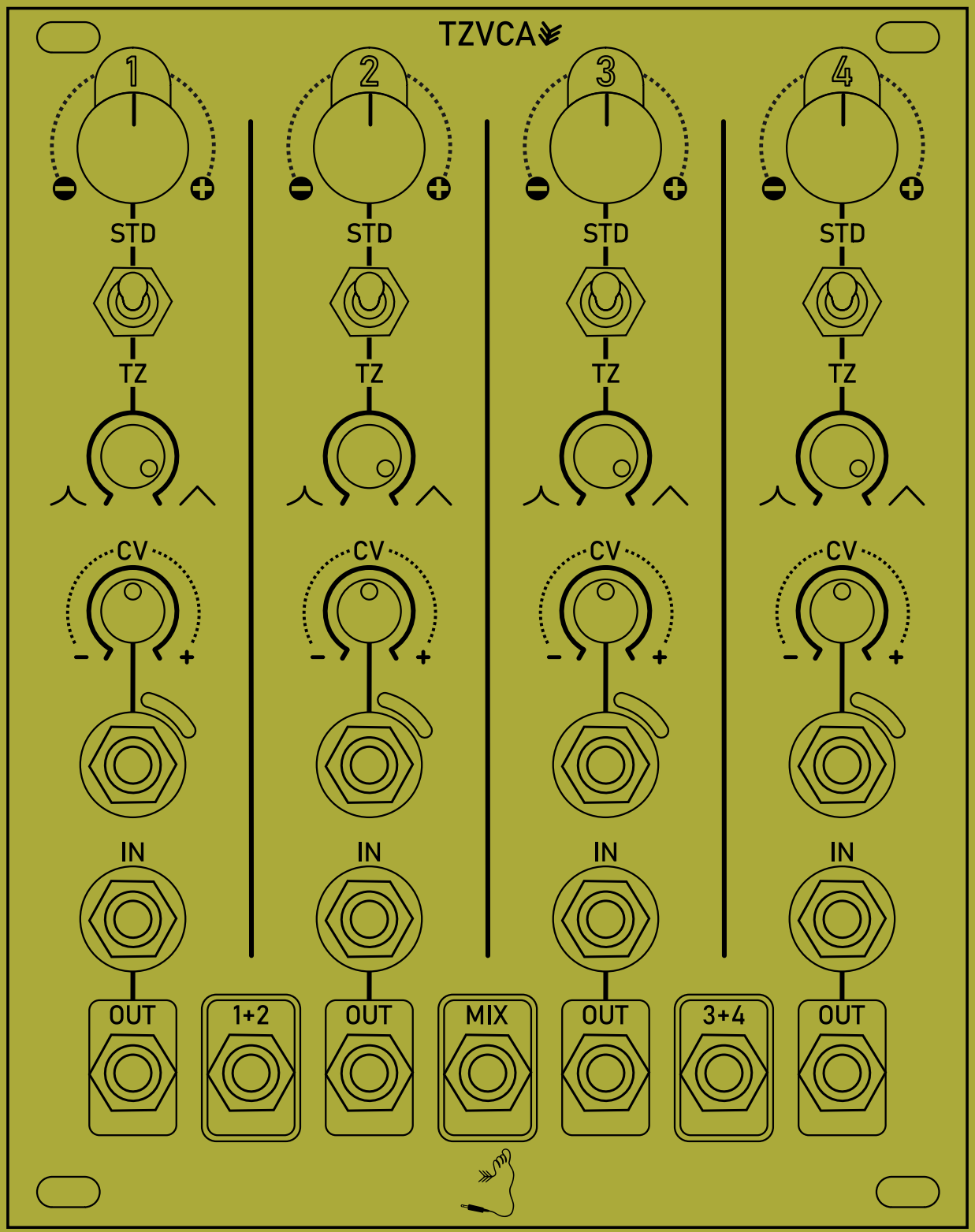
TENDERFOOT ELECTRONICS

TZVCA - MIXING VCA/FOUR-QUADRANT MULTIPLIER

MANUAL REV1 - 2023/9/11



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INTRODUCTION

TZVCA is a 4-channel, DC-coupled, mixing VCA with an individual four-quadrant multiplier mode (TZ) for each channel. Multiple TZVCA modules can be chained together via ribbon cable on the reverse side for the seamless creation of a larger mixing VCA.

