MAN O' WAR

FX TYPE: DELAY

Enclosure Size: 1590BB or 125BB

Based on the Maxon® AD-900™

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 is the same exact delay circuit as the Man O' War Deluxe but does not feature modulation. It is an easier and slightly less expensive build than the Deluxe version. It also uses 1/4W resistors instead of 1/8W.

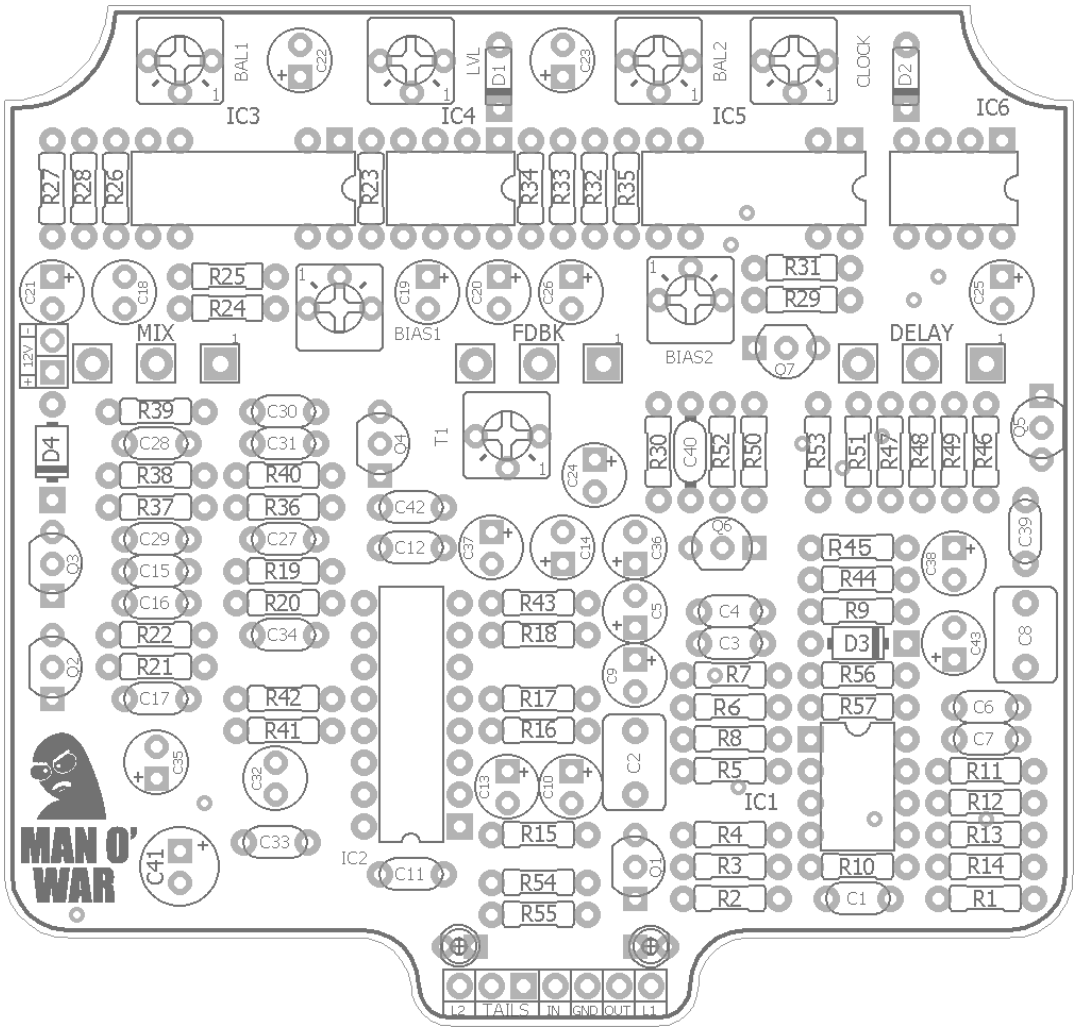
This is not a build for the novice. You should have some experience building pedals and also have a testing/prototyping rig as well as an audio probe.

