

CTR2-Max

Hardware Manual

v1.0



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Revised sections for this version are highlighted in yellow

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Introduction

CTR2-Max (referred to as **Max** 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](#).

Max's hardware is based on a generic 2.8" capacitive-touch display with an integrated ESP32-S3. While not as rugged as the M5Dial used in several other CTR2 controllers, the display makes up for it with its larger size. **Max** is similar in design to the **CTR2-Quad** controller, but features several improvements that have been requested by current **Quad** users. Like the other CTR2 controllers, **Max** can run in either **Flex WiFi** or **MIDI** control modes. Operation of **Max** is covered in two manuals, **CTR2-Max Flex WiFi Operation Manual** and **CTR2-Max MIDI Operation Manual**.

CTR2-Max hardware has the following features:

- Color capacitive-touch screen user interface
- Supports both **Flex WiFi** and **MIDI** control modes (both are included in the **CTR2-Max** firmware package).
- Five knobs (encoders). Knobs A, B, C, and D use detent (bumpy) style encoders, Knob E uses a no-detent (smooth) style encoder. Knob E has a large 32mm aluminum knob and is typically used for the VFO control. All knobs are programmable and support a turn and push-and-turn function).
- All knobs have dual-function push-switches. These can be programmed to operate two button controls by using short-push and long-push actions.
- Four large pushbuttons. These pushbuttons are dual-function and can be programmed to operate two button commands, like the knob switches. Pushbuttons can also be assigned to be a dedicated PTT switch.
- A dedicated 3.5mm (1/8") stereo input jack for a CW paddle
- A dedicated 3.5mm stereo input jack for a straight key/external keyer and an external PTT switch
- Built-in charger and power switch to support up to a 2000 mAh 3.7-volt LiPo battery
- Battery state of charge icon
- Sinewave CW sidetone a 1.2-watt speaker and software volume control for the internal keyer in **Flex WiFi** mode
- Optional Sidetone Audio Interface board provides a transformer-isolated Line-Out jack with level control that allows you to patch the sidetone into your headphones, PC sound card, or powered speakers.
 - DIP switches allow you to send the sidetone to the left or right ear, or both. With these switches you can also disable the internal speaker or sidetone Line-Out.

How to use this manual

This manual should be used as a reference manual for the **CTR2-Max** hardware. Full descriptions of the firmware's operating modes are contained in the **CTR2-Max WiFi Mode Operation Manual** and the **CTR2-Max MIDI Mode Operation Manual**, available on the Lynovation.com web site.

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.

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

Legal Notice

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

- This is a hobby endeavor. Nothing is guaranteed! Use this device at your own risk!
- I will do my best to make sure you receive functioning hardware. I will work with you if there is a problem with your unit on arrival.
- 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 ASAP to the best of my ability.
- **CTR2-Max** requires a license key to be fully functional. License keys can be purchased separately if you build your own unit. A license key is included with your purchase of a **CTR2-Max** controller from Lynovation.com.
- License keys are tied to your call sign. This allows you to use the same registration key on as many CTR2 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.
- Contact me if you sell your CTR2 unit. I will create a new key from call sign of the new owner

Change Log

v1.0: July 24, 2026

- Initial hardware release

Changes to previous versions of this manual can be found [here](#).

System Overview

CTR2-Max hardware utilizes a 2.8" capacitive-touch screen display with a built-in ESP32-S3 processor.

It runs **CTR2-Max** firmware which supports both MIDI control and direct Flex WiFi control, similar to other [CTR2 controllers](#).

The unit features five dual-mode knobs. Each knob can be programmed for a turn and a push-and-turn function. Each knob also has a push-switch. These switches are also dual-function and can be programmed to execute any of the virtual buttons with a short-press (less than 1 second) or long-press action.



Example

You can set Knob C's *turn* action for RIT frequency control in the **Knob** menu, and the same knob's *push-and-turn* action for XIT frequency control. The *short-press* switch can then be set to toggle RIT on/off and the *long-press* action can be set to toggle XIT. Other combinations can be easily configured.

Four dual-mode pushbuttons are also provided. These buttons are similar to the switches on the knobs. However, any of these buttons can also be set as a dedicated PTT button.

Instructions for programming the controls can be found in the [operation manuals](#) for **CTR2-Max**.

Max hardware also supports CW paddle, straight-key, and PTT inputs through 3.5mm (1/8") jacks on the rear panel. A 1.2-watt amplifier drives an internal speaker with software volume control to provide a sidetone for CW operation when using the CW keyer in **Flex WiFi** mode.

CAUTION: The Paddle and Key/PTT jacks are for inputs only. They are not designed for output. Do not connect either jack to your radio as this may damage the unit.



NOTE: Pushbutton #2 is hardwired to the external PTT input jack (RING on the Key/PTT jack). In order to use an external PTT switch on this jack, Pushbutton #2 must be configured for PTT in the Settings menu.

An optional Sidetone Audio Interface module allows you to connect the sidetone in the **Max** to your headphones, amplified speaker, mixer, or PC sound card. DIP switches allow you enable/disable the internal speaker and the sidetone Line-Out. Switches are also provided that allow you to send the sidetone to the left or right ear (Tip and Ring), or to both ears.

Power Options

Max is normally powered from your device's USB port. On older iOS devices with the Lightning connector, an OTG adapter (also referred to as a Camera Adapter) allows you to use your iPad or iPhone as a power source. A 5-volt cell phone charger can also be used, as well as a USB battery pack. You can also install up to a 2000 mAh 3.7-volt Lithium-Polymer battery in the unit. An optional on-screen battery icon shows the battery's estimated state of charge.

Battery Installation

I do not install batteries in any **CTR2** controller, primarily because of shipping restrictions. This means that you'll need to install your own battery if this is something you want.

