TotalRecall

FX Type: **ANALOG DELAY**
Build Level: Very Advanced
Based On: EHX® Deluxe Memory Man™

Last Updated: April 24, 2024 9:38 AM

Overview

The **Total Recall** project was originally released in 2015. It was designed as an accurate reproduction of the big box version of the Deluxe Memory Man™ (with a couple small features missing). Following the release of the Tourbus and Skoolie projects (positive and negative ground versions for 125B) my intention was to discontinue the 2015 Total Recall. However, after a little more consideration I thought it would be fun to offer an updated project closer to the outward appearance and with all the features of the original Memory Man™.

This latest version has the same control layout as the big box Memory Man™ and adds the missing Direct Out option and the overload LED from the 2015 project. Whereas the 2015 version required a 24vDC supply, the updated project only requires 18vDC 100mA. The circuit is still positive ground, so it does require that 18v tap to be fully isolated. Power supplies like the One Spot CS12 and Pedal Power II already have this option available, as well as others. The PCB design has also been upgraded to a 4-layer layout for low noise operation.

The updated version does not have an option for four MN3008 in place of two MN3005. Since the Xvive MN3005 repros are now widely available, this is no longer necessary. This version also has a larger footprint. It requires either a 1790NS or 1590XX enclosure. I've included a link to a 1590XX drill template made available through the Tayda Electronics drill service should you want to order a pre-drilled enclosure from them.

Audio Controls

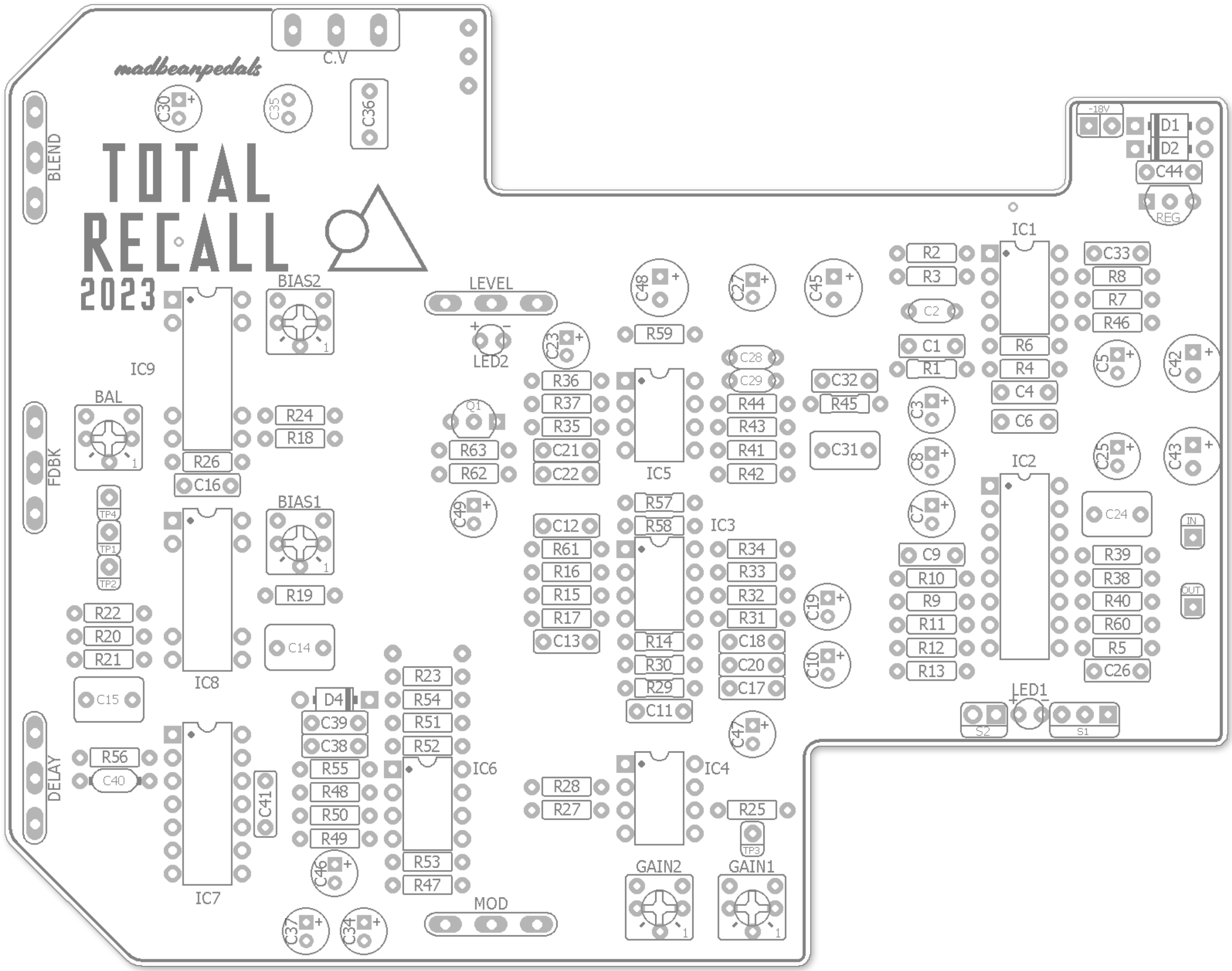
- **DELAY:** Total delay time from slap-back to approximately 550ms.
- **FDBK:** The total number of repeats from one to many to self-oscillation.
- **LEVEL:** The input gain of the circuit. This control can create mild overdrive when turned up. It also increases the output volume of the effect.
- **BLEND:** The dry/wet ratio of dry signal and delay.
- **MOD:** The depth of modulation applied to the delay signal. The modulation rate is fixed via the C.V switch. There's also an option to extend the modulation with a Rate control which eliminates the toggle switch altogether.
- **C.V.:** This switches between chorus (slow) and vibrato (fast) type modulation.