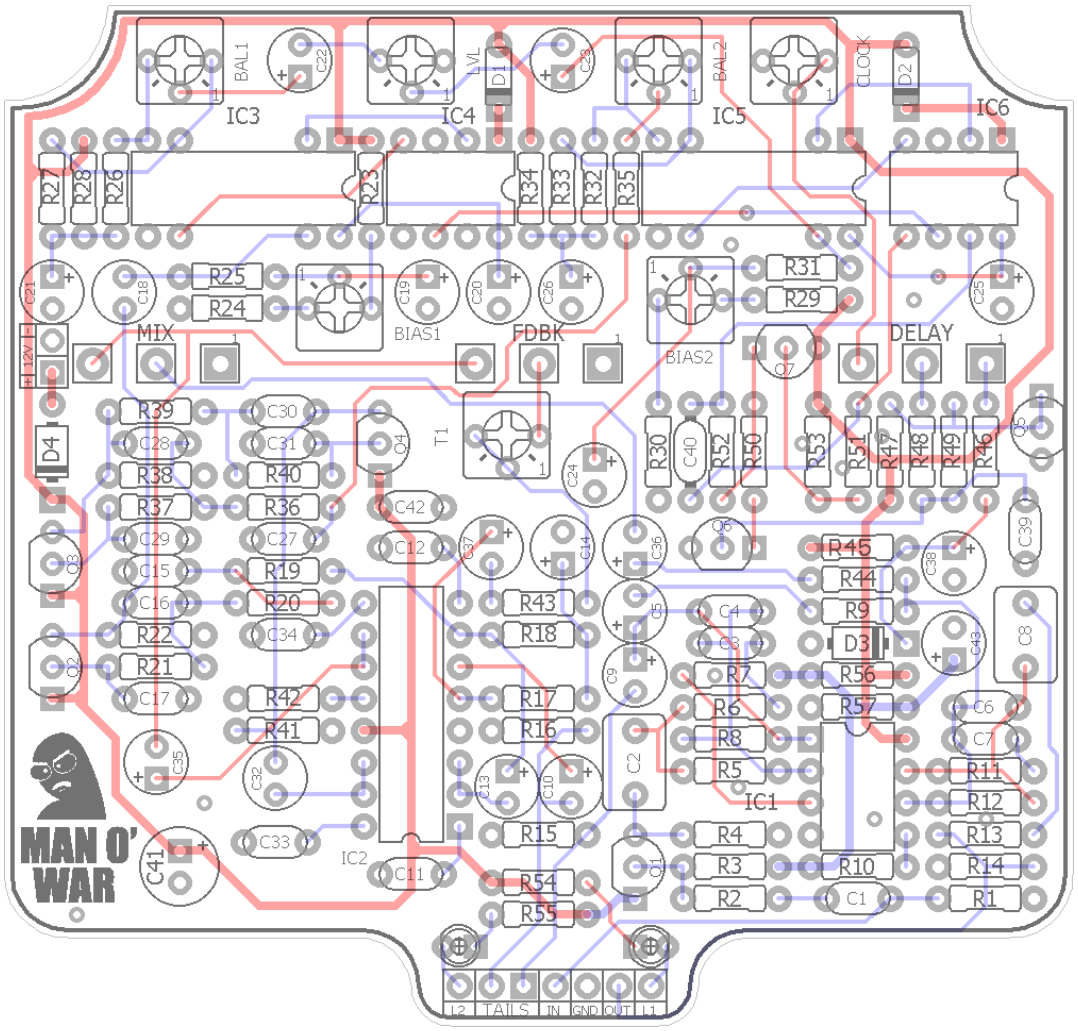
Controls

- **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.

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.

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.


