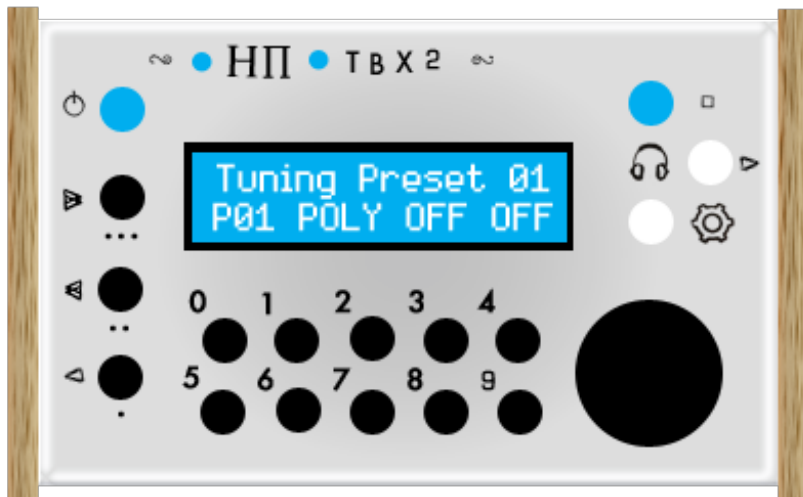


# TBX2



**Hπ INSTRUMENTS**

Aaron Andrew Hunt

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# Changes from Previous Documentation

Here are lists of changes for each version of this documentation.

Please report typos or problems with this text via email to [hpiinstruments@zentral.zone](mailto:hpiinstruments@zentral.zone)

## **v1.8 - January 15, 2020**

- **Using TBX2 with UTE (Universal Tuning Editor):** Moved documentation over TBX2 from UTE documentation to here, and changed the title of Chapter 7 to reflect this. This way all relevant information is in one place, and confusion between TBX2 and TBX2b is avoided.

## **v1.7 - January 28, 2019**

- **MIDI Interface Requirements:** Added section describing MIDI Interface requirements, listing MIDI interfaces which are known not to work, and listing a recommended MIDI interface.

## **v1.6 - January 11, 2019**

- **Precautions:** Added note about battery life/discharge when the unit is not in use.
- **Startup Options:** Fixed *Factory Reset Startup* diagram (missing power button indication)
- **Chapter 8:** improved the text, added a diagram of *Battery Warning Bypass Startup*, and a final section *Handling Battery End-of-Life*.

## **v1.5 - December 18, 2018**

- **Startup Options:** Added new chapter to show startup options with pictures and summary.
- **Chapter 1:** updated user interface diagram with corrected labels (there were inconsistent names for controls used in the text). Added section *Status LEDs (Bottom of Unit)*, showing image with notes about the red and green LEDs visible there. Added note about display brightness and battery life. Updated boxed note about battery warnings to include description of *Battery Warning Bypass Startup*.
- **Chapter 2:** Added boxed note about MIDI DIN ports being used for uploading tunings and firmware. Added section on micro-USB plugs to explain why some cables will not work.
- **Troubleshooting:** Added description and remedy for a POLY issue encountered by one user.

## **v1.4 - December 7, 2018**

- **Chapter 1:** (firmware update-related changes) Added note about *Low Power Warning* and *Hibernation State*. Added notes about *Set & Exit* function for Settings button. Added notes about *Cancel* function for THRU button. Added notes about micro-USB Power Input usage and precautions.
- **Chapter 4:** Added information about Settings and THRU buttons behaviour during programming. Updated *Local Control OFF* with new option per firmware v1.9.2 and added a new section *Turning Local Control back ON*. Added precautions concerning Sysex *Retransmission*.
- **Chapter 6:** Updated descriptions *Bank Select* and *Patch Select* with precautions for use.
- **Chapter 8:** This chapter was added to explain battery management firmware features introduced to guard against data corruption: *Low Power Warning & Hibernation State*.

## **v1.3 - November 15, 2018**

- **Chapter 1:** Added boxed notes on USB-Host Input, Battery Charge, and micro-USB input.
- **Chapter 3:** Added explanation of the difference between Keyboard Controllers and Keyboard Synthesizers, and added a paragraph discussing use of TBX2 with software synthesizers.
- **Chapters 4 & 6:** Explained that the Browse/Enter button and pushing the knob act the same way when programming Settings and Presets, and changed language “push the knob” to “press enter”.
- **Chapter 5:** Attempted to improve descriptions of all modes, especially POLY.
- **Troubleshooting:** Added descriptions and remedies for several issues encountered by users.
- Added this section for quick overview of changes.
- Added version number and publication date to the page header.
- **Chapter 7:** added embedded links to [Universal Tuning Editor](#).
- Fixed a few typos.

# Precautions

## *Location*

Using the unit in the following locations can result in malfunction and damage to the unit.

- In prolonged direct sunlight
- In extreme temperature or humidity
- In excessively dusty or dirty locations
- In excessive vibration
- In close proximity to magnetic fields

## *Power supply*

Use only a 5 Volt DC power supply (standard mobile phone charger) with this unit. A DC power supply of more than 5 Volts will destroy the unit. A DC power supply of less than 5 Volts will not cause damage, but the unit will not function. An AC power supply will destroy the unit.

## *Battery*

TBX2 has a built-in rechargeable Lithium-ion battery with power routing and overcharge protection, providing up to 12 hours of continuous use without external power. The battery will fully recharge in about 4 hours using a 5V 2,5A micro-USB power supply (standard cell phone charger). Supplies with higher amps (A or mA) ratings will charge faster. When connected to a computer via USB cable, charging will take 6 to 8 hours. The battery will discharge in about one month when not in use, as it is connected to management circuitry requiring a small current draw at all times. This is normal behaviour for all mobile devices.

## *Handling*

Do not physically abuse the unit. Do not use excessive force to plug or unplug any cable to or from any port of this unit, especially the power port. Do not apply excessive force to the buttons, switches, knob or display.

## *Cleaning*

Clean the housing of the unit only with a clean, dry cloth. Never use liquid cleaners or flammable polishes.

## *FCC REGULATION*



This device complies with Part 15 of FCC Rules (USA). Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

## *DISPOSAL*



Disposal of this product, manual, package or battery must be done in an approved manner (EU). Do not discard this product, manual, package or battery along with ordinary household waste. Disposing in the correct manner will prevent harm to human health and potential damage to the environment. The correct method of disposal depends on the applicable laws and regulations in your locality.



# Introduction

TBX2 is a unique second-generation microtonal MIDI retuning device which receives standard (non-microtonal) input from a MIDI controller and sends microtonal output to a MIDI synthesizer according to stored tuning tables. Tunings are uploaded to the device using software called *Universal Tuning Editor* (license included with purchase of TBX2).

## *Tuning*

TBX2 features MIDI tuning precision better than 0.006 cents. Four preset modes allow retuning GM (multichannel) synths, monophonic synths, MTS synths, and even proprietary sysex synths. It offers storage space for 8,192 tuning tables of 128 notes each, for a total of over a million pitches. 40 tuning presets can be navigated hands-free using dual pedal input.

## *MIDI I/O*

The unit features both MIDI DIN input and USB-MIDI Host input. Each of the 16 MIDI input channels can be assigned to a unique tuning table in POLY and MONO modes, for up to 2048 microtonal pitches output, providing full compatibility with microtonal controllers like the Tonal Plexus, microzone, and Terpstra keyboards, as well as more conventional multichannel controllers like MIDI guitars and MIDI organs. MTS and USR modes allow 128 pitches output.

## *Manufacture*

TBX1, the predecessor to TBX2, was in manual production for ten years. For the latter half of that time, TBX2 was in development. This device is not mass produced. TBX2 begins its life with a run of 100 units produced in Bulgaria using a combination of state-of-the-art machine and hand assembly. Each unit is individually “brought to life” and given a unique and slightly imperfect aluminium and bamboo enclosure 142 x 84 x 42 mm, hand-made in Germany.

## *Using This Documentation*

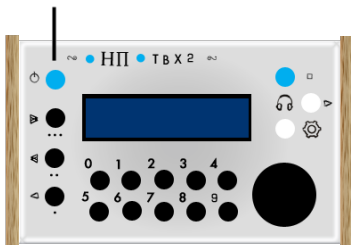
Please read through this text completely. It is written to be read from beginning to end, and also contains a lot of cross referencing for normal use. Detailed information concerning MIDI implementation is found in separate *TBX2 MIDI Reference* document.

Please report typos or problems with this text via email to [hpiinstruments@zentral.zone](mailto:hpiinstruments@zentral.zone)

# Startup Options

There are several options available when powering up the unit, explained briefly here.

## Battery Power Startup



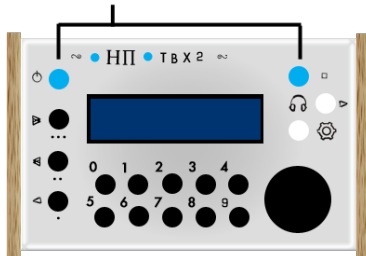
When you simply switch on the blue button on the left, **this tells the unit “we are using battery power”**, regardless of whether the unit is plugged in or not.

The following things may happen once the power switch is in the ON position:

Behaviour	Explanation	Procedure
Display comes on normally.	<i>The battery is charged.</i>	You may use the unit normally.
Display flashes ...	<i>The battery is getting weak.</i>	Plug in the unit to external power immediately.
Display flashes and then goes blank ...	<i>The battery is almost dead.</i>	Plug in the unit to external power, wait 1-5 minutes, and then use External Power Startup routine (see below) – OR – let the unit charge for 4-6 hours before using.
Display does not come on at all ...	<i>The battery is dead.</i>	Plug in the unit to external power, wait 10-15 minutes, and use External Power Startup routine (see below) – OR – let the unit charge for 4-6 hours before using.

Chapter 8 explains display warnings when running on battery power.

## External Power Startup

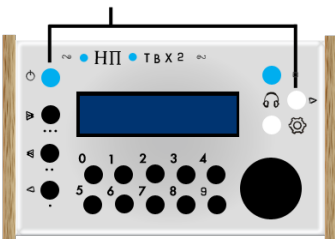


Only when plugged into external power, use both blue buttons to start the unit. Press the blue button on the right first and keep it held down while turning on the unit with the blue switch on the left. This tells the unit “we are connected to external power”. Keep the right button held down until you see the display read as shown below, then you can release it.



This startup routine turns off battery warnings which are not needed when connected to external power. See **Chapter 8**.

## Firmware Update Startup

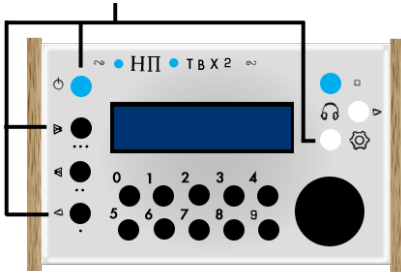


Press the rightmost white button and hold it down while you turn on the unit with the blue power switch on the left. This tells the unit “we are ready to update the firmware”. The display will read as shown below.



