Tap tempo tremolo
Build instructions

This circuit is a deep, full-featured tremolo, with a large variety of waveforms and tap tempo control, and a completely analog signal path. No programming or knowledge of digital technology is necessary to build it. Since this is a DIY project, you can build it in a number of different forms, but here's all of what it's capable of having/doing:•

•Depth knob
•Speed knob (marked "Tempo" on the PCB)
•Waveform knob: chooses between the following waveforms:
      -Up ramp
      -Down ramp
      -Square/pulse
      -Triangle
      -Sine
      -Hypertriangle (the top of this waveform is a triangle, the bottom is a sine)
      -Inverted hypertriangle (the top is a sine, the bottom is a triangle)
      -Random steps
•Multiplier knob: once you tap in a tempo using the tap switch, the Multiplier knob selects what division of time is used for trem. For example, you can tap on the quarter notes, then use the Multiplier knob to change the speed of the tremolo from half notes, quarter notes, triplet quarter notes, eighth notes, triplet eighth notes, or sixteenth notes. Using the sixteenth note multiplier allows you to get much faster speeds than it's possible to tap, while still allowing tap tempo control.

•Wave Distort knob: this knob distorts each waveform. Setting it to center gives the standard waveforms. Turning up or down changes the pulse width (on-to-off ratio) while also changing the "hardness" of each wave. Using this knob with the square wave is especially useful, to create a very narrow pulse wave that sounds like a stuttering blip. For more info explaining this function, see the TAPLFO chip's datasheet at http://electricdruid.net/datasheets/TAPLFO2Datasheet.pdf

•Gain knob: by default, this is an internal trimpot. In most uses, it's not necessary to tweak it while playing. You can bring it out to the front panel, however, which lets you increase gain to make up for the lower overall volume, when using very narrow pulse widths.

•Tap tempo switch: this is a momentary SPST stomp switch. The chip takes the last 2 taps to determine tempo. At any time, if the band starts to drift and you want to realign the trem to the start of the beat, just tap the switch once.

Building the PCB

Presumably if you're building this you've built some electronics previously. But there are some things here which deviate a bit from the usual.

1. Wave Distort
On the left of the board, there is a label that says "Wave Distort" above 2 resistors. The pads the resistors fit into are labeled 1, 2, and 3. If you're building this with the Wave Distort knob, wire the outside lugs of the pot to the pads labeled 1 and 3. The wiper of the pot goes to the pad labeled 2. If you don't want the Wave Distort knob, simply fill these 2 resistor spots with 10k resistors as marked. Important note: You must either wire a pot to these pads, or fill the resistors, but do not do both.

2. The Expansion pads
Right below the Wave Distort pads, is a white-outlined box with 2 pads, labeled EXP. This is an expansion pad of sorts, which at the time of designing the PCB was not used by the code of the TAPLFO chip. Now, with TAPLFO V2.0, these pads are used as a momentary switch to step through Multiplier settings. If you want to use this feature, wire up a momentary SPST switch to the pads.

3. U3
At the bottom of the board there is a diode marked "U3". This is a 1n4001 diode.

4. Setting the trimpots
The 2 trimpots in between the TAPLFO chip and the TL072 are for limiting current to the LEDs. The one directly next to the TAPLFO limits the current to the optocoupler, and the other one limits the visible LED. Carefully setting these 2 trims will prevent ticking and give the ideal optocoupler performance as well as a tolerable LED brightness. Set them to the position that eliminates ticking.

The trimpot above the TL072 sets the gain of the output stage (makeup gain after the trem). After setting the LED trims, use this to bring the effect volume to the same level as the bypassed volume. You may want to bring this control out to the front panel for ultimate tweaking.

5. Ticking
This trem does not tick when setup properly. The LED trimpots generally allow you to trim ticking out completely without any other modifications. It's also recommended that you buy 2 optocouplers, because occasionally you get a dud which exhibits ticking no matter what you do.

Modifications
The circuit can be modified to fit your setup easily.