Biasing Controls

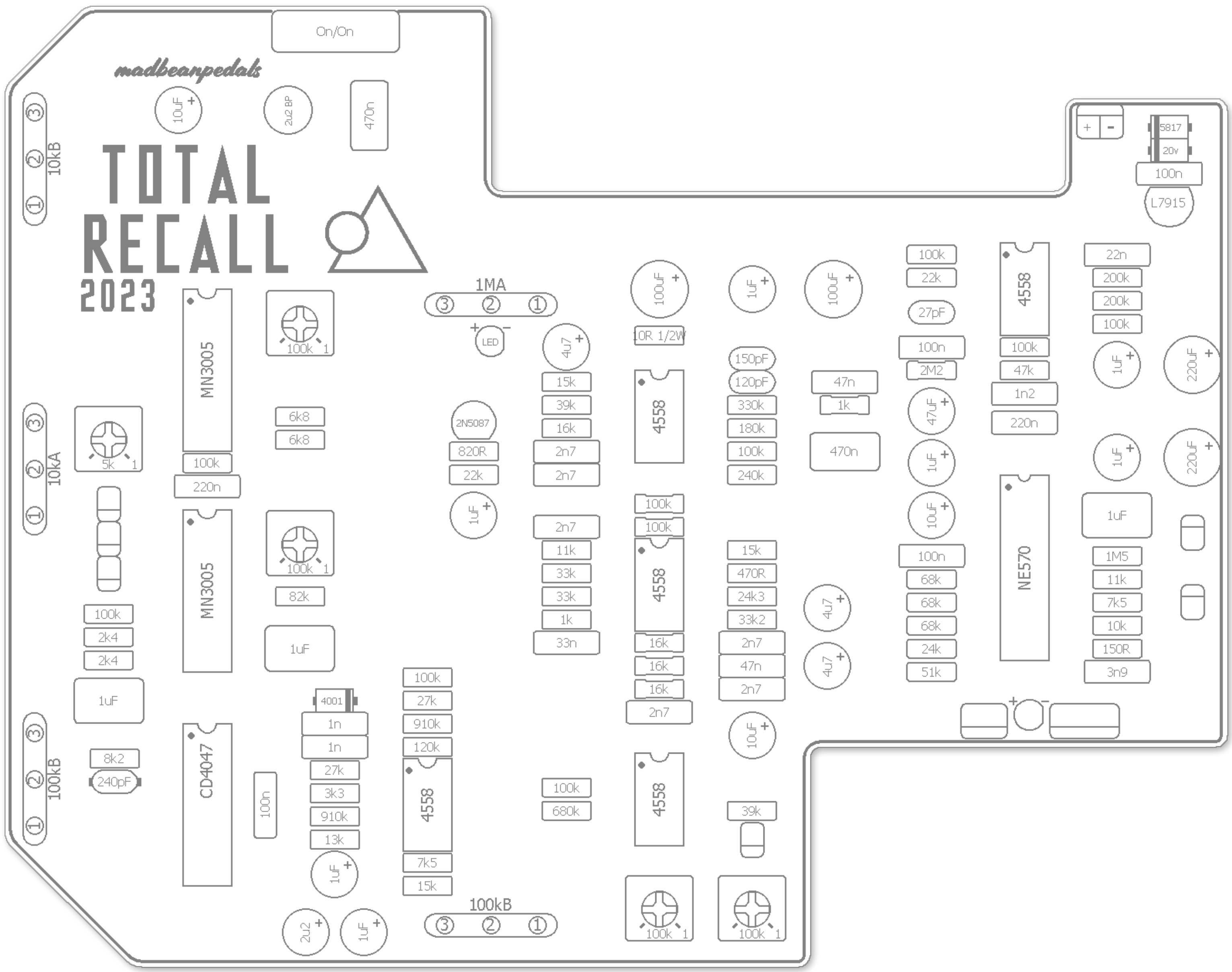
- **BIAS1, 2:** These trimmers set the input bias voltage of the BBD chips.
- **GAIN1, 2:** These trimmers set the gain recovery after BBD1 and BBD2.
- **BAL:** This trimmer balances the two outputs of the second BBD for minimum phase cancellation and clock bleed.

Further study:
https://pedaltown.nl/en/electro-harmonix-memory-man-a-brief-history
https://sites.google.com/site/davidmorrinoldsite/home/trouble/troubleeffects/electro-harmonix-memory-man
https://catalinbread.com/blogs/kulas-cabinet/electro-harmonix-deluxe-memory-man
https://www.perfectcircuit.com/signal/ehx-memory-man-series
https://www.tinkercitymusic.com/gearheads/2017/4/20/the-king-of-analog-delays-electro-harmonix-deluxe-memory-man

