CTR2-Dial

Operation Manual

v2.03.03

Revised sections for this version are highlighted in yellow

Contents

Introduction

CTR2-Dial is a custom MIDI controller designed for ham operators. It is based on the popular **CTR2-MIDI** controller's firmware, also available from Lynovation.com. It supports both USB and Bluetooth-LE MIDI connections and is used with radio control programs like Marcus Roskosch's (DL8MRE) apps for iOS and MacOS. It's also at home working with Thetis, Simon Brown's SDR-Console, and SparkSDR to control your Apache Labs ANAN or Hermes Lite 2 (among others) on your Windows computer. It's also a great addition for those that use Remote Ham Radio. It can even be used as a general-purpose MIDI controller.

CTR2-Dial Firmware is Now Part of CTR2-Flex v2 Firmware

The CTR2-Dial's firmware can run on either CTR2-Dial or CTR2-Flex hardware. Likewise, CTR2-Flex firmware can also run on either hardware platform.

Since both firmwares are compatible with either hardware platform, it made sense to integrate the firmwares into a single program. If you use the CTR2-Dial to control a Flex radio this gives you two options:

- Controlling your radio through a 3rd party control app using CTR2-Dial's MIDI control firmware
- Controlling your radio directly (with or without SmartSDR) using CTR2-Flex's WiFi control firmware. Simply select the mode you want to run in the Settings menu. Your unit will run the selected firmware until you change it.

Both programs look and work the same as they did when they were separate. This just makes it more convenient for Flex users that have a need to run both firmwares without having to re-flash their unit.

If you don't run a Flex radio, just select the CTR2-Dial firmware and use this manual for your reference. When you run the CTR2-Flex firmware, refer to the CTR2-Flex operation manual for program information.

NOTE: With a few exceptions for added features, this manual can be used for CTR2-Dial v1.01.01 firmware too.

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.

Some have commented that I use too many hyperlinks in the text. I do this so you can go to any section in the manual and easily navigate back to the descriptions of each control without having to read the entire manual first.

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 before purchasing.
- Software bugs are a fact of life and I try to find and correct all bug reports to the best of my ability ASAP.

Change Log

> **NOTE: You must reset your unit to factory settings (page 7 in the Settings menu) when updating v1.00.xx firmware to v2.xx.xx firmware in order to get the correct mapping. You will also need to update the mapping on your control app and export a new backup file. If you use EspressIF Flash Download tool, use the "Erase" option to reset the unit to Factory settings.**

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
- Added Paddle Normal/Reverse to Setting menu to roll paddle wiring

v2.03.02: September 10, 2025

- Added 120 mSec debounce to screen touch – Some M5Dials send random touch events
- NOTE: v2.03.01 was released for one day – removed it to fixe bugs in debounce code

v2.03.00: September 4, 2025

- You can now enter your registration credentials without using a terminal program.

v2.02.00: August 18, 2025

- You can now edit control labels (and MIDI types for **Dial** controls) without using a terminal program.
- Added **Ring Control** options – you can now assign a dial function to the gray ring encoder on the display
- Added a Tuning Lock option

v2.01.01: August 10, 2025

- You can now choose whether or not you want to reset your call and registration key in the Reset to Factory option.
- Updated the Dial and Button labels in Map 1 so they match the MIDI function mapping in SmartSDR for iOS/MacOS.
  NOTE: You will need to reset your unit to Factory settings to update the labels on you unit.

v2.01.00 – August 9, 2025

- Removed the **Maps and More Maps** section and replaced it with **How CTR2-Dial Works with Your Control App**. Also rearranged and edited sections to make it easier to use this manual.

v2.01.00 – August 7, 2025

- Added the ability to assign encoder switches on CTR2-Flex hardware to virtual buttons
- Added additional information about mapping CTR2-Dial to your control app
- Added a new link to download Tera Term. Get it from the CTR2 Group IO File folder here.

v2.00.00 – July 24, 2025

• Integrated CTR2-Dial firmware into CTR2-Flex v2.00.00 firmware

- This gives you the ability to run either CTR2-Dial MIDI firmware or CTR2-Flex WiFi firmware on the same device
- CTR2-Flex v2 runs on CTR2-Dial and CTR2-Flex hardware
- No functional changes were made to CTR2-Dial firmware when it was integrated into CTR2-Flex v2 with the exception of a few Settings menu items being moved around
- Your current CTR2-Dial v1 settings will automatically be converted and saved to CTR2-Flex v2
- You can run CTR2-Flex from the Settings menu
- If you don't run a Flex 6000 or 8000 radio and/or don't have CTR2-Flex hardware, you can continue running CTR2-Dial v1.01.01

Changes to previous versions can be found in Appendix H

System Overview

CTR2-Dial doesn't "talk" to any radio directly. It uses MIDI commands to tell a radio control app what to do. The MIDI protocol was developed to control musical instruments. It's a very small, simple, and fast protocol. Many radio control apps are adopting MIDI to control their functions instead of proprietary CAT protocols.

The main advantage of using a dedicated MIDI controller like the CTR2-Dial over using a mouse is that the radio control app doesn't have to be "in focus" on your computer for CTR2-Dial to control it. Controls from CTR2-Dial go directly to the app it's registered to. You can change frequency or other parameters using CTR2-Dial while you are entering log data or working in another program.

Like a mouse, CTR2-Dial only sends commands. It doesn't receive information back from the app. It has no idea what the app or the radio is doing. The app manages the user interface and the control communications with the radio.

CTR2-Dial can be powered from a variety of sources including the USB port on your computer or mobile device, a USB phone charger, a USB battery pack, an external 6 to 36 VDC power supply, or an internal 3.7 VDC Lithium battery. See the Power Options section for more information on powering your unit.

CTR2-Dial can connect to your computer or mobile device using either Bluetooth or USB MIDI. For Apple iOS devices Bluetooth works well but can have up to 15 milliseconds of latency so you may notice the delay when using paddles. Windows doesn't support Bluetooth MIDI very well. USB MIDI works well on Windows, iOS/MacOS, and Linux devices and the latency is below 1 millisecond. On older iOS devices with the Lightning connector, you'll need to use an On-The-Go (OTG) adapter to connect CTR2-Dial to USB on the Lightning port. OTG adapters are also called "camera adapters" on Amazon and can be purchased for around USD 10.

NOTE: To use USB MIDI, you must use a USB-C data cable. Many USB-C cables are charge only cables and don't have data lines for communication. If you're using a Windows computer you should hear a beep from the computer when it registers the USB port on CTR2-Dial when you plug it in. If you don't hear the beep, try another cable.

Two Controllers / Two Firmwares

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

CTR2-Dial firmware 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 firmware, on the other hand, works exclusively with Flex 6000/8000 series radios. It connects directly to the radio's server and works in parallel with any version of SmartSDR, including Windows versions.

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

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

This example shows SmartSDR for MacOS controlling a Flex radio, but any other 3rd party app that support MIDI can be used.
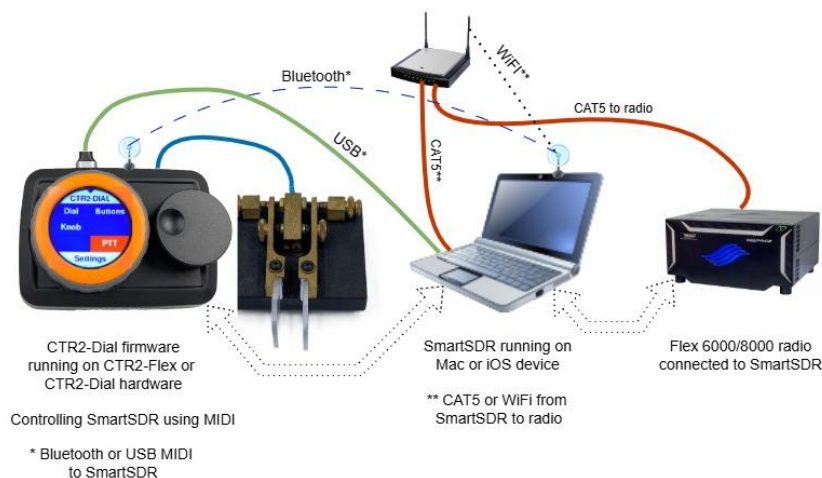
For Flex radio users, CTR2-Flex firmware is great for controlling your Flex radio locally running any version of SmartSDR (or even without the SmartSDR user interface). However, since it doesn't support SmartLink, it presents challenges for remote operation.

When using *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.

The *Flex* firmware includes a dashboard mode that presents radio information and allows control with or without SmartSDR running.
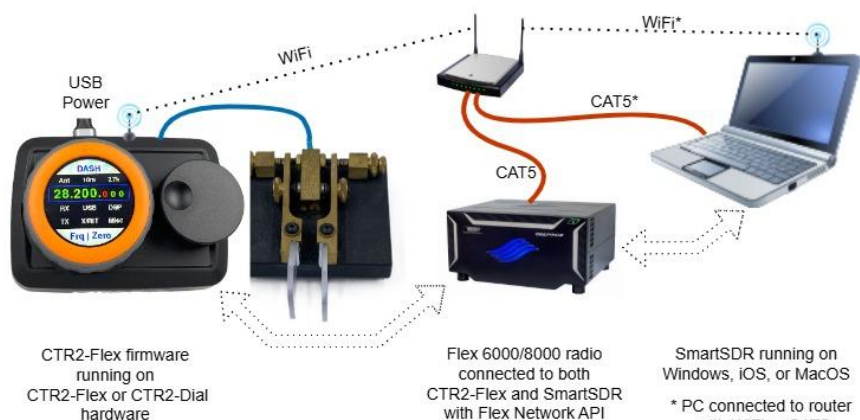
There are a few of advantages when running CTR2-Dial firmware on CTR2-Flex hardware:

- CTR2-Flex hardware has encoder switches so you can assign **Knob** switches to Button functions.

- CTR2-Flex dual-encoder hardware supports the CW paddle input jack where CTR2-Dial hardware does not

NOTE: If you update your CTR2-Dial *v1* firmware to CTR2-Flex v2, your CTR2-Dial *v1* settings will automatically be converted and saved in the new file format.

Which firmware you use will depend on your use case. This manual covers the CTR2-Dial firmware

How CTR2-Dial Works with Your Control App

Before getting into the operation of CTR2-Dial, it's important that you have a basic understanding of what CTR2-Dial does, and how it works with your radio control app.

CTR2-Dial is a MIDI controller with a touchscreen display. The gray ring on the display is used to navigate the menus or can be assigned to control a dial control function. The firmware supports 30 virtual dial controls and 42 virtual buttons. These controls can be executed by touching the display and they can be assigned to the physical knob(s) on the device. The control labels on the display let you know what each control does *if they are properly mapped to functions in your radio control app.*

When you execute a control in CTR2-Dial, a 3-byte MIDI command is sent to your app. The MIDI command includes the MIDI point #, *and depending on the control type*, either a direction for a Wheel control, or a level value for a Slider control. The labels displayed in CTR2-Dial are for your information only and are not sent to the app.

Every app has a function map that you must configure separately. This map tells the app what function to execute when it receives a MIDI command. This map is different in every app. For Marcus' iOS/MacOS apps you can find it in **Tools->CTR2 Dial Controller->Edit Mapping** page.

IMPORTANT: The default labels for the controls for Map 1 in CTR2-Dial are setup to match the default mapping in Marcus' SmartSDR for iOS/MacOS apps. Map 2 is set up for Thetis but you'll need to map Thetis to match the labels in CTR2-Dial.

NOTE: There are six spare dial controls in Map 1 because Marcus only mapped 12 dial controls in SmartSDR. You can use these additional controls by adding a label to each blank control in the Dial Menu. You will also need to edit the MIDI control function map in SmartSDR to match the labels that you add.

Your App Executes the Wrong Control

If you execute a control on CTR2-Dial and the app executes the wrong function you must either edit the label in CTR2-Dial to match the function mapped for that MIDI control # in the app, or edit the app's map to execute the function shown by the label in CTR2-Dial. It doesn't matter which data you change, but they must match.

NOTE: All of the controls in CTR2-Dial are hardcoded to specific MIDI control #s. These cannot be changed.

