SKOOLIE

FX TYPE: Delay

Based on the EHX® Deluxe Memory Man™

Enclosure Size: 125B

“Softie” compatibility: none

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Overview

The Skoolie is a compact Deluxe Memory Man™ like the Tourbus project, but has been converted from positive to negative ground. The Skoolie *only requires 9v 100mA* so it will integrate easily with your existing power supplies.

There are no significant changes from the Tourbus other than those needed for the power adaptation. The Skoolie utilizes a charge pump for 15v circuit operation. A clock trimmer was also added for finer delay time calibration.

To fit this in a 125B enclosure, a couple compromises were made. The build requires 1/8W resistors and stacked PCBs. The project spans two PCBs: the Audio board and BBD board. The Audio board contains most of the audio and the LFO circuits. The BBD board comprises two MN3005 BBD and surrounding circuitry, plus most of the calibration trimmers. Stacking boards like this introduces some size limitations on components. See the Notes section for more.

If you’ve already built the Tourbus the Skoolie will likely be an easy build. While I don’t recommend this build for the novice, I will provide extensive notes with build tips and calibration procedures at the end of this document.

Audio Controls

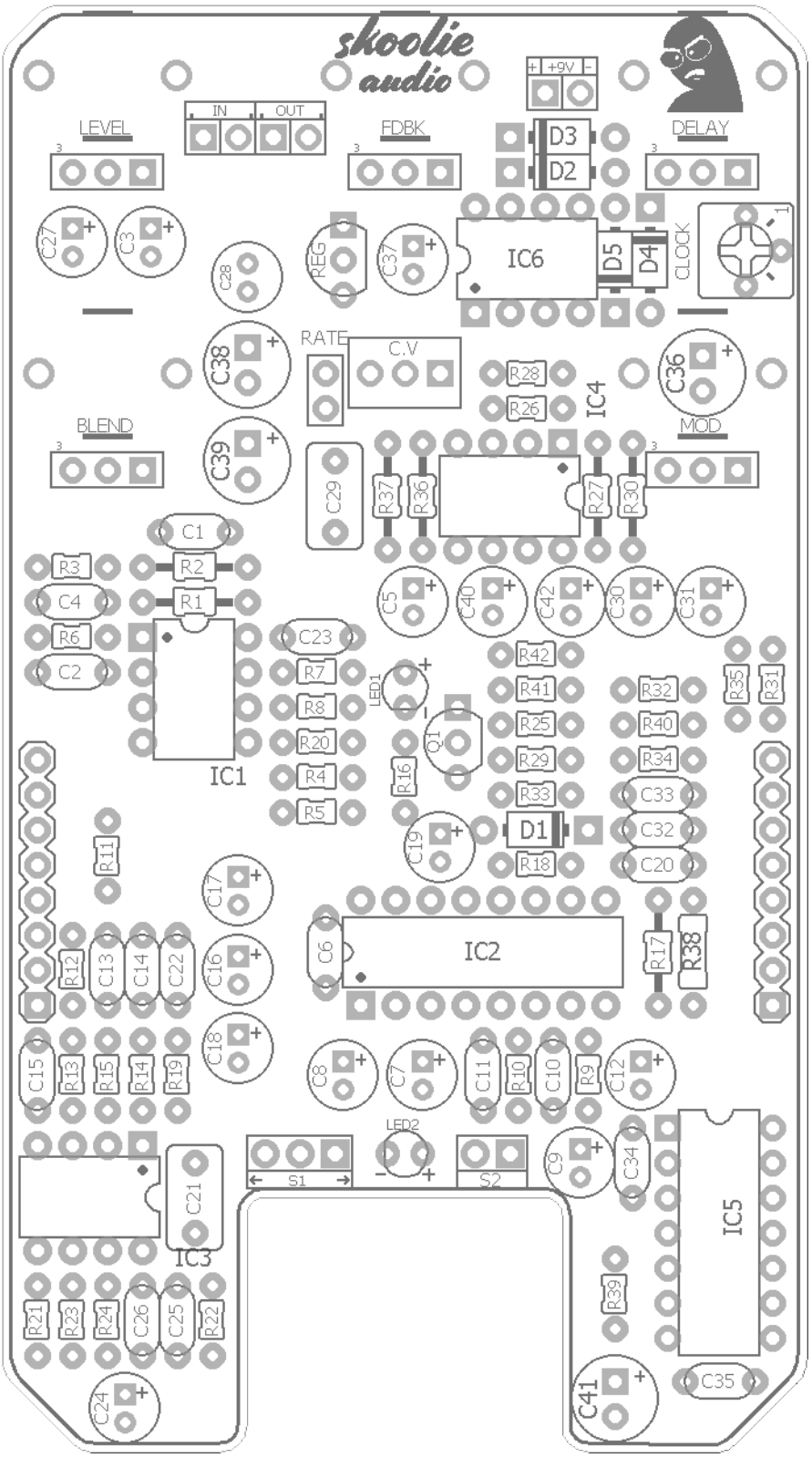
DELAY - Total delay time from slap-back to approximately 550ms.
FDBK - The total number of repeats from one to many to self-oscillation.
LEVEL - The input gain of the circuit. This control can create mild overdrive when turned up. It also increases the output volume of the effect.
BLEND - The dry/wet 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.

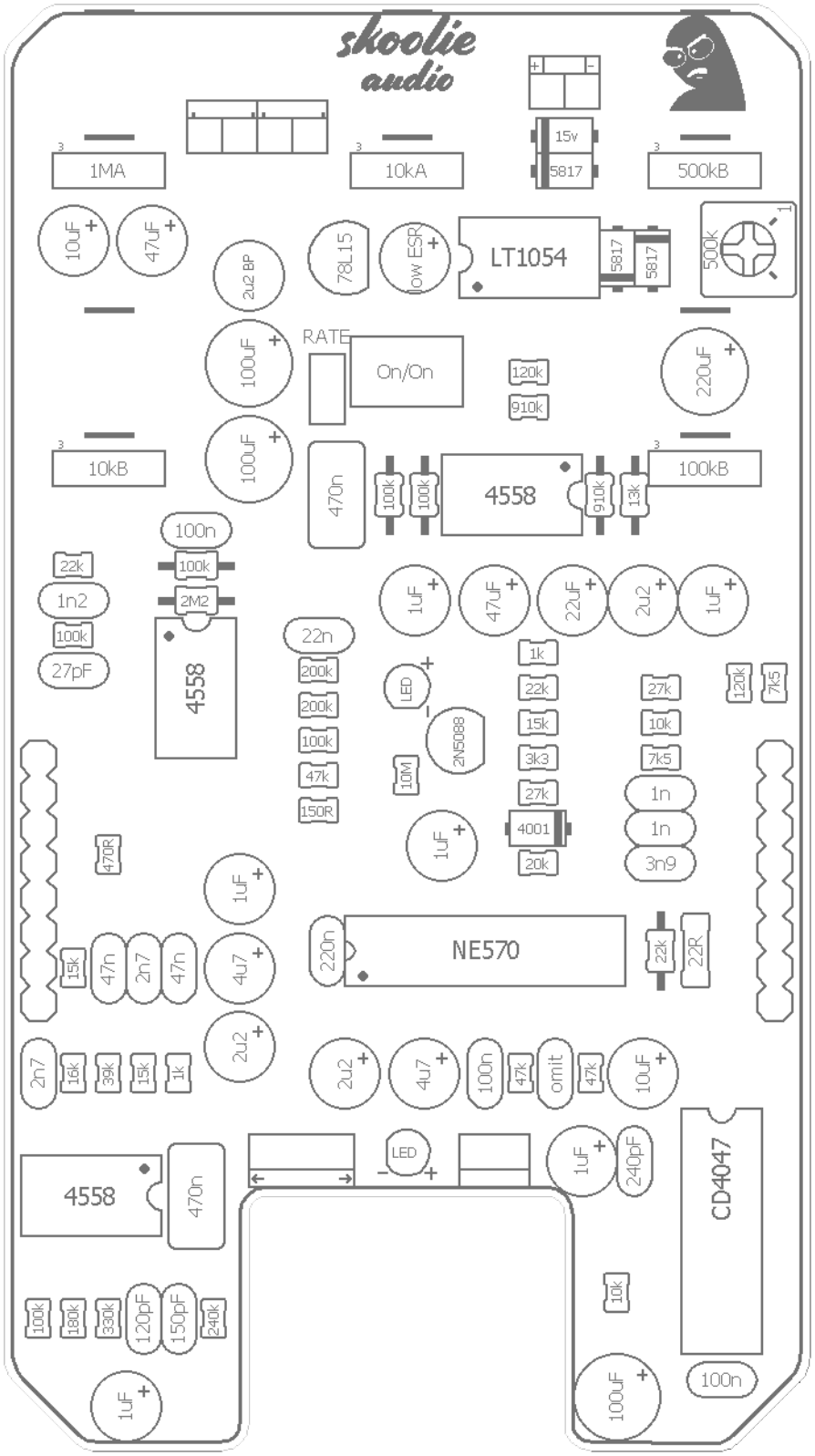
Biasing Controls

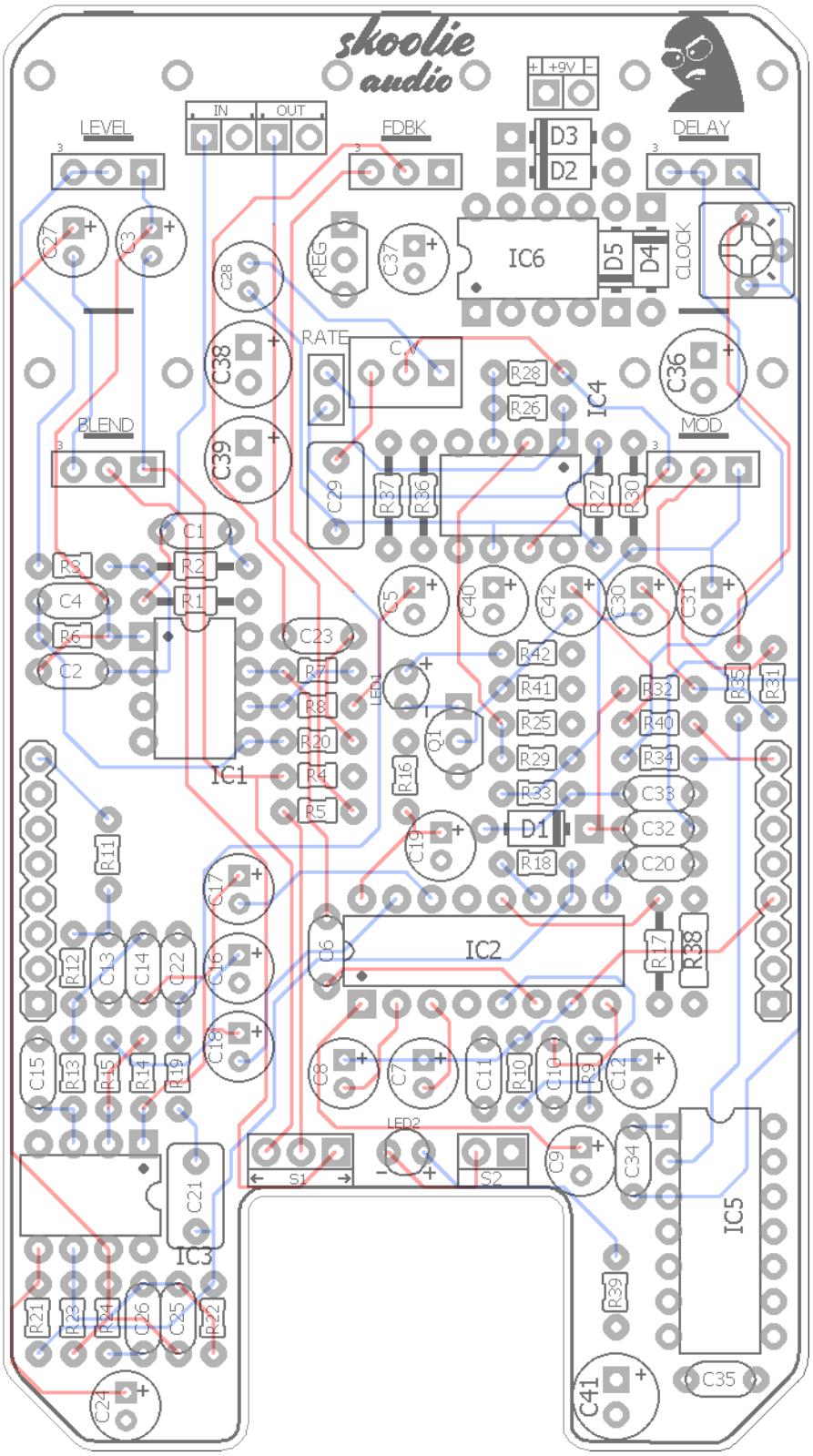
BIAS1, 2 - These trimmers set the input bias voltage of the BBD chips.
GAIN1, 2 - These trimmers set the gain recovery after BBD1 and BBD2.
BAL - This trimmer balances the two outputs of the second BBD for minimum phase cancellation and clock bleed.
CLOCK - This timmer sets the fine calibration for the maximum allowable delay time.

