Quiver manual

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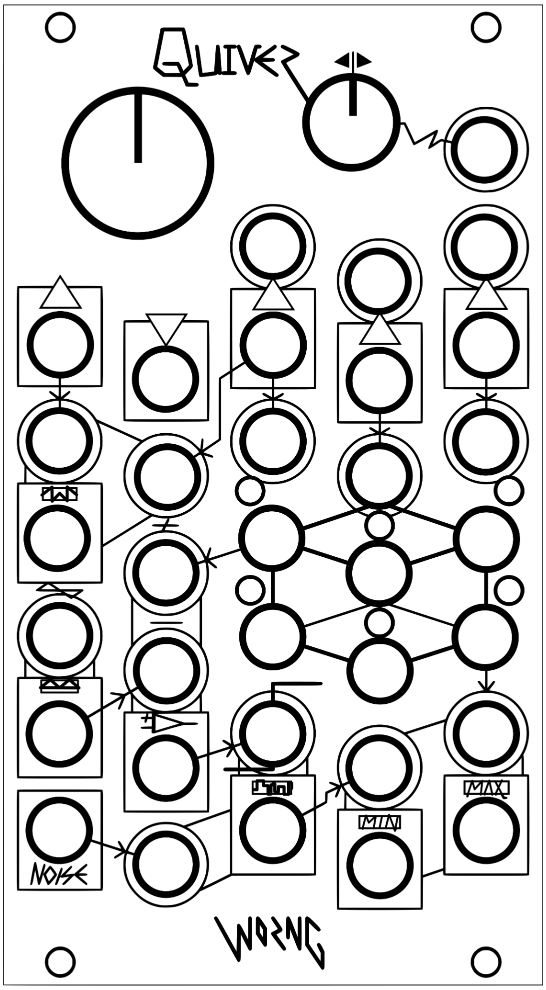


Quiver

Verb: tremble or shake with a slight rapid motion.

"the tree's branches quivered in the breeze"

Noun: a set of surfboards (or skateboards, snowboards) of different lengths and shapes for use in different conditions.

"she had put together a whole new quiver of boards specifically for Hawaii"

Congratulations on acquiring a WORNG Electronics Quiver modulation module! Quiver was designed to be the analogue modulation heart of your modular system, no matter what size it is.

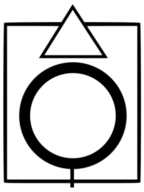
Quiver was initially conceptualised as a way to take the idea of 'many interrelated control voltages from few' of the Vector Space and pare it back to its essence, add some internal modulation sources to feed it without needing additional modules, then add a collection of essential analogue utilities, all fed from one another with clever signal normalling to create a patch programmable modulation source that comes in handy in every patch.

The sections of Quiver are as follows:

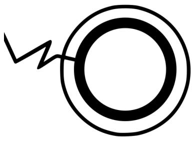
- **Cube** modulation matrix based on the circuitry of our acclaimed Vector Space module, with three inputs and six outputs
- Four analogue **LFOs** of differing speeds, with macro Rate control and additional Rate CV inputs for Follower LFOs A, B, and C.
- **Wavefolder** with variable fold point
- **Full wave rectifier**
- Analogue **Voltage Comparator**
- Analogue white **Noise** source
- Low-droop **Sample and Hold**
- Analogue Logic/**Min Max**

Like many WORNG Electronics modules, physical controls are reduced to the minimum amount needed, with a single **Rate** macro control for all four LFOs and attenuverter for **Rate CV**. Each output (apart from white noise) has an LED to give you visual feedback of what the voltage is doing, so you never get lost in the patch.

Keeping track of what's going on with Quiver is easy, with all the information you need right there on the panel.

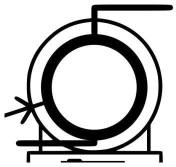


Apart from the six Cube CV outputs, all **Outputs** have a rectangle around them and (except for Noise) have an LED above them and a graphic showing the nature of the output.



All **Inputs** have a circle.

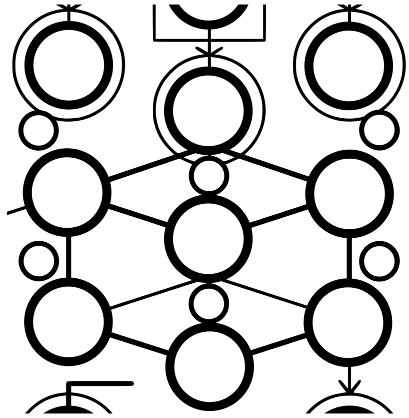
The **rising edge clock input** of the Sample and Hold has an additional rising edge marked through the circle to indicate that it's an edge sensitive input.



