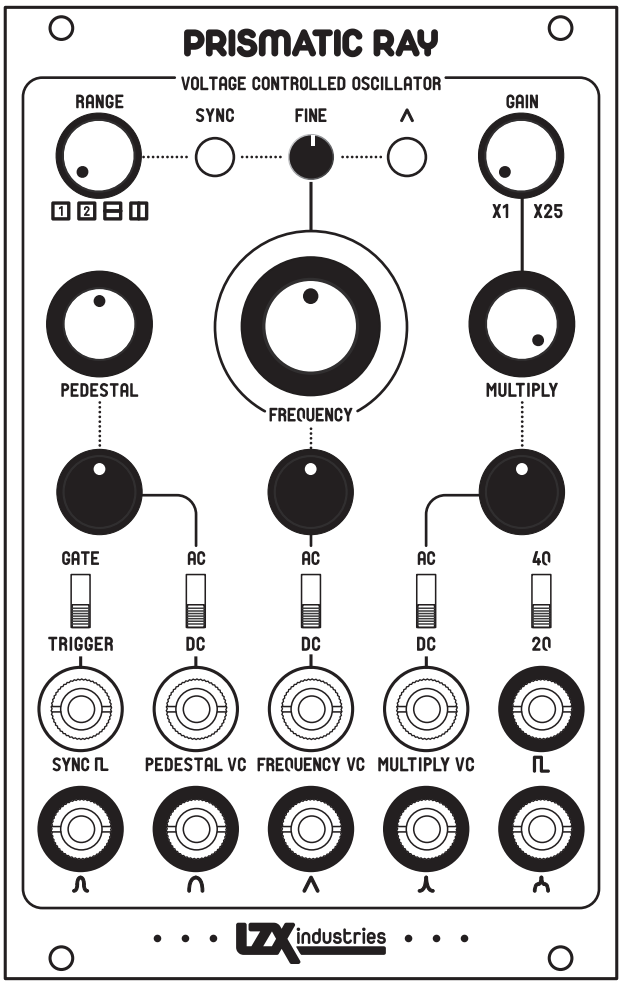
# PRISMATIC RAY
## OWNER'S MANUAL




LZX industries

# THE EXCELLENT PRISM

Prismatic Ray is a reference to the mid-century fantasy fiction of Jack Vance, and to the tabletop roleplaying games inspired by it. It is a magic spell which blinds ones opponents with searing rays of multi-colored light. Your video synthesis projections likely accomplish the same effect, if you perform live with your video synthesizer.

VCOs are an essential building block of both audio and video synthesis, and a stable, highly usable wide frequency range VCO core was one of the first items on our to-do list as we began developing video synthesis circuitry. Prismatic Ray represents the latest evolution of our video VCO design, also seen in the Video Waveform Generator module and earlier prototypes.

With Video Waveform Generator, we followed a design inspired by audio oscillators: Sine Shape and Pulse Width modulation had dedicated control circuits and independent outputs. In Prismatic Ray, I wanted to make these features more molded around the needs of a visual synthesizer. To that end, rather than having separate PWM and Sine shape modulators, we have an offset (Pedestal) and amplitude modulation (Multiply) section, and a high gain amplifier, in the signal path between the VCO core and ALL of the output waveshapers. Modulation of these parameters now happens to all output waveshapes simultaneously, and the high gain control allows for a smooth interpolation between gradual slopes or hard edged pulses. We've also introduced 4 quadrant multiplication as a feature, which allows the inversion of the output waveshape to be a function of voltage control! This allows XOR-style patternmaking without the need for external logic circuitry.

Please send us photos and videos of your dazed audiences after exposing them to the Prismatic Ray. Happy patching!

Lars Larsen
December, 2016

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Written by Lars Larsen

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LZX Industries
814 SE 14th Ave.
Portland, OR 97214
USA


www.lzxindustries.net
lzx@lzxindustries.net
Creative tools for video synthesis
and analog image processing.

