

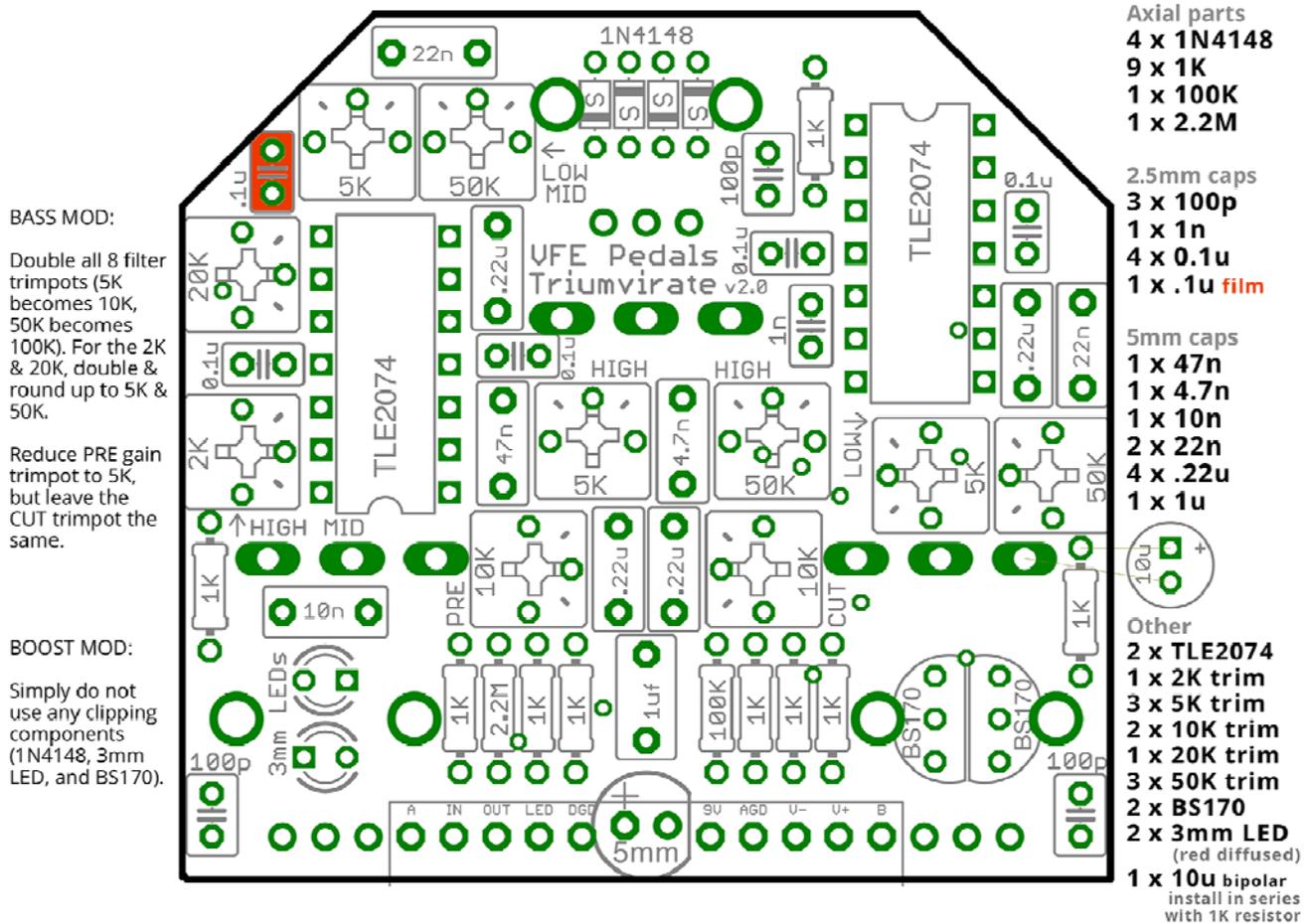
TRIUMVIRATE™

FX TYPE: Multi-Band Distortion

Images © VFE and MBP

Project Doc © madbeanpedals

2.17" W x 2.01" H



Note: Use the values listed on the image above – not the values indicated on the silk-screen of the PCB. Some values changed over time in the VFE product cycles.