Quiver requires **14hp** of space, is **39mm deep** with power cable attached and consumes **75mA of +12V** and **75mA of -12V** from a standard 16 pin Eurorack power supply.

Quiver sections in detail:

Cube

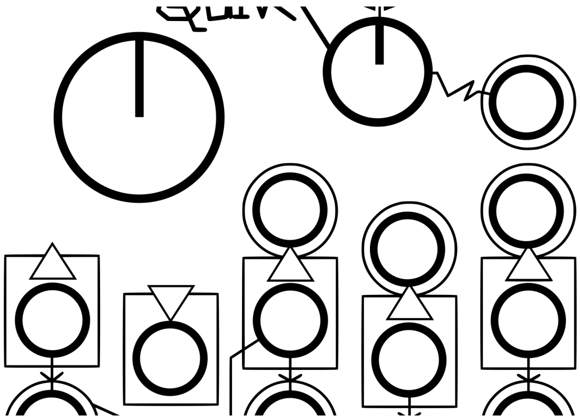


The **Cube** section is based on the Sphere outputs of the Vector Space, it takes three CVs and generates six interrelated CVs using analogue computation.

These voltages skew toward the positive and are arranged in a way so that opposite corners will move in opposite directions, so as the top left voltage increases the bottom right will decrease, likewise the top right and bottom left, and the top middle and bottom middle.

The three CV inputs are normalled from the three **Follower LFOs**, meaning without patching the outputs produce meandering voltages which move around the Cube in a quasi-random manner.

LFOs



The four triangle wave **LFOs** are designed with a single **Rate** macro control and **Rate CV** input, which alters the Rate of all four. The **Leader LFO** on the left is the fastest of the four, and also includes a filtered and inverted copy which is more musical in certain applications, as it rounds off and decreases amplitude as the frequency increases.

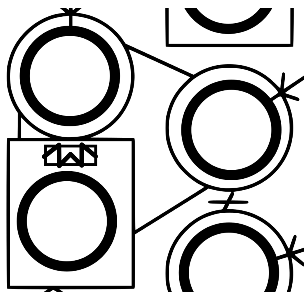
The three other LFOs are **Follower A**, **Follower B**, and **Follower C**. These are each incrementally slower, are controlled by the **Rate** macro controls and also have their own individual CV inputs. When unpatched these are fed small amounts of the other LFOs, which adds subtle cross modulation, meaning these LFOs move in a more complex fashion than a straight triangle LFO. The normalling can be defeated individually with a dummy patch cable if you require less quivering of your LFOs.

Approximate LFO cycle times:
Leader: 33ms to 1min
Follower A: 150ms to 4min
Follower B: 700ms to 18min
Follower C: 1.5sec to a ??? (>35min)

All LFOs periods can be extended in either direction using the CV inputs.

All four LFOs have an amplitude of approximately +-4.5V.

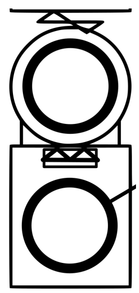
Wavefolder



The **Wavefolder** circuit takes two voltages, nominally a **wave** input and a **break point CV**, and breaks the wave at the break point and wraps it around the 0V point. It can be used as a wave folder, as a primitive inverting phase shifter for a saw tooth wave, or just as a way to create new interesting shapes for any voltage.

The wave input is normalled from the **Leader LFO** output and the break point CV is normalled from the **Follower A** output, creating a shifting double saw shaped wave with no inputs patched.

Full wave rectifier

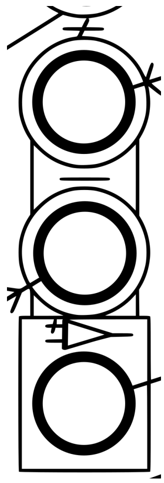


The full wave **rectifier** is a useful circuit which takes a bipolar waveform and outputs a positive voltage equal to the magnitude of the input voltage, i.e. positive voltages pass through unaltered and negative voltages come out as positive voltages.

It can be used with a slew limiter to create an envelope follower, can double the frequency of a triangle wave, can ensure a random voltage stays in a positive range for inputs that only respond to positive voltages, and more.

