DEPARTMENT OF
Electrical and Computer Engineering

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Smart Ammo Box Power Supply

Sponsored by

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1. Objective

Design a bench power supply based on a “Shuttle” computer power supply that will fit into a .30 caliber ammunition box. The power supply will provide multiple fixed value DC outputs and at least one positive, variable value DC output.

2. Motivation

Who doesn’t need an inexpensive, portable power supply?

It is very easy to strip a perfectly good power supply from an obsolete computer. Some of the more compact power supplies will fit perfectly into a surplus steel ammunition (ammo) box [1]. They are rugged, easy to work with, and already have a nice handle for carrying.

With purpose-made adapters for the standard ATX connector [2], breaking out the various DC voltage supplies from the compact power supply is straightforward.

Adding an embedded computer and some relay circuits to be able to remotely control the voltage outputs via WiFi or Bluetooth would make it “smart”, and suited for applications like automated testing.

Why build a “dumb” DIY power supply when you can make it “smart”?

3. Suitable Background for the Project

Since this project requires working with enough power to seriously hurt or even kill someone, the team must have good, formal safety training. The confidence to work with power electronics is a must. Good experience designing custom PCBs is a benefit. The ability to design and prototype embedded control systems with wireless interfaces is required.

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4. Description

This project was inspired by the for an inexpensive, smart bench power supply. Making it portable was highly desired, but most of all the parts should be easily sourced and ideally reused from previous devices. Overall, this open0-source design should be as functional as possible, but easy for a do-it-yourself (DIY) person to build. Thus, documentation will be very important.

The overall build envelope (aka form factor) is fixed because of the requirement to use an ammo box. The use of the existing computer power supply as the based power supply also constrains the space it must occupy, and it's assumed it will be placed at the bottom of the box. This would make the rest of the build easier, and support having the power receptacle at the bottom of the case where it is easier to access and there is less danger of tipping the box, for example.

Careful planning for the location of various voltage outputs/terminals, adjustment knobs, switches, and display is needed. It's suggested that a CAD program be used for planning.

It is a "nice to have" goal to have wireless access to the power supply control and monitoring functions. However, since many candidate embedded processors have wireless capability, this is not that hard. What will be a challenge is to have decent signal propagation is the entire wireless module is contained in the ammo box. Thus, it's recommended a processor module with wireless capability have a connector for an external antenna.

To help constraint the design choices, it's suggested that entry level power supplies from companies like Rigol [3] and Siglent [4] be used as guides. From their functional and performance specifications, and their features, a suitable set of requirements for the design can be derived and reviewed with the sponsor.

The ammo box and power supply are shown in Figures 1 and 2.

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Figure 1 Surplus 0.30 caliber ammunition (ammo) box.

Figure 2 The power supply that fits the ammo box.

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5. Functional and Performance Requirements / Objectives

Overall, the desired goal is to create a power supply with specifications comparable to an inexpensive supply from Rigol [3] or Siglent [4]. In addition to those defined by the design team (see section 4 above),

1. Voltage accuracy must be no worse than ±0.03% of the display value with a 10 mV offset, both under load and unloaded.
2. Current accuracy must be no worse than 3% of the display value with a 10 mA offset, both under load and unloaded.
3. The voltage ripple factor should be less than 350 µVrms / 3 mVpp, which is about 12.
4. The current ripple should be less than 2 mArms
5. Assuming only one output is enabled[1], the amount of power delivered for a single fixed voltage like 5 and 12 VDC should be at least 90% of what the computer power supply can produce.
6. Assuming only one output is enabled[1], the amount of power for vartiable voltages should be at least 50% of what the computer power supply can produce.
7. A stretch goal is to make, or at least design for the supply to be programmable.
8. The power supply must provide fixed 3.3, 5, and 12 VDC outputs
9. There shall be a USB A socket that provides 5 VDC with at least 2A.

10. Specifications / Constraints

The final prototype design,

1. Must not exceed the build envelope defined by the ammo box by more than 15% in any dimension.
    a. An exception is made for any external antenna
2. Shall weigh less than 8 kg.
3. Shall not have any permanently attached cords or wires.
    a. That is, shall have receptacles, sockets, binding posts or similar for all connections.
4. May have an external antenna that is not longer than 10 cm.
5. Shall cost less than $CA100 for components.

[1] It's assumed that the other fixed output voltages are enabled, but not loaded.

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11. Information Resources / Links

References:

[1] Amazon, Fortress Metal Ammo Can, amazon.ca, https://www.amazon.ca/Fortress-Caliber-Metal-Ammo-Can/dp/B01M15XC2O?th=1 , accessed October 25, 2024.

[2] Amazon, 24/20-pin ATX DC Power Supply Breakout Board Module 24Pin ATX to terminal block, amazon.ca, https://www.amazon.ca/20-pin-Supply-Breakout-Module-Terminal/dp/B07KDX5CK8, accessed October 25, 2024

[3] Rigol, DP700 Series | Entry Level Benchtop Power Supplies, rigolcanada.com, https://www.rigolcanada.com/products/dc-power-loads/dp700/, accessed October 28, 2024

[4] Siglent, SPD1000X Series Programmable DC Power Supply, siglentna.com, https://siglentna.com/power-supplies/spd1000x-series-programmable-dc-power-supply/, accessed October 28, 2024

12. Prototyping / Testing Resources

The University of Alberta Electrical and Computer Engineering Department shall provide lab resources including test apparatus. It may provide a budget for materials. The sponsor may provide materials.

13. Intellectual Property Restrictions

Note: Public presentation and, hence, disclosure is a course requirement. All results and intellectual property created will be open source with a suitable license as determine by the team and the sponsor.

14. Contacts

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