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Terms of Use: These projects are intended for DIY use only and may not be used in any commercial Endeavour including the sale of completed pedals or "kits". The PCBs are the actual boards used to build the recently discontinued line of VFE pedals and have been generously provided to the DIY community by VFE for the purpose of DIY only.

Shopping List				
Value	QTY	Type	Rating	Spacing
1k	8	Carbon / Metal Film	1/4W	
4k7	1	Carbon / Metal Film	1/4W	
100k	1	Carbon / Metal Film	1/4W	
2M2	1	Carbon / Metal Film	1/4W	
100pF	2	Ceramic / MLCC	25v min.	2.5mm
470pF	1	Ceramic / MLCC	25v min.	2.5mm
1n	1	Ceramic / MLCC	25v min.	2.5mm
100n	4	Ceramic / MLCC	25v min.	2.5mm
100n	1	Film	25v min.	5mm
4n7	1	Film	25v min.	5mm
10n	1	Film	25v min.	5mm
22n	2	Film	25v min.	5mm
47n	1	Film	25v min.	5mm
220n	4	Film	25v min.	5mm
1uF	1	Film	25v min.	5mm
10uF	1	This does not have to be Bi-Polar	25v min.	
1n4148	4	or, 1n914		
LED	2	Red, Diffused	3mm	
BS170	2			
TLE2074	2			
2k	1	Bourns 3362p		
5k	3	Bourns 3362p		
10k	2	Bourns 3362p		
20k	1	Bourns 3362p		
50k	3	Bourns 3362p		
100kA	3	Right Angle, PC Mount	16mm	
500kA	3	Right Angle, PC Mount, Plastic Shaft	9mm	

This list is for the audio board only. See the v.2 Switching Board oc for the parts needed for the switching system. This effect does use a split-rail power supply so you will need to build the Switching Board with the charge pump.

The TLE2074 is a pretty hi-fi (and expensive) IC used in a lot of VFE pedals. These are almost \$6 a piece. If you are not keen on spending that much you can try other quad-amps as a sub such as TL074 or LM324. I have tested the Triumvirate with both the TLE2074 and TL074. They are pretty comparable on my build.

The 100n cap shown in red in the image on pg.1 should be film, however it spaced for 2.5mm. You should be able to bend a lead on most 5mm spaced box caps to get it to fit in the 2.5mm allotment.

In the Notes section I suggest a mod for the Treble band distortion which replaces R11 with 4k7 and C14 with 470pF. I **strongly urge you to use this mod (or at least socket both components and compare them yourself)**. The 4k7 and 470pF are listed in the Shopping List above.

2.5mm caps, MLCC:

100pF:

<http://www.mouser.com/ProductDetail/KEMET/C320C101J5G5TA?qs=sGAEpiMZZMt3KoXD5rJ2N54QGdmtVhtg63%252bt7NgZMo0%3d>

470pF:

<https://www.mouser.com/ProductDetail/KEMET/C320C471J1G5TA?qs=sGAEpiMZZMt3KoXD5rJ2N%252bwgBI1a522xYgsJjt2GQNY%3d>

1n:

<http://www.mouser.com/ProductDetail/KEMET/C320C102J5G5TA?qs=sGAEpiMZZMt3KoXD5rJ2NyCoF5j9nbtORIOIqJ9L0hY%3d>

100n:

<http://www.mouser.com/Search/ProductDetail.aspx?R=C320C104K5R5TAvirtualkey64600000virtualkey80-C320C104K5R>

TLE2074:

<https://www.mouser.com/ProductDetail/Texas-Instruments/TLE2074CN?qs=sGAEpiMZZMtCHixnSjNA6CumnoLUEIGjtkQTPuP%252bT7A%3d>

Bourns 2k (3362p):

