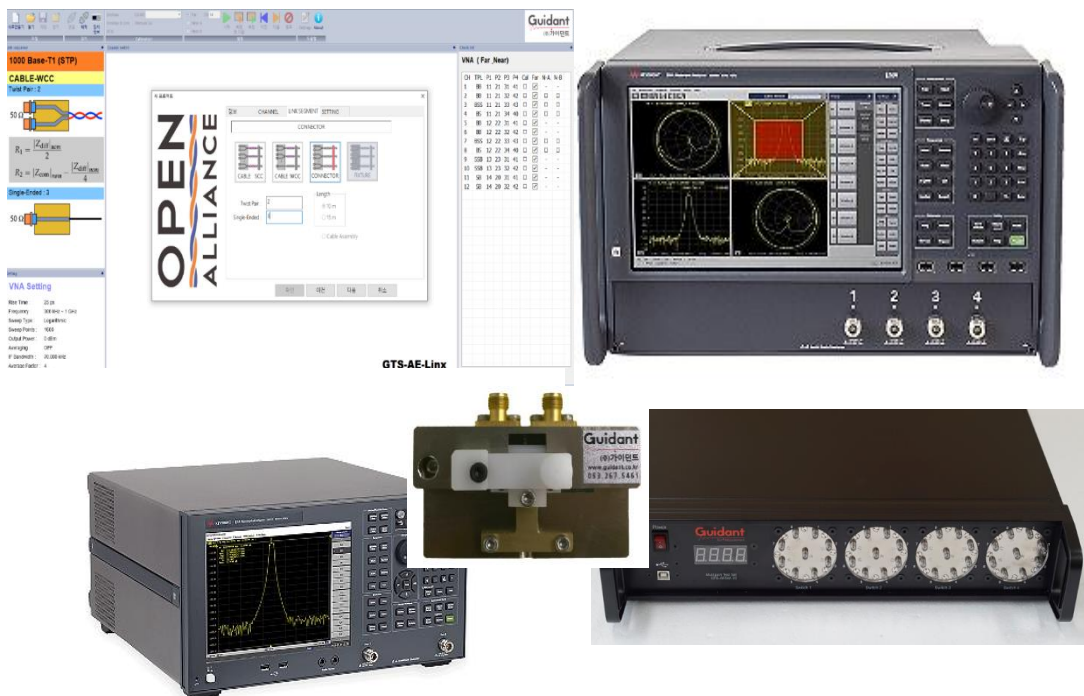


# Automotive Ethernet Channel Test Solution

Harness, connector, cable testing for Automotive Ethernet devices



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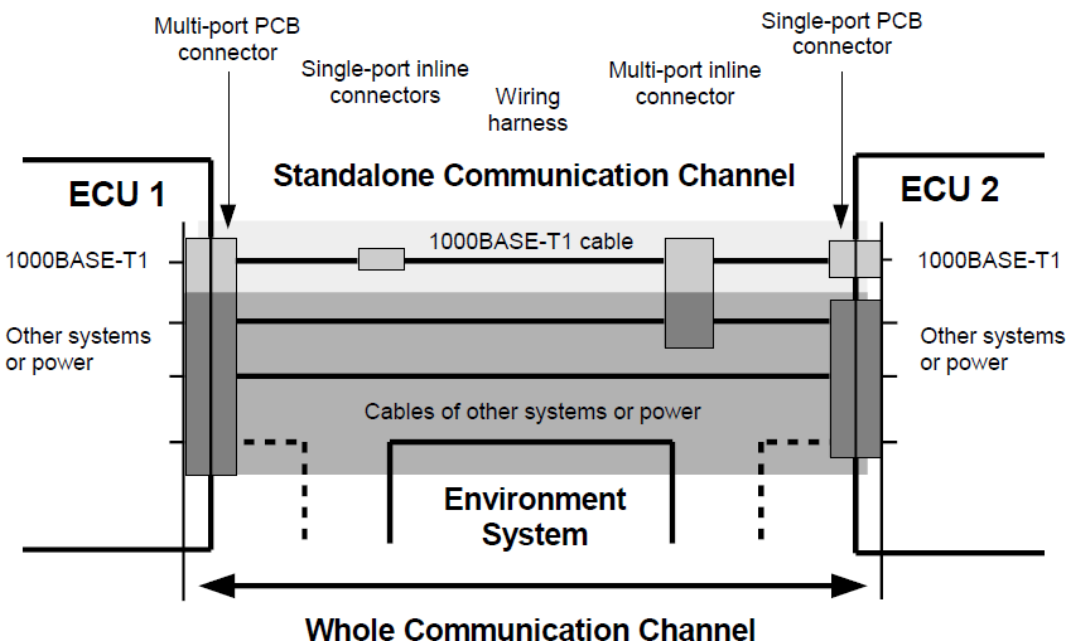
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## Introduction