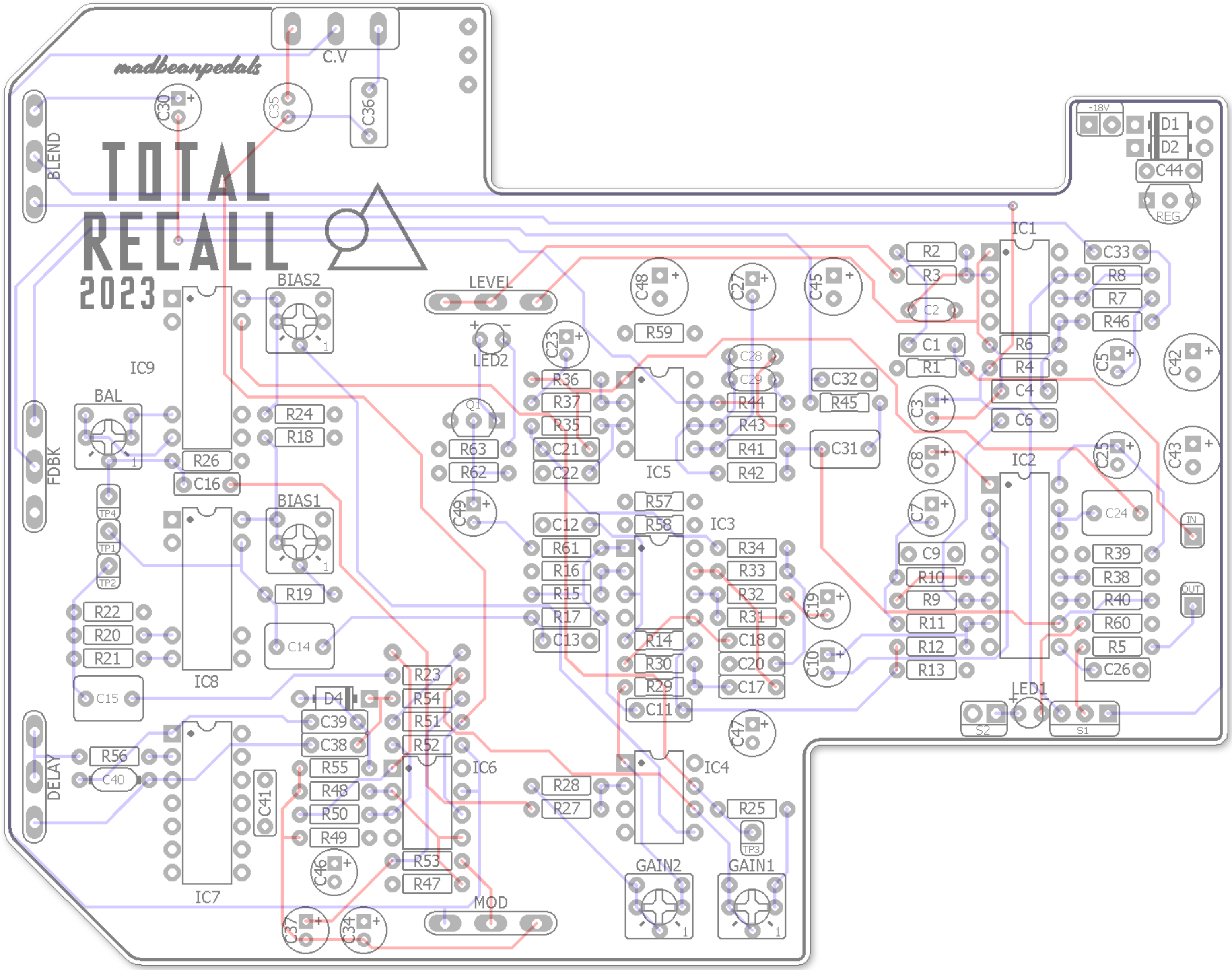
Parts Layout



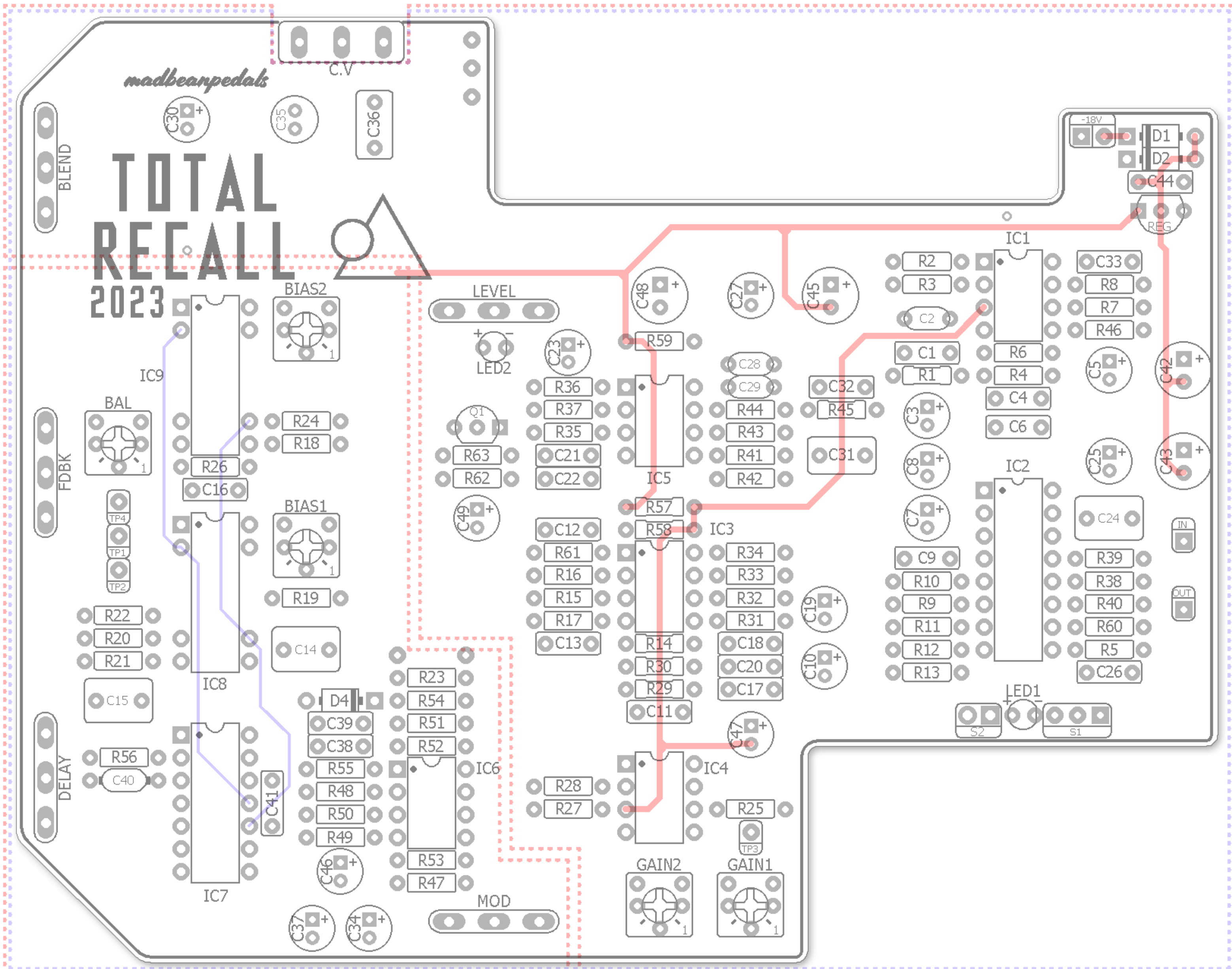
Component Values



Outer Traces



Inner Traces



B.O.M.

Resistors		Resistors		Caps		Caps		IC	
R1	2M2	R33	470R	C1	100n	C34	1uF	IC1	4558
R2	100k	R34	15k	C2	27pF	C35	2u2 BP	IC2	NE570
R3	22k	R35	16k	C3	47uF	C36	470n	IC3	4558
R4	47k	R36	15k	C4	1n2	C37	2u2	IC4	4558
R5	150R	R37	39k	C5	1uF	C38	1n	IC5	4558
R6	100k	R38	11k	C6	220n	C39	1n	IC6	4558
R7	200k	R39	1M5	C7	10uF	C40	240pF	IC7	CD4047
R8	200k	R40	7k5	C8	1uF	C41	100n	IC8	MN3005
R9	68k	R41	100k	C9	100n	C42	220uF	IC9	MN3005
R10	68k	R42	240k	C10	4u7	C43	220uF	**Switch**	
R11	68k	R43	180k	C11	2n7	C44	100n	C.V	On/On
R12	24k	R44	330k	C12	2n7	C45	100uF	**Trimmers**	
R13	51k	R45	1k	C13	33n	C46	1uF	BAL	5k
R14	16k	R46	100k	C14	1uF	C47	10uF	BIAS1	100k
R15	33k	R47	15k	C15	1uF	C48	100uF	BIAS2	100k
R16	33k	R48	3k3	C16	220n	C49	1uF	GAIN1	100k
R17	1k	R49	13k	C17	2n7	**Diodes**		GAIN2	100k
R18	6k8	R50	910k	C18	2n7	D1	1n5817	**Pots**	
R19	82k	R51	910k	C19	4u7	D2	20v Zener	FDBK	10kA
R20	2k4	R52	120k	C20	47n	D4	1n4001	BLEND	10kB
R21	2k4	R53	7k5	C21	2n7	LED1	any	DELAY	100kB
R22	100k	R54	27k	C22	2n7	LED2	Red	MOD	100kB
R23	100k	R55	27k	C23	4u7	**Transistors**		LEVEL	1MA
R24	6k8	R56	8k2	C24	1uF	Q1	2N5087		
R25	39k	R57	100k	C25	1uF	**Regulators**			
R26	100k	R58	100k	C26	3n9	REG	L7915		
R27	680k	R59	10R 1/2W	C27	1uF				
R28	100k	R60	10k	C28	150pF				
R29	16k	R61	11k	C29	120pF				
R30	16k	R62	22k	C30	10uF				
R31	33k2	R63	820R	C31	470n				
R32	24k3			C32	47n				
				C33	22n				

Shopping List

Note: A 1/4W 10R resistor can be used in place of 1/2W.

