THIRTEENTH ANNUAL
BiTS 2012
Burn-in & Test Strategies Workshop

Poster Session 1

ARCHIVE 2012

Sure, podium presentations are great, but sometimes it's nice to have a one-on-one chat with the author. And, we all wonder: how many people are inclined to ask those provocative questions in front of the whole audience?

With a variety of topics being addressed, poster sessions offer the perfect opportunity for authors and attendees to interact directly and even share ideas in an informal setting while enjoying some refreshments.

IM Material for High Pin Count Socket

Jiachun (Frank) Zhou, Dexian Liu, Khaled Elmadbouly, Brad Henry, Kevin DeFord
—Interconnect Devices, Inc.

Socket Spring Probes - Degradation Experiments

Shaul Lupo—Intel Israel

Low Force SuperButton® Connector Technology

Amit Varma—High Connection Density, Inc.

Use of Conical Inductors for Load Boards Testing

Gustavo Cozacov, Maroon Maroon, Isar Reichman, Tali Korin, Shimon Manor
—Intel Corporation

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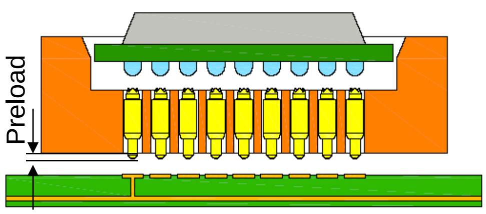
INTERCONNECT DEVICES, INC.
smiths interconnect

IM Material for High Pin Count Socket

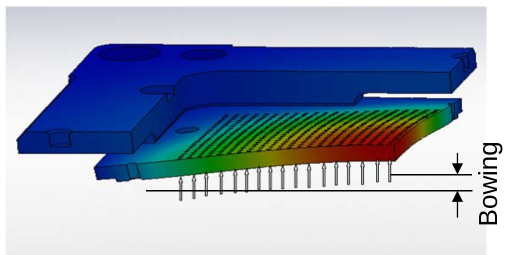
Jiachun (Frank) Zhou, Dexian Liu
Khaled Elmadbouly, Brad Henry, Kevin DeFord
Interconnect Devices, Inc.

Plastic Presents Special Challenges

- Plastic deflects under contact preload
- Plastic grows hygroscopically
- Plastic is not always sufficiently durable



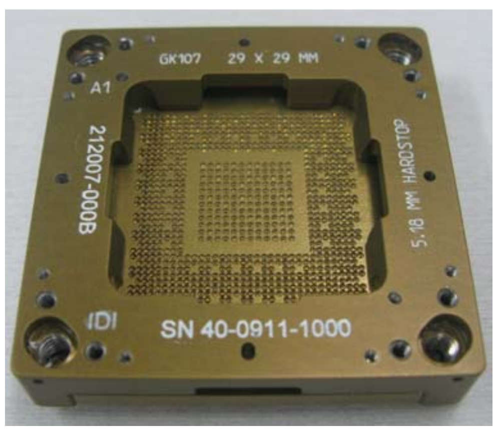
Pin preload



Socket Bowing

An Alternative to Plastic Exists for Sockets

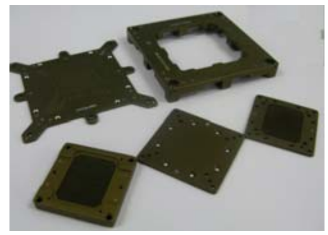
- A robust insulation technique has been developed for metal
- Metal deflects much less than plastic
- Metal does not grow hygroscopically
- Insulated metal wears better than plastic



Material Properties: Surface Resistivity

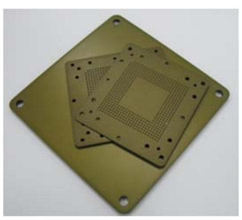
- Comparable to anti-static / ESD plastics
- Passes leakage through 1000 V

Material	EKH SS09	Ins. Metal	Cer. PEEK	TORLON 4203
Surface Resistivity (Ohm-cm)	~10^9	10^{10} ~ 10^{11}	> 10^{13}	> 10^{16}



Material Properties: Mechanical Strength and Hardness

- Much stronger than all common socket plastics
- Hardness ~400HV; composite materials do not exceed 200HV

