SETBACK

FX TYPE: DELAY

Based on the DOD® FX-90™ rev.A

Enclosure Size: 1590BB

“Softie” compatibility: none

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- **04/20/21: I made an update to the NOTES section. Please see the correction regarding R4.**

Overview

I’ve read that the DOD® FX-90™ goes up to rev.J, which means either 10 or 11 versions of this analog delay were manufactured. That’s almost half the number of revisions of the Fulltone® OCD™ according to my math. The **Setback** is based on rev.A, which has some differences in both the analog through and clock set-up as compared to later versions. I chose this one (to start) because it was the most prevalent version with a schematic and one that I own. However, there were still discrepancies between those two so I have incorporated the changes into the Setback. Obviously, I have removed the FET bypass switching used in the FX-90™ and converted the Setback to true bypass.

I’ve also made a number of value changes based on my builds and these are noted on my drawn schematic (last page). I made these changes for better performance and to use more common values than used in the original design. This is the version you want to build. It sounds and works better.

I’ve also added a Tails option. This allows you to disconnect the delay input while keeping the effect on. So, if you like having your delay repeats spill over when you turn the delay off, the Tails feature allows for that (the whole unit is true bypass regardless). However, it is not required for the build and you can refer to the Notes section on how to build it with just bypass.

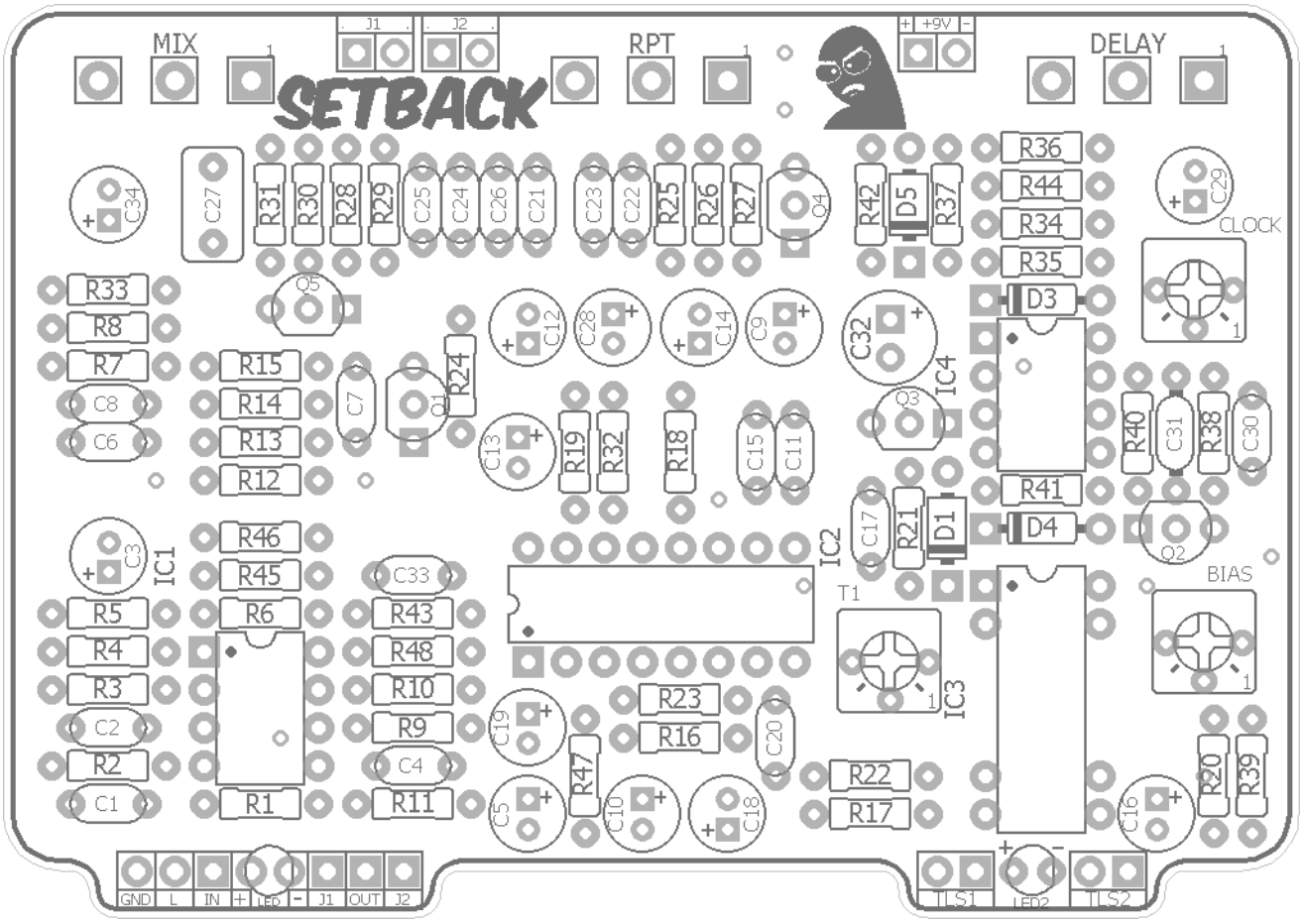
Lastly, I recommend running the Setback at 12v instead of 9v. This is a case where a few extra volts seem to make a noticeable difference, namely in the quality and clarity of repeats. Of course, you can run it at 9v if that’s your only option. But, use 12v if you can.

Controls

- **DELAY -** Total delay time. The delay range will go up to about 300ms.
- **RPT** - Delay repeats. The Setback has been modified to allow for self-oscillation at the max RPT setting.
- **MIX** - CCW: analog through only, no delay. CW - delay only. About 1/2 up is where the two signals are evenly mixed.

