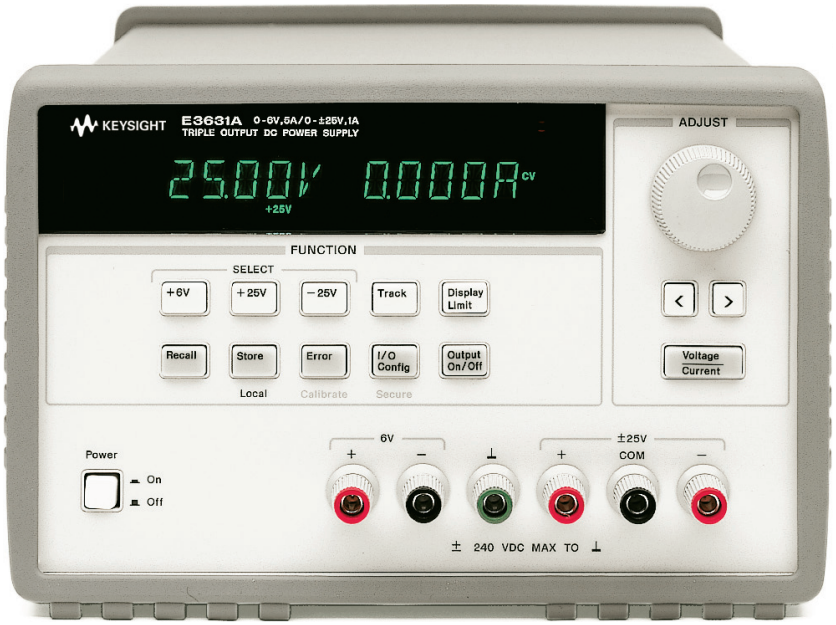
Keysight Technologies

Specifying and Buying a Bench Power Supply

Application Note



KEYSIGHT TECHNOLOGIES

Introduction

Having problems deciding which DC bench power supply you need? Are you confused with the vast number of power supplies available in the market?

It's important to recognize that all power supplies are not created equal, and price alone is not the best way to select a power supply. In fact, when selecting a general purpose bench power supply there are multiple factors to consider.

For any application, it is essential that a power supply provide clean and stable DC power output. It is also important that they are affordable, easy to use, and will not damage the device under test (DUT). A compact footprint is also beneficial to leave as much working space as possible on the bench top.

While DC bench power supplies are intended for general use, they are typically used for applications such as:

- General purpose testing in R&D
- QC & QA inspection
- Bias power for circuits
- Production testing where throughput is not critical
- Sub-assembly testing
- Teaching lab experiments
- General circuit troubleshooting

Identifying which application areas will likely be used can help you narrow down the purchasing options and help you choose the optimum power supply. For example, Keysight Technologies, Inc. has more than 150 different power supplies, and each supply has its own advantages to suit a specific use.

This application note discusses some of the fundamental considerations for specifying and buying a DC power supply. It addresses questions such as "Which power supply will suit my application needs? How can I avoid paying too much for my power supply? What features should I look for? What are the key characteristics I should consider?"

Specifically, the topics of the application note include:

- Output and power requirements
- Performance characteristics
- Protection features
- Packaging density
- Total cost of ownership

Output & Power Requirements

Consider the DUTs that need to be tested. How much power is required? Will the DUTs need maximum power at one specific point? Does maximum power need to be supplied at various voltage and current configurations? What is the range of power that you want to supply in your applications? For instance, a range of 30 to 200 W can be supplied by Keysight E3600 Series bench power supplies. An advanced single output power supply might have more than one voltage and current ranges, as shown in Figure 1.

Multiple outputs are vital when a supply is used to test multiple devices simultaneously. When choosing a multiple output power supply, consider if the outputs need to be isolated from one another. Also consider the supply's tracking capabilities.

You may want to consider choosing a higher power model to provide room for future expansion. When opting for the extra power margin you also want to recognize the tradeoffs, including the extra size, heavier weight, and greater AC power consumption.

Another point to consider is the type of load that the supply needs to power: resistive, inductive, or capacitive. This is because the nature and behavior of the load inherently affects the voltage programming response time.

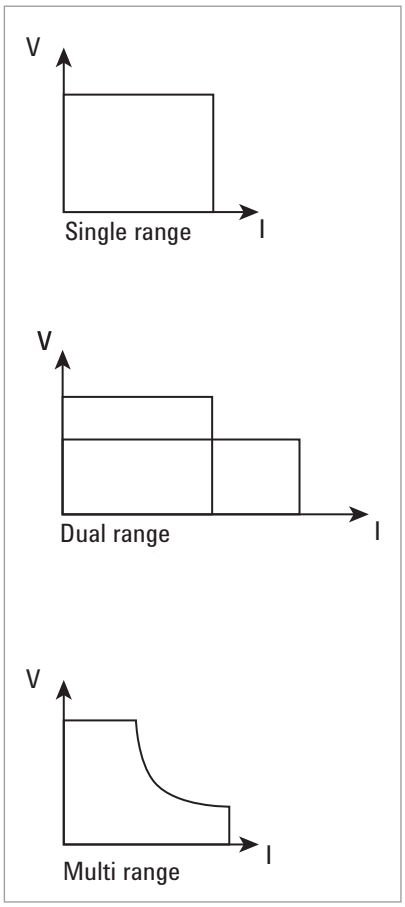


Figure 1. Power supply output V-I characteristics

Performance Characteristics

Once the amount and type of power have been established, the features and specifications of these supplies need to be considered.

