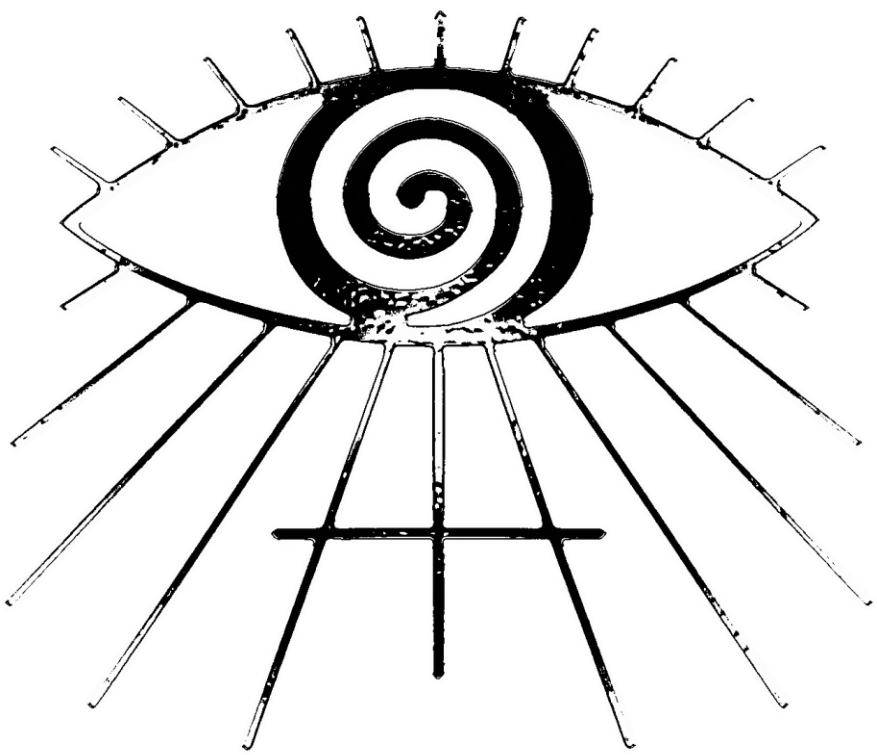
BÈSIA Modular

Human designed electronic instruments

Eye Of The Beholder

Creative analog interface from Eurorack to ILDA laser



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BÈSIA Modular statement

BÈSIA Modular handcrafts electronic instruments with particular focus on usability, especially in live performance contexts. We're not afraid of digital and sometimes we need digital control, but we try to stay as analog as possible, like the old engineers before us. We love when the current flows strong through the speakers, making people smile.

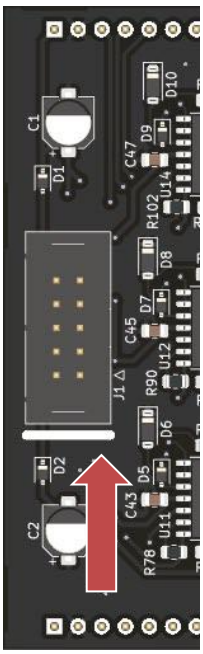
Purpose of the module

Eye Of The Beholder is a fully analog interface designed to connect musical instruments in Eurorack standard to laser devices equipped with a DB-25 ILDA port.

A non-resonant 2 pole (12dB) OTA low-pass filter positioned in the signal path helps you to preserve the life of the laser's galvo scanners and it can also be used creatively as the cutoff is CV-controllable!

This 14 HP module features two invertible X/Y inputs per channel. DC coupled buffered outputs where the processed signal is available for listening. Internal generation of the RGB color signal with manual adjustment and attenuated CV control over it. Manual and semi-normalled CV control of the X/Y scale.

Eye Of The Beholder provides you a creative, reliable and funny laser interface!



SPECIFICATIONS

Width: 14 HP

Depth: 43mm

Current draw: TBD (+12/-12/+5)

Installation

The white bold line near the power socket on the PCB indicates you the negative voltage (-12V) side. *Usually* this side correspond to the "red side" of ribbon cables in the eurorack world, please check the manual of your power supply for more specific instructions. With your eurorack system turned off, just connect the headers of the ribbon cable to the module and to your power delivery hub.

Panel overview

We know the struggle of rotating knobs when they are placed too close each other, so we design **Eye Of The Beholder** module with ergonomics (you) in mind. Also, we choose the best possible quality for our hardware: potentiometers, switches and jacks.

