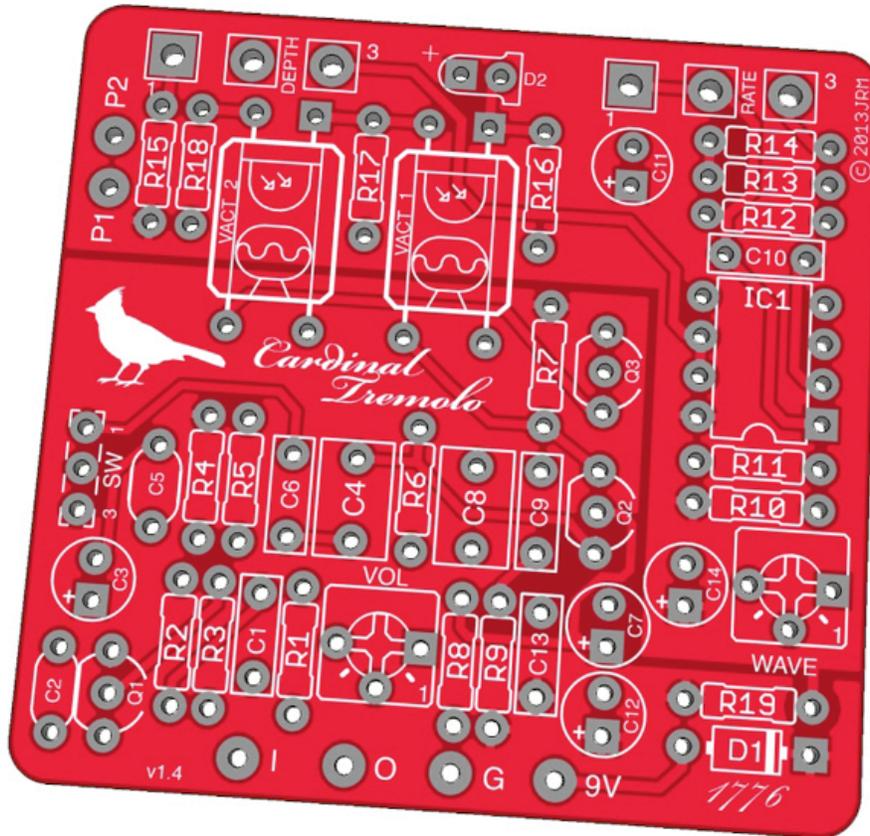


Cardinal Tremolo

PCB by 1776 Effects/JRM ©2013

Circuit Design by Jon Patton



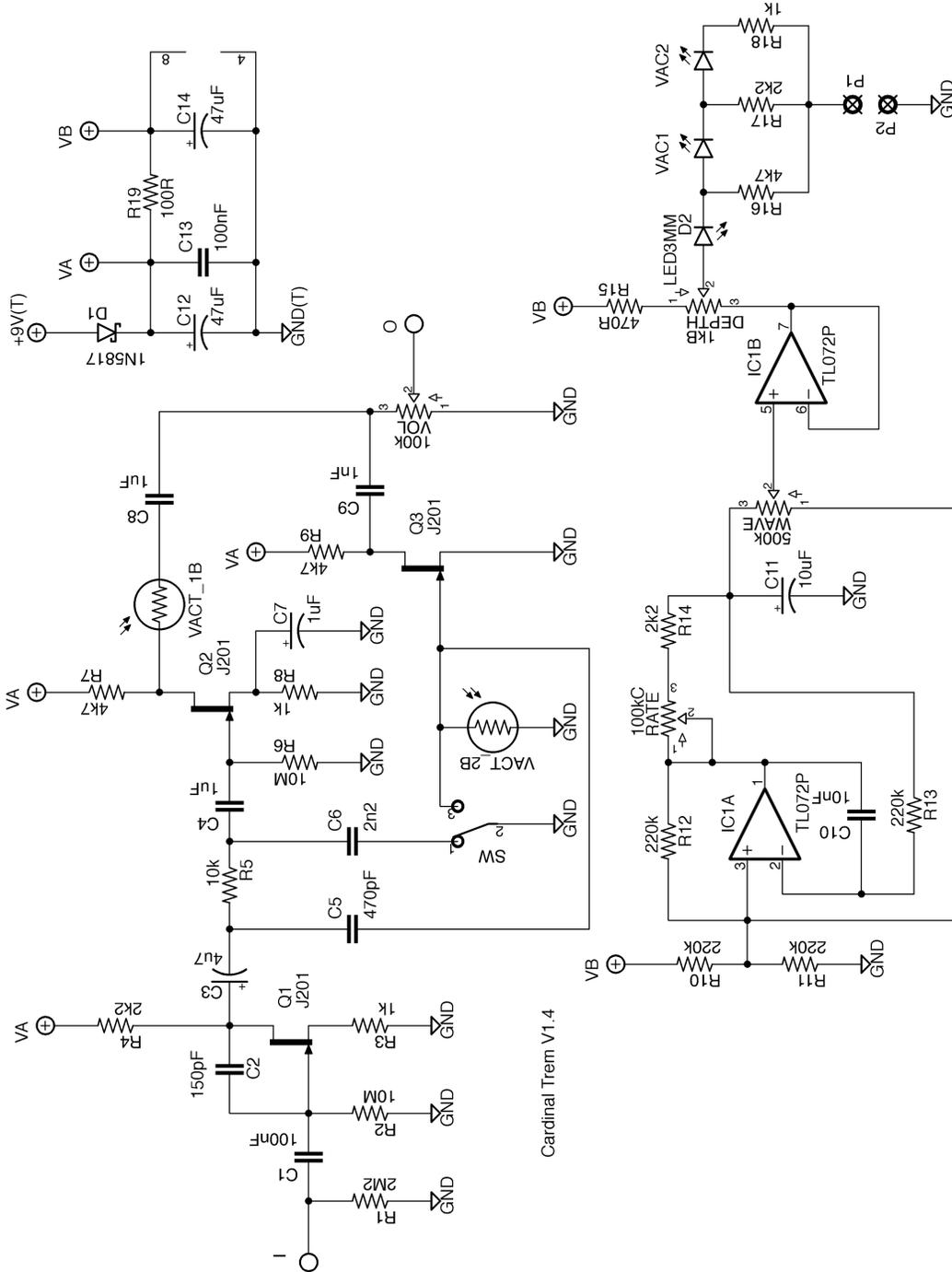
The Cardinal Tremolo is a transistor and vactrol implementation of the Harmonic Tremolo. It resembles the harmonic tremolo from Fender's 1960-1963 amps; the Super, Pro, Twin, Showman, and Concert models.

Parts List

<i>Resistors</i>				<i>Capacitors</i>		<i>Diodes</i>	
R1	2M2	R12	220k	C1	100nF	D1	1N5817
R2	10M	R13	220k	C2	150pF	D2	LED Diffused
R3	1k	R14	2k2	C3	4u7		
R4	2k2	R15	470R	C4	1uF	<i>Transistors</i>	
R5	10k	R16	4k7	C5	470pF	Q1	J201
R6	10M	R17	2k2	C6	2n2	Q2	J201
R7	4k7	R18	1k	C7	4u7*	Q3	J201
R8	1k	R19	100R	C8	1uF	<i>Potentiometers</i>	
R9	4k7			C9	1nF	VOL	100k (trim)
R10	220k			C10	10nF	WAVE	500k (trim)
R11	220k			C11	10uF	DEPTH	1kB
				C12	47uF	RATE	100kC
<i>Vactrols</i>				C13	100nF	<i>Mode Switch</i>	
VACT 1		VTL5C1		C14	47uF	SW1	SPDT
VACT 2		VTL5C1		<i>IC's</i>			ON/ON
				IC1	TL062 or TL072		

*Previous value was 1uF, 4u7 is now the recommended value

Schematic



Cardinal Trem V1.4

General Notes:

- D2 is the rate indicator LED
 - Put a jumper wire between P1 and P2 if you want a visual indicator of the tremolo rate to flash all the time.
 - Wiring P1 to the 3PDT LED indicator lug (top left lug on madbean's wiring diagram) will allow you to turn the rate indicator LED on and off when the effect is on/off. Leave pad P2 empty. Please note if you are "boxing before your rocking" that you will need to attach P1 to ground when testing and you are wiring it as an on/off and rate indicator.
- The mode switch is for harmonic tremolo or a standard optical tremolo.
 - If you use an on/off/on SPDT switch you can get an additional "bright" mode in the middle position that sounds a bit like a vibe -- the highs will stay more constant in the signal while the low frequencies will oscillate.
 - If you only want to use the pedal for the harmonic tremolo you can just put a wire jumper between switch pads 1 and 2.
- In order to keep the external controls simple the the volume and wave adjustments were meant to be "set and forget" adjustments. The trim pots can be substituted with external potentiometers. Use 100kA for the volume and 500kB for the wave.

