2007 Session 6

ARCHIVE 2007

SOCKET DESIGN AND USE CHALLENGES

"Spring Probe Based Socket Design for Fine-Pitch Applications"

Tushar Mazumder
Emulation Technology, Inc.

"Challenges of Molding ESD Grade Plastics"

Andrew Gattuso, Dr. Shih-Wei Hsiao
Foxconn Electronics, Inc.

"Monte Carlo Based Package to Socket Alignment Assessment Methodology"

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"Auto Contact Cleaning Engineering Study Applied to Package Test"

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Spring-Probe Based Socket Design for Fine-Pitch Applications

2007 Burn-in and Test Socket Workshop
March 11 - 14, 2007

Tushar Mazumder
Marketing Manager

EMULATION TECHNOLOGY, INC.
World Leader in Adapters, Clips, and Test Accessories

Agenda

- Problem Statement – *Help!*
  - Fine-pitch die test
  - Die characteristics
- Solution – *Here's what we can do…*
  - Concept
  - Contact element
  - Material
  - Design
- Conclusion – *Thank you!*
  - What ET learned

Problem Statement

- Customer wants to test fine-pitch die
  - Test 16 die simultaneously
  - Die will be manually loaded into assembly
  - Assembly will be loaded into burn-in chamber
- Die have exposed diaphragms that cannot have any physical contact
- An independent vacuum force will be applied to each die

Spring-Probe Based Socket Design for Fine-Pitch Applications 3

Die Dimensions

Spring-Probe Based Socket Design for Fine-Pitch Applications 4

Die Dimensions

- Die size is 1.65mm x 1.19mm x 0.41mm
- Pad size is 0.25mm x 0.43mm
  - 4 pads per die
- Min pad pitch is 0.33mm
  - Center-to-center
- 4 diaphragms are adjacent to the pads
  - These diaphragms cannot have any external contact

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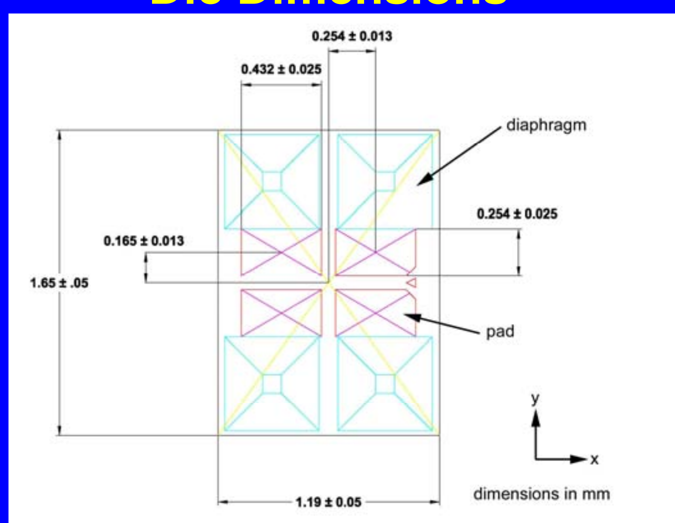
Die Dimensions



Drawing courtesy of Endevco/MEMS

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Die Dimensions

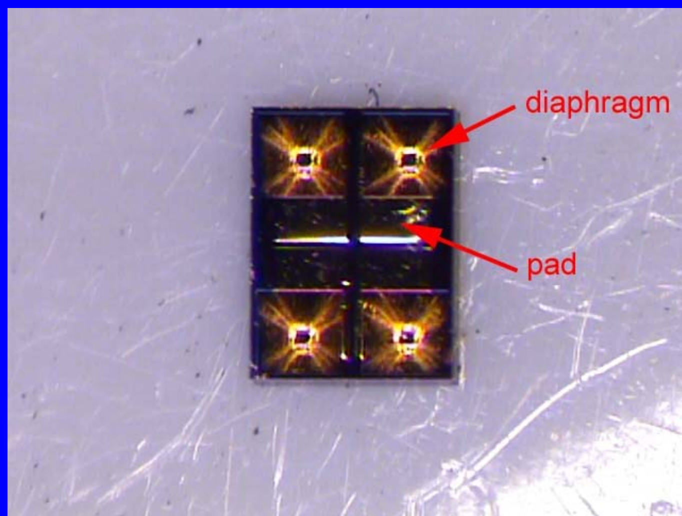

Photo courtesy of Endevco/MEMS

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Solution Concept

- One socket for many die or many sockets for a few die?
  - One large socket won't hold flatness tolerance as well as multiple smaller sockets
  - One large socket would lead to complete system downtime if socket refurbishment is required

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Solution Concept

- Multiple smaller sockets are optimal
  - 4 die per socket
  - Each die cavity has its own vacuum fitting
- PCB and interface hardware are also required

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Socket Design – Contact Element

- Stamped or Formed leads
  - Pincer, buckling beam
  - Not available for fine pitch
- Elastomer
  - High compression force
- Capped spring
  - Difficult to house

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Socket Design – Contact Element

- Proprietary contacts
  – Metallized particles
  – Compressible cylindrical wire
  – Embedded contacts
  – Others

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Socket Design – Spring-Probe

- Low spring force
  – Ideal for low mass die
  – High force not required to probe Au pads
- Fine pitch
  – 0.3mm

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Socket Design – Spring-Probe

- Easy maintenance
  - Can be refurbished or replaced at customer's site
- Wide operating temperature range
- Only contacts die at targeted locations

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Socket Design – Spring-Probe

- POGO-PIN-5.70-5
  - $10/pin at low volumes
    - Relatively costly due to fine pitch and low volume
  - Double point ideal for contacting pads
  - Long travel provides design flexibility
    - 0.7mm recommended travel

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Socket Design – Spring-Probe

- POGO-PIN-5.70-5
  - Low force
    - 4g initial; 11g at recommended travel
  - One plunger is double the length of the other
    - Simplifies manual handling and loading

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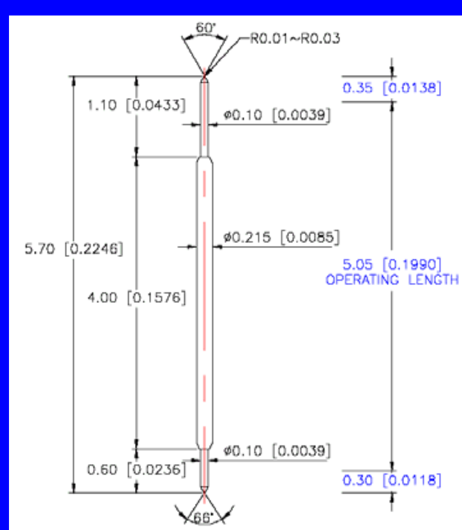
Socket Design – POGO-PIN-5.70-5



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Socket Design – Material

- PEEK-GF30 or Torlon 4203
  - Good tensile and flexural strength
  - High hardness and compressive strength
    - Won’t deform if die is misplaced in cavity
  - High operating temperature
  - Easier to machine
    - Not as damaging to tools as FR-4

Spring-Probe Based Socket Design for Fine-Pitch Applications 17

Socket Design – Material

- PEEK-GF30 or Torlon 4203
  - Common material used in BiTS
  - CTE double or triple Si’s
    - Si: 3ppm/K; PEEK or Torlon: 6.7 or 9.4ppm/K
    - A non-issue at these very small dimensions even over the wide temperature range
    - E.g.: Worst-case die length: 1.70mm @ 25°C increases to 1.7005mm at 125°C

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Socket Design – Die Placement

- Constraints
  - Die placed manually into socket
  - Simple loading and retention mechanism required
    - Technician loading of die
    - Repetitious task may lead to fatigue and/or carelessness
  - Minimal tools required
    - The load/unload process should be quick
  - Diaphragms cannot be contacted

Spring-Probe Based Socket Design for Fine-Pitch Applications 19

Socket Design – Die Placement

- Solution
  - Floating base design not required
    - Costly, complicated and may interfere with diaphragms
  - Socket cavity walls used for alignment
  - Die placed into cavity by vacuum pen

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Socket Design – Die Placement

- Solution
  - Die pads rest on pins
    - No diaphragm contact
  - Socket lid contacts top of die and holds die in place
    - Lid guided by alignment pegs and closes parallel to the socket body
    - Thumb screws used to fasten lid

Spring-Probe Based Socket Design for Fine-Pitch Applications 21

Socket Design – Cavity

- Die height is 0.41mm
- Socket cavity is 0.46mm deep
  - Deeper cavity provides no benefits since die travel is limited by die height
- Die placement depth is 0.20mm from top of cavity
  - Too high of a placement depth won’t provide enough wall for alignment
  - Too low a depth won’t provide enough plunger travel

Spring-Probe Based Socket Design for Fine-Pitch Applications 22

Socket Design – Cavity

- This results in 0.21mm of exposed die sidewall
  - Vacuum pen is primary insertion/ extraction tool
  - Tweezers can be used as secondary tool
- Total plunger travel is 0.7mm
  - Meets recommended plunger travel spec.

