

Giga-tronics Sensor Care Training

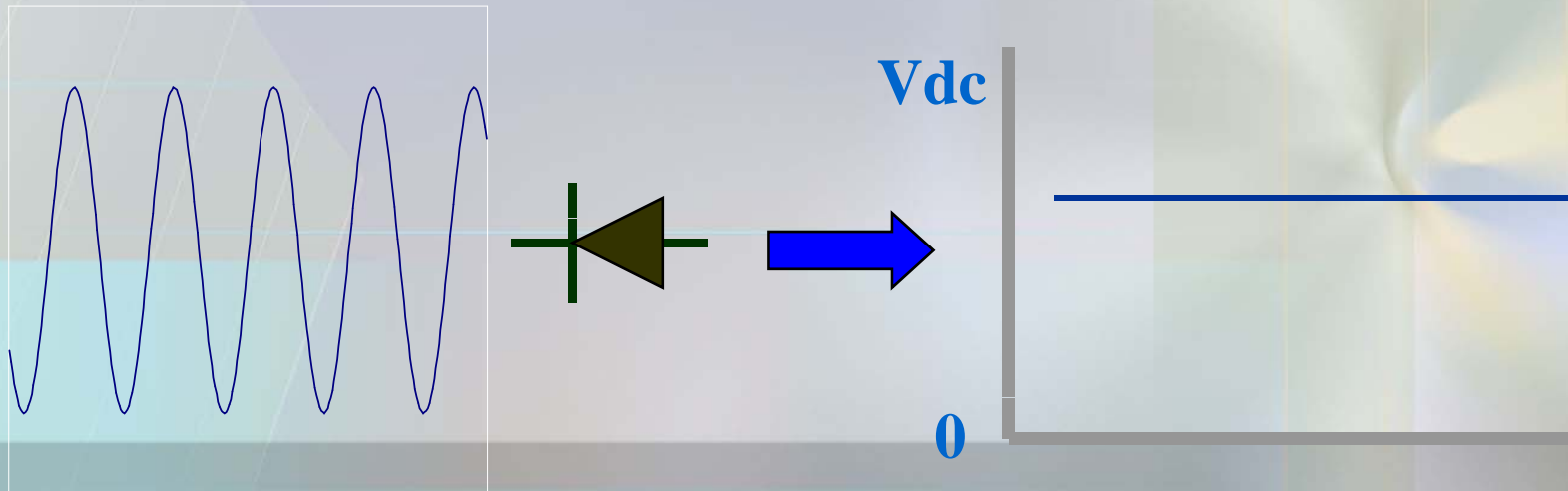


Giga-tronics Sensor Care Training

- **Product Overview**
- **Making Accurate Measurements**
- **Sensor Failures at Northrop-Grumman**
- **Physical Care and Handling**
- **Questions and Answers**

