MAN O' WAR DELUXE

FX TYPE: DELAY

Enclosure Size: 1590BB or 125BB

Based on the Maxon® AD-900™

11.5.19 - See an important update on the last page to address an issue with the modulation!

Overview

The Maxon AD series is sometimes overlooked by guitar players in search of a good analog delay and has most definitely been neglected in the DIY pedal world. While it shares a lot of likeness to the more popular DM-2™, the AD-900™ has its own unique voice. It's neither as percussive as the DM-2™ nor so warmly filtered as the Memory Man™. The AD-900 is neither too bright nor too dark and has perhaps more low end than the DM-2. Overall, it's an excellent in-between of the pillars of DM-2 and DMM.

Design-wise it parts most noticeably from the DM-2™ in the way the BBDs are arranged. It uses one main clock and one slave clock as drivers. My guess is that this was done for maximum efficiency and lowest noise floor (one MN3101 can drive up to two MN3005 easily so it is not a matter of economics). But, I wouldn't necessarily call this a pristine analog delay either. It can, and does, get pretty gritty after a few repeats. But, that's not a bad thing for an analog delay.

The **Man O' War** takes one further step and adds two bypasses: Regular and Tails. The regular bypass is just like every other true bypass build. The Tails allows you to spill over the delay repeats when you turn the delay off. Both are footswitches so you can change the bypass method on the fly.

The Man O' War Deluxe is the same exact delay circuit as the Man O' War with optical modulation added. It is a more difficult and slightly more costly build but if you like modulation with your delay (and who doesn't) it is a great addition!

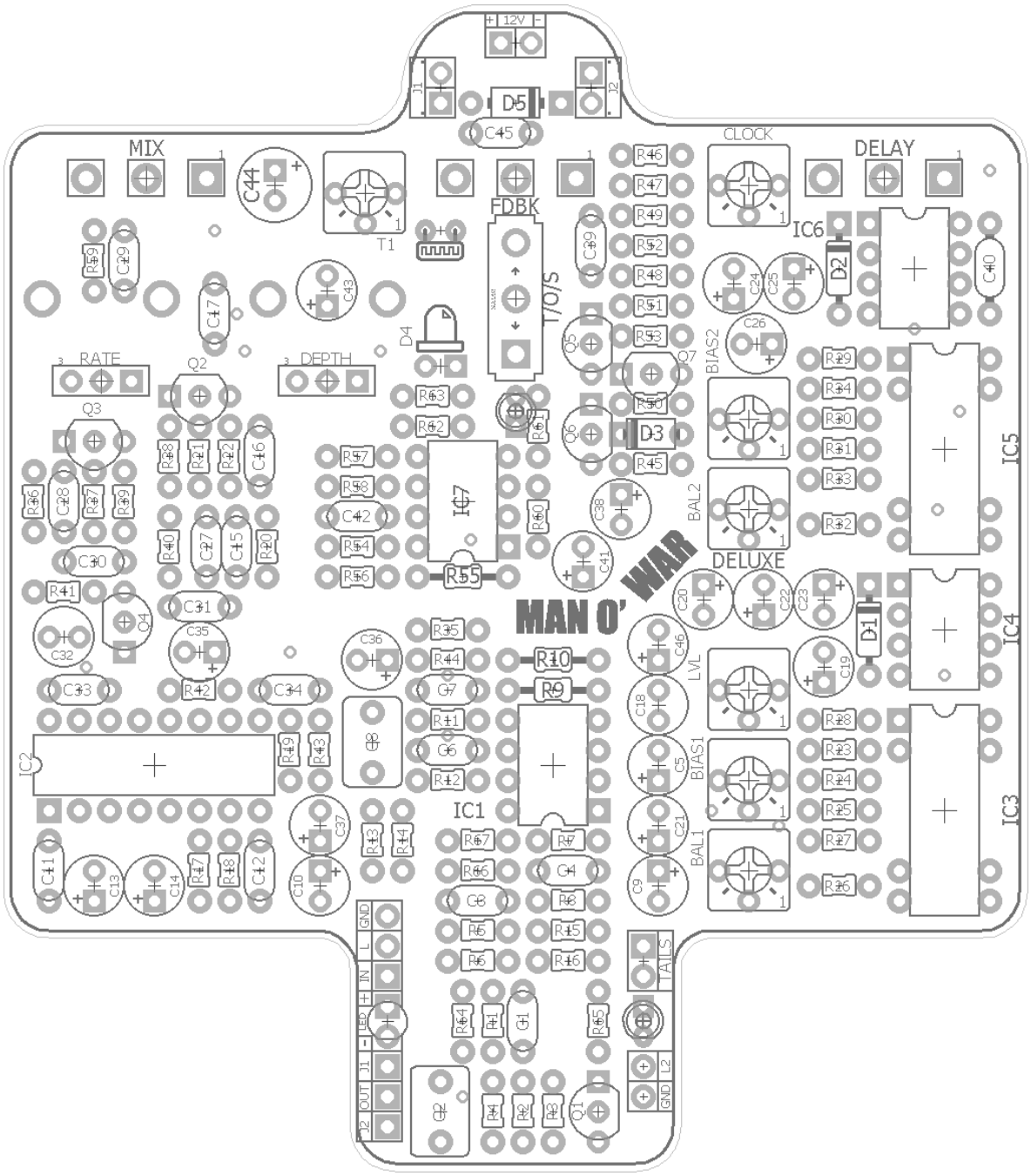
This is not a build for the novice. You should have some experience building pedals and also have a testing/prototyping rig as well as an audio probe.

