POE Single-In-Line (S-I-L) Module Thermal Considerations

Introduction

When using a Powered Device (PD) in a Power over Ethernet (PoE) application; one important parameter that is essential to consider at the design stage is “temperature”.

Within a PoE system, Power Sourcing Equipment (PSE) can source between 42V to 57V; the lower voltage can drop down to 37V at the input of the PD under worst case conditions (with 100m of Cat5e cable). For most applications, these voltages are higher than is required and need to be reduced and regulated (typically to 3.3V, 5V, 12V or 24V).

The most effective way to drop the voltage to a usable level is with a DC/DC converter. But no DC/DC converter is 100% efficient, which means that whatever losses will be converted into heat.

One of Silvertel’s primary goals when designing our PD modules is to make the efficiency as high as possible, whilst managing two of the major constraining factors of Size and Cost.

This document explains some cooling methods for Silvertel Single-in-Line (SIL) PoE modules.

Definition

In our product datasheets, the specified operating temperature relates to the ambient air temperature around the module and not the temperature outside the enclosure (see Figure 1).

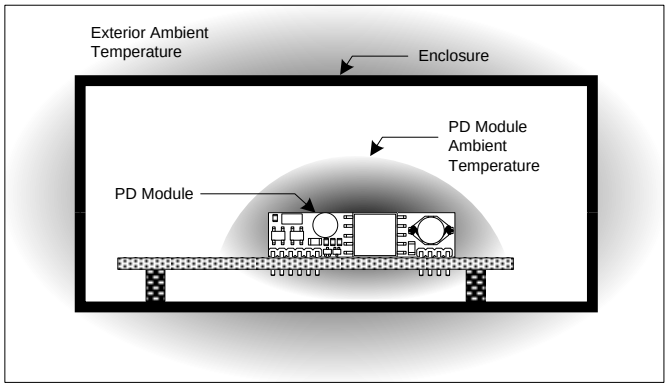

Figure 1: Ambient Temperature

In some cases, depending on the application and design of the enclosure, it may be necessary to use cooling techniques to help remove heat from the enclosure. The following pages describe different cooling methods for our Single-in-Line (SIL) modules.

Forced Air Cooling Solution

Using a fan or blower to force air from outside of the enclosure over the PD module is one way to control the temperature (see Figure 2).

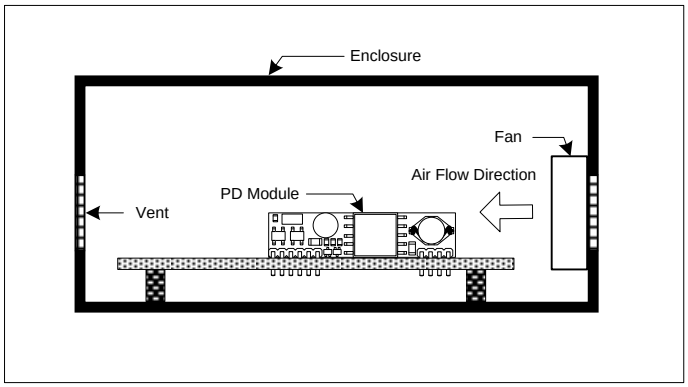

Figure 2: Forced Air Cooling with Ventilation

Even if the enclosure is completely sealed, using a fan to move air over the module will still greatly improve the thermal performance (see Figure 3). Circulating the air inside the enclosure reduces the hot spots and pushes the heat from the PD module to the walls of the enclosure. This allows the heat to be conducted through the wall to the outside ambient.

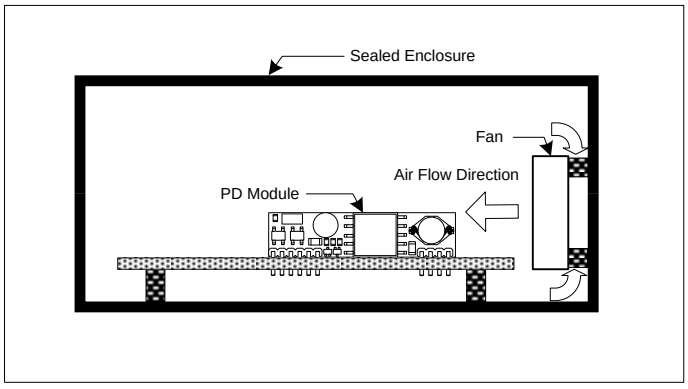

Figure 3: Forced Air Cooling without Ventilation

But Fans (or blowers) can be expensive; they also require power to run and their long-term reliability is often questioned.

