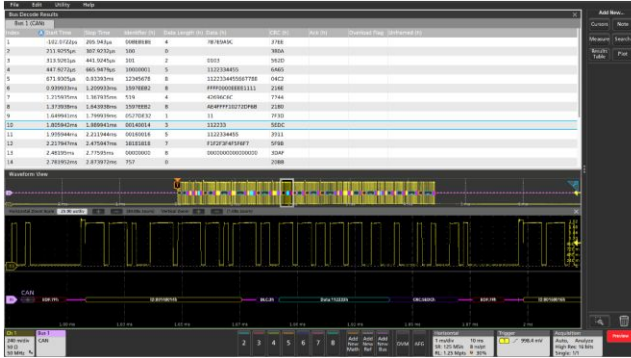


# Serial Triggering and Analysis

## 3 Series MDO, 4/5/6 Series MSO Applications Datasheet



Screen images shown in this datasheet are from the 5 Series MSO.

On a serial bus, a single signal often includes address, control, data, and clock information. This can make isolating events of interest difficult. Optional serial applications transform the oscilloscope into a robust tool for debugging serial buses with automatic decode and analysis for I<sup>2</sup>C, SPI, CAN, CAN FD, LIN, FlexRay, 100BASE-T1, SENT, RS-232/422/485, UART, USB 2.0 (LS, FS, HS), Ethernet, I3C, SPMI, Spacewire, 8b10b, NRZ, MIL-STD-1553, ARINC 429, I<sup>2</sup>S, LJ, RJ, PSI5 and TDM.

### Key features

- Automated Serial Decode and Analysis Options for I<sup>2</sup>C, SPI, I3C<sup>1</sup>, CAN, CAN FD, LIN, FlexRay, SENT<sup>1</sup>, RS-232/422/485, UART, USB 2.0, Ethernet<sup>1</sup>, SPMI<sup>1</sup>, MIL-STD-1553, ARINC 429, I<sup>2</sup>S, LJ, RJ, PSI5 and TDM
- Trigger on all the critical elements of a serial bus such as address, data, etc.
- Decode all the critical elements of each message. No more counting 1s and 0s!
- Search through long acquisitions with user-defined criteria to find specific messages
- Event Table shows decoded serial bus activity in a tabular, time-stamped format for quick summary of system activity

### Serial Triggering and Analysis Applications

The serial applications support automatic trigger and decode for I<sup>2</sup>C, SPI, CAN, CAN FD, LIN, FlexRay, 100BASE-T1, SENT, RS-232/422/485, UART, USB 2.0 (LS, FS, HS), Ethernet, I3C, SPMI, Spacewire, 8b10b, NRZ, MIL-STD-1553, ARINC 429, I<sup>2</sup>S, LJ, RJ, PSI5 and TDM buses, making it easier to locate, analyze, and debug events of interest.

<sup>1</sup> Not available for 3 Series MDO.

### Serial triggering

Trigger on packet content such as start of packet, specific addresses, specific data content, unique identifiers, etc. on popular serial interfaces such as I<sup>2</sup>C, SPI, CAN, CAN FD, LIN, FlexRay, SENT, RS-232/422/485, UART, USB 2.0, Ethernet, SPMI, MIL-STD-1553, ARINC 429, I<sup>2</sup>S, LJ, RJ, PSI5 and TDM.

### Bus display

The bus display provides a higher-level, combined view of the individual signals (clock, data, chip enable, and so on) that make up your bus, making it easy to identify where packets begin and end and identifying sub-packet components such as address, data, errors, and so on.

### Bus decoding

Tired of having to visually inspect the waveform to count clocks, determine if each bit is a 1 or a 0, combine bits into bytes, and determine the hex value?

Let the oscilloscope with a serial application do it for you! Once you've set up a bus, the oscilloscope decodes each packet on the bus, and displays the value in hex, binary, ASCII, or decimal (certain buses only) in the bus waveform.

### Results table

In addition to seeing decoded packet data on the bus waveform itself, you can view all captured packets in a tabular view much like you would see in a software listing. Packets are time stamped and listed consecutively with columns for each component (Address, Data, and so on).

### Wave Inspector<sup>®</sup> search

Serial triggering is very useful for isolating the event of interest, but once you've captured it and need to analyze the surrounding data, what do you do?

In the past, users had to manually scroll through the waveform counting and converting bits and looking for what caused the event. With a serial application, you can enable the oscilloscope to automatically search through the acquired data for user-defined criteria including serial packet content. Each occurrence is highlighted by a search mark. Rapid navigation between marks is as simple as pressing the ← and → arrow buttons on the oscilloscope front panel or the Search badge. The 3 Series MDO uses the arrows in the Search badge to navigate.

## Characteristics

### I<sup>2</sup>C characteristics

#### Bus setup options

Characteristic	Description
I <sup>2</sup> C Sources (Clock and Data)	Analog channels Digital channels Active Math channels <sup>2</sup> Active Reference channels <sup>2</sup>
Thresholds	Per-channel thresholds
Recommended Probing	Single-ended
Include R/W in Address	Yes or No
Address/Data Formats Available	Hex Binary

#### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

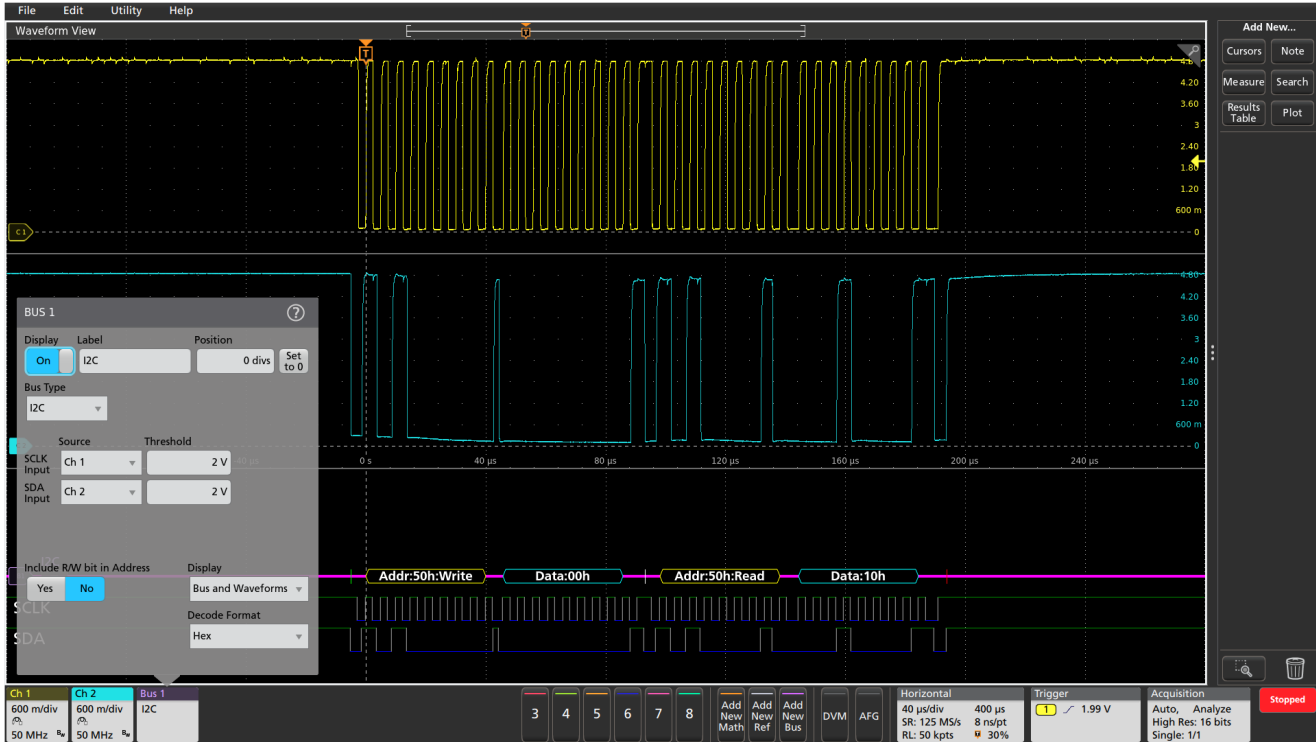
#### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Start Repeated Start Stop Missing Ack Address (7 or 10 bit) Data (1-5 bytes) Address and Data

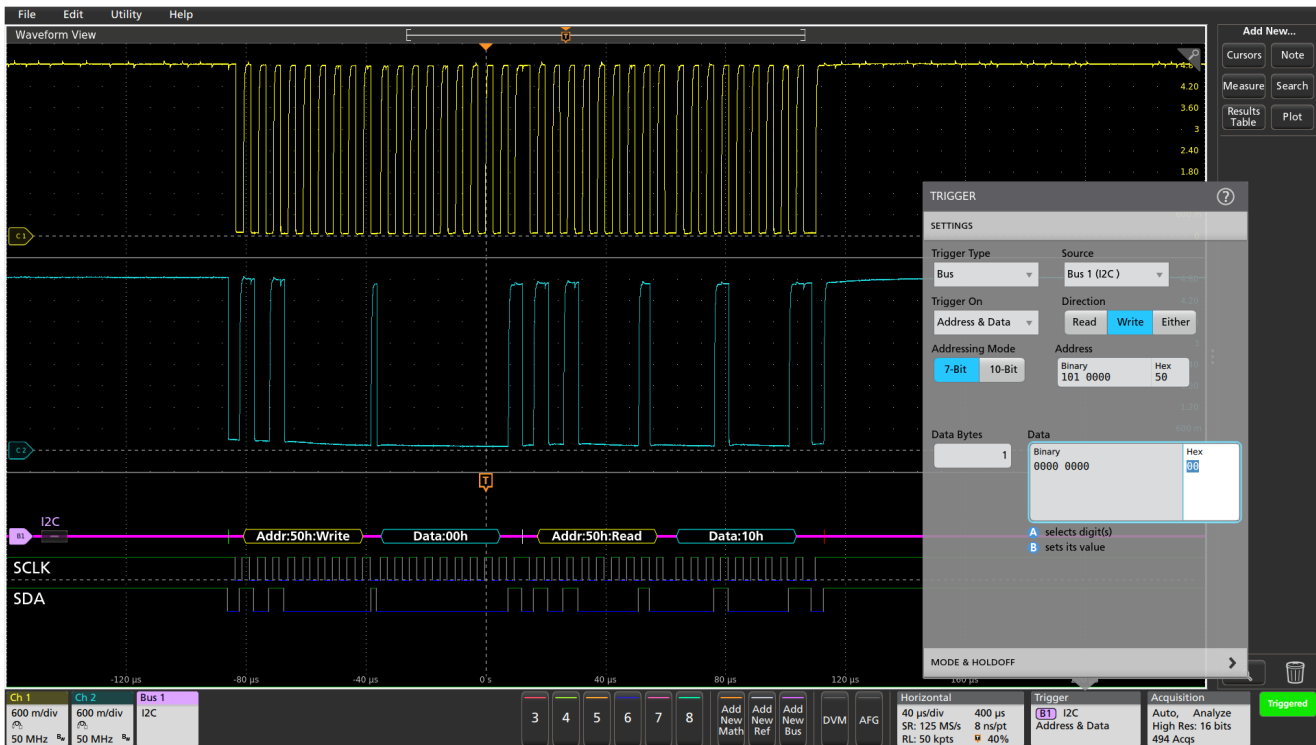
### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 10 Mb/s (automatic selection)
Decode Display	Start (green bar) Address (yellow packet) Data (cyan packet) Missing Ack (! symbol in red box) Stop (red bar)

<sup>2</sup> Not available on 3 Series MDO



Color-coded I<sup>2</sup>C bus display, using hexadecimal display format.



Triggering on a specific address value on the I<sup>2</sup>C bus.

## SPI characteristics

### Bus setup options

Characteristic	Description
SPI Sources (Clock, Data, and Slave Select)	Analog channels Digital channels Active Math channels <sup>3</sup> Active Reference channels <sup>3</sup>
Thresholds	Per-channel thresholds
Recommended Probing	Single-ended
Decode Configuration: Framing Clock Slave Select Data Word Size Bit Order	Slave Select (3-wire SPI), Idle Time (2-wire SPI) Rising or Falling Edge Active High or Active Low Active High or Active Low 4 - 32 bits Most Significant (MS) First, Least Significant (LS) First
Formats Available	Hex Binary

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

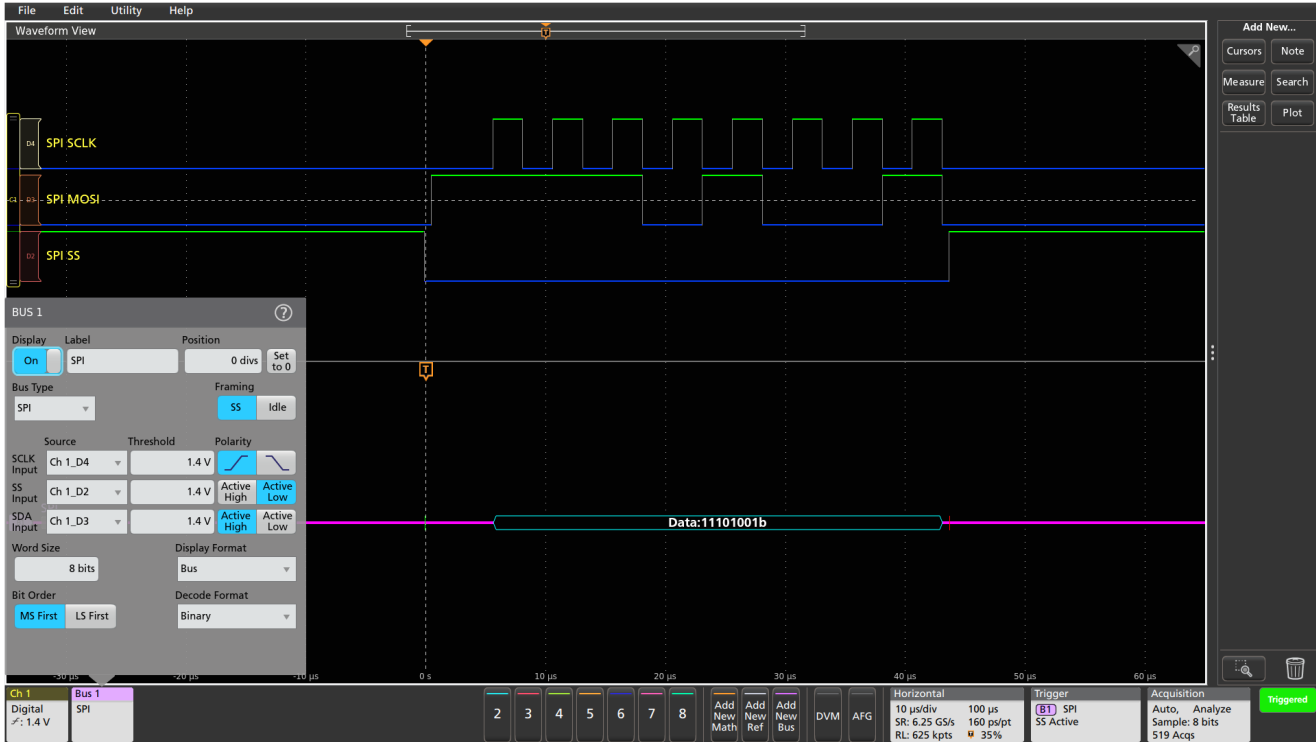
### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	SS Active (3-wire SPI) Start of Frame (2-wire SPI) Data (1-16 bytes)

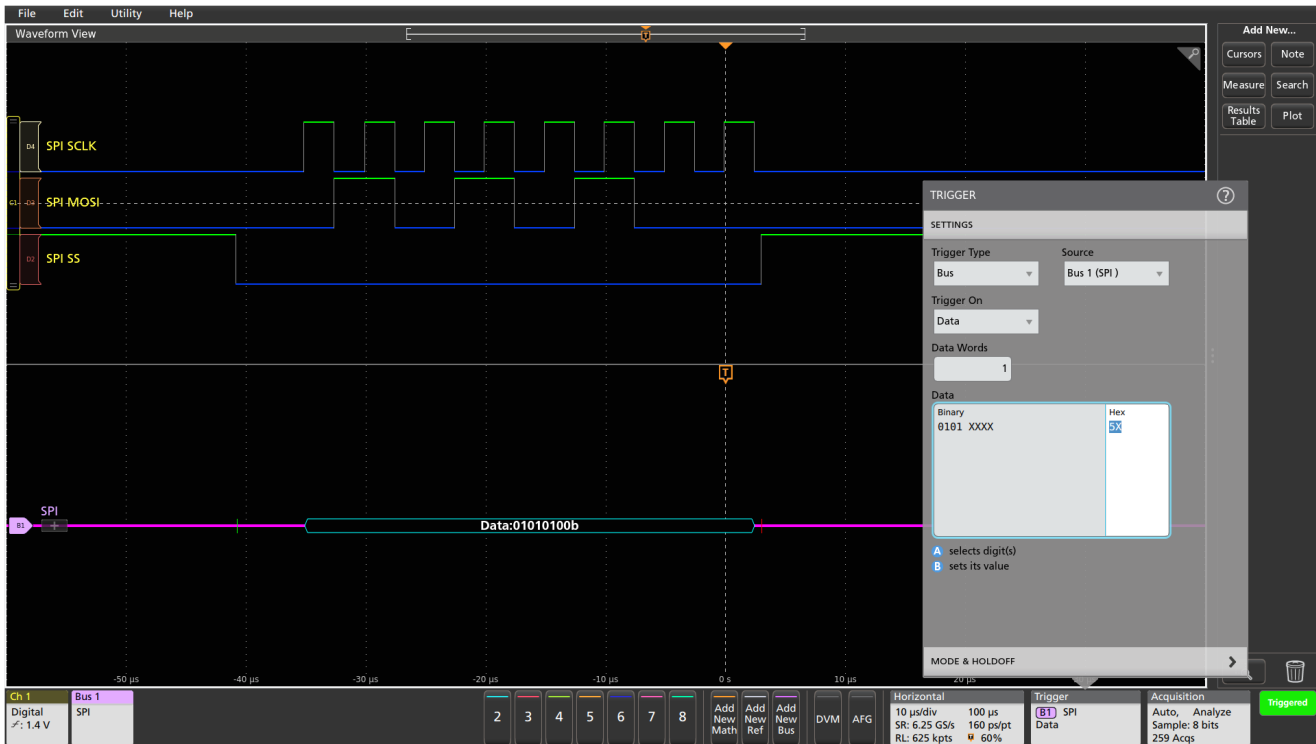
### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 10 Mb/s (automatic selection)
Decode Display	Start (green bar) Data (cyan packet) Stop (red bar)

<sup>3</sup> Not available on 3 Series MDO.



SPI bus, captured with digital channels, showing binary display format of the color-coded SPI bus decoding.



Triggering on a specific data value on the SPI bus.

### I3C characteristics <sup>4</sup>

#### Bus setup options

Characteristic	Description
I3C Sources (Clock and Data)	Analog channels Digital channels Active Math channels Active Reference channels
Thresholds	Per-channel thresholds
Speed	High Speed (480 Mb/s) Full Speed (12 Mb/s) Low Speed (1.5 Mb/s)
Recommended Probing	Single-ended
Formats Available	Hex Binary Mixed Hex

#### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

#### Bus search options

Characteristic	Description
Search On	Start Repeated Start Address Data I3C SDR Direct Message I3C SDR Broadcast Message I3C DDR Message Errors Hot-Join Direct Message End Stop HDR Restart HDR Exit

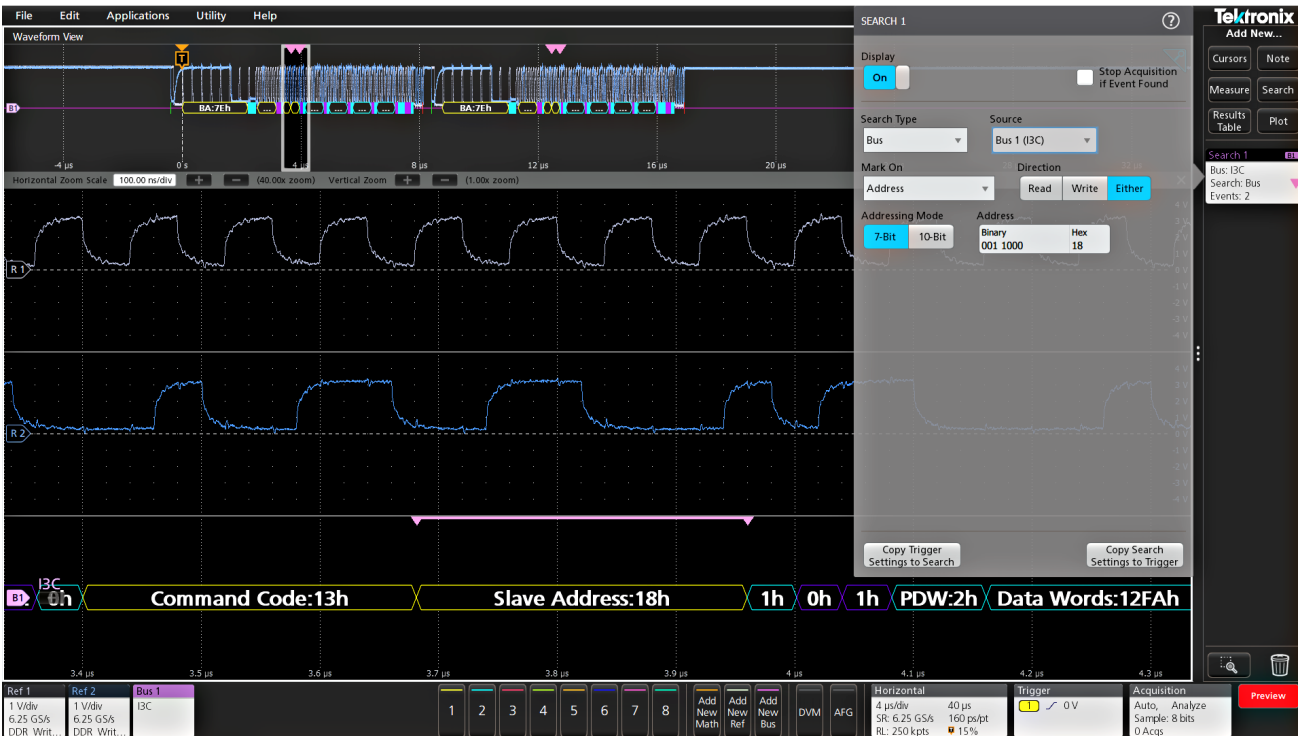
#### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 12.5 Mb/s (automatic selection)
Decode Display	Start (green bar) Address (yellow packet) Commands (cyan packet) Data (cyan packet) Parity (purple packet) Stop (red bar)

<sup>4</sup> I3C is not available on 3 Series MDO.



The Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the I3C bus.



Searching on a specific data pattern on the I3C bus and automatically searching on Sync.

## RS-232, RS-422, RS-485, UART characteristics

### Bus setup options

Characteristic	Description
Sources, RS-232, UART	Analog channels Digital channels Active Math channels <sup>5</sup> Active Reference channels <sup>5</sup>
Sources, RS-422, RS-485	Analog channels Active Math channels <sup>5</sup> Active Reference channels <sup>5</sup>
Polarity	Normal (RS-232) Inverted (UART, RS-422, RS-485)
Parity	None Odd Even
Recommended Probing, RS-232, UART	Single-ended
Recommended Probing, RS-422, RS-485	Differential
Number of Bits	7 - 9
Formats Available	Hex Binary ASCII Packet View

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

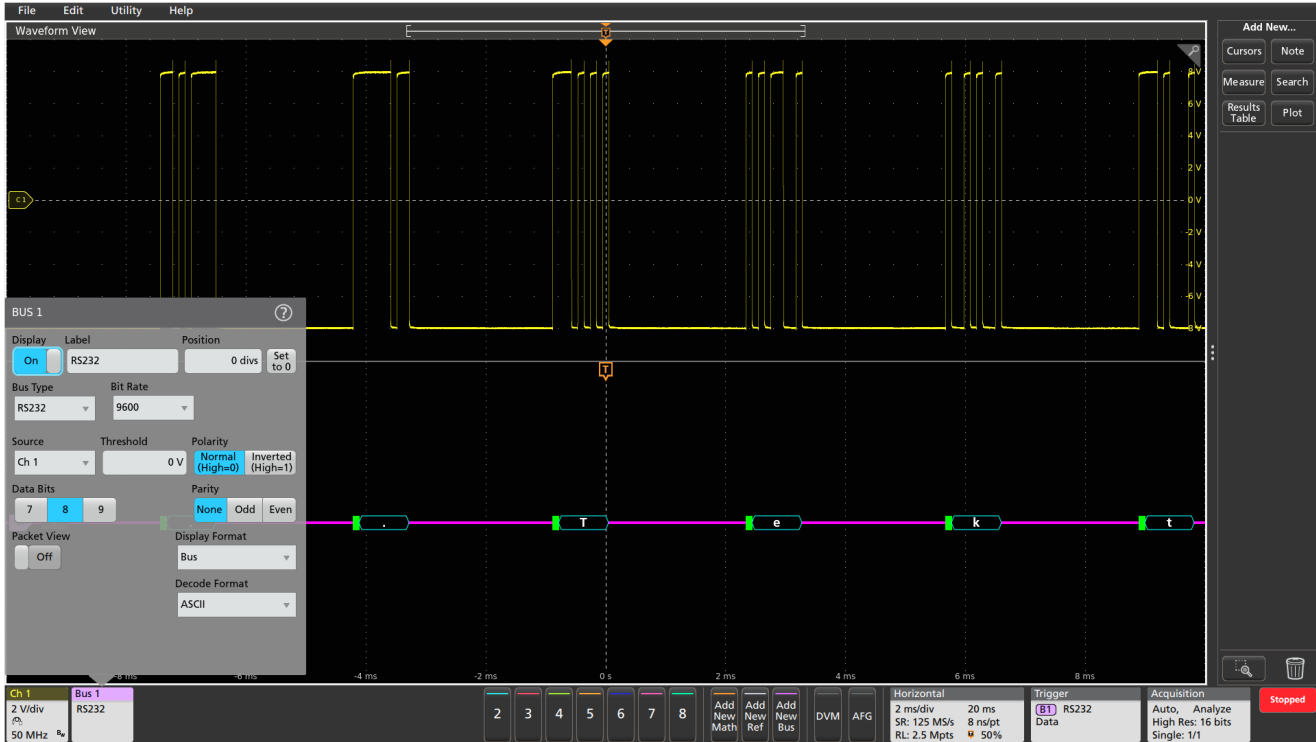
Characteristic	Description
Trigger and/or Search On	Start End of Packet Data (1 - 10 bytes) Parity Error

### Bus decode

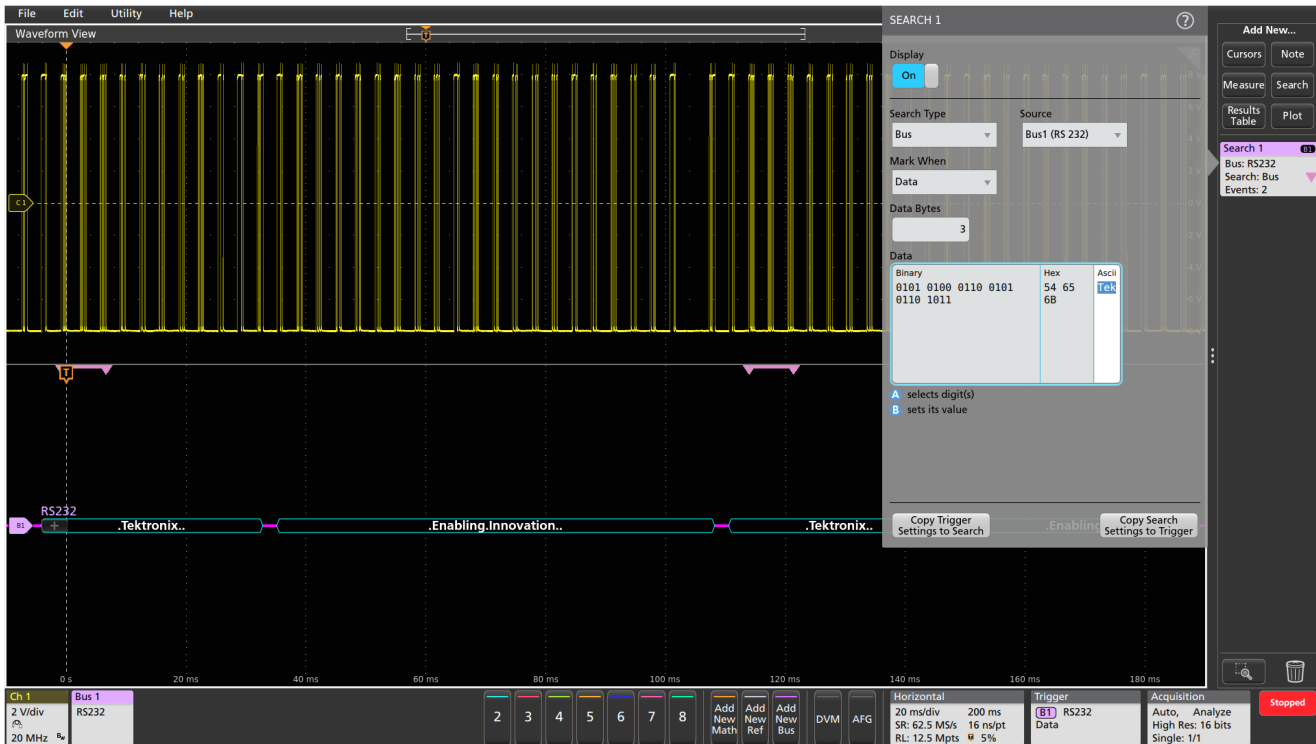
Characteristic	Description
Maximum Clock/Data Rate	Up to 15 Mb/s For 3 Series MDO: Up to 10 Mb/s
Bit Rate Selection	300 b/s 1,200 b/s 2,400 b/s 9,600 b/s 19,200 b/s 38,400 b/s 115,200 b/s 921,600 b/s Custom (All but 3 Series MDO): 50 b/s - 15 Mb/s Custom (for 3 Series MDO): 50 b/s - 10 Mb/s
Decode Display	Start (green packet) Data (cyan packet) Parity (purple packet) Parity Error (red packet)

<sup>5</sup> Not available on 3 Series MDO.





RS-232 bus setup and ASCII display, showing assignment of source signal, digital threshold, and polarity.



RS-232 bus shown in Packet View format, with the Wave Inspector search automatically searching for the data string "Tek".

## CAN characteristics

### Bus setup options

Characteristic	Description
Source for CAN_H, CAN_L, Rx, or Tx (single-ended probing)	Analog channels Digital channels Active Math channels <sup>6</sup> Active Reference channels <sup>6</sup>
Source for Diff (differential probing)	Analog channels Active Math channels <sup>6</sup> Active Reference channels <sup>6</sup>
Thresholds	Per-channel thresholds
Recommended Probing: CAN_H, CAN_L, Rx, Tx Diff	Single-ended Differential
Bit Rate Selection: Predefined list of rates	10 kb/s - 1 Mb/s
Custom	All but 3 Series MDO: 1 kb/s - 1 Mb/s 3 Series MDO: 10 kb/s - 1 Mb/s
Sample Point	All but 3 Series MDO: 0% - 100% of bit period of unit interval 3 Series MDO: 5% - 95% of bit period of unit interval
Formats Available	Mixed Hex Hex Binary Symbolic (.dbc) <sup>6</sup>

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Start of Frame Type of Frame (Data, Remote, Error, Overload) Identifier (Standard or Extended) Data (number of bytes 1-8, trigger or search when =, ≠, <, ≤, >, ≥) Identifier and Data EOF Missing Ack Bit Stuff Error

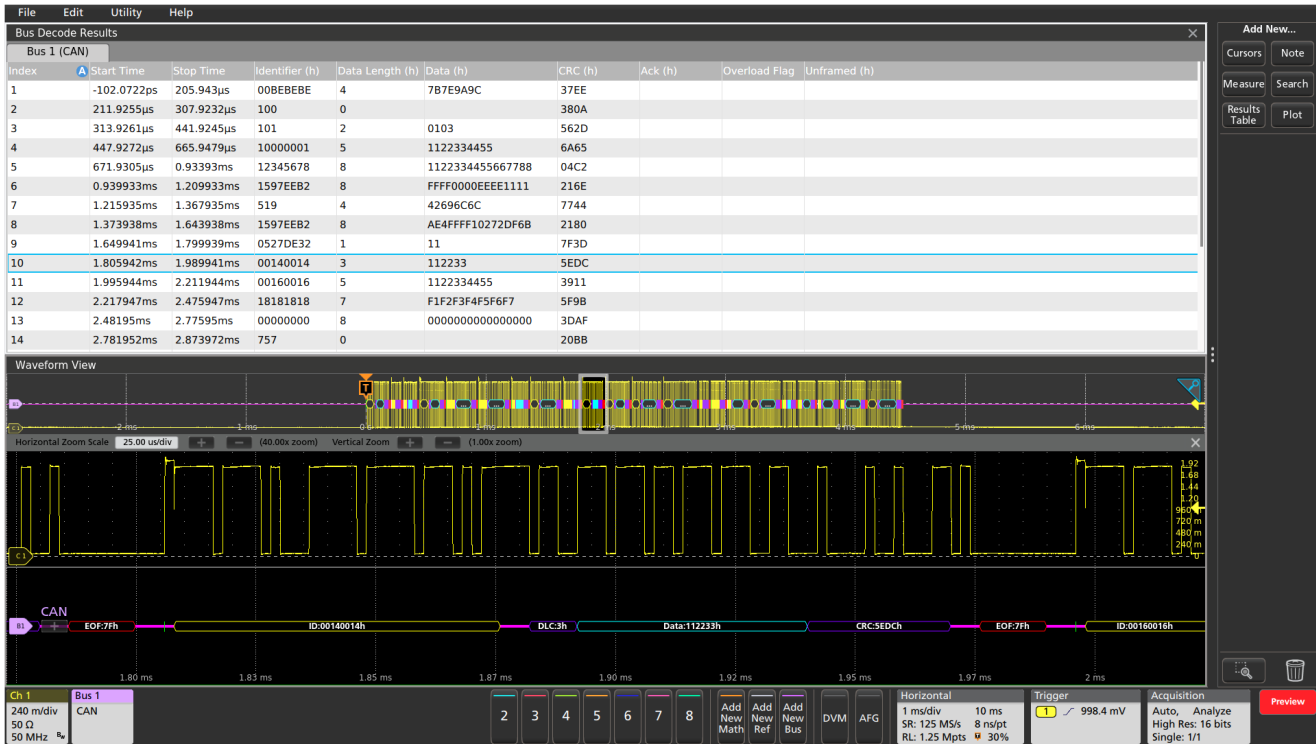
### Symbolic bus search options

Characteristic	Description
Message	As defined by the .dbc file <sup>6</sup>
Message and Signal	As defined by the .dbc file <sup>6</sup>

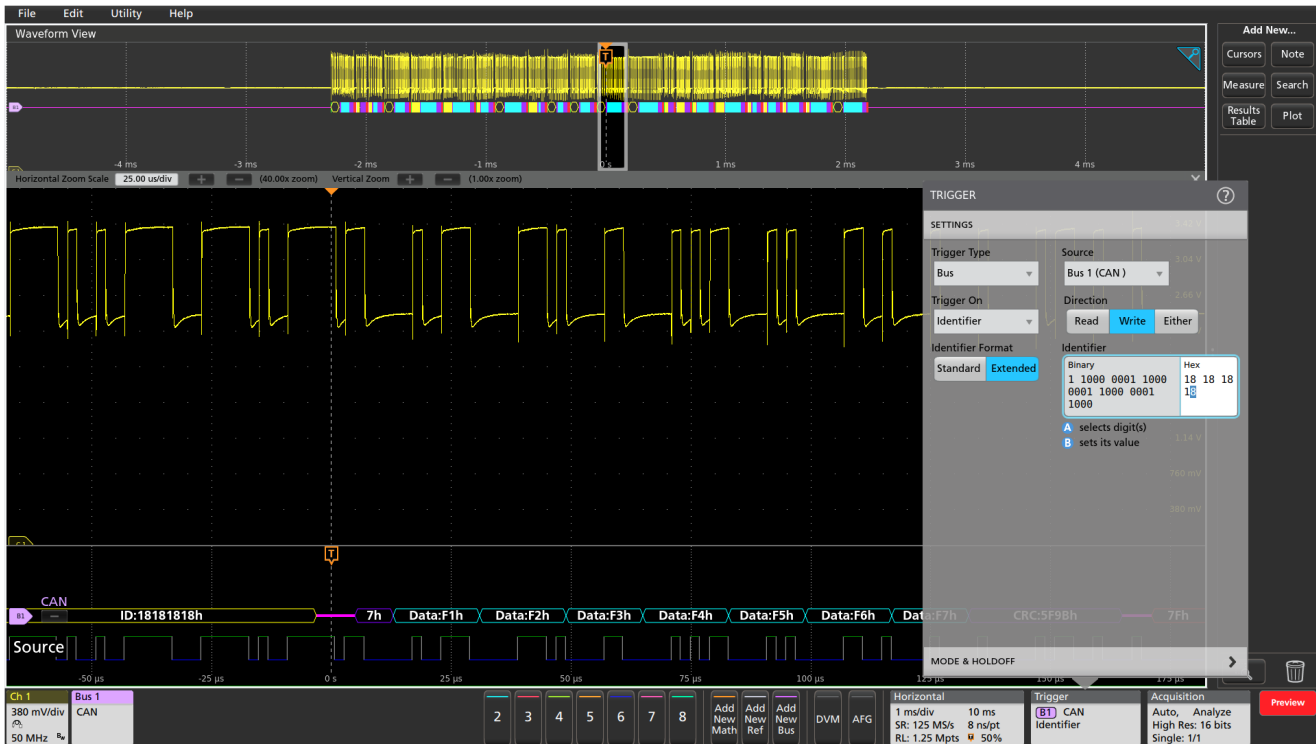
<sup>6</sup> Not available on 3 Series MDO.

## Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 1 Mb/s (automatic selection)
Decode Display	Start of Frame (green bar) Identifier (yellow packet) Data Length Control (purple packet) Data (cyan packet) CRC (purple packet) End of Frame (red bar) Errors (red packet)



Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the CAN bus.



Triggering on a specific extended Identifier value on the CAN bus.

## CAN FD (ISO and non-ISO) characteristics

### Bus setup options

Characteristic	Description
Source for CAN_H, CAN_L, Rx, or Tx (single-ended probing)	Analog channels Digital channels Active Math channels <sup>7</sup> Active Reference channels <sup>7</sup>
Source for Diff (differential probing)	Analog channels Active Math channels <sup>7</sup> Active Reference channels <sup>7</sup>
Thresholds	Per-channel thresholds
Recommended Probing: CAN_H, CAN_L, Rx, or Tx Diff	Single-ended Differential
Version	ISO non-ISO
SD Bit Rate Selection: Predefined list of rates Custom	10 kb/s - 1 Mb/s All but 3 Series MDO: 50 kb/s - 10 Mb/s 3 Series MDO: 10 kb/s - 1 Mb/s
FD Bit Rate Selection: Predefined list of rates Custom	All but 3 Series MDO: 1 Mb/s - 16 Mb/s 3 Series MDO: 1 Mb/s - 7 Mb/s All but 3 Series MDO: 500 kb/s - 16 Mb/s 3 Series MDO: 500 kb/s - 7 Mb/s
Sample Point	All but 3 Series MDO: 55% - 95% of bit period of unit interval 3 Series MDO: 15% - 95% of bit period of unit interval
Formats Available	Mixed Hex Hex Binary Symbolic (.dbc) <sup>7</sup>

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Start of Frame Type of Frame (Data, Remote, Error, Overload) FD Bits (Bit Rate Switch bit, Error State Indicator bit) Identifier (Standard or Extended) Data (1-8 bytes, trigger or search when =, ≠, <, ≤, >, ≥) Identifier and Data End of Frame Error (Missing Ack, Bit Stuffing Error, FD Form Error, Any Error)

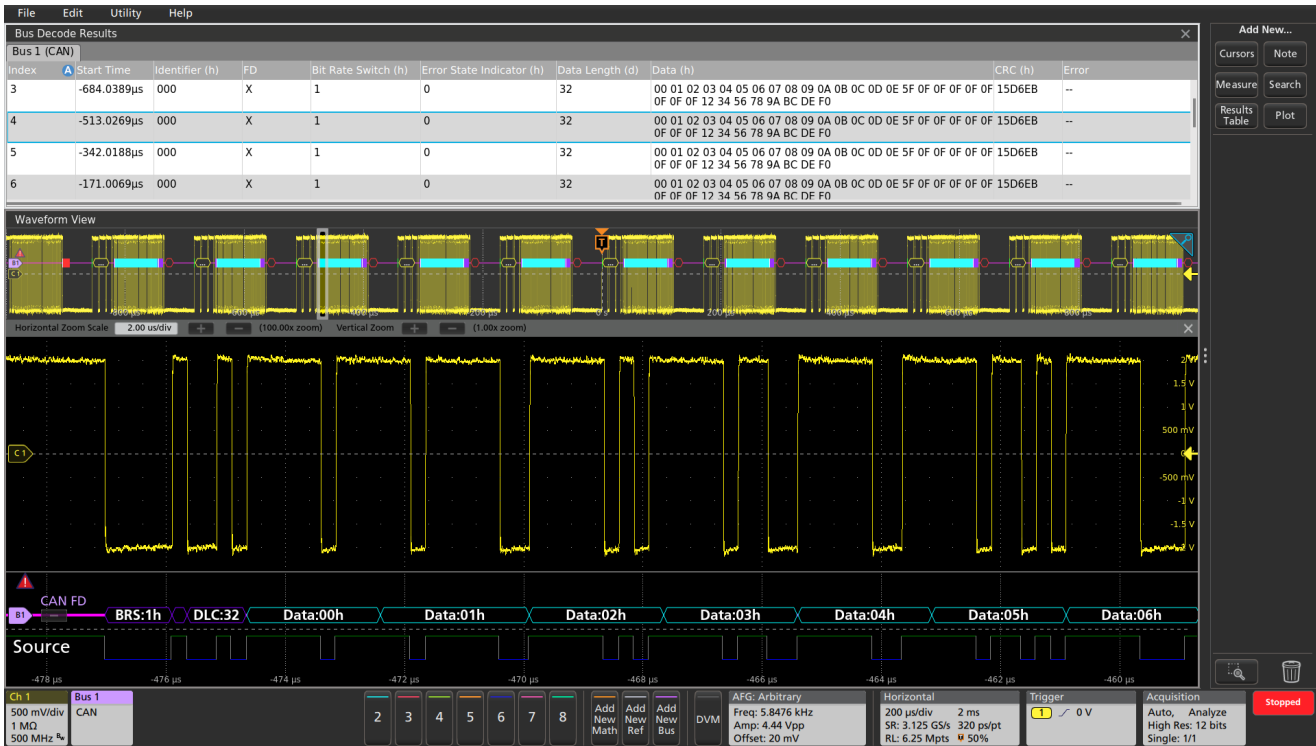
### Symbolic bus search options

Characteristic	Description
Message	As defined by the .dbc file <sup>7</sup>
Message and Signal	As defined by the .dbc file <sup>7</sup>

