Making Precise

RF and µW Measurements

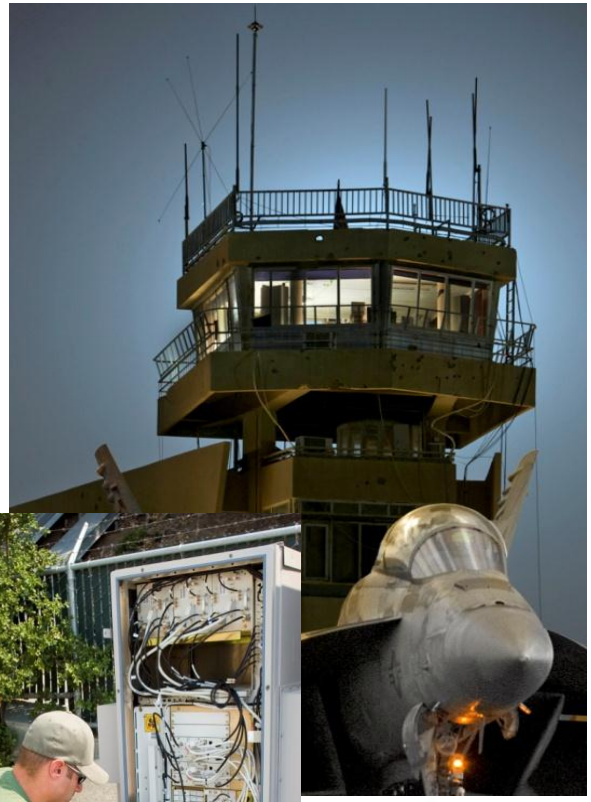
in the Field

Wilkie Yu
RF/µW Handheld Marketing Manager
Andrew Benn
Business Development Manager EMEA

© 2013 Agilent Technologies

Part 1: Making Precise RF & µW Measurements in the Field

1. Introduce Cable and Antenna Testing and its importance for optimizin and troubleshooting transmission systems and antennas
2. Present different types of user calibrations for precision in the field
3. Explain and demonstrate measuring cable insertion loss using 1-port and 2-port techniques
4. Discuss antenna parameters and field measurements
5. Introduce and demonstrate Distance to Fault (DTF) measurement and concepts
6. End of Part 1



© 2013 Agilent Technologies

INTRODUCING AGILENT TECHNOLOGIES

The premier measurement company

Dates back to: 1939
When Bill Hewlett and Dave Packard founded a technology company that shaped Silicon Valley and the technology industry

Separated: from Hewlett-Packard in 1999

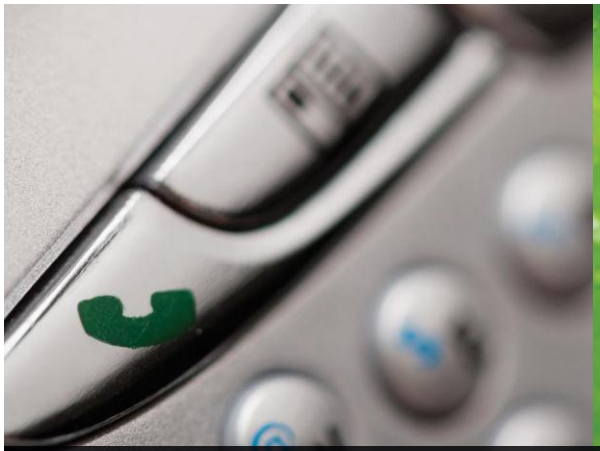
Facilities: over 30 countries

Customers:
over 110 countries

© 2013 Agilent Technologies

Agilent Technologies

A Singular Focus on Measurement



Electronic Measurement

- Wireless technologies
- Mobile phone R&D and manufacturing
- Aerospace/defense
- Low-cost instrumentation

Chemical Analysis

- Food safety, quality
- Energy research, production
- Quality of air, water, soil
- Forensics, drugs of abuse

Life Sciences

- Pharmaceutical research and manufacturing
- Genomics, proteomics, metabolomics tools for disease research

© 2013 Agilent Technologies

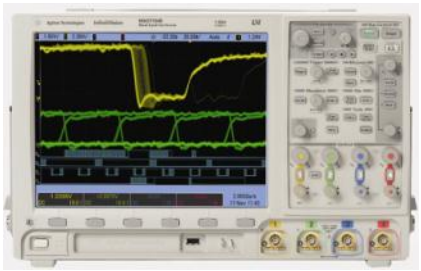
Electronic Test Solutions - over Vast Frequency Range

Basic Measurements

Voltage, Current, Impedance, Frequency, Power, etc.

