



ELECTRONIC DEVICES LAB 1: LINEAR POWER SUPPLIES AND REGULATORS

1. DC REGULATED POWER SUPPLY

Power supplies are essential for the operation of electronic devices and systems, as their primary function is to provide a stable DC voltage and current. Rectifiers act as AC/DC converters (Figure 1), utilizing diode characteristics to control the direction of current flow.

A capacitor filter minimizes voltage oscillations by eliminating high-frequency components from V_2 . Further smoothing is achieved through a voltage regulator circuit, which may include Zener-BJT configurations or dedicated integrated circuits (ICs) such as the LM7XXX voltage regulator series from National Semiconductors.

Short-circuit protection is a crucial design feature that prevents component damage. This protection can be implemented using relays, BJT transistors, or even Silicon Controlled Rectifiers (SCRs).

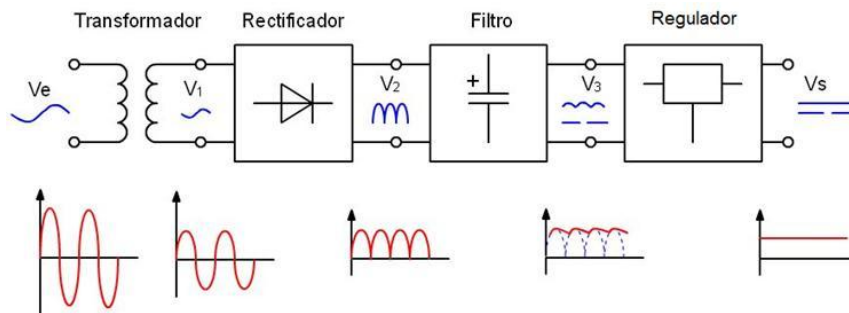


Figure 1. AC/DC converter block diagram (taken from <https://pcsinmisterios.com/2016/04/03/la-fuente-de-alimentacion/>)

2. ZENER DIODE

A zener diode is a heavily doped semiconductor device specifically designed to operate in reverse bias.

When forward biased, a silicon zener diode behaves like a standard rectifier, with a threshold voltage of approximately 0.7V.

When reverse biased, it allows a regulated reverse current with minimal variation in zener voltage.

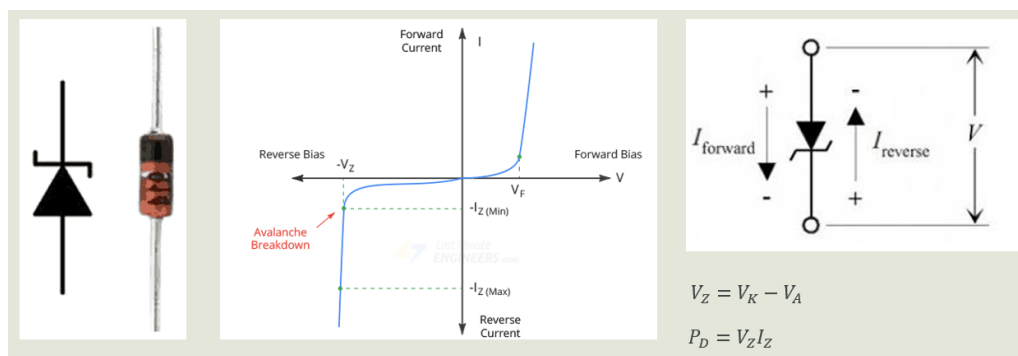


Figure 2. Zener Diode.



Avalanche Breakdown

This phenomenon occurs predominantly at voltages above approximately 5.6V. Also known as impact ionization or avalanche multiplication, this process begins when a strong negative bias is applied to the PN junction. The resulting electric field imparts sufficient energy to thermally generated minority charge carriers in the semiconductor, leading to continuous collisions that generate reverse current.

Zener Breakdown in Zener Diode

When the applied reverse bias voltage approaches the Zener voltage, the electric field in the depletion region becomes strong enough to extract electrons from their valence bands. These electrons, energized by the intense electric field, break free from their parent atoms. At the Zener breakdown region, a small increase in voltage results in a significant surge in electric current.

3. Assignment

- 3.1. Simulate and assemble the circuit shown in Figure 3, then explain the function of each component.
- 3.2. Simulate and assemble the circuit shown in Figure 4 and explain the function of each component.

Deliverables: Breadboard assemblies; IEEE report including memory calculations, theoretical foundations, simulations, measurements, conclusions, recommendations and bibliography.