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

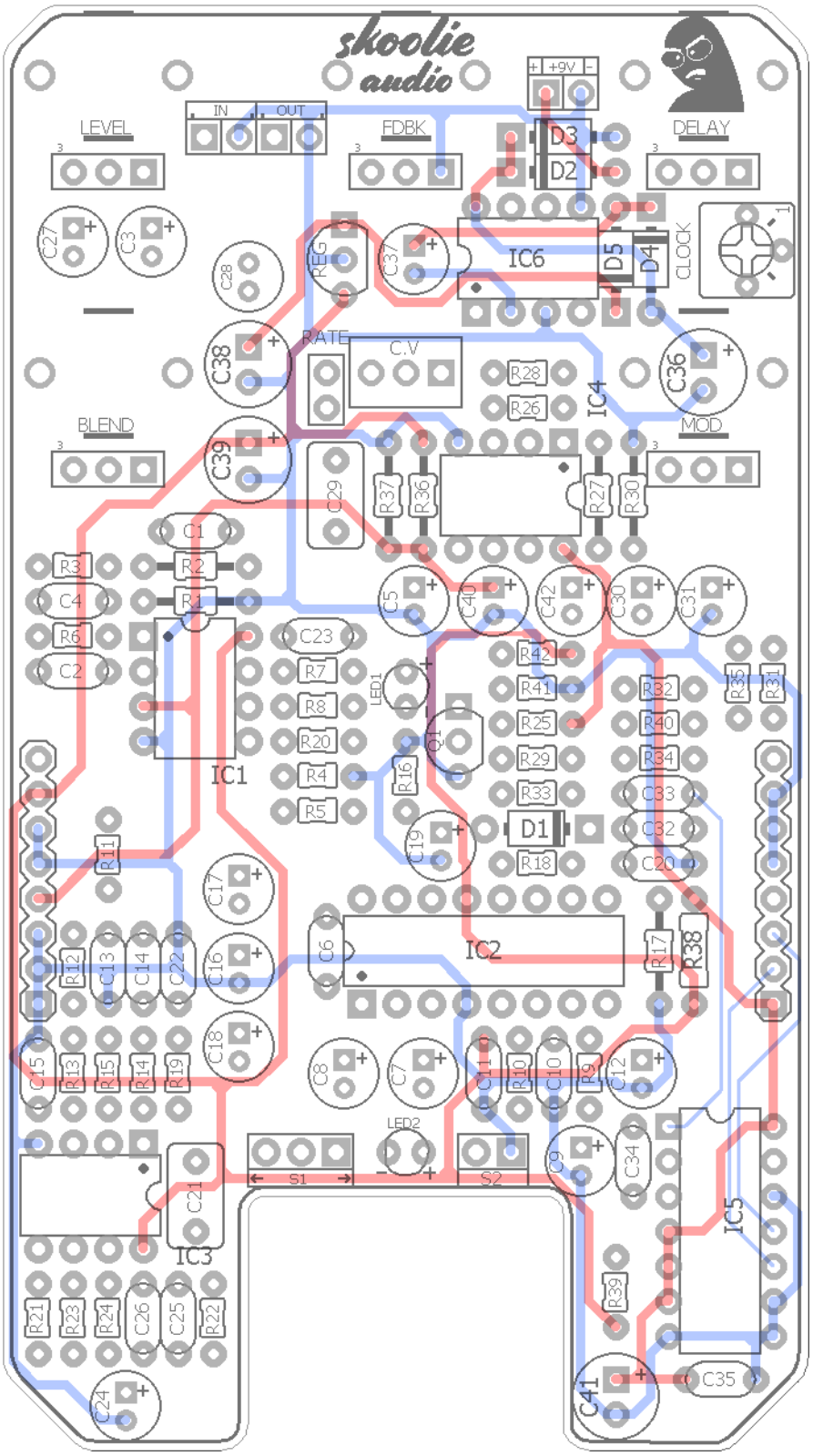
Technical assistance for your build(s) is available via the madbeanpedals forum. Please go there rather than emailing me for assistance on builds. This is because (1) I’m not always available to respond via email in a timely and continuous manner, and (2) posting technical problems and solutions in the forum creates a record from which other members may benefit.


skoolie
audio
+9V
IN
OUT
LEVEL
FDBK
DELAY
D3
D2
IC6
D5
D4
CLOCK
REG
C27
C3
C28
C37
C38
RATE
C.V
C36
IC4
R28
R26
BLEND
MOD
C39
C29
R37
R36
R27
R30
C1
R3
R2
C4
R1
R6
C2
IC1
C23
R7
R8
R20
R4
R5
LED1
Q1
R16
C5
C40
C42
C30
C31
R42
R41
R25
R29
R33
R32
R40
R34
R35
R31
C33
C32
C20
D1
R18
C19
R11
C17
C16
C18
IC2
C6
R17
R38
R12
C13
C14
C22
C15
R13
R15
R14
R19
C8
C7
C11
R10
C10
R9
C12
LED2
S1
S2
C9
C34
IC5
C21
IC3
R39
R21
R23
R24
C26
C25
R22
C24
C41
C35

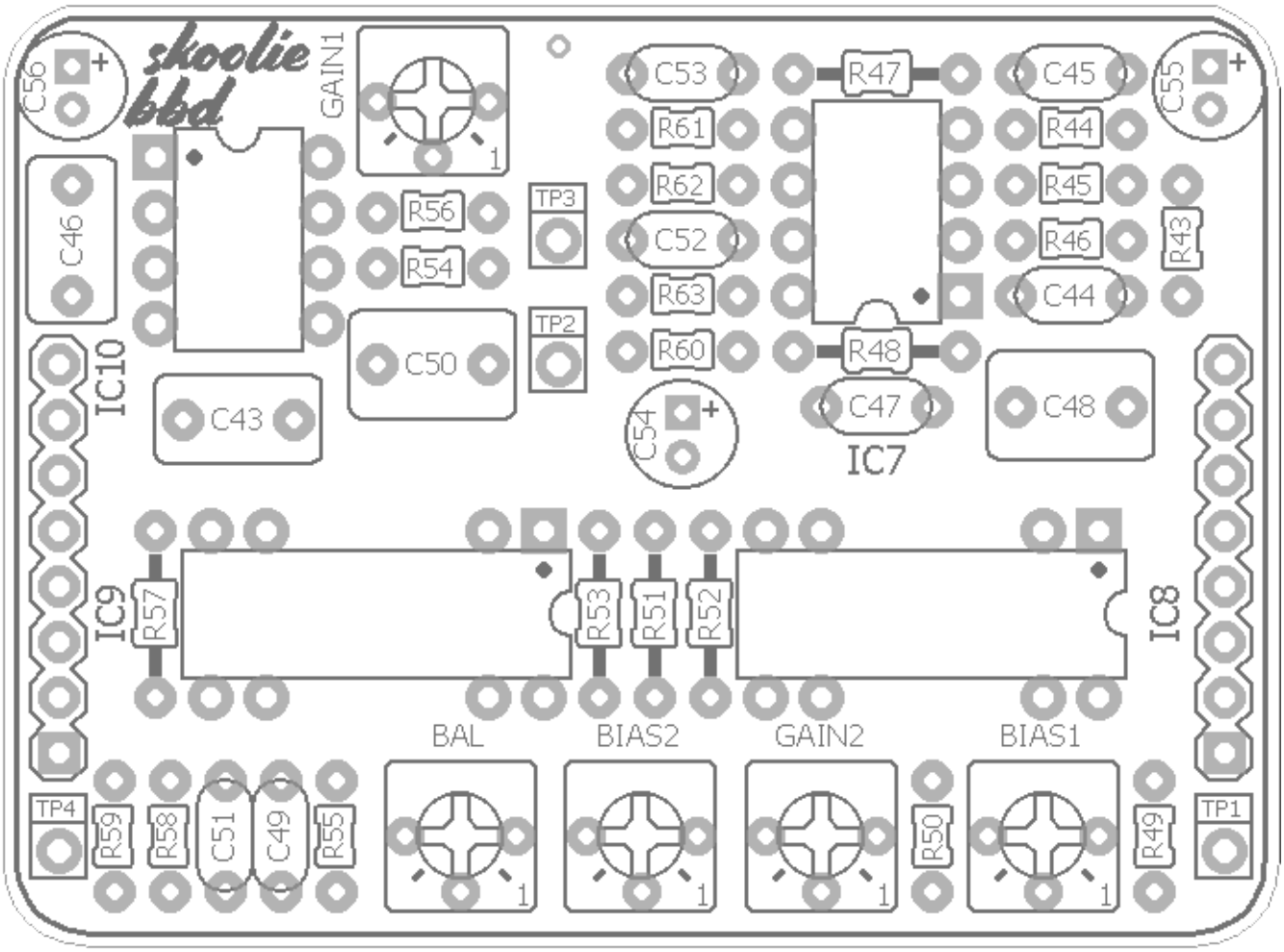

skoolie
audio
1MA
10kA
15v
5817
500kB
10uF
47uF
2u2 BP
78L15
low ESR
LT1054
5817
5817
500k
RATE
On/On
100uF
100uF
120k
910k
220uF
10kB
470n
100k
100k
4558
910k
13k
100kB
100n
22k
100k
2M2
1n2
100k
27pF
4558
22n
200k
200k
100k
47k
150R
1uF
47uF
22uF
2u2
1uF
1k
22k
15k
3k3
27k
LED
2N5088
10M
4001
20k
1uF
27k
10k
7k5
1n
1n
3n9
120k
7k5
470R
1uF
15k
47n
2n7
47n
4u7
2u2
220n
NE570
22k
22R
2n7
16k
39k
15k
1k
2u2
4u7
100n
47k
omit
47k
10uF
4558
470n
LED
1uF
240pF
CD4047
100k
180k
330k
120pF
150pF
240k
1uF
10k
100uF
100n

