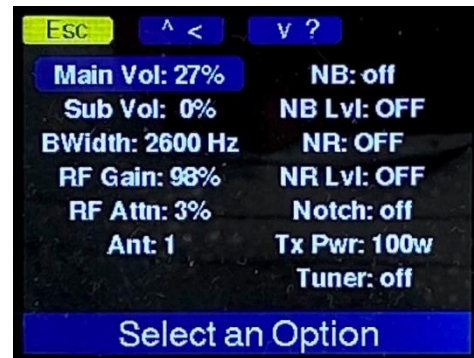
The Tuner option just toggles the radio's tuner between **Bypass** and **Auto** mode.

The K4 has network CAT control built in so you can enter the radio's IP address and TCP port **9200** into the [Config->CAT Connection](#) menu then connect to WiFi instead of using a wired RS-232 connection between the Mini and the radio.

NOTE: A user reported that the Mini would not work on his KX3. After several weeks of troubleshooting this problem remotely he finally sent his radio to me to test. I found that the KX3 is very sensitive to the RS232 MARK level on its CAT RD port. Most radios with RS232 CAT ports accept any voltage level below 1 volt as a MARK state and any voltage over 3 volts as a SPACE state. The KX3 detects any voltage over .3 volts as a SPACE. The Mini outputs .55 volts in the MARK state and 4.8 volts in the SPACE state. If your Mini doesn't work with the RS232 port on one of your radio's, see [Appendix H](#) for a modification to fix this issue.

Kenwood Menu

The Kenwood menu was added in Mini v1.07.00 firmware. This menu provides advanced control features for newer Kenwood radios such as the TS-480 and TS-2000. I used the TS-2000 protocol document to create this menu so not all of these features will be available on every Kenwood radio. Most older Kenwoods (like my old TS-680) use the Kenwood2 (two stop bit) protocol and don't support any of these features so this menu isn't available for these radios.



Kenwood Menu

This menu will be revised similar to the same format as the [FTdx menu](#) in a future update.

NOTE: Many of the Kenwood menu features haven't been thoroughly tested because I don't have a newer Kenwood radio. If you have one and find problems with features in the menu, or would like to see something else implemented, let me know. I need your input!

The options on the Kenwood menu are pretty straight forward, with a couple of oddities.

- If your radio doesn't have a Sub receiver (such as the TS-480) the Sub Rx options obviously won't work.
- The *Bandwidth* control adjustment is shown in Hz in the *Value Input* window. The radio however has discrete frequencies for this mode. When you accept the new value the actual frequency the radio is using will be shown on the menu.
- The *Tuner* menu option opens the *Tuner* menu. On this menu you can choose to route the receiver and/or transmitter RF path through the tuner. Click the *Tuner Status* option to start or stop the tuner.

Terminal Mode

The Mini supports a terminal connection on its USB serial port. This allows you to plug the Mini into your computer and connect a terminal program such as Putty or Tera Term to the Mini's USB serial port. Select the Mini's serial port reported by your PC's Device Manager and set the baud rate to 115.2 Kbaud. Once connected press the [Enter] key to start the terminal session.

This menu should appear. If it doesn't, make sure you have the right serial port and baud rate set.

```
COM13 - Tera Term VT
File Edit Setup Control Window Help
CTR2-Mini Terminal Menu

-----FREQUENCY/MENU CONTROL-----
[Enter] Encoder Click - Next Menu          [Tab] Display this screen
[ESC] Return to Home page                  [ / ] or [ ? ] List Current Status
[Up Arrow] Increment Selection            [Down Arrow] Decrement Selection
[Left Arrow] Freq Step Up                 [Right Arrow] Freq Step Down
[Page Up] Open Frequency Menu             [Page Down] Open User Menu

-----KEYER CONTROL-----
[F1] Repeat last message                   [F2] Contest Exchange
[F3] to [F9] Send Message 3-9             [F10] Send Call ^
Shift [F3] to [F7] Send Message 10-14    [F11] Send Contest SN #
Insert] Pause Tx Message                  [F12] Send Exchange %
[End] Delete Tx Message                   [Enter] Send Keybd Buffer
[Home] Toggle Tx Enable/Disable

-----TX MSG PROSIGNS-----
[^] Call      [#] Contest SN      [%] Contest Exchange
["] RR      [$] SX      ['] WG      [(] KN      [)] KK      [+] AR      [-] DN      [/] DN
[:] KN      [:] AA      [<] AR      [=] BT      [>] SK      [@] AC      [[] AS      []] KN

Type chrs then [Enter] to Tx. [Enter] opens Menu. [Tab] displays this screen
```

Terminal Menu

Once Terminal mode is running, you can use the cursor control keys to change the frequency and the tuning digit. The changes will be displayed in the terminal and on the Mini.

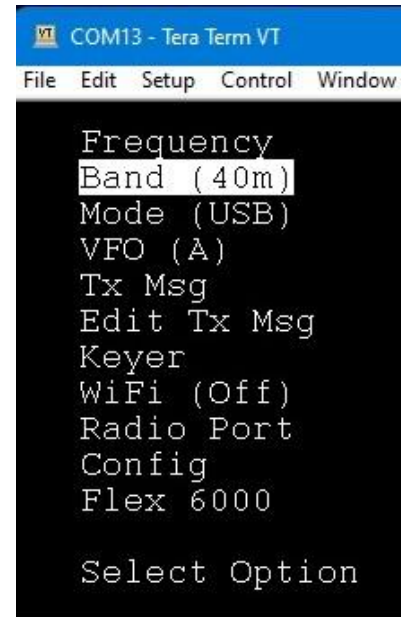
The menu shows the other key commands that are available.

Keyboard Keyer

If you just enter text and prosigns on the keyboard then press [Enter] that text will be sent to the keyer (and to the radio if Tx is enabled on the Mini). You can use the F-keys on the keyboard to send CW message buffers, your call, the contact SN, or the contest exchange. Pressing [Insert] will pause the buffer's transmission so you can key in additional information such as RST. Press [Insert] again to resume the buffer transmission. Pressing [End] will immediately stop the transmission and clear the buffer. Yes, you have a keyboard keyer!

Mini Menu Control

Pressing [Enter] with no text entered is the same as clicking the encoder and opens the Mini's main menu. Use the cursor control keys to navigate and press [Enter] again to select or [Esc] to exit. You'll find this comes pretty natural. This is a great way to enter the initial setting in the Mini, especially text strings, message buffers, or unsupported characters for passwords. To turn Terminal mode off just reboot the Mini.



Mini control on a terminal

Radio Emulation Mode

The Mini emulates a Kenwood TS-2000 radio on its USB serial port. This is a way for 3rd party applications to control the radio connected to your Mini.

Emulation mode starts when the Mini detects a valid Kenwood command on its USB serial port. The Mini decodes the commands and replies to them as if it were a Kenwood TS-2000 radio. The 3rd party application can read and change the frequency and mode on the Mini/radio and do a few other things.

To use this mode, connect the USB port on your Mini to your PC and note the virtual serial port assigned to it. (On Windows this can be found in the Device Manager). Once you know the serial port, enter it into your 3rd party application and select the TS-2000 as the radio. Use the slowest baud rate your application will allow because servicing this function is not very high on the Mini's priority list.

The Mini doesn't fully support TS-2000 CAT protocol but since I've added an expanded menu for the Kenwood radio I'll work on adding additional functionality to the emulation mode. So far I've worked with WSJT-X to make sure it supports the information it's looking for (and supports CAT keying) for but I haven't tested it with the various logging programs out there to see how they work. Let me know if you find something that doesn't work and I'll be happy to look into support it.

One of the advantages of this mode is that whatever radio you control with the Mini looks like a TS-2000 to your 3rd party software so you never have to change settings in your application when you switch radios.

When *Radio Emulation* mode is running *Terminal* mode is not available. Reboot the Mini to turn this mode off.

FAQs and Troubleshooting

The Mini packs a lot of functionality into a small device. While I have tried to make the controls intuitive and easy to remember, the compromises required for the simple user interface can cause misunderstandings on what does what.

The easiest way to get a little help on any menu item is to select the item then press and hold the [C] button. This brings up a help window for that item. While it may not answer all of your questions, it's the first place to start.

The table below lists some common problems that come up occasionally, particularly for new users. Once you become familiar with the Mini you should be able to operate it without issues.

Let me know if you have any ideas, questions, or suggestions that you'd like to see added to this section.

Issue	Solution
Power Issues	
What is the jack size on the 12 VDC power plug on the Mini+ and how is it wired?	The power connection is a standard 2.1x5.5mm coaxial power jack with (+) wired to the center pin. Then Mini+ has reverse polarity protection in case you get the wiring wrong. I supply a pigtail with full assembled Mini+ units.
The Mini+ is plugged into 12 VDC but the Wio doesn't boot when I turn the Mini's Volume power switch on.	The Wio Terminal has its own power switch which also must be turned on (in the center position). The Wio Terminal on the original Mini is powered by the USB connection to your PC or a 5 volt phone charger. In either case, make sure the Wio's power switch is on.
Connection Issues	
How do I connect the Mini to my radio?	See the Quick Start Guide for a detailed description of getting the Mini connected to your radio.
I've followed the Quick Start Guide but I still can't control my radio.	<ol style="list-style-type: none">1. Make sure you have the Mini's baud rate set to match the baud rate setting in your radio.2. Verify the CAT signal polarity jumpers are set correctly for your radio. Generally you'll use Normal TTL for most radios unless you are connecting to a DB9 (RS-232) connector. In that case, use the Inverted polarity. For Icom radios, always install jumpers 1, 2, 3 and 8 for CI-V.

	<p>WARNING: Jumper 8 shorts CAT TD to RD. Only install this jumper when using Icom CI-V.</p> <ol style="list-style-type: none"> If you built your own CAT cable check the wiring. Verify you have the CAT cable plugged into the 'C' jack on the external radio I/O module, or the 'CAT I/O' jack on the Mini+ Make sure the connection to the radio's CAT port is secure
I can't connect to my Elecraft KX3 using RS-232 CAT.	The RS-232 port (ACC1) on the KX3 is overly sensitive to the RS-232 MARK voltage level. Any voltage above .3 volts will be detected as a SPACE. The Mini's RS-232 MARK voltage is .55 volts. To work with the KX3 you will need to add a 2N3904 in parallel with the TX_RADIO! output. See Modification for Improved RS-232 CAT Control in Appendix H .
WiFi Connection Issues	
Sometimes it takes several tries to connect my Min to my WiFi network.	The Wio Terminal supports both the 2.5 and 5 GHz bands however; it seems to have issues connecting to routers when both bands share the same SSID. Newer routers also have an Automatic Connect option that selects which band to use. The Wio Terminal doesn't appear to like this option either. Use different SSIDs for each band on your router (I just add '5' to the end of the 5 GHz SSID) and turn off the Auto Connect feature if your router has it.
General Issues	
What do Radio Ports do? Why do are there 16 of them?	Think of Radio Ports as individual radios. Each port can be programmed for a specific radio. Radio ports save the radio's protocol settings, the favorite frequency list, the keyer settings, and the CW message buffers. If you have multiple radios set up a radio port for each one then just select it when you want to use that radio. You can use one or more manual RJ45 switches to connect the CAT, PTT, and Key outputs to control multiple radios as shown here .
Does the Mini use the radio's B VFO or its internal memories?	No, the Mini manages its own VFOs and memories. You can use your radio's B VFO and memories independently of the Mini. In effect this gives you three VFOs and three sets of memories to work with (when you use the memories from the shared database).
What's the "shared database" used for?	The shared database can be thought of as the 17 th radio port that can be shared with any (and all) of the other 16 radio ports. Any changes made to this database will be available on all the ports it is shared with. For instance, you might want to program the CW message buffers in the shared database with your basic information so you can use them in any radio port. Same thing goes for the favorite frequency list.
I don't hear the radio's receive	The Mini does not connect to your radio's transmit or receive audio

audio when I turn the Volume control on the Mini+ up.	signals. The Volume control on the Mini is only to adjust the volume of the keyer sidetone.
What does the Rmt option in the Keyer menu do?	<p>The Rmt option defines the function of the PTT/Key In jack on the Mini (or PTT/K Input jack on the Mini+). This jack has three possible functions.</p> <ol style="list-style-type: none"> 1. You can connect a remote PTT switch such as a foot switch or desk switch to it to control the Mini's PTT Output to the radio. 2. On the original Mini you can connect a function keypad to it in addition to a remote PTT switch. See Appendix C for information on building this keypad. 3. You can connect a straight key to this jack and use it along with a set of paddles. <p>For options 1 and 2, set the Rmt option for PTT (momentary, push PTT on, release PTT off) or PTT Latch (push PTT on/push PTT off). For option 3, Key, the PTT input will generate a Key Output to the radio. A full description of this option can be found in the Rmt section. NOTE: Because of the Mini's hardware design if you select option 3 the function keypad will be disabled.</p>
The radio's power is not controllable on the External Tuner page.	Normally you can adjust the output power with the encoder in this mode. This won't work if your radio's CAT protocol doesn't support output power adjustment, or I haven't added that option to the Mini's CAT implementation for your radio. In either case, you'll need to manually adjust the radio's power.
I set the RIT on the radio or the Mini but it turns off as soon as I change the radio's frequency with the Mini.	When RIT is Off the Mini controls the radio's transmit and receive frequency. When you turn RIT On the RIT control tunes the receiver's frequency and the Mini tunes the transmit frequency. When you change the transmit frequency with the Mini the radio turns RIT Off .
Function Button Issues	
The F1 and F2 function buttons don't work	This occurs when you select Key in the Keyer->Rmt menu item. When the PTT/Key In has been set to use a straight key. The ADC values for F1 and F2 are invalid when the straight key is connected.
How do I program functions into the Function Keypad	Select Config->Function Btns then select from the list of buttons to program that button's <i>primary function</i> . Select the SHIFT FUNCTN item to switch to the <i>secondary function</i> menu. Select NORM FUNCTN to return to the <i>primary function</i> menu. To access the <i>secondary function</i> of a button you must program the SHIFT function into the <i>primary function</i> of one of the buttons. Pressing the SHIFT button will open an information window that lists the <i>secondary function</i> assignments. Pressing one of the buttons while this info page is visible will execute the <i>secondary function</i> .
Function buttons do not execute their programmed function.	This may happen if you build your own Mini and use resistors in the function button resistor ladder that are different than the default values. To correct this select the Config->Function Btns->RECALIBRATE option to update the ranges for each button.
I get a FUNCTION BUTTON LOCKOUT when I boot the Mini. What is this?	A Function Button Lockout occurs when one of the buttons on the function button keypad are pressed and held down longer than 10 seconds. This feature protects you from a hardware failure. To reset this lockout make sure there are not failed pushbuttons then execute

