Boss Interface Test Systems

Your Complete Connection

Boss Interface Test Systems

Presentation Outline

- CORPORATE HISTORY
- PRODUCT OVERVIEW
- SYSTEM OVERVIEW
- MEASUREMENT TECHNIQUES
- OPTIONS & ACCESSORIES

Boss Interface Test Systems

Product Overview – Features and Capabilities (1)

■ **System:** What is a BOSS Interface Test System? The BOSS Interface Test System is a tool used for verifying the electrical integrity of Test Interfaces. The core of the Interface Test System is the BOSS Tester. The BOSS Tester is a measurement instrument incorporating an Analog Measurement Board for Resistance, Capacitance, Leakage and Voltage Measurements. Multiple Relay Matrix Boards switch the Analog Signals to thousands of different Kelvin Connected Test Points

■ **Application:** Used for testing

- Burn-in Boards
- Load Boards
- Sockets/Contactors
- Cables
- Probe Cards (without Robotics)
- other Test Interfaces

■ **System Control:** PC Driven operating under

- Advanced PC-driven Interconnect
- MS DOS, Windows NT, Windows 2000 & Windows XP Operating Platforms
- ISA and PCI Interface Bus Protocol

Boss Interface Test Systems

Corporate History (1)

- **July 1983 - Triple S Engineering (TSE) incorporated in Colorado Springs, CO. Product Lines - Passive Component Testers for Probe Card and Burn-in Board Testing**

- **June 1985 - First Tester sold**

- **July 1993 - TSE Burn-in Board Tester Product Line sold to Motay Electronics, Chandler, AZ**

- **November 1994 – TSE sold to OZ Technologies, Hayward, CA**

- **December 1999 – OZ Technologies acquired by Cerprobe Corporation, Gilbert, AZ**

- **December 2000 - Cerprobe Corporation acquired by Kulicke & Soffa Industries, Willow Grove, PA**

- **March 2007- Exclusive manufacturing and sales rights to the TSE tester acquired by Delta V Instruments Inc.**

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Boss Interface Test Systems

Corporate History (2)

- **Present Locations:**
  - **Manufacturing and Sales – Richardson, Tx.**
- **Present Personnel/Support:**
  - **Direct Personnel – General Manager, Admin Assistant, Product Engineer, Technician**
  - **Hardware Design: Internal**
  - **Software Design: Internal**
  - **Sales: Direct, Distributor, Representative**
  - **After Sales Support: Direct, Distributor, Representative**

Boss Interface Test Systems

Product Overview – Product Evolution (1)

- 1985 – 1988: Semi-automatic Probe Card Analyzer (PCA)
- 1985 – 1985: Generation I Burn-in Board Tester. 384 Channels, 8 Bit Bus
- 1985 – 1997: Generation II Burn-in Board Tester. 384 Channels, 8 Bit Bus
- 1987 – 1990: XYZ Table Option for Generation II Testers
- 1988 – 1996: Generation III Burn-in Board Tester. 384 Channels, 16 Bit Bus
- 1988 – 1991: Automated Probe Card Analyzer. 1152 Channels, 16 Bit Bus
- 1989: Generation IV Burn-in Board Tester. 672 Channels, 16 Bit Bus
- 1994: Generation V Stacked Burn-in Board Testers. 5,376 Channels Max
- 1995: Generation IV & V Tester Hardware Upgrades for Load Board Testing
- 1996: Relay Control Option for activating Relays on Load Boards
- 1997: XYZ Table (R Tech designed) Option for Burn-in Board Testing
- 1998: Windows ISA IO Card and Windows NT Operating/Interim Database Software (V1.0) Option
- 1999: Digital Control Card Option Hardware. Software support on hold
- 2000: Windows NT Operating/Database Software (V2.0) Option
- 2001: Hardware & Software Upgrades for CRes Testing (accuracy from 100mΩ - 1Ω)
- 2002: Windows PCI IO Card and Windows 2000/XP Operating/Database Software (V2.5) Option

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Product Overview – Product Evolution (2)

- **2004: High Accuracy Calibration Verification Box (Calbox) for system profiles**
- **2008: Scheduled Hardware & Software Upgrades for improved accuracy from 1mΩ - 100mΩ**
  - **Analog Board Auto Calibration Circuitry Software Upgrades V3.0**

Boss Interface Test Systems

Product Overview – Features and Capabilities (2)

- **Programming and Database Storage:**
  - Test Programming using Text Editor, Spreadsheet, and File Conversion
  - Scramble Files simplify Programming
  - Channel Scan for Generating Scramble Files
  - Permanent or Temporary Database Storage using Microsoft Access
- **Measurement Features:**
  - Tester Chassis capable of 672 Channels. Expandable up to 5,376 Channels
  - Auto-Calibrating System to insure accurate Measurements
  - Unparalleled Accuracy: Two-Wire and Four-Wire Kelvin Measurements
  - Driven Guard (Six-Wire Kelvin Measurement) capability for measuring Parallel Resistors
  - Unique Pin-to-Pin Leakage Measurement insures 100% Test Coverage
  - Multiple Force and Ground Application for Parallel Measurements
  - Auto-Range Control for reduced Measurement Time
  - One-time Testing capability for reduced Measurement Time
  - Zoning for Testing Sockets with non-common Edge Connector Points
  - Measurement Offset for Nulling out Stray Measurements (Windows only)
  - Diagnostics Capability for isolating Leakage Paths
  - Channel Scan for Troubleshooting Interconnects
  - Low Voltage Leakage (0.5V) to prevent turning on PN Junctions

Boss Interface Test Systems

Product Overview – Features and Capabilities (3)

- **Options and Accessories:**
  - High voltage (37V) Option for Zener and Leakage Test
  - Relay Control Card Option for closing Relays in Series with Traces
  - XYZ Robotics Option for Burn-in Board Testing (R Tech designed)
  - Test Benches and Rack Options for Ergonomics
  - Complete Line of Accessories
- **Documentation, Certifications & Reliability:**
  - Comprehensive Software and Hardware Manuals
  - External Calbox for NIST Traceability
  - Full Compliance with Mil-Std 883 and 38510 Testing
  - ETI and CE Certified assuring Construction meets Worldwide Standards
  - Mean Time Between Failures (MTBF) > 40,000 hours
  - Two Year Parts and Labor Warranty

Boss Interface Test Systems

System Overview – BOSS Tester

■ **The BOSS Tester is the core of the Interface Test System and consists of a hardware/software combination driven by a PC using the MS DOS® or Windows® Platform. The PC and Tester communicate through a Proprietary Plug-n-play PCI Bus Interface Card with On-board Processor and memory. The Tester may be a Single Unit or Multiple Units (672 Maximum Channels each) mounted in an Optional Ergonomic Bench or Rack.**

