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Automated Contact Resistance Tester CR-2604

The World Depends on Sensors and Controls

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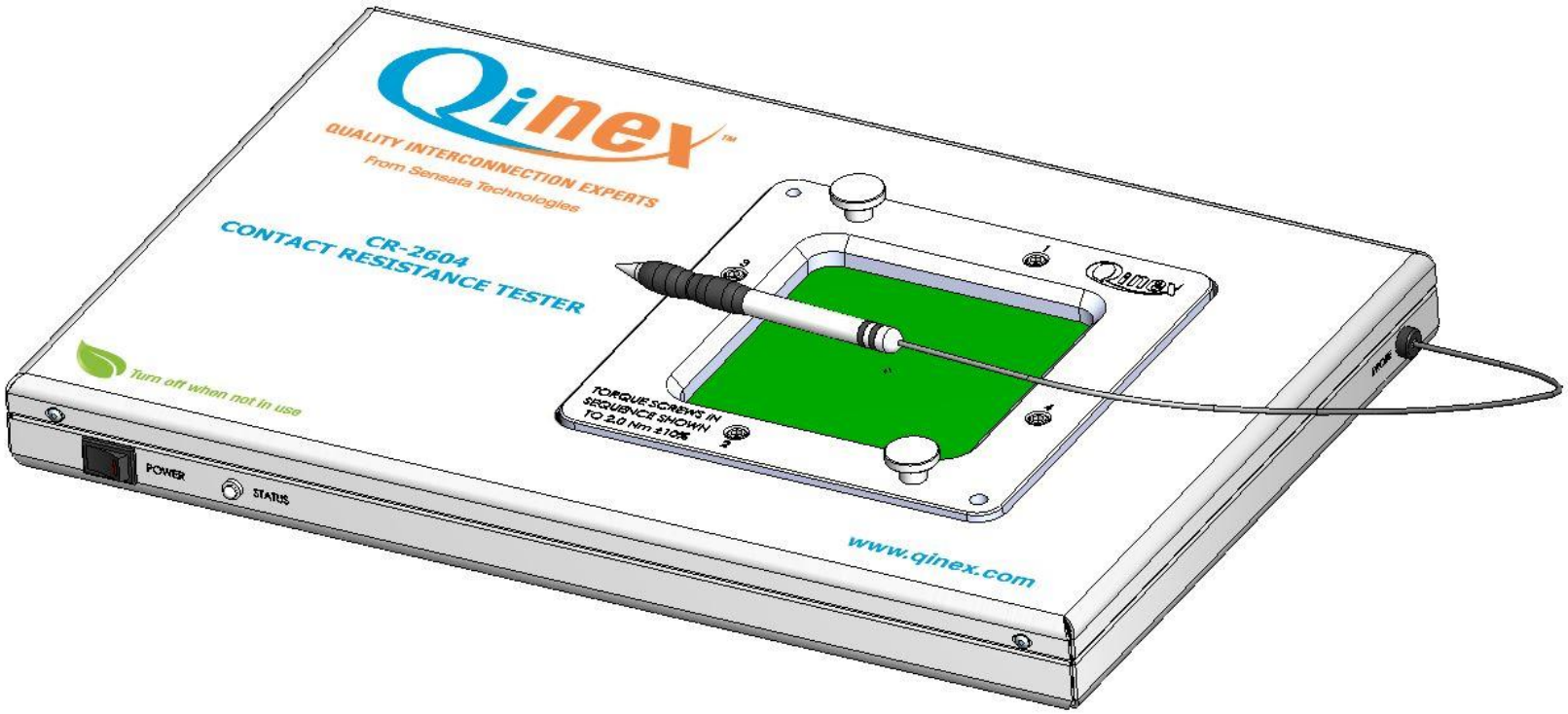
What's New



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What's New

- Summary of Software Improvements:
  - Improved CRESHost V1.3.9
    - Print/Save image support for Win7
    - Added view of diagnostic log file
    - Support Win7 USB connection at power up
    - Improved verification file format for easier PASS/FAIL display
  - Improvements made for better reliable USB connectivity with CRESHost V1.3.9
  - Software adjustment to incorporate the revision change on microprocessor within CR tester.

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CR-260X Users

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CR-2604 Payback Periods Customer Example

- Production Use
  - Customer utilizes CR-2604 to avoid throwing out good pins
  - Customer uses 385,693 pins per quarter at average cost of $1.89 each
  - Customer saves average of ~10% Pins that were previously thrown away
  - **1 month Payback period**

- Lab Use
  - Customer utilizes CR-2604 on a project basis
  - Cost savings derived from savings of Tester & Engineering time = $3000 per project
  - **9 project Payback Period (<1.5 years)**

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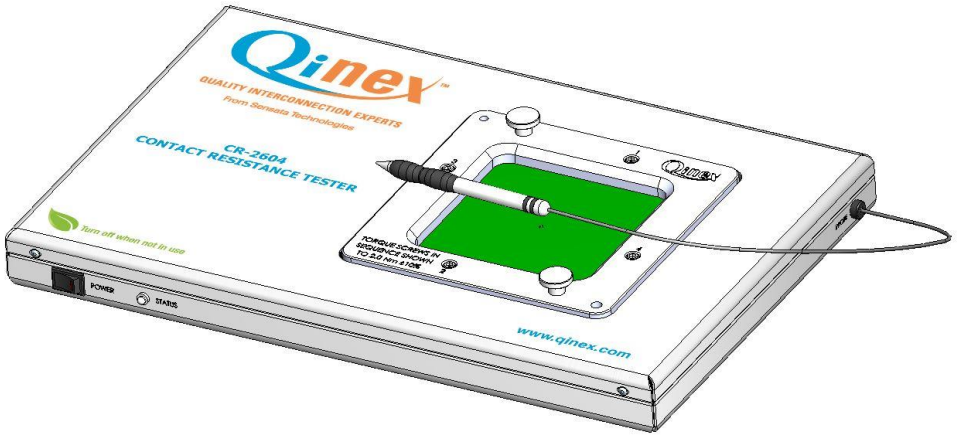
CR-2604
Contact Resistance Tester

- **Incoming Socket Inspection**
- **Routine Socket Performance Verification**
- **Pin Resistance/Opens**
- **Pin Shorting**
- **Socket Preventative Maintenance**



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Introduction

Test Socket

- **What is a test socket?**

  The single interface between a device being tested and a > $100K ATE

- **How do you know the test socket is "good"?**
- **How do you test a test socket?**

