COLLOSALUS2022

FX TYPE: Flanger
Based on the MXR® 117™
Enclosure Size: 1590BB
“Softie” compatibility: none

Overview

The Collosalus first arrived in 2014. It was based on the work done on DIYSB to convert the vintage SAD1024 MXR 117 to the MN3007 BBD. The project had a great run, was popular and then was discontinued around 2018 for some reason I cannot remember (I think because I had planned on doing a bunch of new flangers at the time). Coming back to it in 2022, I decided to do a total redesign of the project and schematic redraw to make it more legible and to make a better, cleaner build.

The 2022 version does not have a charge pump from the previous version and operates on a standard 18v 100mA power supply instead. This was to address issues with noise when using a charge pump powered by 9v supply. Some builders had no problems with 9v, while others had better results using 12v with the on-board charge pump. Making the default power 18v seems the best way to eliminate any potential noise issues. However, I will provide instructions on using a charge pump if you want to test this yourself. I did test the 2022 version with a 9v powered charge pump and it seemed to work okay. So, that option is there if 9v is a must for you.

The PCB has also been converted to a 4-layer layout. This helps reduce noise and greatly improves the signal routing between audio, power, clock and LFO.

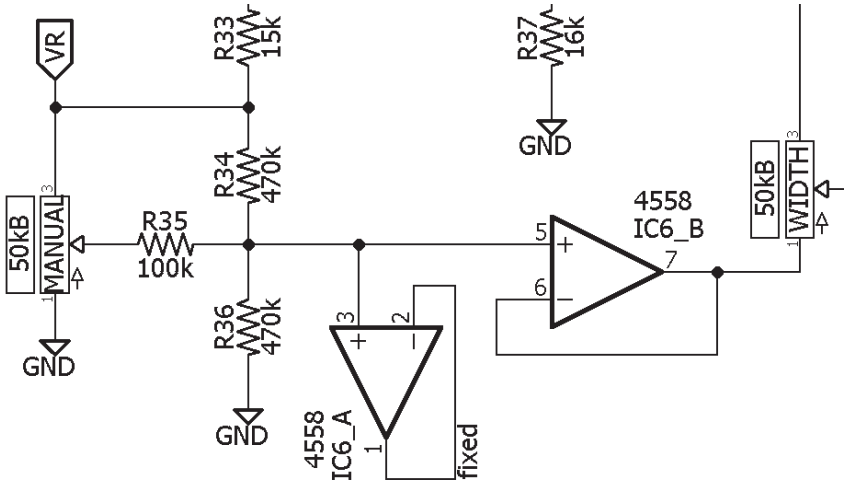
Controls

- **RATE -** Modulation (flanger) speed.
- **WIDTH -** Depth control.
- **MANUAL -** Creates fixed resonant peaks at different frequencies as it is turned up and with WIDTH CCW. It will interact with WIDTH until that control is turned above 1/2 up or so.
- **REGEN -** Flanger feedback control.
- **BIAS -** This trimmer is used to fix the bias input of the MN3007 for cleanest delayed signal (see notes).
- **LVL -** This trimmer is set in tandem with the REGEN control to prevent oscillation (see notes).
- **CLOCK -** This trimmer is used to set the clock range for the BBD (see notes).

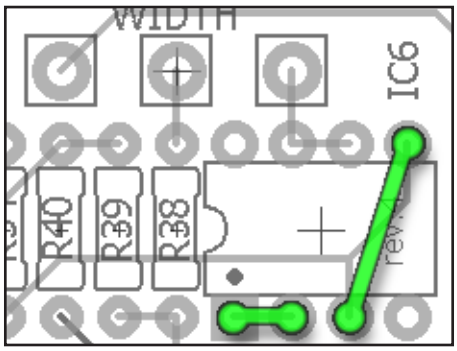
04.02.23 Update - The board has been updated to rev.4. Please see page2 of this doc.

Technical assistance for your build(s) is available via the madbeanpedals forum. Please go there rather than emailing me for assistance on builds. This is because (1) I’m not always available to respond via email in a timely and continuous manner, and (2) posting technical problems and solutions in the forum creates a record from which other members may benefit.

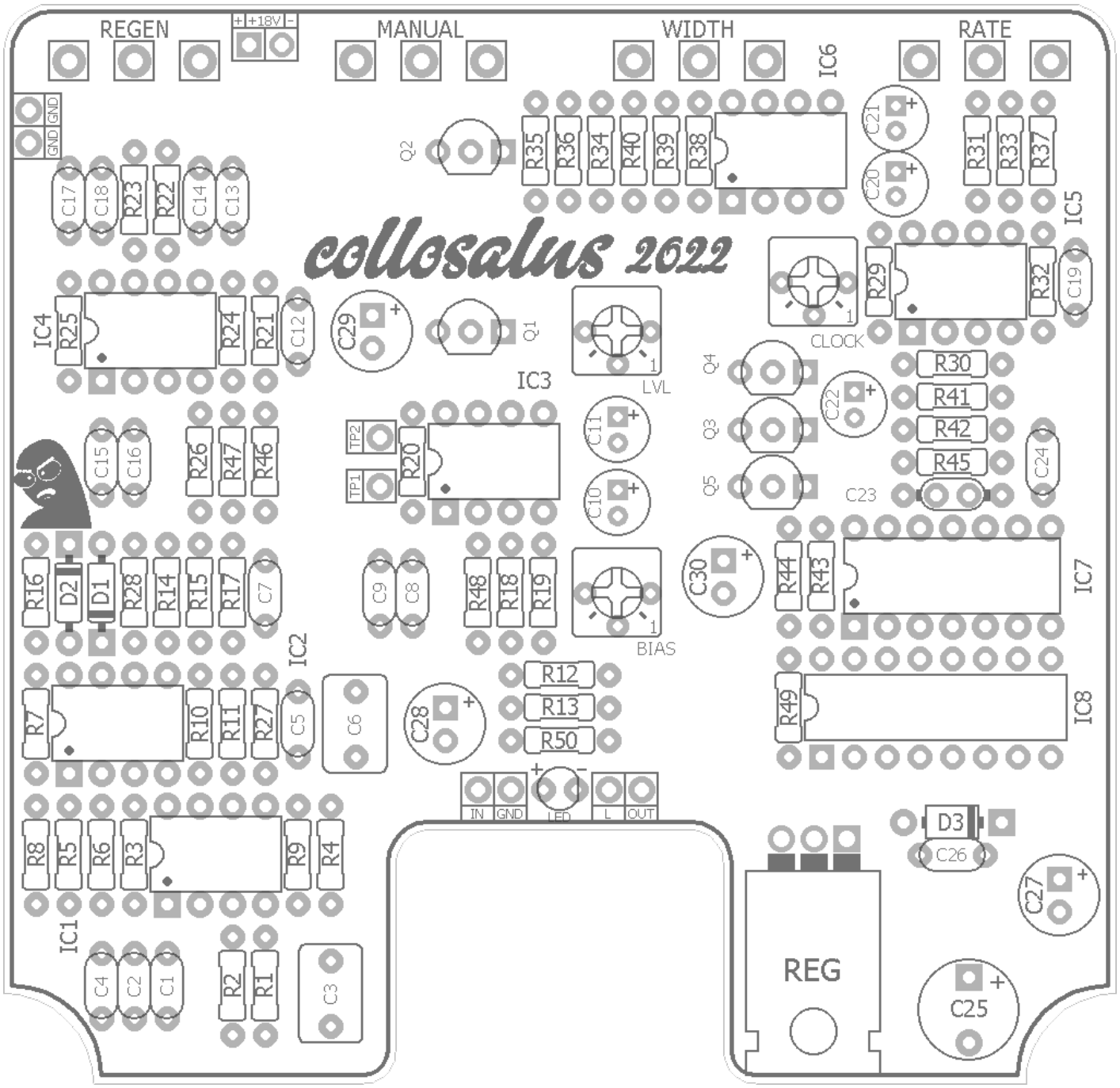
The rev.4 update includes a fix to the PCB (rev.3 of the PCB was the original release so this is the first update). When I partially re-drew the schematic for this version of the Collosalus, I left one half of IC6 floating. This is not good practice as it can cause problems with latch-up in some cases. Although I did not experience any issues with the error in my build, and I have not seen anyone report a problem thus far I went ahead and made the correction just to be safe. Here is the corrected portion of the schematic:

