

ENDORPHINES × ANDREW HUANG

GHOST ^{16hp} 

FIRMWARE V3.02

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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.

VISIT US

<https://endorphin.es>

<https://youtube.com/user/TheEndorphines>

<https://facebook.com/TheEndorphines>

https://twitter.com/endorphin_es

<https://www.instagram.com/endorphin.es/>

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

For technical requests: [**support@endorphin.es**](mailto:support@endorphin.es)

For dealer / marketing inquiries: [**info@endorphin.es**](mailto:info@endorphin.es)

ENDORPHIN.ES is a registered trademark.

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

THE GHOST

- creative stereo effect processor with delay, reverb, filter and distortion with quickly explorable routing chain with a single button press
- matrix of micro-modulations creates infinite, alive and unexpected interactions of controls
- lush hall with shimmer and freeze and whooshing reverse reverb with tone control and pre-delay
- sidechain audio ducking with trigger input and one knob single band compressor
- 24 bit 96 kHz new generation ARM Cortex-M7 processor with 32 bit floating point internal processing
- zero-delay feedback state-variable filters: bipolar low-pass / high-pass, band-pass and alternative comb filter with resonator
- tap delay with external clock and clock divider, 1v/oct time control for Karplus-Strong, looper, tone control, various taps settings with up to 2,5 sec. maximum delay time
- 8x oversampled distortion algorithm, bit crusher and sample rate reducer
- pre- and post- VCA controls. Input Tone and output Volume/Mix controls with extra gain/drive reserve

INTRO

In collaboration with Andrew Huang, based on his modern music production techniques we developed a creative audio processor with multiple blocks that can be moved around in order to achieve different flavors for sound design.

GHOST is a fully digital stereo processing unit without a fixed structure in 16hp: intuitively create astonishing and ephemeral timbres, from atmospheric rumbles to heavily distorted textures.

The extremely flexible audio chain consists of a delay, reverb, multimode filter and distortion, where the order of these audio processing blocks can be easily switched with a single press of a button.

The ability of the delay to self-oscillate at audio rate frequencies, track 1v/oct signals, be processed by onboard VCAs and an envelope make GHOST a complete Karplus-Strong Synthesis voice in itself.

CONNECTING THE POWER

Before installing a new module in your case, ensure your power supply has a free power header and sufficient available capacity to power the module.

Connect the module directly to the power bus-board with supplied 10-16 ribbon cable like any other eurorack module. Pair of **RED/BROWN** pins on the multicolor ribbon cable corresponds to negative **-12V**.

Make sure to align the power cable with the '**RED/BROWN STRIPE**' label on the module that corresponds to -12V, to the 10-pin connector and with typically a white line for the 16-pin connector on the bus board.