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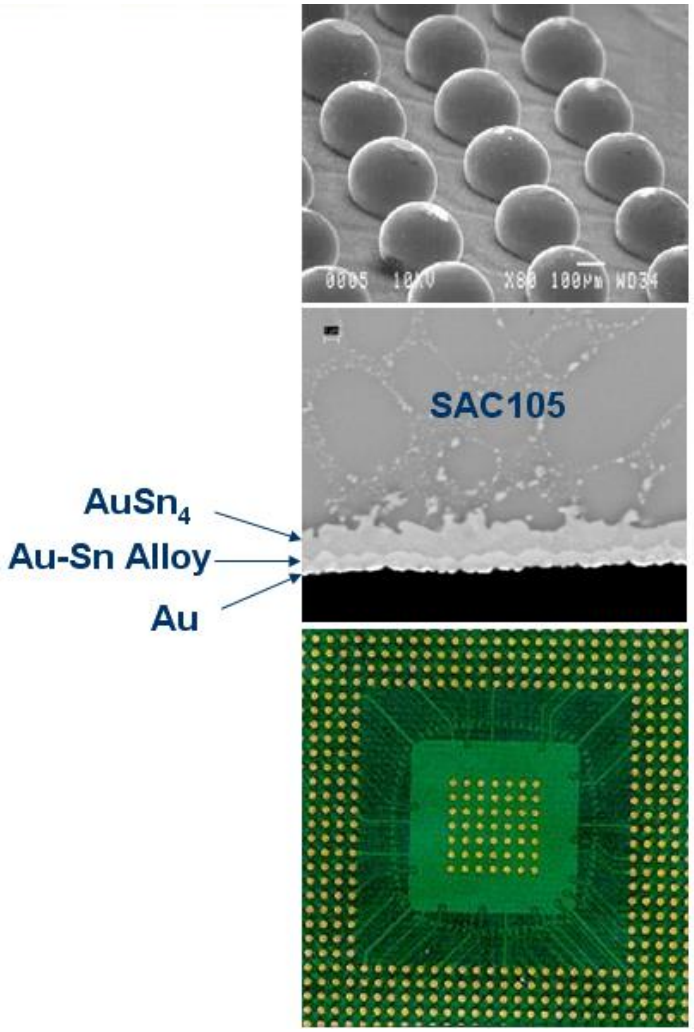
Introduction – Industry Conditions

- **Decreasing Pitches**
  - 1.27mm 1mm 0.8mm 0.5mm 0.4mm …
  - Smaller pitches require new and more complex socket probe designs.
- **RoHS Directive**
  - The proliferation of solder ball compositions such as SAC105, SAC305 and SAC405 lead to new contamination problems.
- **Increasing Device I/O Count & Power**
  - Systems on chip are driving up I/O counts.
  - High performance devices are requiring more power.



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Introduction – Industry Need

Problem: Inconsistent and unreliable socket performance

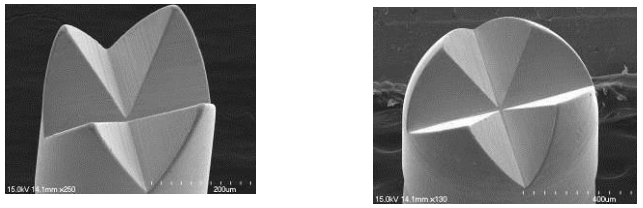
Cause: Contamination build-up on socket pins

Why is high contact resistance bad?
- Can cause excessive pin heating
- Limits available power on supply pins

Why is inconsistent contact resistance bad?
- Decreased yield
- Intermittent failures
- Equipment downtime to resolve "problem"
- Difficult to detect and isolate in ATE

A system is needed to identify failing socket pins before they impact production schedules and yield.
- High contact resistance is an early indicator of failing socket pins caused by wear or contamination
- Sometimes ATE capital equipment can measure this, but the *time is expensive and not flexible*
- Both the contact (spring-loaded pin, elastomer, etc) and the device interface need to be measured

Solution: A device to independently verify a socket's performance by measuring the resistance of each pin.



Socket Pin With New Pins

When?
How many cycles?
Which pins?

Socket Pin With Contaminated Tips

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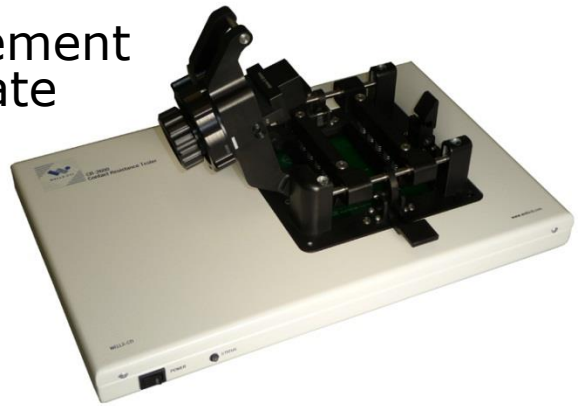
CR-2604 Socket Contact Resistance Tester

- The CR-2604 tester is a portable, easy to use tool used to validate socket integrity by measuring contact resistance.
- Measure your socket's contact resistance using this PC compatible, lightweight, measuring tool.
- The CR-2604 tester will allow you to identify the locations of open or high resistance pins within your socket array.
- The user interface is displayed on a Windows XP or Windows 7 computer via USB connection.
- No standard maintenance required on tester. The unit has 8 internal low-drift precision 4-Wire resistors for reference. Before each measurement cycle, these resistors are measured to calibrate the measurement circuitry.



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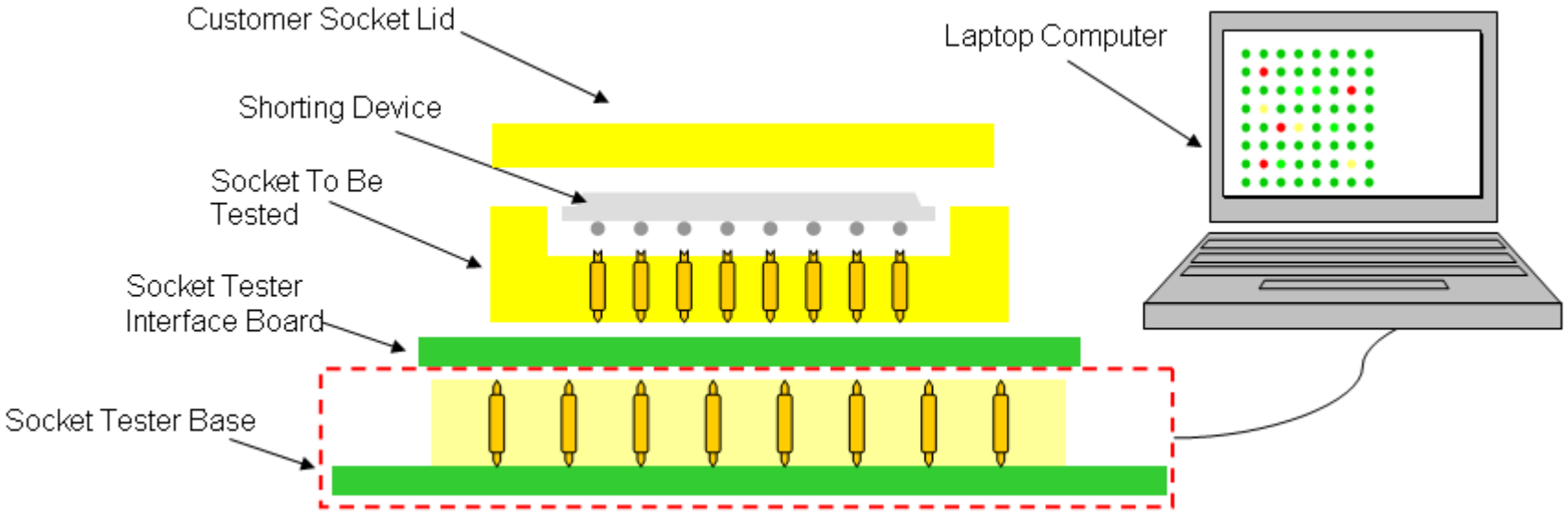
Solution Overview



