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Presentation And Panel Discussion  
Sunday 3/02/03 8:00PM  

Reducing The Cost Of Test & Burn-in - 
What Are The Options?  

“Cost Considerations In Burn-In Equipment Development”

Anne Sepic - Intel Corporation  
Dan Weinstein - Intel Corporation

**Moderator:** Fred Taber  
IBM Microelectronics

**Panel Members:**
- Ken Heiman  
Micro Control Company
- Marc Knox  
IBM Microelectronics
- M.S. Maung  
Advanced Micro Devices
- Helge Puhlmann  
Yamaichi Electronics Deutschland
- Steve Strauss  
Intel Corporation
- Bob Zacharis  
Pycon
Panel Members

Ken Heiman - Micro Control Company
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Bob Zacharis - Pycon
Marc Knox - IBM Microelectronics
Steve Strauss - Intel Corporation
Cost Considerations in Burn-In Equipment Development

2003 Burn-in and Test Socket Workshop
March 2 - 5, 2003

Anne Sepic & Dan Weinstein
Capital Equipment Development
Intel Corporation
Agenda

• Semiconductor Industry Trends
• Burn-in trends:
  – Costs
  – Capability
• Equipment strategies for lowering total BI cost of ownership:
  – Equipment architectures to enable high utilization
    • Process considerations
  – Cost drivers and tradeoffs
  – Design for extendibility
  – Design for reliability/maintainability
Semiconductor Revenues: 31%

High Tech Job Cuts: 740,529

Chip Equipment Revenues: 41%

Tech Sector Return: -37.2%

Source: VLSI Research
Semiconductor Industry Cycles

- 2001 = $139B down 32%
- 2002 = $141B up 1.3%
- 2003 = $171B up 20%

15% CAGR 1958-2007

Chip Sales $B
Chip Sales % Change
CAGR 1958-2006

(Compounded Annual Growth Rate)
• Margins continue to erode as ASP’s decline and competition increases.
• Cost pressures require revolutionary changes
• The supply base must provide a highly capable manufacturing solution at a low cost.
BI Module Cost Distribution

- Equipment capital cost is by far the largest cost driver.
- Tooling cost is substantial and increases proportionally with *cycle time*. 
• Expect actual power to be in the middle of these prediction extremes.
• Industry will face ever-increasing challenges in power delivery and dissipation.
Equipment Architecture

• Process cycle time = Cost.
• Employ the Lean Manufacturing objectives and methods to reduce individual device non-stress time through process optimization:
  – Minimize material transfer time.
  – Inter-module: Oven proximity to inline operations.
  – Intra-module: Handler and oven linking.
  – Continuous device feed instead of batch level
  – Reduce burn in boards as ‘expensive’ device carriers.
• **Burn In equipment must be treated as an integral link in the assembly and test processing chain and the processes which it impacts.**
Equipment Cost Drivers and Tradeoffs

- **Power delivery:**
  - The industry uses custom solutions and interconnects at a high cost.
  - Can requirements be adjusted to use lower cost, off the shelf solutions?

- **Thermal capability:**
  - Higher power devices on verge of exceeding passive control capability, but active thermal control technology costs too high.
  - Breakthroughs in ATC technology are needed to achieve higher capability at costs less than passive control.

- **Signal delivery:**
  - Precise signal drivers and complicated burn in boards assist in routing signals to the devices.
  - Does the evolution in firmware designs change how we test our devices?
Design for Reliability and Maintainability

• Reliable equipment costs less.
  – Minimal efforts to manage spares.
  – Dedicated field service support is not required.
  – Equipment engineering activity reduced.

• Reliability must be designed up front.
  – Incorporate input from engineering field work and customer feedback.

• As complexity and component count increases? AT&T Reliability Model produces reduced performance indicators.
  – If components are to fail, ensure maintenance required is simple.
Design for Extendibility

• Exponential rise of power requirements requires radical thinking in planning future equipment extensions.
  – What is requested today runs the risk of being outdated upon introduction.

• Can the infrastructure to support more power delivery or thermal removal be designed into the system?
  – With what cost impact?
Conclusion

• The increased product power roadmaps and reduced cycle time demands drive the need for burn in equipment development to go through a revolutionary change.
• The process architecture and core technology improvements will facilitate a low cost burn in solution.
• The industry is not keeping ahead of the capability or cost pressures!
System Power Analysis

Cost Per Amp

Total System Current (Amps)

ABES-II (1990)
ABES-III (1994)
ABES-M (1996)
HPB-1 (1998)
HPB-2 (1999)
HPB-3 (2001)