THIRTEENTH ANNUAL BiTS 2012 Burn-in & Test Strategies Workshop

# Marketplace Reports

# ARCHIVE 2012

## MARKETPLACE REPORTS

This year's Marketplace segment of the BiTS program, offers 2 new and unique topics and reprises last year's report on the business side of sockets with fresh data.

This one is sure to be standing room only, so don't be late! Jon Diller of Interconnect Devices, Inc., shares his insights on the 'geography' of sockets, while Jim Brandes of Multitest shines a light on what socket specifications really mean. And once again, BiTS General Chair, Fred Taber, looks to spur discussion with a fresh analysis of the burn-in and test socket market in his annual Socket Marketplace Report.

### Where It's At - Understanding the Geography of the BiTS Market

Jon Diller—Interconnect Devices, Inc.

### Specsmanship

James Brandes—Multitest

### Socket Marketplace Report

Fred Taber—BiTS Workshop & Taber Consulting

# Where It's At

## Understanding the Geography of the BiTS Market

**Jon Diller**
**Interconnect Devices, Inc.**

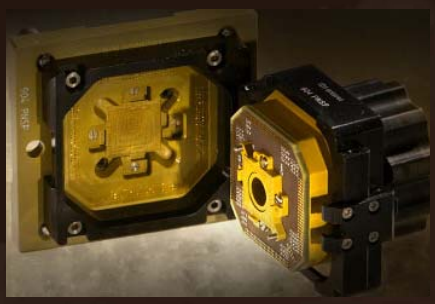
2012 BiTS Workshop
March 4 - 7, 2012

## Agenda

- Introduction, Caveats, and Excuses
- Types of Sockets and Who Uses Them
- Where the Customers Are
- Where the Suppliers Are

## Types of Sockets

- Characterization
  - Used in development anywhere engineers are plentiful
- Burn-in
  - Used in production
- Final Test
  - Used in production



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Understanding the Geography of the BiTS Market

## Customer Locations: Headquarters

Top 50 by Population

US Japan Taiwan Europe S. Korea China

Top 50 by Revenue

US Japan S. Korea Taiwan Europe China

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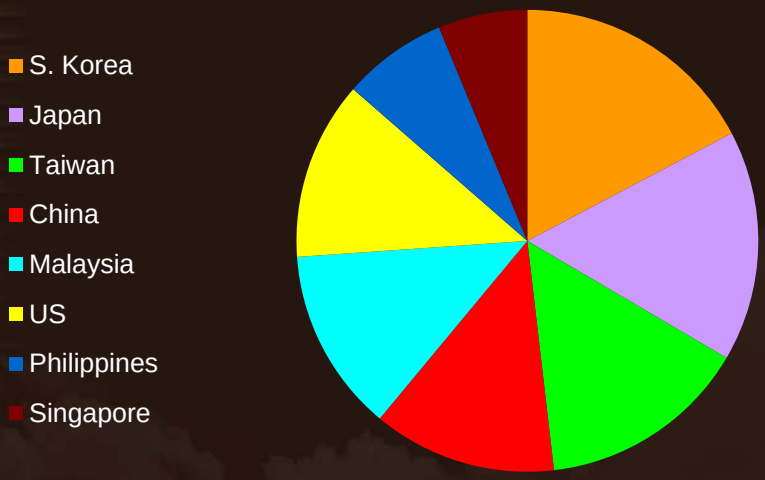
Understanding the Geography of the BiTS Market

