PROBABILITY AND REDUNDANCY

TECHNICAL WHITE PAPER

Process plants are striving now more than ever to reduce operational expenditures while increasing productivity and efficiency. Today's process engineers place a tremendous amount of emphasis on system integrity requirements. Why? Because it's a variable that can be controlled when the right equipment is in place.

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PEPPERL+FUCHS
PROTECTING YOUR PROCESS

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System Integrity Requirements

System integrity: State of a system where it is performing its intended functions without being degraded or impaired by changes or disruptions in its internal or external environments.

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System reliability is a calculation based on estimates. Certain procedures and component evaluations are used to predict the integrity of a given system or individual component. Each component of a system is evaluated individually and its probability of failure is estimated. The manner in which components are connected will influence the integrity of the system. For example a system component connected in series will have more probable impact on the system integrity than a more reliable parallel connection. Each component estimates are combined to provide an over all estimate to the probability of failure for a given system. Redundancy is used to add to the systems overall availability and reduce a given systems probability of failure.

Redundancy

Parallel Redundancy
Two or more system components are operating simultaneously. Only one component is required to be working for the system to operate, and it should continue to function at acceptable performance levels after the loss of any component. Both components must fail in order for a system failure. See figure 1.

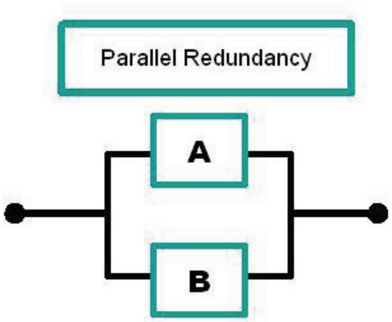


Figure 1

One or more system components are connected for redundancy but by default one is the primary in full operation. The secondary, by default, is not in operation under normal operating conditions. The switch from primary to secondary source is done to resume normal operations.

Standby Redundancy
In a standby redundancy configuration additional components are necessary to switch between the primary and secondary source. See figure 2. This switching is not seamless and adds to the probability of failure within a given system. To offset this increased probability, additional hardware can be added to the redundancy configuration to help assist in the switching from the primary to secondary source. While these system components add to the reliability, they are normally connected in series, which creates a hybrid parallel-series connection and introduces another point of failure for the system.

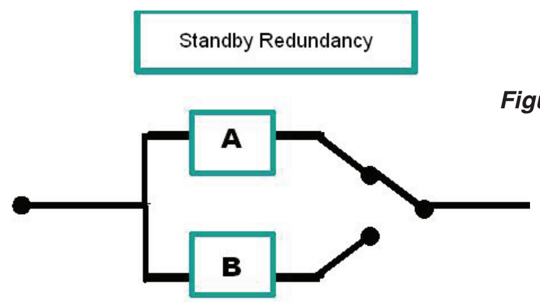


Figure 2

Redundant Power Supplies

Power supply redundancy is a very popular means to increase system reliability.
Industrial process facilities rely tremendously on the bulk power supplies because they not only power the control system architecture but also bus powered control and measurement instruments. These critical continuous production process applications require more than a single off-the-shelf industrial power supply. A single power supply failure could have a catastrophic effect that equates to a tremendous amount of lost revenue. This need for system integrity and guaranteed performance in these demanding conditions necessitates power redundancy. N+1 is an affordable redundancy method that guarantees system functionality will continue even during a supply failure.

N+1 Power Redundancy

In the simplest terms, N+1 is a robust power supply redundancy method that guarantees continuous system functionality in the event of a single power supply failure. With redundancy, a supply failure will not initiate an emergency repair situation; it can be replaced without shutting down the power system or the process. See figure 3.

With an N+1 redundant configuration, multiple components (N) have at least one independent backup component to ensure system functionality continues in the event of a system failure. In a power supply configuration, N represents the primary power supplies, and + 1 represents one power supply that is backing up that primary supplies.

