

# Q169 Oscillator++

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The Q169 Oscillator++ module combines two audio oscillators offering an amazing array of cross-modulation possibilities, along with an LFO, envelope generator and sample-and-hold functions - all gracefully organized on a triple-wide 5U panel.

Oscillator++ can be used as a dual oscillator in a traditional synth patch, as a stand-alone voice, as a pair of FM operators for additive synthesis, as independent functions, or as a complex modulation source. Go from tame to chaos with the turn of a knob.

Both audio oscillators are paired with a VC amplifier, and each can modulate the others pitch, pulse width and amplitude at the same time and in variable amounts. A cross-modulation extravaganza!

The Q169 is the equivalent of 10 modules and 20 patch cables arranged in a musically -useful and understandable way. Configurations you probably wouldn't patch naturally are easily accessible. Oscillator++ is complexity dignified.

The optional Q168 Aid module provides patch points for LFO waveforms, the envelope, noise, S&H and a multi-purpose invertible attenuator.



## Q169 Oscillator++ Specifications

**Panel Size:** Triple Width 6.375"w x 8.75" (Moog Unit Format)

**Input/Output Signals:** 10Vpp

**Control Voltage Signals:** 0-5V unipolar or 10Vpp bipolar

**Gate Signals:** 5V

**Pitch CV Response:** 1V/Octave

**Pitch Tracking Range:** 10+ Octave

**VCA Response:** Linear

**LFO Range:** .01hz - 20hz

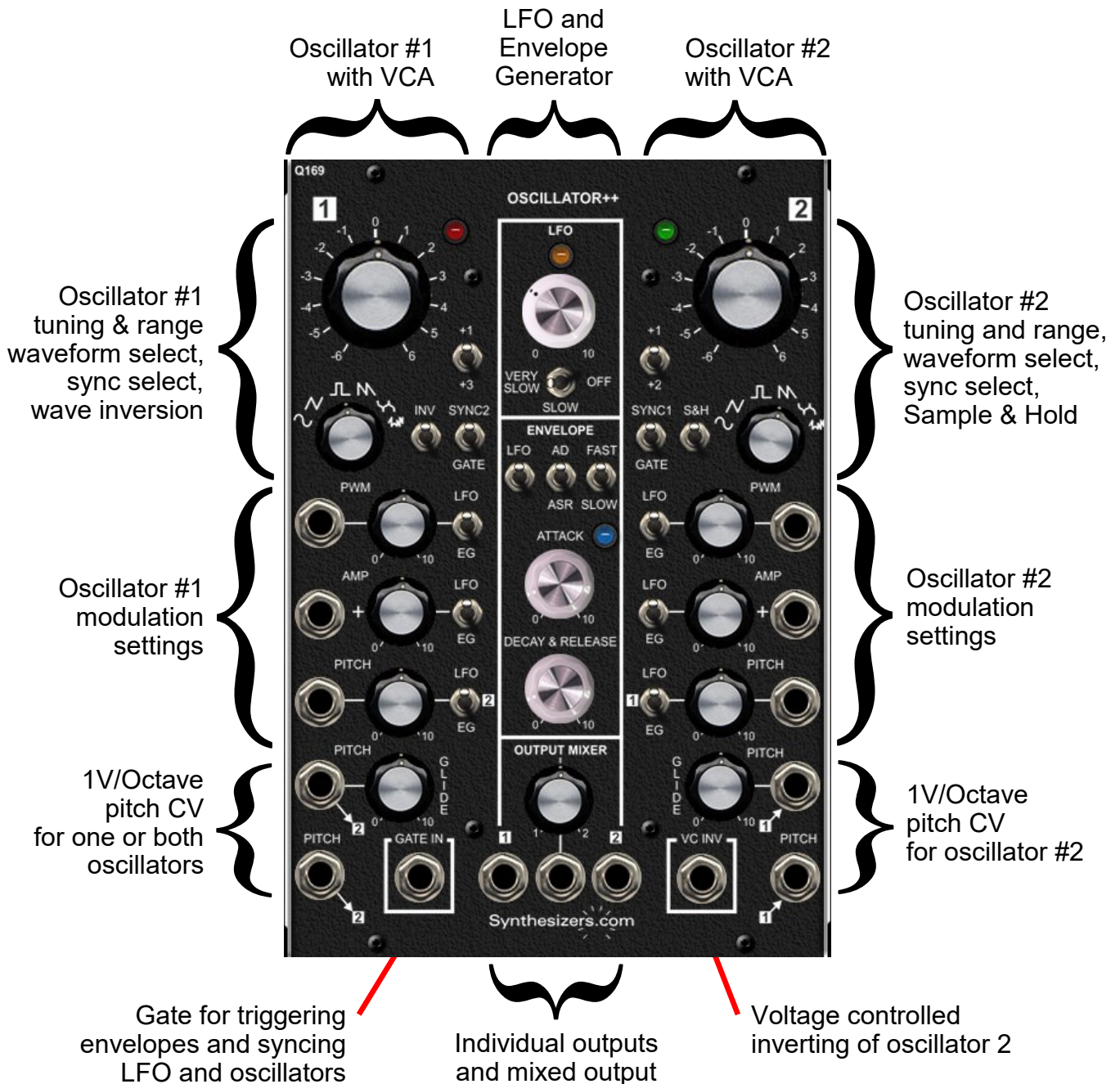
**EG Speed:** 10s - 10ms

**Power Requirement:** +15V@150ma, -15V@150ma, +5V@10ma. Synthesizers.com standard.

# Q169 Oscillator++

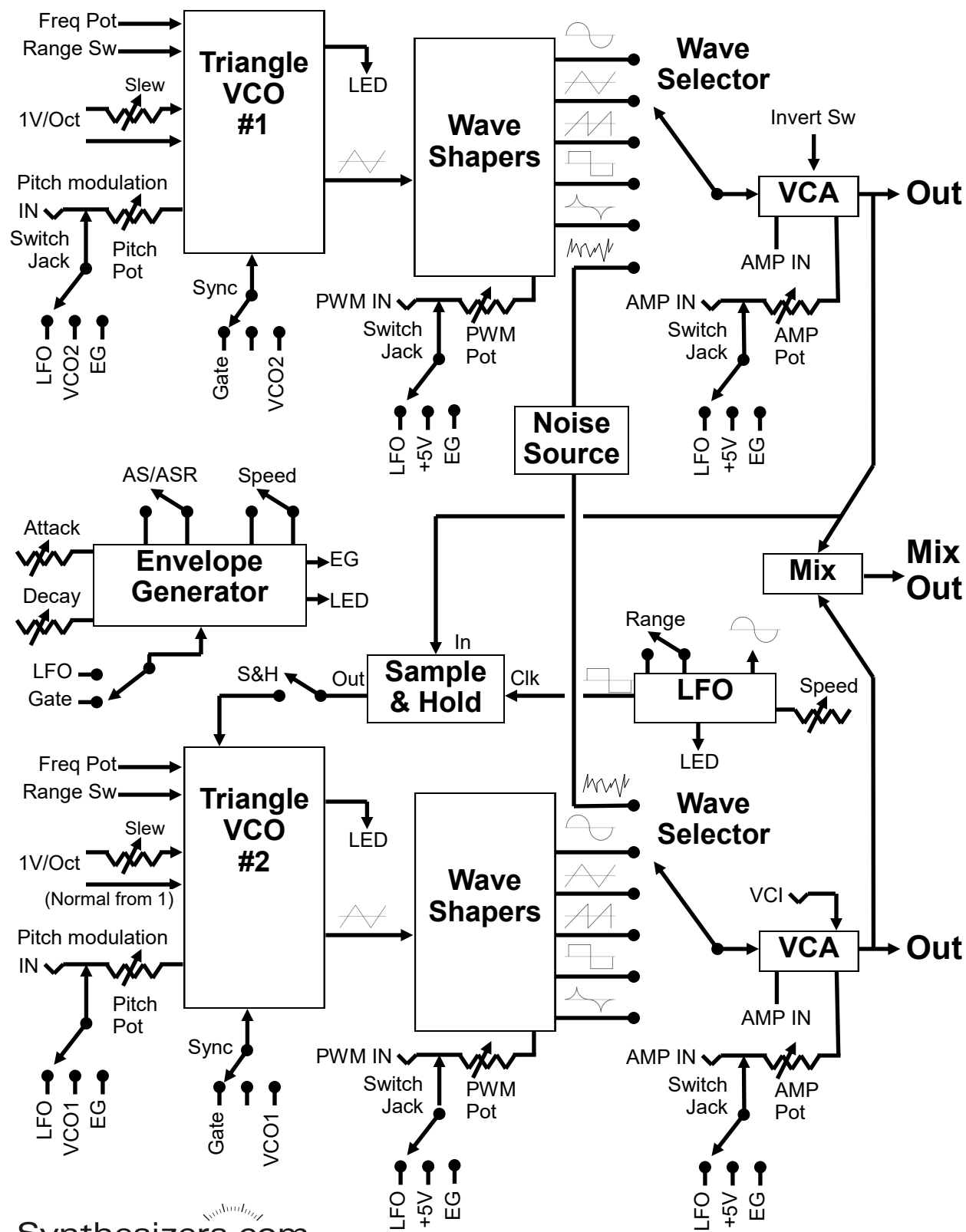
## Panel Overview

The Q169 module consists of more than 10 function blocks - two VCOs, each with its own VCA and glide, an LFO, Envelope Generator, Mixer, Sample & Hold, and more. VCOs offer extensive cross-modulation of pitch, pulse width and amplitude with easy connection to the LFO, EG and external signals.



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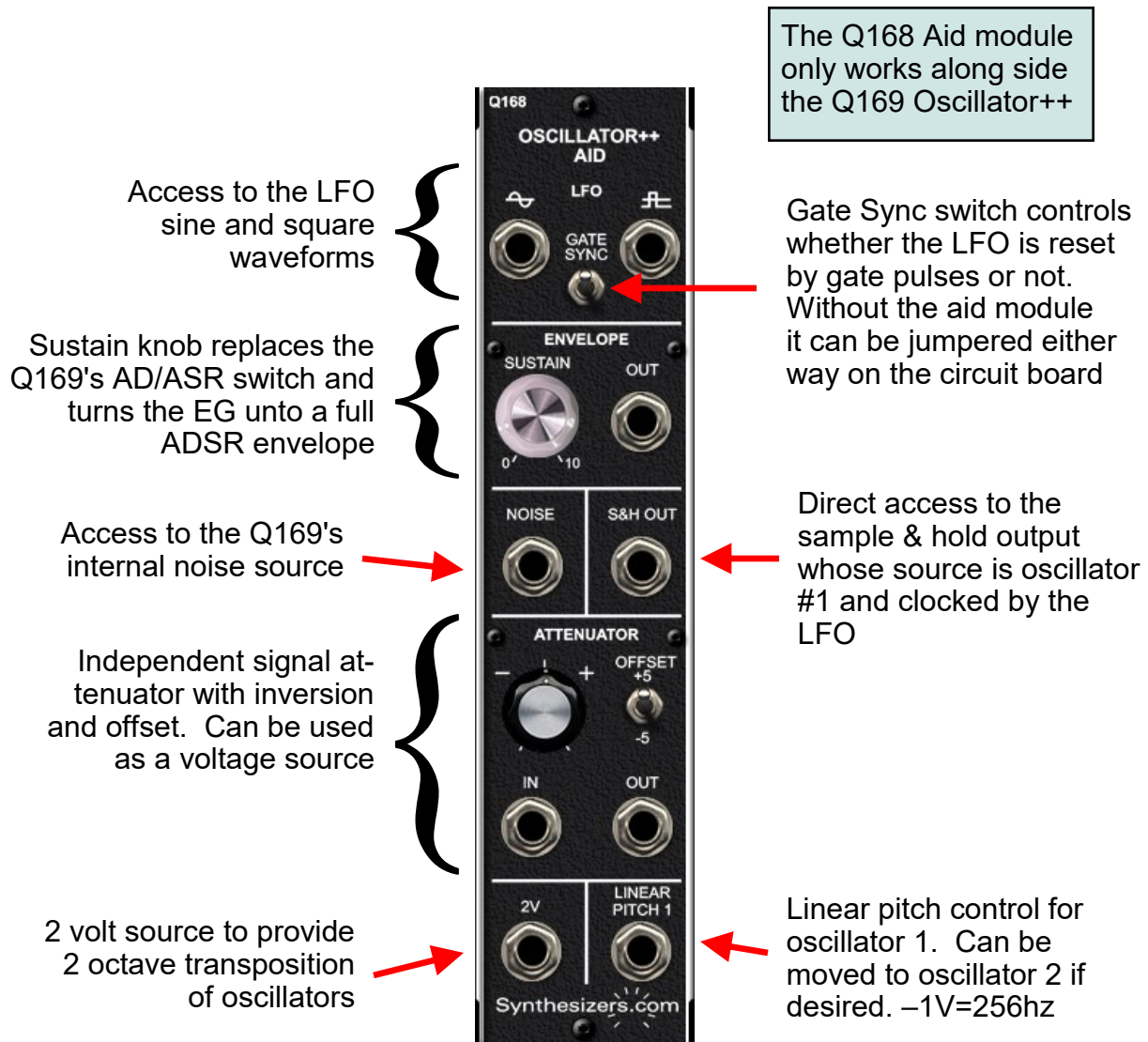
## Functional Diagram



