

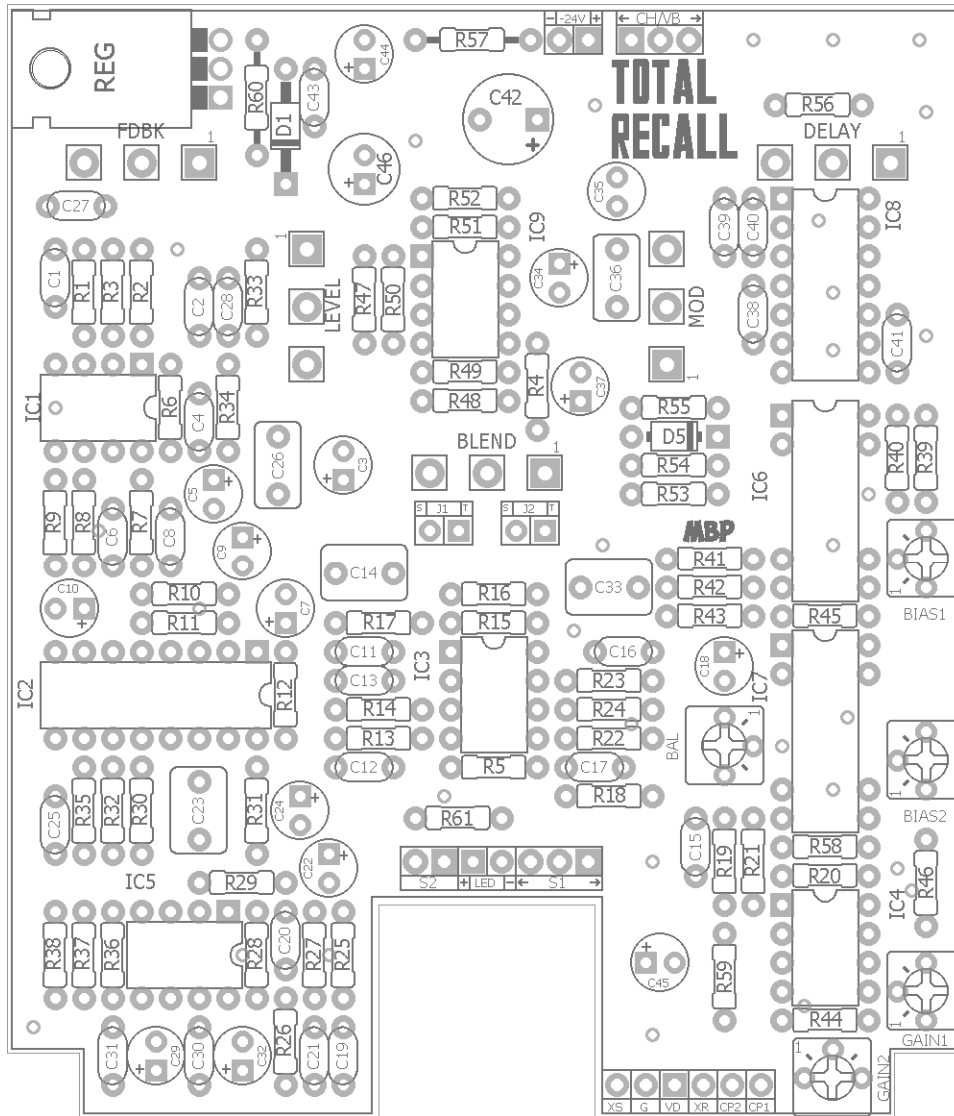
TOTAL RECALL

FX Type: Delay

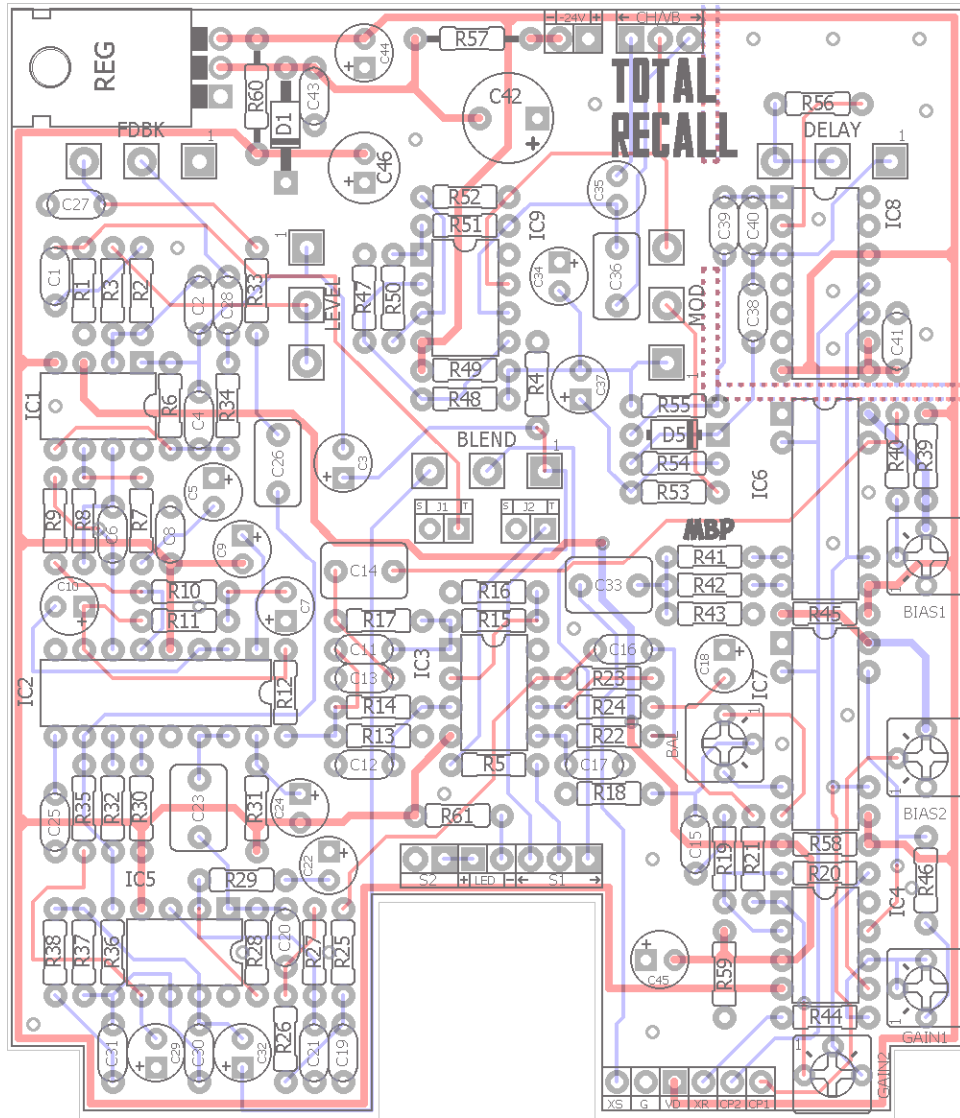
Based on the EHX® Deluxe Memory Man™

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3.34" W x 3.875" H



Terms of Use: You are free to use purchased **Total Recall** circuit boards for both DIY and small commercial operations. You may not offer **Total Recall** boards for resale or as part of a "kit" in a commercial fashion. Peer to peer re-sale is, of course, okay



B.O.M.

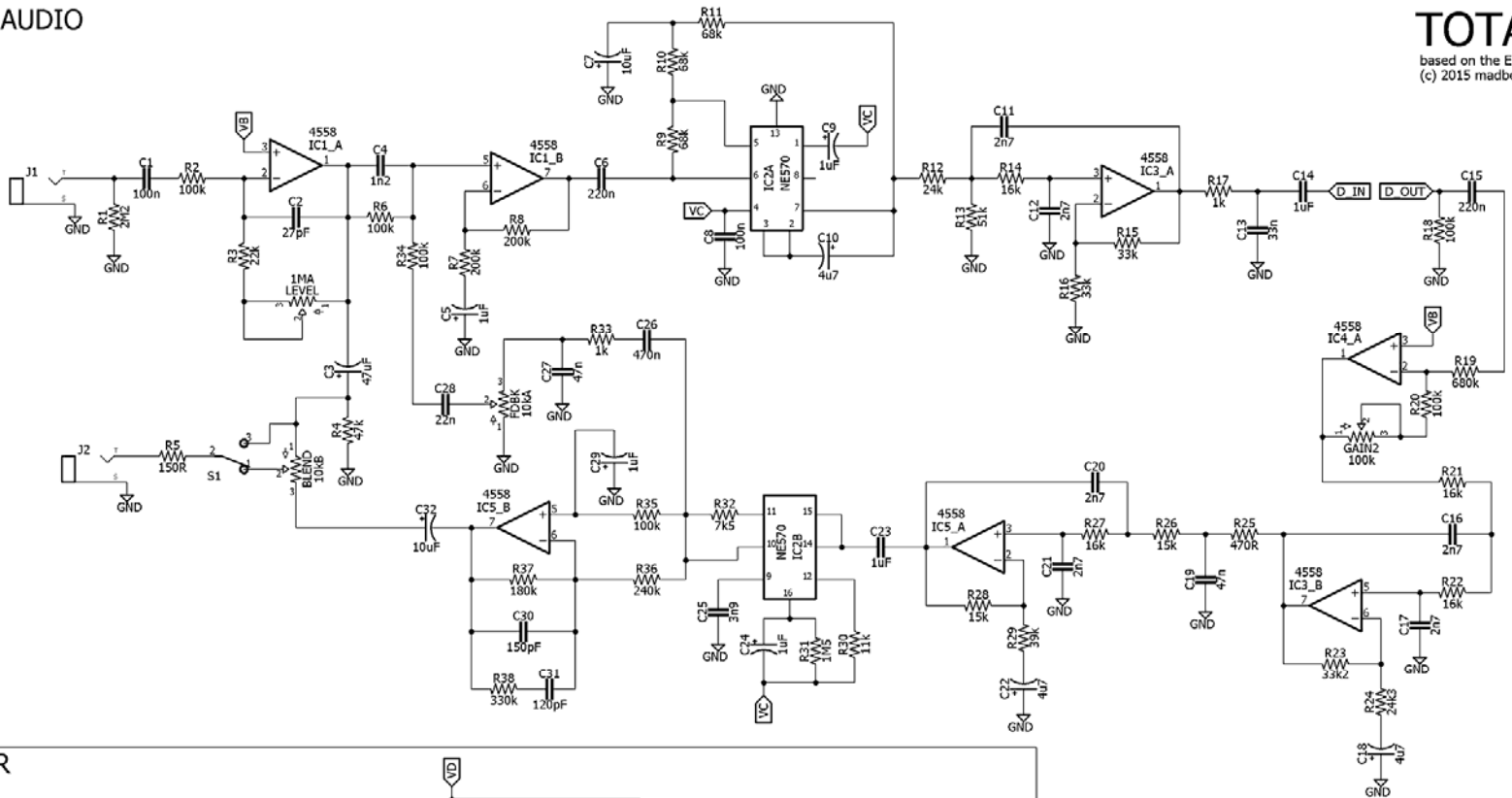
Resistors		Resistors		Caps		Caps		Diodes	
R1	2M2	R32	7k5	C1	100n	C32	10uF	D1	1N4751A
R2	100k	R33	1k	C2	27pF	C33	1uF	D5	1N4001
R3	22k	R34	100k	C3	47uF	C34	1uF	IC	
R4	47k	R35	100k	C4	1n2	C35	2u2 BP	IC1	4558
R5	150R	R36	240k	C5	1uF	C36	470n	IC2	NE570
R6	100k	R37	180k	C6	220n	C37	2u2	IC3	4558
R7	200k	R38	330k	C7	10uF	C38	1n	IC4	4558
