



IEEE Joint Section Reliability Chapter

*Dramatic COTs Pro-Active
Design Dfx traced to
Innovative PDCA Practice*

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Gene Bridgers
6/15/2011



Mercury Design for Reliability Agenda (Dfx)

- Introduction to Design for Reliability (Dfx)
- Mercury Dfx PDCA Automation Timing
- Our COTs Electrical Design Steps
- Examples of Actual DfR Alerts
- Examples of Actual Dfx Failures
- Key Performance Metrics
- The Customer MTBF View
- Impacts of Dfx
- PDCA Dfx Future Opportunities
- Questions



Mercury Introduction to Dfx

- This presentation describes Mercury's Dfx process:
 - Innovation
 - Practice
 - Success
- Mercury's innovative DfR process was initiated in late 2005.
- Automated DfR starts very early in the design cycle – The DNA of our Module or System is based on selection of the electrical parts.
- It automatically contains MTBF predictions:
 - Telcordia SR 332-1
 - MIL-Handbook-217F-1
- Includes closed loop lessons learned for avoidance and a positive feedback for the preferred decisions on part standardization.
- DfR Practice is documented and audited as an ISO policy.
- Management tracks metrics each month and quarter to identify trends.

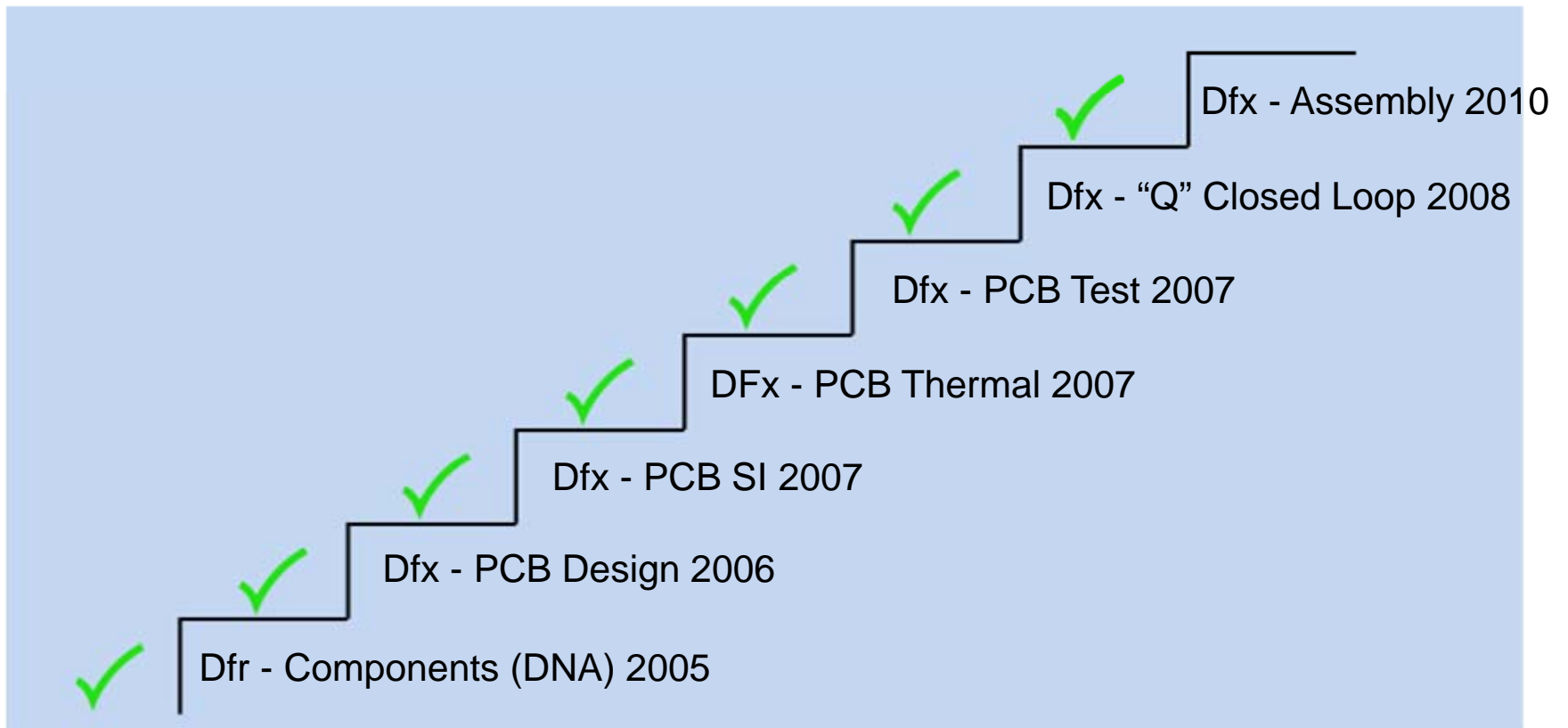


Mercury Introduction to Dfx

- Proactive DfR drives COTs designs:
 - Increases design accuracy
 - Increases design reuse
 - Reduces design cycle-time
 - Minimizes cost
- Electrical design staff has embraced our Dfx guidance.
- Design improvements are endorsed by NPI in Operations.
- This presentation includes:
 - Dfx alerts describing lessons learned
 - Positive Dfx initiatives
 - Key Dfx performance metrics



