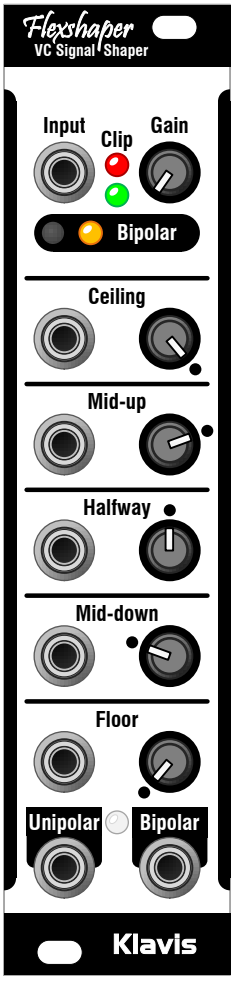
Flexshaper voltage mapper

CV-controlled voltage mapper and waveshaper

Introduction

The Flexshaper is a highly versatile module when it comes to modify evolving voltages in other directions and levels. Five settings allow you to fold/expand/clip/compress/invert partially or completely any CV or audio signal. The module can act as an envelope-shaping tool, frequency multiplier, waveshaper, clipper, distortion, limiter, curve changer, and more. Five CV inputs offer limitless control over the placement of the voltage points for dynamic signal sculpting.



Features at a glance

- Process from DC to full audio range
- Unipolar/bipolar input mode switch
- Nominal & clip level LEDs
- Output signal LED
- Input gain knob for nominal level setting, allows clean flat clipping when overdriven
- Five manual voltage mapping potentiometers
- Five CV control of the voltage mapping points
- Simultaneously active unipolar and bipolar outputs
- Firmware update via a simple audio file
- Compact and skiff-friendly module

Installation and security

Purpose

This module is meant for installation in a Eurorack-compliant chassis.
It adheres to Eurorack Doepfer mechanical and electrical specifications.

Do not attempt using this module in other mechanical or electrical contexts.

Installation

Before the installation, disconnect the mains power supply from your modular system. Some power supplies are not safely isolated; there is a risk of injury!

See in the specifications if this module requires 5V from the supply rails. If 5V is needed and your rack is not providing 5V, do not attempt connection!

Check that the current consumption requirements of this module, when added to your installed set of modules do not exceed the available current from your supply. This is done by adding up the current draw of all modules (mA) separately for each of 5V, 12V and -12V rails. (1000mA = 1 amp). If any of these 3 sums exceeds the available current of your supply for that voltage, do not connect the module to your system; you need a stronger power supply.

The provided supply flat cable can only be inserted in the appropriate orientation at the back of the module, so there is no risk of error on that end. However, you should pay attention to the orientation of the cable in the socket of the supply PCB inside your chassis. Cheap sockets without shrouding may allow you to plug in the connector the wrong way!

The red stripe on the cable should match a stripe printed on the supply board. The stripe also indicates the -12V side. In case there is no stripe, a -12V marking is a safe indication of the orientation.

Double check that the connectors are fully inserted and correctly oriented before switching on the power supply. In case of an anomaly, switch off the power supply immediately and check everything again.

Firmware update

If needed, the product can be updated by playing an audio file such as "Flexshaper_1.00.wav".

Not finding any file on Klavis web product's page means there is no update available.

Procedure

- Connect a mono or stereo cable between your audio playing device headphone output and the Flexshaper input.
- Prepare to play the audio file
- Set the play level of your playing device at two thirds
- While pressing the Bipolar button, switch on your modular case supply
- The yellow LED will flash
- Start playing the audio file

If everything goes fine

- The yellow LED will goes steady on
- As the update is progressing, the output white LED will go brighter
- When the white and green LEDs are flashing, the firmware is updated successfully
- Press the button to restart the module

If the sound level is too low

- The red, yellow and white LEDs will blink
- Stop audio playback
- Slightly increase the audio playback level
- Press the button
- Start audio playback from the beginning

If there is an error during the playback

- The red and white LEDs will blink

It is possible that the sound setting was too loud to begin with.
Diminish the sound level drastically and restart the procedure.