Boss Interface Test Systems

System Overview – Specifications

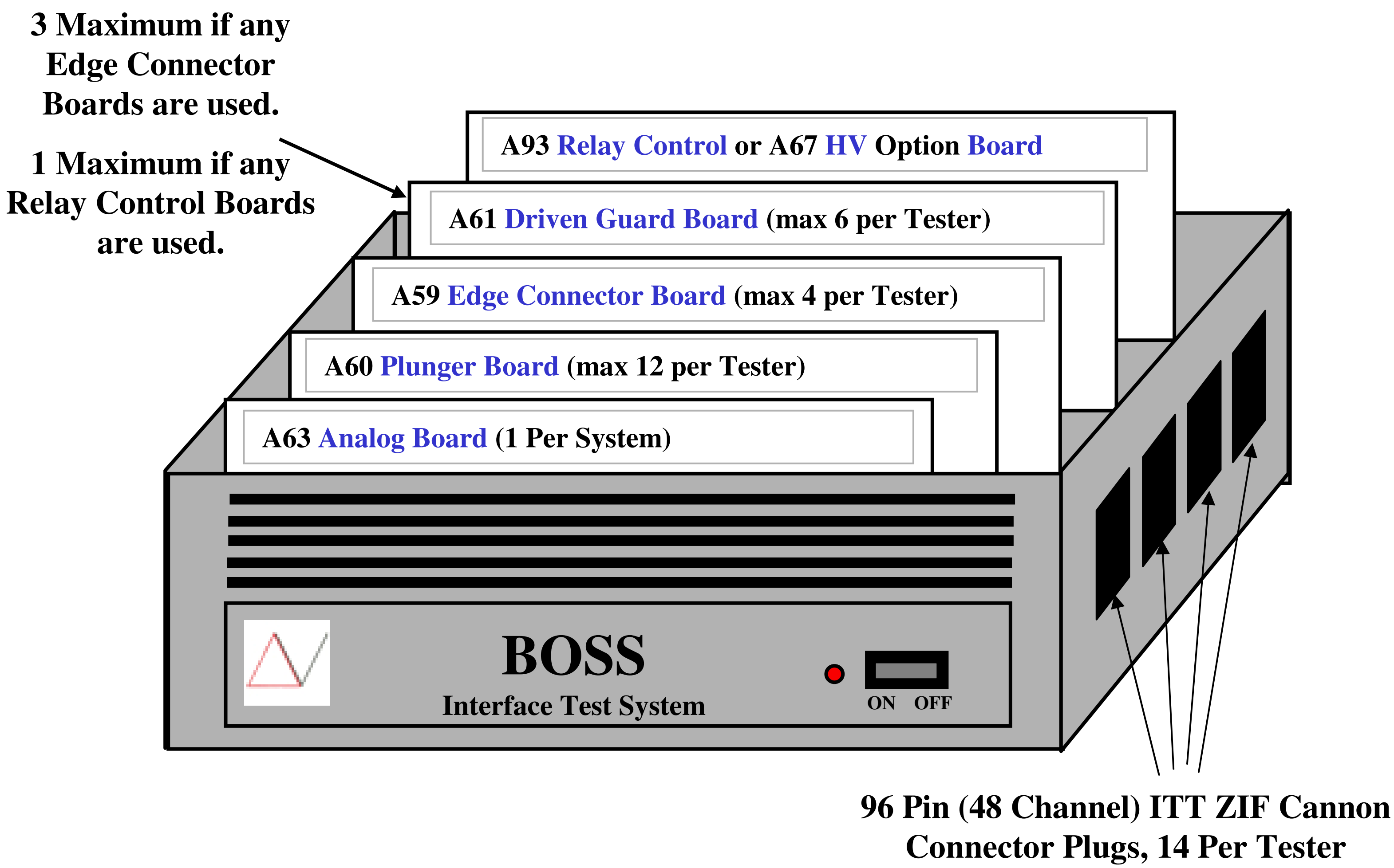
- **General Specifications:**
  - **Operating Temp:** 0º to +50ºC (+32º to +122ºF)
  - **Storage Temp:** -40º to +70ºC (-40º to +158ºF)
  - **Power Requirements:** 115/230VAC, +/- 10%, 7.5/3.75A, 50 to 60Hz,
  - **Dimensions:** 558.8 mm (22 in) W,
    203.2 mm (8 in) H,
    609.6 mm (24 in) D
  - **Weight:** 22.68 kg (50 lbs)

- **Measurement Specifications:**

Type	Range	Accuracy	Resolution	Technique
Resistance	1mΩ to 100MΩ	0.1%	0.1%	Force Constant Current; Measure Resultant Voltage
Capacitance	10pF to 10,000uF	5%	0.1%	Force Constant Current; Measure dV/dT
Leakage	5nA to 99.9uA	1%	1%	Force Constant Voltage; Measure Resultant Current
Voltage	0V to 9.5V	1%	1%	Force Constant Current; Measure Resultant Voltage

Boss Interface Test Systems

System Overview – Tester Design



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System Overview – Descriptions of Tester Boards (1)

- **Motherboard (A70): The Motherboard incorporates 15 Slots for insertion of the Analog Board, Relay Matrix Boards and Options. The motherboard incorporates a Bus Design and as such, is not slot dependent.**

- **Analog Measurement Board (A63): The Analog Board circuitry includes a Precision 4-Wire Ohmmeter, Ammeter, Voltmeter and Capacitance Meter. Additional circuitry includes Auto-calibration, Precision Reference and Driven Guard (6-Wire). The Analog Board provides the Force, Sense +, Sense -, Agnd, Driven Guard Force (DGF), and Driven Guard Sense, stimulus to the Relay Matrix Boards.**

- **Plunger Relay Matrix Board (A60): The Plunger Board provides switching for 4-Wire Kelvin Connections. It can route the Kelvin Connected Plus or Minus Lead (Force, Sense +, Sense -, Agnd) of the Analog Board. There are 48 Channels on the Plunger Board.**

- **Edge Connector Relay Matrix Board (A59): The Edge Connector Board provides switching of 2-Wire Kelvin Connections. It can route only the Kelvin Connected Minus Lead (Sense -, Agnd) of the Analog Board. Therefore, this board must be used in conjunction with a Plunger or Driven Guard Board that can route the Plus Lead. There are 96 Channels on the Edge Connector Board.**

- **Driven Guard Relay Matrix Board (A61): The Driven Guard Board provides switching of 6-Wire Kelvin Connections. It can route the Kelvin Connected Plus, Minus or Guard Lead (Force, Sense +, Sense -, Agnd, Driven Guard Force (DGF), Driven Guard Sense) of the Analog Board. There are 32 Channels on the Driven Guard Board.**

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System Overview – Descriptions of Tester Boards (2)

- **Relay Control Board (A93) Option:** **The Relay Control Board provides the capability for closing Relays in Series with Traces on Load Boards. Closure of the Relays is controlled by the Test Program. Each Relay Control Board can activate up to 80 Relays. Two Relay Control Boards can be installed in one Tester Chassis. Generally applies only to Load Board Testing.**
- **High Voltage Board (A67) Option:** **The High Voltage Board increases the Zener Diode Measurement Capability from 10 Volts to 35 Volts and the Leakage Voltage from 5 Volts to 35 Volts. Generally applies to companies manufacturing Linear Devices and BIB Testing.**

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System Overview – Tester Boards Summary

Type	Description	Capability	Kelvin	Chan	Max/Tester
A60	Plunger	Force & Gnd	4-Wire	48	12
A59	Edge Connector	Gnd Only	2-Wire	96	4
A61	Driven Guard	Force, Gnd & Guard	6-Wire	32	6 (See Note 1)
A93	Relay Control Option	N/A	N/A	80	2
A67	High Voltage Option	N/A	N/A	N/A	1

Note 1. * 3 Maximum if any Edge Connector Boards are used. 1 Maximum if any Relay Control Boards are used.

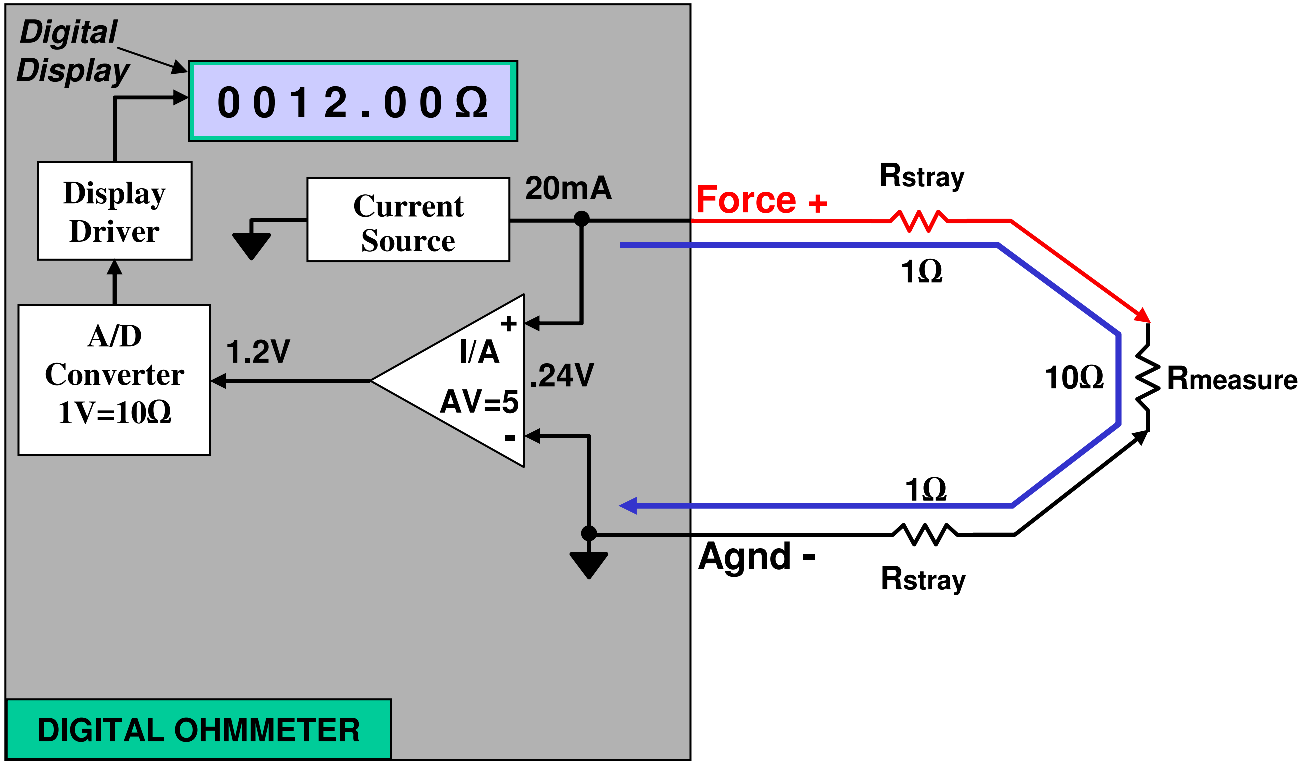
- **Kelvin Connection: A 4-Wire Kelvin Connection is a 4-terminal connection, usually made on a 2-Terminal resistance or device. The 4-Wire connection improves the measurement accuracy by directly sensing the voltage drop across the resistance or device being measured. The sense voltage is applied to a high-impedance circuitry (draws no input Bias Current) Instrumentation Amplifier (I/A). This eliminates inaccuracies caused by voltage drops across resistor leads, measurement leads, relay contacts, connector pins, etc. The 4-Wires are commonly referred to as:**
  - **Force: The plus (+) lead of the measuring instrument normally associated with the Constant Current Source. Normally terminated with the Sense +.**
  - **Sense + : The + input to the high-impedance measurement circuitry**
  - **Sense - : The – input to the high-impedance measurement circuitry**
  - **(Agnd): The negative(-) lead of the measuring instrument or return for the Constant Current Source. Normally terminated with the Sense -.**

A 2-Wire Kelvin is a term normally associated if only the S- and Agnd terminals of the 4-Wire connection are used in a particular application.