Value	QTY	Type	Rating	Value	QTY	Type	Rating
10R	1	Carbon / Metal Film	1/2W	1n	2	Film	25v min.
150R	1	Carbon / Metal Film	1/4W	1n2	1	Film	25v min.
470R	1	Carbon / Metal Film	1/4W	3n9	1	Film	25v min.
820R	1	Carbon / Metal Film	1/4W	2n7	6	Film	25v min.
1k	2	Carbon / Metal Film	1/4W	22n	1	Film	25v min.
2k4	2	Carbon / Metal Film	1/4W	33n	1	Film	25v min.
3k3	1	Carbon / Metal Film	1/4W	47n	2	Film	25v min.
6k8	2	Carbon / Metal Film	1/4W	100n	4	Film	25v min.
7k5	2	Carbon / Metal Film	1/4W	220n	2	Film	25v min.
8k2	1	Carbon / Metal Film	1/4W	470n	2	Film	25v min.
10k	1	Carbon / Metal Film	1/4W	1uF	10	Film	25v min.
11k	2	Carbon / Metal Film	1/4W	2u2 BP	1	Electrolytic, Bi-Polar	25v min.
13k	1	Carbon / Metal Film	1/4W	2u2	1	Electrolytic	25v min.
15k	3	Carbon / Metal Film	1/4W	4u7	3	Electrolytic	25v min.
16k	4	Carbon / Metal Film	1/4W	10uF	3	Electrolytic	25v min.
22k	2	Carbon / Metal Film	1/4W	47uF	1	Electrolytic	25v min.
24k	1	Carbon / Metal Film	1/4W	100uF	2	Electrolytic	25v min.
24k3	1	Carbon / Metal Film	1/4W	220uF	2	Electrolytic	25v min.
27k	2	Carbon / Metal Film	1/4W	1n5817	1		
33k	2	Carbon / Metal Film	1/4W	Zener	1	20v	1W
33k2	1	Carbon / Metal Film	1/4W	1n4001	1		
39k	2	Carbon / Metal Film	1/4W	LED	1	any	5mm
47k	1	Carbon / Metal Film	1/4W	LED	1	Red	5mm
51k	1	Carbon / Metal Film	1/4W	2N5087	1		
68k	3	Carbon / Metal Film	1/4W	L7915	1		
82k	1	Carbon / Metal Film	1/4W	NE570	1		
100k	10	Carbon / Metal Film	1/4W	4558	5		
120k	1	Carbon / Metal Film	1/4W	CD4047	1		
180k	1	Carbon / Metal Film	1/4W	MN3005	2		
200k	2	Carbon / Metal Film	1/4W	5k	1	Bourns 3362p or 6mm	
240k	1	Carbon / Metal Film	1/4W	100k	4	Bourns 3362p or 6mm	
330k	1	Carbon / Metal Film	1/4W	SPDT	1	On/On, Solder Lug or PCB Pin	
680k	1	Carbon / Metal Film	1/4W	10kA	1	PCB Right Angle	16mm
910k	2	Carbon / Metal Film	1/4W	10kB	1	PCB Right Angle	16mm
1M5	1	Carbon / Metal Film	1/4W	100kB	2	PCB Right Angle	16mm
2M2	1	Carbon / Metal Film	1/4W	1MA	1	PCB Right Angle	16mm
27pF	1	Ceramic / MLCC	25v min.				
120pF	1	Ceramic / MLCC	25v min.				
150pF	1	Ceramic / MLCC	25v min.				
240pF	1	Ceramic / MLCC / Mica	25v min.				

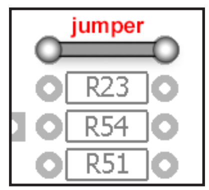
Build Notes

The population and building of this project isn't much more difficult than any other DIY pedal. There are lots of parts, obviously, but plenty of space to work with. What makes this an "advanced" build is the setup and calibration. For that reason, I don't recommend this project for novice builders. You should be comfortable working with multimeters and audio probes (in case you need to debug). The calibration itself can be done by ear or scope depending on what resources you have.

Like the DMM™, the Total Recall is not true bypass. The LEVEL control is active in bypass and can be used to drive the front end of an amp (or whatever else you might have after the pedal). Conversion to true-bypass is not difficult but that it left up to the builder should they want to implement it.

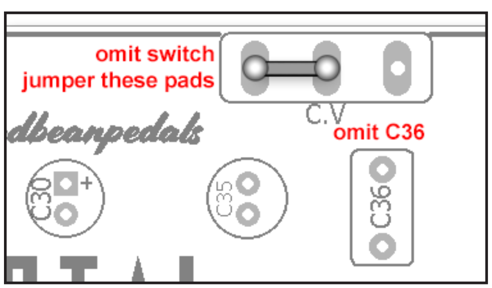
Like the DMM™, the Total Recall does not have any sort of clock calibration. This wasn't available until some of the more recent offerings form EHX®. There are a couple things you can do to ensure you get the most delay time range out of the build. One is to use as close to 100k as possible for the Delay pot. I used my multimeter to check about 10 different 100kB pots I had on hand and found one of those that fell right at 100k. A tiny bit more or less is okay. Just don't used one that measures 85k, for example.
The second is to use a MICA cap for C40. These usually have a tolerance of +/- 5%, whereas film or ceramic can deviate as far as 10% or more. 240pF in MICA isn't all that common, but I have use 250pF several times without issue.

The Total Recall has two modulation options. The first option is for stock modulation, which uses Depth control and CV switch. In this setup, the CV switch changes between two fixed modulation speeds: chorus and vibrato. To use the stock modulation, solder a jumper between the pads just above R23:

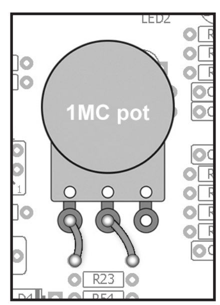


The second option ditches the CV switch and uses a pot for continuous Rate control. For this mod, do the following:

(1)



(2)



Wire a 1MC 16mm pot under the PCB as shown.

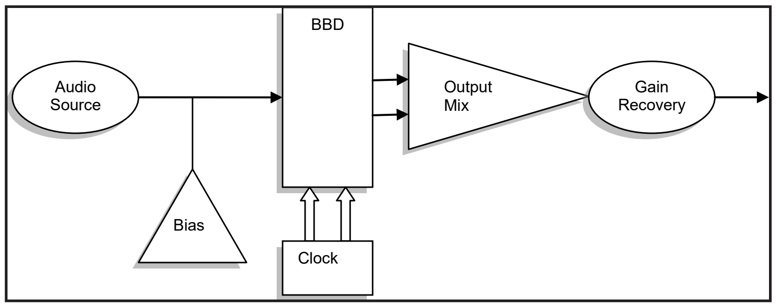
(3)

Make R51 120k instead of 910k (use 68k for super fast rates).

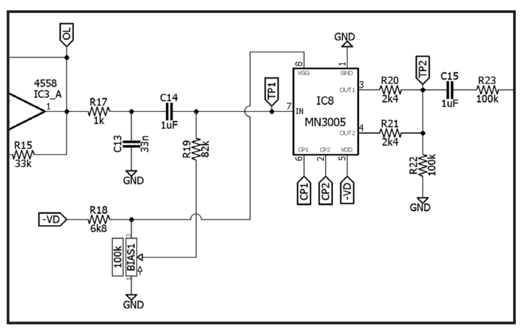
There are two ways to bias the Total Recall. One is by ear and the other is with an oscilloscope. This document will show you how to do it by ear. For scope biasing there are a few guides online the give lots of detail on how to do the procedure.