Next-generation ADAS systems require camera and radar systems with increasingly high resolution. That means new requirements for speed and bandwidth. Automotive Ethernet enables faster data communication to meet the demands of today's vehicles and the connected vehicles of the future.

Unlike other serial technology in the car, CAN, LIN or MOST, Automotive Ethernet demands rigorous compliance verification. The requirements include complex measurements that, until recently, have been uncommon in the auto industry: vector network analysis measuring and monitoring cross talk, insertion loss, mode conversion between all and any cables bundled together in an Automotive Ethernet network. The channel or link in any system can create a point of failure and as such must be fully tested.

To help you save time and effort, Guidant offers solutions that automate the testing and validation of Automotive Ethernet designs. These proven applications help ensure proper test configuration and valid, repeatable measurement results. The net result: you'll have greater confidence that your device is compliant with the IEEE standard, a faster development cycle, repeatability of testing and less human error.



## Harness and connector validation

The GTS-AE-LinX Automotive Ethernet channel test solution provides an easy and accurate way to verify and debug automotive Ethernet harness assemblies, cables and connectors. The channel in this case represents the complete wired connection between two transmit/receive modules with an automotive Ethernet interface using a two-wire twisted pair cable. The GTS-AE-LinX automotive Ethernet channel test solution verifies that information is carried, without loss or cross talk, to its intended destination. Performing these tests is not only required but will give you confidence in your design/s. The Guidant GTS-AE-LinX link segment solution will save you hours of valuable time with configuration, instrument setup, calculations and report generation.

## Link Segment = Cabling + Inline Connectors + Mating Connectors

The Connector type is not standardized and will be specific to each connector vendor. Using the Guidant GTS-AE-LinX channel test solution greatly simplifies automotive Ethernet harness and connector testing.

## Open Alliance Specifications

The GTS-AE-LinX Automotive Ethernet channel test software covers the following specifications.

### TC9 STP

Open Alliance Channel and Components Requirements for 1000BASE-T1 Link Segment Type A

Section	Description	Test parameter and related S-parameter	Related S-parameter
4.2-3	VNA calibration accuracy requirements	Return Loss LCL (Mode Conversion) LCTL (Mode Conversion)	$S_{dd11}$ , $S_{dd22}$ $S_{dc11}$ , $S_{dc22}$ $S_{dc21}$ , $S_{dc12}$
4.4.3-1	Fixture balance requirements	LCL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$
6.1.1	Electrical limits for connectors	CIDM	$Z_{RF}$
		Propagation Delay	$t_d$
		Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
		LCL/LCTL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$ $S_{dc21}$ , $S_{dc12}$
6.1.2	Electrical limits for cables	CIDM	$Z_{RF}$
		Propagation Delay	$t_d$
		Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
		LCL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$
		LCTL (Mode Conversion)	$S_{dc21}$ , $S_{dc12}$
6.1.3	Electrical limits for cable assemblies in context of standalone communication channel without the coupling parameters to neighbor wires	Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
		LCL/LCTL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$ $S_{dc21}$ , $S_{dc12}$
6.1.4	Electrical limits for whole communication channel in context of standalone communication channel without the coupling parameters to neighbor wires	CIDM	$Z_{RF}$
		Propagation Delay	$t_d$
		Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
		LCL/LCTL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$ $S_{dc21}$ , $S_{dc12}$
6.2	Power sum cross talk	PSANEXT Loss	$S_{dd31}$ , $S_{ddy x}$
		PSAFEXT Loss	$S_{dd41}$ , $S_{ddy x}$

