MULTI - DIMENSIONAL EFFECTS CHAIN PROCESSOR

ENDORPHINES × ANDREW HUANG

GHOST
P E D A L

VOLUME /crush* DELAY /tone* REVERB /tone* FILTER /reso* DISTORT /tone* MIX /cabinet*

lp   hp   dry   wet

5/4 x1 3/4
3/2   1/2
3/4   1/3
x2   1/4

env.

TIME /midi clk* REPEATS /taps* DECAY /predelay* SHAPE /midi ch* SPEED /midi clk* MODULATION /exp*

hall/shim   lp/hp   dist · filter · fx   filter · fx · dist
reverse   bp   dist · fx · filter   fx · dist · filter
spring   comb   filter · dist · fx   fx · filter · dist

REVERB /filter*   ROUTING /midi dump*   SHIFT /*

ENDORPHINES ×
ANDREW HUANG

24BIT 96KHZ
GHOST
PEDAL

TAP /assign*   BYPASS /preset load ←   hold to save/ PRESET

CONTENT

WARRANTY

1-year warranty is guaranteed from the product's purchase date in case of any manufacturing errors or other functional deficiencies during runtime.

The warranty does not apply in case of:

→ damage caused by misuse

→ mechanical damage arising from careless treatment (dropping, vigorous shaking, mishandling, etc.)

→ damage caused by liquids or powders penetrating the device

→ heat damage caused by overexposure to sunlight or heating

→ electric damage caused by improper connecting

The warranty covers replacement or repair, as decided by us. Please contact us via email for a return authorization before sending anything. Shipping costs of sending a module back for servicing is paid by the customer.

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https://www.modulargrid.net/e/modules/browser/vendor:167

For technical requests: **support@endorphin.es**

For dealer / marketing inquiries: **info@endorphin.es**

ENDORPHIN.ES is a registered trademark.

It is doing business as FURTH BARCELONA, S. L. (EU VAT ID: ES B66836487).

INTRO

From earth shaking subharmonics and distorted drones, to angelic shimmer reverbs and anything in-between, GHOST is a pedal for the adventurous sound designers and the most demanding guitar and synth players. Immerse yourself and go beyond the boundaries of what is possible with a conventional guitar or synth pedal.

GHOST PEDAL brings you new possibilities of tone shaping with its state of the art flexible audio routing chain, allowing you to jump between dimensions with a single press of a button. An intuitive UI coupled with hands-on control and preset storage allows you to stay in the now and focus on your performance.
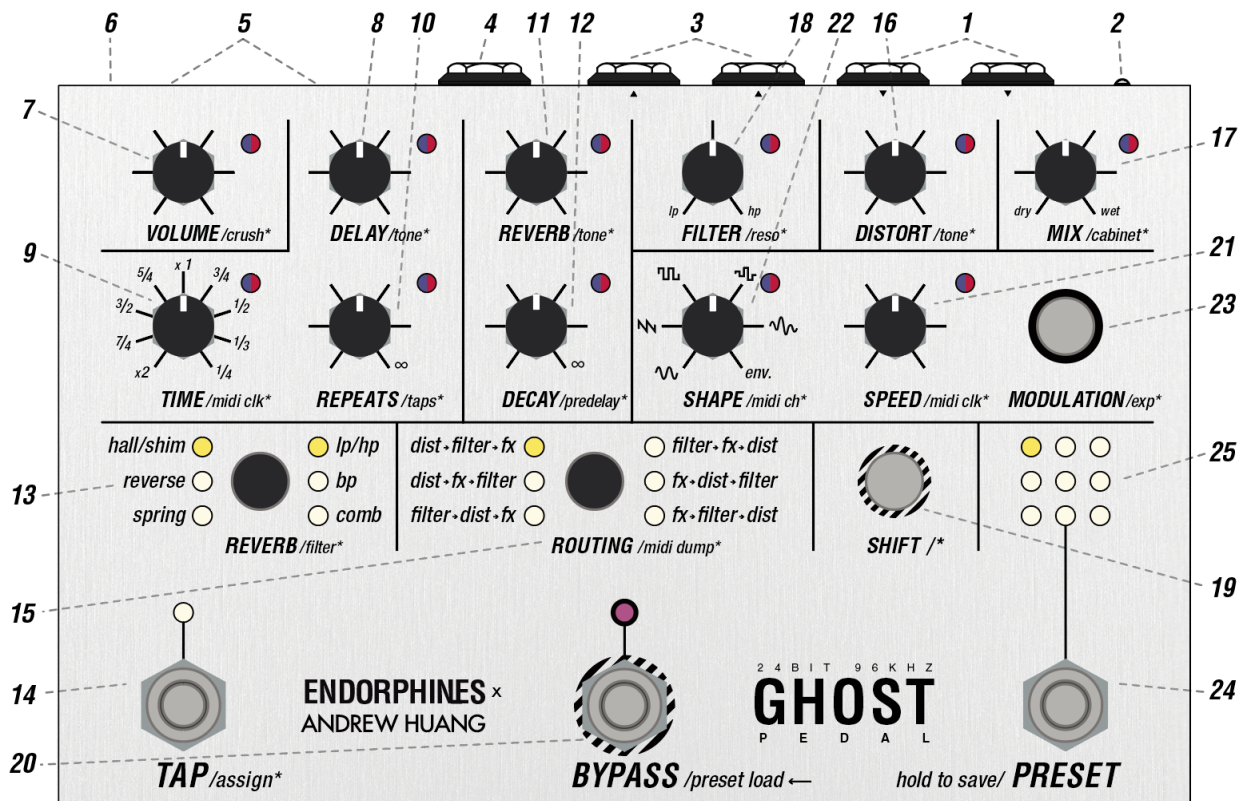
CONNECTING THE POWER

Use a quality 9V 'Boss'-standard center negative power adapter, typically 500mA. However the unit may be powered from any 9 to 18V center-positive or center-negative DC plugs (full protection). Power supply not included.
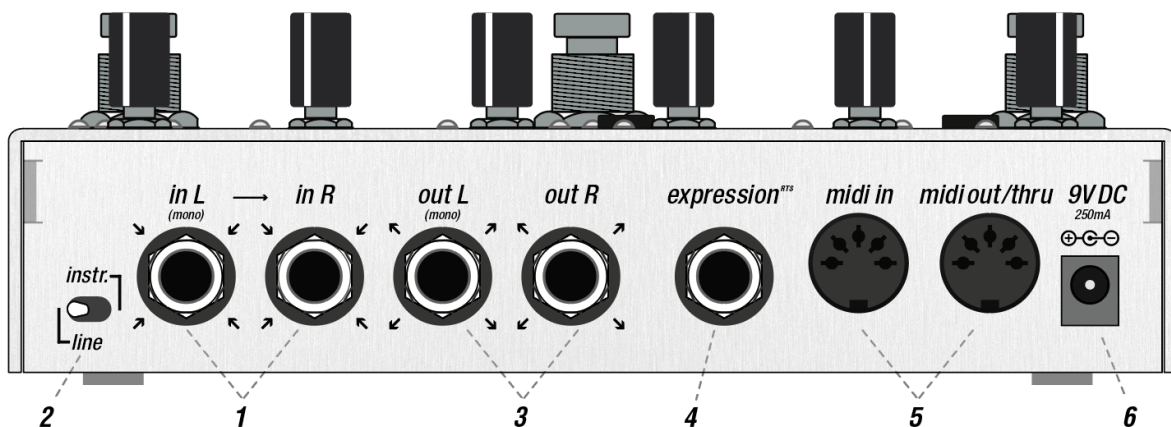
TECHNICAL SPECIFICATIONS

