The Aquababy is nearly identical to the Aquaboy project, but shrunk down to fit in a 1590B enclosure. This is a good project if you want an analog delay in the smallest enclosure possible, or if you just want a new challenge. This project does compromise from its counterpart in that it requires 1/8W resistors and wired pots.

It is possible to include modulation on the Aquababy...if you are a total DIY masochist!

Controls

MIX – The ratio of delay vs. clean signal.
FDBK – The number of delay repeats. Maximum FDBK setting will induce self-oscillation.
Delay – Delay time from slap-back to about 300ms.
Bias – Used to set the proper bias on the input of the MN3005 for it to produce clean delay.
Cancel – Sets the mix of the two delay outputs on the MN3005.
Clock – Sets the correct clock frequency range produced by the MN3101 to drive the BBD delay lines in the MN3005

Calibration

Make the following adjustments before beginning:

Mix control at center.
Delay at max position.
FDBK at about 1/3 up.
*BIAS and Cancel trimpots to their center position.*
If you have frequency measurement on your DMM, adjust the Clock trimmer to about 6.5kHz while probing either pin2 or pin4 of IC5. If you don't have this feature set the Clock trim half-way up (note: this is when using a 9v supply).

Audio probe pin3 of IC3 while either strumming the guitar or send some audio through the input of the circuit. Adjust the BIAS trimmer until you get delay passing. The range over which the trimmer will result in delay is usually about 1/4 to 1/6 of its entire rotation. Continue refining the position of BIAS until you get the smallest amount of distortion on the delay signal. Now probe pin4 of IC3 to confirm it is also passing delay. If it does not, make sure that you have clock frequency on both pins 2 and 6.

Now finely adjust the CLOCK trimmer until just before you hear any high pitch whine in the audio path. This is the maximum delay setting. The clock frequency should land somewhere between 6 and 7 kHz.

Unless you are using an oscilloscope to calibrate the delay, leave the Cancel trim in the center position.