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Socket Design – Die Alignment

- But what about pin-to-pad alignment? How can we be sure the diaphragms won't be touched?
- Spreadsheet analysis required of worst-case cavity and die tolerances

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Socket Design – Die Alignment

- Worst case occurs with minimum die size and features along with maximum cavity size and spring-probe offsets
  - Features meaning pad sizes and pad offsets from center
  - Socket cavity and spring-probe offset tolerance is ±0.01mm

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Socket Design – Die Alignment

- Assume die is placed in one corner of cavity
  - Bottom left corner of cavity is used in this analysis
  - Pads are numbered 1 through 4 in a counter-clockwise manner starting at bottom left (refer to die dimensions drawing)

Spring-Probe Based Socket Design for Fine-Pitch Applications 26

Socket Design – Die Alignment

minimum die with minimum features		
1.14	package x dimension	
1.60	package y dimension	
0.24	pad center offset from die center along die x-axis	
0.15	pad center offset from die center along die y-axis	
0.41	pad x dimension	
0.23	pad y dimension	
maximum cavity with maximum offsets		
1.27	cavity x dimension	
1.73	cavity y dimension	
0.27	pin center offset from cavity center along cavity x-axis	
0.18	pin center offset from cavity center along cavity y-axis	
pin-center to pad-center shift	**minimum pin to pad edge distance**	**pin-pad location**
0.038	0.165	1x
0.038	0.076	1y
0.089	0.114	2x
0.038	0.076	2y
0.089	0.114	3x
0.089	0.025	3y
0.038	0.165	4x
0.089	0.025	4y
dimensions in mm		

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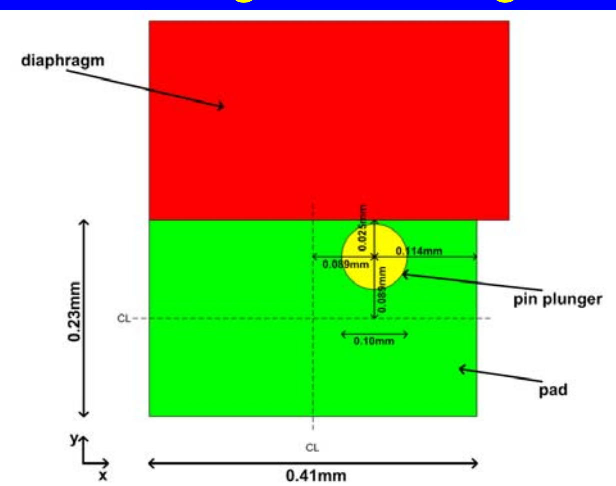
Socket Design – Die Alignment



Pad 3: pin-center to pad-center shift
(drawing not to scale)

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Socket Design – Die Alignment

- Worst case situation gives 0.025mm from pin to edge of pad
- Although there is not much room, the design is satisfactory, as it works in the worst case scenario
- Benefit of thermal expansion is that the pin to pad edge space will expand slightly
  - Die will expand whereas cavity will shrink

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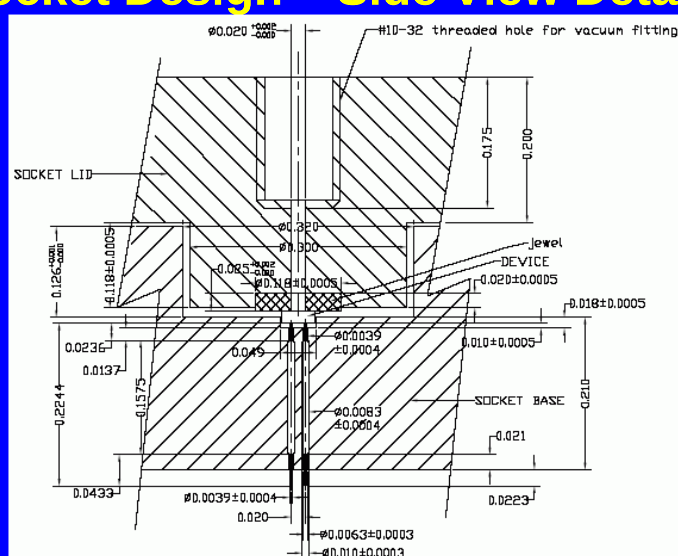
Socket Design – Side View Detail



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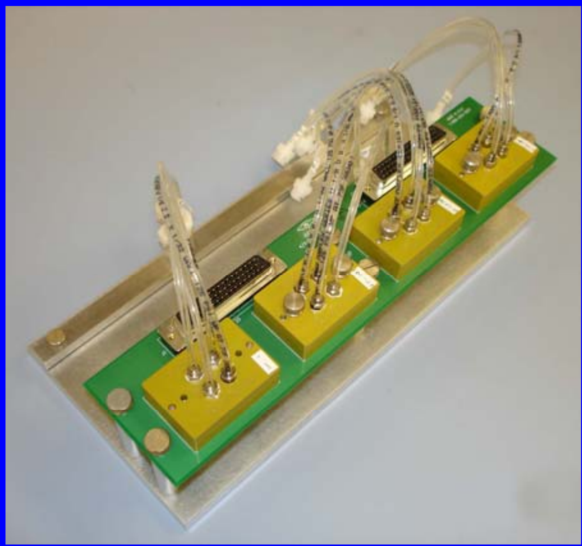
Socket Body

Spring-Probe Based Socket Design for Fine-Pitch Applications 31

Socket Lid

Spring-Probe Based Socket Design for Fine-Pitch Applications 32

Test Fixture



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Conclusion

What did ET learn?

- Contact element depends on the situation
- Material selection is as important to design as to the manufacturability
- Keep the design simple
- Keep the design modular
- Design to the worst case scenario
  - But don't over-design!

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Conclusion

- Customer is extremely satisfied
  - Multiple assemblies are currently in use

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Thank You!

Spring-Probe Based Socket Design for Fine-Pitch Applications 36

Challenges of Molding ESD Grade Plastics

2007 Burn-in and Test Socket Workshop
March 11 - 14, 2007

Andrew Gattuso
Sr. Project Design Manager
Foxconn Electronics, Inc.

Dr. Shih-Wei Hsiao
BiTS Team Leader
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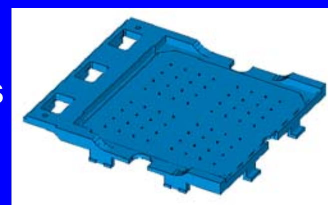
Agenda

- Requirement
- Background
- Success
- Molding Challenges
- Testing Equipment and Methods
- Resource Commitment
- Summary

3/2007 Challenges of Molding ESD Grade Plastics 2

Requirement

- Fatigue: 10,000+ cycles
- Strength: thin wall features
- ESD: SR $10^9 \rightarrow 10^{11}$
- DWV >650V
- Insulation Resistance: 1000MΩ min
- Temperature: 125°C
- High volume application → molded



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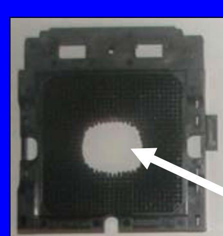
Background

- Short shot (PEEK, PEI based resin)
- Molding ejection issues (PEEK, PEI)
- Unable to meet SR spec (LCP, PES, PPS)
- Unable to meet DWV spec (LCP, PES, PPS)



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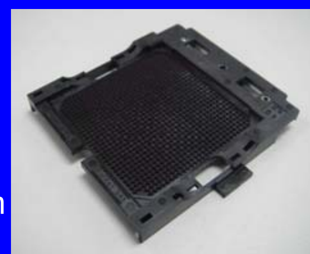
Success

- **Sufficient filling (PEEK based resin)**
- **Clean part ejection from mold**

  - ✓ Flat plate with metal part inserted
  - ✓ ~ 50x50mm, ~ 1000 pins
  - ✓ 1.27mm pitch
  - ✓ 0.7 ~ 1.0mm thickness
  - ✓ The min wall thickness is 0.17mm
  - ✓ ESD: SR 10^9 ~ 10^{11} ohms



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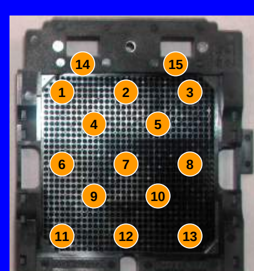
Success

- **Meet customer's SR spec (10^9 ~ 10^{11} ohms)**
- **Meet customer's DWV spec (> 650 Volts)**

