CTR2-Flex

Firmware Manual

v2.04.01

Last Revision: February 12, 2026

Updated to firmware v2.04.01

Revised sections for this version are highlighted in yellow

Table of Contents

Introduction

CTR2-Flex firmware is the descendant of a long line of microcontroller-based radio controllers from Lynovation. If you're interested in its background, you can read the QEX and QST articles about the **CTR** series here.

Both **CTR2-Flex** and **CTR2-Dial** firmware are included starting with the release of **CTR2-Flex** v2.00.00 firmware. You can easily switch between the two firmwares in the Settings menu to fit your operating needs. You should refer to the CTR2-Dial Firmware Manual for information about running **CTR2-Dial** firmware.

This firmware runs on any M5Dial based **CTR2** controller including **CTR2-Uno**, **CTR2-Duo**, **CTR2-Quad**, in addition to the older **CTR2-Flex**, and **CTR2-Dial** hardware.

CTR2-Flex firmware creates a custom WiFi controller specifically designed for the Flex 6000 and 8000 SDR radios. It is based on the popular **CTR2-Micro** controller firmware. It utilizes the Flex Network API to monitor and control the Flex radio over an IP network connection. In addition, it provides real-time CW keying and PTT control over the network.

Because the Flex API is a two-way protocol, unlike **CTR2-Dial**, **CTR2-Flex** is aware of the radio's operating state (frequency, mode, band, etc). A **Dashboard** display provides easy access to many of the radio's functions.

NOTE: If this firmware is installed on the older dual-encoder **CTR2-Dial** hardware you must select either **# Knobs: Two** or **# Knobs: Swap A/B** in the **Settings** menu, otherwise the encoder on **Port B** will continually key the internal keyer.

How to use this manual

This manual should be used 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. I've tried to group things logically and have added hyperlinks so you can quickly jump to other sections.

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.

Legal Notice

What would a manual be without a legal notice? Here goes…

- This is a hobby endeavor. Nothing is guaranteed! Use this device at your own risk!
- I will do my best to make sure you receive functioning hardware if you buy the assembled unit and will work with you if there is a problem with your unit on arrival.
- I cannot guarantee or warranty the hardware supplied in kits.
- I make no warranty that the firmware provided will perform up to your expectations or be suitable for your application. A lot of compromises had to be made to fit the small display so review this manual to be sure you're comfortable with the user interface.
- Software bugs are a fact of life and I try to find and correct all bug reports to the best of my ability ASAP.
- **CTR2-Flex** requires a license key to be fully functional. License keys can be purchased separately if you build your own unit. They are included with any purchase of any M5Dial based **CTR2** controller from Lynovation.com.
- License keys are tied to your call sign. This allows you to use the same key on as many devices as you own. You are not allowed to include your license key on units you build to sell or give to others. They will need to purchase their own key.

Change Log

v2.04.01: February 12, 2026

- Updated Appendix A: Installing or Updating CTR2-Flex Firmware to include ESPConnect as the primary method to flash firmware to the M5Dial on PCs and Macs (sorry, not Linux).
- Fixed the text editor page so pressing and turning knob A moves the editor cursor – previously it was executing the function assigned to knob A's switch.
- Removed the second page of Dial functions for the **Uno's Knob** menu. Only 6 functions are available for the knob now.
- Extensive changes were made to **CTR2-Dial** firmware. It it's firmware manual for details.

v2.04.00a: January 30, 2026

- Revised this manual to focus on **CTR2-Flex** firmware. Hardware references have been moved to the **CTR2-Uno**, **CTR2-Duo**, and **CTR2-Quad** hardware manuals. Click the links to open these manuals.
- A new **configuration repository** has been added for **CTR2-Dial** users. to the Lynovation web site under Download -> Configuration Files. The **CTR2-Flex** is pre-configured and doesn't require user configuration, other than setting the WiFi credentials and radio IP address, as covered here.
- **CTR2-Dial** firmware is covered under a separate manual. This manual can be found here.
- The following new features have been added to this version:
    - Support for **CTR2-Quad's** four knobs, two pushbuttons, and separate input jacks for paddles and key/PTT
    - Added Ring: Fine-Tune mode to the *Settings* menu
    - Support for three WiFi profiles for users that use their controllers on more than one WiFi network
    - Added the option to export just your unit's basic settings or its basic settings and all of your favorite frequency lists. Export just the basic settings when sharing your unit's configuration with others.

Changes to previous firmware versions can be found in Appendix F

System Overview

CTR2-Uno, **CTR2-Duo**, and **CTR2-Quad** utilize the M5Dial from M5Stack. The M5Dial is small, rugged controller based on the ESP32-S3 processor. It includes a 1.28" round color touchscreen display and an integrated encoder (the gray ring). It can be powered from a USB connection, an external 6-to-36-volt battery, or from a 3.7-volt Lithium battery. The current versions of **CTR2** M5Dial based units use USB for power. The user can upgrade their unit to use these other power sources if desired.

CTR2-Flex firmware is compatible with Flex 6000 and 8000 model radios. It uses WiFi to connect directly to the radio over your IP network using the Flex API and provides a small but flexible control surface for your radio. Unlike controlling SmartSDR with a mouse, SmartSDR doesn't need to be "in focus" on your

computer to use your **CTR2** controller. In addition, its small size allows you to conveniently locate it anywhere on your operating desk.

Since it connects directly to the radio it works with any Flex control app including SmartSDR for Windows and SmartSDR for iOS/MacOS.

CTR2-Flex firmware provides the essential controls you need to operate your radio without any other control app. This is ideal if you just want to monitor a band or operate your radio in POR mode (i.e. Plain Old Radio) without booting your computer or iPad to use SmartSDR.

CTR2-Flex firmware includes a built-in keyer that produces a sidetone on all M5Dial based **CTR2** controls (with the exception of the older **CTR2-Dial** hardware). It can also send both key and PTT inputs to the radio over the IP network. Using *Straight Key* keyer mode allows you to connect an external keyer, PTT switch, or app such as N1MM to the controller's CW paddle jack to key the radio. In addition, the virtual PTT switch can be configured for momentary or latched PTT.

CTR2-Flex firmware has two user interfaces and you can use the one that works best for you.

Multiple Controllers / Two Firmwares

As mentioned previously, three versions of hardware and two versions of firmware are available. Which hardware device you choose depends on your use case. Both versions of firmware are included in the **CTR2-Flex** firmware binary starting with v2.00.00. You can choose the firmware you want to run from the *Settings* menu. **CTR2-Flex** and **CTR2-Dial** firmware runs on any M5Dial based **CTR2** hardware.

CTR2-Flex firmware is great for controlling your Flex 6000/8000 series radio locally running any version of SmartSDR (or even without the SmartSDR user interface). However, since it doesn't support SmartLink, it presents challenges for remote operation.

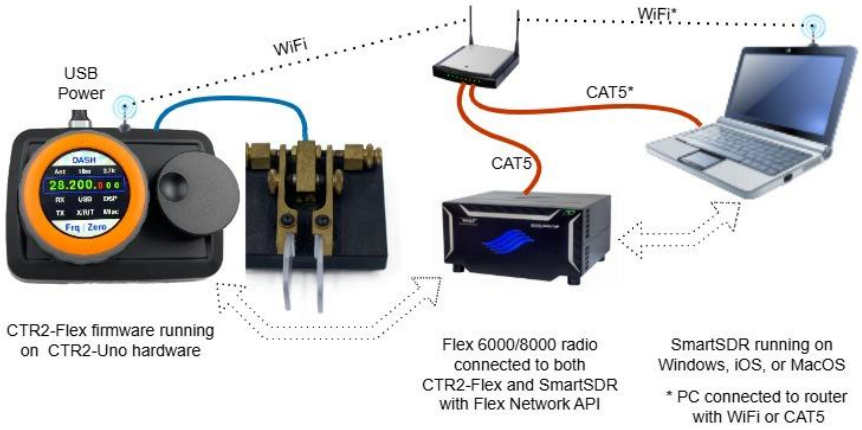
CTR2-Dial firmware on the other hand, uses MIDI commands over Bluetooth or USB to control a 3rd party app such as SmartSDR for iOS/MacOS, SDR-Control, FT-Control, TS-Control, K4-Control, Thetis, SDR-Console, and many other apps that support MIDI control of their functions

Switching Firmwares

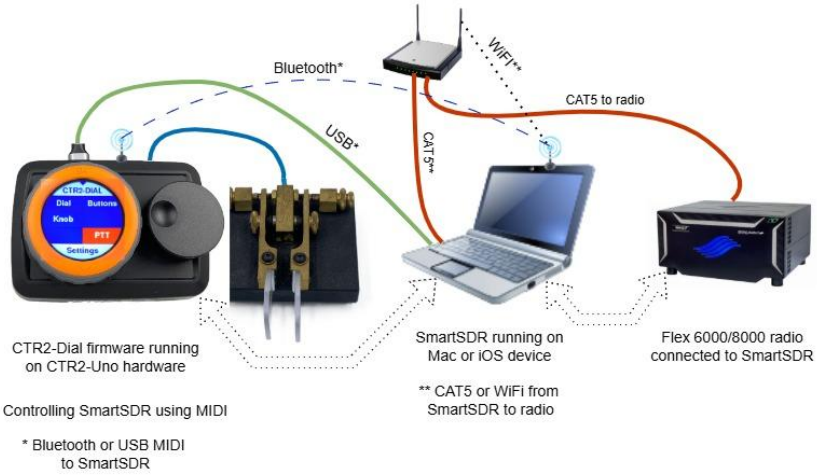
To switch firmwares, open the **Settings** menu and navigate to the last page (page 11 on **CTR2-Flex** and page 9 on **CTR2-Dial**) and select *Run CTR2-Dial* or *Run CTR2-Flex*, depending on which firmware is running.

The diagrams below should give you an idea of how each firmware interfaces to your radio and your computer/iOS device.

When using **CTR2-Flex** firmware as shown here, the controller connects to, and directly controls the radio through the IP network using WiFi and the Flex Network API.



When using **CTR2-Dial** firmware, the controller connects to, and controls the 3rd party app that is controlling the radio.



There are a few of trade-offs when running **CTR2-Flex** firmware on older **CTR2-Dial** hardware:

- **CTR2-Dial** hardware doesn't have encoder switches so you can't press and turn **Knob A** to change the frequency step or assign **Knob** switches to Button functions.
- **CTR2-Dial** dual-encoder hardware doesn't support the CW paddle input jack while the older **CTR2-Flex** hardware (rebranded to **Uno** and **Duo**) and the newer **CTR2-Uno**, **CTR2-Duo**, and **CTR2-Quad** hardware does
- The M5Dial's speaker is used for sidetone on **CTR2-Dial** hardware – it's pretty quiet

An upgrade kit is available for those wishing to upgrade their older **CTR2-Dial** or **CTR2-Flex** hardware to a **CTR2-Quad**.

CTR2-Flex Features

CTR2-Flex runs on the M5Dial from M5Stack. The M5Dial features an ESP32-S3 processor, a 1.28" color touchscreen, and a built-in selector ring and hardware pushbutton. The firmware includes the following features:

- WiFi connectivity – connects directly to the radio
- Three WiFi profiles can be set up for users that operate from multiple networks.
- Multiple **CTR2** units running the **CTR2-Flex** firmware can be connected to the same radio, to the same slice or different to a different slice
- Works with any version of SmartSDR (Windows, iOS, or MacOS)
- **CTR2-MIDI** or **CTR2-Dial MIDI** controllers can be used at the same time in SmartSDR for iOS/MacOS apps while a **CTR2** unit running **CTR2-Flex** firmware is connected
- Works in standalone mode without SmartSDR
- Two user interface modes
    - Menu pages provide easy to use controls if you just want to control one or two items
    - Dashboard pages provide a small control surface for your radio with easy access to all functions
- 60 virtual button controls for modes/bands/filters or page selection
- 30 virtual Dial (wheel/slider) controls for tuning frequency, volume, RIT, XIT, etc.
- Assign the gray Ring encoder on the M5Dial display to any of the available **Dial controls**
- Up to four optional physical encoders (referred to as **Knobs**)
    - Map 12 of the *Dial* controls to the **Knob** on the **CTR2-Uno** unit
    - Map 6 of the *Dial* controls to each **Knob** on the **CTR2-Duo** unit
    - On the **CTR2-Quad** unit:
        i. Knobs can be programmed to two functions (turn and push-and-turn)
        ii. Unassigned knobs control the selected *Dial* control and the selected control in the dashboard
    - Knob push switches can be mapped to two virtual button functions using short and long-press
- Two pushbuttons are provided on the **CTR2-Quad** – each of these can be programmed to any two button functions (using short and long-press) or be dedicated to control PTT.
- The gray ring on the M5Dial can be configured as a fine-tuning control (to make fine adjustments to the selected *Dial* function), or it can be assigned to always control the selected *Dial* function, or it can be assigned to always control any of the *Dial* functions in any page.
- VFO Lock control
- 3.5mm (1/8") stereo input jack allows you to use your paddles to control the keyer, straight key, or PTT over the network connection
    - Separate jacks are provided on **CTR2-Quad** for paddles and key/PTT
- Nine CW macros
- Swipe tuning for parameter adjustments on the **Dashboard** pages
- Panadapter control
- Control any slice, A through H, depending on radio's capacity
- Adjustable filter controls – adjust low-cut, high-cut, and offset independently

- Speaker with volume control for sidetone
- A virtual PTT switch or hardware PTT switch. On **CTR2-Quad** you can select either pushbutton as a dedicated PTT switch.
  NOTE: Switch #1 on **CTR2-Quad** is hardwired to the RING input on the **Key/PTT** input jack.
- Keypad for direct frequency entry (press **Frq** on the dashboard **Home** page)
- Favorite frequency lists for each band
- Speed sensitive controls
- Adjustable virtual **Dial** sensitivity
- Seven color themes and backlight control
- Sleep and power down timers to save battery power
- Manual power down
- Multiple Power options
- Backup CTR2-Flex's settings using the **Import** and **Export Settings** option
- Easily switch between CTR2-Flex and CTR2-Dial firmware

Initial Startup

There are a few tasks you must perform before the **CTR2-Flex** firmware will be ready to control your radio.