UTE refers to [Universal Tuning Editor](#) software. See the Chapter *Using TBX2 with UTE*.

## Factory Reset Startup



This 4-button startup combination tells the the unit “reset to initial factory state”. All tuning data will be lost and all settings will be overwritten with factory defaults. It is made intentionally awkward so that the function is not accidentally used.

## Summary

Diagram	Button Combination	Meaning
A diagram of the TBX2 unit with a wire connecting the Power button (top left) to the Power button (bottom right), indicating a simultaneous press of these two buttons.	<i>Power only</i>	“Using battery power”  Battery warnings: ON
A diagram of the TBX2 unit with a wire connecting the THRU button (top left) to the Power button (bottom right), indicating a simultaneous press of these two buttons.	<i>THRU (Cancel)</i> + <i>Power</i>	“Using external power”  Battery warnings: OFF!
A diagram of the TBX2 unit with a wire connecting the Browse (Enter) button (top right) to the Power button (bottom right), indicating a simultaneous press of these two buttons.	<i>Browse (Enter)</i> + <i>Power</i>	“Ready to update firmware”  (See <i>Using TBX2 with UTE</i> )
A diagram of the TBX2 unit with a wire connecting the Power button (top left), the Settings button (top right), and the Power button (bottom right) in a loop, indicating a simultaneous press of these three buttons.	<i>F1 + F3</i> + <i>Settings (Set &amp; Exit)</i> + <i>Power</i>	“Factory reset”  NOT FOR NORMAL USE!

## MIDI Interface Requirements

TBX2 is programmed over MIDI, using the MIDI DIN connectors. This requires a MIDI Interface, which normally has a USB connection on one end and MIDI DIN jacks or plugs on the other. It is important to be aware that not all MIDI interfaces are made the same. TBX2 programming is done using System Exclusive MIDI messages (known as “sysex”), and some MIDI interfaces do not handle these messages properly. Below is a list of interfaces which we know do NOT work properly with sysex. Note that these interfaces may work fine with some very short sysex messages, but they do not have large enough buffers for large sysex message. This is a hardware problem and cannot be solved with driver updates, so these interfaces simply should not be used.

**THESE MIDI INTERFACES DO NOT TRANSMIT SYSEX PROPERLY (DO NOT USE)**

*Roland UM-ONE*  
*E-MU 1x1 Tab*  
*All cheapo / no-name interfaces from China*

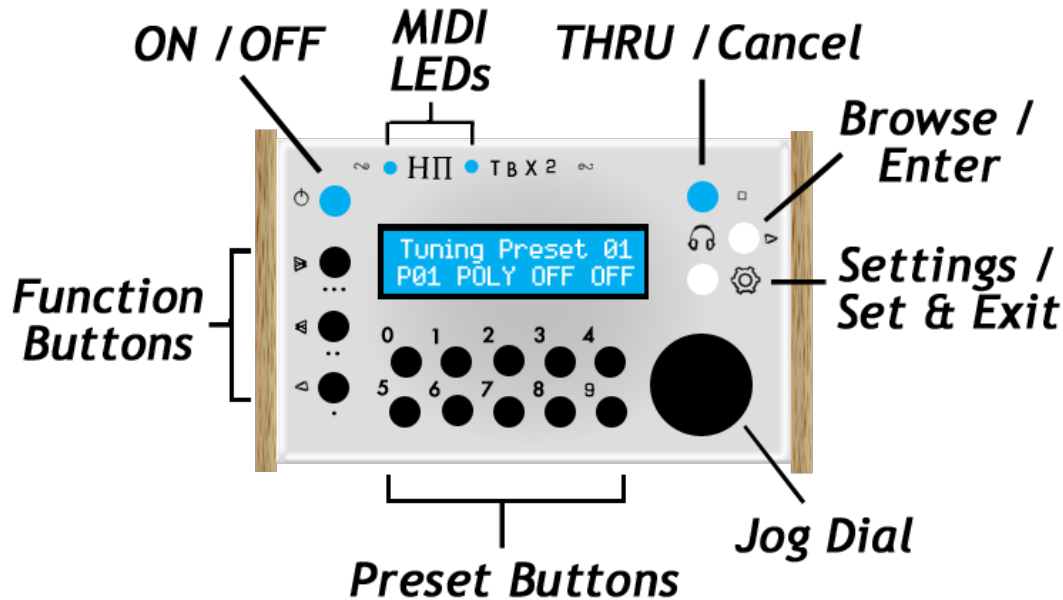
Because this is an important requirement for our hardware devices, we will be offering our own MIDI interface in the future. Until our MIDI interface is available, we recommend the following third-party product which is known to work correctly for all sysex:

**WE RECOMMEND THIS MIDI INTERFACE WHICH TRANSMITS SYSEX CORRECTLY**

*iConnectivity mio*

# 1. User Interface

TBX2 has a simple interface consisting of a display, two LEDs, two switches, fifteen buttons and a jog dial.



## ON / OFF Switch



When the unit is plugged into external power, battery charging takes place regardless of the state of the power switch, and power status LEDs can be read from the bottom of the unit (see below).

## Display



The top line of the display shows the 16-character name of the currently selected preset. The bottom line shows the number of the preset (here, P01), the mode (here, POLY), and the bank and patch numbers (here both set to OFF). Display backlight brightness defaults to 50% and can be changed using the settings button. *Please note that the backlight brightness level has major impact on the life of the battery.*

## Jog Dial



Value selection is done using the jog dial, which turns continuously in both directions, so that values “start over” when reaching maximum or minimum. The knob also acts as a button. Pushing the knob as a button during normal operation will begin programming the currently selected preset, a process involving many steps outlined in

**Chapter 6.** During programming, pushing the knob enters a selected value. See also **Chapter 4** which outlines the process of programming Global Settings using the jog dial.

## Function Buttons



There are 3 function buttons on the left side of the unit, labeled up from the bottom with arrows and dots respectively. The dots denote the function number counting from the bottom up as Function 1, 2, and 3, which we will refer to as **F1**, **F2**, and **F3**. These buttons are modifiers which work in combination with other buttons (similar to SHIFT, ALT, and CTRL on a computer keyboard). There are three modifying functions for each button: 1. **PRESET**, 2. **TURN**, 3. **ENTER**. Also, when two function buttons are pressed together, some special **INFORMATION** is shown on the display.

1. **PRESET** - when pressed in combination with a preset button, the function buttons add 10, 20, or 30 to the preset number. The number of dots under each function button shows how many times ten will be added.

	<b>F3 + PRESET</b> = select preset number + 30 ..... [  = $+(10 \times 3)$ ]
	<b>F2 + PRESET</b> = select preset number + 20 ..... [  = $+(10 \times 2)$ ]
	<b>F1 + PRESET</b> = select preset number + 10 ..... [  = $+(10 \times 1)$ ]

**Examples:** holding down **F3** and pressing Preset 9 activates preset 39  
 holding down **F2** and pressing Preset 2 activates preset 22  
 holding down **F1** and pressing Preset 3 activates preset 13

2. **TURN** - when held down and the jog dial is turned during programming or browsing, value changes are altered by powers of ten. The number of dots under each function button shows which column in the number (in other words, which power of ten) will change.

	<b>F3 + jog dial TURN</b> = +/- 1000 ..... [  = $\pm 10^3$ ]
	<b>F2 + jog dial TURN</b> = +/- 100 ..... [  = $\pm 10^2$ ]
	<b>F1 + jog dial TURN</b> = +/- 10 ..... [  = $\pm 10^1$ ]

3. **ENTER** - when function buttons are held down and the jog dial (or alternate enter button) is pressed during programming, the functions have to do with navigating forward and back, as shown by the arrow icons to the left of each button. Double-arrows denote moving forward or back between programming pages, and the single arrow denotes moving back a step on the current page.

	<b>F3 + ENTER</b> = GO FORWARD to the NEXT PAGE	
	<b>F2 + ENTER</b> = GO BACK to the PREVIOUS PAGE	
	<b>F1 + ENTER</b> = STEP BACK on THIS PAGE	

Note that the missing function to STEP FORWARD on THIS PAGE is handled by the **Browsing & Enter Button** (see below).

4. **INFORMATION** - when two function buttons are pressed together, special information is shown on the display.

1. Pressing **F2** & **F3** together shows the firmware version.

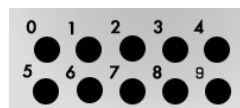


2. Pressing **F1** & **F2** together shows the battery charge level.



*About 5 minutes before the battery dies, the LCD backlight will flash on and off as a warning telling you to plug in the unit to external power. When the battery reaches a critical level, the unit will enter Hibernation State. Press and hold both blue buttons at startup to bypass these warnings, only when connected to external power. These behaviours were introduced in firmware v1.9.2 and are necessary to protect data from being corrupted. Always update the firmware! (see Chapters 7 & 8).*

## Preset Buttons



TBX2 stores 40 presets, numbered 0-39. Pressing a preset button 0-9 recalls the preset of that number. Holding down one of the function buttons at the same time as pressing a preset button adds 10, 20 or 30 to each number to recall presets between 10 and 39 (see **Function Buttons** above). Presets and preset programming are the subjects of **Chapter 6**.

## Settings (Set & Exit) Button



Pressing this button begins programming global system settings, a process consisting of several steps outlined in **Chapter 4**. As of firmware 1.9.9, during programming of any kind, pressing this button will save any changes made and exit the programming process before it is finished. The connection between **SETTINGS** and *saving (setting)* & exiting should make this easy to remember.



## Browse (Enter) Button



The two symbols to the left and the right of this button denote its two different functions. The headphones symbol to the left denotes a listening / browsing function, which is a simple way to try out any of the different tunings in memory. When pressed during normal operation, a special *browsing behaviour* begins and the display changes to show temporarily selected tunings for quick auditioning.



When entering browsing behaviour, the *MODE*, *Bank*, and *Patch* of the currently selected preset are respected, and the tuning table assigned to MIDI Input Channel 1 of the current preset is applied to all input channels (see **Chapter 6** for an explanation of presets).

During browsing behaviour, all input channels are assigned to the same tuning for easy auditioning. Turning the jog dial selects different tunings. Pressing any of the function buttons while turning the knob navigates tunings by tens, hundreds, or thousands (see **2. TURN** under **Function Buttons** above).

Pressing the browse button or any preset button exits the browsing state without altering any preset tunings, and returns the unit to normal functioning. *Pressing the jog dial applies the tuning to all MIDI Input Channels of the current preset*, then exits browsing and returns the unit to normal functioning.

*Pressing a preset button during browsing assigns the currently auditioned tuning to all MIDI Input Channels of that preset and then exits browsing.*



The right-facing arrow to the right of this button denotes its behaviour during programming, belonging to the set of arrow symbols used for the function buttons navigation behaviours (see **3. ENTER** under **Function Buttons** above). During programming, the behaviour of this button is the same as the jog dial button, to **ENTER** a value or STEP FORWARD on THIS PAGE. In this sense the button acts as a fourth navigation button, only during programming (see **Chapter 4 Global Settings** and **5 Presets**).

