CTR2-Quad

Upgrade Kit

Assembly Manual

v1.0

Last Revision: January 22, 2026

Version: 1.0

Revised sections for this version are highlighted in yellow

Table of Contents

Introduction

CTR2-Quad (referred to as the **Quad** 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.

The **Quad's** hardware is based on the M5Dial from M5Stack. This is a rugged, commercial touchscreen controller. The **Quad** is similar in design to the **CTR2-Uno** (aka **Uno**) and **CTR2-Duo** (aka **Duo**) controllers, although it is only available in a 3D printed enclosure. Like the **Uno** and the **Duo**, it can run either **CTR2-Flex** or **CTR2-Dial** firmware.

This hardware upgrade kit was created to allow owners of older **CTR2-Dial** and **CTR2-Flex** single and dual-knob controllers the opportunity to upgrade their units to a **Quad** by reusing the M5Dial in their current unit. All boards are completely assembled and tested on an M5Dial here before shipping. No soldering is required to complete this kit.

This upgrade kit also saves new international customers the additional postage required to ship the heavier assembled **Quad**. They can purchase the M5Dial from a local supplier and save the shipping costs.

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** firmware requires a license key to be fully functional. License keys can be purchased separately if you build your own unit. They are included for free with any purchase of an M5Dial based **CTR2** 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

v1.0: January 22, 2026

- Initial release

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

System Overview

The **Quad's** hardware utilizes the M5Dial from M5Stack. M5Dial is small controller based on the ESP32-S3 processor and includes a 1.28" round color touchscreen display and an integrated encoder. Two PCBs are provided. The main PCB with the physical knobs and buttons mounts to the enclosure using the threaded shafts on the encoders. A smaller jack interface board includes two 3.5mm (1/8") stereo jacks for paddle and key/PTT inputs. This board mounts to the rear panel using ¼" jack nuts.

The main board includes two 4-conductor ribbon cables that plug into ports A and B of the M5Dial and a 6-conductor ribbon cable that plugs into the jack board. It's shown connected to the jack board in the title page photo.

All boards come completely assembled and tested. No soldering is required. Just mount the boards and plug them in.

Parts List

The upgrade kit includes the following list of components. They are included in a plastic bag inserted into the opening for the M5Dial in the enclosure.

Gently remove the bag, being careful not to tear it. Verify the parts received to the list below.

Quantity	Description	Purpose
1	3D printed enclosure shell	
1	3D printed enclosure base	
1	Main PCB with 4 encoders, 2 switches	Assembled and tested
1	Jack PCB with two 3.5mm stereo jacks	Assembled and tested
2	4-conductor ribbon cables	Attached to main PCB – connects main PCB to Ports A and B on the M5Dial
1	6-conductor ribbon cable	Attached to main PCB – connects to Jack PCB
1	32mm aluminum knob	For knob D
3	15mm plastic knobs	For Knobs A, B, and C (style may vary)
4	Hex nuts for the encoders	To attach the main PCB to the enclosure
4	Flat washers	For encoders
2	¼” jack nuts	To attach the Jack PCB to the enclosure
4	2mm cap head screws	To attached the enclosure base to the shell
1	2mm Allen wrench	For the shell attachment screws
1	1.5mm Allen wrench	For the 32mm aluminum knob

Assembly Instructions

Step 1 – M5Dial Removal

If moving the M5Dial from an existing **CTR2** controller:

- Remove the base from the controller – on New Age enclosures the screws are under the rubber feet.
- Unplug the cables on Ports A and B on the M5Dial
- On the 3D printed or **CTR2-Flex** dual-knob enclosure, unscrew the jack nut and remove the jack from the enclosure
- On **CTR2-Flex** hardware, remove the nut(s) and washer(s) on the encoder(s) and remove the PCB
- Use a sharp knife (Xacto type) to cut through the glue that was applied to the shell/orange ring nut/M5Dial body to prevent the M5Dial from rotating
- Use a small flat-blade screwdriver to push the ring nut counter-clockwise. You may need to clean the glue off the threads. Once it is loose, unscrew it from the M5Dial.

- Remove the M5Dial from the enclosure

If using a new M5Dial:

- Unpackage the M5Dial
- Plug the green plug supplied with the M5Dial into the green socket on the M5Dial. You can connect 6-to-36 VDC to this connector to power the M5Dial. This plug can be wired to a 2.1x5.5mm coaxial power jack mounted to the side of the enclosure. A power jack is not included in the kit.
- The connector to connect a 3.7-volt Lithium battery to the M5Dial is under the M5Stamp processor. Instructions for installing a Lithium battery can be found here.