R8	200k	R39	6k8	C8	100n	C39	1n	IC5	4558
R9	68k	R40	82k	C9	1uF	C40	240pF	IC6	BBD
R10	68k	R41	2k4	C10	4u7	C41	100n	IC7	BBD
R11	68k	R42	2k4	C11	2n7	C42	470uF	IC8	CD4047
R12	24k	R43	100k	C12	2n7	C43	100n	IC9	4558
R13	51k	R44	100k	C13	33n	C44	10uF	Regulator	
R14	16k	R45	6k8	C14	1uF	C45	10uF	REG	LM7915
R15	33k	R46	39k	C15	220n	C46	100uF	Trimmer	
R16	33k	R47	15k	C16	2n7			GAIN1	100k
R17	1k	R48	3k3	C17	2n7			GAIN2	100k
R18	100k	R49	13k	C18	4u7			BIAS1	100k
R19	680k	R50	910k	C19	47n			BIAS2	100k
R20	100k	R51	910k	C20	2n7			BAL	5k
R21	16k	R52	120k	C21	2n7			Switch	
R22	16k	R53	7k5	C22	4u7			CH/VB	On/On
R23	33k2	R54	27k	C23	1uF			Pots	
R24	24k3	R55	27k	C24	1uF			DELAY	100kB
R25	470R	R56	8k2	C25	3n9			FDBK	10kA
R26	15k	R57	240R	C26	470n			BLEND	10kB
R27	16k	R58	100k	C27	47n			LEVEL	1MA
R28	15k	R59	100k	C28	22n			MOD	100kB
R29	39k	R60	10R	C29	1uF				
R30	11k	R61	10k	C30	150pF				
R31	1M5			C31	120pF				

