“Contactor Selection Criteria Overview for RF Component Testing”
James Migliaccio, Ph.D
RF Microdevices

“Design Optimized, Manufacturing Limited - A 250W Thermal Solution”
Trevor Moody, Kevin Hanson, Rick Davis
Antares Advanced Test Technologies

“Test Socket Tracking: From Cradle to Grave”
Angelo Giaimo
IBM Corporation

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Overview

We'll take a lighthearted look at one RF test guy's criteria for socket selection.

I'll give a couple examples of the good and not so good.

Finally, toss out a need for looking at the problem a little differently.
Customer View of Contactor Supplier

Contactor Supplier View of Customer
RFMD PA TEST

- Tried/used many different contactors for RF test:
  - Spring Probes
  - Sliders
  - Rockers
  - Interposers
  - Particle Interconnect
  - Fibrous Gold Balls
  - Cantilever
- Most consist of a plastic body holding small metal pieces in place

Mechanical Requirements

- Tolerancing and relationship to the handler
- Material composition
- Cost vs. life balance
- Competitive cost of ownership
- Field serviceable
- Documentation
  - Assembly drawings with part numbers
  - Training and maintenance procedures
  - Cleaning and lifetime interval recommendations
Electrical Requirements

- Typical DUT has low pin count
- Mix of RF & DC pins
- Current requirement can exceed 2A on a pin
- May need to have external components close to the DUT
- Minimal ground inductance preferred
- PCB Real-estate concerns
- RF performance
- ESD

Other Considerations

- Acquisition Costs
- Existing Relationship
- Anything New and Innovative
- Unique DUT or close relative of existing product
- Custom or standard package?
- Part pad composition
- Accelerated mechanical life testing
- NDA
- Changing design is very painful
- Cres is not an important data point. We measure RF performance directly and use an SPC system to determine performance.
- Will go to production
What Can Go Wrong, Will

- Vendor expertise and experience is exaggerated
- Schedules are not met
- Socket stops working on the second insertion
- Load board issues
- Long time for feedback

Trying Something Different

- Application: 3x3 QFN PA
- Previous contactors were not optimum for first pass yield and longevity
- Tried 3 solutions in parallel – two using new contactors
- Vendors built contactors at their expense
- 3 Layouts, PCBs, assembly, code, docs
- Engineer’s time
- Tester time
- Phone conferences, etc.
The Big One - Cost

- Initial development cost
  - Sockets, load boards
  - Time
- Production Cost
  - Initial
  - Replacements, spares, training
  - Down time - yield
  - Re-use
- Know the alternative – price & performance
- Service/Quality/Reliability are the great equalizers

What does it all Mean?

Socket Maintenance Cost
per 1k units, vs. I/O count
From Socket to Application

- Socket maintenance cost is a function of contactor lifetime and repair cost
- This chart ignores the cost of tester down time, labor, spares and first pass yield loss
- Although lifetime cost is a major factor, performance is king
- Not all performance variation is associated with the socket
- Final application can change everything

Application Implications

- Interaction between DUT, Socket and Handler
- Socket and Handler are often designed separately
- Non-Linear effects change the way test data correlates to reference
- Ideally have test environment mimic application environment
- Need handler and socket to simulate shielded environment
Typical Final Application

Application Versus Test Environment
Summary

- Not possible to evaluate all contactors
- Know your value proposition
- Know your competition and what differentiates your product from the rest
- Have your contactor properly evaluated and data available
- Start thinking about systems to solve problems

Thank You Questions?

March 9 - 12, 2008
Design Optimized, Manufacturing Limited – A 250W Thermal Solution

2008 Burn-in and Test Socket Workshop
March 9-12, 2008

Trevor Moody
Kevin Hanson
Rick Davis

HOW CAN A DESIGN MEET ALL REQUIREMENTS?

Customer Requirements
- Technical Specifications
- Lead Time
- Cost
- Ease of Use

Internal Company Requirements
- Profitable
- Reduces Complexity
- Manage Resources
- Manufatureabilty

LOW VOLUME MANUFACTURING

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Paper #2

March 9 - 12, 2008
INTRODUCTION

- What The Customer Wants!
- System Overview
- Designing for Low Volume Manufacturing - Cold Plate
- Product Performance
- Did We Give The Customer What They Wanted?
- Did We Satisfy Our Internal Company Requirements?

What the Customer Wanted

- 250 Watt Processing Module
- Characterize From 0°C to 100°C
- Minimize Temperature Undershoot And Overshoot
- Customize The Solution To Their Current Hardware
- Must Be Mobile With A Small Footprint
- Closed System
- No Consumable Gases
The Module

- High End / High Reliability Processing Module
- High power CPU
- Standard DUT Board
- Standard Tester Footprint

SYSTEM COMPONENTS

Mechanical Actuator

Thermal Control Unit
HOW DOES THE SYSTEM WORK

Recirculating Chiller

Liquid Recirculation Lines

Cold Plate

TEC

Electrical Power

Interconnect

DUT

Test Board

SYSTEM COMPONENTS

Thermal Control Unit

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COLD PLATE

Exchanges heat from a solid to a fluid that are at different temperatures.

EXISTING TECHNOLOGY

Product that works within the size restraint.

