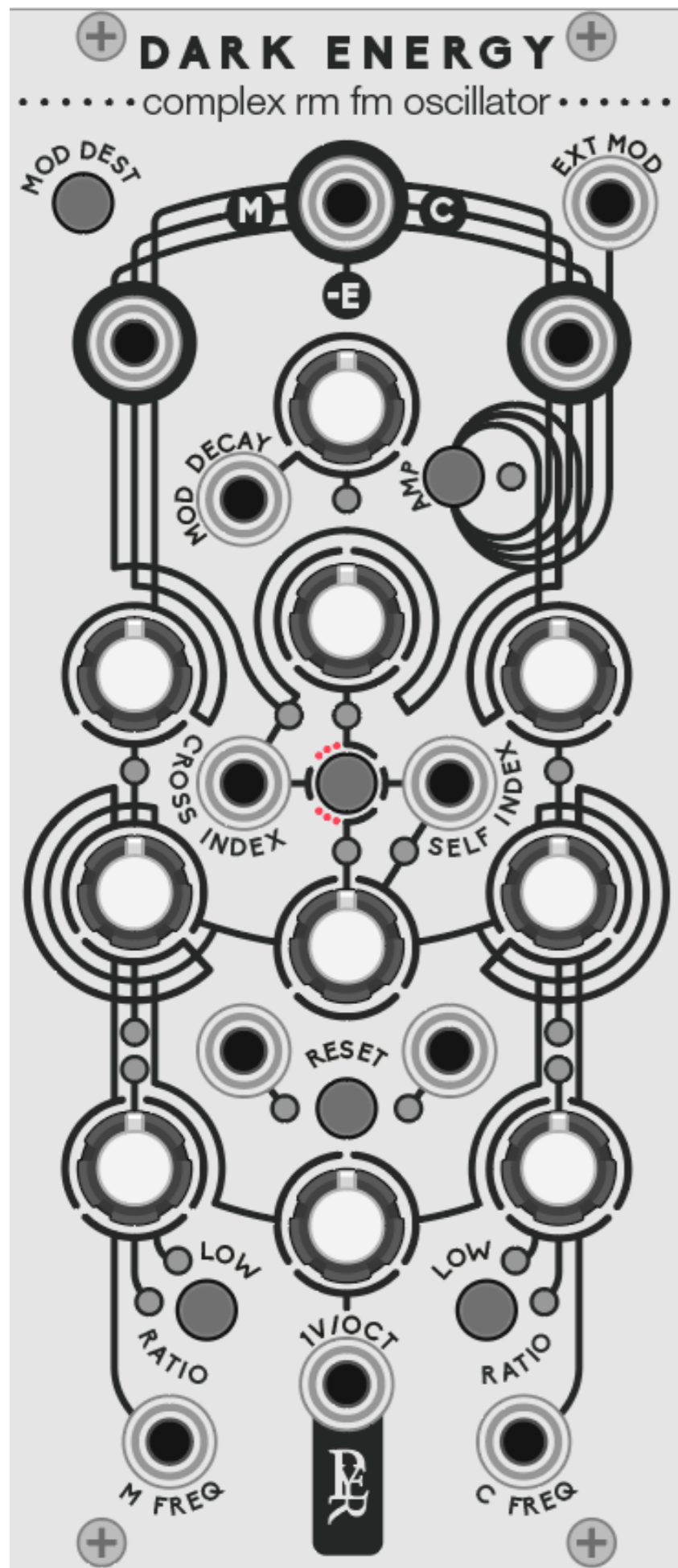


# GEODESICS

A modular collection for VCV Rack by Pyer & Marc Boulé



User Manual



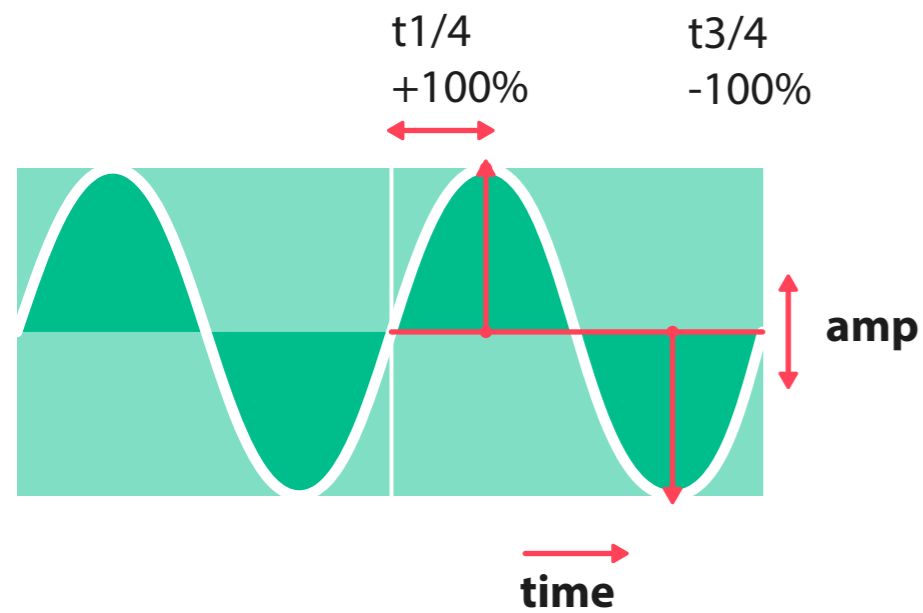
# DARK ENERGY

complex r.m. f.m. oscillator

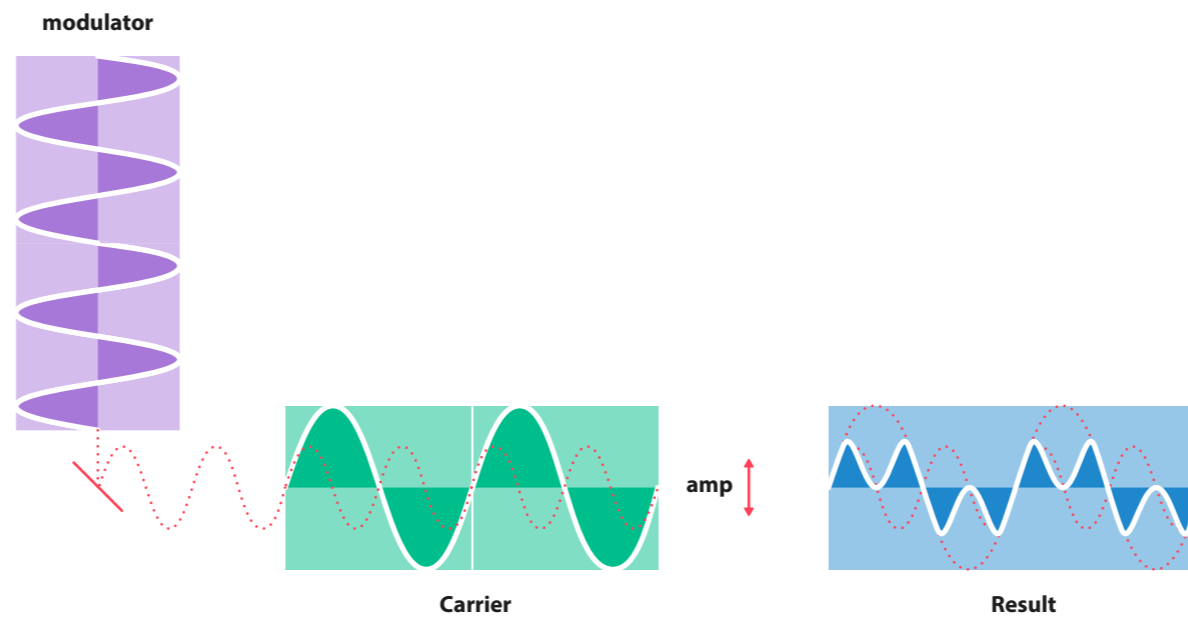
So much is known about energy but so little about dark energy, so much is yet to be discovered, for all we know, it is expanding over and over...