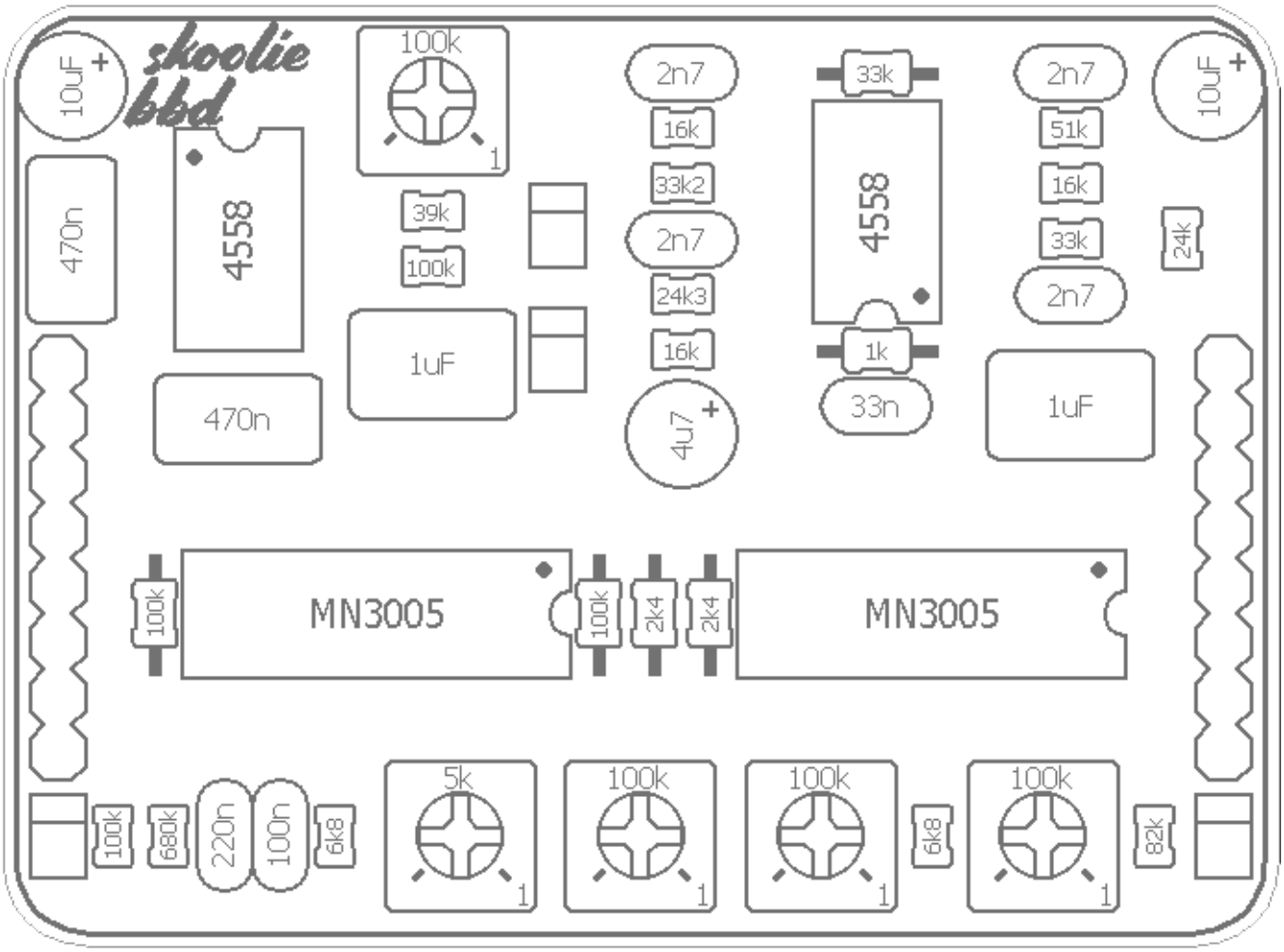


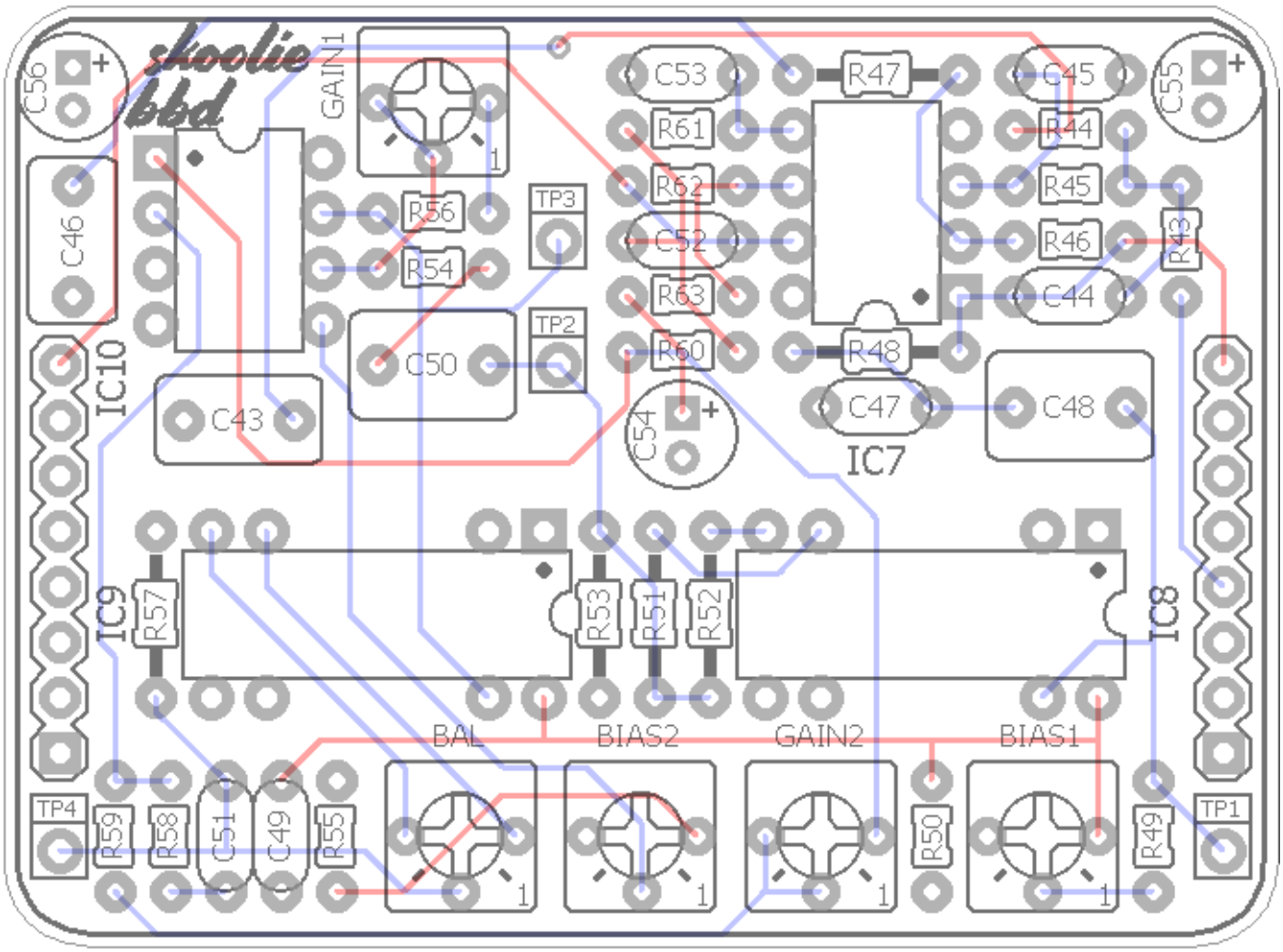
Signal layers (top and bottom)



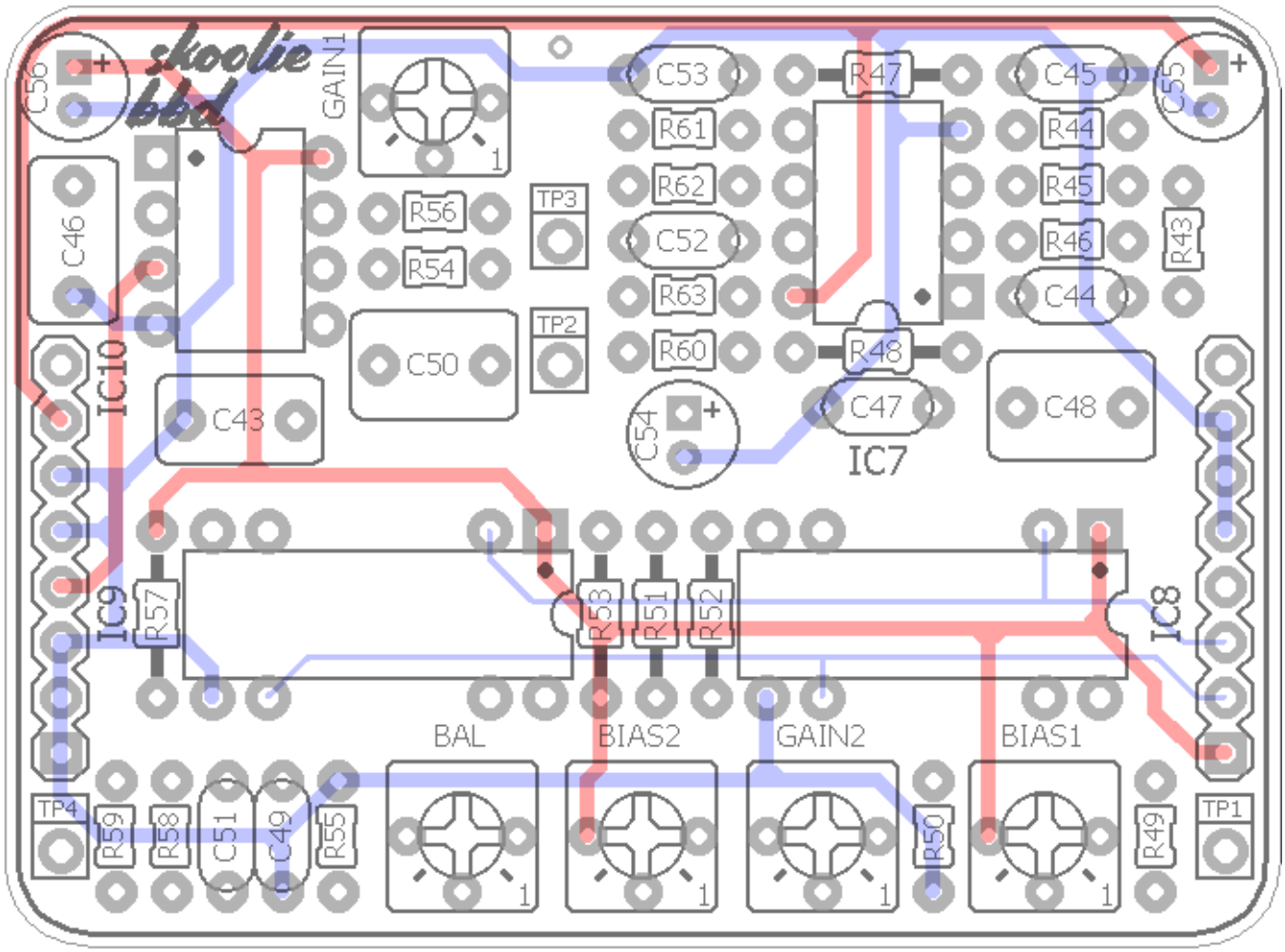
Power and ground (inner layers)


skoolie
bbd
GAIN1
C56
C46
IC10
C43
C50
TP3
TP2
R56
R54
C53
R61
R62
C52
R63
R60
R47
R48
C47
IC7
C54
C45
R44
R45
R46
C44
R43
C55
C48
IC9
R57
R53
R51
R52
IC8
BAL
BIAS2
GAIN2
BIAS1
TP4
R59
R58
C51
C49
R55
R50
R49
TP1


skoolie
bbd
10uF
470n
4558
100k
1
39k
100k
1uF
470n
2n7
16k
33k2
2n7
24k3
16k
4u7
33k
4558
1k
33n
2n7
51k
16k
33k
2n7
24k
10uF
1uF
MN3005
100k
100k
2k4
2k4
MN3005
100k
680k
220n
100n
6k8
5k
1
100k
1
100k
1
6k8
100k
1
82k