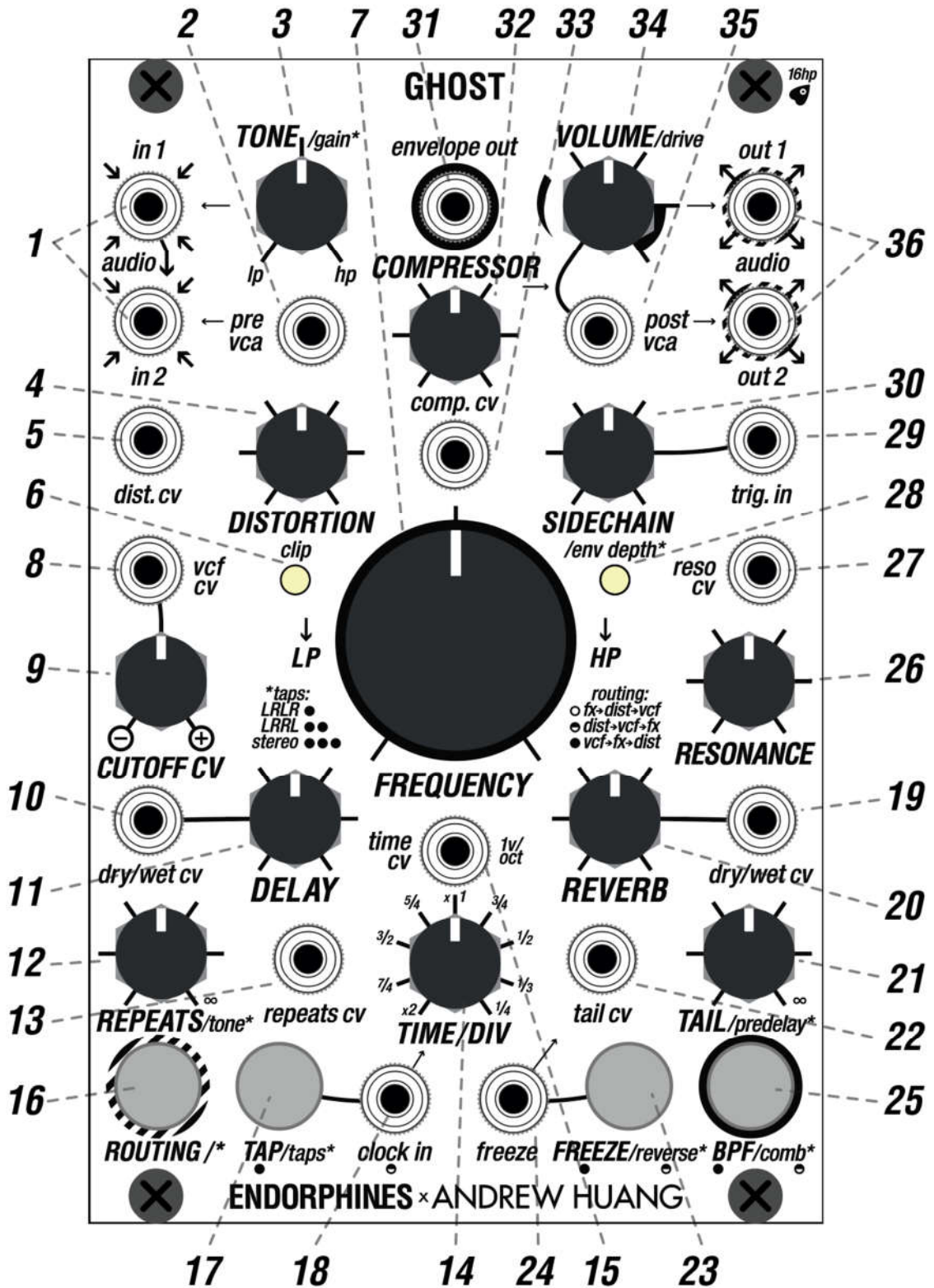
TECHNICAL SPECIFICATIONS

- Width: 16 HP/TE, depth: 25 cm or 1" with inserted ribbon cable
- Current draw: +12V: 130 mA, -12V: 35 mA
- Audio I/O: 24 bit 96 kHz with 32 bit floating point internal processing
- CV capture: 16 bit, 2 kHz
- CV range: 0...+5V typically with up to 0...+10V. -5...+5V for *1v/oct* and *vcf cv*.
- Audio input range: typical eurorack standard +/-5V (10Vpp) with up to 18Vpp when saturation starts (at around +21 dBu)
- Audio output: typical +/-5V eurorack standard

FEATURED OVERVIEW / DEMO VIDEO

- <https://youtu.be/YGxffD8169g>
- <https://youtu.be/dMv1zkeLZho>
- https://youtu.be/OWo_KKaxp0
- <https://youtu.be/xTAsE5YUysQ>
- <https://youtu.be/57UaTmpjyPQ>

INTERFACE



FRONT PANEL CONTROLS

- 1. IN 1, IN 2 JACKS:** stereo audio inputs, *INPUT 1* (typically left) – is *normalled*, i.e. pre-routed → to *INPUT 2* (right) when no audio cable is present on *INPUT 2*. Typical input audio level: eurorack modular +/-5V with maximum up to +/-9V when saturation starts with higher audio amplitude. Line level audio signals also accepted just bear in mind the output will also be similar amplitude (or you can always adjust the gain with the **/GAIN*** knob (3)).
- 2. PRE-VCA CV INPUT JACK:** external 0...+5V CV input that controls the amplitude of the incoming stereo signal. Normalled to +5V when no patch cable is inserted.
- 3. TONE/gain* KNOB:** multi-function knob. By default it acts as a 6db/oct *TILT EQ* for low and high frequencies (CCW and CW respectively) with no effect when the knob is at 12 o'clock. Secondary function is a gain boost for incoming audio, activated by turning while holding the **ROUTING** button. Fully CCW the signal is at its original unity level - turn CW to boost.
- 4. DISTORTION KNOB:** manual control over the distortion level. Is summed with an external CV applied to the *DIST. CV* jack (5). Secondary hidden function (holding **ROUTING** while turning **DISTORTION**) lowers the **BITRATE** ^{FW V3.0} amount output of the *FILTER* chain: full 24 bits at CCW and crushing to a certain moment until the audio falls down to noise. When turning feature, it radically brings aliasing to the audio signal – use on your own discretion creatively to add lo-fi flavor.
- 5. DISTORTION CV JACK:** external 0...+5V control over the distortion level (4).
- 6. CLIP LED:** lights up when clipping occurs at the distortion stage (4).
- 7. FREQUENCY KNOB:** manual control over the *FILTER CUTOFF*.
- 8. VCF CV INPUT JACK:** -5V...+5V CV input for the *FILTER CUTOFF*. The polarizer *CUTOFF CV* knob defines its amount, mixed with the setting of the *FREQUENCY* knob (7).
- 9. CUTOFF CV KNOB:** polarizer / attenuverter for incoming CV input jack (8) to the *FILTER CUTOFF*.
- 10. DELAY DRY/WET CV JACK:** 0...+5V external CV input for the *DRY/WET* mix of the delay effect (11). Normalled to +5V when no patch cable inserted.
- 11. DELAY KNOB:** manual control of the *DRY/WET MIX OF THE DELAY* effect, acts as attenuator for *DRY/WET CV jack* (10). When *DELAY* knob is fully wet (CW), no dry signal passes anymore.