## THRU (Cancel) Button



You may notice that the small box next to this switch is the same symbol used to mark

MIDI THRU on the port side of the unit. This is because when engaged, the MIDI OUT port essentially becomes a MIDI THRU port, and TBX2 passes all incoming MIDI data direct to MIDI OUT without processing the data in any way.

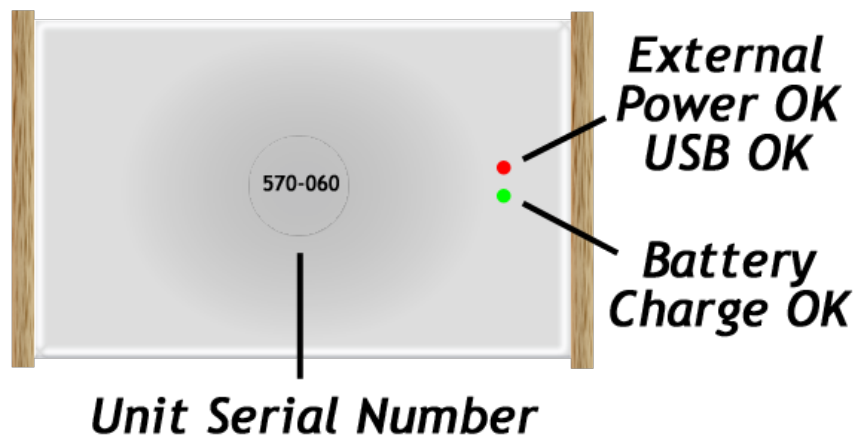
When the THRU button is pressed during normal functioning, the display changes to:



As of firmware 1.9.9, During programming of any kind, this button acts as a *Cancel* button. Any changes made during programming will be cancelled and the unit will return to normal functioning. The similarity between *BYPASS* and *exit/Cancel* concepts should make this easy to remember.

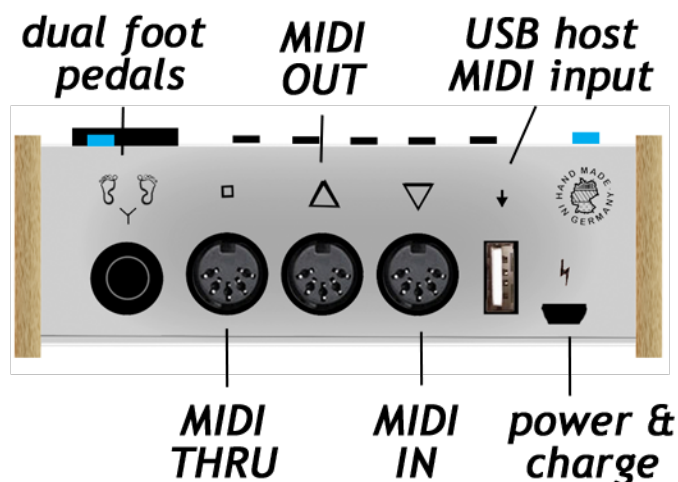
### ***Status LEDs (Bottom of Unit)***

When the unit is plugged in, turn the unit over and look at the bottom to find two LEDs in the right side. When top LED is red, this means the external power supply is working when plugged in, and USB is OK when connected (in most cases, external power must be connected to use USB). The green LED on the bottom lights up when the battery is charging.



## 2. Inputs & Outputs

The port side of the unit has six sockets for input and output.



### Dual Pedals Input



This is a *split stereo input* for two pedals (the two footprints above this jack are meant to remind you of this), although you may also connect only one pedal. The pedals are used to navigate forward and backward through 40 presets (see **Chapter 6**).

Values “start over” when reaching maximum or minimum. When only one pedal is connected, the navigation will only step forward from one preset to the next.

The type of pedal expected is the piano sustain variety, which is a simple switch. Such a pedal normally has a *mono* 1/4” plug. To connect two of these pedals, an adapter is needed, such as *Hosa YPP-118* shown with two pedals below.

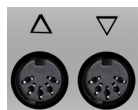


Some dual pedals are available which have a stereo plug so that no adapter is needed, such as *Studiologic (Fatar) VFP-2-15* or *Kawai F-20* shown below.



Other dual pedals have two plugs, which may be easier to work with because having separate plugs allows you to assign left and right pedals to your preferred behaviour by switching the left or right channels. In any case, TBX2 senses the polarity of each switch at startup and considers that state as open. Some pedals have normally closed switches, so if a pedal seems to behave “backwards” and there is no polarity switch on the pedal, start up TBX2 with the pedal held down.

## MIDI IN & OUT



The two DIN5 sockets marked with arrowhead triangles pointing IN and OUT are for connecting standard MIDI devices to TBX2. MIDI DIN5 ports became a standard in 1983 and are still used on the majority of devices, although many manufacturers now primarily design for USB (see **USB Host Input** below), so these ports can be used with almost all older devices but not all newer devices. To upload tunings, presets and settings, backup or restore data to TBX2 using UTE software, and send firmware updates, the MIDI IN / OUT ports must be connected to a MIDI Interface, which is in turn connected to your Mac or Windows PC (see **Chapter 7**). Examples of connecting DIN5 devices to TBX2 are in **Chapter 3**.

*The MIDI DIN inputs are used for uploading tunings and firmware to the unit!*

## USB Host Input



TBX2 includes a USB Host input for connecting to a controller that does not have MIDI DIN5 output but instead has MIDI-over-USB output, which has become more common in recent years. The arrow symbol above the USB port is there to remind you that this is a **USB Host Input** and does *not* provide a USB connection between TBX2 and your computer.

*The USB-Host input port is **NOT** used to connect TBX2 to your computer!*

The USB-Host port serves two-way traffic both as MIDI IN and MIDI OUT for compatible USB devices. USB device requirements are as follows:

1. **Must be class-compliant ... if it requires a 3rd party driver, it will not work**
2. **Must register as a single device ... if it registers as a “USB device tree”, it will not work**
3. **USB hubs not allowed ... if there is a port on it for other USB devices, it will not work**
4. **“Port-powered” devices require external power ... TBX2 battery power will not work**

In cases where a port-powered device has no external power input, a power source connected to the micro-USB input on TBX2 can provide power for both devices. All USB power supplies are 5 Volts, but the number of amps (A) varies. Use a power brick providing 1A or more.

## USB Host & MIDI DIN IN Non-merge

*The MIDI IN port and the USB Host input port may be used together only if MIDI data is never sent to both ports simultaneously, because there is no merge function between these ports. Data received simultaneously will result in unexpected behaviour.*

## MIDI THRU



Regardless of whether MIDI is received through the DIN5 or through the USB Host Input, all MIDI data coming into TBX2 is passed on to MIDI THRU unprocessed. This allows you to send data from your controller both to TBX2 and to another destination without having to buy a separate MIDI splitter / MIDI thru box.

## Power & Charge Input



Micro-USB has become a standard connector for powering mobile devices such as smartphones. Since most people already own a power supply with micro-USB output, we adopted use of this jack to be more friendly to the environment. TBX2 has an internal Lithium-ion battery which is charged whenever external power is plugged into the micro-USB port. *The lightning-bolt symbol is there to remind you that this port is used only for power.*

***The micro-USB input port is used ONLY for external power & battery charging. The micro-USB port is NOT a USB-MIDI interface and it is NOT used to update firmware!***

A power charger **must be 5V**. Fewer Volts and the unit will not work, more Volts and the unit will be destroyed. Use a supply providing at least 500mA. A higher number of Amps is better.

***Use ONLY 5V power supply! Higher Voltage will destroy TBX2! Use at least 500mA. At least 1A is needed for USB. Higher Amps are better. See Precautions, above.***

### ***Incompatible micro-USB Power Cables***

There are two types of micro-USB plugs, one which is slightly longer than the other, and the short type will not work properly with TBX2 because of the thickness of the device enclosure wall (2mm). If the plug fits only loosely, it is the wrong type and should not be used!



*Use only long type micro-USB plugs. Short plugs will not fit snugly into the power jack.*

### 3. Setups

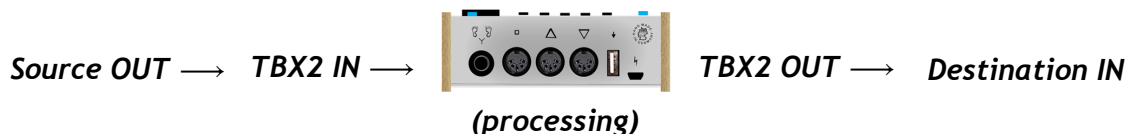
There are many possible combinations for connecting inputs and outputs when using TBX2. In this chapter we outline the concepts that you need to figure out the best setup for your gear, and we take a look at some example setups.

#### ***Basic MIDI Signal Path***

TBX2 is placed between a MIDI source (usually a keyboard) and a MIDI destination (usually a synthesizer).



A *Source* is any MIDI controller which produces MIDI Note ON and Note OFF messages (usually a keyboard, but can be some other type of device like a wind controller for example). A *Destination* is any MIDI device which receives MIDI Note ON and OFF messages and produces sound in response (usually this is called a synthesizer). Below, this model is expanded to explicitly show inputs, outputs, and processing.



The above model is referred to in this chapter as the "*MIDI signal path*". The input and output connections vary with the type of cable used, USB or MIDI DIN. So first we take a look at how these two approaches differ.

#### ***USB Signal Path***

A single USB cable provides bidirectional communication, so when the source and destination are the same, as in a keyboard synthesizer, only one USB cable is needed to complete the MIDI signal path.



If the destination is not the same as the source, another cable is needed. If a USB device is used as the source, the only option is to use the MIDI DIN OUT port on TBX2 for the destination.

## MIDI DIN Signal Path

Unlike USB cables, MIDI cables connect data flowing in one direction only (not because of the cable, but because of the ports). When traffic is needed in two directions, two cables must be used. The rule is simple: *MIDI OUT* from device 1 gets connected to *MIDI IN* of device 2.



## Converting between USB & MIDI

As the name suggests, a USB-MIDI Interface converts MIDI to USB and vice versa. Since TBX2 has both kinds of ports, a MIDI Interface can be used both on the MIDI ports, and (less usefully, but by no means useless) on the USB Host port. When connected to the MIDI DIN ports, TBX2 can send and receive MIDI to a computer, which is what is needed to upload tunings, presets and settings, restore and backup, and update firmware. Connecting a USB-MIDI interface to the USB Host port gives you a second set of MIDI DIN ports. When this is done, only the second MIDI OUT can be used reliably (see *USB Host & MIDI DIN IN non-merge in Chapter 2*). A MIDI THRU port at the destination would give you the same option without requiring a USB-MIDI Interface connected to the USB Host Input of TBX2. Alternatively, doing this does provide a way to connect sources and destinations having MIDI DIN ports using only one port (the USB Host port) on TBX2, which may be more convenient.

