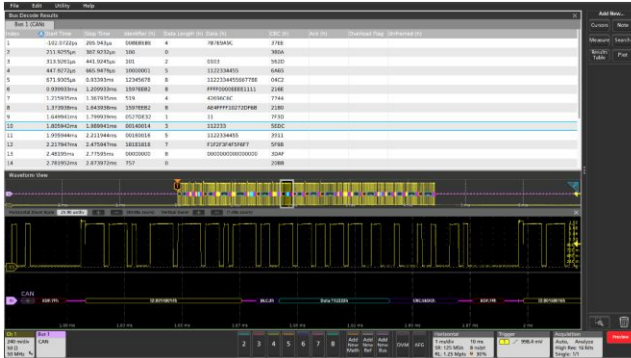


# Serial Triggering and Analysis

## 5/6 Series MSO Applications Datasheet



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 trigger and decode for 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, and TDM.

### Key features

- Automated Serial Triggering and Decode Options for 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, 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, SENT, RS-232/422/485, UART, USB 2.0, Ethernet, SPMI, MIL-STD-1553, ARINC 429, I<sup>2</sup>S, LJ, RJ, and TDM buses, making it easier to locate, analyze, and debug events of interest.

### 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, 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® 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 → buttons on the oscilloscope front panel.

## 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 Active Reference channels
Thresholds	Per-channel thresholds
Recommended Probing	Single-ended
Include R/W in Address	Yes or No
Address/Data Formats Available	Hex Binary

#### Display modes

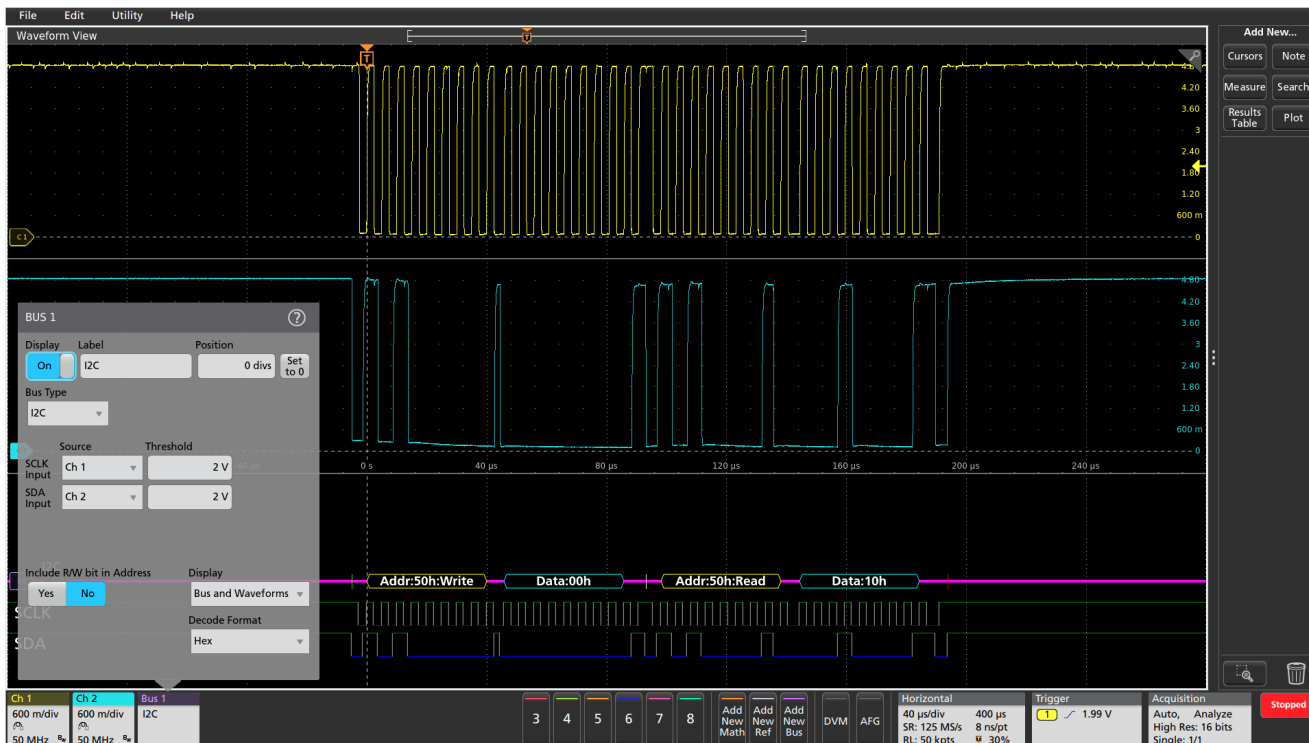
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

#### Bus trigger and search options

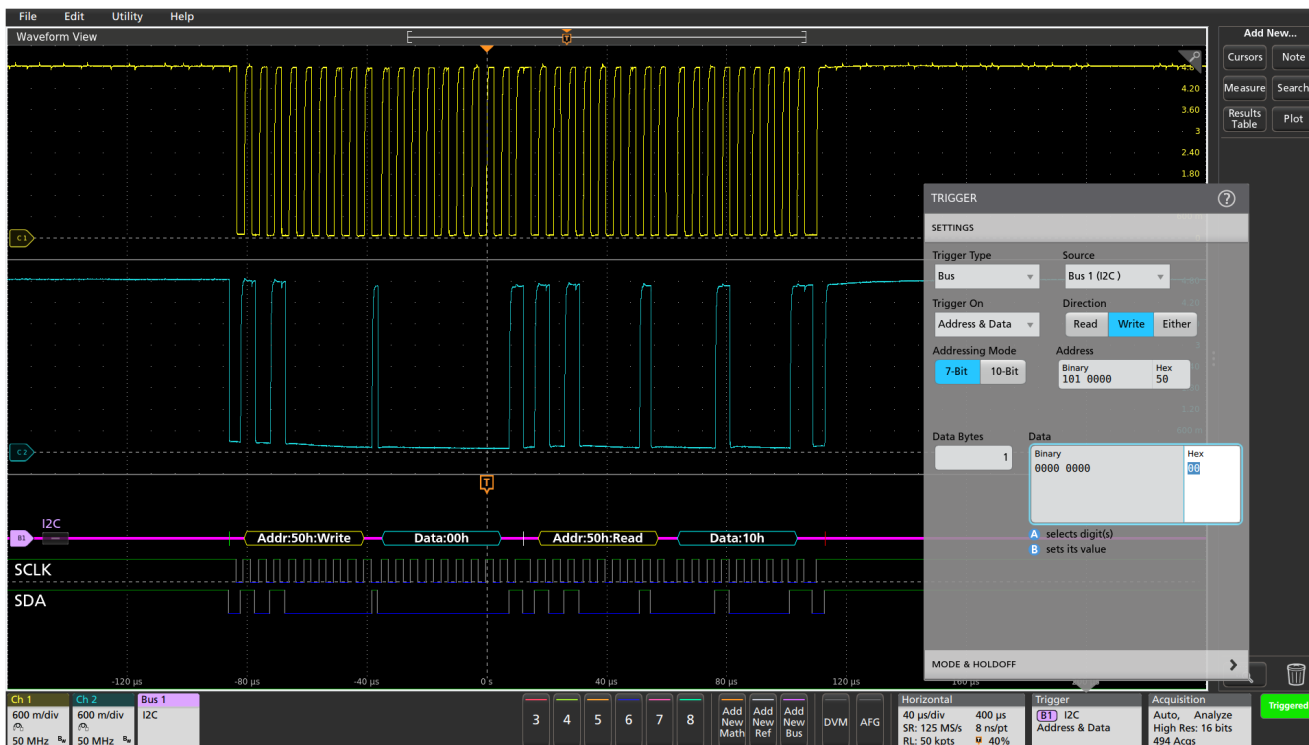
Characteristic	Description
Trigger and/or Search On	Start Repeated Start Stop Missing Ack Address (7 or 10 bit) Data (1-5 bytes) Address and Data

### 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)



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 Active Reference channels
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

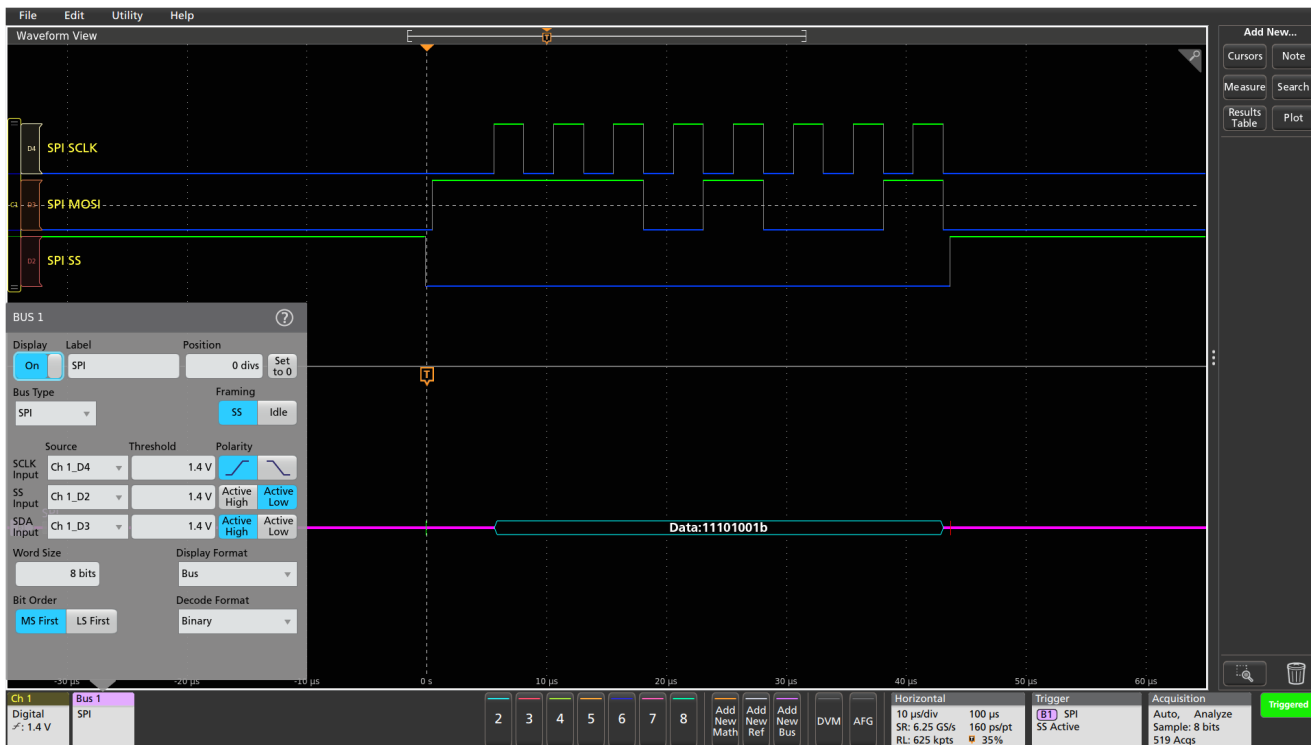
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