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# FEATURES

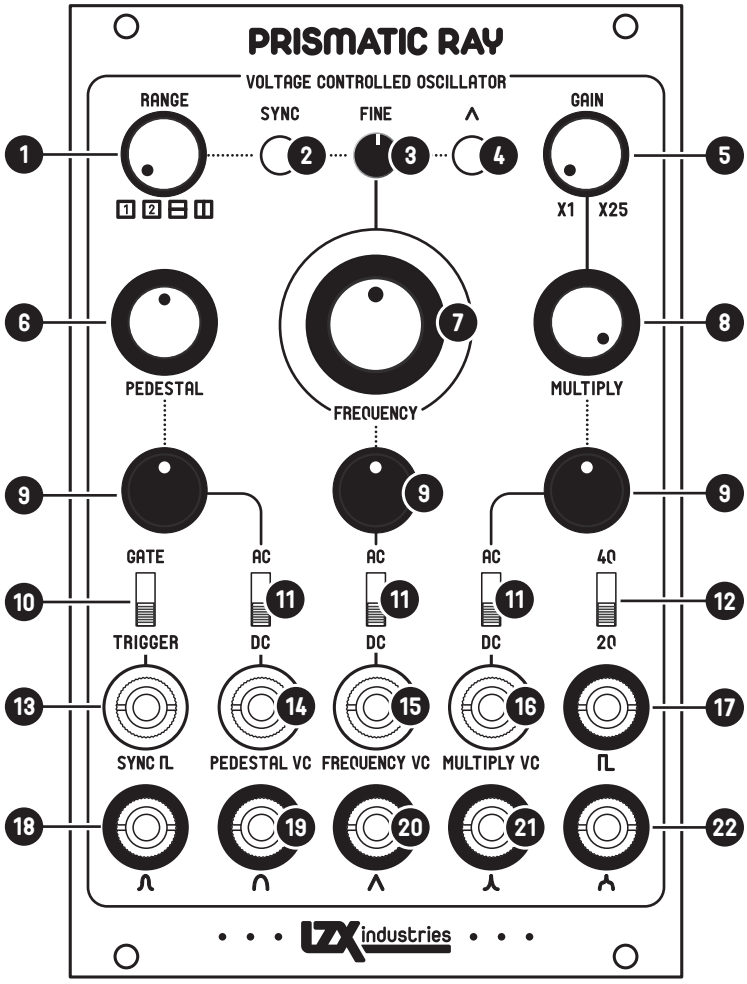
Prismatic Ray is the next generation of the LZX Industries analog widerange Voltage Controlled Oscillator design. With a max frequency range into the megahertz and hard sync input with phase stability, it is uniquely qualified for video synthesis techniques. In many VCO designs, modulation of waveform shape is achieved after the oscillator core, with modulation over output waveshaper circuits. In this design, we place modulation in the core of the oscillator itself, allowing complex summing, linear key generation, multiplication and inversion to affect all the output waveshapes simultaneously. When multiple waveshapes are patched to different color channels, the prismatic nature of this module begins to emerge.

- Coarse & Fine tuning controls for oscillator frequency. Frequency Modulation voltage control input with dedicated level and inversion control.
- Simultaneous Triangle, Square, Sine, Anti-Sine, Exponential and Logarithmic waveshape outputs.
- VCO core multiplier with dedicated level control and voltage control input. High gain amplifier control enables fluid morphs between hard and soft edged waveshapes. In 4 Quadrant mode, the output waveshapes can be inverted under voltage control.
- VCO core bias level control and voltage control input allows control over the relative brightness of all the output waveshapes. With other patterns or video as a modulation source, the bias input allows this module to function as a powerful external slope and key processor for any video signal.
- All signal and control paths perform at high frequency, video rate modulation speeds.
- AC/DC input coupling switches and inverting level attenuators on voltage control inputs.