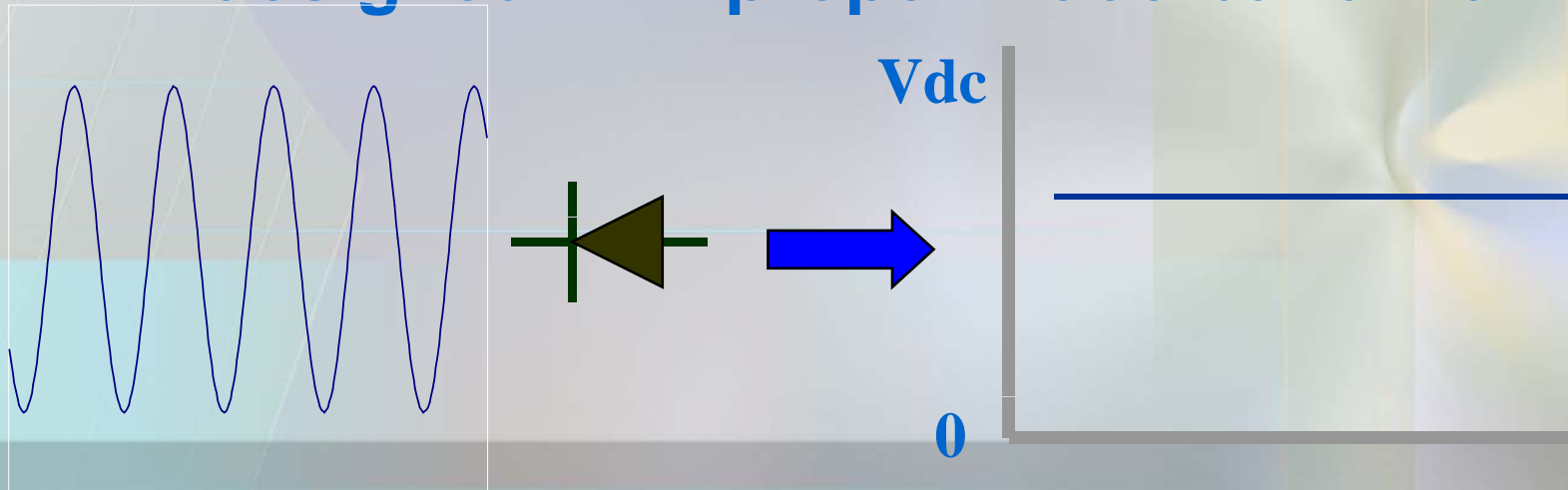
Product Overview

- **What are Power Sensors?**
 - Devices rectify RF energy to a DC voltage.
 - **Diode and Thermal Sensors**
 - Giga-tronics uses Diode Sensors
 - All Giga-tronics Sensors are DC Coupled

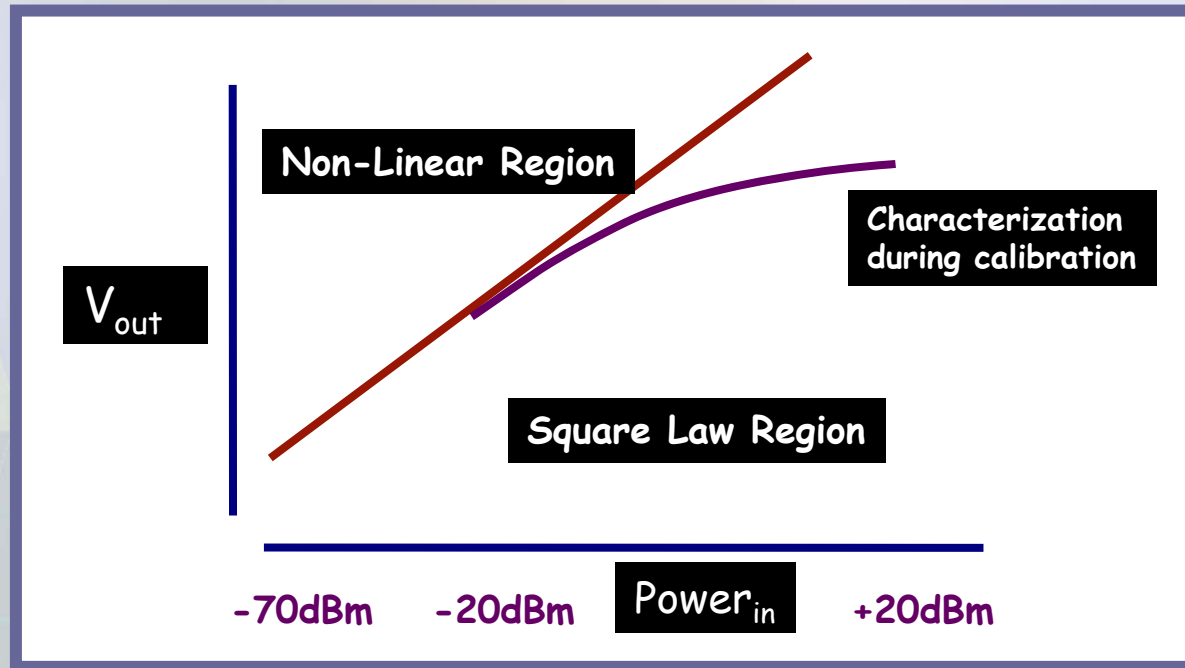


Product Overview

- **Diode Sensor Advantage**
 - Thermal sensors respond slowly
 - Fast - capable of tracking rapid power changes
 - Measure peak modulated power when designed with proper video bandwidth



