

2nd Annual



September 13, 2016

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Session 1

Yuanjun Shi
Session Chair

BiTS China

High Frequency & Burn-In

"Implementation Challenges of and ATE Test Cell for At-Speed Production Test of 32 Gbps Applications "

Jose Moreira - Advantest

"Addressing Challenges in High Temperature Burn-In"

Paolo Rodriguez - Analog Devices Philippines

"Derating Transient Voltage Suppressor Diodes for Burn-In Applications"

Gil Conanan - Analog Devices Philippines

"An Ignorable Testing Technology for High Speed/Frequency Device Testing"

Pang Cheng Chiu - Jthink Technology

Session 1

施元军

Session Chair

BiTS China

High Frequency & Burn-In

"32 Gbps速度应用在自动测试单元量产实施中的挑战"

Jose Moreira – Advantest

"高温老化测试挑战的讨论"

Paolo Rodriguez - Analog Devices Philippines

"老化测试中瞬态电压抑制器的降额设计"

Gil Conanan - Analog Devices Philippines

"一个不容忽视的高速芯片测试方法"

Pang Cheng Chiu - Jthink Technology

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Addressing Burn-In Challenges for High Temperature Products

Paolo F. Rodriguez
Analog Devices



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Suzhou
September 13, 2016



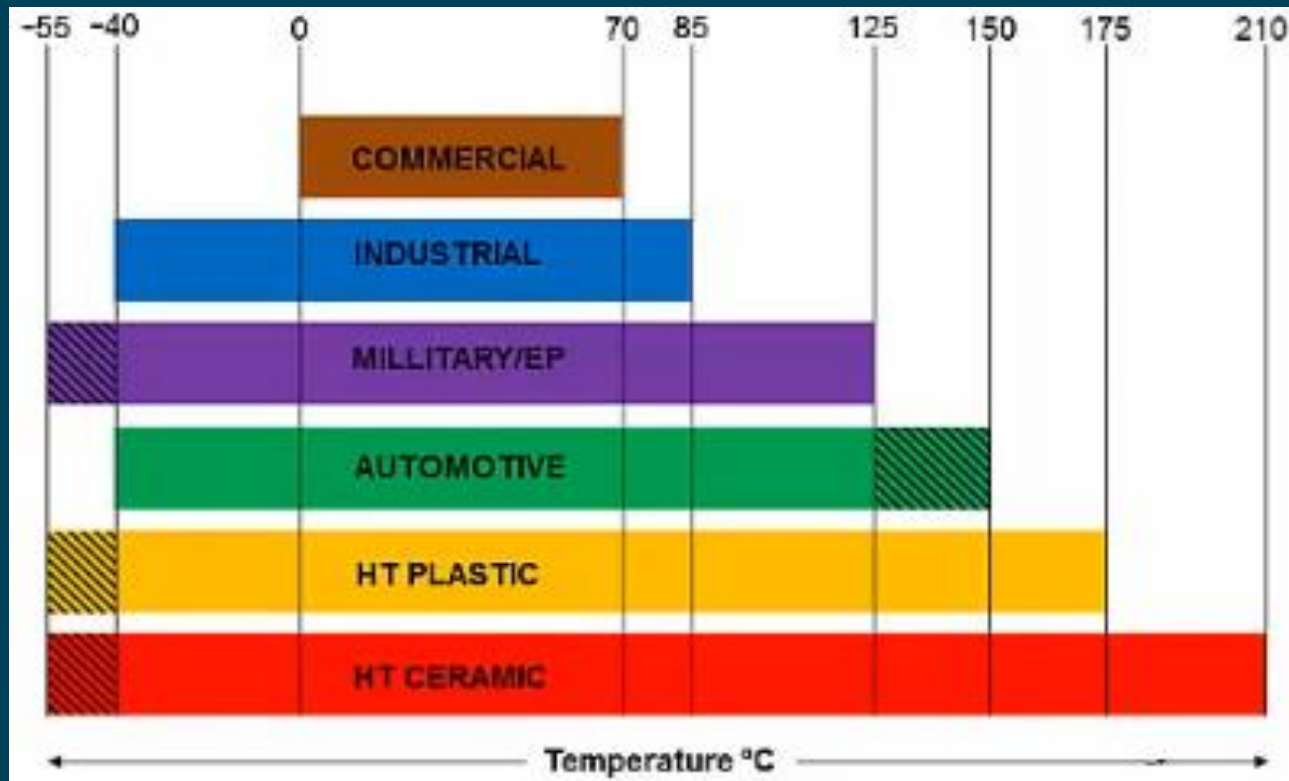
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Presentation Outline

- I. Introduction
- II. Objective
- III. Challenges
- IV. Material/Component Selection
- V. Design
- VI. Qualification
- VII. Conclusion
- VIII. Recommendation
- IX. Acknowledgement

