

Automotive Ethernet 10BASE-T1S Receiver Compliance Test Software

10BASE-T1S Design Validation for Receiver Performance

Introduction

The Keysight AE6930R 10BASE-T1S Rx Compliance Test Software provides a fully automated solution for verifying the receiver performance of 10BASE-T1S devices in accordance with the Open Alliance TC14 PMA specifications. Because 10BASE-T1S operates on a noisy, shared multidrop bus, receiver testing is critical to ensure reliable communication in real automotive environments.

AE6930R works seamlessly with Keysight MXR/EXR oscilloscopes, the APM3000E media converter, and Keysight's dedicated MDI adapter and ringing board to recreate accurate worst-case test conditions. The software automates calibration, stressed-signal generation, BER measurement, and reporting, enabling engineers to quickly validate compliance and characterize receiver margins with confidence.

With an easy-to-use interface and a consistent workflow aligned with Keysight's other Automotive Ethernet receiver test tools, the AE6930R enables OEMs, Tier 1s, and chipset vendors to confidently validate the robustness of 10BASE-T1S receivers—ensuring interoperable and reliable operation in modern zonal architectures.



Why 10BASE-T1S Receiver Testing Matters

10BASE-T1S is designed to operate on a shared, multidrop bus, where multiple ECUs communicate over a single cable. This environment is inherently noisy, creating reflections, stubs, and interference that can severely impact receiver performance. Even if a transmitter is fully compliant, a weak receiver can cause communication failures once the system is installed in a vehicle.

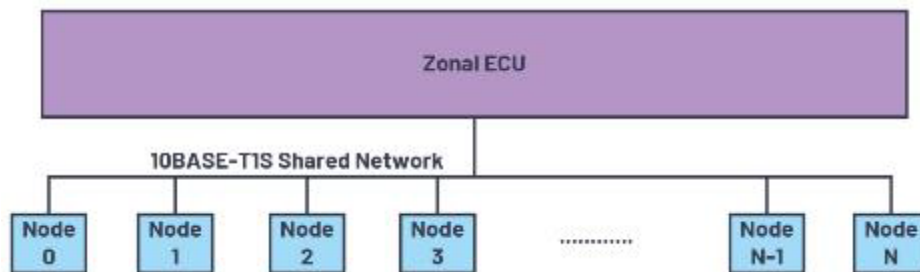


Figure 1. 10BASE-T1S Network

Receiver testing is essential because:

- Real vehicle networks are electrically noisy
- Multidrop networks stress the Rx first
- PLCA timing depends on accurate packet reception
- Interoperability across vendors requires strong Rx tolerance

In summary, 10BASE-T1S cannot be validated with Tx tests alone. Reliable in-vehicle communication requires robust, well-tested receivers, making Rx compliance testing a critical part of product development for OEMs, Tier 1 suppliers, and chipset vendors.

10BASE-T1S Receiver Test Specifications

The AE6930R Automotive Ethernet Rx Compliance Test Software implements receiver compliance tests defined by:

- Open Alliance TC14 PMA Test Suite 5.2
- One primary test case – Receiver BER verification with impaired channel and coupled noise

The Open Alliance TC14 PMA working group significantly refined the test condition and limits compared to the IEEE 802.3cg specification. Keysight's 10BASE-T1S Rx test solution is designed to comply with the Open Alliance TC14 PMA requirements.