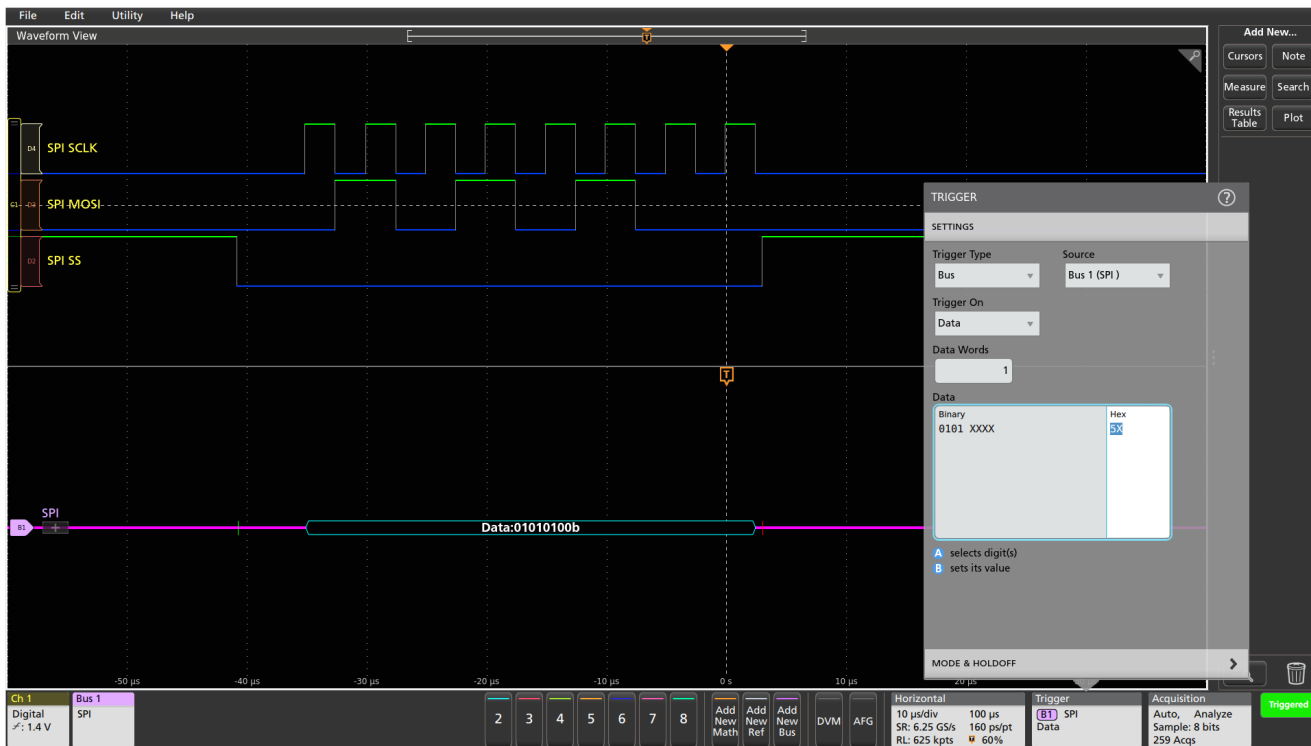
Characteristic	Description
Trigger and/or Search On	SS Active (3-wire SPI) Start of Frame (2-wire SPI) Data (1-16 bytes)

### 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)



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.

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

### Bus setup options

Characteristic	Description
Sources, RS-232, UART	Analog channels Digital channels Active Math channels Active Reference channels
Sources, RS-422, RS-485	Analog channels Active Math channels Active Reference channels
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

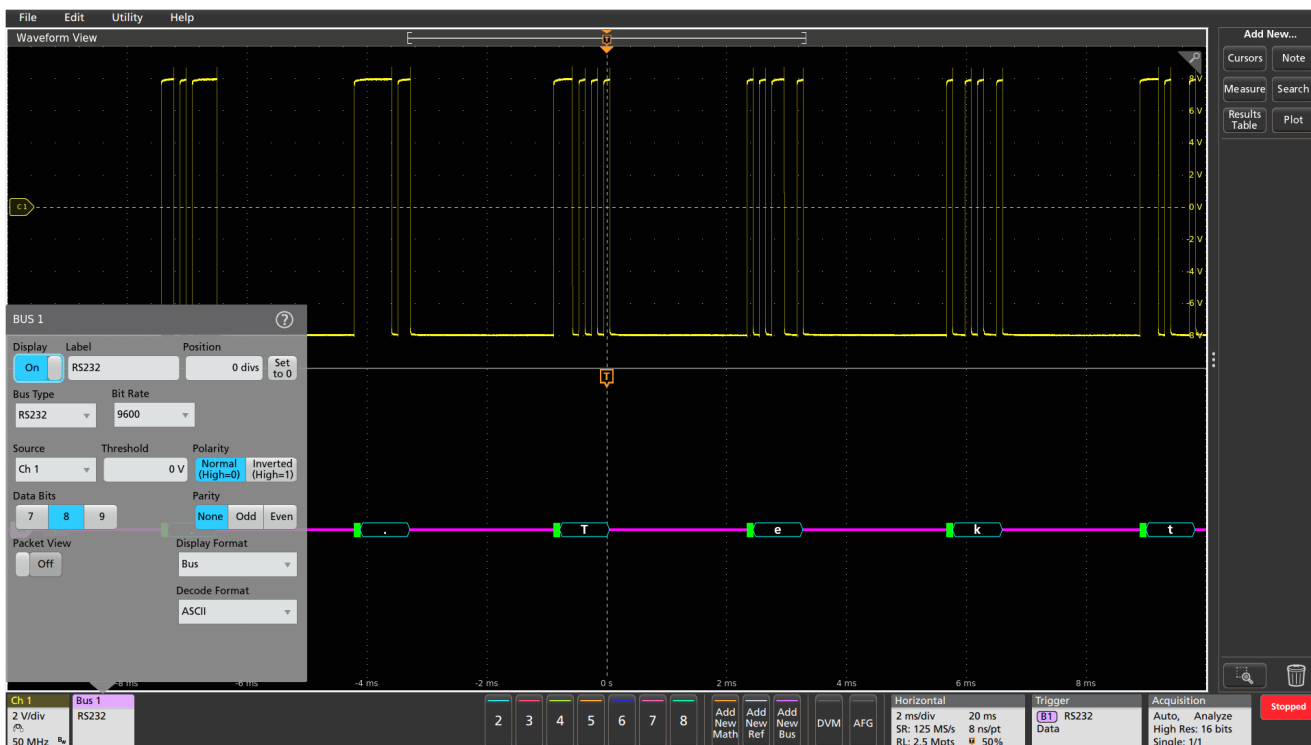
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

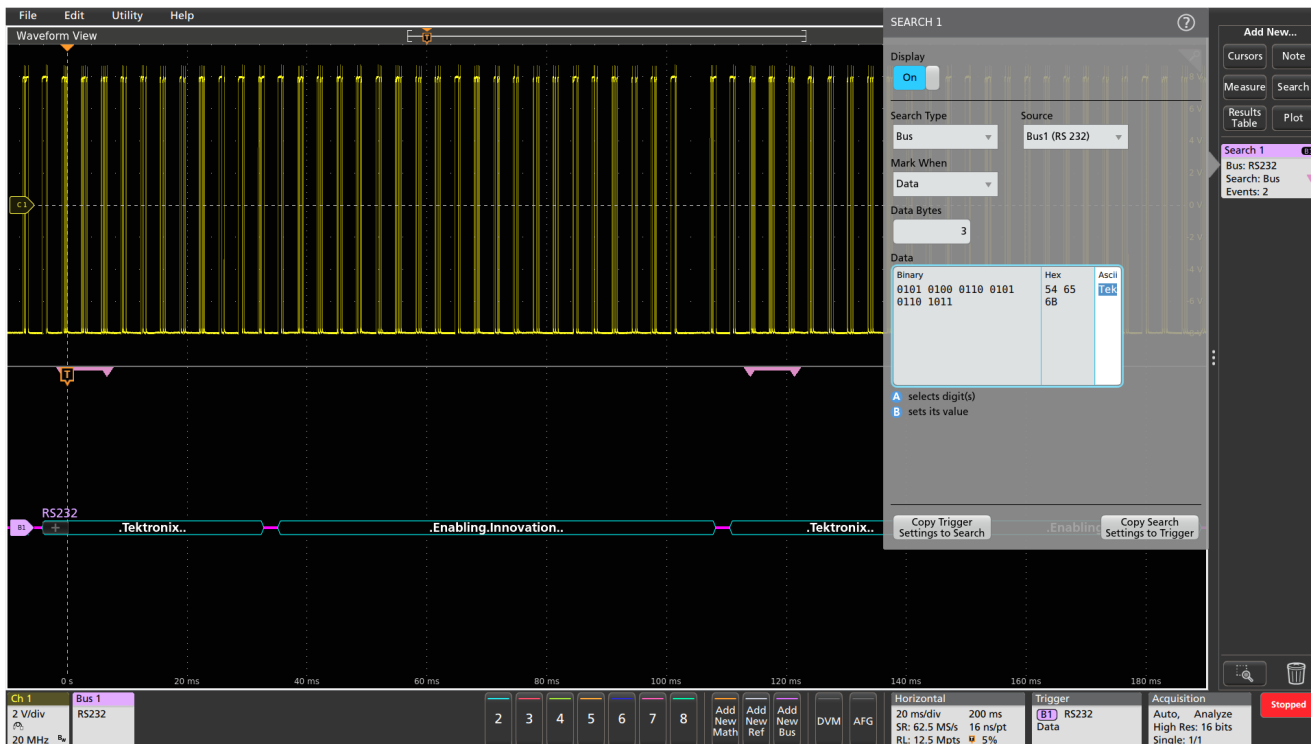
Characteristic	Description
Trigger and/or Search On	Start End of Packet Data (1 - 10 bytes) Parity Error

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 15 Mb/s
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 (50 b/s - 15 Mb/s)
Decode Display	Start (green packet) Data (cyan packet) Parity (purple packet) Parity Error (red packet)



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 Active Reference channels
Source for Diff (differential probing)	Analog channels Active Math channels Active Reference channels
Thresholds	Per-channel thresholds
Recommended Probing: CAN_H, CAN_L, Rx, Tx Diff	Single-ended Differential
Bit Rate Selection: Predefined list of rates Custom	10 kb/s - 1 Mb/s 1 kb/s - 1 Mb/s
Sample Point	0% - 100% of bit period of unit interval
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