The PS3500 is Pepperl+Fuchs' modular N+1 power supply. It provides economical reliability and redundancy to a power system. The balanced load sharing of the PS3500 enables all of the modules to share the load evenly. This load sharing functionality is built-in to each power supply, without the need for an external diode module. Balanced load share ensures that one power module is not working harder than another, adding to the longevity of the power supply modules. The PS3500 power supply is easily expandable in 15 A increments just by adding another module when the load requirement increases. The end result is a highly available and affordable redundant power solution.

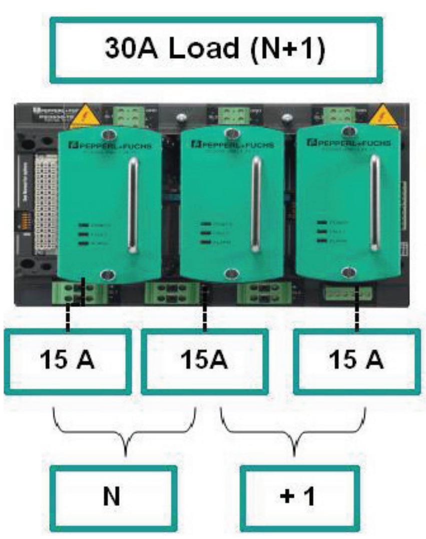
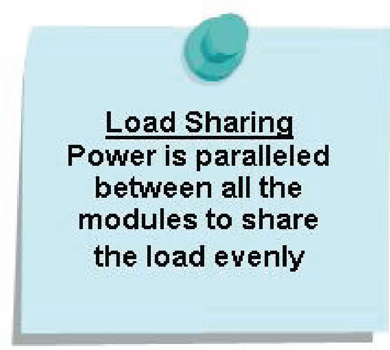


Figure 3
An N+1 redundant configuration



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N+N Power Redundancy

An N+N redundant topology consists of two power supplies of equal power coupled by a diode that work together to power the same load. N+N redundancy is an economical solution when a redundant power system is required; however this is not recommended for critical processes.

In an N+N configuration a diode module is required to connect the two power supplies. The use of diode modules will causes an unbalanced load on one of the power supplies requiring certain modules to work harder than others, resulting in premature aging of the power module. This failure results in increased maintenance and operating expenditures. In N+N configurations hot swapping in normally not permitted while in operation. See figure 4.

N+N is commonly used for noncritical systems. In practice, N+N is used for loads smaller than 40 A. It may be difficult to increase the load and even more difficult to expand your existing system. In an instance where you have an N+N system where N = 20 A, you would have to replace both 20 A modules if the load requirement became 30 A or 40 A.

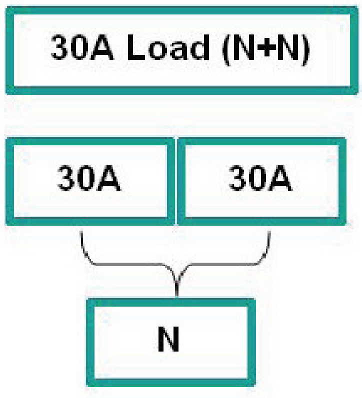
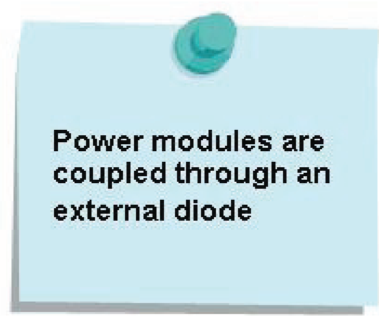


