



Get More Usable Power with Autoranging Power Supply

Introduction

Most **power supplies** provide a single range because it is the most straightforward, cost-effective design. A single-range power supply can deliver its maximum output power using one voltage and current value. However, a single-range solution may not provide a high enough current or voltage for your designs even if the power specification is sufficient.

Traditional high-power supplies are not suitable for research and development (R&D) because they are bulky and loud. A power supply's internal components include voltage tolerances, the maximum output power, and fans that dissipate heat coming from the components. Conventional power supplies can also cause problems for the device under test (DUT) because they generate more output noise.

Programmable DC power sources are an essential tool in product development and production testing of a wide range of electronic devices and systems. In many instances, functional test requires submitting the device-under-test (DUT) to a wide range of operating conditions. In some cases, the DUT draws constant power under variable input conditions. Common examples are DC motor drives and regulated DC/DC supplies. In such circumstances, the ability of the programmable DC source to provide more current at reduced output voltage is valuable. We refer to this ability as "autoranging." DC supplies without autoranging often require users to use multiple supplies to test the DUT under varying input voltage conditions.

Autoranging power supply provides more current at higher voltages, resulting in more usable power. The Keysight E36200 Series autoranging power supply design manages more applications and provides more current at every voltage.

What is Autoranging?

“Autoranging” describes the ability of a programmable DC source to maintain full power output across a wider range of output voltages and currents than traditional DC power supplies. In most applications, a DUT will not require a power supply’s full-scale voltage, meaning that the power supply is not fully used. As a result, in many cases, an engineer will have to specify a more expensive power supply that can supply the necessary output power at the required voltage.

Autoranging supplies, on the other hand, are not as constrained; they automatically supply higher output current at lower voltages. When current outputs are modest, autoranging supplies can provide a higher output voltage than traditional supplies. This feature gives autoranging power supplies extra range and more flexible performance than conventional supplies.

When it appears on a voltage-current graph, an autoranging output characteristic looks like an infinite number of overlapping rectangular output characteristics capable of maximum power (P_{max}). An autoranging power supply cannot output V_{max} and I_{max} at the same time, but it can provide more voltage-current combinations than a dual-range power supply. It is easy to compare the Keysight 200 W E36231A autoranging power supply and the Keysight 200 W E3633A dual-range power supply (Figure 1). While both supplies provide 200 W, the E36231A offers voltages up to 30 V and higher current at most voltages.

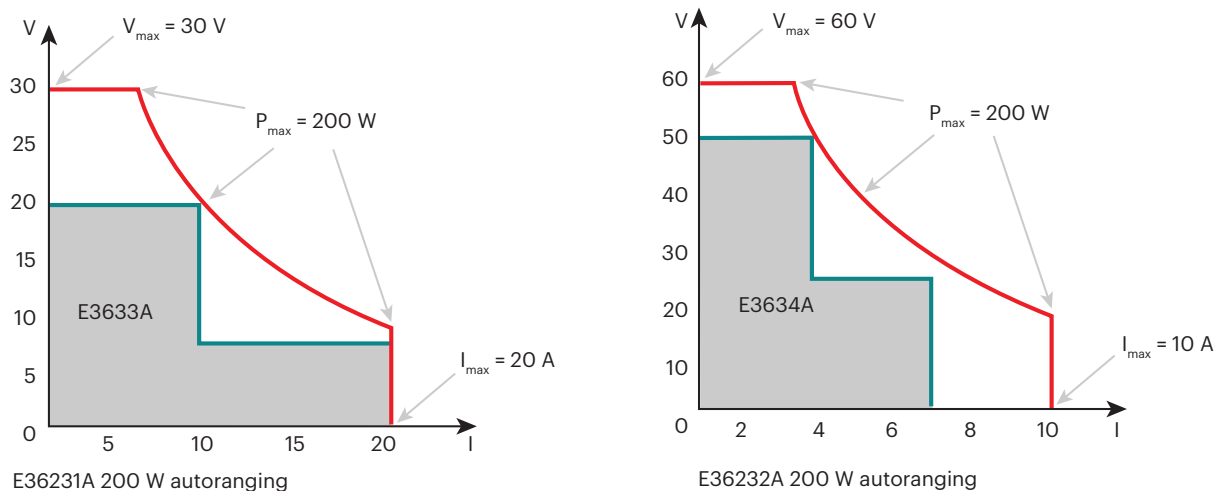


Figure 1. The Keysight E36231A Autoranging Power Supply provides more voltage-current combinations than the Keysight E3633A dual range power supply

