Ultra Flanger

Design by John Hollis

The Ultra Flanger is John Hollis' design of a very flexible flanger based on the MN3007 bucket-brigade analog delay chip.

U1A is an input amplifier and mixer. The input signal comes in through C1 and R2 where it meets the Regen feedback signal from one side of the Odd/Even Regen switch. R1 is a pulldown resistor to prevent popping when switched. R3 biases U1A (and through it U3 and U1B) to Vbias1, about 4.9V. U1A has a slight gain boost.

The output from U1A goes to two places: through R5 to the input to U2 for delay processing and to the output through R12 to be mixed with the delayed signal out of U2. The signal level at the input to U2 is limited by D1 and D2 - these are not for deliberate distortion. The output of U2 is available at pins 7 and 8, and this is then applied to U1B, which low pass filters the delayed signal to remove the sampling noise caused by U2's analog sampling. The lowpass filtered signal is mixed with the dry signal through R13, and goes to the output jack through C5. The output of U1B also feeds the Regen control to determine the amount of feedback to be mixed with the input.

U5A serves as a Schmitt trigger to determine the min and max size of the LFO triangle wave. U5B is an integrator that ramps up and down, controlled by the output signal of U5A. The amount of U5A's output that is applied to U5B's input is controlled by the Rate control; this determines how fast the integrator ramps.

U5B's outpu goes to the Sweep control, which determines how large a triangle wave is fed to the high frequency clock generator, U4. The triangle is further smoothed by R23/C9.

U4 generates a biphase output on pins 2 and 3/4 at a speed determined by the voltage on its pin 9. This output is between 50kHz and 1MHz. It is buffered by the paralleled sections of U3, and this drives the clock inputs of U2.

Count	Value	Designation(s)
5	1N914	D1,D2,D3,D4,D5
2	Red	LED1,2
2	Dual Opamp	U1,U5
1	MN3007	U2
1	CD4049	U3
1	CD4046	U4
1	100R	R27
1	470R	R21
1	2.7k (2K7)	R25
5	10K	R12,R13,R15,R17,R5
1	12K	R16
1	22K	R22
1	39k	R24
4	47K	R11,R19,R7,R8

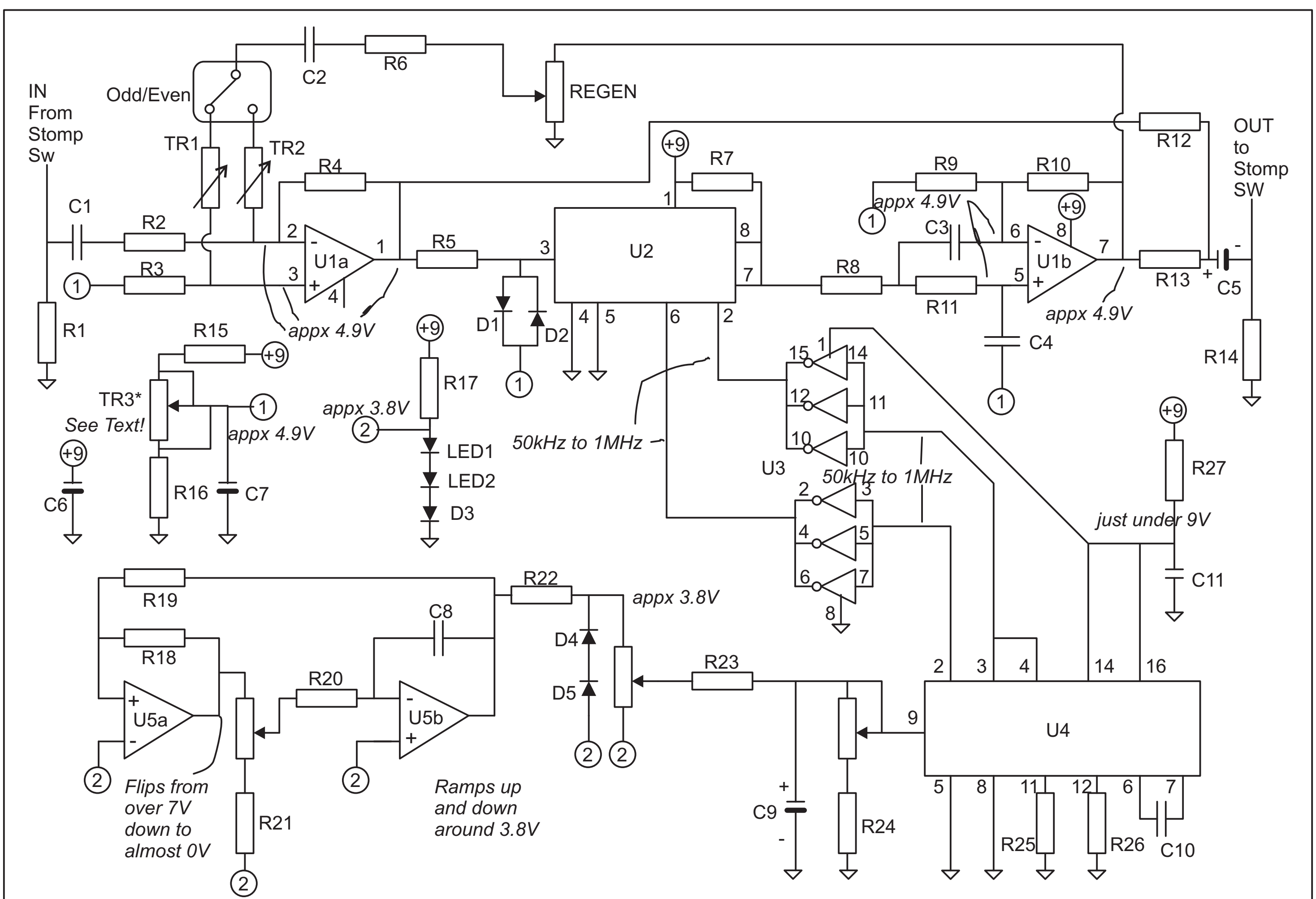
Count	Value	Designation(s)
1	150K	R4
1	470K	R20
1	3.3M (3M3)	R26
1	10M	R1
1	5K trimpot	Tr3
2	100K trimpot	Tr1,Tr2
1	22pF	C10
2	0.001uF (1nF)	C3,4
1	0.0047uF (4n7)	C2
1	0.1uF (100nF) cer	C11
2	0.1uF (100nF)	C1,8
2	1uF radial electro	C5,C9
1	10uF rad electro	C7
1	100uF rad electro	C6

