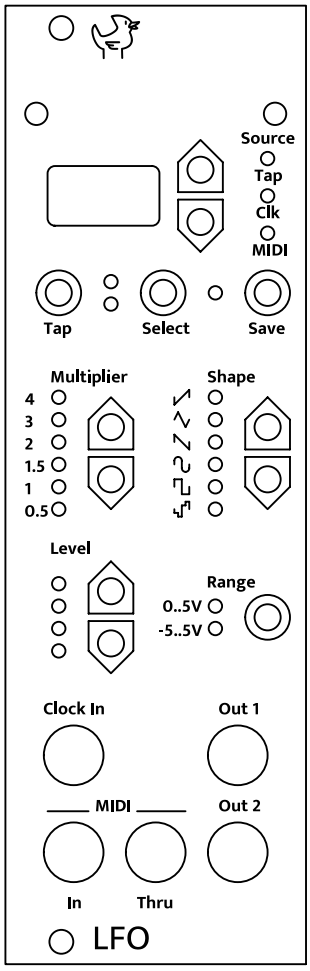
Entineering LFO

User Manual

v1.1



Entineering

Introduction

Entineering LFO is a module for Eurorack synthesizers. A low frequency oscillator, in short LFO, can be used as a modulation source for other modules. It generates control voltages in configurable waveforms.

Features of Entineering LFO include:

- Frequency inputs: Tap button, CV clock input or MIDI beat clock
- Clock phase synchronization with MIDI or CV clock (since firmware v1.1)
- Input clock frequency up to 250 BPM.
- Six selectable clock multipliers
- Six selectable waveforms with additional five variations
- Output range selectable between 0 to 5V or -5V to 5V
- Configurable output level (modulation depth)
- Two outputs, individually configurable
- Configurations can be saved and later restored using front panel buttons or MIDI Program Change commands
- Output waveforms can be scaled by MIDI Control Change commands, e.g. from a MIDI keyboard mod wheel

Connecting the Module

Connecting Power

Your Eurorack synthesizer module comes equipped with a 16-pin keyed connector for power supply.

To connect the module:

1. Power Off Your System: Before connecting the module, ensure that your Eurorack case and power supply are turned off.
2. Locate the Power Connection on Your Case: Identify the power headers on your Eurorack case. These headers will also have a 16-pin connector.
3. Use the supplied ribbon cable to connect the module to your Eurorack power supply. The red mark on the ribbon cable identifies the -12V supply line. On the module, the red mark points towards the bottom on the module.
4. Secure the Module: Once connected, mount your module into the case using the appropriate screws, ensuring it is securely in place.

