

# Automotive Ethernet: Verifying BroadR-Reach® interfaces



Ethernet communications has been introduced in automotive networks to enable fast and cost efficient data communications, e.g. for the rearward camera or audio/video streaming. In the OPEN alliance ([www.openSIG.org](http://www.openSIG.org)), the automotive industry has standardized the BroadR-Reach® physical layer as the automotive Ethernet communications standard. It will be part of the IEEE 802.3 standard. BroadR-Reach® uses full duplex twisted pair communications, enabling 100 Mbit/s data transfer. For interface verification the OPEN Alliance has specified a BroadR-Reach® conformance test with six test cases.

### Your task

BroadR-Reach® utilizes bidirectional communications similar to 1000Base-T Ethernet, where both interfaces communicate simultaneously over the same twisted pair cable. It is therefore not possible to electrically test a single interface during data transmission without the presence of a communications partner. The OPEN alliance has specified a compliance test for BroadR-Reach® Ethernet. Like the other Ethernet compliance tests, this test focuses on the transmitter quality. The receiver is tested only with one test case, the MDI return loss measurement. The compliance test needs specific test signals from the transmitter. Each communications chipset has to be able to generate these test signals, typically activated via one of the chip's register settings.

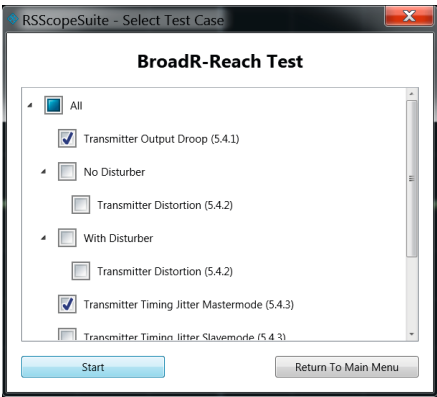
### T & M solution

The R&S®RTO digital oscilloscope is ideal for BroadR-Reach® compliance testing due to its superior signal fidelity and automated test execution capability. For a full BroadR-Reach® compliance test, the test equipment listed in the table is needed. In addition to the oscilloscope, a signal generator is mandatory for the distortion tests with disturber and a vector network analyzer is necessary for the return loss measurements. For proper test setup, an appropriate differential probe is needed as are test fixtures for a defined connection between the DUT and the test setup. The compliance test setup, the result calculation and the documentation are automated in the R&S®ScopeSuite test software.

### Application

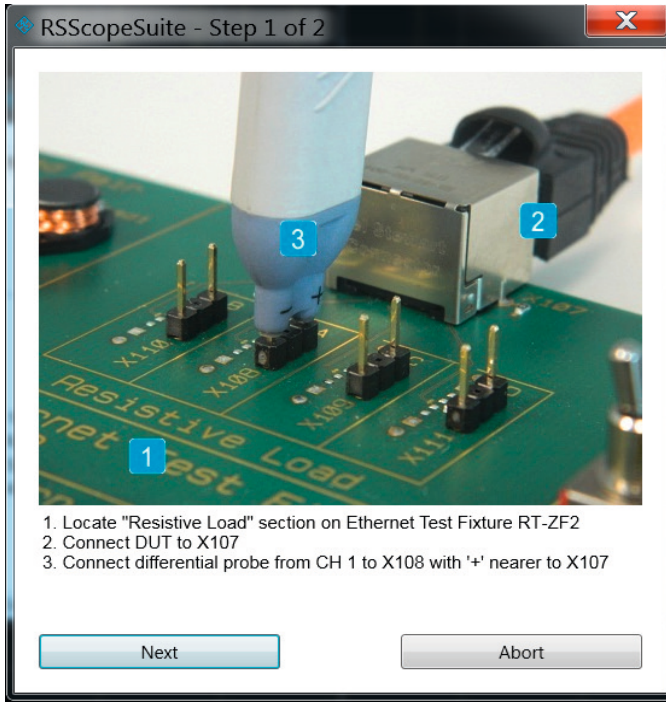
#### Automated measurements with R&S®ScopeSuite test software

The R&S®ScopeSuite offers a guided test setup and automatic execution of all test cases specified by the OPEN alliance and listed in the table below. As a result, the compliance test is executed in much shorter time and with reliable and reproducible results. The test results are fully documented in a comprehensive report, including the full test setup information. R&S®ScopeSuite is a standalone application that runs on a separate PC or on the digital oscilloscope.



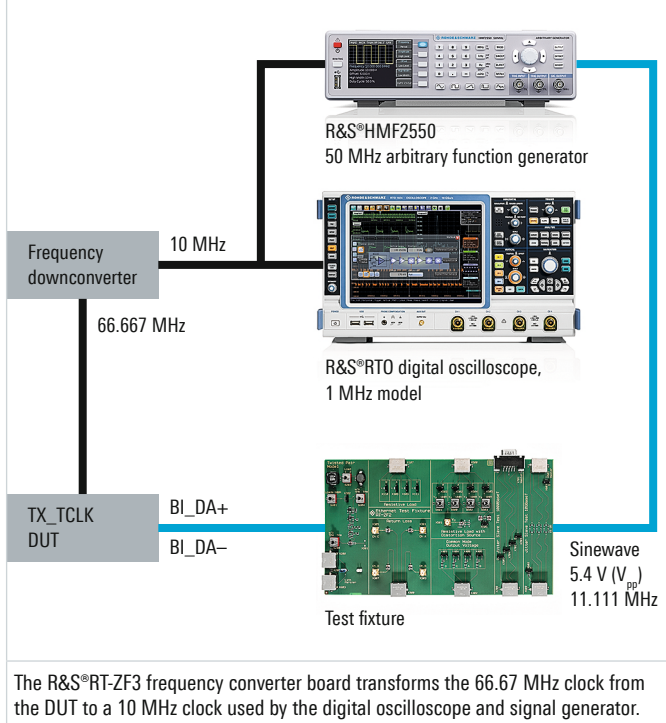
R&S®ScopeSuite test wizard: selecting test cases.