# SPECIFICATIONS

| | |
|---|---|
| Format | EuroRack Synthesizer Module |
| EuroRack Width | 16HP |
| Mounting Depth | 1.25 inches (31.75 mm) |
| Frontpanel Dimensions | 3.185 inches (80.9 mm) * 5.059 inches (128.5 mm) |
| +12V Power Consumption | 120mA |
| -12V Power Consumption | 90mA |
| Series Output Resistance | 499 ohms |
| Input Termination Resistance | 100K ohms |
| Voltage Levels (Expected) | 0-1V DC |
| Voltage Levels (Absolute Maximum) | +/-12V DC |

# USER CONTROLS & CONNECTIONS




**1** Frequency Range & Sync Source selection switch. First position is slow animation (no sync), second position is fast animation (no sync), third position is horizontal bars (vertical sync) and fourth position is vertical bars (horizontal sync.)

**2** Sync pushbutton switch. Push to activate or deactive oscillator sync.

**3** Frequency fine tuning control.

**4** Triangle output level LED indicator.

**5** Multiplier high gain control. Fully counter-clockwise and the multiplier functions at unity gain. Adjusted clockwise and the outputs clip, creating more hard-edged waveforms.

**6** Pedestal offset control. Pedestal mixes a voltage with the internal triangle waveshape. Its position in the signal path is determined by the multiplier mode switch (12.)

**7** Frequency offset control. Fully counter-clockwise, frequency is at its minimum value for the selected range. Adjusted clockwise, frequency increases.

**8** Multiply offset control. Controls the amplitude and inversion of the internal waveform. Its function and signal path are determined by the multiply mode switch (12.)

**9** Inverting level controls. These controls set the depth of external voltage control modulation applied to the associated parameter. In their center positions, the output is 0. Adjusted clockwise from center, the signal is added to the associated parameter. Adjusted counter-clockwise, the signal is subtracted.

**10** Sync mode selection switch. In trigger mode, the VCO will stop oscillation and reset as quickly as possible based on the rising edge of the sync input signal. In gate mode, the VCO will not resume oscillation until the sync input signal goes low.

**11** Voltage control AC/DC coupling switches. In AC mode, slow moving voltages are removed from the input signal and only high frequency content remains.

**12** Multiply mode switch. In 2Q (2 Quadrant) mode, the multiply control functions as a crossfader between the Pedestal value (6) and the internal triangle VCO waveform. In 4Q (4 Quadrant) mode, multiply controls both the inversion and amplitude of the internal triangle VCO waveform, and the Pedestal value (6) is summed with the waveform afterwards. See the block diagrams for details.

**13** Oscillator sync/reset input. 0-1V DC expected, 0.5V comparator threshold. The oscillator will reset on the rising edge of any input signal. Patching this connection will override any sync source selected by the range selection switch (1).

**14** Pedestal voltage control input. 0-1V DC full scale. The depth of modulation is set by the associated inverting level control (9).

**15** Frequency voltage control input. 0-1V DC full scale. The depth of modulation is set by the associated inverting level control (9).

**16** Multiply voltage control input. 0-1V DC full scale. The depth of modulation is set by the associated inverting level control (9).

**17** Square wave output, 0-1V level.

**18** Sine wave output, 0-1V level.

**19** Parabolic wave output, 0-1V level.

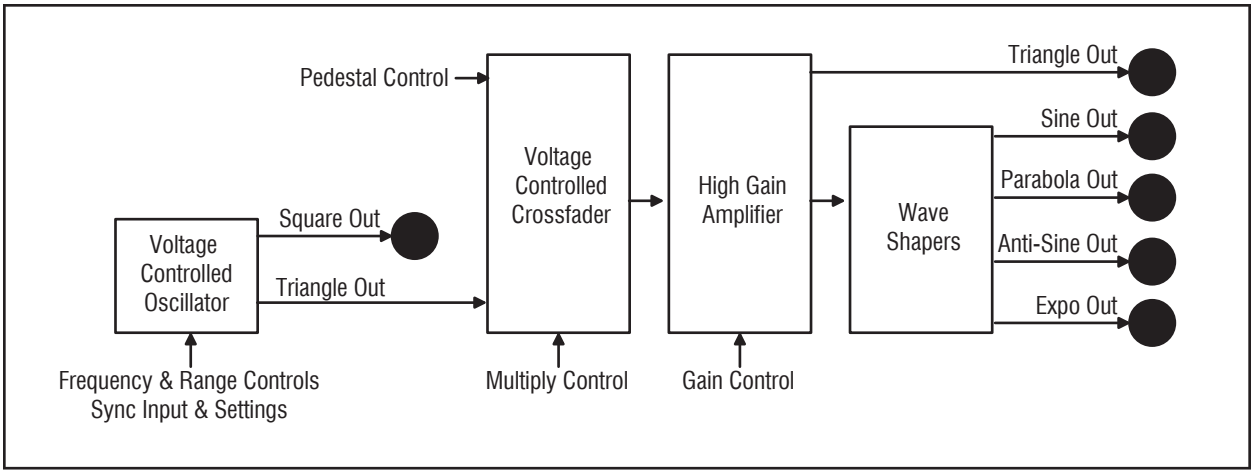
**20** Triangle wave output, 0-1V level.

