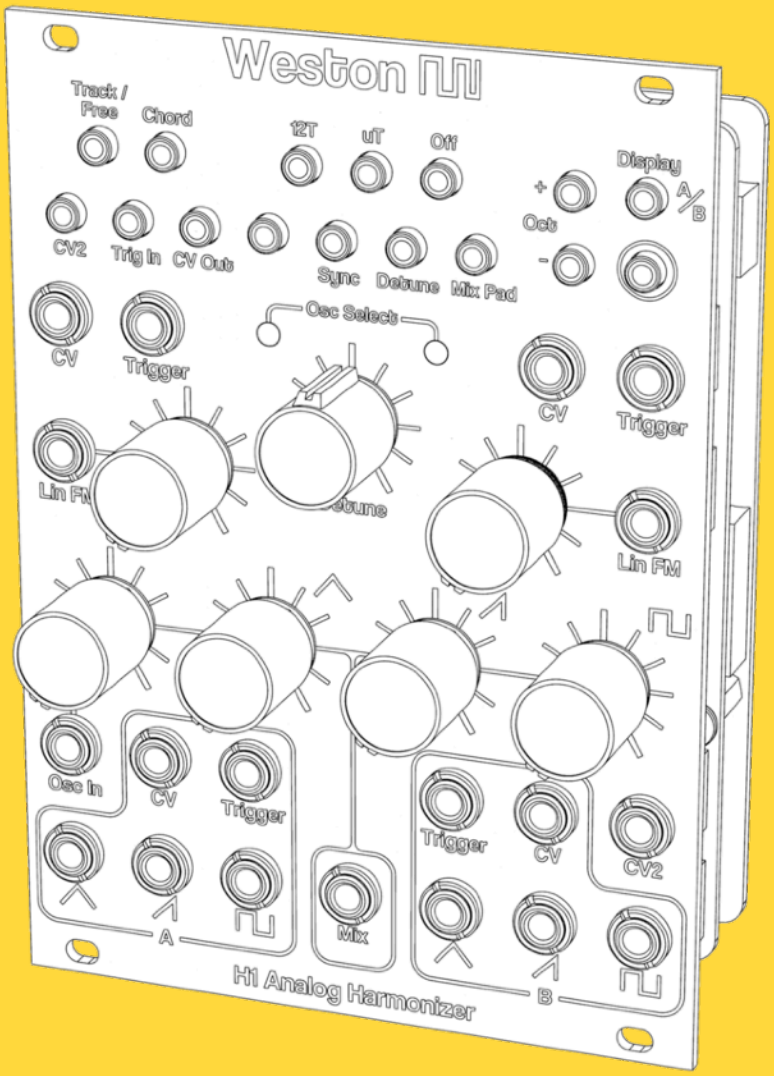
H1

Analog Harmonizer

Eurorack Module

User Manual



Weston Precision Audio

Designed In Portland, Oregon
Revision 04 - April 22, 2024

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H1 Quick Start

(Save the manual reading for a rainy day, right!?)

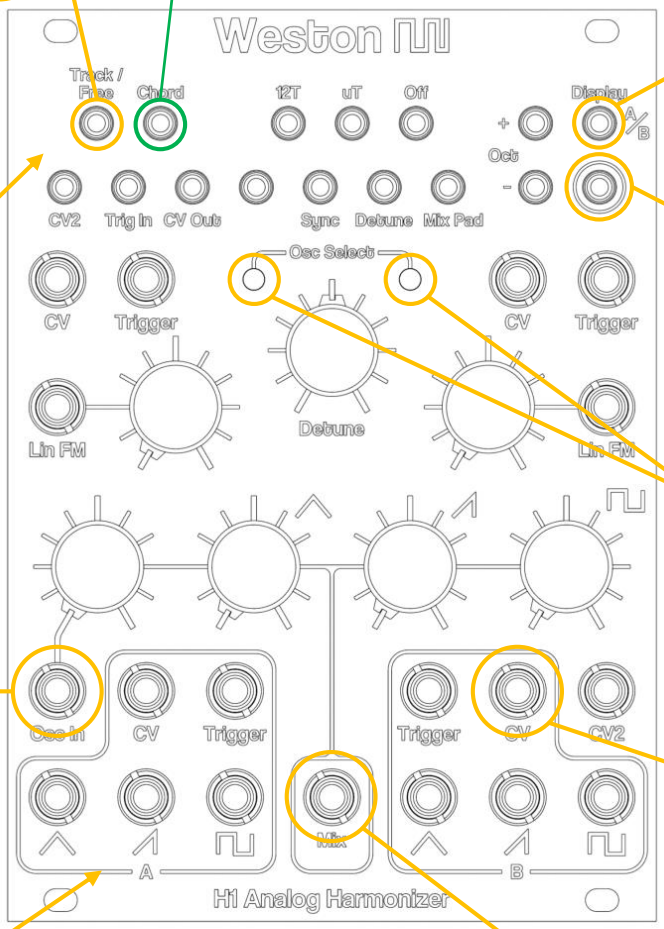
First, for quick start, hold the option button and make sure this button is unlit. If not, press it until it is unlit. This will put us in Main/Normal mode for quick start purposes.

