
AE6930R Automotive Ethernet 10BASE-T1S Receiver Test Automation Software

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Table of Contents

1	Introduction	
	Overview	10
	Document History	11
	First Edition (June 2026)	11
	Support and Troubleshooting	12
2	Preparing to Take Measurements	
	Overview	16
	Hardware and Software Requirements	16
	Downloading and Installing the AE6930R Software	16
	Normal Workflow	18
	Starting the AE6930R Software	19
	Configuring the Test Station	20
	Supported Instruments	21
	Instrument Configuration	22
	Configuring the Product and Test Parameters	24
3	Using the Software	
	Introduction to Using the Software	28
	Parts of the Main Window	28
	AE6930R Toolbar	29
	Modifying and Running Procedures	31
	Modifying Parameters	31
	Running Procedures	32
	State Icons	33
	Connection Diagrams	34
	Required Calibration Data	37
	AE6930R Data Structure	38

Results	39
Run-Time Data Display	39
Description of Results	39
Exporting Results	39
AE6930R Parameters	42
Sequencer Parameters	42
Procedure Parameters	43
4 Calibration	
Overview	46
AE6930R Calibration Procedure	47
Noise Signal Calibration	47
5 Receiver Test	
Overview	52
AE6930R Receiver Test Procedure	53
Test 147.5.5.1 – Bit Error Rate Verification	53
A Scripting Details	
Scripting Details	58
B AE6930R Parameters	
Overview	60
AE6930R Sequencer Parameters	61
AE6930R Parameters for Individual Procedures	62
AE6930R Parameters for Individual Calibrations	62
AE6930R Parameters for Individual Receiver Tests	64
C Acronyms and Abbreviations	
List of Acronyms	66

List of Figures

Figure 1-1	Accessing the log file	12
Figure 1-2	About button in the toolbar	13
Figure 1-3	Creating an issue report file	13
Figure 2-1	Required software	17
Figure 2-2	AE6930R Automotive Ethernet ValiFrame icon	19
Figure 2-3	AE6930R app main window	20
Figure 2-4	Instrument configuration window	22
Figure 2-5	New and Load buttons in the main window	24
Figure 2-6	Configure Product window	25
Figure 3-1	AE6930R main window with procedure tree	28
Figure 3-2	AE6930R toolbar	29
Figure 3-3	Modifying parameters	31
Figure 3-4	Running a selected procedure	32
Figure 3-5	State icons	33
Figure 3-6	Connection setup window – default view	34
Figure 3-7	Connection setup window with step-by-step instructions and list of instruments and accessories	35
Figure 3-8	Example list of required calibrations	37
Figure 3-9	Example Procedure Results Summary page of an AE6930R report	40
Figure 3-10	Example Instrument Summary table of an AE6930R report	41
Figure 3-11	AE6930R sequencer parameters	42
Figure 4-1	Connection diagram for Noise Signal Calibration	48
Figure 4-2	Example result for Noise Signal Calibration	50
Figure 5-1	Example connection diagram for Test 147.5.5.1 – Bit Error Rate Verification	54
Figure 5-2	Example result for Test 147.5.5.1 – Bit Error Rate Verification	55

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List of Tables

Table 2-1	DUT Parameter List	25
Table A-1	Scripts for Bit Error Rate Verification test	58
Table B-1	AE6930R Sequencer Parameters	61
Table B-2	AE6930R Parameters for Noise Level Calibration	62
Table B-3	AE6930R Parameters for Test 147.5.5.1 – Bit Error Rate Verification	64

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1 Introduction

Overview	10
Document History	11
Support and Troubleshooting	12

Overview

The Keysight AE6930R Automotive Ethernet 10BASE-T1S Receiver Test Automation Software is based on BitifEye's ValiFrame test software, which is an automated compliance test tool. It enables you to verify and debug the receiver characteristics of a PHY module in accordance with the OPEN Alliance TC14 PMA specifications.

This document describes the calibrations and test procedures conducted by the AE6930R Automotive Ethernet 10BASE-T1S Receiver Compliance Test software in detail.

The AE6930R Automotive Ethernet software implements the compliance tests according to the requirements defined by the OPEN Alliance *10BASE-T1S Physical Media Attachment Test Suite*. It also offers the possibility of modifying the parameters of the tests to provide more details of the behavior of the DUT beyond the limits of compliance testing. The software runs on a standard Windows PC and controls the hardware test resources through appropriate interfaces, such as USB.

NOTE

The definitions of the acronyms and abbreviations used throughout this User's Guide are given in [Appendix C: Acronyms and Abbreviations](#).

Document History

First Edition (June 2026)

The first edition of this User's Guide describes the functionality of software version AutomotiveEthernetCg_ValiFrame_AE6930R_1.0.0 based on tests specified in *OPEN Alliance 10BASE-T1S Physical Media Attachment Test Suite v1.0*, corresponding to the *OPEN Alliance TC14 System Implementation Specification, Version 1.0*.

Support and Troubleshooting

If you encounter problems when running the software, check the log list at the bottom of the main window. The log file can be viewed by right-clicking within the log list section (see red frame in [Figure 1-1](#)). The log file is temporarily saved at *C:\ProgramData\BitifEye\ValiFrameK1\Tmp*. Note that all log information will be lost when the AE6930R application is terminated unless you save the log file.

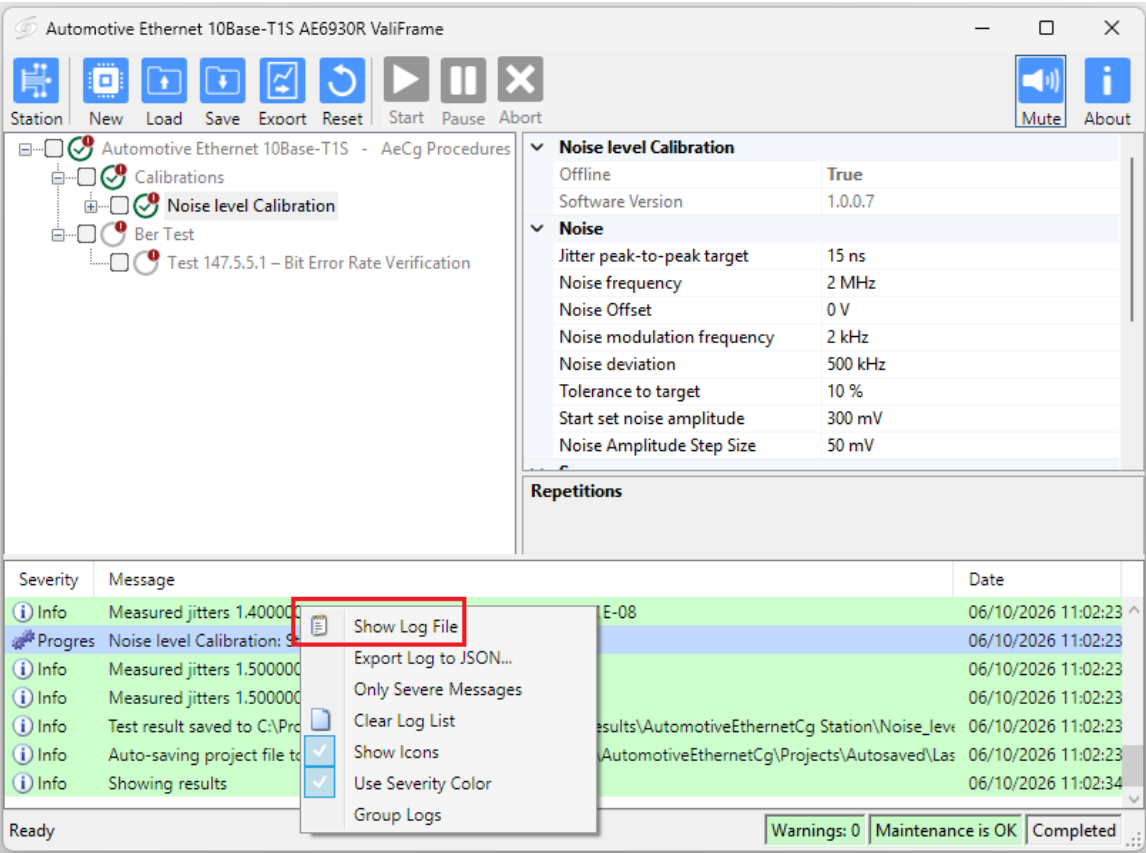


Figure 1-1 Accessing the log file

If a problem with the application persists:

- 1 Click the **About** button in the main window (Figure 1-2).
- 2 Click the **Create issue report** button in the About window (Figure 1-3). This will create the file BitifEye_IssueReportFile.zip saved on your desktop.
- 3 Send this zip file to your Keysight support contact.