	<p>the Config->Function Btns->RESET LOCKOUT option.</p> <p>NOTE: Holding the PTT button on the keypad longer than 10 seconds does not cause lockout.</p>
How do I use the Passthru keyer mode?	<p>The Passthru keyer type simply takes the left and right inputs from the paddles connected to the Mini's Paddle input jack and transfers them to the Key and PTT Outs on the Radio I/O PTT/Key (or Mini+ PTT/K Out) jack. You can use a standard 1/8" (3.5mm) to 1/8" stereo cable to connect this jack to the Key Input jack on your radio. This allows you to use paddles connected to the Mini to key the internal keyer on your radio or key an aftermarket keyer.</p> <p>NOTE: You cannot use Passthru mode with the split PTTKEY6 or PTTKEYFLEX6 cables I provide because only the Key Out signal is wired to the key plug. The PTT Out is wired to the second plug for PTT service.</p>
Flex Radio Issues	
I have a Flex radio. Where do I enter the IP address of the radio in the Mini so that it can control it?	<p>The radio's IP address and TCP port number are set in the Config->CAT Connection menu. The IP address for your Flex radio can be found in SmartSDR under the Radio Setup... menu under the Network tab. Make sure you specify TCP Port 4992 in the Mini for the Flex radio. Once you have this information entered, go to the WiFi menu on the Mini to connect to your network. The Mini will automatically connect to the Flex once the network connection is established.</p>
The Mini "hangs" when I try to connect to my Flex radio.	<p>This can happen if you have entered the wrong IP address for your radio or have a TCP port other than 4992 set in the Mini. The Mini will eventually fail out of this "hang up" but it will take several minute. It's easier to just reboot the Mini and fix the address or TCP port error.</p>
The Mini fails to stay connected to the Flex	<p>The Mini requires a solid signal to stay connected to the radio. If your network has a lot of traffic on WiFi (cameras, streaming video, etc.) you might consider installing a gateway router (a router connected to your main router via Ethernet) near your Mini. Connect it to the same Ethernet switch your radio is connected to. This provides a direct route between your radio and the Mini without the network congestion present on the main router.</p>
How to I connect to my Flex radio as a GUI client?	<p>Normally, the Mini tries to connect to your Flex as a "non-GUI client". In this mode it shares the slice with the GUI client. The GUI client is usually SmartSDR. In non-GUI client mode the radio does not send the client panadapter data. If you want to use the mini-panadapter in the Mini you'll need to connect as a GUI client. You do this by changing Non-GUI to GUI in the Flex 6000 menu on the Mini. If you are online with the radio you'll need to go to the WiFi menu and execute Reset IP Connection to reinitialize the connection to the radio.</p> <p>NOTE: Flex v2.xx and below software only supports one GUI client. To connect the Mini as a GUI client you need to close SmartSDR.</p>
Can I have more than one Mini connected to my Flex radio at	<p>Yes. Just assign a different slice for each Mini in the Flex 6000->Slice menu item.</p>

the same time?	
I can't see the mini-panadapter on the Mini's display when I connect to my Flex radio.	The mini-panadapter on the Mini is only available when you connect to your Flex as a GUI client and you have selected to Show the mini-panadapter in the Flex 6000->Pan Menu->Mini Panadapter menu. The Flex radio does not send FFT panadapter data to non-GUI clients.
How do I setup the Mini so control the PTT and Key inputs on my Flex radio over the network?	Both PTT and Key can be controlled over the IP network. To enable these functions on the Mini go to the Flex 6000 menu and change the PTT and/or Key options from Hw (hardware) to Net (network) control. NOTE: The Flex does not generate CW sidetone when keyed over the network. You'll need to use the Mini's sidetone to hear your keying.
I have two Flex radios. Can one Mini control both of them?	Not at the same time. However you can set up a Radio Port for each radio then just switch between those ports to control each radio.
The mini-panadapter on my Mini connected as a GUI client isn't displaying the signal I'm listening to. I have two Minis connected to my radio.	When two or more Minis are connected to your radio the mini-panadapter on the GUI client Mini displays the spectrum for the active Mini (i.e. the Mini that was most recently tuned). If the center frequency of the panadapter is different than the tuned frequency on the GUI client the panadapter's center frequency will be displayed in a blue text box to the right of the Mode text box under the frequency display (where the channel memory label is normally displayed).
I powered down my Mini while connected as a GUI client. When I reconnected I hear audio from two receivers.	When you connect in GUI client mode the Mini creates a new panadapter and slice for this session. If you power the Mini down without disconnecting from the radio first, that panadapter and slice will remain active. Reconnecting to the radio again as a GUI client will create another panadapter (if available) and another slice, producing two receiver audios. To reset this condition, go to the WiFi menu and select Reset IP Connection to disconnect and reconnect to the radio. This will close one of the sessions.
Can the Mini connect to my Flex radio from a remote network?	Yes. There are several ways to do this. The most secure method is to use a VPN (Virtual Private Network). The advantage of using a VPN is that besides protecting your network from bad actors the Mini thinks it's on the same network as your radio so the IP address and port #s don't change. There are several VPNs available. I like the Tailscale option. The least secure, and <u>highly not recommended</u> way to connect remotely to your Flex radio is to forward the TCP and UDP ports your Flex uses through your router. With this method the radio's IP address (from the Mini's perspective) would be the external facing IP address on your router and the TCP port would be the port # you forwarded TCP Port 4992 to on your router. To get meter and panadapter UDP data from your radio you would also need to forward port UDP port 42022 through your router. UDP Port 42022 is the port the Mini listens to for meter and panadapter data. I have not had luck getting UDP data to forward, your mileage may vary. WARNING: TCP Port 4992 on the Flex radio has no authentication

	<p>mechanisms. This means that anyone that connects to it can do whatever they want with your radio. You need to decide if this is a risk you're willing to take. You have been warned!</p>
--	--

Linking Issues	
<p>I can't link two Minis together. What am I doing wrong?</p>	<p>The Mini has the ability to connect to another Mini using either WiFi or Bluetooth (BLE). This is accomplished in the Link menu. No matter how you link them, one needs to be the server and one needs to be the client (or host/device, master/slave, etc). In the Mini this is defined as Mini-A and Mini-B and is done on the Link menu.</p> <p>To link Mini's using BLE simply set each Mini's to A or B and connect the link.</p> <p>WiFi is a little more complicated. After you define Mini-A and Mini-B you must set the IP address of the other Mini in the Link menu. Each Mini's IP address can be found in its WiFi menu <u>after</u> it is connected to your network (the router assigns this address using DHCP). Once you've entered the far-end Mini's address connect to WiFi then connect the Link.</p> <p>A full description of the various link options can be found here.</p>

Wrapping it up

I hope you found this manual useful. I'm sure I've made some mistakes or left something out. If you have any questions or have suggestions for additional content please contact me. I'm always looking for new ideas! Radio keyer speed control, External Tuner mode, and 'sticky' value editor windows came from Mini's users. My email address is good on QRZ.com or you can use the [Contact Me](#) link on my blog.

73, Lynn, KU7Q

Appendix A – Mini 101 – Basic Training

This section includes simple short lessons to help you get familiar with some of the Mini's capabilities. Once you learn the basics you'll be ready to start exploring all the other things the Mini can do.

Lesson 1 – Basic Controls

In this lesson we'll explore the basic controls the Mini provides.

Encoder

Let's start with the primary control, the encoder. This control has multiple functions but its primary function is tuning your radio's frequency. When you're on the Home page, just turn it to tune your radio. The amount of frequency change is determined by the **tuning digit**. Press and hold the encoder then turn it to change the **tuning digit**.

Pressing the encoder opens the menu system. In menu mode turning the encoder moves the menu item selection. Short-pressing it will select that item. Pressing and holding the encoder then turning it left will return you to the calling menu. Long-pressing the encoder in any menu will return you to the Home page.

Refer to [Encoder Functions](#) for a full description of the encoder.

Wio Buttons

The Wio Terminal has three buttons on the top. The function of these buttons change depending on the mode of the program as described in the [Wio's Top Buttons](#) section.

For now, just remember that on the **Home** page the [A] button controls the **transmit interlock**. The Mini can't put your transmitter into transmit mode unless this button is set to **Tx Enab**.

In menus the [A] button is **Esc**. Short-pressing it will return you to the calling menu. Long-pressing it will return you to the Home page the same as long-pressing the encoder.

Mini+ Controls

The Mini+ includes a volume control with an integrated power On/Off switch and six pushbuttons. The volume control only adjusts the sidetone oscillator's volume. The power On/Off switch controls the 12 volts power supply when the Mini+ is connected to a +12 VDC power source. If you connect the Mini to a USB port on your PC you don't need to use an external 12 volt power source. In either case, *the power switch on the Wio Terminal* must be turned on.

The six pushbuttons can be programmed for an array of functions. See the [Programming Function Buttons](#) section to learn about programming them.

Lesson 2 – Selecting a Radio Port

This lesson explains the concept of **Radio Ports** and how to use them.

You can think of a **Radio Port** as a database of settings for one radio. By default the Mini starts with **Radio Port 1** selected. The Mini supports 16 **Radio Ports**, allowing you to have 16 different radio configurations stored. User's controlling just one radio can leave the **Radio Port** set to 1.

To change the **Radio Port**, press the encoder to open the main menu. Use the encoder to scroll over to **Radio Port** then press the encoder again. From the **Radio Port** menu you can select one of the 16 ports. You can also rename, copy, or erase the *currently selected* port.

Lesson 3 – Selecting a Radio CAT Protocol

Every radio speaks a specific language, known as a CAT (Computer-Aided Transceiver) protocol. Radio controllers like the Mini must speak the radio's language in order to control it.

You tell the Mini which language to use in the **Config->Radio CAT** menu. To get to this menu, open the main menu, select **Config**, then scroll down and select **Radio CAT**. Select the CAT

protocol that your radio uses. You'll also need to match the radio's CAT baud rate. This is explained in the next lesson.

In addition, the radio's serial CAT hardware uses a specific data polarity. The Mini can use normal TTL, inverted TTL (for RS-232 compatibility), or Icom CI-V. These are selected using hardware jumpers on either the [Mini+ or Radio I/O module](#).

NOTE: There are two CAT protocols for Kenwood radios. **Kenwood1** uses 1 stop bit and is used with newer radios. **Kenwood2** uses 2 stop bits and is used with older radios that use the IC10c computer interface. The IF232 interface is not required for the Mini.

Lesson 4 – Selecting the CAT Connection Type

The Mini provides a couple of options to connect to your radio's CAT port. This lesson will describe these options.

The Mini can use either a serial or network (IP) connection to control your radio. Sorry, Bluetooth is not supported. Most radios have a serial CAT port while some of the newer radios like the Elecraft K4 support serial, Bluetooth, and Network CAT connections.

To tell the Mini how to connect to your radio, select **Config->CAT Connection**.

The first eight selections are baud rates. When you select a baud rate the Mini will use the **CAT I/O** port on the Mini+ or **C** port on the [Radio I/O module](#) to connect to your radio.

The **IP Address** connection option allows you to use a [serial terminal server](#) (or [serial terminal server software](#) on your PC) or your radio's network connection to connect to your radio via WiFi and the Internet. Serial terminal server software allows you to forward a serial port on your PC to an IP address/port and is a great alternative if your radio only has a USB CAT port (such as the Icom IC-705 and Xiegu X6100). More information on these options can be found in the [CAT Connection](#) section.

When you select a **Radio CAT** protocol the Mini automatically selects the serial CAT port and assigns the default baud rate specified for that protocol. The baud rate on the Mini and the radio must match. You can change the baud rate on your radio or on the Mini.

Lesson 5 – Changing Bands and Modes

Changing bands and modes are things you do all the time. The Mini brings these controls (and a tuning knob) closer to your operating position. They controls can also be [assigned to function buttons](#) or the blue 5-way switch on the Wio to make it even easier to change them.

To change the band, press the encoder and select the **Band** menu. Scroll to the desired band and click the encoder to select it.

To change the mode, press the encoder and select the **Mode** menu. Scroll to the desired mode and click the encoder to select it. You'll also find several other mode options in this menu, such as toggling the **Transmit Interlock**, and opening the **Meter** or **External Tuner** modes.

The Mini displays the band and mode in blue text boxes just under the frequency display.

NOTE: The Mini uses the same mode designations for every radio and not every mode on every radio is supported.

Lesson 6 – Preparing the Mini for Transmit

The Mini features a **Transmit Interlock** that must be activated before the Mini can key your transmitter. This prevents unintended transmission when you just want to use the Mini's keyer for code practice.

To enable the **Transmit Interlock** simply press the [A] button on the Mini. It's label will change from **Tx Off** to **Tx Enab** with a green background. Sending CW with the paddles changes the label to **Tx CW** with a red background and keying PTT changes it to **Tx PTT** with a red background. Pressing the [A] button again will disable transmit and return it to **Tx Off** with no background color.

NOTE: This mode is persistent through power cycles.

Lesson 7 – Zeroing Digits

One of the advantages to using the Mini to tune your radio is its ability to zero (round off) the frequency sent to the radio. You might want to do this when tuning SSB as it seems most everyone settles on 1 kHz spacing, or tuning broadcast channels.

To use digit zeroing, select the lowest digit using the tuning step adjustment. Just press and hold the encoder then tune it to change the tuning digit. Next, select **Zero Low Digits** in the **Frequency** menu and press the encoder to toggle it **On**. The digits below the tune digits are now zeroed out and will be displayed as small grey 0s on the frequency display.

