

CTR2-Max

MIDI Mode Manual

V1.00.01



Last Revision: August 9, 2026

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Updated to firmware v1.00.01

Revised sections for this version are highlighted in yellow

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Introduction

CTR2-Max (referred to as simply **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, like other **CTR2** controllers, supports both **Flex WiFi** and **MIDI** modes. You can easily switch between the two modes in the [Settings](#) menu to fit your operating needs. You should refer to the [CTR2-Max Flex WiFi Mode Manual](#) for information about **Flex WiFi** mode operation.

Max firmware only runs on **Max** hardware with the ESP32-S3 2.8" touchscreen.

Max will be available in three versions. **Max-5 is the only version currently shipping.**

Max-1 has a single large aluminum knob, a single pushbutton, and a CW paddle jack. Both the knob and pushbutton are dual-function.

Max-2 has two dual-function knobs but no pushbuttons. The CW paddle jack is shared with the switches on the knobs. If the paddle jack is enabled the knobs become single-function.

Max-5 is the most capable of all **CTR2** controllers. It has five dual-function knobs, four dual-function pushbuttons, a paddle jack, a Key/PTT jack, and an optional Sidetone audio interface board that allows you to patch the keyer's sidetone in **Flex WiFi** mode into your headphones, powered speaker, or PC sound card.



MIDI Mode

When operating in **MIDI** mode, each knob, knob switch, and button function are hardwired to specific MIDI commands. For instance, the first virtual dial control sends MIDI Change Command (CC) #100. The second dial control sends CC #101, etc. You can change the label assigned to each control. The real magic happens when you connect **Max** to a radio control app. Each MIDI command is mapped in the app to execute a certain function. In the case of CC #100, the app typically controls the radio's frequency based on the direction the knob is turned.

MIDI is a one-way protocol, so when using this mode, the radio control app provides the radio information.

Many apps are capable of receiving MIDI commands. These include Marcus' (DL8MRE) excellent SmartSDR/SDR-Control/FT-Control, TS-Control, and K4-Control for iOS and MacOS, AetherSDR, and RimuSDR, SDR-Console, and SparkSDR, to name a few. **MIDI** mode is also compatible with browser control apps like Remote Ham Radio, Online Remote Radio, and RemoteTx.



Flex WiFi Mode

Flex WiFi mode creates a custom WiFi controller specifically designed for the Flex 6000, 8000, and Aurora 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.

The Flex API is a two-way protocol, unlike **MIDI** mode, so **Flex WiFi** mode 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.

When used as the only controller connected to the radio, **GUI** mode can be enabled in the **Settings** menu to enable a small panadapter in the Dashboard, as show here.



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 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.
- 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.
- 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

v1.00.01 – August 9, 2026

- Initial product release

Changes to previous versions can be found in [Appendix H](#)

System Overview

CTR2-Max is a custom-built radio controller that is designed specifically for the needs of amateur radio operators. It includes a large, 2.8" color touchscreen with up to 5 knobs and 4 buttons that are dual-mode (turn and push-and-turn knob functions and short-press and long-press button actions) for a total of 18 physical controls. These can be assigned to any of the virtual dial and button controls.

Unlike generic MIDI controllers, all **Max** controllers include a 3.5mm (1/8") CW paddle input jack. The **Max-5** also includes a 3.5mm key/PTT input jack.

For **Flex WiFi** mode users, a transformer-coupled sidetone audio interface board is available that allows you to patch **Max's** keyer sidetone into the receive audio from your radio. The sidetone from the keyer is sinusoidal and is generated by a codec. A 1.2-watt amplifier drives a large speaker, giving you plenty of sidetone volume.

Information on the sidetone audio interface and internal battery options can be found in the [CTR2-Max Hardware](#) manual.

NOTE: The CW keyer, sidetone, and **Sidetone Audio Interface** board are not used in **MIDI** mode.

The unit can be powered by any USB power source or a user-installed 3.7-volt Lithium-Polymer battery. Batteries up to 10mm x 35mm x 55mm can be accommodated. A 2000 mAH battery will power the unit for about 12-hours. The built-in charge controller automatically ramps down the charge current as it approaches full-charge. A battery icon can be displayed that shows the estimated state of charge.

MIDI mode doesn't "talk" to your 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 allow other programs to control their functions instead of proprietary CAT protocols.

Since **MIDI** mode doesn't receive updates from the app, there is no **Dashboard** like the one in **Flex WiFi**.

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

Like a mouse, **Max** only sends commands. It does not receive information back from the app or the radio. It has no idea what is going on in the “real world”. The 3rd-party app you’re using manages the user interface and the control communications with the radio.

The [Quick Start Guide](#) will help you configure **Max** and get it setup up with your 3rd-party app.

Quick Start Guide

If you’re like most hams, when you receive a new tool for your shack, you just want to plug it in and try it out.

Your **CTR2** controller is not one of those tools! Be prepared for a learning curve as you discover the features in your controller.

MIDI mode uses Bluetooth MIDI, USB MIDI, or USB HID to control a 3rd-party app and that app controls your radio. The radio you can control, and the functions you have available, are determined by the 3rd-party app. The goal of this section is to give you a basic understanding of how **MIDI** mode works so you can start using your **Max**.

Basic Concepts

Let’s start with how **MIDI** mode works with your 3rd-party app.

CTR2-Max Controller

All of the controls in **MIDI** mode are “hardwired” to MIDI command numbers. You can edit the label associated with each virtual [Dial](#) control or [Button](#). What each dial or button does is determined by the MIDI mapping in the 3rd-party app.

Unlike **Flex WiFi** mode, which monitors and displays the status of the functions it controls, **MIDI** mode is a one-way controller. It only sends MIDI commands to the 3rd-party app. It has no awareness of what the radio or control app are actually doing, therefore you won’t find a **Dashboard** in **MIDI** mode.

3rd-Party Control App

The key to controlling your radio with **Max’s MIDI** mode is the 3rd-party app that it controls. The app’s MIDI map translates the incoming MIDI commands from **Max** to radio functions such as tuning the frequency or changing the volume. There are many 3rd-party apps available. They are generally designed for a specific radio manufacturer, and sometimes a specific radio model. Examples include several iOS/macOS apps by [Marcus](#), [DL8MRE](#), [Thetis](#) for the Apache and Hermes Lite 2 radios, and [SDR-Console](#) by Simon Brown, among others. If your app supports MIDI control, **Max’s MIDI** mode should work with it.

As an added bonus, **Max** works with several browser-based control apps such as [RemoteHamRadio](#), [RemoteTx](#), [OnlineRemoteRadio](#), and [Hams.Live](#). Many of these apps use USB HID instead of MIDI to control their functions. When USB HID is used, the control functions in the app are “hardwired” to controls **Max**. Connecting to these apps is as easy as clicking on the **CTR2** controller button. Mapping can be found in your app’s documentation.

Initial Startup

The first order of business is to power up your **Max**. This is generally done by plugging it into a USB port on your computer. It can also be powered by a 5-volt phone charger, a USB battery, or an optional internal 3.7-volt Lithium Polymer battery. Do not plug it into an unpowered USB hub. Unpowered hubs cannot provide the power the unit requires.

When the unit boots, the flash screen will show **CTR2-Max**, the firmware version number, and the current operating mode (**Flex WiFi** or **MIDI**). If your unit boots into **Flex WiFi** mode, open the **Settings** menu, navigate to the last page, and select **Run MIDI Mode**. The unit will reboot into **MIDI** mode.

Enter your Call and Registration Key

If your unit starts in Demo mode, you'll need to enter your call sign and registration key before configuring your unit. Your call and registration key are written on the label on the bottom of the unit.

There are two ways to enter your registration credentials.

1. Connect your unit to a terminal program such as Tera Term or Putty (see [Appendix C](#) or [D](#), or to use the terminal in your Mac, [Appendix E](#)). Once connected, press any key to start the terminal server on the unit. Next, press the [Del or Backspace](#) 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).
2. Use the on-screen editor to enter your registration credentials. Select **Enter Call & Key** on the last page in the **Settings** menu. Turn **Knob A** to change the letter and touch the screen (or press and turn the knob) to advance to the next letter position. Press the **OK** button to accept. The input sequence starts with your call and advances to your registration key once your call has been entered.

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. Your call will can also be automatically inserted into a CW macro using the ^ prosign.

Connect to your App

Once you have **MIDI** mode running, you'll need to connect it to your app. By default, the firmware supports both USB and Bluetooth MIDI. The connection mode you choose will depend on your hardware. If you're using a desk computer or notebook with **Max** connected to one of its USB ports, USB MIDI is the best way to go. If you're running an iPad or iPhone, Bluetooth may be easier because it doesn't require **Max** to be plugged into the device's USB port.

You can find specific information on connecting to different devices in [Appendix A](#).

Configure the MIDI Mapping in your App

Now that you have **Max** connected to your device, open the MIDI mapping menu in your 3rd-party app and check the default labels in **MIDI** mode against the mapping in the app. **Max** ships with labels for SmartSDR control in Map 1 and labels for Thetis in Map 2. The **Ctrl Map** can be selected in the **Settings**

menu on page 1. Neither set of labels match the default mapping in these apps. In fact, Thetis does not come with a MIDI map pre-installed.

Luckily, most apps have an **Import** feature that will allow you to import a MIDI map into the app. I have maps available for a variety of 3rd-party apps on the [CTR2-Dial Configuration Files](#) page on [Lynovation.com](#).

NOTE: Max is compatible with all maps used with all M5Dial based controllers running **CTR2-Dial** firmware.

Apps use different name extensions for their map files. *.map* is used with SmartSDR, SDR-Control, etc. *.xml* is used with SDR-Console, and *.m2c* is used with Thetis. Instruction for loading these map file can be found in the [Editing 3rd-Party App Maps](#) section below.

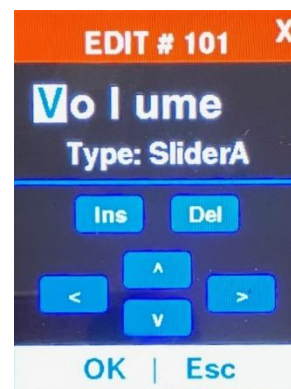
To find out how a control in **Max** is mapped in your app, open its map editor and turn the dial control or touch a button on **Max**. The app should highlight the MIDI command it received in its map, along with the radio function mapped to that MIDI command. Your app will provide a menu of functions to choose from for each MIDI command.

The last item of business is setting the label on the control in **Max** to match the functions mapped in the app.

Editing Labels in CTR2-Max

There are two ways to edit the labels associated with the controls in **MIDI** mode.

1. Use the simple [text editors](#) built into **Max**. These can be found on page 4 in the **Settings** menu. This editor allows you to change each character in the label using a knob that has been set to **<DIAL>** in the [Knobs](#) menu, or by using the [^] and [v] buttons on the screen. You can change the selected character, insert new characters, or delete the current character using the onscreen buttons. When editing a **Dial** setting, you also have the option of changing the [MIDI control type](#) for that dial. Touch the **Type:** label to step through the available types. For more than one or two labels, this can be tedious.
2. Connect a dumb terminal to **Max** and edit labels using the terminal's keyboard. Information on doing this can be found in the [Editing Labels and Control Types](#) section.



The goal is to match up the label for each control in **MIDI** mode with the actual function controlled by the 3rd-party app.

There are spreadsheets in the [CTR2-Dial Configuration Files](#) zip file that provide examples of how **Max** and 3rd-party apps are mapped. You can use these sheets as a basis for setting up your own configuration.

Importing Configurations into CTR2-Max

Max includes [Import](#) and [Export](#) tools that you can use to load a configuration or save an existing configuration. The [CTR2-Dial Configuration Files](#) web page includes **CTR2** configuration files that match the 3rd-party app maps that you can import directly into **Max**. These are text files with the extension .txt. The [Backing Up and Restoring your Settings](#) has Information on using these tools.

Time to Play!

With the basic configuration done, the best way to learn about **MIDI** mode is to use it. Feel free to edit the labels and functions in **Max** and in your 3rd-party app to fit you're operating style.