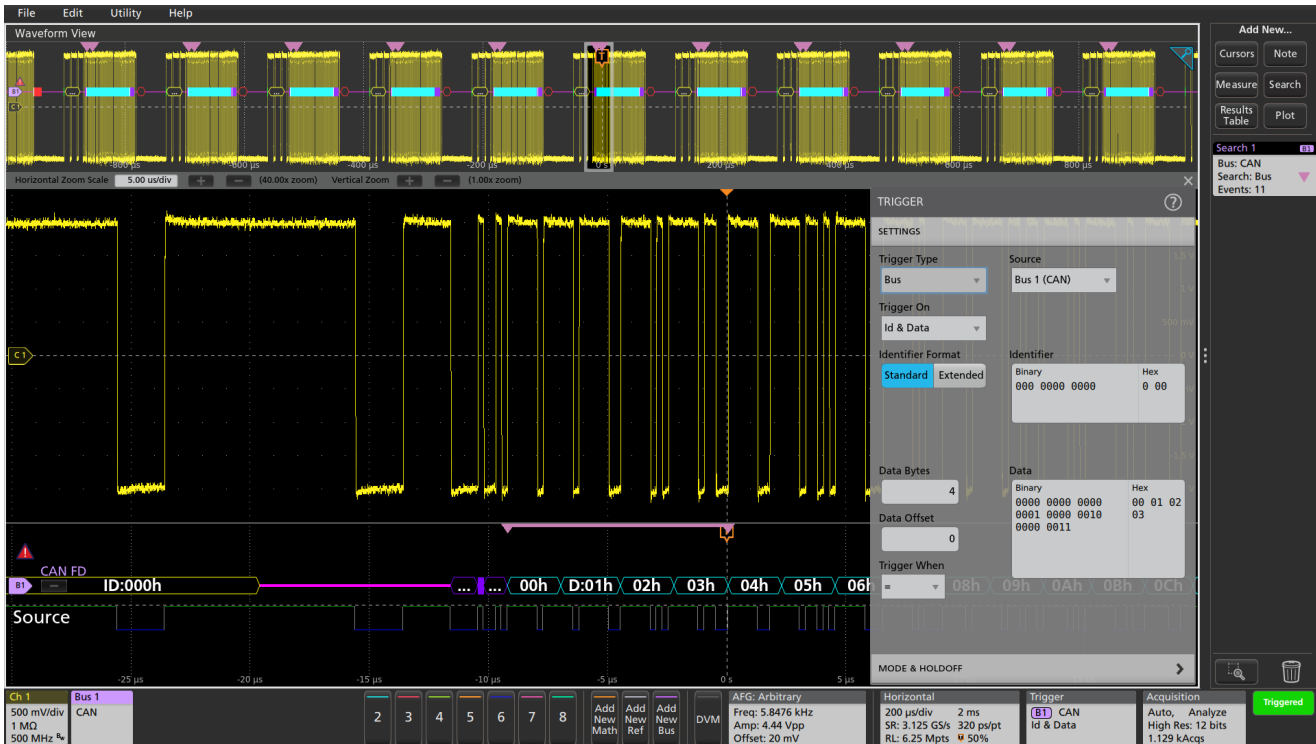
### Bus decode

Characteristic	Description
Decode Display	Start of Frame (green bar) Identifier (yellow packet) Data Length Control (purple packet) Data (cyan packet) CRC (purple packet) End of Frame (red bar) Errors (red packet)

<sup>7</sup> Not available on 3 Series MDO.



Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the CAN FD bus.



Triggering on a specific Identifier value and data pattern on the CAN FD bus and automatically searching on the same data pattern.

## LIN characteristics

### Bus setup options

Characteristic	Description
LIN Source	Analog channels Digital channels Active Math channels <sup>8</sup> Active Reference channels <sup>8</sup>
Thresholds	Per-channel thresholds
Recommended Probing	Single-ended
Polarity	Normal Inverted
Bit Rate Selection: Predefined list of rates Custom	1.2 kb/s - 19.2 kb/s All but 3 Series MDO: 1 kb/s - 100 kb/s 3 Series MDO: 800 b/s - 100 kb/s
Sample Point	All but 3 Series MDO: 0% - 100% of bit period of unit interval 3 Series MDO: 10% - 90% of bit period of unit interval
LIN Standard	V 1.x V 2.x Both
Include Parity Bits with ID	Yes No
Formats Available	Hex Binary Mixed

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

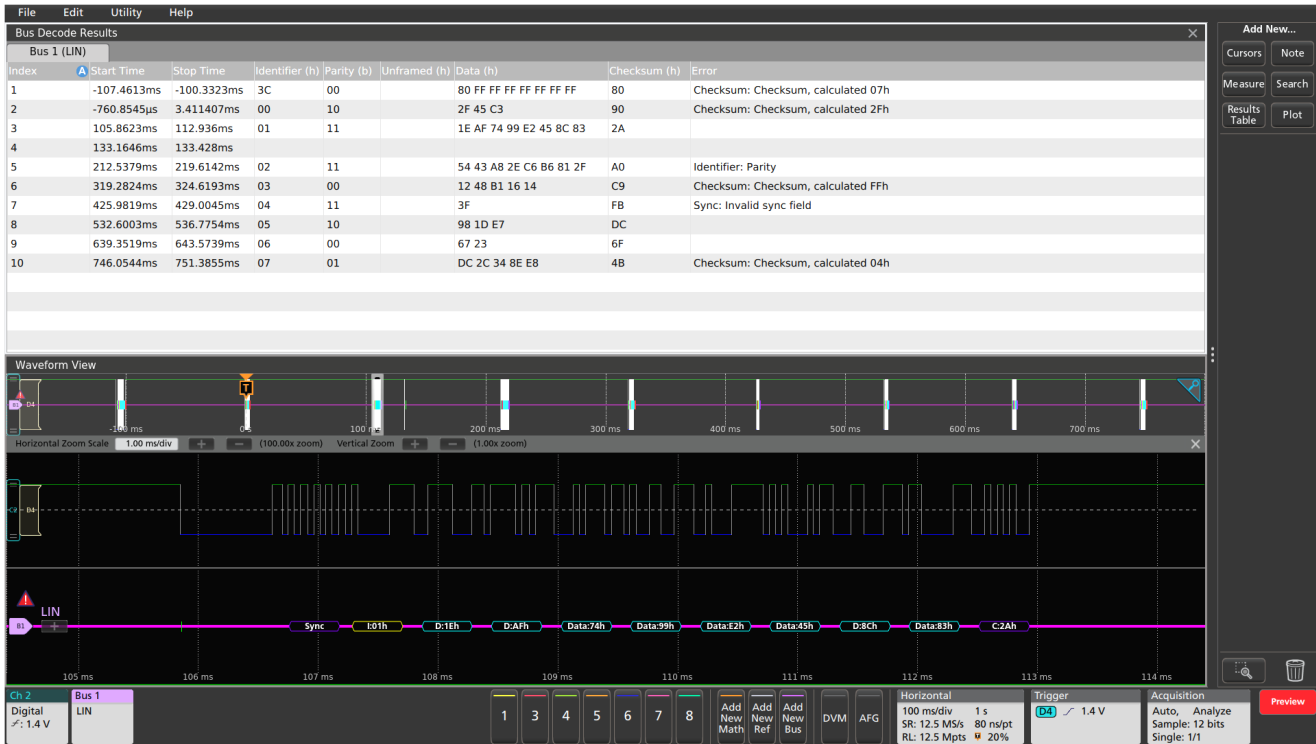
### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Sync Identifier Data (number of bytes 1-8, trigger or search when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) ID and Data Wakeup Frame Sleep Frame Error (Sync, ID Parity, Checksum)

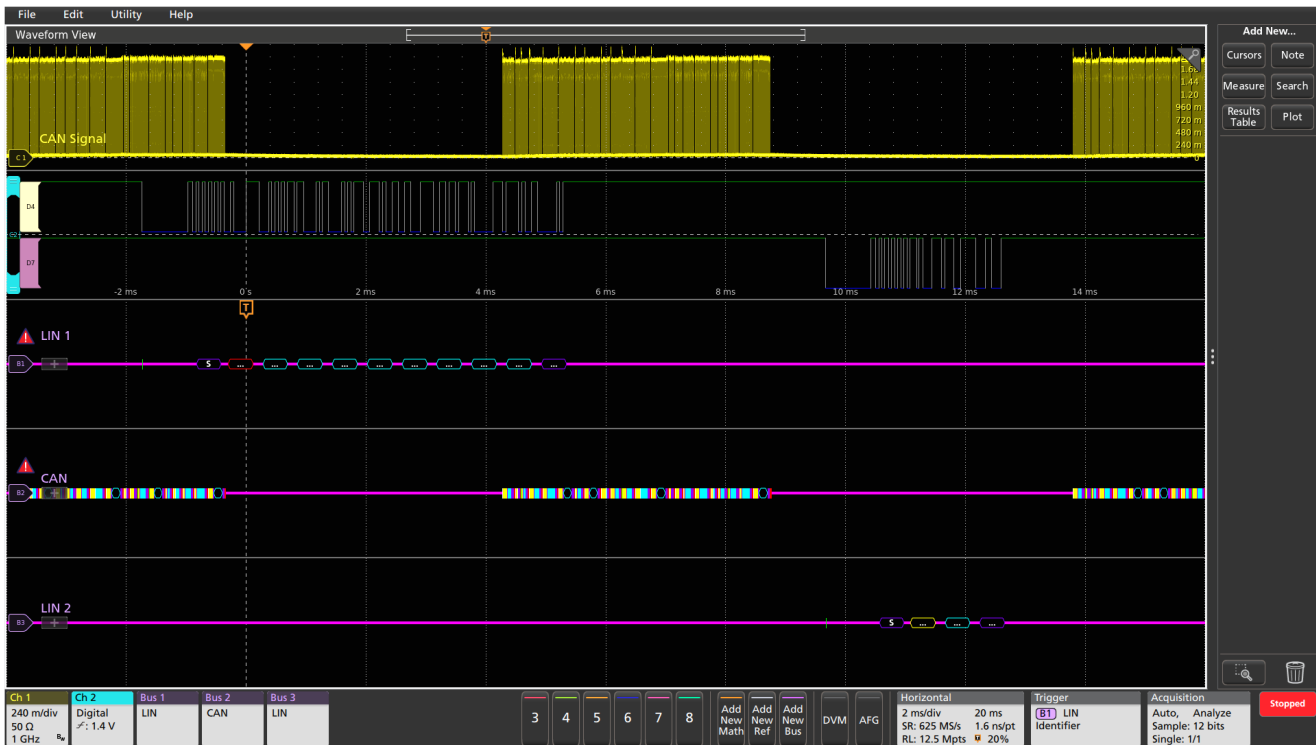
<sup>8</sup> Not available on 3 Series MDO.

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 100 kb/s, by LIN definition up to 20 kb/s (for automated decoding of bus)
Decode Display	Start of Frame (green bar) Sync Identifier (yellow packet) Data (cyan packet) CRC (purple packet) Errors (red packet)



Protocol Decode Results Table provides a time-stamped, tabular view of all captured LIN packets.



Display of multiple LIN and CAN buses, showing timing between the buses.

## FlexRay characteristics

### Bus setup options

Characteristic	Description
Source for Differential Probing (Bdiff)	Analog channels Active Math channels <sup>9</sup> Active Reference channels <sup>9</sup>
Source for Single-ended Probing (BP, BM)	Analog channels Digital channels Active Math channels <sup>9</sup> Active Reference channels <sup>9</sup>
Source for Single-ended Probing (Tx, Rx)	Analog channels Digital channels Active Math channels <sup>9</sup> Active Reference channels <sup>9</sup>
Thresholds: Bdiff BP, BM (analog channels) BP, BM (digital channels) Tx, Rx	High and Low thresholds High and Low thresholds Single threshold Single threshold
Recommended Probing: Bdiff, BP, BM Tx, Rx	Differential Single-ended
Channel Type	A B
Bit Rate Selection: Predefined list of rates Custom	2.5 Mb/s, 5 Mb/s, 10 Mb/s 1 Mb/s - 10 Mb/s
Formats Available	Hex Binary Mixed Hex (Decimal: ID, Len, and Count; Hex: Data and CRCs)

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

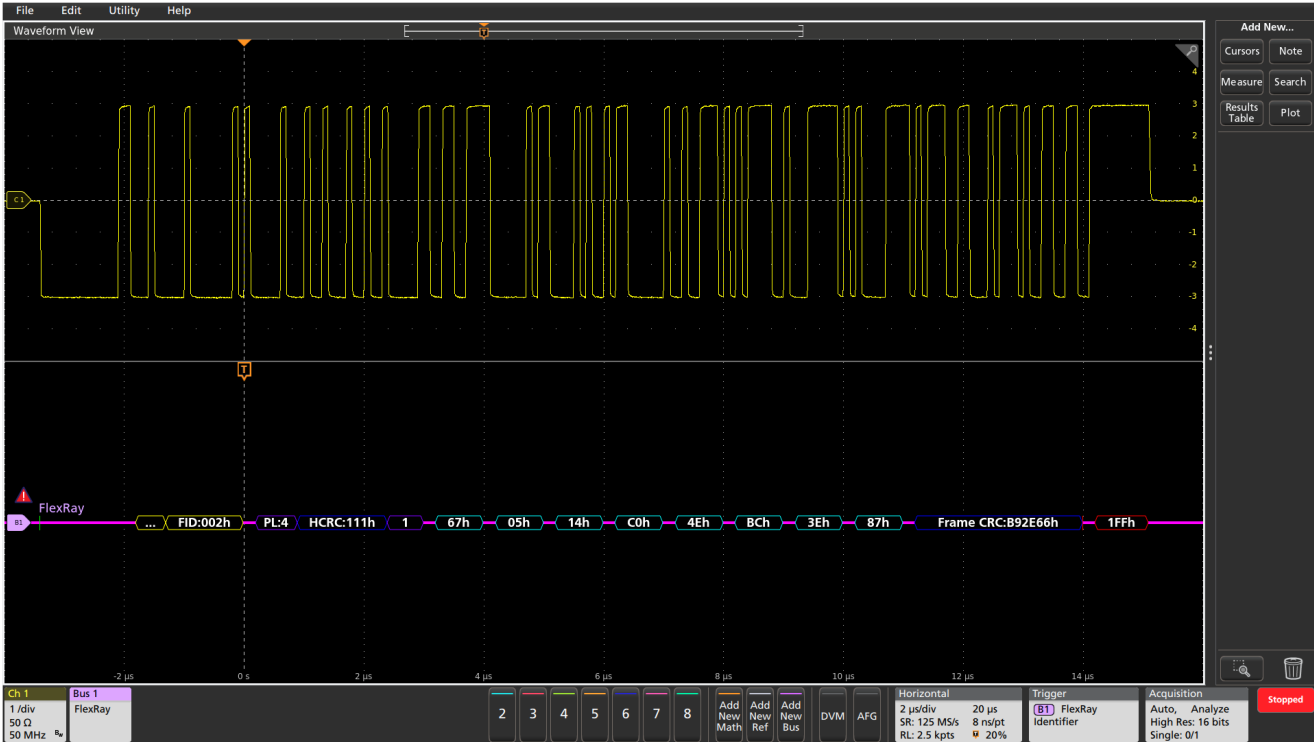
Characteristic	Description
Trigger and/or Search On	Start of Frame Indicator Bits (Normal, Payload, Null, Sync, Startup) Cycle Count (when =, ≠, <, ≤, >, ≥) Header Fields (Indicator Bits, Identifier, Payload Length, Header CRC, and Cycle Count) Identifier (when =, ≠, <, ≤, >, ≥) Data (when =, ≠, <, >, ≤, ≥) Identifier and Data End Of Frame (Static, Dynamic) Error (Header CRC, Trailer CRC, NULL Frame in Static, NULL Frame in Dynamic, Sync Frame in Dynamic, Start Frame No Sync)

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 10 Mb/s (for automated decoding of bus)
Decode Display	TTS (purple box) Start (green bracket) Frame ID (yellow box) Payload Length (purple box) Headers (purple box) Cycle Count (yellow box) Data (cyan box) CRC, DTS, CID (purple box) Stop (red bracket)

<sup>9</sup> Not available on 3 Series MDO.





Decoded FlexRay bus, with the acquisition triggered on a specified identifier value.



Decoded FlexRay bus, with all data values in a specific range marked with pink brackets.

