CRES Control Using CDA as a Shielding Gas

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Outline

- Background – the journey
- Problem Statement
- Measurement/Methodology
- Key Findings
- Solution's
- Acknowledgments

Background

- Factory Expansion Phase 4 – just completed
- Phase 4 automotive factory was experiencing significant CRes yield loss issues between testers and devices
- Phase 5 to ramping ~ 150 systems migrating to automotive 3 insertion test methodology

Problem Statement

- Factory was experiencing significant CRes yield loss issues between testers and devices during 3 insertion probing sequence at different temps
- CRes fails were causing significant yield loss and requiring significant reprobe time losses
- Traditional CRes solutions were reaching the limits of effectiveness

Objective

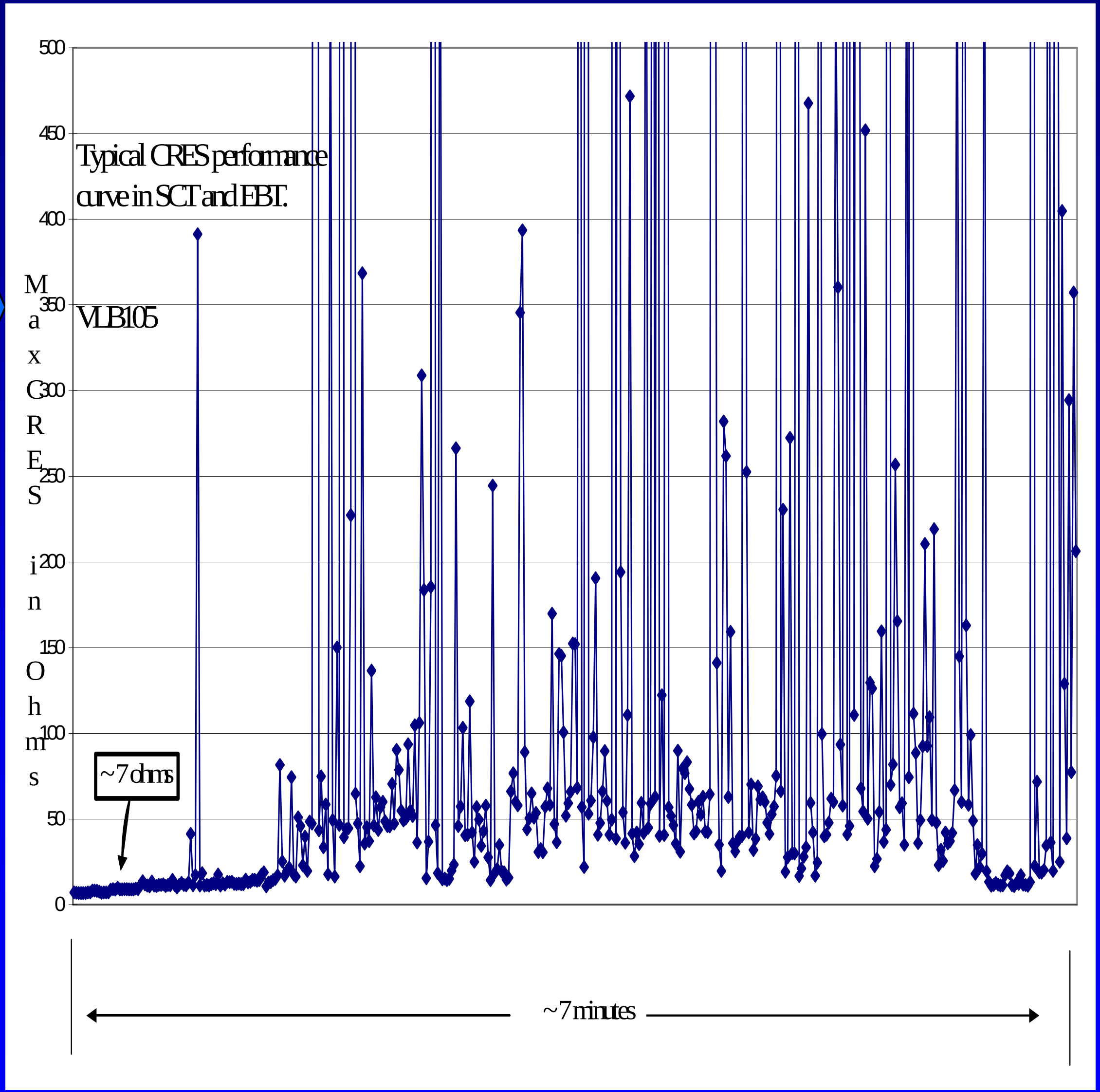
- Show the effects of CDA on CRes
- Review the potential impact of CDA that effect die temperature
- Review design/hardware procedures needed to manage CDA
- Share key learning's – the journey