With option held, yellow means active channel is in free mode (acts like regular VCO), white means track mode (channel follows frequency of "Osc In")

This button (A/B / Display) toggles active channel

Option + A/B flips between viewing base interval of active channel and control of active steps for quantizer

Any of the 12 "keys" buttons selects base interval of active channel relative to "Osc In" (Track Mode) or to middle C (Free Mode) (C, C#, D, etc..)



This is the option button. Hold it to see applicable options illuminated and access the secondary functions of those buttons

These LEDs show active channel being edited

Plug output of VCO with clean periodic waveform here to have H1 track its frequency

CV output gives either voltage proportional to "Osc In" frequency OR quantized voltage of CV in (option + CV Out) to toggle

All OUTPUTS have a box drawn around them. All INPUTS do not

Mix output contains a mix of "Osc In" (left knob) and mix of channel A+B triangle, saw, and square (right 3 knobs)

DESCRIPTION

H1 is a Eurorack module designed to make it easy to add harmonic layers or basic polyphony to your modular patches. It is primarily designed to be used by patching the output of a VCO to the "osc in" input and letting the H1 derive 2 notes that are related to the pitch of that oscillator (ie a 3rd and 5th to form a major triad for example). However, H1 can also be used as a dual quantizer, a frequency-to-voltage converter, or simply as 2 analog VCOs. The choice is yours.

At its heart are two identical channels of digitally-controlled, pitch-tracking analog oscillators and 2 quantizers. The oscillators make use of precision multiplying DACs (digital to analog converters) and stable reference circuitry so they are extremely stable in pitch and tracking, but at the same time their signal-generating parts are completely analog so they impart the full richness of an analog oscillator. To be clear, H1 is NOT a digital or wavetable oscillator.

An output mixer section completes the package and minimizes patch cord clutter by giving a mix of the pitch-tracked input signal and the 3 waveforms of the 2 oscillator channels. Each channel also can be modulated with true analog through-zero FM.

Important or helpful bits will be in red.

SPECS

Module Size: 18HP
Depth: 25mm (To back PCB), 33mm (To end of power connector)

Audio Outputs:
<=1kOhm Output Impedance

Inputs (All inputs >=100kOhm Impedance): CV, Trigger, Lin FM, Osc In.

Power input:
+12V & -12V via standard 10 pin Eurorack connector. Protected against reverse polarity internally and with shrouded connector.

Power consumption (+12V / -12V):
Typ: 185mA / 75mA
Max: 200mA / 85mA

ADC Resolution (CV ins):
12-bit

DAC Resolution:
Main osc. channels: 16-bit
CV outputs: 14-bit

USB firmware update port:
Micro Type-B

MAXIMUM LIMITS

Supply Voltage: +13.5V / -13.5V

All inputs: Up to power supply levels.

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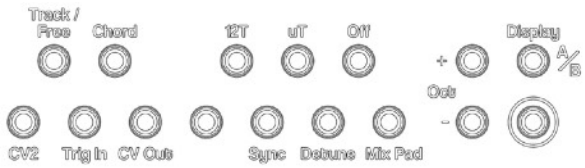
MAIN CONTROLS

Most functions of H1 are controlled through the row of LED-backlit buttons on the top of the module:

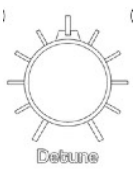


You may notice the leftmost group of 12 buttons is arranged as an octave of a standard piano keyboard. The next column of buttons is an octave control. Finally, there is the display/AB button and the Option or "circle" button.

Text written above or below a button refers to the button's function while HOLDING the Option button. For example, the A/B button on its own toggles between selecting channel A or B. If Option/circle is held and this same button is hit, the "display" function is invoked. More in this later.

OTHER CONTROLS

Detune:

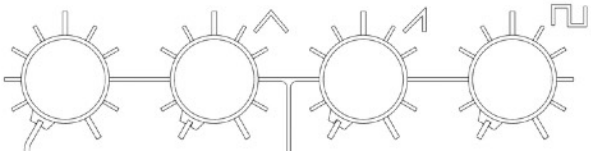


If detune is enabled for the selected channel, this pot provides a fine detune for the selected channel with a range of +/- one semitone. If detune for channel A is adjusted, and then channel B is selected and the knob is turned, the knob will not effect channel A's detune when returning to channel A until the knob is turned back to the point at which it was set while the channel was active. If detune is disabled for the channel, the detune knob will have no effect.