Terms of Use: *You are free to use purchased **Setback** circuit boards for both DIY and small commercial operations. You may not offer **Setback** PCBs for resale or as part of a “kit” in a commercial fashion. Peer to peer re-sale is fine, though.*

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.


SETBACK
MIX
RPT
DELAY
CLOCK
BIAS
J1
J2
+9V
IC1
IC2
IC3
IC4
T1
Q1
Q2
Q3
Q4
Q5
D1
D3
D4
D5
LED1
LED2
TLS1
TLS2
GND
L
IN
OUT
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
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R14
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R16
R17
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R30
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R41
R42
R43
R44
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R46
R47
R48
C1
C2
C3
C4
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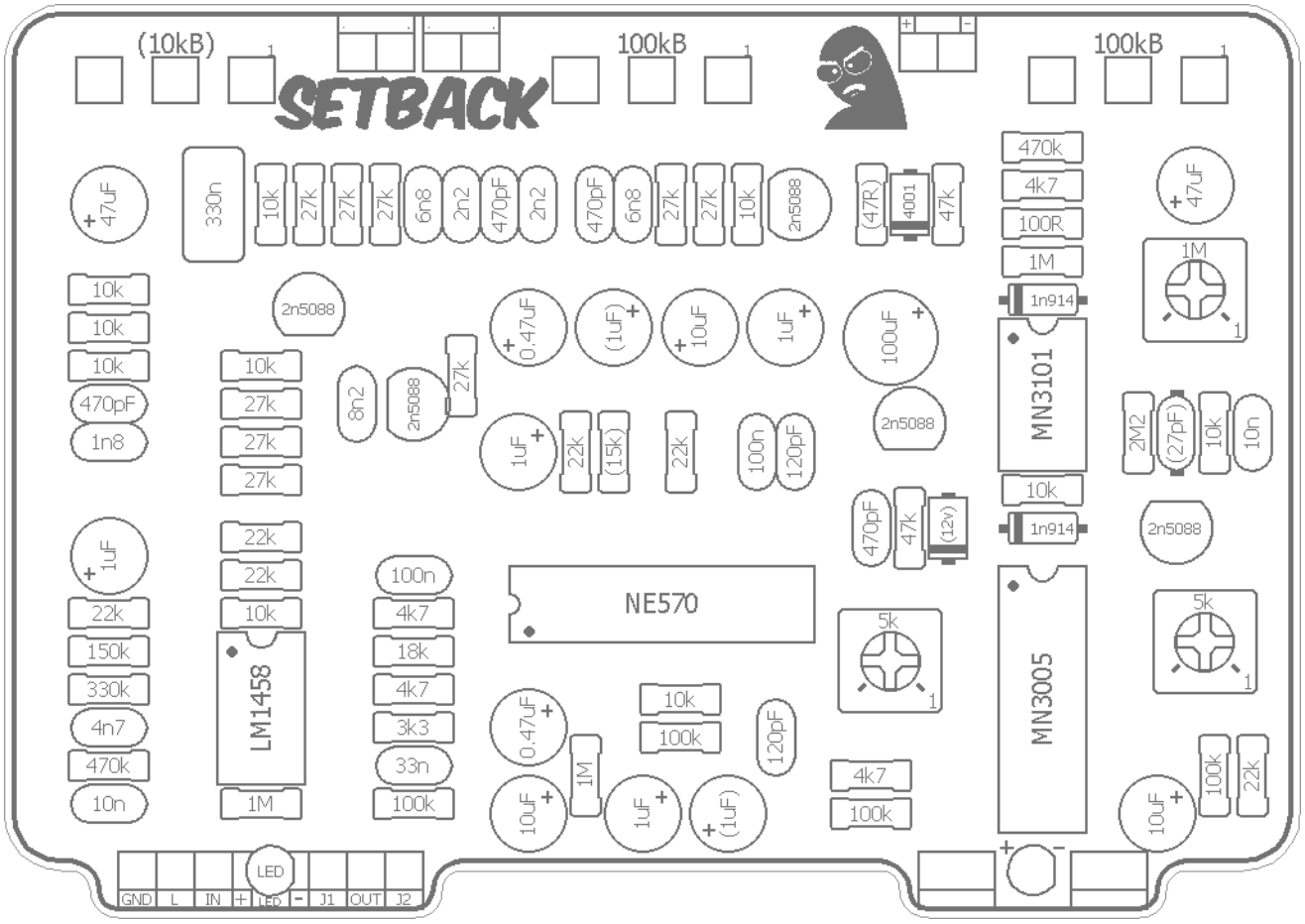
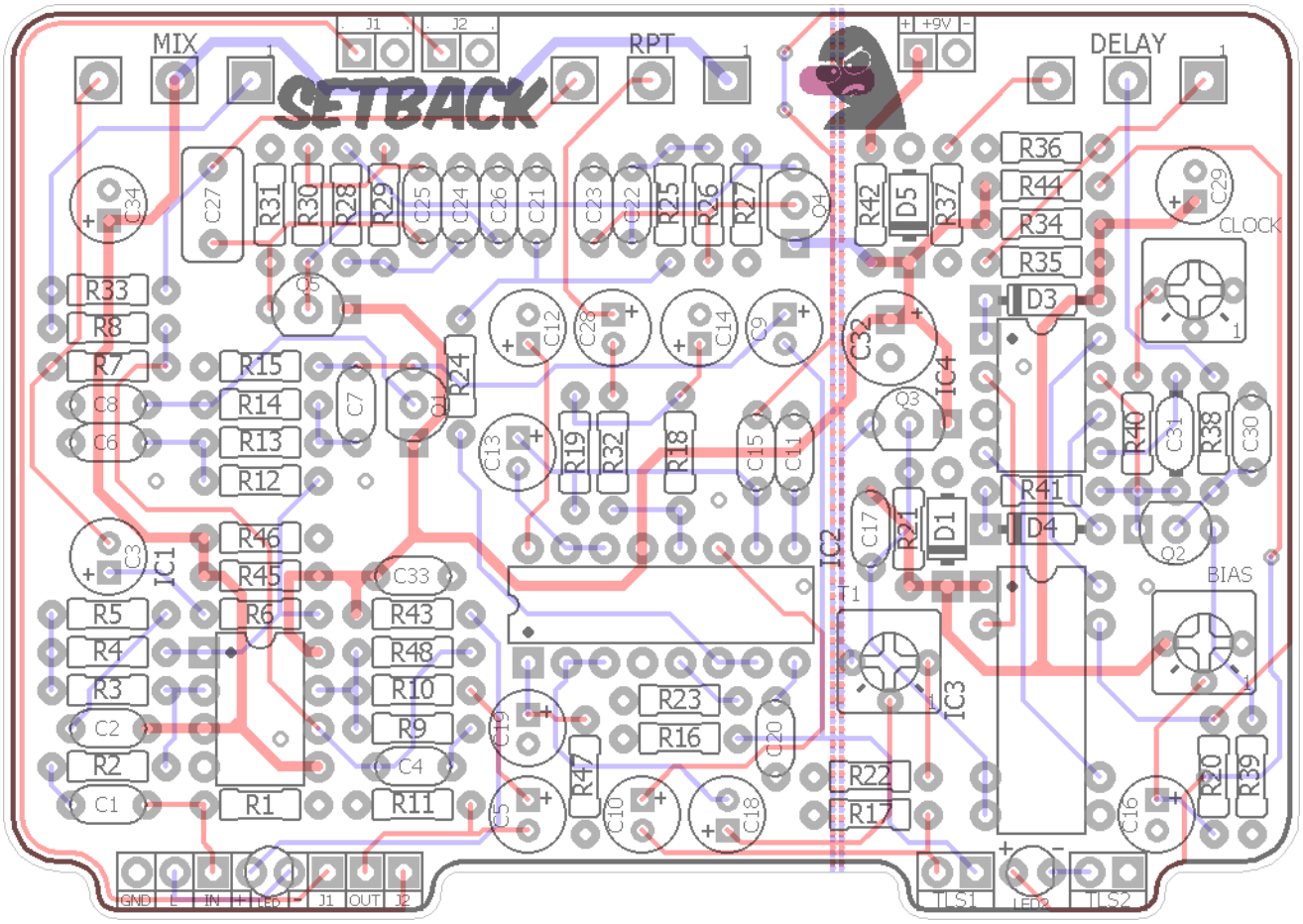
C34