→ Audio input impedance: 100 kΩ (line) / 1 MΩ (instrument)

→ Audio output impedance: 100 Ω

→ Audio input range: up to +12 dBV, instrument amplification +11dB

→ Audio connectors: 1/4 or 6.35mm TS unbalanced, MIDI connectors: DIN-5, power connector: 2.1mm tip / 5.5mm barrel DC jack

→ Bypass options: true-stereo on electromechanical relays, buffered, trails

→ Audio I/O: 24 bit, 96 kHz with 32 bit floating point internal processing

→ Current draw: 250 mA minimum, 9V (adapter not included)

→ Pedal dimensions: 186 mm x 118 mm x 60 mm (7.3″ x 4.6″ x 2.4″)

→ Box dimensions: 190 mm x 125 x 65 mm (7.5″ x 4.9″ x 2.6″)

→ Weight: pedal only: 640 gram / 1.4 lbs; incl. box & packaging: 800 gram / 1.76 lbs

INTERFACE – FRONT PANEL

6 5 8 10 4 11 12 3 18 22 16 1 2

7

VOLUME /crush*   DELAY /tone*   REVERB /tone*   FILTER /reso*   DISTORT /tone*   MIX /cabinet*

lp   hp   dry   wet

17

9

5/4 x 1 3/4
3/2   1/2
7/4   1/3
x2   1/4

TIME /midi clk*   REPEATS /taps*   DECAY /predelay*   SHAPE /midi ch*   SPEED /midi clk*   MODULATION /exp*

env.

21

23

hall/shim   lp/hp   dist→filter→fx   filter→fx→dist
reverse   bp   dist→fx→filter   fx→dist→filter
spring   comb   filter→dist→fx   fx→filter→dist

REVERB /filter*   ROUTING /midi dump*   SHIFT /*

25

13

15

14

ENDORPHINES ×
ANDREW HUANG

24BIT 96KHZ
GHOST
PEDAL

24

20

TAP /assign*   BYPASS /preset load ←   hold to save/ PRESET

INTERFACE – REAR SIDE

instr.
line

in L → in R   out L   out R   expression^RTS   midi in   midi out/thru   9V DC
(mono)   (mono)   250mA

2   1   3   4   5   6

1. ***IN LEFT (MONO), IN RIGHT JACKS:*** line level or high impedance stereo audio inputs, *INPUT LEFT – is normalled*, i.e. pre-routed → to *INPUT RIGHT* when no audio cable is plugged into *IN R jack*. Accept standard unbalanced TS instrument 1/4″cables, guitar or line levels (up to 12dBV or +/-2V) with soft clipping introduced with higher audio amplitudes.

2. ***LINE / INSTRUMENT AMPLIFICATION SWITCH:*** select audio input amplification: line level (to the left, no amplification) or guitar level (to the right, +11 db or approx. 3.5x gain amplification) to have enough guitar signal.

3. ***OUT LEFT (MONO), OUT RIGHT JACKS:*** final stereo audio outputs, accept standard unbalanced TS instrument 1/4″ cables.

4. ***EXPRESSION PEDAL JACK:*** assignable expression pedal input. Accepts standard RTS expression pedal, +5V supplied from the ring. Expression pedal morphing macro settings are saved for each of the nine presets separately. For more details on how to assign the expression pedal jack check *EXPRESSION PEDAL ASSIGNMENT* section below.

5. ***MIDI IN / MIDI OUT CONNECTORS:*** are standard *DIN-5* **MIDI** input and output connectors. *MIDI IN* accepts a list of *CC* values (see MIDI implementation chart at the end of the manual) on the configured receiving MIDI channel and MIDI clock. *MIDI OUT* can act as a MIDI THRU or generate *CC* messages and MIDI clock on knob's movement.

6. ***DC IN JACK:*** 2.1mm/5.5mm connector for the power adapter – typical Boss® standard, 500mA, +9V, center negative. This jack has internal reverse protection and voltage rectification therefore accepts any DC adapter of 9 to 15 volts of any polarity – center positive or center negative.

7. ***VOLUME/CRUSH* KNOB with LED:*** controls the final output volume (this amount is shown with the brightness of the blue LED brightness: fully lit shows 100% volume (by default) and fully off - silence). Secondary ***/CRUSH**** function (pressing or holding **SHIFT** while turning the knob) enables the **BITCRUSHER**, or in other words: lowers the **SAMPLE RATE** amount out of the *FILTER* chain: full 96 kHz at CCW and crushing to a certain moment until the audio falls down to noise. The amount of *bitcrushing* is shown with the brightness of the red LED. When turning this feature, it radically brings aliasing to the audio signal – use on your own discretion to creatively add lo-fi flavor. Bitcrusher always stands after the distortion (16) with cabinet simulator (17*) stages in every routing.

8. ***DELAY KNOB with LED:*** controls the *DRY/WET MIX OF THE DELAY* effect (that amount is shown with the brightness of the blue LED brightness). Secondary ***/TONE**** function (pressing or holding **SHIFT** while turning the knob) adjusts the tilt EQ after the WET output of the delay chain (the amount is shown with brightness of the red LED), which is useful to enhance the delays or for dub-delays.

9. **TIME/DIV KNOB with LED:** controls the delay time, from short audio rate repeats CCW and longer taps CW as a primary parameter (the amount is shown with the brightness of the blue LED). Secondary **/MIDI CLOCK*** function (pressing or holding **SHIFT** while turning the knob from noon CW) enables the delay to be synchronized to an external MIDI clock received at the *MIDI IN* connector (5). While the external clock is enabled, *TIME*/**DIV** knob acts as a divider / multiplier for the clock with the dividers written around the knob on the panel and LED flashes red according to the external clock speed.

10. **REPEATS/TAPS* KNOB with LED:** controls the *REPEATS* or *FEEDBACK* level of the delay (this amount is shown with the brightness of the blue LED). Turn it fully CW for self-oscillation. Secondary **/TAPS*** function (pressing or holding **SHIFT** while turning the knob in 3 sectors from CCW to 11 o'clock, 11 to 14 o'clock and 14 to full CW shown with brightness of the red LED) changes the stereo behavior of the taps produced by the delay (see DELAY section below).

11. **REVERB KNOB with LED:** controls the *REVERB DRY/WET MIX* level (that amount is shown with the brightness of the blue LED). Secondary **/TONE*** function (pressing or holding **SHIFT** while turning that knob) adjusts the tilt EQ before the reverb tank (the amount is shown with the brightness of the red LED) which is useful to get rid of the boomy low-end

12. **DECAY/PREDELAY* KNOB with LED:** primary function controls the decay of the *REVERB's TAIL* (that amount is shown with the brightness of the blue LED). Secondary function in combination with the **SHIFT** button controls the *AMOUNT OF PRE-DELAY* - time of the beginning of the first reflections of the reverb (the amount is shown with the brightness of the red LED). Amount of pre-delay may be perceived as the apparent size of our 'space'.