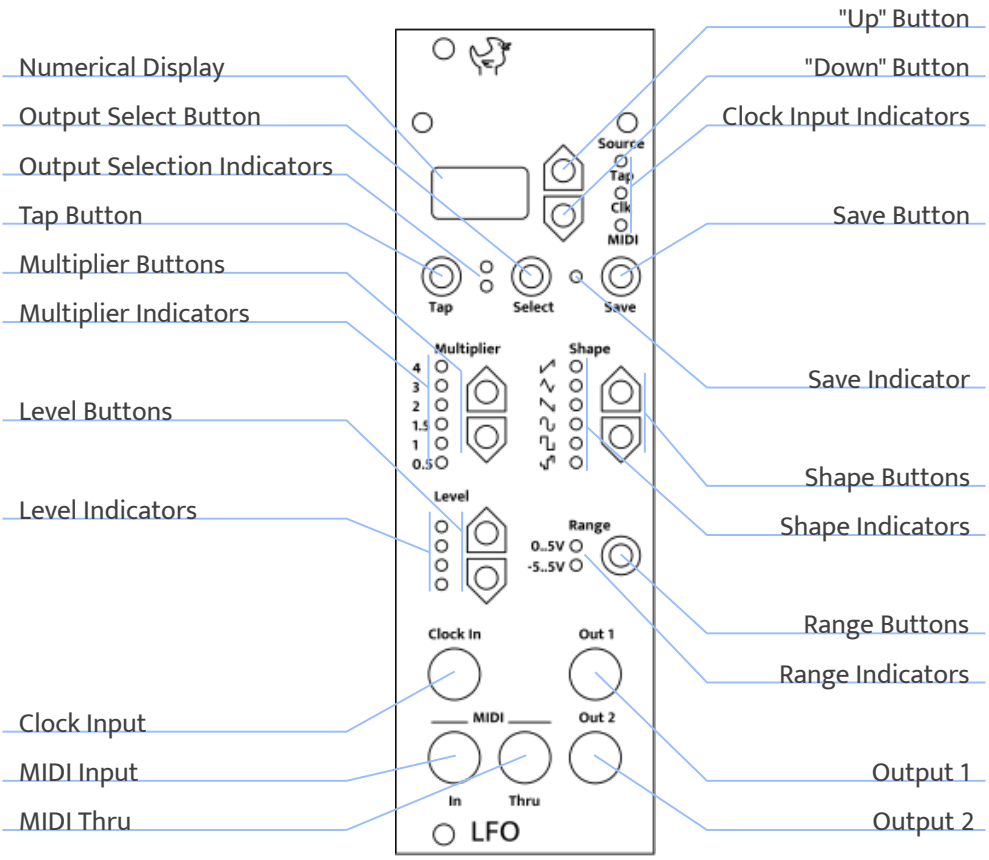


Figure 1: Front Panel Description

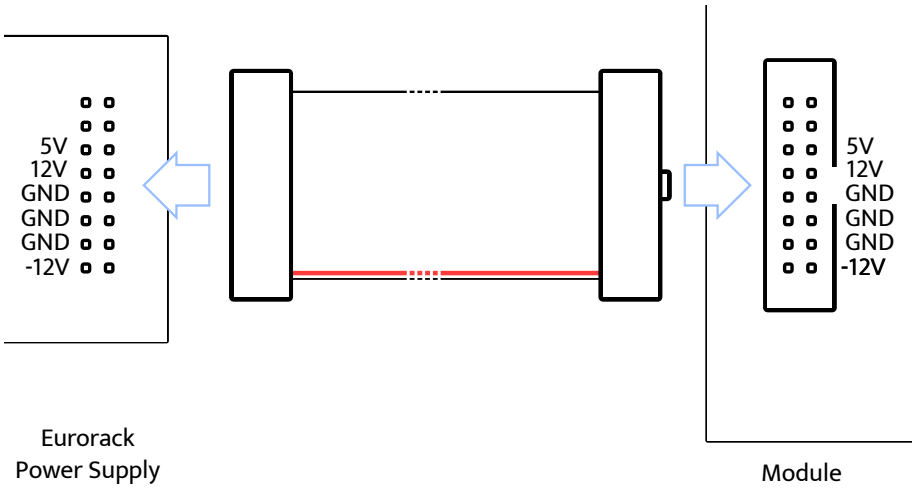


Figure 2: Connecting Power

Only use proper Eurorack power supplies with voltages of -12V, +12V and +5V.

Connecting MIDI

To connect a device with a 5-pin DIN connector to the module, you need a MIDI DIN-to-TRS adapter. The TRS jacks on the module use the A pinout that is now included in the official MIDI standard.

To be able to send MIDI data to the module, connect the MIDI Out or MIDI Thru port of your MIDI keyboard, audio interface or similar, to the MIDI In jack of the module.

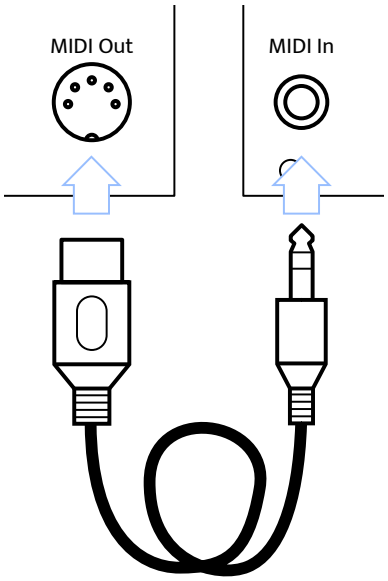


Figure 3: Connecting MIDI

Using the Module

Using the Tap Button to Set a Tempo

To manually set a tempo, first ensure that no clock signal is fed to the clock input jack and that no MIDI beat clock is sent to the MIDI input. Now press the Tap button repeatedly in the frequency you want as the base clock. The module averages the

last three to five button presses for the resulting frequency. The frequency is also shown in the display as tens of beats per minute (BPM).

Although the display only show tens of BPM, the internal precision of the LFO is single BPM.

The Tap clock input indicator will light up and flash in the chosen frequency.

Using the Clock CV Input

Entineering LFO can be fed with an external clock up to 250 BPM. Use a patch cable to connect the external clock source to the Clock In connector. The Clk clock input indicator will light up and flash with the input clock frequency.

Using a MIDI Clock

Entineering LFO can use a MIDI clock on its MIDI input as a clock source. It interprets Clock messages (0xF8) with 24 PPQN (pulses per quarter note). It also interprets Start (0xFA) and Continue (0xFB) to mark the start of a beat (since firmware v1.1).

Selecting the Output to be Configured

The Entineering LFO has two independent outputs. The output which is currently being configured can be selected using the output select button. The active output is indicated by the output selection indicators. The multiplier, shape, level and range indicators show the state in the currently selected output.

The source tempo is always shared between the two outputs, even the tap tempo. That means that changing the tap tempo will also change the tempo of the output that is currently unselected.