**DARK ENERGY** is the expanded version of ENERGY: a 3 outputs voice that combines ring modulation and FM synthesis inspired by complex oscillators from the past. Two sinewaves are modulated and multiplied in various ways for creating rich tones, from vibrating drones to sharp screaming leads and percussive effects.

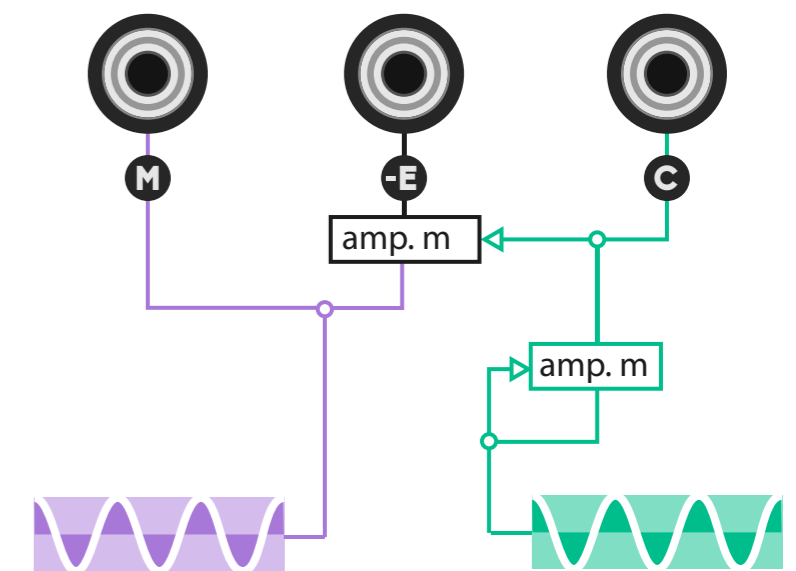
## Amplitude



## Amplitude (ring) modulation



## AM in DARK ENERGY

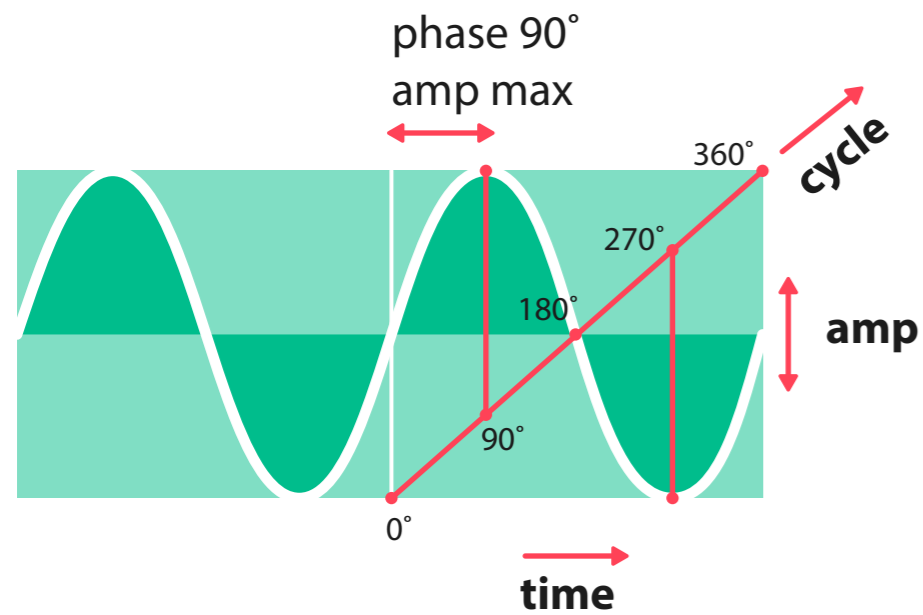


## Ring modulation (aka A.M.)

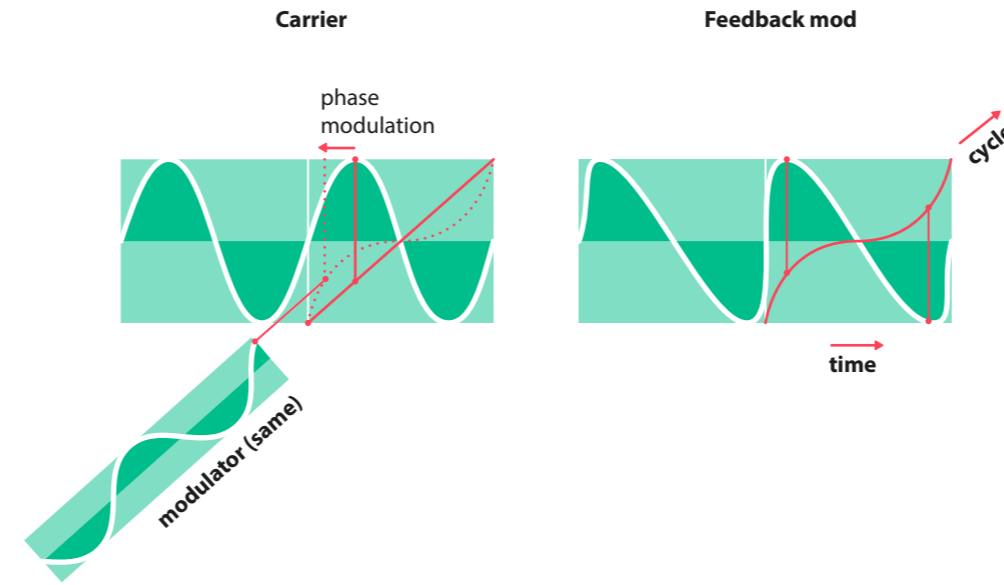
This analog (ring) or digital (amplitude) process multiplies two signals together. a modulator affects the amplitude of a carrier signal from 100% to -100%. A low-rate modulator creates a tremolo effect.