- **Shorting Device:** Shorting/Daisy chain package
- **Socket and Lid:** Spring Probe Socket to be tested
- **Interface Board:** Footprint specific, socket interface card.
- **Socket Tester Base:** Electronic circuitry to perform tester function
- **Host Computer:** Runs Tester software to configure tester and report results

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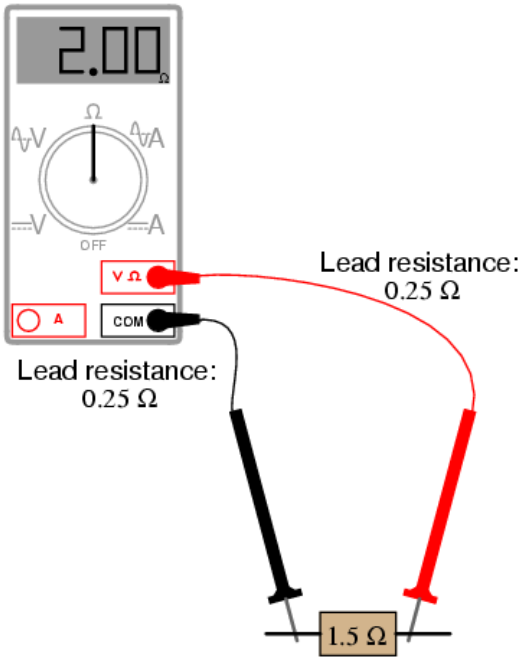
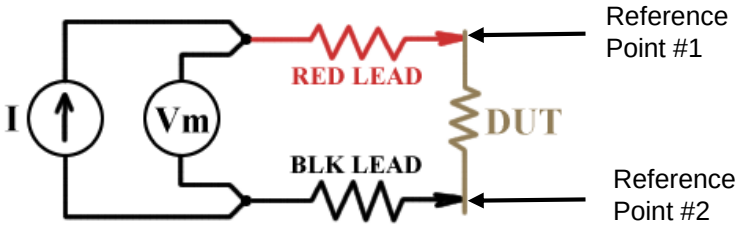
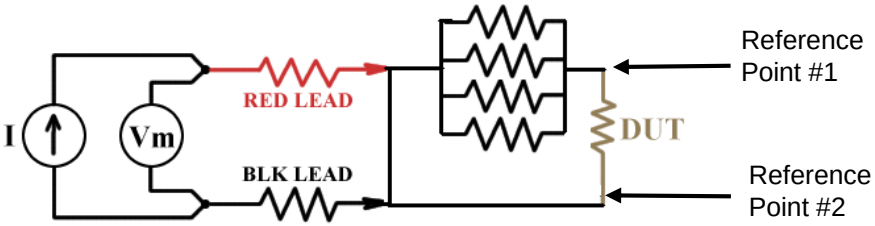
Resistance Measurement Methodology

WORST PIN MEASUREMENT METHOD

- 2-Wire Standard Approach
  - NOT used by the CR-2604 Tester
  - Measure the DUT resistance plus the test lead resistance
  - Cannot accurately measure low-valued resistors (pins)
  - Typically can only measure Pin pairs plus lead resistance losses (NOT individual Pins)







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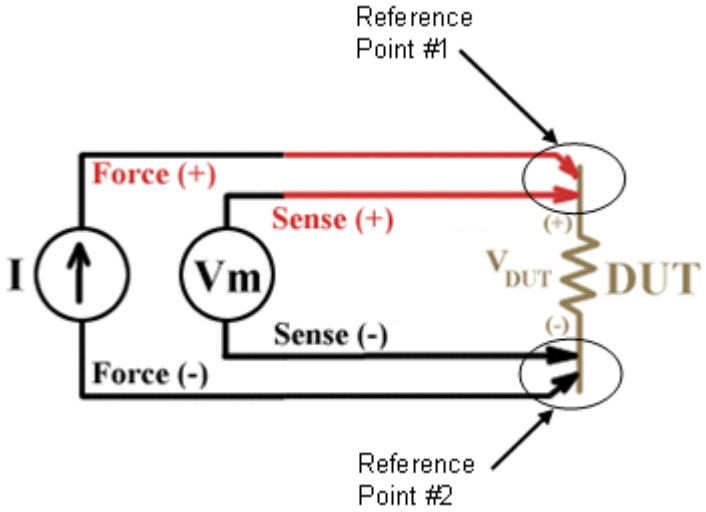
Resistance Measurement Methodology

BEST PIN MEASUREMENT METHOD

- 4-Wire (Kelvin) Approach
  - USED by the CR-2604 Tester
  - Eliminates PCB and Cabling From Measurement
  - Requires Separate Current & Voltage Path
  - Accurately measures low-valued resistors
  - Allows for single pin measurement



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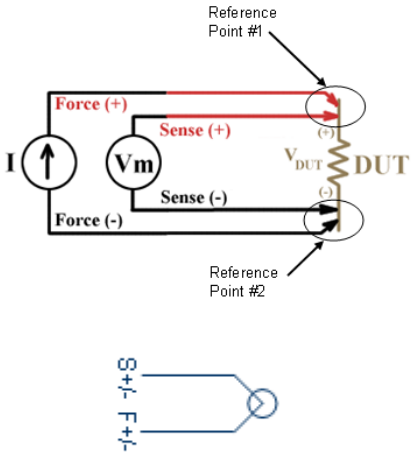
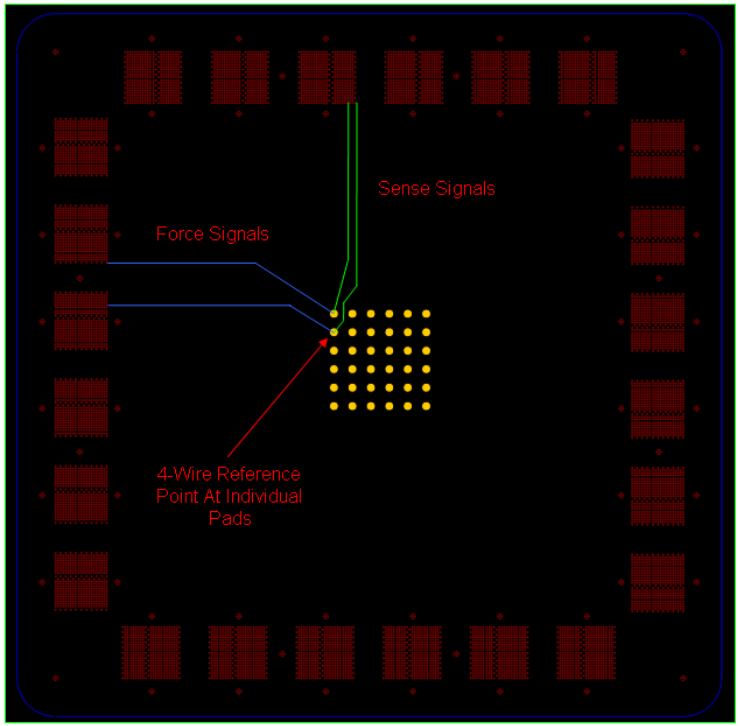
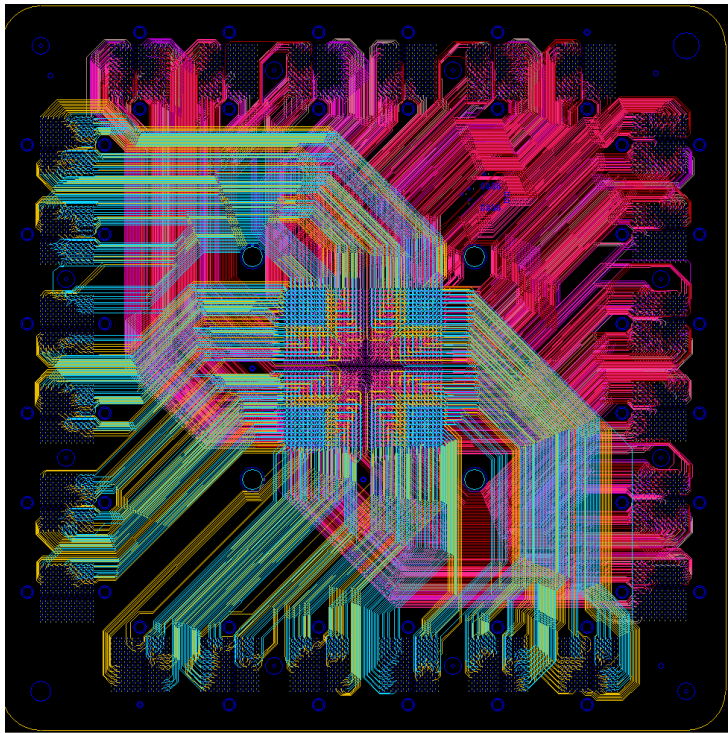
CR-2604 Measures Only the Pin Resistance (no bulk)?

