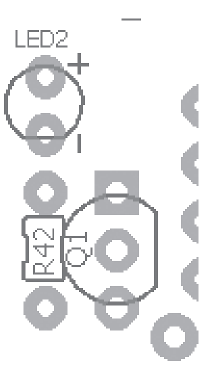
TOURBUS_PGE

FX TYPE: Delay
Based on the EHX® Deluxe Memory Man™
Enclosure Size: 125B
“Softie” compatibility: none

Oct 12th, 2022 - Rev.1 Update

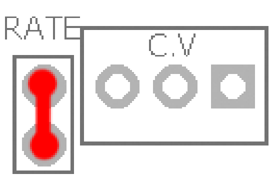
The Tourbus has been updated to “Rev.1” status.

1 - Q1 (2n5087 used for the overload LED) was backwards on the initial layout. This has been corrected for rev.1 . If you are building rev.1 then you should put Q1 in exactly as shown on the PCB.



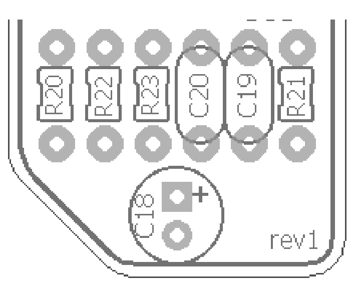
On the rev.1 Tourbus PCB, place the 2n5087 exactly as shown on the PCB.

2 - I neglected to mention in the initial documentation that if you are using the Rate pot mod instead of the C/V switch, you must jumper two pads. This applies to the intial release and the Rev.1 boards.



When building the Tourbus stock (CV switch instead of the Rate pot modification) jumper these two pads on the PCB.

Rev.1 boards are labeled on the lower left hand side of the Audio board PCB. The BBD board is also labeled as rev.1 for consistency, but there are no layout changes to it..



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.

TOURBUS_PGE

FX TYPE: Delay
Based on the EHX® Deluxe Memory Man™
Enclosure Size: 125B
“Softie” compatibility: none

Overview

The Tourbus is a dream I’ve had for a long time - a Deluxe Memory Man™ in a 125B. I started the design in early 2020 but progress was slow. Then EHX® came out with the Nano version a few months ago so I figured it was time to get my act together and get this thing finished. I’m happy to say the design came out just as well as I’d hoped. It’s pure Memory Man™, but in a small package that sticks with through-hole components *and* is relatively easy to build as a DIY project.

The Tourbus PGE (positive ground ed.) is the exact same circuit as the mbp Total Recall with the following changes:

1. It remains **positive ground and non-true bypass**, but only requires an 18v power supply instead of the EHX 24v used in the Total Recall.
2. It includes the “overload” LED.
3. It offers the option to build it with either the traditional modulation (Mod pot + Switch between Chorus and Vibe) or with extended modulation (LFO Speed and Depth, no switch required).
4. The PCB design was converted to 4-layer for compactness and lowest noise possible.

To fit this in a 125B enclosure, a couple compromises were made. The build requires 1/8W resistors and stacked PCBs. I broke the circuit into two boards: the Main board and Daughter board. The Main board contains most of the audio and the LFO circuit. The Daughter board comprises two MN3005 BBD and surrounding circuitry, plus all 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 Total Recall, the Tourbus should be pretty easy to pull off. While I don’t recommend this build for the total novice, I will provide extensive notes with build tips and calibration procedures at the end of this document to ease your pain :)

Audio Controls

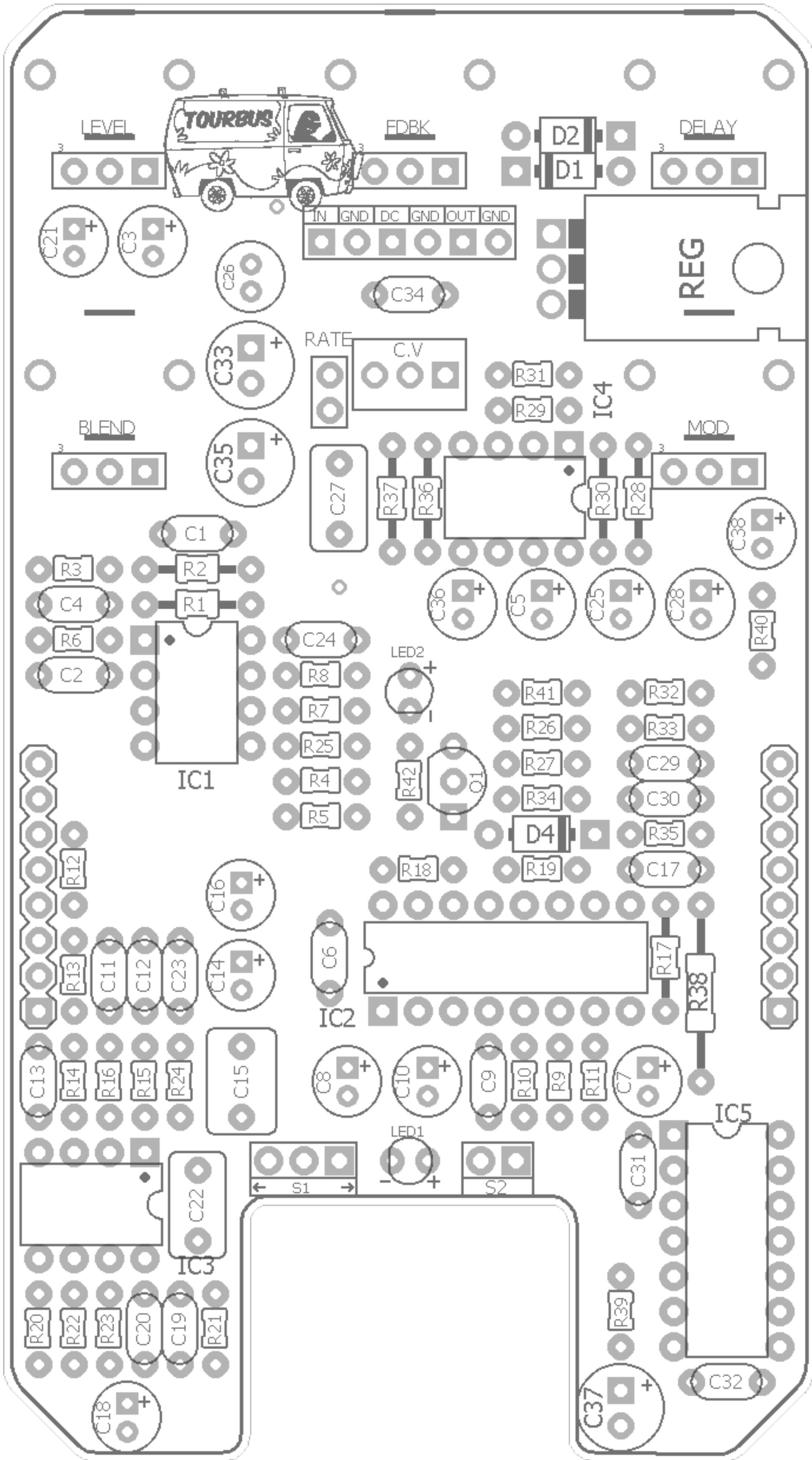
DELAY - Total delay time from slap-back to approximately 550ms.
FDBK - The total number of repeats from one to many to self-oscillation.
LEVEL - The input gain of the circuit. This control can create mild overdrive when turned up. It also increases the output volume of the effect.
BLEND - The dry/wet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

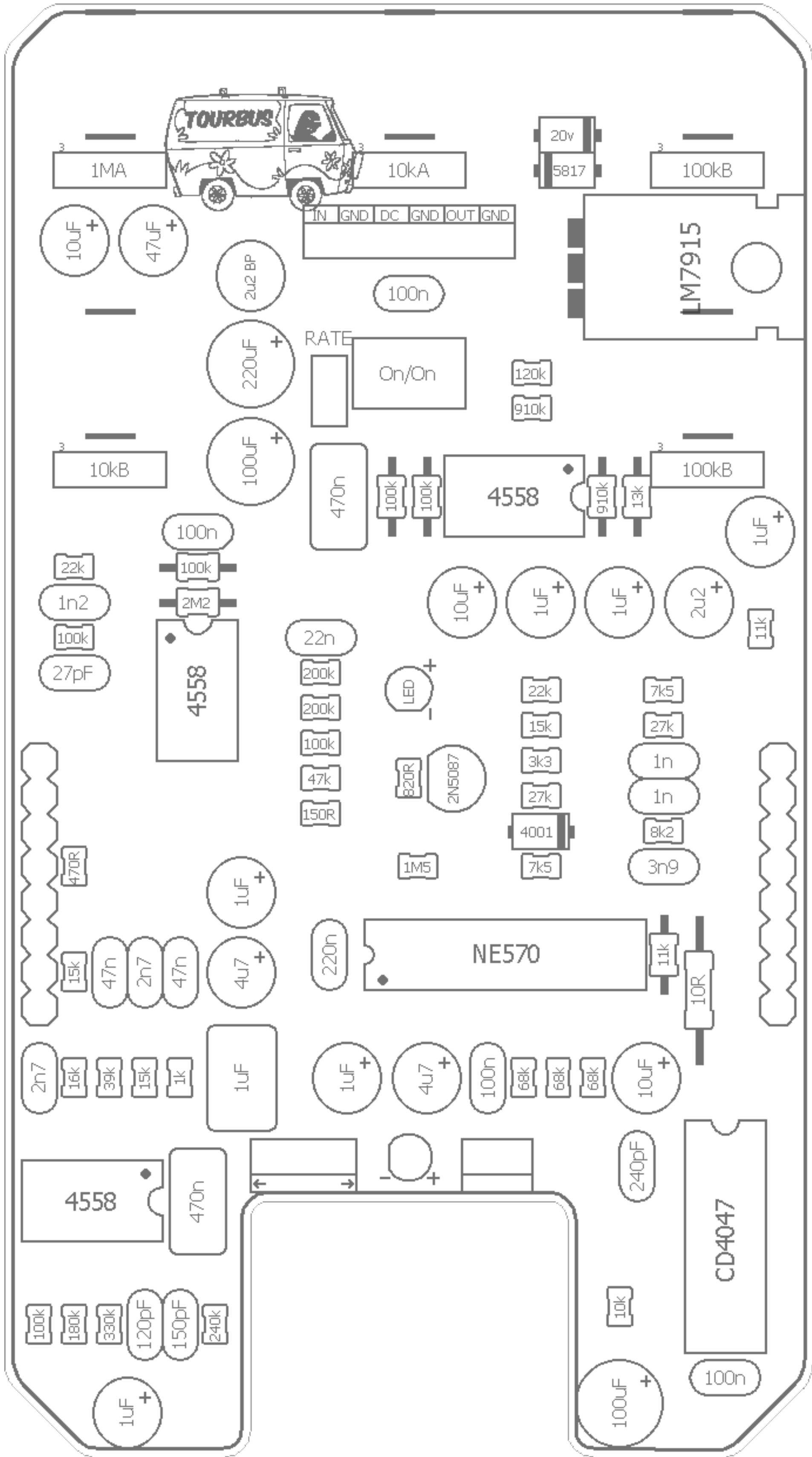
BIAS1, 2 - These trimmers set the input bias voltage of the BBD chips.
GAIN1, 2 - These trimmers set the gain recovery after BBD1 and BBD2.
BAL - This trimmer balances the two outputs of the second BBD for minimum phase cancellation and clock bleed.

Special thanks to mbp forum member benny_profane who provided some exceptional feedback and assistance on the development of this document.

