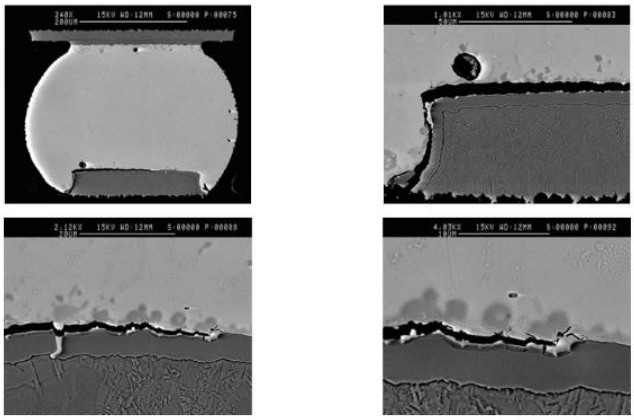
Title: BOTTOM TERMINATED COMPONENTS – the challenges and solutions



Outline:

This paper explores the challenges of reflowing Bottom Terminated Components - referred to as **BTC** and including QFNs (quad flat no leads), LGAs (land grid arrays), DFNs (dual flat no leads), MLF (micro lead-frame)
The main issues discussed are Coefficient of Thermal Expansion (CTE) flux entrapment, voiding and explains the innovative solution that Retronix offers for these issues.

The Problem - CTE:

The issues that CTE causes for the electronics industry is that when you have two materials of a different thermal expansion rate you can find the stress that this causes between the two materials can lead to fractures and cracks in the medium that you use to join these two materials, in this case – Solder.

Coefficients of **T**hermal **E**xpansion affects high reliability and harsh environment electronics in particular.

The recommendation is that thermomechanical stresses due to different coefficients of thermal expansion in the materials used in electronic assembly should be factored in during the design phase. The issue with this is that this is not always possible due to the expansion rates not always being known at the design phase.

Stress fractures can occur not just at the assembly stage but can also be the cause of time delayed effects when the assemblies are in their end use environment. The stress the PCB and components can be placed under can cause CTE to take place and fractures to show over a duration of time due to the temperature and environment of the end use.

CTE puts the solder joint under stress since the two materials that the solder is joining are expanding at two different rates, this makes joints that use a smaller amount of solder or a lower contact area most at risk of this fracturing. A mismatch in the materials expansion rate puts these joints under a stress that the surface area of the solder cannot absorb, therefore leading to fractures in the solder connection. This fracture may not be enough to always stop the functioning of the part straight away, but can lead to a slow degradation in the function of the assembly and an eventual critical failure. A micro fracture in a solder joint on an assembly that is under use in a benign environment may never cause a critical failure, but if you factor in vibration and temperature changes that PCBs in the automotive, Mil/Aero or Oil and Gas industry for example would be under, then a micro fracture can very soon become a critical and expensive failure.

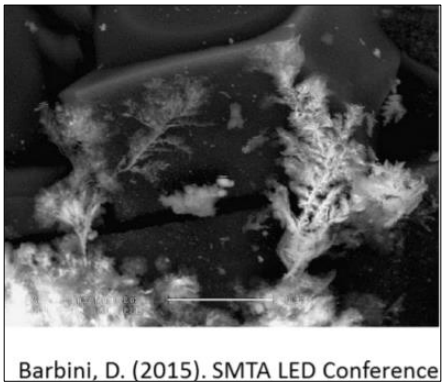
The Retronix Solution:

What Retronix can offer is the addition of solder balls/bumps to the pads of BTC part meaning that the component will be placed with an increased solder mass and better thermal conductivity between the component and the PCB. By raising the component from the board, you eliminate the direct bond between the component pads and the PCB pads and therefore create an air gap and an increased solder mass which acts to absorb the stresses that CTE can cause.

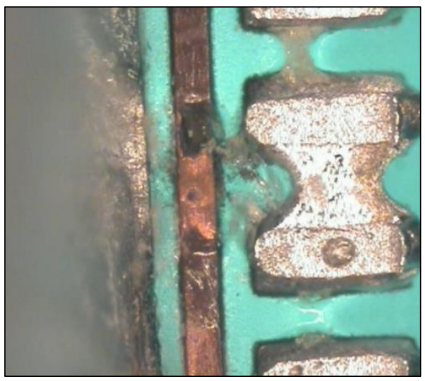
The Problem – Flux entrapment:

Flux entrapment under BTC parts is an increased risk compared with devices that are elevated (however minimally) from the PCB, the problem is the flux entrapment causing issues due to the lower standoff height with potential to cause leakage in current, dendritic growth, shorts *(flux and contaminates bridging power and ground connections)* and this can lead to eventual failure.

