Vacuum Reflow Systems

A **PALOMAR** solution

eBook:

Glass to Metal Sealing

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Introduction

Glass to metal sealing technology has been around for decades and is still an important technology for many microelectronics products. Glass to metal sealing is used on devices ranging from glass diodes to hermetic electrical feedthroughs for vacuum packages. Ultimately glass to metal sealing is used to create a hermetic seal between two environments while allowing an electrical conductance path. The subsequent seal can withstand higher environmental and operational temperature than many other sealing technologies. To ensure “sealability” (which means the thermal contractions of the two sealing components match each other below the transformation temperature of the glass), glasses of special composition are required.

Glass to Metal Seals

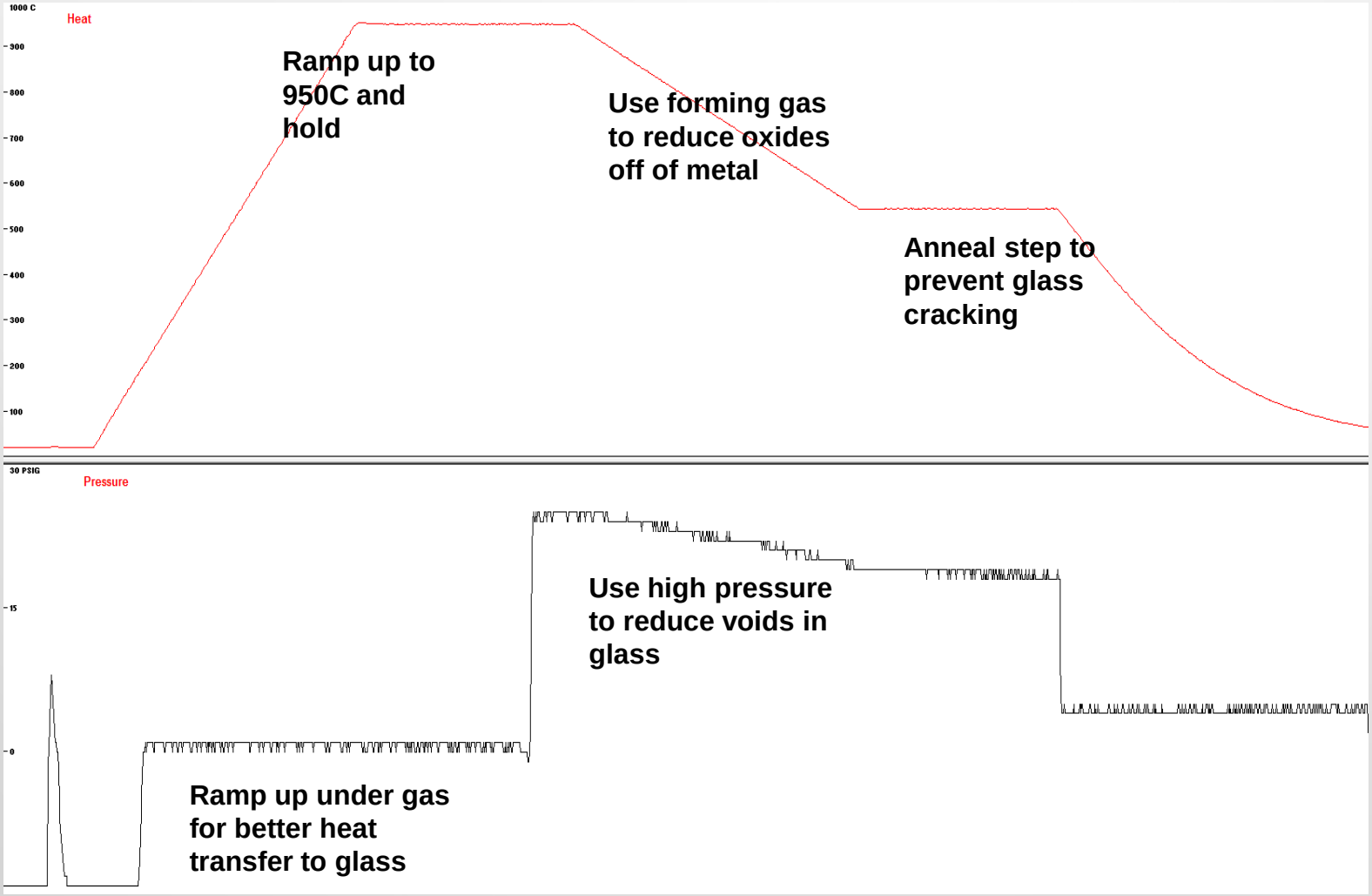
- Two primary methods to fuse glass to metal
- Matched Glass to Metal Seal
  - Matched Glass to Metal Seal (requires matched thermal coefficient of expansion of glass and metal)
  - Metals must be oxidized for proper seals
- Compression Glass to Metal Seal
  - Coefficient of thermal expansion of the housing metal is considerably higher than the coefficient of thermal expansion of the glass and metallic inner conductor
- Hermetic sealing to protect devices from environmental conditions
- Positive gas pressure reduces voids and bubbles that may be trapped
- Annealing can be controlled through transition temperature ranges