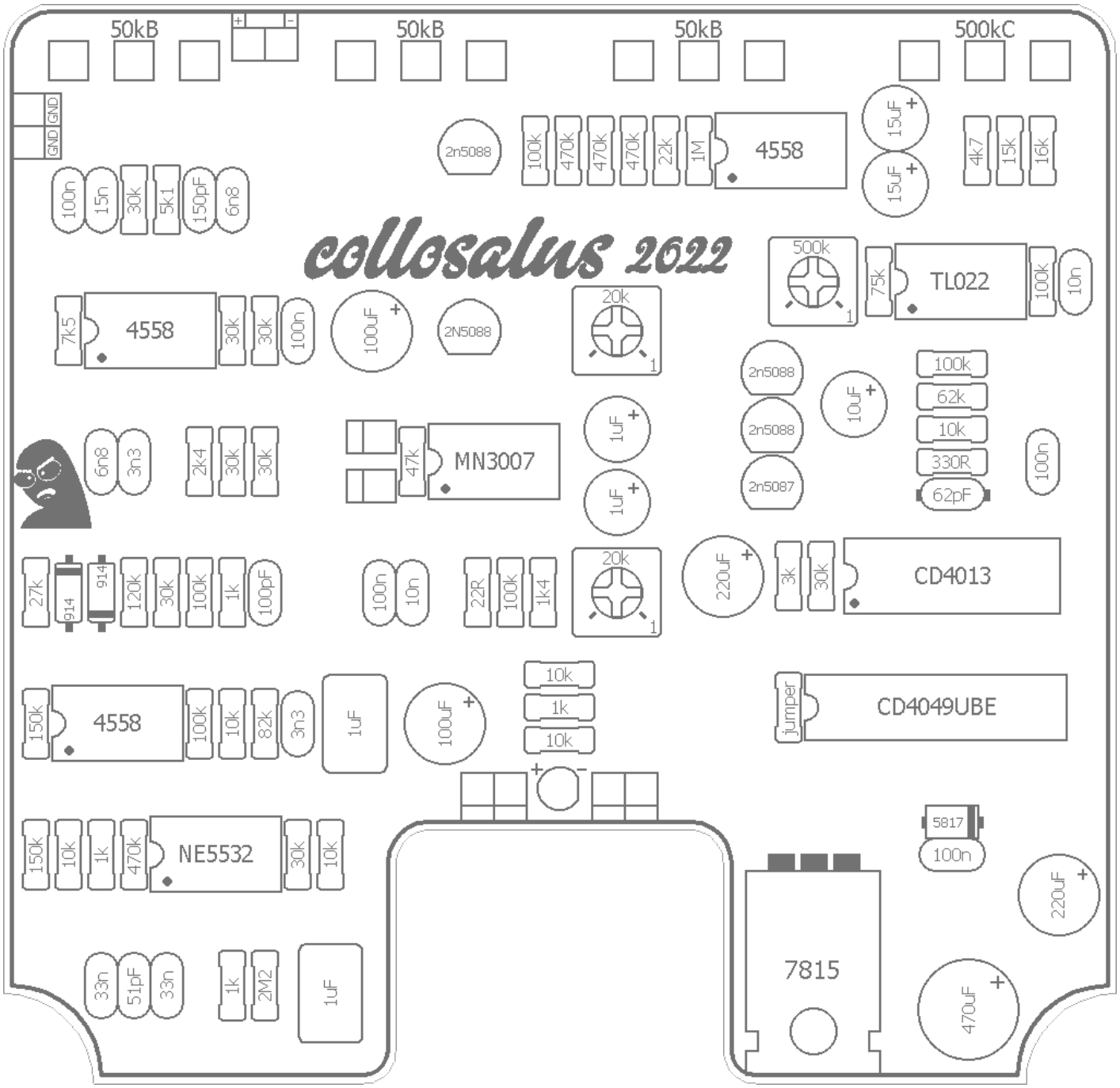


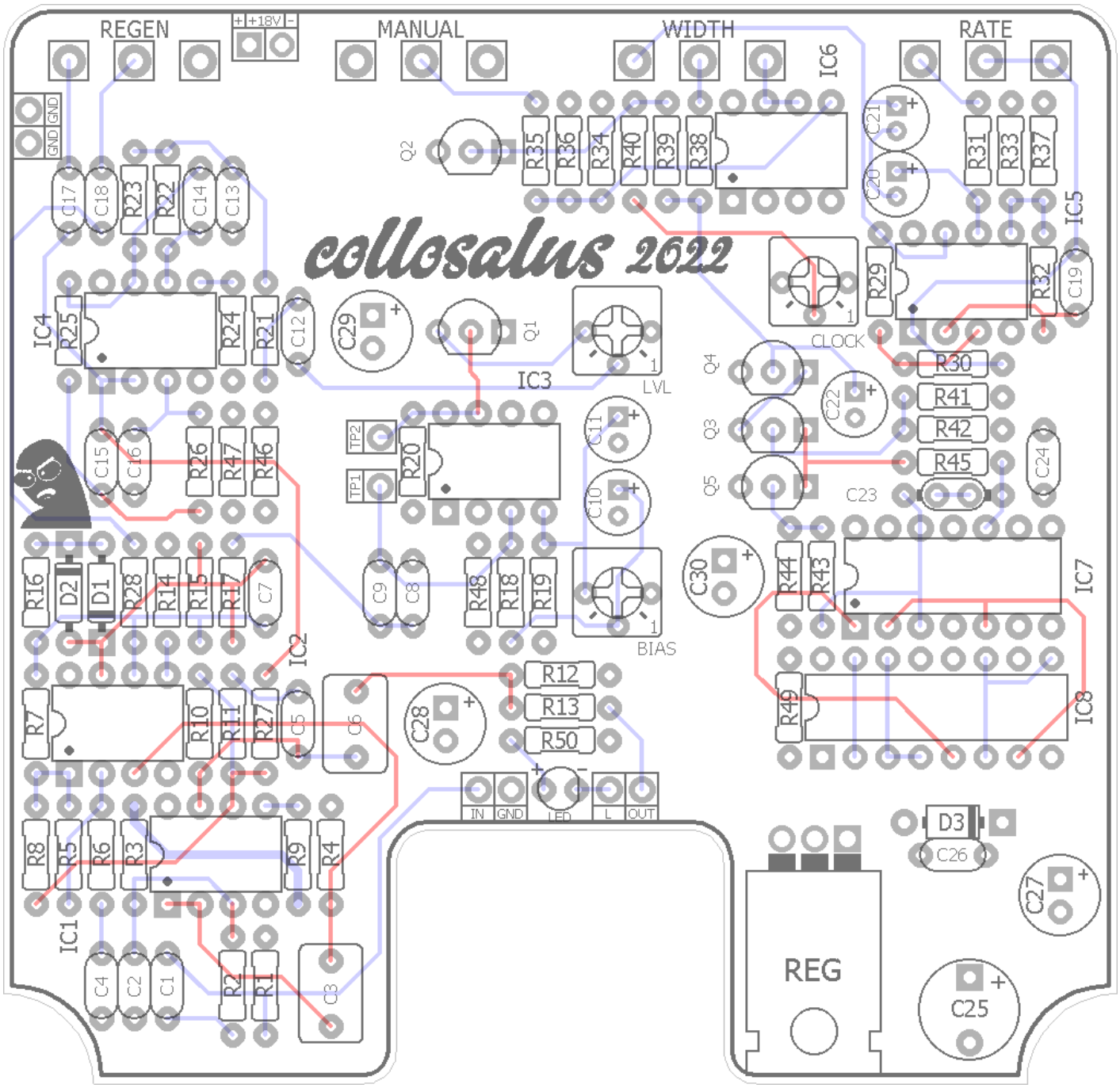
If you had the version previous to rev.4 and want to implement the correction it's very easy to do. Simply solder in a jumper from pin5 to pin3, and then solder another jumper from pin2 to pin1, all on IC6. Do this on the bottom of the PCB.