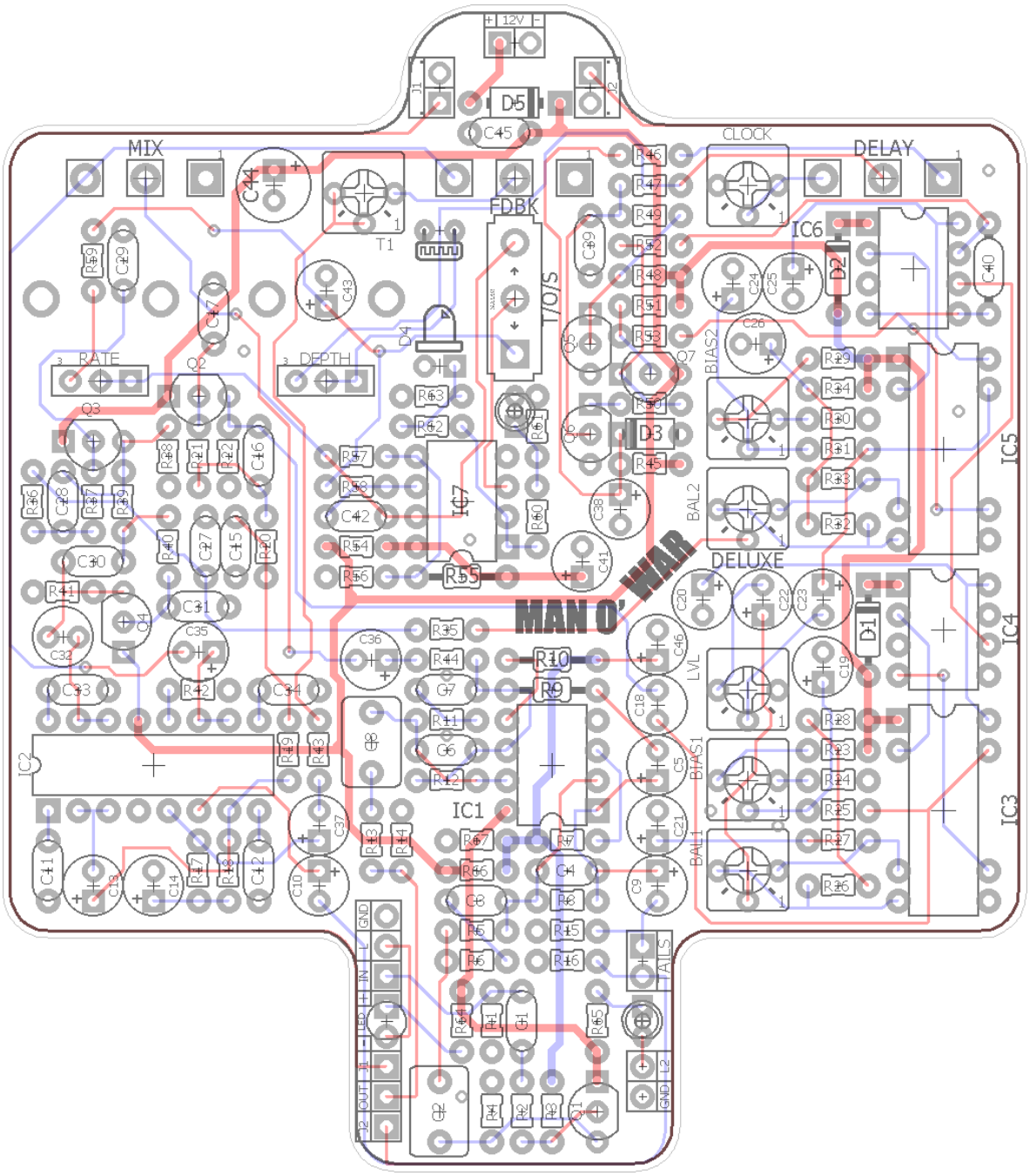
Controls

- **DELAY:** Sets delay time (max delay time will be between 500 and 550ms).
- **FDBK:** Number of delay repeats from 1 to "infinity".
- **MIX:** Delay level mix.
- **BAL1, BAL2:** Sets the balance between the two outputs on each BBD.
- **BIAS1, BIAS2:** Used to calibrate the input bias on each BBD.
- **CLOCK:** Sets the correct clock range for the min and max delay times.
- **LVL:** Sets the output of BBD1 for cleanest delay signal.
- **T1:** Adjusts the point at which the FDBK control goes into "infinite" repeats. The ManOWars do not do self-oscillation.
- **RATE:** Modulation rate from slow to fast.
- **DEPTH:** Modulation depth from min to max.
- **T/O/S:** Triangle, Off, Square modulation. Setting this switch to the center position turns modulation off. Switch UP is the triangle position.

Like the AD-900™, the Man O' War runs on 12v DC power. But it can also run on 9v. What's the difference? About 3v, dawg! Also, 12v operation has a bit more output and overall sounds better to me. If you do run it at 9v change R55 and R56 from 470k to 220k for the LFO.

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.


