

The new Integrated Seal Frame and Lid technology allows for smaller lighter microelectronic packages with reduced stress and improved long term reliability.

Background

Hybrid microelectronics, including those that use low temperature cofired ceramic (LTCC) substrates require an enclosure to protect surface mounted components and devices from damaging environments, particles, and contaminants. Hermetic enclosures used in microelectronics often consist of a metal seal frame that is attached with solder or sealing glass to the ceramic substrate. A metal lid is later either soldered or welded to the seal frame to complete the enclosure. The metal components provide the additional benefit of electromagnetic interference shielding. An LTCC machined, molded, or direct digitally manufactured single piece seal frame and lid have been developed as an alternate to the metal technology with the benefit of matching the substrate material properties for improved long term reliability. The LTCC seal frame and lid are completely metallized to provide a solderable surface for attachment and also to provide the secondary function of electromagnetic interference shielding.

Description

An integrated Seal Frame and Lid technology has been developed using Low Temperature Cofired Ceramic (LTCC). The one piece, thin walled ceramic structure has inherent advantages over the two piece metal seal frame and lid designs currently used in microelectronic packages (including radio frequency-RF applications). In the two piece designs the metal frame is soldered to an LTCC Multi Chip Module (MCM) and then the lid is welded or soldered in place to provide the required hermetic Faraday enclosure. The thermal coefficient of expansion mismatches between the LTCC base and the metallic frame can present significant reliability issues. A one piece LTCC design that has been metalized through a Physical Vapor Deposition (PVD) process or other metallization technique can simply be soldered on to the LTCC base without the CTE mismatch stresses.

The new Integrated Seal Frame and Lid technology allows for smaller lighter microelectronic packages with reduced stress and improved long term reliability. It reduces the number of components, the number of potential leakage paths and the number of process steps required to fabricate.

Advantages

The primary issue addressed with this invention is the long term reliability of hermetically sealed ceramic microelectronic packages that are subjected to thermal cycling in storage or use. Metal seal frames and enclosures have a thermal expansion mismatch with ceramic substrates which induce stress in the solder attachment joint between the two materials or in the ceramic substrate during temperature cycling and use. These induced stresses can lead to cracking and loss of hermeticity. This invention provides an enclosure that has the potential to exactly match the thermal expansion of the substrate, thus lowering the overall stress of the system, while also enabling the electromagnetic isolation of rooms within the MCM.

Kovar and other metal lids and seal frames are the most common competition for ceramic microelectronic package enclosures. New and traditional LTCC fabrication techniques can be employed to form a single piece hermetic enclosure for LTCC hybrid microelectronics in shapes and sizes that are not otherwise practical or achievable. The ability to create a single piece enclosure reduces the number of potential leak paths (fewer seams/joints) and also reduces the number of required components. The LTCC manufacturer is able to fabricate both the substrate and enclosure, reducing the number of suppliers in the supply chain. Using this single piece enclosure eliminates the seal frame attachment prior to surface mount and die attachment which can make those processes capable of attaching devices closer to the substrate perimeter and reduce the overall size of the package.

Applications

The new Integrated Seal Frame and Lid technology allows for smaller lighter microelectronic packages with reduced stress and improved long term reliability. Applications include high fidelity microelectronic packaging designs that require high frequency signal processing, robust hermetic enclosures and electromagnetic interference shielding. Example applications include:

- Military radar and avionics packages using high frequency multi-chip modules (MCM)
- Automotive radar market emerging due to federal safety requirements
- Hand held high end consumer electronics, custom GPS devices, next generation smart phones and tablets
- Military Communications

Intellectual Property Status

This technology is protected under US Patent # 9,374,923.

Keyword List

LTCC Packages, Multi-Chip Modules, Microelectronic packaging, Hermetic ceramic enclosures, Electromagnetic shielding.

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