CTR2-Flex

Operation Manual

v2.03.06

Updated to firmware v2.03.06

Revised sections for this version are highlighted in yellow

Table of Contents

Introduction

CTR2-Flex 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.

CTR2-Flex hardware uses the same M5Dial touchscreen controller as **CTR2-Dial** hardware and can run CTR2-Flex or CTR2-Dial firmware. CTR2-Flex hardware has the following modifications:

- The simple encoder/paddle jack interfaces on CTR2-Dial were replaced with a custom PCB that uses a I2C port expander IC to add additional I/O capabilities to the ESP32-S3 processor
- The encoders were replaced with units that have push switches
- Support for the CW paddle jack was added for dual-encoder hardware
- A speaker driver, volume control, and speaker were added for greater sidetone volume

Both CTR2-Flex and CTR2-Dial firmware are included in 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 Operation Manual for information about running CTR2-Dial firmware.

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** and **CTR2-Dial** controllers' and 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 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 addre1ss 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 a CTR2-Dial or CTR2-Flex product 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

v2.03.06: 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

Changes to previous firmware versions can be found in Appendix F

System Overview

CTR2-Flex hardware utilizes the M5Dial from M5Stack. M5Dial is small controller based on the ESP32-S3 processor and includes a 1.28" round display and an integrated encoder. 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 version of CTR2-Flex unit uses USB for power. The user can upgrade their unit to use these other power sources if desired.

CTR2-Flex hardware is similar to CTR2-Dial in that it provides one or two external encoders and a 3.5mm CW paddle jack. Unlike CTR2-Dial, the interface PCB in CTR2-Flex allows for two encoders with push switches and the CW paddle jack. It also provides a speaker with a volume control to provide a useable sidetone for CW operation. CTR2-Flex firmware can be installed on CTR2-Dial hardware but you don't get the knob switch feature and the sidetone on CTR2-Dial isn't loud enough for regular use.

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 CTR2-Flex. 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 hardware includes a built-in keyer with sidetone and can 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 CTR2-Flex'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.

Two Controllers / Two Firmwares

As mentioned previously, two versions of firmware and two versions of hardware are available.

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

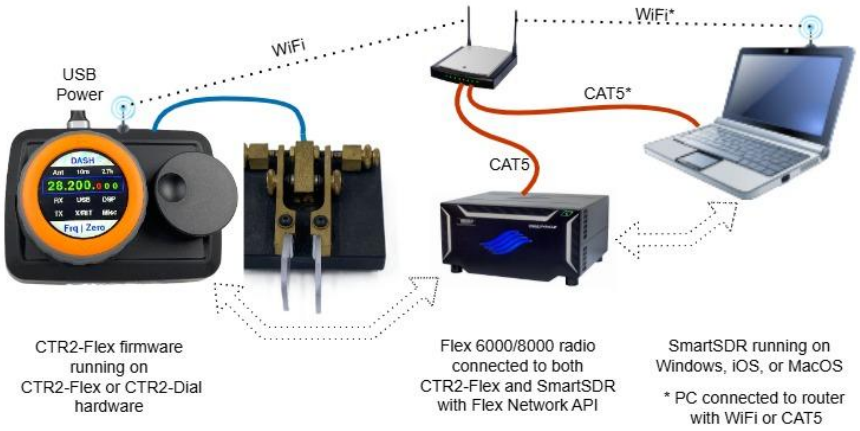
CTR2-Flex and CTR2-Dial firmware can run on either **CTR2-Flex** or **CTR2-Dial** hardware. Starting with CTR2-Flex v2.00.00 firmware you can switch between the two firmwares without re-flashing your unit.

