SQUAREWAVE INDUSTRIES

COMPTROLLER

MANUAL

Ver 1.0

Contact: Sam Winston | 253.265.1979 (call or text) | squarewaveind@gmail.com

INTRODUCTION

The Comptroller combines a VCA compressor with a JFET peak limiter. However, it doesn't behave like a traditional compressor or peak limiter. It's wild, complex and a bit unwieldy until you get used to it. Don't just drop it into your usual signal chain and expect typical results. It was not designed to be transparent, so you need to listen to what it's doing. That's part of the reason why there's no meter.

The Contour control is what makes the compressor unique. It responds to transients in a very unusual way. With Contour, the compressor overreacts to transient changes, creating a brief drop in volume before returning to a normal, steady compressed level. Figure 1 shows the effect on a straightforward oscillator pulse. The graph in the middle is with Contour set to "off". The dotted line represents the volume envelope. This type of graph is called a step response (because the input resembles a step up) and it's very helpful for visualizing the behavior of control systems such as a compressor.

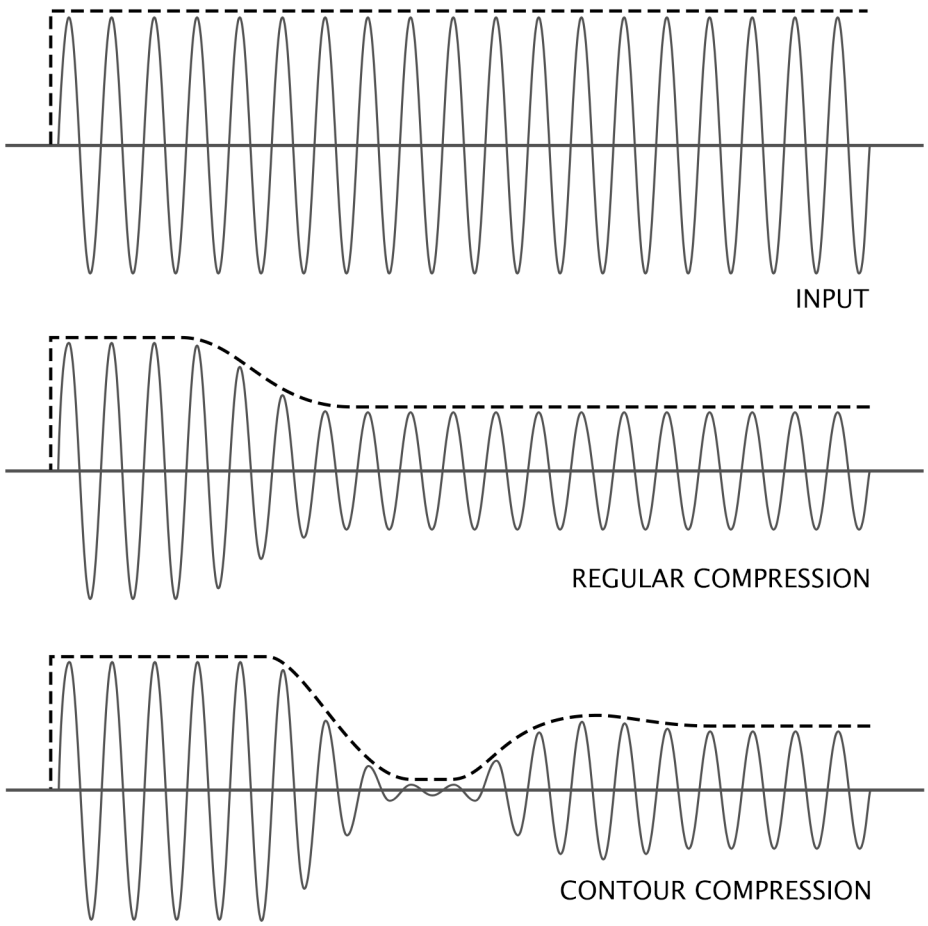

FIGURE 1: COMPRESSION VOLUME ENVELOPES

All of the compressor controls interact to determine the shape of the Contour volume envelope. There are general rules of thumb you can follow, but it's not a straightforward relationship and the mechanics are kind of hard to understand. If you're patient you can figure out how to get specific sounds out of it. You can also just start turning knobs and see what comes out. It's probably not going to be anything that you expected. This unit was designed for experimentation and unexpected results. I recommend turning the gain all the way up. It's most effective on really dynamic signals, so don't compress or limit beforehand.