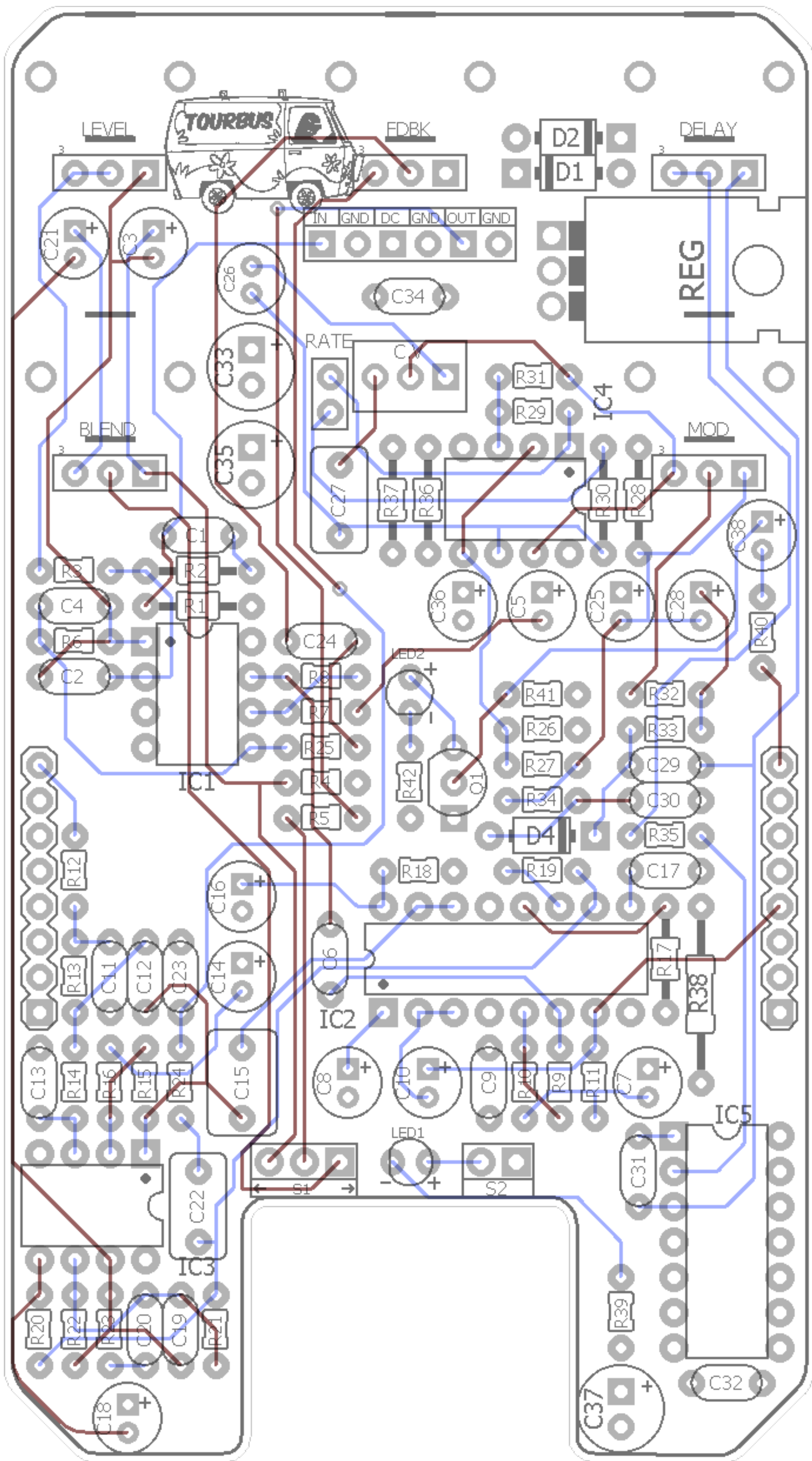
Technical assistance for your build(s) is available via the madbeanpedals forum. Please go there rather than emailing me for assistance on builds. This is because (1) I’m not always available to respond via email in a timely and continuous manner, and (2) posting technical problems and solutions in the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



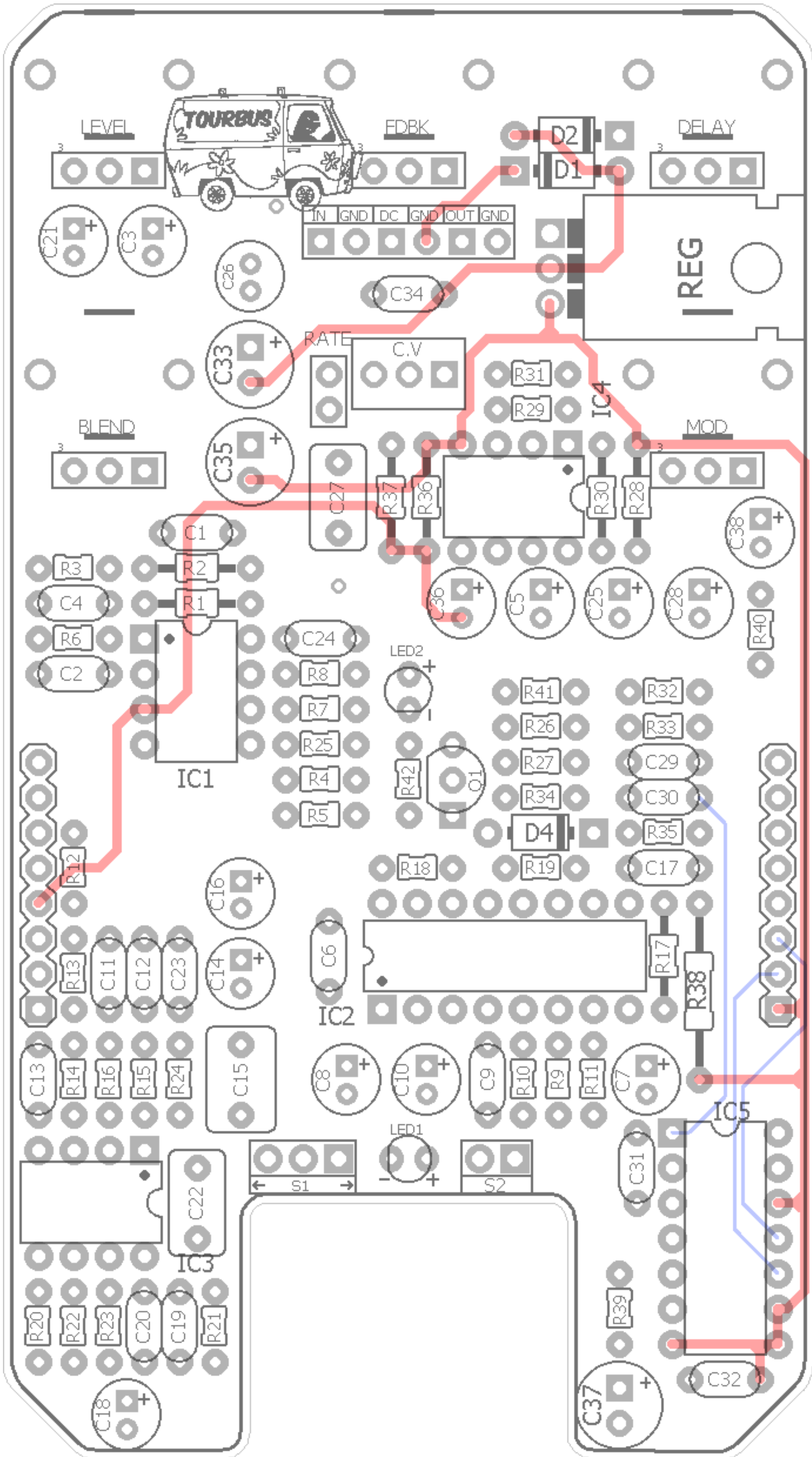
Note: Q1 should be reversed 180° as shown on the PCB!



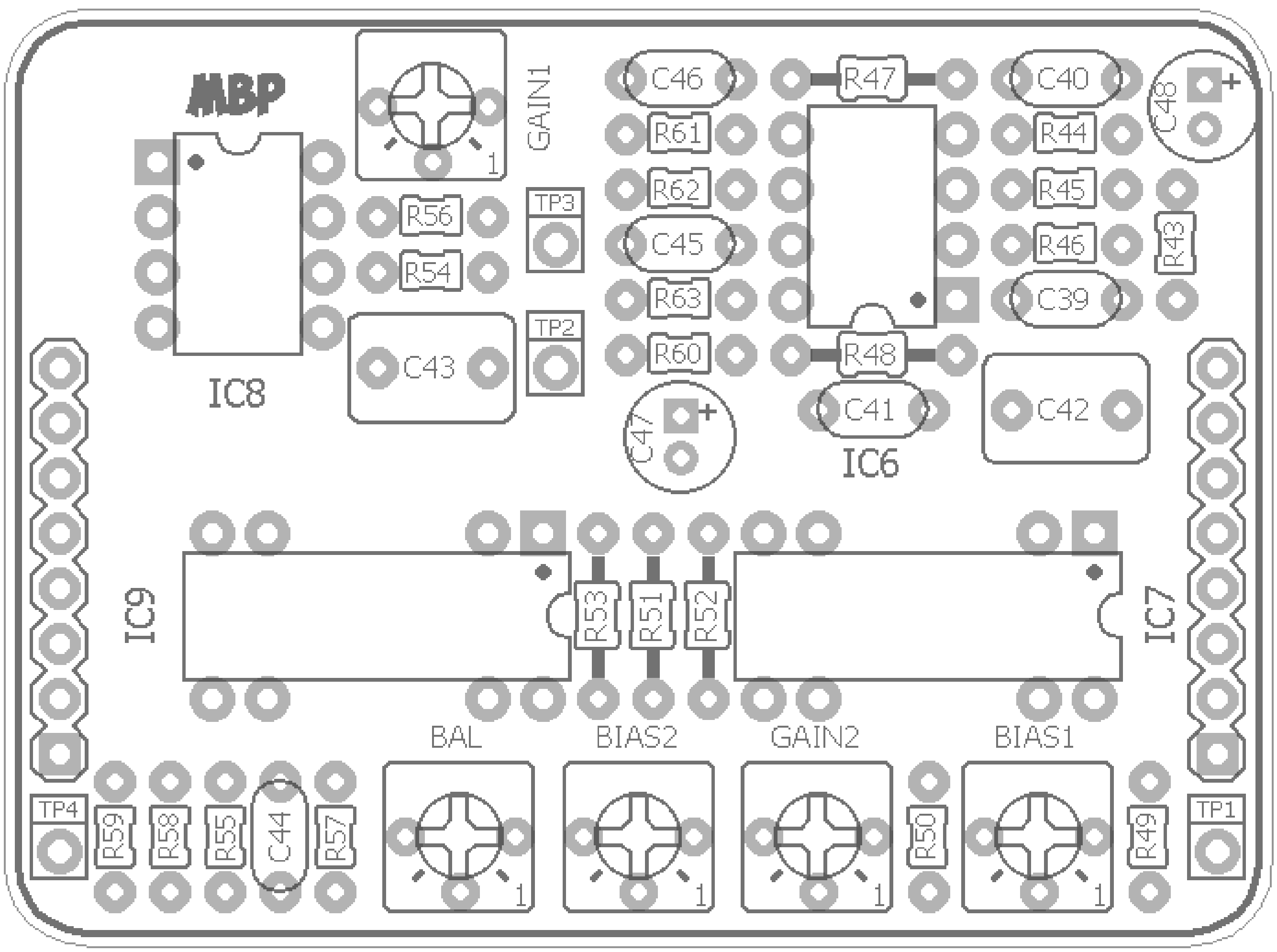
Note: Q1 should be reversed 180° as shown on the PCB!

