BMC097. Rectifier and Recombiner

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If you have any questions, or need help trouble shooting, please e-mail
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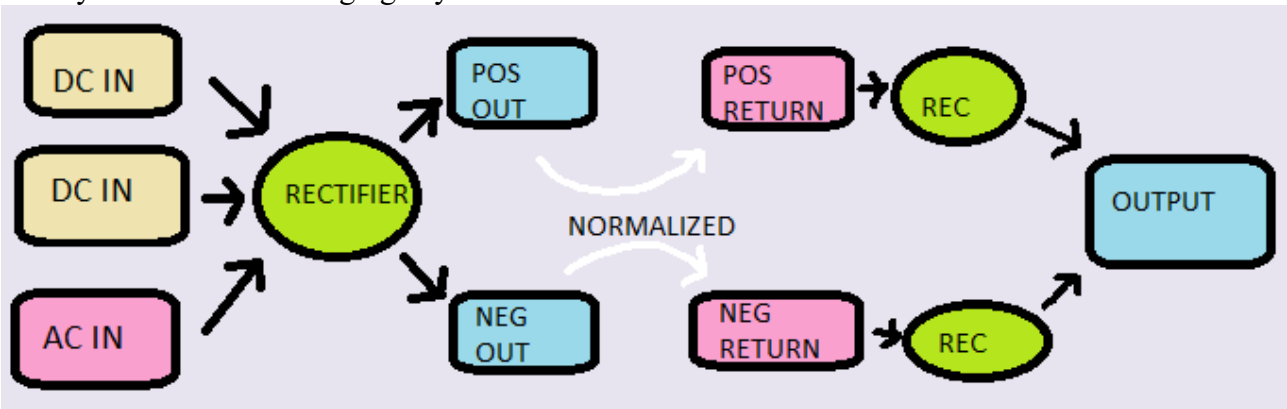
I. What The Knobs And Jacks Do.

A. Summary

This module rectifies an input's positive and negative voltages and outputs them to separate jacks so they can be processed separately. The signals can then be returned and mixed back together in the re-combiner section. The re-combiner's inputs have their own rectifiers built into them so it can also be used to mix together different signals while preserving the polarity difference.

This module is designed for Eurorack style systems, but includes mounting holes and a MOTM style power connector on the PCB so it can be adapted to other systems. It will work on +/- 15V systems without changing any resistor values.



B. INPUTS/OUTPUTS

1.DC INPUT JACKS – There are two of these jacks. Their inputs are mixed with the AC input jacks before being sent to the rectifiers. Inputting control voltages or LFOs will allow for control on how much DC offset is applied to the AC input's signal.
2.AC INPUT JACK – An input going through a .1uf capacitor for audio signals, this ensures the signal is centered around 0V for the rectifier.
3.POSITIVE/NEGATIVE OUT JACKS – The outputs of the rectifier section, the positive jack only outputs voltages above 0V and the negative jack only outputs voltages below 0V.
4.POSITIVE/NEGATIVE RETURN JACKS – These are the inputs for the recombiner section, these are normalized to the positive/negative output jacks, so you can process just one side of a signal and keep the other natural. These inputs go through rectifiers, so only voltage above 0V will input to the positive return will appear at the output, and the inverse for the other input.
5.OUTPUT – The output of the recombiner.