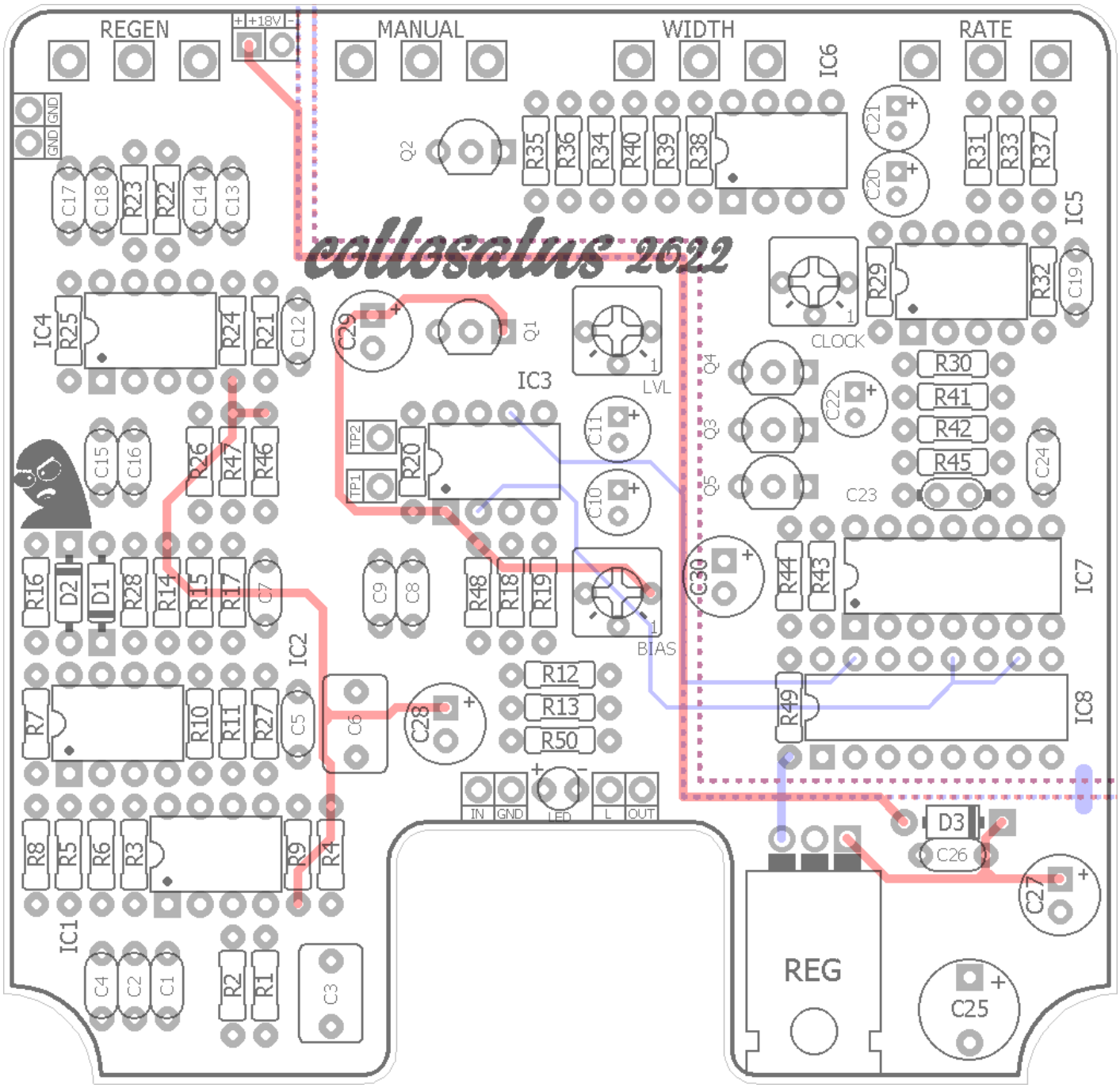
Rev.4 is labeled as such on the silk screen @ IC6. If you do not see this label, you have the previous version.


REGEN
+18V
MANUAL
WIDTH
RATE
IC6
IC5
IC4
IC3
IC2
IC1
IC7
IC8
collosalus 2022
CLOCK
LVL
BIAS
REG
IN
GND
LED
L
OUT


50kB
50kB
50kB
500kC
GND
GND
2n5088
100k
470k
470k
470k
22k
1M
4558
15uF
15uF
4k7
15k
16k
100n
15n
30k
5k1
150pF
6n8
collosalus 2022
500k
75k
TL022
100k
10n
7k5
4558
30k
30k
100n
100uF
2N5088
20k
2n5088
2n5088
2n5087
10uF
100k
62k
10k
330R
62pF
100n
6n8
3n3
2k4
30k
30k
47k
MN3007
1uF
1uF
27k
914
914
120k
30k
100k
1k
100pF
100n
10n
22R
100k
1k4
20k
220uF
3k
30k
CD4013
150k
4558
100k
10k
82k
3n3
1uF
100uF
10k
1k
10k
jumper
CD4049UBE
150k
10k
1k
470k
NE5532
30k
10k
5817
100n
220uF
33n
51pF
33n
1k
2M2
1uF
7815
470uF



Audio/LFO traces - top and bottom layers



Power/Clock traces - inner layers

Resistors		Resistors		Caps		Diodes	
R1	2M2	R31	4k7	C1	33n	D1	1n914
R2	1k	R32	100k	C2	51pF	D2	1n914
R3	470k	R33	15k	C3	1uF	D3	1n5817
R4	10k	R34	470k	C4	33n	Transistors	
R5	10k	R35	100k	C5	3n3	Q1	2N5088
R6	1k	R36	470k	C6	1uF	Q2	2n5088
R7	150k	R37	16k	C7	100pF	Q3	2n5088
R8	150k	R38	1M	C8	10n	Q4	2n5088
R9	30k	R39	22k	C9	100n	Q5	2n5087
R10	100k	R40	470k	C10	1uF	Regulators	
R11	10k	R41	62k	C11	1uF	REG	LM7815
R12	10k	R42	10k	C12	100n	ICs	
R13	1k	R43	30k	C13	6n8	IC1	NE5532
R14	30k	R44	3k	C14	150pF	IC2	4558
R15	100k	R45	330R	C15	6n8	IC3	MN3007
R16	27k	R46	30k	C16	3n3	IC4	4558
R17	1k	R47	30k	C17	100n	IC5	TL022
R18	100k	R48	22R	C18	15n	IC6	4558
R19	1k4	R49	jumper	C19	10n	IC7	CD4013
R20	47k	R50	10k	C20	15uF	IC8	CD4049U
R21	30k			C21	15uF	Trimmers	
R22	5k1			C22	10uF	BIAS	20k
R23	30k			C23	62pF	CLOCK	500k
R24	30k			C24	100n	LVL	20k
R25	7k5			C25	470uF	Pots	
R26	2k4			C26	100n	MANUAL	50kB
R27	82k			C27	220uF	REGEN	50kB
R28	120k			C28	100uF	WIDTH	50kB
R29	75k			C29	100uF	RATE	500kC
R30	100k			C30	220uF		