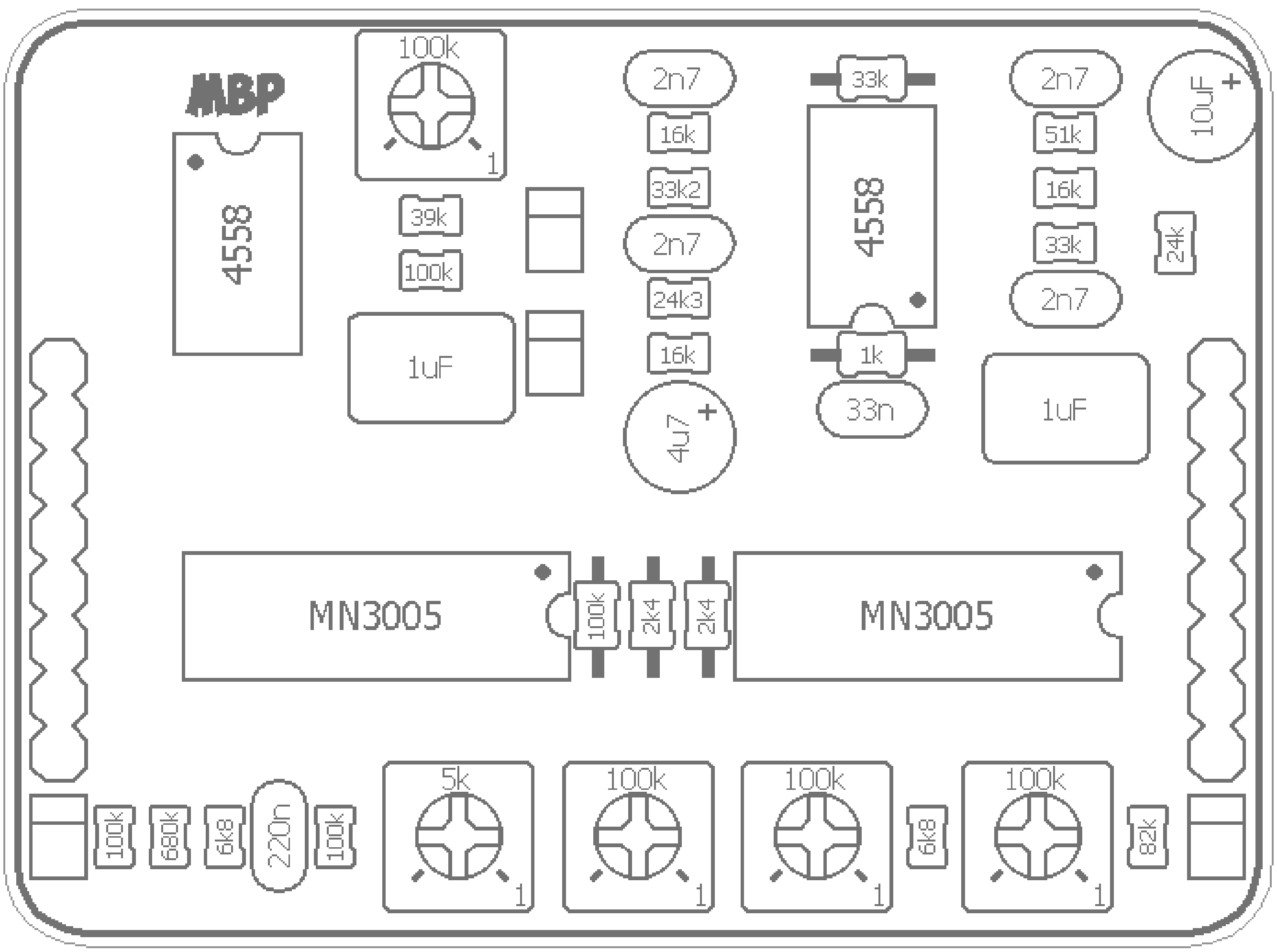


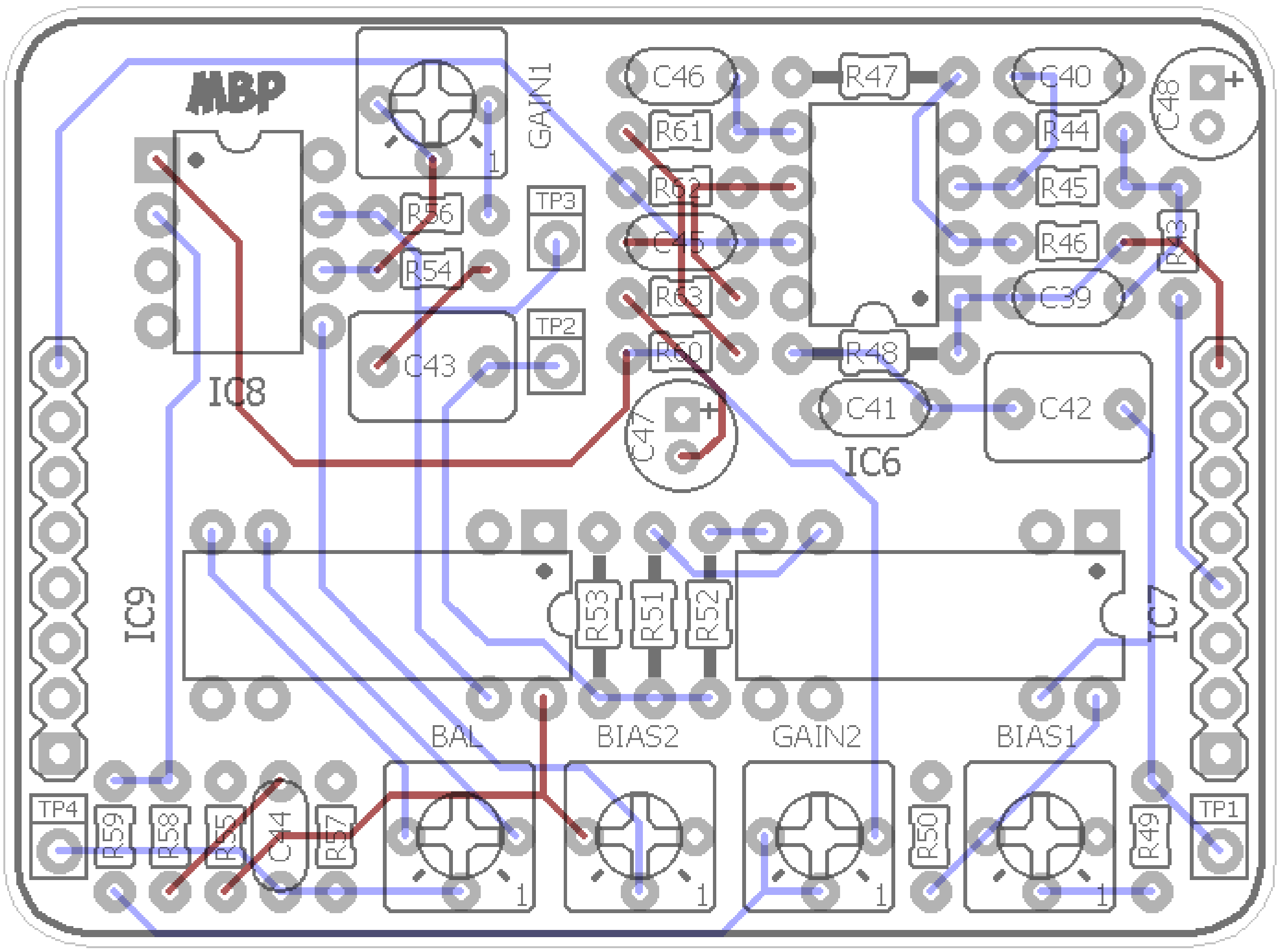
Top (brown) and Bottom (blue) Signal Layers



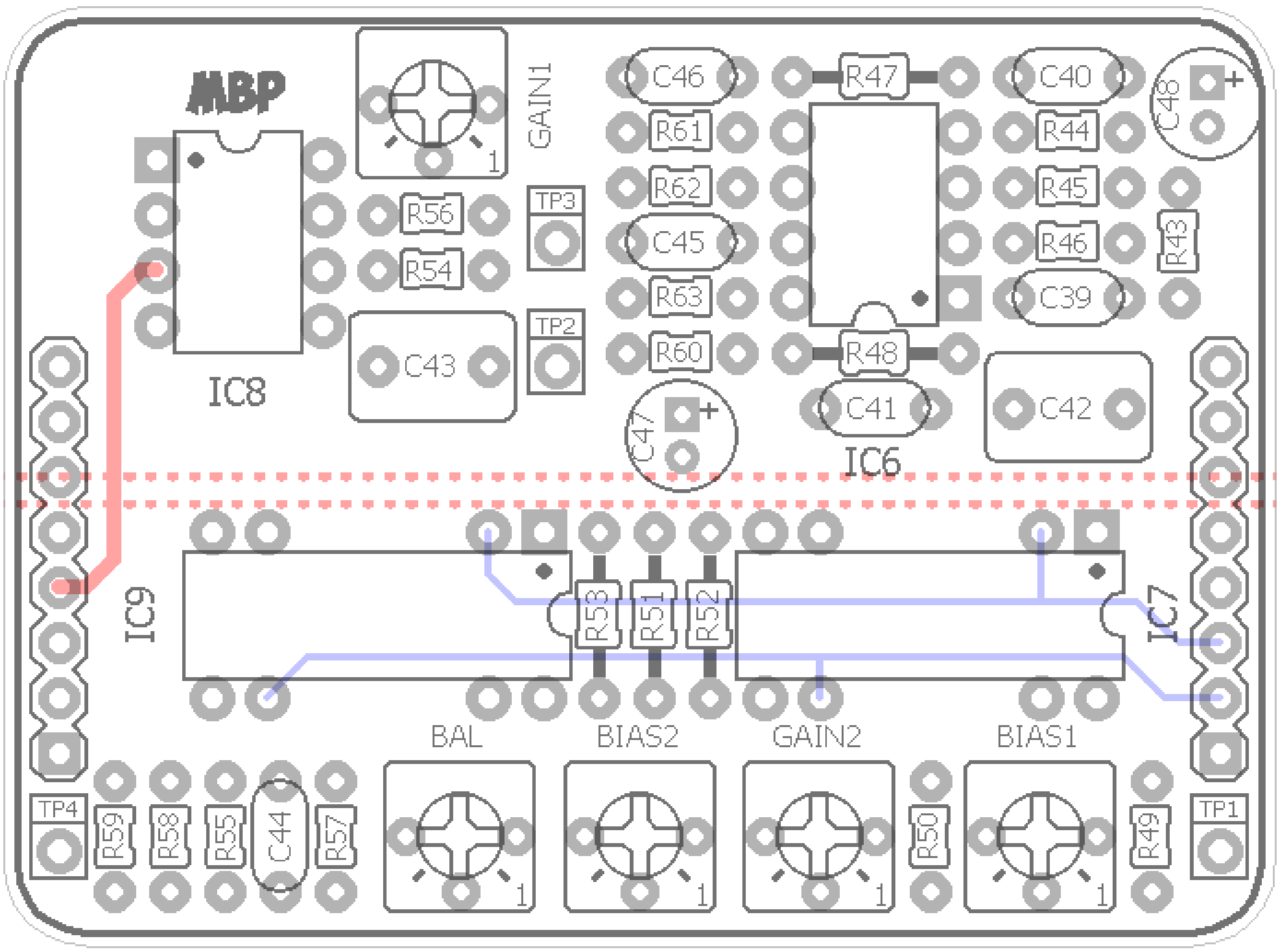
Inner Layers: Power (red) and GND (blue). The inner layers also use power and ground pours (not shown).


MBP
IC8
GAIN1
R56
R54
C43
TP3
TP2
C46
R61
R62
C45
R63
R60
C47
R47
R48
C41
IC6
C40
R44
R45
R46
C39
C42
C48
R43
IC9
R53
R51
R52
IC7
BAL
BIAS2
GAIN2
BIAS1
TP4
R59
R58
R55
C44
R57
R50
R49
TP1


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



Top (brown) and Bottom (blue) Signal Layers



Inner Layers: Power (red) and GND (blue). The inner layers also use power and ground pours (not shown).