Shopping List

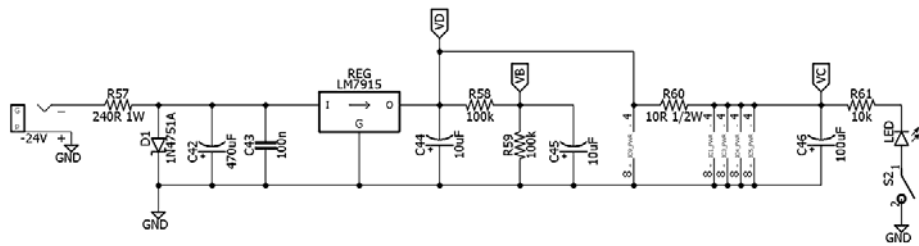
Value	QTY	Type	Rating	Value	QTY	Type	Rating
10R	1	Metal / Carbon Film	1/2W	27pF	1	Ceramic	25v Min.
150R	1	Metal / Carbon Film	1/4W	120pF	1	Ceramic	25v Min.
240R	1	Metal / Carbon Film	1W	150pF	1	Ceramic	25v Min.
470R	1	Metal / Carbon Film	1/4W	240pF	1	MLCC / Mica - 5% tolerance	25v Min.
1k	2	Metal / Carbon Film	1/4W	1n	2	Film	25v Min.
2k4	2	Metal / Carbon Film	1/4W	1n2	1	Film	25v Min.
3k3	1	Metal / Carbon Film	1/4W	2n7	6	Film	25v Min.
6k8	2	Metal / Carbon Film	1/4W	3n9	1	Film	25v Min.
7k5	2	Metal / Carbon Film	1/4W	22n	1	Film	25v Min.
8k2	1	Metal / Carbon Film	1/4W	33n	1	Film	25v Min.
10k	1	Metal / Carbon Film	1/4W	47n	2	Film	25v Min.
11k	1	Metal / Carbon Film	1/4W	100n	4	Film	25v Min.
13k	1	Metal / Carbon Film	1/4W	220n	2	Film	25v Min.
15k	3	Metal / Carbon Film	1/4W	470n	2	Film	25v Min.
16k	4	Metal / Carbon Film	1/4W	1uF	3	Film	25v Min.
22k	1	Metal / Carbon Film	1/4W	1uF	5	Electrolytic	25v Min.
24k	1	Metal / Carbon Film	1/4W	2u2	1	Electrolytic	25v Min.
24k3	1	Metal / Carbon Film	1/4W	2u2	1	Non-Polar	25v Min.
27k	2	Metal / Carbon Film	1/4W	4u7	3	Electrolytic	25v Min.
33k	2	Metal / Carbon Film	1/4W	10uF	4	Electrolytic	25v Min.
33k2	1	Metal / Carbon Film	1/4W	47uF	1	Electrolytic	25v Min.
39k	2	Metal / Carbon Film	1/4W	100uF	1	Electrolytic	25v Min.
47k	1	Metal / Carbon Film	1/4W	470uF	1	Electrolytic	35v
51k	1	Metal / Carbon Film	1/4W	1N4751A	1	30v Zener	
68k	3	Metal / Carbon Film	1/4W	1N4001	1		
82k	1	Metal / Carbon Film	1/4W	4558	5		
100k	10	Metal / Carbon Film	1/4W	NE570	1		
120k	1	Metal / Carbon Film	1/4W	BBD	2	MN3005 / MN3008	
180k	1	Metal / Carbon Film	1/4W	CD4047	1		
200k	2	Metal / Carbon Film	1/4W	LM7915	1		
240k	1	Metal / Carbon Film	1/4W	100k	4	Bourns 3362P	
330k	1	Metal / Carbon Film	1/4W	5k	1	Bourns 3362P	
680k	1	Metal / Carbon Film	1/4W	On/On	1	SPDT	
910k	2	Metal / Carbon Film	1/4W	100kB	2	Alpha Right Angle PCB mount	16mm
1M5	1	Metal / Carbon Film	1/4W	10kA	1	Alpha Right Angle PCB mount	16mm
2M2	1	Metal / Carbon Film	1/4W	10kB	1	Alpha Right Angle PCB mount	16mm
				1MA	1	Alpha Right Angle PCB mount	16mm