Lesson 8 – Selecting a VFO

The Mini manages its own VFOs and frequency memories and *always* tunes the A VFO on the radios with dual VFOs (generally single receiver radios). This allows you to use the B VFO on your radio independently from the Mini effectively giving you three VFOs to choose from. On radios with two independent receivers (that generally don't have two VFOs on each receiver), the Mini's VFOs give you back two VFOs per receiver. In this lesson we'll step through the VFO options.

By default the Mini starts with its VFO-A selected. If your radio is set to its B VFO you'll want to switch it to its A VFO so the Mini can control it.

Use the [B] button on the Wio to step through the Mini's main VFO options: **VFO-A**, **VFO-B**, **Split**, and **Memory**. Remember that these options *always use the A VFO on the radio (or the selected receiver on dual receiver radios)*. They do not change the selected VFO on radios with a single receiver, or select the Main/Sub receivers on dual receiver radios.

Although this may seem counterintuitive, it actually has some benefits.

First, this gives you two VFOs on each receiver on radios with dual receivers (or slices on a Flex radio).

Second, on radios with a single receiver and two VFOs, the Mini only controls the radio's A VFO so you can switch the radio to its B VFO and tune it to any band or frequency you like independently from the Mini. This is handy for search & pounce contest operations. The Mini's display will follow the radio's tuning but will return to the Mini's VFO frequency when you switch the radio's VFO back to its A VFO. If you want to stay on the new frequency simply turn the encoder on the Mini slightly. This loads the new frequency into the Mini's VFO-A. Now, when you return the radio to its A VFO the Mini will set the radio's A VFO to the frequency on its B VFO. I suggest that you practice setting various VFO modes to learn how they work.

All of the VFO options are on the [VFO menu](#). One VFO option that isn't very clear is the **A Memory Tuning** option. Each memory location holds the both A and B VFO settings. This option selects whether memory A or B settings are used when **Memory Tuning** is selected on the [B] button. In any other VFO mode, the frequency list will display memories for the selected VFO on the Mini.

NOTE: Long-pressing button [B] toggles the frequency and mode **Lock** on the Mini.

Lesson 9 – Shared Radio Database

As explained in [Lesson 2 – Selecting a Radio Port](#) the Mini can manage up to 16 separate radios. Each **Radio Port** has a database that holds the favorite memory list, keyer settings, and CW message buffers for that port. But what if you want to use these settings with other radio ports? That's where the shared database comes in.

The Mini has a 17th radio port database, called the **Shared Database**. This database can be used by any of the **Radio Ports**. Changes made to the shared database are available to any radio port that is using it and any changes made while it is selected will be available on any other radio port using it. In addition, you can toggle between the normal radio port database and the shared database to increase the number of frequency memories and CW message buffers available for one radio. You can also configure more than one **Radio Port** for a single radio if you really need a lot of frequency memories or CW message buffers.

To select the **Shared Database** for the active **Radio Port** simply go to the **Frequency** menu and scroll down to the **Using [Radio Port] Database** option and press the encoder to toggle it to **Using Shared Database**.

Lesson 10 – Managing Frequency Memories

As mentioned previously the Mini provides 100 memories for the Mini's A and B VFOs for each **Radio Port** in addition to another 100 for the **Shared Radio Database**. This lesson will introduce you to managing these memories on your Mini.

The **Frequency** menu allows you to **Load**, **Save**, and **Rename** the frequency memories.

NOTE: When the Mini is tuned to a frequency in the A or B frequency list, the name of that memory slot appears in a blue text box below the right side of the frequency display.

To load frequency and mode from memory, select **Frequency->Load from Memory** and scroll up or down the list. Press the encoder to load the selected memory. If the Mini's VFO-A is selected memories for VFO-A will be displayed. If the Mini's VFO-B is selected memories for VFO-B will be displayed.

To save the current VFO frequency and mode to memory, select **Frequency->Save to Memory**. The selected VFO will determine which memory (A or B) is updated. Once the save has completed you will be taken to the text editor where you *must* enter a name for this entry. Leaving the name field blank will delete all information in this slot. You can use the **Frequency->Rename Memory** option later to change this name or delete the entry if needed.

To **Delete** a memory slot, select **Frequency->Rename Memory**, select the slot to delete then set the first character of its name to a SPACE. This will delete both the A and B frequencies and modes and clear the name.

NOTE: There is only one name available for each memory slot.

Lesson 11 –Tx Message Buffers

Each **Radio Port** database contains 14 CW transmit buffers that you can use. Each buffer can be a maximum of 75 characters. This lesson teaches you how to select and play a buffer.

To select a Tx message buffer simply press the encoder, select the **Tx Msg** menu, then scroll down to the message you want to send and press the encoder.

If the **Transmit Interlock** is disabled (button [A] on the Home page) the message will play through the sidetone (if it's enabled and the volume is turned up). You can use this mode for code practice or checking your buffers. If the **Transmit Interlock** is enabled the message will transmit over the air.

While the message is playing you can **Stop** or **Pause** it using the [A] and [B] buttons on the Wio. The speed is set by **Keyer->Speed** and the character spacing is set by **Keyer->FarnSpd** (Farnsworth speed).

[Keyer prosigns](#) that are embedded in the message will be converted to their actual text when transmitted by the keyer. For example, embedding the '^' character in your message will send your call sign if it's been saved in **Keyer->Call**. The '#' prosign sends the contest serial number from **Keyer->SN** then automatically increments it, and the '%' prosign sends the contest exchange from **Keyer->Exch**.

NOTE: The #1 message buffer is used as a repeat buffer. The last buffer sent is saved in this buffer so you can replay it if necessary. This comes in handy if you are using the contest keyer function and need to repeat a message without incrementing the contact serial number in the message.

To edit a Tx message press the encoder, select **Edit Tx Msg**, then scroll to any of the available messages and press the encoder. The text editor will open where you can create a new message or edit an existing message.

Hint: You will find it much easier to edit messages using the [Terminal mode](#).

Lesson 12 – Setting up the Keyer

The Mini includes a built-in contest keyer. The keyer is configured in the [Keyer menu](#). You should refer to this section for additional information.

The **Keyer Speed** is a ‘sticky’ window. Once you open it, it will remain open until you close it. Therefore, you can open it during a QSO and leave it open if case you need to quickly change speed. You can also assign it to the [C] button or to one of the function buttons.

If your radio’s protocol supports it, changing the keyer speed on the Mini also changes the radio’s keyer speed. This is handy if you use the [Passthru](#) mode or prefer to connect your paddles to your radio and use its keyer instead.

The **Keyer Type** allows you to select the type of keyer you want to use. If you want to use the Mini’s keyer on your radio be sure to turn the radio’s keyer off. The Mini will key the radio just like a straight key was connected to it.

If you use **Passthru** mode you will need to connect the Mini to your radio’s keyer input using a standard 1/8” (3.5mm) to 1/8” or ¼” (depending on your radio) stereo cable. In this mode you won’t be able to use the PTT options in the Mini since the Mini’s **PTT Output** will be used for the DAH side of the paddle.

If you like to use both a keyer and a straight key at the same time, simply configure the Mini’s keyer to your liking then set the **Keyer->Rmt** setting to **Key** and plug your straight key into the **PTT/K In** jack on the Mini or Mini+. In this mode, pressing the straight key activates the **Key Out** signal on the Mini.

Switching the **Rmt** mode back to **PTT** or **PTT Latch** changes the **PTT/K In** jack back to a remote PTT switch input and closing this switch activates the Mini’s **PTT Out** signal on the Mini.

NOTE: Because of the way the Mini reads the **PTT/K In** signal in **Rmt: Key** mode the function button keypad is not available while this mode is selected. To enable the function button keypad select the **Rmt: PTT** or **Rmt: PTT Latch** mode.

Lesson 13 – Programming the [C] Button

One of the most useful features of the Mini is your ability to customize the [C] button, function buttons, and the blue 5-way switch on the Wio Terminal to fit your operating style. We’ll cover the [C] button programming in this lesson. See the [Programming Function Buttons](#) section for an in-depth look at this extremely useful feature.

The function of the [C] button is user definable and can easily be changed on the fly as your operating requirements change. To program this button simply long-press it (> 1.25 seconds). Once the **[C] Btn** menu opens simply scroll to the desired function and press the encoder to select it. You can also access this menu from the **Config->[C] Btn** menu.

Once the [C] button has been programmed simply press it to execute its function.

Lesson 14 – Programming and Using the Function Buttons

Programmable function buttons are one of the features about the Mini you'll really appreciate. They let you define two functions on each button to streamline your operations and make changing settings that are buried in your radio menus much easier. [Appendix D](#) covers programming the function buttons and the Wio's 5-way switch in great detail. This lesson will cover just the basics you need to know to get started.

Each button and the 5-way switch on the Wio Terminal can have a primary and a secondary (shift) function. The primary function is executed when you press the button. The secondary function is executed after you press the SHIFT function assigned to one of the primary button functions. The default setting for the SHIFT function is function button #5.

To see a help window listing the functions assigned to the primary buttons press and hold the encoder for more than 1.25 seconds. The window will appear for 4 seconds or until you move the encoder.

To see a list of the secondary (shift) functions, press the button assigned to the SHIFT function. This help window will also appear for four seconds. While this window is active, pressing any of the function buttons or the 5-way switch on the Wio will execute its secondary function.

Programming buttons is done through the **Config->Function Btns** menu. When this menu opens the primary functions of the first five function buttons and the four switches on the 5-way switch are shown. Scroll to the **SHIFT FUNCTN>** item then press the encoder to switch to the secondary (shift) button menu.

Select any of the buttons on either menu to define a function for it. The functions are listed on two pages so you need to use the **MORE>** menu item to see the second page, or return to the first page.

The first 13 items on the second page are specific to the selected radio protocol.

NOTE: The function button programming is saved with the selected **Radio Port**. This means that if you change the radio CAT protocol assigned to that **Radio Port**, radio specific functions will probably be mapped incorrectly. Therefore, you should always select the radio CAT protocol before defining function buttons.

Lesson 15 – Meter Mode

In normal operation the Mini displays the S-meter and power meter as small bar graphs on the Home page. The Mini also has the ability to be a remote meter display when you're not using it to control your

radio. In this mode the S, Power, SWR, ALC, and Compression meters will be continually displayed. Which meters are active depends on the CAT protocol and whether the radio is in transmit or receive mode.

To enable [Meter mode](#) simply select it from the [Mode](#) menu. It can also be assigned to the [C] button on the Home page or to a function button for quick access. **Meter** mode is 'sticky' meaning that once you select it, it will remain visible until you press button [C] (Esc) to close it. **Meter** mode is persistent through power cycles.

To temporarily close **Meter** mode so you can control your radio or do other housekeeping chores simply turn the encoder slightly. This will return you to the Home page. Pressing the encoder will open the main menu. After 15 seconds of in activity the Mini will return to **Meter** mode automatically.

The levels on the meters in the Mini may not align with the levels shown on your radio. You can use the **Config->Calibrations** menu to adjust the calibration multipliers for each meter as necessary. These calibrations are saved in the radio port database for this receiver so if you have multiple receivers you'll need to calibrate each one as necessary.

Lesson 16 – External Tuner Mode

This mode is useful if you have an external tuner on your radio and you're tired of the 'change mode, reduce power, key radio, tune tuner, unkey radio, reset power, reset mode' dance.

To enable [External Tuner mode](#) simply select it from the Mode menu. It can also be assigned to the [C] button on the Home page or to a function button for quick access.

Once **External Tuner** mode starts it will automatically set your radio to CW mode and reduce the transmit power to the tune power setting you choose. To adjust the tune power simply turn the encoder.

To key your radio make sure the Tx interlock is enabled (**Tx Enab** on the [A] button) then press the [B] (Key) button. This button latches the Mini's **Key Output** low to key the radio. Press the [B] button again to unkey the radio. You can also disable the Tx interlock on the [A] button, or exit **External Tuner** mode to reset the key latch.

You can also press the **PTT** switch on the function keypad to momentarily key the radio. In this mode, the **PTT** switch also controls the **Key Output** on the Mini. Releasing the **PTT** button unkeys the radio.

When you exit **External Tuner** mode the radio will be returned to its original Tx power and mode.

Lesson 17 – WiFi Configuration

The Mini utilizes WiFi to connect to your local network. This connection is used for connecting to network enabled radios like the Flex and Elecraft K4 radios and it can be used to link two Minis together for SO2R operation and/or connect a Mini to the [CTR2-Mini Antenna Switch Controller](#) in [Link](#) mode.

NOTE: While the Mini ecosystem utilizes CAT5 cable for interconnections, *Ethernet connectivity is not supported*. The RJ45 port on the Mini is strictly used to connect to external [Radio I/O modules](#) and **IS NOT compatible with network switches and routers**.

To connect the Mini to your network open the [WiFi](#) menu and enter the [SSID](#) and [password](#) for your WiFi router. When you select [Connect to WiFi](#) the Mini will connect to your router and receive an [IP station address](#) from it. This address is listed at the bottom of the **WiFi** menu after the connection has been made. Take note of this address as you'll need it if you want to link to another Mini or connect this Mini to the **CTR2-Mini Antenna Switch Controller**.

This menu also has an [Auto Connect](#) option. Turning this option **On** will cause the Mini to try to connect to your WiFi network on power up. This is very handy when you're controlling a network based radio like a Flex or K4.

NOTE: To temporarily disable the **Auto Connect** feature on startup simply hold the encoder down during the boot and initialization process.

Lesson 18 – Link Configuration

As mentioned in Lesson 17 the Mini has the ability to be linked to another Mini and/or to the [CTR2-Mini Antenna Switch Controller \(ASC\)](#). Linking two Minis together gives you the ability to run two separate radios in diversity receiver or SO2R mode. You can also link them to the **ASC** and control it remotely from either Mini. The [Link Menu](#) section explains these options so they won't be covered here.

