Terminal 4

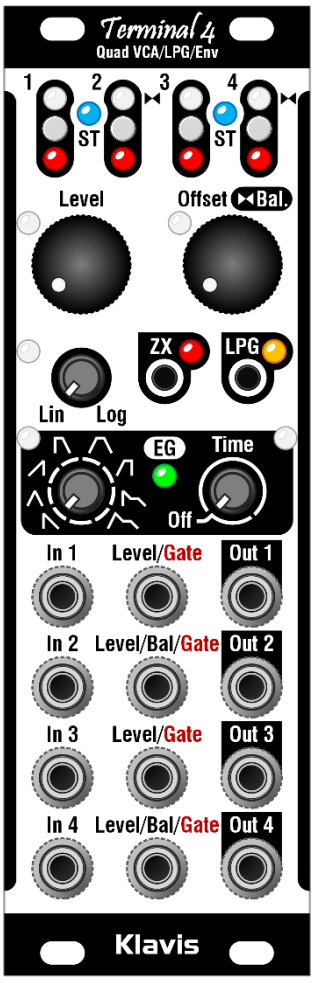
Quad VCA/LPG/Envelope generator - User manual

Klavis' Terminal 4 is the result of years of exploration around a simple question: "What can still be added to the world of VCAs that doesn't already exist?" It took time — but here is the answer. The result is a compact module that effortlessly behaves as:

- a pristine quad VCA
- four organic low-pass gates (and more)
- a bank of highly expressive envelopes
- a flexible stereo imager and final mixer

… or all of these simultaneously.

From the smallest skiff to the largest modular system, once you've used Terminal 4, it quickly becomes indispensable. It truly stands apart.



Features at a glance

- Four independent DC-coupled VCAs
  - Zero-crossing for click-free transitions
  - Channel pairs configurable in stereo
  - Stereo mode with balance control and CV
  - Lin/log response for external CV
- Each VCA can operate as an LPG with 3 modes:
  - 6dB/oct soft Vactrol emulation
  - 12 dB/oct classic Vactrol emulation
  - 24dB/oct LPG/VCF hybrid
- 4 Envelope generators,
  - Can drive their VCA/LPG (lin/log)
  - Or output envelope CV (lin/exp)
  - Envelope types: ADR, AR, ASR, ADSR
  - Multi-segment proportional time control
- Matrix mixer with flexible mono/stereo outputs
- LED indication of pots parameter matching
- Per-channel clipping indicators
- Stereo status LEDs
- Settings restored after power cycle
- Firmware update via a audio file
- 2mm thick aluminium panel
- Compact skiff-friendly design

Table of Contents

Installation and security

Purpose

This module is meant for installation in a Eurorack-compliant system and meets Eurorack mechanical and electrical specifications.

Do not use this module outside of a Eurorack environment.

Installation

Power requirements

Before installation, disconnect your modular system from the mains power. Some power supplies are not safely isolated and may present a risk of injury!

Check in the specifications whether the module requires a 5 V rail.
If your system does not provide 5 V, do not connect the module.
A Klavis NoDrain adapter can supply the required 5 V.

Ensure that the total current consumption of your system — including this module — does not exceed your power supply's limits.
Calculate the total current draw separately for: +12 V, –12 V, 5 V
If any limit is exceeded, upgrade your power supply before installation.

Supply cable connection

The supplied ribbon cable is keyed on the module side and cannot be connected incorrectly.

However, care must be taken when connecting it to the bus board. Unshrouded connectors may allow incorrect insertion, which can short power rails and potentially damage modules.

The red stripe indicates –12 V
Align it with the –12 V marking on your bus board

Always double-check orientation before powering on.
If anything appears abnormal, immediately switch off the system and recheck connections.

Firmware update

Version check

- Hold ZX + LPG while powering up the module
- The top row LEDs will indicate the version according to the table below
- Switch the power off to exit version checking

General recommendation

Always ensure that your module is running the latest firmware version before use. Firmware updates are performed by playing an audio file (e.g. Terminal4_Vx.wav) into the module.