Value	QTY	Type	Rating
22R	1	Metal / Carbon Film	1/4W
330R	1	Metal / Carbon Film	1/4W
1k	4	Metal / Carbon Film	1/4W
1k4	1	Metal / Carbon Film	1/4W
2k4	1	Metal / Carbon Film	1/4W
3k	1	Metal / Carbon Film	1/4W
4k7	1	Metal / Carbon Film	1/4W
5k1	1	Metal / Carbon Film	1/4W
7k5	1	Metal / Carbon Film	1/4W
10k	6	Metal / Carbon Film	1/4W
15k	1	Metal / Carbon Film	1/4W
16k	1	Metal / Carbon Film	1/4W
22k	1	Metal / Carbon Film	1/4W
27k	1	Metal / Carbon Film	1/4W
30k	8	Metal / Carbon Film	1/4W
47k	1	Metal / Carbon Film	1/4W
62k	1	Metal / Carbon Film	1/4W
75k	1	Metal / Carbon Film	1/4W
82k	1	Metal / Carbon Film	1/4W
100k	6	Metal / Carbon Film	1/4W
120k	1	Metal / Carbon Film	1/4W
150k	2	Metal / Carbon Film	1/4W
470k	4	Metal / Carbon Film	1/4W
1M	1	Metal / Carbon Film	1/4W
2M2	1	Metal / Carbon Film	1/4W
51pF	1	Ceramic / MLCC	25v min.
62pF	1	Ceramic / MLCC	25v min.
100pF	1	Ceramic / MLCC	25v min.
150pF	1	Ceramic / MLCC	25v min.
3n3	2	Film	25v min.
6n8	2	Film	25v min.
10n	2	Film	25v min.
15n	1	Film	25v min.
33n	2	Film	25v min.
100n	5	Film	25v min.
1uF	2	Film	25v min.

Value	QTY	Type	Rating
1uF	2	Electrolytic	25v
10uF	1	Electrolytic	25v
15uF	2	Electrolytic	25v
100uF	2	Electrolytic	25v
220uF	2	Electrolytic	25v
470uF	1	Electrolytic	25v
1n914	2		
1n5817	1		
2n5088	4		
2n5087	1		
LM7815	1		
NE5532	1		
4558	3		
MN3007	1		
TL022	1	or, LM1458	
CD4013	1		
CD4049	1	UBE - unbuffered version	
20k	2	Bourns 3362p	
500k	1	Bourns 3362p	
50kB	3	PCB Right Angle	16mm
500kC	1	PCB Right Angle	16mm

LM7815:
https://smallbear-electronics.mybigcommerce.com/ic-lm7815ct/
Sub - L7815: https://www.mouser.com/ProductDetail/511-L7815CV

MN3007:
https://smallbear-electronics.mybigcommerce.com/ic-mn3007-xvive-audio-re-makes/

NE5532:
https://smallbear-electronics.mybigcommerce.com/ic-ne5532p/
https://www.taydaelectronics.com/ne5532-5532-ic-dual-low-noise-op-amp.html
https://stompboxparts.com/semiconductors/ne5532p-dual-op-amp-ic/

TL022:
https://www.mouser.com/ProductDetail/595-TL022CP
https://www.taydaelectronics.com/tl022cp-tl022-operational-amplifier-ic.html
https://stompboxparts.com/semiconductors/tl022cp-dual-op-amp-ic/

LM1458:
https://stompboxparts.com/semiconductors/lm1458n-dual-op-amp-ic/
https://www.mouser.com/ProductDetail/595-MC1458P
https://smallbear-electronics.mybigcommerce.com/ic-mc1458p-ti/

CD4013:
https://www.mouser.com/ProductDetail/595-CD4013BE
https://smallbear-electronics.mybigcommerce.com/ic-cd4013/
https://stompboxparts.com/semiconductors/cd4013be-dual-flip-flop-ic/
https://www.taydaelectronics.com/cd4013-4013-ic-cmos-dual-d-flip-flop.html

CD4049UBE:
https://www.mouser.com/ProductDetail/595-CD4049UBE
https://smallbear-electronics.mybigcommerce.com/ic-cd4049ube/
https://stompboxparts.com/semiconductors/cd4049ube-hex-inverting-buffer-converter-ic/
https://www.taydaelectronics.com/cd4049ube-cd4049-4049-ic-hex-buffer-converters.html

20k trimmer:
https://www.mouser.com/ProductDetail/652-3362P-1-203LF
https://www.taydaelectronics.com/potentiometer-variable-resistors/cermet-potentiometers/3362p/20k-ohm-trimmer-potentiometer-cermet-1-turn-3362p.html

500k Trimmer:
https://www.mouser.com/ProductDetail/652-3362P-1-504LF
https://www.taydaelectronics.com/potentiometer-variable-resistors/cermet-potentiometers/3362p/50k-ohm-trimmer-potentiometer-cermet-1-turn-3362p.html

16mm pots:
https://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-right-angle-pc-mount/
https://stompboxparts.com/pots/16mm-potentiometer-short-pcb-leg/
https://lovemyswitches.com/16mm-potentiometers-1-4-smooth-shaft-right-angle-pcb-mount/

DC Jacks:
https://smallbear-electronics.mybigcommerce.com/2-1-mm-all-plastic-round/
https://stompboxparts.com/power-connections/dc-power-jack-2-1mm-low-profile/
https://lovemyswitches.com/thinline-lumberg-dc-power-jack-2-1mm/

1/4” jacks:
https://smallbear-electronics.mybigcommerce.com/1-4-in-mono-nys229/
https://smallbear-electronics.mybigcommerce.com/1-4-in-mono-switchcraft-11/
https://lovemyswitches.com/1-4-mono-jack-lumberg-klbm-3/
https://lovemyswitches.com/1-4-mono-jack-neutrik-rean-nys229/

My preferred 3PDT switch:
https://lovemyswitches.com/pro-3pdt-latched-foot-switch-solder-lugs-feather-soft-click/

- You can use either TL022 or LM1458 for IC5 (LFO). I do not recommend the TL062 or the 4558 (they do not preform as well as the other two). I personally prefer the LM1458 so that's my recommendation.

- R49 should be jumpered on the PCB. I added this in the hopes it might reduce any potential thumping/ clicking from the LFO. While this is often the case for many LFO driven circuits, in this one it has the opposite effect: it made the LFO preform much worse and created a thump. It just goes to show there is never a "one solution fits all" when it comes to guitar pedals.

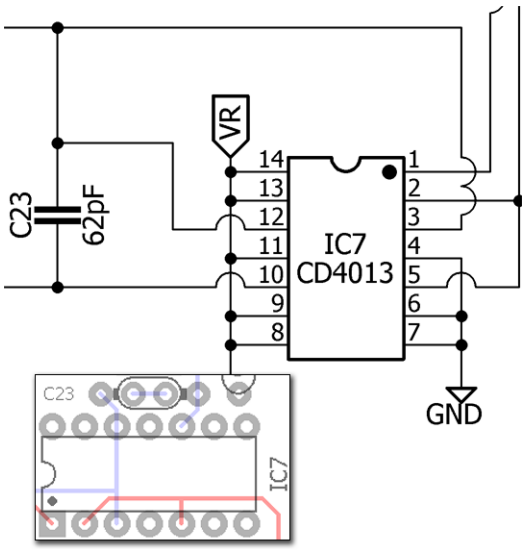
- The regulator does not absolutely have to be an LM7815/L7815 TO-220. The current draw is low enough that an LM78L15 TO-92 style regulator should work. But, I recommend sticking with the former. The cost difference is negligible and there's plenty of space on the layout for the larger one. Note that the TO-92 LM78L15 has the opposite pinout as the one used in the build.

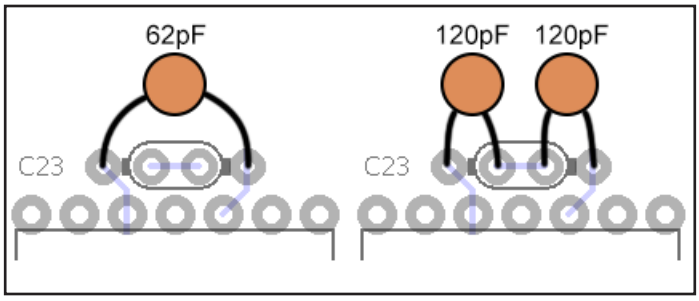
- I decided to do a different wiring and I/O setup for this build. It's less tidy than my normal template. The reason is to keep all the audio wiring as far away from the LFO as possible. Take a look at my build at the end of the doc to see how I placed the wiring in the enclosure. I have zero noise/thumping in my build. If you replicate what I did then neither should you.

