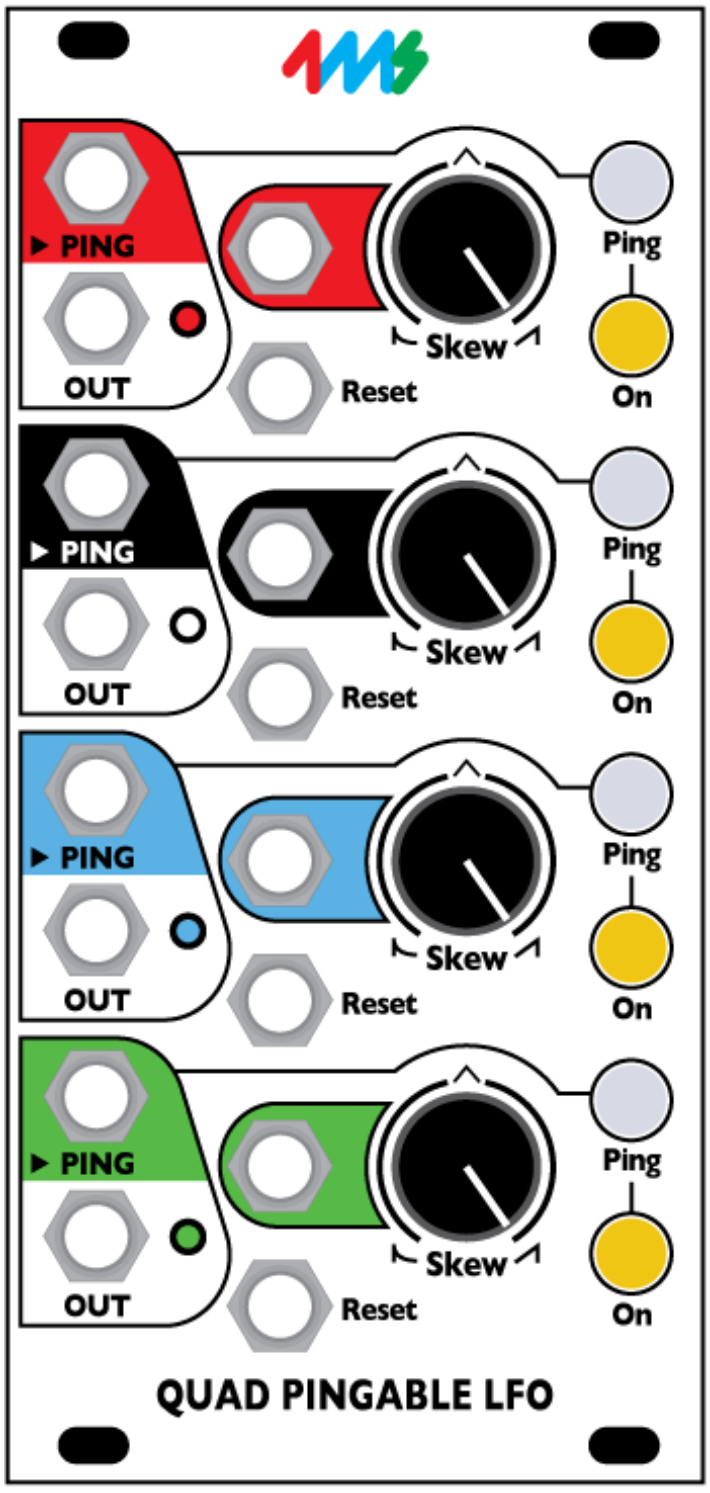
4ms Quad Pingable LFO

Eurorack Module User Manual v2016-Mar-04 (PCB rev 2.2)



The Quad Pingable LFO (QPLFO) from 4ms Company is a compact, playable four-channel tap-tempo, pingable (clock-syncable) LFO with variable skew and reset. Each channel's speed is set by a **Tap Tempo** button or an external clock (**Ping**). Each channel can be **Muted** with a latching button and **Reset** with an external trigger. The **Skew** CV and knob allow for a variety of waveshapes without losing sync to the ping clock. A plethora of headers allows for connection to other modules, including the 4ms Quad Clock Distributor, the 4ms VCA Matrix, the 4ms SISM, and the Toppobrillo Mixiplexer. Several advanced features are hidden within the QPLFO: Floating Reset mode, one-shot mode, "mutli-shot" mode, Fire-on-unmute, Bipolar/Unipolar outputs, and more...

The QPLFO is designed to be useful in small portable systems that require maximum functionality in minimal space, as well as large systems that need maximum modulation sources.

The QPLFO has a variety of uses:

- Four LFOs with mutes
- Master tap clock
- Clock delay (Clock phase shifting)
- Quadrature LFO
- Square/Pulse to Triangle/Ramp waveshaper
- One-shot

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http://4mscompany.com/qplfo.php

Basic features:

- Quad “pingable” LFO's – frequency is set by time between pulses ("ping")
- Each of the 4 channels is an independent LFO
- Can produce a variety of waveshapes: triggers, to near-expo "pluck", to ramp-down, to triangle, to ramp-up, and all shapes in-between
- Channels can easily modulate, trigger, and reset each other for complex and slowly morphing outputs
- Slowest period is 71 minutes (0.0002 Hz), fastest speed is about 500Hz (marginal tracking up to 1kHz)
- Tap tempo button is free-running (LFO runs indefinitely), but external clock/Ping is auto-stopping (LFO stops when external clock stops)

Controls and jacks:

- **Tap tempo button** ("Ping") for manually setting the tempo
- **Ping jack** sets tempo with an external clock (any signal can be used)
- **On/mute button** enables or mutes the output (latching button)
- **Skew knob and CV jack** control the waveshape by altering the ratio between rise and fall times
    - At 0% Skew (0V of CV), the shape is a 10ms trigger
    - At 1% Skew is a near-exponential "pluck"
    - As Skew increase to about 3%, it becomes less exponential and more linear
    - At about 3% Skew, the shape is linear ramp-down
    - At 50% Skew (about 5V of CV), the shape is triangle
    - At 100% Skew (about 10V of CV), the shape is ramp-up
    - Skew knob provides offset to the incoming CV signal, so any range of CV is acceptable
- **Reset jack** restarts the LFO without changing the tempo (rising edge triggered)
- **OUT jack** outputs either a 0 to 10V waveshape, or a -5V to +5V waveshape (jumper selectable)
- **LED** flashes and dims to the signal on the OUT jack
- Tap tempo button flashes to the internal tap-tempo clock or to incoming pulses on the Ping jack
- On/Mute button lights up when channel is On

Advanced

- Ping and Reset inputs use comparators, so any waveshape can be used for triggering (audio waves, complex LFOs, even the QPLFO itself!)
    - Trim-pot on PCB allows for adjustment of comparator threshold value

- "Fire-on-unmute" jumper per channel:
    - When this optional jumper is installed, pressing the On button to turn the channel on will reset the LFO.
    - If the jumper is **not** installed (factory default), pressing On will unmute the LFO without resetting (LFO runs in the background when muted)

- Bipolar/Unipolar jumper:
    - Setting jumper to Bipolar makes the outputs -5V to +5V
    - Setting jumper to Unipolar makes the outputs 0V to +10V
    - One jumper controls all four channels

- One-shot mode: Reset jack can be used to trigger a one-shot envelope if the external ping clock is stopped. See section below for detailed discussion

- Floating Reset mode: Holding a high gate on Reset jack allows the waveshape to run freely without automatically re-syncing to the ping clock. A bare cable plugged into the jack causes a high gate

- Connects to other modules using ribbon cables:
    - Outputs can connect to the 4ms VCA Matrix, or the 4ms SISM, or the Toppobrillo Mixiplexer
    - Normalization of ping jacks can connect to the 4ms Quad Clock Distributer

Dimensions

- 12 HP Eurorack format module
- 1.04” (26.4mm) deep including cable
- 0.85” (21.6mm) deep without cable

Power consumption

+12V rail: 86mA max
-12V rail: 37mA max
(+5V rail is not used)

Your first QPLFO patch

The QPLFO is a different kind of LFO than you might be used to. Rather than setting the speed with a knob and/or CV jack like a traditional LFO, the QPLFO sets the speed by using an external clock or tap button. To do anything with the QPLFO you first need to give it a Ping. Let's get started with your first patch:



1. Start by tapping in a tempo on the red channel: just press the top Ping button twice
Instantly, the button will flash to your tempo, and keep running.



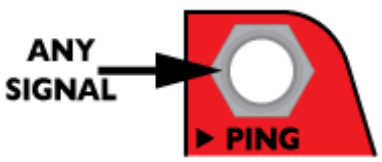
2. Press the On button and it will light up orange.
When this button is off, the channel is muted (no output).
The Ping button will continue to flash even if a channel is muted,
so you can see what tempo it'll be when you unmute it



3. Plug the OUT jack into something you want to modulate (try the pitch of a VCO, or run one VCO into a VCA and then into the FM of another VCO, and use the QPLFO to open up the VCA).
When the On button is lit up, notice that the LED by the OUT jack will also be flashing.
The brightness of this LED follows the signal of the output.



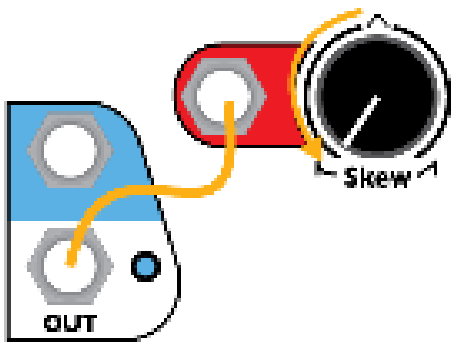
4. Play with the Skew knob and listen to how the waveshape changes. Notice how the total frequency (or period) of the output does not change. Technically, Skew sets the ratio between the rise and fall times without changing the total time.
For most of the range, the waveshape will be linear rise and fall.
But when Skew is at 0%, the output will be a sharp attack with sharp drop-off... similar to an expo curve (technically it's a quadratic curve). If you nudge Skew up just a hair, it will output a linear Ramp-down sawtooth shape. At center it will do a Triangle wave. All the way up, you get a Ramp-up shape.



Now try **sync'ing the QPLFO channel to an external clock**.
Plug a clock, or anything, into the Ping jack. Maybe an RCD or SCM output, or the output of another LFO or cycling envelope, or a VCO at a very slow speed.
The Ping button will light up when a signal is present on the jack, and will switch from running at your tap-tempo to the incoming clock's tempo.

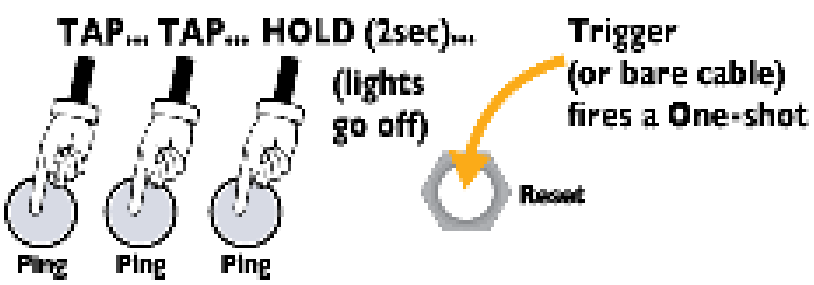


Next, let's play with **Reset**. Plug a manual gate/trigger (or a really slow clock) into the Reset jack.
The LFO will start over each time it receives a signal on this jack.
(See below for a technical description of what Reset is actually doing.)