•Any of the pots can be hardwired internally by putting 2 10k resistors where the pot would be.
•Any pot can be modded for CV (control voltage) input easily. Just add a jack with the tip connected to the center pad where the pot would go. Send a CV from 0-5v. Probably a good idea to put a 10k resistor in series between the jack and the PCB to limit current.

For deeper info on the TAPLFO chip,
see http://electricdruid.net/index.php?page=projects.taplfo

Credits:
Tom Wiltshire, http://electricdruid.net/
Chris Safi, http://www.strangedesigncs.heliohost.org/
Dann Green, http://4mspedals.com/
Taylor Livingston
.Mike

Tap tempo tremolo
Bill of Materials

Part type
    quantity - part   (Mouser part number where available, additional info)

ICs
    1 - Electric Druid TAPLFO
    1 - TL072   (dual opamp)
    1 - 78L05   (5 volt regulator)

    1 - 14pin IC socket
    1 - 8pin IC socket

Transistor
    1 - 2N3904   (NPN transistor)

Potentiometers
    5 - B10K   (if you're not using the Wave Distort knob, you'll only need 4 B10K potentiometers.)
    1 - A25K   (Optional. This is for an external gain knob if you want one)
    3 - 22K trimpot

(For trimpots, strongly recommend you use Mouser part# 652-3362P-1-223LF. Other trimpots maybe difficult to fit.)

Resistors   Color Code
    3 - 10k   Brown Black Orange Silver
(if you aren't using the Wave Distort feature, you'll need 2 more 10k resistors, for a total of 5)

    4 - 1K   Brown Black Red Silver
    1 - 3K6   (3.6K)   Orange Blue Red Silver
    2 - 1M   Brown Black Green Silver
    1 - 10R(10 OHMS)   Brown Black Black Silver
    2 - 220K   Red Red Yellow Silver
    2 - 100K   Brown Black Yellow Silver

Diodes
    1 - 1N4001
    1 - LED   (superbright blue is ideal)

Capacitors   (cap types are just suggestions)
    7 - 100NF (.1UF) film
    2 - 1UF film   (Mouser part# 80-R82DC4100DQ60J)
    1 - 330NF film

        NOTE: all film caps are intended to be boxed metal film caps. Other cap types will not fit.

    2 - 22PF ceramic
    1 - 330PF ceramic
    1 - 10UF electrolytic
    1 - 100uf electrolytic

OPTO
    1 - NSL-32 is recommended. If using something else, look for around 500 ohm ON resistance, 500k OFF
resistance.

Switch
	1 - Momentary SPST stomp switch for the tap function, labeled "TAP SW" on the board. If adding the Multiplier step switch, you'll need a second momentary SPST.
	1 - 3PDT stomp		(bypass)

Crystal
	1 - 20 MHZ crystal, labeled "XTAL" on the board. (Mouser part #815-ABL-20-B2)

