This is the second year of an ITC experiment, the ITC Lecture Series on Unpowered Opens Testing (UOT). Open solder joints on printed circuit boards have become a frustrating problem in today’s era of advanced component packaging. This forum brings condensed technical and product information to board test engineers (and their managers) that will be immediately useful in their daily endeavors.

It was pointed out last year that “traditional” In-Circuit board test has become a hotbed of innovation due to the advancement of UOT support. The trend continues, with this year’s lectures giving expanded coverage with the addition of a new diode-based test technique and the inclusion of X-Ray-based inspection technology. One significant contribution of X-Ray-based inspection is that it gives coverage for “unmodeled” open solder defects, most notably those affecting redundant IC power pins for which no known electrical technique offers coverage.

A taxonomy of UOT technology is given in the figure below. The seven technologies shown in bold are subjects of today’s lectures. The two that are not covered are Voltage Contrast which is not used beyond the IC realm and Reflective Imaging which has been made less practical due to the optical obstructions presented by flip-chip and BGA technologies.

Three fundamental approaches have been classified. Voltage Based techniques utilize electric fields across insulators. Current Based techniques rely on completed current paths through the circuit under test. Image Based techniques allow either human or computer-based examination of solder joint quality.

The Lecture Series describes technologies that exist in real products, some on display in vendor exhibits. Introductory portions of the lectures may point to these products so you might later investigate them. The majority of each presentation will be technical. Enjoy!

![Unpowered Opens Test Diagram]

- **Voltage Based**
  - Voltage Contrast
  - Capacitive
  - Parasitic Transistor

- **Current Based**
  - Conductive
  - Parasitic Diode
  - Substrate Resistance

- **Image Based**
  - Inductive
  - Transmissive
  - X-Ray Imaging
  - Reflective
  - X-Ray Laminography