Now try a fun trick: modulate Skew of one channel with another channel's output.
Set the red channel tempo to about 1-3 cycles per second.
Tap the blue channel's Ping button once. Listen to the red channel make 8 cycles, and then tap the blue Ping a second time.
Plug the blue channel output into the red channel Skew CV jack.
Turn the red channel Skew knob all the way down.
Turn blue channel Skew to triangle (center).
You should be hearing the red channel skew shift from falling ramp to triangle to rising ramp.
You can mute the blue channel to make the red channel go back to a static waveshape.

If you want to get chaotic, mult or stack the red channel output, and plug it back into the blue channel's Skew. Keep going, try chaining all 4 channels together, plug into Reset and Ping, it's easy to get crazy quick...



Here's another fun trick: **One-shot mode**.
First, you have to arm it by stopping your clock:

- If you're running an external clock into Ping, either stop it at the source, or unplug the Ping jack.
- If you're using Tap tempo, then tap the button three times and hold it down on the third time for 2 seconds.
- The orange button should be lit up (unmuted) but the channel should not be running. This is "armed."

To trigger a one-shot, give a pulse on the reset jack. You can plug Reset into a trigger pad (Synthwerks FSR, or Makenoise Pressure Points, or FoH Choices...). *Hint:* in a pinch you can use a bare cable by touching the tip to metal (cheap and dirty hack, but it works!)

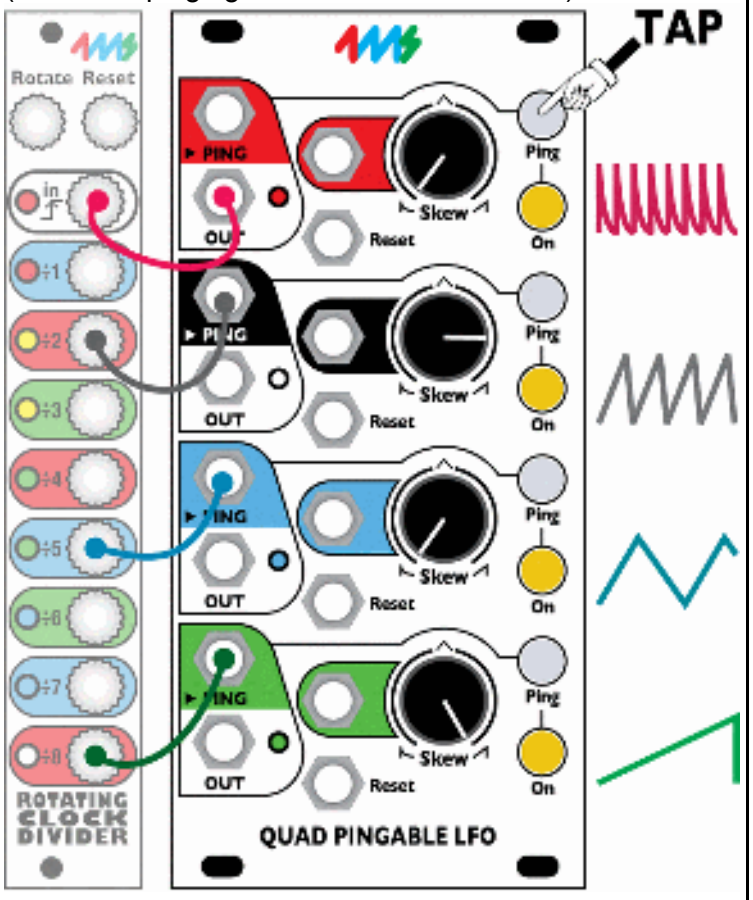
Example Patches

Tempo syncing:

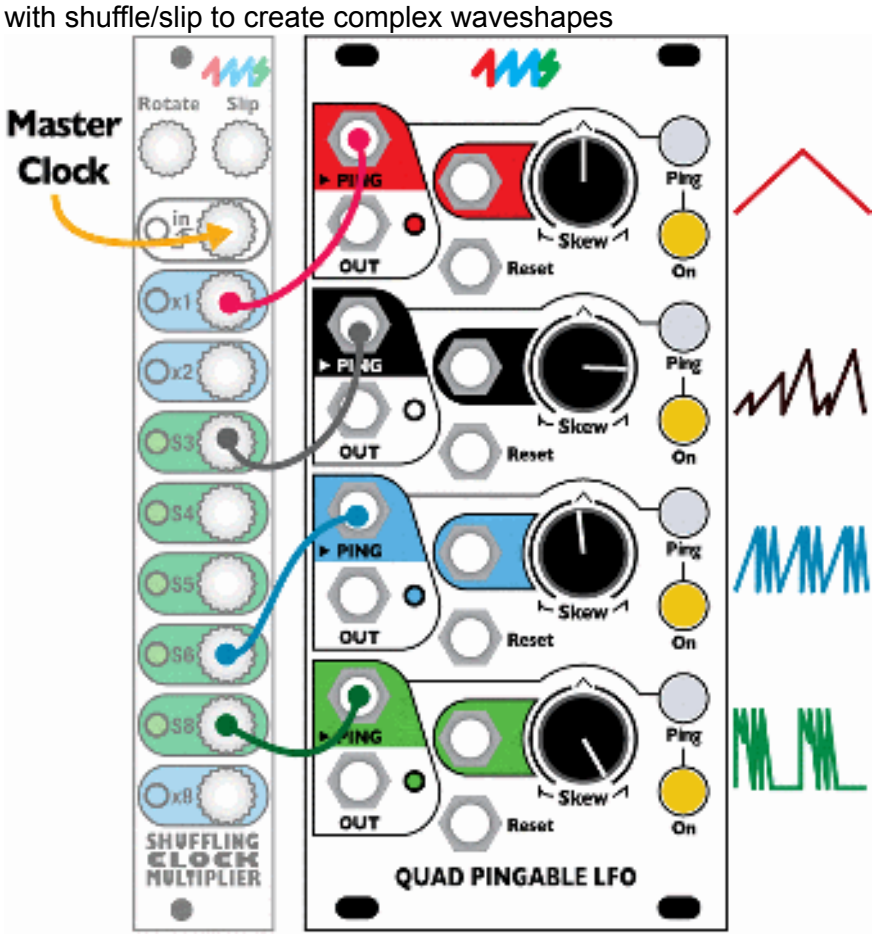
If you want all the channels to be synced to a master clock (or multiples and divisions of a clock), you can use a clock divider or multiplier.

