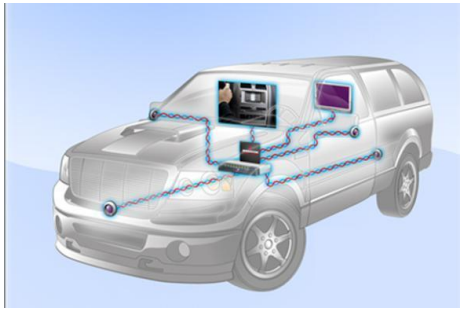
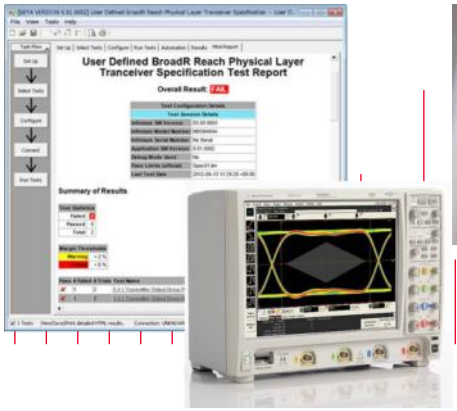
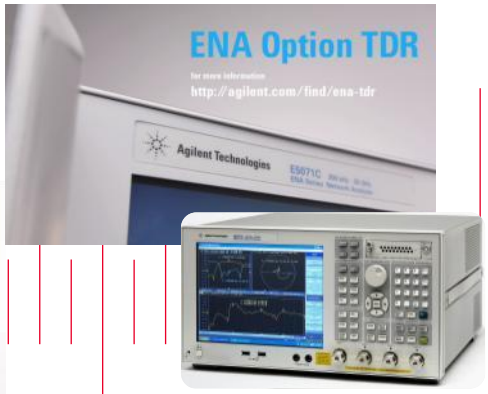


# BroadR-Reach
# PHY Compliance Solutions

Last Update: 2014/12/10 (YS)



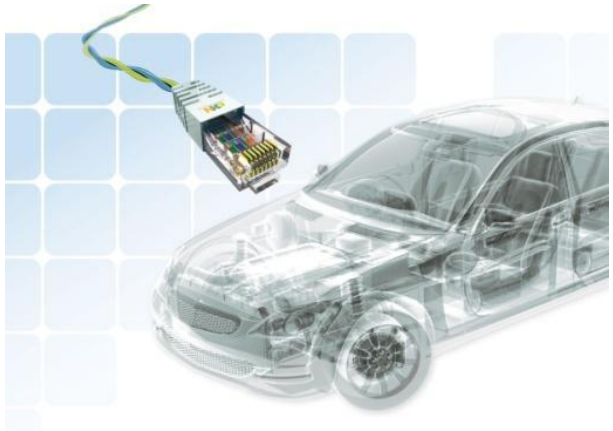




Oscilloscope and Protocol Division
Component Test Division

KEYSIGHT TECHNOLOGIES

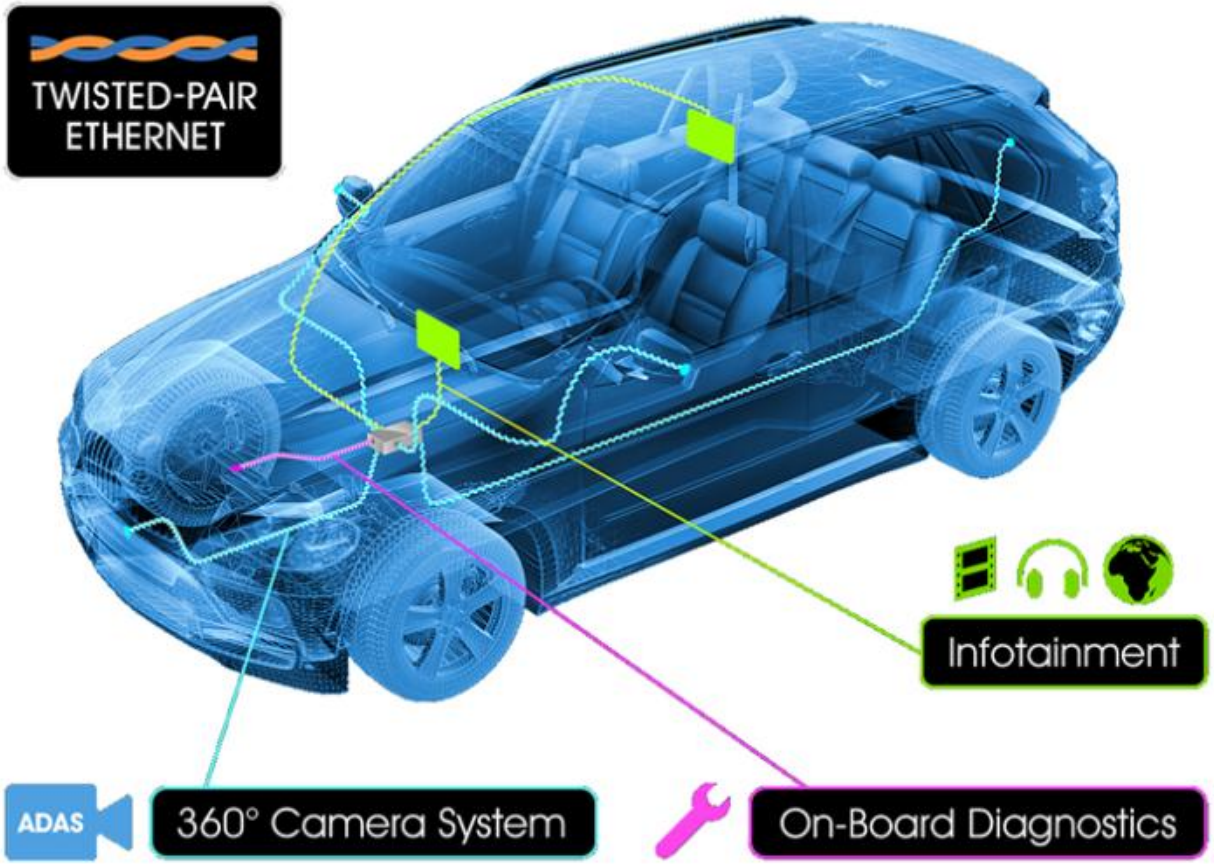
# Agenda

- BroadR-Reach Overview
- Transmitter Testing
- Link Segment Testing

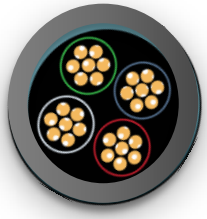
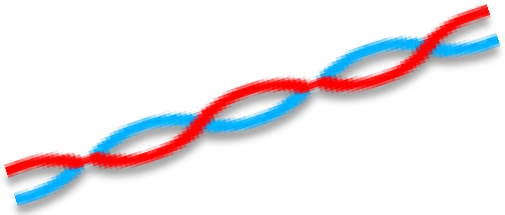
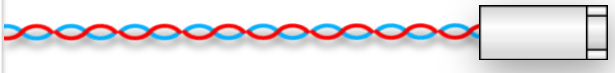


KEYSIGHT TECHNOLOGIES

# BroadR-Reach Applications

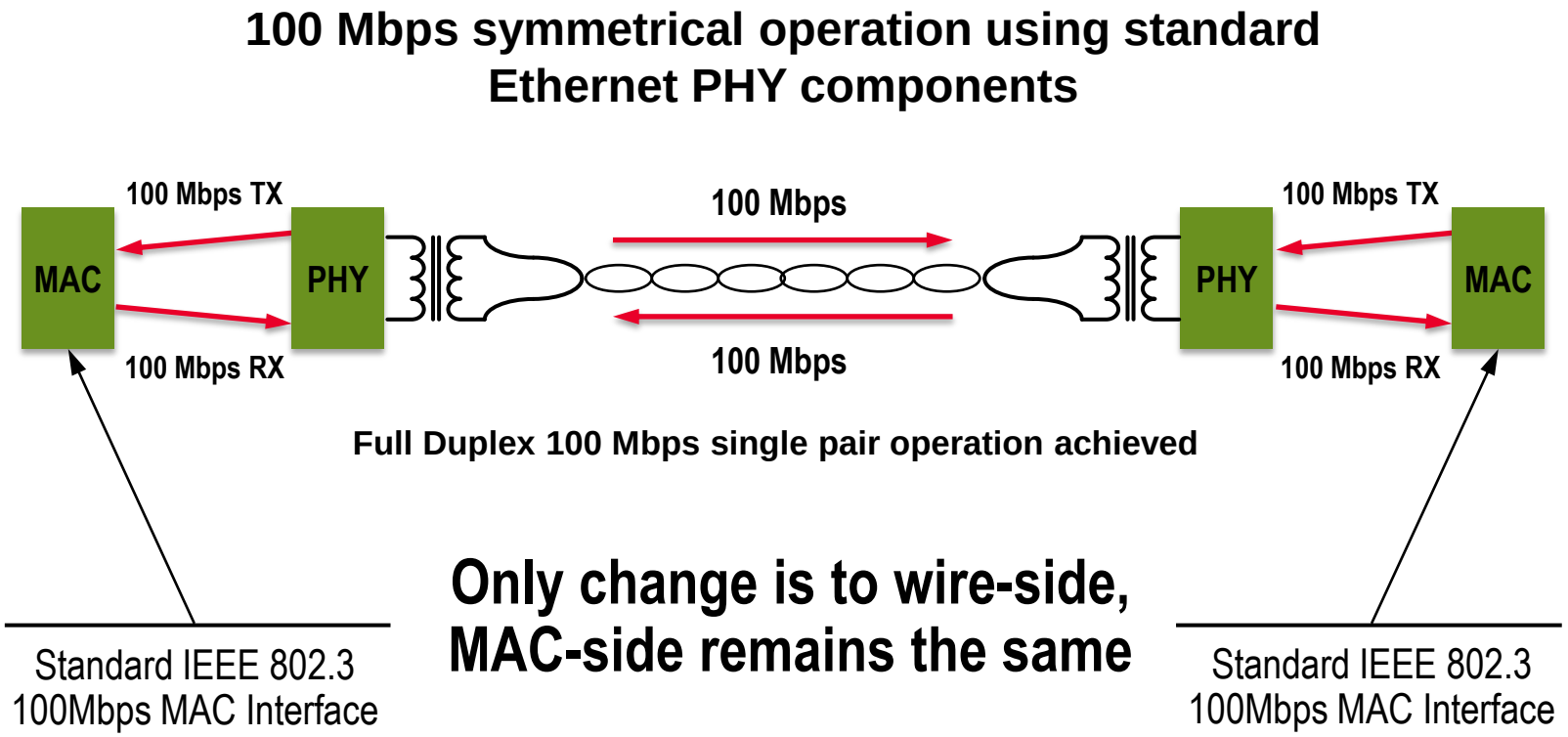


# Connectivity Comparison

| | Cable | Connector (2 ends, on-board and cable) |
|---|---|---|
| **Standard Ethernet** |  |  |
| **BroadR-Reach** |  |  |