SPECIFICATIONS:
OMFG = 20HP
Depth = 22mm

CURRENT DRAW:
+12V = 115mA
+5V = 0mA
-12V = 110mA

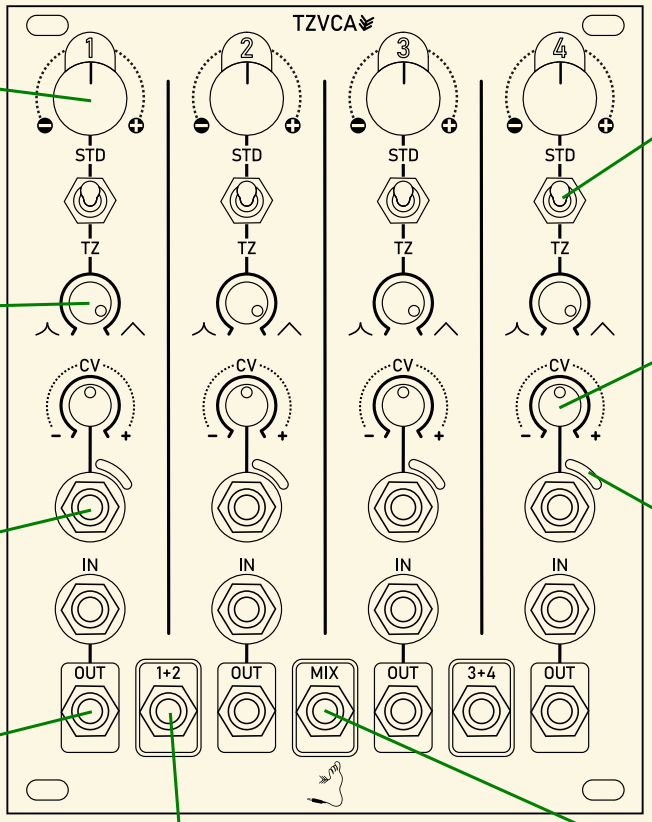
REQUIREMENTS
In order to use the TZVCA, ensure the case you are installing it into uses a eurorack specification power supply and has enough available current to supply the module.

When connecting the power cable, align the red stripe of the cable with the indicated -12V marker on the back of the module. The power connector is the 10-pin connector that is labelled at the top of the reverse-side. DO NOT plug the "link in" and "link out" pins into your rack power supply.

FRONT PANEL LAYOUT

CHANNELS

The 4 channels of the TZVCA are arranged from left to right, with identical controls for each channel arranged from top to bottom. The output jacks for each channel are located at the bottom of the module, with the 3 different mix outputs set between them.



CHANNEL LEVEL
Controls the output level of the channel

RESPONSE CURVE dial
Allows adjustment of the channel's response to CV and the level dial from being linear (CW) to exponential (CCW).

CV INPUT jack
Input your CV to control the VCA level here.

CHANNEL OUTPUT jack
Output signal for the channel emerges here. Patching a cable into a channel output will remove it from the master MIX output.

MODE switch
UP = standard VCA mode
DOWN = 4-quadrant multiplier mode (Through-Zero)

CV INPUT ATTENUVERTER
This allows you to dial in the level of CV input as well as the polarity. The centre-point is the "off" position for the CV input.

CV INDICATOR LIGHT
The light window shows the approximate amplitude of the CV input as well as the polarity: Red =negative, green =positive.

1 + 2 (and 3 + 4) jacks
Permanent mixes of the two indicated channels emerge from the respective jack. Patched channels are not removed from this max, and patching this jack does not remove it from the master MIX.

MIX output jack
The mixed signal of any unpatched individual channels will emerge from the MIX jack. If multiple TZVCA modules are linked, all channels will be mixed down to the final MIX jack in the chain.

(figure 1. TZVCA front panel)

