



The information you need...when you need it®

REAL-TIME HIGH RESOLUTION X-RAY MICROSCOPY (XM)

This high resolution system offers nondestructive real-time inspection with magnifications up to 1000X. The high resolution is achieved by means of a virtual point source of X-rays. Internal mechanisms, not normally visible under any other means, may be observed while in operation. Another advantage of the real time radiography system over a static radiography system is that the sample under examination may be positioned in exactly the correct orientation to best depict the features of interest. The sample may be moved in the X, Y and Z directions and can be tilted and rotated as well. With suitable calibration, area and linear measurements can be made of internal components nondestructively.

XM Applications include but are not limited to:

Failure Analysis

- percentage of voiding in die attach
- opens/shorts in bond wires
- bond wire placement
- extraneous components
- construction detail
- loose components
- deformed internal components

Quality Control Screening

- Ball Grid Array (BGA) voiding in solder balls
- voids in welds
- clearance between embedded wires
- die attach voiding
- linear measurements

Materials Evaluation

- dispersion of fill in encapsulant
- delamination in thin films

Mechanical Real-time Evaluation

- switches and relays
- potentiometers
- thermostats
- micro surgical implements

Microfracture Detection

- tubing
- polymers
- feedthroughs

Principle Of Operation:

The X-rays are generated by impinging a stream of electrons onto a puntiform (see definition below) target. The energy of an impinging electron is transferred to the orbital electrons of the atoms of the target. When the excited electrons jump to a lower energy level, photons are emitted. These photons have a frequency which places them into the range of electromagnetic radiation which we call X-rays. The energy of these X-rays is directly related to the energy of the impinging electrons. This electromagnetic radiation has the property of penetrating solid objects. The variable density of the object determines how many photons penetrate to the detector.

The puntiform target is practically a point-source of X-rays. The point-source is created by focusing the electrons upon the smallest point practical. These X-rays extend out from the source in the shape of a cone. Geometric magnification is obtained by adjusting the distance between the source of the X-rays, the sample being irradiated and the detector. The closer the sample is to the source, and the further the detector, the larger the image will be upon the detector.

The detector can be either of two types, an image intensification tube sensitive to X-rays or a photographic negative. The photographic negative can have a magnification of 500 which is directly related to the geometric positioning of the three elements. The image intensification system can also have an electronic magnification related to the ratio of the sensing scan to the output scan; thus a 150 mm scan on the detector when scanned to a 300 mm monitor will give a magnification of 2. The multiplication of geometric and electronic magnification can give a theoretical magnification of up to 500 times. The practical limit, based on the relative opacity to the X-rays of the objects being imaged, is about 400 times.

Data Output:

The output is in several forms:

- viewing on the monitor
- video tape
- wet negative film
- high resolution printout
- tiff image files on disk

Sample Constraints:

- maximum weight of 2.2 lbs. (1 kilogram) for the tilt and rotate stage.
- maximum weight of 10 lbs. (5 kilograms) for X, Y and Z translation.
- maximum sample size is determined by the amount of translation needed
 - maximum specified size is 14 by 15 inches (370 X 390 mm)
- maximum X axis translation is 14 inches (350 mm)
- maximum Y axis translation is 10 inches (250 mm)
- maximum Z axis translation is 10 inches (250 mm)
- maximum rotation about the X-axis is 360⁰
- maximum tilt in the Y-axis is +25⁰, -5⁰