



**KEYSIGHT
WORLD 2019**

Risk of Poor Calibration: What the Automotive Industry Should Know

Services Business Development Manager / Keysight Technologies

Renu C



How many of you use Cars ?



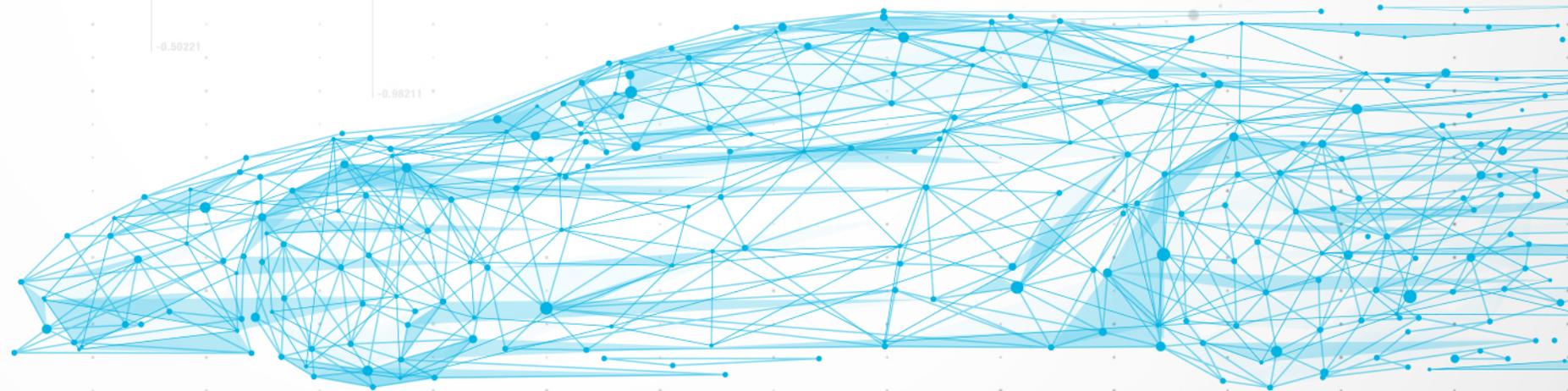
Top 10 Causes of Road Accidents

LET'S LOOK AT FACTS

1. Distracted Driving
2. Drunk Driving
3. Speeding
4. Reckless Driving
5. Rain
6. Running Red Lights
7. Night Driving
8. Design / Manufacturing Defects
9. Tailgating
10. Drugs



Chances of Automotive Safety Recall ?



What You Need to Know About: IATF 16949:2016



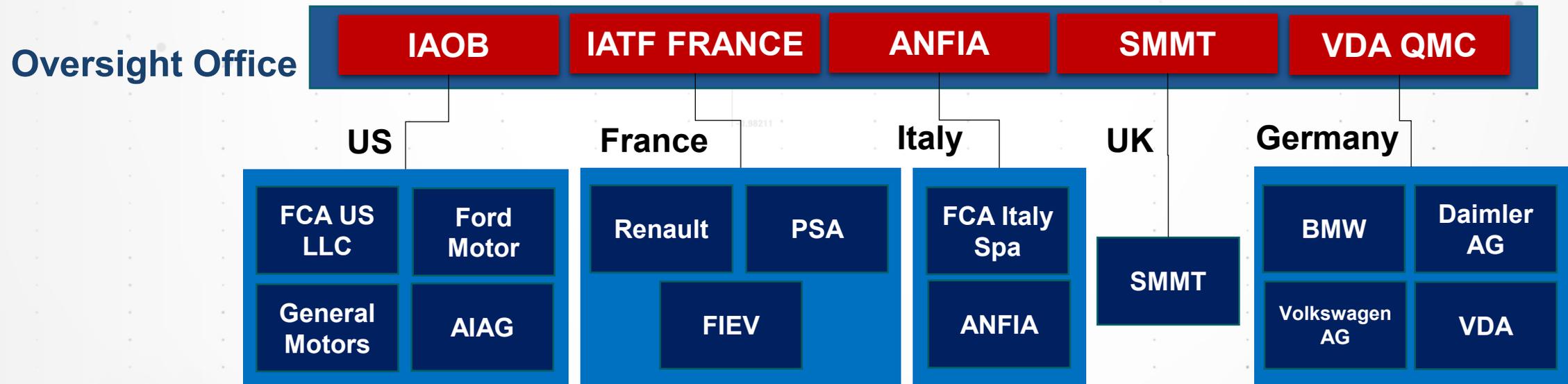
IATF – International Automotive Task Force

WHAT IS IT ?

An “ad hoc” group of automotive manufacturers and their respective trade associations, formed to **provide improved quality products** to automotive customers worldwide.

IATF creates guideline for QMS (quality management system) requirements.

IATF : International Automotive Task Force



Why is IATF 16949:2016 Important to Your Organization?

From 14th September 2018, IATF 16949:2016 will become an essential requirement for any organization operating in the global automotive supply chain.

Many of the world's leading car manufacturers now make certification a contractual requirement for their suppliers.



Goal of IATF 16949:2016

The goal of Automotive QMS standard is:

the development of quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain.



The Scope of IATF 16949:2016

This automotive QMS Standard defines the quality management system requirements for the design and development, production and, when relevant, assembly installation, and services of automotive-related products, including products with embedded software.

Applicable to sites where manufacturing of customer-specified production parts, service parts and/or accessory parts occurs.

Applied throughout the automotive supply chain.