REVERSE LAYOUT

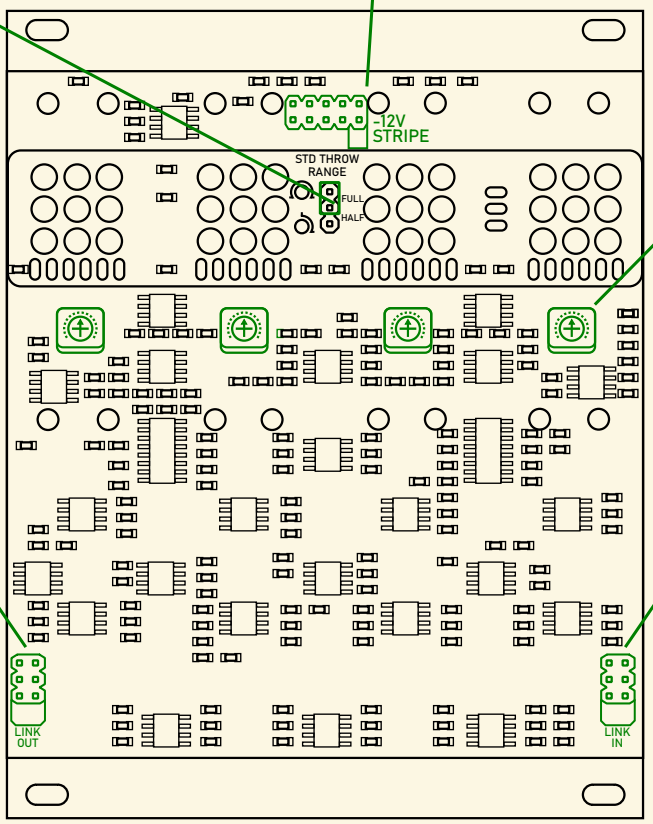
REVERSE SIDE

The back side of the module has a few features that are important to understand and are explained in the diagram below.

STD THROW RANGE jumper
In Standard VCA mode (STD), the range of control from the dial can be selected with this jumper. Set to "FULL" the off position in standard mode will be fully anti-clockwise. Set to "HALF", the off position in standard mode will be in the centre of the dial's throw (12o'clock). Set it to Half if you wish for the off position of the STD and TZ modes to be matched.

POWER connector
Connect the power cable from your eurorack PSU to the module here. Align the red stripe of the cable with the -12V stripe mark on the module.

UNITY GAIN trimmer
This trimmer is set to provide unity gain for the level dial in STD mode with a linear response curve. This trimmer is set upon manufacturing and shouldn't need adjusting, but can be used if you find a channel isn't giving unity gain in the above stated circumstances.



LINK OUT connector
To join multiple TZVCA modules together, you can connect the "LINK OUT" of one to the "LINK IN" of another using the provided 6-channel ribbon cable. The entire mix will be present at the "MIX" output of the final module connectedvia it's "LINK IN" connector. Connect the cable with its red stripe aligned with the white marking on the module.

LINK IN connector
To join multiple TZVCA modules together, you can connect the "LINK OUT" of one to the "LINK IN" of another using the provided 6-channel ribbon cable. The entire mix will be present at the "MIX" output of the final module connectedvia it's "LINK IN" connector. Connect the cable with its red stripe aligned with the white marking on the module.

(figure 2. TZVCA reverse side)