FM input attenuator:

Each channel has an input for analog through-zero frequency modulation (TZFM). The knob next to each jack controls the amount of FM signal applied. That is to say it is simply an attenuator for the input signal.

Mixer:



H1 has a mix output which contains a mix of whatever signal is input to "Osc In" and the 3 primary waveforms from each oscillator. The 4 potentiometers, from left to right, control the amount of "Osc In", Triangle A + Triangle B, Saw A + Saw B, and Square A + Square B. The mixer section has a gain of either 1 (0db), or -9dB if the "Mix Pad" feature is enabled. The Mix Pad option gives more effective headroom to crank the mixer controls up more without clipping.

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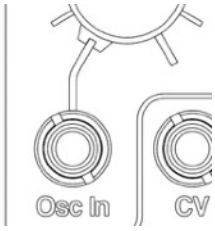
INPUTS

As noted in the Quick Start, all outputs have a border drawn around them on the panel, and inputs do not. This standard will be adhered to on future Weston modules.

Oscillator In (Osc In)



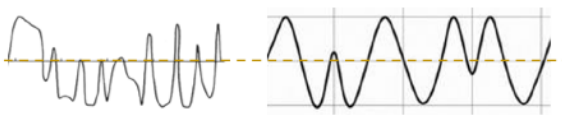
The Osc In input accepts a periodic waveform with amplitude ranging from around 1Vpp to 20Vpp and determine's that waveform's frequency. The signal input must be of a single primary frequency (e.g. from a VCO or self-oscillating filter) in order to get good frequency-tracking results. If the signal is highly wave-folded or filled with other strong frequency content, glitching and jumping can occur. This may be enjoyed by some users though, so by all means experiment and abuse this input if you wish!

In track modes, the closest note of the detected input signal will be displayed as a pulsating white/yellow light on the keypad

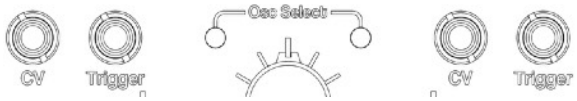
In short, the waveform to be accurately frequency-tracked must have consistent zero-crossings. See table below for some examples:

Good frequency tracking results

Unpredictable frequency tracking results



Primary CV and Trigger



Each channel has a primary CV input which controls the relative pitch of that channel. It can be quantized (more on that later) and has an input range of -3V to 7V.

Each channel's quantizer also has a trigger input. When trigger in is enabled, the quantizer will only output the next quantize step if a rising edge of the trigger input is seen. This trigger voltage can be anywhere from around 1V to 12V.

Linear FM

Each channel has a Lin FM input which allows that channel's oscillator to be through-zero frequency modulated by the signal input to this jack.

Auxiliary CV (CV2)

There is also an auxiliary CV input (labeled CV2) which, when enabled, can either transpose the base note of one or both channels, or transpose the 2 notes of a chord pair together when in Chord Mode (more on this later).

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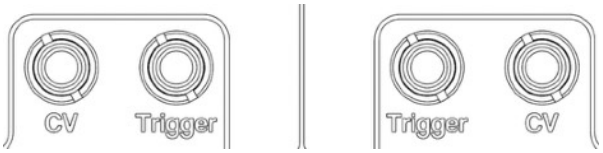
OUTPUTS

CV Out & Trigger Out



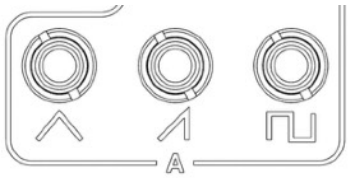
Each channel has a CV output which can be set to operate in 2 different ways. Holding the Option key and pressing "CV Out" will toggle between the 2 and change the status color of that button as follows:

When illuminated white, the active channel's CV output will present a voltage which is proportional to the frequency of the "Osc In" signal, in a 1 Volt/Octave scale. Thus, in this mode, H1 is essentially functioning as a FREQUENCY TO VOLTAGE converter.

When illuminated yellow, the active channel's CV output will present a quantized version of the voltage input to the corresponding CV input. It's behavior depends on the quantize mode described later in the "UsingThe H1" section.

Next to each CV Out jack is a Trigger Out jack. If the H1 is being used as a quantizer and the Trig Out option is enabled, a trigger pulse will appear here each time the active quantize step changes. The signal amplitude is 5V and has a pulse width of 1millisecond.

Individual Wave Outs



Each channel has outputs for the 3 primary waveforms from that channel's oscillator: Triangle, Sawtooth, and Square. These can be used for more complex patching and mixes outside the H1.

Mix Out

For simpler patches and for keeping patch cord clutter minimized, the mix output can be used. As described in the controls section, this mix contains a mix of "Osc In" and the combined primary waves from channel A and B (Triangle A + Triangle B, Saw A + Saw B, and Square A + Square B) which are controlled by the knobs immediately above the mix out. The mixer section has a gain of either 1 (0db), or -9dB if the "Mix Pad" feature is enabled. The Mix Pad option gives more effective headroom to crank the mixer controls up more without clipping.

