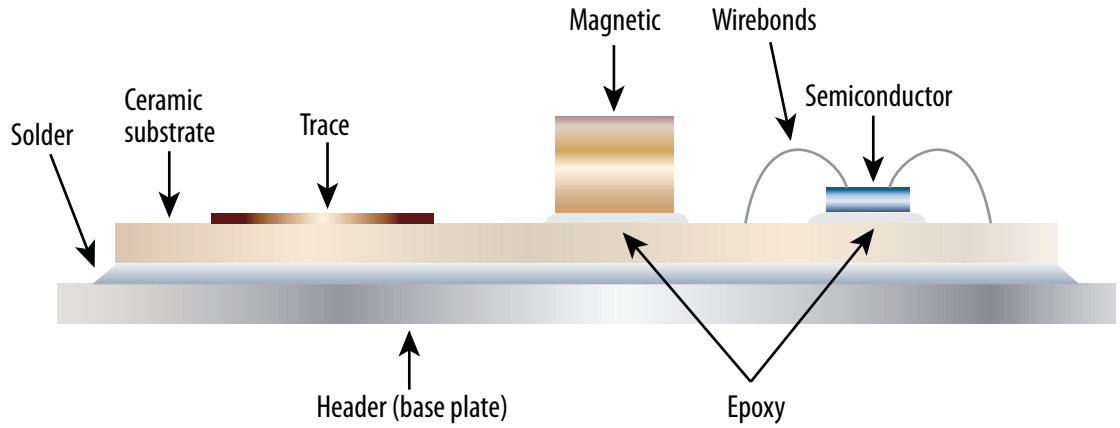
Application Note 3

Recommended Mounting of IPC Hybrid DC-DC Converters

Introduction

Hybrid DC-DC Converters are power supplies that are fabricated with bare die as compared to using packaged parts. Elimination of the intermediate packages allows the size of the DC-DC Converter to be dramatically reduced and ensures that a minimum of heat that would normally be trapped inside the package. All parts are mounted on ceramic substrates which are well attached to the base plate of the package.



Above is a typical representation of components of a Hybrid DC-DC Converter.

IPC metal packaged converters have compression glass seals around the pins and, as such, should be handled carefully to protect the integrity of the seal. For example, dropping a part on a pin from even a short distance can result in cracking of the glass bead and consequent loss of the hermetic seal. A significant drop with contact on almost any part of the metal case may result in permanent seal or other type of damage. Anything that bends or twists the pins may fracture the glass, possibly cracking the substrate.

Never cut an unsupported pin with a pair of side cutters or by other means. To cut pins before mounting the part on a PC card or other structure, the pins must be supported. A gauge block or other tool which slips over the pins, should be used for support. Once this is done, the pins can be cut or sheared with a sharp blade. If the part is mounted and soldered on a PC card before cutting the pins, the solder joints will provide the support for safe cutting.

Heat in the converter can be transferred by conduction (heat flow through solid material), convection (heat flow through air movement) and radiation to a cooler surrounding. Unlike some larger power supplies, hybrid DC-DC Converters are designed to be cooled by conduction cooling. Specifically, heat generated by the operation of the DC-DC Converter is designed to be removed from the base plate of the package by conduction cooling, which is commonly known as heat sinking.

Determining how much heat is generated can be calculated by dividing the delivered power by the efficiency and then subtracting the delivered power. Dissipation may increase when the part is short circuited or overloaded. The efficiency may drop when the part is lightly loaded compared to full load ratings.

IPC DC-DC Converters are rated at various base plate temperatures. It is the responsibility of the design engineer to assure that the base plate temperature of the converter does not exceed the rated value. The power dissipation of the elements is spread over a broad area . The thickness of the substrate and hybrid package does a good job of spreading the heat over the hybrid base plate area.

In order to get the maximum benefit out of our hybrid, or maximum reliability, the surface on which the hybrid is mounted must be maintained at or below the hybrid's rated temperature. If the heat sink below the hybrid is very thin, the area under the DC-DC Converter's base plate will be hotter than necessary. Also, a thin heat sink may not conduct heat away from the hybrid very well, in areas not below the DC-DC Converter. Sometimes the heat sink is very thick and connections to the DC-DC Converter's pins are difficult to wire. In this event, the heat sink should be locally counter bored in the vicinity of the pins.

Scenarios to avoid:

Running the Converter without a heat sink:

This is commonly done during incoming inspection. The hybrid DC-DC Converter's small thermal mass allows the temperature to rise rapidly to high temperatures that may exceed the DC-DC Converter's rating.

Using a printed circuit board as a heat sink:

A printed circuit board or copper traces on the printed circuit board will conduct heat. However, the thermal resistance may be very high. Special types of boards that have higher thermal conductivity are available. The mistake made in this instance is in using a printed wiring board as a conductive heat path, but not computing the thermal resistance of this path to the heat sink.