## Keyboard Controllers vs. Keyboard Synthesizers

For those less experienced with MIDI, it is important to point out that a keyboard which does not provide any internal sounds is not called a keyboard synthesizer, it is called a *keyboard controller*. A keyboard controller can only function as a *Source* in the MIDI Signal Path (see above). A keyboard which has internal sounds is actually two devices in one, and is called a *keyboard synthesizer*, which can act as both a *Source* and a *Destination* in the MIDI Signal Path. TBX2 is useful only when you have both a *Source* and a *Destination*. If all you have is a keyboard controller, you need to get another device (a synthesizer) to use as the *Destination*.

## MIDI DIN Keyboard Synthesizers

When a MIDI keyboard is also itself a synthesizer, it is actually two MIDI devices in one, connected internally through *Local Control*. MIDI has a message for turning *Local Control ON* or *OFF*, and TBX2 turns it *OFF* by default (the behaviour is selectable, see *Chapter 4*). When *Local Control* is *ON*, the keyboard and synthesizer are connected, and playing keys on the keyboard generates sound in the synthesizer. When *Local Control* is *OFF*, playing the keyboard results in no sound from the synthesizer, because they are no longer connected. In a typical TBX2 setup involving a keyboard synth, the source and destination are the same device, with



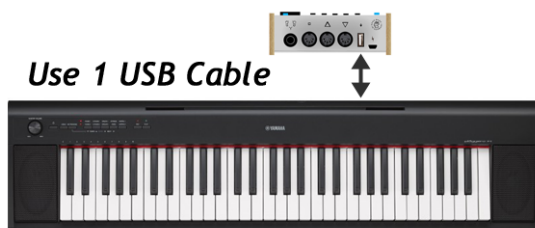
*Local Control OFF*. For example, we connect TBX2 to a Yamaha PSR-E313, an older keyboard synth having only MIDI DIN ports and no USB port.



In the above diagram, MIDI OUT from the source is connected to MIDI IN on TBX2, and MIDI OUT from TBX2 is connected back to MIDI IN on the source, which is also the destination. TBX2 sends *Local Control OFF* to disconnect the source from the destination. If *Local Control* is not turned OFF, two notes will sound for every key pressed.

### ***USB Keyboard Synthesizers***

A setup involving a USB keyboard synth will be the same as one involving a MIDI DIN keyboard synth above, except that only one USB cable is needed. For example, we connect TBX2 to a Yamaha NP-12, a newer keyboard having only a USB OUT (Type-B) port and no MIDI DIN ports.



TBX2 receives MIDI from the keyboard (source), turns *Local Control OFF* to disconnect the source from the destination (so that only one pitch sounds and not two), and sends microtonal output to the destination.

### ***Separate Keyboard & Synthesizer***

The possibilities start to multiply when the source and the destination are not the same device and therefore may have different ports (USB or MIDI DIN). If you understand how these ports work, as described above, then you should be able to figure out how to arrange your setup. When the source and destination are not the same device, TBX2 does not need to send *Local Control OFF*, so you should disable that function in the Global Settings (see **Chapter 4**).

### ***Keyboard Controller & Computer***

When the source is a keyboard controller and the destination is a software synthesizer running on a computer, the possibilities multiply even further. This type of setup requires a broad

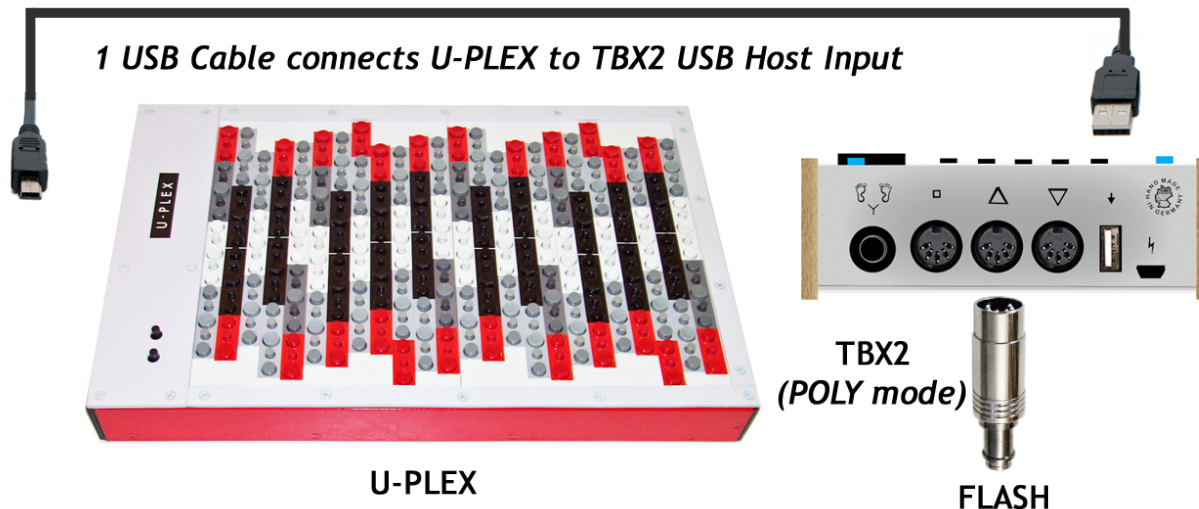
range of knowledge and experience with MIDI and computers, and therefore is not recommended for novice users. Not only are the source and destination separated, but also a MIDI Interface is required between TBX2 and the computer, connected from the MIDI DIN OUT of TBX2 as shown in the diagram below.



Once the MIDI data arrives at the computer, it must be routed correctly to the final destination software, and that software must be configured properly to receive the data (see *Chapter 5*).


### Using TBX2 with U-PLEX

U-PLEX was designed as a USB device to be used with a computer. Since TBX2 features a USB Host Input, U-PLEX can now connect to TBX2 to function without a computer. Essentially TBX2 turns U-PLEX into a standalone microtonal controller. Simply connect a destination synth to complete the MIDI signal path. Our [FLASH](#) microtonal synthesizer is an excellent choice for the final output.



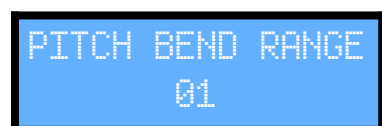
Note that the octave-switching buttons on U-PLEX will have no effect when using the keyboard with TBX2. A small modification to the U-PLEX main PCB is also needed to make the MIDI signal path work properly (see the *Appendix*).

## 4. Global Settings

 TBX2 has seven global parameters which affect output behaviour for all presets. Press the **Settings** button to enter Global Settings programming mode. As of firmware 1.9.9, pressing this button a second time will save any changes made and exit, and pressing the **THRU/Cancel** button will cancel any changes made and exit. Pressing a preset button will also exit programming, and activate the given preset. Push the knob or press the **Browse/Enter** button to enter a value, referred to as pressing “enter”.

### *Target Device Pitch Bend Range*

TBX2 sends pitch bend range setting messages to destination devices when pitch bend is used for microtuning. Some devices may require a fix pitch bend range, or you may want a particular range for performance purposes. The default value is  $\pm 01$ .



01 flashes, and turning the knob navigates values between 01 and 96. Press enter to select and exit.

Unlike TBX1, tuning tables stored in TBX2 remain independent of this value. TBX2 processes each tuning table data according to the value when loading a preset. When the value changes, the active preset is reloaded to reflect the change upon exiting programming.

### *Transposition*

You may want to transpose a scale that you have uploaded to TBX2, without having to change it at the computer and upload a new scale. TBX2 provides a MIDI Transpose function for this purpose.



+00 flashes, and turning the knob navigates values between -64 and +63. Press the knob to select and exit. These values are in MIDI Notes, so transposition is done in twelve-tone equal temperament. For example, a value of +01 will transpose all notes output up by one MIDI note, which is the same as an equal tempered halfstep. A value of -12 will transpose all notes down one octave.

TBX2 processes the tuning table notes according to this value when loading a preset. When this value changes, the active preset is reloaded to reflect the change upon exiting programming.

## Local Control OFF

*Local Control* is the name given to the connection between a keyboard and its internal synthesizer, and this connection needs to be turned OFF when TBX2 is connected to the keyboard, or you will hear two notes when you play one key. In POLY and MONO modes, the unit sends a *Local Control OFF* message by default before sending other messages. This is a convenience to avoid having to turn local OFF manually every time you use the unit. Here you can select the behaviour for this parameter. In some cases you may not want *Local Control OFF* to be sent. You may want the unit only to send this message once, when it boots, and not send it again with any preset. You may also want to send *Local Control ON* at startup, instead of OFF (see below).



STARTUP+PRESET flashes, and turning the knob cycles between the following options:

STARTUP+PRESET

STARTUP ONLY

DO NOT SEND

StartON+PreOFF

The default is the first option, STARTUP+PRESET which sends *Local Control OFF* at startup, and when POLY and MONO presets are selected.

## How to turn Local Control back ON

Most keyboard synthesizers do not remember the *Local Control* setting when you power down the keyboard, so to turn *Local Control* back ON, you can just turn the keyboard off and back on again. However, some keyboards remember this setting, in which case you may want to use the last option above StartON+PreOFF to send *Local Control ON* at startup and OFF only for POLY and MONO presets. Then when you want to turn *Local Control ON*, simply reboot TBX2 while it is still connected to the keyboard. The Local Control ON message will be sent, and then you can disconnect without having to turn Local Control back ON manually. This option was added in firmware version 1.9.3, so if you do not see it on your unit, you need to update your firmware (see [Chapter 7](#)).

## Display Brightness



The LCD backlight uses more power than the functioning of the device, so the display brightness defaults to 50% to save on battery life. Turn the knob to change the brightness level in real time.

## Bank Select Format

These options are available to support various synthesizers which implement the Bank Select message in different ways.



The bottom line flashes. Turn the knob to select an option.

1 BYTE CC0  
1 BYTE CC32  
2 BYTES CC0 CC32  
2 BYTES CC32 CC0

Check the documentation for your synthesizer to choose the right value. In most cases it will be the first option, which is the default setting.

## Pitch Bend Timing

TBX2 defaults to sending pitch bend messages with no time lag between the bend message and the note ON message.



The bottom line flashes. Turn the knob to select an option.

FAST (0ms)

MEDIUM (5ms)

SLOW (20ms)

The slower timing options are required by some older synthesizers which react more slowly to pitch bend messages. If you hear pitches bending at onset, a slower setting should fix the problem.

### ***Sysex Retransmission***

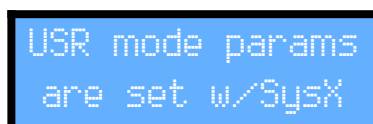
In some rare cases you may want to send sysex messages through TBX2 to another unit connected somewhere in the MIDI chain from MIDI OUT. Control of this behaviour is most important in POLY mode (see *Chapter 5*) where an incoming sysex message will be copied to multiple output channels when retransmission is on.



NO flashes, and turning the knob alternates between NO and YES. Press enter to select. You must be very careful that you know exactly what you are doing when you set this to YES, because some sysex messages may confuse TBX2 or confuse other gear in your setup and result in unpredictable behaviour.

### ***USR Data***

At the end of the Global programming process, the display shows the following message to remind you that although USR settings are global, they are too involved to program directly through the TBX2 interface, and are programmed instead via sysex messages. USR Data is discussed in *Chapter 5*.



