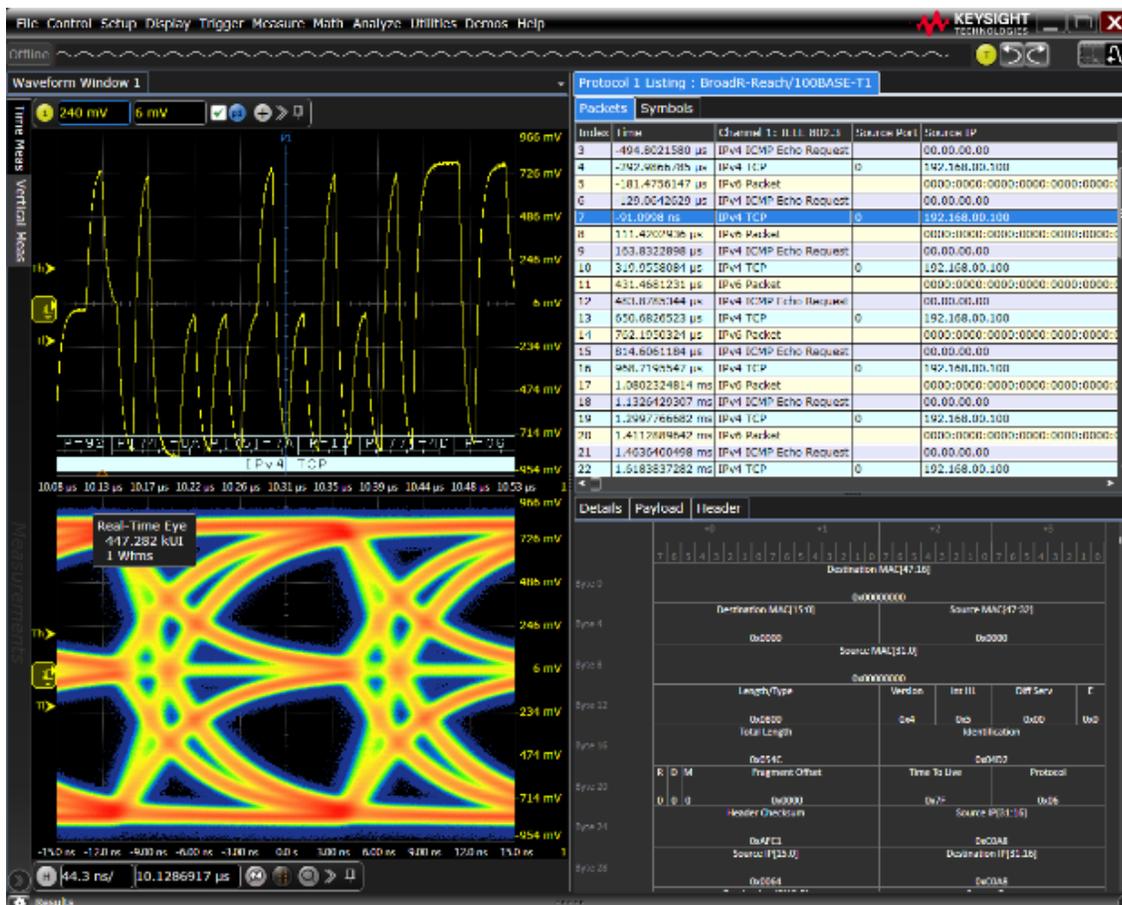


Automotive Ethernet Triggering and Decode

100BASE-T1 Protocol Trigger and Decode for Infiniium Oscilloscopes



Easily Debug and Test Designs That Include Automotive Ethernet or 100BASE-T1 Protocols Using Your Infiniium Oscilloscope

The Keysight AE6910T Automotive Ethernet protocol triggering and decode software provides you with an easy and accurate way to verify and debug your 100BASE-T1 designs.

Automotive Ethernet enables faster data communication to meet the demands of today's vehicles and the connected vehicles of the future. Expertise with low-speed buses is less relevant than you may expect. Unlike with CAN or LIN, you can't glance at a few bits on the screen of an oscilloscope and quickly understand what's happening on the bus. Protocol decoding enables you to correlate a packet error back to the physical bus. Keysight's full suite of automotive Ethernet solutions automate testing and validation across Tx, Rx and link segment for 100 Mb/s and 1000 Mb/s automotive Ethernet.