Layout &Traces
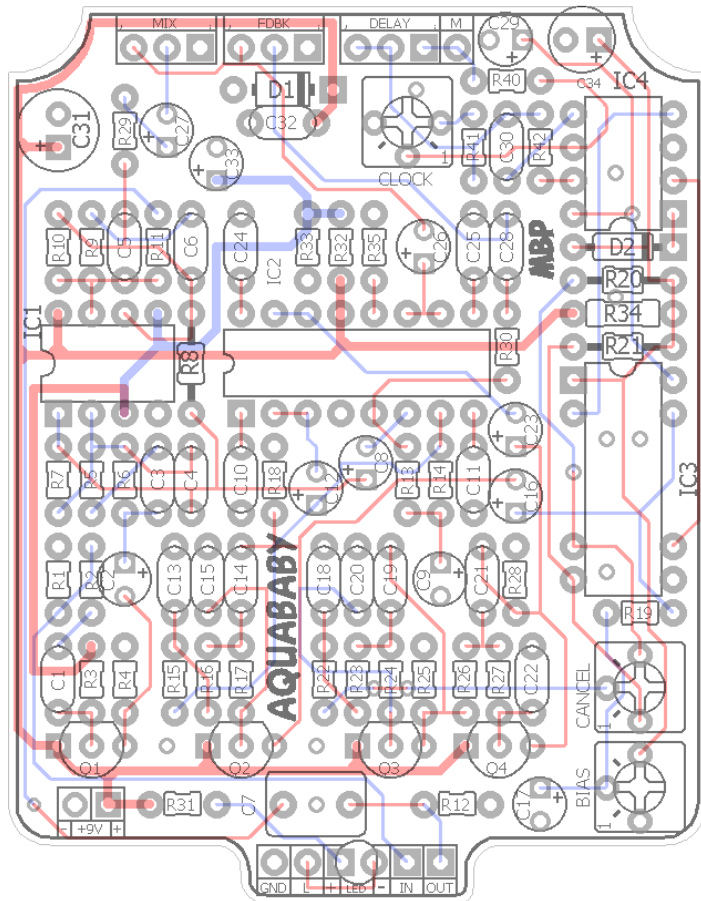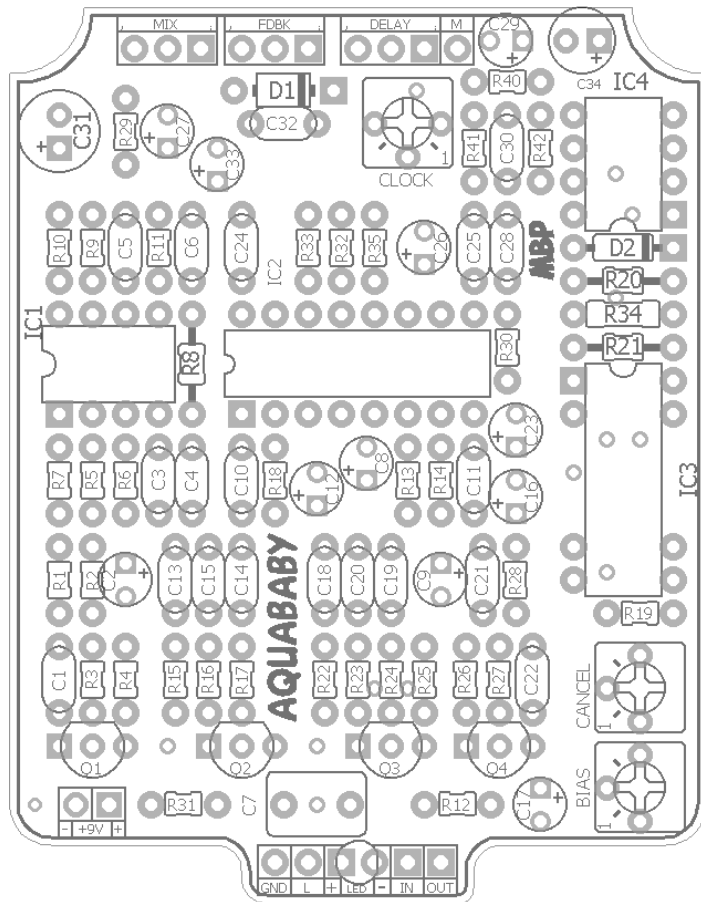
B.O.M.

Resistors		Caps		Diodes	
R1	1M	C1	47n	D1	1N4001
R2	10k	C2	1uF	D2	1n914
R3	470k	C3	6n8	**Transistors**	
R4	10k	C4	100pF	Q1	MPSA18
R5	10k	C5	100pF	Q2	MPSA18
R6	47k	C6	6n8	Q3	MPSA18
R7	47k	C7	1uF	Q4	MPSA18
R8	47k	C8	10uF	**IC**	
R9	10k	C9	10uF	IC1	4558
R10	47k	C10	220n	IC2	NE570
R11	470R	C11	100pF	IC3	MN3005
R12	100k	C12	10uF	IC4	MN3101
R13	10k	C13	6n8	**Trimmers**	
R14	10k	C14	82n	BIAS	20k
R15	10k	C15	330pF	CANCEL	10k
R16	10k	C16	1uF	CLOCK	1M
R17	10k	C17	1uF	**Pots**	
R18	10k	C18	2n2	DELAY	1MB
R19	100k	C19	33n	FDBK	50kB
R20	100k	C20	1n	MIX	50kB
R21	100k	C21	39n		
R22	10k	C22	330pF		
R23	10k	C23	1uF		
R24	10k	C24	220n		
R25	10k	C25	100pF		
R26	10k	C26	1uF		
R27	10k	C27	1uF		
R28	10k	C28	100n		
R29	47k	C29	1uF		
R30	22k	C30	100pF		
R31	10k	C31	100uF		
R32	10k	C32	100n		
R33	10k	C33	10uF		
R34	22R 1/4W	C34	22uF		
R35	*see notes				
R40	18k				
R41	10k				
R42	22k				