Summary: IATF 16949:2016

WHAT YOU NEED TO KNOW



- **What** is IATF – International Automotive Task Force
- **Why** it's Important – Leading car manufacturers making certification a contractual requirement for their suppliers
- The **Goal** – QMS system that provides **continual improvement**, emphasizing **defect prevention** and the **reduction of variation and waste** in the supply chain.
- The **Scope** – Applied **throughout the automotive supply chain**.

Requirement for Calibration in IATF 16949:2016

7.1.5.2 : Measurement Traceability

7.1.5.2.1 : Calibration / Verification Records

7.1.5.3 : Laboratory Requirements

7.1.5.3.1 : Internal Laboratory (calibrate in your company)

7.1.5.3.2 : External Laboratory (calibration by vendor)



What You Need to Know About: Calibration



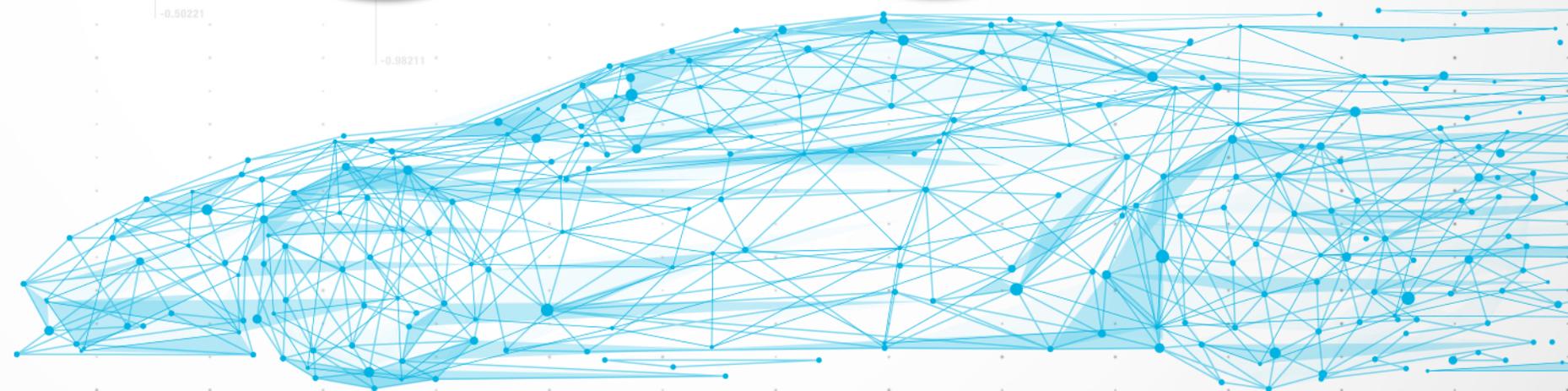
What is Calibration

ENSURES INSTRUMENT IS PERFORMING TO ITS SPECIFICATION

Calibration is periodically verifying instrument specifications by measuring actual performance using lab standards and are traceable to the International System of Units (SI) through standards maintained by National Institutes

**ANY INSTRUMENT THAT IS USED & RELY ON
THE (WARRANTED) SPECIFICATIONS NEEDS
PERIODIC CALIBRATION**

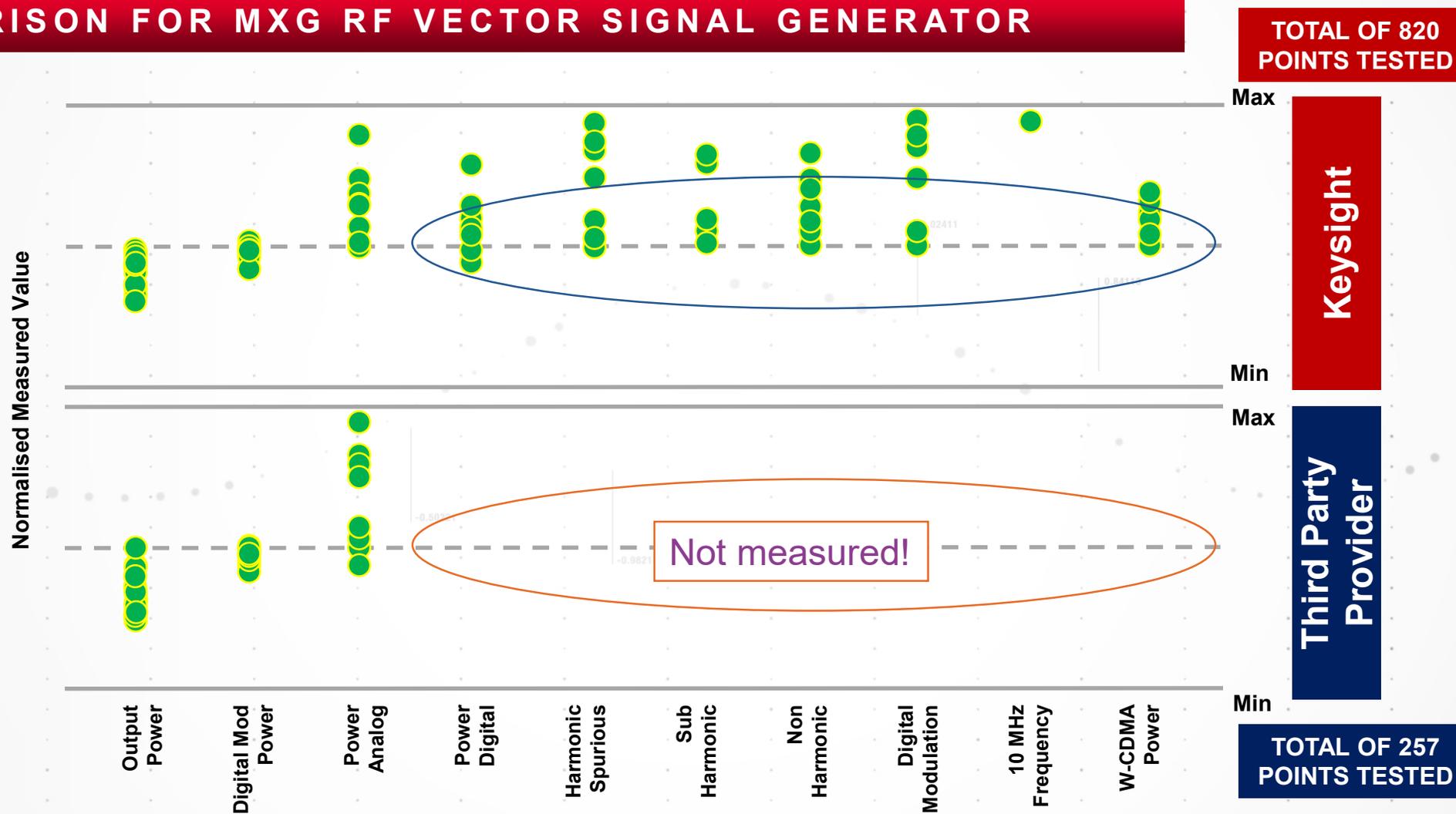
What is Your Criteria in Selecting Calibration Service?