Revisions History

10/26/01: First release.

04/07/02: Corrected schematic and layout per John Hollis Instructions. Previous Hollis schematic incorrectly connected C9 and R24 to Vbias, not ground.

09/08/15: R24 should have been marked R25; corrected



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Making the circuit board

I've received som comments that the normal trace spacing I use gets eaten away a bit by printer and file conversion tolerances, making the pads and traces a bit fatter. Because this is a very busy board, I've pre-compensated for that by making the majority of the traces a bit thinner. Most are laid out as 0.020" (20 mils) wide.

To make the circuit board, print the pattern to toner paper. Press-N-Peel Blue is recommended, because the smaller traces will be trickier with other toner transfer types. The pattern is the correct way 'round for toner transfer printing.

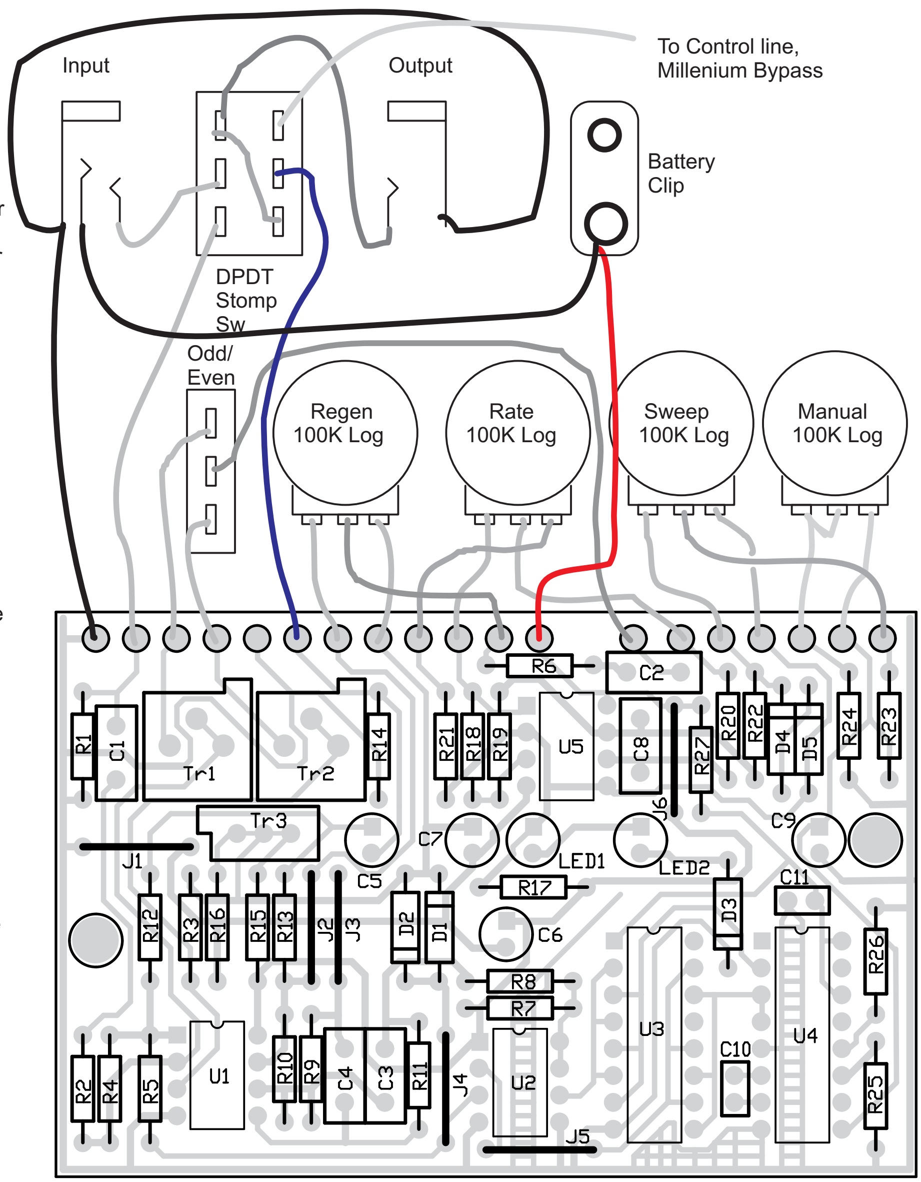
I recommend printing the pattern directly onto the paper. A good way to do this is to print this sheet onto paper, then cut out a rectangle of PNP Blue that is slightly larger than the toner section. Tape this to the previously printed paper sheet; tape along the leading edge of the toner section. Now print the sheet again, manually feeding it into your printer. Resolution and accuracy will be best on an original print, not a print that is then copied.

