Innovative strategies for improved test measurements using Kelvin contacts with a Flying prober

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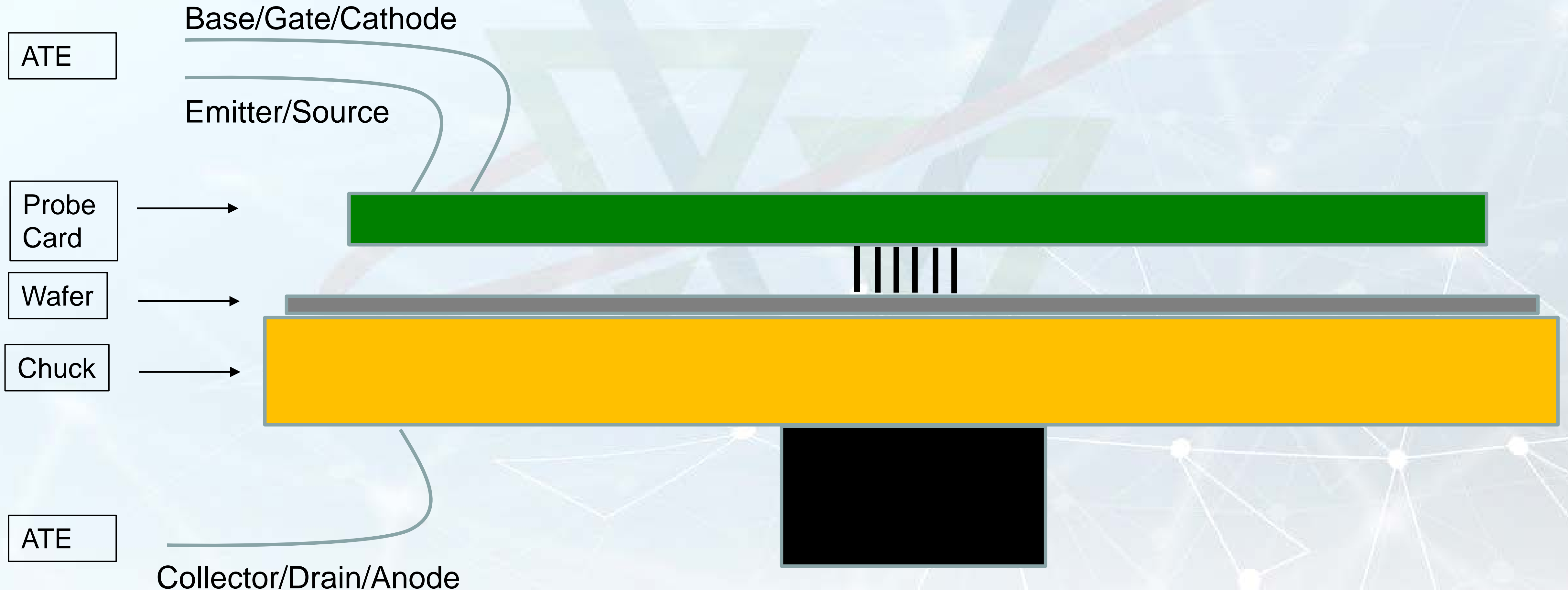
Overview

- Current probing Power Devices at wafer level Architecture
- Physical limit of probing on discrete power devices
- Tomorrow needs on discrete power device applications
- Double sided Kelvin contacts architecture
- STMicroelectronics field experience
- Summary

