

BMC109. VC Distortion

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I. What it Does

This module combines a simple voltage controlled amplifier circuit with some LED clipping diodes. It has two channels, which can be used in series or parallel.

The module is designed for use with +/-12V systems, but should work fine on +/-15V systems without modification.

CONTROLS/INPUTS/OUTPUTS

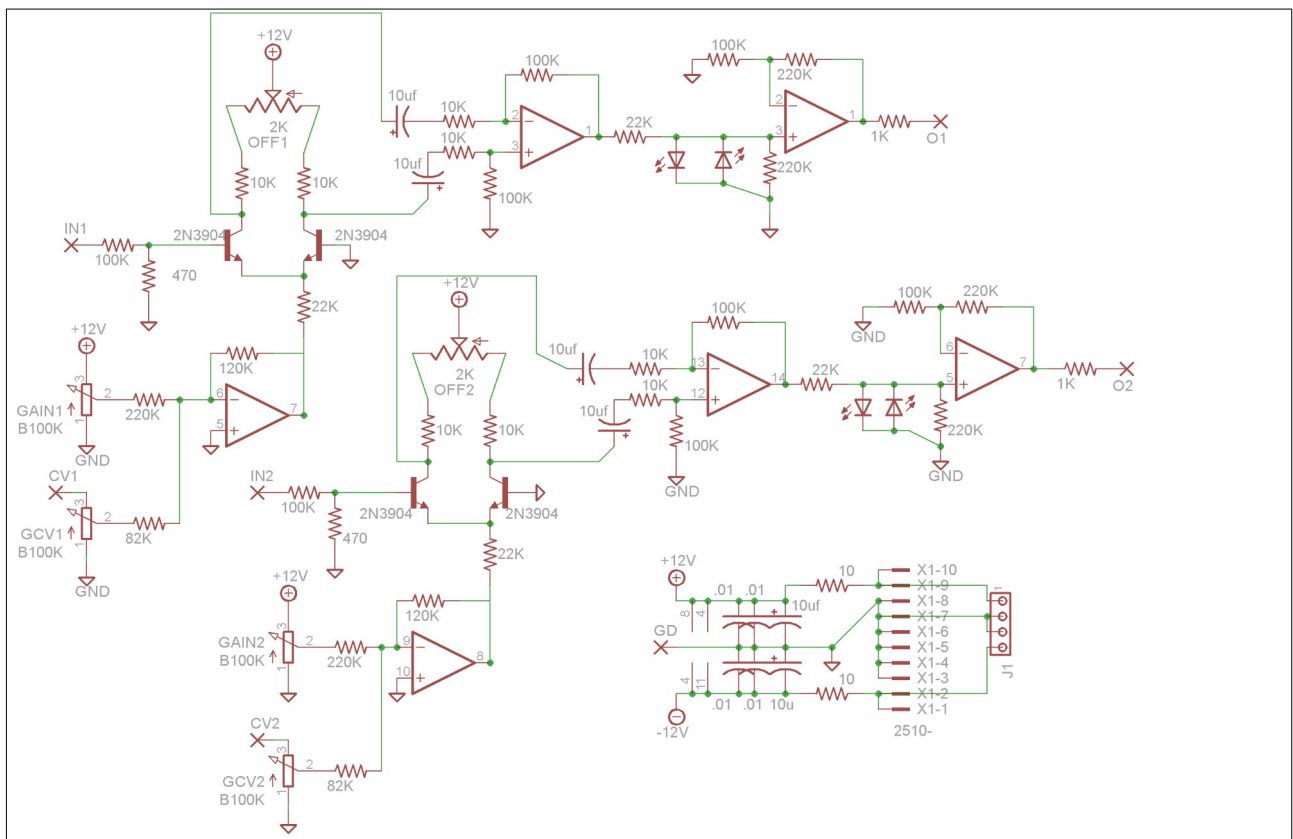
1. Gain knobs – One for each channel. These set the signal gain before the clipping diodes. The setting is modulated by the Gain CV knob. If you want the signal to completely cut out when no CV is input, turn this knob completely counter clockwise.

2. Gain CV Knobs – One for each channel. This attenuates the CV input that modifies the gain knob's setting.

3. Input Jacks – One for each channel. Audio is input here. The module uses AC coupling internally, so DC signals like envelopes or control voltages aren't recommended for processing.

