

- Cycles

Cycles is an 8HP module that makes use of four independent Low Frequency Oscillators (LFOs) to create a wide range of Control Voltage (CV) and audio sources. This manual intends to help you understand the module and inspire you to explore what it is capable of.

I - Specification

- Supply Voltage Required: +/- 12V
- Maximum Current Draw:
 - 12V: 70mA
 - -12V: 70mA
 - 5V: 0mA
- Width: 8HP
- Height: 3U
- Depth: 40mm

II - Description

The module uses four independent LFOs to create ten different outputs. Each LFO has two different but synced waveforms, generating both a triangle and a square wave. The user can change the frequency of each LFO over a wide range going from several minutes up to audio rate oscillation.

From these oscillations, the module generates two new outputs. One is a mixed output of two user selectable triangle waves to create ever evolving patterns from these two independently running LFOs. The second output is a 4-bit DAC where each square wave is assigned to a bit in order to create pseudo-random voltage. Each output and control will have a section of its own to explain exactly how it works and what it can be used for.

III - Connecting the Module to Power

Supplying voltage to the module requires a 10-pin (5x2) ribbon cable. The cable should be connected to the header on the back of the module. Care should be taken in matching the red stripe of the cable to the “RED STRIPE” indication written on the board.

IV - Module Functions

The following sections will go over each output and control to specify and describe their purpose:

1. [LFO](#)
2. [Frequency Control](#)
3. [Mixer](#)
4. [4-bit DAC](#)

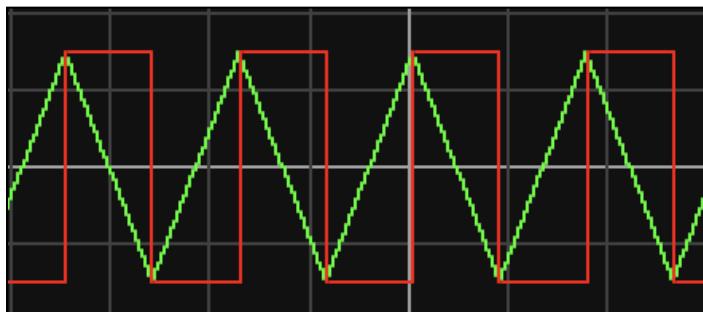


LFO -

The LFO's outputs are vertically aligned and numbered on the front panel. The outputs on the bottom are for square waves and the top ones are for triangle waves. LEDs indicate the state of the triangle wave of each respective LFO. Please note that the phase relationship between the two waveforms is as follows for every LFO on the module:



- LFO outputs on Front Panel



- Phase relationship between triangle (green) and square (red) waves

The voltage range of these outputs is +/- 5V for both waveforms and each pair of Tri/Square waves are completely independent. The LFOs can be used as clean, slow, and oscillating CV sources. Additionally, the waves can go up to audio rates for some crazy modulation or as four independent pitches.

FREQUENCY CONTROL -

Each LFO has a respective set of potentiometer and switch to control its frequency. The potentiometers tune the oscillators while the switches select between two specific frequency ranges. Those ranges can be altered using various capacitor values (see *the Cycles Build Document*), but by default their values are approximately:

- In "L" mode: **2[min] 30[sec]** - **1[Hz]**

- In "H" mode: **2[sec]** - **113[Hz]**



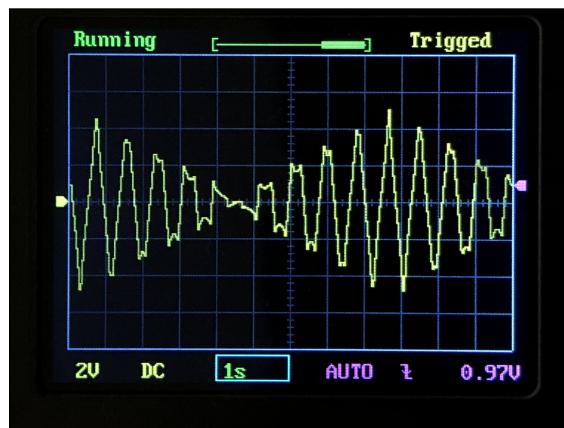
- Frequency Control on Front Panel

MIXER -

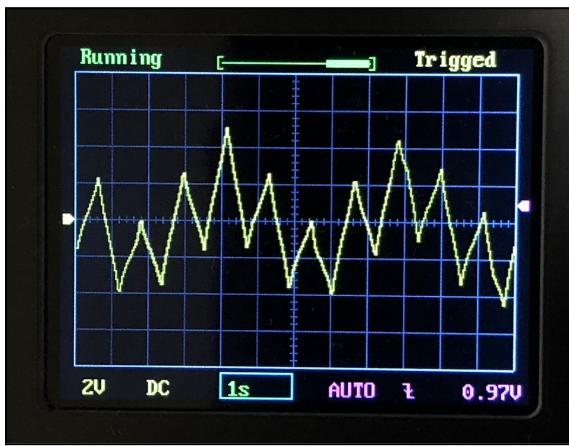
The mix output is a combination of two user-selectable triangle waves. The two switches select which triangle waves are to be mixed, and the output will generate the sum of both with a voltage range of +/- 5V. This is an incredibly versatile output as the combination of two free-running LFOs can yield unexpected results depending on how you set their relationship in time.



- Mix output and control on Front Panel



- Mix output Example n°1



- Mix output Example n°2

Exploring the various patterns that the mix output produces is encouraged, as the smallest offset in phase or frequency will generate evolving patterns that fluctuate both in time and in amplitude.

4-BIT DAC -

The DAC output treats all four square waves as digital bits, with a binary value of “1” when high and “0” when low. This generates pseudo-random voltage by feeding them through a Digital to Analog Converter (DAC). The DAC will output a voltage between 0V and 5V depending on the binary value of each LFO at one point in time, that is approximately:

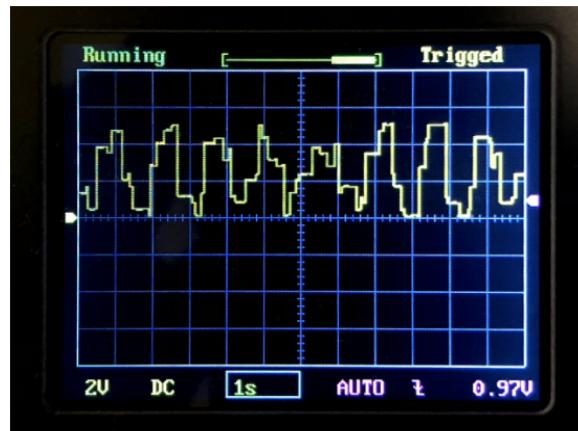
- DAC[0000] = 0V
- DAC[0001] = 0.3V
- DAC[0010] = 0.6V
- [...]
- DAC[1110] = 4.7V
- DAC[1111] = 5V



- DAC output on Front Panel

This means that there are 16 different voltage levels the output can sit at, and whenever a square wave changes its state the DAC will change its voltage level. The most significant bit is assigned to LFO “1” and this goes respectively to the least significant bit being assigned to LFO “4”.

The voltage produced is a seemingly random fluctuation, both in voltage and in time. However, the fluctuations are set and derived from the time and phase relationships between all four square waves, meaning that they are not random but only seem like it because of the complex relationship between LFOs. This thrives as a CV source for repeating and varying “random” fluctuations, but can do much more (e.g. at audio rates this creates interesting tones and textures).



- DAC output