- As far as testing the build before calibration, I recommend taking a methodical approach. When I build very complicated circuits I don't rush right to testing them on my prototyping rig. Instead, I work through the testing in stages. The first step is to leave ALL ICs off and power up. Next verify that each IC socket is receiving the correct DC. For example, IC1, 2, 4, 5 pin8 on each socket reads about 15v. IC3 pin1 is slightly less than 15v (VD on the schematic). You get the idea. Then power down, and load the audio ICs (except for the MN3007) and power back up. So, that would be IC1, 2, and 4. Check pin8 again on each and verify you have about the same reading as before. It might go down very slightly with the load, but not too far. If the supply voltage goes way down then you have a problem like a bad chip or maybe something else. So long as everything checks out, you can power down and load more or all ICs, then check the DC supply again. It takes longer to describe than to actually do and removes a lot of guesswork if there is a problem.

Calibration

- Before we start, take a look at how I have C23 set up. This is the clocking cap for the CD4013. That cap is listed as 62pF but quite possibly the final value was dialed in somewhat on the vintage units. 62pF may not be optimal for our build, and it's certainly not a typical value, so I have provided a little more control on the Collosalus PCB.





We have two ways to populate C23: 1) use a single 62pF cap spread across the four pads for C23, or 2) use two 120pF caps in series to approximate the 62pF value. And, if we need some different value cap to get the optimal clock range, we could do the same for the new value should it fall in between conventional ones (for example, on my 2015 version build I used a single 47pF with no issue). Will it be necessary? Probably not, but the option is there. I recommend socketing all four pads of the C23 footprint and just stick in a 62pF or two 120pF to begin the calibration procedure.

For reference, the 117 is reported to have a clock range of about 30-50kHz min to around 1MHz max. Decreasing the value of C23 will push clock range further up the scale. Using the Biasing procedure below I dialed my build in by ear then measured the clock range using the slowest Rate setting. I measured the range of my build from about 24kHz to 600kHz. So, it's lower than expected but still sounded great to me. I may go back and try a smaller value cap for C23 at some point, though.

You can find some helpful info in these threads:
https://www.diystompboxes.com/smfforum/index.php?topic=93223.0
https://www.diystompboxes.com/smfforum/index.php?topic=78741.0

Biasing

Set Manual fully counter-clockwise, Width and Regen about ½ up, and Sweep about ¼ up.

Set the CLOCK and LVL trimmers ½ up and the BIAS full CCW.

Apply power to the effect.

Using an audio probe, check TP1 on the Collosalus PCB to verify that you signal at the input of IC3 (pin 3). If you have no audio, then you need to work backwards through the PCB using the schematic as reference to determine where you have lost signal. Debug as necessary.

Now audio probe TP2 on the PCB. This is the output of the IC3 (pins 7 and 8).

Adjust the BIAS trimmer clockwise until you hear output on TP2. Leave the BIAS trimmer at the position that produces the cleanest output signal possible. You should hear some flanging effect at this point.

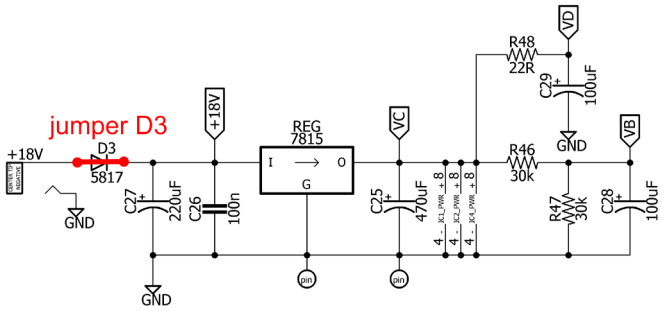
Now adjust the CLOCK trimmer left and right. In the left-most position, the bottom of the flanger sweep will tend to flatten out at the most extreme. As you turn the trimmer up, the range of the sweep will decrease and become more shallow. Set this trimmer at the position where you have the most depth and about equal amounts of rise and fall in the flanger sweep. I found this to be about ¼ up on the trimmer. You can alter the RATE control to check how the flanger responds at different speeds and adjust the CLOCK trim accordingly.

Set the Regen fully clockwise. Now adjust the FDBK trimmer to increase the maximum amount of feedback you can achieve before it begins to self-oscillate. You will hear this as a loud "sproing" at the bottom of the flanger's sweep. Back off the trimmer from this position until the "sproing" goes away.

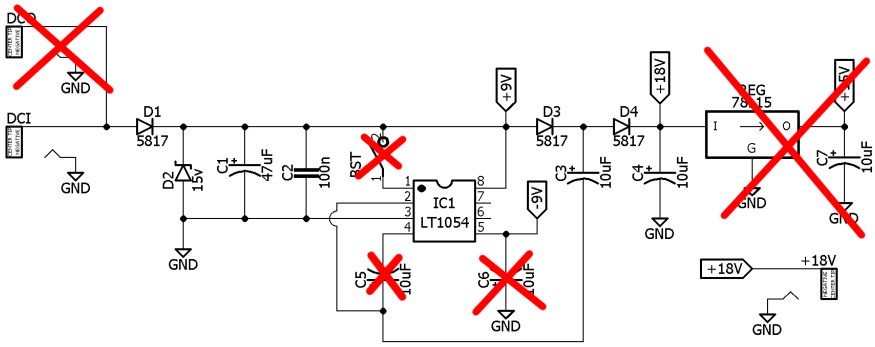
As I said in the introduction, the previous version of the Collosalus ran off a charge pump with a 9v power supply, but it ended up requiring 12v to ensure the flanger was noise-free. The 2022 version was designed without a charge pump and is intended to run on 18v.

I have tested the 2022 version with a charge pump running on 9v and I was able to get good results with it on my testing/prototyping rig. So, you are welcome to try this yourself. I cannot guarantee optimal results. The safest bet for optimal (noise free) results is simply to use an 18v power supply.

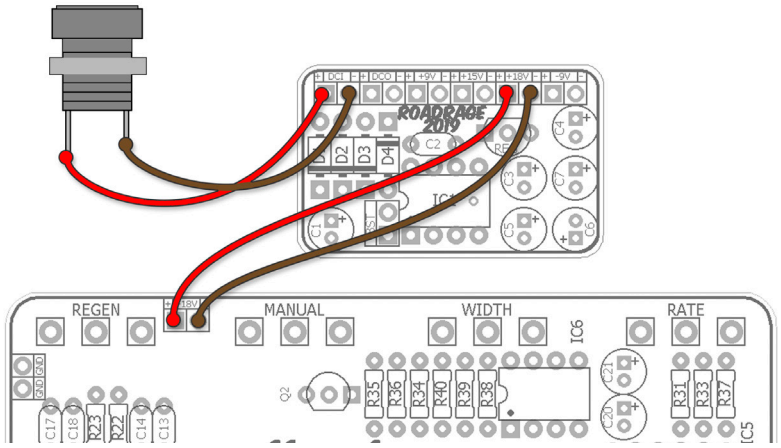
If you want to test yourself, here's how to do it with the mbp Road Rage utility PCB.



The Collosalus PCB is built stock with the exception of D3 which is replaced with a jumper.