The following sections provide an in-depth look at the hardware and how **MIDI** mode works with **Max** and your 3rd-party app.

Hardware

Max's hardware, including the sidetone interface board and internal battery options are covered in a separate manual. The hardware manual can be found [here](#).

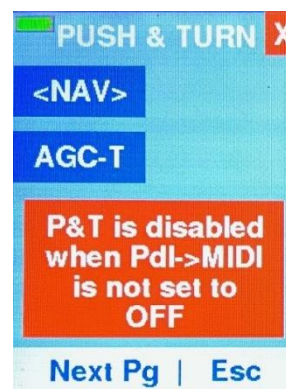
3.5mm Jacks on Max

CAUTION: The 3.5mm jack(s) on Max are for paddle, key, and PTT inputs only. They are not designed for output. Do not connect these jacks to your radio as this may damage the unit.

Shared Inputs for Paddles and Knob Switches on Max-2

Due to the limited I/O on the two-knob version of Max, the paddle jack and the knob switches share the same processor inputs. This means that if the paddles are assigned to MIDI button controls (**Pdl->MIDI**), the push-and-turn functions of the knobs are disabled. To use the push-and-turn functions, set **Pdl->MIDI: OFF** in the **Settings** menu.

If paddles are enabled, this warning will appear in the **Knob Push & Turn** page of **Max-2**. This limitation does not affect the **Max-1** and **Max-5** units.



Internal Battery Option

Max is designed to support an internal 3.7-volt Lithium Polymer battery. I do not ship batteries with any **CTR2** unit, primarily due to postal regulations. You can purchase them from many suppliers. The [CTR2-Max Hardware manual](#) provides instructions for installing it.

Battery Operation

The ESP32-S3 2.8" display used in **Max** was not designed for ultra-low power operation. The display and the screen touch sensor remain powered up, even when the processor is put into deep-sleep mode. Because of this, the unit draws 35 mA from the USB power or internal battery while powered down. This will discharge a 1100 mA battery in about 30 hours.

The workaround to this problem is to add a battery isolation switch. This switch is mounted on the side of the unit and is in series with the internal battery.

With the **Battery** switch In the ON position, the internal battery is connected to the display board. In this state, the unit will run on the battery, and the battery will be charged if the unit is plugged into a USB power source. A battery icon can be enabled in the **Settings** menu to monitor the battery's relative state of charge.

NOTE: If you power down the unit from the **Settings** menu, and leave the battery switch ON, the unit will discharge the battery if the unit is not connected to USB power.

With the **Battery** in the OFF position, the internal battery is isolated from the unit and the unit will turn completely off when USB power is removed. The battery will not charge and no current is drawn from the battery. With the **Battery** switch OFF you can store **Max** for long periods of time.

How MIDI Mode Works with Your Control App

Before getting into the details of **Max's MIDI** mode, it's essential that you have a basic understanding of what **Max** does, and how it works with your radio control app.

MIDI mode creates a MIDI controller with a touchscreen display. **MIDI** mode supports 18 virtual dial controls and up to 60 virtual buttons. The number of buttons displayed in the **Buttons** menu can be changed on page 3 in the **Settings** menu. Each of these controls are "hardwired" to MIDI command numbers. In other words, the MIDI command # for each control never changes.

You can [edit the label](#) displayed for each control and change the [type of MIDI command](#) used for wheel and slider controls in the [Dial](#). The label is just a convenient way to let you know what a control is supposed to be changing in your 3rd-party app. The app's [MIDI mapping](#) determines what it *actually* controls.

Example: MIDI wheel control #100 is always sent by the first [Dial control](#) in **Max**. This control is labeled "VFO" in **Max's Dial Control** page when it's selected. In order for **Max** to change the frequency of your radio, MIDI control #100 must be "mapped" to the VFO frequency control object in your 3rd-party app.

Your app will have a method to edit the function assigned to each MIDI control number.

Controls in **Max** can be executed by touching the control on the display, or they can be assigned to the physical knobs and switches on the unit.

When you execute a control in **Max**, a 3-byte MIDI command is sent to your app. The MIDI command includes the MIDI control #, and a modifier. The modifier can be a direction value for a [wheel](#) control, a value for a [slider](#) control, or an On/Off value for a [button](#) control.

IMPORTANT: The default labels for the controls for [Map 1](#) in **CTR2-Max** are setup for Marcus' SmartSDR for iOS/MacOS apps, but they do not match the default settings he ships in SmartSDR. You'll need to edit

the mapping in SmartSDR to match **Max's** default settings. [Map 2](#) is set up for use with **Thetis** but you'll need to map Thetis to match the labels in **CTR2-Max**.

You can download the configuration and map files for various radio control apps from the [CTR2-Dial Configuration Files](#) web page. All **CTR2-Dial** configuration files are compatible with **Max**.

Your App Executes the Wrong Control

If you execute a control on **Max** and the app executes the wrong function (or no function at all) you can either [edit the label](#) in **CTR2-Max** to match the function mapped to that MIDI control # in the app, or edit the app's map to execute the function shown by the label in **CTR2-Max**. It doesn't matter which setting you change, but they must match.

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 60 button controls are assigned to MIDI control #1 through #60. 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](#). If you find that you don't need 60 buttons, you can change the # of buttons displayed in the **Buttons** menu with the [# Buttons](#) option on page 1 of the [Settings](#) menu.

The table below lists the MIDI button numbers on each page of the [Buttons](#) menu, in the order they're displayed.

Page	Buttons		Page	Buttons		Page	Buttons		Page	Buttons		Page	Buttons	
1	1	4	2	7	10	3	13	16	4	19	22	5	25	28
	2	5		8	11		14	17		20	23		26	29
	3	6		9	12		15	18		21	24		27	30
Page	Buttons		Page	Buttons		Page	Buttons		Page	Buttons		Page	Buttons	
6	31	34	7	37	40	8	43	46	9	49	52	10	55	58
	32	35		38	41		44	47		50	53		56	59
	33	36		39	42		45	48		51	54		57	60*

* Button 60 is shared with Dial 100's CCW action when using the [Button MIDI type](#) for the dial.

I have posted a video on YouTube describing the mapping process. You can find it [here](#).

NOTE: You can export **Max'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-Max** can be found in the [Backing Up and Restoring Your Settings](#) section.

Multiple Controllers / Two Modes

Max can be used in parallel with any of the other **CTR2** controllers. If you have an older **CTR2** unit, you can continue to use it with **Max**. You can use multiple **CTR2** controllers in **Flex WiFi** mode, and if your app allows MIDI control, you can have one controller in **Flex WiFi** mode and the other in **MIDI** mode. Marcus's apps (SmartSDR, SDR-Control, etc.) all you to connect multiple MIDI devices to it. Just select the **MIDI**, **CTR2-MIDI**, or **CTR2-Dial** tools in the **Tools** menu to connect your **CTR2** controller to the app. You can never have too many knobs!

Switching Operating Modes

To switch operating modes, open the [Settings](#) menu and navigate to the last page and select **Run Flex WiFi Mode** or **Run MIDI Mode**, depending on which mode is enabled.

In **MIDI** mode, the controller uses Bluetooth or USB MIDI to connect to, and control, the 3rd party app that is controlling the radio.



CTR2-Max's MIDI Mode Features

Max runs on a 2.8" capacitive touchscreen display with an integrated ESP32-S3 processor. The firmware includes the following features for **MIDI** mode:

- Supports USB MIDI and Bluetooth-LE MIDI connections and USB HID for browser-based apps
- Up to 60 virtual button controls for modes/bands/filters selection
- 18 virtual dial (wheel/slider) controls for tuning, volume, RIT, XIT, etc.
- Five physical encoders (referred to as **Knobs**)
 - Knobs can be programmed [Knobs](#) menu for two functions (turn and push-and-turn)
 - Selecting **<Dial>** for a knob function in the **Knob** menu allows that knob to be used to control the selected dial function in the **Dial control**
 - Knob push switches can be mapped to two virtual button functions using short and long-press
- Four pushbuttons are provided – each of these can be programmed for any two button functions (using short and long-press) or be dedicated to control PTT.
- [VFO Lock](#) control

- 3.5mm (1/8") stereo input jacks allow you to use your paddles to control your app's keyer, straight key, or PTT
- A virtual PTT switch
- Four beep volume levels, Off, Low, Medium, and High
- Automatic speed sensitive tuning & control adjustments
- Two maps allow **Max** to be used with separate programs without requiring configuration changes
- Seven color themes and backlight control
- Sleep and power down timers to save battery power
- Power Down button in the **Settings** menu
 - **NOTE:** **Max** will draw 35 mA even when powered down – use the **Battery** disconnect switch to turn off the unit if using an internal battery.
- [User programmable labels](#) for each button and dial control
- Many power options – see the [hardware manual](#)
- Turn the Bluetooth radio off to save 50 mA of current draw for battery operation
- [Backup](#) **CTR2-Max's** settings using the **Import** and **Export Settings** option
- [Firmware updating](#) is done through the USB-C port
- Run **MIDI** or **Flex-WiFi** mode without re-flashing the unit

MIDI Control Types

Before discussing **MIDI** mode's functions, it's important to understand the types of MIDI controls **Max** supports. The table below summarizes each function.

Buttons	Application
Button controls	Buttons are implemented using MIDI Note controls. Each button in MIDI mode is assigned to a MIDI Note # starting at 1 and continuing to 60 . 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 <i>Marcus' iOS/MacOS programs, AetherSDR, RimuSDR, RHR, RemoteTx, and Online Remote Radio</i> for frequency control. This control is continuously adjustable and is centered at 64 counts. Frequency up/down control is initiated by sending a modifier 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 WheelA and is used with <i>Thetis</i> 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 <i>Speed Tuning</i> is enabled the <i>Dial</i> or <i>Knob</i> 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 <i>PI HPSDR</i> control program.
SliderA	This control is similar to potentiometer. Its range is 0 to 127 counts. Turning the <i>Dial</i> control CCW reduces the count until 0 is reached. Turning it clockwise increases the count until 127 is reached.
SliderB	This control is similar to SliderA except that it is used specifically for center tuned controls like RIT and XIT. 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, Max beeps and pauses for 750 milliseconds. This allows you to find zero on the control. HINT: Touching the control's label in the center of the <i>Dial</i> display when the control is "off zero" resets the control to its zero position (64 counts).
Buttons Wheel Type	This control assigns a pair of MIDI buttons controls to send up and down button controls to the control program using the <i>Dial</i> or <i>Knob</i> . The lower control # is sent when the control is turned CCW and the upper control # is set when the control is turned CW. This is normally used for frequency or frequency tuning step up/down control. The control pair is determined by the Dial # as shown in the next table.

MIDI Button Pairs for Dial Button Mode

When the **Button** control type is selected for a **Dial** control, the MIDI button pair is determined by the Dial control #. Turning the knob CCW sends the lower MIDI command #, and turning it CW sends the upper MIDI command # from the table below.

Dial Ctrl #	Button Pair	Dial Ctrl #	Button Pair	Dial Ctrl #	Button Pair
100	60*/61	106	72/73	112	84/85
101	62/63	107	74/75	113	86/87
102	64/65	108	76/77	114	88/89
103	66/67	109	78/79	115	90/91
104	68/69	110	80/81	116	92/93
105	70/71	111	82/83	117	94/95

* **Button 60** is shared with the last button in the [Button](#) menu.

EXAMPLE

To assign a knob control to increment or decrement the frequency tuning step in SmartSDR, do the following:

1. Determine which Dial control you want to use. We'll use #103 in this example.
2. Using the **Edit Dial Setting** option on page 8 of the **Settings** menu, select the fourth button on the first menu (#103). Edit its label as needed, then touch the **Type** option to step to **Button**.
3. Open the **Edit Mapping** menu in the **CTR2 Dial Controller Tool** in SmartSDR
4. Select control 103 on the **Dial control** then turn the dial CCW. MIDI button 56 should be highlighted in the **Edit Mapping** menu in SmartSDR.
5. Select the *Tune Step Previous* function from the function list.
6. Turn the dial CW. MIDI button 57 should highlight in the **Edit Mapping** menu in SmartSDR.
7. Select the *Tune Step (1,20,100,1000)* function from the function list.