Playback error can also be due to various parasitic sound causes:

- Touching the cable
- Using sound-generating features of your phone or computer
- Some power saving feature affects the audio playback
- Surrounding noisy modules, bad electrical grounding or modular supply noise

Birth of the product

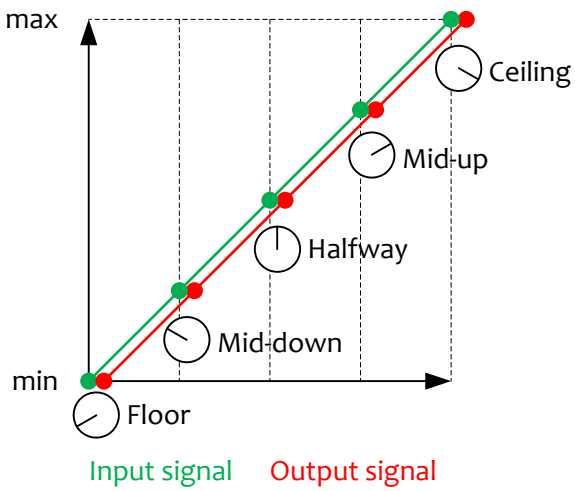
The idea of the Flexshaper comes from a feature in the Oberheim® Matrix synthesizers called Tracking Generator. This signal processor was part of the modulation matrix and meant to be virtually inserted between modulation sources and destinations in order to change the shape of the controlling signal.

The Flexshaper applies the same concept using the same 5 shaping points. However, it goes beyond Oberheim's implementation on two main aspects:

- It goes fast enough to process signals at full audio rate
- The 5 points are dynamically adjustable (CV) in real-time

Besides, the Flexshaper can process adequately bipolar and unipolar Eurorack signals.

Concept of voltage mapping



Note: actually the input and output lines should superpose exactly; they're here shown apart for clarity.

Incoming voltages are divided in 4 consecutive ranges defined by 5 points. The floor and ceiling points define the minimum and maximum voltages processed. Voltages beyond those limits will be considered at the limit. Three other points are set equally between the floor and ceiling points.
The knobs tell for each point's default place where the incoming voltage should go. In other words, the knob "Halfway" defines where a voltage entering at halfway will end up.
When the knobs are set as shown, outgoing voltages are replicating the incoming voltages. The module does "nothing". With such default setting, we define that what comes at the top should go at the top, and so on for each setting point.

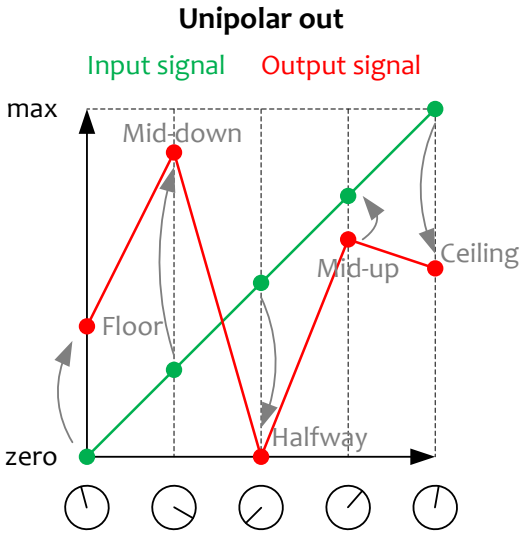
Unipolar and bipolar considerations

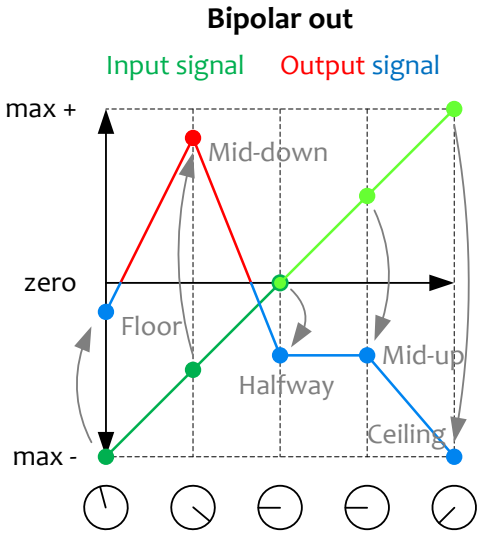
The Flexshaper handles unipolar and bipolar signals differently. To benefit from the entire control range, it is better to select the appropriate unipolar/bipolar setting.