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Summary of H1 modes and input functions

		Track	Free	Track	Free	Track	Free	Track	Free
		Osc In		**CV In A**		**CV In B**		**CV In 2 (Aux CV)**	
Main/Normal Mode		Pitch basis for channel A/B or both.	Nothing	Ch. A Note Interval		Ch. B Note Interval		Transposes Ch. A/B or both note intervals	
Chord Modes	**Stored Chord**	Pitch basis for both ch.	Nothing	Nothing	Pitch basis for both ch.	Selects chord 1-12		Transposes active chord (If CV2 Option is on)	
	Diatonic Chord	Pitch basis for both ch.	Nothing	Nothing	Pitch basis for both ch.	Selects key of diatonic scale		Selects major or minor diatonic (If CV2 Option is on)	

USING H1 - DESCRIPTION OF MODES

H1 has 2 distinct modes of operation: Normal, and Chord. Chord mode has 2 versions: Stored Chord and Diatonic Chord.

Main Mode:
Each channel's oscillator note interval is simply selected with the keypad. This interval can be selected with the channel's CV in and used like a quantizer with the note enable/disable page.

Stored Chord Mode:
Each channel's oscillator note interval is determined by a stored chord table. There are 12 slots to store chords and these can be selected with channel B's CV in.

Diatonic Chord Mode:
Each channel's oscillator note interval is determined by the appropriate diatonic triad for whatever the pitch basis is (either Osc In in track mode or CV A in in free mode). The key of the diatonic scale can be selected with channel B's CV in. The key can be minor or major by pressing Option + Octave up or down.

A summary of these modes is provided in the table above.

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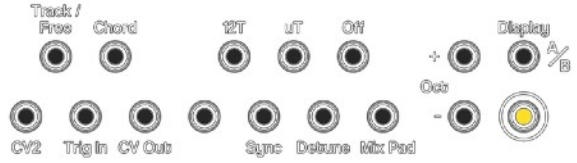
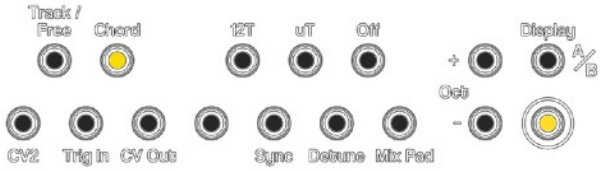
USING H1 - OPTION KEY AND MAIN MODES (NORMAL/CHORD)

At any point while using H1, you can hold the Option button (the one with the circle around it) and see applicable options and modes. Let us start with the primary modes of operation. Holding Option look at the E-flat key (with "chord" above it):

In Normal Mode:



In Stored Chord Mode:



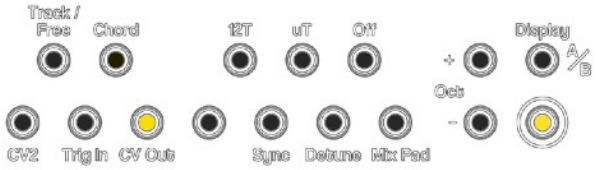
Both modes are fairly similar and differ in this way:

NORMAL MODE: Each channel's base interval is selected with one of the 12 "key" buttons on the first display page ("DISPLAY" is unlit) and this note can be modulated by that channel's CV input and optionally quantized. If it is quantized, the quantize steps can be selected on the second display page ("DISPLAY is lit yellow). Option + A/B toggles display page

CHORD MODE: Both channel's base intervals are displayed and controlled on the first display page and the active chord is displayed on the second display page. There are 12 "slots" to store these "chords" or 2 note combinations in, corresponding to the 12 "key" buttons. Chanel B's CV input is used to select a chord slot using CV and CV2 can be used to transpose the active chord with CV.

<u>Examples of page 1 view in each primary mode:</u>

In Normal Mode:



Active channel's base interval is lit in yellow. In this case it is set to a 3rd or "E"

In Stored Chord Mode:

Channel A's base interval is lit in yellow and Channel B's base interval is lit in white. Active channel is still selected with the A/B button just as in Normal Mode.

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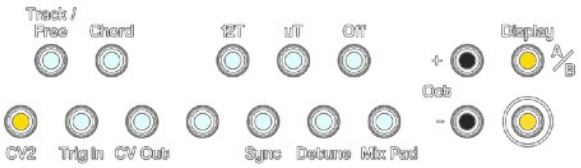
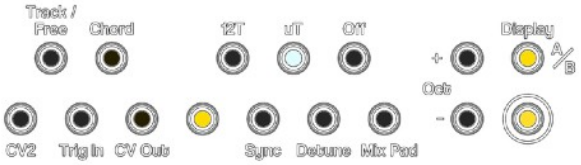
Examples of page 2 view in each primary mode:

In Normal Mode:



The active Chanel's active quantize step is lit in yellow and the enabled quantize steps are lit in white. All steps are enabled in this example.