The 18 dial controls are assigned MIDI control #100 through #117. The MIDI control # is shown on the display just above the label. The Dial Editor allows you to edit the dial's label and MIDI control type.

The 42 button controls are assigned to MIDI control #1 through #42. Buttons are displayed in the **Buttons** menu. MIDI button numbers are not displayed due to size constraints. You can edit the label for each button in the Button Editor.

The table below lists the MIDI button # starting on Button menu page 1, in the order they're displayed.

Page	Buttons		Page	Buttons		Page	Buttons		Page	Buttons	
	1	4		7	10		13	16		19	22
1	2	5	**2**	8	11	**3**	14	17	**4**	20	23
	3	6		9	12		15	18		21	24

Page	Buttons		Page	Buttons		Page	Buttons	
	25	28		31	34		37	40
5	26	29	**6**	32	35	**7**	38	41
	27	30		33	36		39	42

I have posted a video on YouTube describing the mapping process. You can find it here.

NOTE: You can export CTR2-Dial's settings to your computer to back them up, and import them back in as needed. To do this, you must use a terminal program that supports XModem file transfer. Tera Term is the easiest terminal program to use and it supports XModem. Putty and Apple/Linux Terminal programs do not support XModem. More information on importing and exporting settings in CTR2-Dail can be found in the Backing Up and Restoring Your Settings section.

Power Options

CTR2-Dial 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, making CTR2-Dial an idea companion for portable operation.

Current draw when powering the unit with USB are shown in Appendix F – Power Requirements

In this photo CTR2-Dial is connected to an OTG adapter. 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-Dial when plugged in. For extended remote operation, a 20,000 mA USB battery can be used to power both CTR2-Dial and the iPad. You can power CTR2-Dial directly from the iPad or iPhone through the OTG adapter without an external power supply.
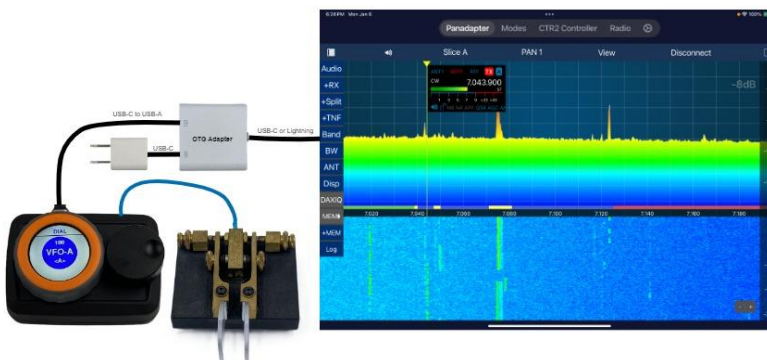
When using the OTG adapter you should turn the Bluetooth radio off on CTR2-Dial and use USB MIDI. This drops the current consumption about 50 milliamps. If CTR2-Dial is powered by a separate power supply (as shown in the photo in the Maps section), use Bluetooth-LE MIDI to connect it to the app.

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-Dials but no external power jack is provided.

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

The M5Dial also has a small 1.25mm two-pin connector to connect a single cell 3.7 volt lithium battery. This port will charge the battery (at around 100 milliamps). The STAMP-S3 processor must be removed to access this connector. Provisions are not included in any of the kits or assembled units to connect a battery to this plug. You can find information on adding this battery online.

CTR2-Dial Features

CTR2-Dial 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
- Support for USB MIDI and Bluetooth-LE MIDI connections
- 42 virtual button controls for modes/bands/filters selection
- 18 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**)
    - Single encoder models can use 12 wheel/slicer controls in the **Knob** menu
    - Dual encoder models each have 6 wheel/slider controls available
- Tuning can be locked to prevent inadvertent tuning
- 3.5mm (1/8") stereo input jack allows you to use your paddles to control the keyer, straight key, or PTT in the app (not all apps support all modes)
- A virtual PTT switch
- Four beep volume levels, Off, Low, Medium, and High
- Automatic speed sensitive tuning & control adjustments
- Two maps allow CTR2-Dial to be used with separate programs
- Adjustable virtual dial sensitivity
- Seven color themes and backlight control
- Sleep and power down timers to save battery power
- Manual power down
- User programmable labels for each button, dial, and knob control
- Many power options
- Turn the Bluetooth radio off to save 50 mA of current draw for battery operation
- Backup CTR2-Dial's settings using the **Import** and **Export Settings** option
- Firmware updating is done through the USB-C port
- Run CTR2-Dial or CTR2-Flex firmware without re-flashing the unit

Hardware

 CTR2-Dial is built with an M5Dail touch screen controller and can be supplied in several different enclosures. It also supports up to two physical encoders and/or a 3.5mm (1/8") stereo jack to connect your CW paddle, key, or external PTT switch.

 In this photo, 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. Rubber boots are also provided to tilt the enclosure for better viewing and control if desired. The rubber boots can be moved to other foot holes to tilt the enclosure to suit your needs.

3D printed enclosures are also available are also available in my shop.

NOTE: The CTR2-Dial with the basic controls (no port expander) has the first encoder (**Knob A**) connected to Port A and Port B is used for either the second encoder (**Knob B**) or the 3.5mm (1/8") stereo jack for CW paddles, key, and PTT). CTR2-Flexl units are equipped with a port expander board and can support two encoders and the paddle input jack.

Registering the CTR2-Dial Firmware

You must enter a registration key for your CTR2-Dial if you don't purchase an assembled CTR2-Dial (i.e. you purchased the M5Dial separately)*.* Registration keys are provided for free when you purchase an assembled unit from me. Users who prefer to source their own parts can purchase a registration key for the firmware at a minimal cost.

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 C, D, or E). Once connected, press any key to start the terminal server on the unit. Next, press the **DEL** 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.

I recommend writing your call and registration key on the unit's bottom label with a permanent pen. Cover it with a piece of transparent tape so it doesn't rub off. This way you'll have it if you reset your unit back to factory settings.

The terminal server will also be used to [edit the control's MIDI types and their labels](#).

MIDI Control Types

Before discussing the CTR2-Dial's functions, it's important to understand the types of MIDI controls CTR2-Dial supports. The table below summarized each function.

Buttons	Application
Button controls	Buttons are implemented using MIDI Note controls. Each button in CTR2-Dial is assigned to a MIDI Note # starting at 1 and continuing to 41. When you execute a button function the program sends a MIDI Note ON command followed by a MIDI Note OFF command to the app for the assigned button.
Wheels & Sliders	**Application**
WheelA	This control is used with Marcus' iOS/MacOS programs and RHR; for frequency control. This control is continuously adjustable and is centered at 64 counts. Frequency up/down control is initiated by sending a value above or below 64 depending on the direction the dial is turned. The offset from 64 counts determines the turning speed.
WheelB	This control is similar to Wheel A and is used with Thetis and most Windows control programs. This wheel sends 126 counts to decrement the frequency by one step and 1 to increment the frequency by one step. When the Dial or Knob is quickly turned the firmware sends 10 commands for each step instead of one to speed up tuning.
WheelB-r	This control is the same as Wheel B except that 1 is sent to decrement frequency and 126 is sent to increment frequency. This control type was added to support the PI HPSDR control program.
SliderA	This control is similar to potentiometer. Its range is 0 to 127 counts. Turning the **Dial** CCW reduces the count until 0 is reached. Turning it CW increases the count until 127 is reached.
SliderB	This control is similar to Slider A except that it is used specifically for RIT and XIT control. This control is centered at 64 counts. Decrementing below 64 counts applies a negative offset and incrementing above 64 counts sends a positive offset. When the value of this control reaches 64 when turning from either direction, CTR2-Dial beeps and pauses for 750 milliseconds. This allows you to zero RIT/XIT. **HINT:** Touching the control's label in the center of the display when the control is "off zero" resets the control to its zero position (64 counts).
Buttons	This control assigns a pair of MIDI notes (buttons) to send up and down control to the control program using the **Dial** or **Knob**. It's only used on Marcus' iOS/MacOS apps for frequency up/down control.

Home Page

The user interacts with CTR2-Dial using the touch screen to select from a series of menus and control pages. The **Home** page is the default display and is titled **CTR2-Dial**. From here you can select the various control pages and **Settings** menu.

There is a single physical button labeled **M5**, (yes, it's upside down) built into the orange ring of the M5Dial. To press it, press the gray ring directly above the **M5** label. It's on the same side as the USB-C connector. M5 is circled on the photo at the right.

The small triangle at the top of the display (just above **CTR2-Dial**) indicates the unit is using Bluetooth to connect to the app.

Press the **M5** button in any control or menu page to return to the **Home** page.

From the **Home** page you can quickly access the **Dial**, **Buttons**, **Knob**, and virtual **PTT** pages or open the **Settings** menu.

Pressing the **CTR2-Dial** caption at the top of the **Home** page will return you to the previously displayed menu or control.

Dial Control

The virtual **Dial** control supports 18 MIDI wheel or slider controls. The dial touch pad is the outer ring around the round center label. Swipe your finger around the outer ring to adjust the control.

Each dial control is assigned a MIDI control number starting at 100 and is shown of the top of the center label. This # indicates the control # you need to map in your app's MIDI function menu to execute this control.

The gray ring on the M5Dial can be used for menu and control navigation, or it can be assigned to any of the dial controls. When used for navigation, turn the ring to select another dial control. If the ring is assigned to a dial control, the MIDI control # to open the Dial menu.

The label for the selected control is shown below the MIDI control #. The label lets you know which function the app is *supposed to* execute for this control. If the label doesn't match the MIDI function mapped in the app, you can edit it to match.

Hint: Quickly change to the **Buttons** or **Knob** 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.

Dial Graphics

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

Control types are set using a terminal program.

The lead photo above shows a wheel control. Wheels are continuously variable and used for tuning. The MIDI control # (100) is shown on the top line of the center circle. The label in the middle (in this case **VFO-A**) indicates the control function and can be edited by the user using a terminal program. **<A>** at the bottom of the label indicates that this is a *WheelA* control.

In addition to wheel controls, you can select from two slider controls.

SliderA control is the most common. The outer touch ring on the **Dial** control represents a gauge with the level indicated by the filled arc that starts on the bottom left. In the photo to the right the volume is set at 26% and the level gage is 26% full. The MIDI control # (101) is displayed at the top of the center label.
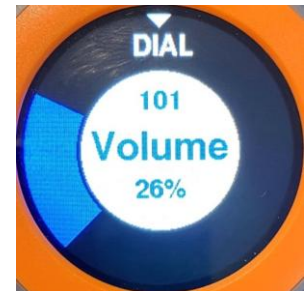
SliderB is used for RIT, XIT, and other +/- offset functions. In this display the offset is represented by an arc that starts at the top center of the display. For negative offsets it grows to the left and for positive offsets it grows to the right from center. The MIDI control # (107) is displayed at the top of the center label.

When the RIT/XIT control is offset as shown, touching the label (**RIT>**) resets the offset back to 0. You can enable/disable RIT/XIT from the **Buttons** menu.

You can also select buttons instead of wheels to be used with a **Dial** control. These are typically used in Marcus' apps that support button up/down controls for frequency control. Generally, you won't use buttons with the **Dial** but the option is there if you want to try it.

Touching the center label opens the **Dial menu** where you can select a control for the dial. You can also rotate the gray ring on the M5Dial to change dial controls.

Shortcut: Touch to the *left* of the **DIAL** caption at the top to switch to the **Knobs** menu or touch to the *right* to switch to the **Buttons** menu. The **Knobs** and **Buttons** menus have the same controls.

Tuning Lock

To lock tuning to prevent inadvertent changes simply long-press the label on a control that is set for the Wheel MIDI type (typically VFO controls). When tuning is locked, the **Dial control** will be "grayed out" as shown here. Adjusting the control, or turning a knob assigned to this control will post a message with instructions on how to reset the lock.

To unlock the control, long-press the label.
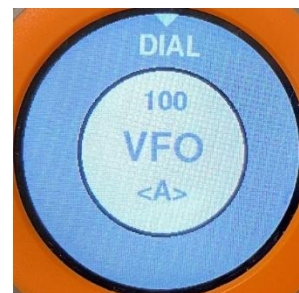
Ring Control Options

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 7.

