CTR2-Uno

Hardware Manual

v1.00

Last Revision: January 12, 2026

Version: v1.00

Revised sections for this version are highlighted in yellow

Table of Contents

Introduction

CTR2-Uno (referred to as the **Uno** in this document) is the descendant of a long line of microcontroller-based radio controllers from Lynovation. If you're interested in its background, you can read the QEX and QST articles about the **CTR** series here.

At the start of 2026, the single-encoder **CTR2-Flex** hardware was rebranded to **CTR2-Uno**. This was done to eliminate the confusion over the **CTR2-Flex** hardware and the **CTR2-Flex** firmware naming convention. This manual can be used for the single-encoder **CTR2-Flex** hardware unit.

The **Uno's** hardware is based on the M5-Dial from M5Stack. This is a rugged, commercial touchscreen controller. The **Uno** is similar in design to the **CTR2-Duo** (aka **Duo**) and **CTR2-Quad** (aka **Quad**) controllers, and is available in either a 3D printed enclosure, or a commercial, molded, CNC milled, New Age enclosure. Like the **Duo** and the **Quad**, it can run either **CTR2-Flex** or **CTR2-Dial** firmware. You can find the operation manuals for the **Flex** and **Dial** firmware here and here.

CTR2-Uno hardware has the following features:

- Color touchscreen user interface
- Runs either **CTR2-Flex** or **CTR2-Dial** firmware (both are included in the **CTR2-Flex** firmware package).
- One knob (encoder) with a 32mm aluminum knob. This knob uses a no-detent (smooth) style encoder. The knob is programmable to any of the *Dial* functions. Push-and-turn operation is not supported.
- The knob has a dual-function pushbutton that can be programmed to operate two button commands.
- A single 3.5mm stereo input jack that can be set for either for a CW paddle or straight-key/PTT input from the *Settings* menu.
- A volume control and speaker for CW sidetone for the internal keyer in **CTR2-Flex** firmware.

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

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

How to use this manual

This manual should be used as a reference manual. An expanded Help system if you will. Items in the Table of Contents link to their write up in the manual. I've tried to group things logically and have added hyperlinks so you can quickly jump to other sections.

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

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

Feel free to contact me if you have question about a certain feature or have ideas for future improvements. I love to get feedback on my work. My email addre1ss is good on QRZ.com.

Legal Notice

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

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

Change Log

v1.00: January 12, 2026

- Separated the original **CTR2-Flex** hardware into separate devices, **CTR2-Uno** and **CTR2-Duo**, and created separate hardware manuals for each of them.
- Added **CTR2-Quad** to the Lynovation product suite and created a manual for it.
- **CTR2-Flex** and **CTR2-Dial** now identify firmware products. They are described in separate manuals.

Changes to previous versions of this manual can be found here.

System Overview

CTR2-Uno hardware utilizes the M5Dial from M5Stack. M5Dial is small controller based on the ESP32-S3 processor and includes a 1.28” round display and an integrated encoder. It can be powered from a USB connection, an external 6-to-36-volt battery, or from a 3.7-volt Lithium battery. The current version of the **Uno** uses USB for power. The user can upgrade their unit to use these other power sources if desired.

The **Uno** is available in either a commercial, molded, CNC milled New Age enclosure (shown on the left) or a 3D printed enclosure (shown on the right).

The **Duo’s** hardware is similar to the **Duo** and **Quad** in that it provides a physical knob, and supports CW paddle, straight-key, and PTT inputs. It also provides a speaker with a **volume control** to provide a useable sidetone for CW operation when running **CTR2-Flex** firmware.

Like the **Duo**, the **Uno** provides a single 3.5mm stereo jack that can be software configured to be either a CW paddle or key/PTT jack.

Two Firmwares

As mentioned previously, two versions of firmware are available.

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

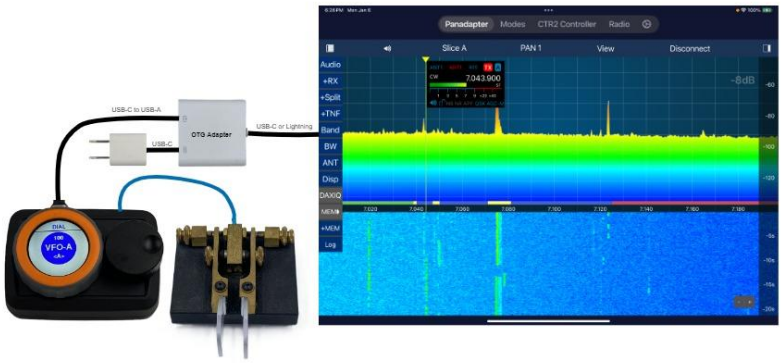
CTR2-Dial firmware on the other hand, uses MIDI commands over Bluetooth or USB to control a 3rd party app such as SmartSDR for iOS/MacOS, SDR-Control, FT-Control, TS-Control, K4-Control, Thetis, SDR-Console, and many other apps that support MIDI control of their functions

You can switch between the two firmwares in the *Settings* menu without re-flashing your unit.

Power Options

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

In the photo below, an **Uno** is shown connected to an OTG adapter on an iPad running SmartSDR for iOS. (a **Duo** or **Quad** can also be used.) 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** unit when plugged in. For extended battery operation, a 20,000 mA USB battery can be used to power both the **CTR2** unit and the iPad. You can power the **CTR2** unit directly from the iPad or iPhone through the OTG adapter without an external power supply. When running **CTR2-Flex** firmware, both the **CTR2** unit and the iPad must be connected to the same network your radio is on.