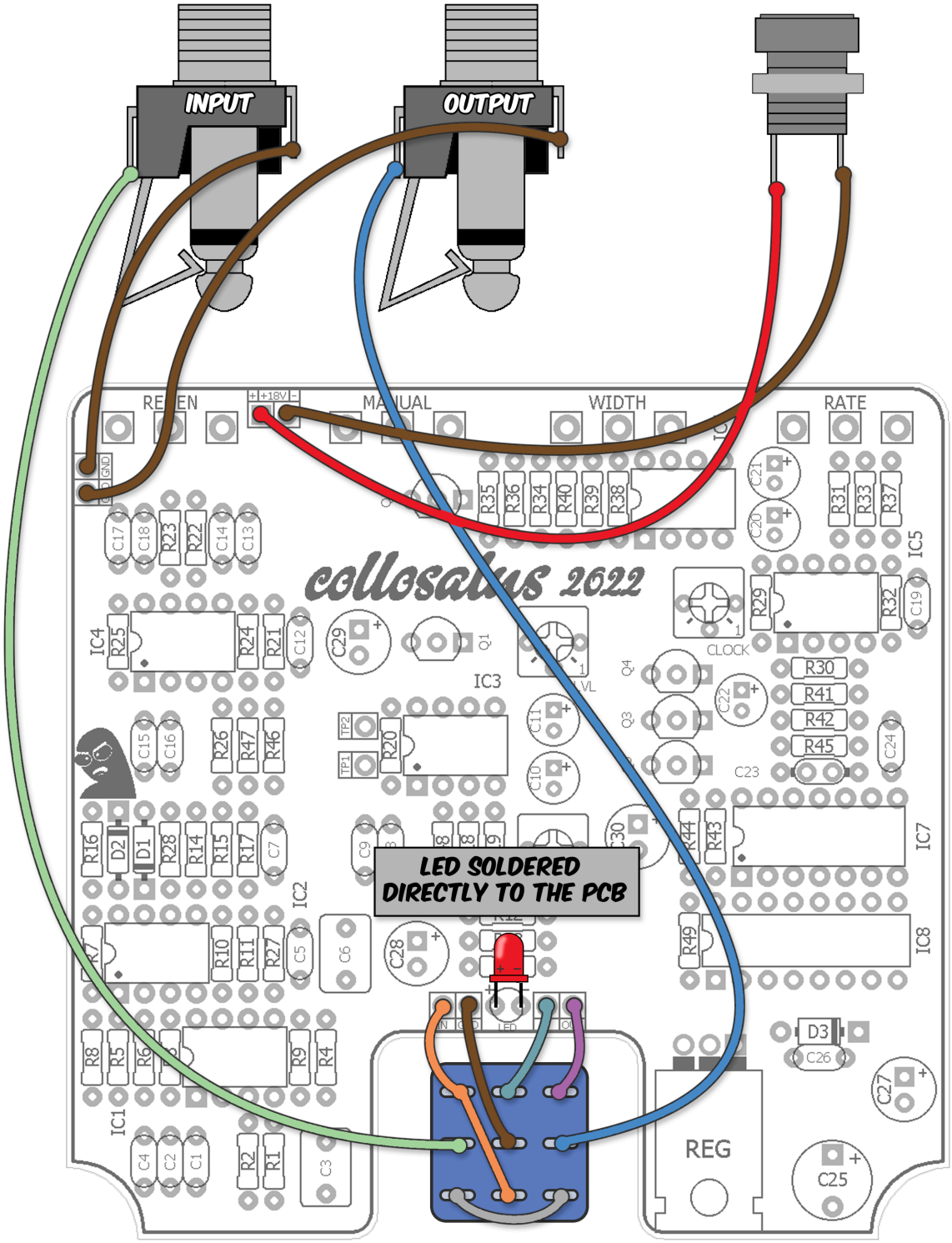


Populate the RoadRage using the above schematic. *Omit* everything that is crossed out. Use an LT1054.

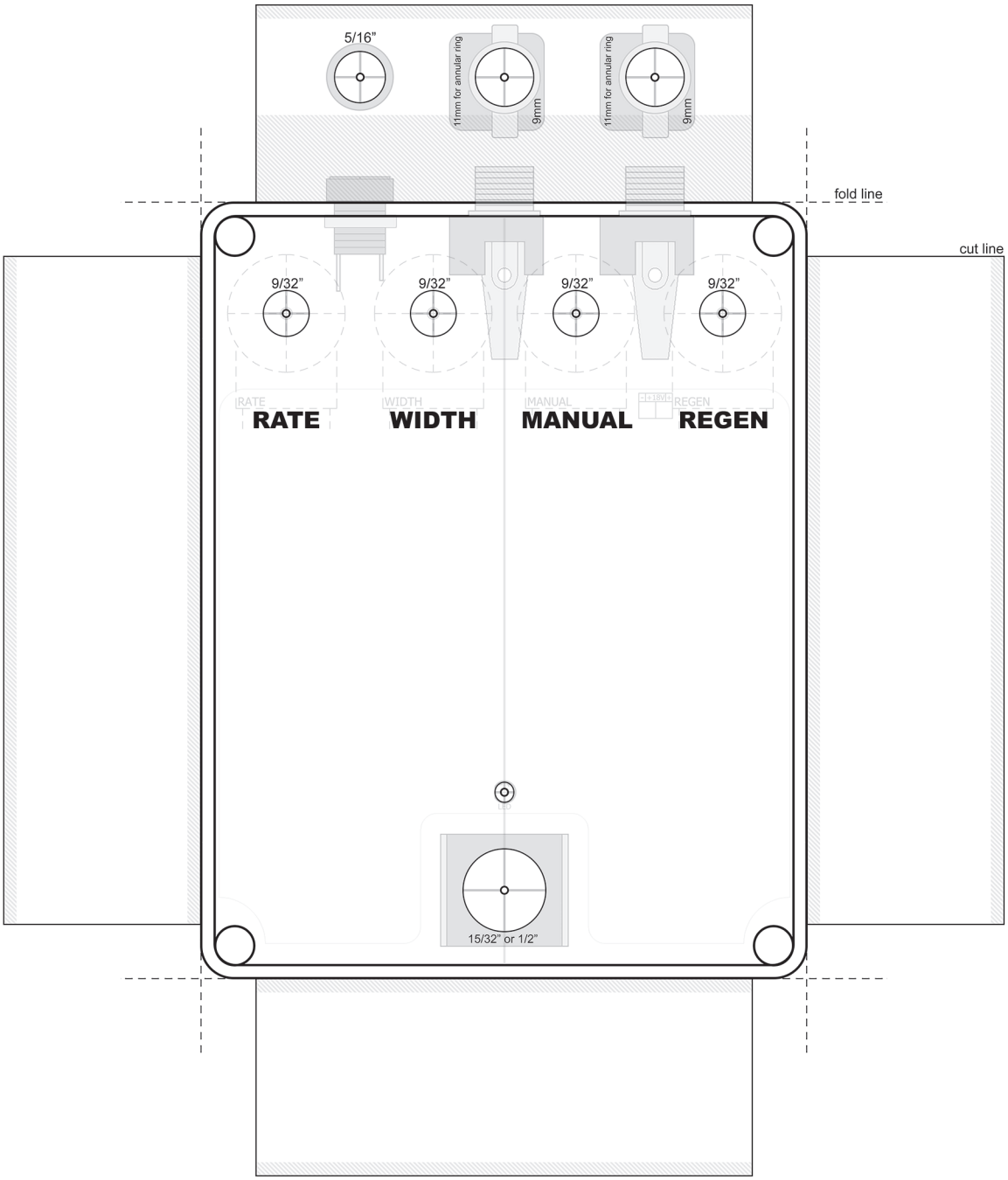


Wire the DC jack to the RoadRage PCB. Wire the RoadRage to the Collosalus using the 18v connections.

As far as placement in a 1590BB enclosure, you may be able to put the RoadRage on top of Rate and Width pots. Or, use longer wires and put it by the 3PDT switch at the bottom.


INPUT
OUTPUT
RATE
WIDTH
collosalus 2022
LED SOLDERED DIRECTLY TO THE PCB
REG
CLOCK

Note: *Drill Guides are approximate and may require tweaking depending on the types of jacks, switches and pots you use.*



I chose this format for the top I/O in order to keep the input and output as far away from the LFO as possible.