Table 1. TC9 STP specifications

## TC9 UTP

TC9 UTP specifications Open Alliance Channel and Components Requirements for 1000BASE-T1 Link Segment Type A

Section	Description	Test parameter and related S-parameter	Related S-parameter
4.2-2	VNA calibration accuracy requirements	Return Loss LCL (Mode Conversion) LCTL (Mode Conversion)	$S_{dd11}$ , $S_{dd22}$ $S_{dc11}$ , $S_{dc22}$ $S_{dc21}$ , $S_{dc12}$
4.4.3-1	Fixture balance requirements	LCL (Mode Conversion)	$S_{dc11}$
6.1.1	Electrical limits for connectors	CIDM	$Z_{RF}$
		Propagation Delay	$t_d$
		Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
		LCL/LCTL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$ $S_{dc21}$ , $S_{dc12}$
6.1.2	Electrical limits for cables	CIDM	$Z_{RF}$
		Propagation Delay	$t_d$
		Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
		LCL (Mode Conversion)	$S_{dc11}$ , $S_{dc22}$
6.1.3	Electrical limits for whole communication channel in context of standalone communication channel without the coupling parameters to neighboring wires	LCTL (Mode Conversion)	$S_{dc21}$ , $S_{dc12}$
		CIDM	$Z_{RF}$
		Propagation Delay	$t_d$
		Insertion Loss	$S_{dd21}$
		Return Loss	$S_{dd11}$ , $S_{dd22}$
6.2.1	Power sum cross talk Required for multi-pair connectors	PSANEXT Loss	$S_{dd31}$ , $S_{ddy x}$
		PSAFEXT Loss	$S_{dd41}$ , $S_{ddy x}$
6.2.3	Power sum cross talk Required for cable harnesses in the whole communication channel	PSANEXT Loss	$S_{dd31}$ , $S_{ddy x}$
		PSAFEXT Loss	$S_{dd41}$ , $S_{ddy x}$

Table 2. TC9 UTP specifications

## Save Time and take advantage of VNA automation

The GTS-AE-LinX channel test software saves you time by setting the stage for automatic execution of required cable, connector and harness tests. Some of the difficulties in performing these tests include properly understanding the specification, configuring/ running the instrument/s and then analyzing the measured results by comparing them to limits published in the specification. The GTS-AE-LinX channel test software does much of this work for you.

The GTS-AE-LinX channel test software is installed directly onto a vector network analyzer or the PC that is controlling the network analyzer. The GTS-AE-LinX software automatically configures the VNA for the test and provides an informative results report that includes insertion loss, crosstalk, mode conversion among others along with a pass/fail limit. See Table 1 and Table 2 for a list of the measurements and specifications tested in the GTS-AE-LinX.

