The Reverberatory

Dual Delay and Reverb Workstation

Overview

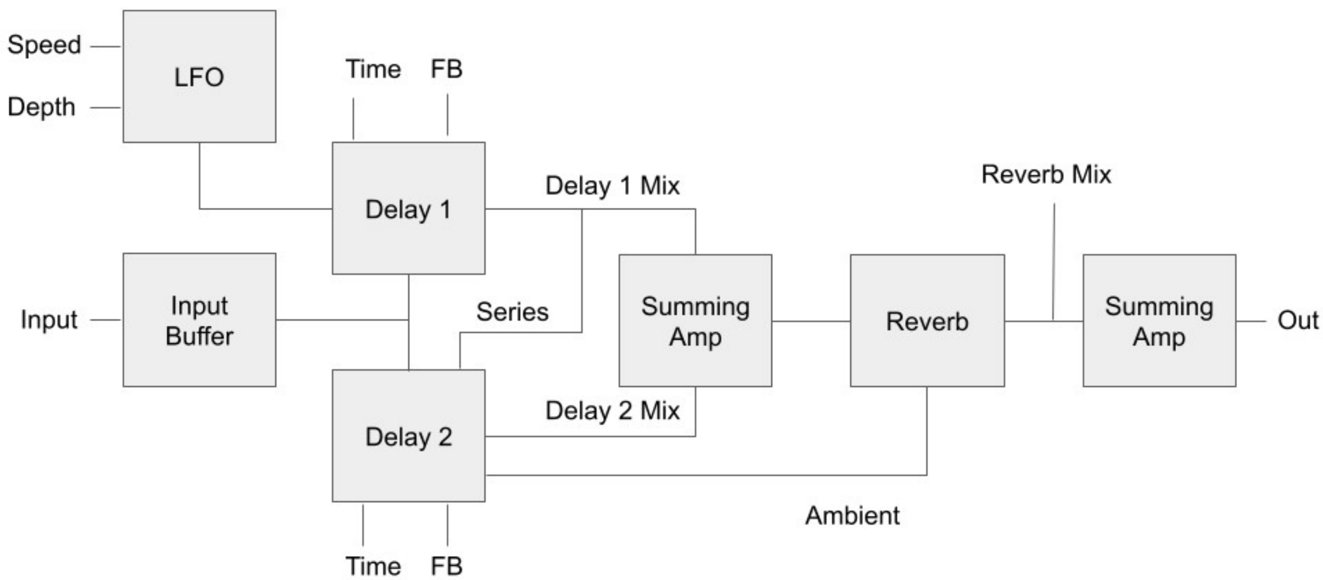
Every once and a while, an idea presents itself to me that I feel I have to do, even if I'm not sure it's a great idea. The Reverberatory is one such project. I had the idea of a dual delay and reverb that had some features that would allow for the creation of everything from simple delays to ambient washes and sonic mayhem. I had diagrammed it all out and had the schematic almost done when I happened upon the Earthquaker Devices Disaster Transport Sr, which I had not heard of before. This now discontinued pedal is also a dual delay and reverb pedal, but the structure was a little different than the Reverberatory. However, there was one idea that I totally stole, and that was the “series” delay control. With that addition, it brought the number of control pots up to 11, which is a new personal record for me. However, each control does something very useful and specific.

How it Works

The Reverberatory is built on six (6!) PT2399 chips. I've never seen a schematic for the EQD Disaster Transport Sr, but I'm all but certain the reverb is provided by a Belton brick, as is the case with many of their pedals, especially the earlier designs. It's a great solution, but I prefer not to use bricks or FV-1 for cost reasons. That and I have a whole boatload of PT2399 chips on hand. Besides, it's not like I needed to shrink board space with a circuit that has 11 controls.

