Advel Application Note – AAN2015.1

New features of SPF power supplies series

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1. Introduction

In January 2015, the new **SPF** power supply series was born, produced by Advel.
It is a rack-mounting series of power supplies, but it is advisable to analyze the peculiarities of this new series and compare it with the classic **SPS** version.

2. Compactness

The most obvious difference between an **SPS** and an **SPF** rack is the power density:
for example a 19" rack_height 3HE **SPS** version can reach a maximum power of 2000W, whereas a rack of the same size **SPF**_version can reach a maximum power of 3000W, as shown below in Figure 1.

Rack 19"_3HE containing n.2 1000W **SPS** power supplies (total 2000W).

Rack 19"_3HE containing n.5 600W **SPF** power supplies (total 3000W).

***Figure1** – Direct comparison between two 19" racks (3HE) produced by Advel: the first is a classic SPS-series, the second is a SPF-series.*

In addition a 19" rack_heigh 4HE **SPF**, can accommodate inside n.5 1000W power supplies, reaching a total capacity of 5000W (NOTE: the 5000W version is not yet available now, but will be in production soon).

3. Maintenance

In general simplicity of maintenance is one of the strenghths of power supplies in rack-mounting version (see **AAN 2009.2**).

Fault of a power supply module:
If one of the power supply modules inside a rack fails, it is sufficient to remove the faulty module and insert a new one: this operation can be done without any line disconnection or system block, if the modules are equipped with HOT SWAP technology.
Both **SPS** and **SPF** modules are equipped with this technology.

Fault of internal fans:
If a fan fails in an **SPS** rack, the rack must be disconnected and opened to allow the replacement of the faulty fan. Typically this operation can be carried out during a programmed stop of the system, since the **SPS** racks are equipped with 2 fans but can also work without fans. Anyhow the operation of replacing a fan is simple but not very easy, in addition the FCD (Fan Control Device) alarm remains active until the failed fan is replaced.
Conversely in the case of a **SPF** rack, each power supply module has integrated its cooling fan, so in the event of a fan failure it is sufficient to remove the module and insert a new one, making the alarm disappear immediately.

Fault of a decoupling diode:
Each parallelable power supply is equipped with a decoupling diode. It is unusual that these diodes go in short circuit, however it is a possible failure, even if remote.
In an **SPS** system, these diodes, one per module, are wired inside the rack, so replacing one of these diodes involves, as in the case of a fan failure, the rack being turned off.
In an **SPF** system these diodes are located inside their module, so in case of failure of the decoupling diode it is sufficient to remove the module and insert a new one.

Ultimately in an **SPF** system the parts subject to failure are all mounted on the modules and therefore the repair operation is extremely simple and fast (Figures 2 and 3).

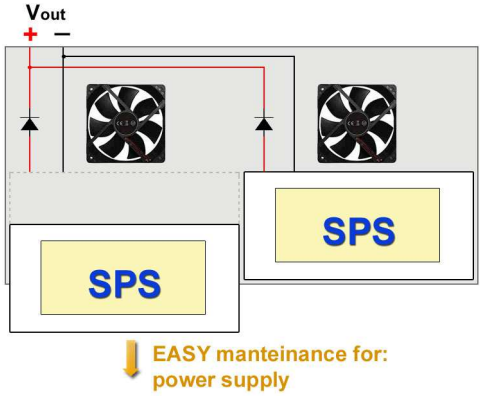

Figure2 *– HOT SWAP of SPS modules, however the fans and the decoupling diodes are not easily replaceable.*

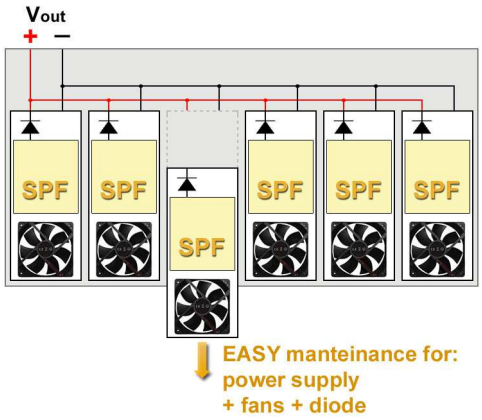

Figure3 *– HOT SWAP of SPF modules, which also contain the fans and the decoupling diodes.*

4. V_{out} accuracy

Each power supply tends to keep its output voltage V_{out} stabilized, at the point where the so-called "voltage sensing" is achieved.

In **SPS** systems, the senses are positioned exactly on the output terminals: this means that the output voltage V_{out} is very precise, even under high load conditions (Figure 4).

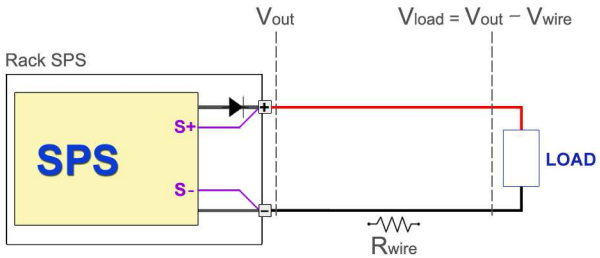

Figura4 *– In a standard SPS system, voltage sensing takes place on the output terminals of the rack. The voltage on the load is equal to $V_{out} – V_{wire}$ (NOTE: V_{wire} = voltage drop on the connecting cables).*

Moreover, always in **SPS** systems, it is possible to use the Remote Sense option to be able to position the voltage sensing directly on the load, to compensate the voltage drop on the connection cables, as shown in Figure 5.

