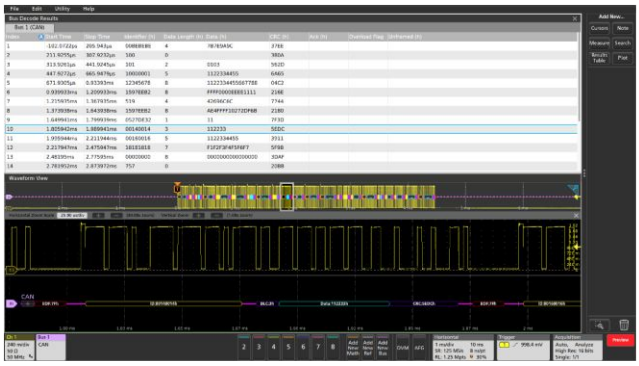
Tektronix®

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^2C, SPI, I3C, CAN, CAN FD, LIN, FlexRay, SENT, RS-232/422/485, UART, USB 2.0, Ethernet, SPMI, MIL-STD-1553, ARINC 429, I^2S, LJ, RJ, and TDM.

Key features

- Automated Serial Decode and Analysis Options for I^2C, SPI, I3C [1], CAN, CAN FD, LIN, FlexRay, SENT [1], RS-232/422/485, UART, USB 2.0, Ethernet [1], SPMI [1], MIL-STD-1553, ARINC 429, I^2S, 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^2C, SPI, CAN, CAN FD, LIN, FlexRay, SENT, RS-232/422/485, UART, USB 2.0, Ethernet, SPMI, MIL-STD-1553, ARINC 429, I^2S, 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^2C, SPI, CAN, CAN FD, LIN, FlexRay, SENT, RS-232/422/485, UART, USB 2.0, Ethernet, SPMI, MIL-STD-1553, ARINC 429, I^2S, 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 or the Search badge. The 3 Series MDO uses the arrows in the Search badge to navigate.

1 Not available for 3 Series MDO.

Characteristics

I²C characteristics

Bus setup options

Characteristic	Description
I²C Sources (Clock and Data)	Analog channels Digital channels Active Math channels [2] Active Reference channels [2]
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