Shopping List

Value	QTY	Type	Rating
22R	1	Metal / Carbon Film	1/4W
470R	1	Metal / Carbon Film	1/8W
10k	21	Metal / Carbon Film	1/8W
18k	1	Metal / Carbon Film	1/8W
22k	2	Metal / Carbon Film	1/8W
47k	5	Metal / Carbon Film	1/8W
100k	4	Metal / Carbon Film	1/8W
470k	1	Metal / Carbon Film	1/8W
1M	1	Metal / Carbon Film	1/8W
100pF	5	Ceramic / MLCC	25v min
330pF	2	Ceramic / MLCC	25v min
1n	1	Film	25v min
2n2	1	Film	25v min
6n8	3	Film	25v min
33n	1	Film	25v min
39n	1	Film	25v min
47n	1	Film	25v min
82n	1	Film	25v min
100n	2	Film	25v min
220n	2	Film	25v min
1uF	1	Film	25v min
1uF	7	Electrolytic	25v min
10uF	4	Electrolytic	25v min
22uF	1	Electrolytic	25v min
100uF	1	Electrolytic	25v min
1N4001	1		
1n914	1		
MPSA18	4	or, other BJT	
4558	1		
NE570	1		
MN3005	1		
MN3101	1		
20k	1	Bourns 3362p	
10k	1	Bourns 3362p	
1M	1	Bourns 3362p	
1MB	1	Solder Lug	16mm
50kB	2	Solder Lug	16mm

- You can use either 20k or 25k for the trimmer if you cannot get a 22k.
- You can use either NOS MN3005 (if you have one) or the new Xvive reproduction MN3005. No, I do not know where you can buy genuine NOS MN3005…sorry!
- You can use other BJT like 2n3904 or 2n5088 for the MPSA18. Just mind the pinouts if subbing transistors.
- Using a silver mica or MLCC type cap for C30 (100pF) will produce optimal results (due to tighter tolerance).

Parts Guide

Mini 1uF electrolytic caps (recommended but not absolutely necessary):
https://www.mouser.com/ProductDetail/Lelon/SG010M1HBK-0407P?qs=%2Fha2pyFadug8BwuCWCMjxIcLopjZQ3XC-J7%2FDZotRQwdYDLhCTplE8Q%3D%3D

MPSA18:
http://smallbear-electronics.mybigcommerce.com/transistor-mpsa18/

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

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

MN3101 (currently out of stock):
http://smallbear-electronics.mybigcommerce.com/ic-mn3101/

Bourns 3362p 22k:
https://www.mouser.com/ProductDetail/Bourns/3362P-1-223LF?qs=sGAEpiMZZMvygUB3GLcD7v%2F2K2JTtKgbVP-DHLENkzyQ%3D

Bourns 3362p 10k:
https://www.mouser.com/ProductDetail/Bourns/3362P-1-103LF?qs=sGAEpiMZZMvygUB3GLcD7k%252Bod3ZqvEIQboR-RPdOKB6M%3D

Bourns 3362p 1M:
https://www.mouser.com/ProductDetail/Bourns/3362P-1-105LF?qs=sGAEpiMZZMvygUB3GLcD7kddhVJPyV2kST-8Lo8GI%252B%2F8%3D

16mm Solder Lug pots:
http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-solder-terms-linear-audio-taper/

If you want to build the Aquababy with modulation like I did (see my build pic later in this doc) this is the dual pot I used:
http://smallbear-electronics.mybigcommerce.com/alpha-dual-gang-9mm-pc-mount-dual-concentric/

Notes

R35 is not used on the DM-2, but some analog delays do use a resistor there. Supposedly it can improve the THD from the compander although I have yet to hear an actual difference (perhaps it's only be detectable on a scope). In any case, if you want to try it yourself, use a 20k resistor for R35. Otherwise just leave it empty.

