Escape Artist

Pedalboard-Friendly Ducking Reverb

Overview

Who doesn't love the glorious wash of a reverb after hitting a big chord? The only issue with it is that the wash can also turn the attack of new notes to mush, making it hard to get any real definition of the notes being played. That can be desirable at times, but other times you want that big wash of reverb on the tails of the notes but a more present, dry attack. The Escape Artist allows for precisely this. It's a pedalboard-friendly reverb circuit with an envelope follower and optical compression of the reverb signal so that you can dial in just the right amount of detail for new notes while allowing the wash of a heavy reverb to fill the space between notes. Add to that the ability to have mono or stereo out and the Escape Artist becomes a very compelling solution for adding space without sacrificing clarity.

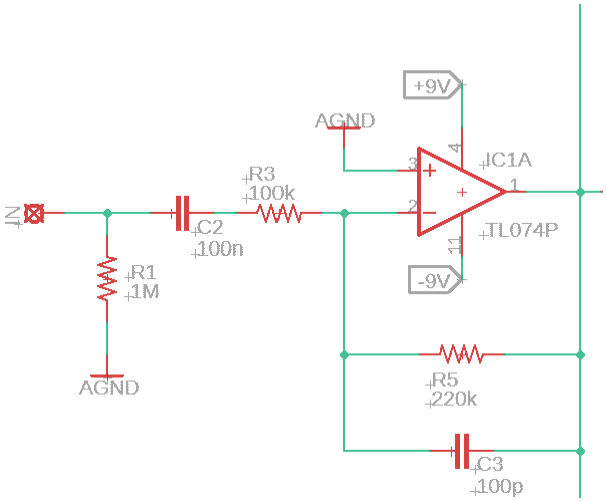
Ducking of effects using a side chain input is a common studio technique that allows key signals to be more forward in the mix. It gets used on vocals, snares, kick drums, and more all the time. However, this technique is not used much in a pedalboard environment, which I think is a gross oversight. So come on and let's dive in to this deceptively simple circuit!

How it Works

At its most basic level, the Escape Artist can be broken up into two parts: a reverb effect circuit and an envelope follower/optical compressor. The reverb comes courtesy of the Belton BTDR-3H. You may have noticed that I've never used one of these before. That is primarily due to cost. I like to try to make my circuits budget friendly and a $20-ish single component is not something I want to use very often. However, at this point I have designed many a reverb without one, and the other circuitry required for the ducking of the reverb necessitates a very compact reverb solution, which the brick is.

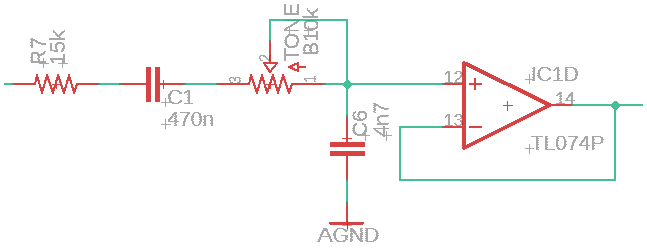
The actual effect portion of the circuit is pretty straightforward. The Belton datasheet shows example circuits. I pulled only the essential parts from the datasheet and coupled it with the envelope follower/compression scheme of the Disappearing Act and added in a couple other features that I thought were useful to make the Escape Artist what it is.

The first block is the input buffer. The input buffer is NOT unity gain for a couple of good reasons. First, the amplification in the input buffer means that the first stage of the envelope follower doesn't have to have as much gain. Secondly, the Belton brick does well when being driven a little more than with a unity gain guitar signal. The input buffer should look very familiar to those who have seen the Disappearing Act.



