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Closed Loop Top Side Preheat-How It Impacts the Selective Soldering Process

What is Closed Loop Top Side Preheat?

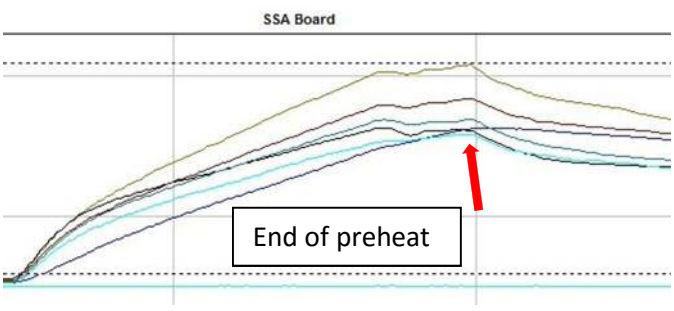
Closed Loop Top Side preheat generally refers to any preheating unit that presents energy from above the PCB and is used for heating the board to specific temperature and holding it at this value throughout the process. The system must include some form of temperature measuring and feedback system through which a real-time control loop can be established. The heating method can be Convection, Infrared (low-medium wavelength) or Quartz elements. In selective soldering, the predominant heating method is Infrared (IR). IR can add more energy to raise the temperature quickly at the beginning of the cycle and is able to actively control the heat as required real-time during the process, thus maintaining the temperature. Convection adds the same benefit for holding the board at temperature once the target temperature is achieved but the slow rate of temperature change would increase the cycle time at the initial ramp of the process. This article applies to either method as holding the PCB temperature during the process is the primary concern. The experiments and profiles presented are taken from a 4 lamps IR preheat unit with closed loop pyrometer control. The value of the closed loop top side heater is twofold; it provides the primary energy to reach the target temperature and just as critically ensures the temperature remains constant throughout the process. The closed loop system ensures that the process remains homogeneous throughout the cycle and eliminates the variables associated with changes in incoming board temperature and board thermal requirements as a direct result of the soldering process.

TOP SIDE PREHEAT UNIT

Challenges

The challenges experienced in non-closed loop top side preheat equipped machines have been well documented as early systems were gantry based units making included top side preheat difficult. While bottom side heaters prior to the soldering process are capable of achieving soldering temperature, the inability to continue to add heat as needed, during the process results in a less stable process and increased variability. In some cases, depending on the PCB thermal characteristics, the PCB can lose upwards of 20°C before the process begins. Shown to the left, in Graph one, is a typical profile for a machine without the ability to provide stability via closed loop top side preheat through the process.

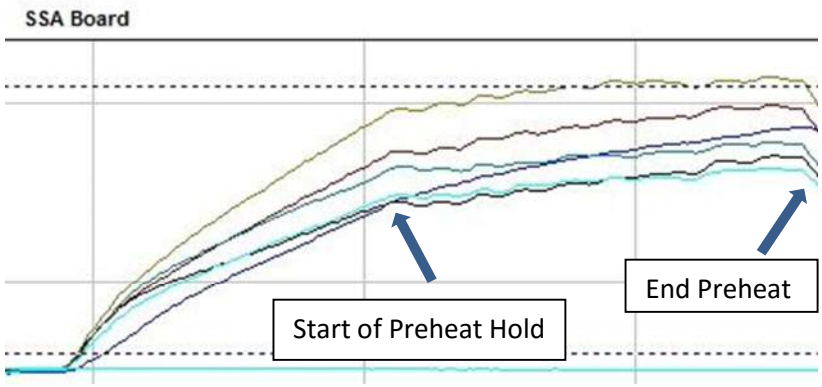
Graph 1-Entire Soldering Cycle without Closed Loop Top Side Heating



Graph one clearly shows that once the PCB is removed from the preheater, all locations indicate that the temperature immediately starts to drop. Heat is added

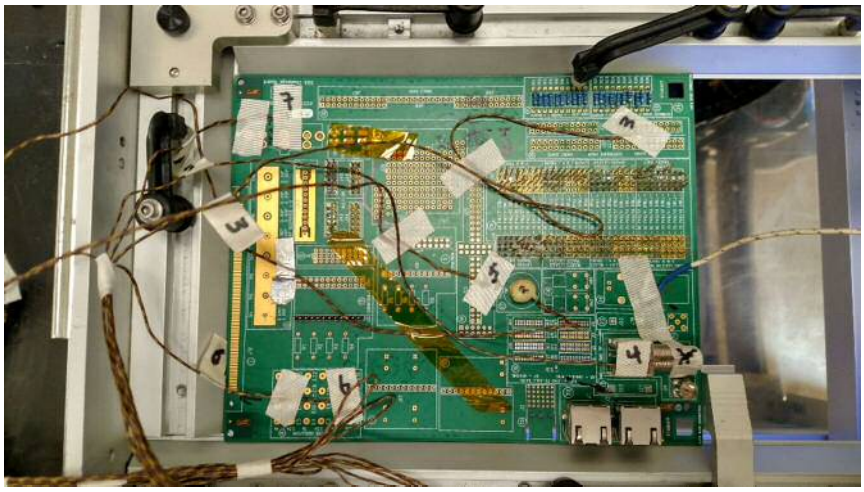
locally during the soldering process but the effect of the localized preheat is product specific and cannot be assumed to be adequate for all PCBs. The rate of temperature decline is directly related to the board design and must be tested to get accurate results. A typical scenario for a non-closed loop top side equipped machine is that a PCB with several of the same components (assume connector) would see a different requirement in dwell times or travel speeds as the machine progressed from the first to the last connector. These settings are programmable but the difference becomes more pronounced when the incoming board temp into the system is considered. This means that the variable programming method is not consistent for all foreseeable conditions. The reason for the required process change is the energy added during the actual soldering changed the thermal requirements for the subsequent processes. With closed loop top side heat, the process for each connector is the same making it possible to use the same template or part package to cut and paste the entire product. The result is a significant reduction in programming time; program complexity and much greater process uniformity.

Graph 2-Entire Soldering Cycle with Closed Loop Top Side Heating



In other words, any system not equipped with a closed loop top side heater will likely see differing results using the same soldering profile across an arrayed PCB.

Graph 2 above shows the same process as Graph 1 but with the addition of a closed loop top side preheater. It is clearly evident that the stability of the board temperature is greatly enhanced and would result in more consistent soldering results.



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