

CASE STUDY

# Probe Heatmap Visualization Tool Helps EMS Company Pinpoint a Costly Issue

Bringing a new product to market requires agility and speed. That typically means streamlining the testing process to keep production costs and downtime under control. But when an unknown issue caused a low first pass yield (FPY) on a new printed circuit board assembly (PCBA), the electronics manufacturing services (EMS) company that makes it turned to Keysight. Its PathWave Manufacturing Analytics solution helped the company identify the problem.

## The Key Issue: Identify and Resolve the Root Cause of Low First Pass Yield

A global EMS company based in China makes a computing PCBA for a large original equipment manufacturer. The PCBA is in the new product introduction stage and will move to mass production soon. However, a pin contact issue in the in-circuit test (ICT) station was resulting in FPY as low as 76%. This would have a huge impact on production, which the company expects will reach as many as 1,500 boards per line per day. Because of the low FPY, the existing systems would not meet the volume demand per day. The EMS company would have to add systems to the production line to meet the target volume. In a typical scenario, the EMS company executes a pin test upon board failure. This helps in overall test throughput; the test team assumes production boards are good and do not require the pin test.

**PATHWAVE**

### Company:

- Computing PCBA manufacturer

### Key Issues:

- Identify the root cause of low first pass yield and resolve it
- Eliminate false failures and reduce unplanned downtime

### Solution:

- PathWave Manufacturing Analytics

### Results:

- Identified the root cause of low FPY
- Resolved the pin contact issue
- Improved FPY to above 97%
- Increased manufacturing productivity by 30%



Only boards with failure are subject to a pin test, which incurs additional test time. Knowing it had a pin contact issue, the EMS company had no choice but to execute a pin test for every board.

To overcome the low FPY the pin contact issue caused, the EMS company implemented the following measures:

- Modifying the test plan to actuate (turn on and off) the fixture three times before the test begins
  - This helps achieve better pin contact between the test points and the fixture (beds of nails)
- Implementing a retest using Keysight's Intelligent Yield Enhancement Test up to three times
- Scheduling more frequent tester/fixture maintenance, including probe replacement, to maintain good probe condition

These measures added test time and cost while reducing production throughput. And the EMS company was still unable to identify the root cause. It could only work around the problem.

## The Solution: PathWave Manufacturing Analytics

Keysight approached the EMS company with its PathWave Manufacturing Analytics solution. Keysight, the domain expert in ICT testing, was confident it would be able to identify the root cause and resolve the pin contact issue. The EMS company used PathWave Manufacturing Analytics to leverage and analyze big data collected from the ICT datalog files (including both pass and fail measurements) of every board. PathWave Manufacturing Analytics unlocked a new level of transparency to determine the issue.

During testing, the user was unable to see the measurement trends, especially the passing measurements. If a test is passed, that meant the measurement was within the upper and lower limits. However, the user did not know if the passing measurement was too close to either the upper or lower limit, which may contribute to false failures. The user would replace the probe only when the test started failing. This resulted in more unplanned downtime, reducing productivity and lowering overall equipment effectiveness (OEE).

Degradation anomaly detection in PathWave Manufacturing Analytics can determine probe deterioration via test measurement. Once PathWave Manufacturing Analytics detects a measurement deterioration trend away from the main population, it triggers an alert. The user can then plan to replace the probe — before failure occurs — during breaks, shift changes, or scheduled downtime. This process converts unplanned downtime to planned downtime, maximizing machine uptime and resulting in a higher OEE score.

