Public Abstract

First Name:Ahmed

Middle Name:Sadeq

Last Name:Yousif

Adviser's First Name:Gary

Adviser's Last Name:Solbrekken

Co-Adviser's First Name:

Co-Adviser's Last Name:

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Title:EVALUATION OF USING FERROFLUID AS AN INTERFACE MATERIAL FOR A FIELD-REVERSIBLE THERMAL CONNECTOR

The electrical functionality of an avionics chassis is limited due to heat dissipation limits. The limits arise due to the fact that components in an avionic computer boxes are packed very compactly, with the components mounted onto plug-in cards, and the harsh environment experienced by the chassis limits how heat can be dissipated from the cards. Convective and radiative heat transfer to the ambient are generally not possible. Therefore it is necessary to have heat transferred from the components conducted to the edge of the plug-in cards. The heat then needs to conduct from the card edge to a cold block that not only holds the card in place, but also removes the generated heat by some heat transfer fluid that is circulated through the cold block. The interface between the plug-in card and the cold block typically has a high thermal resistance since it is necessary for the card to have the capability to be re-workable, meaning that the card can be removed and then returned to the chassis. Reducing the thermal resistance of the interface is the objective of the current study and the topic of this thesis.

The current design uses a pressure interface between the card and cold block. The contact pressure is increased through the addition of a wedgelock, which is a field-reversible mechanical connector. To use a wedgelock, the cold block has channels milled on the surface with widths that are larger than the thickness of the plug-in card and the un-expanded wedgelock. The card edge is placed in the channel and placed against one of the channel walls. A wedgelock is then placed between the card and the other channel wall.

The wedgelock is then expanded by using either a screw or a lever. As the wedgelock expands it fills in the remaining channel gap and bears against the other face of the plug-in card. The majority of heat generated by the components on the plug-in card is forced to conduct from the card into the wall of the cold block, effectively a single sided, dry conduction heat transfer path.

Having started as a student design competition named RevCon Challenge, work was performed to evaluate the use of new field-reversible thermal connectors. The new design proposed by the University of Missouri utilized oil based iron nanoparticles, commonly known as a ferrofluid, as a thermal interface material. By using a liquid type of interface material the channel gap can be reduced to a few micrometers, within machining tolerances, and heat can be dissipated off both sides of the card. The addition of nanoparticles improves the effective thermal conductivity of base fluid. The use of iron nanoparticles allows magnets to be used to hold the fluid in place, so the electronic cards may be easily inserted and removed while keeping the ferrofluid in the cold block channel. The ferrofluid-based design which was investigated has shown lower thermal resistance than the current wedgelock design. These results open the door for further development of electronic cards by using higher heat emitting components without compromising the simplicity of attaching/detaching cards from cooling plates.