IC3
IC4
IC5
IC6
BAL1
LVL
BAL2
CLOCK
MIX
BIAS1
FDBK
BIAS2
DELAY
IC1
IC2
T1
MAN O' WAR
+12V
L2
TAILS
IN
GND
OUT
L1


IC3
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IC2
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L2
TAILS
IN
GND
OUT
L1

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

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	Value	QTY	Type	Rating
10R	1	Metal / Carbon Film	1/4W	1n914	2		
330R	1	Metal / Carbon Film	1/4W	8.2v	1	Zener diode	
470R	1	Metal / Carbon Film	1/4W	1N5817	1		
1k	1	Metal / Carbon Film	1/4W	Si	4	2n5088, 2n3904, etc.	
2k	3	Metal / Carbon Film	1/4W	2N5088	2		
3k3	2	Metal / Carbon Film	1/4W	2N5087	1		
4k7	2	Metal / Carbon Film	1/4W	4558	1		
5k1	4	Metal / Carbon Film	1/4W	NE570	1	or, SA571, v571	
8k1	1	Metal / Carbon Film	1/4W	MN3005	2		
10k	21	Metal / Carbon Film	1/4W	MN3101	2		
12k	2	Metal / Carbon Film	1/4W	2k	1	Bourns 3362p	
15k	1	Metal / Carbon Film	1/4W	10k	3	Bourns 3362p	
33k	2	Metal / Carbon Film	1/4W	20k	1	Bourns 3362p	
47k	2	Metal / Carbon Film	1/4W	250k	1	Bourns 3362p	
100k	5	Metal / Carbon Film	1/4W	10kA	1	Right Angle, PCB Mount	16mm
130k	4	Metal / Carbon Film	1/4W	10kC	1	Right Angle, PCB Mount	16mm
510k	1	Metal / Carbon Film	1/4W	20kB	1	Right Angle, PCB Mount	16mm
1M	2	Metal / Carbon Film	1/4W				
2M2	1	Metal / Carbon Film	1/4W				
47pF	1	MICA / 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.				
3n9	1	Film	25v min.				
10n	1	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.				
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	5	Electrolytic	25v min.				
10uF BP	2	Bi-Polar	25v min.				
47uF	1	Electrolytic	25v min.				
220uF	1	Electrolytic	25v min.				

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=sGAEpiMZZMvygUB3GLcD7kddhVJPyV2kST8Lo8GI%252B%2F8%3D

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

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:** Min
- **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