Mercury Dfx PDCA Automation Timing



PDCA stairs to reliability improvements

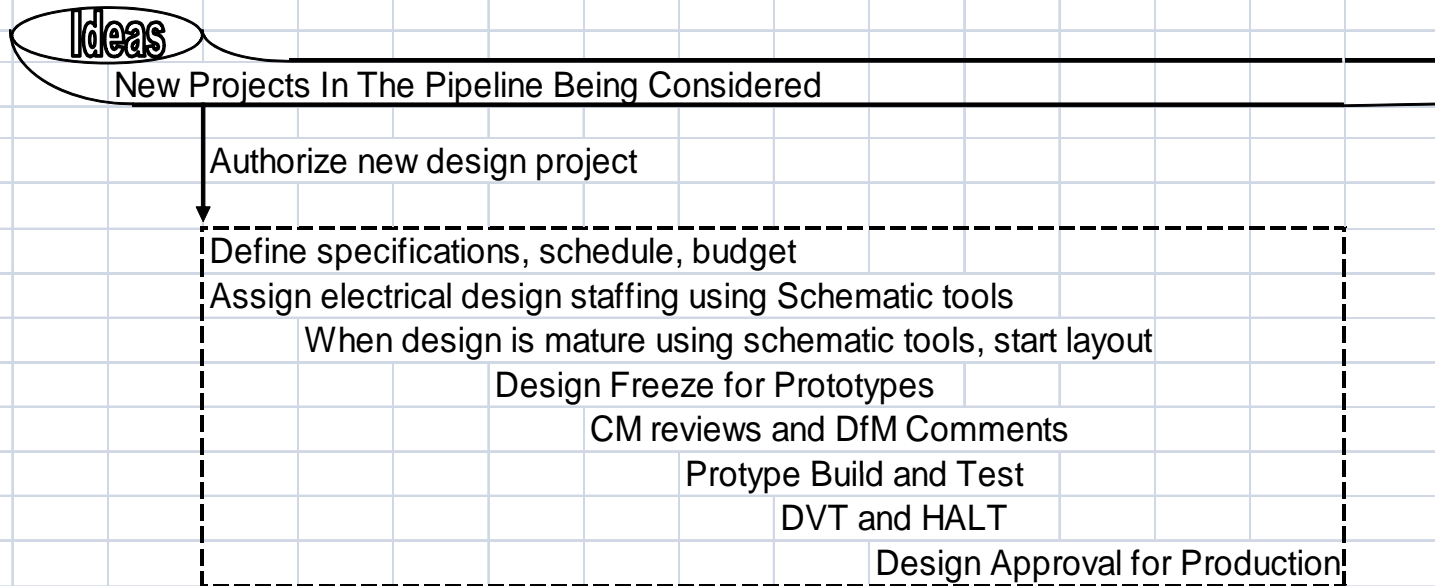


Mercury Dfx Automation Data Fields

1. Base failure rate (in FITs) for Telcordia SR-332 (1) assuming:
 - Air is +40°C
 - Electrical stress is 50%
 - Quality Multiplier is 1.0
2. Source of failure rate in item 1.
3. Base failure rate (in FPMH) for Mil-Hdbk-217F1 for Ground Benign (GB) assuming:
 - Air is +30°C
 - Electrical stress is 50%
 - Quality Multiplier is 1.0
4. Assigned DfR Alert #.
5. Assigned DfR Comments.
6. Mil-Handbook-217F1 Complexity.
7. MIL-Handbook-217F1 Part Family.
8. Reality MTBF value (Gene Bridgers) is in process.



Mercury COTS Electrical Design Steps



A: DfR Library is prepared and available at Every Design seat

B: DfR is visible as Designer selects parts

C: DfR/BOM is automatically mailed to Reliability Engineer as layout starts

D: DfR updates occur when schematic is changed.

