Using Rugged PCB Retainers for Single-Board Computers
A Thermally Efficient Solution

Introduction

Single-board computer (SBC) designers of high performance 3U, 6U, and 9U form factors have limited options for cooling and securing their rugged boards that are used in military and aerospace applications. Existing designs utilize an aluminum frame to encapsulate the SBC for stabilizing and conduction-cooling in high shock/vibration applications. This solution screw mounts a pair of board retainers to each side of the frame for locking the SBC in a cold plate chassis. The CTS line of Zero Insertion Force (ZIF) board retainers offers designers alternative solutions that improve operational efficiency and thermal transfer.

Description

The ZIF retainer consists of three components: aluminum housing, stainless steel rod, and beryllium copper spring. This simple three-piece assembly features a quarter-turn cam for locking/unlocking. Its inherent design features a uniform clamping pressure for efficient thermal transfer. The two products designed for SBCs are the ZIF III (PCB or frame mounted) and the iZIF™ (integrated into frame).

A pair of ZIF III retainers screw-mount to the SBC's frame using threaded holes. The frame assembly then slides into a cold plate slot and is locked into place with 1/4 turn. A slot in the retainer's hex-head rod is color high-lighted yellow to provide visual indication of the lock-status of the retainer. Once securely locked into the cold plate slot, the ZIF III provides an extremely low thermal resistance path to the cold plate with a 0.9°C-in./W thermal resistance. The ZIF III is a replacement alternative for screw-mounted wedge-retainer solutions.

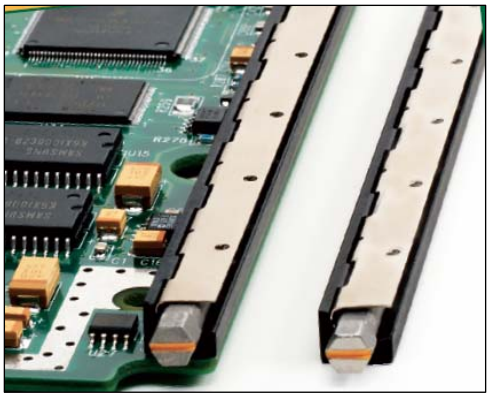

Figure 1. ZIF III retainer both un-mounted and mounted on a PCB.

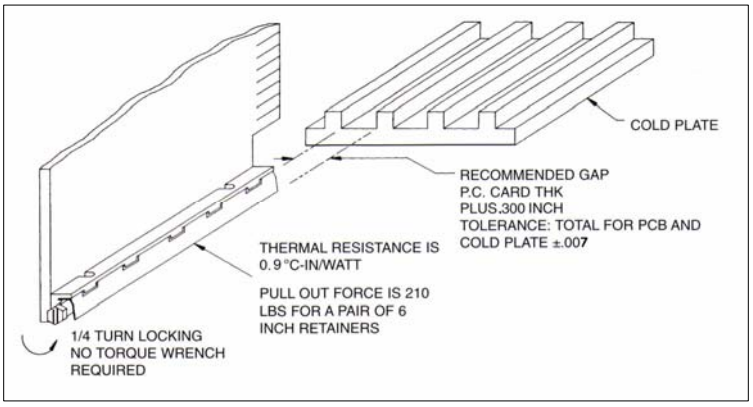

Figure 2. Typical ZIF III assembly and cold plate mounting arrangement.

The second solution, iZIF™, integrates the retainer into the frame while offering the same features as the ZIF III. The integration eliminates one thermal barrier, reduces tolerance stack-up, and eliminates the labor required to screw-mount the retainers to the board. Integration of the ZIF retainer into the heat frame is shown in the Figure 3. The iZIF™ is custom designed to fit board sizes up to 9U VME. The frame assembly slides into a cold plate, locks with a simple quarter-turn, and efficiently dissipates the heat along the entire length of the retainer (0.8°C-in./W).

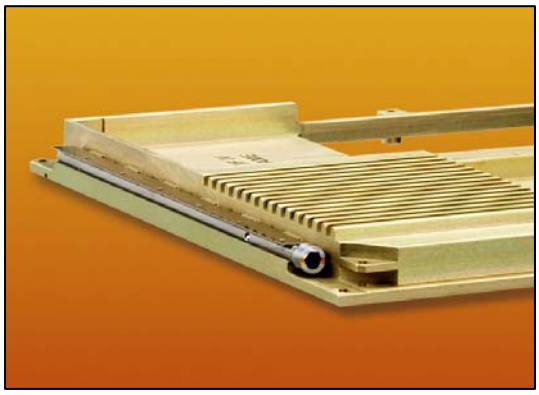

Figure 3. iZIF™ integrated heat frame.

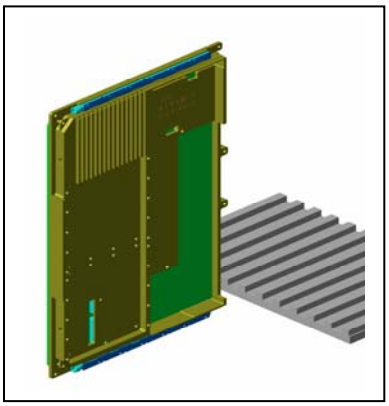

Figure 4. iZIF™ sliding into a cold plate.