Procedure

- Put a mono or stereo cable from your audio device's headphone output and Level input 4
- Set the playback volume to approximately two thirds
- While holding ZX and LPG, power on your modular system
- The 5 potentiometer-LEDs and the LPG LED begin flashing; this indicates the module is ready to receive the update; the top row shows the current version (see table)
- Start playback of the firmware audio file

During update

- The LPG LED remains on while data is received
- The top-row LEDs show update progress

Successful update

- The [EG] green LED turns solid ON
- Press any button to restart the module

Identified errors

- All red LEDs flashing: download error
- With red LED 1 steady on: no audio playback at startup
- With red LED 2 steady on: sound too low -> increase slightly
- With red LED 3 steady on: inadequate audio file

Restart the procedure.

Version	LEDs ON
1	● ● ● O
2	● ● O ●
3	● ● O O
4	● O ● ●
5	● O ● O
6	● O O ●
7	● O O O
8	O ● ● ●
9	O ● ● O
10	O ● O ●
11	O ● O O
12	O O ● ●
13	O O ● O
14	O O O ●
15	O O O O

If an error occurs without clear LED feedback

- The input level may be too high → reduce it significantly
- Restart the full procedure

Other possible causes of error

- Touching or moving the cable during playback
- System sounds or notifications interfering with audio playback
- Power saving features affecting playback stability
- Electrical noise from nearby modules or poor grounding

Finding your way around the panel

The module comprises four sections called in focus by the 4 top-row buttons and associated white LEDs.

The row of 4 red clipping LEDs underneath the 4 buttons and the two ST (stereo) blue LEDs in between are relating to their nearby channel(s).

Shared control

All other controls (5 potentiometers + 2 push buttons) and LEDs are virtual and shared between the 4 sections.

Potentiometer-related white LEDs are lit when a knob position and the value it controls match. Values are only changed after the knob's pointer crosses the actual setting in the current section.

If the knob's physical position differs from the stored value, rotating the knob triggers an LED animation indicating the required direction of adjustment. The lights will flash twice once the current position matches the stored setting.

Connections

Signal inputs – In 1~4

These inputs accept audio and modulation signals, including DC and bipolar.

Level/Bal/Gate inputs

In this manual, we mostly refer to these inputs as control, CV, or Gate depending on the context.

The function of these inputs depends on the EG and/or stereo mode being enabled.

EG active	Stereo active	CV inputs 1 & 3 usage	CV inputs 2 & 4 usage
no	no	Level CV	Level CV
no	yes	Level CV	Balance CV
yes	no	EG gate/trigger	EG gate/trigger
yes	yes	EG gate/trigger	Balance CV

The Level CV input is bipolar to allow diminishing a fixed level applied with the Offset knob.

Signal Outputs – Out 1~4

The role of a signal output depends on the presence of a jack in the related signal input, and/or on the stereo mode being enabled.

- When there's no jack in a signal input, the output will be a positive voltage modulated by the CV control input or internal EG if enabled.
- When in stereo, in case there's a jack in input 1 (3) and none in input 2 (4), the signal 1 (3) will be replicated in channels 1 & 2 (3 & 4) to benefit from the Balance control and CV.

Controls

Channel selection 4-buttons + LEDs

The four buttons at the top select which channel is currently in focus for editing.

- Only one channel can be edited at a time
- The corresponding white LED indicates the active channel

All parameter changes apply only to the selected channel.

Stereo mode (ST)

Pressing simultaneously the buttons 1 & 2 (or 3 & 4) toggles the stereo mode for this pair of channels. Stereo active is indicated by the ST blue LED.

In stereo, the CV input 2 (4) becomes a balance control; a Balance setting is available.

Signal normalization in stereo

If input 2 (or 4) is left without jack, it replicates the signal from input 1 (or 3). This allows balancing a mono signal in the stereo field without duplication.