	Customer	Foxconn
No.	Front	Front
1	3.00E+10	8.21E+10
2	4.00E+10	7.95E+10
3	3.00E+10	6.57E+10
4	6.00E+10	6.57E+10
5	5.00E+10	5.96E+10
6	5.00E+10	6.20E+10
7	4.00E+10	6.30E+10
8	4.00E+10	6.01E+10
9	5.00E+10	6.00E+10
10	6.00E+10	5.56E+10
11	8.00E+10	5.35E+10
12	7.00E+10	5.60E+10
13	7.00E+10	4.95E+10
14	7.00E+10	3.74E+10
15	7.00E+10	3.01E+10
Ave	5.40E+10	5.87E+10
Max	8.00E+10	8.21E+10
Min	3.00E+10	3.01E+10



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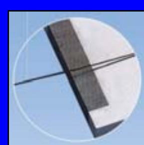
Molding Challenges

- **Tooling Technology**
  - ✓ Precision of wire-cut: ± 0.002mm
  - ✓ Precision of grinding: ± 0.002mm
  - ✓ Precision of EDM: ± 0.002mm
  - ✓ Coating to improve friction


Wire-cut


Grinding


EDM


Coating

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Molding Challenges

- **Molding Equipment**


Nozzle temperature
> 390°C


Mold temperature
> 180°C

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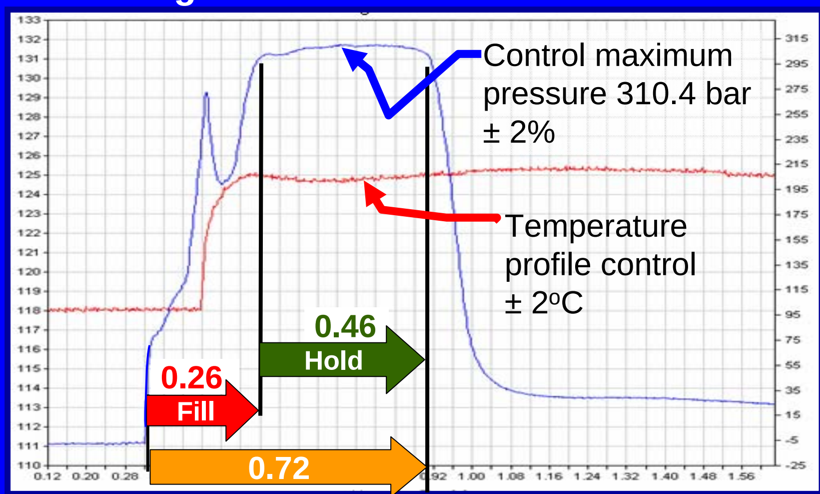
Molding Challenges

- **Molding Controls**



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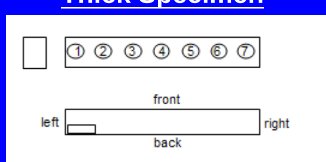
Test Equipment and Methods

- **Specimen Correlation**
  - **3 locations – Vendor, Customer, Foxconn**

Thick Specimen



Thin Specimen

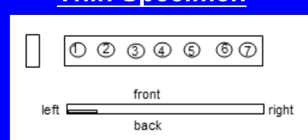


Table 1: Thick sample SR data

No	Customer		Foxconn	
	Front	Back	Front	Back
1	4.00E+10	2.00E+10	5.66E+10	5.94E+10
2	2.00E+10	1.00E+10	5.13E+10	5.50E+10
3	3.00E+10	2.00E+10	4.74E+10	5.21E+10
4	4.00E+10	2.00E+10	7.21E+10	5.54E+10
5	6.00E+10	3.00E+10	7.77E+10	5.49E+10
6	4.00E+10	3.00E+10	7.98E+10	5.88E+10
7	2.00E+10	3.00E+10	5.01E+10	3.84E+10
Ave	3.57E+10	2.29E+10	6.21E+10	5.34E+10
Max	6.00E+10	3.00E+10	7.98E+10	5.94E+10
Min	2.00E+10	1.00E+10	4.74E+10	3.84E+10

Table 2: Thin sample SR data

No	Customer		Foxconn	
	Front	Back	Front	Back
1	3.00E+09	4.00E+09	1.68E+10	1.67E+10
2	3.00E+09	3.00E+09	1.59E+10	1.66E+10
3	4.00E+09	4.00E+09	2.21E+10	2.01E+10
4	4.00E+09	4.00E+09	3.28E+10	2.82E+10
5	5.00E+09	5.00E+09	3.23E+10	3.03E+10
6	6.00E+09	6.00E+09	4.67E+10	4.19E+10
7	3.00E+10	1.00E+10	5.44E+10	5.37E+10
Ave	7.86E+09	5.14E+09	3.16E+10	2.96E+10
Max	3.00E+10	1.00E+10	5.44E+10	5.37E+10
Min	3.00E+09	3.00E+09	1.59E+10	1.66E+10

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Test Equipment and Methods

- **SR Measurement**

Equipment
Brand: Prostat
Model: PRS-812

Test Process

Step 1: Apply the calibration standard to calibrate the electrometer.

Step 2: Plug the resistance probes into the electrometer; press the probes on the sample to measure SR.

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Testing Equipment and Methods

- **DWV Measurement**

Equipment

Brand: Chen Hwa
Model: CWV-902

Test Process

Applied VAC between adjacent contacts for 60 seconds.

Spec

Leakage current: 0.5mA Max

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Resource Commitment

- Modifying plastic material mid-project
  - Time
    - New compound needed?
    - Qualify the material (vendor, Foxconn, customer)
    - New tooling needed?
    - Fine tune molding process
  - Cost
    - New mold tooling needed if shrink rates differ
    - New Resin compound cost

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Summary

- Molding a strong, reliable, ESD grade plastic in a thin wall application was possible.
- Overcoming the molding challenges were critical to successfully mold PEEK.
- Correlating testing equipment and methods were integral to qualifying the socket ESD performance.
- Tight SR specs were challenging to meet and required a commitment of resources
- Next steps: How thin can we get?

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Monte Carlo Based Package to Socket Alignment Assessment Methodology

2007 Burn-in and Test Socket Workshop
March 11 - 14, 2007

David Shia (Intel) &
Wei-ming Chi (Mobility Electronics)

Background

- Trends in package design
  - Smaller size + finer land pitch
- Short tooling design cycles and expensive prototyping cost
- Need accurate alignment assessment capability

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State of the Art

- Worst case (WC) approach
  - unrealistically conservative
- Root-sum-squared (RSS) approach
  - Fundamental assumptions (e.g. linearity, normality & independence) violated in many alignment cases
- Monte Calo (MC) based approach overcomes limitations

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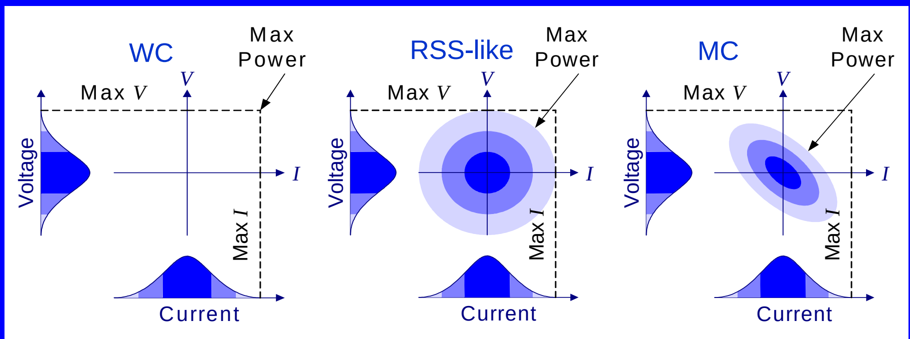
Max Power Estimation Example



- WC gives unrealistically conservative estimate of max power
- RSS gives less conservative estimate
- MC gives most realistic estimate

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Agenda

- Brief MC Introduction
- Mis-alignment mechanisms
- Alignment criterion
- Size effect consideration
- Case study

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What is MC Simulations?