Signal layers (top and bottom)



Power and ground (inner layers)

Resistors		Resistors		Caps		Caps		Pots	
R1	2M2	R40	10k	C15	2n7	C54	4u7	DELAY	500kB
R2	100k	R41	22k	C16	4u7	C55	10uF	FDBK	10kA
R3	22k	R42	1k	C17	1uF	C56	10uF	BLEND	10kB
R4	47k	R43	24k	C18	2u2	Diodes		LEVEL	1MA
R5	150R	R44	51k	C19	1uF	D1	1n4001	MOD	100kB
R6	100k	R45	16k	C20	3n9	D2	1n5817		
R7	200k	R46	33k	C21	470n	D3	15v Zener		
R8	200k	R47	33k	C22	47n	D4	1n5817		
R9	47k	R48	1k	C23	22n	D5	1n5817		
R10	47k	R49	82k	C24	1uF	LED1	Red 5mm		
R11	470R	R50	6k8	C25	150pF	LED2	5mm		
R12	15k	R51	2k4	C26	120pF	Transistors			
R13	16k	R52	2k4	C27	10uF	Q1	2n5088		
R14	15k	R53	100k	C28	2u2 BP	Regulator			
R15	39k	R54	100k	C29	470n	REG	78L15		
R16	10M	R55	6k8	C30	2u2	ICs			
R17	22k	R56	39k	C31	1uF	IC1	4558		
R18	20k	R57	100k	C32	1n	IC2	NE570		
R19	1k	R58	680k	C33	1n	IC3	4558		
R20	100k	R59	100k	C34	240pF	IC4	4558		
R21	100k	R60	16k	C35	100n	IC5	CD4047		
R22	240k	R61	16k	C36	220uF	IC6	LT1054		
R23	180k	R62	33k2	C37	47uF	IC7	4558		
R24	330k	R63	24k3	C38	100uF	IC8	MN3005		
R25	15k	Caps		C39	100uF	IC9	MN3005		
R26	910k	C1	100n	C40	47uF	IC10	4558		
R27	910k	C2	27pF	C41	100uF	Connectors			
R28	120k	C3	47uF	C42	22uF	HDR1, 2	Pins (8)		
R29	3k3	C4	1n2	C43	470n	HDR3, 4	Sockets (8)		
R30	13k	C5	1uF	C44	2n7	Switch			
R31	7k5	C6	220n	C45	2n7	C.V	On/On		
R32	27k	C7	4u7	C46	470n	Trimmers			
R33	27k	C8	2u2	C47	33n	BAL	5k		
R34	7k5	C9	1uF	C48	1uF	BIAS1	100k		
R35	120k	C10	omit	C49	100n	BIAS2	100k		
R36	100k	C11	100n	C50	1uF	GAIN1	100k		
R37	100k	C12	10uF	C51	220n	GAIN2	100k		
R38	22R	C13	47n	C52	2n7	CLOCK	500k		
R39	10k	C14	2n7	C53	2n7				

Shopping List

Skoolie

Value	QTY	Type	Rating
22R	1	Carbon / Metal Film	**1/4W**
150R	1	Carbon / Metal Film	1/8W
470R	1	Carbon / Metal Film	1/8W
1k	3	Carbon / Metal Film	1/8W
2k4	2	Carbon / Metal Film	1/8W
3k3	1	Carbon / Metal Film	1/8W
6k8	2	Carbon / Metal Film	1/8W
7k5	2	Carbon / Metal Film	1/8W
10k	2	Carbon / Metal Film	1/8W
13k	1	Carbon / Metal Film	1/8W
15k	3	Carbon / Metal Film	1/8W
16k	4	Carbon / Metal Film	1/8W
20k	1	Carbon / Metal Film	1/8W
22k	3	Carbon / Metal Film	1/8W
24k	1	Carbon / Metal Film	1/8W
24k3	1	Carbon / Metal Film	1/8W
27k	2	Carbon / Metal Film	1/8W
33k	2	Carbon / Metal Film	1/8W
33k2	1	Carbon / Metal Film	1/8W
39k	2	Carbon / Metal Film	1/8W
47k	3	Carbon / Metal Film	1/8W
51k	1	Carbon / Metal Film	1/8W
82k	1	Carbon / Metal Film	1/8W
100k	10	Carbon / Metal Film	1/8W
120k	2	Carbon / Metal Film	1/8W
180k	1	Carbon / Metal Film	1/8W
200k	2	Carbon / Metal Film	1/8W
240k	1	Carbon / Metal Film	1/8W
330k	1	Carbon / Metal Film	1/8W
680k	1	Carbon / Metal Film	1/8W
910k	2	Carbon / Metal Film	1/8W
2M2	1	Carbon / Metal Film	1/8W
10M	1	Carbon / Metal Film	1/8W
27pF	1	Ceramic / MLCC	25v min.
120pF	1	Ceramic / MLCC	25v min.
150pF	1	Ceramic / MLCC	25v min.
240pF	1	Ceramic / MLCC	25v min.
1n	2	Film	25v min.
1n2	1	Film	25v min.
2n7	6	Film	25v min.

Value	QTY	Type	Rating
3n9	1	Film	25v min.
22n	1	Film	25v min.
33n	1	Film	25v min.
47n	2	Film	25v min.
100n	4	Film	25v min.
220n	2	Film	25v min.
470n	4	Film	25v min.
1uF	2	Film	25v min.
1uF	6	Electrolytic	25v min.
2u2	3	Electrolytic	25v min.
2u2 BP	1	Electrolytic	25v min.
4u7	3	Electrolytic	25v min.
10uF	4	Electrolytic	25v min.
22uF	1	Electrolytic	25v min.
47uF	3	Electrolytic	25v min.
100uF	3	Electrolytic	25v min.
220uF	1	Electrolytic	16v min.
1n4001	1		
1n5817	3		
15v Zener	1		
LED	1	5mm Red	
LED	1	5mm (any)	
2n5088	1		
78L15	1	TO-92	
4558	5		
CD4047	1		
MN3005	2		
NE570	1		
LT1054	1		
Pins	2	***included w/PCB**	
Sockets	2	***included w/PCB**	
SPDT	1	Mini On/On	
5k	1	Bourns 3362p	
100k	4	Bourns 3362p	
500k	1	Bourns 3362p	
10kA	1	PCB Right Angle	9mm
10kB	1	PCB Right Angle	9mm
100kB	1	PCB Right Angle	9mm
500kB	1	PCB Right Angle	9mm
1MA	1	PCB Right Angle	9mm

I've created a Mouser project that has all the items highlighted in yellow on the Shopping List:
https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=a392c1b82e

This includes the low-profile electrolytic caps needed on and underneath the BBD PCB.

Additional parts needed

1/8W Resistors:
https://www.taydaelectronics.com/resistors/1-8w-metal-film-resistors.html

v571:
https://stompboxparts.com/semiconductors/v571d-dual-compander-ic/

XVIVE MN3005:
https://cabintechglobal.com/semi (Under BBD section. They also have the v571 under Analog Signal Processing)
https://synthcube.com/cart/xvive-mn3005-bbd-clone-ic-14-pin-dip-package?search=mn3005&description=true

SPDT (On/On):
https://smallbear-electronics.mybigcommerce.com/spdt-on-on-mountain-10tc410/
https://lovemyswitches.com/taiway-sub-mini-spdt-on-on-switch-pcb-mount-long-shaft/

9mm PCB Right Angle Pots:
https://stompboxparts.com/pots/9mm-potentiometer/
https://www.taydaelectronics.com/catalogsearch/result/?q=9mm+potentiometer

DC Jacks:
https://smallbear-electronics.mybigcommerce.com/dc-power-jack-all-plastic-unswitched-2-1-mm/
https://stompboxparts.com/power-connections/dc-power-jack-2-1mm-low-profile/
https://lovemyswitches.com/thinline-lumberg-dc-power-jack-2-1mm/

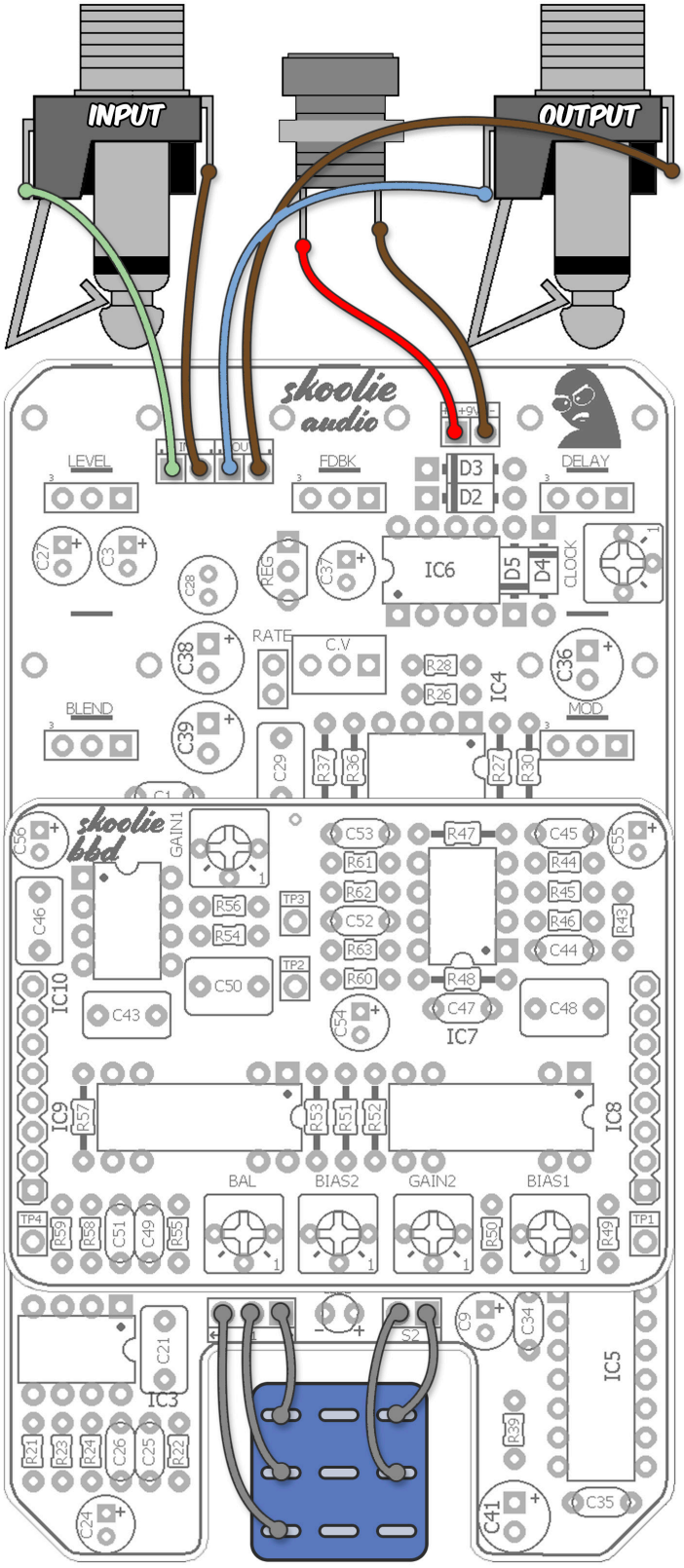
1/4" jacks:
https://lovemyswitches.com/1-4-mono-jack-lumberg-klbm-3/
Sub - Lumberg Stereo Jack: https://lovemyswitches.com/1-4-stereo-jack-lumberg-klb-3/

My preferred 3PDT switch:
https://lovemyswitches.com/pro-3pdt-latched-foot-switch-solder-lugs-feather-soft-click/

Unless you have a substantial parts library, you will likely need to source items for this build from more than one vendor. This is complicated by a shortage of components due to supply chain issues. You can find everything you need, just not likely in a single shop.