- 4 wire measurements
- Tester interconnects, traces, and switches not included in measurement
- 4-Wire reference at DUT pad







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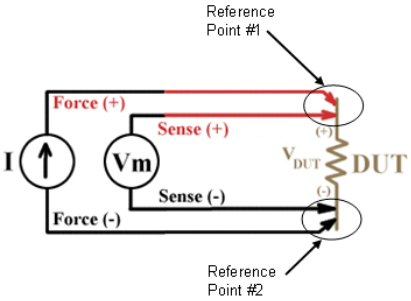
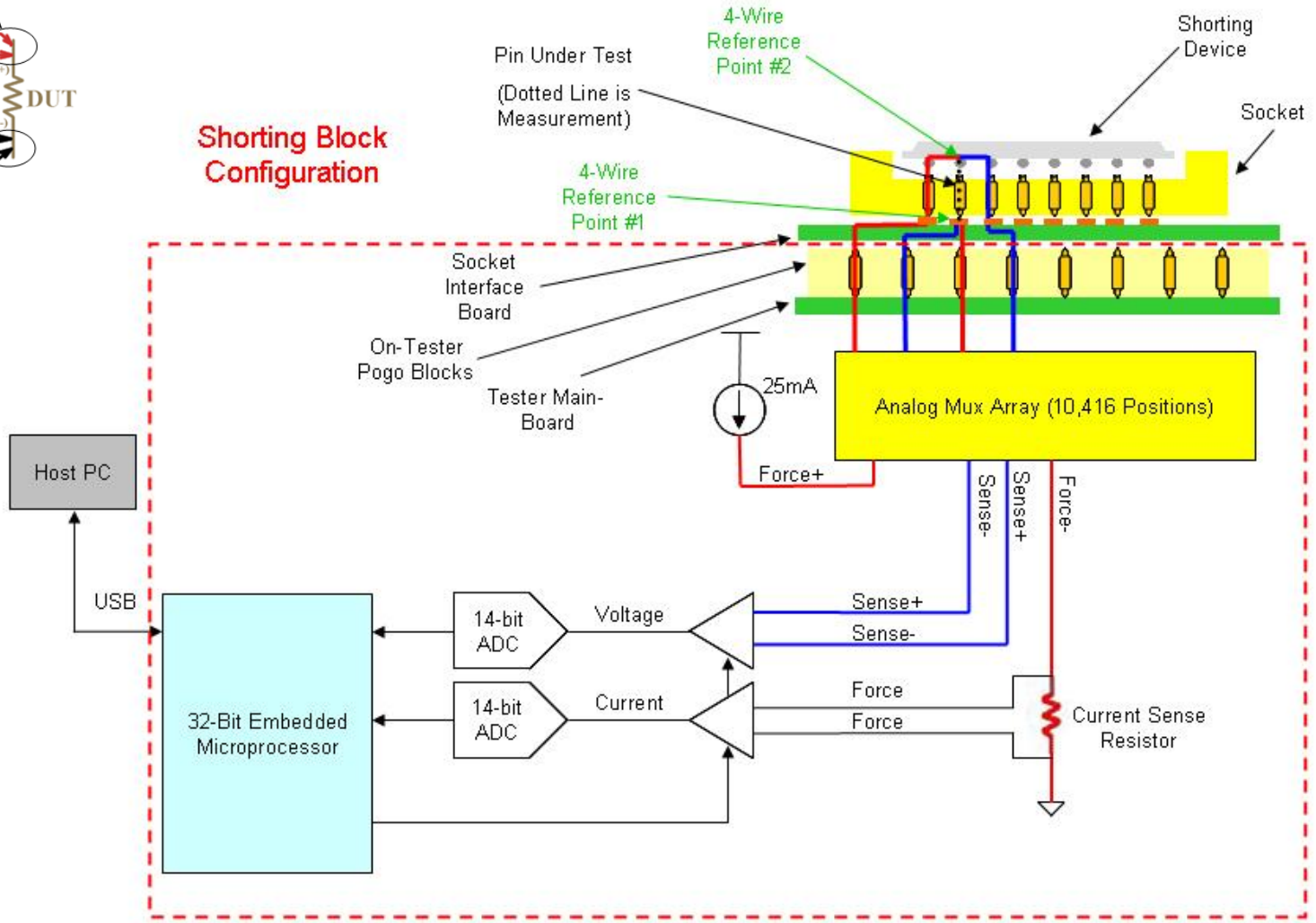
Electrical System Block Diagram Using Shorting Block