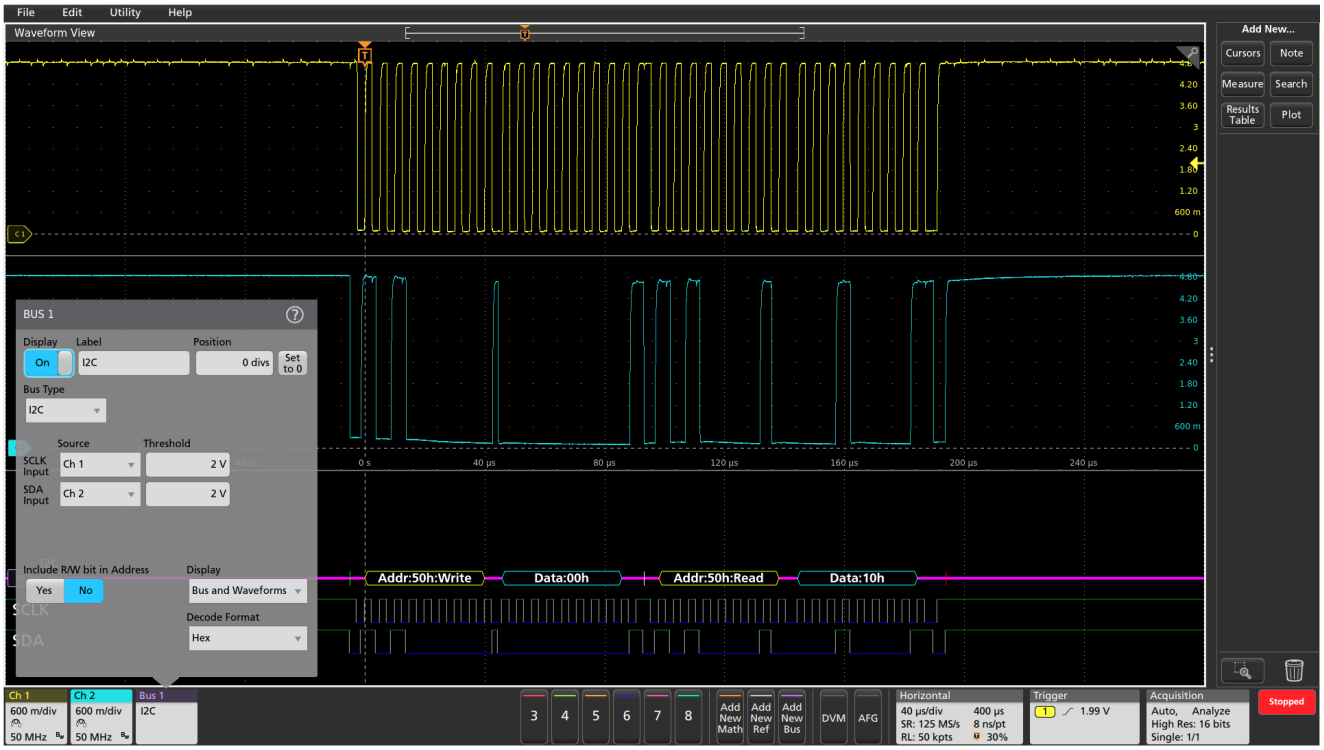
Bus trigger and search options

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

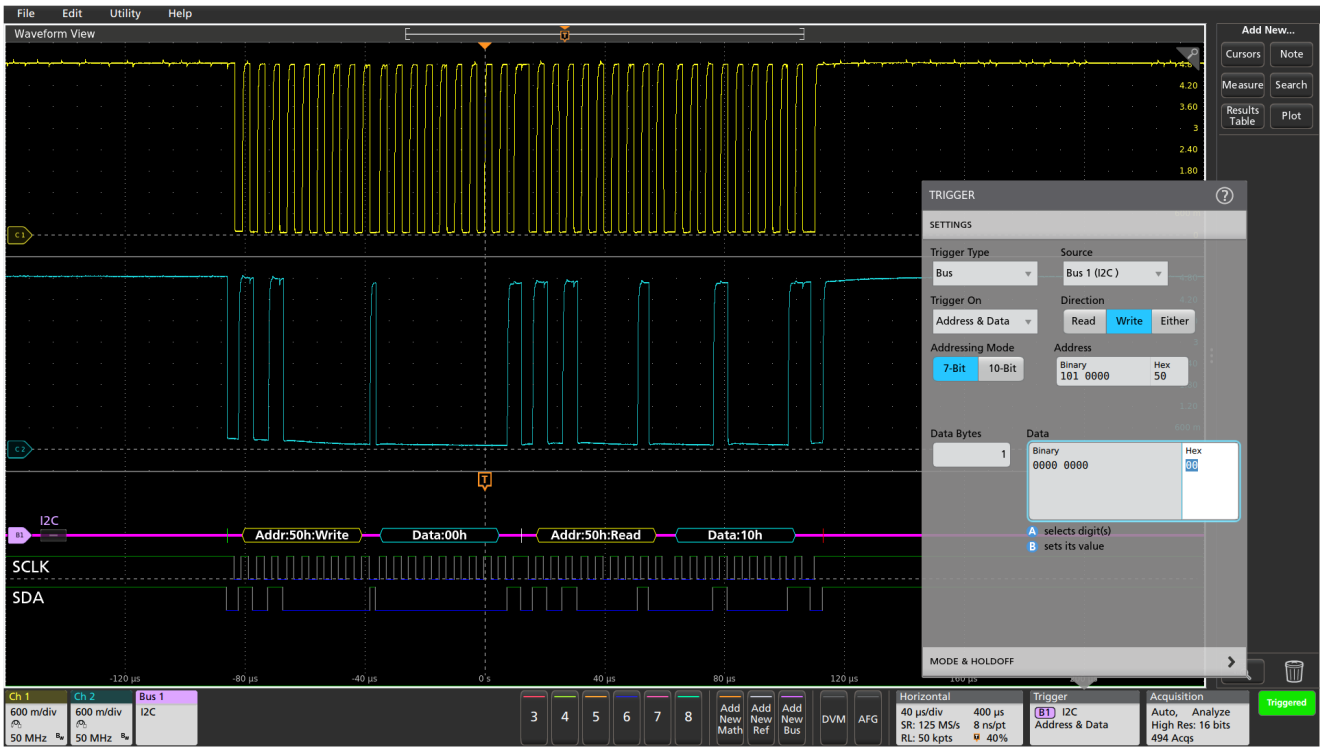
Bus decode

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)

2 Not available on 3 Series MDO



Color-coded I²C bus display, using hexadecimal display format.



Triggering on a specific address value on the I²C bus.

SPI characteristics

Bus setup options

Characteristic	Description
SPI Sources (Clock, Data, and Slave Select)	Analog channels Digital channels Active Math channels [3] Active Reference channels [3]
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

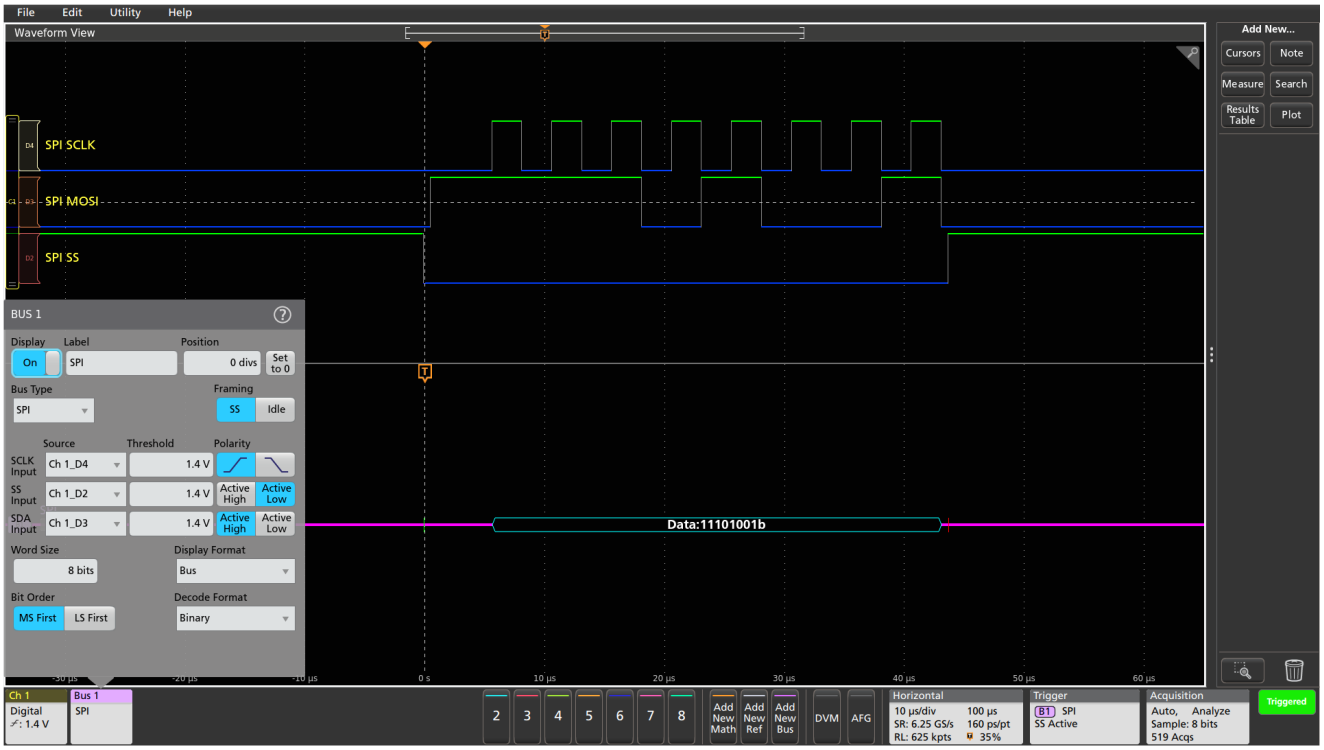
Bus trigger and search options

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

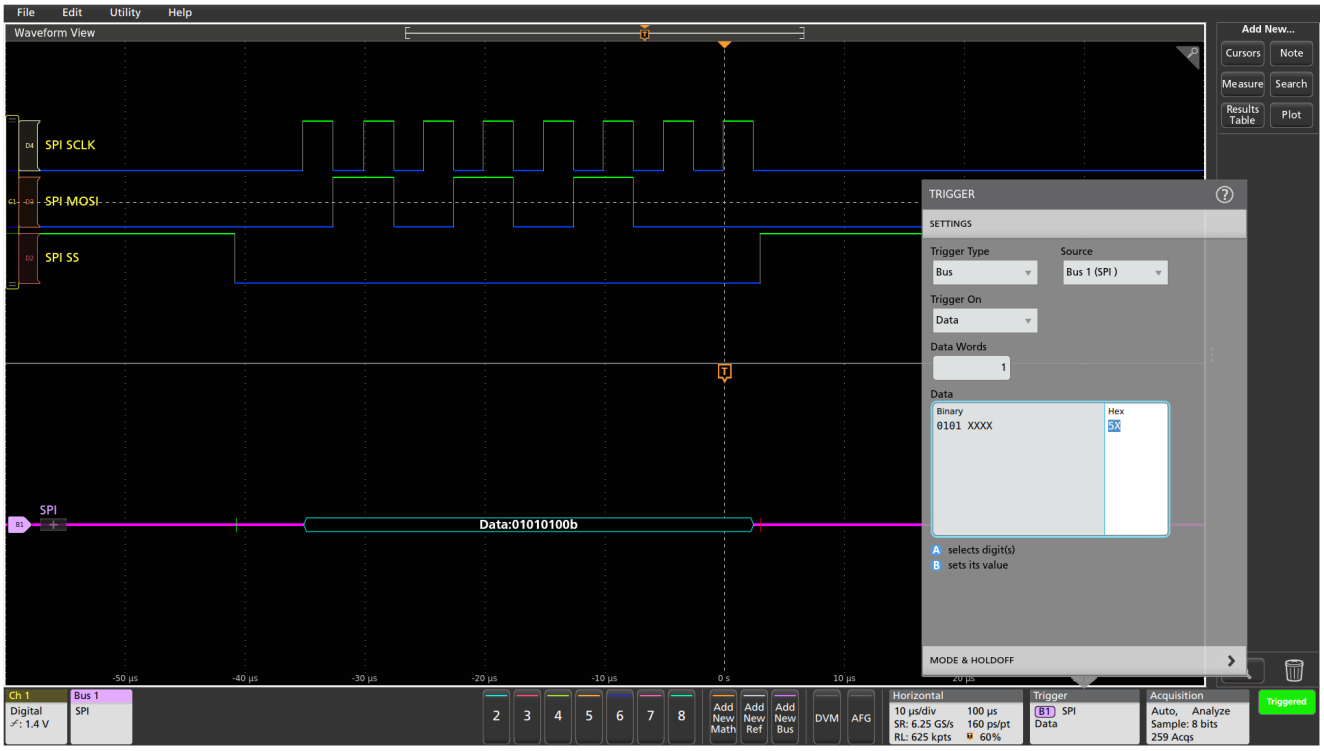
Bus decode

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

3 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 [4]