- Nondeterministic computational algorithms, i.e. makes use of random numbers
- Useful for modeling phenomena with significant uncertainty in inputs
  - Business risk assessment
  - Alignment accuracy assessment

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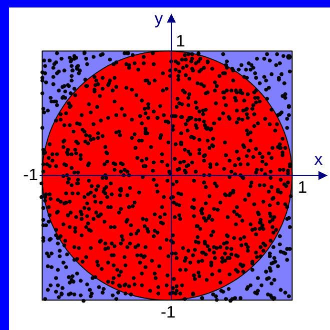
Example – Find Area of Circle Using MC



- Deterministic algorithm = πR^2
- MC algorithm = throw points randomly at square and count points that fall within circle

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Mis-alignment Mechanisms

- Socket side
  - Shift of hole TP
  - Shift of pin TP within hole
- Package side
  - Shift of package within inner socket guide
  - Shift of overall pad pattern
  - Pad-to-pad variation (pitch tolerance)

MC simulations developed for each mechanism

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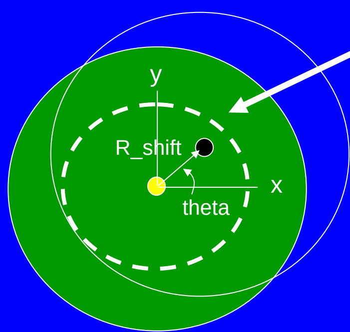
MC Simulations - Shift of TP

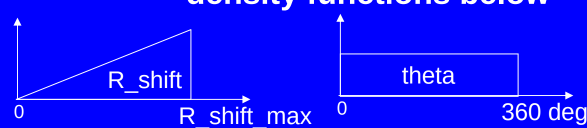
- Applicable for following mechanisms
  - Shift of hole TP, shift of overall pad pattern, and pad-to-pad variation (pitch tolerance)

TP anywhere within tolerance circle (dashed line)



X,Y of TP given by
X = R_shift *cos(theta) &
Y = R_shift*sin(theta)

R_shift & theta sampled from density functions below



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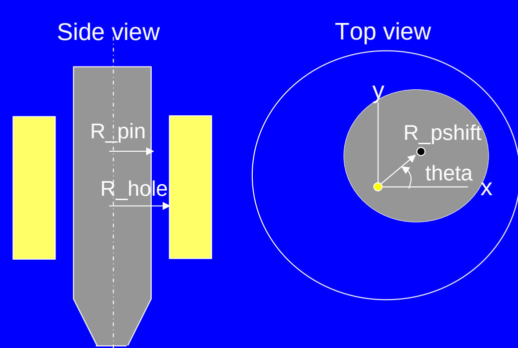
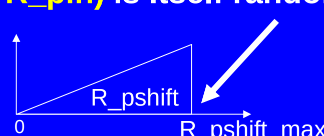
MC Simulations - Shift of Pin TP



- Simulations same as shift of TP except for size of tolerance circle not fixed
  - R_pshift_max = (R_hole – R_pin) is itself random



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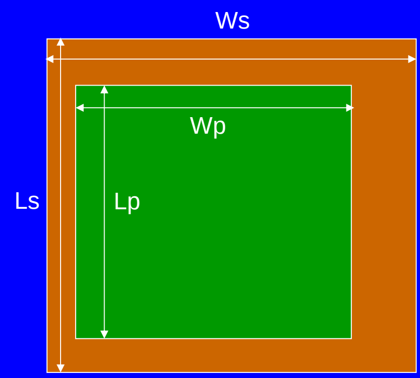
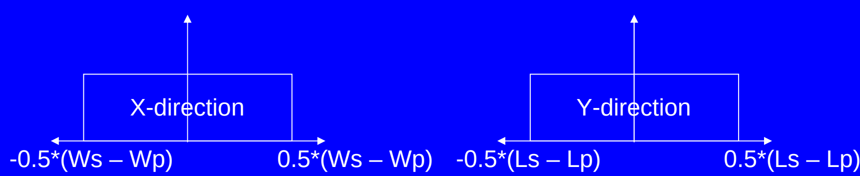
MC Simulations - Package Shift in Guide



- Package move anywhere within confine of socket
- Shift in X & Y sampled from uniform densities below



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Relative Distance Computation

- Sum up net X & Y shifts for pin and pad pair per five mechanisms
- Distance between centers computed as follows
  - *[(X_pin – X_pad)^2 + (Y_pin – Y_pad)^2]^(0.5)*
- Calculated every simulation instance to form alignment distribution, R

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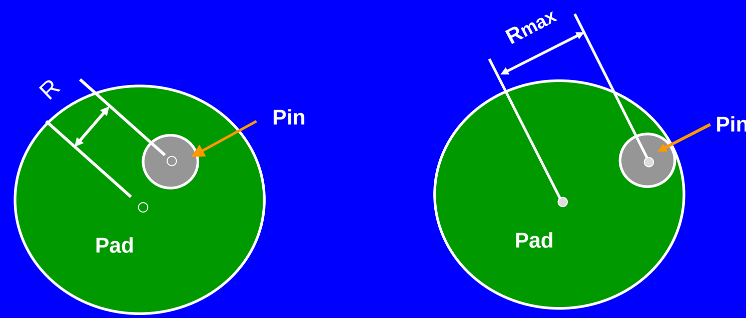
LGA & Pogo Pin Contact Criterion



- Assume pin tip and pad are circular
- Mis-alignment occurs when R > Rmax
- Note Rmax = R_pad – R_pin

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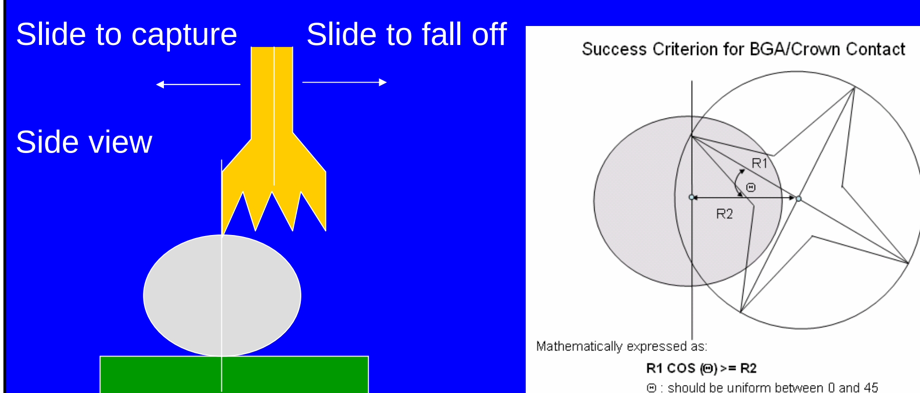
BGA & Crown Pin Contact Criterion



- Mis-alignment occurs with insufficient overlap
- Other criterion possible, e.g. penetration mechanism

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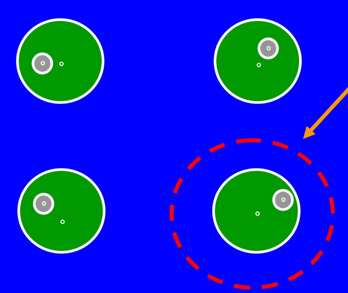
Size Effect - Order Statistics

- For many pairs, can rank relative distances from smallest to greatest
- Distribution for greatest relative distance estimated via order statistics



- Alignment at socket/package level - apply criterion to distribution for greatest relative distance

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Case Study

	Dimension	Lower Tol.	Upper Tol.	Nor. Dimension	3σ
Package Shift in Socket	Units = mm			0.013	0.007
Socket Inner Dim. (X)	34.050	-0.01	0.02	34.055	0.015
Socket Inner Dim. (Y)	34.050	-0.01	0.02	34.055	0.015
Package Outside Dim. (X)	34.000	-0.04	0.04	34.000	0.040
Package Outside Dim. (Y)	34.000	-0.04	0.04	34.000	0.040
Pin Shift in Hole				0.006	0.002
Hole Dia. of Floating Carrier	0.250	-0.02	0	0.240	0.010
Contact pin Thickness	0.206	-0.01	0.01	0.206	0.010
Contact pin Width	0.206	-0.01	0.01	0.206	0.010
Hole True Position	N/A	N/A	N/A	N/A	0.010
Pad True Position	N/A	N/A	N/A	N/A	0.070
Pad to Pad Variation	NA	NA	NA	NA	0.01
Pad Size Variation	N/A	N/A	N/A	0.3048	0.020
Pin Tip Size Variation		N/A	N/A	0.04	0.010

Fine Pitch Pogo Pin Socket for LGA Packages

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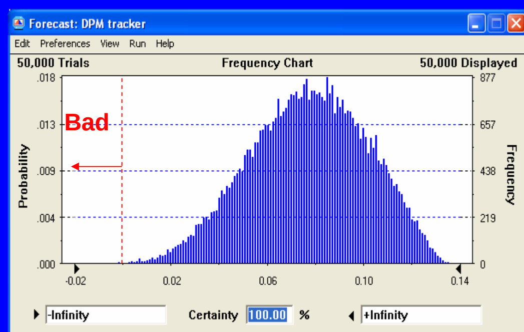
Case Study

At pin/pad level…

- WC calculation gives alignment Cpk of 0.33
- RSS calculation gives alignment Cpk of 1.36
- MC calculation gives alignment Cpk of 1.16