# Q169 Oscillator++

## Q168 Oscillator++ Aid

The optional Q168 module provides additional features to the Q169 by giving access to several of the Q169's internal signals including the LFO waveforms, envelope generator, noise source, and sample & hold. A sustain knob replaces the AD/ASR switch providing a complete ADSR envelope. Also included is an invertable attenuator with offset control that can also be used as a voltage source. A 2 volt output provides transposing of the oscillators by 2 octaves, and access to oscillator #1's linear pitch signal is provided.



**Note:** Q168 requires a power connection

# Q169 Oscillator++

## Oscillator #1 and #2

The foundation of the Oscillator++ module are two precision triangle-core VCOs (Voltage Controlled Oscillator) - #1 on the left side, #2 on the right side. Triangle cores don't have a reset glitch like sawtooth cores and produce smoother Sine and Triangle waves.

Both oscillators track a standard 1V/Octave keyboard pitch voltage accurately over a wide range of temperatures. The VCOs can be used independently or together. They can track together and modulate each other.

The main frequency knobs are large and easy to tune with a range of +/- 1/2 octave either side of center. At 0 pitch voltage, the center position is approximately C.

The range switches are wired so the oscillators can be 0, 1, 2 or 3 octaves apart.

A 6-position waveform switch selects sine, triangle, pulse, sawtooth, anti-sine and random. The pulse waveform is variable from 0 to 100%. The sawtooth wave is double frequency. The anti-sine wave is like subtracting a sine wave from a triangle wave and produces interesting harmonics.

The next section is the modulation matrix. This arrangement gives you easy access to amazingly complex cross-modulation between the two oscillators - pitch, pulse width, and amplitude.

The PITCH jacks at the bottom are 1V/Octave scaling to track a standard keyboard. VCO #1's jack is automatically connected to VCO #2's jack unless a plug is inserted into VCO #2. This makes dual-oscillator patching easy.

Just above that, each VCO has a PITCH jack wired to a variable glide circuit, aka slew-limiter, aka portamento. The jack for VCO #1 is also automatically connected to VCO #2's jack unless a plug is inserted into VCO #2 as indicated by the panel graphics.

## Outputs

At the bottom of the panel in the center are the output jacks. The oscillators can be operated completely independently or together.

Each oscillator has its own dedicated output jack that can be used any way you wish in a system patch.

In the center is a mixed output which provides a combination of the two oscillators.



# Q169 Oscillator++

## Pitch Control

Both oscillators offer multiple ways to control the most important aspect of their sound - pitch.

Pitch, note, frequency all describe the same thing.

### Manual Control

The large knob at the top of each oscillator provides fine tuning of the pitch - plus or minus 1/2 octave from center. At the center position and control voltages summing to zero the pitch is C. There is no standard for what pitch an absolute control voltage produces, but the scaling of 1 volt per octave is standard. Our keyboard controllers produce integer volts (0V, 1V, 2V, etc) at their C keys which matches our oscillators.

### Range Switch

Next to the manual pitch control is the 3-position range toggle switch. The center position set the pitch to C1 for 0 volts. This is about 32hz and corresponds to 16' organ pipes.

The upper and lower switch positions changes octaves above or below that according to the numbers shown, each side is different. This arrangement allows for unison between the oscillators as well as separation by 1, 2 or 3 octaves.



### Pitch Jack

At the very bottom is a Pitch jack which is scaled at 1V per octave - standard scaling for modular synthesizers. VCO #1's pitch input is normalized to VCO #2's pitch input as indicated by the panel graphics. This connection is broken when a plug is inserted into VCO #2's jack. A typical use for this jack is a pitch bend wheel.

### Pitch with Glide

Second from the bottom pitch jack is also 1V per octave scaling. A knob controls glide time for the control voltage signal. This feature can also be referred to as portamento or slew limiting. VCO #1's pitch input is normalized to VCO #2's pitch input and broken in the same way as the pitch jack on the bottom. A typical use for this jack is a keyboard controller.



### Pitch Modulation

Third from the bottom is a pitch jack with variable scaling via a knob. This is part of the modulation section where signals from the other VCO, the EG and the LFO provide modulation.

When there is a plug inserted into the jack, the incoming signal is attenuated through the pot from 0 to 1V per octave. In this case the toggle switch is ignored.