Switching Firmwares

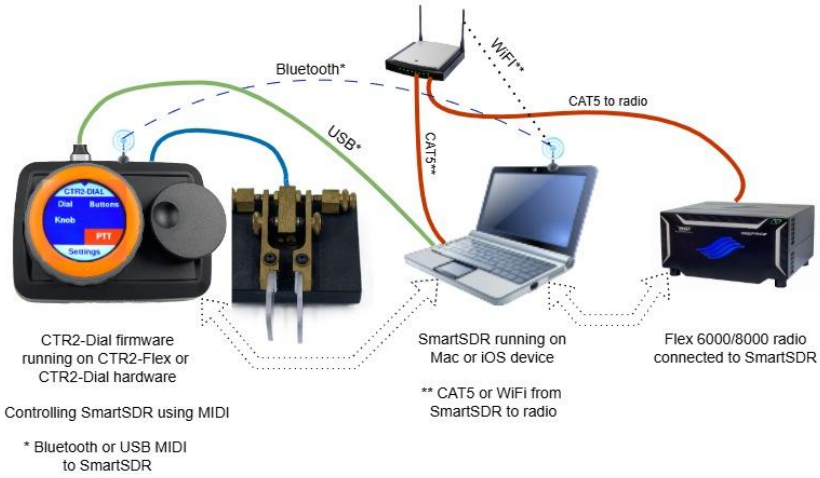
To switch firmwares, open the **Settings** menu and navigate to the last page (page 11 on CTR2-Flex and page 9 on CTR2-Dial) and select *Run CTR2-Dial* or *Run CTR2-Flex*, depending on which firmware is running.

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 **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 **CTR2-Flex** hardware does
- The M5Dial's speaker is used for sidetone on CTR2-Dial hardware – it's pretty quiet

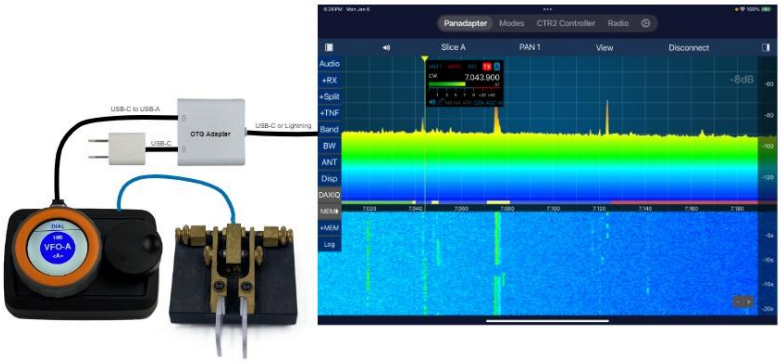
NOTE: If you update your CTR2-Dial v1 firmware to CTR2-Flex v2, your CTR2-Dial settings will be converted to the new file format when you run CTR2-Dial firmware from the Settings menu.

Which firmware you use will depend on your use case.

Power Options

CTR2-Flex hardware can be powered from the computer's USB port, and iOS device's accessory jack using an OTG adapter (also referred to as a Camera Adapter), directly from a newer iOS device with a USB-C cable, a 5-volt cell phone charger, a USB battery pack, an external 6-to-36 VDC power source, or even an internal 3.7-volt lithium battery pack.

In the photo below, CTR2-Flex is connected to an OTG adapter on an iPad running SmartSDR for iOS. This adapter has a USB-C power port and a Lightning connector that plugs into the iPad. The phone charger plugged into the OTG adapter is optional and powers both the iPad and CTR2-Flex when plugged in. For extended battery operation, a 20,000 mA USB battery can be used to power both CTR2-Flex and the iPad. You can power CTR2-Flex directly from the iPad or iPhone through the OTG adapter without an external power supply. Both CTR2-Flex and the iPad must be connected to the same network your radio is on.



The green power jack on the back of the M5Dial allows you power the unit from an external 6-to-36 VDC power supply. This connector is provided with assembled CTR2-Flex units but no external power jack is provided.

CAUTION: If you power your CTR2-Flex from an external power supply (+6 to +36 volts into the green connector on the back of the M5Dial), DO NOT connect the CTR2-Flex to a USB connector on your computer at the same time. Your external power supply's ground may not be at the same potential as the USB ground and the voltage difference may damage your computer.

Using a 3.7-volt Lithium Battery

The M5Dial also has a 1.25mm two-pin connector under the STAMP-S3 processor that is used to connect a single cell 3.7-volt lithium battery. The M5Dial will charge the battery (at around 100 milliamps) so a battery of at least 1000 mAH should be used. The STAMP-S3 processor must be removed to access this connector and it can be very difficult to replace the processor when you're done. This is a user modification. I do not sell battery equipped CTR2-Flex units.