## 5. Preset MODES

In this chapter we look at the four different primary functions provided by TBX2 called “modes” from which to choose for each of 40 presets. The modes primarily concern MIDI *Output*, and each mode is made for a different kind of MIDI synth (destination), with different ways of tuning. Understanding how each mode works will allow you to choose the appropriate mode for a given destination, and properly configure the destination for that mode.

### *Pitch Bend 2048 vs. Sysex 128*

The modes are categorised into two groups: *Pitch Bend 2048*, and *Sysex 128*. In a *Pitch Bend 2048* mode, TBX2 processes all incoming MIDI data to produce microtonal output in real time using pitch bend, and each input channel can be assigned to a unique tuning table, for a total of 2048 possible pitches. In a *Sysex 128* mode, tuning data is sent via MIDI sysex to configure the destination when the preset is selected, and incoming MIDI data is then sent passively through to the destination with no realtime processing, and each input channel is routed to the same tuning, for a total of 128 possible pitches. The four modes break down as shown.

<i>Pitch Bend 2048</i>	<i>Sysex 128</i>
POLY	MTS
MONO	USR

The *USR* mode is special because it can be used not only for retuning, but also to send arbitrary sysex messages to any destination. Each mode is outlined in detail below.

### ***POLY***

This mode is intended for use with any synth that does not natively support microtuning *but supports pitch bend and is able to receive MIDI input and send MIDI output on separate multiple channels*. Please note that if a synth can receive on multiple MIDI channels, that does *not* guarantee that it can also send on multiple channels. *The synth must be able to both send and receive MIDI on multiple channels*. If the synth only sends output on one MIDI channel, it cannot be used with TBX2 POLY mode, but it can be used in MONO mode (see below). In POLY mode, each input channel on TBX2 is assigned to a 128 note tuning table, for a total of 2048 possible output pitches. Full-range microtonal output is achieved by sending each next incoming note out from TBX2 to the destination on a different MIDI channel, sending pitch bend before each Note ON event. The number of resulting retuned voices is thus equal to the number of available MIDI output channels in the destination (synth). The destination needs to be prepared to receive MIDI coming in on the channels that TBX2 uses for output, which you select. For example, if the destination supports General MIDI, then channel 10 is reserved for percussion and 15-part polyphony is available. This is the default output

channel configuration for POLY mode. All synths marked with the General MIDI symbol (GM or GM2) are compatible with TBX2 POLY mode. Other types of synths may or may not be compatible; you must consult the documentation for the synth to find out.

## MONO

This mode is intended for use with monophonic synths which do not natively support microtuning, *but do support pitch bend*. This mode also may be used with synths that are otherwise polyphonic and support pitch bend, but do not support multiple MIDI output channels (see above). Like POLY mode, each input channel on TBX2 is assigned to a 128 note tuning table, for a total of 2048 possible output pitches. Full range microtonal output is achieved using pitch bend over a single MIDI channel, by tracking keys played and sending pitch bend values for each sounding note, correctly reproducing the expected behaviour for a monophonic destination.

## MTS

This mode is for synths which support the MIDI Tuning Standard (MTS) Bulk Tuning Dump (non-real time) sysex message, as defined by the MIDI Manufacturer's Association (MMA). Check the documentation for your device to see if it supports this message. Sometimes this information is not in the user manual but in a separate MIDI reference document. Sysex looks cryptic, and is it not necessary to understand it. The sysex is shown below as given in the official MMA documentation so that you can compare it to what you find in the documentation for your device to be sure it supports this message.

```
[ F0 7E <device ID> 08 01 tt <tuning name> [xx yy zz] ... chksum F7 ]
```

```
F0 7E Universal Non-Real Time SysEx header
```

```
<device ID> ID of responding device
```

```
08 sub-ID#1 (MIDI Tuning)
```

```
01 sub-ID#2 (bulk dump reply)
```

```
tt tuning program number (0 – 127)
```

```
<tuning name> 16 ASCII characters
```

```
[xx yy zz] frequency data for one note (repeated 128 times)
```

```
chksum checksum (XOR of 7E <device ID> 01 tt <388 bytes>)
```

```
F7 EOF
```

The MTS message is sent to MIDI OUT immediately when an MTS preset is selected. TBX2 sends a <device ID> value of 7F, which is defined by the MMA to mean **All Devices**, and any destination supporting this message should be able to receive it. If your device does not respond to the **All Devices** ID and requires a specific device ID, the manufacturer has not



followed the MIDI specification, and in that case you will need to set up a USR preset to send the right header bytes for the synth (see below).

As defined by the MMA, this message supports 128-note tunings. To our knowledge there are no destination devices which support multi-channel MTS tables for more than 128 notes, so an MTS preset sends only one MTS sysex message out over one MIDI channel to retune 128 notes.

*If you find a device which supports multi-channel MTS, please let us know so we may add a multi-channel MTS mode to allow MTS tunings with up to 2048 pitches.*

## USR

This mode is intended for synths which support sysex retuning of some kind but do not support the standard device-agnostic MTS Bulk Tuning Dump message. Required sysex messages vary, so the structure of the USR sysex message is flexible, allowing you to define the message from a set of options, including up to 32 arbitrary header bytes. This mode can be used to retune synths which support any of several other MTS messages made for 12-tones-per-octave tunings, as well as non-MTS (a.k.a. proprietary) sysex retuning found on some devices, or for cases where a device supports MTS but requires a specific **Device ID** value.

TBX2 stores ten banks of USR Data, numbered 0-9, so that you can define up to ten different sysex messages for various purposes. These sysex messages also do not necessarily need to send retuning data, so USR presets can also be used to send arbitrary sysex messages. USR Data is programmed using [Universal Tuning Editor](#). Further details about USR Data, including example use cases, are included in the documentation for the software.

## A Note About MPE

Our POLY method of retuning has been implemented in H-Pi Instruments products since the development of our first tuning devices over twenty years ago. At the first release of the Tuning Box TBX1 in 2006, we referred to this type of tuning as **dynamic channel allocation**. A similar algorithm was being used by at least one other MIDI manufacturer around that time. In 2010 we changed the name of our algorithm to **General MIDI Microtuning**, to sound less technical and to emphasise the fact that the algorithm is compatible with any device that supports **General MIDI**. In the following years a few other products were brought to market by other companies using similar algorithms. With input from a few of the larger of these companies, in 2015 the MIDI Manufacturer's Association officially recognised this method of microtuning, calling it **Multidimensional Polyphonic Expression (MPE)**. There are however a few key differences between our POLY algorithm and the MIDI specification for MPE, namely that MPE requires a sequence of startup messages to assign channel zones, and has a

dedicated common message channel. We chose not to implement MPE as such in TBX2, because our tried and true POLY algorithm is more flexible than the MPE specification, and as far as we know it is fully compatible with synthesizers that support MPE.

*If you have a MIDI synth (destination) which supports MPE but does not seem to respond correctly with TBX2 in POLY mode, please let us know.*

## 6. Presets

To use TBX2 you will prepare at least one preset out of the 40 presets available. A preset is simply a set of instructions for TBX2, to tell it how to behave for a given setup. All presets have a 16-character name, a bank and patch setting, and at least one assigned 128-note tuning table (some modes allow up to 16 different tuning tables). Other aspects vary according to the mode chosen for the preset (see [Chapter 5](#)). Preset programming can be done at the unit, and can also be done using [Universal Tuning Editor](#) (see [Chapter 7](#)). The process of programming a preset at the unit is described in this chapter. As of firmware 1.9.9, pressing the [Settings/Save&Exit](#) button will save any changes made and exit, and pressing the [THRU/Cancel](#) button will cancel any changes made and exit preset programming.

### Preset Programming

Programming a preset begins by pressing the knob (jog dial button). Once in programming mode, values are entered using either this knob button, or the Browse/[Enter](#) button, both of which we will refer to here simply as “enter”. Whichever preset is currently active will be programmed, so in order to program a certain preset, first select that preset. This is done by pressing a preset button, or a function button and a preset button together, or by navigating presets using pedals. Once a preset is selected, press the knob to begin programming it. For illustration, we will program preset 01.

1. Choose a mode for the preset (modes are explained in [Chapter 5](#)).



POLY flashes and turning the knob scrolls through the following options:

```
POLY
MONO
MTS
USR0 ... USR9
```

Select a MODE and press enter to continue. For information on modes, see [Chapter 5](#).

2. Assign a bank and patch to the preset. This allows you to change the bank and patch of the destination synth when the preset is selected. By default these values are set to OFF meaning that no bank select or patch change message will be sent.

A screenshot of a blue LCD display with a black border. The text '01 SELECT BANK:' is on the top line and 'OFF' is on the bottom line, both in white capital letters.

OFF flashes, and turning the knob cycles through numbers 000 through 127. Press enter to select the desired value, and the display will change to patch selection. Note that if you choose a value other than OFF, the bank message will be sent according to the format selected in Global Parameters (see **Chapter 4**). Please note also that some synthesizers do not support the Bank Select message at all, or they use the message in a non-standard way. Check the documentation for your synthesizer so that you fully understand how it will respond to this message before using it. Whenever you are not sure, just set it to OFF.

A screenshot of a blue LCD display with a black border. The text '01 SELECT PATCH:' is on the top line and 'OFF' is on the bottom line, both in white capital letters.

Again, OFF will flash, and turning the knob will cycle through numbers 000 through 127. Press enter to select the desired value for the patch and continue. Some synthesizers use the message in a non-standard way. Please check the documentation for your synthesizer so that you fully understand how it will respond to this message before using it. Whenever you are not sure, just set it to OFF.

3. Assign a tuning table to each MIDI Input Channel. Each of the 16 MIDI Channels is assigned, and the process begins with the first Input Channel, shown on the display top line as CH01.

A screenshot of a blue LCD display with a black border. The top line shows 'TUNING CH01 0000' and the bottom line shows 'TableNameIsShown', both in white capital letters.

The tuning table number 0000 flashes, and turning the knob changes values between 0000 and 8191. Use the function buttons in combination with turning the knob to change values  $\pm$  by 10, 100, or 1000. Press enter to select the desired table for MIDI Input Channel 1 and continue.

4. For MTS or USR modes, the table selected in step 3 will apply to all input channels, and programming skips ahead to step 5 below.

For POLY or MONO modes, you have an option to assign the selected tuning table to all input channels, or to assign each input channel to a different tuning table.



```
ALL INPUT CHANLS
SAME TUNING? YES
```

YES flashes, and turning the knob alternates between NO and YES. If you select YES, then the table selected in step 3 is assigned to all MIDI Input Channels, and programming continues with step 5 below. If you select NO, then step 3 is essentially repeated for each of the remaining MIDI Input Channels 2-16, shown on the display as CH02 ... CH16.



```
TUNING CH02 0000
TableNameIsShown
```

5. At this point a MIDI output channel is assigned. For MONO, MTS, and USR modes, only one output channel is assigned, and programming skips ahead to step 6 below.

