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Heat removal from high temperature hardware while shielding electromagnetic interference

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Heat removal from high temperature hardware while shielding electromagnetic interference

ABSTRACT

For devices with space constraints or lower heat generating components, connecting the heat generating component to another larger body, such as the enclosure metal, is a common heatsink solution. To ensure that the device antenna can function correctly, electromagnetic noise of the component is usually shielded by encapsulating the component with a grounded metal shield. For efficient heat dissipation, the number of intermediate items in the heat conduction path can be reduced by removing the shield cover or cutting a hole in the shield in order to sandwich a pad of conductive material between the component and the heatsink. While such an approach improves heat dissipation, it has a detrimental effect on the antenna because of the alteration to the electromagnetic interference (EMI) shield cover around the component. This disclosure describes a thermal and desense architecture to improve thermal conduction of high temperature components while incorporating and maintaining appropriate shielding for EMI.

KEYWORDS

- Heat dissipation
- Electromagnetic shield
- Electromagnetic interference (EMI)
- Heatsink
- Thermal pad
- Compressible conductive shield foam
- System on Chip (SoC)
- Desensitization

BACKGROUND

There is often a need to dissipate heat generated by electronic components, such as the Central Processing Unit (CPU) , memory, etc. of an electronic device such as a laptop computer, phone, wearable device, etc. A common heat dissipation technique is to attach heat fins with fans on the CPU to increase convection rate. For devices with space constraints or lower heat generating CPUs, heat fins might not be feasible or necessary. However, heat dissipation is still needed. A common solution in such cases is to connect the heat generating component to another larger heatsink body, such as the enclosure metal. The connection provides a path of conduction to draw heat away from the heat source to keep the system at a safe functional temperature.

Many devices with fast CPUs additionally require isolation of the electromagnetic noise emitted by the CPU to ensure that the device antenna can function correctly. By isolating and containing the electromagnetic interference (EMI), the antenna is prevented from desensitization (“de-sense”). Electromagnetic noise of the CPU is typically shielded by encapsulating the CPU with a grounded metal shield can.

Efficient conduction of thermal energy to a heatsink requires a low number of intermediate items between the top surface of the CPU and the heatsink, e.g., enclosure metal in the cases of devices that do not utilize heat fins. The number of intermediate items in the heat conduction path can be reduced by removing the EMI shield cover or cutting a hole in the shield in order to sandwich a pad of conductive material between the CPU and the heatsink. While such an approach improves heat dissipation, it has a detrimental effect on the antenna because of the alteration to the EMI shield cover around the CPU.

DESCRIPTION

This disclosure describes a thermal and desense architecture to improve thermal conduction of high temperature components while incorporating and maintaining appropriate shielding around EMI-emitting components. The thermal and desense architecture for an electronic device provides a thermal conduction path for a heat generating component, such as the Central Processing Unit (CPU), memory, System on Chip (SoC), etc. At the same time, a shielding loop is maintained around the electromagnetic noise emitted by the component.

The architecture is based on the observation that it is possible to remove layers in the thermal path and still retain the grounded shielding around the component by creating a ground path against the heatsink enclosure. For instance, the shield cover can be removed to sandwich the heat conducting material against the component enclosure while placing a compressible conductive material on the main logic board (MLB) around the component to form a grounded cover. The architecture can be realized in a number of ways, some of which are described below.

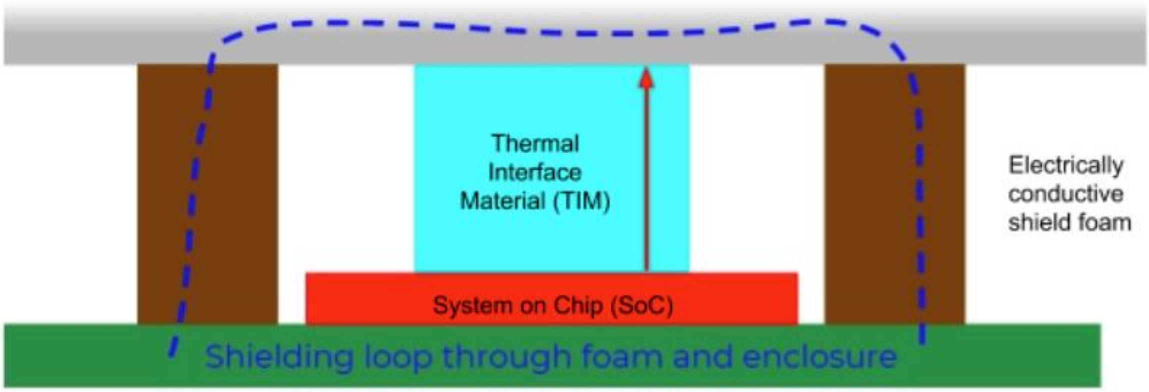

Fig. 1: Example of thermal and desense architecture

Fig. 1 shows an example of the architecture. As shown in the Fig. 1, a compressible conductive material, such as conductive shield foam, is placed around the EMI emitting component. The conductive shield foam stays in contact with the metal enclosure to form a shielding loop through the conductive shield foam and the enclosure. A shield cover is removed to place Thermal Interface Material (TIM), such as a thermal pad, directly between the metal enclosure and the heat generating component, such as an SoC.