The **rectifier** input is normalled from the **wavefolder** output.

Voltage comparator

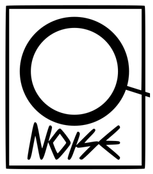


The **voltage comparator** outputs +5V if its positive input is higher than the negative input, and -5V if the negative input is higher than the positive input.

It can be used to create pulse waves from other waveform types, to create PWM from a saw wave and an LFO, to create clocks from other voltages, and more.

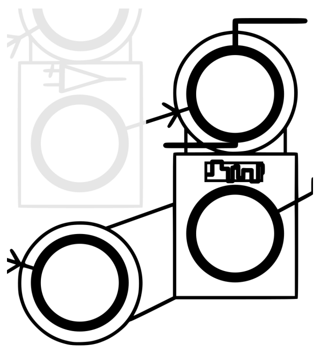
The **positive input** of the **comparator** is normalled to the top left output of the **cube** and the **negative input** is normalled to the **full wave rectifier output**, creating sporadic clock bursts without needing any additional patching.

Analogue white noise source



The classic analogue white **noise** is a signal whose power is equal at all frequencies. It's useful as a signal in synthesis to add extra non-harmonic content to a signal, or it can be used as a random signal for modulation.

Sample and Hold



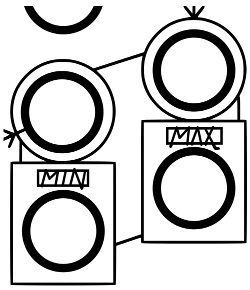
Sample and hold is a classic synthesis building block which takes two inputs, a **signal input** and a **clock input**. When the **clock input** goes high the circuit samples the voltage at the **signal input** and keeps the **output** at that voltage until the next time the clock input goes high.

Sample and hold can be used for the classic clocked random filter cutoff modulation, for duophonic VCO patching, for sample rate reduction effects and more.

The **Clock input** is normalled from the output of the **voltage comparator** and the **Signal input** is normalled from the **white noise source**, giving classic bursts of random voltages without requiring additional patching. Note this input is edge sensitive rather than level sensitive, so if you're not getting good solid clocking from a non-binary voltage source then try running it through the **Voltage Comparator** first to give a good rising edge.

Min/Max

The **Min/Max** analogue logic circuit has two **inputs** and two **outputs**, the circuit looks at the two voltages and outputs the lower of the two from the **Min output** and the higher of the two from the **Max**.



Min/Max is very useful for creating two complex waveforms from two simpler ones. For example, creating more complex stereo harmonics from two mono oscillators. It can also be used for things like sending the lower of two sequenced notes to one voice and the higher to another, to get interesting interwoven melodies from two sets of notes or polyphonic playing.

Min/Max has its two inputs normalled from the **Sample and Hold** and the bottom middle **Cube** output, so they will swap between a smooth voltage and a stepped one without requiring additional patching. Because the **Sample and Hold** is bipolar and the **Cube** output tends toward the positive, the **Max** will tend to be the **Cube** output and the **Min** will tend to be the **S&H** output, except when they aren't.

Min/Max can be used as a kind of mixer for audio sources, but with somewhat unusual results. Depending on the waveforms you patch in, you can get interesting mixes and superpositions of the harmonics of the audio.

Patch Ideas:

Quiver has many sections that can be used in many ways, and can be quickly reconfigured with a few patch cables, so we can only scratch the surface of the patching possibilities in this manual. Here are a few suggestions to get started.

Modulation Patch Ideas:

Massive Modulation Of Regular Patch Groupings (MMORPG)
Quiver is perfect for delivering large amounts of modulation to your modular or semi-modular patches, simply by patching any of the 18 outputs to any CV inputs available in your patch, without needing to patch anything to the 16 inputs. Due to the normalling of outputs to inputs there's always something interesting happening on all of the outputs, no prepatching required.

Externally Clocked Modulation
To clock your modulation from an external source for rhythmic effects, patch your external clock to the Clock input of the Sample & Hold, then patch the Sample & Hold output back to the Rate CV input.

Inverse Stochastic Modulation
The cube outputs are arranged so that when the voltage in one corner increases, the voltage in the opposite corner will decrease, while still being influenced by all three inputs. You can take advantage of this to control pairs of voices so they move together but always leave space for one another, by patching to have one VCA or filter opening while another one closes. This can be used to great effect by patching three stepped random voltages (for example the S&H output, a turing machine, etc) to the Cube inputs, creating six interrelated stepped random voltages on the outputs.