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)

4 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 [5] Active Reference channels [5]
Sources, RS-422, RS-485	Analog channels Active Math channels [5] Active Reference channels [5]
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

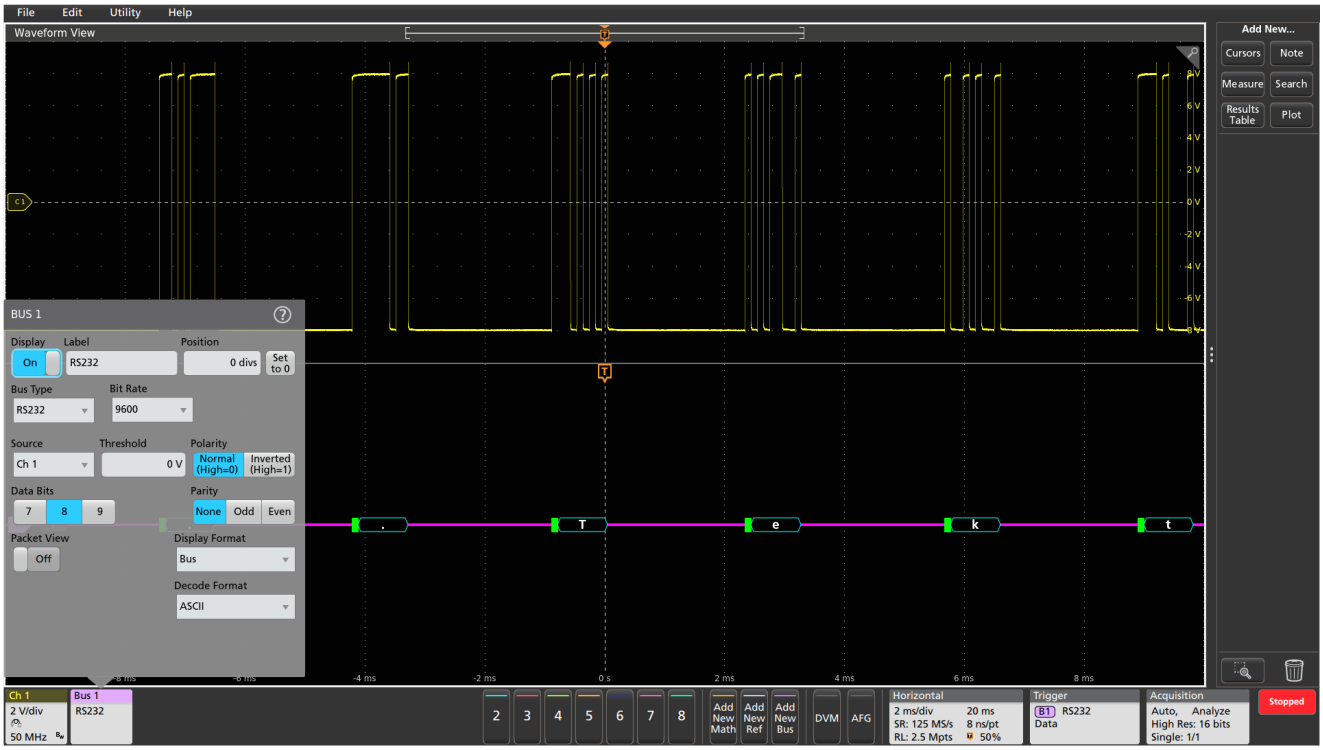
Bus trigger and search options

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

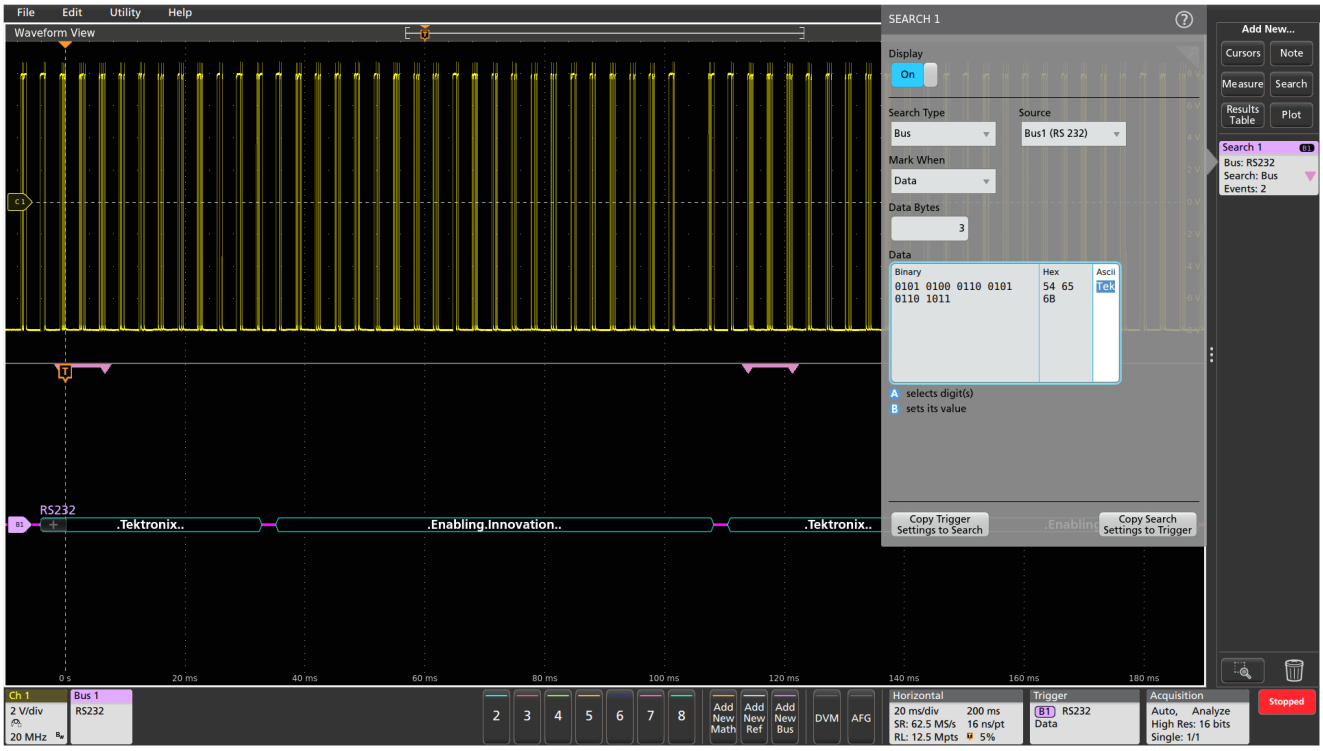
Bus decode

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)

5 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 [6] Active Reference channels [6]
Source for Diff (differential probing)	Analog channels Active Math channels [6] Active Reference channels [6]
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 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) [6]