- Reduces connectivity costs up to 80%
- Reduces cabling weight up to 30%

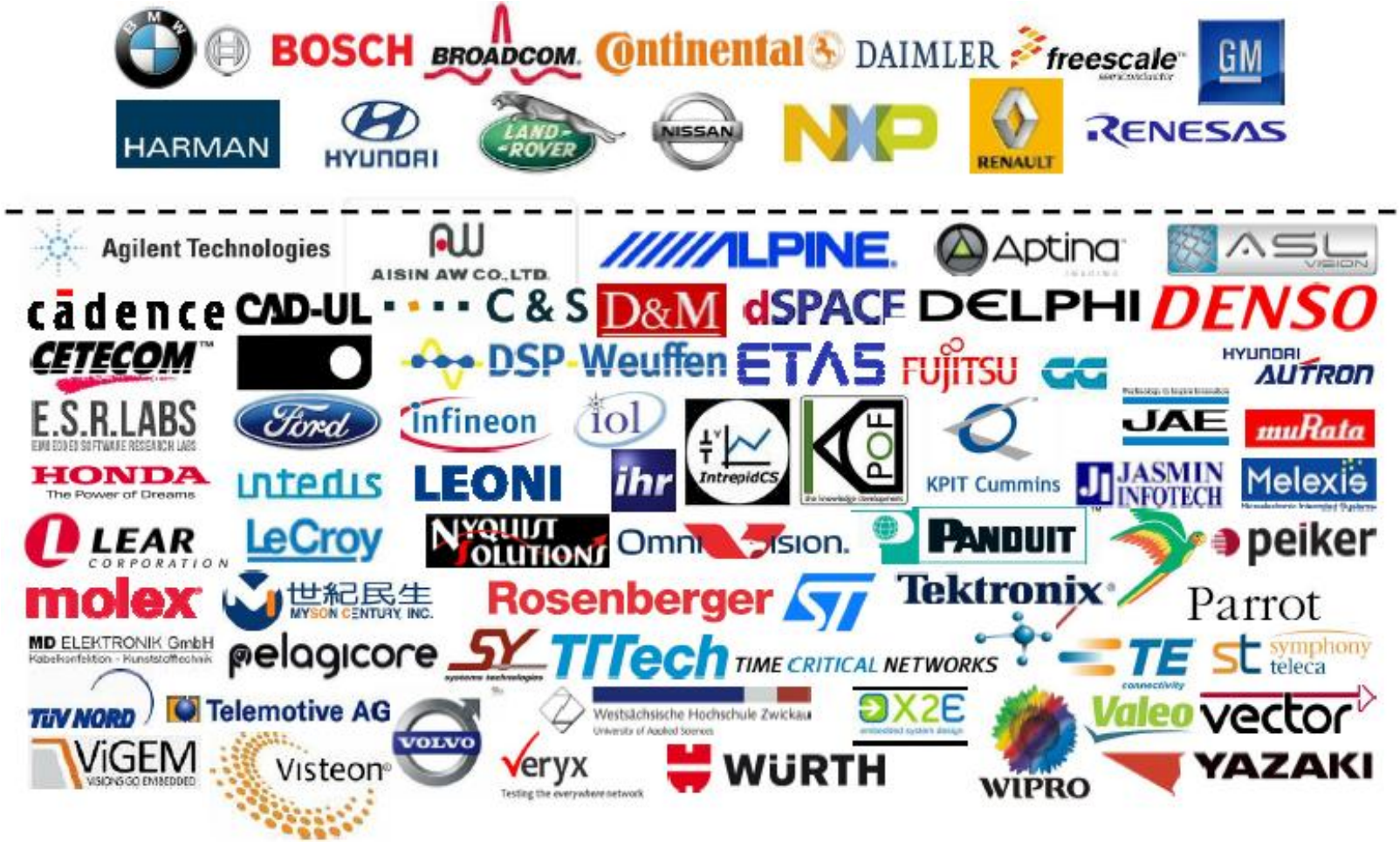
# Cabling and Signal Communication




(Source : Automotive Update, Broadcom, 2012/2)

# OPEN (One Pair EtherNet) Alliance Members

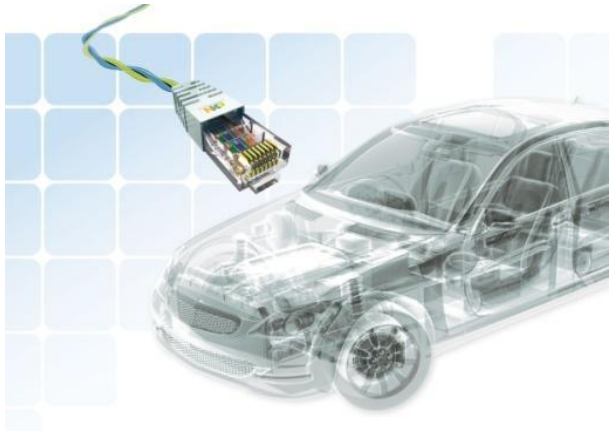
http://www.opensig.org/partners.php




Promoters 14, Adopters 66

# Agenda

- BroadR-Reach Overview
- Transmitter Testing
- Link Segment Testing



# Keysight Automotive Applications

– **InfiniiVision Oscilloscopes**

- CAN, LIN, FlexRay triggering and decode
- CAN Eye-diagram mask testing

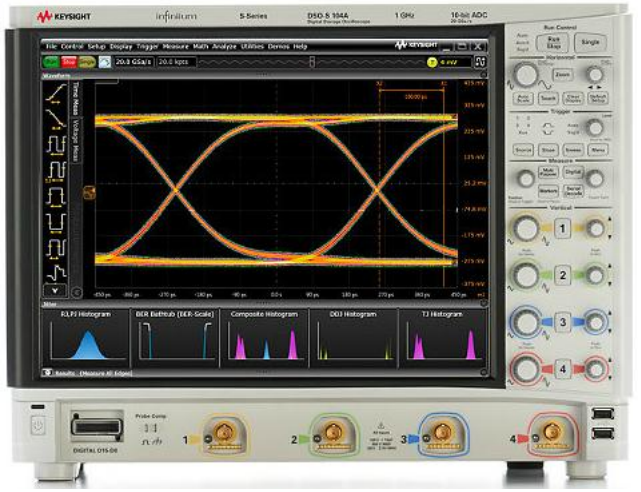
– **Infiniium Oscilloscopes**

- CAN, LIN, FlexRay triggering and decode
- User-definable application (CAN signal quality testing)
- Compliance apps
  - BroadR-Reach (N6467A)
  - MOST150 and MOST50 (N6466A)

– **Probing**

- N2783L 100 MHz current probe (5m cable)
- N5450A high-temperature extension cables for InfiniiMax probes
- N2820/N2821A high-sensitivity current probes