You can use WiFi or Bluetooth to link two Minis together but *you have to use WiFi* if you want to link to the **ASC** or control a network based radio like a Flex or Elecraft K4. Select WiFi or Bluetooth for the connection type in the **Link** menu.

Regardless of the connection type used to create the link between two Minis you must define one Mini as the **Server** and one as the **Client**. The server is named **Mini-A** and the client is named **Mini-B**.

The **Link** menu also has an [Auto Connect](#) option. Selecting this option with **WiFi** selected as the connection method will automatically enable the [WiFi Auto Connect](#) option.

When linking two Minis you must tell each Mini the [IP address](#) of the other Mini. This allows them to find each other in the network.

When linking to the **ASC** you must tell each Mini its IP address too. **Mini-B** receives **ASC** status updates from **Mini-A** but sends control commands directly to the **ASC**.

Lesson 19 – Using 3rd Party Applications with the Mini

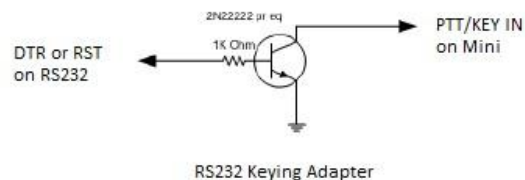
Many hams use 3rd party applications like WSJT-X or logging programs. These programs usually connect to your radio's CAT port to monitor or change the radio's frequency or mode. The Mini works with these programs by providing [Kenwood TS-2000 protocol emulation](#) on the Wio Terminal's USB-C port and acting as a protocol converter to allow both the Mini and the 3rd party application to control the radio.

To use this mode simply connect the Mini to your radio's CAT port as usual. Next, plug the Wio's USB-C port to your PC and note the virtual serial port that's created on your PC for the Wio.

Set your 3rd party application to connect to the Wio's serial port and set the radio CAT protocol to **Kenwood TS-2000**. If the program doesn't see the Mini try setting **DTR HIGH** in the application. That's it! The baud rate on the USB serial port is not important since the Mini's radio CAT port sets the baud rate to the radio. The Mini will translate the TS-2000 commands from the 3rd party application to the CAT protocol the Mini is using to control your radio. This mode also supports keying the radio over the TS-2000 CAT connection using the TX; and RX; commands. Enable **CAT Keying** in your apps to use this function.

If you are using a logging program like N1MM that can output CW you can build a simple keying interface using a single 2N2222 or 2N3904 and a 1K resistor to convert the DTR (pin 4) or RTS (pin 7) on a separate USB serial adapter to convert the normally low RS232 signal to a normally high signal. Plug this interface into the Mini's **PTT/KEY IN** jack and set the **Key->Rmt:** setting to **KEY**.

The [N1MM web site](#) shows this circuit as an example. Connect GND on the RS232 port (pin 5) to the transistor's emitter and the SHIELD of a 1/8" stereo plug. Then connect the 1K ohm resistor to RTS or DTR on the serial port and the collector of the transistor to the TIP of the 1/8" stereo plug.



Lesson 20 – Using Terminal Mode on the Mini

In addition to the [radio emulation](#) described in [Lesson 19](#) the Mini also provides a [terminal interface](#). This interface has several uses however, it cannot be used when the Mini is under control of a third party application since both applications need to use the same serial port.

To use the terminal interface connect the Wio's USB-C port to a USB port on your PC as described in Lesson 19. Next, open a terminal program such as Putty or Tera Term and connect it to the serial port created for the Wio on your PC. Again, baud rate is not important since this is a USB connection.

Once you have started the terminal program, press the [Enter] key on the PC's keyboard to start the Mini's terminal program. A menu describing the terminal options will appear. From here, you have several options.

Keyboard keyer

To use the keyboard keyer simply enter text in the terminal and press [Enter] to start the keyer. The Mini will start keying out the text. You can enter more text while the first text is being sent. To pause the keying press the [Insert] key. Press [Insert] again to continue sending or [End] to

stop sending and clear the buffer. Press [Home] to toggle the [Tx interlock](#) on and off. Press the [Tab] key to bring the terminal menu back up.

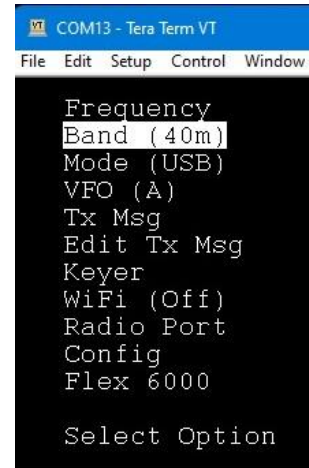
Transmit Buffer F-Keys and Prosigns

The keyboard keyer supports sending all 14 transmit message buffer. F1 to F9 send message buffers 1 to 9 and Shift+F3 to Shift+F7 send buffers 10 to 14. The terminal menu also lists the keyer prosigns that you can embed in transmit message buffers.

Mini Control

The Mini can be completely controlled from the terminal. The cursor control Up/Down keys inc/dec the frequency and the left/right keys move the tuning digit. To open the Mini's menu press [Enter] without entering any test. Once the Mini's menu is open you can navigate it using the cursor control keys to move the cursor and pressing [Enter] to select an item. Press [Esc] to back out of a menu.

This mode is extremely useful if you are first initializing the Mini and need to enter IP addresses and transmit message buffers.



Lesson 21 - Setting the Frequency Range for Range Tuning

Range Tuning was introduced in v1.14.00 firmware. This mode allows you to define a frequency range to stay within while tuning with the Mini's encoder or when using the [Scan](#) function. The tuning range is not enforced when tuning the radio with its tuning knob.

To set a tuning range:

1. If VFO-A mode is not selected, press the [B] button to step to it or select it in the VFO menu
2. Set VFO-A to the *start frequency and desired radio mode*
3. Select VFO-B by pressing the [B] button again
4. Set VFO-B to the *end frequency*
5. [Save these settings](#) to one of the memory slots
6. Once saved, edit the label for this slot. I recommend starting the label with an '*' or other special character to denote this as a tuning range entry. You can rename the memory slot at any time using the [Frequency->Rename/Erase](#) menu

NOTE: Any memory slot that is programmed with the B frequency greater than the A frequency will be used as a tuning range when that memory slot is loaded. If no memory has been selected the tuning range default to the selected band.

To enter **Range Tuning** mode select it from the **VFO** menu or by pressing the [B] button to cycle to this mode. The [B] button label and the frequency digits will be violet in **Range Tuning** mode.

NOTE: When pressing the [B] button **Memory Tuning** appears just before **Range Tuning**. You can use the encoder to select a memory slot in **Memory Tuning** before you proceed to **Range Tuning**.



Range Tune Mode

The selected memory slot and frequency range will be displayed in the options area. In the screenshot to the right we have selected the *40M-QRP* memory slot and the tuning range is 7.05 MHz to 7.06 MHz.

The [C] button toggles **Scan** on and off in this mode. The scan step is determined by the frequency tune digit (the red digit). You can change this at any time by clicking and holding the encoder then turning it to the left or right. Changing the tuning digit will speed up or slow down the scan rate.

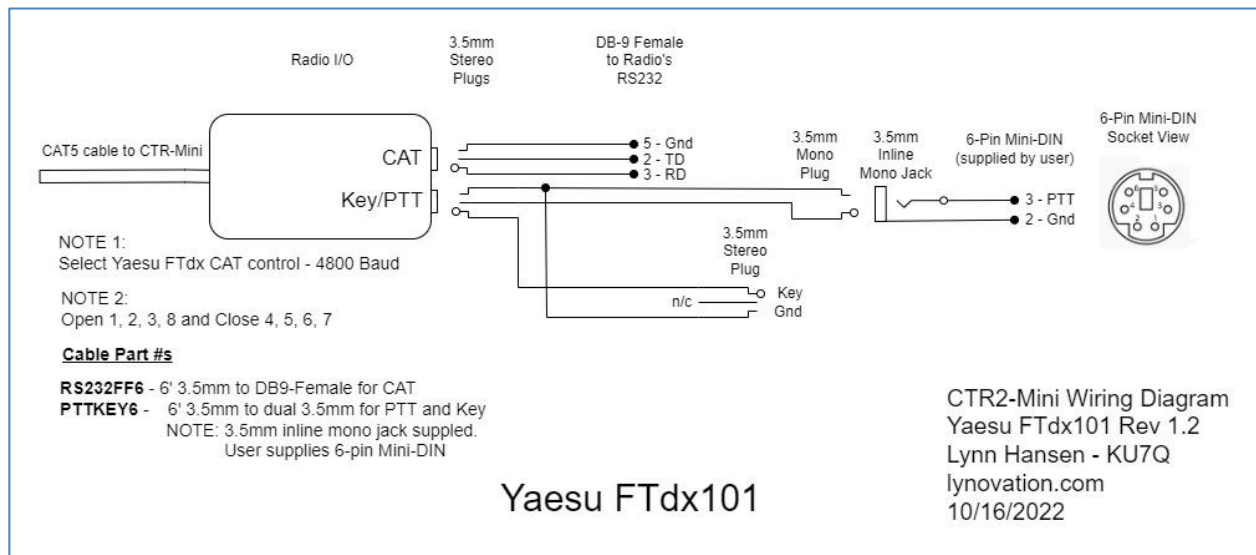
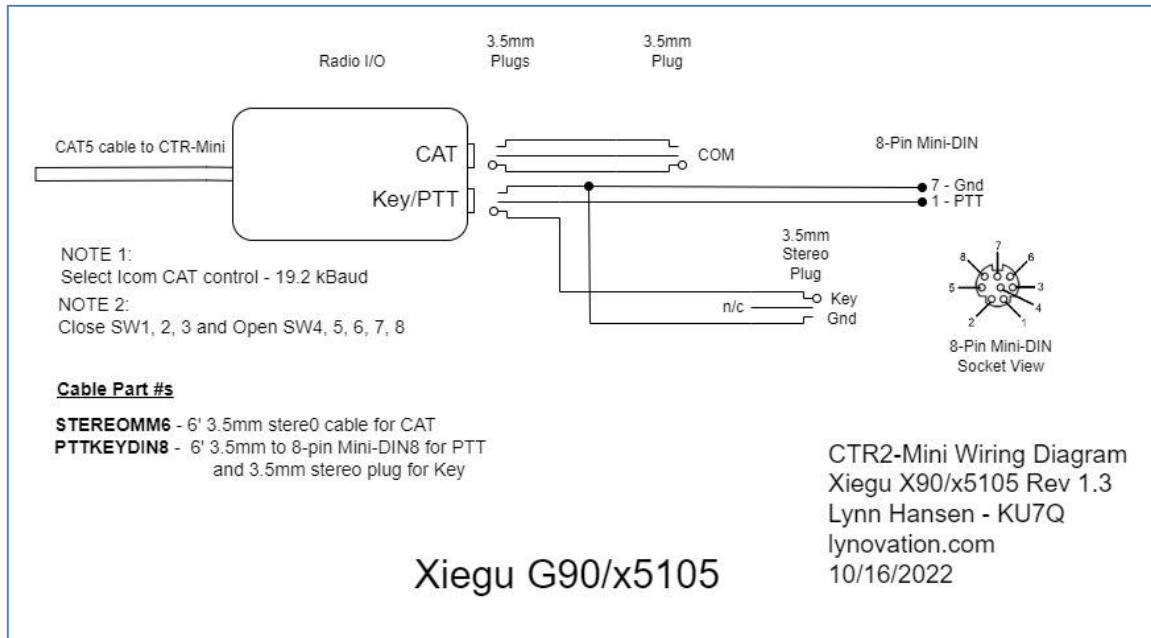
To change the direction of the scan once it has started turn the encoder to the left to scan down and turn it right to scan up the range. In this example the scan is set to scan up the tuning range in 100 Hz steps.