Current probing Power Devices at wafer level Architecture



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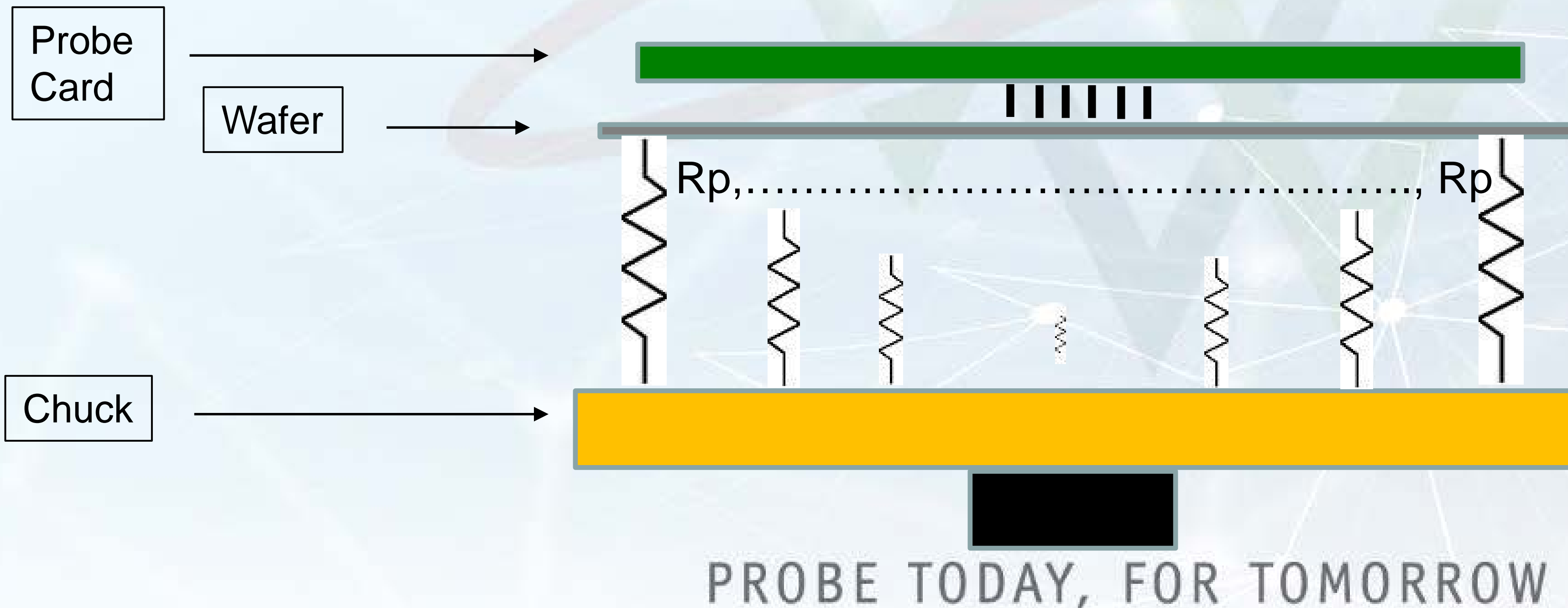
Physical limit of probing on discrete power devices

- There is NOT a uniformly distributed parasitic resistance between the wafer backside and the chuck top
- Parasitic resistance affects the conduction measurement on Power discrete devices (Diode, MOSFET, IGBT)



