Echoplexus

PT2399-Based Tape-Style Delay

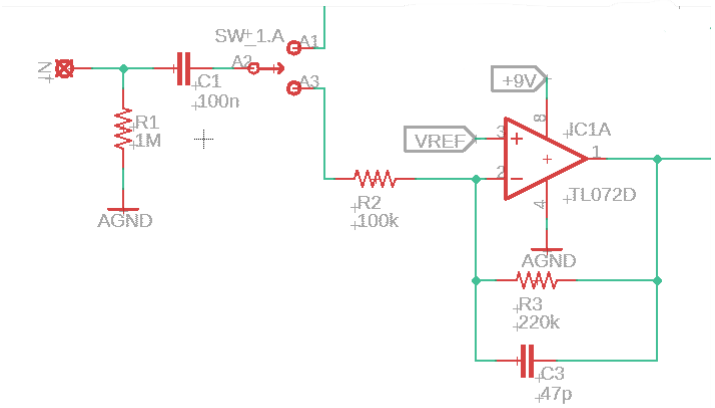
Overview

I know, I know. Another PT2399 delay. Big whoop. But wait, I promise you'll like this one! The Echoplexus is a PT2399-based take on the legendery Echoplex EP-3, complete with discrete JFET preamp. But that's not all. The preamp can be switched out for an opamp-based preamp if you prefer. There is also a “wet kill” function that will allow you to use the preamp on it's on and run the pedal in buffered bypass mode for that mojo and give you trails functionality. The filtering has been painstakingly tailored to get that “tape” sound where both high and low end are rolled off on the repeats. Additionally, a modulation section with two different frequencies is implemented to provide modulation at frequencies that correspond to the physical tape motion of the EP-3. In short, it's not the run-of-the-mill “analog” voiced PT2399 delay. So stick around, you just might like what you see.

How it Works

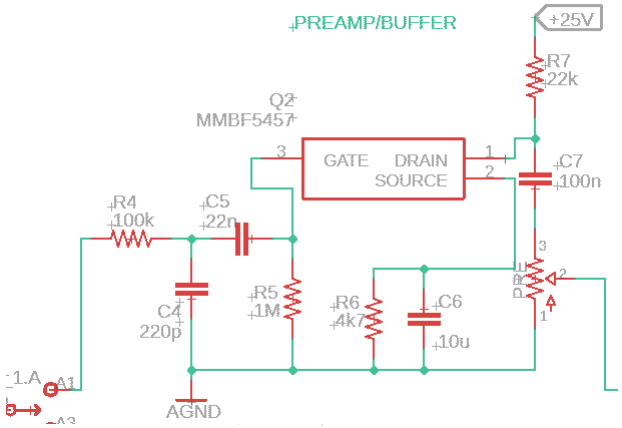
In concept, the Echoplexus is pretty straightforward: input section, PT2399 delay section with modulation, summing amplifier to output. However, I tried to get some good old fashioned tone out of this thing.

The input section allows for selection of one of two different input sections. The first is a standard opamp buffer stage. This is done because I had an extra opamp and sometimes you just want two different options for tonal color. This buffer is pretty standard.



