

NeoVibe, a Univibe (tm)Workalike

The Univibe is one of the trademark effects used by Jimi Hendrix and Robin Trower, just to name a couple of the more famous users. The Univibe is at its heart, a four stage phase shifter, not much different in concept from the common MXR Phase 90. It is, however, an earlier-technology implementation, built from transistors and not opamps; the “imperfections” of the transistor phase shifting stage show through clearly, and produce a unique sound.

Note that there are several reissue and clones of the Univibe on the market now. This unit replicates the circuit of the old original as manufactured by Unicord. It is not and should not be confused with any of the reissues or other clones; it is intended only as a DIY project. The term “Univibe” is a trademark of the current owner (I think Dunlop), and remains such.

How does it work?

If you can, go to <http://www.geofex.com> and read “The Technology of the Univibe” for a much more in-depth description of how the original Univibe worked. The Univibe was an interesting way to get unusual sounds out of simple circuitry. The first three transistors (Q1, 2, 3 in the Neovibe schematic) form a feedback preamp with an overall gain of about three, and with complementary outputs at the collector and emitter of Q3. The collector signal goes through capacitor C5 only, and the other through one of the photoresistors. The two are mixed back together at the base of the first darlington-connected signal stage (Q4). The addition of the two would cancel to no signal at all if the signal through the capacitor was not phase shifted by the C5. As it is, the two signals add back together to make a single signal whose phase is shifted an amount depending on the value of the photoresistor and the frequency of the signal. The darlington stage (Q4 and Q5) also has complementary outputs, and feeds a similar circuit following it.

After a total of four of the variable phase shift stages (one per photocell) the signal is mixed back to a single signal which is buffered by the last signal-path transistor, Q10, and is available on Q10’s emitter. This phase-shifted signal is then routed to the chorus/vibrato switch where you can select vibrato by NOT mixing any of the unprocessed signal with it (your ear hears the phase shift as a pitch shift) or “chorus” by selecting the signal which mixes unprocessed and phase shifted signals together. This “chorus” is not the chorus you’d hear from a chorus pedal, but actually more like a phase shifter output.

The phase shift networks in the Univibe are staggered in frequency, as each of the phase shift caps are a different value. This is unusual for a phase shifter design and was perhaps done so that there would be a notable amount of phase shift for any audio signal at any point in the LFO sweep. This would be consistent with the “vibrato” setting.

The Low Frequency Oscillator (LFO), which sweeps the value of the photocell resistance is also an unusual design. The thing is a phase shift oscillator, implemented oddly. It exhibits a rising output level with rising speed, which seems to compensate for the fall off in response of the incandescent lamp’s response to rising speed.

To get the thing running properly, you’ll need to adjust the idle bias on the lamp. That is the purpose of the PCB mounted trim pot TR1. Some Univibes I’ve seen dispense with the pot altogether, and just use a 150 ohm resistor. Since the light bulb you get may vary a lot, I recommend using the pot and adjusting it for a dim orange glow with the amplitude pot all the way down.

I’ve included typical voltages at various points in the schematic to help with the initial troubleshooting.

Construction Details Unique To The ‘Vibe

For the most part, building the Neovibe board is like other effects boards – image and etch the board, drill the holes and populate it. There are some tips that may help you. For one, all of the resistors and jumpers on the board have lead spacing of 0.4”. You can save some time by making a 0.375” wide stick and forming all the resistor leads around this to start with. No individual bending is needed. Solder in resistors and jumpers first, and progress by height of the components so they don’t fall out when you turn it over to solder.

Populate the whole board, but leave the light shield off till last. You have to set the lamp brightness with the thing powered up.

TO MAKE THE LIGHT SHIELD

The 'vibe relies on controlling the light that strikes four Light Dependent Resistors (LDR's) to make its phase shifting work. Controlling the light means that you have to have some way to keep normal room light away from the LED's. In the original, this was done by a sheet metal light shield.

There are two ways to make a light shield. One uses a 35mm film canister, the other uses a sheet of metal, preferably a sheet of thin copper from a crafts store, although the side of a food can will work too, if you can cut it out.

For the sheet metal version:

Either procure a piece of copper sheet about 2" by 2" from a crafts store, or cut a sheet of solderable metal out of the side of an empty food can. Wear gloves as you do this, as the edges of the metal will be sharp. If you use a can, using heavy scissors or shears, cut the top and bottom away, and slit the side so you can unroll the metal to get a rectangular flat sheet. Bend the sheet until it is flat; tapping with a hammer on a flat surface may help. Cut out the paper print of the light shield outline (included in this package) and glue it to the sheet metal. Then cut out the metal shield, using the paper as a guide.

