

# Q158 VCA2++

Oct 12, 2019

The Q158 VCA++ module combines two VCAs along with innovative connectivity to provide a panner, fader, 3-channel mixer and ring modulator functions - all in a single-wide module.

You can never have enough VCAs in a modular system and the Q158 addresses this by providing two full-featured VCAs complete with invertable attenuators and bipolar gain controls.

The signal input and CV input for VCA #1 are normalized to VCA #2, in other words, they are automatically connected to VCA #2 unless plugs are inserted into VCA #2 jacks. This makes patching easy to create a 2-channel panner (one input panning between two outputs) and a fader (two inputs fading to one output).

Automatic connection between the two VCA channels also provides an easy way to do ring modulation (4-quadrant multiplier). Multiplying 2 audio signals produces frequencies that are the sum and differences of the originals resulting in inharmonic bell-like tones, a classic synthesizer function.

VCA channels #1 and #2 are mixed together along with a third un-attenuated channel in the center section. This gives you a 3-channel mixer with 2 of the channels having attenuators. The INVERT switch inverts the polarity of VCA #2's contribution to the mixer and is used to produce ring modulation.

Both VCAs have manual gain controls and VCA #2's invert switch provides simple signal processing functions.



## Q158 VCA2++ Specifications

**Panel Size:** Single Width 2.125" w x 8.75" (Moog Unit Format).

**Input/Output Signals:** 10Vpp

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

**VCA Response:** Linear

**Power Requirement:** +15V@60ma, -15V@60ma. Synthesizers.com standard.

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## Panel Overview

The Q158 module consists of 3 sections - two VCAs and a mixer. The input signal and CV signal for VCA #1 are normalized to VCA #2 to simplify patching. Inserting plugs into VCA #2 signal and CV inputs breaks the connections from VCA #1.

The image shows the front panel of the Q158 VCA2++ module, which is divided into three main sections: VCA #1, a Mixer, and VCA #2. Each VCA section has a GAIN knob and a CV knob, both with scales from -5 to +5. The Mixer section has three input jacks labeled IN 3, INV2, and OUT, and a NORM knob. The panel is labeled 'Q158' at the top and 'Synthesizers.com' at the bottom. Brackets on the left group the controls into their respective sections, and arrows on the right point to specific knobs with explanatory text.

**VCA #1 Section.**  
Manual Gain and CV attenuation/inversion.

**Mixer Section.**  
Mixes VCA #1, #2 and a third input. VCA #2 signal can be inverted.

**VCA #2 Section.**  
Manual Gain and CV attenuation/inversion. Signal input and CV come from VCA #1 if no plugs inserted.

Both VCAs operate the same.

Each VCA controls gain (amplitude/volume) of a signal. Gain can be anywhere from 0% (off) to 100% (unity gain).

Gain is determined by a combination of the GAIN knob, the CV knob and the CV input. When the resulting CV is 0 volts the output is off. When 5 volts the output is fully on.

The GAIN knob adds a voltage to the gain formula - -5V to +5V. The CV knob multiplies the CV input signal by -1 through +1.