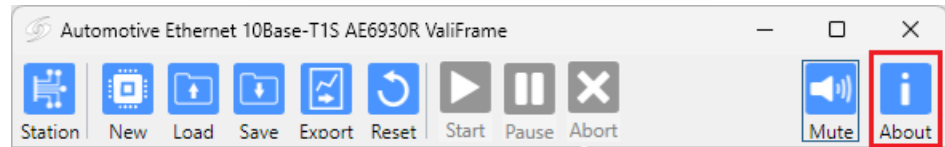


Figure 1-2 About button in the toolbar

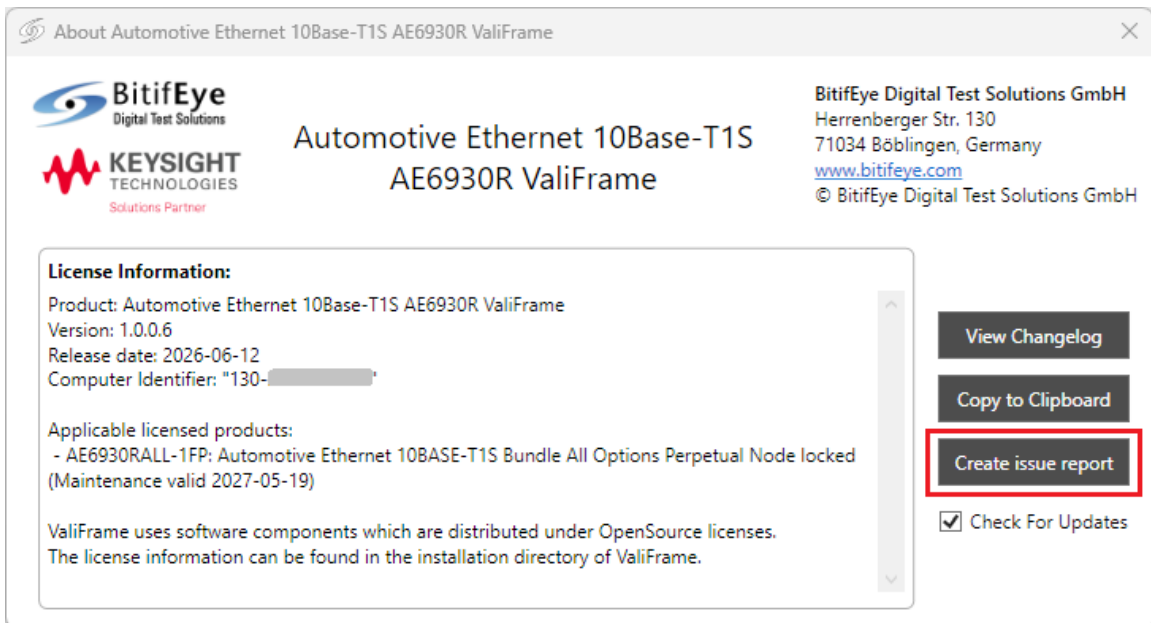


Figure 1-3 Creating an issue report file

The Keysight support team is also happy to help you should you require further information about a particular application.

For Keysight support options, visit www.keysight.com/find/contactus.

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2 Preparing to Take Measurements

Overview	16
Hardware and Software Requirements	16
Downloading and Installing the AE6930R Software	16
Normal Workflow	18
Starting the AE6930R Software	19
Configuring the Test Station	20
Configuring the Product and Test Parameters	24

Overview

The set of test instruments that are used for Automotive Ethernet 10BASE-T1S Receiver Test Automation Software are referred to variously as either a *test station* or *station*. The test station is controlled by a suitable PC and the AE6930R Automotive Ethernet 10BASE-T1S Rx Test Automation Software.

Hardware and Software Requirements

The hardware and software requirements to run the AE6930R test automation software can be found in the *AE6930R Data Sheet*, which can be downloaded from [here](#).

Downloading and Installing the AE6930R Software

The AE6930R SW consists of the following components:

- 1** Keysight Serial Protocol Driver, version 2.4.0 or higher, for the APM3000E 10BASE-T1S Media Converter. You can download this from [here](#). Install this component first.
- 2** The AE6930R Automotive Ethernet 10BASE-T1S ValiFrame SW. Download this from the [BitifEye Download Hub](#).

During the installation of the AE6930R app, you will see a list of required software. If all of the required software is already installed, the list will appear as in [Figure 2-1](#). If some of the software is missing, first install the missing software and then attempt the installation of the AE6930R app again.

Further details about installing the test automation SW and the licenses required can be found in the [ValiFrame Getting Started Guide](#).

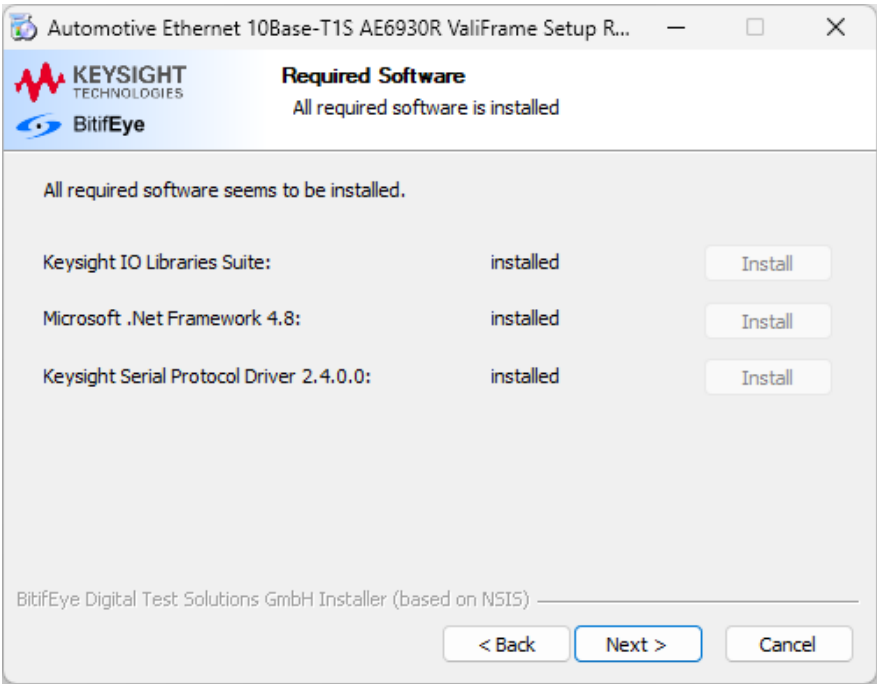


Figure 2-1 Required software

Normal Workflow

The following list outlines the normal DUT testing procedure after installing the AE6930R software. More details about each step are provided in the following sections.

- 1 Start the AE6930R app**
(see [Starting the AE6930R Software](#) on page 19)
- 2 Configure the station**
(see [Configuring the Test Station](#) on page 20)
- 3 Configure the DUT**
(see [Configuring the Product and Test Parameters](#) on page 24)
- 4 Calibrate the system**
 - a** Modify parameters (see [Modifying Parameters](#) on page 31)
 - b** View the connection diagram and connect the setup (see [Connection Diagrams](#) on page 34)
 - c** Run calibration procedure(s) (see [Running Procedures](#) on page 32)
 - d** Save/export calibration results (see [Exporting Results](#) on page 39)
- 5 Run test procedure(s)**
 - a** Modify parameters (see [Modifying Parameters](#) on page 31)
 - b** View the connection diagram and connect the setup (see [Connection Diagrams](#) on page 34)
 - c** Run test procedure(s) (see [Running Procedures](#) on page 32)
 - d** Save/export test results (see [Exporting Results](#) on page 39)

Starting the AE6930R Software

Double-click the AEcg ValiFrame (AE6930R) icon on the desktop (see [Figure 2-2](#)) to launch the app. Alternatively, to access the AE6930R app on a Windows 11-based PC, search 'AEcg ValiFrame (AE6930R)'.

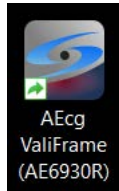


Figure 2-2 AE6930R Automotive Ethernet ValiFrame icon

Configuring the Test Station

When the AE6930R app is launched, the main ValiFrame window opens, as shown in [Figure 2-3](#). Next, configure the instruments.

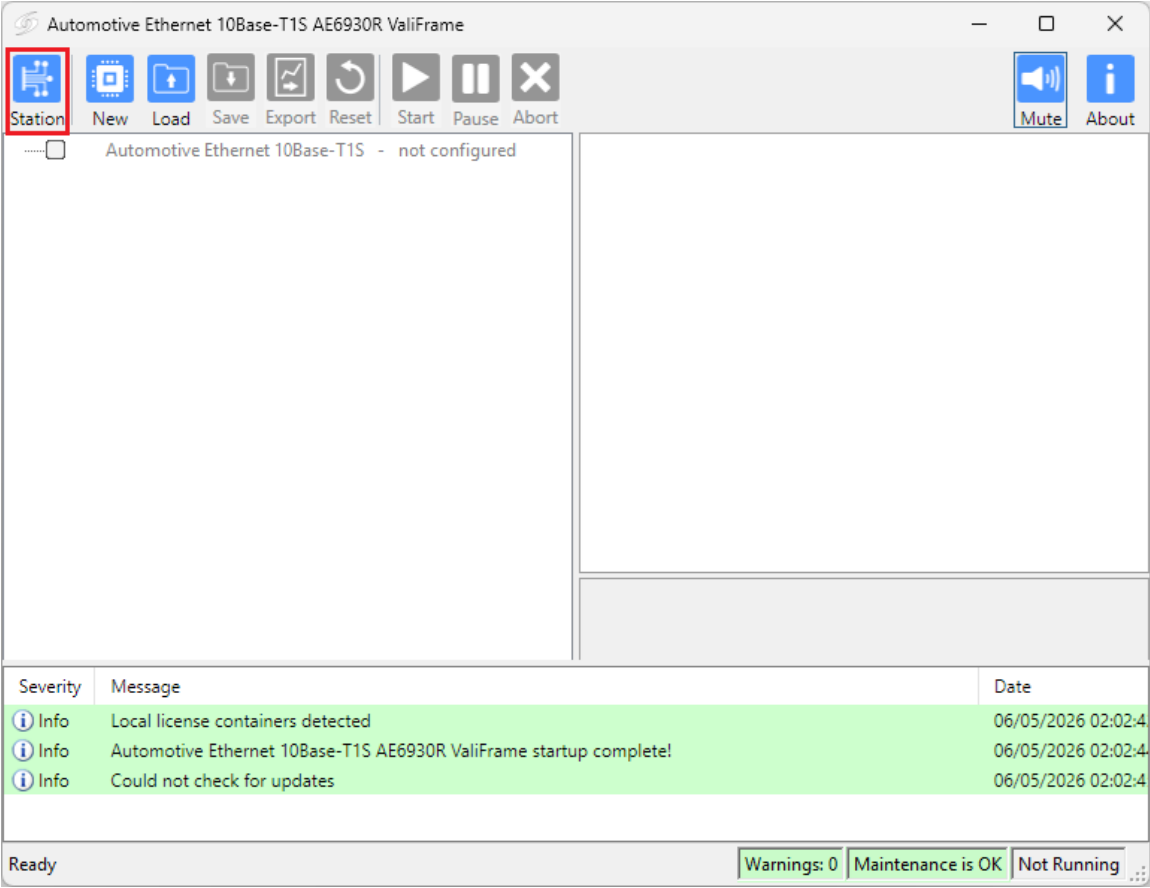


Figure 2-3 AE6930R app main window

Supported Instruments

The AE6930R app supports the following instruments for Automotive Ethernet testing:

APM3000E Media Converter

The Keysight APM3000E 10BASE-T1S media converter is used as the test pattern generator and link partner. It is configured to generate the test pattern according to IEEE 802.3cg Test Mode 3 and is used as a link partner for the DUT.