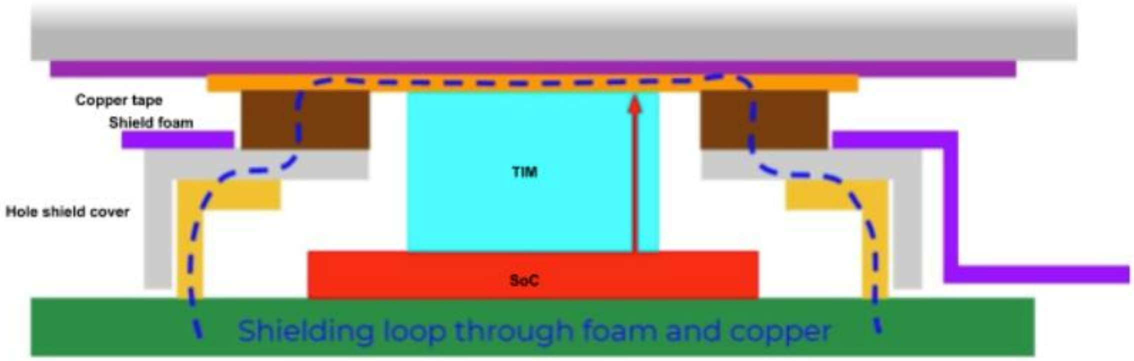

Fig. 2: Example of thermal and desense architecture

Fig. 2 shows another implementation of the architecture. As shown in Fig. 2, an open shield cover, i.e., a shield cover with a hole, is used to place the TIM between the metal enclosure and the heat generating component. The conductive shield foam surrounds the shield cover hole. The shielding loop is formed through the conductive shield foam, the copper tape, and the enclosure.

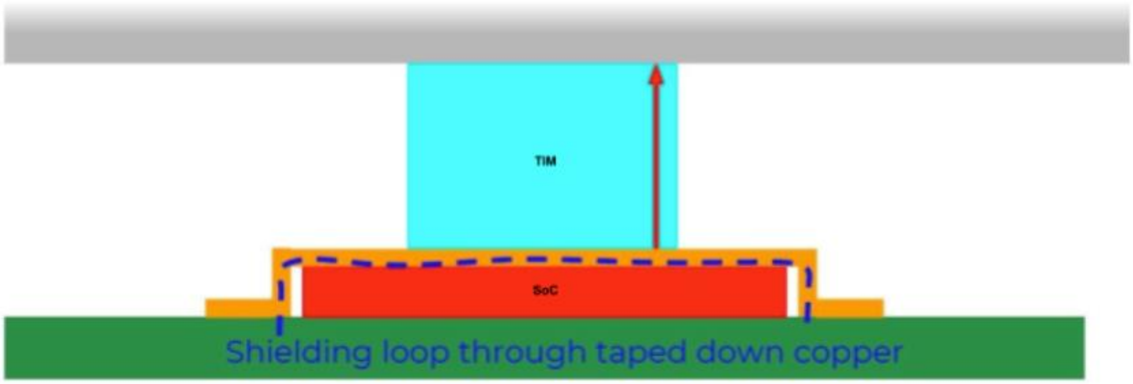

Fig. 3:Example of thermal and desense architecture

Fig. 3 shows another implementation of the architecture. As shown in Fig. 3, the EMI emitting component is covered with a copper layer that forms the shielding loop. The TIM is placed on top of the copper layer to provide the thermal conduction path as the heatsink for the heat generated by the component.

The solutions described herein (and shown in the figures above) allow a single TIM to be used directly against the component instead of sandwiching a shield cover between two TIMs. Even though some shield cover material is missing, there is a compressible, electrically conductive foam that surrounds the component to retain the ground loop and maintain good EMI shielding.

The architecture can be implemented in other, similar ways as those shown above. The combined thermal and desense architecture solution improves the ease of assembling components and enables products to be thinner in size by avoiding the use of thick heat pipes. The architecture also facilitates the use of faster components that produce greater heat while ensuring that antenna performance is not affected by the EMI from such components.

The architecture can be utilized to assemble a wide variety of devices that require small, thin, and light form factors while maintaining faster speeds and efficient antenna operation. Such devices include, e.g., laptops, smartphones, tablets, virtual reality (VR) goggles and other wearable devices, desktops, TVs, vehicle accessories, etc.

CONCLUSION

This disclosure describes a thermal and desense architecture to improve thermal conduction of high temperature components while incorporating and maintaining appropriate shielding for EMI. The architecture is based on the observation that it is possible to remove layers in the thermal path and still retain the grounded shielding around the component by creating a ground path against the heatsink enclosure. The architecture can be realized in a number of ways and can be applied to assemble a wide variety of devices that require small, thin, and light form factors while maintaining faster speeds and efficient antenna operation.