CRes Sources

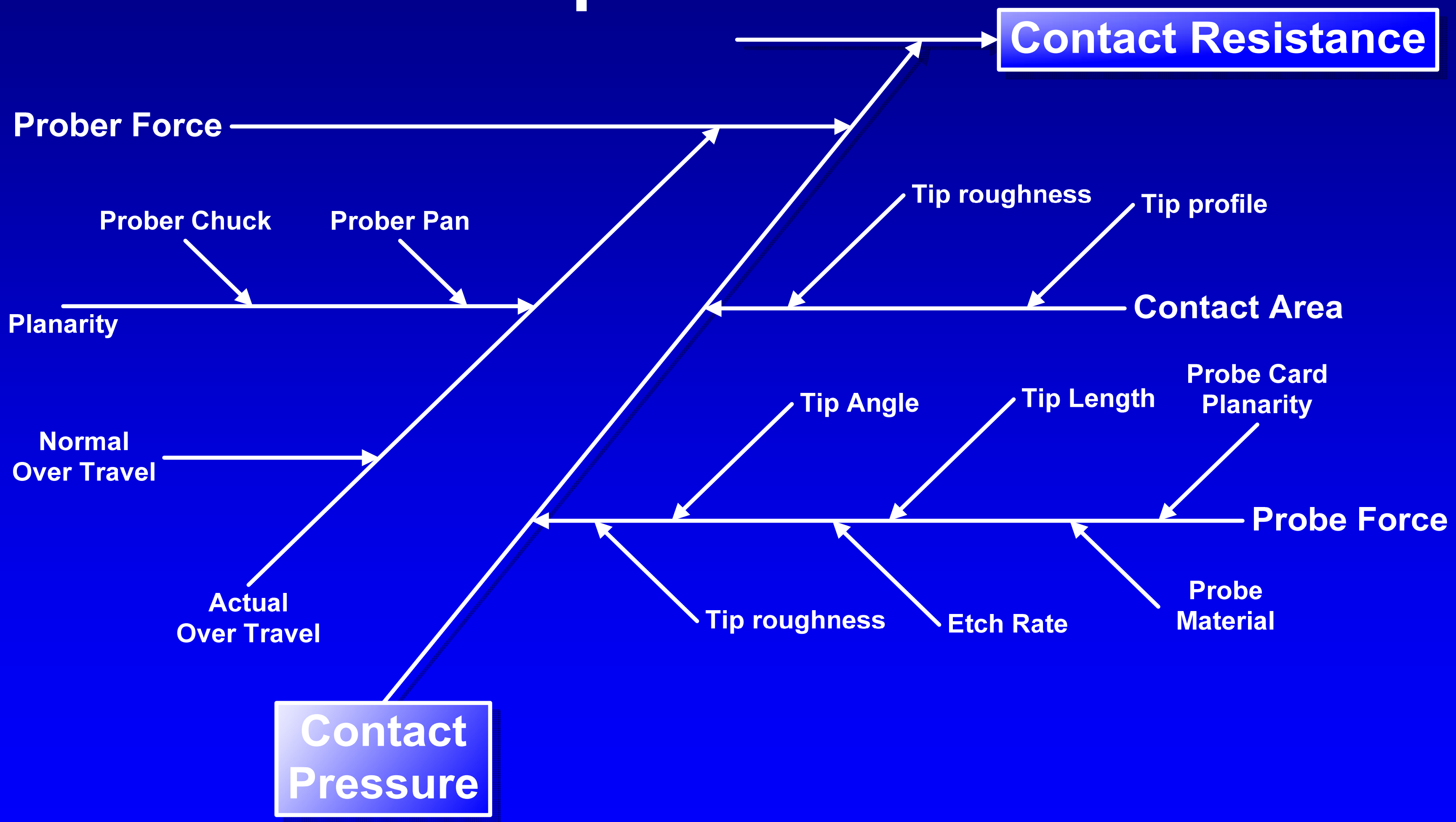
Probe

- Bond Pad Surface
- Test Program
- Diode Structure
- PC Planarity
- Cleaning Frequency
- Debris Field
- Test Head Level
- Z-Axis Travel
- Chuck Speed
- Muffin Fans
- Air Handlers
- Raised Floor
- Equipment Density
- H_20 ?

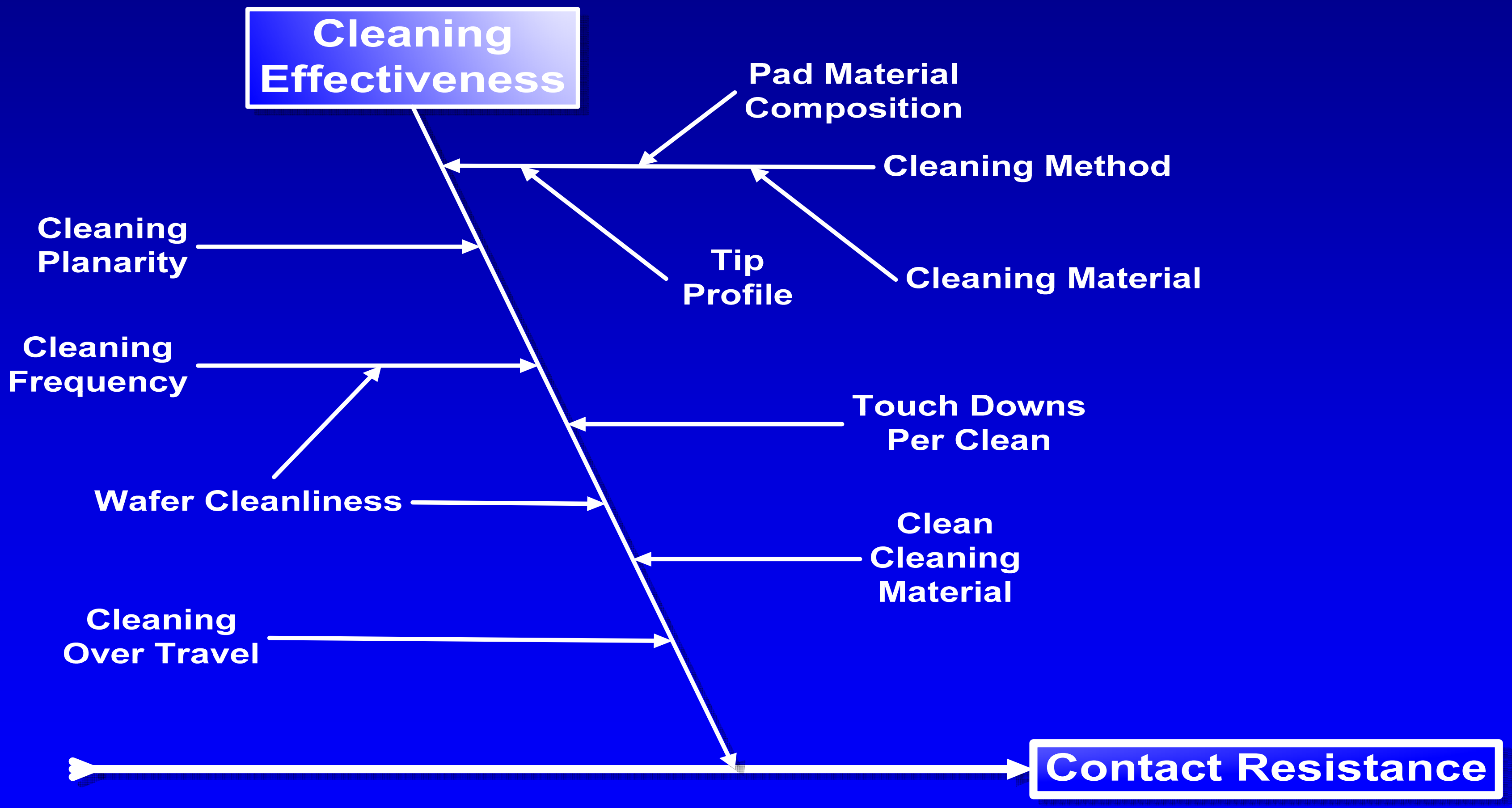
Conditions that effect CRes



Cres Causes by Category
Nearly all are out of the control of operations



Cleaning Frequency change most common approach to control CRES at probe.