Like the Aquaboy, you can run the Aquababy at 15v, but it might be very difficult to fit a charge pump in such a small enclosure. If you intend to run the Aquababy at 15v, change R13 and R14 to 36k from 10k.
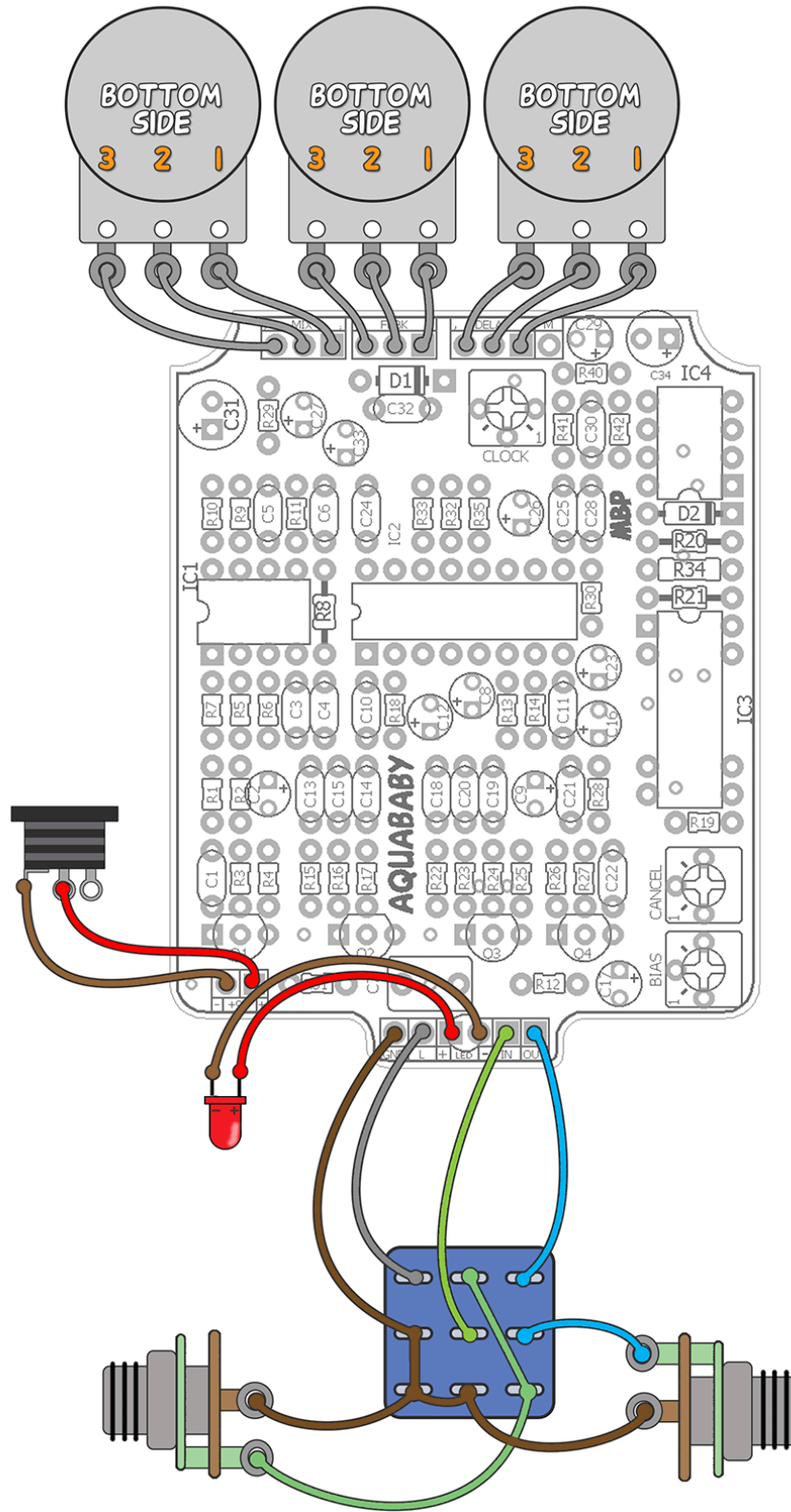
1590B Drill Guide - 3 pots
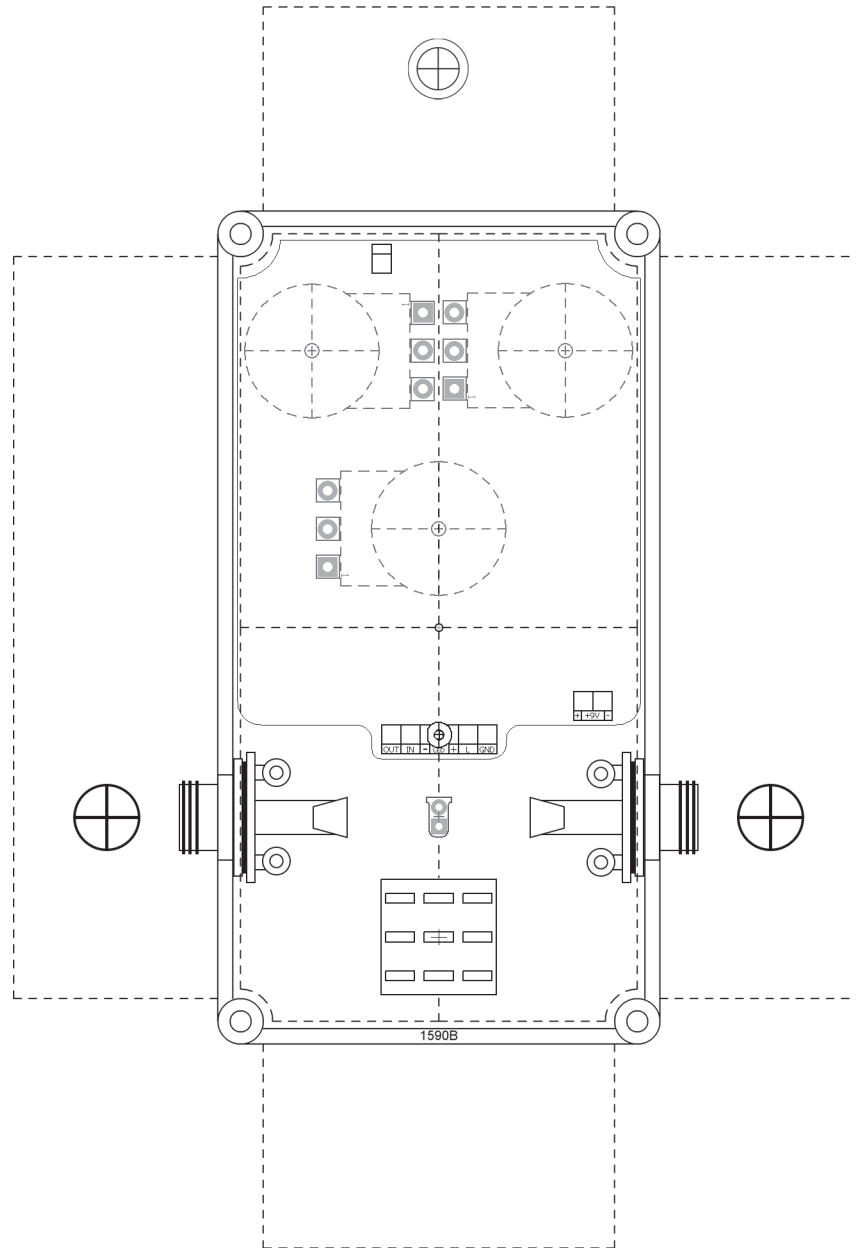
1590B