NOTE: When powering the unit using a 3.7-volt lithium battery you must press and hold the M5 button for at least 10 seconds to wake the unit up when using the sleep timers or power off option in the Settings menu.

CAUTION: If you choose to connect a 3.7-volt battery to your M5Dial you MUST verify the battery connector is wired correctly! There is no standard for the + and – power leads on these batteries and there is no reverse polarity protection on the M5Dial. If you connect the battery in reverse, you will probably destroy the M5Dial. For more information see this post: https://github.com/m5stack/M5Dial/issues/14

CTR2-Flex Features

CTR2-Flex is based on the M5Dial from M5Stack. It features an ESP32-S3 processor and includes the following features:

- 1.28” color touch screen with built-in selector ring and hardware pushbutton
- WiFi connectivity – connects directly to the radio
- Multiple CTR2-Flex units can be connected to the same radio, to the same slice or different slices
- Works with any version of SmartSDR (Windows, iOS, or MacOS)
- CTR2-MIDI or CTR2-Dial MIDI controllers can be used in SmartSDR for iOS/MacOS apps at the same time
- 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
- 48 virtual button controls for modes/bands/filters selection
- 30 virtual Dial (wheel/slider) controls for tuning, volume, RIT, XIT, etc.
- Assign the gray Ring encoder on the M5Dial display to any of the available **Dial controls**
- Up to two optional physical encoders (referred to as **Knobs**)
    - Map 12 of the Dial controls to the **Knob** for single encoder units
    - Map 6 of the Dial controls to each **Knob** in dual encoder models
    - Knob push switches can be mapped to virtual button function
- 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
- Nine CW macros
- Swipe tuning and 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
- 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

Hardware

CTR2-Flex hardware is based on an M5Dail touch screen controller. It supports up to two physical encoders with push switches, has a 3.5mm (1/8”) stereo jack to connect your CW paddle, straight key, or external PTT switch, a volume control for sidetone level, and an internal speaker for louder sidetone volume.

This is photo, the CTR2-Flex hardware is installed in a commercial, injection molded, CNC milled New Age enclosure. The M5Dial is mounted on the left and the encoder knob is on the right. The USB-C and 3.5mm (1/8”) stereo Paddle Input jack connections are on the rear of the enclosure and the sidetone volume control is accessible through a hole on the back-left side. Rubber boots are provided to tilt the enclosure for better viewing and control.

A 3D printed enclosure designed by Neil, G7UFO, is also available. This enclosure is well suited for desktop use and looks nice in any station. It is available in a single or dual encoder model. Both include a with 3.5mm (1/8”) paddle jack.

Sidetone Volume Control

CTR2-Flex has a small speaker with a volume control for sidetone. The volume control can be changed with a 1/8” (3.2mm) Phillips screwdriver through a 1/8” hole in the side of the enclosure. The location of this hole depends on the enclosure type and the number of encoders.

Enclosure Type	# of Encoders	Sidetone Volume Location
New Age	1	Right-rear corner
New Age	2	Front-center
3D Print	1	Front-right
3D Print	2	Right side

CTR2-Flex - vs - CTR2-Dial Hardware

CTR2-Flex and CTR2-Dial controllers look and operate almost the same. The major difference is internal.

CTR2-Dial uses the two I/O ports on the M5Dial for discreet devices, i.e. you can have one encoder and a CW paddle jack installed or two encoders installed. Also, the encoders on CTR2-Dial do not have push switches so you can't assign button functions to the knob switches.

CTR2-Flex on the other hand has a port expander PCB plugged into the M5Dial's Port A and a sidetone speaker circuit plugged into Port B. The port expander PCB supports up to two encoders with push switches, and the CW paddle jack. You can assign a button function to each encoder switch.

A volume control is provided to adjust the volume of the sidetone. It is accessible through a 1/8" (3.2mm) hole in the side for the enclosure.

Initial Startup

There are a few tasks you must perform before your CTR2-Flex 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 if built your own hardware and purchased the M5Dial separately. Registration keys are provided for free and installed when you purchase any kit or assembled unit from me or Neil. Users who prefer to source their own parts can purchase a registration key for the firmware at a minimal cost.

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**).

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.

