Boundary-Scan Test

A Practical Approach

by

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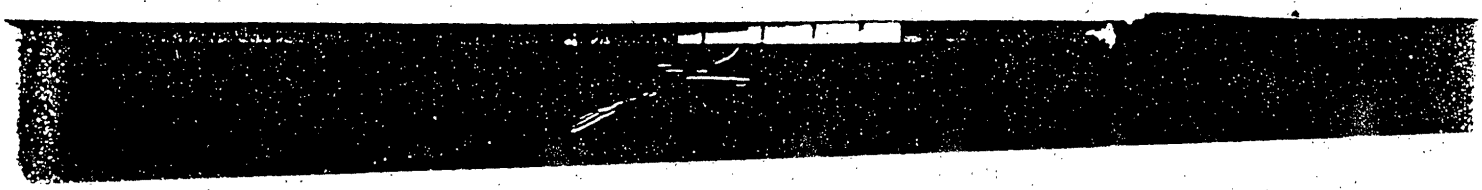

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MINIATURIZATION IN ELECTRONICS

Printed Circuit Boards (PCBs) add the most value to electronics hardware. Over the years, PCBs have become loaded with more components and hence have become increasingly complex and expensive. This is mainly caused by the ongoing miniaturization in electronics.

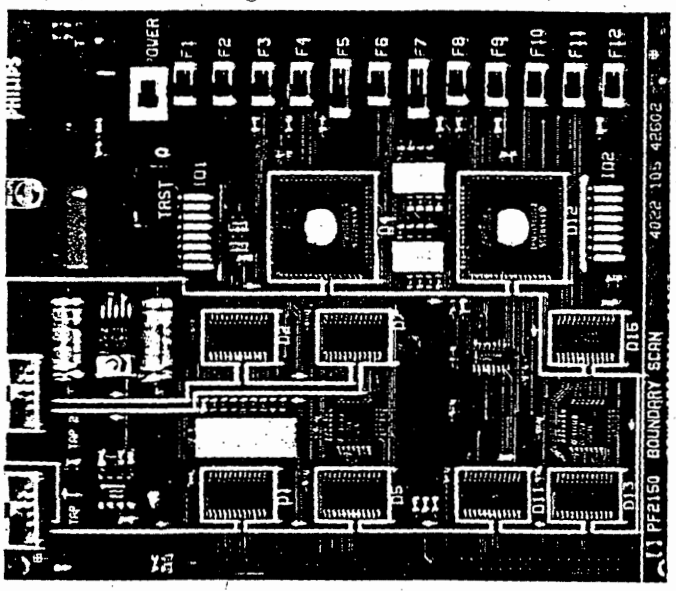
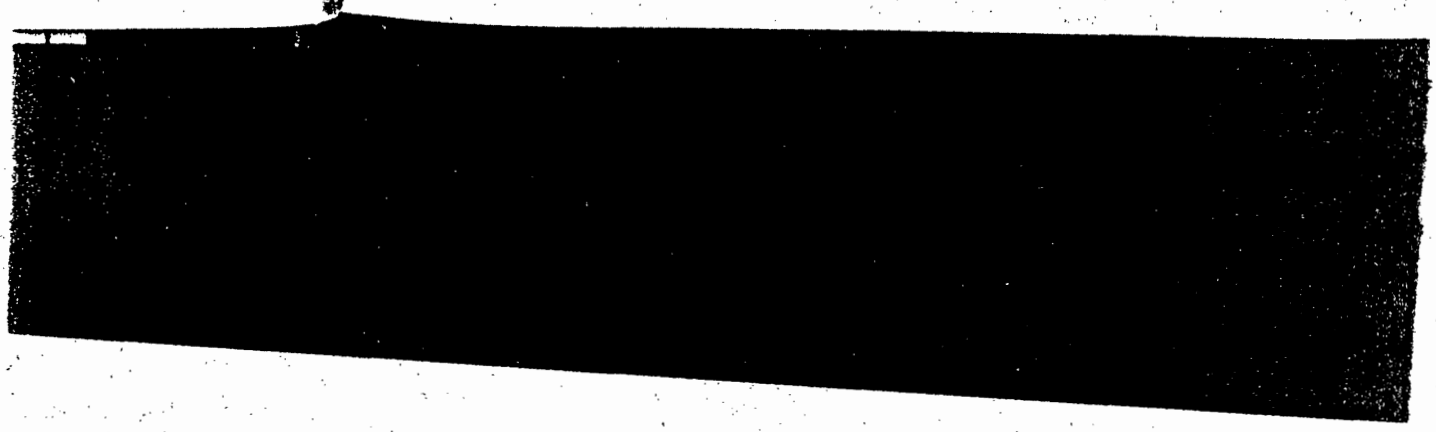