Level control

The Level knob determines how strongly the VCA/LPG is opened. Its behavior depends on whether a signal input is present.

- When there's a signal going from in to out, the Level knob controls the amplitude of the CV entering the Level (control) jack.
- When there's no jack inserted in the signal input, Level Knob and CV will control a permanent positive voltage. This is useful for signal curve shaping plus manual gain control. This is also used to control the generated envelope level

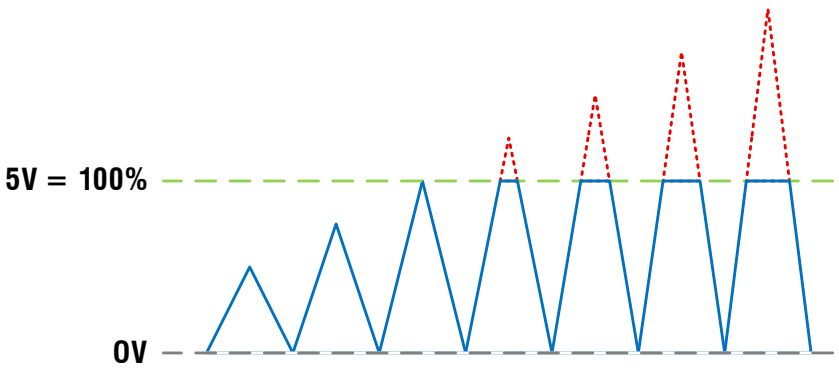
Clipping

Because the Level knob can amplify the Level CV, the VCA/LPG can reach its maximum opening before the incoming CV peaks! This is indicated by the red clipping LED.

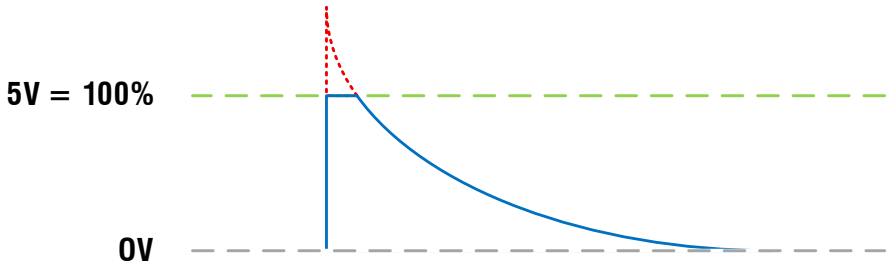
Such clipping does NOT distort the audio or modulation signal coming from the input. It only limits how much further the VCA can open.

Creative use of control clipping

However, when clipping, the Level CV will see its behavior changed:



This clipping can be put to good use deliberately; for example, by reshaping a modulation wave (above), or creating a little plateau flattening at the top of an external percussive envelope for punchier bass sounds. (below)



When the Level setting is acting on the on-board envelope, it cannot clip. Its control range is 0 to 100% by design. When generating an envelope CV the peak level is 8 Volts.

Offset/Balance control

1. Offset

Offset is available in in mono or stereo mode.

Offset allows part of the signal to pass even without modulation. With Offset set to the maximum, the Level pot and positive CV become irrelevant.

Offset is added to the Level CV or internal envelope. The more Offset is open the less room is left to modulate the remaining amplitude and the likelihood of clipping increases.

2. Balance (stereo)

This setting is only available when a pair of channels is set to stereo.

The two buttons 1 & 2 (or 3 & 4) in a stereo pair define the use of the Offset/Bal knob.

Selecting the odd channel (1 or 3) makes the knob acting on the Offset; the other button (2 or 4) calls the Balance setting. See the printed reminder (bow-tie like).

Set halfway, the Balance knob applies an equal amplitude to both channels of the stereo pair. The even channel control CV becomes a balance control. Negative/positive voltage pushing towards odd/even channel.

Constant loudness perception

To maintain consistent perceived loudness across all Balance settings, the circuit reduces the overall amplitude when both channels are at equal level (center position). This ensures the perceived volume remains the same whether the sound is panned fully to one side (one channel only) or centered (both channels). Consequently, the same signal pair will sound quieter in stereo versus dual-mono.