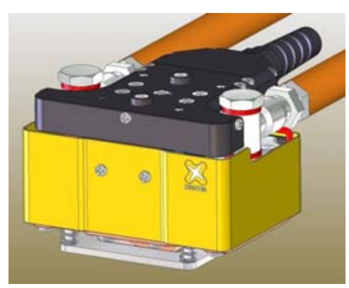


Properties (MPa)	Ins. Metal	Ceramic PEEK	Semitron MDS 100	Torlon 4203
Elastic Modulus	70300	4482	10340	5000
Tensile Yield Strength	193	90	101	192

Material Properties: Temperature and Humidity

- Does not absorb water; stable dimensionally in all environments
- High thermal conductivity and temperature range

Properties	Ins. Metal	Cer. PEEK	MDS 100	Torlon 4203
Water Absorption, %	0.00	0.00	0.1	0.33
Max Working Temperature, °C	260	260	249	260
Melting Point, °C	593		335	-
Thermal Conductivity, kcal / hour / M^2-° C	119	0.3	0.2	0.2

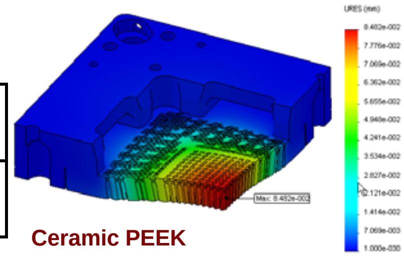


Analysis: Deflection

- 1750 pin, 0.5 mm pitch socket evaluated
- Less deflection permits less preload

Max Deflection due to Preload

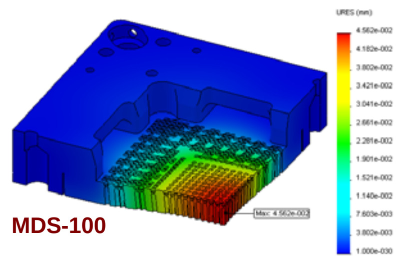
Material	Ins. Metal	Ceramic PEEK	MDS-100
Max Deflection, mm	0.009	0.085	0.046



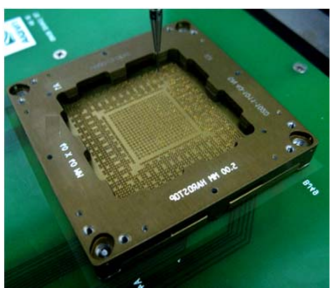
Ceramic PEEK

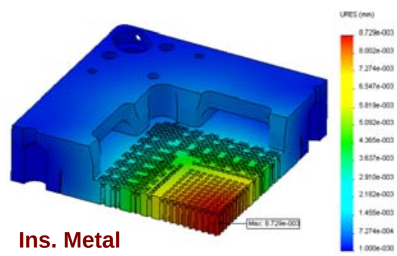
Material	FEA	Measurement
Max Deflection, mm	0.009	0.008*

* Within measurement error range.



MDS-100



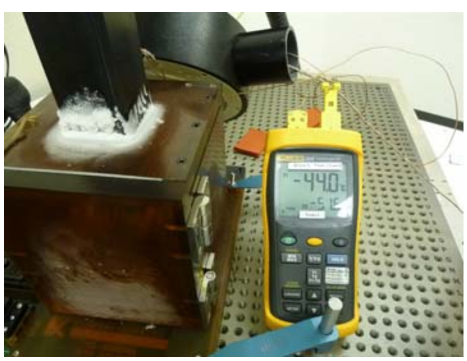


Ins. Metal

Analysis: Durability

- Socket cycled 500K insertions
- No delta in current leakage before and after test indicates insulation is robust to cycles

