Excellence in automotive Ethernet solutions

100BASE-T1
1000BASE-T1
Trigger and decode
EMI debugging
Power integrity

ROHDE&SCHWARZ

Automotive

Your challenge

Inside a typical car you will find over 100 electronic control units (ECU), controlling everything from brakes, transmission, engine, A/C, steering, cameras, radar, acoustic sensors and even the non-cellular and cellular wireless communications.

ECUs communicate via buses on the car, including CAN (controller area network), LIN (local interconnect network) and FlexRay™ automotive OEMs and Tier1s are moving away from mixing so many different bus types to something more uniform, enabling higher data throughput, lower latency and less weight in order to reduce complexibility and to increase cost-efficiency.

Rohde & Schwarz offers state-of-the-art testing solutions for:
❚ Trigger and Decode capability for 100BASE-T1, CAN, CAN-FD, LIN, FlexRay™, CXPI and SENT
❚ Compliance tests for automotive Ethernet (100BASE-T1, 1000BASE-T1)
❚ EMI debugging capabilities

Find out more:
www.rohde-schwarz.com/automotive/ethernet

Find out more about Automotive topics:
www.rohde-schwarz.com/automotive

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.

EMI debugging
❚ EMI tests during development
❚ High dynamic range and sensitivity
❚ Visualizing sporadic emissions

Compliance testing
❚ 100BASE-T1
❚ 1000BASE-T1

Power integrity
❚ Detect small signals and small interference
❚ Increased resolution on ripples, noise and interference
❚ Powerful FFT and multi-domain functionality to analyze signals

Trigger and decode
❚ Bootup time measurements
❚ Finding and fixing bus failures
❚ Bus timing analysis
❚ Debugging 100BASE-T1 communications
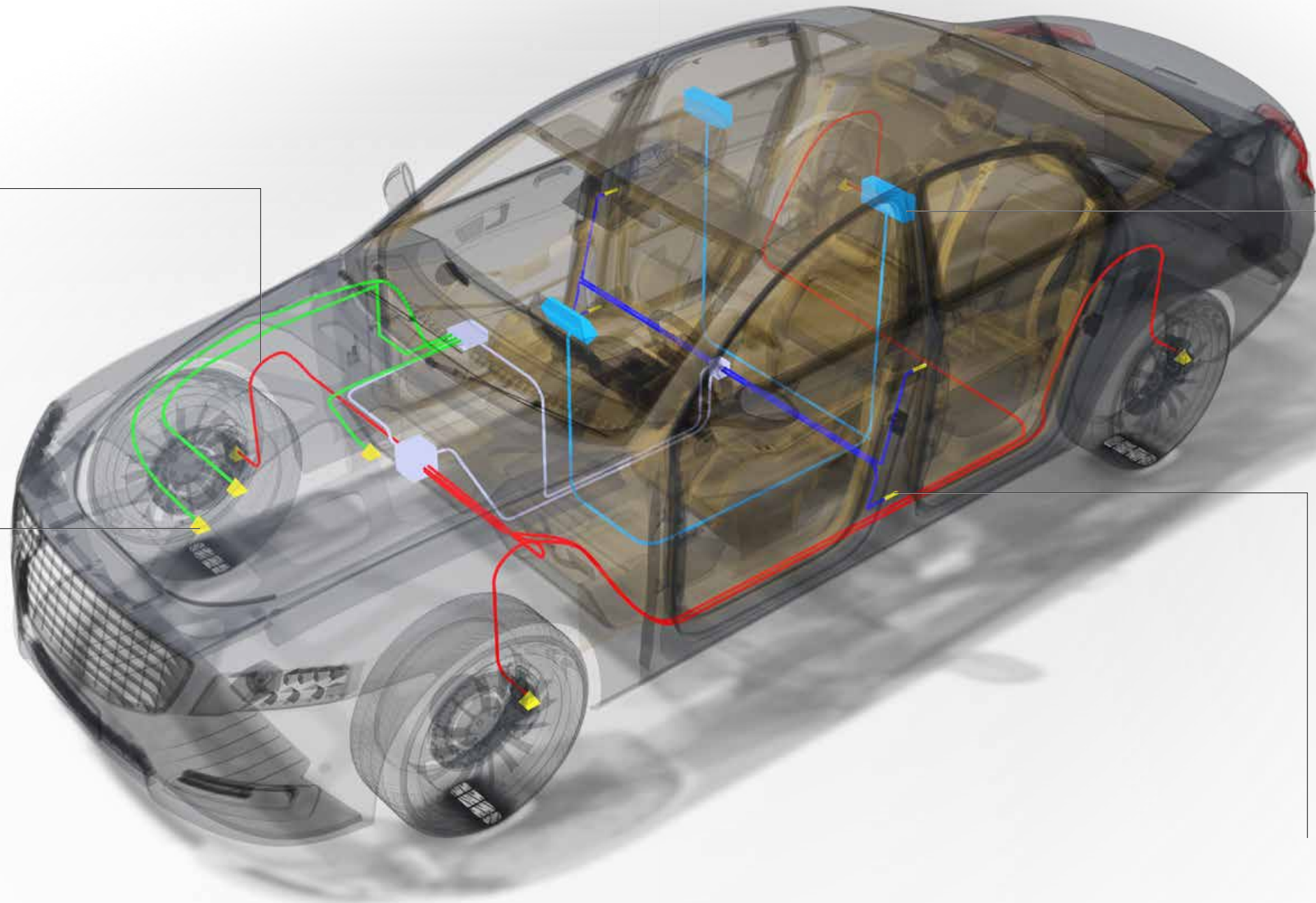
Introduction

