

A Complexity-Free Approach to Selecting High-Voltage Power Supply Modules

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Designing a high-voltage supply can be a daunting task, especially if you've only dealt with more common low-voltage supplies, such as those used in consumer devices. Trends in miniaturization, power component functionality and integration have delivered small, low-voltage and low-cost packages. The criteria used for low-power supply selection does not scale well in the high-voltage realm.

While low-voltage supplies often focus on size and cost, high-voltage supplies typically deal with high precision, high stability requirements that are inherent to the end applications they service. The consequences of these differences can often result in a time-wasting and expensive process of trial and error to select the correct high-voltage power supply for the application at hand.

Removing unnecessary complexity involved in the selection of high-voltage power supplies is a key part in accelerating product development processes - avoiding the risks of choosing a supply that is over-specified, under-specified, over-priced or one that is just incompatible with the end application.

What is Involved in the Selection Process?

When choosing a high-voltage power supply for 'mission-critical' applications (i.e. where the form, fit and function of the application is directly tied to the power supply), it is important to have a clear view of the performance and operation of the supply before the rest of the system architecture is designed.

Central to the selection of a high-voltage supply is the need to understand the precision and performance of the supply, the physical and electrical environment that it will be located in and how the supply needs to be controlled.

If not adequately considered, users can find themselves having to reprioritize power supply features, such as efficiency, size and performance, all of which can dominate the decision process of which high-voltage power supply to select.

In all cases though, avoiding an "almost fit" situation is critical. Establishing a frustration-free approach to high voltage power supply selection that is based on best practices should be a priority.

Removing Complexity

So, exactly what knowledge is needed beforehand to make an educated high voltage power supply selection?

There are three categories or environments to consider when researching high-voltage power supply modules: electrical, physical and power supply functionality.

The following are an excerpt from [Advanced Energy's white paper](#) that describes that top 15 questions and related considerations that should be asked to remove complexity and provide clarity when selecting a high voltage power supply.

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Electrical Environment

In your design, what high-voltage output ripple performance is required? What is the maximum allowable ripple specification?

- Output ripple or noise on the high voltage signal can affect the accuracy in the end-use application.
- Overspecifying ripple requirements can result in paying for performance that’s not really needed.

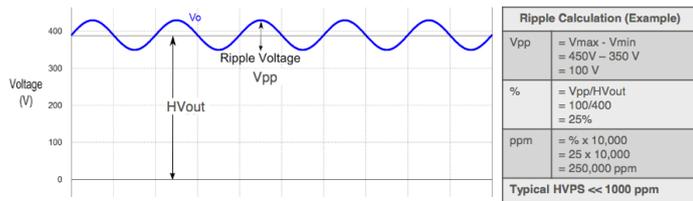


Figure 1. Excessive ripple can reduce measurement sensitivity or accuracy, as well as reduce reliability ancillary components around the power supply. Source: Advanced Energy

Physical Environment

In your application, are there any footprint or size constraints?

- The mounting type (such as direct PCB or chassis mount), footprint, volumetric size of the connectors and other mechanical requirements can define the power supply selection and ultimately cost.
- Materials of construction can be important, particularly for portable applications, where weight and sensitivity to out-gassing (among other factors) are critical design considerations.

Power Supply Module Requirements

What type of power supply is required: proportional, regulated or amplifier?

- Unregulated proportional power supplies tend to exhibit lower accuracies and narrower operating range but are less expensive.
- Regulated power supplies are often considered ideal for the majority of standard and precision applications but typically cost more than proportional supplies.
- Regulated capacitor charging supplies are ideal for applications where high energy transfer is required in a short time period.

- High voltage amplifiers provide fast response high voltage outputs and accurately track both the level and waveform of dynamic input signals.

Start with the Benefits First

Once the environmental and performance criteria have been defined, it is important to evaluate the features, advantages and benefits of the power supply – but start with assessing the desired benefits first.

Moving from benefit to feature may seem counter-intuitive, however the reality is that finding the right solution is much more reliable using this process.

As an example, if the desired benefit is to reduce product development time and expenses, one way to do this is to generate a partnership with a high-voltage supply specialist and avoid the time and cost of internal custom designs or trying to force-fit non-ideal supplies into the application.