<https://www.mouser.com/ProductDetail/Bourns/3362P-1-202LF?qs=sGAEpiMZZMvygUB3GLcD7sb71EWCGEDbMej%2fZaROi94%3d>

Bourns 5k (3362p):

<http://www.mouser.com/ProductDetail/Bourns/3362P-1-502LF/?qs=sGAEpiMZZMvygUB3GLcD7pXz6c6XAR3tLU32B218z4E%3d>

Bourns 10k (3362p):

<https://www.mouser.com/ProductDetail/Bourns/3362P-1-103LF?qs=sGAEpiMZZMvygUB3GLcD7k%252bod3ZqvEIQboRRPdOKB6M%3d>

Bourns 20k (3362p):

<https://www.mouser.com/ProductDetail/Bourns/3362P-1-203LF/?qs=sGAEpiMZZMvygUB3GLcD7iDNlz%2fNDK0mhkYgCqD12rc%3d>

Bourns 50k (3362p):

<https://www.mouser.com/ProductDetail/Bourns/3362P-1-503LF?qs=sGAEpiMZZMvygUB3GLcD7vRbQqL9uMLMZqtO2Ks3Q%2f4%3d>

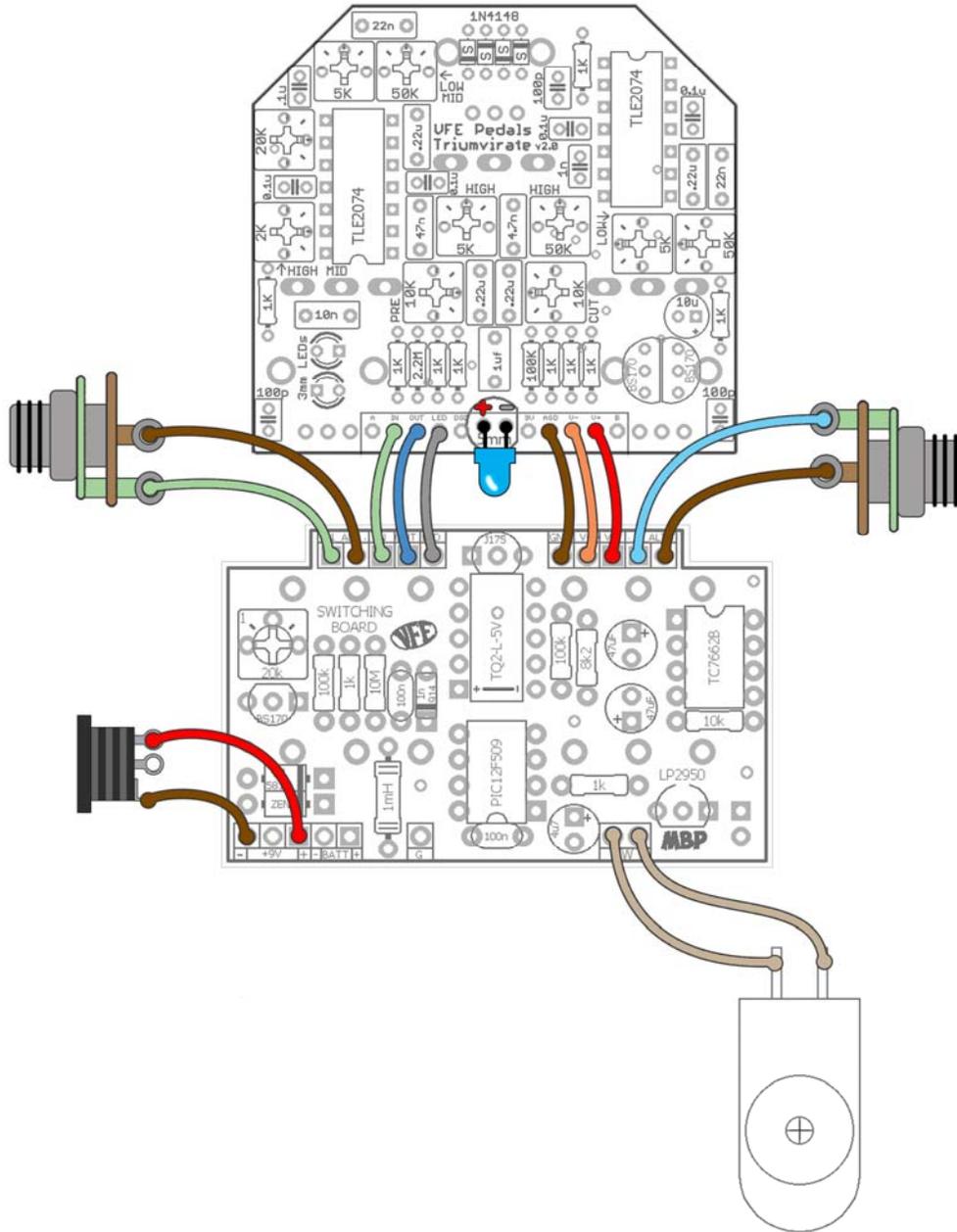
9mm Plastic Shaft, PC Mount (500kA,):