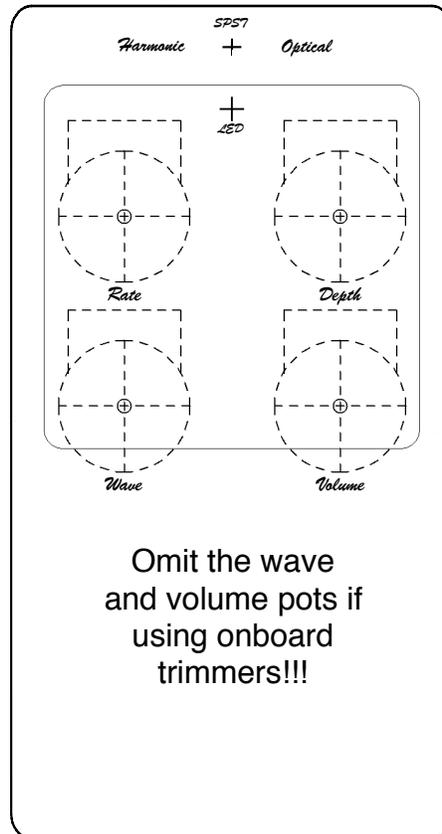
Jon's Notes on optimizing the circuit:

- JFETs have a wide range of gain tolerances, and occasionally some adjustment may be necessary to ensure best performance. J201s known to be genuine Fairchild's seem to have noticeably higher gains on average than the same part number from Tayda at the time of prototyping. A decision not to use trimpots was made to avoid noise issues and keep the layout compact.
 - If possible, you should socket all three transistors in this effect. This will not only protect the transistors from soldering damage but will allow you to isolate Q2 and Q3 for troubleshooting or optimization.
 - Target bias voltages (acceptable range): Q1: ~8v (6v-8.5v); Q2: ~7v (5v-7.5v); Q3: ~3.5v (2v-4.5v).
 - 2N5457 is an acceptable substitute for Q1--Q3 without re-biasing and happens to sound very good, especially in Q3. In a pinch, other FETs may work with re-biasing or with different pinouts, but some (e.g. 2n5952,

- 2SK170) have an extremely small workable range and low output in Q3 and will be very hard to bias correctly.
- Q3 will sometimes overdrive slightly with high output pickups or a boosted signal -- this is normal and simulates some of the breakup found in the amp circuitry.
 - If you want to take things one step further, you can socket the drain resistors on both Q2 (R7) and Q3 (R9) to optimize the effect. This is much easier than matching FETs or plugging in several transistors to each slot searching for the one that sounds best. To do this, set the depth at max and remove Q2. Adjust the bias for maximum gain (you can also use a 10K pot to find the best value, then choose the closest resistor). Now insert Q2 and adjust its drain resistor, if necessary, to have a similar maximum output level.
 - The harmonic phasing effect is created when frequencies cross over each other as the volume of Q2 and Q3 oscillates. Although this effect is *not* a true phaser, some builders may want a more extreme effect, and other builders may find that darker pickups (or their neck pickup) don't provide much harmonic effect. There are two easy ways to adjust the intensity of the phasing effect in harmonic mode. To increase the amount of phasing, you need to increase the range of frequencies that cross, either by adding more low-end to Q3 or reducing treble in Q2.
 - *If you plan on including the mode switch:* The easiest way to change the maximum intensity of the phasing sound in harmonic mode only, without altering the sound in "normal" mode, is to change C6 (which forms a low-pass filter with R5). Lower values will have fewer crossover frequencies. Higher values will have more crossover frequencies. Keep in mind that values above about 3.3nF will noticeably remove high frequency content from the signal at lower depth settings. (For some people, this may be a feature, not a bug.)
 - *If you plan on omitting the mode switch:* Change C9 to a 2.2nF. This will shift the total frequency response of BOTH sides downward slightly and allow more signal to pass from Q3, but without as much treble *loss* in Q2, and the highs will not be dulled quite as much on low depth settings.

Jon's credits: This circuit is based in part on RG Keen's Pro-Vibrato schematic. The LFO was adapted from CultureJam's Shoot the Moon Tremolo, which in turn adapted from Dann Green's Tremulus Lune. Thanks to Jimi Photon for the inspiration and samhay, ~arph, and duck_arse for discussions and suggestions on DIYStompboxes.

Drill Guide



Print this document 100% scale.

Board Dimensions: 1.93" x 1.99" (49mm x 50mm)

The Cardinal Tremolo PCBs can be used for small quantities of commercial pedal building. You may not however, offer these PCBs as part of a "kit" or redistribute the PCB's for sale as a commercial endeavor. All PCB artwork is property of 1776 effects.

If using PCB's for commercial building please rename your project so there is no confusion to the end user and it will be clear I offer no official support to those you sold your pedal to :)