Test	IEEE 802.3cg 147.5.5	Open Alliance TC14 PMA 5.2 (where Keysight AE6930R fully complies with)
Test Case Definition	Alien crosstalk noise rejection test (147.5.5.2)	Receiver bit error rate verification
What/how to test	The receiver DUT is linked with a transmitter/LP. Gaussian noise source of 10 MHz and -106 dBm/Hz is applied to the linked channel through a resistive network.	The receiver DUT is linked with a transmitter/LP through a worst case channel using a ringing board. External noise source generates a 2 MHz sine wave with 15 nsec p-p jitter coupled to the test channel.
Test channel	Following 147.7 and 147.8 link segment characteristics (up to 8 nodes, 25m in mixing segment)	Emulated worst case channel using a ringing board in the middle of link segment. Test setup as shown in A.4.1
Noise source	Gaussian noise with 10 MHz BW and -106 dBm/Hz amplitude at the MDI	2 MHz sine wave carrier with 2 kHz frequency modulation and 500 kHz deviation, 15 nsec peak-to-peak jitter within ± 30 mV window
Test data	12.5 Mbd symbol rate ± 100 ppm	12.5 Mbd symbol rate ± 100 ppm
Target BER	BER < 10^{-9} or frame error ratio of < 10^{-6} for 125 octet frame	BER < 10^{-10} or frame error ratio of < 10^{-7} for 125 octet frame measured at MAC/PLS service interface