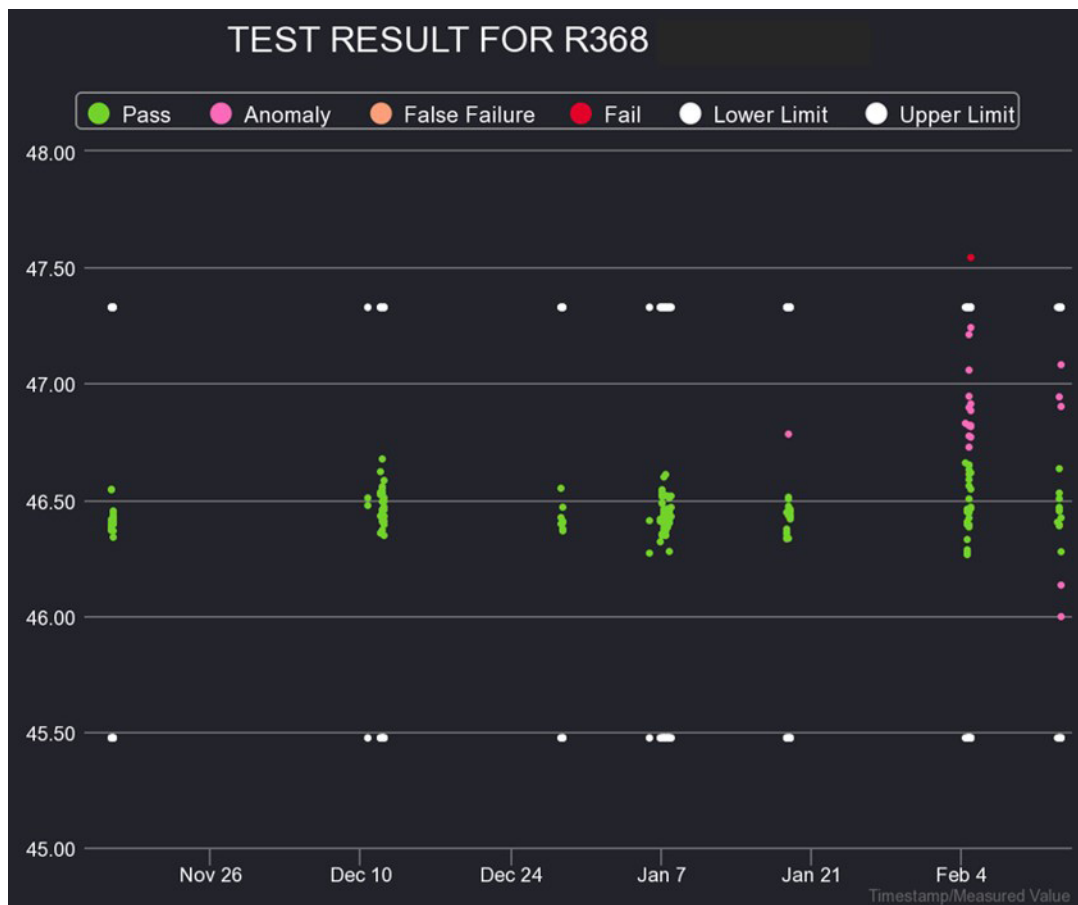


Figure 1: Scatter plot with degradation anomaly

Figure 1 shows a scatter plot depicting a test measurement. This provides valuable insight into the measurement trend, the passing measurement trend, which was not previously visible to the user. The measurement is stable and consistent at the beginning. Subsequently, an upward trend suggests a high possibility of probe degradation. PathWave Manufacturing Analytics' algorithm triggered an alert when it detected the first degradation anomaly (highlighted by the pink dots) on January 20.



Figure 2: Probe Finder

In addition, the Probe Finder feature in PathWave Manufacturing Analytics (as shown in Figure 2) displays the probe locations of the affected test that detected the degradation anomaly. This helps the user easily identify the probe location for replacement.

With degradation anomaly detection, the maintenance model moves from preventive to predictive. This reduces the engineering effort (time and resources) because only the affected probes that PathWave Manufacturing Analytics detects need replacing.



Figure 3: Probe Heatmap

Applying analytics on all the passing and failing measurements shows the probe performance on the fixture. The Probe Heatmap (as shown in Figure 3) clearly highlights the probes that contributed to most of the failures/retests. From here, the user can determine whether the probe problem comes from a certain area of the fixture. That could point to a critical flaw in the fixture or board design or even in the manufacturing process.

By ingesting and analyzing all the data logs the EMS company provided, Keysight determined that most of the pin contact issues occurred in certain areas of the board/fixture. Keysight presented this Probe Heatmap display to the product design team at the EMS company. The team was immediately able to pinpoint the root cause.