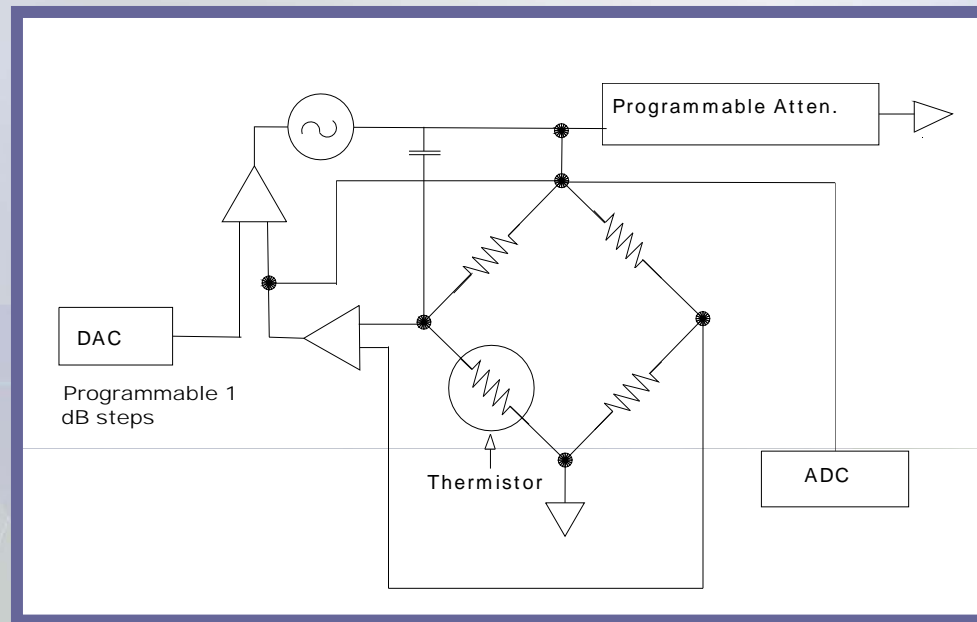
Product Overview



- Square Law region from -70 to -20 dBm
- Non-linear characteristics from -30 to +20 dBm identified during calibration and corrected during measurement

Product Overview

- **Giga-tronics Sensor Calibration Techniques**



Thermistor used in a patented swept power bridge circuit provides NIST-traceable 90 dB dynamic range

Product Overview

- **Connector Types**

- **18 GHz**

- Type N
 - Type K, True RMS and 1 Watt Models only
 - APC 7

- **26 and 40 GHz**

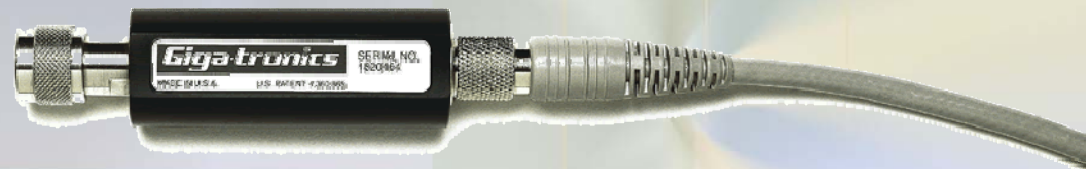
- Type K



Sensor Specifications

80300A CW Sensor Series

- 10 MHz to 40 GHz (Sensor Dependent)
 - 100 kHz Frequency Range w/ Option 10
- Maximum Power to 50 Watts (47 dBm)
- Continuous Amplitude Signals Only
- Connector Types
 - Type N to 18 GHz
 - Type K to 40 GHz



Sensor Specifications

80350A Peak Sensor Series

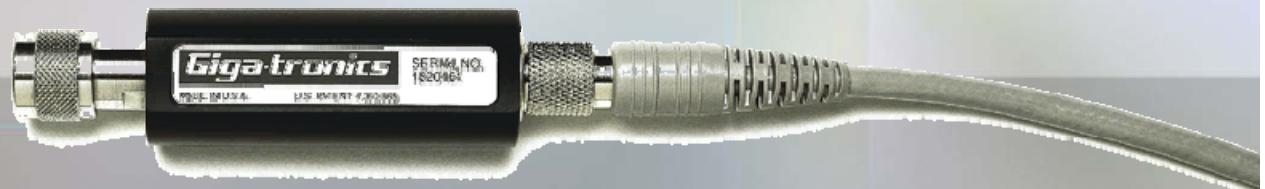


- 45 MHz to 40 GHz (Sensor Dependent)
- CW and Pulsed RF Applications
- Rise Time
 - 100 nsec., 75 nsec. typical
 - 50 nsec., 40 nsec. typical with Configuration 418
- Settling Time - 250 nsec. (50% to 3%)
- Sample Delay - -20 nsec. to 104 msec.