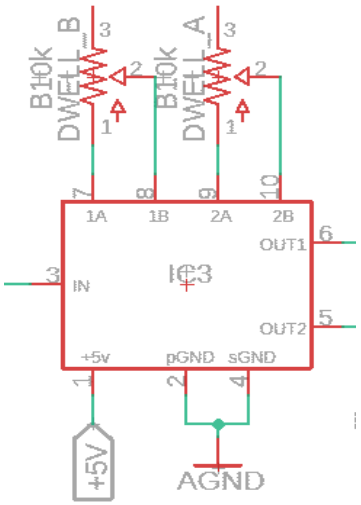
Escape Artist Input Stage

The signal from the input stage is then conditioned prior to the Belton brick. This consists of a fixed high pass filter to remove very low frequency components and a variable low pass filter that acts as a tone control for the reverb signal. Tone controls are typically placed after reverb generation, but because of the optical compression scheme, putting the tone control first is more reliable and easier to do. This tone control is a classic low pass tone control that is then buffered so that it has a low output impedance.



Escape Artist Pre-Reverb Tone Stage

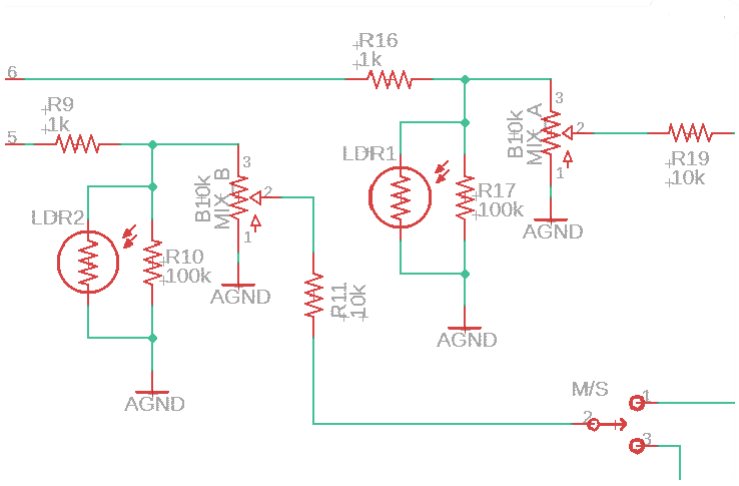
After shaping the reverb input signal, we generate the actual reverb using the Belton BTDR-3H. The motivation for using this as opposed to the BTDR-2H is that the 3 is able to produce stereo reverb out and it has adjustable dwell, both of which were things that I thought easily justified the extra $3 in cost. The reverb dwell time is governed by a dual gang 10k linear potentiometer, as shown in the datasheet.



Escape Artist Reverb Stage

Now that we have our reverb outputs on pins 5 and 6 of the brick, we implement the optical compression of the reverb signal by using two fixed resistors and an LDR to create a voltage divider. When the signal level or sensitivity controls are low enough, there will be no compression of the reverb. With higher signal levels or sensitivity, the signal will get attenuated courtesy of the LDR.

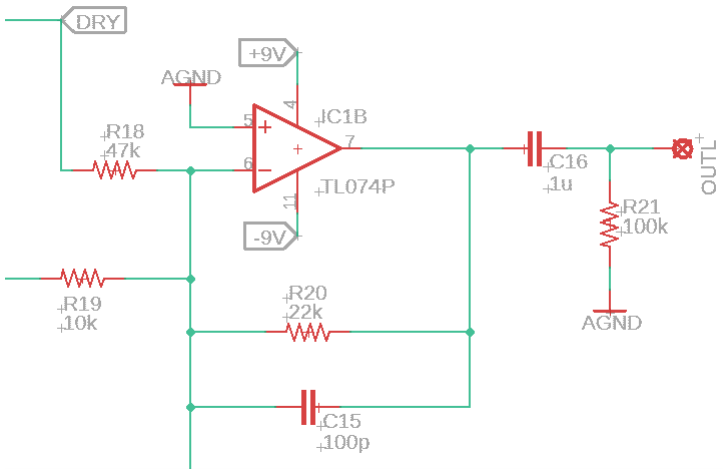
The output of the compression section goes to the mix control. The mix control is fairly standard, being followed by a fixed resistor that sets that signals gain when combined with the summing amplifier/output buffer. Notice that the output of the second reverb signal goes to an SPDT switch that governs whether the output will be stereo or mono. For mono, both reverb outputs are summed with the dry signal and output to a single output. For stereo operation, the reverb outputs go to separate output buffers which are sent to separate output channels.