Individual Control of Follower LFOs
The three follower LFOs are always influenced by the Rate macro control, but can be individually controlled with their Rate CV inputs also. The broad timing will remain, so Follower C will be best for really

slow modulation, but there is a lot of overlap available. It's recommended for individual control that the Rate macro control is set to the ideal point and then not modulated unless you wish to additionally affect all LFOs.

Quiver, But With Less Quivering

If you desire a clean Triangle wave from one of the Follower LFOs, you can remove the cross-modulation between LFOs by patching a dummy cable (a short cable with the other end unpatched) into the CV input of that LFO and the cross modulation will be disconnected.

Complex Duophonic Lines

Take two Pitch CVs from your sequencer of choice, which are operating in a similar note range, and mult them both. Patch one copy of each to a pair of VCOs, then the other copies to the inputs of the Min/Max section. Now take the outputs of the Min/Max and patch them to another pair of VCOs. Patch up two voices, each with one VCO with a direct CV connection and one from the Min/Max outputs. Now the second oscillators will swap which sequence they're tracking as the two CV lines intersect, creating interesting interwoven harmonies.

This patch can be taken further by patching a third copy of each of the Pitch CVs from the sequencers to the Voltage Comparator inputs, now the output will be high when sequence A is pitched above sequence B, and low when they're reversed. This gate signal can be used however you see fit, for example switching on a sub oscillator, triggering an envelope, adding a fixed modulation amount to another module, etc.

Intelligent LFO Pitch Modulation

The second output of the Leader LFO contains an integrator circuit, so that as the frequency of the LFO increases the corners of the triangle are rounded off and the amplitude starts to decrease. Additionally, the phase of the output changes from 180 degrees towards 90 degrees out of phase with the primary output. This gives musical results for modulation of VCO pitch, so that as the rate of the modulation increases towards audio rate the modulation becomes smoother and less extreme. If you want for more extreme modulation, the regular output will remain at full level regardless of the frequency.

Audio Rate Patch Ideas:

Sawtooth Phase Shifter

Patching a +-5V Sawtooth wave to the top input of the Wavefolder will result in an inverted, phase-shifted version of the Saw on the output. The amount of phase shift will be determined by the voltage at the other input. This pair (Saw and phase shifted Saw) can be used as a wide stereo pair, or the shifted Saw can be inverted and summed with the Saw (LRMSMSLR is perfect for this) to make the sound of two detuned saw waves from a single one.

PWM Generator

Patch any non-pulse waveform into the Voltage Comparator negative input to get a moving PWM from the output.

With the positive input unpatched you'll get modulation from the Cube giving you a slow moving, quasi-random PWM from the Follower LFOs, but any other source can be patched in here to change the character of the modulation.

Triangle Octave-Up Generator

Patching a triangle wave to the Full Wave Rectifier will give you an octave-up triangle wave on the output, useful for doubling a bassline to create a second voice above it. Also try patching the octave-up triangle to the Wavefolder to create more harmonics for the top line.

Stereo Waveforms

Patch a pair of waveforms from an oscillator to the two inputs of the Min/Max section, and then take the two outputs and use them as left and right waves into a filter for phase locked stereo waveforms.

Analogue Sample Rate Reduction

Patch your signal to be processed to the Sample input of the Sample & Hold, then patch a high frequency VCO to the Clock input. Take the processed signal from the Sample & Hold output. Varying the VCO frequency will change the amount of Sample Rate Reduction introducing grit, noise, and clock signal to your signal, replicating the effects of primitive low bit rate samplers.

Drum Loop Destruction

Patch a drum loop to the top input of the wavefolder and a VCO to the Fold CV input. The output signal will be a dirty distorted mix of the two signals, varying the levels of the two allows you to control the amount of distortion and how much VCO signal blends into the loop. Try a mix of 80% volume on the drum loop and 50% volume on the VCO to mimic the sound of running a drum machine through an overdriven guitar amp that's feeding back.

These are just a few of the many many ways that Quiver can be patched, to greatly expand the functionality of your modular or semi-modular synth.

We're sure you'll keep discovering new techniques and would love to see what you come up with, don't hesitate to tag us on social media to let us know!

Instagram - @worng_electronics
YouTube - @worng_electronics