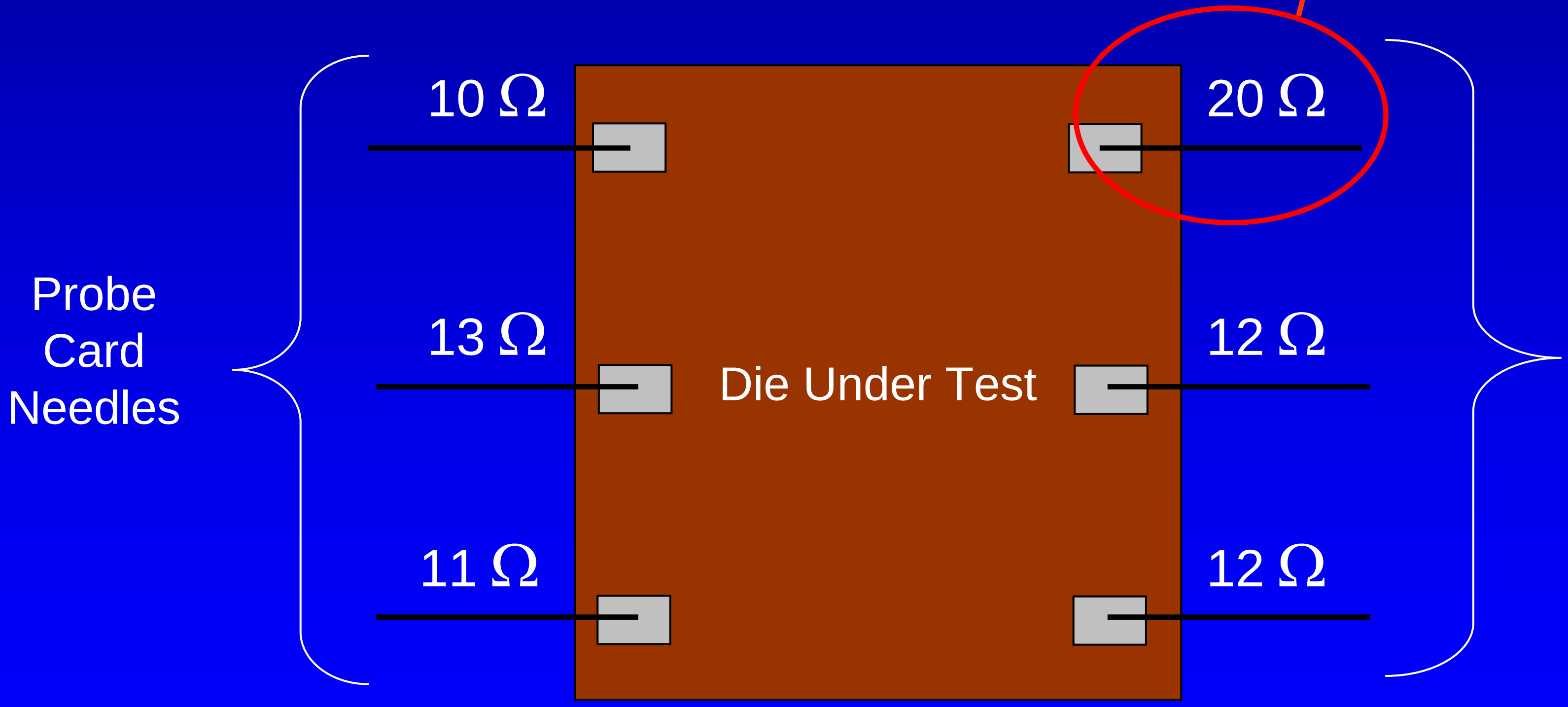
Cleaning Effectiveness

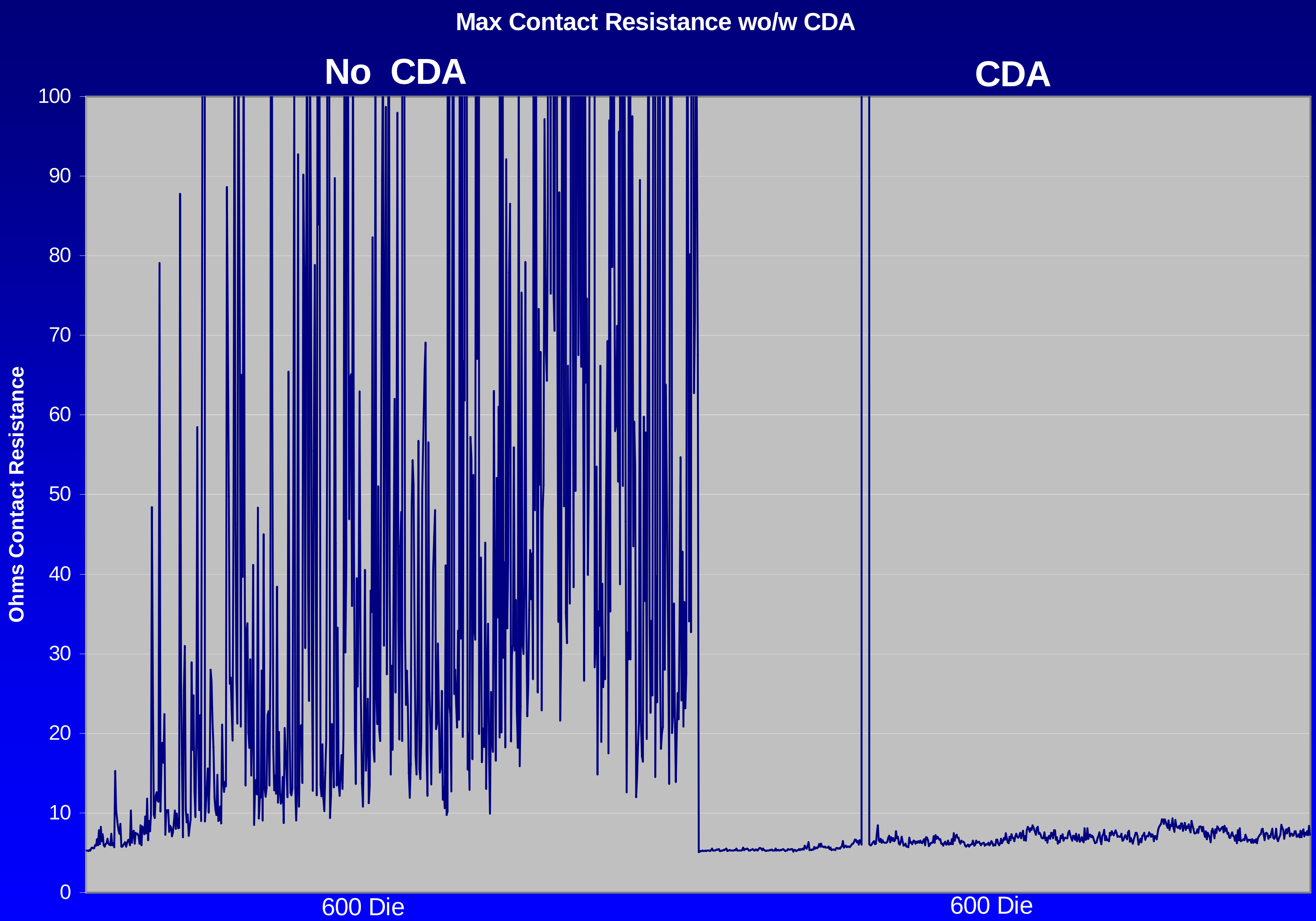
- A Paradigm Shift
  - Improving Contact Resistance without Increasing on-line Cleaning?
    - Injecting Compressed Dry Air (CDA) on the Die Under Test has improved the stability of CRES and reduces the need for additional on-line cleaning