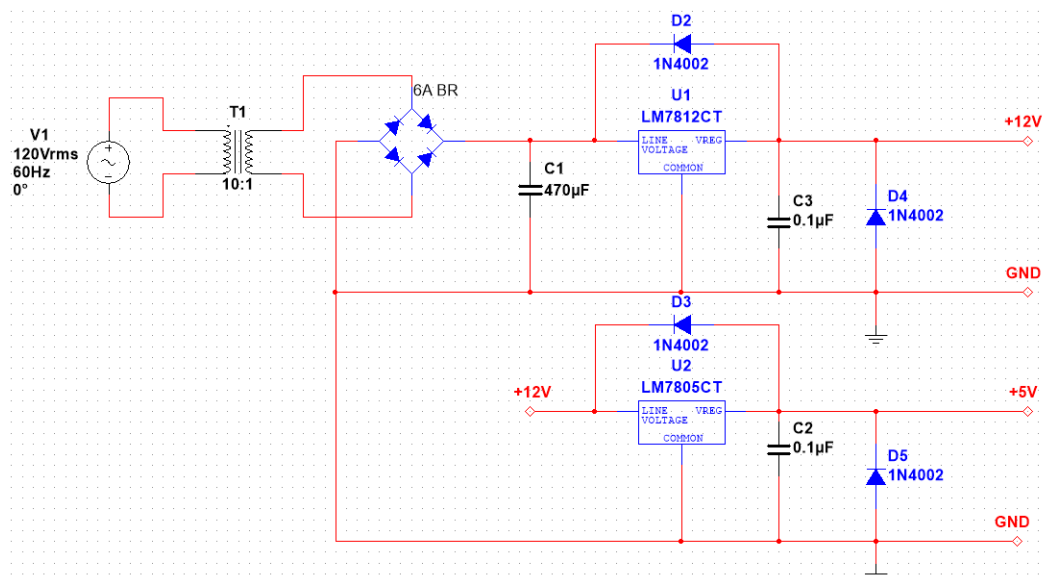


Figure 3. 12V/5V regulated power supply

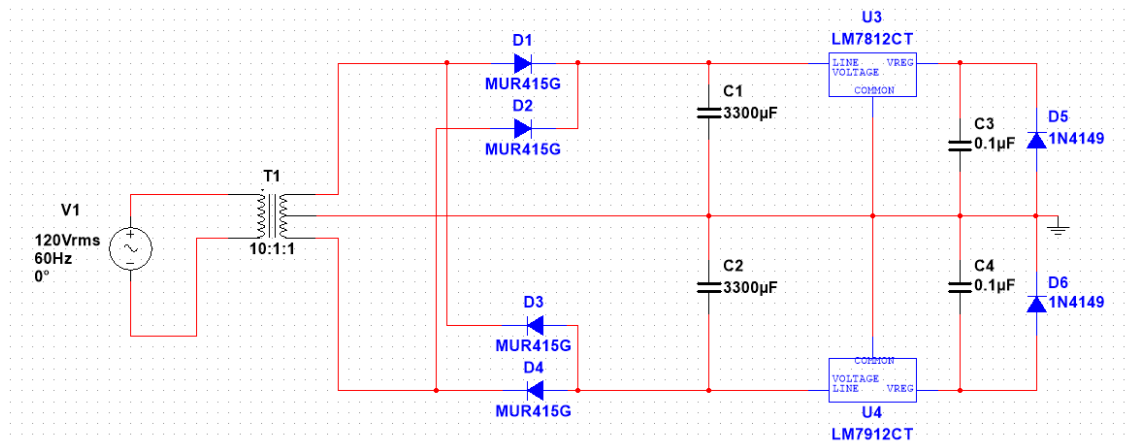


Figure 4. 12V/1A Dual power supply

REFERENCES

- Boylestad, R., & Nashelsky, L. (2012). Electronic Devices and Circuit Theory (11th ed.). Pearson.
- Floyd, T. (2017). Electronic Devices (10th ed.). Pearson.
- González, M. L. (2015). Dispositivos Electrónicos. Editorial de la Universidad Nacional de la Plata.
- Millman, J., & Halkias, C. (1995). Electrónica Integrada: Circuitos y Sistemas Analógicos y Digitales(9th ed.). Editorial Hispano-Europea.
- Neamen, D. (2011). Semiconductor Physics and Devices: Basic Principles (4th ed.). McGraw-Hill.
- Rashid, M. (2016).
- Microelectronic Circuits: Analysis and Design. Cengage Learning.
- Sze, S., Li, Y., & Ng, K. (2021). Physics of Semiconductor Devices (4th ed.). Wiley.