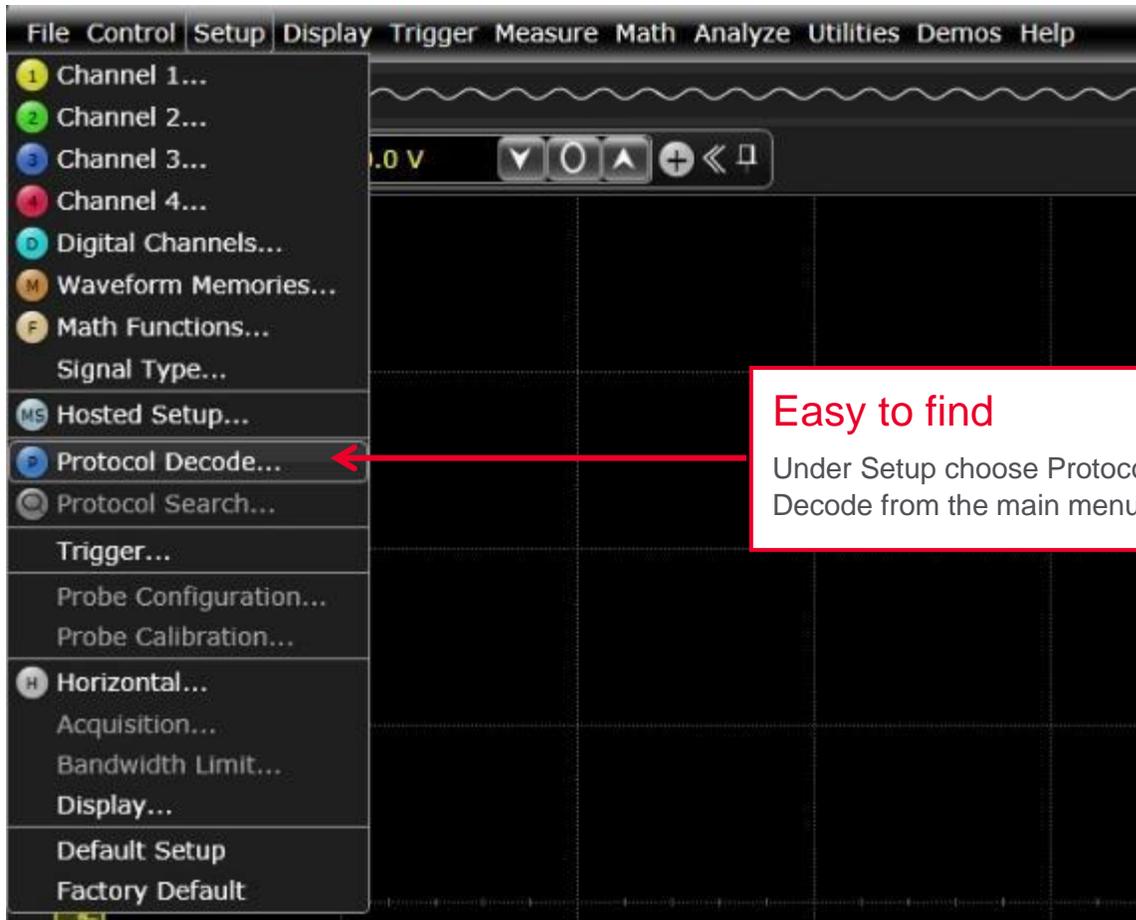
Automotive Ethernet and 100BASE-T1 buses are widely used today in automotive designs. In many designs, these buses tend to provide content-rich points for debug and test. The AE6910T Automotive Ethernet protocol triggering and decode software enables you to :

- Set up your scope to show Automotive Ethernet protocol decode in less than 30 seconds
- Get access to a rich set of integrated protocol-level triggers
- Save time and eliminate errors by viewing packets at the protocol level
- Use time-correlated views to quickly troubleshoot protocol problems back to their timing or signal integrity root cause.

The AE6910T Automotive Ethernet protocol triggering and decode software includes a suite of configurable protocol-level trigger conditions specific to Automotive Ethernet. It enables you to save time and eliminate errors by viewing packets at the protocol level.

Decoding at the protocol layer enables you to map errors back to the physical bus, giving you more confidence in your design. The AE6910T software helps you debug quickly to get to the root cause and get back to testing the rest of your components.

The software is installed and runs on a Keysight Infiniium oscilloscope. There are a variety of license types and terms available. Please see ordering instructions for more information.



Easy to find

Under Setup choose Protocol Decode from the main menu.



30-second BroadR-Reach trigger setup

Configure your oscilloscope to display protocol decode in under 30 seconds. Use *Auto Setup* to automatically configure sample rate, memory depth and threshold and trigger levels.

Automotive Ethernet Protocol Triggering and Searching

Get access to a rich set of integrated protocol-level triggers. The application includes a suite of configurable protocol-level trigger conditions specific to Automotive Ethernet. When protocol triggering is selected, the application enables special real-time triggering hardware inside the scope. Hardware-based triggering ensures that the scope never misses a trigger event when armed. It then inspects these protocol frames against specified protocol-level trigger conditions and triggers when the conditions are met. Hardware-based triggering for Automotive Ethernet is available on Infiniium S-Series.