Enter your Call and Registration Key

You must enter your call and registration key for your firmware using a terminal or the on-screen editor *if you purchased a **CTR2-Quad** upgrade kit and purchased the M5Dial separately.* Registration keys are provided for free and installed when you purchase an assembled unit from me or Neil.

NOTE: Registration keys are issued based on your call sign. Once registered you can use your key on any M5Dial based Lynovation product (**CTR2-Dial** and **CTR2-Flex**). Contact me if you decide to sell your controller to another ham and I will create a key for their call. My email is in QRZ.com.

The firmware will run in **Demo** mode until registered. In this mode, the unit will automatically power down after 15 minutes. You can edit the settings and labels on the unit but you can't save or export them.

To enter your registration key, connect your unit to a terminal program such as Tera Term or Putty (see Appendix B or C, or to the terminal in your Mac, Appendix D). Once connected, press any key to start the terminal server on the unit. Next, press the **Del** or **Backspace** key on the keyboard. Enter the call sign you registered and the registration key you received from me. The registration key is 8 hexadecimal digits (0 to 9 and A to F). Once registered, your call sign will appear on the splash screen at boot up, the program won't shut down after 15 minutes, and you'll be able to save changes in the maps and import or export backup files. You call will can also be automatically inserted into CW macros using the **^** prosign.

You can also use the on-screen editor to enter your registration credentials. Just select **Enter Call & Key** on the last *Settings* page. Turn the knob to change the letter and touch the screen (or press and turn the

knob) to advance to the next letter position. Press the **OK** button to accept. The input starts with your call and advances to your registration key once the call has been entered.

Factory assembled units have the unit's Bluetooth name (CTR2_xxxx), your call, and your registration key written on the unit's bottom label. They are covered with a piece of transparent tape so they don't rub off. This way you'll have them if you reset your unit back to factory settings.

The dumb terminal or on-screen editor can also be used to edit the CW macros, your router's SSID and password, and your radio's IP address and IP port#.

Select the Number of Encoders

Once you have successfully registered **CTR2-Flex** firmware the Settings menu will open on page 4 so you can select the number of knobs (encoders) on your unit. Your options are **None**, **One**, **Two**, and **Swap A/B.** The swap option is used for **CTR2-Duo** 3D printed enclosure units. You can also reverse the direction of each encoder if needed on **Uno** and **Duo** units.

CTR2-Quad units automatically detect the four knobs. The *Knob* menu page on these units includes controls to set the PTT function of either pushbutton. This selection overrides any button functions you may have set for these buttons.

Connecting to your radio

CTR2-Flex connects directly to your radio on your network using WiFi. Network credentials (router SSID and password) can be entered from a terminal or directly by selecting **SSID:** and **PW:** on page 6 of the **Settings** menu.

Text input is tedious in the text editor. Turn **Knob A** to select a character then *press and turn* **Knob A** to advance to the next character. *To minimize frustration, use the terminal interface to set these parameters*. You will also need to set **Flex Adrs:** on page 7 of the **Settings** menu. This can be found on the **Settings -> Radio Setup -> Network** tab in SmartSDR for Windows or on the **Available Radios** popup window in SmartSDR for iOS/MacOS. The default IP port for the Flex radio is 4992. You can change this if it has been changed on your radio with the **Flex Port:** option.

If you would like **CTR2-Flex** to automatically connect to your radio when it boots, turn **AutoConn: ON**. You can temporarily disable auto-connect by holding the **M5** button on the M5Dial down during boot.

Once your WiFi credentials and the radio's IP address have been entered, select **Connect WiFi** on page 6 of the **Settings** menu to connect CTR2-Flex to your WiFi system. Once connected, **CTR2-Flex** can be used as a control surface for SmartSDR or it can operate your radio as a standalone controller.

The firmware connects to **Slice A** by default. Once connected you can change the **Slice** by touching the *Slice* caption in the Dashboard display. The firmware will then connect to the new slice setting each time you connect until you change the Slice setting again.

NOTE: Always connect **CTR2-Flex** to your radio after starting SmartSDR so it connects to the radio as a non-GUI client that is linked to SmartSDR. If you connect it before starting SmartSDR v3.xx with

multiFlex enabled, it will create a second GUI client and will work separately from SmartSDR. SmartSDR 2.xx will not be able to connect to your radio if **CTR2-Flex** is already connected.

Multiple Clients

The server in your Flex radio supports multiple clients. This means that you can have several devices connected to, and controlling it, all at the same time. For instance, you can have SmartSDR for iOS connected as a GUI client, one or more **CTR2** units running **CTR2-Dial** firmware connected to your iPad controlling the SmartSDR app, and one or more **CTR2** units running **CTR2-Flex** firmware connected to the radio as non-GUI clients. **CTR2-Flex** units can be connected to the same slice or to different slices. Any change on any of the connected devices will be sent to all the other clients subscribed to that slice.

TX Enable

Flex radio support multiple slices, but only one slice can be designated as the transmit slice. On SmartSDR this is done by clicking on the **TX** button on the slice flag.

CTR2-Flex allows you to toggle the transmit state of the slice using one of these methods.

- Touch the bottom-left **TX** button on the Dashboard's **TX** page.
- Touch the **Tx Enbl** button on page 4 of the **Buttons** menu
- Assign the **Tx Enbl** button to one of the knob switch functions (or to one of the pushbuttons on a **CTR2-Quad**).

When transmit is enabled on the slice **CTR2-Flex** is controlling, the caption on all pages will be displayed in red font. (I know, it looks orange here… it's red)

When using multiple **CTR2-Flex** controllers this allows you to easily identify which controller is controlling the transmitter on your radio.

Using an External Keyer and/or Hardware PTT Switch

Many users may want to use an external keyer and/or an external PTT switch with their **CTR2** unit. If your external keyer has a built-in sidetone you can use a small Phillips screwdriver to turn the sidetone volume on the **CTR2** unit down.

On **CTR2-Quad**, simply plug you straight-key, keyer, or PTT switch into the **Key/PTT** 3.5mm jack on the back of the unit. Wire the **Key** input to *TIP and SHIELD* and your **PTT** switch to *RING and SHIELD* of the plug.

NOTE: The *RING* on **CTR2-Quad's Key/PTT** jack is hardwired to Switch 1 on the front panel. This means, that in order to use an external PTT switch with **CTR2-Quad**, you must assign Switch 1 to PTT (see **SW1** on page 4 in the *Settings* menu). Otherwise, your external switch will control the functions assigned to Switch 1.

To use an external key/keyer, or PTT switch on **CTR2-Uno**, **CTR2-Duo**, and the older **Flex** and **Dial** hardware, do the following:

- Wire the external keyer (or straight key) to the *Tip* and *Shield* of a 3.5mm (1/8") stereo plug
- Wire the external PTT switch (foot switch, hand switch, etc.) to the *Ring* and *Shield* of the same stereo plug
- In the **Settings** menu:
    - On page 2 select **Momentary** or **Latch** for **PTT:** - this determines the PTT action
    - On page 5 select **Passthru** for the (paddle) **Type:** - this passes the paddle jack's *Tip* input to the *CW Key* function and the *Ring* input to the *PTT* function

Now that you have your hardware wired, configure the firmware as follows:

- Enable **TX** on the slice you're controlling – this can be done in the **Button** menu or in the **TX** page in the dashboard
- To enable CW keying, select CW mode and enable **Breakin** in the dashboard's **Misc** menu
- To enable PTT, select a voice mode in the dashboard's **Mode** menu

User Interfaces

CTR2-Flex firmware supports two user interface models. The *Basic User Interface* (left screenshot) uses simple menus to select controls and buttons, similar to **CTR2-Dial** firmware, and will be described in the next section. Use this interface when you just want to use your **CTR2** unit to control one or two parameters. The second user interface (right screenshot) is a fully functional dashboard that allows you to easily select and modify parameters. Go to the Dashboard section for a full description of this user interface.

NOTE: When using either UI, *Knob A* is used to change the selected parameter on **CTR2-Uno**, **CTR2-Duo**, and on the older **CTR2-Flex** and **CTR2-Dial** hardware. On **CTR2-Quad**, any knob set to **<DIAL>** will control the selected parameter.

Basic UI

Dashboard UI

Basic User Interface

CTR2-Flex's Home page allows you to open the control pages in the basic user interface. This interface is the same interface used on **CTR2-Dial** firmware, with the addition of the **DashBrd** button.

- **Dial** opens the *Dial control*. This is a virtual dial where you can select from 30 different parameters to control. Once selected, just swipe your finger around the perimeter of the display to change the parameter. To change the selected parameter, turn the gray ring on the M5Dial or touch the control # above the center label to open the Dial menu.
  - If the **Ring** option in the *Settings* menu is set for **Ring: Fine-Tune**, touching the outside ring on the display enables *Ring fine-tuning mode*. In this mode, turning the ring will adjust the selected control by one count per ring click. Fine-turning will turn off after 3 seconds.
  - If the **Ring** option in the *Settings* menu is set for **Ring: Sync2Dial**, disables ring navigation (switching pages or *Dial* controls with the ring) and adjusts the selected control in the *Dial* page as you turn the ring on any page. To navigate between pages, touch the page #s at the bottom of the display, or touch the control # in the *Dial* control to open the Dial menu
  - If the **Ring** option in the *Settings* menu is set to a *Dial* control (for example **Ring: Volume**), ring navigation is disabled and turning the ring on any page adjusts the *Dial* control selected in the **Ring** option. To navigate pages, touch the page #s at the bottom of the display, or touch the control # in the *Dial* control to open the Dial menu.

- **Button** opens the Buttons menu where you can select from 60 functions on ten menu pages. Turn the gray ring on the M5Dial to change menu pages or touch the page #s at the bottom button to switch pages.
    - You can assign a button function to any of the knob pushbuttons (or pushbuttons on **CTR2-Quad**) on your unit. To do this, find the button function you want to program in the *Buttons* menu. Press and hold the pushbutton you want to assign, then touch the button control to assign to the switch. The knob (or button # on **CTR2-Quad**) will appear in the button's label. The first touch assigns it to the switch's short-press. Touch the button again, (while still holding the switch down) to set the long-press function. When set as the long-press function, the knob (or switch #) will be displayed with a "~".
- **Knob** opens the Knob menu where you can assign *Dial* controls to the knobs. This menu allows you to quickly change the *Dial* control assigned to a knob.
    - On **CTR2-Uno** units (and older single-knob **CTR2-Dial** and **CTR2-Flex** units) you can select from 12 different *Dial* controls.
    - On **CTR2-Duo** units (and older dual-knob **CTR2-Dial** and **CTR2-Flex** units) you can select from 6 different *Dial* controls for each knob.
    - On **CTR2-Quad** units you can assign a turn and push-and-turn *Dial* function to each knob. Unassigned knobs use the selected *Dial* control, or adjust the selected Dashboard control.
- **DashBrd** opens the Dashboard user interface that is described in this section.
- **PTT** opens the virtual PTT page where you can control PTT on your radio by simply touching the display. There are three modes on this page. They can be controlled by touching the bottom button in this display or in the **PTT** option in the *Settings* menu.
    - **Off** disables PTT control from this page, and from the external PTT input. It also disables PTT control on the **CTR2-Quad** if PTT is assigned to one of the pushbutton switches.
    - **Momentary** enables momentary PTT control. PTT is key up as long as you press the PTT switch and drops off when you release the switch.
    - **Latched** enabled latched PTT. Touch and release the screen (or PTT switch) to key PTT. It will stay keyed until you touch and release PTT again.
- **Settings** opens the Settings menu where you can change the configuration of many of CTR2-Flex's parameters.