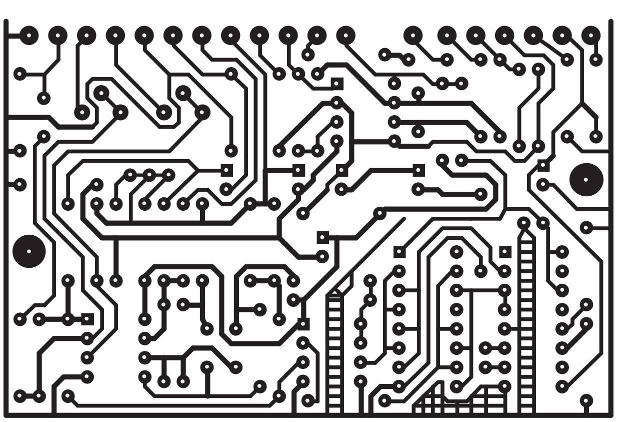
Follow the instructions for the toner sheet. *Clean the copper board very, very well. Most failures are due to improper cleaning of the board.* Iron the sheet onto your copper clad blank. If you look at the shiny side of the sheet at a grazing angle, you can see the slight indentation where the toner on the bottom side is adhering to the copper. Do not iron so much that the pattern spreads. If you foul it up, just clean the toner off the copper with acetone, then print and iron another. Do any necessary touch up with a Sharpie marker or a Radio Shack etch resist pen - which I think is a relabeled Sharpie.

Etch in your favorite etchant. I like ferric chloride, even though it's messy and smells bad.

Drill with a 0.030" drill bit. It helps to indent the centers of the pads a bit with a sharp pointe too like an ice pick.

The fifth pad from the left is a ground pad. It can be used to ground the output jack, or jus left open as in the wiring diagram.





Notes on the layout:

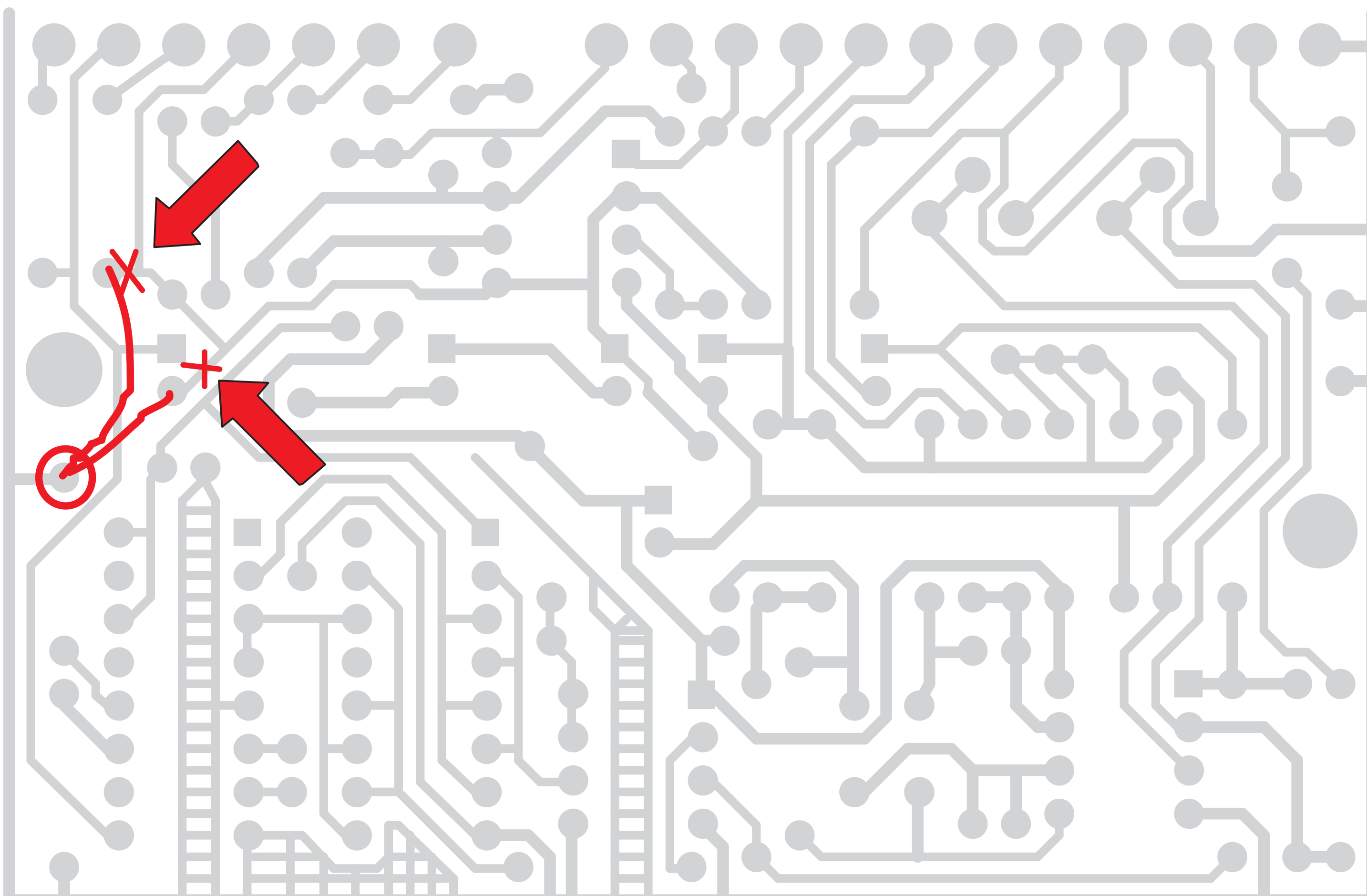
I've added a couple of things to the design. R27/C11 decouples the digital noise from U3 and U4 from the analog +9V. You might be able to sub in a jumper for R27 and leave C11 out if you like living dangerously. Trimmer TR3 is there for tweaking in the analog bias voltage. The pads of TR3 are shorted together by thin traces on the PCB. If you want to use TR3, make R15 9.1K, use 5K for TR3, and change R16 to 10K; cut the shorting traces between the pads of TR3. If you just want it simple, leave off TR3, make R15=10K and R16=12K as per the parts list.

I've left the option for a 3.9V zener instead of LED1,2, and D3. If you prefer this, put the zener in the space on the board for D3, but with the cathode the other 'way round. LED1 and 2 are spaced so that two 0.4" long wire jumpers fit neatly into their holes. If you put in the jumpers and the zener, the zener circuit works as shown in John's original schematic.

I've included some typical DC voltages as an aid to debugging.

4/8/02: The layout at left is the updated one with the newest fixes from John H.

Mods to Fix the Previous Board Level



Board is shown from the Copper Side!!

To correct the previous board level to match the latest update, do this:

1. Find the trace leading to the Vbias net from C9 and R24. On C9, this will be the round (not square) pad on C9, and the pad on R24 nearest C9. Refer to the copper-side diagram above.
2. Cut the trace leading to the C9 pad and the trace leading to the R24 pad with an X-Acto hobby knife or similar. Remove enough trace length to ensure that it will not short accidentally in the future. The red X's show which trace to cut. The arrows highlight the X's.
3. Solder short insulated wires from the circled ground pad to the now-isolated pads on C9 and R24. This is easiest with solid core wire. Cut a length of solid core wire long enough to make both runs from ground to the two pads, plus a bare length at each end and in the middle to solder.
4. Strip 1/8" length of insulation from each end and fold the wire for a trial fit. Find the off-center place where the connection to the ground pad will be and strip 1/8" of insulation from this spot with an X-Acto knife.
5. Bend a small loop in the middle of the wire with needle nosed pliers and slip it over the lead coming out of the ground pad. Solder the middle.
6. Bend a small loop in each stripped end. Slip them over the leads in the pads on C9 and R24. Solder.
7. All done. Enjoy!!