1 – R, G, B color levels

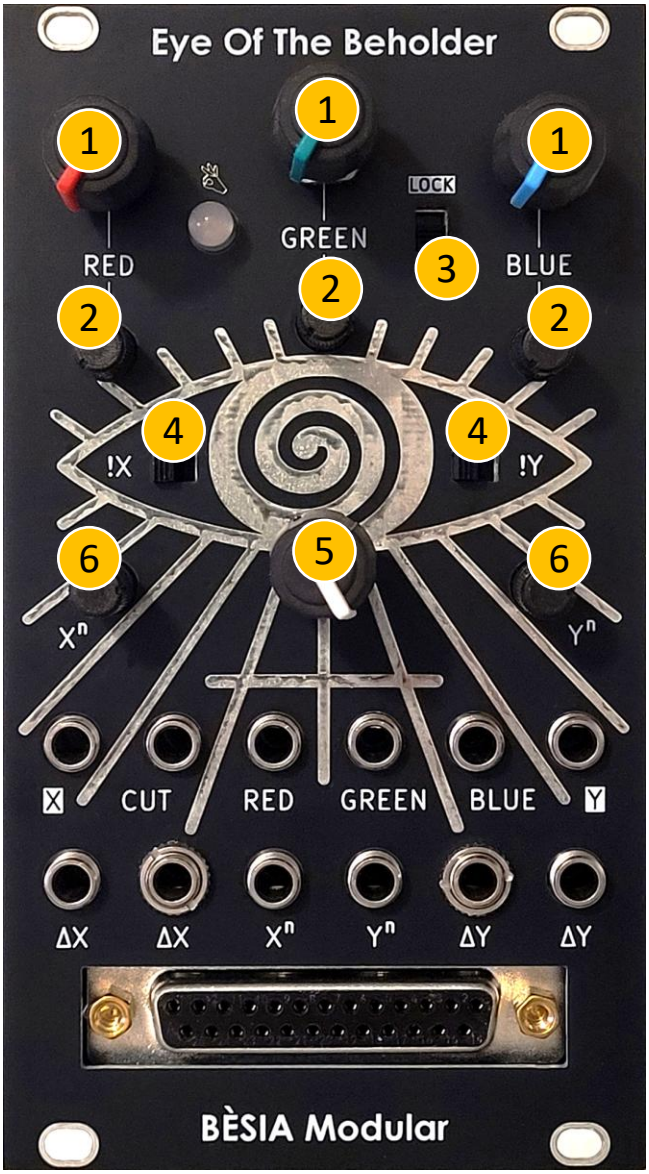
2 – R, G, B CV attenuators

3 – Interlock on/off

4 – X, Y signal inversion

5 – X, Y LPFs cutoff point

6 – X, Y scale control



With Interlock control switch you can turn on and off the laser beam.

All the values manually set by knobs are added to the respective CV input, where present.

The LED on the panel will show you the color currently delivered to your laser beam.

There are two Low Pass Filters (LPFs), one for the X channel and one for the Y channel, however the cutoff control is shared between them.

A, B – X, Y outputs

These outputs are buffered and DC coupled, nevertheless, you can use them to listen the 'stereo' signal that is driving the laser beam.

C – ILDA output port

D – Cutoff CV input

E, F, G – R, G, B CV inputs

H,I – X inputs

These inputs are summed together.

J, K – X, Y scale CV inputs

X and Y scale CV inputs are semi-normalled, it means the module automatically send to Y^n the signal you feed into X^n. The normalization is broken when you patch a cable into Y^n.

L, M – Y inputs

These inputs are summed together.

This module is quite protected from high frequencies (with various LP filters), but care must be taken when sending HF signals to scale CV or cutoff CV inputs because galvo scanners are very sensitive to this type of signals, especially if they are not sinusoidal.

The output signals generated by the **Eye Of The Beholder** module and sent to the ILDA port (the good old DB-25 connector) are certainly not low-current and will easily drive your laser. Furthermore, as required by the ILDA standard, all these signals are sent via differential pairs, allowing for long cables (e.g. 50m) without worries.

Selecting the Low Pass Filter range

As you may know, galvo scanners (the 'motors' that move the laser lenses) are quite delicate mechanical devices that are sensitive to sudden changes in speed so, as long as they are driven by slow signals (e.g. < 1kHz sinusoids) there is no problem, when the variations become very frequent or discontinuous (e.g. square signals > 0.5kHz), things get quickly and literally hot.