Dial Control

The virtual **Dial** control supports 30 controls. Swipe your finger around the outer ring to adjust the control.

If a knob is set to **<DIAL>** in the **Knob** setting menu, turning the knob on a single or dual-knob unit (or any unassigned knob on **CTR2-Quad**) will adjust the value of the currently select control in the *Dial* control.

If the gray ring on the M5Dial is in navigation or fine-tune mode, turn the ring to switch dial controls. Otherwise, touch the dial # (**1** in this example) to open the *Dial menu* where you can select a dial function from 5 pages of menus.

If the ring is in fine-tune mode (*Settings* -> **Ring: Fine-Tune**), touching the outside ring (the blue ring in this photo) enables fine-tune mode and **<RING>** will be displayed in the page caption. Turning the ring while in this mode adjusts the current control's value. Fine-tune mode times out after 3 seconds of inactivity.

NOTE: When the *Dial control* is in VFO mode, as shown above, the push-and-turn function of *Knob A* is used to change the frequency step.

Control options, if any, will be displayed at the bottom. In this VFO example, **v 100 ^** controls the frequency tuning step. Touch to the left or right of **100** to change the tuning step.

The VFO display also has a **Zero** button. Touch this button to zero the digits below the tuning digit.

Other controls such as **Volume**, **NB**, **NR**, **RIT**, and others have virtual On/Off options. Touch the control at the bottom of the display twice to toggle the option.

Dial Graphics

The **Dial's** background depends on the selected control.

The lead photo in the **Dial Control** section shows a *tuning* control. Tuning controls are continuously variable and used for VFO tuning. The tuning ring is the background color of the selected theme. The label in the middle (in this case **VFO**) indicates the control function. Unlike **CTR2-Dial** firmware, you cannot edit the control labels, these are fixed in firmware.

There are two other control displays. These controls are similar to potentiometers and have a minimum and maximum range.

For most controls like volume, squelch, etc., the outer touch ring on the **Dial** control represents a gauge with the level indicated by the filled portion. Like a potentiometer, the gauge starts at 0% on the lower left and progresses around the display to 100% on the lower right. The **Volume** control on the right is set to 55%.

Controls with positive and negative offsets, like **RIT**, **XIT**, and **Balance** controls use a slightly different display. The **Dial** graphic for this control displays the +/- offset referenced to the top of the dial. For negative offsets it grows to the left and for positive offsets it grows to the right from center. The amount of offset (in this case RIT frequency) is shown under the label. When the control is offset, touch the label to reset it to 0 offset. If a control has an enable/disable or zero option it will be displayed at the bottom of the dial. Touch this button to operate the control.

Shortcut: Touch to the *left* of the **DIAL** caption at the top to open the **Knob** menu. Touch to the *right* of the **DIAL** caption to open the **Buttons** menu. Similar options are provided on the **Knob** and **Buttons** menus.

VFO Control

When the VFO control is selected the frequency and frequency step will be displayed in the center of the control. Touch any digit in the frequency to select that digit as the tuning step. The step digit will turn red. Touch it again to select the *half-step*.

For example, touching the 100's digit (1) in the example at the left switched the frequency step from 100 Hz to 500 Hz. *Half-steps* are indicated by highlighting the digit to the left in magenta.

You can also press and hold, then turn **Knob A** while in this control to change the frequency step. You can also touch the left or right side of the bottom **^ xxx v** button twice to change it.

Pressing the **Zero** label in this control will zero all of the digits below the frequency step digit.

Hint: You can quickly change to the **Button** or **Knob** menus from the **Dial** control by swiping across the center of the display either left or right. Swipe from the *left* to open the **Knob** menu or from the *right* to open the **Buttons** menu.

VFO Lock

To lock VFO tuning to prevent inadvertent changes simply long-press the frequency on the VFO dial control or on the Dashboard **Home** page. When the VFO is locked, the frequency will be "grayed out" as shown here. Adjusting the tuning, or turning a knob assigned to the VFO, will post a message with instructions on how to reset the lock.

To unlock the VFO, long-press the frequency digits.

Ring Control Options

The encoder used in the gray ring control on the M5Dial display is a detent (bumpy) encoder with 12 "clicks" per rotation. Because it isn't very sensitive, and somewhat difficult to turn, it has only been used for selecting dial controls and menu pages (i.e. navigation).

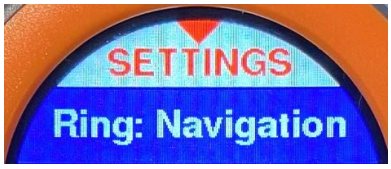
By user request, beginning with v2.02 I've added the ability to choose from several ring control options with the **Settings** menu's **Ring** option on page 8.

- **Navigation** mode – (default) – use the ring to select dial controls and menu pages.
- **Fine-Tune** mode – while in the *Dial control* page, touching the outside ring on the display enabled fine-tune mode. **<RING>** will be displayed in red on the page caption and turning the gray ring will increment or decrement the current control's value by one count per click. Fine-tune mode times out after 3 seconds of inactivity. When fine-tune mode is not active, the ring operates in navigation mode.
- **Sync2Dial** mode – the ring adjusts the dial control selected in the **Dial menu** or on the **Dial control**– this works in any page, similar to how the knobs work.
- **Selected Dial Control** – the ring adjusts a dial control that you select from the **Ring Ctl** menu. This also works from any page.

NOTE: When **Sync2Dial** or **Selected Dial Control** modes are enabled, you must use the on-screen navigation controls to move between menu pages. While in the *Dial control* you must touch the control # (above the center label) to open the *Dial menu* in order to select a different dial control

The following screenshots should help explain the process of selecting a ring control option on page 10 of the *Settings* menu.

Navigation mode



The screenshot at the right shows that the ring is in the default **Navigation** mode.

In this mode, turning the ring will change menu pages or the selected control on the *Dial control* page.

The antenna icon at the top of the page is solid.

Double-touch the **Ring: Navigation** button in the *Settings* menu to switch to **Fine-tune** mode.

Fine-Tune mode

In **Fine-Tune** mode, the antenna icon has a single line through its middle.

In this mode, the gray ring on the display can be used as a fine-tuning control for the selected dial control. To enable fine-tuning, touch the outside ring on the *Dial control* page. **<RING>** will be displayed in the page's caption. Turning the ring will now increment or decrement the current dial control's value by one count. Fine-tune mode will time out after 3 seconds on inactivity.

Double-touch the **Ring: Fine-Tune** button in the *Settings* menu to switch to **Sync2Dial** mode.

Sync2Dial mode

In **Sync2Dial** mode the M5Dial's ring controls the currently selected *Dial control* from any page, similar to how the **Knob** controls work.

In this mode, two lines are displayed in the antenna icon at the top of each page.

NOTE: While **Sync2Knob** mode is active, you must use the onscreen navigation controls to switch menu pages. On the *Dial control*, you must touch the control # above the center label to open the *Dial menu* to select another dial control.

Touch the **Ring: Sync2Dial** button to open the **Ring Control** menu.

Ring Control Menu

The *Ring Ctl* menu appears when you double-touch the **Ring** option in the *Settings* menu while in **Sync2Dial** mode. It is similar to the *Dial menu* and is used to assign one of the dial controls to the **Ring** control. There are 5 pages of menus. You must use the **Next** button on the bottom to step to the next page because the ring mode is still in **Sync2Dial**. Touch a control label to assign that control to the **Ring** control. In this example, the **AGC-T** control is selected.

Pressing **Esc** will exit this menu and reset the ring mode to **Navigation** mode.

Selected Dial Control Mode

Once you select a control in the Ring Control menu you will return to the **Settings** menu and the **Ring:** option will show the selected control (AGC-T in this example).

Note that there are now three lines in the antenna icon at the top of the page in this mode.

NOTE: While **Selected Control** ring mode is active, you must use the onscreen navigation controls to switch menu pages. On the *Dial control*, you must touch the control # above the center label to open the *Dial menu* to select another dial control.

To return to ring **Navigation** mode, touch the **Ring:** button in the *Settings* menu again.

Dial Menu

Touching the dial # on a Dial control will open the **Dial** menu. The current dial setting will be highlighted (**VFO** in this example). Touch a button to select that function and return to the *Dial control* page. Touch the selected function to return to the *Dial control* without changing the selection.

If the gray ring on the M5Dial is in **Navigation** or **Fine-Tune** mode, turn the ring to switch menu pages. Otherwise, touch to the left or right on the footer button that is showing the menu page you are on (**<1/5>**).

The caption button (**DIAL MNU**) is a two-function button.

- Touch the *left* side to switch to the **Knob** menu.
- Touch the *right* side to switch to the **Buttons** menu.

Dial functions are listed in the table below.

VFO	Slice freq control	NB-Lv	Noise Blanker Lvl	HPh-Gn	Headphone Gain
Volume	Slice volume	NR-Lv	Noise Reduction Lvl	Speed	Keyer Speed
Squelch	Slice squelch	ANF/APF	Auto Notch/Peaking	Pitch	Sidetone freq
AGC-T	AGC-Threshold	RIT	Rx Increment Tuning	Delay	CW Dropout Delay
Moni	Monitor level	XIT	Tx Increment Tuning	Zoom	Panadapter Zoom
Balance	Left/Right balance	PwrOut	Tx Power Out	PanMax	Panadptr Max Level
Hi-Cut	Filter high cut freq	TunOut	Tune Power Out	PanMin	Panadptr Min Level
Lo-Cut	Filter low cut freq	VOX	VOX Level	PanAvg	Panadptr Average
Offset	Filter high/low offset	Mic-Gn	Mic Gain	PanGn	Panadptr Gain
WNB-Lv	Wide Noise Blanker	LnO-Gn	LineOut (Spkr) Gain	PanBlk	Panadptr Black Lvl

Hint: Quickly change to the **Knob** or **Buttons** menus by swiping across the center of the display either *left* or *right*. Swipe from the *left* to open the **Knob** menu or from the *right* to open the **Buttons** menu.

Knob Menu

The *Knob* menu allows you to assign *Dial* controls to the knob(s) on the unit.

The caption at the top of the page is a dual-function button. Touch the left side to navigate to the *Dial control* page, and touch the right side to navigate to the *Buttons* page. To prevent unintended operation, the caption button requires two touches.

- Touch the *left* side to switch to the **DIAL** control.
- Touch the *right* side to switch to the **Buttons** menu**.**

If the gray ring on the M5Dial is in navigation mode, turn the ring to switch pages. Otherwise, touch the footer button.

The style and functions of the *Knob* menu depend on the controller you are using.

CTR2-Uno and CTR2-Duo Controllers

On these units, each knob can be assigned to one of 6 functions. Duo units have a menu page for each knob.

The first option always displays **<DIAL>**. When this option is selected, turning the *Knob* on any page will change the control selected in the *Dial control* page.

Selecting one of the other five functions on this page assigns that function to the **Knob** and it will be controlled independently from the *Dial control*. On Duo units, touch the bottom button to navigate to the next menu page.

CTR2-Quad Controller

The *Knob* menu on the **CTR2-Quad** is different than the menu for the **Uno** and **Duo** controllers, but editing the selected controls is the same as with the other units.

CTR2-Quad supports dual-function knobs. Each knob has a *turn* and a *push-an-turn* function.

The menu you are in is displayed in a label block on the left side of the menu. In this photo, we're in the *Set Knob Turn Function* menu.

The functions assigned to each knob are show on the buttons.

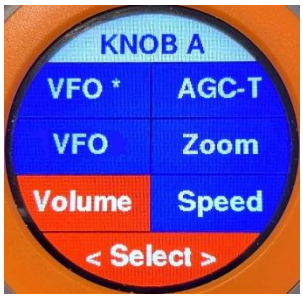
The *Knob* menu is laid out the way the knobs are positioned on the **Quad**. *Knob A* is the bottom-left button (and shown selected in this photo), *knob B* is the upper-right button, *knob C* is the right-middle, and *knob D* is the bottom-right button.

Touching the black label toggles the menu to the *Set Knob P&T Func* (*Push-and-Turn*) menu. This menu allows you to assign the *Dial control* that is used when you push the knob down and turn it (while holding it down).

NOTE: Any knob on **CTR2-Quad** can be assigned to the **<DIAL>** function. When this function is selected, the knob will control the selected *Dial control*. Knobs assigned to **<DIAL>** will also control parameters selected in the Dashboard.

Editing the Knob Menu

You can easily change the *Dial control* assignments in the *Knob* menus. Just touch a button to select it, then touch it again to edit it. The selected function and the bottom button will turn red. Turn any knob to scroll through the functions available in the *Dial control* menu.