Sensor Specifications

Modulation Sensor Series

- 10 MHz to 18 GHz
- Video Bandwidths
 - 40 kHz 80400A series
 - 1.5 MHz 80600A series
 - 10 MHz 80700A series
- Connector Types
 - Type N to 18 GHz



Power Measurement Accuracy



Power Measurement Accuracy

- **8 Factors considered when calculating measurement uncertainty:**
 - **Instrumentation linearity**
 - **Sensor power linearity**
 - **Calibrator uncertainty**
 - **Calibrator/sensor mismatch**
 - **Calibration factor uncertainty**
 - **Zero Error**
 - **Noise**
 - **Mismatch sensor/source**

Making Accurate Measurements

Sources of Measurement Errors

- Not Zeroing the meter for low power measurements
- VSWR
- Changes in temperature
- Exceeding Sensor Video Bandwidth

Power Measurement Accuracy

Low Power Measurements

- Lowest 15 dB dynamic range
 - “Zero” meter to the source
 - Start from low power setting

Power Measurement Accuracy

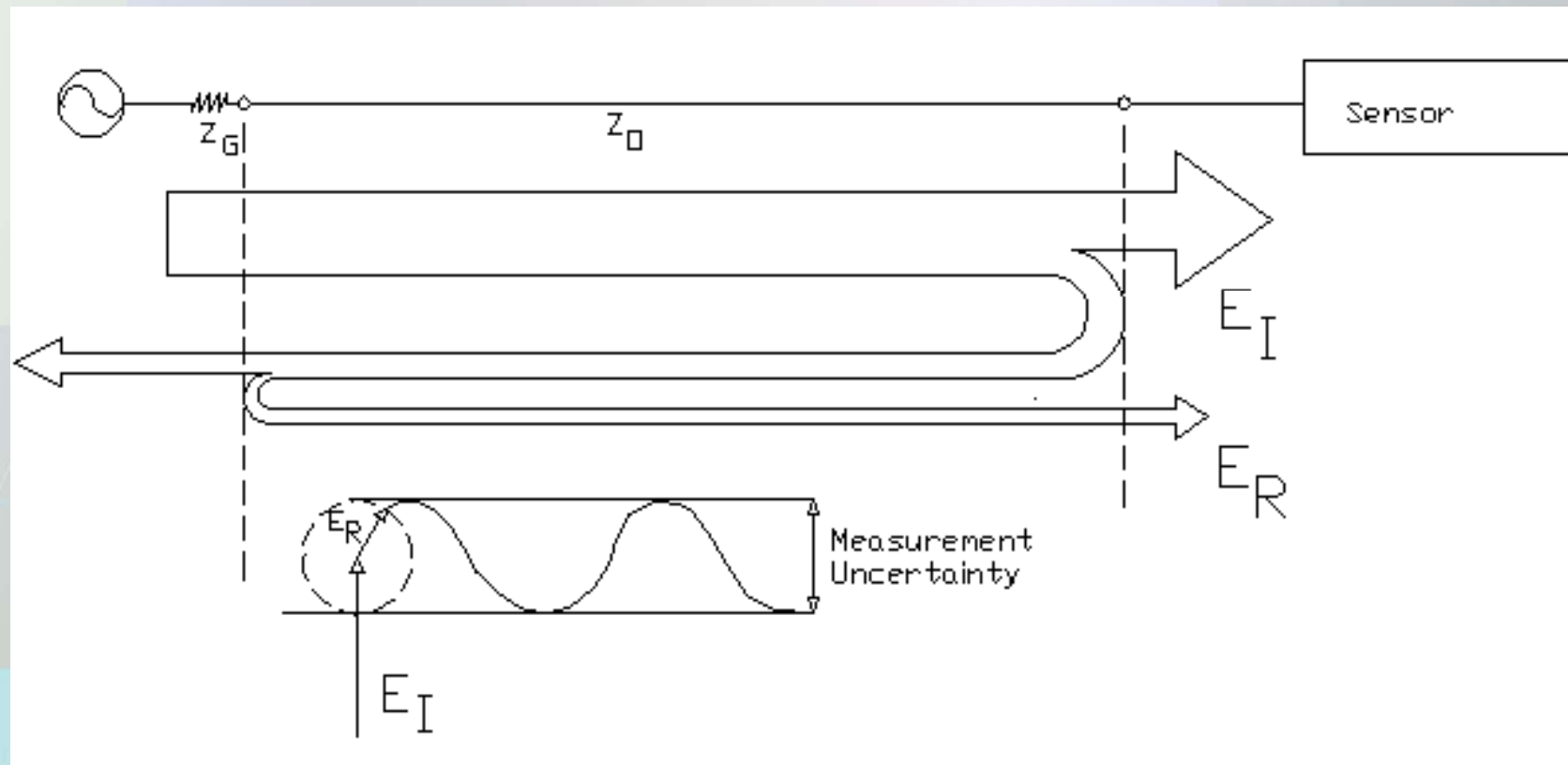
Measurement Uncertainty: Noise

- **Zero Error**
- **Meter noise floor**
- **Significant in the last 15 dB of dynamic range**
 - e.g. Noise specification = $\pm 50 \text{ pW}$ (-73 dBm), Signal measured = -63 dBm (0.5 nW)

$$\text{Noise Error} = 50 \text{ pW} / 0.5 \text{ nW} = 10\% (0.4 \text{ dB})$$

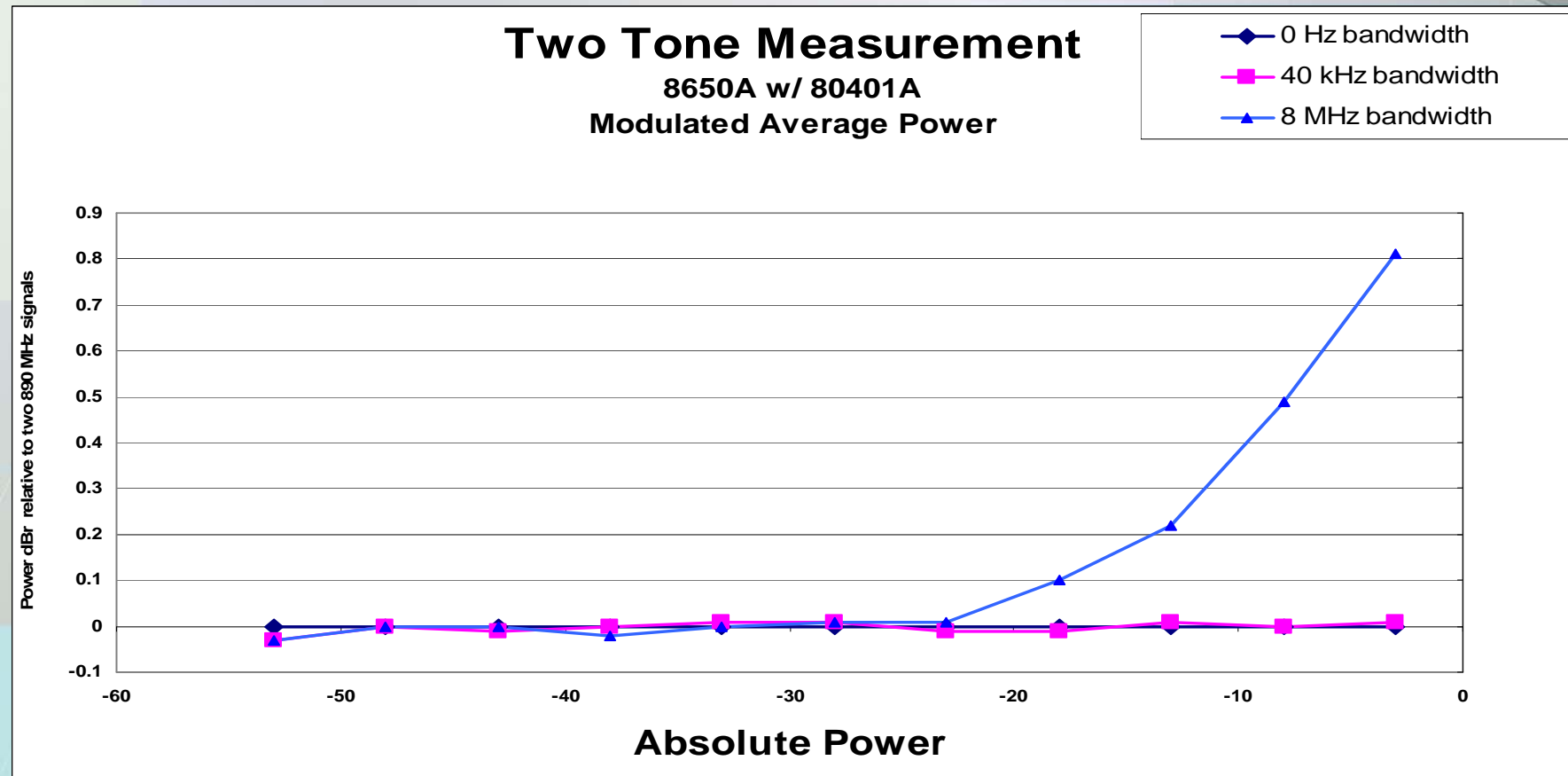
Measurement Uncertainty:

Sensor / Source Mismatch



Making Accurate Measurements

- Exceeding Sensor Video Bandwidth



Making Accurate Measurements

DC Levels in the RF Path

- **All Giga-tronics Sensors are DC coupled**
- **RF source must not have DC present on output**

Making Accurate Measurements

Maximum Power Ratings

- All Diode Sensors have a maximum rating of +23 dBm (200 mW)
- Rating applies for CW and Peak Levels
- High Power Sensors use Attenuators to reduce the power to the diode element

Sensor Failure Types:

- Operational/Test
 - Physical Damage
 - Miscellaneous

Physical Care and Handling

- **Handling Giga-tronics Sensors**
 - **Inspecting and Cleaning Sensor Connectors**
 - **Making a Proper Connection**

Physical Care and Handling

Handling Giga-tronics Sensors

- **Observe ESD precautions at all times!**
- **Know the approximate levels being tested**
- **Do not place sensors in locations where they can be easily dropped**
- **Never strain sensor body once connected**
- **Do not leave long sensor cables on the ground**

Physical Care and Handling



Cleaning Sensor Contacts

- **Dirty Connectors**
 - Connector Degradation, Measurement Repeatability, Accuracy, Connector Life
- **Inspect connectors**
 - Every 20 connections
 - Inspect sensor and device connectors for signs of damage and wear
 - Dirt and Metal Flakes

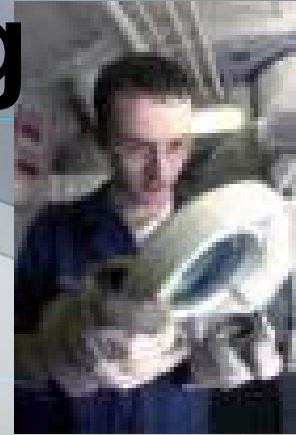
Physical Care and Handling

Cleaning Sensor Contacts

- **Visual Inspection**

- Damage and dirt can significantly degrade repeatability and accuracy
- Gold plated surfaces are especially sensitive to connector damage
- Dents, burrs, metal particles, rough spots, and damaged threads
- Bent or damaged inner conductor

- **Never use a damaged connector**



Physical Care and Handling

Cleaning Sensor Contacts

- **Visual Inspection**



If the connector has the following:

- Deep scratches
- Dents
- Particles clinging to mating plane surfaces
- Uneven wear

Clean connector and re-inspect

Physical Care and Handling

Cleaning Sensor Contacts

- **First Step**
- **Compressed Air**
 - **Filtered**
 - **Vapor and Oil Free**
 - **<60 PSI**
- **High velocity air can generate Electrostatic effects on the connectors**