Without a plug inserted into the jack, the toggle switch determines the pitch control voltage source - LFO, envelope generator, or the output of the other VCO (cross modulation). For all 3 of these sources the knob controls the amount. In the center position, make sure the other oscillator has its AMP turned on or there will be no effect. Set the knob to zero if you do not want any of these modulations - this is a common source of unexpected results, sometimes unwanted, sometimes wonderful.

# Q169 Oscillator++

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## Inverting Waveforms

Each oscillator provides control over the polarity of its waveform.

Oscillator #1 provides manual control using the INV switch located next to the waveform selector. This can be useful when using the oscillator as a modulator while being sync'd to the GATE input.



Oscillator #2 provides voltage control of its waveform polarity using the VC INV jack at the bottom of the panel. Audio speed VC inverting offers some very nice metallic effects. To use this, patch Oscillator #1's output to the VC INV jack while listening to Oscillator #2 or a mix of the two. Changing waveforms on both oscillators offers many different results.



## Sync

Each oscillator offers a sync (synchronize) input which allows a signal, usually from another oscillator to restart the waveform at some point within its cycle. This is a classic effect found on many synthesizers sometimes referred to as Hard Sync.

A toggle switch near the waveform knob controls sync for each oscillator. The center position is off - no sync. The upper position syncs the oscillator to the other oscillator. Typically a slower oscillator will sync the faster oscillator for the best effects. Oscillator #1 is typically used as the slower oscillator.



The bottom position causes the waveform to sync to the GATE IN jack. This is useful when using an oscillator as a modulator where each press of a key produces the same waveform progression.

## Sample & Hold

Oscillator #2 can be controlled by the internal Sample & Hold circuit. The switch can be found next to the waveform knob. This circuit captures the waveform from Oscillator #1 and feeds it to Oscillator #2's pitch. The speed of the capture is clocked by the LFO.



Normally when using the Sample & Hold feature, Oscillator #1 is run at a fixed speed, and Oscillator #2 is listened to. Oscillator #2 can be controlled by a keyboard during this process or free running.

The amount of waveform feeding the Sample & Hold is adjusted from Oscillator #1's AMP control (Amplitude).

Use Oscillator #1's sine, anti-sign or Triangle wave for up and down sequences. Use the sawtooth wave for descending sequences, or flip the INV switch for ascending. Use the random waveform setting for random pitches.

Sync Oscillator #1 to a keyboard using the GATE IN for sequences that act the same way each time a key is pressed.

# Q169 Oscillator++

## Modulation Section

The magic of the Q169 module is the modulation possibilities and their easy access. Modulation is just a fancy word for having one signal change something about another signal. For each oscillator, three things can be modulated - Pulse width, waveform amplitude, and pitch. These three things can be modulated by the LFO, by the Envelope Generator, by the other oscillator, by an external signal into the jack, or manually controlled by the knob. The possibilities are amazing, and most don't require patch cables.

### Pulse Width (PWM)

The width of the pulse waveform is controllable and has a nice effect on the sound, like phase shifting. The oscillator's pitch stays the same but the waveform appears to our ears as moving. PWM only applies to the pulse waveform.

The toggle switch determines the source of the modulation. Options are LFO or EG (Envelope Generator). When LFO or EG is selected, the knob provides control over the attenuation (strength of the effect).

The center toggle switch position is off and then the knob gives you manual control over the pulse width from 0 to 50%. Since an inverted waveform sounds the same to our ears, 50% to 100% sounds the same. If you need an inverted form of the pulse for modulation purposes, use the INVERT switch.

A jack is provided for an external signal to control the pulse width. When a plug is inserted, the toggle switch sources are bypassed and the knob provides attenuation. The external signal can come from another module or perhaps the S&H output on the Q168 Aid module, or possibly noise or another waveform from the other oscillator.



### Amplitude

Each oscillator on the Q169 has a built-in VCA (amplifier) to provide control over the waveform amplitude. This provides many possibilities not found on other oscillators such as using the module as a stand-alone voice with the VCAs controlled by the internal EG, or by creating FM-style operator synthesis where pitch and amplitude modulation provides amazing new sounds. All of this is easy with Oscillator++.

The toggle switch determines the source of modulation. When LFO or EG is selected, the knob provides attenuation. When the toggle switch is in the center, the knob provides manual control of the amplitude - this is basically a volume control.

A jack is provided for an external signal to control amplitude. This signal is added to the other sources as indicated by the panel graphics. Use the jack to modulate from the other VCO.

### Pitch

The toggle switch provides the source of pitch modulation - LFO, EG, or the other VCO. The knob provides attenuation in each position. When an external signal is plugged into the jack, the toggle switch source is bypassed and the knob becomes the attenuator for it.

The result of pitch modulation is dramatic, especially when having both oscillators modulate each other. Experimentation is the only way to fully appreciate this.

When selecting position [2] on the toggle switch, make sure oscillator #2 has its AMP turned on.



# Q169 Oscillator++

## LFO

The center-top section of the module is an LFO. The output of the LFO is a sine wave and used for modulation. You'll see the LFO label several places in the modulation section - for PWM, amplitude (tremolo), and pitch (vibrato). Speed of the LFO is set by the knob and the range switch selects between slow, very slow and off.

In the SLOW position, speeds range from .1hz to 20hz. In very slow position speeds range from .01hz to 2hz.



It's not mandatory to use the LFO or the envelope generator. Don't let their availability sway your creativity.

## Envelope Generator

The center-middle section of the module is an envelope generator (EG).

You'll see the EG label several places in the modulation section - for PWM, amplitude, and pitch. This feature may be used or ignored.

Typically a gate signal patched into the gate jack will trigger the envelope, but the LFO can also trigger the envelope by setting the first toggle switch to LFO.

The envelope can be either Attack/Decay or Attack/Sustain/Release as set by the AD/ASR switch. In the AD position, the envelope will trigger at the beginning of the gate, then when the peak is reached begins decay regardless of the gate's status (typically a keypress). In the ASR position, the envelope stays on (sustains) as long as the gate is present (typically a keypress), then the release phase begins. Decay and release are the same speed.