(10kB)
100kB
100kB
SETBACK
47uF
330n
10k
27k
27k
27k
6n8
2n2
470pF
2n2
470pF
6n8
27k
27k
10k
2n5088
(47R)
4001
47k
470k
4k7
100R
1M
1n914
47uF
1M
MN3101
10k
10k
10k
470pF
1n8
2n5088
0.47uF
(1uF)
10uF
1uF
100uF
2n5088
2M2
(27pF)
10k
10n
10k
27k
27k
27k
8n2
2n5088
27k
1uF
22k
(15k)
22k
100n
120pF
1n914
2n5088
470pF
47k
(12v)
1uF
22k
22k
10k
LM1458
100n
4k7
18k
4k7
3k3
33n
100k
NE570
5k
MN3005
5k
22k
150k
330k
4n7
470k
10n
1M
0.47uF
1M
10uF
10k
100k
1uF
(1uF)
120pF
4k7
100k
10uF
100k
22k
LED
GND
L
IN
+
LED
-
J1
OUT
J2


SETBACK
MIX
RPT
DELAY
CLOCK
BIAS
J1
J2
+9V
GND
IN
OUT
LED1
LED2
TLS1
TLS2
IC1
IC2
IC3
IC4
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
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R42
R43
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R45
R46
R47
R48
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
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C14
C15
C16
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C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
C34
D1
D3
D4
D5
Q1
Q2
Q3
Q4
Q5
T1

Resistors		Resistors		Caps		Diodes	
R1	1M	R35	1M	C1	10n	D1	12v Zener
R2	470k	R36	470k	C2	4n7	D3	1n914
R3	330k	R37	47k	C3	1uF	D4	1n914
R4	150k	R38	10k	C4	33n	D5	1N4001
R5	22k	R39	22k	C5	10uF	Transistors	
R6	10k	R40	2M2	C6	1n8	Q1	2n5088
R7	10k	R41	10k	C7	8n2	Q2	2n5088
R8	10k	R42	47R	C8	470pF	Q3	2n5088
R9	3k3	R43	4k7	C9	1uF	Q4	2n5088
R10	4k7	R44	4k7	C10	1uF	Q5	2n5088
R11	100k	R45	22k	C11	120pF	ICs	
R12	27k	R46	22k	C12	0.47uF	IC1	LM1458
R13	27k	R47	1M	C13	1uF	IC2	NE570
R14	27k	R48	18k	C14	10uF	IC3	MN3005
R15	10k			C15	100n	IC4	MN3101
R16	100k			C16	10uF	Trimmers	
R17	100k			C17	470pF	BIAS	5k
R18	22k			C18	1uF	T1	5k
R19	22k			C19	0.47uF	CLOCK	1M
R20	100k			C20	120pF	Pots	
R21	47k			C21	2n2	MIX	10kB
R22	4k7			C22	6n8	RPT	100kB
R23	10k			C23	470pF	DELAY	100kB
R24	27k			C24	2n2		
R25	27k			C25	6n8		
R26	27k			C26	470pF		
R27	10k			C27	330n		
R28	27k			C28	1uF		
R29	27k			C29	47uF		
R30	27k			C30	10n		
R31	10k			C31	27pF		
R32	15k			C32	100uF		
R33	10k			C33	100n		
R34	100R			C34	47uF		

04/20/21 update: I changed the BOM to reflect the correction made with R4 (see Notes section).