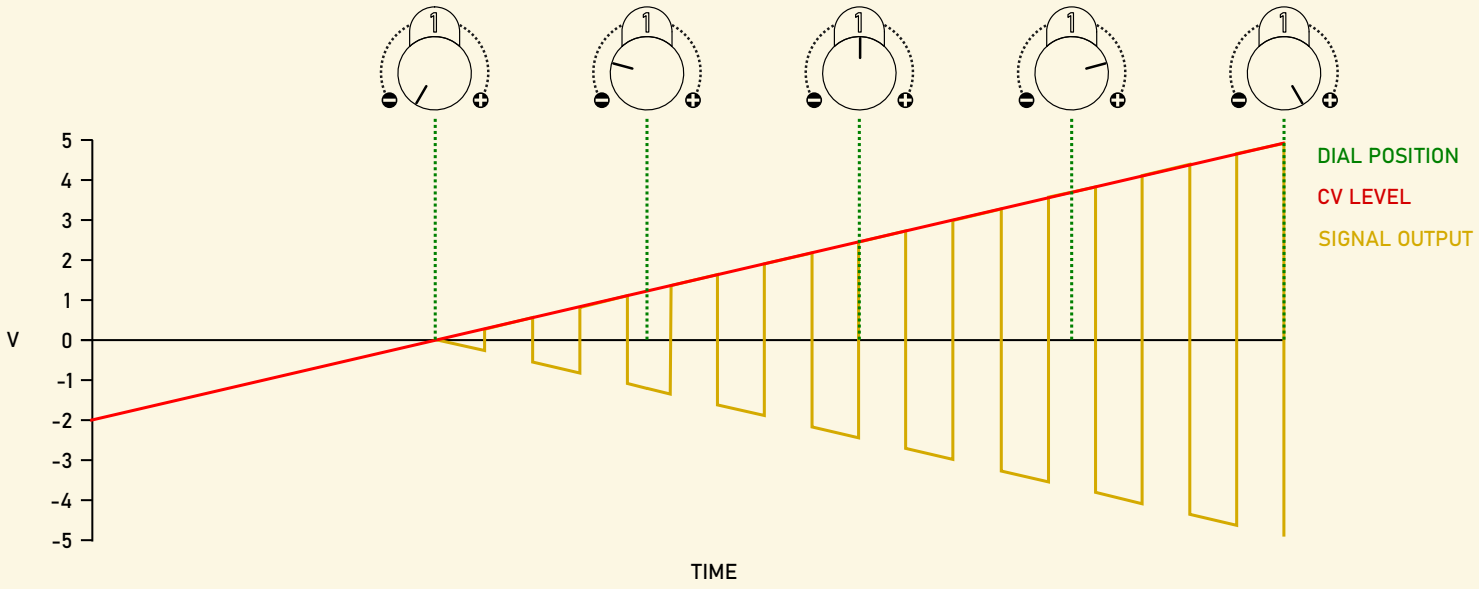
MODES OF OPERATION

MODE SWITCH

The mode switch is the control that allows each channel to be set as either a standard VCA (STD) or as a 4-quadrant multiplier (TZ). The exact funtions of both modes of operation will be detailed in the following sections.

STANDARD MODE (STD)

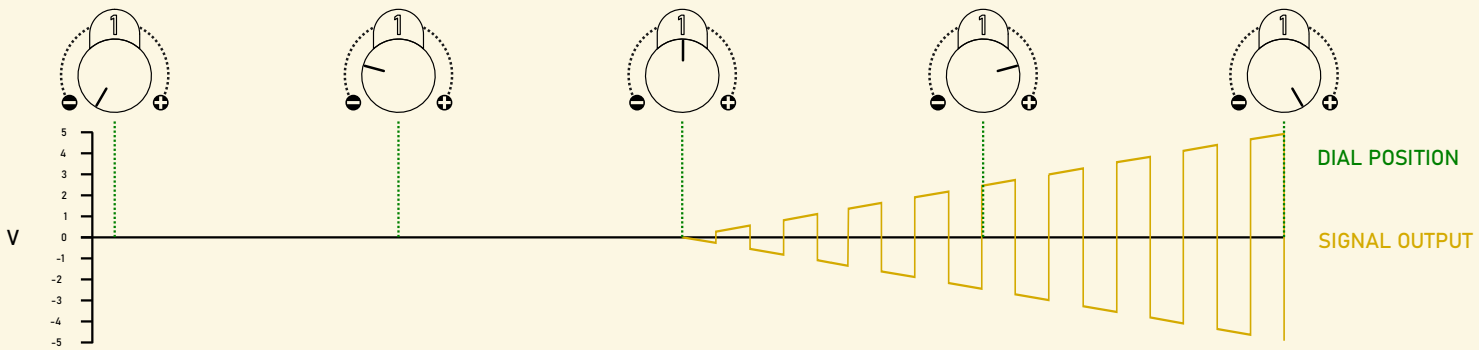
When a channel is set to STD mode, it will operate as a regular VCA. This means that setting the level dial to the zero position, and having no voltage present at the CV input, there will be no output of the signal at the output jack. With the response dial set to linear, adding either 5V at the CV input, or turning the level dial all the way clockwise will result in the output signal being at the same amplitude as the input signal. If CV of a negative polarity is received at the CV input, while in STD mode the output will remain at 0V. This is illustrated in the diagrams below.



(figure 3. Illustration of the relationship between CV input or level dial position and the gain of the output signal. In this example we are assuming the input signal is a square wave remaining at a constant frequency and 10V peak-to-peak amplitude, and the response dial is set to LINEAR)