- 12. REPEATS/tone* KNOB:** manual control over *REPEATS* or *FEEDBACK* level of the delay. Turn it fully CW for self-oscillation. Secondary */TONE** function (holding *ROUTING* while turning *REPEATS/TONE**) adjusts the tilt EQ after the WET output of the delay chain (see advanced delay parameters below). Is summed with an external CV applied to the *REPEATS CV* jack (13).
- 13. REPEATS CV JACK:** 0...+5V external CV input for the repeats (or feedback) control of the delay effect (12).
- 14. DELAY TIME/DIV KNOB:** manual control of the delay time, from short audio rate repeats CCW and longer taps CW. When an external clock is present at the *CLOCK IN* jack (18), the knob acts as a divider / multiplier for this clock with the divisors written around the knob on the panel.
- 15. TIME CV INPUT JACK:** -5...+5V external CV control for the speed of the delay's repetitions (14), follows *1v/oct* tracking. Is *inversely* summed with the *TIME/DIV* knob value when no external *CLOCK IN* applied: higher CV values shorten the delay time and lower values increase the delay time. When the delay is synchronized to external *CLOCK IN*, that CV sets the clock divider also summed with the value of *TIME/DIV* knob (14).
- 16. ROUTING /* BUTTON:** routing chain switching as well as multifunction *shift* button. Short presses will cycle through three different orders of audio effects (see *DISTORTED REALITY* paragraph, page 11 below). Acts as a *shift* button when held down while using other controls (shift functions are labeled with */** on the panel).
- 17. TAP/TAPS* BUTTON:** acts as a tap tempo button for setting delay time overriding *TIME/DIV* KNOB setting. When internal clock is enabled (no patch cable connected into *CLOCK IN* jack (18) this button blinks fully lit, shown by the symbol under it: ● . When external clock is patched, the button blinks semi-lit shown by the symbol under it: ◐ . Secondary function (***ROUTING + TAPS***) changes the stereo behavior of the taps produced by the delay. Available delay tap configurations are:
- ***LRLR:*** left and right summed, their taps 1 and 3 hard-panned left, taps 2 and 4 hard panned right (one ● blink when enabled)
 - ***LRRL:*** left and right summed, their taps 1 and 4 hard-panned left, taps 2 and 3 hard panned right (two ● ● blinks when enabled)
 - ***STEREO:*** left and right inputs tap independently in their corresponding left and right outputs. In this mode the total delay time is halved (three ● ● ● blinks when enabled)
- 18. CLOCK IN JACK:** 0...+5V external input for the clock that sets the *TEMPO* of the delay. External clock expects the clock pulses in sixteenth notes. Module switches to external clock automatically when a patch cable is inserted in the *CLOCK IN* jack: *TAP* button (17) blinks semi-lit following that incoming clock.

- 19. REVERB DRY/WET CV JACK:** 0...+5V external CV control over the *DRY/WET MIX OF THE REVERB*. Normalled to +5V when no patch cable is inserted.
- 20. REVERB KNOB:** manual control of the *REVERB DRY/WET* mix level, acts as attenuator for *DRY/WET CV* jack (19). FW V2.0: secondary */TONE** function (holding **ROUTING** while turning **REVERB**) adjusts the tilt EQ before the reverb tank (see advanced reverb parameters below).
- 21. TAIL/PREDELAY* KNOB:** primary function controls the decay of the *REVERB's TAIL*. Secondary function in combination with **ROUTING /*** button controls the *AMOUNT OF PRE-DELAY* for the reverb. Is summed with an external CV applied to the TAIL CV input jack (22).
- 22. TAIL CV INPUT JACK:** 0...+5V external CV input for the *DECAY* of the reverb (21).
- 23. FREEZE/REVERSE* BUTTON:** primary function freezes the reverb or the delay, allowing you to *hold* a part of audio until you press this button again. When freeze is enabled, this button is fully lit, shown by the symbol under it: ●. Secondary function in combination with **ROUTING /*** button switches the algorithm to *REVERSE REVERB*. When reversed reverb is activated, the button is semi-lit, shown by the symbol under it: ◐
- When *REVERSE REVERB* activated, a single *FREEZE* button press along with *FREEZE* trigger input activates and deactivates delay freeze – a.k.a. **LOOPER** (infinitely recirculating delay's audio buffer).
- 24. FREEZE JACK:** 0...+5V external trigger input to enable the *FREEZE/LOOPER* of the reverb or the delay (23) from incoming voltage pulses. Has a latch action: each consequent trigger either enables or disables that feature.
- 25. BPF/comb* BUTTON:** switches the filter type from default *STATE-VARIABLE FILTER LP/HP* to *BAND-PASS* filter and back. When band-pass filter is enabled, this button is fully lit shown by the symbol under it: ●. Secondary function switches to *COMB FILTER* with resonator by using the **ROUTING + BPF/COMB*** button combo. When the *COMB FILTER* is activated, the button is semi-lit, shown by the symbol under it: ◐. A second press on the button switches back to the *LP/HP filter* (button unlit).
- 26. RESONANCE KNOB:** manual control over the *RESONANCE OF THE FILTER*; is summed with the external CV applied to the *RESONANCE CV* input jack (27). When the *BAND-PASS* filter is selected (25), this knob defines the width of the band. In *COMB FILTER* mode this 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. Secondary hidden function (holding **ROUTING** while turning **RESONANCE**) lowers the **SAMPLE RATE** ^{FW V3.0} amount output of the *FILTER* chain: full 96 kHz at CCW and crushing to a certain moment until the audio falls down to noise. When