Glue aluminum foil, shiny side out, to one side of the metal. Trim the foil with a sharp knife so that it comes to the very edge of the pattern. Fold the sides of the pattern up to make a shallow box. Fold so that the shiny aluminum foil is inside the box. Solder two cut-off resistor leads to the center of opposite sides of the box so they stick out past the open side of the box. The "legs" now stick up from the centers of two opposing sides. On the circuit board, there are two pads at the edges of the light shield pattern which are not connected to any of the other circuitry. These pads have holes which allow the wire "legs" of the light shield to be placed in them and soldered in place. Once the shield is soldered in place, wrap electrical tape around the metal shield's corners to keep light from coming in the slits.

For this version of shield, solder the photocells down flat, with their sensitive faces parallel to the circuit board. Solder in the light bulb and photocells, the bias of the bulb driver, then stick the shield on, soldering the legs on the bottom of the board to keep it in place. This essentially duplicates the light shield on the original Univibe.

For the film canister version:

Get a Kodak 35mm plastic film canister, black with a grey snap on cap. Remove the cap. On a flat surface place a 1/2" (12mm) spacer and hold the point of a thin, sharp knife blade flat on the spacer so the point sticks a little off the edge of the spacer. Place the closed bottom end of the canister on the flat surface, and slide it over so it touches the point of the blade. Press the canister side into the blade gently and rotate the canister several times so the blade cuts slowly into the canister. Do not hold the canister so if you slip or if the canister cuts through suddenly your finger or other personal part will contact the blade. Use light pressure and make several rotations until the canister cuts through. Clean up the edge if needed.

Take the now-shortened canister and press the edge of the open end over a relatively sharp corner, as of a table or cabinet, and again rotate the canister, pressing the edge into the edge of the corner. Rotate and press evenly so the corner edge forms the open edge of the canister into a small lip turned outwards. Try to work evenly so the plastic forms into an even lip. The lip is needed so the cap will stay attached; you cut the original plastic lip away when you shortened the canister. Try the cap, and then keep forming the plastic until the cap stays snapped in place.

Once the canister is formed, remove the cap. Cut a very small hole exactly in the center of the bottom, smaller than the space between the two holes on the circuit board for the light bulb. This will be used to align the shield.

Take your circuit board and mark a spot exactly in the center of the space between the two holes for the bulb on the component side of the board.

Cover the bottom of the canister with double-sided foam tape, leaving the covering paper on the outside. Cut through the foam tape so you can see through the alignment hole you made in it earlier. Place the canister bottom down on the with the center alignment hole exactly over the alignment mark on the circuit board between the holes in the circuit board for the bulb. Practice this a couple of times before you remove the covering paper to stick down the canister. When you can do it every time, remove the paper covering the sticky surface of the foam tape on the bottom of the canister and stick it down exactly centered.

Turn the board over and use the holes in the circuit board as a guide to drill through the canister bottom so the leads for the bulb and four photocells can pass through the bottom.

Now, form the photocell leads so they come about 0.1" out from the back of the photocell and bend at a right angle to be parallel to the body. Stick the leads through from the inside of the canister through to the copper side of the circuit board and solder them in place. When you are done, there will be a little square formed inside the canister by the photocells, with the holes for the bulb in the center. You may have to slightly bend or resolder the leads to get them all nice and neat and the same height, etc. Solder in the bulb in. When you snap the cap on, the bulb and photocells are held inside the light shield.

I recommend doing all this in two phases: Make the shortened canister and place it on the board and drill the holes before you place any other components on the board. Solder the photocells and bulb in after all other components are on the board.

MORE ON BUILDING IT

The GEO neovibe layout is quite old. I did the first version in about 1994. I've had a couple of guys correspond with me while they built 'vibe clones from my pcb layouts, so I now have some good (and independent) reviews of the process.

To get it working you will have to adjust the bias on the lamp driver transistor by adjusting the emitter resistor. The circuit seems to like about 200 ohms of emitter resistance. The emitter resistance is the sum of the 68 ohm R48 and the setting of TR1 trimpot. Notice that while the trimpot could do this all by itself, the 68 ohm resistor keeps you from accidentally turning it to zero and burning out your driver transistor (Q13).