STD THROW JUMPER - REVERSE SIDE

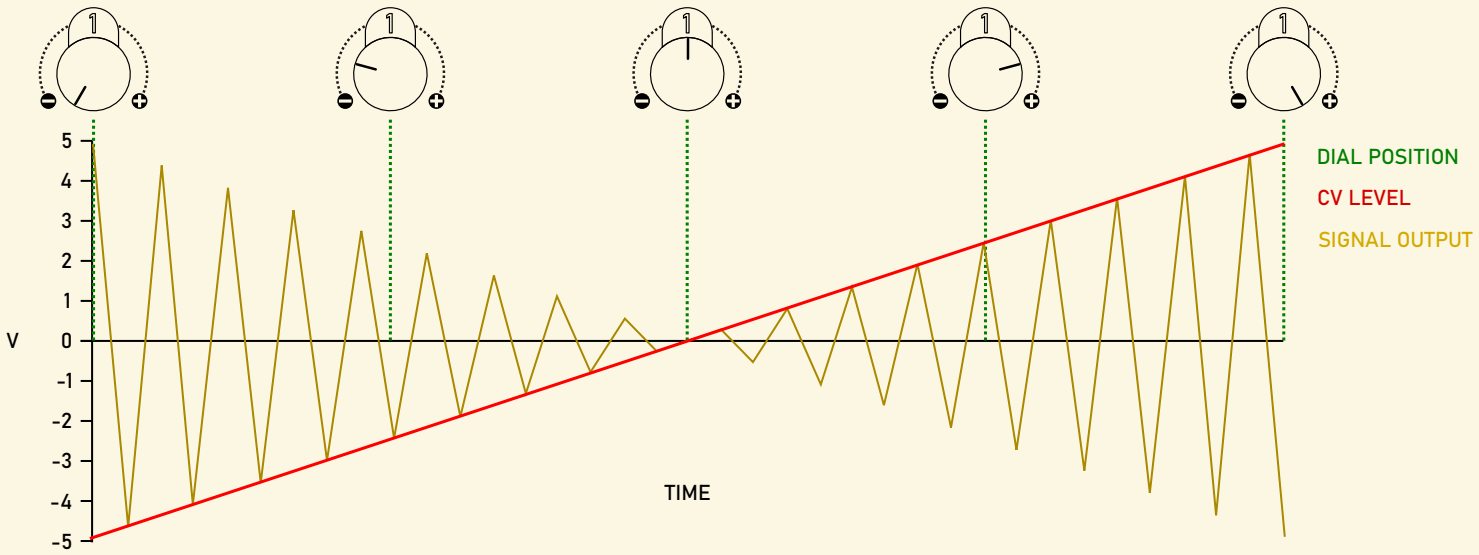
When the jumper on the back is set to FULL THROW, all 4 level dials will respond in the way shown above in figure 3. If you wish for the centre position of the level dial to be the "off" position for both the TZ AND STD mode, then you can move the jumper to the HALF THROW position. With the jumper at HALF throw, and the mode switch set to STD, then the response of the output to the level dial will be as follows.



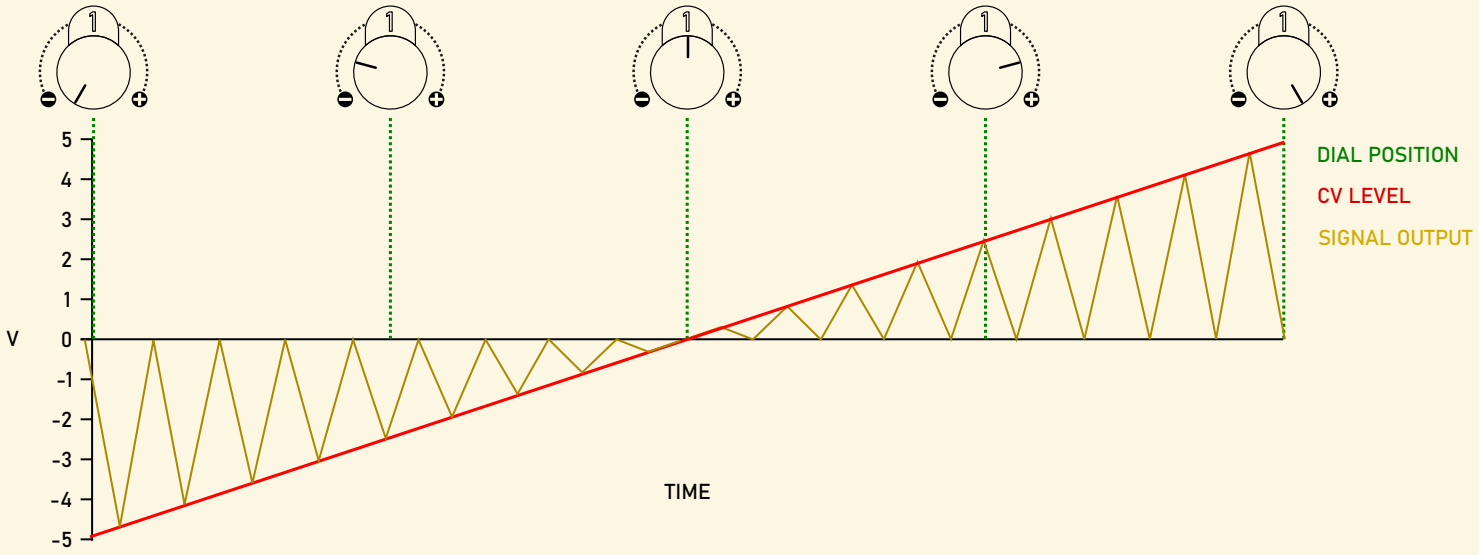
(figure 4. Diagram showing STD mode relationship between dial position and output level with jumper in HALF throw position)