Lin/Log

This setting affects the Level CV signal and the envelope generator, but behaves differently for each of them.

Whatever the setting, the maximum amplitude of the signal remains unchanged.

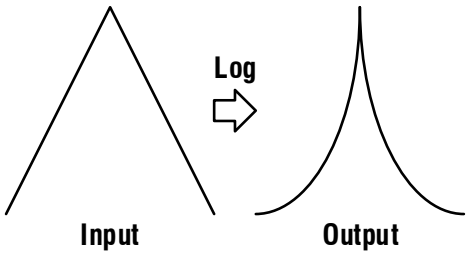
1. Action on the Level CV

- Lin (linear) → the control signal shape is preserved
- Log (logarithmic) → lower signal levels are attenuated more
  This can produce a response similar to traditional audio mixer faders

Important:

- The waveform shape itself is not distorted
- Only the amplitude response is reshaped

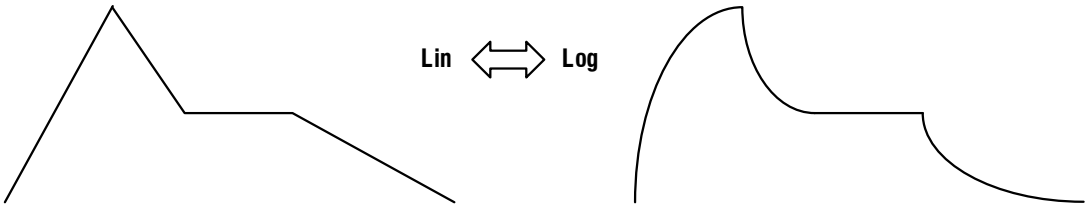
Note that the Log setting allows much pronounced curvature than found in analog VCA circuits.



2. Action on the built-in envelope generator

The behavior of Lin/Log on the built-in EG is very different from the one applied to external CV. Here, Lin setting means that the envelope A, D and R segments will present straight (linear) slopes.

Conversely, turning the knob towards Log, a two-thirds setting will replicate the classical analog curves. Going further up, leads to extreme curvatures, up to approach "instant" transitions.



Note on terminology

The Lin/Log knob labeling could be misleading. The convention is that analog envelopes present exponential decay curves. In math, swapping the time and level axes of an exponential curve produces a logarithmic curve (showing that the two are simply a matter of perspective).

In our labelling, Lin meaning 'unchanged signal' or 'straight lines', and Log referring to a 'applying a curvature'.

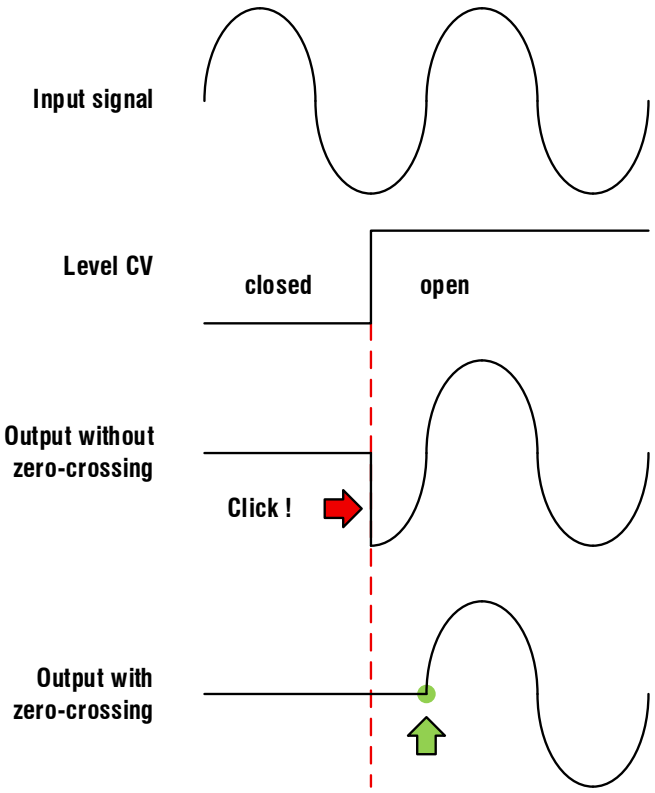
ZX – Zero-crossing button

ZX is designed to prevent clicks in audio signals that happen when the amplitude changes abruptly in the middle of a waveform.

