Zane Gyorko
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5193-6096

Report – Power Supply

Introduction

The purpose of this module is to explore two methods for creating a 5V power supply supplying different levels of current to a load. There are two main circuits to be designed for this module. The first of which is a 5V power supply using a Zener diode to regulate voltage. The second circuit will use a voltage regulator IC to drive a load at 5V. The circuits will both utilize a resistive load to demonstrate a supply current of 25mA and a supply current of 100mA.

Design

For part 1 of this module, the following circuit was utilized.

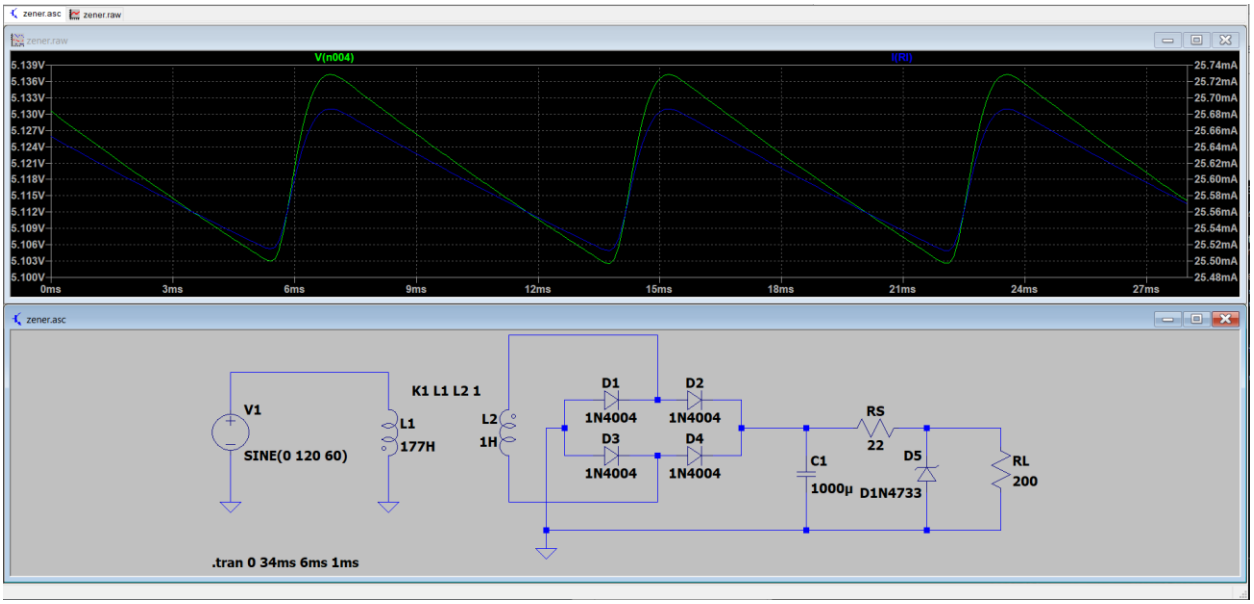


Figure 1. LTSpice schematic 5.1V @ 25mA

A transformer with an output of 9VAC was used to step down the line voltage coming out of the wall. At the secondary of the transformer, a full bridge rectifier was used consisting of 1N4004 diodes. After the rectifier stage, a 1000uF smoothing capacitor was placed in parallel. After the smoothing capacitor, a current limiting series resistor is placed before the Zener diode. In parallel with the Zener is the 200 Ohm load to give an output current of 25mA at 5.1V. As shown in the simulated output above, the voltage and current readings are well within the required range.