You may have to increase the 47K resistor from the base of the driver transistor to ground (Q50). Some transistors like this at 100K-330K, and some like it open. The right point to hit is where the bulb is glowing dimly orange when the amplitude pot is all the way down. Twiddle the emitter resistor and base-to-ground resistors until the board mounted pot lets you dial in the proper bias.

The transistor pads are fairly close together. It's easy to leave a short between the pads of the transistors when you're etching, and it's easy to bridge between the pads with solder. If you suspect this problem, cut between the transistor pads with an X-Acto or similar sharp pointed knife after etching and again after soldering to ensure that you've caught any shorts. It's also probably worth your time to use a resistance meter set to its lowest range to test for shorts as soon as you finish soldering. This will avoid a lot of debugging time.

DEBUGGING

If you do run into problems, first suspect soldering shorts, then incorrect component placement (for instance, a 4.7K in place of a 47K, or vice versa, or a capacitor turned the wrong way round), incorrect connection of wires off the board, and only then start thinking of bad components. If you're certain that you have the parts in the right places, oriented correctly, wired right, etc., then use a voltmeter to check the voltages as listed on the schematic.

Checking DC voltages is a deadly effective way to find bugs. For an NPN silicon bipolar transistor to be amplifying (all of the transistors in this unit fit that description), the collector must be at the highest voltage, the base somewhat lower than the collector, and the emitter lower than the other two. The emitter must be at 0.5 to 0.7Vdc lower than the base in all cases, and the collector will be some number of volts above the other two. If you don't have 0.5 to 0.7V from base to emitter, the collector several volts higher than the base and emitter, then something is wrong with the biasing on that stage.

About Bypassing

The original Univibe did not do any kind of bypass. The footswitch on the speed pedal merely shorted the base of the lamp driver to ground, turning the lamp off entirely, and thus leaving the LDR's in a very high resistance state. In this condition, there is very little phase shift in any of the stages, so the signal is merely buffered in each stage and passed to the output. Some people are nuts about "originality", so I brought out a pad to the edge of the circuit board for your use if you prefer to do it this way. Pads "I" and "X" do the cancel function like the original if you use a switch to short/unshort them. If you do this, leave off the bypass wiring and wire input and output jacks directly to the circuit.

I have shown the schematic and wiring for true bypass, as I believe that this is a better sound in most instances. There may be a slight drop in volume when the effect is engaged. The original cancel circuit did not do this, although it did leave you with the loading and tone coloration in the "bypassed" mode.

If you want to fix the volume drop and use true bypass, change resistor R9 to 3.6K and resistor R8 to 910 ohms. This increases the gain of the initial preamp to make up for some of the losses.

There is a very little-known secret to getting good, deep phasing out of phasers in general and the 'vibe in particular. The depth of phasing depends on getting a good mix at the output. Resistors R35 and R36 mix the dry and phase-delayed signal together. The stock values may not be the right one for a good mix. If you want the best performance out of your Neovibe, leave these two resistors out and use a 200K pot to adjust the mix for deepest phasing. Then measure the resistance on each side of the wiper and put the nearest 1% resistor values in for R35 and 36.

Neo-vibe Parts List

Count	Designation(s)	Label-Value	Mouser Part number
1	R48	68 ohm (all resistors 1/4W carbon film)	All resistors "291-value"
1	R8	1.2K	
2	R39,R9	3.3K	
16	R11,R15,R16,R17R18,R22,R23,R27,R28, R29,R31,R41,R42,R43,R46,R49	4.7K	
1	R6	6.8K	
3	R1,R2,R34	22K	
8	R10,R12,R21,R24,R3,R33,R37,R50	47K	
1	R30	68K	
11	R13,R14,R19,R20,R25,R26,R32,R35,R36 ,R47,R5	100k	
3	R38,R44,R45	220K	
2	R4,R7	1.2M	
1	R40	2.2M	
1	TR1 200 ohm trim pot (can use 500 ohm)	200	594-63P201 (\$1.02)
1	DB1	Diode Bridge, DIP	583-DB102 or 625-DF01M (\$0.33)
2	D1,D2	1N4148	78-1N4148 (\$0.03)
14	Q1,Q10,Q11,Q12,Q13,Q2,Q3,Q4,Q5,Q6, Q7,Q8,Q9	See notes	512-2N5088 (\$0.06 ea!) 512-2N3904 (\$0.09 ea)
1	C4	330pF	23PS133 (\$0.22)
1	C12	470pF	23PS147 (\$0.22)
1	C15	0.0047uF	140-PF2A472K (\$0.14)
1	C5	0.015uF	140-PF2A153K (\$0.14)
1	C26	0.1uF	140-PM2A104K (\$0.36)
1	C9	0.22uF	140-PM2A224K (\$0.36)
16	C1,C10,C11,C13,C14,C16,C17,C18,C19, C2,C20,C21,C3,C6,C7,C8	1uF 50V	140-XRL50V1.0 (\$0.05)
2	C22,C23	10uF 25V	140-XRL25V10 (\$0.05)
2	C24,C25	1000uF 35V	140-XRL35V1000 (\$0.41)
8	J1,J1,J3,J4,J5,J6,J7,J8	Wire Jumper (use cut off resistor leads)	N/A
	100K dual reverse log taper control [1]		313-2420-100K (\$2.35)
	100k log		31VJ501 (\$1.25)
	50k log pot		31VJ405 (\$1.25)
	7815 or 78L15 [4]		511-L7815ACV (\$0.67)
	photocell (LDR)		338-54C679 (\$1.31) (see