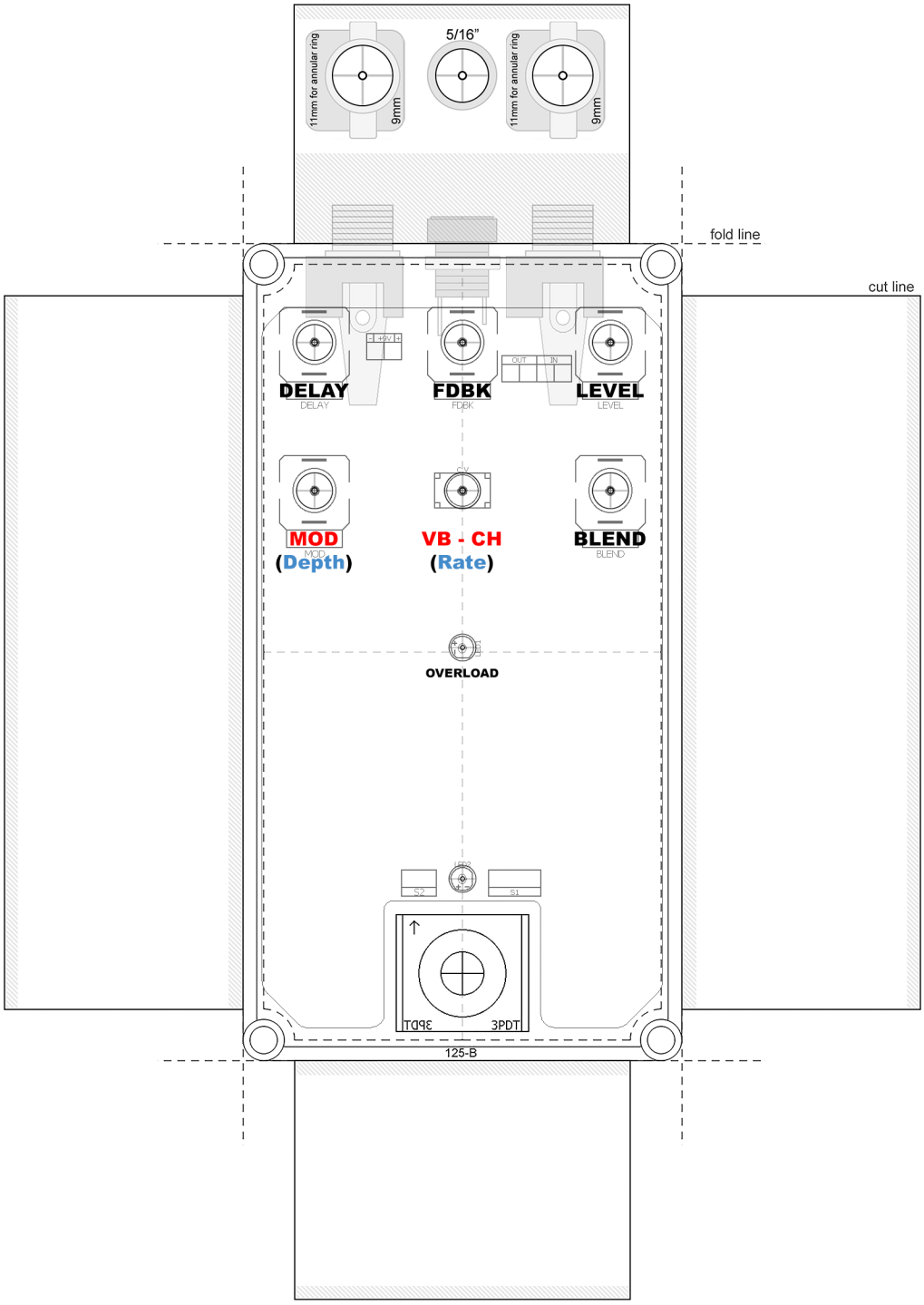
To modify the Skoolie for extended modulation:
This uses a pot as a rate control instead of the two preset speeds you get from the toggle switch. To do this mod you will need:

- An additional 120k resistor (or 68k for redonkulous speeds).
- A 1MB or 1MC 9mm pot
- You can omit one 470n cap and one 910k resistor from the Shopping List if you do the mod. See Notes for further explanation.



The middle row of the 3PDT is not used. The two LEDs are soldered directly to the Audio PCB.

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



This template works for both the stock and extended modulations options. Stock controls are in red, extended modulation controls are blue. See the Notes section for further explanation.

IC1	4558
1	7.53
2	7.54
3	7.51
4	0
5	7.44
6	7.52
7	7.53
8	15.08

IC2	NE570
1	1.1
2	1.88
3	1.88
4	0
5	1.89
6	1.89
7	7.82
8	1.88
9	1.88
10	8.16
11	5.01
12	1.89
13	15.08
14	1.89
15	1.88
16	~450mV

IC3	4558
1	5.3
2	5.3
3	3.18
4	0
5	8.07
6	8.15
7	8.15
8	15.08

IC4	4558
1	varies
2	7.85
3	7.82
4	0
5	7.85
6	7.85
7	varies
8	14.92

IC5	CD4047
1	8.12
2	6.71
3	6.75
4	14.92
5	14.92
6	14.92
7	0
8	0
9	0
10	7.44
11	7.47
12	0
13	8.17
14	14.92

IC6	LT1054
1	2.31
2	4.95
3	0
4	5mV
5	0
6	2.56
7	1.38
8	9.19

IC7	4558
1	7.82
2	7.84
3	7.79
4	0
5	7.5
6	7.52
7	7.52
8	15.08

IC8	MN3005
1	14.66
2	6.97
3	4.62
4	4.62
5	0
6	6.93
7	7.12
8	0.96

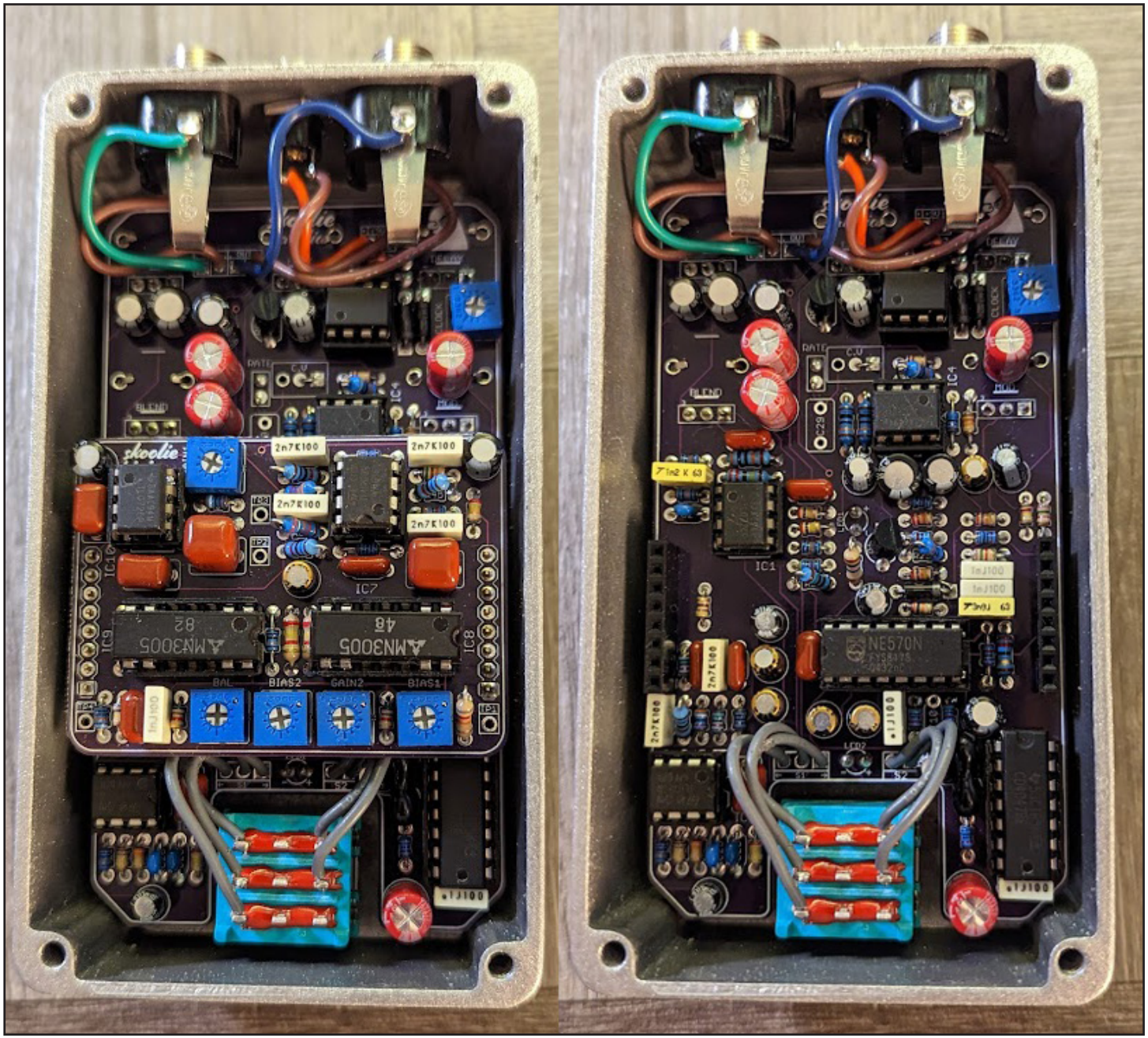
IC9	MN3005
1	14.66
2	6.97
3	5.25
4	5.25
5	0
6	6.93
7	7.95
8	0.96

