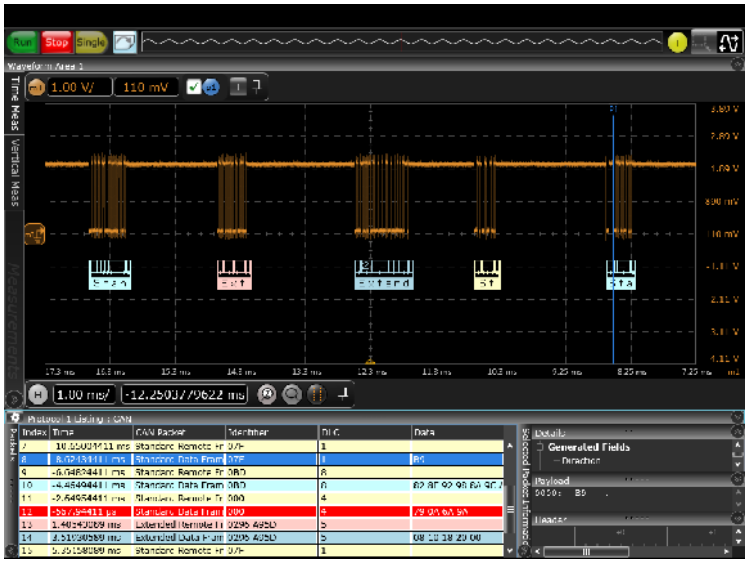
Keysight Technologies

CAN, LIN and FlexRay Protocol Triggering and Decode for Infiniium 9000 and S-Series Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

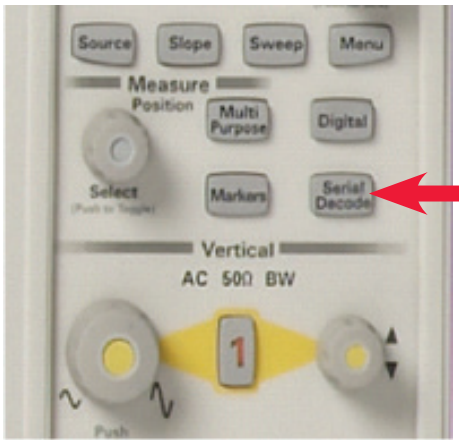
Can, Lin and FlexRay Serial Buses

The Keysight Technologies, Inc. oscilloscope automotive options help electronic system designers test and debug the physical layer of automotive serial buses faster. CAN, LIN and FlexRay 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 debug and test. However, since these protocols transfer bits serially, using a traditional oscilloscope has limitations. Manually converting captured 1's and 0's to protocol requires significant effort, can't be done in real-time, and includes potential for human error. Also, traditional oscilloscope triggers are not sufficient for specifying protocol-level conditions. Extend your oscilloscope capability with Keysight's CAN, LIN and FlexRay protocol triggering and decode application. This application makes it easy to debug and test designs that include these buses using your Infiniium oscilloscope.

- Set up your oscilloscope to show CAN, LIN or FlexRay 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 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.

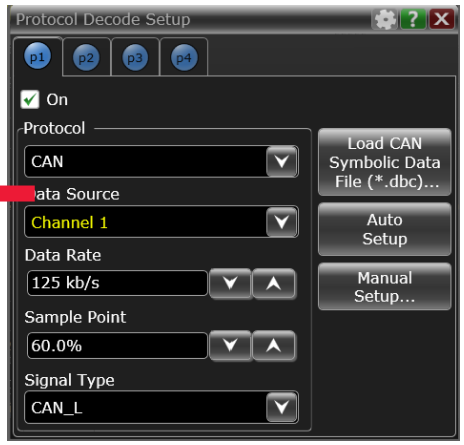
This application is available in the following license variations:

- Fixed to an oscilloscope frame
- Floating license
  - Server-based license
  - Transportable license



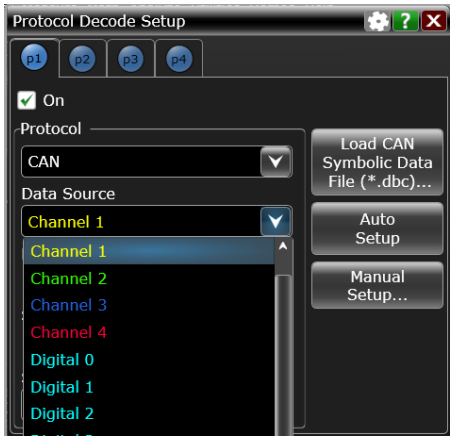
Easy to find

Turn decode on/off via the "Serial Decode" button on the front of the oscilloscope or in the "Setup" menu. View decode embedded on the waveform display or in the protocol viewer listing window. (See pages 4-5.)