~ 480 pin sample	>35 Nano A	> 15 Nano A
Failed Pins	0	0



-40C & 150° C Cycle & Leakage Test Set up

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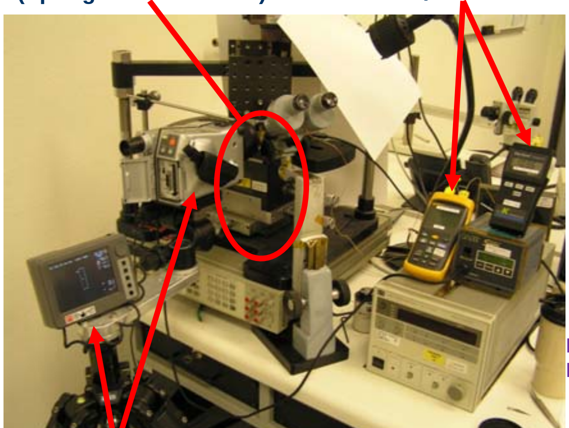
Socket Spring Probes - Degradation Experiments

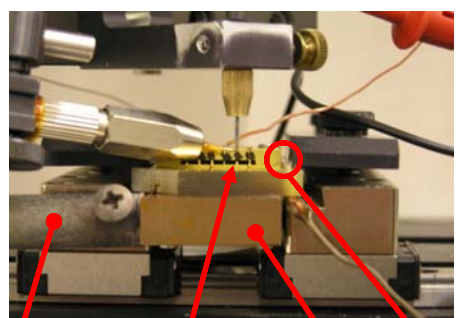
Shaul Lupo - Intel Israel

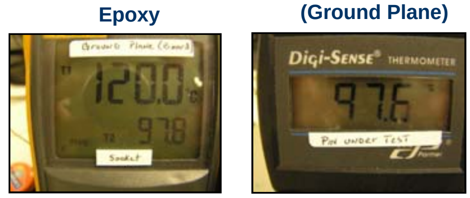
Background

- Spring probes degradation is the main factor to ATE boards failures causing huge delay in testing activity
- This issue lead to equipment damage like burnt spring probes, burnt sockets, burnt PCB pads & damage to the unit / package
- The main reasons to this phenomena are testing at high temp, long test time & high currents
- Many experiments were held to investigate the factors which impact on socket spring probes degradation

Test Setup



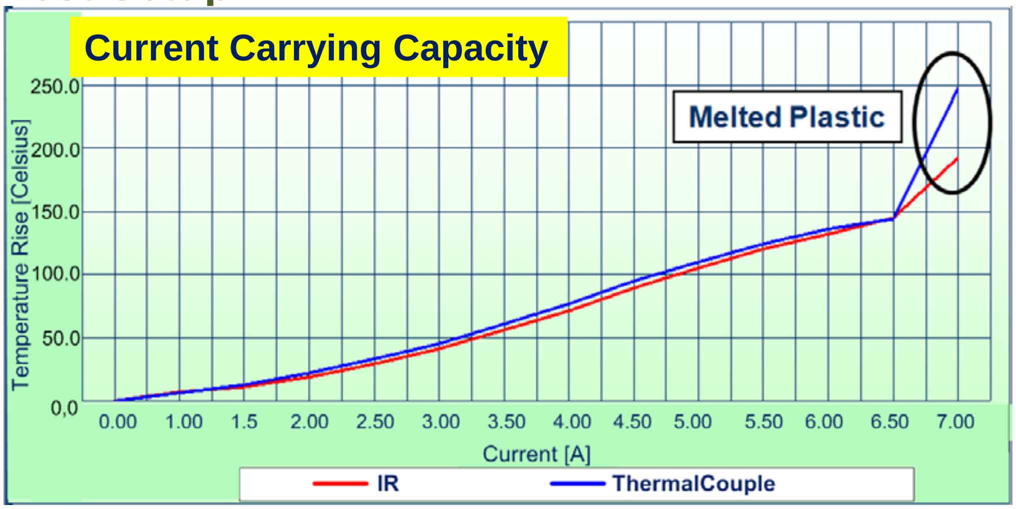


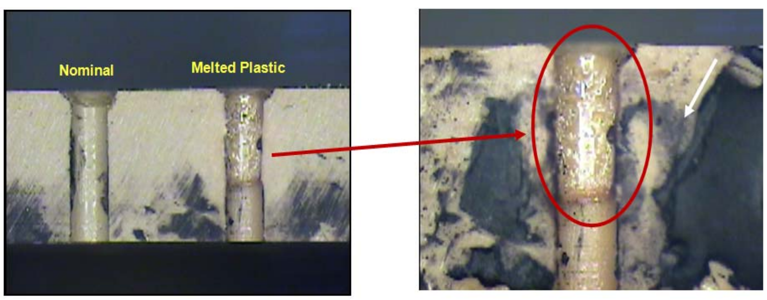


Thermal Couple Digital Display (At Initial after 1hr Soak)