QUICK START

Put it on a drum bus and start with the following settings to get a feel for what it does.

Input Gain:	3
Attack:	3
Release:	3
Contour:	3
Threshold:	10
Compression:	10
Peak Limiter:	Mode = Hard
	Threshold = 7
Post Pk Lim:	IN
Mono:	OUT
Ext SC/Key:	CENTER
Low Pass:	IN
Output:	0 (Unity)

Turn the Compressor Threshold down until it starts grabbing the peaks. Once it's really digging in and you can hear the effect, adjust Attack, Release and Contour to change the timing. Contour is broad strokes and Attack/Release are fine tuning. Lower numbers are faster, higher numbers are slower. The Contour effect is more pronounced when the timing controls are all on similar settings.

After you get a feel for the timing, turn the Compression down to 5 and adjust the Threshold again. A high Threshold that only catches the transient peaks will give you a more aggressive, open sound. A lower Threshold will accentuate the peaks by attenuating the signal in between and smooth out the response. Threshold also affects the attack time. The compressor will respond faster (give you shorter transients) with a lower Threshold. Readjust the timing controls to compensate.

The Peak Limiter comes after the compressor and can be used to control the level of the transient peaks relative to the compressed signal. It's a true peak limiter that reacts instantly. That means it will generate harmonic distortion and in Hard mode absolutely nothing will go over the threshold. High input gain with heavy compression can generate extreme transient peaks. The Peak Limiter allows you to attenuate the peaks while still getting the same response from the Contour effect. The Post Pk Lim switch puts the Peak Limiter into the control loop for the Compressor, which will dramatically change the Compressor response with heavy peak limiting. It's really helpful for evening out Compression when the signal has inconsistent or uneven transient levels.

CONTROLS

INPUT GAIN: 1 = Unity / 6 = +25dB

OUTPUT: Off to +6dB / 0 = Unity.

IN: Engages the circuit. In bypass the input XLR is routed directly to the output XLR, with the compressor input wired in parallel. This keeps the response consistent when A/B ing. When the unit is powered off it's 100% true bypass.

COMPRESSOR

ATTACK/RELEASE: 1 = Fast / 6 = Slow

CONTOUR: 1 = Fast / 5 = Slow / Off = Normal compression

THRESHOLD: 1 = Low / 10 = High

COMPRESSION: 0 = Off (No compression) / 10 = High. Equivalent to the ratio control on a traditional compressor. The LED indicates when compression is happening.

PEAK LIMITER

THRESHOLD: 1 = Low, 10 = High. 7.5 is around +18dBu, which is the standard maximum level for most A/D converters. Use this setting in Hard mode to avoid clipping converters. The LED indicates when Limiting is happening.

MODE: Soft is JFET saturation, Medium adds some feedback, and Hard is brick wall clipping. The peak limiter can't be bypassed but the maximum threshold is set just below the clipping point of the circuit.

DETECTOR

(This section only affects the Compressor, not the Peak Limiter)

POST PK LIM: Changes the source for the compression detector to after the peak limiter.

MONO: The compression detector is only fed from the left channel, but the right channel is still affected.

EXT S/C & KEY: Center position is normal compression. **EXT S/C** engages the external side chain input. **EXT KEY** routes the sidechain input/return through a separate VCA so you can trigger compression from an external source while still getting the correct response from the Contour control. If no signal is coming into Sidechain Return then compression is disabled in either of the external modes.

Low pass at 500Hz. In this mode the compressor will only respond to low frequencies. Makes full frequency signals like a drum or stereo buss more punchy. Only affects the compression response, not the output signal.

OVERVIEW

CONTOUR: The Contour control makes the compressor slower and slightly unstable. The volume drop is a brief oscillation or overshoot in the control signal. When a transient goes over the threshold, the compressor tries to turn it down. Contour adds an extra delay so it can't respond right away. During that initial delay it's also storing up the energy coming in. Once it finally starts to compress it releases the stored-up energy and overreacts. One practical way to think of it is that whatever transient information goes over the threshold before the compressor kicks in is then subtracted afterward. This is illustrated in Figure 2 below.