Resistors		Resistors		Caps		Caps		Diodes	
R1	2M2	R33	27k	C1	100n	C33	220uF	D1	1n5817
R2	100k	R34	27k	C2	27pF	C34	100n	D2	20v Zener
R3	22k	R35	8k2	C3	47uF	C35	100uF	D4	1n4001
R4	47k	R36	100k	C4	1n2	C36	10uF	**Transistors**	
R5	150R	R37	100k	C5	1uF	C37	100uF	Q1	2N5087
R6	100k	R38	10R	C6	220n	C38	1uF	**Regulators**	
R7	200k	R39	10k	C7	10uF	C39	2n7	REG	L(M)7915
R8	200k	R40	11k	C8	1uF	C40	2n7	**ICs**	
R9	68k	R41	22k	C9	100n	C41	33n	IC1	4558
R10	68k	R42	820R	C10	4u7	C42	1uF	IC2	NE570
R11	68k	R43	24k	C11	47n	C43	1uF	IC3	4558
R12	470R	R44	51k	C12	2n7	C44	220n	IC4	4558
R13	15k	R45	16k	C13	2n7	C45	2n7	IC5	CD4047
R14	16k	R46	33k	C14	4u7	C46	2n7	IC6	4558
R15	15k	R47	33k	C15	1uF	C47	4u7	IC7	MN3005
R16	39k	R48	1k	C16	1uF	C48	10uF	IC8	4558
R17	11k	R49	82k	C17	3n9			IC9	MN3005
R18	1M5	R50	6k8	C18	1uF			**Switches**	
R19	7k5	R51	2k4	C19	150pF			C.V	On/On
R20	100k	R52	2k4	C20	120pF			**Trimmers**	
R21	240k	R53	100k	C21	10uF			BAL	5k
R22	180k	R54	100k	C22	470n			BIAS1	100k
R23	330k	R55	6k8	C23	47n			BIAS2	100k
R24	1k	R56	39k	C24	22n			GAIN1	100k
R25	100k	R57	100k	C25	1uF			GAIN2	100k
R26	15k	R58	680k	C26	2u2 BP			**Pots**	
R27	3k3	R59	100k	C27	470n			BLEND	10kB
R28	13k	R60	16k	C28	2u2			DELAY	100kB
R29	910k	R61	16k	C29	1n			FDBK	10kA
R30	910k	R62	33k2	C30	1n			LEVEL	1MA
R31	120k	R63	24k3	C31	240pF			MOD	100kB
R32	7k5			C32	100n				

This list covers both the Main and Daughter boards. The Shopping List (next page) highlights parts that are included with the Tourbus Bonus Pack. Those parts are used on both boards.

Shopping List

Tourbus_PGE

Value	QTY	Type	Rating	Value	QTY	Type	Rating
10R	1	Metal / Carbon Film	1/4W or 1/2W	1n	2	Film	25v min.
150R	1	Metal / Carbon Film	1/8W	1n2	1	Film	25v min.
470R	1	Metal / Carbon Film	1/8W	2n7	6	Film	25v min.
820R	1	Metal / Carbon Film	1/8W	3n9	1	Film	25v min.
1k	2	Metal / Carbon Film	1/8W	22n	1	Film	25v min.
2k4	2	Metal / Carbon Film	1/8W	33n	1	Film	25v min.
3k3	1	Metal / Carbon Film	1/8W	47n	2	Film	25v min.
6k8	2	Metal / Carbon Film	1/8W	100n	4	Film	25v min.
7k5	2	Metal / Carbon Film	1/8W	220n	2	Film	25v min.
8k2	1	Metal / Carbon Film	1/8W	470n	2	Film	25v min.
10k	1	Metal / Carbon Film	1/8W	1uF	2	Film, low profile	25v min.
11k	2	Metal / Carbon Film	1/8W	1uF	1	Film	25v min.
13k	1	Metal / Carbon Film	1/8W	1uF	5	Electrolytic, low profile	25v min.
15k	3	Metal / Carbon Film	1/8W	1uF	2	Electrolytic	25v min.
16k	4	Metal / Carbon Film	1/8W	2u2	1	Electrolytic, low profile	25v min.
22k	2	Metal / Carbon Film	1/8W	2u2 BP	1	Electrolytic, Non-polar/Bi-Polar	25v min.
24k	1	Metal / Carbon Film	1/8W	4u7	3	Electrolytic, low profile	25v min.
24k3	1	Metal / Carbon Film	1/8W	10uF	3	Electrolytic, low profile	25v min.
27k	2	Metal / Carbon Film	1/8W	10uF	1	Electrolytic	25v min.
33k	2	Metal / Carbon Film	1/8W	47uF	1	Electrolytic	25v min.
33k2	1	Metal / Carbon Film	1/8W	100uF	2	Electrolytic	25v min.
39k	2	Metal / Carbon Film	1/8W	220uF	1	Electrolytic	25v min.
47k	1	Metal / Carbon Film	1/8W	1n5817	1		
51k	1	Metal / Carbon Film	1/8W	20v	1	Zener, 1W	
68k	3	Metal / Carbon Film	1/8W	1n4001	1		
82k	1	Metal / Carbon Film	1/8W	2N5087	1		
100k	10	Metal / Carbon Film	1/8W	LM7915	1	TO-220	
120k	1	Metal / Carbon Film	1/8W	4558	5		
180k	1	Metal / Carbon Film	1/8W	NE570	1	or, v571	
200k	2	Metal / Carbon Film	1/8W	MN3005	2		
240k	1	Metal / Carbon Film	1/8W	CD4047	1		
330k	1	Metal / Carbon Film	1/8W	SPDT	1	On/On, mini	
680k	1	Metal / Carbon Film	1/8W	5k	1	Bourns 3362p	
910k	2	Metal / Carbon Film	1/8W	100k	4	Bourns 3362p	
1M5	1	Metal / Carbon Film	1/8W	10kB	1	Right Angle, Metal Shaft	9mm
2M2	1	Metal / Carbon Film	1/8W	100kB	2	Right Angle, Metal Shaft	9mm
27pF	1	Ceramic / MLCC	25v min.	10kA	1	Right Angle, Metal Shaft	9mm
120pF	1	Ceramic / MLCC	25v min.	1MA	1	Right Angle, Metal Shaft	9mm
150pF	1	Ceramic / MLCC	25v min.	Pins	2	8-pin SIL	2.54mm
240pF	1	Ceramic / MLCC	25v min.	Sockets	2	8-pin SIL	2.54mm

Corrected 7.22.22

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

Film Caps:
https://www.taydaelectronics.com/capacitors/polyester-film-box-type-capacitors.html
https://stompboxparts.com/capacitors/box-film-capacitors-bag-of-10/

20v Zener:
https://www.mouser.com/ProductDetail/512-1N4747A
Sub - 24v Zener: https://www.taydaelectronics.com/1n4749a-1n4749-zener-diode-1-3w-24v.html

LM7915: https://www.mouser.com/ProductDetail/926-LM7915CT-NOPB
Sub- L7915: https://www.taydaelectronics.com/l7915cv-l7915-7915-voltage-regulator-ic-15v-1-5a.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

CD4047:
https://smallbear-electronics.mybigcommerce.com/ic-cd4047/
https://stompboxparts.com/semiconductors/cd4047be-cmos-monostable-astable-multivibrator-ic/
https://www.taydaelectronics.com/cd4047-4047-ic-cmos-monostable-multivibrators-926.html
https://www.mouser.com/ProductDetail/595-CD4047BE

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/

5k Bourns 3362p Trimmer:
https://www.taydaelectronics.com/5k-ohm-trimmer-potentiometer-cermet-1-turn-3362p.html
https://www.mouser.com/ProductDetail/652-3362P-1-502LF

100k Bourns 3362p Trimmer:
https://www.taydaelectronics.com/100k-ohm-trimmer-potentiometer-cermet-1-turn-3362p.html
https://www.mouser.com/ProductDetail/652-3362P-1-104LF

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

8-pin DIP Socket, Ultra Low Profile: (For Daughter Board)
https://www.mouser.com/ProductDetail/575-343308

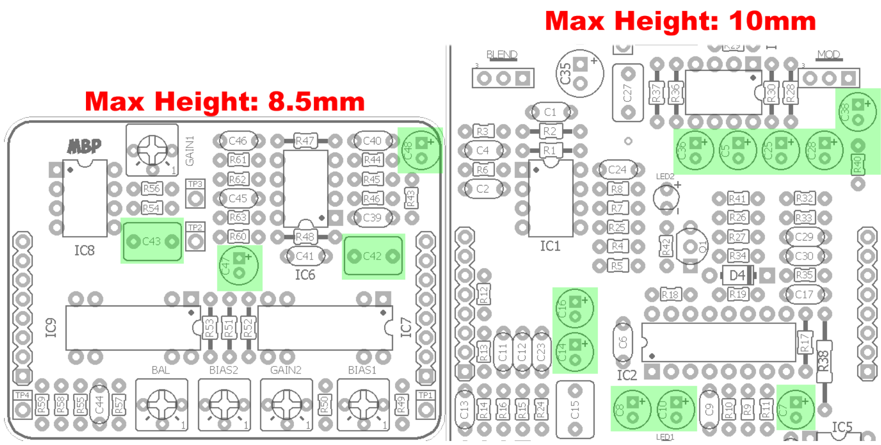
14-pin DIP Socket, Ultra Low Profile: (For Daughter Board)
https://www.mouser.com/ProductDetail/575-115433143

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/

- 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.

- The **“Tourbus Bonus Pack”** includes some critical parts required to make this a successful build. The build requires a number of low-profile caps for both the Main and Daughter boards. The maximum height restriction is shown below.



- The Bonus Pack has all the required low-profile film and electrolytic caps needed, plus the 2u2 BP cap for the LFO, pin headers to connect the Main and Daughter boards, and three of the odd-ball resistor values. Note: I can only offer those resistors in 1/4W due to the 1/8W versions being ridiculously expensive (you just need to stand those on end and fold the leads over to fit in the 5mm spacing). *All the items included are highlighted in yellow on the Shopping List*.

- I listed two low-profile IC sockets in the Parts Guide (8-pin and 14-pin) for use on the Daughter PCB. These are great to have but not required. Standard-sized “leaf-style” sockets can be used on the Daughter PCB without exceeding the max height threshold.

