

# Contact Pin Design Complexities:

Are Cost and Capability Mutually  
Exclusive?

2008 Burn-in and Test Socket Workshop

March 9 - 12, 2008



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**Plastronics**

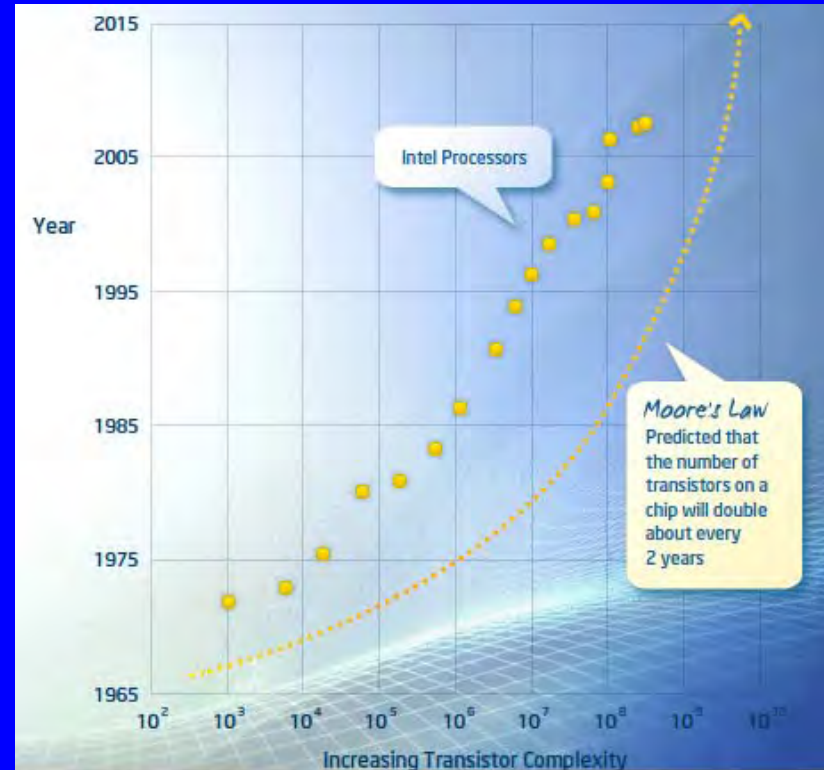


# Agenda

- **Introduction**
- **Technology Trends**
- **Cost Background**
- **The Conflict**
- **The Development Challenge**
- **Contact Solution Comparison**
- **Optimal Solution**
- **H-pin – Solution & Innovation**
- **Conclusion**

# Introduction

- Technology trends driving Moore's law increasingly at odds with the economics needed to sustain past business performance
- As a percent of total product cost, tooling is low, but rising
  - Cost pressures never greater



Source: Evolution of a Revolution.  
[www.intel.com](http://www.intel.com)