MIX
DELAY
CLOCK
FDBK
T/O/S
RATE
DEPTH
IC1
IC2
IC3
IC4
IC5
IC6
IC7
DELUXE
MAN O' WAR
BIAS1
BIAS2
LVL
BAL1
BAL2
TAILS
12V
GND
OUT
IN
LED


MIX
RATE
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BIAS2
BIAS1
BAL2
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LVL
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IC1
IC2
IC3
IC4
IC5
IC6
IC7
T1
D1
D2
D3
D4
D5
12V
GND
IN
OUT
LED
FATS

Resistors		Resistors		Caps		Caps		ICs	
R1	1M	R34	12k	C1	47n	C35	4u7	IC1	4558
R2	1k	R35	10k	C2	1uF	C36	4u7	IC2	NE570
R3	510k	R36	10k	C3	33n	C37	1uF	IC3	MN3005
R4	10k	R37	10k	C4	470pF	C38	10uF	IC4	MN3101
R5	10k	R38	10k	C5	4u7	C39	100n	IC5	MN3005
R6	2k	R39	10k	C6	470pF	C40	47pF	IC6	MN3101
R7	3k3	R40	10k	C7	33n	C41	10uF	IC7	TL062
R8	10k	R41	10k	C8	1uF	C42	10n	Photocell	
R9	10k	R42	33k	C9	4u7	C43	22uF	LDR1	9203
R10	3k3	R43	15k	C10	4u7	C44	220uF	Switches	
R11	2k	R44	10k	C11	220n	C45	100n	TAILS	3PDT
R12	10k	R45	2k	C12	100pF	C46	47uF	T/O/S	On/Off/On
R13	470R	R46	10R	C13	10uF	Diodes		Trimmers	
R14	100k	R47	1M	C14	10uF	D1	1n914	CLOCK	2k
R15	100k	R48	2M2	C15	10n	D2	1n914	BAL1	10k
R16	100k	R49	8k1	C16	56n	D3	8.2v	BAL2	10k
R17	10k	R50	10k	C17	330pF	D4	LED	BIAS1	10k
R18	10k	R51	10k	C18	10uF BP	D5	1N5817	BIAS2	10k
R19	10k	R52	330R	C19	1uF	LED3	LED	T1	20k
R20	10k	R53	33k	C20	1uF	Transistors		LVL	250k
R21	10k	R54	100R	C21	10uF	Q1 - Q4	Si NPN	Pots	
R22	10k	R55	470k	C22	1uF	Q5	2N5088	MIX	10kA
R23	5k1	R56	470k	C23	1uF	Q6	2N5088	DELAY	10kC
R24	5k1	R57	220k	C24	1uF	Q7	2N5087	FDBK	20kB
R25	100k	R58	220k	C25	1uF			DEPTH	50kB
R26	130k	R59	1k	C26	10uF			RATE	100kC
R27	130k	R60	4k7	C27	4n				
R28	12k	R61	4k7	C28	39n				
R29	5k1	R62	4k7	C29	820pF				
R30	5k1	R63	4k7	C30	27n				
R31	100k	R64	4k7	C31	470pF				
R32	130k	R65	4k7	C32	10uF BP				
R33	130k	R66	47k	C33	220n				
		R67	47k	C34	100pF				

The transistors used for Q1-Q4 in the stock unit were 2SC1815 but the exact component type doesn't really matter much. A lot of NPN will work fine (pinout on the board is C-B-E). I suggest MPSA18, 2n3904 or 2n5088. You could also use BC550 but the pinout is reversed on those (E-B-C). The 2SC1815 has a different pinout, too: B-C-E!

Value	QTY	Type	Rating
10R	1	Carbon / Metal Film	1/4W
100R	1	Carbon / Metal Film	1/4W
330R	1	Carbon / Metal Film	1/8W
470R	1	Carbon / Metal Film	1/8W
1k	2	Carbon / Metal Film	1/8W
2k	3	Carbon / Metal Film	1/8W
3k3	2	Carbon / Metal Film	1/8W
4k7	6	Carbon / Metal Film	1/8W
5k1	4	Carbon / Metal Film	1/8W
8k1	1	Carbon / Metal Film	1/8W
10k	21	Carbon / Metal Film	1/8W
12k	2	Carbon / Metal Film	1/8W
15k	1	Carbon / Metal Film	1/8W
33k	2	Carbon / Metal Film	1/8W
47k	2	Carbon / Metal Film	1/8W
100k	5	Carbon / Metal Film	1/8W
130k	4	Carbon / Metal Film	1/8W
220k	2	Carbon / Metal Film	1/8W
470k	2	Carbon / Metal Film	1/8W
510k	1	Carbon / Metal Film	1/8W
1M	2	Carbon / Metal Film	1/8W
2M2	1	Carbon / Metal Film	1/8W
47pF	1	Ceramic / MLCC	25v Min.
100pF	2	Ceramic / MLCC	25v Min.
330pF	1	Ceramic / MLCC	25v Min.
470pF	3	Ceramic / MLCC	25v Min.
820pF	1	Ceramic / MLCC	25v Min.
4n	1	Film	25v Min.
10n	2	Film	25v Min.
27n	1	Film	25v Min.
33n	2	Film	25v Min.
39n	1	Film	25v Min.
47n	1	Film	25v Min.
56n	1	Film	25v Min.

