

CTR2-Max-5

Hardware Manual

v1.02



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Version: 1.02

Revised sections for this version are highlighted in yellow

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Introduction

CTR2-Max-5 (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. **Max** is similar in design to the [CTR2-Quad](#) controller, but features several improvements that have been requested by **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**. These manuals can be downloaded [here](#).

CTR2-Max-5 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 turn and push-and-turn functions.
- All knobs have dual-function push-switches. These can be programmed to operate two virtual button functions by using short-push and long-push actions.
- Four large pushbuttons. These pushbuttons are dual-function and can be programmed to operate two virtual button commands, like the knob switches. Any of the pushbuttons can be configured as 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 battery charger, battery holder, and battery switch. The battery holder is 35mm x 55mm and supports up to a 2000 mAh 3.7-volt LiPo battery
- Battery state of charge icon
- **Flex WiFi** mode features a sinewave CW sidetone with a 1.2-watt amplifier that drives the internal speaker. Volume is controlled with a virtual volume control.
- Optional Sidetone Audio Interface board provides a transformer-isolated Line-Out jack with level control that allows you to patch the **Flex WiFi** mode 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 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.
- Each **Max** is hand-built and uses a 3D printed enclosure. This means that there may be small cosmetic flaws on your unit.
- Units are not "plug and play". Be prepared for a learning curve, especially when mapping MIDI commands to your radio control app for the first time. There are videos on my [YouTube channel](#) that can help with this.
- 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.
- **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 **Max** controller from Lynovation.com or from Neil, G7UFO.
- 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

v1.02 – August 15, 2026

- Added additional information to the [Sidetone Audio Interface](#) section

v1.01 - August 10, 2026

- Updated [Battery Installation](#) section
- Added [Wiring Diagram](#) section

v1.0.0 - July 24, 2026

- Initial hardware release

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

System Overview

CTR2-Max-5 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.

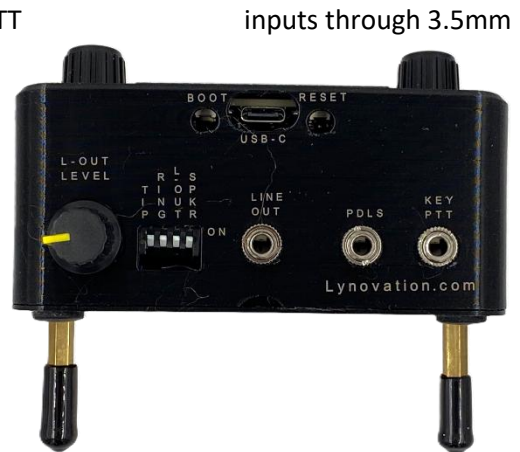
Instructions for programming the controls can be found in the [manuals](#) for **CTR2-Max**.

Max hardware also supports CW paddle, straight-key, and PTT (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.