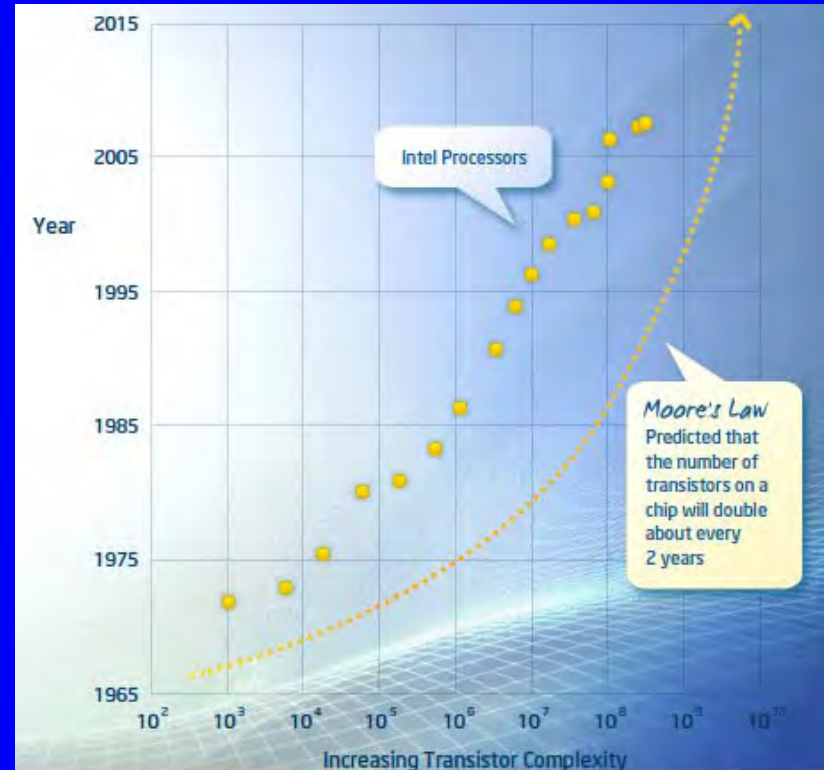


1969

2006

# Introduction

- Technology at any price is gone and best capability at lowest price is now the goal
- Any solutions to minimize this conflict?



Source: Evolution of a Revolution.  
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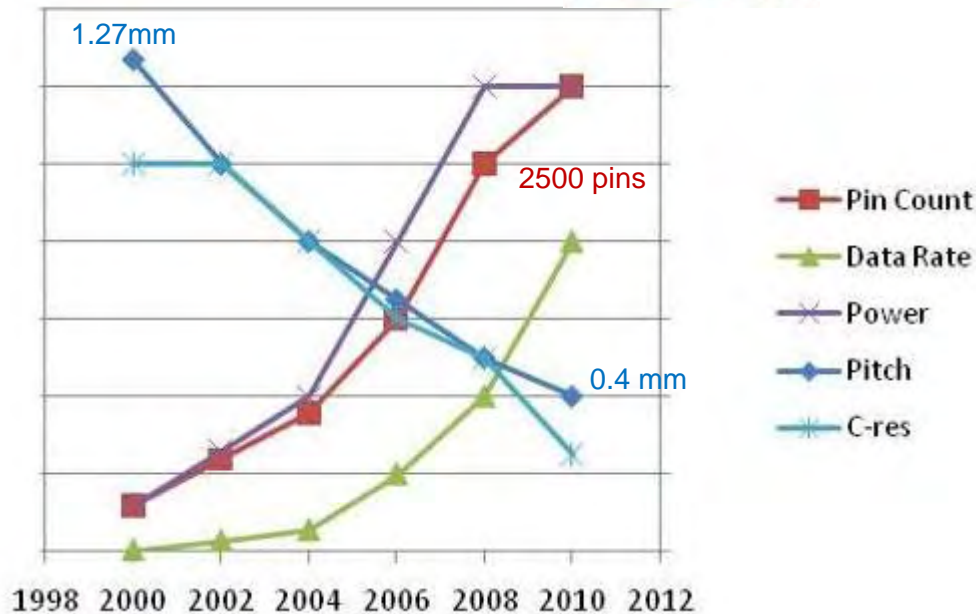
1969