In the past, the solution for higher current was to use a more powerful single-range power supply. A larger power supply typically means higher output noise and more difficulty controlling smaller currents. But autoranging provides more current at higher voltages, resulting in more usable power.

Likewise, Keysight's E36232A can provide up to 60 V and more current than Keysight's E3634A which provides up to 10 A.

Autorange Versus Single Range and Dual Range

Autoranging power supplies produce more current at all voltage settings than traditional single-range supplies. Figure 2 shows how power supplies can have three common output architecture: single range, dual range, and autorange.

A single-range power supply is the most straightforward architecture because maximum output power occurs at only one setting — maximum voltage and current. If you plot the maximum voltage and current, the results form a rectangle on a V-I graph. All valid voltage and current combinations reside within the rectangle.

A dual-range power supply increases the number of voltage / current combinations for the same maximum power. This combination offers a high and a low voltage range, with the low range providing more current. Autorange provides continuous ranging and offers higher current at more voltage settings.

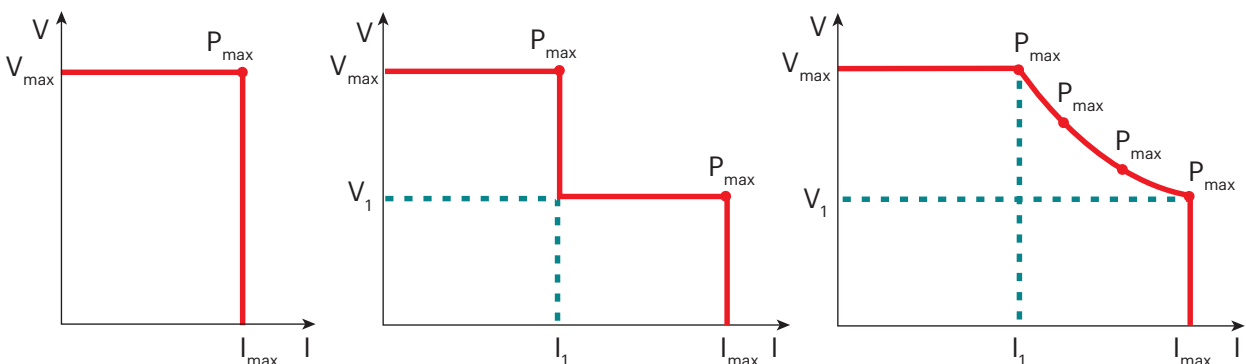


Figure 2. Power supply output characteristics are single range, dual range, autorange (left to right)

Use parallel and series connections to increase voltage and current

When you need higher voltage or more current, similar power supplies can connect in parallel or in a series to meet the needs of your DUT. Using two power supplies is helpful because they work individually for low-power applications. Keysight's 36200 Series with autoranging capability allows you to combine the two outputs to create a single output with twice the current.

Auto-parallel: combine two outputs to create one with twice the current

Auto-parallel combines the two outputs to create a single 400 W output with twice the current. The power supply makes all the parallel connections internally, and the front panel displays a single high-current output. For example, Keysight's 400 W E36233A Autoranging Power Supply provides two independent outputs that are each identical to the Keysight E36231A. It is like having two E36231As in the same instrument. Each output can deliver up to 30 V and 20 A. Similarly, the 400 W E36234A offers two outputs with the same characteristics as the E36232A. Each output can produce up to 60 V, and 10 A. The auto-parallel capability means the E36233A can output a staggering 40 A. For higher voltages, the E36234A can output almost 7 A at 60 V. Figure 3 shows the output characteristics for a 200 W and 400 W parallel output.