Product that satisfies the heat load requirements.
OUTSOURCE THE DESIGN

Form Factor & Performance Requirements

Output

NRE

Higher Per Piece $ Price $
DESIGN FOR LOW VOLUME MANUFACTURING – COLD PLATE

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DESIGN FOR LOW VOLUME MANUFACTURING – COLD PLATE

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DESIGN FOR LOW VOLUME MANUFACTURING – COLD PLATE

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CONCLUSION

Did we give the customer what they wanted?
DID WE GIVE THE CUSTOMER WHAT THEY WANTED?

✓ REQUIREMENTS
  • 250W Solution

✓ CUSTOMER SATISFACTION
  • ¼ Cost of Existing Solutions

DID WE SATISFY OUR INTERNAL COMPANY REQUIREMENTS?

✓ Technical Requirements
✓ Customer Satisfaction

✓ Low Volume Manufacturing
  • Trade-Offs
Test Socket Tracking: From Cradle to Grave

2008 Burn-in and Test Socket Workshop
March 9 - 12, 2008

Angelo Giaimo
IBM Corporation

HOW DO YOU KNOW?

• In today’s dynamic test mfg environment:
  – How do you know that the Front End Hardware that you just put on the tester is good?
  – How do you know that you won’t be wasting precious tester time to figure it out?
  – Can you afford more Testers?
  – Want to lower the cost of test?
AGENDA

- Overview of GTS for Test and B/I HW Tracking.
- Need to improve previous FEH Quality and Performance Tracking.
- Solution: Implementation of new SARA Tool
  - HW Enhancements for Manufacturing
  - SW Enhancements for Manufacturing
- Summary
  - System Overhead
  - Return On Investment

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GTS: OVERVIEW

- Global Tracking System = Test Hardware Life Tracking System.
- DB2 Based with Web Access
- Tracks Inventory of all Test HW
- Matches Correct FEH to Job/Product being Run
  - Saves Operator, Maintenance & Tester Time.
  - Avoids Product Damage

GTS SOCKET TRACKING

FEH CRIB

FEH REPAIR CRIB

SARA

TEST FLOOR
AGENDA

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SARA: BACKGROUND

- SARA = Socket Analog Resistance Analyzer
- Metrology Tool used to make accurate mass measurements of Socket and Probe Assemblies.
  - Architected for 2,209 usable I/O’s (47X47 Array)
  - Pseudo-4 Point Measurements (BiTS 2000 Paper)
- Originally designed as an Engineering Tool.
  - Lab/Development Environment
  - Used for the development, evaluation and test of Test and B/I Sockets.
- HW and SW upgrades for MFG use.

SARA HARDWARE:
BURLINGTON, VT

Operator GUI  Switch Arrays (X6)  Socket Interface
SARA HARDWARE: BROMONT, CANADA

Switch Array Rack  Socket Interface  Operator GUI

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SARA HW: 2 Point System

+PMU: Array selects pin to be tested.
-PMU: Array selects all remaining pins.
Minfile subtracts out system resistance
High pincount return path => 0 Ohms
Remaining loop resistance = Contact Resistance

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As Relays Age and/or Fail, Relay Contact Resistance values varied by over +/- 4 ohms, causing inaccuracies in the measurement system.

Relays with potentially variable resistance

Relay contact resistance removed from measurement path.
SARA REPEATABILITY: BEFORE

2 Point Measurement Range: 100 Highest Channels

Range = +/- 4.128 to +/- 0.216 Ohms

Spec is +/- 5 milliohms!!!

SARA REPEATABILITY: AFTER

4 Point Measurement Range: 100 Highest Channels

System Spec = 0.010 Ohms

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</table>

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2 TO 4 POINT HW CONVERSION:

- TASKS:
  - Updated Relay Configuration
  - Update Test fixtures for Topside –Force/-Sense Contacts
    - Not ALL the sockets we test are ours….
    - Make provisions where we can’t access top of Socket; BGA Socket Testing, etc.
  - Reprogram PMU to 4 point.
  - Create ALL new calibration files for every fixture combination currently in use!

SARA SOFTWARE

- Automated Test, Start to Finish…..
  - Operator just needs to scan socket barcode
  - Socket & Pass/Fail data
  - SARA Setup Parameters
  - Unique output filenames, Timestamped
  - Auto Socket Disposition for Operator:
    - OK, Repair or Repopulate.
SARA SOFTWARE GUI

Interposer Status  Tester HW Status  Failed Channel List

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PASS/FAIL COLORMAP

Filename  Failed Channel Location  Date/Time

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**SYSTEM OVERHEAD**

- EVERY piece of FEH used must be uniquely barcoded for GTS
- Each item must be uniquely identified in lookup table and all test parameters defined. (Netlist, Test Fixture, Norm File, etc, etc.)
- Engineering to monitor/evaluate Process.
RETURN ON INVESTMENT

- Tester Utilization Savings
- Yield Loss reduction due to defective FEH
- Yield Loss reduction due to downbinning.
- Reduced Manufacturing Operator Labor
- Reduced Test Floor Maintenance Labor

FINAL COMMENTS

- GTS and an updated SARA tool has been proven to:
  - Accurately diagnose and aid in the repair of FEH
  - Aid to track pogo pin life.
  - A more efficient test floor and higher yielding product.
  - Socket MTBF and Preventive Socket Maintenance