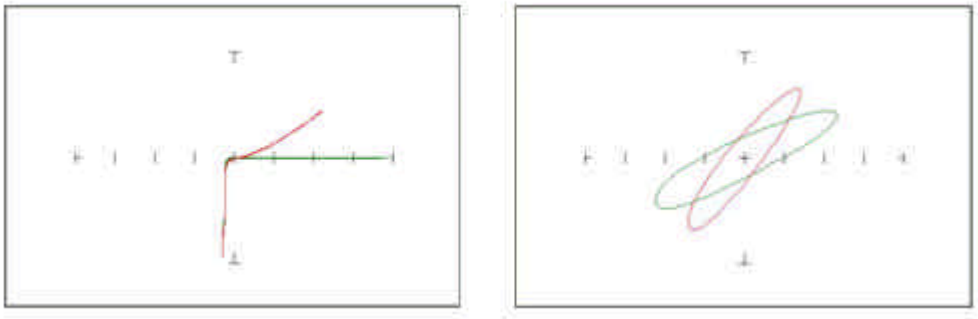
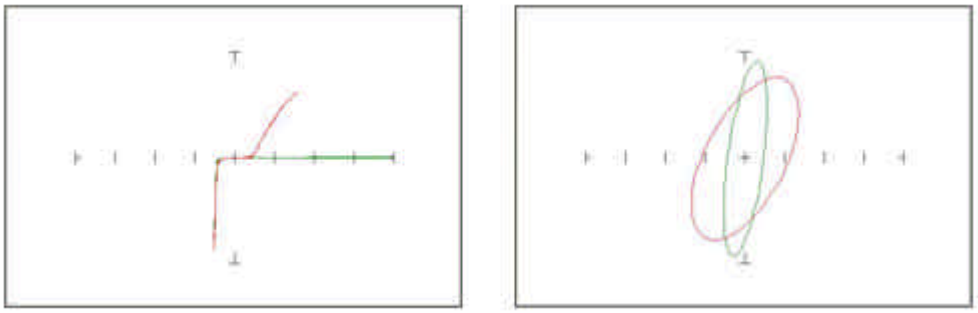
Analog Signature Analysis as a Troubleshooting Method

Prepared By Curtis Smith, Huntron, Inc.

Analog Signature Analysis (ASA) is a test method where the instrument applies a current-limited AC sine-wave across two points of an electronic component or circuit. The resulting voltage/current (V/I) waveform is shown on a signature display using vertical deflection for current and horizontal deflection for voltage. This unique analog signature represents the overall ***health*** of the part being analyzed. By comparing the signatures of known good circuit boards to those of suspect boards, faulty nets and components can be quickly identified.



These images show good versus bad signatures (good is green and bad is red). The signatures on the left show a good transistor and one that is damaged (internal resistive short). The signatures on the right show a good inductor and one with shorted windings.



The signatures on the left show a damaged junction from a 74S04 IC compared to a good IC junction. The signatures on the right show a good capacitor and one with internal leakage.

Analog signature analysis as a troubleshooting method has been in use for many years driven mainly by companies such as Huntron, Diagnosys and Polar Instruments. Basic bench-top units that are used for manual troubleshooting are available as well as fully automated systems that interface to the test points using robotics. These automated systems can provide cost effective component level diagnostics for functional test systems.

What are the advantages of Power-off test?

Power-off testing has several advantages over conventional test methods where the PCA (printed circuit assembly) in functionally tested with power applied.

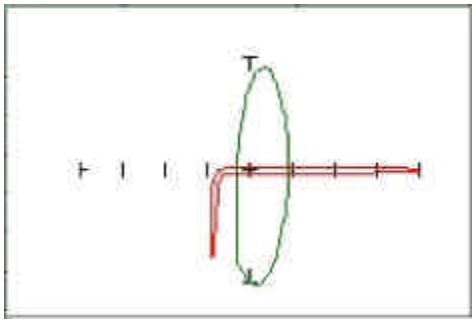
- Testing is possible even if the PCA cannot be powered up for functional test.
- No risk to the PCA where powering it up could damage it further. Signature analysis is power-off.
- Documentation such as schematics and component layouts are not necessary since signature analysis troubleshoots to the component level and does test for PCA function.
- Test setup time is minimal when compared to TPS (test program set) creation times for functional test.
- Signature analysis is based on comparisons to known good information so the test method is easy to learn and understand.

What are the limitations of Power-off test?

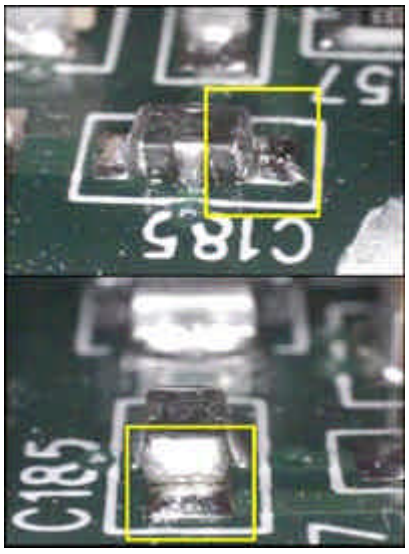
While analog signature analysis is a very useful troubleshooting method there are some limitations that must be realized.

- ASA does not test for PCA or component function so it is not useful with logical or program problems
- Cannot be used for GO/NO-GO or RFI (Ready for Issue) type testing as it is not a functional test
- Requires access to functional PCAs for test development
- Interpreting test results can be subjective but greatly improves with experience

What type of problems will Power-off Diagnostics detect?
Analog Signature Analysis relies on a change in electrical characteristics to detect problems on a circuit board. The following real example illustrates how these electrical differences are presented and analyzed.



The image to the left shows signature differences detected on an actual customer PCA. The issue here is that the capacitance shown in the green good signature (the elliptical signature) is no longer shown in the red bad signature which now shows just a diode shape. This means that the capacitance that is normally in parallel with the semiconductor is no longer there. This indicates a possible open connection to the capacitor.



Upon inspection of the suspect area with a video microscope, the true problem is apparent. Note that the solder connection to the capacitor is bad. This is causing the open problem indicated by the signature analysis.

Analog signature analysis tools are well suited for use in diagnosing component level failures in PCA manufacturing and PCA repair environments. Instruments such as the Huntron Tracker Model 30 can be used to analyze fallout from the production line functional test or screen sample PCAs for problems caused by wrong components, missing components or solder shorts. You can troubleshoot field service returns without the requirements of board schematics or documentation. Different degrees of automation are available to increase productivity and ensure accurate interfacing to surface mounted devices which are difficult to test manually.

About the author

Curtis Smith is a twenty-eight year veteran in the electronics service industry. He has been the primary technical support provider and training instructor at Huntron, Inc. since 1991.