In Stored Chord Mode:



The base chord slot is lit in yellow (in this case slot 6) and the CV-shifted active chord slot is lit in white (in this case slot 9 or 6 + 3).

When in stored chord mode and in page 2 view as shown above, the base chord slot is selected by pressing a key 1-12. Holding that key for 2 seconds saves that chord to non-volatile memory. The keypad will blink white a few times to signify it has been saved.

DIATONIC CHORD MODE

When holding Option, the CHORD button (E flat) will light up YELLOW instead of yellow if in Diatonic Chord Mode. This mode takes the root input (From either Osc In when in track mode or CV A In when in free mode) and generates the diatonic triad for that note. This is very helpful because all diatonic chords always have the notes of that particular scale in them and thus they never sound musically bad.

On the second page of Diatonic chord mode (Option + Display to toggle pages), the key of the scale is shown. So for example, if "C" is selected on the keypad, and a "C" is provided to Osc In, then H1 will generate an E and a G, because a C major is the first diatonic chord of the C major scale. If a "D" is provided to Osc in with the same scale setting, H1 will generate a D minor (F and A), and so forth.

The key of the diatonic scale can be selected through the keypad on page 2 as described above, and can additionally be selected via CV In B.

Finally, the diatonic chords generated can be of a major or minor scale. Major is selected by pressing Option + Octave Up, and Minor is selected by pressing Options + Octave Down. This can also be selected via CV via CV 2 In (Aux CV In). Any "white key" CV will cause the scale to be major, and any "black key" CV will cause the scale to be minor.

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USING H1 - TRACK MODE AND FREE MODE

Holding Option and pressing C# (Track/Free) button toggles the active channel between track and free mode.

(Blinking White) TRACK MODE means the active channel will set its base frequency to the measured frequency of "Osc In". If the "Osc In" signal is removed, the last measured frequency will simply be held indefinitely. When in page 1 view ("Display" key unlit while holding Option), H1 will display the closest note tracked from "Osc In" on the key pad with a pulsating white/yellow light.

(Solid Yellow) FREE MODE means the active channel will set its base frequency to a C 65.41Hz. So if the unit is in NORMAL MODE and Channel A is selected and it's base interval is set to "C" (first button selected) than that channel will run at 65.41Hz.

If in either of the CHORD MODES, and FREE is selected, Channel A CV In will provide the pitch basis for both channels. That is to say, the root of the chord can be either the pitch of Osc In (Track) or based on CV A In (Free). When in page 1 view ("Display" key unlit while holding Option), H1 will display the applicable note interval derived from the CV input on the key pad with a pulsating white/yellow light.

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USING H1 - QUANTIZING

When in NORMAL MODE, the incoming CV for each channel can be quantized. The three options are 12T, uT, and Off and are selected by holding Option and pressing the applicable button 12T, uT, or Off.

12T: This is normal 12 equally-tempered quantizing, meaning the voltage will be quantized to the steps on a musical keyboard (C, C#, D, etc..). Quantize steps are enabled/disabled by pressing the buttons in page 2 view as shown on the left of this page.

uT: The voltage will be quantized to 24 steps or "micro tuning" intervals. Quantize steps are enabled/disabled in the same way as 12T quantizing, but since there are 24 steps, they are displayed in 2 pages. For micro-tuning quantization, alternate between steps 1-12 and 13-24 by pressing Option + Octave Up.

Off: The voltage will not be quantized at all and trigger in will be ignored. In this mode, a channel in FREE MODE will act just like an a regular analog VCO.

Trig In: Holding option and pressing D (Trig In) toggles trigger in on or off for the active channel. If Trig In is enabled, the quantizer will only change to the next enabled quantize step if a trigger in is seen. This is useful when feeding a random or semi-random voltage like an LFO to the CV In but you would like the notes to only change in sync with your sequencer etc...

CV2: When in NORMAL MODE, the CV2 Input can also be used to transpose the base interval of the selected channel. This feature is toggled on and off by holding Option and pressing C (CV2). H1 always quantizes CV2 to 12TET quantizing. When in CHORD MODE, the CV2 input can be used to transpose the active chord up or down using a CV. It is toggled on or off in the same manner as in NORMAL MODE.

When in CHORD MODE, CV1 is always quantized to 12TET and can be used to select the active chord slot using a CV. CV2 is ignored in CHORD MODE.

USING H1 - SYNC

In either CHORD or NORMAL MODE, each channel's oscillator can be soft-synced (reversing sync) by 2 different source signal options. This is selected by pressing Option + G (Sync). The 3 modes for sync are as follows:

Sync off. No soft sync for this channel.