IC1	NE5532
1	6.99
2	6.99
3	6.7
4	0
5	7.58
6	7.58
7	7.64
8	15.28

IC2	4558
1	7.62
2	7.62
3	7.61
4	0
5	7.58
6	7.62
7	7.39
8	15.28

IC3	MN3007
1	15.25
2	7.64
3	8.5
4	1.05
5	0
6	7.64
7	7.6
8	7.6

IC4	4558
1	7.61
2	7.61
3	7.6
4	0
5	7.59
6	7.62
7	7.62
8	15.28

IC5	LM1458
1	varies
2	~7.8
3	varies
4	0
5	~7.8
6	~7.8
7	varies
8	15.28

IC6	4558
1	varies
2	~4.3
3	~4.3
4	0
5	2.26
6	2.28
7	2.28
8	15.28

IC7	CD4013BE
1	~7.63
2	7.63
3	15.25
4	0
5	4.63
6	0
7	0
8	15.27
9	15.27
10	11.4
11	15.27
12	15.25
13	15.27
14	15.27

REG	LM7815
I	17.96
G	0
O	15.28

IC8	CD4049UBE
1	15.28
2	7.63
3	7.63
4	7.63
5	7.63
6	7.63
7	7.63
8	0
9	7.63
10	7.63
11	7.63
12	7.63
13	~4.9
14	7.63
15	7.63
16	~11.4

