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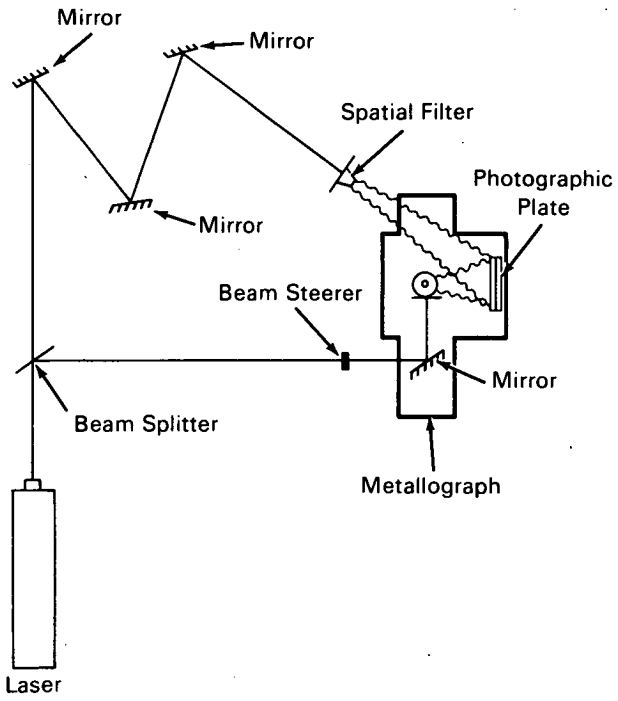
NASA TECH BRIEF

Holographic Stress Analysis



Holographic Analyzer Schematic

A device for nondestructive testing of solder joints has been developed. The holographic method is believed to be the first positive technique for correlating stress with load to predict printed circuit board lifetime.

The laser light is divided into two beams by a beam-splitter, as shown in the figure. The transmitted beam is reflected from a series of mirrors through a spatial filter to a photographic plate. The filter increases the spatial coherence of the beam by filtering out unwanted modes. The reflected beam passes through a beam-steerer and is reflected from a mirror into a metallograph. The metallograph illuminates the test sample and relays the image to the photographic plate. A hologram is produced by the two beams striking the plate. The magnifying power of the metallograph may be varied from 1X to 2000X, depending on the inspection area desired.

Since the hologram stores both phase and amplitude information, it can be used in two ways to determine the stress in solder joints. In the first method, a double-exposed hologram is used. The first exposure is made with the test sample under no load. A load (thermal, mechanical, etc.) is applied and the second exposure made. The hologram then reveals the displacements in the test sample caused by the stress, as a set of fringes around the image of each part of the test sample. The fringe spacing indicates the amount of displacement—the larger the displacement, the smaller the fringes. Thus, the relative motion of each component on the test sample can be determined and, by knowing this, the amount of stress induced by the load can be calculated.

The second method produces the same results, but it operates on a real-time basis. A hologram of the test sample under no load is made, developed, and returned to its original position in the apparatus. When this is done, the image produced by the hologram is exactly superimposed on the original test sample, so that if no change occurs, only the illuminated sample is seen through the hologram. When a stress is applied, fringes will appear as the displacements occur, and the development of fringes may be observed in real time. The analysis of stress from the observed fringes is the same as in the first method.

(continued overleaf)

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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