30 second CAN, LIN or FlexRay setup

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



Support for both analog and digital channels

Acquire serial buses using any combination of scope or digital channels. Using digital channels on MSO models preserves analog channels for viewing other time-correlated signals.

Can, Lin and FlexRay Setup and Protocol Triggering

Get access to a rich set of integrated protocol-level triggers. The application includes a suite of configurable protocol-level trigger conditions specific to CAN, LIN and FlexRay. When serial triggering is selected, the application uses software-based triggering.

Hardware-base triggering for CAN, and LIN ensures reliable triggering even on the most infrequent event. The application used SW-base triggering for FlexRay. With software-based protocol triggering, the oscilloscope takes signals acquired using either 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.



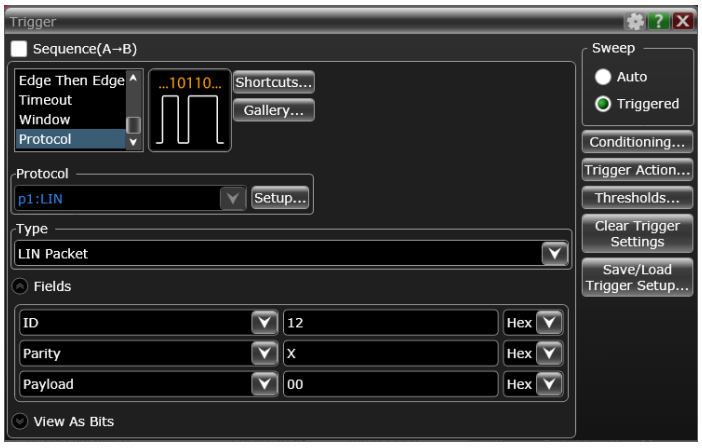
CAN trigger

Quickly set up trigger for a unique frame or error condition.



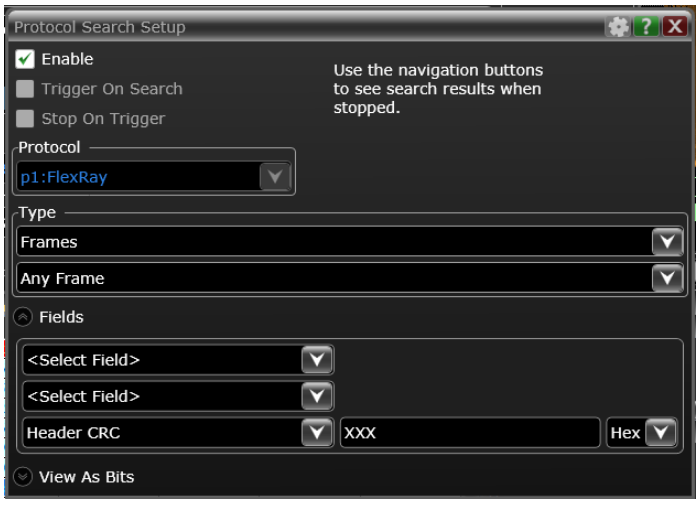
CAN trigger with .dbc files

Importing a CAN .dbc symbolic file gives users the ability to trigger using message and signal names contained in the .dbc file.



LIN trigger

Use the payload editor to specify data values word by word.



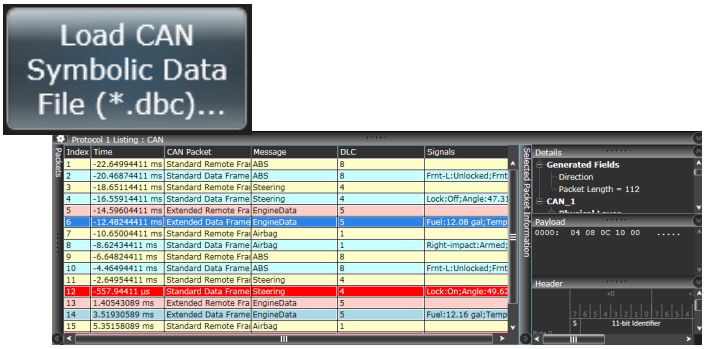
FlexRay trigger

Quickly specify frame ID and repetition factor (optional) for software-based triggering and searching.