MAIN AUDIO

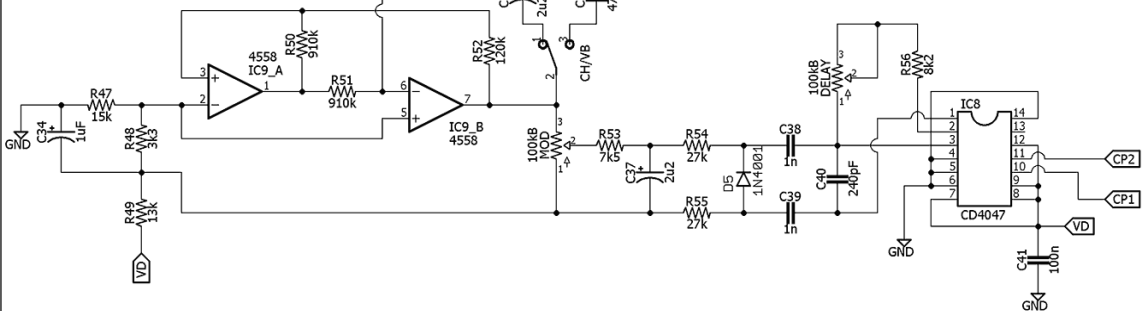
TOTAL RECALL
 based on the EHX Deluxe Memory Man (tm)
 (c) 2015 madbeanpedals