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# Technology Trends



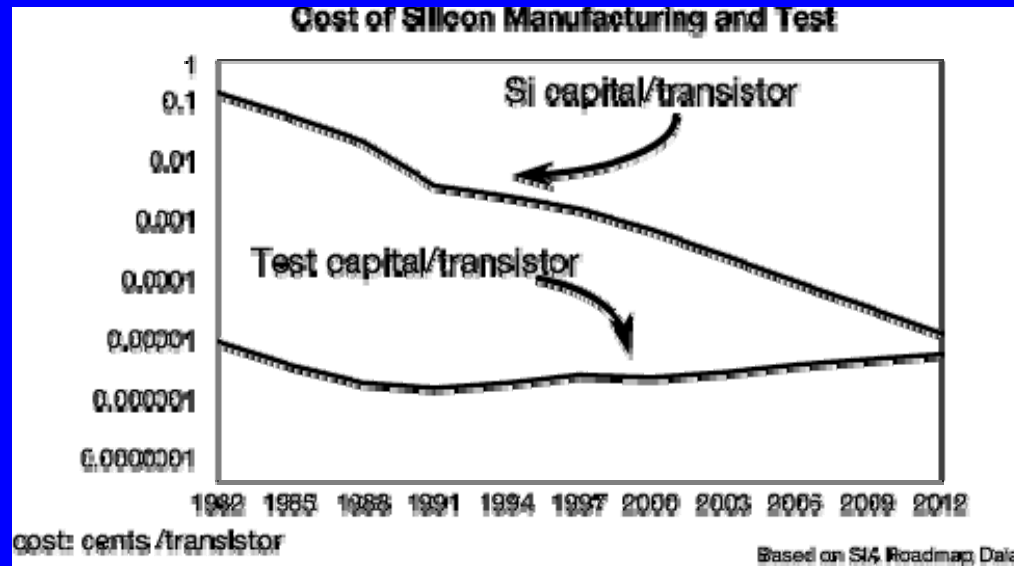
10-15x Size Difference



- Package / Application drive secondary requirements
  - Co-planarity
  - Pin Travel
  - Life cycle requirement
  - Etc.

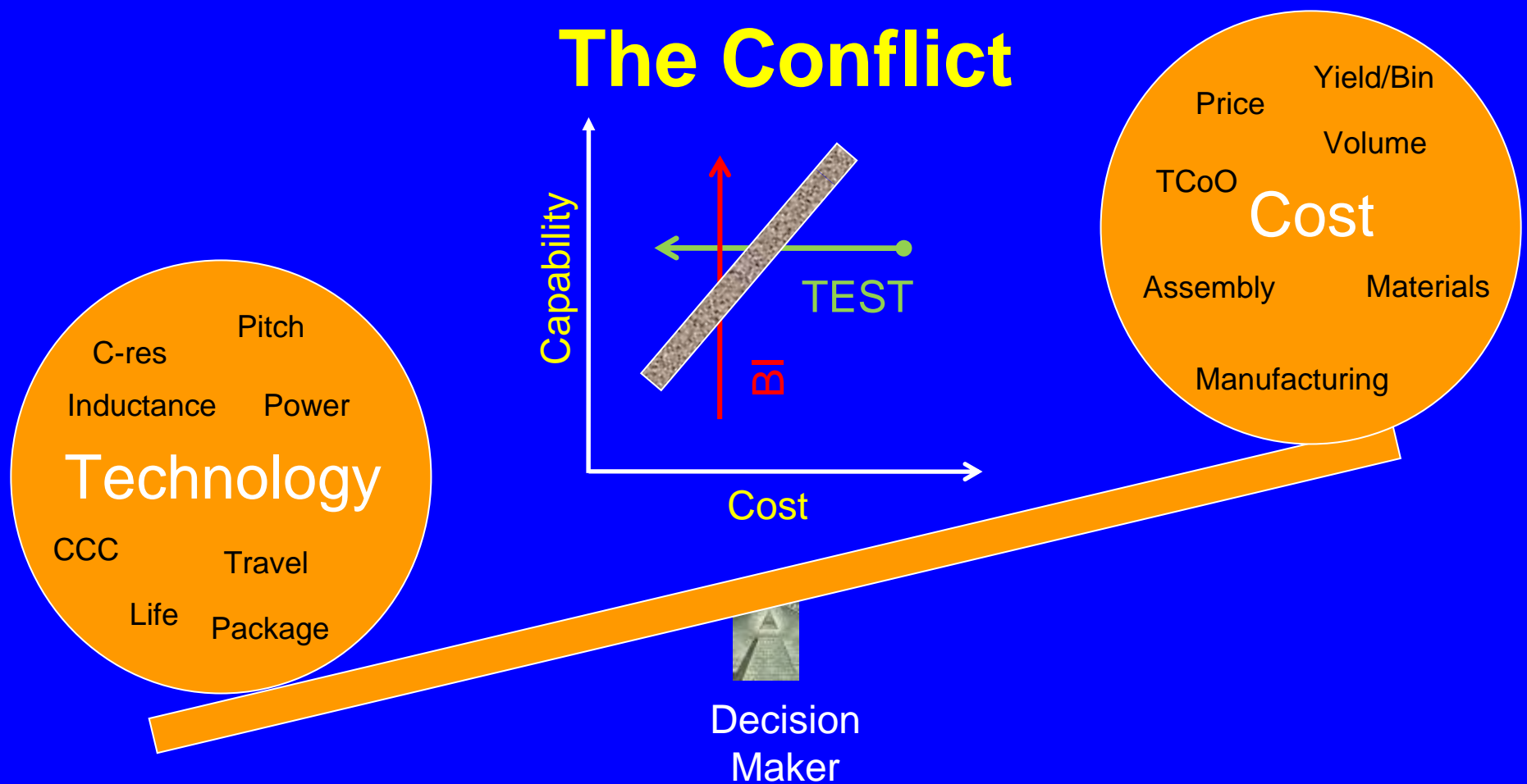
- Pitch / Frequency most compelling technology force
  - Today's mainstream: 0.6 – 1.0 mm / 1 – 4 GHz
  - 2008 - 2009: 0.5 – 0.8 mm / up to 10 GHz
- Power has stabilized
- C-res – varies by application (BI/Test/Sys Test)