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

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

Using a 3.7-volt Lithium Battery

The M5Dial also has a 1.25mm two-pin connector under the STAMP-S3 processor that is used to connect a single cell 3.7-volt lithium battery. The M5Dial will charge the battery (at around 100 milliamps) so a battery of at least 1000 mAH should be used. The STAMP-S3 processor must be removed to access this connector and it can be very difficult to replace the processor when you're done. This is a user modification. I do not sell battery equipped **Uno** units, although Neil, G7UFO does in his shop.

NOTE: The M5Dial doesn't have the hardware required to monitor the 3.7-volt battery's state of charge so you essentially have to "run it till it drops".

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

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

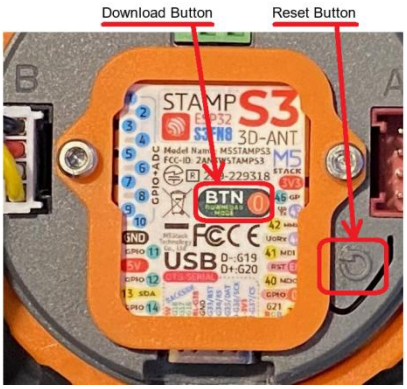
Appendix A: Installing or Updating CTR2-Flex Firmware

As new firmware versions are released, you may want to reflash your unit to get the latest updates. This section will describe how to do that.

CTR2-Flex firmware is pre-installed on all **Uno** units. You have the option when ordering to specify which firmware you want your unit to initially boot into. You can always switch the boot firmware by selecting the other firmware in the *Settings* menu.

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

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

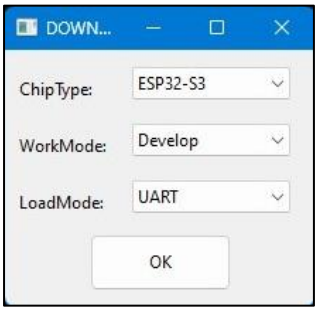


1) Remove the base of the enclosure.
    a. On 3D printed enclosures, remove the four screws holding the base to the shell with a 2mm Allen wrench
    b. On the New Age enclosure, remove the four rubber feet then use a #1 Phillips screwdriver to remove the screws joining the two halves
2) Press and hold the **DOWNLOAD (BTN)** button on the M5Dial then apply power to **CTR2** unit. The display will be blank when the unit boots into programming mode. If the unit is already powered up, press and hold the **DOWNLOAD** button then press and release the **RESET** button. You should hear a beep from your computer as it registers the new USB COM port and the display will be blank.
   NOTE: If you have problems getting the **DOWNLOAD** button to work its lever may have slipped off the button on the board. Remove the label and flick the lever back onto the button. Thanks Joe, KO8V for the tip!
3) You can now use the procedure below with EspressIF Flash Download tool (on Windows) or run the script (on Linux and Mac) with the new COM port to flash the new firmware to the M5Dial.
4) Once the download completes, cycle the power on the unit to start the new firmware.

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

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

2. Download and open the **EspressIF Flash Downloader Tool**. When it starts, select the **ESP32-S3 Chip Type**. Leave **WorkMode** set to *Develop* and **LoadMode** set to *UART.*
NOTE: You can also use the **ESPLaunchPad** browser tool described here.

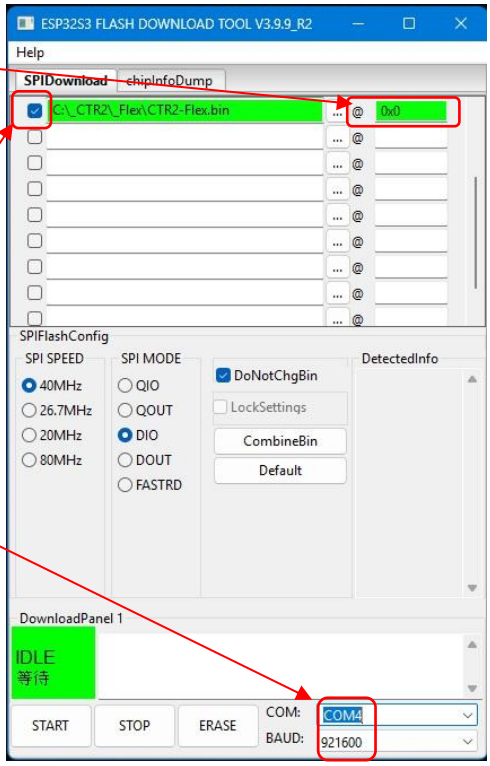


3. Map the **CTR2-Flex.bin** file that you unzipped from the **CTR2-Flex_v2.xx.xx** firmware distribution file into the downloader tool and set the offset address to **0x0**. Your path to this file will be different from mine.

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

5. Set the **COM:** port to the port assigned to your **CTR2** unit and set the **Baud:** to 921600.

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



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

NOTE: If you erase the memory after running the **CTR2-Flex** firmware you will need to re-enter your call sign and registration key and re-enter your WiFi and radio settings the next time you start **CTR2-Flex**. If you previously exported your settings, you can restore them using the *Import Settings* option in the *Settings* menu. See the **CTR2-Flex Firmware Manual** for instructions on doing this.

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

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

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

Installing using Linux or Mac

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

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

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

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

To use the script file:

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

Appendix B: Power Requirements

The approximate current on the **Uno's** USB connection is shown below for various configurations. These values will give you a rough idea of how long the unit can run on a small 3.7-volt battery.

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

Appendix C: Change Log

Changes applied to older firmware versions are documented here.