RAMP UP   RAMP DOWN   PULSE   TRIANGLE   SINE   SWEEP   LUMPS   RAND

Multiplier step switch

VR1–VR4 10K Lin

TEMPO

WAVEFORM

MULTIPLIER

DEPTH

R4–R7 1K

R8 3K6

C4–C7 100nF

C3 100nF

X1 20MHz

C1,C2 22pF

PIC16F684

R1 10K

Wave distort

TAP TEMPO IN

TR1 2N3904 or similar

10k

R9 10K

R9 10K

TAP TEMPO BUTTON

OUTPUT LED

Dual Op-Amp For example: TL072

Vref

C10 1u

TREMOLO OUTPUT

R13, R14 22k

Vactrol or LED/LDR Example: VTL5C3

TREMOLO INPUT

C8 1u

R11 220K

R12 220K

R10 1M

C9 330p

R15 10K

R16 1M

POWER INPUT 9V-12V DC

R17 10R

C11 100u

C12 100n

C13 10u

R18 100K

R19 100K

+9V

Vref

D1 1N4001

Power smoothing and biasing

LM78L05

In   Out

Com

+9V

C14 330n

C15 100n

+5V

+5V power supply for LFO

In jack

Out jack

TEMPO   WAVEFORM   MULTIPLY

WAVE
DISTORT
2

B10K   100NF 100NF 100NF   B10K   B10K   9V

1   3K6   GND

WAVE
DISTORT
10K   330P

10K   OPTO   1M   1UF

1K 1K   1K 1K

TAPLFO   TL072   DEPTH   B10K

10K   10K
2N3904

330NF   22P 22P   220K 220K 1M   1UF   OUT

10UF   100N   100UF   IN

NEG POS

TAP SW   TAP TEMPO TREMOLO   LED

IC orientation:
square pads
indicate pin 1.
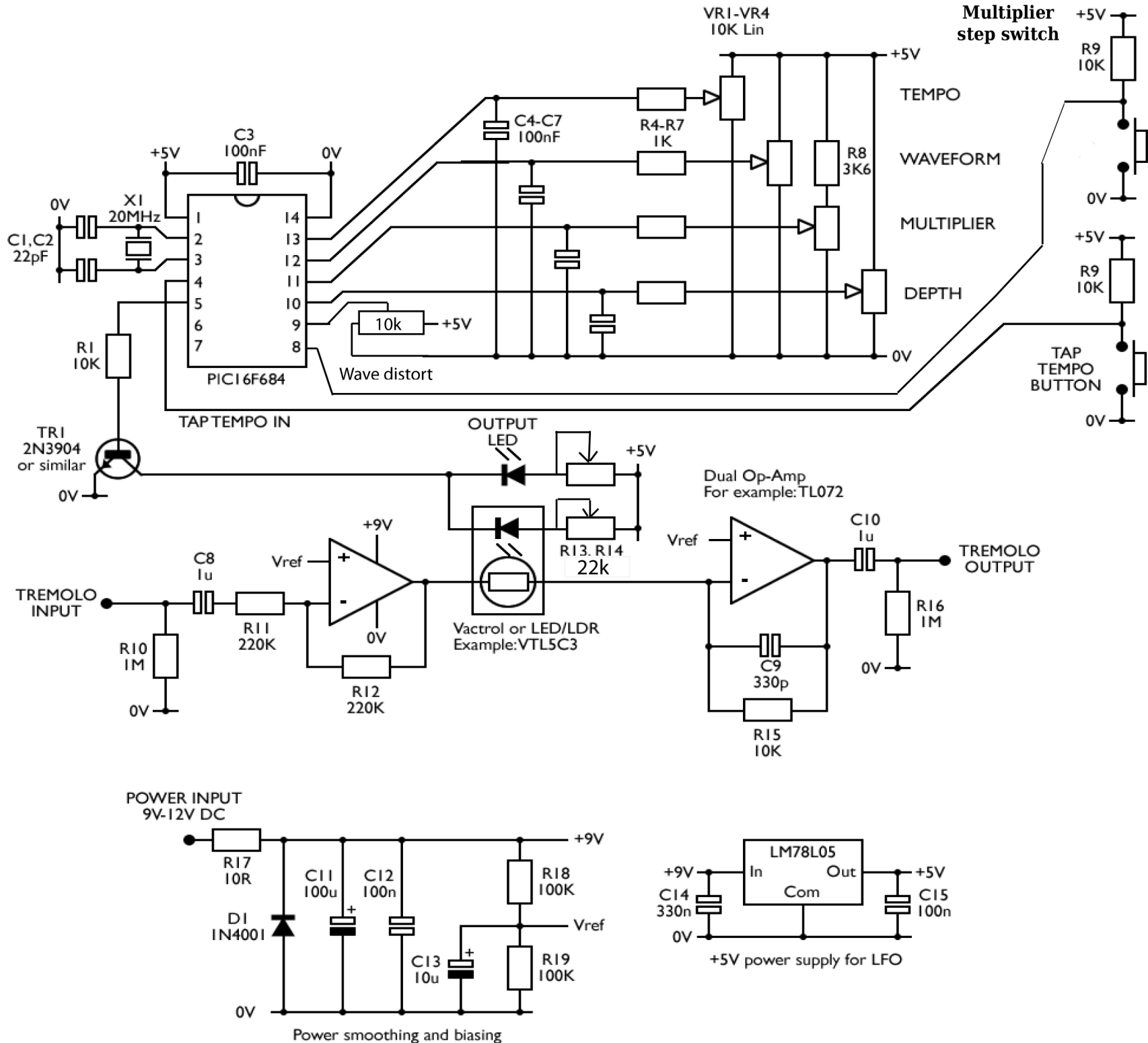
ground
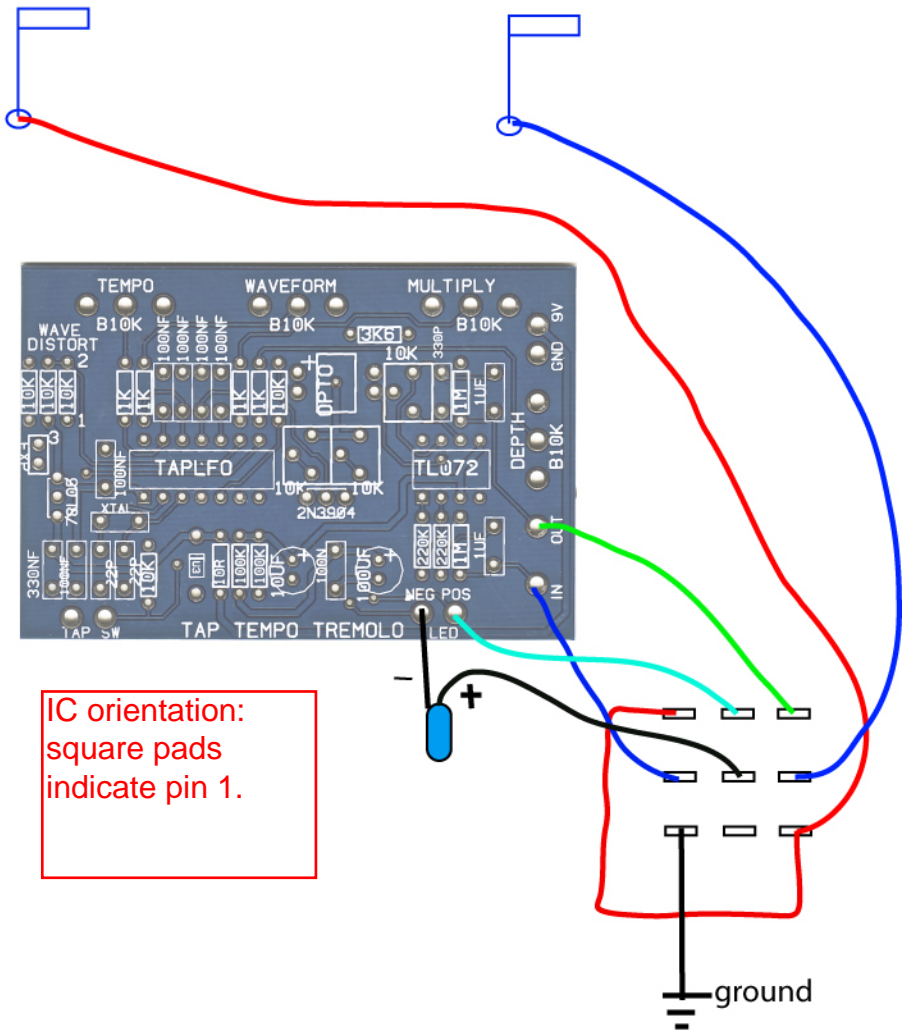
Either fill in these 2 resistors or wire the Wave Distort to the pads marked "1, 2, 3". DON'T DO BOTH.

Always fill in this resistor, regardless of whether you're using the Wave Distort knob.

Multiplier step switch-optional momentary SPST

Tap tempo switch Momentary SPST

This is a 1n4001 diode.