MXR Series Oscilloscope and Signal Generator

The Keysight MXR series real-time oscilloscope serves two purposes in the test setup:

- Its integrated signal generator acts as the external noise source to inject the calibrated sinusoidal noise profile into the ringing board.
- Its oscilloscope channels are used during the calibration phase to measure and verify the 15 ns peak-to-peak target jitter.

NOTE

For more details about supported instruments, contact your local Keysight representative.

Instrument Configuration

Click **Station** (red frame in [Figure 2-3](#)) to open the Instrument Configuration window ([Figure 2-4](#)).

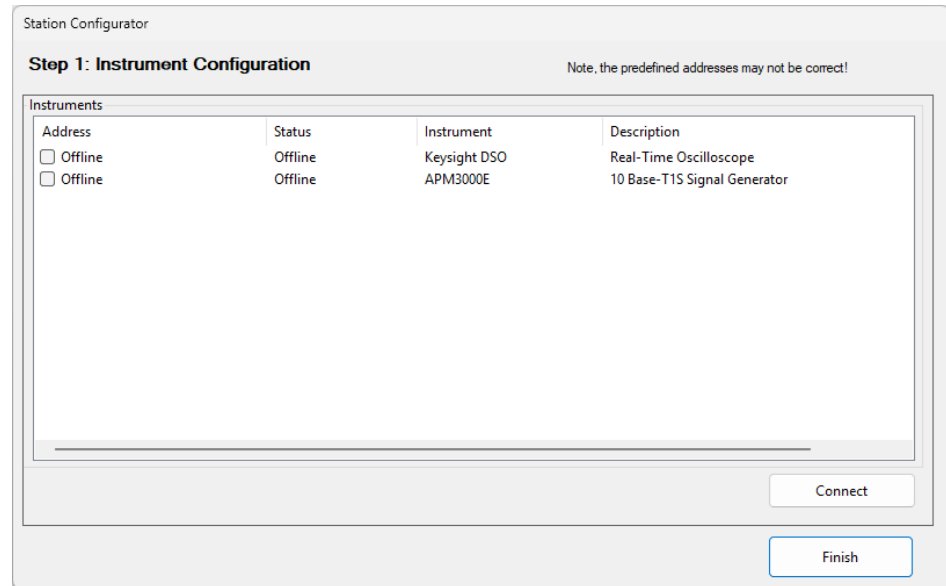


Figure 2-4 Instrument configuration window

NOTE

Make sure that all the selected instruments for the test station are connected to the test station PC controller by remote control interfaces, such as LAN or USB.

After installation, the instruments default to Offline mode. In this simulation mode, hardware does not need to be physically connected to the test controller PC. The AE6930R software cannot connect to any instrument in this mode. To control the instruments connected to the PC, enter the instrument address. The address depends on the bus type used for the connection, for example, LAN or USB.

The oscilloscope requires a VISA connection. To determine the VISA address, run the Keysight Connection Expert, which is part of the [Keysight IO Libraries Suite](#). For the oscilloscope, copy the address string from the Connection Expert entry

and paste it into the instrument Address field in the AE6930R Instrument Configuration window.

For further details about how to use the Keysight Connection Expert, see the [ValiFrame Getting Started Guide](#).

After the address strings have been entered in the AE6930R Instrument Configuration window, click **Check Connections** to verify that the connections for the instruments are established properly. The software checks for the optimal connection, and displays a message if you have entered a connection that is not optimal.

Click **Finish** to save the selected instruments and connections. You will be returned to the main window of the AE6930R app.

NOTE

When starting a specific test station configuration for the first time, all instruments are set to Offline mode. In this mode, the test automation software does not connect to any instrument. This mode can be used for demonstrations or checks only. ***No valid data is produced.***

You will need to repeat the station and instrument configuration whenever you change the instruments that you are using or their connections.

Configuring the Product and Test Parameters

Once the test station has been configured, the next step is to configure the product and test parameters.

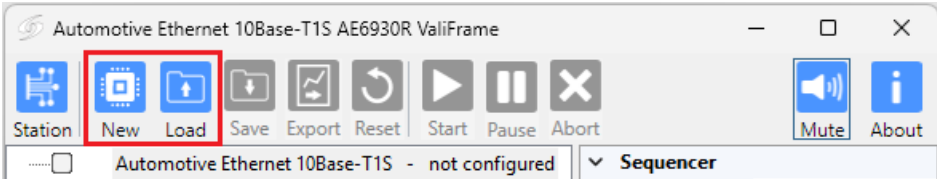


Figure 2-5 New and Load buttons in the main window

Opening a Previously Saved Project

If you have already configured the AE6930R software and saved the settings as a configuration or project file, you can click **Load** (Figure 2-5) to use the same station, product and test parameters again, which can save time.

Beginning a New Project

To begin a new project, click **New** (Figure 2-5), which opens the AE6930R Configure Product window (Figure 2-6).

The Configure Product window allows you to select the DUT and receiver test parameters, such as data rates, DUT access method, and Compliance/Expert mode. These parameters will be used later in the calibrations and test procedures. They are listed and described in Table 2-1 on page 25.

NOTE

To be able to perform automated tests, the DUT must have the capability to configure its PHY and provide register read access to the MAC PHY.

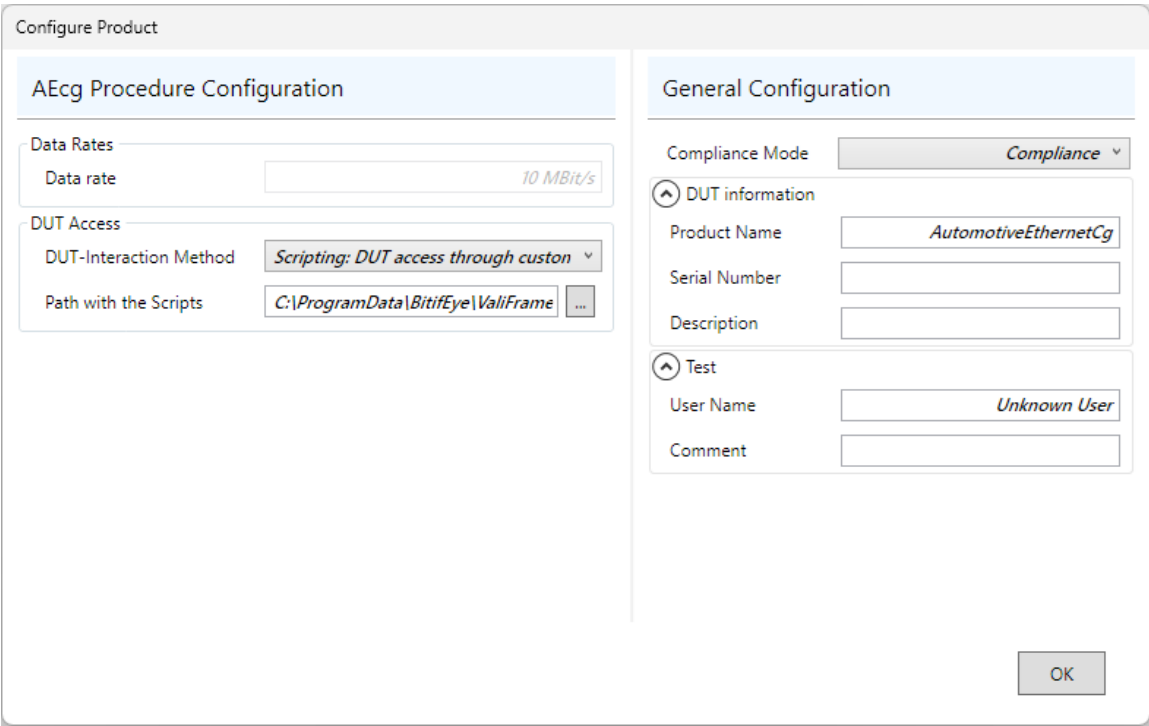


Figure 2-6 Configure Product window

Table 2-1 DUT Parameter List

Parameter Name	Parameter Description
Data Rates	
Data rate	This is read-only and preselected as 10 MBit/s
DUT Access	
DUT-Interaction Method	Options: – Scripting: DUT access through customized scripts (10Base-T1S) – Offline: This is a simulation mode and does not produce valid data.
Path with the Scripts	The path leading to the script files when you select <i>Scripting</i> for the DUT-Interaction Method.

Table 2-1 DUT Parameter List (cont.)

Parameter Name	Parameter Description
General Configuration	
Compliance Mode	– Compliance Mode: Tests are conducted as mandated by the PMA Test Suite. The parameters shown in the calibration and test procedures cannot be modified by the user. – Expert Mode: Calibrations and tests can be conducted beyond the limits and constraints of the PMA Test Suite. The parameters shown in the calibrations and test procedures can be modified by the user.
Product Name	Text field for the name of the product (DUT).
Serial Number	Text field for the serial number of the product (DUT).
Description	Text field for a description of the product (DUT).
User Name	User name text field.
Comment	Text field for user comments.

3 Using the Software

Introduction to Using the Software	28
Modifying and Running Procedures	31
Connection Diagrams	34
Required Calibration Data	37
AE6930R Data Structure	38
Results	39
AE6930R Parameters	42

Introduction to Using the Software

Parts of the Main Window

Once the DUT has been configured, click OK in the AE6930R Configure DUT window. The AE6930R main window will now show the relevant calibration and test procedures listed in groups in a *procedure tree* (left pane of AE6930R main window, see [Figure 3-1](#)).