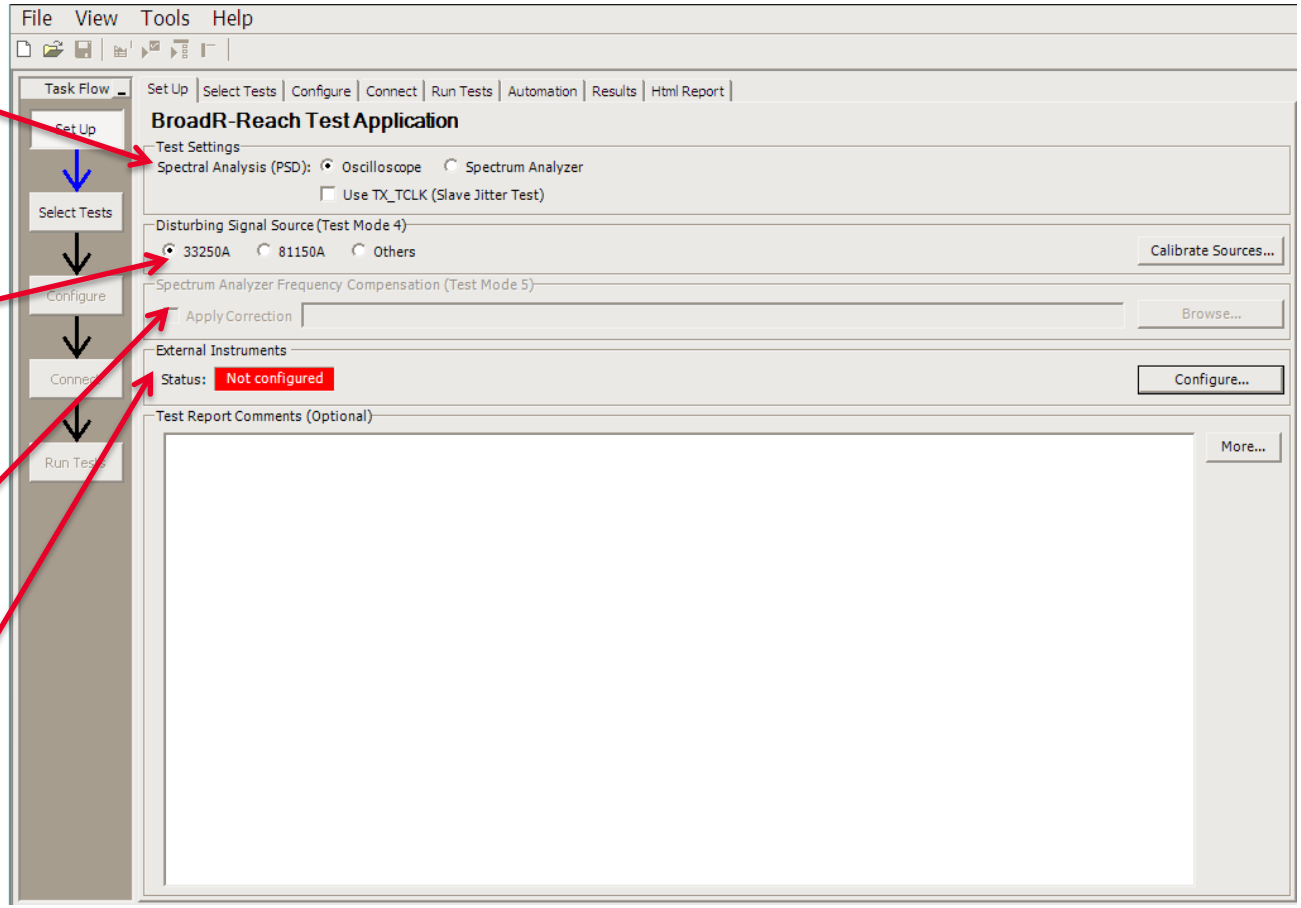
New S-Series Oscilloscope

# BroadR-Reach Transmitter Tests

- • Transmitter Output Droop Test
  - Positive Droop Test
  - Negative Droop Test
- • Transmitter Timing Jitter
  - Slave Jitter Test
  - Master Jitter Test
- Transient Clock Frequency
  - Slave Transient Clock Frequency
  - Master Transient Clock Frequency
- • Transmitter Distortion Test (along with MATLAB)
- Power Spectral Density
  - Scope FFT
  - Spectral Analyzer
- Offline Waveform analysis

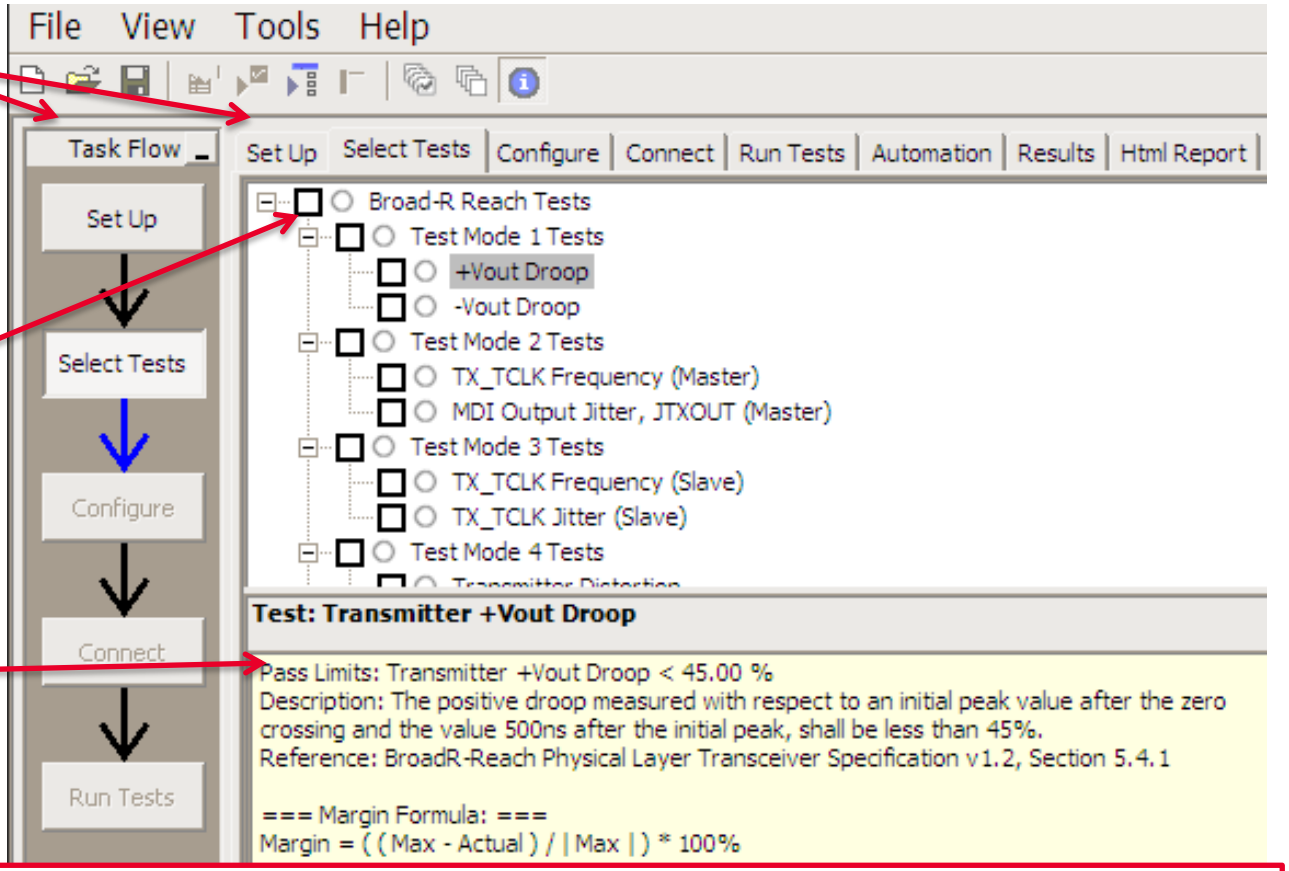
# BroadR-Reach Compliance Application

- For power spectrum density measurement use either Keysight Spectrum analyzer or oscilloscope. We setup the Keysight spectrum analyzer for you.
- We setup the Keysight signal source for you and calibrate it automatically.
- Fixture correction file can be used for the spectrum analyzer to get the most accurate measurement possible.
- Used to setup external instruments such as signal sources and spectrum analyzers.



# BroadR-Reach Compliance Application

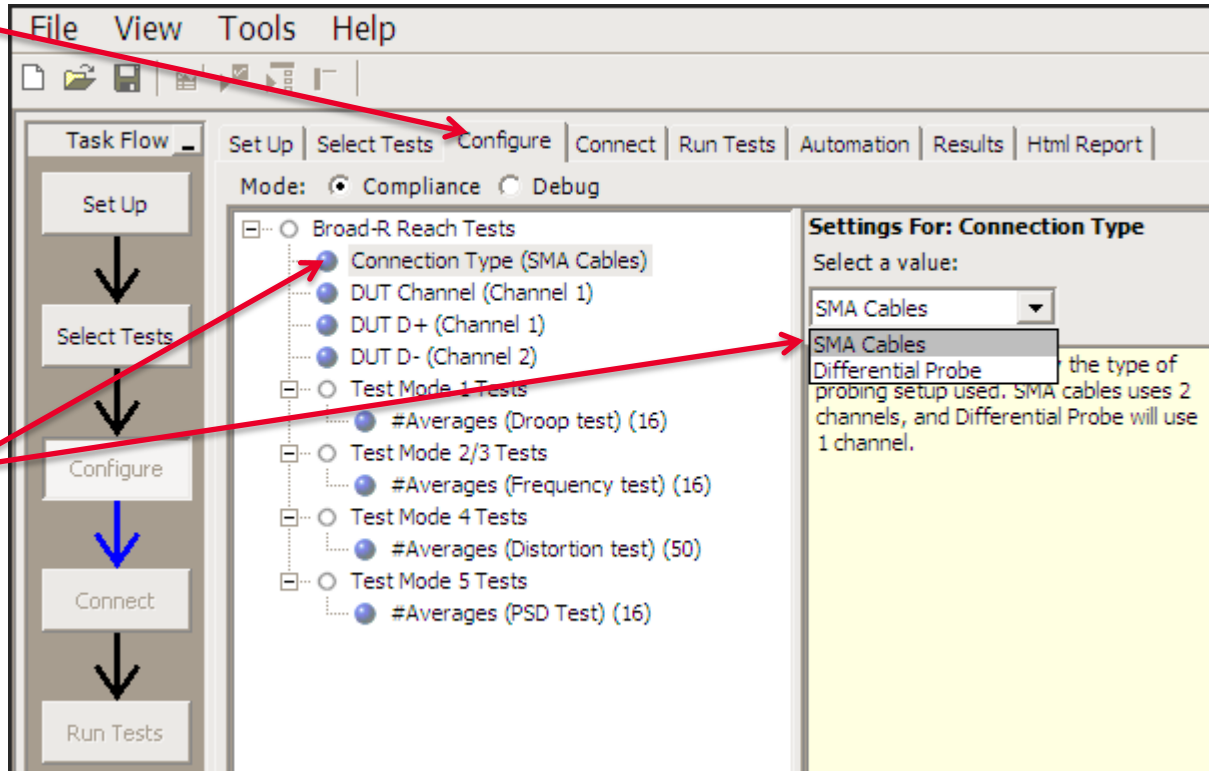
- Tabs along the side and top guide the user to the next logical step.
- Easy to use interface with specific tests categorized by test mode. In this case test modes 1-5.
- Click on the test to get a clear description and location of spec.




The Keysight automated test engine guides you quickly through selecting and configuring tests, setting up the connection, running the tests, and viewing the results. You can easily select individual tests or groups of tests with a mouse-click.