## Customer Locations: Manufacturing

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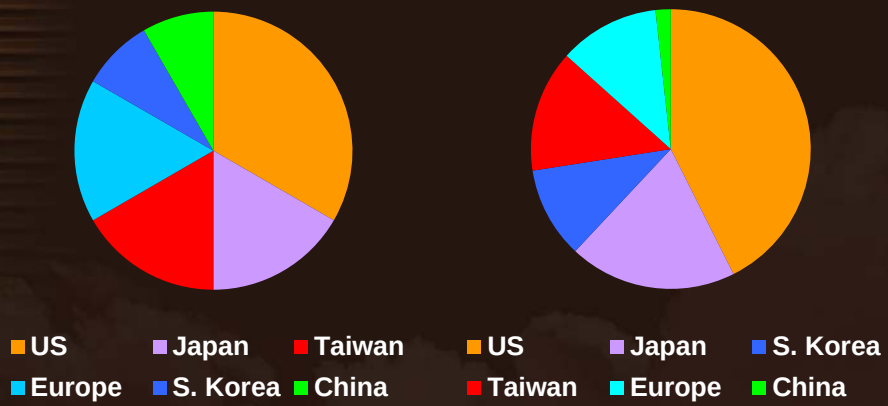
## Supplier Locations: Headquarters

Top by Population

Top 50 by Revenue

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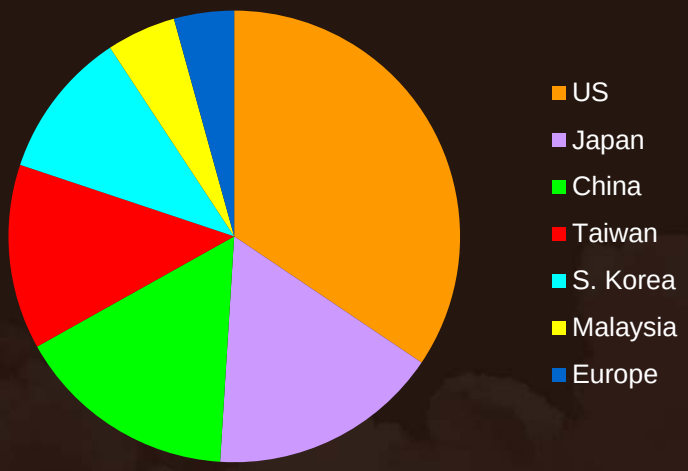
## Supplier Locations: Manufacturing

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Understanding the Geography of the BiTS Market

## Conclusion


- Socket suppliers cluster where selection happens
- Support can be a casualty
- Suppliers must be truly global to be effective

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Understanding the Geography of the BiTS Market

# Specsmanship

Jim Brandes
Multitest

2012 BiTS Workshop
March 4 - 7, 2012

## Contents

## Introduction

- Challenge of comparing contactors from different manufacturers
  - Different manufacturers specify different parameters


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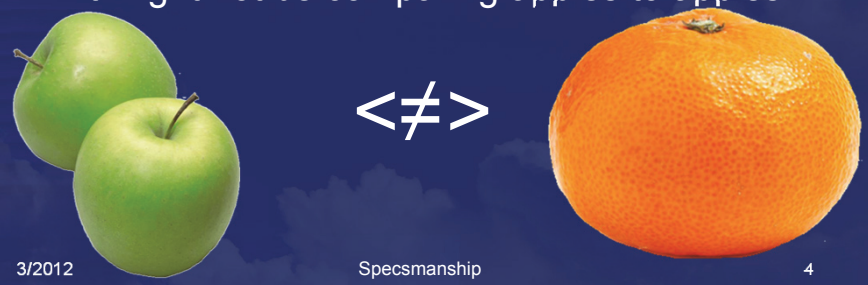
## Introduction

- Challenge of comparing contactors from different manufacturers
  - Different manufacturers specify different parameters
  - Even when specifying the same parameter, it might not be comparing apples to apples

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## Introduction

- Challenge of comparing contactors from different manufacturers
  - Specifications must be approached cautiously
  - Be ready to ask a lot of questions
- Perhaps enough conversation will drive consistency in specifications



## DC Specification: Conductance

- Why is conductance important?
  - For power delivery and the measurement of high-current parameters
  - The conductivity is affected by:
    - Bulk resistance of material and probe cross section
    - Internal contact point(s) of probe, if not monolithic (rocker, cantilever)
    - Resistance at external contact points:
    - A) Board-side and B) DUT-side
- First two above are under control of manufacturer. DUT-side R not so much

## DC Specification: Conductance

- How is it measured
  - Different manufacturers use different techniques
  - There is obviously a current measurement involved, but what does the number mean?