E: Design Freeze for prototypes

F: CM review and DfM comments

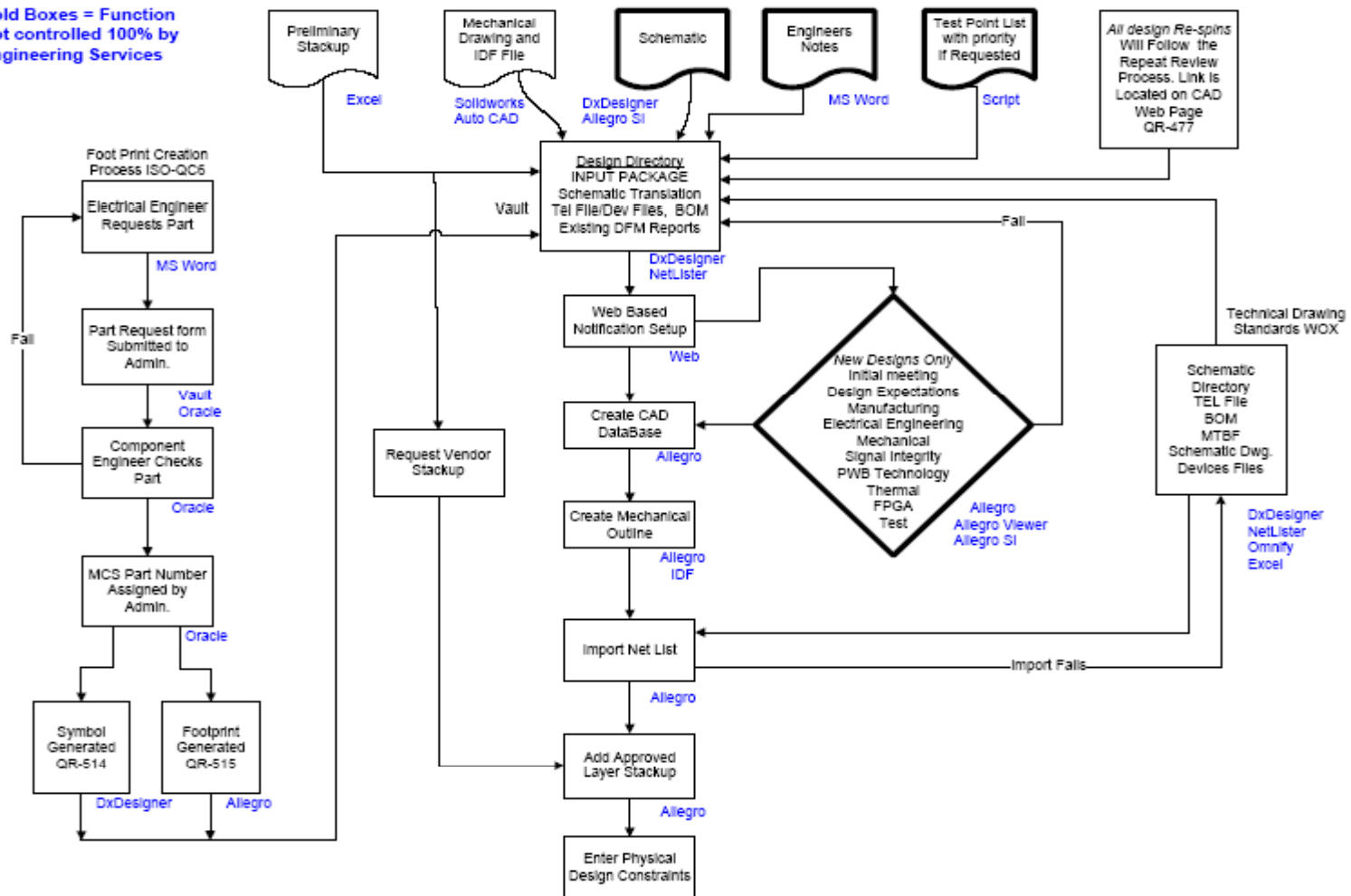


PCB Artwork Design Generation Flow Chart

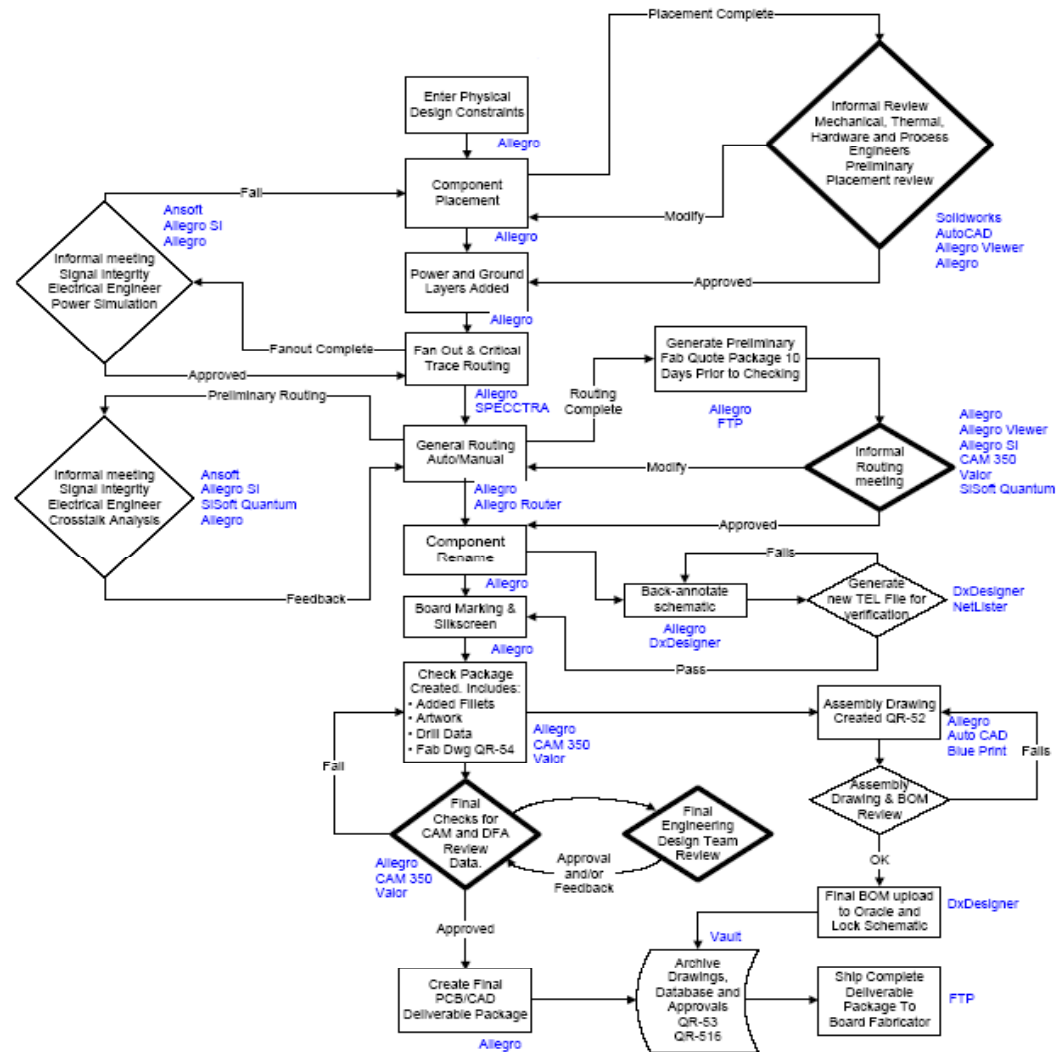
PCB Artwork Generation Work Instructions

Uncontrolled document unless viewed online via the PCB/CAD web page: http://www.mc.com/PCB_CAD_DESIGN/

Bold Boxes = Function Not controlled 100% by Engineering Services



PCB Artwork Design Generation Flow Chart



Last Updated: 04/12/11
Rev 24

Mercury Examples of Dfx Alerts

- Solid tantalum capacitor
- Fragile ceramic chip (case 1210 +)
- Weak X5R ceramic chip part
- Thin gold plating (<30 micro-inches) on mating area of connector pins
- TSOP66 IC Case solder joints fails at cold
- 1M Ω is humidity performance risk
- Purchasing restriction
- Risky short life Electrolytic life
- Risky ESD Margin
- Risky moisture rating
- Fragile PWB
- Fragile solder
- Fragile attachment