- **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

If the gray ring on the M5Dial is set for navigation, it can be used to change the dial control's function. Otherwise, to change the virtual dial's function you'll need to open the **Dial menu**. To do this, touch the MIDI control# on the dial control. This menu allows you to select from a three-page menu of dial functions. The current dial setting will be highlighted (**VFO-A** in this example). Touch the left or right side of the bottom button or twist the gray ring on the M5Dial (if in ring navigation mode) to move to the next page.

Touch a button to select that control and return to the virtual dial control, or touch the selected function to return to the virtual dial control without changing the selection.

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.

Hint: Quickly change to the **Knob** or **Button** 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.
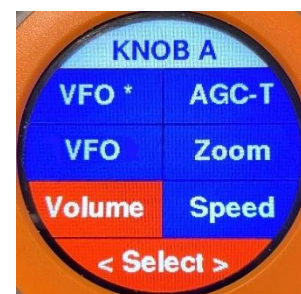
Knob Menu

The **Knob menu** presents up to twelve wheel/slider functions that you can assign to the external encoder (i.e. **Knob**). On dual encoder models each encoder can be assigned one of six wheel/slider functions.

On the photo at the right, the first option (VFO *) is selected. The name of this function has an asterisk (*) next to it indicating that this **Knob A's** function is determined by the **Dial control's** selection. With the VFO function selected, turning **Knob A** while on any page will change VFO frequency. Selecting one of the other five functions on this page assigns it to **Knob A.** On the dual-encoder model shown, each encoder has its own menu page with six functions. On single encoder models there are two menu pages and you can select from 12 functions.
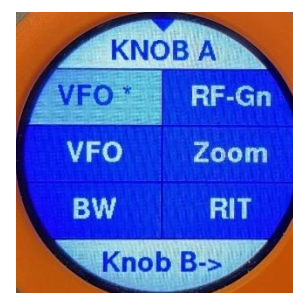
Editing the Knob Menu

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** (or **B**) to scroll through the functions available in the [Dial menu](#).

NOTE: Unlike the **Dial** and **Button** controls, you can edit the MIDI command # assigned to each control in the **Knob** menu using a terminal program. This allows you to map MIDI commands that are not hardcoded to the other controls.

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

To prevent unintended operation, the caption button (**KNOB A**) 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.**

Touch the bottom button (**Knob B->** or **Page 2->**) or turn the gray ring on the M5Dial (if the ring is in [navigation](#) mode) to change the **Knob** menu page.

Selecting the second **VFO** entry in the menu above allows this knob to always be used as a VFO control regardless of the **Dial control's** setting.

The **Knob** page overwrites the current page anytime a knob is adjusted. It is identical to the **Dial control** page but with the title **KNOB** and the page colors are inverted. The current page re-appears 750 milliseconds after you stop turning the knob.

Hint: Quickly change to the **Buttons** menu or **Dial control** page 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** page.

Buttons Menu

Open the **BTN MNU** from the **Home** menu to select from 42 button functions. Touching a button immediately sends the MIDI control for that function.

There are seven pages of buttons with six buttons on each page. If ring navigation is enabled, turn the gray ring on the M5Dial to select a page, otherwise, pressing the *left* or *right* side of the button at the bottom of the display (**m1:1/7** in this photo) to decrement or increment the page.

The bottom button's label indicates the selected Map # (1) and the current button page (1 of 7).

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.

- On the caption button touch the left side to switch to the **Knob Menu** page. Touch the right side to switch to the **Dial** page.
- On the footer button touch the left side to decrement the menu page number. Touch the right side to increment the menu page number.

Press the **M5** button on the orange ring to return to the **Home** page.

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)

When running CTR2-Dial v2.01 and above firmware on CTR2-Flex hardware you can assign a button function to each knob (encoder) switch. To do this:
- 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 behind that button's label and that function's MIDI command will be sent to the app anytime you press that **Knob**. The photo above shows **Knob A's** switch assigned to **Zoom><** and **Knob B's** switch assigned to **Zoom<>**. If your CTR2-Flex hardware only has one **Knob**, you'll only be able to assign a button 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. Simply touch the display to key your radio and lift your finger to unkey. The MIDI control # sent to the app is determined by the **PTT Ctrl #** selected on page 5 in the **Settings** menu.

If your radio control app supports latching PTT, map to that function in your app to the MIDI control # selected for PTT in the settings menu. In latching mode, touching and releasing the display keys PTT. Touch and release the display again to unkey PTT.

The default is MIDI control # for PTT is 99. You can choose from 96, 97, 98, or 99 in the **Settings** menu under **PTT Ctrl**.

NOTE: Controls 20, 21, 30, and 31 are also available in **PTT Ctrl** to allow compatibility with apps such as RHR that are configured for **CTR2-MIDI**. This will be removed once RHR updates their support to include CTR2-Dial.

NOTE: If your radio keys up when you press the PTT display but your microphone doesn't produce power output, check the microphone settings in the app.

Using a Hardware PTT Switch

You can control PTT using a hardware PTT switch (i.e. a hand or foot switch or key) connected to the **Paddle Input** jack on CTR2-Dial. To do this:

1. Connect the switch between the RING and SHIELD (ground) terminals on a 3.5mm (1/8") stereo plug and plug it into the **Paddle Input** jack
2. In the **Settings** menu, set **Pdl In** to **98/99** (or **30/31** if using Remote Ham Radio)
3. In the **Settings** menu, set **PTT Ctrl** to **99** (or **31** if using CTR2-Dial with Remote Ham Radio)

Once configured, pressing the hardware PTT switch will send the MIDI control defined in **PTT Ctrl** to your app to key PTT. Make sure that control # is mapped to PTT or MOX in your app.

If you wire your switch between TIP and SHIELD, set the **Pdls:** option in the **Settings** menu to **Reversed** to roll TIP and RING.

Settings Menu

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

The settings menu is divided up into nine 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**.**

To change menu pages touch on the left or right side if the footer button (**<8/9>** in this example) or turn the gray ring if ring navigation is enabled.

The table below summarizes each setting option.

Page	Btn	Function	Description
1	1	**Beep Mode**	Changes the volume of control beeps: Off, Low, Medium, and High
	2	**Speed Tune**	When enabled, touch and hold the outer ring on the **Dial** for > 1 second to enter speed tuning mode. Valid for *WheelA* and *WheelB*.
	3	**Dial Sens**	Changes the sensitivity of the virtual dial. Range: Low, Medium, High. Default is Medium.
2	1	**Ctrl Map**	Selects control Map 1 or 2. Each map can be configured for a specific radio control app. Use a different color theme for each map. Default is Map 1.
	2	**Theme**	Select the color theme for the selected Map. Options include Dark, Light, Blue, Orange, Green, Red, and Violet. Default is Blue for Map 1 and Violet for Map 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.
	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 USB and Bluetooth connections and turns off the unit reducing current draw to 14 microamps.
4	1	**# Knobs**	Selects the external knob (encoder) and paddle jack options. Options are **None**, **One, Two**, or **Swap A/B**. On units without the port expander PCB the paddle jack interface is plugged into Port B and **# Knobs:** is set to **One**.
	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 on units with two encoders. Default is Normal.

5	1	**Pdl In**	Selects the MIDI control #s mapped to the Paddle Input jack. Default is 96/97 and these are usually mapped to the Left and Right paddle controls in the app. Option 98/99 can be selected and mapped to the Straight Key and PTT options in the app. For compatibility with Remote Ham Radio's mapping for **CTR2-MIDI** you can also select 20/21 and 30/31 pairing. **NOTE:** By default, controls 20/21 and 30/31 are mapped to buttons. Remove these mappings in your app when controlling them with the paddle input.
	2	**PTT Ctrl**	Selects which MIDI control # is mapped to the virtual **PTT** button page. The default 99 is typically mapped to PTT or MOX in the app. Range: 96, 97, 98, and 99. MIDI controls 20, 21, 30, and 31 are also available for compatibility with Remote Ham Radio CTR2-MIDI mapping. To use an external PTT switch, wire it to the RING and SLIEVE of the **Paddle Input** jack and select **98/99** on the **Pdl In** option above and set **PTT Ctrl** to **99**. If using Remote Ham Radio, select **30/31** on the **Pdl In** option and set **PTT Ctrl** to **31**. See Using a Hardware PTT Switch.
	3	**Pdl Normal/Rev**	Swaps the TIP and RING inputs on the **Paddle Input** jack.
6	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.
	2	**Export Settings**	Backup your CTR2-Dial'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 also use the import/export options to create setting files for different radio control apps.
	3	**Info**	Displays program version #, registered call sign, and registration key
7	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.
8	1	**Edit Dial Setting**	Opens the Dial control label and MIDI control type editor. See Editing CTR2-Dial's Labels and Control Types for more information on dial labels and MIDI control #s.
	2	**Edit Btn Label**	Opens the Button label editor. See Editing CTR2-Dial's Labels and Control Types for more information on button labels.
	3	**BT**	Turns the Bluetooth radio on or off. When using a USB connection to your radio control app you can turn the Bluetooth radio off and save about 50 milliamps of current draw.

9	1	**Run CTR2-Flex**	Available on v2.xx firmware. Shuts down the CTR2-Dial MIDI controller firmware and restarts the unit with CTR2-Flex WiFi controller firmware.
	2	**Restore to Start Up**	This option allows you to reset your settings to what they were when you first booted CTR2-Dial, *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 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 will be given the option to reset 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.

Label and Settings Maps

CTR2-Dial supports two maps for control settings. Select the map you want to use on page 2 of the **Settings** menu. These maps store control labels and MIDI control types for the dial controls. They do not change the MIDI command #s assigned to the controls in CTR2-Dial. You must *edit your apps' map* to change the *function* the app executes for MIDI command #'s that CTR2-Dial sends.

You can edit the labels and control types in each map to fit your needs. For instance, you can configure Map 1 to contain the labels and control types for SmartSDR and Map 2 for labels and control types for SDR-Control. Simply switch maps to match the app you're using.

HINT: I recommend using different color themes on each map so it's easy to determine which map you're using.

Editing Labels and Control Types

Prior to v2.02.00 firmware, to edit the labels or MIDI control types associated with each control in CTR2-Dial you had to run a terminal program such as Putty or Tera Term. Refer to Appendix C, D, or E for information on connecting to a terminal.

v2.02.00 adds additional editing options. You can now choose from two new control editors that allow you to edit the properties associated with CTR2-Dial' Dial and Button controls without using a terminal.

The Dial editor allows you to edit the label and the MIDI control type assigned to each Dial control.

The Button editor allows you to edit the label associated with each Button control.

These editors can be found on page 8 in the Settings menu. For more information on how CTR2-Dial controls your radio control app, see How CTR2-Dial Works with Your Control App.

Dial Editor

When you select the **Edit Dial Settings** option the **EDIT DIAL** menu opens. This menu is similar to the **Dial menu** in that it has three pages of dial controls to choose from. The selected dial control will be highlighted, but it's not used in this menu.

Turn the gray ring on the M5Dial (if ring navigation is enabled), or touch the left or right side of the bottom button (**< 1/3 >**) to select a menu page.

Touch the label of the dial control you want to edit to open the edit page.
Touch the **EDIT DIAL** caption to cancel this mode and exit back to the **Settings** menu.

The MIDI control # for the selected dial control will be displayed in the caption of the edit page. MIDI control # is hardcoded and cannot be edited.

The edit cursor will highlight the character to be edited ("V" in this example). Turn **Knob A** to change the character. Touch **Next** to move the edit cursor to the next position, or touch another character position to move the edit cursor to that position. There are eight characters available for labels.
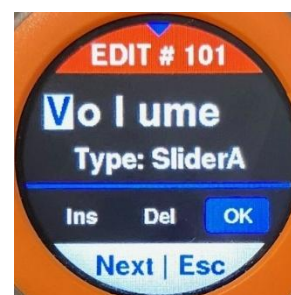
NOTE: If you are running CTR2-Dial firmware on CTR2-Flex hardware you can press and turn **Knob A** to move the edit cursor.

To change the MIDI control type associated with this control, touch **Type:**. The MIDI control type will step to the next control type. Refer to the MIDI Control Types section for a description of each control type.