An audio rate modulator carves its own wave shape into the carrier. The result can be pleasant to the ear if the two frequencies are set in harmonic ratios. Breaking this harmony by just a little creates some experimental tones

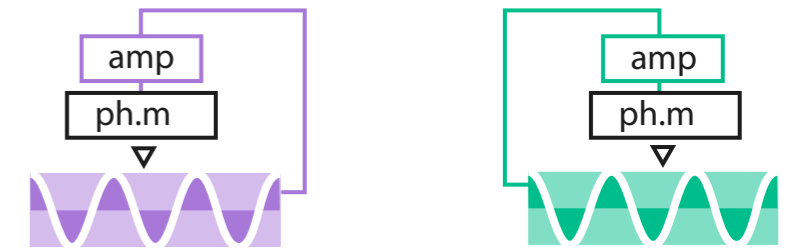
## Phase



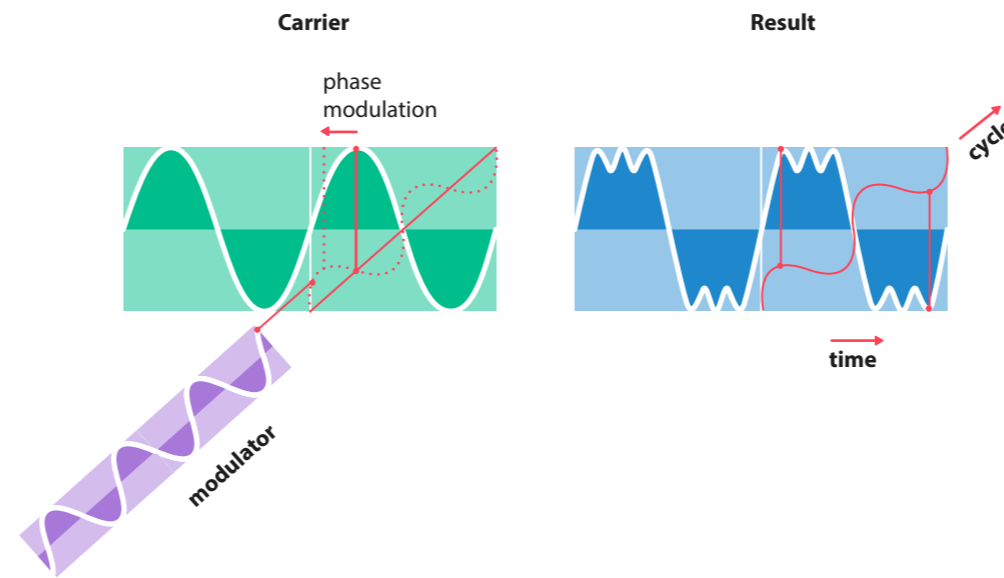
## phase (FM) self modulation



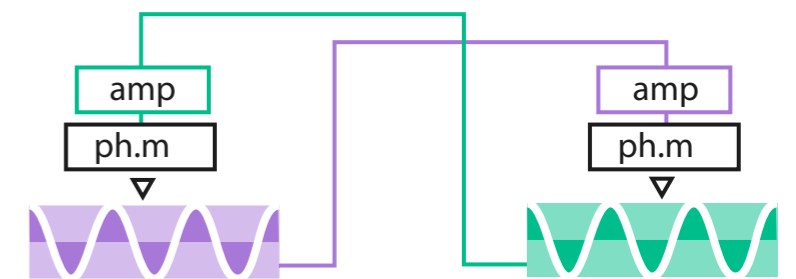
## self FM in DARK ENERGY



## phase (fm) modulation



## FM (crossed) in DARK ENERGY

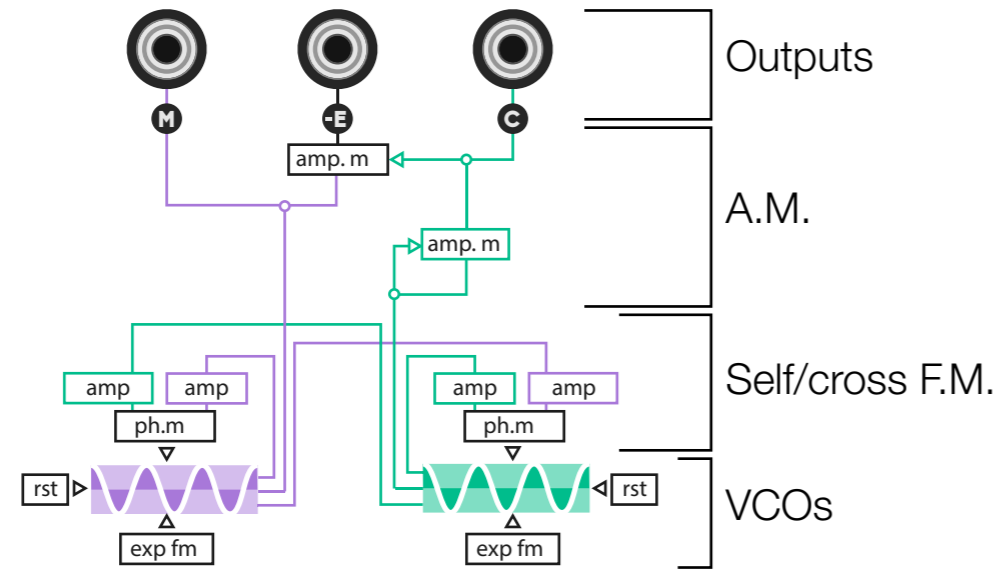


## Phase modulation (aka FM)

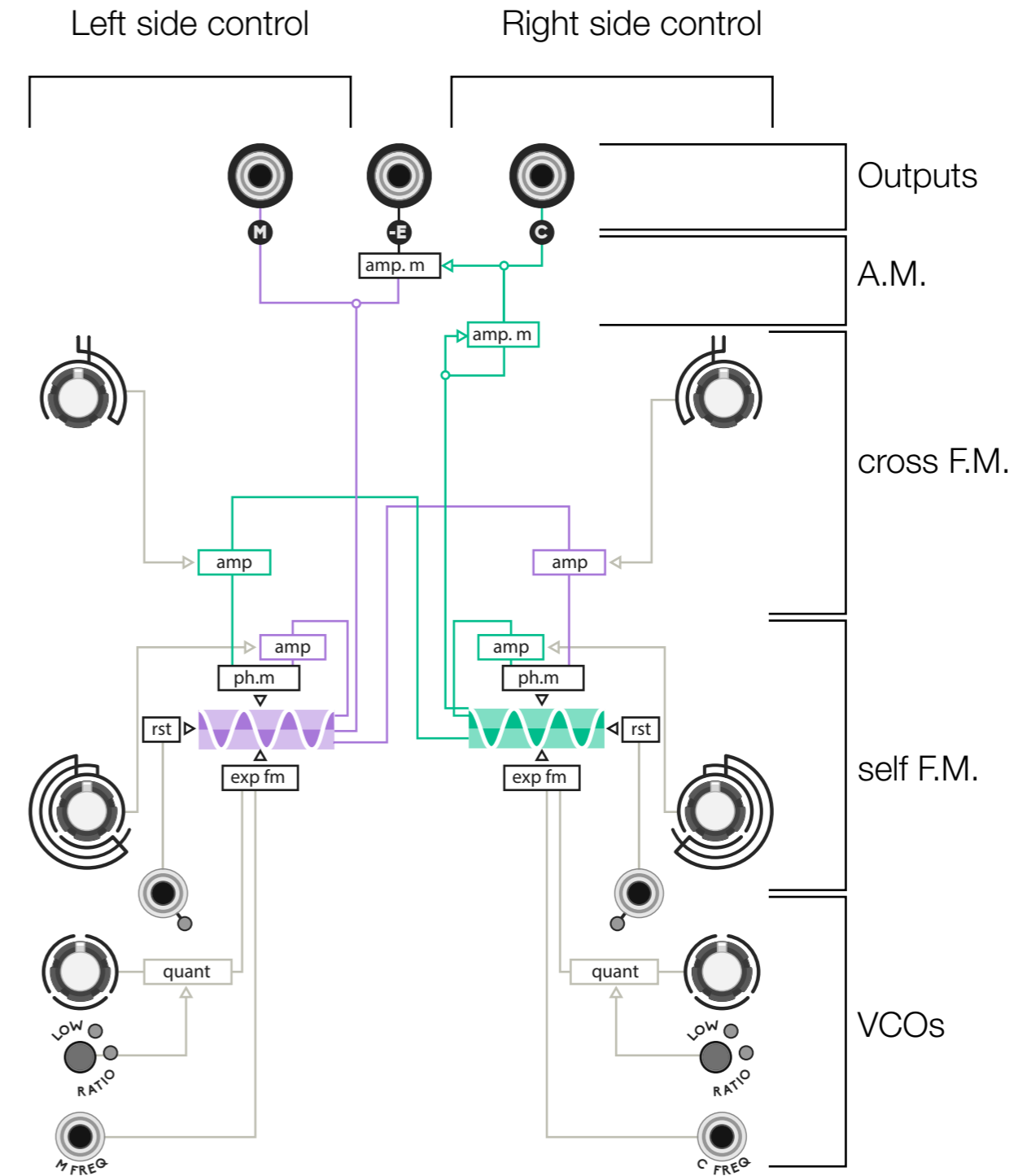
It is the digital counterpart of analog linear frequency modulation (FM). In digital synthesis, a sine wave is generated by an equation involving various parameters. The phase is the position of the wave in its cycle at a specific time. This parameter can be modulated by another sine wave or even by itself.