Time Domain

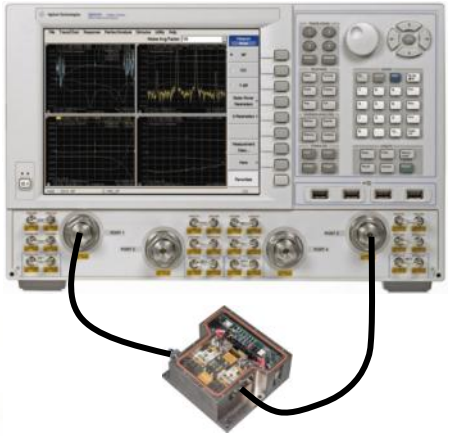
Oscilloscope



Digitizers

Stimulus and Response

Network Analyzer



Combo Handheld

Frequency Domain

Spectrum Analyzer

Complex System Characterization

Mobile Phone One-Box Tester

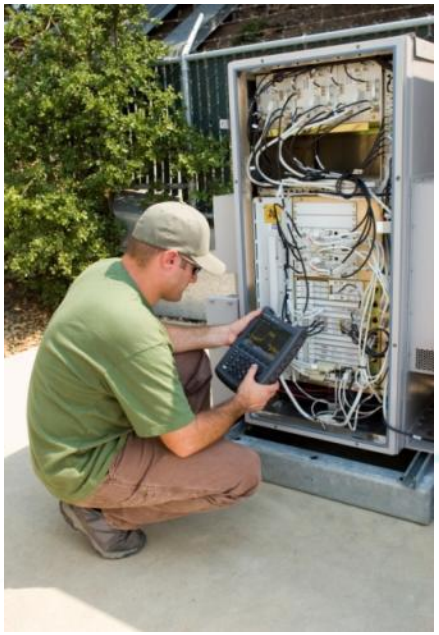
1 10 10^2 10^3 10^4 10^5 10^6 10^7 10^8 10^9 10^{10} 10^{11} 10^{12}

Frequency in Hz | Audio | LF | AM Radio | TV/FM | Microwave | mmWave | THz

© 2013 Agilent Technologies

Leveraging our Measurement Leadership

FieldFox analyzers integrate Agilent's *Measurement Science* into a ruggedized, handheld multi-functional platform.



2012 FieldFox microwave handheld analyzer

2001 PSA spectrum analyzer

2000 PNA vector network analyzer

2009 PXA X-Series signal analyzer

1984 8510A vector network analyzer

2007 PNA-X vector network analyzer

1978 HP 8566B spectrum analyzer

© 2012 Agilent Technologies

Outline

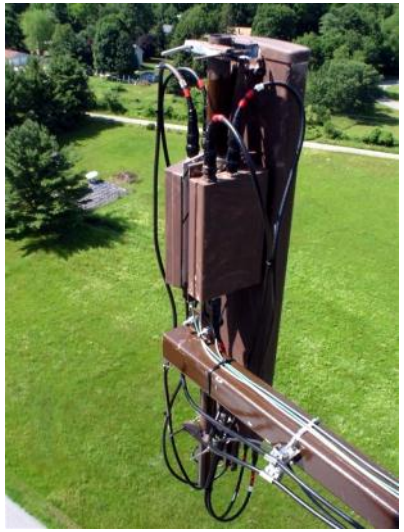
- Why is Cable and Antenna Testing Important?
- Cable Loss Testing
- Antenna Testing
- Distance to Fault (DTF)
- FieldFox Calibration

Image courtesy of John Arthur, Wireless EDGE

© 2013 Agilent Technologies

Why is Cable and Antenna Testing Important?

- Verify transmission performance (line sweeping)
- Measure installed antenna performance and isolation
- Determine the location of damaged components



Types of cable damage

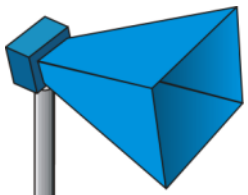
- Failed seal at a cable splice (liquid ingress)
- Failed solder joint at connector interface
- Cut, crushed and/or weather-induced cracks
- Minimum bend radius exceeded