Factory assembled units have the unit's Bluetooth name (CTR2xxxx), 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 terminal server 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** (for dual-encoder 3D printed enclosure units).

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.

NOTE: Always connect the CTR2-Flex to your radio after starting SmartSDR so it connects to SmartSDR 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, at the same time. For instance, you can have SmartSDR for iOS connected as a GUI client, one or more CTR2-Dial units connected to your iPad controlling the SmartSDR app, and one or more CTR2-Flex units 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

While the Flex radio supports multiple slices, 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 switches

When transmit is enabled on the slice CTR2-Flex is controlling, the caption on all windows is displayed in red font.

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-Flex. This can be easily accomplished by changing the following configuration options in the **Settings** menu.

- 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
- 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

The CTR2-Flex firmware supports two user interface models. The first (left screenshot) uses simple menus to select controls and buttons, similar to CTR2-Dial, and will be described next. Use this interface when you just want to use your CTR2-Flex 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 that user interface.

Menu UI

Dashboard UI

Menu 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 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 parameter to control, turn the gray ring on the M5Dial or touch the center label to open the Dial menu.
- **Button** opens the Buttons menu where you can select from 36 functions on six menu pages. Turn the gray ring on the M5Dial to change menu pages or touch the left or right side of the bottom button to switch pages.
- **Knob** opens the Knob menu where you can assign **Dial** controls to the external encoder. If you have a dual-encoder CTR2-Flex unit there will be a **Knob A** and a **Knob B** button on the **Home** page.
- **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.
- **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.

Turning **Knob A** (or **Knob B** on a dual-encoder unit) while in the **Dial Control** will also adjust the value of the control if the **Knob setting** is set to default.

If the gray ring on the M5Dial is in navigation 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.

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 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. You can not edit the control's label.

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.
- **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.

The selected ring mode is indicated by a ½-circle dot next to the WiFi antenna icon at the top of each page. No dot indicates the ring control is in **Navigation** mode. A dot to the *left* of the antenna indicates **Sync2Dial** ring mode is active. A dot on the right side of the antenna indicates a selected dial control is assigned to the ring control.

Navigation Mode

Sync2Dial Mode

Selected Dial Ctl Mode

NOTE: When **Navigation** mode is not selected you must use the on-screen navigation controls to move between menu pages and select **Dial controls**.

The following screenshots should help explain the process of selecting a ring control option.

Navigation mode

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

In this mode, turning the ring will change menu pages or the selected dial control.

No ½-circle dots are shown at the top of the display.

Touch the **Ring: Navigation** button to switch to **Sync2Dial** mode.

Sync2Dial mode

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

Note the ½-circle dot is on the *left* of the antenna icon at the top.

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

Ring Ctl Menu

The **Ring Ctl** menu is similar to the **Dial menu** and is used to assign one of the dial controls to the **Ring** control. There are three pages of menus. Use the **Next** button on the bottom to step to the next page. Touch a control label to assign that control to the **Ring** control. In this example, the **VFO** control is selected.

Press **Esc** to return to the **Sync2Dial** mode without selecting a control.

Selected Dial Control Mode

Once you select a control in the **Ring Ctl** menu you will return to the **Settings** menu and the **Ring:** option will show the selected control.

Note the ½-circle dot is on the *right* of the antenna icon at the top.

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

Dial Menu

Touching the dial # or the center of the dial display (except for the VFO display) 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 mode, turn the ring to switch pages. Otherwise, touch to the left or right on the footer button (**<1/4>**).

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.

To prevent unintended operation, the caption button requires one touch to select the function and one touch to execute the function.

The dial functions are described in the following table.

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	Weight	Keyer Weight
AGC-T	AGC-Threshold	RIT	Rx Increment Tuning	Delay	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

When your unit is equipped with one encoder (**Knob A**), any of 12 knob functions can be assigned to it. If you unit is equipped with two encoders (**Knob A** and **Knob B**), each knob can be assigned one of 6 functions. This is done on the **Knob** page.

The first option (with the asterisk *) always displays the current **Dial Control** setting (**RIT** in this example). When this option is selected, turning the **Knob** will change the parameter selected in the **Dial Control**. When you change the parameter the **Dial control's** is set to, the knob's "*" function will follow.

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**.

