

# Hπ TONAL PLEXUS

## PLEXUS 2s/4s/6



USER MANUAL

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# 1. Introduction

The H-Pi Instruments Tonal Plexus TPX2s/4s/6 is a hand-made instrument designed to be lightweight, easy to use, and compatible with the widest range of existing MIDI hardware and software, allowing easy exploration of the limitless universe of alternative tunings. Please refer to this manual to get the most out of your keyboard.

Your input is appreciated. If you have a question or comment about something in this manual, or something which is not addressed in this manual, please contact H-Pi Instruments via email at [contact@h-pi.com](mailto:contact@h-pi.com). In response to your input, this manual may be updated and made available for PDF download from the H-Pi Instruments website at [www.h-pi.com/downloads.html](http://www.h-pi.com/downloads.html).

This manual was uploaded July 17, 2008 and supersedes all previous TPX2s/4s/6 manuals. This manual may be replaced at any time by another manual.

## Checklist

- TPX2s/4s/6



Every TPX2s/4s/6 unit is built by hand. Please do not be alarmed by any small blemishes you may find. Always handle the unit with care.

- International 12V 4.5A Power Supply



The power supply runs on 100 - 240V, 50 - 60Hz, and will work in most countries around the world – just plug in a locally supported grounded cable (US standard cable shown above, left) or adapter.

- Two MIDI cables (optional)



Having these items, you are ready to begin.

## Overhead Diagram

### Programmer

When pushed and released, the currently selected preset tuning or patch and bank can be programmed. First, a tuning preset or patch preset is chosen to program, then a table is chosen or a bank and patch is chosen.

When pushed and held for 4 seconds, the currently selected tuning table is sent to MIDI OUT. Use this for sharing tunings or uploading tunings to a computer.

### Local Control Switch

When Local Control is OFF, the blue LED lights up, and only MIDI received at MIDI IN travels to the internal synthesizer, which can be useful when working with sequencing and notation software.

### Sustain Pedal polarity

Allows for the use of any sustain pedal, by selecting normally open or normally closed switch type.

### Volume Pedal Direction

Allows for the use of any Lo-Z (20kOhm) volume pedal, by selecting the pedal direction (wiring scheme).

### Tuning Resolution

Toggles between HI (14-bit) and LO (7-bit) MIDI Pitch Bend format for tuned output. If the synthesizer connected to MIDI OUT (TUNED) does not support 14-bit Pitch Bend, change this switch to LO.

### Octave Up / Down Switches

Navigates the currently selected tuning table by table octaves. *NOTE: In the default Master Tuning, this corresponds to transposition by octaves; however, the pitches stored in user tables may correspond to anything, so shifting by table octaves does not necessarily require shifting by octaves in terms of pitch.*



### GM Patch List

TPX/2s/4s units include a patch list for the built-in GM/GS Synthesizer.

### 2 x 20 Character LCD

Displays the currently selected preset tuning table, bank, patch, preset, and polyphony.

### 16 Channel Switches

Use these switches to control polyphony – which channels receive retuned MIDI output.

### 16 Tuning Presets

Press these buttons to recall a preset tuning tables.

### 16 Patch Presets

Press these buttons to recall a preset banks and patches.

### PANNING Fader

Sends MIDI Panning (Controller number 10) on all selected channels.

### MOD, VOL, and VEL Faders

Sends MIDI Modulation (Controller number 1), MIDI Volume (Controller number 7) and MIDI Note Velocity on all selected channels. *NOTE: side panel Volume and Velocity pedal inputs override these faders.*

## Side Panel Diagram

### LINE IN

Input a line level audio signal from any other source directly to the internal amplifier using this 1/4" jack. *NOTE: This input turns off internal audio.*

### LINE OUT

Output line level audio from the internal amplifier to an external device such as a mixer or amplifier using this 1/4" jack.

### Stereo Headphones

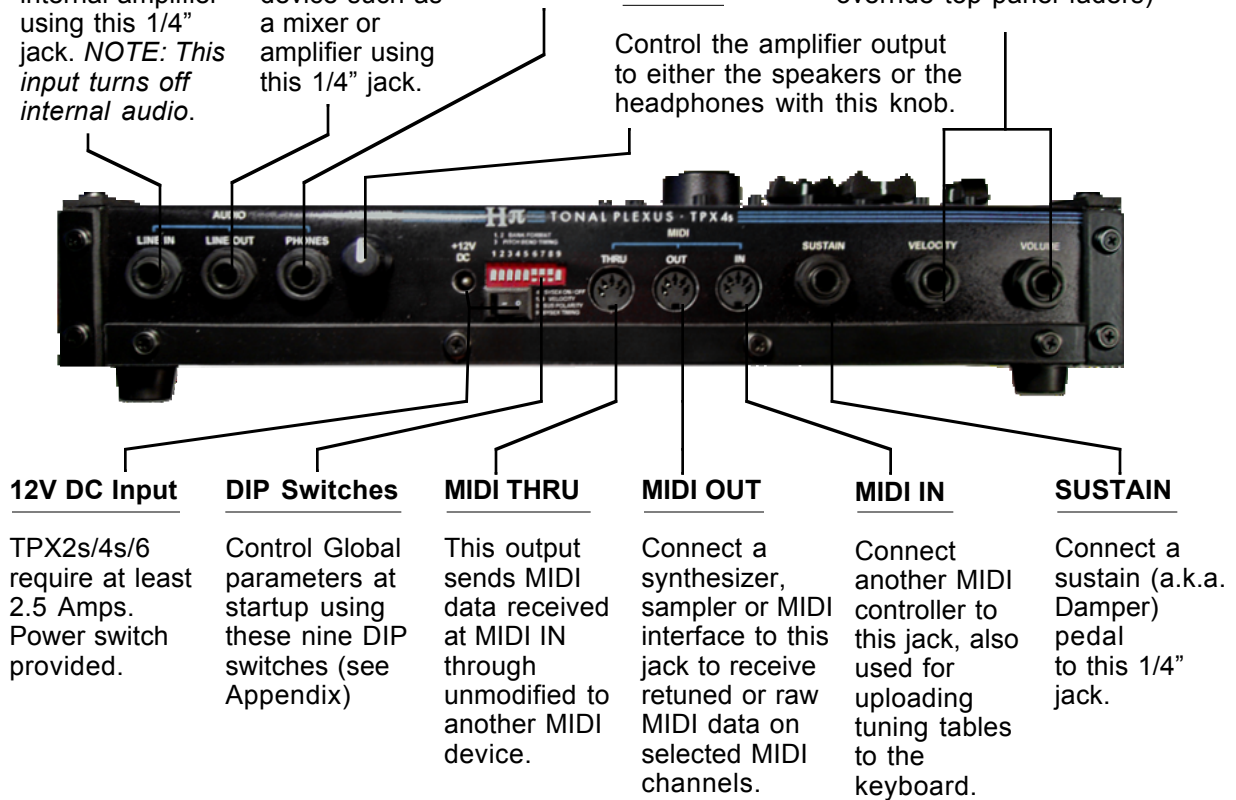
Connecting headphones to this attenuated stereo output turns off speaker output.

### Volume

Control the amplifier output to either the speakers or the headphones with this knob.

### Volume Pedals

Connect Lo-Z (20 kOhm) volume pedals to these 1/4" jacks to control MIDI Volume and Key Velocity (these inputs override top panel faders)



## Recommended Accessories

### Sustain Pedal



Because TPX2s/4s/6 has a sustain pedal polarity switch, all sustain pedals are compatible.

### Volume Pedals



Volume pedals may be used to control MIDI key velocity and MIDI volume, overriding the top panel faders. The pedal should be 20KOhm. High impedance guitar volume pedals will work, but not very well. The volume pedal we recommend is made by in Italy by bespeco, and is available to European customers as the VM16L and in the US as Quiklok VP16. This pedal is nice because it has the cable built in; however, it is no longer readily available in the US. A slightly different pedal in stereo configuration with the handy addition of a lowest-volume control pot is also available from bespeco as the VM14L, and fortunately this pedal is available in the US from Zzounds as the Quiklok VP15. With this pedal, you will need to get a cable which is 1/4" Stereo plug to 2 1/4" Mono plugs (a.k.a a standard Send / Return Insert Cable), and we recommend the STP-200 from Hosa.