Convection Cooling Solution

An alternative (more limited) solution is to use natural air convection to move air over the PD module (see Figure 4).

This can be achieved by creating a chimney within the enclosure. When warm air rises from the module and exits the top vent, it will pull cooler air in through the bottom vent over the module.

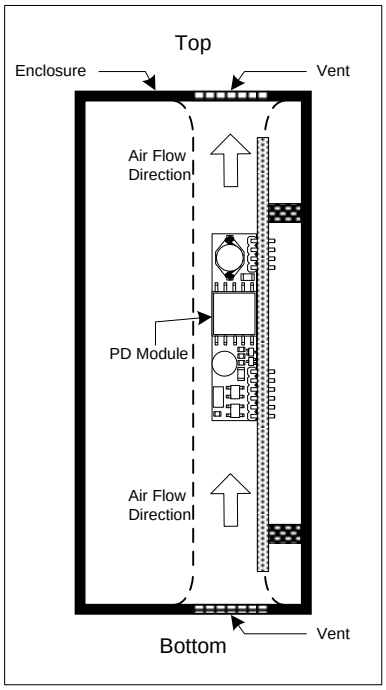

Figure 4: Convection Cooling

The advantage of this solution is that it is more cost effective than using a fan. But it does have restrictions as the vents must be kept clear of any obstruction and the enclosure must always be mounted vertically.

Thermal Relief Solution

One method of extracting some of the heat is to use power planes on the mother board, to draw the heat away from the module.

The power planes must be on the outer layers of the mother board and the PD module cannot be fitted in a socket (see Figure 5)

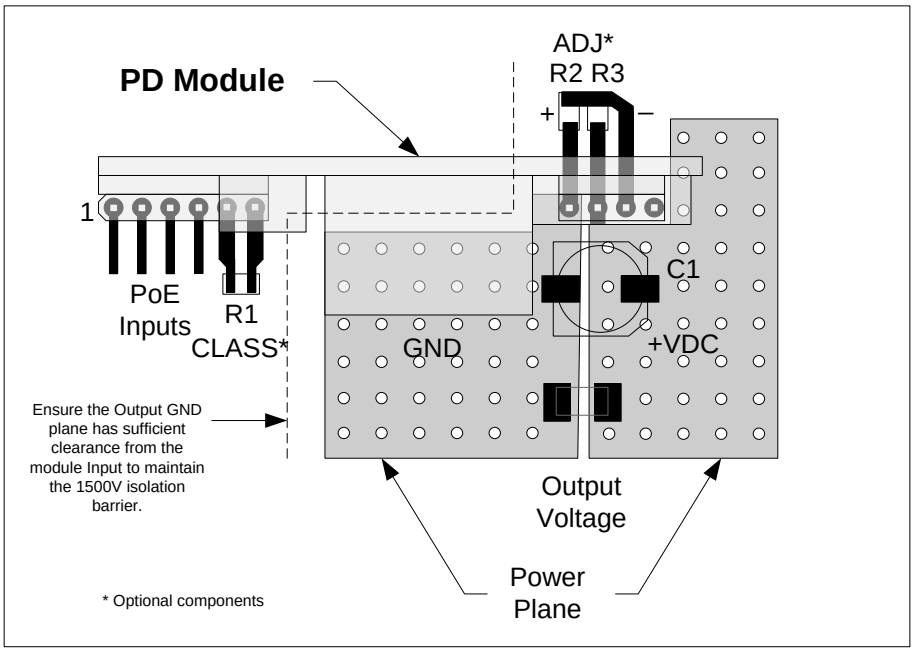

Figure 5: Power Plane

In addition to Power Planes, placing ventilation below the module will allow airflow through the mother board (see Figure 6).

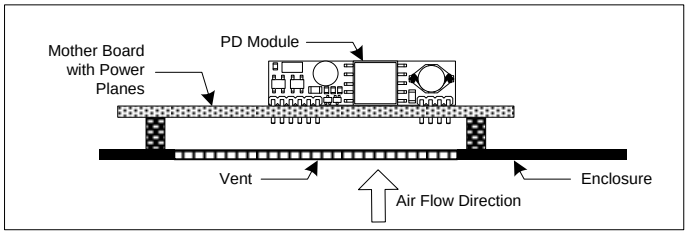

Figure 6: Power Plane and Ventilation

Heatsink Solution

Another solution is to fix a heatsink to the power components. In the example shown in Figure 7 an AAVID THERMALLOY – DIP1495 heatsink is attached to the power components on the back of a PD module using a thermal epoxy. The same technique can be used with all Silvertel PD modules; some of which have mounting hole to allow the module to be attached to a heatsink or the enclosure wall.