1590B Drill Guide - 4pots
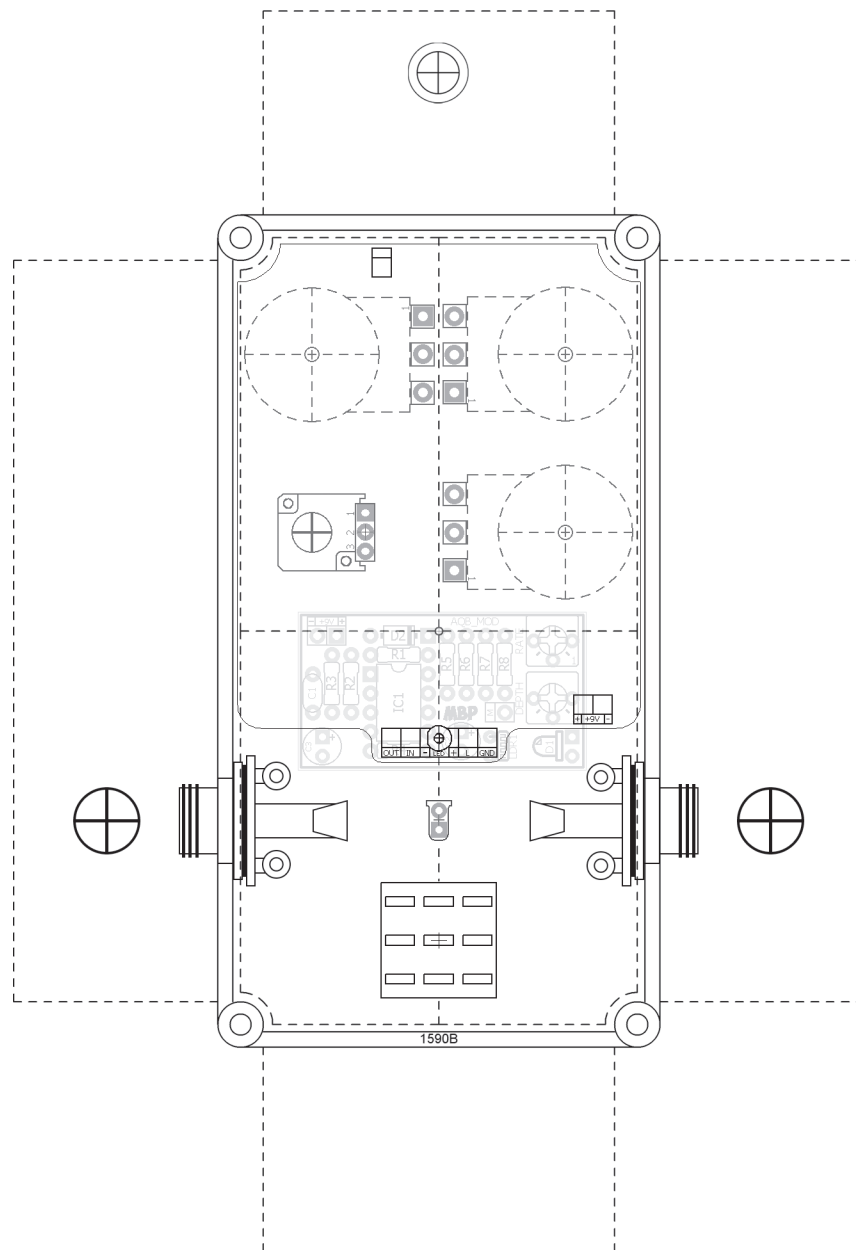
If you are a real glutton for punishment and want to try the dual concentric pots for modulation.