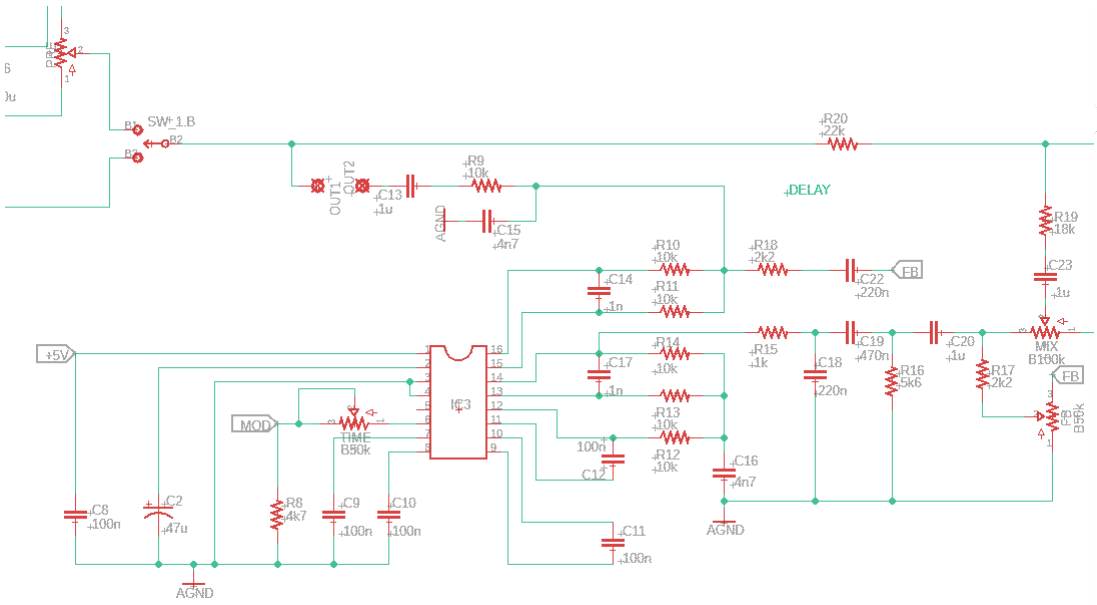
Echoplexus Input Buffer

One of the more characteristic parts of the EP-3 is the discrete preamp. This is based around a TIS-58 JFET, which is no longer in production. However, the 2N5457 is a pretty good substitute. Another part of the preamp is the fact that it is run at a relatively high voltage of about 25 volts. I decided that this was necessary to make this a more convincing implementation, so a TC1044 DC-DC converter is used to boost the voltage up to 25V (more on this in the power section discussion).



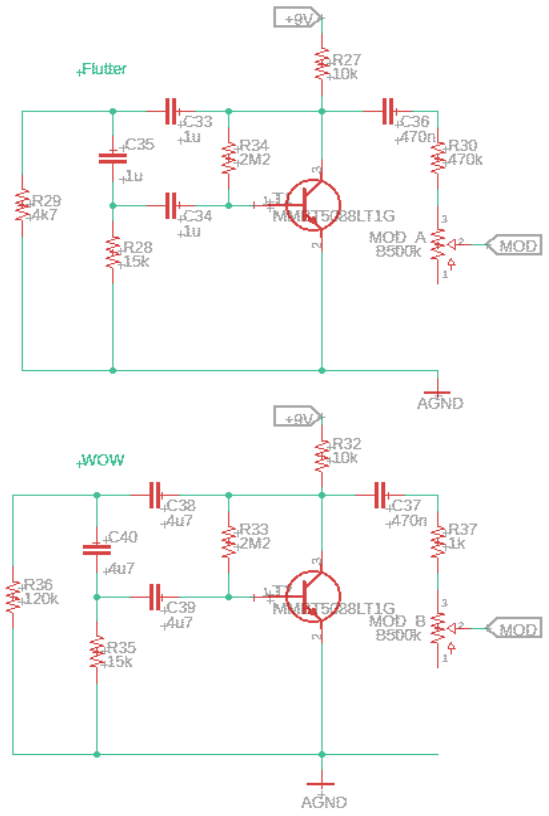
Echoplexus Discrete Preamp

Next up is the delay stage. For the most part, this is pretty standard. It has multifeedback low pass filters for both input and output and time control is the standard implementation. However, once the repeats are generated, the go through additional filtering that helps roll off some of the low frequencies in addition to some high frequencies. You will notice the presence of cascaded RC low pass and high pass filters prior to going to mix and feedback controls. The feedback values prior to summing at the PT2399 input are also not the usual. When using caps to roll off some of the low frequency, the overall signal level gets weaker and therefore a smaller resistor is necessary to be able to get feedback that will just get into self oscillation when maxed out.



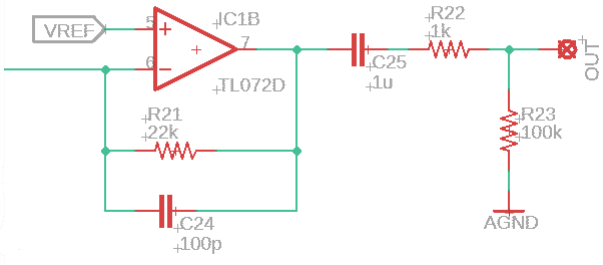
Echoplexus Delay Stage

Now that we have delay, we need to create our modulation. In a tape delay, there are a couple of different frequencies that can come into play on a machine that is not well adjusted. One is the “wow” associated with slightly assymetric rotation of the tape, resulting in low frequency content. Then there is “flutter” associated with the tape physically fluttering due to an incorrect amount of tension in the tape. Finally, there is “scraping flutter”, a very high frequency phenomenon of the tape scraping over the heads and vibrating, much like a violin bow over the strings. Scraping flutter tends to introduce small amounts of signal content in the 3 kHz region and is not actually a pitch modulation of the delayed signal. For this reason, I decided to use two LFO's, one for wow and one for regular flutter. These LFO's are the simple single transistor topology for simplicity and space savings. They are at fixed frequencies. The flutter frequency is approximately 4 Hz, which corresponds to the tape speed of the Echoplex. The wow frequency is about 0.4 Hz.