Here is one guide you might find useful for scope calibration: https://sites.google.com/a/davidmorrin.com/www/home/trouble/troubleeffects/electro-harmonix-memory-man/eh-7850/eh-7850-calibration

Before biasing, let's understand what we are doing and why. The bucket-brigade device (BBD) requires a bias voltage applied to its input in order to pass a delayed signal. This is done via a trimmer set up as a voltage divider connected to the power supply. An audio source is applied to the BBD input (pin7) and the trimmer is adjusted until we get a result on the two outputs of the chip (pins 3 and 4). The output is the delayed signal where the delay time is controlled by the two out-of-phase clock signals (pins 2 and 6) generated by the CD4047 and processed through the sequential "bucket" steps. The two outputs are mixed together and then sometimes sent to a gain recovery stage. This helps make up any volume loss introduced by the sequential steps in the BBD (2048 steps for MN3008 and 4096 for MN3005). After the gain recovery, the signal is sent to the next BBD and the same process is repeated.

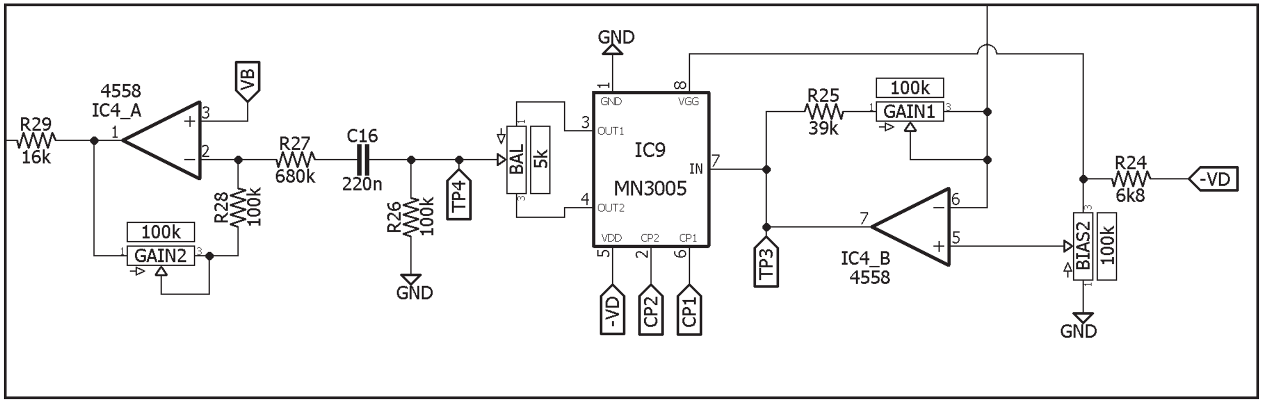


Let's compare that to a circuit snippet from the TR schematic.



Our audio source comes in at C14 and goes to pin7 of IC8. BIAS1 is our voltage divider also connected to pin7. CP1 and CP2 are the two clock signals, pins1 and 5 are ground and power resp., pin8 is the Vgg voltage (in this case it is set to -14vDC) and our outputs come from pins 3 and 4. These are mixed with another voltage divider created by R41 - R43.

Build Notes



The gain recovery stage starts at IC4_B. It is fed through an inverted gain stage with a trimmer to adjust the output volume. Here the biasing is done differently with the bias voltage applied to the non-inverted input of the op-amp. At the outputs, we have a new trimmer, BAL. This trimmer is used to align the two output waveforms for minimum phase cancellation and minimal clock bleed. After the BAL trimmer the signal gets sent to the second and final gain recovery stage.

Testing

Before you load a single IC, you should check for power. Hook up your supply voltage and take some voltage readings. I suggest you start with the LM7915 and make sure it's getting about -18v in and outputting around -15v.

Note for the instructions below: whenever you are loading or removing ICs, you should temporarily disconnect the power supply, then re-connect it after the IC is in place. This prevents any possible damage that can occur from live swapping.

Once proper supply voltage is confirmed, I suggest loading the ICs onto the PCB sequentially. Start with IC1, make sure you have -15v on pin4, disconnect power, add IC2, check for -15 on pin4, and so forth. If at any point in this process the supply voltage suddenly drops, you'll know exactly which IC is causing it. IOW, it takes out guess work. You'll still need to check your soldering and potentially replace a bad IC if you've got one.

From here, do some audio probing. First check pin1 of IC1 to make sure there is an audio signal and the LEVEL control is responding (meaning that the audio level increases as the LEVEL control is turned up). Probe pin6 of IC2 for input and pin7 of IC2 for output. The signal at pin7 will be much louder - that's okay. Finally, probe pin1 of IC3 to confirm audio is present and feeding into the first BBD, IC8. Now rough calibration can begin.

Calibration by ear

This part requires an audio probe

The Total Recall has four testing points labeled TP1-TP4. At this stage, we are going to do a rough calibration by ear. We'll refine it later. You'll want to have all ICs loaded except IC9. Leave all trimmers in their mid position and set the pots on the PCB as follows: LEVEL at 1/3rd, FDBK and MOD at 0, DELAY and BLEND at max.

1. Audio probe TP1 for signal. This verifies that audio is passing to the input of the first BBD (IC8).

2. Now probe TP2. Adjust BIAS1 until you get the cleanest delayed output possible. It's usually around the middle of the trimmer.

3. Go to TP3. Adjust GAIN1 so that audio level is about the same the level that you had at TP1.

4. Power off and add IC9. Power back up.

5. Go to TP4. Adjust BIAS2 until you get the cleanest delayed output possible from IC9. You may need to make a slight adjustment on GAIN1 to achieve this. Leave BAL and GAIN2 in the middle for the time being.

6. At this point, you can check all the controls for function. Turn the FDBK knob up for multiple repeats and the BLEND to 1/2 to hear a mix of clean and delay signal. Check the DELAY knob range, check the MOD knob for modulation.

7. Next we''ll set the Total Recall for self-oscillation control. This means the delay signal adds to itself in a positive feedback cycle and each repeat increases in volume and distortion. Be careful with this since the volume level can get out of control quickly. Set the LEVEL control to about 1/3rd. Set the FDBK control to from 1/2 to 3/4th up. Now adjust the GAIN2 trimmer back and forth so that the FDBK control goes into self-oscillation at its current setting. You can adjust and refine this setting to your liking. The "overload" LED should light up, as well.

8. Make any final adjustments to the trimmers to improve the level and clarity of the repeats. You cannot adjust the BAL trimmer by ear, so leave it in the middle. This completes calibration "by ear".

For reference, the clock range (measured at any CP1 or CP2 connection) on my build is:
Min delay: ~75kHz / Max delay: ~8.4kHz

FREQ. RESPONSE CHECK #1

- LEVEL: Observe first MN3005 pin 7, turn down until 1.5V p-p
- INPUT: Change freq. to 900Hz, 2.5kHz and 3.8KHz as per instructions.
- Slowly increase the input frequency. The response at pin 7 of the MN3005 should be flat up to about 9OOHz, rise to a max. of about 2V p-p at around 2.5KHz at which point the overload light should glow dimly, drop back to 1.5V p-p at_ about 3.8KHz and roll off sharply above this.

