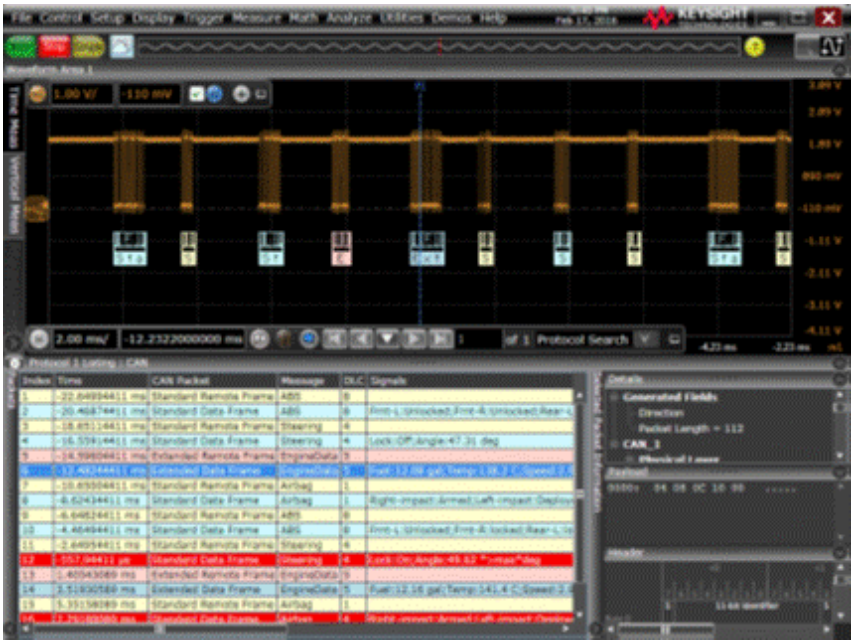
D9010AUTP

Automotive protocol trigger and decode software for Infiniium oscilloscopes

Introduction

The D9010AUTP software package for Infiniium oscilloscopes gives you the ability to trigger and decode on a large and ever-expanding suite of low-speed automotive serial protocols: CAN, CAN-FD, CAN-XL, LIN, FlexRay, and SENT. This package applies to the Keysight MXR, EXR, 9000, 90000, S, V, Z, and UXR-Series Infiniium Oscilloscopes.



KEYSIGHT

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Product Overview

This document is designed to help you understand what is available in D9010AUTP. For assistance in using the software, please reference the latest user's guide, programmer's guides, and online help for Infiniium available on Keysight.com.