  NOTE: The M5Dial does not have the hardware required to monitor the battery state-of-charge, so you will not know how much capacity you have in the battery while operating the unit.

Step 2 – M5Dial Installation

Remove the parts bag and use the 2mm Allen wrench to remove to two screws holding the base to the shell. Remove the main PCB from the enclosure shell.

WARNING: The main PCB contains CMOS devices. Use ESD precautions when handling this board.

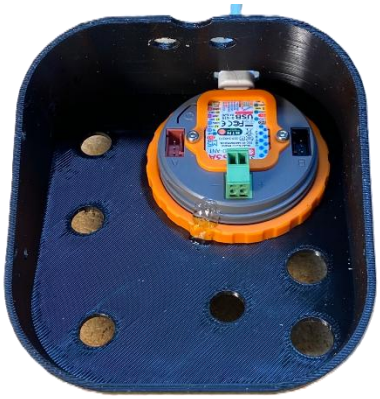
Insert the M5Dial into the top side of the 45mm hole in the **Quad's** enclosure shell.

Screw the orange ring nut onto the M5Dial. Leave it slightly loose.

Insert a USB-C connector into the M5Dial then twist the M5Dial so the USB-C connector is centered in the slot in the enclosure, as shown here.

Once the USB-C connector is centered, apply gentle pressure to the M5Dial to keep it from rotating and use a small flat-blade screwdriver to slightly tighten the ring nut.

WARNING: The ring nut should be finger tight. Do not overtighten it! This will cause additional friction on the gray ring on the M5Dial, making it harder to turn.



Once you are satisfied with the alignment of the M5Dial, apply a small amount of glue (E6000 or equivalent) to the lock the M5Dial's body to the ring and the ring to the enclosure. This will keep the M5Dial from rotating.

Step 3 – Install the Main PCB

Install the main board into the enclosure. The alignment is tight, so take your time and done not force it.

Gently maneuver the board so the two buttons protrude through their holes.

Place the flat washers on each encoder shaft the finger-tighten a nut on each shaft.

Button Alignment

Align the PCB so that the buttons are centered in their holes then tighten the nuts on the encoders with a small wrench. Do not overtighten.

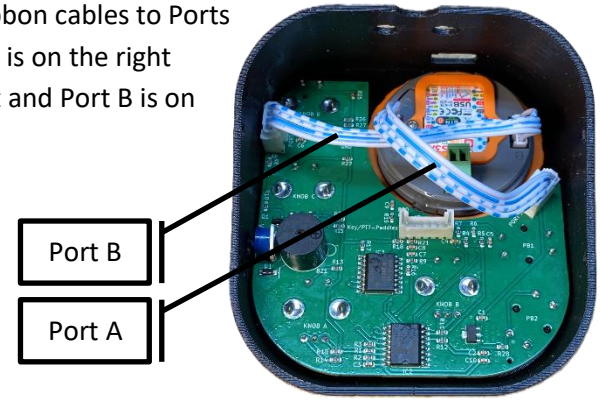
NOTE: If the buttons are misaligned they will be hard to press and “sticky”. If this is the case, loosen the encoder nuts and realign the board.

Step 4 – Connect the Cables to Ports A and B

Once the main PCB has been installed, connect the ribbon cables to Ports A and B on the M5Dial. Port A is on the left and Port B is on the right on the M5Dial. On the main PCB, Port A is on the right and Port B is on the left.

As shown on the photo, the cables will cross over each other.

Once connected, flatten the cables down on top of the M5Dial.



Step 5 – Install the Jack PCB

Plug the Jack PCB into the 6-conductor ribbon cable that is attached to the main PCB.

Using the supplied ¼” jack nuts, mount the jack PCB to the back of the enclosure with the solder side facing towards the bottom, as shown here. There are special screwdrivers that fit the slots on these nuts, but if you don’t have one, you can use a pair of diagonal cutters to grip the knurls on the nuts so you can tighten them.

WARNING: Be careful not to pinch the A and B port cables under the jacks when you mount the board.

Fold the 6-conductor ribbon cable as show.

Step 6 – Install the Base

Set the base on the bottom of the enclosure shell. The white label should be toward the rear of the enclosure and the base should easily snap on. If it is hard to insert the base into the shell, turn it 180 degrees and try again.

Using the supplied 2mm Allen wrench, install the black 2mm cap screws into the holes on each side of the shell.

WARNING: Do not overtighten. These holes are slightly undersized for the screws but will easily strip out if you overtighten them.