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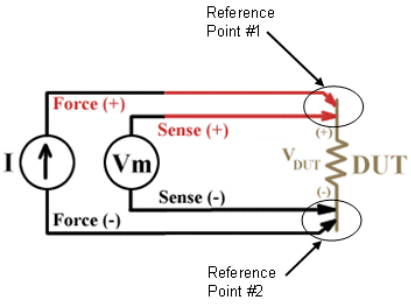
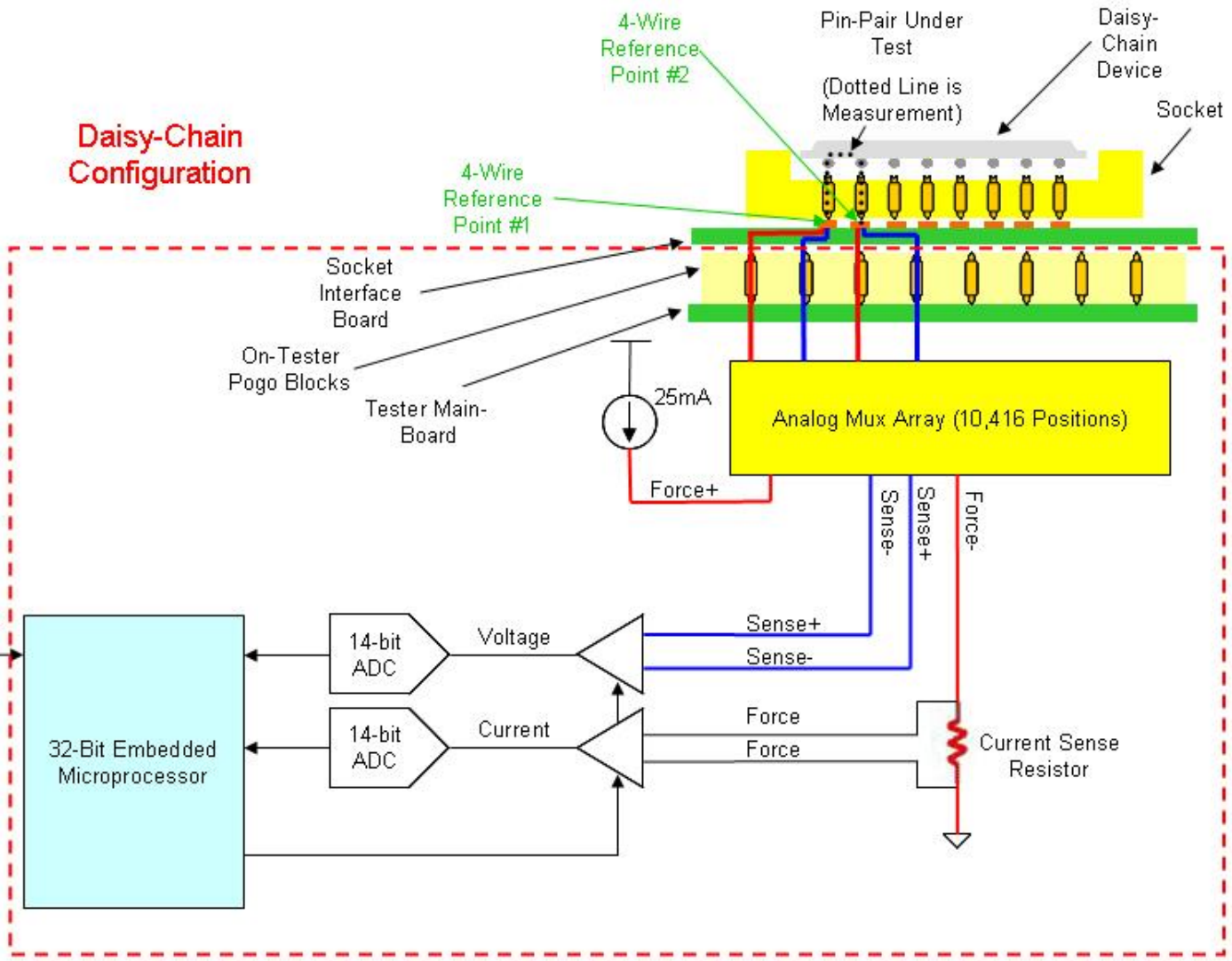
Electrical System Block Diagram Using Daisy Chain Device



Daisy-Chain Configuration



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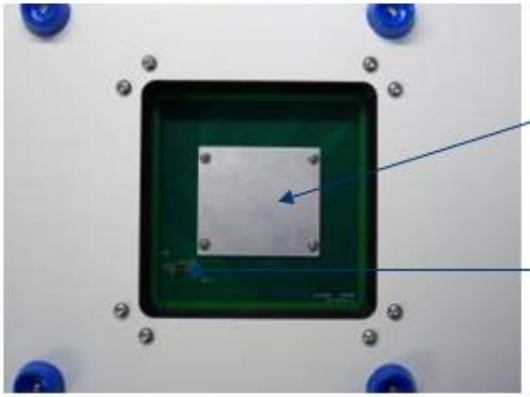
Socket Mounting on Interface Board

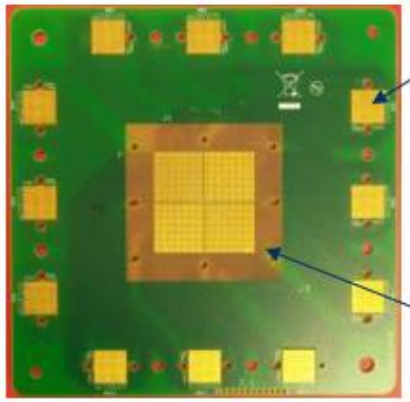
Bottom View



Bottom of Socket Interface Board Access

EEPROM For Serialization And Netlist

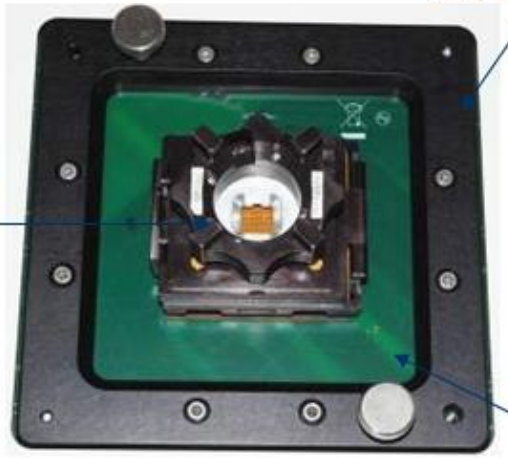
Interface Board



Interface Board To Main Board Pads

Test Socket Pads

Mounting Plate



Customer Socket

Interface Board

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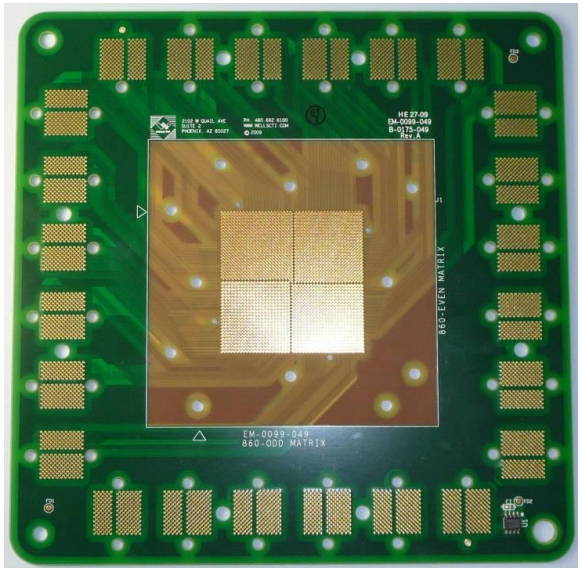
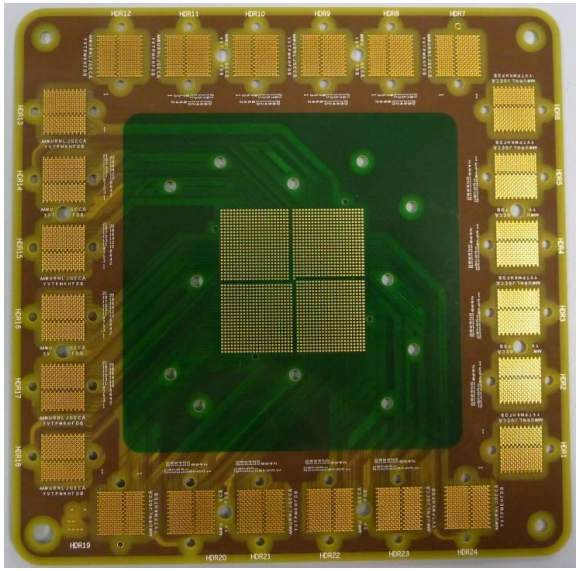
Interface Boards