Application

Thermal management in air- and ground-based military systems often requires the use of zero insertion force retainers. They are preferred whenever there is a need for quick or frequent board exchanges to minimize system down-time without sacrificing system reliability. Zero insertion force retainers are a standard for such applications to assure reliability for the entire project life-cycle.

Shock and vibration stresses in military systems must be minimized and the iZIF™ and ZIF III are ideally constructed to aid in providing an added level of protection over more ridged mounting systems. The cam locking action of the rod in the retainer forces the beryllium copper spring to lock against the side of the cold plate slot. Because of this spring lock feature, the retainer attenuates forces that could be harmful to the system boards. When used in ruggedized military chassis, these key features in both styles of ZIF retainers make them ideal for mission critical applications utilizing single board computers.

Integration of iZIF™ retainers into the heat frame allows thermal designers to implement conductive thermal features that uniquely handle system thermal demands in an efficient manner. Each custom heat frame provides conductive cooling with no assembly or maintenance requirements.

Thermal and Mechanical Characteristics

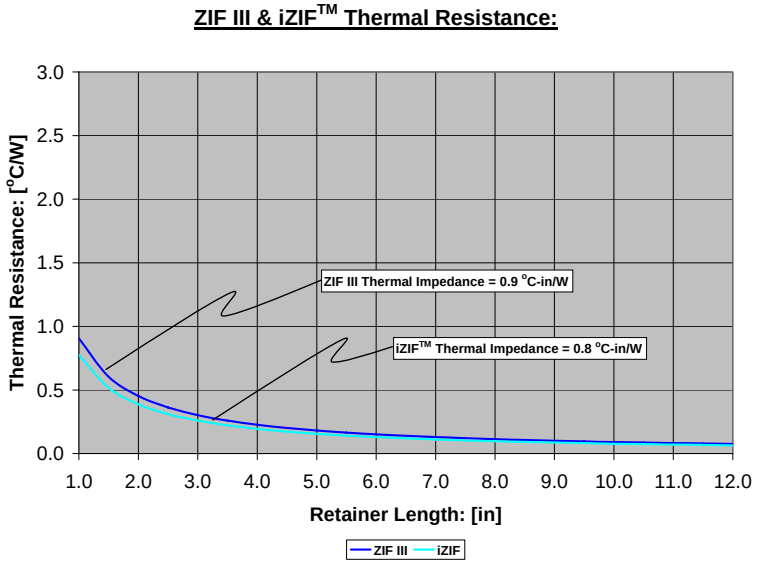

Figure 5. iZIF and ZIF III Thermal Resistance.

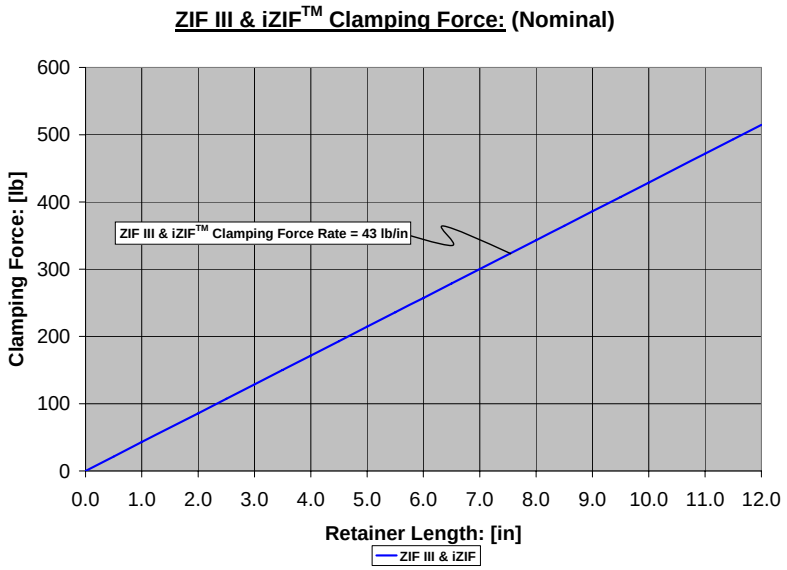

Figure 6. iZIF and ZIF III Clamping Force Graphs.

"Thermal Resistance" and "Clamping Force", shown in Figures 5 & 6, illustrate two properties that are of concern to system integrators. The thermal resistances of ZIF III and iZIF™ are extremely low. The advantage of integration is represented as the difference between the two plotted curves. A key feature to note regarding "Clamping Force" is that it increases linearly with retainer length, providing security to the systems contained on the SBC cards.

Conclusion

ZIFIII and iZIF™ retainers have low thermal impedances and provide uniform clamping pressure with a simplistic quarter-turn lock. Integrating ZIF style retainers into a custom heat frame design maximizes thermal transfer and is a unique approach only available with iZIF™ retainers.

Referenced Documents

ZIF retainers are tested per:

MIL-STD-810
MIL-E-16400
MIL-S-901

Complete Details on ZIF III, iZIF™ and other ZIF products can be located at:

http://www.ctscorp.com/components/heat_sinks/zif_III.htm

ZIF III - U.S. Patent No. 5,200,882
iZIF™ - Patent Pending

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