BBD BIAS

- INPUT: 250Hz
- TRIM 2 (GAIN): 50%
- Connect the scope to pin 7 of the second 4558, which is also the wiper of the first gain trimpot.

TRIM 1 (BIAS 1)

- Set for maximum unclipped signal
- Increasing the level setting as necessary, set the first bias trim for maximum p-p unclipped signal.

TRIM 2 (GAIN 1)

- Set for unity.
- Decrease signal level and set the gain to unity (output level = input level). The output level before clipping should be 3.8V p-p or greater.
- Vary the delay over its full range and if clipping becomes very unsymmetrical at either end, trim the bias a bit for a good compromise over the range. It is normal to see a lot of clock noise at the highest frequencies.

TRIM 3 (BALANCE/CANCEL)

- Adjust for minimum clock signal (maximum clock cancellation).

TRIM 4 (BIAS 2)

- Set for maximum unclipped signal.
- The second MN3005 is aligned in the same way as the first , except that the clock balance trim is carefully set for min. clock frequency at its wiper at maximum delay (min clock frequency) setting. This should be done before fine trimming the bias for symmetrical clipping and again after the bias is finally set, with the input signal to the unit disconnected and the scope gain high.

TRIM 5 (GAIN 2)

- Unity between NE570 pins 14/15 and 7.
- Set the 2nd gain trim last looking at pins 14 and 15 of the NE570 and setting this trim so that the signal is equal in level to that at pin 7 of the 570. If this can't be done, go as far as the trimmer permits and re-adjust the first gain trim to achieve it.

FREQ. RESPONSE CHECK #2

- LEVEL: Set so overload in on dimly.
- Looking at the signal at pins 14 and 15 of the NE570.
- DELAY: CW
- INPUT: 40Hz
- Vary the input frequency from 40Hz upward. The signal should be unclipped and clean over the range. The response should show no peaks, but be flat at about 2.5 KHz and -3db,(x.7) at about 3.2KHz, where only a small amount of aliasing ripple of the waveform should be visible.

DELAY: CCW

- The response should now have a peak of about +3db (x1.4) around 2.5KHz and roll off sharply above 3.5 KHz with no trace of noise or aliasing.
- INPUT: 250Hz
- LEVEL: 1.0V p-p at NE570 14/15
- There should now be between .6 and .8V p-p at NE570 pin 10.

FEEDBACK CHECK

- INPUT: Disconnect
- DELAY: CW
- Looking at the unit's output and overload light (see next step)

FEEDBACK: CW

- Touch the input to introduce a transient signal.
- Runaway oscillation should occur with the overload light flashing brightly.

FEEDBACK: CCW

- FINAL CHECK:
- BLEND: 50%
- INPUT: 250Hz Sine 500mV p-p
- Reconnect input and observe output as input frequency is varied slowly. It should show a peak and null (comb filter) response.
- Check that the footswitch connects the direct signal to the output when it is thrown and that this signal is always present at the direct output and is controlled with the level control.
- The test and alignment is now complete.

Original procedure credited to Howard David 1978, edited by David Morrin and posted 2015

Circuit Voltages

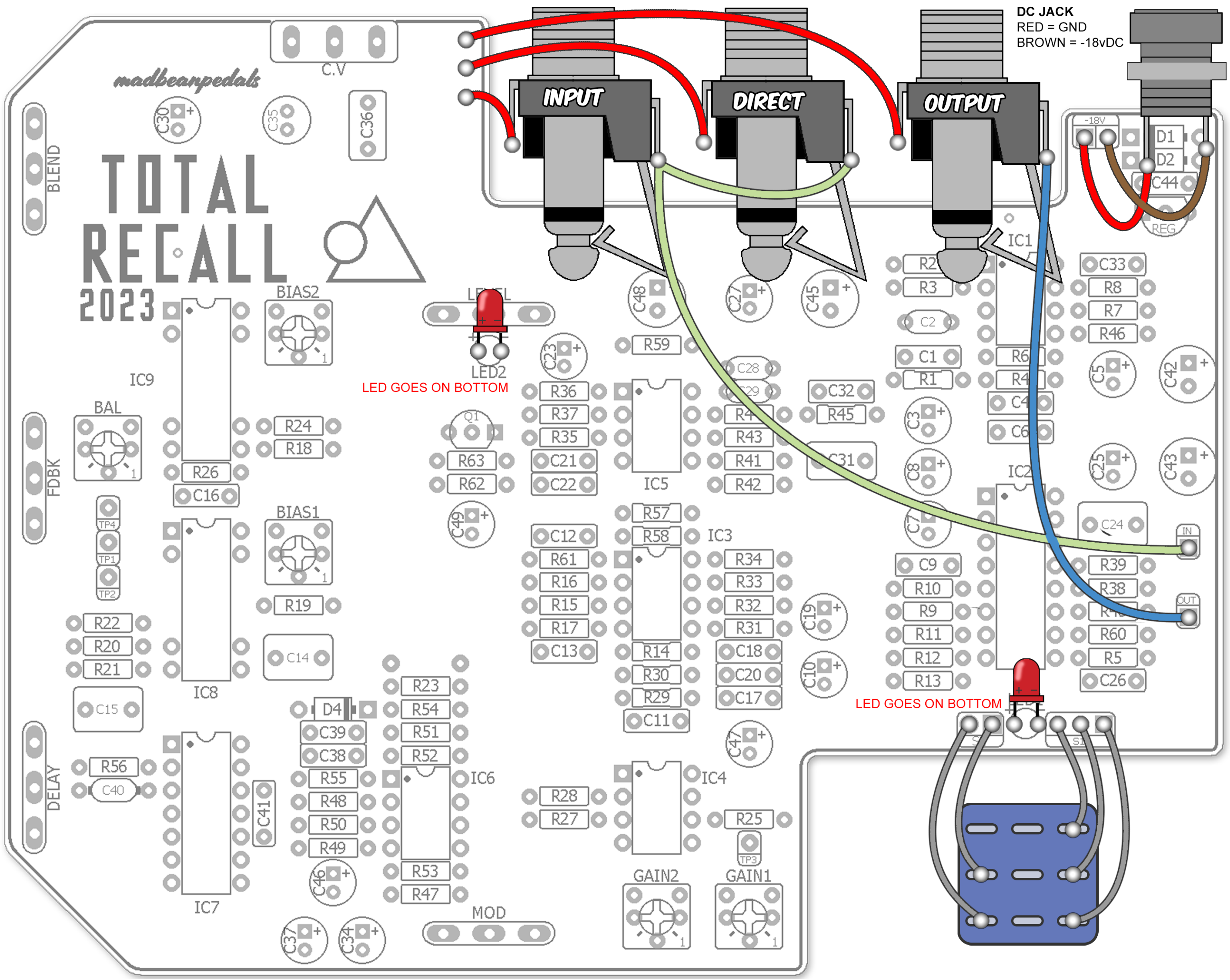
IC1		IC2		IC3		IC4		IC5		IC6		IC7	
4558	DC	NE570	DC	4558	DC	4558	DC	4558	DC	4558	DC	CD4047	DC
1	-7.66	1	-13.88	1	-6.65	1	-7.68	1	-7.68	1	varies	1	-7.17
2	-7.66	2	-13.27	2	-3.32	2	-7.60	2	-7.67	2	-7.23	2	-8.14
3	-7.62	3	-13.27	3	-3.31	3	-7.62	3	-7.65	3	-7.30	3	-8.00
4	-15.12	4	-15.12	4	-15.12	4	-15.12	4	-15.12	4	-15.28	4	0.00
5	-7.57	5	-13.28	5	-7.65	5	-7.68	5	-6.91	5	-7.23	5	0.00
6	-7.61	6	-13.26	6	-7.68	6	-7.74	6	-6.99	6	-7.25	6	0.00
7	-7.66	7	-4.87	7	-7.68	7	-7.74	7	-6.98	7	varies	7	0.00
8	0.00	8	-13.28	8	0.00	8	0.00	8	0.00	8	0.00	8	-15.28
		9	-13.28									9	-15.28
		10	-7.00									10	-7.51
		11	-8.72									11	-7.50
		12	-13.28									12	-15.28
		13	0.00									13	-7.11
		14	-13.27									14	0.00
		15	-13.27										
		16	-14.18										