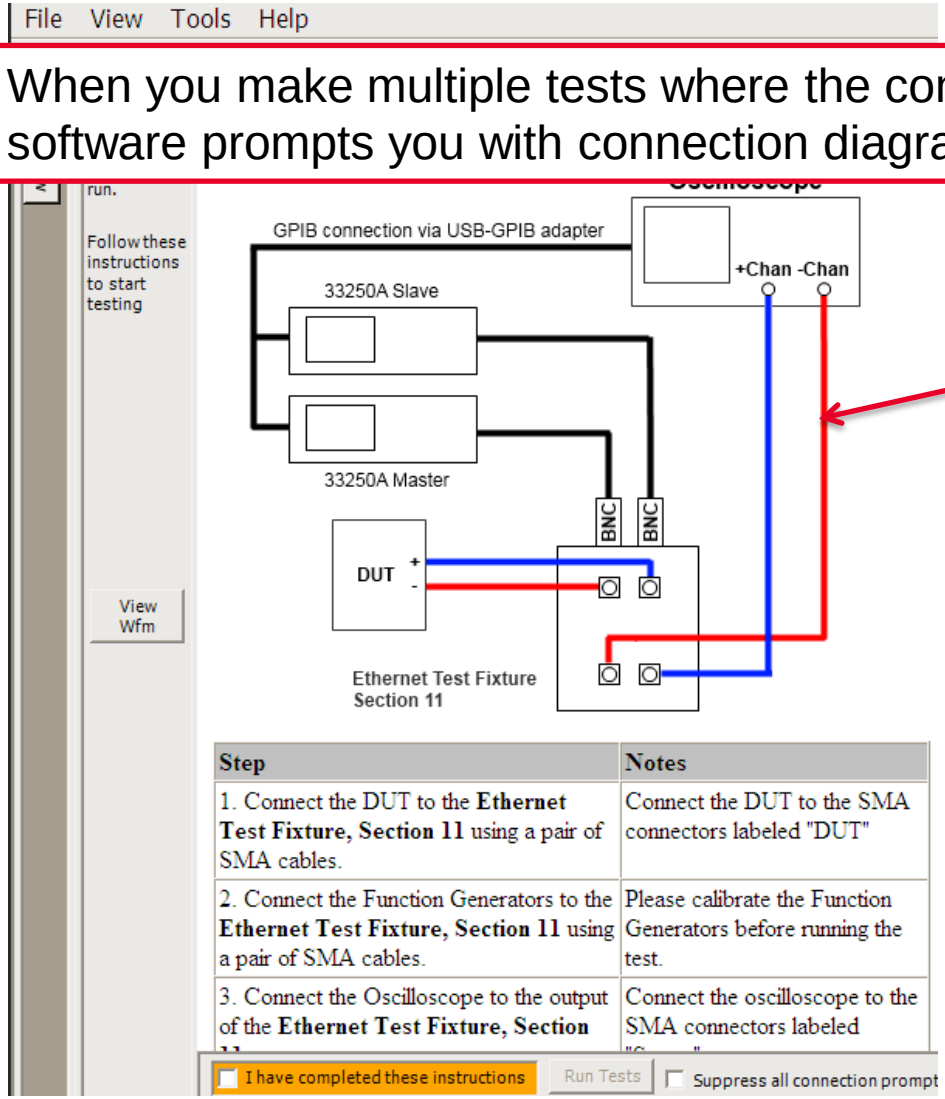
# BroadR-Reach Compliance Application

- The configure tab allows the user to select different channels and other measurement attributes.
- For example the signal input can be changed from a differential probe to 2 SMA cables.



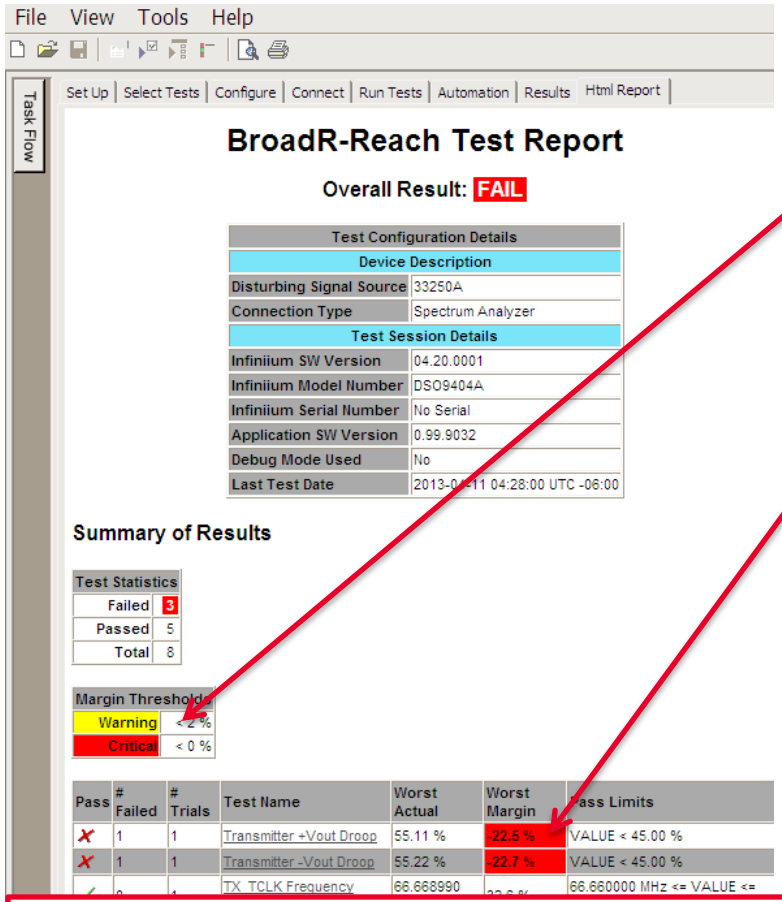
# BroadR-Reach Compliance Application

When you make multiple tests where the connections must be changed, the software prompts you with connection diagrams.




Each connection is clearly identified for the user including additional hardware and cables

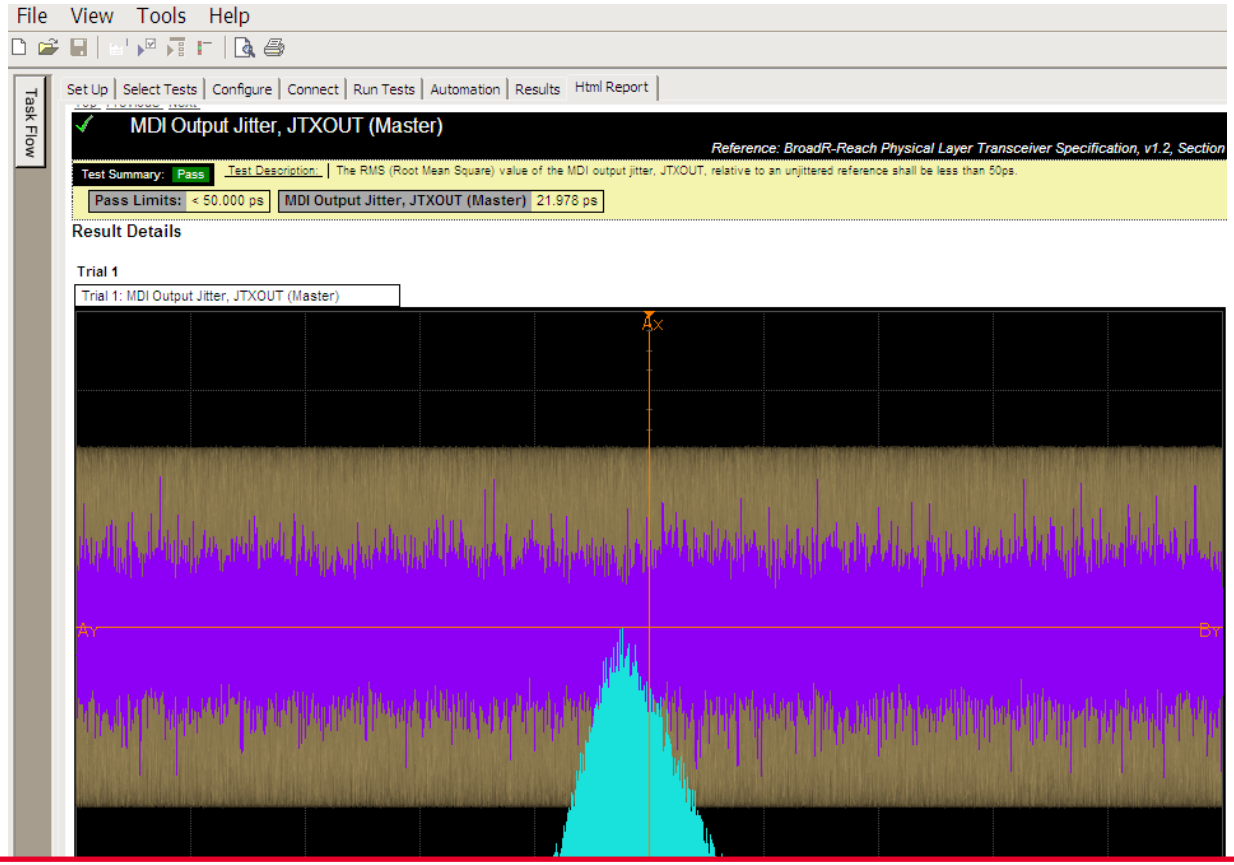
# BroadR-Reach Compliance Application




- Margins and thresholds can be changed to reflect current design model testing. Yellow is marginal while red indicates the spec threshold has been broken.
- In this case the test has failed because the signal was over the threshold.

The Ethernet electrical test software results screen shows a summary of the tests performed, pass/fail status, and margin. Clicking on a specific test also shows the test specification and a measurement waveform, if appropriate.

# BroadR-Reach Compliance Application




Additional details are available for each test, including the test limits, test description, and test results, Including waveforms, if appropriate.

