

Advanced Fault Isolation for Microelectronic Packaging Yield and Reliability Enhancement

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Abstract

Microelectronics development and manufacturing depend on rapid, accurate, high-confidence root-cause defect identification. 'Brute-force' inspection of large-areas by acoustic or x-ray microscopy is time-consuming, lacks sufficient resolution, and most importantly cannot definitively pinpoint electrically active defects, and time-domain reflectometry (TDR) is limited primarily to open circuits and can only estimate location to within millimeters. Three new techniques - EOTPR (electro-optical teraHertz pulsed reflectometry), LIT (lock-in thermography), and MCI (magnetic current imaging) – can localize buried, electrically-active defects in thick densely populated matrices and in some cases determine depth, especially critical with the emergence of highly integrated 3D package schemes.

EOTPR greatly enhances the estimation of the distance to discontinuities within package conductors. With faster pulse delivery and lower jitter electronics, open-circuits are localized with a resolution of microns (vs. millimeters with conventional TDR). Lock-in thermography uses a pulsed power source to minimize thermal diffusion to localize short circuits to single microns with sensitivity down to microwatts. The phase between the power and resulting signal is also used to estimate depth. MCI uses a SQUID (superconducting quantum interference device) to image current from buried conductors and defects by the magnetic fields generated. Leakages, shorts, and opens are localized with resolution to microns and sensitivity to femtoWatts.

This presentation briefly discusses operating principles, illustrates examples including 3D, comparatively summarizes key attributes and limitations, and describes benefits to package manufacturers, buyers, and integrators.

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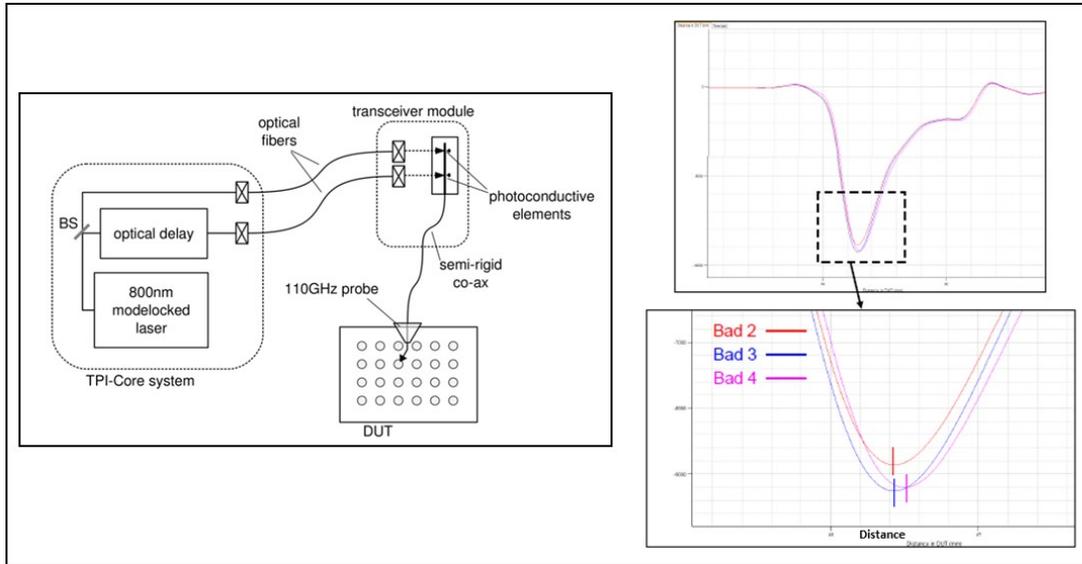


Fig. 1: EOTPR (electro-optical TeraHertz pulsed reflectometry) data estimating open circuit locations in a BGA package to <75 microns separation.