turning feature, it radically brings aliasing to the audio signal – use on your own discretion creatively to add lo-fi flavor.

- 27. RESONANCE CV INPUT JACK:** 0...+5V external CV control for the *RESONANCE* of the filter (26).
- 28. /ENV DEPTH* LED:** Brightness shows the internally generated envelope from trigger input (29). When *SIDECHAIN KNOB* (30) turned while pressing the **ROUTING /*** button, this LED shows the amount of the envelope applied to the internal sidechain audio ducking effect.
- 29. TRIGGER INPUT JACK:** trigger input for the onboard sidechain envelope.
- 30. SIDECHAIN KNOB:** Sets the decay of the onboard envelope from zero (no envelope) to approx. 5 seconds. When turned while pressing the **ROUTING /*** button, this knob adjusts the depth of the envelope to the internal sidechain audio ducking effect.
- 31. ENVELOPE OUTPUT JACK:** 0...+5V envelope output triggered from **TRIG IN** jack (29). The envelope has fixed 1mSec attack and a natural-sounding exponential curve. While the internal envelope for sidechaining is negative (to duck the audio), this output provides a positive version of the envelope to use elsewhere in your system or modulating module's parameters.
- 32. COMPRESSOR KNOB:** manual control over the amount of compression applied after the effects processing chain is summed with an external CV applied to the **COMPRESSOR CV IN** jack (33).
- 33. COMPRESSOR CV IN JACK:** 0...+5V external CV input for the compressor amount (32).
- 34. VOLUME/drive KNOB:** controls the final output volume. Acts as an attenuator for the **POST VCA CV** jack (35). When the knob passes after 15 o'clock it adds extra *DRIVE* saturation to the output signal while trying to maintain its amplitude. Firmware v2.0 addition: secondary function in combination with **ROUTING /*** button controls the *GLOBAL DRY/WET MIX* between the clean input signal after the *IN GAIN* (pre-VCA) at full CCW and the final processed audio chain output before the Volume knob (before post-VCA) at full CW.
- 35. POST-VCA CV INPUT JACK:** 0...+5V external CV input for the final volume level (34). Normalled to +5V when no patch cable is inserted.
- 36. OUT 1, OUT 2 JACKS:** final stereo audio outputs. *OUTPUT 1* is typically left and *OUTPUT 2* is typically right. *OUTPUTS 1/2* can drive headphones or be used as separate mono L/R outputs connected with mono cables. When each jack is used with stereo TRS cables, these outputs can be used in *PSEUDO-BALANCED CONNECTION* for example to your audio interface directly. Pseudo-balanced connection ensures less noise hum on

the long cables but cuts the audio signal amplitude by half – to approximate *pro-line* level +/-2.5V. Both audio inputs and outputs support airline audio jack adapter (sold separately) to connect with a single 3,5mm TRS stereo (AUX) cable directly.

KNOB SNAPPING *FW V3.0*

When editing secondary parameters marked with /* (with **ROUTING** pressed) or returning to primary (when **ROUTING** released), previously set knob's value has to be caught to not accidentally have unexpected jumps in values. However, the distance to which the knob has to cross to catch the value is halved approximately to catch it faster. That feature was introduced with the firmware v3 and previous firmware versions had instant jumps after the knob move.

TONE SHAPING

TONE knob adjusts input tone shaping after initial pre-VCA with a light TILT EQ leaving more low frequencies at knob's full CCW position or leaving more high frequencies at knob's full CW position. After that stage, the signal is passed to the main processing chain.

By pressing and holding the **ROUTING** button, **TONE/GAIN*** knob acts as a digital **GAIN BOOSTER** for the applied audio signal (1) from 100% at full CCW to boosted at full CW enough to bring line or even guitar levels into modular amplitude.