Quality Calibration: Risk of Poor Selection



COMPARISON FOR MXG RF VECTOR SIGNAL GENERATOR



Quality Calibration: Risk of Poor Selection

COMPARISON FOR AGILENT ESG SERIES SIGNAL GENERATOR

Coverage	Keysight (Accredited Cal)	Third Party Provider (Accredited Cal)
# of Test Parameters	16	6 (Only 37% of the Test Parameters are covered)
# of Test Points	435	45 (Only 9% of the Test Points are covered)
# of Calibration Equipment used	11 (including High-end equipment)	4 (Low-end equipment)
Include Adjustment ?	√	X
Report Details - # of pages	97	5

Case Study: Out of Tolerance

SWITCHING FROM CHEAPER TO BETTER

- Our data shows that in customers who return to Keysight Calibration services after using other service providers, 20%-30% of the instruments are found to be out of tolerance (OOT). Highest found is over 80%.
- By the third year of Keysight calibration, the same pool of instruments shows 4%-8% OOT.
- Adjustment vs Repair

Calibrating with trusted calibration service provider year after year reduces your risk and exposure to hidden costs.



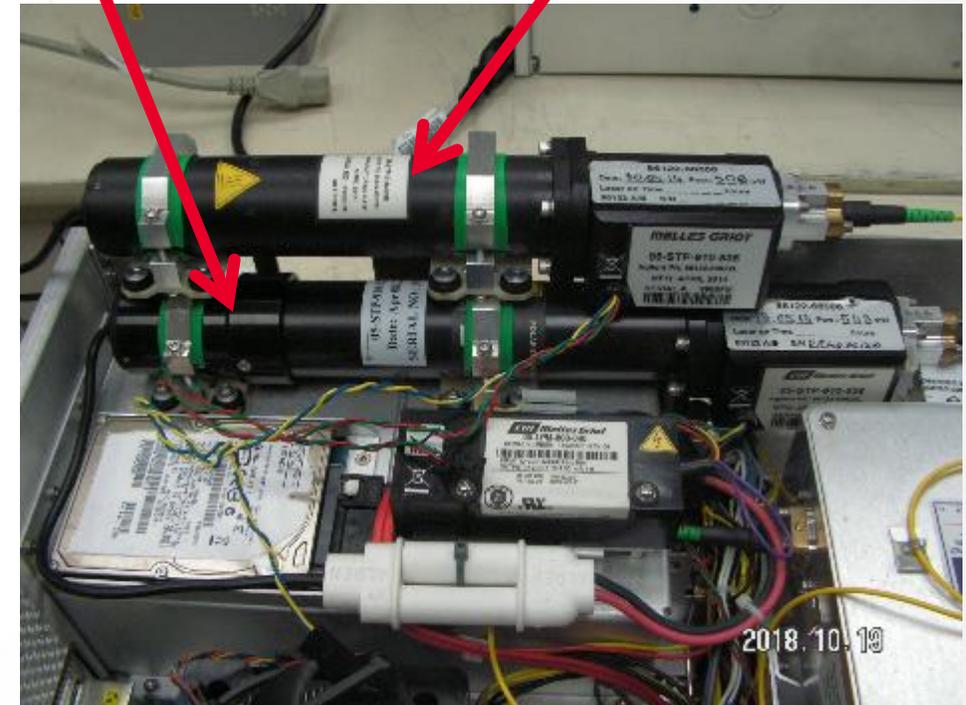
Risk of Low Quality Calibration To Your Equipment

HIDDEN COST OF CALIBRATION

- Use of non-genuine parts – affects the equipment performance and life span
- Poorly calibrated equipment have shorter life span

modified

genuine part



Risk of Non-Compliance to Your Business

AVOIDABLE UNNECESSARY COST

- The implication of **NOT** complying to IATF16949:2016 requirement:
 - Will fail compliance audit
 - Production stop
 - Will fail customer audit
 - **Risk of losing customer/business**

The cost of poor calibration on your business is **MORE** than the price of right calibration

What is Your Criteria in Selecting Calibration Service?