Channel is sync'd at the frequency of the signal input to "Osc In"

Channel is sync'd at the frequency of the other channel (e.g. Channel A is sync'd at Channel B's frequency).

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USING H1 - DETUNE

Each channel's oscillator can be detuned + or - 1 whole half tone. If detune is disabled, the channel should stay in tune to normal 440Hz A musical tuning to within a cent or 2, but sometimes having a fine tune is called for, especially when using H1 to "double" or "triple" a signal by mixing copies of slightly detuned versions of the original signal together for rich phasing effects. Detune is toggled enabled/ disabled for the active channel by pressing Option + A (Detune):

Detune disabled and detune knob has no effect.

Detune is enabled. Turn the detune knob to control amount. If you have switched active channels and adjusted the knob and then switched channels back again, detune knob is locked until it is moved again. Detune information is stored when unit is power cycled.

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USING H1 - MIX PAD

The Mix output of H1 has a selectable gain of either 1 or -9dB. Turning the -9db "Mix Pad" option on is accomplished by pressing Option + B (Mix Pad):

Mix Pad is disabled and Mix output stage has a gain of 1.

Mix Pad is enabled and Mix output stage has a gain of -9dB.

USING H1 - OCTAVE CONTROL

The octave + and - buttons control the octave for selected channel. When in CHORD MODE, the octave information for that chord is saved with the chord. The LED on the Oct + and Oct - buttons indicate the octave status as follows:

No octave shift for this channel.

Octave shifted by 1.

Octave shifted by 2 or 3.

The octave control has a max adjustment of + or - 3 octaves.

USING H1 - TUNER MODE

H1 also has a tuner mode, which can be accessed by holding Option and pressing the middle of the lower buttons (The "F" key). Once in tuner mode, H1 will show the closest chromatic note that Osc in is tuned to (C, C#, D, etc..) on the keypad, and will show the fine tuning difference on the octave + and octave - keys (where + means sharp, and - means flat).

At tuning errors of 8 cents or more, the octave keys will blink yellow, sharp or flat. As the tuning is improved, the octave keys will blink white, then blink slower white. When the signal present at Osc In is tuned to within 2 cents of the closest chromatic note, both octave keys will light up solid white.

When in tuning mode, H1 will set Channel A and B oscillators to 1Hz so that it is easy to monitor the Osc In signal through the mixer by ear during tuning.

Tuner mode is exited the same way it is entered: Holding Option and hitting the "F" key.

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APPENDIX A: UPDATING FIRMWARE

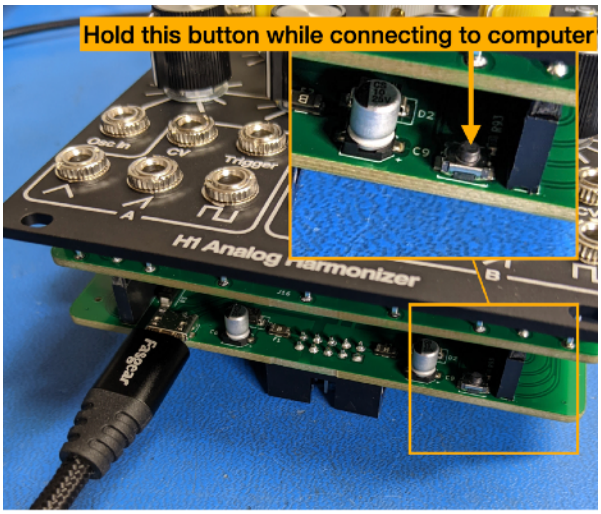
The firmware of H1 can be user updated fairly easily. In the even that a new firmware is available from Weston Precision Audio, the update procedure is as follows:

1) Download the firmware (.UF2) file.

2) Take H1 out of your rack if not already, and make sure it is NOT connected to the ribbon cable from your case or power supply.

3) Connect a USB micro B cable to the USB port on the bottom rear of H1.

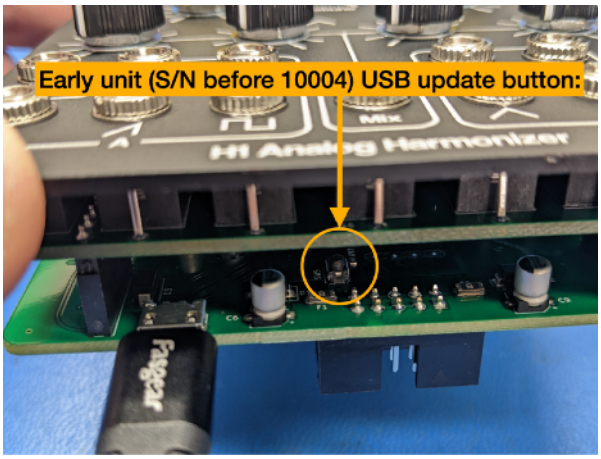
4) While HOLDING the button shown below, connect the other end of the USB cord to your PC or Mac.