→ **REMINDER:** *digital gain brings digital noise when increased past 100%. Use it creatively at your own discretion.*

DISTORTED REALITY *ROUTING*

The power of the **GHOST** lies in its complex stereo audio effect chain with 96kHz, 32-bit internal audio processing, consisting of 2 VCAs (pre and post), 3 distortion stages, a multimode filter with bitcrushers on the end, delay, reverb, compressor, and sidechain ducking envelope. The order of the three main processing blocks - **DELAY/REVERB**, **FILTER**, and **DISTORTION** - can be changed by pressing the **ROUTING** button, letting you achieve many different flavors of sound without having to repatch. The settings of the **GAIN**, **DRIVE** and **COMPRESSOR** in the audio chain are adjusted manually for optimal control over the dynamics.

There are three possible orders for the **DELAY/REVERB (FX)**, **DISTORTION (DIST)** and **FILTER (VCF)** blocks written as a hint on the panel:

1. ○ **FX → DIST → VCF**

2. ◐ **DIST → VCF → FX**

3. ● **VCF → FX → DIST**

The selected order is shown by the brightness of the **ROUTING** button (16), and written as a hint on the faceplate:

→ when **ROUTING** button LED is off ○ – first chain is selected

→ when **ROUTING** button is semi lit ◐ – second chain is selected

→ when **ROUTING** button is full on ● – third chain is selected

→ **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. From our sound design experience with the module, the first routing chain is well suited to rumble/ghost sounds, the second is good for cleaner effects based on overdriving the filter, and the third will generally have the heaviest distorted tones.

THREE FLAVORS OF DISTORTION

→ **/GAIN:** digital input gain (3) capable of up to 10x digital signal amplification with light saturation, adjusted with **ROUTING + TONE/gain***

→ **DISTORTION:** 8x oversampled distortion algorithm with a single (8) knob control

→ **/DRIVE:** final output saturator when **VOLUME** (34) is pushed to the end of its range after 3 o'clock as indicated around the knob on the panel

THREE FLAVORS OF FILTER ^{VCF}

→ Bipolar **LOW-PASS / HIGH-PASS** filter aka *isolator* opens *LP* from silence at CCW to clean unprocessed sound at noon and closes smoothly in *HP* silence at CW

→ **BAND-PASS** filter (*BPF*) with the resonance setting the width of the band

→ **COMB** filter with resonator at high resonance settings.

To switch the filter type you simply press the **BPF/comb*** button (25). A single press will switch the filter type to a band-pass, and a combination of **ROUTING + BPF/comb*** buttons will change the filter type to Comb, which is also capable of self-oscillation at full CW or CCW **RESONANCE** settings. Resonance knob (26) behavior in Comb filter is special: it is bipolar, so from noon (zero resonance) it either adds negative (CCW) or positive combs (CW).

LO-FINESS ^{FW V3.0}

Two new rectifying effects added in the firmware update V3: bitrate and sample rate reducers. By lowering audio fidelity, they radically bring aliasing to the audio path the more we turning them up – use on your own discretion creatively to add *lo-fi* flavor. Those both effects always stand after the **VCF** block in the *routing* chain and are great to be enriched with the resonance.

→ **BITRATE REDUCER** ^{FW V3.0} **a.k.a. BITCRUSHER:** set by holding **ROUTING** while turning **DISTORTION** knob – lowers the *BITRATE* amount output of the *FILTER* chain: full 24 bits at CCW and crushing to a certain moment until the audio falls apart to noisy clicks and buzzes. Default value at CCW (clean signal).

NOTE: bitrate reduction may cause audio dropouts if the audio level is too low (e.g. line level). You can adjust that by holding **ROUTING + TONE/gain*** more to 50-100%.

→ **SAMPLERATE REDUCER** ^{FW V3.0} **a.k.a. DOWNSAMPLING:** set by holding **ROUTING** while turning **RESONANCE** knob – lowers the *SAMPLE RATE* amount output of the *FILTER* chain: from full 96 kHz at CCW and crushing to a certain moment until the audio falls apart to noisy clicks and buzzes. Default value at CCW (clean signal).

SPATIAL EFFECTS ^{FX}

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

→ **DELAY:** stereo delay with 1v/oct tracking, capable of Karplus-Strong synthesis. The delay can be synchronized externally via *CLOCK IN* (18), or by using the onboard *TAP TEMPO BUTTON* (17), with maximum delay time of 2,5 seconds. Three configurations of delay taps are available, toggled between by holding the *ROUTING* button and short pressing the *TAP* button. Delay tap configurations are *LRLR*, *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.

→ **REVERB:** lush stereo hall reverb with additional controls and configurations such as tail decay adjustment, pre-delay adjustment, reverse reverb and audio freezing.

→ **MID/SIDE** widener stays after the reverb and increases the stereo field simultaneously with the amount of *TAIL* reverb knob (21). This feature is best audible on true stereo signals processed with the *GHOST*.