The advantage of using the ‘benefit first’ approach is that it enables the vendor to understand what the customer is trying to achieve, link this back to how the product works and make a more educated decision on what the required performance of the power supply is. This adds clarity to the selection process and can drastically reduce the risk of selecting the wrong product for the application.

Comparing and Contrasting Competitive Offerings

After weighing the answers from asking a complete set of selection questions (see link to get a copy of these) and working backwards from benefits to features, what’s the next step? How do designers wade through the clutter and noise to find the actual high-voltage power supply and the vendor that provides it?

At this stage of selection, you will need to take a deeper look into exactly what is offered by different vendors, including their product portfolio and their available technical support. Areas to look for should include:

- Education, including webinars, catalogs and libraries
- Comprehensive but easy-to-understand datasheets with accurate specifications

FEATURE	ADVANTAGE	BENEFIT
High Voltage & Power Density	Smaller footprint	Reduced tool size & costs
Regulated Output	More stable & accurate HV _{out}	Increased resolution & stability
Reliability / MTBF	Increased tool life and stability	Lower maintenance costs
Application dedicated HVPS	Wide application knowledge & coverage	Core vendor application focus & expertise
Active input noise rejection filtering	Improved output ripple & stability	Lower system design cost / Improved end system performance
Portfolio Breadth	μ size, standard module & HVA	Single vendor for all needs

Table 1. Feature and Benefits of High Voltage Modules Source: Advanced Energy

- Easy-to-use tools that narrow selection possibilities
- Repeatable, demonstrable product performance
- Products that are intentionally designed for different applications

Advanced Energy’s Approach

As engineers developing solutions for engineers, Advanced Energy knows that when there is confidence in the high-voltage power supply, engineers can concentrate on other critical design goals such as performance, reliability and cost. As a result of this, Advanced Energy’s [HiTek Power®](#) and [UltraVolt®](#) products have been designed to match all levels of system performance and complexity in both end user and OEM applications, with output voltages from 62 V to 500 kV and output power levels from 100 mW to 120 kW.

In order to simplify the sometimes daunting product selection process, Advanced Energy has created a set of resources (a number of which are listed below) to remove the complexity from - and simplify the process of - choosing a high voltage

power supply.

- Webinars: [Best Practices for Product Selection of High Voltage Power Supplies](#)
- A comprehensive Quick Selection Chart
- [Product information](#)
- A [reference library](#)
- Clear, comprehensive [datasheets](#) (.pdf)

With nearly 40 years of successful power conversion and control technology history, a broad portfolio of proven solutions and rapid-response service and worldwide support, Advanced Energy is ready to partner with designers, simplify the selection process and quickly provide fit-for-purpose solutions for a multitude of application types.

To see how Advanced Energy can simplify high-voltage power supply selection for your unique application, visit [Advanced Energy](#) online.

Size	Type	Typical Installation	General High Voltage	Bias Supplies	Capacitor Charging	Detectors (PMTs/APDs)	Electrophoresis	Electrostatic Chucks	Filament Supplies	Lasers	Mass Spectrometry	Piezoelectronics	Pulsed Power	Portable Devices	Voltage Isolation
Micro size	Proportional	PCB	•	•		•				•				•	
	Regulated	PCB	•	•		•				•				•	
Compact	Proportional	PCB	•	•		•				•				•	
	Regulated	PCB	•	•		•	•	•		•	•			•	
	Regulated	Chassis	•	•			•	•			•				
	Cap Charging	PCB/Chassis	•		•					•			•		
Standard	Regulated	PCB/Chassis	•	•			•	•	•		•				•
	Cap Charging	PCB/Chassis	•		•					•		•	•		
	Amplifier	Chassis	•				•	•			•				
	Dedicated	Chassis	•			•					•				

Table 2. High-voltage power supply by typical application

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ABOUT ADVANCED ENERGY INDUSTRIES

Advanced Energy has devoted more than three decades to perfecting power—enabling design breakthroughs and driving growth for leading semiconductor and industrial customers. Our precision power and control technologies, along with our applications know-how, inspire close partnerships and perpetual innovation in thin-film and industrial manufacturing.

Founded in 1981, Advanced Energy has built a diversified and global business, delivering advanced power and control technologies to customers across a broad range of industries. The AE team, deployed throughout North America, Europe, and Asia, provides technical expertise and responsive and agile power solutions for thin-film and industrial manufacturing.