Escape Artist Optical Compression and Mix Stage

The final portion of the audio signal path is the summing amplifier/output buffer. You will notice that the input resistors for the two signals are very different. This is for two reasons. First, the dry signal comes from the input buffer, which has amplified the signal roughly 2x. We need to knock it back down so that it isn't creating a huge dry signal boost when the circuit is engaged. Thus the 47k/22k resistor ratio for this signal. Next, because I wanted to make sure that at full mix the circuit can deliver a huge reverb wash, I chose the 10k input resistor so that it will add another 6 dB of boost to the reverb signal. This allows for a final signal that is positively dripping with spring reverb goodness.

The rest of the components are bog standard and the values have some flexibility, but the values shown are a great place to be.



Escape Artist Output Buffer

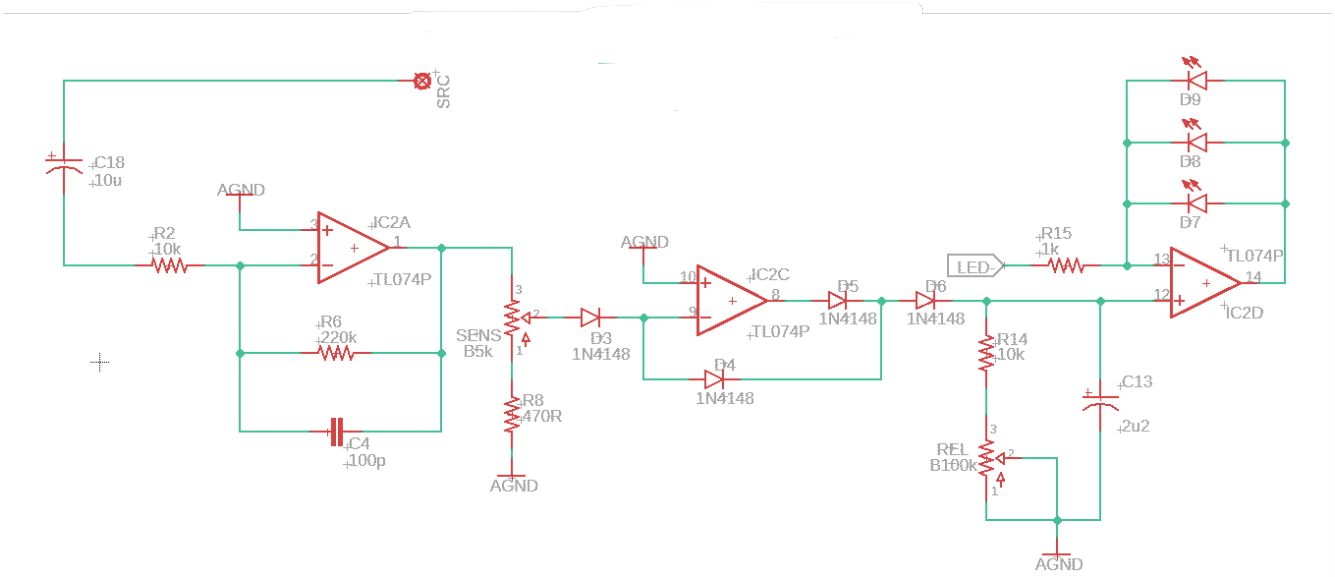
Even though we have discussed the audio signal path, we aren't going to have any ducking if we don't trigger the LDR with an LED. To do this, we need an envelope follower of some kind. There are many choices here, but I decided to go with an opamp-based full wave rectifier. This consists of a first amplification stage that boosts the input signal such that we can get a robust rectified voltage at full sensitivity. This is a simple inverting opamp stage with a fixed gain.

After the fixed gain stage, the Sensitivity control is a simple voltage divider before the rectification happens. With the Sensitivity control all the way up, the resulting rectified DC voltage will be strong enough to drive the LED to full or near-full brightness. With the control rolled down, the DC voltage will be low enough so that it won't drive the LED fully. In fact, with the sensitivity control rolled all the way down, there will be no ducking action at all and the Escape Artist will act like a reverb. This is handy if you are trying to rock out to Miserlou or something similar.