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

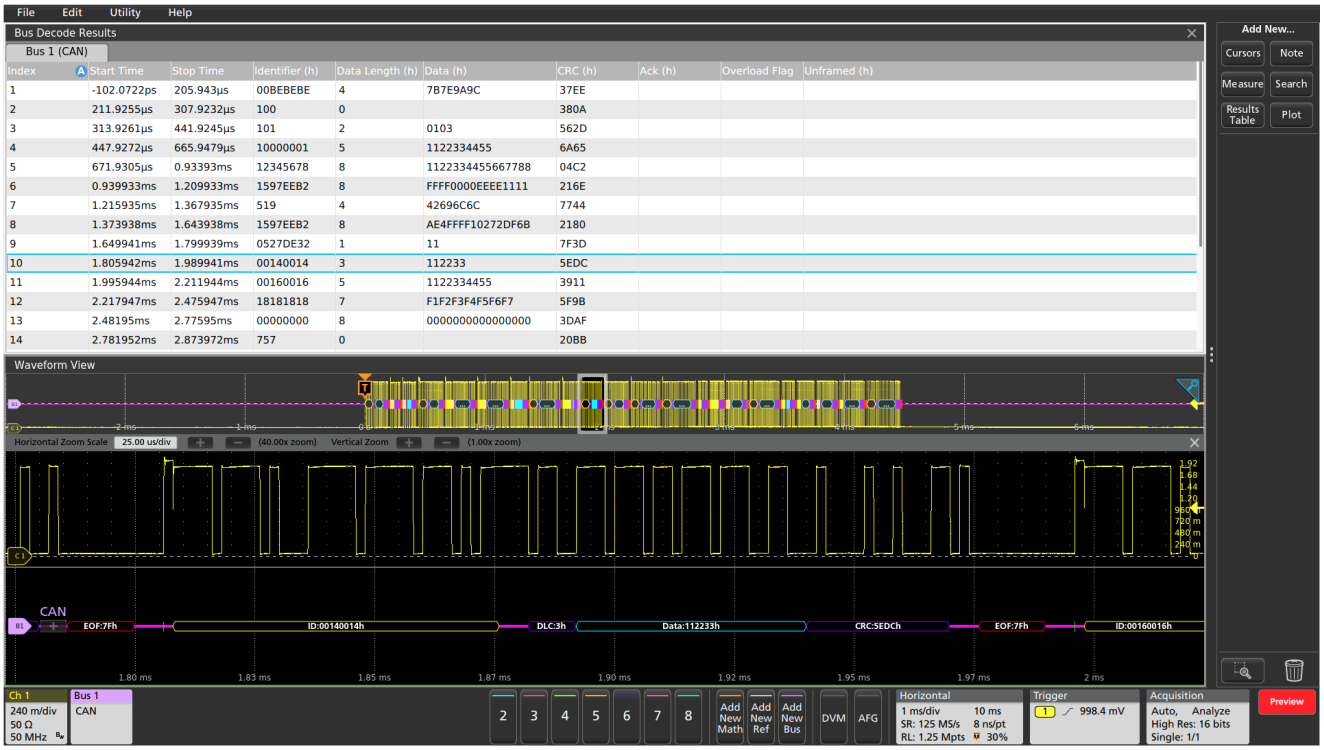
Symbolic bus search options

Characteristic	Description
Message	As defined by the .dbc file [6]
Message and Signal	As defined by the .dbc file [6]

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)

6 Not available on 3 Series MDO.



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 [7] Active Reference channels [7]
Source for Diff (differential probing)	Analog channels Active Math channels [7] Active Reference channels [7]
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) [7]

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)

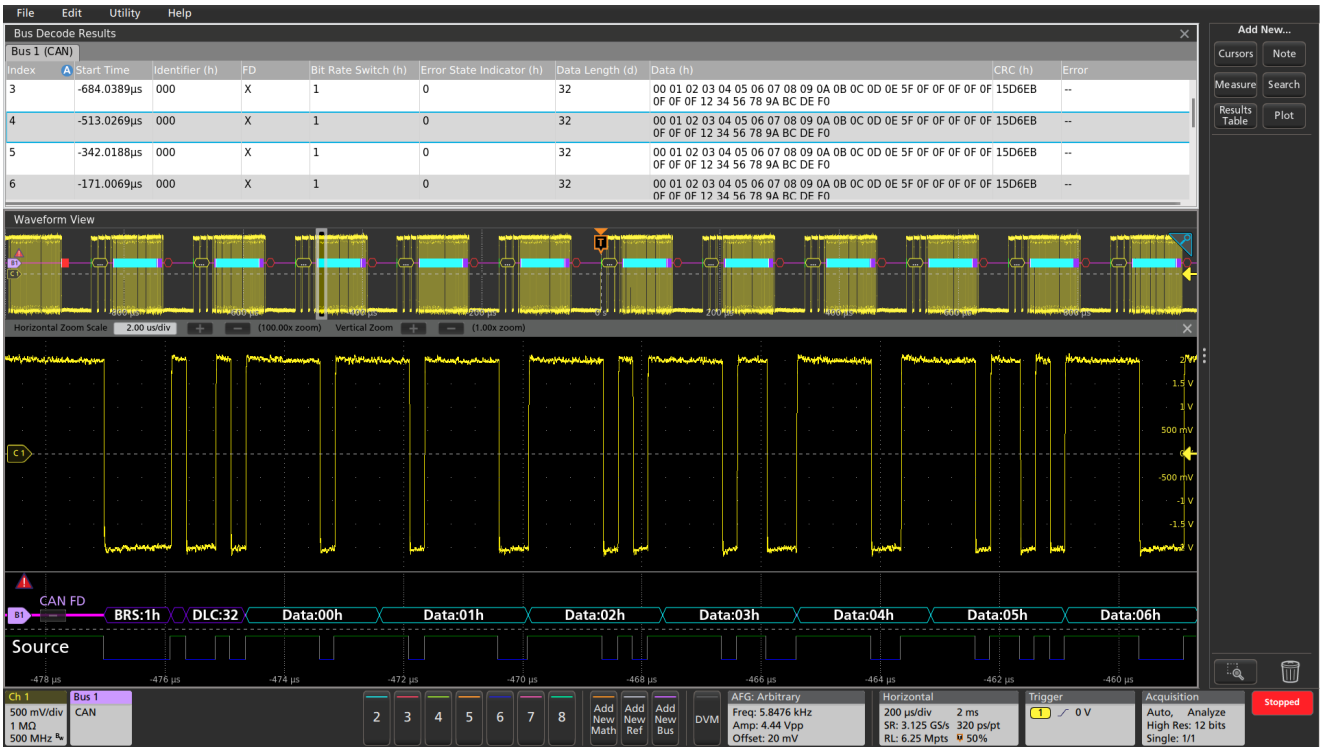
Symbolic bus search options

Characteristic	Description
Message	As defined by the .dbc file [7]
Message and Signal	As defined by the .dbc file [7]