# Cost Background



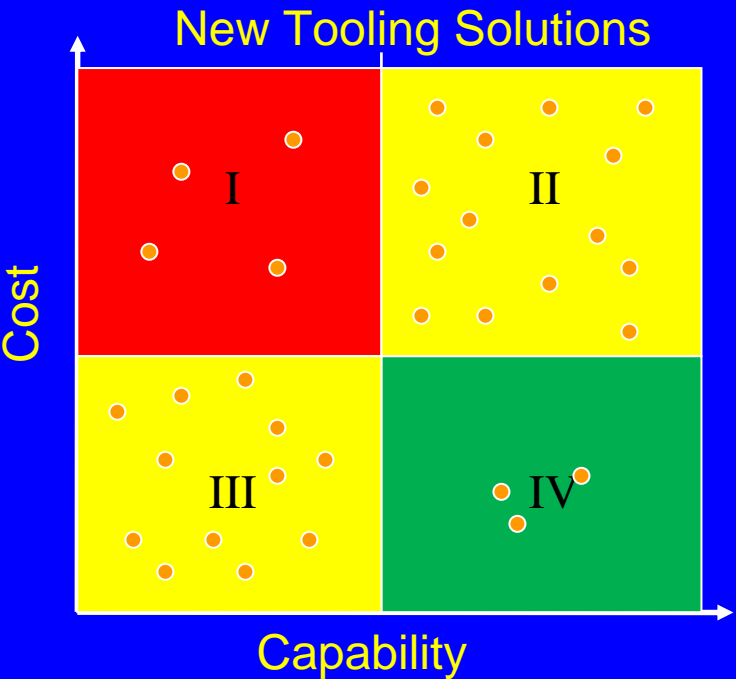
- Tooling Cost per pin improves generation to generation
  - Reached plateau based on capability of current mainstream technology (probe pins) and technology requirements (pitch / electrical)
- Next generation requirements may increase cost / pin price