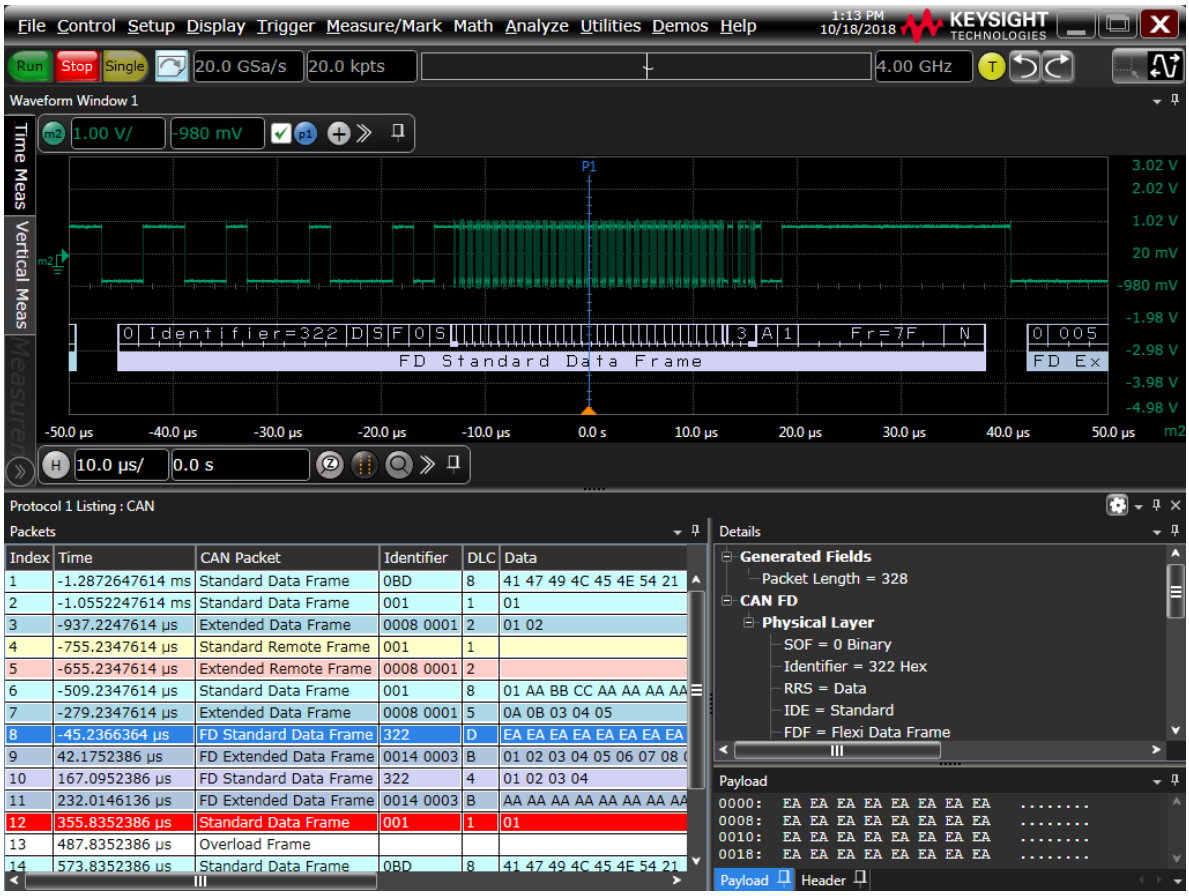
Keysight's D9010AUTP oscilloscope automotive option helps electronic system designers test and debug the physical layer of automotive serial buses faster. CAN, CAN-FD, CAN-XL, LIN, FlexRay, and SENT serial buses are the backbone for communication among many separate controllers, sensors, actuators, and ECUs located throughout automotive and industrial designs. These serial bus interfaces provide content-rich points for debugging and testing. However, since these protocols transfer bits serially, using a traditional oscilloscope has limitations. Manually converting captured 1s and 0s to protocol requires significant effort, cannot be done in real-time, and includes potential for human error. Also, traditional oscilloscope triggers are not sufficient for specifying protocol-level conditions. This software makes it easy to debug and test designs that include these buses using your Infiniium oscilloscope.

- Set up your oscilloscope to show CAN/CAN-FD/CAN-XL, LIN, or FlexRay protocol decode in less than 30 seconds
- Get access to a rich set of integrated protocol-level software triggers
- Save time and eliminate errors by viewing packets at the protocol level
- Use time-correlated views to quickly troubleshoot serial protocol problems back to their timing or signal integrity root cause
- With the CAN-dbc symbolic trigger and decode capability, engineers can now test the physical layer of this differential bus at a higher abstraction level

CAN

The differential Controller Area Network (CAN) bus is used extensively in all of today's automobiles for drive-train and body control. This protocol was developed by Bosch more than 30 years ago, and it is still considered the "workhorse" serial control bus of the automobile. The CAN bus has also been heavily adopted for industrial and medical equipment control applications.

D9010AUTP includes a suite of configurable protocol-level trigger conditions specific to CAN, CAN-dbc, CAN-FD, and CAN-XL. When serial triggering is selected, the application uses software-based triggering or hardware-based serial triggering. With protocol triggering, the oscilloscope takes signals acquired using either a scope or digital channels and reconstructs protocol frames after each acquisition. It then inspects these protocol frames against specified protocol-level trigger conditions and triggers when the condition is met.



Index	Time	CAN Packet	Identifier	DLC	Data
1	-1.2872647614 ms	Standard Data Frame	0BD	8	41 47 49 4C 45 4E 54 21
2	-1.0552247614 ms	Standard Data Frame	001	1	01
3	-937.2247614 µs	Extended Data Frame	0008 0001	2	01 02
4	-755.2347614 µs	Standard Remote Frame	001	1	
5	-655.2347614 µs	Extended Remote Frame	0008 0001	2	
6	-509.2347614 µs	Standard Data Frame	001	8	01 AA BB CC AA AA AA AA
7	-279.2347614 µs	Extended Data Frame	0008 0001	5	0A 0B 03 04 05
8	-45.2366364 µs	FD Standard Data Frame	322	D	EA EA EA EA EA EA EA EA
9	42.1752386 µs	FD Extended Data Frame	0014 0003	B	01 02 03 04 05 06 07 08
10	167.0952386 µs	FD Standard Data Frame	322	4	01 02 03 04
11	232.0146136 µs	FD Extended Data Frame	0014 0003	B	AA AA AA AA AA AA AA AA
12	355.8352386 µs	Standard Data Frame	001	1	01
13	487.8352386 µs	Overload Frame			
14	573.8352386 µs	Standard Data Frame	0BD	8	41 47 49 4C 45 4E 54 21