Table 1. 10BASE-T1S Rx Test Specification

TC14 PMA Receiver Test Configuration

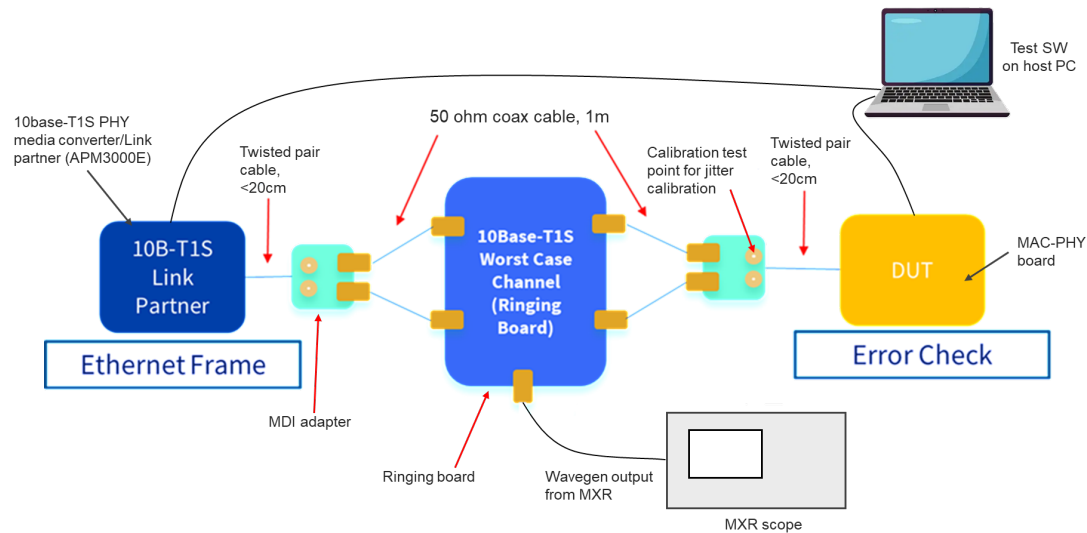


Figure 2. 10BASE-T1S Receiver Test Connection Diagram

Software User Interface

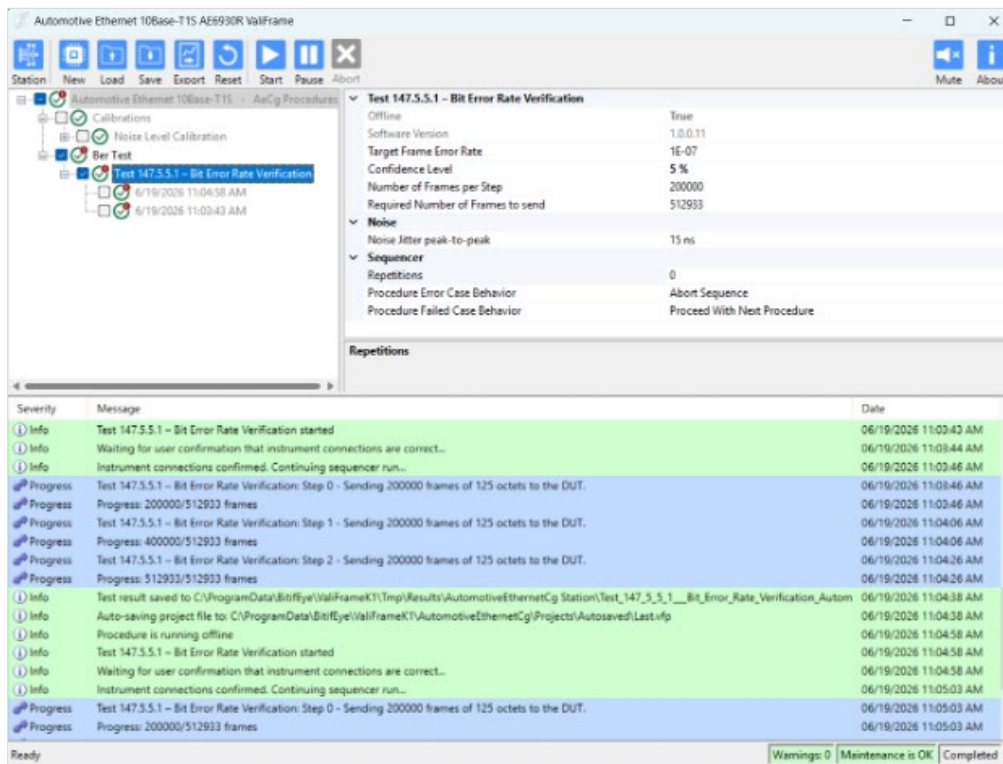


Figure 3. The main screen of the AE6930R ValiFrame environment. The panel on the right displays detailed information for the selected test, while the status window along the bottom shows the progress of the running tests and provides immediate feedback on whether each test passes or fails.

Configurability and Guided Connections

Building the Bit Error Rate (BER) verification system to characterize the receiver signals and get an accurate BER count can be difficult. Keysight removes the complexity and offers a clear objective validation of the BER count. This saves engineers time and effort in understanding the specifications, setting up the tests, and interpreting the results.

The AE6930R Automotive Ethernet 10BASE-T1S Receiver Test Compliance Software operates with Keysight MXR/EXR oscilloscopes, the APM3000E media converter, and MDI adapter and ringing board to create accurate worst-case test conditions. The software automates calibration, stressed-signal generation, BER measurement, and reporting, enabling engineers to quickly verify compliance and characterize receiver margins.

With a guided workflow, **AE6930R leads users through the entire process—from test setup to execution and result analysis—making receiver compliance testing efficient and straightforward.**