- The CR-2604 uses interface boards to map a socket footprint to the common tester footprint
- ALL BOARDS PURCHASED FOR USE ON THE CR2600 or CR2601 ARE COMPATIBLE WITH THE CR2604
- Up to 2604 test points (5208 4-Wire traces)
- Interface Board is 7”x7”, variable thickness (usually 0.093” – 0.125” thick)



Interface Board Top View



Interface Board Bottom View

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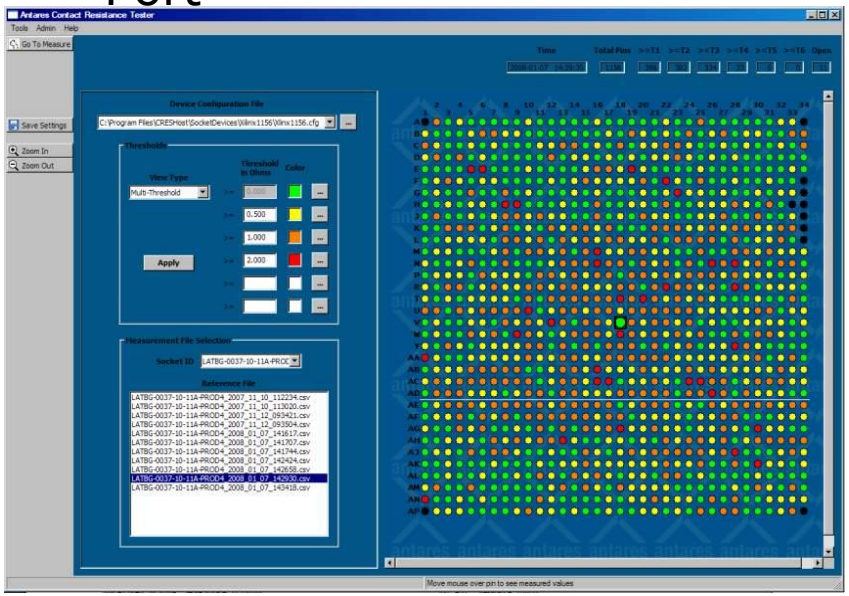
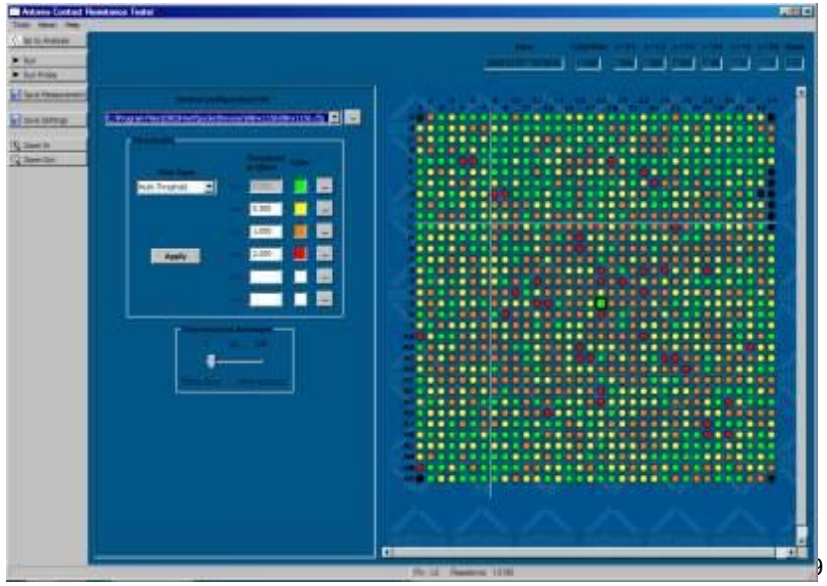
CRES Host Software – User Interface

- Controls CR-2604 tester and allows measured values on all pins to be viewed
- Allows manual saving of socket data for later analysis (CSV Format)
- Compares multiple data sets for trend analysis
- Configurable color-coded resistance thresholds
- Requires Windows XP or Windows 7 computer with Available USB Port





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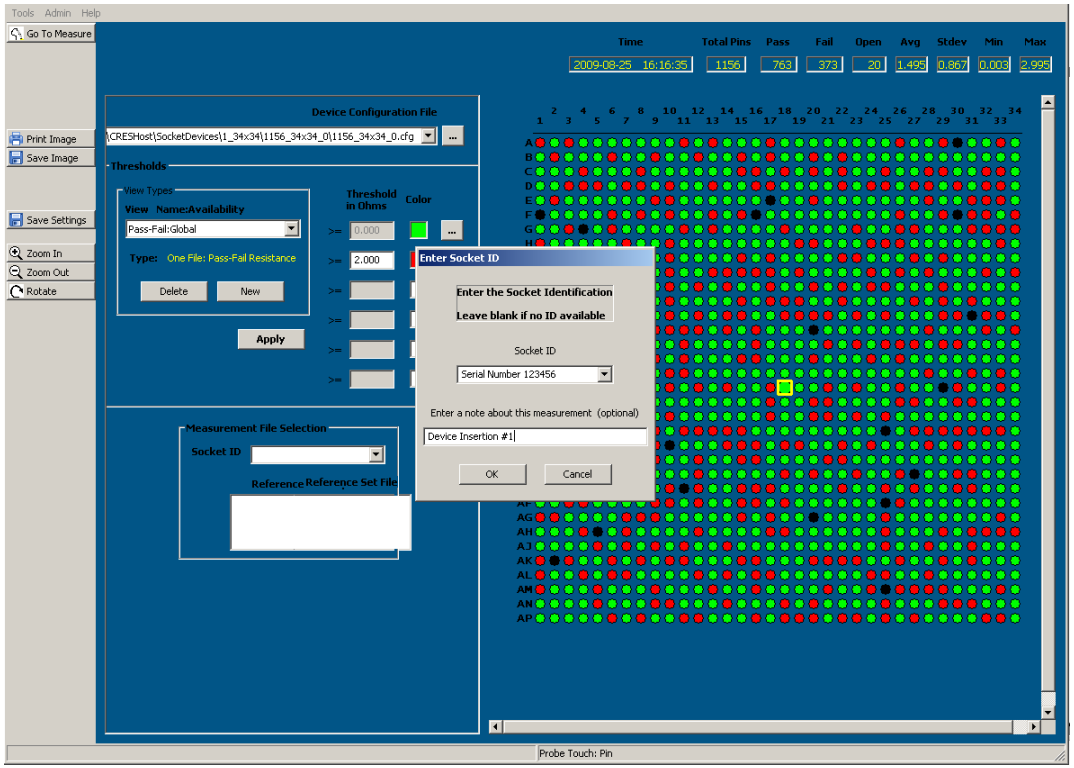
CRES Host Software – User Interface