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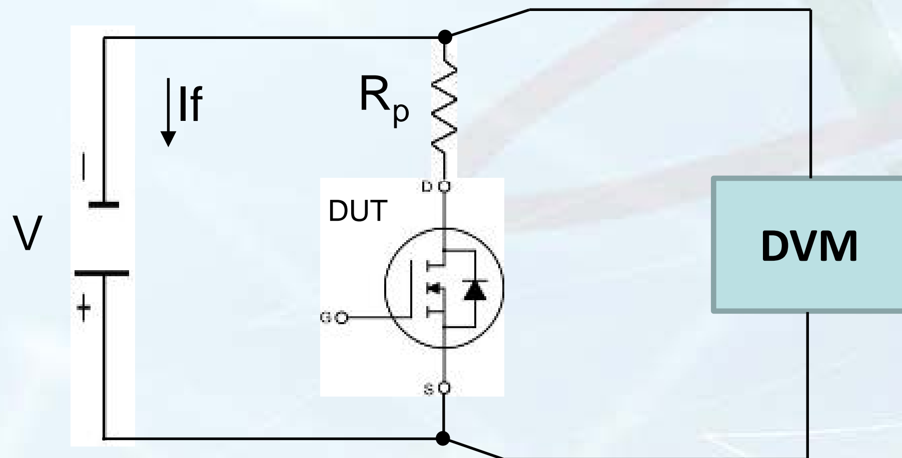
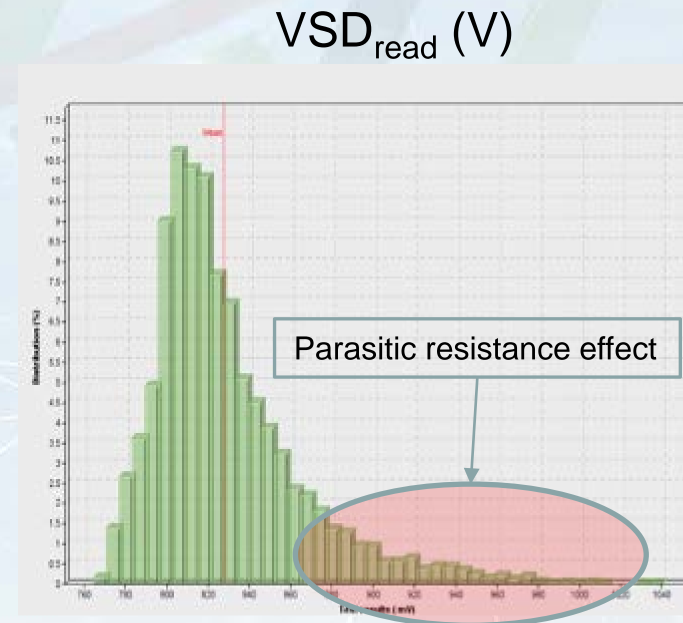
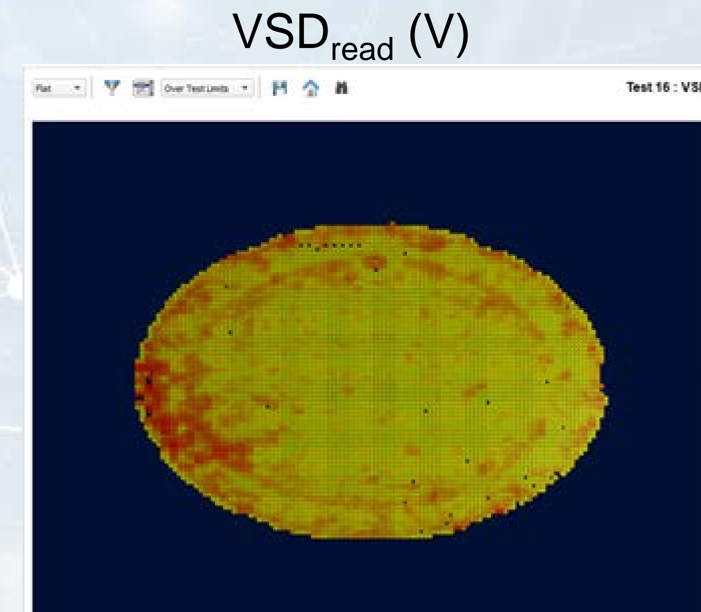
Physical limit of probing on discrete power devices

- **Effects on electrical measurement readings of a not-uniform parasitic resistance among all the wafer backside on conduction tests (i.e.: VSD)**