Touch the **< Select >** button on the bottom or let the select timer timeout (3 seconds) to save the new setting.

NOTE: On **CTR2-Uno** and **CTR2-Duo** (and older Flex and Dial hardware) the first function (**<DIAL>**) cannot be changed in this menu.

Using the Knob

The *Knob control* display overwrites the current page anytime a knob is turned. The display is identical to the *Dial control* page but the colors are inverted. The current page re-appears 750 milliseconds after you stop turning the knob.

Buttons Menu

Open the *BTN MNU* to select from 60 button functions. Touching a button immediately sends that control to the radio (if the controller is online).

There are 10 pages of buttons with six buttons on each page. The last six buttons open pages on the controller. If the gray ring on the M5Dial is in navigation or fine-tune mode, turn the ring to select a page, otherwise, touch the *left* or *right* side of the bottom label to decrement or increment the page #.

To prevent unintended operation, the caption and footer buttons are dual-touch buttons. The first touch selects the button and the second touch executes the selected function. Press the **M5** button on the orange ring to return to the *Home* page.

The caption button (*BTN MNU*) has the following functions:

- Touch the *left* side to switch to the *Knob* menu.
- Touch the *right* side to switch to the *Dial* menu**.**

Assigning a Knob Switch to a Button Function

Knob switches (and pushbuttons on a **CTR2-Quad**) can be set to two actions: a short-press (less than 1 second) and a long-press (greater than 1 second).

Switch Short-Press Action

To assign a short-press button action to a knob's push switch (or pushbutton on a **CTR2-Quad**), do the following:

- Open the *Buttons* menu and navigate to the page with the function you want to assign
- Press and Hold the *Knob* (or *pushbutton* on the **Quad**) switch you want to use
- Touch and release the function button you want the switch to execute

Once you have assigned a function to a *Knob* (or *pushbutton* on the **Quad**), the knob's letter (or switch #) will appear in that button's label. That function will be sent to the radio anytime you press that *Knob* (or *pushbutton*).

Switch Long-Press Action

To assign a long-press button action to a knob's push switch (or pushbutton on a **Quad**), follow the steps above for setting the short-press action then while still holding the knob (or switch) down, touch the desired function a second time. *Buttons* set to long-press actions will have a **~** appended to the knob (or switch #) displayed on the button.

The photo above shows the *Buttons* menu on a **CTR2-Quad.** *Knob A's* short-press action is set to the **Mute** function and its long-press action is set to the **BW** function. *Knob D's* short-press function is set to **Band ^** and its long-press action is set to **Band v**.

To clear a function, hold the **Knob** switch down and touch the selected function again.

NOTE: You must clear both switch actions from the button before you can assign it to another knob or switch#.

NOTE: Changing the PTT assignment on **CTR2-Quad's** pushbutton #1 or #2 (on page 4 of the *Settings* menu) automatically cancels any switch action assigned to those switches.

NOTE: *Buttons* are preset in the factory default. Feel free to edit them to fit your operating requirements.

PTT Page

The **PTT** page offers a virtual PTT button. There are three options to choose from on this page. Touch the bottom button to step from **PTT Off**, **PTT Momentary**, and **PTT Latch** modes.

When PTT is **Off**, touching the screen, or operating an external PTT switch has no effect.

When PTT is set to **Momentary,** touching the screen or operating an external PTT switch keys the radio's PTT over the network. Lifting your touch or releasing the external PTT switch unkeys the radio.

When PTT is set to **Latch**, touching and releasing the touch keys the radio over the network. It will remain keyed until you touch and release the screen again or the three-minute timer expires.

NOTE: An external PTT switch will control PTT in any page or menu.

Using a Hardware PTT Switch

To configure an external hardware PTT switch, see Using an External Keyer and/or Hardware PTT Switch.

Settings Menu

To enter the **SETTINGS menu**, press the *Settings* button at the bottom of the **Home** page.

The settings menu is divided into 11 pages with three buttons on each page. You must press a settings button twice to change its setting.

Press the **M5** button or touch the **SETTINGS** caption to return to the **Home** page**.**

If the *Ring* on the M5Dial is in navigation or fine-tune mode, turn the ring to select a settings page, otherwise, touch the *left* or *right* side of the bottom label to decrement or increment the page #.

The table below summarizes each setting.

Page	Btn	Function	Description
1	1	**Beep Mode**	Changes the volume of CTR2-Flex's button beeps. Range: Off, Low, Medium, and High. Sidetone volume is set through a small hole in the enclosure using a 1/8" (3.2mm) Phillips screwdriver.
	2	**Speed Tune**	When enabled, touch and hold the outer ring on the **Flex** for > 1 second to enter speed tuning mode. Valid for VFO control only.
	3	**Dial Sens**	Changes the sensitivity of the virtual Dial. Range: Low, Medium, High. Default is Medium.
2	1	**PTT**	Changes the PTT mode from **Off** -> **Momentary** -> **Latch**. This can also be changed on the **PTT** page by touching the bottom button. This option also controls keying PTT with a hardware PTT switch.
2	2	**Theme**	Select the color theme for the selected Map. Options include Dark, Light, Blue, Orange, Green, Red, and Violet.
2	3	**Backlight**	Adjusts the backlight. Range: **Low**, **Medium1**, **Medium2**, and **High**. Lower settings reduce current draw on the unit.
3	1	**Sleep**	Sets a timer that turns off the display backlight after no activity for the set number of minutes to reduce current draw. Sleep mode does not close USB or Bluetooth connections. Range: **Never**, **1**, **5**, **10**, **30**, and **60** minutes.
3	2	**Pwr Off**	Sets a timer to turn off the unit after no activity for the set number of minutes. Pwr Off mode reduces current draw to 14 microamps and closes USB and Bluetooth connections. Range: **Never**, **10**, **30**, **60**, **120**, and **180** minutes.
3	3	**Power Down**	Immediately closes the WiFi connection and puts the unit to sleep, reducing current draw to 14 microamps. Touch the display to wake up the unit. **NOTE:** If you are powering your **CTR2** controller with a 3.7-volt battery you will need to press and hold the **M5** button on the orange ring for > 10 seconds to wake the controller up from sleep mode.
4	1	**# Knobs**	Selects the number of external knobs your unit is equipped with. (One and two knob configurations cannot be detected in the firmware.) For **CTR2-Uno**, **CTR2-Duo**, (and older **CTR2-Flex** and **CTR2-Dial** hardware) you have the following options: **None**, **One, Two**, or **Swap A/B** (for two knob units) • When this firmware is running on **CTR2-Dial** hardware the paddle jack is only available in the **None** and **One** options. **CTR2-Quad** hardware is automatically detected and this setting is fixed to **# Knobs: Four**
	2	**Knob/Knob A Or SW1 Setup**	On **CTR2-Uno**, **CTR2-Duo**, (and older **CTR2-Flex** and **CTR2-Dial** hardware) this option selects either Normal or Reverse direction for *Knob A*. The default is **Normal**. On **CTR2-Quad** this option toggles the PTT setting of pushbutton #1. When PTT is enabled, you can use this switch instead of the virtual PTT page or an external PTT switch to key your radio. **NOTE:** Toggling this setting resets any button switch actions that were assigned in the *Buttons menu*.

4	**3**	**Knob B Or SW2 Setup**	On **CTR2-Duo**, (and older **CTR2-Flex** and **CTR2-Dial** dual-knob hardware) this option selects either Normal or Reverse direction for *Knob B*. The default is **Normal**. This option is not available on single knob units. On **CTR2-Quad** this option toggles the PTT setting of pushbutton #2. When PTT is enabled, you can use this switch instead of the virtual PTT page or an external PTT switch to key your radio. **NOTE:** Toggling this setting resets any button switch actions that were assigned in the *Buttons menu.*
5	**1**	**(Keyer) Type**	Selects the internal *keyer type*. Options are **Off**, **Straight**, **PassThru**, **Iambic A**, **Iambic B**, **Ultimatic**, and **Bug** – *does not change radio keyer*. Use **Passthru** for external keyers or PTT switches. **NOTE: CTR2-Quad** units have a separate *Key/PTT* input jack so there is no need to set the keyer to **Passthru** on these units.
	2	**Pitch**	Selects the sidetone frequency for the sidetone oscillator in **CTR2** units with sidetone capabilities. This option has no effect on older **CTR2-Dial** hardware. Frequency range is from **500 Hz** to **1000 Hz** in 50 Hz steps. To turn off the sidetone, turn the volume control fully CCW. **NOTE:** This setting also affects the radio's audio bandpass filter in CW mode.
	3	**Paddles**	Select **Normal** or **Reverse** paddle wiring
6	**1**	**Fav Mode**	Switches the Favorite Frequency list between all bands and the selected band
	2	**Xvtr Mode**	Indicates whether transverter mode is On or Off. Transverter mode is automatically enabled when **XVTA** or **XVTB** are selected in the dashboard's **Ant** menu. When transverter mode is enabled 2m, 1.25m, 70cm, 33cm, and 23cm bands are added to the **Band** menu and the frequency display is slightly compressed to display the additional digits.
	3	**WiFi Profile**	This option allows you select one of three WiFi configurations. This is useful when you have more than one WiFi network that you use your **CTR2** controller on.
7	**1**	**Connect/ Disconnect WiFi**	Connects or disconnects WiFi. You must have the router's SSID and password and the radio's IP address and IP port # set before connecting to the radio.
	2	**SSID**	Set router's SSID. Touch to open the screen editor or use a terminal program connected to CTR2-Flex to set the SSID.
	3	**PW**	Set router's password. Touch to open a screen editor or use a terminal program connected to CTR2-Flex to set the password.
8	**1**	**AutoConnect**	Enable or disable WiFi auto connect. When enabled CTR2-Flex will try to connect to the WiFi network when it is first powered up. *You can override this setting by pressing and holding the **M5** button during boot.*

8	**2**	**Flex Adrs**	Set the radio's IP Address. Touch to open the screen editor or use a terminal program connected to CTR2-Flex to set the IP address. The address can be found in the *Settings -> Radio Setup… ->Network* tab in SmartSDR.
	3	**Flex Port**	Set the radio's IP Port. Touch to open the screen editor or use a terminal program connected to CTR2-Flex to set the IP port #. This is normally **4992** but you can change if you're changed it on the radio or are connecting to the radio from outside your LAN.
9	**1**	**Import Settings**	Import settings from a previously exported setting file using XModem. In Tera Term select *File->Transfer->XMODEM->Send* and select a previously saved settings file on your computer. Next, touch **Import Settings** to start the transfer. See the Backing Up and Restoring Setting section for more information.
	2	**Export Settings**	Backup CTR2-Flex's settings by exporting them to a file on your computer. To do this, in Tera Term select *File->Transfer->XMODEM->Receive* then enter the name of the file you wish to save. Next, touch **Export Settings** to start the transfer. Once this file has been saved you can recover from a unintended memory erase when flashing new firmware by using the **Import Settings** option above. **NOTE:** You can select to export just your unit's basic settings or the basic settings and all of the favorite frequency lists.
	3	**Info**	Displays version #, call sign, and registration key. If the unit is connected to WiFi the RSSI is displayed too.
10	**1**	**Ring Mode**	Selects the operating mode of the gray ring on the display. See Ring Control Options for a complete discussion on *Ring* modes.
	2	**Rotate Screen**	Rotates the screen 90 degrees for each selection. This allows the screen to be aligned for various M5Dial mounting configurations.
	3	**Touch Delay**	Enables or disables a 120-millisecond delay on touch input. This can be used to reduce unintended touch events and occasional randomly generated touch events from the M5Dial touch sensor.
11	**1**	**Run CTR2-Dial**	Select this option to switch to **CTR2-Dial** firmware on your unit. **CTR2-Dial** uses Bluetooth or USB MIDI to control a 3rd party app such as Marcus' (DL8MRE) SmartSDR for iOS/Mac. It is not compatible with SmartSDR for Windows. For more information on **CTR2-Dial** refer to the *CTR2-Dial Operation Manual*.
	2	**Restore to Start Up**	This option allows you to reset your settings to what they were when you first booted CTR2-Flex, *if you didn't choose to reset your call and registration key in* ***Reset to Factory***. This is handy in case you want to "roll back" changes you made during the current session.
	3	**Demo Mode: Edit Call & Key** **Normal Mode: Reset to Factory**	**In Demo Mode:** This option allows you to enter your call and registration key without using a terminal program. To enter text, use the ring encoder on the M5Dial or turn Knob A to select a character and touch the display or press and turn Knob A to move to the next character. Press **OK** to accept. You can also connect a terminal program and use the terminal keyboard to enter your call and registration key. **In Normal Mode:**

11			This option resets CTR2-Flex's configuration back to the original factory settings. **NOTE:** You have the option of resetting your call sign and firmware registration key. **NOTE:** If you reset the configuration by mistake, and didn't choose to reset your call and registration key, execute the **Restore to Start Up** option to restore your settings before powering the unit down.