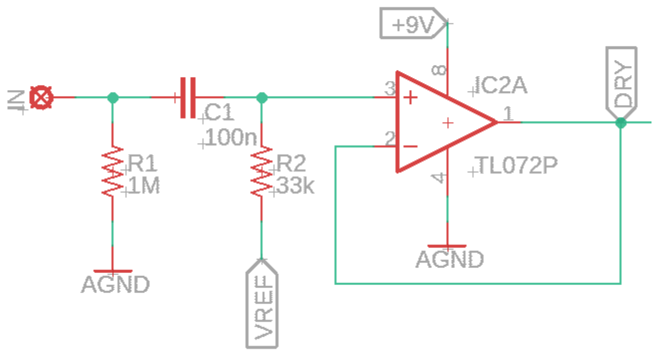
Before I jump into the schematic, it's helpful to understand the high level concept of the design. Below is a block diagram of the functional blocks in the pedal. First, we have an input buffer like on all my other delay/reverb projects. After the buffer, there are two delay stages that are both fed by the input. Each delay stage has controls for time, feedback, and mix. The first delay stage also has the ability to have modulated repeats through the use of a simple, single-opamp LFO design. It has controls for speed and depth. The second delay stage has a fun trick of its own that I will discuss shortly.

The delay outputs are then summed with the dry signal using a typical summing amplifier configuration. The output of this summing amplifier goes to the input of the reverb stage. The reverb circuit is a lightly modified version of my T60 Reverberator design, with fixed size and dwell controls. This utilizes 4xPT2399 and roughly a bajillion 100 nF capacitors. The output of the reverb is then sent to a mixing amplifier with the dry delay signal before going to the output. The reverb output also goes to an “Ambience” control that sends some of the reverb out signal into the Delay 2 feedback input, which creates some large ambient wash effects when used in moderation. When cranked up, you can get all kinds of self oscillation and other weird sound effects.



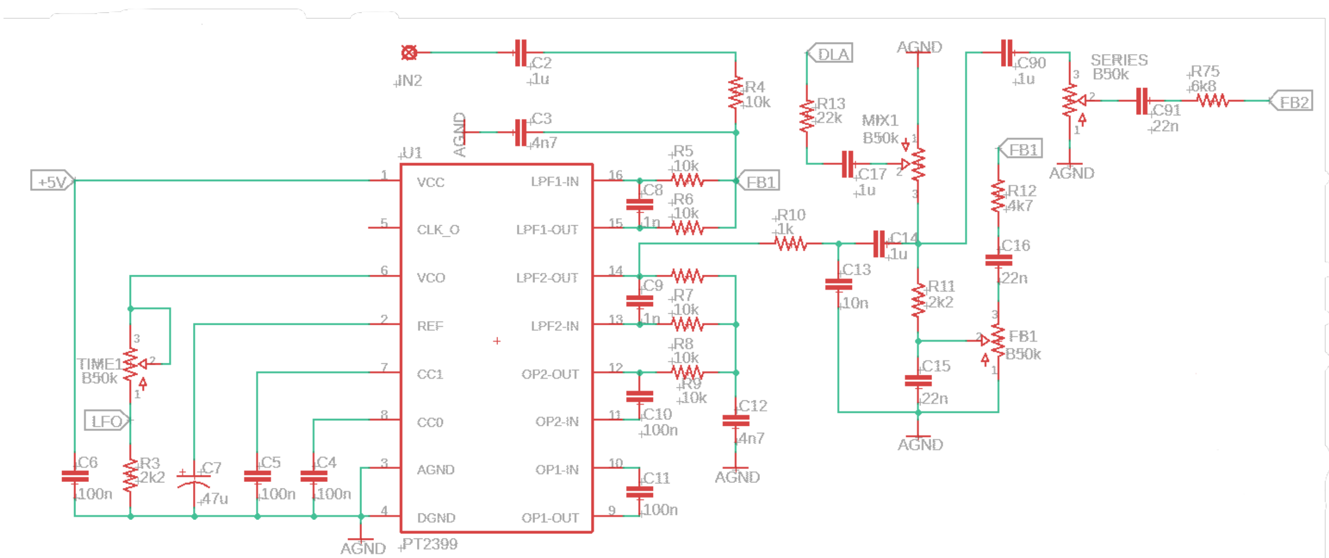
Reverberatory Block Diagram

The input buffer is not my typical buffer. You will note that it is a unity gain, non-inverting opamp buffer, as opposed to the traditional inverting opamp input buffer. The reason for this has to do with the fact that we are combining dry signal with our effects. Because we need to sum the dry signal with the delay and then the dry+delay with the reverb, we need to ensure that we aren't combining any of the effects out of phase. So the first buffer is non-inverting so that after the necessary inversions for the two summing amplifiers, the dry signal will still be in phase with the effects. If we made the input buffer inverting, then we would get the dry signal summed with the effects causing comb filtering, which we don't want.