R_p = Parasitic resistance

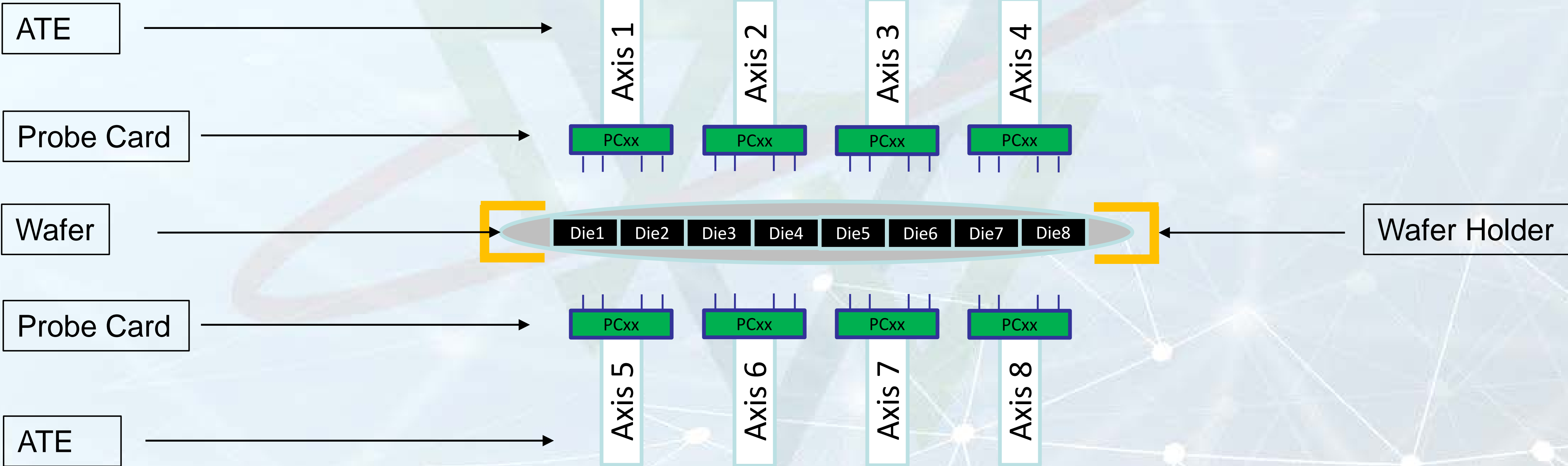
$VSD_{read} = VSD_{real} + (R_p * If)$

Tomorrow needs on discrete power device applications

- **Bare die for hybrid module is the today and tomorrow business for**
  - Industrial application
  - Automotive application
  - Vehicle electrification

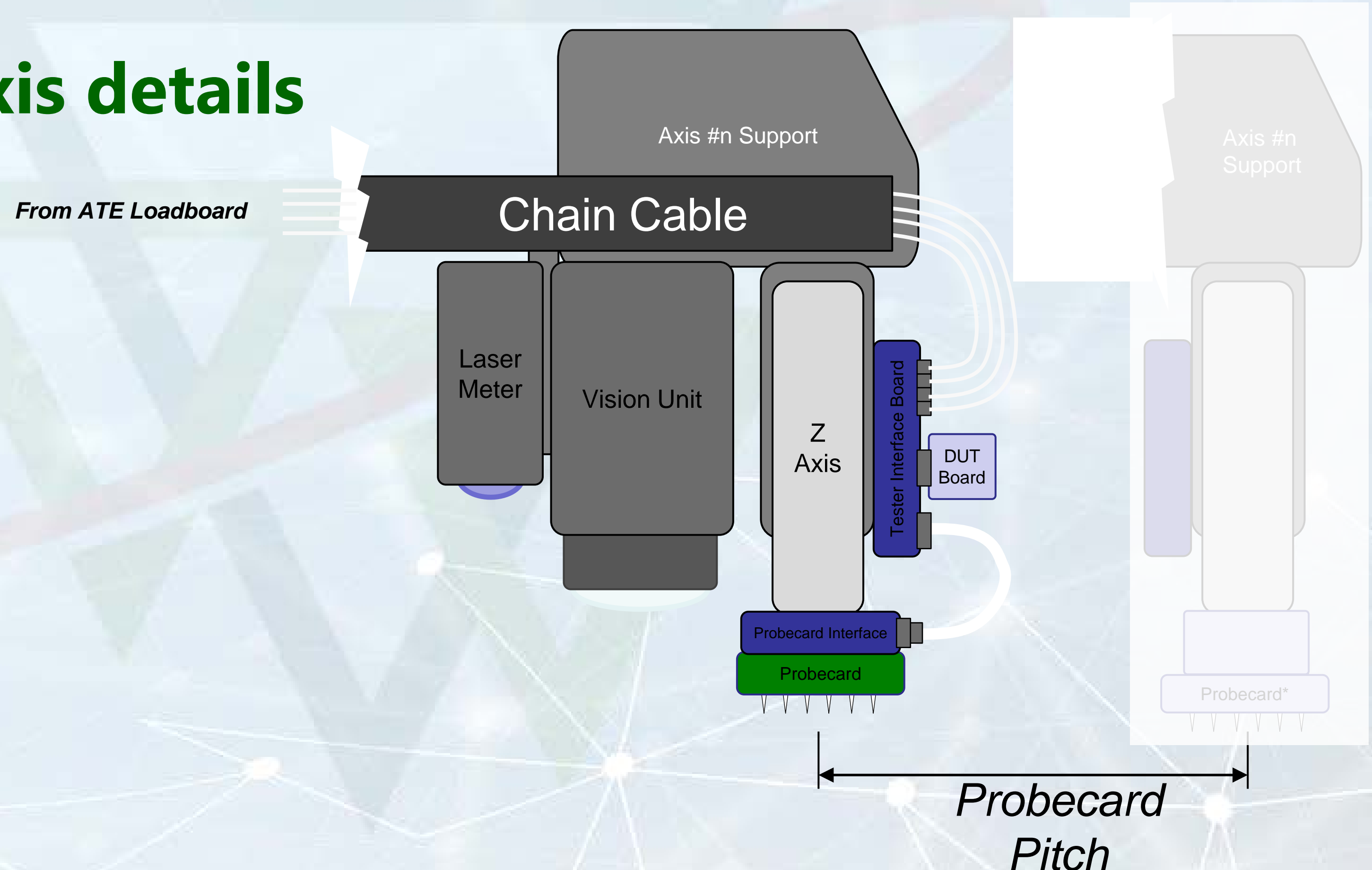
- **To guarantee as much as possible the real electrical measurements in conduction (high current) it is essential to eliminate the parasitic resistance of the conventional probing solutions**