# BroadR-Reach Compliance Application

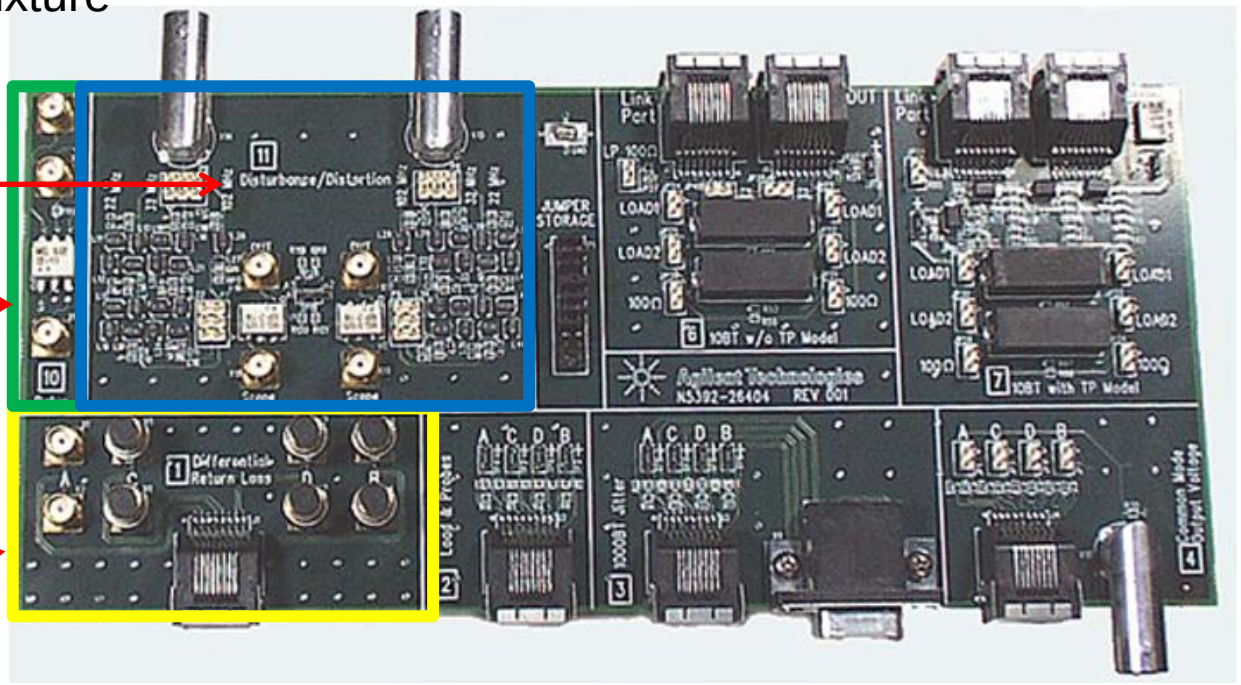



In the report we can display screen shots of the device under test to show how the signal passed or failed. In this case we are showing the Droop test measurement.

# Keysight Ethernet Fixture

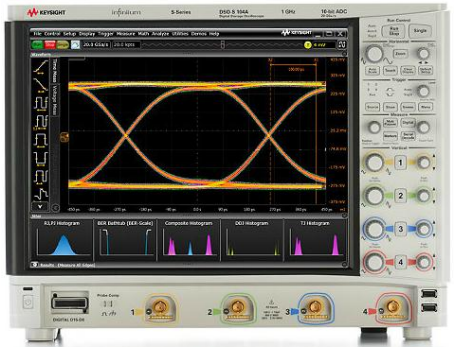
- Supports
  - Automotive BroadR-Reach specification
  - 10/100/1000 Ethernet compliance spec
- Includes:
  - Fixture
  - 2 Ethernet Cables
  - Calibration fixture

- Disturbing signal test section (Blue)
- Balun used for Power spectrum density test (Green)
- Break out board used for RJ45 connections (Yellow)



# Keysight Advantages

N6467A BroadR-Reach Compliance application does it all…



Saves you money…on analysis software

- ✓ No extra cost for software analysis tools such as EZJIT+ and SDA a savings of $18K USD.
- ✓ HTML results can be displayed in any computer that has Internet explorer, no need to have a scope to see reports.



Saves you time…you don't need to be an expert on every instrument

- ✓ Full automated control of the oscilloscope
- ✓ Full automated control of the vector network analyzer
- ✓ Full automated control of spectrum analyzer
- ✓ Full automated control of signal source



No need for a live signals…

- ✓ Full offline analysis, just import waveforms even from other scopes.

The N6467A Compliance application will calibrate, setup and run the hardware for you so you don't have to be an expert, saves you time and money!!!

# Scope Configuration: DSOS104A example

| Model Number | Product Description | Qty |
|---|---|---|
| **Oscilloscope** | | |
| • DSOS104A or better | 1GHz, 10 bit ADC, 20GSa/s, 50 Mpts/Ch Oscilloscope | 1 |
| **Application SW** | | |
| • N6467A | BroadR Reach PHY Compliance application | 1 |
| **Probing & Connection to DUT*** | | |
| • 1130A (*) | InfiniiMax I 1.5GHz | 1 |
| • E2678A (*) | Socket Probe Head | 1 |
| • N5395C (*) | Ethernet Test Fixture | 1 |
| | SMA(m)-SMA(m) Cable * | 2 |

* BroadR Reach specification does NOT define connector spec so probing will vary from user to user. Keysight scope needs D+ and D- . This can be done with SMA or BNC cabling, with a differential probe, or using a test fixture..

# Configuration – Transmitter test

| Model Number | Product Description | Qty |
|---|---|---|
| DSOS104A | 1GHz, 10 bit ADC, 20GSa/s, 50 Mpts/Ch Oscilloscope | 1 |
| N6467A | BroadR Reach PHY Conformance Test Software | 1 |
| 1130A (*) | InfiniiMax I 1.5GHz | 1 |
| E2678A (*) | Socket Probe Head | 1 |
| N5395C (*) | Ethernet Test Fixture | 1 |
| 82357B (**) | USB-GPIB Interface | 1 |
| 33SMA-Q50-0-4 (***) | Fairview Microwave SMA(f) to QuickMate SMA(m) push-on adapter (Optional) | 2 |

(*) These products are shown as example.
BroadR Reach specification does NOT define connector spec, so please discuss with customer about the way of probing.
(**) Needed to control spectrum analyzer from oscilloscope
(***) Optional productivity saver, used for quick connection from fixture to scope to DUT. 4 can be added for even further productivity enhancements.

# Configuration – Transmitter test – PSD Test

| Model Number | Product Description | Qty |
|---|---|---|
| N9010A | EXA series spectrum analyzer (*) | 1 |
| N9010A option 503 | 9kHz - 3.6GHz | 1 |
| N9010A option FSA | Fine Step Attenuator | 1 |
| 1250-1250 | N(m)-SMA(f) adapter | 1 |
| | Balun (Built into the Ethernet Fixture) | 1 |
| | SMA(m)-SMA(m) Cable (*) | 2 |

(*) Power Spectral density test is done by default by the scope through an FFT function, however customers can also use the spectrum analyzer for PSD test as well.
(**) These products are shown as example.
BroadR Reach specification does NOT define connector spec, so please discuss with customer about the way of probing.

# Configuration – Transmitter - Return Loss Test

| Model Number | Product Description | Qty |
|---|---|---|
| E5071C | ENA Series Network Analyzer | 1 |
| E5071C option 440 | 9kHz-4.5GHz 4port S parameter Test set | 1 |
| 1250-1250 | N(m)-SMA(f) adapter | 2 |
| N4431B | 4 ports Ecal 9kHz-13.5GHz | 1 |
| N4431B option 010 | 4 x 3.5mm (f) connectors | 1 |
| | Fixuture (***) | 1 |
| | Cables (***) | |

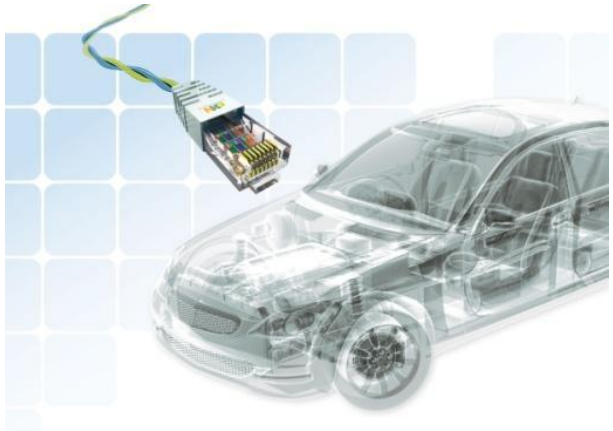
(***) BroadR Reach specification does NOT define connector spec, so please discuss with customer about the way to acquire signal to ENA.

# Ethernet Compliance Applications

- N6468A SFP+ Ethernet Compliance Application
  www.keysight.com/find/SFP
- N8814B 10GBASE-KR Ethernet Backplane Compliance Application Software
  www.keysight.com/find/10G-KR
- N8815A 10GBASE-KR 64B/66B Ethernet Backplane Decoder
  www.keysight.com/find/10GBASE-KR
- N5392B 10/100/1000BASE-T Standard and Energy Efficient Ethernet Compliance application
  www.keysight.com/find/EEE
- U7236A 10GBASE-T Ethernet Electrical Conformance Application
  www.keysight.com/find/10gbase-t
- N5431A XAUI Electrical Validation with 10GBase-CX4, CPRI, OBSAI, and Serial RapidIO Support
  www.keysight.com/find/N5431A
- N6467A BroadR-Reach Compliance Application
  www.keysight.com/find/BroadR-Reach
- N8828A 40GBASE-CR4 and 100GBASE-CR10 Compliance Application
  www.keysight.com/find/100G-CR10
- N8829A 100GBASE-KR4 Compliance Application
  www.keysight.com/find/100G-KR4
- N8830A 100GBASE-CR4 Compliance Application
  www.keysight.com/find/100G-CR4

# Agenda

- BroadR-Reach Overview
- Transmitter Testing
- Link Segment Testing



KEYSIGHT TECHNOLOGIES

# Link Segment Test Overview

| Test Items |
| --- |
| 7.1.1 Characteristic Impedance |
| 7.1.2 Insertion Loss |
| 7.1.3 Return Loss |
| 7.1.4 Mode Conversion |
| 7.2 Power Sum Alien Near End Crosstalk (PSANEXT) |
| 7.2 Power Sum Alien Attenuation to Crosstalk Ratio Far End (PSAACRF) |

•Reference: Open Alliance BroadR-Reach™ (OABR) Physical Layer Transceiver Specification For Automotive Applications, V3.2, June 24, 2014, Broadcom Corporation

# Link Segment Test Solution

BroadR-Reach link segment testing requires parametric measurements in both time and frequency domains.