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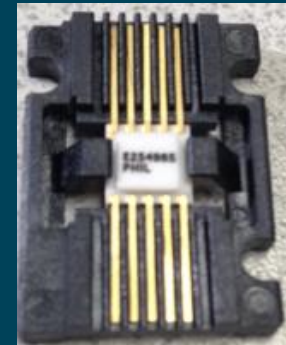
High Temperature (HT) Electronics



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High Temperature (HT) Electronics

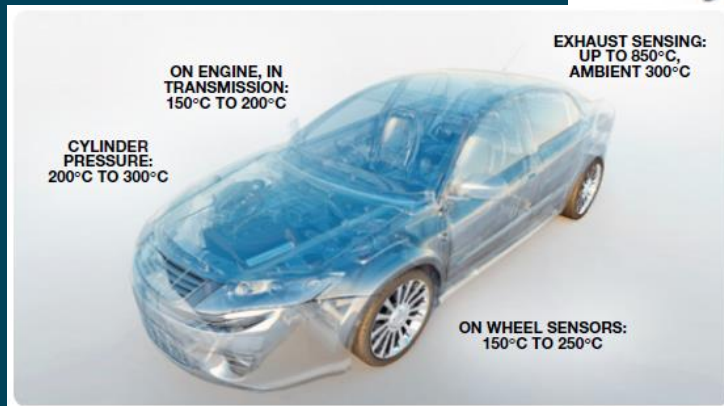
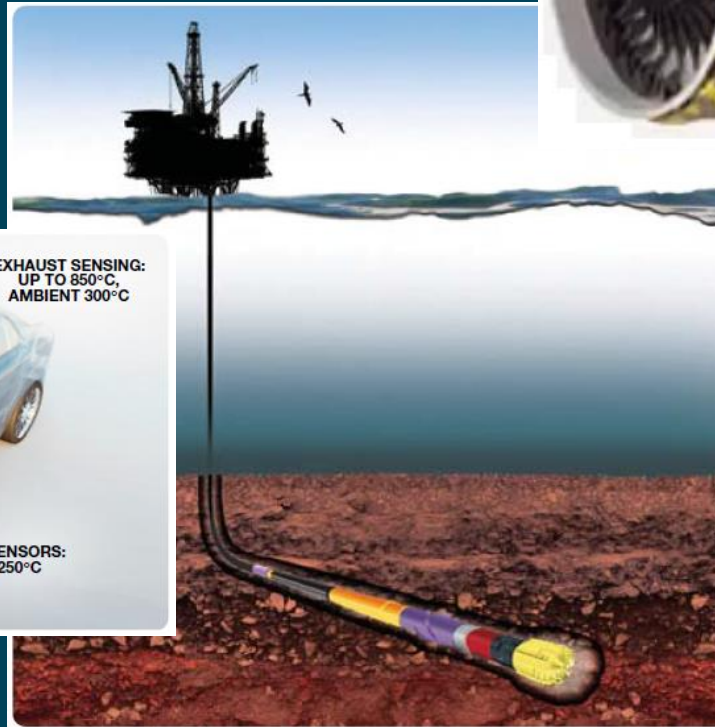
- Old systems depended on active or passive cooling
- Disadvantages:
 - Cooling adds cost and weight
 - System reliability
 - Impractical solution in harsh environments
- So, why NOT just operate the electronics HOT?