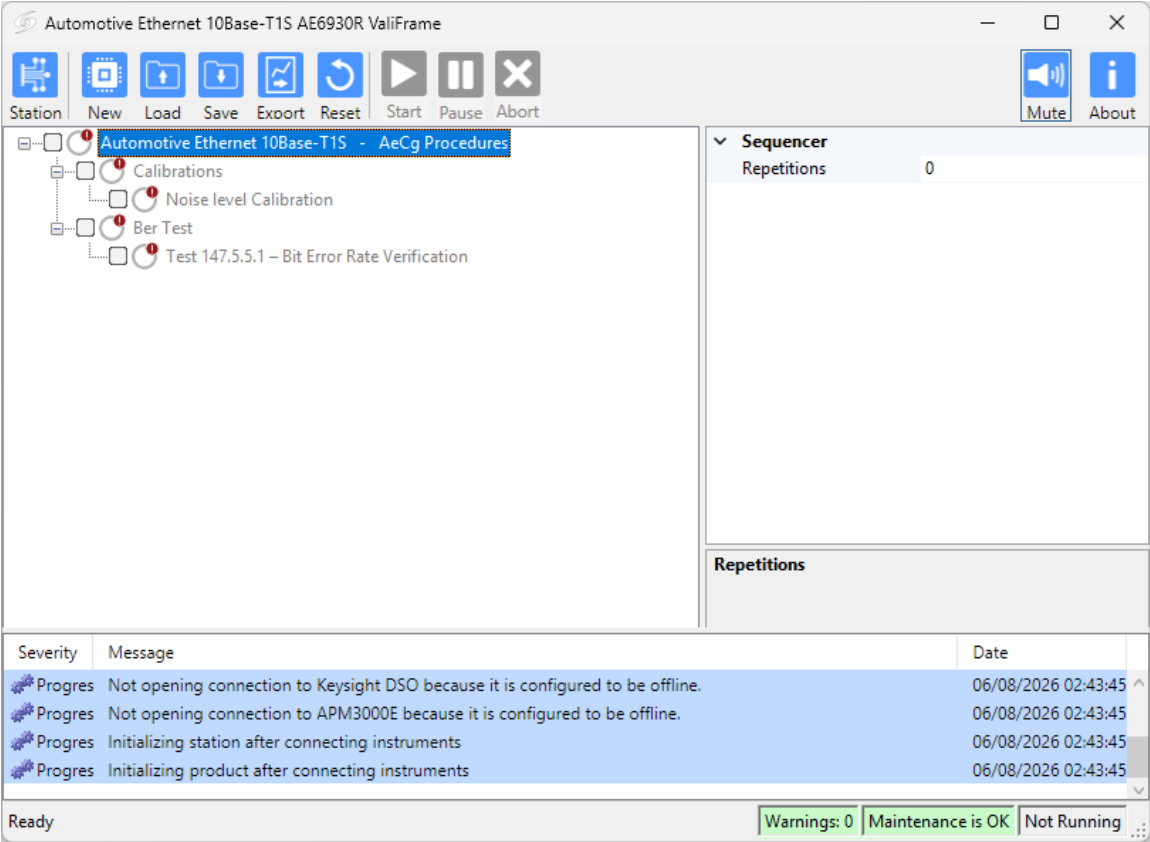


Figure 3-1 AE6930R main window with procedure tree

The *parameter grid* in the right pane of the window shows the parameters that are related to the individual procedure or group of procedures selected on the left.

The *log list* in the bottom pane of the window shows calibration and test status messages (regular progress updates as well as information, warnings, and error messages).

The *status bar* at the very bottom provides information about how many critical errors have occurred, how many warnings have been sent, the status of the software maintenance license, whether a procedure is running, which step has been reached, and whether the instruments were successfully connected.

AE6930R Toolbar

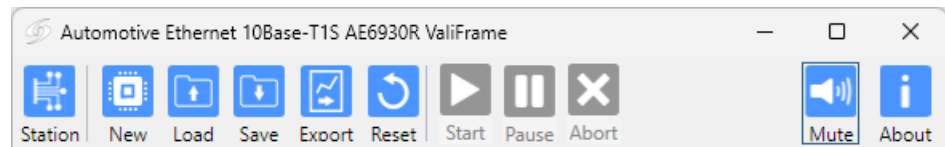


Figure 3-2 AE6930R toolbar

Use the **Station** button to configure the test station. See [Configuring the Test Station](#).

Use **New** to open the AE6930R Configure Product window. This allows you to configure a new DUT or change the DUT and test parameters. See [Configuring the Product and Test Parameters](#).

If you have already configured the AE6930R software for a particular product and saved the settings as a configuration file, you can click **Load** to use the same station, product, and test parameters again, which can save time.

The **Save** button is used to save settings for a particular project. You can save the settings as either a ValiFrame configuration file (.vfc; this contains the changed parameters and the selected procedures) or a ValiFrame project file (.vfp; contains the same as the configuration file and in addition the results of the current run). See the [ValiFrame Getting Started Guide](#) for more details.

Use the **Export** button to save results of measurements. See [Exporting Results](#) for details.

Reset sets ALL parameters to their default values.

To start one or more procedures, select the corresponding check box(es). The *Start* button is enabled and turns blue. Click **Start** to run the selected procedure(s).

Pause interrupts the current run at the end of the current step. When the test is paused, the *Start* button is relabeled *Step*.

You have two options when a procedure is paused:

- Click **Step** to continue the procedure and pause at the next step.
- Click **Pause** again to continue running the test until the end of the procedure.

The *Step* feature is useful for debugging purposes; for example, to analyze the signal on the oscilloscope at each step. When a procedure is paused, a message in the bottom-left corner of the main window indicates which step has been reached.

Abort stops the current run and closes the procedure window.

The AE6930R app produces a sound to indicate when a different state of the program has been reached. You can turn this off (and on again) using the **Mute** button.

The **About** button opens a window that provides details of the software, such as the version of the AE6930R app that is being run, the License Container ID of the computer, and when the software maintenance will expire. The window can also be used to send a report to support if you encounter persistent problems. For more details, see the [ValiFrame Getting Started Guide](#).

CAUTION

Before executing the calibration or test procedures, ensure that the Automotive Ethernet Station Configuration has been conducted properly, with all necessary instruments, such as the oscilloscope, set to “online”. All calibrations can be run in offline mode; that is, without any instrument connected. The offline mode is intended for product demonstrations with simulated data. CALIBRATIONS RUN IN OFFLINE MODE DO NOT GENERATE VALID CALIBRATION DATA.

Modifying and Running Procedures

Modifying Parameters

NOTE

Modifying parameters might break the conformance status.

Most calibration and test procedures, as well as some of the groups containing them, have parameters that control the details of how the procedures are run. In compliance mode, most of these parameters are read-only. In expert mode, most of the parameters can be modified. To modify a parameter, first select a specific procedure in the procedure tree, as shown in the left pane of [Figure 3-3](#). The corresponding parameters are displayed in a property list (parameter grid) in the right pane. These procedure parameters can be configured only before the selected procedure is started. All of them are listed in the procedure results.

For more details about parameters, see [AE6930R Parameters](#).

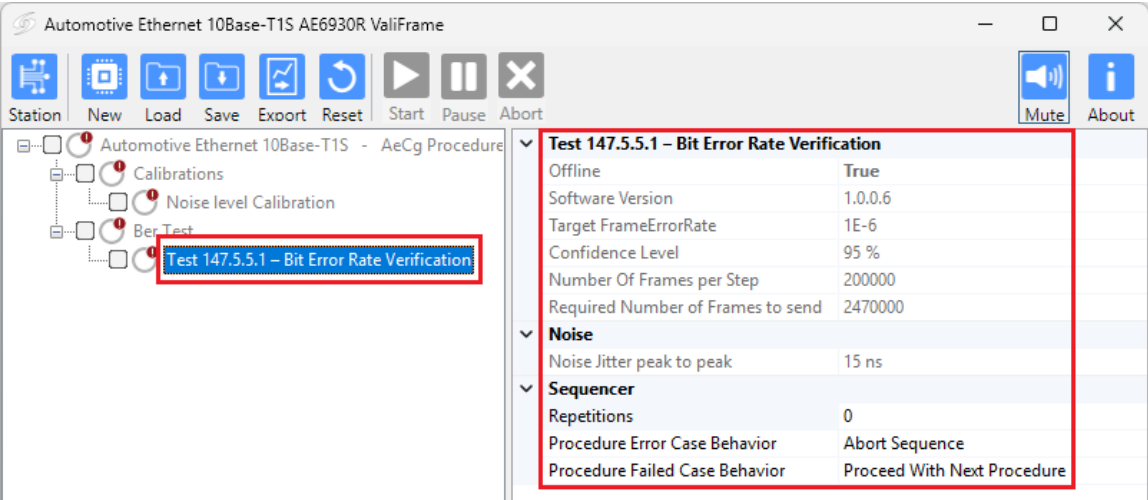


Figure 3-3 Modifying parameters

Running Procedures

First select the procedure or group of procedures that you want to run. Procedure groups (e.g., Calibrations, Ber Tests) can be selected by clicking the check box next to the group name. Alternatively, an individual procedure can be selected by clicking the corresponding check box. This will cause the Start icon on the toolbar to be enabled (it turns blue; [Figure 3-4](#)).

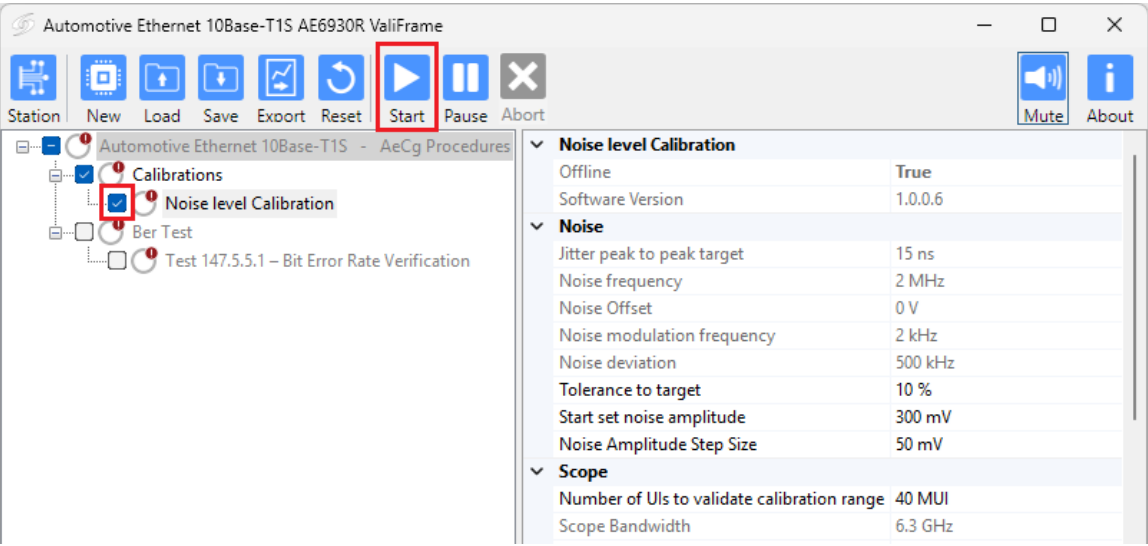


Figure 3-4 Running a selected procedure

When you click **Start**, the selected procedures are run sequentially in the order shown in the procedure selection tree. Some procedures may require user intervention, such as changing cable connections or entering DUT parameters. The required action is prompted in pop-up dialog boxes.