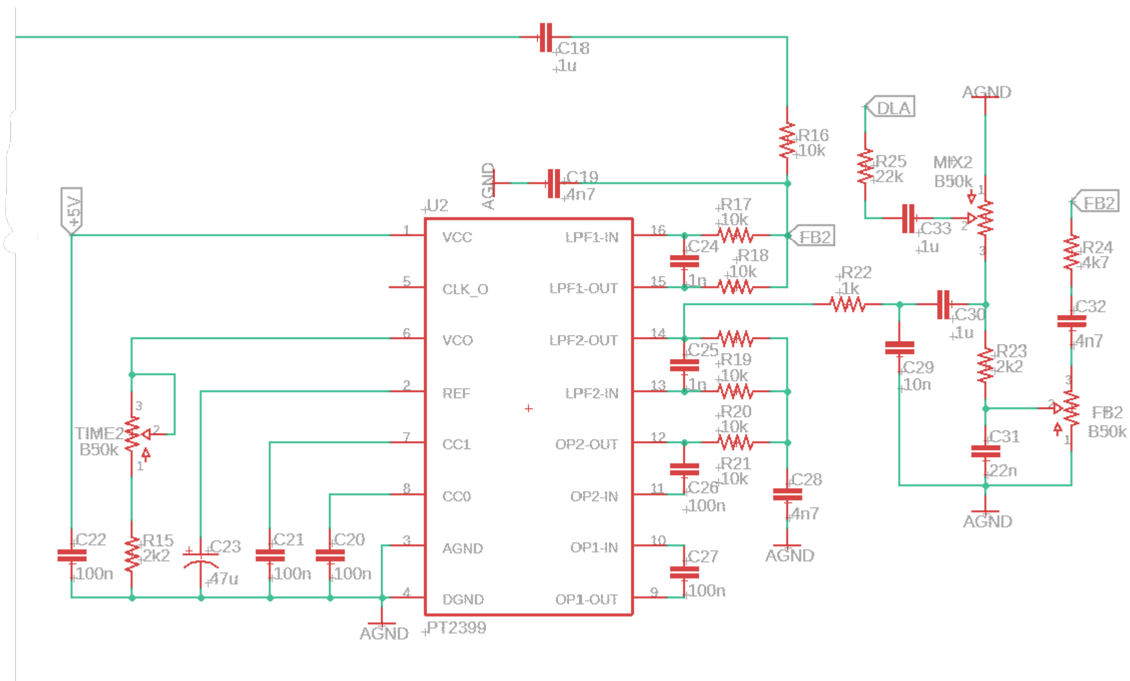
Reverberatory Input Buffer

Next up is the first delay stage. This is configured as a very standard PT2399 delay stage with the typical multifeedback input and output filters. The most notable differences with this stage are the presence of the LFO signal on the pin 6 output and the added “Series” control that takes the output of stage 1 and feeds it into the input of stage 2. Another thing you will see is the presence of two sets of solder pads. These allow for cutting the input to the delay stages, which allows you to disable delay while still having the trails, or tails, decaying out when switched off. These can be wired either to a single DPDT switch for turning of delay with a single control, or to two SPDT or SPST switches to allow for enabling/disabling each delay individually. Instructions for these scenarios are in the Build Notes section.



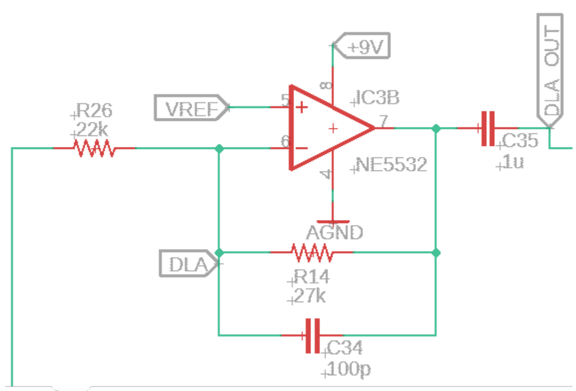
Reverberatory First Delay Stage

The second delay stage is also a fairly typical PT2399 delay stage, with the notable difference being that it takes as an input to the feedback loop the “Ambient” control, which is a portion of the reverb output signal. This will cause a delayed and reverbed signal to get delayed again, which will create a big wall of repeats that are delayed/reverbed/delayed/reverbed/etc.