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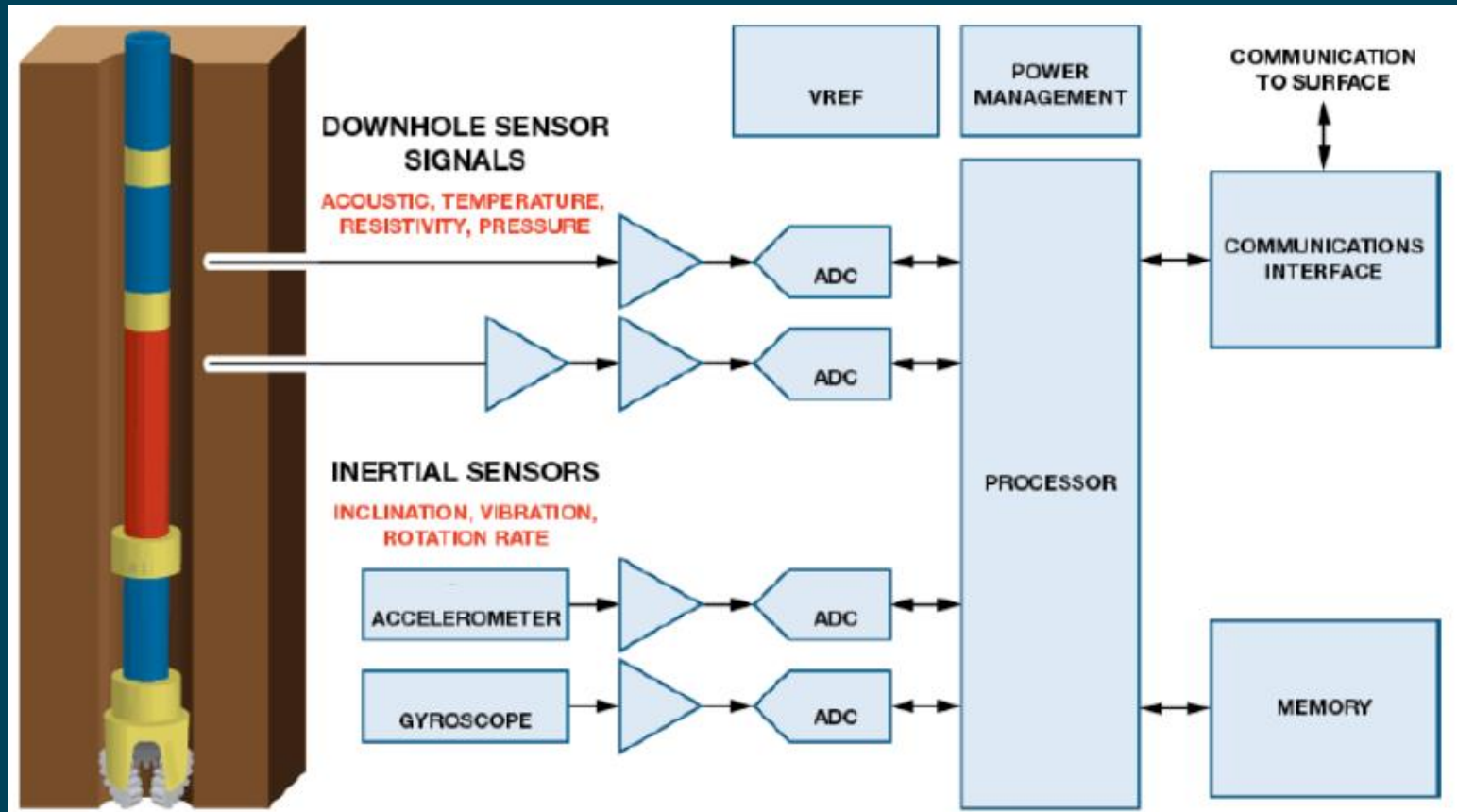
High Temperature (HT) Applications

- Emerging applications for HT
 - Oil and Gas Drilling Industry
 - Avionics
 - Automobiles



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ADI's HT Portfolio



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Product Qualification...

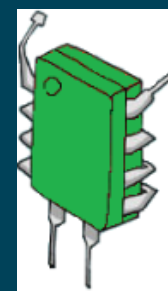
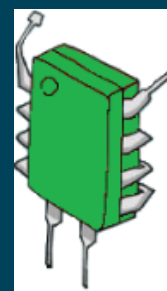
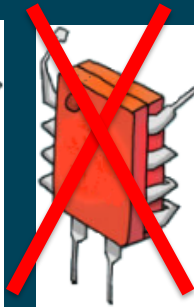
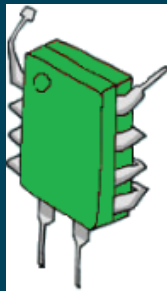
- Necessitates rigorous testing at temperature
- High Temperature Operating Life (HTOL) is required for design or fabrication changes

Test Group	Test Code	Package	Description	Sample Plan (per lot)			Number of Lots Sampled	Notes
				LTPD	SS	N		
9a	1a 1b 36 15 1a 1b	C, P, H, B, O, L, M C, P, H, B, O, L, M C, P, H, B, O, L, M C, P, H, B, O, L, M C, P, H, B, O, L, M C, P, H, B, O, L, M	ELECTRICAL ENDURANCE - HIGH TEMPERATURE SEQUENCE Guardbanded Electrical Test or Data Log Electrical Test - (New die types) Solder Heat Resistance Sequence - Note 1 <u>High Temperature Operating Life (HTOL)</u> Guardbanded Electrical Test or Data Log Electrical Test - (New die types)	See Table 5	3	Delta Analysis of Key Parameters (t0 to Post- Reflow and Post HTOL) should be considered. Cpk \geq 1.33 recommended post-reflow and post- HTOL. Note 1 - CSAM not applicable (e.g., use Solder Preconditioning - Table 4 Test Code 20) for Hermetic/Cavity Packages		

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Mr. BURN-IN...