Images courtesy of John Arthur, Wireless EDGE

© 2013 Agilent Technologies

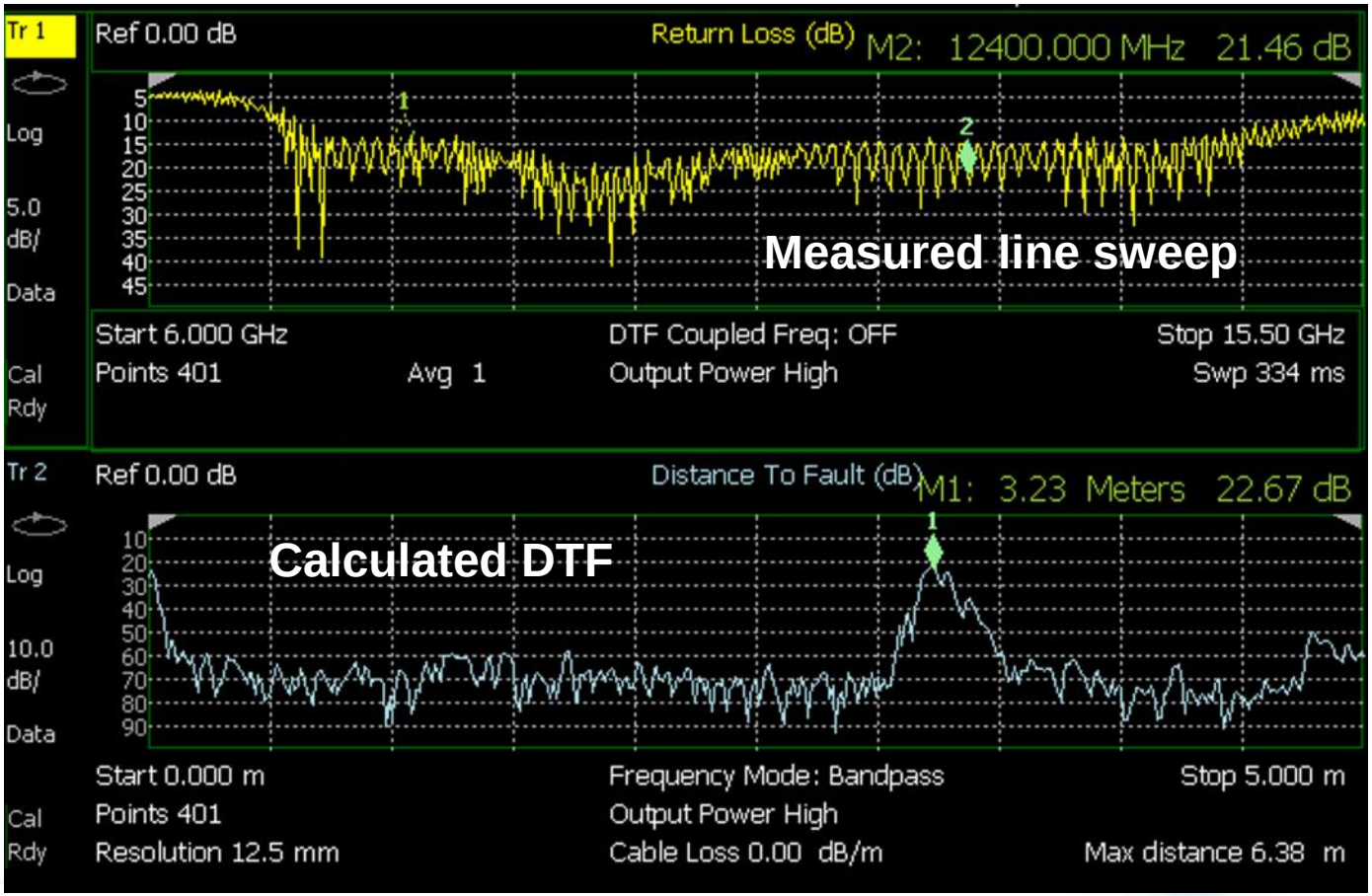
Line Sweeping and Distance-to-Fault (DTF)

