Maximizing Production Efficiency through Automated Inspection

In these tough economic times, electronics manufacturers are forced to maximize their production efficiency by implementing lean manufacturing initiatives and optimizing production processes. With this in mind, manufacturers are relying upon automated inspection equipment to streamline the manufacturing process and provide real time root cause analysis of manufacturing defects. The objective is to increase profitability by improving production yields and reducing costly rework.

There are two widely adopted forms of automated inspection that provide the quickest return on investment for the electronic manufacturing process. These are Automated Solder Paste Inspection (SPI) and Automated Optical Inspection (AOI).

Automated Solder Paste Inspection

It is a well known fact that the majority of manufacturing defects are attributed to the solder paste printing process. Some publications and companies claim this number to be as high as 80% of their overall defects. By implementing SPI post-print, manufacturers are able to monitor and maintain the screen printing operation on a real time basis. Defects such as insufficient or excessive solder paste volume, clogged stencil apertures, miss-registration, solder bridging, shape deformity etc. may be detected by the SPI system at the inception of the assembly process with minimal cost for rework. It is important to understand that rework costs significantly increase with each advanced stage of the assembly process. A defect detected post-print may be resolved by simply cleaning the PCB thereby removing the solder paste and the associated defect, whereas a defect detected post-reflow requires costly rework and repair with a risk of damage to the PCB.

All SPI systems employ one of two basic technologies for post-print solder profilometry. These are: Laser Scan Technology, and Moiré Phase Shift Image Processing. Laser Scan Technology is by far the fastest and least expensive means of inspecting for solder profilometry, however, these attributes come with a tradeoff. Laser systems are more susceptible to reflective noise and variations in PCB surface and density. There is also an inherent lack of accuracy due to the "shadow effect" whereby one side of the solder deposition is unable to be illuminated and thus characterized by the laser system.

Moiré Phase Shift Image Processing is by far the most accurate means of inspecting for post print solder profilometry. Using this methodology, a structured light projects a pattern such as a grid, or series of stripes onto the solder paste deposition. This pattern is then incrementally shifted across the deposition and a series of images are captured by a downward high resolution CCD camera. The most advanced systems employ a "shadow free" design in which both sides of the solder deposition are characterized simultaneously. The main benefits of Moiré technology include superior solder paste height resolution capability, and the ability to withstand external factors such as PCB variations and substrate warpage. The end result is a highly accurate 3-D image from which the system can extract precise volume and shape characteristics. Please refer to figure 1.

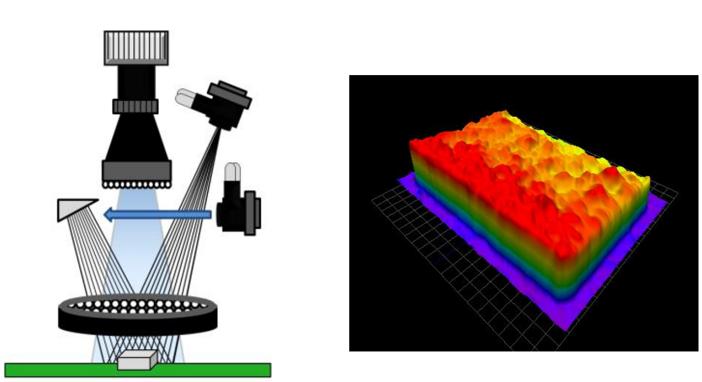

Figure 1

The MIRTEC MS-11 In-Line SPI System uses "Shadow Free" Moiré Phase Shift Image Processing and ultra high resolution four mega pixel camera technology for precision post-print PCB inspection. The MS-11 uses the same robust platform as MIRTEC's MV-7xi AOI System. Inspection heads are interchangeable between the two systems adding ultimate flexibility to the inspection process.