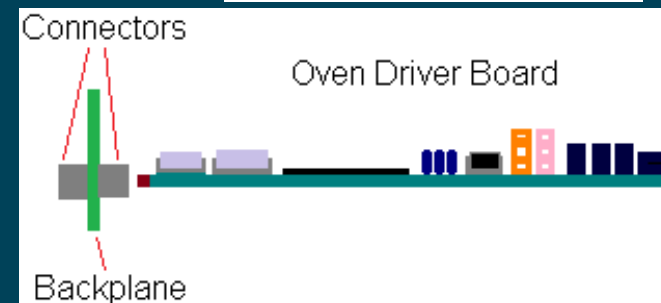
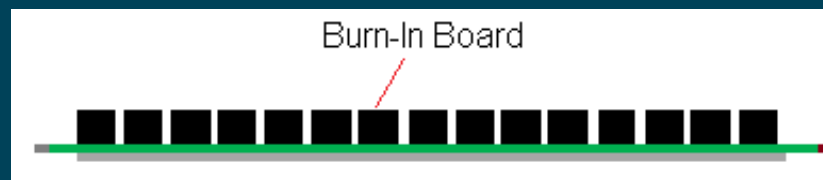
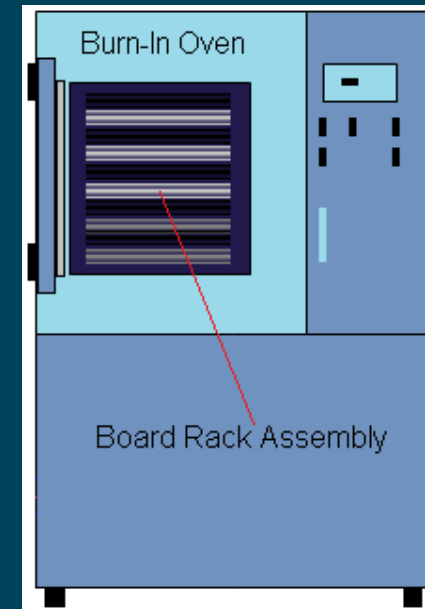
- Is a screen to weed out weak devices
- Utilizes thermal stress and electrical excitation to maintain the device junction temperature within a certain range



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Burn-IN Hardware

- Anything inside the “HOT BOX” must be able to withstand prolonged exposure to temperature



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Objective

- Document the *challenges* and *innovations* that led to the development of a 210°C *dynamic burn-in* solution for *high temperature* products

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The Challenges

- How do we keep the burn-in boards from failing at high temperature?
- How do we prolong the life of the oven connectors which are costly and difficult to replace?
- How do we guarantee that the oven will pass high temperature calibration?

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Materials

- ✓ Selection focused on high temperature characteristics
- Burn-In Board PCB Material used POLYIMIDE
 - ✓ $T_g > 250^{\circ}\text{C}$
- Chamber surfaces & assemblies used ALLOY STEEL
 - ✓ Max. service temperature $> 500^{\circ}\text{C}$



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Components

- ✓ Selection focused on reliable datasheet performance at high temperature
- METAL OXIDE FILM Resistors
 - ✓ High endurance and stability at temperature
 - ✓ Start to derate above 70°C

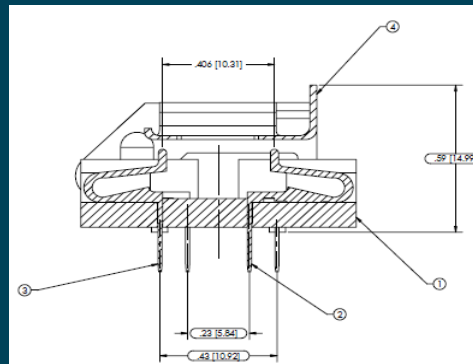
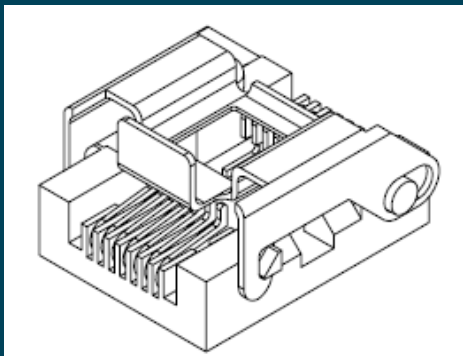


- CERAMIC RADIAL MOLDED Capacitors
 - ✓ Higher insulation resistance above 200°C

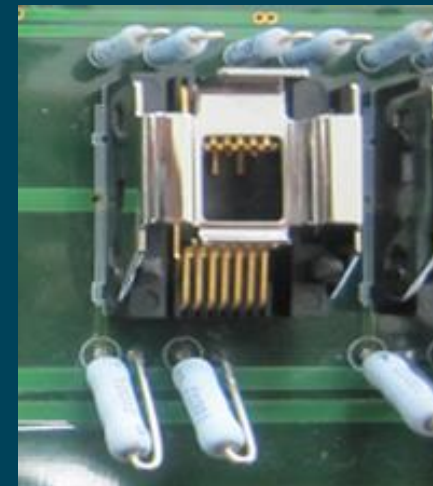
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Burn-In Socket

