design FAQs

How to Select the Right Power Supply

FREQUENTLY ASKED QUESTIONS

Q: I need a power supply. What are my options?

A: The choice of power supply is one of the more critical choices facing a system designer as it affects system performance, efficiency, reliability, and safety. It may also adversely affect surrounding systems if it isn't properly chosen, grounded, and mounted. The best option depends on the circumstances and application, of course, but some considerations include: a team's time to market window; cost; available space; special performance and mechanical requirements; and a team's own level of internal power-supply design expertise. These vary across applications from consumer to commercial, industrial, medical, and military. That said, there are three main options:

- Choose an off-the-shelf solution;
- Use an outside power-supply specialist for a custom design; or
- Design from scratch, in-house.

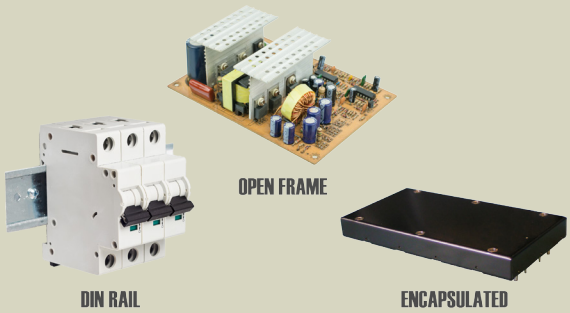
I'd rather just pick a supply that's already out there. What types are best?

A: The "best" power supply is the one that meets the voltage, current, power, space, safety, agency approval, EMI requirements, thermal, mechanical constraints, and cost needs of the application. However, off-the-shelf power supplies typically fall into five general categories:

Encapsulated: Encapsulated supplies are fully enclosed with a thermally conductive material that helps conduct the heat away quickly from the internal converter.

Open frame: Here, the internal components are exposed and the supply is usually inserted into a system where it is housed safely. The supplies may be PC-board-mount only, with mounting pem nuts, housed within a "U" chassis, or fully enclosed with a perforated cover for hazard protection and EMI shielding.

DIN-rail mount: Typically used in industrial applications, the supplies attach directly to the EN and IEC DIN standard rail, usually within a cabinet.



Off-the-shelf power supplies come in five general categories: open frame, encapsulated and DIN rail, as well as wall mount and desktop. (Image source: Wall Industries)

Wall mount: These plug straight into a wall outlet and the converted power is fed to the destination system.

Desktop: A desktop supply is a standalone power supply connects via a cable to the ac outlet on one end and to the destination system via another cable.

What are the tradeoffs associated with each type?

A: Encapsulated supplies can be smaller in size and can be PC-board-mounted (thru hole or SMT). However, they may require external components for EMI and input surge protection. Also, in high-power applications, an external heatsink may be needed, as might airflow cooling. Note that the extra heatsinking and airflow cooling add to the overall cost and space requirements. At a certain power point, they might start to offset the inherent advantages of the encapsulated power-supply and its form factor.

Open-frame supplies are generally more available, less expensive, and lighter than encapsulated power supplies. They also typically have the filtering and shielding in place to meet EMI, flicker, and surge specs, as well as all the necessary connections. They are generally wired to their I/O terminals. This allows remote placement of the supplies, as long as proper care is taken in wire gauge and length, to keep power regulation within spec.

However, unless severe derating is used, open-frame supplies may require airflow or conduction for cooling, or a combination of both. Also, they are not recommended for wide ambient temperature ranges, such as in industrial applications, where the ambient temperature can rise above 50 to 70°C. This can thermally stress the power components, which do not benefit from the encapsulated power supply's thermally conductive material. The material not only serves to reduce thermal resistance, it also serves to keep all components within a relatively close operating temperature range.

From a cost point of view, a 100-W open-frame, EMI-certified supply can cost as little as $30. A 100-W encapsulated power supply can be less than $100 and will still need other parts, like EMI suppression.

Wall-mount power supplies and desk-

top power supplies are inexpensive, generally used for very low-power applications, and are not meant for wide operating-temperature ranges; the plastic housing doesn't dissipate heat well. They also have poor load regulation due to the long output leads. Desktop supplies are usually used as battery chargers for items such as laptop computers.

Din-rail power supplies are air-cooled and usually are lower power, typically under 100 W.

Q: What are some of the "gotchas" I need to be aware of when choosing a power supply?

A: When selecting the power supply it would seem that going small, while meeting the basic specifications, is a good idea. It may even be seem like a good idea to go beyond the applications specified requirements, "just to be sure." However, there are some considerations to keep in mind:

- Smaller isn't always better: A half-brick converter with the same power and efficiency as a full-brick converter will dissipate the same amount of heat. Consequently, extra attention will need to be paid to thermal management. So, if the circumstances permit, avoid optimizing for the smallest possible form factor for a given output power. The higher power density just increases the likelihood of a thermal management problem.
- Encapsulated is good, but once all the extra components are added that are needed to make it work (EMI filtering, connectors), an open-frame power supply may be better.
- Avoid over-specifying: Know what's important and what's not important. It'll help contain costs.

Q: Are there any geographic considerations?

A: No. There used to be different requirements in terms of power factor correction and other specifications, but they're all harmonized now.

Q: How can I plan ahead so that I'm able to use a standard power supply?

A: Excellent question! Become versed in the options and what is standard in the industry up front: this article is a good starting point. It can mean a lot of research, but it's the only way. One item that is essential for planning ahead is to research what are the typical footprint sizes for a given power range and to make room to accommodate that, and for cooling. (Refer back to "gotchas.")

Q: A vendor seems to have the right power supplies, but how do I know if the vendor is trustworthy?

A: Nothing beats making a call and establishing a relationship with a vendor's technical team. Ideally, find a vendor that does both standard as well as custom power supplies, so they can guide you in the right direction for the application. For example, the best solution may end up being a combination of using standard supplies to meet the main power needs, while adding circuitry for ancillary functions such as communication between the supply and system. A good vendor can guide a designer through the decision-making process.

Q: If I can't find a suitable standard power supply, what then?

A: This is where it pays dividends to have established a trusted relationship with a vendor that does standard and custom designs: they will know exactly how far along the scale to go from standard, toward a semi-custom or a full-custom design.

Come prepared to answer application-specific questions, starting with the basics: input voltage, output voltage, the output power/current, space constraints, and operating temperature range, just to start. From there, the custom design team will guide you through the process. ■

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