The rectification of the signal happens with the second opamp stage using diodes that make is to that voltage swings can't be negative and so that we see a DC signal with plenty of rippling on it. Cap C13 helps to smooth out these ripples, but it also works in conjunction with R14 and the Release control to determine the time constant of the envelope follower. With the Release control all the way up, R14

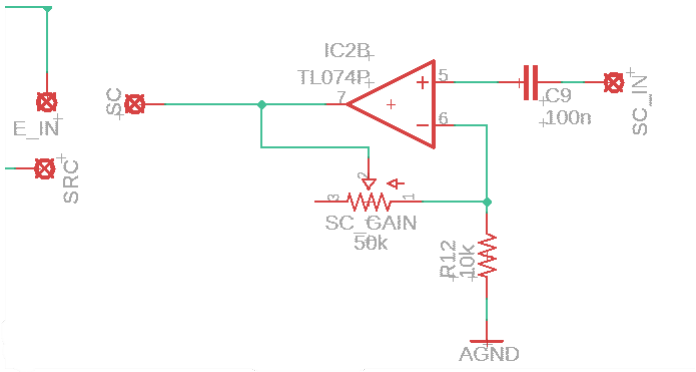
presents a low-ish resistance path to discharge C13, resulting in a fast time constant and the LED responds virtually instantaneously to signal level changes. With the release control all the way down, C13 discharges more slowly and it takes more time for the LED to dim, resulting in a longer time constant of the ducking action. The LED's are driven by the third opamp stage and are placed in the negative feedback loop. This is what drives the LED's brightness. The LED brightness can be tweaked some by adjusting R15, but if it goes too low, you can burn out the LED by sinking too much current and that's a bad day, trust me. If you really want to tweak the LED brightness, I suggest looking at the first opamp stage.

Note that there are three LED's in the feedback path. Only D8 and D9 are used for the optical compression of the reverb signal. I added D7 as a visual indicator of how much compression is happening, since doing it just by ear with various guitars can be a little finicky. A visual indicator means you can adjust the sensitivity and release for a given guitar quickly and accurately.



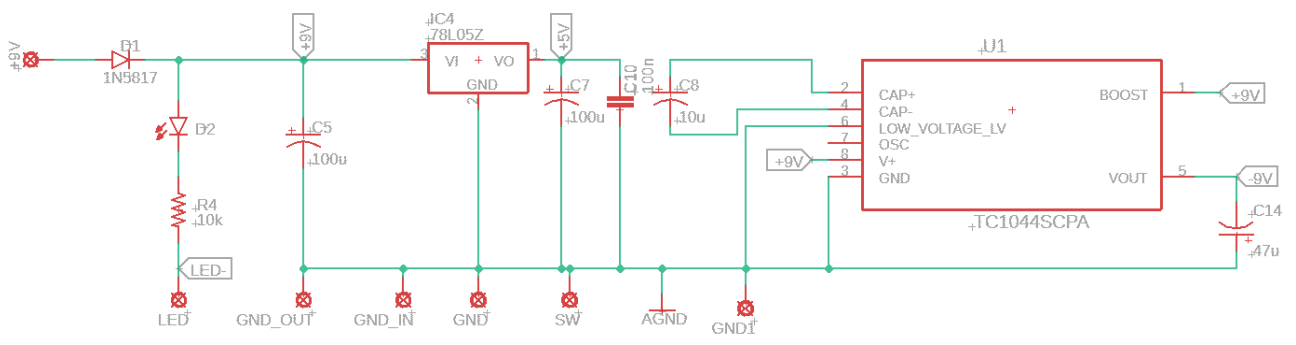
Escape Artist Envelope Follower

The original Escape Artist design concept essentially ended there, but I ended up with an opamp left over, so I decided that I could do something fun. Because reverb is frequently used in effects loop of an amplifier, it often has noisy signals coming into it courtesy of drive pedals, preamps, or other effects. Since we don't necessarily want that noise to trigger any ducking of our reverb signal, I decided to re-purpose the previously unused opamp as a side chain input. Side chaining is very common in studio conditions and, in this application, allows for cleaner triggering of the optical compression/ducking. This allows one to use the signal directly from the guitar to trigger the ducking of the reverb effect, eliminating false triggering from boosted noise floors. This side chain control also has an adjustable input sensitivity control so that the range of the sensitivity control can be optimized for both the side chained and non-side chained cases. Use of the side chain can be set with a switch, jumpers, etc.