Reverberatory Second Delay Stage

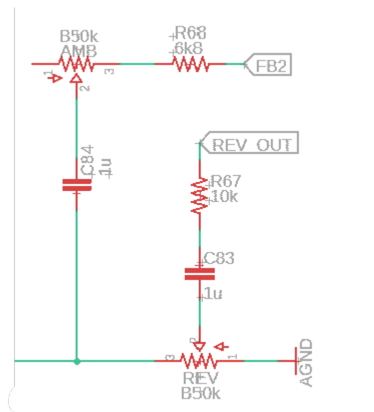
The two parallel delay stages then have their outputs summed with the dry signal. This is the first of the aforementioned two inverting summing amplifier stages. This is a pretty straightforward buffer.



Reverberatory Delay Output

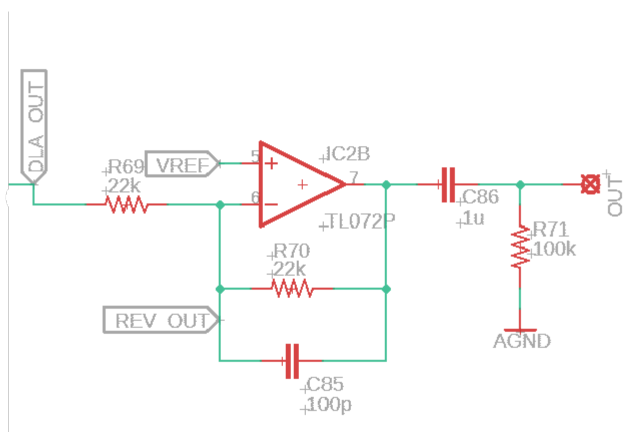
The delay output is now fed to the input of the reverb section of the circuit. Because the topology is the same as the T60 Reverberator, we won't go into it in depth here. I refer you to the documentation for that circuit for more info. However, do note that the delayed signal output can be cut using the two supplied solder pads to allow for turning off reverb with trails.

Once the signal has been reverberated, it goes to two separate controls. Reverb controls the mix of the reverb signal with the delay output and dry input. The “Ambient” control determines how much of the reverb signal gets fed back into the delay stage 2 feedback loop. It is a very large value because smaller values can result in bleed where you can't get rid of the reverb signal in delay stage 2 entirely.



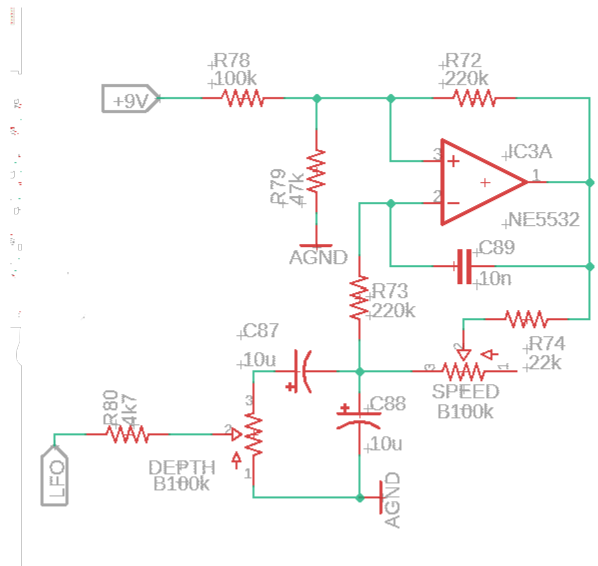
Reverberatory Reverb Controls

Now that we have all of our effects generated, we have one final summing amplifier to sum everything together prior to the output. This is another standard inverting opamp summing amplifier.



