SWITCHING POWER, INC.
Regulated D.C. Power

SPI-APPNOTES: COOLING METHODS, CONSIDERATIONS

Heat must be removed from a power supply to keep its components operating within their maximum rise temperatures. Generally, lower component case temperatures will yield greater longevity and improved reliability of the components and the power supply as an assembly, so proper cooling must always be a key consideration by system and the power supply designers.

There are three basic cooling methods: forced air, conduction, and convection. Often a combination is used. For example, a ‘U’ channel power supply may require 30 to 60 CFM, but if the supply is fastened to cooler sheet metal in the system the supply’s components can operate at further reduced rise temperatures.

Power supply efficiency should be taken into consideration. A more efficient supply provides several key advantages:

- The system can have a lower rise temperature.
- The system’s burden of heat removal can be reduced.
- Power supply components will be cooler with less cross heating.

COOLING METHODS DESCRIBED:

Forced Air Cooling: Most commercial and industrial grade switching power supplies over 100 watts require forced air cooling. Manufacturers typically specify the amount of forced air required in CFM. The air can be provided by system fans or by the power supply manufacturer in the form of fan(s) on-board the power supply.

Conduction Cooling: In certain telephony, telecommunications, and military requirements fan cooling is not acceptable. In these applications, conduction cooled power supplies have become widely used. Internal components conduct their heat into aluminum extrusions and base plates and require no forced air. Watt for watt, conduction cooled power supplies are generally more costly than forced-air cooled supplies.

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Convection Cooling: Heat dissipating from the power supply's components into the surrounding air with little or no air movement is sometimes the main vehicle for heat removal. Fixing the power supply to a metal surface is highly desirable in these cases to benefit from some amount of cooling via conduction. Employing the most effective natural convection cooling techniques is important. Plan to keep the power supplies away from other heat generating or heat sensitive components to the greatest extent possible. Orient the power supply so that its heat will rise above it and not stay trapped. Vertical mounting may be best. Lying the supply flat is the least effective mounting to get the heat to rise out. Deration of the power supply is usually required when convection cooling. This, unless the supply was specifically designed for convection cooling. Here the power supply designer will implement internal deration, select higher temperature components, and use more heat sinking. In any case, convection cooled supplies are more costly than forced-air cooled supplies.

TERMS DEFINED:

CFM: Cubic Feet per Minute is the most often used measure of airflow available to cool power supplies and other electronic components and devices. Fan manufacturers specify the volume of air delivered in CFM.

LFM: Linear Feet per Minute is the volume of air passing through a specific cross sectional area. Power supply designers often prefer LFM because it describes where the air flows and its potential to remove heat.

Conversions: Use the example of a Switching Power model TR-500 with no fans attached. Its dimensions are 9.65 x 5.0 x 2.05 inches. The model is specified to require 30 CFM of forced air through the chassis end to end, so the air inlet opening is 5.0 x 2.05 inches.

Convert CFM to LFM…

CFM / Cross Sectional Area in Square Feet = LFM
Example: 30 CFM / [(5.0 inches x 2.05 inches) / 144 inches^2] = 422 LFM

Convert LFM to CFM…

LFM * Cross Sectional Area in Square Feet = CFM
Example: 422 LFM * [(5.0 inches x 2.05 inches) / 144 inches^2)] = 30 CFM

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