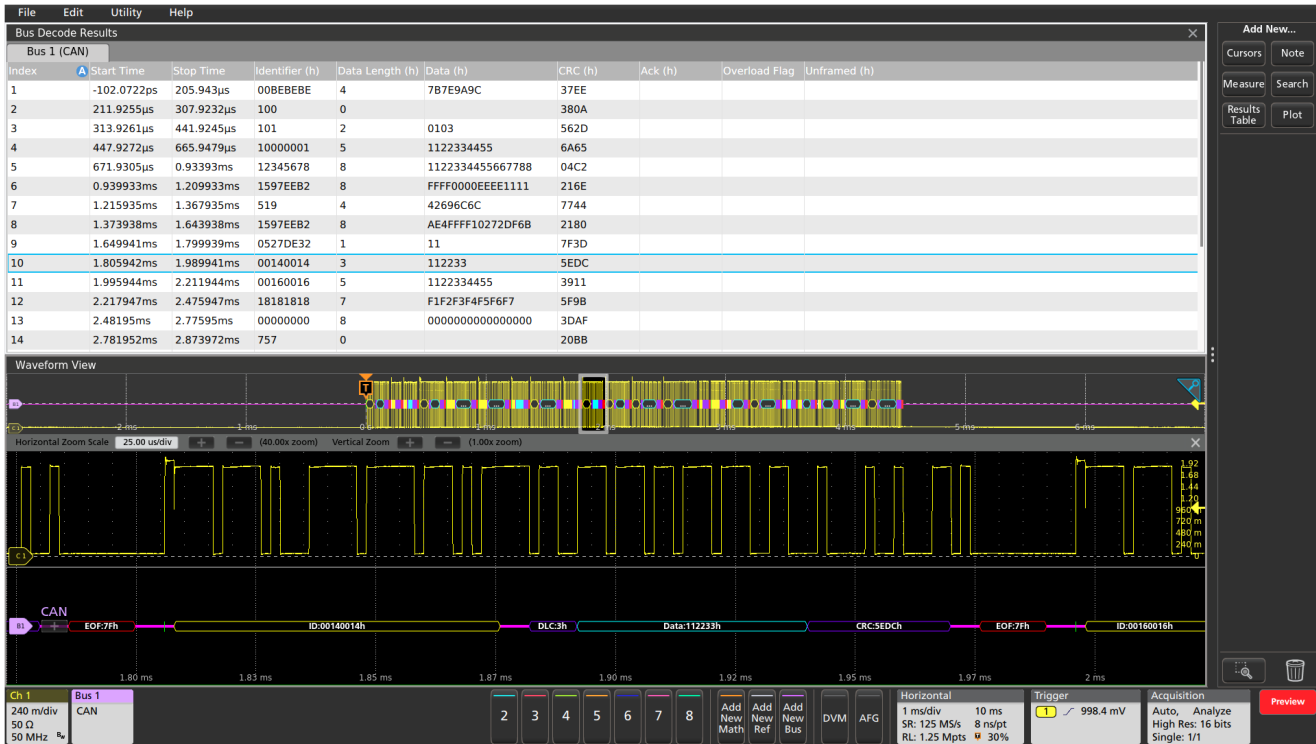
### Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Start 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

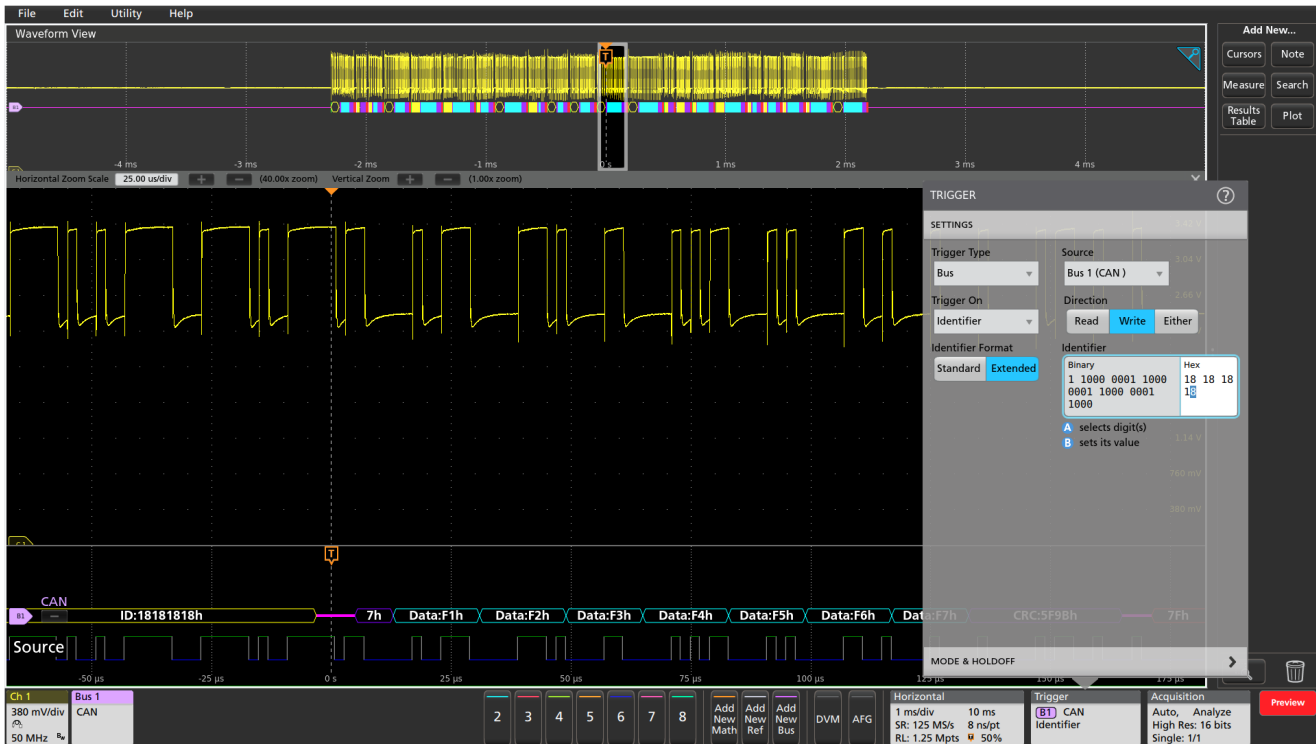
### Bus decode

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 Active Reference channels
Source for Diff (differential probing)	Analog channels Active Math channels Active Reference channels
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 50 kb/s - 10 Mb/s
FD Bit Rate Selection: Predefined list of rates Custom	1 Mb/s - 16 Mb/s 500 kb/s - 16 Mb/s
Sample Point	55% - 95% of bit period of unit interval
Formats Available	Mixed Hex Binary

### Display modes

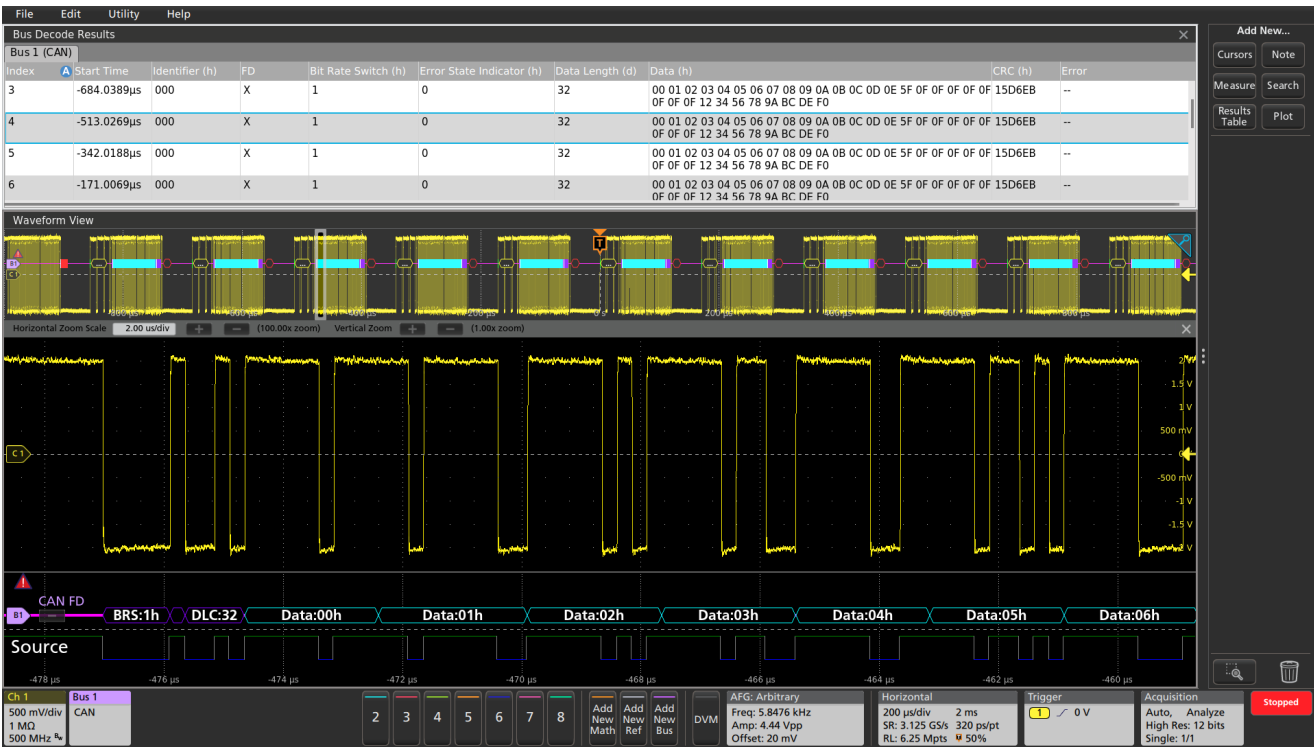
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