Whatever the input setting, both unipolar and bipolar outputs are simultaneously available. The only differences between them are a voltage offset and the overall amplitude.

Nothing forbids you from entering a bipolar signal to use it as a unipolar result and vice-versa. This might be useful for modulation signals such as a (bipolar) LFO you want to use as a positive modulation only.

Here are examples of signal processing in both input modes.





Module description

Input

Bipolar button and LED

Selects the type of signal you bring to the module. When the bipolar LED is off, you are in unipolar input mode.

Gain button and level LEDs

To benefit from the best dynamics it is recommended to adjust the gain knob so that the green LED goes regularly on. If you want to avoid clipping, the red LED should never go on.

NOTE about clipping

Since signals beyond the valid range are clipped, they could not be handled differently from those reaching the top and bottom limits of the optimal range. Everything beyond a limit is considered at the limit.

However, clipping can be done purposely in order to achieve interesting wave shaping results.

The Flexshaper clips the signal in a perfectly flat and clean way; this feature is useful to purposely limit or flatten a signal.

Point setting knobs and CV inputs

The five setting knobs position the voltage for each level point. Default points are printed as black dots around the pots. When the pots' cursors match the dots, the output signal is identical to the input signal (besides possible discrepancy due to bipolar<>unipolar in/out mismatch)

The CV inputs add up to the manual setting of the knobs. The knobs are an offset of the CV.

Outputs and LED

Both outputs deliver the same signal with only the offset and gain being different. They can be used simultaneously.

The bipolar output is typically used for audio signals or LFO; the unipolar output could be used for envelopes or similar positive-only signals.

The output LED amplitude represents the unipolar signal. On the bipolar output, the LED off represents maximum negative voltage, half brilliance is zero volt, and full bright corresponds to maximum voltage.

Use tips

Shaping vs modulating CV signals – Setting the out level

Theoretically, the knob settings can modify a signal such as each setting point of the resulting signal is not only at the right place among other points, but also at the right overall level.

In practice, defining the shape and out level in a single operation is difficult to do.

It is much easier to shape the signal on the Flexshaper using the full range of the pots and patch a gain control on the output signal. Otherwise, one would have to tweak most Flexshaper pots every time the modulation needs a gain adjustment.

What input signals give the best results?

Since the Flexshaper remaps the voltages, it is better to have signals that go through voltages progressively and/or present several intermediate levels.

In this view, an audio square wave or gate signal are the poorest you can bring to the Flexshaper. Given that there are only two different levels (one min and one max), all the Flexshaper can do is change the overall level, offset and possibly polarity.

However, a simple audio/LFO triangle will allow creating various levelling effects given that a triangle shape goes progressively through all levels between min and max.

The most interesting audio shapes to process are found in wavetable, additive synthesis, FM and other VCOs offering shapes more complex than the ones in basic VCOs. Preprocessed or “final” sound are also interesting audio sources.

For modulation signals, LFO’s sine and triangle are interesting enough to be remapped; even better if they allow some waveshaping on their own. When using envelopes, non-zero attack, decay and release times as well as a sustain level away from min or max allow more creativity.

Dynamic clipping for more waveshaping – Adding a VCA

When doing waveshaping, we suggest setting up a modulated VCA in front of the Flexshaper and adjust the Flexshaper gain such as to clip deliberately. This will also change the relation between the signal and the setting points which will all move at once, creating drastic changes.

Applications

The examples are deliberately "academic" to help you understand the logic of the system. Any deviation from these examples and adding CV might result in more interesting results! ☺

Since the Flexshaper checks the various voltage levels to remap, waves with slopes tend to offer more interesting results. This is why the examples rely on sine, sawtooth and triangle rather than square or pulse waves.

Triangle to sine

Signal	Triangle
Mode	Bipolar
Gain	Very subtle clipping
Ceiling	Almost maximum
Mid-up	Just above default
Halfway	Default
Mid-down	Just below default
Floor	Almost minimum
Output	Bipolar
Result	Pseudo-sine

Altering the Ceiling and Floor settings inflects the min and max voltages for a rounder shape.
A subtle touch of clipping finishes the rounding off by shaving the top and bottom peaks.
If you can't look at the wave on an oscilloscope to fine tweak the settings, you can tell that you tend to a sine wave when sounds gets softer.

