S-Bend Ceramic Feedthrough for Enhanced RF Signal Performance

OFC 2016
Anaheim, CA
Design Challenge

• Hermetic Packages for Telecommunication Applications Require Improved Signal Integrity > 40 GHz

• Conventional Ceramic Feedthroughs Have Performance Limitations Due to the Use of Via Transitions that Distort the RF Signal Path through Abrupt 90° Bends
Introduction of S-BEND Ceramic Feedthrough

- AMETEK’s S-Bend Ceramic Feedthrough Provides a Smooth Uninterrupted Signal Path for Superior RF Performance

- The S-Bend Design Eliminates the Requirement for Vias in the Signal Path
CONVENTIONAL HTCC DESIGN IS FLAT
Multilayer Structure Similar to Printed Wiring Board (PWB)

- High Routing Density
- Solid Metal Planes
  - Power / Ground
  - Controlled Impedance
  - Cross-talk Shield
  - Differential Signal Pairs
- Wirebondable Pads
- Kovar Sealrings
  - Parallel Seam Sealable
  - Laser Weldable
- Brazed-On Terminals
  - Pins
  - Leads
- Solder Pads
100G Receiver Module

Conventional Ceramic RF Feedthrough Uses Via Transitions to Direct the RF Signal Path through the Ceramic Feedthrough
Conventional Ceramic RF Feedthrough

Conventional Ceramic Feedthrough Uses Vias to Direct the RF Signal Path from the Input Pads on Top of the Feedthrough Down to the Output Leads on the Bottom

*See US Patent 6,933,450 B2, August 23, 2005
Kyocera Corporation
S-Bend Ceramic Feedthrough has a Smooth Uninterrupted Signal Path to Direct the RF Signal Path from the Input Pads on Top of the Feedthrough Down to the Output Leads on the Bottom.

*See US Patent Number 9277643, March 1, 2016 Ametek Aegis
HTCC Process Advantage

- HTCC - High Temperature Cofired Ceramic
- Ceramic “Tape” is flexible prior to sintering
HTCC Process Review

CERAMIC TAPE IS FLEXIBLE

Tape Preparation → Greenline Operations → Firing Operations → Post-Fire Operations

Braze Integration → Final Plating → Final Inspection → Ship
Cross-Section View of S-Bend Ceramic Feedthrough

Sample#1 after cutting

Sectioning line #3; #2; #1

Direction of Sanding and polishing

X-Section M-168 of Sample#1

Observations after three sectioning lines:
No evidence of any ceramic cracks or delamination
No evidence of internal Circuit Line braking, tearing, cracking or skips
100G Receiver with S-Bend Ceramic Feedthrough

AMETEK’S S-Bend Feedthrough Advantage

Improved RF Performance by Eliminating Via Transitions

*Patented Design
S-Bend Ceramic Feedthrough for 100G Receiver Application

- Smooth, Uninterrupted RF Signal Path
- Increased Bandwidth
- 25 mm Height is Possible

- Eliminates 90° Via Transitions
- Improved Return Loss
- Reduced Insertion Loss
- 80 GHz+ May be Achievable
S-Bend Ceramic Feedthrough Simulation

- Material Thickness is the limiting bandwidth factor
- Initial Market Goals >40GHz
- Future Goals >80GHz
S-Bend Ceramic Feedthrough Pitch and Height Advantage

- **High Density vs Press-Fit Coaxial Interconnects**
  - I/O Separation of <0.050”
  - Compare to SMP, SMPM, SMPS
  - Compact hermetic packaging applications

- **Vertical Height Advantage**
  - 0.010” – 1.0” height change
  - Solution for mismatched “device to board height” designs
Summary of S-Bend Ceramic Feedthrough Advantages

- Smooth Uninterrupted RF Signal Path
- No Vias in Signal Path
- No 90° Via Transitions
- Improved Return Loss
- Reduced Insertion Loss
- Improved Signal Integrity
- Increased Bandwidth
- Frequencies >80 GHz may be achieved
- Ideal solution for mismatched “device to board” height application
- 25 mm Height is Possible
- Density improvement over traditional press-fit coax solution
S-Bend Ceramic Feedthrough

Applications
- Micro-Intradyne Coherent Receivers (Micro-ICR)
- Lithium Niobate Modulators
- DP-QPSK InP Modulators
- Transmit/Receive Modules

Cross Section Of S-BEND

* U.S. Patent No. 9277643
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