Dashboard

CTR2-Flex firmware includes a second method to control the radio called the **Dashboard**. To enter this mode, select **DashBrd** from the **Home** menu.

Dash Home Page

The dashboard's **Home** page displays the frequency along with buttons to select various command groups.

The small inverted triangle above the caption indicates that **CTR2-Flex** is connected to WiFi and to the radio.

When online the caption will display the active slice. Touch the caption to open the Panadapter window to change the active slice.

Touch any element on this page to select or execute that item or open its associated menu.

You can lock the VFO frequency by long-pressing any of the frequency digits. Unlock the VFO using the same method.

The VFO frequency is always selected on the **Home** page as shown here. Turning the knob assigned to **<DAIL>** changes the frequency by the selected step digit (the red digit, 1 kHz in this example). You can change the step simply by double-touching another digit in the frequency or by pressing and holding the knob assigned to **<DIAL>** then turning it CW or CCW. To select the ½ step (5, 50, 500, 5000, etc.) using the touch method, touch the selected step digit again.

Knob Control

The selected parameter in the Dashboard can be adjusted by either swipe method (explained next), or by turning the knob assigned to the **<DIAL>** function.

To use the knob on a **CTR2-Uno** (and older single-knob **CTR2-Flex** or **CTR2-Dial**) hardware, it must be set to **<DIAL>** in the *Knob* menu. On **CTR2-Duo** (and older dual-knob **CTR2-Flex** and

CTR2-Dial) hardware, *Knob A* is generally used as the dashboard parameter control knob, unless you've changed its default setting from **<DIAL>** in the *Knob A* menu. On dual-encoder units, *Knob B* can be set to **<DIAL>** in the *Knob B menu* and used as a dashboard parameter control knob.

On **CTR2-Quad** hardware, any knob can be assigned to the **<DIAL>** function and then be used to control the Dashboard's parameters.

Swipe Method

When you touch an adjustable parameter in the dashboard, the selection indicator around the that parameter turns red indicating that swipe adjustment is enabled. To change the parameter's value, simply swipe your finger to the *left* or to the *right* anywhere on the display. On the dashboard **Home** page, swiping below the frequency is recommended so you can see the frequency as you swipe. You can raise your finger and swipe again as long as the select indicator is red. Swipe mode will automatically turn off after 3 seconds of inactivity.

To zero the digits below the selected tuning digit on the dashboard **Home** page, double-touch the **Zero** button on the bottom of the page.

NOTE: If the VFO is locked (by long-pressing the VFO frequency digits), all frequency digits will be "grayed out" and the **Zero** function will be blocked. To unlock the VFO, long-press the frequency digits.

To return to the controller's **Home** page, press the **M5** button on the M5Dial's orange ring.

Touching the other buttons on this page will open their page. These pages will be described next.

Keypad Frequency Entry

CTR2-Flex has a built-in keypad for direct frequency entry. To open the keypad, press **Frq** on the left side of the bottom button on the dashboard's **Home** page.

The current frequency will be displayed on the top of the display in Hertz with the keypad below.

You can edit the current frequency by pressing the **<** button to delete digits to be replaced then entering the new digits. In this mode you must enter all digits to 1 Hz and press the **H** button to accept the new frequency in Hz. Be sure to add any trailing 0s needed.

To enter a new frequency, press the **X** button to clear the current frequency, then enter the new frequency. You can enter the frequency in MHz, kHz, or Hz. Once you've entered the new frequency press the **M**, **K**, or **H** button to accept it. Use the **<** button to delete the last digit in the frequency.

Here are a few examples:

- Entering **10M** sets the frequency to 10 MHz.
- Entering **28.074M** sets the frequency to 28.074 MHz.

- Entering **28074K** also sets the frequency to 28.074 MHz (28074 kHz).
- Entering **2807400H** sets the frequency to 2.807400 MHz. Add another 0 to make it 28.074 MHz.
- Entering **28074020H** sets the frequency to 28.074020 MHz.

Touch **Fav** on the bottom-left button to open the Favorite Frequency page from this page.

NOTE: If the VFO is locked (by long-pressing the VFO frequency digits), this page is not available. Unlock the VFO by long-pressing the frequency digits.

Antenna Page

The **Antenna** page allows you to select the antenna configuration on your radio. Simply touch the antenna option you want to use.

Selecting **XVTA** (or **XVTB** on dual SCU radios) enables **Transverter** mode. This mode adds the 2m, 1.25m, 70cm, 33cm, and 23cm bands to the **Band** page and compresses the frequency display to accommodate the additional digits.

The top half of this page displays the receive antenna options and the bottom half displays the transmit antenna options. Touch a button to select an option.

When you're done, touch the **Esc** button at the bottom of the page to return to the dashboard's **Home** page.

Band Page

The **Band** button (top-center of the dashboard's **Home** page) displays the current band setting on the radio. Touch this button to open the **Band** page.

When either the **XVTA** or **XVTB** transverter options are selected in the **Antenna** page the 2m, 1.25m, 70cm, 33cm, and 23cm bands are added to the **Band** page.

Normal Band Options

Additional Transverter Bands

Touch **Fav** on the bottom-left button to open the Favorite Frequency page from this page.

Touch the **Esc** button at the bottom of the page to return to the dashboard's **Home** page.

NOTE: If the VFO is locked this page is not available. Unlock the VFO by long-pressing the frequency digits.

Filter Page

The current bandwidth is displayed in the top-right corner of the dashboard's **Home** page. Touch this button to open the **Filter** page.

On this page you can change the **Hi-Cut** and **Lo-Cut** frequencies independently and change the filter **Offset** to move the filter within the pass band. The total bandwidth (**3.3k**) is indicated on a button at the center of the 4th row. Touch this button to step the bandwidth down to the next standard bandwidth for the selected mode. If the filter offset has been moved off-center (40 Hz in this example) the **Zero** button is displayed. Touch this button to remove the offset and reset the filter to its default settings.

The selected control (with the blue square) can be adjusted with the knob assigned to **<DIAL>**. You can also enable swipe control by touching the selected control. The select indicator will turn red while swipe is enabled. In swipe mode, simply swipe your finger on the display either to the *left* or to the *right* to change the control. Swipe mode automatically turns off after 3 seconds of inactivity. Touching an unselected control selects it. Touch it again to enable swipe.

RX Page

The **RX** page allows you to change several parameters related to the receiver.

Touch any control to select it. For variable controls, turn the knob assigned to **<DIAL>** to change the setting. You can also touch the selected control to enable swipe mode, then swipe your finger *left* or *right* to change the parameter. The select indicator will turn red while swipe is enabled. You can continue to swipe until swipe mode times out (in 3 seconds).

Touch the **AGC** or **Gain** settings to step through the settings for those controls.

The Volume control has a Mute function. Touch the **Vol** label to toggle mute on and off.

Touch **ESC** to return to the dashboard's **Home** page.

Mode Page

The **Mode** button (center of the dashboard's **Home** page, below the frequency) displays the mode setting on the radio. Touch this button to open the **Mode** page.

In the **Mode** page, touch a mode to switch the radio to that mode and return you to the dashboard's **Home** page. Touch **Esc** to return without changing the mode.

DSP Page

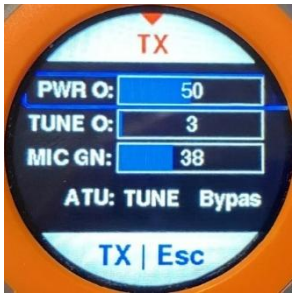
The DSP page allows you to adjust and enable or disable each DSP setting on the radio.

To adjust a setting, touch its gauge to select it then turn the knob assigned to **<DIAL>**. You can also use the touch to select then swipe method described earlier.

To enable or disable a control, touch the control's label. When enabled the control text will be inverted. **Noise Reduction** is enabled in this example. You can also select the control's gauge then touch the **Tgl** button to enable or disable that control.

Touch **Esc** on the bottom button to return to the dashboard's **Home** page.

TX Page



Controls associated with the transmitter are accessed by touching the **TX** button on the **Home** page.

You can adjust the Power Out, Tune Out, and Mic Gain by selecting those gauges.

The knob assigned to **<DIAL>** can be used to adjust the selected parameter or you can enable swipe method to change it.

Both **ATU** buttons require one touch to select the tune function then a second touch (on **EXEC**) on the left-bottom button to execute it.

To toggle the **TX** mode on the current slice, touch **TX** on the left-bottom button. The state of the **TX** mode is indicated by the caption of the page (**TX** in this example). When **TX** is enabled the caption on all pages will be red. When **TX** is disabled the caption on all pages will be the default background color.

You can also open the **Buttons** menu to change **TX** mode on the radio. If you use it a lot you can assign the **Tx Enbl** button on the **Buttons** page to one of the knob switches.

Touch **Esc** on the bottom button to return to the dashboard's **Home** page.

X/RIT Page

Enter the **X/RIT** page by touching the **X/RIT** button on the dashboard's **Home** page.

As with the other control pages, select a control then use the knob assigned to **<DIAL>** or the touch to select then swipe method to change the control's value.

Enable and disable the selected control by touching the control's label or by touching **Tgl** on the bottom button.

When a control is not set at 0 Hz, a **Zero** button will appear below its gauge. Touching this button sets the control to 0 Hz.

Touch **Esc** on the bottom button to return to the dashboard's **Home** page.

NOTE: If the VFO is locked this page is not available. Unlock the VFO by long-pressing the frequency digits.

MISC Pages

The **Misc** page contains several sub-pages. These pages include the **Keyer Settings**, **CW Macro Selection**, **Panadapt1/Slice Settings**, and **Panadapt2** pages.

Touch **PG>** on the bottom button (if available) or turn the gray ring on the M5Dial to move to the next page.

These pages will be described next.

Keyer Setting Page

The keyer's settings can be changed in this page. As in the other dashboard pages you either use the knob assigned to **<DIAL>** or touch to select it then use the swipe method to change the value. Changing the **Speed** setting changes the speed for both the internal keyer on the radio and the keyer in **CTR2-Flex**.

The radio's sidetone can be enabled or disabled by touching the **SdTone** label or the **Tgl** label on the bottom button. There is a physical volume control on CTR2-Flex hardware to adjust the sidetone volume.

> **NOTE:** The radio's sidetone is only available when your paddles are connected directly to the radio and you're using the radio's internal keyer. It is not available when keying the radio with CTR2-Flex over the network.

The **Breakin** button controls the radio's breakin mode.

> **NOTE:** To key the radio, you must have **Breakin** enabled (as shown in photo above) and the current slice must have **TX** enabled. The caption will be red when **TX** is enabled.

The knob assigned to **<DIAL>** can be used to adjust the selected parameter or you can enable swipe mode to change it.

You can step through the keyer **Type** by selecting **Type** then pressing the **Chng** label on the bottom button or by pressing the **Type** label again once it is selected.

When **SdTone** and **Type** are not selected, touch **Pg>** on the bottom button to open the **Panadapter/Slice** page. You can also turn the gray ring on the M5Dial CW to move to the next or previous page if the *Ring mode* is not in **Sync2Dial** or **Selected Control**.

Marco Select Page

This page allows you to select, play, and edit one of the nine CW macros. Macros are listed using the first 5 characters of each buffer. Touch a macro to select it then touch **Play** to start it or **Edit** to edit it.

Once you start a macro the button options change to **Pause**, **Stop**, and **Add**. Touch each button as required. Once a macro has started you can leave this page and let it run.

Touch **Pg>** on the bottom button or turn the gray ring on the M5Dial CW to open the **Panadapter/Slice Settings** page or turn it CCW to open the **Keyer Settings** page.

Touch **Esc** on the bottom button or the **M5** button on the orange ring to return to the dashboard's **Home** page.

Macro Edit Page

Pressing the **Edit** button on the **Macro Select** page opens the editing page for the selected macro.

- Turn the knob assigned to **<DIAL>** to change the selected character
- Touch the screen to move the cursor to that location
  - or -
- Press and hold the knob assigned to **<DIAL>** down then turn it to move the cursor to the next character
- The **^** character is used to insert your registered call into the buffer
- Use the **Ins** and **Del** buttons to insert or delete a character
- Touch **OK** to accept the changes or **Esc** to exit without changing the buffer

NOTE: You can also edit the macros using a dumb terminal such as Putty or Tera Term on a Windows PC or the built-in terminal program in a Mac or Linux. Simply press the # of the buffer to edit (1 to 9) in the terminal.

Panadpt1/Slice Page

The **Panadpt1/Slice** page allows you to change the ranges used on the panadapter and select which slice you want CTR2-Flex to control.

You can access this page directly from the dashboard's **Home** page by touching the caption on the **Home** page.

The normal methods to change the selected value are available, i.e. turn the knob assigned to **<DIAL>** or touch then swipe.

