Professional Development Course

Flip Chip, WLCSP, and FOWLP Assembly and Reliability

John Lau, Ph.D., ASM Pacific Technology

The major trend in the electronic industry today is to make products such as smartphones, tablets, wearables, internet of things, etc. more personal by making them smarter, lighter, smaller, thinner, shorter, and faster, while at the same time making them more friendly, functional, powerful, reliable, robust, innovative, creative, and less expensive. As the trend towards miniature and compact products continues, the introduction of cool products that are more user-friendly and contain a wider variety of functions will provide growth in the market. Some of the key technologies that are helping to make these cool product design goals possible are flip chip, WLCSP (wafer-level chip scale package), and FOWLP (fan-out wafer-level packaging). Their PCB (printed circuit board) assembly and solder joint reliability will be presented and discussed in this lecture. Since wafer bumping is the mother of flip chip and WLCSP technologies, it will be briefly mentioned first.

Speakers

Versatility in X-ray Inspection for the Electronics Manufacturing Industry

Steven Hursey, Nordson Dage X-ray

As technology moves in to a new level of ever shrinking dimensions, and ever-increasing complexity, the requirements for the X-ray inspection microscope needs consideration in its system configuration.

Whether used for Electronic Manufacturing of Printed Circuit Board Assembly, (PCBA) or for Semiconductor Manufacture, the fundamental components that make up the inspection system will vary in operation and design.

With the need for High Resolution X-ray to qualify the image integrity, at the smallest component geometry, the flexibility of the inspection technique needs to be considered to achieve the best utilization of the inspection system.

A Holistic Approach for Technology and Quality Audits in the New Era of Computer Servers Design and Manufacturing

Yvonne Yeo, IBM

Supplier audits have played an essential role in supplier technology qualification and supplier quality assurance for many generations of hardware offerings, including computer servers, storage systems, and associated computer hardware products. Most recently, IBM's hardware offerings have focused on the enablement of cloud computing, big data and data analytics, mobile transactions, and cognitive

computing. The complexity of system design and technology integration has increased tremendously for these product offerings. In addition, it's important to note that the electronics hardware supply chain has been undergoing substantial consolidation over this same period. Therefore, it is important to ensure the relevance of the approach and practice of supplier audits, so that supplier audits would continue to effectively mitigate quality risks for future generations of product offerings.

This paper introduces a holistic approach to enhance the effectiveness of technology qualification and quality assurance audits to address the challenges in both internal design complexity and external industry dynamics. The approach focuses on streamlining governing processes in audit execution and auditor training, as well as on IT and mobile applications development that further enables streamlining. To illustrate these points, this paper presents examples and case studies from electronic card assembly and test (ECAT) audits conducted across several contract manufacturing suppliers.

New LED technology challenges for X-Ray

Justin Kow, Yxlon International

Recent advances in LED technology have placed increased demands on the joint interfaces and materials used during production. Higher power, smaller size and increased reliability requirements intensify the need for higher quality more consistent production output. Flaws in the products can no longer be accepted as the performance requirements have increased dramatically, high power means higher temperatures and this needs very good thermal conductivity to move heat away from the key areas allowing the LED to last longer, as heat stresses the interfaces causing delamination or die fractures. Poor bond joints mean less transmission of power and this will reduce the life time of the components or their ability to perform at the required level. Many LEDs are potted or encapsulated and after this process the only non-destructive test option is x-ray, so as the requirement for LED inspection grows the need for high quality x-ray systems increases. This presentation will look at the common LED faults, most of which are only visible using x-ray technology and show good pass and fail images, also some of the recent technology advances in x-ray which make these images possible. Voiding is becoming more relevant too as there is a direct correlation between voids and thermal transfer and therefore reliability and product lifetime. We will look at technology which allows measurement of voids in individual interface areas of the assembly at the same time and see a video of an automated inspection routine measuring different areas on individual LEDs which are assembled onto a printed circuit board and how the voiding percentage in each area can be compared to pre-set acceptable limits. The concluding part of the presentation will include some 3D computer tomography images which could best be described as e micro-sections, these reconstructed images can be zoomed and cut though in any direction allowing the operator to look at any features within the structure. This technology produces great and very detailed images and with the latest powerful reconstruction and manipulation software allows the user to see details not previously seen before.