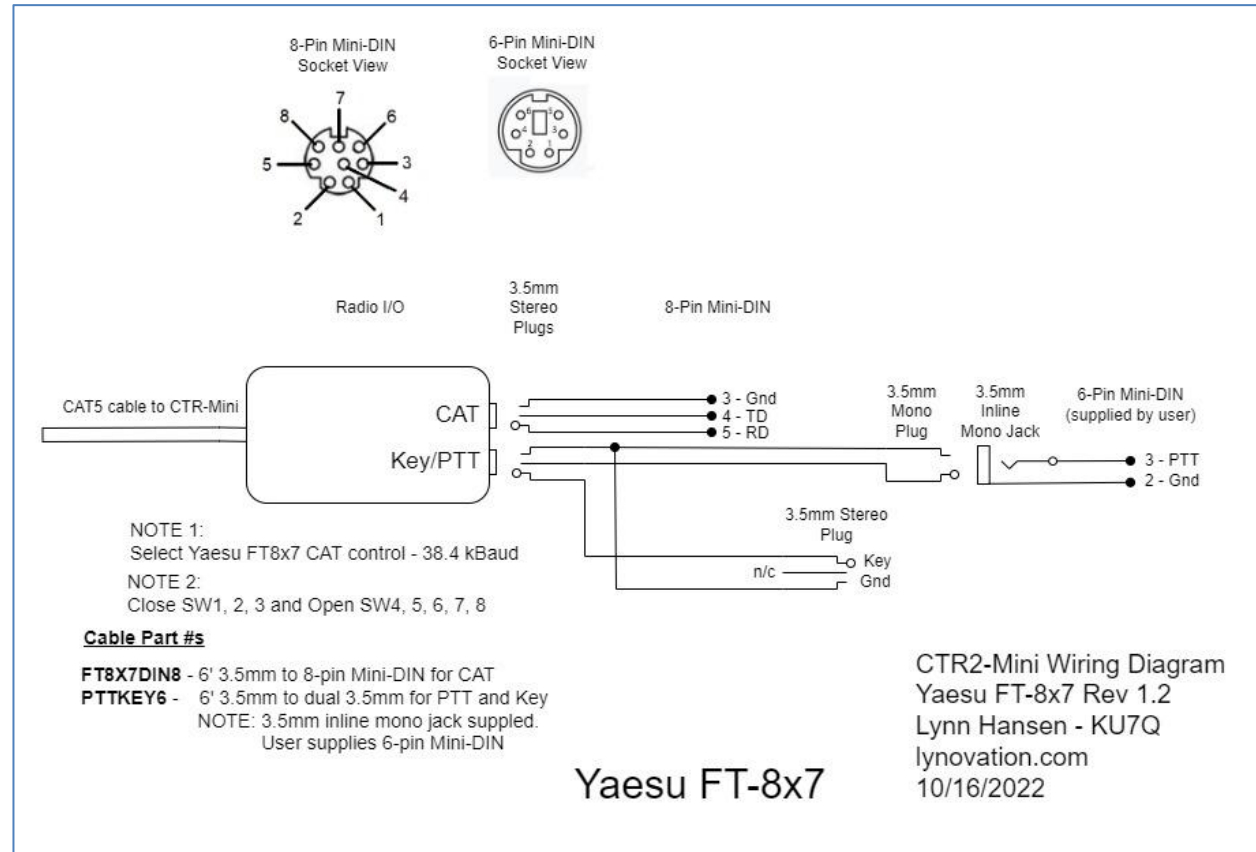
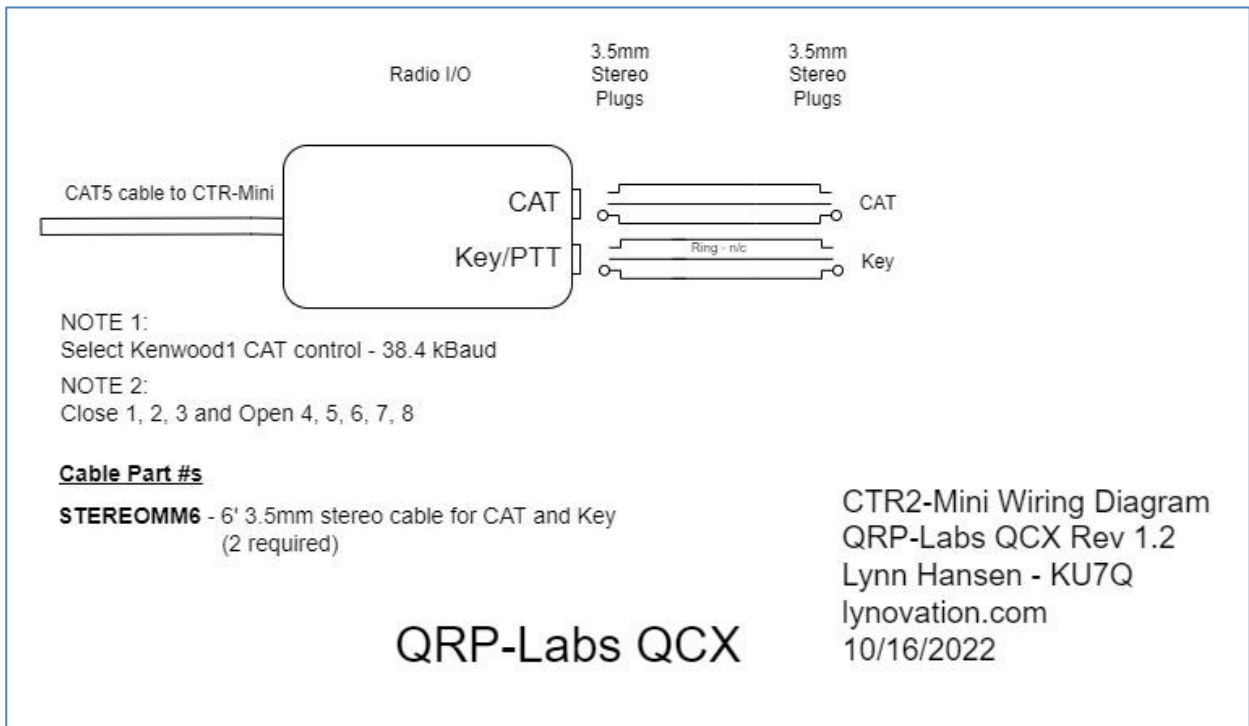
To reset the range to cover the entire band, [select an open memory slot](#).

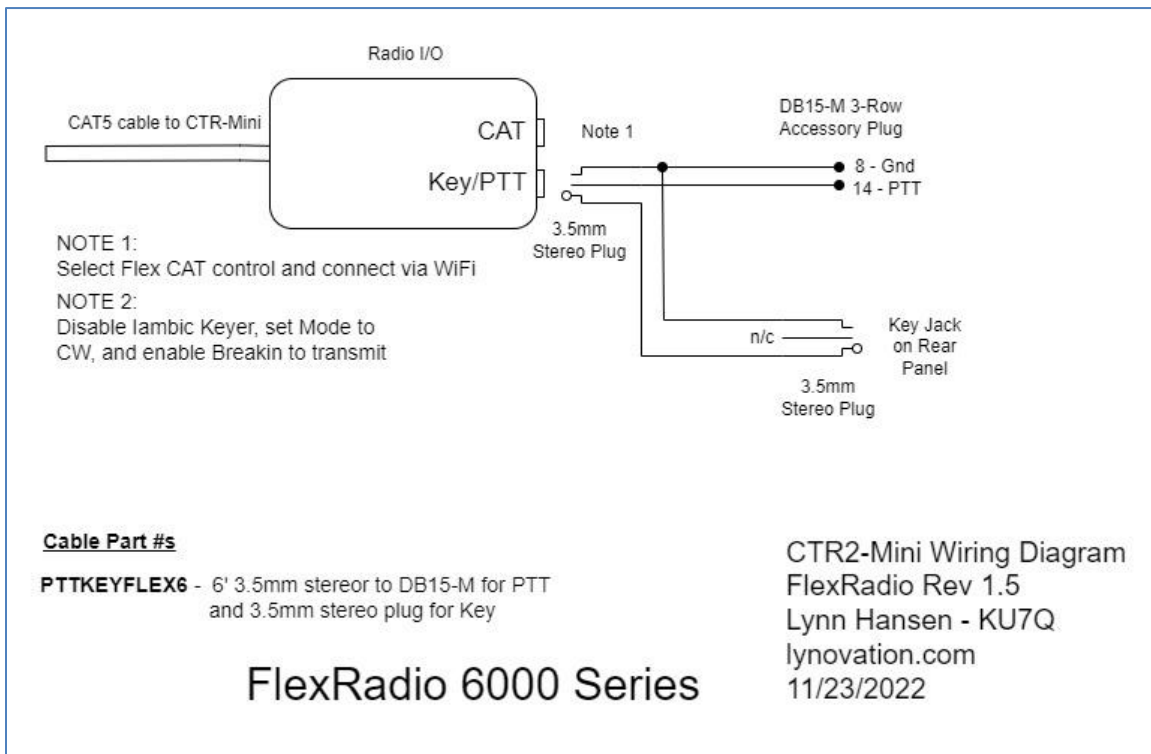
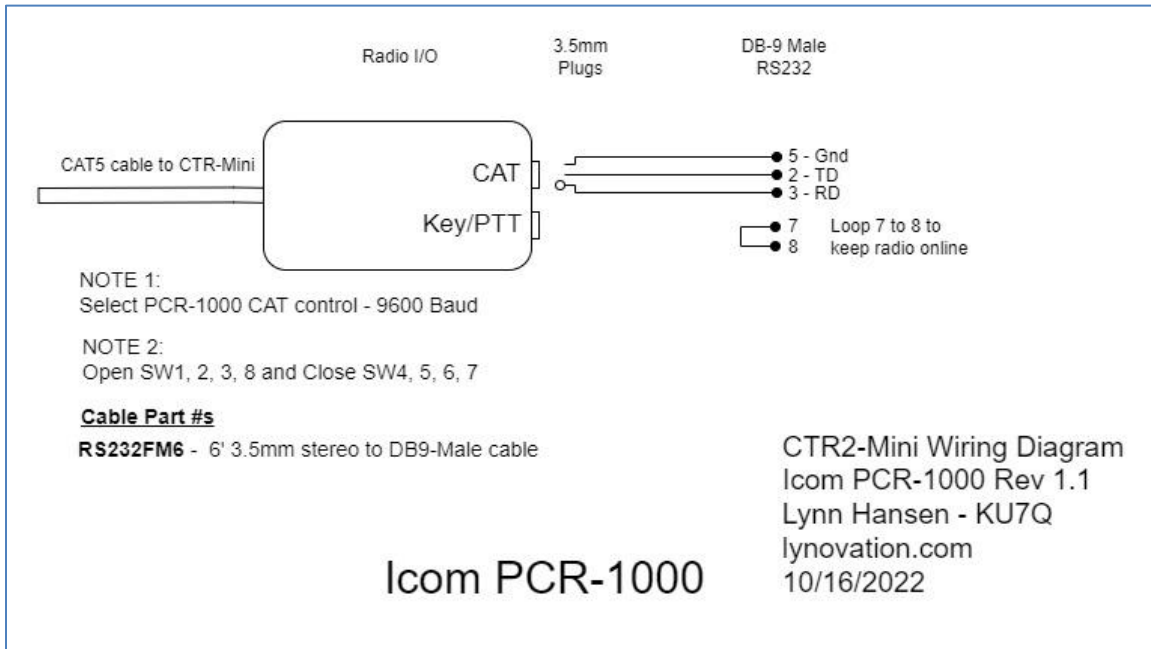
Appendix B – Radio Wiring Diagrams

This section contains the wiring diagrams you'll need to connect the *Radio I/O* module to your radio. Many of them are simple mono or stereo 1/8" (3.5mm) to 1/8" cables. Others require a custom connector to be added to a factory built stereo to mono adapter such as a DB9, or a 6 or 8-pin mini-DIN. None of them are difficult to build. These can be found on the [Radio Interface Cable](#) page on my blog.

I can supply pre-built cables for your radios. The drawings below have cable part #s. Use these part #s on the [CTR2-Mini Order Form](#) to order the cables you need.





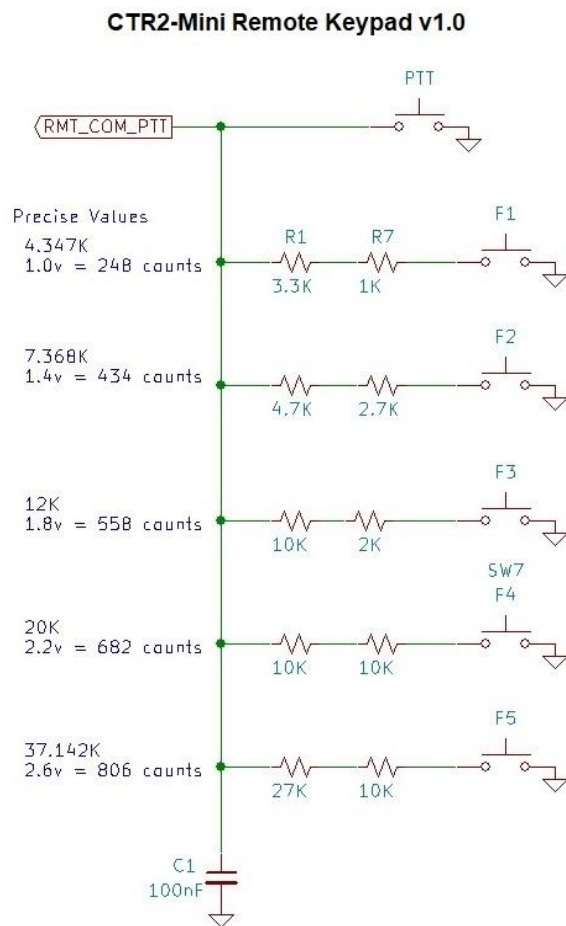


Appendix C – Function Button Keypad

The *Function Button Keypad* is a simple device to build for your Mini. It's basically a string of pushbuttons connected to the [Remote PTT](#) input of the Mini. As each pushbutton is pressed it presents a different resistance to ground. This generates a different voltage for each button that the Mini uses to identify which button is pressed.

The schematic of the keypad is shown here. Resistors don't have to be high precision or 'right on the money' values. Anything within 500 ohms will do. The Mini's [Config->Function Buttons->Recalibrate Buttons](#) function can be used to calibrate the Mini for the resistors you used.

NOTE: The new Mini+ and the [CTR2-Mini SO2R Controller](#) have this keypad built in.

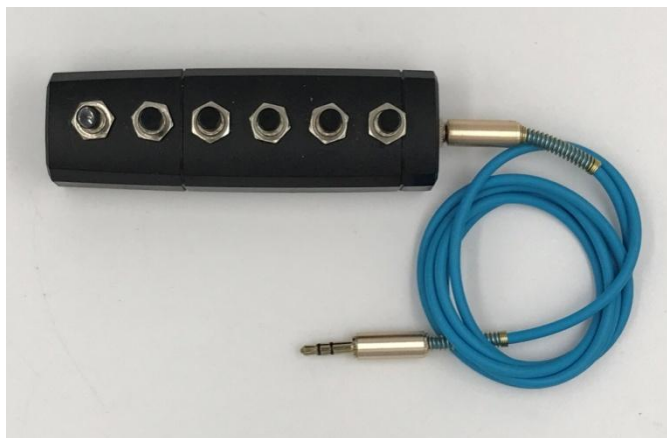


Wire RMT_COM_PTT to TIP and Ground to SHIELD on a 3.5mm phone plug using shielded cable. Plug this cable into the Remote PTT jack on CTR2-Mini.

Here are a couple of photos of the keypad I built. You can use any housing you want.



Figure 27



I also offer an external keypad PCB kit on my web site. It uses inexpensive tactile buttons and fits in a Hammond 1551 case (same as the Radio I/O module). A photo of this PCB and the finished unit is shown below.

The buttons are laid out such that you don't need labels on them. Buttons 1 through 4 are on the left, 5 is in the center, and 6 (PTT) is on the bottom right.



Appendix D – Programming Function Buttons

Programming the function buttons is not difficult, but unfortunately with the small display and limited navigation options on the Mini, it can be overwhelming at first considering there are a total of 18 buttons that can be programmed and 36 functions to choose from for each button!