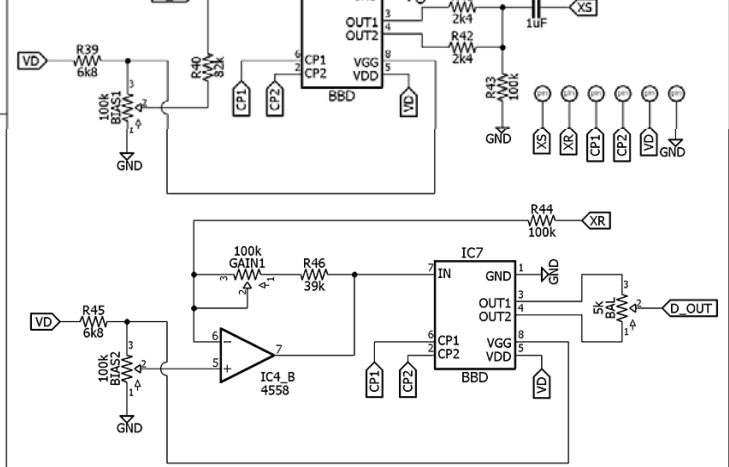
POWER



MODULATION/ CLOCK

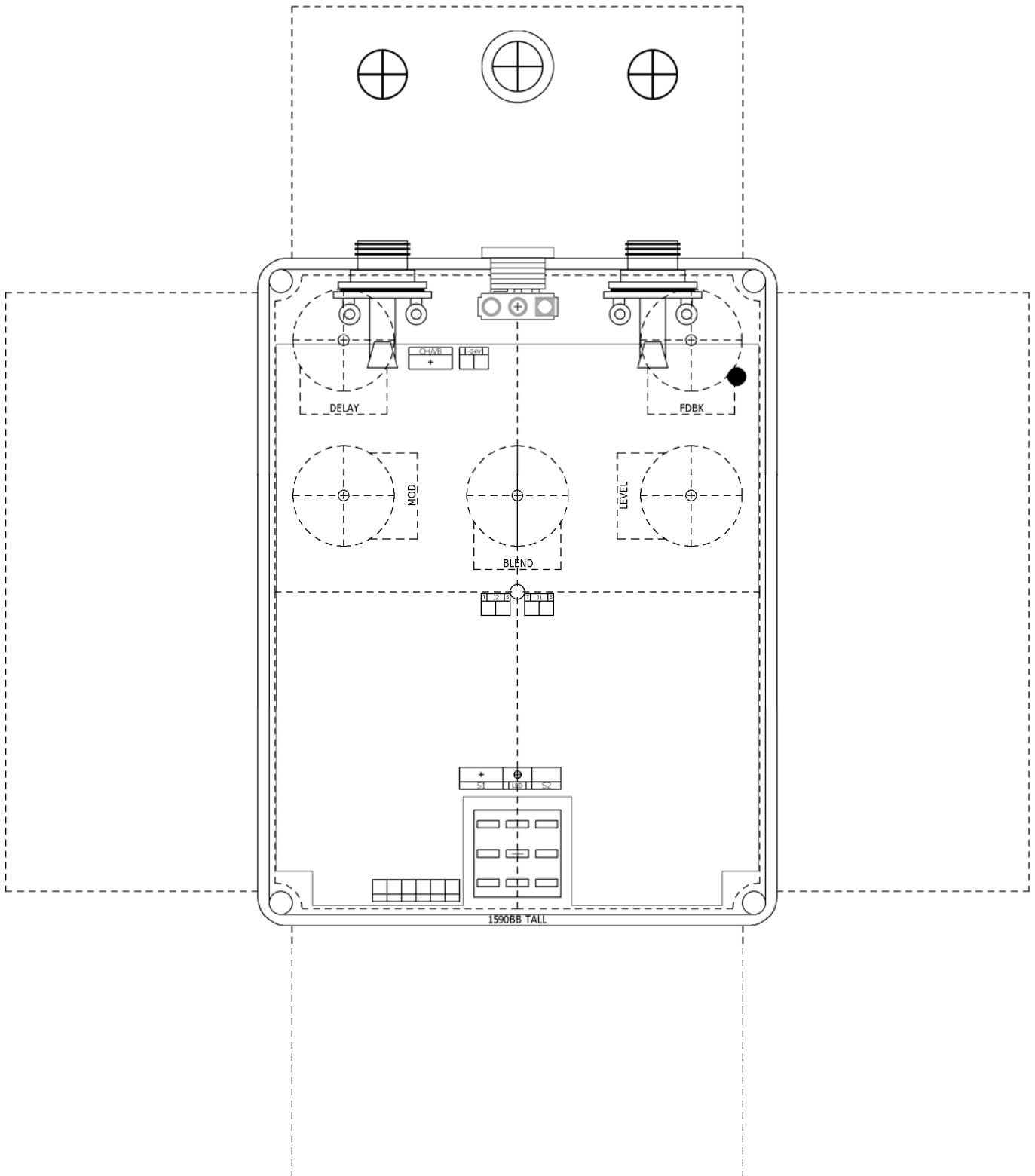


DELAY



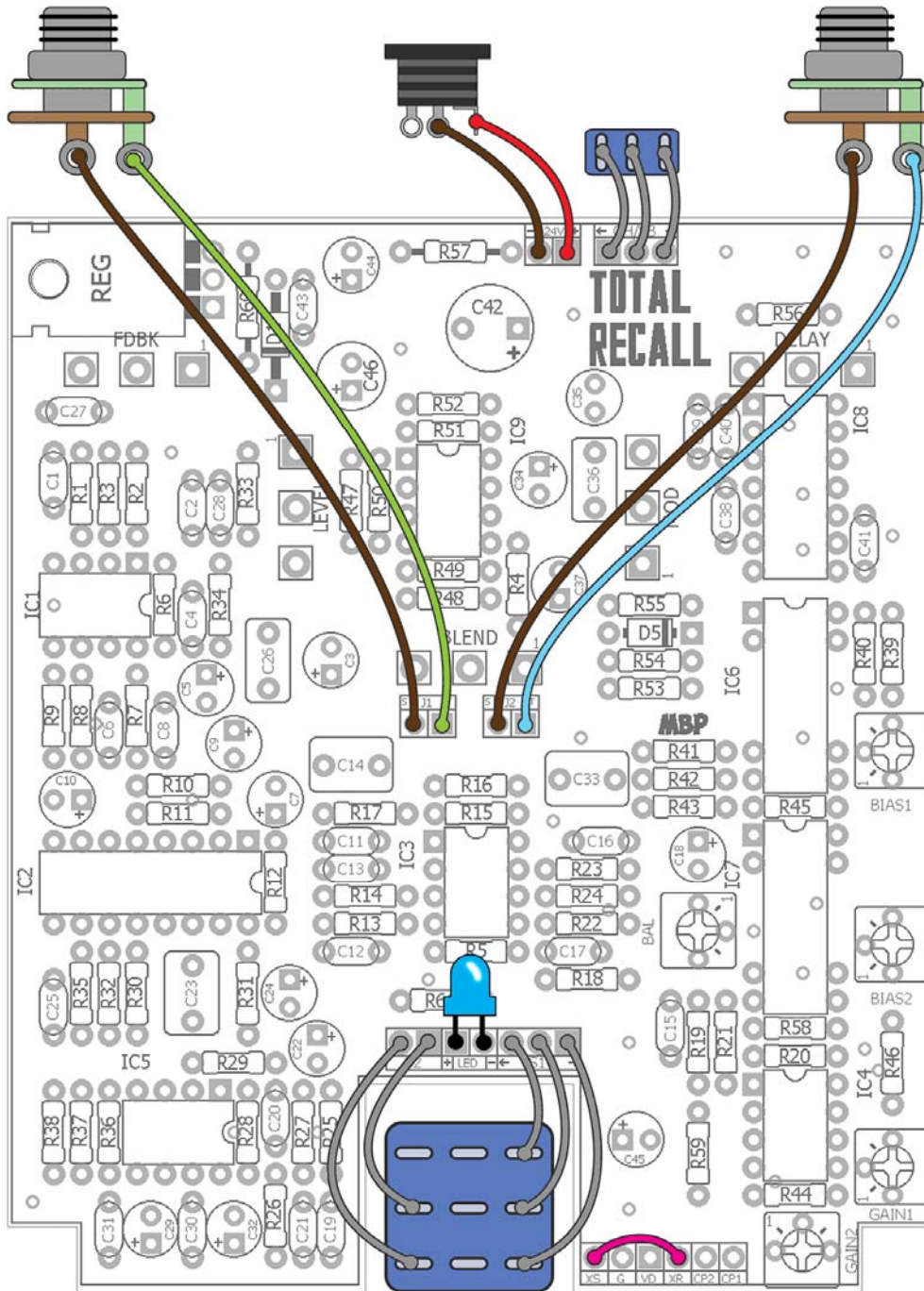
1590BB Tall Drill Guide

7.08" W x 8.1" T



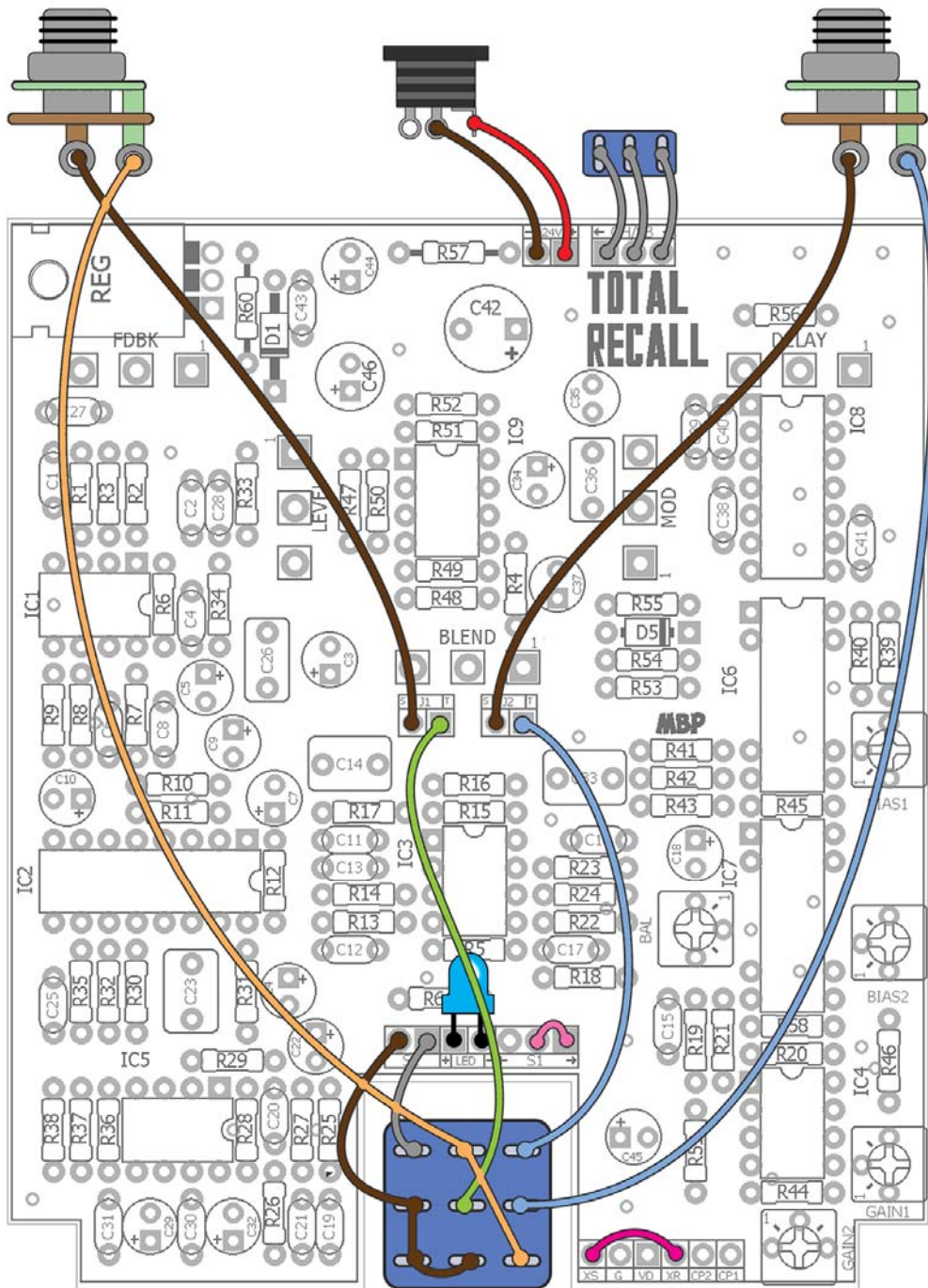
Photoshop Drill guide: http://www.madbeanpedals.com/projects/TotalRecall/TotalRecall_DRILL.zip

Stock Wiring



- Leave enough clearance between the wires and IC6 - IC8 so they do not pick up any clock signal.
- The indicator LED can be soldered directly to the PCB.
- If you are using the TRXPN board, refer to that documentation on how to install the expansion board properly. If not, be sure you jumper XS and XR pads together on the lower right of the TR PCB.

True Bypass Wiring



- Leave enough clearance between the wires and IC6 - IC8 so they do not pick up any clock signal.
- The indicator LED can be soldered directly to the PCB.
- If you are using the TRXPB board, refer to that documentation on how to install the expansion board properly. If not, be sure you jumper XS and XR pads together on the lower right of the TR PCB.

At long last, the vintage Memory Man™ project is here! The **Total Recall** is a clone of the big box DMM which allows you to use either two MN3005 or four MN3008 (if you include the optional expansion board; the TRXPN). With the recent release of the Xvive MN3005 clones this project is suddenly much more viable for builders not lucky enough to get their hands on NOS MN3005 chips (which can go for as much as \$40 a piece these days, if you are lucky to get a non-counterfeit one). The good news is that the Xvive chips seem to work very well in the Total Recall. Tests were done comparing them to 2xMN3005 (NOS) and 4xMN3008 (NOS) and they performed very comparable (at least with the two Xvive chips I have on hand). While I won't get into any machinations on precision MOJO between the NOS and new production chips, I am satisfied that the Xvive are fine for this project and the end result sounds great. Perhaps they are even slightly cleaner in output (which is not terribly surprising when you compare recently manufactured IC's with those made 30 years ago).

Some important notes before considering this project