Figure 1. Infiniium CAN bus decode

CAN XL

CAN XL is the third-generation CAN standard being developed by CAN in Automation (CiA). Although CAN XL provides full backward compatibility with CAN FD, the frame format has been extensively updated. CAN XL follows the concept of CAN FD with a low-speed arbitration phase and a high-speed data phase. However, the CAN XL data phase speed is specified to reach 10 Mbps or more, depending on the transceiver capabilities and physical layer components. Another key characteristic of CAN XL is that the payload length can be as large as 2048 bytes, enabling it to handle extra large files commonly required for applications such as the connection of radar sensors, eCall devices, and microphones.

The CAN XL decode setup is merged to the existing CAN/CAN FD protocol decoder menu with a separate data rate sample point selection. The decoder will display the fields of the CAN-XL frames in the waveform viewer like other protocols would. Various search capabilities of CAN XL would enable the user to search the decoded packet of interest.

CAN XL has two modes of operation – FAST mode and SIC mode (or slow mode). The fast bit rate at the data phase higher than 5 Mbps is enabled by using a CAN SIC XL transceiver. The D9010AUTP triggers and decodes the SIC mode (or slow mode) signal in the arbitration phase as well as the fast mode signal in the data phase correctly. It also handles the CAN XL protocols implemented with the CAN HS/FD/SIC transceivers.

The D9010AUTP software is compatible with the Infiniium oscilloscopes. To use CAN XL protocol trigger and decode, use the Infiniium oscilloscope with the software version 11.30 or higher for MXR/EXR/UXR models or version 6.72 patch 1 or higher for legacy Infiniium models. The D9010AUTP license on the Infiniium scope is extended to cover the CAN XL protocol trigger and decode.

