Automation Analysis for Class 0 & CDM

Professional Services Only
No Product Sales!

Client Locations

Ted Dangelmayer
www.dangelmayer.com
Hard at Work “Down Under”!
Agenda

- Introduction
- Examples of Automation Issues
- Diagnostic Methods
- Materials Testing
- Corrective Action Trials
- 50 V Qualification Case Studies
Strategic Options to Begin Analysis
Pros and Cons

- Detailed Resistance & Voltage Measurements
  - Process Surrogate Module
  - ESDA Working Group
- ESD Event Detection
  - Then Detailed Resistance & Voltage Measurements
Hand-held ESD Event Detectors
Low cost alternative to high speed scopes
Event Detectors Useful for Workstation Analysis
Wafer Saw Class 0 Failures

- 90% failure rate
  - 30 volt CDM Withstand Voltage

- Complex Resolution
  - CO₂ Bubbler
  - Cutting Blade Material Change
  - Depth of Cut
  - Travers Speed
ESD Events at Contact with Solder Wave
Charged Carrier Tape
Events at Solder Past Tool
Die Attach
Metal Automation Fixture
Events in Glove Box
Diagnostic Methods
Initial Diagnostics

Step 1 – “Wet Run”

- Watch movement
- Listen for Beeps
- If No Events, No Corrective Action
- Events Detected, go to Step 2

Event Detector
Approximately 30 cm from movement of pieces
Initial Diagnostics

Step 2

- Do beeps occur at Touch Down?:
  - With contact to conductive surface?
  - With the rhythm of contact?
- If yes, go to Step 3

- Are the beeps EMI Interference?:
  - Come in bursts?
  - In rapid succession?
  - In rhythm with relays?
- If yes, go to Step 3
Step 3: “Dry Run”

• “Normal Operation!”
• But No Pieces

Same Tool Movements

Same Relay Activity

Same Trays

• Hard to Isolate ESD Source!
• Therefore, shut down part of tool
Step 3: “Dry Run”

Same # of Events
Step 3: “Dry Run”

Still Operating Normally
No Events!

Not Operating
Step 4: Continuity to Ground Test

High Resistance
Step 5: Materials Testing

Surface Resistance Test

Measure Points of Contact

Lower Limit:
> 1 x 10^4 Ohms
Upper Limit:
< 1 x 10^{10} Ohms

Too Conductive!
Step 6: Corrective Action Trials: - *Material Substitution*

Pomalux Substitution – Static Dissipative

**Note:** Conduct Proof of Concept First – If possible
Step 6: Corrective Action Trials: - *Temporary Ionization*

Do ESD Events Stop?

If yes, Repeat prior Steps to try to Correct Root Cause.

Add Ionization **Only** if other steps do not work!

Go to Next Step
Two Automation Case Studies

Customer Requires 50 Volt Qualification
Class 000 (< 50 V) Automation Qualification

- Are Voltage Measurements the Correct Criteria?
  - No! Current (not Voltages) Causes IC Damage
  - Customers Require Class 000 Certification for 50 volt Devices
    - Often Current Thresholds Not Available
- Discharge Currents & Voltage
  - Difficult to Measure
    - Due to Process Speeds
    - Limited Access Points
    - Pausing for Measurements Alters Charge/Voltage Levels
Class 000 (< 50 V) Automation Qualification

- ESD Event Detection – Good Option
  - Can be Correlated to Voltage on Devices in Automation Tool
  - Requires Calibration of Event Detectors
    - CDMES Provides Reproducible CDM Source In-situ
    - Creation of Calibration/Characterization Curves
  - Event Free Automation Ultimate Objective
    - Justification for 50 Volt Certification/Qualification
ESD Simulator & Test Equipment
# Simco-Ion Mini Pulse Set/Reject Table

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<th>Distance (inches)</th>
<th>MP Setting</th>
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<td>1.84</td>
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Simco-Ion MiniPulse

- **Setpoint Adjust**
- **Beeper**
- **Setpoint**
- **No Alarm LED**
- **Ground**
- **Alarm LED**
- **Power**
- **Antenna Input**
- **Alarm Output**
- **9-24Vdc**
- **30mA**
- **ANTENNA INPUT**
- **ALARM OUTPUT**
200 Volts on Device
Evaluate Risk With Event Detection
200 Volts:
No ESD Events Above 10 Volts

Event Detector Antenna
30 Volts on Device
Evaluate Risk With Event Detection
30 Volts on Device
ESD Events Detected – Must Determine Source!
Case Study #2: 50 Volt Qualification
MyData Automation Pick & Place Tool Case Study: 50 Volt Qualification
Tests Conducted

- Fields
  - Electrostatic Voltmeter
- Ionizer Performance
- Resistance Measurements
  - RTG; SRM
- Material Qualification
- ESD Event Detection
  - 50 Volt Sensitivity Settings
Circuit Board Input Tray
ESD Event Detector Location
Circuit Board Input Tray
ESD Event Detector: Location and 50 V Sensitivity Setting
ESD Event Detector: Location and 50 V Sensitivity Setting
RF Interference: Vacuum Line Relay
RF Interference: Vacuum Pump Starter Capacitor
Input Tray Materials
Input Tray Materials
Input Tray Materials
Individual Device Input Tray: SRM - Dissipative Powder Coat Paint
SRM Double Sided Tape
Pick Up Nozzle RTG
Pick Up Nozzle Resistance
Questions?

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