Value	QTY	Type	Rating
47R	1	Metal / Carbon Film	1/4W
100R	1	Metal / Carbon Film	1/4W
3k3	1	Metal / Carbon Film	1/4W
4k7	4	Metal / Carbon Film	1/4W
10k	10	Metal / Carbon Film	1/4W
15k	1	Metal / Carbon Film	1/4W
18k	1	Metal / Carbon Film	1/4W
22k	6	Metal / Carbon Film	1/4W
27k	10	Metal / Carbon Film	1/4W
47k	1	Metal / Carbon Film	1/4W
100k	4	Metal / Carbon Film	1/4W
150k	1	Metal / Carbon Film	1/4W
330k	1	Metal / Carbon Film	1/4W
470k	2	Metal / Carbon Film	1/4W
1M	3	Metal / Carbon Film	1/4W
2M2	1	Metal / Carbon Film	1/4W
27pF	1	Ceramic / MLCC	16v min.
120pF	2	Ceramic / MLCC	16v min.
470pF	4	Ceramic / MLCC	16v min.
1n8	1	Film	16v min.
2n2	2	Film	16v min.
4n7	1	Film	16v min.
6n8	2	Film	16v min.
8n2	1	Film	16v min.
10n	2	Film	16v min.
33n	1	Film	16v min.
100n	2	Film	16v min.
330n	1	Film	16v min.
0.47uF	2	Tantalum or Electrolytic	16v min.
1uF	6	Electrolytic	16v min.
10uF	3	Electrolytic	16v min.
47uF	2	Electrolytic	16v min.
100uF	1	Electrolytic	25v min.

Value	QTY	Type	Rating
Zener	1	12v	
1n914	2		
1N4001	1		
2n5088	5		
LM1458	1		
NE570	1	or, v571	
MN3005	1		
MN3101	1		
5k	2	Bourns 3362p	
1M	1	Bourns 3362p	
10kB	1	PCB Right Angle	16mm
100kB	2	PCB Right Angle	16mm

04/20/21 update: I changed the Shopping List to reflect the correction with R4 (see Notes section). Also, the 0.47uF can be either Tantalum or Electrolytic. I tested both and couldn't hear any real difference.

27pF:
http://smallbear-electronics.mybigcommerce.com/ceramic-disc-capacitors-4-7-pf-33-pf/
https://www.mouser.com/ProductDetail/81-RDE5C1H270J0M1H3A

0.47uF Tantalum:
http://smallbear-electronics.mybigcommerce.com/dipped-tantalum-15-f-10-f-16-volt/

LM1458:
http://smallbear-electronics.mybigcommerce.com/ic-mc1458p-ti/

v571:
http://smallbear-electronics.mybigcommerce.com/ic-v571d/

MN3005:
http://smallbear-electronics.mybigcommerce.com/mn3005-re-makes-xvive-audio/

MN3101:
http://smallbear-electronics.mybigcommerce.com/ic-mn3101/

12v Zener:
http://smallbear-electronics.mybigcommerce.com/diode-zener-1n4742a/

16mm pots (10kB, 100kB):
http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-right-angle-pc-mount/

5k Bourns 3362p:
https://www.taydaelectronics.com/potentiometer-variable-resistors/cermet-potentiometers/3362p/5k-ohm-trimmer-potentiometer-cermet-1-turn-3362p.html

1M Bourns 3362p:
https://www.taydaelectronics.com/potentiometer-variable-resistors/cermet-potentiometers/3362p/1m-ohm-trimmer-potentiometer-cermet-1-turn-3362p.html

Thinline DC Jack:
http://smallbear-electronics.mybigcommerce.com/dc-power-jack-all-plastic-unswitched-2-1-mm/

Lumberg Mono:
http://smallbear-electronics.mybigcommerce.com/lumberg-1-4-compact-shrouded-mono-jack/

Remember, you'll need (2) 3PDT and (2) LEDs if you are using the Tails option!

A word about analog delays

I've addressed this many times on the forum but it's worth reiterating here. Analog delays are imperfect circuits. We love them because they are warm and create a nice audio bed under our playing. But, when you actually build them there is a bit of an awakening vis-à-vis expectation vs. reality. Analog delays have noise and distortion. Some are better at handling these than others, but all have them. Many people rightly think this is the inherent nature of the Bucket Brigade Device and that's true: it's a consequence of their internal building blocks and reduced audio frequency range.

But, a large part of the audio downgrade also comes from the compander. The companders that everyone used (NE570) in the vintage delays were a matter of convenience. They were cheap and readily available when most analog delays were being manufactured. They are not designed for the kind of high end audio we've come to expect these days. They are slow to compress (reduced dynamics) and introduce moderate low frequency distortion. I've found this to be true for every analog delay I've made and the Setback is no exception. You simply have to accept this as inherent to the design. But, despite these shortcomings there is a lot of musicality in these devices. So, bear that in mind in with this project and any BBD delays you build in the future.