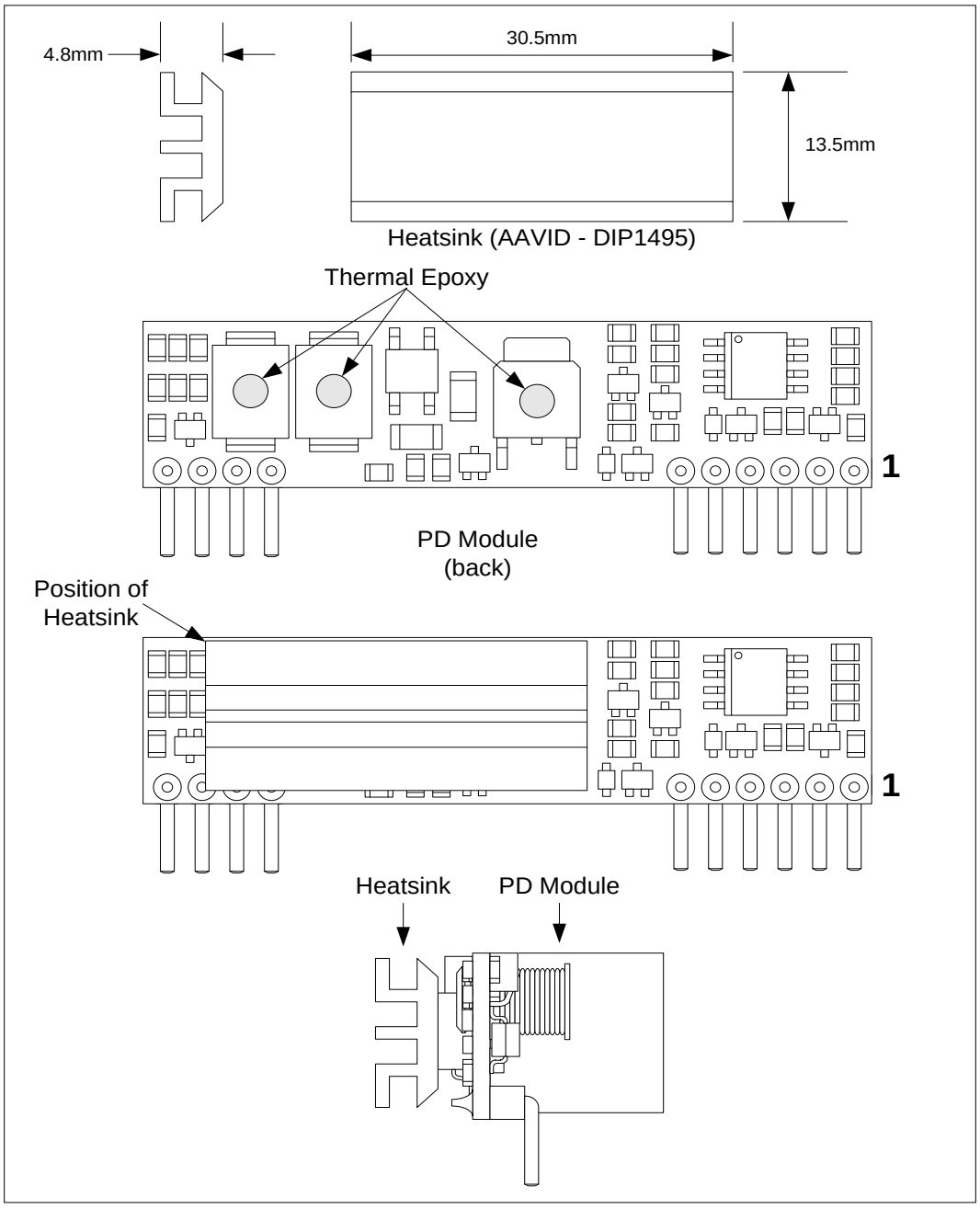

Figure 7: Heatsink Solution

Note: Using a heatsink will help, but if there is no circulating air within the enclosure its effectiveness will be limited.