**SENT Characteristics <sup>10</sup>**

**Bus setup options**

Characteristic	Description
SENT source	Analog channels Digital channels Active Math channels Active Reference channels
Thresholds	Per-channel thresholds
Recommended Probing	Single-ended
Polarity	Normal Inverted
Clock Tick	1 $\mu$ s - 300 $\mu$ s
Tick Tolerance	1% - 30%
Fast Data Channels	1 or 2
Data Nibbles (1 Fast Data Channel)	3, 4, or 6 nibbles
Channel Widths (C1/C2) (2 Fast Data Channels)	12/12, 14/10, or 16/8 bits
Pause Pulse	Yes No
Slow Channel	None Enhanced w/ 4-bit ID Enhanced w/ 8-bit ID Short
Formats Available	Mixed Hex Binary Hex Mixed Decimal

**Display modes**

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

**Bus trigger options**

Characteristic	Description
Trigger On	Start of Packet Fast Channel(s) (Status/Communication, Data) Slow Channel (Message ID, Data) CRC Error (Fast channel, Slow channel)

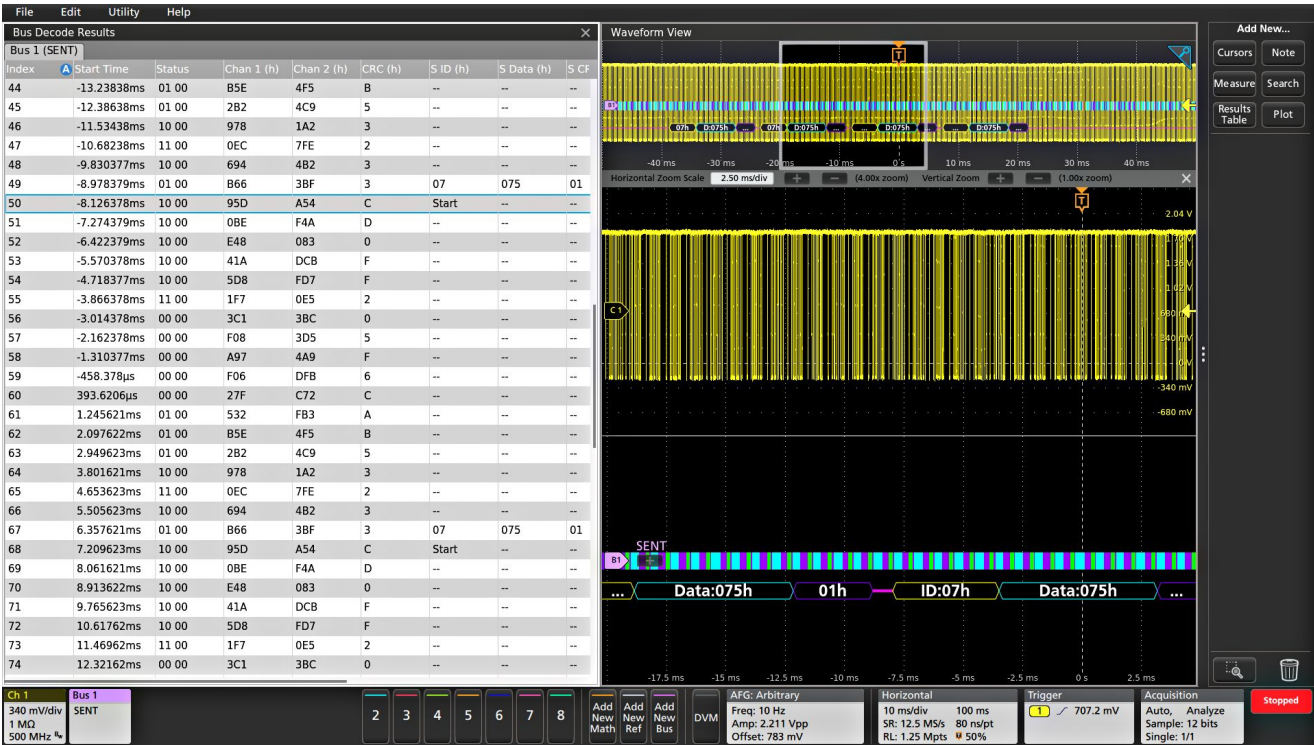
**Bus search options**

Characteristic	Description
Search On	Start of Packet Fast Channel(s) (Status/Communication, Data) Slow Channel (Message ID, Data) Pause Pulse (Number of Ticks) Error (Frame Length, Fast channel CRC, Slow channel CRC)

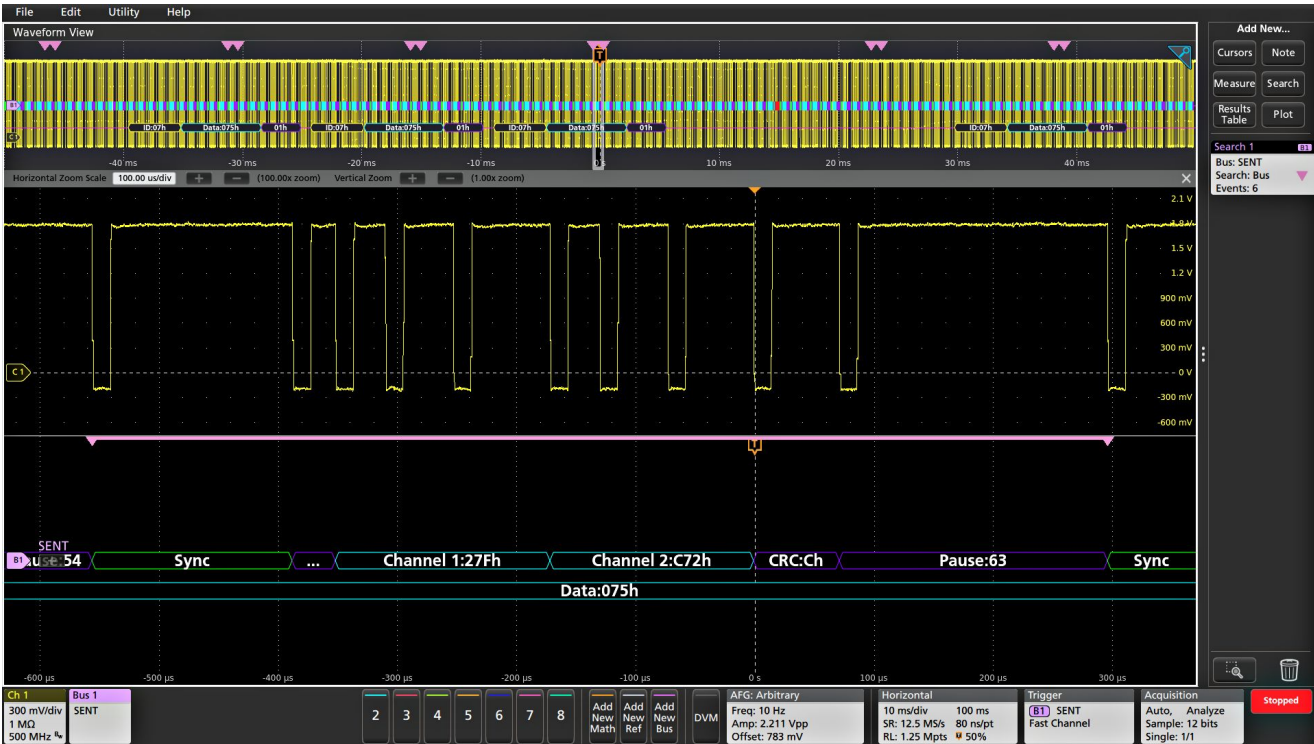
**Bus decode**

Characteristic	Description
Maximum Clock/Data Rate	Up to 10 Mb/s (for automated decoding of bus)
Decode Display	Sync (green packet) Fast Channel Status (purple packet) Slow Channel Message ID (yellow packet) Data (cyan packet) CRC (purple packet) Pause (purple packet) Errors (red packet)

<sup>10</sup> SENT is not available on 3 Series MDO.



Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the SENT bus.



Triggering on a specific Fast Channel Status and data pattern on the SENT bus and automatically searching on the same data pattern.

## MIL-STD-1553 characteristics

### Bus setup options

Characteristic	Description
MIL-STD-1553 Source	Analog channels Active Math channels Active Reference channels
Polarity	Normal Inverted
Thresholds	Single-ended: Per-channel thresholds Differential: High and low thresholds
Recommended Probing	Single-ended or differential
Bit Rate	1 Mb/s per the standard
Response Time	2 $\mu$ s-100 $\mu$ s
Formats Available	Mixed Hex Mixed ASCII Hex Binary

### Bus decode

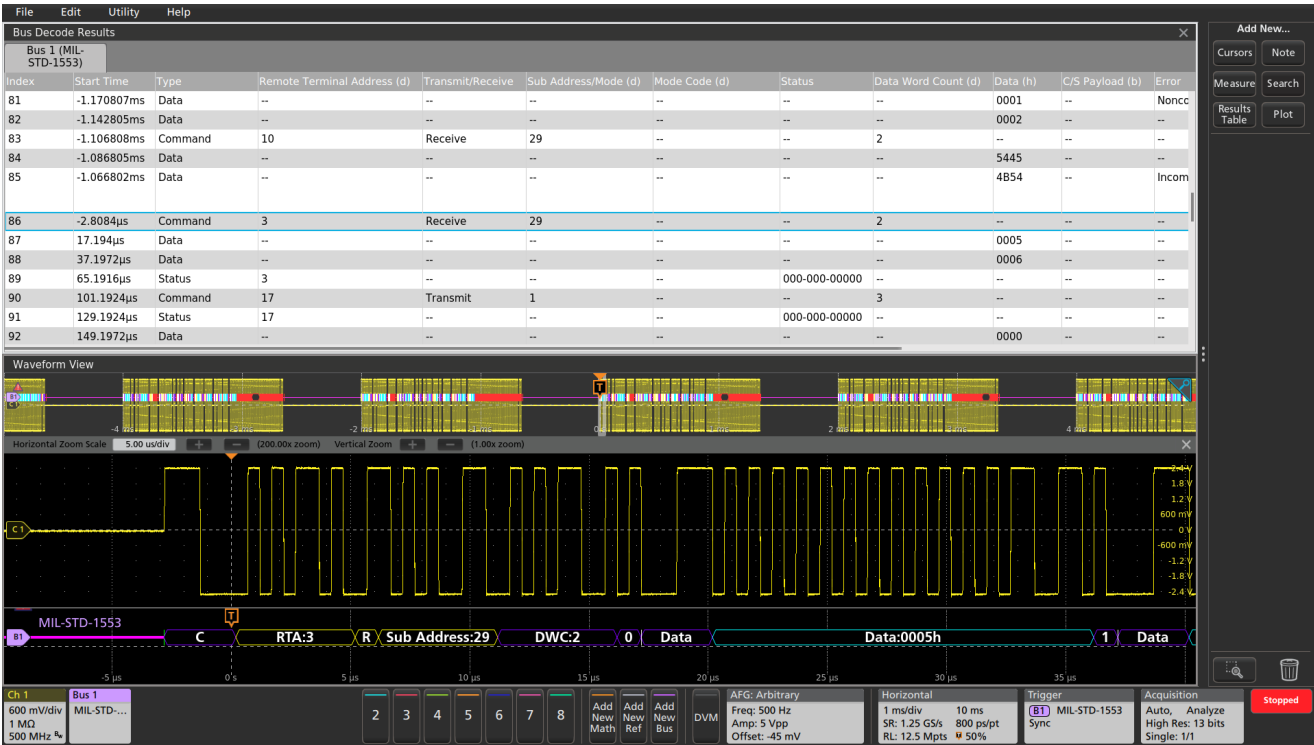
Characteristic	Description
Maximum Clock/Data Rate	Up to 1Mb/s (for automated decoding of bus)
Decode Display	Start (green bar) Sync (purple packet with Word Type identified) Address (yellow packet) R/T (purple packet) Word Count (purple packet) Data (cyan packet) Parity (purple packet) Errors (red packet) Stop (red bar)

### Display modes

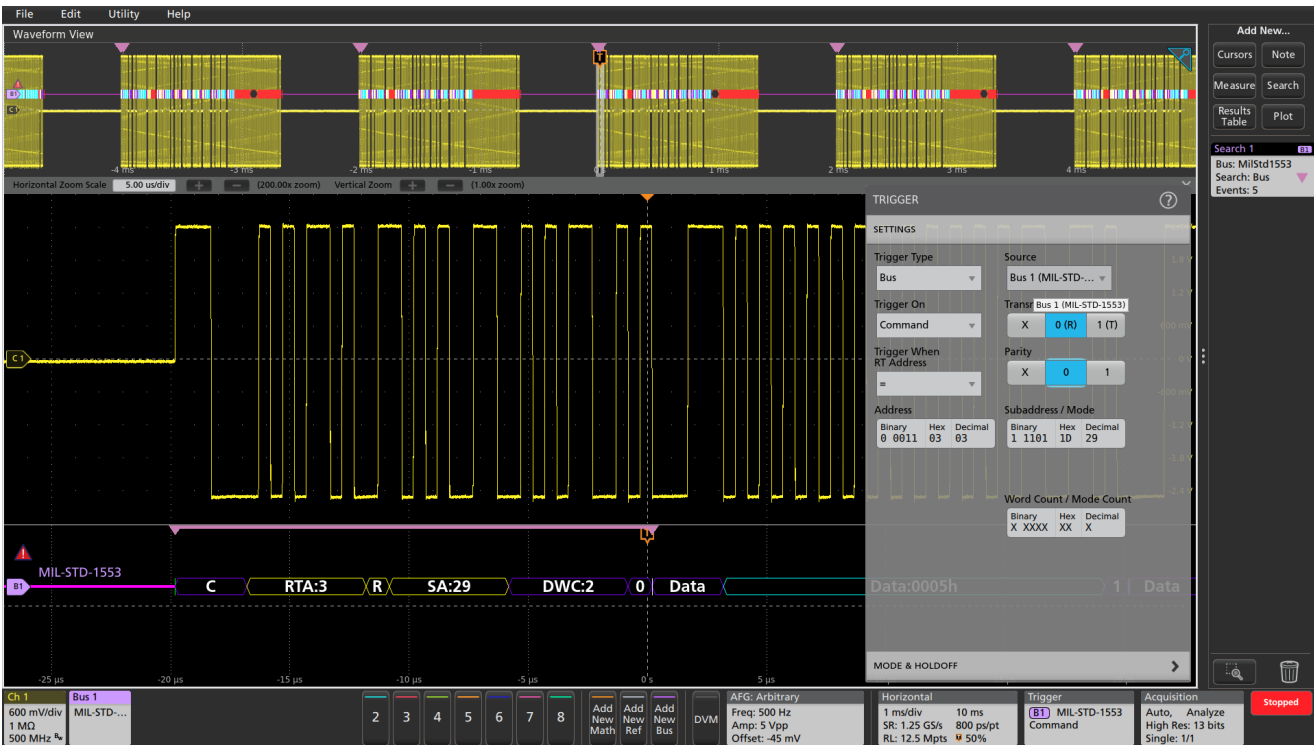
Characteristic	Description
Bus	Bus only
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Sync Command (Transmit/Receive Bit, Parity, Subaddress / Mode, Word Count / Mode Count, and RT Address =, $\neq$ , <, $\leq$ , >, $\geq$ , Inside Range, Outside Range) Status (Parity, Bit 9 - Message Error, Bit 10 - Instrumentation, Bit 11 - Service Request, Bit 15 - Broadcast Command Received, Bit 16 - Busy, Bit 17 - Subsystem Flag, Bit 18 - Dynamic Bus Control Acceptance, Bit 19 - Terminal Flag, and Data =, $\neq$ , <, $\leq$ , >, $\geq$ , Inside Range, Outside Range) Data (Parity, and Data =, $\neq$ , <, $\leq$ , >, $\geq$ , Inside Range, Outside Range) Time (RT / IMG) (> Maximum, < Minimum, Inside range, Outside Range) Error (Parity Error, Sync Error, Manchester Error (trigger only), Non-contiguous Data)



Protocol Decode Results Table provides a time-stamped, tabular view of all captured MIL-STD-1553 packets.



Triggering on a specific command pattern on the MIL-STD-1553 bus and automatically searching on the same pattern.

## ARINC 429 characteristics

### Bus setup options

Characteristic	Description
ARINC 429 Source	Analog channels Active Math channels Active Reference channels
Signal Type	Differential
Polarity	Normal Inverted
Thresholds	High and low thresholds
Recommended Probing	Differential
Bit Rate Selection: Predefined list of rates Custom	12.5 kb/s, 100 kb/s 10 kb/s - 1 Mb/s
Data Format	Data (19 bits) SDI+Data (21 bits) SDI+Data+SSM (23 bits)
Formats Available	Mixed Hex Hex Binary

### Display modes

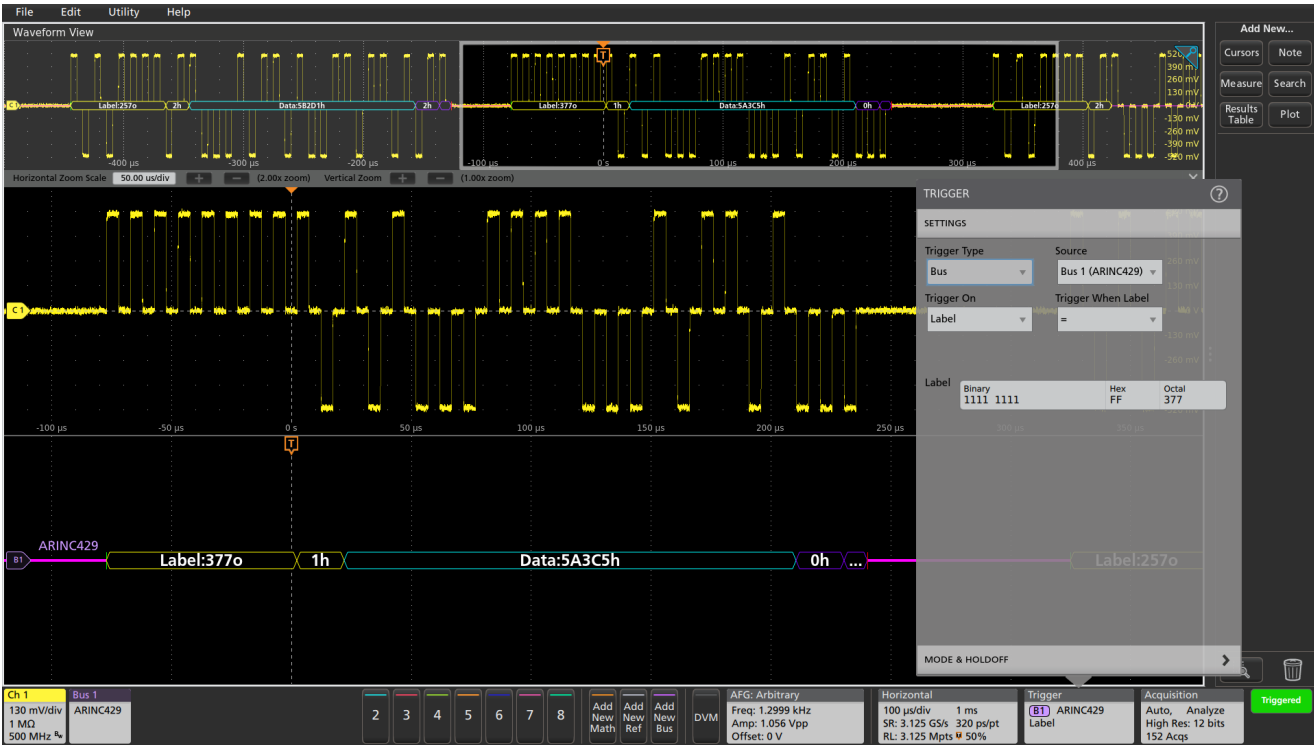
Characteristic	Description
Bus	Bus only
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

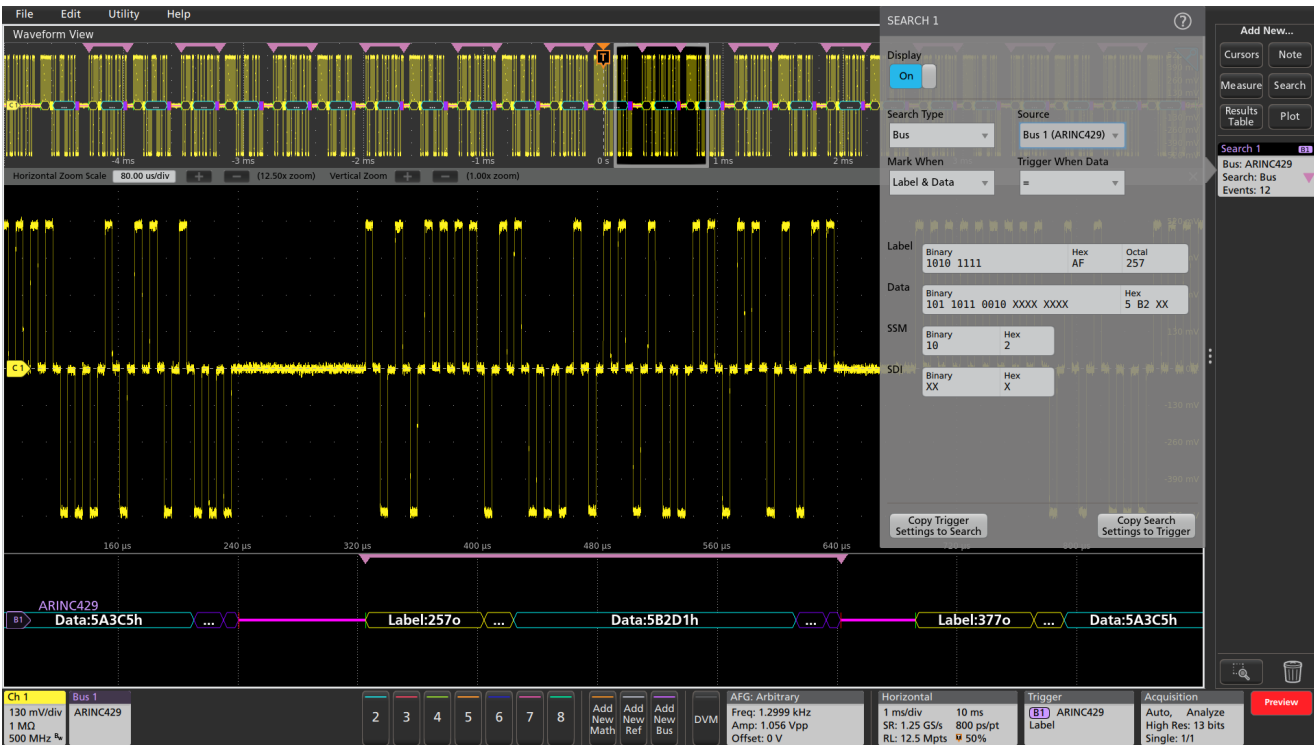
Characteristic	Description
Trigger and/or Search On	Word Start Label (when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Data (when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Label and Data (Label value and Data =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Word End Error (Any Error, Parity Error, Word Error, Gap Error)

### Bus decode

Characteristic	Description
Decode Display	Start (green bracket) Label (yellow box) Source Destination Identifier (yellow box) Data (cyan box) Sign/Status Matrix (purple box) Parity (purple box) Stop (red bracket) Error (red box)



Decoded ARINC 429 bus, with the acquisition triggered on a specified label value.



Decoded ARINC 429 bus, with all data values in a specific range marked with pink brackets.

