

Testing: Everything You Wanted to Know, but Were Afraid to Ask

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This month, *Testing Todd* presents some readers' questions about the basics of electrical test, including the different types of testing available today.

Reader: *I recently found out that all points are not necessarily checked during electrical test. Why is that, and which types of boards do not get all of their points tested? Isn't there a chance that something will be missed? Is there a type of test that hits all of the points?*

Todd: When a board is programmed for test, certain points of the board are de-selected. To properly answer this question, we need to revisit IPC-9252A, Amendment 1, which stipulates that Class I and II can remove the mid-points of a net on the board. What this means is that we are only concerned with the end-to-end connectivity of the net. With IPC Class III we need to include the mid-points of the net to quickly isolate any problems in the chain. However, this is cautioned by the additive properties of solder mask encroachment or via-fill. In these cases,

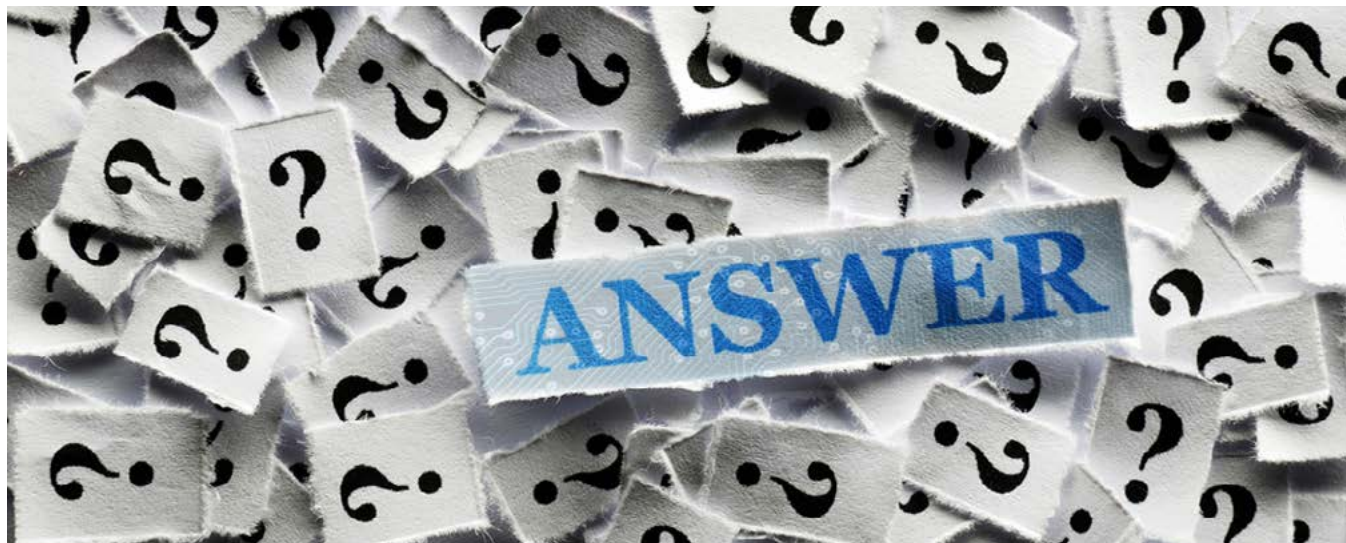
although Class III, they cannot be tested and are allowed the waiver under the 9252A with Amendment 1 release.

Within the Class III requirement of 9252A with Amendment 1, we can add probes to validate each landing pad. With Class I and II we are only validating the end points of the net to make sure the signature is intact. By adding mid-points with Class III we validate that the connectivity is valid to all landing pads. This is in case there may be contamination to any of the intermediate landing pads in the chain of the net.

Adding all pads in the net is referred to as Class III per IPC-9252A with Amendment 1, which hits all of the points.

Reader: *When and why do your customers decide to use the different kinds of testing?*

Todd: Class III is the strongest requirement. In this class, basically zero downtime of the product is allowed—usually medical or aerospace. The utmost care in test and reliability is expected.



Reader: Is one type of test better than another? Why?

Todd: What it comes down to is the product itself: What is it designed to do and what precautions and life cycle does the OEM expect? I cannot speak for other service organizations, but with my group we are going to test the product as if it were going to keep us alive, keep our kids online with school and keep us informed when we need to be. There are minimums that PCBs need to be tested. The informational database with OEMs goes back years; notes and such just get re-pasted into new prints. My group continues to work strongly with these OEMs to make sure their product is tested to the most updated parameters.

Reader: What are the different types of electrical test that you can perform on a circuit board, and which is best for my product?

Todd: Let's start with flying probe testing. Flying probe direct will test the PCB 100% in resistive mode and isolation test 100% based on an adjacency window. (Industry standard .050.) Flying probe indirect will do a capacitive gather and full resistive test of first board; subsequent boards will receive capacitive gather and be compared to master. Possible faults will receive full resistive retest.

Flying probe is just another tool today for the test bureaus. Flying probe can test product without the use of the historic bed of nails fixture. There are tradeoffs though. Indirect testing with signature analysis does allow faster testing but does not subject the PCB to full resistive test. However, this is allowed under the IPC for Class I and II. On a Class III board it is allowed, but only after an agreement between the OEM and manufacturer, which is the hard part for service bureaus. This communication conduit does not exist for most. Many OEMs just expect their boards to be electrically tested but do not have any idea what options are available. When presented with the quandary they will opt for fixture test as that is historic. Unfortunately, fixture test also increases the price for their product, often without the OEM knowing why.

Reader: What is bed-of-nails testing and when is it used?

Todd: Bed-of-nails testing is the old-school test, and it is also stipulated as a requirement for a lot of military product. This is the "fixture" test. This is an apparatus that probes directly at all points necessary, simultaneously. These are large, costly machines that were the beginning of the solution of electrical test.

Reader: What is hi-pot testing and when is it used?

Todd: Hi-pot is a test used to verify that the dielectrics in the board are sound or that the power and ground layers are isolated. With the thin cores used today it has become imperative that these isolations are met or the PCB can fail in its duty cycle.

007: What is netlist testing and when is it used?

Todd: Netlist testing is the process where the electrical test equipment tests the product against a known good signature. What this means is that the electrical test machine already knows what to expect from the PCB. Years ago it was self-learn and compare. Today, the machines already know what to expect from the product based on the design data and will re-learn accordingly.

In an upcoming column, I will discuss what the future of e-testing will look like and I will elaborate on subjects such as testing requirements for embedded components, high resolution measurements, and Kelvin high-resolution testing.

Questions are encouraged and will be addressed in future columns. **PCB**



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