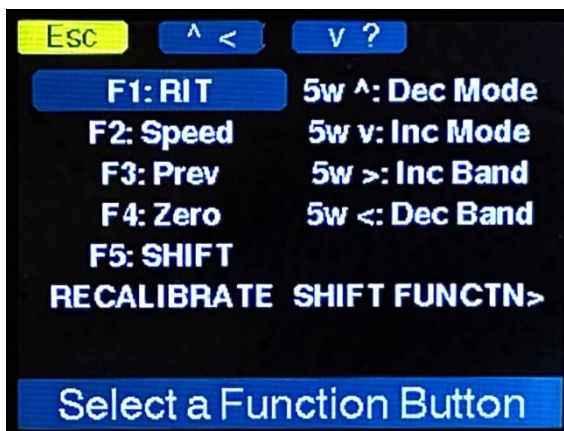
To access all of the available function buttons on the original Mini you'll need to add the remote keypad described in [Appendix C](#) above. Without the function keypad only the switches on the blue 5-way switch on the Wio Terminal can be programmed. The function keypad is built into the Mini+.

As shipped, the blue 5-way switch is programmed such that the up and down buttons change the radio's mode and the left and right buttons change the band. To simplify this discussion the keypad buttons and 5-way switches will be referred to as buttons.

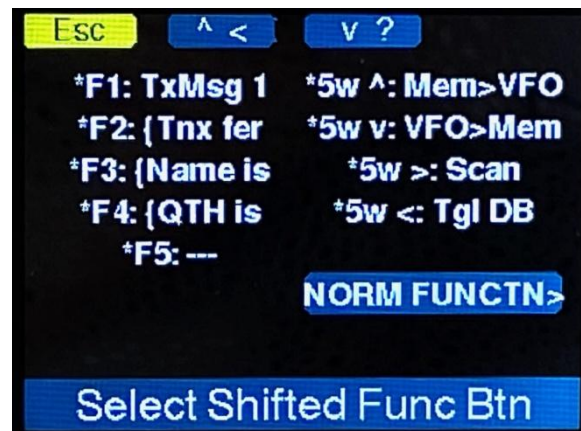
There are a total of 9 buttons that you can program, five on the keypad and four on the 5-way switch. The center switch on the 5-way switch is not used as it is too easy to press it when you're trying to press one of the parameter switches. Each button has a *primary* and a *secondary* function giving you a total of 18 programmable buttons.

To edit the function buttons, select the [Config->Function Btns](#) menu.

The nine buttons and their *primary* functions are shown on page 1 of the **Function Btns** menu along with the [RECALIBRATE](#) option. To access the *secondary* function menu, turn the encoder to select **SHIFT FUNCTN>** then click it.



Function Button Menu – Normal Functions



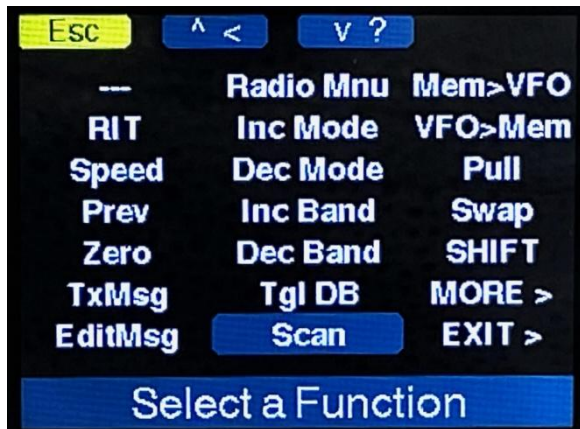
Function Button Menu – Shifted Functions

Button captions for the *secondary*, or *shifted*, functions are preceded with a '+' on **Function Btns** menu Page 2. To return to the *primary* function menu, select **NORM FUNCTN>**. To exit the **Functions Btn** menu, click and hold the **Ok** ([A]) button until it turns to **Esc** or press and hold the encoder and turn it to the left. The menu automatically times out after 7 seconds of inactivity.

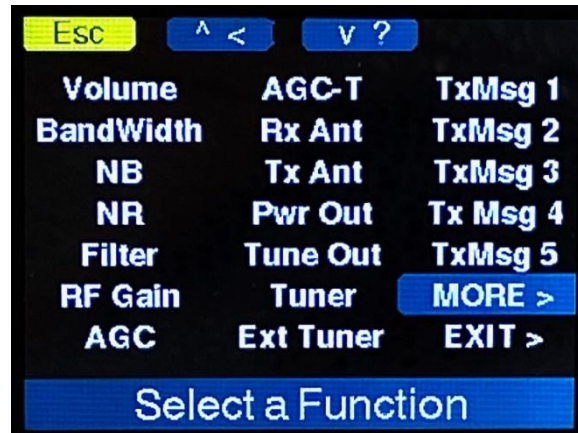
NOTE: A partial copy of the selected Tx Msg buffer, preceded by the character {, is displayed next to a button label instead of the Tx Msg # on buttons programmed to send Tx Message buffers.

To program a button select the normal or shifted page then select the desired button.

The **Function** menu will appear with the currently selected function highlighted. Scroll to a new function and short-press the encoder to accept the new function. There are two pages of functions. To switch between the two pages select **MORE>** on the menu. To return to the **Function Button** menu select **EXIT>**.



Function Menu – Page 1



Function Menu – Page 2

The first 13 options on **Function Menu Page 2** are used for expanded radio commands. Currently Flex, PCR1000, Elecraft, Icom, Kenwood, Yaesu FTdx, and Xiegu radio CAT profiles support expanded commands. Each radio has different functionality and therefore different **Function** options on this menu page based on its CAT protocol. **Function Menu Page 2** above shows the expanded commands for the Flex radio CAT.

The second page also contains the first eight of the 14 Tx Msg buffers. When you highlight a Tx Msg buffer the message in that buffer will be displayed on the status bar at the bottom of the menu. If the buffer has been programmed with text the first seven characters of the message preceded with a { will appear in the **Function Btns** menu when this Tx Msg has been selected for a button.

After you select a function you will be returned to the **Function Btns** menu where you can verify the change and select another button to program. Selecting *Exit...* or *long-pressing the encoder* will return you to the main menu.

Using Function Buttons

Primary function buttons are always available. To activate one simply press and release one of the buttons.

To view a window showing the *primary* button functions, **long-press** the encoder in the **Home** page.

The blue circle represents the 5-way switch and it's programmed primary functions.

In this example, button F5 has been programmed as the **SHIFT** button.

Accessing Secondary Functions

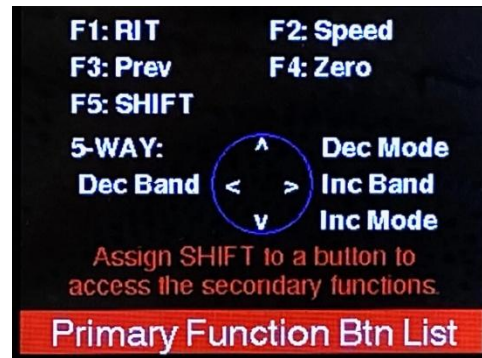
There are two ways to access the secondary functions of the function keys.

1. Press the blue 5-way switch on the Wio while in the Home page
2. Program one of the *primary* buttons to the **SHIFT** function. This function is available on **Page 1** of the **Function Btns** menu.

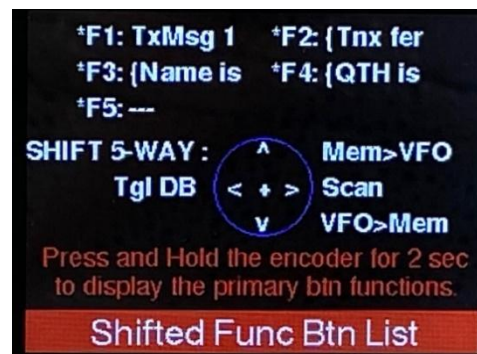
When the *secondary* functions are enabled the help window opens showing their *secondary* or *shifted* button functions. The **SHIFT** function will be active for about 7 seconds. You must press one of the buttons while this help screen is visible in order to activate that function.

Function Button Lockout

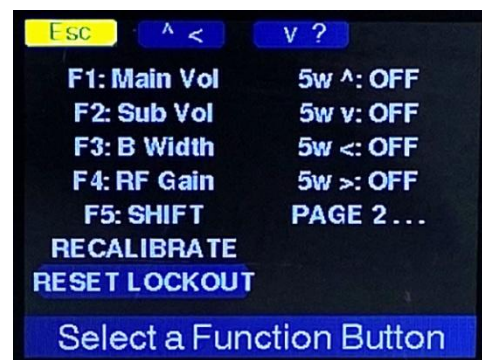
If you hold a function button down longer than 10 seconds the program will detect this as a function button failure and set a **Function Btn Lockout**, disabling further use of the function buttons. To reset the lockout open the [Config->Function Btns](#) menu and use the **RESET LOCKOUT** option to reset the detector.



Primary Function Button Help



Secondary Function Button Help



Resetting the Function Button Lockout

Appendix E – Updating the Mini's Firmware

The Mini's firmware is always (it seems) in development. New features are constantly requested or dreamt up by me. In my working years we called this *feature creep*, and that was bad on multi-million dollar projects. Now that I'm retired, *creeping the features* is fun 😊.

Fortunately, it's extremely easy for the user to update the Mini's firmware. Here are the steps to follow:

1. Go to <https://ctr2.lynovation.com/download-mini-firmware> and download the latest firmware.
2. Connect the Wio Terminal to your PC. This can be a Windows, Linux, or Mac PC.
3. Quickly double-click the power button (pushing it down past the 'On' position twice) on the Wio to put it into programming mode.
4. Your PC's file browser should open with the **Arduino** folder selected. If not, navigate to it. It will be with your removable drives. This is the Wio Terminal in USB drive mode.
5. Open the file you downloaded above (**CTR2-Mini_v10xxxx.zip**) and copy and paste the **CURRENT.UF2** file in it into the **Arduino** folder, replacing the original **CURRENT.UF2** file.
6. That's it! The Wio Terminal will reboot and you'll be running the latest Mini firmware.

Appendix F – Updating the Wio Terminal's eRPC Firmware

A brand new Wio Terminal must be updated before it can be used with the CTR2-Mini firmware. This is because the Wio Terminal ships with outdated firmware for the RTL8720 chip that manages the WiFi stack and it doesn't support Bluetooth LE. I used both modes in the Mini so it must have the updated RTL8720 firmware to operate. **Fully assembled and tested Minis have this update applied.**

To install the eRPC firmware update, just follow the steps on this new [Seeed Studio page](#). They have greatly simplified the process of updating the eRPC firmware and they have examples for both Windows and Apple OS.

You will need to install GIT on your computer for Seeed's installation instructions to work. You can get the Windows version of GIT [here](#). Other versions are available for Apple and Linux.

NOTE: Once you install the updated eRPC firmware you'll need to double-click the power switch and then load the Mini's firmware using the instructions in Appendix E.

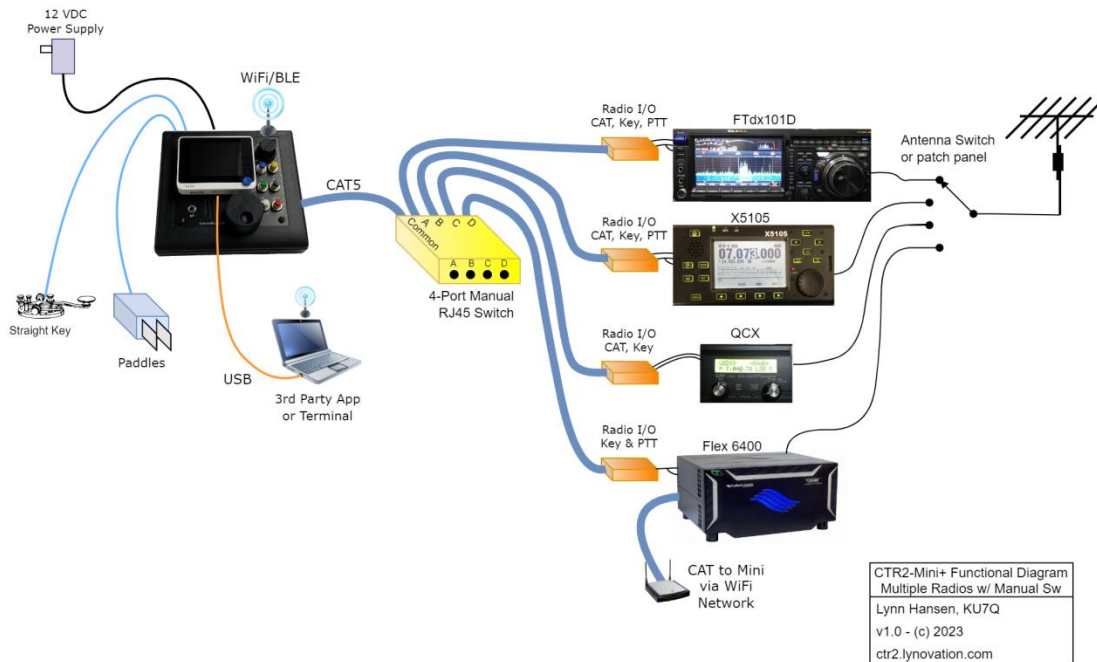
NOTE: The eRPC update only needs to be done once. Do this procedure before you copy the CTR2-Mini firmware to your Wio Terminal for the first time.