Q1	2n5088
C	15.28
B	7.69
E	7.12

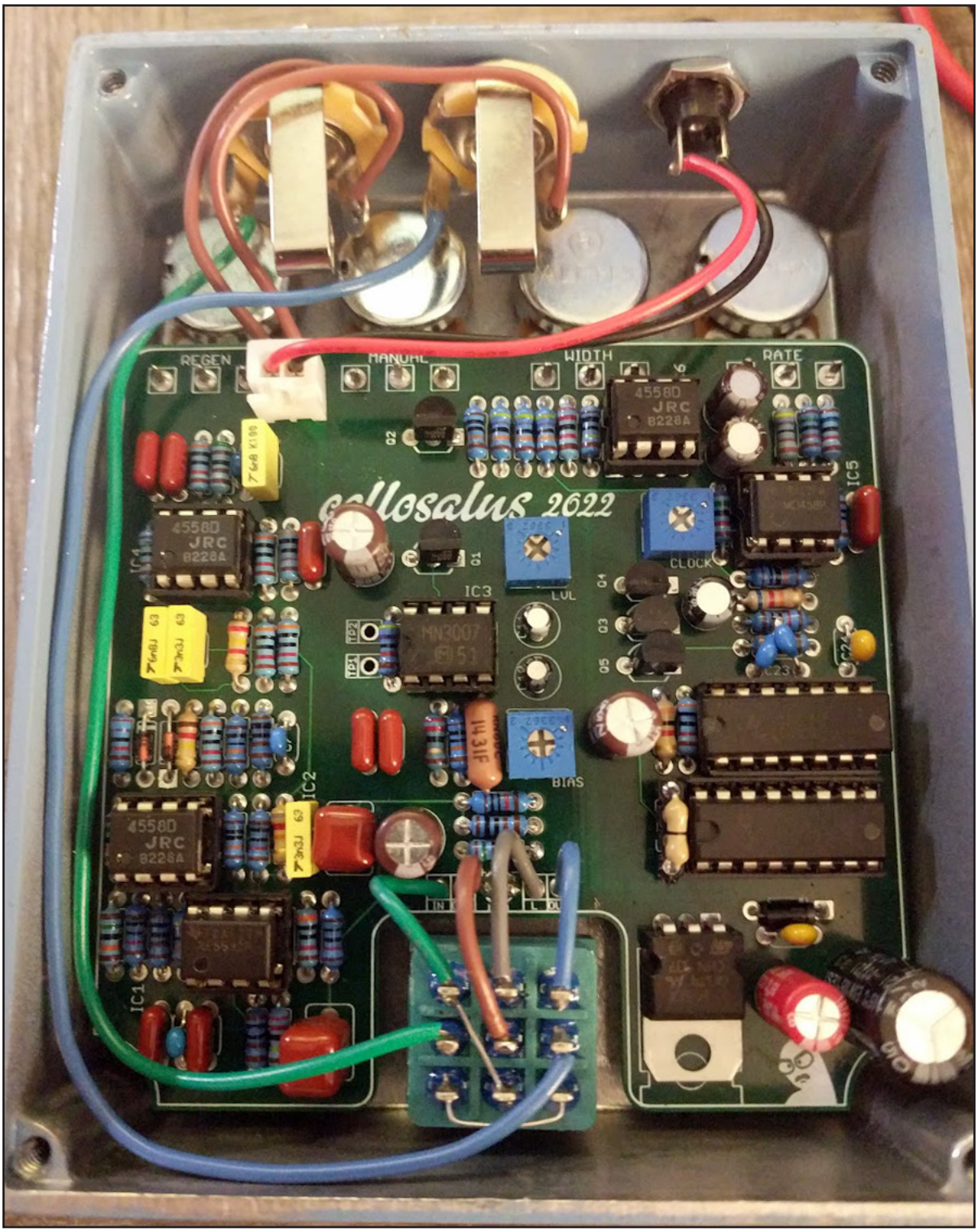
Q2	2n5088
C	~420mV
B	~420mV
E	0

Q3	2n5088
C	11.43
B	2.15
E	1.99

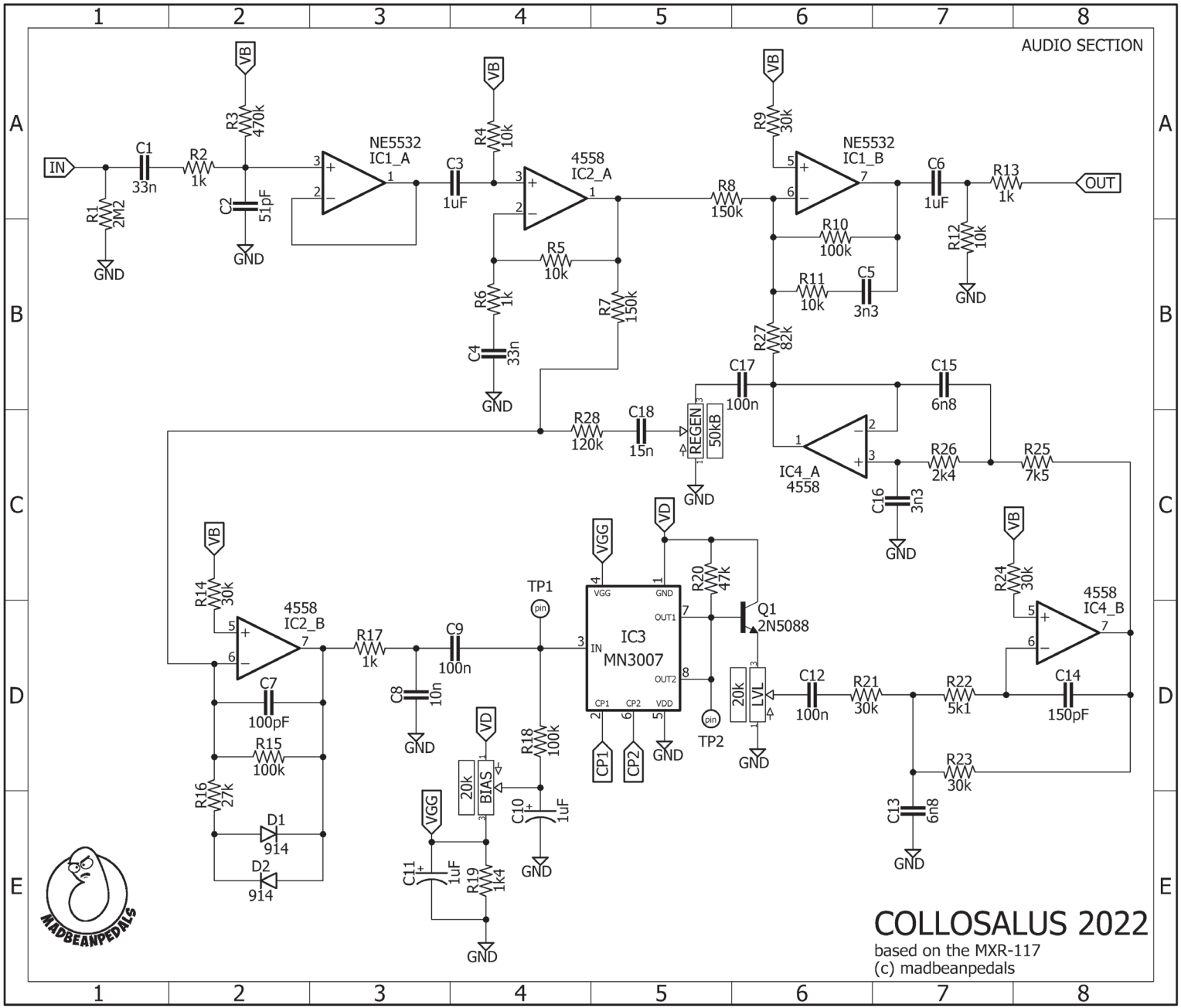
Q4	2n5088
C	1.99
B	485mV
E	0

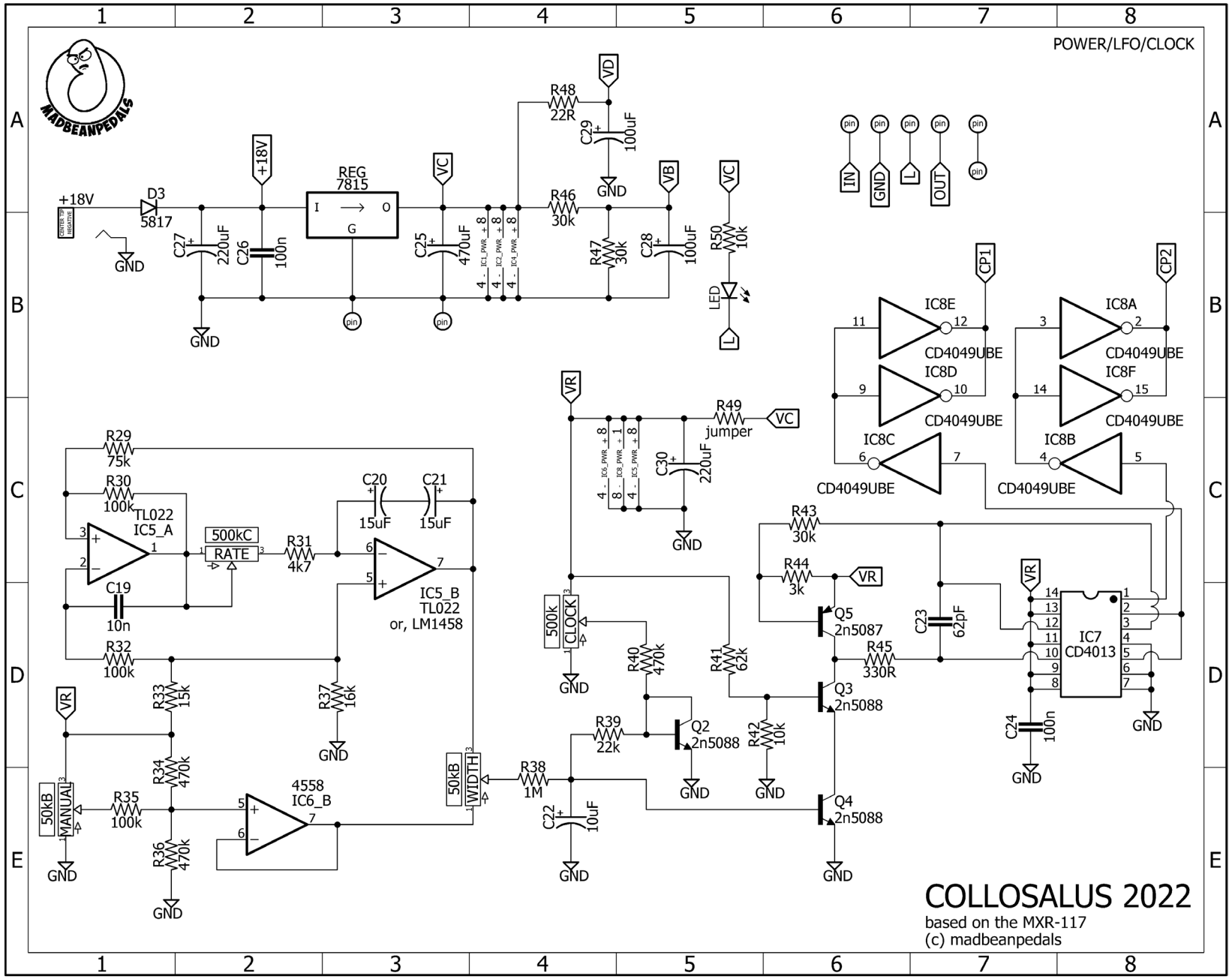
Q5	2n5087
C	11.43
B	15.28
E	15.28

- Dunlop 18v 1A power supply (18.24v output w/ no load)
- Current Draw: ~35mA
- Testing Conditions: All knobs CCW
- Some results will vary depending on trimmer settings.



This is the prototype, which had some electrolytic caps in different places than the final version. Everything else is about the same.


AUDIO SECTION
IN
OUT
VB
VD
VGG
GND
NE5532
IC1_A
NE5532
IC1_B
4558
IC2_A
4558
IC2_B
4558
IC4_A
4558
IC4_B
IC3
MN3007
Q1
2N5088
REGEN
50kB
BIAS
20k
LVL
TP1
TP2
CP1
CP2
R1 2M2
R2 1k
R3 470k
R4 10k
R5 10k
R6 1k
R7 150k
R8 150k
R9 30k
R10 100k
R11 10k
R12 10k
R13 1k
R14 30k
R15 100k
R16 27k
R17 1k
R18 100k
R19 1k4
R20 47k
R21 30k
R22 5k1
R23 30k
R24 30k
R25 7k5
R26 2k4
R27 82k
R28 120k
C1 33n
C2 51pF
C3 1uF
C4 33n
C5 3n3
C6 1uF
C7 100pF
C8 10n
C9 100n
C10 1uF
C11 1uF
C12 100n
C13 6n8
C14 150pF
C15 6n8
C16 3n3
C17 100n
C18 15n
D1 914
D2 914
COLLOSALUS 2022
based on the MXR-117
(c) madbeanpedals
MADBEANPEDALS


POWER/LFO/CLOCK
MADBEANPEDALS
+18V
D3
5817
REG
7815
C27
220uF
C26
100n
C25
470uF
R48
22R
C29
100uF
R46
30k
R47
30k
C28
100uF
R50
10k
LED
IN
GND
L
OUT
CP1
CP2
IC8E
IC8D
IC8C
IC8A
IC8F
IC8B
CD4049UBE
R49
jumper
C30
220uF
R29
75k
R30
100k
TL022
IC5_A
500kC
RATE
R31
4k7
C20
15uF
C21
15uF
C19
10n
IC5_B
TL022
or, LM1458
R32
100k
R33
15k
R37
16k
R34
470k
R35
100k
R36
470k
50kB
MANUAL
4558
IC6_B
50kB
WIDTH
R38
1M
C22
10uF
500k
CLOCK
R40
470k
R41
62k
R39
22k
Q2
2n5088
R42
10k
R43
30k
R44
3k
Q5
2n5087
R45
330R
Q3
2n5088
Q4
2n5088
C23
62pF
IC7
CD4013
C24
100n
COLLOSALUS 2022
based on the MXR-117
(c) madbeanpedals