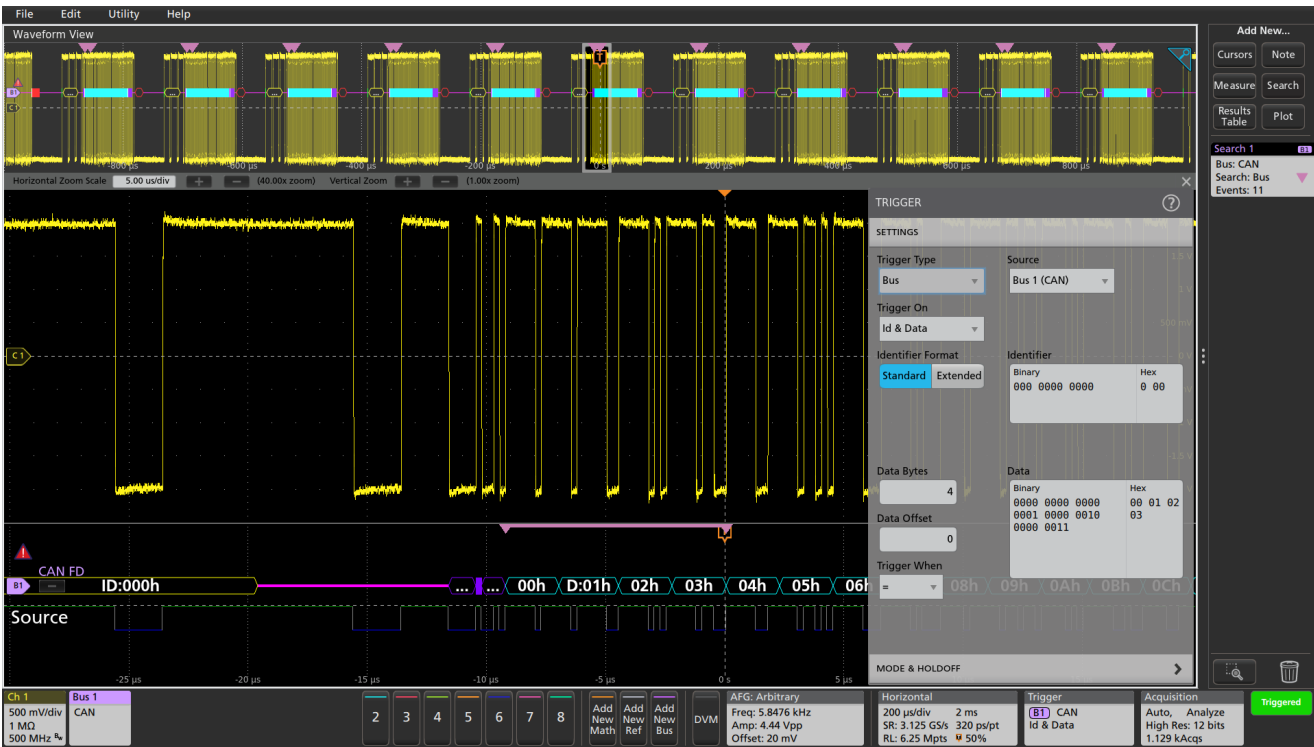
Characteristic	Description
Trigger and/or Search On	Start of Frame Type of Frame (Data, Remote, Error, Overload) FD Bits (Bit Rate Switch bit, Error State Indicator bit) Identifier (Standard or Extended) Data (1-8 bytes, trigger or search when =, ≠, <, ≤, >, ≥) Identifier and Data End of Frame Error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

### 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)



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 Active Reference channels
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 1 kb/s - 100 kb/s
Sample Point	0% - 100% 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

### Bus decode

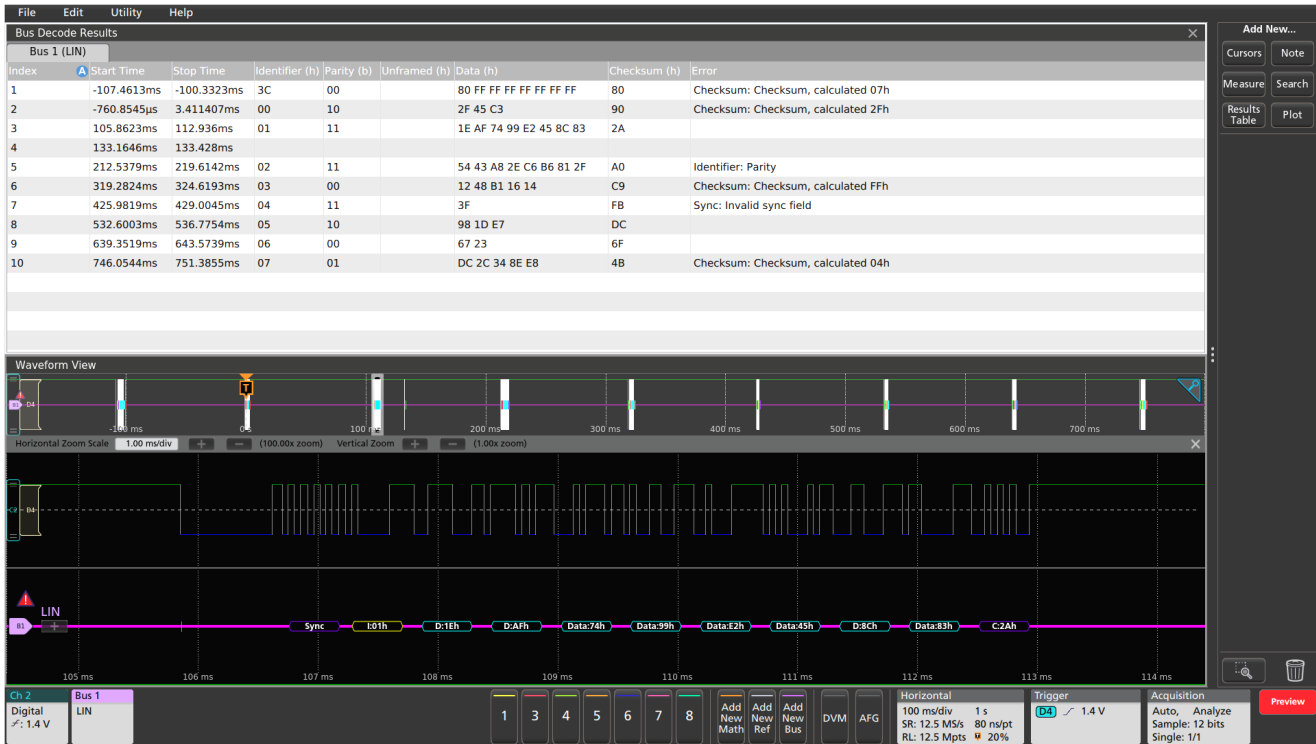
Characteristic	Description
Maximum Clock/Data Rate	Up to 100 kb/s, by LIN definition up to 20 kb/s (for automated decoding of bus)
Decode Display	Start of Frame (green bar) Sync Identifier (yellow packet) Data (cyan packet) CRC (purple packet) Errors (red packet)

### Display modes

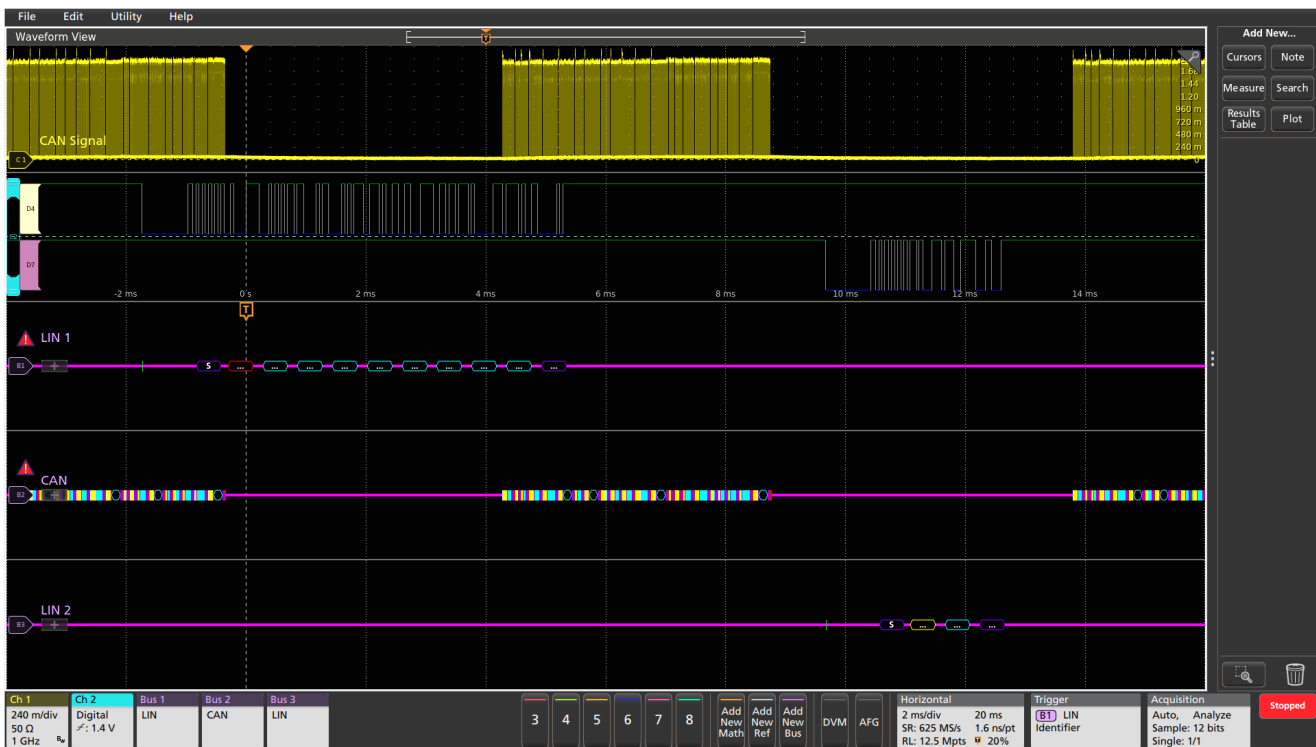
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### 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)



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 Active Reference channels
Source for Single-ended Probing (BP, BM)	Analog channels Digital channels Active Math channels Active Reference channels
Source for Single-ended Probing (Tx, Rx)	Analog channels Digital channels Active Math channels Active Reference channels
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