**Frequency Domain**
- Insertion Loss (Sdd21)
- Return Loss (Sdd11)
- Mode Conversion (TCT, TCTL)
- Alien Crosstalk (PSANEXT, PSAACRF)

**Time Domain**
- Characteristic Impedance (TDR)

Traditional Solution

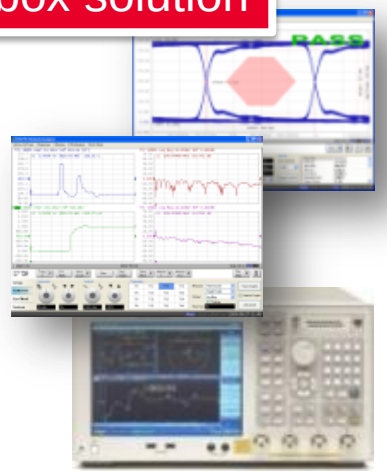
Vector Network Analyzer (VNA)

TDR Scope

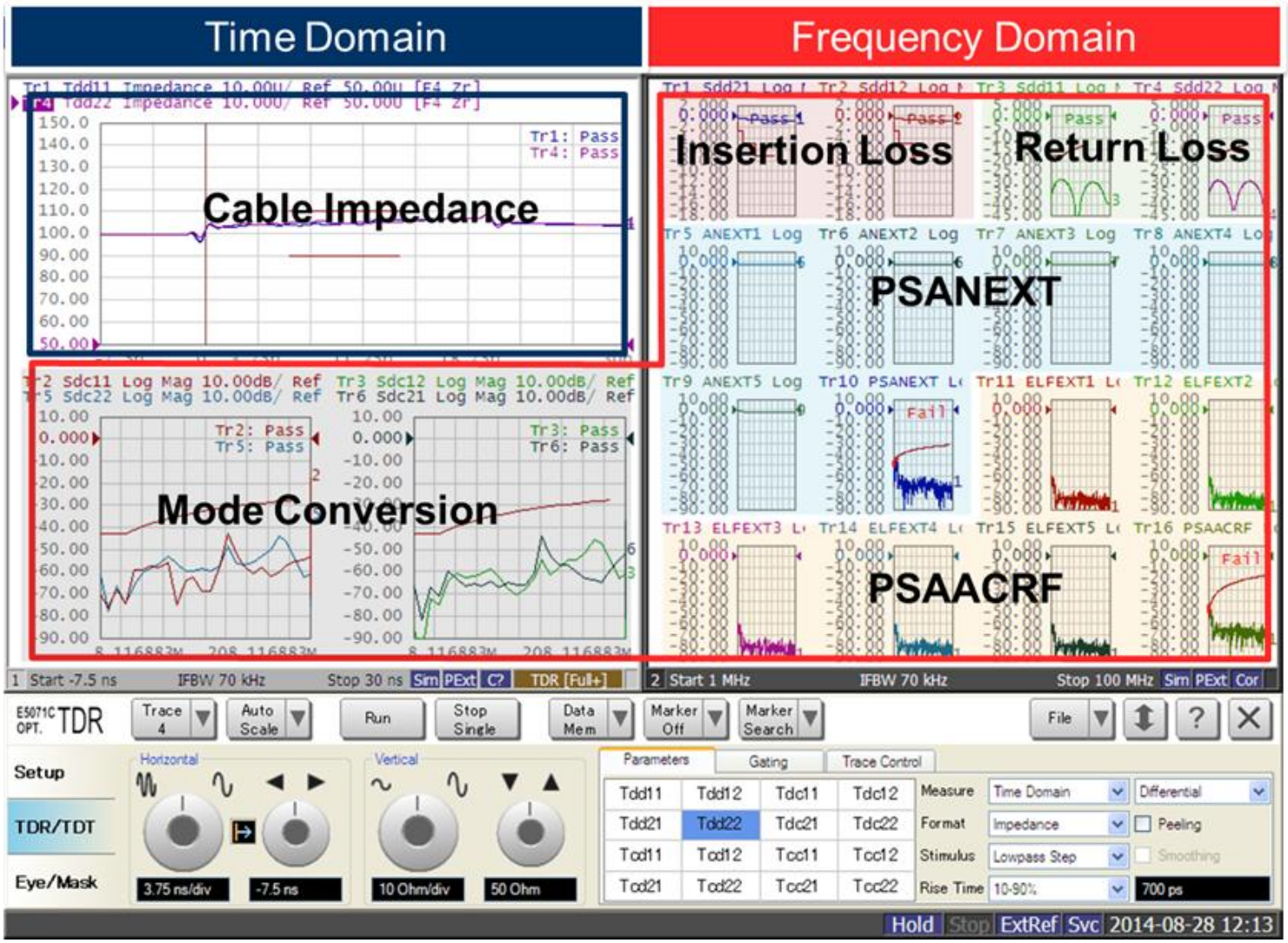
New Solution

ALL parameters can be measured with ENA Option TDR

One-box solution



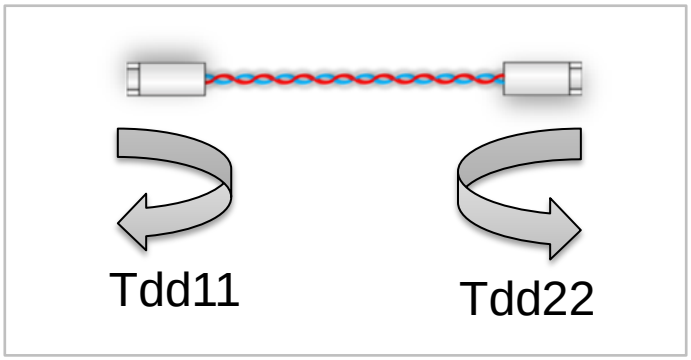
# Link Segment Test Measurement Example

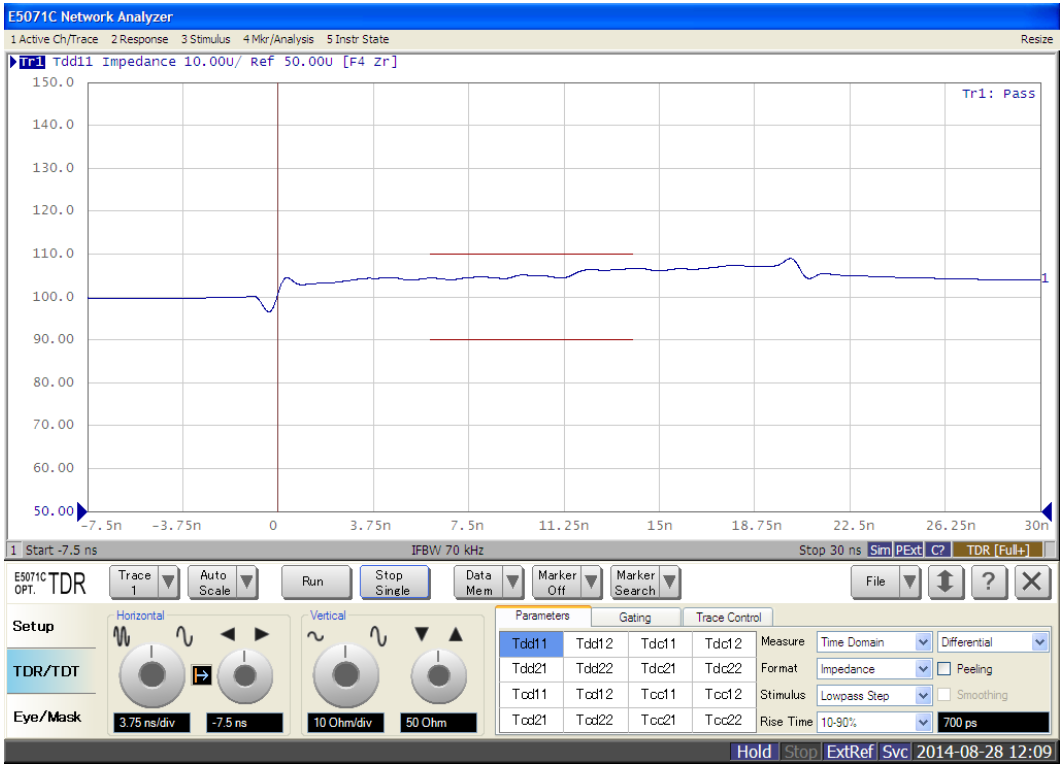


# 7.1.1 Characteristic Impedance

**Specification**

Z = 100Ω +/- 10% @ tr<700ps



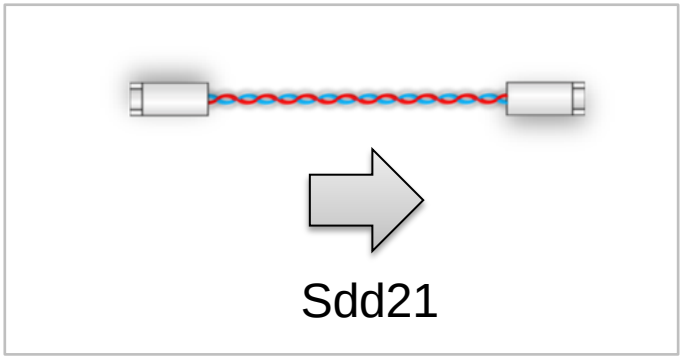



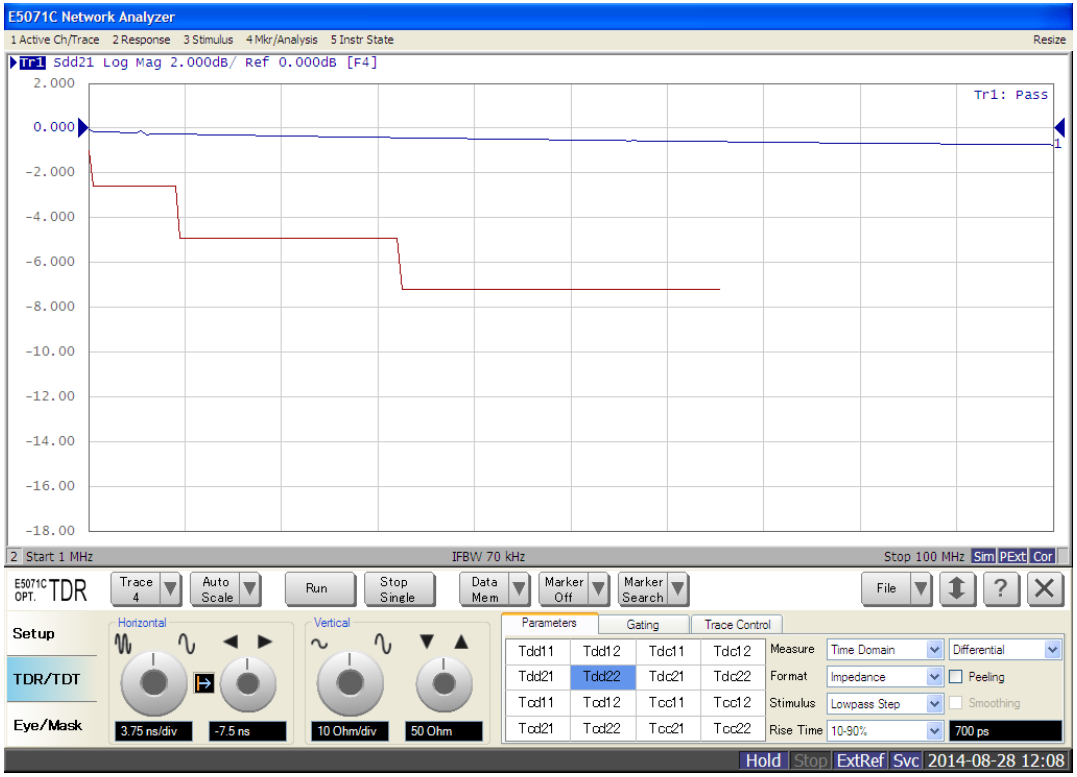
# 7.1.2 Insertion Loss

## Specification

| Freq | Loss (*) |
|---|---|
| 1 MHz | < -1.0 dB |
| 10 MHz | < -2.6 dB |
| 33 MHz | < -4.9 dB |
| 66 MHz | < -7.2 dB |