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## DC Specification: Conductance

- How is it measured
  - Different manufacturers use different techniques
  - There is obviously a current measurement involved, but what does the number mean?

| Item | Performance | Note |
|---|---|---|
| Rated Current | 1A or 2A | 1-2A Refer to the Table |

• Current rating up to 6 amps

High current carrying capacity: 3A

| Current Carrying Capability: | 4 A |
|---|---|

| Electrical Current | 0.1 A | 0.3A | 0.4A | 0.5A | 1.0A | 1.6A |
|---|---|---|---|---|---|---|
| Current Carrying Capabillty | 1.0A | 0.6A | 0.4A | 0.3A | 0.2A | |

**Current Carrying Capacity:** 3 amps continuous
(Individual probe in free air @ ambient temperature)

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## DC Specification: Conductance

- What determines the published value?
  - When details are provided, two techniques are found:
    - Current resulting in a particular temperature rise: e.g. 20° C

| | | |
|---|---|---|
| Current Carrying Capability: | ≥ 2.8 A Force* | ≥ 2.8 A Force*<br>≥ 0.8 A Sense* |

* Steady state, 100% duty cycle conditions for a 20°C temperature rise. Higher currents allowed for lower duty cycles and higher temperature rises. Consult factory when necessary.

4.5 Current Carrying Capacity:
- 20°C temperature rise
  0.4 mm pitch: 1.8 A continuous
  0.5 mm pitch: 2.2 A continuous
  0.8 mm pitch: 2.4 A continuous

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## DC Specification: Conductance

- What determines the published value?
  - When details are provided, two techniques are found:
    - Current just less than the amount resulting in a mechanical failure

| *Rated Current* Note 4) | | | |
|---|---|---|---|
| *25℃* | *100℃* | *125℃* | *150℃* |
| 0.55A | ~ | | |
| 0.6A | 0.5A | 0.4A | 0.3A |
| 0.6A | 0.5A | 0.4A | 0.3A |

Note4) Evaluating criterion : 20% reduction of spring force after 1 hour current loading

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## RF Specification: Inductance

- Why is inductance important?
  - Important to balance with capacitance to achieve desired characteristic impedance
    - Typically 50Ω for single-ended, 100Ω for differential
    - "Lower is better" not always true for maximum bandwidth
    - Bandwidth specification is a better indicator of RF performance
    - Inductance is important to understand power delivery
      - For power delivery, lower *IS* better



## RF Specification: Inductance

- How is inductance measured or derived?
  - Inductance is calculated after taking an $S_{11}$ measurement through the contactor, shorted on one side
  - Inductance is calculated by solving the formula $Z = 2\pi fL$ for L ($L = {}^{Z}/_{2\pi f}$)
  - This includes the inductance of the return path

## RF Specification: Inductance

- What does "Self Inductance" mean?

**Self Inductance:** 0.63 nH @ 0,75 (.029) pitch

| Inductance: | Self: 0.47 nH<br>Mutual: 0.10 nH | Self: 3.5 nH<br>Mutual: 0.77 nH |
|---|---|---|
| Inductance: | Self: 0.42 nH<br>Mutual: 0.24 nH | |

**Self Inductance:** 0.93 nH @ 0,50 (.020) pitch

| *Inductance* Note 1) |
|---|
| 0.66nH |
| 0.71nH |
| 0.71nH |
| 0.8nH |

Note1) Approximate Pin Inductance at any frequency



## RF Specification: Inductance

- What does "Self Inductance" mean?
  - Self inductance is a mathematical construct
  - It can only be calculated from the loop inductance
  - It is not simply a fraction of the loop inductance
  - The calculation requires assumptions which may or may not be valid
  - Consequently, the value derived is questionable

## RF Specification: Inductance

- Why loop inductance makes more sense and is more useful
  - Loop inductance takes the coupling between the signal and the return path into consideration
  - The coupling between the signal and return paths cancels some of the inductance
  - Loop inductance more realistically describes the performance of the entire path