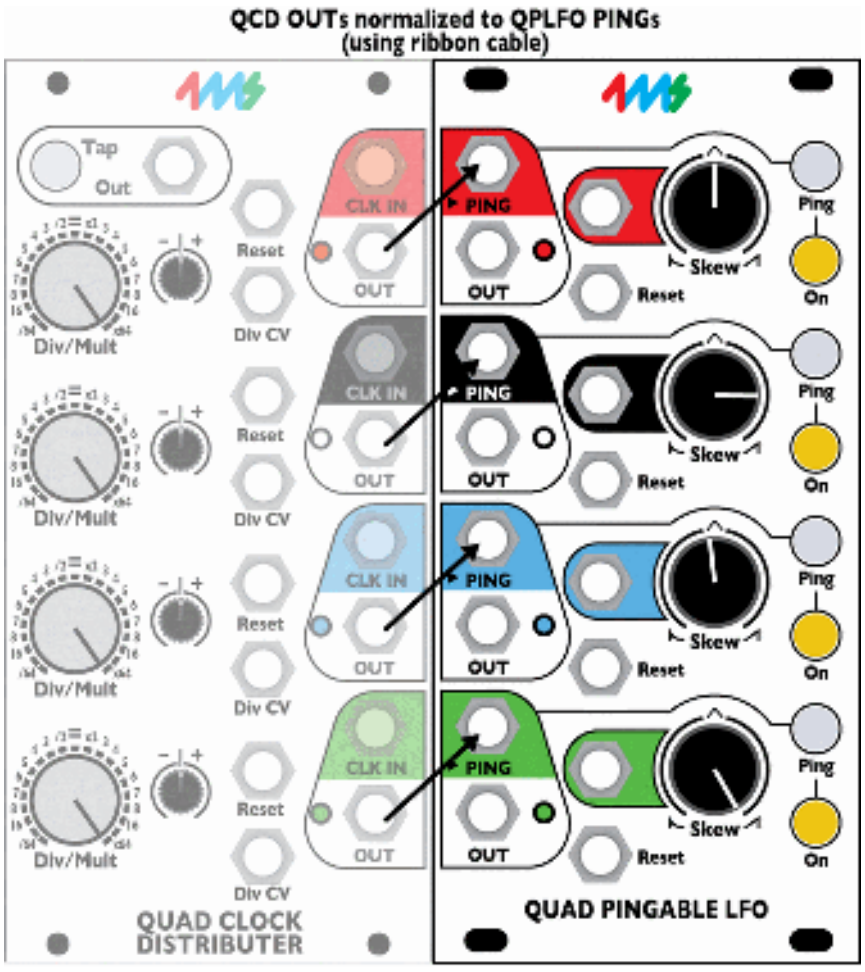
In a small system, you might want to use one channel of the QPLFO as a master clock to clock such devices as the Rotating Clock Divider (RCD) or the Shuffling Clock Multiplier (SCM). Turn the Skew knob all the way down to use the channel as a master clock (this produces an output that's somewhat like a trigger pulse).
Any of the RCD or SCM outputs can be used to Ping and Reset the QPLFO.
Advanced: After setting up this patch, try running the slowest QPLFO channel output to the Rotate jack... Or try running one of the slower clock outputs to the Reset jack of a faster LFO

Using one channel of the QPLFO as a master clock:
(with RCD pinging the other three channels)



