DC Electronic Load

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**Concept of Operations**

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Concept of Operations

for

DC Electronic Load

Team <28>

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# Executive Summary

Obtaining accurate current and voltage readings from a power source is necessary for any power supply manufacturer. These manufactures need to test their supplies repeatedly in order to meet the quality and safety standards expected by their customers. In this project, we aim to provide an instrument to test a power supply with 25W power which could be used to test small supplies for accuracy. Most DC electronic loads currently on the market are rated for a much higher power rating than 25W, but these loads are typically bulky and expensive. The goal of this device is to be more portable and cheaper than most of the existing devices on the market today.

# Introduction

This document is meant to provide information about a project that will help testing power supplies that are designed for products that take power up to 25W. The project aims to provide users the ability to test their equipment prior to production to make sure that these products are ready to be produced without errors in terms of power. The project will also give the users the ability to test supplies in constant voltage and current mode or set a power input limit. The instrument should be able to control the current or voltage (depending on the power supplies set max current output) and monitor the voltage and current at any time. The controlling part of the circuit can be done through a knob and LED screen on the device or a mobile app for convenience.

## 2.1. Background

There are many electronic loads on the market with different functionalities and abilities. Some of these are capable of measuring and testing equipment that are equipped with a large power supply, so they will need a sophisticated electronic load to measure the power supply and some do not require electronic loads with high qualities. This project aims to provide high accuracy in testing devices that do not require a high power supply; less than 25W. Most of the electronic loads on the market are designed to test relatively products that take a high power. Usually, these loads are expensive. The instrument we are designing does not cost as much as the electronic loads on the market.

The DC electronic load we are designing is very similar to the ones on the market except that it is designed for products that do not require loads that measure high power supply. The instrument will be able to do the basic jobs of most of the electronic loads in a small scale with high accuracy. For example, the instrument can produce a constant voltage independent of the current and vice versa. Designing a mobile app that controls the circuit is another advantage of the instrument that other electronic loads do not have which shows that this project is adding something new to the market.

At the end, having a device that produces a constant voltage independent of the current and vice versa without having to pay a big price for it is hard to find on the market. In addition, the ability to control the circuit through a mobile app is another benefit for choosing this instrument over the others when testing small devices.

## 2.2. Referenced Documents and Standards

The following documents are reference documents utilized in the development of this specification. These documents do not form a part of this specification and are not controlled by their reference herein.

|  |  |  |
| --- | --- | --- |
| **Document Number** | **Revision/Release Date** | **Document Title** |
| AD8630 | N/A | Zero-Drift Single-Supply Rail-to-Rail Input/Output Operational Amplifier |
| MCP4725 | N/A | 12-Bit Digital-to-Analog Converter |
| MCP3426 | N/A | 16-Bit Multi-Channel ΔΣ Analog-to-Digital Converter |
| P30N06LE | N/A | N-Channel 60 V (D-S) MOSFET |
| LM7805 | N/A | 3-Terminal 1A Positive Voltage Reg |
| TCH35 TO220 | N/A | 35 Watt TO220 Package Thick Film Power |

# Operating Concept

## 3.1. Scope

This DC electronic load will have the ability to switch between settings to either draw and read a constant current and voltage or draw a constant amount of power based on the user settings and the input power supply voltage. This will all be controlled through a mobile phone app but can also be done by controls directly on the DC electronic load itself through the use of knobs and buttons. The DC electronic load will have an LED screen(s) displaying the present setting of the device. The screen(s) will also display the current, voltage, and power provided from the input device. as well as the output power limit.

## 

## 3.2. Operational Description and Constraints

* The DC electronic load will have a maximum test load of 25W.
* The minimum voltage input of 6V and a maximum of 25V
* The minimum current input of 45mA and a maximum of 1A
* The test equipment will display measurements of both the voltage and current.
* All controls for the device will either be through knobs and buttons on the device or through a mobile phone application.

## 3.3. System Description

The device will have the following subsystems:

1. Load Circuit
   1. Where the load would be connected
   2. Attached to a microcontroller to read measurements
2. Firmware
   1. Programs the microcontroller to read data and control power output
3. Interface
   1. Displays voltage, current, input power, and power output limit
   2. Allows user to change between constant current and constant voltage, and change power output limit
   3. Either an App or LED screen
4. Mobile Phone Application
   1. Controls settings for the device.

## 3.4. Modes of Operations

-Constant Current and Voltage setting: If the load is drawing less than the maximum current the power supply can provide, this setting reads a constant voltage and varies the current input. If the load is drawing the maximum current the power supply can provide this setting draws a constant current and varies the voltage input.

-Power Output Limit: This setting provides a limit to how much power the DC electronic load can draw from the input device to prevent from damaging the device being tested.

## 3.5. Users

This DC electronic load is perfect for anyone needing to test low/mid power electronic devices on the go. Possible users may include engineering students, electronic technicnitions, etc. Users of this device will require basic electrical concepts such as Ohm's Law and power ratings for electronic devices. If one understands these basic concepts this device will be very simple and useful to use.

## 3.6. Support

Instructions and details of this device will be provided in the Functional System Requirements (FRS) and the Interface Control Document (ICD). These two documents will provide the user with detailed information about the system and instruction on the interface and settings of the device.

# Scenario(s)

## 4.1. DC Power Supply

-Can be used to test a power supply with up to 25 Watts of power.

-This can be used to test a supply with a constant current or a constant voltage output by changing the read settings on the DC Electronic Load.

# Analysis

## 5.1. Summary of Proposed Improvements

Our device will be able to perform measurements of current and voltage readings and power supplies more accurately than similar instruments at a higher accuracy and display the results conveniently either through an LED screen or a mobile application.

## 5.2. Disadvantages and Limitations

One limitation of this electronic load is its limited power rating of 25 Watts. Devices currently on the market can perform measurements at a much higher power output than this. While those devices can perform measurements with a higher range at the expense of precision, our device can provide more accurate measurements suited for smaller products powered by a smaller power supply.

## 5.3. Alternatives

One alternative to the DC electronic load would be to use a high power variable, resistor and a multimeter to measure the voltage and current. There are several disadvantages to using this method. This method requires multiple components and may introduce an electrical hazard with the open wires of the multimeter. There is also a possibility of damaging the device you are trying to measure by overdrawing current. It also requires that the user changes the configuration of the multimeter to measure either voltage or current and then they must calculate the power generated by hand. The DC electronic load does all these things in one device in a fast and reliable manner.

## 5.4. Impact

Our device is built to perform accurate results in a controlled environment, measuring power supplies of smaller systems. This device has little involvement with the environment, with society, and raises little to no ethical concerns, unless the systems that we are testing