Build Pic
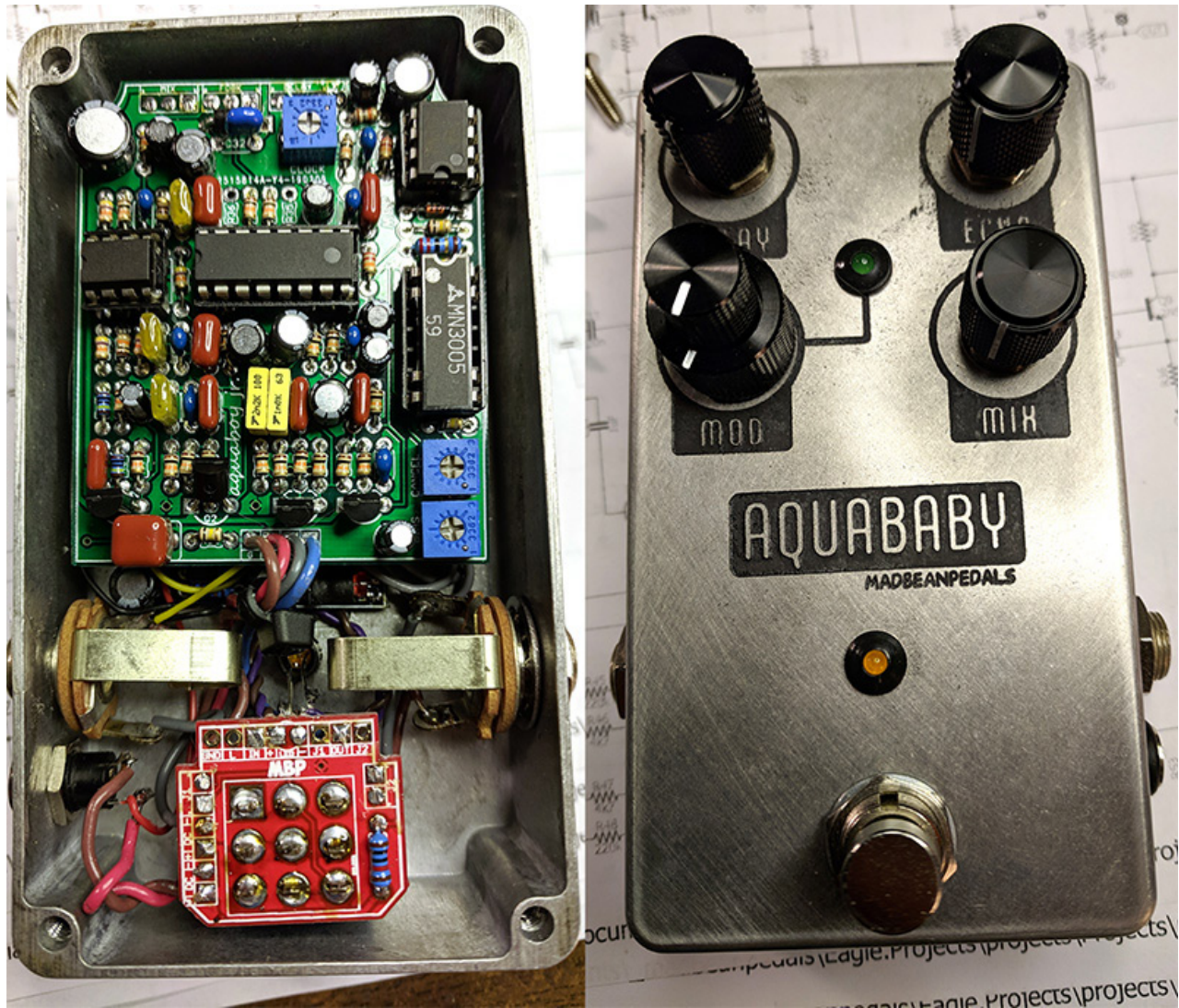
For my prototype build, I went all out and included modulation using an AQB_MOD board. I used one of the 100kB dual concentric pots and knobs from smallbear. Since there was no room for a switch to turn the modulation off, I opted to include a series resistor. This is the wiring I used for the mod board. I did use a 1550B instead of 1590B enclosure, though.
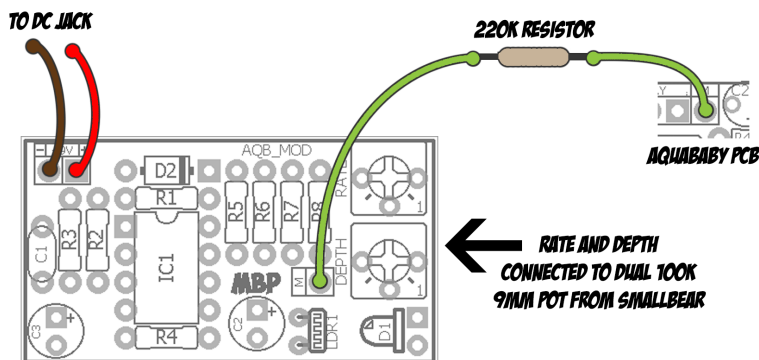
I don't remember the exact value I used for the resistor. It might have been 220k or smaller. The idea is to pick the right value so when the Depth is turned all the way down the modulation is essentially cut-off. To be clear: I do not recommend trying modulation with the Aquababy unless you are really patient and experienced!