Impact of Stencil Quality on Solder Paste Printing Performance

Jeffrey Len, Indium Corporation

The growth of internet of thing (IOT) segment has induced much miniaturization development on the packaging and board level assembly. As the industry are moving to smaller and finer pitch such as 008004 , 0.3mm CSP and BGA, screen printing becomes one of the critical processes in the assembly to produce good quality surface mount assembly. It has been widely accepted that 50-70% of SMT defect come from printing application. There are a lot of variable that will impact the quality of printing such as machine set up, solder paste handling & storages, stencil quality, stencil aperture design, printing parameter and others. In this paper, we will evaluate the impact of stencil quality statistically through MiniTab software by comparison printing performance of different stencil supplier in 0.35mm pitch and 01005 pads

PCB Surface Finishes & The Cleaning Process- A Compatibility Study

GuanTatt Yeoh, ZESTRON

All PCBs that are manufactured require a surface finish to protect exposed copper on the surface which if left unprotected, can oxidize, rendering the board unusable. To address this issue, it is common to surface treat the PCB prior to assembly and reflow. The surface finish not only prevents oxidation of the underlying copper, but guarantees a solderable surface. A cost effective and widely used approach to PCB surface finish is HASL (Hot Air Solder Leveling). However, as circuit complexity and component density have increased, HASL has reached its limitations, necessitating the need for thinner coatings. Thus, coatings such as Immersion Tin (ImSn), Immersion Silver (ImAg), Organic Solderability Preservatives (OSP), and Electroless Nickel Immersion Gold (ENIG) are becoming more widely used.

As most PCBs designed for use in high reliability applications are cleaned in aqueous-based cleaning systems, the effect of the cleaning solution on the surface finish is of great concern. Depending on the cleaning process employed, stains could appear on the plating or in the worst case, the plating can be completely stripped from the PCB rendering the applied surface finish useless.

This study was designed to investigate the effect of reflow and various cleaning agent types on ImSn, ImAg and ENIG surface finishes. Unpopulated ZESTRONŽ test vehicles, with the appropriate surface finish, were used for all trials. Two alkaline cleaning agents, inhibited and uninhibited, and one pH neutral cleaning agent were used. Cleaning system process variables were established and held constant for all trials.

Surface finish assessment following reflow and cleaning was conducted using visual inspection, adhesion test, copper test (ImAg and ImSn), nickel test (ENIG), and the X-Ray Fluorescence (XRF) test. Additionally, baseline tests were conducted on boards without exposure to reflow or the cleaning process in order to assess the effect of the reflow process.

Improving Automatic X-ray Inspection Process with Artificial Intelligence

Chwee Liong Tee, Intel

Automatic X-ray Inspection (AXI) is widely used in the PCB assembly process to detect manufacturing defects as well as provide feedback for process improvement. With the proliferation of BGA and PoP packages, the importance of AXI is gaining more prominent. However, maintaining a robust AXI process is a challenge because it relies on human operator to make the final judgment to either Pass or Fail a board. It is a norm for human operator to review few hundreds of false calls images on each board. Base on observation, operator only spend about 1s to review each image so as to keep up with the output which could lead to escapes. Escapes could also be due to human fatigue. Not only that, human judgment varies depending on the knowledge and experience.

Lately Artificial Intelligence (AI) is in vogue. Various solutions have been thought of revolving around AI. Although AI is an emerging technology, there has been tremendous breakthrough in hardware, software model coupled with huge amount of dataset generated by factory, we think that AI can be an effective tool in improving the factory PCB assembly process.

We initiated this project to demonstrate that the number of AXI false calls to be reviewed by operator can be reduced with the introduction of AI. Our AI model is able to hit above 90% accuracy. It is also able to detect some of the escapes judged by the operator. We will share what are the strategies and preparation needed to implement AI. We will discuss about the quality of dataset and its impact to the accuracy of the AI model. Also shared are benchmark results of the various AI models.

We would also like to propose to the industry on how we can accelerate the adoption of AI to improve the factory PCB assembly process.