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		notes)
	1/4" jack	502-111
	power jack	To match transformer
	lamp bulb	Radio Shack 12V/25ma
	transformer	14-16VAC or 20-24VDC wall xfmr.
	SPDT sw.	108-MS550A
	DPDT sw.	Carling 316P, Arrow, Eaton
	Box	
	Knobs	

Notes on the Parts List

[1] A proper 100K dual speed pot will be hard to find. The original was a 100K dual log taper, which is the same as an audio taper. In the original, the foot pedal for speed control mechanically reversed the direction of rotation of the pot, making tone-down be faster. If you're using this as a panel mounted speed pot, a 100K audio pot (as specified in the parts list) will work, except that if this is mounted in a panel or on a box, turning the knob clockwise slows the oscillator down, making it a "slowness" knob instead of a "speed" knob. I thought this was better than not having a 'Vibe clone for myself. If you put the pot into a footpedal like the original, you can rig the turning mechanism to turn it the opposite direction and reverse the outside leads. This happens naturally if you use a gutted Crybaby rocker pedal and fit a 100K stereo volume control into it. A linear taper pot will crowd all of the speed variation to one end of the pot, but can be made to turn the right direction. You can also use tapering resistors (See "The Secret Life of Pots" at GEO, <http://www.geofex.com>) for how to do this).