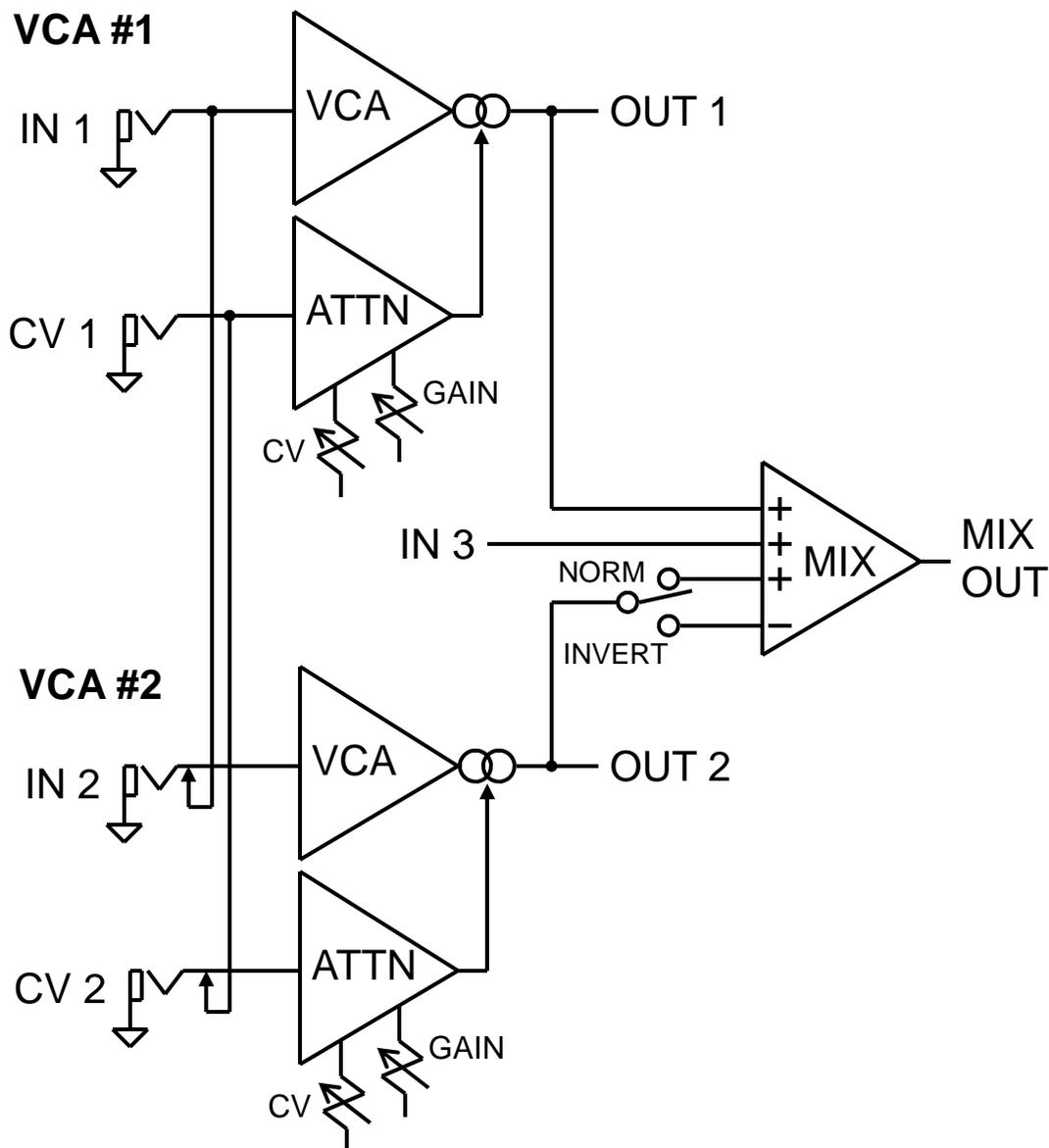
For 5V envelope operation, set GAIN knob to 0 and set the CV knob to 5. For manual-only control, use the GAIN knob between 0 and +5.

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## Functional Diagram

The Q158 module consists of two VCAs, each with an invertable attenuator connected to the CV input. Additionally there is a 3-channel mixer with channel #2's signal optionally inverted to the mix output.

In addition to these function blocks, VCA channel #1 signal input and CV inputs are normalized to VCA channel #2. So if no plugs are inserted into VCA channel #2 jacks, they get their inputs from channel #1.



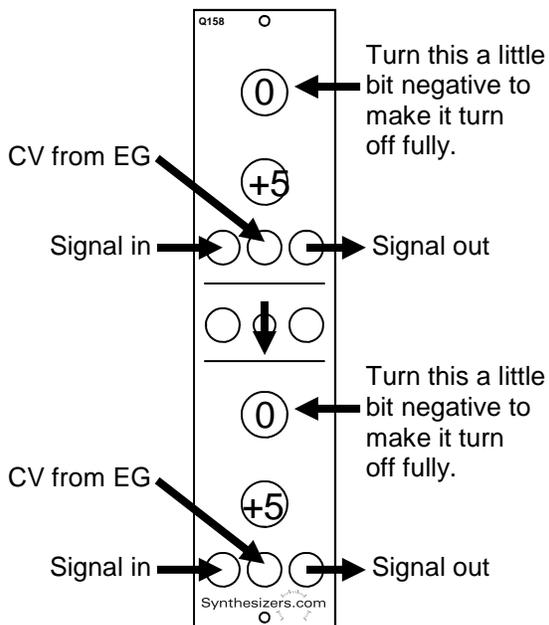
# Q158 VCA2++

## Cheat Sheet

The Q158 can be used in many different ways - dual VCA, panner, fader, mixer, ring modulator. Use this sheet as a settings reference to achieve each function.

