

Specifying your exact choice of power supply: alternatives to full customization

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Users of AC-DC and DC-DC power supplies are no longer tied to the selection of either a standard power supply or a full custom project. Power system designers can now benefit from flexibility and the ability to customize electrical parameters by using configurable and programmable power supplies as well as fast and low-cost modifications of the electrical and mechanical properties of standard power supplies.

This white paper explains how, through either route, power system designers can approach closer to their ideal power supply specification than is possible with a standard fixed power supply, while avoiding the long lead times, and minimizing the development costs, associated with a full custom solution.

There is an abundance of standard product offerings available from manufacturers of AC-DC and DC-DC power supplies. However, it is common for system design engineers to be faced with a gap between their ideal power supply specification and the closest fit available from the choice of standard products.

Power supply manufacturers' standard products are designed for broader market appeal to address various applications. It has been an industry practice to introduce commonly used input and output voltage ranges and combinations including output power ratings and form factors.

But for some users, a small variance to these standard preset power supply parameters can be valuable: for instance, a system that would ideally be specified for a power supply with a 12.5V output might be capable of accepting a standard unit's 12V output, with awkward modifications to the circuit design.

But for financial and commercial reasons, it would be preferable to avoid the modifications and to use a power supply with a 12.5V output.

For other users, the standard selection of input and output voltages and power ratings might be perfect. But the form factor of a standard power supply, its degree of ruggedization, or its thermal performance, might not be.

In fact, for any standard part, there are numerous ways in which the actual specification of the closest-fit standard part might deviate from a user's ideal specification. These include:

Electrical	Input voltage range, output voltage, output power rating
Thermal	Operating temperature range, output power derating, cooling requirement (forced air; conduction; convection cooled)
Mechanical	Footprint, input/output termination/connectors, IP rating, enclosure design, shock and vibration requirement

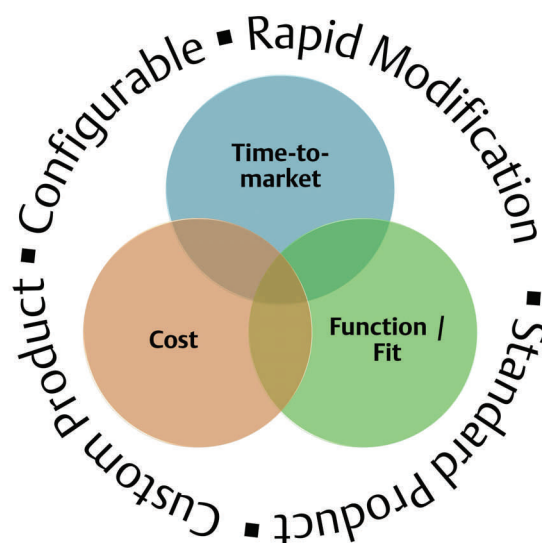
Any variances from the user's requirements can, of course, be eliminated – but with consequences which have to be taken into account.

Power supply manufacturers offer users the option of 'full customization' – the development and production of a custom power supply to the user's precise electrical, thermal and mechanical specifications.

The user thus procures their ideal power supply, but pays a penalty in terms of:

- Time to market – the time to develop a full custom power supply can extend to more than nine months
- Development and tooling costs
- Minimum order quantity commitment