Your Complete Connection

Boss Interface Test Systems

System Overview – Resistance Measurements without Kelvin Connections



Theory: Non-Kelvin Connected Digital Ohmmeter

1. 20 milliamps is forced through the Stray Resistance and the resistance being measured
2. Total Resistance after Sense Connections = 12 Ω
3. Ohms Law: Voltage across the I/A Input Terminals (S+ & S-) = .02(12Ω) = .24V
3. I/A Gain (AV) =5. Therefore, input to A/D Converter = 1.2V
4. A/D Conversion Ration: 1V=10Ω. Therefore, 12Ω is indicated on Digital Display

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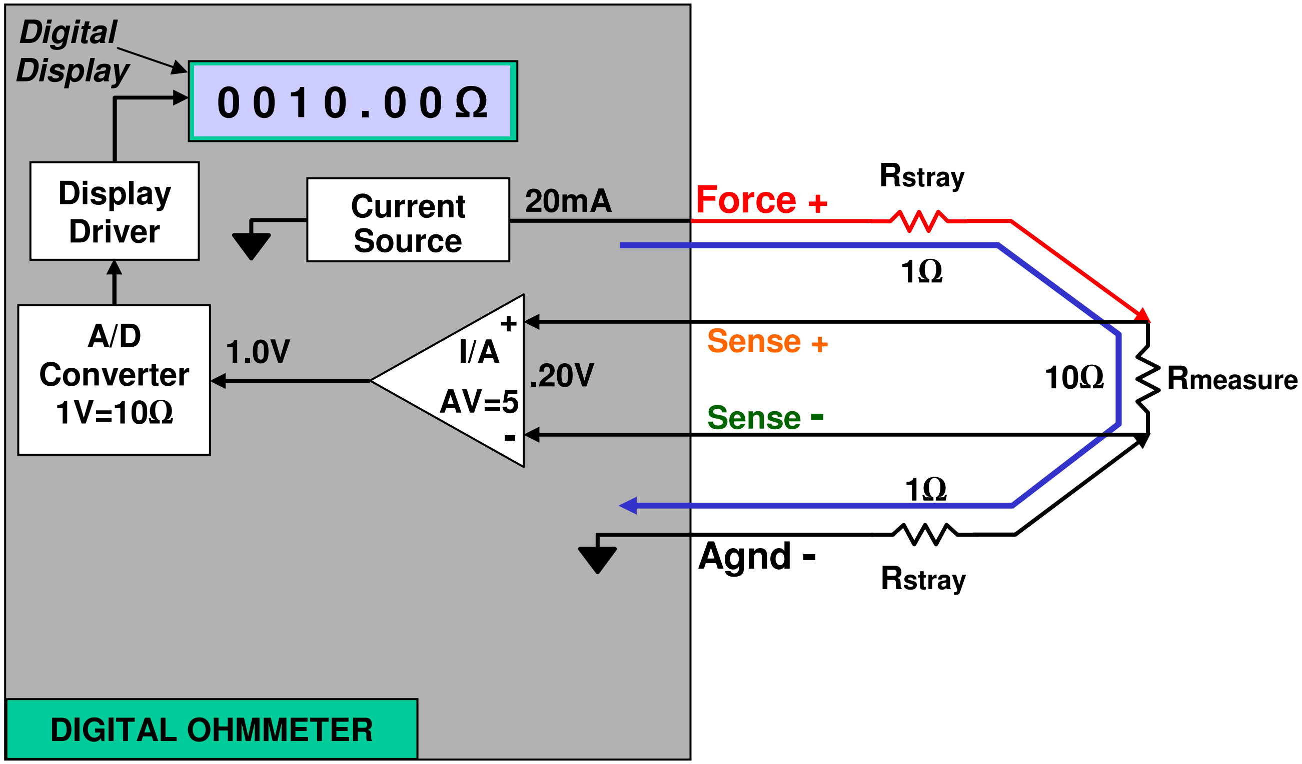
Boss Interface Test Systems

System Overview – Resistance Measurements with Kelvin Connections



Theory: Kelvin Connected Digital Ohmmeter

1. 20 milliamps is forced through the Stray Resistance and the resistance being measured
2. Total Resistance after Sense Connections = 10 Ω
3. Ohms Law: Voltage across the I/A Input Terminals (S+ & S-) = .02(10Ω) = .20V
3. I/A Gain (AV) =5. Therefore, input to A/D Converter = 1.0V
4. A/D Conversion Ration: 1V=10Ω. Therefore, 10Ω is indicated on Digital Display

Boss Interface Test Systems

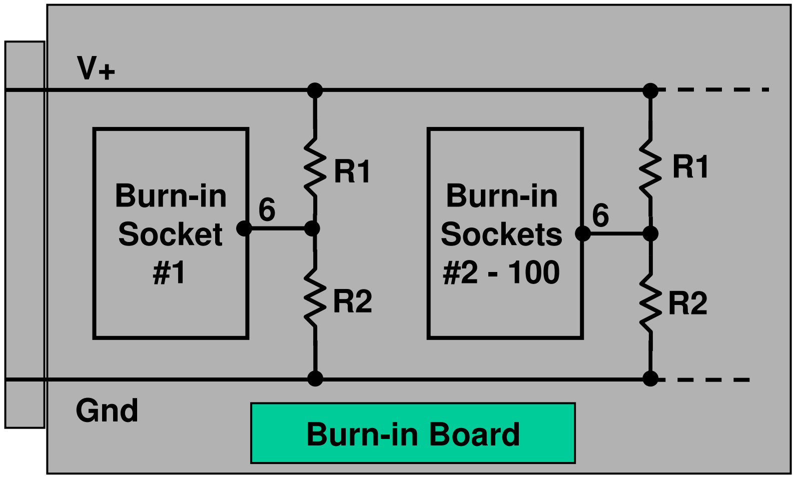
System Overview – Definition of Driven Guard

■ **Driven Guard: Driven Guard is a measurement technique utilized to eliminate parallel current paths normally associated with Resistor Delta Networks. This technique builds on the 4-Wire Kelvin and is often referred to as a 6-Wire Kelvin. Eliminating the parallel current paths is accomplished by applying equal voltages to two of the three nodes of the delta network, thus preventing current flow through the parallel path. The Sense + input from the 4-Wire connection is applied to the Positive Input of an Operational Amplifier (Op Amp) Follower Circuit or Guard Buffer. The Guard Buffer is configured Closed Loop (Output connected back to the input). Therefore, the Negative Input of the the Guard Buffer is Driven to the same potential as the Positive Input by the Guard Buffer Output (Summing Point Properties of an Op Amp). In addition to the 4-Wires, the two additional wires of the 6-Wire Kelvin are often referred to as:**

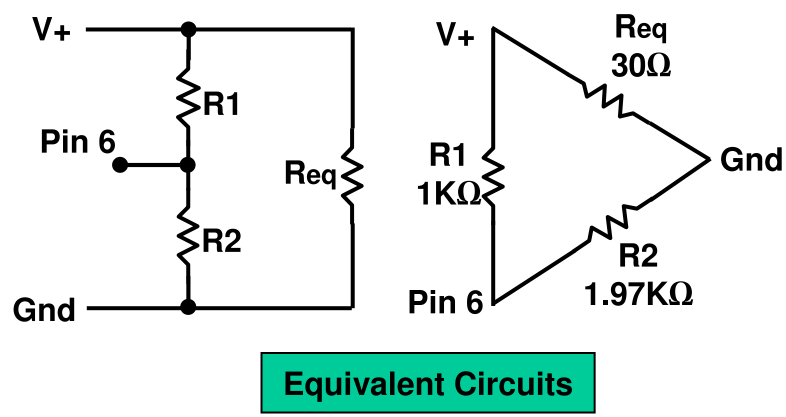
- **Driven Guard Force (DGF): Output of the Guard Buffer. Normally terminated with the Driven Guard Sense.**
- **Driven Guard Sense (DGS): Feedback to the Negative Input of the Guard Buffer from the Output (Closed Loop)**

Boss Interface Test Systems

System Overview – Why is Driven Guard Required?



