Plastic Encapsulated Integrated Circuits

Application Overview:

Plastic encapsulated microelectronic devices are the most common application for scanning acoustic microscopes. The first industrial application for SAM systems was inspecting for moisture-induced popcorn cracks. The various applications for the use of SAMs with plastic ICs is now very broad. But most inspections are conducted as part of an overall failure analysis procedure. Automated SAM inspection can now be conducted on ICs in tray or strip form.

Package Types:

PLCC, PQFP, SOIC, TQFP, TSOP, PAKs

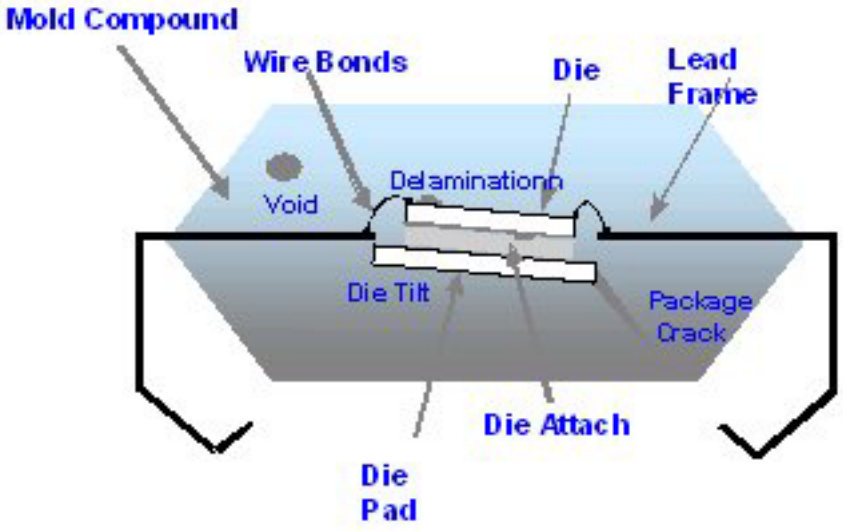
Inspection Standards:

JEDEC-020
MIL-STD-883 Method 2030
JEDEC-035
EIA/JEDEC Test Method A112-A

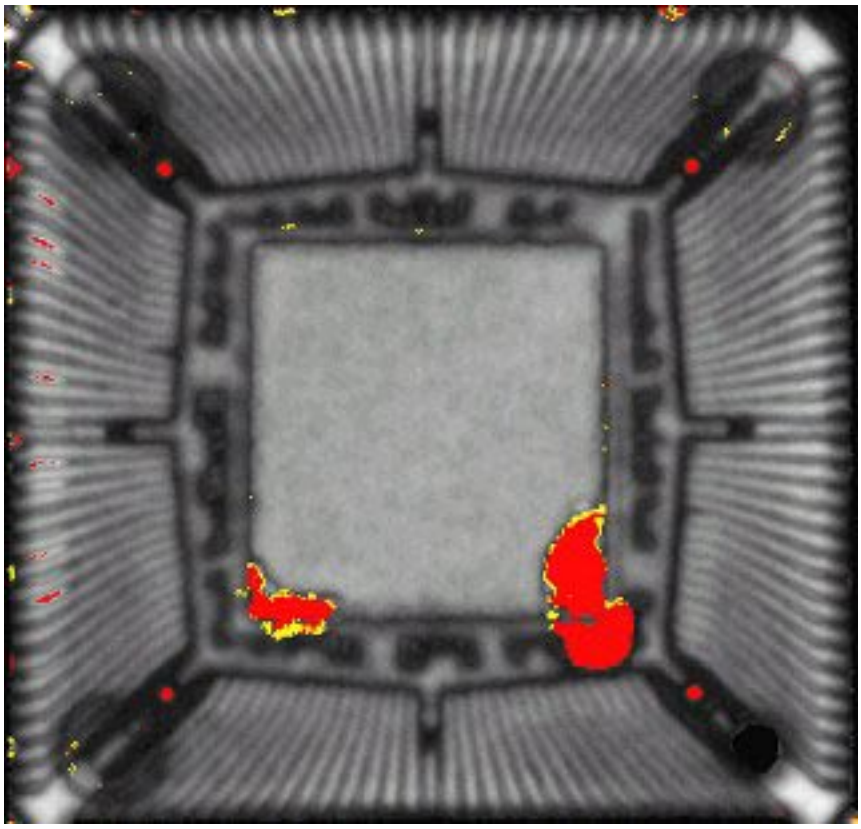
Failure Types Commonly Detected:

Non-bonded interfaces
Die tilt or cupping
Porous die attach
Die cracks
Delaminations
Lack or insufficient die attach
Molding compound voids
Package cracks (Popcorning)
Lead frame delamination
Encapsulant material characterization

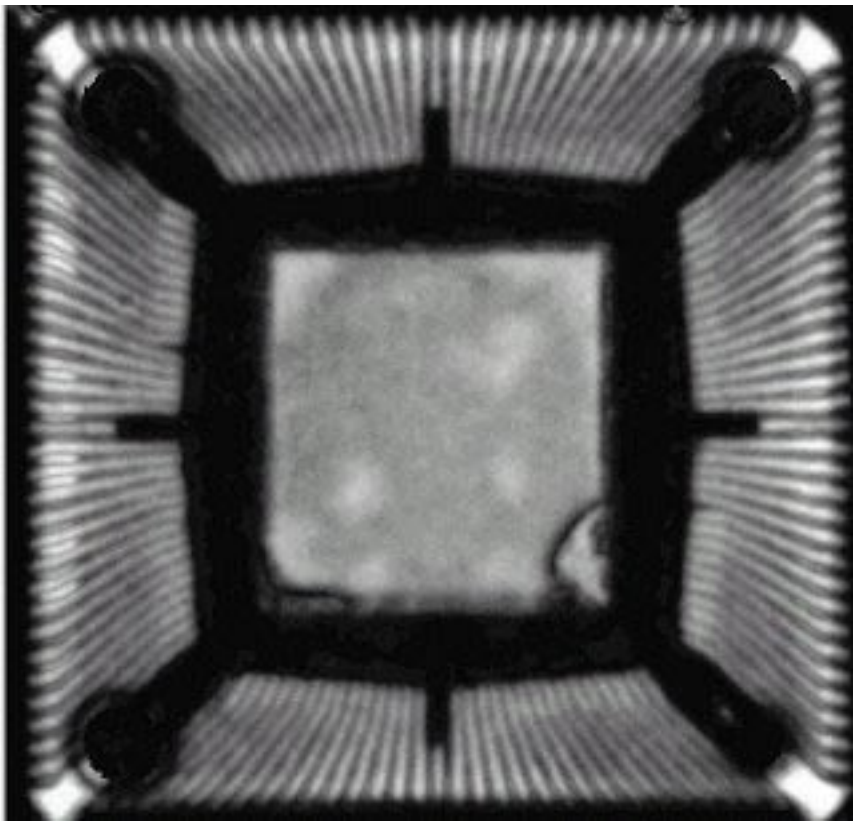
Images:



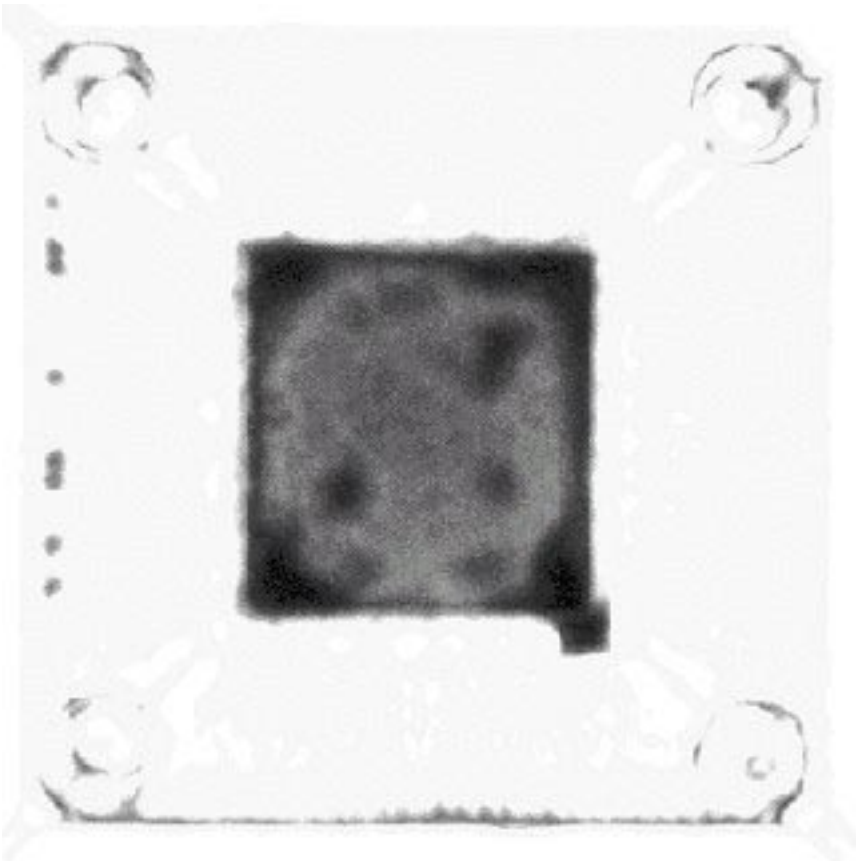
Schematic of the types of defects detectable with a Scanning Acoustic Microscope (SAM).



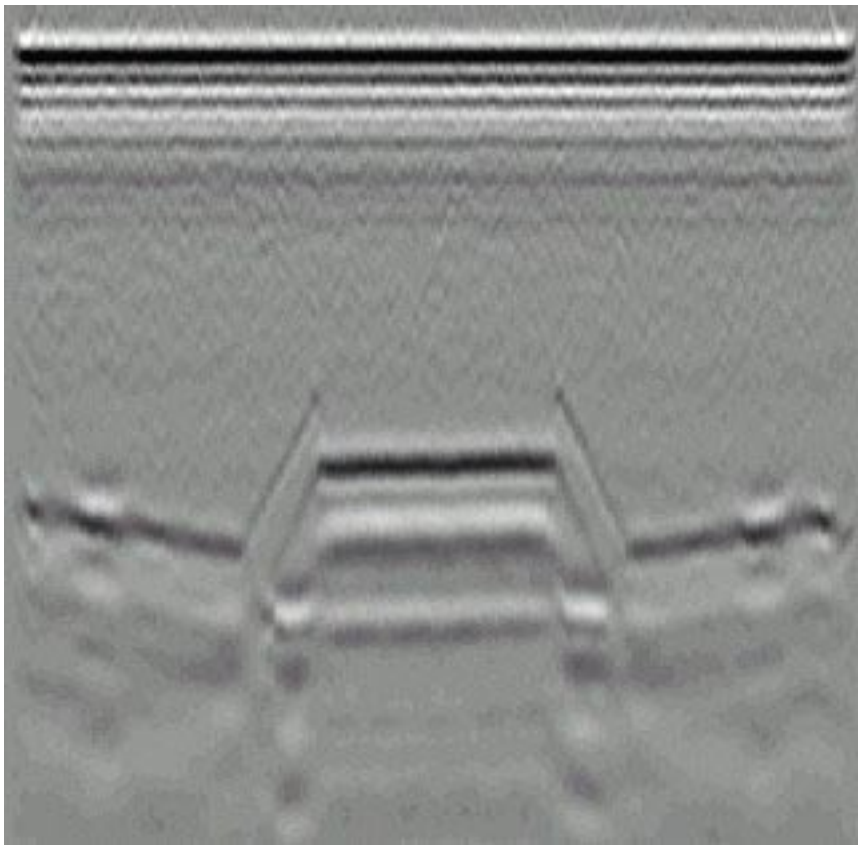
This is a pulse-echo (reflected) mode image of the top side of a PLCC package. A 15MHz 0.5" focal length transducer was used to create this image. This phase inversion image displays information regarding the bond quality of the die top, die pad and top-side lead frame. Red areas represent disbonds between the encapsulant and die. Disbonding on the top of the die will cause the bond wires to not make an adequate electrical connection. Disbonding, also seen in red, can also be found on the lead frame and die pad to encapsulant interfaces.