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## RF Specification: Inductance

- Why loop inductance makes more sense and is more useful
  - Depending on the geometry and calculation, loop inductance might be less than "self inductance"
  - As stated earlier, understanding inductance is critical to understanding power delivery
  - Again, it is the **loop** inductance that matters

| Loop Inductance, L (nH) |
|---|
| 1.23 |
| 0.74 |
| 0.81 |
| 0.63 |
| 0.80 |

4.2 Loop Inductance:
- 0.8 @ 0.8 mm pitch: 1.96 nH
- 0.8 @ 1.0 mm pitch: TBD

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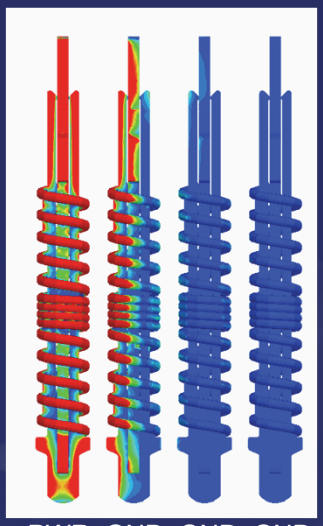
## RF Specification: Inductance

- The probe on the left is PWR
- The other three are GND
- All conduct DC
- AC noise travels on PWR probe and immediately-adjacent GND probe only
- Other two do not reduce overall Inductance

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## Other Questionable Specifications

- Life expectancy – How is it determined?
- Bandwidth
  - Measured or simulated?
  - What are the conditions?
    - Ground configuration, Pitch, Dielectric
  - Separate values for single-ended and differential?
- Force
  - Pressure is really the important parameter
  - *Precision* springs are ± 20%!
- Compliance – DUT-side or total?

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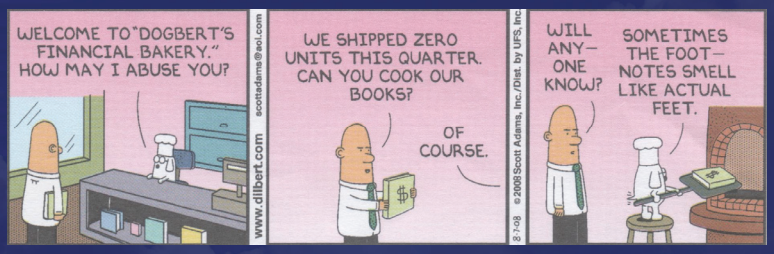
## Understanding Specifications Further

- Footnotes – should provide limited details & caveats on the data sheet
- Test reports – ideally give all the information required to fully understand and trust the specification






## Summary

- Specifications are critical, but must be read with a grain (or more) of salt
  - Understand which are important
  - Disbelieve incredible specifications
  - Be prepared to ask, ask, ask:
    - How was the specification derived?
    - Is it typical or best-case?
    - Is there a test report to back it up?

Might not be able to compare Apples to Apples, but don't want to end up with a . . .

## Summary

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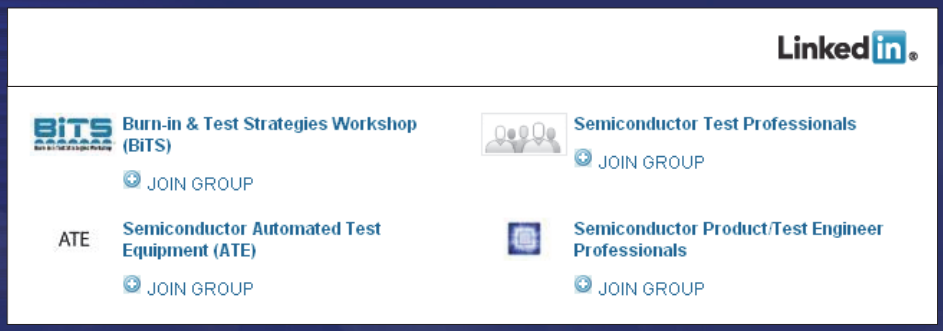
## Discussion

- Several on-line forums are available:



# Socket Marketplace Report

**Fred Taber**
**BiTS Workshop**
**&**
**Taber Consulting**

BiTS Burn-in & Test Strategies Workshop

**2012 BiTS Workshop**
**March 4 - 7, 2012**

Frederick L. Taber
TEST TECHNOLOGY CONSULTING

## Content

- Motivation
- Acknowledgements
- Socket Market Data
- Socket Pricing
- Wrap-up

## Motivation

- Feedback & Interest

  Reprise Last Year's Report with the Latest Data

- A quick look at the business side of sockets
- Share some research data



## Acknowledgements


- **Data Graciously Provided by Fleck Research**
- **More Info: Can be Found Their Socket Reports**
- The fine print:


**This Report: Data Was Extracted & Summarized From Fleck Research Reports**

## Acknowledgements

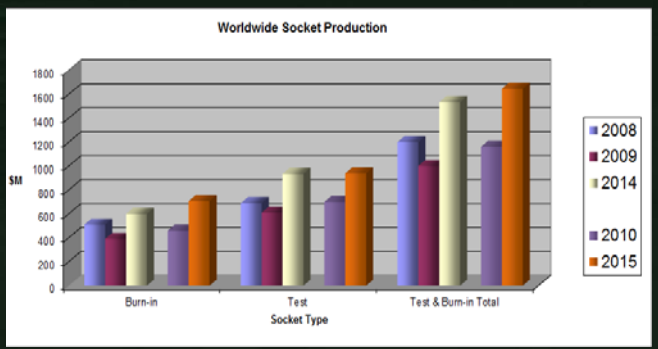
- Data Graciously Provided by Fleck Research
- More Info: Can be Found Their Socket Reports
- The fine print:

**For Your Analysis & Interpretation**

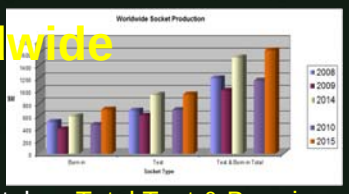


## Sockets Worldwide

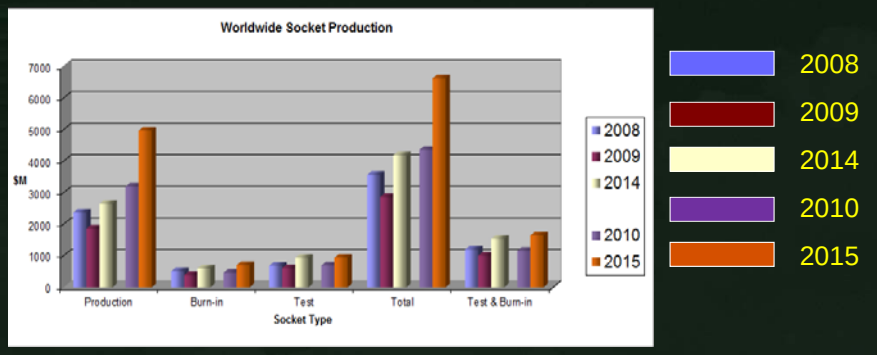
- 09 to '10
  - Production Burn-in Test Total Total Test & Burn-in
    +71.90% +17.90% +14.70% +52.30% +16.00%
- 5 Year ('10 to '15) Growth forecast ..... 42%



## Sockets Worldwide



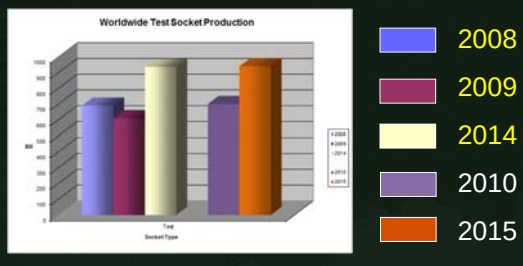
- 09 to '10
  - Production +71.90%, Burn-in +17.90%, Test +14.70%, Total +52.30%, Total Test & Burn-in +16.00%
- 5 Year ('10 to '15) Growth forecast ..... 42%