R1=1KΩ; R2=1.97KΩ.



Theory:

1. R1 & R2 are referred to as Pull-up and Pull-down Resistors respectively. Their purpose is to stress the Iol and Ioh output on Pin 6 of the devices on the Burn-in Board. R1 & R2 on Sockets # 2 – 100 are defined as Requivalent (Req). R1, R2 & Requivalent form a Delta Resistor Network.
2. R1=1KΩ; R2=1.97KΩ. Equivalent Resistance in parallel with R1 & R2 = (R1+R2)/99 = 30Ω
3. Ohms Law: Without Driven Guard, measuring between V+ and Pin 6 (R1) of the Socket # 1 will result in a reading of (R2+Requivalent)xR1/(R2+Requivalent)+R1=666.67 Ω

Your Complete Connection

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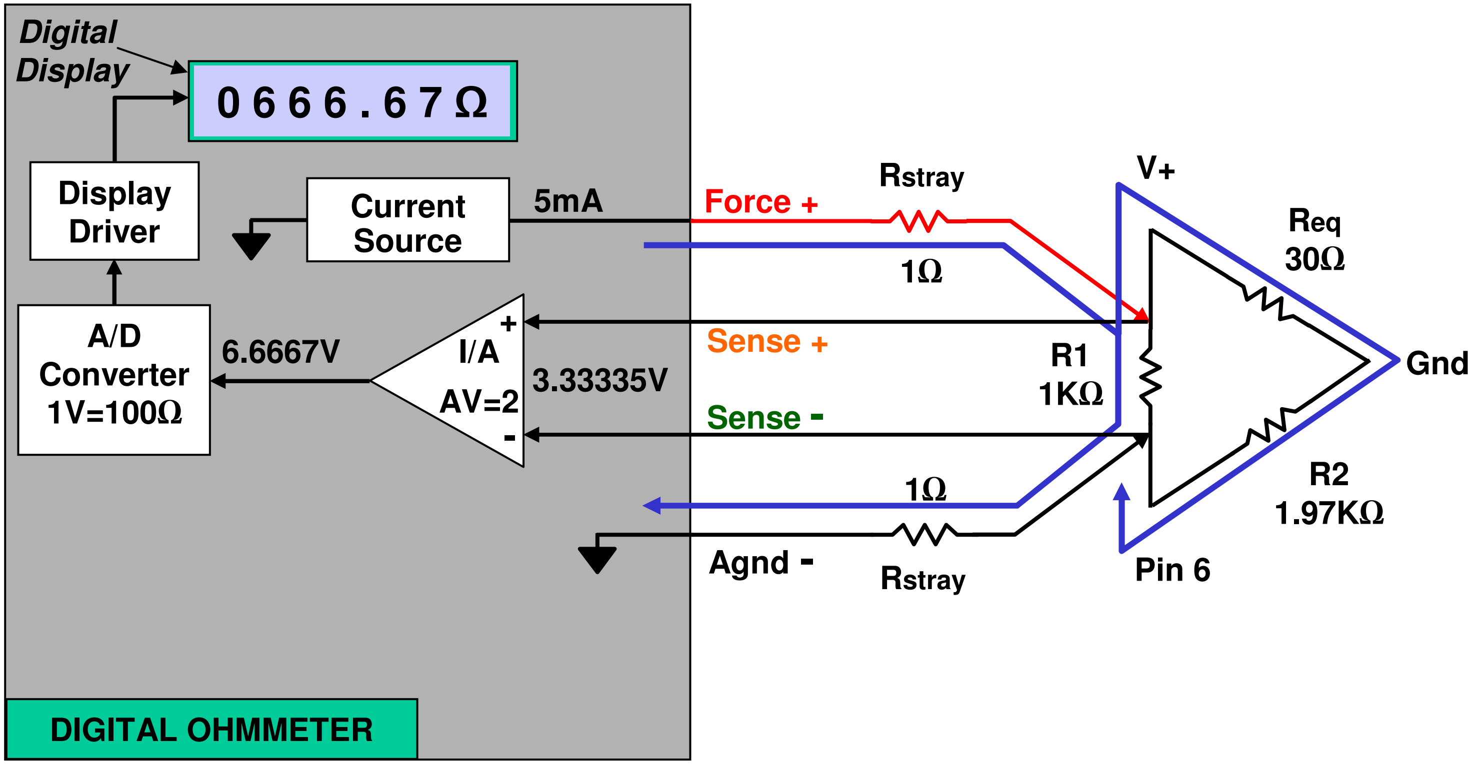
System Overview - Parallel Measurements without Driven Guard



Theory: Parallel Measurements without Driven Guard

1. 5 milliamps is forced through the Stray Resistance and the resistance being measured
2. In addition, current is flowing through the parallel path Req and R2.
3. Ohms Law: Resistance between V+ and Pin 6 = (R2+Req)xR1 / (R2+Req)+R1 = 666.67 Ω
4. Ohms Law: Voltage across the I/A Input Terminals (S+ & S-) = .005(666.67Ω) = 3.33335V
5. I/A Gain (AV) = 2. Therefore, input to A/D Converter = 6.6667V
6. A/D Conversion Ration: 1V = 100Ω. Therefore, 666.67Ω is indicated on Digital Display

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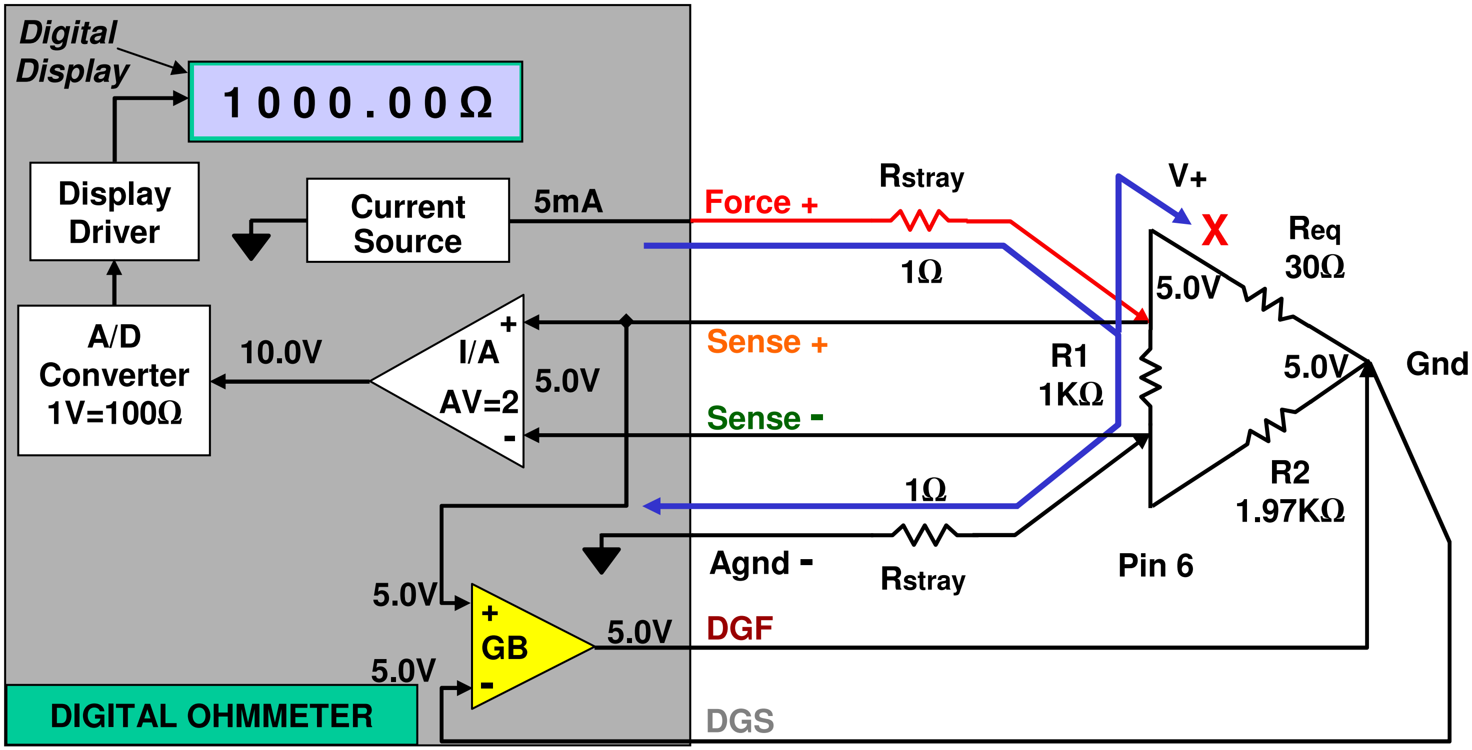
System Overview - Parallel Measurements with Driven Guard