Discovery Experiments

- Blanket Aluminum Wafer
- Cantilever Dual-Site Probe Card
- VLCLT Tester
- CDA
- Nitrogen
- Maximum Contact Resistance (MAXCRES) used to plot effects

Single Power Pin Maximum Contact Resistance (MAXCRES)





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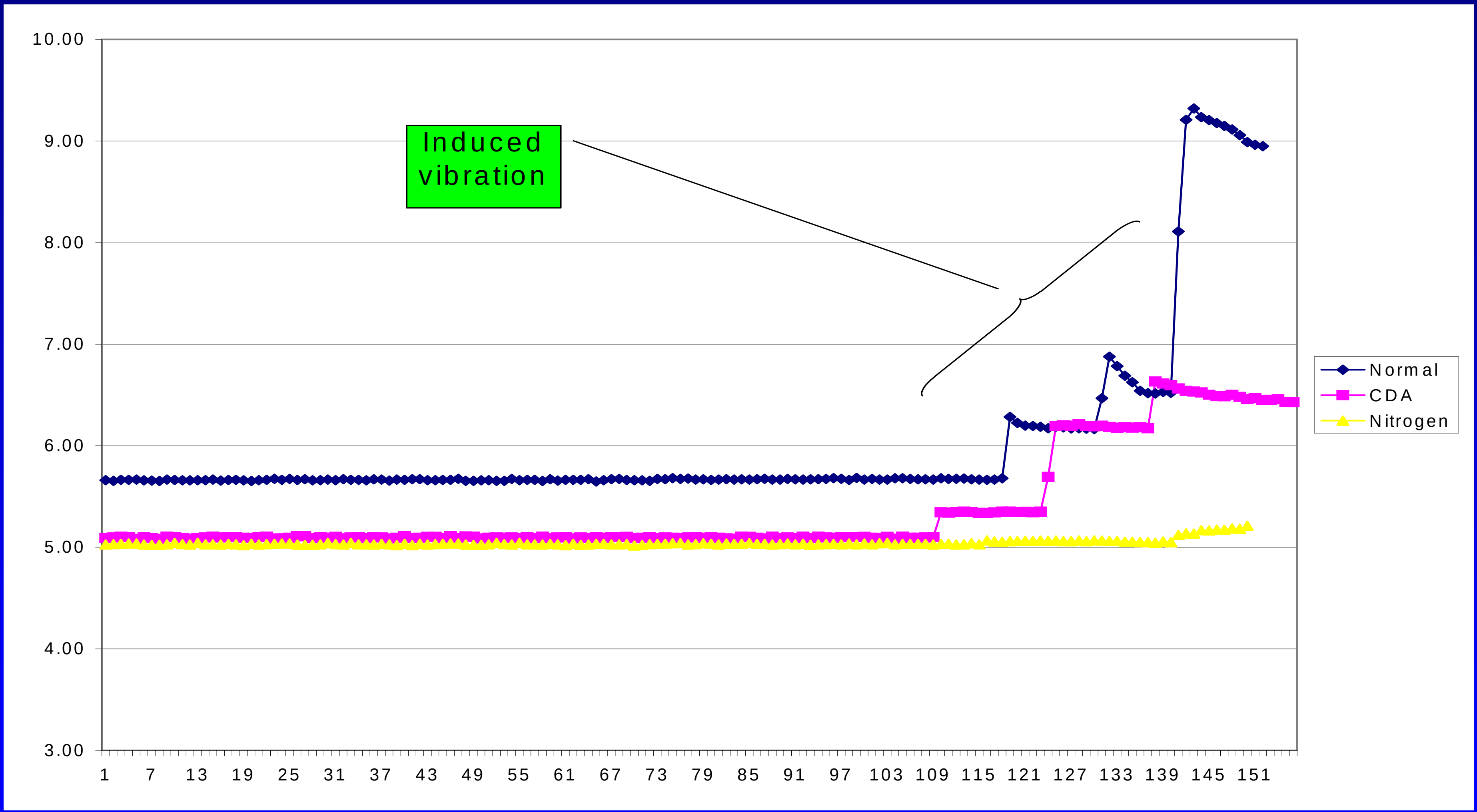
Effectiveness of CDA vs. Nitrogen Purge