To change the **Slice**, touch either the **<** or **>** button. The new **Slice** character will be displayed inverted. To accept the change touch **Chng** on the bottom button. The controller will disconnect from the radio and then reconnect to the new slice.

To move to the **Panadpt2** page touch the **Pg>** button or turn the gray ring on the M5Dial CW. To move back to the **Macro Sel** page, turn the gray ring CCW.

Touch **Esc** on the bottom button to return to the dashboard's **Home** page.

Panadpt2 Page

The second panadapter page allows you to control the **Average**, **Gain**, and **Black** levels on the panadapter and waterfall.

The two buttons on the 4th row allow you to toggle **Weighted Average** and **Auto-Black** functions.

These functions are also available on the virtual **Dial control**.

Favorite Frequency Page

Access the **Favorite Frequency** page by pressing **Fav** on either the Keypad or Band page. This page displays 10 frequencies that you have visited.

In the Settings menu you can select to save frequencies from all bands to one list (shown in this screenshot) or you can have a favorited frequency list for each band.

Frequency and modes are automatically added to the first unlocked bin on this list when you stop on a frequency for longer than 10 seconds. Modes are represented by their first letter, U=USB, C=CW, etc.

Lock a frequency bin by selecting it then touching **Lock** on the bottom-left button. Locked bins have an asterisk to the right of the mode character. Once locked the bin will not be overwritten by new frequency or mode data. This allows you to freeze your favorite frequencies and quickly return to them. **Unlock** the selected bin by touching **UnLk** on the bottom button.

Touching any frequency bin will highlight that bin and automatically tune the radio to that frequency and mode (if **CTR2-Flex** is online). The bin will be highlighted with a red outline for 3 seconds and **Move** will appear on the bottom left button. During this time, touching **Move** will move the selected bin to the top left position. This allows you to organize your frequency list.

Turn the knob assigned to **<DIAL>** to move to another bin. Favorite frequencies will be restored after a power cycle. Once all of the bins have been locked the list will not accept new frequencies.

Touching a frequency twice will return you to the dashboard's **Home** page.

Press **Esc** to return to the dashboard's **Home** page.

Backing Up and Restoring your Settings

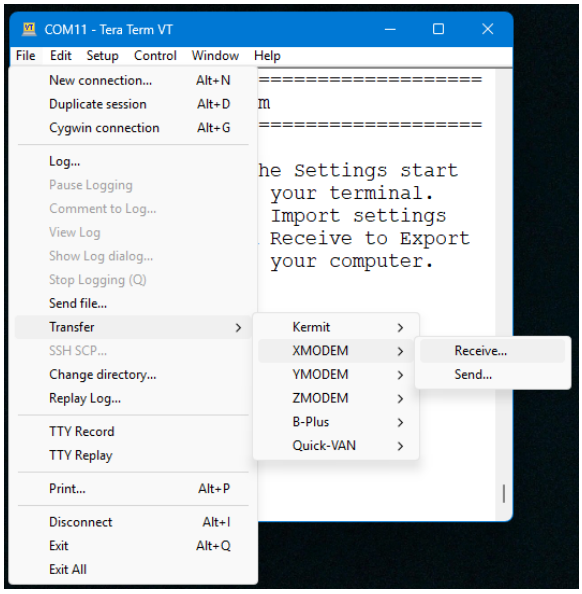
Once you have your **CTR2-Flex** setup the way you want it, go to the **Settings** page and **Export** your settings to a backup file on your computer.

CTR2-Flex uses the XModem file transfer protocol to transport settings to and from backup files on your computer. XModem is an older protocol and not many dumb terminal programs support it anymore. Tera Term does and I'll use it in the document. Putty does not. To get XModem functionality with Putty you need to download and install ExtraPutty. This program is a branch of Putty. You can download it from here.

Before you can use the **Import Settings** option you must export the settings on your **CTR2** unit once you've made changes. If you want to just return to factory settings, select the **Reset to FACTORY** option in the **Settings** menu.

Export Settings

To export the current settings in **CTR2-Flex**, connect your dumb terminal to your **CTR2** unit then open its XModem transfer utility. On Tera Term, open the *Files->Transfer->XMODEM->Receive* option shown here.



When you select this option Tera Term will ask you to enter the file name for the file you want to create. Navigate to the folder you want to save it in then give it a name. I prefer to use the *.txt* extension but you can use any extension you want.

NOTE: If you don't enter an extension, your file will not have one, which can confuse Windows.

When you click OK Tera Term will open the XModem transfer window and wait for the transfer to start. At this point, touch the **Export Settings** option in the **Settings** menu.

You have the option to export just the unit's basic settings or the basic settings and all of the favorite frequency lists. If you plan on sharing your settings with other users, just export the basic settings so you favorite lists don't overwrite theirs.

The transfer should complete in a second or two and you should have a new file in your backup folder. You can view this file with a text editor. I don't recommend editing the values in this file because invalid values may cause problems with CTR2-Flex's program.

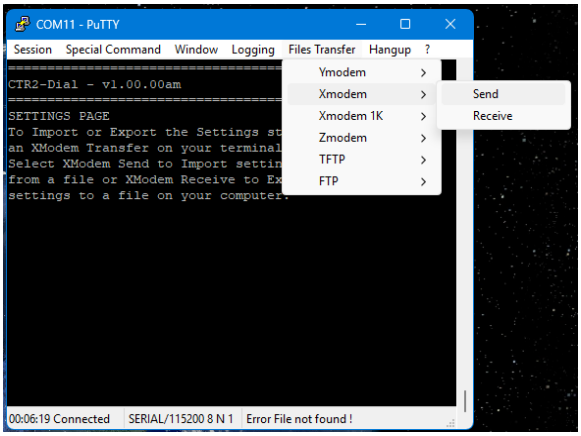
Import Settings

Now that you have a backup file of your settings you can import them at any time. This is handy if, for instance, you select **Erase** in the *EspressIF Flash Download* tool. This will clear all the memory on your **CTR2** unit including all of its settings.

To import a settings file in Tera Term, navigate to the *File->Transfer->XMODEM-Send* option. Once there, Tera Term will ask you to select a file from your backup directory. Select one of the files you previously saved using the **Export Settings** option. Tera Term will then open the file transfer window and wait for **CTR2-Flex** to tell it to start. Touch the **Import Setting** button to start the transfer. It should only take a second or two. Once it completes your **CTR2** unit will load the new configuration.

NOTE: Backup files from v1.xx firmware are not compatible with v2.xx firmware.

If you use the XModem transfer option in ExtraPutty as shown here, use the *Xmodem* option, not the *Xmodem 1K* option.



Flex Radio CW Zombie Mode

Occasionally the Flex radio exhibits an odd problem when keying over the network. The radio can go into what I call **CW zombie** mode. This happens occasionally when connecting and disconnecting multiple clients to the radio that send remote keying commands (at least I think that's what causes it).

In **zombie** mode the radio looks like it is transmitting CW, the light on the front panel turns red, the TX icon turns red, the MOX button turns blue *but* ***no RF carrier is generated*** *or displayed on the panadapter.* The only way I have found to get the radio out of zombie mode is to disconnect all clients and power cycle the radio.

Appendix A: Installing or Updating CTR2-Flex Firmware

CTR2-Flex firmware is pre-installed on assembled **CTR2** units supplied with the M5Dial controller. If you're using your own hardware, you'll need to install the firmware yourself.

Starting with v2.00.00, **CTR2-Dial firmware became part of the CTR2-Flex firmware package**. As of v2.03.05, **CTR2-Flex/Dial** firmware is now distributed as a single BIN file. This simplifies the installation process and reduces the possibilities of entering the wrong offset address for individual BIN files. The address of the single BIN file always starts at **0x0**. Instructions for switching between the two firmwares can be found here.

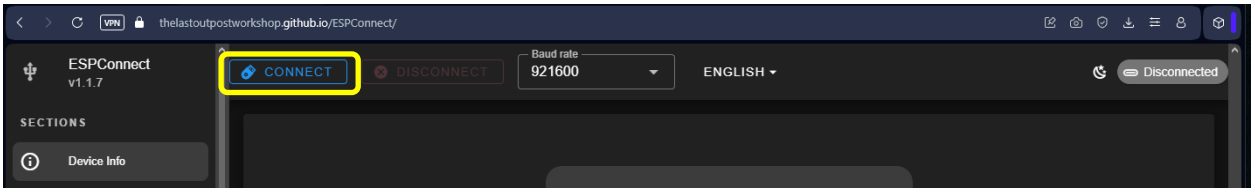
Before you begin, download the latest **CTR2-Flex/CTR2-Dial** firmware from my web site. Unzip the firmware distribution zip file into a folder.

Installing Firmware using ESPConnect (New Method)

By far, the easiest, and recommended method to install or update firmware on an ESP32 process is by using ESPConnect, an open source ESP32 management project.

ESPConnect is a browser-based tool that must be opened on a Chromium-based browser that supports Web Serial, such as Chrome, Edge, or Opera. It will run on a Windows PC or an Apple Mac. Unfortunately, Linux doesn't support Web Serial in any browser.

To start, open **ESPConnect** here: https://thelastoutpostworkshop.github.io/ESPConnect/



Next, plug your **CTR2** unit into a USB port on your computer.

NOTE: Do not connect it to an unpowered USB hub.

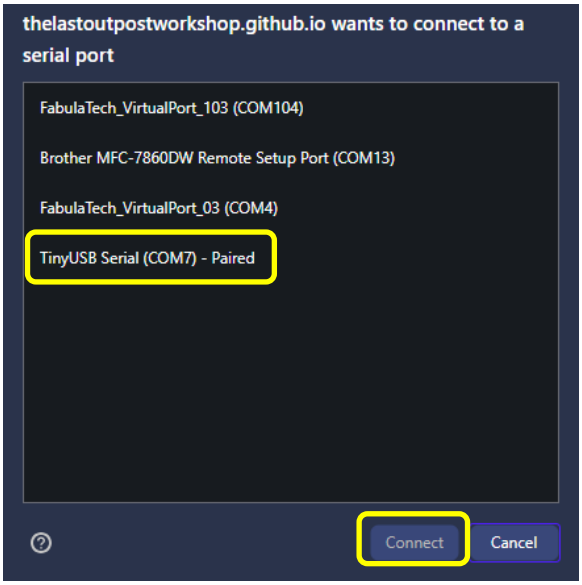
Click the **Connect** button.

A device list will pop up showing the available USB devices on your computer.

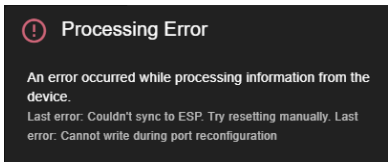
On a Windows PCs, all **CTR2** units will be shown as a **TinyUSB Serial** device, as shown here.

On Macs, **CTR2** units based on the M5Dial will be listed as an **M5STACK_DIAL** device.

Select the **CTR2** device and click the **Connect** button.



A popup warning will appear telling you that an error occurred. Some errors may tell you to press the BOOT button on the processor to put it into bootloader mode. You do not need to do this.



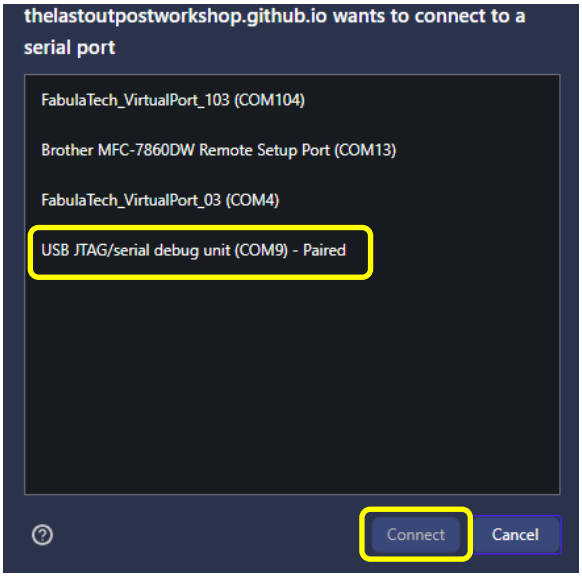
This is the normal response when trying to connect to a **Tiny USB serial** device.

Click the **Connect** button on the home page again.

This time, the **TinyUSB serial** (or **M5STACK_DIAL** on Macs) will not be shown on the list. Instead, a new device, **USB JTAG/serial debug unit** will be shown (on both PCs and the Mac).

This is the bootloader port and the unit is now ready to program.

Select the **USB JTAG/serial debug unit** device then click **Connect**.



Once you're connected to your **CTR2** unit, the left menu items on the page will be enabled.

<<< WARNING >>>
ESPConnect is a powerful device editor. Many of the functions can cause problems with **CTR2** firmware if you change them. If you don't know what a functions does, DON'T CHANGE IT!