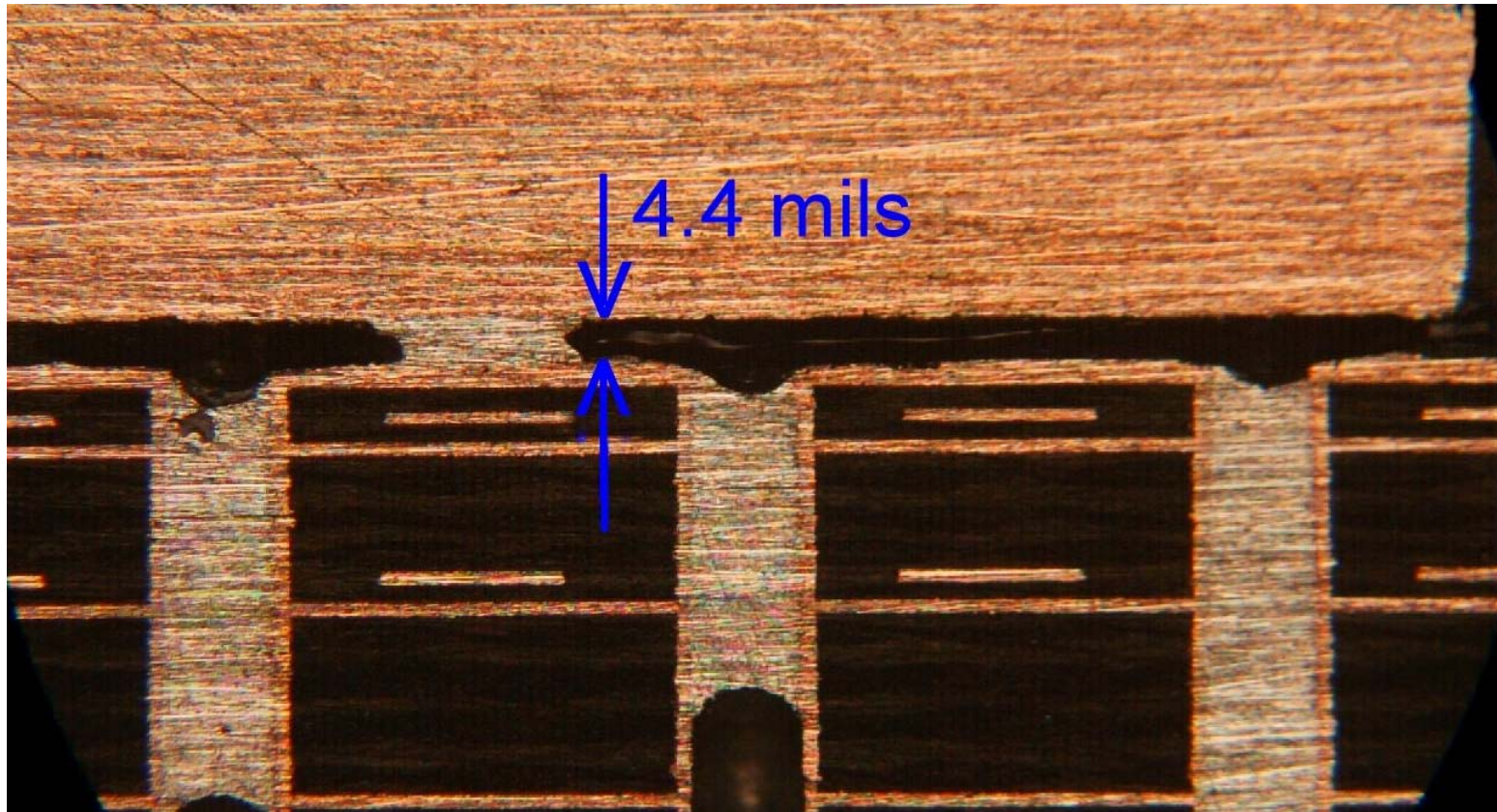


Mercury Positive Dfx Alerts

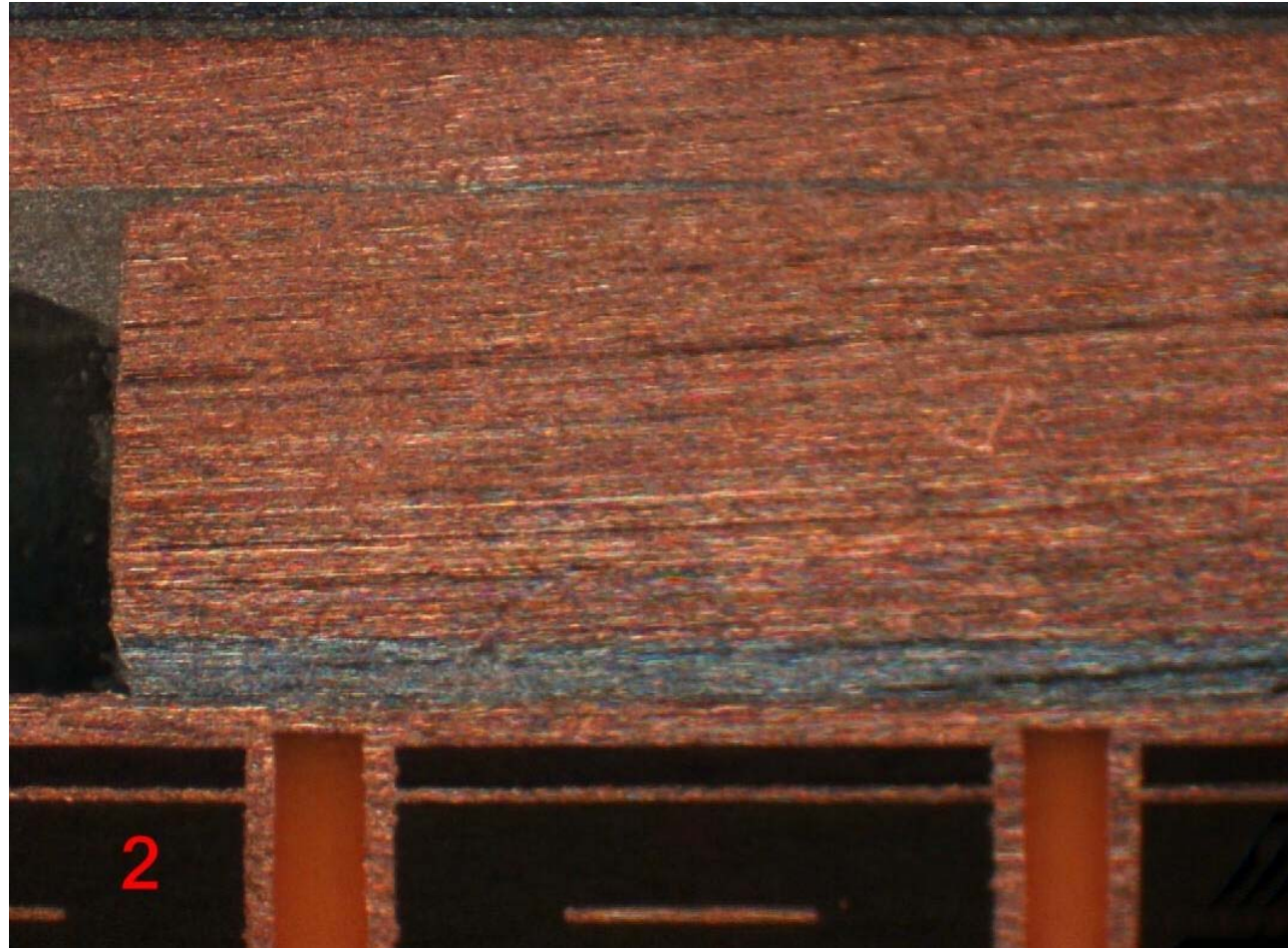
- Parts designated as “Common” increase standardization.
- Parts from “Preferred” suppliers