Now, turning the knob for Dial control 103 will increment or decrement the frequency tuning step in SmartSDR.

NOTE: If you use the **Dial Button** mode for **Dial** control 100, you cannot use **Button 60** on the **Button** menu for another function.

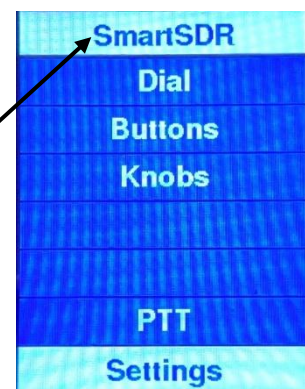
Home Page

The user interacts with **Max** using the touch screen to select from a series of menus and control pages. The **Home** page is the default display and is titled **SmartSDR** (this can be changed in the **Settings** menu). From here you can select the various control pages and **Settings** menu.

The small triangle at the top of the display (just above the map name) indicates the unit is using Bluetooth to connect to the app.

The [map name](#) indicates the radio control app the current map is configured for. It can be edited in the [Settings](#) menu.

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

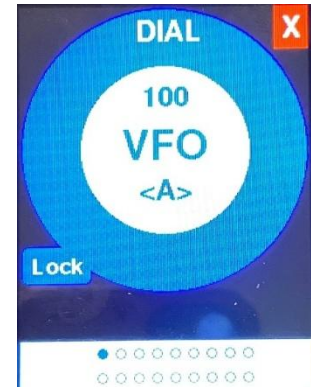


Dial Control

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 on 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 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.



To select another dial control, touch the center of the label or touch button at the bottom of the display.

Touch the red [X] in the top-right corner to return to the **Home** page.

NOTE: Assigning the **<NAV>** function to one of the knob functions in the **Knobs** menu allows you to use that knob to select a dial control on this page.

Dial Graphics

The **Dial's** background depends on [the MIDI control type](#) selected for the control.

Control types can be set using a [dumb terminal](#) program, or you can use the **Edit Dial Setting** in the [Settings](#) menu.

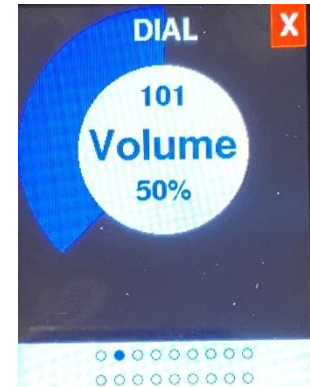
Wheel Controls

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. **<A>** at the bottom of the label indicates that this is a *WheelA* control. The same display is used for *WheelB* and *WheelB-r* controls.

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

SliderA

SliderA 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 50% and the level gage is 50% full. The MIDI control # (101) is displayed at the top of the center label.



SliderB

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 center label (**RIT>**) resets the offset back to 0. You can enable/disable RIT or XIT from the **Buttons** menu. You can also assign the enable/disable RIT or XIT buttons to one of the knob switches or pushbuttons.



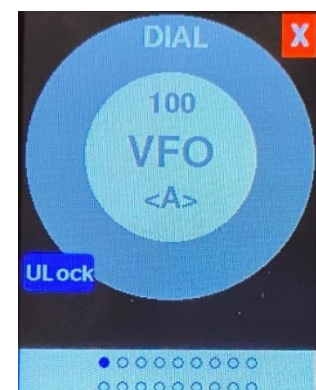
Buttons

You can 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.

Tuning Lock

You can lock tuning to prevent inadvertent changes simply by touching the **[Lock]** button on a control that is set for a [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, touch the **[ULock]** button.



Dial Menu

If a knob has been set to **<NAV>** in the **Knobs** menu, 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** in this example). Touch the bottom button or twist the knob assigned to **<NAV>** to move to the next page.

Touch a button to select that control and return to the virtual dial control, or touch the page's caption to return to the virtual *Dial control* without changing the selection.



Knob Menu

Max supports dual-function knobs. Each knob has a *turn* and a *push-an-turn* function.

The knob menu you are in is displayed at the top of the page. In this photo, we're in the *Knob Turn* function menu.

The function assigned to each knob is shown on its button. Buttons reflect the knob's position on **Max**.



Touching the page caption toggles the menu to the *Push & Turn* menu. This menu allows you to assign the *Dial control* that is used when you push the knob down and turn it (while holding it down).

<DIAL> Function

Any knob function can be assigned to the **<DIAL>** function. When this function is selected, that knob will control the function selected in the *Dial control*.

<NAV> Function

Any knob function can be assigned to the **<NAV>** function. When this function is selected, that knob will change pages in menus or *Dial controls* on the **Dial** control page.



Editing the Knob Menu

You can easily change the function assigned to a knob in the **Knob** menu. Just touch a button to select it, then touch it again to edit it. The selected function will turn red. Turn any knob to scroll through the functions available in the [Dial menu](#).

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



Buttons Menu

Open the **Buttons** menu from the **Home** menu to select from 60 button actions. Touching a button immediately sends the MIDI control for that action.

There are ten pages of buttons with six buttons on each page. If a knob is assigned to the **<NAV>** function, turning it will select a page, otherwise, touching one of the dots on the bottom button will open that page.

Press the red **[X]** in the top-right corner to return to the **Home** page.



Assigning a Knob Switch or Pushbutton to a Button Function

Knob switches and pushbuttons can be set to two actions: a short-press (less than 1 second) and a long-press (greater than 1 second).

Switch Short-Press Action

To assign a short-press button action to a knob's push switch pushbutton, do the following:

- Open the **Buttons** menu and navigate to the page with the action you want to assign
- Touch and Hold the knob switch or pushbutton you want to use
- Touch and Release the action button you want the switch to execute

Once you have assigned a function to a knob switch or pushbutton, the knob's letter or pushbutton's # will appear in that button's label. That action will be sent to the radio anytime you press that knob or pushbutton.

Switch Long-Press Action

To assign a long-press button action to a knob's push switch or pushbutton, follow the steps above for setting the short-press action then while still holding the knob or pushbutton down, touch the desired function a second time. **Buttons** set to long-press actions will have a * appended to the knob or pushbutton # displayed on the button.

The photo above shows the **Buttons** menu. *Knob A*'s short-press action is set to the **Mute** action and its long-press action is set to the **WNB** action. *Knob D*'s short-press action is set to **Band ^** and its long-press action is set to **Band v**.

To clear a knob switch or pushbutton's assignment, hold the knob switch or pushbutton down and touch the selected action again.

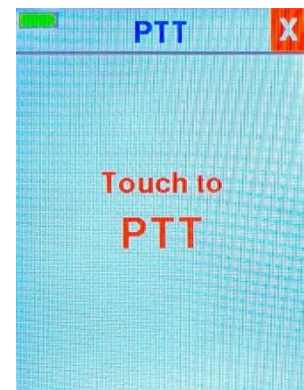
NOTE: You must clear both switch actions from the button before you can assign it to another knob switch or pushbutton.

NOTE: Changing the PTT assignment on any pushbutton automatically cancels all switch action assigned to all pushbuttons.

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 from this page is determined by the **PTT->MIDI Ctrl #** selected on page 3 in the **Settings** menu.

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



NOTE: If your app supports latched PTT, the display on **Max** will not remain red when you lift your finger after PTT is keyed.

The default 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->MIDI** to allow compatibility with apps such as RHR and RemoteTx that are configured for **CTR2-MIDI**. Selecting one of these controls overrides the **Button** menu action associated with it.

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 and Straight Key

You can use a straight key (or external keyer) and/or an external PTT switch connected to the **Key/PTT** jack on **Max**.

1. Connect your straight key (or external keyer) to the TIP and SHIELD (ground) terminals on a 3.5mm (1/8") stereo plug. Connect your PTT switch between the RING and SHIELD on the same plug.
2. Plug the stereo plug into the *Key/PTT* jack.
3. In the **Settings** menu, set **PTT->MIDI: 99** (or **31** if using CTR2-Max with Remote Ham Radio)

Once configured, pressing the straight key will send MIDI command 98 (or 30) and pressing the PTT switch will send the MIDI control defined in **PTT->MIDI** to your app to key PTT. Make sure those control # are mapped to MOX or PTT in your app.

CAUTION: The 3.5mm jack(s) on Max are for paddle, key, and PTT inputs only. They are not designed for output. Do not connect these jacks to your radio as this may damage Max.

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 5 pages with six buttons on each page. You must press a button twice to change its setting.

Press the page caption or the red [X] to return to the **Home** page.

To change menu pages touch one of the dots on the bottom button. If a knob has been set to <NAV> in the **Knobs** menu, rotating that knob will also change the page.



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 <i>WheelA</i> and <i>WheelB</i> .
	3	Dial Sens	Changes the sensitivity of the virtual dial. Range: Low, Medium, High. Default is Medium.
	4	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 <i>Map 1</i> .
	5	Info	Displays the firmware version #, you call, registration key, and the unit's unique Bluetooth ID
	6	Future	
2	1	Backlight	Adjusts the backlight. Range: Low, Medium1, Medium2, and High. Lower settings reduce current draw on the unit.
	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	Rotate Screen	Rotates the screen 180 degrees. This allows the screen to be aligned for various mounting configurations
	4	Future	
	5	BT On/Off	Turns the Bluetooth radio on and off. Turning it off can save up to 50 milliamps when running on internal batteries.
	6	Battery Icon	Enables or disables the internal battery's state of charge icon in the top-left corner of the display
3	1	Pdl->MIDI	Selects the MIDI control numbers mapped to the <i>Paddle Input</i> jack. Default is 96/97 and these are usually mapped to the <i>Left</i> and <i>Right</i> paddle controls in the app. Option 98/99 can be selected and mapped to the Straight Key and PTT options in the app if you want to use your paddle for these functions (Max provides a separate jack for key and PTT inputs). For compatibility with Remote Ham Radio and RemoteTx'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->MIDI	Selects which MIDI control # is mapped to the virtual PTT button page and the pushbutton switch selected in the SWx set to PTT option below. The default of 99 is typically mapped to PTT or MOX in the app. Options are 96, 97, 98, and 99. MIDI controls 20, 21, 30, and 31 are also available for compatibility with Remote Ham Radio and RemoteTx's CTR2-MIDI mapping. To use an external PTT switch, wire it to the RING and SHIELD of the Key/PTT input jack, select Pdl->MIDI: 96/97 above, PTT->MIDI: 99 here, and SW2 set to PTT . If using Remote Ham Radio or RemoteTx, select set PTT Ctrl to 31 . See Using a Hardware PTT Switch and Straight key .

3	3	SWx set to PTT	This option allows you to select which pushbutton is assigned to PTT. To use an external PTT switch on the 5-knob Max , the Key/PTT input jack, this must be set to SW2 . On the one-knob Max , only SW1 is available for PTT. On the two-knob Max there are no switches available for PTT.
	4	PDLS & KEY	This option swaps the TIP and RING on either the <i>Paddle</i> input jack and/or the <i>Key/PTT</i> input jack. Steps through all possible combinations.
	5	# Knobs	Allows you to select the # of knob available on your Max unit. The current hardware is fixed at 5 knobs.
	6	# Buttons	Changes the number of buttons displayed in the Buttons menu. This allows you to limit the # of buttons to the buttons you actually use. Range is 6 to 60.
4	1	Edit Map Name	Allows you to edit the current map's name. This name is displayed in the caption of the Home page. You can enter the radio control app's name here to identify the app this map is used with.
	2	Edit Dial Setting	Opens the Dial control label and MIDI control type editor . See Editing CTR2-Max's Labels and Control Types for more information on dial labels and MIDI control #s.
	3	Edit Btn Label	Opens the Button label editor . See Editing CTR2-Max's Labels and Control Types for more information on button labels. Opens the Button label editor . See Editing CTR2-Max's Labels and Control Types for more information on button labels.
	4	Future	
	5	Export Settings	Backup CTR2-Max's configuration by exporting them to a file on your computer. To do this, in Tera Term select <i>File->Transfer->XMODEM->Receive</i> 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.
	6	Import Settings	Import settings from a previously exported setting file using XModem. In Tera Term select <i>File->Transfer->XMODEM->Send</i> and select a previously saved configuration file on your computer. Next, touch Import Settings to start the transfer.
5	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.