Oxidation Theory

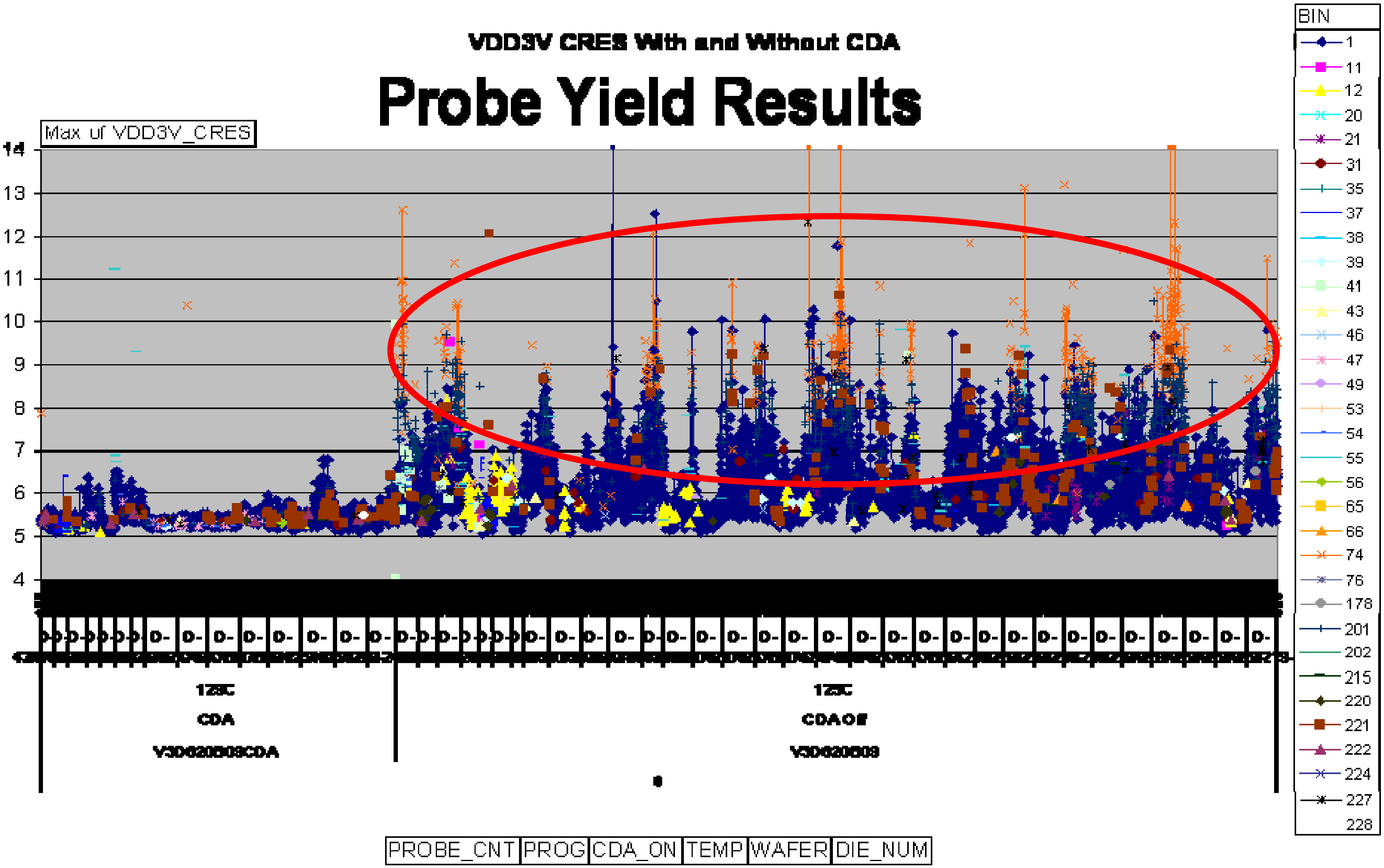
- Consider the Mechanical Contact to Al Pads
  - A native oxide layer of Al2O3 exists on the Al pads to be tested at probe
  - Some of this native oxide is removed by the mechanical probing & good contact is made by mechanical abrasion
  - However, once micro-contacts are made, local heating can lead to oxide growth in the presence of air, leading to the formation of Al2O3 (GT° ~ -400kcal, therefore spontaneous)
  - In the presence of moisture, hydrated aluminum oxides (Al2O3+H2O) are formed which can be thicker & more porous than the native Al2O3
  - The hydrated oxides are colorless to white and can lead to resistive or semiconducting contacts[1]
- CDA Purge Effects on Contact Process
  - Elimination of moisture and therefore, hydration of the oxide

[1]Broz & Rincon, "Probe Contact Resistance During Elevated Temperature Wafer Test," ITC Proceedings, p. 396, 1999.

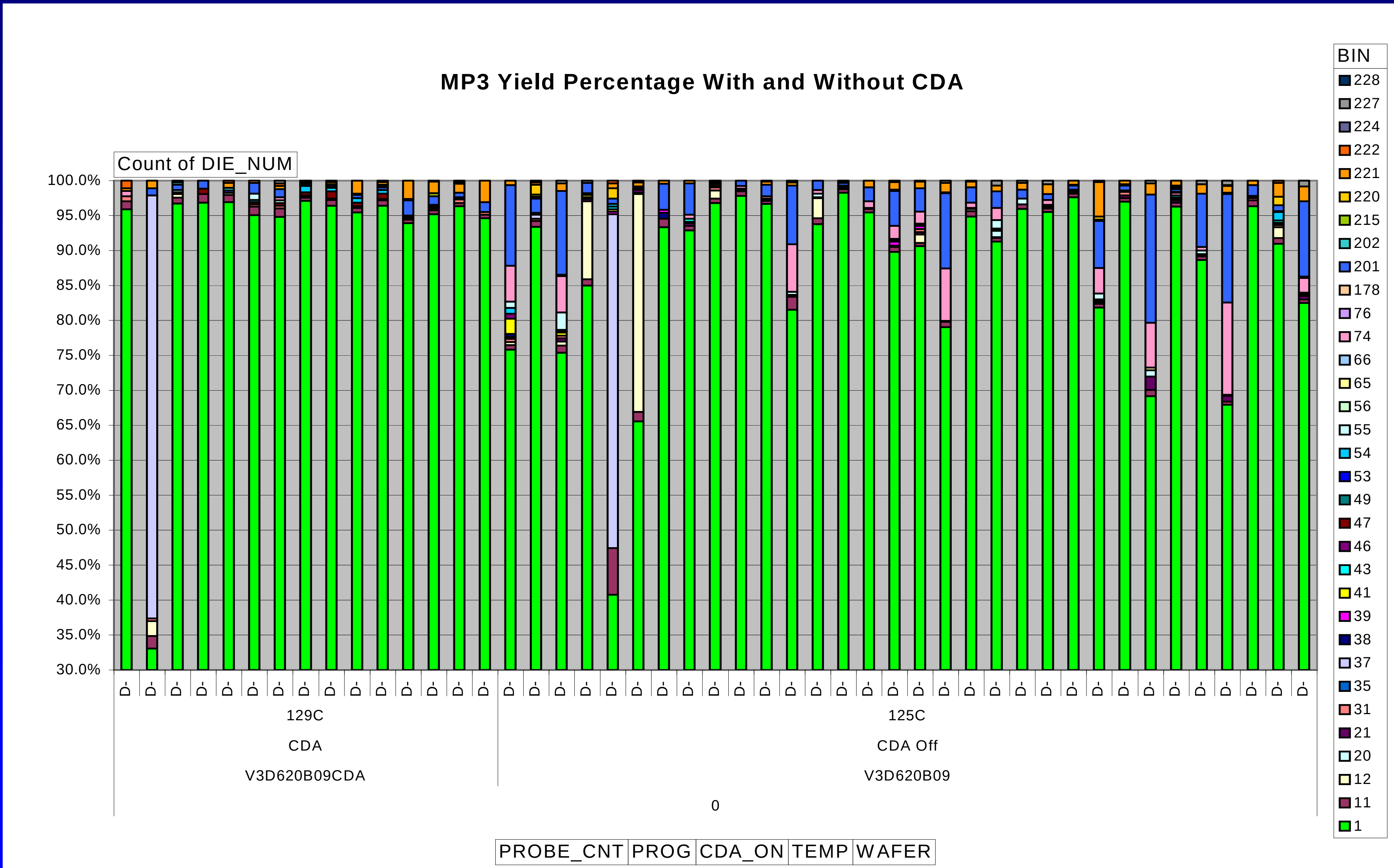
CDA Contamination Within Factory Specs.