Changes made and the reasons for them

R42: 51R to 47R
C31: 25pF to 27pF
More common values. 25pF is actually a bit hard to find now!

~~**R4: 150k to 220k**~~
~~**R48: 18k to 27k**~~
~~The revA has a pretty noticeable volume drop. I goosed the front and rear of the analog-through to add more volume. There is still a slight volume drop but it is much closer with these values. You might be able to increase R4 even further if the remaining drop bothers you (maybe 270k or 300k). Depends on whether or not it ends up producing any distortion.~~
04/20/21 update: Changing R4 to 220k actually ends up hitting the front end of the compander too hard. Leave it at 150k. I recommend simply increasing R48 instead. 18k is the stock value. I tested up to 47k. There is still a little volume drop with the effect on.

C12: 0.56uF to 0.47uF
C19: 0.56uF to 0.47uF
Well, I just don't stock 0.56uF. Plus, all the later revisions of the FX-90 I've seen use 0.47uF. I spec'd tantalum because I've seen reports that this can slightly improve the responsiveness of the compander. It's probably not critical but two tantalum caps is not expensive. 4/20 update: I compared tantalum with electrolytic and couldn't hear any noticeable difference. So, use either type for the two caps.

C18: 0.56uF to 1uF
C28: 0.56uF to 1uF
Same reason as above but here 1uF and a regular electrolytic is fine. Tone impact is negligible.

R32: 22k to 15k
Reducing this resistor allowed for self-oscillation at max RPT settings.

R40: 2M2 (12v) or 1M5 (9v)
With 9v operation, the clock range at the max Delay setting is too low. I could not get above about 5.8kHz and this setting produced telltale clock noise and dithering. So, for 9v operation a 1M5 gives better clock settings. Again, I do recommend running the Setback at 12v. BTW: this is confirmed with my actual DOD pedal. There is too much clock in the delay the way it was designed (IMO). Lowest clock setting should be around 6kHz for this delay.

MIX: 100kB to 10kB
The 100kB makes the delay mix come on too quick, IMO. Reducing this pot to 10kB makes it much better and allows for more subtle delay mixing.
Zener:
These were two Zener diodes in series stock. I simplified them to one 12v for convenience

Tails Option

I pretty much design all my delay projects with the Tails option now. It does add a little extra to the cost but it's just such a useful feature. The Tails switch will let you turn off the delay but retain spill-over so that the repeats die naturally. The effect remains on when the Tails are turned off. One drawback in the implementation here: because the Mix control is actually a blend b/w dry and wet, if you have the Mix up all the way for delay repeats only (for some reason) and then turn off the Tails switch off you will have no signal. But, that's a pretty unlikely scenario.

If you don't want the Tails switch it's easy to defeat. Simply solder a jumper between the TLS1 pads on the PCB. Leave the TLS2 and LED2 pads empty. You can also omit R16 and R17 in this case.

Calibration

If you are building BBD delays you must already have a prototyping rig and audio probe. Because despite the effort to make the Setback as accessible and easy to build as possible, it's still an advanced project and these are the tools you need to make it painless. So, let's assume you have those and are using due diligence to test and evaluate this build on a rig and not just soldering everything together, putting it in a box and then becoming frustrated if it doesn't work. This may sound a bit tough but it's only to put a point on the idea that complicated builds require testing and evaluation. They are not "paint by numbers." And, I have high confidence you can do it with the right preparation! That said, the Setback is easy to calibrate just by ear.

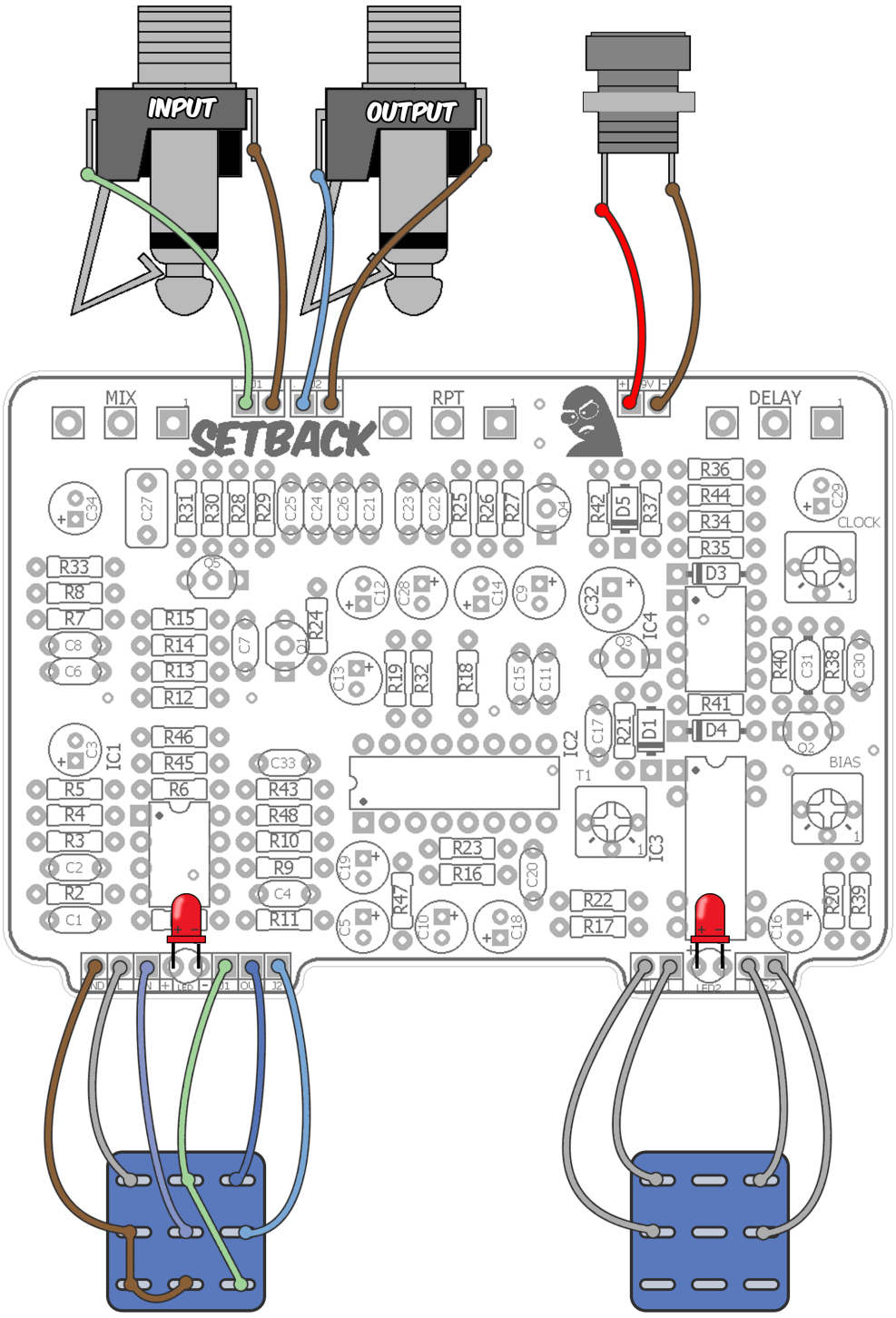
Starting conditions: Set all knobs and trimmers to 50%.