The worst performing probe/test point locations are close to several high-profile components. It is likely that the flux on these test points did not completely burn off. The remaining flux on the boards caused the pin contact issue. The manufacturing team adjusted the heat profile of the reflow oven. The team began having good pin contact for this project. With that, the FPY improved tremendously — to 98% (up by 22 percentage points).

## The Results: Optimized Test Time and Improved Productivity

The test plan reverted to pin test upon failure, and fixture actuation reverted to one time, optimizing the test time to achieve maximum productivity throughput. Cutting 10 seconds from the original cycle time of 40 seconds achieved an incremental productivity improvement of 30%.

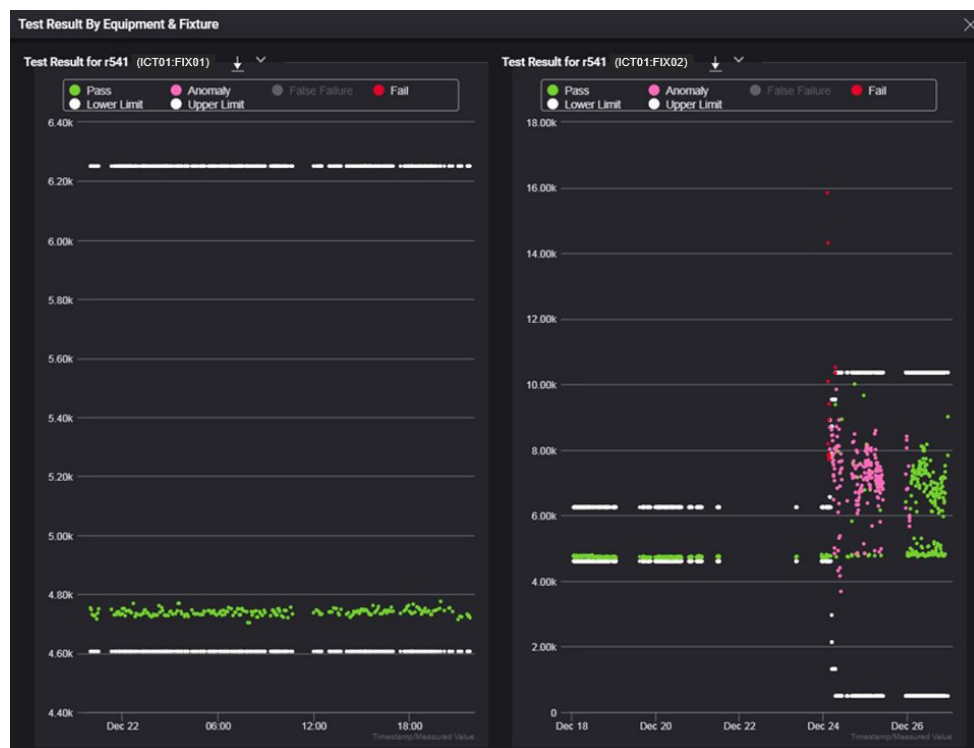


Figure 4: Fixture-to-fixture/equipment-to-equipment comparison

In addition, when deploying multiple fixtures and testers to meet high-volume production demand, PathWave Manufacturing Analytics also provides a quick and easy way to make fixture-to-fixture or equipment-to-equipment comparisons (as shown in Figure 4 above). One can easily differentiate and isolate whether the issue is fixture-related, equipment-related, or board-related.



## Key Takeaways

The unique features in Keysight's PathWave Manufacturing Analytics enable test measurement analytics that provide different perspectives and a whole new level of insight. Together with other Keysight-patented analytics algorithms, such as Component Anomaly, PAT Limit Anomaly, and Limit Change Anomaly, the manufacturer can identify process variance and issues faster and more easily. Thereafter, it can take the necessary steps to improve overall manufacturing efficiency.

”

**PathWave Manufacturing Analytics has provided us a different dimension view to our issue. The Probe Heatmap visualization tool has enabled us to immediately pinpoint the root cause, which we were unable to discover previously. Delivering quality product and meeting delivery quantity are key commitments to our customers. Keysight's solution is a key factor to the improvement seen in our manufacturing efficiency.**

Plant manager,  
EMS company

Learn more at: [www.keysight.com](http://www.keysight.com)

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: [www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)