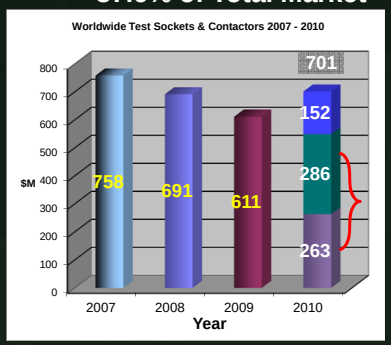



## Test Sockets & Contactors

- Total Market
  - 2011 report – Down 8.8% - '07 to '08
  - 2011 report – Down 11.6% - '08 to '09
  - 2011 report – Up 53% '09 to '14
  - 2012 report – Up 14.7% - '09 to '10
  - 2012 report – Up 34% '10 to '15

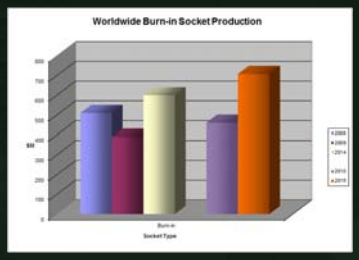


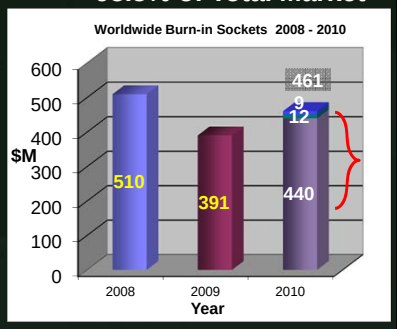

- Survey Market (2010)
  - 86 companies; 78.4% of Total Market - $M549
    - Top 10 (of 68): $M263; 37.6% of Total Market



## Burn-in Sockets

- **Total Market**
  - 2011 report – **Down 23.3% - '08 to '09**
  - 2011 report – **Up 53% '09 to '14**
  - 2012 report – **Up 17.9% - '09 to '10**
  - 2012 report – **Up 53.6% '10 to '15**
- **Survey Market (2010)**
  - **86 companies; 98.2% of Total Market - $M452**
    - **Top 10 (of 15): $M440; 95.5% of Total Market**

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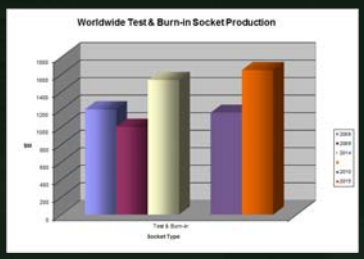
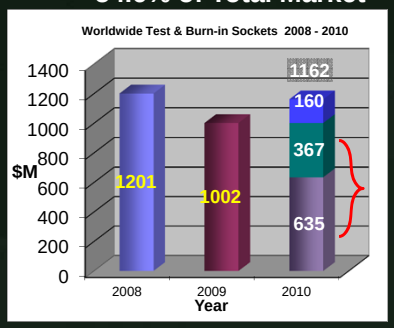
## Test & Burn-in Sockets

- **Total Market**
  - 2011 report – **Down 16.6% - '08 to '09**
  - 2011 report – **Up 53.3% '09 to '14**
  - 2012 report – **Up 16.0% - '09 to '10**
  - 2012 report – **Up 41.8% '10 to '15**
- **Survey Market (2010)**
  - **86 companies; 86.2% of Total Market - $M1002**
    - **Top 10 (of 68): $M635; 54.6% of Total Market**

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## Socket Pricing

- Production sockets
  - Dramatically Declined in Price over the Last 10 Years
  - 400 - 600 pins: $9 in 1990; <$1 Now; some @ $.01
- Burn-in sockets
  - Most Priced From $12 to $40
  - Often Large Order Quantities: e.g. 10,000
  - Per pin production cost as low as $.02/ pin
- Test Sockets
  - Pricing is Pin Count Dependent
  - ~1000 pins as high as ~$10K



## Wrap-Up

- Market Research Data: A Snapshot of the Business Side of Sockets
- Substantial Growth is Projected