- Effects of prolonged thermal exposure is the primary concern
 - ✓ minimum of 2,000 hours @ 210°C



ITEM NO.	QTY.	DESCRIPTION
1	1	BODY
2	7	CONTACT (INSIDE LEG)
3	7	CONTACT (OUTSIDE LEG)
4	1	LATCH



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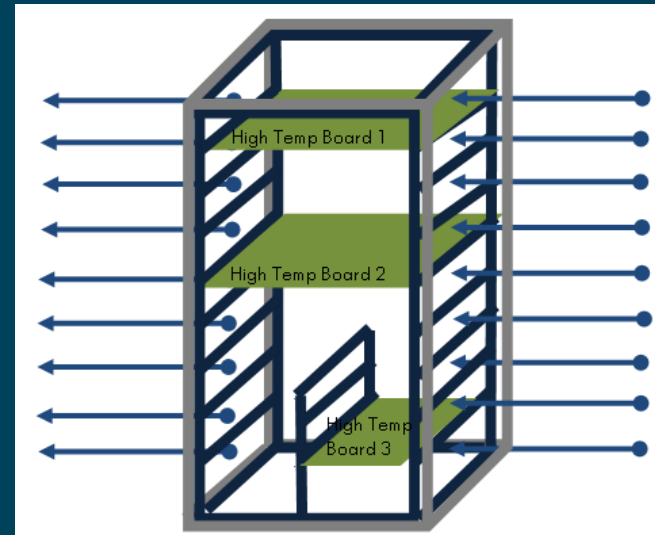
Board Rack



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Board Rack

- Tower board rack design has clearance from chamber walls
- Reduced chamber volume



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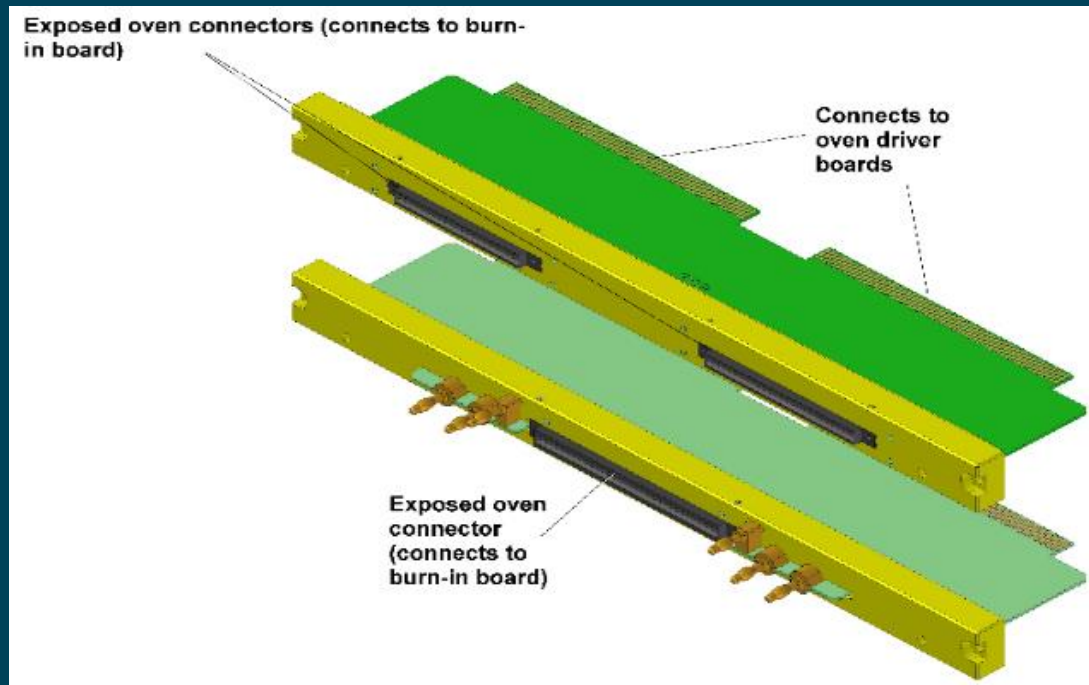
Backplane Connectors