**21** Exponential wave output, 0-1V level.

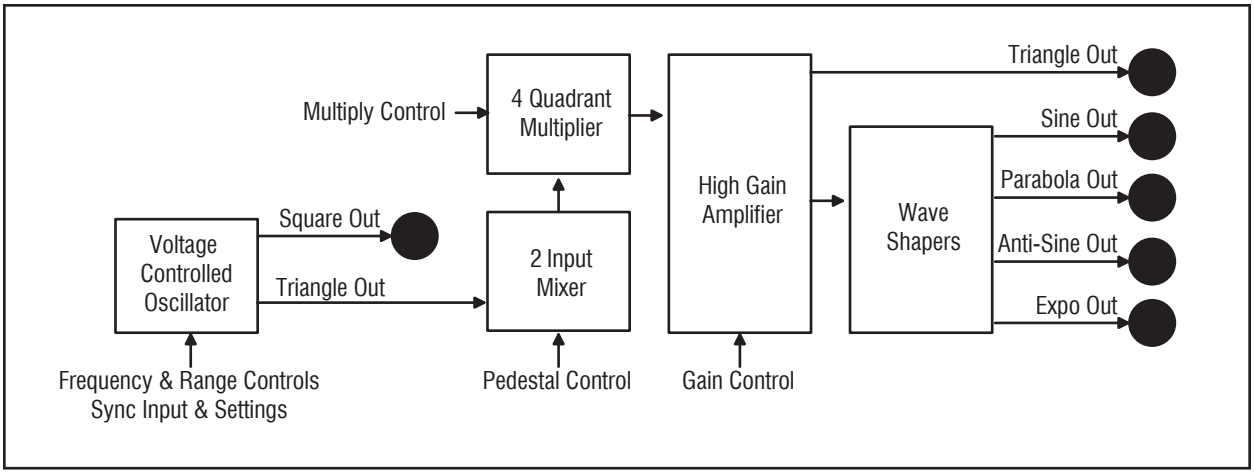
**22** Anti-sine wave output, 0-1V level.