Step 7 – Install the Knobs

To complete the assembly, press the plastic knobs onto encoders A, B, and C. It may require a little force to get them snapped all the way down. They should be about 1mm (around 1/16”) above the mounting nut to allow for pushbutton action.

Install the 32mm aluminum knob on encoder D.

If the encoder in your kit as a knurled shaft as shown here, install the knob so the set screw aligns with the slot in the shaft, otherwise it will compress the shaft and the knob will not be concentric.

Step 8 – Load the Firmware

This completes the assembly of your **Quad**. The last order of business is to flash the latest firmware to you M5Dial.

The **Quad** requires **CTR2-Flex v2.04.00** and above. This firmware can run in either **CTR2-Flex** or **CTR2-Dial** mode, depending on your use. **CTR2-Flex** mode allows the **Quad** to connect directly to your Flex radio using WiFi and the Flex API for control. It does not require a 3rd-party app. **CTR2-Dial** firmware supports Bluetooth and USB MIDI to control a 3rd-party radio control app that accepts MIDI commands, such as SmartSDR for iOS/MacOS, Thetis, etc.

You can download the latest firmware at https://ctr2.lynovation.com/dual-boot-firmware/. The instructions for flashing the firmware can be found in Appendix A.

Appendix A: Installing or Updating CTR2-Flex Firmware

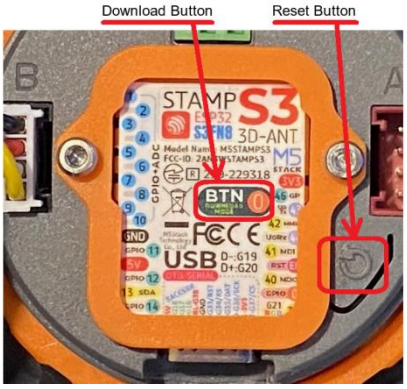
As new firmware versions are released, you may want to reflash your unit to get the latest updates. This section will describe how to do that.

CTR2-Flex firmware is pre-installed on assembled **Quad** units supplied with the M5Dial controller. You have the option when ordering to specify which firmware you want you unit to initially boot into. You can always switch the boot firmware by selecting the other firmware in the *Settings* menu.

If you bought an upgrade kit and provide your own M5Dial, you'll need to follow the directions below to flash **CTR2-Flex** v2.04.00 or above to your M5Dial in order to use it with **Quad** hardware.

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

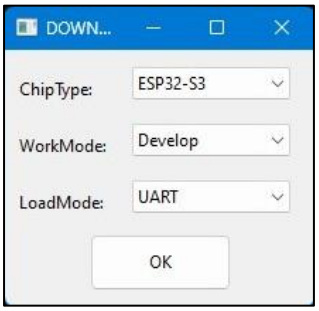


1) Remove the four screws holding the base to the shell with a 2mm Allen wrench
2) Press and hold the **DOWNLOAD (BTN)** button on the M5Dial then apply power to **CTR2** unit. The display will be blank when the unit boots into programming mode. If the unit is already powered up, press and hold the **DOWNLOAD** 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.

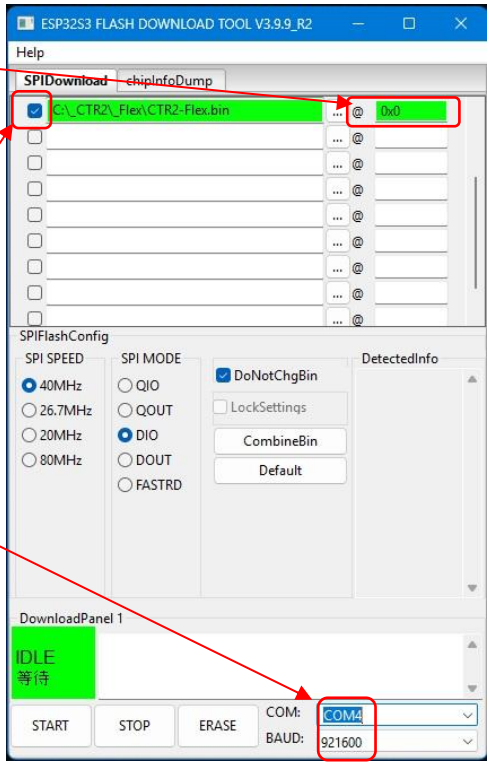


3. Map the **CTR2-Flex.bin** file that you unzipped from the **CTR2-Flex_v2.xx.xx** firmware distribution file into the downloader tool and set the offset address to **0x0**. Your path to this file will be different from mine.

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 **Quad's** USB connection is shown below for various configurations. Since the M5Dial doesn't include battery monitoring hardware, 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.