Delivery Mode & Impact to Turn-Around-Time

EXPERIENCE THE TURN-AROUND TIME YOU NEED

Return-to-Bench

Send your equipment to us for Keysight procedures, parts, and trained technicians



On-site Calibration Service

Reduce downtime from days to hours with an on-site service that fits your schedule



On-site Calibration Lab

Manage calibrations and repairs with a Keysight professional at your site



Uptime Loaner Service (System Uptime)

MINIMIZE YOUR DOWNTIME

- **Your challenge:** Keep test systems operating
- **Typical resolution:** Stock spares, rent, or pay for expedited repairs
- **Our solution:** Let Keysight send you a loaner while your equipment is being serviced
- **Your Benefits**
 - Lower cost compared to purchasing spares or rental
 - Avoid capital and operating expenses to acquire and maintain spares
 - Avoid unplanned costs of expedited repairs and rentals
- **Keysight delivers**
 - Send a loaner by carrier or Keysight Customer Engineer
 - Speed of delivery options: same day, next day, and three-day
 - Manage maintenance of the loaner

BE PREPARED.
MAXIMIZE UPTIME.
LOWER COST

What is Your Criteria in Selecting Calibration Service?



Calibration Type & Option

SELECT THE RIGHT CALIBRATION & PAY THE RIGHT PRICE

Deliverables	Keysight Calibration	Z540-1 Calibration	Keysight Cal + Uncertainties ⁵	Keysight Cal + Uncertainties + Guardbanding ⁶	Accredited Calibration	Standards Lab Calibration
Primary lab standards ¹						✓
Locally accredited					✓	✓
Measurement guardband ²				✓	✓	✓
Measurement uncertainties		✓	✓	✓	✓	✓
Adjustments ³	✓	✓	✓	✓	✓	✓
As received data report	✓	✓	✓	✓	✓	✓
As shipped data report ⁴	✓	✓	✓	✓	✓	✓
Calibration certificate	✓	✓	✓	✓	✓	✓
Sample calibration certificates						

➤ Know what you need

➤ Know what you are paying for

1. Primary lab standards, such as a Josephson junction, used for lowest measurement uncertainty comparable to a National Measurement Institute.

2. Guardbanding deliverables vary based on local country accreditation body requirements.

3. See Application Note titled [Layout of Calibration Certificates and Measurement Reports](#) for information on how results are reported and when adjustments are performed.

4. Provided when adjustment(s) are made.

5. Keysight Cal + Uncertainties is offered only in China and Singapore. For other Asian countries, order Z540-1. Call us to confirm Z540-1 standard compliance.

6. Keysight Cal + Uncertainties + Guardbanding previously named ISO 17025 Cal.

What Should You Look for in a Calibration Report ?



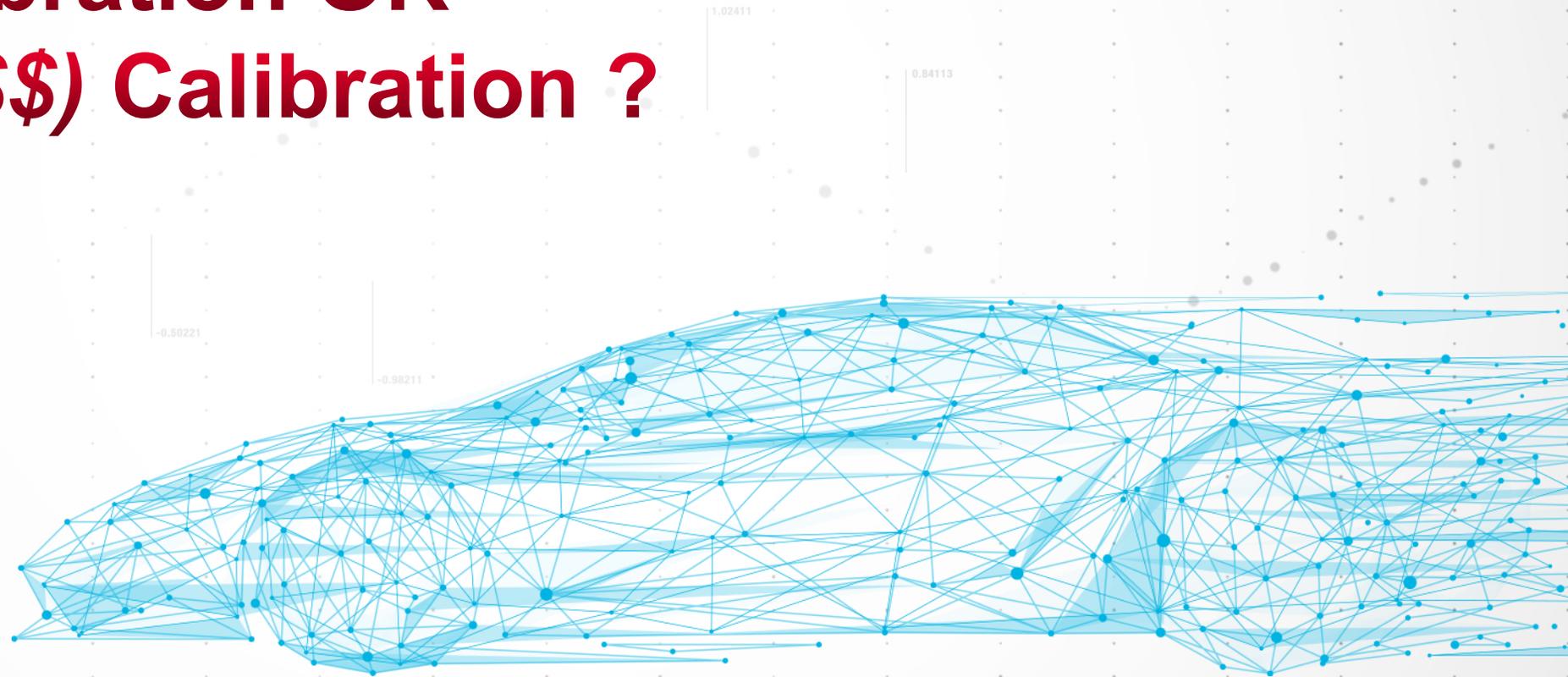
Quality Calibration: Be an Informed Customer

WHAT YOU SHOULD LOOK AT

- Type of Calibration Equipment used
- Number of Test Parameter Covered
- Number of Test Points Covered
- Is Adjustment included. Do you need to pay for it.
- Measurement Uncertainty
- The Limit used
- Is Traceability note included

READ YOUR CALIBRATION
REPORT

What is Your Preference: Cheap Calibration OR Value (*for \$\$*) Calibration ?