5	3	Power Down	Immediately closes the Bluetooth and USB connection and puts the unit to sleep, reducing current draw to 14 microamps. Touch the display to wake up the unit. NOTE: If you are powering your CTR2 controller with a 3.7-volt battery you will need to press and hold the M5 button on the orange ring for > 10 seconds to wake the controller up from sleep mode.
	4	Run Flex WiFi Mode	Shuts down MIDI mode and restarts the unit into Flex WiFi mode
	5	Restore to Start Up	This option allows you to reset your settings to what they were when you first booted CTR2-Max , <i>if you didn't choose to reset your call and registration key in Reset to Factory</i> . This is handy in case you want to “roll back” changes you made during the current session.
	6	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 [^] and [v] buttons to select a character and [<] and [>] 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 Max'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, <u>and didn't choose to reset your call and registration key</u> , execute the Restore to Start Up option to restore your settings <u>before powering the unit down</u> .

Label and Settings Maps

MIDI mode supports two maps for control settings. Select the map you want to use on page 1 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 **Max**. You must *edit your apps' map* to change the *function* the app executes for MIDI command #'s that **Max** sends.

The name of each map is displayed in the caption of the **Home** page. You can [edit this name](#) to reflect which radio control app **Max** is configured to control. Map names are limited to 8 characters.

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

Two methods are provided for you to edit the control labels. The first is to connect a dumb terminal to **Max** and use the keyboard. Just select which control you want to edit (select the dial on the **Dial** menu or touch a button on the **Button** menu) to display that controls label options.

The second method is to use the built-in editors that allow you to edit the properties associated with **Max's 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 4 in the [Settings](#) menu. For more information on how **Max** controls your radio control app, see [How CTR2-Max 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 2 pages of dial controls to choose from. The currently selected dial control will be highlighted.

Touch the open dot on the bottom button, or, if a knob has been assigned to **<NAV>** in the **Knobs** menu, rotate that knob to change pages.

Touch the label of the dial control you want to edit. The edit page will open. Touch the **EDIT DIAL** caption or red **[X]** to cancel this mode and exit back to the **Settings** menu.

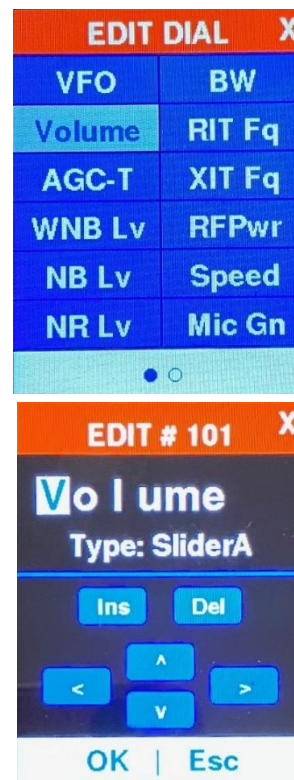
The MIDI control # for the selected dial control will be displayed in the caption of the edit page. MIDI control # is hardcoded and cannot be edited.

The edit cursor will highlight the character to be edited ("V" in this example). Turn **Knob A** or use the **[^]** and **[v]** buttons to change the character. Touch **[<]** or **[>]** to move the edit cursor to the next position. You can also touch another character in the label to move the edit cursor to that position. There are eight characters available for labels.

Touch **Ins** to insert a character at the cursor position and **Del** to delete the character at that position.

To change the MIDI control type associated with this control, touch **Type:** on the display. 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.

When you're done editing, touch **OK**. To exit without saving your changes, touch **Esc** or the red **[X]**.



Button Editor

When you touch the **Edit Button Labels** the **EDIT BTN** menu opens. This menu has 5 pages of buttons with 12 buttons on each page, similar to the **Buttons** menu.

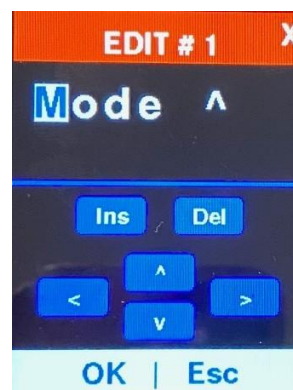
Touch an open dot on the bottom button, or, if a knob has been assigned to **<NAV>** in the **Knobs** menu, rotate that knob to change pages.

Touch the button you want to edit. Touch the caption or the red **[X]** to exit.



Once you select a button the **Button Editor** opens. The MIDI control # is shown in the caption – it cannot be changed.

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 dumb terminal.

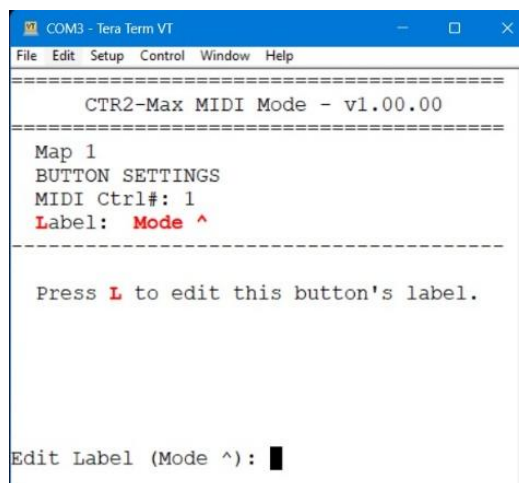
Start your terminal program and connect it to the virtual USB serial port assigned to **Max** by your operating system.

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-Max**. To add a label to a blank control, select it in the [Dial menu](#).

The header of each page contains the firmware version #.

To edit a control, simply select it on **Max**. The terminal page will update with that control's settings. In the screenshot at the right, **Max** is on page 1 of the *Button menu*. 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 prompt.



```
COM3 - Tera Term VT
File Edit Setup Control Window Help
=====
CTR2-Max MIDI Mode - v1.00.00
=====
Map 1
BUTTON SETTINGS
MIDI Ctrl#: 1
Label: Mode ^

Press L to edit this button's label.

Edit Label (Mode ^):
```

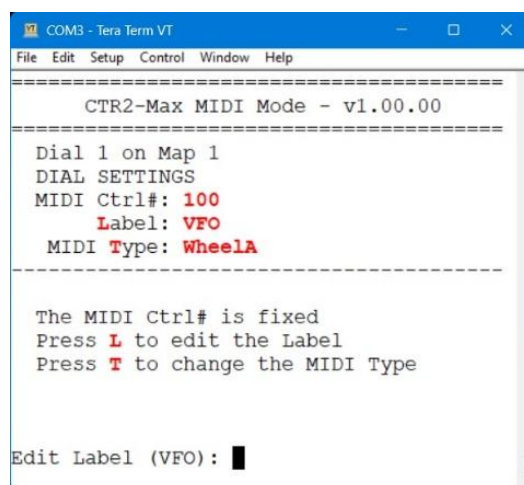
Wheel and slider controls on the **Dial** page include additional settings.

Dial controls are assigned to MIDI control #s 100 through 117. You cannot change these.

Press **T** to step through the MIDI [control type](#) assigned to the control or press **L** to edit the label.

Once you have **Max'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. You can also import settings from other configurations. You can find configurations on the [Lynovation](#) web site on the [CTR2-Dial Configuration Files](#) page.



```
COM3 - Tera Term VT
File Edit Setup Control Window Help
=====
CTR2-Max MIDI Mode - v1.00.00
=====
Dial 1 on Map 1
DIAL SETTINGS
MIDI Ctrl#: 100
Label: VFO
MIDI Type: WheelA

The MIDI Ctrl# is fixed
Press L to edit the Label
Press T to change the MIDI Type

Edit Label (VFO):
```

Backing Up and Restoring your Settings

Once you have your **CTR2-Max** setup the way you want it, go to page 4 on the Settings menu and **Export** your settings to back up the file on your computer.

Max 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 nowadays. Tera Term does and I'll use it in the document. Putty does not. 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 from **Max** first to save it's configuration files. If you want to just return to factory settings, select the **Reset to FACTORY** option on the last page of the **Settings** menu.

Export Settings

To export the current settings from **Max**, connect Tera Term to **Max** then open its XModem transfer utility. This can be found at *Files->Transfer->XMODEM->Receive...* option shown here.

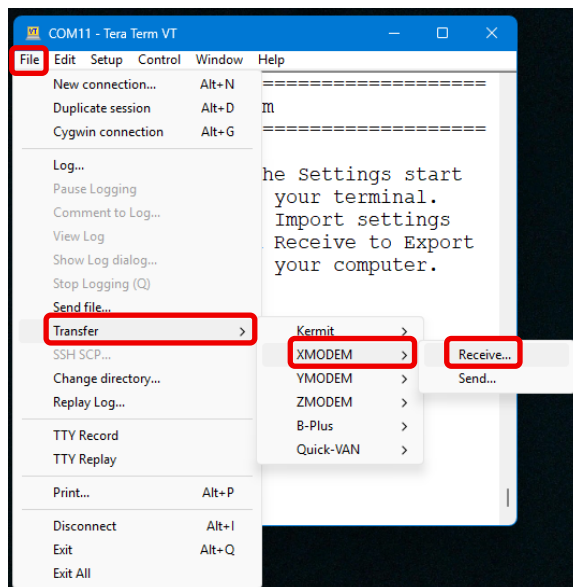
When you select this option, Tera Term will ask you to enter the file name for the file you want to create. Navigate to the folder you want to save it in then give it a name. *I prefer to use the .txt extension but you can use any extension you want.*

NOTE: If you don't enter an extension, your file will be created without one.

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.

You can select whether to send just the basic configuration of you unit, or a full system backup that includes all of the radio and frequency information (including your WiFi credentials and radio address). If you plan on sharing your configuration with others, I recommend saving just the basic configuration.

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 **Max's** boot process.



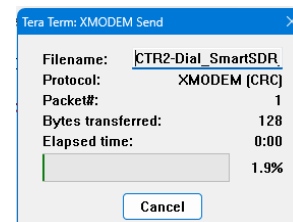
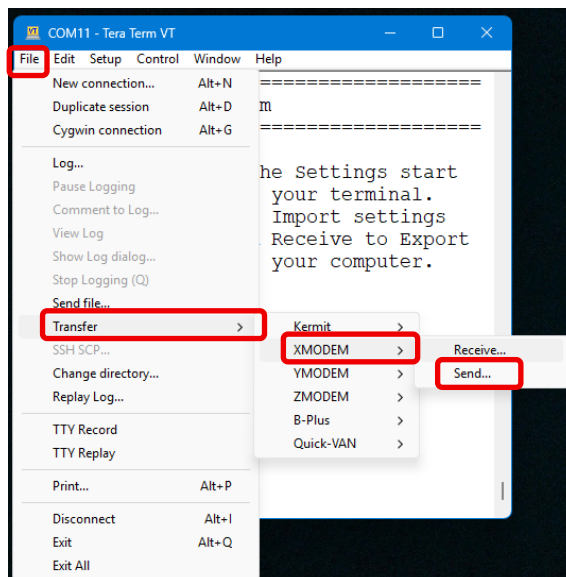
Import Settings

Now that you have a backup file of your settings (or have downloaded a configuration file from the [Lynovation](https://lynovation.com) web site) you can import it using the **Import Settings** option.

To start an import, touch the **Import Setting** button in the **Settings** menu. Next, in Tera Term, navigate to the *File->Transfer->XModem* and select the *Send* option. Tera Term will ask you to select a file. Select one of the files you previously exported, or a file from the [CTR2-Dial Configuration File](#) zip file. Tera Term will then open the file transfer window and transfer the file.