Appendix G – System Configurations

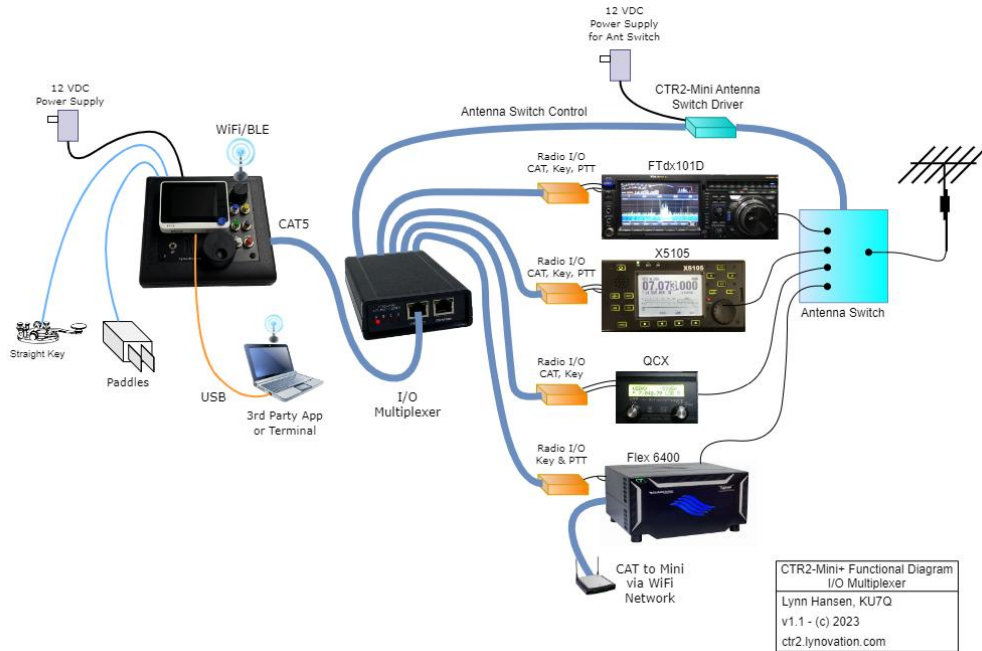
The following diagrams show the various system configurations with the CTR2-Mini ecosystem. Choose the configuration that works for your station today and expand it with easy to build modules in the future.



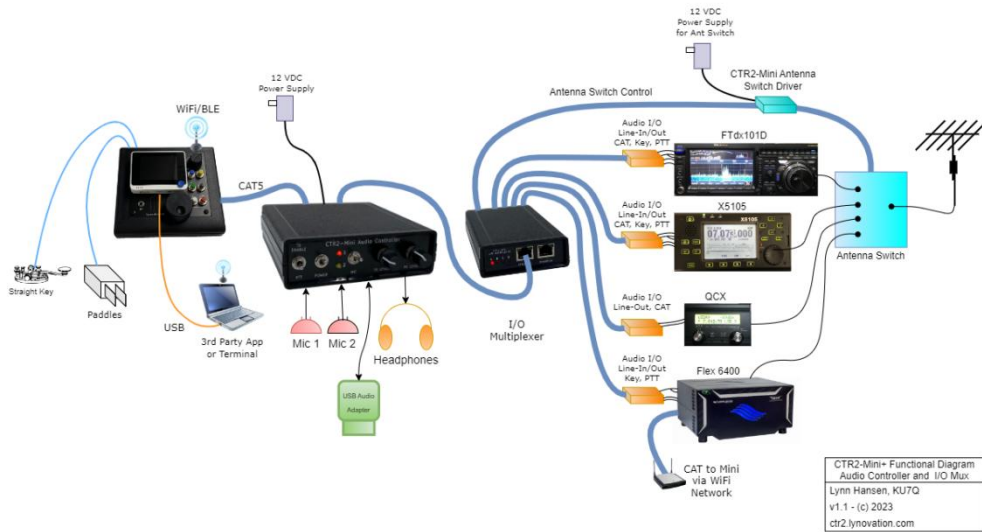
Mini+ controlling one radio



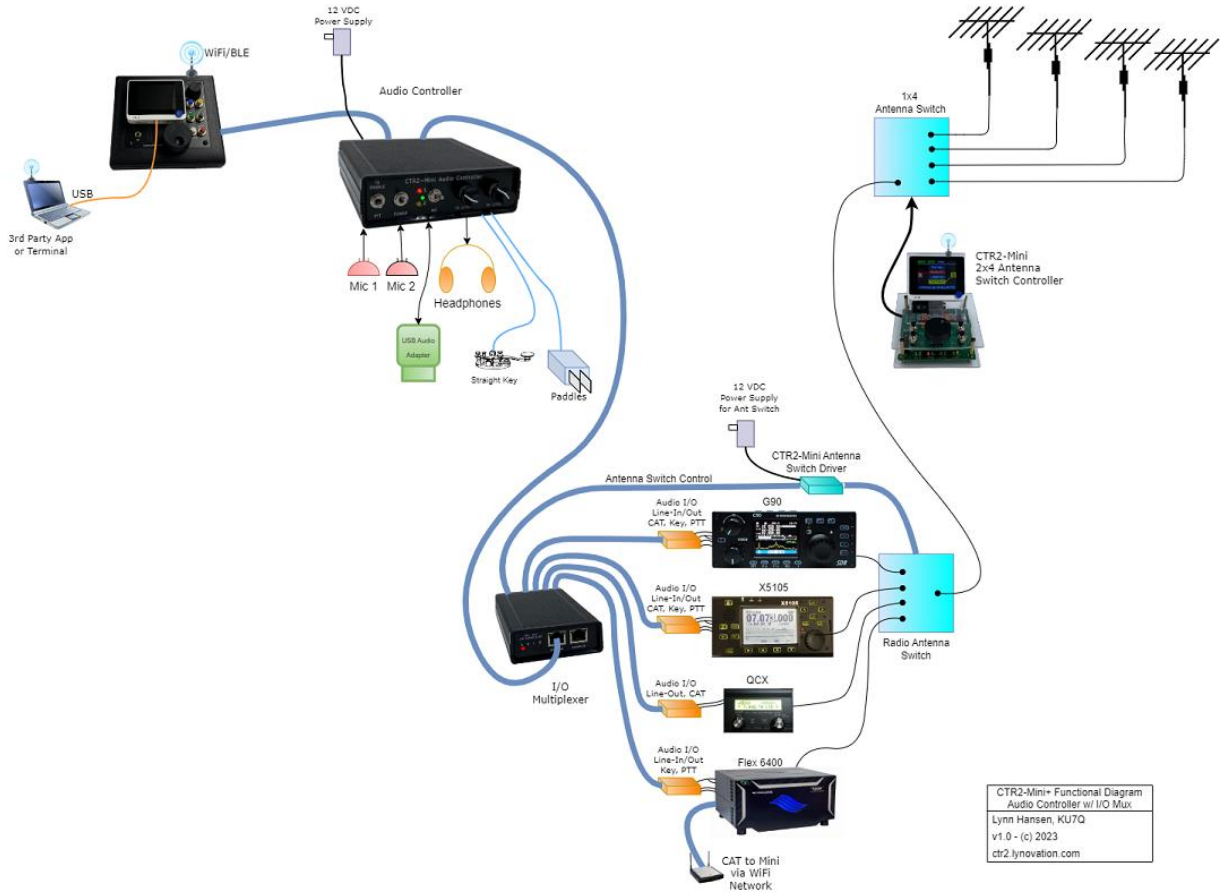
Mini+ controlling multiple radios with RJ45 switch



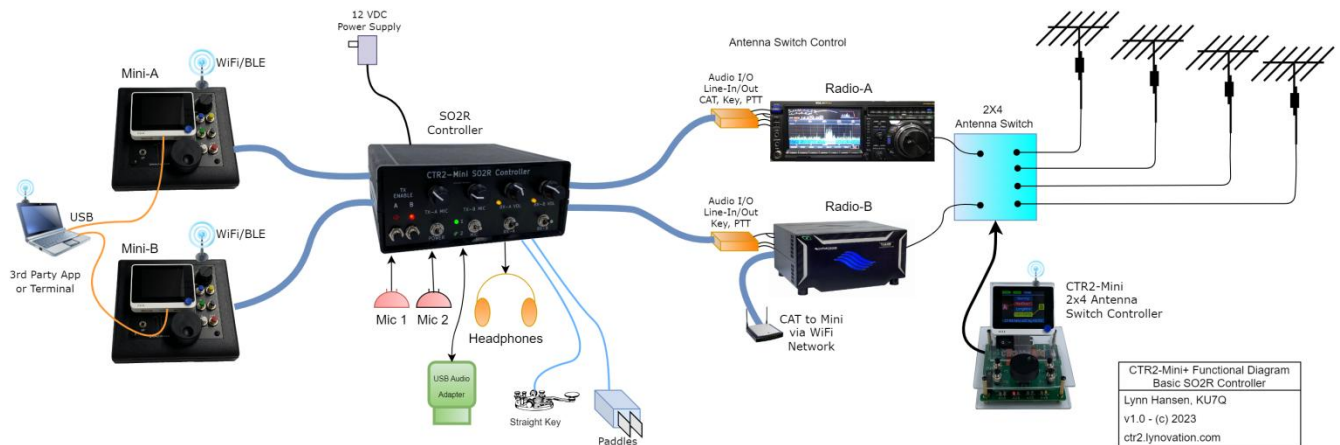
Mini+ controlling multiple radios and antenna switch with [CTR2-Mini I/O Multiplexer](#)



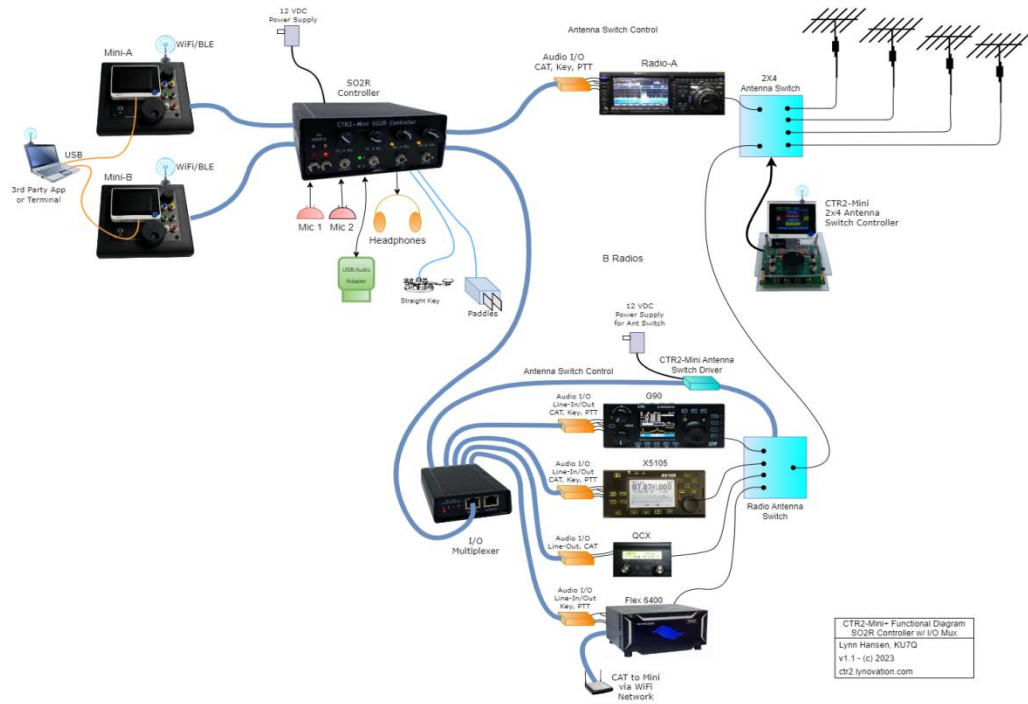
Mini+ with CTR2-Mini Audio Controller



Mini+ with CTR2-Mini Audio Controller, I/O Mux, and Multiple Antennas



Two Mini+ units and the CTR2-Mini SO2R Controller in SO2R mode



SO2R mode with multiple radios on the Mini-B port

Appendix H – Modification for Improved RS-232 CAT Control

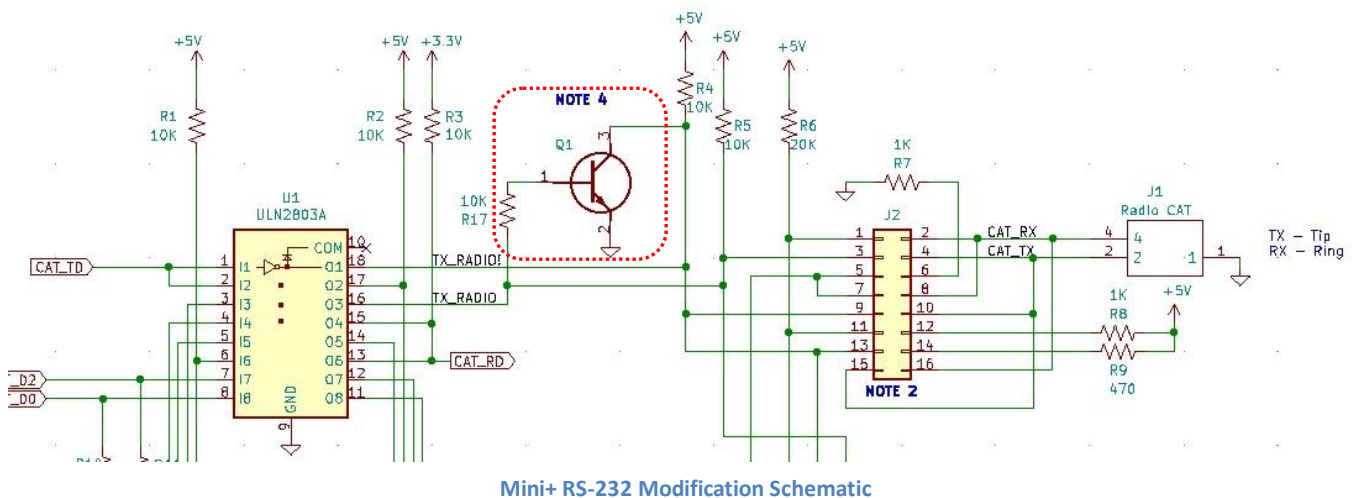
A Mini user with an Elecraft KX3 reported that he was unable to control his KX3 with the Mini. We worked on the problem for several weeks to no avail. He finally sent me his KX3 so I had the radio to test with.

I found that the KX3 is very sensitive to the voltage level on its RS-232 Rx Data line. The RS-232 specification defines the minimum voltages for MARK and SPACE levels. Since RS-232 is a bi-polar signal the spec defines any voltage under -3 volts as a MARK and any voltage over +3 volts as a SPACE. The gray area between allows for noise and DC bias developed on long transmission lines.