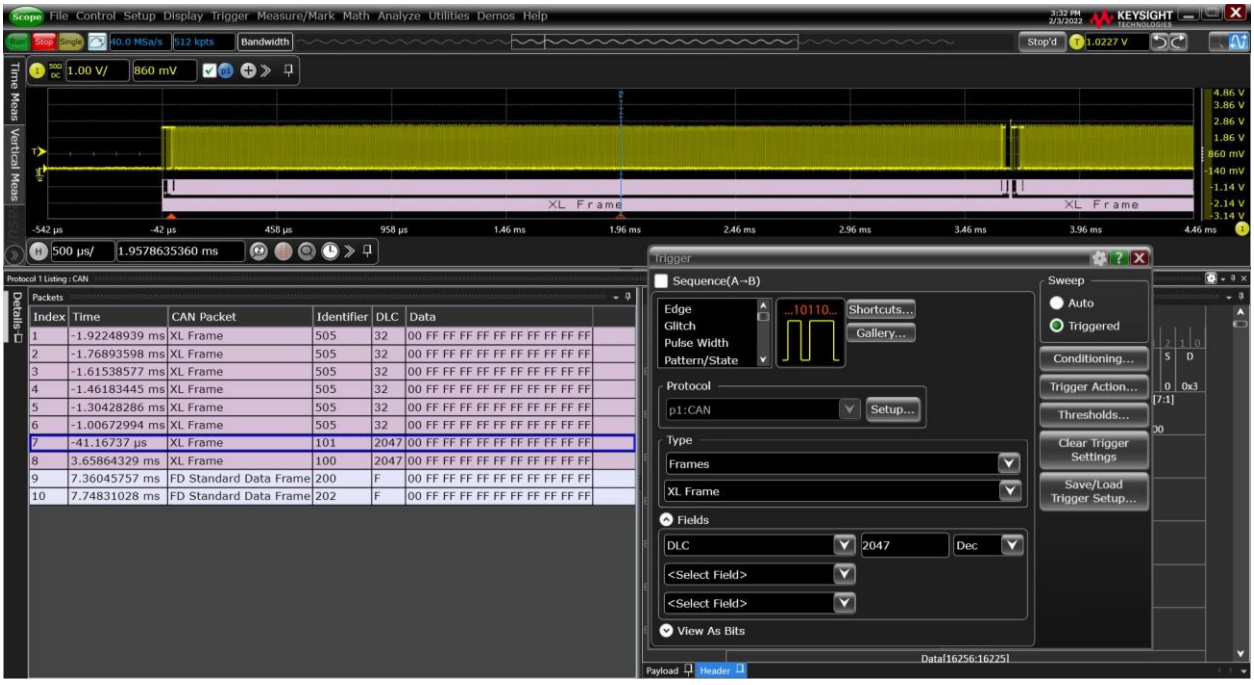


Figure 2. Infiniium CAN XL trigger setup and decode

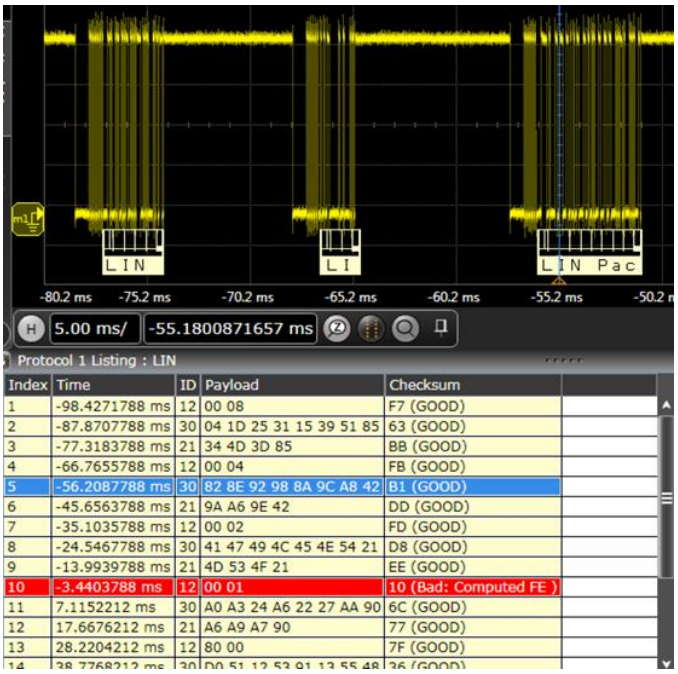
CAN specifications and characteristics

Supported Specifications and Characteristics

CAN sources	Any analog channel (differential probing recommended) Any digital channel (MSO only, single-ended) Any waveform memory
Signal types	Differential (L-H), Differential (H-L), CAN_L, CAN_H, Tx
Maximum data rate	Standard: 10 kbps to 5 Mbps FD: 10 kbps to 10 Mbps XL: 10 kbps to 20 Mbps
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Decode options	Type: Standard, flexible data rate, XL SIC mode, XL FAST mode Sample point (30% to 90%) Setting of the standard, FD, XL SIC, XL FAST data rates
Decoded fields	All, including extended frame format Symbolic: up to first 8 bytes of CAN-FD data, uses industry-standard .dbc file type, max number of messages = 256
Trigger options	All frames Data frames (standard and extended) ID, DLC, Data, res, BRS, and ESI fields Remote frames (standard and extended) ID, R0, and DLC fields Overload frames Errors: CRC, form, stuff, error frame, ACK, any Specific bits: BRS, CRC delimiter, ESI active/passive, EOF
Trigger type	Hardware trigger: MXR/EXR Software trigger: MXR/EXR/UXR, S, V, Z, 9000, 90000X

LIN

D9010AUTP provides a fast and easy way to debug LIN buses found in a wide variety of embedded designs in the automotive industry. It provides protocol-level debug information to Keysight's Infiniium series oscilloscopes. With new, enhanced serial analysis capabilities, D9010AUTP provides not only decode but also listing window view, software searching, and trigger on search. When serial triggering is selected, for triggering on LIN packets, choose a combination of ID, parity, and payload values. The application enables special real-time triggering to ensure that the scope never misses a trigger when armed.