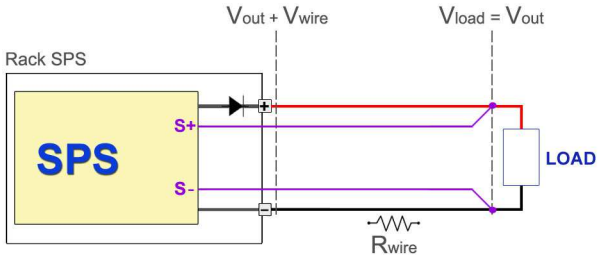

Figure5 *– In an SPS system with **Sense Remote** option, the voltage sensing is brought directly to the load, to compensate the V_{wire}.*

In **SPF** systems, the voltage sensing is positioned upstream of the decoupling diodes, then passing from no-load to load condition, immediately is noticed (at the output terminals of the rack) a voltage drop of about 0.2V (ie the typical voltage drop on the Shottky diodes). Furthermore, it is not possible to implement the Remote Sense option (see Figure 6).

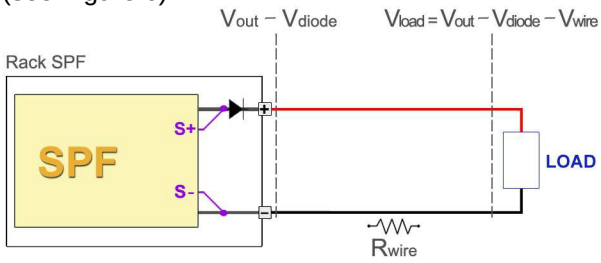

Figure6 *– In an SPF system, the voltage sensing is always positioned upstream of the decoupling diodes, so it is not possible to compensate the voltage drop on the decoupling diodes or on the connecting cables.*

5. Hold Up time

Hold Up time is defined as the maximum period in which a power supply can maintain the V_{out} voltage within the specified values in absence of the input voltage.

The current European standards (**EN60950, ICC1000-4-11**) impose a Hold-Up time equal to a sinusoidal network voltage cycle, ie 20msec, for power supplies with 115-230Vac_50Hz single-phase input.

The **SPS** power supplies series guarantees, in a 100% load condition, a Hold-Up time equal to 100msec. This characteristic derives from the presence inside the **SPS** modules, of rather large electrolytic capacitors.

The **SPF** series power supplies, on the other hand, guarantee a hold-up time of 50msec at 100% load.

Naturally, a longer Hold-Up time guarantees greater resistance to the so called “input voltage holes”, but typically customers do not require a Hold-Up time greater than 50msec, except in very special cases. One of the reasons for the smaller size of **SPF** power supplies, compared to **SPS**, derives precisely from the smaller electrolytic Hold-Up capacitors inside it.

However, 90% of the power supplies on the market offers a Hold-Up time of just 20msec, which is the minimum required by the regulations.

6. Input and output voltage availibility

All power supplies produced by Advel typically have a wide range of choice for input and output voltages, even at the customer's specific request.
However, while for the **SPS** series DC/DC power supplies the maximum output voltage per single power supply can not exceed 150Vdc, output voltages up to 300Vdc can be reached for the **SPF** series DC/DC power supplies.

7. Signalings and setup

Both the modules of **SPS** and **SPF** series have several led indicators on the front (LED ON, FCD alarm, temperature alarm, ...).
The **SPS** modules have, in addition to the **SPF** modules, an "unbalancing LED" which indicates that the module is unbalanced with respect to the others in parallel. In any case, both series are equipped with Active Current Sharing, and therefore it is very rare that the parallel modules are unbalanced, except perhaps due to a very rough initial calibration.

The **SPF** modules have, in addition to the **SPS** modules, a trimmer for the regulation of the alarm thresholds of the single module: this trimmer can be useful in case, by calibrating the V_{out} of the modules at a slightly different voltage than the $V_{out\text{-}rated}$, the alarm intervention thresholds should also be calibrated accordingly.

8. Available options

There are several options for the **SPS** and **SPF** racks, but the latter can not provide circuit breakers, voltmeters/ammeters, insulation resistance monitors, ... just for obvious reasons of space.

9. Conclusions

The power supplies of the two racks series produced by Advel were compared directly: the traditional **SPS** series, and the new **SPF** series. The particular characteristics of the two systems are summarized in Table 1.

	Sistema SPS	Sistema SPF
Indicative photo rack 19"		
Power density	*Max 2000W for rack 19"*	*Max 3000W for rack 19" (3HE)* (*)
Maintenance	*Easy for replacement of modules, not easy for replacemente of fans and decoupling diodes*	*Very easy*
V_{in} availability	*88 ÷ 264Vac* *24Vdc (max P_{out} = 1200W)* *48Vdc (max P_{out} = 1400W)* *110Vdc (max P_{out} = 2000W)*	*88 ÷ 264Vac* *24Vdc (max P_{out} = 3000W)* *48Vdc (max P_{out} = 3000W)* *110Vdc (max P_{out} = 3000W)*
V_{out} availability	*24 ÷ 150Vdc*	*24 ÷ 300Vdc*
HOT SWAP technology	*YES*	*SI*
Active Current Sharing	*YES*	*SI*
"remote sense" option	*YES (optional)*	*NO*
IN/OUT switches	*YES (optional)*	*NO*
Voltmeter/ammeters	*YES (optional)*	*NO*
Version -CB (battery charger)	*YES*	*YES (optional)*
T_{MAX} without derating	*60°C*	*60°C*
Reliability	*Very high*	*Very high*

(*) Max **5000W** for rack 19"_4HE, version available soon by Advel.

Table1 *– Direct comparison between the main features of the two rack 19" series of power supplies produced by Advel: SPS and SPF.*

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