# The Conflict



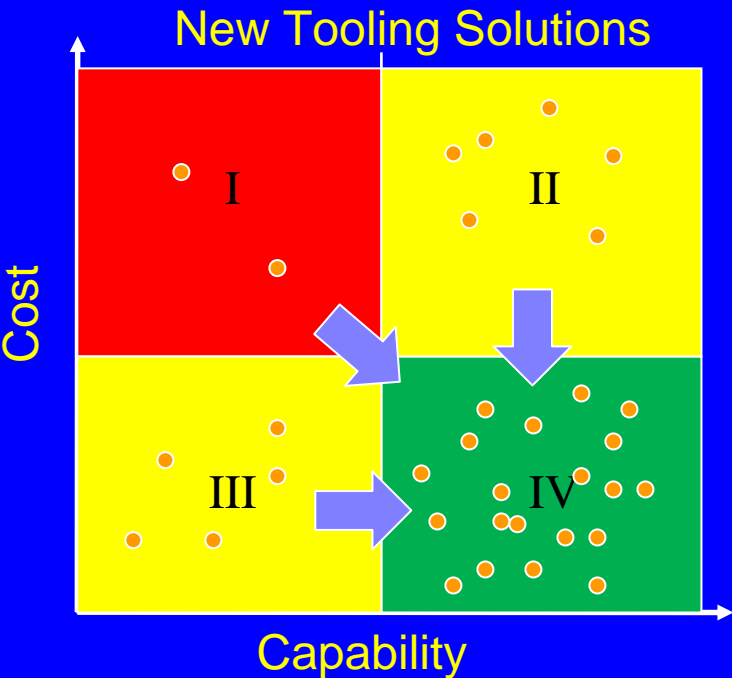
- Gross margin / ASP pressures have lead to new paradigm
  - BI: Better capability at same cost / Test: Same capability at lower cost
- Need to optimize performance & cost has never been greater
- Key concern is where does the envelope stop e.g. where does quality suffer at expense of cost

# The Development Challenge



- Zone I: Character Building Zone
    - Often seen by early adaptors
  - Zone II: Necessary Evil
    - Product must have the capability
  - Zone III: Settle For Zone
    - Low cost, but sacrifice capability e.g. yield, retest, Bin split, etc.
  - Zone IV: Cost Effective Envelopes (CEE)
    - Is there a “Cheap and Good” of test technology?
- 
- New tooling development =  $f(\text{cost, resources, capability, lead time...})$ 
    - Too often, mutually exclusive

# The Development Challenge



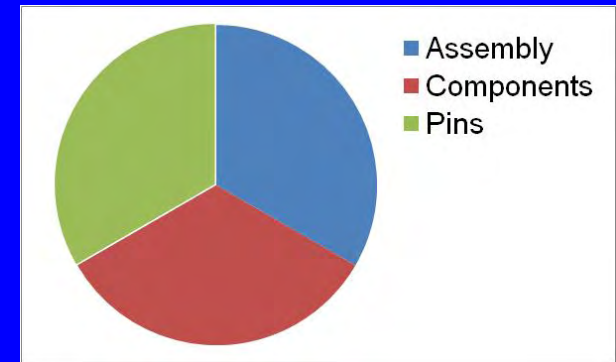
- Customer Desire/Industry Goal: Migrate as many new development programs into a single technology (Zone IV)

Nature of industry is that all 4 zones will exist

- Standardization benefits all
  - Reduces development lead times / resources / costs
  - Enables economies of scale
    - Reduces manufacturing / component / assembly costs
  - Reduces product lead time & inventory costs

# Contact Solution Comparison

- Three primary solutions:
  - Stamped (BI)
  - Probe / Membrane (Test/Sys Test)

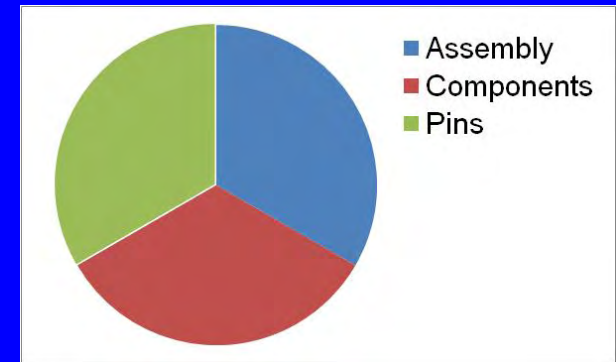


Relative Performance of Test and Burn-in Technologies				
		Stamped Socket	Probe Pin Socket	Membrane Socket
Electrical	Current Carrying Capacity Amps (higher the better)	~ 1	2+	2+
	Resistance mOhms (lower the better)	50	100	10
	Inductance nH (lower the better)	6	2	0.4
Mechanical	Life of Contact Thousands of cycles	10	250+	25
	Contact Travel (mm)	~ 0.2 - 0.5	.50+	0.10
Production Costs	Assembly of Socket	A	M	M
	Method - Automation or Manual			
	Cost	A	B	C
	Contact cost per pin			