Enclosure Wall Solution

An alternative to using a heatsink is to thermally connect the PD module to the enclosure wall (see Figure 8). This method takes the heat from the PD module to the outside ambient. The example shown uses a PD module with a thermally conductive material, "GAP PAD V0 Soft" manufactured by BERQUEST (alternative materials are available).

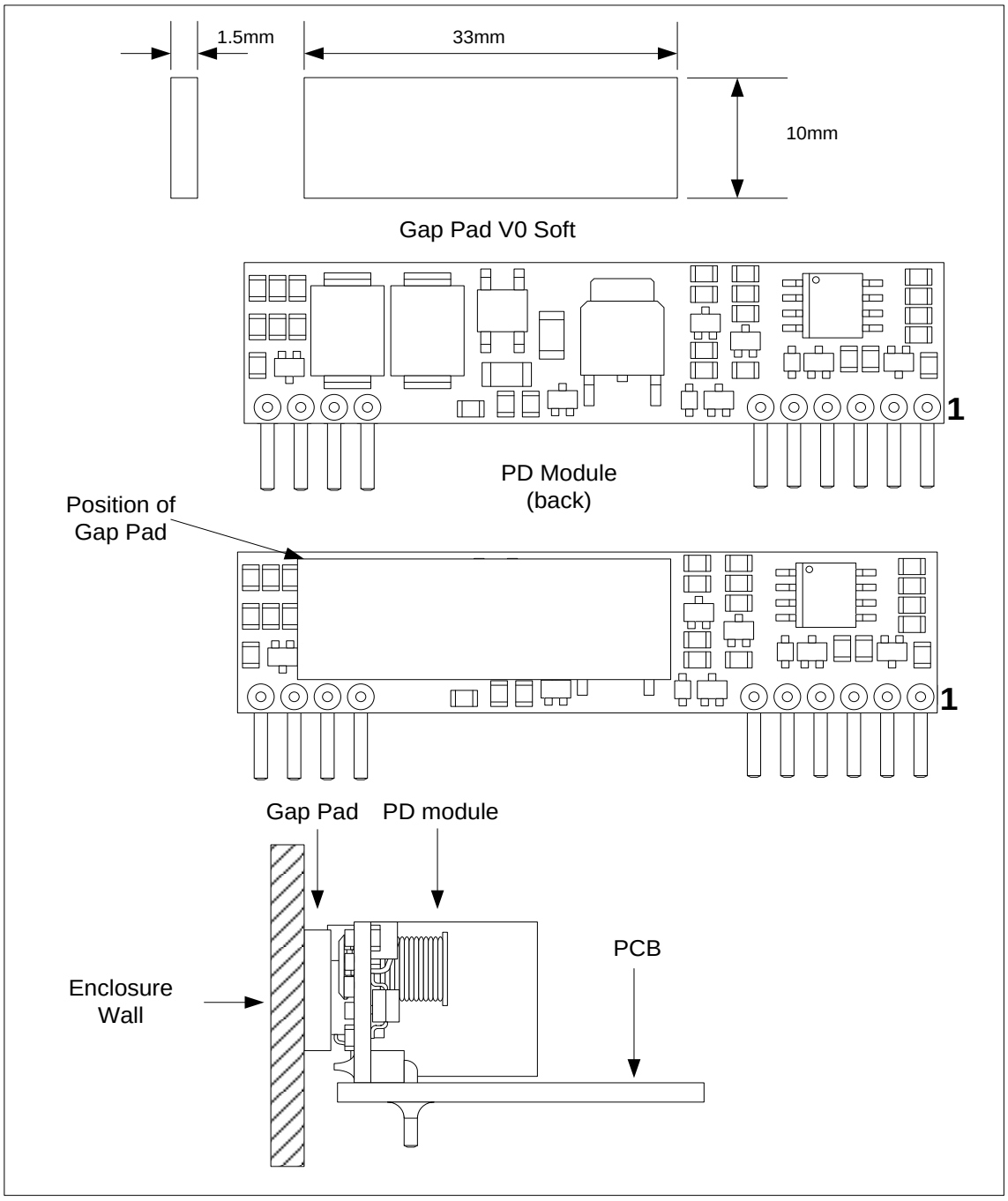

Figure 8: Enclosure Solution

Comments

This application note is written as an aid to help understand the importance of thermal management in PoE applications.

Because each application is different it is impossible to give a fixed and absolute solution. Some applications may need to use more than one technique to get an effective result.

The examples show in this document use a Single-in-Line (SIL) PoE module to illustrate the different techniques.