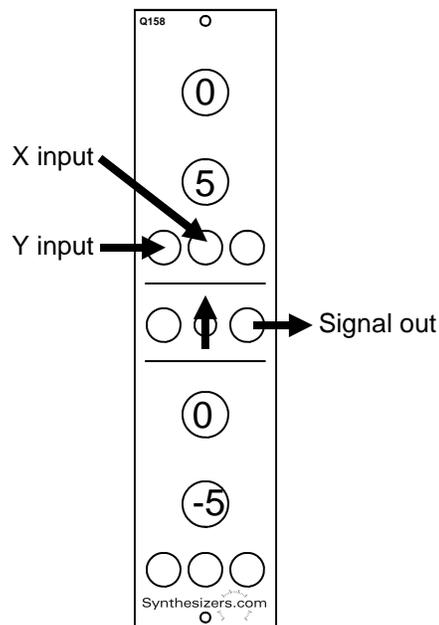
### Dual VCA

The individual VCA sections can be used independently just like any VCA, ignoring the mixer section.



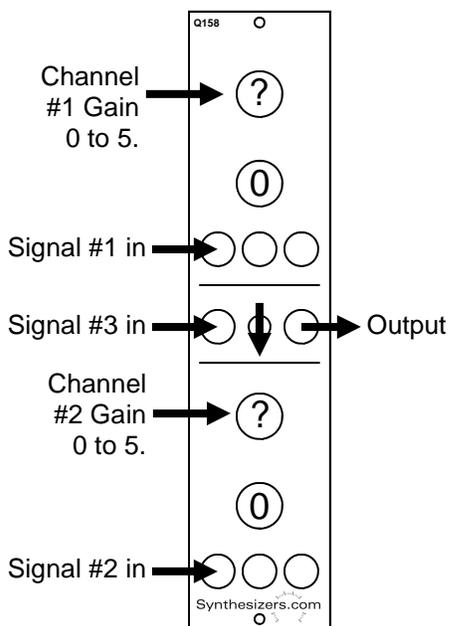
### Ring Modulator

This patch multiplies 2 signals producing a ring modulation output.



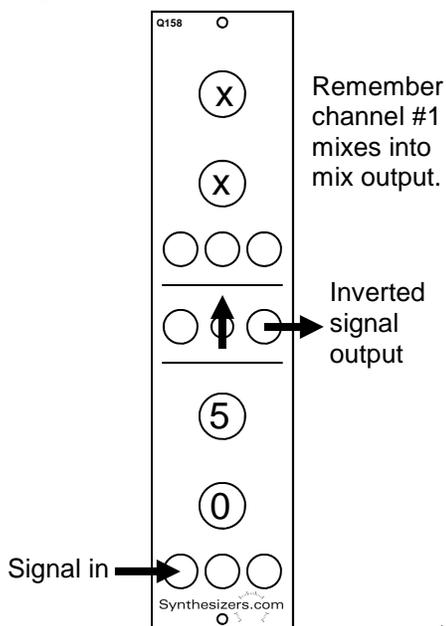
### Mixer

3 Channel mixer with one channel unattenuated.



### Invert

Simple signal inverter.