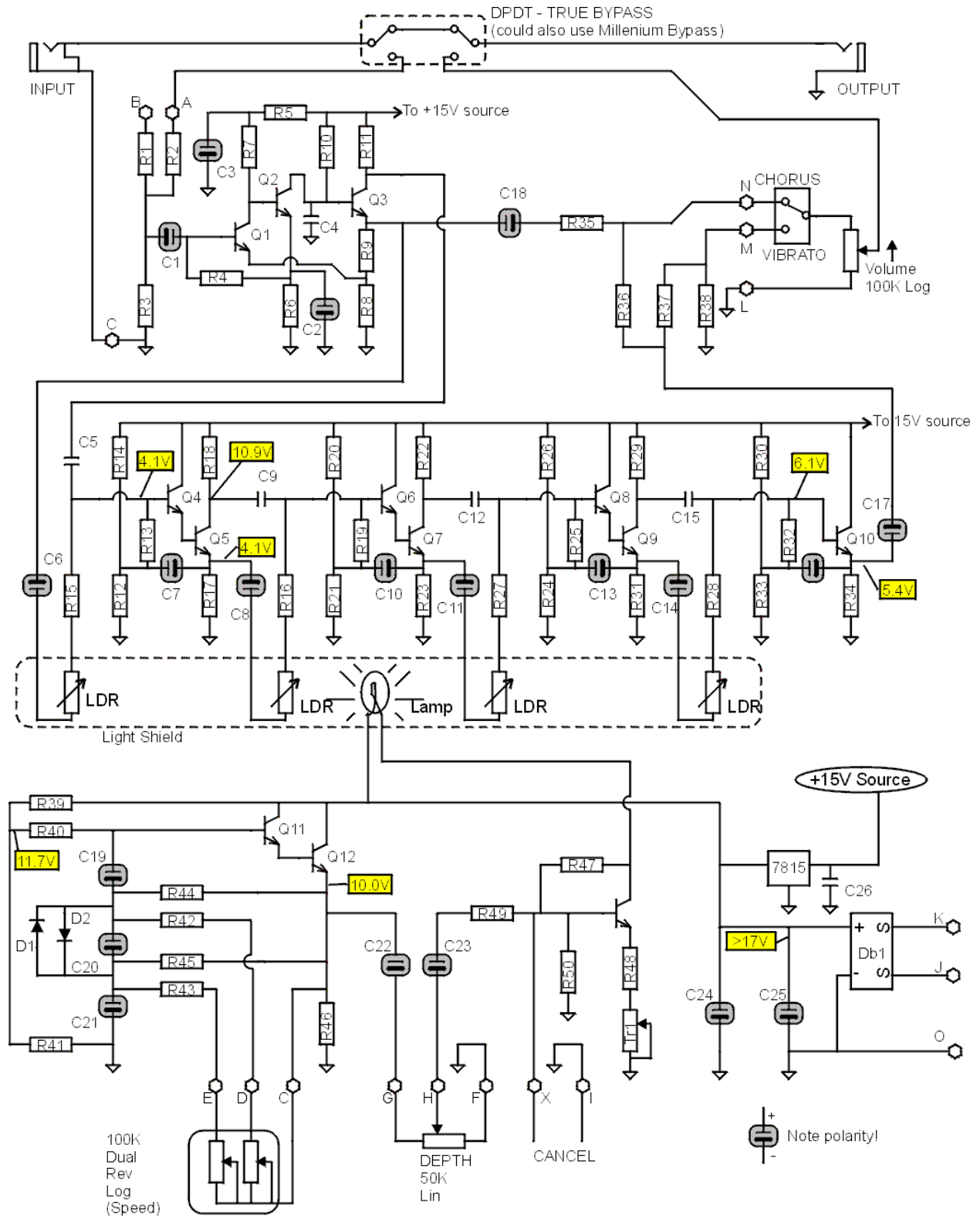
[2] The transistor selections for the 'Vibe clone are not critical. I used all 2N3904's in my first one, and a mixture of 2N5088 and 2N5210 in my second one. The 2N5210 and 2N5088 are good all-round choices. The only transistor which really needs to be different is the lamp driver transistor which needs to handle higher currents. The original used 2SC539 for the first transistor, Q1, and 2SC828 for all the rest. If you find and want to use the original part types, be aware that the originals have a different pinout (ECB) than the ones the board is laid out for (EBC), and bend the leads to fit the right holes - or it will not work!

I picked 2N3904 for the lamp driver for its 100ma collector current rating. It wouldn't hurt to get a spare for this one for your debugging efforts, as it is easy to kill this one if you short the lamp while probing. This is the only transistor under any power or voltage stress. I have now fixed several broken Univibes, and it is common for this transistor to die. I have included on the circuit board the option to use a TO-220 medium power transistor instead of the TO-92 package like the rest. If you do this, pick a transistor with high gain (100 or more Hfe). The lead positioning for it is marked just above the Q13 position on the parts diagram, and it shares the collector and emitter holes with the TO-92 footprint.