To view the associated connection diagram, right-click the desired test or calibration and select **Show Connection....** See also [“Connection Diagrams”](#) on page 34.

State Icons

Once the selected procedures have been run, the state icon next to a group or an individual procedure indicates the result (pass/fail/incomplete) and provides further information.

Right-click the procedure name and select **Show State Details...** to see an explanation of the corresponding icon (Figure 3-5). For more information about all state icons, refer to the [ValiFrame Getting Started Guide](#).

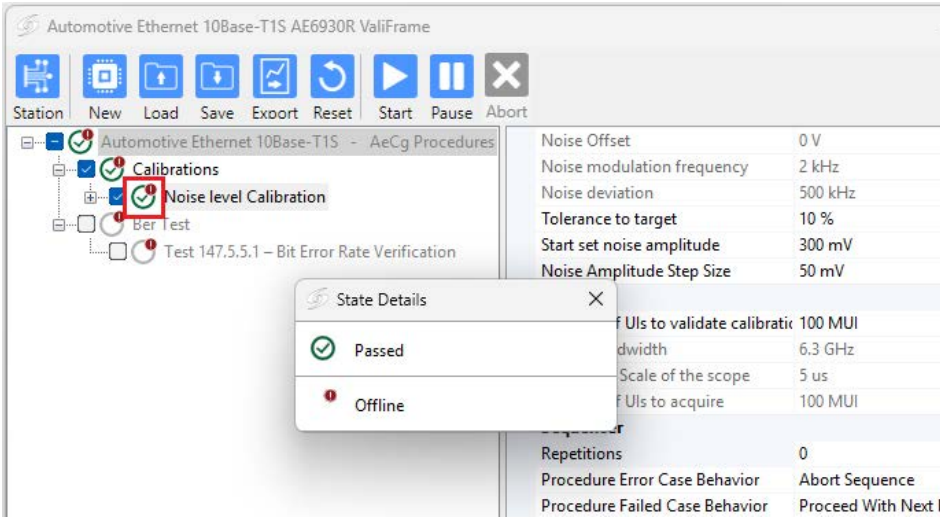


Figure 3-5 State icons

Connection Diagrams

To view the connection diagram for a particular set of instruments and procedure, right-click the desired test or calibration in the procedure tree. From the context menu, select **Show Connection...**

The default Connection Setup window shows a connection diagram on the left and connection instructions on the right (Figure 3-6). The numbers of the buttons shown in the figures here correspond to the instructions below Figure 3-7.

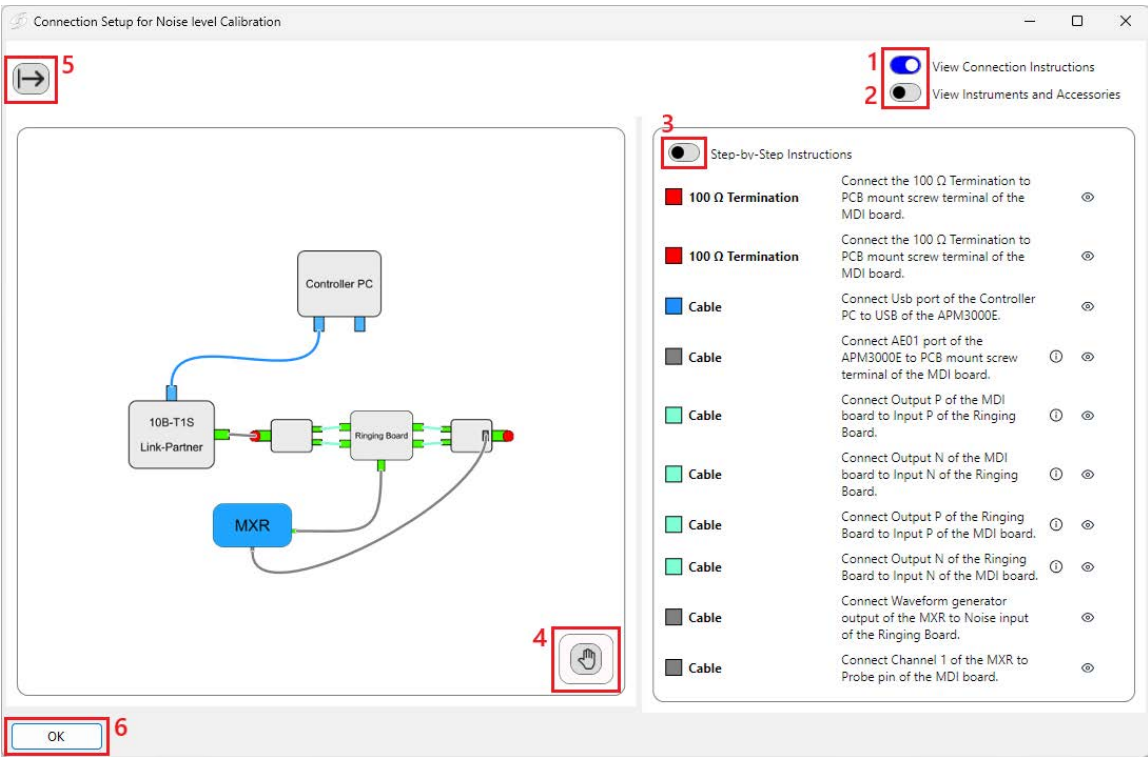


Figure 3-6 Connection setup window - default view

- 1 **Connection Instructions:** In the default view (Figure 3-6), connection instructions and further information are visible. Toggle off to close the right-hand pane. The connection diagram will fill the whole window.
- 2 **Instruments and Accessories:** Toggle on to view the list of required instruments and accessories (lower left pane in Figure 3-7).
- 3 **Step-by-Step Instructions:** Toggle on to view step-by-step instructions and each connection highlighted in turn (Figure 3-7).
- 4 **Export Mode:** Click here to change the positions of the individual instruments and cables in the connection diagram before exporting it. You can use this to increase the clarity of the connections.

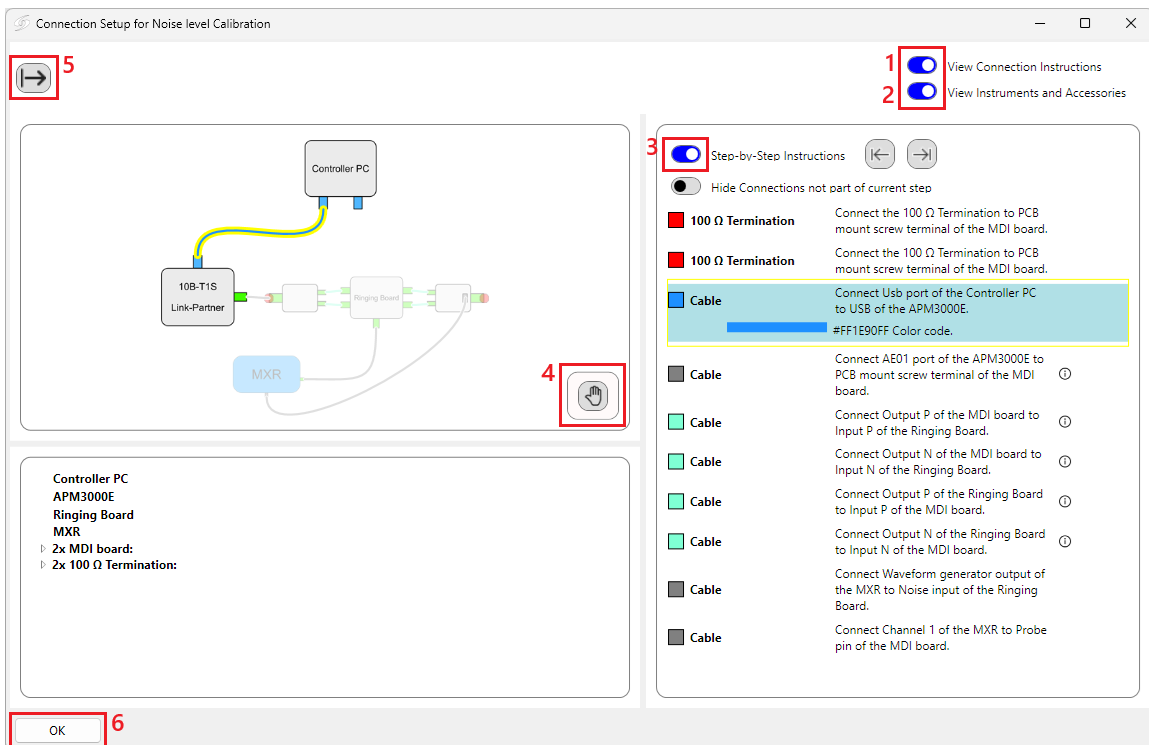


Figure 3-7 Connection setup window with step-by-step instructions and list of instruments and accessories

5 Export: Export the diagram as an HTML file. If the list of instruments and accessories is expanded, that will be included in the HTML report as well.

6 OK: Click here to close the connection diagram window.

For more details, see the [ValiFrame Getting Started Guide](#).

Required Calibration Data

The test procedure requires calibration data that has been measured previously. You can see the calibration data required by right-clicking the procedure's name in the procedure tree and selecting **Required Calibration Data...**. A list of the prerequisite calibrations is displayed. In this software version, there is just one entry. See [Figure 3-8](#).