If you have a frequency setting on your digital multimeter, connect the black probe to ground and touch the red probe to pin2 or pin4 of the MN3101. Adjust the CLOCK trimmer until you read about 6.5kHz (precision not required). If you do not have a frequency meter, just set the CLOCK trimmer to 50%.

Using an audio probe, check either pin3 or pin4 of the MN3005 while feeding some audio to the circuit input. If you have a frequency generator that's fine. I just pick a single note repeatedly on the guitar. Adjust the BIAS trimmer until you have the cleanest and most clear output you can get over its range. This signal will be LOUD so don't be surprised. The range over which the BIAS trimmer works is generally 40% through 60% of its full turn.

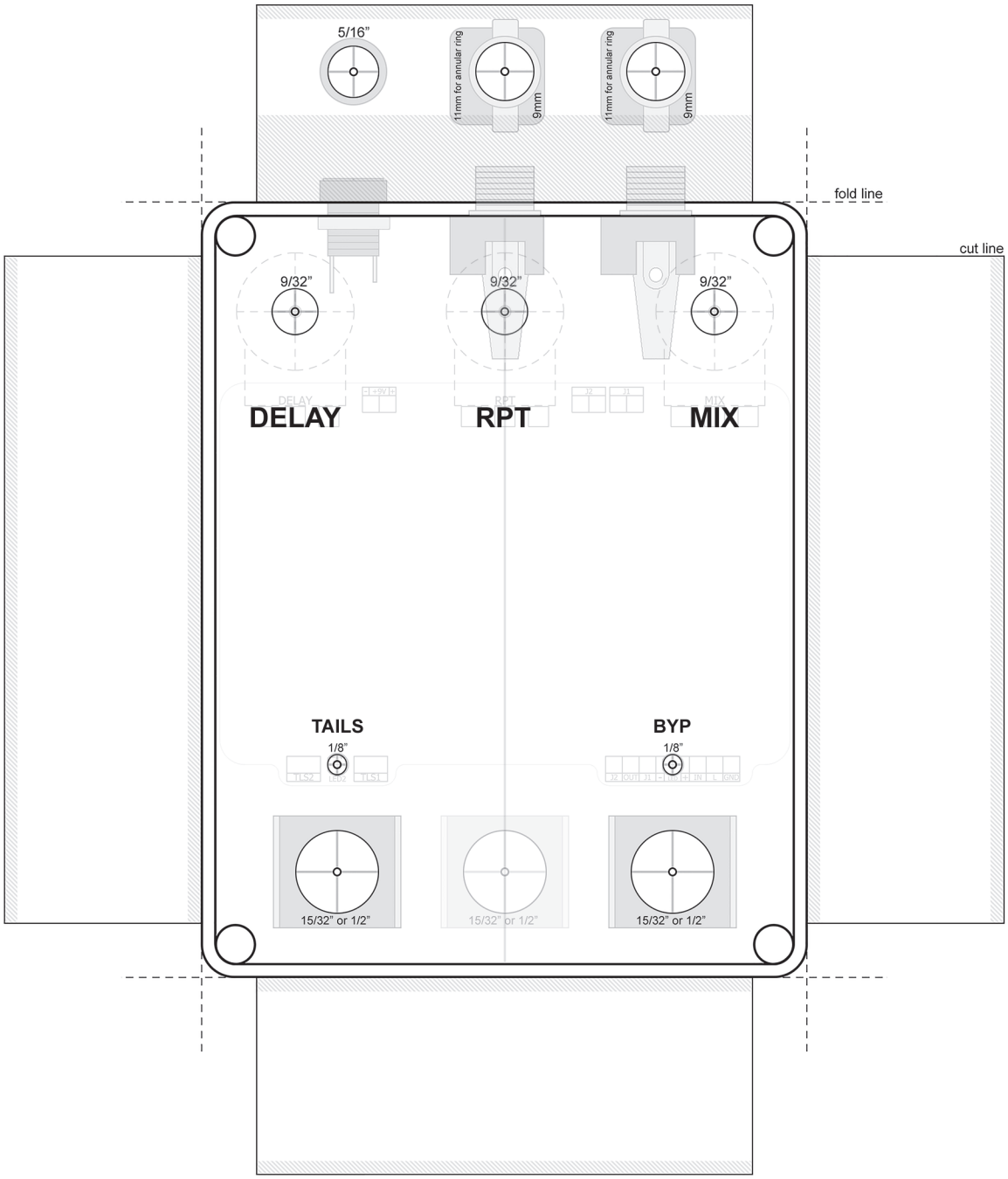
Now set the DELAY to max and RPT to about 75%. Adjust the CLOCK trim counter-clockwise until you get the longest delay repeats possible without clock noise, dithering or thumping. For my build, this worked out to be right at 6kHz. At that setting I got around 300ms of delay which is expected.