Value	QTY	Type	Rating
100n	2	Film	25v Min.
220n	2	Film	25v Min.
1uF	1	Film	25v Min.
1uF	8	Electrolytic	25v Min.
4u7	5	Electrolytic	25v Min.
10uF	6	Electrolytic	25v Min.
10uF BP	2	Electrolytic - BiPolar	25v Min.
22uF	1	Electrolytic	25v Min.
47uF	1	Electrolytic	25v Min.
220uF	1	Electrolytic	25v Min.
1n914	2		
8.2v	1	Zener	
LED	2	Red, Diffused	3mm
1N5817	1		
Si NPN	4	MPSA18, 2n5088 or 2n3904	
2N5088	2		
2N5087	1		
4558	1		
NE570	1	or, V571	
MN3005	2		
MN3101	2		
TL062	1		
9203	1	Photocell	
3PDT	1	or, DPDT (footswitch)	
On/Off/On	1	SPDT, Pin Mount	
2k	1	Bourns 3362p	
10k	4	Bourns 3362p	
20k	1	Bourns 3362p	
250k	1	Bourns 3362p	
10kA	1	PC Mount, Right Angle	16mm
10kC	1	PC Mount, Right Angle	16mm
20kB	1	PC Mount, Right Angle	16mm
50kB	1	PC Mount, Plastic Shaft	9mm
100kC	1	PC Mount, Plastic Shaft	9mm

10uF Bi-Polar cap:
http://www.mouser.com/Search/ProductDetail.aspx?R=ECE-A1EN100Uvirtualkey66720000virtualkey667-ECE-A1EN100U

8.2v Zener:
http://smallbear-electronics.mybigcommerce.com/diode-zener-1n4738a/

NE570:
http://smallbear-electronics.mybigcommerce.com/ic-ne570/

V571 (sub for NE570):
http://smallbear-electronics.mybigcommerce.com/ic-v571d/

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

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

Bourns 3362p 22k:
https://www.mouser.com/ProductDetail/Bourns/3362P-1-223LF?qs=sGAEpiMZZMvygUB3GLcD7v%2F2K2JTtKgbVPDHLENkzyQ%3D

Bourns 3362p 10k:
https://www.mouser.com/ProductDetail/Bourns/3362P-1-103LF?qs=sGAEpiMZZMvygUB3GLcD7k%252Bod3ZqvEIQboRRPdOKB6M%3D

Bourns 3362p 1M:
https://www.mouser.com/ProductDetail/Bourns/3362P-1-105LF?qs=sGAEpiMZZMvygUB3GLcD7kddhVJPyV2kST8Lo8Gl%252B%2F8%3D

16mm Right Angle PC-Mount:
http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-right-angle-pc-mount/

9mm Right Angle Plastic Shaft:
http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-9mm-right-angle-pc-mount-w-knurled-plastic-shaft/

On/Off/On SPDT:
http://smallbear-electronics.mybigcommerce.com/spdt-center-off-short-lever-pc-mount/

9203 photocell:
http://smallbear-electronics.mybigcommerce.com/photocells-cds-5mm-diameter/

Calibration (by ear)

This procedure should be done in a testing environment before boxing up the pedal. You do not need to fully wire up the jacks and switches to do it. You'll need wires for 12v, GND, IN, OUT, and the two wires for the TAILS connection. An audio probe is required.

Set pots and trimmers as follows (**make sure the TAILS wires are connected first)**:

- **DELAY:** 12 o'clock
- **FDBK, MIX, RATE and DEPTH:** Min
- **T/O/S:** Off (center position)
- **LVL:** A little less than half-way up
- **All remaining trimpots to 12 o'clock**

1. For this step, remove IC5 from its socket on the PCB. Connect power.
2. Use an audio probe to probe pin7 of IC3 to verify that you have signal to the input of the first BBD. If you do not, check pin7 of IC2a and the emitter of Q2 for output. Debug as necessary.
3. Using the audio probe, probe either pin 3 or 4 of IC3. Adjust BIAS1 until you get the cleanest sounding delay.
4. Disconnect power and insert IC5. Reconnect power.
5. Audio probe pin7 of IC5 for input. Adjust the LVL trimmer so the volume at pin7 is more or less equal to the outputs of pins 3 or 4 of IC3.
6. Adjust BAL1 left and right to listen for any improvement in the delay output of IC3. If none, leave it in the center.
7. Probe pin 3 or 4 of IC5 and adjust BIAS2 to get the cleanest sounding delay output.
8. Probe R35 and adjust BAL2 left and right to see if it improves delay output at all. If not, leave it in the center.
9. Set the Delay pot to max and FDBK to 12 o'clock.
10. Probe pin10 or 11 of IC2b. Adjust the clock trimmer clockwise for the most delay time possible without any clock noise (whine) in the signal.

After these steps, disconnect your audio probe and listen to the actual output of the pedal. Turn FDBK all the way up. While listening to the output, adjust T1 left to increase the maximum number of repeats to the desired amount. You can adjust the LVL trimpot up to increase both the total FDBK and MIX output. These two trimpots are interactive and I advise against adjust the LVL too high (shoot for a setting between 1/3 and 2/3 up) or it may start to distort the delays. The Man O' War doesn't really do self-oscillating feedback. At least not without adjusting the LVL so high as to make the volume of feedback get too loud. Shoot for as close to infinite repeats as possible when making your T1 and LVL adjustments.

Bypass Operation

- **True bypass operation:** Leave the Tails switch on and use the Byp switch for on/off. Delay repeats will cut off when the effect is bypassed.