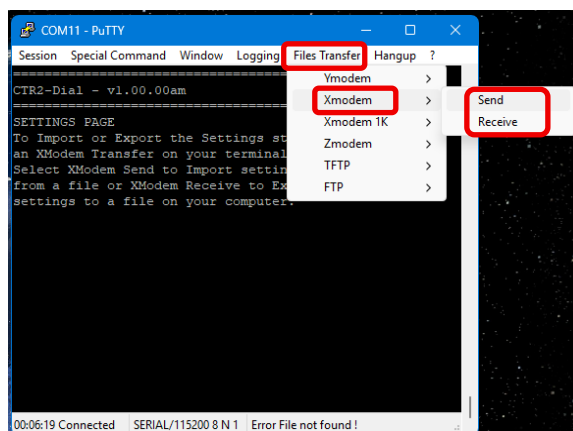
HINT: You can use the export and import settings functions to save and reload multiple versions of your settings. Perhaps you use **Max** on more than two apps and have each app configured differently. You can export the settings for each of your apps then import them back in when you want to change apps. This is also handy if you have more than one **CTR2** controller, or if you want to share your configuration with other users.

NOTE: If the file transfer stalls (as shown here), cancel the transfer in Tera Term and run it again. This seems to be a random bug in Tera Term as it doesn't happen all the time. The import function in **CTR2-Max** will timeout after 30 seconds if the transfer doesn't complete.



Using ExtraPutty

If you use the XModem transfer option in ExtraPutty as shown here, use the *Xmodem* option, not the *Xmodem 1K* option.



Editing 3rd-Party 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. These instructions are included in the configuration files available on the [Lynovation](#) web site under [Download->CTR2-Dial Configuration Files](#).

NOTE: **Max** is compatible with the original **CTR2-Dial** configuration file format.

Before editing the settings in **Max**, you may want to [export](#) the settings to your computer in case you need to restore them in the future.

Remote Ham Radio Maps

Important: Remote Ham Radio does not work in **Flex WiFi** mode (unless you at the remote site and connect to the radio over WiFi).

The current release of [Remote Ham Radio](#) does not include mapping for **Max**. It is optimized for [CTR2-MIDI](#). The instructions below allow you to change the map in **Max** to fit the current MIDI mapping in RHR.

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

Connect a terminal to **Max** and change the labels on the following controls:

Keying Input

Navigate to page 3 in the **Settings** menu and change the **Pdl->MIDI** to **20/21** to use your paddles to control the keyer in RHR. Change **Pdl->MIDI** 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 or with the **Edit Dial Setting** option in the **Settings** menu 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 control* page (but not in the **Dial** menu) until you connect a terminal to **Max**.

Button Controls

The number of buttons available in **Max** greatly exceeds those available on the **CTR2-MIDI**. This means that there will be a lot of holes in the **Buttons** menu in **Max** when set to match the current mapping used in RHR for **CTR2-MIDI**.

BUTTON ACTIONS			
Button and MIDI Ctrl #	Original <i>MIDI</i> Button	Action Taken	Dial Label
1	BTN1	CW Mode	CW
11	BTN1 (long-press)	Toggle NR	NR
2	BTN2	SSB Mode	SSB
Button and MIDI Ctrl #	Original <i>MIDI</i> Button	Action Taken	Dial Label
12	BTN2 (long-press)	Toggle NB	NB
3	BTN3	FT8	FT8
13	BTN3 (long-press)	FT4	FT4
4	BTN4	Toggle PTT	PTT
14	BTN4 (long-press)	Toggle VOX	VOX
5	BTN5	Band Down	Band v
6	BTN6	Band Up	Band ^

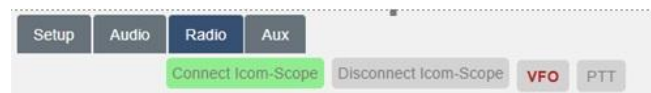
All other button labels on **CTR2-Max** can be changed to a single space.

To hide the buttons not used in the **Buttons** menu, go to page 3 of the **Settings** menu and change **# Buttons:** to **18**.

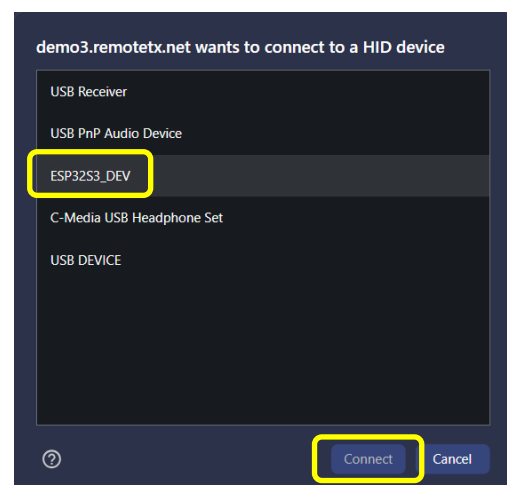
RemoteTx Mapping

Important: RemoteTx does not work in **Flex WiFi** mode.

To use **Max** with [RemoteTx](#), click **VFO** in **RemoteTx's Radio** page, before you connect to the radio.



A list of USB devices on your computer will open. Select the **ESP32S3_DEV** device, then press **Connect**. The **VFO** button should turn red, indicating that the **Max** is connected to this browser session.



To use **Max** with **RemoteTx**, you'll want to edit the labels and knob control types to match the HID controls **RemoteTx** is programmed for. A spreadsheet showing the required mapping can be found at [CTR2-Dial Configuration Files](#) on [Lynovation.com](#). Download the zip file and navigate to the **RemoteTx** folder. This folder also contains the configuration file, *CTR2-Dial_RemoteTx.txt*, that you can [import](#) into **Max** to change all of the settings for **RemoteTx**.

PTT Input

RemoteTx only supports PTT control. It does not support a CW keyer. Plug a straight key or PTT switch into the 3.5mm **Paddle** jack on **Max**. Wire your switch to TIP or RING and SHIELD of a 3.5mm stereo plug.

NOTE: **RemoteTx** is looking for MIDI control 20 or 21 for PTT. To set your unit up for this, open the **Settings** menu and navigate to page 3. Touch the **Pdl->MIDI** button until it shows **Pdl->MIDI: 20/21**. If you've wired your switch to the TIP and SHIELD of the paddle plug, touch the **PTT->MIDI** button until it shows **PTT->MIDI: 20**. If you wired your switch to the RING and SHIELD of the paddle plug, select **PTT->MIDI: 21**.

iOS and MacOS App Maps

Maps for [Marcus' apps](#) are available from the [CTR2 group](#) or from the [CTR2-Dial Configuration Files](#) page on [Lynovation.com](#).

To change the default map that comes with you iOS/MacOS app, first, make sure your app has permission to use your iCloud drive.

Load the app map you want to use into your iCloud folder. Next, open the **CTR2 Dial 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 **Max's Map 1** is setup for SmartSDR for iOS/MacOS, *but it does not match the default map shipped with SmartSDR*. You will need edit this map manually or import the correct map from the [Lynovation web site](#) for your app. If you use other apps from Marcus (SDR-Control, FT-Control, TS-Control, or K4-Control) you'll also need to import the correct map to your app *and import the correct Max configuration file*, or [edit the labels in Max manually](#). I have a [video on YouTube](#) explaining the mapping process.

Using Paddles with the App's Keyer

Marcus' iOS/macOS apps include a keyer that you can control with the paddles connected to **Max**.

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 connection can cause up to 15 milliseconds of delay. This will throw your "fist" timing off, especially in Iambic B mode where an extra element may be added. It may take some practice to get use to the timing change. If this is a problem for you consider using USB MIDI instead.

NOTE 2: Using Bluetooth headphones adds additional latency. You might consider using an adapter on your iOS device that supports a wired headphone along with an OTG connection to minimize this latency.

Follow these steps to configure the app and **Max** 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 your paddles are wired backwards.
- Plug your paddles into the **Paddle In** jack on **Max**
- 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. DO NOT 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 **Max**, 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") stereo plug and insert it into the **Key/PTT** jack on **Max**. Do not use a mono jack.

PTT Switch Wiring

If you want to use an external PTT switch with **Max**, 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") stereo plug and insert it into the **Key/PTT** jack on **Max**.

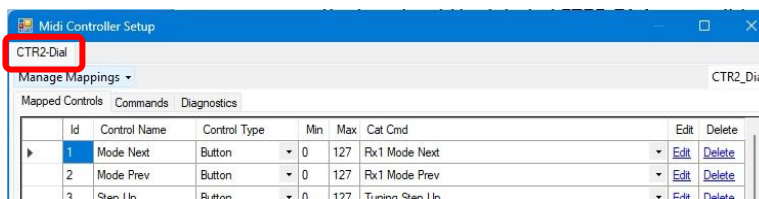
NOTE: You can wire your straight key and external PTT switch to the same stereo plug.

CAUTION: The 3.5mm jack(s) on all CTR2 units are for paddle, key, and PTT inputs only. They are not designed for output. Do not connect these jacks to your radio as this may damage the unit.

Thetis Maps

Thetis is a little different than RHR and iOS/MacOS apps in that it uses **Max's WheelB** control instead of **WheelA** for frequency tuning. **Map 2** is pre-configured with **WheelB** for tuning. You can select **Ctrl Map: 1** on page 2 in 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-Max** using USB.



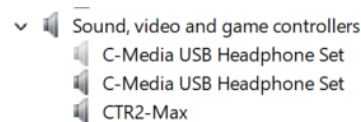
Windows doesn't support Bluetooth LE, so you must use USB with Thetis.

NOTE: If the program doesn't initialize **Max**, check to make sure you are using a USB-C data cable, not a USB-C charge cable.

It's a Software Device

If you can't get Thetis to recognize **Max**, verify that **CTR2-Max** appears in the **Device Manager** under **Sound, Video, and game controllers**.

Try right clicking on the entry and uninstall it. Cycle the power on your PC and try connecting **CTR2-Max** again.



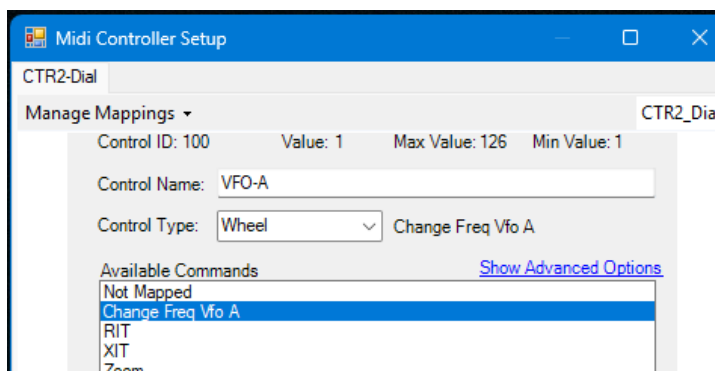
Mapping Controls

You can download a default Thetis map from the [Lynovation web site](#). Once you have unzipped the Thetis 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 **Max** to Thetis, or change the default mapping, use the following process:

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

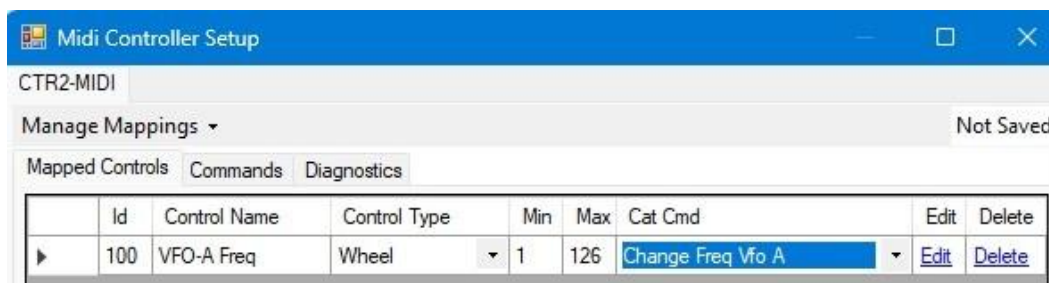
In this example, I changed the dial control when it was set to the first control (VFO-A, MIDI control 100).



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, 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.



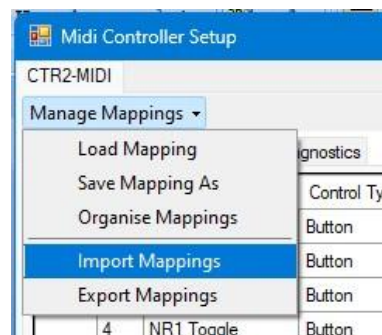
Now follow the same procedure to the other *dials*, *knobs*, and *buttons* in **Max**.