Poster #2
1

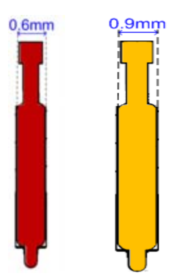
Test Setup





Results:

Maximum CCC (Current Carrying Capacity)						
EXP#	1	2	3	4	5	6
Parameter	Pogo pin thickness		Socket material - Melting point		Spring probe material	
	0.6mm	0.9mm	Teca Peek (250°C)	Torlon 4203 (275°C)	Music wire	Stainless steel
Ambient temp	7A	8A	6A	7A	7A	8A
100°C temp	6A	7A	5A	6A	6A	7A



Environmental Conditions

Spring Material	Max Temperature (1 hr)
Music Wire	250°F (120°C)
Beryllium Copper	400°F (205°C)
Stainless Steel	500°F (260°C)

3/2012 Socket Spring Probes - Degradation Experiments 2

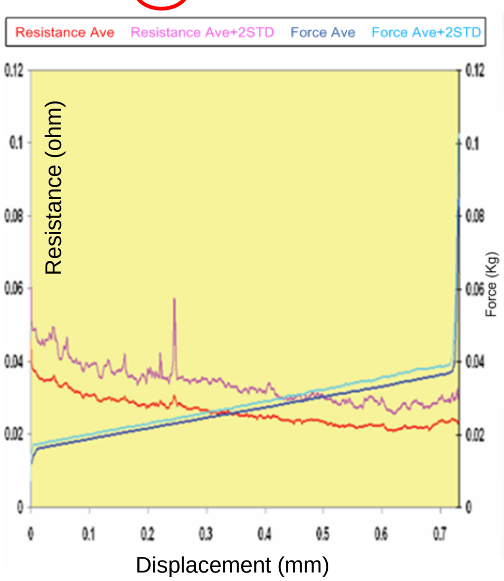
Results

CRES & FDR - Degradation Results (Kg)

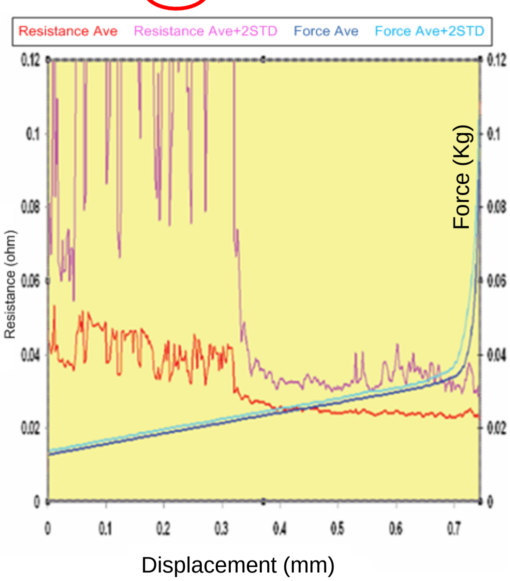
			Pre Test		Post Test	
#	Test Duration	Temp	CRES	FDR	CRES	FDR
1	24 hours	85°C	0.0266	0.0286	0.029	0.0266
2	24 hours	90°C	0.026	0.0293	0.0319	0.0264
3	24 hours	100°C	0.0273	0.0289	0.0827	0.0258
4	1 hour	120°C	0.0281	0.0286	0.0282	0.0278
5	10 minutes	150°C	0.0243	0.028	0.025	0.0259

Burn-In without current for **24 hours** at **90C**

Force-Displacement-Resistance Plot
Pre 24hrs at 90C



Force-Displacement-Resistance Plot
Post 24hrs at 90C



Conclusions

- Using spring probes in long time testing (burn in conditions), result in CRES increase & FDR decrease
- Spring probes dimensions, socket material melting point, spring probe material, impact on maximum CCC (current carrying capacity)
- Users which are working on ATE boards, may consider to choose the appropriate spring probes dimension, socket material, spring probe material in order to decrease spring probe degradation issues

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HCD HIGH CONNECTION DENSITY, INC.