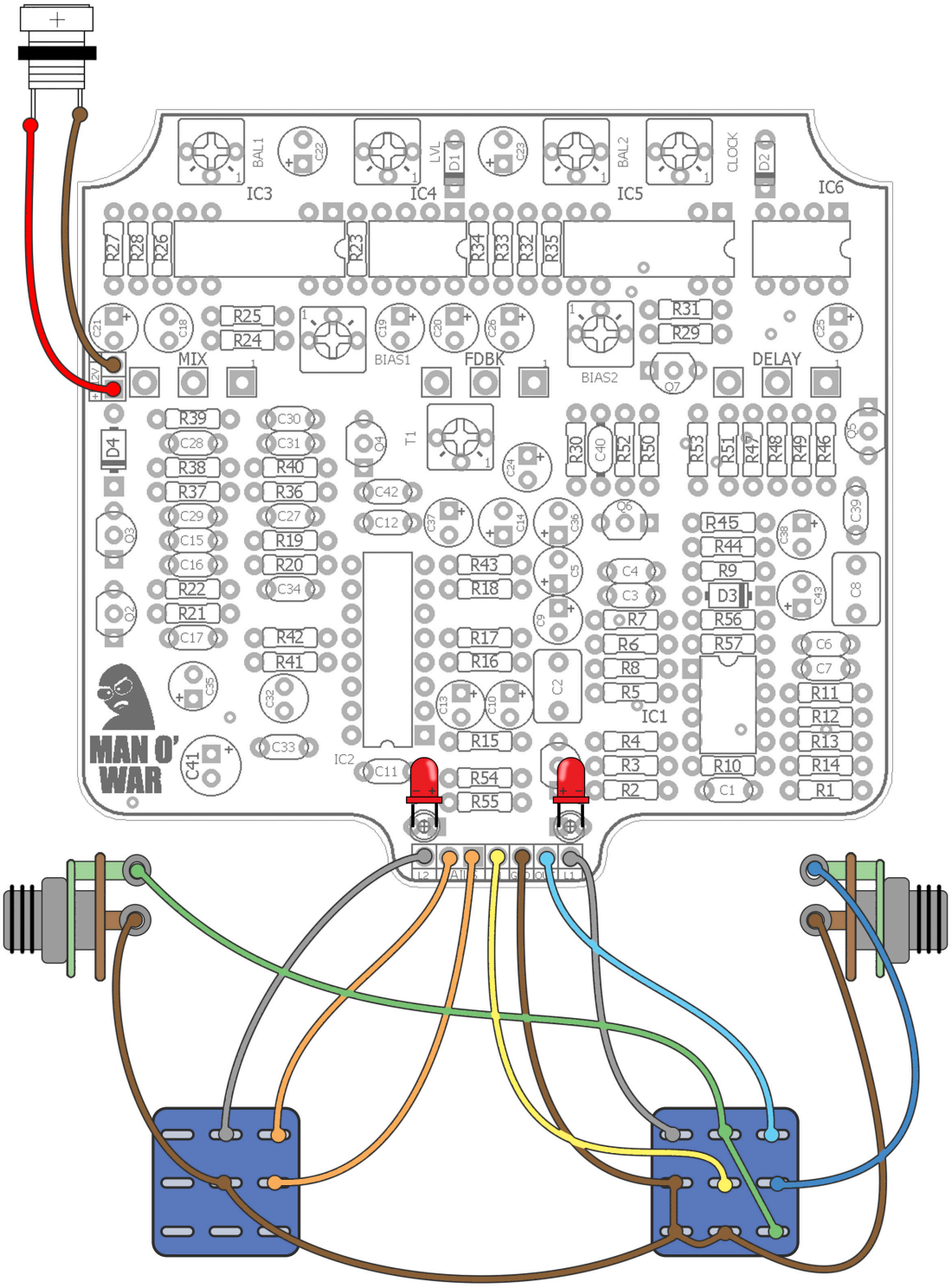
- **True bypass operation:** Leave the Tails switch on and use the Byp switch for on/off. Delay repeats will cut off when the effect is bypassed.

- **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.