Having an internal synthesizer and amplifier, a TPX2s/4s/6 keyboard is a standalone performance instrument. However, if sounds other than those of the internal synthesizer are needed, the internal amplifier of TPX2s/4s/6 can be used with external sources by connecting External Source LINE OUT to TPX2s/4s/6 LINE IN. To save space, TPX2s/4s/6 uses a Stereo (TRS) 1/4" jack for LINE IN, so that a cable adapter may be needed to connect external sources having other types of output jacks. Adapter cables are available from HOSA, shown below: a 1/4" Male Stereo to 2 Female Mono 1/4" Cable, a 1/4" Male Stereo Phone to 2 RCA Female Cable, and a 1/4" Stereo to Stereo Mini Cable.



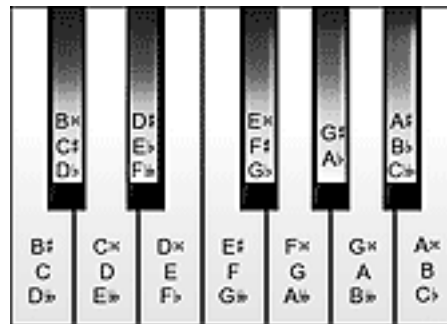
## 2. Keyboard Layout

The Tonal Plexus keyboard geometry was designed in 2002 by Aaron Andrew Hunt. This particular geometry is unique in the history of the musical keyboard, although it bears resemblance to previous inventions known as generalized keyboards, early examples of which are found in the work of Paul Von Janko (1875) and R.H.M. Bosanquet (1877).

### *From Piano To Plexus*

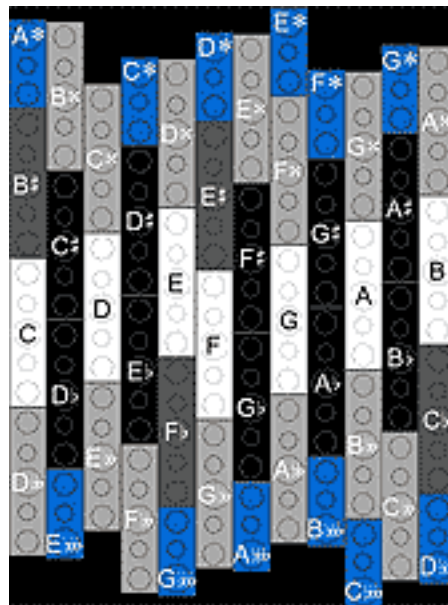
The Tonal Plexus keyboard layout is based on the traditional piano keyboard pattern of 7 white and 5 black keys, with standard fifths-based note names as shown below, piano keys carrying multiple names as shown.

- 7 naturals
- 7 sharps
- 7 flats
- 7 double-sharps
- 7 double-flats



All standard note names correspond to unique, non-duplicate keys on the Tonal Plexus. Extended fifths-based note naming leads to a new set of enharmonics.

- 6 triple-sharps



- 6 triple-flats

These 12 new enharmonic keys are shown at the top and bottom edges of the layout, the blue keys in the images above and Figure 1 below.

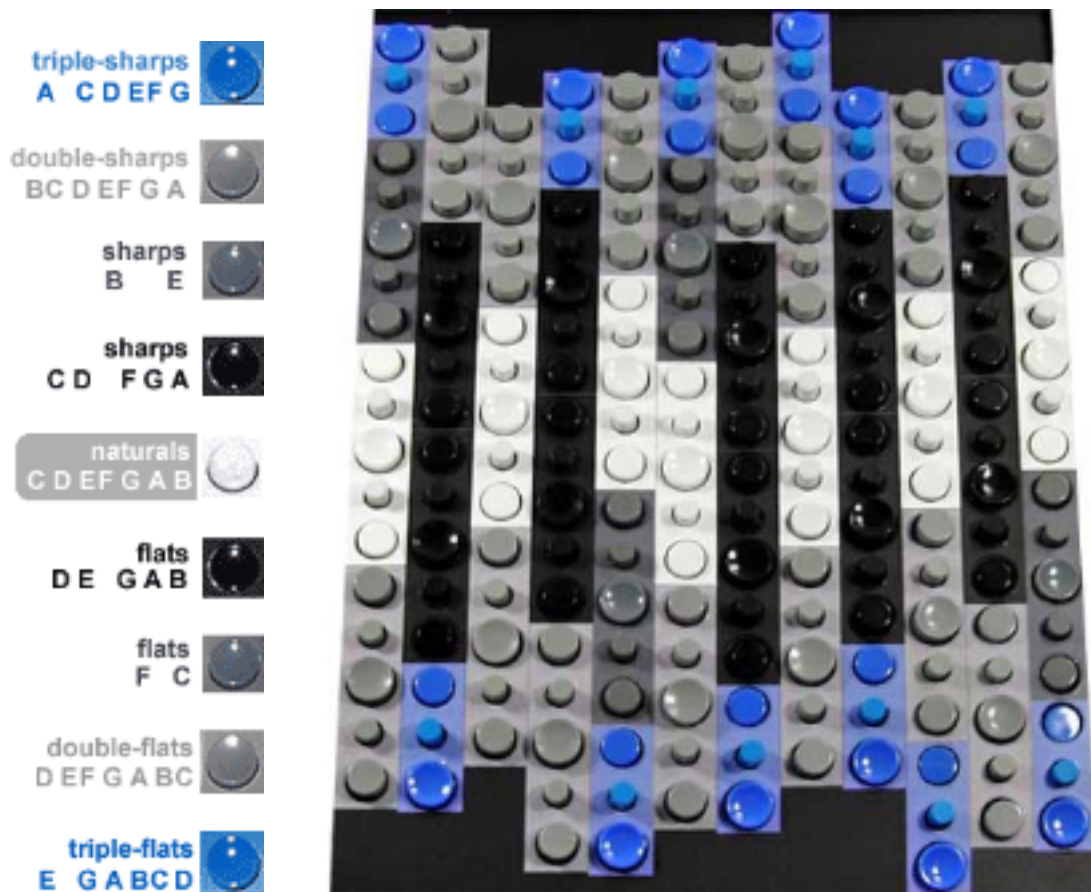


Figure 1

### ***Default Master Tuning 205ET***

The master tuning of the Tonal Plexus was determined by way of thorough research in music theory, music notation, and pitch perception. The result is a system which allows the free exploration of all possible pitch combinations in a coherent way, according to reasonable limits of human perception. A few main concepts behind the master tuning are given below. Further information about the master tuning will be made available in a separate document.

### ***Octaves and fifths***

Octaves and fifths define the basis of Western music theory and notation. Hence, these intervals form the basis of the master tuning. Octaves are tuned purely, and fifths are tuned virtually purely, with a deviation of less than half of one cent. These two intervals provide a reference for pitch ordering and naming relative to which all other intervals are defined.