Using an external master clock:
with shuffle/slip to create complex waveshapes





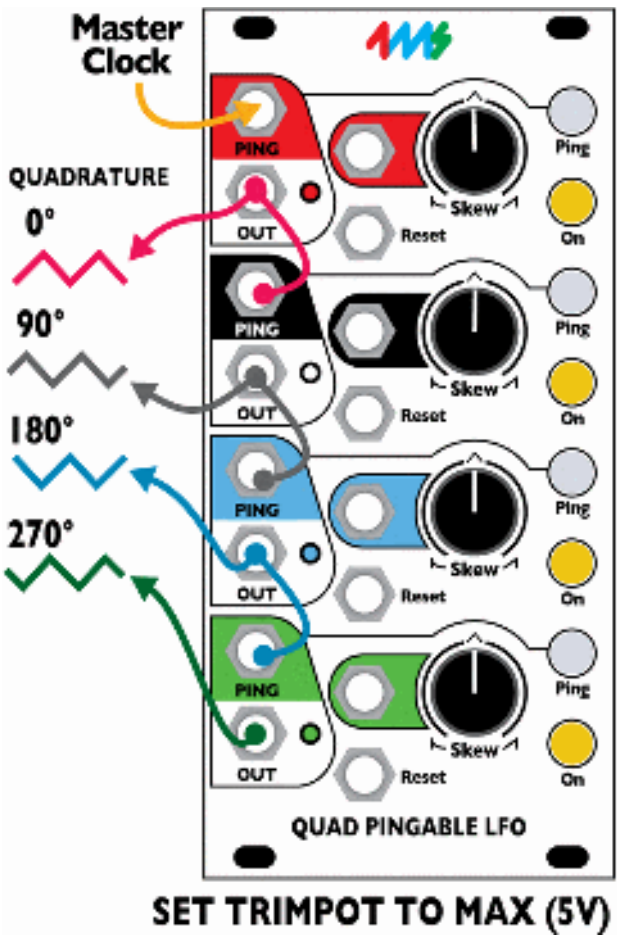
QCD + QPLFO

The QPLFO is designed to connect to the Quad Clock Distributer (QCD), which provides clock multiplication/division.

The QPLFO and QCD connect in the back with a 8-pin ribbon cable. Connect the "PINGS" header on the QPLFO to the "CLOCK OUTS" header on the QCD. Make sure the red stripe is aligned to the white line on both modules. When connected together, each QPLFO Ping jack is normalized to the corresponding channel output on the QCD. Whatever tempo each QCD channel is running at, the QPLFO channel will run at the same tempo. Plugging into the Ping jack will override the QCD connection, so the two units can still be used separately. More detailed information will be found in the QCD manual.

Quadrature LFO

There's several ways to generate quadrature with this quad LFO module.



SET TRIMPOT TO MAX (5V)

A. The most clever method uses the QPLFO by itself. This method takes advantage of the trimpot on the back of the QPLFO, which sets the threshold voltage for the Ping and Reset comparators. Adjust this trimpot so the threshold voltage is 5V (all the way up), assuming you are set to Unipolar outputs (0 to 10V). Now patch channel 1's output to channel 2's Ping input, channel 2's output to channel 3's Ping, and channel 3's output to channel 4's ping. Tap a tempo on channel 1 or use an external clock. The four channel outputs will be 90 degrees out-of-phase from each other, in quadrature (you need to stack/mult the outputs for channels 1-3).

B. Another way is to first make a quadrature clock, and then feed that into the QPLFO's ping inputs. There's various ways to make a quadrature clock. An A-151 or other sequential switch is and easy way, just run a steady high voltage into the common (O/I) jack and patch the four I/O jacks to the QPLFO pings. Clock the A-151 as normal. Or you can use an RCD that's re-flashed as a Triggered Gate Sequencer. Also, an A-152 provides quick quadrature clock outputs by using Dig.Outs jacks 1-4, and patching jack 5 to Reset.

C. Another way is to use the Reset jacks. This method doesn't give perfect 90 degrees, but it does allow you to "feel" out the desired phase difference and change each channel's phase offset independantly and on-the-fly.
1. Ping all the channels with the same external clock (stack/mult to all four ping jacks)
2. Run a manual gate into each Reset jack.
3. Fire a trigger into each gate at the appropriate time, approximately a quarter of the way through the previous channel's cycle.

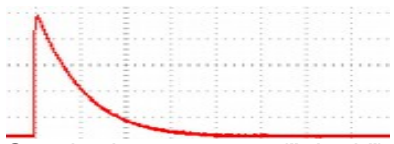
Quad VCO FMing

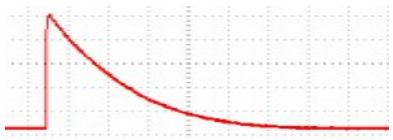
It might not be hard to find four things to modulate with the QPLFO, but if you need something to try out, the following patch creates an endless variety of complexly changing sounds.
Run the outputs of four VCOs into the inputs of a VCA Matrix. (If you only have 3 VCOs, or even 2, the patch will still work!) Run the VCAM outputs into the FM or 1V/oct inputs of the same four VCOs (try to keep them in the same order: A->1, B->2, etc). Pick four different CV-jacks on the VCAM and plug in the outputs from the QPLFO. At first, try to avoid the CV-jacks that feed a VCO back into itself (A1, B2, C3, D4), these are less interesting.
As the LFOs cycle, the VCA Matrix creates different permutations of VCOs FM'ing each other. Mute/unmute LFOs and VCAM channels at will, and play with the VCAM attenuators. Since this can quickly get out of control, try keeping the four QPLFO channels synced to a master clock (see Tempo Syncing patch). Using the plucky skew setting gives intense percussive effects, and triangle skew is nice to slowly bring in a sound. Modulating Skew slowly is also great.

Detailed Discussions and Special Features

Skew curves


10ms trigger pulse
Skew at <200mV (7:00)


Quadratic root curve ("pluck")
Skew at ~300mV (7:25)

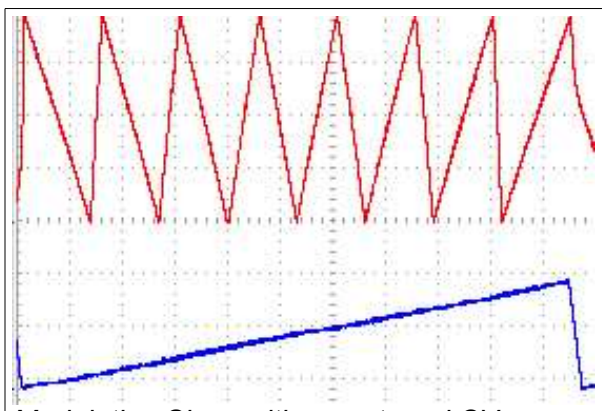

Cubic root curve ("pluck")
Skew at ~400mV (7:30)