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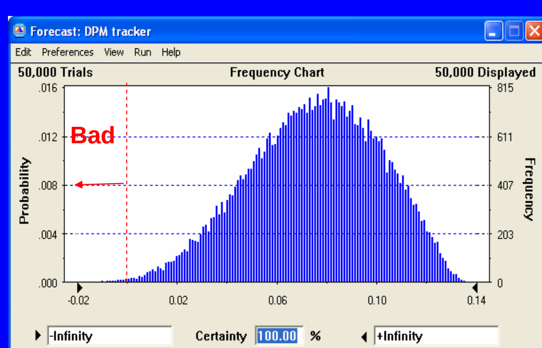
Case Study

At socket/package level…

- MC calculation gives alignment Cpk of 1.00
- High pin count reduces alignment Cpk



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Conclusion

- MC method overcomes limitations in WC and RSS approaches
- MC method based on five mis-alignment mechanisms
- Include size effect to estimate alignment Cpk at socket/package level

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Auto Contact Cleaning Engineering Study Applied To Package Test

2007 Burn-in and Test Socket Workshop
March 11 - 14, 2007

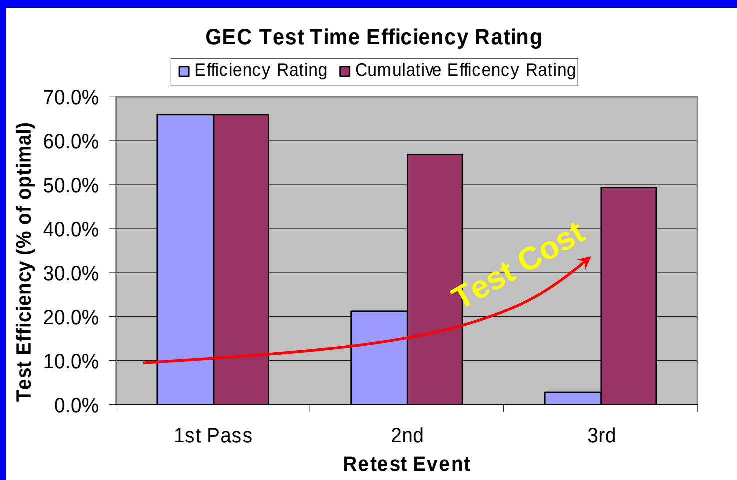
Byron Gibbs
Kevin McNamara
Texas Instruments
Delta Design
A Cohu Company

Agenda

- Motivation
- SCD (Surrogate Cleaning device) concept development
- Manual Handler application
- Handler Automation
- *ACC* (Auto Contact Cleaning) Benefits
- Conclusions

03/2007 Auto Contact Cleaning - Applied To Package Test 2

Motivation
The Cost of Rescreen



03/2007 Auto Contact Cleaning - Applied To Package Test 3

Motivation

$$EfficiencyRating = \left(\frac{GoodUnitTestTime * GoodUnits * SitesUsed}{LotProcessTime * PhysicalSites} \right) * 100\%$$

Test Efficiency Factors

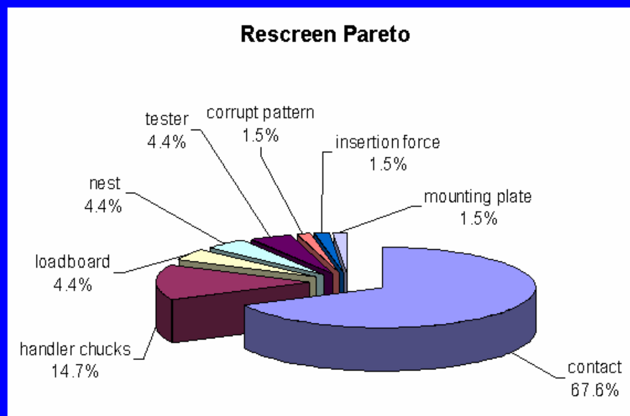
- Site Utilization +
- Yield +
- Lot size +
- Setup time –
- Index time –
- Retest –

Retest Effects

- Setup time - constant
- Site Utilization
- Yield - diminishing returns
- Lot Size

03/2007 Auto Contact Cleaning - Applied To Package Test 4

Motivation
Contact → #1 Cause for Rescreen



03/2007 Auto Contact Cleaning - Applied To Package Test 5

Cleaning device concept
Contaminants a problem

- **Contaminant sources**
  - Process
    - Oxide layer, Singulation debris, Mold compound, Flux
  - Self contaminating
    - Insertion action generates debris
    - Smaller sizes amplify debris
- Ratio of debris particulate size to contact area rising
- Resistance may cause false fails
- Yield recovery typically includes rescreen

4pt crown on BGA

3pt crown on QFN

03/2007 Auto Contact Cleaning - Applied To Package Test 6

Cleaning device concept
Address The Problem

- Lessons from probe
  - Remove Contaminates During Lot Testing
  - Use On-Line Needle Cleaning
- Final Test
  - Typical Manual Off-Line Contactor Cleaning
    - Brushing / blowing / manual means of removing debris
    - May require breaking the setup
    - May require shop and bench cleanup
  - Need On-line Automatic Contactor Cleaning

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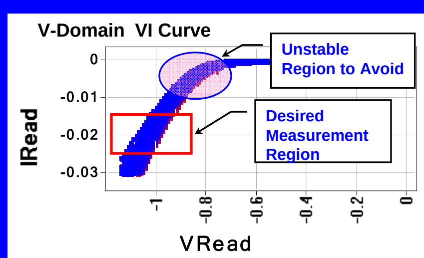
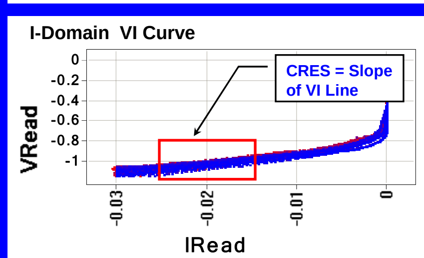
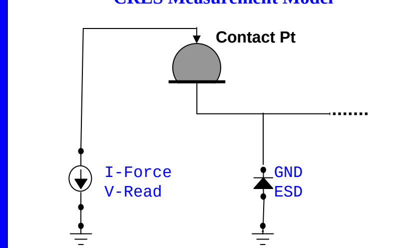
Cleaning device concept
CRES (Contact Resistance)





CRES Measurement Model



$$CRES = Slope = Rise / Run$$
$$CRES = (V_2 - V_1)/(I_2 - I_1)$$
$$CRES = \sum_{GND}^{PMU} R$$
$$CRES = R_{ESD} + R_{Contact} + R_{LB} + R_{Interface} + R_{Other}$$

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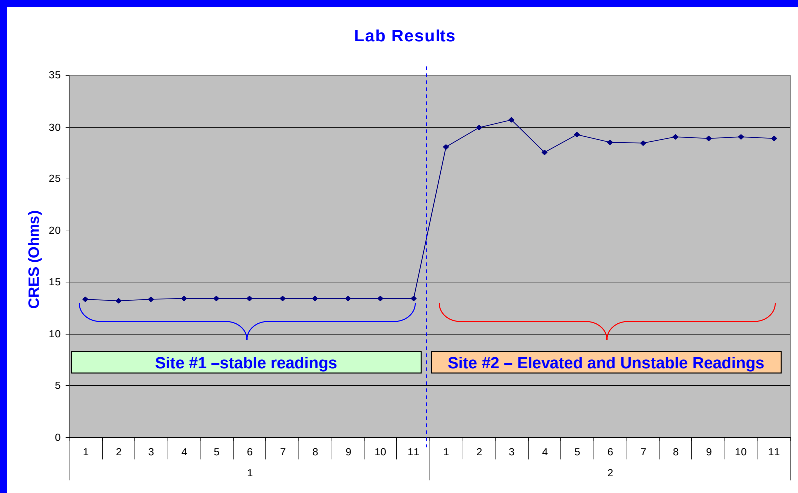
Cleaning device concept
High CRES on Site 2



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Cleaning device concept
Lab Results Summary

- The observation
  - CRES (Contact Resistance) application in lab
  - Resistive LB (Load Board) and Socket
- Possible solutions
  - Brushing, Blowing, Washing, Cleaning device
- Decision – Use Surrogate Cleaning Device (SCD)
  - Form and fit similar to DUT
  - Insertion and extraction action cleans contacts

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Cleaning device concept
Cleaning Device and Method

- **<u>Cleaning Device</u>**
- Size & shape similar to DUT
- Cleaning Media
- Elastic
- Contains Abrasion
- Capability for adherence