The Mini uses uni-polar inverted TTL levels and outputs +.55 volts in the MARK and +4.8 volts in the SPACE state. The MARK voltage is a little high for TTL (but within spec) because of the ULN2803A Darlington driver I used in the Mini.

While testing the KX3 I found that it detects a SPACE at around .3 volts. In fact it works quite well with a 0 volt MARK and a .5 volt SPACE! Clearly, the voltages the Mini generates won't work on this radio.

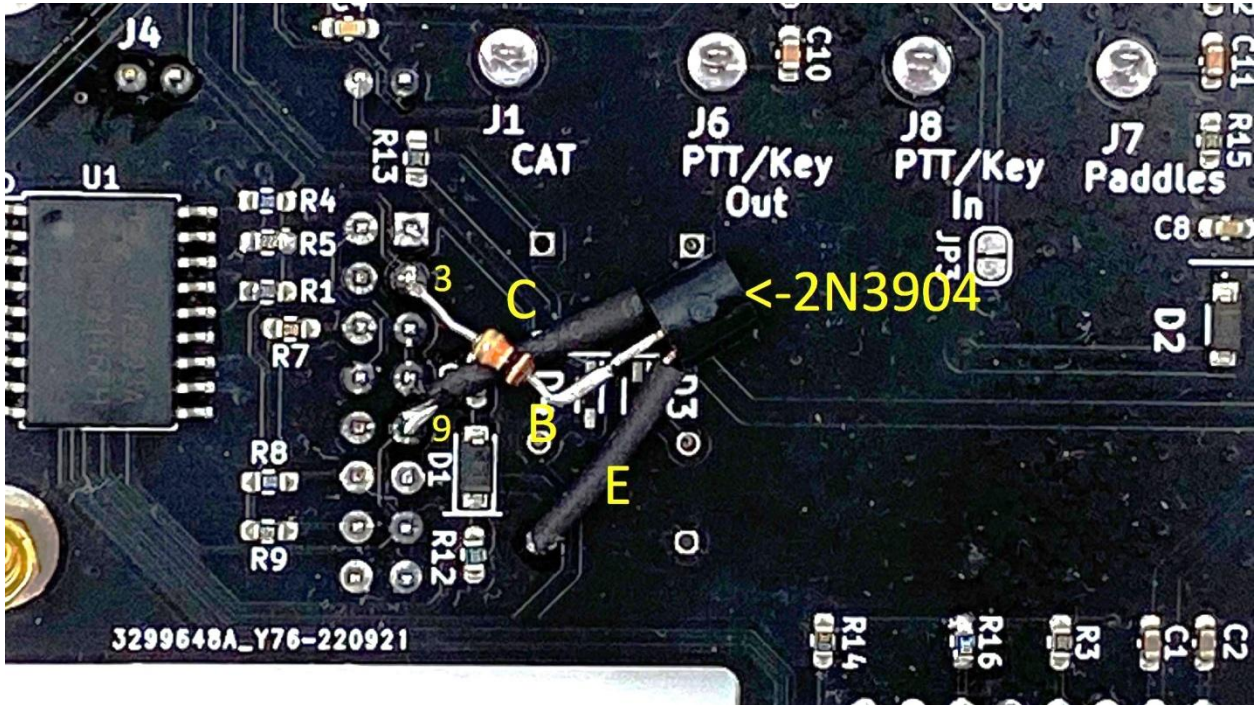
To solve the problem on existing Mini and Mini+ units manufactured before March 2023 I added Q1, a 2N3904 in parallel across the TX_RADIO! inverted output as shown in the Mini+ schematic below. This transistor is driven from the non-inverted TX_RADIO signal through a 10K ohm resistor. This transistor shunts the inverted output to .1 VDC when the non-inverted output is HIGH and the KX3 works.



NOTE: This modification is only required if your Mini doesn't work with a radio with an RS232 CAT port.

To modify your Mini+ just remove the base board from the Mini+ then add a 2N3904 (or 2N2222) to the bottom of the board. Solder the Collector to pin 9 of J2 (the jumper header) and insert the Emitter into the pin 4 hole of K2 (K2's bottom hole). Solder a 10K ohm resistor to the base of the transistor and solder the other end to pin 3 of J2. Modifying the original Mini is more difficult. Contact me if you need to modify an original Mini.

A photo of a modified Mini+ board is shown below. Use heat-shrink tubing on the leads to prevent shorts and always remove the power from the Mini before you open it up.



Mini + RS-232 Modification

After further research I found the Toshiba TBD62083A IC. It's a nearly direct replacement for the ULN2803A (U1 above) with the same output rating, 50 volts at 500 milliamps. It uses a DMOS MOSFET instead of a Darlington pair so it will inherently have lower output voltage and will solve this problem completely. All new Mini+ units manufactured after March 2023 will use this IC instead of the ULN2803A. If you have a hot-air workstation I recommend replacing U1 in your Mini or Mini+ if you experience any I/O problems.

Appendix I – Previous Version Changes

Changes made to the latest version that are highlighted in yellow in this manual are described in [Version Changes](#) at the start of this manual. When this manual is updated that information will be moved to this section.

v1.13.00 to v1.13.08 Changes

The following changes have been made to CTR2-Mini firmware v1.13.03 and to this manual.

1. I added the [Mini 101 – Basic Training](#) section as Appendix A. This section contains mini lessons that help you learn the Mini’s user interface.
2. The [A] button in all menus is now [Esc] instead of [Ok]. Short-press returns you to the calling menu. Long-press returns you to the Home page. Use the encoder to select items on the menus.
3. Standardized the FTdx, Elecraft, and Icom **Radio** menus so they look and act the same.
4. A new menu has been added to support the [Xiegu radio CAT protocol](#). Although the Xiegu radios are based on the Icom protocol, there are enough variances to justify a separate protocol implementation.
5. The [expanded Radio menu](#) is hidden until the radio responds to polling and has been made ‘sticky’ (i.e. it remains open until you press [Esc] or long-press the encoder. It also updates every 3 seconds.
6. **Tx Enable** is now ‘sticky’ through power cycles. Once enabled it stays enabled until you disable it
7. Fixed the RIT implementation to work the way the radio handles RIT. Previously it was turned off if you changed Tx frequency. It now stays on until you specifically turn it off (by setting it to 0).
8. Added a new [Calibration](#) menu to the **Config** menu. This menu allows you calibrate the Mini’s meter indications to your radio’s meters. The Encoder resolution has also been moved to the **Calibration** menu.

v1.13.01 Changes

9. Fixed several issues with Mini VFO management and FTdx NB/NR controls, and DIG-H mode decoding bug in FTdx.
10. Additional work on the Elecraft protocol. Still a work in progress but it is working!
11. Mini now respects the radio’s frequency and mode when connecting
12. --- is displayed for the **Mode** when the user selects a mode on the radio that the Mini doesn’t support. Previously unsupported modes defaulted to **USB** and the Mini would overwrite the user’s selection on the radio.
13. The Icom, Elecraft, and Yaesu FTdx menus have been reworked to add additional space for future commands.
NOTE: Because of this menu rearrangement you will need to remap the function keys for these radios.
14. A new **PTT: Hw/CAT** has been added to Icom, Elecraft, and FTdx menus. This option allows you to choose between hardwired (hardware) control or CAT control. Using CAT control eliminates the need to wire a special PTT cable from the Mini to your radio.
15. The Mini no longer rounds of the frequency when you tune the radio with [Zero Low Digits](#) turned on. Only tuning with the Mini zeros the digits below the tune digit in this mode.
16. Debugged [Split Mode](#). It now works but does not support CW modes.

17. Debugged Morse entry in text editor
18. Debugged Function Button mapping issues created in v1.13.01.
v1.13.02 Change
19. Removed check for rPC firmware version. This was locking up some Wio Terminals.
v1.13.03 Change
20. Fixed a bug that was blocking normal keying while in Meter or External Tuner mode.
v1.13.04 Changes
21. Fixed a bug in Icom that was causing the radio to go into Split mode and added a [Speech Compression](#) control to Elecraft.
v1.13.05 Changes
22. Cleaned up [Link code](#) to allow switching modes without disconnecting WiFi or BLE
23. Fixed the [Function Button Recalibration](#) code to work with new Audio and SO2R controllers. They change the loading on the ADC and require different calibration values.
NOTE: You must recalibrate function buttons when adding the Audio Controller or SO2R Controller to your station.
24. Added code to create a backup of the INIT.TXT (initialization) file. This prevents losing this file if you power down the Mini while it is updating this file.
25. Added a new [Prev Freq/Mode](#) menu to the **Frequency** menu. Previously this option just stepped you back to the last frequency the radio was tuned to. It now presents a menu with the last 13 frequencies and modes you've visited.
26. Added the ability to select the mode used in [External Tuner mode](#). Press and turn the encoder to change the mode. You can select from CW, AM, and FM.
v1.13.06 Changes
27. Added an SWR graph to the [External Tuner mode](#) and allow the user to select any mode in this mode. Note that only CW, AM, and FMn produce a carrier.
28. Fixed scaling issues in Icom and Xiegu meters. Some Xiegu radios return little-endian values
29. Fixed meter issue on Flex – the latest SmartSDR firmware added additional info to meter updates.
30. [Zero Low Digits](#) is now momentary. Selecting it just zeros out the digits below the frequency step digit. Also fixed rounding error so main frequency doesn't change now.
31. Added [variable frequency control to keyer sidetone](#). Range is 120 to 1200 Hz. Set to 0 to disable sidetone.
32. Allow transmitter ([Tx Enab](#)) to be enabled in [CW Practice](#) mode to allow for on-air practice sessions
v1.13.07 Changes
33. Updated the Elecraft protocol to better support the K2, KX2, K3, and KX3
34. Added [Appendix H](#) to document a modification to the Mini+ CAT port so it works with the Elecraft KX3's RS-232 CAT port.
v1.13.08 Changes
35. Fixed folder initialization issues on new install.

v1.12.00 to v1.12.01 Changes

The following changes have been added to CTR2-Mini firmware v1.12.00/01 and to this manual:

1. The [Elecraft protocol](#) has been added to the Mini.
 - a) This protocol gives you control over the Main and Sub receivers
 - b) It has been tested on the K4 but will need tweaking as problems arise
 - c) WiFi CAT connection supported
 - 2) Added the following controls to the FTdx menu:
 - a) [MAIN RX / SUB RX](#) allows you to select the active receiver. Once a receiver is activated the controls on this menu update to show that receiver's status and control that receiver.
 - b) [Bandwidth](#) allows you to change the receiver's bandwidth filter.
 - c) [Scope](#) allows you to adjust the selected receiver's panadapter's reference level
 - d) [AGC, Noise Blanker, Noise Reduction, and Auto Notch](#) filter controls
 - 3) The WiFi antenna icon now shows RSSI by the number of bars displayed. 4 bars = >-55 dBm. 3 bars = between -55 and -65 dBm. 2 bars = between -65 dBm and -75 dBm. 1 bar = less than -75 dBm. 1 bar will probably be an intermittent connection.
 - 4) When connecting to a radio using the network the WiFi antenna icon will be yellow while the connection is initializing and turns green once the radio is responding to polls.
 - 5) A new text box has been added on the options line (the line above the bottom status line). This box shows the GUI/no-GUI status of a Flex radio connection, or the Main/Sub receiver selected for dual receiver radios such as the Elecraft and FTdx101 radios.
 - 6) Fixed several Flex parsing bugs that were introduced in v1.11.00. Tx settings were not being parsed properly. Also fixed the behavior of the External Tuner mode when used with the Flex.
 - 7) Removed the dual-VFO control option for the FTdx101. This was too complicated, took too many resources, and nobody was using it, even me!
 - 8) Removed the Yaesu FT-757, FT-890, and FT-1000. These were taking up valuable resources and not used by anyone that I know of. I left the FT-100 and FT8x7 protocols because the Mini is great to use with these radios and their tiny displays.
 - 9) **v1.12.01** was released on December 19, 2022 and includes a few stability improvements for the Flex protocol
-

v1.11.00 Changes

The following changes have been added to CTR2-Mini firmware v1.11.00 and to this manual:

1. Renamed the **Config->Radio Baud** menu to [Config->CAT Connection](#) and added the following options
 - a. **Radio's IP Address** allows you to set the IP address for a radio with network support such as the Flex or for any radio with its CAT port connected to a [Serial Terminal Server](#)
 - b. **TCP Port #** allows you to define the TCP port used by the radio or Serial Terminal Server
 - c. **Reset IP** allows you to reset the TCP and UDP connections without disconnecting WiFi
 - d. The **Reset IP** option has also been added to the **WiFi** menu
2. Refinement to the Flex radio protocol
 - a. The [mini-panadapter](#) has been refined so it's faster and shades the receive bandwidth
 - b. 10 kHz bandwidth has been added to the mini-panadapter
 - c. A new GUI/Non-GUI menu option lets you decide if you want to connect to an existing GUI (i.e. SmartSDR) as a non-GUI client or connect as a GUI client to run the radio entirely with the Mini
NOTE: You must be a GUI client to display the mini-panadapter in the Mini
 - d. Added **AGC** and **AGC-Threshold** controls to **Flex 6000** and **Config->Function Btn** menus
 - e. The **Rx Ant**, **Tx Ant**, and **Bandwidth** controls have been added to the **Config->Function Btn** menu
 - f. Fixed a bug in parsing panadapter values – they update correctly
 - g. Fixed a bug in the **External Tuner** mode where the radio would send Dits when **Key** was pressed if the radio's keyer was enabled – the Mini now forces the internal keyer off in this mode
 - h. Disable the radio's internal keyer if any of the Mini's keyer modes are selected except **None** and **Passthru**
 - i. The **IP Address** and **TCP Port** options have been moved to the **CAT Connection** menu
3. Added three new radio function slots to the **Config->Function Btn** menu and included additional functions for all radios
NOTE: This may change the functions you currently have programmed
4. Long-pressing the encoder in any menu returns you to the **Home** page