4. CV Jacks – One for each channel. The gain CV is input here.

5. Output Jacks – One for each channel.



II. Schematic

Above is the schematic for this module. The VCA/clipping section is repeated twice, and both sections are identical. The “IN” wirepad connects to the audio input jack and then attenuates the input signal through the 100K/470 ohm voltage divider. This small signal is connected to the base of a 2N3904 transistor. The emitter is connected to the emitter of a 2nd 2N3904 which has its base grounded and the emitters also connect to a 22K resistor. This arrangement is known as emitter coupling, and it makes it so the current draw at the collector of the 2nd transistor is out of phase with the draw of the 1st transistor when audio is applied.

The 22K resistor connects to the output of an inverting op-amp. As the voltage from the inverter becomes more negative, it increases the voltage difference between base and emitter of the

2N3904 which then causes it to draw more current through the emitter and increase the gain. The op-amp's output voltage is determined by the Gain and Gain CV knobs. Both knobs are wired as variable attenuators, with the gain knob attenuating the +12V supply and the Gain CV knob attenuating the Gain CV input. The wipers of the pots connect at the negative input of the op-amp through a 220K resistor for the Gain knob and an 82K resistor for the Gain CV knob. They are mismatched because the CV signal will usually be lower voltage than the +12V DC supply.

The collectors of the two 2N3904s connect to the +12V supply through a pair of 10K resistors in series with a 2K trimpot which can be adjusted to provide better balance between the two sides. The better the balance, the less control voltage is audible in the output. These resistors will convert the changes in current draw at the collector into changes in voltage, due to ohm's law. These voltage signals connect to 10uf capacitors which will remove DC offset and then connect the signals to an op-amp wired as a differential amplifier.

The differential amp's output connects to the clipping section through a 22K resistor which will limit how much current the op-amp sinks to ground through the clipping diodes and acts as half of a voltage divider with the 220K resistor to ground. The clipping diodes are red LEDs, they will limit the voltage swing to +/- their forward voltage so, approximately +/-2.2V.

The clipped signal is then amplified again by the non-inverting op-amp gain stage. The 220K/100K resistor combo sets the gain at 2.2, making the ~+/-2.2V signal into a ~+/-5V signal. A 1K resistor connects the output of the op-amp to the output wirepad.

III Construction

A.PARTS LIST

SEMICONDUCTORS

Name/Value	QTY	Notes
TL074	1	Or any quad op-amp
TL072	1	Or any dual op-amp
Red 3MM LED	4	

RESISTORS

Name/Value	QTY	Notes
10	2	1/4W metal film
470	2	1/4W metal film
1K	2	1/4W metal film
10K	8	1/4W metal film
22K	4	1/4W metal film
82K	2	1/4W metal film
100K	8	1/4W metal film
120K	2	
220K	6	1/4W metal film
2K trimpot	2	3296W package
B100K pot	4	Either 9mm or 16mm PC mount package

CAPACITORS

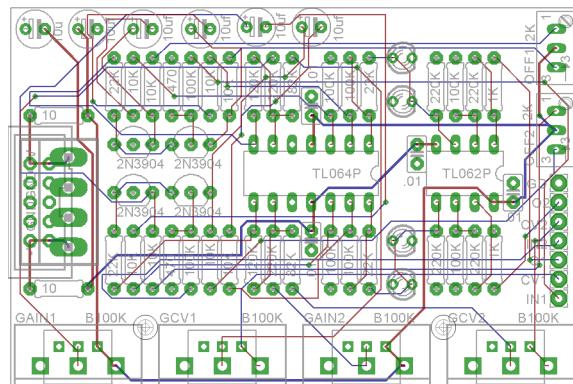
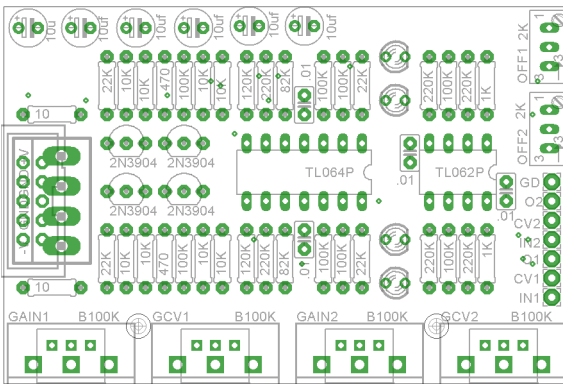
Name/Value	QTY	Notes
.01uf	4	Ceramic disc
10uf	6	Electrolytic