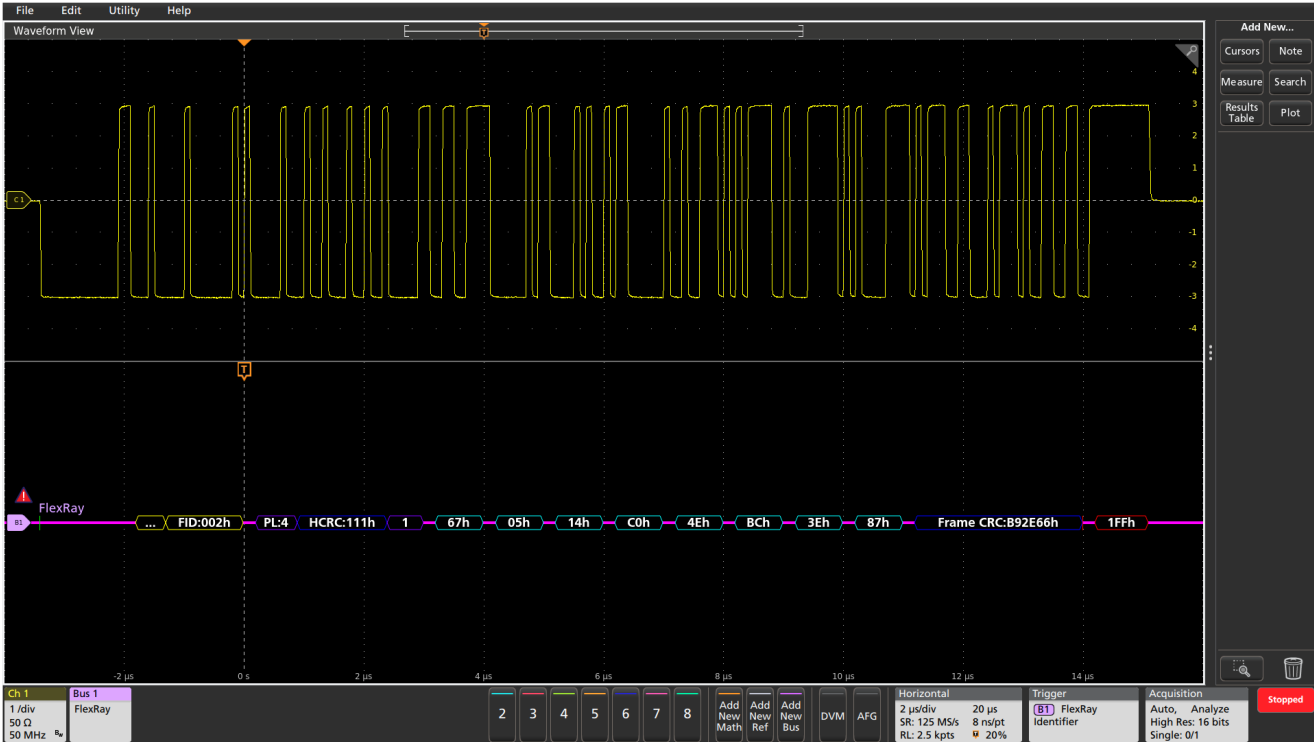
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### 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)



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

### 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)

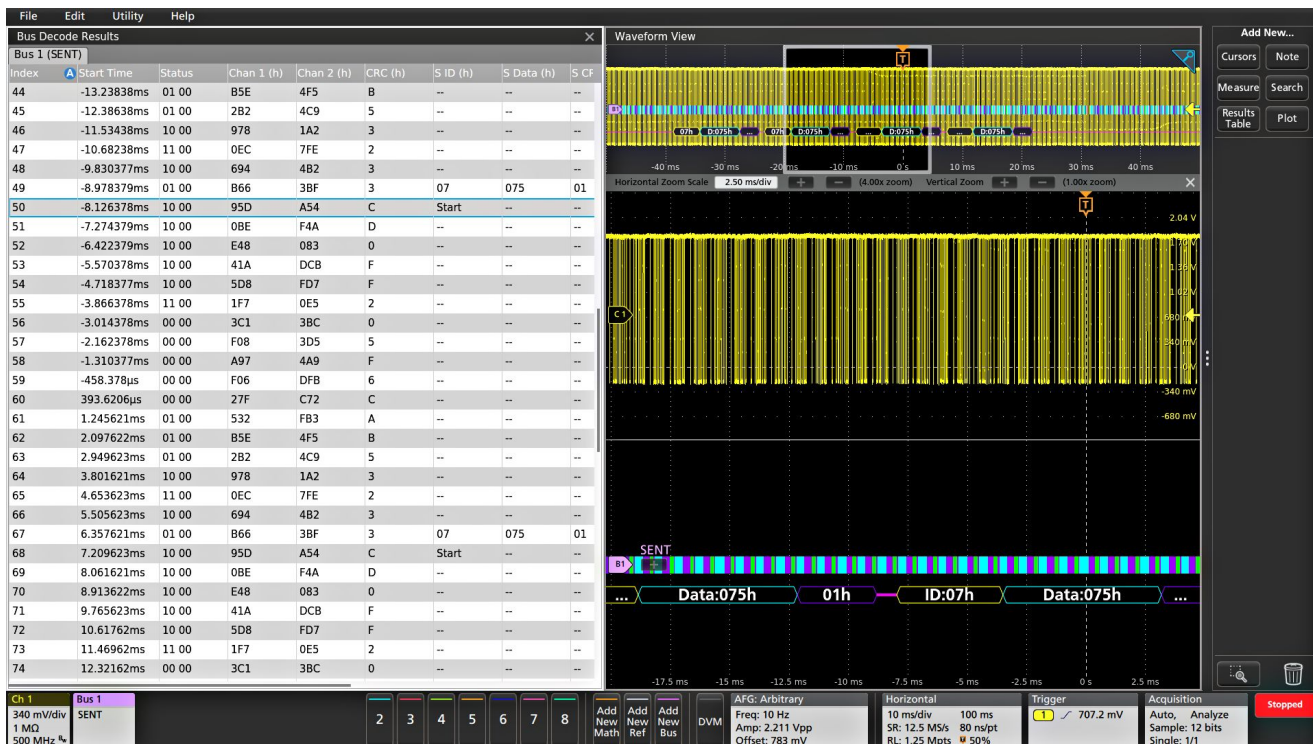
### Bus search options

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)

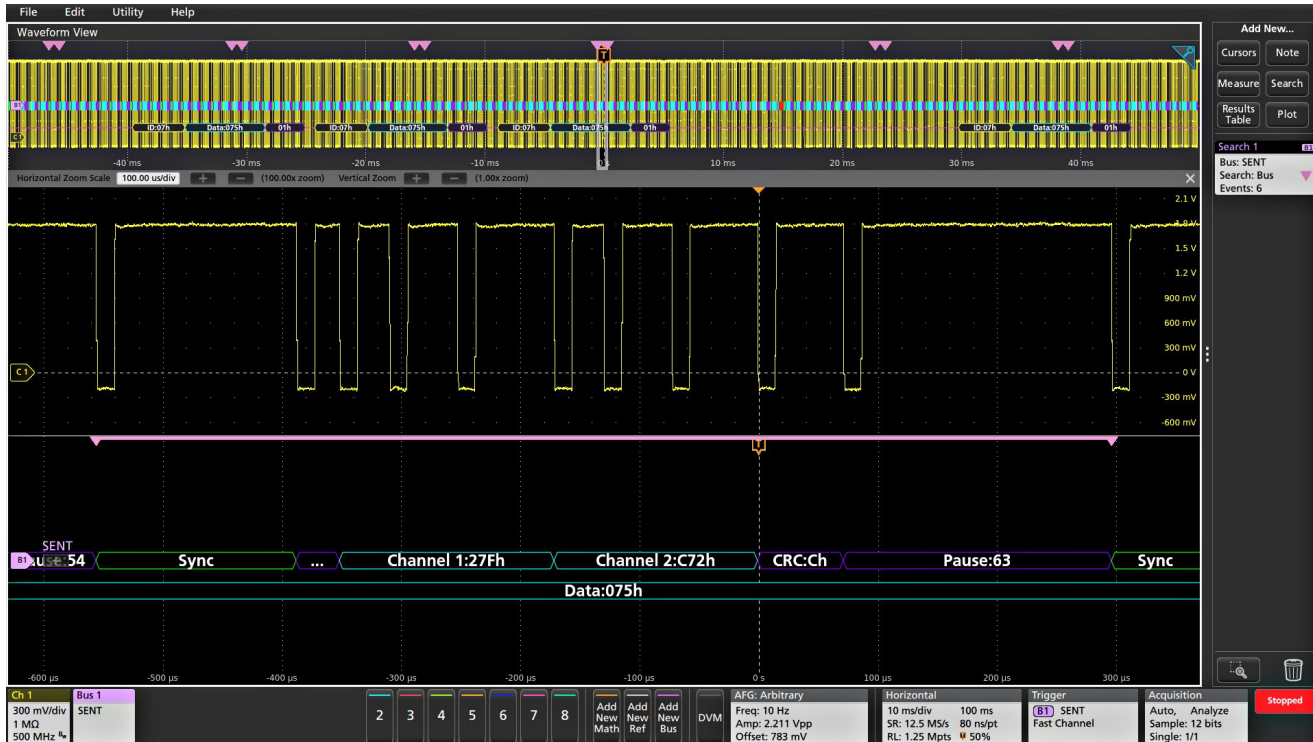
### Bus decode

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)





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 Binary

### Display modes

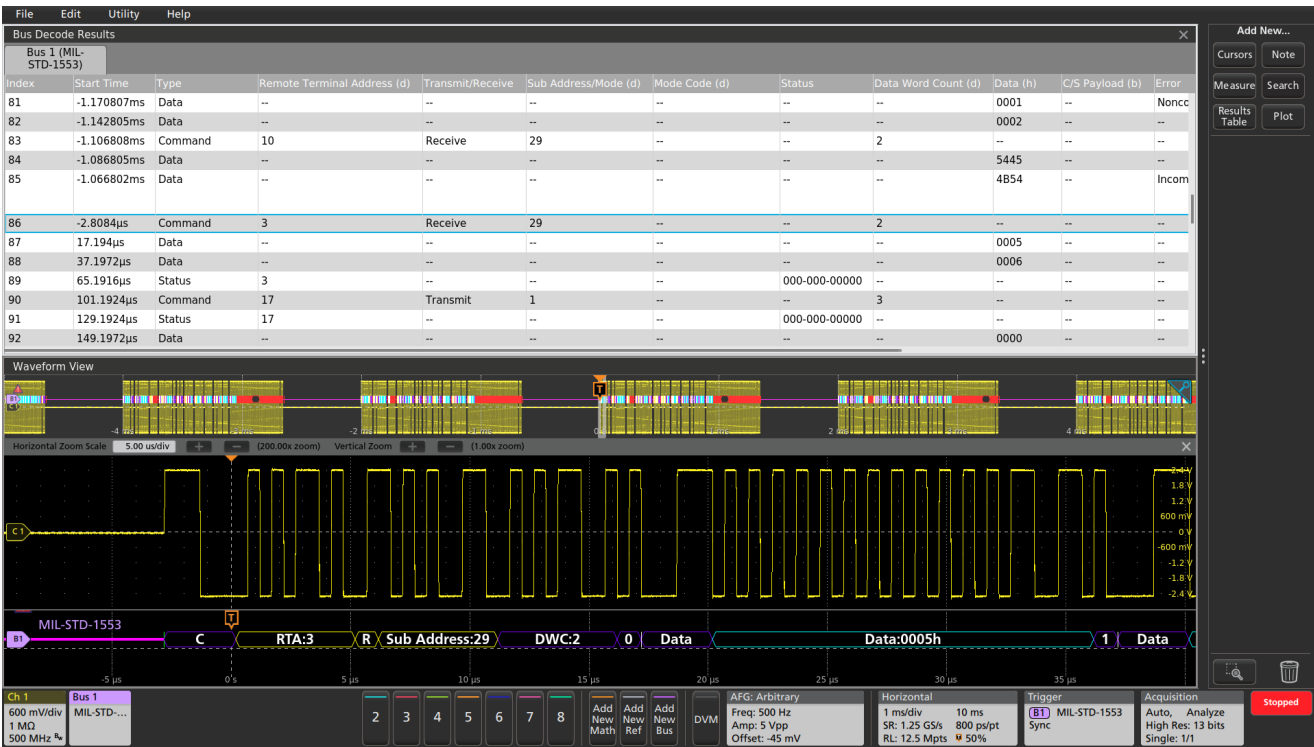
Characteristic	Description
Bus	Bus only
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