Low Force SuperButton® Connector Technology

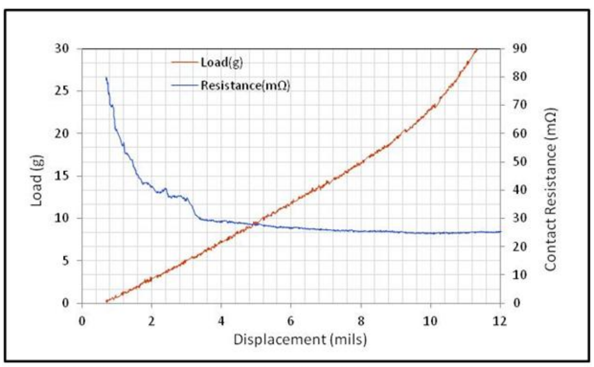
Amit Varma
High Connection Density, Inc.

• Problem Statement

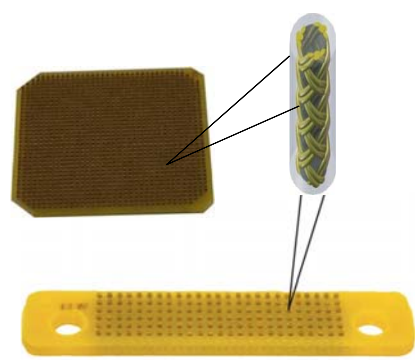
- Large array applications gives rise to an overall higher load for high density arrays, requiring more sophisticated & hence more expensive clamping hardware
- Large forces have tendency to warp probe cards and load boards

• Solution

- The 3rd generation low force SuperButton® is the technology of choice with high electrical performance and reliable contact and is ideal for high density package to board, board to board and board to flex applications



FDR Curve highlighting low CRes and enhanced compliance at low forces starting at 10g/pin



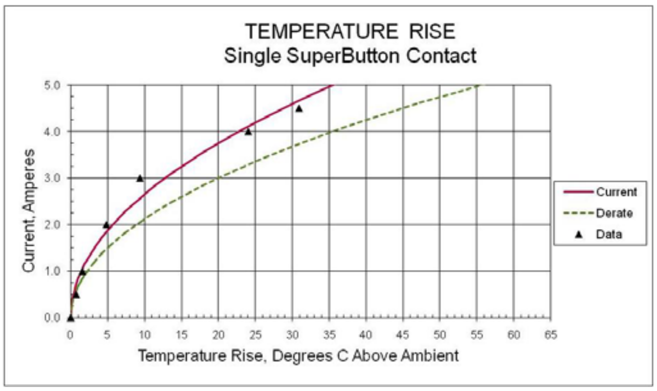
SuperButton®

- Continuous wire spring structure supported by elastomer

Electrical Performance

- The current carrying capacity becomes important as device frequencies and power increases
- For low contact resistance & high current carrying capacity, the SuperButton® connectors have a continuous cross-section throughout the contact element and are plated with Ni/Au for noble metal contact at the interface

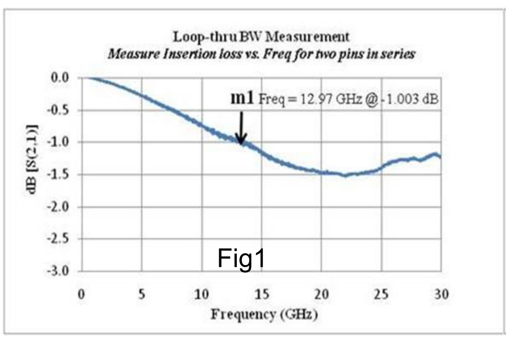
Current Carrying Capacity

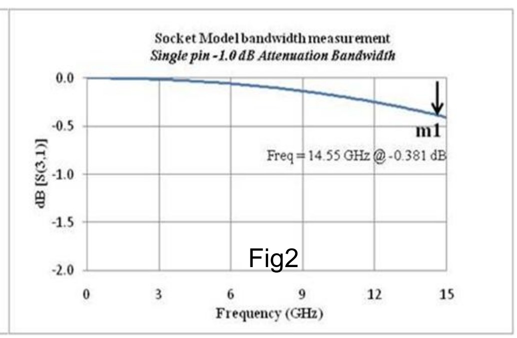


Highlighted SuperButton® contact element reduces the joule heating by providing multiple contact points