X-band horn antenna



Coaxial cable

FieldFox N9918A



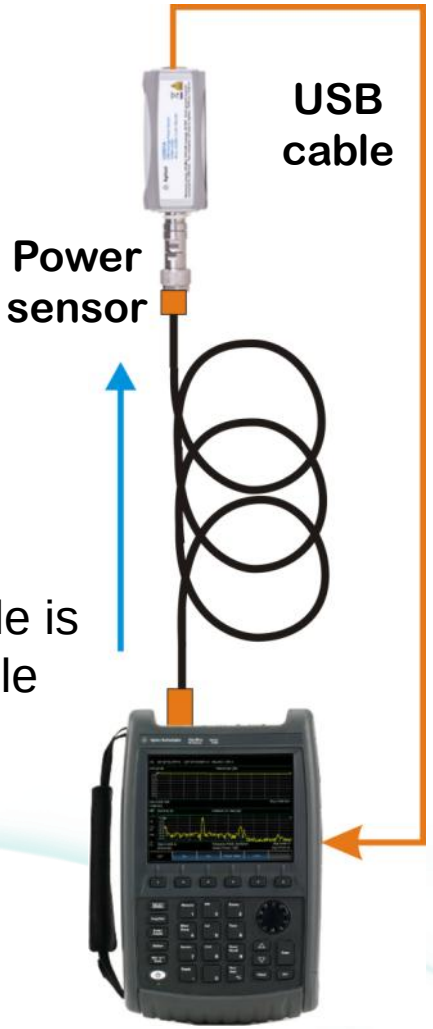
© 2013 Agilent Technologies

Cable Loss Measurement Techniques

2-port
loss measurement

1-port
loss measurement

Power sensor-based
loss measurement

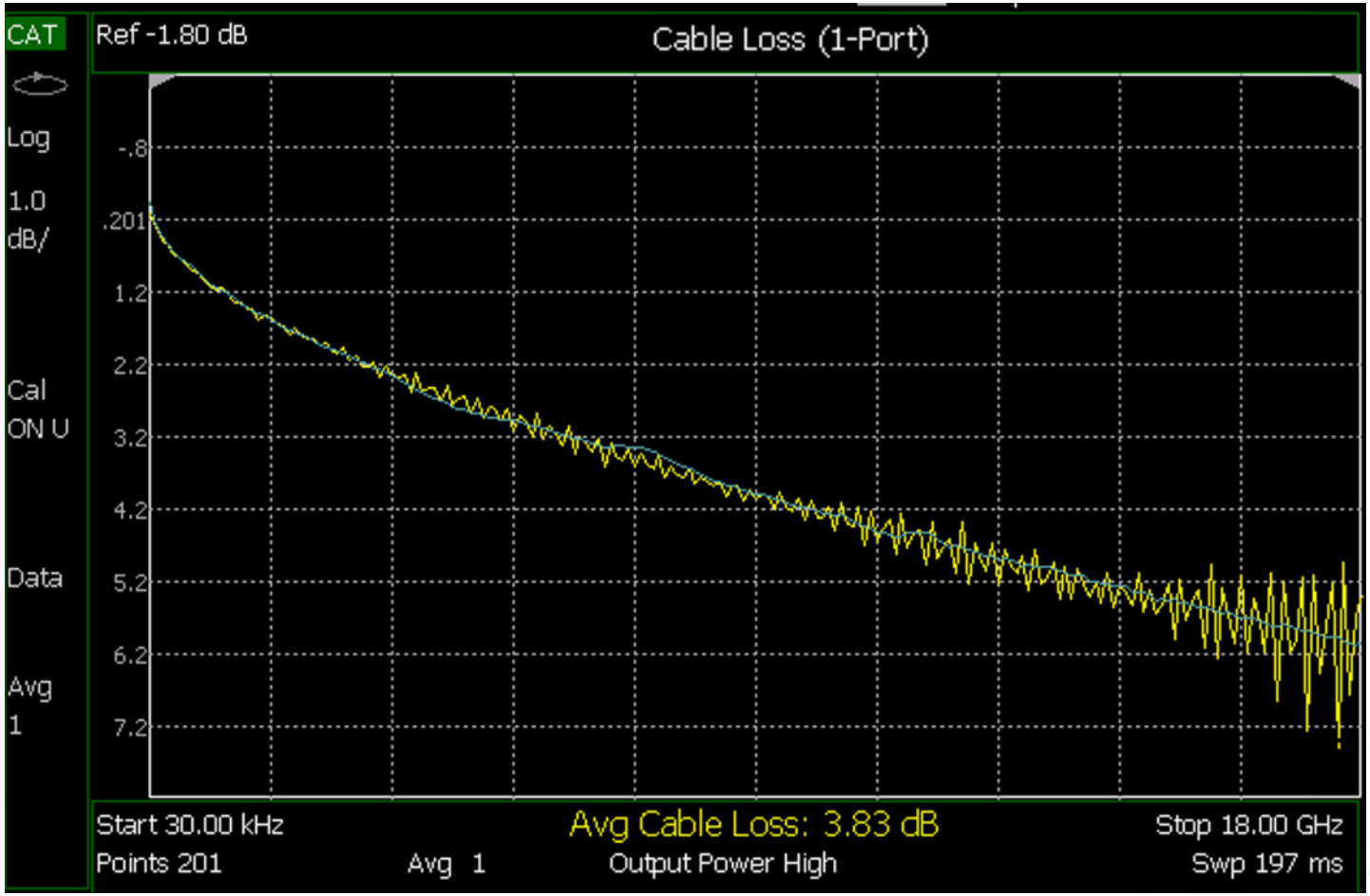


Note:
USB cable is
extendable

© 2013 Agilent Technologies

Cable Loss Measurement Examples

2-port and 1-port cable loss



© 2013 Agilent Technologies

Demo –1 Port Loss Measurements

© 2013 Agilent Technologies

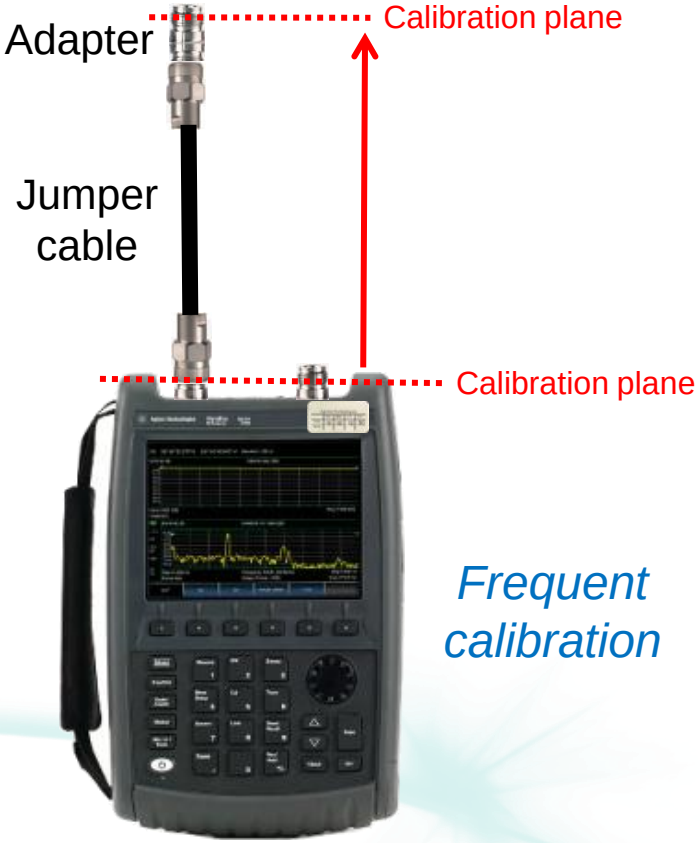
FieldFox Calibration Requirements

Factory calibration

Re-calibration recommended 12 to 18 months

Certificate of calibration

User calibration



Frequent calibration

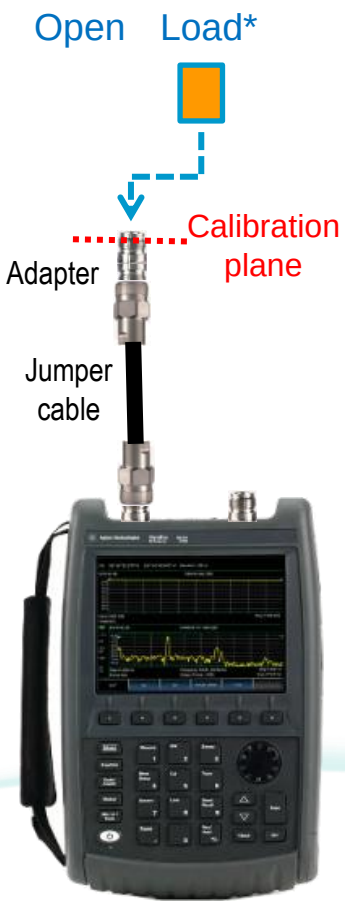
© 2013 Agilent Technologies

Calibrating for 1-Port Measurements

CalReady (built-in)