who have an excellent qualification process.
- Cost swapping “opportunities” as things change in supply chain.



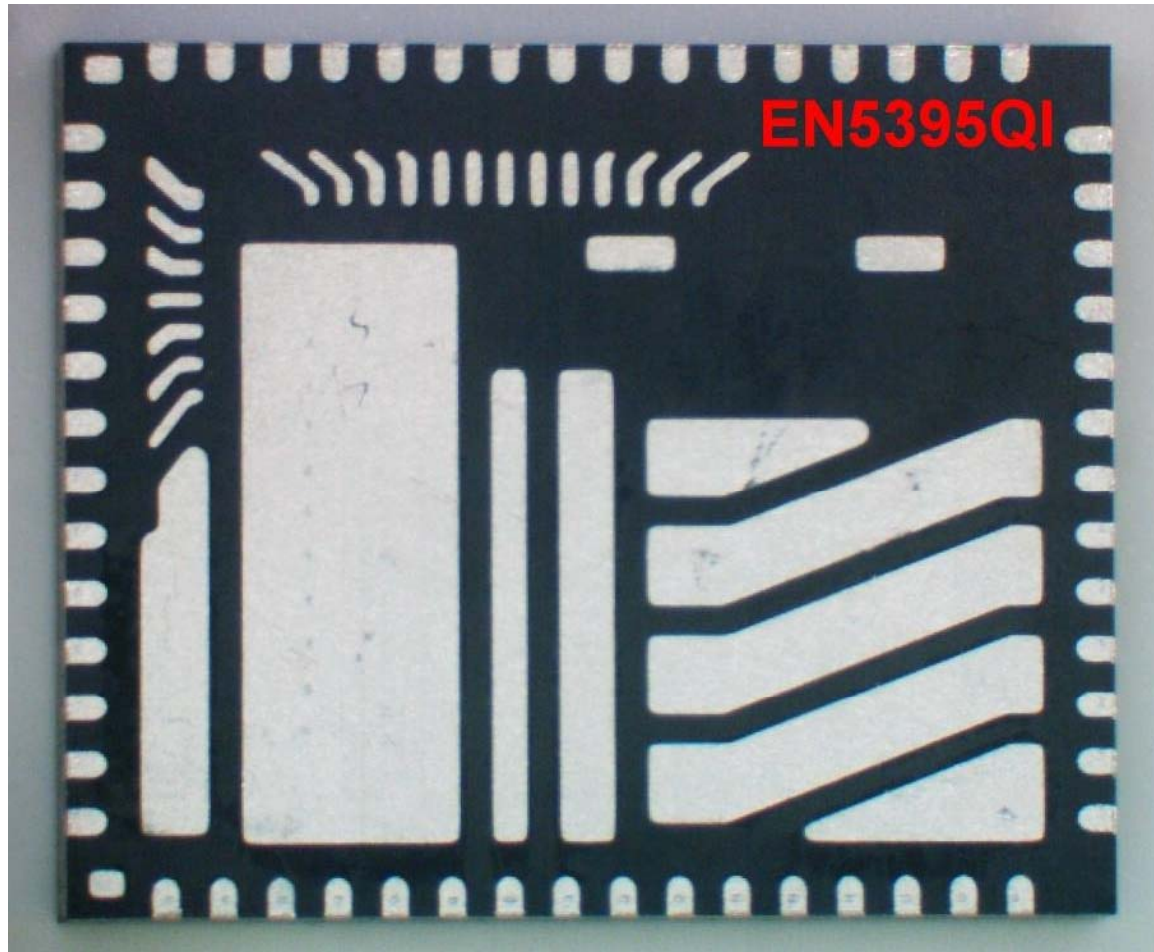
Dfx Thermal Component Assembly Issue – Z-Axis