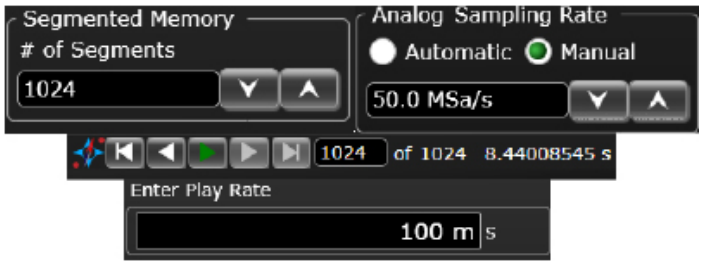
CAN and CAN-dbc Protocol Decode



Quickly move between physical and CAN 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. For CAN minor tick marks indicate clock transitions. Major tick marks indicate segments of the serial packet such as ID, DLC, CRC, CAN measurements are automatically time-correlated with measurement on other scope channels.



Import industry-standard .dbc files for symbolic triggering and decode. Message and signal values are displayed on the lister and in the waveform in symbolic format, making it easier to understand the oscilloscope capture.



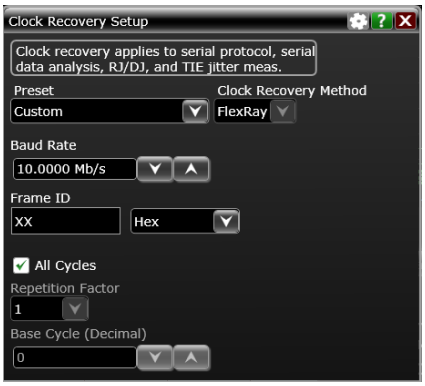
Long time captures using segmented memory

In this example, CAN traffic was captured for near 9 seconds. Segmented memory uses time tags to track time between segment acquisitions.

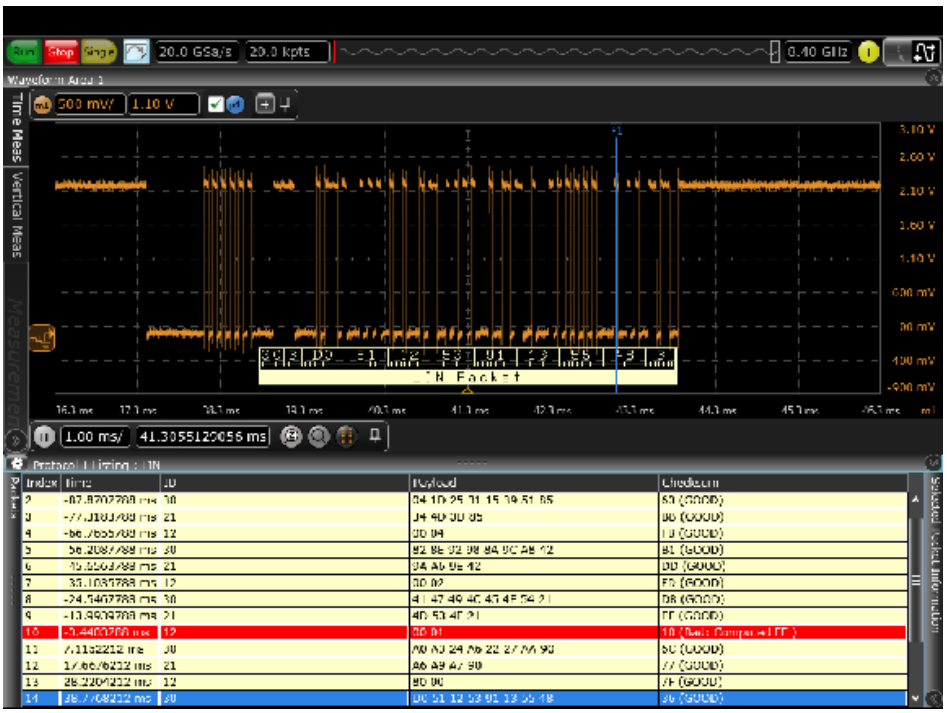
FlexRay and LIN Protocol Decode



Quickly move between FlexRay physical and 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. Minor tick marks indicate clock transitions. Major tick marks indicate segments of the serial packets.