## Audio characteristics

### Bus setup options

Characteristic	Description
Audio Sources (Bit Clock, Word Select, Data)	Analog channels Digital channels Active Math channels <sup>11</sup> Active Reference channels <sup>11</sup>
Thresholds	Per-channel thresholds
Bit Clock Polarity	Rising Edge Falling Edge
Word Select Polarity	Normal Invert
Data Polarity	Active High Active Low
Word Size	4 - 32 bits
Formats Available	Hex Binary Signed Decimal

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

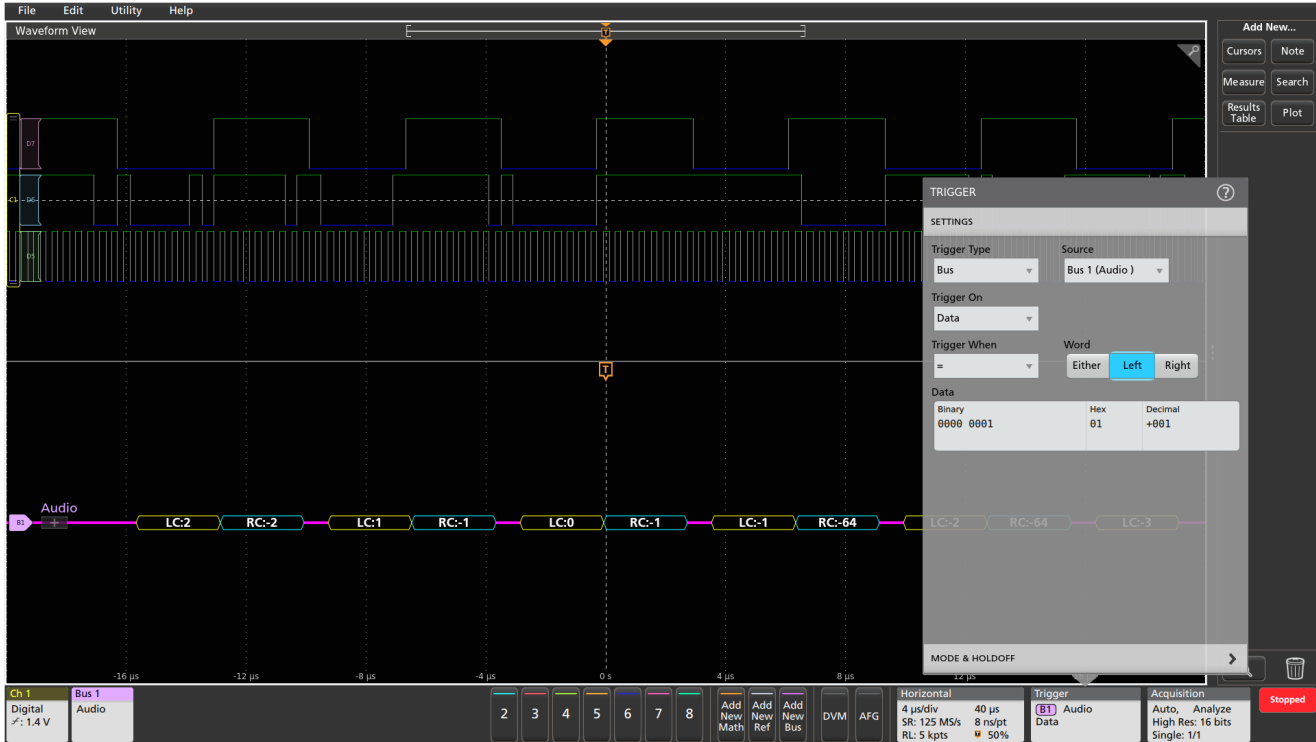
Characteristic	Description
Trigger and/or Search On	Word Select (I <sup>2</sup> S, LJ, RJ only) Frame Sync (TDM only) Data (when =, ≠, <, >, ≤, ≥, Inside Range, Outside Range; Left, Right, or Either Word)

### Bus decode

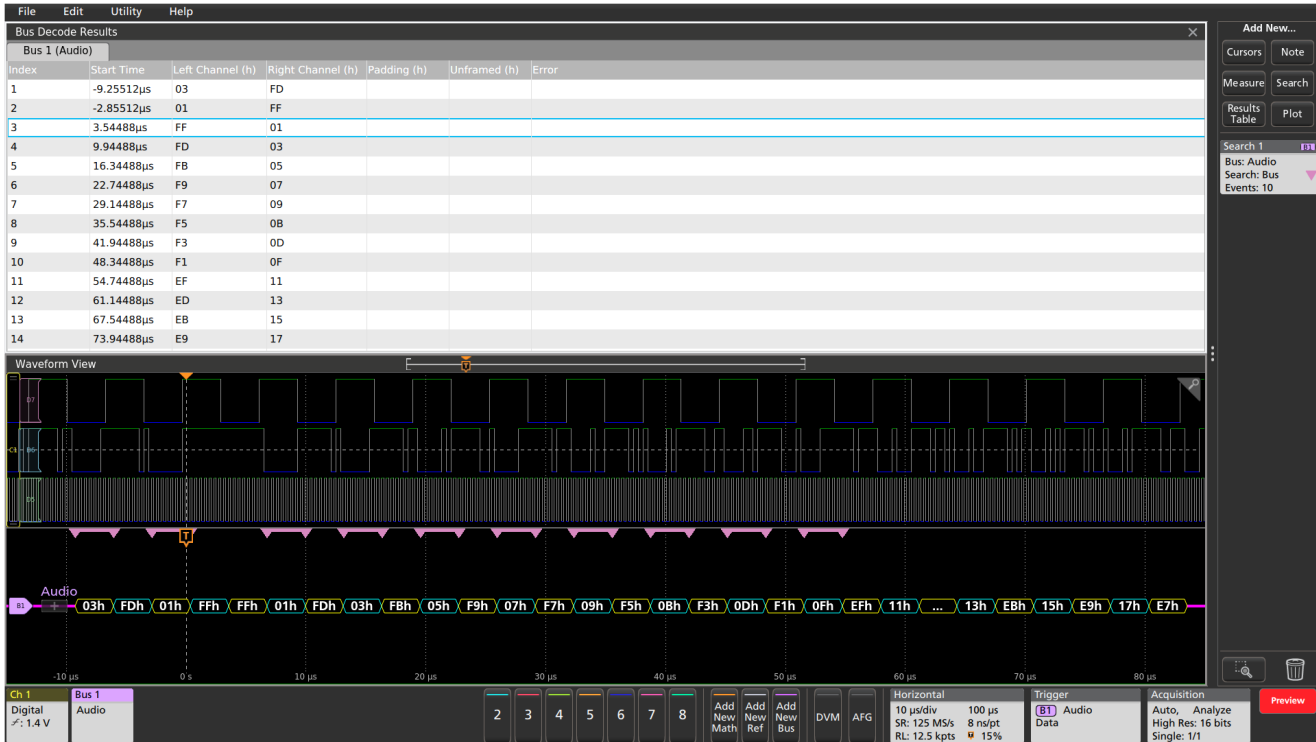
Characteristic	Description
Maximum Clock/Data Rate	All but 3 Series MDO: Up to 10 Mb/s (for automated decoding of bus) 3 Series MDO: Up to 12.5 Mb/s (for automated decoding of I <sup>2</sup> S/LJ/RJ bus) 3 Series MDO: Up to 25 Mb/s (for automated decoding of TDM bus)
Decode Display	Left Channel Data (I <sup>2</sup> S, LJ, RJ) (yellow box) Right Channel Data (I <sup>2</sup> S, LJ, RJ) (cyan box) Channel 1 Data (TDM) (yellow box) Channel 2 - N Data (TDM) (cyan box)

<sup>11</sup> Not available on 3 Series MDO.





Decoded I<sup>2</sup>S bus, with data values displayed in signed decimal format, and the MSO triggered on a specific data value.



Decoded I<sup>2</sup>S bus, with data values displayed in hex and Results Table format, and the Wave Inspector automatic search marking all occurrences of the data values equal to 0X hex.

## USB 2.0 Characteristics

### Bus setup options

Characteristic	Description
USB 2.0 Source(s)	Analog channels Digital channels (single-ended) Active Math channels Active Reference channels
Thresholds	Per-channel thresholds
Speed	High Speed (480 Mb/s) Full Speed (12 Mb/s) Low Speed (1.5 Mb/s)
Recommended Probing, LS and FS	Single-ended
Recommended Probing, HS	Differential
Formats Available	Mixed Hex Hex Binary Mixed ASCII

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger options

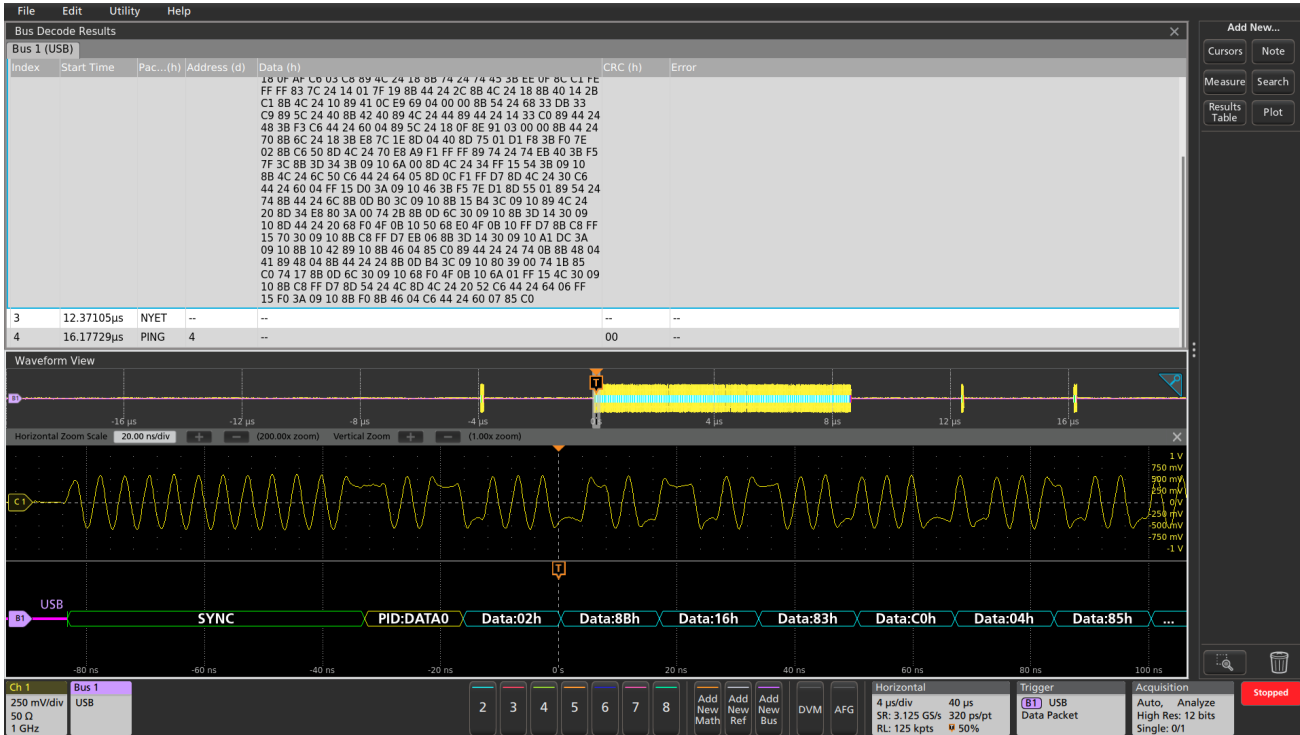
Characteristic	Description
Trigger On	Sync Reset Suspend Resume End of Packet Token (address) Packet Data Packet Handshake Packet: ACK, NAK, STALL, NYET (HS only) Special Packet: PRE (FS only), ERR, SPLIT, PING, Reserved Error: PID check, CRC5 or CRC16, Bit stuffing (LS and FS only)

### Bus Search options

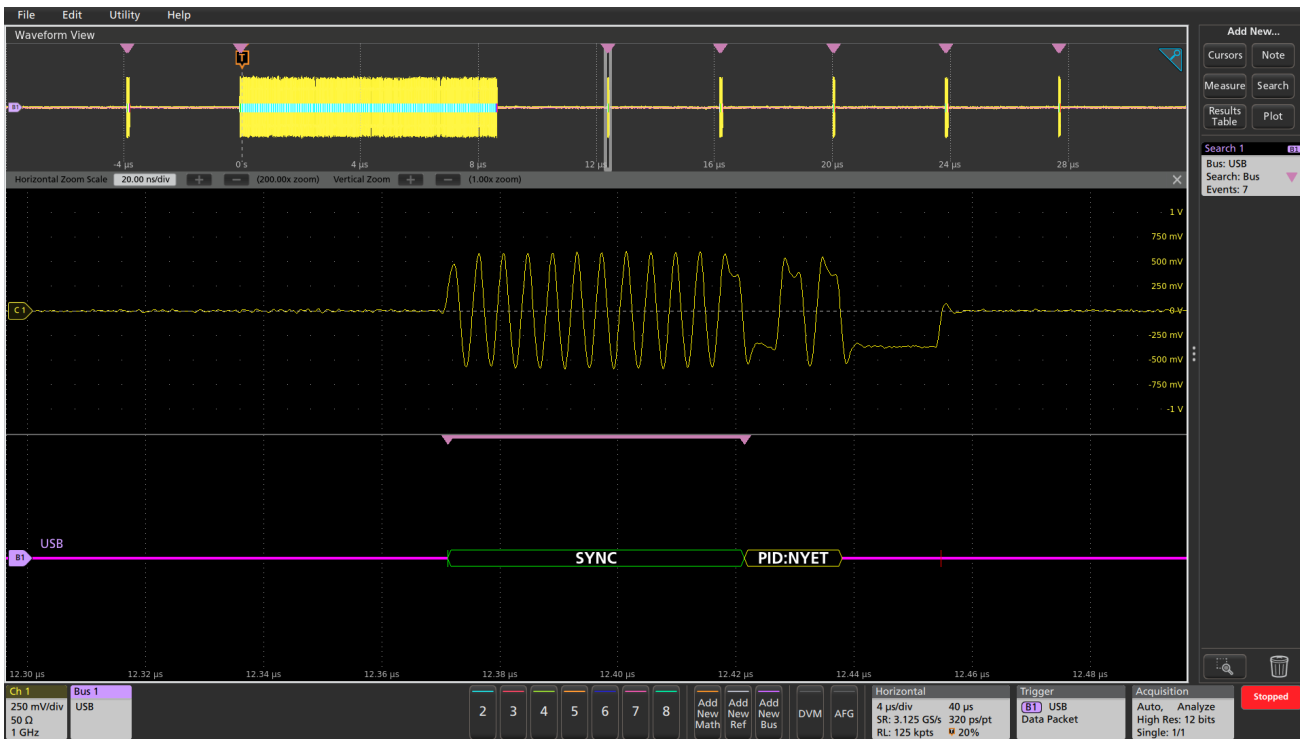
Characteristic	Description
Search On	Sync Reset Suspend Resume End of Packet Token (address) Packet Data Packet Handshake Packet: ACK, NAK, STALL, NYET (HS only) Special Packet: PRE (FS only), ERR, SPLIT, PING, Reserved Error: PID check, CRC5 or CRC16, Bit stuffing (LS and FS only)

### Bus decode

Characteristic	Description
Decode Display	Start of packet (green bar) Sync (green packet) PID (yellow packet) Token (address) (yellow packet) Data (cyan packet) CRC (purple packet) Error (red packet) End of packet (red bar)



Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the USB bus.



Triggering on a specific data pattern on the USB 2.0 bus and automatically searching on Sync.

## Ethernet characteristics <sup>12</sup>

### Bus setup options

Characteristic	Description
Ethernet Source(s)	Analog channels Active Math channels Active Reference channels
Thresholds	Per-channel thresholds
Speed	10BASE-T 100BASE-TX
Recommended Probing	Differential
Formats Available	Mixed Hex Hex Binary Mixed ASCII

### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger options

Characteristic	Description
Trigger On	Start Frame Delimiter MAC Addresses Q-Tag Control Information MAC Length/Type IPv4 Header TCP Header MAC Data TCP-IPv4 Client Data Idle End of Packet Frame Check Sequence (CRC) Error

### Bus search options

Characteristic	Description
Search On	Start Frame Delimiter MAC Addresses Q-Tag Control Information MAC Length/Type IPv4 Header TCP Header MAC Data TCP-IPv4 Client Data Idle End of Packet Frame Check Sequence (CRC) Error

### Bus decode

Characteristic	Description
Decode Display	Start of Packet (green bar) Preamble (purple packet) SFD (purple packet) Address (yellow packet) EtherType (yellow packet) IP packet (purple packet) Data (cyan packet) IPv4 packet (pink packet) TCP packet (white packet) Frame Check Sequence (yellow packet) Error (red packet) End of packet (red bar)

<sup>12</sup> Ethernet is not available on 3 Series MDO.



### SPMI characteristics <sup>13</sup>

#### Bus setup options

Characteristic	Description
SPMI Sources (Clock and Data)	Analog channels Digital channels Active Math channels Active Reference channels
Thresholds	Per-channel thresholds
Recommended Probing	Single-ended
Formats Available	Mixed Hex Hex Binary

#### Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

#### Bus trigger options

Characteristic	Description
Trigger On	Sequence Start Condition (SSC) Reset Sleep Shutdown Wakeup Authenticate Master Read Master Write Register Read Register Write Extended Register Read Extended Register Write Extended Register Read Long Extended Register Write Long Device Descriptor Block Master Read Device Descriptor Block Slave Read Register 0 Write Transfer Bus Ownership Parity Error

#### Bus search options

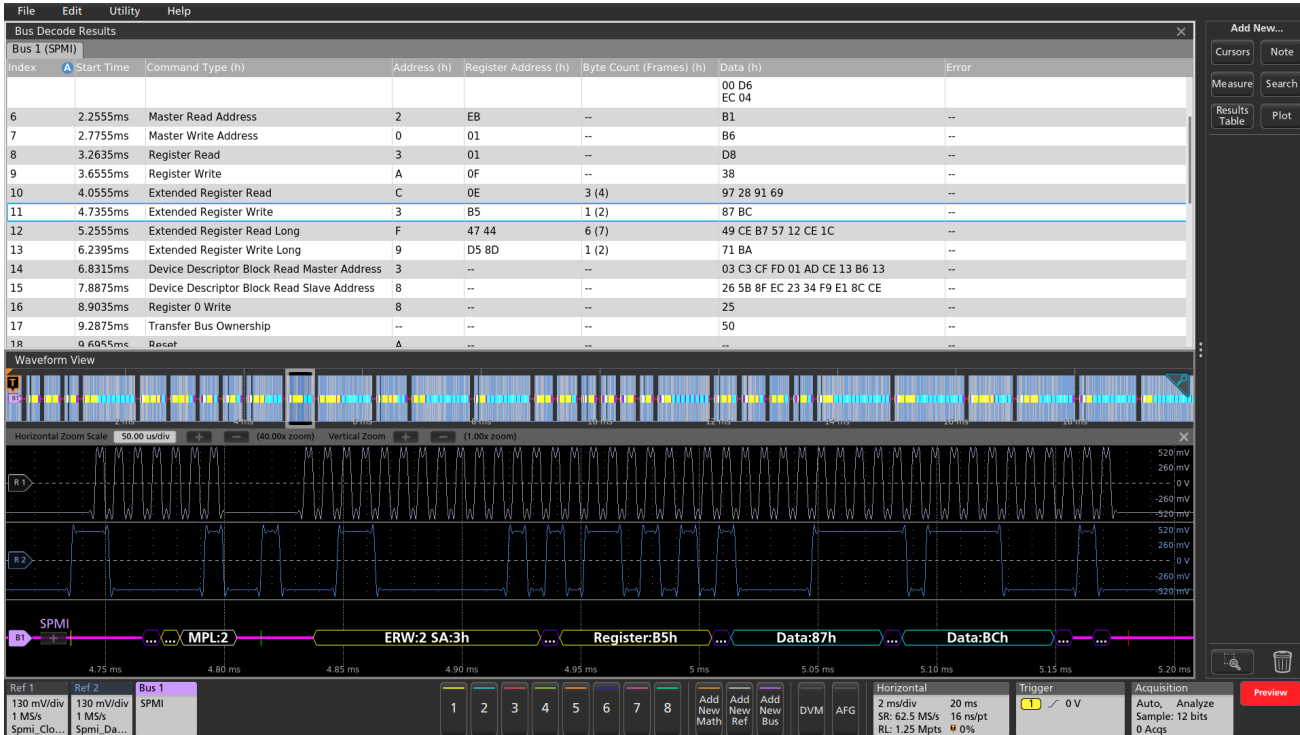
Characteristic	Description
Search On	Sequence Start Condition (SSC) Reset Sleep Shutdown Wakeup Authenticate Master Read Master Write Register Read Register Write Extended Register Read Extended Register Write Extended Register Read Long Extended Register Write Long Device Descriptor Block Master Read Device Descriptor Block Slave Read Register 0 Write Transfer Bus Ownership Parity Error

#### Bus decode

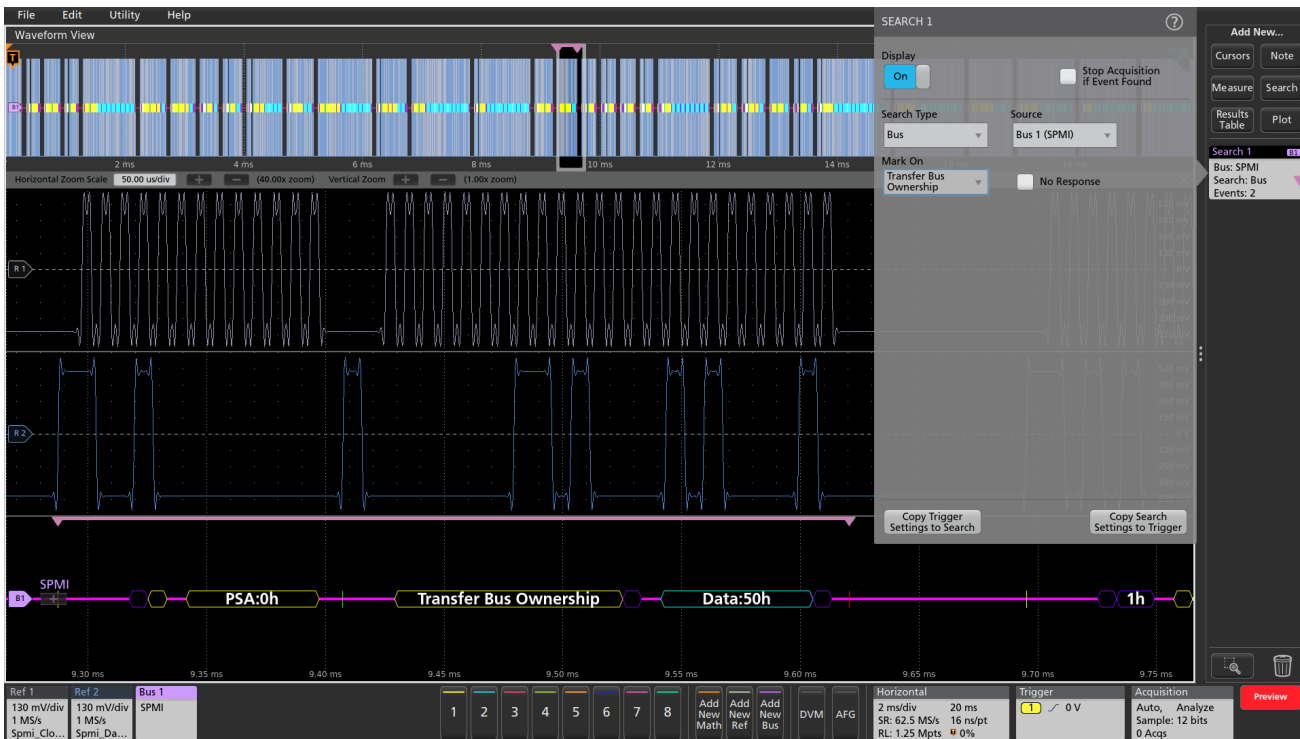
Characteristic	Description
Decode Display	Arbitration Start (yellow bar) Connect Bit (purple packet) Master ID (purple packet) Alert Bit (yellow packet) Slave Request Bit (yellow packet) Master Priority Level (gray packet) SSC (green bar) Command Frame, including Byte Count <sup>14</sup> (yellow packet) Address (yellow packet) Data (cyan packet) Parity (purple packet) Ack/Nack (purple packet) Parity error (red packet) End of packet (red bar)

<sup>13</sup> SPMI is not available on 3 Series MDO.