Voltages

IC1	4558	IC2	NE571	IC3	MN3005	IC4	MN3101
1	4.7	1	0.92	1	9.37	1	8.76
2	4.7	2	1.84	2	4.39	2	4.39
3	4.7	3	1.84	3	4.69	3	0
4	0	4	0	4	4.68	4	4.39
5	4.7	5	1.84	5	0	5	3.88
6	4.7	6	1.83	6	4.38	6	4.72
7	4.7	7	3.03	7	4.27	7	4.25
8	9.41	8	1.84	8	0.59	8	0.59
		9	1.84				
		10	3.1				
		11	3.1				
		12	1.84				
		13	9.41				
		14	1.84				
		15	1.84				
		16	0.9				

One Spot: 9.42vDC - Current Draw: 13mA
Clock Frequency: 6.44kHz at max Delay setting

Clock frequency depends on where the Clock trim is set.
IC3 pin7 depends on where the Bias trim is set.

Schematic

AQUABABY
Based on the Boss DM-2 (TM)
(c) 2019 madbeanpedals

+9V

VD — R34 22R 1/4W — C34 22uF — GND

VB — R33 10k — C33 10uF — R32 10k — C32 100n — C31 100uF — D1 1N4001 — R31 10k — GND

VC

BYP_GND BYP_LED BYP_⊥

IC1_A 4558

IN — BYP_IN — R2 10k — R1 1M — GND — C1 47/n — R3 470k — Q1 MPSA18 — R4 10k — GND — C2 1uF — C3 6n8 — R5 10k — R6 47k — C4 100pF — R7 47k — GND

IC1_B 4558 — R8 47k — C5 100pF — C6 6n8 — R9 10k — R10 47k — R11 470R — C7 — BYP_OUT — OUT — R12 100k — GND

R30 22k — C28 100n — FDBK 50kB — GND

IC2A NE570
INV_IN_1 5 — RECT_CAP_1 1 — C10 220n
RES_R3_1 6 — THD_TRIM_1 8 — C11 100pF — GND
GND 4 — OUTPUT_1 7
^G_CELL_IN_1 3 — RECT_IN_1 2 — C12 10uF
VCC — VC
C9 10uF — GND — R13 10k — R14 10k
C8 10uF — GND

IC2B NE570
RECT_IN_2 15 — RES_R3_2 11
^G_CELL_IN_2 14 — OUTPUT_2 10 — C26 1uF
INV_IN_2 12 — THD_TRIM_2 9 — C25 100pF — GND
RECT_CAP_2 — C24 220n — GND
R35 — GND
50kB MIX — C27 1uF — R29 47k — GND

R15 10k — R16 10k — R17 10k — Q2 MPSA18
C13 6n8 — GND — C14 82n — GND — C15 330pF — GND — R18 10k — GND — VC

R22 10k — R23 10k — R24 10k — Q3 MPSA18
C18 2n2 — GND — C19 33n — C20 1n — GND — R25 10k — GND — VC

R26 10k — R27 10k — Q4 MPSA18
C21 39n — GND — C22 330pF — GND — C23 1uF — R28 10k — GND — VC

IC3 MN3005
VGG 8 — GND 1
IN 7 — OUT1 3
— OUT2 4
CP1 6 — CP2 2 — VDD 5
CP1 — CP2 — GND
VGG — VD
C16 1uF — R19 100k — 20k BIAS — C17 1uF — GND — VD

10k CANCEL — R20 100k — R21 100k — VD

IC4 MN3101
GND 1 — OX3 5
VGG 8 — OX2 6
VDD 3 — OX1 7
CP2 4 — CP1 2
VGG — VD — D2 1n914 — C29 1uF — GND
MOD — 1MB DELAY — R40 18k — CLOCK 1M — R41 10k — C30 100pF — R42 22k
CP2 — CP1