RF Companion Chip Based on PICS Technology for Small and Reliable Medical Device Packaging: Application to Ultra-Low Power RF Implants

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Abstract

This work presents a new way for packaging RF-linked implants based on silicon IPD with low profile, high reliability and high degree of integration while keeping very good performance of the communication link both for the wake-up signal and in-body data communication. Commonly, the communicating implant is composed of a dual band RF transceiver (MICS 402-405 MHz and ISM 2.4GHz) mounted on a PCB with SMD decoupling capacitances, crystal oscillator, SAW filter and different matching networks. The performances of the communication link are directly related to the electrical parameters of these components and the way they are connected to each other. This new packaging technique is based on functionalized silicon Passive Integration Connective Substrate (PICS): all the components are integrated within the IPD except the transceiver, the crystal oscillator and the SAW filter. The IPD integrates 3D trench capacitors for the decoupling purpose and the different RF paths (matching networks, DC blocks) for both MICS and ISM band. The matching networks are composed of inductors and MIM capacitor structures connected together using thick copper metallization layer to increase inductors quality factor and reduce ESR. All the passive components are embedded within the silicon substrate and thus we suppress all the reliability problems related to mounted SMD components. Then, the silicon integrated passive device is mounted on multilayer PCB interposer to be connected to the bare die transceiver.

A detailed description of the RF module package is given. The benefits of such packaging technique are highlighted. Finally, RF simulation results will be presented and compared to the RF module measurements.