Touch **Ins** to insert a character at the cursor position and **Del** to delete the character at that position. When you're done editing touch **OK**. To exit without saving your changes, touch **Esc**.

Button Editor

When you touch the **Edit Button Labels** the **EDIT BTN** menu opens. This menu has 7 pages of buttons with six buttons on each page. Turn the M5Dial's ring if ring navigation is enabled, or touch the left or right side of the bottom button (**< 1/7 >**) to move to the next page. Touch the **EDIT BTN** caption to cancel this mode and exit back to the **Settings** menu.

Once you select button to edit the **Button Editor** opens. The MIDI control # is shown in the caption.

The **Button Editor** has the same features as the **Dial Editor** but it doesn't have a MIDI **Type** setting. This is because buttons always send MIDI button On/Off commands.
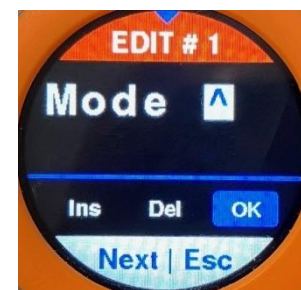
Editing With a Terminal

Onscreen editors are useful for small editing changes but if you have several controls to edit, it's easier to use a terminal.
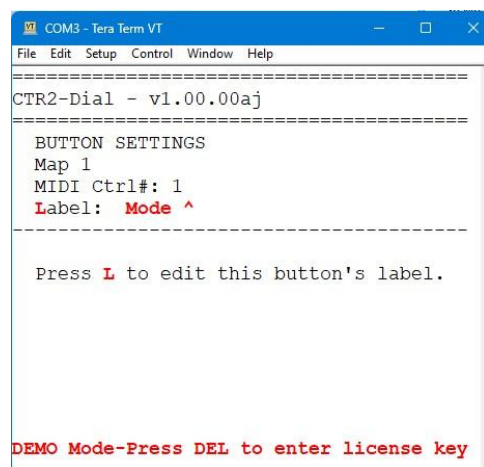
Start your terminal program and connect it to the virtual USB serial port assigned to CTR2-Dial by your operating system.

When the terminal first starts you will be presented with a blank screen because the terminal server is waiting for you to wake it up. This is done by pressing any key (usually [Space] or by selecting a control on the display.

NOTE: Dial controls without labels will not show up on the Dial Control unless a terminal is connected to CTR2-Dial. To add a label to a blank control, select it in the Dial menu.

The header of each page contains the firmware version #.
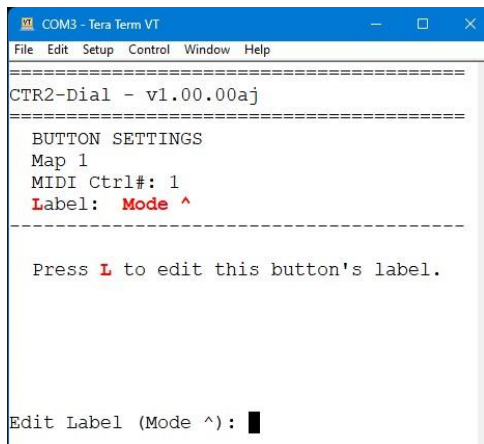
The first time you connect, CTR2-Dial will be running in **Demo** mode and a note will be displayed at the bottom of the terminal page instructing you to press the **DEL** key to enter your registration key. If you don't have a key your can ignore this message and remain in **Demo** mode. In this mode the program will shut down in 15 minutes and changes you make will not be saved. Other than that, the program is fully operational.

To edit a control, simply select it on CTR2-Dial. The terminal page will update with that control's settings. In the screenshot at the right, CTR2-Dial is on **Button** page 1. The first button on the selected page is always displayed first. To edit the label on this button, press the **L** key on the terminal. The **Edit Label:** line will appear with the current label in parenthesis. Enter the new label at the cursor.
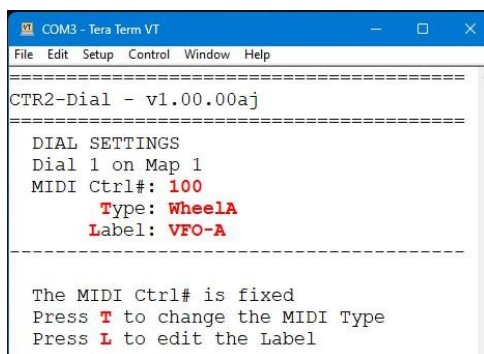
Wheel and slider controls on the **Dial** and **Knob** pages include additional settings.

Dial controls are assigned to MIDI control #s 100 through 117. You cannot change these. You can edit the MIDI control # assigned to **Knob** controls. This allows you to send MIDI control #s that aren't included in the default settings.

Press **T** to step through the MIDI control type assigned to the control or press **L** to edit the label.

Once you have CTR2-Dial's map configured the way you want, edit the map in your radio control app to match.

You can export your settings to your computer so you have a backup copy. This process will be described next.

Backing Up and Restoring your Settings

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

CTR2-Dial 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 <u>does not</u>. 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-Dial 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-Dial, connect your terminal to CTR2-Dial 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-Dial's program.
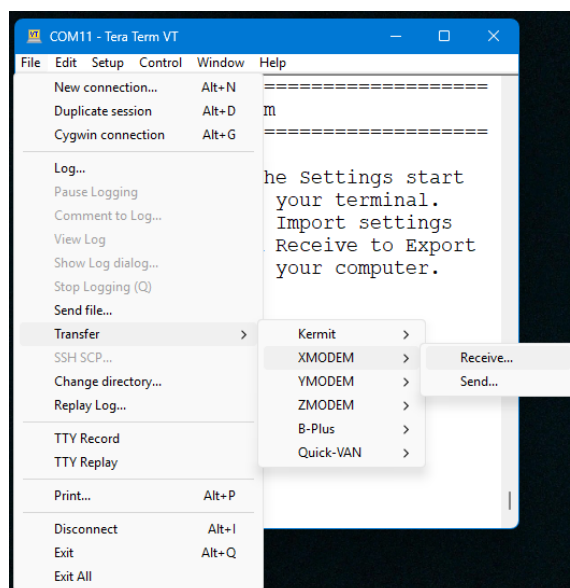

Import Settings

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-Dial 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-Dial 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-Dial will load the new configuration.

HINT: You can use the export and import settings functions to save and reload multiple versions of your settings. Perhaps you use CTR2-Dial on more than two apps and have each app configured differently. You can export the settings for each of your apps then import them back in when you want to change apps. This is also handy if you have more than one CTR2-Dial device.
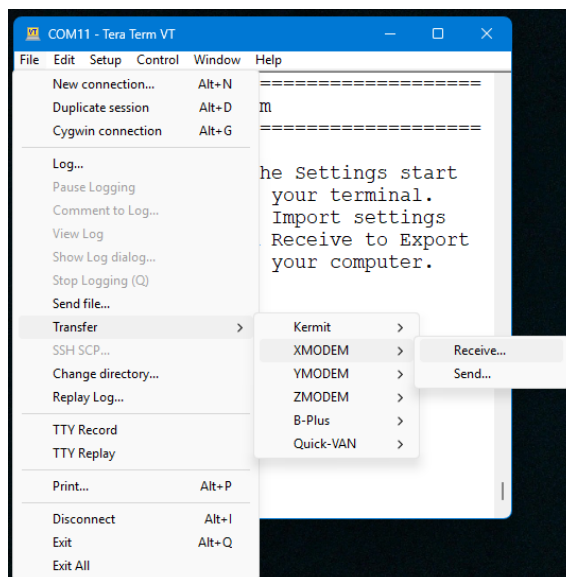
Control App Maps

The following sections describe how to map several apps that you may use. It's not an inclusive list of all the apps that support MIDI control.

Before editing the settings on CTR2-Dial, you may want to export the settings to your compute incase you need to restore them in the future.

Remote Ham Radio Maps

The current release of Remote Ham Radio does not include mapping for CTR2-Dial. This should change once CTR2-Dial gains popularity on the platform. The instructions below allow you to change the map in CTR2-Dial to fit the current *MIDI* mapping in RHR.

In the RHR console, open the **Tools** menu and select **CTR2-MIDI**.

Connect a terminal to CTR2-Dial and change the labels on the following controls:

Keying Input

Navigate to page 5 on the **Settings** page and change the **Pdl In:** option to **20/21** to use your paddles to control the keyer in RHR. Change **Pdl In:** to **30/31** to use the paddle input jack to control the straight key and PTT functions instead.

Dial Controls

The **Dial** labels should be edited in a terminal to match the function assigned in RHR.

DIAL ACTIONS		
Dial #	MIDI Control #	Action Taken
1	100	Change VFO
2	101	Slice Volume
3	102	NR Level
4	103	NB Level
5	104	VOX Level
7	106	Keyer Speed

The other **Dial** controls are not currently used. To avoid confusion set their labels to a single space. This will hide them on the **Dial** display (but not in the **Dial** menu) until you connect a terminal to CTR2-Dial.

Button Controls

The number of buttons available on CTR2-Dial has been greatly expanded over those available on the *MIDI.* This means that there will be a lot of holes in the **Buttons** menu on CTR2-Dial when set to match the current mapping used in RHR for the *MIDI*. Future versions of RHR will hopefully consolidate the buttons and may add more functions.

BUTTON ACTIONS			
Button and MIDI Ctrl #	**Original *MIDI* Button**	**Action Taken**	**Dial Label**
1	MFB1	CW Mode	CW
11	MFB1 (long-press)	Toggle NR	NR
2	MFB2	SSB Mode	SSB
Button and MIDI Ctrl #	**Original *MIDI* Button**	**Action Taken**	**Dial Label**
12	MFB2 (long-press)	Toggle NB	NB
3	MFB3	FT8	FT8
13	MFB3 (long-press	FT4	FT4
4	MFB4	Toggle PTT	PTT
14	MFB4 (long-press)	Toggle VOX	VOX
5	MFB5	Band Down	Band v
6	MFB6	Band Up	Band ^

All other button labels on CTR2-Dial can be changed to a single space.

iOS and MacOS App Maps

Maps for Marcus' apps are available from the CTR2 group and they are shipped with the firmware files. There are too many settings to list here.

To change the default map that comes with you iOS/MacOS app, first, make sure your app has permission to use your iCloud drive. Next, open the **CTR2 Controller** object in the app's **Tools** menu then go to the **Edit Mapping** page. On this page, click or touch the **File** icon at the top of the page then select *Import Mapping from iCloud Drive*. This will open a list of files available on your iCloud drive. Select the appropriate map from the list.

<<< IMPORTANT >>>
Once you have loaded the map you must change one of the control assignments before the map will be saved to your app. To do this, select one of the controls, change it to something else, then change it back to its original setting. If you don't do this the map will revert back to the original map.

The default configuration for CTR2-Dial's **Map 1** is set for SmartSDR for iOS/MacOS.

Using Paddles with the App's Keyer

Marcus' iOS/MacOS apps include a keyer that you can control with the paddles connected to CTR2-Dial.

> **NOTE 1:** If you're using Bluetooth-LE MIDI you may notice a difference in how the paddles work with the app's keyer as opposed to a hardwired paddle/keyer. The latency in the Bluetooth-LE

Follow these steps to configure the app and CTR2-Dial for paddle keying:

- In the app, map **Button 96** to **Trigger CW Left Paddle** and **Button 97** to **Trigger CW Right Panel**. You can swap this mapping if they are wired backwards.
- Plug your paddles into the **Paddle In** jack on CTR2-Dial.
- Set the radio's mode to CW
- In SmartSDR, press the **View** menu in the Panadapter display and select **CWX Panel**. You can adjust speed and other setting here.
- In SDR-Control, select the **CW Keyer** option in the **Tools** menu to configure the keyer. <u>DO NOT</u> enable the MIDI device in this panel, this is done in the **CTR2 Dial Controller Tool** panel.
- Pressing either paddle will now activate the keyer and key the radio.

Using a Straight Key or an External PTT Switch

Straight Key Wiring
If you want to use a straight key with CTR2-Dial, map **Button 98** to **Trigger CW Straight Key** in the app then wire your straight key to the TIP and SHIELD of a 3.5mm (1/8") <u>stereo jack</u> and insert it into the **Paddle In** jack on CTR2-Dial. <u>Do not use a mono jack</u> as the shield will ground the RING lead on the **Paddle In** jack.