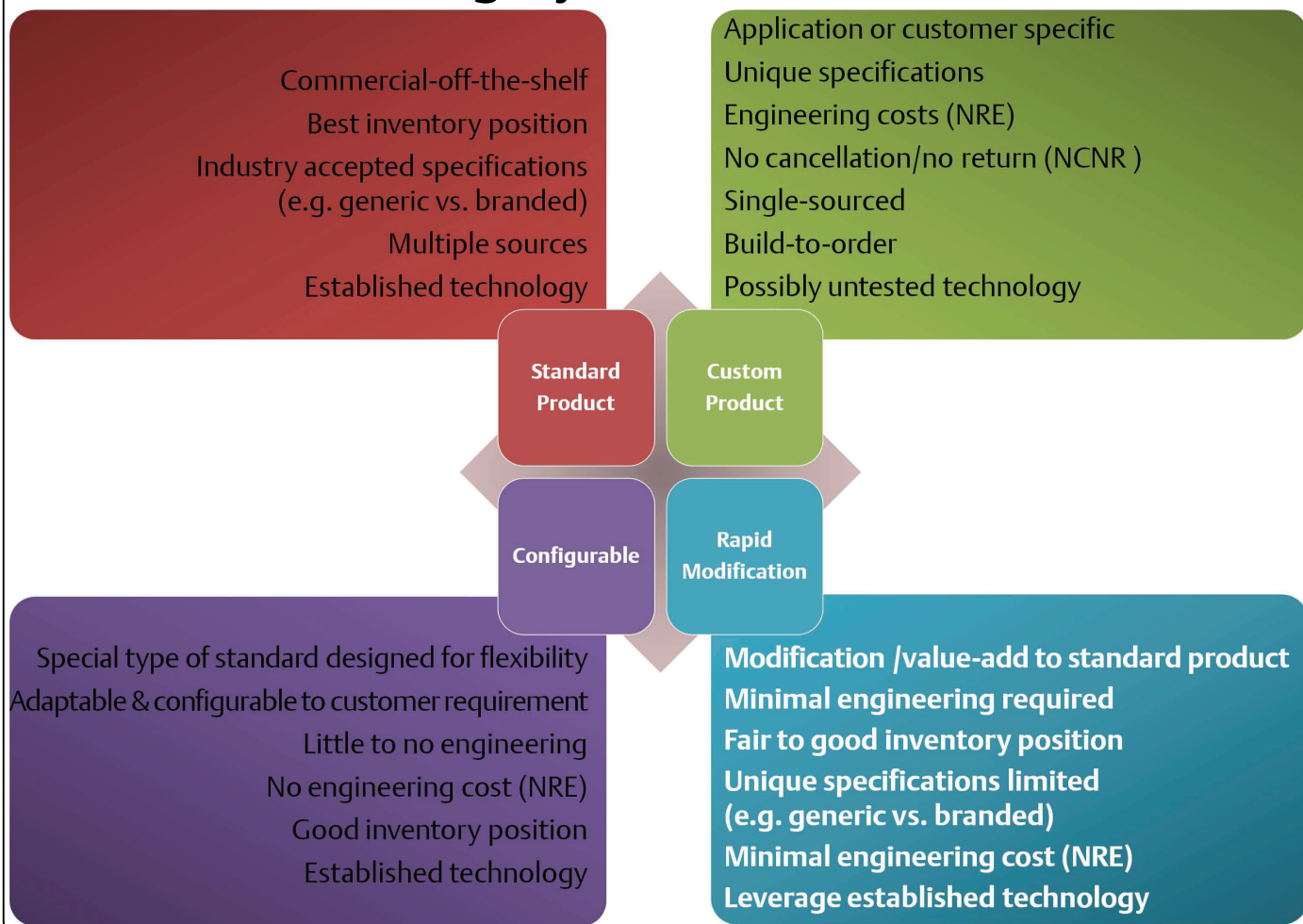
Traditionally, then, the user of power supplies has been faced with a choice between **time-to-market**, **cost** and **fit**.



Standard products offer immediate availability with no development costs, but might not always fit perfectly the user's electrical, thermal or mechanical specifications.

A full custom power supply will perfectly fit the user's specifications, but has drawbacks relating to time to market and development costs.

Power Solution Category Definitions



New options: two ways to optimize for cost and specification

There are sound reasons why power supply designers have traditionally been faced with a stark trade-off between cost and specification.

Full customization and the available choice of standard parts cannot cover every user requirement. Even in a portfolio as big as that of Emerson Network Power, one of the world's largest manufacturers of power supplies.

So is there a 'third way' which fits the gap between standard parts and full customization?

Through innovations developed by Emerson Network Power, it has been possible to significantly reduce the time to market and development costs associated with full custom programs, and to bring

customization capabilities into the standard product portfolio. In other words, Emerson Network Power has found new approaches which blend a measure of customization with standard products rapidly and cost effectively.

These innovations are configurable power supplies and rapid modification:

Configurable power supplies

Standard base units accept a variety of standard power modules, the output of which can be precisely configured in software by the user. Output voltages can therefore be fine-tuned to values unavailable in any portfolio of standard products. But because configurable and digitally programmable power supplies are based on

standard hardware elements, their unit costs are close to those of standard parts, and they are not subject to development costs.

Rapid Modification

By first defining a set of common customizations of standard power supplies which are frequently specified by different customers, and then building specific tools, equipment and processes to implement these common customizations, Emerson Network Power is able to both accelerate their execution and lower costs.

Using a **configurable power supply**, then, offers a form of customization at a lower development cost than that of a full custom power supply.