Double sided Kelvin contacts architecture



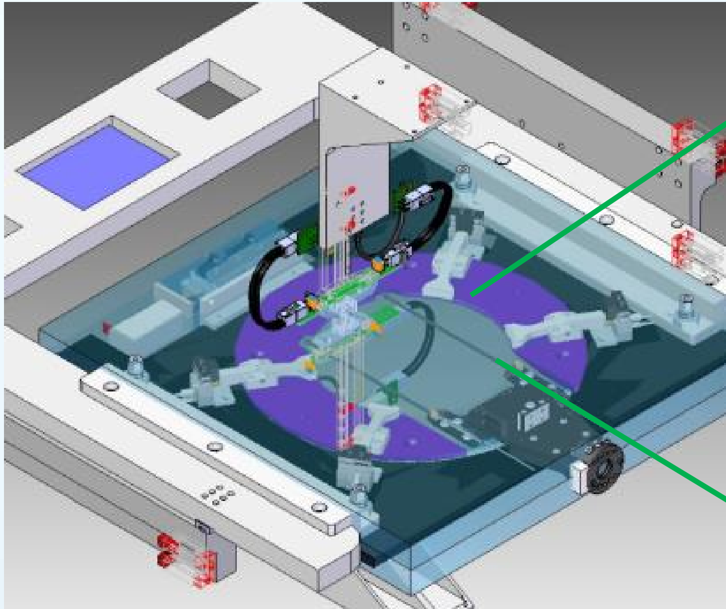
Double sided Kelvin contacts architecture

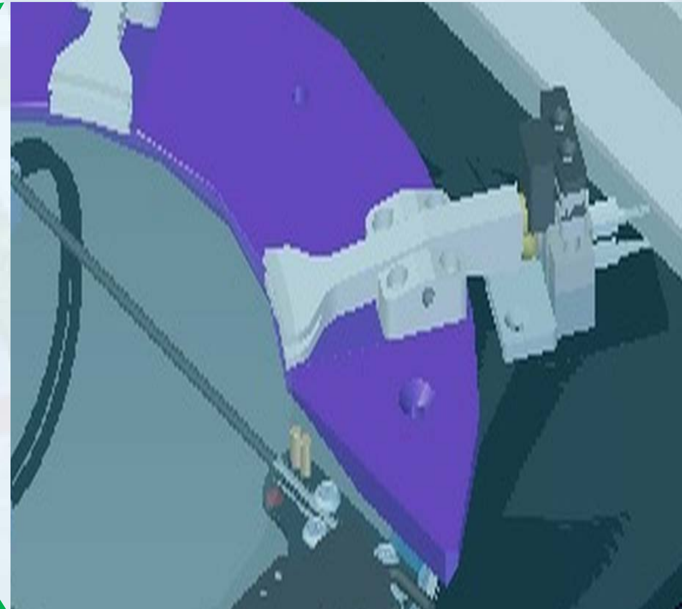
- **Spea Flying prober Axis details**
  - Full motion X,Y,Z
  - LASER autofocus
  - Vision unit
    - Pattern recognition
    - Wafer alignment
    - Probe card alignment
  - DUT board
  - Probe card holder