13. **REVERB TYPE / /FILTER* BUTTON:** primary function selects the reverb algorithm between: hall with shimmer, reverse and spring reverbs. Secondary function in combination with the **SHIFT** button switches the filter algorithms: bipolar SVF LP/HP, BANDPASS or COMB filter. Selected reverb and filter types shown with the columns of LEDs.

14. **TAP/ASSIGN* FOOTSWITCH with LED:** multi-function foot switch, can be assigned to various controls via **SHIFT+TAP** combination. By default assigned to the TAP tempo of the DELAY and **white** TAP LED blinks according to the delay clock. For more details on modes see the *TAP FOOTSWITCH ASSIGNMENT* section below.

15. **ROUTING BUTTON:** routing chain switching. Each press cycles through six different orders of audio effects (see *DISTORTED REALITY* paragraph below).

16.   DISTORTION KNOB with LED: control over the distortion amount (shown with the brightness of the blue LED). Secondary function in combination with the **SHIFT** button controls the amount of treble content after the distortion output. Acts as a 6db/oct *TILT EQ* for low and high frequencies: clean in the middle (default value), CCW settings being darker and higher CW settings being brighter (this amount is shown with the brightness of the red LED).

17.   MIX/CABINET* KNOB: primary function controls the *GLOBAL DRY/WET MIX* between the clean input at full CCW and the final processed audio chain output before the *VOLUME KNOB* (7) at full CW (this amount is shown with the brightness of the blue LED). Secondary function in combination with the **SHIFT** button controls the amount of **SPEAKER CABINET (or COMBO-) SIMULATOR** applied from clean audio path at CCW to full at CW (amount is shown with the brightness of the red LED). Cabinet simulator has a set of filters to quickly sculpt a distorted tone signal from your guitar without the need for extra amps or pedals. Cabinet simulator always stands after the distortion stage (16) before the bitcrusher stage (7*) in every routing.

18.   FILTER/RESONANCE* KNOB: primary function controls the *FILTER CUTOFF FREQUENCY* (the amount is shown with the brightness of the blue LED). Secondary function in combination with the **SHIFT** button controls the *RESONANCE* of the filter (the amount is shown with the brightness of the red LED). When the BAND-PASS filter is selected (13), this knob defines the width of the band. In *COMB FILTER* mode the resonance knob is bipolar and defines the feedback, adding negative (to CCW) and positive (CW) combs and at maximum side CW/CCW values enables the resonator.

19.   SHIFT /* BUTTON with LED: adjusts secondary parameters while held down and when using other controls (shift functions are labeled with asterisk **/…*** on the panel). When the shift is enabled, its **white** LED is on and you may see all the LEDs near the knobs switch from blue to red, showing visually the amount of secondary parameters with their brightness and allowing you to edit them (or assign modulation as well!). *SHIFT* button has an additional latched action, so you may press it once to leave enabled and adjust other parameters while operating with one hand only, however, some rarely used settings like bypass types or tap assignments require the *SHIFT* button to be held. After you press and hold *SHIFT*, tweak some parameters and release the button - it turns that button action off.

20.   BYPASS /PRESET LOAD FOOTSWITCH: is essentially a **BYPASS /** enable / activate effect / on footswitch. Each consequent press enables and disables the whole effects chain. When the effects chain is enabled, the pink **LED** near that footswitch is ON. When the effect chain is bypassed, the LED is off and also all the remaining LEDs except the preset selection LEDs are dimmed. Additionally is used to confirm the load of the newly selected preset with *PRESET* (24) footswitch.

21. **SPEED** */MIDI CLOCK* **KNOB with LED:** controls the frequency time (speed) of internal *LOW FREQUENCY OSCILLATOR* or **LFO** from *0.04 Hz* (25 seconds per cycle) at CCW to *15 Hz* (0.0666 seconds per cycle) at CW as a primary parameter. LED flashes in red LED according to internal LFO clock. Secondary */MIDI CLOCK* function (pressing or holding **SHIFT** while turning this knob from noon CW) enables the LFO SYNCHRONIZATION to an external MIDI clock received at *MIDI IN* connector (5). In the external clock mode this knob acts as a divider / multiplier for the clock with the divisors similar to values around the *TIME/DIV* knob (9) and LED flashes blue according to the external MIDI clock speed.

22. **LFO SHAPE** */MIDI CHANNEL* **KNOB with LED:** gradually selects the LFO shape from the list below (the amount shown with the brightness of the red LED). Secondary */MIDI CH* function (pressing or holding **SHIFT** while turning this knob in 17 sectors from CCW to CW) changes the MIDI channel from OMNI, then 1st to 16th channels from which the pedal will receive and send the MIDI data on. OMNI setting means the pedal will accept CC messages from all MIDI channels.

23. **MODULATION** */EXPRESSION* **BUTTON with LED:** used to assign LFO (22) and expression pedal (4). While holding this button (it will light up) tweak any of the knobs. The amount by which you tweak this knob from center position to the sides while holding the *MODULATION* button sets the depth of the selected LFO (22), which will be applied to the assigned parameter. Secondary combination of *SHIFT + MODULATION* will set the expression pedal (4) morphing (see 4. *EXPRESSION PEDAL ASSIGNMENT* below for assigning procedure). Same as *SHIFT* (19), *MODULATION* button has an additional latched action, so you may press it once to leave enabled and adjust other parameters while operating with one hand only. After you press and hold *MODULATION*, add some parameters modulations and release the button - it turns that button action off.

24. **PRESET** */HOLD TO SAVE* **FOOTSWITCH:** selects one of 9 presets (25). Once you select the preset, its LED starts to blink. To load that preset you have to confirm it with the BYPASS footswitch (20). Loading the presets will not alter current bypass effect state on or off.

To save the preset you have to hold the **PRESET** footswitch for longer than 3 seconds. One of the 9 slots will start to blink and you may choose the new slot to save by pressing the *PRESET* footswitch a few times. To confirm the preset save in the selected slot press and hold *PRESET* (20) footswitch for longer than 3 seconds.

➜ when **SHIFT** button is enabled, pressing the *PRESET* (20) footswitch will select the presets in the reverse direction.

25. **9 PRESET LEDS:** nine **white** LEDs show the currently selected preset slot and blink when you select the new one without activating it yet.

EFFECT TECHNIQUES QUICKSTART

The fastest way to check the effects palette in the GHOST Pedal is to go through the factory presets by selecting them with the PRESET footswitch and confirming the load with BYPASS footswitch.

You can also create effects very fast and intuitively with the GHOST Pedal yourself. For instant sound design from scratch press and hold four buttons for 2 seconds to obtain an *init* patch. Techniques below will explain how to tweak popular sounds each obtained from that clean init state.

CLASSIC GUITAR OVERDRIVE

To achieve a typical guitar distortion/overdrive effect, adjust the *DISTORTION* knob to around 80% and enable the cabinet simulator by pressing the *SHIFT* button and turning the *MIX* knob to approximately 80-90%.

BIG SHIMMER REVERB

GHOST Pedal has 2 types of shimmer reverbs that can be used to create lush ambient soundscapes.