When modulated by itself, the sine wave becomes sharper. A low-rate modulation creates a vibrato effect. An audio rate modulator creates some complex effects from pitch distortion to harmonic wave shaping depending on the frequency ratio of the two signals and the amount of modulation (aka index).

## Signal path

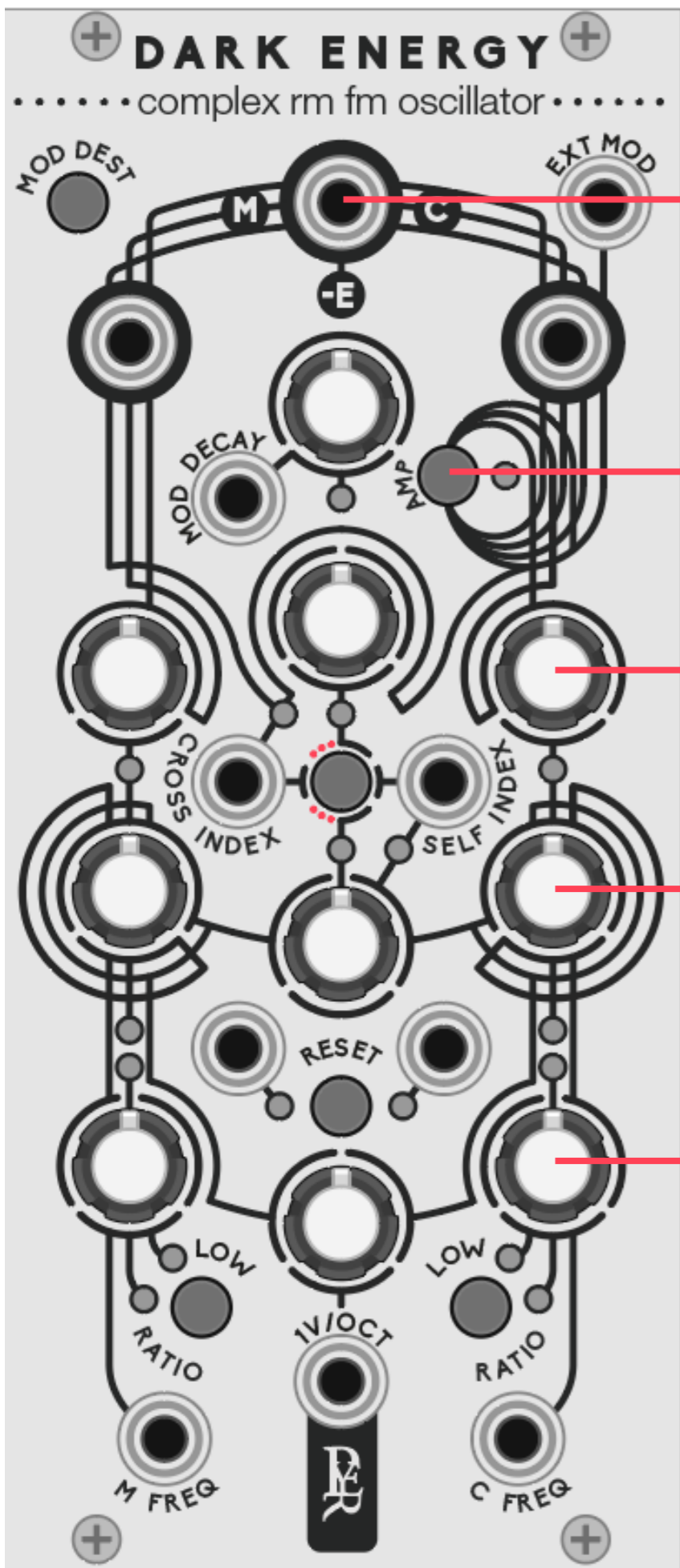


## Left and right side control



## Architecture

Dark energy is made of two sinewaves called M and C, they can modulate their own phase (self F.M.), and each other's phase (cross F.M.). They are then multiplied (ring mod) together in a specific way inspired by Einstein/Pointcarré's equation  $E=MC^2$ . The frequencies and modulation amount can be set separately with the side knobs or together with the center section and a powerful modulation routing.