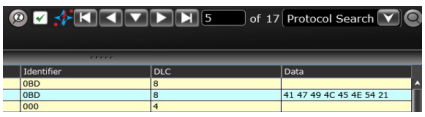


Solution includes FlexRay receiver clock recovery necessary for protocol decode and triggering.



LIN decode embedded in waveform area

Utilize the oscilloscope waveform area to display decode information. Minor ticks indicate clock transitions, and major ticks show segments within each LIN packet.



Post-acquisition searching

Search acquired protocol listings using a menu that is identical to the trigger menu. Quickly move to next occurrence of a specified event.

CAN	
CAN sources	Analog channels 1, 2, 3, or 4 MSO models can additionally use digital channels D0 to D15 Any waveform memories The application relies on probing and trigger/measurement thresholds to properly condition the signal for triggering and decode. Differential probing may be required. MSO channels are single ended and require a minimum 500mV swing around the threshold to differentiate between 1's and 0's
Data rate	100 bp/s up to 5 Mb/s
Signal type	Differential (L-H), CAN_L, or CAN_H
Auto setup	Automatically configures scope settings for proper CAN decode and SW-based protocol triggering including memory depth, edge triggering, holdoff, sample rate, and measurement thresholds, and clock recovery
Decoded fields	All including extended frame format
Triggering (hardware-based)	Start of frame Data frame (frame containing node data for transmission) User specified value for data byte 0 in hex, binary, or decimal Immediately followed by data byte specified in hex, binary, or decimal Remote frame (frame requesting the transmission of a specific identifier) User specified identifier in hex, binary, or decimal Data or remote frame Error frame (frame transmitted by any node detecting an error)
.dbc support	Import of industry-standard .dbc files for symbolic trigger and decode Maximum number of messages = 256

LIN	
LIN sources	Analog channels 1, 2, 3, or 4 MSO models can additionally use digital channels D0 to D15 Any waveform memories The application relies on probing and trigger/measurement thresholds to properly condition the signal for triggering and decode. Differential probing may be required. MSO channels are single ended and require a minimum 500mV swing around the threshold to differentiate between 1's and 0's
Data rate	2400 bp/s to 625 kb/s
Auto setup	Automatically configures scope settings for proper LIN decode and SW-based protocol triggering including memory depth, edge triggering, holdoff, sample rate, and measurement thresholds, and clock recovery
Decoded fields	All. Supports LIN versions 1.3, 2.0, and 2.1
Triggering (hardware-based)	LIN packets, including user-specified values for ID, parity, and payload wakeup, or errors including: parity, check, sync, frame length, header length or wakeup

FlexRay	
FlexRay sources	Analog channels 1, 2, 3, or 4 MSO models can additionally use digital channels D0 to D15 Any waveform memories The application relies on probing and trigger/measurement thresholds to properly condition the signal for triggering and decode. Differential probing may be required. MSO channels are single ended and require a minimum 500mV swing around the threshold to differentiate between 1's and 0's
Data rate	Up to 20 Mb/s
Cycle time	100 ns up to 100 ms
Auto setup	Automatically configures scope settings for proper FlexRay decode and SW-based protocol triggering including memory depth, edge triggering, holdoff, sample rate, and measurement thresholds, and clock recovery.
Decoded fields	All
Triggering (software-based)	Cycle TSS Any TSS User specified frame ID in hex, decimal, or binary, All cycles Repetition factor of 1, 2, 4, 8, 16, 32, or 64 Base cycle (decimal)

Ordering Information

This application is compatible with all 9000 and S-Series oscilloscope models.

Application software			9000 Series	S-Series
CAN/LIN/FlexRay protocol	Fixed	Factory-installed	Option 008	N8803B-1FP
		User-installed	N8803B-1NL	N8803B-1FP
			N8803B-1FP*	
	Floating	Transportable	N8803B-1TP*	
		Server-based	N5435A-033	