<sup>14</sup> The actual decimal Byte Count is displayed in Mixed Hex format, but the raw value is shown in Binary and Hex formats.



Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the SPMI bus.



Automatically searching the SPMI bus for the Transfer Bus Ownership command

## SpaceWire characteristics

### Bus setup options

Characteristic	Description
SpaceWire Sources (Strobe and Data)	Analog Channels Digital Channels Active Math Channels Active Reference Channels
Thresholds	Per-Channel Thresholds
Recommended Probing	Differential
Address/Data Formats Available	Hex Binary

### Display modes

Characteristic	Description
Bus	Bus Only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus search options

Characteristic	Description
Search On	Synchronization Control Code Control Character Data Errors

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	2 Mbits/sec to 200 Mbits/sec
Decode Display	Null Control Character Control Code FCT Time-Code Parity Data-Control Flag Data End Of Packet Error End Of Packet Escape Sequence Escape Error Start FCT Start NULL



SEARCH 1

Display: On

Search Type: Bus

Source: Bus 1 (SpaceWire)

Mark On: Control Code

Control Code Type: Time Code

Time Code: Binary (XX XXXX), Hex (XX)

Horizontal: 100  $\mu$ s/div

Vertical: 2.00 mV/div

Horizontal Zoom Scale: 50.00x zoom

Vertical Zoom Scale: 2.40x zoom

SpaceWire Data:5Eh ESC:7h 0h Time-Code:3Ch

Ref 1: 500 mV/div, 104.5361... spacewire...

Ref 2: 500 mV/div, 104.5361... spacewire...

Bus 1: SpaceWire

Horizontal: 100  $\mu$ s/div, SR: 1.25 GS/s, RL: 1.25 Mpts

Trigger: 0 V

Acquisition: Auto, Analyze, Sample: 12 bits, 2.575 kAcps

18 Jun 2019 3:26:41 AM

Searching on a specific data pattern on the SpaceWire bus and automatically searching on Sync.

Bus Decode Results

Index	Start Time	Control Character (h)	Control Code (h)	Data (h)	Error
7	177.9241 $\mu$ s	FCT FCT FCT FCT FCT FCT FCT FCT	--	--	--
8	213.2803 $\mu$ s	--	--	89 C4 CD 17 D8 D9 32	--
9	258.1069 $\mu$ s	EOP	--	--	--
10	260.001 $\mu$ s	FCT FCT FCT	--	--	--
11	267.5773 $\mu$ s	--	--	5A 72 86	--
12	287.1495 $\mu$ s	EOP	--	--	--
13	289.0436 $\mu$ s	FCT FCT	--	--	--
14	294.0945 $\mu$ s	--	--	97 71	--
15	307.353 $\mu$ s	EOP	--	--	--
16	309.2471 $\mu$ s	FCT FCT FCT FCT	--	--	--

SpaceWire FCT:4h 0h FCT:4h 0h FCT:4h 0h FCT:4h 0h FCT:4h 0h FCT:4h 0h FCT:4h 0h FCT:4h

Horizontal: 100  $\mu$ s/div, SR: 1.25 GS/s, RL: 1.25 Mpts

Trigger: 0 V

Acquisition: Auto, Analyze, Sample: 12 bits, 1.847 kAcps

18 Jun 2019 3:25:53 AM

The Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the SpaceWire bus.

## Automotive Ethernet (100BASE-T1) characteristics

### Bus setup options

Characteristic	Description
Ethernet Source(s)	Analog Channels Active Math Channels Active Reference Channels
Thresholds	Per-channel Thresholds
Speed	100 Mb/s/sec
Recommended Probing	Differential
Formats Available	Mixed Hex Hex Binary Mixed ASCII

### Display modes

Characteristic	Description
Bus	Bus Only
Results Table	Decoded packet data in a tabular view

### Bus search options

Characteristic	Description
Search On	Start of Frame Start of Frame Delimiter MAC Addresses Q-Tag Control Information MAC Length/Type IPv4 Header TCP Header MAC Data TCP-IPv4 Client Data End of Packet Frame Check Sequence (CRC) Error

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	100 Mb/s/sec
Decode Display	Start of Packet (green bar) Preamble (purple packet) SFD (purple packet) Address (yellow packet) EtherType (yellow packet) IP packet (purple packet) Data (cyan packet) IPv4 packet (pink packet) TCP packet (white packet) Frame Check Sequence (yellow packet) Error (red packet) End of packet (red bar)

The screenshot displays the 'Bus Decode Results' window for 'Bus 1 (Auto Ethernet)'. The table below shows the decoded data for a packet at index 1.

Index	Start Time	MAC Destination Address	MAC Source Address	Tag Protocol Identifier (h)	Tag Control Information (h)	Ether Type (h)	Data (h)	IP Version (h)	IP Header Length
1	30.6038µs	D0:67:E5:50:6F:6E	F0:1F:AF:38:FE:A2	--	--	0806	00 01 08 00 06 04 00 01 F0 1F AF 38 FE A2 C0 9E 01 01 D0 67 E5 50 6F 6E C0 9E 01 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	--	--

The waveform view below shows the signal timing with a zoomed-in section of the packet. The protocol decode bar at the bottom identifies the components: Preamble:555555555555h, MACDA:D0:67:E5:50:6F:6E, MACSA:F0:1F:AF:38:FE:A2, and 0806h.

The Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the Automotive Ethernet (100BASE-T1) bus.

The screenshot shows the search configuration window for 'SEARCH 1'. The search is set to 'On' and 'Bus 1 (AutoEth...)'. The search criteria are set to 'Start of Frame'.

- SEARCH 1**
  - Display:  On
  - Stop Acquisition if Event Found:
  - Search Type: Bus
  - Source: Bus 1 (AutoEth...)
  - Mark On:
    - Start of Frame**
    - Start of Frame Delimiter
    - MAC Address
    - Q-Tag Control Information
    - MAC Length/Type
    - IP Header
    - TCP Header
    - Client Data
    - End of Packet
    - FCS (CRC) Error
  - Copy Trigger Settings to Search:
  - Copy Search Settings to Trigger:

The background shows the waveform view with the search results highlighted in yellow and blue. The protocol decode bar at the bottom shows the packet details: Preamble:555555555555h, MACDA:D0:67:E5:50:6F:6E, MACSA:F0:1F:AF:38:FE:A2, and 0806h.

Searching on a specific data pattern on the Automotive Ethernet (100BASE-T1) bus and automatically searching on Start of Frame.

## 8b10b Characteristics

### Bus setup options

Characteristic	Description
8b10b Sources (Strobe and Data)	Analog Channels Digital Channels Active Math Channels Active Reference Channels
Thresholds	Per-Channel Thresholds
Recommended Probing	Differential
Formats Available	Hex Binary Symbolic

### Display modes

Characteristic	Description
Bus	Bus Only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus search options

Characteristic	Description
Search On	Symbols [Format:8bit,10bit&symbol] Errors

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	1 Tbits/sec
Decode Display	Control Symbol (yellow packet) Data Symbol (cyan packet)
Error Handling	Invalid Symbols Running Disparity (6 bit and 4 bit)

File Edit Utility Help WARNING: This oscilloscope has not been calibrated. SEARCH 1

Bus Decode Results					
Bus 1 (8b10b)					
Index	Start Time	Raw Data (b)	Data (h)	Control (h)	Error
28	111.4412ns	0101010101	D10.2	--	--
29	122.9276ns	0101010101	D10.2	--	--
30	134.4162ns	0101010101	D10.2	--	--
31	145.9012ns	0101010101	D10.2	--	--
32	157.4013ns	0101010101	D10.2	--	--
33	168.8876ns	0011111010	--	K28.5-	--
34	180.3807ns	0100101101	D2.4+	--	--
35	191.861ns	0001101101	D8.4+	--	--
36	203.4415ns	1011000100	D13.0+	--	--
37	214.9765ns	1100101100	D19.3-	--	--
38	226.4654ns	1001011011	D9.0-	--	--
39	237.9154ns	1011001010	D13.5	--	--
40	249.326ns	0011010101	D12.2	--	--
41	260.8957ns	1000110011	D17.3+	--	--

Waveform View

Horizontal Zoom Scale: 20.00 ns/div (10.0x zoom) Vertical Zoom: (1.00x zoom)

8b10b  
B1 2 D10.2 D10.2 D10.2 D10.2 D10.2 D10.2 D10.2 K28.5- D2.4+ D8.4+ D13.0+ D19.3- D9.0- D13.5 D12.2 D17.3+

Ch 1 Bus 1  
100 mV/div 8b10b  
1 MΩ  
500 MHz

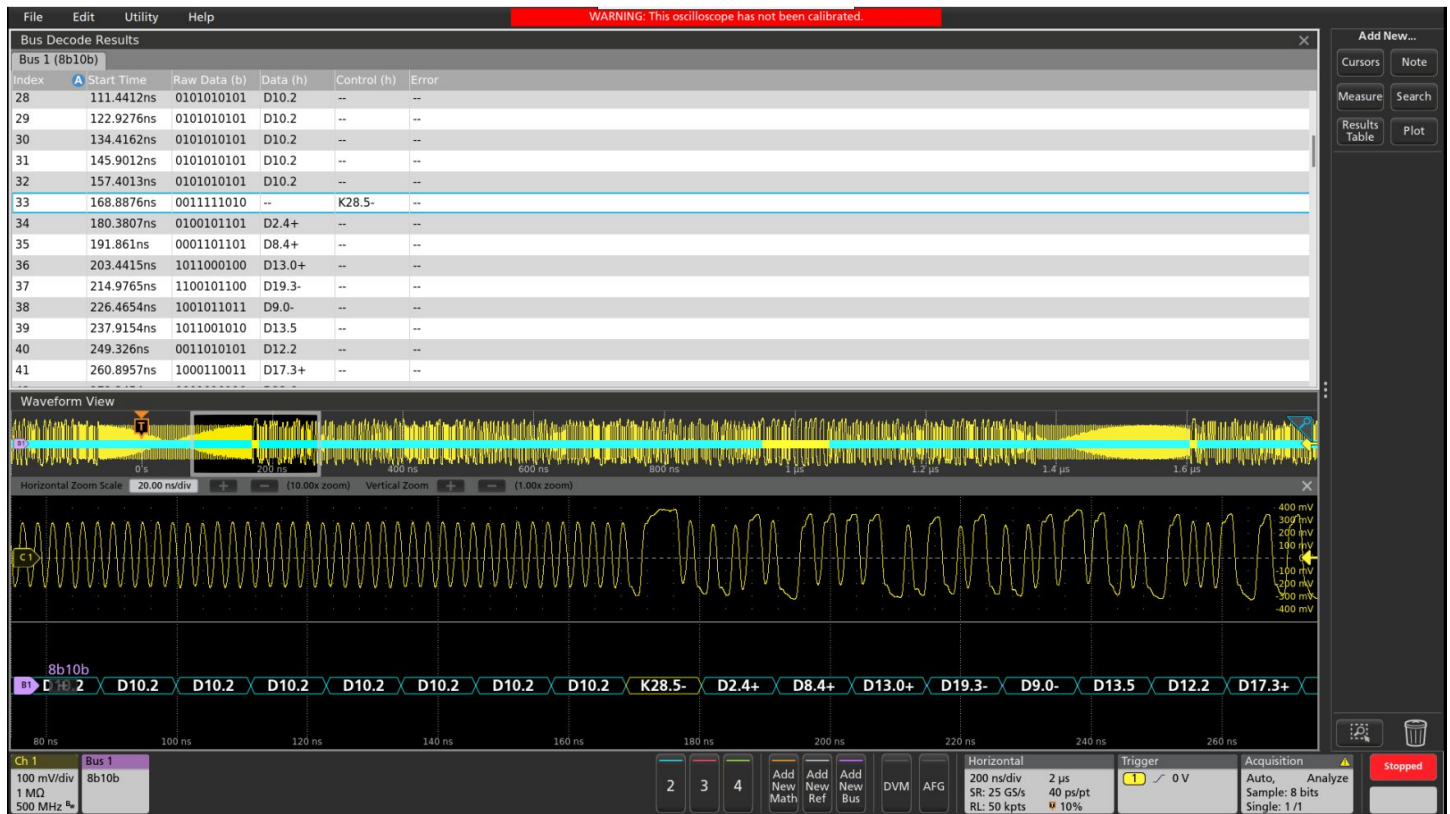
Horizontal: 200 ns/div 2 μs  
SR: 25 GS/s 40 ps/pt  
RL: 50 kpts 10%

Trigger: 1 0 V

Acquisition: Auto, Analyze  
Sample: 8 bits  
Single: 1/1

Stopped

Searching on a specific data symbol in symbol format on a 8b10b bus



The Protocol Decode results table provides time-stamped, tabular view of all captured packets on a 8b10b bus

## NRZ Characteristics

### Bus setup options

Characteristic	Description
NRZ Source(s)	Analog Channels Digital Channels Active Math Channels Active Reference Channels
Thresholds	Per-channel Thresholds
Recommended Probing	Differential
Bit Order	MSB First LSB First
Polarity	Normal Invert
Formats Available	Hex Binary

### Bus search options

Characteristic	Description
Search On	Data Bytes [Maximum 5]

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	1Gbits/sec
Decode Display	Data (cyan packet)

### Display modes

Characteristic	Description
Bus	Bus Only
Bus and Waveforms	Simultaneous display of bus and digital waveforms.
Results Table	Decoded packet data in a tabular view

**Bus Decode Results**

Index	Start Time	Data (h)	Error
1	-10.29854ps	73 37 2A 65	--
		2C 6D 95 6C	
		9A A5 69 59	
		C9 A6 AA 56	
		59 56 A5 35	
		AD 92 AD 5A	
		AC 79 AC 99	
		A8 64 6A 5A	
		99 A2 D5 63	
		6A 9A 96 5A	
		82 E9 9D 35	
		9A 51 9C C6	
		A9 96 E1 91	
		4E 54 82 AB	
		9A 6D 2E 6C	
		5A C5 64 AE	
		55 5B 24 AD	
		AA AE 8E 52	
		AA A5 65 6E	
		4C 9A 56 3C	

**SEARCH 1**

Display:  On Act on Event

Search Type: Bus Source: Bus 1 (NRZ)

Mark On Data

Data Bytes	Data	Hex
1	Binary 0100 1011	4B

Copy Trigger Settings to Search D5h = 5Ch Copy Search Settings to Trigger

**Waveform View**

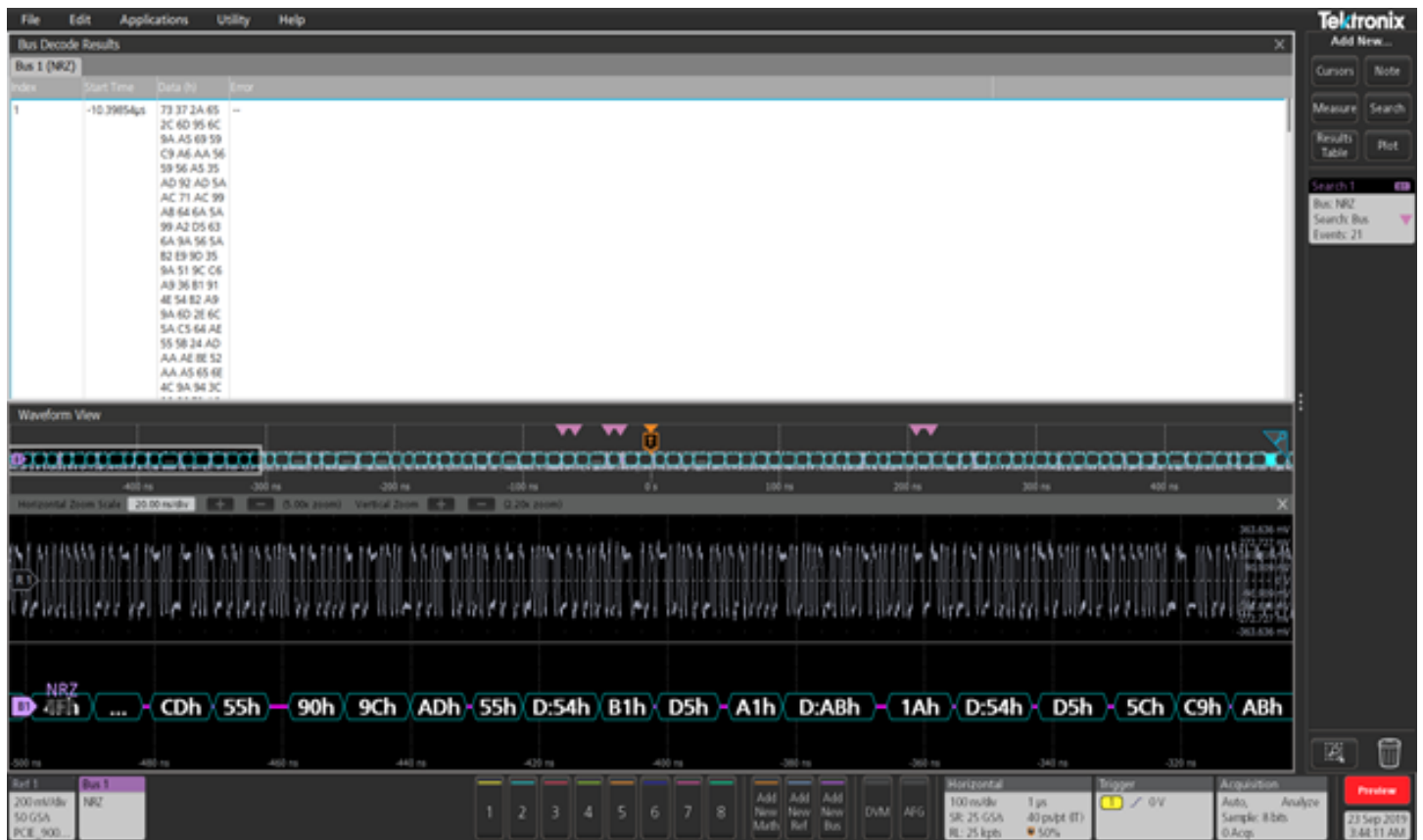
Horizontal Zoom Scale: 20.00 ns/div Vertical Zoom: 0.25V (zoom)