# BLOCK DIAGRAM

## SIGNAL PATH IN 2 QUADRANT (2Q) MODE



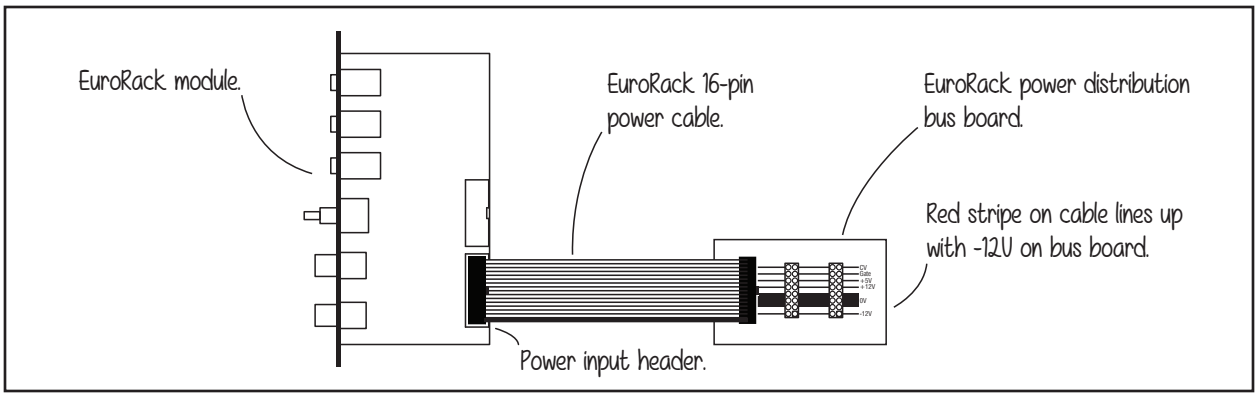

## SIGNAL PATH IN 4 QUADRANT (4Q) MODE



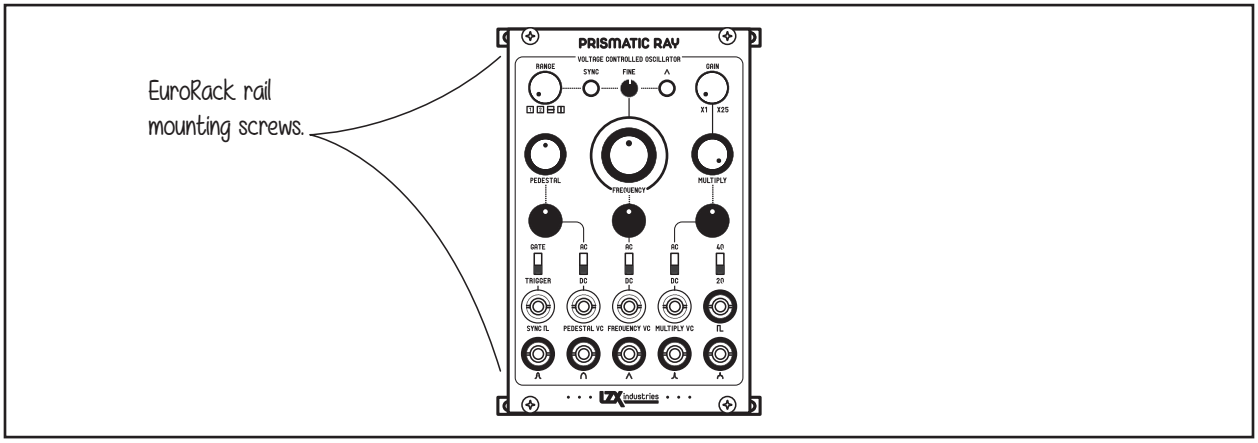
# INSTALLATION

Power down your EuroRack case and disconnect it from AC power outlet while installing new modules.

Remove the module from its packaging and connect the 16-pin power cable to the keyed power entry header on the rear of the module as shown. Connect the other end of the power cable to an empty connector on your EuroRack power distribution busboard. Ensure pin 1 (-12V, with the red stripe) is oriented as indicated on your power distribution busboard.