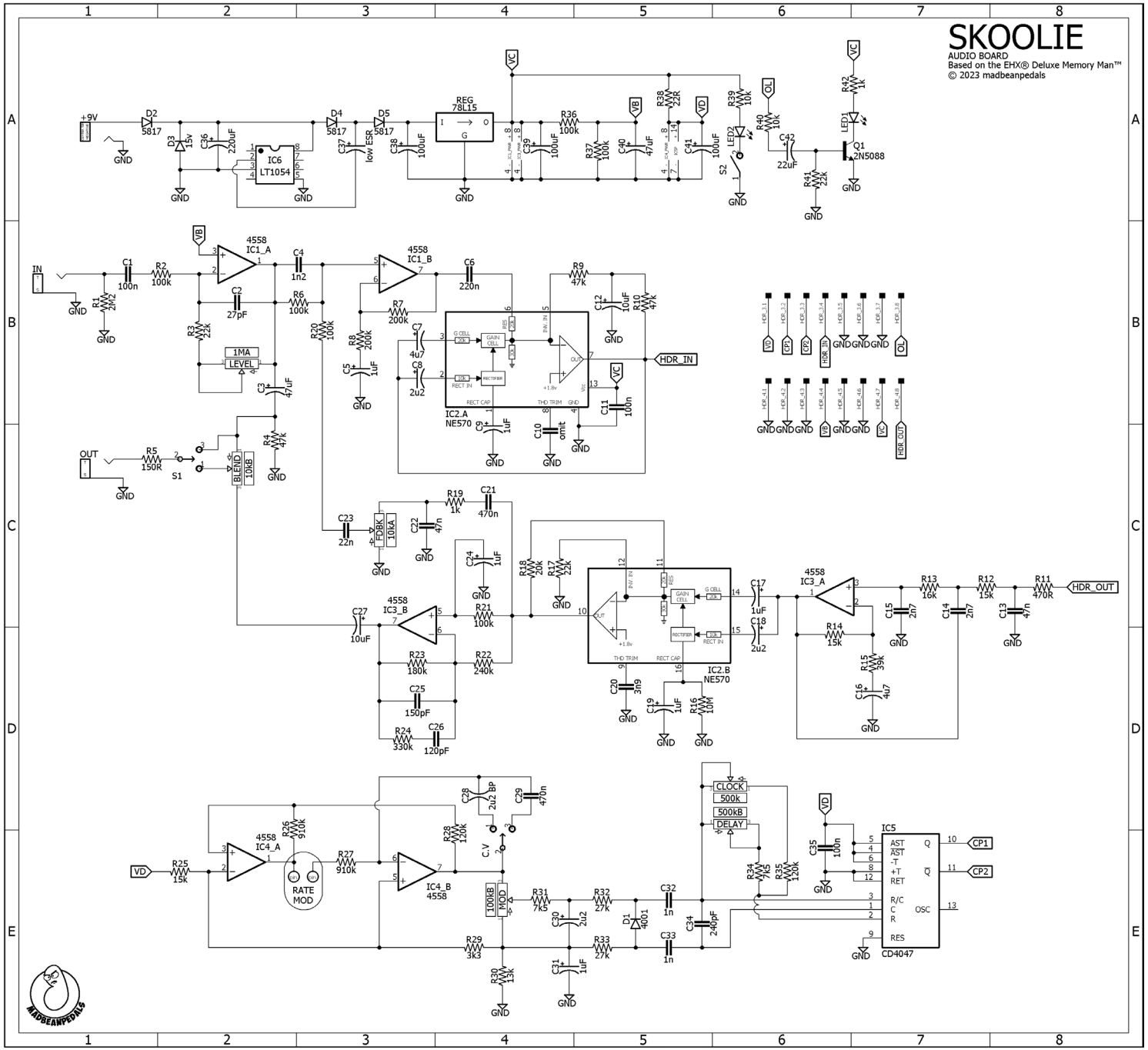
IC10	4558
1	7.53
2	7.52
3	7.52
4	0
5	7.93
6	7.95
7	7.95
8	14.66

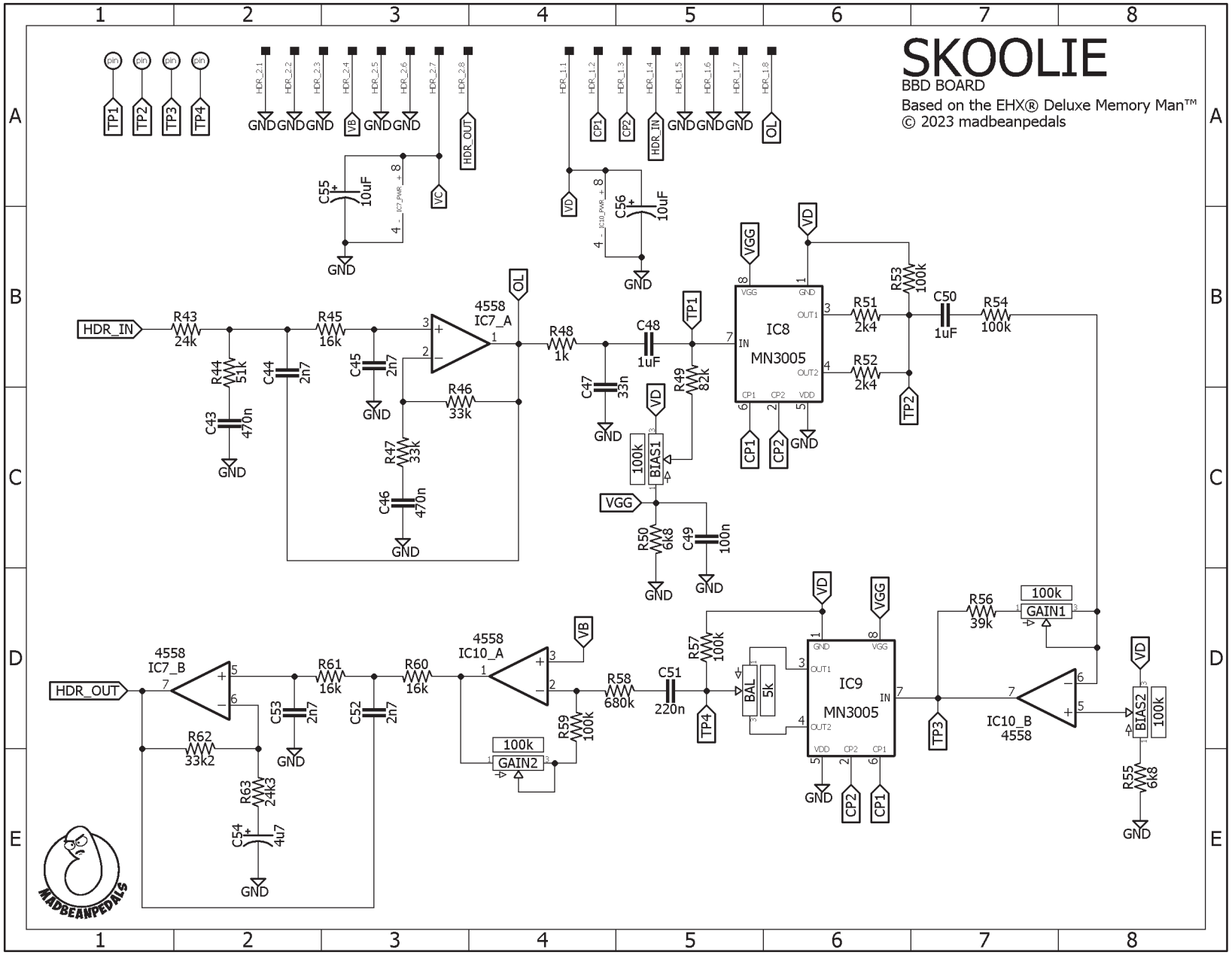
Q1	2n5088
C	13.77
B	16mV
E	0

REG	78L15
I	17.47
G	0
O	15.08

- 9.5vDC One Spot
- Current Draw: ~48mA
- Testing Conditions: All knobs @ 0
- Some results will vary depending on trimmer settings.
- I took the voltages readings on the Audio board without the BBD board attached. This means some voltages will be changed from their normal operational value. When taking voltages on your Audio board, leave your BBD board off for the most accurate comparison.

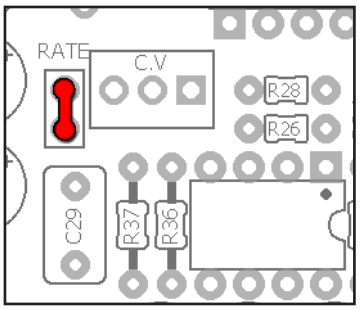

skoolie
2n7K100
2n7K100
2n7K100
2n7K100
IC7
IC9
IC8
AMN3005
82
AMN3005
48
BAL
BIAS2
GAIN2
BIAS1
100nF
1uF
BLEND
RATE
CV
IC4
IC1
NE570N
1nJ100
1nJ100
1nJ100


SKOOLIE
AUDIO BOARD
Based on the EHX® Deluxe Memory Man™
© 2023 madbeanpedals
+9V
D2
5817
D3
15v
C36
220uF
IC6
LT1054
D4
5817
D5
5817
C37
low ESR
C38
100uF
REG
78L15
VC
R36
100k
VB
R38
22k
VD
R39
10k
OL
R40
10k
LED2
S2
C42
22uF
R41
22k
R42
1k
LED1
Q1
2N5088
GND
IN
C1
100n
R1
2M2
R2
100k
4558
IC1_A
C4
1n2
C2
27pF
R6
100k
R3
22k
1MA
LEVEL
R20
100k
C3
47uF
4558
IC1_B
C6
220n
R7
200k
R8
200k
C7
4u7
C8
2u2
C5
1uF
R9
47k
C12
10uF
R10
47k
IC2.A
NE570
C9
1uF
C10
omit
C11
100n
HDR_IN
OUT
R5
150R
S1
BLEND
10kB
R4
47k
C23
22n
FDBK
10KA
C22
47n
R19
1k
C21
470n
C24
1uF
C27
10uF
4558
IC3_B
R21
100k
R23
180k
R22
240k
C25
150pF
R24
330k
C26
120pF
R18
20k
R17
22k
IC2.B
NE570
C20
3n9
C19
1uF
R16
10M
C17
1uF
C18
2u2
4558
IC3_A
R14
15k
R15
39k
C16
4u7
R13
16k
R12
15k
R11
470R
C15
2n7
C14
2n7
C13
47n
HDR_OUT
HDR_1-1
HDR_1-2
HDR_1-3
HDR_1-4
HDR_1-5
HDR_1-6
HDR_1-7
HDR_1-8
VD
CP1
CP2
HDR_IN
GND
OL
HDR_4-1
HDR_4-2
HDR_4-3
HDR_4-4
HDR_4-5
HDR_4-6
HDR_4-7
HDR_4-8
VB
VC
HDR_OUT
C28
2u2 BP
C29
470n
C.V
4558
IC4_A
R26
910k
R27
910k
RATE
MOD
IC4_B
4558
R28
120k
R25
15k
VD
100kB
MOD
R31
7k5
R32
27k
C32
1n
C30
2u2
D1
4001
C34
240pF
R29
3k3
R33
27k
C33
1n
R30
13k
C31
1uF
CLOCK
500k
500kB
DELAY
R34
5k
R35
120k
C35
100n
IC5
CD4047
AST
-T
+T
RET
R/C
C
R
OSC
RES
Q
Q
CP1
CP2
MADBEANPEDALS