Connecting a heat sink to the top of the case:

The top of the case is typically quite thin and only attached to the base plate at the periphery of the base plate. Therefore, heat is conducted from the base plate to the case, however, the thermal resistance is less than optimum. This results in unsatisfactory part utilization, except in the case of a very low output power.

Using a heat sink that is too small or too thin:

The temperature drop from the base plate to the ultimate heat sink is too high because the thermal resistance is too high for the power flux and the desired temperature rise through the heat sink. Therefore, the converter operates at an unsatisfactorily high base plate temperature.

Trying to cool by convection or radiation in thin air or vacuum:.

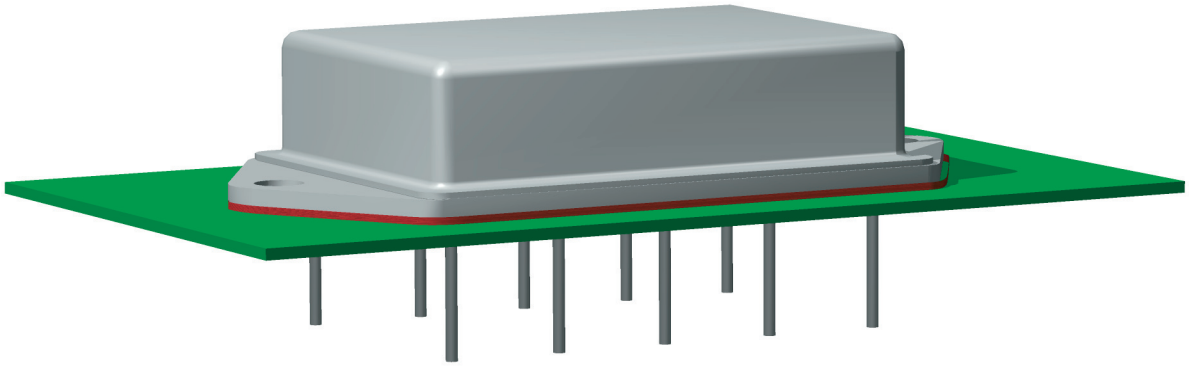
In high altitude aircraft applications, the air available for free convection is practically nil, therefore to be conservative, all conduction should be designed to be satisfied by conduction cooling.

Controlling the temperature of the mounting, not the base plate of the DC-DC Converter:

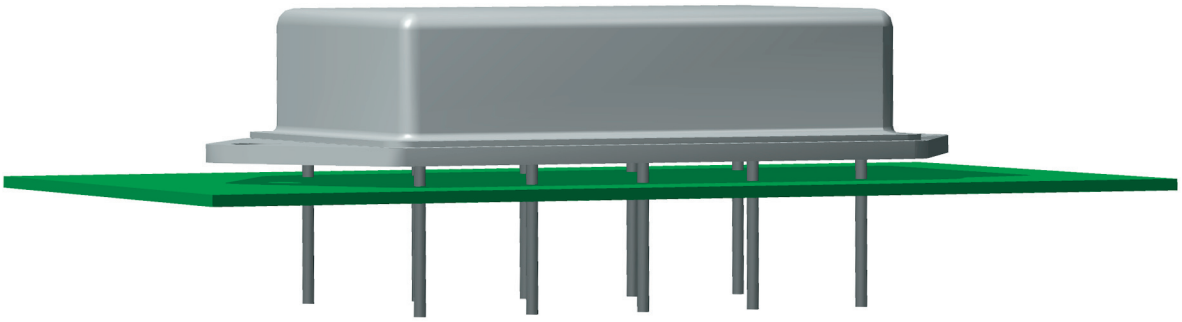
The heat of the base plate of the DC-DC Converter is the controlling variable for controlling the temperature of the internal components. Controlling the heat of the mount ing surface alone is not sufficient. Moreover, as heat flows from the DC-DC Converter through to the underlying heat sink, the temperature of the underlying heat tends to be increased by the heat flux. This must be accounted by the analysis.

Mounting a high power converter on a non-flat surface:

Both the hybrid DC-DC Converters and the underlying mounting surfaces tend to have irregularities. Therefore, the tendency would be that contact between the DC-DC Converter and the mounting surface is only made at a few points. This results in a higher than desirable thermal resistance. The way to improve this situation is to use a thermal gap filler. This can be a high thermal conductivity grease or a high thermal conductivity silicone rubber pad. Since the case of the DC-DC Converter is usually electrically isolated from the internal circuitry, the gap filler does not need to be electrically isolating. In fact, the gap filler should be as thin as possible but still fill in the irregularities. Excess gap filler will raise the temperature.



Correct secure mounting to PCB showing thermal pad.



Incorrect PCB mounting showing gap between converter and PCB.