Outputs

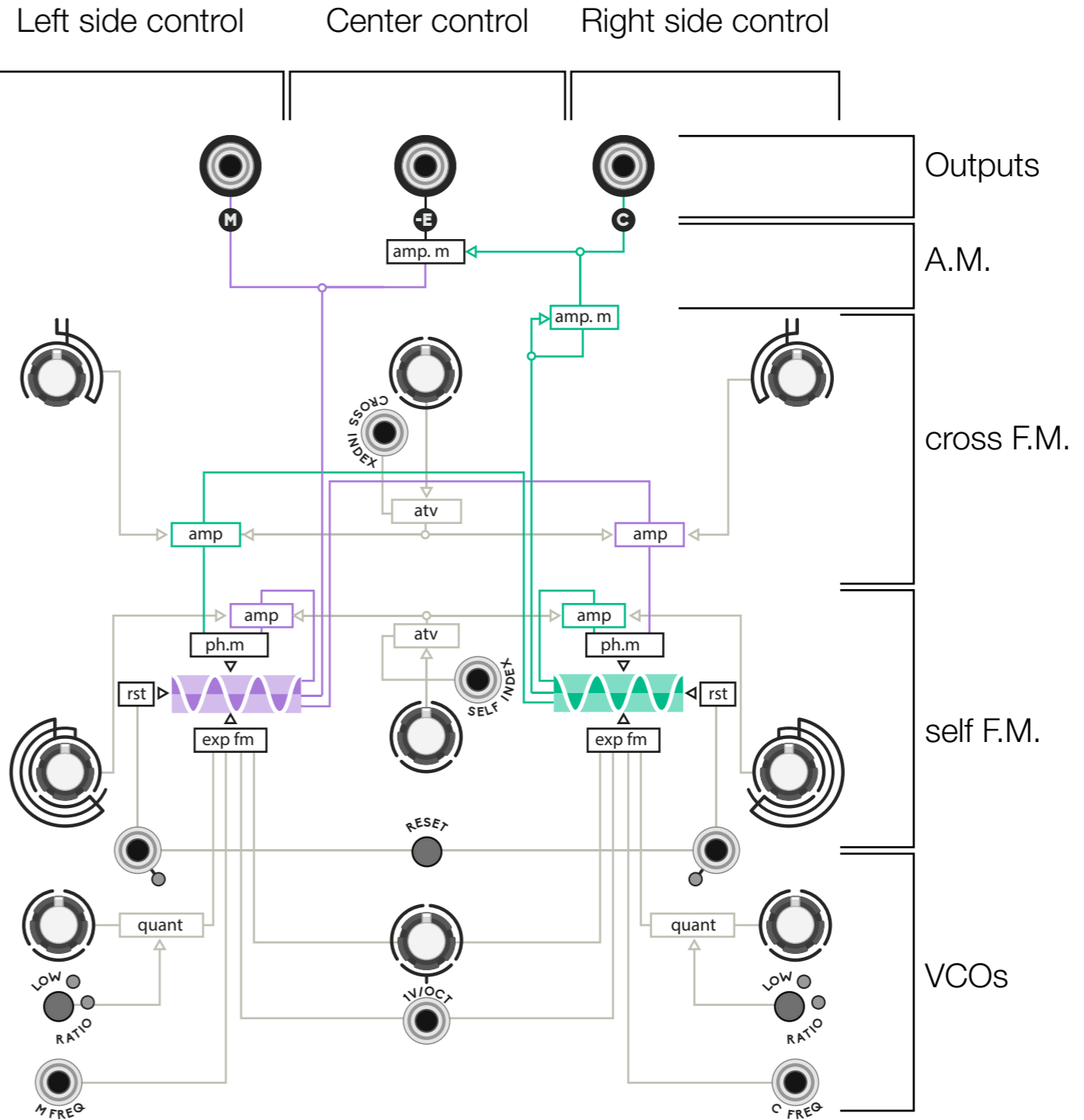
A.M.

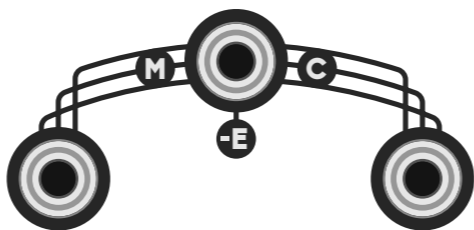
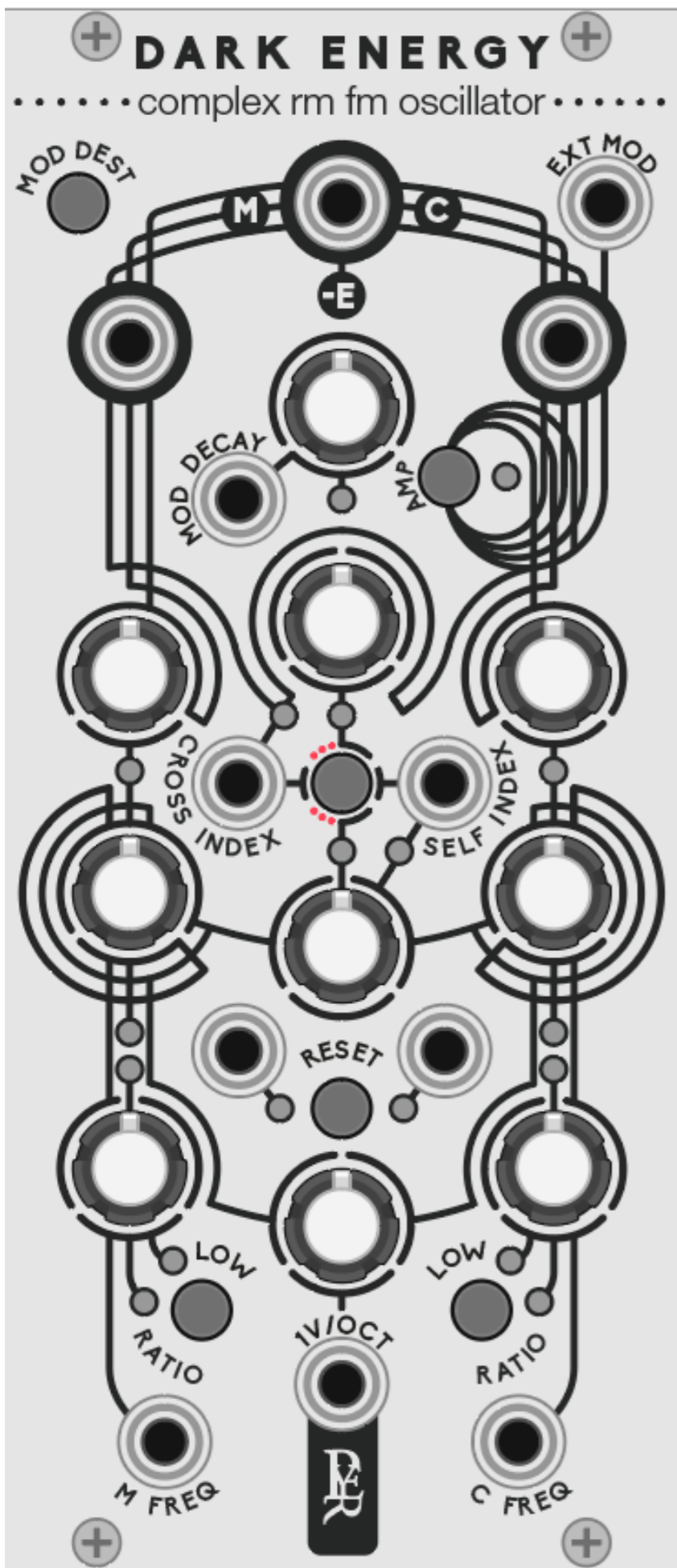
Cross F.M.