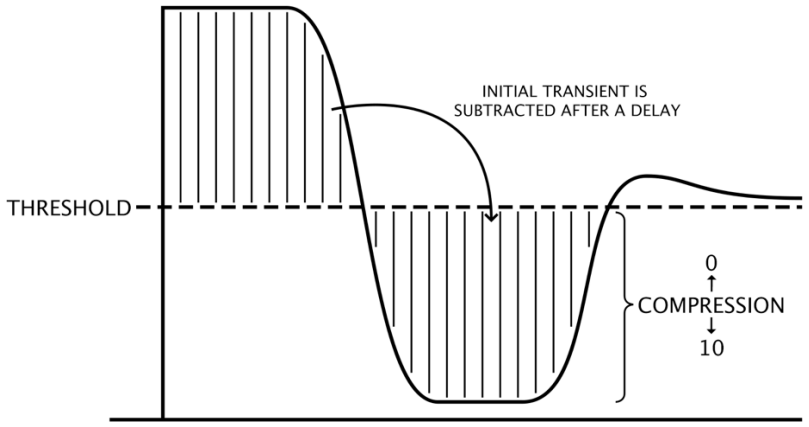

FIGURE 2: CONTOUR COMPRESSION VOLUME ENVELOPE

TIMING: Attack, Release and Contour all interact to control the timing and shape of the response. Contour affects the entire curve in broad strokes while Attack and Release allow finer adjustment of the beginning and end respectively. See Figure 3 below. The timing controls have a cumulative or overlapping effect so the depth of the Contour response is more pronounced when they're all on similar settings/numbers (i.e. all fast or slow).

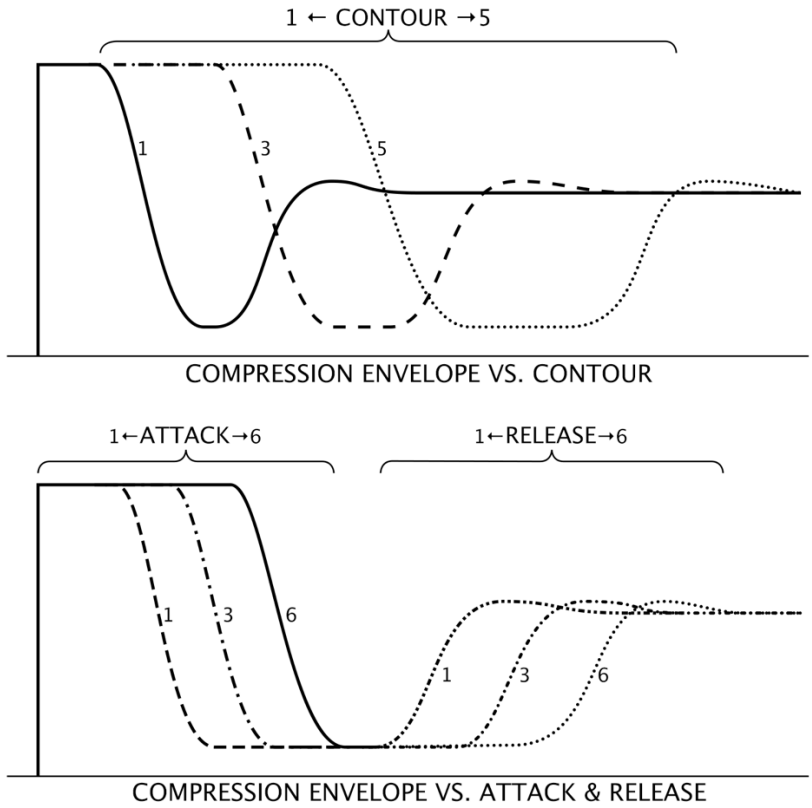

FIGURE 3: TIMING CONTROLS

COMPRESSOR THRESHOLD: The Threshold level has a big impact on how the Contour effect behaves. The depth of the volume drop depends on the level of the transient, **relative to the Threshold.** That means a higher transient peak or a lower threshold will give you more of a drop. However, the depth of the drop also depends on the level of the transient, **relative to how much compression was happening before the transient.** A high Threshold that only grabs the peaks will give the compressor time to release or recover in between transients and enhance the Contour effect. A low Threshold will compress more of the signal but without time to recover the Contour effect will be less pronounced.

THRESHOLD TIMING: In a typical compressor the threshold comes before the attack and release (timing) controls. Once the signal goes over the threshold the attack and release times are fixed. The Comptroller reverses this by having the threshold after the timing controls. The practical result is that the threshold level affects the attack and release times. Figure 4 shows the response for three different threshold levels. When the signal initially rises, the timing circuit starts to charge up, creating a voltage ramp over time. When this voltage goes over the threshold compression starts. Because of the ramp the onset of compression comes later with higher thresholds. There is a similar ramp down when the input signal stops, which has the opposite effect on release. The general relationship is: **high threshold = slow attack & fast release** and **low threshold = fast attack & slow release.** The timing controls can be adjusted to compensate for this effect (to a certain extent).