To prevent unintended operation, the caption button (**KNOB Pg1**) is a dual-function button and requires a select and execute touch.

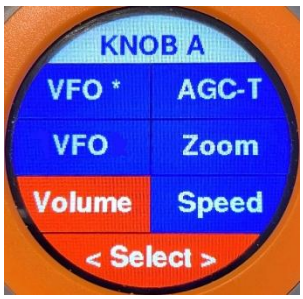
- Touch the *left* side to switch to the **DIAL** control.
- Touch the *right* side to switch to the **Buttons** menu**.**

If the gray ring on the M5Dial is in navigation mode, turn the ring to switch pages. Otherwise, touch the footer button (**Pg->**).

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

Editing the Knob Menu

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



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

NOTE: The first function (*) is changed by changing the **Dial Contrtol's** selection. It cannot be changed in this menu.

The **KNOB** display overwrites the current page anytime the knob is adjusted. The display is identical to the **DIAL** 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 48 button functions. Touching a button immediately sends that control to the radio.

There are 7 pages of buttons with six buttons on each page. If the gray ring on the M5Dial is in navigation 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-function 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.

To prevent unintended operation, the caption button (**BTN MNU**) is a dual-function button and requires a select and execute touch.

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

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

Assigning a Knob Switch to a Button Function (CTR2-Flex Hardware Only)

To assign a button function to each knob's (encoder) switch, do the following:

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

Once you have assigned a function to a **Knob**, the knob's letter will appear in that button's label and that function will be sent to the radio anytime you press that **Knob**. The photo above shows **Knob A's** switch assigned to **Band ^** and **Knob B's** switch assigned to **Band v**. If your CTR2-Flex unit only has one **Knob**, you'll only be able to assign a function to **Knob A**.

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

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 has no effect.

When PTT is set to **Momentary,** touching the screen keys the radio's PTT over the network. Lifting your touch 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.

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 10 pages with three buttons on each page. You must press a button twice to change its setting.

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

If the gray ring on the M5Dial is in navigation 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 #.

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	**Theme**	Select the color theme for the selected Map. Options include Dark, Light, Blue, Orange, Green, Red, and Violet.
	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.
	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	**Power Down**	Immediately closes the WiFi connection and turns off the unit reducing current draw to 14 microamps.
4	1	**# Knobs**	Selects the external knob (encoder) options. Available options are determined by the interface hardware. • Options are **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.
	2	**Knob/Knob A**	Selects Normal or Reverse direction for **Knob A**. Default is **Normal**.
	3	**Knob B**	Selects Normal or Reverse direction for **Knob B**. This option only appears if two knobs are selected in **# Knobs**
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.
	2	**Pitch**	Selects the sidetone frequency for units supplied with **CTR2-Flex** hardware. Has no effect on **CTR2-Dial** hardware. Options are **Off** and **500 Hz to 1000 Hz** in 50 Hz steps.
	3	**Paddles**	Select **Normal** or **Reverse** paddle wiring

6	**1**	**Fav Mode**	Switches the Favorite Frequency list between all bands and single 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	**Future**	Future option
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.*
	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.
	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:** 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 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 CTR2-Flex is connected to WiFi and 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.

Knob A always changes the selected parameter (with the box around it). If you have a dual-encoder unit, **Knob B** can be programmed to change any of the **dial controls** in the **Knob B menu**.

The VFO frequency is always selected on the **Home** page as shown here. Turning **Knob A** changes the frequency by the selected step digit (the red digit, 100 Hz in this example). You can change the step simply by touching another digit in the frequency or by pressing and holding the (A) encoder knob 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.

Swipe Method

When you touch the frequency box the selection indicator around the frequency display turns red indicating that swipe tuning is enabled. To change the frequency, simply swipe your finger to the *left* or to the *right* anywhere on the display. 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. Slider functions in the dashboard also use this method of adjustment.

To zero the digits below the selected tuning digit, double-touch **Zero** at the bottom of the display.