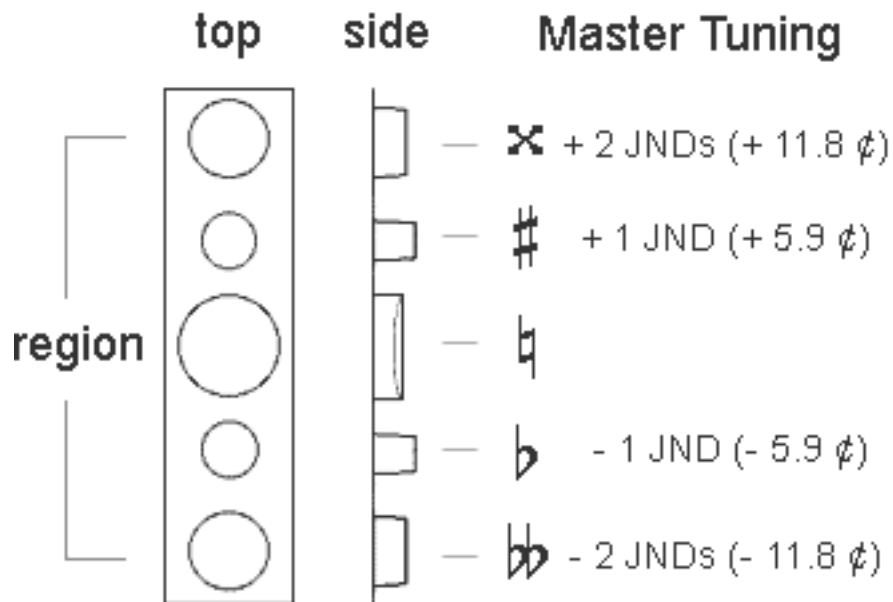
### ***Commas and JNDs***

The master tuning is designed around the comma as a basic interval. The comma used is just under 30 cents in size, forming the basis of a key layout in which one octave contains 41 commas. To

maximize pitch control and expressivity, each comma is broken into 5 JNDs, so that the smallest steps on the keyboard are just under 6 cents in size. Each octave contains 205 JNDs. Using JND fine tuning, any interval can be played with a maximum tuning deviation of less than 3 cents. Though under certain conditions such small mistunings can be heard, in practice the errors are so small that they are not noticeable; other natural variables such as timbre and duration introduce similar small margins of error. The master tuning is thus able to produce all pitches and intervals in a manageable way.

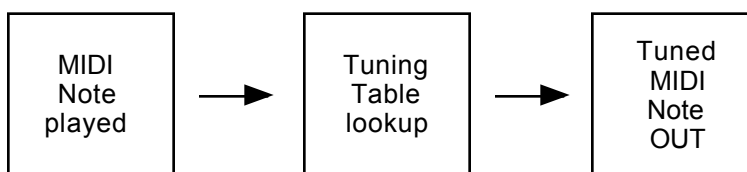
### Key Diameter and Elevation

Tonal Plexus keytops vary in diameter and elevation, arranged symmetrically in 41 regions per octave. The center key of each region has a concave surface and is the largest in diameter. The other keys are smaller and have flat tops. These variations of diameter and elevation provide a tactile terrain for navigation of the keyboard by touch. In the default Master Tuning, the variations correspond to JND inflections of a given letter name, allowing harmonic intervals to be easily found by touch alone.



### 3. Tuning Tables

Each tuning table provides a simple 1 to 1 correspondence between raw MIDI Notes played and retuned MIDI Notes output. Any MIDI Note input can be retuned to any pitch output, in any register with any frequency, limited only by the internal or external synthesizer.



There are 32 memory locations, numbered 0 - 31, available for storing tuning tables. There are 16 preprogrammed default tuning tables, including the Master Tuning 205ET. The default tuning tables may be overwritten, and there are no protected memory locations. Each table is given a 16-character name. The name and number of the currently selected tuning table is displayed on the top row of the LCD. For each MIDI Note, there are three values stored in the tuning table: MIDI Note, Pitch Bend MSB and Pitch Bend LSB. When a MIDI Note ON message is received, these values are looked up and immediately transmitted to MIDI OUT in the following order: Pitch Bend MSB, Pitch Bend LSB, MIDI Note ON.

#### ***MIDI Mapping***

Each octave of a Tonal Plexus keyboard uses two MIDI Channels, each assigned to six columns of keys. These two MIDI Channels are shown as CHANNEL A and CHANNEL B in Figure 2 (next page). The MIDI Note numbers are the same in each octave, and the MIDI Channels are fixed according to the size of the keyboard. The chart below shows MIDI Channel assignments for TPX2s and TPX4s. These MIDI Notes and Channels should be sent from external devices connected to MIDI IN.

OCTAVE	1	2	3	4	5	6	7	8
CHANNEL A	1	3	5	7	9	11	13	15
CHANNEL B	2	4	6	8	10	12	14	16
TPX4s			X	X	X	X		
TPX2s				X	X			

MIDI Notes 0-104 are used from Channel A and MIDI Notes 0-105 are used from Channel B. This leaves 22 MIDI Notes (105-127) unused on Channel A and 21 MIDI Notes (106-127) unused on Channel B. These 43 unused MIDI Notes correspond to 43 unused Tuning Table Registers for each Tonal Plexus octave. Although these free memory registers are ignored by the keys of a Tonal Plexus keyboard, they may be accessed from an external keyboard by sending the correct MIDI Notes on the correct MIDI Channels to MIDI IN.

### Untuned Output Mode

The Tonal Plexus keyboard normally sends tuned output corresponding to MIDI Note and Pitch Bend data stored in a Tuning Table; however, when the top panel TUNED OUTPUT switch is set to OFF, the raw MIDI Note and Channel data shown above is sent to MIDI OUT. This data can then be received by an external processor such as a software sampler to result in retuned output.

### Duplicate Keys

In the default Master Tuning, the following pairs of keys are tuned to the same pitch: Channel A 17 & 18, 68 & 69, 104 & Channel B 0. Channel B 35 & 36, 51 & 52, 87 & 88. These are the keys referred to as *duplicate keys* in TPXE software, the large blue keys in Figure 2 below. These keys are not hard-wired as duplicates; custom user tunings can have any key mapped to any pitch.