Select the *HALL/SHIMM.* reverb algorithm and set the *REVERB* beyond the 12:00 position. Once the 13:00 point is crossed you will start hearing a hall shimmer reverb that gets more intense as you move the DRY/WET knob towards the fully CW position, adjusting the *DECAY* to taste. By selecting the 3rd TAP footswitch mode by pressing SHIFT + TAP until the TAP LED blinks 3 times, the reverb can be frozen to infinity for additional texture.

Select the *REVERSE* reverb and set the *TAP* footswitch to mode 3. Once the *TAP* footswitch is pressed a shimmer effect will be added to the Reverse reverb.

LO-FI TAPE A.K.A. 'SHALLOW WATER'

Low-fidelity effects are generally associated with instability in pitch and have a darker / corrupted frequency content that can be achieved by using filters, distortion and sample rate reducers. GHOST Pedal allows you to achieve all of these characters in a variety of forms, below you will find a list of techniques that can be used to achieve a lo-fi sound:

➜ Pitch warble: select a fluctuating random *LFO SHAPE* with low or medium *LFO SPEED*. Adjust the *DELAY* to around 40-50% with delay time set to 9:00, set delay *REPEATS* anywhere between 7:00 and 12:00. Map LFO to delay *TIME* by pressing the *MODULATION* button and turn the delay *TIME* knob from the 12:00 position to approximately 12:30 (small modulation usually works best).

➜ Frequency spectrum effects: by adding *DISTORTION* you can warm up the sound and make it more tape-like when used with the pitch warble effect above, for this purpose keep distortion effect before the delay in the signal chain. Additional low

pass filtering can make your sound darker, adjust the *FILTER* cutoff to taste. If you desire to break the sound even more, try adding a bitcrusher effect by pressing the *SHIFT* button and turning the *VOLUME/crush** knob clockwise.

WAH-WAH

Wah-wah effects are fun to explore if you want to make your guitar sound more like a synthesizer. This can be achieved by selecting the **env.** - envelope follower *LFO SHAPE*. Map the LFO to the *FILTER* cutoff by pressing the *MODULATION* button and turn the *FILTER* knob clockwise from the center 12:00 position to approximately 14:00-15:00. Set the filter */RESONANCE** to taste by pressing the *SHIFT* button and turning the *FILTER* knob. Play some short notes and adjust the *FILTER* knob to desired position until you hear the filter modulation. If you want a low pass filter wah-wah set it fully CCW and if you want a more high pass filter feel set it to approximately 12:00. Use the *LFO SPEED* knob so set the sensitivity of the envelope follower: from slow at fully CCW position to fast and snappy at fully CW position. By mapping an expression pedal to the *FILTER* cutoff can give you more control over the cutoff point.

ROBOT VOICE

You can achieve a robotic vowel synthesis effect by adding bitcrusher effect to the wah-wah configuration above. Since the bitcrusher is part of the Distortion effect make sure that *DISTORTION* comes after the *FILTER* in the selected *ROUTING* configuration. Add bitcrusher by pressing *SHIFT* and turning the *VOLUME* knob. Set the filter resonance to at least 50% to create resonance peaks, which are essential when dealing with vowel synthesis.

DUB ECHO

To achieve a dub-style echo effect, turn the *DELAY* to taste and apply a low pass filter to the delayed signal by adjusting the Delay */TONE** control by pressing *SHIFT* and turning the *DELAY* CCW from the center position. Tweak the main *FILTER* cutoff to add even more variation to the input signal or alternatively map a random *LFO SHAPE* to the *FILTER* cutoff to free up your hands.

EXPERIMENTAL DELAY FREEZE

One way to create strange delays on the GHOST Pedal is to enable the delay *LOOPER* by setting the *TAP* footswitch to mode 2 by pressing *SHIFT + TAP* until the *TAP* LED blinks twice. Apply *stepped random LFO SHAPE* to delay *TIME* to taste and play some notes into the pedal while pressing the *TAP* button. This will result in a randomly modulated delay looper buffer that can create a strange and beautiful bubble-like texture which usually works best with shorter notes.

QUANTISED LOOPER

Set the *TAP* footswitch to enable the delay LOOPER - mode 2. Press the *SHIFT* button and turn Delay *TIME* knob clockwise (delay TIME LED will turn blue) to

enable MIDI clock sync of the delay time. Send a MIDI clock signal to the MIDI input and play some audio while pressing the *TAP* button. The length of the looper can be adjusted in subdivisions or multiplications of the tempo by turning the Delay *TIME* knob. By applying a random LFO to Delay *TIME* the looper can turn into an interesting glitch and stutter effect.

VISUALIZING THE REAL TIME VALUES

You may notice each knob has an LED next to it which can become of different brightness of blue, red or a mixture of both colors - fuchsia.

When you change the preset or apply modulation you may see those LEDs will change their brightness or will be *breathing*. Those are real time parameter's change visualization while the physical knobs remain motionless.

Since each knob may set various parameters: primary, secondary and modulation depth, the current physical knob position may not always reflect its real parameter value. That's where the LEDs come to help.

Primary parameters are written in capitals: *VOLUME, DELAY, TIME, REPEATS, REVERB, DECAY, FILTER, DISTORTION* and *MIX* are shown with the brightness of the blue LED.

Secondary parameters are labeled with an asterisk */…** next to the primary parameter: */crush*, /midi clk*, /tone*, /taps*, /predelay*, /reso*, /midi ch*, /cabinet**. They and are set in combination with the *SHIFT /** button and are shown with the brightness of the red LED.

Some parameters have a *bipolar nature* with an important center position: *LP/HP FILTER* and all */tone** controls of the *DELAY*, *REVERB* and *DISTORTION* pass clear unaffected sound when they are in the center position. The LED becomes fuchsia when that certain parameter stands exactly in or crosses the center value.

Also some parameters have *discrete values*: i.e. not a continuous change but a selection of a few parameters placed around the knob moving range: */midi clk*, /taps*, /midi ch*, /midi clk**. You will see LED shortly blinking fuchsia when we move to the next settings from the list.

DISTORTED REALITY

The power of the **GHOST PEDAL** lies in its stereo complex audio effect chain with 96kHz, 32-bit internal audio processing, consisting of 8x oversampled **distortion** algorithm with **cabinet simulator** and **bitcrusher**, a multimode **filter**, **delay**, **reverb** and a modulator - **LFO**. All the knobs positions and settings can be saved and recalled from 9 presets slots. The order of the three main processing blocks - *DELAY/REVERB, VCF,* and *DISTORTION* - can be changed by pressing the *ROUTING* button (15), letting you instantly achieve different flavors of sound.

There are six all possible orders for the *DELAY+REVERB **(FX)**, DISTORTION+CABINET SIM+BITCRUSHER **(DISTOTION)** and *VCF **(FILTER)** blocks:

1. DISTORTION➟FILTER➟FX   **4. FILTER➟FX➟DISTORTION**

2. DISTORTION➟FX➟FILTER   **5. FX➟DISTORTION➟FILTER**

3. FILTER➟DISTORTION➟FX   **6. FX➟FILTER➟DISTORTION**

The selected order is shown by the **white** LED (15) near the selected option.