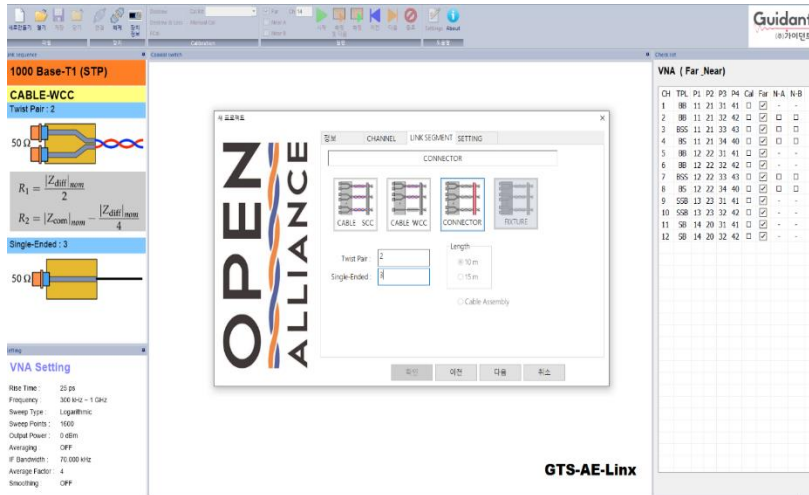
The test specifications software offers several features to simplify the validation of automotive Ethernet designs:

The GTS-AE-LinX Software:

- Enables selection of which standard to test.
- Automatically detects the number of available ports.
- Creates a test plan for those lanes selected with all the required tests.
- Test plan created will include all the required tests for specification selected.
- Automatically sets up the network analyzer for each measurement and applied the limit lines.
- Expandable to cover proprietary limits as well as quickly adapt to new standards.
- Provides detailed information of each test that has been run.
- Creates a printable PDF report of the tests that have been run.

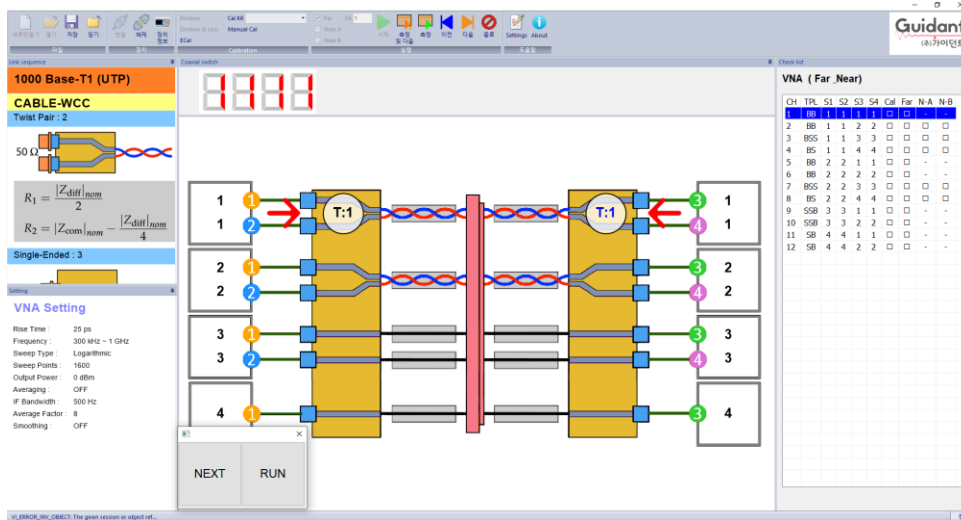
## Test Selection

The test automation software platform lets you select which standard you would like to test to with a pull-down menu. Once selected all the relevant and correct tests and limits will be selected.