Self F.M.

VCOs

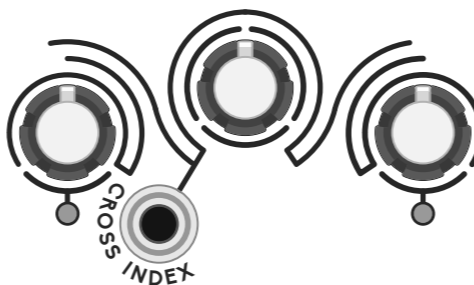
## Control center





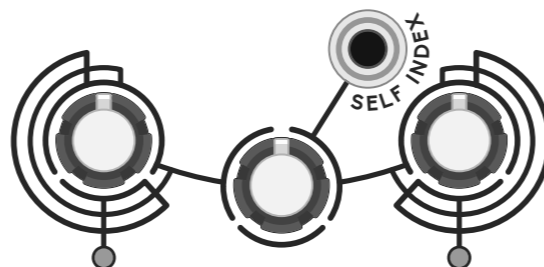
### Output section

- **-E** is the main ring modulated output. The phase comes out inverted for richer result when mixing the 3 outputs together
- **M** is the left side sinewave after FM
- **C** is the right-side sinewave after FM. C is multiplied by itself and therefore it is unipolar and affected by the extra modulation system.



### Cross modulation section

Each oscillator can modulate the phase of the other using their “cross mod” knob. It defines the amount of modulation (index) from the other sinewave in their phase. The center knob affects both sinewaves together in different ways depending on the modulation routing. When a modulation signal is connected, the knob acts as an attenuverter for the external CV.



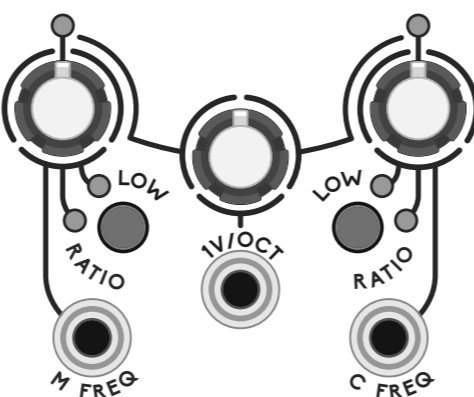
### Self modulation section

Each oscillator can modulate its own phase using their “self mod” knob. The center knob affects the 2 sinewaves together in different ways depending on the modulation routing. When a modulation signal is connected, the knob acts as an attenuverter for the external CV.



### Phase reset section

Each oscillator’s phase can be reset independently using the trigger inputs or together with the reset button. This effect is interesting with complex FM ratio or in LFO mode. It can also be used in audio rate to mimic a VCO sync effect



### VCOs section

The frequency of the oscillators are set by different means: each of them has an external 1V/oct modulation input, a knob that can move freely or locked to specific ratio for more melodic effects thanks to the “ratio” button. The two frequencies can be controlled at the same time using the center knob and the main V/oct input.

Each sinewave can be set in LFO mode with self and cross FM for tremolo VCO and complex but not random LFO. Reset input sets the LFO to zero for repeatable results.

## Modulation routing

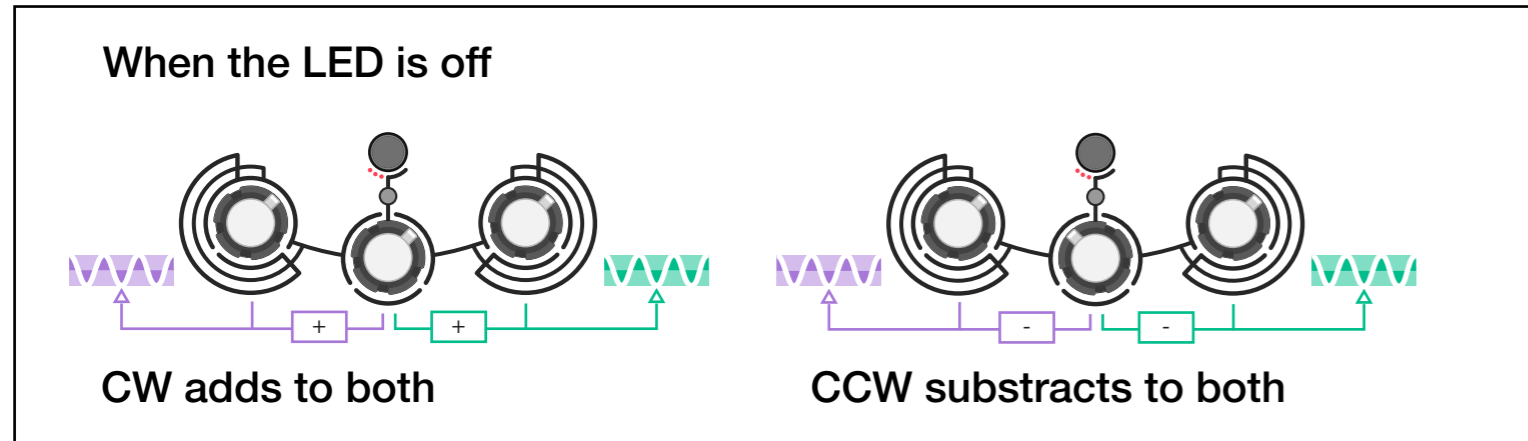
Each parameter (freq, self FM and cross FM) is defined by:

- The side's knob + the center knob
- The side's knob + the CV attenuated by the center knob

The **center button** defines the behavior of the self and cross mod center section.