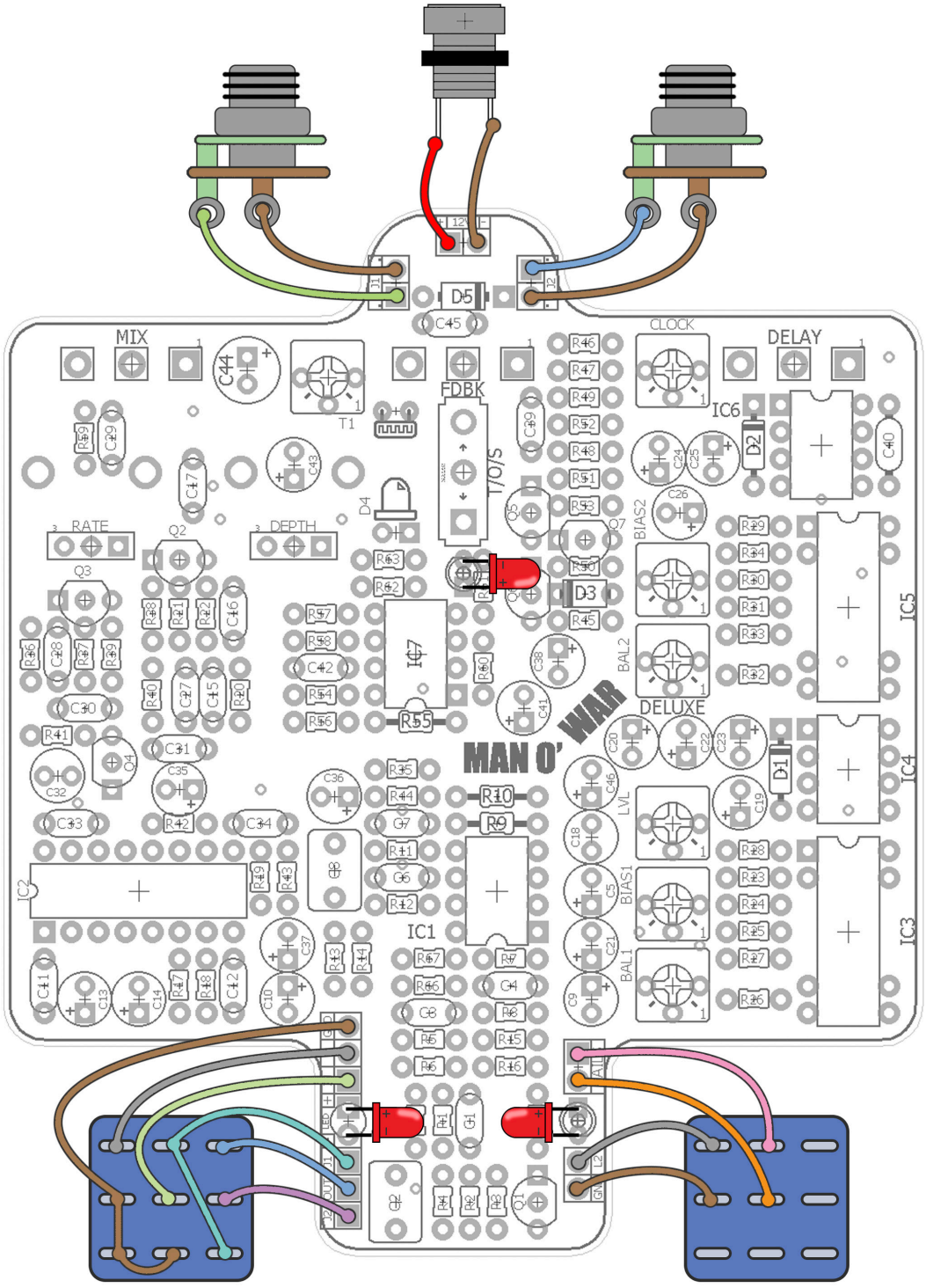
- **Tails bypass operation:** Leave the Byp switch on and use the Tails switch to toggle the effect on and off. Delay repeats will continue after the effect is turned off. In this state the effect is not true bypass.

As mentioned, the Man O' War(s) don't do self-oscillating feedback. IMO, this is due to the low output of the first half of the Compander (NE570). On a DM-2 this is typically about 3v on a 9v supply. Here it is about 3v (pin7) on a 12v supply. There may be a good reason it was done this way. Perhaps the designer thought it was better to hit the input of the first BBD with a lower amplitude signal and then use the LVL trimmer to make up volume at its output to keep the delays as clean as possible. And, yet, the Sallen-Key style filter directly after the output of the compressor portion would benefit from a higher bias voltage. But, these are guesses. I did not spend any time working through this "problem" since I like the effect as designed.

