

## Fault Detective Case Study #1 Presentation:

*Improving the Quality and Yield of RF Printed Circuit Assemblies*

### Situation:

Agilent division manufacturing RF instruments

- Family of RF PCAs with >1,200 components each
- Outsourced to contract manufacturer

Start-up problems with quality & yield

- Resolved initial issues with first-pass yield
- *Problem:* Low whole-instrument turn-on rate

CM: Used only X-ray & in-circuit testing

- Not equipped to identify faults or isolate bad components

Division: Sought solution that CM staff could operate



One of Agilent's own instrument divisions struggled to meet its goals for quality and yield after transferring production of several high density RF printed circuit assemblies (PCAs) to a contract manufacturer (CM).

Initially, first-pass yield was less than 50 percent but Agilent and the CM worked together to boost this to over 90 percent. Unfortunately, the instrument turn-on rate remained low because faulty boards weren't being discovered until final assembly.

To complicate matters, the CM was checking the PCAs with only in-circuit testing (ICT) and X-ray inspection. It wasn't equipped to identify faults or isolate defective components so it was shipping failed boards to Agilent for repair.

In response, Agilent's manufacturing engineering team sought a testing solution that could be operated by CM staff to provide immediate feedback about process and product problems and also enable onsite troubleshooting and repair of faulty boards.

## Implementing a Test Optimization Solution

### Strategy:

#### Defined three-part solution

- Screening with functional test station
- Two-stage troubleshooting process
  - Visual inspection by operator
  - Guided probing by technician

#### Combined into PC-based test station

- Off-the-shelf test equipment
- Universal test fixture
- Barcode scanner
- Agilent Fault Detective software



The Agilent team developed a three-part solution: boards that passed ICT and X-ray would be screened with a functional test station; any that failed screening would move to a two-stage troubleshooting process (visual inspection by an operator; guided probing by a technician).

Those capabilities were combined in a PC-based test station (*see photo*) that uses off-the-shelf test equipment, a universal test fixture, a barcode scanner and Agilent Fault Detective software.

## Assisting Users at Every Step

### Implementation:

#### Screening Mode – Operator

- System reads barcode, configures & tests
- Takes 4 minutes or less, catches 98% of faults
- Sends pass/fail signatures to Fault Detective

#### Visual Inspection Mode – Operator

- Guided by prioritized list from Fault Detective
- Checks for visible defects
  - If found, performs repairs & re-tests
  - If none, replaces two mostly-likely devices & re-tests
- Takes 10 minutes, >50% successful

#### Guided Probing Mode – Technician

- Reruns failed tests, probes along signal path
- Takes less than 20 minutes, >80% successful



The system has three modes that assist an operator or technician at every step.

- **Screening:** After reading a barcode that identifies each type of PCA, the system configures the test station and performs a suite of functional tests in less than four minutes—and catches 98 percent of faults in even the most problematic RF PCAs. All pass/fail “signatures” are sent to Fault Detective for analysis.
- **Visual Inspection:** An operator performs a visual inspection of any failed board, guided by Fault Detective, which isolates the most likely causes and generates a prioritized list of suspected components. If the operator finds no visible defects, they replace the two most-likely components and repeat the screening tests. The entire process takes about 10 minutes and has been more than 50 percent successful. Boards that fail go to the final stage.
- **Guided Probing:** A technician places the board in the fixture then uses the system software to rerun any failed test and probe along the associated signal path (*see photo*). This requires the ability to read a schematic, follow a signal path through a circuit, and use a spectrum analyzer to probe, check and compare signal levels. This process typically takes less than 20 minutes and has an 80-percent success rate.

## Achieving Meaningful Benefits

**Results:**

**Quantitative benefits**

- 99.8% cumulative yield
- \$2.2M/year reduction in repair costs (98% decrease)

**Qualitative gains**

- Agilent: Greater confidence in quality
- CM: Greater self-sufficiency in testing

**Future improvements**

- Use Fault Detective & Fault Detective Test Analyzer
- Apply early in the development process
- Boost fault-isolation accuracy, improve test coverage

- ✓ Improve test suite effectiveness
- ✓ Transfer test knowledge quickly while protecting intellectual property
- ✓ Reduce repair costs through consistent & accurate troubleshooting

For more information, go to [www.agilent.com/find/tos](http://www.agilent.com/find/tos)

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With this solution in place, the cumulative yield for individual PCAs has improved to 99.8 percent. More impressive is the \$2.2M/year reduction in repair costs: hands-on testing that previously required three hours of technician time can now be done in just 30 minutes by less-skilled personnel. This is enabled in part by Fault Detective and its detailed knowledge of the PCA.

Going beyond the numbers, this innovative solution has created a win-win situation for Agilent and its CM.

- **Agilent** has greater confidence that the CM will deliver good boards, and it knows the trickle of returned boards can be quickly evaluated because each comes with a meaningful fault signature. It also knows its intellectual property is protected because it's embedded within Fault Detective.
- With a test system onsite, the **CM** gets immediate feedback that helps it identify and address process and product problems in a timely manner. The CM is also gaining the ability to troubleshoot and repair a significant number of faulty boards in-house, guided by Fault Detective.

In the future, the team expects to surpass these results by applying Fault Detective and its companion, Fault Detective Test Analyzer, during the design process. For complex PCAs, earlier application of Fault Detective could push fault-isolation accuracy to over 80 percent. Using the test analyzer early in the design process can improve test coverage and reduce the number of tests needed to achieve the desired level of fault-isolation accuracy.