Theory: Parallel Measurements with Driven Guard

1. 5 milliamps is forced through the stray resistance and the resistance being measured (R1)
2. Current will attempt to flow through the parallel path Req and R2
3. Ohms Law: Voltage at V+ = (.005 X 1KΩ) = 5V
4. Therefore, Voltage at the I/A S+ and the Guard Buffer (GB) Amplifier + will be 5V
5. Negative Input of the the GB Amplifier is Driven to the same potential as the Positive Input
6. Therefore, no voltage potential difference across, or current flow through Req
7. Ohms Law: Voltage across the I/A Input Terminals (S+ & S-) = .005(1KΩ) = 5.0V
8. I/A Gain (AV) = 2. Therefore, input to A/D Converter = 10.00V
9. A/D Conversion Ration: 1V = 100Ω. Therefore, 1KΩ is indicated on Digital Display

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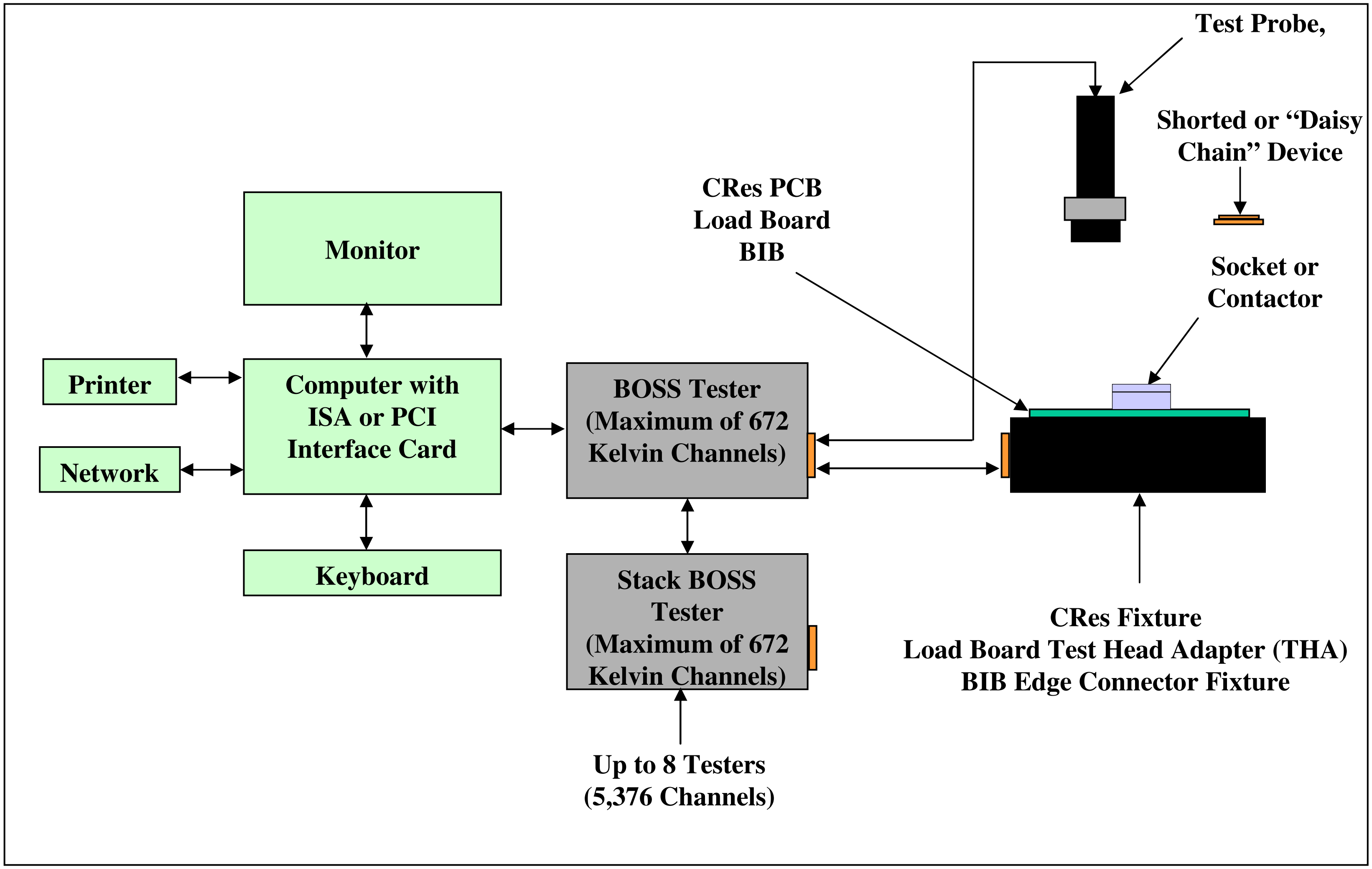
Measurement Techniques – Block Diagram



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Measurement Techniques - Types

- **Technique Types:**
  - **<u>Test Probe:</u> A Test Probe is inserted in the Contactor or Socket**
  - **<u>Shorted Device:</u> A Shorted device is inserted in the Contactor or Socket**
  - **<u>Device Simulator (Daisy Chain Device):</u> A Device Simulator is inserted in the Contactor or Socket**

- **Advantages and Disadvantages of Techniques:**

Measurement Technique	Advantage	Disadvantage
Test Probe	1. Verification of Load Board PCB (Traces correctly routed) 2. Can measure Discrete Components	1. Twice the number of Test Channels required 2. Test Probes are costly 3. Complex Set-up
Shorted Device	1. Half the number of Test Channels required 2. Test Probes not required 3. Less complex Set-up	1. Cannot verify Load Board PCB traces are properly routed 2. Cannot measure all Discrete Components
"Daisy Chain" Device	1. Half the number of Test Channels required 2. Test Probes not required 3. Less complex Set-up	1. Same as Shorted Device, plus: 2. Complex Daisy Chain Device Design 3. May pass a Pin that is out of Tolerance (One pin may have a high resistance and the second pin a low resistance. Combined resistance is within tolerance.)

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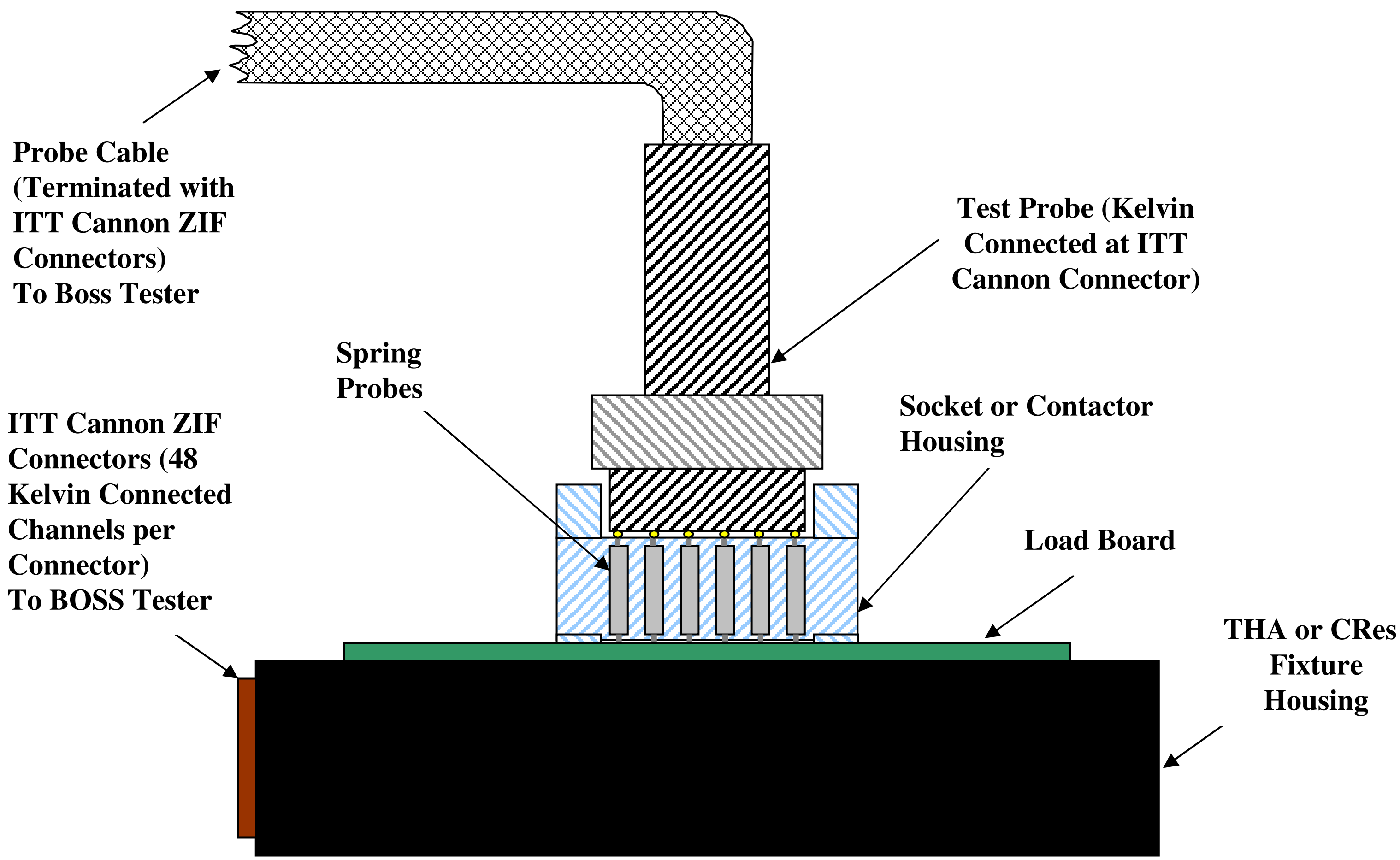
Measurement Techniques – Test Probe Diagram