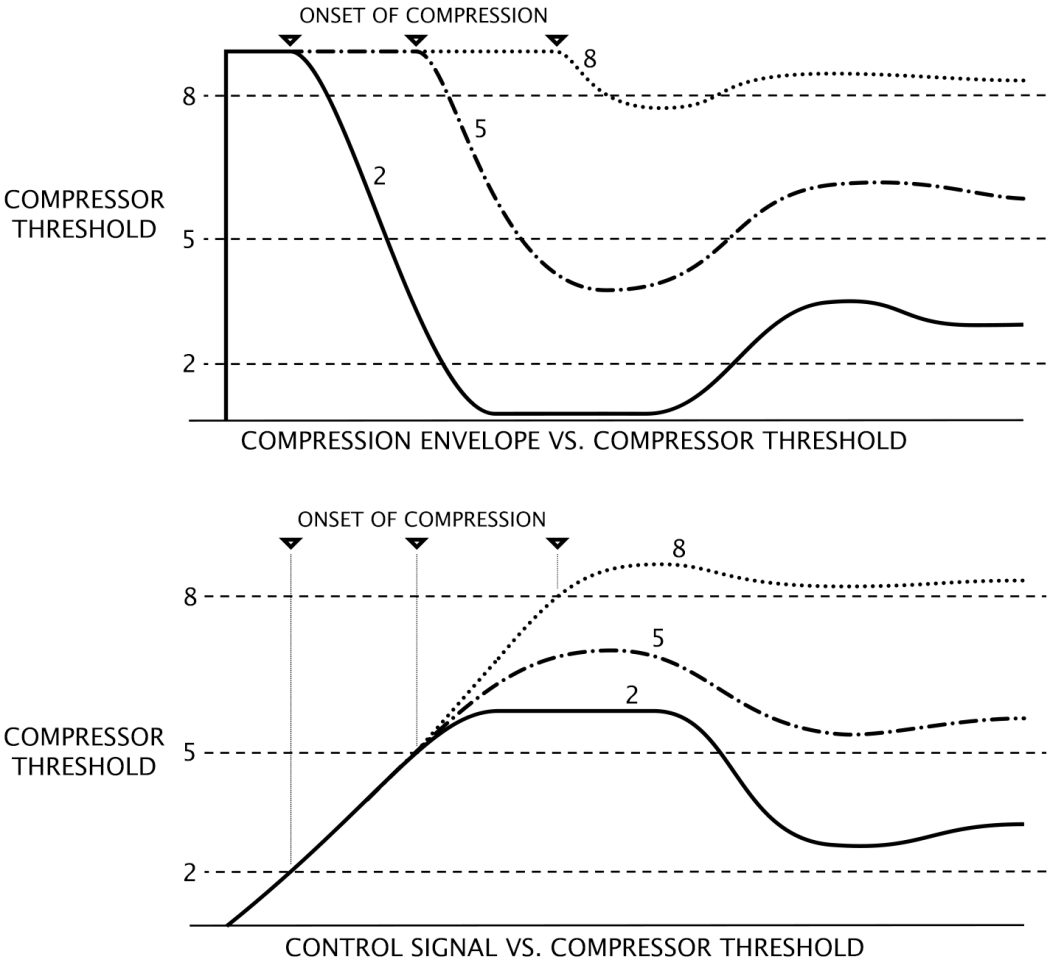

FIGURE 4: EFFECT OF COMPRESSOR THRESHOLD

COMPRESSION CONTROL: Comes after the Threshold and basically acts as a volume knob for the control signal. It's equivalent to the ratio control on a traditional compressor. It affects the depth of the Contour volume drop as well as the following compressed signal level. It does not affect the timing in any significant way. A high threshold combined with high compression will produce the most extreme Contour response. Figure 5 shows the resulting Contour volume envelope for 3 different Compression settings.