The customization is limited to electrical parameters (output voltage and, in the case of digitally programmable power supplies such as the iMP Series, other features such as over-temperature protection thresholds); the form factor and thermal properties of a configurable power supply cannot be customized.

Alternatively, when an existing standard product's specification approximates to, but does not fit perfectly, the user's ideal specification, **Rapid Modification** can quickly deliver a perfect or near-perfect fit at a low development cost.

Use cases: when is a configurable power supply an appropriate choice?

A configurable power supply combines some of the advantages of both standard parts and full custom units.

Like a custom part, a configurable power supply enables the design team to specify precise output power ratings that are not supported by standard parts, and to support more than the single or dual power outputs commonly provided by standard parts.

A configurable power supply is formed by the assembly in a common base unit of a number of

standard modules. This means that the configuration process is much quicker than the full custom design process, thus providing for a fast time to market, as a standard part does.

The base unit is designed to accommodate multiple modules, and to support up to 42 different output voltages concurrently.

Configurable power supplies from Emerson Network Power are suited to systems with a total power load of 300W or higher, and support output voltages in a wide range, from as low as 2V up to more than 60V.

Because of their large base unit and multiple -output capability, configurable power supplies are ideal for relatively complex systems which require more than two different output voltages: when one multi-output configurable power supply replaces multiple single-output standard units, the total bill-of-materials cost is comparable.



iMP series configurable power supply from Emerson Network Power

Flexible power supplies are available in the form of configurable power supply units (such as the MicroMP or μ MP Series from Emerson Network Power), and fully programmable power supplies (such as Emerson Network Power's iMP Series).

The fully programmable types provide more fine-grained control of output voltages, and greater flexibility in the control of electrical parameters such as protection thresholds.

But both types provide power system designers with flexibility during and after the product development process.

Having determined the appropriate input and output power range, the system design team can implement a board layout with a power supply footprint and connections that will remain constant for the life of the product.



μMP series configurable power supply from Emerson Network Power

Changes to output voltage or current values, or the addition of extra outputs, can be implemented through the selection of the appropriate modules and, in the case of programmable power supplies, through software changes to the digital control loop.



μMP series modules

Thus configurable and programmable power supplies offer the user the ability to customize the electrical specifications of a fixed-footprint base unit over a defined voltage range.

Use cases: when is Rapid Modification an appropriate choice?

A full custom power supply exactly matches the user's ideal specification across every parameter, including electrical and thermal behavior and mechanical and safety requirements.

Often, however, a standard product can almost match the user's ideal specification.

In this case, a power supply that exactly matches the user's ideal specification can be delivered by modifying the existing standard product. This is a markedly quicker, easier and cheaper process than the development and production of a full custom design, which starts from a clean slate.

This is the principle underlying the Rapid Modification service from Emerson Network Power. Tools, equipment and processes have been optimized to support the modification of standard products, bringing power supply customization within the reach of almost every customer.

This is because, unlike a full custom project, a Rapid Modification project entails low development costs, lower minimum order quantities and a short development time.

Operation of the Rapid Modification service

Rapid Modification can be applied to any standard product from Emerson Network Power, including flexible power supply types such as the μMP Series and iMP Series.

There are three levels of modification:

- Simple modifications are those which do not affect PCB layout or safety approvals
- Moderate modifications affect PCB layout, but have no effect, or only a limited effect, on safety approvals
- Complex modifications involve multiple changes to the base product, including

changes which affect PCB layout and other value-added operations. As a result of a complex modification, the power supply will require its own safety approval.

With a simple modification, a sample will be supplied to the customer within days of the order being placed.

With moderate and complex modifications, sample delivery can take longer, from a few weeks to months depending on the scope of the modifications. Unit and development costs (where applicable) are quoted individually for each design project, and compare favorably with alternative solutions.

In addition, users enjoy the comfort of knowing that their customized power supply is based on a standard part which has been proven in the field. Data on reliability and performance can be ascertained in advance, and so detailed product testing is not required to verify the system's performance.

Conclusion

Innovations from Emerson Network Power have provided two new choices for users of AC-DC and DC-DC power supplies: no longer tied to the selection of either a standard power supply or a full custom project, power system designers can now benefit from:

- flexibility and the ability to customize electrical parameters by using the μ MP, iMP and MP Series of configurable and programmable power supplies from Emerson Network Power
- fast and low-cost limited modifications of the electrical and mechanical properties of standard power supplies through Emerson Network Power's Rapid Modification service

Through either route, power system designers can approach closer to their ideal power supply specification than is possible with a standard fixed power supply, while avoiding the long lead times, and minimizing the development costs, associated with a full custom solution.