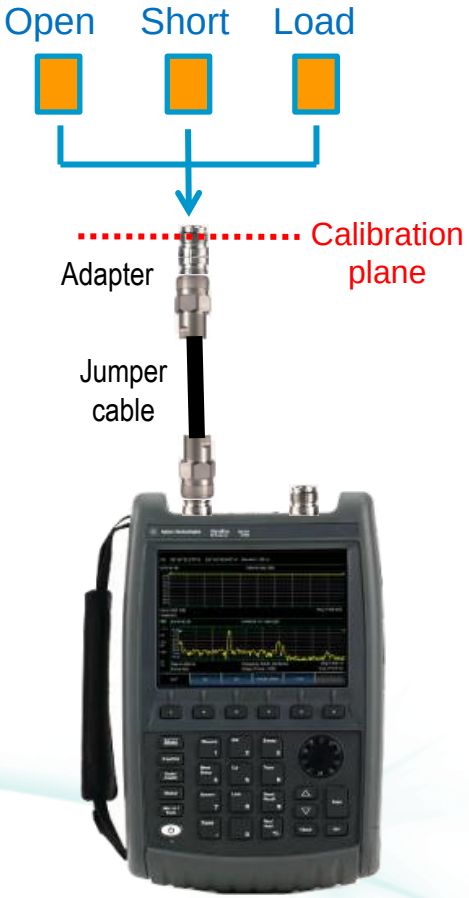
Factory calibrated

QuickCal



** Load optional*

Mechanical



Requires mechanical cal kit

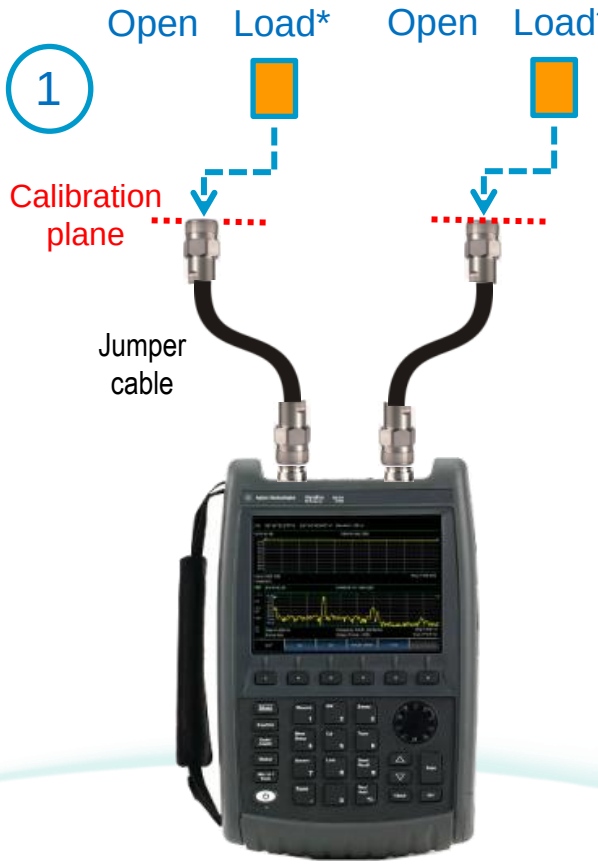
© 2013 Agilent Technologies

Calibrating for 2-Port Measurements

CalReady
(built-in)