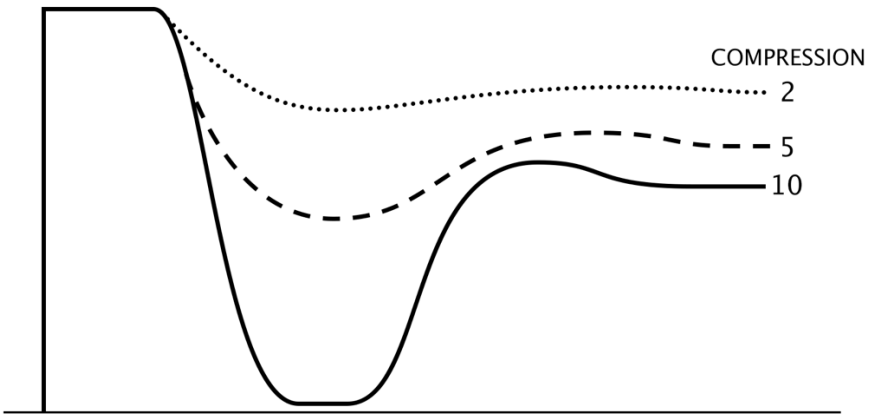

FIGURE 5: COMPRESSION ENVELOPE VS. COMPRESSION LEVEL
(FIXED THRESHOLD)

POST PK LIM: The source of the Compression Detector is fed from the output of the VCA by default. The Post Pk Lim switch changes the source to after the output of the Peak Limiter. This will dramatically change the transient response of the compressor depending on the amount of peak limiting. The depth of the volume drop produced by the Contour effect is proportional to the level of the transient. Signals with uneven or inconsistent transients will therefore generate an uneven or inconsistent Contour response. For example, a room mic that's picking up significantly more kick than snare. Engaging the Post Pk Lim switch and applying limiting will normalize the transient levels seen by the compressor and make the contour effect more consistent. It will also change the sound, generally making it less constricted and more open.

MONO: Sums the left and right channels by default and applies the same control voltage to both. In Mono mode only the left channel is driving compression, but the right channel is still being affected. You can get some creative ducking effects by putting two unrelated signals through each channel. For example, kick drum in left and bass in right. In Stereo mode the two channels are attenuated by half (-6dB) and then summed, which results in a 0dB signal. Mono mode uses the left channel with no attenuation. This keeps the Threshold consistent between modes. It's important to engage Mono mode on a mono signal otherwise the level going to the detector will be too low.

EXTERNAL SIDECHAIN: (EXT S/C) loop lets you apply EQ or other processing to the detector signal. In External Key (EXT KEY) mode the Sidechain Input/Return is routed through a separate VCA before going to the Detector. This allows you to trigger compression from an external source and still have the proper response from the Contour effect. Both external modes are affected by the Low Pass filter. If no signal is present on the Sidechain Return then compression is disabled in either EXT KEY or EXT S/C mode. The Sidechain Output/Send is always active, and the signal will reflect the Post Pk Lim and Mono switch settings. See the accompanying Block Diagram for signal flow.

LOW PASS: Only affects the Compressor Detector signal, not what you hear. It's a 2nd order filter with a 12dB per octave slope at 500Hz. When applied the compressor will only respond to low frequencies. It's very useful for enhancing the Contour effect when compressing a full frequency signal like a drum bus, room mic, or stereo mix.

PEAK LIMITER: The JFET Peak Limiter follows the Compressor and is completely independent. Each channel has its own separate detector and limiter circuit. It responds instantly with no attack or release time. The 3 Modes offer increasing amounts of peak reduction. Soft mode exploits the saturation region of the JFET and is fairly gentle. Medium mode adds some negative feedback that further reduces the maximum signal level. Hard mode acts as a brick wall, clipping the signal beyond the threshold. The Peak Limiter can't be bypassed, but the maximum Threshold has been set just below the clipping point of the circuit itself (around +25dBu).

SPECIFICATIONS

I/O:	Electronically Balanced, Pin 2 Hot. For unbalanced connection: Pin 2 = Signal, Pin 3 = Ground. Pin 1 is capacitively bonded to chassis to prevent ground loops.
Input Impedance:	> 20k ohms
Output Impedance:	50 ohms
Input Gain:	+25dB in 5dB steps
Output:	+6dB to -infinity
Maximum Overall Gain:	+31dB
Maximum Output Level:	+25dBu @ 0.1% THD
THD + Noise:	-80dBu (10Hz – 80kHz Un-weighted)
Frequency Response:	+/- 0.1dB 10Hz-63kHz
Power:	110-120VAC or 220-240VAC, 50-60Hz. Switchable on the back. Fuse: 5mm x 20mm Slow-Blow / Time Delay 110-120V = 250mA 220-240V = 125mA Maximum Power Consumption: 16 Watts

COMPTROLLER BLOCK DIAGRAM