One of the first misconceptions people have is that any number which appears on a data sheet is a guaranteed specification. However, there are in fact, two different types of specifications: guaranteed and typical.

A guaranteed, or warranted, specification is determined by the manufacturer through complete error analysis, and by accounting for all the sources of uncertainty that can affect performance of the product. Such a specification is also referred to as a worst-case specification. In other words, even with the combination of worst-case parameters expected to occur, the measurement still remains within the specification.

A typical specification is an average or normal value of the product's capability. A typical specification is usually based on test results from a predetermined set of measurements taken from a number of product units.

In reality, it is acceptable to have the measurement value vary above or below the stated typical specification, however a product is considered to have failed once its measurement value is above the stated guaranteed specifications.

Most of the Keysight E3600 Series power supply primary specifications are guaranteed specifications, ensuring that the performance of the power supply is as it is stated in the data sheet.

The key characteristics are as follows:

- **Load regulation** — the variability in the output V/I due to change in load. Some loads will not tolerate voltage variations greater than a few percent
- **Line regulation** — the variability in the output V/I due to change in AC input
- **Programming accuracy** — the quality of the programmed value being near to the actual V/I
- **Read back accuracy** — the quality of the displayed value being near to the actual V/I
- **Resolution** — the smallest value of V/I that can be programmed
- **Output noise** — consists of common mode and normal mode
- **Transient response** — time taken for the output voltage to return to the programmed state after a disruptive change in load current
- **Sense connections** — local and/or remote sense capability
- **Interface** — front panel and/or remote (GPIB, USB, RS232, etc)

Low noise, excellent regulation, and remote sensing capability that reduces the voltage drop across load leads, are the desired characteristics in a power supply. The Keysight E3600 Series, E3631A to E3634A, and E364xA come with GPIB and RS232 standards that provide a remote interface in addition to a full-featured front panel interface.

Protection Features

When dealing with power, safety comes first. Sometimes when devices fail, it may be catastrophic. It is important that a power supply not only protect itself, but also protect the DUT. Protection circuits in the power supply can limit the voltage or current to a preset level or shut down the power supply when an overvoltage or overcurrent condition occurs. Some power supplies also have a down programmer circuit to quickly discharge the DUT while some, upon receiving a fault trigger, are able to open a relay and isolate the DUT from the source of the power. For instance, the Keysight E3600 Series power supplies offer a host of protection features, including overvoltage, overcurrent, and current limit protection.

Packaging Density

How much space do you have on the bench? Do you plan to place this supply close to an oscilloscope or computer monitor? Will you be carrying it? Power supplies come in various sizes and weights. Higher power usually means more space, AC power, and cooling. DC power supplies are in either linear or switch mode. Each offers significant advantages over the other based on the intended application.

Linear power supplies have the following advantages:

- Low output noise
- Fast transient response
- High programming speed

However, they also come with a series of disadvantages:

- Low efficiency
- More cooling required
- Higher level of low frequency magnetic radiation causes flicker in CRTs
- Larger in size

Switch mode power supplies offer the following benefits:

- Smaller in size
- High efficiency
- Less cooling required

While the benefits of a switch mode power supply are attractive, some power supplies vendors make switch mode power supply products with the following drawbacks:

- Slower transient response
- Higher output noise
- Slower programming speed
- Availability 150 W and above

Note that Keysight switch mode power supplies (available primarily for ATE and advanced, higher power bench applications), offer excellent transient response, low noise outputs, and fast response time.

Power supplies that are compact, lighter, and have smaller footprints are desired especially if they come without the typical tradeoffs of higher output noise and slower transient response.

The Keysight E3600 Series bench power supplies achieve this by implementing hybrid regulation techniques, which combine the size and efficiency of a switch mode power supply with the low noise and fast speed of linear power supply.

Total Cost of Ownership

When you purchase a power supply, take into account the price of the power supply and the whole product experience. This includes the cost of downtime for calibration and repair, protection for your DUT and test instruments, and the reliability you will get out of the power supply.

Look for a manufacturer that will provide maintenance support and a dedicated support team that is available during setup and daily product use. This will help ensure smooth integration of the supply to your application.

Ultimately, the goal is to select a supply that can provide clean power day in and day out, while being able to protect itself and the DUT. In the event of a failure, it would be ideal that a solid, efficient, and committed service and support team gets the supply up and running as fast as possible. You can depend on consistent performance and Keysight's trademark reliability using the Keysight E3600 Series bench power supplies.

Related Keysight Literature

Publication title	Publication number
E3631A, E3632A, E3633A, and E3634A Bench Power Supplies, Data Sheet	5968-9726EN
E3640A – E3649A DC Power Supplies, Data Sheet	5968-7355EN
E3610A – E3630A Manual Power Supplies, Data Sheet	5968-9727EN

Visit www.keysight.com/find/E3600 and www.keysight.com/find/dcpower for more information.

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