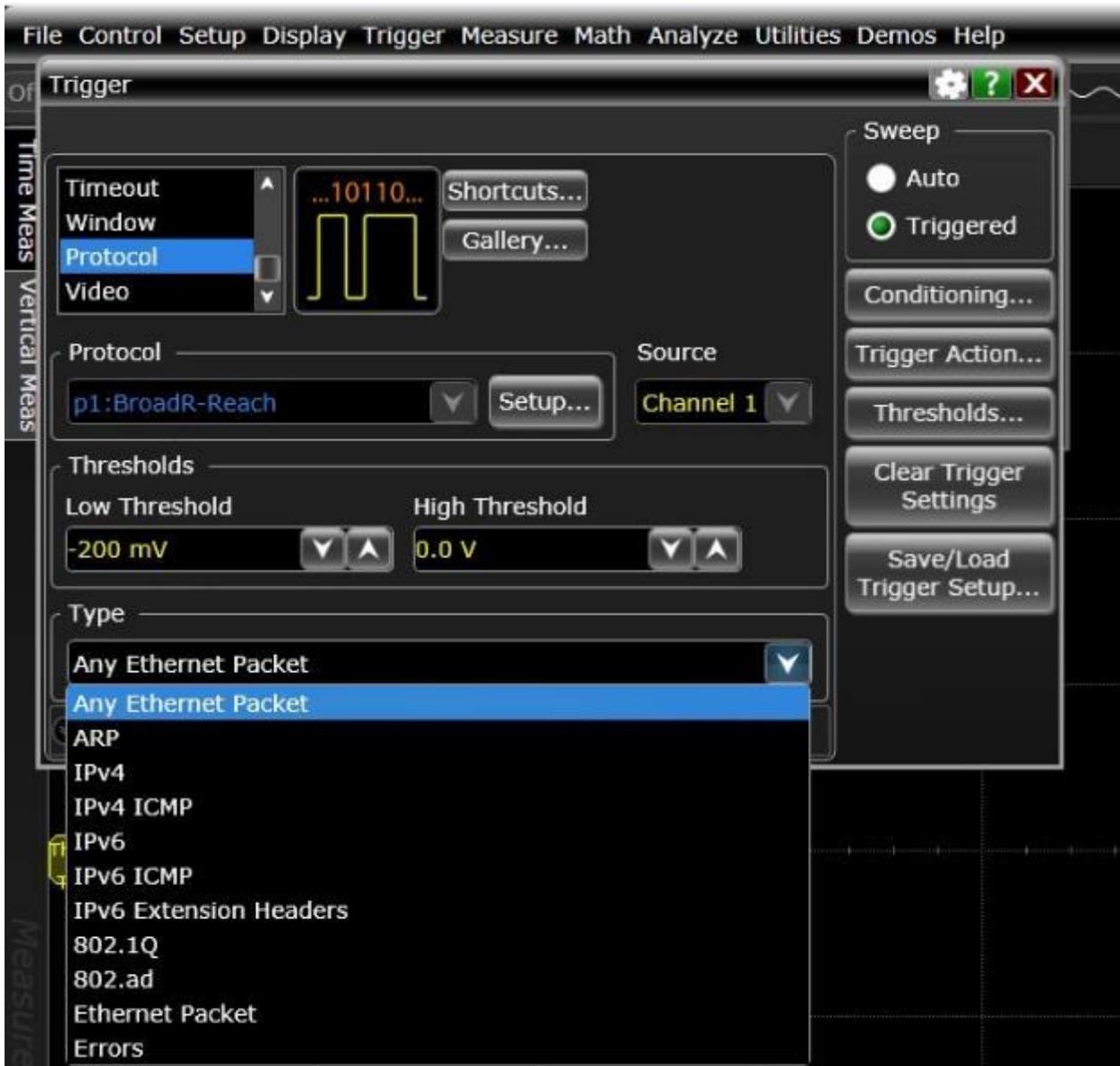
Trigger setup

Keysight's AE6910T Automotive Ethernet triggering supports the following trigger options:

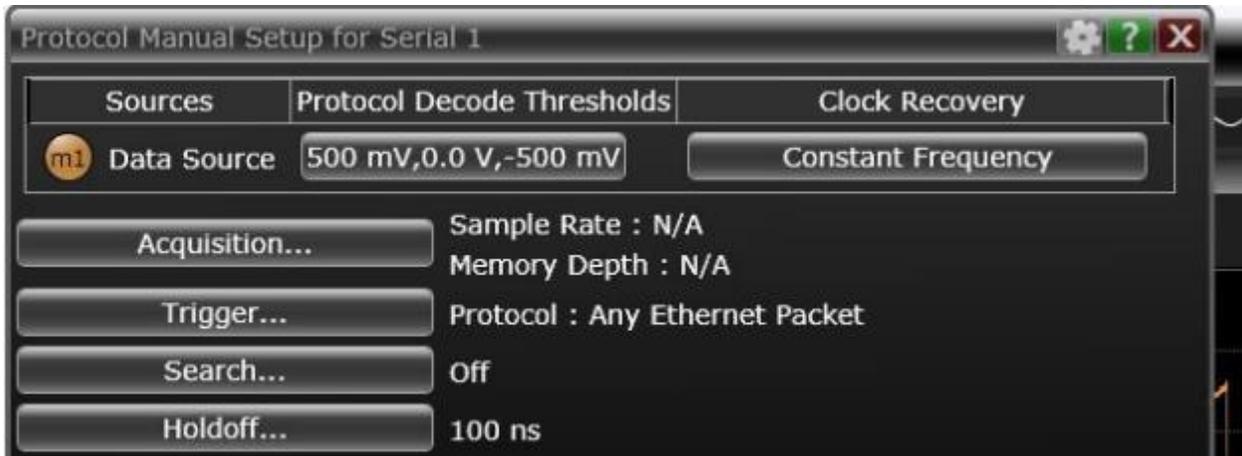
Trigger	Description
Any Ethernet packet	Triggers on any ethernet packet
ARP	Triggers for ARP frames . the user can select following fields for further refining the search: <ul style="list-style-type: none">• Destination MAC• Source MAC• Hardware Type• Protocol Type• Hardware Length• Protocol Length• Operation• Sender MAC Address• Sender IP Address• Target MAC Address• Target IP Address• Payload
IPv4	Triggers on the following <ul style="list-style-type: none">• Any IPv4 packet• IPV4 TCP• IPV4 UDP• IPV4 Packet The fields within the packets can also be set with a defined value for refined search
IPv4 ICMP	Triggers on different types of IPv4 ICMP (Internet Control Message protocol) types and their fields
IPv6	Triggers on the following

	<ul style="list-style-type: none"> • Any IPv6 packet • IPV6 TCP • IPV6 UDP • IPV6 Packet <p>The fields within the packets can also be set with a defined value for refined search</p>
IPv6 ICMP	Triggers on different types of IPv6 ICMP (Internet Control Message protocol) types and their fields
IPv6 Extension Headers	Triggers on different types of IPv6 Extension Header types and their fields
802.1Q	<p>Triggers on 802.1Q frames . the user can select following fields for further refining the search:</p> <ul style="list-style-type: none"> • Destination MAC • Source MAC • Priority Code Point(PCP) • Drop Eligible Indicator(DEI) • VLAN Identifier(VID) • TPID • Payload
802.ad	<p>Triggers on 802.ad frames . the user can select following fields for further refining the search:</p> <ul style="list-style-type: none"> • Destination MAC • Source MAC • Priority Code Point(PCP Outer) • Drop Eligible Indicator(DEI Outer) • VLAN Identifier(VID Outer) • TPID (Outer) • Priority Code Point(PCP Inner) • Drop Eligible Indicator(DEI Inner) • VLAN Identifier(VID Inner) • TPID (Inner) • Payload
Ethernet packet	<p>Triggers on the following fields of an Ethernet packet</p> <ul style="list-style-type: none"> • Destination MAC • Source MAC • Length/Type

	<ul style="list-style-type: none"> • Payload
Symbol Sequence	Triggers when specified symbol sequence matches
Errors	<p>Triggers if following errors are detected:</p> <ul style="list-style-type: none"> • Bad FCS CRC • Bad IPv4 or TCP or ICMP or UDP Checksum • Bad Ethernet Payload Length > 1500 bytes • Any of the above errors



Example of triggering options



Manual setup

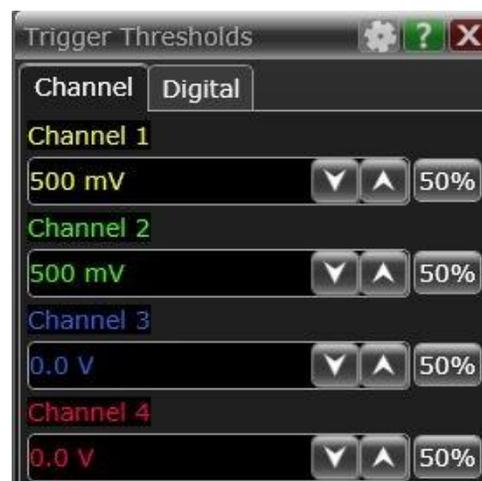
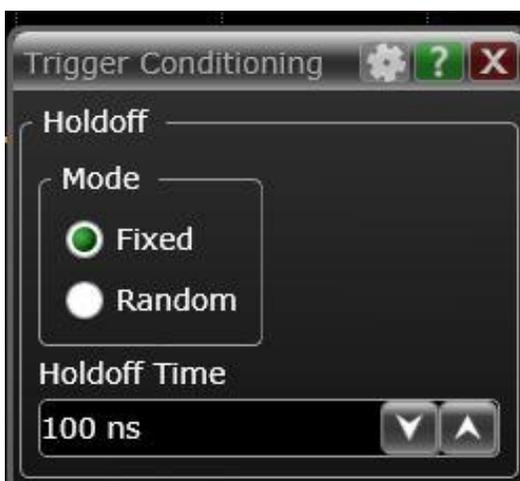
Choose to automate the trigger and decode setup or use the manual setup option. Manual setup enables you to set the Protocol decode and trigger thresholds, acquisition sample rate and depth, and clock recovery method.