5) H1 should show up on your PC or Mac like a thumb drive does, titled "RP2040". Simply drop the downloaded *.UF2 file downloaded from Weston Audio onto "RPI-RP2". FW update is now complete. Disconnect the USB cable and re-rack the module.

FW UPDATE ADDENDUM FOR PRE 10004 SERIAL NUMBERS:

For H1 units with S/N earlier than 10004, the procedure for firmware updating is identical to the one on the left, but the button from step (4) is more inboard and thus must be pressed with a flat, non-conductive tool such as a tongue depressor, plastic pen handle, or popsicle stick. The locating of the pre-10004 S/N unit's button is shown below:



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APPENDIX B: CALIBRATION/ SERVICE MODE

H1 has a hidden calibration mode which, in normal use should not need to be accessed. In the event that this mode should need to be used, however, this section of the manual will explain it.

To enter calibration mode:

Hold OPTION and OCTAVE +, then press "C" (CV2) key.

H1 will blink the OPTION and DISPLAY buttons continuously, indicating that calibration mode has been entered. One of the 5 upper row keys will blink yellow, indicating which calibration sub-mode is active. These modes are summarized in the table to the right.

To switch sub-modes, press OPTION + (one of the 5 upper keys).

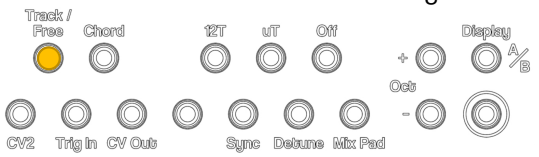
*To exit calibration mode without saving any changes: power down the module

*To exit calibration mode WITH saving all changes: Hold OPTION and "C#" (TRACK/FREE), then press "Eb" (CHORD). H1 will rapidly flash all of the main keys white for a few seconds to indicate the calibration changes were made.

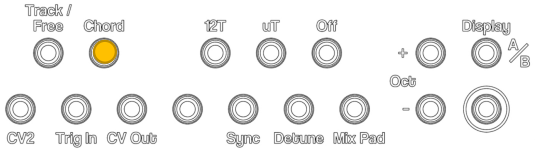
The following pages will explain each calibration sub-mode.

CALIBRATION SUB-MODES (YELLOW LIGHT SHOWN WILL BLINK)

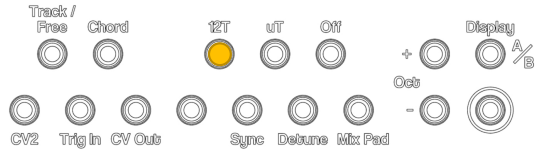
Oscillator DAC Calibration Low Range



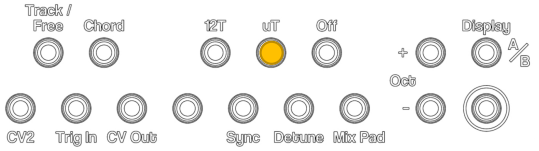
Oscillator DAC Calibration High Range



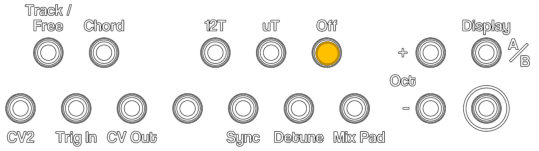
CV DAC Calibration



ADC Scale/Offset Calibration



Detune Pot Center Calibration



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CALIBRATION MODE: OSCILLATOR DAC SUB-MODE

This calibration normally won't need to be used. It is used to calibrate the linearity tables for the DACs which feed each oscillator.

*make sure the unit has warmed up for at least 15 minutes before adjusting any calibrations.

While this mode is active, H1 will output precise test frequency square waves on the TRIG OUT A output, and each oscillator will attempt to run at these frequencies. Each mode (LOW RANGE, and HIGH RANGE) has 12 test frequencies and they are selected by pressing one of the 12 main keys on the key pad. The frequencies are as follows:

LOW RANGE: 10Hz, 20Hz, 35Hz, 60Hz, 90Hz, 130Hz, 170Hz, 225Hz, 285Hz, 350Hz, 420Hz, 500Hz

HIGH RANGE: 501Hz, 1kHz, 1.5kHz, 2kHz, 2.7kHz, 3.7kHz, 4.7kHz, 6kHz, 7kHz, 8kHz, 9kHz, 10kHz

To adjust any of the calibration table points, simply monitor the desired oscillator triangle output (A or B) and TRIG OUT A with a 2 channel oscilloscope. Then make sure the oscillator channel you want to adjust is active (A/B) by looking at the LED and press OCTAVE + or OCTAVE - to increment or decrement that step's DAC setting until the 2 signals match frequency as close as possible. Holding OPTION + OCTAVE + or - will jump 10 steps instead of 1.