- Moisture readings pre and post filter (Spec ~ 100 ppm)
  - Pre filter was at 9.02 ppm after 14 hours of analysis
  - Post filter was at 10.8 ppm and dropping after only 2 hours of analysis
- Hydrocarbon (THC) readings from pre and post filter (Spec ~ 5 ppm)
  - Both Samples were analyzed using a GC/FID for total hydrocarbons (THC) as CH_4 per the site specification for CDA
  - The pre filter sample averaged 3.26 ppm THC as CH_4
  - The post filter sample averaged 3.46 ppm THC as CH_4

Probe Yield Results



CDA vs. Non - CDA Results



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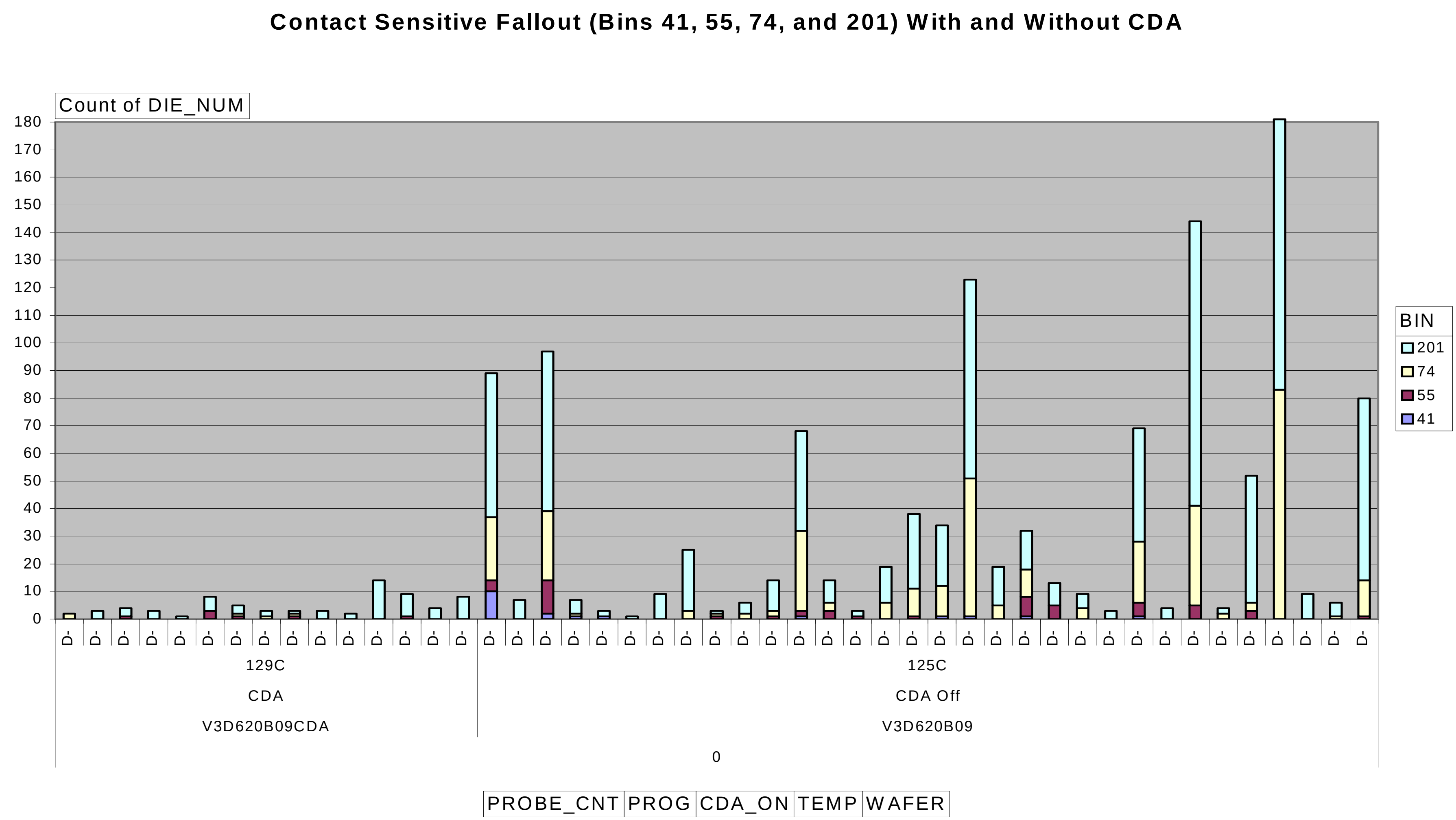
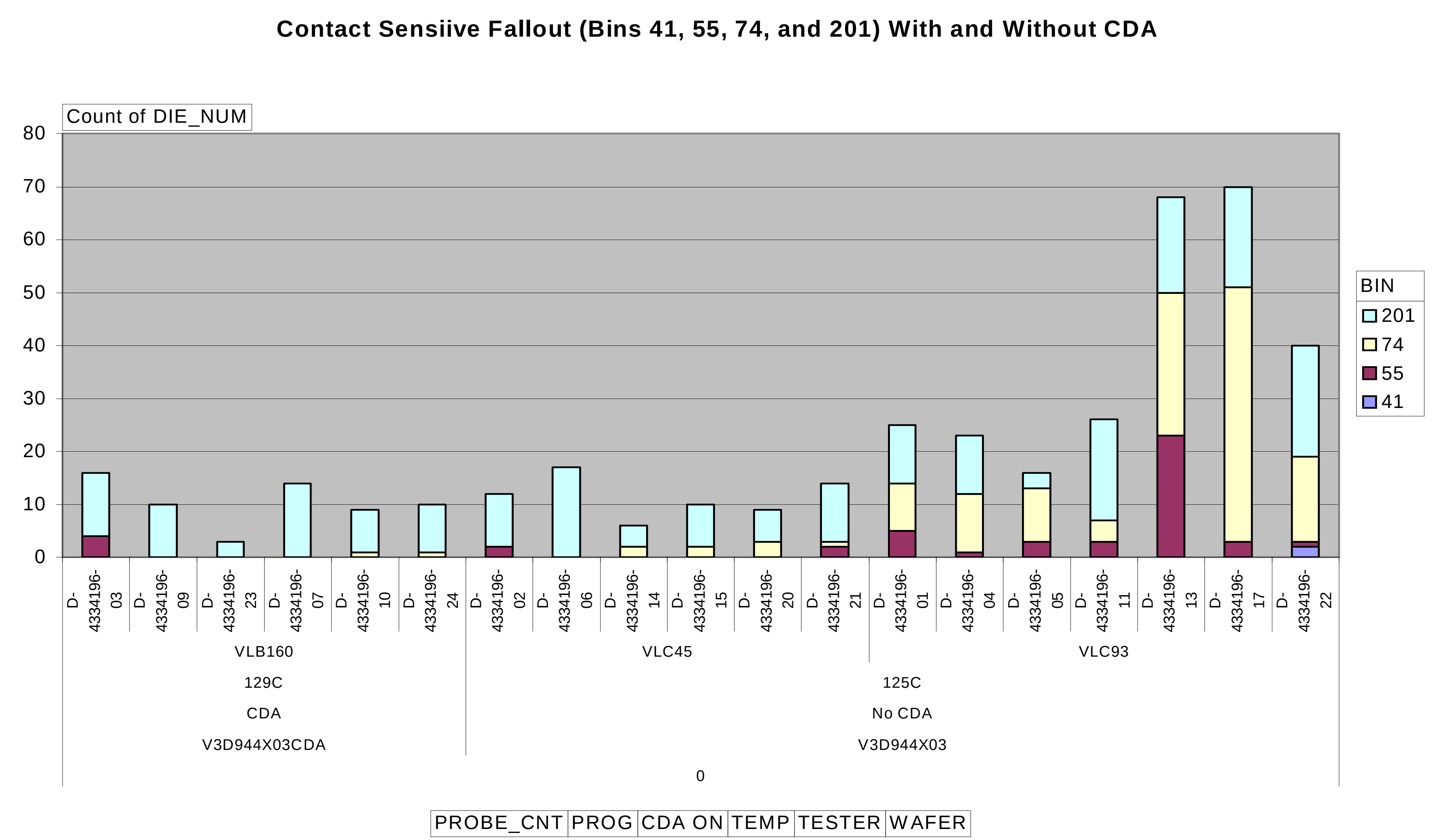