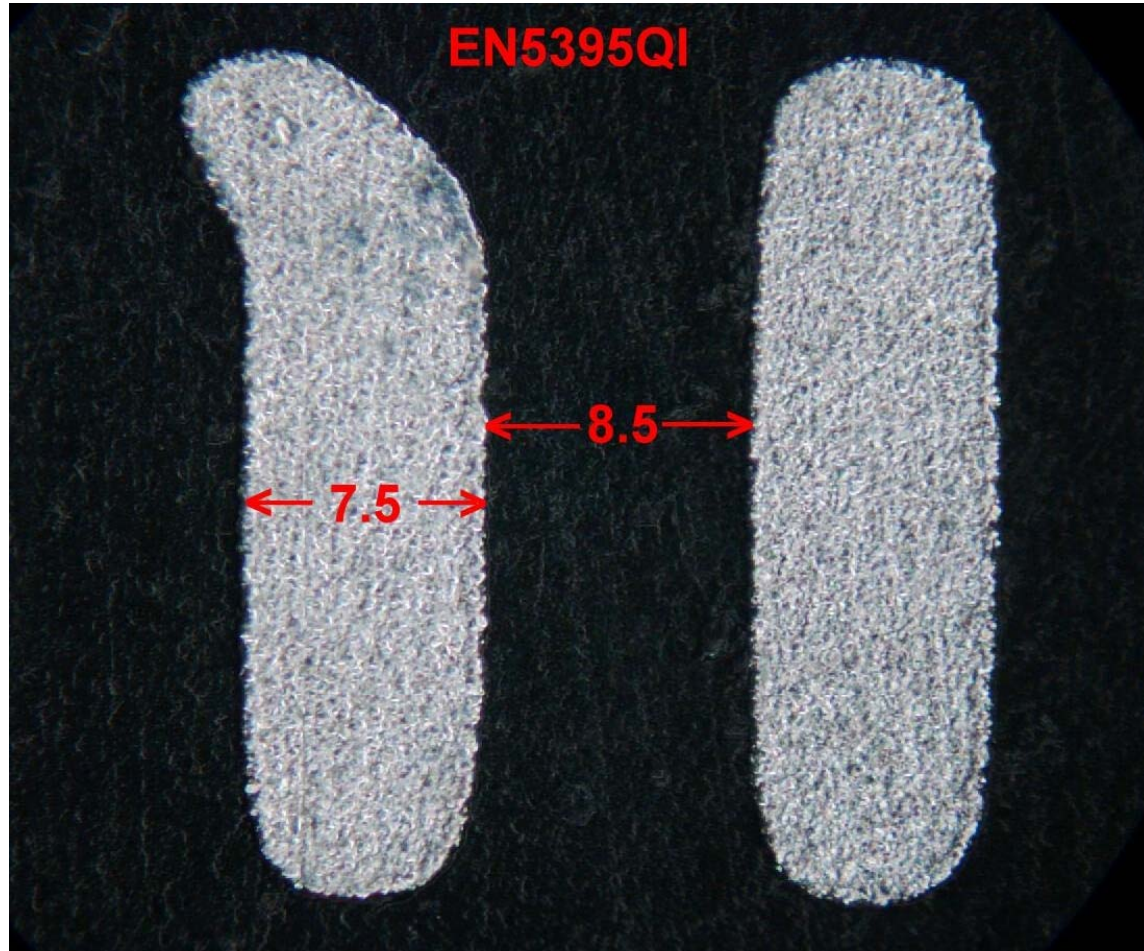
Dfx Thermal Component Assembled Correctly