Adjusting Parameters

Choosing a Clock Multiplier

The clock multiplier can be selected with the arrow buttons under the Multiplier label on the front panel. The default is 1, which means that for every clock beat (usually one quarter note), the waveform repeats once. Pressing the up arrow increases the multiplier, while pressing the down button decreases it.

Table 1: Meanings of the multipliers. The given note value corresponds to quarter notes as input beat.

Value	Meaning	Note value
4	Four waveform repetitions per clock cycle	Sixteenth notes
3	Three waveform repetitions per clock cycle	Eighth note triplets
2	Two waveform repetitions per clock cycle	Eighth notes
1.5	Three waveform repetitions per two clock cycles	Quarter note triplets
1	One waveform repetitions per clock cycle	Quarter notes
0.5	One waveform repetitions per two clock cycles	Half notes

Choosing a Waveform Shape

Waveform Shapes can be selected with the shape buttons on the front panel. The six waveform indicators next to these buttons indicate the following selected waveforms:

- Rising sawtooth
- Triangle
- Falling sawtooth
- Sine

- Rectangle
- Random sample & hold

There are two variations of the sawtooth and triangle waveforms:

- Slow rise, fast fall (between rising sawtooth and triangle)
- Fast rise, slow fall (between triangle and falling sawtooth)

The rectangle shape five selectable duty cycles. While the rectangle shape is selected, duty cycles can be selected with the shape up/down buttons as well.

- 10%
- 30%
- 50%
- 70%
- 90%

Pressing “down” increases the duty cycle, while “up” decreases it. Decreasing from 10% or increasing from 90% selects the previous or next shape respectively.

Adjusting the Output Level

The output level can be adjusted from 0% to 100% in ten steps. 100% corresponds to a range of 0 to 5V in unipolar mode, and -5V to 5V in bipolar mode. Scaling always happens towards zero, i.e. a level of 50% changes the output range to 0 to 2.5V in unipolar and to -2.5V to 2.5V in bipolar mode.

MIDI controller messages, if configured, scale the output with respect to the configured level. This means if the output level is configured to 50%, a controller message of 50% results in an output signal of 25%.

Switching Between Unipolar and Bipolar Output

Pushing the Range button toggles between unipolar (0 to 5 Volts) and bipolar output (-5 to 5 Volts) for the selected channel.

Saving and Loading Programs

The configuration of the two outputs can be saved in programs, and later be restored.

Saving a Program

After making changes to the configuration of either output, the save indicator will light up. Now, press the Save button. The number shown in the display will start to blink. With the Up and Down buttons, select one of the 99 program slots where you want to save the configuration. Then press save again. A short animation on the display will indicate that the save was successful. To cancel saving the program, press any other button except Save.

Loading a program

Programs can be loaded in one of two ways: - With the Up and Down buttons on the front panel - With MIDI Program Change messages

Pressing the the up button will load the program one above the one currently shown on the display, while pressing the down button will load one program below. Programs outside of the range 1 to 99 cannot be loaded.

The module also listens to MIDI Program Change messages on the currently selected MIDI channel, or on all channels (“Omni Mode”). The MIDI channel can be configured in the settings menu.

One program consists of the configuration for both channels. That means when loading a program, the current configuration of both channels is loaded from the program.

Loading a program will discard any temporary changes made to the configuration. The save indicator is lit if you have any temporary changes.

Accessing the Settings Menu

The module has a number of global settings like the MIDI channel which can be configured through a menu.

To access the menu, the Save indicator must be off. If it is lit, load a program first to discard any configuration changes. Now press and hold the Save button for several

seconds, until the display contents begin flashing. You can now cycle through menu items with the up and down buttons, and activate them with the save button.

The menu items are as follows:

1. Ch: MIDI channel
2. C1: MIDI controller for output 1
3. C2: MIDI controller for output 2
4. Fr: Factory reset
5. FI: Firmware information

Ch: MIDI Channel

The MIDI channel the module should listen all. Can be one of channels 1 through 16, or AL for listening on all channels at once. The latter is the default setting.

MIDI clock messages are generally not associated to a MIDI channel, so they will always be processed, regardless of the configured MIDI channel.

C1 and *C2*: MIDI Controller for Outputs 1 and 2

Configures the MIDI CC (Controller Change) messages to listen to. Can either be oF to disable the functionality (the default), or a number from 1 to 31. The most common setting would be 1 for the keyboard mod wheel.

Table 2: Meanings of MIDI controller numbers.

Number	Description
1	Modulation, e.g. keyboard mod wheel
2	Breath controller
3	Undefined, freely usable
4	Foot controller
5	Portamento time
6	Data byte for NPN/NRPN
7	Main volume
8	Balance

Number	Description
9	Undefined, freely usable
10	Panorama
11	Expression
12	Effect Control 1
13	Effect Control 2
14..15	Undefined, freely usable
16..19	General purpose 1..4
20..31	Undefined, freely usable

Fr: Factory Reset

After toggling from no to YE, pressing the Save button will reset all settings and programs of the module to the default state.