For POLY mode, multiple output channels are assigned.



```
01 OUT CHANNELS:
oooooooooXoooooooo
```

The bottom line of the display represents 16 MIDI Output Channels in a row from left to right. An O means that a channel is ON, and an X means that the channel is OFF. By default all channels are ON except for channel 10, as this channel is reserved for percussion in the General MIDI specification. Each output channel flashes its default value, and turning the knob toggles the value ON or OFF. Pushing enter selects the value and moves right to the next channel. The output channels you select here should match the receiving channels of your chosen destination device.

**Example:** if a destination receives MIDI Input on channels 1-6, then only channels 1-6 should be set to ON and the rest should be set to OFF, as shown below.



```
01 OUT CHANNELS:
ooooooXXXXXXXXXX
```

For POLY modes, programming continues skipping ahead to step 8 below.

6. For MONO, MTS, and USR modes, only one output channel is selected.



01 SELECT OUTPUT  
CHANNEL: 01

Channel number 01 flashes, turning the knob changes values from 01 to 16. Press enter and continue. MONO mode programming skips ahead to step 8 below.

7. For MTS, and USR modes, a program number is assigned for the sysex message. This number is optionally used by the destination to assign the received MTS tuning to a specific memory location.



01 PROGRAM NUM.  
000

000 flashes, and turning the knob selects values from 000 to 127. Press enter to select the desired value and continue.

8. Last, a 16-character preset name is assigned. To simplify this process, a few options are given.



01 PRESET NAME:  
EDIT STORED NAME

Turning the knob cycles through the following options:

EDIT STORED NAME ... edit the currently stored preset name  
USE TUNING NAME ... use the name of the table assigned to the first input channel  
USE GENERIC NAME ... use TUNING PRESET XX (where XX is the preset number).  
USE BLANK NAME ... input an arbitrary name starting with empty spaces

Press enter to make a selection.

Each character of the chosen name can now be edited. If no editing is needed, simply press enter to confirm the name.

To edit the name, turn the knob. Each character flashes, starting with the leftmost character. Turning the knob scrolls through all available ASCII characters, and pressing enter selects the character, moving to the next one through all 16 characters left to right. After editing the last character, the name is entered, and the preset programming process is over.

### ***Recalling a Preset***

Presets are recalled by pressing preset buttons 0-9. Use the function buttons together with preset buttons to select presets 10-39. Presets can also be navigated forward and backward from any given value using pedals. See ***Chapters 1 & 2*** for more information.

## 7. Using TBX2 with UTE (Universal Tuning Editor)



Some TBX2 functions require connecting the unit to a computer and running [Universal Tuning Editor](#) (UTE). The connection between the computer and TBX2 is made using a MIDI Interface connected to the MIDI DIN ports on the unit. Note that this connection is *not* made using either of the USB ports on TBX2.

### ***Download, Install & Authorise UTE***

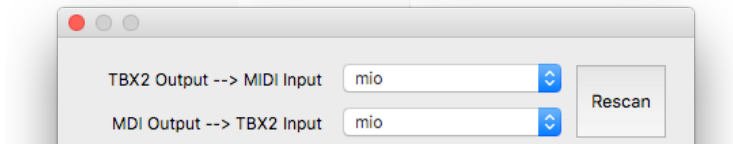
With your purchase of TBX2 you received a license code via email for UTE. Go to the [H-Pi Instruments website](#) and log into your account to download the latest version of the software. The download link is found on the UTE product page. After installing the software, select the menu option Authorize (enter license) and enter the information exactly as it appears in the email you received. The computer must be connected to the internet. If registration fails with an unknown error, disable your firewall and/or virus software and try again. After authorising, you can migrate the software from one computer or hard drive to another by selecting the menu option Deauthorize (remove license) from within UTE.

Before proceeding, please review the section on ***MIDI Interface Requirements ...***



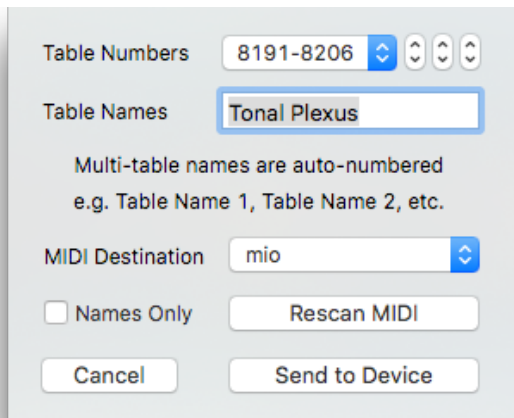
## Editing Data Stored on Your TBX2

If you want to edit data already programmed in your TBX2, UTE needs to be able to ask TBX2 for information (referred to as a “query”), and TBX2 needs to be able to send data to UTE (called a “response”). To do this, you need to connect both MIDI IN and MIDI OUT from your TBX2 to your MIDI Interface, and select that interface using the popup buttons at the top of the window from which TBX2 is being programmed. This will be referred to below as having “**TBX2 I/O Connected**”.



## Programming a Tuning

To program TBX2 with your tuning, click **Devices** toolbar icon and select **Send Tuning to TBX2**. Be sure to have **TBX2 I/O Connected**.



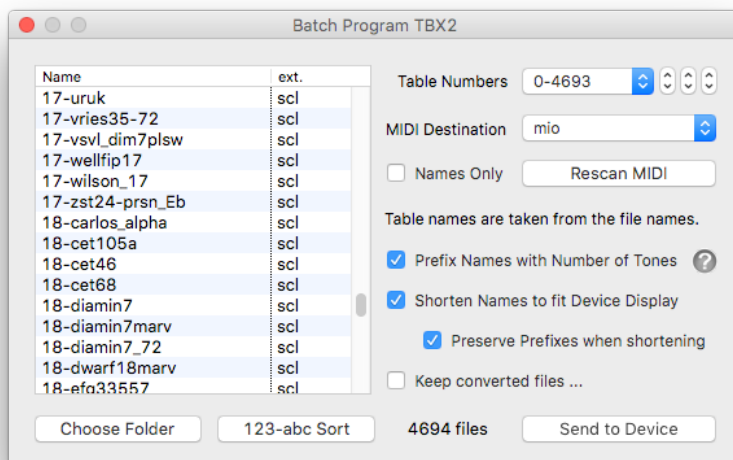
TBX2 assigns one tuning table per MIDI channel, with 128 notes per tuning table, so if your tuning contains more than 128 notes, it will be broken into multiple tables in TBX2 memory. For example, Tonal Plexus tunings contain 2048 notes ( $16 \times 128 = 2048$ ), so the tuning is spread across 16 tuning tables in TBX2 memory. UTE automatically figures out how many TBX2 tuning tables are needed to store your tuning, and provides a popup menu for selecting the table numbers to program, with three arrow controls for navigating the table numbers more easily in increments of 10, 100, or 1000.

When the tuning spans multiple TBX2 tuning tables, the names of the tables are numbered. In the example shown above, the table names will be **Tonal Plexus 1**, **Tonal Plexus 2**, **Tonal Plexus 3**, and so on, through **Tonal Plexus 16**. The checkbox **Names Only** also allows you to update only the table names without sending the tuning itself.

## Batch Programming Tunings

To upload many tunings TBX2 at once in sequence, prepare a folder containing the tuning files, click the **Devices** toolbar icon, and select **Send Batch Tunings to TBX2**. Click the **Choose Folder** button and navigate to the folder containing the files. The tunings may be in any format which can be imported by UTE (see **Chapter 4**). Once imported, you may change

the order of the files by dragging them up or down in the list. Select the table numbers to be assigned to the files using the popup menu at the upper right.



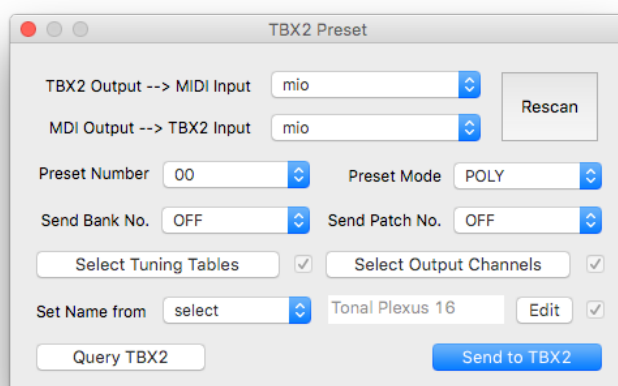
TBX2 limits tuning names to 16 characters. Because TBX2 stores thousands of scales, it can be helpful to include the number of tones in the scale as a prefix to the tuning name in order to aid navigation. Options for converting the tuning names with prefixes and a shortened number of characters are provided as a convenience. If names are not shortened, any name longer than 16 characters will simply be cut off at the 16th character when sent to TBX2. If you have chosen to number the files, you can use the button marked **123-abc Sort** to order the files by both number and name.

Check the option **Keep converted files ...** to archive the unique order of the imported files and save time should you want to upload the files again later. The converted files have the extension **.tbxtuning** and are read faster by the batch window than the other file types. The names of the converted files are numbered in the order you have placed them in the listbox. Be sure to have **TBX2 I/O Connected** and select the correct **MIDI Destination** before clicking **Send to Device**. Uploading one file takes less than one second, but if you upload thousands of files, be aware that this can take some time. For example, to upload the entire Scala archive of about 4700 scales takes about 90 minutes.

Be aware that tuning files containing more than 128 notes will be incomplete when using batch-upload, because TBX2 stores tuning tables in the MIDI standard of 128 notes. Although it is possible to import these larger scales and map them manually, this cannot be done using batch-import. Keep in mind the limitations concerning Scala files listed in **Chapter 4**.

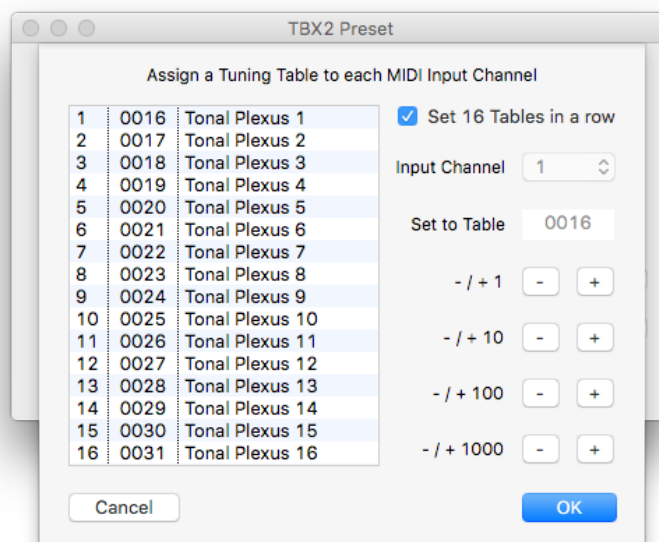
## Programming a Preset

TBX2 has 40 presets (numbered 0-39) which can be programmed at the device itself, but sometimes it will be easier to set up your presets using UTE, for example particularly when you are working with multi-table presets such as those needed for Tonal Plexus keyboards. Click the **Devices** toolbar icon and select **Program a Preset** to open the window.