IC8		IC9		REG	
BBD	DC	BBD	DC	7915	DC
1	0.00	1	0.00	I	-15.28
2	-7.50	2	-7.50	O	-17.93
3	-11.56	3	-10.90	G	0.00
4	-11.56	4	-10.89	Q1	2N5087
5	-15.28	5	-15.28	C	-13.67
6	-7.50	6	-7.51	B	0
7	-8.55	7	-7.74	E	0
8	-14.31	8	-14.29		

18.24vDC isolated supply
Current Draw: ~32mA
Knobs @ 0

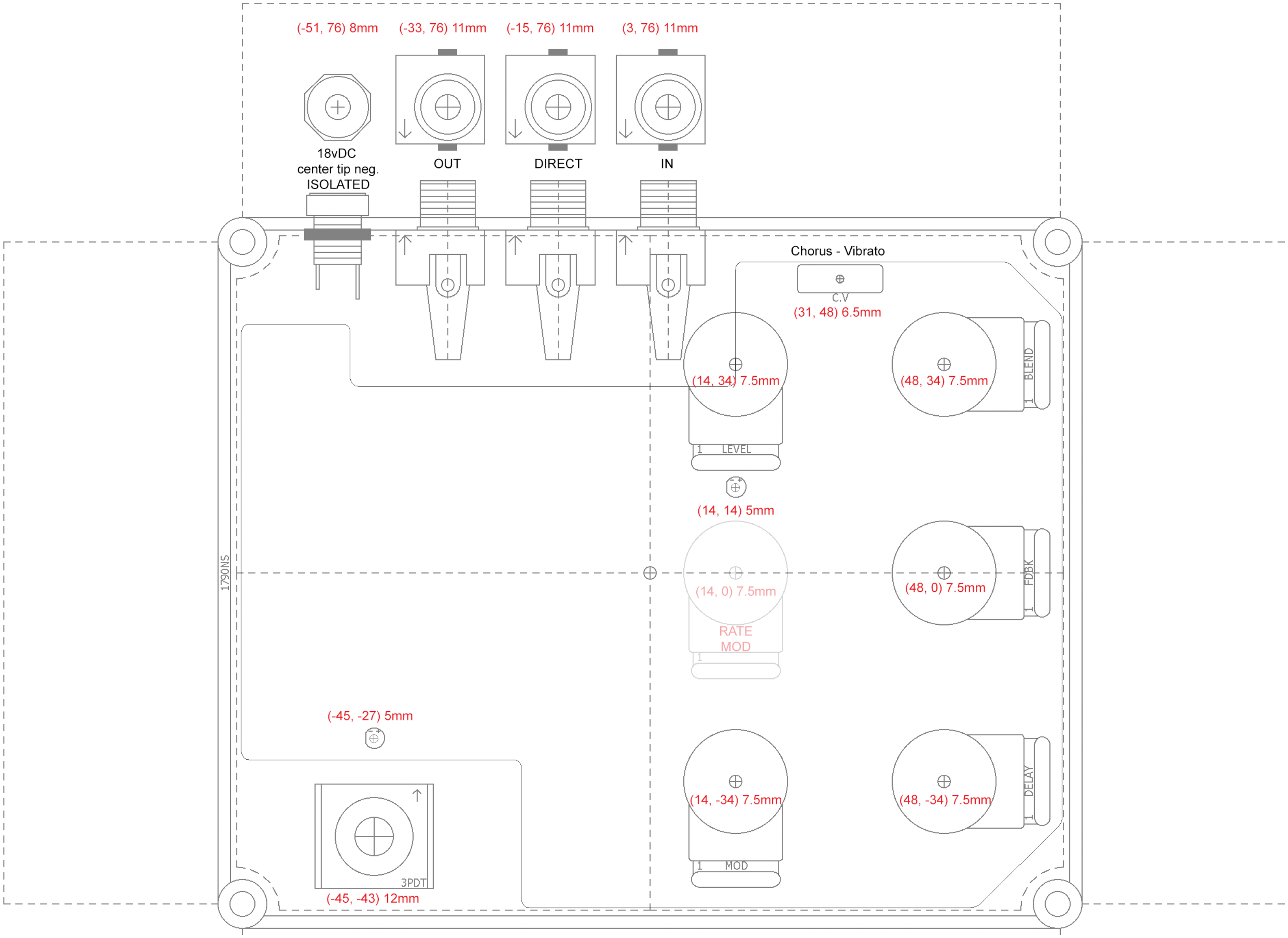
Clock Frequency Range:
76.97kHz to 8.35kHz

Wiring



For simplicity, this diagram shows the DC Jack wired just like a negative ground circuit. But, in this case all the red wires are ground and the brown wire is -18vDC. Remember, you must use an isolated 18v supply tap for this positive ground circuit!

1790NS / 1590XX Drill Template



Tayda Drill File: https://drill.taydakits.com/box-designs/new?public_key=SDRlVHYxcGZJY0xkc2hvUGVPOTB5dz09Cg==