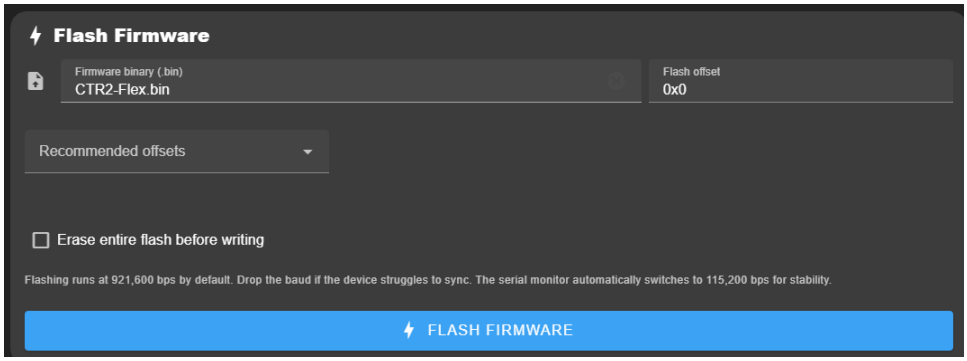
Click on the **Flash Tools** menu item and scroll down to the **Flash Firmware** section.

Click the **Firmware binary (.bin)** text box.

A file navigation screen will appear. Navigate to where you unzipped the firmware zip file from the firmware update page and click on the **CTR2-Flex.bin** file.

Your display should now look like this:

Leave the **Flash offset** set to **0x0** and uncheck the **Erase entire flash before writing** checkbox.



Click the **FLASH FIRMWARE** button to start the flash process.

Once the process completes, cycle the power on your **CTR2** unit. The version # will be displayed when the unit boots. The version # should match the version # from the firmware zip file.

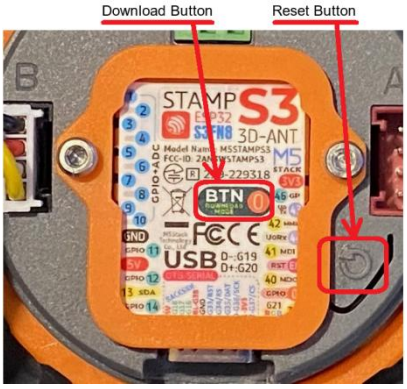
This completes the firmware update process.

Installing Firmware using EspressIF Flash Download Tool (Old Method)

The EspressIF Flash Download Tool is the original flash tool provided by the makers of ESP32 micro controllers. It's geared for developers and many find it difficult to use.

This section will describe the process of using this tool to update your M5Dial. I highly recommend using **ESPConnect**, described above, instead.

You must force the M5Dial into programming mode before you can flash firmware to it. To do this, follow this procedure



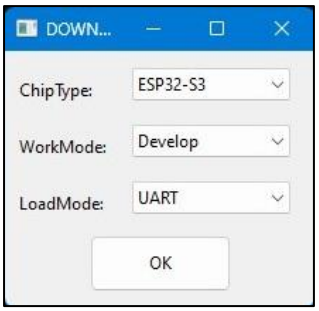
1) Open the enclosure and locate the back of the M5Dail
    a. On 3D printed enclosures remove the four screws holding the base to the shell with a 2mm Allen wrench
    b. On the New Age enclosure remove the four rubber feet on the bottom by pulling them off then remove the four Phillips screws under the feet
2) Press and hold the **DOWNLOAD (BTN)** button on the M5Dial then apply power to CTR2-Flex. The display will be blank when the unit boots into programming mode. If the unit is already powered up, press and hold the **DOWNLOAD** button then press and release the **RESET** button. You should hear a beep from your computer as it registers the new USB COM port and the display will be blank.
    NOTE: If you have problems getting the **DOWNLOAD** button to work its lever may have slipped off the button on the board. Remove the label and flick the lever back onto the button. Thanks Joe, KO8V for the tip!

3) You can now use the procedure below with EspressIF Flash Download tool (on Windows) or run the script (on Linux and Mac) with the new COM port to flash the new firmware to the M5Dial.
4) Once the download completes, cycle the power on the unit to start the new firmware.

Now that you have the M5Dial in programming mode, follow these steps to install or update to the latest **CTR2-Flex/CTR2-Dial** firmware:

1. Download and unzip the latest **CTR2-Flex** firmware from **my web site**. Unzip that file into a different folder than where you store other Lynovation firmware update files.

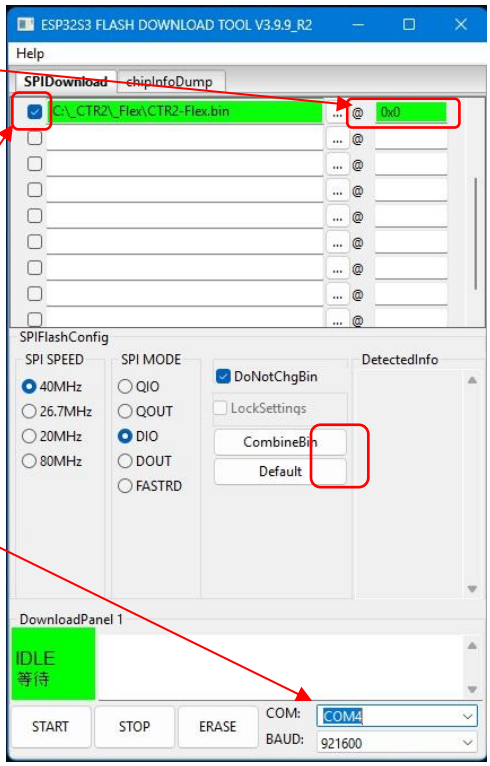
2. Download and open the **EspressIF Flash Downloader Tool**. When it starts, select the **ESP32-S3 Chip Type**. Leave **WorkMode** set to *Develop* and **LoadMode** set to *UART.*



3. Map the **CTR2-Flex.bin** file that you unzipped from the **CTR2-Flex_v2.xx.xx** firmware distribution file into the downloader tool and set the offset address to **0x0**.

4. Select the checkbox on the left of the **CTR2-Flex.bin** filename as shown.

5. Set the **COM:** port to the port assigned to **CTR2-Flex** and set the **Baud:** to 921600.



NOTE: You must use a USB-C data cable. USB-C charge-only cables (supplied with may devices) will not work.

6. On new installs, click the **ERASE** button to clear the factory demo from the M5Dial's memory.

NOTE: If you erase the memory after running the **CTR2-Flex** firmware you will need to re-enter your call sign and registration key, re-select the number of knobs on your unit, and re-enter your WiFi and radio settings the next time you start **CTR2-Flex**. If you previously exported your settings, you can restore them using the Import Settings option in the Settings menu.

7. Click the **START** button to download the firmware.

8. Once the download is complete, cycle the power on the unit to start the new CTR2-Flex firmware.

   NOTE: The ESP32-S3 processor will revert back to its operating COM port after the reboot.

Installing using Linux or Mac

Mac users should use the new method using ESPConnect, described above. Linux users have no other option, other than to follow the procedure below.

A script file is supplied in the firmware update zip file. This script file can be used in a Linux or Mac environment if you don't have access to a Windows computer.

Instructions for using this script file are include in the CTR2-Micro Operation Manual in **Appendix B**.

The firmware that allows USB MIDI control changes the way the virtual COM port works on the ESP32-S3. One COM port is used in the normal operating mode and another COM port is used for flashing the firmware. In order to flash new firmware to the unit you must force the ESP32-S3 to switch from the normal operating mode to programming mode.

To use the script file:

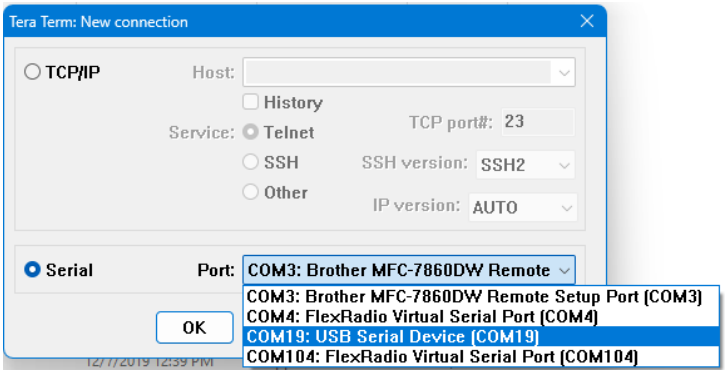
1) Force the M5Dial into programming mode as described above.
2) Edit the COM port in the script to the programming port. This port will be different than the operating COM port.
3) Edit the path to the .BIN file in the script.
4) Run the script.

Appendix B: Configuring Tera Term

On Windows, Tera Term is the simplest terminal program to get running for a serial connection.

If you search for Tera Term you find a lot of garbage with malware attached to it. I've downloaded a clean copy of Tera Term v4.106 and posted it in the **CTR2 Group IO files section**. You can download it here. As far as I know, Tera Term is only available for Windows.

When you first open Tera Term you'll be presented with the **Tera Term New connection** window. Simply select the **Serial** radio button, select the COM port Window's assigned to your Micro when you plugged it in, and click the **OK** button.



Since you are connecting to a USB serial port there is no need to set the baud rate. It will run at USB speed regardless of the baud setting.

That's it! Tera Term should now connect to **CTR2-Flex**. Once connected, press any key to start **CTR2-Flex's** terminal server.

You can change the terminal size in the **Setup** menu. Select **Terminal…** Set the **Terminal Size** to *41 x 20.* CTR2-Flex's terminal interface was designed for this size.

While in the **Terminal…** settings verify the **New-line** options are set to *CR* for both **Transmit** and **Receive** and the **Terminal ID** is set to *VT100*.

You'll probably want to change the font size and colors. These are also changed in Tera Term's **Setup** menu. Select **Display** to change the font and background colors to your liking. Select **Font** to change the font and font size. I like *Courier New*, *Regular*, and *14-point size*. Your preferences may differ.

Once you have the program configured the way you like, select the **Setup->Save Setup…** menu and save your configuration. If you use the default file name, TERATERM.INI the program will automatically start a Telnet session using the COM port you selected above when it opens. This provides one-click access to your **CTR2-Flex** firmware.

Appendix C: Configuring Putty

Putty is a terminal program that can be configured for a variety of needs. **CTR2** controllers based on the M5Dial only supports serial connections. This section describes how to configure the program to interface with **CTR2-Flex**.

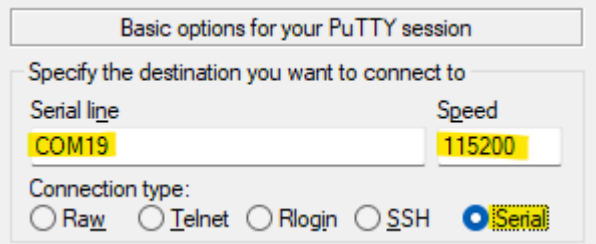
NOTE: Putty does not have XModem transfer capability. If you want to export and import backup files for CTR2-Flex's settings, consider using Tera Term or install ExtraPutty.

Download Putty for Windows from https://www.putty.org/. It's also available for Linux at https://www.ssh.com/academy/ssh/putty/linux and for Mac at https://www.ssh.com/academy/ssh/putty/mac.

You'll need to connect to CTR2-Flex using its USB serial port in order to configure it. Make sure to use a USB data cable, not a "charge-only" supplied with many USB-C devices.

Serial Session

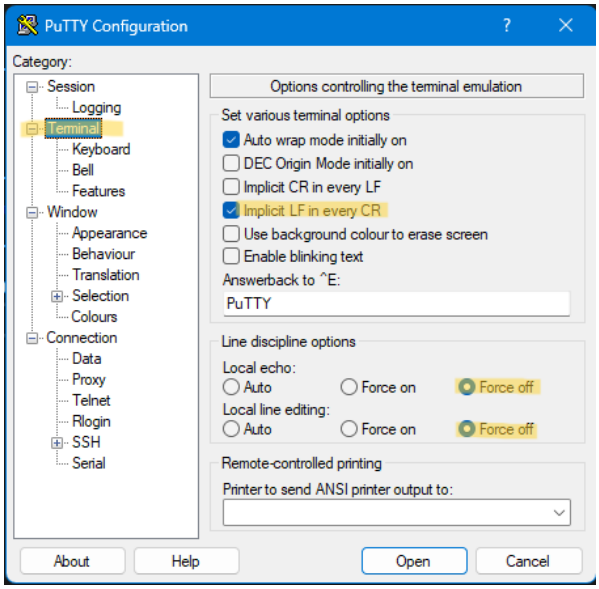
Select **Serial** then set the **Serial Line** to the COM port you found in the Device Manager and set **Speed** (Baud Rate) to 115200.