A speed switch provides short and longer envelopes.



If the EG is set to trigger from the LFO and the LFO is set for Gate Sync on the Aid module then a strange loop will be created.

# Q169 Oscillator++

## Dual Oscillator Voice Patch

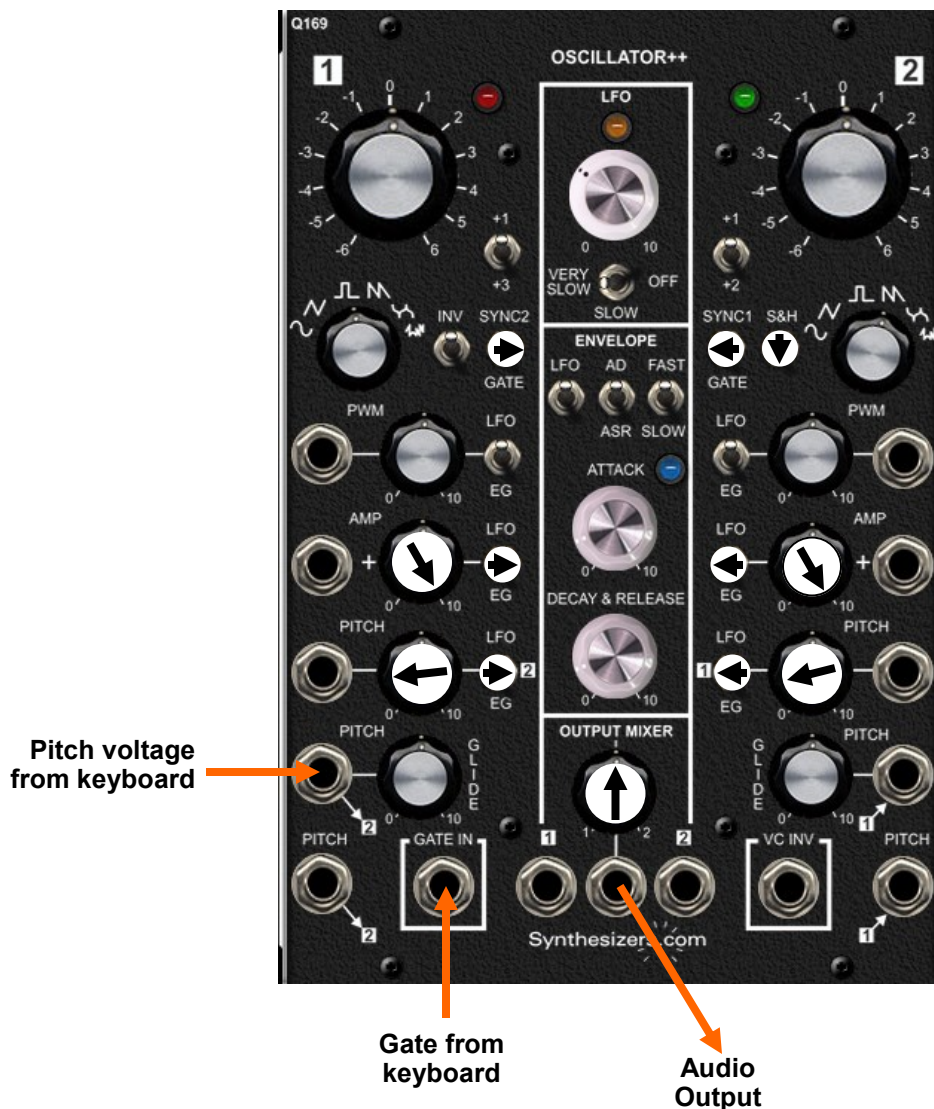
The Q169 is super easy to patch, even complex patches that you wouldn't normally do. In this example Oscillator++ is being used as a complete dual-oscillator voice using the built-in VCAs and envelope generator. Use the center output jack for a mix of the 2 VCOs. The pitch normalization reduces the need for multiples and patch cables. Set pitch range however you'd like. Notice the S&H is turned OFF and the Pitch modulation knobs are 0. Adjust the EG controls to your taste. This patch performs as a complete synth voice. From this humble beginning you can experiment with PWM from the LFO, pitch modulation from LFO, EG or the other oscillator, VC inverting, sync'ing and much more.