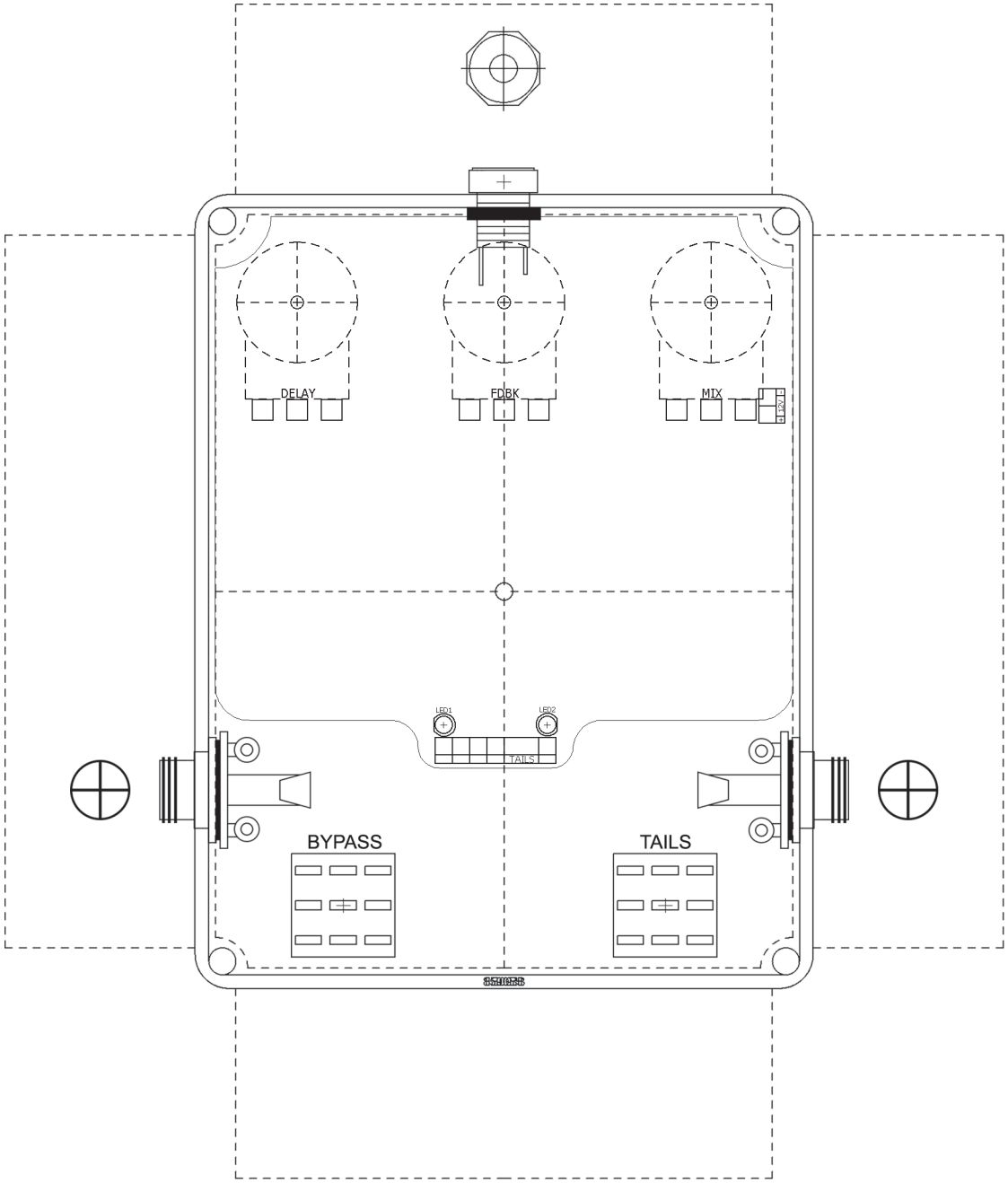
As mentioned, the Man O' War(s) don't do self-oscillating feedback. IMO, this is due to the low output of the first half of the Compander (NE570). On a DM-2 this is typically about 3v on a 9v supply. Here it is about 3v (pin7) on a 12v supply. There may be a good reason it was done this way. Perhaps 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 . 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.