What You Need to Know About: Traceability



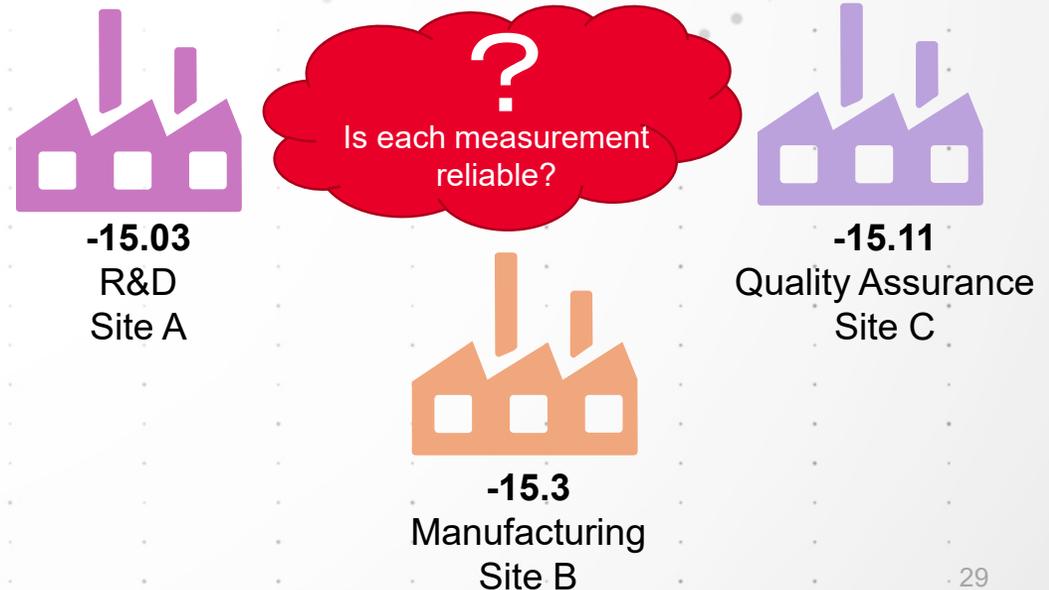
What is Traceability

TRACEABLE MEASUREMENTS ENSURES UNIFORMITY

Property of measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty

LINKAGE TO COMMON STANDARD

Are these Data consistent?



What You Need to Know About: Measurement Uncertainty



What is Measurement Uncertainty

THE IS NO PERFECT MEASUREMENT

Uncertainty is a parameter, associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand.