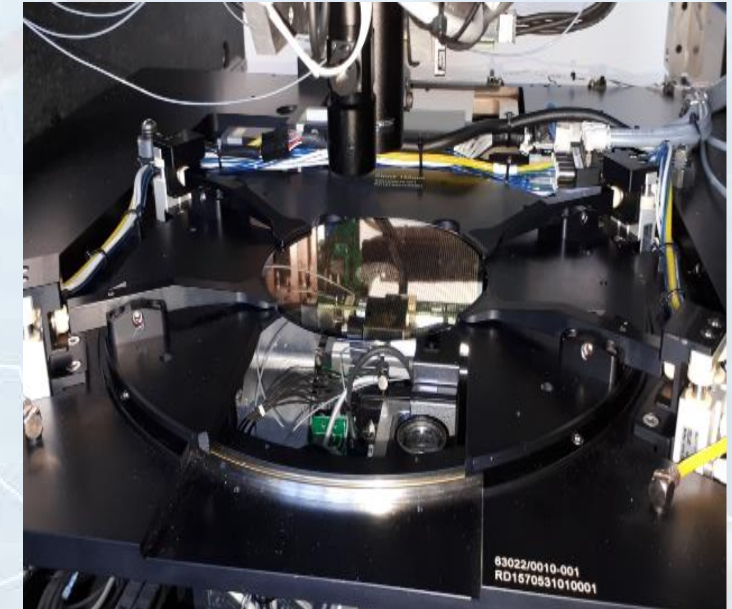


Double sided Kelvin contacts architecture

- **Mechatronic wafer handling/Chuck holder for 6”/ 8” wafer**



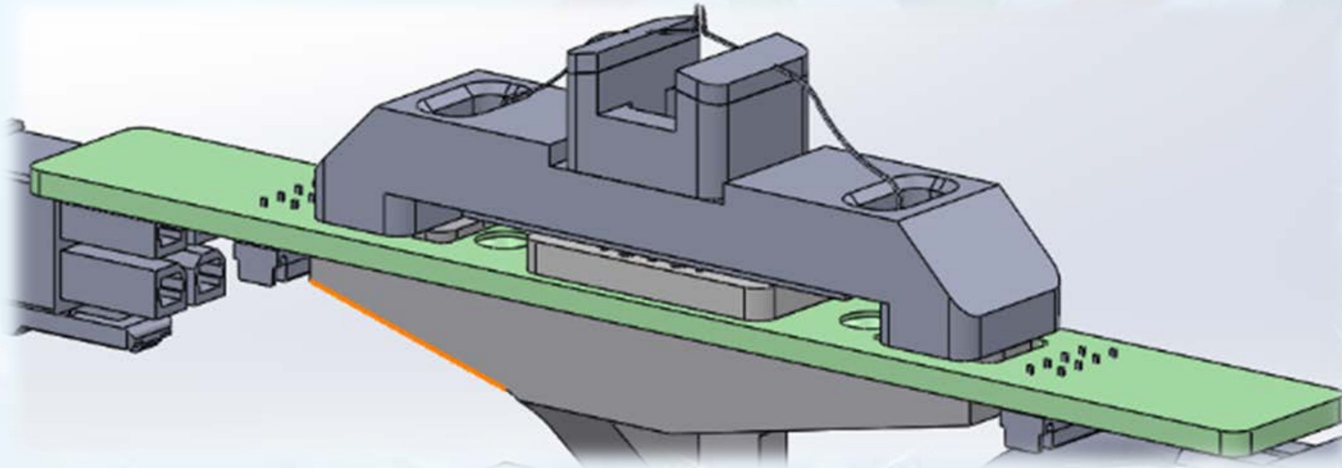




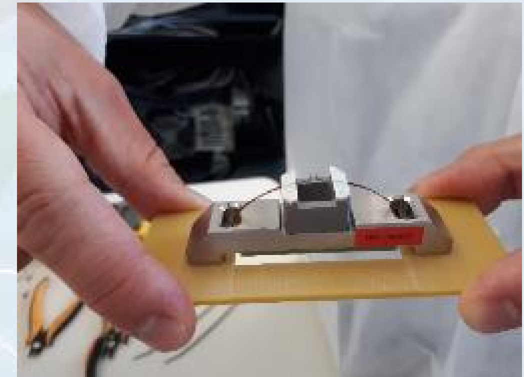
  - Chuck holder based on clamp over exclusion edge area of the wafer