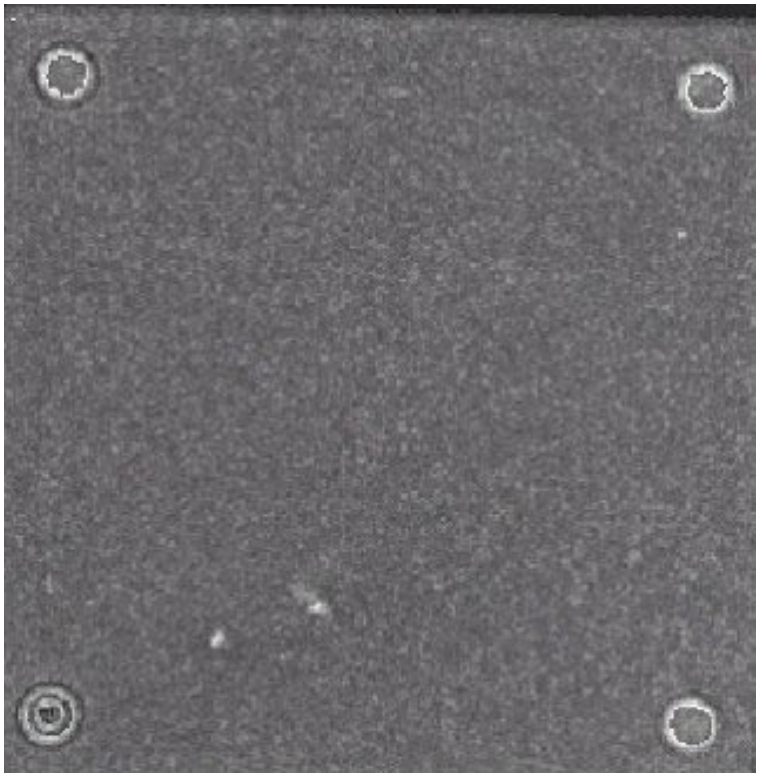
This is a pulse-echo (reflected) mode C-scan image of the die attach interface. A 15MHz transducer was used on the same PLCC package seen previously however, now, the electronic gate was placed deeper within the ultrasonic waveform allowing the C-scan image to be taken at the die attach interface. Disbonding between the die and die attach, voiding within the attach or disbonding between the die and die pad would all appear as bright white areas in this image. Voiding within the epoxy attach material can be seen in this image.



This through transmission mode C-scan image was taken using a 15MHz transducer. A 15MHz transducer was used on the same PLCC package seen previously. Black areas on the image confirm the delaminations seen in both of the previous pulse-echo images.



This pulse-echo B-scan image, taken using a 15MHz transducer, show a non-destructive cross-section of the x-z plane of a PLCC package. It can be seen in this image that the die is tilted within the package relative to the front surface of the package. Die tilt is frequently caused by either misplacement/alignment or forces exerted upon it from the thermally-induced expansion of the materials surrounding it.



This pulse-echo C-scan image, taken using a 15MHz transducer, is of the molding compound of a PLCC package. Called a Material Scan, several locations of air voids trapped within the encapsulant material can be seen as white circular areas. Particle and density variations within the encapsulant can also been seen.