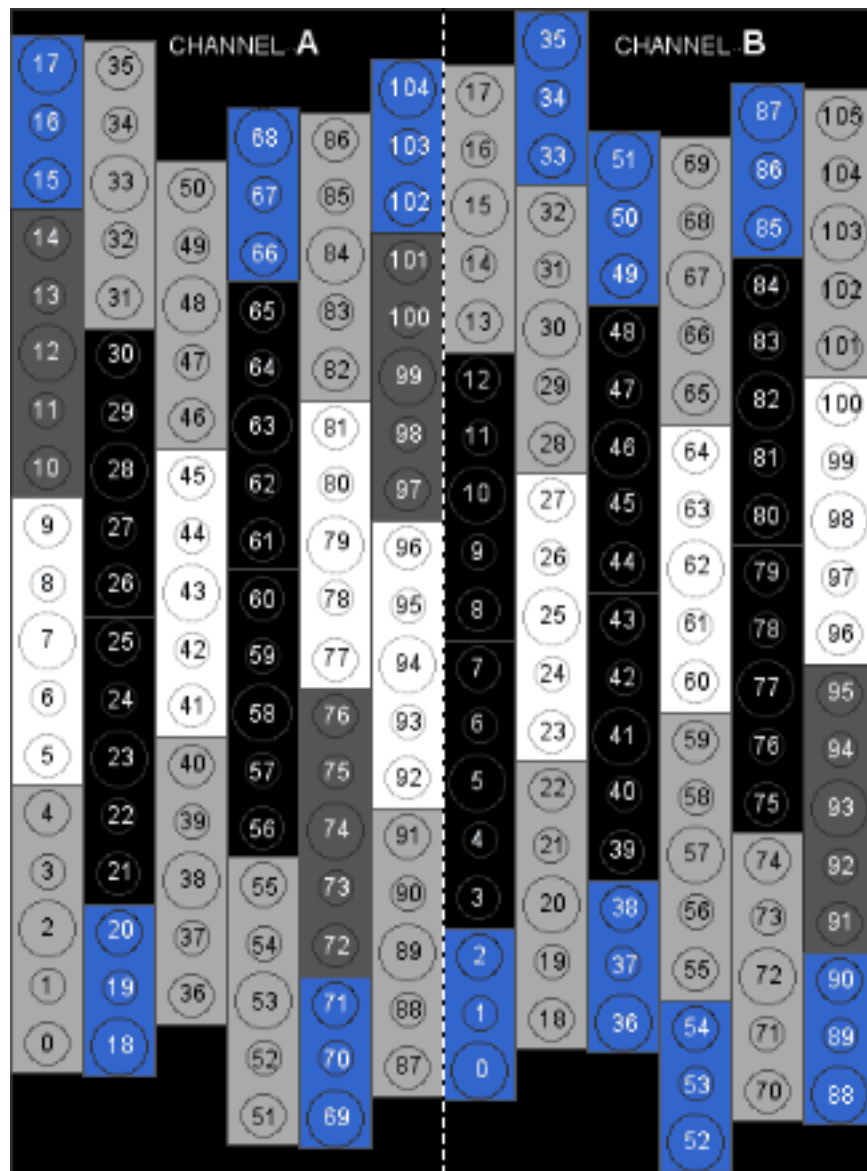


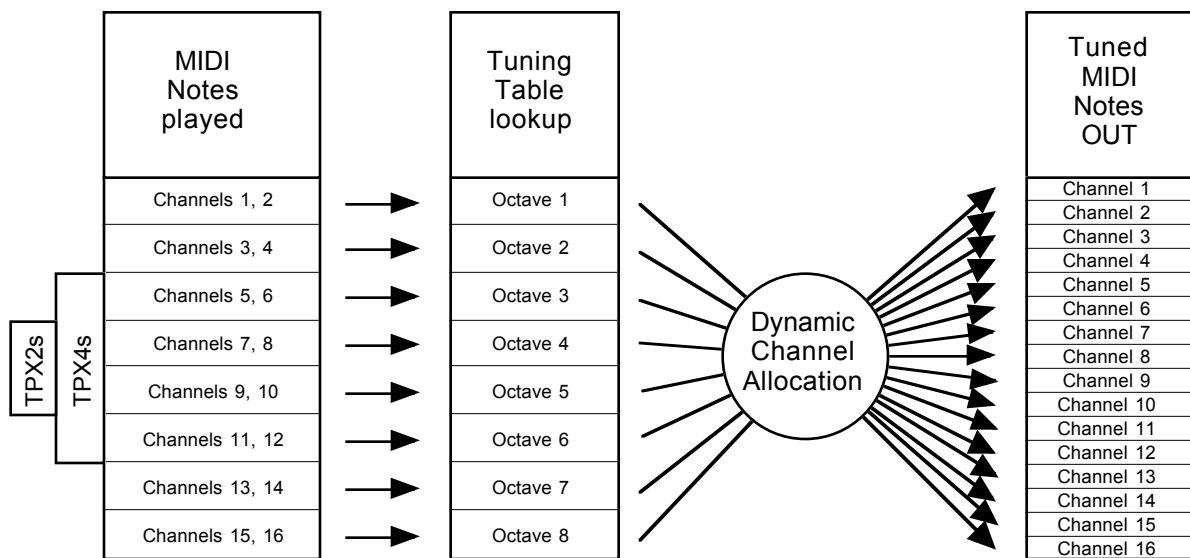
Figure 2

## Programming a Tuning Table

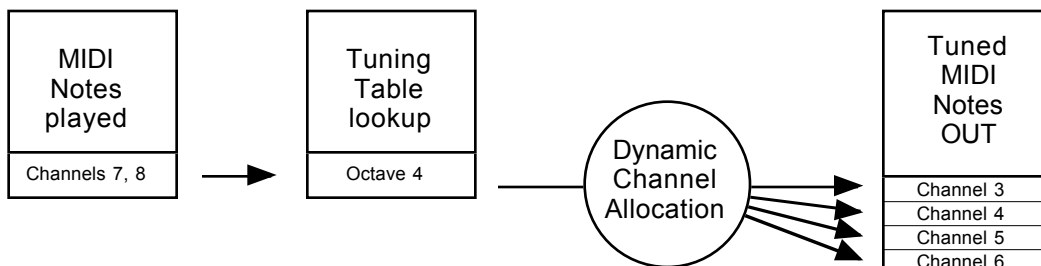
Programming a tuning table means storing it in one of the 32 possible memory locations. Tables are programmed using Tonal Plexus Editor (TPXE) software. Please see the software documentation for information on creating and programming tuning tables.

# 4. Polyphony

TPX2s/4s/6 achieves microtonal polyphony through a MIDI channel assignment system, called a dynamic channel allocation algorithm. Each retuned MIDI Note requires its own MIDI channel. Therefore, polyphony is limited to 16 voices according to the present MIDI standard.



You control which channels receive retuned MIDI output with the 16 channel switches. For example, if channels 3, 4, 5 and 6 are engaged and all other channels are disengaged, MIDI Notes will only be sent on channels 3, 4, 5, and 6. Such control is particularly useful for sequencing multitimbral music.



**NOTE:** MIDI channel 10 is reserved for percussion sounds on General MIDI synthesizers. To remind you of this, the channel 10 button is colored gray rather than black, and the number is underlined. If you hear a percussion sound every few notes, then you need to disengage channel 10.

## 5. Presets

The TPX2s/4s/6 has 16 table presets and 16 patch presets. Each table preset allows a tuning table to be recalled at the touch of a button without affecting the current bank and patch. Each patch preset consists of a bank and patch to be recalled at the touch of a button without affecting the current tuning table.



Pressing the knob initiates the preset programming or browsing process. Browse parameters by turning the knob, and choose values by pressing the knob. While browsing a parameter, that parameter flashes on the display.

### ***Storing a Table Preset***

To store a table preset, follow these steps:

- (1) Push the PROGRAMMER knob. The table preset number and patch preset number flash.
- (2) Push the table preset button you wish to program
- (3) Turn the knob to find the desired tuning table.
- (4) Select a tuning table by pressing the knob. The table preset is stored

### ***Storing a Patch Preset***

To store a patch preset, follow these steps:

- (1) Push the PROGRAMMER knob. The table preset number and patch preset number flash.
- (2) Push the patch preset button you wish to program.
- (3) The bank number flashes.
- (4) Turn the knob to find a desired bank.
- (5) Select a bank by pressing the programmer knob. The patch number flashes.
- (6) Turn the knob to find a desired patch.
- (7) Select a patch by pressing the knob. The patch preset is stored.

The process above may be canceled at any moment by pressing any preset button. In this case the display stops flashing and preset programming stops. Programming may be initiated again according to the steps above.

**NOTE: Bank Select messages are handled differently by different manufacturers. TPX2s/4s/6 includes DIP switches for selecting the correct format for your synthesizer. Consult the Appendix for more information on Bank Select DIP switch settings.**

## 6. Top Panel Controls and Display

This section discusses the control switches and buttons on the top panel and how they relate to the LCD display, excluding the PROGRAMMER knob and PRESET buttons, the functions of which are discussed in section 5.

### LCD Display

The 2 x 20 character backlit LCD normal display is shown below.

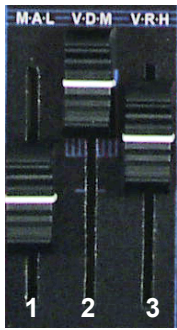


This display changes format in the following situations:

1. when Tuning Table data is being programmed
2. when the FADER OPT switch is engaged
3. when the FADER OPT SELECT switch is engaged
4. when the TUNED OUTPUT switch is set to OFF

### Faders, Fader Opt and Fader Opt Select Switches

The three vertical faders are multifunctional controls. Each fader controls three parameters, as shown by the labels from left to right: M·A·L, V·D·M, and V·R·H; each group of three letters stands for the three functions given to each fader. These functions change according to the states of the FADER OPT and FADER OPT SELECT switches, as shown below.