Graph exhibits the current carrying capacity of ~ 4.5A/pin continuous at industry standard 30°C temperature rise

S - Parameters



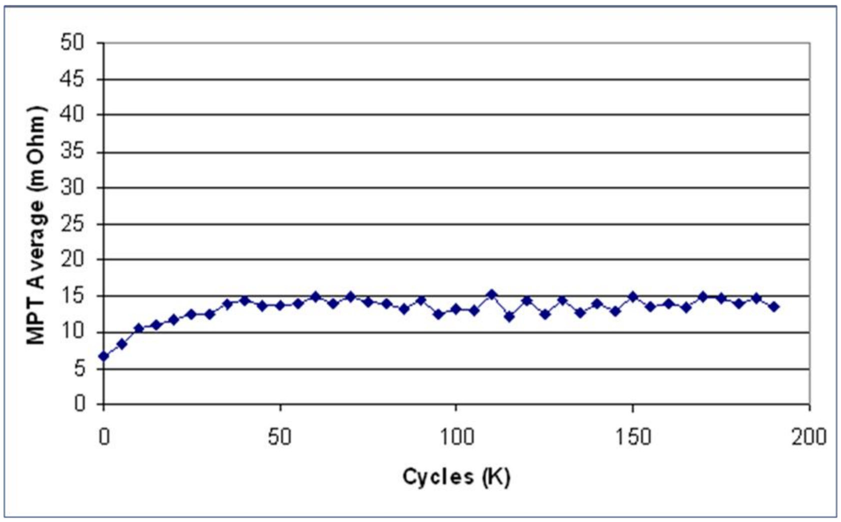


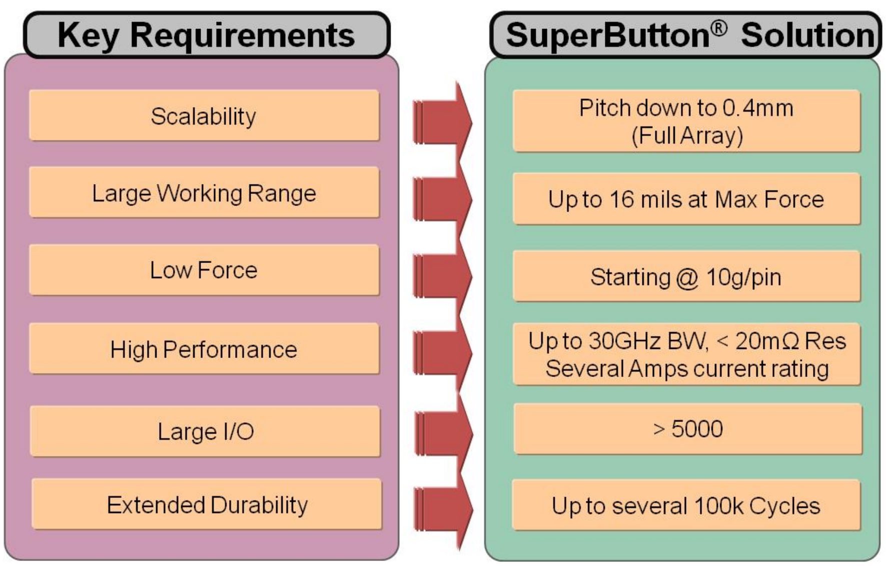
- The measured -1dB loop-thru bandwidth for two pins in series is ~13 GHz as shown in Fig. 1
- For a single SuperButton contact element the measured -1db bandwidth will be ~ 26GHz

- The single-pin bandwidth from the de-embedded model is greater than 15 GHz as shown in Fig. 2 (which is the highest frequency that the model is valid for)
- Upon extrapolating the above curve for -1dB, the observed bandwidth is ~ 26GHz supporting the chart in Fig. 1