Holdoff mode and time

The Holdoff Time control sets the amount of time that the oscilloscope waits before re-arming the trigger circuitry. With a fixed mode as an example, if you have a burst of pulses and want to trigger on the first pulse in the burst, you can set the holdoff time to be slightly longer than the burst width.

Trigger thresholds

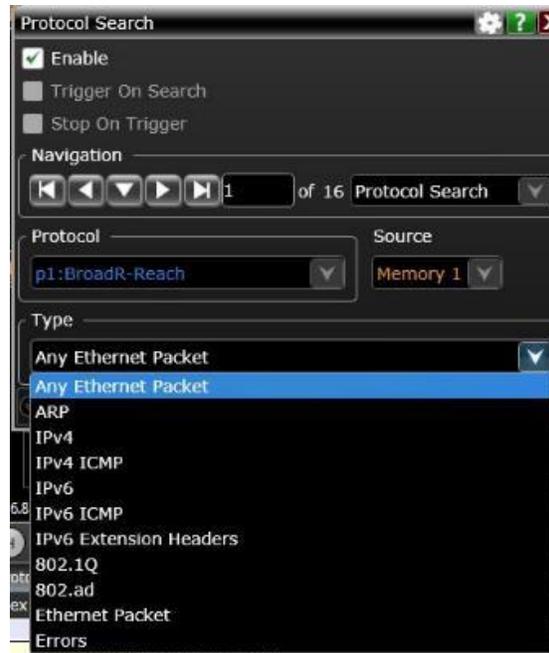
Set specific thresholds for your system and the signals you are looking for.



Post-acquisition searching

When data is being captured and decoded, you can search the decoded data for any Ethernet packet, selected packets, or errors. The software-based packet's "Trigger On Search" causes an automatic decode after each hardware trigger (acquisition). If the packet search specification is found in the captured data, the data is displayed; otherwise, the data is not displayed.

Then, another run (acquisition) is initiated, and the process repeats. If "Stop On Trigger" is also enabled, the first time the packet search specification is found, the oscilloscope stops capturing data and does not initiate another run.



Automotive Ethernet Protocol Decode

Blue row in the packet listing is time correlated to the tracking marker in waveform.

Protocol window

Symbols

Index	Time	Memory 1: IEEE 802.3	Source Port	Source
1	-486.5510480 μs	IPv4 UDP	59273	BC-30-
2	-466.4904662 μs	ARP		98-4B-E
3	-459.6513851 μs	IPv4 ICMP Address Mask Reply		98-4B-E
4	-450.8048959 μs	IPv6 TCP	SMTP	54-75-0
5	-439.8618302 μs	IPv6 UDP	DHCPv6 Client	B4-B5-0
6	-422.2884888 μs	IPv6 ICMP FMIPv6 Messages		C2-00-0
7	-409.1224290 μs	IPv6 Authentication Header (EH)		00-30-0
8	-389.8431347 μs	IPv4 TCP	61303	00-08-0
9	-380.9965015 μs	IPv4 UDP	59273	BC-30-
10	-362.9420914 μs	ARP		98-4B-E
11	-354.0969799 μs	IPv4 ICMP Address Mask Reply		98-4B-E
12	-345.2520277 μs	IPv6 TCP	SMTP	54-75-0
13	-334.3053277 μs	IPv6 UDP	DHCPv6 Client	B4-B5-0