Emerson Network Power can rapidly modify many standard power supplies from it's wide range to suit your exact specifications.

Appendix 1: Emerson Network Power Rapid Modification Capabilities



Electrical Parameters

- Factory Vout Preset
- Low Noise
- Power & Efficiency Upgrades
- Hot Swap Control
- Inrush Current Control
- Integrated PDU Assemblies
- Compliance to Industry Standards



Connectivity

- Cable Wire Assemblies
- Connector Changes
- Busbar Design
- Overmoulding
- Interposer Boards



Packaging

- Conformal Coating
- Ruggedization/Shock & Vib
- Custom Chassis/Sled
- Mounting Plates
- Latch Mechanism
- Sealed/IP Rated Enclosures
- Customized Print/Marking/Labels



Communications & Control

- Logic Signal/Timing Changes
- Adaptive Fan Control
- Output Sequencing
- Peak Load/Efficiency Optimization

Appendix 2: Examples of Rapid Modification in practice

Simple modifications

Simple modifications involve no change to PCB layout. These modifications might be electrical or mechanical.

Examples of electrical modifications:

- Based on a standard power supply with a nominal 5V output, presetting the output voltage in the factory to 5.1V
- Modifying the firmware in a power supply equipped with a fan, so that the fan's speed (and the noise it generates) are reduced in stand-by mode

Examples of mechanical modifications:

- Replacing a power supply's standard enclosure with a customized chassis with special connectors
- Replacing a standard input connector with a cable wire assembly terminated with a customer-specified connector
- Applying a conformal coating

Moderate modifications

Moderate modifications involve changes to PCB layout, and have no or limited effects on safety approvals.

Examples include:

- **Power supply for semiconductor test equipment** – a programmable power supply was given a custom enclosure and interface, and the supply was programmed to provide specific up and down power sequences. Tightened output ripple specifications were applied.
- **Power supply for ATM** – the standard output connector was changed to a custom connector. Firmware changes enabled adaptive fan speed depending on the load. Logic signal and timing changes were applied. Additional safety certifications were gained.
- **Server power supply** – hot-swap capability was added, and an AC/DC connector added at the rear of the unit. The unit was given a custom sled and a latch mechanism.

Complex modifications

Complex modifications involve changes to the PCB layout which require a complete new safety approval.

Examples include:

- **Power supply for network switch** – an open-frame power supply was given a custom slide enclosure and fans. An AC inlet and new switch and output connector were also added. Emerson Network Power secured safety approvals for the modified product.
- **Power supply for in-flight entertainment system** – two brick power supplies were mounted on a single PCB. Addition of EMI filter, and design of sealed enclosure. Special connectors added. Emerson Network Power achieved compliance with RTCA-DO160 standard for the finished product.
- **Power supply for CT (medical) scanner** – programmable power supply's enclosure replaced with a custom enclosure, connectors and accessories. Complete unit ruggedized to withstand shock and vibration.

About Emerson Network Power

Emerson Network Power, a business of Emerson (NYSE:EMR), is the global leader in enabling *Business-Critical Continuity™*. The company is the trusted source for adaptive and ultra-reliable solutions that enable and protect its customers' business-critical technology infrastructures.

The Embedded Power business of Emerson Network Power, which embraces the well-known Astec and Artesyn brands, is one of the world's largest and most successful power supply companies.

The company's standard ac-dc product portfolio covers a power range of 25 watts to 5 kilowatts and includes open-frame and enclosed models, highly configurable modular power supplies, rack-mounting bulk power units, DIN rail power supplies and external power adapters. Many of these products are available in medically approved versions and a large number of the higher power models feature extensive built-in intelligence. A wide range of dc-dc power conversion products includes isolated dc-dc converters, covering industry standard sixteenth- to full-brick form factors and power ratings from 3 watts to 700 watts, and three application-optimized families of non-isolated dc-dc converters.

Renowned for their outstanding performance, reliability and cost effectiveness, Emerson power supplies are used extensively by OEMs and system integrators for diverse applications in the healthcare, communications, computing, storage, test and measurement, instrumentation, military (COTS), aerospace, LED lighting and industrial equipment industries.

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