# Q169 Oscillator++

## Dual Oscillator Cross Modulation Patch

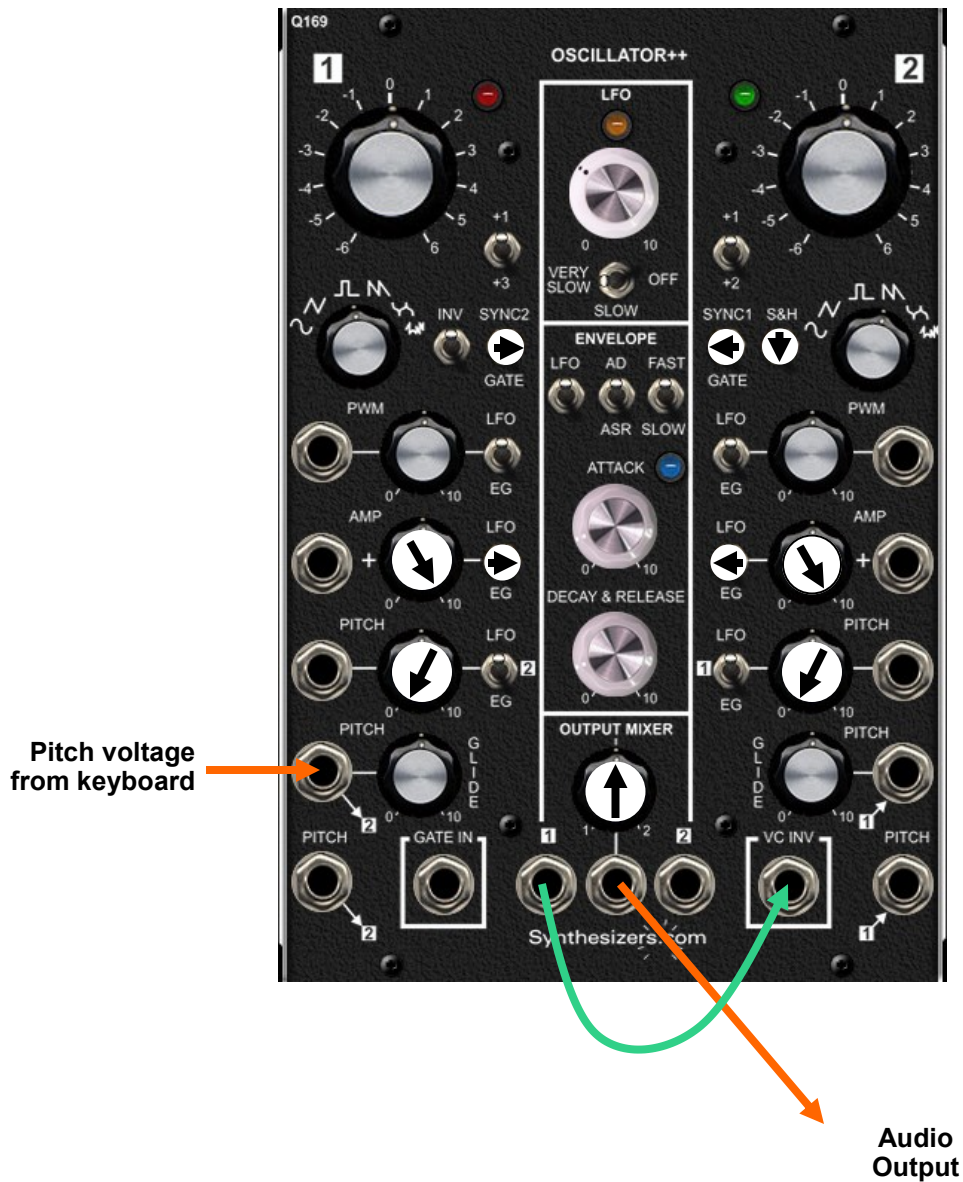
Cross-modulation is having each oscillator's output modulate the pitch of the other while listening to one or both of them. With the Q169, cross-modulation is easy - set the pitch modulation toggle switch to the center position where [1] or [2] shows that the source is the other oscillator. Then set the knob to the desired amount. Start with very small amounts. Take audio out from the center output jack and turn the output mixer to hear one or both of the oscillators. Tune to your liking, experimenting is where the magic happens. In this patch the amplifiers are turned fully on and you can use an external VCA/EG to control that.



# Q169 Oscillator++

## VC Inversion Patch

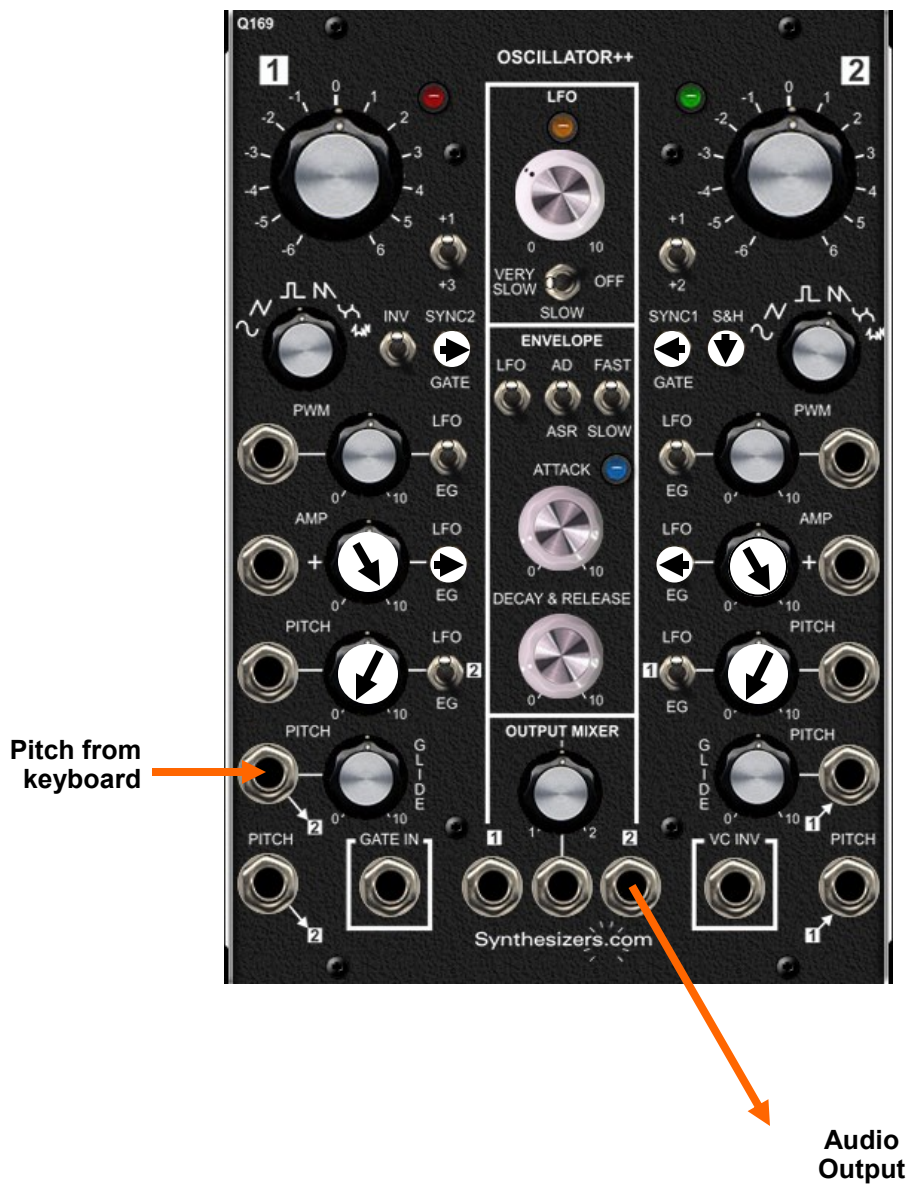
VCI (Voltage controlled inversion) is an interesting effect where one oscillator's output controls the polarity of the other oscillator's waveform. In this particular patch, the amplifiers are set to full for use with an external VCA/EG, but you can also use the internal EG to control them for stand-alone operation.



