System Reliability Center
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Power Supply Design Checklist

For many years power supply reliability has fallen short of expectations, especially when used in adverse environments. Today the situation is even worse as power supplies are being designed to exceed three watts per cubic inch, a challenge to construction and packaging techniques and part technology. And, since high density means more concentrated heat, the enemy of all components, power supply reliability problems will prevail. Design considerations for severe and benign environmental applications and possible solutions to review are included in the following tables.

Design Checklist (Severe Environments)

Items to be Addressed	Solutions/Recommendations
Transient Effects	
• **In-rush current**	Apply resistor-triac technique, thermistor technique
• **High-voltage spikes**	Apply metal oxide varistor (MOV) transient voltage suppressor
• **Short circuits**	Apply constant current and current feedback protection
• **Switching voltage transients**	Apply snubber circuits
Effects of AC Ripple Current	Consider use of electrolytic tantalum capacitors
Corrosion Due to Leakage	Avoid wet slug tantalum capacitors and use plating and protective finishes
Aluminum Electrolytic Capacitors	Epoxy end-seals minimize external contamination
Temperature Stability	Use low temperature coefficient capacitors (mica or ceramic)
Packaging Techniques	Enhance heat transfer, control electromagnetic interference, decrease parasitic capacitance
Saturation	Use antisaturation diodes (Baker Clamps) in conjunction with a switching transistor
Potentiometers	Replace with precision fixed resistor
Short Mounting Leads	Derate the operating voltage below 50% to prevent hot spots
Static Discharge Damage	Use antistatic grounds for manufacturing and maintenance
Field Effect Transistor (FET) versus Bipolar Device	FET's increase switching speeds but reduce drive capability
Junction Temperatures	Do not exceed 125°C
Mechanical Stresses	Use of vibration isolators/shock mountings, parts spaced to prevent contact during shock & vibration
Solder Joint Process	95% (goal) of solder joints should be made via automated process
Cooling	Conductive cooling to a heat exchanger is preferred

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Power Supply Design Checklist (Cont'd)

Design Checklist (Benign Environments)

Items to be Addressed	Solutions/Recommendations
Part Quality	Vendor selects best commercial practice parts
	Vendor selects screened industrial grade parts
Unit Quality	Vendor burns-in all units at higher temperatures
Part Derating	Vendor has in-house standards
Electrical Parameters	Vendor values exceed needs at temperature extremes
Failure Analysis	Vendor has failure tracking program
Protection Circuits	Vendor has built-in voltage and current sensors
Fault Flags	Vendor has built-in failure indicators
Reliability Experience	Successful operation in similar environments

Source:

- RAC Publication, CPE, *Reliability Toolkit: Commercial Practices Edition*.

For More Information:

- Rome Laboratory Report, 1991, RL-TR-91-39, "Power Supply Fault Tolerant Reliability Study."
- Department of the Navy Report, 1989, NAVMAT P-4855, "Navy Power Supply Reliability – Design Manufacturing Guidelines."
- Wright Laboratory Report, 1988, AFWAL TR-88-4143, "Applying AVIP to High Voltage Power Supply Designs."