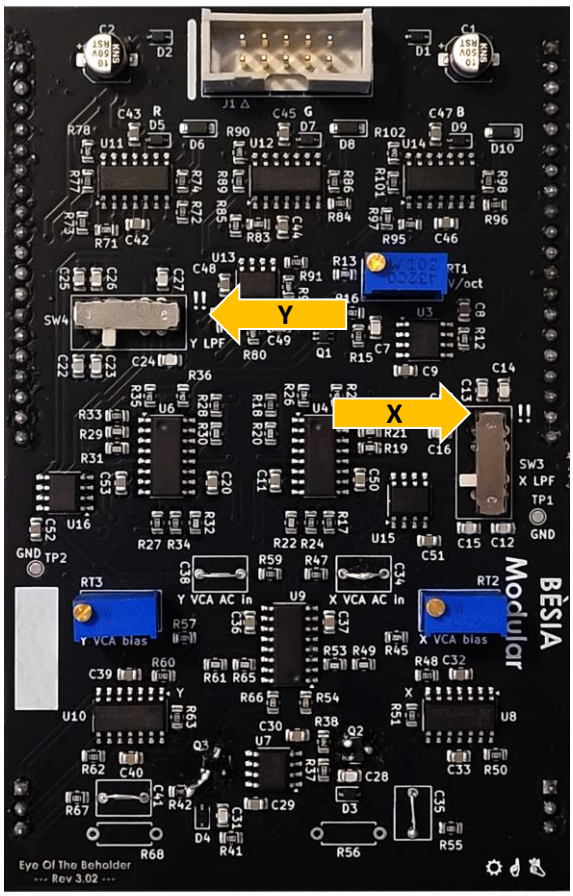
Laser devices should be internally protected from these kind of signals sporting some sort of slew limiters and smoothing most critical frequencies but, who knows. To help you tame the most unpredictable signals, we let you choose the passband of the filter. We've implemented 3 levels of *confidence* in terms of HF filtering:

Hard ("safe") → Cutoff at about 5'7 kHz
Middle → Cutoff at about 10'1 kHz
Loose (expert) → Cutoff at about 25'4 kHz

Since it's a 2 pole LPF, it will pass everything below the cutoff point then starting to attenuate with a slope of 12db per octave.

A common scenario is to set the filter to the **Hard range**, moving both X and Y switches to their corresponding position. This should set the module to block high frequencies without distorting (smoothing and reducing) too much your graphical abstracts.

As a rule of thumb, you can keep your ears open to hear if the laser is whistling or rattling, if it does noticeably, it's not a good sign and you should close a bit the cutoff on the panel.



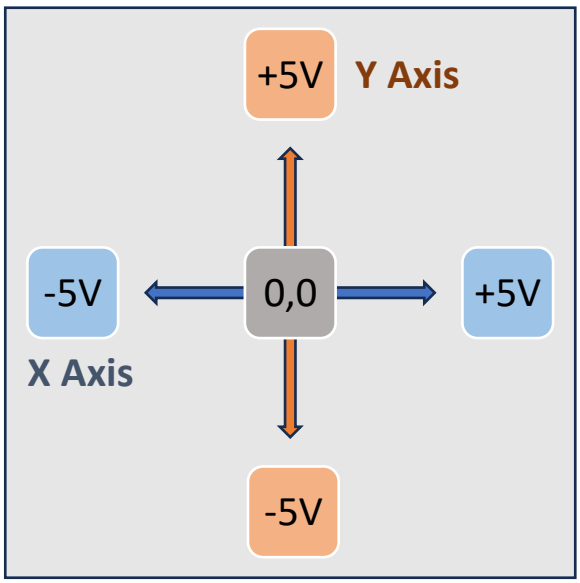
Please refer to the figure on the side to spot the LPF range switches of X and Y channel. Also note the 'loose position' is indicated by exclamation points printed on the PCB while the 'hard position' is in the opposite direction.

More on levels

Just like in the Eurorack world, laser devices have their standard and it's named ILDA (International Laser Display Association, more on ilda.com → link). For our purpose we can focus on two things about the laser beam specifically: movement and color.

Controlling movement

The diagram here aside represent the plane of projection of the laser beam at its maximum width. The standard wants borders are set at -5/+5V for both axis. This is cool because it perfectly matches the amplitude of Eurorack audio signals. Please pay attention to high frequencies, as mentioned before, you can damage your galvo scanners going too high in Hertz so, start as low as possible to avoid blinking and increase the frequency little by little. Often, a LFO put in audio range is perfect to generate control voltages.



Projection plane of the laser beam

Controlling color

Red, green and blue color signals are unipolar, we have darkness at 0V and full bright at 5V, for each component. Since some laser devices can be pushed a little more to obtain an even brighter beam, **Eye Of The Beholder** is built to output about 6V at maximum color level.

Control Voltages

These tables show the expected voltages for different CV inputs (green) and some use case for handling different values.

RGB CV in	Attenuator	Level knob
-5V / +5V	50%	50%
0V / 5V	**0%**	**0%**
0V / 8V	65%	0%
0V / 10V	50%	0%

Scale CV in	Level knob
-5V / +5V	50%
0V / 10V	**0%**

Cutoff CV in	Level knob
-5V / +5V	**50%**
0V / 10V	0%

Use cases

A simple circle

The easiest way to draw a circle is connecting a sine wave to the **Eye Of The Beholder**'s X input and another sine wave to the Y input with the same frequency, but shifted in phase by 90° with respect to the first. If you don't have modules that allow you to control the phase of the oscillator you can do the following little trick.