IC3
IC4
IC5
IC6
BAL1
BAL2
LVL
CLOCK
MIX
BIAS1
FDBK
BIAS2
DELAY
IC1
IC2
MAN O' WAR

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



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

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

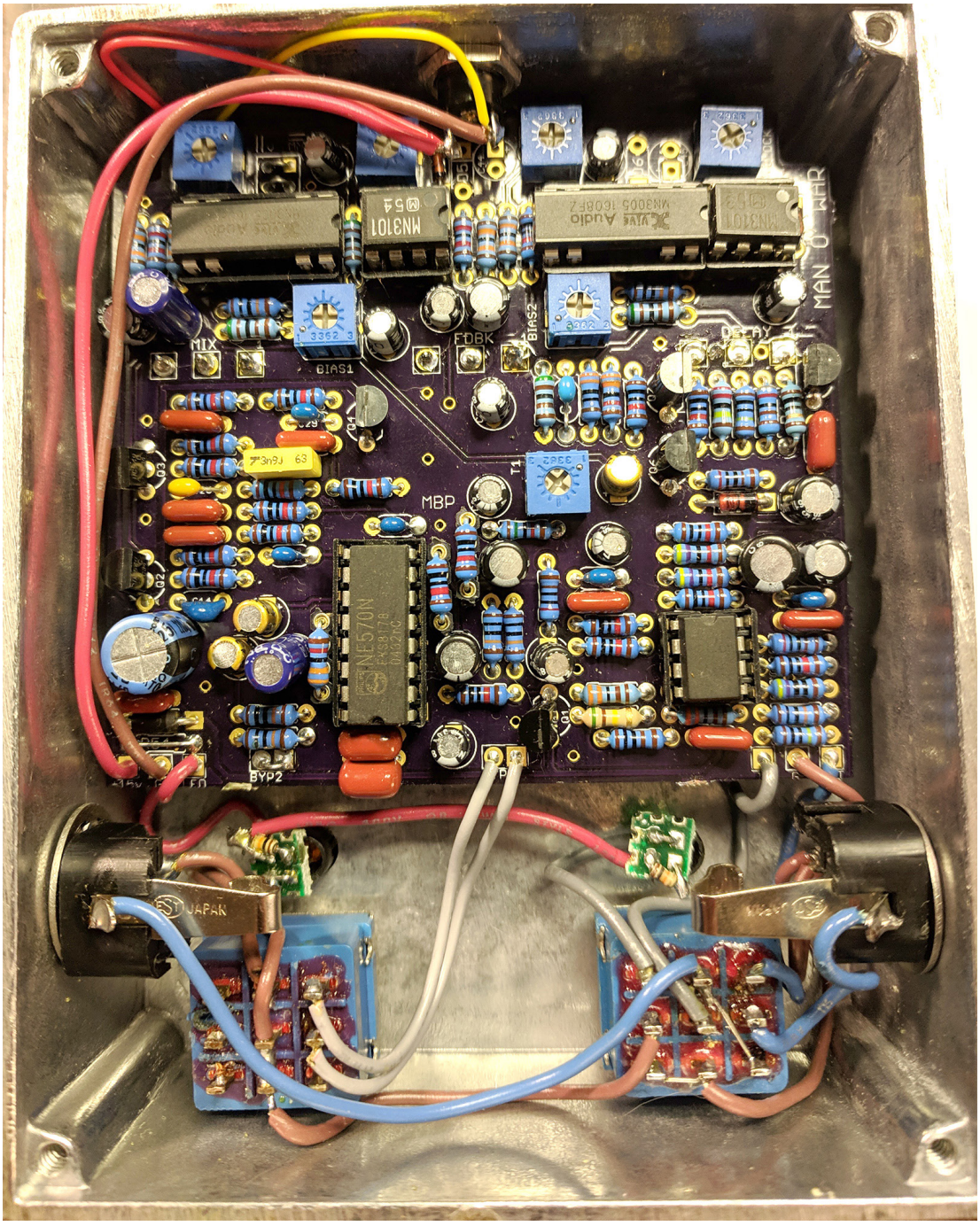
IC4	MN3101
1	11.04
2	5.54
3	0
4	5.51
5	10.81
6	1.7
7	varies
8	0.745