<http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-9mm-right-angle-pc-mount-w-knurled-plastic-shaft/>

16mm Right Angle, PC Mount (100kA):

<http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-right-angle-pc-mount/>

Wiring



For more detailed wiring information and options, please refer to the “v2” Switching Board document.

Note: You can use either wired or PCB mounted jacks. I just happen to draw this diagram with wired jacks.

Overview

(Descriptions from the VFE website)

From the VFE Website: The TRIUMVIRATE is a unique take on a distortion pedal. The guitar signal is first separated into three pathways (lows, mids, and highs) where the range of each is set via internal trimpots. Next, each pathway goes through its own distortion engine, with full control over the amount of gain in each band. Finally, each band is independently mixed together at the end. In short, the Triumvirate is a multi-band distortion, which works great for guitar, bass, synths, even cellos!

Controls

Descriptions from the VFE website: <http://vfepedals.com/triumvirate.html>

Bass, Treble, Mid (100kA): These are the individual volume controls for each distortion band.

Gain (500kA): These are gain control for the individual bands.

Cut (10k): This trimmer allows you to cut high end from the resulting mix of Bass, Treble and Mid distortion.

Pre (10k): This trimmer increases the input gain before the signal is split into the three bands. Turning it down will decrease the amount of distortion you get across all three and takes it more into overdrive territory.

High (5k, 50k): Sets the low/mid cutoff frequency of the treble band. Use it to add more depth, or to really isolate the treble frequencies.

Low Mid (5k, 50k), Hi Mid (2k, 20k): Sets the frequency of the bottom/top of the mid band. Use it to select the range and width of this band.

Low (5k, 50k): Sets the frequency where the mid/treble start to roll off in the bass band. Pull it back to isolate the lower fundamentals.

Notes

Treble band mod:

Based on my personal build, I've found that the Treble side of the circuit can produce some whine and noise if you max out the Treble volume, its gain control and have the PRE trimmer turned way up. For that reason, I suggest you do the following mod: **Replace R11 with 4k7 and C14 with 470pF**. This eliminates the problem at extreme settings. It will reduce the gain/output of the Treble side some but leaves quite a bit on tap. You can also socket both components and try both sets of values for your own comparison.

Bass Mod:

This mod is described in the graphic on the first page. If you are a bass player and want to tune the Triumvirate for bass, use Peter's recommended trimmer values. I have not tested the bass or boost mods he describes.

Hint: It is normal for the red LEDs to light up even when the MID volume control is turned down. Can you guess why?

OMG, how am I supposed to set all these trimmers??

Admittedly, these controls are pretty overkill. From what I've gathered, earlier versions of the Triumvirate had fixed frequency bands to minimize the amount of cross-over in the individual Bass, Treble and Mid bands. I'm sure that Peter realized an opportunity to do something unique in making the frequency ranges tweakable but it was far too complicated to implement them as panel controls. Caution: fiddling with these trimpots is fun, but don't expect dramatic changes with different settings.