NOTE: When using the Thetis **Wheel** control type you must [set the encoder on Max 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.



NOTE: You need to open the **Configure MIDI** page in Thetis every time you start it in order for it to find **CTR2-Max**.

Advanced Options

Operation with N1MM Logger+

You can use **Max** 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 **Max's Key/PTT** input jack. Next, map MIDI button command **98** to **Trigger CW Straight Key**. With this setup you can control your radio using the N1MM Logger+ or **Max** and use keyboard keying in N1MM Logger+.

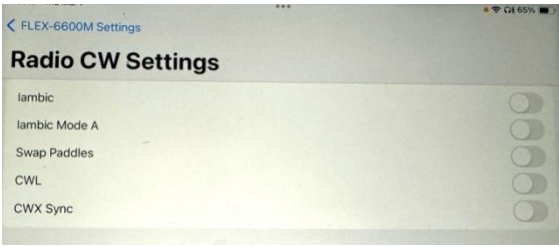
The biggest advantage of using **Max** over using a mouse to control your radio is that commands from **Max** go directly to your radio control app whereas your control app must be "in focus" to use a mouse. This is especially handy when running logging programs like N1MM Logger.

Unfortunately, this configuration doesn't allow you to use a set of paddles with **Max** 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 Max 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 an older Apple device (iPhone or iPad) with the Lightning connector 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 Max's Bluetooth LE	Make sure the Bluetooth radio is turned on and the app has permission to use Bluetooth. Follow the instructions in the Connecting CTR2-Max to the App and Enable Permissions sections. NOTE: Apple devices will not find Max in Bluetooth Settings
I have to connect Max every time I start the app.	Max 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 Max 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. NOTE: You may need to need to open the MIDI Configuration window in Thetis every time you open that app it so it will find Max.
My Flex radio starts sending a string of Dits or Dahs when I select CW mode	This seems to be a bug SmartSDR for iOS/macOS v6.9.15. If you press the paddles when the app is not in CW mode but the CWX panel is open. The 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.
Max connects to my device but does not control anything	1) Verify that you have mapped each control on Max that you are using 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 function 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 Max will beep and pause 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.
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->MIDI in the Settings menu 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. Max 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 <i>Dial</i> or <i>Knob</i>	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 opening the Edit Dial Setting option in the Settings menu. Touch the Type: label to step through the types available.
Pressing either knob switch on a 2-knob Max activates the internal keyer in Flex WiFi mode	The knob switches on the 2-knob Max server double-duty. They are used for both the push-and-turn function of each knob and for the left and right paddle inputs. To use the push-and-turn functions, do the following: In Flex WiFi mode, set the keyer Type to OFF in the Settings menu. In MIDI mode, set Pdl->MIDI to OFF in the Settings menu
The knobs (encoders) on a 1 or 2-knob Max 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.
I can't get the ESP32-S3 in Max I into programming mode	There are two buttons that must be pressed in sequence to force the ESP32-S3 into programming mode. On the back of the unit, next to the USB-C connection, use a toothpick or small screwdriver to <u>press and hold</u> the Boot button then <u>press and release</u> the Reset button, then release the Boot button.

The tuning controls don't work	1) Make sure you have selected the number of knobs on your unit in the Settings menu. 2) Make sure you have selected the correct MIDI Wheel Type for the app you're using. Most Apple apps (SmartSDR, SDR-Control, etc.) use type WheelA. Windows apps (Thetis, SDR-Console, etc.) tend to use type WheelB. PiHPSDR uses WheelB-r. 3) If the tuning control has been locked it will be "grayed out". To unlock the control, long-press on the control's label.
How do I know which app Max is configured for?	You can to enter a name for each map on page 4 in the Settings menu. This name is displayed in the caption of the Home page. Set the name to the name of the app this map is configured for (i.e. SmartSDR, SDR-Control, Thetis, etc.)
The Key and PTT jack does not control my radio	The 3.5mm jack(s) on Max are designed for <u>input only</u> . Connecting these jacks directly to your radio may damage Max . To use a straight key, external keyer, or external PTT switch to control your radio, refer to this section .

Appendix A: Connecting CTR2-Max to Your App

This section describes how to connect **Max** to various apps. Once you are connected to the app see the [How CTR2-Max Works with Your Control App](#) section to understand how **Max** controls work with the app.

Remote Ham Radio

To connect **Max** to [Remote Ham Radio](#) simply plug **Max** into your one of your computer's USB ports. **Do not use an unpowered hub**. Set **Max** to run in **MIDI** mode. Next, select the **CTR2-MIDI** option in the RHR console's **Tool** menu. The **CTR2-MIDI** option is pre-configured for **CTR2-MIDI** mapping so you'll need to change the configuration of **Max** to match RHR. You can see how **Max's** controls should be mapped to RHR in the [Remote Ham Radio Configuration](#) section.

RemoteTx

[RemoteTx](#) is a browser based remote control system. Instead of connecting to the browser using MIDI commands, **Max** connects to **RemoteTx** as an HID (Human Interface Device). This eliminates most of the problems users experience with MIDI control in browser, especially when refreshing a page.

NOTE: **RemoteTx** is a subscription service and requires a Chrome, Edge, or Opera based browser.

To connect **Max** to [RemoteTx](#), plug **Max** running in **MIDI** mode, into a USB port on



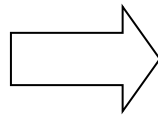
your computer and start the **RemoteTx** web page. Select the *Radio* button at the top of the page click the **Connect Icom-Scope** button. Next, click the **VFO** button. Next select the **ESP32S3_DEV** device from the dropdown list.

For information about setting **Max** up to work with **RemoteTx**, see the [RemoteTx Mapping](#) section.

Marcus' Apps for iOS or MacOS

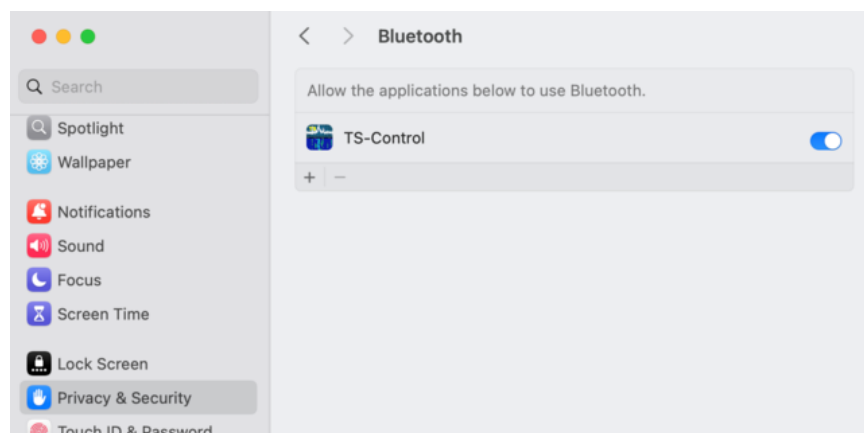
Enable Permissions

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.

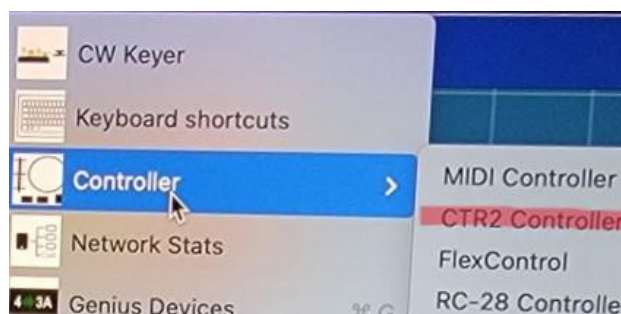
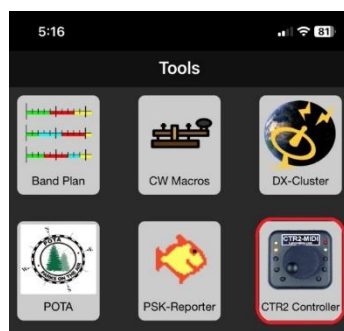
The app on **MacOS** will generally ask you if you want to enable Bluetooth the first time you start it. If you're already running SmartSDR, navigate to **Apple -> System Settings -> Privacy & Security -> Bluetooth**. This screenshot shows the *TS-Control* app has permission to use Bluetooth.



Select the CTR2 Controller Device

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

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



NOTE: These photos were taken before **CTR2 Dial Controller** was added to these apps.

CTR2 Dial Controller Screen

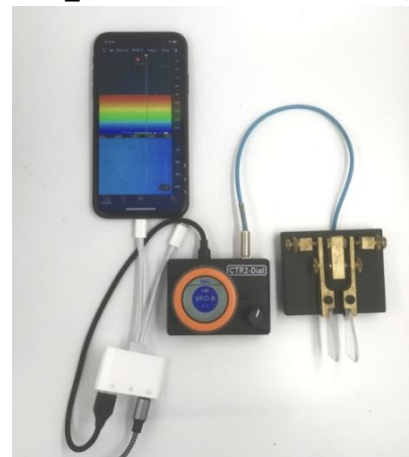
Once you select **CTR2 Dial Controller** from the **Tools** menu a screen like this will appear. It may look different depending on the Apple device you're using but it has basically the same information.



USB Wired Connection

To use **Max** running **MIDI** mode with a wired USB connection on Mac's and newer iOS devices, connect **Max** to your device using a USB data cable, select **ESP32S3_DEV** 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 **Max**.



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 **Max** (it must be running in **MIDI** mode). 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 **Max** (your device's name is **CTR2_xxxx** with xxxx being the last four digits of **Max'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** units running in **MIDI** mode at the same time.

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

If you can't get the app to connect to your **Max**, 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 **midimitttr** for iOS or **Conji** for the Mac from the App store. They are free apps used to troubleshoot BLE MIDI connection issues. Connect **Max** to one of these apps first and then try to connect again in the radio control app.

MacOS Bluetooth Connection Problems

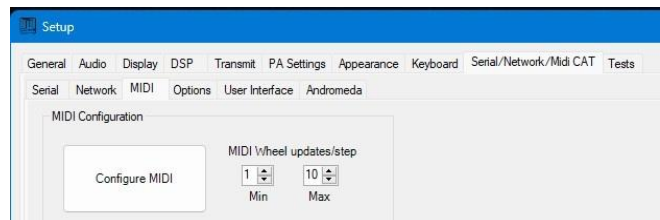
Follow these steps to connect **Max** to your Mac using Bluetooth:

1. Connect **Max** running in **MIDI** mode to a USB port on your Mac.
2. In the **CTR Dial Controller** tool screen in the app, 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 then click **Find CTR2 Bluetooth-LE Device** again.
4. The Mac should report that it has found a Bluetooth device named **CTR2_xxxx** where xxxx is the address of **Max**.
5. Select **ESP32S3_DEV** on the **Device** list to use USB MIDI while connected to the Mac.
6. Select **CTR2_xxxx** on the **Device** list to use Bluetooth MIDI.
7. You may need to change the state of the **Enabled** checkbox to get **Max** to connect.
8. You can now unplug **Max** from the Mac and use it remotely with Bluetooth.

Windows Applications

Thetis

Windows only supports USB MIDI connections. When you connect **Max** 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).



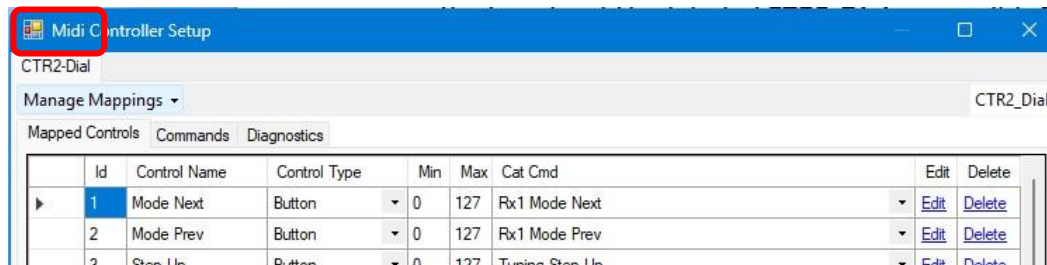
NOTE: USB MIDI requires a USB-C data cable. USB-C power cables, provided by many consumer products, will not work!