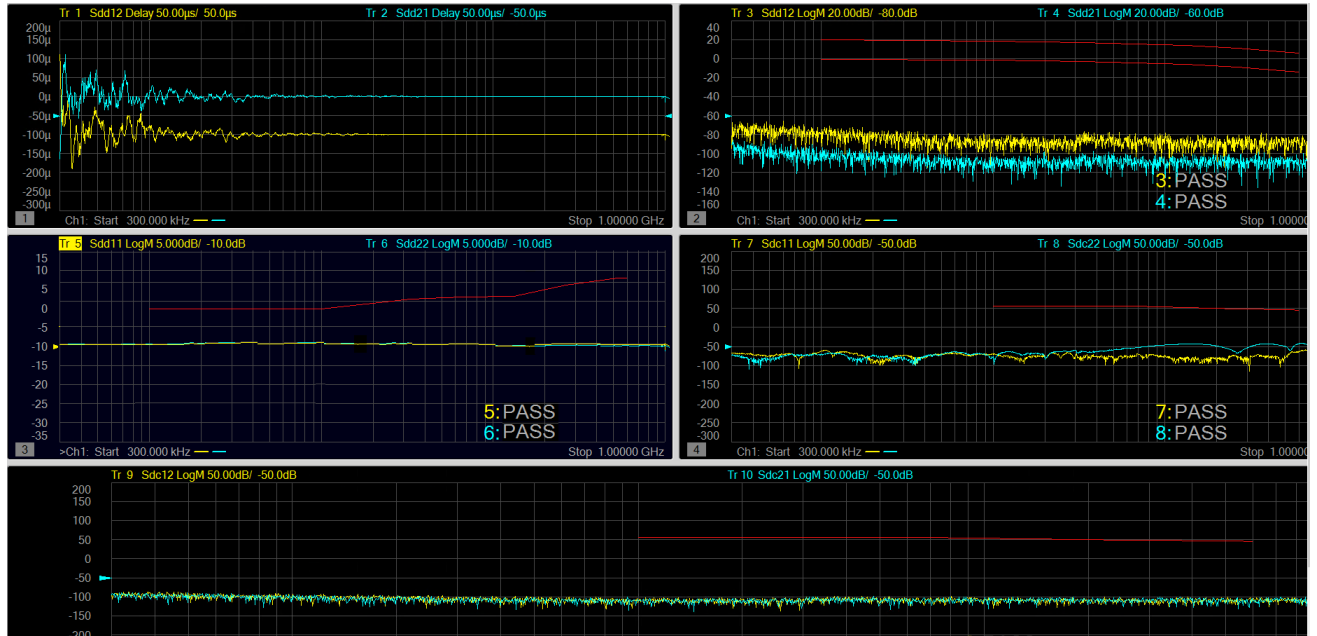
## Expandable

The software is expandable to the number of ports used. For example, a 3-cable bundle will need 4 ports for each cable, measuring each differential end, so a 3-cable example uses 12 lanes.



## Test Report

In addition to giving you measurement results, the GTS-AE-LinX Automotive Ethernet Link test Software also provides a report format that shows you if your product passes or fails. The test automation software platform provides test results in excel at C:\Temp\glink folder. The GTS-AE-LinX displays and updates all the results on-line. After stopping or pausing the test, you can access any result for analysis at your convenience.

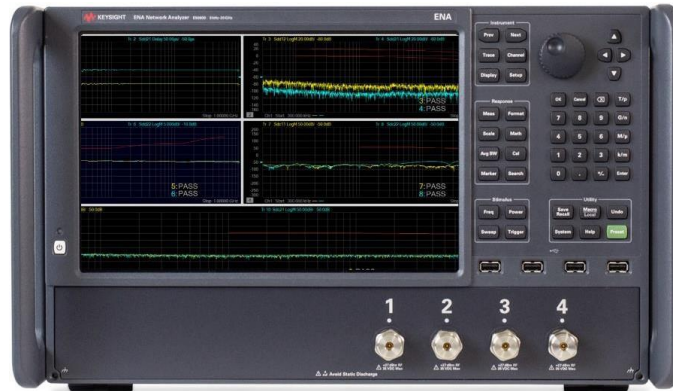




## Requirements: Instruments & Accessories

### Instruments

The GTS-AE-LinX software runs on a separate computer and controls the instruments. The primary hardware on which the solution is built can be any of the following 2 different VNA options and Multiport Test Set