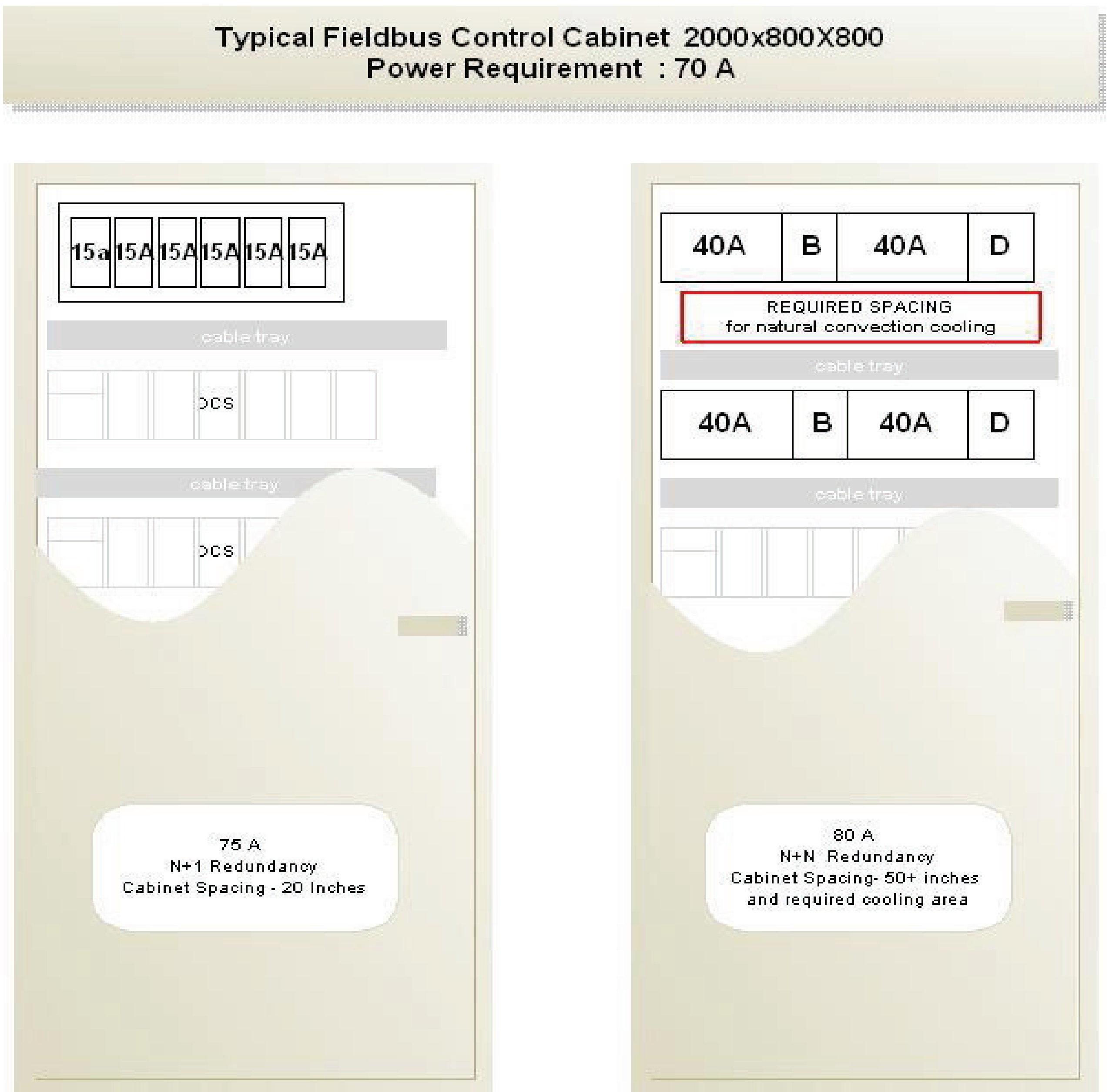
Figure 4
An N+N configuration



Redundancy Solutions

When considering power redundancy solutions:

- A typical field marshalling control cabinet (2000 X 800 X 800) has an average power requirement of 75 A. Every square inch of a marshalling cabinet exploited is to maximize the investment. Footprint and required spacing will have an impact on the amount of control network equipment.
- Lower cost doesn’t always equal lower total cost of ownership.
- The cost of one unplanned shutdown far outweighs the costs of redundancy.
- Buying the right tool for the job…continuous process application require continuous duty power supplies.
- Power module efficiency and heat dissipation
- Maintenance associated with internal fans