Here's the most basic explanation of they work: the High and Low-Mid are 2nd order HP filters that reduce the bass going into the Treble and Mid gain section, resp.. The Low and Hi Mid are second order LP filters that reduce the treble going into the Bass and coming out of the Mid section, resp.

Here is how Peter describes the trimmers on the VFE website:

The signal is split into 3 pathways, and each is fed through a series of filter networks. The cutoff points of these networks is set via 8 internal trimpots - 2 trimpots per filter type. Each trimpot is independent, so it's possible to set any filter network to have multiple cutoff frequencies - let your ears be your guide!

LOW = LOW PASS FILTERS (BASS BAND)

Min: 145Hz, Stock: 290Hz, no upper limit

LOW MID = HIGH PASS FILTERS (MID BAND)

Min: 145Hz, Stock: 290Hz, no upper limit

HIGH MID = LOW PASS FILTERS (MID BAND)

Min: 800Hz, Stock: 1.6kHz, no upper limit

HIGH = HIGH PASS FILTERS (TREBLE BAND)

Min: 680Hz, Stock: 1.35kHz, no upper limit

How does he arrive at these calculations and where does he set the trimmers to achieve them? The second part is easy – he set them at about the midpoint in each case for the “stock” frequencies. Figuring out the first part takes some simple math. Let's look at just the Treble filters for an example.

There are two high pass filters in series. Why two? Because this creates a deeper attenuation before the gain stage and forces the cross-over to be more narrow between the three overlapping frequency bands. In order to calculate the roll-off frequency of a single HP filter we use the following formula: $f = 1/(2*\pi*R*C)$. The units we use here are uF for the caps and M-ohm for the resistors.

So, for the first HP filter we have a 47n cap followed by a 5k variable resistor to ground. When we set that trimmer to its halfway point, the value is 2.5k and our calculation works out like this:

$f = 1/(6.28*.047*.0025) = 1355 \text{ Hz}$. Pretty much on the money!

The second HP filter has a 4n7 cap followed by a 50k variable resistor to ground. Why are they different than the first? Because caps placed in series yield a summed value which is calculated by the following: $1/C = 1/C1 + 1/C2$. So, for a 47n and 4n7 cap in series we have:

$1/C = 1/47 + 1/4.7$, and $C = 4.27\text{nF}$. So, our result is about 4.3nF when these two caps are in series. Therefore, we calculate the second HP filter like this:

$f = 1/(6.28*.0043*.025) = 1481 \text{ Hz}$. Not exactly the same as the first filter, but pretty close for rock and roll. Turning the 50k trimmer just slightly to the right of midpoint would line the two values up even more closely.

Calculations for the rest of the filters is similar to the above. You use the same formulas for both HP and LP filters.