Activating ZX applies the level change after the audio wave is at zero volt, which occurs twice per wave cycle.

Cutting through a waveform creates a sharp edge. Such edge contains an infinite number of harmonics resulting in a very audible click.

ZX and the LPG variations are exclusive.



LPG – Low-pass Gate

This feature changes the VCA into a low-pass filter / VCA combination and offers 3 pre-set variations. Presets are activated and selected by cycling through them with repeated presses of the LPG button. (1, 2, 3, off, 1, 2, …). To quickly switch off the LPG without cycling through all steps, press the ZX button twice.

Step	Function	LPG LED
Off	Off = VCA only	Off
1	LPG 6dB/oct	On
2	LPG 12dB/oct	On with single off-pulse
3	24dB/oct LPF/VCA combo	On with double off-pulse

ZX and LPG are exclusive.

LPG 6 dB/oct

This 6 dB/oct vactrol LPG emulation offers a gentle, open response, ideal for preserving transients and add subtle acoustic shaping. It complements the classic 12 dB/oct version by providing a lighter alternative.

LPG 12dB/oct

A vactrol-based 12 dB/oct LPG is renowned for its smooth, organic response, a hallmark of classic West Coast analog designs. Our emulation faithfully captures this natural behavior and distinctive acoustic character. It delivers the warmth of a true analog LPG.

24dB/oct LPG/VCF hybrid

This third variation is not a direct LPG emulation but adopts the LPG concept of coupling filtering and amplitude control. The VCF part relies on a resonant OTA 24 dB/octave emulation. Moderate resonance ensures maximum versatility.

The unavoidable timbre/level relation!

Since LPGs imply a tight coupling of level and filtering, the Level control knob and CV act on both sound aspects simultaneously. It is possible that the sound you desire will not be at the appropriate level, with the need to amplify/diminish the sound from the T4 output by a level control module.

Envelope generator (EG)

The EG is built around the concept of template selector. Further variations are made by:

- Global Time control, which acts on all durations jointly
- Level which is also a timbral control with LPG
- Lin/log curve setting allowing dramatic dynamic changes
- Offset that adds droning to the envelope
- Gate duration acting on the switching from Decay to Release

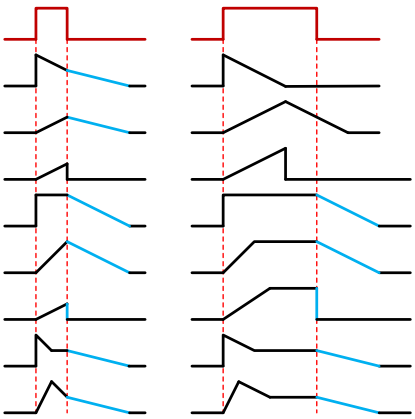
EG modes – internal vs. external

When a signal is present in the section's input, the EG controls the VCA/LPG internally. When there is no jack in the input, the EG becomes an envelope generator whose CV is available at the output; the VCA and LPG capabilities are disabled.

Envelope template selection knob

The templates offer various envelope types whose overall duration is set with the Time knob. However, when the icon shows a vertical line, that segment is instantaneous, thus unaffected by the Time setting.

The icons are drawn with a linear setting for ease of identification.