Square root curve ("pluck")
Skew at ~500mV (7:35)


Ramp-up: Skew at ~600mV (7:40)


Triangle: Skew at 5V (12:00)


Ramp-up: Skew at 10V (5:00)

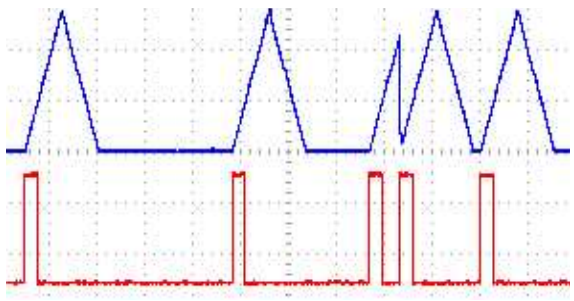

Modulating Skew with an external CV. Output in red (top), Skew CV in blue (bottom).

Skew changes the waveshape in real-time. The full range of the Skew jack is 10V. The Skew knob provides offset for the jack. For maximum modulation range, turn the Skew knob all the way down if you are plugging in a positive-only modulation source. Likewise, if your modulation source is positive and negative, you will get maximum modulation range if you keep the knob towards the center. These are just rules of thumb, always trust your ears.
At 0% (Knob at CCW, or 0V on the jack), the output will be a 10ms trigger pulse. This is useful for clocking other devices (drum modules, clock divider/multiplier, etc). With Skew turned up just a hair, there will be a near-exponential falling curve. Turning it up a tiny bit more, it will morph into a linear ramp-down curve. From here to 100%, the output stays linear: the skew will smoothly transition from ramp-down to triangle to ramp-up.
One interesting feature is that the QPLFO won't switch to the trigger or expo curves unless Skew was near 0 **before** the start of the curve.

Ping jack and Ping button

The QPLFO can use either a tap-tempo or an external clock, and it switches between them automatically. Tapping a tempo with the Ping button enables the tap-tempo circuit, and the Ping button will flash to the tempo of the internal clock. As soon as an external signal is recognized on the Ping jack, the internal tap-tempo clock is turned off, and the Ping button will displaying the signal on the Ping jack. To re-enable the tap tempo circuit, tap in a new tempo.

One-shot mode



op: output (one-shots)
Bottom: Triggers into the Reset jack

See "Your first QPLFO patch" section.

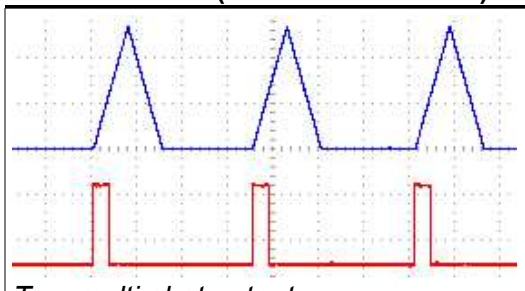
The key to this mode is to set a Ping time, then let the clock expire (which stops the LFO without muting the channel). You can fire the One-shot with the Reset jack.

If you're using tap tempo, just hold the Tap button down for 2 seconds. This tells the QPLFO to stop the internal tap clock. To avoid double-triggering or weird intermediate tempos, you may want to tap the tempo immediately before holding the button down for 2 seconds, thus we recommend "Tap-Tap-Hold".

If you're using external clock: stop the clock upstream, or unplug it (or mute it with a VCA, for example). The QPLFO will notice that the clock is stopped and force the output to stop. However, the timing from the ping will be remembered.
(Note: you can mute the channel and still give it a ping/tap. This prevents any output while you are setting up the one-shot timing. Unmute the channel when you're ready to start firing reset pulses)

Next, To fire the one-shot, send a pulse into Reset jack. A manual gate module works great for this. Or, a quick hack is to plug a bare cable into Reset: it will fire a one-shot envelope if the other end of the cable is unplugged. You also can touch the bare end of the cable on some metal (the nut of the jacks, for example) and it will fire each time. Doing this isn't pretty, but it works in a pinch and/or can be a great space-saver for small systems.

Clocked Reset ("Multi-shot" mode)

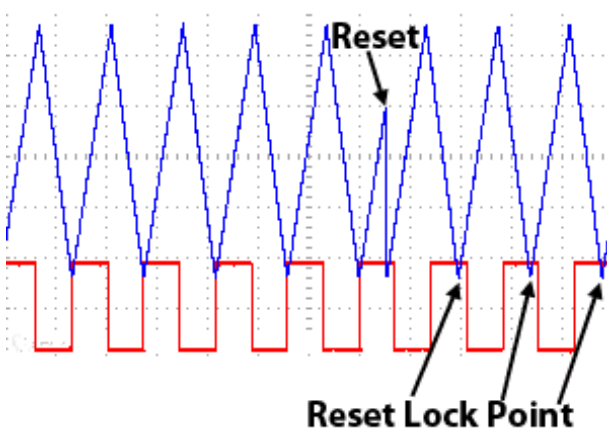


Top: multi-shot output
Bottom: Clock on the Reset jack

Set up the ping/tap timing as described in the One-shot mode patch. The QPLFO should be unmuted, but not running. Now plug a clock into Reset. The length of the output waveshape will match the timing obtained from the ping or tapping, but the frequency of the output will match the frequency of the Reset. Thus you can fire short bursts with a pause/silence between pulses.

Hint: If this output is inverted, you will obtain a trapezoidal wave whose shape is set entirely by clock timing.