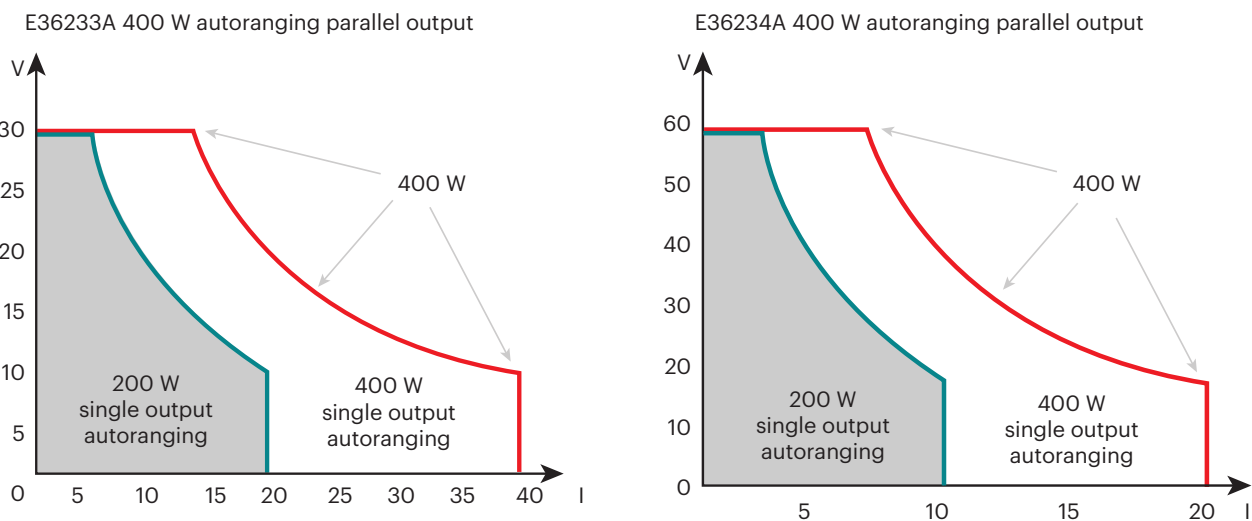


Figure 3. The E36233A and E36234A provide two 200 W outputs — the auto-parallel combines them for a single output with higher current

Auto-series combines two outputs to create a single output with twice the voltage

Auto-Series is to combines the two outputs the Keysight E36233A and E36234A to create a single output with higher voltage. The E36234A with series outputs can output up to 120 V, and the E36233A can output 60 V. Output characteristics appear below in Figure 4. It is interesting to note that the E36234A in auto-parallel, and the E36233A in auto-series, have the same output characteristic.