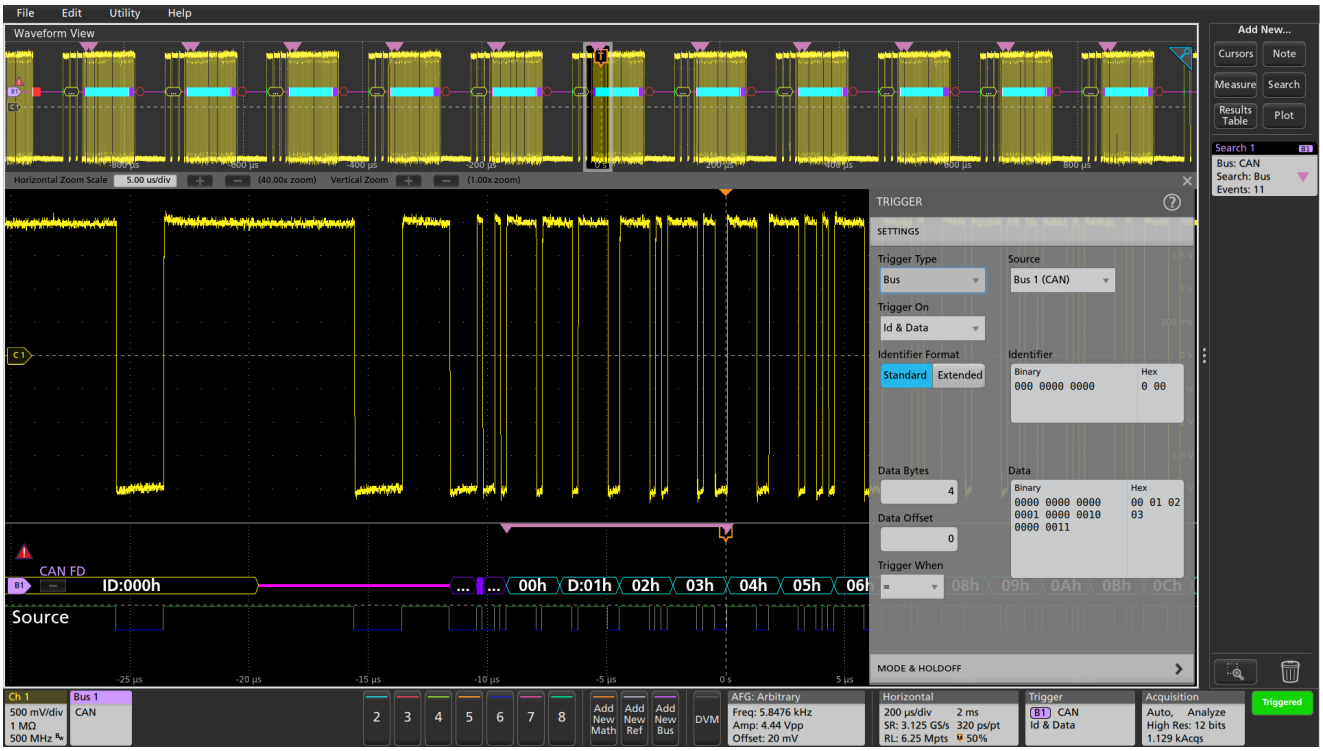
Bus decode

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)

7 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 [8] Active Reference channels [8]
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

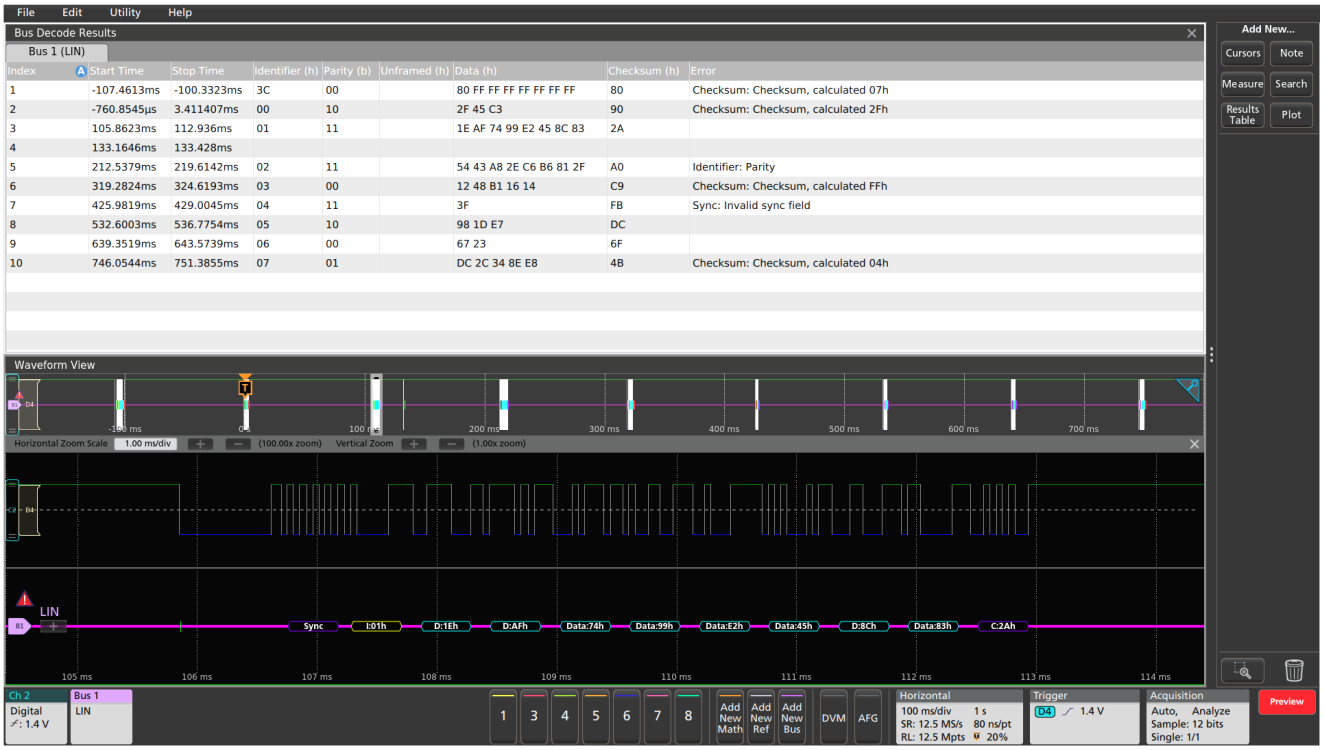
Bus trigger and search options

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)