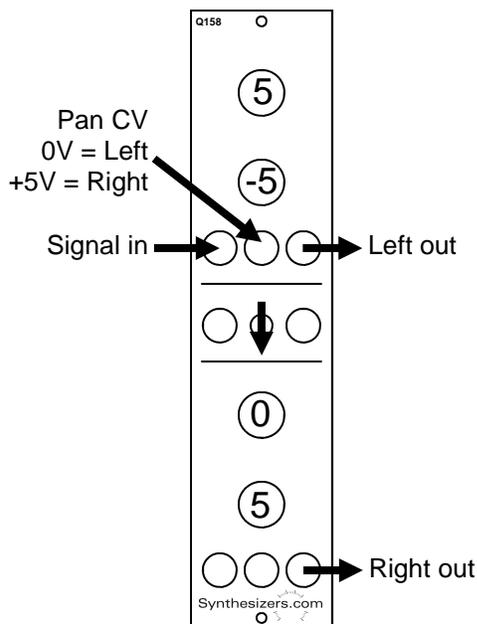


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## Cheat Sheet - Continued

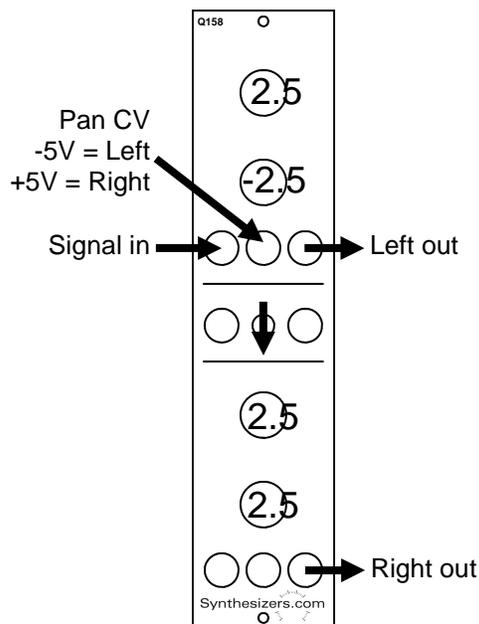
### Panner with 0-5V (unipolar) control

Pan one signal between 2 outputs. Control is from a unipolar source like an envelope with a 5V output.



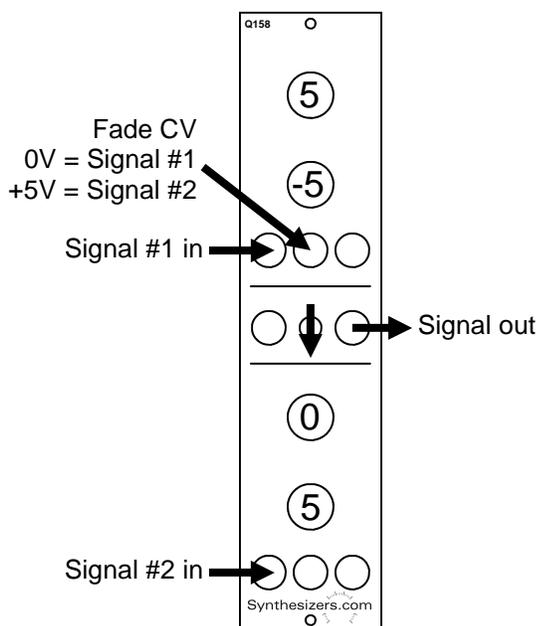
### Panner with -5-5V (bipolar) control

Pan one signal between 2 outputs. Control is from a bipolar source like an LFO with a 10Vpp output.



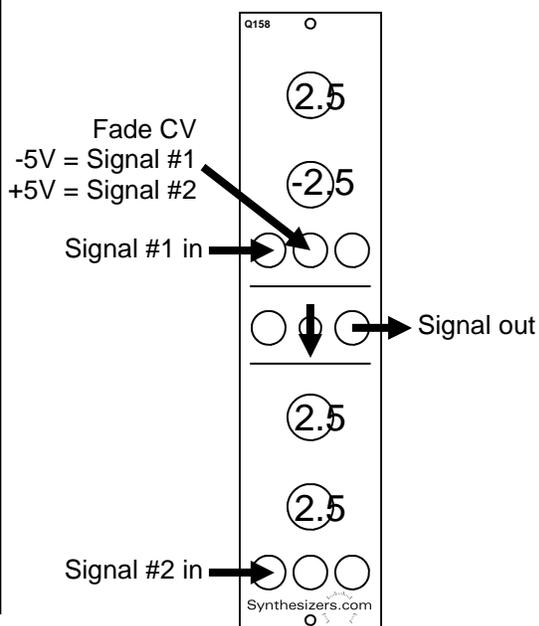
### Fader with 0-5V (unipolar) control

Fade from 2 signals to one output. Control is from a unipolar source like an envelope with a 5V output.



### Fader with -5-5V (bipolar) control

Fade from 2 signals to one output. Control is from a bipolar source like an LFO with a 10Vpp output.



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## Gain Discussion

The gain of each VCA is controlled by a combination of the CV (Control Voltage) input, the CV knob, and the Gain knob. The total gain ranges from 0 (off) to 100% (unity gain). Technically the VCA is a voltage controlled attenuator since no amplification beyond unity is provided.

The internal VCA core circuit responds to a voltage of 0 volts to 5 volts where 0 volts is off and 5 volts is fully on. This voltage is supplied by the gain knob and/or the control voltage applied. The control voltage passes through an invertable attenuator which is controlled by the CV knob.