Factory calibrated

QuickCal

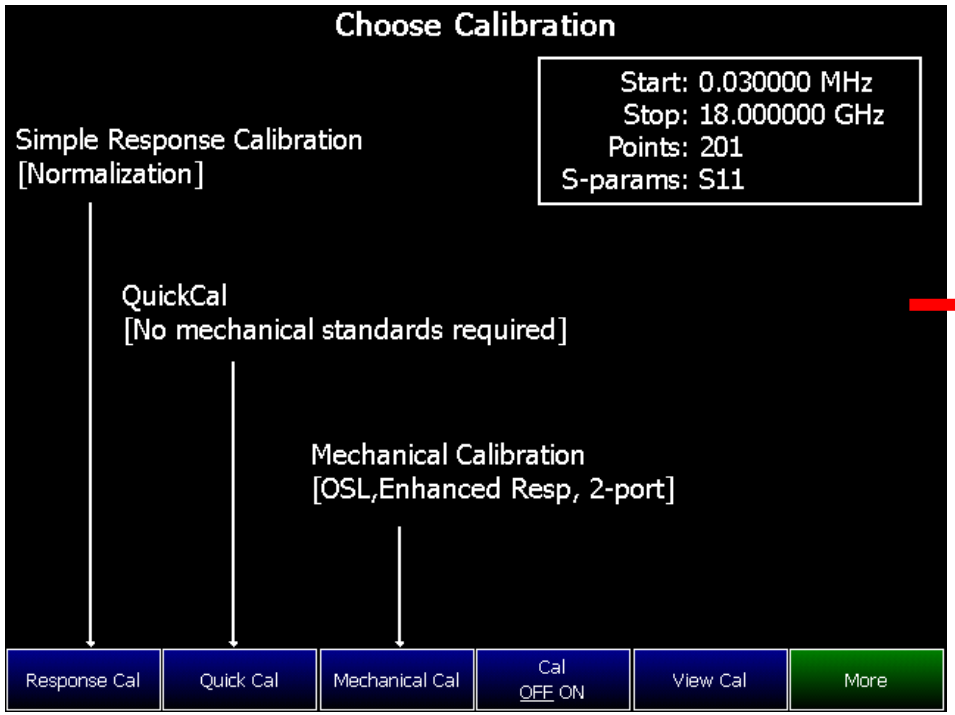


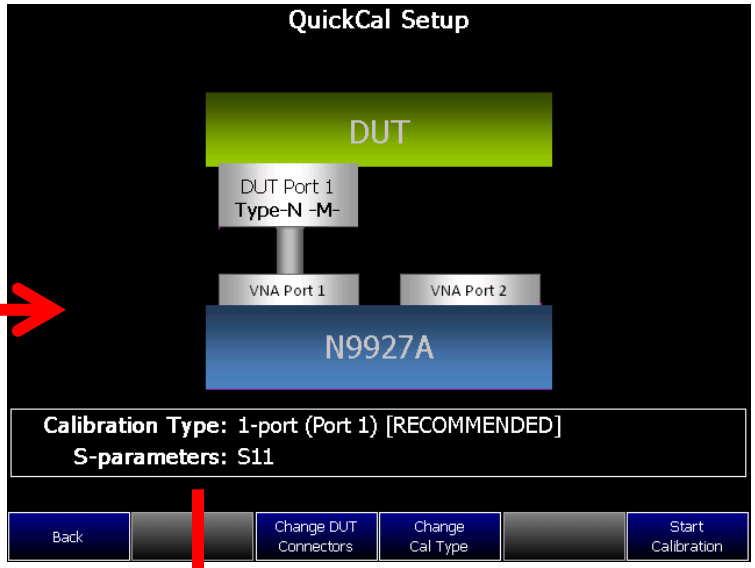
** Load optional*

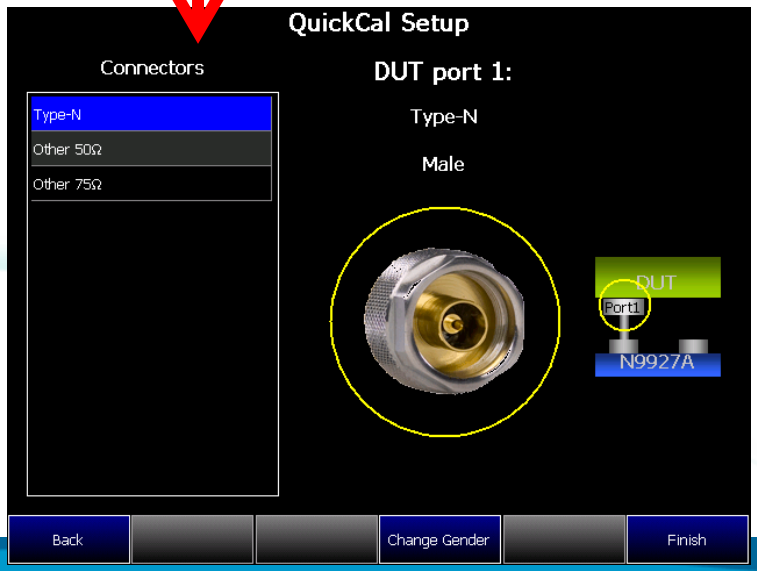
Mechanical cal requires O, S, L during step 1

© 2013 Agilent Technologies

FieldFox Guided Calibration – *Cal Wizard*







- FieldFox recommends calibration type