What exactly is Reset? What is the Reset Lock Point? Can I do clock phase shifting with the QPLFO?



Bottom trace is ping (20ms period)
First four waveshapes start on the Ping. Then a reset pulse is applied about 8ms after a Ping. This defines the Reset Lock Point (8ms after each Ping). Subsequent waveshapes all start on this Reset Lock Point

Reset on the QPLFO behaves the same as reset on a traditional/typical LFO: it re-starts the LFO when a trigger is received on the Reset jack. However, there are some unique subtleties to the QPLFO.

When you first power the QPLFO on (without having given a reset pulse), the output waveform always starts at the same moment the Ping button lights up. Try setting a slow tempo, about 3 seconds or so, and turn Skew all the way down. See how the LED by the output jack and the Ping button light at the same time? This means that they are *in-phase*. See in the diagram (left), the first few triangle waves all start on the ping's rising edge: they are in-phase.

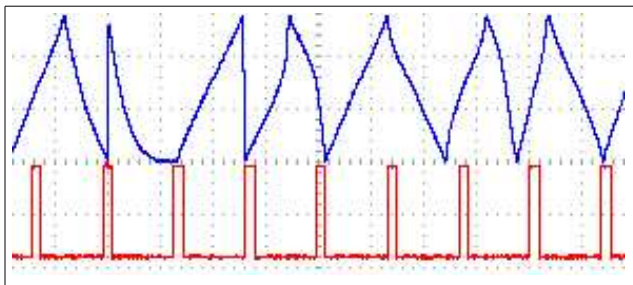
Reset changes the *phase* relationship between the incoming Ping and the output. Let's say your incoming Ping is a clock that marks the start of a measure. By default, the LFO will begin at the start of each measure (ONE two three four). But, if you give a reset pulse mid-way through the measure, the LFO will begin at this point mid-way through the measure (one two THREE four). It will keep resetting/re-starting when this point in the measure happens, until/unless you assign a different reset point.

This point in time is called the **"Reset Lock Point"** and it's measured in the amount of time to delay the start of the wave after a ping is received. The QPLFO will make sure the output always is synced to this Reset Lock Point, unless you tell it otherwise. See the diagram: after a Reset pulse is given, the triangle waves always start at a point to the right of each ping's rising edge. This feature is a critical difference between the QPLFO and other/traditional LFOs.

Note that the Reset Lock Point is relative to the ping. If you change the ping time (by tapping in a different tempo, or changing the speed of the external clock), the reset will stay the same in terms of **length of time (not in proportion of time).** So if you

give the QPLFO a reset pulse 500ms after the ping, the LFO will always start 500ms after the ping, even if you slow the ping time down. If you change your clock speed (ping time) to faster than 500ms, then the reset time will be meaningless and by default it will be set to 0ms (in-phase with Ping). This is a quick way to clear the Reset Lock Point: speed up your clock, then slow it back down again. Another way is to give a reset pulse at the same moment as the ping (either manually, or plug the ping clock into the reset jack).

Floating Reset mode



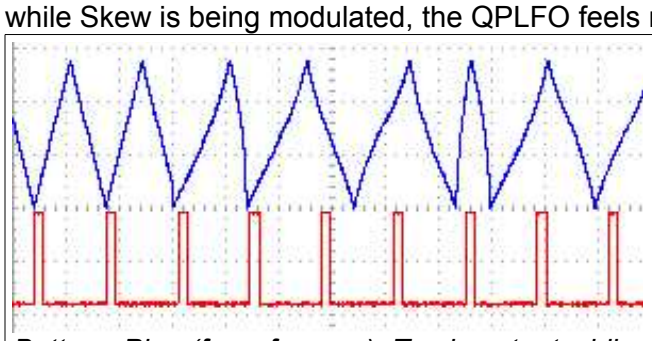
Bottom trace is Ping clock. Skew is being modulated manually. Reset is being held high to put us in Floating Reset mode. Notice how output does not always start on the Ping.

Holding a gate high on the Reset jack tells the QPLFO to stop resetting/re-syncing your waveshape on each Ping or Reset Lock Point. This is called "Floating Reset mode" because the LFO will not reset to a specific lock point. Nothing else changes in Floating Reset mode: the Ping is still actively creating the timing of the output: if the ping clock stops, the output will still stop; and if the ping clock speeds up or slows down, the output will still speed up or slow down.
In a small system you might not have a steady high gate handy, so you can simply plug a cable into the Reset jack and leave the other end dangling (or plugged into another channel's Reset jack). A reset pulse will occur when you plug a bare cable in, and you have entered Floating Reset mode.

Floating Reset mode might not be noticed by a casual user, but it does have some important (though subtle) uses.
For example, the QPLFO will slowly drift off time with an external Ping in Floating Reset mode. Often this is not desirable, but for some works of music this is an interesting (perhaps crucial) element.
Another use for Floating Reset mode is if you want to modulate the phase by changing Skew instead of giving Reset pulses. This will completely avoid any sharp re-syncing that would occur if you changed phase with Reset triggers. Since the automatic reset at the Reset Lock Point or Ping is disabled in Floating Reset mode, you are free to twiddle skew without any attempt by the QPLFO's to sync you back to a clock. As the output changes period when its Skew is modulated, the result is that after you are done turning Skew, the output will have a different phase.