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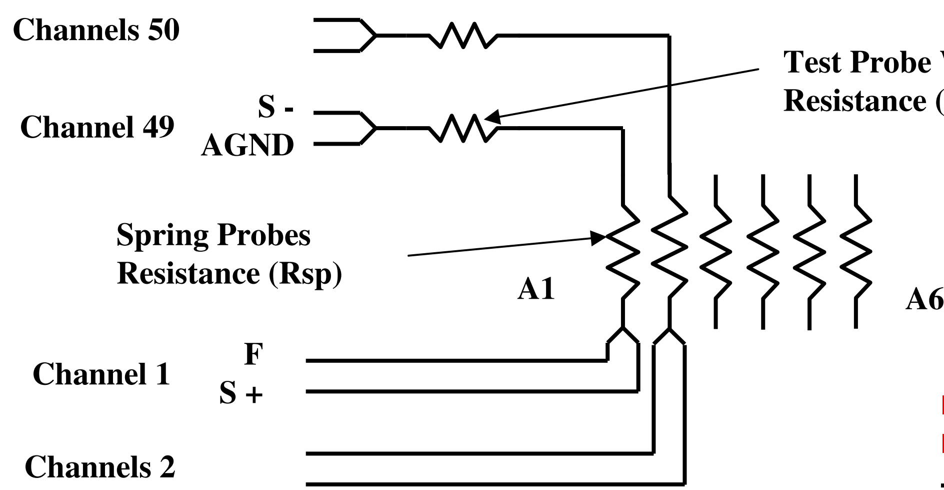
Measurement Techniques – Test Probe Circuit Analysis

Technique: Force a Constant Current on one end of Spring Probe, Ground opposite end of Spring Probe. Measure Resultant Voltage Drop. Convert Voltage to Ohms.



Contactor: BGA, 36 Leads
Example Measuring Pin A1

- Rt=Total Resistance
- Rsp=Spring Probe (Nominal Resistance - 50 milli-ohms)
- Rtpw=Test Probe Wire (Nominal Resistance - 250 milli-ohms)

Rt=Rsp+Rtpw
Rt=50m+250m
Rt=300 milli-ohms

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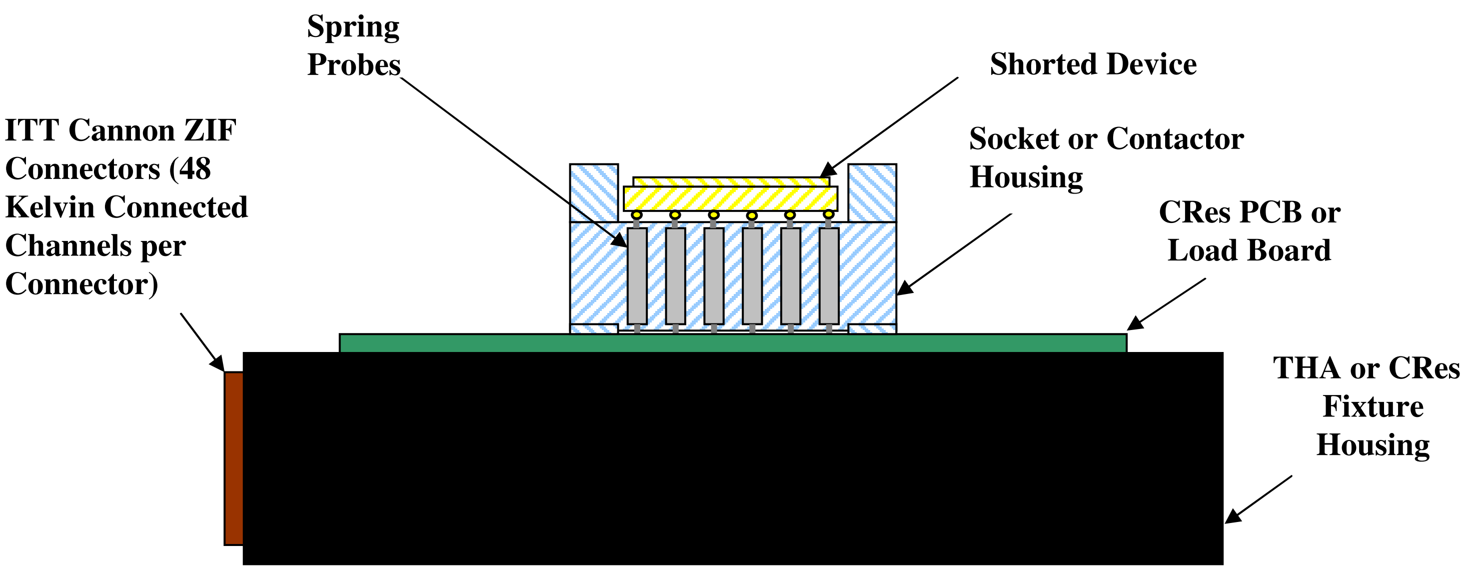
Measurement Techniques – Shorted Device Diagram



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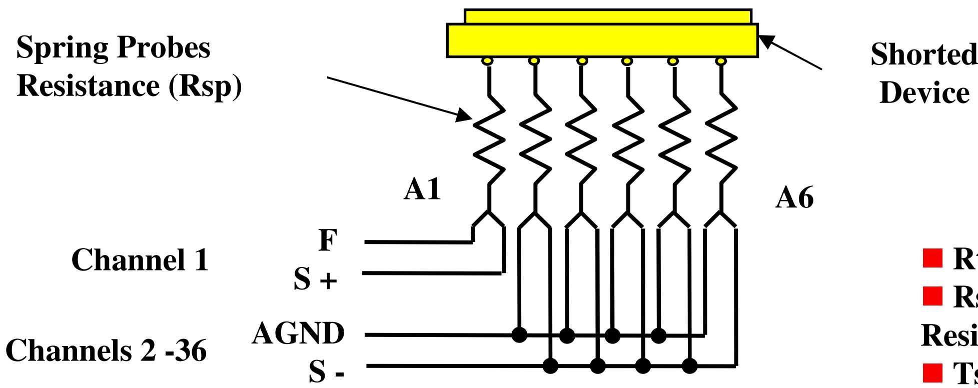
Measurement Techniques – Shorted Device Circuit Analysis

Technique: Force a Constant Current on a Spring Probe, Ground all remaining Spring Probes. Measure Resultant Voltage Drop. Convert Voltage to Ohms.



