The Tasmanian Devil

Design By Erik Vincent

Using easy-to-find components, including common opamps, this design embodies the classic sound of a ProCo RAT but with choices of how to handle the clipping section; Metallica’s Kill’Em All, Early Foo Fighters, and Nirvana’s Nevermind. This pedal uses the standard 3 pot control of Volume, Tone, and Distortion. The layout is small enough to fit into a 1590B enclosure.

The LM308, how important is it...really...?

Probably the hardest aspect of building a pedal based on the Proco Rat is finding that LM308 chip since it has been long out of production. Well, hopefully with the information I’m about to arm you with, that will no longer be the case! Here’s the TLDR version: The audible difference between the LM308 (out of production “end of life”) and the OP07 (still in production) is...well...rats droppings. Consider the OP07 as a very valid options when building your Tasmanian Devil and be sure to order your OP07 from the webshop when you order the Tasmanian Devil PCB!

For the full story on the LM308 check out these videos:

Test your LM308, Real or Fake?
https://www.youtube.com/watch?v=Up4E7AFgJ5E

Proco Rat LM308 Shoot Out
https://www.youtube.com/watch?v=l0qVnxUJwsw

Link to the OP07:
# Bill of Materials, Stock Tasmanian Devil

<table>
<thead>
<tr>
<th>Capacitor</th>
<th>Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 22nF (film)</td>
<td>R1 1M</td>
</tr>
<tr>
<td>C2 1nF (film)</td>
<td>R2 1M</td>
</tr>
<tr>
<td>C3 30pF (ceramic)</td>
<td>R3 1K</td>
</tr>
<tr>
<td>C4 100pF (ceramic)</td>
<td>R4 47</td>
</tr>
<tr>
<td>C5 2.2μF (Electrolytic)</td>
<td>R5 560</td>
</tr>
<tr>
<td>C6 4.7μF (Electrolytic)</td>
<td>R6 1K</td>
</tr>
<tr>
<td>C7 4.7μF (Electrolytic)</td>
<td>R7 1.5K</td>
</tr>
<tr>
<td>C8 3.3nF (film)</td>
<td>R8 1M</td>
</tr>
<tr>
<td>C9 22nF (film)</td>
<td>R9 10K</td>
</tr>
<tr>
<td>C10 1μF (film)</td>
<td>R10 47</td>
</tr>
<tr>
<td>C11 100μF (Electrolytic)</td>
<td>R11 100K</td>
</tr>
<tr>
<td>C12 100nF (film)</td>
<td>R12 100K</td>
</tr>
<tr>
<td>C13 1μF (film)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diode</th>
<th>Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1 1N4148</td>
<td>Clip SPDT Switch</td>
</tr>
<tr>
<td>D2 1N4148</td>
<td></td>
</tr>
<tr>
<td>D3 1N4001</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LED</th>
<th>Potentiometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED1 T1-Red LED</td>
<td>Volume 100ka (16mm)</td>
</tr>
<tr>
<td>LED2 T1-Red LED</td>
<td>Tone 100ka (16mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transistor/JFET</th>
<th>IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 J109</td>
<td>U1 OP07CP / LM308</td>
</tr>
</tbody>
</table>
**PCB Spacing**
The Tasmanian Devil PCB is spaced for 1590B sized enclosures or larger

**Pot Spacing**
The Tasmanian Devil PCB mounted potentiometers are spaced for Alpha 16mm potentiometers.
Modifications
Following is a couple of worthwhile modifications that can be applied to the Tasmanian Devil.

Capacitors
To get more bass out of the Tasmanian Devil, slightly increasing the value of C6 up to no higher than 10μF should accomplish the task.

Resistors
To get more bass out of the Tasmanian Devil, making R5 smaller will accomplish this task. Try not to go below 100 ohms. Be careful when changing R5 AND C6 will also add gain to the circuit.

Clipping Tone Filters and Gain (Resistors and Capacitors)
C4 in parallel with the Feedback Resistor section of the opamp creates a low pass filter. To figure out what frequencies it is cutting off, use this formula.

\[
f = \frac{1}{(2 \pi VR \cdot C_4)}
\]

\[
f = \frac{1}{(2 \pi \cdot 100,000 \cdot 0.0000000001)}
\]

\[
f = \frac{1}{(0.0000628318)}
\]

\[
f = 15923.508 \text{ Hz (roughly 16KHz)}
\]

When the distortion knob is maxed out, the distortion's cut-off minimum frequency is 16 KHz, which softens the distortion a bit.

Also present on the Inverted/Negative input of the opamp are two active resistor/capacitor filters via R4 & C5 and R5 & C6. The first high pass RC filter by R4 and C5 can be calculated this way:

\[
f_c = \frac{1}{(2 \pi \cdot R_4 \cdot C_5)}
\]

\[
f_c = \frac{1}{(2 \pi \cdot 47 \cdot 0.0000022)}
\]

\[
f_c = \frac{1}{(0.000649680812)}
\]

\[
f_c = 1539.217 \text{ Hz}
\]

The second high pass RC filter by R5 and C6 can be calculated this way:

\[
f_c = \frac{1}{(2 \pi \cdot R_5 \cdot C_6)}
\]

\[
f_c = \frac{1}{(2 \pi \cdot 560 \cdot 0.0000047)}
\]

\[
f_c = \frac{1}{(0.01653732976)}
\]

\[
f_c = 60.469 \text{ Hz}
\]

So, harmonics below 1.5 KHz will drop 20dB / decade and ones lower than 60 Hz will be dropped even further at 40dB / decade. This means bass notes will be cut before the clipping action, making the low end less clipped. This is how one can selectively distort some frequencies but not others.

Diodes (Hard Clipping Switch)
Changing the diodes to different types will give a different sound of how the signal is hard-clipped. Traditionally, fast silicon switching diodes, such as the 1N4148 or 1N4448 would be used for D1-D2, while changing D1-D2 to Germanium 1N34A’s or silicon 1N457’s will have a less harsh clipping. The second hard-clipping set are traditionally LEDs, such as the red ones found in the Turbo RAT. Different LEDs have different forward voltages and different clamping properties which can also alter the hard clipping slightly, so changing to a larger forward voltage blue LED will be a hair different than red ones.
OpAmps
Though changing the OP07 to an actual LM308 single opamp would be a more accurate representation of the “original ProCo RAT” sound they are practically tonally identical. Also note that other single opamp chips can also be used, such as the TL071, which may add more gain to the clipping section due to its limiting characteristics.

JFETs
Q1 is only for an output buffer stage, it can be substituted for a J201 or a 2N5458 will little-to-no change to the sound.
Testing Your Effect

Using alligator clips or soldering directly, wire your effect as in the following...

EFFECT PCB

INPUT
(6.35mm Stereo Socket)

OUTPUT
(6.35mm Mono Socket)

Input and Output Sockets

Pay close attention to the lugs of your sockets. Look at them side on so that you can distinguish the sockets individual layers. For instance the tip lug is connected to tip contact. The stereo jack looks the same as the socket below except it has an extra lug and contact for “Ring”.

Tip Lug

Tip Contact

Sleeve Lug

Sleeve
Offboard Wiring Diagram

Using a non-switched Miniature DC Jacks and 2 Mono Jacks