Lastly, set the T1 trimmer as high as you can without too much distortion being introduced. This is basically the delay repeats level. I set mine somewhere between 2/3rd and 3/4.



LEDs can be soldered directly to the PCB.

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



- They greyed out 3PDT in the center is used if you plan on excluding the Tails option and prefer a center location for your bypass switch. Adjust the bypass LED location according to your preference.
- The jacks are located next to each other in order to place them as far away as possible from the clock portion of the circuit.

IC1	LM1458
1	5.74
2	6
3	5.72
4	0
5	5.72
6	5.73
7	5.73
8	11.46

IC2	570/571
1	1.04
2	1.82
3	1.82
4	0
5	1.82
6	6.66
7	6.66
8	1.82
9	1.82
10	4.5
11	1.82
12	1.82
13	11.46
14	1.82
15	1.82
16	1.02

IC3	3005
1	11.06
2	5.22
3	6.45
4	6.45
5	0
6	5.22
7	6.59
8	0.71

IC4	3101
1	10.46
2	5.22
3	0
4	5.22
5	10.35
6	0.4
7	6.45
8	0.71

Q1	5088
C	11.46
B	5.6
E	5.06

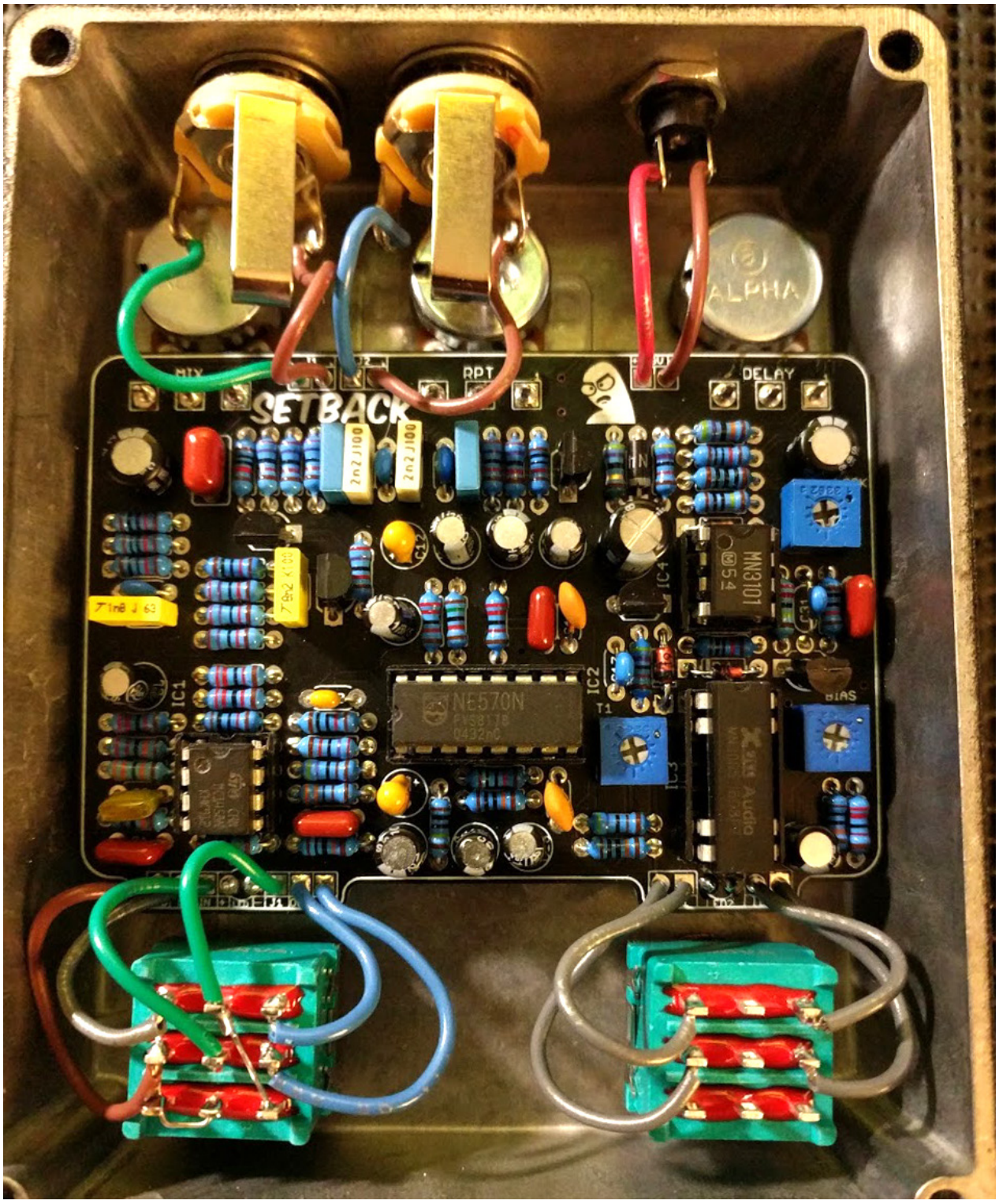
Q2	5088
C	6.2
B	368mV
E	12mV

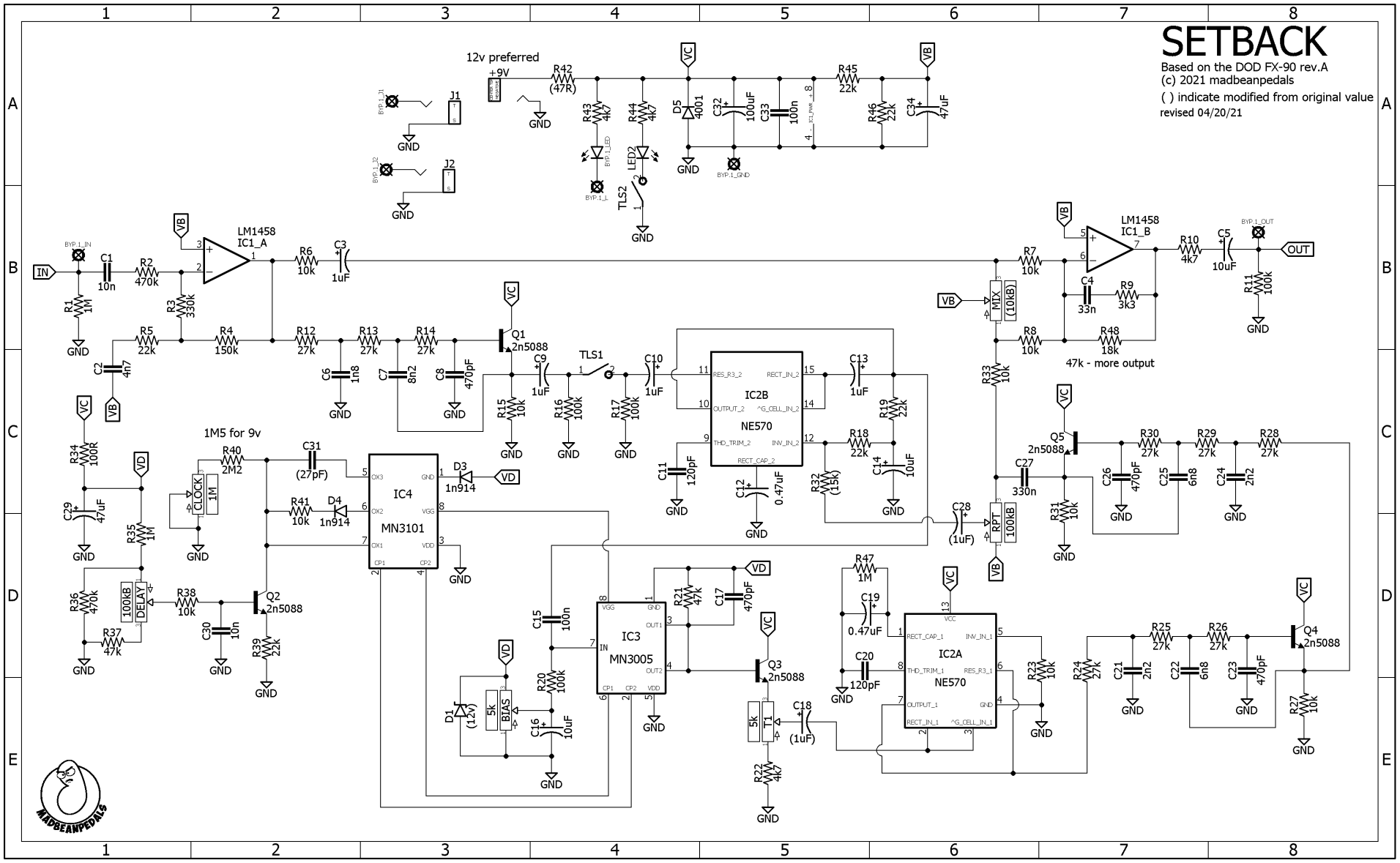
Q3	5088
C	1.46
B	6.45
E	5.86

Q4	5088
C	11.46
B	6.5
E	5.9

Q5	5088
C	11.46
B	5.83
E	5.28

- 12vDC
- Current Draw ~ 12mA
- Some readings may differ depending on the BIAS or CLOCK trim settings.


ALPHA
MIX
RPT
DELAY
SETBACK
2n2 J100
2n2 J100
MN3101
NE570N
IC1
IC2
IC3
IC4
T1
BIAS


SETBACK
Based on the DOD FX-90 rev.A
(c) 2021 madbeanpedals
( ) indicate modified from original value
revised 04/20/21
12v preferred
+9V
LM1458
IC1_A
IC1_B
IC2B
NE570
IC2A
IC3
MN3005
IC4
MN3101
Q1 2n5088
Q2 2n5088
Q3 2n5088
Q4 2n5088
Q5 2n5088
TLS1
TLS2
LED2
D1 (12v)
D3 1n914
D4 1n914
D5 4001
47k - more output
1M5 for 9v
IN
OUT
VB
VC
VD
GND
MADBEANPEDALS