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Backplane Connectors

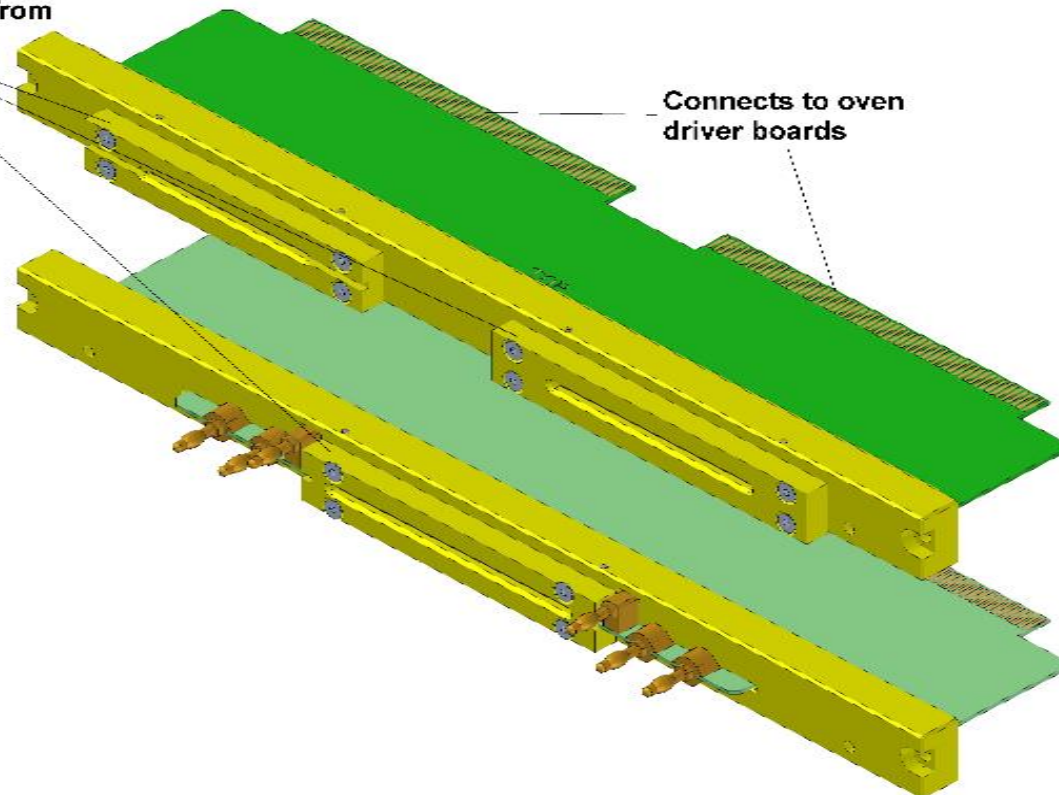
- Mechanical shielding protect oven connectors from direct heat