FADER	FADER OPT OFF	FADER OPT ON	FADER OPT SELECT ON
1. M · A · L	Modulation	Attack	Low Frequency Equalizer
2. V · D · M	Volume	Decay	Middle Frequency Equalizer
3. V · R · H	Velocity	Release	High Frequency Equalizer

As shown above, in addition to standard MIDI controllers, the faders can be used to control the waveform envelope as well as relative synthesizer frequency amplitudes. When the FADER OPT and FADER OPT SELECT switches are engaged or disengaged to change the functions of the faders, the faders must be moved in order to send new data controlling the new parameter. If the fader is left stationary, no data should be sent, but occasionally there may be data sent from a fader at rest, due to electromagnetic interference or acoustic vibration causing small movement of the fader control.

The following messages are sent by faders 1, 2, and 3 when FADER OPT is OFF (MVV):

- CC Bnh 01h Modulation
- CC Bnh 07h Volume
- CC Bnh 3Fh (to signal change of Key Velocity, sent only when TUNED OUTPUT is OFF)

The following messages are sent when FADER OPT is ON and FADER OPT SELECT is OFF (ADR):

- NRPN 0163h Envelope Attack Time (40h = no modification)
- NRPN 0164h Envelope Decay Time (40h = no modification)
- NRPN 0166h Envelope Release Time (40h = no modification)

The following messages are sent when FADER OPT and FADER OPT SELECT are both ON (LMH):

- NRPN 3700h Low Frequency Equalizer (bass) 0 = -12 dB, 40h = 0 dB, 7Fh = +12 dB
- NRPN 3701h and 3702h Middle Frequency Equalizer 0 = -12 dB, 40h = 0 dB, 7Fh = +12 dB
- NRPN 3703h High Frequency Equalizer (treble) 0 = -12dB, 40h = 0dB, 7Fh = +12 dB

*NOTE: the fader option parameters (ADR and LMH) are global, affecting all patches, and are not stored in memory. The Modulation function of fader 1 may control either MIDI Modulation or Global Pitch Bend, according to the setting of DIP switch 7 (see section 9).*

The horizontal fader marked PANNING always sends CC Bnh 0Ah.

## ***Local Control Switch***

The switch called LOCAL CONTROL on TPX2s/4s/6 provides a way to disconnect MIDI traffic coming from the keyboard. This setting should be used when you wish to control the synthesizer from an external source such as a sequencer. When LOCAL CONTROL is set to OFF, the blue LED lights up and the keyboard no longer generates MIDI data; however, incoming MIDI data is still sent to the internal synthesizer. This function is unlike standard LOCAL OFF control, where MIDI data is still sent from the keyboard. The reason for this is that MIDI channel control may possibly be in conflict if MIDI data input and MIDI output are both allowed to directly control the internal synthesizer when bypassing the internal dynamic channel allocation algorithm.

## ***Octave Buttons***

The octave buttons do not simply transpose MIDI Notes by octaves. Instead, they control which tuning table registers are accessed by the MIDI Notes played. So, the word “octave” in this case should be understood to mean a tuning table MIDI map octave as described in section 3.

# **7. External MIDI Devices**

This section gives some basic information about using external MIDI controllers and tone modules with TPX2s/4s. Information on working with a sequencer will be made available in a separate document.

## ***Controllers***

All MIDI controllers connected to MIDI IN will be compatible with TPX2s/4s, including keyboard controllers, ribbon controllers, breath controllers, wind controllers, MIDI guitars, etc.

## ***Standard Synthesizers and Samplers***

Synthesizers and samplers connected to MIDI OUT should be MULTITIMBRAL. Check the MIDI Implementation Chart of any unit you will be connecting. The following parameters must be there:

YOUR SYNTHESIZER'S MIDI IMPLEMENTATION CHART			
FUNCTION	TRANSMITTED	RECOGNIZED	REMARKS
Pitch Bend	(X or O)	O	Channels 1-16
Control Change 6	(X or O)	O	Data Entry MSB
100, 101	(X or O)	O	RPN MSB, LSB

MODE 1: OMNI ON, POLY

X = No O = Yes

There may be some menu settings on the external unit which you will need to configure to satisfy the requirements outlined above.

**NOTE: If MIDI Pitch Bend messages are not recognized, the external device connected to MIDI OUT with TUNED OUTPUT switched ON will not be retuned!**

## Natively Microtonal Synthesizers and Samplers

Hardware or software synthesizers and samplers which already have native microtonal support can be controlled by TPX2s/4s/6 using either MIDI THRU or MIDI OUT with TUNED OUTPUT switched to OFF. In each case, TPX2s/4s/6 will send standard MIDI Note messages and the retuning will take place in the external unit.

## Startup Sequence

The following startup sequence should always be used with TPX2s/4s/6 and anything connected to it:

1. Turn on any external units connected to MIDI OUT or MIDI THRU
2. Turn on TPX2s/4s
3. Turn on any external controller connected to MIDI IN

**NOTE: TPX2s/4s/6 will do nothing in response to an Active Sensing external controller if the controller is turned on before TPX2s/4s.**

# 8. Sequencer / MIDI Footswitch Control

TPX2s/4s/6 can receive MIDI instructions remotely from many kinds of controllers, including sequencers, notation programs and MIDI footswitches. In addition to NOTE ON and NOTE OFF messages, TPX2s/4s/6 responds to other MIDI messages which can be used to control the currently selected bank, patch, and tuning table independent of TPX2s/4s/6 physical controls. This way, MIDI sequences and live performances can employ a number of different patches and tunings without

ever having to touch the controls on TPX2s/4s. For this reason we will refer to such control as **Remote** (not to be confused with wireless control).

## ***Patch Changes***

TPX2s/4s/6 responds to remote messages received on any channel. One simple message recognized is Patch Change, which is Status byte 192-208 for channels 1-16. The Status byte should be followed by one Data byte. The MIDI message format for this message is shown below.

**Patch Change on Channel (192 - 208 = 1 - 16), Patch (0-127)**

## ***Bank Select***

TPX2s/4s/6 responds to several MIDI Continuous Controller (CC) messages. Controller messages are MIDI Status bytes 176-190 for channels 1-16. The Status byte should be followed by a Controller ID byte and then a Data byte. Bank Select MSB and LSB messages are both recognized.

**Controller on Channel (176 - 190 = 1 - 16), Bank Select MSB, LSB (0, 32), Bank (0-127)**

TPX2s/4s/6 must be configured to send Bank Select messages in the format recognized by your synthesizer, and this format is used by TPX2s/4s/6 for both sending and receiving Bank Select messages. For more information, see the Appendix: Bank Select DIP Switch.

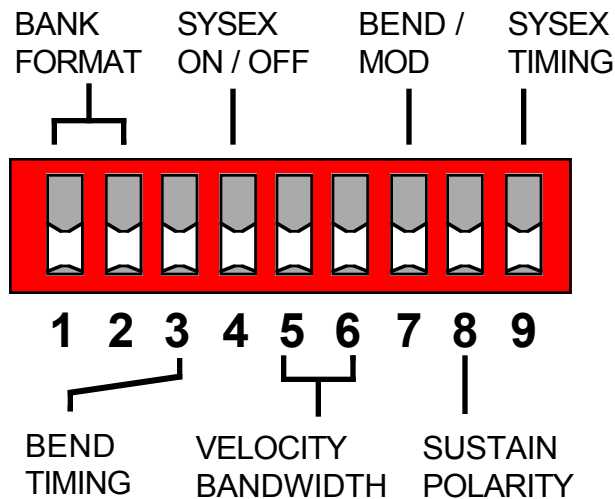
## ***Tuning Table Changes***

Other controller messages allow remote selection of TPX2s/4s/6 tuning tables. Three messages are available which differ in the way that held notes are handled. These are Undefined Controllers, numbers 116-118 (formerly 80-82). A Controller Status byte is followed by an ID byte and Data byte.

