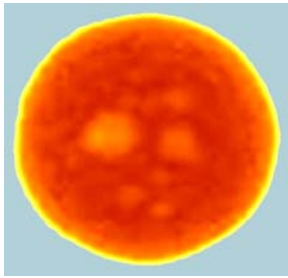
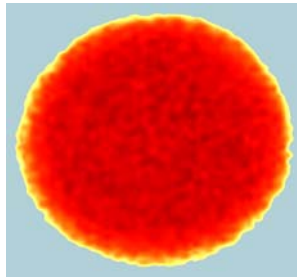


## Reflow Soldering Under Vacuum

We always marvel at new technical solutions and ideas engineers are coming up with, creating new products or enhancing and improving existing ones. This is particularly true in the electronic industry; case in point is the ever increasing complexity of printed circuit boards. Not surprisingly, more complexity is most often accompanied by unexpected issues demanding a solution in order to provide a high quality product and meeting the expectations of high performance, troubles free operation and safety but without neglecting economic considerations. Meeting these criteria SMT Maschinen- und Vertriebs GmbH, Wertheim/Germany has introduced their SMT Vacuum Plus N<sub>2</sub> module at Productronica 2009 in Munich, which has the advantage of being an integrated part of a new SMT Reflow Soldering System or can be retrofitted into an existing SMT line any time. The ability of continuous operation of such line is a distinctive advantage.



Normal soldering process



Soldering with vacuum

In the realm of soldering, the occurrence of voids in the soldering process is reality and has to be dealt with. Voids can impair the reliability of electronic board assemblies and influence its electric integrity, mechanical and thermal performance. Effect and consequences on the reliability of the solder joint depend to a large degree on the nature and/or kind of the void.

The causes for the forming of voids in the reflow as well as wave soldering process are not always easy to define, and they affect lead-free or non lead-free solder joints alike. Following a few examples:

- crystalline inclusions of flux
- bubbles from out gassing of solvents and humidity from components and their material
- out gassing of non polymerized photoresists of solder masks
- inclusions of air below components as a result of an imperfect print and/or pad design

There are a variety of other reasons contributing to the creation of voids, and also the size of the voids,  $\mu$  or macro voids, is of importance.

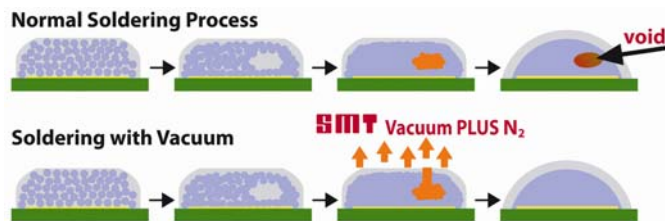
As we have named a few causes of the forming of voids above, it is just as important to point out some of the negative effects on product quality:

- limited heat dissipation of components or solder joint structures
- reduced stability of solder joint
- performance limitation of components in high frequency applications
- reduced stability against vibration
- reduced capacitance of components (i.e. power modules)
- increased solder problems (bridging, solder splashes, i.e. at  $\mu$ BGAs)

It should be mentioned that there are 3 Standards (IPC-A-610D, IPC-7095B, J-STD-001D) dealing with electronic assemblies affected by voids and covering a range of subjects. They are applicable for BGAs only and provide guidance for accepting voids within certain limits. For all other solder joints a rule-of-thumb value of ~ 25% is commonly used in the industry.

A quality conscious PCB manufacturer has to be aware of and control voids in particular if his main business is to supplying board assemblies used in the automotive, medical, defence and aerospace industries. A close to perfect solder joint is of utmost importance for reasons of reliability and safety. In support of the manufacturers the equipment and process industry has come up with methods and processes, and a continuous vacuum based process is the most promising catching the attention of the industry.

Not afraid of challenges, the engineers of SMT Maschinen und Vertriebs GmbH, Wertheim/Germany have developed the SMT Vacuum Plus N<sub>2</sub> module with the mission to eliminate voids using a continuous reflow soldering process. SMT is already known as a specialist for thermal processes and a prime supplier of reflow soldering ovens world-wide. Inspired and challenged by their customers, SMT came to the conclusion that a vacuum technology based process was a promising path to follow but it had to be a continuous process for meeting economic considerations. Other vacuum processes exist but they are stop and go, lack certain beneficial features, are less environmentally benign, more costly and cannot match SMT's much more favourable cost of ownership.



The SMT Vacuum Plus N<sub>2</sub> module is an independent unit which can be fully integrated into a SMT Reflow Soldering System. As our reflow soldering systems are also of modular design our new Vacuum Plus module can easily be retrofitted into an existing SMT Reflow Oven.

This direct integration provides the manufacturer with a high degree of flexibility, and is significantly more economical than a separately operated system.

The Vacuum Plus unit is positioned immediately behind the peak zone and can be called up when required, as the vacuum process is centrally controlled **with the option of being switched on or off**. During the continuous reflow pass the Vacuum Plus module is then automatically switched to vacuum operation. The PCB product is exposed to vacuum on pre-set parameters, kept under sub-pressure for a short period of time and then vented. Voids in the solder joint are reduced to a minimum improving significantly its quality. The cycle time for the vacuum reflow soldering process is between 60 to 90 seconds.



The Vacuum Plus N<sub>2</sub> module does not impose any restrictions on the usual requirements and/or parameters of the SMT Reflow Soldering Systems, i.e. dual sided PCBs can be processed, board width remains at 510 mm, length 350 mm, pass-through height: 30 mm (top and bottom), smaller boards can be processed with carrier, etc. The use of nitrogen and cooling modules is also possible.

Always keeping economics in mind, the SMT Vacuum Plus N<sub>2</sub> module has been designed of small foot print and low energy consumption at 1.5 kWh. There is only one sealing surface indicating that an effort has been made to keeping things simple. The fully integrated software controlled operating mode, including automatic setting of all parameters, contributes to a nearly maintenance free operation and easy service access.

From its inception SMT has always paid close attention to including environmentally responsible features in their designs. This is apparent in their main product line, the SMT Reflow Soldering Systems, which is the most energy efficient reflow system of the many different brands available worldwide. As already mentioned above the SMT Vacuum Plus N<sub>2</sub> module is following this tradition by adding a mere 1.5 kWh. Other environmentally friendly features include their low consumption nitrogen system and unique ABS process gas cleaning system. The latter is truly different compared to other liquid gas cleaning systems which need to be manufactured, transported, stored or disposed of in compliance with strict environmental hazardous material standards. SMT uses a "dry" cleaning medium requiring significantly less disposal efforts and easier compliance standards resulting in cost savings and relieving the disposal chain. SMT is committed to a dual environmental concept: Avoidance of the environmental burden and protection of the resources from start to finish in the process chain.

Adding or retrofitting the SMT Vacuum Plus N<sub>2</sub> module permits to operate a SMT Reflow Soldering System as a fully integrated vacuum soldering system for high-end quality products in mission critical assemblies. This innovative development will result in significant reduction of voids in solder joints and improve their reliability and safety. **It also increases versatility as with one system you are able to 1. vacuum solder, 2. reflow solder and 3. cure, also in an inert atmosphere.**

For more information:

SMT Maschinen- und Vertriebs  
GmbH & Co. KG  
Roter Sand 5  
D-97877 Wertheim, Germany  
Phone: +49-(0)9342-970-0  
E-Mail: [info@smt-wertheim.de](mailto:info@smt-wertheim.de)  
[www.smt-wertheim.de](http://www.smt-wertheim.de)