SKOOLIE
BBD BOARD
Based on the EHX® Deluxe Memory Man™
© 2023 madbeanpedals
HDR_IN
HDR_OUT
4558
IC7_A
IC7_B
IC10_A
IC10_B
IC8
IC9
MN3005
R43 24k
R44 51k
R45 16k
R46 33k
R47 33k
R48 1k
R49 82k
R50 6k8
R51 2k4
R52 2k4
R53 100k
R54 100k
R55 6k8
R56 39k
R57 100k
R58 680k
R59 100k
R60 16k
R61 16k
R62 33k2
R63 24k3
C43 470n
C44 2n7
C45 2n7
C46 470n
C47 33n
C48 1uF
C49 100n
C50 1uF
C51 220n
C52 2n7
C53 2n7
C54 4u7
C55 10uF
C56 10uF
100k
BIAS1
BIAS2
GAIN1
GAIN2
BAL
5k
TP1
TP2
TP3
TP4
VGG
VD
VB
VC
OL
GND
CP1
CP2
MADBEANPEDALS

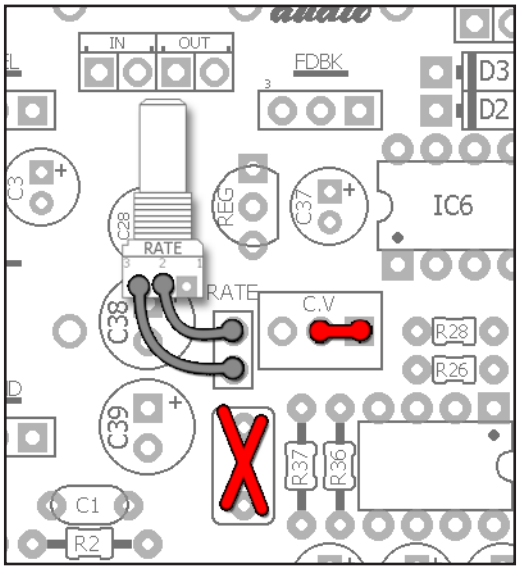
Before you begin your build, you should decide if you want to build the Skoolie with stock or extended modulation. To build it with stock modulation, simply follow the BOM as listed on pg.10. This means you will use a switch to select between two preset modulation speeds, where the speed is determined by the value of the integrator capacitor used in the LFO (2u2 BP and 470n, chorus and vibrato, resp.)

When building the Skoolie with the CV switch, you will need to jumper these two pads:



Extended Modulation Option

If you want full modulation control, then replace the CV switch with an pot. This gives all the in-between rate values plus faster speeds. You'll need to use a regular 9mm pot (not the PCB mounted type) and hand solder a couple of wires for the connection. Omit C29 and change R27 from 910k to 120k. You will also need to jumper two of the CV switch pads together, as shown below.



Shown from the top-side view of the 9mm pot (not the pin side)

As far as building the Skoolie, follow whatever order you like for populating and soldering both the Audio and BBD boards. But, don't solder in the pots/switch, headers, pin connectors or wires until later. We want to have a precise alignment between headers and pins so that the BBD and Audio boards seat well together.

In addition to the negative ground conversion, some additional mods were applied to the circuit. These enhance the operation without altering the fundamental delay tone we all love from the DMM.

Clock circuit

If you've built any of the other mbp DMM style projects, you know one caveat is that there was no way to adjust the BBD clock. This is why some vintage DMMs may have slightly different max delay times and in some cases clock noise at those settings. Previously, it was recommended to select a Delay pot that measured exactly 100k to prevent those issues.

The new clock circuit was copied directly from the mbp Prognosticator project (Stereo Memory Man™) and altered slightly in Delay pot and clock trimmer values to make it easier to dial in. The clock circuit is an additional adjustment but it guarantees that you can get the max delay time possible without any sort of artifact or dithering in the delay signal. And, it's easy to do.

Compander

All DMMs use DC coupled inputs on the compressor and expander portions of the NE570. For the Skoolie, these parallel inputs were decoupled at each input function. This is a very minor change but it's good practice, as I've learned. Two additional changes are boosting the output voltage of the expander to approximately Vb (7.5v) and a larger resistor in parallel with the RECT cap to prevent gating at high feedback settings. Some gating may still be present but only at the most extreme Delay and Feedback settings from what I've found. Overall, these changes seemed to work well in tandem with the negative ground conversion.

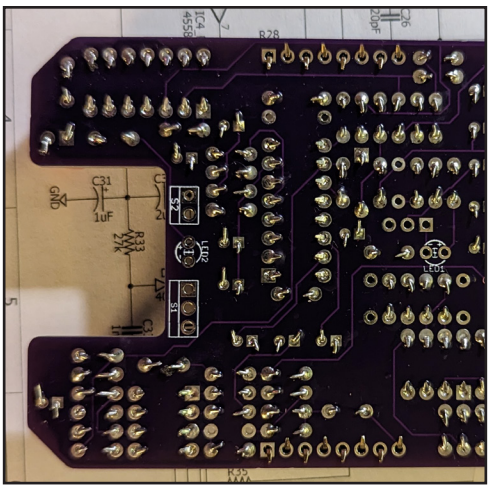
User Mods

There are two mods you can choose to perform, if you like:

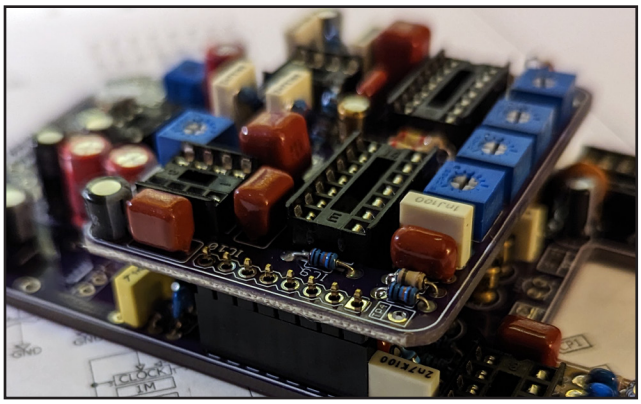
1. Input impedance mod: The stock DMM has a very low input impedance directly into IC1 (100k). Ideally, we like to see something more like 470k or even 1M (actually, the absolute best route is to use a high impedance input buffer, then use much smaller value resistors for that gain stage to reduce noise but that's getting far and away from a traditional DMM). Long story short: increase the value of R2 to make the overall frequency response better to different pickup outputs. Just increasing this resistor to 220k would make a difference. For my build, I went a bit further. I used 300k for R2 and changed R3 from 39k to 100k. This does three things at once: increases input impedance, reduces the total gain output possible but at the same time reduces the likelihood of any nasty op-amp clipping at high Level settings; a good balance to address several shortcomings.

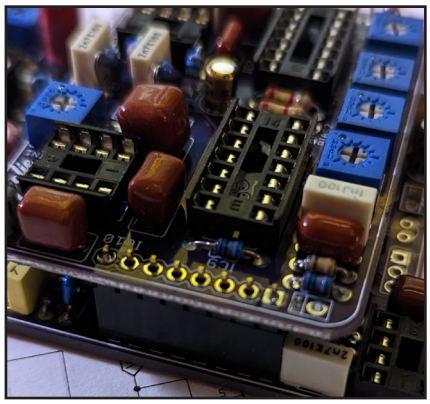
2. Noise reduction mod: Change all the 4558 to TL072 to lower the noise floor. There is a little bit of noise no matter what at high modulation settings (not ticking but frequency modulation noise) but it's not bad. At the very least, if you want to keep the 4558 for the sake of legitimacy then change IC4 to TL072 or maybe even a TL022.

After you have populated and soldered all the main components, but before you solder in the pots and toggle switch, let's deal with the headers and pins. Load one 8-pin header loosely onto the Audio board. I suggest folding alternating pins in an opposing pattern on the back of the PCB to secure them in place before soldering. Repeat for the second header on the opposite side.

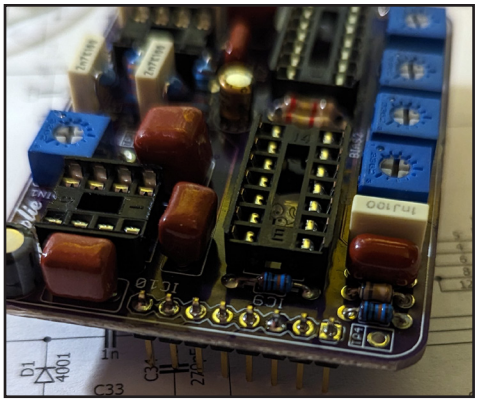


With the two headers soldered into place, insert the pins into each (long pins in, short pins exposed). Now place the BBD board loose onto the two pin strips. Solder the first and last pin of each row of pins.





Remove the Daughter board and solder the remaining pins on both sides of the board. The reason we remove it is so the pins don't get too hot and melt the headers.



Once this is completed, you can load and solder the pots/switch and wires. You're ready to move onto the testing phase. You do not need to wire up the bypass switch but you do need wires soldered to the "S1" pads on the Audio board.

It's tempting, but don't jump right to loading all the ICs in and firing it up yet. Being a little bit methodical at the beginning of testing can potentially save a lot of guess work later on. And, obviously, do not box this build up until you are sure everything is working properly. Use whatever testing apparatus you have available. I used my Protoyping/Testing rig.

Follow this procedure (reminder - never load an IC when the PCB is powered. Always unplug power first!)

1. Leave the BBD board unplugged. Load in IC6, the LT1054 charge pump. Now connect 9v power.

2. Using your multimeter, verify you have about 9v on pin8 of IC6. Now check pin8 of the IC1 socket. You should be seeing about 15v. If so, go to step 3. If not, you will need to check over the charge pump circuitry and 15v regulator to see if you've made a mistake somewhere.

3. Disconnect power. Load IC1, IC2 and IC3 into their sockets and power back on. Check the voltage readings on pin8 of IC1 and IC3, and also pin13 on IC2. You should still see about 15v. If not, one of the ICs may be bad so you'll want to figure out which one and use a replacement.

4. At this point, we can check for audio even without the BBD board attached. Connect the wires soldered to pads 1 and 2 from the S1 bypass together (the two round pads). With your guitar or signal source plugged in the IN jack, you should hear audio from the OUT jack. Check the LEVEL control to see if it increases the output gain.

5. Power off. Load IC4 and IC5. Power back on and check pin8 of IC4 and pin14 of IC5 for 15v. Once you have verified all the voltages are good on the power pins of the Audio board we can go to the next step.

6. Power off and load IC7 and IC10 into the BBD board. Do not put in either MN3005 at this point. Attach the BBD board to the Audio board and power back on. Now check pins8 of IC7 and IC10 for 15v. Also, check pin1 of each MN3005 socket for *about* 15v as well. Finally, check pin8 of each MN3005 socket. You should read about 1v on both.

Testing is complete. Now you can move to the calibration stage!