Skew modulation suspends automatic resetting/re-syncing (unless you tell it not to)

This feature happens automatically in the background and is not necessary to understand, even for advanced users.
Normally, when no skew modulation is happening, the output will be reset automatically when a ping is received (or the Reset Lock Point occurs, see "What exactly is Reset" section). An interesting feature of the QPLFO is that this automatic resyncing/resetting is disabled if Skew is actively being modulated (e.g. you are turning the Skew knob). This is similar to Floating Reset mode, but it only lasts as long as Skew is changing value.
Why? When you turn the Skew knob, it might take you a fraction of a second or so to turn the dial. During this fraction of a second, the waveform is changing shape while tracking the knob. Since it's changing shape, it's also changing period and phase. Trying to re-assign phase while phase is changing is counter-intuitive and results in weird artifacts (double-hits and false starts). It's better to reset/re-sync when you're done changing the shape. So by disabling the automatic reset feature while Skew is being modulated, the QPLFO feels more friendly and it "just does what you think it will do". As soon as a Skew holds steady for a fraction of a second, the auto-reset is re-enabled and it will snap back in sync at the next Ping or Reset Lock Point.



Bottom: Ping (for reference). Top is output while skew is being modulated continually, starting with the second triangle wave. Notice how period and phase are variable.

Delving further into the nitty-gritty of timing, you can override this feature. Let's say your patch requires resyncing 100% of the time, on every beat without compromises, and at the same time you want to modulate skew all over the place. Just mult/stack your ping clock into the Reset jack (or send some other clock into Reset if you want phase shift). A pulse received on the Reset jack will force a reset to occur, even if Skew is being modulated. Again, this "just does what you think it will do", but if you've made it this far in the manual, you deserve to know what's really going on!

Jumpers and Trimpots

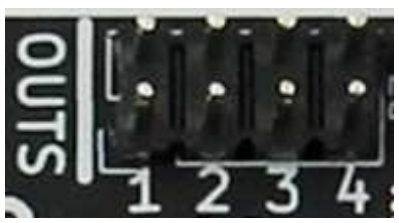


Bipolar/Unipolar jumper
This jumper selects "Bipolar" output (-5V to +5V waveforms), or "Unipolar" output (0V to +10V).
On PCB v2.2, the jumper is labeld UNI or BI.
On PCB v1.0.1, the jumper is labeled +/-5V and 0/+10V.
On PCB version 1.0, the jumper is labeled "BIPOLAR" on the left side. The right side is Unipolar

Factory default is Unipolar mode.



Fire On Unmute jumpers
Each channel has a jumper to enable "Fire On Unmute" mode.
In this mode, turning the On button from off to on will fire a quick pulse into the Reset jack. This will reset the waveform. If you're in one-shot mode, the channel will fire once. This is useful for playing the QPLFO live by firing waveshapes by hitting the buttons. It's also useful for manually re-syncing the LFO.
Each channel has its own jumper, so you could enable this on all, none, or only some of the channels.
On PCB v2.2, these jumpers are in a 2x4 header labeled “FIRE”. Installing a jumper bridging the top and bottom pin in a column will enable Fire-on-Unmute mode for the labeled channel.
On PCB v1.x, these jumpers are located in between the two PCBs, above the buttons for each channel.
Factory default is no jumpers (all off).



The QPLFO has an 8-pin header labeled "OUTS" that outputs the LFO signals (0 to +10V). This can connect to other modules for behind-the-scenes connectivity. The On/Mute button stays active, the signals on the header pins are the same signals that are on the OUT jacks.
Compatible modules:
• 4ms VCA Matrix: use the "DAISYCHAIN INPUTS" header. The LFOs appear on the main input jacks (not the CV jacks). This is extremely useful for routing combinations of LFOs to various places in your patch. *Note: to minimize clipping, use the QPLFO in Bipolar +/-5V mode when connecting to the VCA Matrix or any DC mixer.*
• 4ms Shifting Inverting Signal Mingler (SISM). Details in the SISM manual.
• The Mixiplexer from Toppobrillo accepts this cable with a special mod board. Pressing the X/I button on the Mixiplexer selects the QPLFO's four LFOs to control the four VCAs of the Mixiplexer. Level knobs on the Mixiplexer attenuate the LFOs, and the mute buttons on the QPLFO can mute the channel. The Slope parameter on the Mixiplexer is also active.



The QPLFO has an 8-pin header labeled “PING” that connects to the switch tabs on the Ping jacks. This can be used to connect to other modules such as the QCD for syncing tempos.
If nothing is plugged into the Ping jack on the QPLFO, the signal on the PING header will clock the channel. By plugging into the Ping jack on any channel, the PING header will be overridden for that channel only.



Threshold Trimpot Adjustment
The trimpot on the back of the QPLFO adjusts the voltage required to trigger a ping or reset.
At fully CCW, the voltage is 5.0V. At center, it's 2.5V. At fully CW it's 0V and the unit will not respond to Ping or Reset.
The QPLFO can be interfaced with LZX-level compatible equipment by setting this trimpot to about 0.8V.
It's safe to turn the trimpot with the unit powered up, but normal cautions apply when handling any piece of equipment that's "live". You can use a volt meter to measure the voltage on the wiper of the trimpot as you turn it. This voltage will be the threshold voltage.
Factory default is about 2.5V, or roughly half-way.



LED Dim trimpot
This trimpot adjusts the brightness of the LEDs. If the LEDs appear too dim to your eyes, you can adjust them to be dimmer by turning this trimpot down. On the other hand, if you enjoy a light-show while playing with the QPLFO, turn the trimpot up.
Factory default is a random setting!



Power header
This 2x5 header connects the QPLFO to a power source. A standard 10pin-to-16pin Eurorack power cable must be used (included).
The red stripe on the power cable should be orientated towards the white stripe on the QPLFO (where it says -12V). On the power supply distribution, the red stripe should correspond to the -12V power rail.

The QPLFO is reverse-voltage protected. If the power cable is installed backwards the QPLFO will simply not turn on.