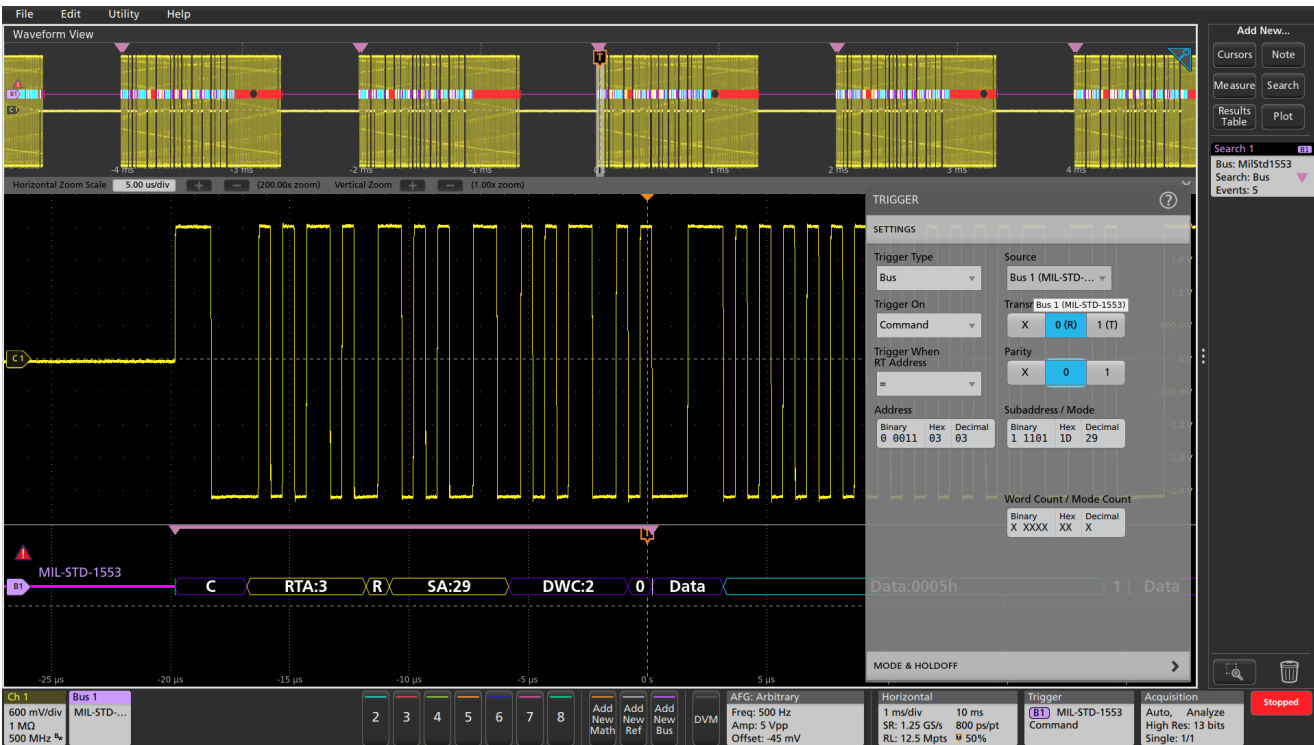
Characteristic	Description
Trigger and/or Search On	Sync Command (Transmit/Receive Bit, Parity, Subaddress / Mode, Word Count / Mode Count, and RT Address =, $\neq$ , <, $\leq$ , >, $\geq$ , Inside Range, Outside Range) Status (Parity, Bit 9 - Message Error, Bit 10 - Instrumentation, Bit 11 - Service 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)

### 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)



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	Single -ended Differential
Polarity	Normal Inverted
Thresholds	Single-ended: Per-channel thresholds Differential: High and low thresholds
Recommended Probing	Single -ended or 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 Binary

### Display modes

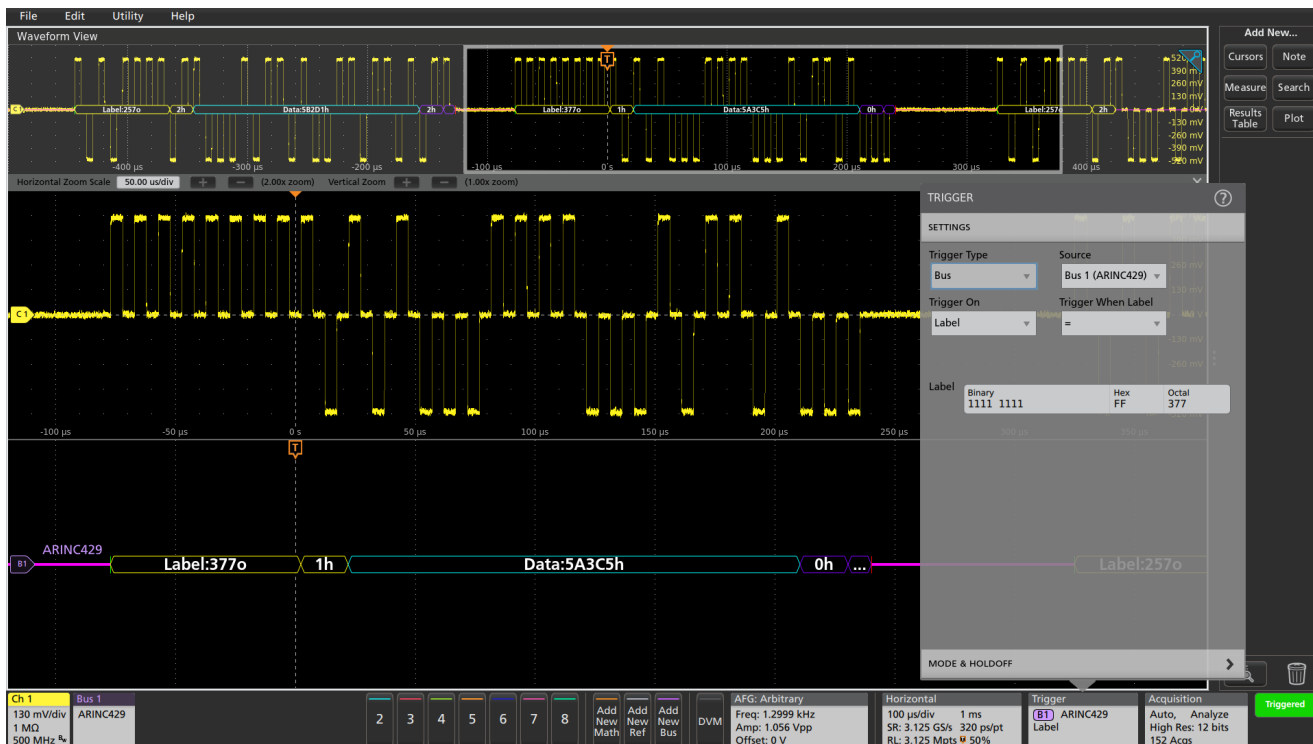
Characteristic	Description
Bus	Bus only
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

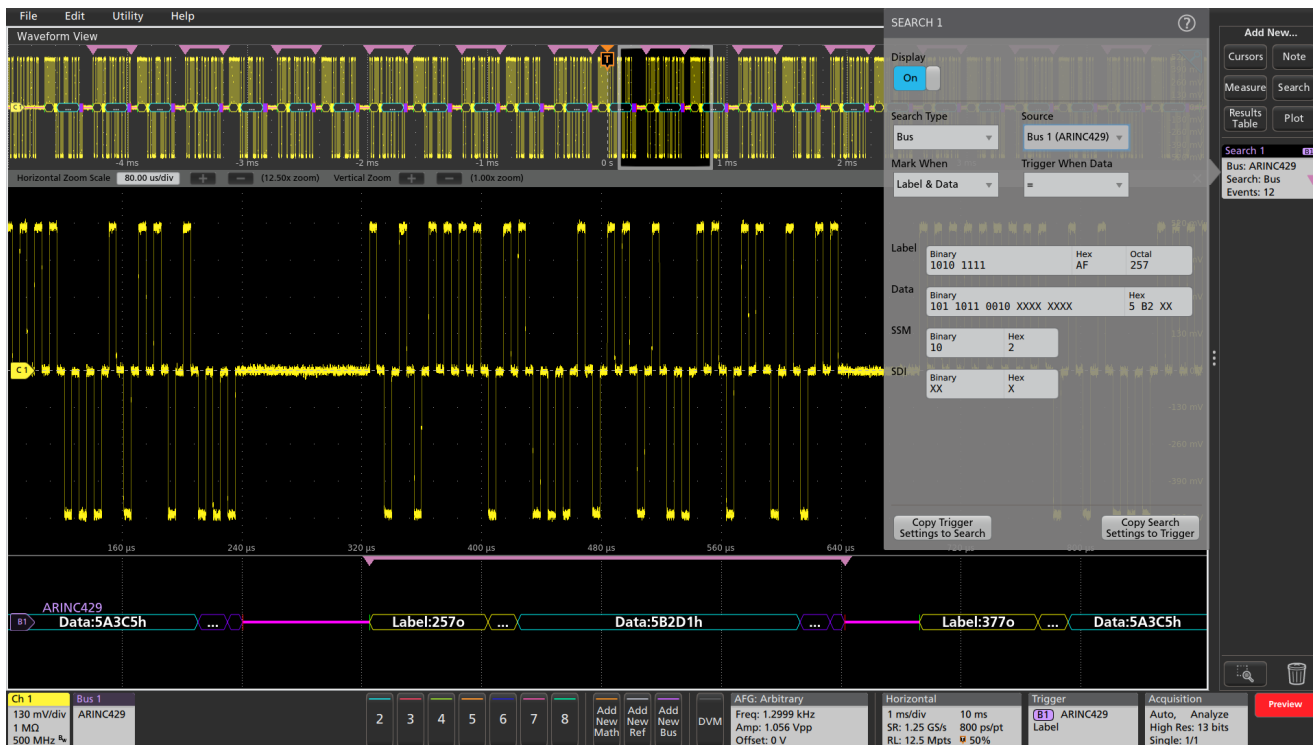
Characteristic	Description
Trigger and/or Search On	Word Start Label (when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Data (when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Label and Data (Label value and Data =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Word End Error (Any Error, Parity Error,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