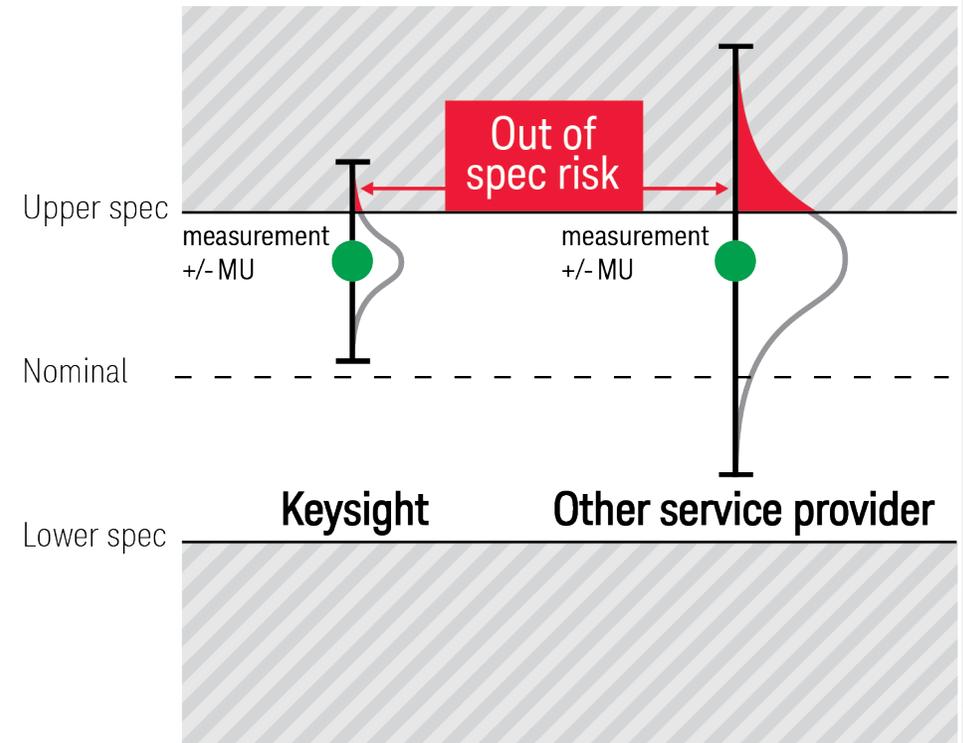
HOW ACCURATE IS THE
MEASUREMENT

What is Measurement Uncertainty

THE IS NO PERFECT MEASUREMENT

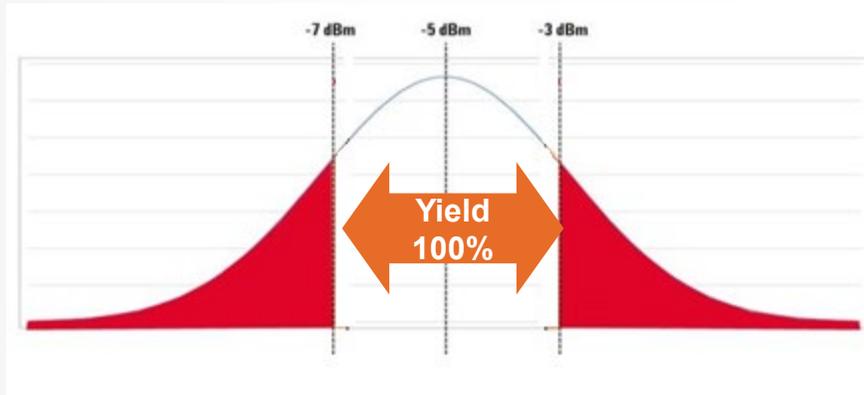
- There is no perfect measurement, as they involve errors and imperfections
- Large calibration uncertainty increases the risk that your instrument is operating out-of-specification, risking instrument errors that impact the quality or performance of your design
- Calibration measurement uncertainty of your test equipment contributes to your overall test system inaccuracy: Keep it small

Low measurement uncertainty (MU) matters

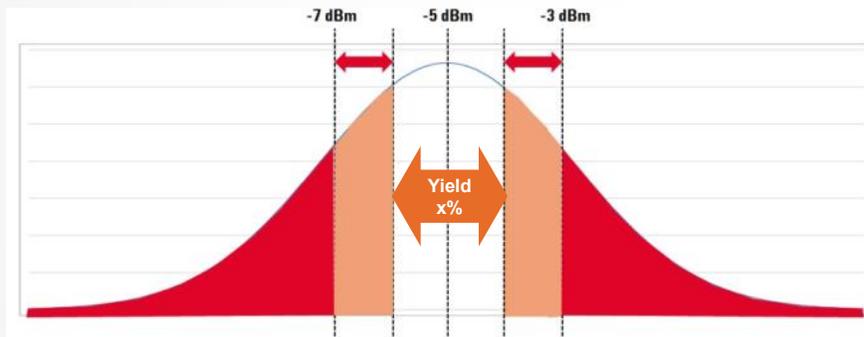


Measurement Uncertainty : Without vs With

Without Measurement Uncertainty :



With Measurement Uncertainty :



Good & Bad Products

- X Recall | X Long investigation |
- X Intermittent issues | X Cost |
- X Reputation

Release bad products into the market

Good Products

Calibration Impacts Measurement Uncertainty

MEASUREMENT UNCERTAINTY IMPACTS YIELD

		Test Outcome	
		Fail	Pass
True State of Product	Good	Increases Scrap & Repair Costs	
	Bad		Increases Recalls, Costs Threatens Reputation

Risk of Poor Calibration: Recap & Solution



Risk of Poor Calibration - Business

Product Recall

Lose of Customer/
Business

Fail audit /
Stop Production

NON-COMPLIANCE

Poor Performance

Shorter Life Span

AFFECT TO EQUIPMENT

Risk of Poor Calibration - People



YOU AND ME

-0.50221

-0.98211

Solution

RISK OF POOR CALIBRATION: WHAT THE AUTOMOTIVE INDUSTRY SHOULD KNOW

- **Know your NEEDS & Ensure its FULFILLED**
 - *Know what type of calibration you need & what you are paying for*
- **Ensure PROPER Calibration**
 - *Accredited Cal*
 - *All required parameters & points are covered, right test limits is used etc.*
- **Select TRUSTED Calibration Service Provider**
 - *Quality Calibration vs Cheap Calibration*



Conclusion

RISK OF POOR CALIBRATION: WHAT THE AUTOMOTIVE INDUSTRY SHOULD KNOW

- **Ensure only good products are released**
 - *Higher measurement accuracy*
 - *Reduce the risk of bad products slipping through*
- **Ensure compliance**
 - *Accredited Cal*
 - *Trusted calibration service provider*
- **Win business opportunity**
 - *IATF 16949:2016 - essential requirement for any organization operating in the global automotive supply chain.*
 - *Accreditation a contractual requirement for automotive suppliers*





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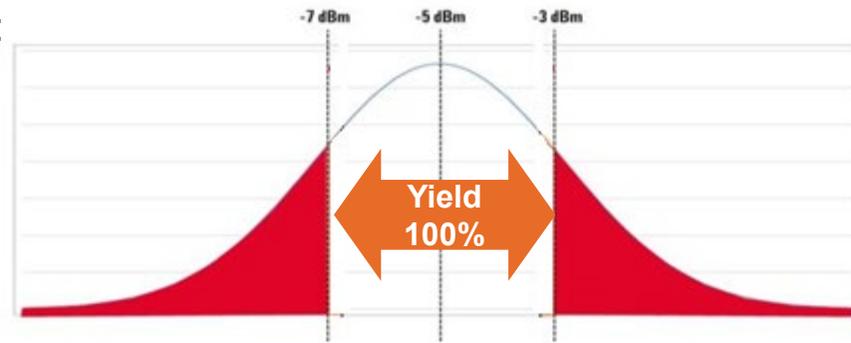


