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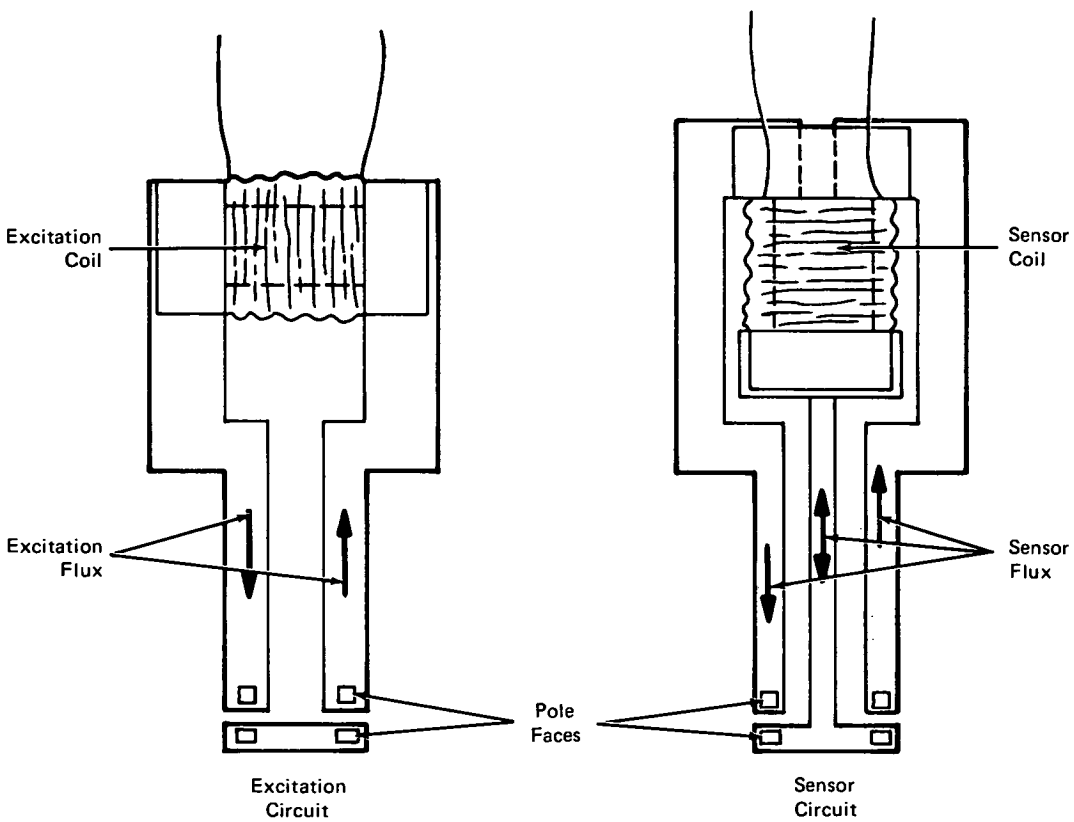
NASA TECH BRIEF

Marshall Space Flight Center

Magnetic Circuitry Mutual Coupling Probe



Magnetic Circuits Of Probe

The use of multilayer printed circuit boards has increased in recent years and has subsequently caused a greater interest in effective nondestructive testing techniques to augment conventional quality assurance methods. Since multilayer circuit boards are essentially three-dimensional wiring networks, the ultimate failure modes are electrical discontinuities (opens) or electrical leakages (shorts). When electrical opens or shorts exist in the multilayer board as fabricated, the failures can be detected electrically by functional testing. A much more difficult situation arises when the multilayer board contains a structural defect that does not presently cause an open or short, but does represent a point of weakness that may subsequently fail as a result of aging or service stresses.

In multilayer circuit boards, the plated through holes that provide layer-to-layer electrical interconnections are the most critical sites for structural defects that can jeopardize reliability. Typical hole sizes are in the 0.076 to 0.254 cm (0.030 to 0.100 in) range. In the hole wall

(continued overleaf)

plating itself there may be localized voids, cracks, thin spots or inclusions of foreign material that do not completely interrupt the electrical pathway along the wall parallel to the hole axis from layer-to-layer of printed circuitry. Such a defective hole could still test as "good", or show electrical continuity, but be mechanically weaker than a defect-free hole.

A new device for nondestructively testing printed circuit boards for structural defects is a probe with a small tip that can be inserted into the plated-through hole and used to detect defects by mutual coupling of magnetic fields emanated and sensed at the probe tip. The device consists of one or more pairs of magnetic circuits which extend from the probe tip to the probe body (see figure). At the probe tip the two legs of each magnetic circuit terminate at pole faces. The external magnetic fluxes for mutual coupling are formed in the air gap between the pole faces. In the probe body each magnetic circuit is wound with an excitation coil or a sensor coil, which create the interface with conventional accessory instrumentation. The innovation features specific configurations of magnetic and shielding materials to control the flux in the magnetic circuits. The probe is not limited to the testing of plated-through holes, but could be utilized to detect structural defects such as cracks, pits or internal voids in any metallic shape.

Notes:

1. Information concerning this innovation may be of interest to manufacturers of printed circuit boards and nondestructive testing equipment for printed circuit boards.

2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B72-10535

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
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