Both delay and reverb have advanced secondary parameters and modes that can be accessed by pressing the **ROUTING** button (16) in combination with either a knob or another button. These controls are internal and do not have CV control; they are designed as ‘set and forget’ controls to fine-tune your sound.

ADVANCED DELAY PARAMETERS

→ **ROUTING + REPEATS KNOB:** controls the *TILT* EQ that adjusts the */TONE* brightness of repetitions: from sparkling, clean to dub delays. That *TONE** range (12) for repeats is identical to *TONE* input shaping control (3).

→ **ROUTING + TAP BUTTON:** switches the way the delay taps are distributed (hard panned) in the stereo *OUTPUTS 1/2*. When certain mode is enabled, the *TAP* button blinks once ● – the taps appear on *OUTPUTS 1* and *2* in an *LRLR* pattern. When the *TAP* button blinks twice ● ● – the tap pattern is *LRRL*. When the *TAP* button blinks 3 times ● ● ● – *STEREO* mode is selected, where the delay taps appear on either L or R output only when there is something present on L or R input, aka true stereo operation. The true stereo mode shortens the maximum delay time by half. Minimum delay time manually set with *TIME/DIV* knob corresponds to approximate C4 note (~261 Hz) in *LRLR* and *LRRL* taps and approximate C5 note (~523 Hz) and 1 octave more with external 1v/oct *TIME CV* applied.

→ **DELAY DRY/WET + REPEATS, BOTH CCW**^{FW.V.1.02} (or via CV): 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 dry/wet (11) and Repeats (12) knobs to their full CCW positions to delete the buffer content.

→ **LOOPER.** When *REVERSE REVERB* is activated (see above), *FREEZE* button (23) activates and deactivates *LOOPER* for the delay (recirculating delay's audio buffer) instead of the reverb's freeze.

→ **NOTE:** Tap tempo via the *TAP* button (17) doesn't work if an external clock is applied.

ADVANCED REVERB PARAMETERS

→ **ROUTING + TAIL KNOB:** sets the *PRE-DELAY* amount for the reverb, which is an important control that can add additional depth to your sounds, particularly useful when processing percussion. Full CCW knob position (21) corresponds to no pre-delay and full CW position corresponds to maximum possible pre-delay time (up to 0,5 seconds). The pre-delay setting is especially useful when used with *REVERSE* reverb.

→ **ROUTING + REVERB DRY/WET KNOB** ^{FW V2.0} controls the *TILT EQ* that adjusts the */TONE* brightness of both reverb tanks (so called *DAMPING*): is especially useful to cut low frequencies from the reverb to remove reverb's muddiness or vice versa. That *TONE** range (20) for reverb is identical to *TONE* input shaping control (3) or *TONE** for delay repeats.

→ **REVERB DRY/WET KNOB AFTER 12 O'CLOCK** ^{FW V2.0}: shimmered signal is added from turning that knob from the noon till full CW position.

→ **ROUTING + FREEZE BUTTON:** switches the reverb to the *REVERSE* algorithm, particularly useful for obtaining whooshing sounds by processing kicks, snares, pads, vocals and so on, giving you an extra dimension of movement.

→ **FREEZE BUTTON:** freezes the reverb creating an infinite recirculation in the feedback loop, which is reminiscent of what called a '*wall of sound*'. When *REVERSE REVERB* is activated (see above), *FREEZE* button (23) activates and deactivates **LOOPER** for the delay (recirculating delay's audio buffer) instead of the reverb's freeze.

→ **NOTE** ^{FW 1.01}: when switching from Reverb with *FREEZE* on to Reversed reverb and vice versa, the recorded buffer will be cleared and you will be returned to normal *NON-FREEZE* states.

DYNAMICS SHAPING

In order to tame our signal at the end of the main processing chain we have the following dynamics blocks: *COMPRESSOR* and *SIDECHAIN* ducking envelope.

COMPRESSOR

One-band peak stereo compressor controlled by a single knob (32), from none to light to heavy compression settings with pre-defined and manually tuned values to fit various music styles for best performance. Compressor behavior varies on the audio material and music taste. We recommend setting around 12 o'clock for ambient/pads and full clockwise setting for obtaining snappy drums.

SIDECHAIN DUCKING

Sidechain ducking '*compression*': this is the last stage in the audio chain before the final *post-VCA VOLUME* control (34). The sidechain envelope is triggered using the ***SIDECHAIN TRIG. INPUT*** jack (29). Its release time is set with the ***SIDECHAIN*** knob (30). Its depth of ducking is set by holding the ***ROUTING*** button while turning that ***SIDECHAIN*** knob (30).

PARAL-LEL PROCESSING *FW V2.0*

Global dry/wet can be accessed via ***ROUTING + VOLUME/drive*** – that combo sets the mix between the input signal after the *IN GAIN* (before *pre-VCA*) at full CCW and the final audio chain output before the *VOLUME* (before *post-VCA*) at full CW.

RESET

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

Press all four buttons (16) (17) (23) (25) simultaneously and hold them for more than 3 seconds. Release them once they are all four on, and module will reset to its default values.