E5080B 4-port 9 kHz to 20 GHz VNA



E5071C 4-port 300kHz to 20 GHz VNA



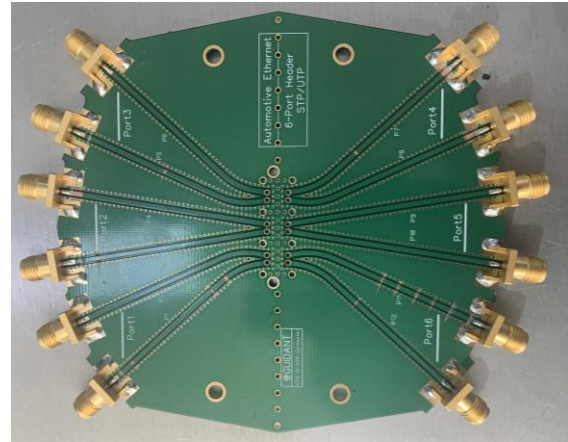
GTS-AWSW-xx

## Accessories

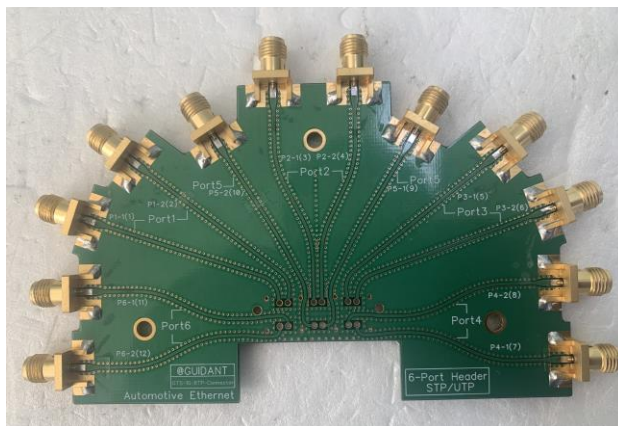
Fixtures are sold help convert SMA to some of the more standard interfaces for Automotive Ethernet.



GTS-1G-PCB-01



GTS-1G-PCB-180.



GTS-1G-PCB-90



GTS-1G-TP-R

## Ordering Information

E5080B: Keysight ENA Network Analyzer( 9KHz to 20GHz,TDR Option)

OR E5071C:Keysight ENA Network Analyzer( 200KHz to 20GHz,TDR Option)

N4433D: Ecal Module (4-port 26.5GHz and 0DC)

GTS-AWSW-xx: Multiport Test Set (xx=24,32,40 available)

GTS-AE-Linx: Automated Software for Automotive Ethernet Link Segment

100BASE T-1/1000BASE T-1(UTP/STP)

Opt 010: Automotive Ethernet Link Segment for E5071C

Opt 020: Automotive Ethernet Link Segment for E5080B

Opt 030: Automotive Ethernet Link Segment for E5071C & GTS-AESW-032 Multiport Test set

GTS-AE-S1000: Group Phase matching Cable,1000mm

GTS-AE-S300: Group Phase matching Cable,300mm

GTS-1G-TP-R: Ethernet Twist Pair Connecting Fixture( up to 1Gbps)

GTS-1G-PCB-01: Customized Automotive Ethernet 1-port PCB Fixture(up to 1Gbps)

GTS-1G-PCB-90: Customized Automotive Ethernet 6-port PCB 90 degree Fixture(up to 1Gbps)

GTS-1G-PCB-180: Customized Automotive Ethernet 6-port PCB 180 degree Fixture(up to 1Gbps)

GTS-100M-PCB-90: Customized Automotive Ethernet 6-port PCB 90 degree Fixture(up to 100Mbps)

GTS-100M-PCB-180:Customized Automotive Ethernet 6-port PCB 180 degree Fixture(up to 100Mbps)

## Conclusion

Learning or remembering how to use a VNA can be frustrating and take a lot of time. With the GTS-AE-LinX, Guidant has done much of the work for you for Automotive Ethernet test solution. And the software can be used with 2 different platforms of VNA and multiport test set depending on what kind of a cable, bundle of cables, connectors or harness assemblies you are testing.

Guidant's GTS-AE-LinX automotive Ethernet software ensures signal quality requirements with OPEN Alliance test for the channel

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