Order	Type	Icon	Relation to gate	Max A	Max D	Fixed S	Max R
1	ADR			0s	8s	0%	8s
2	AR			8s	8s	0%	8s
3	AR			8s	0s	0%	0s
4	ASR			0s	0s	100%	8s
5	ASR			4s	0s	100%	8s
6	ASR			8s	0s	100%	0s
7	ADSR			0s	4s	70%	8s
8	ADSR			2s	4s	70%	8s

Time knob

This knob sets the duration of the longest segment in the current template to 8 seconds. However, when D and R are potentially consecutive, as in templates 1 and 8, the overall slope down can get longer than 8 seconds. Chaining depends on moment the gate goes off, offering a dynamic control of the duration.

When the knob is turned fully down, the EG is disabled and its green LED is Off.

When the EG is on, the CV control input becomes a gate/trigger input. (see exception in stereo)

Mixer

The module automatically mixes unconnected outputs together, up to 4 > 1, or twice 2 > 1. See also mono/stereo hereafter.
To avoid saturating the outputs, each channel's contribution is reduced as more channels are mixed

When not using all channels in the module, it is good practice to use the lowest-numbered channels first. This prevents unintended mixing with lower numbered channel outputs left unconnected.

Mono

When channels are mono, an output left unconnected will be mixed into the next channel up.

Stereo

As soon as there's at least one pair set to stereo:

- If unconnected, out 1 is mixed with output 3
- If unconnected, out 2 is mixed with output 4

Besides mixing two stereo pairs, it is possible to mix two mono channels into one stereo, or reverse. Mono channels will benefit from individual settings, while the stereo pair will benefit from balance control. Of course, the mono channels will be hard-panned!

Autosave over power cycle

The module automatically memorizes the last settings using six independent memory slots:

- Four slots are dedicated to the four channels when mono.
- Two additional slots are used for the stereo settings of paired channels.

All current settings are automatically saved on power-off and restored on the next power-up. To ensure the latest changes are saved correctly, avoid making adjustments during the last 10 seconds before power-off.

Use cases

General advice

Channel usage preference

Use preferably the lowest numbered available channel. This will prevent unexpected results due to mixing with channels left with unconnected outputs.

Modulation rate

For consistent results, the Level and Balance control CVs frequency should not exceed 2KHz.

VCA/LPG with external CV control

Processing of audio or any modulation type signal is valid

With the EG off, the control jack expects a CV.
To the exception of the two EG pots, all settings are available (balance only when stereo).

Keep in mind that the VCA opens with positive voltage only.
Nevertheless, by setting some Offset, it is possible to use a negative CV to reduce the level by CV.
This is how a bipolar LFO signal can fully modulate the VCA (Tremolo).

VCA/LPG using the built-in EG

With the EG LED on, the control jack becomes a gate/trigger input.
All settings are available (Balance only when stereo).

Stereo uses

Bring two signals in the 1-2 or the 3-4 pair and press the related selection buttons simultaneously to light the ST blue LED. Press the same way to exit stereo mode.

You now have access to a Balance control and its CV. When channel 1 (3) is lit the Offset/Bal controls the Offset, selecting channel 2 (4) makes that knob controlling the Balance setting. The control jack 2 (4) is a bipolar Balance CV, with negative voltage pushing the signal towards channel 1 (3) and positive voltage towards 2 (4).

Stereo in to stereo out

Bring two audio/modulation signals to in 1-2 (3-4). All settings apply to both channels.

Mono in to stereo out

With stereo active and input 2 (4) left unconnected, the signal brought to in 1 (3) is replicated in both channels.

This use case is to benefit from the balance capability. Besides the obvious audio application, another practical example is to balance a modulation between two targets with knob and CV.

Balanced envelope generator

When using the built-in EG to generate a pair of balanced envelopes, there should be no jacks in both signal inputs.