NOTE: If the VFO is locked, 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 **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 to directly enter frequencies. 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 a 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 press the **H** button to accept the new frequency in Hz so 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 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 **Knob A**. 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 **Knob A** 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

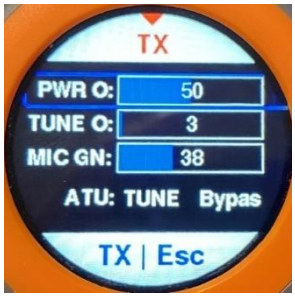
The DSP page allows you to adjust and enable or disable each DSP setting on the radio.

To adjust a setting, touch its gauge to select it then turn **Knob A**. 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.

Knob A 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 **Knob A** 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 **Knob A** or the touch to select then swipe method to change the selected 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.

Knob A 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.

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 **Knob A** to change the selected character
- Touch any character to move the cursor to that character
  - or -
- Press and hold **Knob A** 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 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 **Knob A** 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.

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 **Knob A** 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.

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

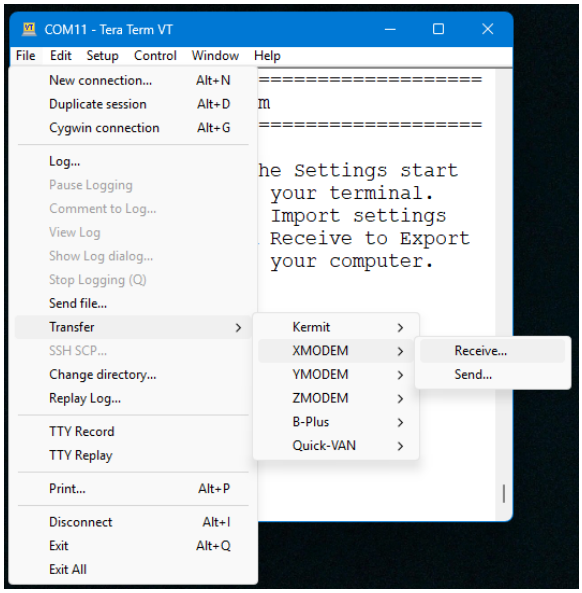
Backing Up and Restoring your Settings

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 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 off of Putty. You can download it from here.

Before you can use the **Import Settings** option you must export the settings on your CTR2-Flex 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 on your CTR2-Flex, connect your terminal to CTR2-Flex 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.

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. 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

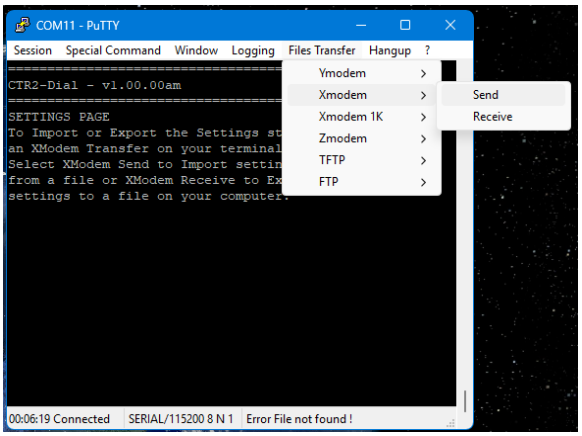
Now that you have a backup file of your settings you can import them at any time. This is handy if, for instance, you select **Erase** in the *EspressIF Flash Download* tool. This will clear all the memory on your CTR2-Flex including all of the setting files.

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 CTR2-Flex will load the new configuration.

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

You can also 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.

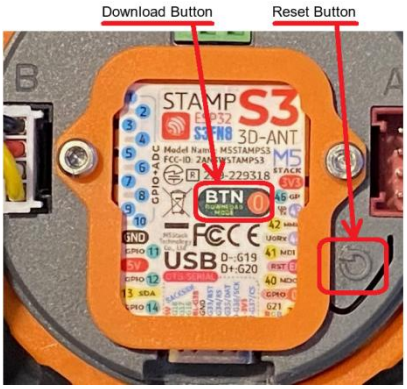
Appendix A: Installing or Updating CTR2-Flex Firmware

CTR2-Flex firmware is pre-installed on assembled CTR2-Flex 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.