➜ **HINT**: *experiment with the audio chain order to fit your needs and find new and unexpected sounds with a push of a button.*

We advise exploring the routing chains and picking your favorite based on each situation.

LO-FI

One of the ways to lower audio fidelity is to use the onboard bitcrusher effect. It radically brings aliasing to the audio path the more we turn it up – use on your own discretion creatively to add lofi flavor.

Bitcrusher can be accessed by holding the SHIFT button and turning the VOLUME KNOB (7). From full 96 kHz at CCW and crushing to a certain moment until the audio falls apart to noisy clicks and buzzes. Default value is at CCW (clean signal). The bitcrusher is placed after the distortion (16) with cabinet simulator (17*) stages. Bitcrusher allows to obtain interesting vowel sounds in ROUTING (15) types when distortion is placed after the filter: modulating the filter cutoff with high resonance and applying the bitcrusher effect after.

➜ **HINT:** another trick to to add lo-fi flavor to your audio is to slowly modulate the time of the *DELAY* (9) with *fluctuating random LFO* (22). That will create a flutter effect simulating a wobbly tape playback.

THREE FLAVORS OF FILTER

To switch the filter type you simply press the ***SHIFT + REVERB** /FILTER** button (13).

There are three filter types to choose with:

➜ Bipolar **LP-HP** zero-delay feedback *12db/oct* state-variable filter aka *isolator:* opens from LP silence at CCW to clean unprocessed sound at noon and closes smoothly in HP silence at CW

➜ **BAND-PASS** *12db/oct* state-variable bypass filter (*BPF*) with resonance control setting the band-width

➜ **COMB** filter with resonator at high resonance settings. Creates *phaser*-alike effects especially when slightly modulated.

Comb filter is capable of self-oscillation at full CW or CCW *RESONANCE* settings. */RESONANCE** knob (18*) behavior in Comb filter is special: it is bipolar, so from noon (zero resonance) it either adds negative (CCW) or positive combs (CW).

SPATIAL EFFECTS

This chain of audio effects *(a.k.a. **FX**)* consists of a delay which is then routed into the reverb with mid/side widener.

DELAY

The delay can be synchronized externally via *MIDI CLOCK* applied from *MIDI IN CONNECTOR* (5), or by using the onboard *TAP TEMPO footswitch* (14), with maximum delay time of 2,5 seconds. Three configurations of delay taps are available, toggled between by holding the **SHIFT + REPEATS**/*TAPS** knob. Delay tap configurations are *RLRL, LRRL,* and *STEREO* mode – also known as true stereo, where taps will appear at *OUT 1 or OUT 2* only if something is present at *IN 1* or *IN 2* respectively. Delay can be looped by infinitely recirculating its audio buffer by setting the *TAP* (14) footswitch to mode 2. Secondary */TAPS** function (pressing or holding **SHIFT** while turning the knob in 3 sectors from CCW to 11 o'clock, 11 to 14 o'clock and 14 to full CW shown with brightness of the red LED) changes the stereo behavior of the taps produced by the delay. Available delay tap configurations are:

➜ **RLRL:** left and right summed aka Ping Pong, taps 2 and 4 hard-panned left, taps 1 and 3 hard panned right (LED in red, but fully off, is a default taps mode). In that mode *LEFT OUTPUT JACK* (3) is a true mono output.

➜ **LRRL:** left and right summed, their taps 1 and 4 hard-panned left, taps 2 and 3 hard panned right (LED in red semi-on)

➜ **STEREO:** left and right inputs tap independently in their corresponding left and right outputs. In this mode the total delay time is halved (LED in red fully on).

BUFFER CLEAR. When using long delay times it may be desirable to clear the delay buffer in order to quickly introduce new audio material into the delay line. To do so, turn both the *DELAY* (8) and *REPEATS* (10) knobs to their full CCW positions to delete the buffer content.

LOOPER. When *TAP* footswitch (14) is assigned for delay *'freeze'* (see *TAP FOOTSWITCH ASSIGNMENT* below), it activates and deactivates delay *LOOPER* - i.e. infinitely recirculating delay's audio buffer. When the looper is enabled, incoming into delay *dry* audio signal is turned off enabling the looped part to be played purely. You may still blend a clean signal to it with a *MIX* knob (17).

➜ *NOTE:* Tap tempo via the *TAP* footswitch (14) doesn't work if an external MIDI clock is applied.

REVERB

There are three very different reverb algorithms:

➜ Lush stereo **HALL REVERB** that adds shimmer after the Dry/Wet control is turned beyond 60%. Additional controls such as *TONE* and *PREDELAY* (12) can be accessed by pressing the SHIFT button and turning either the *REVERB Dry/Wet* (11) or *Reverb DECAY* (12) knob respectively. This HALL REVERB can be frozen by setting the *TAP FOOTSWITCH* (14) to mode 3.

➜ Whooshing **REVERSE REVERB**. By default the *PREDELAY* amount is set to maximum and is reversed, meaning that if predelay is set to fully CCW then the pre delay value is at its maximum. Predelay controls reverse time (length of the buffer that is being reversed), the bigger the predelay value the more of the reverse effect you will hear. Shimmer effect can be added to the REVERSE REVERB by setting the *TAP FOOTSWITCH* (14) to mode 3.

➜ Vintage **SPRING REVERB** with spring excite functionality that can be activated by setting the *TAP* footswitch (14) to mode 3.

MID/SIDE widener stays after the reverb and increases the stereo field simultaneously with the amount of Reverb *DECAY* knob (12). This feature is best audible on true stereo signals processed with the GHOST.

MODULATION ASSIGNMENT

You can assign a movement to literally any knob or as many knobs you like in a desired amount directly or inverted. Applied modulation then sums up in its depth with the manual knob value (a.k.a. *offset*) along with the expression pedal min-max settings.

The LFO can be synchronized to external *MIDI CLOCK* applied from *MIDI IN CONNECTOR* (5) by pressing or holding **SHIFT** while turning **SPEED/MIDI CLOCK*** knob from noon CW. When an external MIDI clock is enabled this knob acts as a divider / multiplier for the clock with the divisors similar to values around the *TIME/DIV* knob (9) and LED flashes blue according to the external MIDI clock speed.

➙ *NOTE: MIDI STOP* and further *MIDI PLAY* message will restart the LFO cycle when it is synchronized to the external MIDI clock.

The **SPEED** or frequency of internal **LFO / MODULATOR** can be set from 0.0333 Hz (30 seconds per cycle) at CCW to 15 Hz (0.0666 seconds per cycle) at CW.