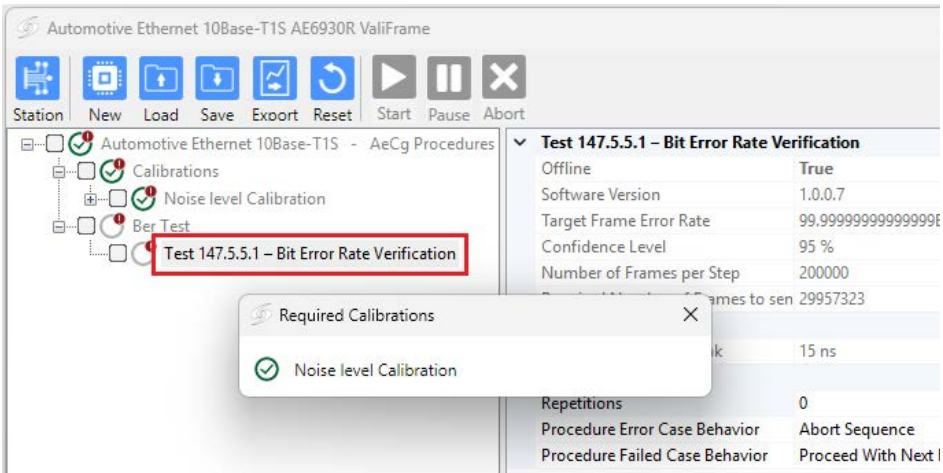


Figure 3-8 Example list of required calibrations

The icon next to the name of the calibration procedure in the list indicates whether the calibration has been run successfully (green), is incomplete (yellow), failed (red), or has not yet been run (gray).

AE6930R Data Structure

All the AE6930R internal data is saved on the PC's local disk in the application data folder *ProgramData\BitifEye\ValiFrameK1\AutomotiveEthernetCg*.

The AutomotiveEthernetCg data folder contains the following folders:

- **Calibrations:** The calibration data is saved in the Calibrations folder. For each calibration procedure run, at least one calibration file is saved.
- **CalibrationsOffline:** If the calibration was run in offline (simulation/ demonstration) mode, the calibration data is saved in the CalibrationsOffline folder. Offline calibrations are for demonstration purposes only. They do not yield valid data.
- **Data:** AE6930R does not save any files in the Data folder.
- **Examples:** This folder contains scripts that are intended as reference examples for customers who want to automate AE6930R test runs from Python, for instance as part of a larger production line or a continuous integration test harness.
- **Pattern:** This folder is not used by AE6930R.
- **Projects:** The Projects folder is the default folder for ValiFrame project (.vfp) and configuration (.vfc) files. These can be saved by clicking the **Save** icon in the AE6930R main window. The most recent previous .vfp file is automatically saved in the Autosaved sub-folder; the previous file is overwritten.
- **Settings:** The Settings folder contains settings files. These will include the instrument connection setup, the station configuration setup, and settings for the last configured DUT, as well as specification-related settings.
- **SParameter:** AE6930R does not save any files in the SParameter folder.

Results

Run-Time Data Display

Most procedures generate data output. While the procedure is running, the data is displayed in a results viewer window, which opens automatically for each individual procedure.

Any results windows that are open during the procedure runs are closed automatically once the specific procedure is finished. As long as the AE6930R app is running, each test result file (HTML page) can be reopened by double-clicking the respective procedure. However, the individual files are lost when the AE6930R application is closed, unless you save the individual files or a collection of them.

Description of Results

In this User's Guide, the descriptions of the calibration and test procedures include example results. In addition to a graph and a table, each result set includes text that records the conditions under which the procedure was performed, including a list of the instruments used and their associated firmware.

Exporting Results

For your convenience, all individual results are summarized in an HTML document at the end of the test run. All calibration and test data can be saved anytime in a report by clicking the **Export** button on the toolbar of the AE6930R main window. More details can be found in the [ValiFrame Getting Started Guide](#).

Keysight recommends exporting results at the end of each AE6930R run to avoid any data loss. If several calibration and test procedures are conducted during the same AE6930R run, the resulting report pages are combined in a single report. If a test procedure is conducted without prior execution of calibration procedures in the same test run, only the test results will be saved to the report.

NOTE

As a safety feature, all calibration and test results are saved by default to the ValiFrame Tmp directory (*C:\ProgramData\BitifEye\ValiFrameK1\Tmp*). The sub-folder *Results\AutomotiveEthernetCg Station* contains the HTML files of the final results measured for each calibration and test procedure.

In addition to the calibration data HTML files, calibration data files are generated. These files are saved by default to *C:\ProgramData\BitifEye\ValiFrameK1\AutomotiveEthernetCg\Calibrations*. If these calibrations are run again, the data file is overwritten. To save the calibration data files at each configuration, the files must be copied from this folder and saved manually in a different folder before the calibrations are rerun.

An exported workbook includes summaries of the procedures performed in that run (Figure 3-9) and the instruments used (Figure 3-10).

Procedure result summary

Shows the procedure results as an overview

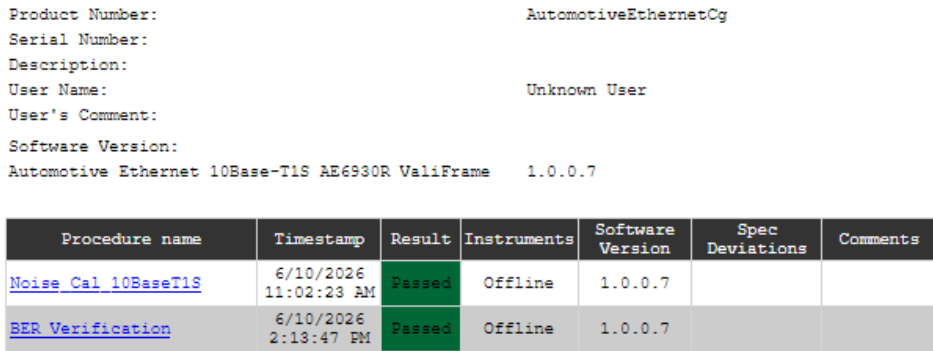


Figure 3-9 Example Procedure Results Summary page of an AE6930R report

- Procedure Name: Abbreviated name of the procedure (test or calibration).
- Timestamp: The date and time at which the procedure ended.
- Result: Whether the procedure was passed or failed.
- Instruments: Either 'Connected' or 'Offline' (simulation mode).

- Software Version: The version of the AE6930R software used to perform the procedure (calibration or test).
- Spec Deviations: The parameters that have been changed so that the procedure no longer agrees with the PMA Test Suite.
- Comments

Instrument Summary

This table lists the instruments used to run these procedures.

Company	Instrument Name	Serial	Instrument Revision	Description
KEYSIGHT TECHNOLOGIES	MXR608A	No Serial	11.71.00035	Real-Time Oscilloscope
Keysight	APM3000E	RAD-Moon T1S	2602	10 Base-T1S Signal Generator

Figure 3-10 Example Instrument Summary table of an AE6930R report

- Company: The manufacturer of the instrument.
- Instrument Name: The model number or name of the instrument.
- Serial: The serial number of the instrument.
- Instrument Revision: The revision number or version of the software running on the instrument.
- Description: The type of instrument, e.g., Real-Time Oscilloscope.

AE6930R Parameters

AE6930R parameters are of two types:

- Sequencer Parameters
- Procedure Parameters

Sequencer Parameters

The sequencer parameters control the flow of the test sequencer only, not the behavior of individual procedures. One parameter, Repetitions, is available for all groups and all individual procedures in the procedure tree. Other parameters are available only for individual procedures. Like all other parameters, the sequencer parameters are shown in the right pane of the AE6930R user interface and can be modified manually, as illustrated in [Figure 3-11](#).

The sequencer parameters are described in [Table B-1](#).

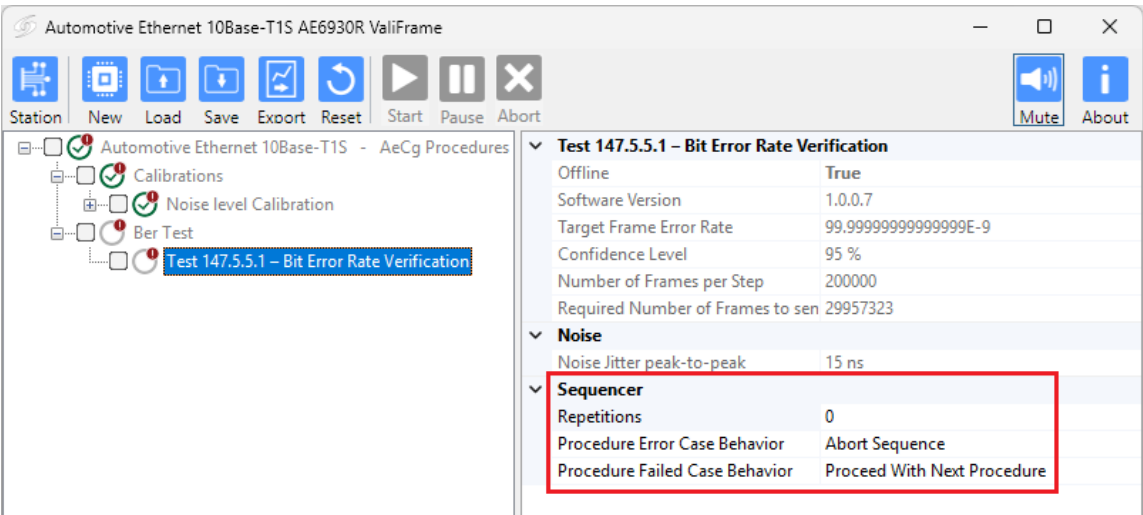


Figure 3-11 AE6930R sequencer parameters

Procedure Parameters

The procedure parameters are those parameters that are not sequencer parameters. They are shown in the right-hand pane of the AE6930R user interface when an individual procedure is selected in the procedure tree on the left. Their purpose is to modify the behavior of a single procedure. Different procedures often have parameters with the same name, however, configured settings always apply only to the selected procedure. The meanings of parameters with identical names may differ slightly between procedures.

- The AE6930R calibration parameters that are available in Expert Mode and used in individual calibration procedures are listed in [Table B-2](#).
- The AE6930R receiver test parameters that are available in Expert Mode and used in individual receiver test procedures are listed in [Table B-3](#).