(*) Insertion loss includes the attenuation of the DUT, equipment cables, and connector losses

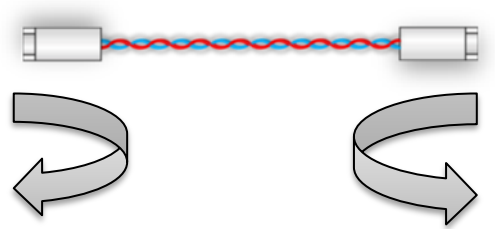


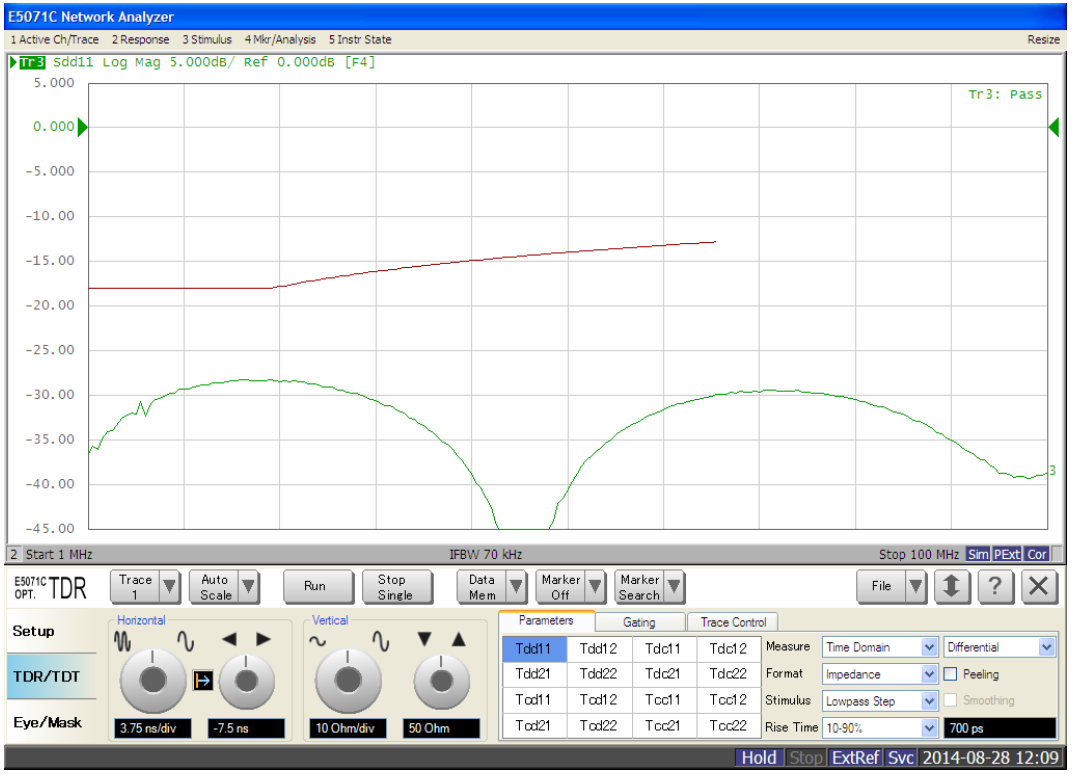



# 7.1.3 Return Loss

## Specification

| Freq | 7.1.3 Return Loss |
|---|---|
| 1-20 MHz | < -18 dB |
| 20-66 MHz | < -18+10log10(f/20) [dB] |

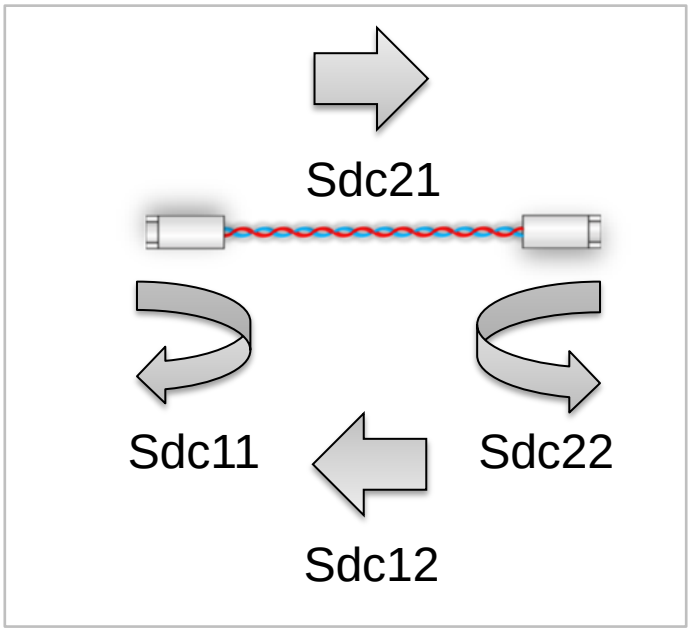


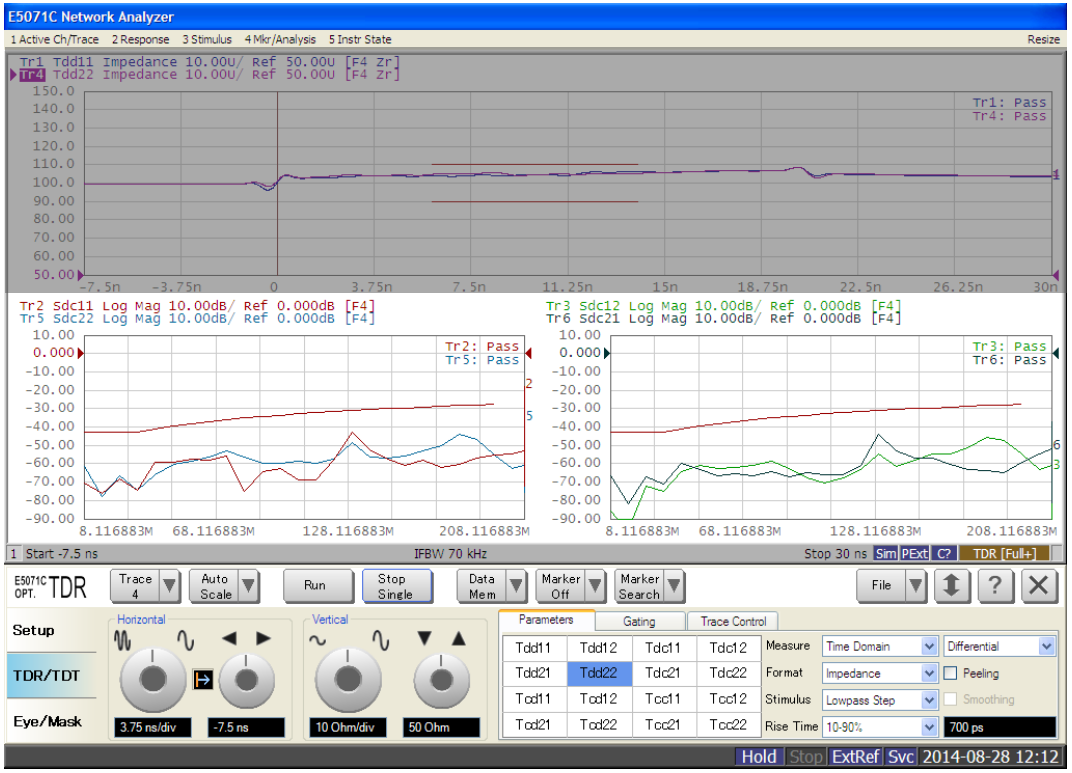



# 7.1.3 Mode Conversion

## Specification

| Freq | 7.1.3 Return Loss |
|---|---|
| 1-33 MHz | < -43 dB |
| 33-200 MHz | < -43+20log10(f/33) [dB] |