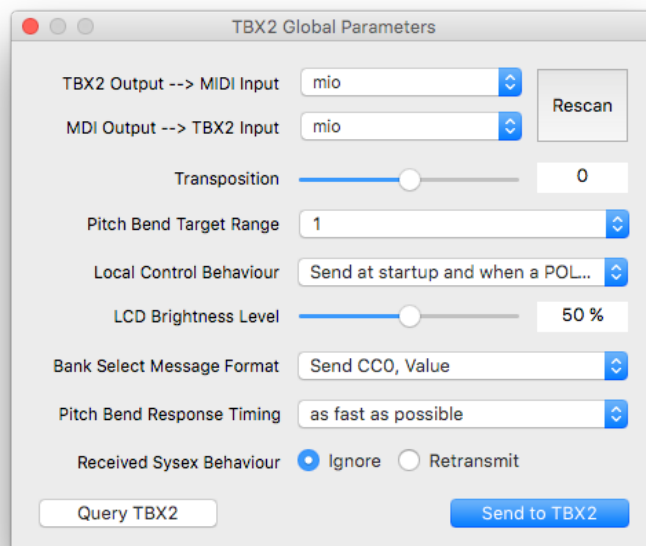
To edit a preset already programmed on your TBX2, be sure to have **TBX2 I/O Connected**, then after selecting a preset number, click the **Query TBX2** button at the bottom left corner of the window, and the data for the selected preset will appear in the window for editing.

Clicking the **Select Tuning Tables** button opens a window allowing you to easily set 16 tables in a row to the 16 MIDI input channels, since this will be a common need for those working with Tonal Plexus keyboards (and possibly other microtonal controllers).



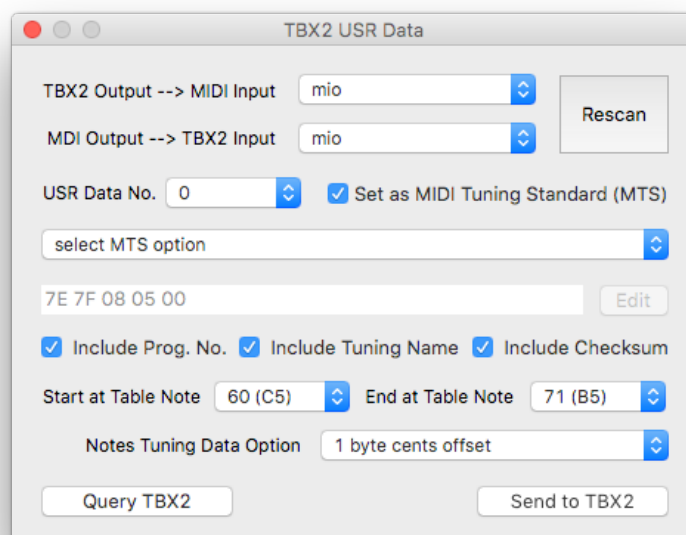
## Setting Global Parameters

TBX2 parameters can be edited directly at the device without using UTE, but sometimes using UTE will make more sense. Click the **Devices** toolbar icon and select **Set Global Parameters**.



## Setting USB Data

TBX2 provides 10 USB presets (numbered 0-9). USB Presets allow sending different kinds of sysex messages to retune keyboards according to manufacturers' specifications.



Unlike other features of TBX2, USB Data functions are rather involved, so they cannot be programmed at the device, and must be programmed using UTE. Each USB Preset Data consists of two parts: *header bytes*, and *options*. The *header bytes* may vary in length anywhere from 0 to 32 bytes. The *options* are as follows:

Options	
Include program number?	Yes / No
Include tuning table name?	Yes / No
Include checksum byte?	Yes / No
Notes formula (4 options)	1 byte ± cents offset per note (MTS 1-byte cents form) 2 bytes pitch bend MSB, LSB (MTS 2-byte cents form) 3 bytes MTS data per note (MTS frequency form) 3 bytes pitch bend data per note (Note, MSB, LSB) do not send any note data (useful for sending misc. sysex)
Tuning table start key	(0..127) [default = Note 60, middle C]
Tuning table end key	(0..127) [default = Note 72, B above middle C]

When the USB Preset is selected at TBX2, a sysex message is sent having the following form:

Description	Bytes
sysex start	1
[ header bytes ]	none or 1 to 32
[ program number ]	none or 1
[ tuning name ]	16
[ notes data ]	none or 1 to 128
[ checksum ]	none or 1
sysex end	1

Refer to the documentation of your synthesizer to determine the correct header bytes and options to assign to a USB Preset. The TBX2 USB Data window has a popup menu for selecting any of the MIDI Tuning Standard (MTS) formats to simplify the process of inputting all the parameters if your keyboard requires one of the MTS message formats.

## USR Data Example 1

The Roland FP-30 keyboard supports the MTS Scale / Octave Tuning 1-Byte Format. USR Data for this message can be prepared simply by selecting that option from the popup menu. The USR Data options will be automatically populated as follows.

USR Data Options for setting up Roland FP-30 MTS Sysex Retuning	
Header Bytes	7E, 7F, 08, 08, 03, 7F, 7F
Include program number?	No
Include tuning table name?	No
Include checksum byte?	No
Notes formula (4 options)	1 byte ± cents offset per note (MTS 1-byte cents form)
Tuning table start key	Note 60, middle C
Tuning table end key	Note 71, B above middle C

## USR Data Example 2

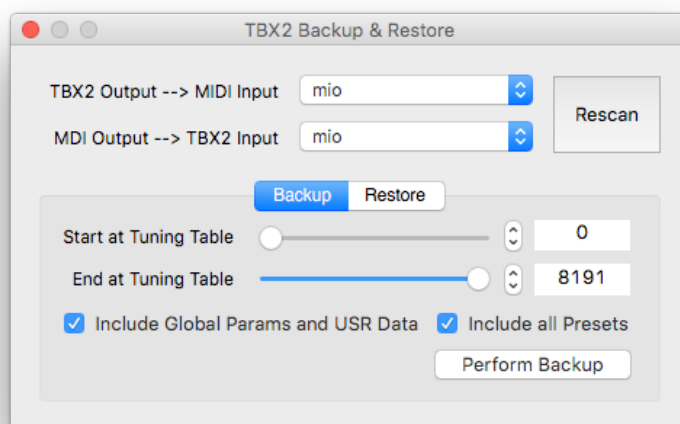
The Roland FP-30 can also be retuned across its entire range to any scale (not just 12 tones) by TBX2 in POLY mode, but only when the keyboard is first put into GM1 or GM2 mode. You can push some buttons on the Roland to set that up, but there is also a sysex message which forces the keyboard into the needed mode. So you can use a TBX2 USR preset to send that message, and then press a button on TBX2 to put the synth into the correct mode, after which you can press other preset buttons programmed to POLY. In the user manual we find that the sysex message required by the Roland for “GM1 System On” is: F0, 7E, 7F, 09, 01, F7. We prepare USR Data for this message as follows.

USR Data Options for setting up Roland FP-30 GM System ON	
Header Bytes	7E, 7F, 09, 01
Include program number?	No
Include tuning table name?	No
Include checksum byte?	No
Notes formula (4 options)	Do Not Send
Tuning table start key	-
Tuning table end key	-

Once this USR Data is assigned to a USR number (0-9) then you can program the USR preset at TBX2 by selecting that USR number as the mode for the preset.

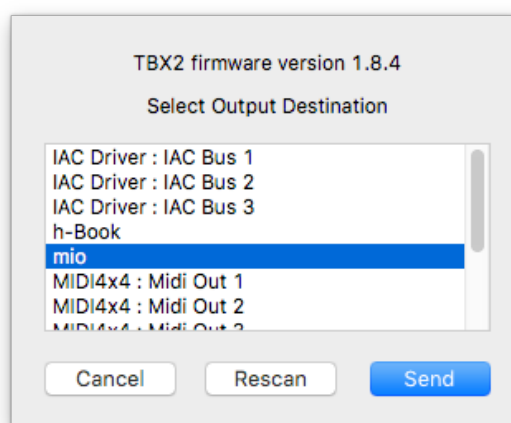
## Backing up & Restoring Data (.udevicebackup)

Because TBX2 is a device having a large memory for presets, USR Data, Global Parameters, and Tunings, it is useful to make backup copies of the contents of the device for example, if it is used for a series of concerts where many presets are involved. Before updating TBX2 firmware, it is also a good idea to backup data, as under some rare conditions memory corruption may occur during a firmware update. A full backup takes about half an hour to complete, and a full restore takes about an hour. Normally you will not need to do a full backup / restore, as it is unlikely that you will be using all 8192 tunings very often, so UTE gives you the option to select a range of tunings to back up. A normal partial backup / restore process can be done in a few minutes.



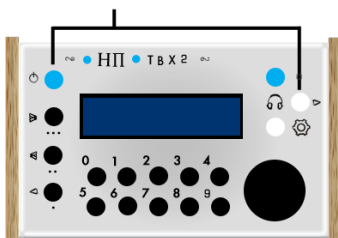
## Updating Firmware (.ubootsyx)

TBX2 firmware can be updated at any time, to fix reported problems or add new features. When you have **TBX2 I/O Connected** to UTE, the software can query the firmware version installed on your TBX2 and alert you to any available updates. Firmware updates are issued as files having a .ubootsyx extension, which is transferred to the device over MIDI. Click the **Devices** toolbar icon and select **Update Firmware** to select a firmware file and upload it to TBX2. The process normally takes about two minutes to complete. Be sure all of the following takes place.



- Always connect TBX2 to external power when updating firmware!
- Use TBX2 Firmware Update Startup:

### TBX2 Firmware Update Startup



Press the rightmost white button and hold it down while you turn on the unit with the blue power switch on the left. This tells the unit “we are ready to update the firmware”. The display will read as shown below.



- Make sure TBX2 is properly I/O connected (see start of this Chapter).
- While firmware is sent, UTE shows a progress bar, and TBX2 displays a percentage complete. If not, see Troubleshooting below.
- At the end, UTE shows an alert, and TBX2 shows a brief message, then restarts itself.

### UTE + TBX2 Troubleshooting

<b>TBX2 seems “frozen” when it is I/O connected and I try to send MIDI.</b>
Your system is producing a MIDI feedback loop. This can happen if you have some other software running which accesses MIDI devices and routes MIDI input and output. Quit the other application(s) or disconnect the cable from TBX2 MIDI OUT and try again.
<b>Trying to send the firmware, TBX2 just shows “TBX2 B/L v.1.4 Please run UTE!”.</b>
MIDI is not properly connected, or you have selected the wrong MIDI destination in UTE.
<b>Sending the firmware, TBX2 does not display an increasing percentage, stays at 0%, or reaches some other number and stops there.</b>
This means your MIDI Interface does not transmit sysex correctly. You must use a different MIDI Interface.



## 8. Essential Information on Power & Battery Use

This section contains information about how TBX2 manages power and provides safeguards against data corruption. To protect your unit against data corruption, updating your firmware to the current version is required.