# Q169 Oscillator++

## Sample and Hold Patch

A sample and hold circuit takes an input and freezes it at every clock pulse. This captured signal is its output until the next clock pulse captures the next input value. The Q169's built-in S&H circuit takes its input from VCO #1 and is clocked by the internal LFO. The output controls the pitch of VCO #2. Flip the S&H toggle switch up to turn it on. Set the AMP on VCO #1 to control the amount of the pitch control. The LFO speed controls how often the S&H is triggered. Normally in this type of patch you want to only listen to VCO #2.



# Q169 Oscillator++

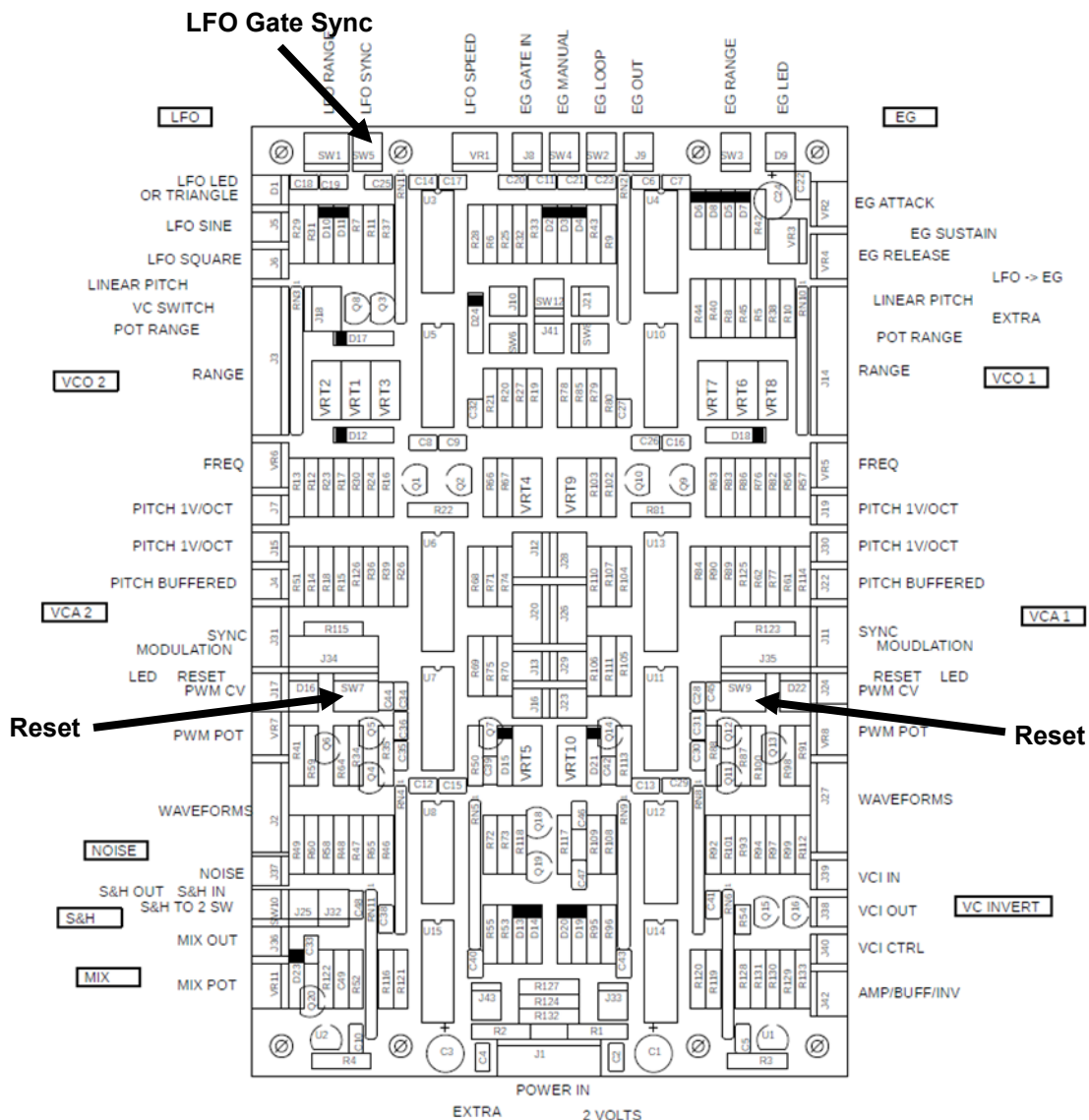
## PCB Board Layout

The Q169 comes pre-wired with some jumpers installed.

Jumpers are installed on both VCO Reset connectors. The default setting is to reset the VCO to 0v. Move the jumper to reset to -5V.

A jumper is installed on the LFO Gate Sync connector so the LFO syncs to a Gate Input.