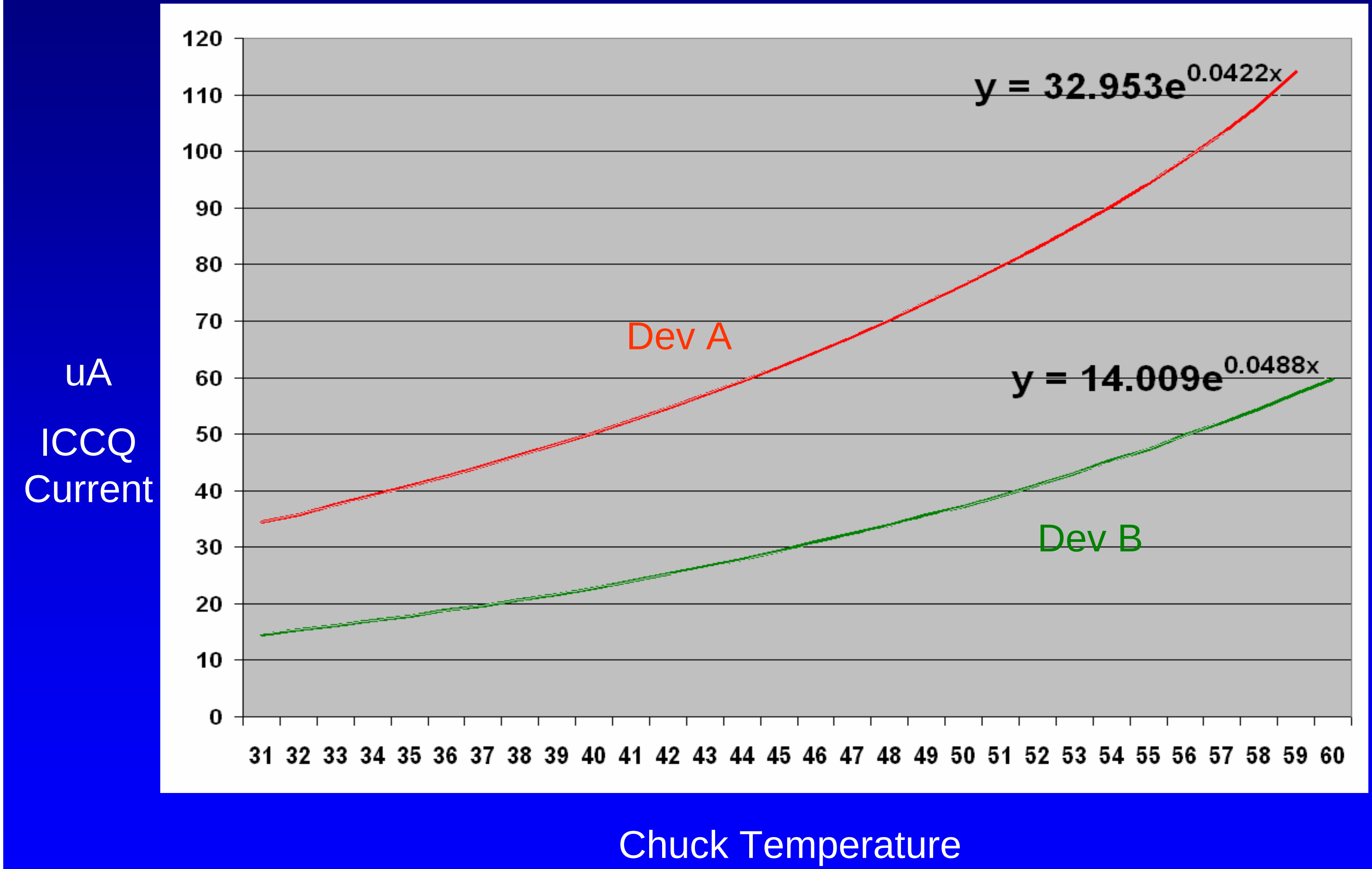
CDA vs. Non - CDA Results



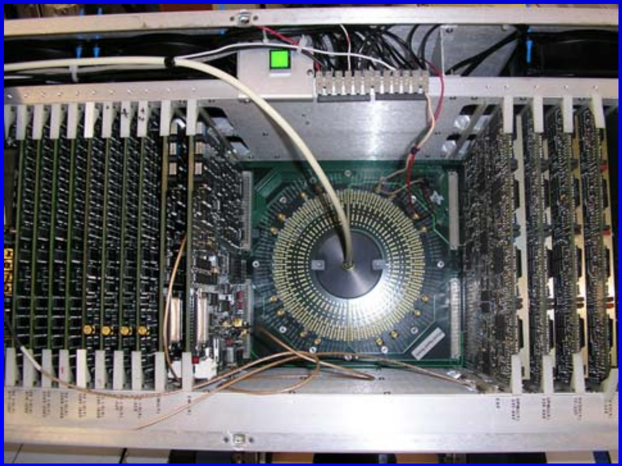
CDA influence on die temperature

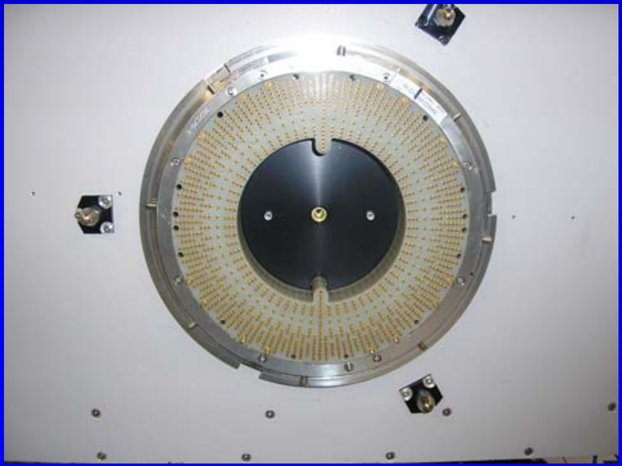
- Response of ICCQ to chuck temperature was characterized with no CDA.
- CDA was injected at room temp (30°C) and hot chuck(125°C). Changes in ICCQ were recorded
- The equation (CDA Temp – Chuck Temp) / 45°C closely defines the effect of CDA on die temperature.
  - CDA temperature is 20°C typical
  - Die temp is effected by <1°C at 30°C chuck temperature
  - Die temp is effected by 2-4°C at 125°C chuck temperature

Effect of chuck temperature on ICCQ current



CDA Hardware Example

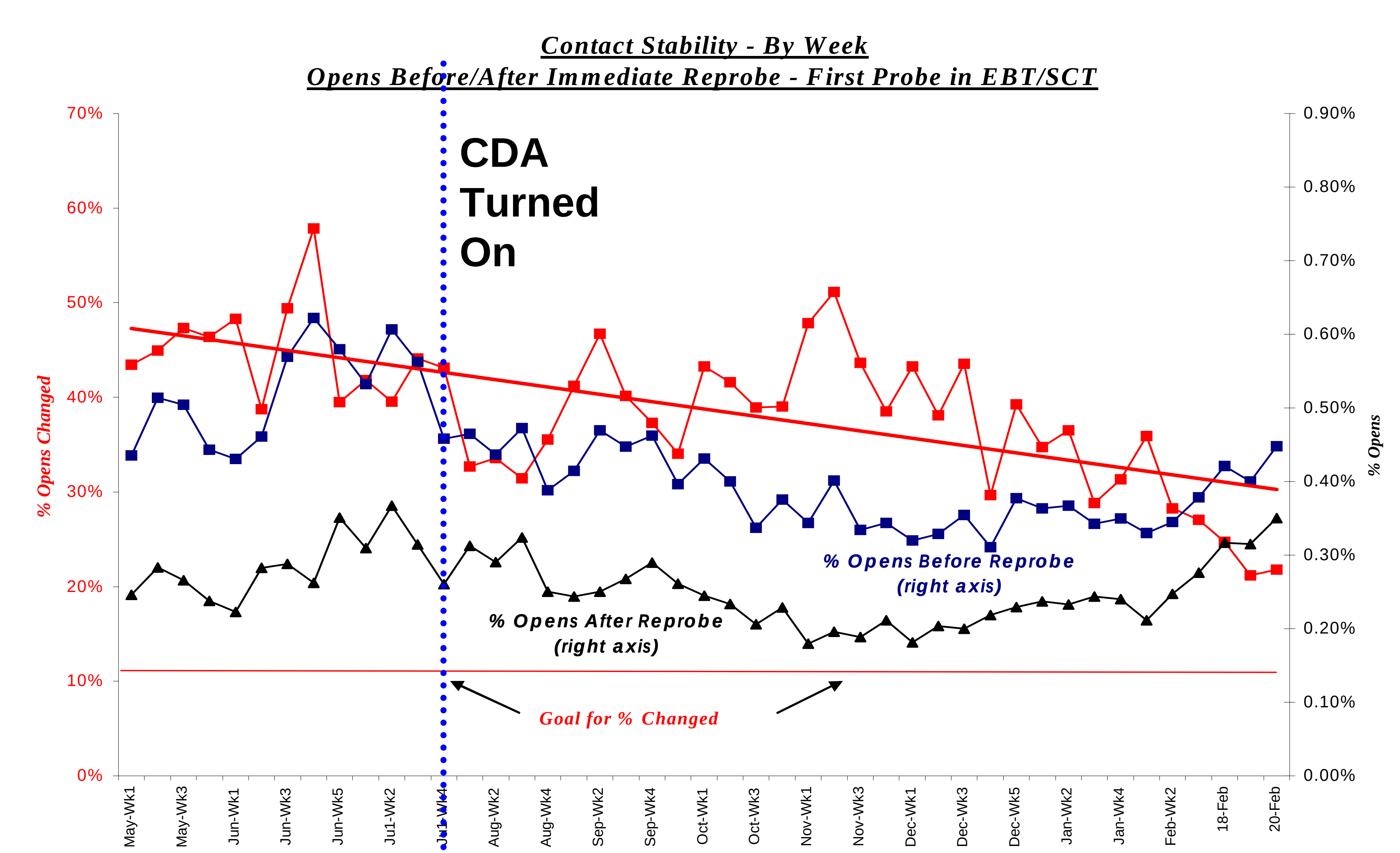




No Measurable ESD Buildup

- Measured ESD on probe needles
  - ACL Model 300B Electrostatic Locator
    - Two testers
    - CDA on needles
    - Measure every 15 minutes
  - No Measurable static build up <1v

Impact on First Pass Opens



Conclusion

- An in-situ method of stabilizing contact resistance using CDA (compressed dry air)
- Reducing oxidation and contaminate build up
- Maximizing yield and reducing reprobe on contact sensitive BINs
- Reduces the need to increase cleaning intervals. This results in longer probe card life and improved throughput.

Acknowledgements

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Thanks For Listening –
Enjoy the Conference