<u>Method</u>

1. Insert SCD into Socket
2. Apply insertion force
3. Extract SCD
4. Do Steps 1 – 3 as required
5. Resume DUT testing

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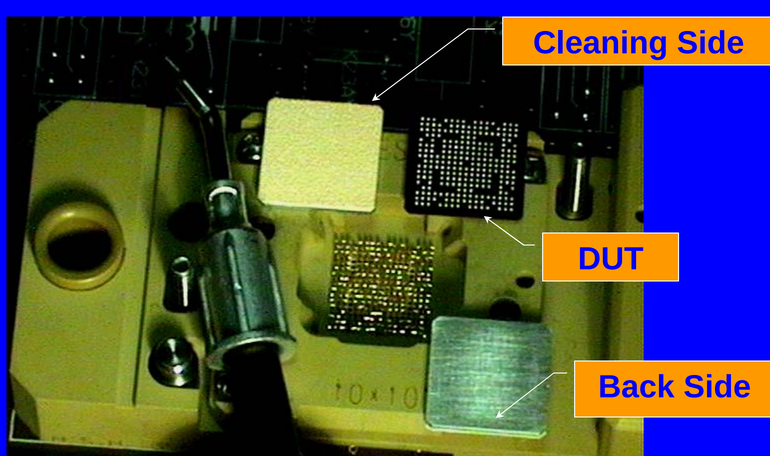
Cleaning device concept
Cleaning Device Example



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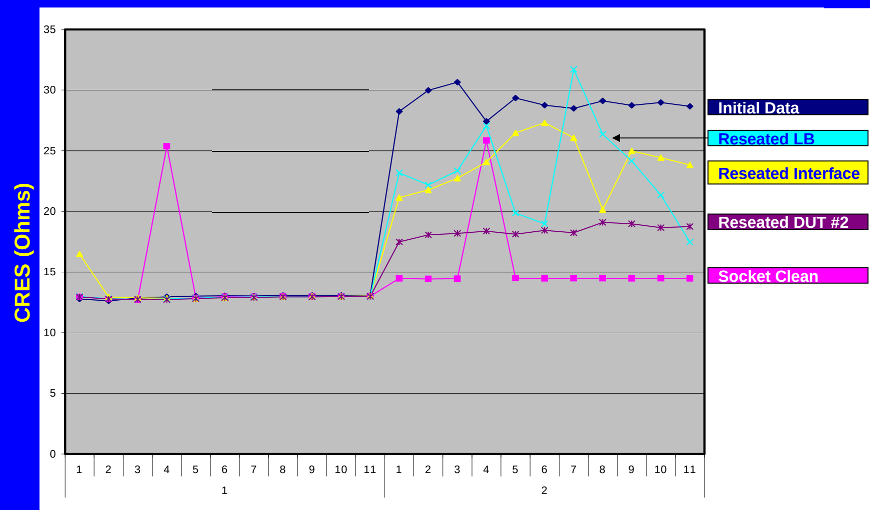
Cleaning device concept

Positive Results



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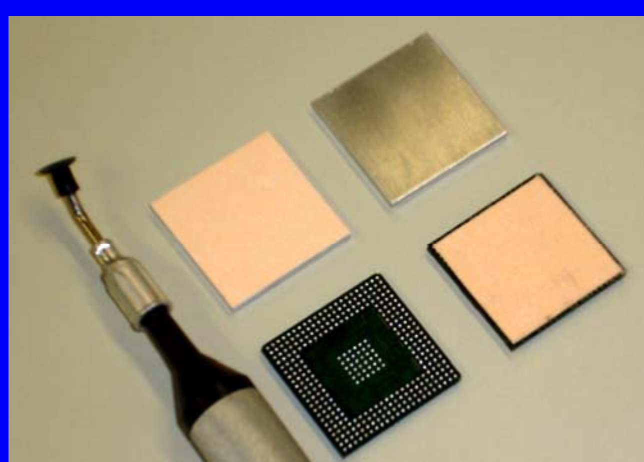
Manual Handler Application

Cleaning Device Fabrication



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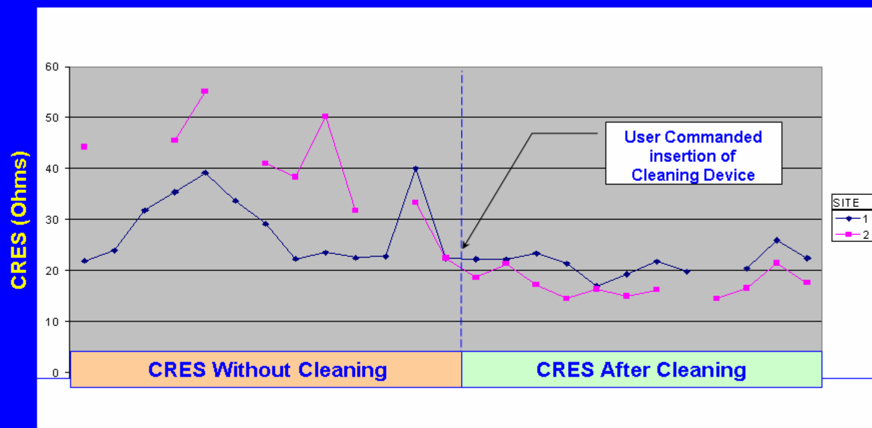
Manual Handler Application
Cleaning Impact on CRES



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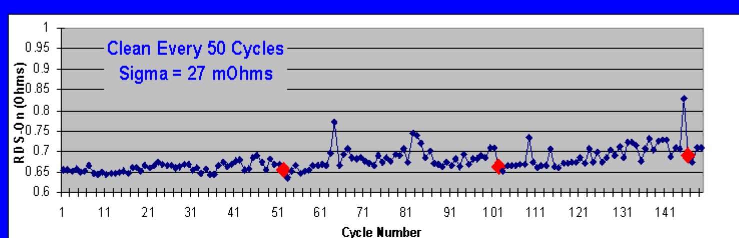
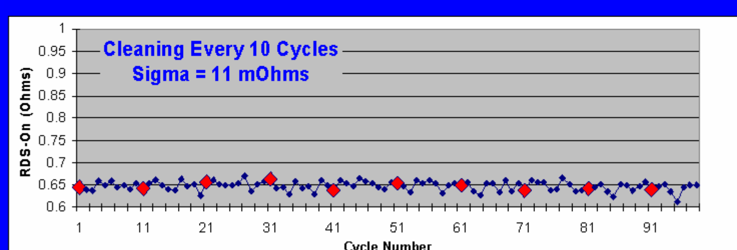
Manual Handler Application
Resistance Drain to Source





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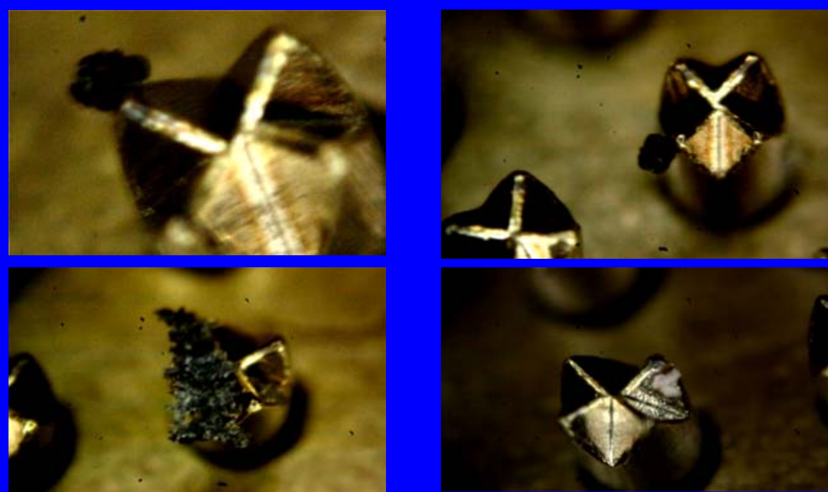
Manual Handler Application
Pin Condition BEFORE Cleaning



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Manual Handler Application
Pin Condition AFTER Cleaning

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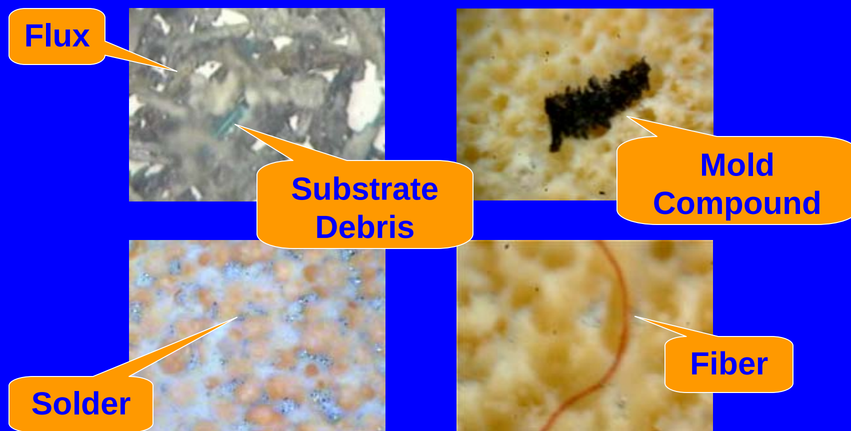
Manual Handler Application
Captured Debris