PTT Switch Wiring
If you want to use an external PTT switch with CTR2-Dial, map **Button 99** to **PTT Push** in the app and wire your PTT switch to the RING and SHIELD of a 3.5mm (1/8") <u>stereo jack</u> and insert it into the **Paddle In** jack on the *MIDI.*

NOTE: You can wire your straight key and external PTT switch to the same stereo plug.

Select **Pdl In: 98/99** in page 5 of the **Settings** menu to tell CTR2-Dial to route the paddle jack inputs to MIDI control #s 98 and 99.

Thetis Maps

Thetis is a little different than RHR and iOS/MacOS apps in that it uses CTR2-Dial's **WheelB** control instead of **WheelA** for frequency tuning. **Map 2** is pre-configured with **WheelB** for tuning. You can select **Ctrl Map: 2** on page 2 of the **Settings** menu.

With the **Setup -> Setup -> Serial/Network/Midi CAT** window open in Thetis, select the **MIDI** tab and click the **Configure MIDI** button. The program will find and initialize CTR2-Dial using USB.
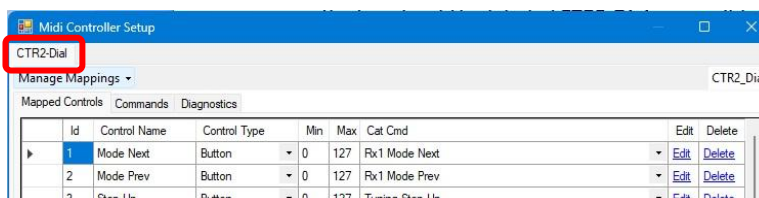
NOTE: If the program doesn't initialize CTR2-Dial, check to make sure you are using a USB-C <u>data cable</u>, not a USB-C <u>charge cable.</u>

It's a Software Device

If you can't get Thetis to recognize CTR2-Dial, verify that CTR2-Dial appears in the **Device Manager** under **Software devices**, and <u>not</u> under **Sound, Video, and game controllers**. If it appears here, right click on the entry and uninstall it. Cycle the power on you PC and try connecting CTR2-Dial again.
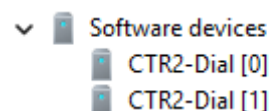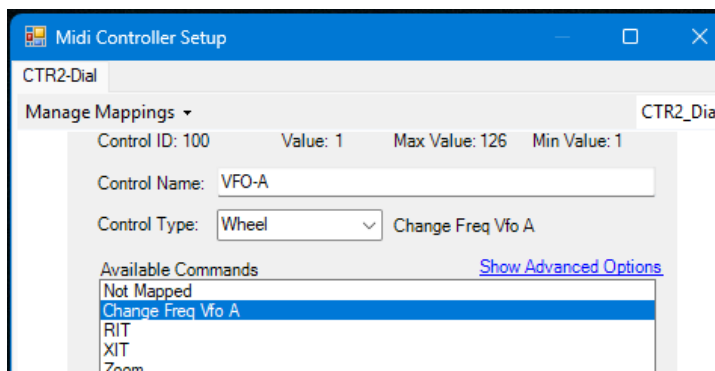

Mapping Controls

You can download a default Thetis map from my web site. Once you have unzipped my map file go to the **Midi Controller Setup** page in the app select **Manage Mappings -> Import Mappings** and select the Thetis map you unzipped.

To manually map your CTR2-Dial to Thetis, or change the default mapping, use the following process:

Touch a button or change a dial or knob setting and the window at the left will open.

In this example I changed the dial control when it was set to the first control (VFO-A, MIDI control 100).

 NOTE: When mapping dial controls you need to run the dial fully CCW until you get to 1 and then fully CW until you get to 127 to set the Min and Max range values.

Next, I give the control a name. I'll call it **VFO-A Freq** and select **Change Freq VFO A** from the **Available Commands** list.

Click the **Done** and then the **Save** button to return to the **Manage Mappings** page.
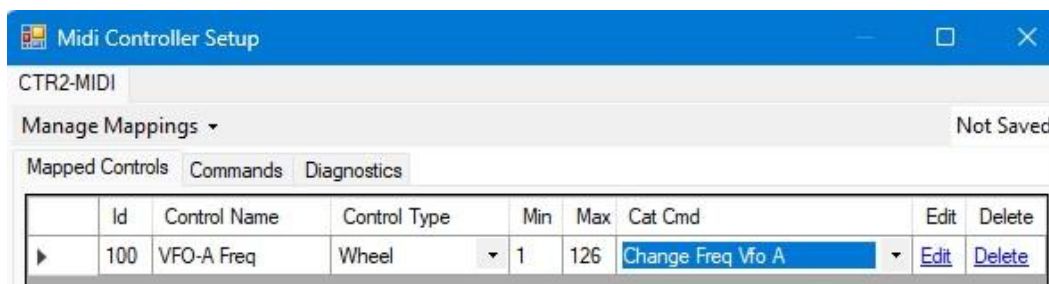
You've mapped your first control! Now follow the same procedure to the other dials, knobs, and buttons on CTR2-Dial.

NOTE: When using the Thetis **Wheel** control type you must set the encoder on the *MIDI* to **WheelB**.

When you're finished mapping controls make sure to click the **Save** button in the **Midi Controller Setup** page and **Apply** before you leave the **Setup** page so these functions will be restored the next time you run Thetis.

Managing Thetis Maps

You can save or load your map setting from the Thetis database using the **Load Mapping** and **Save Mapping As** options on the **Manage Mappings** tab. To load a map from others, use the **Import Mappings** option. To save your map to share with others, use the **Export Mappings** option.
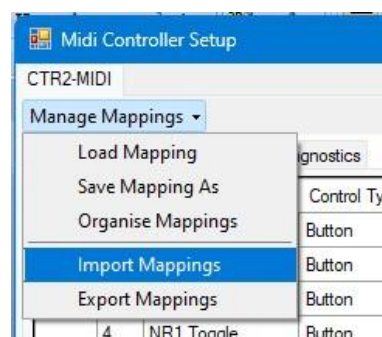
Advanced Options

Operation with N1MM Logger+

You can use CTR2-Dial as an interface to use N1MM's CW keyer with SmartSDR or SDR-Control for iOS. To do this, follow the instructions on the N1MM Interfacing Basics webpage to build a key interface circuit. This will require a USB serial adapter with a keying interface circuit wired to its RTS output. Connect the output of the keying interface circuit to the TIP and SHIELD of CTR2-Dial's Paddle input jack. Next, map the Left Paddle input on CTR2-Dial to **Trigger CW Straight Key**. With this setup you can control your radio using the N1MM Logger+ and use keyboard keying in N1MM Logger+.
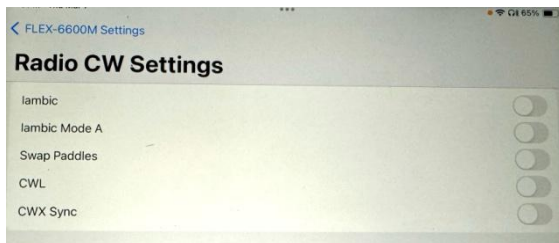
The biggest advantage of using CTR2-Dial over a mouse to control your radio is that CTR2-Dial controls go directly to your radio control app whereas your control app must be "in focus" to use a mouse. This is especially handy when running logging programs like N1MM Logger.

Unfortunately, this configuration doesn't allow you to use a set of paddles with the *MIDI* at the same time nor does it allow N1MM Logger+ to control your radio remotely.

If you're looking to have N1MM Logger control your radio remotely you might consider using CTR2-Micro to remotely control and key your radio with SmartSDR or SDR-Control providing the user interface. Instructions for this can be found in the CTR2-Micro Operation Manual under the **Advanced Options** section.

Troubleshooting

Issue	Solution
I can't connect the app to the CTR2-Dial using USB MIDI	1) Make sure you are using a USB-C <u>data</u> cable. Many USB-C cables are <u>power only</u>. These will not work with USB MIDI. 2) If using a mobile device (iPhone, iPad, Android, etc) you must use an OTG adapter for your device. This adapter provides a USB connection for an external device. Newer iPhones and iPads with USB-C connectors do not require an OTG adapter.
I can't connect the app to the CTR2-Dial BLE device	Make sure the Bluetooth radio is turned on and the app has permission to use Bluetooth. Follow the instructions in the Connecting CTR2-MIDI to the App and Enable Permissions sections.
I have to connect CTR2-Dial every time I start the app.	CTR2-Dial will stay connected to the app on your iOS or Mac device with Bluetooth-LE as long as it remains powered up. If you power down CTR2-Dial you'll need to open the **Tools -> CTR2 Dial Controller** window and click the **Find CTR2 Dial Bluetooth-LE Device** button then click **Enable** to reconnect it to the app. When connecting with USB MIDI it should say connected even through a power cycle.
My Flex radio starts sending a string of Dits or Dahs when I select CW mode	This seems to be a bug SmartSDR v6.9.15. If you press the paddles when the app is not in CW mode but the CWX panel is open that paddle press is buffered in the app. When you change to CW mode from another mode CWX triggers the last paddle press you made and keeps sending it until you press the paddle again, turn off CW mode, or close the CWX panel. This should be fixed in the latest update of SmartSDR.
CTR2-Dial connects to my device but does not control anything	1) Verify that you have mapped each *MIDI* control to a function in your app.
Frequency tuning is not working	1) Make sure you have the correct map selected in the **Settings** page. 2) Use **WheelA** for RHR and Marcus' iOS and MacOS apps. Use **WheelB** for Thetis and other Windows apps. 3) Make sure you have the correct MIDI command mapped to the frequency control in your app.
How can I tell when I'm at the center (0 Hz) when controlling RIT or XIT?	Use the **SliderB** control for RIT and XIT controls. The display will show a black bar indicating the offset and CTR2-Dial will beep and pauses tuning for about ½ second when the control reaches its center position (64 counts). **SliderA** does not beep at center or show the +/- offset.

Speed tuning is not working	Make sure **Speed Tune** is set to **On** in page 1 of the **Settings** page. Touch and hold the dial outer ring for > 1 second until CTR2-Dial beeps and the tuning ring changes color. This indicates speed tuning is active.
Paddles don't key the radio	1) Verify the radio is in CW mode 2) Verify the keyer is in **Breakin** mode and **Sidetone** in **On** in the P/CW panel 3) Verify **Pdl In:** is set the same MIDI control #s that you have mapped in the app for left and right paddle control. 4) Open the CWX Panel in the app's **View** menu 5) If you're using a Flex radio, it might be in CW Zombie mode.
Paddles are reversed	Remap the MIDI control #s to swap Left and Right paddle assignments
No sidetone in SmartSDR when keying	Open the left pop-out window in the Panadapter display on the app and click the **Audio** menu. Set the **Local Audio Monitor** slider to 0.
Slow response or timing issues with keyer	Connecting multiple Bluetooth devices to your iOS device (i.e. CTR2-Dial and a BT headset) may affect the app's keyer response to paddle input. To fix this problem, click the **Flex 6xxx** button on the bottom of the display, select the **CW** item to open the Radio CW Settings window and disable **CWX Sync**. You may also consider using USB MIDI with an OTG adapter on your mobile device.
Frequency does not change correctly when I tune the **Dial** or **Knob**	First, make sure you have mapped the MIDI control # you are changing to your app's frequency control function. Second, there are two MIDI control types used to tune frequency, WheelA and WheelB. You must select the correct type for your app. • WheelA is used in Marcus' iOS/MacOS apps and in RHR. • WheelB is used in Thetis and other Windows programs If the wheel is the wrong type change it by connecting your CTR2-Dial to a terminal program.
Operating the paddles on a single knob unit displays **Knob B's** control and the keyer does not work.	Port B on the M5Dial (without the port expander PCB) supports either paddle input or the second external encoder (**Knob B**). The **# Knobs:** setting in the **Settings** menu determines which device is connected to **Port B**. **NOTE:** Starting with v 1.01.00 a new **None** option has been added to the **# Knobs:** settings. This allows you to turn off all external encoders connected to **Port B**. Options are **None, One** (for a single encoder), **Two** (for two encoders), or **Knobs: Swap A/B**. The paddle interface works in all modes.
Turning **Knob B** causes the **Transmit** indication to show.	See the explanation in the previous topic. Change the **# Knobs:** setting in **Settings** from **One** to **Two**.
The knobs (encoders) don't work.	**# Knobs** in the **Setting** menu is set to **None**. Open the **Settings** menu and change the **# Knobs:** setting to match your unit's configuration. You can also reverse the location of the **A** and **B** encoders on dual-encoder units using **Swap A/B**.

