Plastic Ball Grid Arrays

Application Overview:

The inspection of plastic ball grid array (BGA) devices using SAM equipment is very common. Failure modes such as moisture-induced cracking, or popcorning, and delaminations are the most common. Below you can see a variety of the types of defects that can be found with a Sonix SAM system. Automated inspections are possible, but most inspections are done in FA or process control environments.

Package Types:

PBGA, BGA

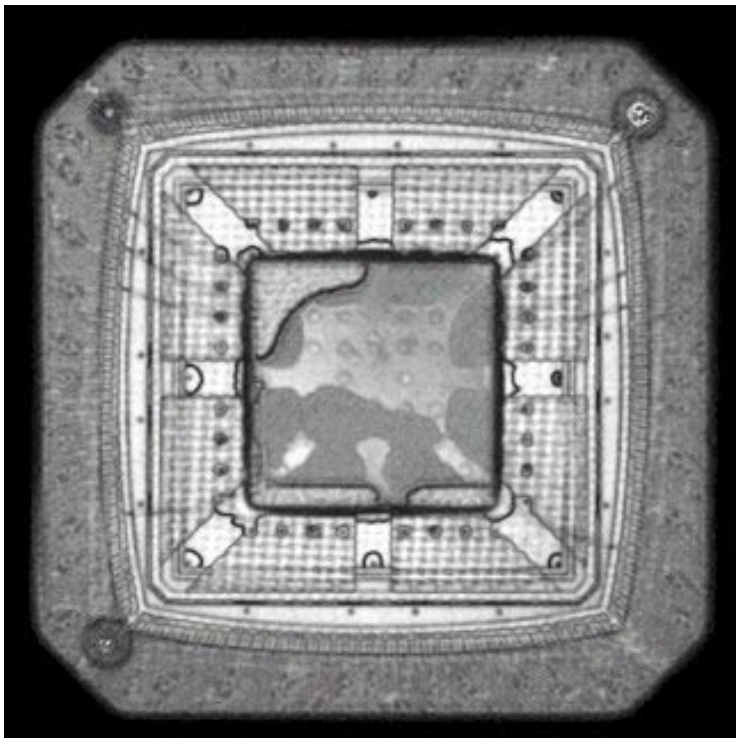
Inspection Standards:

JEDEC-020, JEDEC-035

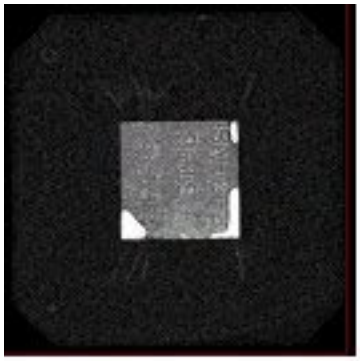
Failure Types Commonly Detected:

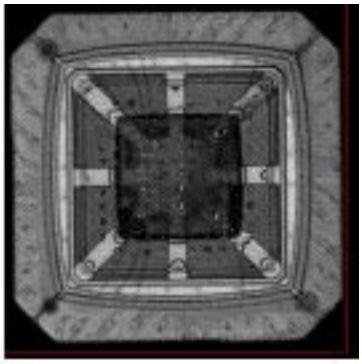
Non-bonded interfaces
Die tilt or cupping
Porous die attach
Die cracks
Delaminations
Lack or insufficient die attach
Excessive fillet height or die attach material
Molding compound voids
Package cracks
Delamination within the substrate
Encapsulant material characterization

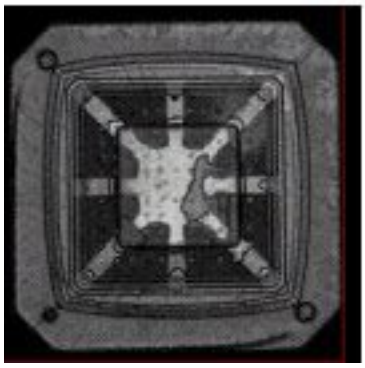
Images:

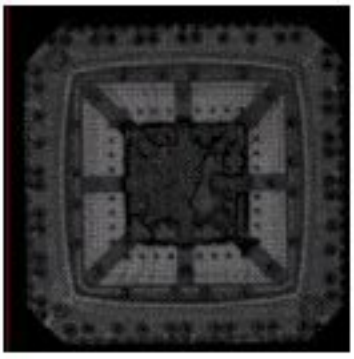


This is a pulse-echo (reflected) mode image of the top side of a ball grid array (BGA) package A 75MHz 12mm focal length transducer created this image. This peak amplitude interface image displays information regarding the bond quality of the die top, die attach, die pad and encapsulant to substrate interfaces. The bright white area in the center square representing 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 can also be found between the die attach and heat sink. This disbonding was likely caused by an insufficient amount of attach material, however, improper force in attaching the heat sink could also be a cause.