THROUGH-ZERO MODE (TZ - four-quadrant multiplier)

When a channel is set to TZ mode: for CV values above 0V, or with the level dial set to anywhere right of 12o'clock, the channel will respond very much in the same way as it would in STD mode. The main difference, however, is how negative values at the CV input or dial are handled. When a control voltage falls below 0V and becomes negative, the amplitude of the output signal starts to increase again. This time however, the signal is inverted from the input signal. The folowing two diagrams represent how this affects both unipolar and bipolar signals.



(figure 5. Illustration of the relationship between CV input or level dial position and the gain of the output signal when in TZ mode. In this example we are assuming the input signal is a triangle wave remaining at a constant frequency and 10V peak-to-peak amplitude, and the response dial is set to LINEAR). As you can see, with negative CV or dial position, the output begins to increase in amplitude but with inverted polarity.)



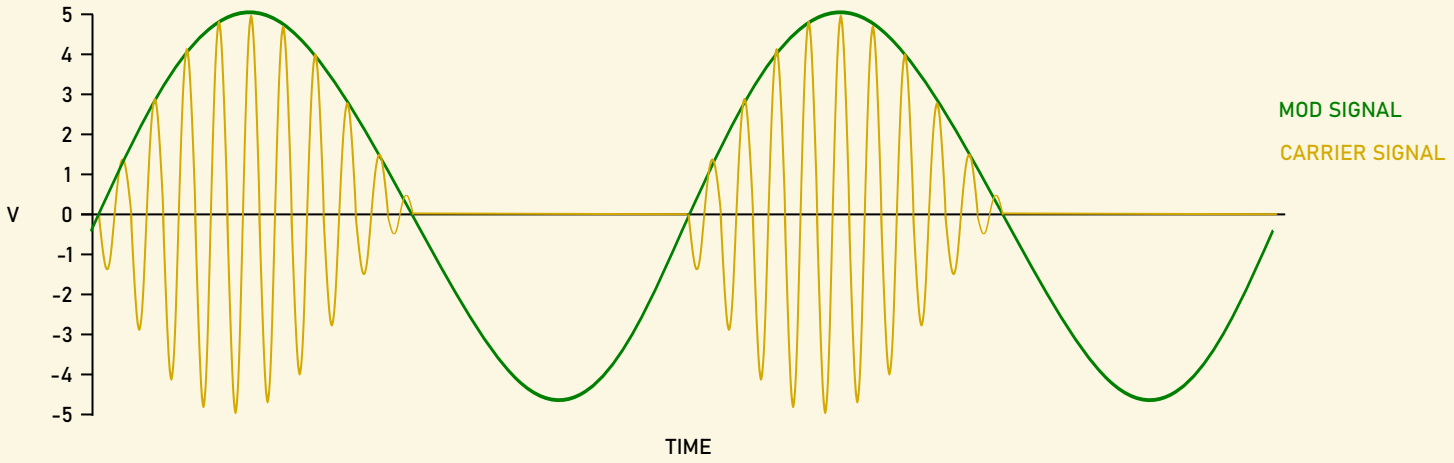
(figure 6. This diagram shows the result of running a unipolar signal (0V-5V) through the TZVCA in TZ mode. The process is identical to that shown in figure 5, but a unipolar signal more-clearly illustrates the inversion of the output signal.)