Extended Durability Test

- Extended durability test was performed to make sure that the contact resistance is stable over a large number of cycles
- Socket was loaded with a given force per pin at each insertion
- At 5,000 cycle intervals, the socket was removed from the automated tool for resistance measurements and the measurements were made while the socket was manually clamped
- The results exhibit very stable and low CRes (< 15mΩ) over a large number of cycles (200K)





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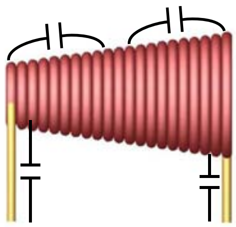
Use of Conical Inductors for Load Boards Testing

G. Cozacov, M. Maroon, I. Reichman, T. Korin, S. Manor
Intel Corporation

High speed interfaces like Thunderbolt, PCI-gen 3 or HDMI are critical portions of any load board. This work explains the use of conical inductors to check the load board itself and some DC parameters of the DUT

Why conical inductors?

Due to its special geometry and small size, conical inductors offer a low stray capacitance and therefore a broader bandwidth than standard inductors.



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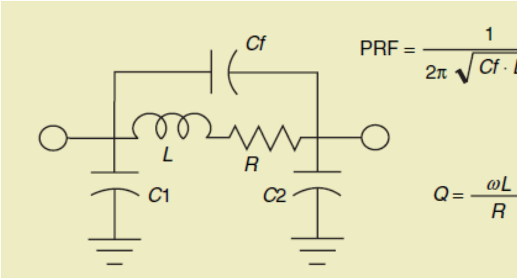


(2)

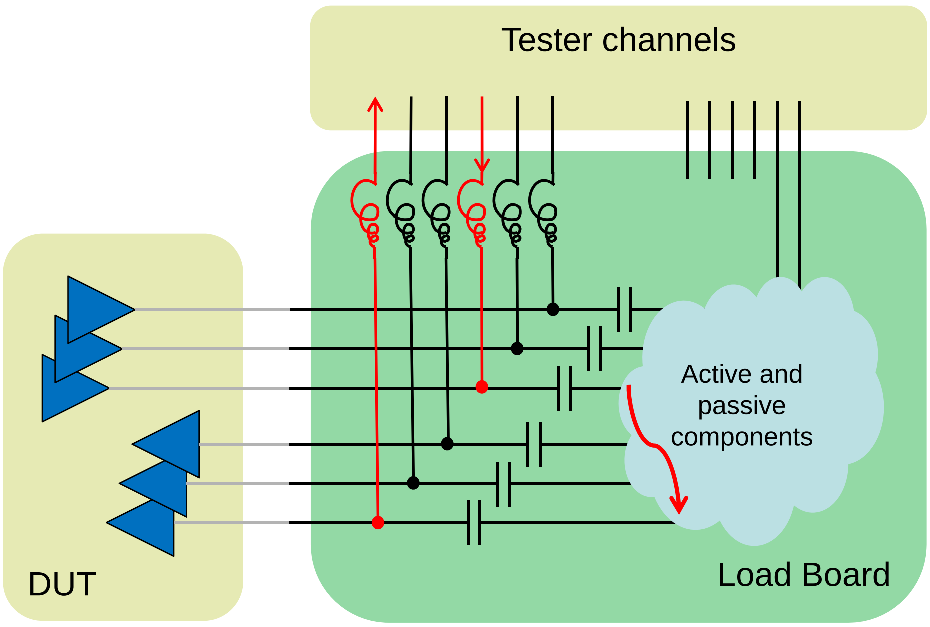
Mounting considerations

To ensure the best performance, the part should be mounted at an angle with the small end closest to the board.

Soldering the part flat may reduce high frequency response on some substrates.

