

# Test & Repair Methods for Electronic Assemblies

# Test & Repair Methods

- Brief History of the Presenter
- Testing Method Hierarchy
- The General Fault Spectrum of Electronic Assemblies
- Typical Repair Processes
- **Process Control Outlet Repair Process**

# Test & Repair Methods

## A bit about the Presenter.....

- 10 Years – Senior Test/Repair Technician
- 12 Years – Senior Test Engineer / Manager
- 10 Years – Repair Center Manager
  - OCS / DCS Systems
  - QCS Systems
  - Drives
  - Process Analytics (Gas Analyzers)
- Technical Product Specialist for PCO

# Test Method Hierarchy

System Testing

Functional Testing

In-Circuit Testing

Manufacturing Defects Analysis (MDA)

Visual Inspection

# Test Method

## System Testing

- Benefits
  - Full Functional Test in a “Real” System Environment
    - Verifies Functionality / Compatibility with other Parts of System
- Limitations
  - Very Difficult to Locate & Isolate Failures
    - Little or no Access to Trouble-Shoot Failed Devices

# Test Method

## Functional Testing

- Benefits
  - Total Access to all Nodes for Trouble-Shooting
  - Complete Control of Input Stimulus
  - Allows Control of CPU / RAM / ROM via Emulation
- Limitations
  - Requires Customized Fixture for Providing Power & Stimulus
  - Each Fixture is Potentially Unique

# Test Method

## In-Circuit Testing (Bed-of Nails & Walking Clip)

- Benefits
  - No Specialized Test Fixture to Interface with Assembly
  - Each Component is Tested Individually, sometimes in Clusters
  - Allows for Parametric Testing of each Component, assures each Component meets Device Specifications (Input / Output Degradation, slow Rise Time, ESD Damage, etc)
  - Same as MDA's but on smaller scale
  - Allows Testing of any Architecture
- Limitations
  - More Time Consuming for Test Development

# Test Method

## Manufacturing Defects Analyzer

- Benefits
  - Highly Automated for High Volume through-put
  - Typically Integrated directly into Manufacturing Assembly Line
  - Can implement full In-Circuit & Functional Test Methods
- Limitations
  - Unique Fixture required for each Assembly
  - Extremely Expensive Method, only used by OEM's for New Production

# Test Method

## Visual Inspection

- Benefits
  - A must for all Test & Repair Processes
  - May quickly determine Cause of Failure or an Impending Failure
  - May indicate Environmental Problems
  - Other Physical Damage
- Limitations
  - Not a Substitute for previous Test Methods
  - May require Microscope in addition to un-aided Human Eye

# Fault Spectrum

Catastrophic Failure

Failed Component

Thermal Intermittent

Degraded Component

No Fault Found (NFF)

# Fault Spectrum

- Catastrophic Failure
  - Indication - Component fails, burns PC Board, Carbon Tracks & Heat produces additional failures of surrounding Components
    - Cause – Incorrect Installation
    - Cause – Voltage Transients
    - Cause – Field Wiring Problems / Connections
    - Cause – Contamination (Dust, Chemicals, Water, Oil)
    - Cause – Ventilation
    - Cause - Component Fatigue
  - Typical Result – Assembly is Destroyed and should not be Repaired

# Fault Spectrum

- Failed Component
  - Indication – Simple Component Failure, Part ceases to Function
    - Cause – Infant Failure
    - Cause – Marginal / Degraded Component
    - Cause – Voltage Transients
    - Cause – Overheating (possible Environmental concern)

# Fault Spectrum

- Thermal Intermittent
  - Indication - Components develops a condition such that at certain Temperatures, normal function ceases.
    - Cause – Usually a Manufacturing Defect
    - Cause - Sometimes caused by operating at marginal temperatures for extended periods (Environmental issue, Air Flow)

# Fault Spectrum

- Degraded Component
  - Indication – Assembly functions, but not correctly
    - Cause – Manufacturing Defect
    - Cause – Thermal Fatigue
    - Cause – External Contamination
    - Cause – Expendable Component (Battery, Lamps, Capacitors, Fuse)

# Fault Spectrum

- No Fault Found
  - Indication – No Failures are diagnosed, part works correctly when re-installed
    - Cause – Incorrect Diagnosis when System Failure occurred
    - Cause – Mixing up parts in the “Heat of the Battle”
    - Cause – Contamination removed during initial Cleaning Process
  - As many as 22% of all reported failures are valid No Fault Found, many times corrected by Cleaning Process (from a study I did at ABB)
  - Controlled Thermal Stress of Components is frequently performed to uncover Thermally Sensitive Components

# Repair Process

## Typical Repair Process

- Visual Inspection
  - Cleaning
  - Testing
    - In-Circuit, Functional, System
  - Fault Isolation
  - Component Replacement
  - Preventive Maintenance Component Replacement
  - Burn-in
  - Repair Completed
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graph TD; A[Preventive Maintenance Component Replacement] --> B[Testing]; C[Component Replacement] --> B; D[Burn-in] --> B; E[Burn-in] --> F[Preventive Maintenance Component Replacement]; F --> D; D --> C; C --> B;
```

# PCO - Repair Process

- Thorough Visual Inspection
  - Including Microscopic Evaluation
- Cleaning of Electronic Assembly
  - Removal of Environmental Contamination is Critical!
- Customized Test Method
  - In-Circuit Test – Verifies Each Component for Functionality, Identify the Walking Wounded
  - Functional and / or System Testing for Full Functionality Verification
- Preventative Maintenance (Expendable Components)
  - Electrolytic Caps, Batteries, BATTRAM's, etc
  - Design Improvement\* (Replace poorly selected Components)
- Burn-In
  - Insure no Thermal Faults Exist

# PCO Repair Process

- A Footnote about OEM Recommended ECN's
  - ECN's (Engineering Change Notices) tend to be the "Holly Grail" of why 3<sup>rd</sup> Parties cannot perform Repairs. False!
  - Most ECN's occur Early in Product Life Cycle and are related to Performance Issues
  - Late ECN's are the result of Obsolete or Discontinued Components

The Bottom Line - Once the Defective Component(s) are Isolated & Replaced, the Electronic Assembly will Function just as it always has.

Test Methods

Questions?

Comments?

# Contact Us

Feel free to contact us about any of the information you have seen in this presentation or if you have any questions about the products and services we can provide.

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