* Requires Infiniium 5.0 or above

Probing CAN and FlexRay Differential Serial Buses

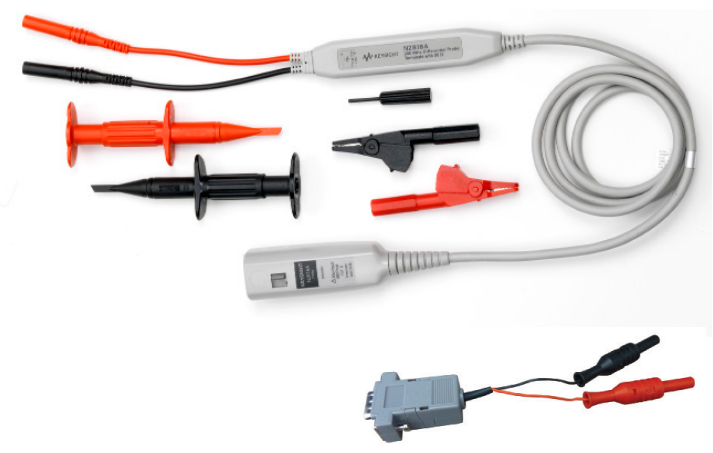
Keysight offers a wide range of differential active probes for various bandwidth and dynamic range applications. Table 1 shows the differential probes that Keysight recommends for CAN and FlexRay.

Table 1: Recommended Probes for Differential Buses

Differential bus (max bit rate)	N2791A (25-MHz bandwidth)	N2818A (200-MHz bandwidth)
CAN (1 Mbps)	√	√
FlexRay (10 Mbps)		√

If you need to connect to DB9-SubD connectors on your differential CAN and/or FlexRay bus, Keysight also offers the CAN/FlexRay DB9 probe head (part number 0960-2926). This differential probe head is compatible with both the N2791A and N2818A differential active probes and allows you to easily connect to your CAN and/or FlexRay differential bus.

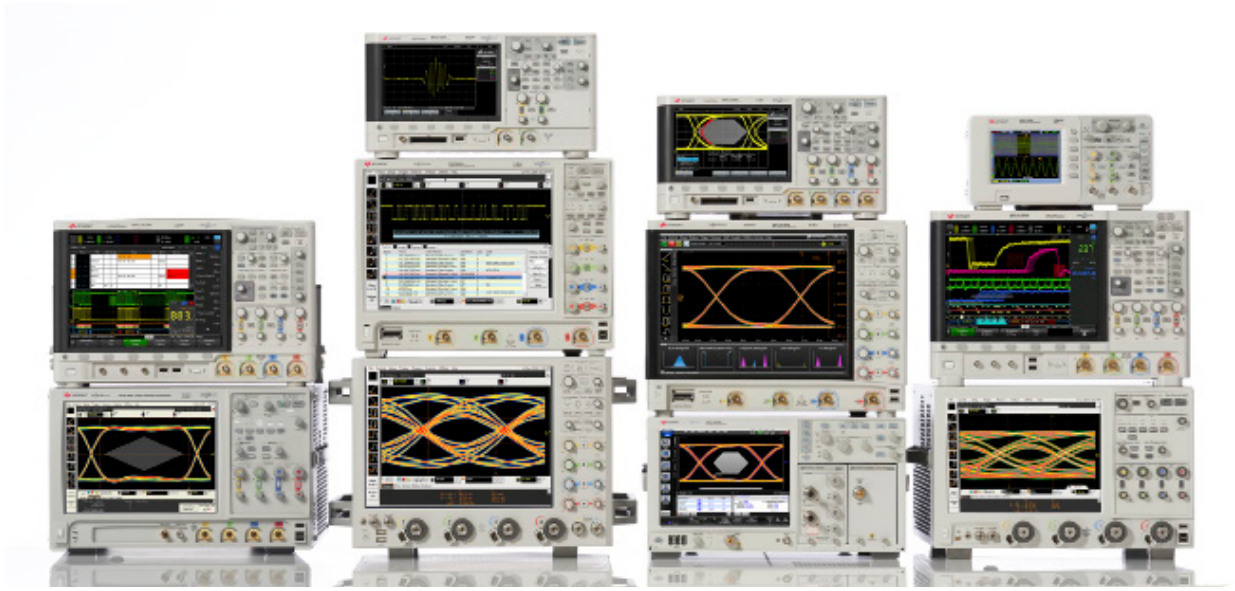
For more information about Keysight's probing solutions, refer to the Infiniium Series Oscilloscope Probes & Accessories data sheet (publication number 5968-7141EN).



Keysight's N2818A 200-MHz differential active probe



Keysight N2791A 25-MHz differential active probe



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