Contactor: BGA, 36 Leads
Example Measuring Pin A1

- **Rt=Total Resistance (one pin)**
- **Rsp=Spring Probe Nominal Resistance (50 milli-ohms)**
- **Tsp=Total Number of Spring Probes (36)**

Rt=Rsp+(Rsp/Tsp-1)
Rt=50m+(50m/36)
Rt=51.4 milli-ohms

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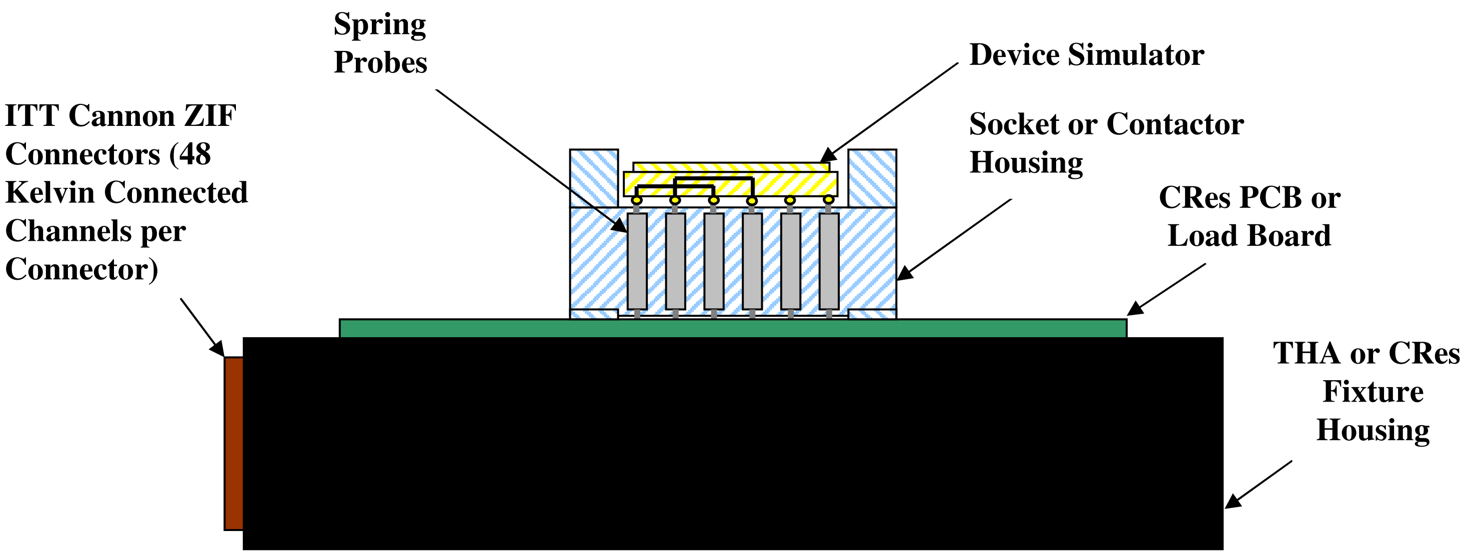
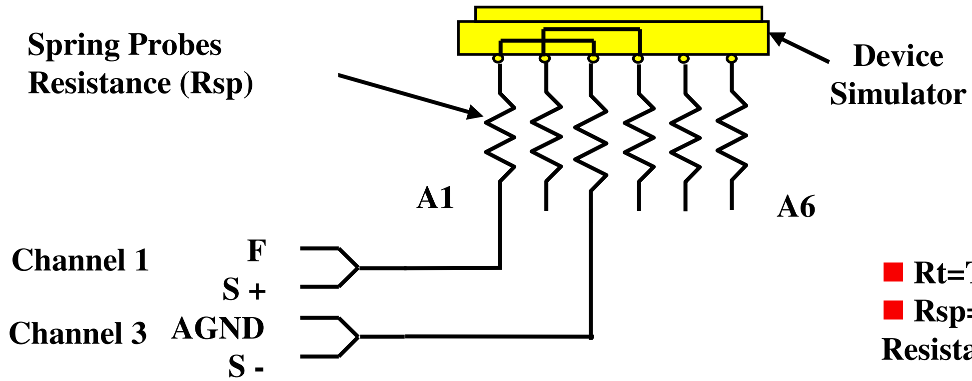
Measurement Techniques – “Daisy Chain” Device Diagram



Measurement Techniques – "Daisy Chain" Device Circuit Analysis

Technique: Force a Constant Current on a Spring Probe, Ground other selected Spring Probe(s). Measure Resultant Voltage Drop. Convert Voltage to Ohms.



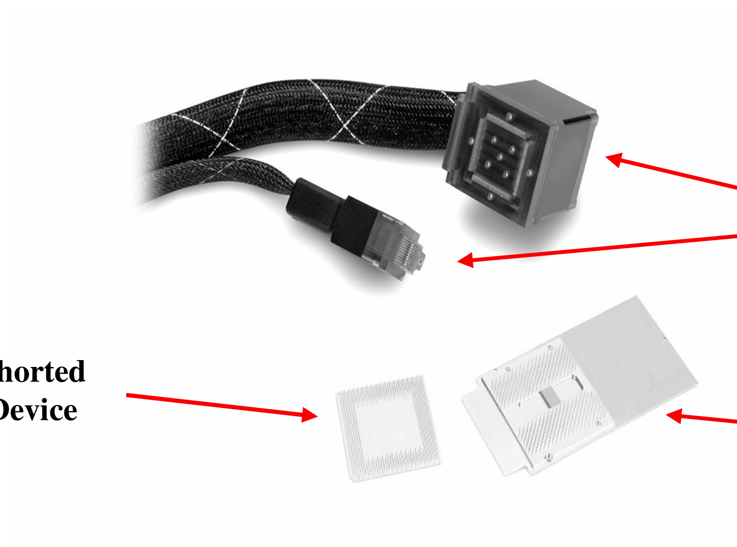
Contactor: BGA, 36 Leads
Example Measuring Pin A1

- Rt=Total Resistance (one pin)
- Rsp=Spring Probe Nominal Resistance (50 milli-ohms)

Rt=2Rsp
Rt=100 milli-ohms

Boss Interface Test Systems

Accessories – Probes, Shorted Devices & Device Simulators

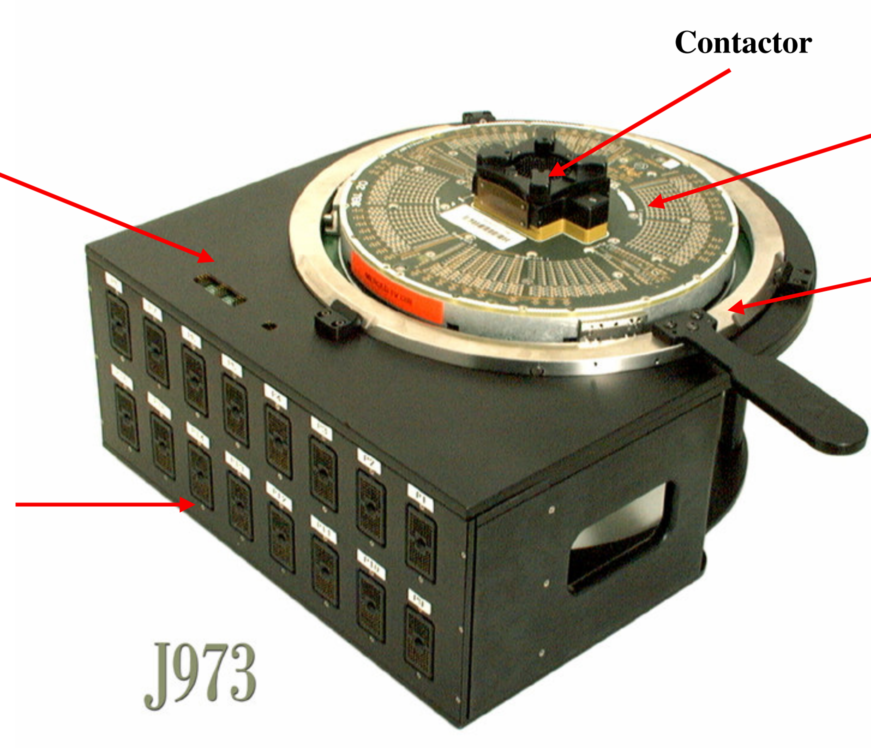


■ The Delta V Interconnect Test system offers the option of using a Test Probe, Shorted Device or Device Simulator for testing. Each method has an advantage:

- When a Test Probe is inserted in the Contactor or Socket the BOSS Tester performs measurements between the Socket Contacts and the Load Board Test Head Pads. With this method of testing, the Load Board is 100% verified for proper DC Electrical Characteristics.
- When a Device Simulator (Shorted or "Daisy Chain" device) is inserted in the Contactor or Socket, the Simulator provides electrical loop-back between the socket contacts, and the BOSS Tester performs all measurements at the Load Board Test Head Pads. This method requires half the channel capacity in the BOSS Tester as compared with using a probe.