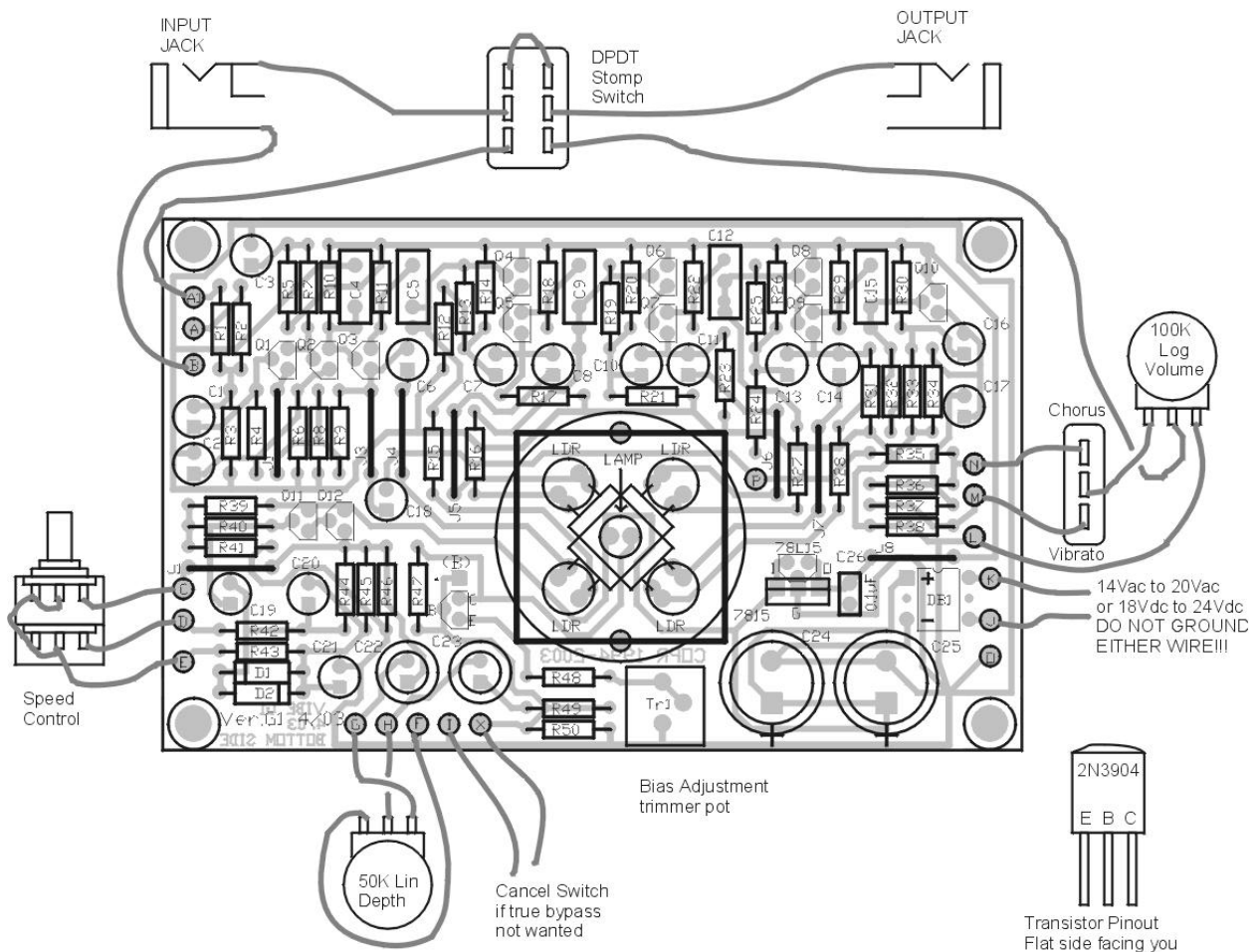
[4] The 7815 is a linear voltage regulator that I used instead of the R-C network in the original. It provides MUCH cleaner power to the signal path, and is cheaper than the additional capacitor that would be needed. I also printed two places for this part to go. The 78L15 can supply 100ma, which is plenty for this application, and comes in a TO-92 package. The TO-220 package is more commonly available. The board is designed to accept either.

[5] Total cost for parts will run to \$50-\$100, depending heavily on your choice of the box and switches, and how well stocked your junk box is.

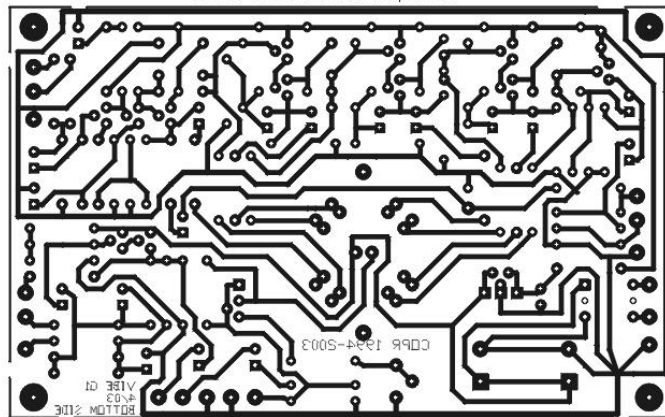
Neo-Vibe



Parts Placement and Wiring Diagrams



Actual size toner transfer pattern.



Transistor Pinout
Flat side facing you



2. Mark centerlines and cut away corners.
Remove paper template.
Glue on aluminum foil.

3. Fold up sides.
Aluminum foil on the inside!

4. Continue folding sides.
When folding up the sides, you can use something like a heavy metal ruler as a folding aid.

5. Box portion complete.

6. Solder on wire "legs".

1. Cut out this real size template with scissors.
Glue/tape paper template on copper.

Making the Neo-Vibe Light shield