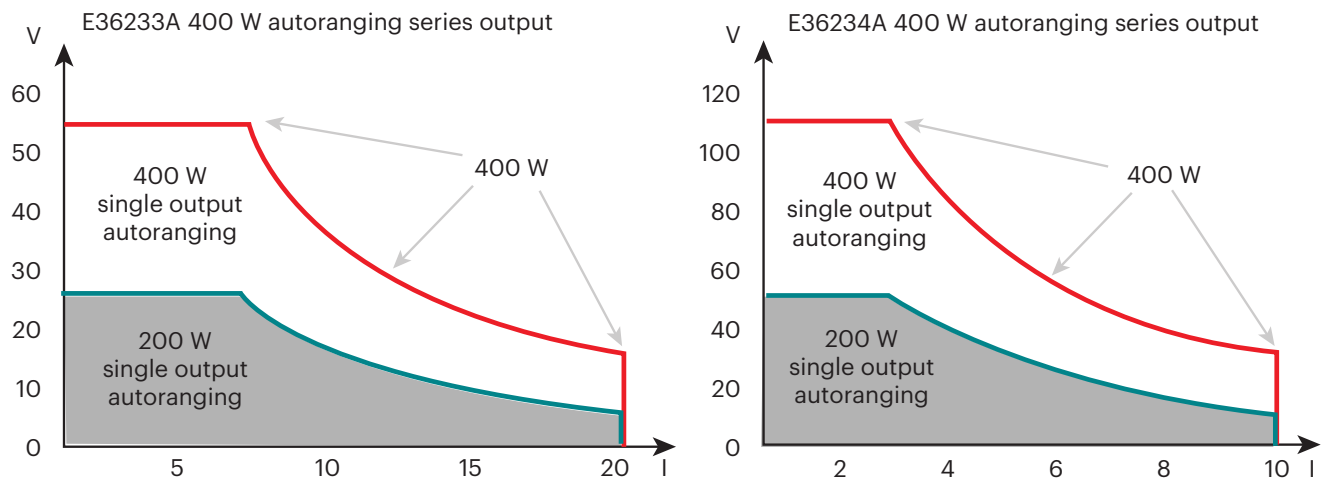


Figure 4. Output characteristics for the Keysight E36233A and E36234A standard output and combined with auto-series

Combining auto-series and auto-parallel

You can configure the power supply for either auto-series or auto-parallel. Relays configure the connections for auto-parallel and auto-series. Setting the outputs to zero volts will eliminate current flowing through the relays when selecting auto-series or auto-parallel to improve their life span. The output characteristics represent all the voltage-current combinations possible when using either auto-series or auto-parallel. Several voltage-current combinations are available through both auto-series or auto-parallel (see Figure 5). Select auto-series if other tests require higher voltages, or auto-parallel if additional current is necessary for future tests.

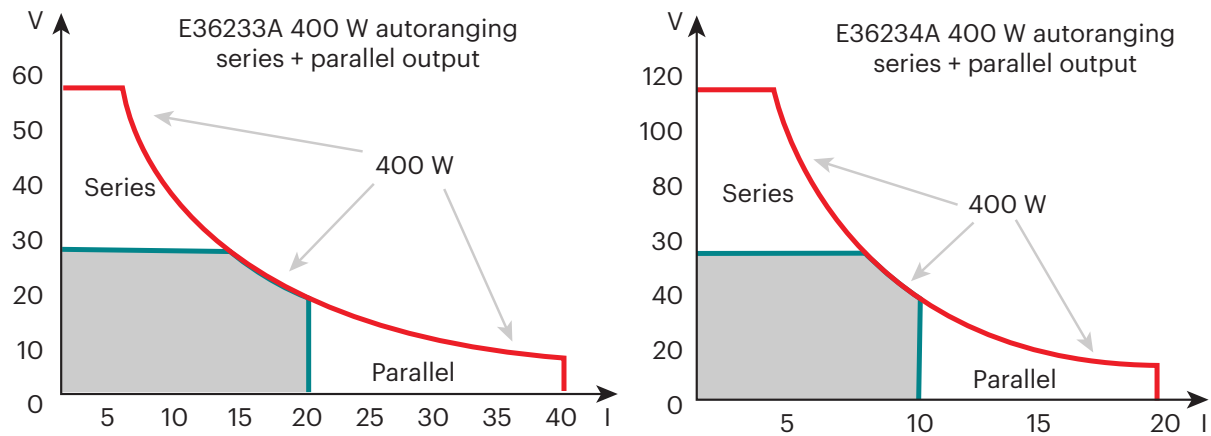


Figure 5. The complete output characteristic for the Keysight E36233A and E36234A

Conclusion

Bench power supply with smart capabilities such as autoranging, auto-series, and auto-paralleling allow a power supply to cover many applications without resorting to a larger power supply. An oversized single-range power supply may be a cost-effective purchase, but it comes with many challenges. Common mode noise, regulation, and inrush current are difficult to control with additional circuitry. Many devices require testing at different voltages and you may need to turn on and off multiple voltages simultaneously. The Keysight E36200 Series Autoranging Power Supply design manages more applications and provides more current at every voltage.

Learn more about the [Keysight E36200 Series Autoranging Power Supply](#)