

Stretching the Limits of Power Supplies: Issues and Answers

If you're restricted by a power supply's rated specifications, you may still have options.



By Polytron Devices staff

Power supply manufacturers sometimes hear from customers with unfortunate dilemmas, such as: “I need to operate the power supply outside its rated voltage range.” Or, “What happens if I exceed my maximum output current?” and “Can I operate my power supply outside its temperature range?” Each scenario has its risks, but we also understand that designers sometimes think about taking those risks. While disregarding the

power supply’s specifications isn’t advisable, power supply manufacturers will do their best to offer as many safe options as possible. This article will provide you with an overview of some of the risks associated with operating a power supply outside its specification limits, along with sound strategies for selecting an ideal power supply when confronted with these situations.

LINEAR POWER SUPPLY UNDERVOLTAGE

Linear power supplies can be an attractive choice for applications requiring low output power, low noise, low ripple and fast transient response, to name a few. These typically cost-effective units also boast a simple design and high reliability. Because some linear power supplies may have a narrow input voltage range, it may be difficult to specify a unit that can accept a low input voltage when needed.

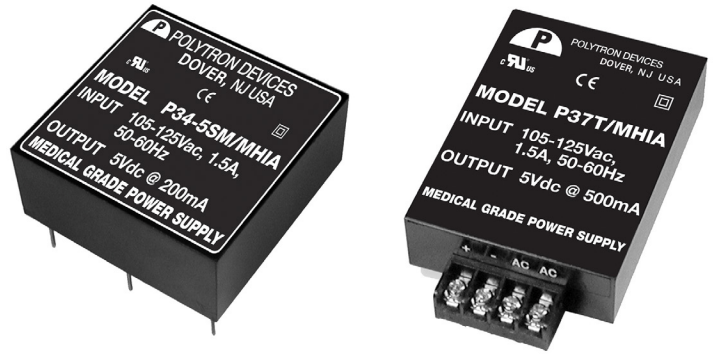
Undervoltage occurs when the average voltage drops 10 percent below the system's rated voltage for more than one minute. Various components will carry more current, resulting in overheating and damaged or poorly performing components. Potential problems could also include distortions or even cracks to the linear supply's casing as well as much lower efficiency. And, keep in mind that operating a power supply outside its rated specs can potentially void the warranty.

Although it may be hard to find a linear power supply with a universal input, you can still find a power supply vendor that offers a wide range of inputs. More inputs mean your supplier can offer more modification options and better tailor the transformer to your required input voltage to avoid overheating and associated damage.

Standard Polytron linear encapsulated power modules are available in five different input voltages — 100, 220, 230, 240V AC and a switchable dual input voltage of 115/220V AC — and output voltages ranging from 5 to 250V DC. Keep in mind that many other manufacturers do not offer switchable dual input units.

Note that linear power supplies are less forgiving for operating outside their rated specs than other power supply types. And if your needs fall outside our range, we recommend getting in touch with your vendor early in the process to make minor adjustments to approach your required input voltage.

Polytron linear power modules feature a high isolation voltage option, short-circuit protection and super low noise, as well as optional sockets or bench adapters built



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for single and dual linear power supplies. They also offer alternative pin configurations, a switching frequency of 50 to 60 Hz, with 400 Hz as an option, isolation resistance of 50 MOhms and free air convection. Medical versions are compliant to IEC 60601-1, CE-certified and feature 2X MOPP insulation, up to 5700V DC IO isolation and very low RMS output noise.

UNIQUE OUTPUT CURRENT CONDITIONS

A power supply's output current rating will often determine the size and cost of the unit you need. Not surprisingly, when choosing a power supply this dynamic can create a potential pitfall: specifying a unit that meets the application's minimal current requirements without also considering how it can handle excessive currents. Operating a power supply beyond its limits is undoubtedly risky. Power supply vendors do their best to eliminate such risks and help you satisfy your performance needs with a safe, reliable unit.

Like undervoltage, thermal issues and component degradation are the consequences of exceeding your application's output current requirement. That's because the higher output power dissipates to nearby components, causing them to overheat, degrade or fail. The power loss also hinders the supply's performance and efficiency. Additional problems may include frequent shutdowns due to transient currents, increased EMI and operation outside of load regulation limits, which may also occur when a power supply operates under its minimum current rating — if it

has one. In order to select a power supply that meets your current requirement, follow these tips and best practices.

- **Derate current.** Lowering, or derating a power supply's current rating can account for conditions that may affect the output current, such as extreme temperatures.
- **Account for transients.** When specifying a power supply, make sure the rated current limit allows for possible transients, such as from surges. In addition, many power supplies offer a Peak Power feature. This allows them to deliver higher power than their rated output power for a short duration when, for example, components elsewhere in the circuit draw more current at start-up than when operating continuously. The [Polytron KUIP300 AC-DC industrial power supply](#) is one such example. While it offers 300 watts of power, it is also capable of delivering 360 watts peak power for 5 seconds (typ.) when temporary load spikes occur.
- **Look for built-in protections.** To prevent overcurrents from damaging the device being powered, many power supplies come with built-in protections. Examples include constant current limiting which, during overloads, prevents the output current from exceeding a specific limit and lowers the output voltage until the overload ends. Another, fold-back limiting, lowers both the output current and output voltage to acceptable levels.