- Socket Labeling, notes about the test conditions
- Administrator and User modes. Password Protected



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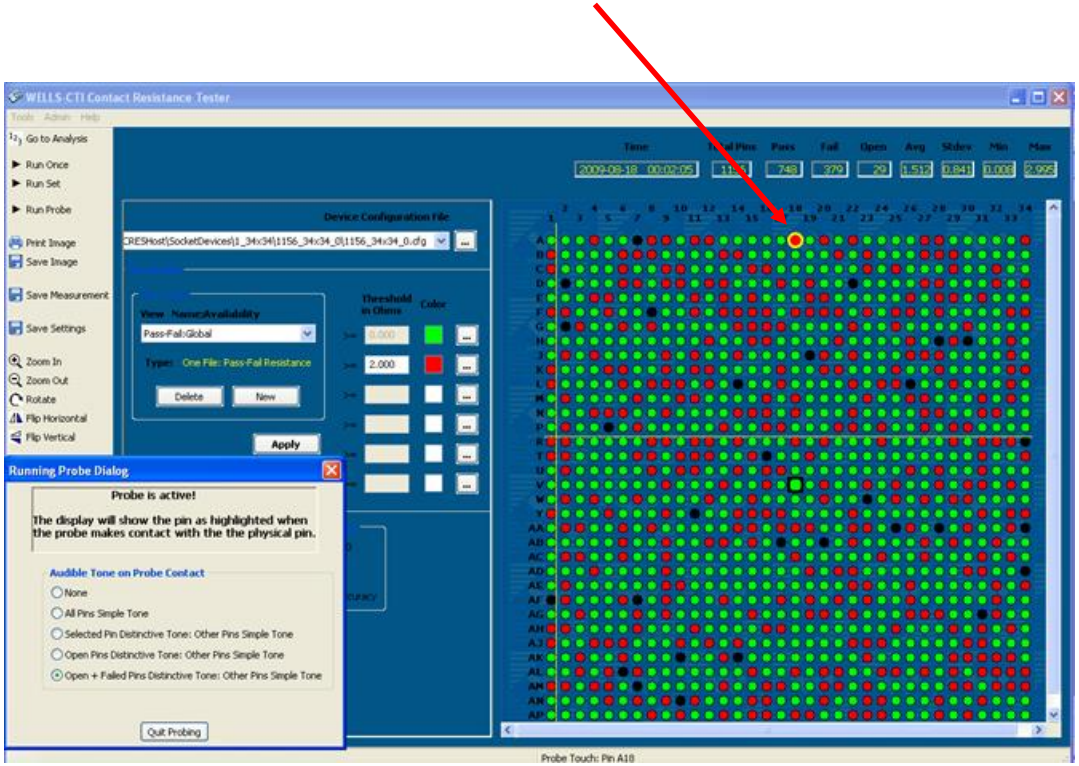
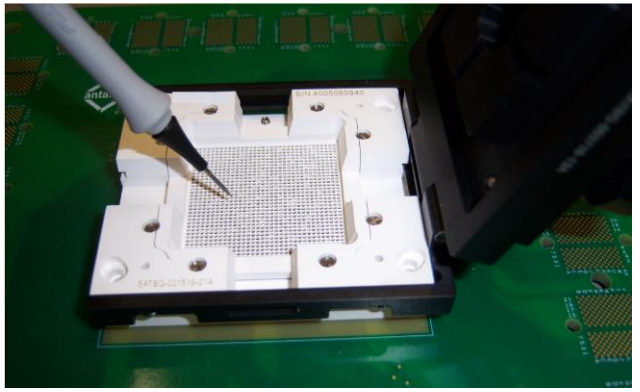
Test Probe Pen

- The included handheld test probe allows easy identification of failed pins
- After performing a measurement, probe mode shows the specified pin on the computer screen when it is touched with the test probe pen





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CR-2604
Contact Resistance Tester Specifications

- 4-wire pin measurements up to bulk of shorting plate.
- Resistance measurement range: 0 ohms to 300 ohms
- 0.5% or 5 mΩ Overall Accuracy, whichever is greater (using Wells-CTI Verification Board, see slide 24)
- Maximum socket I/O supported 2604 pins
- Force Current ~25mA (variable, not adjustable)
- Average Measurement Time : 25 Pins / Second (depending on averaging setting)

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Options – Universal Manual Actuator

- Allows socket to be tested without attaching to interface board with screws.
- Enables quick socket changes
- The plunge depth of actuator pressure pad is configurable and repeatable.
- Comes with replaceable pressure pads supporting packages from 10mm to 50mm.

Manual Actuator Video

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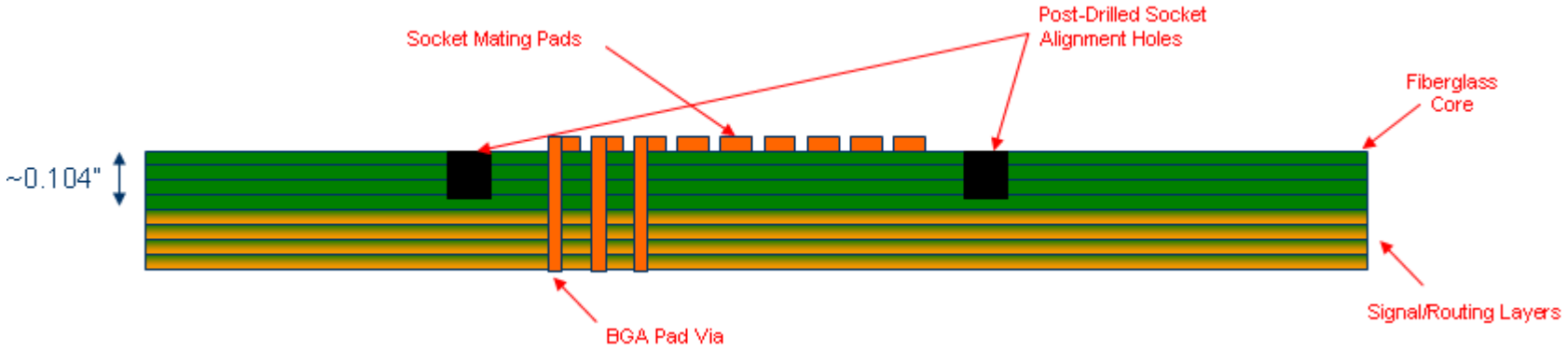
Options – Universal Interface Boards

- Requires Universal Manual Actuator Unit.
- Inexpensive quick turn generic interface boards compared to custom designs.
- Quick socket change out when testing multiple sockets.
- Stocked and post-drilled to accommodate socket alignment features
- Can often support multiple socket footprints
- Available for pitches:

Part Number	Pitch	Matrix Size	Pad Size	Max Dowel Pin Length
EM-0099-100	1.27mm	51x51	30 mil	2.54mm
EM-0099-101	1.0mm	51x51	25 mil	2.54mm
EM-0099-102	0.8mm	40x40	17 mil	2.54mm
EM-0099-103	0.65mm	40x40	14.9 mil	2.54mm
EM-0099-104	0.5mm	40x40	12 mil	2.54mm