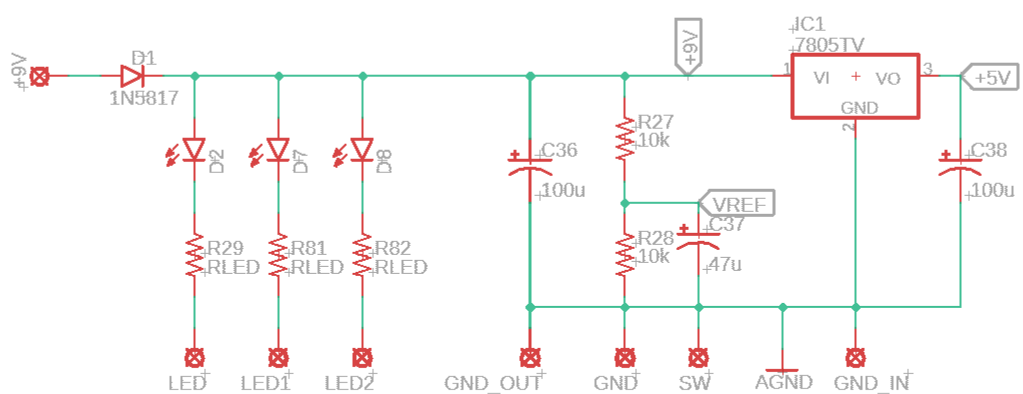
Reverberatory Output Buffer

The modulation for the first delay stage is accomplished using a simple LFO that I basically stole from the Little Angel chorus and then modified to suit. I was searching for a single opamp LFO due to my desire to minimize the size of components in this already monstrous device.



Reverberatory LFO

The power section for the Reverberatory is really bog standard stuff. The 9V in goes through a reverse polarity protection diode, we create a reference voltage for the opamps, and we regulate a 5V line for the PT2399's. Some filtering caps round out the design. However, the one thing that should be noted is that the 5V regulator **MUST** be able to provide 1A. A smaller, TO-92 78L05 that provides 100mA max simply won't cut it here with all the PT2399's sucking up power. The 1A rated regulator does not need to be heatsinked, but it will get a little warm to the touch.



Reverberatory Power Section

BOM

The BOM below is the list of parts I used for mine along with quantities. All parts were purchased from Tayda. Note that **all resistors are 1/8W** metal film due to space constraints. You're going to need a

LOT of 100 nF caps. Just sayin'. Also, because there are so many caps, I recommend film caps, though the 1 uF caps will likely need to be MLCC for space reasons.

Part	Qty.	Notes
1k Resistor	2	
1k2 Resistor	1	
2k2 Resistor	4	
3k3 Resistor	1	
4k7 Resistor	4	
6k8 Resistor	3	
8k2 Resistor	2	
10k Resistor	23	
12k Resistor	11	
15k Resistor	1	
18k Resistor	1	
22k Resistor	13	
27k Resistor	2	
33k Resistor	1	
47k Resistor	1	
68k Resistor	5	
100k Resistor	2	
220k Resistor	2	
1M Resistor	1	
100pF Capacitor	2	
1nF Capacitor	7	
1.5nF Capacitor	2	
4.7nF Capacitor	9	
10nF Capacitor	3	
22nF Capacitor	3	
100nF Capacitor	32	
470nF Capacitor	4	
1uF Ceramic/Film Capacitor	19	
10 uF Electrolytic Capacitor	2	
47uF Electrolytic Capacitor	7	
100uF Electrolytic Capacitor	2	

B50k Potentiometer	9	16mm PCB Mount
B100k Potentiometer	2	16mm PCB Mount
1N5817	1	Voltage polarity protection
LED	3	Bypass LED
White LED	4	MUST be white
LM7805	1	1A rated capacity
NE5532	1	
TL072	1	
PT2399	6	
Enclosure	1	1590XX
1/4” input jack	2	
DC power jack	1	
3PDT footswitch	1	See build notes

Schematic

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

Build Notes

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

Enclosure Size/Drilling

The Reverberatory is massive. There's no other way of saying it. It is sized to fit a 1590XX in the vertical, or portrait, orientation. The drilling, particularly for input/output jacks, needs to be rather precise. The board with controls mounted will take up nearly the entire interior of the enclosure.

Jacks

Most jacks should work for this project, though I recommend measuring carefully after you have drilled for the controls.

Trails Mode

The Reverberatory can be used in the standard way where input and output go to the 3PDT footswitch. If a single footswitch control will be used, the REV and DLA solder pads should be jumpered.

If trails mode will be used, there are two options. One is to have the buffer always on and have two (or 3, if you have separate delay 1 and 2 switches) separate footswitches, one for reverb and one for delay. This will make the pedal a buffered bypass. The other option is to have a 3PDT switch for global bypass and then individual footswitches for reverb and delay, resulting in 3 (or 4) switches.

In Closing

This project was a lot of fun. It's a monster of a circuit, but it can do some really fun stuff. If you are a delay/reverb junkie like me, it's well worth a build.