Ethernet is used in automotive networks to enable fast and cost-effective data communications. The automotive industry has specified the OPEN Alliance BroadR-Reach® (OABR) physical layer, also called IEEE 100BASE-T1, as the automotive Ethernet communications standard. It runs on standard FlexRay™ cabling and is used for high-speed communications such as audio or video streaming or for advanced driver assistance systems (ADAS). 100BASE-T1 uses full duplex communications, enabling up to 1Gbit/s to be transferred over one twisted pair. For interface verification, a 100BASE-T1 conformance test with six test cases is specified. This compliance test focuses on transmitter quality similar to most IEEE Ethernet compliance test specifications.

For more information please see:
www.rohde-schwarz.com/automotive/ethernet

Automotive Ethernet compliance testing in 100BASE-T1 and 1000BASE-T1

BroadR-Reach® compliance testing

The high measurement dynamics of more than 7 effective bits (ENOB) provides reliable results even in tests with interfering signals, enabling you to assess and check your products during type approval tests or end-of-line production tests. The signal quality of the Ethernet interface can be verified using pass-fail tests. The solution's graphical display options offer step-by-step measurement support. The R&S®RTO oscilloscope together with the R&S®ZND vector network analyzer (VNA) is the ideal solution for 100BASE-T1 compliance testing due to its superior signal fidelity and automated test and reporting execution capability.

1000BASE-T1 compliance testing

Today there are limited chipsets on the market fully supporting 1000BASE-T1. However Rohde & Schwarz has tested and validated the compliance testing with all DUTs available today supporting 1000BASE-T1. Furthermore R&S is working together with the UNH IOL Interoperability Test Lab of the University of New Hampshire providing the test equipment for the compliance tests required.

Additional test cases supported

Many OEMs are using the following additional test cases:
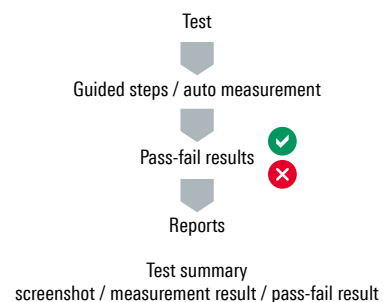▮ MDI Common Mode Emission
▮ MDI Mode Conversion Sdc11

Key facts

▮ Complete test solution including oscilloscope, VNA and test fixtures
▮ Superior signal fidelity up to 16 bit and high acquisition rate
▮ Automated test execution and test reporting capability
▮ Intuitive GUI with step-by-step guided measurement support
▮ Integrated arbitrary waveform generator supporting test signals for 100BASE-T1 and 1000BASE-T1 compliance
▮ Embedded software that controls both the oscilloscope and network analyzer for compliance test

Benefits

▮ All test cases for 100BASE-T1 and 1000BASE-T1 have been validated with all leading chipset vendors
▮ Easy step by step setup guidelines with pictures
▮ Full atomization and test reporting including waveform screenshots, measurements results and pass fail results
▮ Additional test cases supported to comply with OEM requirements

R&S®RTO and R&S®ZND required for the 100/1000BASE-T1 compliance testing.

R&S®ScopeSuite automation software provides step-by-step guidelines.

Report-process

Test

Guided steps / auto measurement

Pass-fail results

Reports

Test summary
screenshot / measurement result / pass-fail result

Trigger and decode 100BASE-T1 real world debugging

Easy debugging of failure sources

The 100BASE-T1 trigger and decode option allows to decode on single ended differential real world bus signals. Just connect the Ethernet probing fixture to the Ethernet cable and start decoding. You can debug the 100BASE-T1 bus communications by analyzing the real electrical bus signals time correlated with the decoded data.
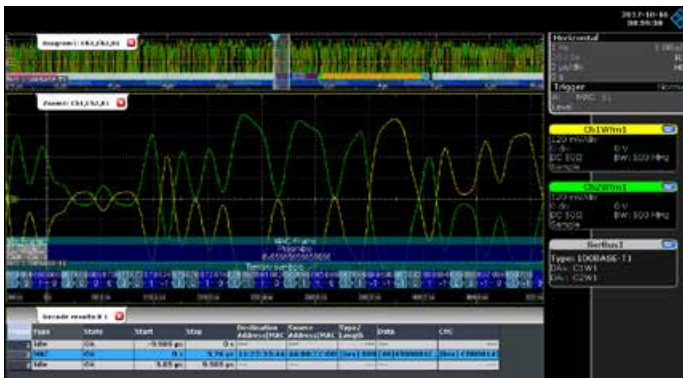
Key facts