UPDATE: EspressIF has released a browser-based version of their Flash Download tool named **ESPLaunchPad**. You can use this version to flash firmware to your CTR2-Flex unit instead of downloading and installing the Flash Download tool described here. For more information, visit https://ctr2.lynovation.com/espressif-browser-flash-download-tool/

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

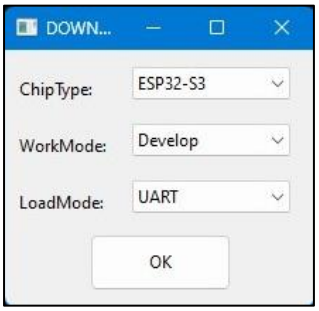


1) Open the enclosure and locate the back of the M5Dail
    a. On 3D printed enclosures remove the four screws holding the base to the shell with a 2mm Allen wrench
    b. On the New Age enclosure remove the four rubber feet on the bottom by pulling them off then remove the four Phillips screws under 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 firmware on

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.*

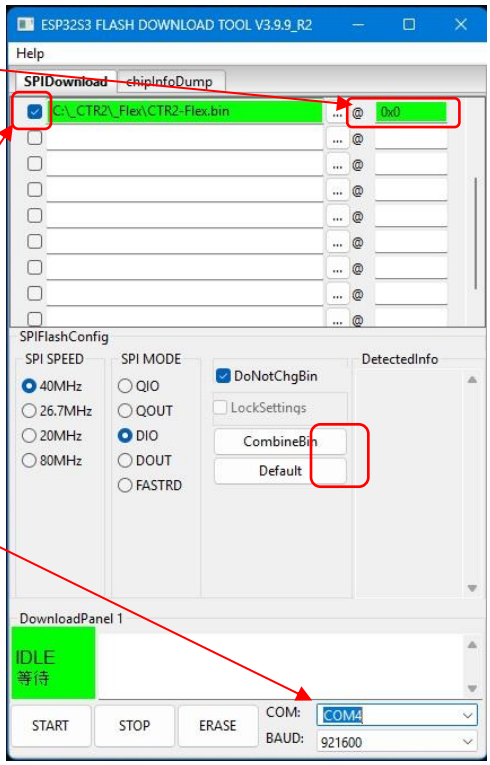


3. Map the **CTR2-Flex.bin** file that you unzipped from the **CTR2-Flex_v2.xx.xx** firmware distribution file into the downloader tool and set the offset address to **0x0**.

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

On Macs you can use the browser-based flash tool called **ESPLaunchPad** instead of using the script below. For more information on this tool visit https://ctr2.lynovation.com/espressif-browser-flash-download-tool/ Currently, Linux based browsers aren't supported in this tool.

A script file is also 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:

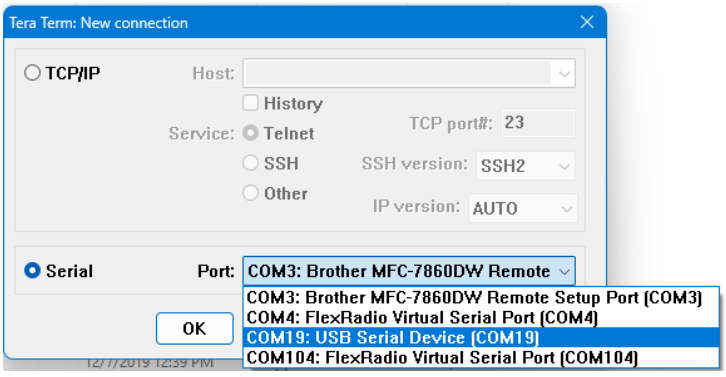
1) Force the M5Dial into programming mode as described above.
2) Edit the COM port in the script to the programming port. This port will be different than the operating COM port.
3) Edit the path to the .BIN file in the script.
4) Run the script.

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*. You're 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.

Appendix C: Configuring Putty

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

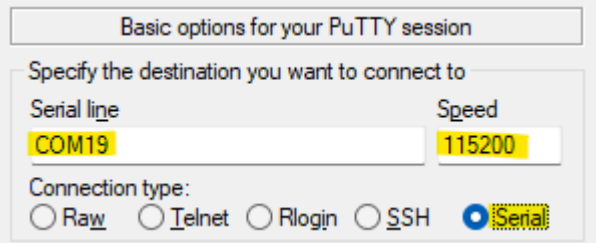
NOTE: Putty does not have XModem transfer capability. If you want to export and import backup files for CTR2-Flex's settings, consider using Tera Term or install ExtraPutty.