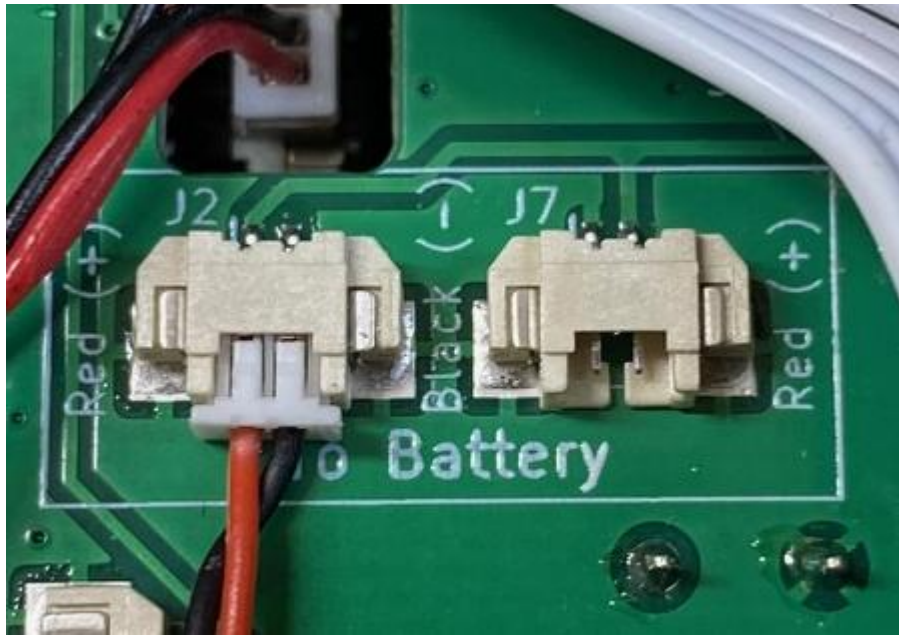
The enclosure is designed to mount a 2000 mAh 1S 1C Lithium Polymer 3.7-volt cell. The maximum dimensions of the battery holder are 35mm W x 55mm L x 10mm H. Batteries can be purchased from a variety of sources. I use these batteries from Amazon.

<https://www.amazon.com/dp/B0FPCWFFYB>



This battery will power the unit for about 12 hours with the display backlight set the Medium2 and WiFi connected. Smaller batteries can also be used. Make sure the battery you choose has a 1.25mm 2-position JST connector.

There is not a standard for the +/- wiring on the connector of these cells. Many come wired as shown above with the Red (+) lead on the left side of the plug. Others come with the Red (+) lead on the right side. **Max** solves this problem by providing two battery connectors. The left connector has the Red (+) connected to the left side and the right connector has the Red (+) connected to the right side. Both connectors connect through a battery isolation switch and then are connected to the BAT input of the display board.



WARNING: Before connecting the battery to either connector, verify the polarity on the connector with a meter then plug it into the connector that places the Black (-) wire between the two connectors. Never connect batteries to both connectors. Connecting the battery with the wrong polarity will destroy your CTR2-Max!

Battery Switch and Interconnect Board

The **Battery** switch is mounted on a small board on the right side of the enclosure base. This board provides an interconnection point for the speaker and battery. It connects to the main PCB mounted in the shell of the enclosure using a 4-pin ribbon cable. This configuration makes it easier to separate the shell from the base when installing the battery.

The **Battery** switch opens the connection between the internal battery and the display. It does not open the 5-volt power connection from the USB-C port.

The switch should be ON when you want to run the unit on the battery, or charge the battery from USB-C power. Otherwise, you should leave the switch OFF. The reason for this is that the 2.8" display board doesn't have a way to turn off the display or touchpad, so it draws 35 mA from the 3.3-volt supply all the time. This will discharge even a large battery if the display is left connected.

NOTE: The unit will always draw 35 mA from the USB-C connection even when you use the **Power Down** option in the **Settings** menu. To completely isolate the unit from power, unplug the USB-C connector and turn the **Battery** switch to the OFF position.

Sidetone Audio Interface Board

In **Flex WiFi** mode, **Max** provides a CW keyer and sidetone. This is necessary because the Flex radio doesn't provide a sidetone when it is keyed over the network. Sidetone volume is controlled by the **ToneVol** control on the **Dial** menu, or by the **TonVol** slider in the Dashboard's **Keyer** menu. You can also adjust the sidetone's pitch using the **ToneFrq** control.

When operating in **MIDI** mode, the keyer and sidetone are not used. This mode only sends paddle contact status to the app it's controlling. The app generates the CW and sidetone.

An optional sidetone interface board is available that allows you to connect the sidetone generated by **Max** to your headphones, power speaker, or PC sound card.

The photo below shows a closeup of the interface controls.



The sidetone audio is available on the 3.5mm stereo **Line Out** connector. Which connection it uses is determined by the **Tip** and **Ring** DIP switches. These switches allow you to send the audio to the left or right ear (Tip or Ring on the jack). Audio goes to both ears when both switches are ON as shown above.

The **L-Out** switch enables or disable the sidetone **Line Out** audio.

The **Spkr** switch enables or disable the internal speaker.

The **L-Out Level** control allows you to set the sidetone volume. This control works in tandem with the **TonVol** control for the keyer.

The sidetone audio interface board can be added at any time to your unit. It is inserted between the **SPKR** output of the power switch interface board and the speaker.

Appendix A: Power Requirements

The approximate current on Max'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 or 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
Display	Power Source	Current
On or Off	Battery or USB-C	35 mA

Appendix B: Change Log

Changes applied to older firmware versions are documented here.