Get two VCOs, tune them at the same frequency and use the PWM square output of one (master) to keep in hard synch the other (slave). Adjust the duty cycle point (PW knob of the master) to simulate an offset in phase obtaining a stable circle.

Note this trick will not work for all VCOs, because it depends on how they handle synchronization and it's influenced by the stability of the pulsed square wave in output.

Also, the modules aside are used only for example purpose, of course the wonderful Generate 3 by Joranalogue Audio Design is well capable of controlling the phase of the signal without workarounds.

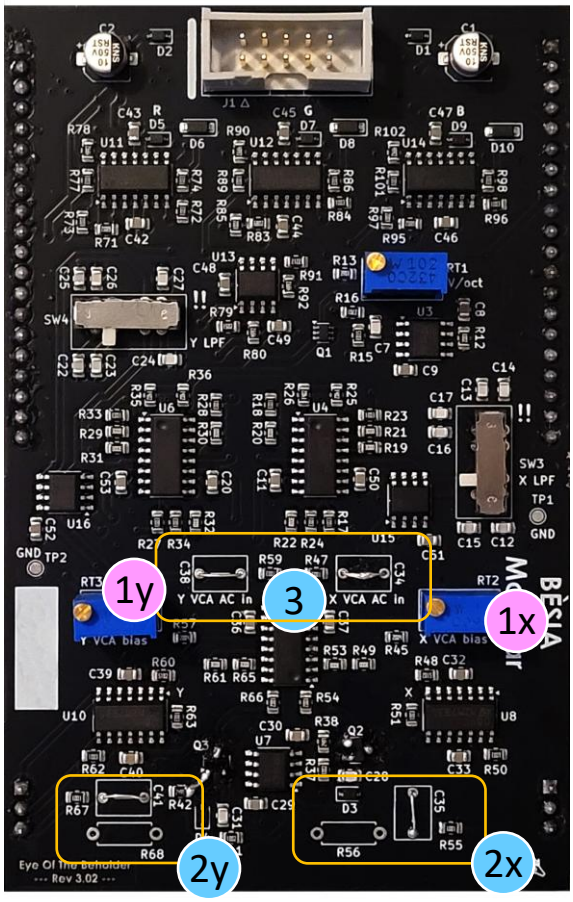
Troubleshooting

1 – Nulling the VCAs

To control the signal amplitude of X and Y, there are two built-in OTA based VCA.

On the rear panel you can find two trimmers to achieve zero-voltage output when no cables are connected and the scale knobs are turned all the way down to silence.

Simply connect X or Y output to a voltmeter and rotate the corresponding trimmer until the reading is zero. Repeat the procedure with other output and trimmer.



Hacking the module

2 – AC Coupling X/Y outputs

If you want to use X/Y jack outputs only for audio purpose, you should want to delete the DC component from signals. You can do it yourself in 3 steps: 1) installing 100k (1/8W should be fine) resistors at R56 and R68; 2) carefully cutting the bridge between the pin holes of C35 and C41, thus 3) installing 10uF (50V, for example RDEC71H106K3K1H03B) ceramic capacitors at C35 and C41.

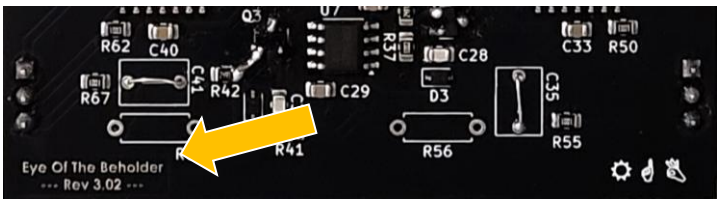
3 – AC Coupling the VCAs

We don't know why you would do this, but you can. The laser beam then will be always centered in the middle of the projection area because no static offset will reach its X and Y inputs. To do so carefully cut the PCB tracks between the pin holes of C34 for X and between the pin holes of C38 for Y. Then install at C34 and C38 a couple of 10uF (50V, for example RDEC71H106K3K1H03B) ceramic capacitors.

Please hack the module only if you know what are doing.

Revisions

You can find the revision number on the rear PCB.



Rev. 3.02 (the very first small batch)

- This schematic includes a LPF V/Oct trimmer to fine tune the filter against cutoff CV in, you can find it in the upper part of the rear PCB
- At maximum aperture (Cutoff CV in = 5V), the LPFs corner frequency (-3dB) are: *hard* (safe) about 5.7 kHz, *middle* (expert) about 10.1 kHz, *loose* about 25.4 kHz

Thank you for having bought this instrument and for supporting our future work!

BÈSIA Modular

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ModularGrid manufacturer page