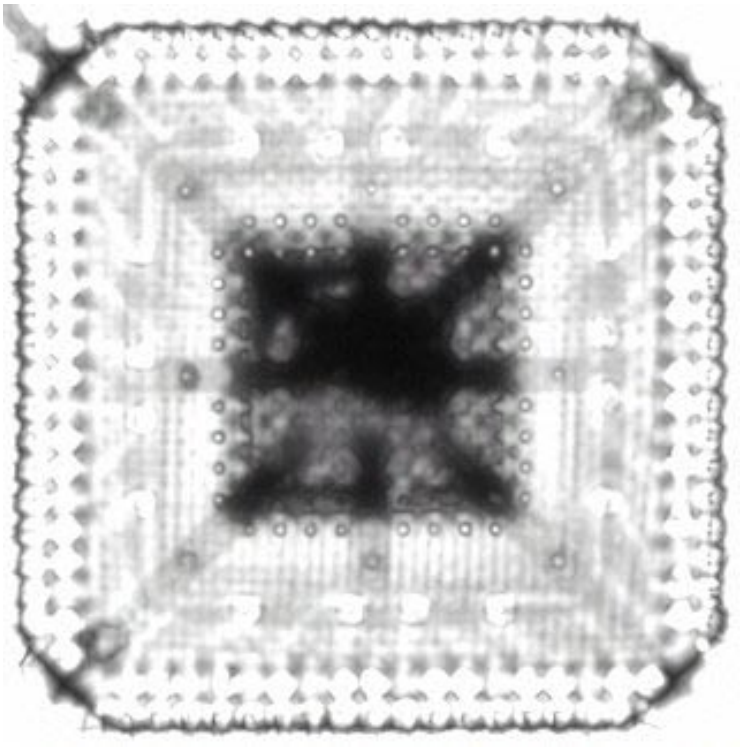




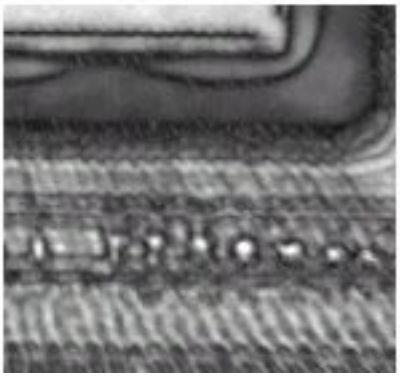




This is a pulse-echo (reflected) mode image of a Ball Grid Array package. A 75MHz 12mm focal length transducer created this image. This peak amplitude TAMI™ Scan image shows all four layers of primary interest in this BGA. Bright white areas in the upper left image represent disbonds between the encapsulant and die. Disbonding on the top of the die will cause the bond wires to not make an adequate electrical connection. Disbonding can also be found between the die attach and heat sink, as seen in the upper right and lower left images. This disbonding was likely caused by an insufficient amount of attach material, however, improper force in attaching the heat sink could also be a cause.



This is a Through Scan image of a BGA package. A 75MHz 12mm focal length transducer created this image. This peak amplitude image displays information regarding the bond quality of all the interfaces and materials within the package. Dark areas represent all types defects within the package. Further investigation is required to determine what layer the defects are occurring. Typically, through transmission imaging is performed as a confirmation technique of results obtained using pulse-echo imaging methods. Comparing this image to the previous images confirms of all previously detected defects.



This pulse-echo (reflected) mode image is of a plastic encapsulated ball grid array device. The lower image is just a zoomed section of the upper image. In this inspection, concern was raised if excess die attach material, upon expansion, would wick up the side of the die and cause die top delamination. The coefficient of thermal expansion of the die attach material can cause a very small, but significant separation of the encapsulant material from the side of the die. If the excess material wicks up the side of the die too high, the delamination can propagate on top of the die, causing device failure. Research has shown that wicking in excess of 0.8 times the height of the die can directly lead to device failure. Acoustic inspection becomes necessary when a new process or material is used to ensure excess die attach wicking does not occur. Due to the vertical geometry of the wicked attach material, the height of the material can not be directed imaged acoustically, however a technique co-developed by Sonix and the packaging industry has shown a relationship between the base width of the excess material and the height of the attach material.