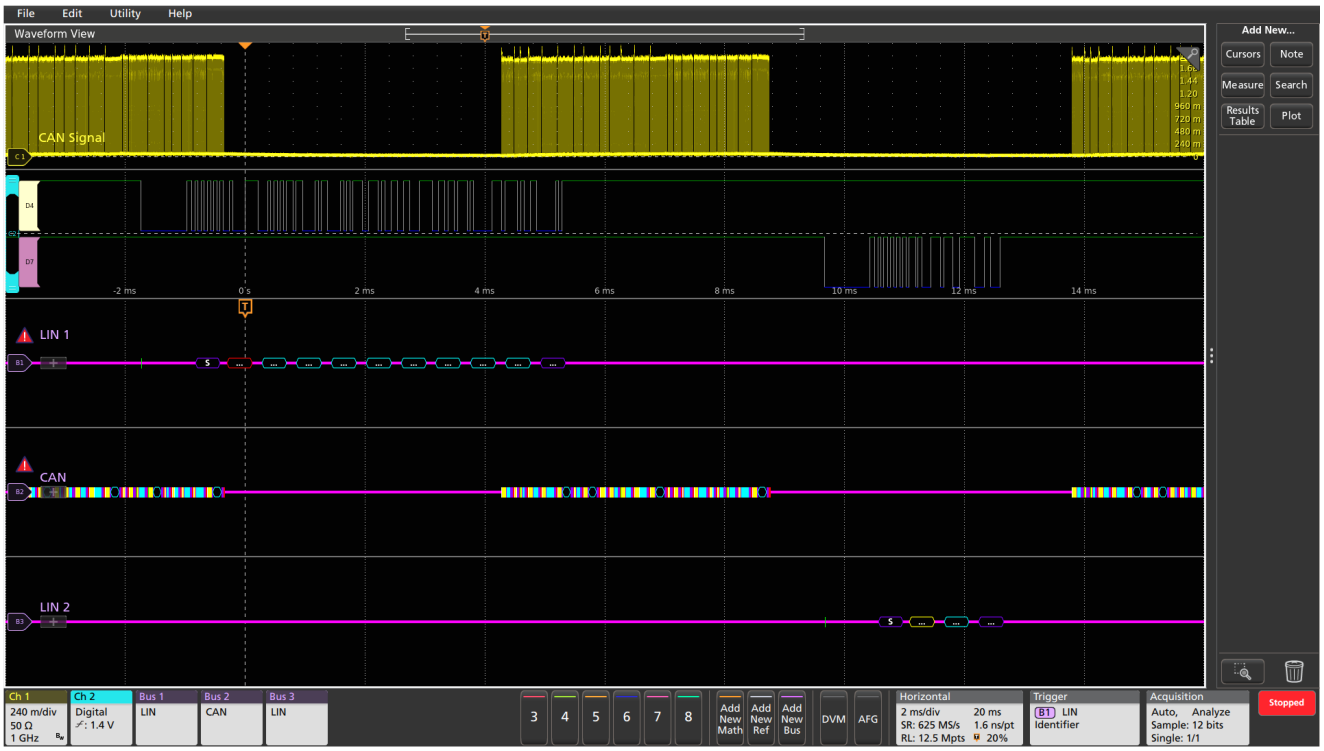
Bus decode

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)

8 Not available on 3 Series MDO.



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 [9] Active Reference channels [9]
Source for Single-ended Probing (BP, BM)	Analog channels Digital channels Active Math channels [9] Active Reference channels [9]
Source for Single-ended Probing (Tx, Rx)	Analog channels Digital channels Active Math channels [9] Active Reference channels [9]
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

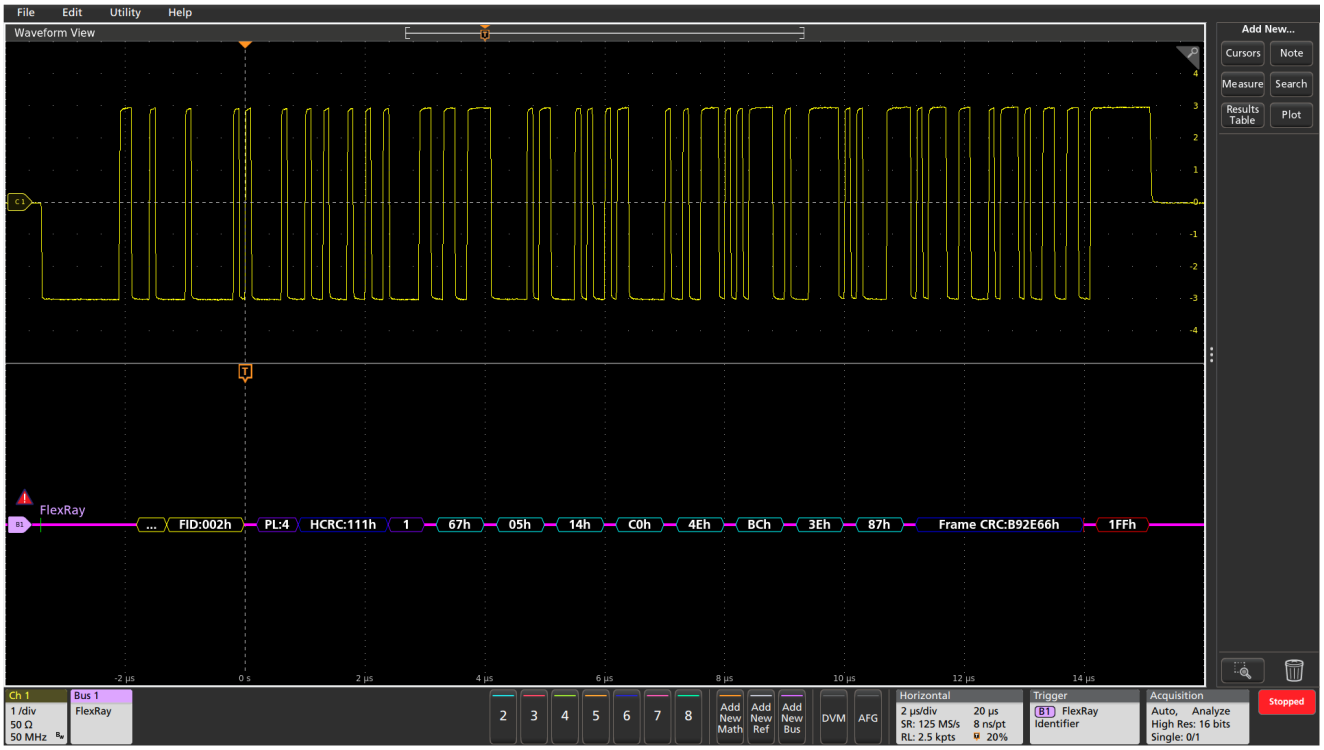
Bus trigger and search options

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)

9 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 [10]

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 µs - 300 µs
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)

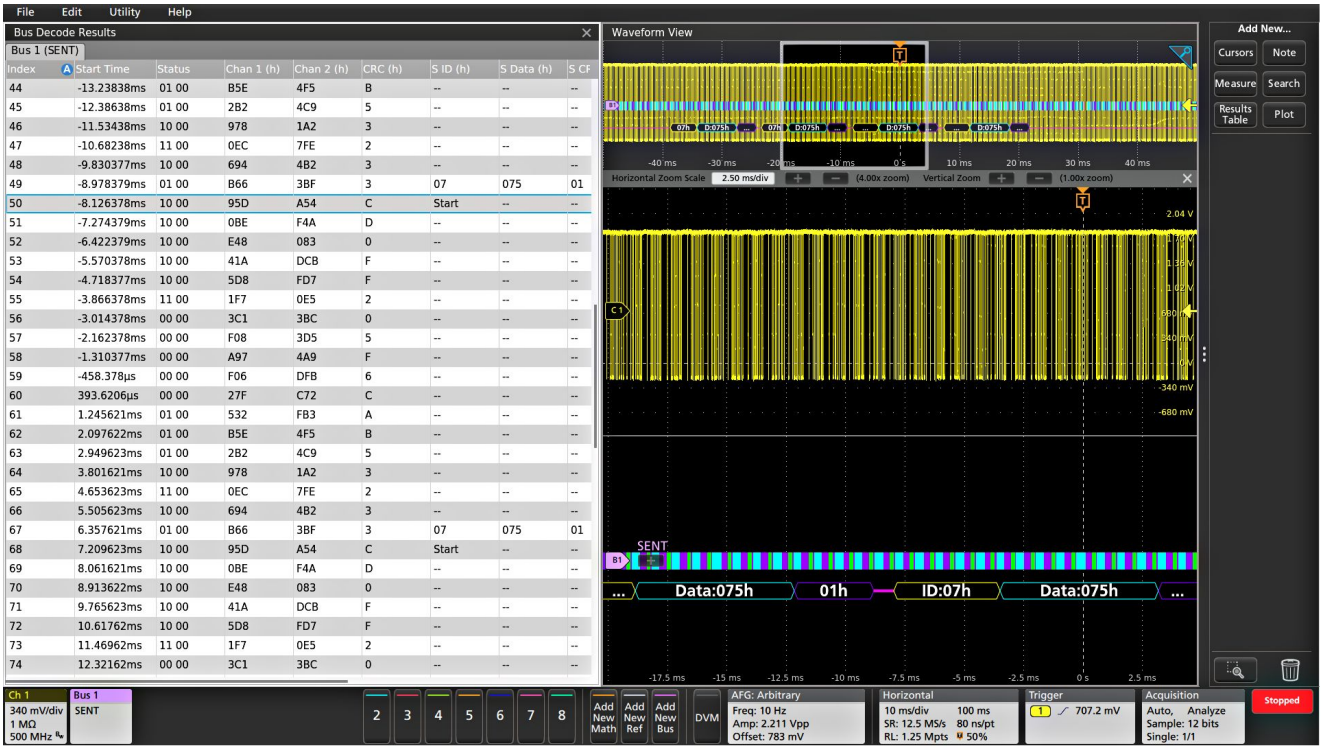
Bus search options

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)