After the module's reset: Delay's and Reverb's */TONE** controls are in the middle (no tone filtering applied); Reverse reverb pre-delay set to max, Hall reverb pre-delay set to min, MIX control set to FULL WET (100%, CW value).

PATCH EXAMPLES

KARPLUS-STRONG SYNTHESIS *ROUTING 1*

Ghost can function as a complete Karplus-Strong Voice by using the delay at the shortest time setting for sound generation and built-in filter, VCAs and envelope as tonal / dynamics control.

→ Set the **ROUTING** mode to the first order (*FX*→*DISTORTION*→*VCF*) when **ROUTING** button LED is off ○

→ Set **REPEATS** to maximum with **TIME/DIV** delay time turned fully CCW. Moderately adjust **DELAY DRY/WET** to the 12 o'clock

→ Feed any audio to the GHOST audio inputs to start up the Karplus-Strong sound generation. You will hear a strong recirculating oscillator sound of approximate C4 note (~261 Hz). Its amplitude is rather high, therefore it is convenient to adjust it by **DELAY DRY/WET** knob

→ Patch a trigger / gate signal from your sequencer to the **SIDECHAIN TRIGGER** input: this will trigger an internal envelope that will come out from the **ENVELOPE OUT**. The decay of the envelope is controlled by the **SIDECHAIN** knob

→ Patch the signal from the **ENVELOPE OUT** to either **DELAY DRY/WET CV IN** or the **POST-VCA** input to shape our oscillator in different stages

→ Split the **ENVELOPE OUT** signal and patch it to the **VCF CV** input for additional tonal shaping

→ Connect the 1v/oct **PITCH CV** output from your sequencer and patch it to the **TIME CV 1V/OCT** input of the **DELAY**

→ **TIP:** if you would like to add one extra octave to the available **PITCH** range of the delay, set the **TAPS DISTRIBUTION** to **STEREO** mode via **ROUTING + TAP**.

LOW-END GROOVE A.K.A. TECHNO RUMBLE BASS *ROUTING 2*

Modern techno music is defined by a groovy low-end rumble, which along with the kick drum defines the key element of the style. Ghost can generate such rumble from any transient sound or same kick applied into the audio inputs.

→ Set the **ROUTING** mode to the second order (*DISTORTION*→*VCF*→*FX*) when **ROUTING** button is semi lit ●

- Split your banging techno 909-style kick drum and apply it into **AUDIO IN 1**
- Set the **DISTORTION** and **COMPRESSOR** knobs to own taste, usually around 12 o'clock
- Set the **VCF** filter type to normal *LP/HP* and set the filter **FREQUENCY** knob around 11 o'clock
- Apply clock from your sequencer into **CLOCK IN** jack (typically expected in 16th notes) and set the **TIME/DIV** knob to obtain desired repeats. Set **DELAY DRY/WET** and **REPEATS** to own taste, usually both around 12 o'clock
- Enable **REVERSED REVERB** by **ROUTING + FREEZE/reverse***. Set **REVERB DRY/WET** and **TAIL** to your own taste until you obtain a whooshing sound. For proper groove set the pre-delay amount by **ROUTING + TAIL/preleday*** to approx. 12 o'clock
- Apply kick-drum trigger into **SIDECHAIN TRIG IN** jack. Set the ducking envelope amount to 50% with **ROUTING + SIDECHAIN** to 12 o'clock. Then move **SIDECHAIN** knob alone to around 10-11 o'clock to catch the proper pumping time
- Mix the sound from **AUDIO OUT 1/2** with the original kick drum using a mixer such as Cockpit 2
- **TIP:** *it is best to keep your low end consistent or even better - MONO. So when using the delay to create the rumble, set **TAPS DISTRIBUTION** to STEREO mode via **ROUTING + TAP** to avoid PING-PONG effect or simply only use **AUDIO OUT 1**.*

GHOST DRONE *ROUTING 3*

GHOST structure and multidimensional modulation matrix is capable of producing dark drones and ephemeral soundscapes full of texture and harmony.

- Set the **ROUTING** mode to the third order (*VCF→FX→DISTORTION*) when **ROUTING** button LED is off when **ROUTING** button is fully lit ●
- Select the **COMB FILTER** by pressing the **ROUTING + FILTER BUTTON** and set the **RESONANCE** fully CW
- Patch a variable waveform oscillator into the **AUDIO IN 1**, SAW and SQUARE waves work best. Feed an additional envelope or LFO to the **pre VCA input** on the GHOST to create movement. Patch the **AUDIO OUT 1/2** to your mixer
- Set **DELAY DRY/WET** to 80% with **REPEATS** around 30-40%, adjust the **REPEATS/tone*** by pressing the **ROUTING + REPEATS** knob to around 13:00 - 14:00. Sync the delay by sending a clock from your sequencer into the **CLOCK IN** and leave **TIME/DIV** knob at 12:00
- Set **REVERB DRY/WET** to 60% with a moderate **TAIL** amount at around 40%. Adjust the **PRE-DELAY** by pressing the **ROUTING + turning the TAIL/predelay* knob** to approximately 70-80%

