

## Key Factors in Selecting AC-DC Power Supplies



### Three Key Factors in Selecting AC-DC Power Supplies: Efficiency, Packaging, and EMI Performance

As industrial automation, EV charging infrastructure, energy monitoring, and IoT applications rapidly expand, selecting the right AC-DC power module is no longer just a matter of wattage and specifications—it now directly impacts system efficiency, reliability, and compliance with international standards. This article focuses on three critical challenges engineers face during selection: efficiency, packaging, and EMI mitigation, and outlines how ARCH Electronics helps customers overcome these challenges and accelerate time-to-market.

#### ☑ Common Selection Challenges Faced by Engineers

- **Poor efficiency leads to overheating and thermal issues**

Particularly problematic in sealed control boxes or high-temperature environments, often resulting in power derating or fan failure.

- **Excessive no-load power consumption prevents compliance with energy regulations**

Especially relevant for IoT devices and smart meters that require <0.5W standby power.

- **Inappropriate packaging compromises integration and mechanical design**

DIN-rail mounting, board space limitations, and enclosure protection requirements must all be considered.

- **Excessive EMI causes certification failure and development delays**

Repeated redesigns and filtering component stacking increase BOM cost and delay project timelines.

#### ☑ Why Efficiency Matters

Power conversion efficiency impacts not only energy consumption but also system reliability and lifespan. For example, a 90% efficient power supply saves 5W of thermal loss per 100W compared to an 85% efficient unit. Over time, this significantly reduces energy waste and thermal management needs.

	Target Efficiency	Recommended Topology	Application Scenarios
<100W	85-90%	Flyback	Consumer Electronics, Compact Devices
100W-1000W	90-94%	LLC、Forward	Industrial Equipment, Communication Systems
>1000W	92-96%	Full-bridge LLC 、Phase-shifted Full-Bridge	Servers, Large-Scale Power Control Systems

**Practical Tips for Efficiency Optimization:**

- Choose modules with wide input ranges to minimize voltage drop losses.
- Design systems to operate at 60–80% load for optimal efficiency.
- Implement synchronous rectification and PFC in mid-to-high power designs.
- Select modules with low no-load power consumption to meet ErP or Energy Star requirements.

☒ **Packaging Considerations: EMI, Space, and Thermal Management**

Packaging impacts more than just mechanical integration—it affects thermal performance, EMI control, and installation flexibility.

Packaging Type Comparison (EMI / Space / Thermal / Cost)

Packaging Type	EMI Performance	Space Flexibility	Thermal Management	Cost	Recommended Applications
Power Module (Encapsulated)	Good	Small footprint	Relies on conduction	Moderate	Industrial controls, automotive, humid environments
Open Frame (PCB Mount)	Poor	Excellent (compact)	Good airflow, requires protection	Lowest	Space-constrained or cost-sensitive applications
U-Bracket (Metal Base)	Moderate	Moderate	Metal base assists heat dissipation	Moderate	Industrial systems, semi-open enclosures
Enclosed (Metal Housing)	Excellent	Least flexible	Good convection + grounding	Highest	Medical, high-EMI environments,

					stringent EMC demands
	EMI Performance	Space Flexibility	Thermal Management	Cost	Recommended Applications

Design Tip :

When selecting packaging, consider operating environment (moisture/vibration), space constraints (board/rail mount), EMI compliance (e.g., Class B), and cooling method (natural convection vs. chassis conduction).

**☑ EMI Mitigation: From Source Control to Design Integration**

EMI (Electromagnetic Interference) should be addressed at the beginning of the design process, not as a post-certification fix. ARCH advocates a four-level strategy for systematic EMI management:

- 1.Component Selection:**  
 Choose power modules with built-in EMI filters and pre-certified to EN55032 / FCC Class B.
- 2.Circuit Design:**  
 Optimize PCB layout: use short paths, single-point grounding, power/signal isolation, and add common mode chokes or Y capacitors as needed.
- 3.System-Level Layout:**  
 Ensure short cable runs, shield sensitive I/O lines, and separate power paths from signal components to prevent radiation loops.
- 4.Early Validation:**  
 Use simulation and pre-compliance EMI testing during early design stages to minimize redesign risk and cost.

**☑ EMI Standards Across Applications**

Application Area	Common EMI Standards	Requirement Level	Notes
Consumer Electronics	EN55032 / FCC Class B	Strict (residential)	Must prevent interference with nearby RF and wireless devices
Industrial Control	EN55011 / CISPR 11 Class A/B	Moderate	Class A for industrial; Class B for public environments
Medical Electronics	EN60601-1-2	Strict	Emphasizes interference immunity for life-critical systems

Communication / Energy	IEC 61000-6-3 / 6-4	Strict	Requires control of conducted, radiated, surge, and ESD EMI
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Tip: Selecting modules that already comply with the appropriate EMI standards for your market greatly simplifies your certification process.

☑ **ARCH's All-in-One Advantage**

- **High Efficiency Designs:**  
Many models achieve 93–95% conversion efficiency, reducing heat and simplifying cooling.
- **Diverse Packaging Options:**  
From encapsulated power modules to open frame, U-bracket, and enclosed types—suited for a wide range of system layouts.
- **Built-In EMI Protection:**  
All modules meet EN55032 Class B requirements, helping you pass CE/FCC compliance effortlessly.
- **Complete Safety Certifications:**  
Certified to IEC/UL/EN 62368, 60335, and other international standards for global market deployment.
- **Wide Temp & High Reliability:**  
Operating range from -40°C to +90°C, with high MTBF for use in harsh or outdoor environments.