There are following LFO shapes available:

➙ ∿ sine wave

➙ ﹨﹨ falling sawtooth ramp (becomes rising sawtooth rap with applied inverted modulation)

➙ ⊓⊔ square wave

➙ ⊓⌐ stepped random / sample & hold wave

➙ ∿ is a smooth / fluctuating random wave, inspired by the Source of Uncertainty™ generators in modular synthesizers. With this shape the selected **LFO SPEED** knob (21) sets the probable rate of random change.
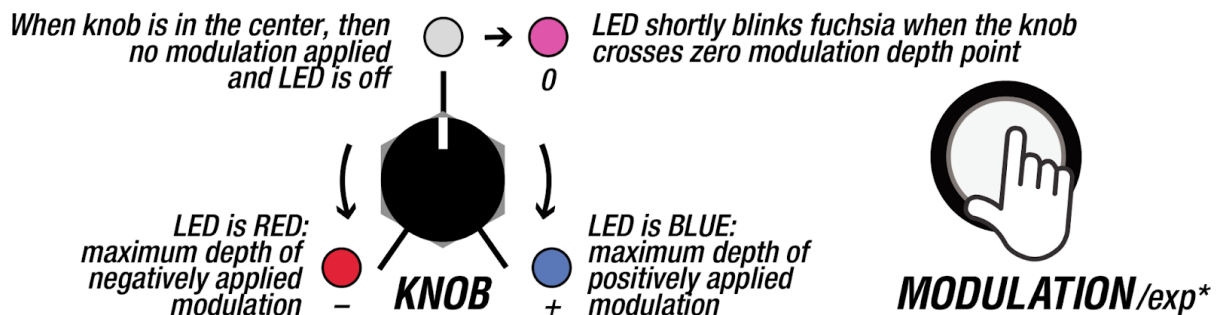
➙ **env.** means **ENVELOPE FOLLOWER**: instead of a cycling wave, a modulation contour shape is extracted from the incoming audio according to its dynamics. *LFO SPEED* knob (21) acts as a slew rate adjustment with long at CCW or fast slew at full CW.

➙ *NOTE:* envelope follower can open a totally new world for dynamic modulation possibilities. Apply it gently to the **FILTER** with adjusted */resonance** to get a *wah-wah* effect. Apply it inverted to **VOLUME** to simulate a *compressor* and that's just the tip of the iceberg.

TO ASSIGN THE MODULATION: simply tweak the knobs while holding the **MODULATION** (23) button. Doing the same with SHIFT /* enabled will assign the modulation to secondary parameters.

The amount by which you tweak a knob from center to side positions while holding the **MODULATION** button (23) sets the depth of the selected **[LFO] SHAPE** (22), which will be applied to the assigned parameter.

You can apply modulation so the LFO will move the knob from its current position directly (positive modulation) or inverted (negative modulation). When you hold or latch *MODULATION* (23) button, all the parameter knobs (except *SHAPE* and *SPEED*) temporary become *polarizer (or so called 'attenuverter')* knobs which set the depth of modulation from center / zero position (no modulation) to CW for positive or CCW for inverted modulation. Amount of positive modulation depth is shown with the blue and negative modulation with the red brightness of the LED which stands next to the parameter we apply modulation and increases to maximum when the knob reaches the sides. There is no modulation applied when the LED is off when *MODULATION* button (23) is active. Parameter LED blinks shortly in fuchsia when the knob crosses the center point - that's convenient to know when we want to set the modulation to zero depth.

When knob is in the center, then no modulation applied and LED is off

LED shortly blinks fuchsia when the knob crosses zero modulation depth point

0

LED is RED: maximum depth of negatively applied modulation − **KNOB** + **LED is BLUE: maximum depth of positively applied modulation**

MODULATION/exp*

After you release the *MODULATION* button, you will see the modulation applied with the LED brightness near the knob - it will *breathe* according to the **[LFO] SPEED** knob (21). You may assign those movements to any primary or certain secondary parameters to the LFO with various depths. To have the LFO covering the full range of the knob, adjust its modulation in maximum or minimum (full blue or red) and then add a manual knob offset.

➔ *NOTE:* you can't modulate discrete values with LFO (e.g. selecting MIDI CHANNEL or enabling MIDI SYNC).

➔ **HINT:** *MODULATION* (23) button can also be pressed once (latched) so you can adjust the modulation depth playing with various parameters with one hand.

EXPRESSION PEDAL ASSIGNMENT

To set the expression pedal press **SHIFT + MODULATION**/EXPR* : the **MODULATION** button starts flashing slowly. Put the expression pedal in the lower *heel* position (or any initial / *min* position) and set the position of the knobs to their desired positions. Then press again **SHIFT + MODULATION**/EXPR* : **MODULATION** button starts flashing fast. We put the expression pedal in the upper *toe* position (or any other final / *max* position) and set the position of the desired knobs. After, we exit the expression assign mode by pressing **SHIFT + MODULATION**/EXPR* third time and **MODULATION** stops flashing: expression settings are made and saved. If in one of the positions we put the pedal not fully up or down, then all further side values have no effect on the parameter. This makes sense when we want to make the expression pedal start working from, let's say the middle of the move. Similar to an expression pedal, all manipulations with the *CC#01* received at *MIDI IN* (5) are interpreted identically to the expression pedal and vice versa: manipulation with the pedal sends *CC#01* on the pedal *MIDI OUT* (5).

TAP FOOTSWITCH ASSIGNMENT

Each of the 9 presets has its own assigned *TAP* footswitch (14) destination. By default it is assigned to the TAP-tempo of the delay (9). The amount of the LED blinks during **SHIFT + TAP** combo shows the assigned mode:

➔ ● one blink (by default) means that the foot switch is assigned to *TAP TEMPO* for setting delay time overriding *TIME/DIV KNOB* (9) setting when internal clock is

enabled and vice versa: when moved, *TIME/DIV KNOB* overrides previously set *TAP TEMPO* values. The *TAP* LED blinks showing the delay tempo (with both internal or external delay sync).

➜ *NOTE:* Tap tempo via the footswitch doesn't work if an external MIDI clock is enabled.

➜ ● ● two blinks means that the *TAP* footswitch is assigned to enable / disable the delay's looper (recirculating the delay buffer audio). This feature has a latched action – meaning that the looper remains enabled after a single press and the LED remains on. On the next press of the *TAP* footswitch the looper is off and the LED is off. While the delay looper is ON, the delay clock still blinks on the same LED, but inverted (turning OFF on each tick of a delay clock).

➜ ● ● ● three blinks assigns the *TAP* footswitch to influence selected active reverb function (13): freezing hall reverb (latched action), adding shimmer to reverse reverb (latched action) or exciting virtual spring reverb (momentary) making it self-oscillate.

➜ ● ● ● ● four blinks assign the *TAP* footswitch to se;lect the *ROUTING* type as if you press the *ROUTING BUTTON* (15) with a foot.

➜ *NOTE:* only one from four options can be assigned to *TAP* footswitch at a time (either tap, either delay looper or selected reverb action). You may access all those functions simultaneously via MIDI (see MIDI implementation chart at the end of the manual).

BYPASS FOOTSWITCH MODES

There are three bypass options that can be selected by pressing and holding **SHIFT + BYPASS** for more than 4 seconds. The number of **SHIFT** button blinks shows the selected *BYPASS* type:

➜ ● one blink (by default): **TRUE BYPASS** means that the stereo relays are physically connecting audio input jacks to the effects or detaching them from the effects rerouting to the output jacks directly without any buffers. You may hear clicks in the pedal inside during relay bypass switching. When the pedal is unpowered, its bypass is always *true* enabled – meaning it will pass the audio signals from audio *IN L/R* to audio *OUT L/R* accordingly preserving your tone.

➜ ● ● two blinks: **BUFFERED BYPASS** means that the relays are always on and we enable/disable effects chain in the DSP code setting the MIX control to CCW. This type of bypass might be useful if you need a buffered audio input to preserve a tone or volume amplitude.