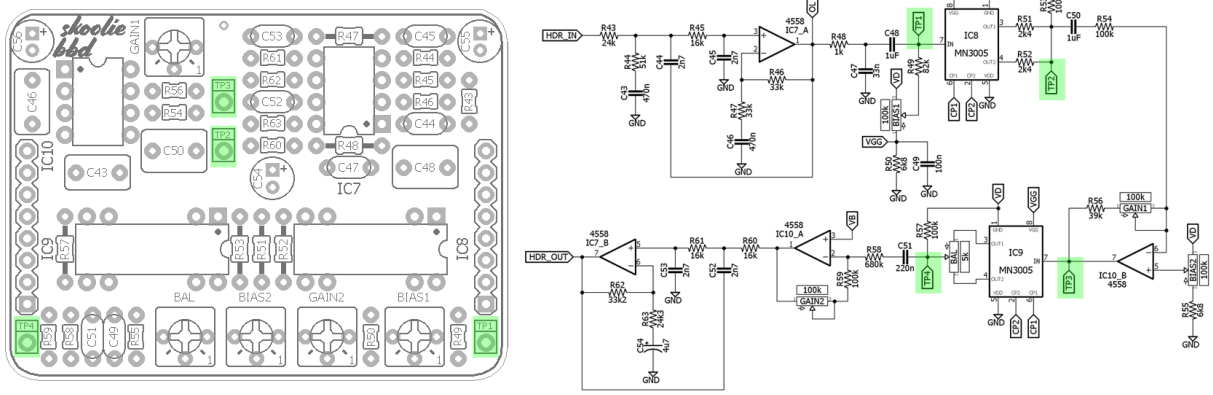
This part requires an audio probe

This procedure is for “ear” calibration. You can get about 90% perfect calibration with this method. Perfect calibration will require an oscilloscope and if you have one, I suggest you follow the scope calibration guide in the Skoolie zip. I’ve done the ear calibration so many times I can legitimately say I can do it *almost* as good as a scope (except for the BAL trimmer). And if I can do that, then so can you!

Start with these settings

LEVEL pot & CLOCK trimmer: about 1/3rd up
DELAY & BLEND: full up
FDBK: full down
MOD/DEPTH: full down
RATE/CV switch: doesn’t matter
All remaining trimmers: 1/2 up.

The BBD board has four testing points labeled TP1-TP4 (the “OL” label on the schematic is a connection back to the Audio board to feed the overload LED and not used for ear calibration). 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.



Use your guitar or a signal source plugged into the IN jack connection.

- Audio probe TP1 for signal. This verifies that audio is passing from the Audio to BBD board and the first BBD (IC8) is receiving input signal.
- Now probe TP2. Adjust BIAS1 until you get the cleanest delayed output possible. It’s usually around the middle of the trimmer.
- Go to TP3. Adjust GAIN1 so that audio level is about the same the level or slightly higher than at TP1.
- Power off and add IC9. Power back up.
- 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.

- 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.

- Next we''ll set the Skoolie 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 about 3/4th. 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.

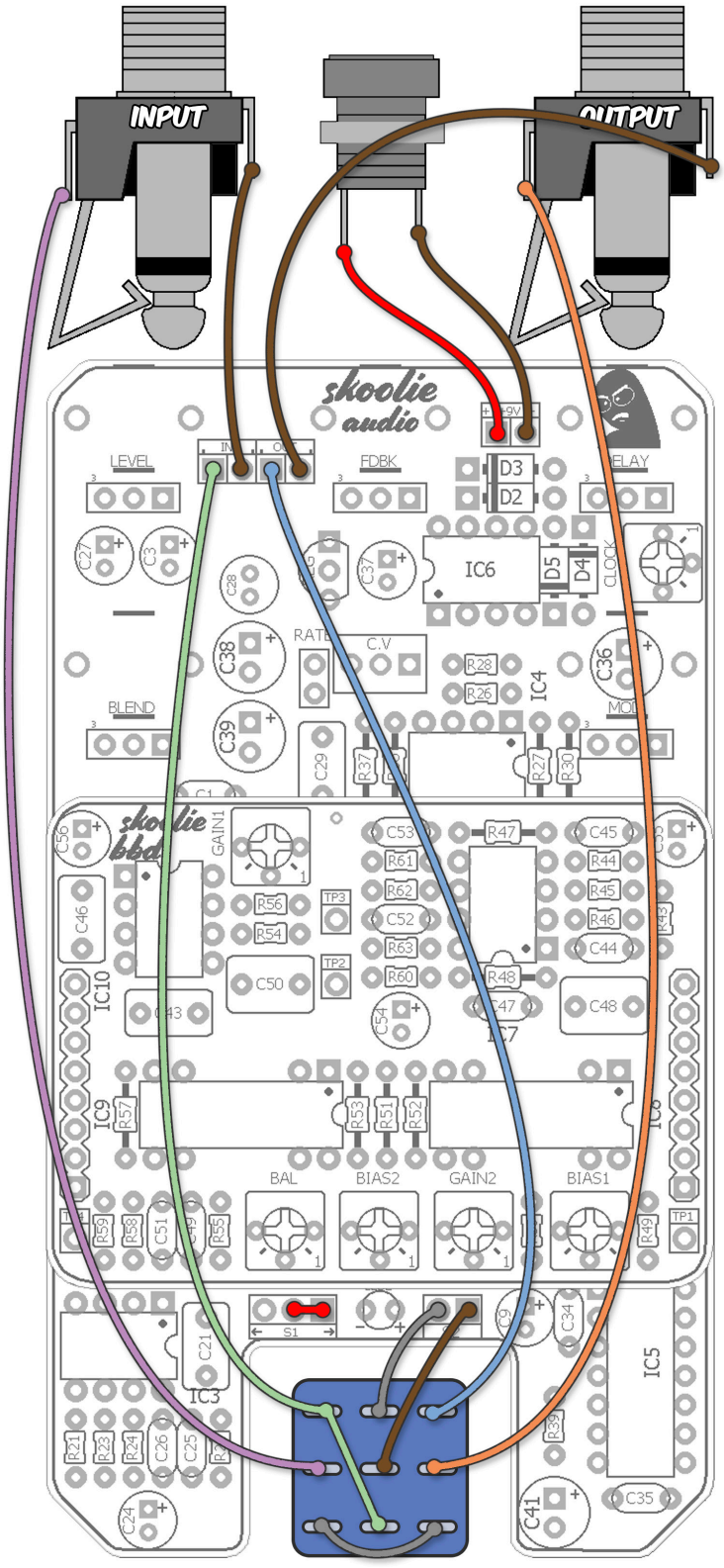
- Make any final adjustments to the trimmers to improve the level and clarity of the repeats. You cannot adjust the BAL trimmer by ear, so leave it in the middle.

- Set the Delay to max and feedback about 1/2 up. Listening to the delay repeats adjust the CLOCK trimmer clockwise for the maximum allowable delay without any sort of artifact in the tone. When you go too far, the delay repeats will have a “bit crushed” type quality. Leave the trimmer at the setting just before this becomes apparent. You should have roughly 550ms of delay.

- 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

For calibration with an oscilloscope, I’ve included an additional pdf document in the Skoolie .zip file.



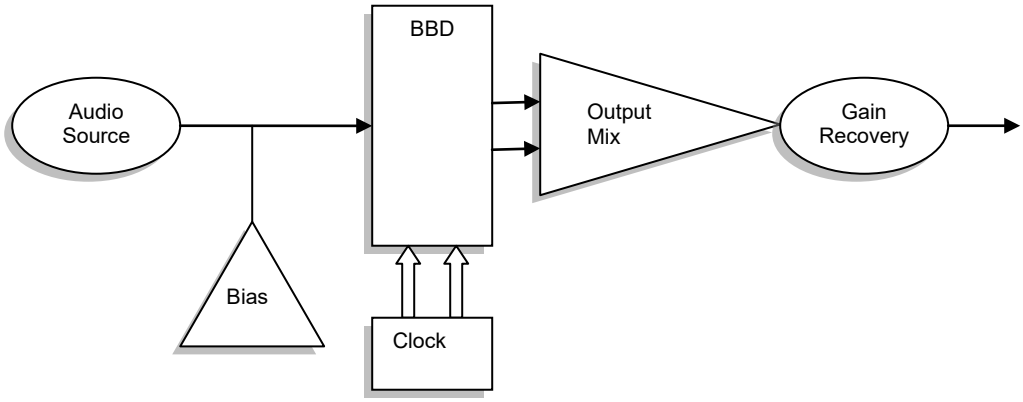
Use this wiring diagram if you prefer true bypass operation. This will disable the LEVEL control in bypass.

This info is copied from the Total Recall documentation to use as a reference. Some of the component numbering and procedures may be different than the Skoolie.

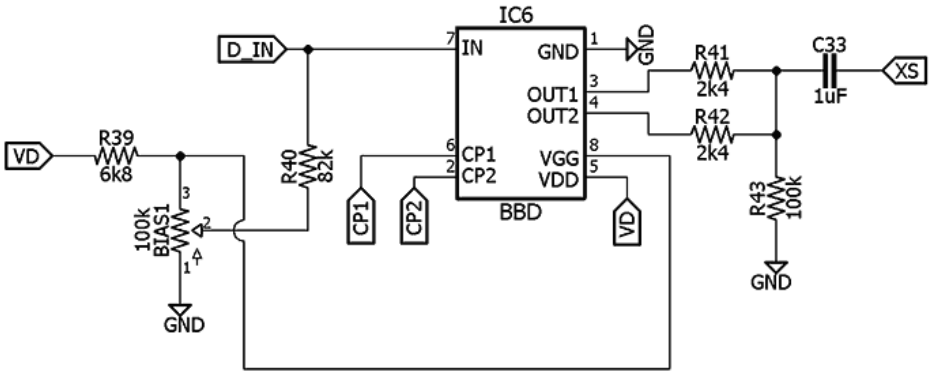
There are two ways to bias the Total Recall. One is by ear and the other is with an oscilloscope. This document will show you how to do it by ear. For scope biasing there are a few guides online the give lots of detail on how to do the procedure.

Here is one guide you might find useful for scope calibration (this info in also available in the TourbusScope.pdf in the project .zip file): https://sites.google.com/a/davidmorrin.com/www/home/trouble/troubleeffects/electro-harmonix-memory-man/eh-7850/eh-7850-calibration

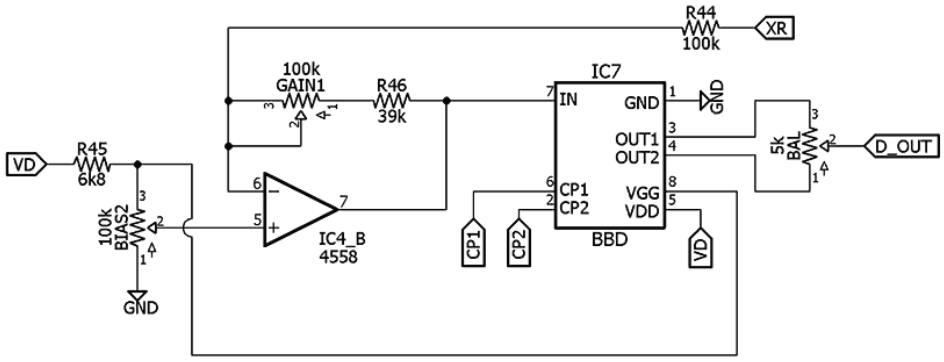
Before biasing, let's understand what we are doing and why. The bucket-brigade device (BBD) requires a bias voltage applied to its input in order to pass a delayed signal. This is done via a trimmer set up as a voltage divider connected to the power supply. An audio source is applied to the BBD input (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.



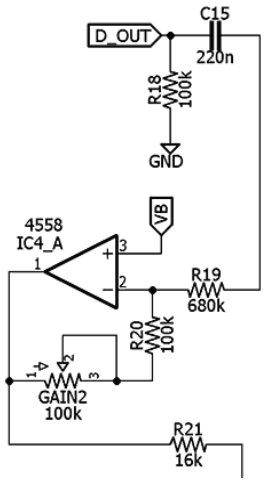
Let's compare that to a circuit snippet from the TR schematic.



Our audio source comes in at D_IN and goes to pin7 of IC6. 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.



The gain recovery stage starts at XR. 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.



After the second gain recovery stage, the signal is sent through additional filters, the expandor, then mixed to the output of the circuit (not shown).