Fig. 1-1 A printed circuit board containing ASICs

To start with, the miniaturization within integrated circuits (ICs) themselves has progressed into the sub-micron technology. This has led to an increased number of gates and a very large number of functions per chip. Consequently, many more pins per IC are needed and hence ICs come in bigger packages with more leads (>500 pins) at smaller pitches (0.3 mm). Therefore, the distance between the foot prints of the ICs on the PCB is becoming equally small.



other technologies are becoming available: Multi Chip Modules (MCMs). These are functional modules built up of dies directly mounted on top of several dielectric and metallization layers supported by a ceramic multi-layer substrate. The component density is very high and accessibility other than via the input and output pins of the MCM is non-existent.

Figure 1-2 shows the reduction of trace distances on PCBs and in ICs.

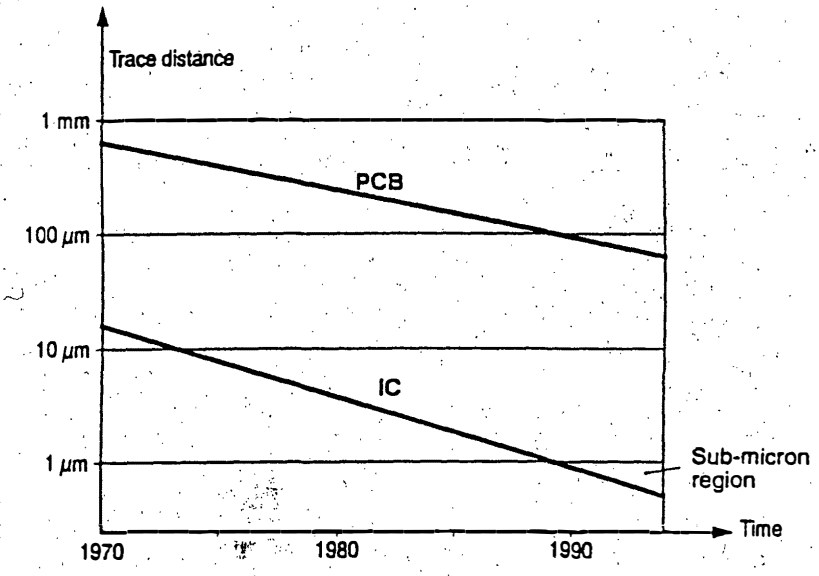


Fig. 1-2 Reduction of trace distances on PCBs and in ICs

Figures 1-3 and 1-4 show, respectively, a part of a PCB and a part of an IC which is soldered onto that PCB. These pictures are taken with a Scanning Electron Microscope and the pitch of the IC's contact pins is 25 mil (= $^1/_{40}$ inch ≈ 0.63 mm).

The ongoing miniaturization has made it more and more difficult to access these "highly loaded" PCBs mechanically, with fixtures, for in-circuit testing. Moreover, the test equipment became so expensive in the 1980s that it severely affects the profitability of producing PCBs. Electronic companies were, therefore, looking for low-cost test methods based on the sofar hardly explored design for testability.