Index	Time	ID	Payload	Checksum
1	-98.4271788 ms	12	00 08	F7 (GOOD)
2	-87.8707788 ms	30	04 1D 25 31 15 39 51 85	63 (GOOD)
3	-77.3183788 ms	21	34 4D 3D 85	BB (GOOD)
4	-66.7655788 ms	12	00 04	FB (GOOD)
5	-56.2087788 ms	30	82 8E 92 98 8A 9C A8 42	B1 (GOOD)
6	-45.6563788 ms	21	9A A6 9E 42	DD (GOOD)
7	-35.1035788 ms	12	00 02	FD (GOOD)
8	-24.5467788 ms	30	41 47 49 4C 45 4E 54 21	D8 (GOOD)
9	-13.9939788 ms	21	4D 53 4F 21	EE (GOOD)
10	-3.4403788 ms	12	00 01	10 (Bad: Computed FE)
11	7.1152212 ms	30	A0 A3 24 A6 22 27 AA 90	6C (GOOD)
12	17.6676212 ms	21	A6 A9 A7 90	77 (GOOD)
13	28.2204212 ms	12	80 00	7F (GOOD)

Figure 3. LIN decode

LIN specifications and characteristics

Supported Specifications and Characteristics

LIN version support	1.3, 2.0, 2.1, 2.2
LIN sources	Any analog channel Any digital channel (MSO models) Any waveform memory
Maximum data rate	2.4 kbps to 625 kbps
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Decode options	Baud rate Sample point (60% to 87.5%)
Decoded fields	All (based on version support)
Trigger options	Packets: ID, parity, and payload Wakeup Errors: parity, checksum, sync, frame length, header length, wakeup

FlexRay

FlexRay is designed to be faster and more reliable than CAN and LIN, but it is also more expensive. FlexRay supports high data rates, up to 10 Mbps, explicitly supports both star and "party line" bus topologies, and can have two independent data channels for fault tolerance.

When developing and/or troubleshooting the FlexRay bus, examination of hardware signals can be very important. Like all other low-speed protocols on Infiniium, you will be able to set specific triggers, decodes, save and export data, run search queries, and view data in the lister. There is also an auto-setup available.

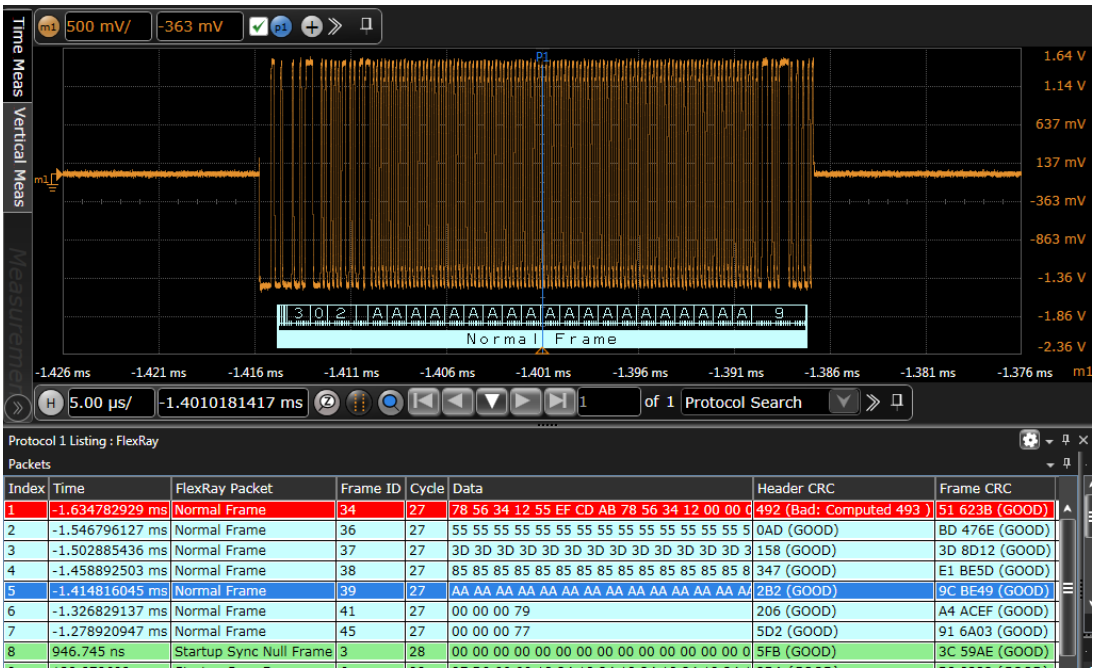


Figure 4. FlexRay decode

FlexRay specifications and characteristics

Supported Specifications and Characteristics

FlexRay sources (all lines)	Any analog channel (only when speed is ≤ 50 MHz) Any digital channel (MSO only, required for speeds > 50 MHz) Any waveform memory (only when speed is ≤ 50 MHz)
Maximum rate (clock or data)	2.5 Mbps to 10 Mbps
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Decode options	Channel: A or B, Baud Rate, Cycle time: 0s to 100 ms
Trigger options	Cycle TSS or Any TSS Frames: startup, sync, normal, null, NOT null, any Frame fields: reserved, PPI, null, Frame ID, startup frame indicator, sync frame indicator, payload length, header CRC, cycle, data Errors: bad header CRC, bad frame CRC, unknown packet, any

SENT

Short for Single Edge Nibble Transmission, SENT is a one-way, point-to-point scheme for transmitting signal values from a sensor to a controller. It is intended to allow for transmission of high-resolution data with a low system cost. It requires three wires: data, power, and ground. Data is transmitted in units of 4 bits (1 nibble) for which the interval between two falling edges (single edge) of the modulated signal with a constant amplitude voltage is evaluated.