MODES OF OPERATION

WHY? - AM vs RM

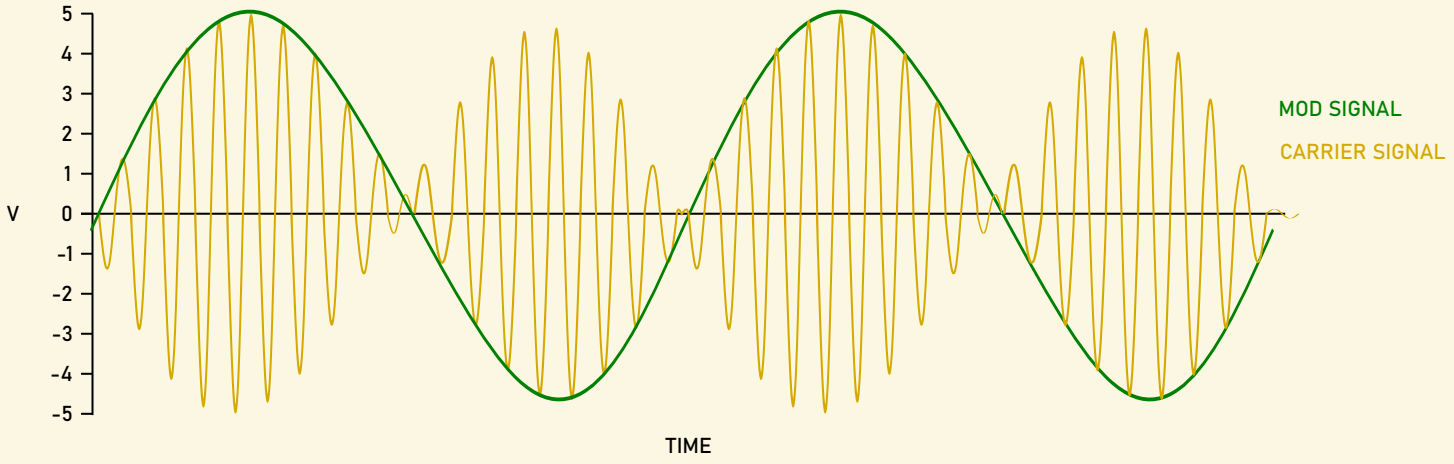
Having a VCA with the ability to perform normal amplitude modulation in STD mode and four-quadrant multiplication in TZ mode gives you a lot of scope for crafting control voltages and manipulating audio signals. In a standard VCA, amplitude modulation (AM) is the normal mode of operation in which the amplitude of your carrier signal is modulated by the CV input. In this case, when the modulation signal drops below zero, there will be no output (as shown in figure7.) If using two audio signals, you will hear the original carrier signal plus sidebands created by the modulation. Using the TZ mode of the TZVCA allows you to achieve ring modulation of 2 signals (illustrated in figure8.). In RM, if using audio signals, only the sidebands will be heard.

AM -STD



(figure 7. diagram represents amplitude modulation (AM) of a carrier signal using STD mode of the TZVCA.)

RM - TZ



(figure 8. diagram represents ring modulation (RM) of a carrier signal by a modulation signal using TZ mode of the TZVCA).