Half-wave rectifier

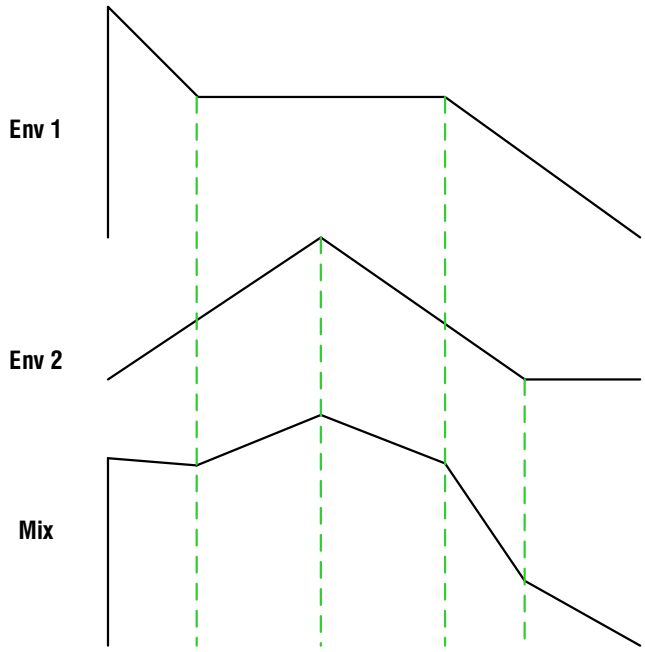
With no signal at the main input, the signal that enters the Level input sees its negative voltage filtered out, with only the positive part being output.

Shaping a modulation signal

The goal is to modify a positive modulation signal thanks to Log shaping and clipping. That modulation signal is brought to the control input, the "normal" VCA input is left unconnected.

Creating a complex envelope by mixing two channels

We use two built-in EGs and mix them. You need to duplicate the gate signal. The output will be taken from the second output of any consecutive pair of channels.



If you miss some AND or OR gate

A DC-coupled VCA can do the job of an AND logic gate. Bring the two signals to the Signal and Control inputs, crank up the level knob and that's it.
As for an OR gate, you get the mix of two channels with their offset open.

Both AND-OR can be combined.

Gate/trigger delay

Generate a envelope with EG template 3 (rise with instant fall). To ease the Time setting – especially for small durations - set the curve setting to Log and keep the Level moderate.

Summary of buttons use

Dual button uses

Combo	Function
1 + 2	Toggle stereo mode for channels 1-2
3+4	Toggle stereo mode for channels 3-4

Power-on button combinations

These functions are accessed by holding the buttons while applying power

Combo	Function
Ch.1 + ch.4	Factory reset to restore the module in its default settings
ZX + LPG	Enter firmware update mode

Summary of LED indications

LEDs provide real-time feedback on module status.
Some indications use short "off pulses" (brief LED dips) to differentiate modes.

LED		On	Single off pulse	Double off pulse
Name	**Color**			
Channel 1-4 selection	white	Ch. selected		
Channel 1-4 clip	red	Control clipping		
Stereo	blue	Stereo active		
ZX	red	ZX active		
LPG	yellow	LPG 6dB/oct	LPG 12dB/oct	LPG/VCF 24dB/oct
EG	green	EG active		

Potentiometer LEDs

LED		Off	On
Pot LEDs	White	Knob does not match the setting	Knob matches the setting

Specifications

Mechanical

Dimensions	mm	inches	Eurorack compliance
Height	128.40	5.06	3HE
Width	40.40	1.59	8HP
Depth behind panel (no supply cable inserted)			

Weight 90 grams/3.17 ounces (module only), 160 grams/5.64 ounces (boxed)

Supply

The supply socket is protected against reverse insertion.

Supply rail	Current draw
+12V	61mA
-12V	21mA

Input/output

All inputs and outputs can withstand signals between -12V and +12V without harm.

Jack	Effective voltage range received or generated
Inputs and Outputs	17Vp/p
Level control input	17Vp/p
Gate control	1V minimum

Packing list

The box contains:

- Terminal 4 module
- 4x M3 black mounting screws + washers
- Eurorack-compliant 16/10 pin supply cable

Klavis products, including PCBs and metalwork, are designed and manufactured in Europe.