

Keysight Technologies

Specifying and Buying a Bench Power Supply

Application Note



Unlocking Measurement Insights

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 80 to 160 W can be supplied by Keysight E36300 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.

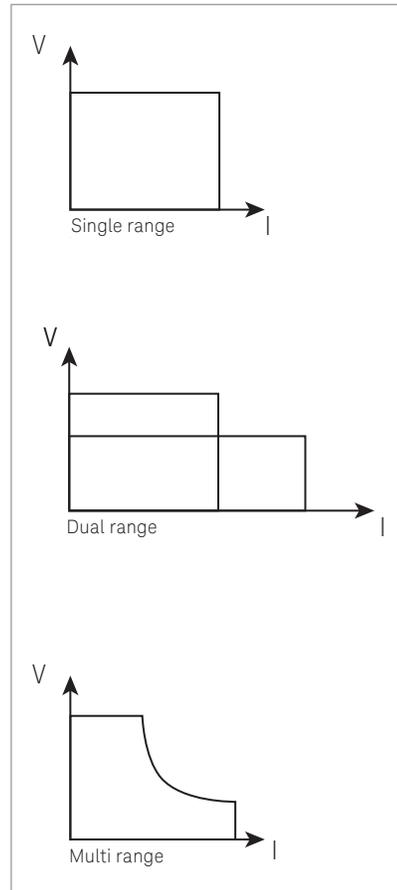


Figure 1. Power supply output V-I characteristics

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.

The Keysight E36300 Series bench power supplies' 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 (LAN, 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 E36300 Series bench power supplies come with LAN and USB standards that provide a modern 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 E36300 Series bench 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 supply 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.

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.

Evolving

Our unique combination of hardware, software, support, and people can help you reach your next breakthrough. **We are unlocking the future of technology.**



From Hewlett-Packard to Agilent to Keysight

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 11 2626
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 805353
	Opt. 1 (DE)
	Opt. 2 (FR)
	Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-2-23-17)



www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2015
Quality Management System

myKeysight

myKeysight

www.keysight.com/find/mykeysight

A personalized view into the information most relevant to you.

KEYSIGHT SERVICES

Accelerate Technology Adoption.
Lower costs.

Keysight Services

www.keysight.com/find/service

Our deep offering in design, test, and measurement services deploys an industry-leading array of people, processes, and tools. The result? We help you implement new technologies and engineer improved processes that lower costs.



Three-Year Warranty

www.keysight.com/find/ThreeYearWarranty

Keysight's committed to superior product quality and lower total cost of ownership. Keysight is the only test and measurement company with three-year warranty standard on all instruments, worldwide. And, we provide a one-year warranty on many accessories, calibration devices, systems and custom products.



Keysight Assurance Plans

www.keysight.com/find/AssurancePlans

Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

Keysight Channel Partners

www.keysight.com/find/channelpartners

Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/E3600
www.keysight.com/find/dcpower



Unlocking Measurement Insights

This information is subject to change without notice.
© Keysight Technologies, 2006 - 2014, 2017
Published in USA, June 13, 2017
5989-5278EN
www.keysight.com