NRZ 4FF1 ... CDh 55h 90h 9Ch ADh 55h D:54h B1h D5h A1h D:ABh 1A

Horizontal: 100 ns/div 1 ps SR: 25 GSa RL: 25 kpts Trigger: 1 ps 40ps@80% 0V Acquisition: Auto Analyze Sample: 8 kSps 0 Acps

23 Sep 2015 5:44:23 AM

Searching on a specific data symbol in symbol format in the NRZ bus

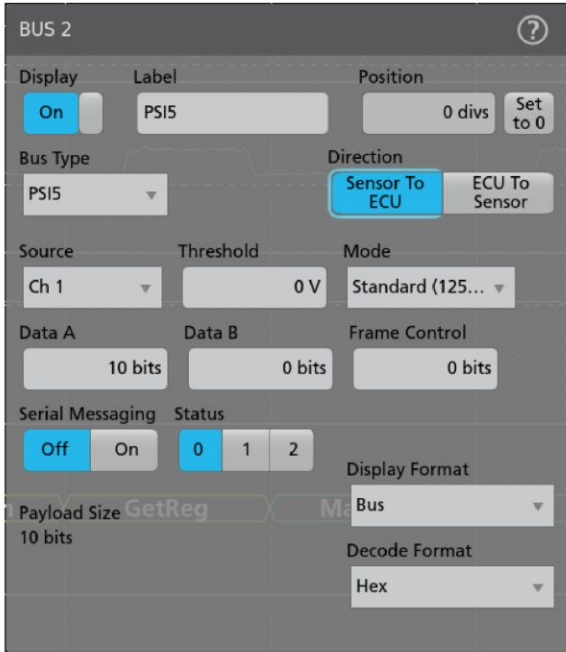


The Protocol Decode results table provides time-stamped, tabular view of all captured packets on the NRZ bus

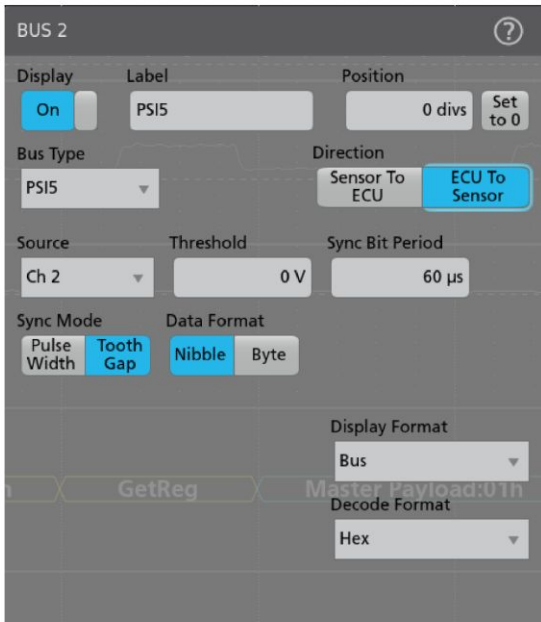


### PSI5 characteristics

PSI5 Sensor to ECU configuration



PSI5 ECU to Sensor configuration



### Bus setup options

Characteristic	Description	
PSI5 Sources	Analog channels Digital channels Active Math channels Active Reference channels	
Thresholds	Per-channel thresholds	
Recommended Probing	Sensor to ECU	Current probe with minimum current rating of less than 50mA - TCP2020, TCP202A
	ECU to Sensor	Differential Voltage probe - TDP1000, TDP1500, and TAP1500
Direction	ECU to Sensor Sensor to ECU	
Direction -Sensor to ECU	Mode	Slow (83.3 kbps) Standard (125 kbps) Fast (189 kbps)
	Data A	10 - 24 bits
	Data B	0 - 12 bits
	Frame Control	0 - 4 bits
	Status	0 - 3 bits
Direction - ECU to Sensor	Sync Bit Period	1 us to 300 us
	Sync Mode	Pulse Width Tooth Gap
	Data Format	Nibble Byte
Decode Format	Hex Binary Mixed Hex	

### Display modes

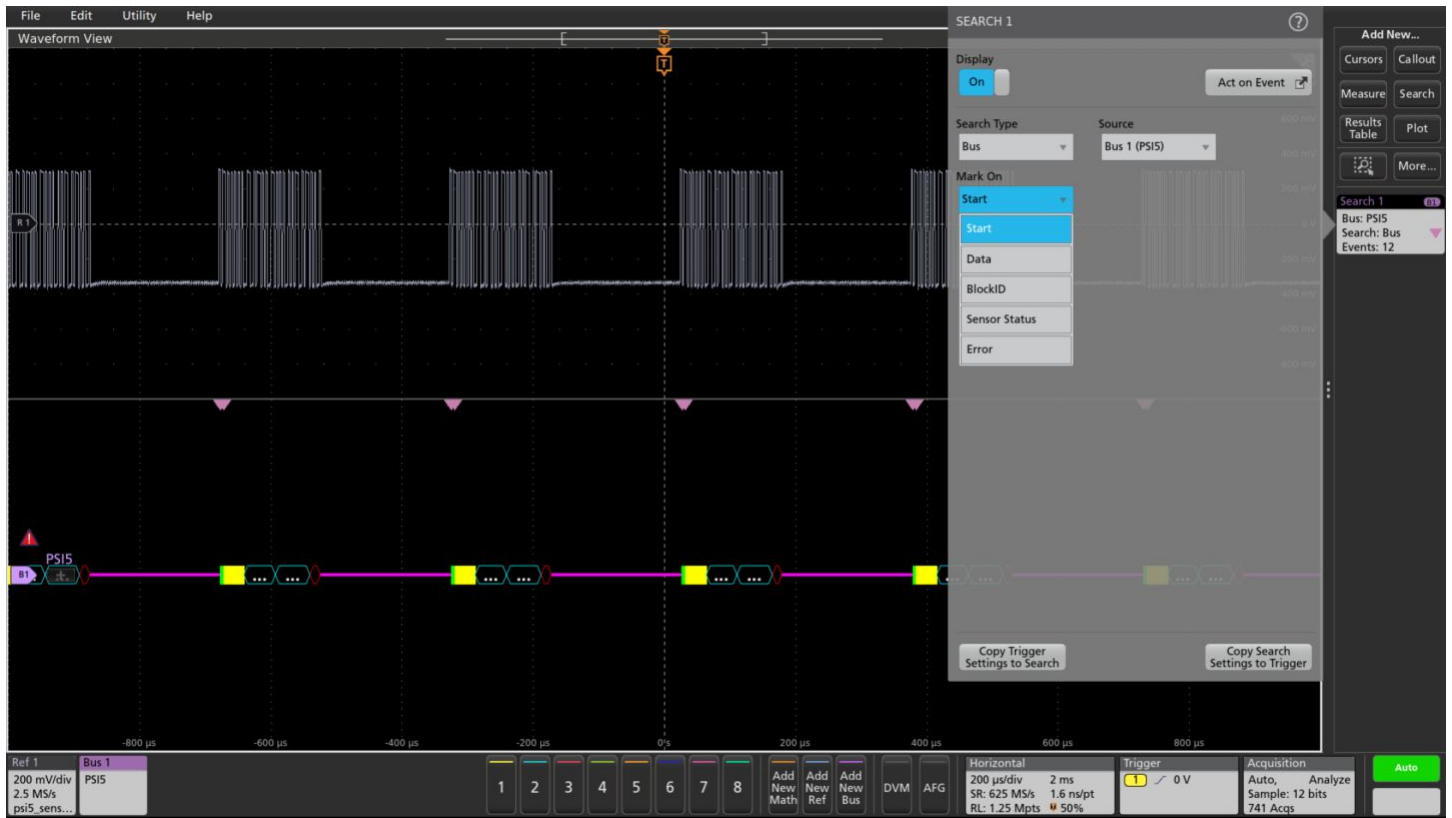
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous displays bus and digital waveforms
Results Table	Decoded packet data in a tabular view

Bus search options

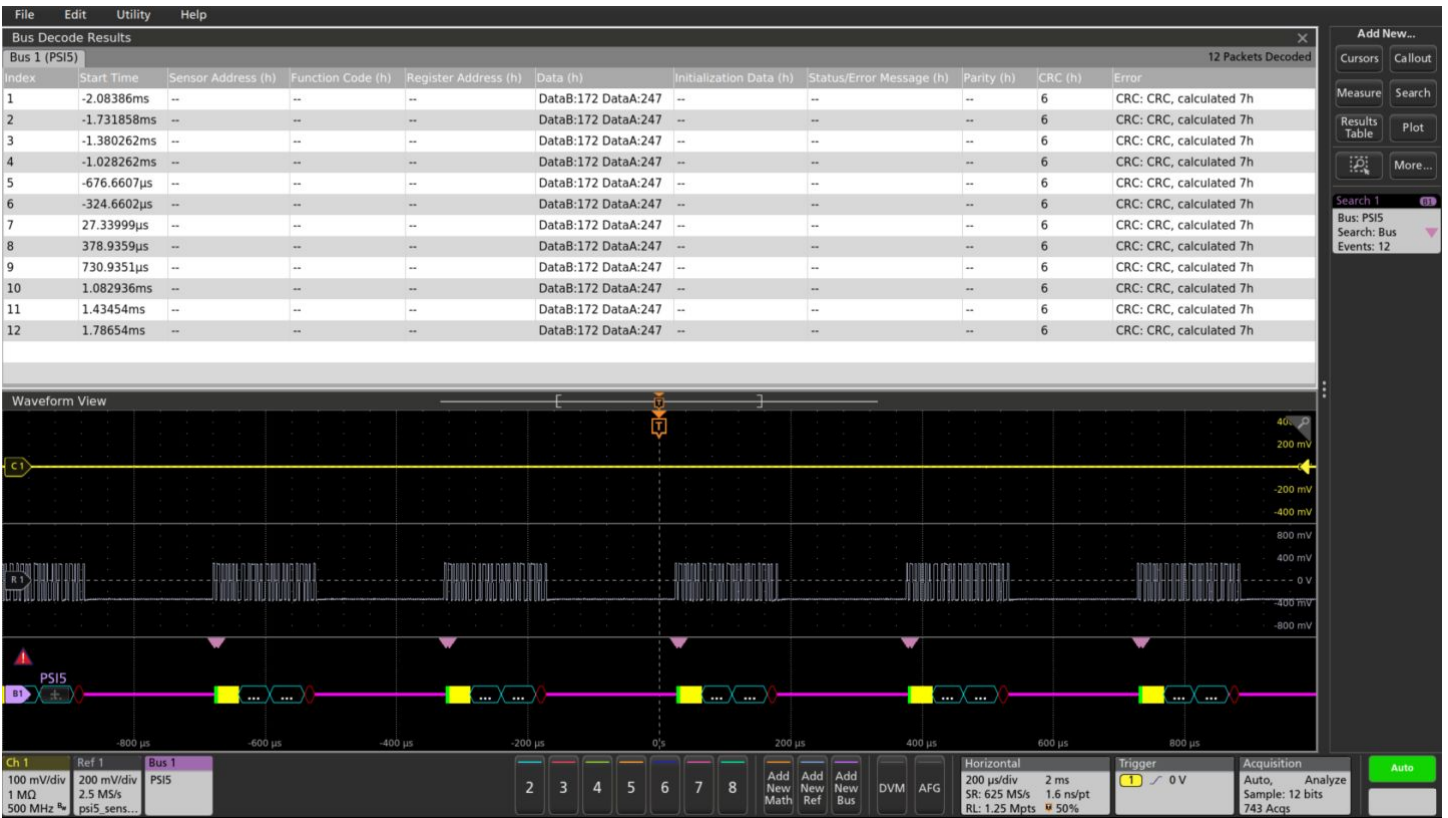
Characteristic	Description	
Mark On	Direction - Sensor to ECU	Start [Start of packet] Status Data [Region B and Region A] Block ID Sensor Status [5 different status] Errors [Parity CRC and any]
	Direction - ECU to Sensor	Start [Start of packet] Status Data [4 or 8 bits] Function Code Sensor Address Register Address CRC Error

Bus decode

Characteristic	Description	
Decode Display	Direction - Sensor to ECU Packets	Message Field (Yellow Field) Status (Yellow Field) Frame Control (Yellow Field) Data B (Cyan Field) Data A (Cyan Field) Parity or CRC (Purple Field)
	Direction - ECU to Sensor Packets	Sensor Address (Yellow Field) Function Code (Yellow Field) Register Address (Yellow Field) Data (Cyan Field) CRC (Purple Field)
Error Type	Parity CRC Response Code (Sensor to ECU)	



PS15 Search configuration

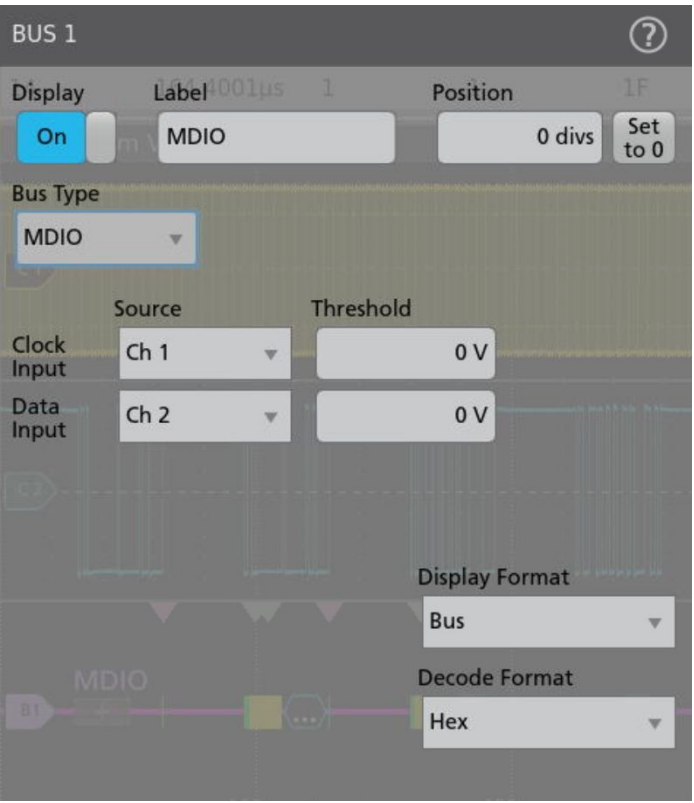


PSI5 Results table

### MDIO Characteristics

#### Bus setup options

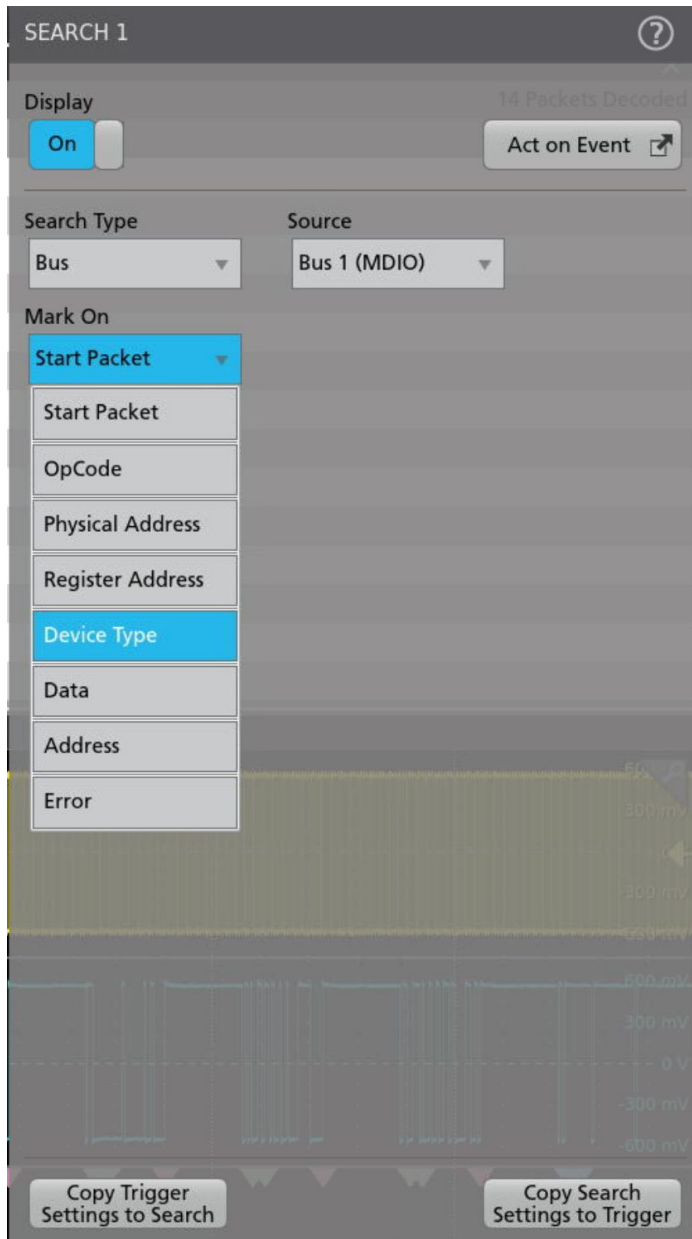
Characteristic	Description
MDIO Sources (Clock, Data)	Analog channels Digital channels Active Math channels Active Reference channels
Thresholds	Pre-channel thresholds
Recommended Probing	Single-ended
Formats Available	Hex Binary Mixed Hex



Bus configuration

**Bus search options**

Characteristic	Description
Search On	Start Packet OpCode Physical Address Register Address Data Error: Any, OpCode Error, Device Type Error



Search configuration

**Display modes**

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Result Table	Decoded packet data in tabular view

**Bus decode**

Characteristic	Description
Maximum Clock/Data Rate	Maximum frequency of up to 2.5 MHz
Decode Display	Start Packet (Green) Clause (Green) OpCode (Yellow) Physical Address (Yellow) Register Address (Yellow) Device Type (Yellow) Data/Address (Cyan) Error: Any, OpCode Error, Device Type Error (Red)



### SVID characteristics

#### Bus setup options

Characteristic	Description
SVID Sources (Clock, Data, Alert)	Analog channels Digital channels Active Math channels Active Reference channels
Thresholds	Pre-channel thresholds
Recommended Probing	Single-ended
Formats Available	Hex Binary Mixed Hex

The screenshot shows the 'BUS 1' configuration menu. The 'Display' toggle is turned 'On'. The 'Label' is 'SVID' and the 'Position' is '-2.06 divs'. The 'Bus Type' is set to 'SVID'. The configuration includes three input sources with their respective thresholds:

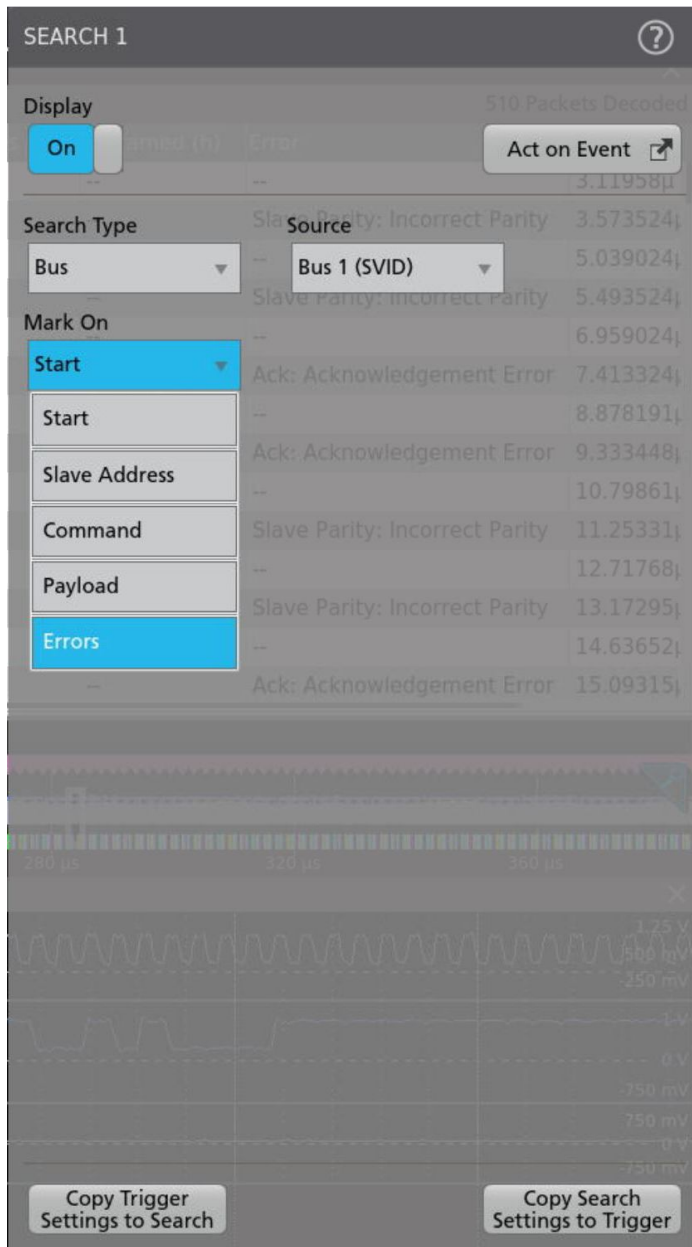
Source	Threshold
Clock Input (Ref 1)	500 mV
Data Input (Ref 2)	500 mV
Alert Input (Ref 3)	0 V

At the bottom, the 'Display Format' is set to 'Bus' and the 'Decode Format' is set to 'Hex'. The packet diagram at the bottom shows 'Start SA:0h', 'C:07h', and 'M'.