### ***DATA Corruption***

In any battery powered device which stores data, corruption of the data can result during low power operation, typically the point at which the battery will die. After we began production of TBX2, it was discovered that firmware v1.8.4 shipped with the first TBX2 units did not provide sufficient safeguards against low-power data corruption. In at least one unit (we received only one reported case), this took the form of “garbage” characters replacing normal characters in preset names and tuning table names, wrong tones in tuning tables, and randomly changed Global settings. Of course, we addressed these problems immediately with firmware updates. TBX2 now guards against these problems, providing user feedback through the LCD display.

### ***Voltage Thresholds***

During normal operation, TBX2 is constantly monitoring the battery voltage level. As of firmware version 1.9.2, two voltage level thresholds have been defined:

- A. *Low Power Threshold*
- B. *Hibernation Threshold*

When the battery voltage is above A, the unit functions normally.

### ***Low Power Warning (Flashing LCD)***

When the battery voltage is between A and B, the unit begins *Low Power Warning*. Normal function continues, but the display backlight flashes ON and OFF to indicate that battery is about to die. Plug in external power as soon as possible after display starts to flash. The unit can then be used while it is plugged in, and the display will stop flashing once the battery charge exceeds the *Low Power Threshold*. The time it takes to exceed the threshold and stop flashing the LCD depends on the battery usage history.

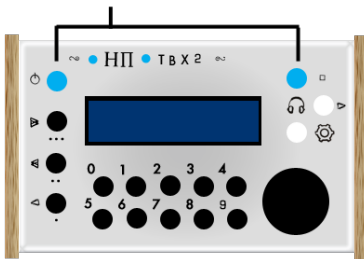
### ***Hibernation State***

When the battery voltage is lower than B, the unit enters *Hibernation State*. The display backlight goes OFF and the following message is shown (it is difficult to read, but it is there):



While in *Hibernation State*, external power can be plugged and battery charging will start immediately; however, TBX2 won't "wake up" from hibernation, because it does not read battery voltage while in this state. It does nothing in this state because any operation in these power conditions may corrupt data. TBX2 must be given some time to charge the battery. The time will vary from less than a minute up to 20 minutes or more, depending on battery usage history. Reboot the unit (turn it unit off and then back on), and TBX2 will read the voltage level. If the level is above **B**, TBX2 will either start *Low Power Warning* (flashing the LCD) or it will enter Normal mode. If TBX2 starts up with the LCD flashing, it can still be used normally, and the flashing will stop as soon as the battery voltage exceeds **A**.

### Battery Warning Bypass Startup



When you have connected the unit to external power, you should start up using *Battery Warning Bypass*. Press the **THRU/Cancel** button and hold it down, then switch on the power, and keep the **THRU** button held down until the LCD shows the following message:

A close-up of the LCD screen showing two lines of blue text on a black background: "BATTERY WARN OFF" and "EXTRN POWER ONLY".

In this mode the battery thresholds **A** and **B** above are not monitored, there is no *Low Power Warning* and no *Hibernation State*. By starting in this mode, you are telling the unit “**we are connected to external power, and low battery power precautions are not needed**”.

In *Battery Warning Bypass Startup*, when the battery level is checked using the function button combination F1+F2, the display reminds you that it is in this state:

A close-up of the LCD screen showing two lines of blue text on a black background: "BATTERY WARN OFF" and a full-length battery level bar consisting of many vertical bars.

*Use **Battery Warning Bypass Startup** only when TBX2 is plugged into external power, and always take care to ensure that the power supply remains stable.*

## ***Handling Battery End-of-Life***

At some unknown future point, depending on how often the unit is used, the battery will reach the end of its life and will not hold charge any more. At that point you can send the unit to us to have a new battery installed. Alternatively, you may choose to simply always plug in external power, using ***Battery Warning Bypass Startup*** as described above and in ***Startup Options***. Note that if you do not use this startup procedure in the situation where the battery is no longer capable of holding sufficient charge, the unit will either be sent directly into unusable *Hibernation State*, or the LCD will flash the *Low Power Warning* continuously.

# Troubleshooting

The unit doesn't power up.			
Have you connected TBX2 to external power through the micro-USB input jack?			
YES		NO	
See <b>Startup Options</b> , <b>Chapter 2: Power &amp; Charge Input</b> and <b>Incompatible micro-USB Cables</b> , and <b>Chapter 8: Hibernation State</b>		The battery is dead. Charge the battery. If the battery no longer holds charge, contact us and send the unit in to have a new battery installed.	
The LCD keeps flashing.			
This is a <i>Low Power</i> (battery) <i>Warning</i> to tell you to plug in external power, see <b>Startup Options</b> and <b>Chapter 8</b> .			
TBX2 is on, but I get no output.			
Does the MIDI IN LED light up when you play a keyboard key (send a Note ON message)?			
YES		NO	
Does the MIDI OUT LED light up?		Are you connecting via USB Host Input?	
YES	NO	YES	NO
The problem is at the destination device. Check connections and MIDI settings there.	Try using a different tuning table.	<ul style="list-style-type: none"><li>Is TBX2 connected to an external power supply? (plug one in)</li><li>Is the source device class-compliant? (if not, it won't work)</li></ul>	The problem is at the source device. Check connections and MIDI settings there.
Using TBX2 in POLY or MONO mode, when I play one key, I hear two pitches.			
Is the TBX2 Global Setting for Local Control set to send Local Control OFF to the destination?			
YES		NO	
<ul style="list-style-type: none"><li>The destination does not support the Local Control OFF message and you must turn off Local Control manually at the destination.</li></ul>		<ul style="list-style-type: none"><li>Press the TBX2 Settings button and change the <i>Local Control</i> option to send this message to the destination.</li></ul>	

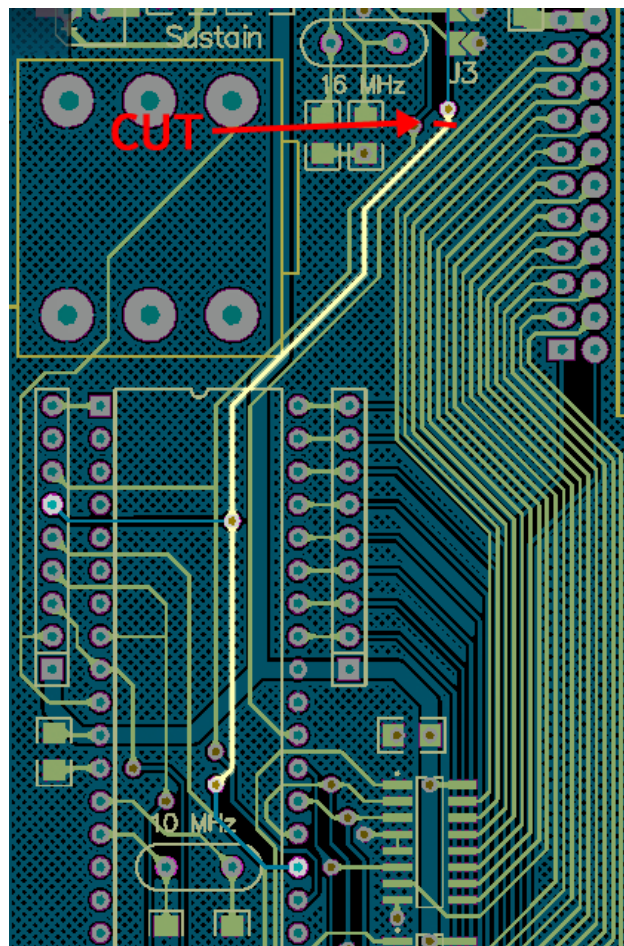
<b>The tuning sounds wrong.</b>	
<i>Are the pitches sounding in 12-tone equal temperament?</i>	
<b>YES</b> <ul style="list-style-type: none"> <li>• Have you connected <b>TBX2 MIDI THRU</b> to destination <b>MIDI IN</b>? Connect TBX2 MIDI OUT to the destination MIDI IN.</li> <li>• For <b>POLY</b> or <b>MONO</b> mode, check that the Pitch Bend Range of the destination matches the Pitch Bend Range in TBX2 Global Settings.</li> <li>• For <b>MTS</b> or <b>USR</b> mode, check that the destination is not filtering incoming sysex messages.</li> </ul>	<b>NO</b> <ul style="list-style-type: none"> <li>• For <b>POLY</b> or <b>MONO</b> mode, check that the Pitch Bend Range of the destination matches the Pitch Bend Range in TBX2 Global Settings.</li> <li>• For <b>USR</b> mode, check that the tuning format you have selected in the TBX2 USR Data matches what is required by the destination.</li> </ul>
<b>I only hear sound only every 15th (or other number) of keys I play, the rest are silent.</b>	
Output from TBX2 using a <b>POLY</b> preset requires multiple channels, and your destination is receiving MIDI on only one channel. You need to match sending and receiving channels, or use a different mode if your destination is limited to input on only one MIDI channel (see Chapter 5).	
<b>Every so often instead of microtonal pitch output, there is a percussion sound.</b>	
The destination is General MIDI and you are sending <b>POLY</b> output on Channel 10. Go to the preset output channel settings and turn off channel 10.	
<b>Pitches are bending after they sound.</b>	
For <b>POLY</b> mode, this means that the destination is responding slowly to pitch bend messages. Select a slower Pitch Bend Response Timing in TBX2 Global Settings.	For <b>MONO</b> mode, this may be normal portamento behaviour. If the bending is not normal portamento, the destination may be responding slowly to pitch bend messages and you may need to select a slower Pitch Bend Response Timing in TBX2 Global Settings.
<b>Some characters in preset names or table names look like “garbage”.</b>	
Data has been corrupted by a memory operation during low power, please see Chapter 8.	
<b>I’m having some other problem I don’t see listed here.</b>	
<i>Have you read through this manual?</i>	
<b>YES</b>  Please send an email to <a href="mailto:hpiinstruments@zentral.zone">hpiinstruments@zentral.zone</a>	<b>NO</b>  Please read the manual from beginning to end.

See also the section *UTE-TBX2 Troubleshooting* in Chapter 7

## Appendix – UPLEX Modification

We found that U-PLEX Tonal Plexus keyboards cause a MIDI feedback loop when connected to the USB Host Input of TBX2. To fix this problem, a trace on the U-PLEX main circuit board should be cut. This is a simple procedure which takes just a couple of minutes and requires only a small philips-head screwdriver and an Xacto-knife (razor blade). Cutting this trace has no negative side effects for using U-PLEX in any other way. It simply solves the problem.

1. Remove the six screws from the leftmost top panel of U-PLEX and remove the top panel.
2. Using an Xacto-knife (razor blade) carefully cut through the trace under J3 as shown in the image below.



3. Replace the top panel and screws.

The keyboard can now be connected to the USB Host Input of TBX2.

## Credits

TBX2 was invented and designed by Aaron Andrew Hunt. PCB & firmware by Jordan Dimitrov Petkov.

Special thanks to everyone who pre-ordered TBX2.

This documentation is written by Aaron Andrew Hunt.

Thank you for supporting H-Pi Instruments and TBX2.

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