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4 Calibration

Overview	46
AE6930R Calibration Procedure	47

Overview

Before you run the receiver test procedure, the 10BASE-T1S test system must first be calibrated.

The physical compliance plane for this test is defined at the ideal 100 ohm termination point, which directly replicates the input conditions seen by the DUT's medium-dependent interface (MDI). The receiver test signal characteristics are affected by the signal transmission path between the Keysight MXR signal generator output ports, the 10BASE-T1S ringing board, and the interconnecting cabling.

The calibration procedure compensates for these deviations by tuning the Keysight MXR noise amplitude over the required parameter range until the target actual value is achieved.

This product includes a single calibration routine required for 10BASE-T1S receiver testing. The implemented calibration procedure is designed to be conducted as fast as possible and is fully automated to minimize user intervention and reduce the need for hardware reconnection before moving to the execution phase.

AE6930R Parameters

AE6930R parameters for individual procedures that can be changed in expert mode are displayed in the parameter grid (right pane) of the main window of the user interface when you click on the corresponding entry in the procedure tree in the left pane of the main window.

Details of AE6930R calibration parameters can be found in [Table B-2](#).

Connection Diagrams

The exact connection diagram for a specific situation can be viewed by right-clicking the appropriate procedure in the procedure tree of the main window of the user interface and selecting **Show Connection....** See also [Connection Diagrams](#) on page 34.

AE6930R Calibration Procedure

Noise Signal Calibration

Availability

Noise Generator Keysight MXR Oscilloscope

Pattern Generator Keysight APM3000E Media Converter

Mode Compliance, Expert

Purpose and Method

The purpose of this procedure is to calibrate the impaired input signal to ensure it precisely meets the 15 ns peak-to-peak jitter requirement before initiating receiver testing.

For this calibration, the Keysight MXR is used as the external noise generator to adjust the total noise level injected into a 10BASE-T1S ringing board. The noise source is configured to output a 2 MHz sinusoidal tone with 2 kHz frequency modulation and 500 kHz deviation. The transmitter is configured to output a Test Mode 3 data pattern.

The duration of the calibration process is determined by the time required to capture a statistically significant sample size on a real-time oscilloscope. The peak-to-peak jitter is defined by a ± 30 mV voltage window and must be measured across at least 100 million waveforms, which typically takes approximately 15 minutes to complete.

Connection Diagram

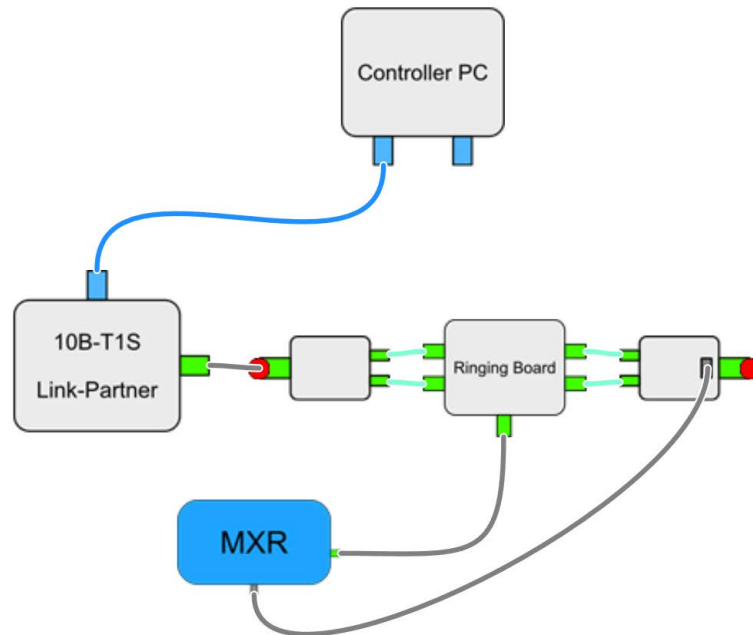
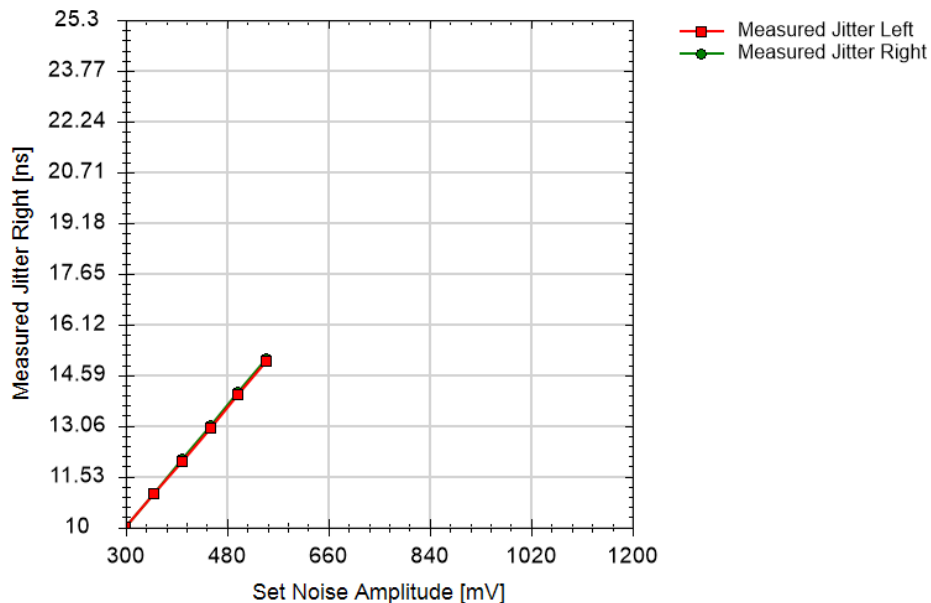


Figure 4-1 Connection diagram for Noise Signal Calibration

Result Description

Noise_Cal_10BaseT1S

Jitter noise level calibration



----General----

Offline False
 Software Version 1.0.0.6
 Spec Deviations
 Comments

----Instruments----

Calibrated Instrument 1 Name: Keysight DSO ; Company: KEYSIGHT TECHN
 Calibrated Instrument
 Measurement Instrument 1 Name: APM3000E ; Company: Keysight ; Model: 1
 Measurement Instrument

----Noise----

Jitter peak to peak target 15 ns
 Noise frequency 2 MHz
 Noise Offset 0 V
 Noise modulation frequency 2 kHz
 Noise deviation 500 kHz
 Tolerance to target 10 %
 Start set noise amplitude 300 mV
 Noise Amplitude Step Size 50 mV

```
----Scope----
Number of UIs to validate calibration range 100 MUI
Scope Bandwidth 6.3 GHz
Time Base Scale of the scope 5 us
Number of UIs to acquire 100 MUI
```

Set Noise Amplitude [mV]	Measured Jitter Left [ns]	Measured Jitter Right [ns]	Measured Eye Width [ns]
300.000	14.875	14.875	28.687
316.667	14.937	14.938	28.125
350.000	15.250	15.250	28.812

Figure 4-2 Example result for Noise Signal Calibration

- **Set Noise Amplitude [mV]:** The set voltage amplitude output by the Keysight MXR noise generator.
- **Measured Jitter Left [ns]:** The peak jitter measured at the left-side crossing point of the eye diagram relative to the eye center.
- **Measured Jitter Right [ns]:** The peak jitter measured at the right-side crossing point of the eye diagram relative to the eye center.
- **Measured Eye Width [ns]:** The horizontal opening of the eye diagram.

5 Receiver Test

Overview	52
AE6930R Receiver Test Procedure	53

Overview

The test should be run with Device Node configured as 0.

The real-time oscilloscope is required for the test as the MXR is also used as a noise generator.

The specification requires the DUT to maintain a BER of less than 10^{-10} or a frame error rate of 10^{-7} for 125 octet frames under stress conditions.

NOTE

The device configuration is not automatic. You are required to implement the batch scripts or set the device manually with an appropriate tool.

Prerequisite Calibrations

Prerequisite calibrations can be found directly in the application (see [Required Calibration Data](#) for details).

AE6930R Parameters

AE6930R parameters for individual procedures that can be changed in Expert mode are displayed in the parameter grid (right pane) of the main window of the user interface when you select the corresponding entry in the procedure tree (left pane).

Details of AE6930R receiver test parameters for individual procedures can be found in [Table B-3](#).

Example Connection Diagrams

The exact connection diagram for a specific situation can be viewed by right-clicking the appropriate procedure in the procedure tree of the main window of the user interface and selecting **Show Connection....** See also [“Connection Diagrams”](#) on page 34.

AE6930R Receiver Test Procedure

Test 147.5.5.1 – Bit Error Rate Verification

802.3cg Subclause 147.5.5.1

Open Alliance 10BASE-T1S Physical Media Attachment Test Suite, Section 5.2.1

Availability

Noise Generator	Keysight MXR Oscilloscope
Pattern Generator	Keysight APM3000E Media Converter
Mode	Compliance, Expert

Purpose and Method

The purpose of this procedure is to verify that the DUT can maintain a bit error rate (BER) of less than 10^{-10} or a frame loss rate of less than 10^{-7} for 125-octet frames in the presence of a worst-case channel impairment.

For this test, the Keysight MXR oscilloscope is used as the external noise generator to inject a modulated sinusoidal noise source. Combined with a 10BASE-T1S ringing board, this setup mimics a worst-case multidrop configuration by introducing channel loss, ringing effects, and crosstalk noise conforming to the Eye Mask Criteria.

Configure the DUT to be the PLCA Coordinator (Node 0). Connect the DUT to the packet monitoring station through the calibrated worst-case channel emulation board. The AE6930R app will call the appropriate scripts to reset the DUT and read its error during the duration of the test. The duration of the BER test is the time taken to reach a specified confidence level of 95%.

