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Trilogy-Net White Papers

TRILOGY-NET WHITE PAPERS

Vapor Phase Soldering

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What is Vapor Phase Soldering?

Vapor Phase Reflow Soldering is an advanced soldering technology. This is fast replacing other forms of soldering processes manufacturers presently use for assembling printed circuit boards (PCBs) in lead technologies for all sorts of electronic products. Soldering electronic components to PCBs is a complex physical and chemical process requiring high temperatures. With the introduction of lead-free soldering, the process is more stringent, requiring higher temperatures and shorter times. All the while, components are becoming smaller, making the process more complicated.

Manufacturers face soldering problems because of many reasons and main among them is the introduction of lead-free components and the lead-free process of soldering. The other reason is that boards often can contain different masses and mixes of components. The heat stored by these components during the soldering process varies according to their mass, resulting in uneven heat distribution and leading to warping or deformation of the printed boards. Other reasons include the use of metal core PCBs and manufacturing for environments where solder joint integrity is critical.

With Vapor Phase reflow soldering, the board and components face the lowest possible maximum temperatures necessary for proper soldering, therefore, there is no overheating of components. The process offers the best wetting of components with solder and the soldering process happens in an inert atmosphere devoid of oxygen. This results in the highest quality of soldering. The entire process is more environmentally friendly now than it was in the past due to the use of Galden PFPE and it's also more cost-effective. In the Vapor Phase Reflow Soldering process, the soldering chamber initially contains Galden PFPE, an inert liquid, with a boiling point of 230°C, 240°C, or 260°C, depending on your needs. This is the same as the process temperature for lead-free Sn-Ag solders. During start-up, the Galden PFPE is heated up to its boiling point, causing a layer of vapor to form above the liquid surface, displacing the ambient air upwards. As the vapor has a higher molecular weight, it stays just above the liquid surface, ensuring an inert vapor zone. A PCBA that is introduced in this inert vapor zone faces the phase change of the Galden PFPE vapor trying to cool back its liquid form. The change of phase from vapor to liquid involves the release of a large amount of thermal energy. As the vapor encompasses the entire PCB and components, there is no difference in temperature, even for high-mass parts. Everything inside the vapor is thoroughly heated up to the vapor temperature. This is the most significant advantage of the vapor phase soldering process. The heat transfer coefficients during condensation of the vapor range from 100-400 $Wm^{-3}K^{-1}$. This is nearly 10 times higher than heat transfer coefficients involved in convection or radiation and about 10 times lower than that with contact during liquid soldering processes. The excellent heat transfer rate prevents any excessive or uneven heat distribution and the soldering temperature of the Vapor Phase Reflow process stays at a constant 230°C, depending on the altitude above sea level.

There are several advantages to the Vapor Phase Reflow Soldering process. Soldering inside the vapor zone ensures there can be no overheating. As the vapor completely encompasses the components, there are no cold solders due to uneven heat transfer and shadowing. The inert vapor phase process precludes the use of nitrogen. Controlled heating of the vapor consumes only one-fifth of the usual direct energy consumption and saves on air-conditioning costs. As the entire process is a closed one, there is no creation of hazardous gasses such as from burnt flux. Additionally, Galden PFPE is a neutral process fluid and more environmentally friendly than its predecessor, CFCs.