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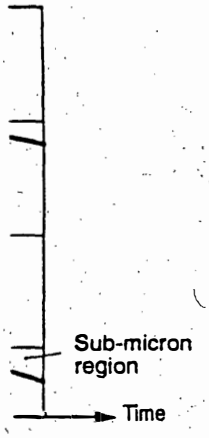
Fig. 1-3 Electron microscope picture of part of a PCB



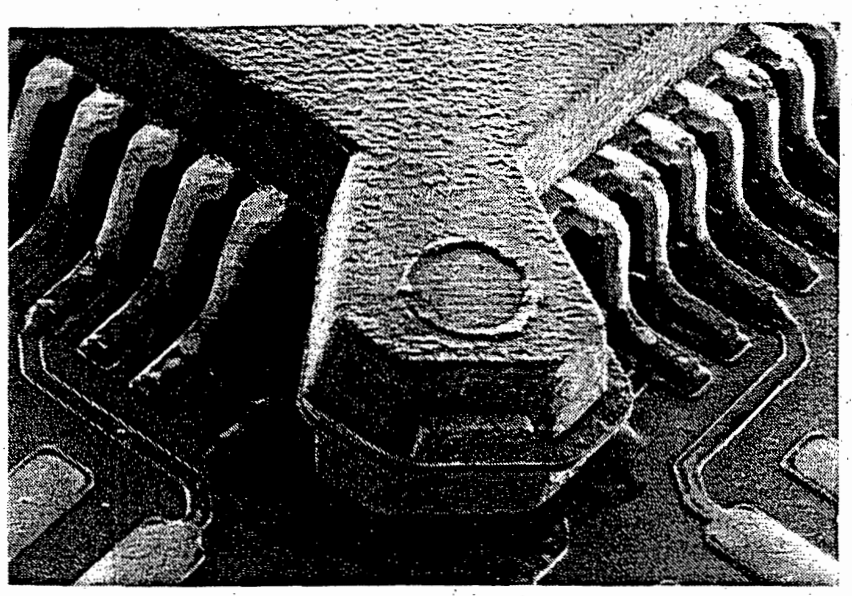


Fig. 1-4 Electron microscope picture of a soldered IC on a PCB

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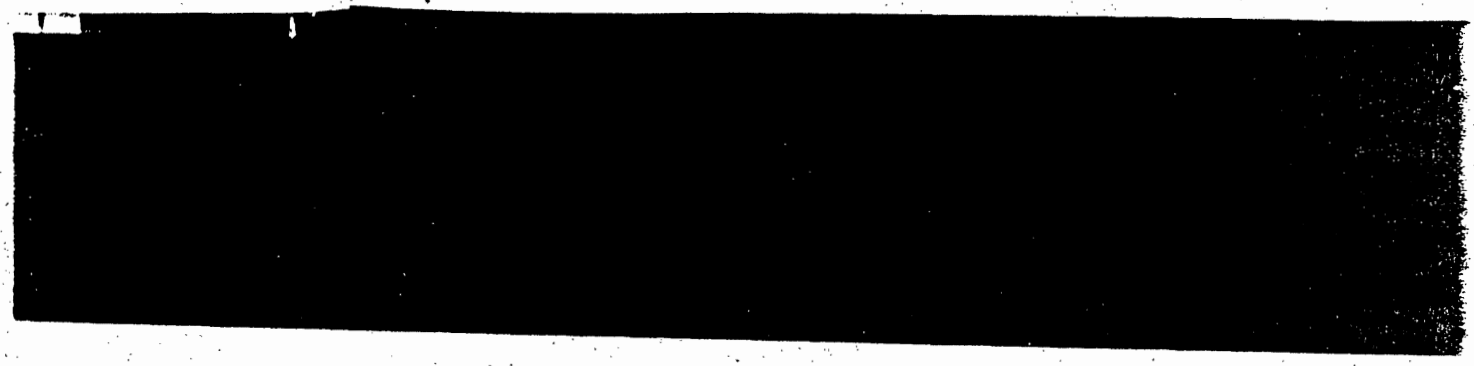

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