Can I change **Knob A** and **Knob B** positions?	Yes, on the dual-encoder unit you can swap the **A** and **B** encoder positions by selecting **Knobs: Swap A/B** in the **Settings** menu.
I can't get the M5Dial into programming mode	There are two buttons that must be pressed in sequence to force the M5Dial into programming mode. Press and hold the **DOWNLOAD** button (labeled **BTN** on the back of the M5Stamp processor), press and release the **Reset** button next to the processor, then release the **DOWNLOAD** button. The **DOWNLOAD** (**BTN**) is under the label on the M5Stamp processor and is similar to the **Reset** button. You should be able to press this button through the label with your fingertip. If you can't, the lever may have slipped of the button. Peel up the label and use an Xacto knife to flick the lever back onto the button. If it's damaged, use a no-conductive toothpick to press the button. See Appendix B for more details.
The tuning controls don't work	1) Make sure you have selected the number of knobs on your unit in the Settings menu. 2) If the tuning control has been locked it will be "grayed out". To unlock the control, long-press on the control's label.

Appendix A: Connecting CTR2-Dial to Your App

This section describes how to connect CTR2-Dial to various apps. Once you are connected to the app see the How CTR2-Dial Works with Your Control App section to understand how CTR2-Dial controls work with the app.

Remote Ham Radio

To connect CTR2-Dial to Remote Ham Radio simply plug CTR2-Dial into a USB port on your computer then select the **CTR2-MIDI** option in the RHR console's **Tool** menu (hopefully a CTR2-Dial option will be added in the future). The **CTR2-MIDI** option is pre-configured **CTR2-MIDI** so you'll need to change the configuration of CTR2-Dial to match RHR. You can see how the *MIDI*'s controls are mapped to RHR in the Remote Ham Radio Configuration section.

Marcus' Apps for iOS or MacOS

Enable Permissions

If you plan on using Bluetooth with Marcus' apps on your **iOS** device, open the app's **Settings** window and allow Marcus' apps access Bluetooth (not all devices have this menu).
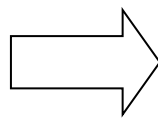
You can also allow the app to use your iCloud Drive to save maps in this window.

The app on **MacOS** will generally ask you if you want to enable Bluetooth the first time you start it. If you're already running SmartSDR, navigate to **Apple -> System Settings -> Privacy & Security -> Bluetooth.** This screenshot shows the *TS-Control* app has permission to use Bluetooth.
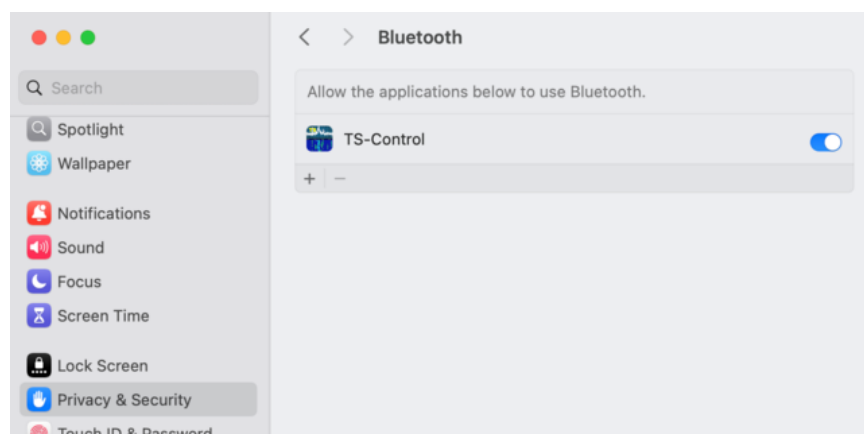
Select the CTR2 Controller Device

In Marcus' apps, select the **CTR2 Controller** device in the **Tools** menu. The **Tools** menu will look different in each app so just look for the **CTR2 Controller**.

Here's an iOS and MacOS example of the **Tools** menu. I've highlighted the **CTR2 Controller** option in each menu…
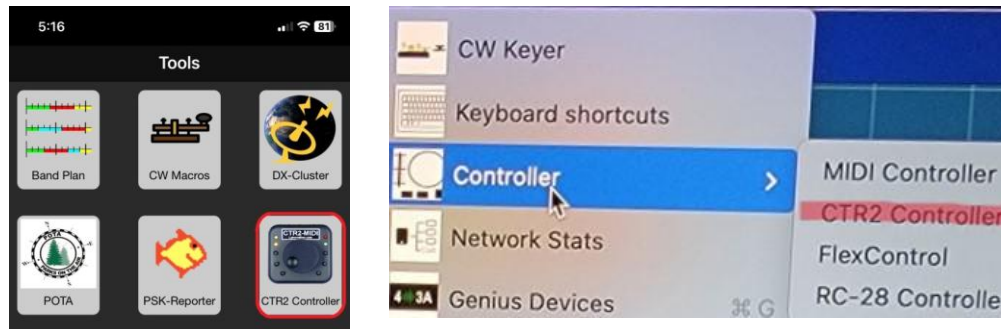
CTR2 Controller Screen

Once you select **CTR2 Controller** from the **Tools** menu a screen like this will appear. It may look different depending on the Apple device you're using but it has basically the same information.

USB Wired Connection

To use CTR2-Dial with a wired USB connection on Mac's and newer iOS devices, connect CTR2-Dial to your device using a USB <u>data</u> cable, select **STAMP_S3** from the **Device** menu, and click the **Enabled** button. The **Status** should change to **Connected**. Press the **Edit Mapping** button and press a button or turn the encoder to verify the app is receiving MIDI commands.

NOTE: To use a wired USB connection with an older iOS device (with a Lightning connector) you'll need to purchase a Lightning OTG (*On The Go*) adapter such as the one shown here. These are also referred to as "Camera Adapters" on Amazon. The adapter I use has two USB-A connectors on it. It also has a Lightning port so you can connect a wall charger or battery to power your phone CTR2-Dial.

Bluetooth-LE Connection

To use Bluetooth-LE MIDI, make sure the Bluetooth radio is on (it is controlled in the **Settings** menu) then click the **Find CTR2 Bluetooth-LE Device** link to initiate a search for your CTR2-Dial. The search will fail the first time you try to access a new device. If you get a failure notice, close the failure popup notification, **wait 10 seconds**, then click the **Find** link again. Once it registers your CTR2-Dial (your device's name is **CTR2_xxxx** with xxxx being the last four digits of the M5Dial's MAC address) click the **Enabled** button to start the Bluetooth connection. You don't need to select the name on the **Device** list unless you have two or more CTR2-Dial units available.

NOTE: You can only have one CTR2-Dial connected via Bluetooth to the app at one time and you can use a second CTR2-Dial connected as a USB device. To do this, connect the Bluetooth CTR2-Dial using the **CTR2 Controller** device in the app's **Tools** menu and connect to CTR2-Dial connected via USB using the **MIDI Controller** device in the **Tools** menu.

NOTE: The **Settings** menu allows you to turn off the Bluetooth radio. Changing the Bluetooth radio state will turn off CTR2-Dial. Touch the display to turn the unit back on.

If you can't get the app to connect to CTR2-Dial you probably haven't allowed the app to use Bluetooth (see Enable Permissions above). If you still can't get it to connect, download **MIDI-Wrench** or **midimittr** for iOS or **Conji** for the Mac from the App store. They are free apps used to troubleshoot BLE MIDI issues. Connect to CTR2-Dial with one of these apps first and then try to connect again in the radio control app.

MacOS Bluetooth Connection Problems

Follow these steps to connect CTR2-Dial to your Mac using Bluetooth:

1. Connect your CTR2-Dial to a USB port on your Mac.
2. In the **CTR Controller** screen, check the **Enabled** button then click **Find CTR2 Bluetooth-LE Device** at the top of the screen.
3. The Mac may report that it can't find a Bluetooth-LE device. Wait 10 seconds the click **Find CTR2 Bluetooth-LE Device** again.
4. The Mac should report that it has found a Bluetooth device named **CTR2xxxx** where xxxx is the address of your CTR2-Dial.
5. Select **Stamp_S3** on the **Device** list to use USB MIDI while connected to the Mac.
6. Select **CTR2xxxx** on the **Device** list to use Bluetooth MIDI.
7. You may need to change the state of the **Enabled** checkbox to get CTR2-Dial to connect.
8. You can now unplug your CTR2-Dial from the Mac and use it remotely with Bluetooth.

Windows Applications

Thetis

Windows only supports USB MIDI connections. When you connect CTR2-Dial to your Windows computer's USB port it will automatically register as a MIDI device and be assigned a virtual COM port. Windows does not support Bluetooth-LE MIDI (at least not very well).
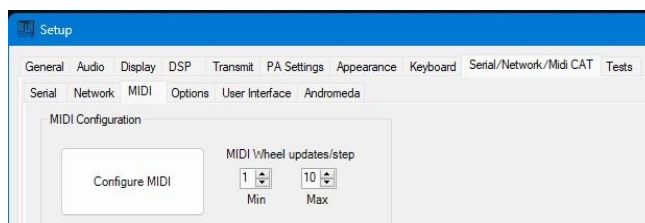

NOTE: USB MIDI requires a USB-C data cable. USB-C power cables will not work!

Most Windows apps will need to be configured (i.e. mapped). **Thetis** is used as an example here but connecting to and mapping controls in other apps should be similar.

Additional information on mapping MIDI controls in Thetis can be found here.

Start by selecting the **Settings** menu on the main page in Thetis then select the **Serial/Network/MIDI CAT** tab. Click the **MIDI** tab as shown above.

Next, click the **Configure MIDI** button to open the **Midi Controller Setup** page. The program should go through an initialization sequence and end up on this page if it finds CTR2-Dial on the USB port. The tab at the top should be labeled **CTR2-Dial** or possibly **STAMP_S3**. If the initialization fails, double-check that you are using a USB-C data cable, not a charge cable and try again.
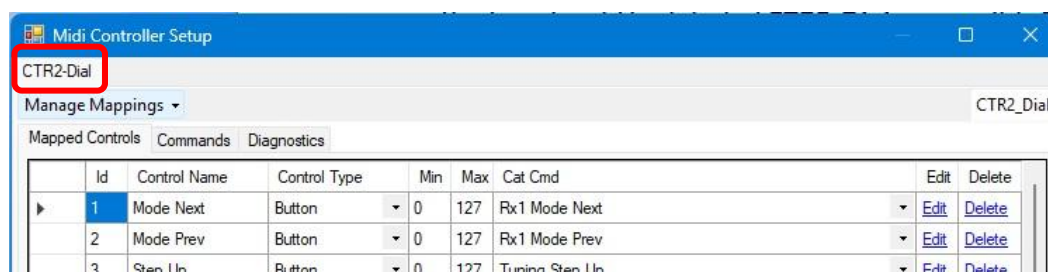
SparkSDR

SparkSDR (https://www.sparksdr.com/) has limited support for MIDI control. It doesn't support buttons, only the dial and knob controls. To map CTR2-Dial encoder functions to this program, first plug your CTR2-Dial-Dial into a USB port on your computer and open SparkSDR. Once you have the program running, click on the **General Settings** menu and select **Midi**. You should see **CTR2-Dial 0** as a MIDI controller and turning the encoder should display MIDI messages from the controller. To map these messages to a control in the app simply press the **+** icon and enter the **Control** number shown in the **Last midi message:** window in the **Control** column. Then select an **Action** and set the **Scale** and **Offset** required for that control. You may need to play with these values to get the control action you want. Check the **Inc** box if you want the value from CTR2-Dial to be added to the current setting of the control. This is only used with the **vfo** control. This screenshot shows the settings I use.
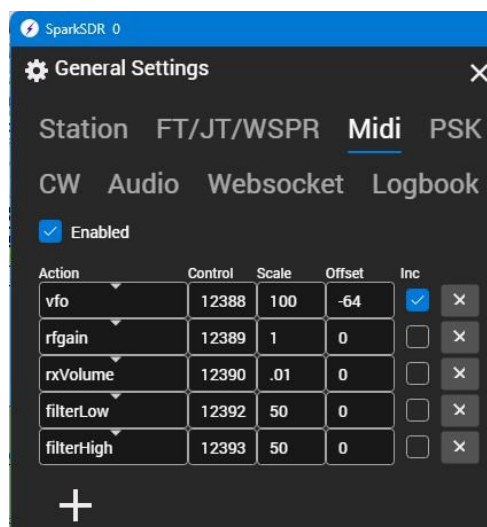
Flex Radio CW Zombie Mode

If you plan on using your CTR2-Dial with a Flex radio using remote CW keying there is an odd problem in Flex firmware where the radio can go into **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 B: Installing or Updating CTR2-Dial Firmware

CTR2-Dial firmware is pre-installed on assembled CTR2-Dials supplied with the M5Dial controller. If you're building one of the kits, or using your own hardware you'll need to install the firmware yourself.