Matched Glass to Metal

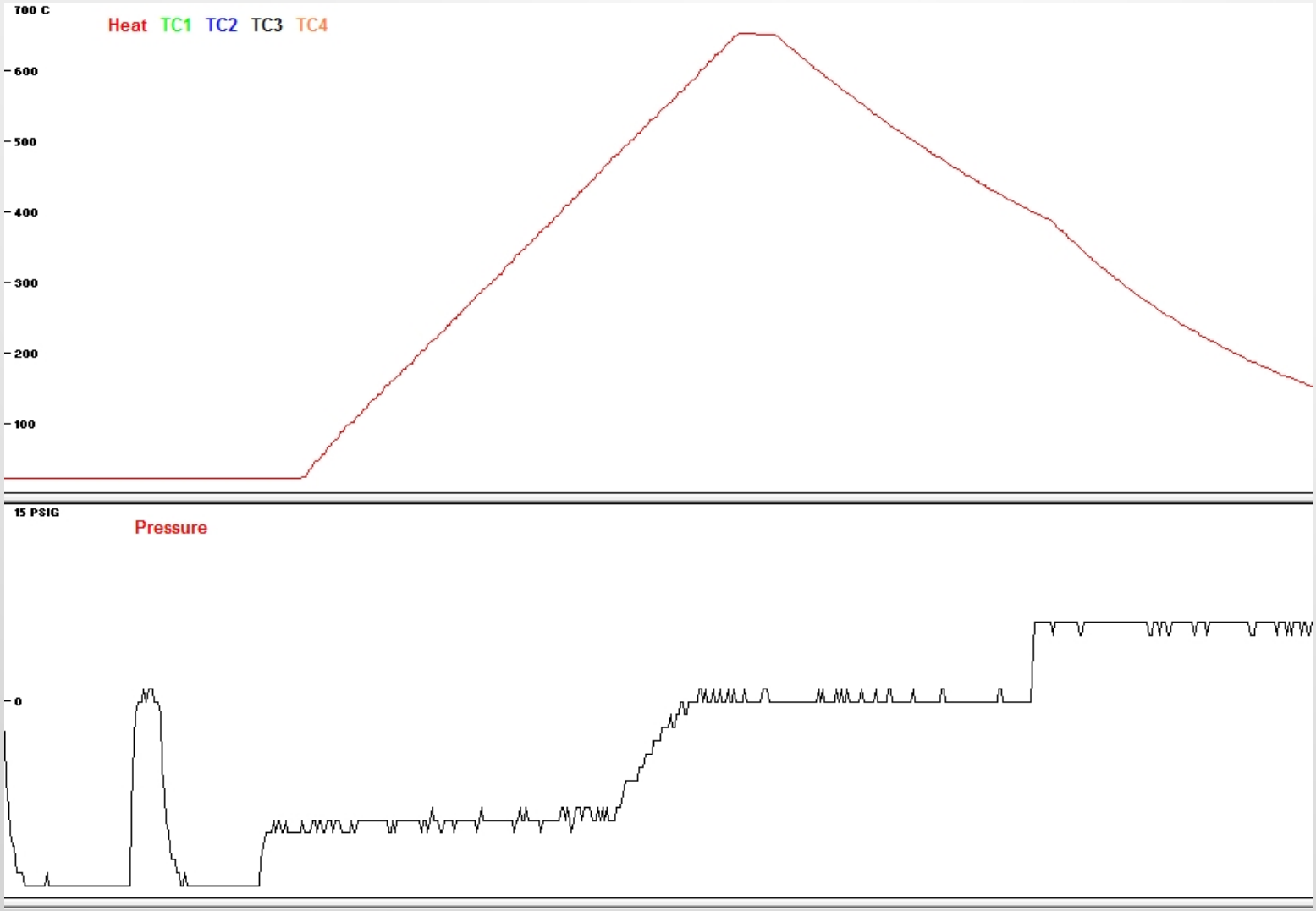
Matched glass to metal seal requires similar thermal coefficient of expansion of glass and metal. Coefficient of expansion of materials must be within 10% to prevent glass cracking. The strength of a matched seal comes primarily from a chemical bond between the glass and the oxide on the metal parts. Metals must be oxidized for proper seals. Matched seals are most often made with Kovar housings and pins, and borosilicate glass. Other typical metals used are Tungsten, and Molybdenum.