Connection Diagram

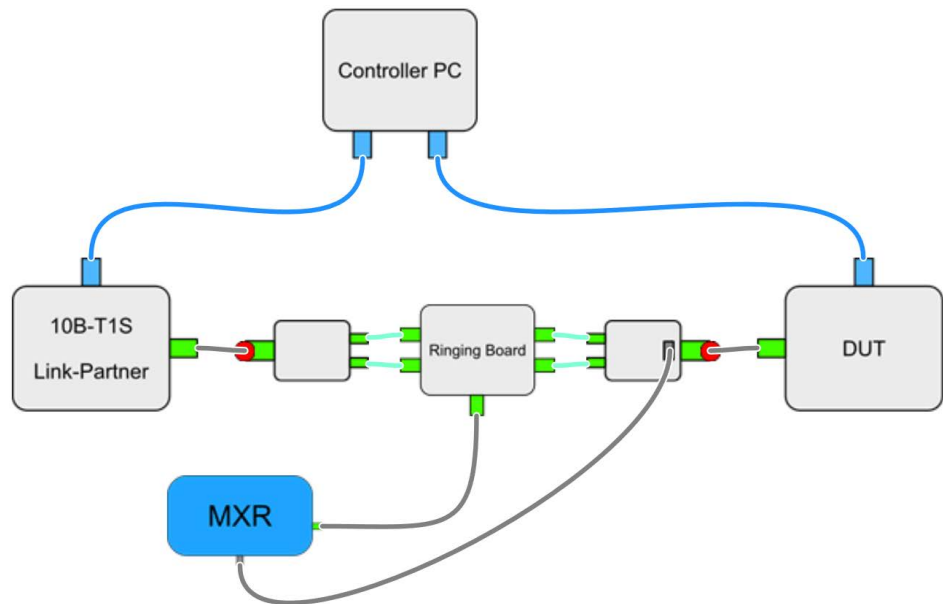


Figure 5-1 Example connection diagram for Test 147.5.5.1 – Bit Error Rate Verification

Result Description

BER Verification

Test 147.5.5.1 – Bit Error Rate Verification

```

----General----
Offline                               True
Software Version                      1.0.0.8
Spec Deviations
Comments
Target Frame Error Rate               1E-07
Confidence Level                      95 %
Number of Frames per Step             200000
Required Number of Frames to send    29957323
----Noise----
Noise Jitter peak-to-peak            15 ns

```

Result	Target Bit Error Rate	Target Frame Error Rate	Confidence Level [%]	Total sent frames []	Total sent bits []	Total received error bits []	Total received error frames []	BER measured on PHY	FER measured on PHY
pass	1E-10	1E-07	95.0	29957323	29957323000	0	0	<1.0E-10	<1.0E-7

Figure 5-2 Example result for Test 147.5.5.1 – Bit Error Rate Verification

- **Result:** (Pass/Fail) Pass if the bit error ratio (BER) was met; otherwise fail.
- **Target Bit Error Rate:** The maximum BER that is allowed for a pass.
- **Target Frame Error Rate:** The maximum frame error ratio (FER) that is allowed for a pass.
- **Confidence Level [%]:** The statistical confidence level to be achieved.
- **Total sent frames:** The total number of frames that were sent during the test.
- **Total sent bits:** The total number of bits that were sent during the test.
- **Total received error bits:** The total number of error bits that were received during the test.
- **Total received error frames:** The total number of error frames that were received during the test.
- **BER measured on PHY:** The actual BER calculated from the total sent bits and received error bits.
- **FER measured on PHY:** The actual frame error rate calculated from the total sent frames and received error frames.

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A Scripting Details

Scripting Details 58

Scripting Details

To run the Bit Error Rate test automatically, AE6930R controls the DUT by calling batch scripts. These scripts are called at special points of the test sequence. Each script has a specific name reported in the AE6930R Logging Window. Some scripts are used to set the DUT into a specific state (e.g., `Reset_DeviceSoft.bat`). Others are expected to return a value (e.g., `Read_ErrorCounter.bat`), which is read via the DUT's MAC-PHY control interface and register access protocol.

The scripts called for the Bit Error Rate Verification test are listed in [Table A-1](#).

Table A-1 Scripts for Bit Error Rate Verification test

Procedure	Script Method	
Bit Error Rate Verification test	- <code>Reset_DeviceSoft.bat</code>	Should reset the DUT and its error counter
	- <code>Read_ErrorCounter.bat</code>	Should read the DUT's error counter

B AE6930R Parameters

Overview	60
AE6930R Sequencer Parameters	61
AE6930R Parameters for Individual Procedures	62

Overview

The parameters used in the AE6930R app are divided here into:

- AE6930R sequencer parameters (Table B-1)
- AE6930R parameters for individual procedures
 - AE6930R parameters for individual calibrations (Table B-2)
 - AE6930R parameters for individual receiver tests (Table B-3)

NOTE

- If the value of a parameter appears in boldface type in the parameter grid of the GUI, this indicates that the value is not the default value.
 - If a parameter is read-only (gray) in the parameter grid, it can often be set when configuring the DUT.
-

AE6930R Sequencer Parameters

The parameter 'Repetitions' appears when you click a group node in the procedure tree, e.g., Calibrations, or an individual procedure. The other sequencer parameters are available only for individual procedures.

Table B-1 **AE6930R Sequencer Parameters**

Parameter Name	Description
Procedure Error Case Behavior	– “Proceed With Next Procedure”: If an error occurs in the test or calibration procedure, continue by running the next procedure in the sequence. – “Abort Sequence”: Abort further running of the sequence.
Procedure Failed Case Behavior	– “Proceed With Next Procedure”: If the test or calibration procedure fails, continue by running the next procedure in the sequence. – “Abort Sequence”: Abort further running of the sequence.
Repetitions	The number of times that the group or procedure will be repeated. If the value is '0', it runs only once.

AE6930R Parameters for Individual Procedures

AE6930R Parameters for Individual Calibrations

In this version of the AE6930R app, there is only one calibration procedure: Noise Level Calibration.

In the table, the parameters are listed alphabetically within each category.

Table B-2 AE6930R Parameters for Noise Level Calibration

Category / Parameter Name	Description/Procedures
No Category Name	
Offline	– If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. – If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid. It can be set during station configuration.
Software version	The version of the AE6930R software currently being used.
Noise	
Jitter peak-to-peak target	The desired peak-to-peak jitter level that the calibration aims to achieve. The procedure adjusts the noise amplitude until the measured jitter reaches this target value.
Noise amplitude step size	The increment in noise amplitude (voltage) between one calibration step and the next. Smaller steps provide finer resolution but require more iterations to reach the target.
Noise deviation	The frequency deviation of the frequency modulation on the noise signal. Larger values spread the noise power over a wider frequency range.
Noise frequency	The carrier frequency of the sinusoidal noise signal injected by the waveform generator.
Noise modulation frequency	The frequency of the frequency modulation applied to the noise signal. It is used together with the noise deviation to spread the noise energy across a wider bandwidth.
Noise offset	The DC offset applied to the noise waveform output.

Table B-2 AE6930R Parameters for Noise Level Calibration (cont.)

Category / Parameter Name	Description/Procedures
Start set noise amplitude	The initial noise amplitude used at the start of the calibration. Should be set low enough that the initial measured jitter is below the target value. The procedure increases amplitude in steps from this starting point.
Tolerance to target	The acceptable overshoot above the jitter target during the validation phase. For example, 10% tolerance with a 15 ns target accepts measured jitter up to 16.5 ns.
Scope	
Number of Uls to acquire	The number of unit intervals acquired by the oscilloscope for the final validation measurement. Higher values improve measurement accuracy but increase acquisition time.
Number of Uls to validate calibration range	The number of unit intervals acquired during each intermediate calibration step. Can be set lower than the final count to speed up the iterative search at the cost of some precision.
Scope bandwidth	The bandwidth setting of the oscilloscope. Controls the upper frequency limit of the captured signal.
Time base scale of the scope	The horizontal time scale of the oscilloscope display. Determines how much time is shown per division on screen.
Sequencer – See Table B-1.	

AE6930R Parameters for Individual Receiver Tests

In this version of the AE6930R app, there is only one BER Test procedure:
Test 147.5.5.1 – Bit Error Rate Verification.

In the table, the parameters are listed alphabetically within each category.

Table B-3 AE6930R Parameters for Test 147.5.5.1 – Bit Error Rate Verification

Category / Parameter Name	Description/Procedures
No Category Name	
Confidence level	The statistical confidence level for the BER measurement. A higher confidence level requires more bits to be transmitted to statistically prove that the DUT meets the target BER.
Number of frames per step	The number of Ethernet frames transmitted in each iteration step. The test runs in multiple steps to allow periodic progress updates and early termination if errors exceed the threshold.
Offline	– If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. – If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid. It can be set during station configuration.
Required number of frames to send	The total number of Ethernet frames (each 125 octets) to transmit to the DUT. Automatically recalculated when the confidence level or target BER changes.
Software version	The version of the AE6930R software currently being used.
Target frame error rate	The maximum acceptable frame error rate. This defines the pass/fail criterion for the DUT.
Noise	
Noise jitter peak-to-peak	The target jitter level used to look up the calibrated noise amplitude from the noise calibration table. This value should match the jitter target that was used during noise level calibration.
Sequencer – See Table B-1.	

C

Acronyms and Abbreviations

List of Acronyms 66

This Appendix contains a list of acronyms and abbreviations used in this User Guide.

List of Acronyms

Acronym	Definition
A	
AE	Automotive Ethernet
B	
BER	Bit Error Ratio
D	
DUT	Device Under Test
F	
FER	Frame Error Ratio
G	
GUI	Graphic User Interface
H	
HTML	HyperText Markup Language
I	
ITS	Interoperability Test Suite
L	
LAN	Local Area Network
M	
MAC	Media Access Control
MDI	Medium-Dependent Interface
MXR	Keysight MXR Series Oscilloscope and Signal Generator
O	
OPEN	One-Pair Ether-Net
P	
PC	Personal Computer

Acronym	Definition
PHY	Physical Layer (or device that implements layer 1 thereof)
PLCA	PHY-Level Collision Avoidance
PMA	Physical Media Attachment
R	
RMS	Root Mean Squared
Rx	Receiver
S	
SNR	Signal-to-Noise Ratio
SW	Software
U	
USB	Universal Serial Bus
V	
.vfc	ValiFrame Configuration (file extension)
.vfp	ValiFrame Project (file extension)
VISA	Virtual Instrument System Architecture

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