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

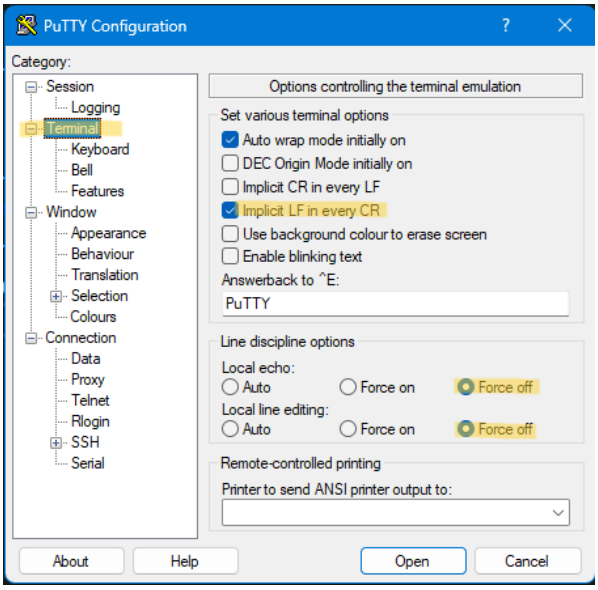
Select **Serial** then set the **Serial Line** to the COM port you found in the Device Manager and set **Speed** (Baud Rate) to 115200.



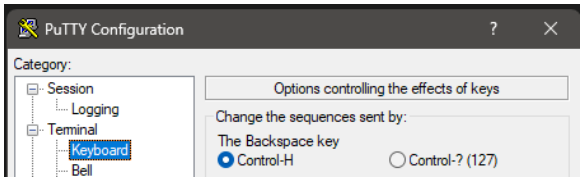
NOTE: Since this is a USB serial port the **Speed** (baud rate) doesn't matter. Data will be sent at USB speeds regardless of the **Speed** setting.

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-Flex to a terminal session use the following process.

First, list your current serial ports without CTR2-Flex plugged in.

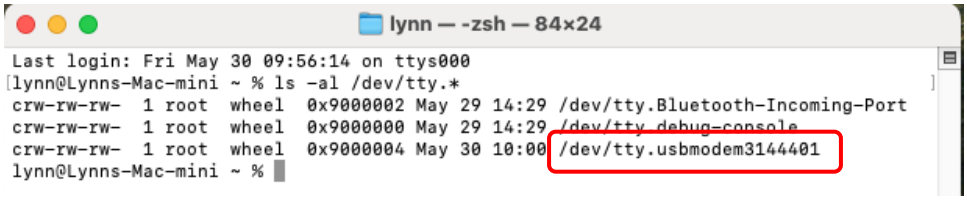
- On the Mac open **Applications/Utilities/Terminal.app**. On Linux open the terminal program supplied by your distro.
- On the Mac, enter ***ls -l /dev/tty.usb****, on Linux, enter ***ls /dev/tty**** This will return a list of all known serial ports.
- Next, plug CTR2-Flex into the computer's serial 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.

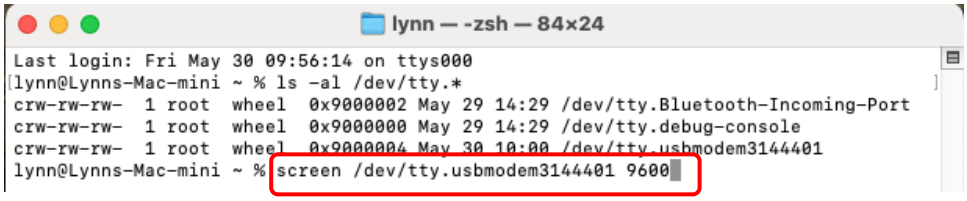
Once you know CTR2-Flex's USB serial port ID, write it on the label on the bottom of the unit using a fine-tipped permanent marker for future reference. Put a piece of transparent tape over the label to seal the ink so it doesn't rub off (it's not as permanent as you think). You can always remove the 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 CTR2-Flex's USB connection is shown below for various configurations.

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.

v2.02.00: 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