**Controller on Channel (176 - 190 = 1 - 16), Controller ID (116-118), Tuning Table (0-127)**

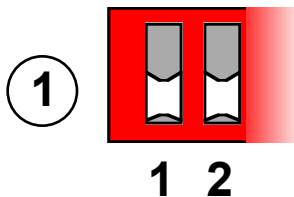
If notes are sustaining in one tuning and you want them to remain sounding in that tuning even after the tuning table has been changed, use Controller ID number 116. If instead you want held notes to change immediately to a new tuning, you have two options. The first is Controller ID number 117 in which notes currently sounding are restruck with pitches in the new tuning. Controller ID number 118 shifts (bends) currently held notes to new pitches without restriking, but the changes in pitch for each note are limited within the range of a 12ET halfstep.

## 9. DIP Switches

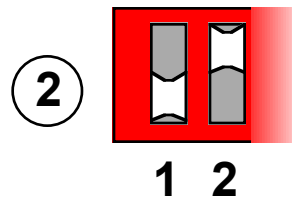


### DIPs 1 & 2: Bank Select Format

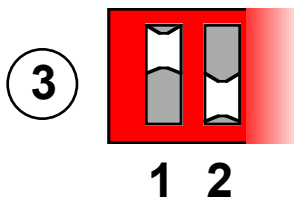
According to the MIDI Specification, manufacturers may use Bank Select messages CC0 or CC32, or both. TPX2s/4s/6 sends Bank Select messages to MIDI OUT, and also recognizes Bank Select messages received at MIDI IN. If you find that bank switching is not being handled correctly, the TPX2s/4s/6 DIP switches should be adjusted. Only switches 1 and 2 are used for the Bank Select message. With only 4 possible combinations, trial and error may be faster than digging for information in your synthesizer manual.



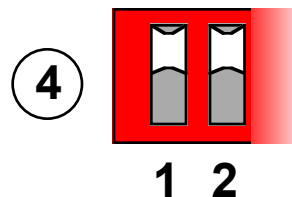
**Default: Bank Select CC0**  
 1 OFF : One byte message  
 2 OFF : Message is CC0



**Option: Bank Select CC32**  
 1 OFF : One byte message  
 2 ON : Message is CC32



**Option: Bank Select CC0, CC32**  
 1 ON : Two byte message  
 2 OFF : Message is CC0, CC32



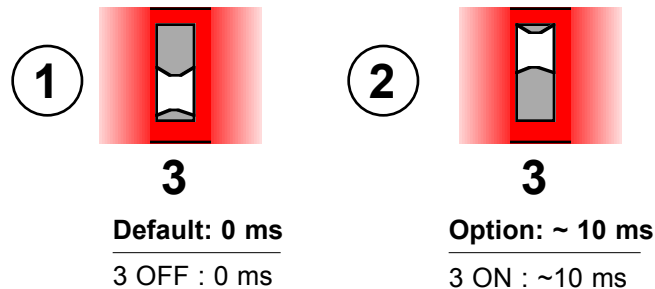
**Option: Bank Select CC32, CC0**  
 1 ON : Two byte message  
 2 ON : Message is CC32, CC0

To change the bank select format, turn the unit OFF, change the position of DIP switches 1 and 2,

and turn the unit back ON.

### DIP 3: Pitch Bend Response Timing

Synthesizers from various manufacturers respond differently to Pitch Bend messages in terms of timing. In order to produce pitches always sounding properly tuned, such that the Pitch Bend is not audible after a note has begun sounding, TPX2s/4s/6 sends MIDI Pitch Bend messages before MIDI Note messages with a default timing gap of less than 5 milliseconds between the two messages. This gap is well below the average perceptual threshold (some sources place this threshold as high as 35 ms). In some cases, a synthesizer or sequencer might quantize the timings of incoming MIDI data such that the default gap is not enough, and a pitch may bend audibly after it is sounding, even though the Pitch Bend message was sent in advance of the Note message. In this case, the Pitch Bend Response Timing DIP switch should be adjusted. Switch 3 is used for this purpose. Timing may be adjusted from the default of less than 5 ms to 15 ms, as shown below.



To change the pitch bend response timing, turn the unit OFF, change the position of DIP switch 3, and turn the unit back ON.

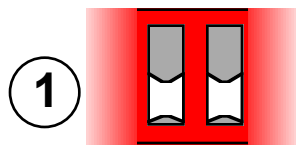
### DIP 4: Sysex Retransmission

By default, TPX2s/4s/6 ignores all sysex messages which are not table programming messages; however, you may want TPX2s/4s/6 to retransmit other sysex messages which it receives. Switch 4 is used for this purpose. A 120 ms recovery timing gap is controlled by DIP switch 9, for compatibility with older equipment. To change the sysex retransmission function, turn the unit OFF, change the position of DIP switch 4, and turn the unit back ON. **NOTE: Switching DIP 4 ON may cause tuning errors! Always turn 4 OFF before sending tuning tables.**



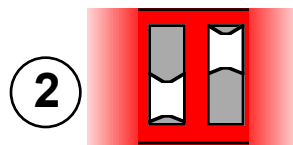
## DIPs 5 & 6: Velocity Randomization Bandwidth

The keys of TPX2s/4s/6 are not velocity sensing, which means that the MIDI NOTE messages will be sent from the unit with a constant velocity value. In some situations, constant velocity is preferable, such as when controlling organ or harpsichord sounds; however, many patches will sound more natural with some variation in the output velocities. To achieve more natural sounding output without velocity sensing keys, a velocity randomization function may be used. DIP switches 5 and 6 control the bandwidth of this randomization, from  $\pm 0$  to  $\pm 15$ .



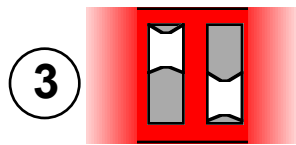
1

5 6

**Default: Velocity Bandwidth = 0**5 OFF :  $\pm 0$ 6 OFF :  $\pm 0$ 

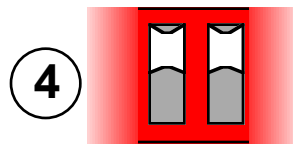
2

5 6

**Option: Velocity Bandwidth = 10**5 OFF :  $\pm 0$ 6 ON :  $\pm 5$ 

3

5 6

**Default: Velocity Bandwidth = 20**5 ON :  $\pm 10$ 6 OFF :  $\pm 0$ 

4

5 6

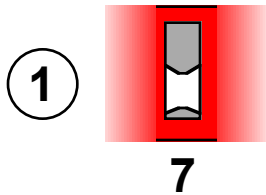
**Default: Velocity Bandwidth = 30**5 ON :  $\pm 10$ 6 ON :  $\pm 5$ 

The velocity fader or pedal control is used to vary the overall velocity output. When either DIP switches 5 or 6 are ON, the velocity fader value serves as the center of a randomized velocity band. For example, if the velocity fader is located around the value 80, and setting 2 above is used (where DIP switch 6 is ON), the velocity values in the output will vary randomly between 75 and 85. To change the velocity randomization settings, turn the unit OFF, change the positions of DIP switches 5 and 6 to the desired function, and turn the unit back ON.

## DIP 7: Global Pitch Bend Mode

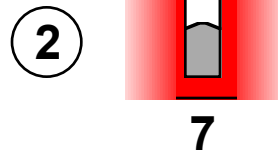
Because the Tonal Plexus uses MIDI Pitch Bend to retune pitches, the conventional expectation of Pitch Bend control is lost. However, the internal synthesizer allows global pitch to be altered using a special MIDI Modulation Pitch mode, which is part of the Roland GS standard. Using a combination of MIDI messages to initialize global transposition and Modulation parameters at startup, the conventional Pitch Bend function can be imitated, in which the MOD Fader controls global pitch. In

this mode, the center position of the MOD fader gives unmodified pitch, the top position bends pitch up a 12ET wholestep, and the bottom position bends the pitch down a 12ET wholestep. To engage this mode, turn the unit OFF and switch DIP switch 7 to the ON position, and then turn the unit back ON.