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-Dial. 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, remember to 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-Dial firmware.

NOTE: EspressIF has released a browser-based flash tool called **ESPLaunchPad**. It can be used instead of using the Flash Downloader Tool described below. It works on Windows and Macs in several browsers. 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.

1. Download and unzip the latest CTR2-Dial 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.*
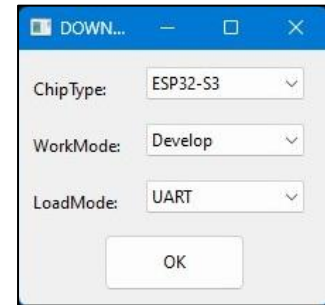
3. Map the four .BIN files in the CTR2-Dial's firmware distribution folder into the downloader tool.
NOTE: The address for each file is embedded in its file name. Enter these addresses in the address fields to the right as shown in this screenshot.

4. Select the checkboxes on the left of the four .BIN filenames as shown.

5. Set the COM: port to the port your computer assigned to CTR2-Dial and set the Baud to 921600.
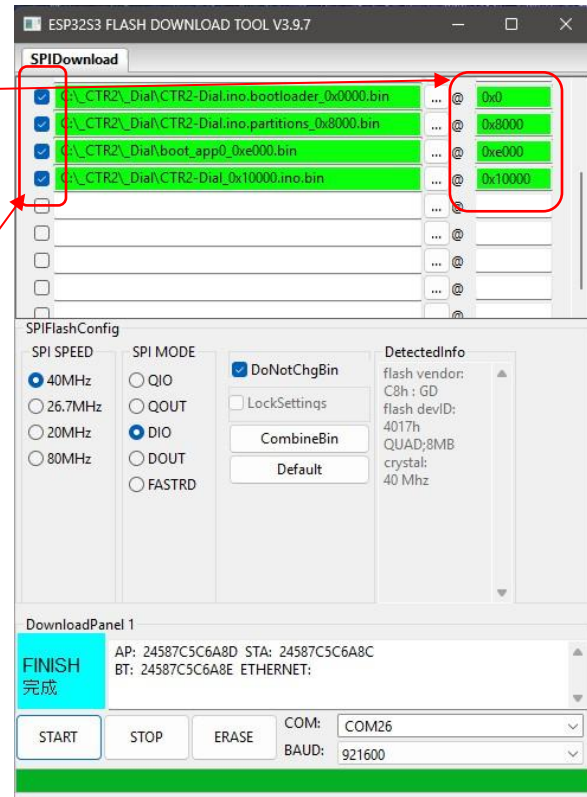
6. On <u>new</u> installs <mark>or when updating from v1.00.xx firmware to v1.01.xx firmware</mark>, click the **ERASE** button to clear all files from the M5Dial's memory.

   NOTE 1: If you erase the flash memory after running CTR2-Dial firmware you will need to <u>re-enter your call sign and registration key</u> the next time you start CTR2-Dial.

   NOTE 2: If you erase the flash memory the # of knobs will be set to **None** by default. You must open the **Settings** menu, navigate to the **# Knobs** option then change it to either **# Knobs: One** or **# Knobs: Two**, depending on whether your unit has a single encoder with a paddle jack or has dual encoder encoders.

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

8. Once the download is complete, <u>cycle the power</u> on the unit to start the new CTR2-Dial firmware.
   NOTE: The ESP32-S3 processor will revert back to its operating COM port after the reboot.

Installing using a Mac or Linux Computer

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 included 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 C: Configuring Tera Term

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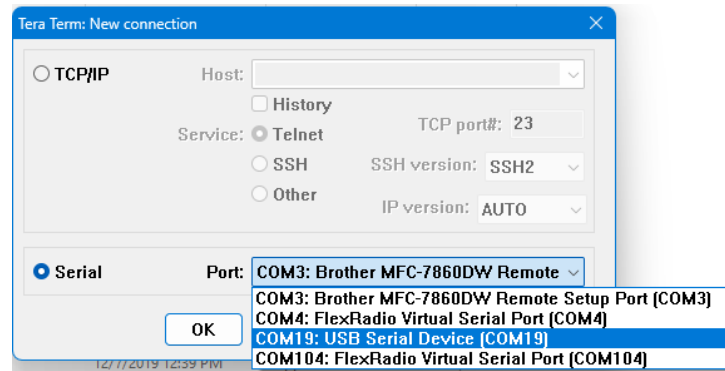
Since you are connecting to a USB serial port there is no need to set the baud rate. It will run at USB speed regardless of the baud setting.

That's it! Tera Term will connect to CTR2-Dial. Press any key to start CTR2-Dial's terminal server.

You can change the terminal size in the **Setup** menu. Select **Terminal…** Set the **Terminal Size** to *41 x 20.* CTR2-Dial'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-Dial.

Appendix D: Configuring Putty

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

NOTE: Putty does not have XModem transfer capability. If you want to export and import backup files for CTR2-Dial'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-Dial using its USB serial port in order to configure it.

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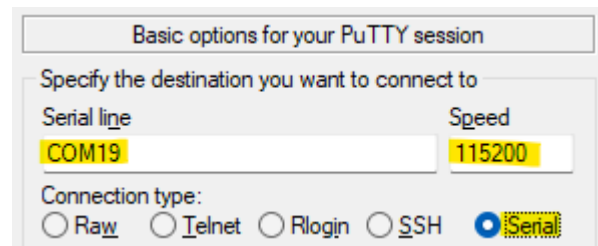
Next, select the **Terminal** item and set the **Implicit LF in Every CR** to on, and **Local Echo,** and **Local Line Editing** to **Force Off**.

You can change the window size under the **Window** item. Set the **Columns** to *41* and the **Rows** to *20*.
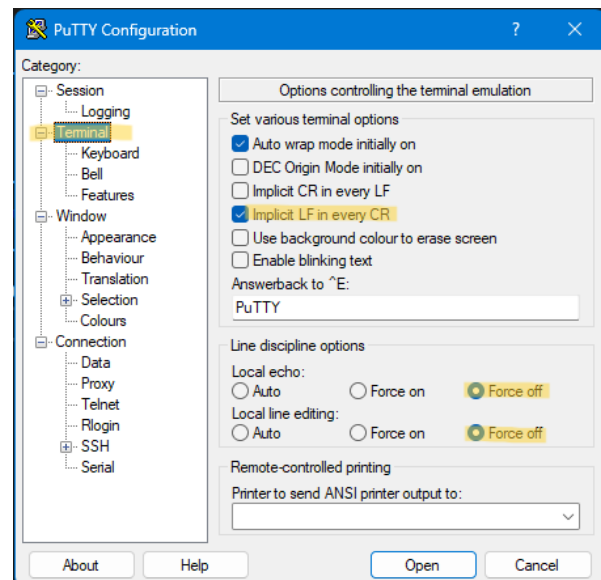
Next, select the **Keyboard** menu option and note the setting for the **Backspace key.** If **Control-H** is selected you will need to press **Ctrl+Backspace** to send the **Del** key (ASCII 127). If **Control-? (127)** is selected, press the **Backspace** key to send the **Del** key code.
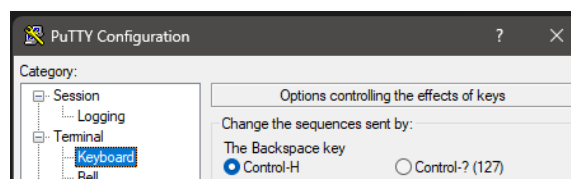
Once this has been done, return to the **Session** menu item, enter a name for this session and click the **Save** button. This allows you to easily re-open this session with just a couple of clicks.

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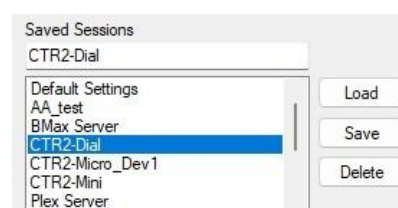
You can adjust the display colors on the **Windows->Colours** menu item. The Micro uses the **Bold** attribute to highlight the *hotkeys* and other items. I like to set the **Background** color to blue and the **Bold** color to yellow but you can find the colors that work for you. After you get a color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

Appendix E: 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 *Flex* to a terminal session, use the following process.

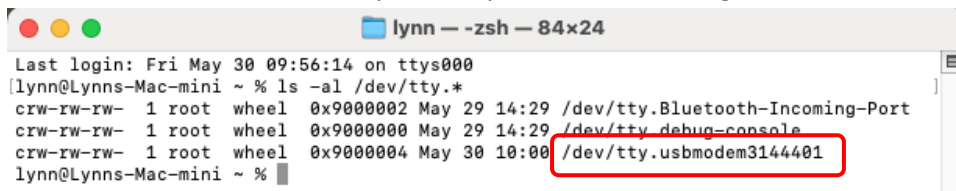First, list your current serial ports without the *Flex* plugged in.

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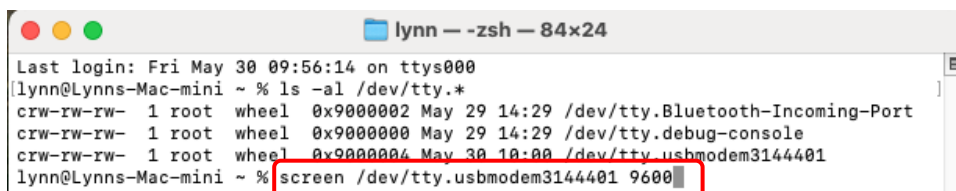
Once you have the serial port ID, enter the following: **screen {serial port ID} 9600**. Include the complete device description (i.e. **/dev/ttyxxxxxxx**) for the **serial port ID**. This will open the serial port using 9600 baud in a terminal session. The following screenshots demonstrate these steps.

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-Dial's terminal display. Select a dial control or button to edit that control's label.

Appendix F – Power Requirements

CTR2-Dial's approximate current is shown below on the USB connection for various configurations.

Bluetooth 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

By comparison, because it has no display, CTR2-MIDI draws 93 mA with the Bluetooth radio on and 43 mA with it off.

Appendix G: Using CTR2-Dial with Non-MIDI Programs

CTR2-Dial is not limited to programs that support MIDI controls. Third-party MIDI translator apps such as CoyoteMIDI can receive MIDI commands from CTR2-Dial and convert them to other actions such as mouse scroll or keystroke actions. MIDI translator programs are available for Windows, Mac, and Linux.

These apps allow CTR2-Dial to be used as a physical tuning knob with radio control programs such a SmartSDR for Windows, wfView, and WebSDR that don't normally support external tuning knobs. And it doesn't stop there. These apps also allow CTR2-Dial to be used with any program that accepts mouse scrolls or keystroke for control. For instance, it makes a great jog wheel for Audacity.