MODES OF OPERATION

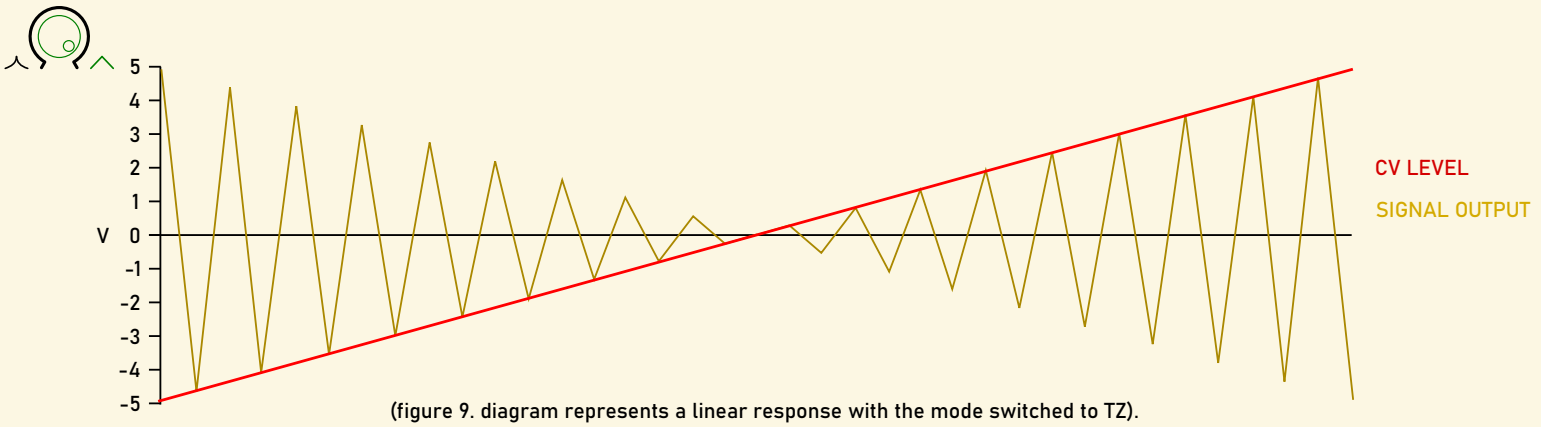
HOW TO - Ring Modulation with TZVCA

The easiest way to get RM with the TZVCA:
1 - Input your carrier signal into thte "IN" jack.
2 - Patch the channel "OUT" or the master "MIX" to your audio output
3 - Switch the channel switch to "TZ".
4 - Turn the channel level dial to 12 o'clock until you hear no audio output.
5 - Patch your modulator signal to the "CV" jack for that channel.
6 - Turn the CV attenuator the desired amount for the sound you want.
7 - Note - if the modulation signal being used is not completely centred around 0V, you can adjust the main channel level dial a small amount to correct for the offset. You should hear when you have done so, as you will hear the sideband frequencies and not the original carrier signal.

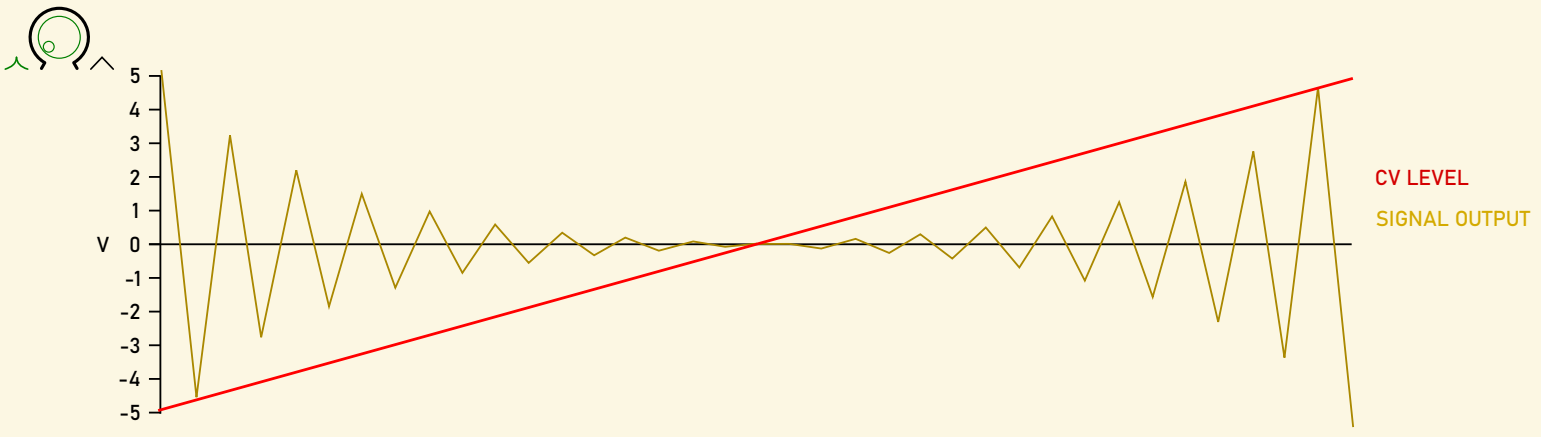
8 - Play Around! Switch between STD and TZ to hear the difference, add offsets, change the response curve and have fun.

RESPONSE DIAL

The response dial for each channel allows you to adjust how the VCA reacts to the level of CV being sent to it. With the dial set all the way to linear (fully clockwise), the relationship between the CV level and the output gain is linear ie. 5V = 1.0 gain, 2.5V = 0.5 gain, and so on. Turning the dial towards the left will make this relationship more exponential, allowing you to get snappier and more natural sounding responses from linear envelopes. The following diagrams illustrate this relationship.



(figure 9. diagram represents a linear response with the mode switched to TZ).



(figure 9. diagram represents an exponential response with the mode switched to TZ).