- Set ***DISTORTION*** to 20% and ***COMPRESSOR*** to 70% to bring in some noise
- Send a PITCH sequence to the ***VCF CV*** input. ***COMB*** does not track 1v/oct, but this allows you to highlight frequencies without doubling the amplitude of the fundamental of the sound source. Set the ***FREQUENCY CUTOFF*** knob to 11:00 with ***VCF CV*** attenuverter fully CW
- Start the sequencer and listen how GHOST creates timbres on top of a steady oscillator
- Patch another 1v/oct PITCH CV signal to your oscillator and play around with the notes, you will hear how new *ghost harmonies* appear, let them direct your next note.

HALF-LIFE λ DR. ISAAC SPEECH *ROUTING 1 FW V3.0*

GHOST module is a perfect processor for game design. With the sample rate and bitrate reducers added with the firmware V3.0 is now very easy to create post-apocalyptic walkie-talkie, megaphone or radio speech simulation. The patch below instantly teleports us into surroundings of The Citadel from City 17 or Black Mesa.

- Set the ***ROUTING*** mode to the first order (*FX*→*DISTORTION*→*VCF*) when ***ROUTING*** button LED is off
- Patch any human speech into the ***AUDIO INPUTS 1/2***. Ensure the applied audio is a proper level with pressing ***ROUTING + TONE/gain**** at 50-100%. Setting lower values of audio signal may cause audio dropouts during bitrate reduction process
- With the hall reverb selected (***FREEZE/reverse**** button unlit) set ***REVERB*** and ***TAIL*** to 50%. Similarly set ***DELAY*** and ***REPEATS*** to 50%. Set first LRLR tap distribution and clock time around 9 o'clock
- Apply audio fidelity reduction: set bit reducer with ***ROUTING + DISTORTION*** to 50% and similarly reduce the sample rate with ***ROUTING + RESONANCE*** to 50%
- Play with the ***FILTER FREQUENCY***, ***DISTORTION*** and ***COMPRESSOR*** to achieve desired level or sound damping and clipping.

FIRMWARE UPDATE

Firmware updates are essential for any digital modules. They bring new features or bug fixes. Feel free to write any bugs, features ideas or improvements to beta@endorphin.es

Update procedure video: <https://youtu.be/J89PHM04ZJk>

To update the firmware on your Ghost, first download the latest firmware file once available on ENDORPHIN.ES website:

<https://www.endorphin.es/modules/p/ghost>

The update procedure is done 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 modular system
 2. Unplug all the cables from GHOST except a simple mono or stereo cable connecting the audio output from your computer headphones output to the **AUDIO IN 1** input of the module
 3. Set the output volume of your computer to 100% or slightly lower
 4. Hold **ROUTING** while powering your system ON - you will see both **CLIP** and **/ENV DEPTH*** LEDs on
 5. Open the *GHOST_UPDATE_XXX.WAV* file with any audio player. Press play and wait 1.5+ minutes while the firmware is updating. Both **CLIP** and **/ENV DEPTH*** LEDs will slowly blink during that procedure and a row of 4 buttons will show the approximate signal level as imaginary VU meter. Try to adjust the volume of the update so it will not clip but also will be enough level to blink the VU meter
 6. If all 4 buttons LEDs blink fast during update or both **CLIP** and **/ENV DEPTH*** LEDs stop blinking, that means an error occurred in the update and you have to stop the audio file playback, reset the firmware listening input (single **ROUTING** button press), adjust the audio file playback volume and then start it again
 7. The module will reboot automatically after new firmware installed and will act normally with TAP button blinking. That's a good sign that update was successful
 8. To ensure the hidden parameters are all properly set after the update, it is also recommended to make a module's reset by simultaneously pressing and holding all its 4 buttons for 3 seconds (see page 15)
 9. Enjoy the new features
- **IMPORTANT:** *to prevent the errors during the audio playback of the firmware, please use any audio editor without any effects applied (EQ, room correction etc.)*

CREDITS

ENDORPHIN.ES x ANDREW HUANG – GHOST

COLLECTION SPRING/SUMMER 2023

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

Hardware design, code direction by Andreas Zhukovsky

Core engine programming by BSVi

Firmware polishing & parameters curves by Kouik03

Manual proofreading and beta testing by Wisdom Water

ENDORPHIN.ES are made in Barcelona, Spain

Follow, like, post and tag us at Instagram: [@endorphin.es](https://www.instagram.com/endorphin.es)

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; EN55103-2:2009 (EN55024); EN61000-3-2; EN61000-3-3

Low Voltage: 2014/35/EU

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

RoHS2: 2011/65/EU

WEEE: 2012/19/EU