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Backplane Connectors

Mechanical shielding that protects oven connectors from high temperature

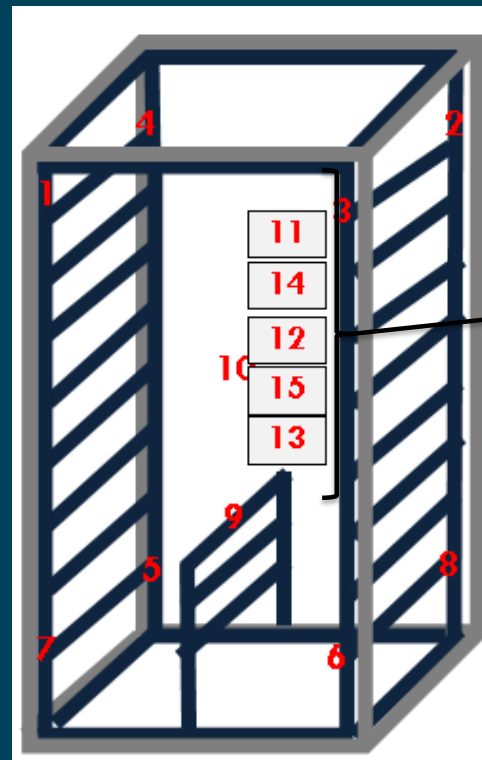


Connects to oven driver boards

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Temperature Profiling

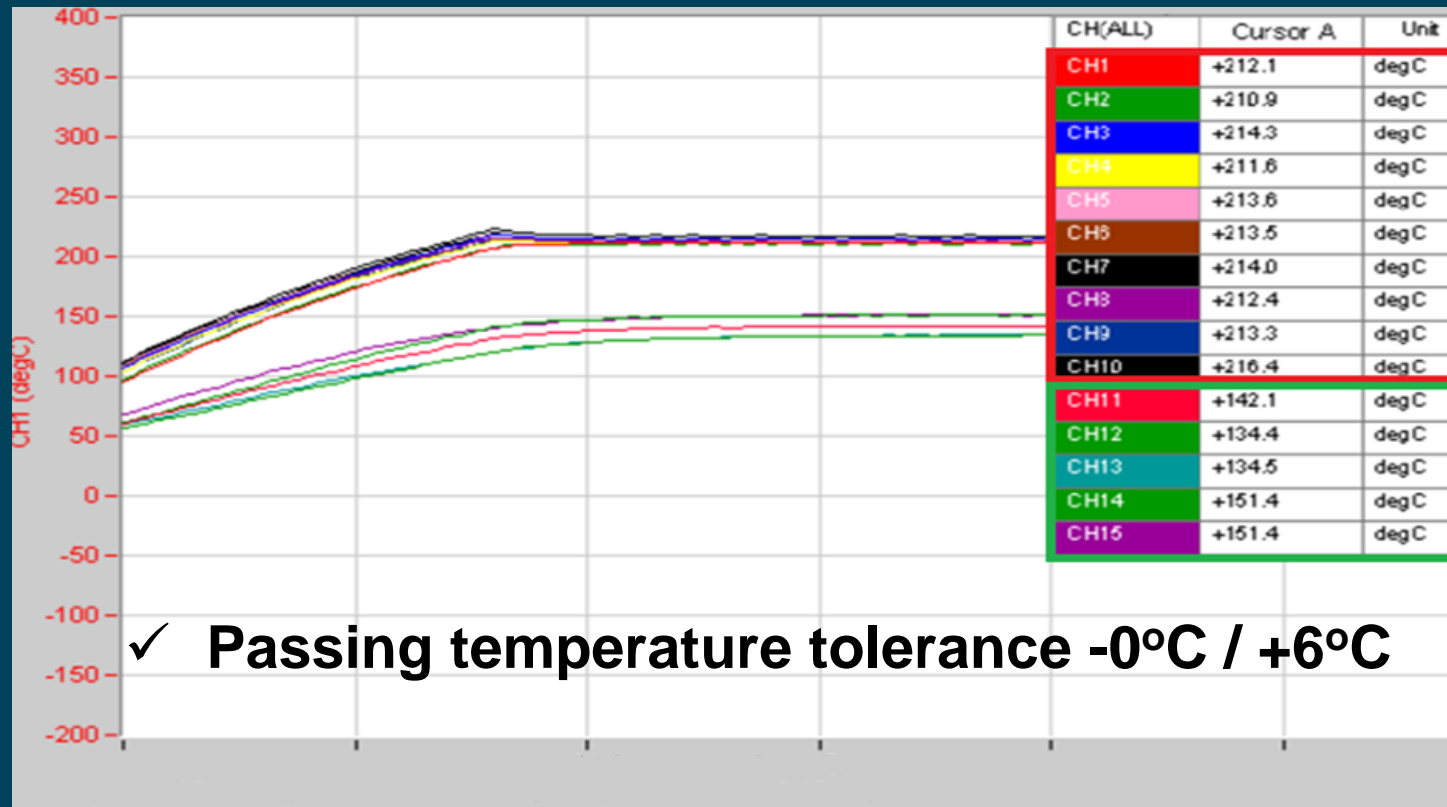
- Thermocouple location points



Thermocouples
embedded
on the connectors
(behind mechanical
shielding)

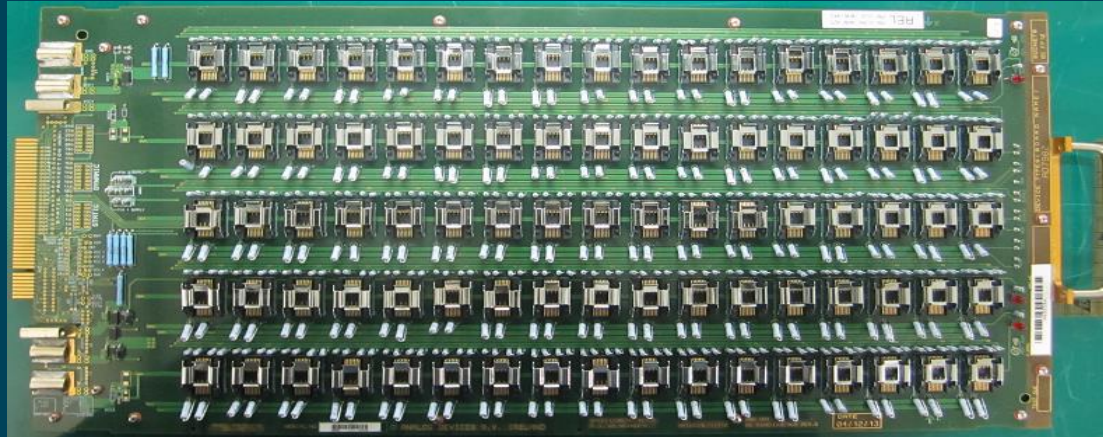
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Temperature Profiling