Relative  
Cost:  
 $A < B, C$

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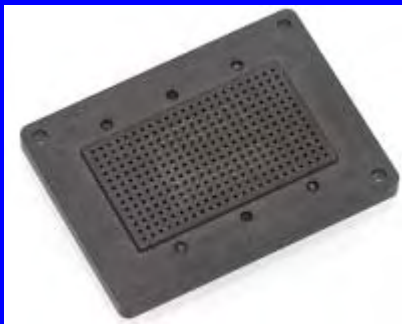
# Optimal Solution

	Attribute	<u>Optimal pin?</u>
Electrical	Current Carrying Capacity Amps (higher the better)	2+
	Resistance mOhms (lower the better)	35
	Inductance nH (lower the better)	0.9
Mechanical	Life of Contact Thousands of cycles	250+
	Contact Travel (mm)	.50+
Production Costs	Assembly of Socket Method - Automation or Manual	A
	Cost Contact cost per pin	D

- Use best technical capability as a technology target
  - Broad product envelope
- Cost – Establish breakthrough cost/performance capability
  - Lower TCoO – everything from price & delivery to probe life & yield
- Design for manufacturing
  - Automated assembly
  - Quality & reliability

# H-pin Solution

Relative Performance of Test and Burn-in Technologies					
	Attribute	Stamped Socket	Probe Pin Socket	Membrane Socket	<i>H-pin</i>
Electrical	Current Carrying Capacity Amps (higher the better)	~ 1	2+	2+	2+
	Resistance mOhms (lower the better)	50	100	10	35
	Inductance nH (lower the better)	6	2	0.4	0.9
Mechanical	Life of Contact Thousands of cycles	10	250+	25	250+
	Contact Travel (mm)	~ 0.2 - 0.5	.50+	0.10	.50+
Production Costs	Assembly of Socket Method - Automation or Manual	A	M	M	A
	Cost Contact cost per pin	A	B	C	D