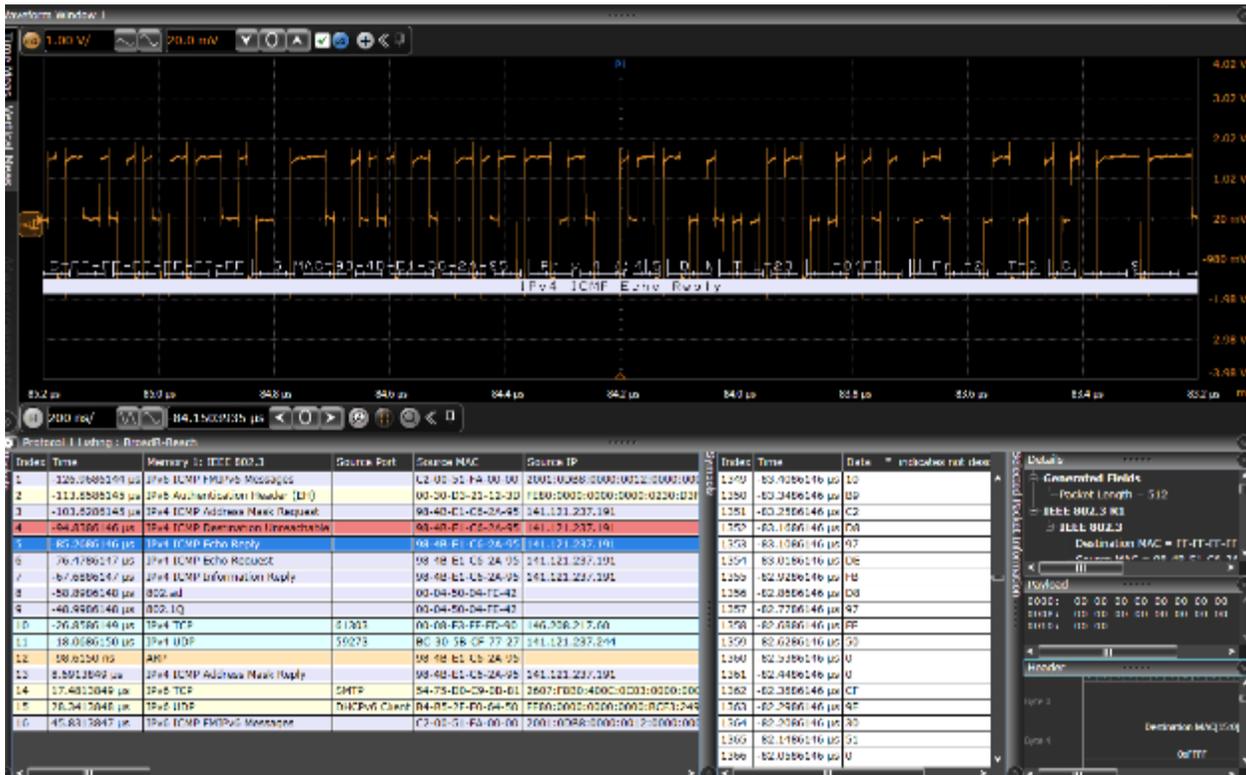
Automotive Ethernet decode with precise time-correlation between waveforms and listings

The Keysight Automotive Ethernet protocol viewer includes correlation between the waveforms and the selected packet. The selected packet, which appears as a highlighted blue row in the listing, is time-correlated with the blue line in the waveform display. Move the blue tracking marker in time through waveforms and the blue bar will automatically track in the packets window. Or, scroll through the packet viewer and highlight a specific packet. The time-correlation tracking marker will move to the associated point in the waveform.



Decode embedded in waveform area

Utilize the oscilloscope waveform area to display decode information. For Automotive Ethernet, minor ticks indicate clock transitions and major ticks show the beginning and end of each word in the serial packet.

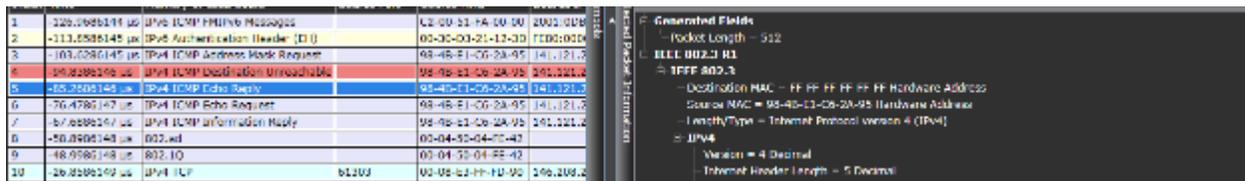


Protocol listing window

Quickly move between physical and I2C protocol layer information using the time correlated tracing marker. Display protocol content using embedded decode in the waveform area, or, see protocol events in a compact listing format using the industry's first scope-based multi-tab protocol viewer. The entries in the Packets listing are color-coded with the waveform so you can easily see which sections of the protocol decode correspond to which packet. This is also convenient when you zoom out because you can easily match the color code even when you are not zoomed in enough to see the decode listings in the display. There can be up to five areas (or panes) within the Protocol Listing window: packets, symbols, details, payload, and header.



Display as many protocol packets as you want to see. The protocol viewer shows index number, time stamp, and data content for each serial packet. Listing content can be saved to a .csv or .txt file for off-line analysis or documentation. Use search capability to quickly navigate through an acquisition.



Details tab breaks the packets into easy-to-read text fields.