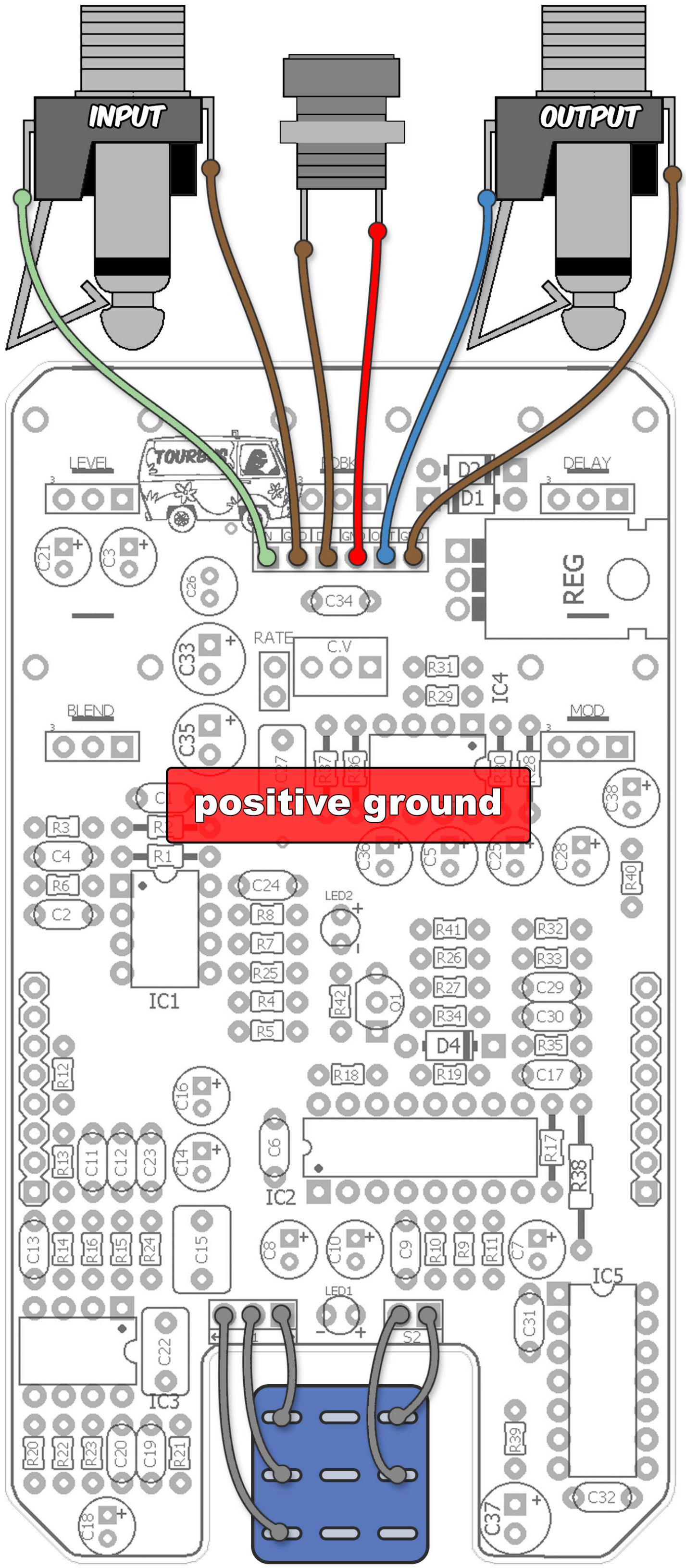
- Although they are in short supply, I highly recommend using the Lumberg 1/4” jacks for input and output. At the time of publication, you can find them at LoveMySwitches. Should they go out of stock, you can sub in the stereo versions of those jacks. This is what I did for my build. I simply shorted the Ring and Sleeve of each jack with a lead. Not totally necessary to do, but it’s *good practice*.

- To modify the Tourbus for extended modulation: omit the C.V switch, omit C27, make R30 120k instead of 910k, wire a 1MB or 1MC 9mm pot into the “Rate” pads on the Main board. See the build notes for more explanation.

- D2 is listed as a 20v Zener, but the 24v sub linked on the previous page is fine. Its purpose is to prevent excess voltage to C33. So long as you are using a well regulated 18v supply it’s a non-issue.

- A lot of modern pedal power supplies have an 18v tap. So long as it’s **isolated** and can provide 100mA, it will work with the Tourbus. If your supply does not meet that qualification, then I recommend the Dunlop ECB-004 18v wall wart. This is an excellent power supply in a slim form factor.

You can find a comprehensive build and calibration guide for the Tourbus at the end of this document.

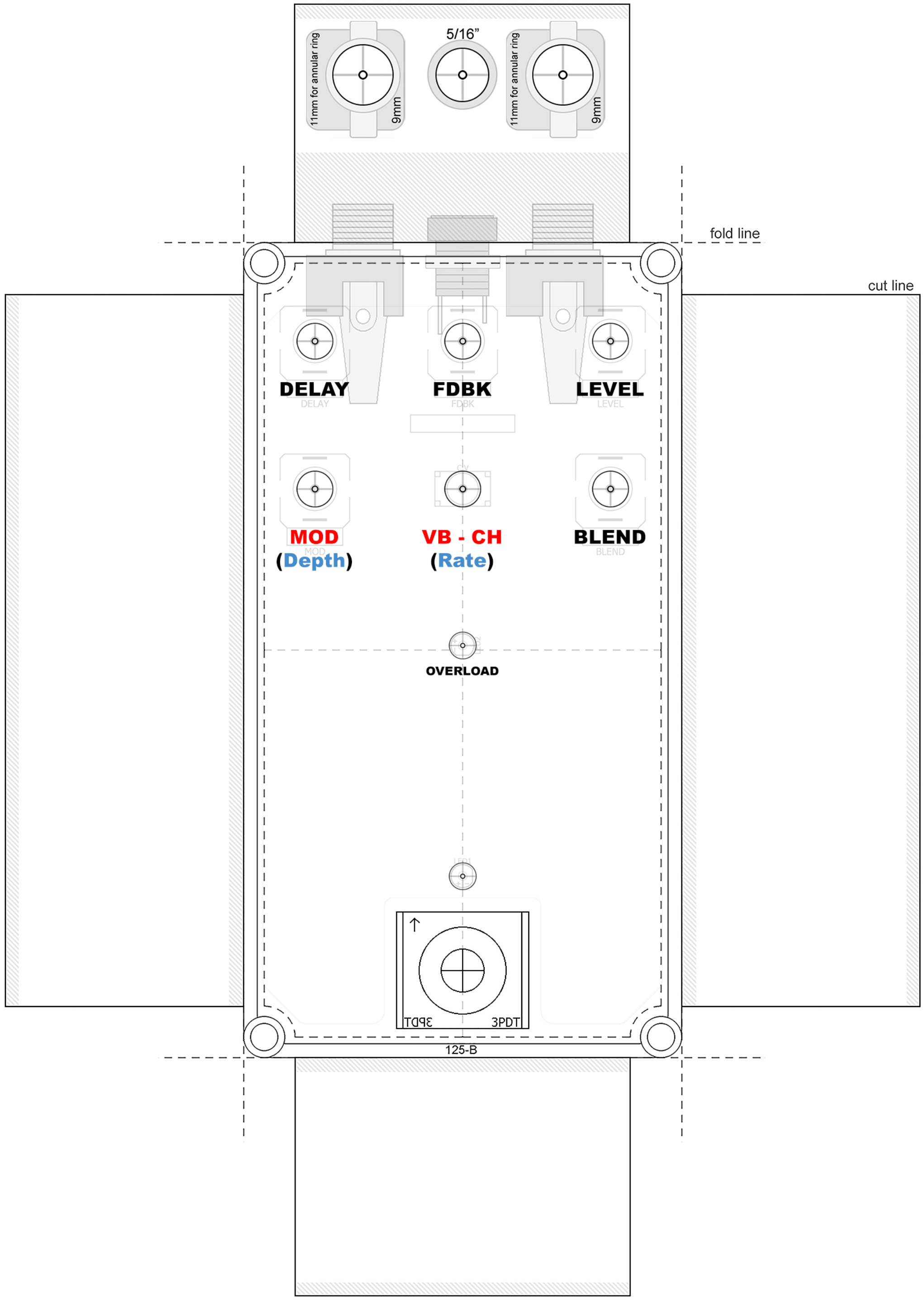


The Tourbus is a positive-ground circuit. This means, relative to ground, all the DC voltages will read negative. It's important to remember that regardless of whether any particular circuit is positive or negative ground, that's only in relation to signal ground. IOW, ground is ground is ground. It's always 0vDC.

I've used color-coded wires to demonstrate the positive ground wiring. The brown wires are all 0vDC i.e. signal ground. So, even though there is a brown wire connecting the "DC" pad to the positive DC jack leg, *that's signal ground* for the Toubus. For the negative DC power, the red wire connects the "GND" pad on the main board to the short leg of the DC jack. It's easy to get confused. Even I sometimes forget. If you follow this diagram exactly your connections will be correct.

You can use a DPDT foot-switch in place of the 3PDT if you like. The middle row of the 3PDT is not used.

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	-7.65
2	-7.6
3	-7.57
4	-15.13
5	-7.41
6	-7.48
7	-7.54
8	0

IC2	NE570
1	-13.98
2	-13.25
3	-13.28
4	-15.13
5	-13.29
6	-13.25
7	-5.31
8	-13.29
9	-13.29
10	-6.99
11	-8.72
12	-13.29
13	0
14	-13.22
15	-13.28
16	-14.17

IC3	4558
1	-2.27
2	-2.26
3	-1.77
4	-15.13
5	-6.92
6	-6.98
7	-7.13
8	0

IC4	4558
1	varies
2	-7.28
3	~-7.3
4	-15.24
5	varies
6	~-7.3
7	varies
8	0

IC5	CD4047
1	-7.32
2	-7.34
3	-7.86
4	0
5	0
6	0
7	-15.24
8	-15.24
9	-15.24
10	-7.63
11	-7.62
12	-15.24
13	-7.3
14	0

IC6	4558
1	-7.04
2	-3.51
3	-3.5
4	-15.05
5	-7.6
6	-7.63
7	-7.63
8	0

IC7	MN3005
1	0
2	-7.66
3	-10.35
4	-10.35
5	-15.24
6	-7.67
7	-7.52
8	-14.32

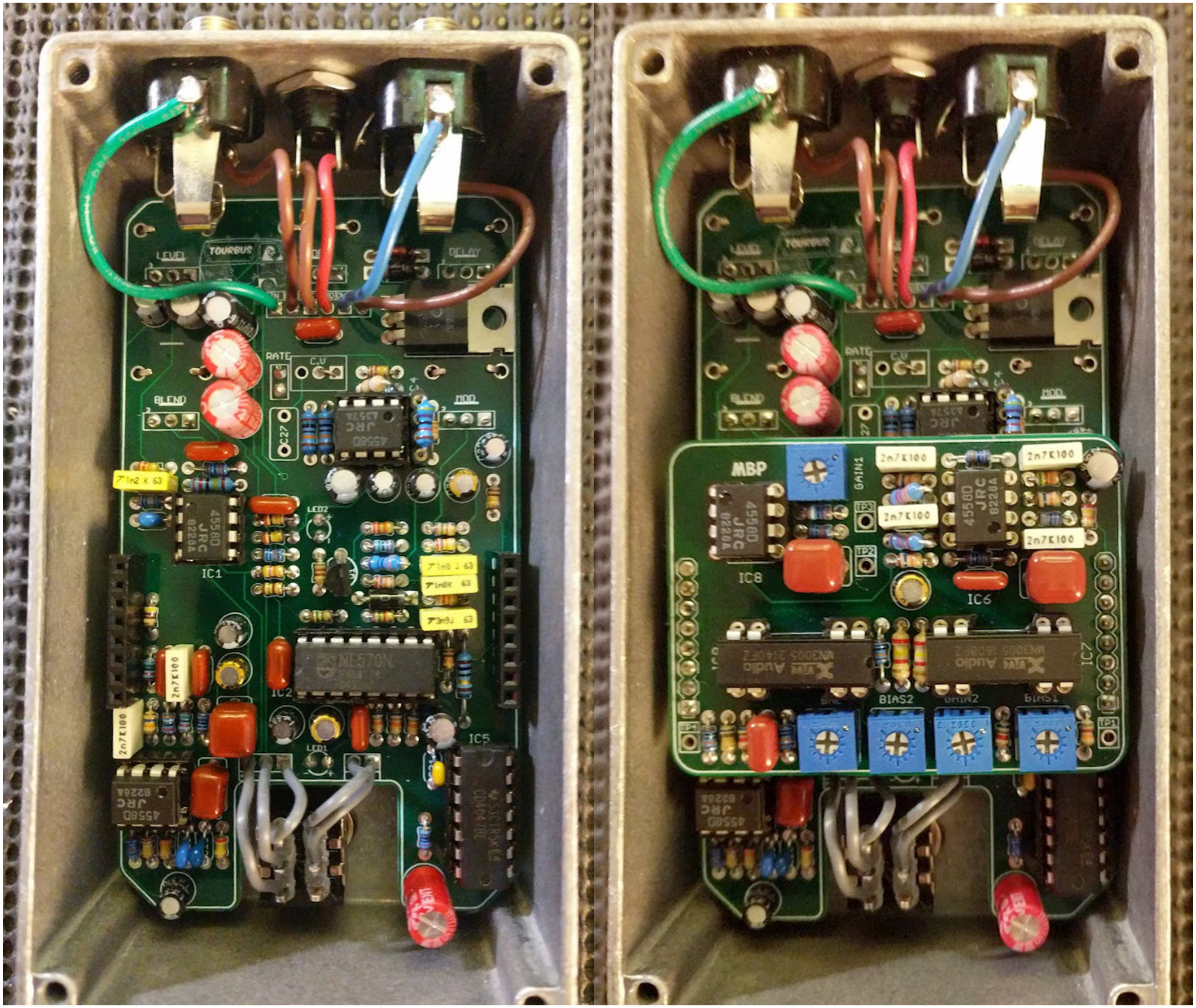
IC8	4558
1	-7.63
2	-7.58
3	-7.59
4	-15.05
5	-7.94
6	-7.96
7	-7.97
8	0