Double sided Kelvin contacts architecture

- **Technoprobe probe card**
  - New electro mechanical interface has been designed to support Top and Bottom coupled probe heads



Probe card architecture



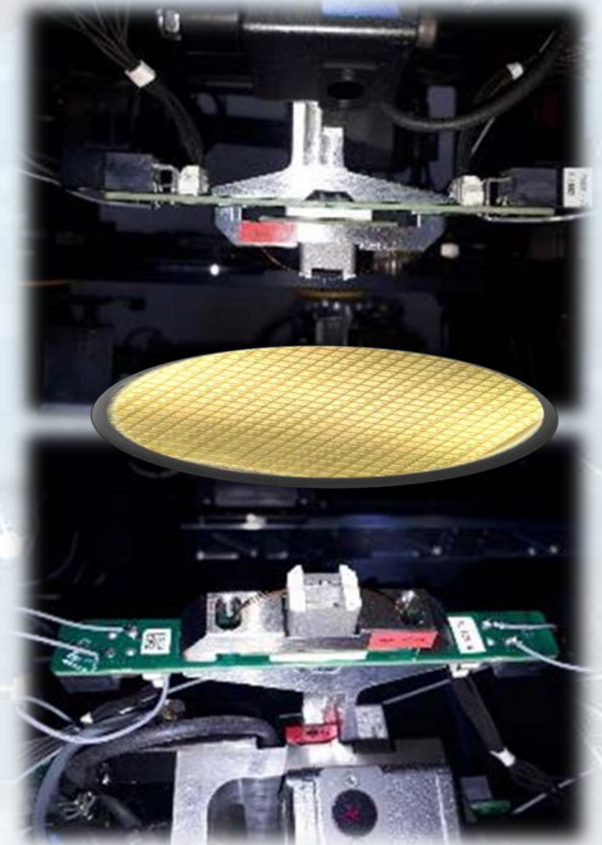
Probe Card with cantilever tips

Probe card electrical/mechanical interface

Double sided Kelvin contacts architecture

- **Custom mechanical and electrical connection the probe cards**
  - Top and bottom probe cards are coupled on same axis to contact devices from top and bottom of the wafer

