LOW VOLTAGE POWER SUPPLIES AND CONVECTION COOLING

ADVANCED ENERGY LOW VOLTAGE RANGE

Advanced Energy offers a range of low voltage power supplies across a range of power specifications. Power supplies are available as modular or single output. XGen and Ultimod power supplies offer modular configuration and analog control signals. XSolo power supplies offer single output power while CoolX power supplies offer the most advanced and efficient solution in modular or single output designations. See the Advanced Energy website for full details.

POWER SUPPLIES

The CoolX range of power supplies support a wide variety of high-end engineering applications that require extreme reliability and performance. Our high density, low voltage power solutions help simplify system integration and enable rapid design and development to reduce time to market.

The CoolX range features several fan-less power supplies including the single output CS1000 which offers up to 1000 Watts of output power.

TYPES OF COOLING

Two basic types of cooling exist for power supplies : Convection and conduction.

While conduction cooling relies on the use of a heatsink, convection cooling can make use of fans if required or simply use the air surrounding a power supply to naturally cool components.

Cooling a power supply by using a fan to move air is known as ‘forced convection’. A power supply which cools by using natural air flow is cooled by ‘natural convection’.

CONDUCTION

Conduction cooling is the transfer of heat from power supply to thermally conductive material such as a heatsink. Advanced Energy power supplies can be heatsink mounted. Various heatsinks exist for different applications. Heatsinks installed in a system with forced air cooling are of a different design to purely conductive heatsinks for example.

While Conduction cooling may allow the CoolX to operate at higher ambient temperatures CoolX supplies have been designed to supply full power with convection cooling only.

NATURAL CONVECTION

Natural convection cooling uses no forced air and relies on the dispersion of heat by the natural movement of air. This a result of thermal transfer due to fluid dynamics. As air rises due to heat cooler air takes it place thereby cooling the components of a working power supply.

With the removal of forced air to cool the power supply the product lifetime is also greatly increased. Fans are often the first components to fail in a powersupply due to wear and tear on moving mechanical parts. This leads to much more favourable 'Mean time before failure rates'. See our MTBF app note for more details on Mean time before failure.

https://www.advancedenergy.com/globalassets/resources-root/application-notes/en-lv-interpretation-of-mtbf-application-note.pdf

POWER SUPPLY ORIENTATION

The orientation of a power supply can affect its thermal performance. Using the supply with the base plate facing down, or mounted on a sidewall is generally preferred, with sidewall mounting providing best thermal performance. Sidewall mounting reates a 'chimney effect' where heat can be dissipated throughout the length of the vertically mounted power supply. Mounting a power supply upside-down should be avoided and will give poor performance.

FORCED CONVECTION

Forced convection can also be described as forced air cooling. During forced convection a fluid is forced to move by some mechanical means creating an artificially induced convection current.

A fan cooled or forced air cooled power supply will usually have air diverted to components for cooling by means of an electrical fan.

This can be useful for high power applications or in enclosed spaces, however one major disadvantage of using forced air is the reduced mean time before failure that comes with using a mechanical component.

In reality a fan cooled power supply will be cooled by a combination of forced and natural convection. This is referred to as mixed convection.

Newton's law of cooling is sometimes referenced as a general scientific description of convection cooling.

While Conduction or forced air cooling may allow the CoolX to operate at higher ambient temperatures CoolX supplies have been designed to operate using convection cooling only.

NEWTON'S LAW OF COOLING

'The rate of heat loss of a body is directly proportional to the difference in the temperatures between the body and its surroundings.'

CONVECTION VS. CONDUCTION

Great care must be taken by system designers when deciding on the placement of a power supply. Any air movement which already exists in the system can be utilised for power supply component cooling and conversely any forced air passing over the power supply or originating from the power supply itself will spread heated air throughout the system enclosure.

Lots of space for air to re-circulate can help cooling at a system level. Ventilation to allow cool air to enter the system is essential. Placing a power supply in a sealed box can lead to thermal runaway and the power consumption of the supply will have a big impact on temperature. Powersupply derating due to high temperatures should also be taken into account. See our designer manuals online for more information on thermal derating and Advanced Energy low voltage products.

https://www.advancedenergy.com/products/low-voltage-power-supplies/acdc-low-voltage-power-supplies/

PRODUCT LIFETIME

While conduction and natural convection methods are suitable for many designs, forced air may be required for more demanding applications. Some systems may already have forced air in place and in these instances the placement of the power supply will drastically affect the outcome.

Advanced Energy offer a range of fanless CoolX supplies including the CoolX 600, CoolX 1000 and CS1000. These no fan featured power supplies have the advantage of longer liftetimes typically than a fan cooled power supply. Due to the nature of fans as an electro mechanical component 'mean time before failure' is lower than that of standard electrical components. What this means is that the moving parts in the fan are a significant contributor to the lifetime fo the fan and the system into which the fan is designed.

For further information on mean time before failure (MTBF) see our application note on the Advanced Energy website.

https://www.advancedenergy.com/globalassets/resources-root/application-notes/en-lv-interpretation-of-mtbf-application-note.pdf.

WHEN TO USE CONVECTION COOLING

When designing an electrical system that requires cooling the method of cooling chosen will depend variously on any existing airflow within the system and power consumption of the chosen power supply as well as heat dissipated by other components within a system.

Where natural convection is possible CoolX no fan featured power supplies can provide reliable future proof options with extended lifetimes.

A natural convection cooled power supply can be used in a low noise application if required to provide patient comfort in medical designs or any system where low audible noise is a requirement.

Existing airflow can be utilised to help cool your Advanced Energy power supply and should be considered in your design. Gathering thermal data through test is the best way to qualify your design.

For applications that require high power or improved thermal performance convection cooling or forced air can be used independently or combined.

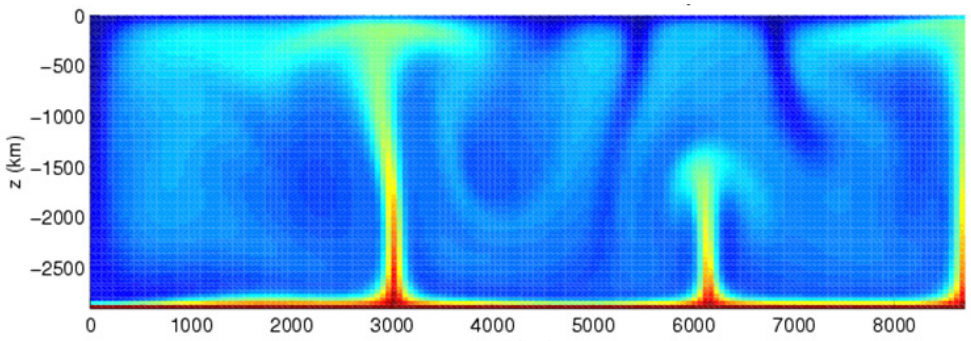

Fig. 1 Simulation of thermal convection. Red hues designate hot areas, while regions with blue hues are cold.

Advanced Energy applications engineers can guide you and provide test data where possible to help you finalise your design. Contact Advanced Energy for more information.

REFERENCE

- https://en.wikipedia.org/wiki/Convective_heat_transfer
- https://www.advancedenergy.com/globalassets/resources-root/application-notes/en-lv-thermal-management-application-note.pdf

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