The Polytron KUIP300 AC-DC industrial power supply can deliver up to 360 watts peak power for 5 seconds (typ.) when temporary load spikes occur.

Hiccup-mode current limiting lowers the output voltage to zero and returns its normal voltage after a brief interval.

- **Consider a custom power supply.** While power supply manufacturers offer units with built-in protections, there may be times when a standard supply may not match your application's current requirements. Daburn's engineering staff can work with you in modifying a standard unit with an appropriate current limiting method, or a means of drawing more current, if necessary.

CHOOSE A POWER SUPPLY WITH THERMAL LIMITS IN MIND

Power supply operation is closely linked with its ambient temperature. Even if you plan to operate your power supply in a conventional commercial environment, your unit may encounter heat in various ways that can ultimately affect its performance and reliability. That's why power supply manufacturers establish an operating temperature range and include it on the data sheet. However, designers don't always have the luxury of specifying a power supply that is limited to a narrow operating temperature range that can otherwise suffice in a room with benign ambient temperatures.

For example, if the power supply must operate in a hot, sunny or arid environment, the location will influence the ambient temperature. In addition, the power supply's load requirements, efficiency, enclosure type and ventilation can cause the unit to operate outside its temperature limits. When a power supply operates higher than its temperature specifications, a host of problems can occur such as reduced component lifetimes, increased output ripple and its associated electrical noise, and over-voltage issues.

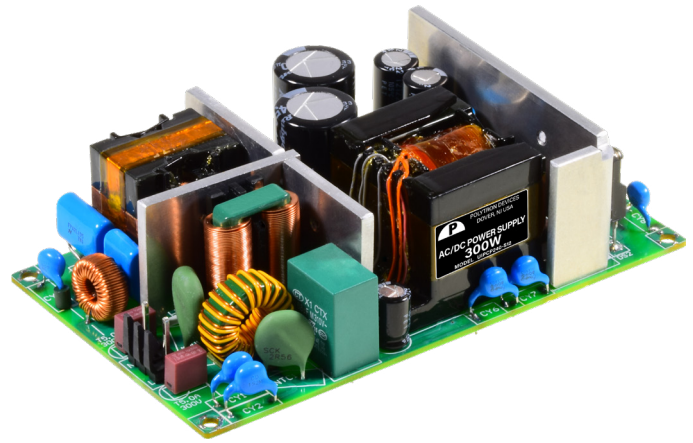
And, if you're specifying an external power supply, its surface temperature can make it hot to touch or even pose a fire risk. This problem is especially concerning for medical applications, where patient comfort and safety are paramount. It's also important to remember that operating a power supply at lower-than-specified temperatures can also hinder performance. Implications can include poor output regulation, an increase in the output ripple or

inability to start up. As you select a power supply, keep in mind a few features that can help your unit run within its temperature limits.

- **A wide operating temperature range.** Power supplies with a wide operating temperature can be desirable for harsh or outdoor environments where high or low temperatures are possible, and they may not require modifications to remove excessive heat. In addition, a higher temperature specification can help avoid derating output power which can otherwise be necessary to avoid high-temperature operation.
- **Over-temperature protection.** A variety of events like high ambient temperature, poor ventilation and power surges can raise the temperature of a power supply. That's why many power supplies come with an over-temperature protection (OTP) feature that shuts down the unit until the temperature returns to a specified threshold.
- **Heat removal.** Because power supplies give off heat, they often come with built-in mechanisms such as fans, heat sinks or thermal plates. Other power supplies rely on convection and liquid cooling. Selecting the right cooling method is often system dependent and will involve trade-offs such as power and noise requirements, and enclosure or frame construction, to name a few.

Two examples — the Polytron [UIPCP industrial](#) and [MUIPCP medical](#) power supplies — have an open-frame design that takes advantage of free-air convection to keep components cool, and they also offer overtemperature protection to prevent high-temperature operation.

Your power supply vendor can offer a variety of options to meet your thermal management goals. Daburn's Polytron Devices division offers a wide range of power supplies for a variety of markets — each with its own operating temperature needs, including industrial, military, EV charging and medical sectors. And if a power supply cannot meet your exact temperature or performance requirements, we stand ready to suggest modifications or external cooling methods and design strategies to best keep your power supply cool.



Polytron UIPCP industrial and MUIPCP medical power supplies have an open-frame, free-air convection design to keep components cool.

WORK CLOSELY WITH YOUR POWER SUPPLY MANUFACTURER

Although you may not always be able to find a unit that can meet your requirements and also operate within specified limits, you can partner with a power supply manufacturer that has the know-how to address this type of challenge if it arises. The right power supply vendor can help by offering:

- A large portfolio of standard products.
- The capability to modify standard products to satisfy your goals.
- The ability to create evaluation samples.
- Safety testing capabilities.

While many companies may be able to customize just one type of power supply, such as switch mode units, they may not have a diversity of products to choose from or the flexibility to make modifications to achieve the ultimate solution. At Polytron Devices, our technical staff will work with you throughout your design process. Beginning with our wide selection of switching and linear power supplies, we'll examine your needs and offer solutions that can best address your scenario and review their upsides and downsides. Based on this extensive collaboration, we can modify and custom-engineer a power supply that can function and meet your expectations in many challenging situations.

For more information, please visit <http://www.daburn.com/polytron-power-supplies.aspx>.