Advel Application Note – AAN2009.2

Rack systems in redundancy

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1. Introduction

Many of today's applications that require fault tolerant and redundancy, also require the ability to "hot" replace the failed power supply. The DIN power supplies does not have this feature in accordance with the security law EN 60950.
This feature requires power supplies specifically designed to avoid any primary voltage may come in contact with the user. It is also essential that the failure of a module is detected and identified by an alarm or an alert. The project must also protect the bus input voltage and output voltage transients generated during the replacement of the power supply.

2. Rack *vs* DIN systems

The rack systems (19" or other standard measures) manufactured by Advel are specially designed to allow the hot replacement of the faulty power supply modules.
However, redundant racks-systems offer many advantages over DIN-systems, in terms of accuracy and reliability.
A comparison is now performed for the characteristics of a redundant DIN-system (Figure 1) and a redundant rack-system (Figure 2) under the same load conditions.

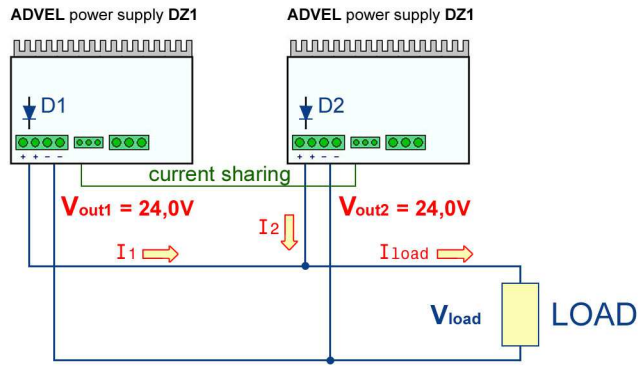

Figure1 *– DIN system with redundant power supplies Advel* ***DZ1****, 24V output*

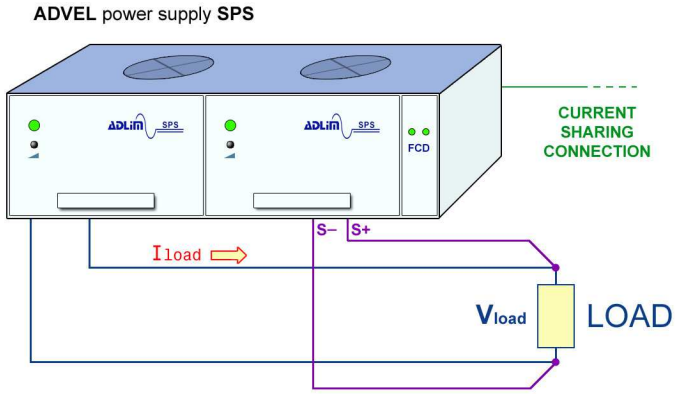

Figure2 *– Rack system with redundant power supplies modules Advel* ***SPS****, 24V output*

3. Wiring and maintenance

The wiring of the rack system is very simple, because the system is internally very well-wired and as per customer's request.
Instead, opting for a DIN solution, the wiring complexity (for the customer) increase with the complexity of the system (redundancy, multiple inputs, multiple outputs ...).
From the standpoint of maintenance, it has been already said that for a rack system all is much simpler: you can hot-swap faulty modules without interrupting the power supply and without risk.

4. Customer customization

In a DIN system there is only the signaling of fault of a power supply, in a rack system the alerts are completely customizable by the customer, and are innumerable (V_{in}, V_{out}, general fault, fault of single module, failed fan, high temperature, overloaded or unbalanced module...) and have a lot of LED signalings as well as contacts on terminals. In addition there is the possibility of including within the rack any circuit breakers, voltmeter and/or ammeter, earth fault alarm, ...

5. Accuracy of V_{out}

The power supply module for the rack and the DIN power supply, are electrically similar, but while the DIN power supplies have the local sense, located just before the output terminals, the rack systems can be equipped with remote sense (**S** + and **S-** connections in Figure 2), which can be placed directly on the load so that power supply can regulate its output voltage by

compensating the voltage drop ΔV_{wire} associated with the connection cables.
In Figure 1 (DIN system) we have:

$$V_{load} = 24V - \Delta V_{wire}$$

whereas in Figure 2 (rack system) we have:

$$V_{load} = 24V$$

thanks to the remote senses.
This feature allows greater stability of the output voltage to the load, even with long cables and/or sudden load changes.

6. System reliability

The reliability of the system depends heavily on:

- equitable sharing of the load current between the power supply modules (see **AAN2009.1**)
- operating temperature.

For the rack systems the calibration of the individual modules and the well done wiring, in addition to the active current sharing, ensure a correct sharing of the load current. In addition, the built-in ventilation (standard on all drawers, even if it's not necessary for the proper functioning of the system) with supervision of the functionality of the fans (**FCD**) ensure an operating temperature of the modules inside the rack without doubt lower than it has for a DIN system (heat transfer by natural convection).
For these reasons, the MTBF of the rack systems is certainly higher than that of a comparable DIN system.

7. Conclusions

As above, in a redundant power supply rack system is an obvious choice for critical applications where high reliability is required, easy maintenance and system security.
Of course, a redundant rack system is more expensive than a similar DIN system, but the greater initial cost is amortized over time.

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