Relative  
Cost:  
 $A < D < B/C$

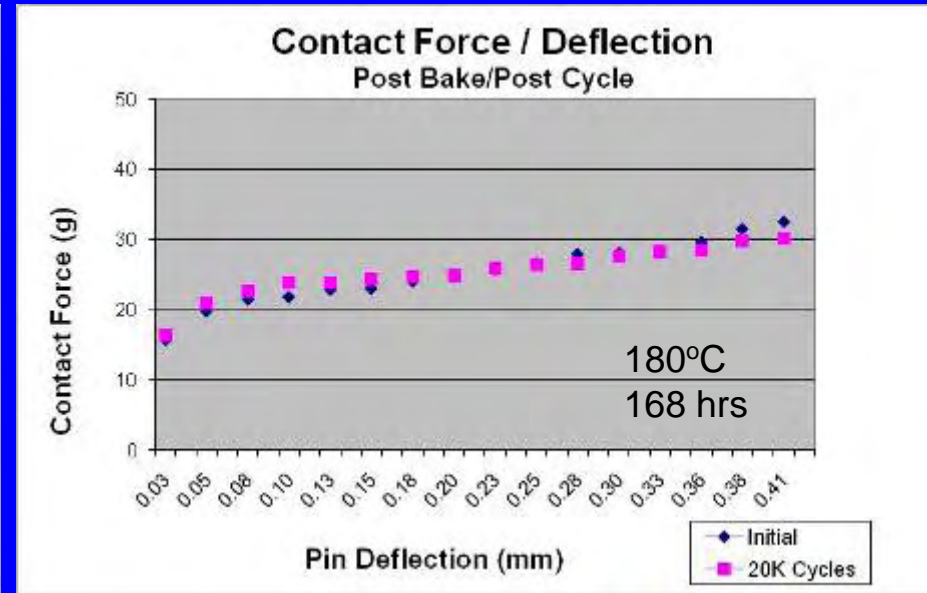
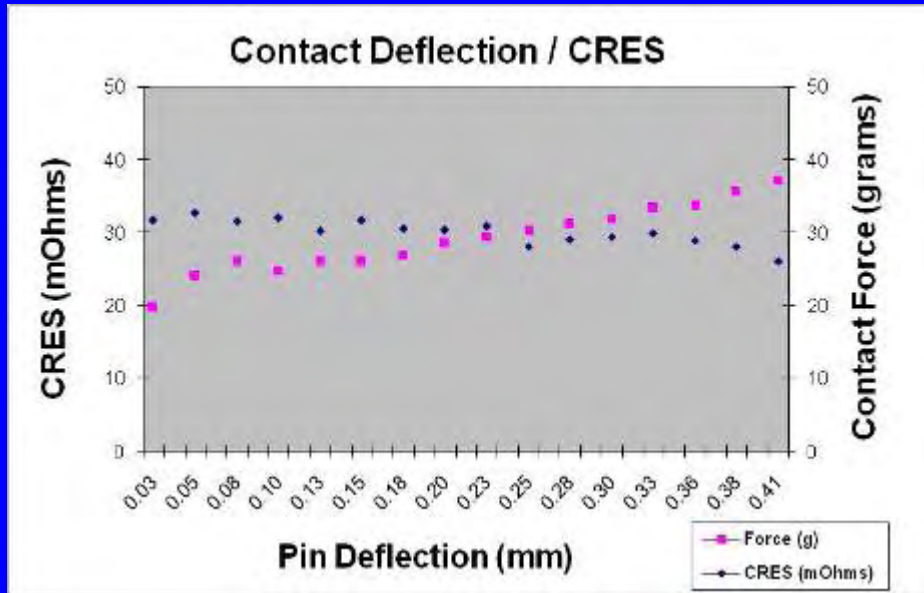


# H-pin Innovation



- H-pin: Innovative pin technology
  - Electrical path comparable to stamped single beam pin
  - High performance of traditional probe / economies of scale of high volume stamping process
  - Scalable for variety of pitches:
    - 0.5 mm ~1.0+ mm
  - BI / Test / Sys Test / Connector applications

# H-pin Performance



- H-pin delivers electrical performance through full stroke
- Excellent durability / stress relaxation performance
  - Negligible contact force change after bake
  - Stable lab performance to 250K cycles



# H-pin Performance

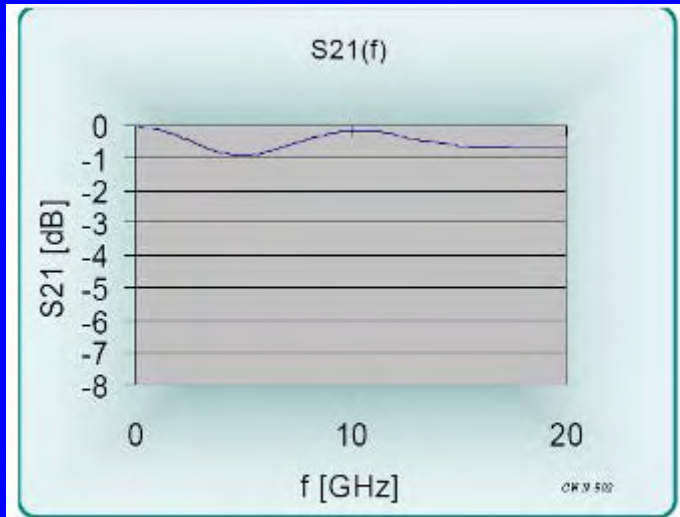


Figure 23. Insertion loss S21 (f) and S12 (f)