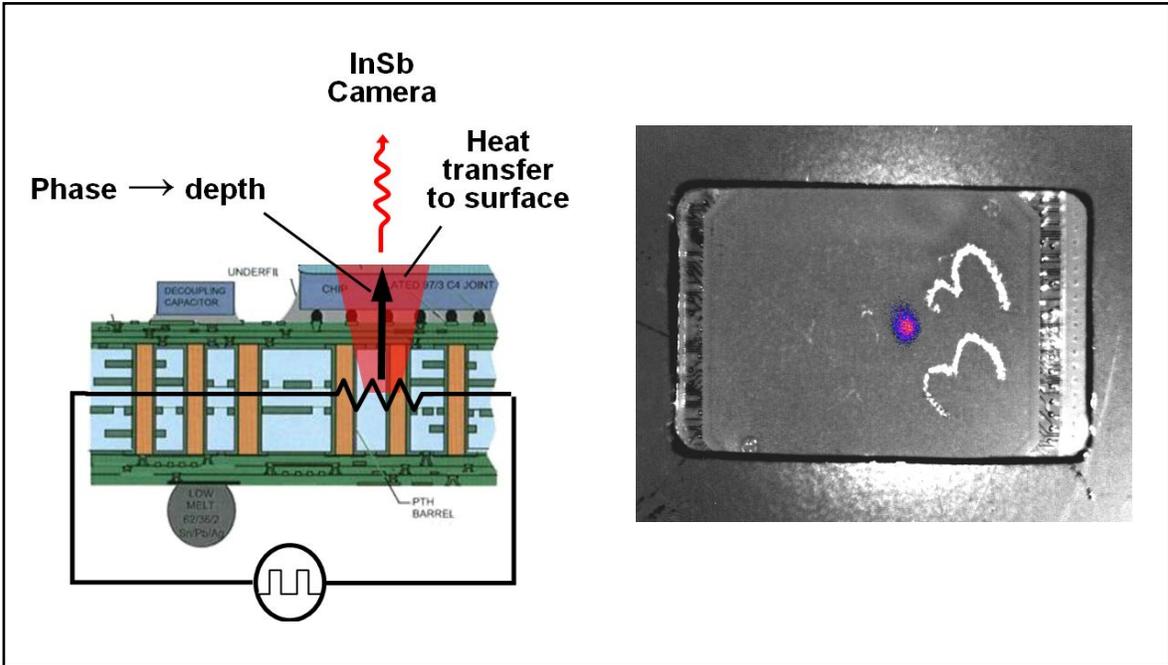


Fig. 2: LIT (lock-in thermography) isolation of a shorted power supply in a plastic encapsulated wirebond device.

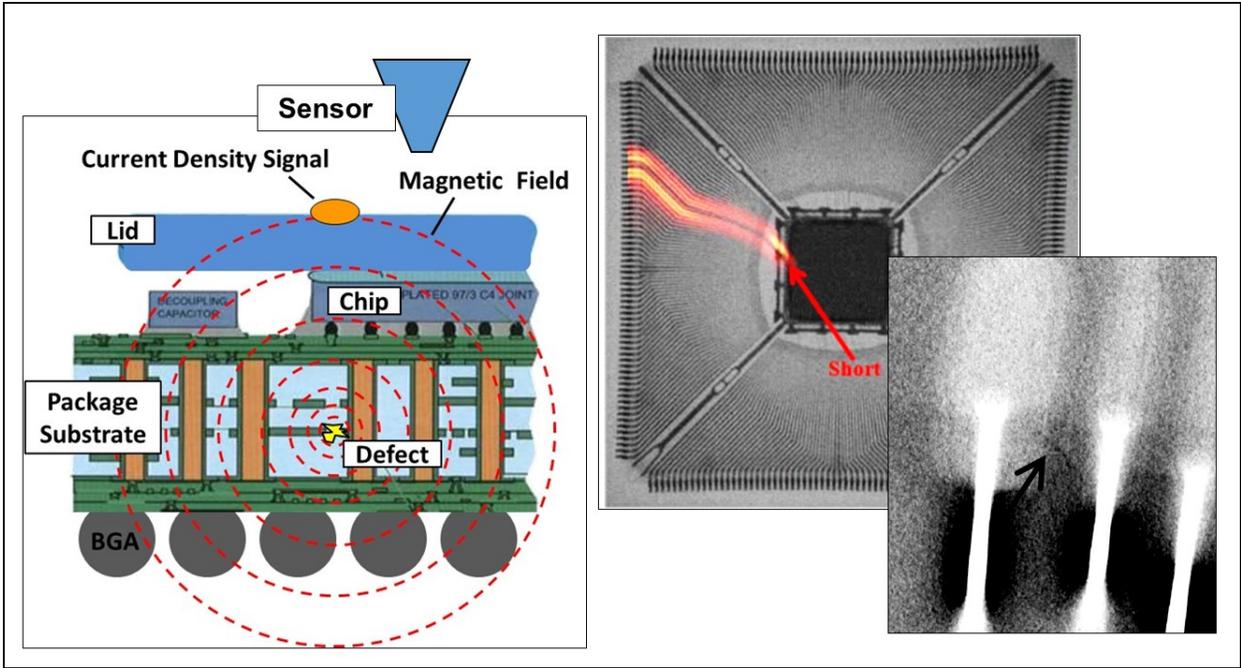


Fig. 3: MCI (magnetic current imaging) isolation of shorted pins in a plastic encapsulated wirebond device.