Escape Artist Side Chain Input

The final piece to the puzzle here is the power supply section. It uses a DC-DC charge pump IC to produce the +/-9V necessary to run the opamps and produce higher headroom as well as a 5V regulator to power the brick. Nothing else here should be a surprise to anyone.



Escape Artist Power Section

BOM

The BOM below is the list of parts I used for mine along with quantities. All parts are through hole with resistors being 1/8W except for R15, which is 1/4W. I got everything except for the Belton brick from Tayda.

Part	Qty.	Notes
470R Resistor	1	
1k Resistor	1	1/4W
10k Resistor	7	
15k Resistor	1	
22k Resistor	2	
47k Resistor	2	
100k Resistor	5	
220k Resistor	2	
1M Resistor	1	
Current Limiting Resistor	1	
100pF Capacitor	4	
4.7nF Capacitor	1	
100nF Capacitor	3	
470nF Capacitor	1	
1uF Ceramic/Film Capacitor	2	
2.2uF Electrolytic Capacitor	1	
10uF Electrolytic Capacitor	2	
47uF Electrolytic Capacitor	1	
100uF Electrolytic Capacitor	2	
B5k Potentiometer	1	16mm PCB Mount
B10k Potentiometer	1	16mm PCB Mount
B10k Potentiometer	1	16mm PCB Mount Dual Gang
B50k Potentiometer	1	16mm PCB Mount Dual Gang
B100k Potentiometer	1	16mm PCB Mount
50k Trimmer	1	Sidechain gain control
SPDT Toggle Switch	1	On/Off
1N5817	1	
1N4148	4	

LED, Red Diffused	3	Ducking, sensitivity indicator
LED	1	Bypass indicator
KE10720 LDR	2	
BTDR-3H	1	
TL074	2	
TC1044	1	
78L05	1	5V regulator
Enclosure	1	
1/4” input jack	2	
DC power jack	1	
4PDT footswitch	1	

Schematic

The schematic for this project is a little big to be legible on a single sheet, so it is included as a separate image in the project documentation folder.

Build Notes

Here are some things I noted from building the Escape Artist that might be helpful to you. Please read this section to make sure you don't go through excessive frustration.

Enclosure Size/Drilling

The Escape Artist fits nicely into a 125B, though it will take up virtually all of the space inside. Larger enclosures can be used to accommodate the various optional jacks.

Jacks

Whatever jacks you use for in/out and power in 125B are fair game; no restrictions here. I used box jacks because those are my standard. While only jacks for input and output are required, jacks for side chain input and side chain through can be optionally added. If you are going to use those jacks, use a larger enclosure.

Side Chain

It is possible to have the ducking of the Escape Artist to use a side chain input. To allow for this, just connect another jack to the SC_IN solder pad at the bottom right of the PCB. Connecting the ground and positive of the side chain input jack to another jack will provide side chain through functionality. This side chain through will be unbuffered, which means it won't interfere with fuzzes, wha's, or other impedance-sensitive effects.

Miscellaneous Tips

I recommend using no bezel for the 5mm sensitivity indicator LED. The placement of the sensitivity pot legs and the corner of the brick will interfere with any kind of a bezel, which I learned first hand.

Put some kind of electrical tape on the back for the Mix pot. Because it is a dual gang pot, a typical plastic dust seal won't work and the Mix pot will short out to connections below. I had to completely disassemble my prototype after having my tape get punctured by the solder joints...

If you want the ability to have mono and stereo true bypass available, or if you will use a single TRS output jack, I recommend a small toggle switch by the footswitch that will kill the dry through to the right stereo output. This way, if you plug in a TS cable, you won't be shorting your bypassed signal, which I have done with mono in/stereo out effects in the past. The tiny toggle switch works well, as does a slide switch. Alternatively, you can just use dedicated left and right output jacks, but that will necessitate a larger enclosure.

In Closing

The Escape Artist is a great way to bring some fun studio tricks to your pedalboard. Enjoy!