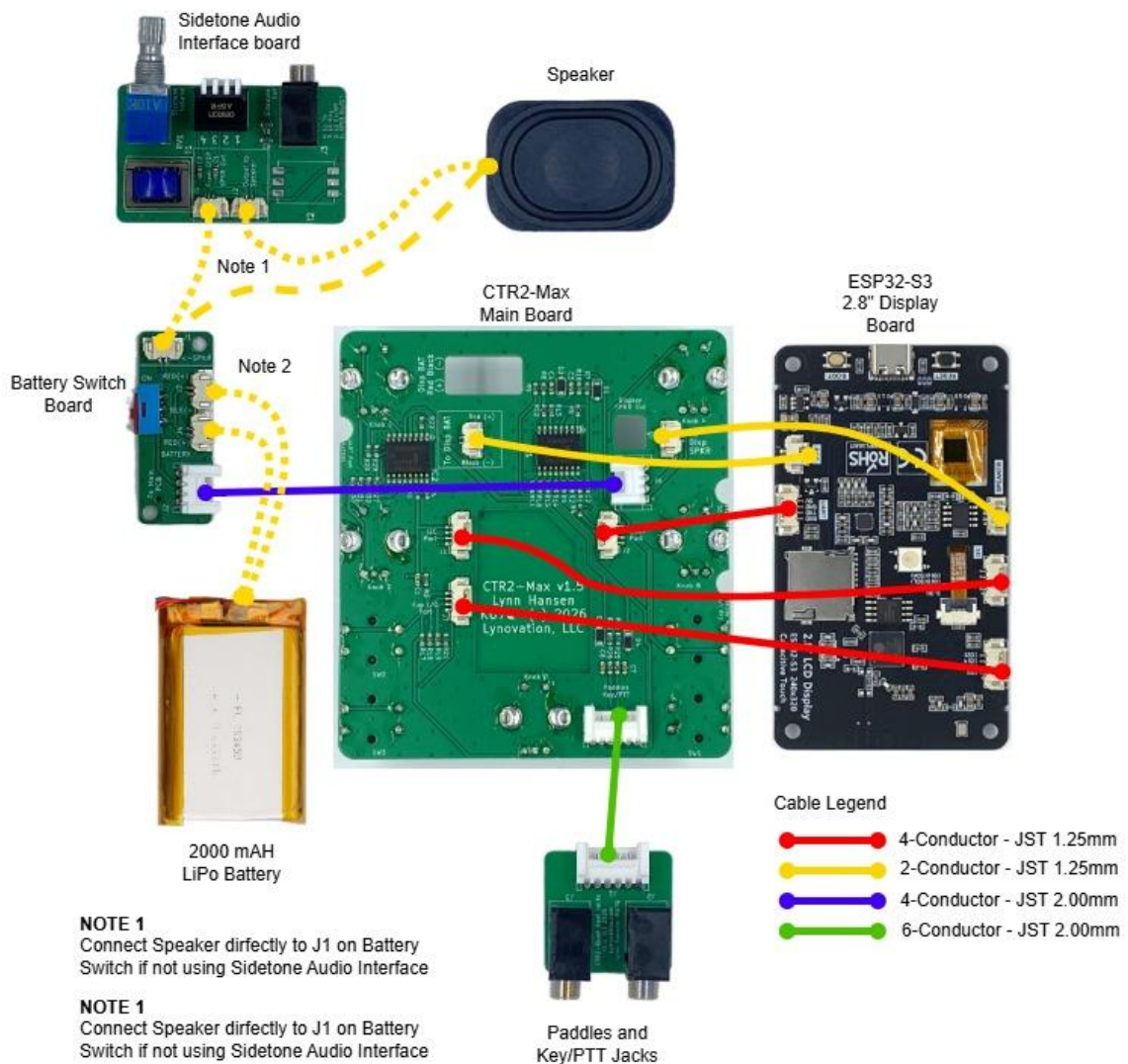
An optional Sidetone Audio Interface module allows you to connect the sidetone in the **Max** to your headphones, amplified speaker, mixer, or PC sound card. DIP switches allow you enable/disable the internal speaker and the sidetone Line-Out. Switches are also provided that allow you to send the sidetone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



inputs through 3.5mm

Wiring Diagram

The following diagram shows how CTR2-Max-5 is connected internally.



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 1 or 2-amp 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 Switch and Interconnect Board

The Battery Switch is mounted on a small board on the left side of the enclosure base. This board provides an isolation switch for the internal battery and 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 battery is left connected to the display.

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.

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 10mm H x 35mm W x 55mm L. (103555). Batteries can be purchased from a variety of sources.

This is a typical battery available from Amazon. It is 10x34x50 and has a JST 1.25mm 2P connector. Make sure the battery you buy has the 1.25mm connector, not the 2.00mm one.

<https://www.amazon.com/AKZYTUE-2000mAh-Battery-Rechargeable-Protection/dp/B0FRFYS2W2>

This battery will power the unit for about 12 hours with the display backlight set to Med2 and WiFi connected. Smaller batteries can also be used.

There is no standard for the +/- wiring on the connector on 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 on the Battery Switch board.



Disassembly

The battery is mounted in the base. To access it, remove the four button-head retaining screws on the sides of the enclosure and gently pull the base off. You'll need the 2mm Allen wrench for these screws.

Unplug the 4-conductor ribbon cable from the switch PCB on the base as shown on the left photo below.



- If your unit doesn't have the Sidetone Audio Interface board (left photo), just unplug the 4-conductor ribbon cable connected to J6 on the Main board to separate the units.
- If your unit has the Sidetone Audio Interface (top-left in the right photo), unplug the two 2-conductor cables from it. J1 (by the transformer) goes to the switch board (it's still connected in the right photo) and J2, the inside connector, goes to the speaker (shown disconnected here).

Next, loosen the clamps over the speaker and the battery holders and move them out of the way as shown.