- Alkaline borosilicate glasses are used
- Metals surfaces must be “OXIDIZED” prior to the glass sealing operation
- Refer to “Oxidation Behavior of Kovar Alloy in Controlled Atmosphere” D.W.Luo Z.S.Shen ScienceDirect Acta. Metall. Sin.(Engl. Lett.) Vol. 21 No. 6 pp409-418 Dec. 2008

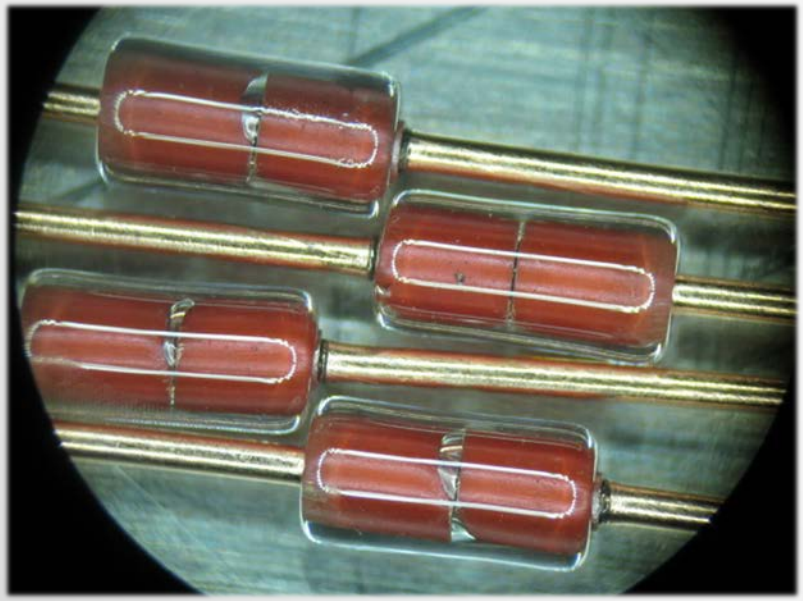
Typical Matched Glass Feedthru Profile

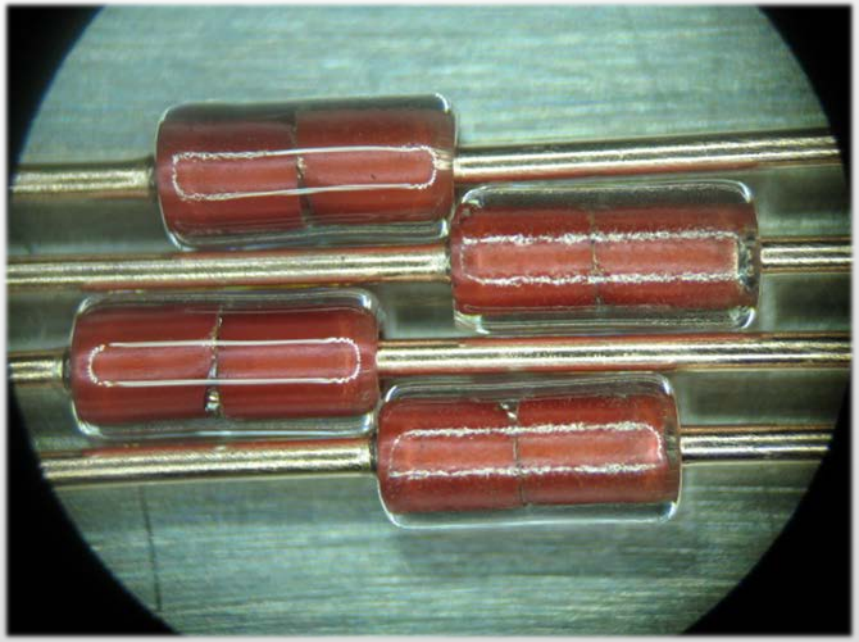


Typical Glass Diode Sealing Profile

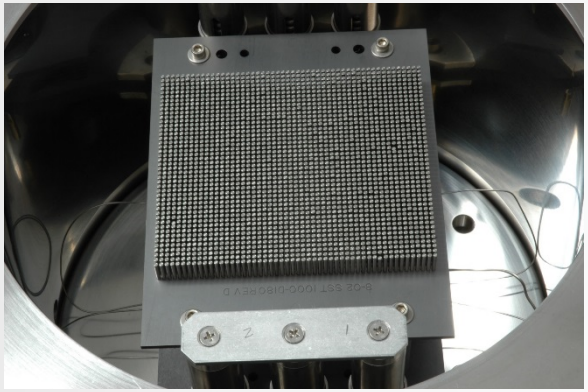


Glass Diodes

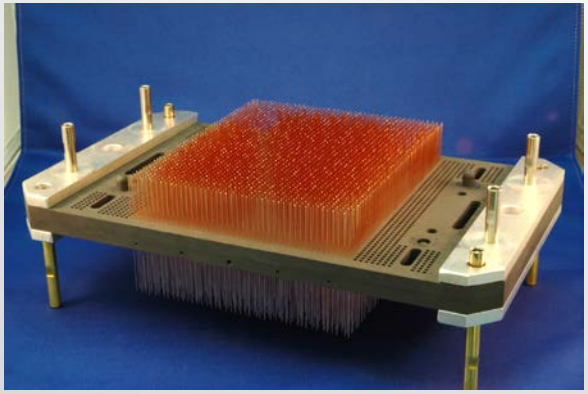




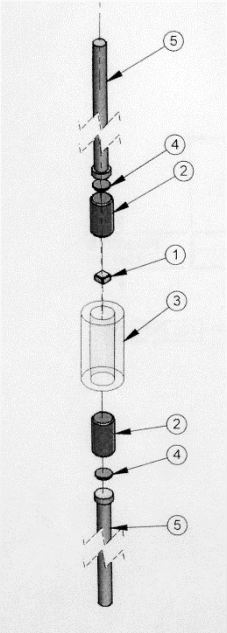
Glass Diode Assembly



Glass sealed Diode
Tooling in Chamber



Glass sealed Diode
Graphite Boat Assembly with 2288 Devices



(5) Copper Nailhead Lead

(4) CuAgP Brazing preform

(2) Tungsten Slug

(1) Diode Chip

(3) Glass Tube

Example assembly of glass diode

Compression Glass to Metal Seals

Compression glass to metal seals do not require the oxidation layer as matched glass sealing. Glass to metal compression seals are made with a housing material and a metallic inner pin. Coefficient of thermal expansion of the housing metal is considerably higher than the coefficient of thermal expansion of the glass and metallic inner conductor. Upon solidification of the seal during the manufacturing process, the housing will contract around the glass, applying a desirable compression stress on the glass bead, thus creating a hermetic seal. Typical compression sealing glasses are for steels and Ni-Fe-Co alloy metals.

