

## SEAL OF APPROVAL

*For space and other harsh environment applications, high reliability packaging is a must to protect electronic circuitry. Richard Warrilow talks to Optocap and Inseto about how an infra-red reflow system is helping ensure seal integrity.*

Established in 2003 and part of the Alter Technology Group, Optocap is a packaging service provider, active in the fields of optoelectronics, microelectronics and MEMS. Its services include the design and manufacture of packages, circuitry encapsulation and package test; enabling its customers to focus on their circuitry design tasks, reduce their overall development and manufacturing costs, reduce risks during the packaging stages and accelerate time to market. In addition, the company supports start-ups and university spin-offs.

Optocap's customers include space agencies, satellite manufacturers, and aerospace and defence companies, all of which have requirements for electronics to operate in harsh environments.

To ensure reliability at a component level - and by extension the system level - electronic devices must be manufactured and sealed to very high standards. Solder oxides must be reduced as much as possible before and during solder reflow to minimise voids in solder joints. Also, components must be hermetically sealed within a controlled environment to minimise moisture content.

For space applications, the package will typically be back-filled with nitrogen or vacuum sealed. Doing so keeps the inner circuitry and bonds free from corrosion. Specifically, moisture levels greater than 5000ppmv within the package can lead to component failure, with catastrophic results at the system level. The 5000ppmv limit is specified so that, in theory, any moisture present within the package will not condense until below freezing conditions; at which point it would form ice crystals that are unable to start the corrosion process. Moreover, some sensors, such as MEMS gyros, must be vacuum sealed to produce repeatable results.

“Most customers come to us with one or more die they need to have attached onto a substrate, then sealed into a package,” comments Stephen Robertson, Engineering Manager of Optocap. “We then design the substrate, source or design a package, assemble the components and seal the package to protect from the outside environment. To confirm the package is sealed, we then leak-test the device. We can also perform a few basic electrical tests here at Optocap but our parent company, Alter Technology, can develop custom and bespoke test platforms, depending on the product and application.”

Robertson goes on to explain that the company tends not to focus on high volume products. Instead, Optocap’s services are tailored for low- to mid-volume projects - ranging from just a few devices up to several thousand devices per month – that require a varied mix of often high complexity devices.

Turnaround times are typically about three months but, depending on the device complexity, can be over a year. Conversely, for less complex devices, Optocap offers a next-day service. However, irrespective of project duration, heavy reliance is placed on the company’s manufacturing and test equipment to ensure seal integrity.

### **Go with the flow**

When Optocap became part of the Alter Technology Group, in 2016, the demand for hermetic solder sealed packages increased. However, the company could not accommodate such projects as, at the

time, its vacuum solder reflow oven had a limited temperature range. This prevented its use for gold-tin soldering, the most common approach to hermetic solder sealing. The oven was also limited to using only nitrogen as a cover gas.

In early 2017, Optocap invested in an ATV SRO-716 infrared (IR) reflow oven, supplied through ATV's representative in the UK and Ireland, Inseto. John Govier, a Director of Inseto, comments: "Because of its good process stability and high repeatability, the ATV SRO-716 is a very popular oven in semiconductor, microelectronics and MEMs manufacturing."

For a process run, a profile (see figure 1) is created in software residing on the ATV SRO-716. The profile controls temperature ramp-ups, hold durations and ramp-downs. It is also used to signal Mass Flow Controllers (MFCs) to release gas into the oven (which may be nitrogen for cooling purposes) or pumps to create a vacuum. The profile also controls the flow of chemicals into the oven. For instance, formic acid is introduced at a low temperature to remove oxides.

"We've developed our control profiles over several years," comments Robertson. "As you'd expect, there are trade-offs to make such as steep temperature ramp rates versus the risk of thermo-mechanical shocks."

Robertson goes on to explain some of the jigs in which the devices are placed have large thermal masses, and temperature differences of between 10 and 15 degrees C frequently occur. Helping the process is the use of thermocouples – an integral part of the ATV SRO-716 - which provide an indication of the temperature inside the jig. These thermocouples, along with pressure sensors, form part of a closed-loop system controlled by the profile.

Though a profile may contain dozens of steps, these tend to be just a few minutes long and a typical gold-tin solder profile is about 45 minutes. Govier notes: "The ATV SRO-716 is a reliable, accurate and repeatable piece of equipment, and as part of our service we ensure full training is given to bring users up to speed on how to get the best from the oven."

