

X-ray detects hidden failure modes

Introduction

Functional testing and visual examination using stereo microscopy are today's 'standard' quality control techniques for characterising yield and workmanship-related issues in IC fabrication and electronics assembly.

Currently used test methodologies - such as IPC-TM-650 - rely heavily on visual examination. The visual detection of defects can still be difficult, as samples need to be inspected three-dimensionally.

However, sample height differences, component shading, solder joint brightness, flux residues and other conditions can limit such examinations. In such cases, X-ray examination becomes a very attractive tool, as it can be performed two-dimensionally - with the results typically immune to obstacles.

Below two case studies illustrate how X-ray inspection can quickly locate the root cause of failures, to resolve production and lifecycle reliability issues:

- Case 1: A drop in PCB assembly yield
- Case 2: Product returns due to field features

Case 1: A drop in PCB assembly yield

During the production of a low-cost, consumer-grade PCB assembly by a subcontractor, an unexpectedly high drop in yield was experienced on one batch. This particular PCB uses two ASIC devices supplied by DELTA - acting as a fabless component supplier.

The PCB manufacturer tested and characterised the electrical failure mode, and the results indicated problems with a particular batch of one of the ASICs. So, a number of suspect PCBs were sent to DELTA for further analysis.

To maximise speed of reaction, DELTA decided to employ X-ray inspection as the first step in the failure analysis procedure. Real-time scanning of the suspect PCBs located the problem almost instantly - showing it to be an assembly error, caused by component displacement or a missing chip resistor in a specific area of the PCB (fig. 1).

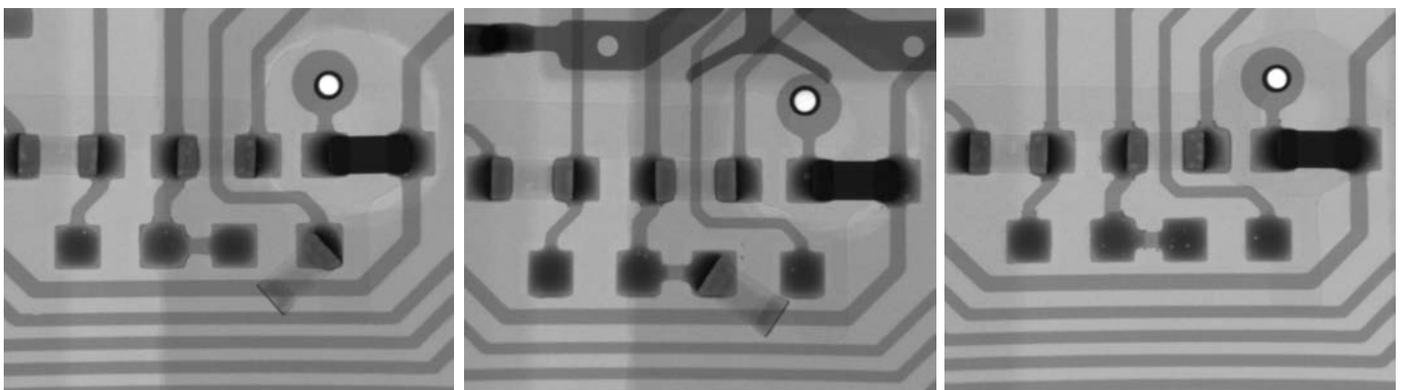


FIG. 1 X-ray view of three PCBs, highlighting misplacement and/or a missing chip resistor.

Case 2: Product returns due to field failures

In this case, a fairly complex PCB assembly was sent to DELTA for detailed failure analysis as part of a manufacturer's follow-up analysis of product returns from the field.

Electrical characterisation already performed by the product manufacturer had initially pinpointed the functional failure to be caused by the short-circuit of a large size QFP-packaged device. But the manufacturer's external visual examination of the device and surrounding PCB area could not identify any defects, and the PCB and solder joints were generally in a clean and acceptable condition.

DELTA visually inspected the IC and surrounding area, using a microscope, and an endoscope to provide views underneath the QFP package. However, even this more detailed visual examination could not identify a defect.

So, the PCBs were subjected to high-magnification and high-resolution X-ray examination. This quickly identified the cause of the failure as short circuiting between the very narrowly-spaced external connections of the QFP caused by 'tin whiskers'.

These defects were later found by careful, high-magnification optical microscopy. The short circuits were so fine that they were almost impossible to see during routine inspection due to their size, viewing difficulties and masking by flux residue (fig. 2).

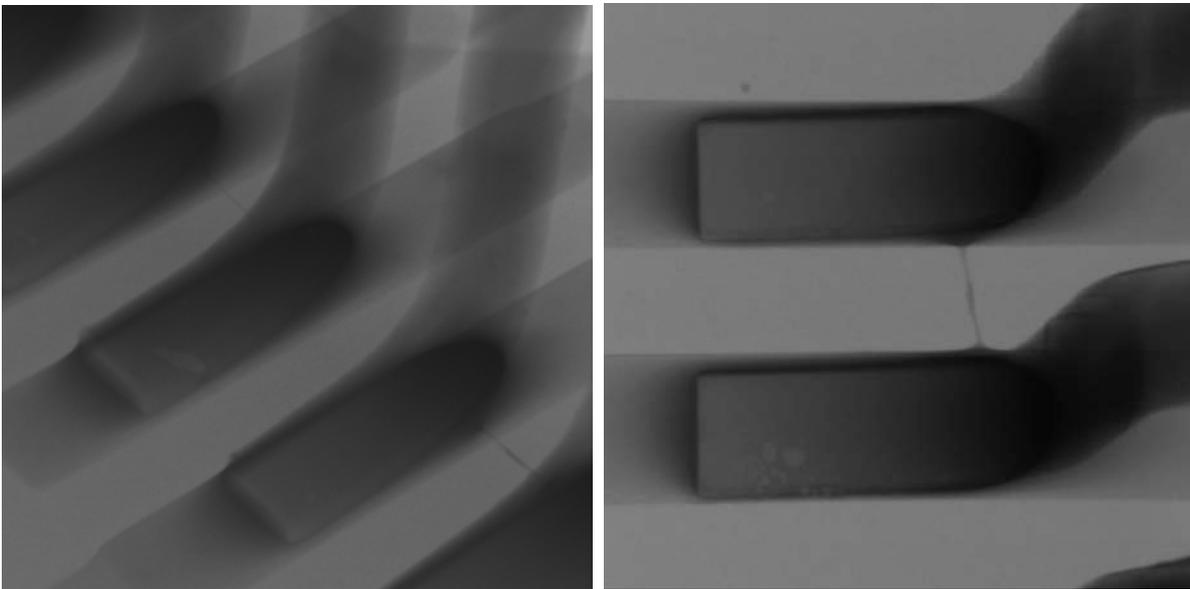


FIG. 2 X-ray showing tin whisker short circuit tracks between the external leads of a large QFP package..

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