OTHER

Name/Value	QTY	Notes
3.5mm Jack	6	
Power connector	1	
8pin DIP socket	1	
14 pin DIP socket	1	

B. THE BOARD

Below are renderings of the PCB, both with and without traces present. The PCB is 74mm x 50mm, with the pots spaced 19.05mm apart.



C. Wiring.

Wirepads should be connected as follows:

GD – ground, wire to the sleeve of any jack.

All other wirepads wire to the tips of their respective jacks.

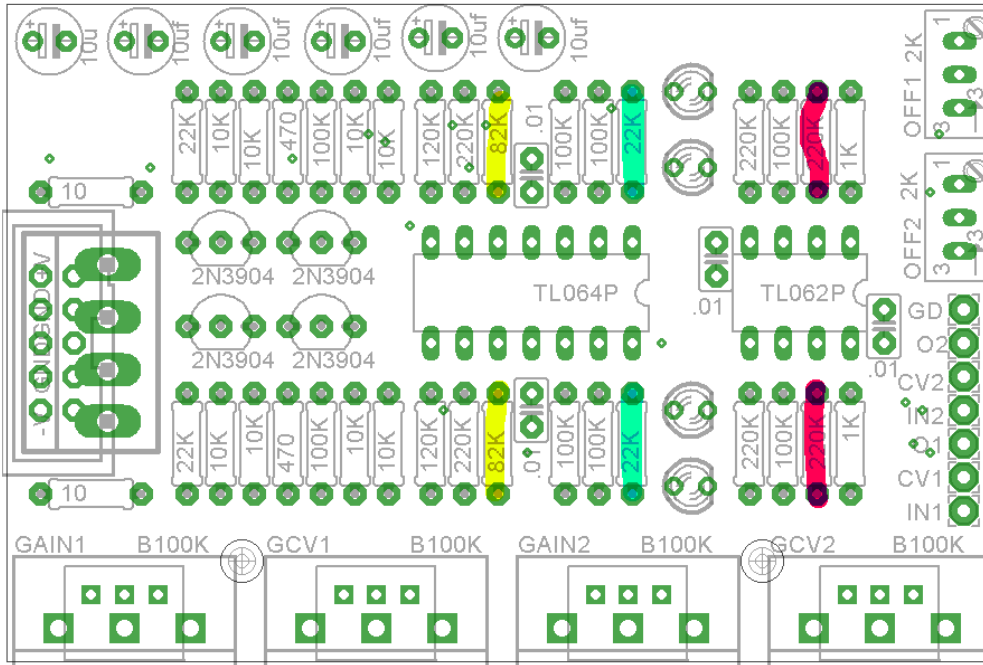
IN1/IN2 – Audio inputs for channel 1/ channel 2

CV1/CV2 – CV inputs for channel 1/ channel 2

O1/O2 – Outputs for channel 1/ channel 2

TO CALLIBRATE.

1. Patch a square wave to the CV input of channel 1. Turn the CV1 knob all the way up.
2. Listen to output 1. Adjust the “OFF1” trimpot until the square wave is as quiet as possible.
2. Repeat for channel 2.



MODIFICATIONS

The module is laid out with channel 1's components in a row closer to the pots and channel 2's components further from the pots, if you only want to modify one channel.

1. Increase distortion: The 22K resistors highlighted in green can be reduced in value to have clipping occur more quickly. I would stick to values higher than 1K. If swapping the LEDs out for a different sort of diode, you may want to adjust this value
2. Stronger CV Control: The 82K resistors in yellow can be reduced to let external control voltages have more control over the signal.
3. Output volume: The 220K resistors in Red control the output volume. You should only need to adjust this if switching to a different clipping diode. Increasing the value will increase the output volume and decreasing the value will lower the output volume.
4. Different clipping diode: The LEDs can be swapped for any other diode if you want to try and hear different flavors of clipping.