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](#).

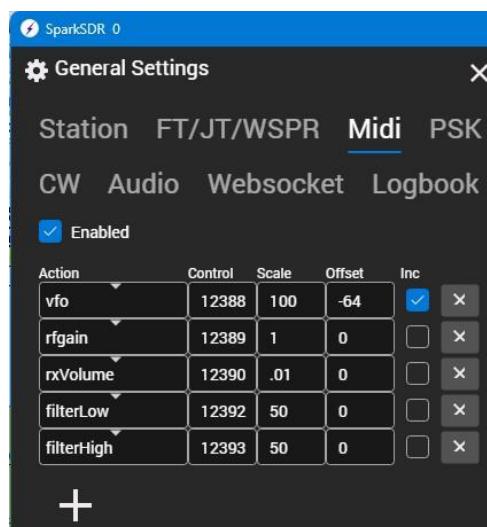
Start by selecting the **Settings** menu on the main page in Thetis then select the **Serial/Network/MIDI CAT** tab. Click the **MIDI** tab as shown above.

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-Max** on the USB port. The tab at the top should be labeled **CTR2-Max** or possibly **ESP32S3_DEV**. 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.sparkedr.com/>) has limited support for MIDI control. It doesn't support buttons, only the *dial* and *knob* controls. To map **Max's** knob functions to this program, first plug **Max** 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-Max 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-Max 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.



Appendix B: Installing or Updating CTR2-Max Firmware

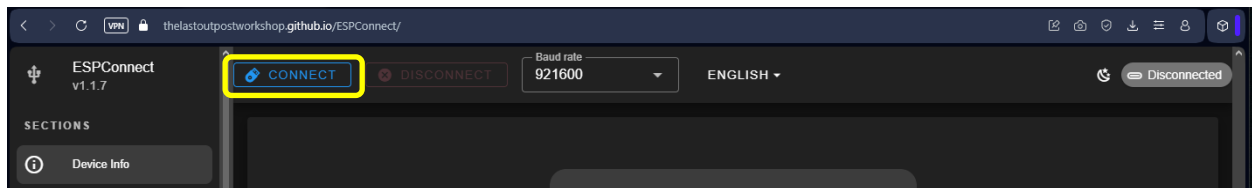
To update the firmware on **Max**, download the latest **CTR2-Max** firmware from my [web site](#). Unzip the firmware distribution zip file into a folder.

Installing Firmware using ESPConnect

By far, the easiest, and recommended method to install or update firmware on an ESP32 processor is with [ESPConnect](#), an open-source ESP32 management project. You can use the Espressif **Flash Download Tool**, but it is geared for developers and many find it difficult to use.

ESPConnect is a browser-based tool that must be opened on a Chromium-based browser that supports Web Serial, such as Chrome, Edge, Brave, or Opera. It will run on a Windows PC or an Apple Mac. Unfortunately, Firefox, Safari, and all Linux browsers don't support Web Serial.

To start, open **ESPConnect** here: <https://thelastoutpostworkshop.github.io/ESPConnect/>



Next, plug **Max** into a USB port on your computer.

NOTE: Do not connect it to an unpowered USB hub.

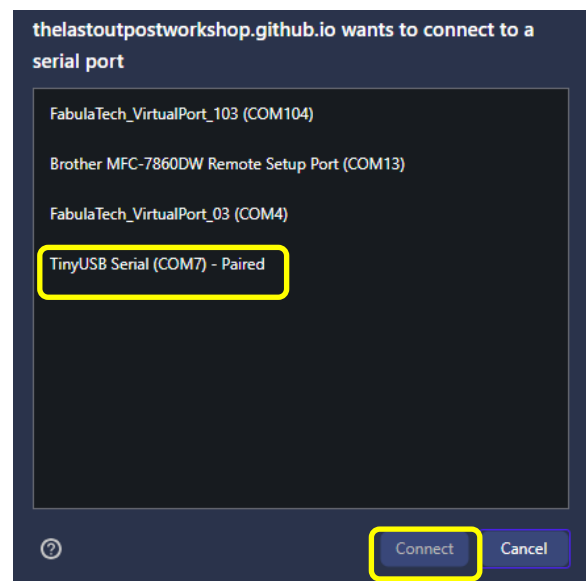
Click the **Connect** button.

A device list will pop up showing the available USB devices on your computer.

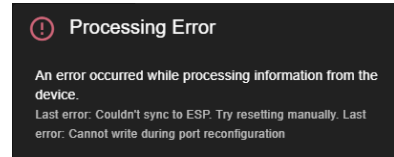
On a Windows PCs, **Max** will be shown as a **TinyUSB Serial** device, as shown here.

On Macs, **Max** will be listed as an **ESP32S3_DEV** device.

Select the **Max** device and click the **Connect** button.



A popup warning will appear telling you that an error occurred. Some errors may tell you to press the BOOT button on the processor to put it into bootloader mode. You do not need to do this.



This is the normal response when trying to connect to a **Tiny USB serial** device. You'll notice that **Max** is frozen at this point because it actually did enter boot mode!

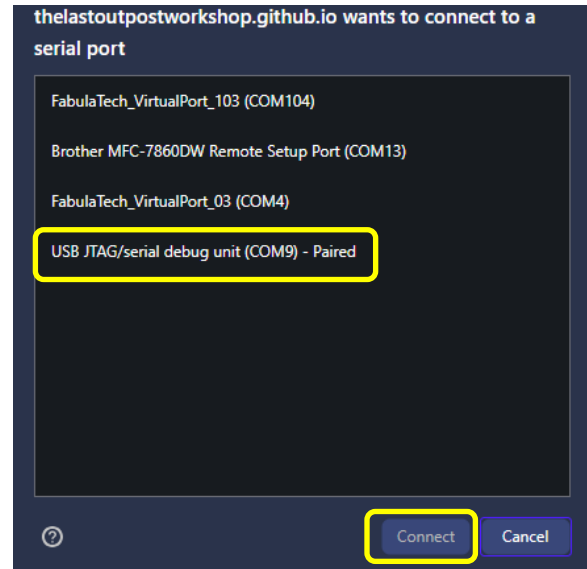
Click the **Connect** button on the **Home** page again.

This time, the **TinyUSB serial** (or **ESP32S3_DEV** on Macs) will not be shown on the list. Instead, a new device, **USB JTAG/serial debug unit** will be shown (on both PCs and the Mac).

This is the bootloader port and the unit is now ready to program.

Select the **USB JTAG/serial debug unit** device then click **Connect**.

NOTE: Apparently, not all ESP32-S3 processors will enable the **USB JTAG** port automatically. If your's doesn't, you'll need to force it into boot mode. Do this by pressing and holding the **Boot** button on the back of **Max**, then press and release the **Reset** button.



Once you're connected to **Max** in Boot mode, the left menu items on the page will be enabled.

<<< WARNING >>>

ESPConnect is a powerful device editor. Many of the functions can cause problems with **Max's** firmware if you change them. If you don't know what a function does, **DON'T CHANGE IT!**

Click on the **Flash Tools** menu item and scroll down to the **Flash Firmware** section.

Click the **Firmware binary (.bin)** text box.

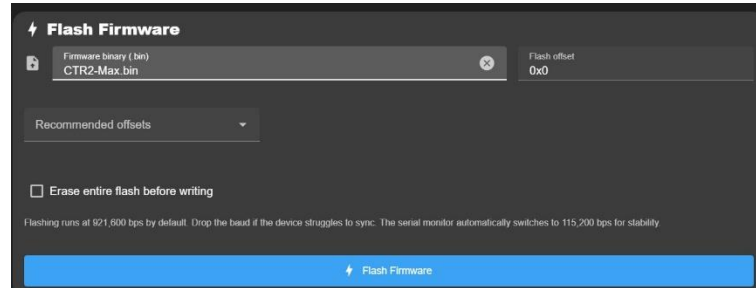


A file navigation screen will appear. Navigate to where you unzipped the firmware zip file from the [firmware update page](#) and click on the **CTR2-Max.bin** file.

Your browser's display should now look like this:

Leave the **Flash offset** set to **0x0** and uncheck the **Erase entire flash before writing** checkbox.

WARNING: If you check the erase box, you'll need to re-enter your call and registration key and reconfigure your unit.



Click the **FLASH FIRMWARE** button to start the flash process.

Once the process completes, cycle the power on **Max**. If your unit has an internal battery, turn the **Battery** switch OFF then disconnect **Max** from the computer's USB port. Next, plug it back into the computer. The version # will be displayed when the unit boots. The version # should match the version # from the firmware zip file.

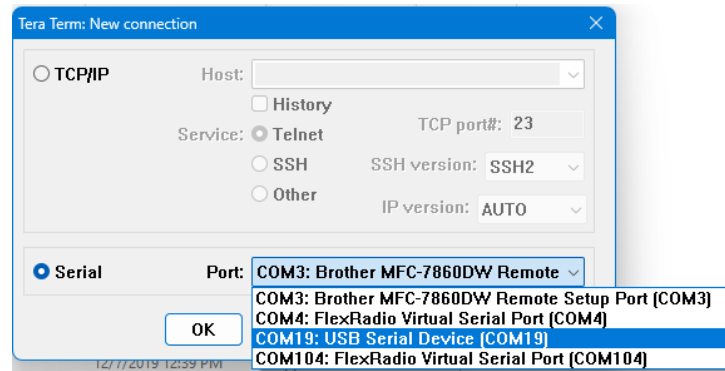
This completes the firmware update process.

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 **Max**. Press any key to start **Max's** terminal server.

You can change the terminal size in the **Setup** menu. Select **Terminal...** Set the **Terminal Size** to at least 41 x 20. **Max'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*. Your 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 **Max**.

Appendix D: Configuring Putty

Putty is a terminal program that can be configured for a variety of needs. **CTR2** controllers only support serial connections. This section describes how to configure the program to interface with **Max**.

NOTE: Putty does not have XModem transfer capability. If you want to [export and import](#) backup files for **Max's** settings consider using Tera Term or install [ExtraPutty](#).

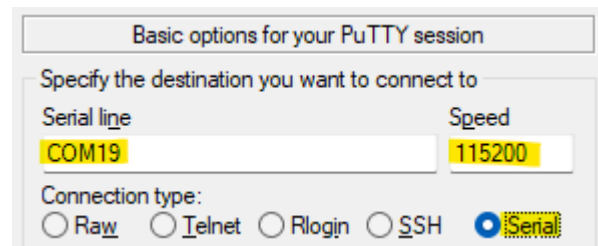
Download Putty for Windows from <https://www.putty.org/>. It's also available for Linux at <https://www.ssh.com/academy/ssh/putty/linux> and for Mac at <https://www.ssh.com/academy/ssh/putty/mac>.

You'll need to connect to **Max** using its USB serial port in order to configure it.

Serial Session

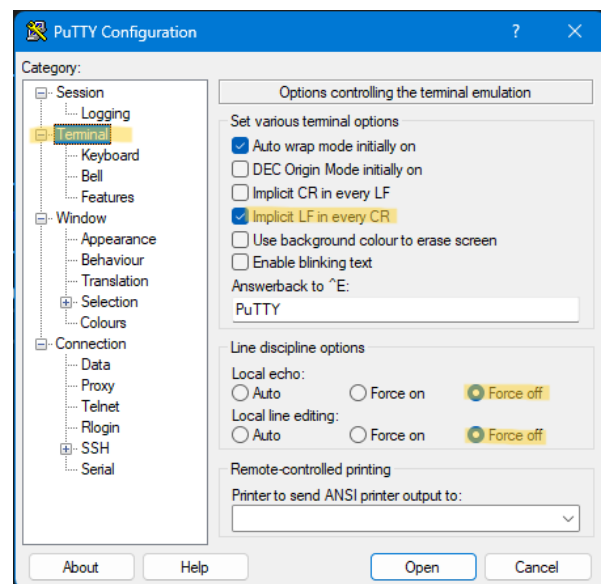
Select **Serial** then set the **Serial Line** to the COM port you found in the Device Manager and set **Speed** (Baud Rate) to 115200.