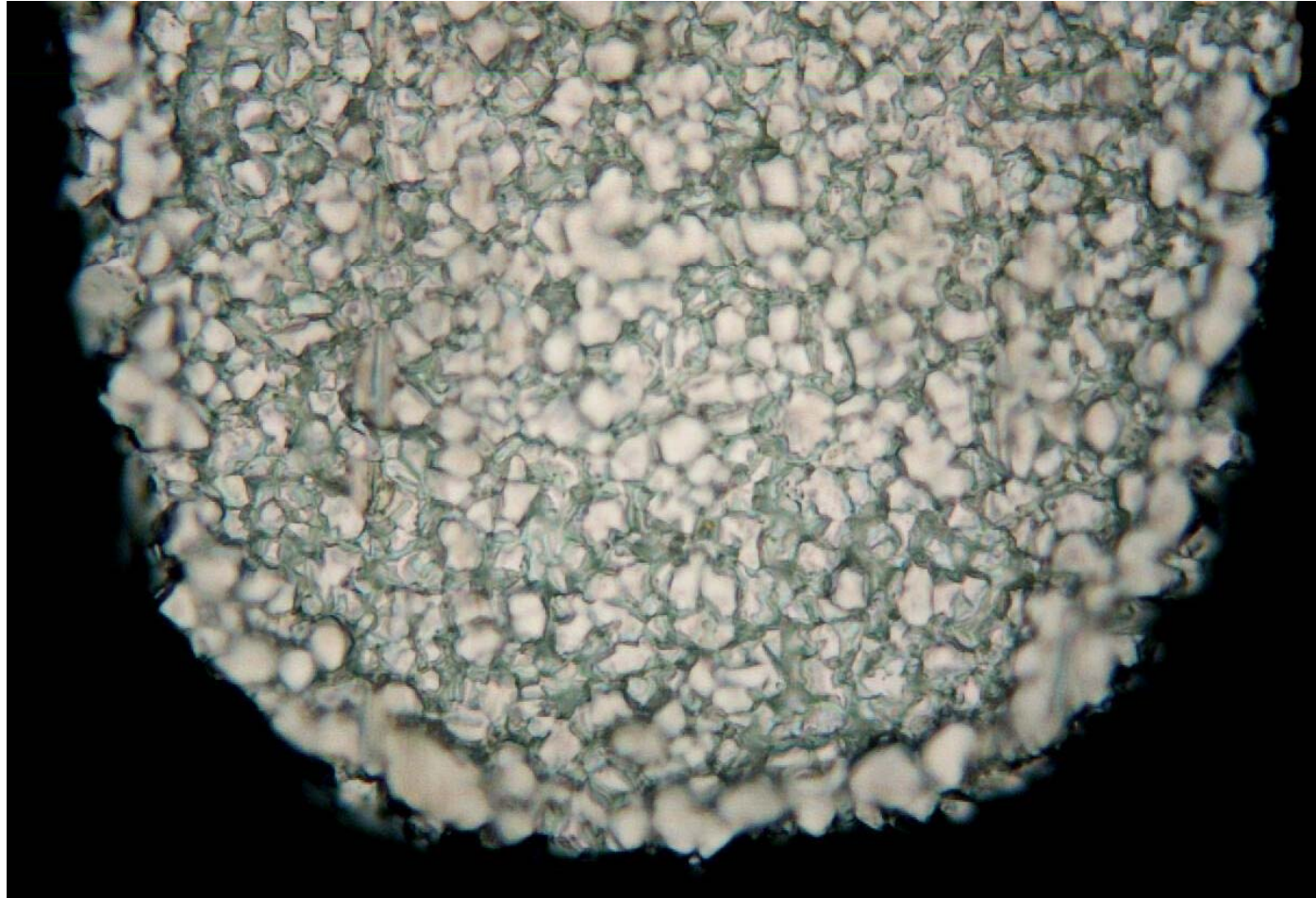
Dfx Component Tin Whisker Reliability Alert



Dfx Component Tin Whisker Reliability Alert



Dfx Component Tin Whisker Reliability Alert



Mercury Key Dfx Performance Metrics

- Dfx is embraced and institutionalized by Electrical, Mechanical, CAD, Reliability, Manufacturing, and Management.
- In 2010:
 - Performed more than 1,150 automated DfR evaluations
 - Identified 11,888 DfR Alerts
- Dfx typically completes within 24 hours.
- Process and Metrics are fully documented with backup.
- Monthly metrics are published and stored in our vault.
- Internal and external customers compliment the MTBF Reports.
- Quality (RMA input) is driven back into the Component library and Dfx alerts.