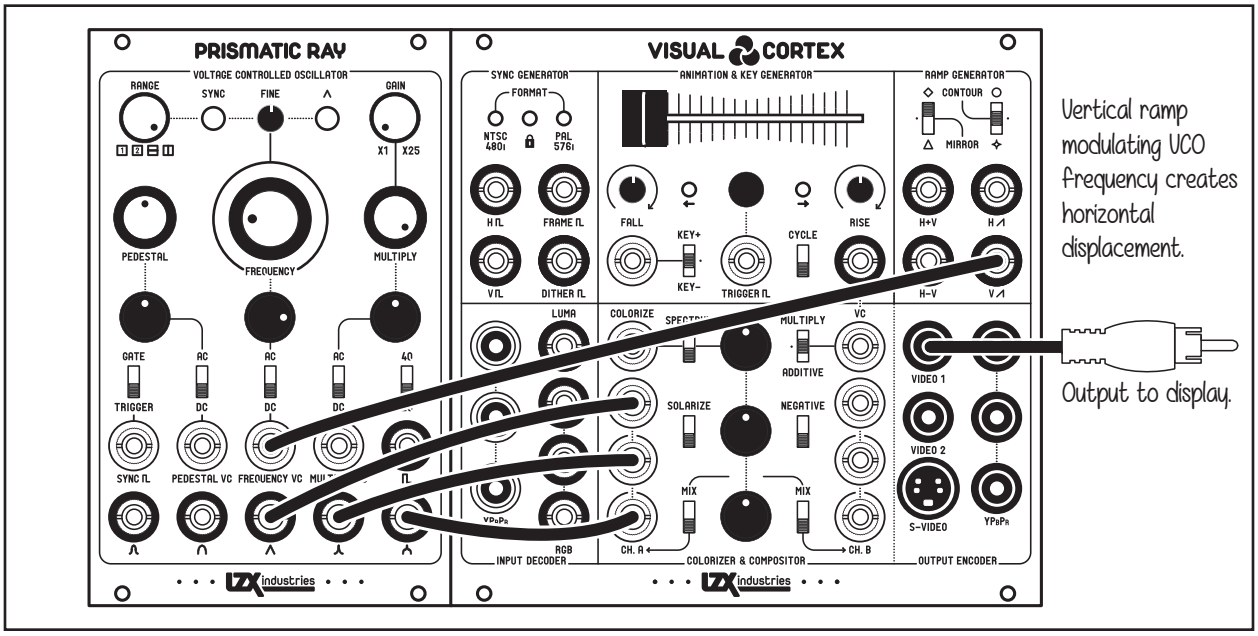

After connecting the power cable, mount the module frontpanel flush to your enclosure's EuroRack mounting rails and secure the module with the mounting screws provided by your enclosure's manufacturer.



# EXAMPLE PATCHES

## 2D PATTERN GENERATION W/COLORIZED EDGE GRADIENTS

The VCO is a core element of analog synthesis, whether we're discussing audio or video. In this patch, we familiarize you with a use case for the simultaneous waveshape outputs of Prismatic Ray and a basic setup for modulating a horizontally synchronized oscillator with a vertically synchronized waveform (such as the V Ramp output on Visual Cortex.)




Further exercises and experiments to explore using this patch as a starting point:

- Patch the RGB connections in different orders and to different waveform outputs to get different color palettes.
- Instead of modulating the frequency CV input, explore the visual differences of modulating Pedestal and Multiply instead.
- Play with the gain control for more pulse-width modulation based responsiveness from pedestal modulation.
- Explore 4 quadrant and 2 quadrant modes, with and without modulation. These modes change the functions of Multiply and Pedestal.
- Try using external audio and video images as modulation sources. Play with all the frequency ranges while doing this.
- Try patching a 2D shape or external camera image into the sync input.
- In 2 quadrant mode, with Multiply fully counter-clockwise and Pedestal centered, patch an external signal into the Pedestal VC input. Put the Pedestal VC level control fully clockwise. You are now processing the external signal through all of Prismatic Ray's output waveshapers and high gain amp, with the internal VCO fully suppressed.
- By patching the Anti-Sine/Sine or Exponential/Parabola outputs into the A/B inputs of a crossfader module, you can control the crossfader to get a waveshape morph. The center position of the crossfader (both inputs at 50%) will give triangle output. Combined with the technique for external processing described above, you can achieve gamma and gray level expansion/compression when your source is a video image.

# MANUFACTURER'S WARRANTY

Fully assembled versions of this product are covered by our manufacturer warranty for one year following the date of manufacture. This warranty covers any defect in the manufacturing of this product., such as assembly errors or faulty components. This warranty does not cover any damage or malfunction caused by incorrect use – such as, but not limited to, power cables connected backwards, excessive voltage levels, or exposure to extreme temperature or moisture levels. The warranty covers replacement or repair, as decided by the manufacturer. Please contact customer service via our website at www.lzxindustries.net for instructions on returning the product. The cost of returning a product for repair or replacement is paid for by the customer.

DIY kits and bare printed circuit boards are not covered under any warranty and come with no guarantee of assembly troubleshooting or customer support. However, we are nice and will help you when possible. Please contact us if you have questions about or problems with your build.