Index	Time	Memory 1: IEEE 802.3	Source Port	Source MAC	Source
1	-126.9686144 µs	IPv6 ICMP FMIPv6 Messages		C2-00-51-FA-00-00	200
2	-113.8586145 µs	IPv6 Authentication Header (AH)		00-30-D3-21-12-3D	FE8
3	-103.6286145 µs	IPv4 ICMP Address Mask Request		98-4B-E1-C6-2A-95	141
4	-94.8386146 µs	IPv4 ICMP Destination Unreachable		98-4B-E1-C6-2A-95	141
5	-85.2686146 µs	IPv4 ICMP Echo Reply		98-4B-E1-C6-2A-95	141
6	-76.4786147 µs	IPv4 ICMP Echo Request		98-4B-E1-C6-2A-95	141
7	-67.6886147 µs	IPv4 ICMP Information Reply		98-4B-E1-C6-2A-95	141
8	-58.8986148 µs	802.ad		00-04-50-04-FE-42	
9	-48.9986148 µs	802.1Q		00-04-50-04-FE-42	

Payload tab shows data carried by the packet in byte-by-byte.

Byte	Hex	ASCII	Field
0-15	0xFFFFFFFF		Destination MAC[15:0]
16-21	0x984B...		Source MAC[47:32]
22-23	0x00000000		Length/Type
24-25	0x00000000		Version
26-27	0x00000000		Int. HL
28-29	0x00000000		Diff. Serv
30-31	0x00000000		E
32-33	0x00000000		Total Length
34-35	0x00000000		Identification
36-37	0x00000000		Fragment Offset
38-39	0x00000000		Time to Live
40-41	0x00000000		Protocol
42-43	0x00000000		Header Checksum
44-45	0x00000000		Source IP[31:16]
46-47	0x00000000		Destination IP[31:16]
48-49	0x00000000		Destination IP[15:0]
50-51	0x00000000		Type
52-53	0x00000000		Code
54-55	0x00000000		Checksum
56-57	0x00000000		Identifier
58-59	0x00000000		Sequence number
60-61	0x00000000		Payload[145:128]
62-63	0x00000000		Payload[127:96]
64-65	0x00000000		Payload[95:64]
66-67	0x00000000		Payload[63:32]
68-69	0x00000000		Payload[31:0]
70-71	0x00000000		FCF CRC

Header tab shows packets in a data book format. Hovering at any field reveals additional detail.

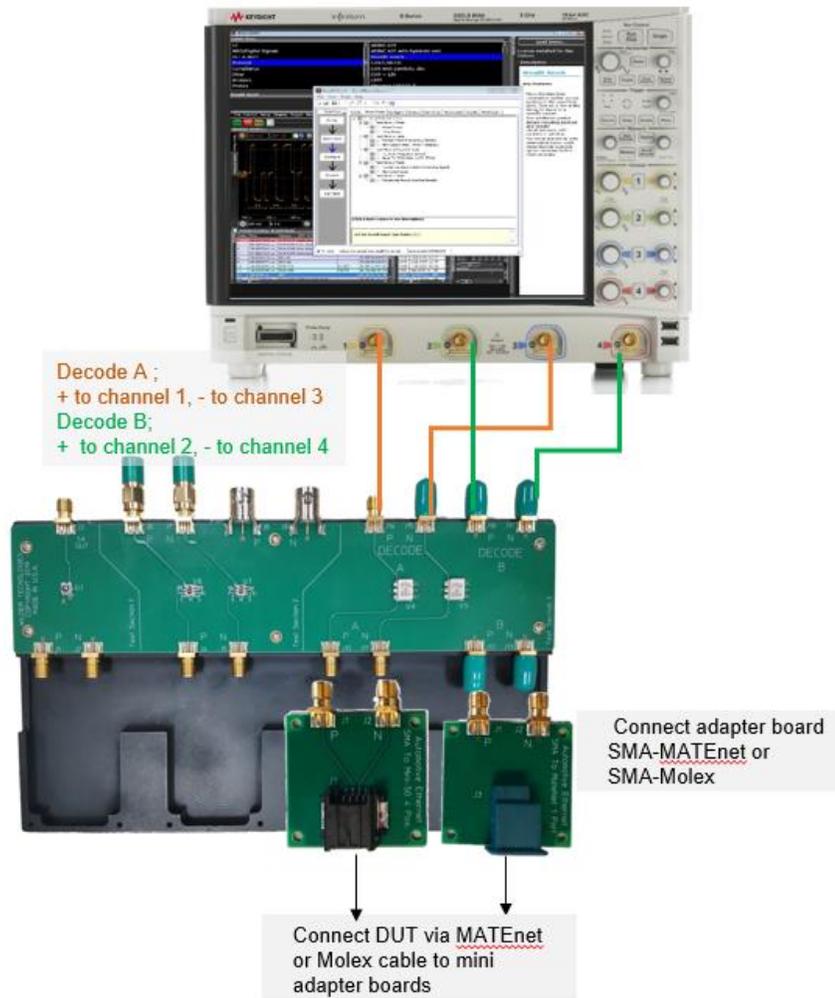
Automotive Ethernet Specifications and Characteristics