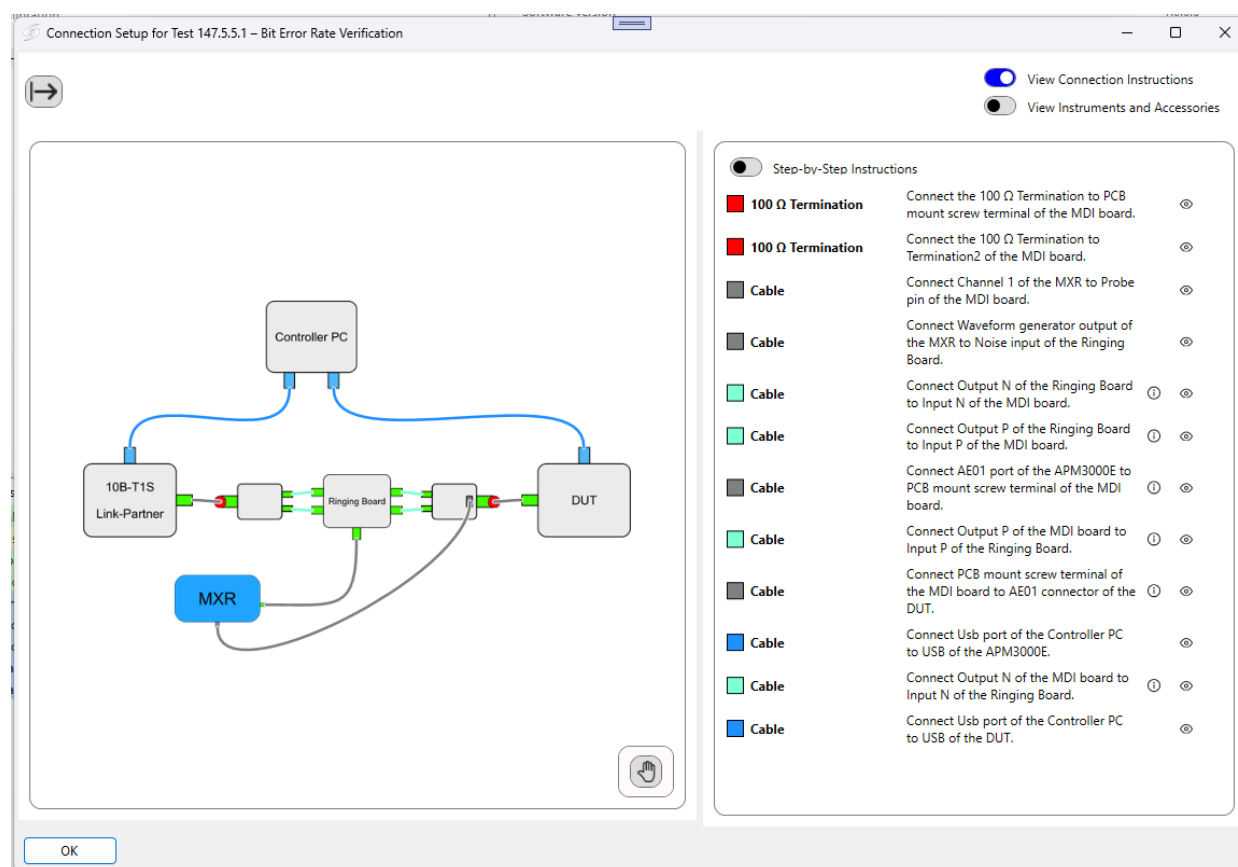


Figure 4. Connection Setup diagram within the AE6930R software for a receiver test with fixtures and an oscilloscope for calibration.

Compliance Mode vs Expert Mode

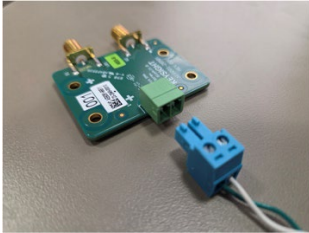
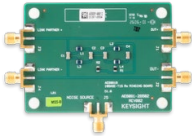
In **Compliance Mode**, users run the receiver tests exactly as specified by the OPEN Alliance test standards, allowing them to verify where their DUT stands relative to the compliance limits.

In **Expert Mode**, experienced users can access advanced test parameters—such as noise and jitter stress levels—and apply stress beyond the standard limits to evaluate how much additional margin the DUT can tolerate.

Automation

Some of the tests require many interactions and steps with the DUT. The AE6930R allows you to run those long-running tests to be executed unattended. Tests can be easily repeated and run multiple times, enabling execution under various conditions, such as climate chamber testing, EMC environments, and other stress scenarios.

Instrument and accessory requirements

Model	Function	Description
MXR054B or EXR054A+EXR2WAV	Noise Source and calibration tool	MXR/EXR 500MHz 4 channel scope with built-in wavegen option (free for MXR-B, paid option for EXR).
		
AE6091A MDI Adapter	MDI adapter	MDI Adapter - SMA to Screw-terminal Block Includes two screw-terminal block adapters
		
AE6091B 10BASE-T1S Rx Ringing Board	The ringing board is used to generate impaired signal to the DUT	10BASE-T1S Rx Ringing Board compliant to Open Alliance TC14
		
APM3000E 10BASE-T1S Media Converter/Link Partner.	10BASE-T1S Link Partner for generating the 10base-T1S frames for Rx testing and also for generating TM3 pattern for 10BASE-T1S Rx calibration	10BASE-T1S Media Converter/Link Partner
		

System Requirements

Visit <https://downloads.bitifeye.com/> and read the changelog of the current software release for detailed information on software and hardware requirements.