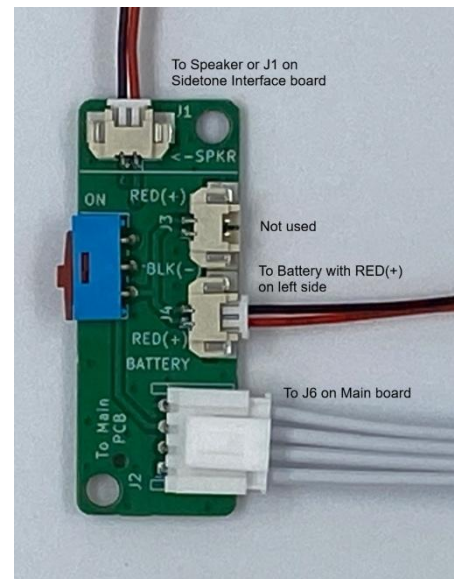
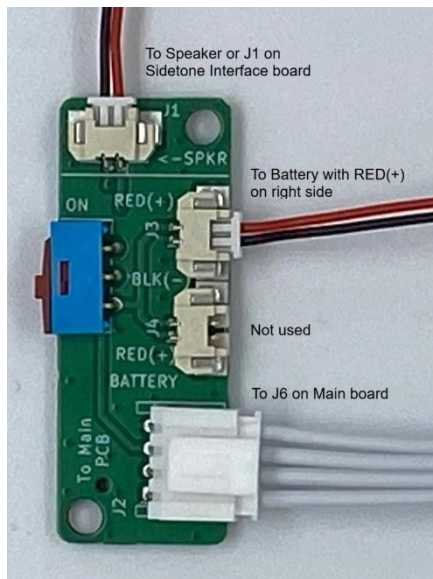
Drop the battery into the battery holder with its cable running next to the Switch board.



Battery Connectors

There are two battery connectors on the Switch PCB, J3 and J4. Both connectors connect through the battery isolation switch and are then routed to the BAT input connector on the display board through the 4-conductor ribbon cable that connects the two boards.

Which connector you plug the battery into depends on how your battery is wired.



- If the battery is wired with its RED(+) lead on the right side of its connector, plug it into the top connector (J3), as shown in the left photo.
- If the battery is wired with its RED(+) lead on the left side of its connector, plug it into the bottom connector (J4), as shown in the right photo.

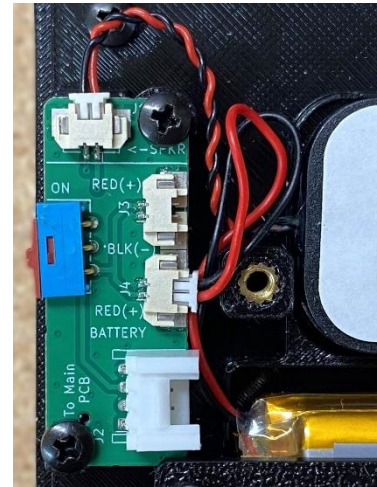
WARNING: Before connecting the battery to either connector, verify the polarity on its connector with a meter. The RED lead must be (+)

Connecting the battery with the wrong polarity may destroy your CTR2-Max!

Battery and Speaker Wire Routing

Route the battery's leads between the standoff for the speaker clamp and the Switch board, then plug it into the correct battery connector on the Switch board. The other connector is left open.

The photo on the right is from a unit without a Sidetone Audio Interface board, so the speaker just plugs into J1 (top connector) on the Switch board.



Reassembly

- On units with the Sidetone Audio Interface board, J1 on the Switch board connects to J1 on the Sidetone Audio Interface board using a 2-conductor cable. The speaker then plugs into J2 on the Sidetone Audio Interface board.

NOTE: The speaker can be a challenge to plug into J2 on the Sidetone Audio Interface board when you reassemble the unit.

- Plug the 4-conductor ribbon cable back into J2 on the Switch board, or J6 on the Main board.
- Gently guide the base back onto the shell and re-install the four button head Allen head screws to secure the base to the shell.

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.

An internal speaker delivers the sidetone through a small grill on the bottom of the unit.

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 the sidetone.

An optional Sidetone Audio Interface board is available that allows you to connect the sidetone generated by **Max** to your headphones, powered speaker, mixer, or PC sound card. It provides an adjustable Line-Output. Transformer isolation removes ground-loop noise.

This photo shows the interface board before installation. It is simply wired in series with the speaker and mounts to the rear panel.



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 on the Line Out jack receives audio 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 disables the sidetone **Line Out** audio.

The **Spkr** switch enables or disables 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.

To use the sidetone Line-Out, connect it in parallel to audio source you want to add the sidetone too. This is easily done using a “splitter” cable with the appropriate connectors, such as the cable shown here. Connect one plug to the Amplified Speaker jack on your Flex, and the other plug to **Max’s Line-Out** jack. Plug your speakers, headphone, mixer, or PC sound card into the jack on the cable.



These cables are readily available on Amazon and other online suppliers. This one can be found [here](#). You can choose others with the connectors to fit your needs.

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.