With no CV patched into the VCA, the Gain knob determines the VCA gain. At 0 and below the VCA is off, and at 5 the VCA is fully on.

With a CV patched into the VCA, the CV knob modifies the CV before it gets added along with the Gain knob to produce the final voltage to control the VCA. This modification is inversion and attenuation.

An envelope generator such as the Q109 produces an envelope voltage from 0 to 5 volts. This is called a unipolar signal since the voltage does not go negative. To make the VCA respond to this voltage from off to fully on, set the Gain knob to 0, and set the CV knob to 5. This CV knob setting means that the CV voltage will pass through as is. This is the setting normally used when the VCA is being controlled by an envelope generator.

An LFO such as the Q167 and a VCO such as the Q106 produces signals from -5 to +5 volts (10V peak-to-peak (Vpp)). This is called a bipolar signal since the voltage swings both negative and positive. The knobs allow this signal to control the VCO by converting it to the 0 to 5 volts required by the VCA core. To do this, set the CV knob to 2.5 which will attenuate the CV input to -2.5 to +2.5 volts (5Vpp). Then set the Gain to 2.5 volts to shift it up to 0 to 5 volts. These settings can all be done by ear without an oscilloscope.

There are times when you want a unipolar (0 to +5 volt) signal to control the VCA in an inverted fashion where 0 volts is fully on and 5 volts is fully off. To do this use the CV knob to invert the control signal by setting it to -5. This results in a CV of -5 to 0 volts. Since the VCA core requires 0 to +5 volts, use the Gain knob to add 5 volts by setting it to 5. Now you have an inverted VCA response. You may have to make small adjustments to the knobs to get fully off and fully on at the right spots.

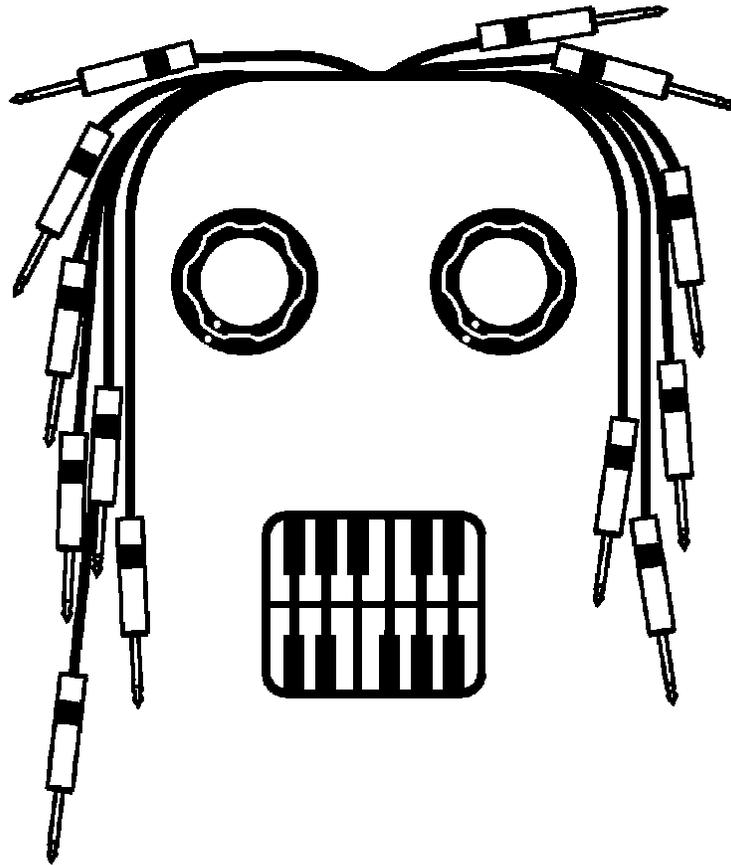
## Inverted #2 Signal

The mixer section has a switch to invert VCA #2's signal as it enters the mixer. This switch does not affect how the VCA operates, only its mixing in the center section. The primary reason for this feature is to provide ring modulation which requires inversion of a signal to complete 4-quadrant multiplication.

This inverting feature along with VCA #2 provides utility inversion of a signal. Simply patch the signal into VCA #2's input jack and take the output from the Mixer section. Set the Invert switch and set the Gain on the VCA to 5 for full on.

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# Patcher Jack



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