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Automated Optical Inspection

As the manufacturing process becomes increasingly more complex, manufacturers must rely upon AOI machines to minimize the ever increasing probability for defects to occur on finished PCB assemblies. But exactly where should AOI occur in the production line? Should the machine be inserted after the placement machine (post-placement), or after the reflow oven (post-reflow)? The answer to this question is a resounding YES! Most manufacturers, however, are forced to select either one location or the other due to budgetary constraints.

AOI may be used post-placement to inspect assembled PCBs for missing components, wrong components, and proper component orientation. Since this process is performed prior to reflow, defects are relatively simple to repair and less costly than if these defects were discovered post-reflow. Another benefit of post-placement inspection is that component placement data may be gathered for trend analysis. This data is useful for early detection of placement machine calibration issues, which if unresolved, may result in an increase in process defects. It is important to understand that post-reflow trend analysis is somewhat ambiguous due to the fact that component placements will be modified by the reflow process itself. Without post-placement inspection, the need for placement machine calibration may go unnoticed until after a significant rise in the number of defective boards.

Post-reflow AOI is perhaps the most widely accepted methodology among electronics manufacturers. An AOI system placed at this point in the assembly process will detect any defects generated throughout the entire process including missing components, wrong components, proper component orientation, insufficient solder, excessive solder, solder opens, solder bridges etc. Some defects may be attributed to the printing process, others may be caused by the placement system, and yet others may result from the reflow process. The purpose of post-reflow AOI is not only to provide defect data necessary for PCB rework and repair, but to provide a means of collecting this data across multiple assemblies for root cause analysis and continuous process improvement.

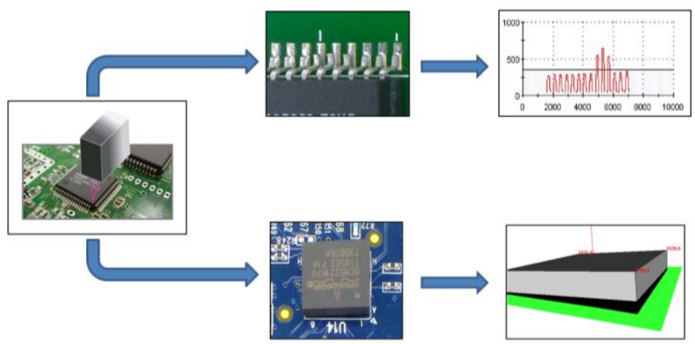

Figure 2

In order to meet the requirements of today's lean manufacturing environment, the AOI machine must be quick and easy to program. This will allow manufacturers to changeover multiple different products in a given production day. Furthermore, engineering resources are at a premium, therefore AOI programming and operation must require minimal technical expertise.

MIRTEC's MV-7xi In-Line AOI System provides technically advanced optics, lighting, and measurement systems necessary for extremely accurate and repeatable inspection results. may be used for either post-placement or post-reflow PCB inspection. The system may be configured with up to five ultra high resolution CCD color cameras. MIRTEC's exclusive ***Intelli-Scan*** Laser System provides; superior lifted lead detection for gull wing devices, four-point height measurement capability for co-planarity testing of BGA and CSP devices, and enhanced solder paste measurement capability (figure 2). The system software is extremely simple yet powerful. Typical programming time is under one hour per assembly. The standard SPC software package promotes continuous process improvement by allowing the user to track and eliminate defects on inspected assemblies.

In summation, electronics manufacturers are competing to capture as much business as possible in an environment which yields ever decreasing profit margins. There is little expectation that these market conditions will change in the foreseeable future. Electronics manufacturers are relying upon automated solder paste inspection and automated optical inspection in order maximize efficiency and acquire quantitative information that may be used to streamline the manufacturing process and reduce manufacturing defects. By increasing first pass production yields, manufacturers are able to decrease costs, save time, and reduce the need for non-value added rework and repair. Electronic manufacturers are becoming ever more selective in purchasing equipment that will add value to their business and allow them to keep up with this ever changing industry. Equipment suppliers are forced to either develop new products which address these specific customer requirements or risk extinction.