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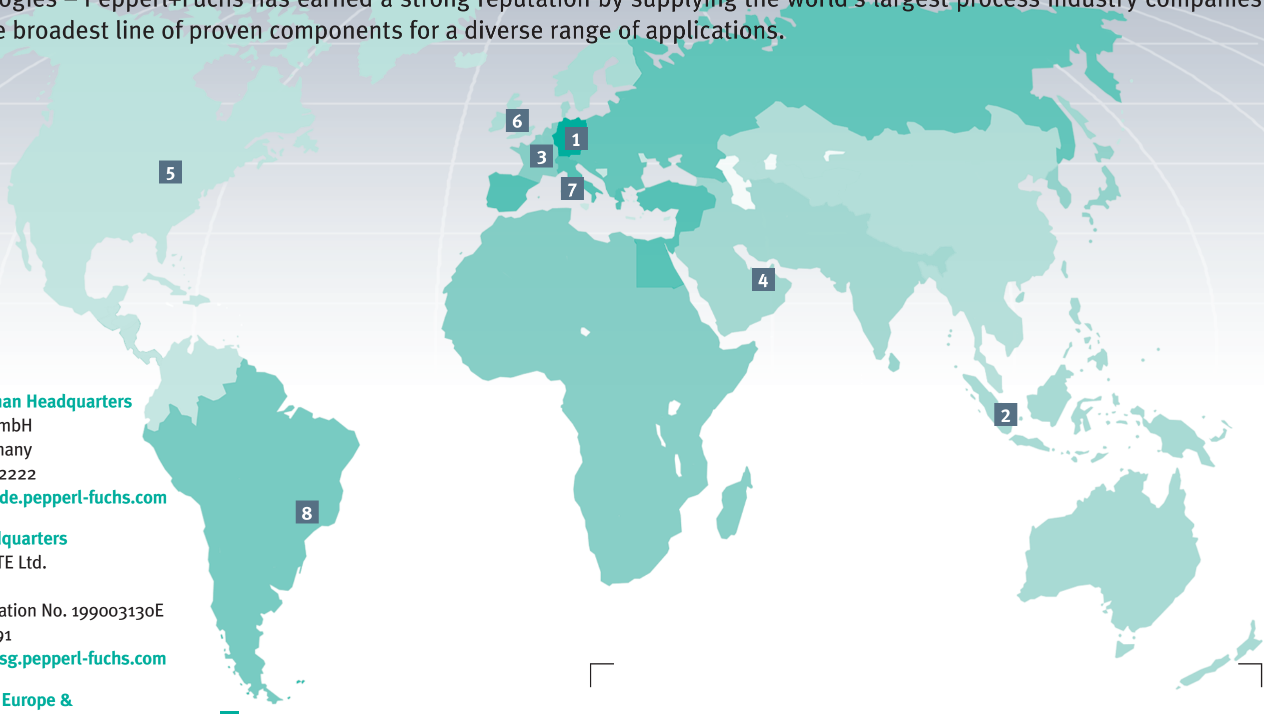
Notes

PROCESS AUTOMATION – PROTECTING YOUR PROCESS

For over a half century, Pepperl+Fuchs has provided new concepts for the world of process automation. Our company sets standards in quality and innovative technology. We develop, produce and distribute electronic interface modules, Human-Machine Interfaces and hazardous location protection equipment on a global scale, meeting the most demanding needs of industry. Resulting from our world-wide presence and our high flexibility in production and customer service, we are able to offer complete individual solutions – wherever and whenever you need us. We are the recognized experts in our technologies – Pepperl+Fuchs has earned a strong reputation by supplying the world's largest process industry companies with the broadest line of proven components for a diverse range of applications.



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