Cooling of Active Components in Structurally Integrated Phased Arrays Antennas

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ABSTRACT

This work presents an innovative cooling solution for active phased array antennas. In X-Band (8-12 GHz) and above, there is a high amount of heat that is produced by the active components of a phased antenna array, especially the power amplifiers of a transmitting chain. Unfortunately the efficiency of these components is very low, so that only 5 to 10% of the consumed power is fed to the antenna elements to be radiated. The rest of the power is lost as thermal losses which have to be dissipated from the circuits. The common way to do this is by integrating a heat spreader, and mounting passive or active coolers onto the devices or to integrate a copper core in the PCB. These solutions require extensive routing space and are heavy and bulky.

In this work an alternative cooling of an antenna Printed Circuit Board (PCB) will be shown, which allows high cooling performance without consuming too much routing space or significantly increasing the weight of the circuit. It consists in integrating a 3D- printed active cooling structure, custom tailored to the need of the active RF-circuits, directly into the PCB stackup. A nickel-based cooler is manufactured using a Single Laser Melting (SLM) process, and integrated in a standard RF-multilayer PCB. A cooling liquid (e.g. deionised water) is injected in the cooler to transfer the heat from the critical points of RF-circuits to a radiator outside of the antenna frontend. With this solution it is possible to get a really high power dissipation (up to 1 kW, cw) in the plane of the PCB.

In this paper the results of the first prototype will be presented and compared to those obtained using a “common”-copper core cooling solution.

REFERENCES

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