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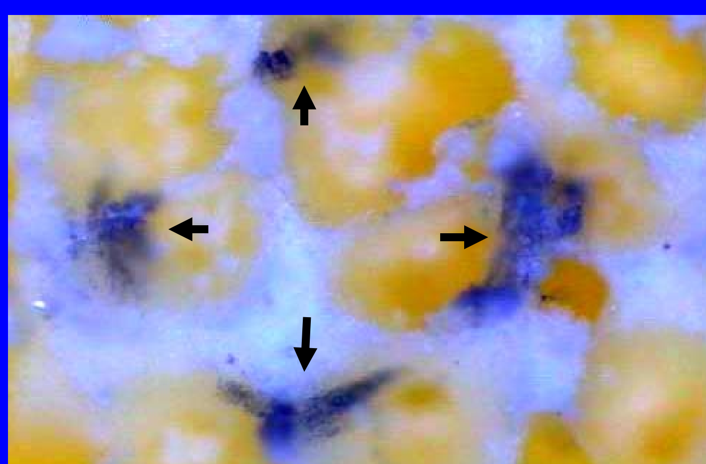
Manual Handler Application
Pin Marks in Cleaning Media



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Handler Automation
The Need

- Good LAB Results
  - Positive CRES improvement
- Good Handler Results
  - Positive CRES improved
- Need automation to go further
  - Yield
  - CRES across lots
  - Rescreen Rate
  - Equipment Utilization

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Handler Automation
Key Features

- Repository for SCDs
- Move SCDs through system
- Track cleaning units in the system
- Providing user interface
- Performing cleans per recipe
- Track SCD usage and provide alerts

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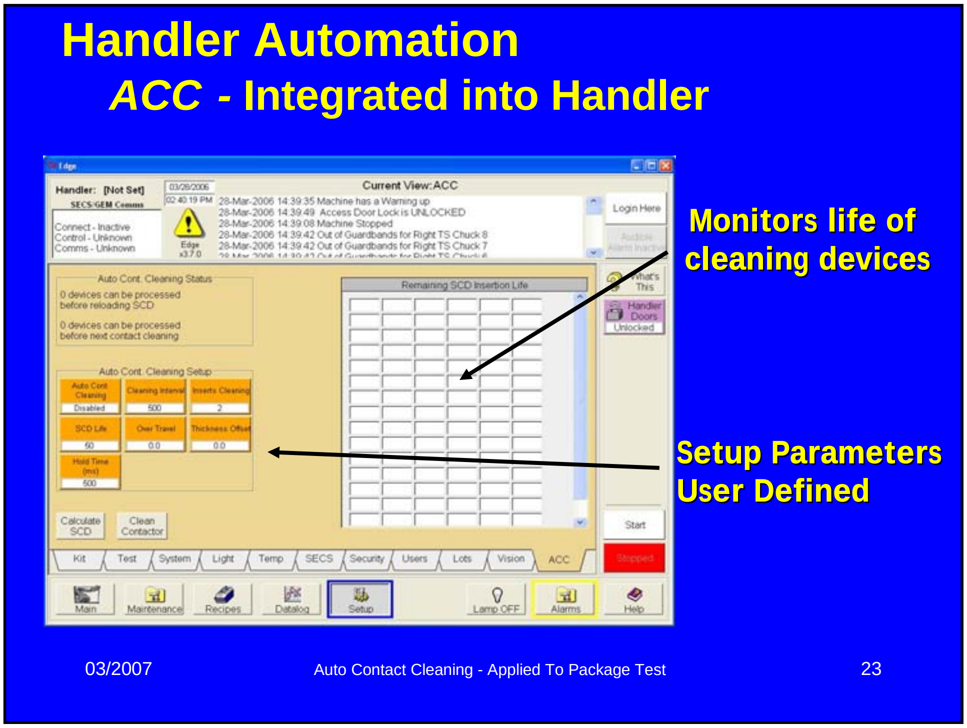
Handler Automation
ACC - Integrated into Handler
Monitors life of cleaning devices
Setup Parameters User Defined
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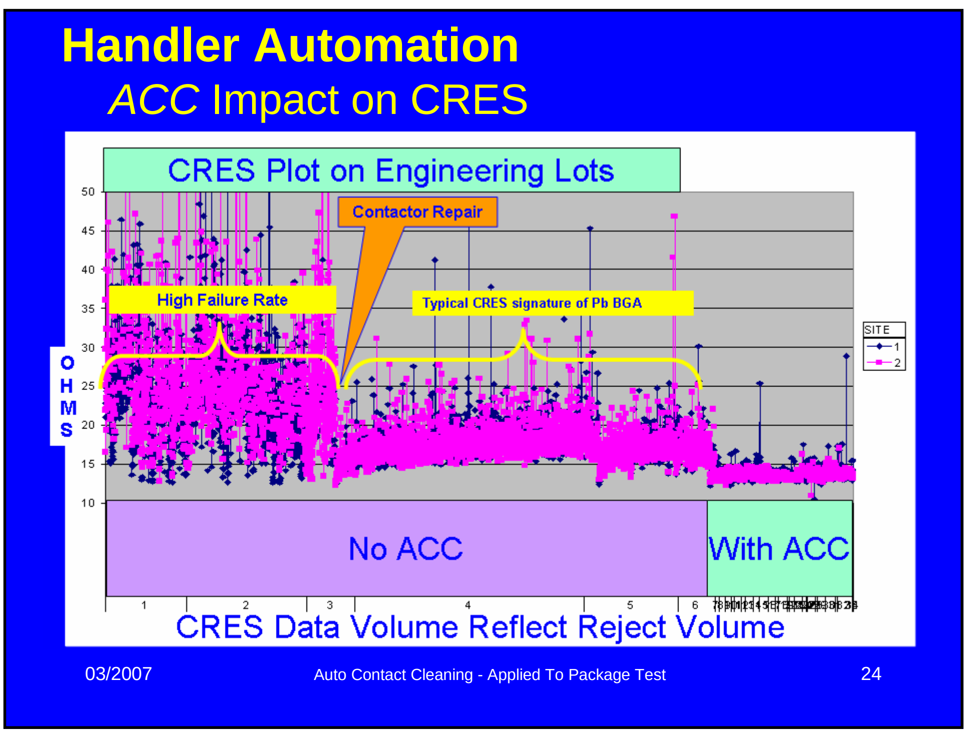
Handler Automation
ACC Impact on CRES
CRES Plot on Engineering Lots
Contactor Repair
High Failure Rate
Typical CRES signature of Pb BGA
OHMS
No ACC
With ACC
SITE
CRES Data Volume Reflect Reject Volume
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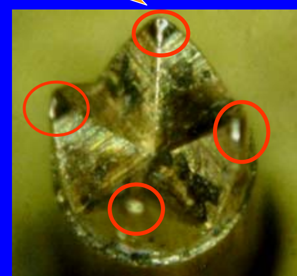
Handler Automation
ACC Impact on Pins

Pin tips clean @ 157K insertions



ACC Cleaning Recipe
- Cleaning interval → 100
- Inserts per clean → 1
- SCD life → 350
- Hold Time → 250 ms

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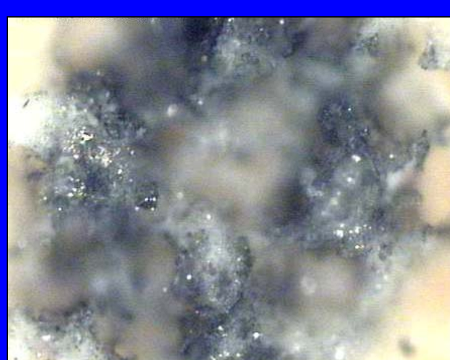
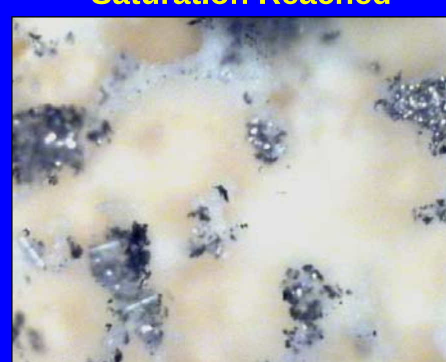
Handler Automation
ACC Impact on cleaning device life