WHEN FINISHED ADJUSTING THIS OR ANY CALIBRATION SUB-MODE:

*To exit calibration mode without saving any changes: power down the module

*To exit calibration mode WITH saving all changes: Hold OPTION and "C#" (TRACK/FREE), then press "Eb" (CHORD). H1 will rapidly flash all of the main keys white for a few seconds to indicate the calibration changes were made.

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CALIBRATION MODE: CV DAC CALIBRATION

This calibration mode is used to adjust the linearity tables for the 2 CV outputs (Channel A and B).

*make sure the unit has warmed up for at least 15 minutes before adjusting any calibrations.

While this sub-mode is active, each CV out will output the current table entry's voltage. These values are:

-8.0V, -7.0V, -6.0V, -5.0V, -4.0V, -3.0V, -2.0V, -1.0V, 0.0V, 1.0V, 2.0V, 3.0V, 4.0V, 5.0V, 6.0V, 7.0V, 8.0V

To go to the next higher table entry, press "Bb" (MIX PAD), and to go to the next lower table entry, press "C" (CV2).

To change the active CV output's table being adjusted, toggle channels A/B with the Display/ A/B key just the same way as in normal use.

Then, simply monitor the CV out to be adjusted with a high-accuracy DMM, and NO OTHER PATCH CORDS CONNECTED TO H1 and press OCTAVE + or OCTAVE - to raise or lower the current table entry's DAC count value to get the output's voltage as close as possible to the nominal value (-8.0V, -7.0V, etc..). Just as in the the oscillator DAC cal, holding OPTION and OCTAVE + or OCTAVE - jumps 10 DAC counts instead of 1.

WHEN FINISHED ADJUSTING THIS OR ANY CALIBRATION SUB-MODE:

*To exit calibration mode without saving any changes: power down the module

*To exit calibration mode WITH saving all changes: Hold OPTION and "C#" (TRACK/FREE), then press "Eb" (CHORD). H1 will rapidly flash all of the main keys white for a few seconds to indicate the calibration changes were made.

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CALIBRATION MODE: ADC SCALE/ OFFSET CALIBATION

This calibration mode is used to adjust the scale and offset of each of the 3 analog inputs (Channel A CV In, Channel B CV In, and CV2 Input (Aux CV).

The A/B key will cycle through the 3 CV inputs in this mode (CVA -> CVB -> CV2 (Aux CV)) and indicated by the OSC SELECT LEDs. CV2 (Aux CV) is indicated active when BOTH LEDs are lit.

*make sure the unit has warmed up for at least 15 minutes before adjusting any calibrations.

First, make sure channel A is active (A LED is lit)

(1) (Offset) Plug the output of the channel A triangle wave into an accurate tuner. Connect your MIDI to CV device that will be used with H1 to the CV input for channel A being measured/calibrated and set to exactly 0.000V. Channel A oscillator output should be at a 32.7Hz C. If not, use "Bb" (MIX PAD) and "C" (CV2) keys to increment and decrement the ADC A offset until it's as close as possible to 32.7Hz C. It should be within 1 or 2 cents.

(2) (Scale) Now make your MIDI to CV device output a note 5 octaves up from the last step (so, 5.000 Volts). Adjust the ADC A scale for this channel with the OCTAVE + and OCTAVE - keys until tuning to a C 1046Hz is achieved. Again it should be within 1 or 2 cents.

(3) Repeat (1)(Offset) and (1)(Scale) steps until both criteria are satisfied for channel A.

(4) Repeat steps 1-3 but for channel B. So measure triangle output from channel B and connect CV source into channel B CV in. Make sure channel B is active (B LED is lit)

(5) Make sure CV2 (Aux CV) is active (both LEDs are lit) and then repeat steps 1-3 but for CV2 (Aux CV), and using 4.000V instead of 5V (since this input has a max range of -5V to +5V). In this step you will monitor the triangle output of oscillator A.

WHEN FINISHED ADJUSTING THIS OR ANY CALIBRATION SUB-MODE:

*To exit calibration mode without saving any changes: power down the module

*To exit calibration mode WITH saving all changes: Hold OPTION and "C#" (TRACK/FREE), then press "Eb" (CHORD). H1 will rapidly flash all of the main keys white for a few seconds to indicate the calibration changes were made.

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REVISION HISTORY

04: Added section explaining calibration /service mode.
03: Updated description of new key illumination for track and free, and detune behavior/key illumination based on v1.0.7 FW update.
02: Corrected description of boot mount device in FW update procedure. Removed incorrect line about CVB input not used in chord modes.
01: Initial release.

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