### Display modes

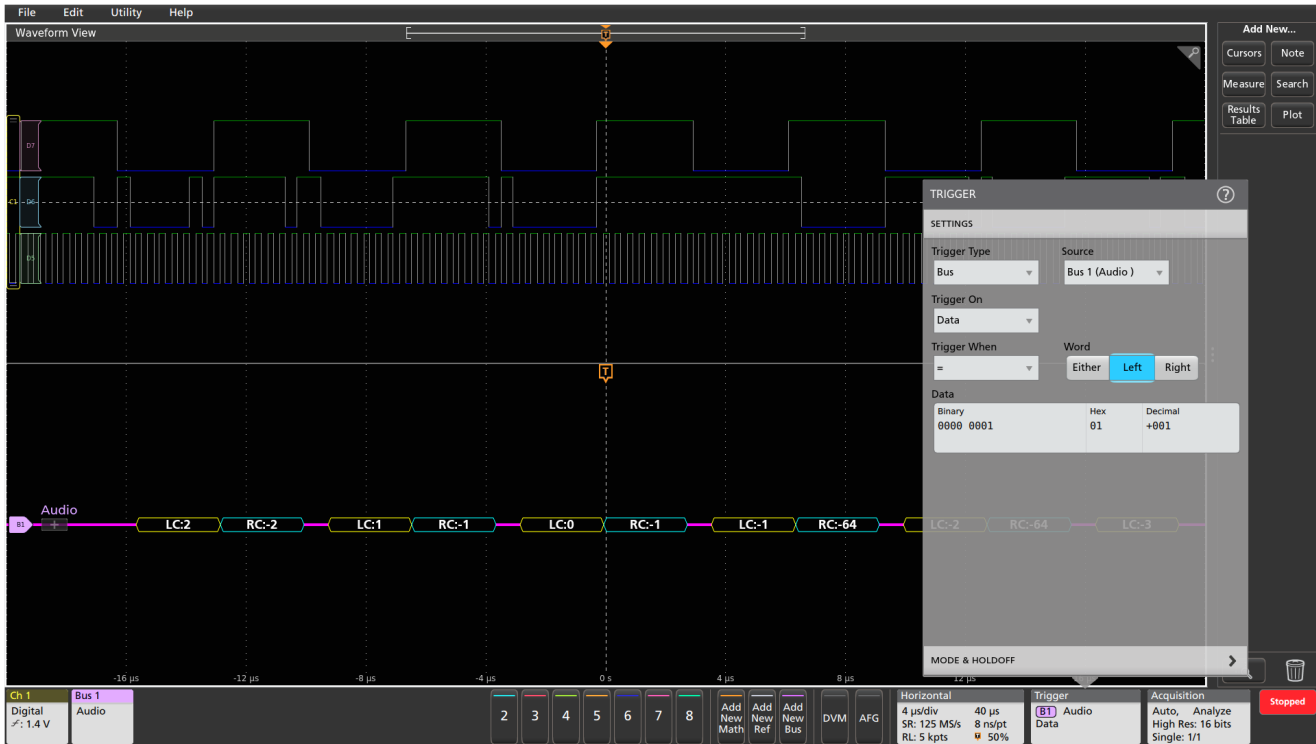
Characteristic	Description
Bus	Bus only
Bus and Waveforms	Simultaneous display of bus and digital waveforms
Results Table	Decoded packet data in a tabular view

### Bus trigger and search options

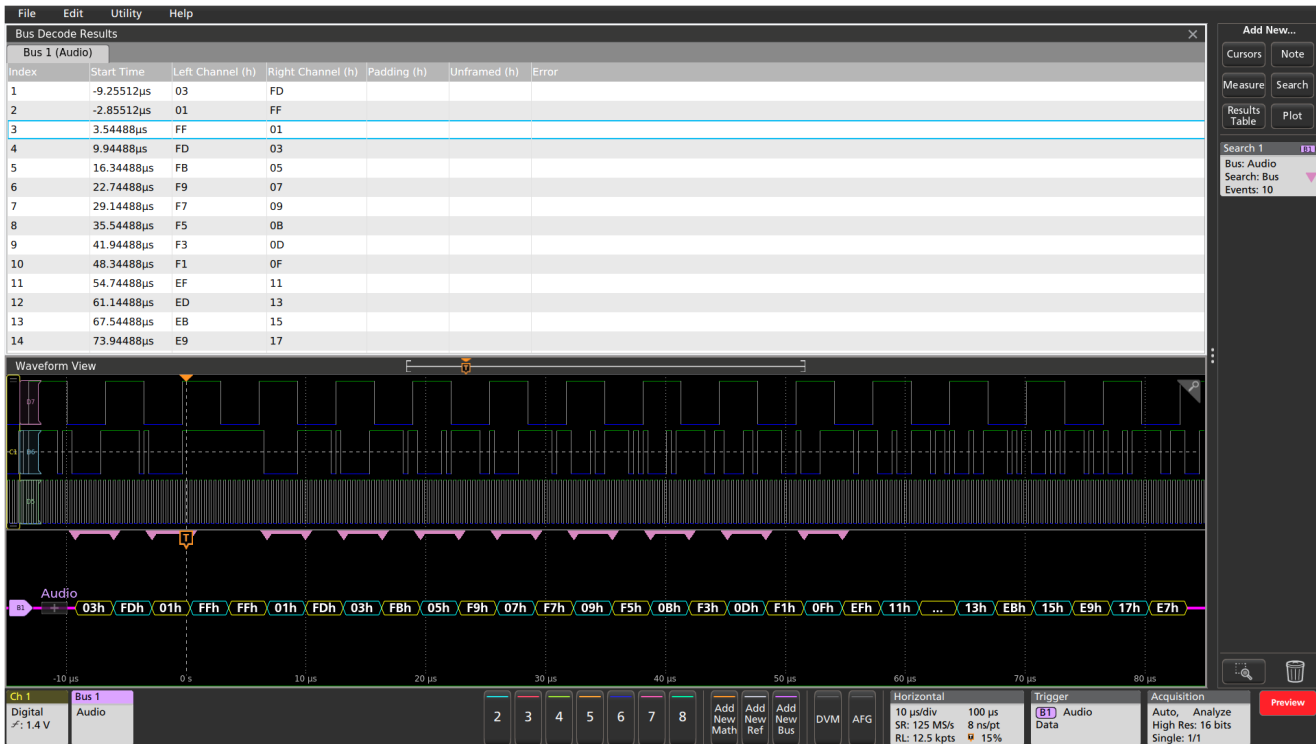
Characteristic	Description
Trigger and/or Search On	Word Select (I <sup>2</sup> S, LJ, RJ only) Frame Sync (TDM only) Data (when =, ≠, <, >, ≤, ≥, Inside Range, Outside Range; Left, Right, or Either Word)

### Bus decode

Characteristic	Description
Maximum Clock/Data Rate	Up to 10 Mb/s (for automated decoding of 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)



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)

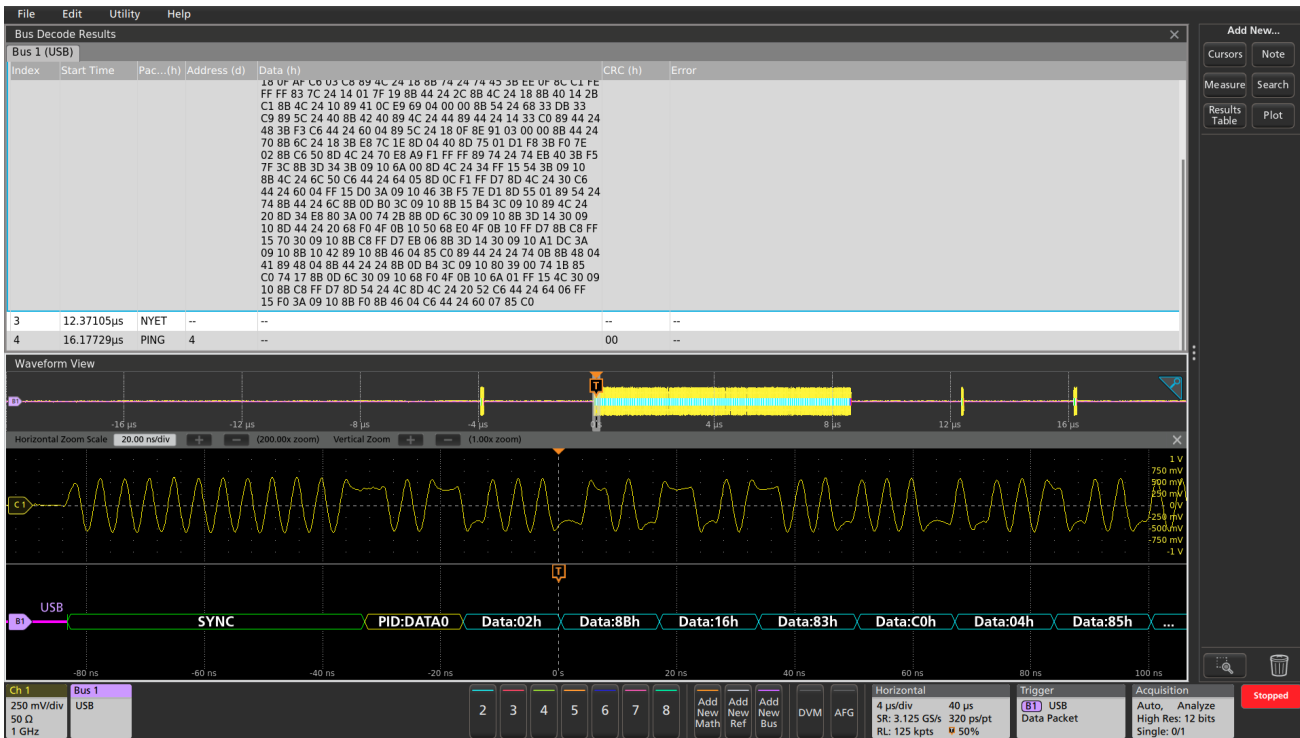
### Bus Search options

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)