- Simple setup process
- Cal Wizard for step-by-step connections

© 2013 Agilent Technologies

Demo: Calibrations in the Field

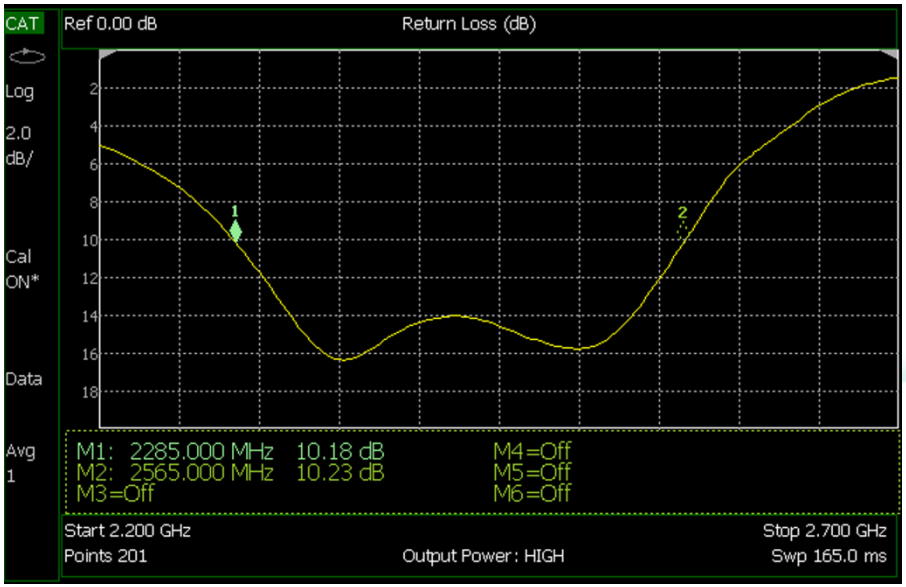
© 2013 Agilent Technologies

Antenna Properties

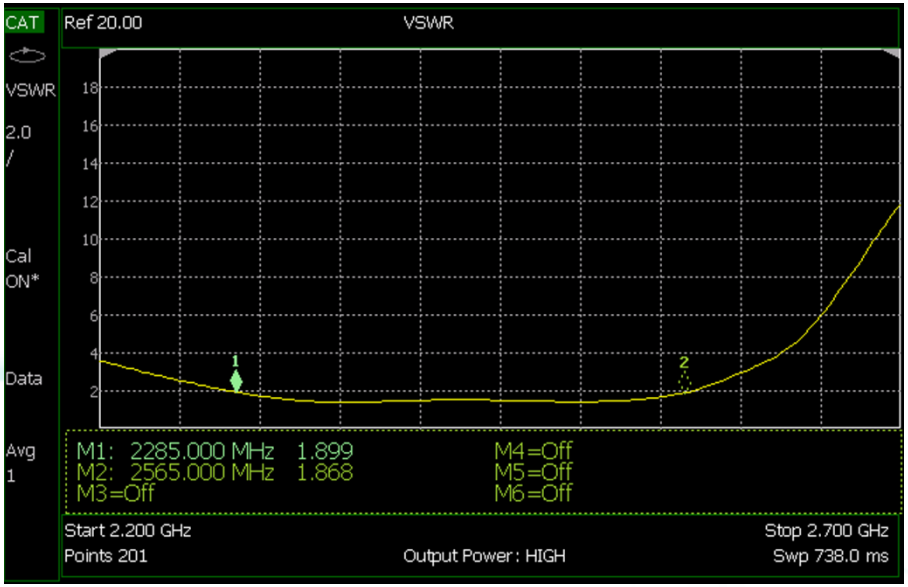
FieldFox
- Return Loss (dB)
- Voltage Standing Wave Ratio (VSWR)
- Antenna to Antenna Isolation