There are a couple of drawbacks to using a translation app instead of native MIDI control. First, like your mouse or keyboard, the app you want to control must be "in focus" to receive the mouse scrolls or keystrokes from the translation app. Second, most programs don't have a lot of control functions tied to mouse scroll or keystroke actions. For instance, SmartSDR for Windows only accepts mouse scroll actions for frequency control and wfView only supports the J and K keys for frequency control.

Configuring CoyoteMIDI

This section will cover configuring CoyoteMIDI to interface with SmartSDR for Windows and wfView. The translator you choose will have a different setup procedure but they're all basically the same.

Before you start, plug CTR2-Dial into a USB port on your computer. It will automatically register as a MIDI device. Open the **Dial** control and turn the gray ring to select the first control, typically named **VFO**. There
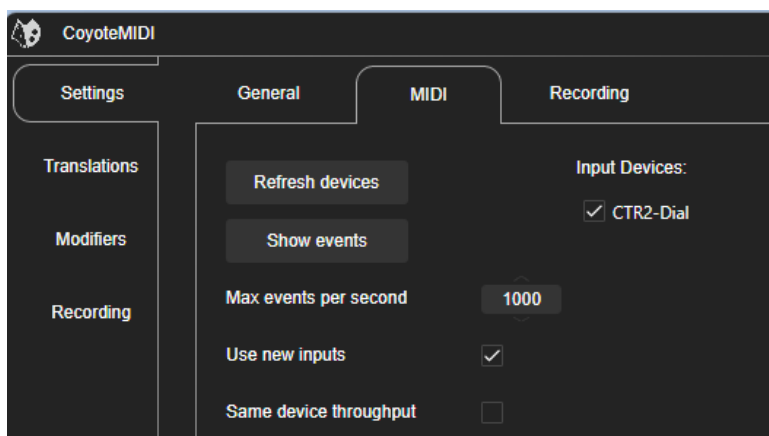

Once you've installed CoyoteMIDI open the app and navigate to the **Settings -> MIDI** tab. CTR2-Dial should show up on the **Input Devices:** list. Click the checkbox to enable it.

Configure SmartSDR for Windows Frequency Control

Next, select the **Translations** tab and click the **+ Add Translation** button in the top-right corner.

The first example uses the **VFO** dial control (MIDI control #100). This mode uses the **WheelA** MIDI control where a value of 65 represents a clockwise turn and 63 represents a counter-clockwise turn of the knob.

Click the box with **Click to record** then turn the knob on CTR2-Dial *slowly* <u>clockwise</u>. You should see **CC 100 value 65** appear in the left box. If you don't see this, make sure the selected control on CTR2-Dial shows control 100 above the control's label. Hover the mouse over this entry to show the violet menu and **>** icons.
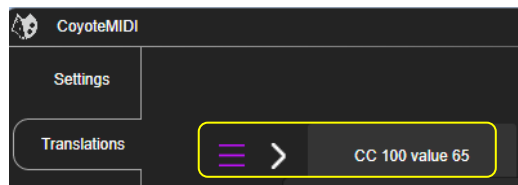
Click the **>** icon to view the details of this command. I've already set this command to be translated to the **SCROLL 1** mouse command.

The options on the left should be as shown. If not, edit them to match what's shown here.

To configure the **SCROLL** 1 output, click the **Action** dropdown box and select **Scroll**. Next, set the **Scroll Amount** to **1** so each tick of the clockwise turn of the encoder produces on scroll tick.
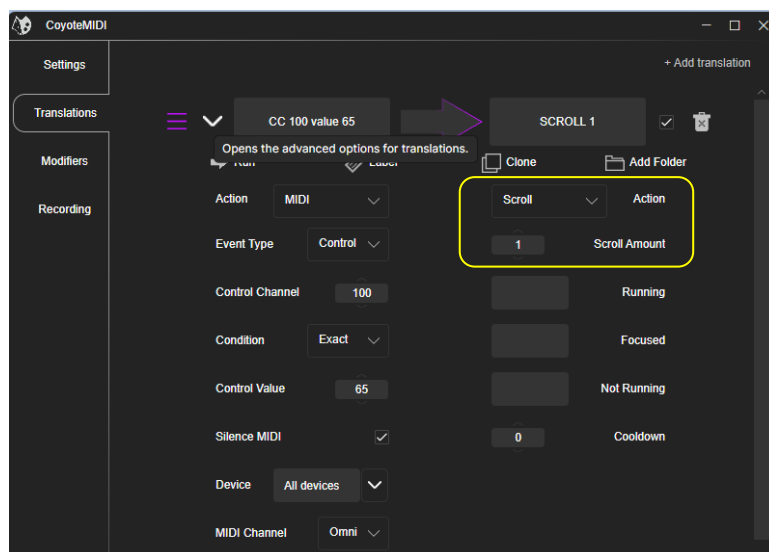
That's it. You configured your first translation. Click the **+Add Translation** button again and follow the same process to program the counter-clockwise knob turn. In this case, set the **Scroll Amount** to **-1**. This will send the reverse mouse scroll.

Now open SmartSDR for Windows and the frequency should change as you change the knob on CTR2-Dial. You can edit the label on CTR2-Dial with a terminal program if you want to change it.

Configure wfView Frequency Control

You can set up translations for many other programs the same way. Next, we'll go over setting up keystroke "J" and "K" to control the frequency in wfView.

Turn the gray ring on CTR2-Dial to switch to control 102. This is normally shown as **AGC-T**. You can change this label with a terminal program. You can also use any other knob control.

NOTE: This encoder uses the **SliderA** control type. This type operates like a potentiometer and has a range of 0 to 127 counts. To use this control type we'll look for the value increasing or decreasing to determine the direction the knob is turning. You can edit the MIDI control type in a terminal if you want to change it to **WheelA**. If you do this, follow the setting in the first example.
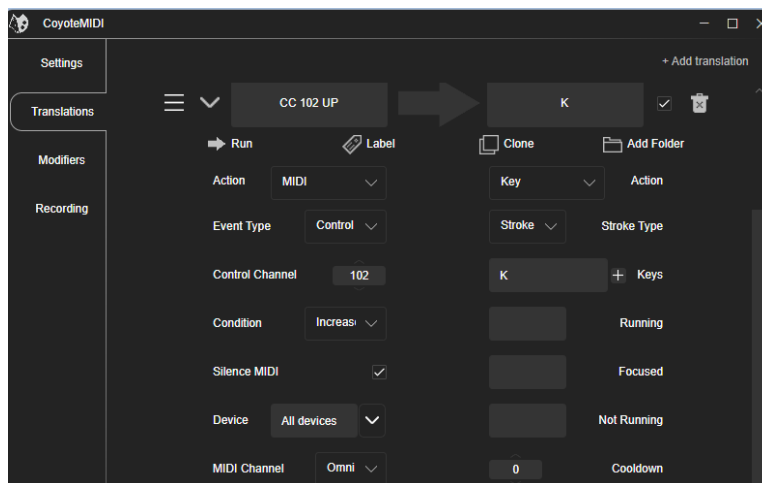
Click the **+Add Translation** button to add another translation.

Click the box that says **Click to record** then turn the knob on the *MIDI* clockwise. You should see **CC 102 value xx**, where xx is a number between 1 and 127.

Hover the mouse next to this box then click the **>** icon to show the details.

On the left column, click the **Condition** dropdown box and select **Increase**. This action will trigger when the MIDI value is increasing. The title in the top box will change to **CC 102 UP**.

In the **Action** dropdown box in the right column select **Key** and in the

Stroke Type select **Stroke**. Finally, in the **+ Keys** box, enter **K**. This is the key used to increment the frequency in wfView.

Next, click the **+ Add Translation** button again, click the new box showing **Click to record** and turn CTR2-Dial's knob counter-clockwise. Now, follow the same process as outlined above except select **Decrease** in the **Condition** box and enter the letter **J** in the **+ Keys** box. wfView uses the **J** key to decrement the frequency. I'm not aware of any other keystrokes wfView supports. If there are more they can easily be added.

CoyoteMIDI Startup Options

There are a couple of options in the **Settings -> General** menu that you might want to set if you regularly use the *MIDI* and CoyoteMIDI with your apps. If you select **Launch on startup** and **Minimize to tray** options CoyoteMIDI will automatically start when you boot your computer and will be available in the Windows tray if you need to change anything.
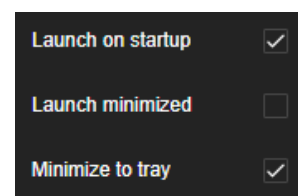
Appendix H: Change Log

v1.01.01d – July 21, 2025

- Added additional information to Appendix B on preparing CTR2-Dial to flash firmware

v1.01.01c – June 29, 2025

- Added information about using EspressIF's new browser-based flash download tool ESPLaunchPad

v1.01.01b – May 30, 2025

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

v1.01.01a – May 22, 2025

- Added a note about using a USB-C data cable

v1.01.01 – May 14, 2025

- Fixed a bug in the new encoder swap code introduced in v1.01.00. Swapping encoders works now.
- Renamed the **Port B:** option in **Settings** to **# Knobs:** and changed the options from **Off, Paddles**, **Enc B** and **Swap A/B** to **None, One**, **Two**, and **Swap A/B**.
- Paddle input now works when **# Knobs** is set to **None**
- Added a note about problems with the **DOWNLOAD** button when flashing firmware
- Added Appendix G: Using CTR2-DialI with Non-MIDI Programs with examples of how to use CTR2-MIDI with programs like SmartSDR for Windows that do not support MIDI control

v1.01.00 – May 7, 2025

- Released for production

v1.01.00k – May 5, 2025

- Added the ability to edit the functions in the **Knob** menus without having a terminal connected
- Added [Knobs: Swap A/B] option for dual-encoder units
- Added Backspace key to start registration entry and added note about Del key mapping in Putty
- Open **Port B:/# Knobs** option in settings after successful registration key entry

v1.01.00f – May 1, 2025

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

v1.01.00e – April 30, 2025

- Increased encoder functions from 12 to 18 for each map
- Hide unlabeled encoder functions on Dial control unless user has connected to the unit with a terminal to edit the function labels.

- Updated the Dial and Knob graphics to minimize the flashing that was present in earlier versions.
- Added a **Port B: Off** option to Port B settings. This allows you to completely turn off Port B when not using the paddle or encoder B options. See this note about setting Port B on a new unit.
- Removed touch & hold speed acceleration on wheel controls – replaced with speed sensitive tuning on all controls.
- Added a new **Info** option in the Settings menu. This option displays the firmware version #, registered call sign, and the registration key for the firmware.
- Added support for the new port expander interface board. This board will support two external encoders and the paddle input jack.

v1.00.06 – January 30, 2025

- Fixed a major bug in the initialization file. I was not updating button labels above #16 so any changes made to buttons above this number would revert back to default on a power cycle. All users should update to this version.
- Fixed the code that allows you to swipe left or right on the **Buttons** menu to change pages

v1.00.05a – January 29, 2025

- Updated manual to include more information about connecting to Mac computers using Bluetooth
- Added troubleshooting information for issues cause by an incorrect setting of **Port B** in the **Settings** menu.

v1.00.05 – January 28, 2025

- Added "double-touch" to many of the caption and footer buttons. Touch once to select and again to execute
- Added left and right functions to some of the caption and footer buttons.

v1.00.04 – January 24, 2025

- Fixed bug causing incorrect MIDI control # to be displayed on Knob changes

v1.00.03 – January 23, 2025

- Fixed bug causing a single reverse pulse when tuning through 0 degrees on the Dial.

v1.00.02 – January 22, 2025

- Fixed minor bug in PTT page – touching **PTT** caption did not return you to the **Home** page
- Added path to Thetis MIDI maps to Thetis section

v1.00.01 – January 20, 2025 – Shipped version

- Added **WheelB-r** (reverse) wheel option to switch direction of dial rotation for PI HPSDR
- Touching the **CTR2-Dial** caption on the **Home** page returns to the previously open page
- Fixed bugs in **Knob B** property editing
- Added Power Requirements to Appendix F

- Changed the procedure to flash firmware to the M5Dial to require manually forcing the M5Dial into programming mode
- Added a new MIDI Control Types table

v1.00.00 – January 16, 2025 – Initial Release
- Updated photos with new enclosure
- Added Import/Export Settings options
- Allows single encoder to use all 12 Knob settings