- It's hard. Not the hardest DIY project ever, but pretty challenging. You need to have enough patience to work through the building AND setting it up properly. This means NO BOXING BEFORE ROCKING. You must test this project adequately with a multi-meter AND audio probe before wiring it up in an enclosure. There will be *no mercy* for tech threads started on the forum by those who ignore this :)
- It's positive ground and it requires a wall-wart. There's no getting around it. If you want the true vintage DMM, you have to design it to use a wall-wart or AC power plus a transformer. I use, and recommend, an actual EHX 24v supply. It's not too expensive and it works perfectly for the project. And with it, my two builds are dead quiet. You can get the power supply here: <http://www.amazon.com/Electro-Harmonix-US24DC-100-24V-Power-Supply/dp/B0042RHT4M>. You *should* be able to use an 18v supply instead of the 24v one listed above, although this has not been tested. You will need to do a couple things: 1) Lower the value of R57 from 240R 1W to something like 22R 1W, and 2) make sure you know what the polarity of your 18v power supply is before hooking it up to the TR PCB!
- It's expensive. Granted, building your own is still way cheaper than buying a vintage unit, but all in all you can expect to drop \$100 or more on this project including the PCBs, power supply and two BBDs.
- The Total Recall does have some differences with the DMM. I use 1uF film caps instead of non-polar electrolytic (as a matter of personal preference), the "overload LED" circuitry is not used due to space limitations and finally the GAIN1 trimmer is located between BBD stages 3 and 4 instead of 2 & 3 (if using the TRXPN board only, otherwise it is between the two BBD stages when using two MN3005). This last one is the most important. While it does not seem to pose any limitations when using four MN3008, I would not recommend plugging in four MN3005 (as some might be tempted to do) to get 1 second of delay instead of 550ms. Four MN3005 should work for all four BBD spots, but it has not been tested and the extra delay time may prove problematic for the gain recovery.

XVIVE MN3005: <http://smallbear-electronics.mybigcommerce.com/mn3005-re-makes-xvive-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.