Compression Glass to Metal Seals

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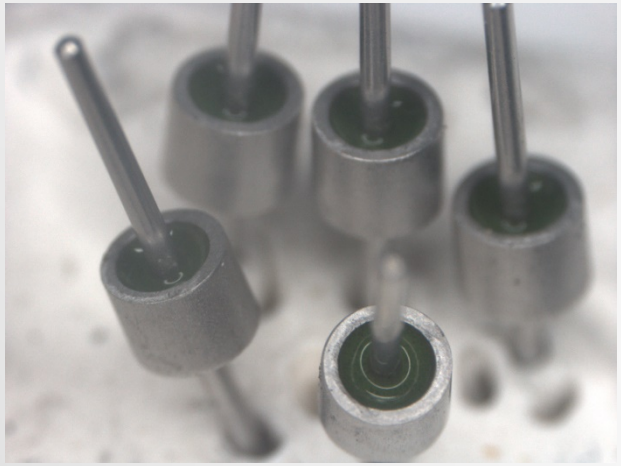
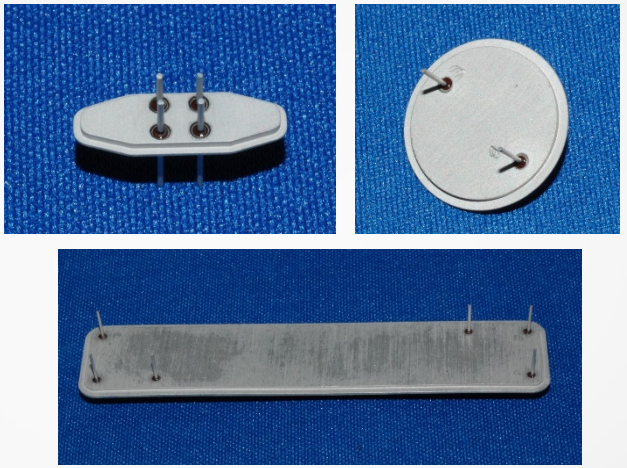
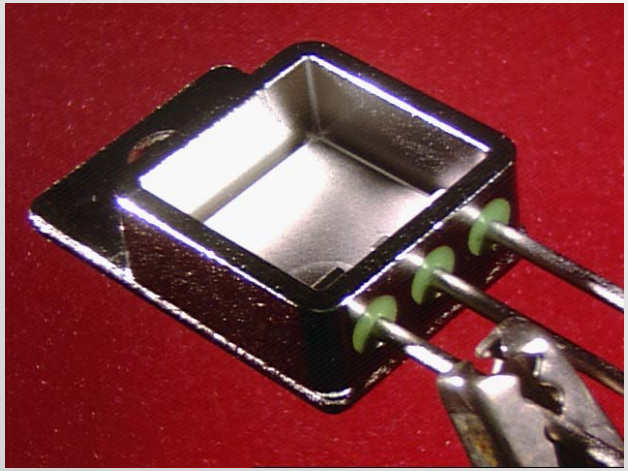
Various Examples of Matched Glass to Metal Seals



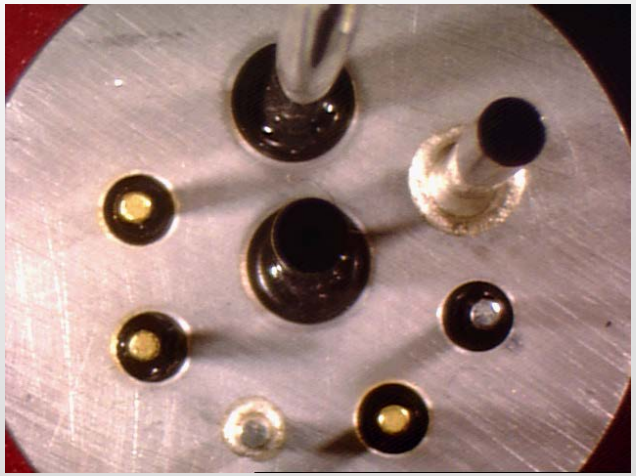
Glass to Metal Seal, Feedthrough



Glass to Metal Seal, hermetic sealing of the contact pins to various headers



Glass to Metal Seal Feedthroughs



Brazing and Glass Sealing

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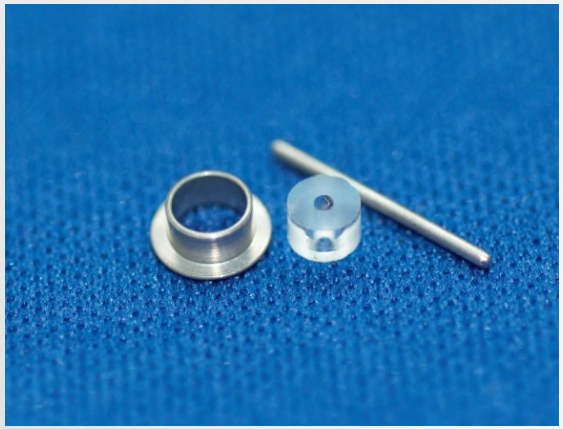
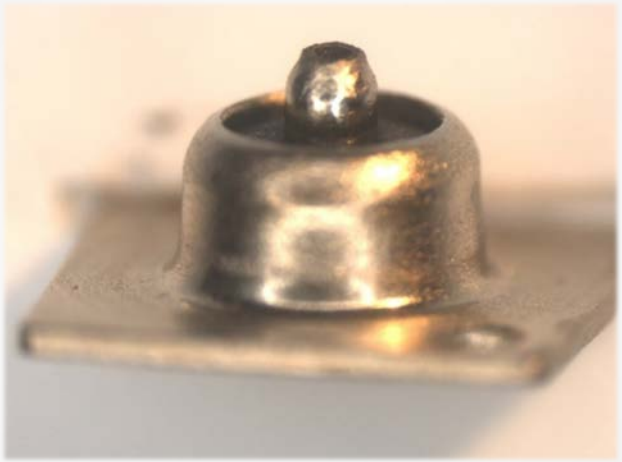
Matched Glass to Metal Seals