## Insertion Loss

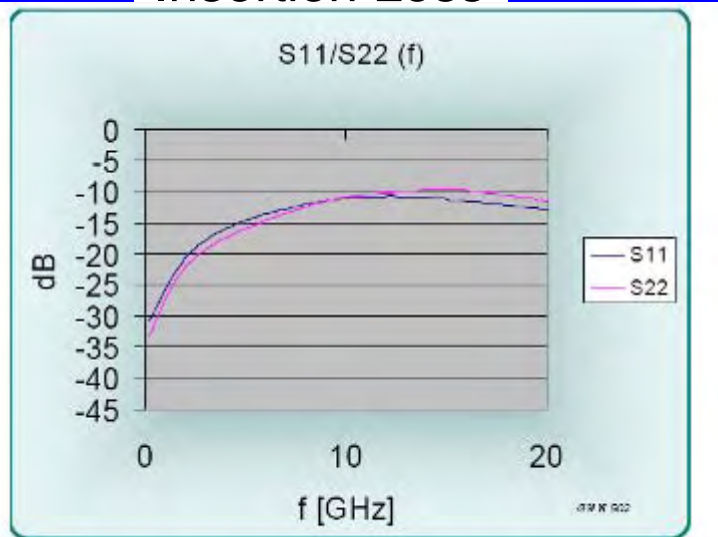


Figure 25. S11 magnitude (f) for the thru measurements into a 50 Ohm probe

## Return Loss

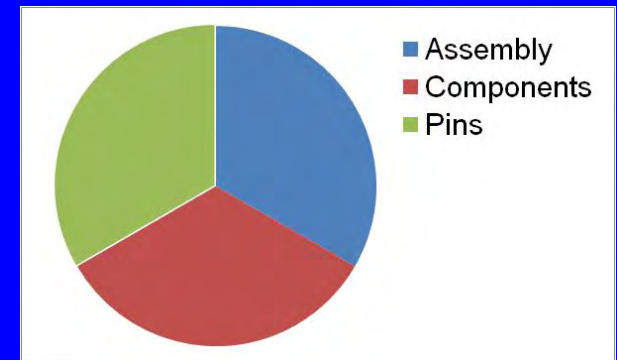
## 0.5mm H-pin Performance

Attribute	Performance
Pin to Pad Resistance	< 40mΩ
Self-Inductance	0.88 nH
Single-ended Insertion Loss	< 1dB to 20 GHz
Single-ended Return Loss	< -10dB to 20 GHz
Differential Return Loss	-17.5 dB @ 5GHz
Differential Insertion Loss	-25dB @ 11.75 GHz
Near End Cross Talk	-25dB @ 14.8 GHz
Far End Cross Talk	-25dB @ 7.5 GHz

# H-pin Innovation

Features:	Benefits:
0.40mm to 0.70mm Travel	Compliancy for Large Package Warpage
Flat Spring Rate	Stable Contact Resistance and Force
BeCu H-PIN™	Solid Beam Electrical Performance
Stainless Steel Core Spring	Compliancy at High Temperatures (180C+)
Bandwidth -1dB @ 15GHz	Correlated BI, System Evaluation and Test
Current Carrying Capacity	Reliable Power and Ground Contact
High Volume Stamping *	Stocked Inventory and Better Lead Time
Automated Pin Assembly *	High Volume Capacity and Quality Control
Reel-to-Reel Pin Insertion *	High Volume Capacity and Ease of Use

- H-pin reduces TCO
  - Single solution for wide array of applications
  - High volume process
    - Competitive price
    - Automated assembly
  - Short lead times / delivery



# Conclusion

- Product enabling through technical innovation continues as our collective goal
- Technology at any cost is long gone and is now focused on best affordable capability
- Current technologies generally offer either technical capability or cost capability
- New H-pin technology is a new technology that combines both in a single solution and enables customers to define windows or envelopes for new products