➜ ● ● ● three blinks: **TRAILS BYPASS** means a variation of buffered bypass, however it keeps the whole effect chain active while the original signal is bypassed. This type of bypass is useful if you wish to for example have a controlled long reverb tails or delay still recirculating while the original signal passes clean.

RESET

In case you have tweaked everything so hard you have distorted signal main outputs, a reset adjusts all advanced / secondary parameters to their default values, so you may start tweaking from the beginning.

SOFT RESET: press all four buttons (13) (15) (19) (23) simultaneously and hold them for more than 3 seconds. Release them once all the LEDs are on and the pedal will reset the current preset to its default values. Current preset is not saved – you have to do that manually, otherwise the previously saved preset will be restored from that slot on the next power up (see *PRESETS LOAD / SAVE* section below)

HARD RESET: press all four buttons (13) (15) (19) (23) simultaneously and hold them for more than 10 seconds. Module will erase all its presets to default empty ones and all the MIDI settings to default as well.

After the module's reset: *FILTER*, *DELAY's*, *REVERB's* and *DISTORTION's /TONE** controls are in the middle (no filtering applied); *MIX* and *VOLUME* controls set to 100% (CW value) and cabinet simulator set to 0 (off).

PRESETS LOAD / SAVE

Ghost pedal has 9 preset slots: which correspond to 3x3 LEDs array (25) above the **PRESET** footswitch (24). You may still play with the current preset but only select the new slot to load. Preset selection and saving is made with the idea to be operated with one foot only.

TO LOAD A PRESET

→ shortly press *PRESET* footswitch (24) a few times to move the blinking LED over to one of nine slots you wish to load.

→ Press *BYPASS* footswitch (20) and the new preset will be loaded. All the parameters which have continuous changes will slew to the new preset values to avoid any clicks.

→ *NOTE:* loading the new preset with a single *BYPASS* footswitch (20) confirmation will not alter current bypass effect state on or off.

Once you make any changes to the knobs on your GHOST Pedal (see *SETTINGS AUTOSAVE* section below) you wish to recall later, you have to save them. If the changes were not saved, you will have a previously saved preset recalled on the next pedal startup.

TO SAVE THE PRESET

➜ Hold the **PRESET** footswitch for longer than 3 seconds: one of the 9 slots will start to blink

➜ You may choose the new slot to save by shortly pressing the **PRESET** (20) footswitch a few times.

➜ To confirm the preset save in the selected slot press and hold **PRESET** footswitch for longer than 3 seconds.

➜ (1) *NOTE:* when **SHIFT** button is enabled, pressing the **PRESET** footswitch will select the presets in the reverse direction.

➜ (2) *NOTE:* there is a blinking LED timeout when you started to load or save a preset and LED is blinking asking for load confirmation with *BYPASS* or save confirmation with *PRESET* footswitches - after approximately 15 seconds it will return to a normal state without any load or save.

PRESETS DUMP / UPLOAD

It is possible to transfer all 9 presets from and to the pedal on either Windows or Mac computer by using MIDI SysEx dump. This can be done using free software available for both Mac and Windows.

SYSEX PRESETS DUMP SAVE ON MAC

➜ Download and install **SYSEX LIBRARIAN** app your Mac:
https://www.snoize.com/sysexlibrarian/

➜ Connect the **MIDI IN/OUT** ports on the pedal to your Mac via a USB MIDI cable or by using your midi interface so the **MIDI IN** jack is connected to **MIDI OUT** on the pedal and **MIDI OUT** jack is connected to **MIDI IN** on the pedal.

➜ Open SysEx Librarian app and select your MIDI interface from the drop-down menu list to send a receive SysEx.

➜ Press **RECORD MANY** and the app will be waiting for the SysEx message to record.

➜ To perform a preset dump, hold the **SHIFT** + **ROUTING** buttons for a few seconds until you see the 9 preset LEDs are on for a moment. You should see the MIDI data being received inside the SysEx Librarian app so you can save it as a *.syx file afterwards.

SYSEX PRESET UPLOAD ON MAC

➜ To upload the presets to the pedal, press the *File* menu in the top menu select *Add to library* in the drop down menu. Select the file you want to transfer from the list and press *Play* in the top left side of the app. All 9 preset LEDs should light up on the pedal to confirm the transfer.

→ If you are experiencing issues during the preset upload, try adjusting the *Send MIDI Buffer* inside the Options menu on to 100 msec.

SYSEX PRESETS DUMP SAVE ON WINDOWS

→ Download and install **BOME SENDSX** software on your PC computer: https://www.bome.com/products/sendsx

→ Connect the MIDI IN/OUT ports on the pedal to your Mac via a USB MIDI cable or by using your MIDI interface so the MIDI IN jack is connected to MIDI OUT on the pedal and MIDI OUT jack is connected to MIDI IN on the pedal.

→ Open Bome SendSX software and configure in the top menu the MIDI IN and MIDI OUT ports to send a receive SysEx to your connected MIDI interface device.

→ To perform a preset dump, hold the *SHIFT + ROUTING* buttons for a few seconds until you see the 9 preset LEDs light up. You should see the midi data being received in the MIDI IN window inside the Bome SendSX software.

→ Save the presets on your computer by pressing the *File* menu in the top left corner of the Bome SendSX and select *Save Midi In As…* in the drop down menu.

SYSEX PRESET UPLOAD ON WINDOWS

→ To upload the presets to the pedal, press the *File* menu in the top left corner of the Bome SendSX and select Open in the drop down menu. Once you have selected your preset bank file in .syx format, press *Send (F4)* in the lower left side of the program. All 9 preset LEDs should light up on the pedal to confirm the transfer.

→ If you are experiencing issues during the preset upload, try adjusting the Send MIDI Speed inside the Options menu on Bome Send SX to around 1.29KB/s.

SETTINGS AUTOSAVE

There are a few layers of data and settings GHOST pedal can save and recall on the next power up cycle. Some of them you may change using the controls of the pedal and some of them are accessible via MIDI CC# messages (see *MIDI IMPLEMENTATION CHART* below).

SINGLE PRESET contains all knob values, routing, filter and reverb types, modulation assignments and expression pedal settings. Those settings must be manually saved via long hold *PRESET* footswitch (24) in one of the nine slots (25) and are individual per each preset (see *PRESETS LOAD / SAVE* above).

➜ *IMPORTANT:* presets are not autosaved! If a preset is not manually saved after being edited (see *PRESETS LOAD / SAVE* section above), the previously saved preset will be loaded on the next power up from the last selected 1-9 preset slot.

SOFT RESET (see *RESET* section above) clears currently selected preset to default values while **HARD RESET** clears all 9 presets and global settings to default values. If a soft reset is performed on a specific preset, then after powering the unit off and on the preset will be reloaded (soft reset does not permanently delete preset data).

PRESET DUMP contains information about all 9 presets above and doesn't include any of the pedal's settings below (so you can import presets of your friends and they will not change your settings).

MOMENTARY SETTINGS contain states like Bypass enable, last preset selected etc. Those are saved every 2 seconds once we change them. That means if you selected the third preset on the pedal, enabled bypass and in 2 seconds turned the pedal off, it will remain bypassed on the third preset recalled on the next power up.