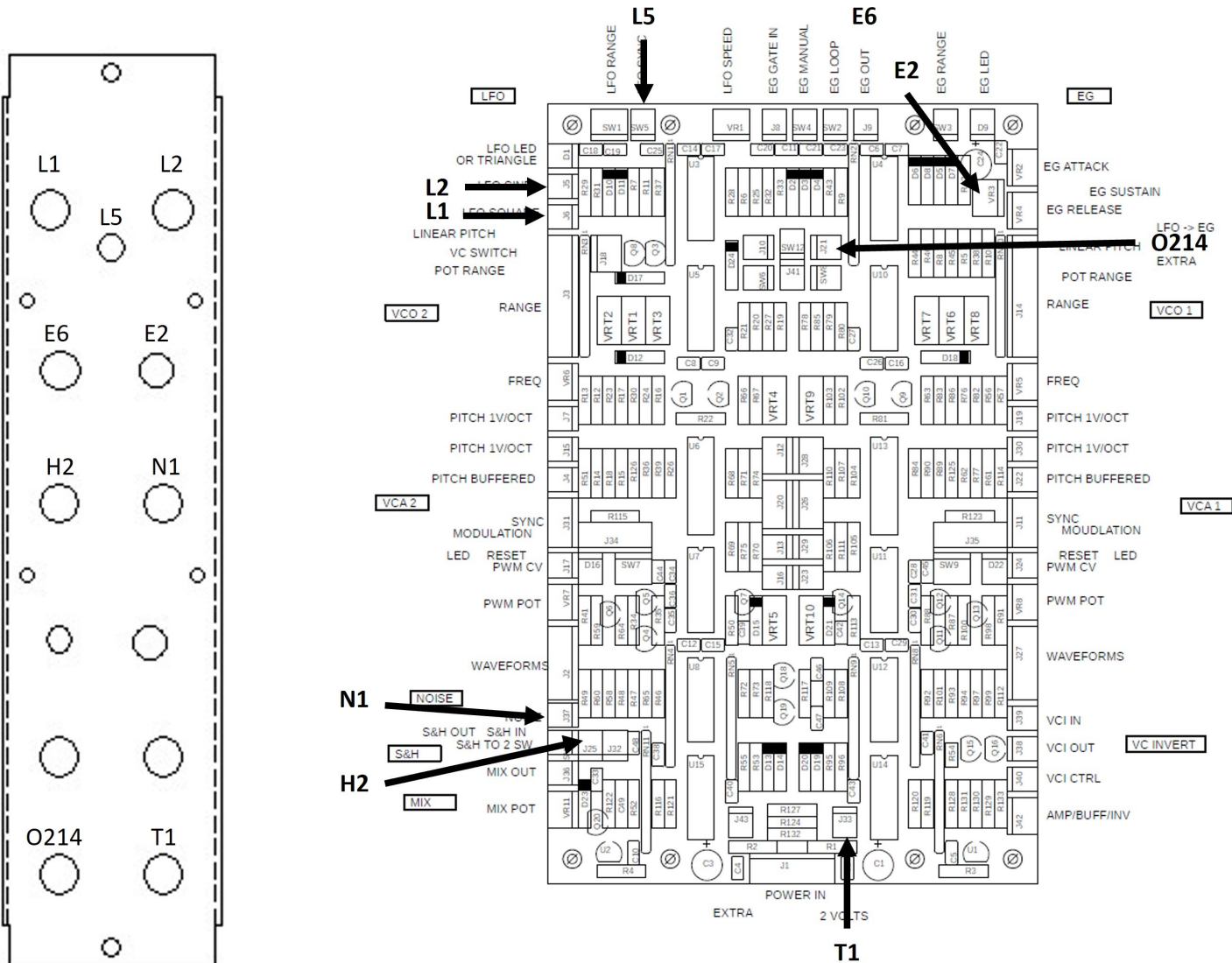
Calibration is done at the factory prior to shipping.



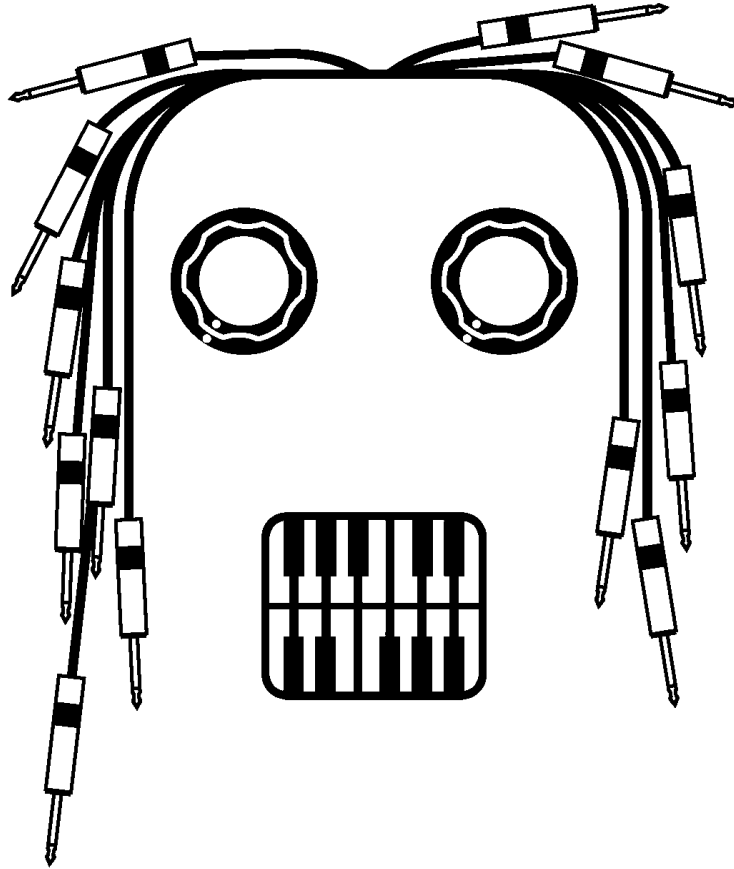
# Q168 Oscillator++ Aid

## Connecting the Q168 and Q169 Modules

Typically the Q168 Aid module mounts to the right of the Q169 Oscillator++ as viewed from the front, but the cables are long enough for it to be on either side. Locate each cable coming from the Q168 Aid module and match the number printed on the connector to the connector on the Q169 Oscillator++ module's circuit board. The Q168 will also require a power connector for the attenuator section. Some jumpers may need to be removed when installing the Q168.



# Patcher Jack



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