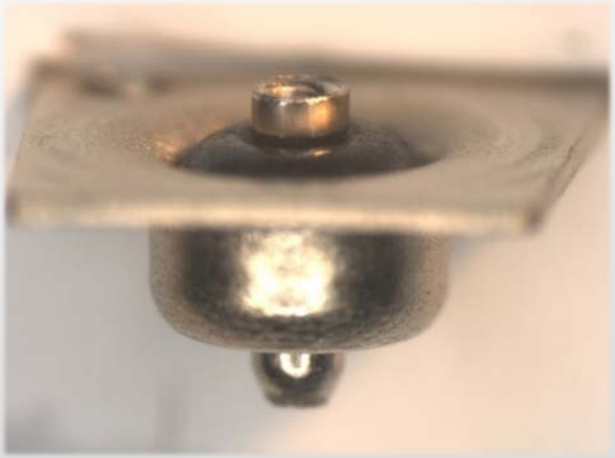


Contact pin to be hermetically sealed with glass inside metal housing

Contact pin to be hermetically sealed with glass inside metal housing



Completed parts cleaned with forming gas



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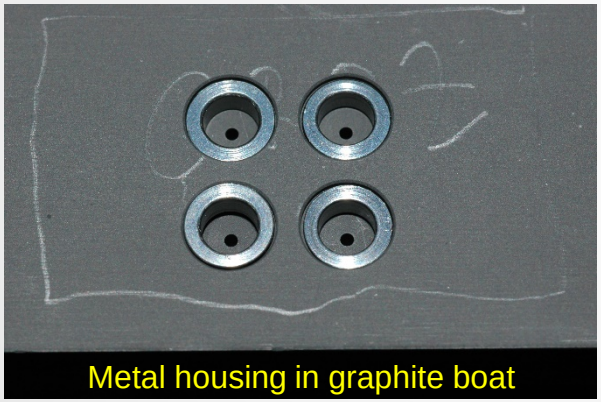
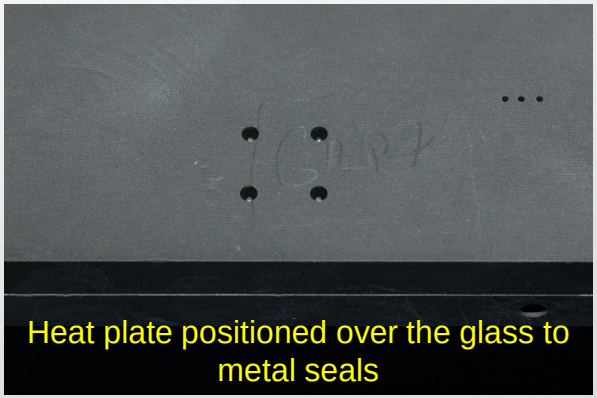
Tooling Concept of Matched Glass to Metal Seal



Metal housing in graphite boat

Glass bead inside the metal housing

Contact pin inserted in glass bead



Heat plate positioned over the glass to metal seals

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Glass to Metal Sealing Technology

Recommended equipment for this technology is Model 3130. It is uniquely designed to handle such applications, by offering:

- Resistive heating for the uniform heating of all components located in the tooling
- Temperature range of up to 1000°C (optional)
- Vertical clearance of the chamber allows to process wide range of device sizes
- Gas pressurization to reduce voids in glass
- Ability to perform the annealing process as a part of the overall glass-to-metal sealing process

Decades of process development experience in this specialty field and tooling designs, plus hundreds of the furnaces installed throughout the world, gives SST International customers confidence to develop a robust assembly process.

Download the Model 3130 Data Sheet

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Vacuum Reflow Systems

A **PALOMAR** solution

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About SST International:
SST International, a subsidiary of Palomar Technologies, is a global leader in the development of solutions and equipment for microelectronic package assembly. SST designs, manufactures, delivers and supports equipment, tooling and services for thermal processes used in the assembly of microelectronic devices. We deliver both standard and custom vacuum furnaces and wafer bonders with specialized capabilities to produce the highest quality results. We have delivered over 1200 systems to more than 400 leading companies worldwide. We support this equipment with custom-designed tooling and fixtures to meet the needs of each customer's application. We provide process development support, equipment and process training, and parts and service.

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