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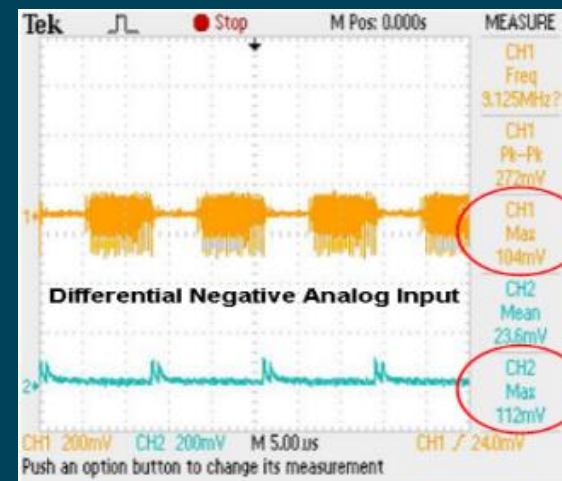
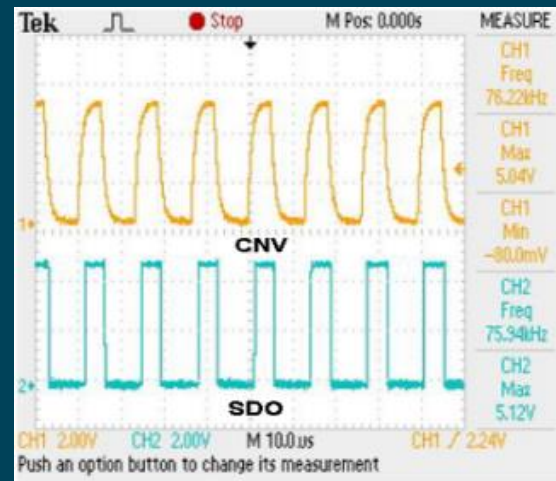
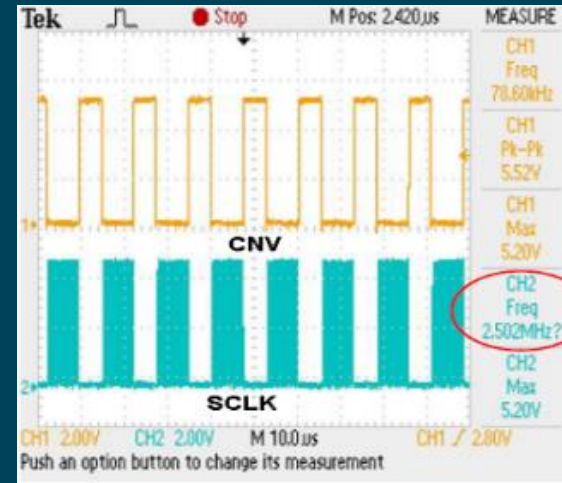
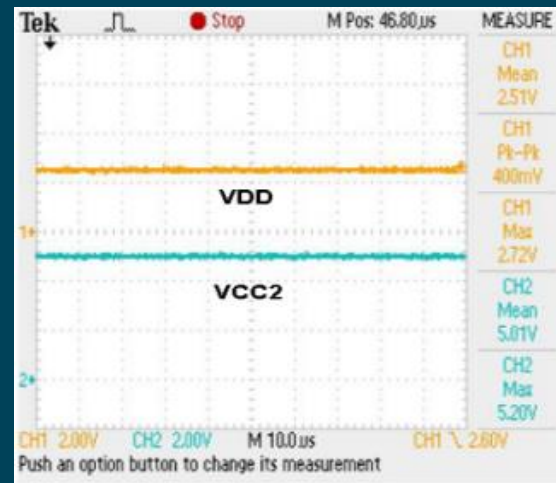
Burn-In Hardware Testing



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Electrical Excitation

- ✓ Supply Inputs
- ✓ Dynamic Stimulus
- ✓ Digital Outputs



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Qualification Checklist

- ✓ BI Boards were checked and found compliant to board build specifications
- ✓ Device excitation was checked and found compliant to bias specification
- ✓ High temperature oven was qualified; documented according to equipment template

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HT Qualification Results

- ✓ Plastic Micro Small Outline Package (MSOP) variant released to market; 2,000h HTOL @ 175°C
- Ceramic Flat Pack variant is scheduled to start HTOL @ 210°C

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Conclusion

- This burn-in system passed all equipment qualification requirements and together with customized high temperature burn-in boards can support the qualification requirements of ADI's high temperature product portfolio.



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Recommendation

- Deploy mechanical shielding solution to other EDA chambers so it would be possible to run 175°C and 210°C HTOL qualifications in parallel.

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Acknowledgements

- Manny Malaki, John Reyes and Rochyll Amarille of AD Philippines Test & Product Engineering
- Colleagues in AD WWMfg Burn-In Engineering
- Emiliano Polpetta and Enrico Melone of EDA Industries