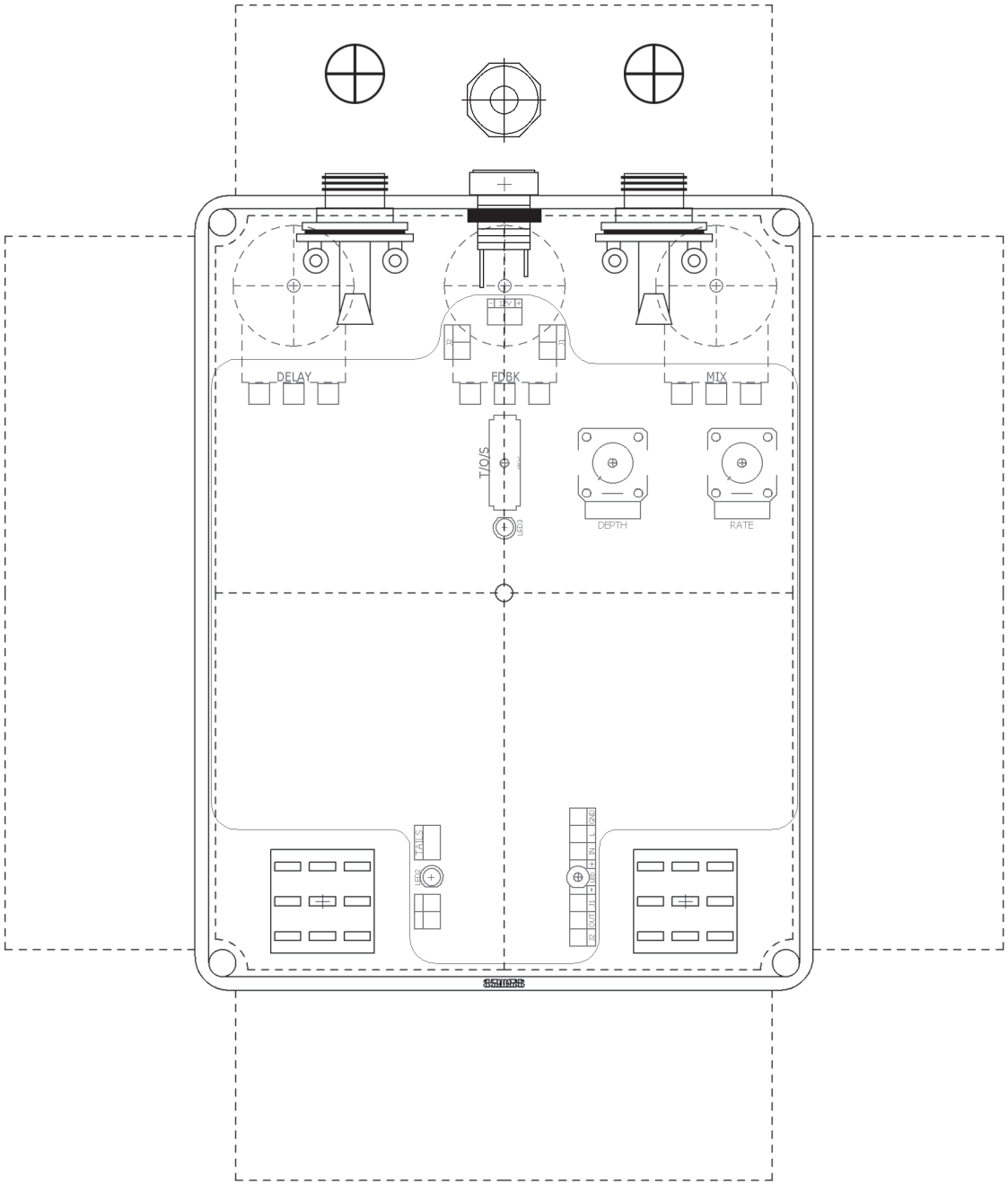
Point being, this is an area where you could try to mod the Man O' War(s) for self-oscillating feedback: by increasing the Compander output. To do this, change the values of R17 and R18. Probably 15k, 18k or 20k for both would be the starting point. Of course, you will want to socket those two resistors if you do this. It might require a re-bias on the BBDs if you calibrate it first with the stock 10k resistors.

And, since someone will ask: can you run the Man O' War(s) on 15v? You should be able to. Again, I have not done it but there is no reason it *cannot* be done. You'll want to set that compander output (pin7) for somewhere between 5v and 7v, I think. Additionally, you should increase R62 and R63 to either 8k2 or 10k. Keep in mind that it would have to be a regulated 15v and you need to take into consideration how to get that. The best way would be to use an 18v supply and make a little breakout board with a LM78L15 or LM7815 regulator plus bypass caps on the 18v input then jumper through D5.

I would not advise using a charge pump. Even though the total current draw of the effect is pretty low, it already has two clocks in it. Adding a charge pump increases the chance of clock noise and heterodyne. YMMV.


MIX
CLOCK
DELAY
FDBK
T/O/S
RATE
DEPTH
DELUXE
BIAS2
BAL2
LVL
BIAS1
BAL1
IC1
IC2
IC3
IC4
IC5
IC6
MAN O' WAR

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



The two LED bypass indicators (effect bypass and Tails bypass) as well as the modulation LED (LED3) should be soldered directly to the PCB. Place them loose in their pads. After mounting the PCB in your enclosure, move the LEDs into place in their respective holes and solder in place.

Q1	Si NPN
C	11.71
B	5.32
E	5

Q2	Si NPN
C	11.71
B	2.96
E	2.39

Q3	Si NPN
C	11.71
B	6.13
E	5.55

Q4	Si NPN
C	11.71
B	5.53
E	4.94

Q5	2n5088
C	0.472
B	0.65
E	0

Q6	2n5088
C	9.3
B	0.47
E	0

Q7	2n5087
C	9.4
B	11.58
E	11.71

IC1	4558
1	5.84
2	5.86
3	5.84
4	0
5	5.83
6	5.85
7	5.85
8	11.71

IC2	NE570
1	0.88
2	1.77
3	1.77
4	0
5	1.77
6	1.77
7	2.97
8	1.77
9	1.77
10	3.98
11	3.98
12	1.77
13	11.71
14	1.77
15	1.77
16	0.832