Boss Interface Test Systems

Accessories – Test Head Adapter (Load Board Fixtures)



■ **Load Board Fixtures or Test Head Adapters (THA) emulate the Test Head of the IC Tester where a Load Board or Tester Interface Unit (TIU) will dock and interface with the BOSS Tester for verification. This allows the flexibility to quickly reconfigure the BOSS Load Board Test System from one Test Head Adapter to another. Shorted TIU's are utilized for profiling the Fixtures.**

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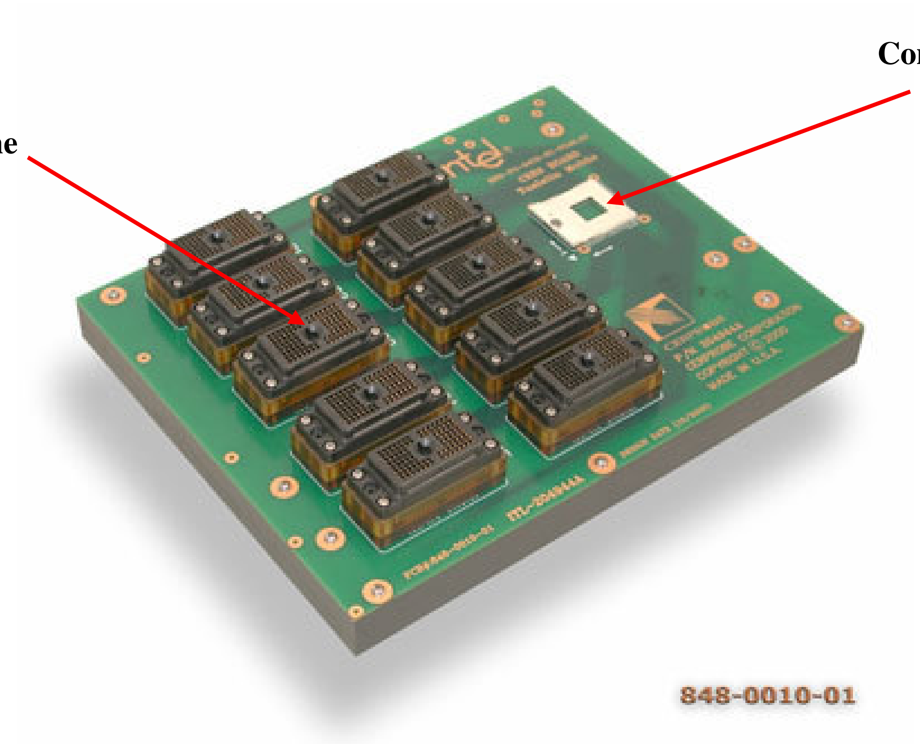
Accessories – CRes Fixtures

Connecters to Interface with the BOSS Tester(s)

Contactor Nest



■ CRes Fixtures provide an Off-line Tool for Contactor Verification and Maintenance. A Nest is provided for mounting the Contactor to the Fixture. CRes Fixtures are available in both Dedicated and Universal Designs.

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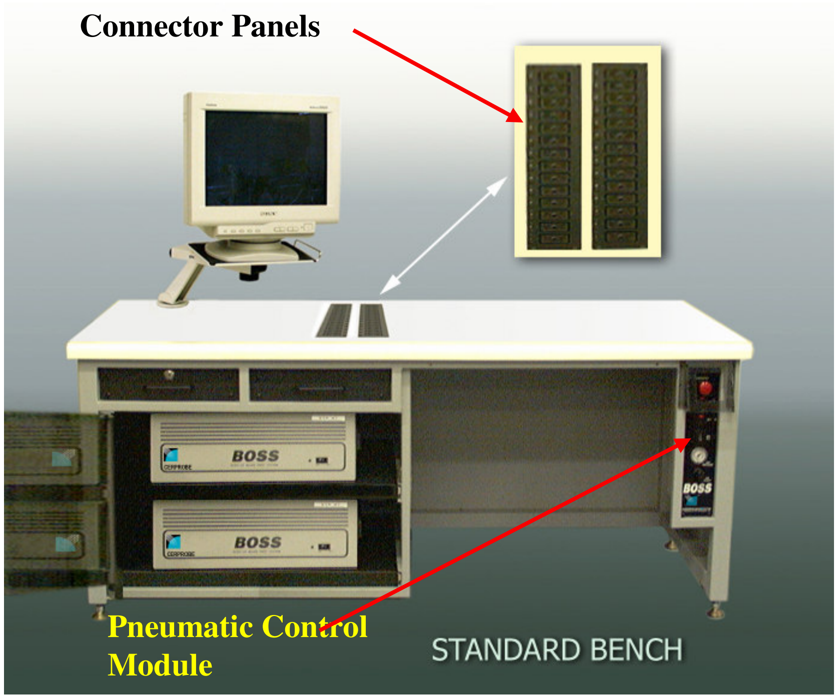
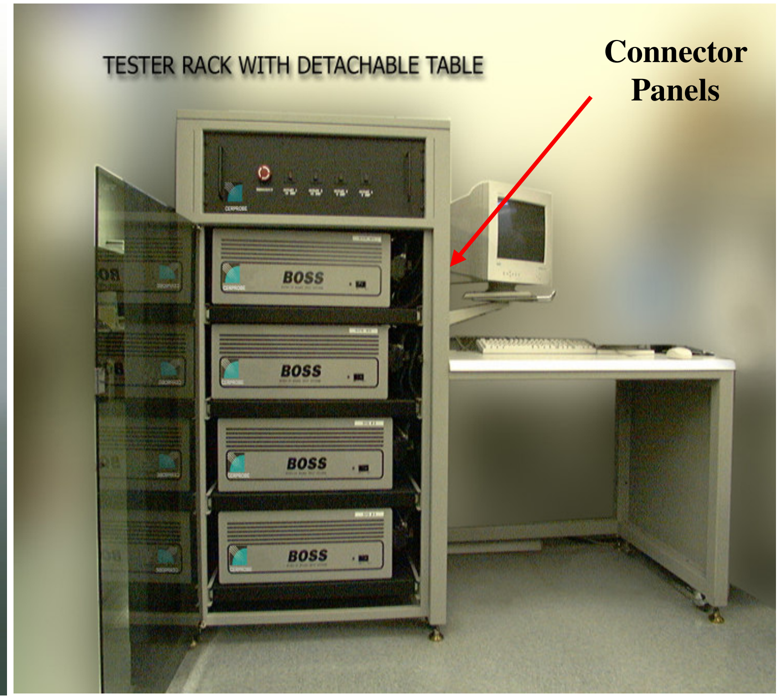
Accessories – Test Benches and Stack Racks (1)



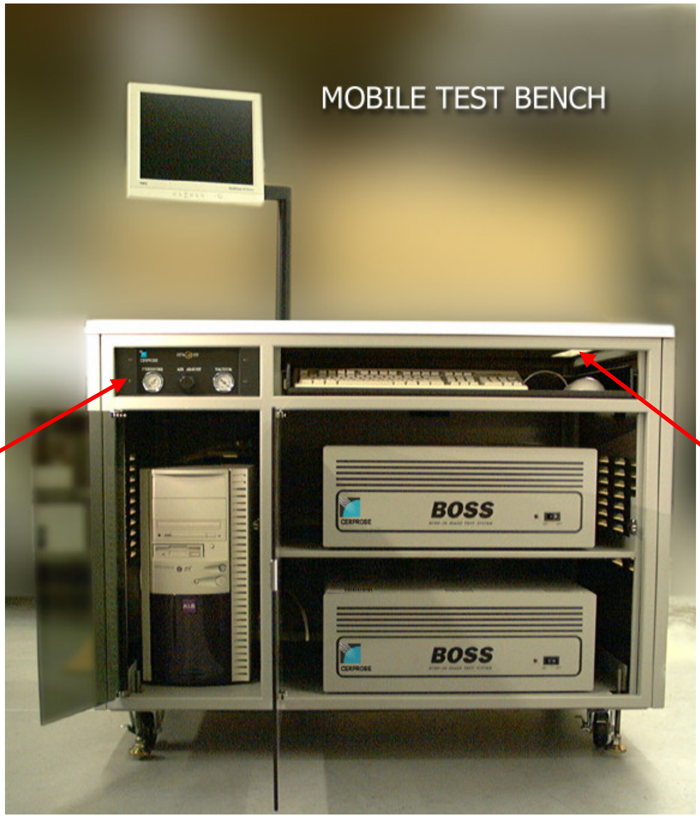


- **The Standard Test Bench Option** can accommodate two Testers or one Tester and the Computer. A Pneumatic Control Module (PCM) provides Air and/or Vacuum for docking Interfaces to Fixtures. The Tester Connector Panels are available on the Bench Top.
- **The Tester Rack with Detachable Table Option** can accommodate up to four Testers or three Testers and the Computer. The Tester Connector Panels are available on the side of the Rack.

Boss Interface Test Systems

Accessories – Test Benches and Stack Racks (2)

Pneumatic Control Module



Slot for access to the Tester Connector Panels

■ **The Mobile Test Bench Option** with Flat Screen Monitor can accommodate up to two Testers and the Computer. A Pneumatic Control Module (PCM) Option provides Air and/or Vacuum for docking Interfaces to Fixtures. Access to the Tester Connector Panels are through slots in the Bench Top.

Contact Information

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