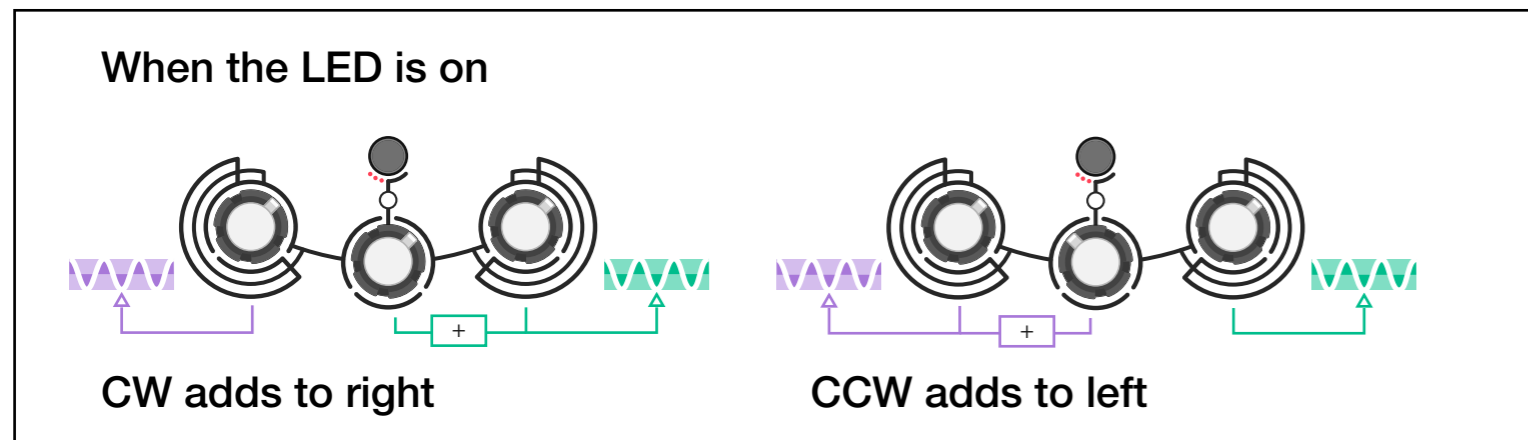
When the **LED is off**, the knob and external CV affects both side in the same way:

- CW direction adds value to both
- CCW direction subtracts value to both



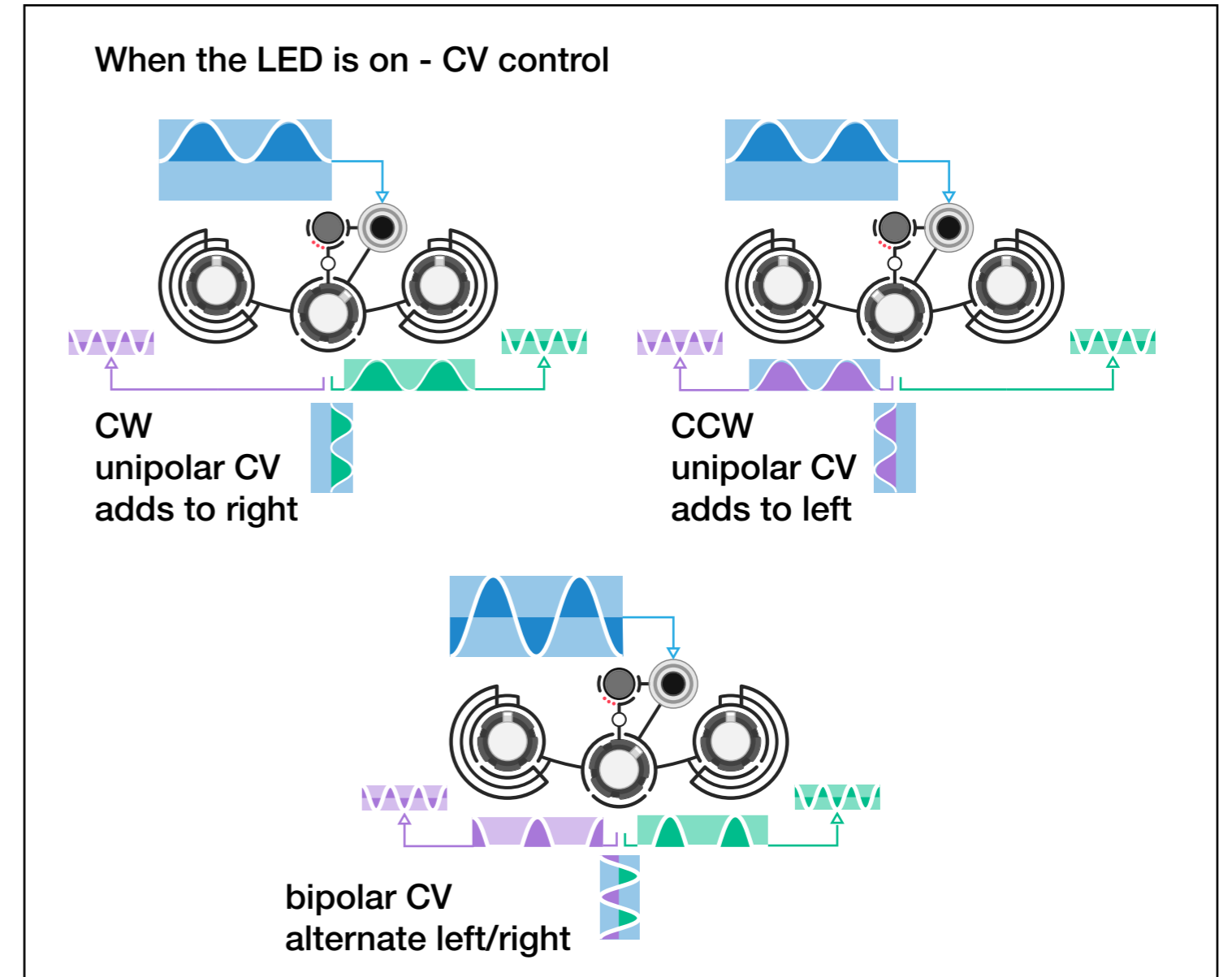
When **LED is on**, the knob and external CV affect each side in a different way: positive value are added to the right side, and negative value are added to the left side.