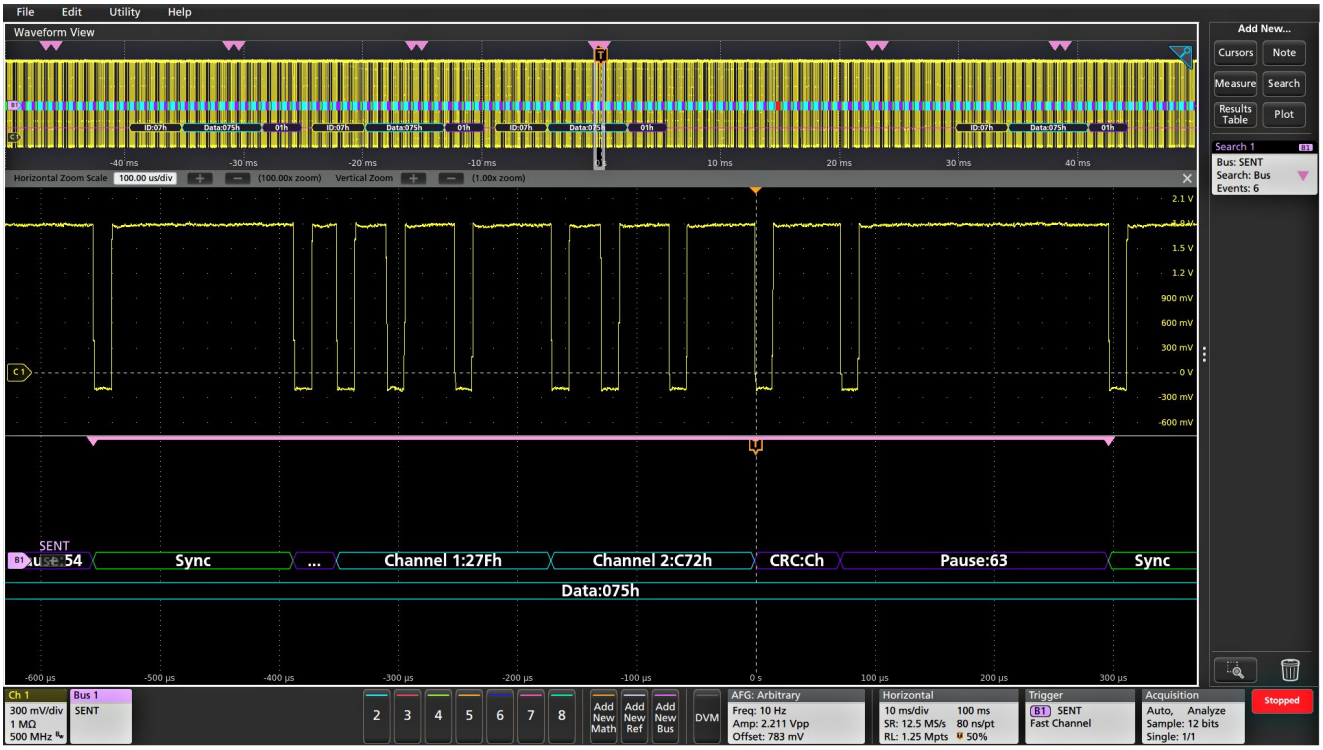
Bus decode

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)

10 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 µs-100 µs
Formats Available	Mixed Hex Mixed ASCII Hex Binary

Display modes

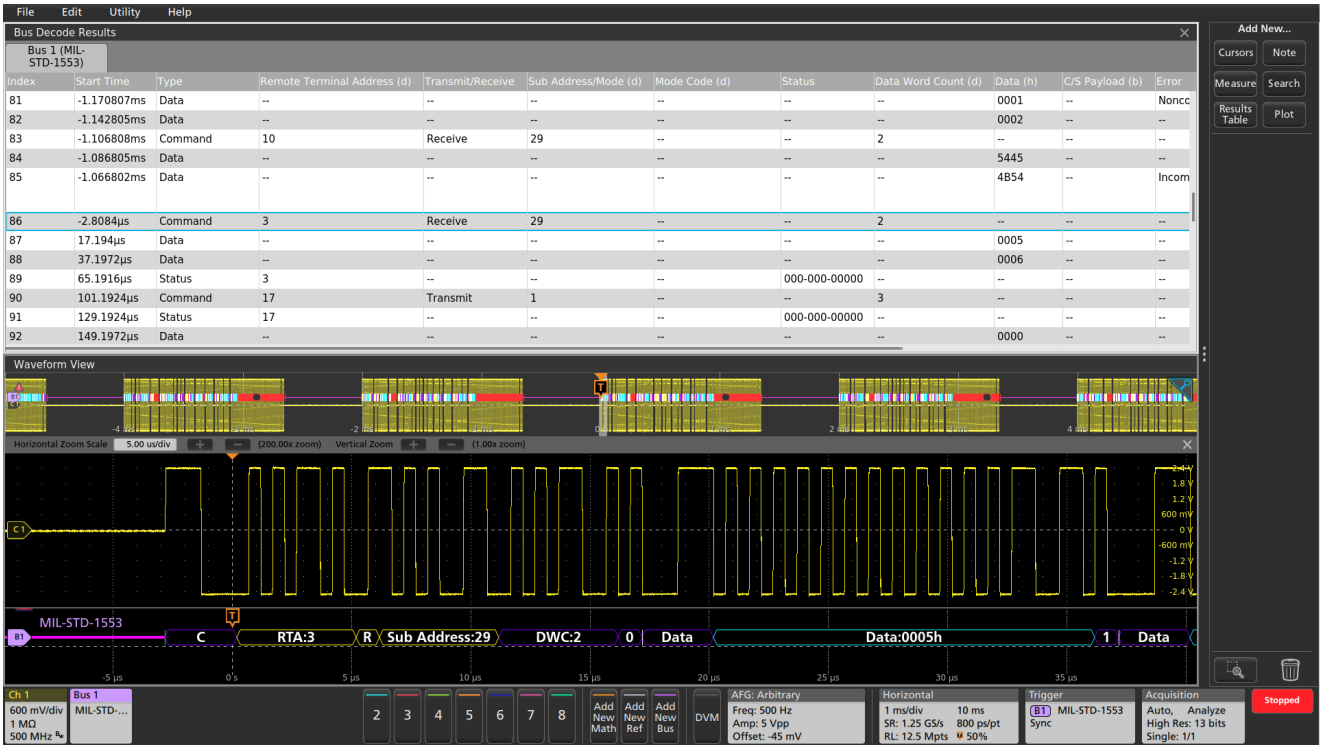
Characteristic	Description
Bus	Bus only
Results Table	Decoded packet data in a tabular view