Software

Requirements

- OS: Windows 11
- Microsoft .NET
- Keysight IO Libraries Suite
- Exact versions of software requirements are listed in the respective changelog file.

Hardware

Requirement

- Connectivity hardware for instrumentation, depending on configuration e.g. USB3, Ethernet

Recommendations

- Multicore processor with 12 logical processors or more
- 32GB RAM or higher

Application Programming Interface (API)

The AE6930R ValiFrame remote interface allows ValiFrame functionality—such as test setup information, calibration, and test procedures, and results—to be accessed from external programming environments. The remote interface does not need a special license to be used; it is included in the base product of standards. The remote interface can thus be used to control the AE6930R with external software.

In typical use, a top-level external test sequencer takes advantage of ValiFrame functionality.

Software Maintenance Extension

The purchase of one -SFM maintenance extension license for -1FP product licenses or one -STM maintenance extension license for -1TP product licenses provides the ability to install updates for one year.

A software maintenance extension license is always valid for the respective RX test or Debug Tool (e.g., Link Training Suite or Frame Generator product only).

Software maintenance extension includes updates to newer instrument firmware, as well as procedure and test-limit changes for the test specifications covered by the licensed. It does not cover upgrades to different test specifications.

Products that do not have a software maintenance extension offering and are not an add-ons cannot be updated but remain operational when using the last software version for which maintenance was available.

Software without an associated software maintenance extension product has a maintenance expiration date set to 14 days after the software issue date. The software itself will remain operational even after maintenance expires.

If software maintenance extension expires, you can purchase a new license. Be aware that the coverage period begins from the previous maintenance expiration date, not from the purchase date of the new license. For example, if the software maintenance extension expired on April 30th, 2024, and a new 1-year software maintenance extension is purchased on August 1st, 2024, the purchased coverage will take May 1st, 2024, and will end on April 30th, 2025.

For additional information, please go to:

<https://www.keysight.com/us/en/product/AE6930R/automotive-ethernet-10base-t1s-receiver-compliance-test-software.html>

Ordering Information

Model Number	Description	Qty	Purpose
AE6930R-1FP	10BASE-T1S Rx Test SW - node locked	Choose 1	Main Software license
AE6930R-1TP	10BASE-T1S Rx Test SW - transportable		
AE6930R-SFM	12 months node locked SW maintenance	Choose 1	Maintenance Support
AE6930R-STM	12 months transportable maintenance		
MXR054B	500MHz 4 channel scope with built-in wavegen option	Choose 1	Noise Source
EXR054A + EXR2WAV	500MHz 4 channel scope with wavegen option		
AE6091A	MDI Adapter	2	SMA to Screw Terminal Block
AE6091B	10BASE-T1S Rx Ringing Board	1	Ringing board
APM3000E	Automotive Ethernet 10BASE-T1S Media Converter	1	Link Partner
DP0010A/11A/12A/13A or N2750A/51A/52A	250MHz/500MHz/1GHz/1.7GHz Differential Active Probe 1.5GHz/3.5GHz/6GHz Infiniium Mode Active Differential Probe	1	Recommended probes for 10BASE-T1S Rx Test Calibration

NOTE : Recommended probes for 10BASE-T1S Rx test calibration include DP0010A, DP0011A, DP0012A, DP0013A, and N2750A, N2751A, N2752A.

License types

Node-locked – License can be used on one specified computer.

Transportable – License can be used on one computer at a time but may be transferred to another using the BitEye License Manager.

Example Order

Full compliance of 10BASE-T1S Rx

Qty	Model Number	Description
1	AE6930R-1FP	10base-T1S Rx Test SW - node locked
1	AE6930R-SFM	12 months node locked SW maintenance
1	MXR054B	500MHz 4 channel scope with built-in wavegen option
2	AE6091A	MDI Adapter
1	AE6091B	10BASE-T1S Rx Ringing Board
1	APM3000E	Automotive Ethernet 10BASE-T1S Media Converter
1	DP0010A	250MHz Differential Probe

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