GLOBAL SETTINGS contain settings about MIDI Thru enable, knobs CC values sent to MIDI OUT, MIDI OUT enable, MIDI Clock out enable, Program change Receive (RX) or Transfer (TX) enable, receiving MIDI channel, Bypass type, internal or external MIDI sync over LFO and Delay clock. These settings are global for all 9 presets and are also auto-saved after a slightly longer time period than momentary settings.

MIDI IMPLEMENTATION CHART

CC#	PARAMETER	RANGE
01	EXPRESSION PEDAL	0…127, expression pedal connected generates CC#01 on the MIDI OUT as well as expression is received from CC#01 from the MIDI IN
07	VOLUME	0…127 0=silence, 100 = 100%, 127=drive
08	MIX	0…127 0=dry, 127=wet
10	DISTORTION	0…127
11	DISTORTION TONE	-63…0…63 (0…127, default 63!)
12	DELAY DRY/WET	0…127
13	DELAY REPEATS (FEEDBACK)	0…127
14	DELAY TONE	-63…0…63 (0…127, default 63)
15	DELAY TIME	0…127
16	DELAY TAPS DISTRIBUTION	0…42 = RLRL, 43…84=LRRL, 85…127=stereo
17	DELAY LOOPER (LATCHED)	0…63=off, 64…127=on
18	ENABLE DELAY EXT. MIDI CLOCK SYNC (DEFAULT OFF)	0…63=off, 64…127=on
19	REVERB DRY/WET	0…127
20	REVERB DECAY (TAIL)	0…127
21	REVERB PRE-DELAY	0…127
22	REVERB TONE	-63…0…63 (0…127, default 63)
23	HALL REVERB FREEZE (LATCHED), REVERSE SHIMMER ON (LATCHED) OR SPRING REVERB EXCITE (NON-LATCHED)	0…63=off, 64…127=on
26	ROUTING TYPE	0…21 = routing #1, 22…42=routing #2, 42…63=routing #3, 64…85=routing #4, 86…107=routing #5, 108…127=routing #6
27	FILTER TYPE	0…42 = LP/HP, 43…84=BP, 85…127=COMB
28	LFO SPEED	0…127
29	LFO SHAPE	0…21 = sin, 22…42=sq, 42…63=saw.a, 64…85=saw.d, 86…107=rand, 108…127=env

CC#	PARAMETER	RANGE
30	ENABLE LFO EXT. MIDI CLOCK SYNC (DEFAULT OFF)	0…63=off, 64…127=on
64	TAP TEMPO (NON-LATCHED)	0…63=off, 64…127=on same CC as sustain pedal
65	BYPASS (NON-LATCHED)	0…63=off, 64…127=on
66*	RECEIVING MIDI CHANNEL	0…16 (17 values in total: 16 per 16 channels + min. CCW value for OMNI, default = OMNI). Output / transferring MIDI channel is always the same as selected receiving MIDI channel. If OMNI is selected as receiving, knobs CC values are always sent via MIDI channel 1
67*	MIDI THRU ENABLE (DEFAULT ON)	0…63=off, 64…127=on
68*	MIDI OUT CC ENABLE (DEFAULT ON)	0…63=off, 64…127=on
69*	MIDI OUT CLOCK ENABLE (DEFAULT OFF)	0…63=off, 64…127=on
24*	PROGRAM CHANGE RX ENABLE (DEFAULT OFF)	0…63=off, 64…127=on
25*	PROGRAM CHANGE TX ENABLE (DEFAULT OFF)	0…63=off, 64…127=on
70	SAMPLE RATE REDUCER	0=off (clean sound), 127=max crushing value
71	FILTER RESONANCE	0…127
74	FILTER FREQUENCY	0…127
Prg	PROGRAM CHANGE	0=preset#1; 1=prest#2; … 8=preset#9
Clock	MIDI CLOCK	Received (CC18, 30 above), Sent (67, 68)

* - marked as Global settings (see Settings paragraph above) which return to default on soft reset

If some parameter receives a mapped midi value via CC message from *MIDI IN* (5), then it is immediately intercepted instead of the current position of the knob (or a secondary value too). However, this CC value still adds up to the LFO modulation and expression pedal morph (or CC#01). And vice versa: when the CC value has stopped being sent and we move the knob, the knob's value intercepts the previous CC value.

FIRMWARE UPDATE

Firmware updates are essential for any digital devices. They bring new features or bug fixes. Feel free to write any bugs, features ideas or improvements to beta@endorphin.es. Have any issues? Write us to support@endorphin.es

To update the firmware on your GHOST Pedal, first download the latest firmware file once available on ENDORPHIN.ES website:
https://www.endorphin.es/modules/p/ghost-pedal

The update procedure is made via audio: either computer or phone will work, we advise you to disable all notifications (flight mode) so that the update is not interrupted.

1. Power **OFF** your pedal.

2. Unplug all the cables from the pedal except a simple mono cable connecting the audio output from your computer headphones output to the audio **INPUT LEFT JACK** of the pedal and select the switch to the *LINE* level

3. Set the output volume of your computer to 100% or slightly lower.

4. Hold **PRESET FOOTSWITCH** while powering your pedal **ON** - you will see the **PRESET 5** LED on.

5. Open the *GHOST_PEDAL_UPDATE_XXX.WAV* file with any audio player. Press play and patiently wait 1.5+ minutes while the firmware is updating. A row of 9 LEDs will slowly fill up showing the upload status. During the update two rows of *ROUTING* LEDs act as a VU meter for incoming audio. Try to adjust the volume of the playback file so it will not clip but also will have enough strength to light up almost all the *ROUTING* LEDs.

6. The pedal will reboot automatically after the new firmware has been installed and will act normally with TAP footswitch blinking. That's a good sign that the update was successful.

7. To ensure the hidden parameters are all properly set after the update, it is also recommended to perform a reset by simultaneously pressing and holding all 4 buttons for 3 seconds (see *RESET* section above).

8. Enjoy the new features.

➜ **IMPORTANT:** *to prevent any errors during the audio playback of the firmware, please use an audio editor without any effects applied (EQ, room correction etc.)*

CREDITS

ENDORPHIN.ES x ANDREW HUANG – GHOST PEDAL

COLLECTION SPRING/SUMMER 2024

Pedal idea, concept and manual by Andreas Zhukovsky and Andrew Huang

Hardware design, code direction by Andreas Zhukovsky

Core engine programming by BSVi

Manual proofreading and beta testing by Wisdom Water

Factory presets by Andrew Huang

ENDORPHIN.ES are made in Barcelona, Spain

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PEDAL

COMPLIANCE

FCC

This device complies with Part 15 of the FCC Rules. 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.

Changes / modifications not approved by ENDORPHIN.ES doing business as Furth Barcelona, S.L. could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

CE

This device meets the requirements of the following standards:

EMC: 2014/30/EU

EN55032: 2015 ; EN 55103-2: 2009 (EN55024) ; EN61000-3-2;

EN 61000-3-3

Low Voltage: 2014/35/EU

EN 60065: 2002+A1: 2006+A11: 2008+A2 :2010+A12: 2011

RoHS2: 2011/65/EU

WEEE: 2012/19/EU