**Default: Pitch Bend Mode OFF**

7 OFF : MOD Fader Controls Modulation



**Option: Pitch Bend Mode ON**

7 ON : MOD Fader Controls Global Pitch

When DIP switch 7 is ON, the following MIDI sysex messages are sent to the internal synthesizer at startup:

Global transposition set down one 12ET wholestep:

FOh 41h 00h 42h 12h 40h 00h 05h 3Eh 00h F7h

Modulation Pitch Range set to a 12ET Major 3rd: (n = all channels)

FOh 41h 00h 42h 12h 40h 2nh 00h 44h 00h F7h

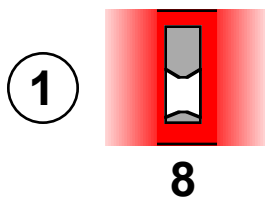
Modulation LFO Amplitude set to Null: (n = all channels)

FOh 41h 00h 42h 12h 40h 2nh 04h 00h 00h F7h

*NOTE: DIP 7 ON will affect the internal synthesizer only, and may confuse external MIDI gear unless that gear recognizes Roland GS sysex messages.*

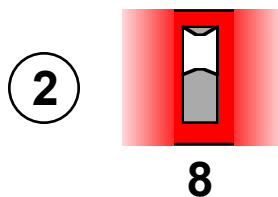
### DIP 8: Sustain Pedal Polarity

Sustain pedals are simple switches which may be either normally open (NO) or normally closed (NC). If you find that your sustain pedal gives reversed results (notes sustain when the pedal is UP) then turn the unit OFF, change the position of DIP switch 8, and turn the unit back ON.



**Default: SUSTAIN POLARITY -**

8 OFF : Sus Pedal is an NO switch



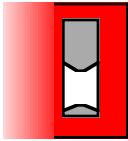
**Option: SUSTAIN POLARITY +**

8 ON : Sus Pedal is an NC switch

### ***DIP 9: Sysex Recovery Timing***

When using DIP 4 ON to retransmit sysex data, you may need to use DIP switch 9 to add a short delay to the retransmission, particularly if your unit is older.

1

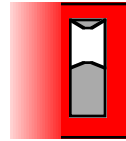


9

**Default: Sysex Recovery OFF**

9 OFF : Sysex is retransmitted immediately

2



9

**Option: Sysex Recovery ON**

9 ON : Sysex retransmission is delayed 20ms

# APPENDIX

## General MIDI Patch List

### BANK 000

000 Grand Piano	032 Acoustic Bass	064 Soprano Sax	096 Synth Rain FX
001 Bright Piano	033 Upright Bass	065 Alto Sax	097 Synth Fifths
002 Electric Piano	034 Picked Bass	066 Tenor Sax	098 Synth Chimes
003 Honkytonk Piano	035 Fretless Bass	067 Baritone Sax	099 Plucky Synth
004 Rhodes Piano	036 Slap Bass	068 Oboe	100 Bright Aahs
005 Cheezy Piano	037 Bright Bass	069 English Horn	101 Synth Goblin
006 Harpsichord	038 Synth Bass	070 Bassoon	102 Oi
007 Clavichord	039 Synth Upright	071 Clarinet	103 Harsh Synth
008 Celesta	040 Violin	072 Piccolo	104 Bendup Sitar
009 Glockenspiel	041 Viola	073 Flute	105 Banjo
010 Music Box	042 Cello	074 Recorder	106 Shamisen
011 Vibraphone	043 Contrabass	075 Chiff Flute	107 Koto
012 Marimba	044 Tremolo Strings	076 Glass Flute	108 Kalimba
013 Xylophone	045 Pizzicato	077 Cheezy Flute	109 Bagpipe
014 Tubular Bells	046 Harp	078 Whistle	110 Fiddle
015 Dulcimer	047 Timpani	079 Blockflöte	111 Regal
016 Draw Organ	048 String Ensemble	080 Square Lead	112 Bells
017 Percussive Organ	049 Cheezy Ensemble	081 Saw Lead	113 Agogo
018 Rock Organ	050 Synth Strings	082 Calliope	114 Twangy Tines
019 Church Organ	051 Mod Synth	083 Bendup Lead	115 Woodblock
020 Reed Organ	052 Choir Aahs	084 Electric Lead	116 Taiko Drum
021 Accordion	053 Voice Doos	085 Voice Lead	117 Melodic Tom
022 Harmonica	054 Synth Voice	086 Mod Fifths	118 Synth Drum
023 Tango Accordion	055 Orchestral Hit	087 Fat Lead	119 Reverse Cymbal
024 Nylon Guitar	056 Trumpet	088 Vibe Pad	120 Guitar Fret Noise
025 Steel Guitar	057 Trombone	089 Warm Pad	121 Bad Breath
026 Jazz Guitar	058 Tuba	090 Polysynth Pad	122 Seashore
027 Clean Guitar	059 Harmon Trumpet	091 Choir Pad	123 Tweety Bird
028 Muted Guitar	060 Horn	092 Glassy Pad	124 Telephone
029 Overdrve Guitar	061 Synth Trumpet	093 Steel Wool	125 Helicopter
030 Distorted Guitar	062 Mod Brass 1	094 Partial Sweep	126 Applause
031 Harmonics	063 Mod Brass 2	095 Sweeping Pad	127 Gunshot

**General MIDI Patch List****BANK 127**

000 GrandPiano	032 CheezElectrc	064 AcousticBass	096 ModBrass2
001 BrightPiano1	033 HurdyGurdy	065 UprightBass	097 Vibes1
002 BrightPiano2	034 SynthAHHs	066 PluckedBass	098 Vibes2
003 ElectricPno1	035 BowedGlass	067 Fretless1	099 Kalimba
004 ElectricPno2	036 ModFifths	068 SlapBass1	100 OrchBells
005 ElecTines1	037 PluckySynth	069 SlapBass2	101 Glockenspiel
006 ElecTines2	038 SynthChimes	070 Fretless2	102 TubularBells
007 HonkeyTonk	039 Bagpipes	071 Fretless3	103 Xylophone
008 FlutterOrgan	040 Bells	072 Flute1	104 Marimba
009 DrawbarOrgan	041 RainFX	073 Flute2	105 Koto
010 TonewheelOrg	042 Oboe	074 Piccolo1	106 TaishoKoto
011 ChorusOrgan	043 ChiffFlute	075 Piccolo2	107 Shakuhachi
012 FullOrgan1	044 Sawtooth	076 Recorder	108 Whistle1
013 FullOrgan2	045 HarshSynth	077 PanFlute	109 Whistle2
014 FullOrgan3	046 TubularBells	078 SopranoSax	110 Bottles
015 Accordion	047 SquareWave	079 AltoSax	111 WeakFlute
016 Harpsichord1	048 SynthStrings	080 TenorSax	112 Timpani
017 Hrapsichord2	049 TremoloStrng	081 BaritoneSax	113 TomToms
018 Hrapsichord3	050 SlowStrings	082 Clarinet1	114 BassDrum
019 Clavichord1	051 Pizzicato	083 Clarinet2	115 SynthTom1
020 Clavichord2	052 Violin	084 Oboe	116 SynthTom2
021 Clavichord3	053 Viola	085 EnglishHorn	117 TaikoDrum1
022 Celesta1	054 Cello1	086 Bassoon	118 TaikoDrum2
023 Celesta2	055 Cello2	087 Harmonica	119 ReversCymbal
024 SynthBrass	056 Contrabass	088 Trumpet	120 BrakeDrum1
025 SlowBrass	057 Harp1	089 HarmonTrmpt	121 BrakeDrum2
026 SynthBrass2	058 Harp2	090 Trombone1	122 OrchHit
027 SlowBrass2	059 NyolonGuitar	091 Trombone2	123 Telephone
028 SynBass1	060 SteelString	092 Horn1	124 Birdy
029 SynthBass1	061 CleanGuitar	093 Horn2	125 Helicopter
030 SynBass2	062 FunkyGuitar	094 Tuba	126 Shimmering
031 SynthBass2	063 BendUpSitar	095 ModBrass1	127 UselessRain