Backup Slides



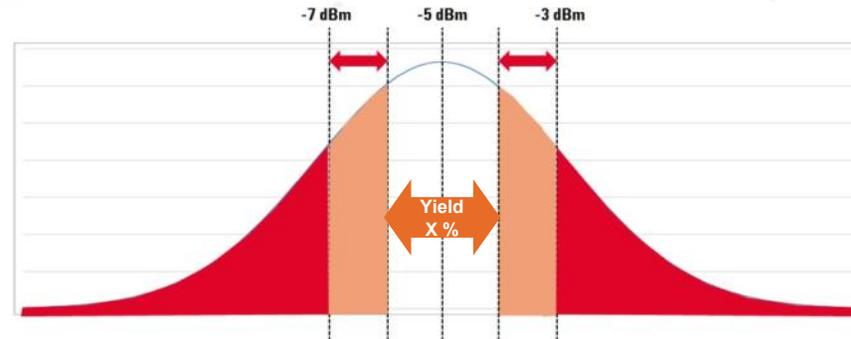
Measurement Uncertainty : Making the Right Selection

Without Measurement Uncertainty :



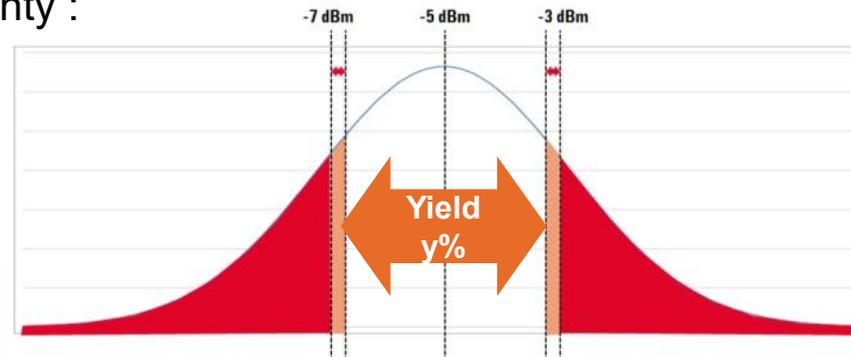
Good & Bad Products

With Measurement Uncertainty :



Good Products

With (lower) Measurement Uncertainty :