The default settings are:

- MIDI channel: all
- Controller 1: disabled
- Controller 2: disabled
- BPM: 120

All programs are reset to the default state:

- Multiplier: 1
- Shape: sine
- 100% level
- Unipolar

Fl: Firmware Information

Displays the version of the firmware (Fi) or bootloader (bL). A typical output would be something like 1.1. Digits 10 through 15 are displayed as letters A through F, so version 1.13 would be displayed as 1.C. A dot after the second digit indicates a prerelease version.

Updating the Firmware

The firmware of the module can be updated by sending MIDI SysEx messages.

Entering Update Mode

1. Disable power to the module
2. Press and hold the Up and Down buttons
3. Enable power to the module
4. The letter F on the display indicates that the module is in firmware update mode

Transfer New Firmware

Connect a MIDI cable from a PC-MIDI interface to the module. Now send the firmware file in .syx format from your PC to the module. You can disable any delays between messages for faster transfer.

Make sure that no other software or device is sending MIDI data to the module while updating.

Some low-cost USB-to-MIDI adapters do not properly support SysEx messages, in particular those based on the CH345 chip.

Table 3: Recommendations for Software that can be used for sending SysEx files.

Operating System	Software	Where to Get
macOS	SysEx Librarian	https://www.snoize.com/sysexlibrarian/
Linux Command Line	`amidi`	`alsa-utils` package

Operating System	Software	Where to Get
Windows	MIDI SysEx Transfer Utility	https://apps.microsoft.com/detail/9pfd4ddwgktn

SysEx Librarian

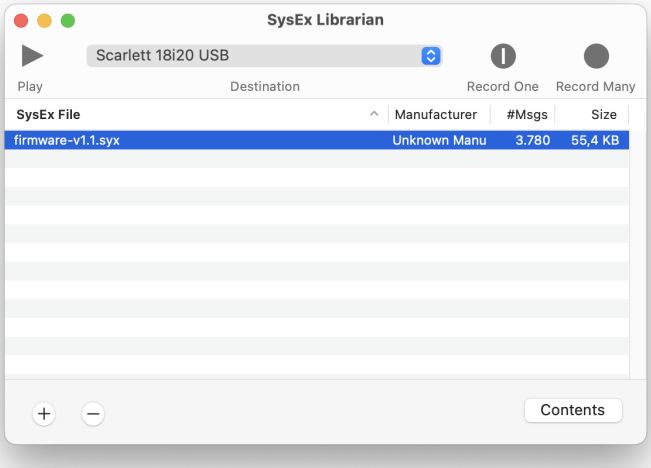


Figure 4: SysEx Librarian

Follow these steps to transmit a new firmware file to the module using SysEx Librarian:

- Add the firmware file to the list of SysEx files in SysEx Librarian.
- Select your MIDI interface in the drop-down menu at the top.
- To speed up the transfer, go to “Settings” under the “SysEx Librarian” menu and set the pause between messages to 0 milliseconds.
- Press the “Play” button in the top left.
- Wait until the file was fully transferred.

`amidi`

Follow these step to transmit a new firmware file to the module using `amidi` on Linux:

- Open a terminal.
- Type `amidi --list-devices` to get a list of your MIDI devices. Note the descriptor in the "Device" column.
- Type `amidi --send=/path/to/firmware-v1.1.syx --port=hw:1,0,0`, where the argument to `--send` is the path to the firmware file, and `--port` is the MIDI device descriptor from the previous step.
- Wait until the file was fully transferred.

MIDI SysEx Transfer Utility

Follow these step to transmit a new firmware file to the module using MIDI SysEx Transfer Utility on Windows:

- Select your MIDI interface in the drop-down menu labelled "MIDI Output Port".
- Press the button "Pick SysEx File to Send" and choose the downloaded firmware file.
- In the field "Transfer Delay", enter 0.
- Press "Validate and Send SysEx"
- Wait until the file was fully transferred.

Completing the Transfer

During the transfer of the new firmware, a rotating animation is shown on the display. After the transfer was successful, the module will boot into the new firmware and can be used normally. If the transfer was not successful, one of the following may occur:

- It still shows the F: Check your MIDI connection and try again.
- A single lit segment is shown on the display: The transfer was incomplete.
- An error code, e.g. E5, is shown on the display: Data was corrupted during the transfer or a different error occurred.

In any case, even after an incomplete transfer resulting in a non-working module, you can always try the firmware update process from the beginning by holding the two buttons during power-up. Try a different MIDI interface or different software if the error persists.