

REDUNDANCY IN POWER SUPPLIES

ABSTRACT

There are many considerations to take into account when designing an electrical system for high reliability applications. Where reliability is critical, power supply failure is not an option. Failure of a critical component can render your electronic system inoperable in the event of failure and can even damage essential components in your system and cause serious damage. In critical systems where operators or patients lives are on the line the case for extreme reliability is clear.

Redundancy can solve many of your problems when it comes to protecting your system from failure.

WHAT IS REDUNDANCY?

In the world of power supplies a redundant system is simply an electrical system that has been designed to feature two or more of the same power supply. In the event that one of the power supplies fails the extra power supply will be able to take over the full operation of supplying power to the system or various subsystems and components as designed.

DEFINE RELIABILITY

Reliability can be quantified as a measure of the frequency of equipment failures over time. Reliability can have a major impact on repair and maintenance costs and system up-time. Failure rate is the number of units failing per unit time which is loosely linked to reliability.

We can define the reliability of a power supply as the likelihood that it will continue to operate for a given amount of time. Exacting standards and analysis exist to help design a product with high reliability. Power supply designers must take into account the power supplies operating environment and power demands. Our Advanced Energy applications team can examine a customer application and provide advice for best practice when installing and using our low voltage products. Helpful information regarding derating and MTBF can be found in our designer manuals online.

<https://www.advancedenergy.com/products/low-voltage-power-supplies>

WHERE ARE REDUNDANT POWER SYSTEMS COMMONLY USED?

Redundant power systems are commonly found in emergency, medical, security and communications systems, server rooms, and data centers. Deploying a redundant power solution is the most common way to increase system reliability. A redundant system can prove to be more cost effective in many cases than using an extremely expensive custom designed power supply.

Needless to say the cost of system failure when calculated against the use of a redundant system will convince any engineer to ensure power supply redundancy wherever appropriate.

Whenever the cost of power failure is high consider redundancy. This can include high end medical applications and military reliability requirements.



REDUNDANCY VS. RELIABILITY

In a system where one unit can support the load, and two units are used in parallel, the system is much more reliable than its component parts, since the system will still work even with one failed unit. Clearly, the probability of two units failing simultaneously is much less than that of one unit failing. This system would have a size and cost penalty, (twice as big and twice as much) so normally an N+1 system is used, where N units can support the load, but N+1 units are used in parallel, "2+1" or "3+1" being the usual combinations.

POWER SUPPLY FAILURE AND BLOCKING ELEMENTS

When a power supply fails in a system with multiple units in parallel a short circuit condition can occur on the output of the remaining supply or supplies. This can cause the remaining fully functional power supplies to go into a protective overload or shortcircuit protective mode which will in turn disable the entire system.

This is a worst case scenario and renders your redundant system ineffective. Blocking elements such as ORing FETS and diodes are used to introduce a high impedance which means that the failed supply cannot bring down the system. Careful selection and design of these components is required.

Our applications team can help to integrate a redundant power supply system safely into your system design. Contact Advanced Energy applications engineers for more details on including blocking elements in your system design or selecting a power supply for your redundant system.

CoolIX CS1000 power supplies feature internal blocking elements in the form of ORing diodes which will allow them to be used in a redundant system with no external components or extra

design hours. This makes the CS1000 power supply the natural choice for mission critical redundant power supply systems.

GUIDELINES FOR DESIGNING A ROBUST REDUNDANT SYSTEM

- N units must be able to supply full load in an N + 1 system
- Failure of any one component must not make the system fail
- If any component fails, this must be brought to the operator or system administrator's notice so that it can be replaced to ensure ongoing redundancy
- In some cases it may be a requirement to ensure that changing individual units must not make the system fail, referred to as "hot swap"

Electronic components can experience lifetime reduction as a result of stresses encountered during operation in a customer system. Some of the most common stresses include:

- Thermal stress (Environmental temperature or thermal stress from component heat)
- Environmental (Ingress of moisture dust and foreign bodies)
- Mechanical stress (Shock and Vibration)
- Electrical stress (Transients and power)

Reducing these stresses on system components will help to ensure high reliability over time.

COOLX POWER SUPPLIES AND REDUNDANCY

Advanced Energy low voltage power supplies are designed with high reliability in mind. Advanced Energy is the first choice for system critical power in cutting edge, world class designs. The CoolX range of power supplies while providing design winning features such as digital control and monitoring and robust and reliable power delivery also provide exceptional redundancy features.

The CS1000 features an internal Oring configuration which will prevent damage during a redundancy shut-down event. CS1000 internal ORing works quickly and effectively to prevent reverse energy from damaging vital power supply components. CoolX reliability and its robust feature set should make Advanced Energy low voltage supplies your first choice for redundant power systems.

LINKS

- [Advanced Energy Low Voltage Product Range](#)

REFERENCES

- <https://www.advancedenergy.com/globalassets/resources-root/white-papers/en-lv-redundant-power-supplies-white-paper.pdf>
- <https://www.advancedenergy.com/globalassets/resources-root/application-notes/en-lv-interpretation-of-mtbf-application-note.pdf>
- <https://www.advancedenergy.com/globalassets/resources-root/application-notes/en-lv-xgen-and-ultimod-platforms-in-harsh-environments-conformal-coating-application-note.pdf>



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