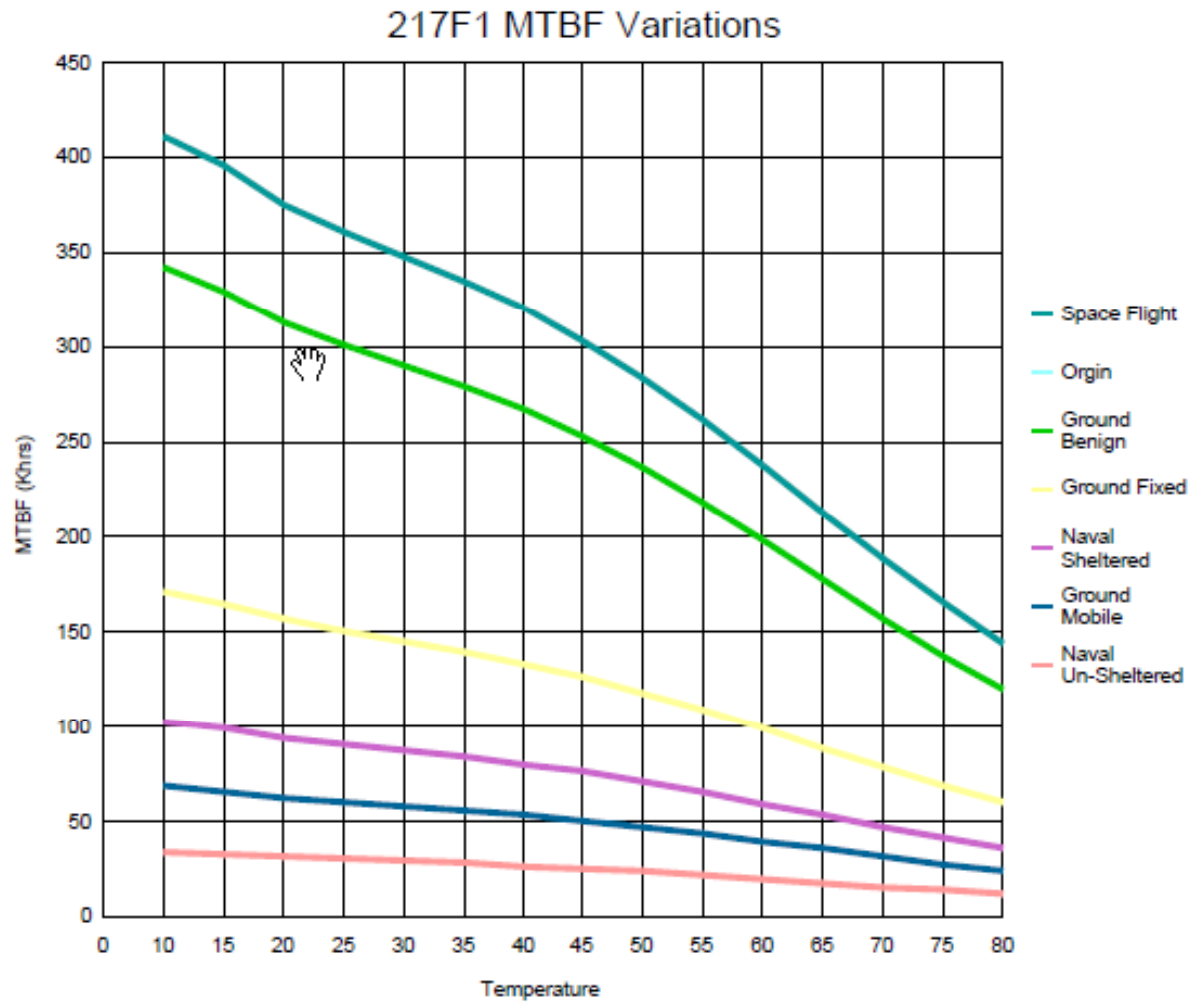


Mercury Customer MTBF Prediction View

- An automated MTBF Report is generated for each released product.
The report includes:
 - Predicted SR-332 MTBF
 - Predicted MIL-Handbook-217F1 MTBF
 - Explanation of field MTBF Realism
 - Graphical MTBF expectation for all thermal situations and all MIL-Handbook-217F1 Environments (displayed on the next slide)
- MTBF variations are derived from QuART PRO available from Quanterion.com.



Mercury Sample Graphical MTBF Variation



Mercury Initiating the DfR Process

- Email notification showing that DfR work is ready for processing.

```
=====
561114 / 3U-vpx-huron-river-xmc_r1 / Wed Jan 19 10:50:46 EST 2011
Note: 75 new components
```

The following DfR BOMs are available:

420-1114-01 = http://hwc.mc.com/vault/ViewDraw/Projects/3U-vpx-huron-river-xmc_r1/420-1114-01_DFR.xls



Mercury Dfx PDCA Design Champions

- Dfc – Design for Components
- Dfp – Design for Component Placement
- Dfsi – Design for Signal Integrity
- Dfth – Design for Thermal
- Dft – Design for Test
- Dfa – Design for Assembly
- Dfm – Design for CM manufacturability
- Dfq – Design for Quality for formal repeat review process



Mercury Dfx Team Member Elements

- DfR Automation Champion: Gene Bridgers
- Dfx Automation Champion: Darryl McKenney
 - Component Champions: Peter Godlewski and Bill Girard
 - Part Cost Design Champion: Darryl McKenney
 - PCB Design Champion: Steve Mariani
 - Thermal Reliability Champions: Tim Fleury and Don Blanchet
 - Signal Integrity Champion: Paul Wade and Kevin Jorczak
 - Operations Parts Champion: Bill Girard and Dennis Maroney
 - ME Reliability Champion: Mike Shorey
 - Oracle Item Master Synchronization Champion: Rich Carlson
 - Oracle and Omnify Champion: Dan Smith
 - CM Synchronization Champions: Darryl McKenney and Tom Orser
 - RoHS Champion: Darryl McKenney



Mercury Dfx PDCA results...

- We have proactive automated MTBFs before design placement in CAD.
- We have reduced our PCB design cycle by more than 25%.
- We have proactively modified more than 180 new designs for DfR alerts.
- We have reduced our prototype cycle time from 45+ days to 14-20 days.
- We have brought up the last 20+ major designs in record time.
 - 6U 32 layers, 15,000 vias, 5,000 components
- Our PCB Test access has gone from 47% to 90% +.
- Our Customer Field returns have reduced by more than 40%.
- Our OCOGS has reduced by more than 30%.
- Data collection metrics established for these major front end design initiatives.
- *Engineering, Operations, Quality, and Supply Chain are a Team!!!*





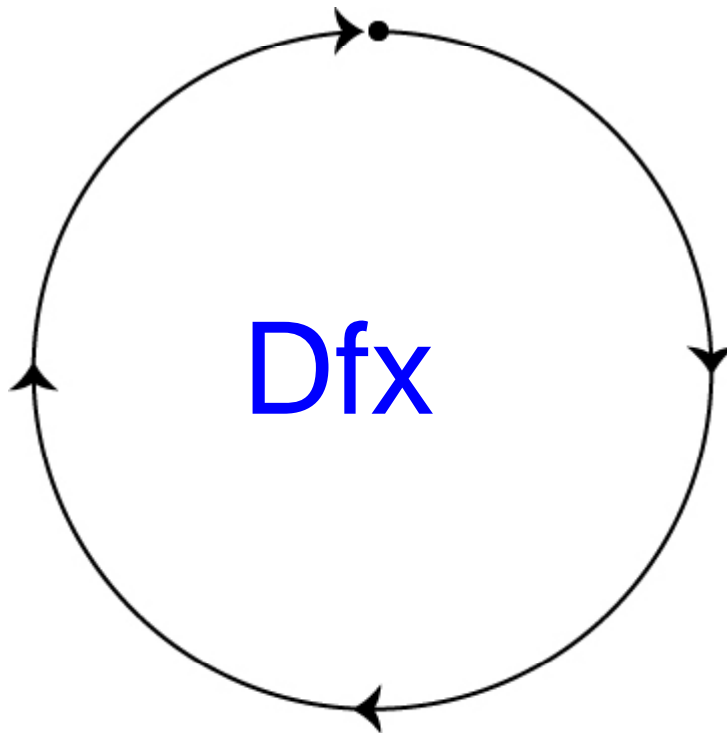
Pro-Active Dfx Integration is a journey not a destination.

It must be driven into the culture from senior management.

We have been institutionalizing this cultural change over 6 years.



Mercury PDCA Dfx Future Opportunities



Opportunities

- CM Tic-Toc Components
- EOL Obsolescence
- 2nd Source Issues
- Lead-Free Migration

We need to continue to drive quality, cost, reliability, and cycle time improvements.





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Thank You!

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Questions?



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