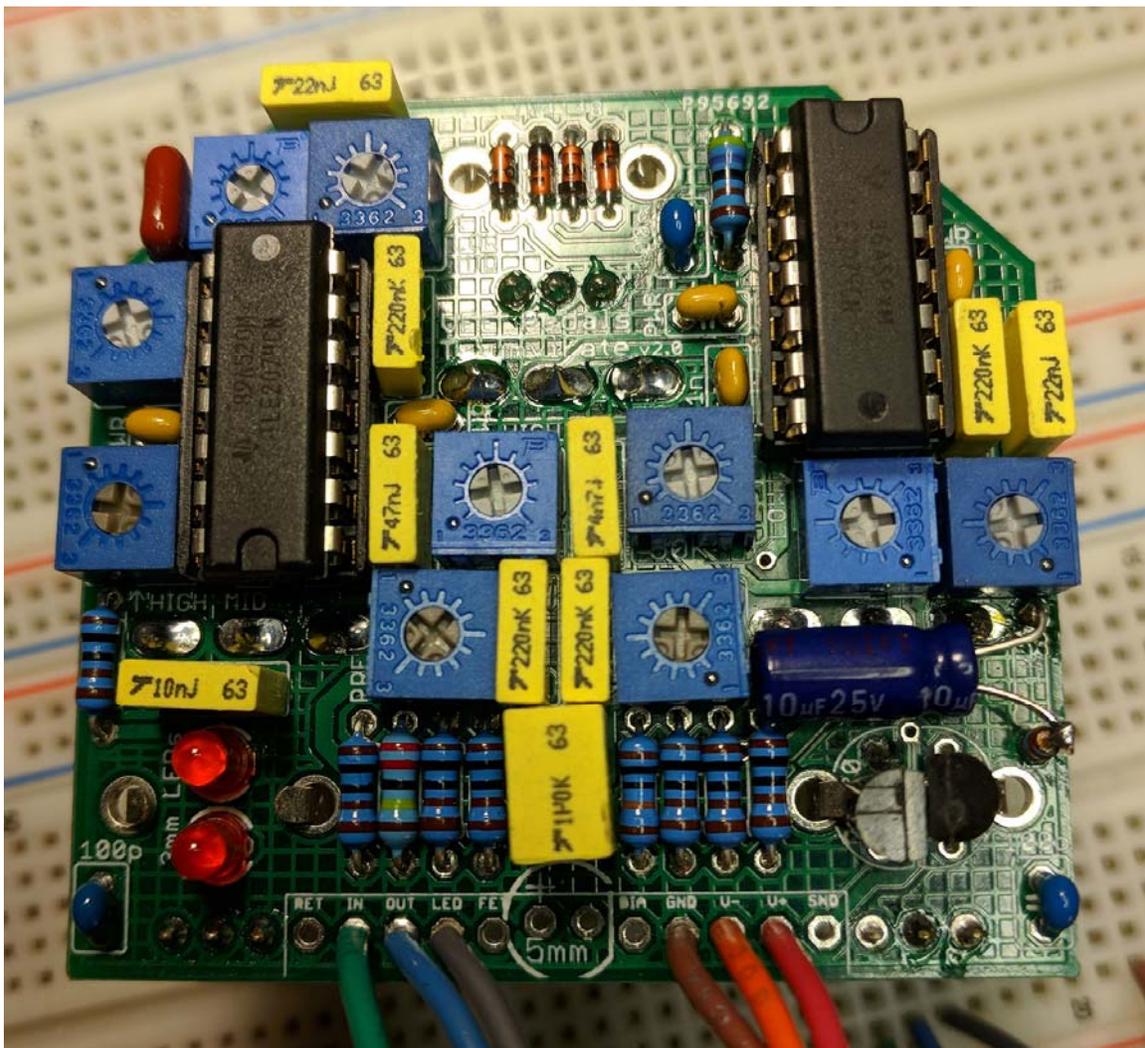
Understanding and being able to calculate roll-off frequencies is a fundamental part of circuit design and I suggest you try using it as often as possible. If you are put off by doing the Algebra, have no fear. You can download the Excel workbook I use to do these calculations. Simply plug in the numbers and get the result quickly! You can get it here:

<http://www.madbeanpedals.com/forum/index.php?topic=18884.msg255373#msg255373>

Example of the filter calculation above in the Excel file:

LP/HP Filter (Hz)		
C1 (uF)	R1 (M-ohm)	Freq
0.047	0.0025	1,355.20
0.0043	0.025	1,481.26