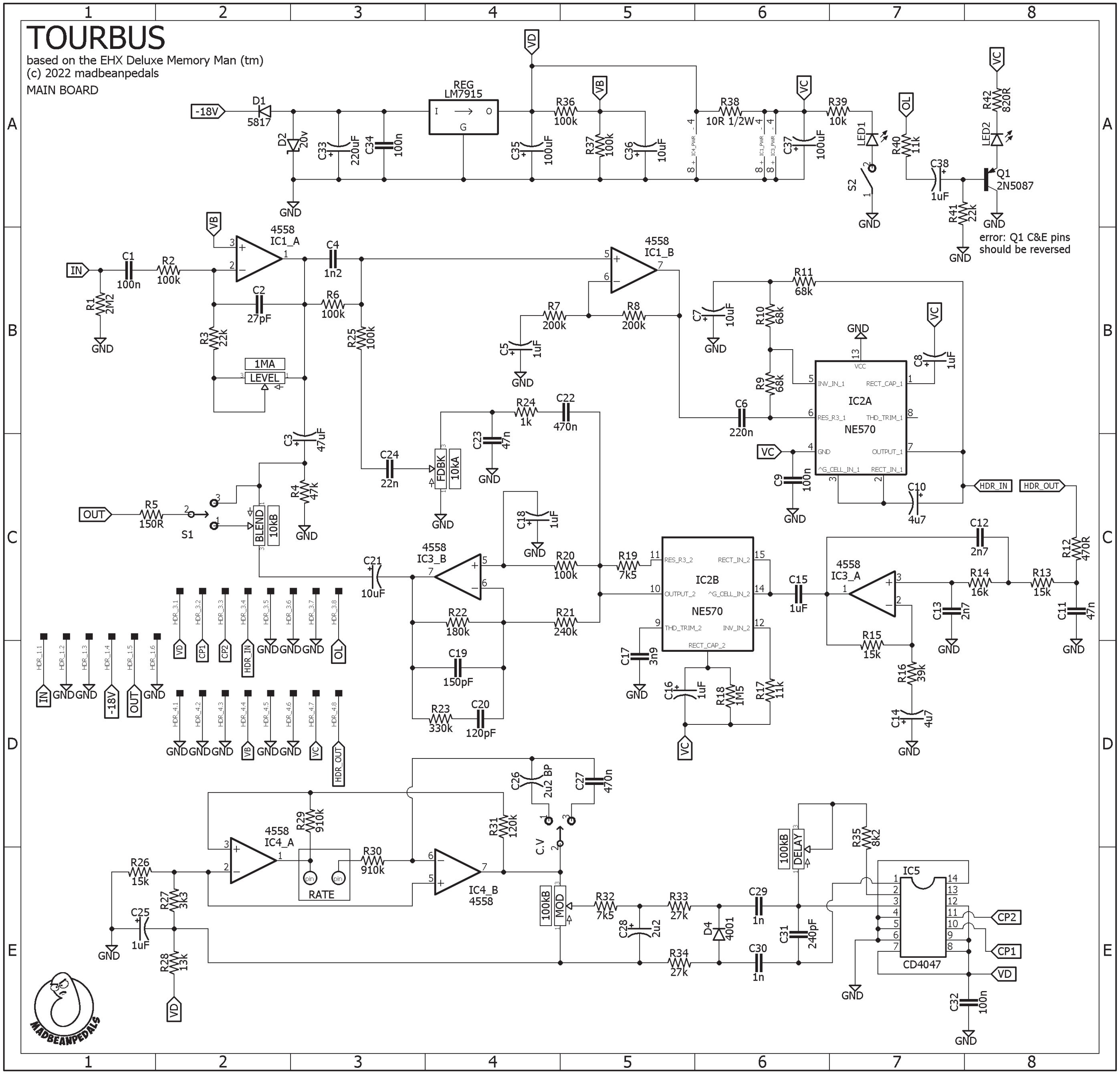
IC9	MN3005
1	0
2	-7.66
3	-10.88
4	-10.87
5	-15.24
6	-7.67
7	-7.98
8	-14.28

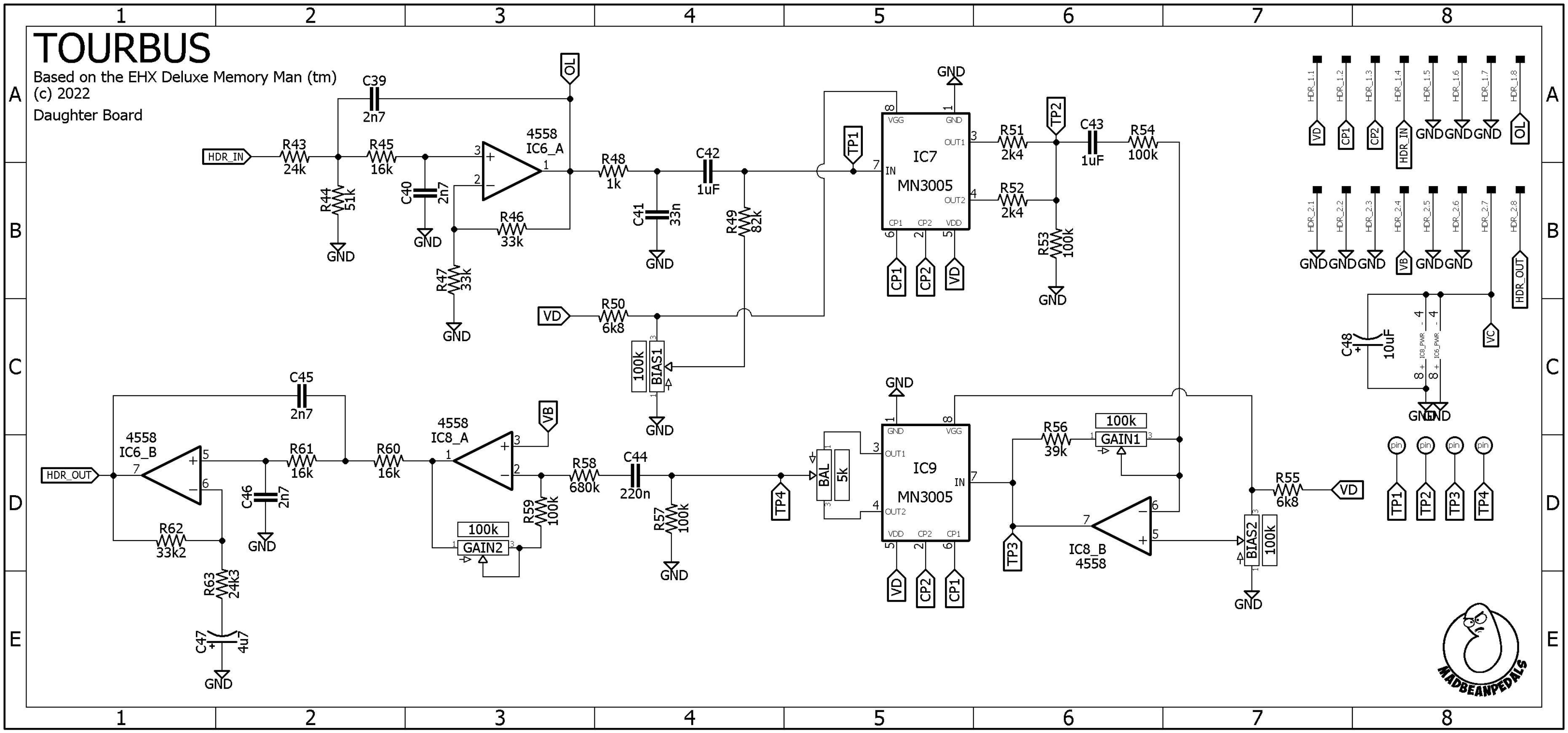
Q1	2n5087
C	-13.84
B	-34mV
E	0

REG	LM7915
I	-17.97
G	0
O	-15.24

- Dunlop 18v 1A power supply (18.24v output w/ no load)
- Current Draw: ~28mA
- Testing Conditions: All knobs @ 50%
- Some results will vary depending on trimmer settings.
- I took the voltages readings on the Main board without the Daughter board attached. This means some voltages be changed from their normal operational value (note the low voltages on IC1 pins1-3). You can also refer to the Total Recall build doc for another set of voltages (which were all taken on one PCB).



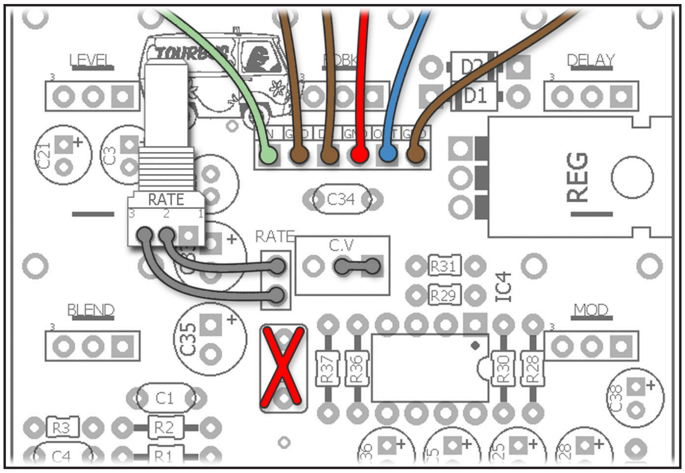

TOURBUS
based on the EHX Deluxe Memory Man (tm)
(c) 2022 madbeanpedals
MAIN BOARD
REG LM7915
-18V
D1 5817
D2 20v
C33 220uF
C34 100n
C35 100uF
R36 100k
R37 100k
C36 10uF
R38 10R 1/2W
C37 100uF
R39 10k
LED1
S2
R40 11k
C38 1uF
R41 22k
R42 820R
LED2
Q1 2N5087
error: Q1 C&E pins should be reversed
IN
C1 100n
R1 2M2
R2 100k
4558 IC1_A
C2 27pF
R3 22k
1MA LEVEL
C4 1n2
R6 100k
R25 100k
C3 47uF
R4 47k
OUT
R5 150R
S1
BLEND 10kB
4558 IC1_B
R7 200k
R8 200k
C5 1uF
C7 10uF
R10 68k
R11 68k
R9 68k
C6 220n
IC2A NE570
C8 1uF
C9 100n
C10 4u7
HDR_IN
HDR_OUT
C24 22n
FDBK 10kA
C23 47n
R24 1k
C22 470n
C18 1uF
4558 IC3_B
C21 10uF
R20 100k
R19 7k5
R22 180k
R21 240k
C19 150pF
R23 330k
C20 120pF
IC2B NE570
C17 3n9
C16 1uF
R18 1M5
R17 11k
C15 1uF
4558 IC3_A
C12 2n7
R14 16k
R13 15k
R12 470R
C13 2n7
C11 47n
R15 15k
R16 39k
C14 4u7
C26 2u2 BP
C27 470n
R29 910k
R30 910k
R31 120k
4558 IC4_A
RATE
IC4_B 4558
C.V
R26 15k
R27 3k3
C25 1uF
R28 13k
MOD 100kB
R32 7k5
C28 2u2
R33 27k
R34 27k
D4 4001
C29 1n
C30 1n
C31 240pF
DELAY 100kB
R35 8k2
IC5 CD4047
CP2
CP1
VD
C32 100n
GND
MADBEANPEDALS