IC3	MN3005
1	11.71
2	5.54
3	6.04
4	6.04
5	0
6	5.51
7	6.06
8	0.755

IC4	MN3101
1	11.04
2	5.54
3	0
4	5.51
5	10.81
6	1.7
7	varies
8	0.745

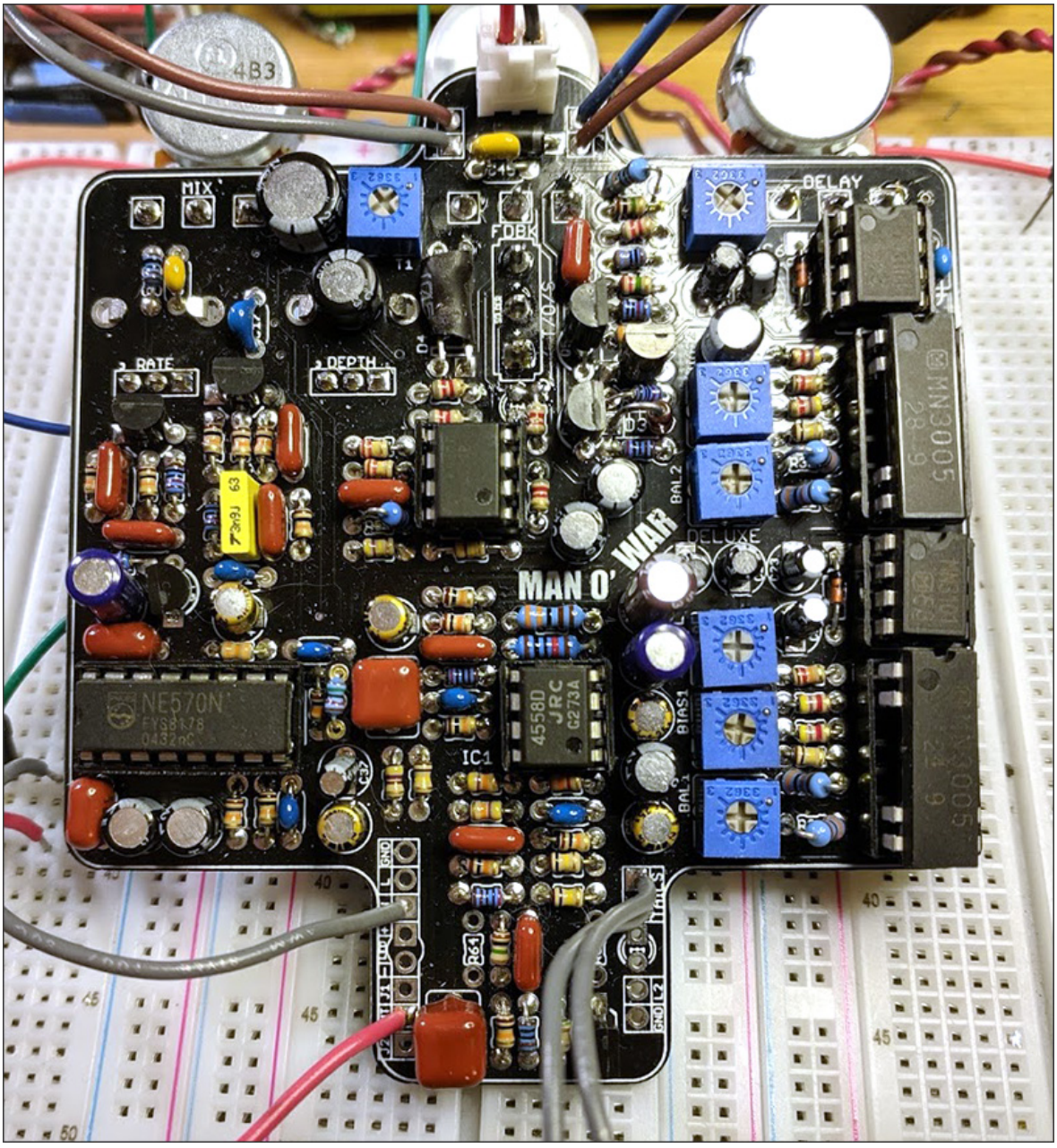
IC5	MN3005
1	11.71
2	5.58
3	6.18
4	6.16
5	0
6	5.58
7	5.96
8	0.745