Flux entrapment can also lead to dendritic growth, leakage in currents, shorts and corrosion of the pads if the flux activators are not properly outgassed as is common for BTC parts. This is due to the lack of channels to allow for proper outgassing because of the low profile. There can also be issues caused with the mixture of flux and the cleaning medium getting entrapped and then reactivating if the end environment of the PCB is at elevated heat or in a harsh environment. The remaining flux activators are easily mobilised with the presence of moisture or elevated heat.



Dendritic Growth



Flux residues with potential to cause shorts & current leakage

The Retronix Solution:

The elevated final location from the ball attachment ensures a clearer pathway to allow your cleaning process to tackle the flux residue and rather than entrap it, ensure it flows through and is removed from the PCB.

Another useful source of information on this subject is below (images from this article used above) - https://www.smta.org/chapters/files/West_Penn_Cleaning_Highly_Dense_Electronic_Hardware_11-10-16.pdf

The Problem – Voiding:

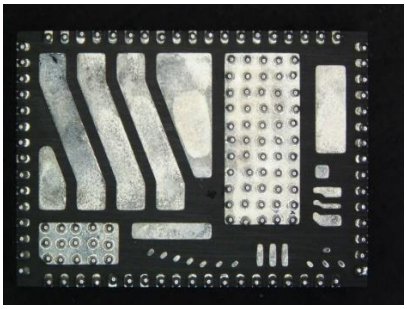
Voiding, like flux entrapment is also a direct effect of poor outgassing channels.

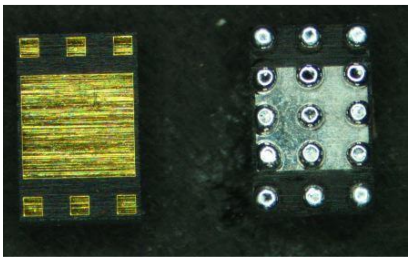
Voiding under BTC parts is an issue faced by PCB assemblers often. This can be minimised via routes such as reflow profile adjustments, pre-baking components, adjustments to PCB pad layout, adjustments to paste volume and use of low voiding solder paste.

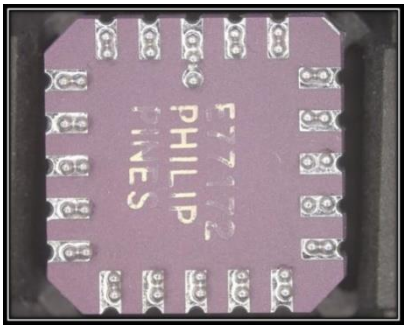
But the addition of solder balls is a highly effective solution for voiding issues on BTC parts. By elevating the device from the PCB, the flux outgassing channel is increased and therefore the voiding percentage is dramatically reduced.

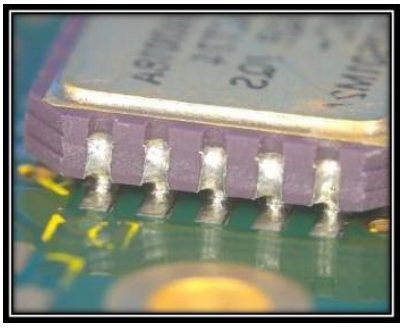
The Retronix Solution:

Creation of more defined channels for flux outgassing during reflow has been proven to offer a very effective solution for excess voiding as the volatiles in the flux are not trapped under the component in the solder joint.









Other ways that the addition of solder balls/bumps have been shown to fix our customers problems have been to increase an air gap to assist with heat dissipation and to elevate a sensitive crystal device that had been placed above a power line in the PCB and was causing interference.

Retronix are willing to undertake FOC sample trials for you to enable you to run environmental temperature cycles to see if our service is your solution

Author - Rob Ronan (UK/Ireland Sales & Support Manager)

Website – www.retronix.com

Email – info@retronix.com

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