Recommended Mounting of Hybrids

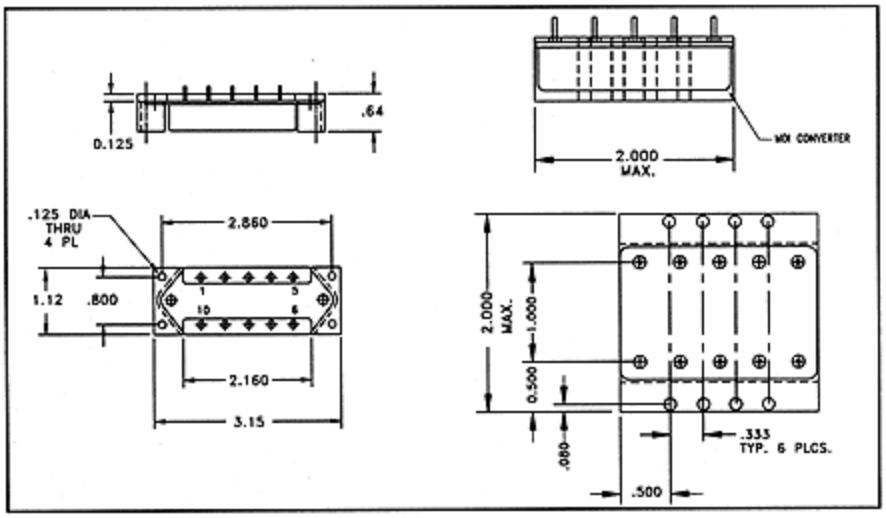
Hybrid DC-DC Converters are power supplies that are fabricated with bare die as compared to using packaged parts. Elimination of the intermediate packages allows the size of the DC-DC Converter to be dramatically reduced. All parts are mounted on ceramic substrates which are well attached to the baseplate of the package.

Heat 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 baseplate of the package by conduction cooling, which is commonly known as heat sinking.

How much heat is dissipated by the DC-DC Converter? This is readily 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.

The DC-DC Converters are rated at various baseplate temperatures. It is the responsibility of the user to assure that the baseplate temperature of the con-verter does not exceed the rated value. The power dissipation of the elements is con-centrated in a number of small areas. However, the thickness of the substrate and hybrid package do a good job of spreading the heat over the hybrid base plate area. In order to get the maximum benefit out of the hy-brid, or maximum re-liability, 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 baseplate 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.

Figure 16
In special applications where "dead bug" mounting is desired, MDI has developed several types of mounting brackets.



Some Common Mistakes:

Running the hybrid DC-DC Converter without a heatsink:
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.

Trying to use a printed wiring board as a heat sink:
A printed wiring board or copper traces on the printed wiring 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 baseplate at the periphery of the baseplate. Therefore, heat is conducted from the baseplate to the case, however, the thermal resistance is less than optimum. This results in an unsatisfactory part utilization, except in the case of a very low output power.

Using a heatsink that is too small or too thin:
The temperature drop from the baseplate 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 heatsink. Therefore, the converter operates at an unsatisfactorily high baseplate temperature.

Trying to cool by convection or radiation in thin air or vacuum:
The following true anecdote illustrates this point. A customer mounted a DC-DC

Converter for a space application on a printed wiring board. The board was mounted inside a unit and extensively tested. The converter operated perfectly until the customer performed a thermal vacuum test. The converter then failed. The unit was disassembled and examined. It was apparent that the DC-DC Converter had been exposed to extremely high temperatures. While operating at normal atmospheric pressure, the converter was cooled by free convection to some extent. When the atmosphere was removed for the thermal vacuum test, the heat removal provided by free convection was not available, and the converter overheated.

In high altitude aircraft applications, the air available for free convection is also 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 baseplate 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.

When bolting the hybrid to the cooling surface, use adequate pressure to minimize the thermal resistance from the hybrid DC-DC Converter to the mounting surface.

It is always the responsibility of the user to insure that the bottom of the hybrid's mounting surface is maintained at a safe temperature.