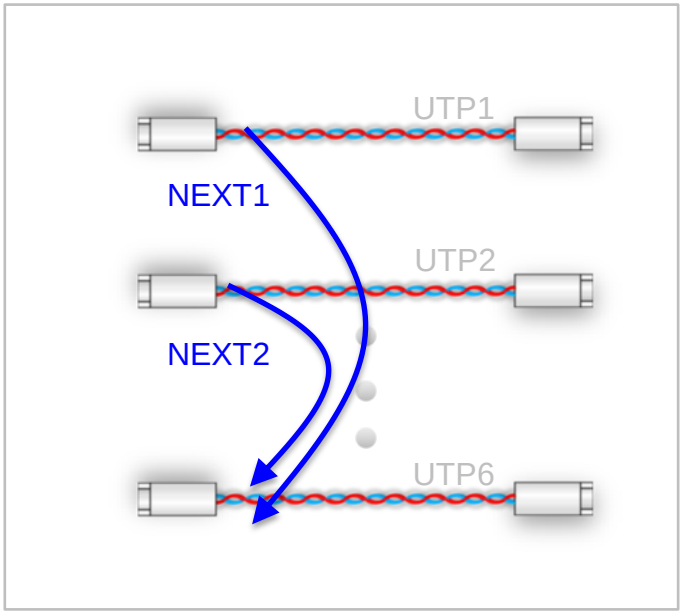


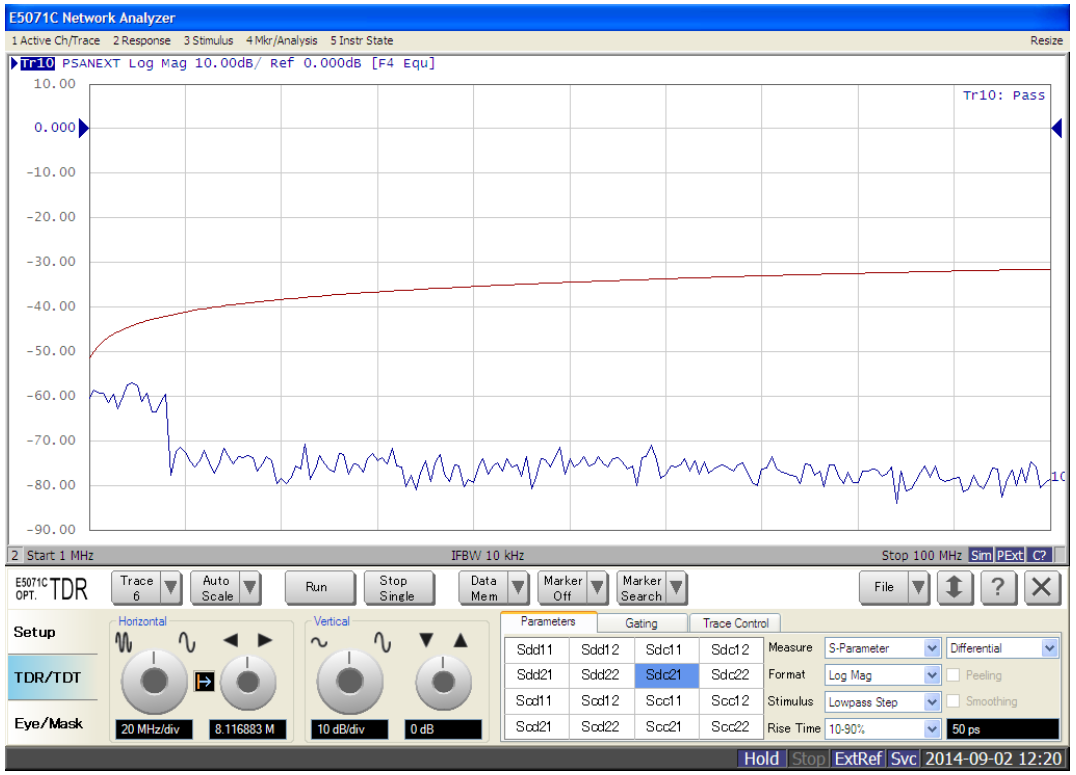



# 7.2 Power Sum Alien Near End Crosstalk (PSANEXT)

**Specification**

PSANEXT > 31.5 – 10log10(f/100) [dB], where f = 1-100MHz



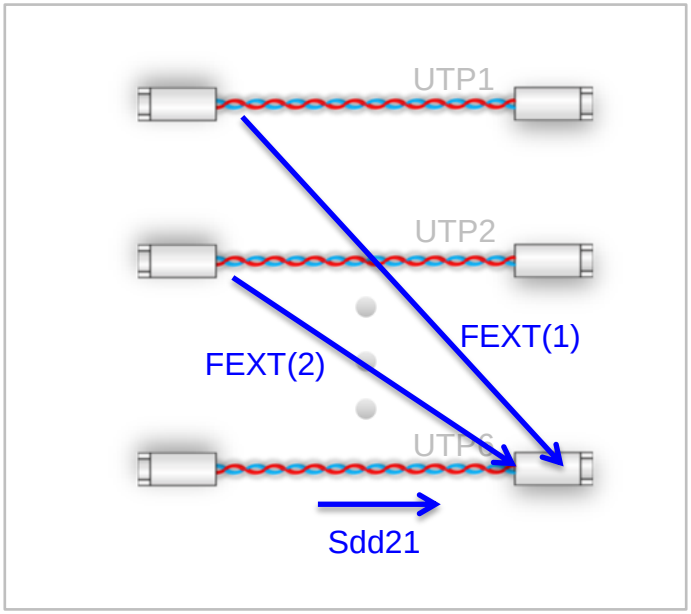



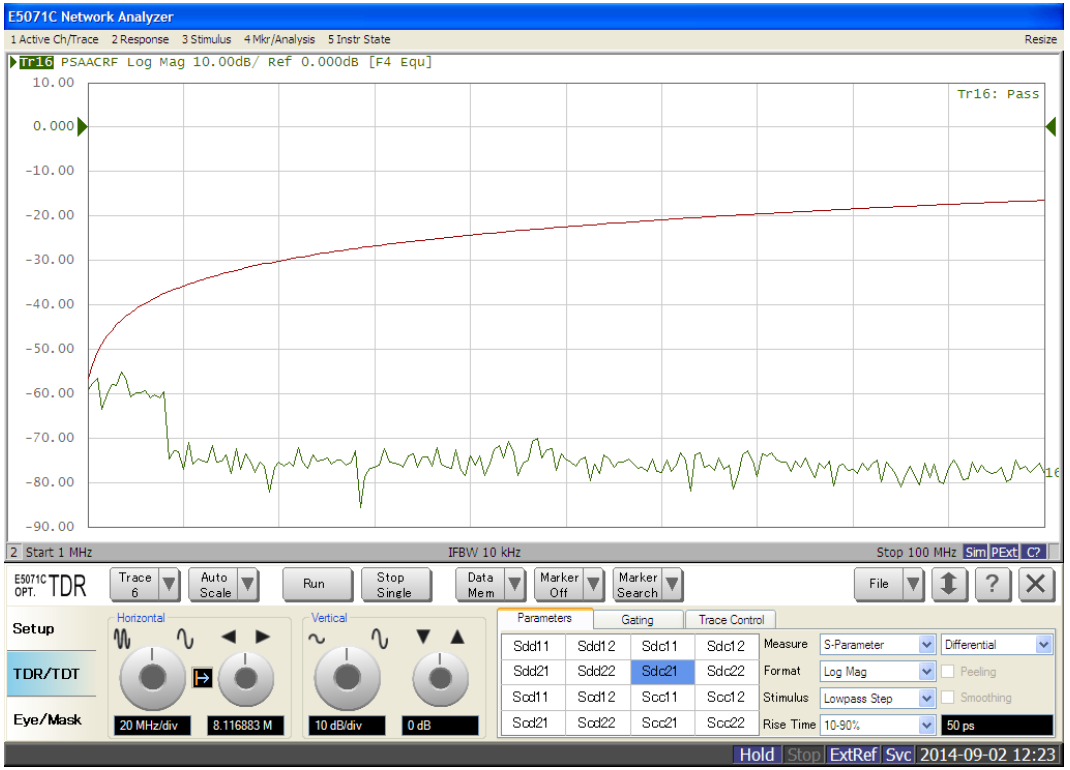

PSANEXT = NEXT (1+2+…+5)

# 7.2 Power Sum Alien Attenuation to Crosstalk Ratio Far End (PSAACRF)

**Specification**

PSAACRF > 16.5 – 20log10(f/100) [dB], where f = 1-100MHz




PSAACRF = ELFEXT(1+2+…+5)

- ELFEXT(1) = FEXT(1) - Sdd21
- ELFEXT(2) = FEXT(2) - Sdd21
- …
- ELFEXT(5) = FEXT(5) - Sdd21

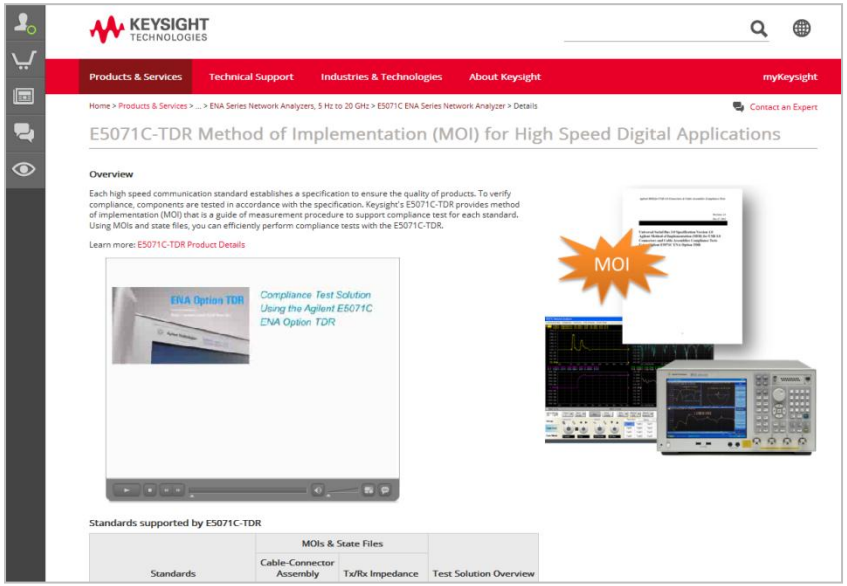
KEYSIGHT TECHNOLOGIES

# Keysight BroadR-Reach Link Segment Test Solution



- ENA Mainframe
  - E5071C-440: 4-port, 9kHz to 4.5GHz
  - E5071C-445: 4-port, 100kHz to 4.5GHz
- Enhanced Time Domain Analysis Option (E5071C-TDR)
- ECal Module (N4431B)

- Instrument setup files available for download on Keysight.com




**BroadR-Reach Cable Test Fixtures**

- When using the standard RJ45 connector, Keysight's Ethernet compliance fixture is available.




- When using a custom connector, the user needs to build own break-out board to connect to the instrument.

# Summary




**ENA Option TDR BroadR-Reach Testing Solution is ….**

•**One-box solution** which provides complete characterization (time domain and frequency domain) of the link segment.

•Similar look-and-feel to traditional TDR scopes, providing **simple and intuitive operation** even for users unfamiliar to VNAs and S-parameters.