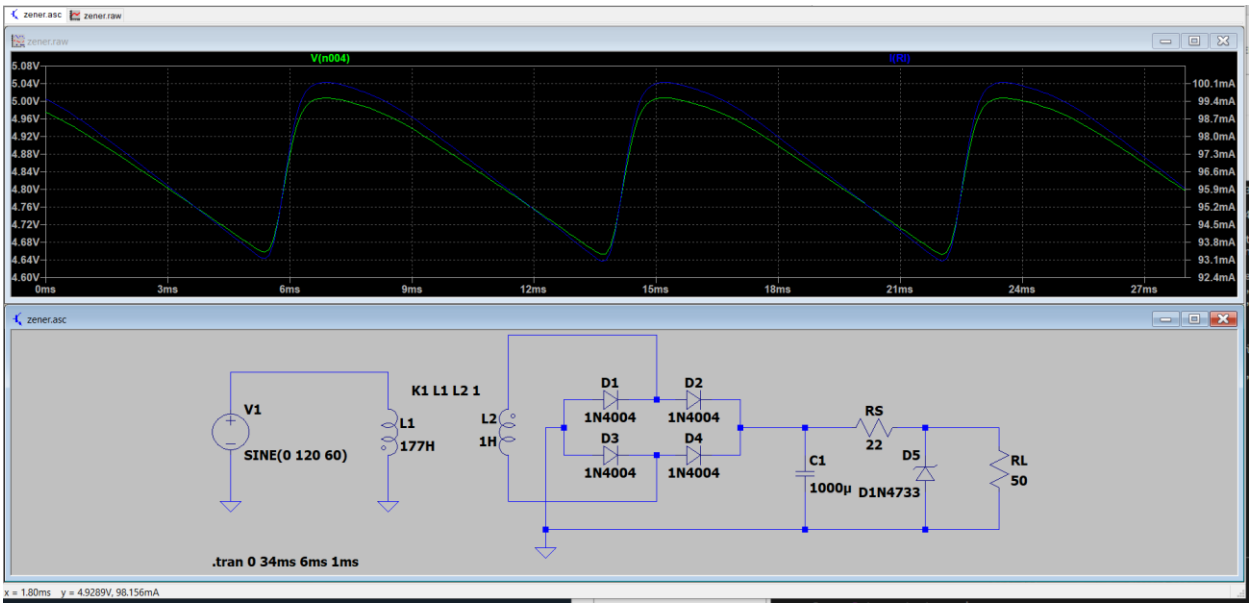


Figure 1. LTSpice schematic 5.1V @ 100mA

As shown in figure 2, when the load is reduced to 50 Ohms to pull 100mA, there are some issues. For most of the time, the Zener is unable to reach breakdown because the load is pulling too much current. For a few brief moments, the circuit is able to supply about 5V at 100mA, but the current going to the load is generally too much for the Zener to handle.

The next circuit uses a LM2940 5V regulator IC to accomplish the same set of tasks. The LM2490 was unavbailable inside of LTSpice, so a similar chip was used in its place.

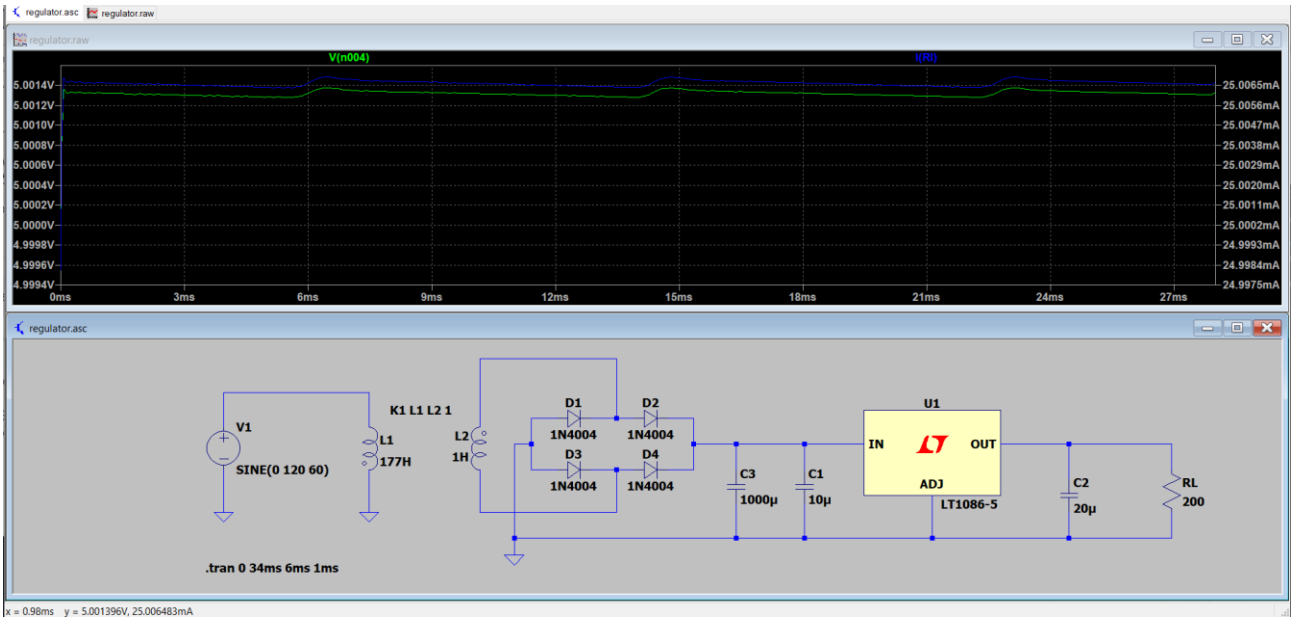
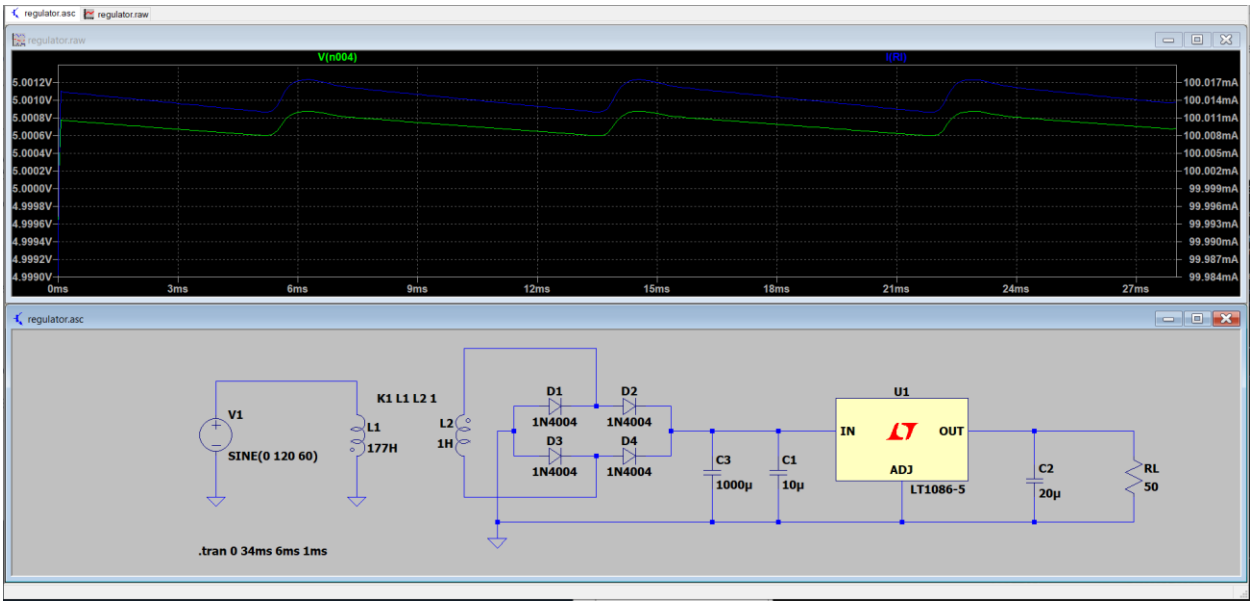