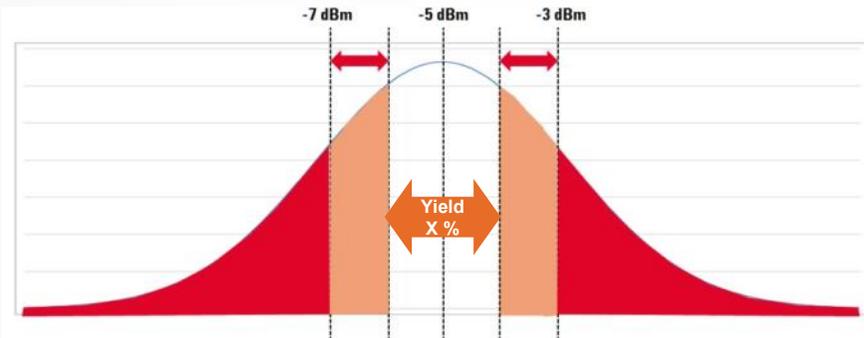


Good Products
+
Improved Yield

Measurement Uncertainty : Risk of Poor Selection

REDUCING MEASUREMENT UNCERTAINTY IMPROVES YIELD

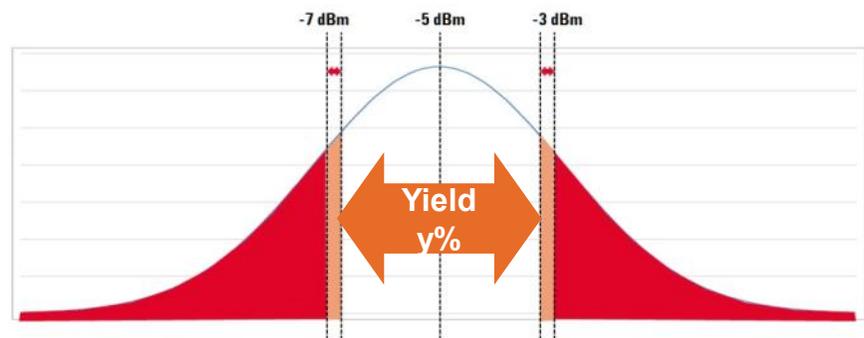
± 1.0 dB meas uncertainty



More Defects Reported

=

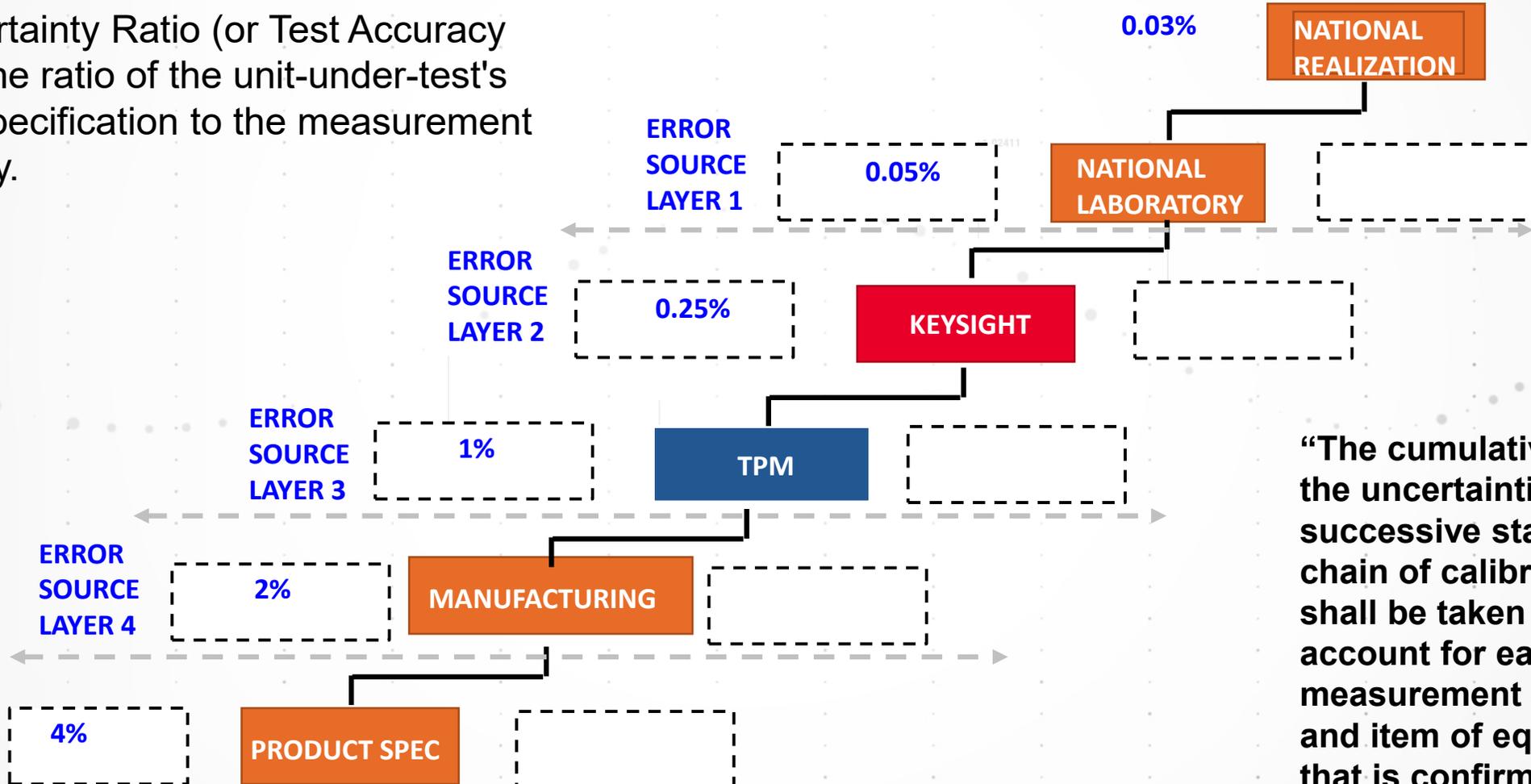
± 0.25 dB meas uncertainty



Measurement Traceability Chain Effects on Uncertainty

THE POTENTIAL INACCURACY AT EACH LEVEL OF THE CHAIN

Test Uncertainty Ratio (or Test Accuracy Ratio) is the ratio of the unit-under-test's working specification to the measurement uncertainty.



“The cumulative effect of the uncertainties of each successive stage in a chain of calibrations shall be taken into account for each measurement standard and item of equipment that is confirmed.”

ISO/TS16949 to IATF16949

WHAT DOES IT MEAN TO AUTOMOTIVE SUPPLIER

More strict requirement comes to QMS for automotive supplier



ISO/TS16949 managed by ISO has been changed to IATF16949 managed by IATF
All TS sites to comply by Sep 14th 2018

Requirement for Calibration in IATF 16949:2016

7.1.5.2 : Measurement Traceability

7.1.5.2.1 : Calibration / Verification Records

Records of the calibration/verification activity for all gauges and measuring and test equipment (including employee-owned equipment relevant for measuring, customer-owned equipment , or on-site supplier-owned equipment.) needed to provide evidence of conformity to internal requirements, legislative and regulatory requirements, and customer-defined requirements shall be retained.

Requirement for Calibration in IATF 16949:2016

7.1.5.3 : Laboratory Requirements

7.1.5.3.1 : Internal Laboratory (calibrate in your company)

The laboratory comply to requirements including – the capability to perform these services correctly, traceable to the relevant process standard;

Included in the quality management system documentation;

Requirement for Calibration in IATF 16949:2016

Summary of 7.1.5.3.2 : External Laboratory (calibration by vendor)

Basically it requires ISO/IEC 17025 accredited calibration:

- Calibrated by ISO/IEC 17025 authorized vendor
- Certification of Calibration needs accredited “logo”
- Accepted by the customer

* When no qualified laboratory is available, calibration can be performed by the equipment original manufacturer (OEM calibration). *In such cases, the requirements listed in Section 7.1.5.3.1 must be met.*

Is Accredited Cal and Standard Cal the Same?



Deliverables	Keysight Calibration	Accredited Calibration
Primary lab standards ¹		
Locally accredited		✓
Measurement guardband ²		✓
Measurement uncertainties		✓
Adjustments ³	✓	✓
As received data report	✓	✓
As shipped data report ⁴	✓	✓
Calibration certificate	✓	✓
Sample calibration certificates		



Requirement for Calibration in IATF 16949:2016

7.1.5.3 : Laboratory Requirements

7.1.5.3.2 : External Laboratory (calibration by vendor)

The laboratory shall be accredited to ISO/IEC 17025 or national equivalent; and calibration service in the scope of accreditation (certificate); The certificate of calibration shall include the mark of a national accreditation body. There shall be evidence that the external laboratory is acceptable to the customer.