Specified BroadR-Reach® physical layer compliance tests according to the OPEN alliance test specification, including required test modes and equipment		
BroadR-Reach® compliance tests	Test mode	Equipment required
Transmitter output droop	1	1 GHz oscilloscope, min. 2 channels with 1 differential probe (min. 1 GHz), Ethernet test fixture
Transmitter distortion with and without disturber	4	1 GHz oscilloscope, min. 2 channels with 1 differential probe (min. 1 GHz), Ethernet test fixture, 50 MHz signal generator, BroadR-Reach® frequency converter
Transmitter timing jitter in master and slave mode	2	1 GHz oscilloscope, min. 2 channels with 1 differential probe (min. 1 GHz), Ethernet test fixture
Transmitter power spectral density	5	1 GHz oscilloscope, min. 2 channels with 1 differential probe (min. 1 GHz), Ethernet test fixture
Transmitter clock frequency	2	1 GHz oscilloscope, min. 2 channels with 1 differential probe (min. 1 GHz), Ethernet test fixture
MDI return loss	4	Vector network analyzer with starting frequency < 1 MHz



Test wizard with explanation of how to correctly connect to the test fixture.

## Test setup for distortion tests needs clock synchronization



## Manual limit editor

Quality requirements for signal integrity testing may differ during product development. Rohde&Schwarz supports the capability to manually change the test limit with a special editor included in the R&S®ScopeSuite software. It is possible to manually adjust the limit of each specified compliance test and therefore adjust the compliance test to customer test needs. Of course these limits are documented in the test report generated by the R&S®ScopeSuite software.

## Accurate results with the R&S®RT-ZF3 frequency converter board

The distortion tests require correct transmission of a series of 12 000 signals. The algorithms specified by the OPEN alliance for the distortion tests assume that "... the disturber signal and the data acquisition clock are frequency locked to the DUT transmit clock". This is achieved by using the transmitter's clock as a master clock for the digital oscilloscope and the signal generator. The specified test setup for the distortion tests is shown in the last figure. Without this frequency locking, the DUT almost always fails the distortion test.

The clock of the BroadR-Reach® transmitter is specified to be 66.67 MHz. Test equipment usually allows synchronization with 10 MHz clock signals. Rohde&Schwarz supports the synchronization of the transmitter clock with a R&S®RT-ZF3 frequency converter board that transforms the 66.67 MHz clock of the BroadR-Reach® transmitter to a 10 MHz clock signal. The use of the R&S®RT-ZF3 frequency converter board leads to precise BroadR-Reach® compliance test results. The Rohde&Schwarz test solution is therefore officially listed by the OPEN alliance as BroadR-Reach® test equipment.

## Ordering information

Designation	Type	Order No.
<b>BroadR-Reach® physical layer compliance test equipment</b>		
Digital Oscilloscope, with 1 GHz or higher bandwidth	R&S®RTO1012	1316.1000.12
OCXO 10 MHz (reference clock synchronization; option)	R&S®RTO-B4	1304.8305.02
BroadR-Reach Compliance Test (option)	R&S®RTO-K24	1320.6684.02
Test software	R&S®ScopeSuite	free download
Test Fixture Set for Ethernet compliance test	R&S®RT-ZF2	1317.5522.02
Frequency Converter Board	R&S®RT-ZF3	5025.0670.02
1.0 GHz Active Differential Probe	R&S®RT-ZD10	1410.4715.02
50 MHz Arbitrary Function Generator, or similar	HMF2550	5800.3921.02
Vector Network Analyzer, 9 kHz to 3 GHz or similar	R&S®ZVL3	1303.6509.03

## Service that adds value

- ▮ Worldwide
- ▮ Local and personalized
- ▮ Customized and flexible
- ▮ Uncompromising quality
- ▮ Long-term dependability

## About Rohde & Schwarz

The Rohde & Schwarz electronics group is a leading supplier of solutions in the fields of test and measurement, broadcast and media, secure communications, cyber-security, and radiomonitoring and radiolocation. Founded more than 80 years ago, this independent global company has an extensive sales network and is present in more than 70 countries. The company is headquartered in Munich, Germany.

## Sustainable product design

- ▮ Environmental compatibility and eco-footprint
- ▮ Energy efficiency and low emissions
- ▮ Longevity and optimized total cost of ownership

Certified Quality Management

**ISO 9001**

Certified Environmental Management

**ISO 14001**

## Rohde & Schwarz GmbH & Co. KG

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Regional contact

- ▮ Europe, Africa, Middle East | +49 89 4129 12345  
[customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)
- ▮ North America | 1 888 TEST RSA (1 888 837 87 72)  
[customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)
- ▮ Latin America | +1 410 910 79 88  
[customersupport.la@rohde-schwarz.com](mailto:customersupport.la@rohde-schwarz.com)
- ▮ Asia Pacific | +65 65 13 04 88  
[customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)
- ▮ China | +86 800 810 82 28 | +86 400 650 58 96  
[customersupport.china@rohde-schwarz.com](mailto:customersupport.china@rohde-schwarz.com)

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG

Trade names are trademarks of the owners

PD 3607.1559.92 | Version 01.01 | March 2015 (sk)

R&S®RTO; Automotive Ethernet: Verifying BroadR-Reach® interfaces

Data without tolerance limits is not binding | Subject to change

© 2015 Rohde & Schwarz GmbH & Co. KG | 81671 Munich, Germany



3607155992