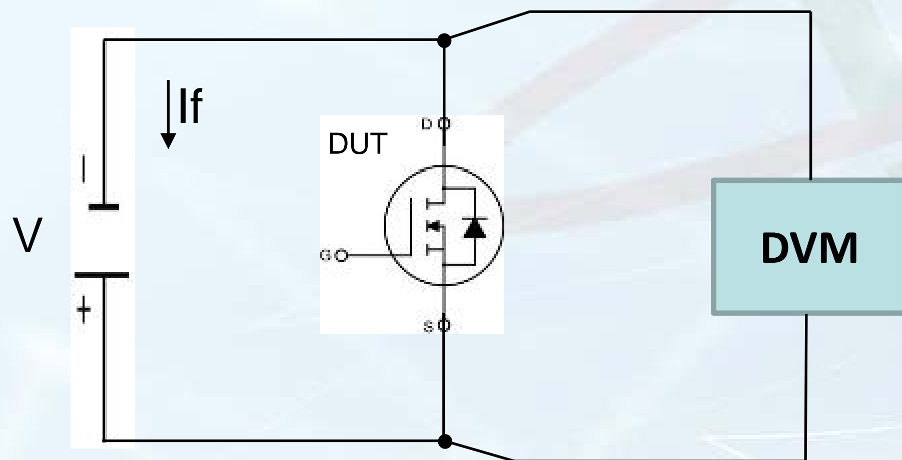
Axis electrical/mechanical coupling



Top-Bottom Probe Cards coupled on axis

STMicroelectronics field experience

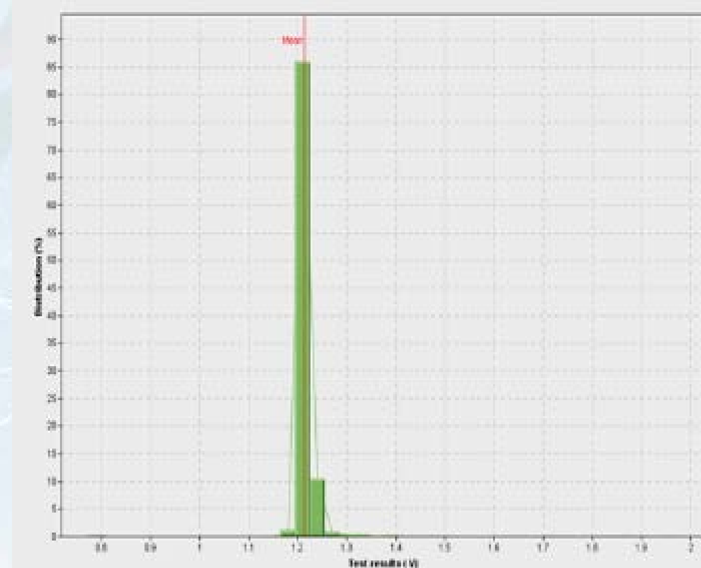
- **Parasitic resistance throughout all surface of the wafer backside is dramatically minimized thanks to the double sided Kelvin contact probing resulting in very narrow VSD_{read} distribution**



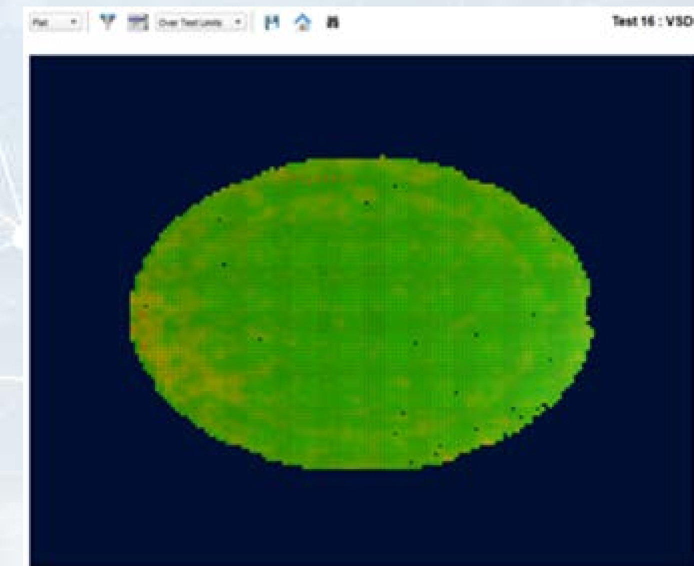
$VSD_{read} = VSD_{real} + (R_p * If)$

- Note: Rp ~ 0Ω

VSD_{read} (V)



VSD_{read} (V)



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STMicroelectronics field experience

The test cell development has been achieved in collaboration **STMicroelectronics**, **SPEA**, **Mechatronic** and **Technoprobe**
This specific application has been released to production in order to increase Test capacity for Automotive Power Discrete products
in STMicroelectronics EWS (Tours, France site)

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Project Team Members

STMicroelectronics

Name	Role
David BOUSSIRON	FMT - EWS Tours Director
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Antonin GALLINETTI	FMT - EWS Tours ProbCard Leader
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Joël BIGRE	FMT - EWS Tours Eng Industrial
Yohann FERRAND	FMT - EWS Tours Maintenance Leader
Cyril SAULE	FMT - DIT Tours
Marie-Noëlle BODIN	FMT - EWS Tours ProbCard
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SPEA

Name	Role
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Diego BOERO	Product Manager BU ETP - Wafer Prober & Functional Tester

Mechatronic

Name	Role
Alexander Oremus	CTO
Hermann HIDEN	Technical Account Manager

Technoprobe

Name	Role
Alessandro ANTONIOLI	Senior Director Business Development and Marketing
Tommaso MASI	Technical Sales Manager

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Project Team Members

Thanks to all the team members for the outstanding project success !

Brainstorming session with all the different organizations

Tours team in front of the tool

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Summary/Conclusion

- **The innovative strategies implemented in this very first equipment prototype, double sided Flying Prober, gives the opportunity to perform a very accurate electrical conduction measurement**
- **This architecture opens new opportunities in the domain of Bare Die and KGD business**
- **Here a 20” video showing the implemented double side Kelvin contacts probing performance**

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