Automotive Ethernet source (clock and data)	Analog channels 1, 2, 3, or 4 Memory can also be used
Max clock/data rate	Any waveform memory up to 3.4 Mbps (automatic)
Auto setup	Automatically configures scope settings for proper Automotive Ethernet decode and protocol triggering

Triggering

- MAC destination addresses
- MAC source addresses
- MAC length/type
- ARP header
- IPv4 header/payload
- IPv6 header/payload
- UDP header
- TCP header/payload
- Frame check sequence – FCS
- Cyclic redundancy check - CRC
- Errors
- 802.1Q (VLAN)
- 802.AD

The Automotive Ethernet/100BASE-T1 protocol generates a full duplex connection using a differential pair of wires for data transmission. If your wire pair signal is transmitting in opposite directions simultaneously, it cannot be decoded. To separate the signals, you can use the AE6941A Automotive Ethernet test fixture. The set-up below shows how the test fixture is used in the test system.



Ordering Information

Recommended oscilloscopes

The protocol triggering and decode software is compatible with Keysight Infiniium Series oscilloscopes with operating software revision 6.10 or higher. For oscilloscopes with earlier revisions, free upgrade software is available here: www.keysight.com/find/scope-apps-sw

Standard	Data rate	Minimum bandwidth	Minimum channels	Oscilloscope models
802.3bw	100 Mb/s	1 GHz	2	Infiniium S-Series,

Recommended fixtures and cables

The recommended configuration would be to use SMA cables, adapters with the fixture boards from keysight. Differential probes may also be used and Please note that although only one probe and probe head are required it is recommended that you order two differential probes and probe heads – one of each direction of the signal.

Description	Keysight Model Number(s)	Comments
Fixture	AE6941A Automotive Ethernet test fixture	
Adapter fixtures	AE6942A SMA to Molex/Mini-50 adapter board AE6943A SMA to MATEnet adapter board	
SMA cables	AE6900T-104 (8121-3118)	Qty 4
SMA to BNC	AE6900T-102 (54855-67604)	Qty 4
Probe	113xA, 116xA or N275xA Series	Minimum 1.5 GHz bandwidth
Probe head	E2678A InfiniiMax socketed differential probe head E2677A InfiniiMax solder-in differential probe head N5381A InfiniiMax solder-in differential probe head E2669A InfiniiMax connectivity kit for differential and single-ended measurements ^[1]	

1. An alternative to purchasing the E2677A and E2678A is the E2669A, which contains one E2575A differential browser probe head, four E2677A solder-in differential probe heads, and two E2678A socketed differential probe heads.

Flexible Software Licensing and KeysightCare Software Support Subscriptions

Keysight offers a variety of flexible licensing options to fit your needs and budget. Choose your license term, license type, and KeysightCare software support subscription.

License Terms

Perpetual – Perpetual licenses can be used indefinitely.

Time-based – Time-based licenses can be used through the term of the license only (6, 12, 24, or 36 months).

License Types

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

Transportable – License can be used on one instrument/computer at a time but may be transferred to another using Keysight Software Manager (internet connection required).

USB Portable – License can be used on one instrument/computer at a time but may be transferred to another using a certified USB dongle (available for additional purchase with Keysight part number E8900-D10).

Floating (single site) – Networked instruments/computers can access a license from a server one at a time. Multiple licenses can be purchased for concurrent usage.

KeysightCare Software Support Subscriptions

Perpetual licenses are sold with a 12 (default), 24, 36, or 60-month software support subscription. Support subscriptions can be renewed for a fee after that.

Time-based licenses include a software support subscription through the term of the license.

* Software can be ordered at the time of purchase and be pre-installed on the oscilloscope, or it can be installed by the user after the initial purchase.

KeysightCare Software Support Subscription provides peace of mind amid evolving technologies.

- Ensure your software is always current with the latest enhancements and measurement standards.
- Gain additional insight into your problems with live access to our team of technical experts.
- Stay on schedule with fast turnaround times and priority escalations when you need support.

Selecting your license

- Step 1.** Choose your software product (eg. D9020AUTP).
- Step 2.** Choose your license term: perpetual or time-based.
- Step 3.** Choose your license type: node-locked, transportable, USB portable, or floating.
- Step 4.** Depending on the license term, choose your support subscription duration.

Examples

If you selected:	Your quote will look like:	
D9020AUTP node-locked perpetual license with a 12-month support subscription	Part Number	Description
	D9020AUTP	High Speed Automotive Decode and Trigger Software
	R-B5P-001-A	Node-locked perpetual license
D9020AUTP transportable time-based 6-month license	R-B6P-001-L	KeysightCare software support subscription, node-locked–12 months
	Part Number	Description
	D9020AUTP	High Speed Automotive Decode and Trigger Software
	R-B4P-001-F	6-months, node-locked KeysightCare software support subscription

To configure your product and request a quote:

<http://www.keysight.com/find/software>

Contact your Keysight representative or authorized partner for more information or to place an order:

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