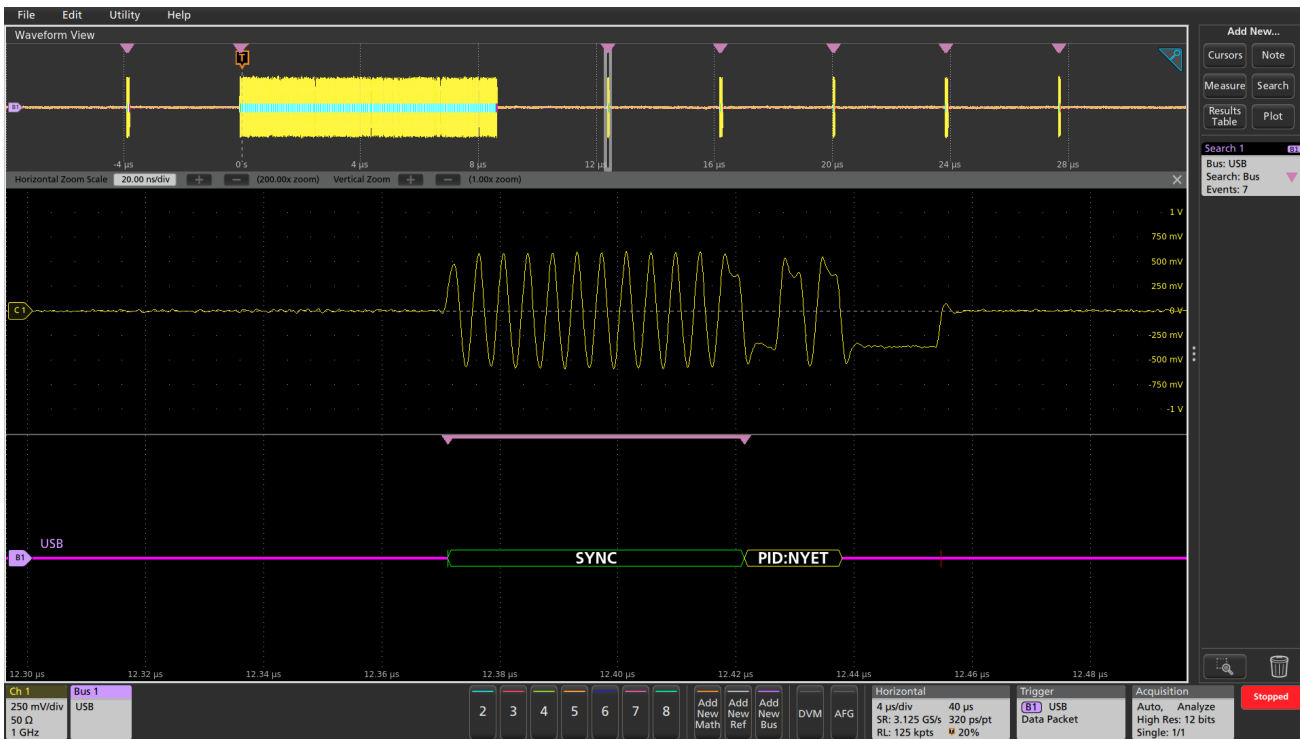
### Bus decode

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

### 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

### 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)

### 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



## SPMI characteristics

### 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

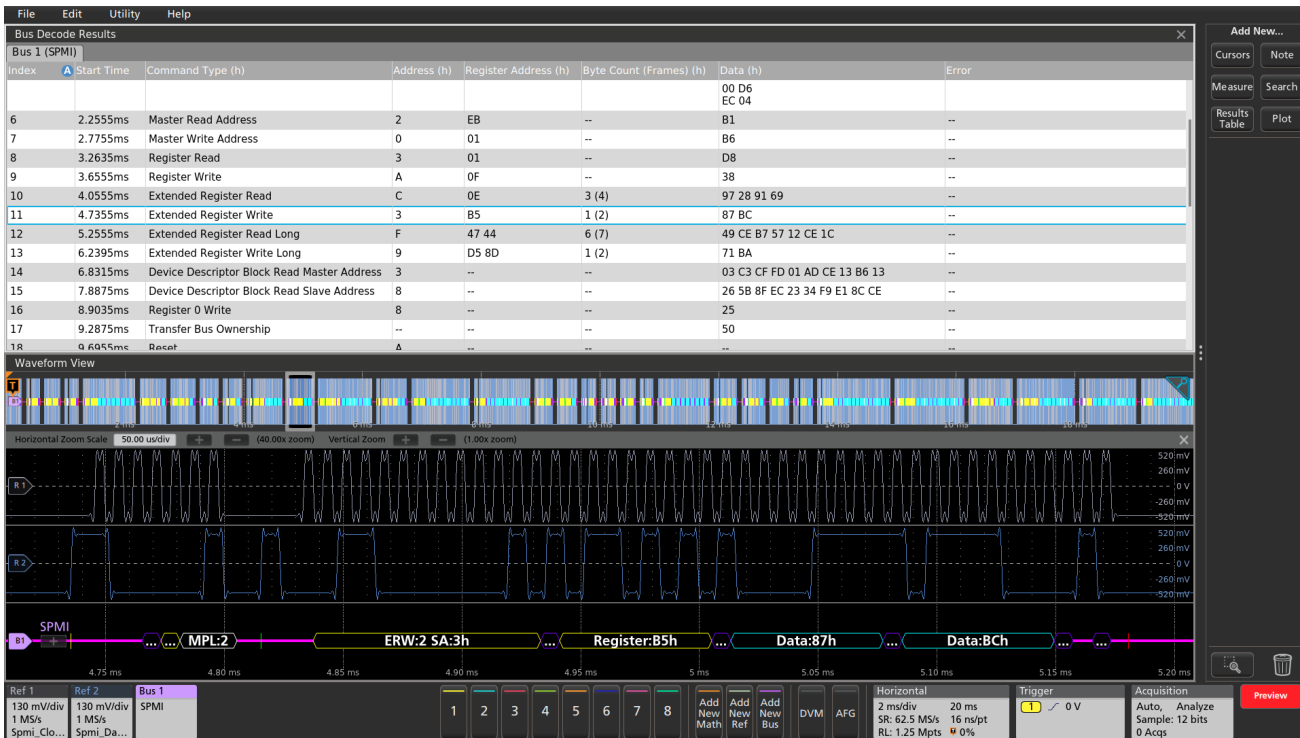
### Bus search options

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

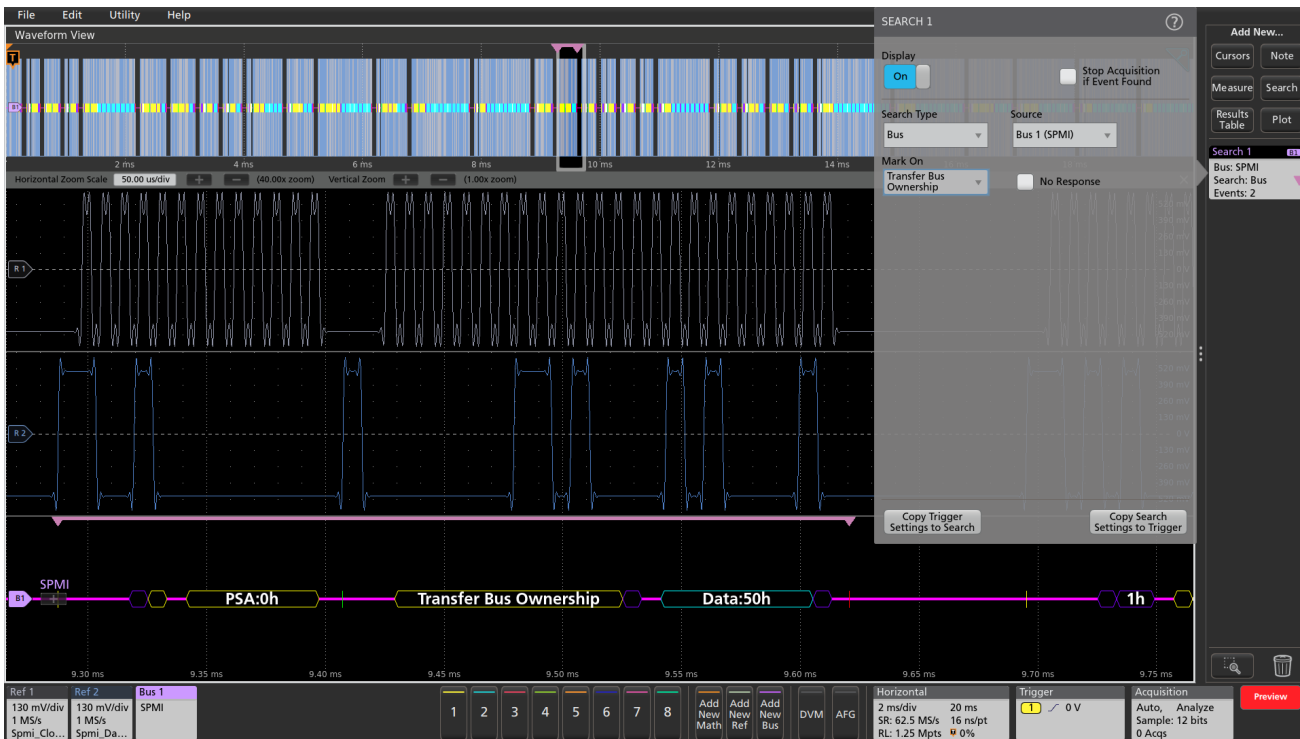
### Bus decode

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>1</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>1</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

## Ordering information

To add to an instrument at purchase

Serial bus	5 Series MSO Option	6 Series MSO Option	Description
I <sup>2</sup> C, SPI	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.
CAN, CAN FD, LIN, FlexRay	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.
SENT	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.
RS-232/422/485, UART	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.
MIL-STD-1553, ARINC 429	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	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.
USB 2.0	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.
Ethernet	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.
SPMI	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.

To upgrade an already purchased instrument

Serial bus <sup>2</sup>	5 Series MSO Node-Locked License	5 Series MSO Floating License	6 Series MSO Node-Locked License	6 Series MSO Floating License
I <sup>2</sup> C, SPI	SUP5-SREMBD	SUP5-SREMBD-FL	SUP6-SREMBD	SUP6-SREMBD-FL
CAN, CAN FD, LIN, FlexRay	SUP5-SRAUTO	SUP5-SRAUTO-FL	SUP6-SRAUTO	SUP6-SRAUTO-FL
SENT	SUP5-SRAUTOSEN	SUP5-SRAUTOSEN-FL	SUP6-SRAUTOSEN	SUP6-SRAUTOSEN-FL
RS-232/422/485, UART	SUP5-SRCOMP	SUP5-SRCOMP-FL	SUP6-SRCOMP	SUP6-SRCOMP-FL
MIL-STD-1553, ARINC 429	SUP5-SRAERO	SUP5-SRAERO-FL	SUP6-SRAERO	SUP6-SRAERO-FL
I <sup>2</sup> S, LJ, RJ, TDM	SUP5-SRAUDIO	SUP5-SRAUDIO-FL	SUP6-SRAUDIO	SUP6-SRAUDIO-FL
USB 2.0	SUP5-SRUSB2	SUP5-SRUSB2-FL	SUP6-SRUSB2	SUP6-SRUSB2-FL
Ethernet	SUP5-SRENET	SUP5-SRENET-FL	SUP6-SRENET	SUP6-SRENET-FL
SPMI	SUP5-SRPM	SUP5-SRPM-FL	SUP6-SRPM	SUP6-SRPM-FL

### 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.



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



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.

<sup>2</sup> Software is supplied with the instrument firmware. Always download and install the latest version of the firmware. User documentation is part of the application Help.

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