Robertson concludes: "We're operating the oven at temperatures of up to 400°C, whereas before 250°C was the limit. This means we can use gold-tin solder, which is now the de facto material for solder lid seal within the microelectronics sector. We're getting better results than before, based on

the reduced level of voiding observed on products previously qualified on the older vacuum oven, so we're using the ATV SRO-716 for lower temperature work too. Also, the new oven gives us control over chemicals and gases that we've not had before, enabling us to take on a variety of new projects.

[www.optocap.com](http://www.optocap.com)

[www.atv-tech.de](http://www.atv-tech.de)

[www.inseto.co.uk](http://www.inseto.co.uk)

### MAIN ENDS

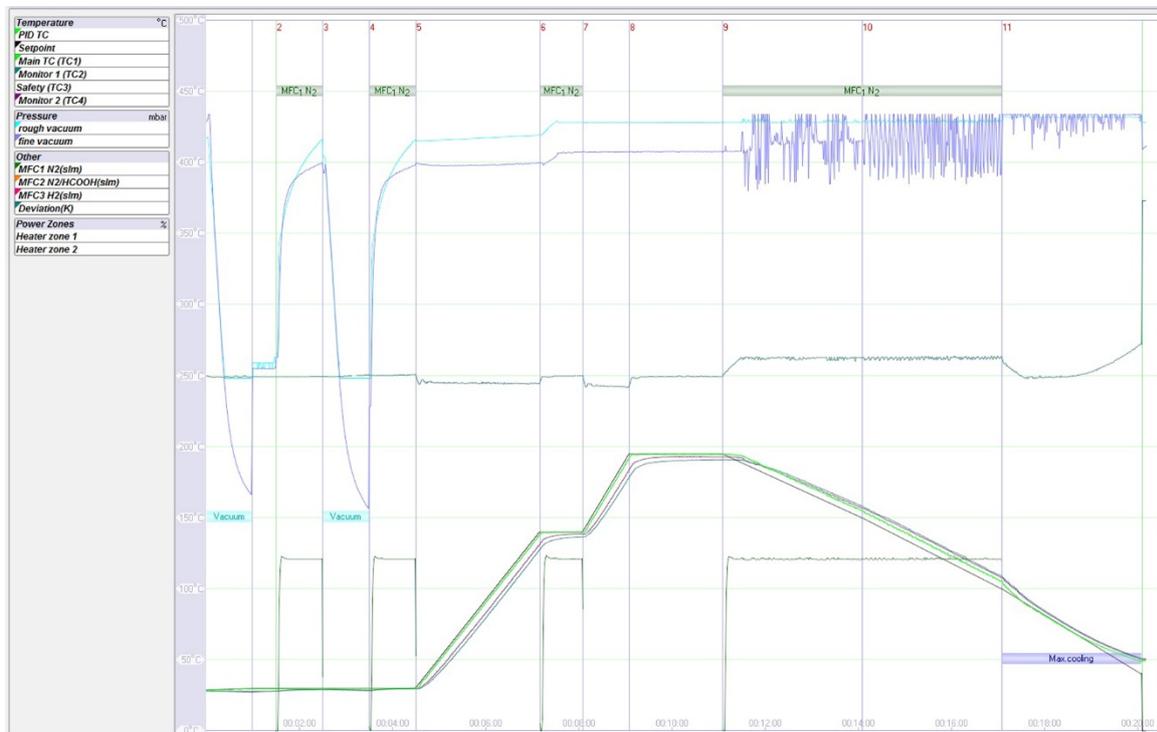
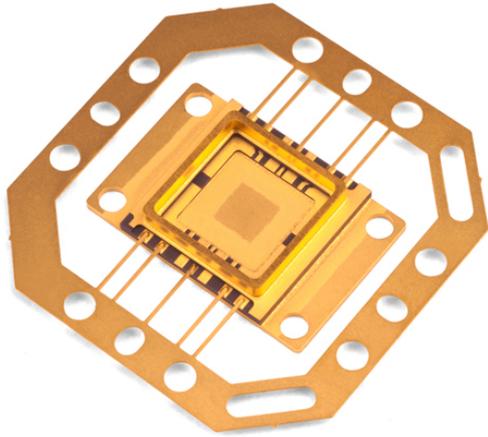


Figure 1: Above is typical time-temp profile for sealing a device in the ATV SRO-716 solder reflow oven used by Optocap.



Above, a typical off-the-shelf hermetic package is shown. The outer ring, which is present for handling purposes and to protect the pins, is removed at the end of the manufacturing process.

*Image courtesy of Egide.*

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