TOURBUS
Based on the EHX Deluxe Memory Man (tm)
(c) 2022
Daughter Board
HDR_IN
R43 24k
R44 51k
R45 16k
C39 2n7
C40 2n7
OL
4558 IC6_A
R46 33k
R47 33k
R48 1k
C41 33n
C42 1uF
R49 82k
VD
R50 6k8
100k BIAS1
TP1
IC7 MN3005
VGG GND OUT1 OUT2 IN CP1 CP2 VDD
CP1 CP2 VD
GND
R51 2k4
R52 2k4
R53 100k
TP2
C43 1uF
R54 100k
HDR_OUT
4558 IC6_B
C45 2n7
C46 2n7
R61 16k
R62 33k2
R63 24k3
C47 4u7
R60 16k
4558 IC8_A
VB
100k GAIN2
R58 680k
R59 100k
C44 220n
R57 100k
TP4
BAL 5k
IC9 MN3005
R56 39k
100k GAIN1
TP3
IC8_B 4558
R55 6k8
BIAS2 100k
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 GND GND OL
HDR_2.1 HDR_2.2 HDR_2.3 HDR_2.4 HDR_2.5 HDR_2.6 HDR_2.7 HDR_2.8
GND GND GND VB GND GND HDR_OUT
C48 10uF
VC
TP1 TP2 TP3 TP4
MADBEANPEDALS

Before you begin your build, you should decide if you want to build the Tourbus stock or with extended modulation. To build it with stock modulation, simply follow the BOM as listed on pg.10.

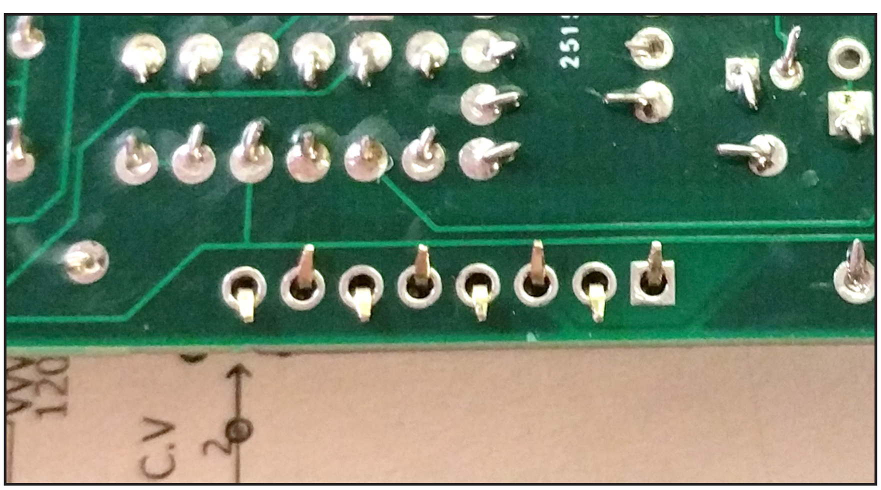
Extended Modulation Option

This option replaces the C.V. switch with a Rate pot to give you all the modulation speeds between and beyond the stock version. To do the mod, omit C27, jumper the C.V. switch pads, and wire the two “Rate” pads to either a 1MB or 1MC 9mm pot (as linked in the Notes on Parts section). You will also need to replace R30 with a 120k resistor instead of the stock 910k. I chose 120k since it seemed to offer the best overall range. Lesser values tended to lock up the LFO at the fastest speed. You can certainly socket R30 to try different values if you’d like.

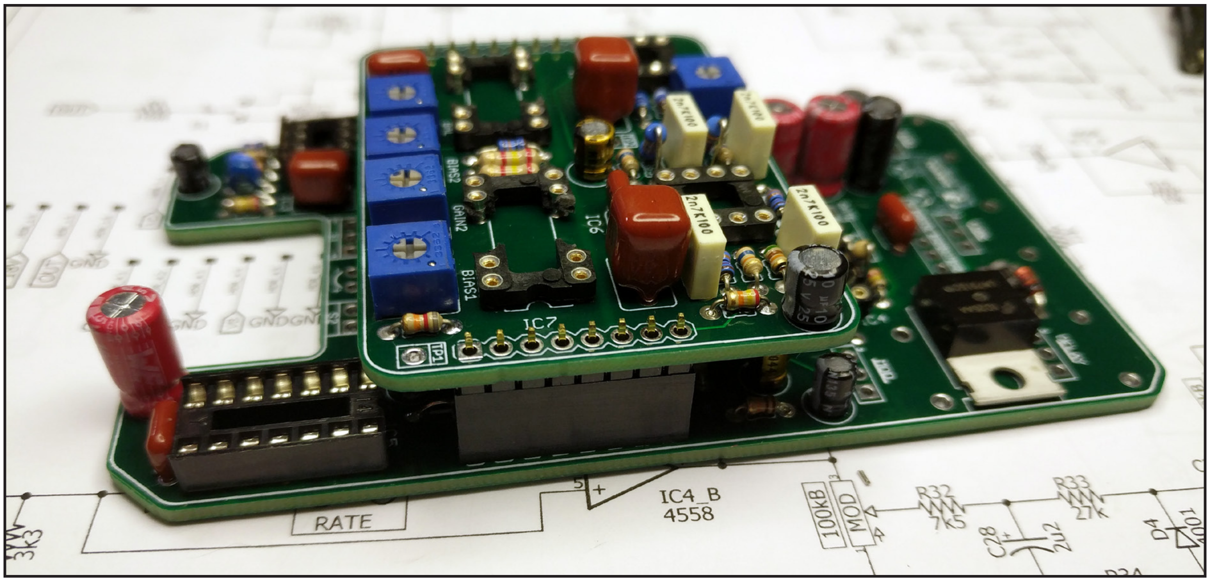


As far as building the Tourbus, follow whatever order you like for populating and soldering both the Main and Daughter boards. But, don’t solder in the pots/switch, headers, and pin connectors until later. We want to have a precise alignment between headers and pins so that the Daughter and Main boards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

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 Main 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 of the Main board.



With the two headers soldered onto the main board, insert the pins into each (long tabs in, short tabs exposed). Now place the Daughter board loose onto the two pin strips.



Solder the first and last pin of each row of pins. Now 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 anything in the headers.

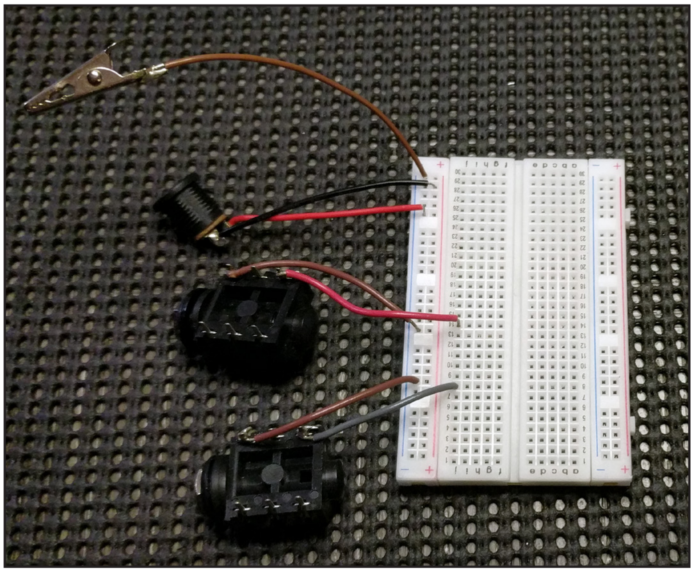
Once this is completed, you can load and solder the pots/switch and wires. You're ready to move onto the testing phase.

TIP#1: Remember that Q1 was drawn backwards on my schematic, so the transistor on the main board faces the wrong way. You need to flip it 180° on the Main board before soldering.

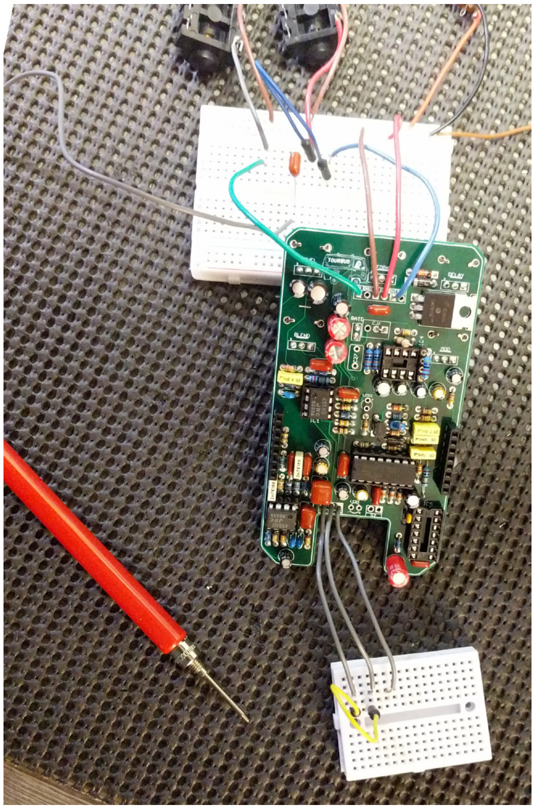
TIP#2: The Deluxe Memory Man™ and Tourbus have no clock range adjustment. This means whatever value (in Ohms) your DELAY pot reads at will set the maximum delay available. If you have several 9mm 100kB pots, I suggest measuring the outside pins of each with your multimeter to find the one closest in value to 100kB. I had to go through about 10 of them to find one that measured 100.5k. Any value +/- 5% from 100k is fine, but above or below that range could cause the maximum delay time to be shorter than normal or too long (which will introduce some dithering type noise in the delay signal).

This section describes the process I used to test my build. You can follow this or devise your own. At the end of my testing process, you'll know you've got a working build that can be boxed up.

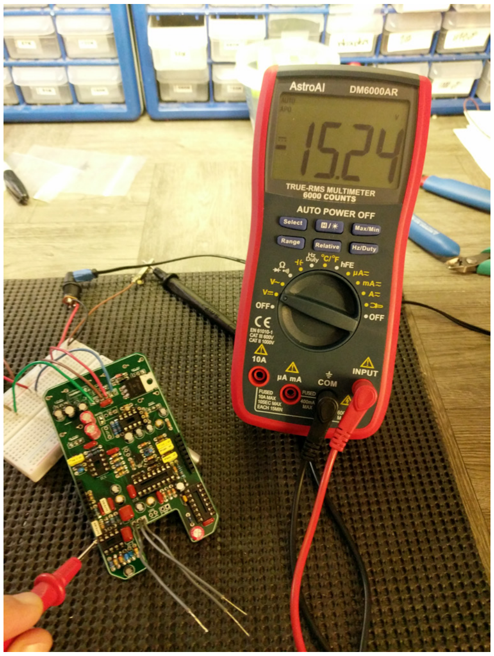
For testing, I set up a temporary rig to plug into. I typically use my ProtoRig for this but since that is set for negative ground it's not appropriate for the Tourbus. This rig only requires a couple of minutes to set up. I used some spare jacks and a ground clip (for taking DC measurements).



Since I did not solder in my bypass switch at this stage, I added another breadboard to switch between bypass and effect. I eventually added a spare audio probe so I could listen to different test points in the circuit. You can leave audio probing and calibration until after boxing the build up, but I think it's better to do it at this point in order to eliminate any issues beforehand. It pays to be meticulous when you are dealing with a complicated build like the Tourbus.