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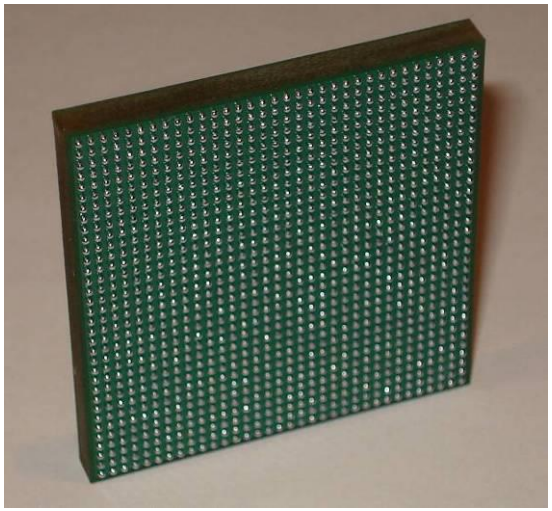
Options – PCB/BGA Shorting Packages

- BGA shorting packages
- 0.8mm and above pitches available
- Built to customer provided package specification



Advantages	Disadvantages
•Ball interface very similar to customer package •Cost per device is relatively low •Solder ball compositions Tin/Lead, SAC305, SAC105.	•Solder balls will wear out (estimated 50-100 insertions) •Reduced measurement repeatability •Minimum lot of 25 pieces

Please provide package details for quotation

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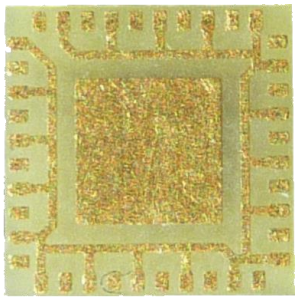
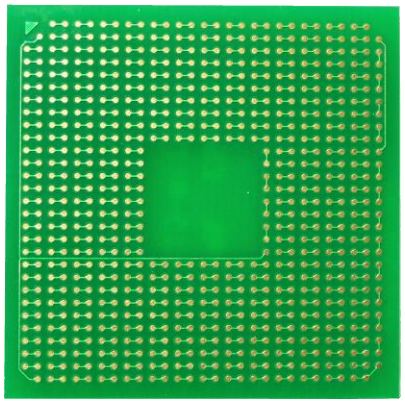
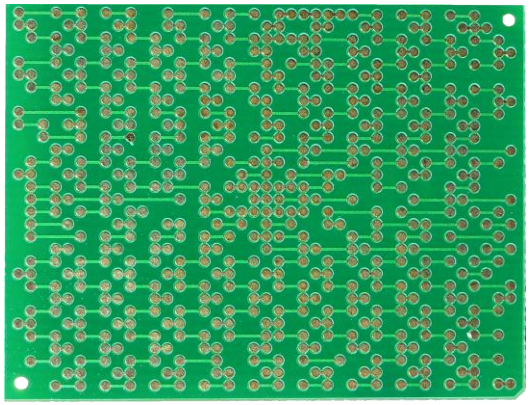
Options
LGA/QFN Shorting Packages

- PCB and Machined available
- Various plating options
- Built to customer provided package specification
- **WELLS-CTI recommends Gold plated pads for best repeatability**

Please provide package details for quotation

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Measurement System Repeatability

- To validate performance we have created verification cards (EM-0125) which are fabricated using commercially available precision resistors
  - The resistors are soldered to the verification card to eliminate any variance due to mechanically cycling the resistors.
- During the verification test each of the channels is used to measure the same resistor providing 2604 data points
- For repeatability verification the board is removed and re-installed and the test repeated. This repeat is performed 5 times producing 5 sets of data. Each data set includes 10,416 measurements
- The validation is conducted with 11 different resistances using different precision resistor boards. The resistor values range from 2.5 mΩ to 60,000 mΩ, or 60 ohms

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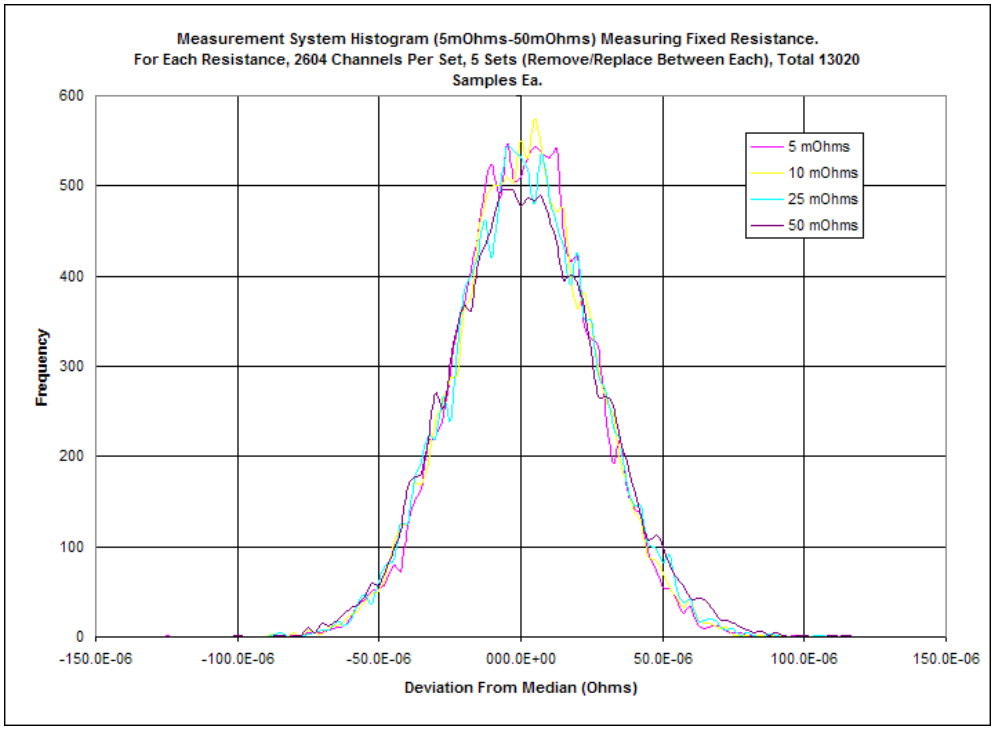
Measurement System Repeatability

R (mΩ)	σ (uΩ)	6σ (uΩ)
2.5	15.78	94.69
5	23.61	141.68
10	24.18	145.05
25	24.85	149.10
50	26.46	158.76
500	32.72	196.30
1000	33.36	200.15
2000	62.40	374.42
5000	89.08	534.49
10000	229.98	1379.89
60000	1074.41	6446.47



- The results are shown graphically. Note that the resistance values are reported in mili-ohms (mΩ) however the units of the std.dev σ are micro-ohms (μΩ)
- The data shows that:
  - the standard deviation is always less than 1% and, at the resistance of a typical pin, 50 mΩ **the std. dev is .05%.**
  - For 6 σ, which will include **99.9997% of the population, the error is less than 0.5%** at the resistances of interest.