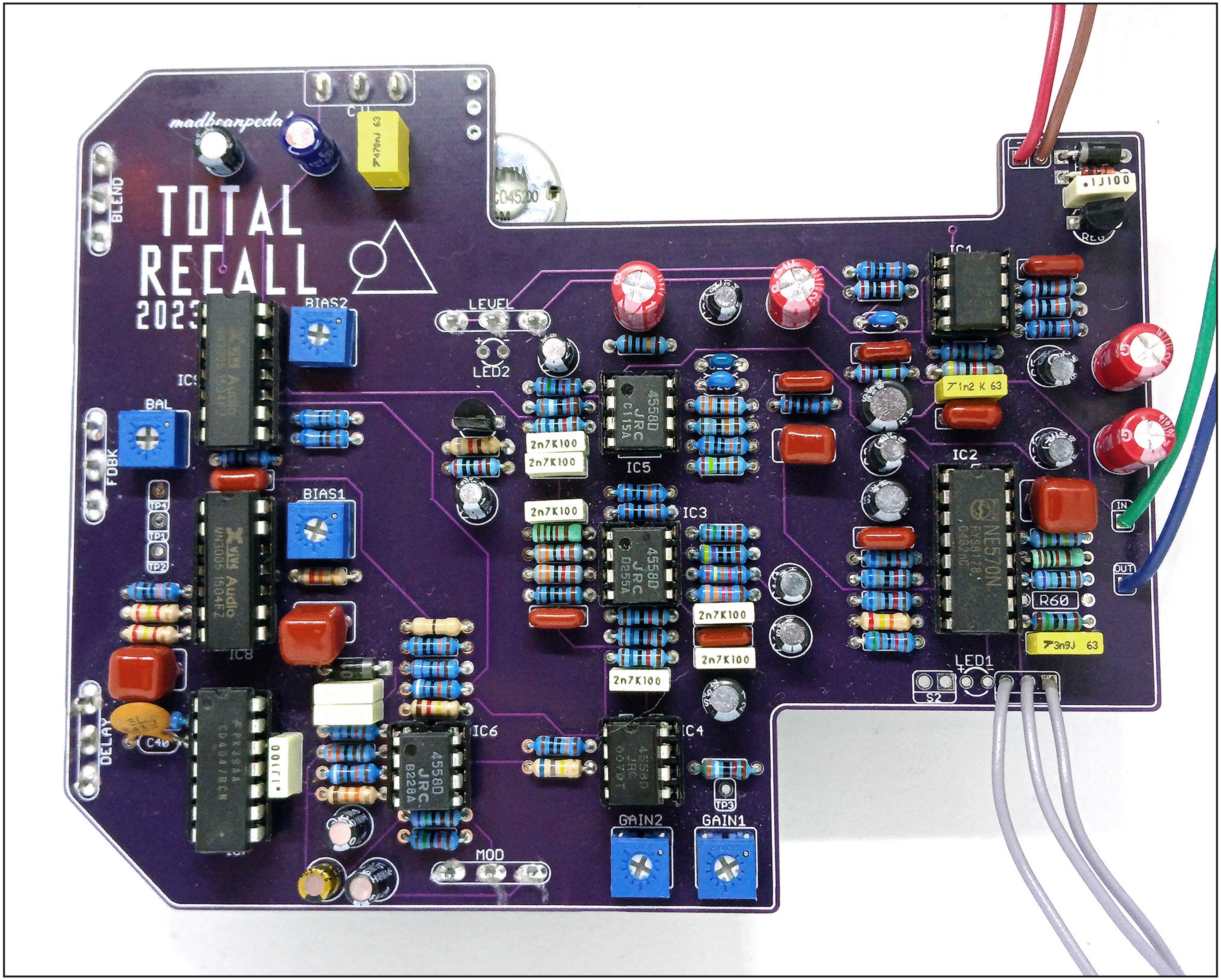
Coordinates are denoted in (X,Y), drill size format starting from the center (0,0) location of the enclosure. If you are drilling your own enclosure, use the closest sized drill bit using imperial measurements.

Hardware

1790NS or 1590XX enclosure, 16mm pots, Lumberg 1/4” Compact mono jacks, Slim 2.1mm DC jack, Standard 3PDT footswitch, 5mm LED

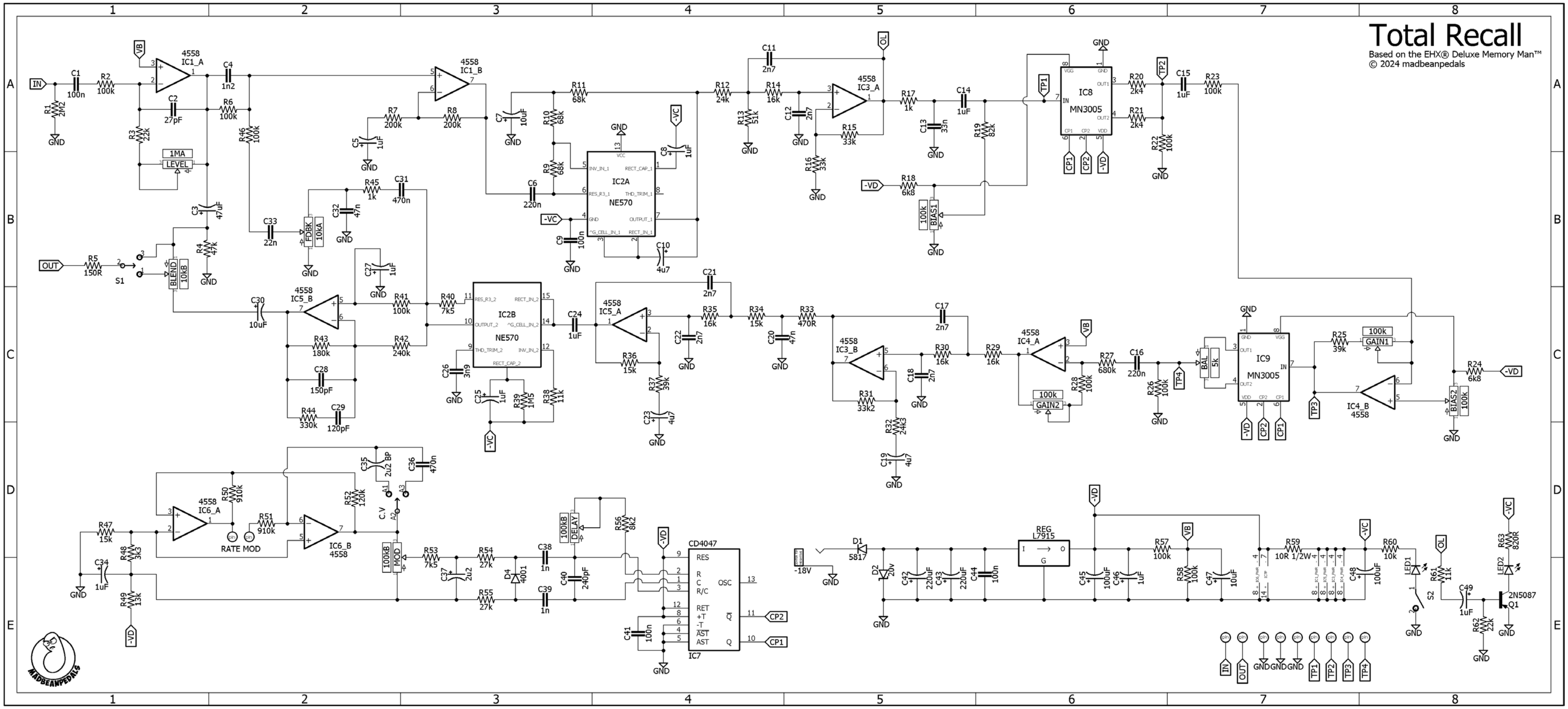
NOTE: Different 1/4” and DC jack styles may require different sized drill holes.

Build Pic



Unfortunately, I only had a ceramic 240pF at the time for this build. I plan on replacing it with a MICA before boxing it up.

Schematic



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