Bus configuration

Bus search options

Characteristic	Description
Search On	Start Slave Address Command Payload: Master, Slave, Either Errors: Any, Missing Ack, Parity End



Search configuration

Display modes

Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Result Table	Decoded packet data in tabular view

Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Maximum frequency of 26.25 MHz
Decode Display	Start (Green) Slave Address (Yellow) Command (Yellow) Master Payload (Cyan) Master Parity (Purple) End (Purple) Turnaround (Purple) Ack (Purple) Slave Payload (Cyan) Slave Parity (Purple)



**e-USB2**

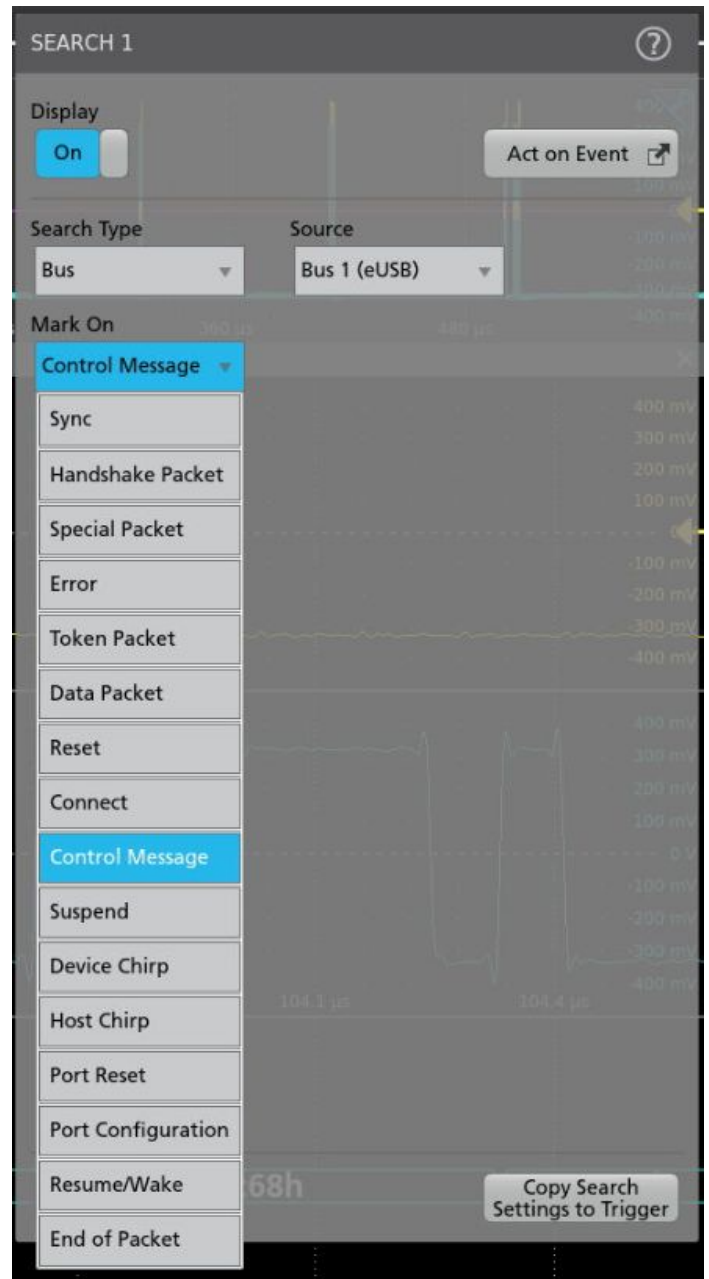
**Bus setup options**

Characteristic	Description
Source(s)	Analog channels Digital channels(single-ended) Active Math channels Active Reference channels
Thresholds	Pre-channel thresholds
Speeds	Speed High Speed (480 Mb/s) Full Speed (12 Mb/s) Low Speed (1.5 Mb/s)
Recommended Probing, HS, LS, and FS	Single-ended [Active Single Ended TAP1500]
Formats Available	Mixed Hex Hex Binary Mixed ASCII

Bus configuration

Bus search options

Characteristic	Description
Search On	Characteristic Description Search On Sync Reset Suspend Resume/Wake Connect Control Message Port Reset Port Configuration Device Chirp Host Chirp End of Packet Token (address) Packet Data Packet Handshake Packet: ACK, NAK, STALL, NYET (HS only) Special Packet: PRE (FS only), ERR, SPLIT, PING Reserved Error: PID check, CRC5 or CRC16, Bit stuffing (LS and FS only)



Search configuration

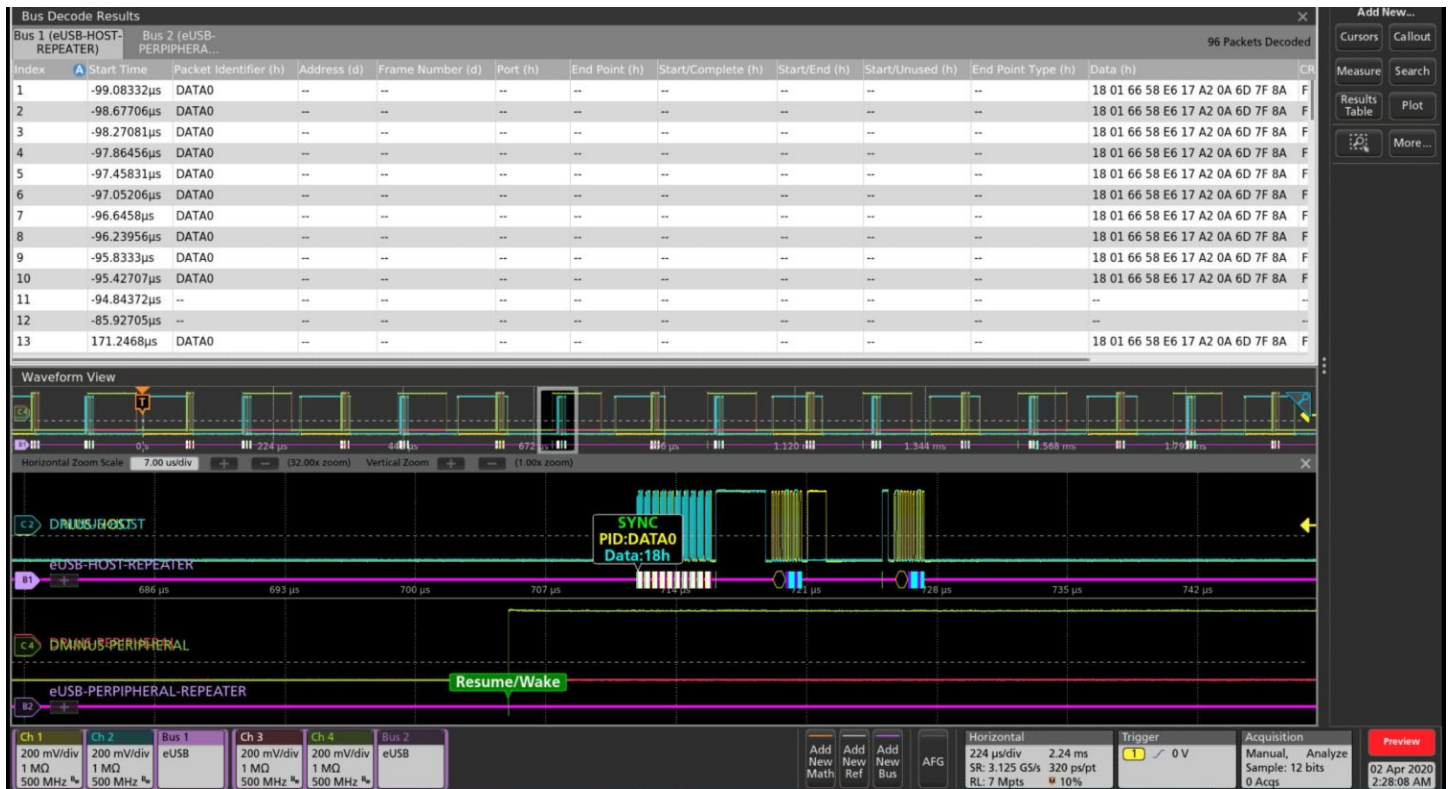


Bus decode

Characteristic	Description
Decode Display	Start of packet (green bar) Sync (green packet) PID (yellow packet) Token (address) (yellow packet) Data (cyan packet) CRC (purple packet) Error (red packet) End of packet (red bar) Control Message (Yellow packet) Zeros (Blue packet) Ack (Purple packet) Port Reset (Red Bar) Port Configuration(Green Bar) Connect (Green Bar) Resume/Wake(Green Bar) Device Chirp(Green Bar) Host Chirp (Green Bar) End Of reset(Red Bar)

Results & other features

Characteristic	Description
Table view	View more than 10000* points
* Depends on the Model	
Save	Save Result table as CSV
Sessions	Save sessions of your protocol setup
Simultaneous Buses	Load multiple Buses simultaneously*
* Depends on the Model	
Upcoming Future addition	Timing Measurements for Protocols
Search Table	Displays the Search hits along with Delta time difference between hits



Results table with decoded waveform

## Ordering information

To add to an instrument at purchase

Serial bus type	3 Series MDO Option	4 Series MSO Option	5 Series MSO Option	6 Series MSO Option	Description
MIL-STD-1553, ARINC 429	3-SRAERO	4-SRAERO	5-SRAERO	6-SRAERO	Aerospace Serial Triggering and Analysis (MIL-STD-1553, ARINC 429). Enables triggering on packet-level information on MIL-STD-1553 and ARINC 429 buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
I <sup>2</sup> S, LJ, RJ, TDM	3-SRAUDIO	4-SRAUDIO	5-SRAUDIO	6-SRAUDIO	Audio Serial Triggering and Analysis (I <sup>2</sup> S, LJ, RJ, TDM). Enables triggering on packet-level information on serial audio buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
8b10b	N/A	N/A	5-SR8B10B	5-SR8B10B	8B10B Serial Decoding and Analysis. Enables decoding and searching the packet-level information on buses with analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information. Finds and displays parity error if found in 4-bit or 6-bit for the 10-bit symbol in 8b10b.
NRZ	N/A	4-SRNRZ	5-SRNRZ	6-SRNRZ	NRZ Serial Decoding and Analysis. Enables decoding and searching the packet-level information on buses with analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information. Variants like NRZ-I, NRZ-M, NRZ-S, and NRZ-C are not supported currently. Supports only NRZ with normal and inverted polarity with Bit Order (MSB or LSB First).
CAN, CAN FD, LIN, FlexRay	3-SRAUTO	4-SRAUTO	5-SRAUTO	6-SRAUTO	Automotive Serial Triggering and Analysis (CAN, CAN FD, LIN, FlexRay). Enables triggering on packet-level information on CAN/CAN FD/LIN/FlexRay buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
Automotive 100BASE-T1	N/A	N/A	5-SRAUTOEN1	6-SRAUTOEN1	100BASE-T1 Automotive Ethernet serial analysis.
SENT	N/A	4-SRAUTOSEN	5-SRAUTOSEN	6-SRAUTOSEN	Automotive Sensor Serial Triggering and Analysis (SENT). Enables triggering on packet-level information on SENT buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.

Serial bus type	3 Series MDO Option	4 Series MSO Option	5 Series MSO Option	6 Series MSO Option	Description
RS-232/422/485, UART	3-SRCOMP	4-SRCOMP	5-SRCOMP	6-SRCOMP	Computer Serial Triggering and Analysis (RS-232, RS-422, RS-485, UART). Enables triggering on packet-level information on RS-232/422/485 and UART buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
I <sup>2</sup> C, SPI	3-SREMBD	4-SREMBD	5-SREMBD	6-SREMBD	Embedded Serial Triggering and Analysis (I <sup>2</sup> C, SPI). Enables triggering on packet-level information on I <sup>2</sup> C and SPI buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
Ethernet	N/A	4-SRENET	5-SRENET	6-SRENET	Ethernet Serial Triggering and Analysis (10BASE-T, 100BASE-T). Enables triggering on packet-level information on Ethernet buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
I3C	N/A	4-SRI3C	5-SRI3C	6-SRI3C	I3C Serial Decoding and Analysis. Enables decoding and searching on packet-level information on MIPI I3C buses with analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
SPMI	N/A	4-SRPM	5-SRPM	6-SRPM	Power Management Serial Triggering and Analysis (SPMI). Enables triggering on packet-level information on SPMI buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
Spacewire	N/A	4-SRSPACEWIRE	5-SRSPACEWIRE	6-SRSPACEWIRE	Spacewire serial analysis. Enables decoding and analysis on Spacewire buses.
USB 2.0	3-SRUSB2	4-SRUSB2	5-SRUSB2	6-SRUSB2	USB 2.0 Serial Triggering and Analysis (LS, FS, HS). Enables triggering on packet-level information on USB 2.0 buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
Serial options bundle	3-BND	N/A	N/A	N/A	Adds all serial analysis options and the power analysis option available for an instrument.
PSI5	N/A	4-SRPSI5	5-SRPSI5	6-SRPSI5	PSI5 Serial Decoding(v1.3 and 2.1) and analysis. Enables decoding and Search Packet level information with analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.
MDIO	N/A	LIC4-SRMDIO	LIC5-SRMDIO	LIC6-SRMDIO	License; MDIO Protocol Decoder and Search, No Hardware Trigger; Node locked

Serial bus type	3 Series MDO Option	4 Series MSO Option	5 Series MSO Option	6 Series MSO Option	Description
SVID	N/A	LIC4-SRSVID	LIC5-SRSVID	LIC6-SRSVID	License; SVID Protocol Decoder and Search, No Hardware Trigger; Node locked
e-USB2	N/A	LIC4-SREUSB2	LIC5-SREUSB2	LIC6-SREUSB2	License; eUSB2 Protocol Decoder and Search; Node locked

To upgrade an already purchased instrument

Serial bus <sup>15</sup>	3 Series MDO Node-Locked License <sup>16</sup>	4 Series MSO Node-Locked/Floating License	5 Series MSO Node-Locked/Floating License	6 Series MSO Node-Locked/Floating License
MIL-STD-1553, ARINC 429	SUP3 SRAERO	SUP4-SRAERO SUP4-SRAERO-FL	SUP5-SRAERO SUP5-SRAERO-FL	SUP6-SRAERO SUP6-SRAERO-FL
I <sup>2</sup> S, LJ, RJ, TDM	SUP3 SRAUDIO	SUP4-SRAUDIO SUP4-SRAUDIO-FL	SUP5-SRAUDIO SUP5-SRAUDIO-FL	SUP6-SRAUDIO SUP6-SRAUDIO-FL
CAN, CAN FD, LIN, FlexRay	SUP3 SRAUTO	SUP4-SRAUTO SUP4-SRAUTO-FL	SUP5-SRAUTO SUP5-SRAUTO-FL	SUP6-SRAUTO SUP6-SRAUTO-FL
8B10B	N/A	N/A	SUP5-SR8B10B SUP5-SR8B10B-FL	SUP6-SR8B10B SUP6-SR8B10B-FL
NRZ	N/A	SUP4-SRNRZ SUP4-SRNRZ-FL	SUP5-SRNRZ SUP5-SRNRZ-FL	SUP6-SRNRZ SUP6-SRNRZ-FL
100BASE-T1 Automotive Ethernet	N/A	N/A	SUP5-SRAUTOEN1 SUP5-SRAUTOEN1-FL	SUP6-SRAUTOEN1 SUP6-SRAUTOEN1-FL
SENT	N/A	SUP4-SRAUTOSEN SUP4-SRAUTOSEN-FL	SUP5-SRAUTOSEN SUP5-SRAUTOSEN-FL	SUP6-SRAUTOSEN SUP6-SRAUTOSEN-FL
RS-232/422/485, UART	SUP3 SRCOMP	SUP4-SRCOMP SUP4-SRCOMP-FL	SUP5-SRCOMP SUP5-SRCOMP-FL	SUP6-SRCOMP SUP6-SRCOMP-FL
I <sup>2</sup> C, SPI	SUP3 SREMBD	SUP4-SREMBD SUP4-SREMBD-FL	SUP5-SREMBD SUP5-SREMBD-FL	SUP6-SREMBD SUP6-SREMBD-FL
Ethernet	N/A	SUP4-SRENET SUP4-SRENET-FL	SUP5-SRENET SUP5-SRENET-FL	SUP6-SRENET SUP6-SRENET-FL
I3C	N/A	SUP4-SRI3C SUP4-SRI3C-FL	SUP5-SRI3C SUP5-SRI3C-FL	SUP6-SRI3C SUP6-SRI3C-FL
SPMI	N/A	SUP4-SRPM SUP4-SRPM-FL	SUP5-SRPM SUP5-SRPM-FL	SUP6-SRPM SUP6-SRPM-FL
Spacewire	N/A	SUP4-SRSPACEWIRE SUP4-SRSPACEWIRE	SUP5-SRSPACEWIRE SUP5-SRSPACEWIRE-FL	SUP6-SRSPACEWIRE SUP6-SRSPACEWIRE-FL
USB 2.0	SUP3 SRUSB2	SUP4-SRUSB2 SUP4-SRUSB2-FL	SUP5-SRUSB2 SUP5-SRUSB2-FL	SUP6-SRUSB2 SUP6-SRUSB2-FL
Serial analysis bundle <sup>17</sup>	SUP3 BND	N/A	N/A	N/A
PSI5	N/A	SUP4-SRPSI5 SUP4-SRPSI5-FL	SUP5-SRPSI5 SUP5-SRPSI5-FL	SUP6-SRPSI5 SUP6-SRPSI5-FL
MDIO	N/A	SUP4-SRMDIO SUP4-SRMDIO-FL	SUP5-SRMDIO SUP5-SRMDIO-FL	SUP6-SRMDIO SUP6-SRMDIO-FL
SVID	N/A	SUP4-SRSVID SUP4-SRSVID-FL	SUP5-SRSVID SUP5-SRSVID-FL	SUP6-SRSVID SUP6-SRSVID-FL
e-USB2	N/A	SUP4-SREUSB2 SUP4-SREUSB2-FL	SUP5-SREUSB2 SUP5-SREUSB2-FL	SUP6-SREUSB2 SUP6-SREUSB2-FL

<sup>15</sup> Software is supplied with the instrument firmware. Always download and install the latest version of the firmware. Option documentation is part of the application Help.

<sup>16</sup> 3 Series MDO option license names do not have a dash in the option number.

<sup>17</sup> All serial bus and power analysis options that are available for an instrument.

**Recommended probes**

Please refer to [www.tek.com/probes](http://www.tek.com/probes) for further information on the recommended models of probes and any necessary probe adapters.



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Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.



Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

**ASEAN / Australasia** (65) 6356 3900  
**Belgium** 00800 2255 4835\*  
**Central East Europe and the Baltics** +41 52 675 3777  
**Finland** +41 52 675 3777  
**Hong Kong** 400 820 5835  
**Japan** 81 (3) 6714 3086  
**Middle East, Asia, and North Africa** +41 52 675 3777  
**People's Republic of China** 400 820 5835  
**Republic of Korea** +822 6917 5084, 822 6917 5080  
**Spain** 00800 2255 4835\*  
**Taiwan** 886 (2) 2656 6688

**Austria** 00800 2255 4835\*  
**Brazil** +55 (11) 3759 7627  
**Central Europe & Greece** +41 52 675 3777  
**France** 00800 2255 4835\*  
**India** 000 800 650 1835  
**Luxembourg** +41 52 675 3777  
**The Netherlands** 00800 2255 4835\*  
**Poland** +41 52 675 3777  
**Russia & CIS** +7 (495) 6647564  
**Sweden** 00800 2255 4835\*  
**United Kingdom & Ireland** 00800 2255 4835\*

**Balkans, Israel, South Africa and other ISE Countries** +41 52 675 3777  
**Canada** 1 800 833 9200  
**Denmark** +45 80 88 1401  
**Germany** 00800 2255 4835\*  
**Italy** 00800 2255 4835\*  
**Mexico, Central/South America & Caribbean** 52 (55) 56 04 50 90  
**Norway** 800 16098  
**Portugal** 80 08 12370  
**South Africa** +41 52 675 3777  
**Switzerland** 00800 2255 4835\*  
**USA** 1 800 833 9200

\* European toll-free number. If not accessible, call: +41 52 675 3777

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