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

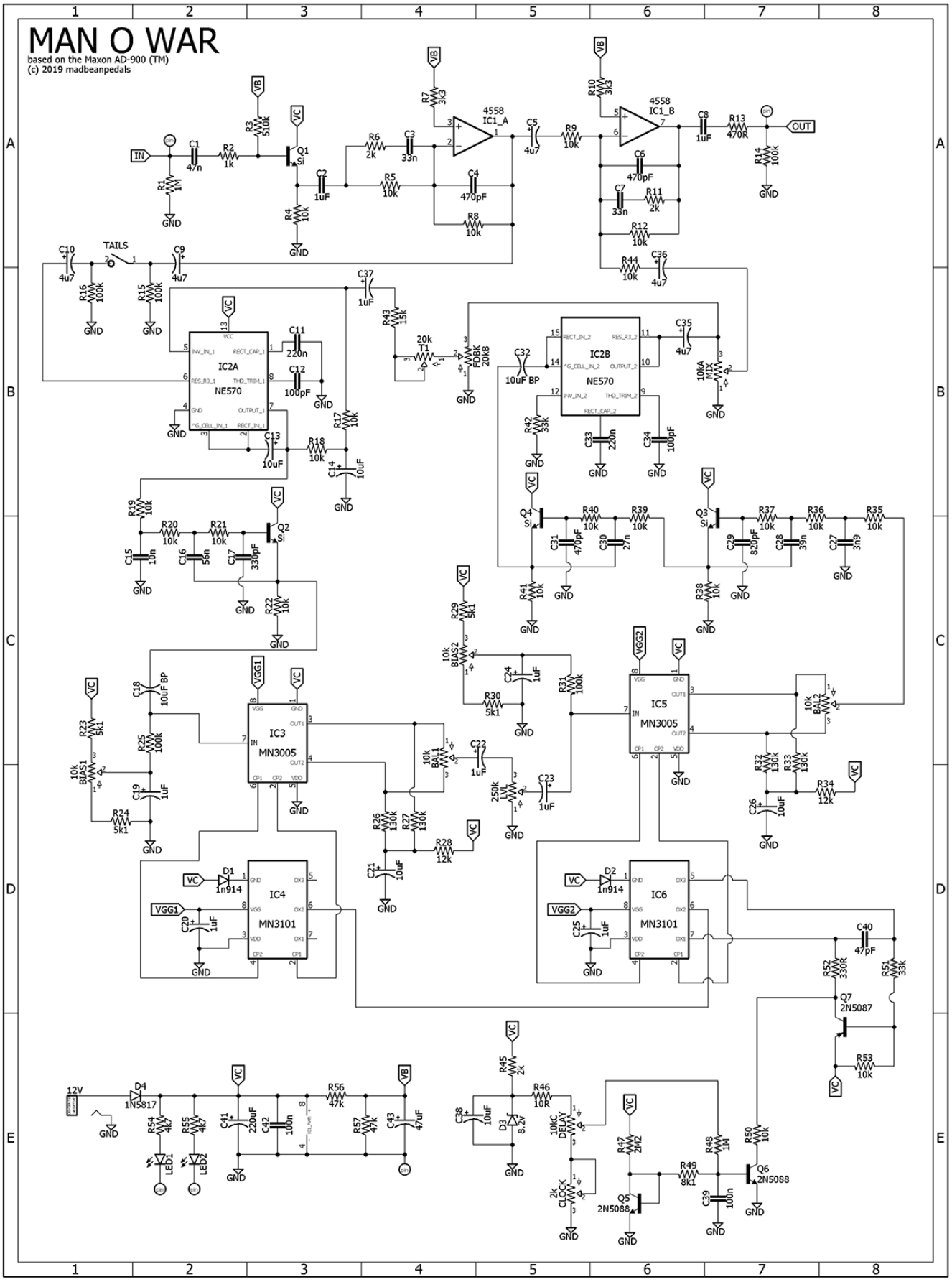
IC6	MN3101
1	11.11
2	5.54
3	0
4	5.57
5	11.04
6	1.69
7	9.38
8	0.755

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

12v, well regulated supply, no bypass LEDs active. Maximum current draw: 33mA



This prototype design is very old. I think I did it around 2013 and did not get around to completing it until 2018. It includes modulation with an AQB_MOD board mounted under the main PCB. Since this was a pretty big hassle, I ended designing two versions of the Man O War - with and without modulation.


MAN O WAR
based on the Maxon AD-900 (TM)
(c) 2019 madbeanpedals
IN
OUT
TAILS
4558
IC1_A
4558
IC1_B
IC2A
IC2B
NE570
IC3
IC4
IC5
IC6
MN3005
MN3101
Q1
Q2
Q3
Q4
Q5
Q6
Q7
2N5087
2N5088
D1
D2
D3
D4
1N914
1N5817
8.2V
LED1
LED2
12V
VB
VC
VGG1
VGG2
GND