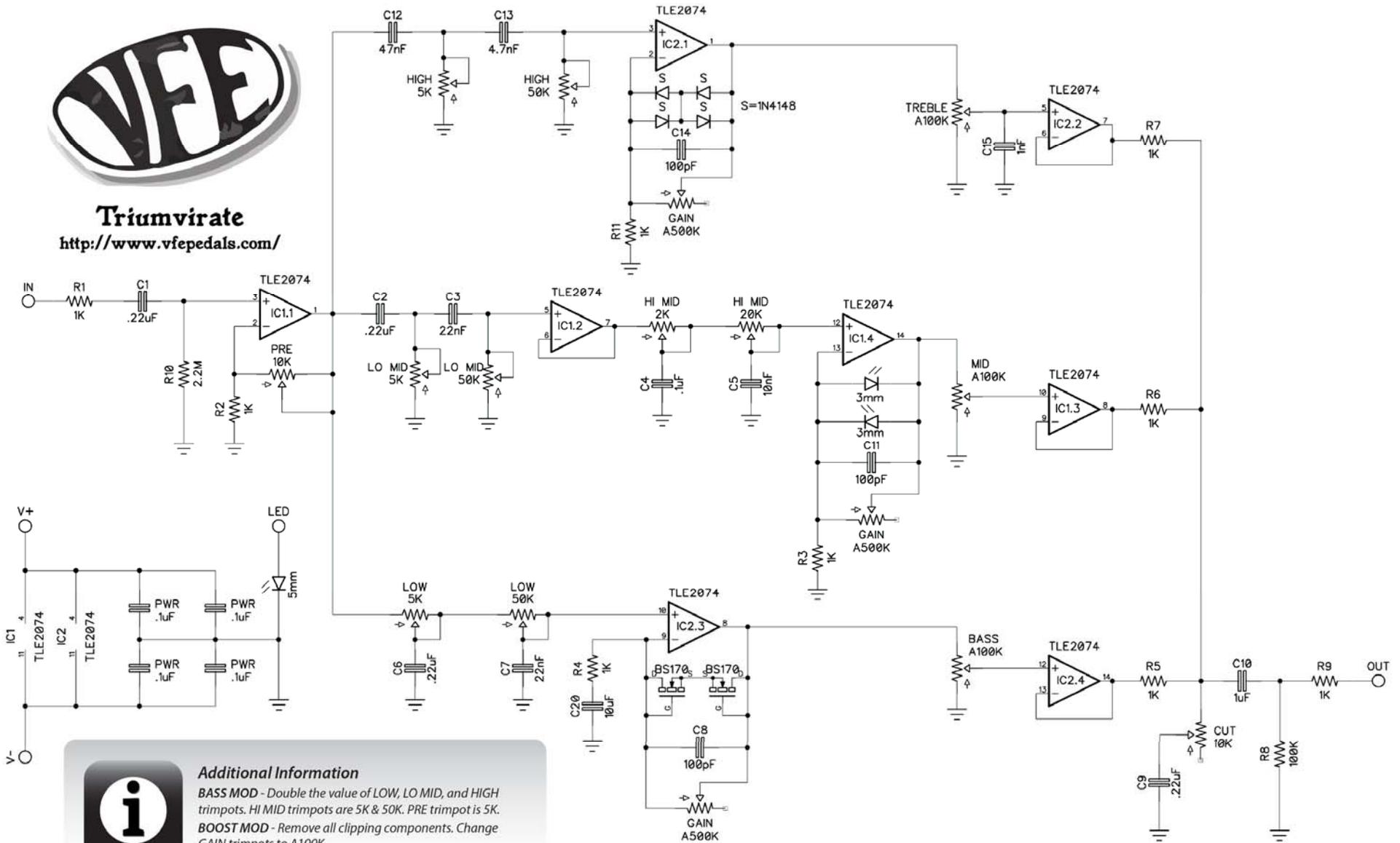
One final note on the trimmers: none of them have a “stopper resistor” meaning there is no fixed resistance to ground between each trimmer. This means if you turn the high-pass trimmers fully counter-clockwise, the signal will get grounded and no stank riffs will ensue. A more ideal design would have them, but there is also a serious footprint limitation with this being a 1590B size effect. Another thought: a different approach to this design could have use fixed LC filters. Using inductors instead of resistors gives you 2nd order filters with half the parts (one cap, one inductor). However, those would not be adjustable like the Triumvirate.





Triumvirate

<http://www.vfepedals.com/>



Additional Information

BASS MOD - Double the value of LOW, LO MID, and HIGH trimpots. HI MID trimpots are 5K & 50K. PRE trimpot is 5K.
BOOST MOD - Remove all clipping components. Change GAIN trimpots to A100K.