Physical Care and Handling

Cleaning Sensor Contacts

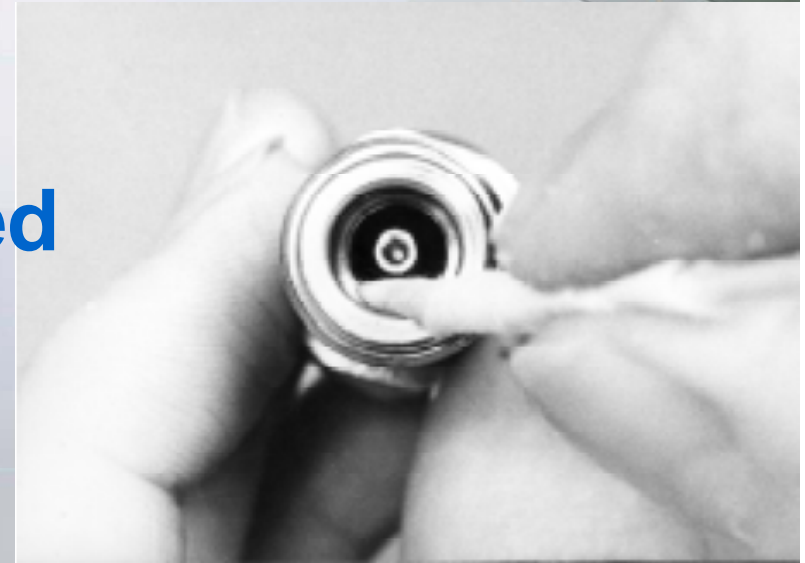
- **Second Step**
- **Cotton Swab moistened with Isopropyl Alcohol**
 - **Clean outer surfaces only**
- **Do not saturate the swab with Isopropyl Alcohol**
- **Never make contact with the inner conductor!**



Physical Care and Handling

Cleaning Sensor Contacts

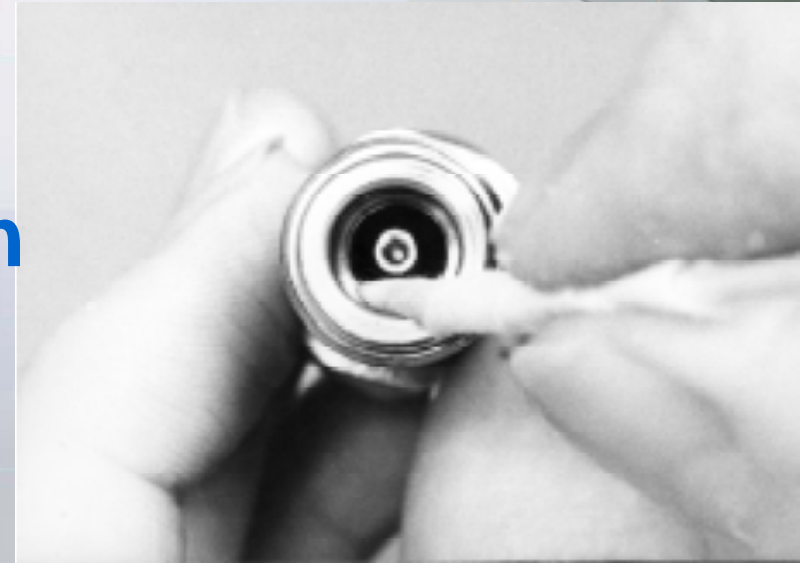
- **Third Step**
- **Lint free cloth wrapped around an applicator**
- **Moisten only**
- **Do not saturate the cloth with Isopropyl Alcohol**
- **Never make contact with the center conductor!**



Physical Care and Handling

Cleaning Sensor Contacts

- **Center Conductor**
- **Use EXTREME caution**
- **Moisten cloth with Isopropyl Alcohol**
- **Never apply pressure to inner conductor**



Physical Care and Handling

Cleaning Sensor Contacts

- **Don'ts**
 - Use Acetone, Methanol or CFC's
 - Overuse Isopropyl Alcohol
 - Wet any plastic parts (dielectrics) in connectors
 - Make contact with the center conductor
 - Use a swab larger than the gap between the inner and outer conductors
 - Blow on a connector

Physical Care and Handling

Tightening a Sensor Connector

- **Align the sensor connector straight in line with mating device connector**
- **Turn the Connector Body Only**
 - Never turn the sensor body or source connector
 - Gold plating wear
- **Hold the sensor stable while connecting and disconnecting the sensor**

Physical Care and Handling

Tightening a Sensor Connector

- **Too much torque will damage a sensor connector**
- **Use a Torque Wrench whenever possible**
- **Tighten using thumb and forefinger only**
- **Recommended Torque**
 - **Type N** **12 – 15 in-lbs.**
 - **Type K** **8 in-lbs.**

Physical Care and Handling

Connector Torque

- **Never use wrenches or pliers to tighten connector**
- **Use “Soft Jaw” Pliers and Channel Locks to **remove** “stuck” connectors only**





Giga-tronics

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