- CW direction adds value to right side
- CCW direction adds value to left side

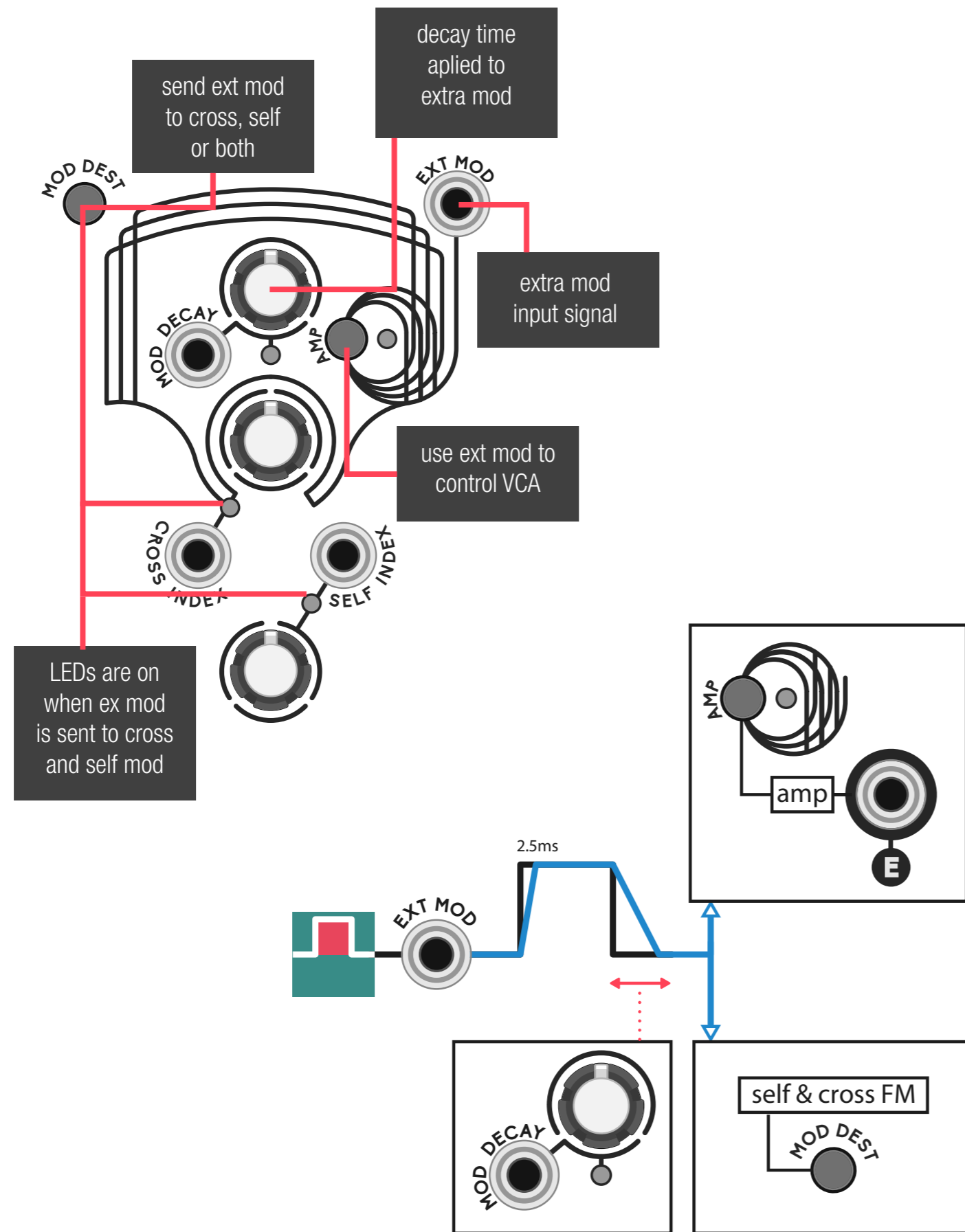


This concept allows flexible routing with **external CV**

- Unipolar CV affects only one of the two side depending on the direction of the knob.
- Bipolar CV affects the two sides alternatively







### Extra modulation system

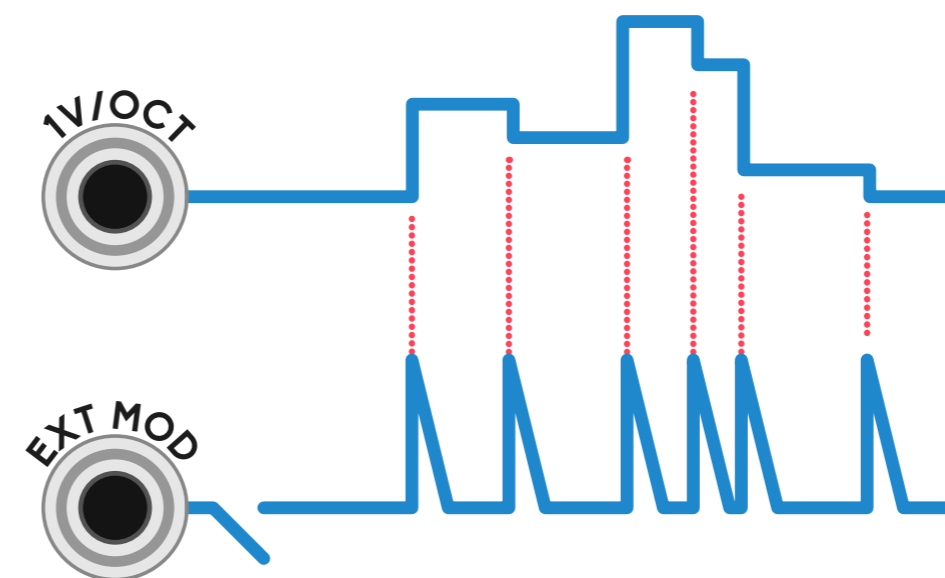
In addition to the main modulation input, Dark energy can process an **extra modulator with an adjustable decay**. A simple trigger can be used for this purpose.

The modulation can affect the multiplication of C and acts as a VCA by activating the **AMP button**

The modulation can be added to the self and cross mod system. The center knob becomes the attenuverter for the ext. mod CV. The destination is set to self mod, cross mod or both using the **MOD DEST** button

Combining dest mod and amp mod affects both timbre and volume in a way reminiscent of lowpass gates

### Internal trigger generator



When no input is connected, Dark Energy emits a short trigger at any pitch change on the 1v/oct input in place of the extra mod signal

# GEODESICS

A modular collection for VCV Rack by Pyer & Marc Boulé

Geodesics has been created in July 2018 by **Pierre Collard** (industrial and graphic designer based in Brussels) and **Marc Boulé** (developer and creator of Impromptu Modular based in Montréal).

Just like many projects within VCV Rack, Geodesics is also a community effort and it would not have been possible without the help of many users, composers and developers participating one way or another to enhance the quality of the project.

Among them we would like to address a special thank to those who helped us in the beta testing phases, who made tutorials, who proposed their help in any way and those who brought the collection to life with some great pieces of music: **Omri Cohen, Georg Carlson, Xavier Belmont, Steve Baker, Marc Demers, Adi Quinn, Ben De Groot, Latif Karoumi, Espen Storo, Synthikat, Dave Phillis, Carbonic Acid, Martin Luders, Ghaleb, Stephen Askew, Lars Bjerregaard, Richard Squires, Lorenzo Fornaciari, Adi Quinn, NO rchestra, Poxbox23 and Ananda Bhishma.**

## Geodesics links

[www.pyer.be/geodesics](http://www.pyer.be/geodesics)

[vcvrack.com/plugins.html#Geodesics](http://vcvrack.com/plugins.html#Geodesics)

[github.com/MarcBoule/Geodesics](https://github.com/MarcBoule/Geodesics)

## Creations from composers using Geodesics:

<https://www.youtube.com/playlist?list=PLEh-5QLxa-BlqLI9rBcncUTFm2Lk-ZMgvZ>

## Tutorials on Geodesics by Omri Cohen:

[https://www.youtube.com/playlist?list=PLEh-5QLxa-Blr4dsurkkwUehFsNI7T\\_Jv-](https://www.youtube.com/playlist?list=PLEh-5QLxa-Blr4dsurkkwUehFsNI7T_Jv-)

## Marc's work links

[github.com/MarcBoule/ImpromptuModular](https://github.com/MarcBoule/ImpromptuModular)

## Pierre's work links

[www.pyer.be](http://www.pyer.be)