Special Equipment
- Gain
- Efficiency

Return Loss (dB)



VSWR



© 2013 Agilent Technologies

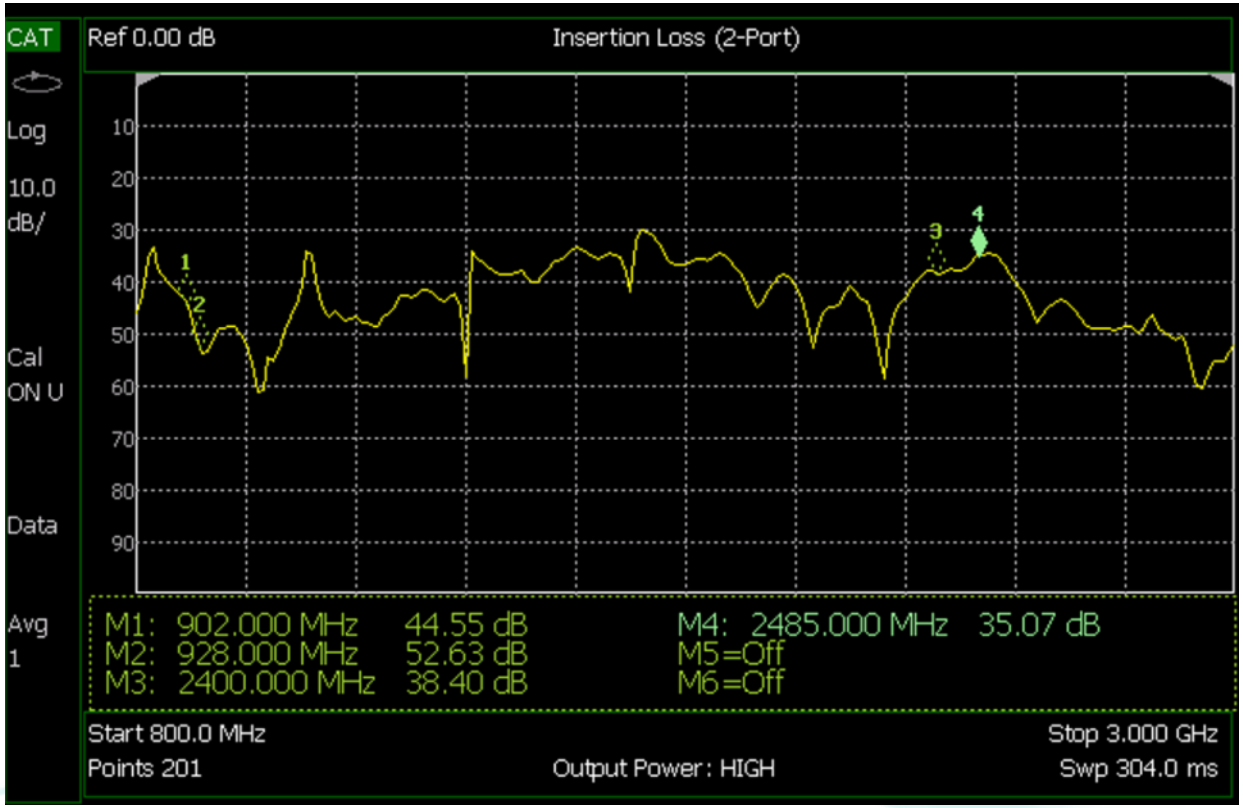
Antenna-to-Antenna Isolation

Copyright J M Briscoe and licensed for reuse under the Creative Commons License.

© 2013 Agilent Technologies

Antenna-to-Antenna Isolation Measurement

Insertion loss (2-port)



Antenna-to-antenna isolation is above 44 dB across the 900 MHz band but is only 35 dB in the 2.4 GHz band. In this case, the system spec calls for 40 dB of isolation.

© 2013 Agilent Technologies

End of part 1

© 2013 Agilent Technologies