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.

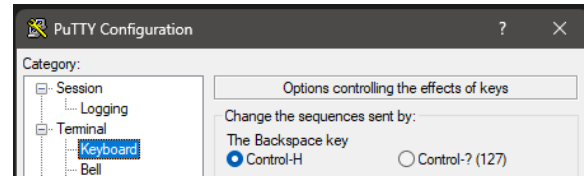


Next, select the **Terminal** item and set the **Implicit LF in Every CR** to on, and **Local Echo**, and **Local Line Editing** to **Force Off**.

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 **Max** to a terminal session, use the following process.

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

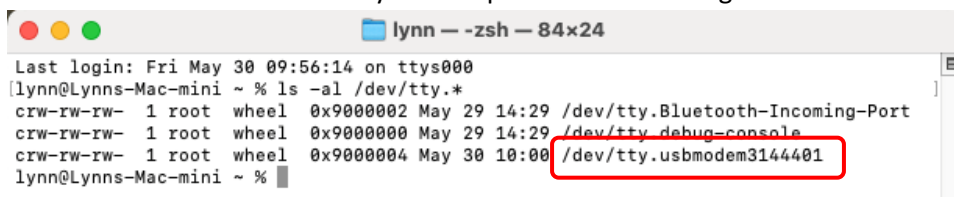
- On the Mac open **Applications/Utilities/Terminal.app**. On Linux open the terminal program supplied by your distro.
- On the Mac, enter `ls -l /dev/tty.usb*`, on Linux, enter `ls /dev/tty*` This will return a list of all known serial ports.
- Next, plug the *Flex* into the computer's serial port and 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 **Max** into your PC, make sure you are using a USB-C cable that supports data. Many USB-C cables that come with consumer electronics only provide power to the device.

Once you know **Max**'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.

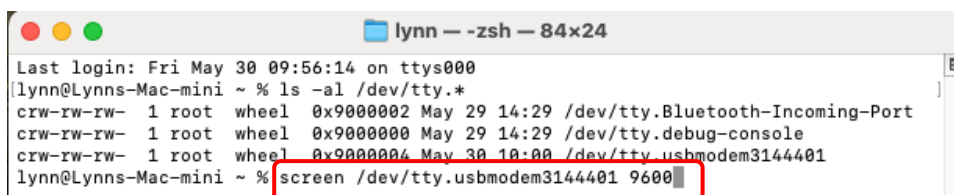
Once you have the serial port ID, enter the following: `screen {serial port ID} 9600`. Include the complete device description (i.e. `/dev/ttyxxxxxx`) for the **serial port ID**. This will open the serial port using 9600 baud in a terminal session. The following screenshots demonstrate these steps.

1. Get the list of serial devices on your computer. We're looking for the **usb** device.



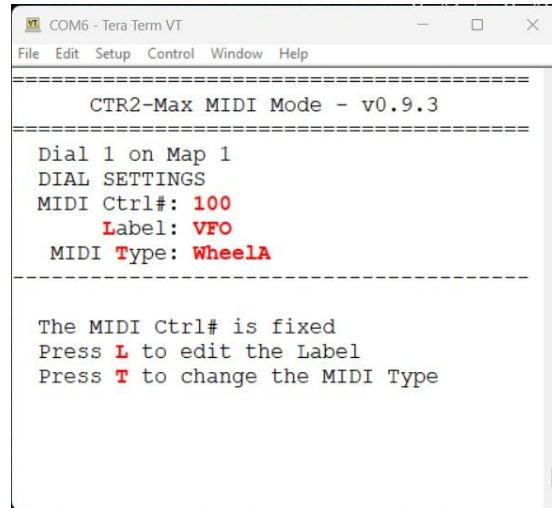
```
lynn - zsh - 84x24
Last login: Fri May 30 09:56:14 on ttys000
[lynn@Lynns-Mac-mini ~ % ls -al /dev/tty.*
crw-rw-rw-  1 root  wheel  0x90000002 May 29 14:29 /dev/tty.Bluetooth-Incoming-Port
crw-rw-rw-  1 root  wheel  0x90000000 May 29 14:29 /dev/tty.debug-console
crw-rw-rw-  1 root  wheel  0x90000004 May 30 10:00 /dev/tty.usbmodem3144401
lynn@Lynns-Mac-mini ~ %
```

2. Open the **screen** utility using the **usbmodem31444-1** device. Your USB device will have a different numerical #.



```
lynn - zsh - 84x24
Last login: Fri May 30 09:56:14 on ttys000
[lynn@Lynns-Mac-mini ~ % ls -al /dev/tty.*
crw-rw-rw-  1 root  wheel  0x90000002 May 29 14:29 /dev/tty.Bluetooth-Incoming-Port
crw-rw-rw-  1 root  wheel  0x90000000 May 29 14:29 /dev/tty.debug-console
crw-rw-rw-  1 root  wheel  0x90000004 May 30 10:00 /dev/tty.usbmodem3144401
lynn@Lynns-Mac-mini ~ % screen /dev/tty.usbmodem3144401 9600
```

3. This is **Max's** terminal display. Select a dial control or button to edit that control's label.



```
COM6 - Tera Term VT
File Edit Setup Control Window Help

=====
CTR2-Max MIDI Mode - v0.9.3
=====

Dial 1 on Map 1
DIAL SETTINGS
MIDI Ctrl#: 100
Label: VFO
MIDI Type: WheelA
-----

The MIDI Ctrl# is fixed
Press L to edit the Label
Press T to change the MIDI Type
```

Appendix F – Power Requirements

Max is designed to support an internal 3.7-volt Lithium-Polymer battery. The display board has a charge controller that will charge at approximately 300 mA until the battery reaches 4.2 volts, then it will reduce to 0 mA. The unit can monitor the approximate battery voltage. This is used to provide a relative state-of-charge via a battery icon that can be enabled on page 5 of the **Settings** menu.

The battery mounts in the base of the unit and has a strap to secure it. The enclosure a battery up to 55mm L x 35mm W x 10mm H. This allows a 2000 mAH battery to be installed. This battery will power the unit for about 12 hours.

Battery installation is covered in the **CTR2-Max Hardware Manual** available on my website.

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

MIDI mode is not limited to programs that support MIDI controls. Third-party MIDI translator apps such as [CoyoteMIDI](#) can receive MIDI commands from **Max** 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 **Max** to be used as a physical tuning knob with radio control programs such as [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-Max** to be used with any program that accepts mouse scrolls or keystroke for control. For instance, it makes a great jog wheel for [Audacity](#).

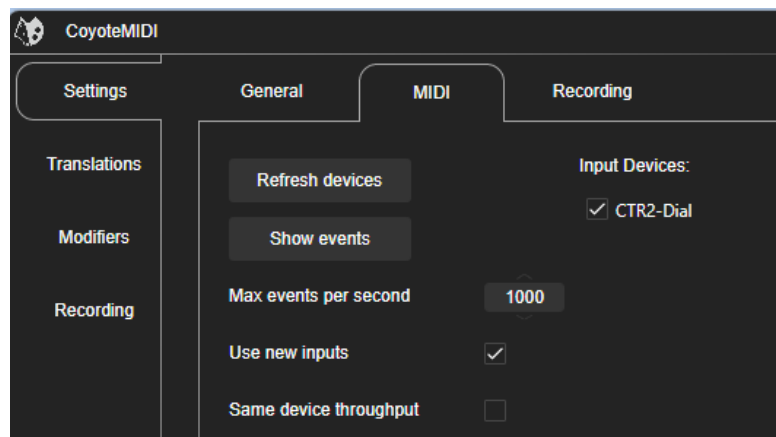
There are a couple of drawbacks to using a translation app instead of native MIDI control. First, like your mouse or keyboard, the app you want to control must be "in focus" to receive the mouse scrolls or keystrokes from the translation app. Second, most programs don't have a lot of control functions 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 **Max** (running in **MIDI mode**) 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



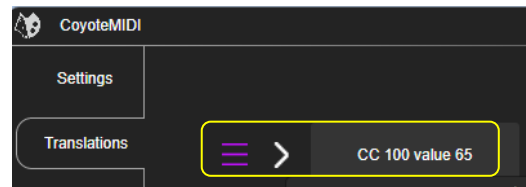
Once you've installed CoyoteMIDI open the app and navigate to the **Settings -> MIDI** tab. **CTR2-Max** should show up on the **Input Devices:** list. Click the checkbox to enable it.

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.

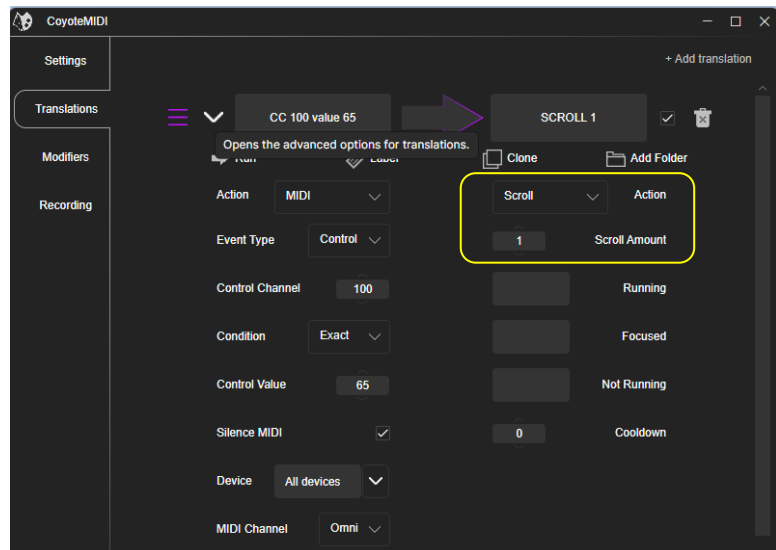
Click the box with **Click to record** then turn the knob on **Max** *slowly clockwise*. You should see **CC 100 value 65** appear in the left box. If you don't see this, make sure the selected control on **Max** shows control 100 above the control's label. Hover the mouse over this entry to show the 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 **Max**. You can edit the label on **Max** 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.

On **Max**, to switch to control 102 on the **Dial control**. 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.

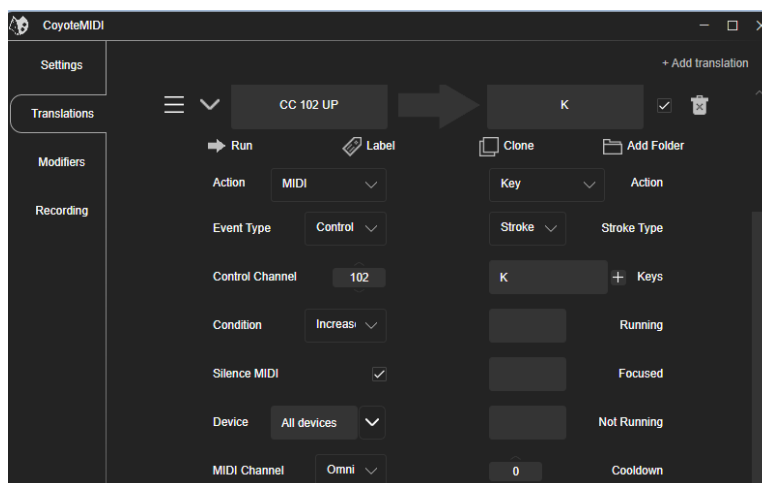
Click the **+Add Translation** button to add another translation.

Click the box that says **Click to record** then turn the knob on **Max 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**.

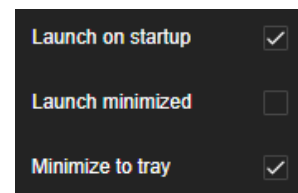
In the **Action** dropdown box in the right column select **Key** and in the **Stroke Type** select **Stroke**. Finally, in the **+ Keys** box, enter **K**. This is the key used to increment the frequency in wfView.



Next, click the **+ Add Translation** button again, click the new box showing **Click to record** and turn CTR2-Max'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

Older change log entries will be save here.