

Probe Accuracy Inspection Tool for In-Circuit Test Fixtures Using PCB Artwork

This article addresses three In-Circuit Test (ICT, bed-of-nails) mechanical problems: positional accuracy of fixture probes, printed circuit board flex induced by the fixture, and the verification of ICT (bed-of-nails) probe types. The invention uses reverse-image printed-circuit board artwork as an imprint on acrylic (transparent and photo-sensitive) panels, where the imprinted panels are referred to as "Artwork Cards". Different layers, or thin sheets, are epoxied to the artwork card depending on the mechanical problem under investigation.

Artwork cards consist of photo-sensitive acrylic panels onto which reverse-image raw card artwork is exposed. The photo-sensitive acrylic panels are treated essentially as 35 mm film, and are machined to the represented printed circuit board size. Reverse-image artwork of a board's backside, external signal layer is transferred onto the acrylic, chemically embedding the artwork into the material, similar to a photograph. The circular transparent areas of the artwork represent test points and vias on the board. Tooling pins orient a printed circuit board relative to the bed-of-nails (ICT) probes. The tooling pins serve the same function on the artwork cards and are drilled according to printed circuit board specifications. Fig. 1 presents an artwork card and illustrates its salient features.

For probe accuracy inspection, a layer of standard bond paper (e.g., 20 lb bond) is adhered to an artwork card using an epoxy with the characteristics (e.g., tackiness) of common rubber cement. The adhesive provides the capability of repositioning and removing the paper layer without affecting (contaminating) the artwork. To record probe locations, an additional layer of carbon paper is adhered to the inspection layer using transparent tape. Probe actuation of the bed-of-nails fixture causes distinct dark markings from the carbon-paper layer onto the paper inspection layer. Probes in an accurate fixture will mark the transparent circular areas (test pads) of the artwork card, while inaccurate probes will leave marks outside the test pad areas. When illuminated properly, the markings and artwork card enable a means of direct visual or optical comparator verification of probe locations. Fig. 2 illustrates this inspection principle. The paper inspection layer records the mechanical features and parameters of interest for inspection, while the artwork card serves primarily as an accurate positioning tool. Artwork cards relate the recorded parameters to the test pads of interest for debugging. For instance, if a known test pad on the artwork card does not exhibit a probe mark, the pad location is matched to a fixture probe for direct resolution of the problem, such as replacing a missing or damaged probe. Position of individual probes is determined using a plotted probe map of the board, i.e., a relative coordinate system with test pad locations.