IC6	MN3101
1	11.11
2	5.54
3	0
4	5.57
5	11.04
6	1.69
7	9.38
8	0.755

IC7	TL062
1	varies
2	varies
3	varies
4	0
5	varies
6	varies
7	varies
8	11.61

Delay Time	Freq (CP1)	mA
min	150kHz	33mA
max	7.6kHz	20mA

12v, well regulated supply, no bypass LEDs active. Maximum current draw: 33mA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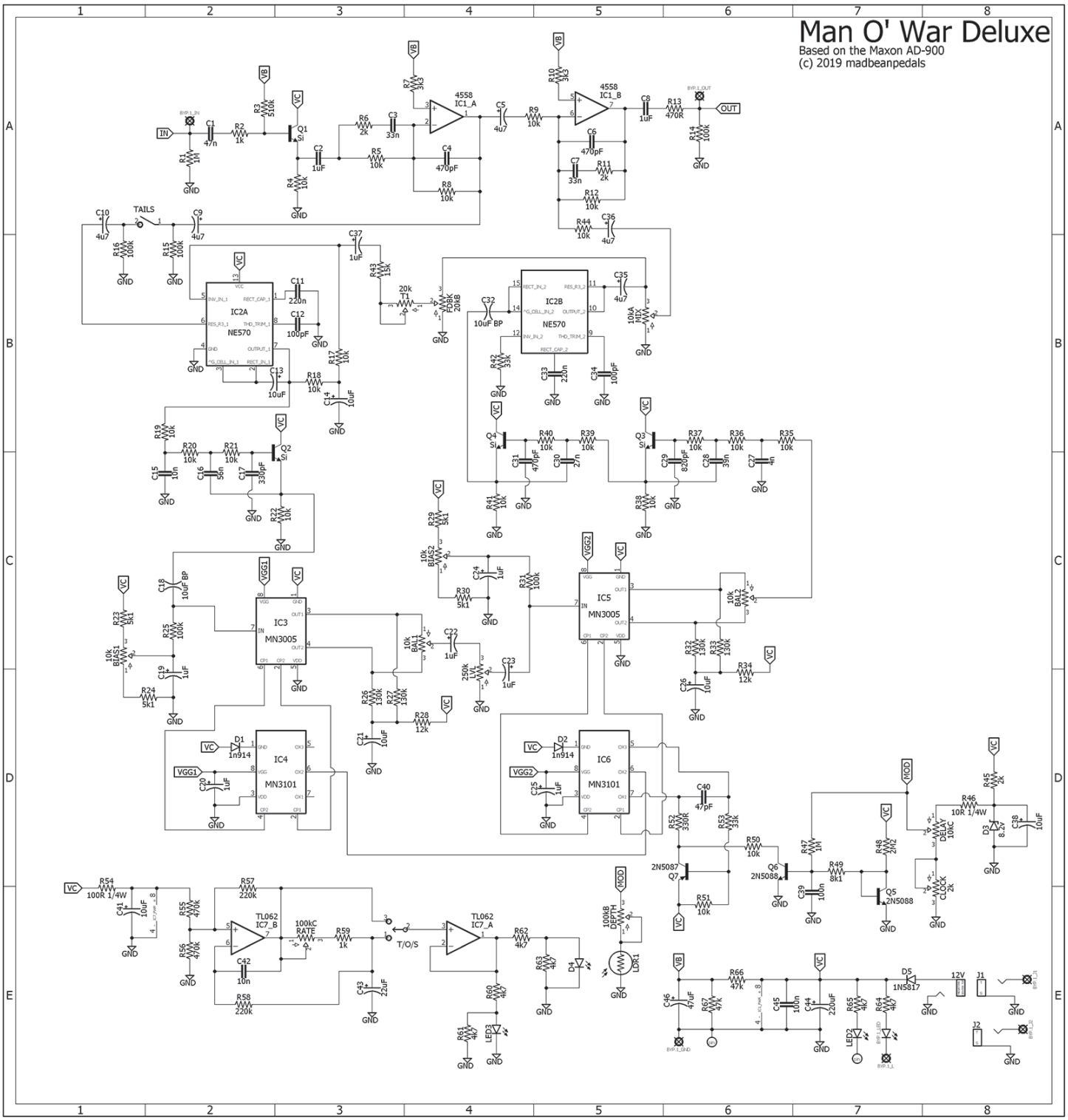
DEPTH
MAN O' WAR
DELUXE
NE570N
4558D
JRC
IC1
BIAS1
BAL1
BAL2
MN3005


Man O' War Deluxe
Based on the Maxon AD-900
(c) 2019 madbeanpedals
IC1_A
4558
IC1_B
4558
IC2A
NE570
IC2B
NE570
IC3
MN3005
IC4
MN3101
IC5
MN3005
IC6
MN3101
TL062
IC7_B
TL062
IC7_A
TAILS
T/O/S
IN
OUT
VB
VC
VGG1
VGG2
MOD
GND

Problem: When the modulation switch is set to the center position to turn modulation off, the rate LED continues to blink for a while before fading out. This also means the LED/LDR combo is active until the LED goes dark.

Cause: The IC pin attached to the center lug of the On/Off/On switch was left floating in the off position. This means any current sitting on that switch continues to drive the LEDs attached to it. Because there is a path to ground through the resistors that current will drain off but can takes several seconds.

Solution: Put a 2M2 resistor from IC7 pin3 to ground. When the switch is in the off position, this has the effect of nearly instantaneously draining that pin and making the LEDs go dark equally as fast.

Why the mistake happened: Most likely because when I originally prototyped the MoW I used an AQB MOD PCB for the modulation and no switch (rather I used a resistor in line with the LDR so the modulation essentially turned off when the depth was turned all the way down). Even though I went further and built both the MoW and MoWDX production boards in addition to my prototype I did not catch the design mistake. Most likely because those pesky LEDs stay lit in sync with the peaks of modulation. IOW, if the LED is fully lit and you put the switch to center, you have the staying lit problem. If the switch is put to off when the LED is in the fully dark part of its swing, it stays dark.

So, my apologies for the mistake. It was pretty noobish on my part and once someone reported the problem I pretty much knew right away why it was happening. Finding the easiest solution actually came from forum member Cybercow. Thank you so much for figuring this out, Mark!

Two images below:
Put a 2M2 between the pin in the orange box and one of the two ground points in the purple boxes. The lower one is a ground via and even though it is very small it is possible to solder to it if you are careful.
Second image is the fix on my build.