Frequency doubling saw to triangle

Signal	Saw
Mode	Bipolar
Gain	Optimal (green)
Ceiling	Maximum
Mid-up	Minimum
Halfway	Maximum
Mid-down	Minimum
Floor	Maximum
Output	Bipolar
Result	Triangle 2x Freq

Alternating the settings to min and max all along the slope creates a pair of perfectly shaped triangles.

This processing is also useful to create a second set of random levels behind a [sample& hold + noise] patch doing random steps.
The derived signal will be in perfect time relation but providing seemingly unrelated levels.

Frequency doubling – triangle to triangle

Signal	Triangle
Mode	Bipolar
Gain	Very subtle clipping
Ceiling	Minimum
Mid-up	Mid setting
Halfway	Maximum
Mid-down	Mid setting
Floor	Mimimum
Ouput	Bipolar
Result	Triangle 2x Frq

The floor setting at the opposite of the incoming wave makes the doubling. The two mid knobs are put halfway to linearize the slopes around the newly created triangle.

Frequency Tripling – sine/triangle to mixed wave

Signal	Sine or triangle	
Mode	Bipolar	
Gain	Optimal (green)	
Ceiling	Maximum	
Mid-up	Minimum	
Halfway	Mid setting	Maximum
Mid-down	Maximum	Mid setting
Floor	Minimum	
Ouput	Bipolar	
Result	Mixed wave 3x Frq	

By mixing slopes derived from doubling and quadrupling we end up with a signal that presents 3 cycles over the time of one incoming cycle.
There are two variations with a different timbre. By modulating the two related CVs with inverted polarity voltages, the timbre change can be automated.

Frequency quadrupling – triangle to triangle

Signal	Triangle
Mode	Bipolar
Gain	Optimal (green)
Ceiling	Maximum
Mid-up	Minimum
Halfway	Maximum
Mid-down	Minimum
Floor	Maximum
Ouput	Bipolar
Result	Triangle 4x Frq

Based on the Saw doubling example, both the rising and falling slopes of the triangle will each create two waves resulting in a triangle signal at four times the incoming frequency.

Half wave rectifying

Signal	Any bipolar wave
Mode	Unipolar
Gain	Optimal (green)
Ceiling	Default
Mid-up	Default
Halfway	Default
Mid-down	Default
Floor	Default
Ouput	Bipolar
Result	Top of the wave

By pretending that the wave is unipolar, the bottom half will be cut off.
The 5 settings will now apply to the remaining positive half of the incoming signal.
On the bipolar output, the resulting signal will be balanced around zero as a typical bipolar wave.

Deriving a melody

When fed with the V/Oct signal from a sequencer, it is possible to remap the incoming voltages to derive a second melodic line from the incoming one. If harmony needs be maintained, a melodic quantizer is required.

Input and output can be used in unipolar or bipolar as needed.

Doubling a decaying envelope

Signal	Falling envelope
Mode	Unipolar
Gain	Optimal (green)
Ceiling	Maximum
Mid-up	Minimum
Halfway	Maximum
Mid-down	Minimum
Floor	Minimum
Ouput	Unipolar
Result	Dual falling envelopes

This trick can be used for percussive sounds where a single decaying envelope becomes a pair of consecutive envelopes.
The peak level of the two envelopes can be set independently by the Ceiling and Halfway pots.

Several variations are possible by using the 5th pot and reassigning the role of the pots 2 to 5. Flats (holds) or two stepped-decay are then possible.

Specifications

Mechanical

Dimensions	mm	inches	Eurorack compliance
Height	128.40	5.06	3HE
Width	30.00	1.18	6HP
Depth behind panel (without supply cable)	21.00	0.83	

Supply

The supply socket is protected against reverse insertion.

Supply rail	Current draw
+12V	6 mA
-12V	7 mA
+5V	32 mA

Input/output

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

Jack	Effective voltage range received or generated
Main input	Minimum 1V p/p for full range processing
CV control inputs	+/- 5V
Unipolar output	0 to 8V
Bipolar output	+/- 5V

Signals

Parameter	Values
Processing Frequency range	DC to 20KHz

Packing list

The box contains:

- Flexshaper module
- 2x M3 black mounting screws + washers
- Eurorack-compliant 16-pin supply cable
- Quick setup notice

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