▮ All-in-one: triggering, decoding and searching
▮ User-friendly: digitized signal displayed with decoded content
▮ Efficient: several event types for complete acquisition cycle
▮ Flexible, convenient and intuitive user interface
▮ Bus timing analysis
▮ Boot time measurements

Your benefit
Debug real world bus signals:
▮ Decoding is time correlated to real bus signals
▮ Decoding on single ended or differential signals
▮ Reverse channel compensation allows stable decoding of very noisy bus signals by utilizing directional couplers

Decode analysis:
▮ Decode idle and Ethernet frames
▮ MAC frames include decoding of destination, source address, frame ID, data and correct CRC
▮ Various decoding layers displayed: unscrambled, scrambled bits, ternary symbols
▮ Decode table tools such as QuickMeas, fingertip zoom and undo/redo

Trigger capability:
▮ Start of frame
▮ Idle frames
▮ MAC frames
▮ Destination and source address
▮ Frame ID
▮ Data
▮ Telegram errors: preamble, CRC, SFD

100BASE-T1 trigger and decode functionality on the R&S®RTO.

100BASE-T1 decoding introduces the same test capabilitiy as CAN bus testing.

OSI	Automotive Ethernet	
7 Application	Applications: FTP, SOME/IP, HTTP, SMTP…)	Error free communications
6 Presentation		Validate sleep/wakeup cycles
5 Session		Resistant to EMI
4 Transport	TCP, UDP	Correct latency
3 Network	IP	Correct boot time
2 Data Link	100BASE-T1 1000BASE-T1	
1 Physical		

Efficient analysis of power and signal integrity

Easy EMI debugging of failure sources

Power integrity

The R&S®RTO and R&S®RTE oscilloscope families are the ideal tools for power integrity measurement on your data converter design. The dedicated R&S®RT-ZPR40 power rail probe offers 2 GHz of bandwidth and an excellent sensitivity with a 1:1 attenuation ratio. It includes a highly accurate, integrated DC voltmeter to verify power supply tolerance requirements. With a large offset range, the probe removes this DC voltage and supports high-sensitivity measurements of noise, ripple, load step response and crosstalk on the power rails:

Key facts

❙ Dedicated 1:1 power rail probes with 2.0 GHz of bandwidth, integrated voltmeter and ±60 V offset range
❙ High scalability in channel count and bandwidth
❙ High frontend sensitivity for measuring small signals
❙ Powerful FFT and multidomain functionality to analyze signals in time and frequency domain
❙ High acquisition rate of up to 1 000 000 waveforms/s for quick worst-case analysis and detection of sporadic signals
❙ HD mode to further increase the resolution up to 16 bit

EMI debugging

Power integrity issues such as noise, ripple and crosstalk have a strong impact on the performance of your design. Rohde & Schwarz oscilloscopes and power rail probes efficiently detect and solve power integrity problems in your designs:
The R&S®RTO/RTE oscilloscope is a powerful instrument for debugging EMI problems during design. In combination with a near-field probe set, it allows designers to quickly locate and analyze EMI problems early on, eliminating the need for debugging in costly test locations.

Key facts

❙ High dynamic range and input sensitivity of 1 mV/div for measuring even very weak emissions
❙ Power rail probes with high offset range to increase resolution on the signal distortion
❙ Powerful fast Fourier transformation (FFT) and multidomain functionality to analyze signals in time and frequency domain to gain insight into ripples, distortions and their origins

Efficent power integrity testing at board level using the R&S®RTO.

Testing for EMI using the R&S®RTO is made easy.

Service that adds value
- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

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

Certified Quality Management
AQAP-2110

Certified Quality Management
EN 9100

Rohde & Schwarz GmbH & Co. KG
www.rohde-schwarz.com

Regional contact
- Europe, Africa, Middle East | +49 89 4129 12345
  customersupport@rohde-schwarz.com
- North America | 1 888 TEST RSA (1 888 837 87 72)
  customer.support@rsa.rohde-schwarz.com
- Latin America | +1 410 910 79 88
  customersupport.la@rohde-schwarz.com
- Asia Pacific | +65 65 13 04 88
  customersupport.asia@rohde-schwarz.com

5216.0267.32 PDP 1 en

5216026732