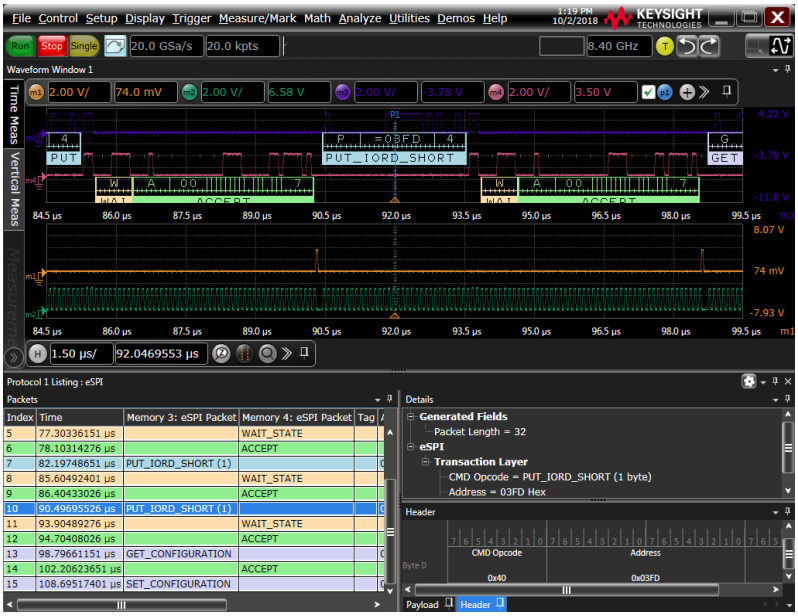


Figure 4. SENT decode

SENT specifications and characteristics

Supported Specifications and Characteristics

SENT data sources	Any analog channel Any digital channel (MSO only) Any waveform memory Any math function
Clock period	1 µs to 300 µs
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Decode options	Tolerance: 3% to 30% Number of nibbles: 1 to 6 Clock idle state: high or low CRC format: 2008 or 2010 Pause mode: ON, OFF, or SPC
Trigger options	Fast Nibbles: S&C, Data Errors: Fast channel CRC error, tolerance violation, successive sync pulses error, pulse period error, any error

Ordering Information

Required hardware

Model	Compatibility
D9010AUTP	Infiniium 9000, S-Series, EXR-Series, MXR-Series, 90000, V-Series, Z-Series, UXR-Series

Flexible software licenses and KeysightCare Software Support Subscriptions

Keysight offers a variety of flexible licensing options to fit your needs and budget. Choose your license term and license type.

License terms

Perpetual – Perpetual licenses can be used indefinitely.

Subscription – Subscription licenses can be used through the term of the license only.

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 SW1000-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) and up to 60-month software support subscription with a user-selected start and end date. Support subscriptions can be renewed for a fee after that.

Subscription licenses include a software support subscription through the term of the license, from 3 to 36 months, with a user-selected start date.

Selecting your license

Step 1. Choose your software product (e.g. D9020ASIA)

Step 2. Choose your license term: perpetual or subscription.

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.

Example

If you selected:	Your quote will look like this:	
D9020ASIA Node-locked Perpetual license	Part Number D9020ASIA SW1000-LIC-01 SW1000-SUP-01	Description Advanced Signal Integrity Software (EQ, InfiniiSimAdv, Crosstalk) Node-locked perpetual license Node-locked KeysightCare software support subscription with user-selected start and end dates
D9020ASIA Transportable Subscription 6-month license	Part Number D9020ASIA SW1000-SUB-01	Description Advanced Signal Integrity Software (EQ, InfiniiSimAdv, Crosstalk) 6-months, transportable subscription license

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:

www.keysight.com/find/contactus

For Keysight Automotive Ethernet solutions, please visit:

www.keysight.com/find/automotive-ethernet