BLEND: The dry/wet ratio of guitar and delay.

MOD: The *depth* of modulation applied to the delay signal. The modulation *rate* is fixed.

CH/VB: This switches between chorus and vibrato type modulation.

Biasing Controls

BIAS1, 2: These trimmers set the input biasing 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.

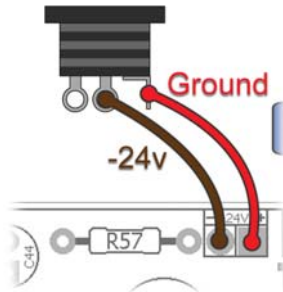
Wiring

You can wire the Total Recall in either stock or true-bypass fashion. In the stock wiring, the LEVEL control is always active and can be used to boost the bypass signal. Personally, I like this option as the circuit's higher voltage provides a nice clean boost at low LEVEL settings up to a mild overdrive at high settings. If you are a true-bypass purist, use the second wiring diagram. This completely removes the circuit from the bypass mode.

Build Notes

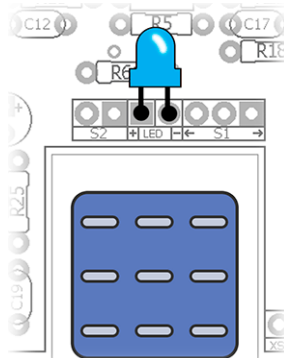
Take your time and build it right the FIRST time! There are a lot of parts here and the attention and focus you employ in soldering and construction will save you loads of headaches later on.

- Before doing any voltage tests, make sure you have wired the power correctly. Remember that this is a positive ground circuit! The illustration below shows how the typical DC jack is wired with the EHX power supply for the correct polarity. If you are using a different jack or power supply, plug the PS into your DC jack before wiring it to the PCB and use your multi-meter to verify which lug on the jack is negative DC. Once you have verified polarity on the jack, hook up the PCB to the power supply. Now check the LM7915 regulator to verify that you are getting about -15v output. Once that is complete, disconnect the power and start loading in the ICs.



EHX power supply wiring for positive ground.

- The clearance in the footswitch cut-out area is very tight. If using the typical blue 3PDT footswitches, remove the extra nut that screws into the base of the switch to ensure the board and switch fit properly. Make sure you install the footswitch to your enclosure first, then the PCB (or at least keep the footswitch underneath the PCB if installing both together). If you are doing the stock (non true-bypass) wiring, you can use a DPDT footswitch, if you like.



Install the footswitch before the PCB in the enclosure so it fits properly.

Mods

- Increase R2 to 220k for higher input impedance. This can be useful for pickups with hot outputs like humbuckers or actives.
- Make the Blend pot Audio taper instead of Linear. I prefer audio here because it allows for a larger range of soft delay mix settings.

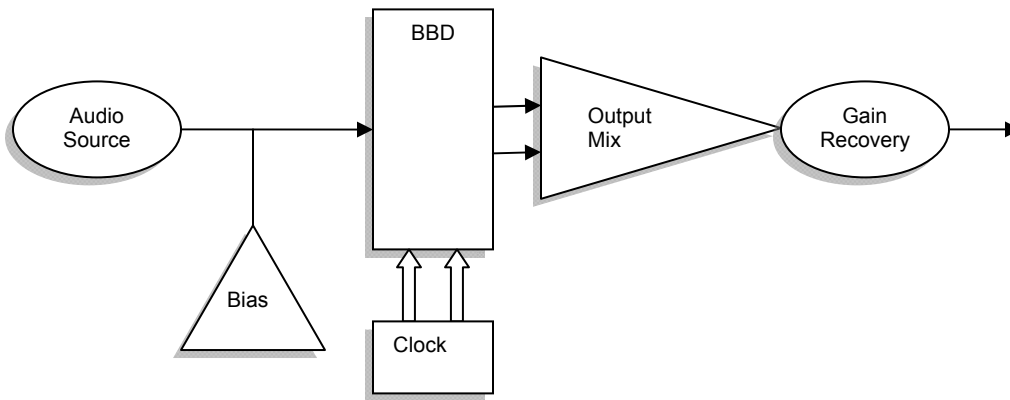
Biasing

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.

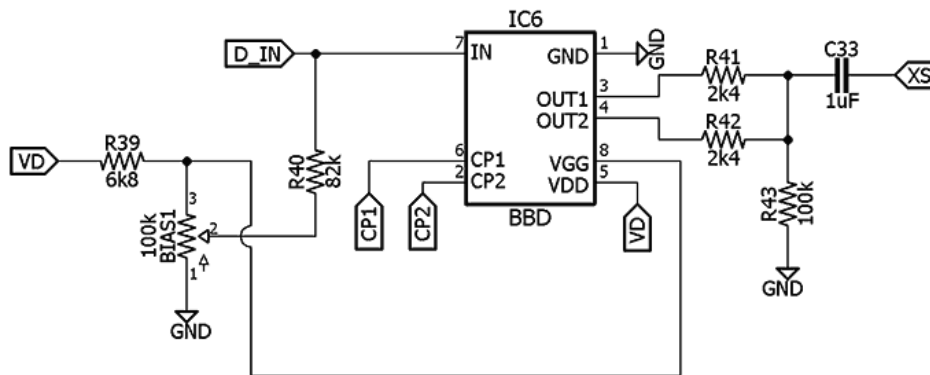
Here is one guide you might find useful for scope calibration:

<http://www.davidmorrin.com/home/trouble/troubleeffects/electro-harmonix-memory-man/eh-7850/eh-7850-calibration>

