AN005

Fan Cooling and DIN Rail Power Supplies

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1 Introduction

Modern DIN rail SMPS applications may require as main features:

a) compactness
b) reliability
c) cost effectiveness
d) use in unconditioned environments

DIN rail power supplies have been launched in Germany about 30 years ago.

There was no major constraint on the size of the units and their efficiency because the ingenious DIN rail fixing method already solved many problems related to the easiness of installation and operation for various devices used in the industrial automation at that time. The use of DIN rail SMPS was still not popular in space critical markets (like Asia) or applications (like various machine tools).
At that time the forced cooling by fans was somehow restricted to special power supplies as TELECOM, laboratory, transportation, mainly due to the fact that high reliability fans were relatively expensive and in many cases they needed programmed replacement.
Traditionally, the German brands have promoted the natural cooling for industrial DIN rail, replicated by most of the Asian manufacturers.

2 Concerns and solutions regarding the fans in DIN rail SMPS

The main concerns were related to:

1) Reliability of the fans (life time)
2) Size
3) Noise (audible and electrical)
4) SMPS behavior in environments with conductive dust

Whilst 4) remains a valid issue (but potentially dangerous also for natural cooling based systems), 1), 2) and 3) are by far solved since long time by:

1) Use of ball bearing or MAGLEV models (as NEXTYS does), with proper sealing of joints. Expected life time is >>50000h. There are even IP67 models available on the market.
2) Use of electronic control of the motors
3) Use of PS thermal/load regulation for ON/OFF and speed, means discontinuous operation, increasing the life expectation
4) Use of “low noise“ propeller profiles

Fans mounting methods have been improved a lot and there are several size standards available on the market, that ease the integration in the design of the power supplies.

3 Advantages of using the fans in DIN rail SMPS

The progress of technology brought good efficiency and compact solutions for SMPS< 500 W, based on natural convection cooling.

Whatever would be the technology and the efficiency of a SMPS there will be always heat dissipating parts as: magnetics, semiconductor power parts (diodes, transistors), resistors, etc.

For power levels > 500W the dissipated power even with 96% of efficiency (not yet a market standard…) would be > 20W.

The problem is that this heat is not concentrated in parts that are fixed to a heatsink (like power semiconductors), but it is also present in parts not easy to cool by natural convection: magnetics, capacitors, PCB, resistors, etc.
This has as consequence the existence of some hot spots with related stress of specific components.

The traditional approach of using “silicon and aluminum“ has some drawbacks:

1) Size of the SMPS
2) Requested skills for correct positioning of the heat generating parts for getting the best airflow
3) Cost of the parts
4) Non uniform cooling of dissipating parts, with consequent hot spots
5) Important induced heat through PCB, that cannot dissipate well just by natural convection
6) Impossibility to comply with certain high temperature environments

The use of fans, especially for units > 500W solves elegantly the above problems and brings many benefits as:

1) Increased life time of the SMPS, due to cooling of temperature sensitive parts as electrolytic caps and magnetics, otherwise not efficiently cooled
2) Extension of the operating temperature range and possibility of use in high temperature environments
3) Decrease of size
4) Cost effectiveness

The main risks in implementing/using the fan cooling are:

a) *Thermally underrating some parts*
Solution: all power parts are rated to work for a limited time at full load and a temperature < T max. with no fan cooling. Means the rating is considering the fan failure.
b) *Not providing proper power supply/ control of the fan*
Solution: The fan is powered by a separate power supply, not depending on the main converter status. The fan operation is thermally and load regulated.
a) *Not providing thermal protection to the unit*
Solution: all fan cooled units are provided with thermal protection implemented by hardware circuitry, with no power needs.

All the above risks are minimized by NEXTYS designs.

4 NEXTYS experience in fan cooling

Fig. 1- 960W SMPS

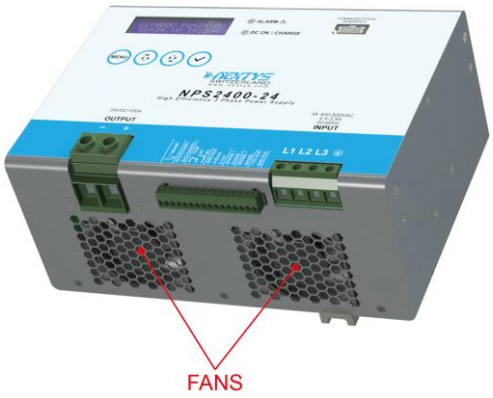

Fig. 2 - 2400 W SMPS

NEXTYS has designed and sold since 2008 up to date > 50'000 pcs SMPS (various models rated 720, 960 and 2400W – see fig. 1, 2 as examples of design) that use forced cooling by DC fans.

Until now there is no reported failure of a fan!

As a further proof that fan cooling should be not a concern for DIN rail we can consider that TELECOM, server power supplies and other critical applications use the fan cooling with excellent results.

Traditionally oriented European producers are slowly changing to forced cooling for high power or high temperature range units, offering a compact, cheap and long life alternate solution to the existing designs.

Due to various advantages as shown above NEXTYS is supporting the forced cooling for the units >500W.