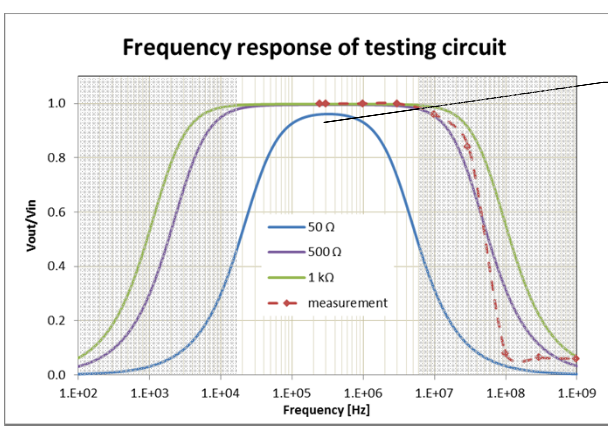
Load board checking

High speed interfaces are connected to the tester using conical inductors. This configuration enables the test of most of the critical components and paths of the board using a lower frequency and without a unit connected to the board.



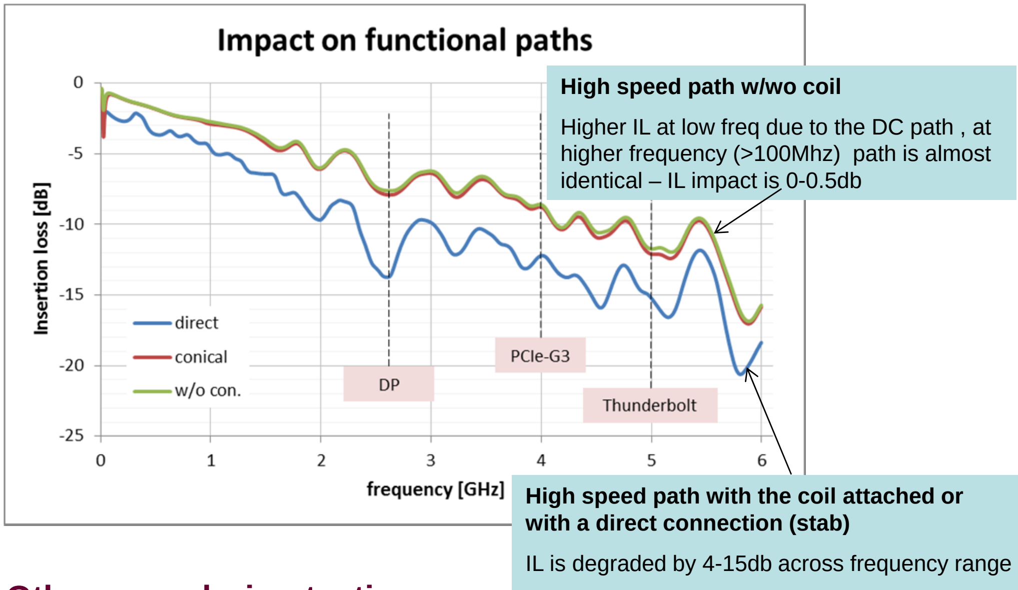
Selection of the frequency

Since the circuit used for testing is RLC, it is not possible to use neither DC nor very high frequency.



Frequency used during the test is selected close to the resonance frequency of the RLC circuit

Spice simulation against measurement



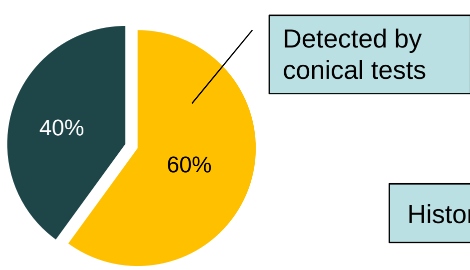
Other uses during testing

Same configuration of conical inductors used tor the load board checking can be used also to check leakage, connectivity and bias insertion without any additional component required

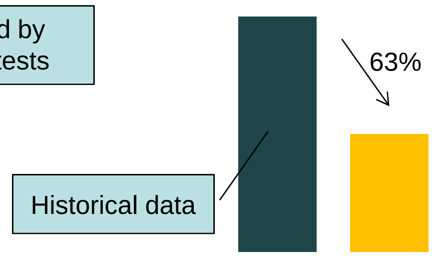
Impact in production

A quick and automatic check is essential for a rapid response in case of load board problems either to detect the problem or to help in pinpointing the problem during the fixing of the boards

Failures by detection type



Average repairing time



Data based in 25 load boards (sort and class)

References:
(1) Piconics datasheet
(2) Conical Inductors for Broadband Applications - Thomas A. Winslow