Opening the bottleneck

Laser-based optics and fast image processing allow Philips' paste inspection unit to perform full checking at line speeds.

Solder paste printing defects are the largest single fault source in contemporary printed circuit board production. Thorough inspection after the stencil printing stage of the assembly process is essential for manufacturing control. It enables substrates to be rejected at a point where they are easily cleaned for reuse, and before any further added value operation are performed.

In contrast, for assemblies with newer components such as BGAs, in line post-solder inspection and rework are expensive and difficult functions.

High yields are founded on close control of paste printing. However, as SMT placement speeds have risen, circuit densities increased and IC lead pitches reduced, existing techniques were failing to keep pace with flow-line production rates and creating bottlenecks.

Alternative methods such as visual examination or periodic sampling were error-prone or could only detect systematic errors.

Optical innovation

Philips "TriScan" laser scanner is a new product designed to allow full 3-D measurement of every pad on every board at flow-line rates. For example, a 300x300 mm PCB with a 0,5 mm minimum pad pith can be checked in just 9,2 s.

Central to this breakthrough is an advanced optical system that enables multi-point pad height measurements to be carried out at very high speed. Average height, volume, area, profile and misregistration can then be calculated, and clogged holes and bridging are also detected.

In the patented TriScan system, a laser beam is projected onto an angled 20-face polygonal mirror, which spins at up to 50 rotations/s to generate a reflection scanning at up to 1000 times/s. The moving beam is then reflected between a pair of "banana" mirrors, which convert its curved path into a straight, telecentric scan line of equally illuminated pixels at the PCB surface.

Light diffused by the PCB and the solder deposits is intercepted at two separate points by elliptical mirrors and each discrete beam returned through the system, to be focused onto a pair of custom built SiTek PSD's in a double triangulation module.

Accurately traversing the board beneath the scan line by means of a linear motor enables height measurement data for the whole circuit are to be gathered very rapidly. The double triangulation technique compensate for spurious reflections and is virtually insensitive to surface texture, giving a z resolution better than 10 µm.

The advanced PSD processing electronics enables a pixel rate of 10 MHz with a four decade dynamic range.

The x,y resolution is adjusted by varying the mirror rotation speed and board translation rate, according to the minimum lead pitch in the circuit under test. For 0,3 mm pitch, the resolution is 18 µm, with a scan speed of 8,4 mm/s. This rises to 33,6 mm/s when pitches are greater than 0,4 mm and a 36 µm resolution can be used. At the highest speed, a fully equipped system enables up to 1600 pads/s to be checked.

Setting up the PC-controlled TriScan to inspect a circuit is done by downloading data from CAD Gerber files into the program preparation software. Volume, area, average height and misregistration measurements are included as standard, while profile and bridging checks are optional. Programs stored in the unit's host PC can be selected manually, or triggered automatically via barcode product identification.

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Two custom designed SiTek PSDs are used in Philips TriScan.