500 Uses - Cleaning Media Over Saturated



350 Uses Saturation Reached



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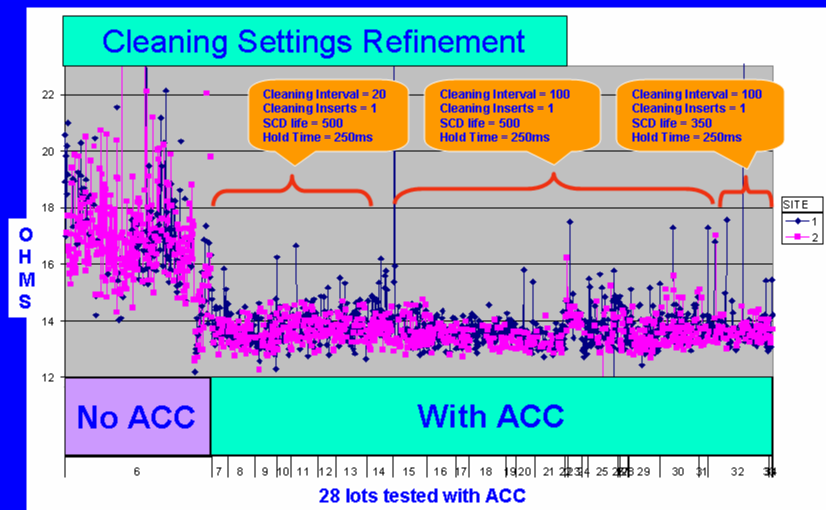
Handler Automation

ACC Recipe Refinement



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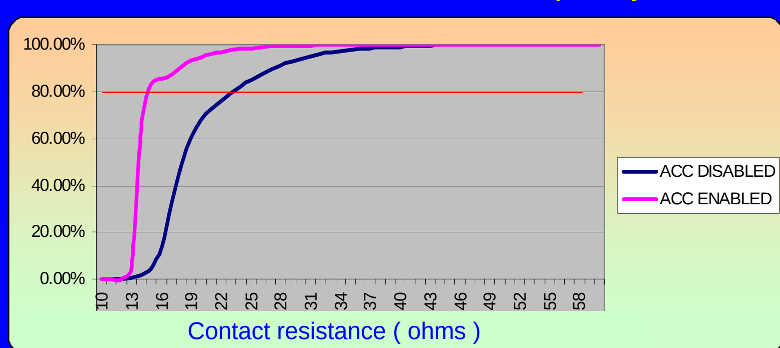
ACC Benefits

Tighter CRES Distribution With ACC

CRES Cumulative Distribution Frequency Plot



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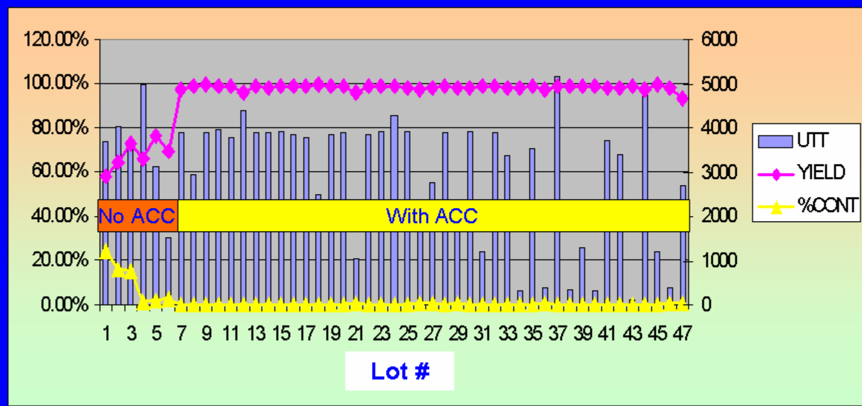
ACC Benefits

Yield, % Continuity



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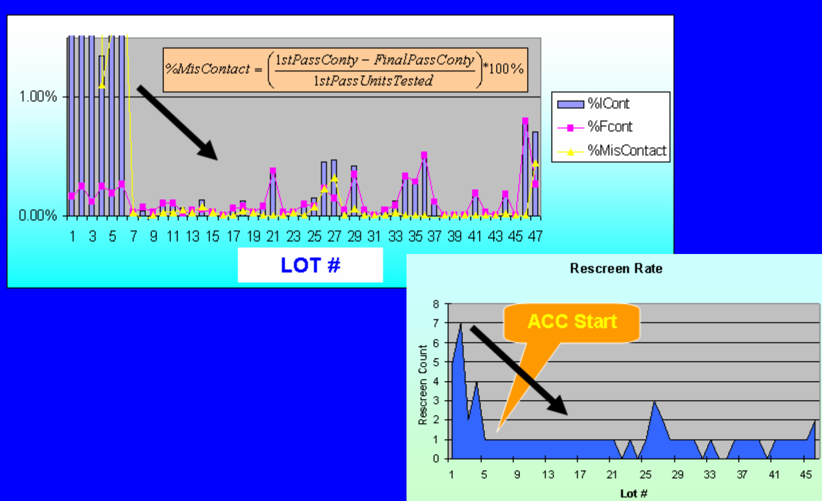
ACC Benefits

Missed Contact / Rescreen Rate



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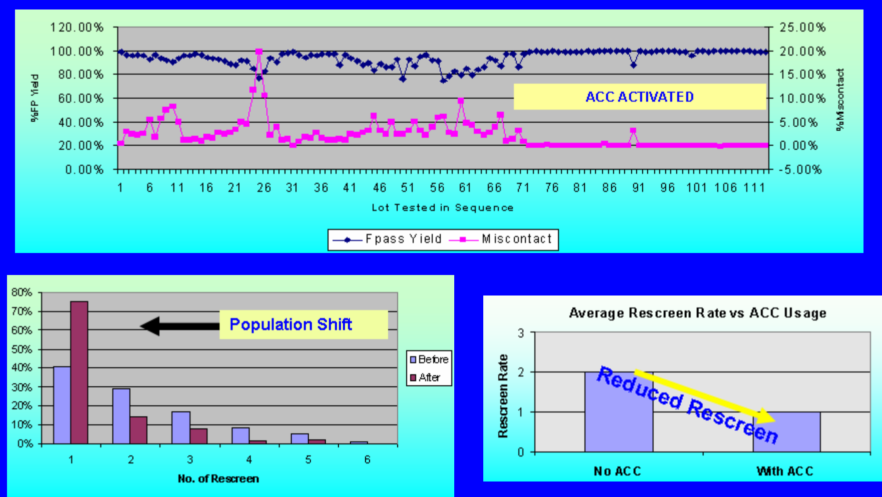
ACC Benefits

1st Pass Yield / Missed Contact / Rescreen



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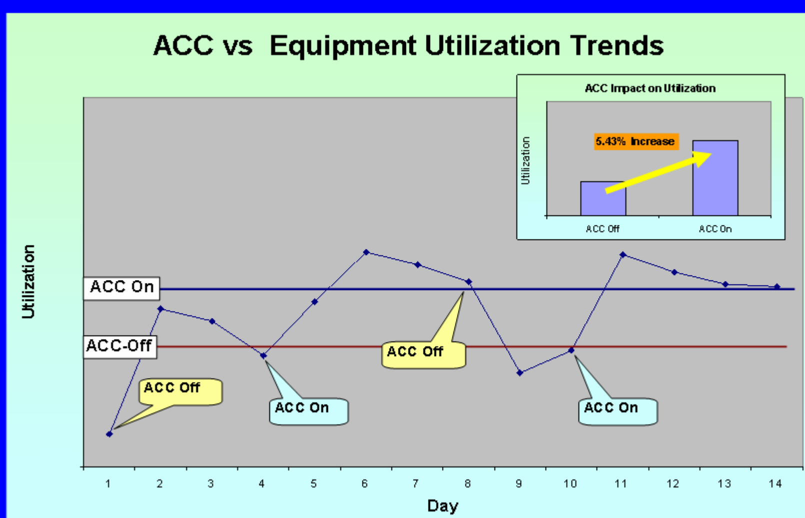
ACC Benefits

1st Pass Yield / Missed Contact / Rescreen



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ACC Benefits

ACC vs Manual Comparison

ACC

- Automated on handler (Delta *EDGE)* ≤ 30 sec down time

Manual

- Clean contacts in handler ≈ 15 mins down time
  - Possible on *EDGE* – good access to test site
- Remove Contactors ≈ 60 mins down time
  - Undock, swap contactors - 30 mins
  - Re-dock and run “golden” devices – 30 mins
- Test cell output suffers

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Conclusions

- Rescreen is costly
- Highest rescreen contributor → Contact
- Positive lab results using of cleaning device
- Positive handler results using cleaning device
- Automation Impact
  - CRES more in control
  - 1^{st} Pass Yield Improvement
  - Rescreen Reduction
  - Equipment Usage Impact

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Acknowledgements

Presenters

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