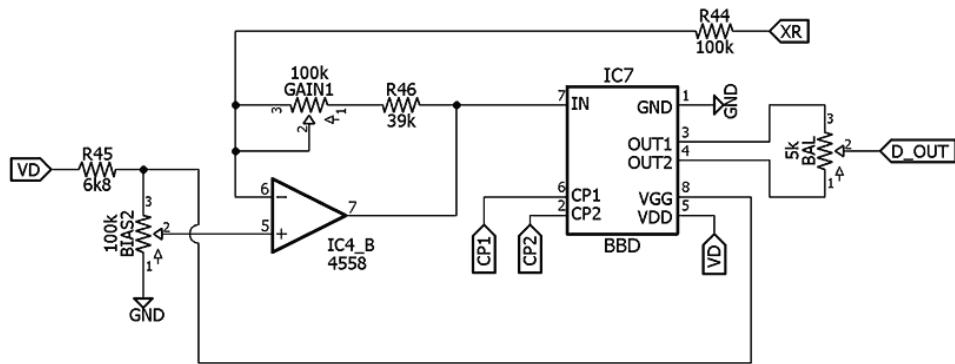
Before biasing, let's understand what we are doing and why. The BBD IC requires a bias voltage applied to its input in order to work properly. This is done via a trimmer set up as a voltage divider connected to the power supply. An audio source is applied to the BBD input (pin7) and the trimmer is adjusted 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 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.



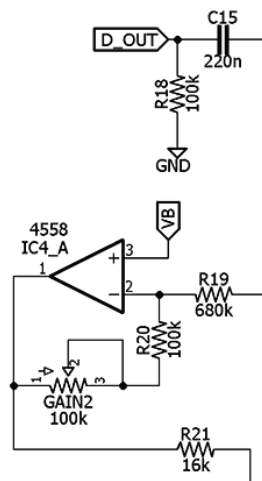
Let's compare that to a circuit snippet from the TR schematic.



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 cleanest delay signal obtainable. 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 expander, then mixed to the output of the circuit (not shown).

Procedure

Tools required: audio source, audio probe.

Before you start, remove IC7 if you have it installed. We will bias one BBD at a time. Set your controls as follows:

- DELAY - full up
- FDBK - a little less than halfway up
- MOD - all the way down
- LEVEL - about 1/3rd up
- BLEND - doesn't matter (you should leave the circuit output disconnected since we will be audio probing)
- CH/VB switch - doesn't matter

Leave all the trimmers in their halfway position to start.

- Connect the TR PCB to your power supply. Use an audio source at the input of the circuit (J1). While you can just strum your guitar it might be difficult to make trimmer adjustments at the same time. If you have a looper, record a few single notes a few seconds apart and feed that into the circuit. Or, improvise with something else.
- Connect your audio probe to either pin3 or pin4 of IC6. Now adjust BIAS1 until you hear delay output. Adjust BIAS1 further until you find the min and max settings where you have clean delay output. Set BIAS1 to approximately the middle point of this range. Now make very small adjustments left and right until you find the spot where the delay output is cleanest and strongest.

- Now connect your audio probe to pin7 of IC4_B. Adjust GAIN1 until the volume output is approximately the same as the volume input on pin7 of IC6 (this balances the signal volumes between the two BBDs).
- Disconnect the power supply from the circuit and install IC7. Reconnect the power supply.
- Connect your audio probe to pin3 or 4 of IC7. Do the same type of adjustment to BIAS2 to get clean delay output.
- Re-connect your audio probe to pin7 of IC4_B. Make any adjustments needed to GAIN1 to reach the same volume output you had before. This part is a bit of fine tuning between GAIN1 and BIAS2 to get the optimal result.
- Leave the BAL trimmer in the middle position. Connect your audio probe to pin1 of IC4_A. Adjust the GAIN2 trimmer until the output is the same or slightly above the volume input of pin7 on IC6.
- You are done!

If you are using the BBD expansion board, refer to that documentation on how to do this procedure with four BBDs. It is generally the same thing with a few added steps.

Mouser Cart

For convenience, I have created a cart in Mouser that includes most of the items in the BOM. All the items highlighted in blue are in the cart in the correct quantities. Items in yellow are not included in the cart. Caveat: I have not personally ordered this cart. It was made using my "best guess" on the parts I would order for this project.

<http://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=16a26046e1>

Also, **this cart does not include the quantities needed for the TRXPN board**. However, those parts and values are already listed in the Mouser cart. Simply put in the additional quantities needed for the resistors, caps and trimmers for the TRXPN board.

Voltages

Using the EHX 24v supply measuring -34.68 / no load

IC1		IC2		IC3		IC4		IC5	
4558	DC	NE570	DC	4558	DC	4558	DC	4558	DC
1	-7.48	1	-13.74	1	-6.41	1	-7.48	1	-7.48
2	-7.48	2	-12.98	2	-3.21	2	-7.48	2	-7.48
3	-7.44	3	-12.99	3	-3.18	3	-7.44	3	-7.46
4	-14.82	4	-14.82	4	-14.82	4	-14.82	4	-14.82
5	-7.40	5	-13.00	5	-7.46	5	-7.43	5	-6.69
6	-7.48	6	-12.97	6	-7.48	6	-7.45	6	-6.76
7	-7.48	7	-4.71	7	-7.48	7	-7.45	7	-6.76
8	0.00	8	-12.99	8	0.00	8	0.00	8	0.00
		9	-12.99						
		10	-6.76						
		11	-8.48						
		12	-12.99						
		13	0.00						
		14	-12.99						
		15	-12.99						
		16	-13.76						

IC6		IC7		IC8		IC9		REG	
BBD	DC	BBD	DC	CD4047	DC	4558	DC	LM7915	DC
1	0.00	1	0.00	1	-7.94	1	vaires	I	-25.57
2	-7.48	2	-7.49	2	-7.09	2	-7.14	G	0.00
3	-10.12	3	-9.71	3	-6.91	3	vaires	O	-15.00
4	-10.12	4	-9.70	4	0.00	4	-15.00		
5	-14.99	5	-15.00	5	0.00	5	-7.14		
6	-7.49	6	-7.49	6	0.00	6	-7.14		
7	-7.66	7	-7.45	7	-15.00	7	vaires		
8	-14.05	8	-14.06	8	-15.00	8	0.00		
				9	-15.00				
				10	-7.49				
				11	-7.48				
				12	-15.00				
				13	-7.01				
				14	0.00				

