

Hőátadás vizsgálata újraömléztéses forrasztás során/Investigating heat transfer during reflow soldering

Kutatási jelentés/Research report

Írta/By: Dr. Géczy Attila

Purpose: The goal of my work was to improve the investigation methodologies and to optimize the measurement approaches on heat transfer during reflow soldering. With the improvement of the used data logging equipment, more thorough and precise analysis of the recorded temperature (consequently the heat transfer) can be achieved. Also the local heat transfer on printed wiring board substrates during condensation heating was investigated.

Design/methodology/approach: During my work I have analysed different data logging devices, and possible methods for substituting the currently available, affordable DAQ (Data Acquisition) devices. I have researched different commercial solutions, such as the available data logging instrumentation, and their capabilities, regarding precision, ergonomics and channel count. I have pointed a direction of advance development, where a completely new device is designed to improve upon the already available solutions, focusing on cold junction point compensation and available channel count. A possibility of using a commercial IC (Linear LTC 2983) for this goal simplified the development. The device helps to improve the monitoring of the working zone of a reflow soldering oven; also helps to improve the local investigation of heat transfer on selected samples positioned in different reflow ovens.

During the research I have also implemented the findings of the previous years' work for the analysis of heat transfer on board level during reflow soldering. This year I started to investigate the local temperature distribution and the effect of different substrates during condensation heat transfer. The method highlights local temperature differences, pointing to soldering failure possibilities.

Findings: The development reached the status of the first working prototype, where the logged data could be sent out to a computer, and the prototype enables channel count increase up to 19 working channels with selected K-type thermocouples. The device can be applied generally for any reflow soldering equipment. The prototype was inspected and tested with industrial reflow soldering equipment, and control measurements were performed with calibrated, industry-standard 3 channel, portable DAQ device (V-Mole), designed specifically for reflow technologies.

Figure 2 (left) shows a comparison between the prototype and the control device. The data of the prototype was logged via standard serial connection between the device and a computer. The control results could be reproduced with the prototype without significant deviance.

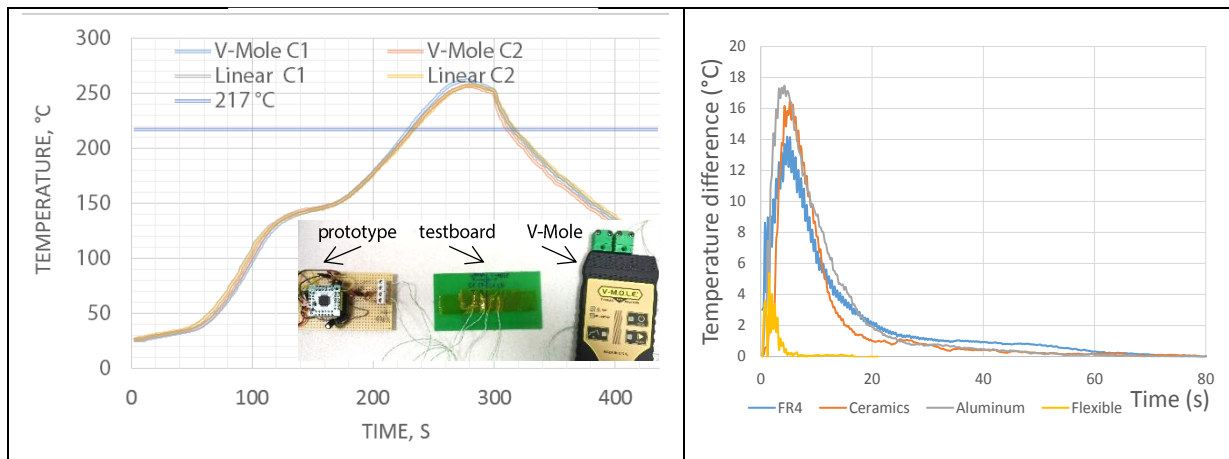


Figure 2 – (left) comparison profiles of the Linear LTC 2983 DAQ prototype board and the commercial V-Mole reflow profiler with a testboard and 4 K-type thermocouple; recorded profiles during the same IR reflow run. (right) Temperature differences during condensation heat transfer on different substrates with same dimensions; the temperature difference is non negligible along the bare substrate surface due to thermal capacities – the differences may point to possible soldering failures during heat transfer.

Figure 2 (right) presents the temperature differences along boards with the same surface, but different thermal capacitance, thermal diffusivity and thickness. The investigated results shows non-negligible differences along the central and the corner points of the boards, highlighting possible root causes for soldering failures originated from non-uniform heating. At this point the investigation was performed with a Novus DAQ, while the prototype was still in the advance design phase.

Research limitations/implications: Research was limited by the currently used analysis equipment (Linear IC, V-Mole, K-type thermocouples, Novus DAQ) and thermocouples.

Practical implications: The results point out to the extended testing of the device and a design of a commercial device based on the prototype. The results also show the importance of the highlighted parameters during reflow for future investigations. The acclaimed results highlight possibilities of soldering failures along the investigated difference. The results of the research helped to induce new international cooperation in the topic.

Originality/value: The work presents novel approaches on designing a capable DAQ device for reflow and heat transfer research, also pointing to a possible failure root cause during condensation heating.

The results of the work were presented and published at:

David Bušek, **Attila Géczy**, László Fazekas, *Substrate influence on temperature distribution along the PCB during vapour phase soldering*, In: T Blecha (szerk.) *39th International Spring Seminar on Electronics Technology. Konferencia helye, ideje: Plzen, Csehország, 2016.05.18-2016.05.22. IEEE, pp. 267-272.*

Attila Géczy, PhD, Budapest, 2017.01.06.