Echoplexus LFO

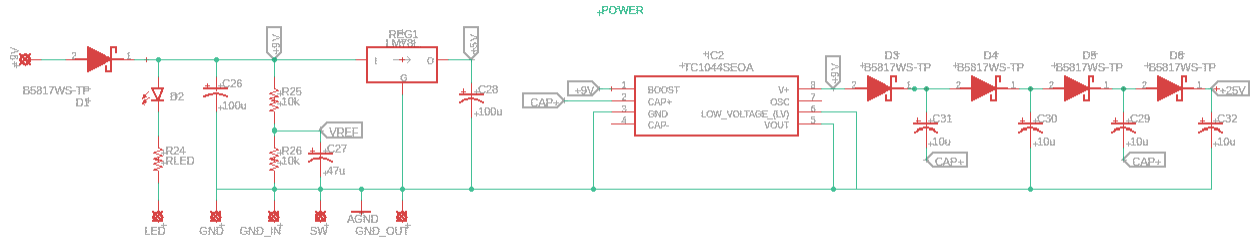
The remainder of the signal path is the summing of dry and delayed signal and output buffering. This is pretty standard stuff, so not much to discuss here.



Echoplexus Output Buffer

Finally, we have the power section. Because there is a charge pump section, there is a little more going on here. We have the standard polarity protection, filter cap, reference voltage, and 5 V regulator that is common to PT2399 delays. However, we also have the TC1044 set up in charge pump mode. For regular voltage doubling, two diodes and two electrolytic caps are used. However, we can continue to replicate the diode/cap configuration to continue to increase the voltage. Note that the voltage will not completely double or triple, due to the forward voltage drop of the diodes. Normally, Schottky diodes would be used here to minimize that drop, but because I want about 25V and not 27, I decided to go

ahead and use regular silicon diodes. They each have a forward voltage drop of about 0.7V, so with four of them, we get V = (3*9V) – (4*0.7V) which gives us just over 24V. I have used charge pumps with multiple stages to get them over 50V from a 9V input supply, but do note that the current capacity drops in proportion to the voltage multiplication, so you can't run anything that requires high amounts of current.



Echoplexus Power Section

BOM

The BOM below is the list of parts I used for mine along with quantities. The project is available in both through hole and SMD, though I built mine in SMD.

Part	Qty.	Notes
1k Resistor	3	
2k2 Resistor	2	
4k7 Resistor	3	
10k Resistor	10	
5k6 Resistor	1	
15k Resistor	2	
18k Resistor	1	
22k Resistor	3	
100k Resistor	3	
120k Resistor	1	
220k Resistor	1	
470k Resistor	1	
1M Resistor	2	
2M2 Resistor	2	
100k Trimmer	1	CLR for bypass LED
47pF Capacitor	1	
100pF Capacitor	1	

220pF Capacitor	1	
1nF Capacitor	2	
4.7nF Capacitor	2	
22nF Capacitor	1	
100nF Capacitor	7	
220nF Capacitor	2	
470nF Capacitor	3	
1uF Ceramic/Film Capacitor	7	
4.7uF Ceramic/Film Capacitor	3	
10uF Ceramic/Film Capacitor	1	
10uF Electrolytic Capacitor	4	
47uF Electrolytic Capacitor	2	
100uF Electrolytic Capacitor	2	
B50k Potentiometer	2	16mm PCB Mount
B100k Potentiometer	1	16mm PCB Mount
B500k Potentiometer	1	16mm PCB Mount
B5817WS	5	
MMBF5457	1	
MMBT5088	2	
LED	1	
78L05	1	
TL072	3	
TC1044	1	
PT23299	1	16 pin DIP
Enclosure	1	
1/4” input jack	2	
DC power jack	1	
3PDT 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 Echoplexus that might be helpful to you. Please read this section to make sure you don't go through excessive frustration.

Enclosure Size/Drilling

The Echoplexus fits nicely into a 125B. The board is a little too wide to fit a 1590B. There is plenty of room for the placement of the footswitch.

Jacks

Whatever jacks you use for in/out and power in 125B are fair game; no restrictions here.

Preamp tuning

There are two aspects of the preamp that can be tuned. First is the spectral content. I started by following the EP-3 service manual schematic to a tee, but found that it had a thinner tone than I wanted. I changed the source bypass cap to a 10 uF cap, which gave better bass response to my ear.

The second aspect is the output level. The gain of the preamp is highly dependent on the source bypass cap. With the 10 uF cap, you get more bass response but also much more output. This can be useful if you want to replace the level trimmer with a pot and have the ability to use the preamp as a boost. However, if you go with the vintage-correct value, the output level will drop and maxing out the trimmer will give roughly unity gain, maybe a little more.

Modulation Range

While a dual gang pot is required, the specified 500k value allows for the range to go from very little if any modulation to pretty in your face. If you want to always have more modulation, a 250k dual gang pot will work fine.

In Closing

While few people will confuse this pedal with a real EP-3 when listened to carefully in isolation, it cops the tone rather well and allows for a fun variation on PT2399-based delays. I hope you have as much fun with it as I had designing it!