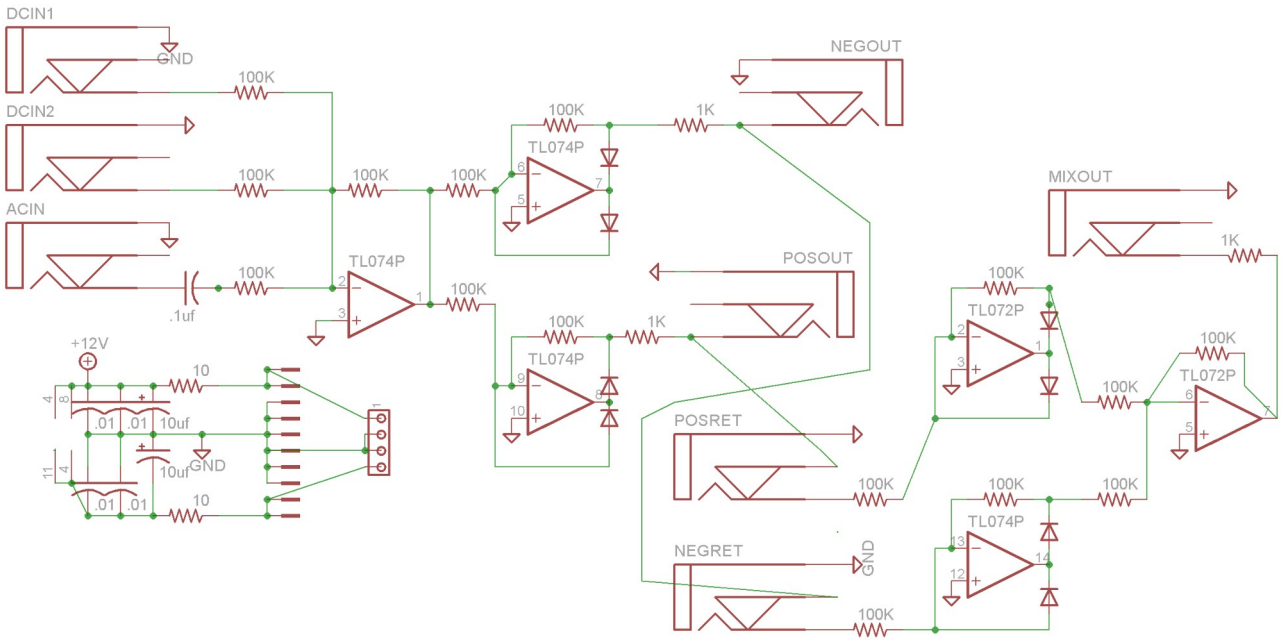
C. DEMONSTRATION RECORDINGS

Demo 1 – Rectifying CV only. An LFO is input to a DC input. The positive and negative outputs are connected to the cutoff CV inputs of a pair of VCFs. The VCFs are connected in stereo with one as a low pass and the other a high pass. This creates a bandpass filter with a changing pass band that is very small in the middle frequencies and gets larger in the bass and treble ranges.

Demo 2 – Frequency doubling one side of a sine wave. A sine wave is input to the AC input. The positive output connects to a BMC82 Frequency doubler and is then sent to the positive return. An LFO is added to a DC input to add offset to the sine wave.

Demo 3 – Mixing waveforms into the recombiner. Different waveforms from a VCO are patched to the positive and negative return jacks to create hybrid/broken waveforms. When the pulse is input I adjust the PWM. Then a second VCO which is sync'd to the first is input to the negative return jack.

II. Schematic.



Above is the schematic for this module. Starting in the upper left are the DC and AC input jacks. All of these are in series with 100K resistors that meet at the negative input of an op-amp, with the AC jack also in series with a .1uf capacitor. The op-amp mixes and inverts these voltages and then sends them to a pair of inverting half-wave converters.

The upper converter outputs positive voltages from negative voltages and the one below does the opposite. Because the signal was inverted at the mixer before this, this keeps polarity correct.

The rectifiers work like a standard inverting op-amp gain stage, but with two diodes added and the feedback resistor moved slightly. The first diode connects straight from the output to the negative input shorts outputs of the wrong polarity back to the negative input giving almost infinite negative feedback on the wrong polarity of voltages making a gain of 0 for wrong polarity.

The other diode connects from the output of the op-amp to the output jack and to the 100K feedback resistor. This diode makes it so only the correct voltage passes to the output. By connecting the 100K feedback resistor to the output, the op-amp will adjust it's output to make up for the diode voltage drop. This sets the gain for voltages of the correct polarity at -1.

These rectifiers connect to the positive/negative output jacks. These jacks are normalized to the inputs of the positive/negative return jacks. The return jacks connect to another pair of inverting rectifiers. The outputs of these rectifiers are mixed together by another inverting mix stage and then sent to the output jack through a 1K resistor.

In the bottom left we see the power connections. A passive low pass filter is formed by the 10ohm, 10uf capacitors and .01uf capacitors next to the power pins of the ICs provide extra high frequency filtering.

III. Construction

A.Parts List

Semiconductors

Name	Quantity	Notes
TL072	1	Any dual op-amp should work
TL074	1	Any quad op-amp should work
1N4148	8	

Resistors

Name/Value	Quantity	Notes
10 ohm	2	All resistors 1/4w metal Film for all resistors unless otherwise noted
1K	3	
100K	15	

Capacitors

Name/Value	Quantity	Notes
.01uf	4	Ceramic disc. Value not critical
0.1uf	1	Film capacitor
10uf	2	Electrolytic

Other

Name/Value	Quantity	Notes
8 pin DIP socket	1	
14 pin DIP socket	1	
Power connecter	1	Right angle 2x5 2.54mm, like this.
Jacks	8	PCB is designed around these jacks: PJ-323M

B. The PCB

The PCB is 97mmx 41mm. The mounting holes are 90.5mm apart and the jacks are spaced 12.7mm apart. Below are renderings of the PCB with and without traces present.