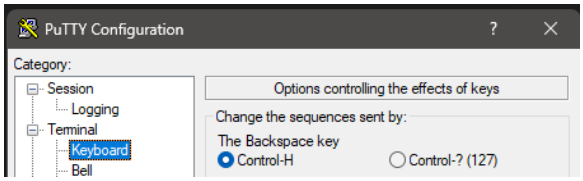
NOTE: Since this is a USB serial port the **Speed** (baud rate) doesn't matter. Data will be sent at USB speeds regardless of the **Speed** setting.

Next, select the **Terminal** item and set the **Implicit LF in Every CR** to on, and **Local Echo,** and **Local Line Editing** to **Force Off**.

You can change the window size under the **Window** item. Set the **Columns** to *41* and the **Rows** to *20*.



Next, select the **Keyboard** menu option and note the setting for the **Backspace key.** If **Control-H** is selected you will need to press **Ctrl+Backspace** to send the **Del** key (ASCII 127). If **Control-? (127)** is selected, press the **Backspace** key to send the **Del** key code.



Once this has been done, return to the **Session** menu item, enter a name for this session and click the **Save** button. This allows you to easily re-open this session with just a couple of clicks.

If you right-click on the Putty icon in the Windows toolbar the last few sessions you had open will be displayed. Just select the one you want to open it.

You can adjust the display colors on the **Windows->Colours** menu item. The Micro uses the **Bold** attribute to highlight the ***hotkeys*** and other items. I like to set the **Background** color to blue and the **Bold** color to yellow but you can find the colors that work for you. After you get a color combination you like return to the **Session** menu and **Save** the session.

Appendix D: Apple or Linux Terminal Programs

The Apple Mac and Linux have built-in terminal programs so there is no need to install a separate app. To connect your **CTR2** unit to a terminal session use the following process.

First, list your current serial ports without your **CTR2** unit plugged in.

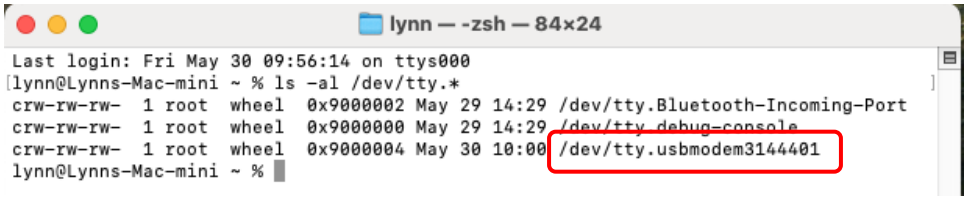
- On the Mac open **Applications/Utilities/Terminal.app**. On Linux open the terminal program supplied by your distro.
- On the Mac, enter ***ls -l /dev/tty.usb****, on Linux, enter ***ls /dev/tty**** This will return a list of all known serial ports.
- Next, plug CTR2-Flex into the computer's serial port and execute the command above again. This is easily done by pressing the *Up* arrow key.
- Compare the new list with the old list. CTR2-Flex's serial port ID will appear on just the new list. For Mac users the serial port ID format will be **/dev/tty.usbserialxxxxx** where **xxxxx** is a unique device ID #. Linux users will see something like **/dev/ttyACMx** or **/dev/ttyUSBx**, where **x** is a unique # for that port.

NOTE: If a new virtual serial port is not created when you plug your CTR2-Flex into your PC make sure you are using a USB-C cable that supports data. Many USB-C cables only provide power to the remote device.

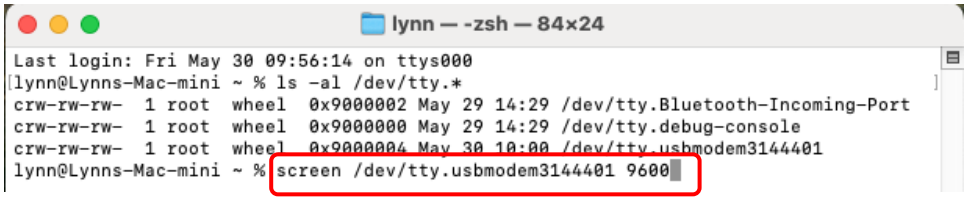
Once you know your **CTR2** unit's USB serial port ID, write it on the label on the bottom of the unit using a fine-tipped permanent marker for future reference. Put a piece of transparent tape over the label to seal the ink so it doesn't rub off (it's not as permanent as you think). You can always remove the tape if you want to change what's written on the label.

Once you have the serial port ID, enter the following: **screen {serial port ID} 9600**. Include the complete device description (i.e. **/dev/ttyxxxxxxx**) for the **serial port ID**. This will open the serial port using 9600 baud in a terminal session. The following screenshots demonstrate these steps.

1. Get the list of serial devices on your computer. We're looking for the **usb** device.



2. Open the **screen** utility using the **usbmodem31444-1** device. Your USB device will have a different numerical #.



3. This is CTR2-Flex's terminal display. Press the indicated key to edit each field.

Appendix E: Power Requirements

The approximate current on an M5Dial equipped **CTR2** unit's USB connection is shown below for various configurations. If you've installed the 3.7-volt lithium battery option, these numbers will help you determine the length of time your unit will run on the battery. The M5Dial doesn't have the hardware necessary to monitor the battery's state of change, so you won't know when the battery is about to be depleted.

WiFi Mode	Backlight	Current
On	High	170 mA
	Medium 2	152 mA
	Medium 1	133 mA
	Low	115 mA
Off	High	121 mA
	Medium 2	105 mA
	Medium 1	82 mA
	Low	70 mA

Appendix F: Change Log

Changes applied to older firmware versions are documented here.

v2.03.06: December 26, 2025

- Additional work on paddle debouncing to eliminate random code elements

v2.03.05: November 10, 2025

- Firmware is now released as a single .BIN file instead of four .BIN files
- Added information on switching between CTR2-Flex and CTR2-Dial firmware modes
- Added paddle release debounce to fix issues with cheaper paddles adding extra code elements
- Improved keyer Bug mode so it works properly now
- Fixed several bugs in the Export and Import Settings functions
    - WiFi credentials and radio IP settings are now encrypted in exported settings files

v2.03.04: October 9, 2025

- Fixed a bug that caused Dial/Flex modes to switch when running unit on lithium batteries
- Fixed a bug that caused the frequency display to appear whenever a VFO knob is turned
- Added CW Macros 1 to 5 and Macro Stop to Flex mode's Button menu
- Removed Keyer Weight in Flex mode (not used) – replaced with Sidetone Pitch control

v2.03.03: September 16, 2025

- Added Touch Delay On/Off to **Setting** menu to enable or disable the 120-millisecond delay on touch events that was added in v2.03.02
- Display selected Rx antenna on the dashboard home page

v2.03.02: September 10, 2025

- Added 120 mSec debounce to screen touch – Some M5Dials send random touch events
- NOTE: v2.02.01 was released for one day but had bugs in the debounce code

v2.03.00: September 4, 2025

- **Fixed major bug causing radio to reset when disconnecting CTR2-Flex from WiFi**
- Added option to save favorite frequencies per band or for all bands
- Added Edit Call & Key option to Setting menu – allows you to enter your registration credentials without a terminal program

v2.02.00: August 18, 2025

- Added **Ring Control** options – you can now assign a dial function to the gray ring encoder on the display
- Removed the **Mono** option on the **Dial** menu and replaced it with **LnO-Gn** (Lineout Gain) to set external speaker drive.
- Documented how to set up you CTR2-Flex to use an external keyer and/or hardware PTT switch on the Paddle Input jack.
- Added a VFO Lock option

v2.01.01: August 10, 2025

- You can now choose if you want to reset your call and registration key in the Reset to Factory option.

v2.01.00: August 7, 2025

- Added extended frequency support for transverters. Selecting **XVTA** or **XVTB** on the Antenna page in the dashboard adds 2m, 1.25m, 70cm, 33cm, and 23cm bands to the Band page.
- Fixed a bug that was causing unpredictable control states on radios with **multiFlex** enabled.
- Removed the **Knob A** double-click to toggle the radios' TX mode and now allow the switch on **Knob A** (and **Knob B** on dual-encoder units) to be assigned to execute any **Button** function.
- Rearranged the Antenna, Band, and Mode pages in the dashboard.
- Added a new link to download Tera Term. Get it from the CTR2 Group IO File folder here.

v2.00.00: July 24, 2025

- Combined CTR2-Dial firmware with CTR2-Flex firmware
    - Firmwares are independent of each other
    - If you migrate from CTR2-Dial v1 to CTR2-Flex v2 firmware your settings from CTR2-Dial v1 will be applied to CTR2-Dial v2 and be available when you switch to CTR2-Dial mode
    - This manual covers the CTR2-Flex firmware – see the CTR2-Dial Operation Manual for CTR2-Dial firmware information
    - Select which firmware to run in the Settings menu
    - This firmware is compatible with both CTR2-Dial and CTR2-Flex hardware
- Added toggle **TX** control of the current slice to the CTR2-Flex **Dashboard – Tx** page

v1.01.00 – July 21, 2025

- Added additional information to Appendix A on preparing CTR2-Flex to flash firmware

v1.01.00 – June 28, 2025

- Added Favorite Frequency page to Keypad and Band pages
- Start on WiFi Connect when starting without WiFi AutoConnect enabled
- Bumped v1.00.09 to v1.01.00 since Favorite Freq is a feature addition

v1.00.08 – June 16, 2025

- Added formatted frequency display to Dial VFO control
- Added double-click to toggle TX enable mode on/off
- Darkened Orange and Green theme colors for better contrast

v1.00.07 – June 9, 2025

- Added **Panadapter Page 2** to the **Misc** pages to add controls for the panadapter and waterfall – these are also included in the virtual Dial menu
    - Added **Average**, **Gain**, and **Black** level controls
    - Added **Weighted Average** and **Auto-Black** buttons

- Added a **Mute** function to the **Volume** control

v1.00.06 – June 4, 2025

- Added a Breakin button to the Keyer menu to control breakin mode
- Caption now shows if transmit is blocked because TX is not enabled or keyer is not in breakin mode
- Bug fix: not saving radio settings when changing slices

v1.00.05 – June 3, 2025

- Don't force keyer mode on radio to Straight if not in CW mode or TX is not enabled

v1.00.04 – June 1, 2025

- Fixed bug that was causing multiple controllers to follow the frequency of the slice that had Tx enabled
- Added **Tx Enable** control to enable Tx in the selected slice
    - Added **Tx Enbl** to page 4 of the **Buttons** menu
    - Press and release **Knob A** to toggle **Tx Enable** on any screen
    - The screen caption text turns red when TX is enabled

v1.00.03a – May 30, 2025

- Added Appendix D with information on using the **screen** command in Mac and Linux for a terminal interface

v1.00.03 – May 23, 2025

- Fixed bug in reverse Knob A/B so press & turn Knob A changes frequency step
- Display selected slice as caption in Dashboard Home page
    - Touch Dash Home page caption to open Panadapter page to change selected slice
- The parameter values now follow changes made in SmartSDR

v1.00.02 - May 18, 2025

- Fixed bug in v1.00.01 that was blocking WiFi connection

v1.00.01 –May 17, 2025

- Fixed bug in Dashboard Panadapter controls – swipe to change wasn't working

v1.00.00 – May 15, 2025

- Fixed bugs with **Swap A/B** option when using it on CTR2-Dial hardware

v1.00.00aq – May 10, 2025

- Allow Knob B to change knob functions in the **Knob** menu.
- Added hint on getting to Programming Mode

v1.00.00ao/ap – May 3, 2025

- Added Backspace key to start registration entry and added note about DEL key mapping in Putty
- Automatically enable swipe tuning when selecting a frequency digit in the **Dashboard** Home page.
- Added double-touch to turn on swipe adjustment mode on **Dashboard** pages to accept swipe actions

- Added [Knobs: Swap A/B] option

v1.00.00am – May 1, 2025

- Added left/right swipe to the **Dial control** and the **Dial, Knob**, and **Buttons** menus to switch between pages.

v1.00.00al – April 28, 2025

- Updated all control graphics to match new control graphics in CTR2-Dial
- All controls are now speed sensitive
- Added a new keypad for direct frequency entry to the Dashboard

v1.00.00ae - March 30, 2025

- Added on-screen editing for WiFi SSID, password, radio IP address and IP port
- Display virtual dial when changing settings in dashboard
- Moved dashboard Keyer page in front of Macro Select page
- Can use encoder to select keyer macro to edit – turn to change, press to edit
- Added an **Info** button to the **Settings** menu. It displays version #, call, and registration key

v.1.00.00ac – March 11, 2025

- Added touch & hold to dashboard VFO to unselect it so knob can be used for other settings

v1.00.00aa – March 9, 2025

- Added a new Filter page to the dashboard
- Swapped bandwidth and mode button locations on Dash Home page

v1.00.00 – March 5, 2025 – Initial Alpha Release

- First alpha release on CTR2 user group