Placid Power Supply

User Manual

Revision 1.0a

For PCB Revision 2.0.1

Twisted Pear Audio

Overview

The Placid is a shunt regulated DC power supply designed for low noise and excellent line and load regulation. It is primarily intended for 5-15V supplies using transformers with 5-15VAC secondaries. It is important your read the manual prior to trying to use this power supply. Make sure you understand how to adjust the output voltage and current before you do anything else. You could easily destroy something if you do not know what you are doing. So be careful, and read the schematic and this manual. This is not a difficult circuit to use, but it is not trivial so be careful. You can learn a lot from the schematic. Take advantage of it. There is no shame in asking questions. Please ask them before you do anything you might regret later.

Default Configuration

The supply is designed to be fed by a single secondary (or two in parallel) of a transformer. For the purposes of this manual we will assume you are aiming for 5.5VDC output and ~350mA per rail max load current. This is the approximate load of a Buffalo II with AVCC module. The kit included parts are suitable for this setup. If you need another current/voltage you may need to change some parts. This is covered later. We will also assume you have a transformer with a 7VAC secondary rated at 15VA or more.

The 350mA supply current configuration should fit projects like powering VD of the Buffalo II very well. It is very easy to configure the supply for other current demands by simply adjusting a few part values. As always you can ask us for help you have a special need. If you need more or less current I will explain how to achieve it.

First Steps

The simplest and most flexible way to setup the supply is by using the provided variable resistors.

Populate the PCB as you normally would stuffing components from shorted to tallest. Mount the TO-220 transistors to the large heat sinks prior to soldering them.

IMPORTANT!!! Prior to applying power or even wiring the transformers adjust the CCS pot so that the resistance across the CCS R position (VR1) is about 100Ω. Then adjust the V_{OUT} pot (VR2) to close to the maximum resistance which should be ~10K. It is easy to check the resistance of the pots by measuring the resistance across the pads of either R1 for VR1 or R2 for VR2 . Be careful adjusting the potentiometers. Do not turn the adjustment screws beyond their stops.

Once you have completed the above steps, you should leave the output of the supply unconnected to any load. Now connect it to the transformer secondary at AC1. Then apply power and you should see some nice glowing LEDs and no smoke. You will need to adjust the output voltage next. Adjust the potentiometer (VR2) for V_{OUT} until the voltage at the output terminals is as desired. For this example ~5.5V

Now adjust the CCS pot (VR1) until the measured voltage across R8 is ~ 0.35V. The Placid is now ready to supply current of up to 350mA.

You are now ready to connect the supply to your load. Power down, connect it to the load, and then power up. Now re-check the output voltage. There should be no voltage sag. If there is some you may need to increase the output current. The output current is calculated as **Voltage across RE divided by value of RE** where RE is R8. The supplied value for R8 is 1Ω making the calculation pretty easy. Every millivolt across R8 is 1 milliamp of supply current.

Now you are ready to fine tune the current sources. In the case of the Buffalo II VD supply and most other Twisted Pear Audio digital modules 50-60mA of current headroom (the amount of current shunted by the shunt element) is a very good operating point. It is very easy to adjust and measure the amount of current being shunted. This is current not used by the load. To measure the shunted current you simply carefully measure the voltage across R3 which is 1Ω. With the load powered and operating adjust VR1 and carefully measure the voltage across R3. Adjust until this voltage is between .050VDC and .075VDC. Congratulations. You should now have your Placid running well.

Some Helpful Setup Tips

The voltage reference (V_{REF}) used to regulate the supply normally is ~4V and in my prototype I am measuring 4.15VDC. A little variation is normal because of variances in the LEDs and JFETs and supply voltages after rectification. This is why you must measure the actual voltage at the output before you proceed to the use the supply. The more gain you use the more the V_{REF} variation will be apparent. The LED V_{REF} will vary a small amount with temperature. For this reason I tend to adjust the voltage to just under my desired maximum output voltage. The V_{REF} will tend to decrease voltage a bit as it warms so it will start slightly high and then settle down little as it warms to a steady state. So if I know I want a absolute maximum V_{OUT} of 5.5VDC I will set the supply Vout to around 5.45VDC when warm to allow for the slightly higher value at startup. In most circuits the little bit of extra startup voltage will not be an issue, but if it is in your case you now know how to manage it.

The formula for the output voltage is this: $V_{OUT} = V_{REF} * (1+(RF/RG))$ Where RF is R7 and RG is R2.

Based on that here are some possible configurations using a fixed resistor to set V_{OUT}. These assume the feedback resistor value is 1K. When using a fixed resistor for output voltage you would omit VR2. You may need to try a few values of R2 to get the voltage you want. You can use VR2 temporarily to find that value, and then remove and replace it with R2.

RG(R2)	**Approximate V_{OUT}**
Open	~ 4V
4.02K	~5V
2K	~6V
1K	~8V
511Ω	~12V

If you require more than 12V you will probably want to increase R7. See the formula given earlier.

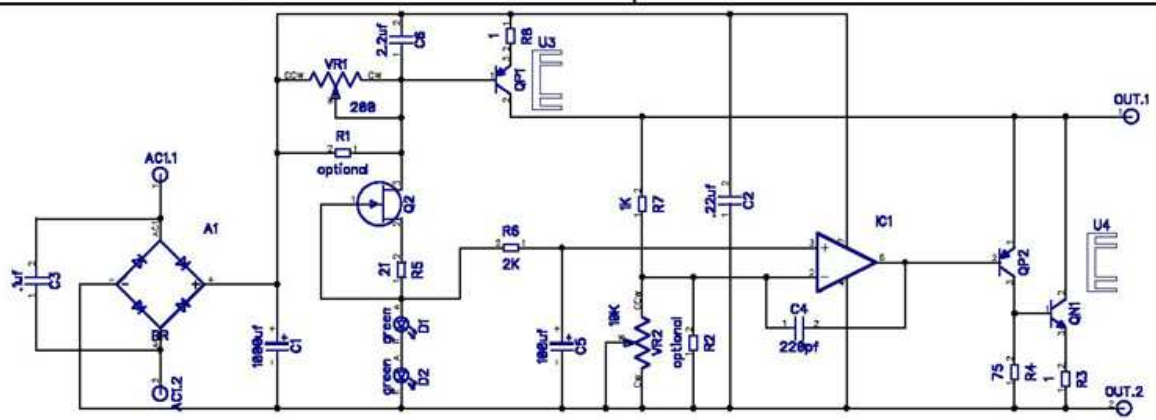
A Few Advanced Tips

Advanced users who want to do something other than the default configuration should understand the provided schematic. If you don't understand something then please ask for help before you go forward. If you do understand the circuit well enough to be confident in changing things around a bit then here are some tips.

If you need to supply > 500mA you will want to make sure you use adequate heat sinks. If the transformer is correctly sized this will not be too hard.

You can also substitute fixed a resistor for the CCS potentiometer. Just do the calculations before hand or measure the resistance across the potentiometer with it in place temporarily and after your happy with the current you can remove the potentiometer and substitute a .25W metal film fixed resistor at R1.

If you need a 3.3V supply you can replace one of the V_{REF} LEDs with a silicon diode. This will give you a V_{REF} of about ~2.65V.



VRef as shown will be close to 4V
Vout = VRef * (1 + (RF / RG))
Where RF is R7 and RG is R2

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