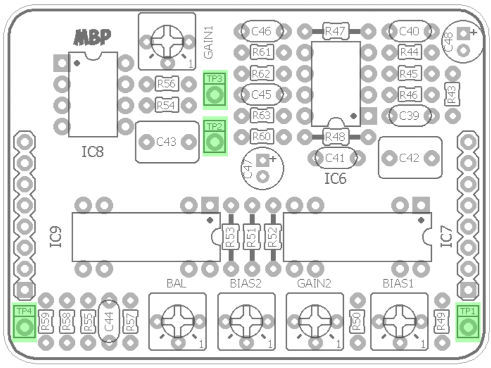
Before you load a single IC, you should check for power. Hook up your supply voltage and take some voltage readings. I suggest you start with the LM7915 and make sure it's getting about -18v in and outputting around -15v.

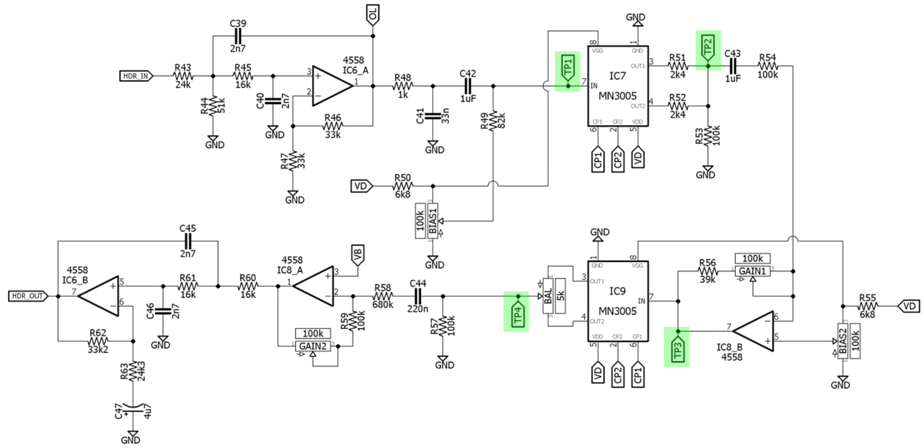


Note for the instructions below: whenever you are loading or removing ICs, you should temporarily disconnect the power supply, then re-connect it after the IC is in place. This prevents any possible damage that can occur from live swapping.

Once proper supply voltage is confirmed, I suggest loading the ICs onto the Main board 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, I chose to do some audio probing on the Main board. First I checked pin1 of IC1 to make sure I was getting a signal and the LEVEL control was responding (meaning that the audio level increases as the LEVEL control is turned up). Then I checked pin6 of IC2 for input and pin7 of IC2 for output. Once I confirmed I had audio passing through that entire section, I plugged in the Daughter board. At this point, final testing and rough calibration can begin.





This part requires an audio probe

The Daughter board has four testing points labeled TP1-TP4 (the "OL" label on the schematic is a connection back to the Main board to feed the overload LED and not used for 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. Leave all trimmers in their mid position and the pots on the Main board 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 from the Main to the Daughter board and the first BBD (IC7) is receiving input signal.

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 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.

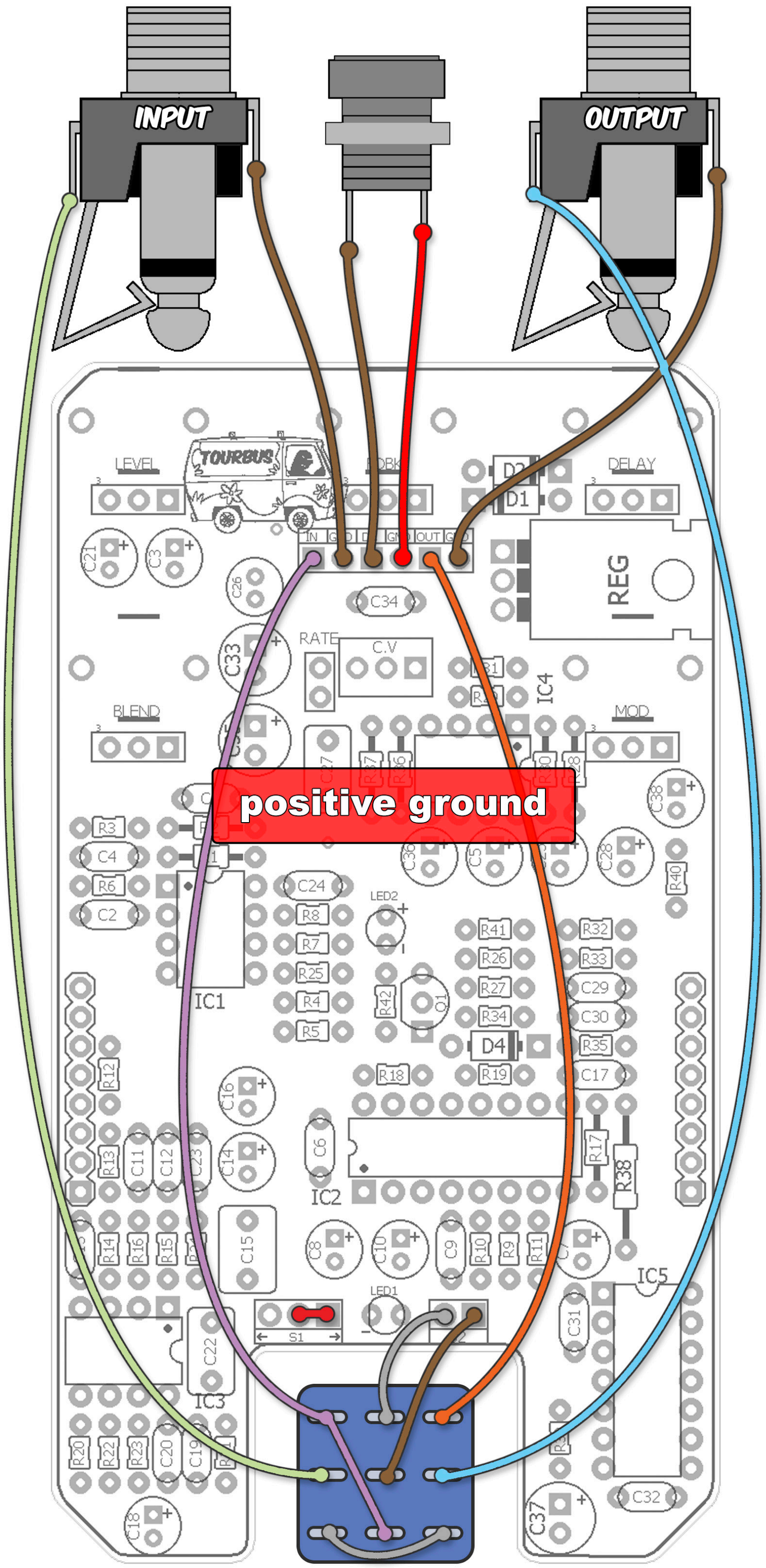
6. At this point, you can check all the controls for function. Turn the FDBK knob up for multiple repeats and the BLEND to 1/2 to hear a mix of clean and delay signal. Check the DELAY knob range, check the MOD knob for modulation.

7. Next we''ll set the Tourbus 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.

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

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



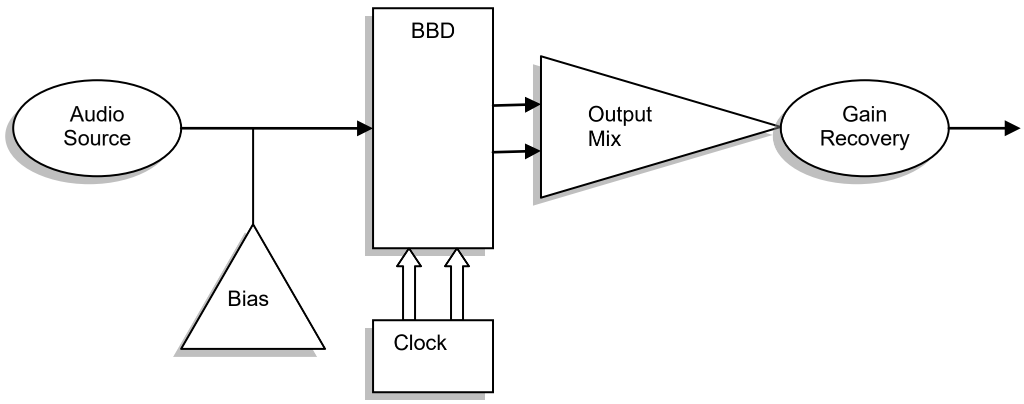
If you are a stickler for it, use this wiring diagram for true bypass operation. This will disable the LEVEL control in bypass.

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 Tourbus.

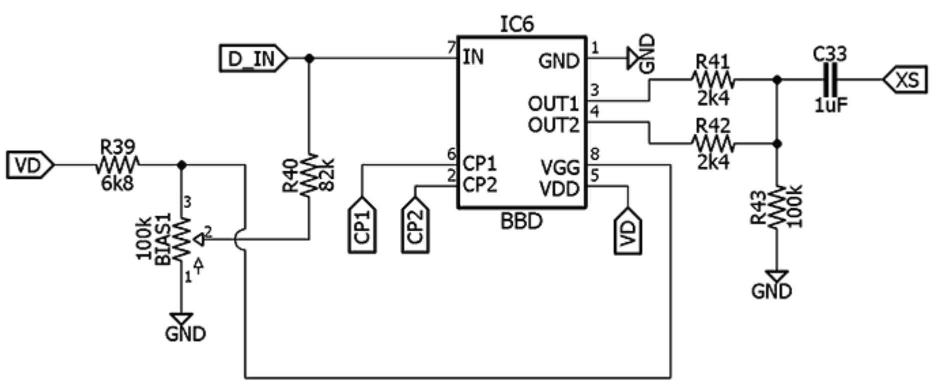
There are two ways to bias the Total Recall. One is by ear and the other is with an oscilloscope. This document will show you how to do it by ear. For scope biasing there are a few guides online the give lots of detail on how to do the procedure.

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

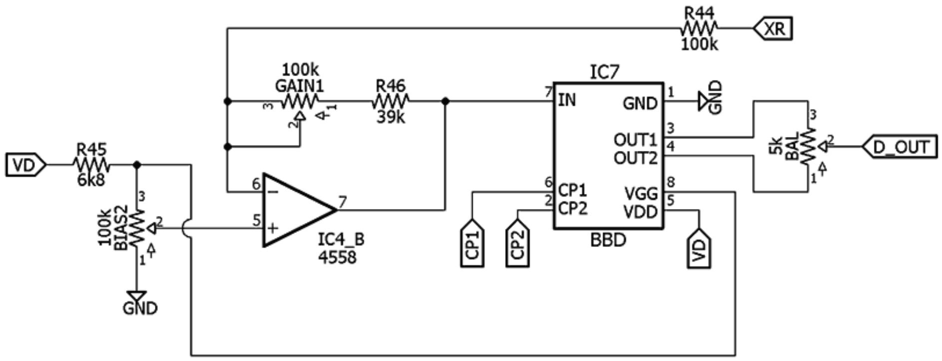
Before biasing, let's understand what we are doing and why. The bucket-brigade device (BBD) requires a bias voltage applied to its input in order to pass a delayed signal. This is done via a trimmer set up as a voltage divider connected to the power supply. An audio source is applied to the BBD input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



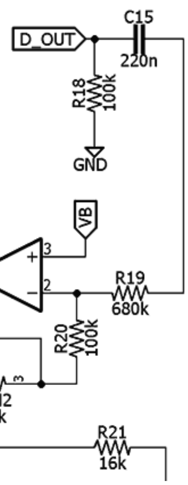
Let's compare that to a circuit snippet from the TR schematic.



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).