Figure 3. LTSpice schematic 5V @ 25mA

The circuit built for part 2 is largely the same as part 1, with the primary difference being the IC in place of where the Zener was previously. Additional capacitors are also added to maintain stability. As shown, the IC does an excellent job of regulating to 5V at 25mA.



When increasing the supply current to 100mA, the regulator still performs very accurately and meets the specification for this module.

Design 1 - Power Supply - Bill of Materials				
Description	Quantity	Price/Part	Part Number	Source
Resistor - 22 Ohms - Through-Hole	1	$ 0.31	EP1WS22RJ	https://www.digikey.com/en/products/detail/te-connectivity-passive-product/EP1WS22RJ/8566619
Resistor - 50 Ohms - Through-Hole	1	$ 2.91	41F50RE	https://www.digikey.com/en/products/detail/ohmite/41F50RE/823198
Resistor - 200 Ohms - Through-Hole	1	$ 0.10	WHC200FET	https://www.digikey.com/en/products/detail/ohmite/WHC200FET/678865
Capacitor - 10uF - Through-hole	1	$ 0.28	ESC106M035AC3AA	https://www.digikey.com/en/products/detail/kemet/ESC106M035AC3AA/2712570
Capacitor - 20uF - Through-hole	1	$ 2.02	EGXF401ELL200MJ30S	https://www.digikey.com/en/products/detail/united-chemi-con/EGXF401ELL200MJ30S/6204618
Capacitor - 1000uF - Through-hole	1	$ 1.19	108KXM035M	https://www.digikey.com/en/products/detail/illinois-capacitor/108KXM035M/5410867
Rectifier Diode	4	$ 0.09	1N4004	https://www.digikey.com/en/products/detail/rectron-usa/1N4004/13573399
Voltage Regulator	1	$ 2.54	LM2940T-5.0	https://www.digikey.com/en/products/detail/texas-instruments/lm2940t-5-0/3701344
Zener Diode	1	$ 2.16	1N4733AP/TR8	https://www.digikey.com/en/products/detail/microchip-technology/1N4733AP-TR8/261312
	Total:	$ 11.87		

Conclusion

The design and implementation of this module was overall a success. During the live demo, after initially working within required specifications, the Zener diode circuit failed to perform its required duties and the series resistor and Zener diode were ultimately deemed to be burnt out. Fortunately, the demo was essentially complete by this point. Ultimately, the circuit designs demonstrated met all requirements for this module.