### MIDI Implementation Chart

FUNCTION	TRANSMITTED	RECOGNIZED	REMARKS
Note ON	O	O	Channels 1-16
Note OFF	O	O	Channels 1-16
Velocity	O	O	Channels 1-16
Pitch Bend	O	X	Channels 1-16 14-bit MSB, LSB
Control Change			
0	O	O <sup>1</sup>	Bank Select MSB
32	O	O <sup>1</sup>	Bank Select LSB
6	O	O <sup>1</sup>	Data Entry MSB
38	O	O <sup>1</sup>	Data Entry LSB
64	O	O <sup>1</sup>	Sustain
100, 101	O	O <sup>1</sup>	RPN MSB, LSB
0 - 115, 119-127	O	O <sup>1</sup>	See 1 below
Program Change	O	O	Channels 1-16
System Exclusive	O <sup>3</sup>	O <sup>2</sup>	See p. _
Aux Active Sensing	X	O	See p. _

X = No O = Yes

1. Effects of Received Messages: (Presets are not altered by these messages)

**Bank Select:** changes the bank.

**Program Change:** changes the patch.

**Controller 116:** changes the tuning table, held keys remain sounding old pitches

**Controller 117:** changes the tuning table, held keys restrike with new pitches

**Controller 118:** changes the tuning table, held keys bend into new pitches

NOTE: Pitch bending without restriking is limited to the range of a 12ET halfstep.

All other controller messages are retransmitted on all currently engaged channels.

2. Sysex retransmission is controlled by DIP switch 4, recovery timing by DIP switch 9.



## Troubleshooting

<b>There is no output from the internal synthesizer.</b>	
<ul style="list-style-type: none"> <li>• Is the amplifier volume at or near zero?</li> <li>• Are the Volume and Velocity faders at or near zero?</li> <li>• Is the tuning table empty?</li> </ul>	
<b>YES</b>	<b>NO</b> Reboot the unit.
Boost the volume or faders, or choose a tuning table which is not empty.	if you have followed these instructions and there is still no output, please email <a href="mailto:contact@h-pi.com">contact@h-pi.com</a>
<b>There is only very high pitched output from the internal synthesizer from every key.</b>	
The tuning table is empty. Use a programmed tuning table or program the tuning table.	
<b>A key is sticking.</b>	
Rotate the key. If this does not free the key, you may need to use the tip of the bade of an X-acto knife to remove foreign material from the opening around the key. In an extreme case you may need to use th blade to increase the size of the opening so that the key moves freely.	
<b>I hear two pitches from an external MIDI synthesizer or sampler when I play a single key.</b>	
Your synthesizer's LOCAL CONTROL is ON. Turn LOCAL CONTROL OFF.	
<b>I hear only one pitch from an external MIDI synthesizer or sampler and it bends audibly.</b>	
<ul style="list-style-type: none"> <li>• Do you have only one MIDI channel engaged on TPX2s./4s? See section 4.</li> <li>• Is the synthesizer compatible? See section 7.</li> <li>• Is the synthesizer in Multitimbral MIDI mode? See your synthesizer owners manual.</li> </ul>	
<b>Some notes do not sound on an external MIDI synthesizer or sampler.</b>	
<ul style="list-style-type: none"> <li>• Does the synthesizer have MIDI input enabled on all selected channels? see section 4</li> <li>• Is the synthesizer filtering incoming MIDI data? see your synthesizer owners manual.</li> </ul>	

<b>Pitches are tuned incorrectly on a external MIDI synthesizer or sampler.</b>	
Is MIDI IN of the synthesizer connected to TPX2s/4s/6 MIDI THRU?	
<p><b>YES</b></p> <p>TPX2s/4s/6 MIDI THRU gives untuned output. Connect the synthesizer to TPX2s/4s/6 MIDI OUT.</p>	<p><b>NO</b></p> <p>Synthesizer MIDI IN must be connected to TPX2s/4s/6 MIDI OUT.</p>
Are the pitches still incorrect?	
<p><b>YES</b></p> <ul style="list-style-type: none"> <li>• The patches you are using could be altering the Pitch Bending response. Try some other patches.</li> <li>• Check your synthesizer user manual; the synthesizer may have a fixed Pitch Bend range; . in which case your tuning tables must be specially created for this range, see Tuning Box Editor documentation.</li> <li>• Turn DIP Switch 4 OFF. See section 9.</li> </ul>	<p><b>NO</b></p> <ul style="list-style-type: none"> <li>• Most likely the synthesizer was accidentally reset and this canceled previously received Pitch Bend range setting messages.</li> <li>• The first patch you were using may alter Pitch Bending response, try it again.</li> </ul>
If your synthesizer is compatible according to its MIDI Implementation chart, you have followed these instructions and pitches are still not tuned correctly, please email <a href="mailto:contact@h-pi.com">contact@h-pi.com</a>	
<b>Pitches of an external MIDI synthesizer or sampler are bending after they sound.</b>	
Does the selected patch use MIDI Portamento?	
<p><b>YES</b></p> <p>Pitches bending audibly is the correct result for patches using MIDI Portamento, and will also result when Portamento ON has been sent to a MIDI Channel. Try a different patch or turn Portamento OFF. Portamento is MIDI CC65, and Portamento Time is controlled by CC5 (MSB) and CC37 (LSB).</p>	<p><b>NO</b></p> <p>The synthesizer is smoothing data between Pitch Bend values, or it is quantizing the timings of incoming MIDI messages. Increase the Pitch Bend Response Timing. See <b>section 9: Pitch Bend Response Timing DIP Switches</b></p>
If pitches are still bending audibly after they begin sounding, please email <a href="mailto:contact@h-pi.com">contact@h-pi.com</a>	

### TPX2s/4s/6 Technical Specification

Tuning Tables	2048 notes per table, 1688 notes accessed by keyboard 32 User Programmable Tuning Tables (no protected registers) 32 x 2048 Notes = 65,536 pitches stored in nonvolatile memory	
Tuning Protocol	MIDI Pitch Bend using a Dynamic Channel Allocation Algorithm with Sustain Pedal Support	
Tuning Resolution	Pitch Bend Resolution: 14 bit Pitch Bend Range: ±1 semitone	98,304 steps per octave 0.01 ¢ steps 0.005 ¢ greatest error
Polyphony	Selectable Polyphony: 1-16 voices, monotimbral	
MIDI	IN, OUT, THRU ports; General MIDI compatibility Latency: less than 5 ms, Selectable 15 ms	
Physical Controls	Jog Dial / button, Local Control switch, Fader Opt Select switch, Fader Opt switch, Tuned Output switch, 16 MIDI channel switches, 16 Tables Preset buttons, 16 Patches Preset buttons, 2 Octave buttons, 9 DIP switches, Power switch. 4 faders.	
Audio	Amplifier: 2 x 22 Watts, THD = 0.1% Low / High f rolloffs = -1 dB Speakers: Polypropylene Woofer, Mylar dome Tweeter, 4 Ohms	
Display	20 x 2 LCD character display with backlight	
Power	Source: 12VDC	Consumption: < 3 A
Physical Dimensions	2: 18.5 x 9.5 x 3 in. 4: 30.5 x 9.5 x 3 in. 2s: 18.5 x 13.5 x 3 in. 4s: 30.5 x 13.5 x 3 in. 6: 18.5 x 9.5 x 3 in.	48 x 25 x 8 cm. 78 x 25 x 8 cm 48 x 37 x 8 cm. 78 x 37 x 8 cm 108 x 25 x 8 cm.
Weight	2: 7.5 lbs, 3.4 kg 4: 12 lbs, 5.4 kg 6: 7.5 lbs, 3.4 kg	2s: 7.5 lbs, 3.4 kg 4s: 12 lbs, 5.4 kg
Accessories	1 Power adapter (included) 1 Sustain Pedal 2 Lo-Z (20 kOhm) Volume Pedals	MIDI cables Audio Cables