Bus trigger and search options

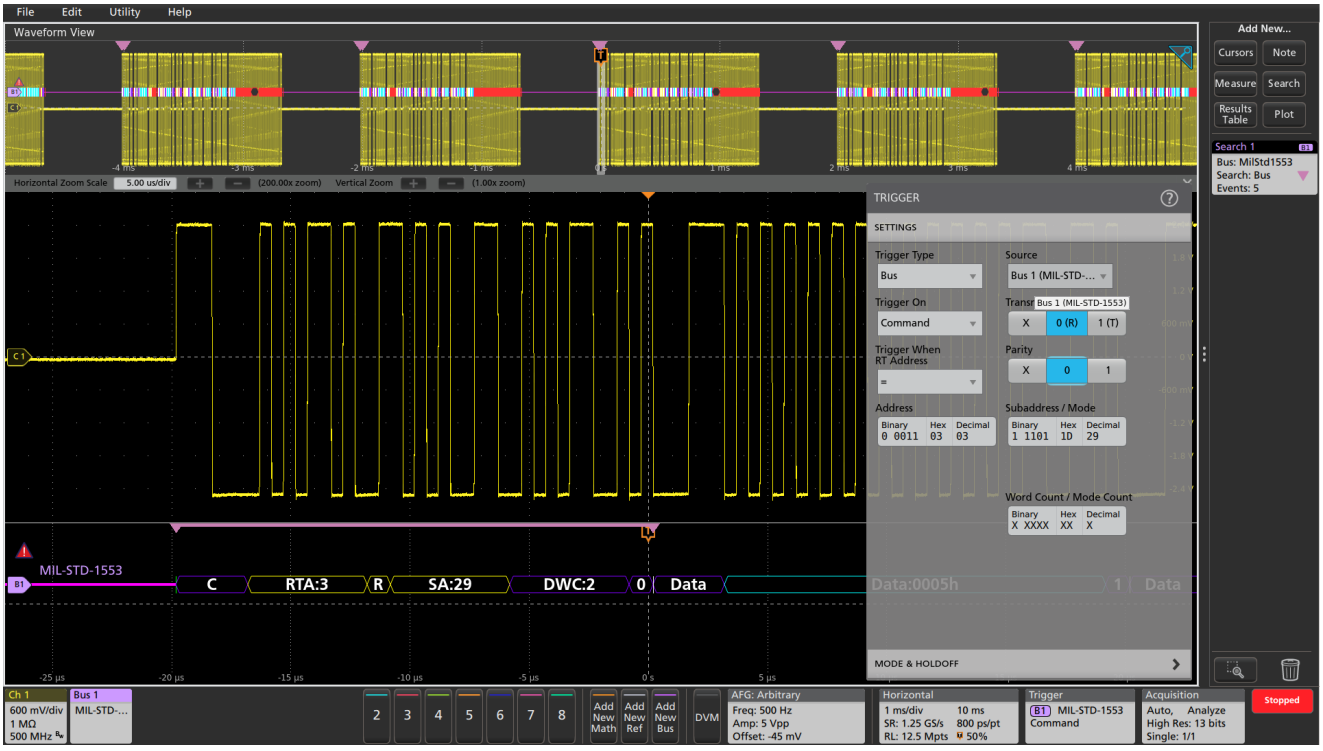
Characteristic	Description
Trigger and/or Search On	Sync Command (Transmit/Receive Bit, Parity, Subaddress / Mode, Word Count / Mode Count, and RT Address =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Status (Parity, Bit 9 - Message Error, Bit 10 - Instrumentation, Bit 11 - Service Request, Bit 15 - Broadcast Command Received, Bit 16 - Busy, Bit 17 - Subsystem Flag, Bit 18 - Dynamic Bus Control Acceptance, Bit 19 - Terminal Flag, and Data =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Data (Parity, and Data =, ≠, <, ≤, >, ≥, 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	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

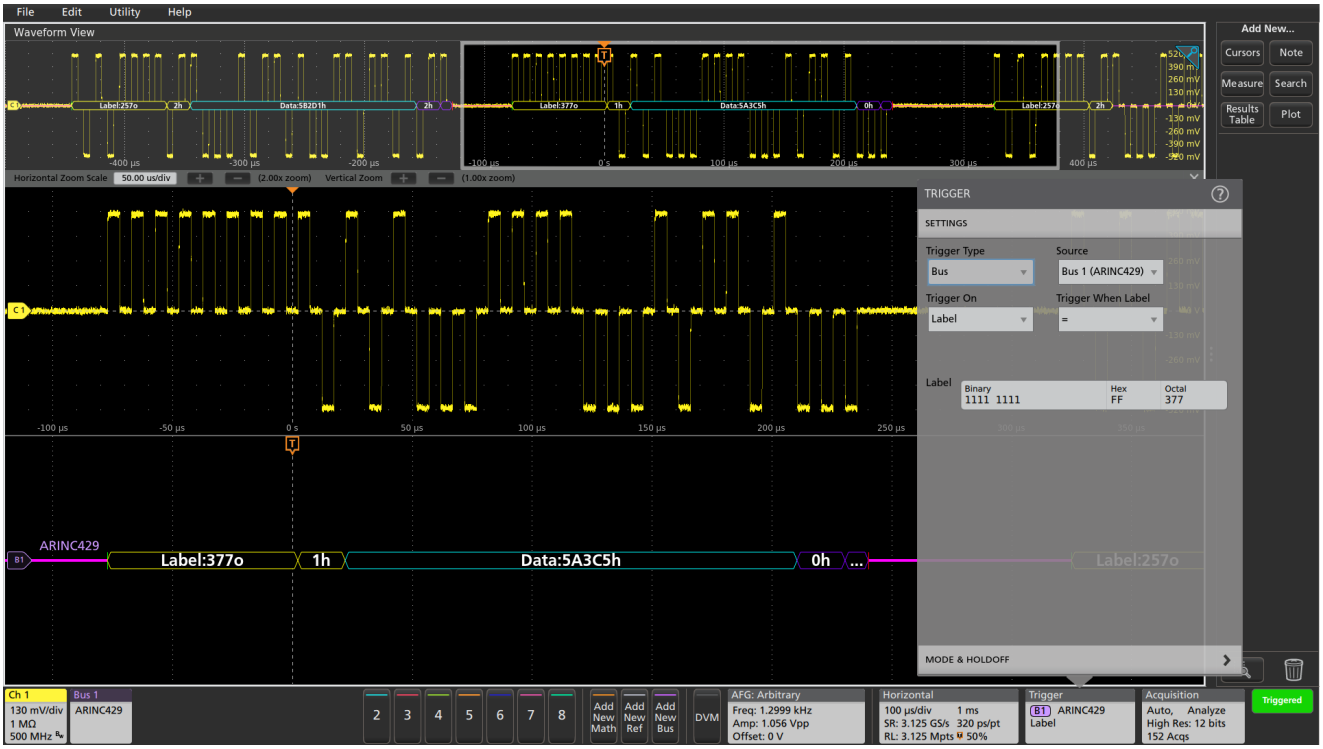
Characteristic	Description
Bus	Bus only
Results Table	Decoded packet data in a tabular view

Bus trigger and search options

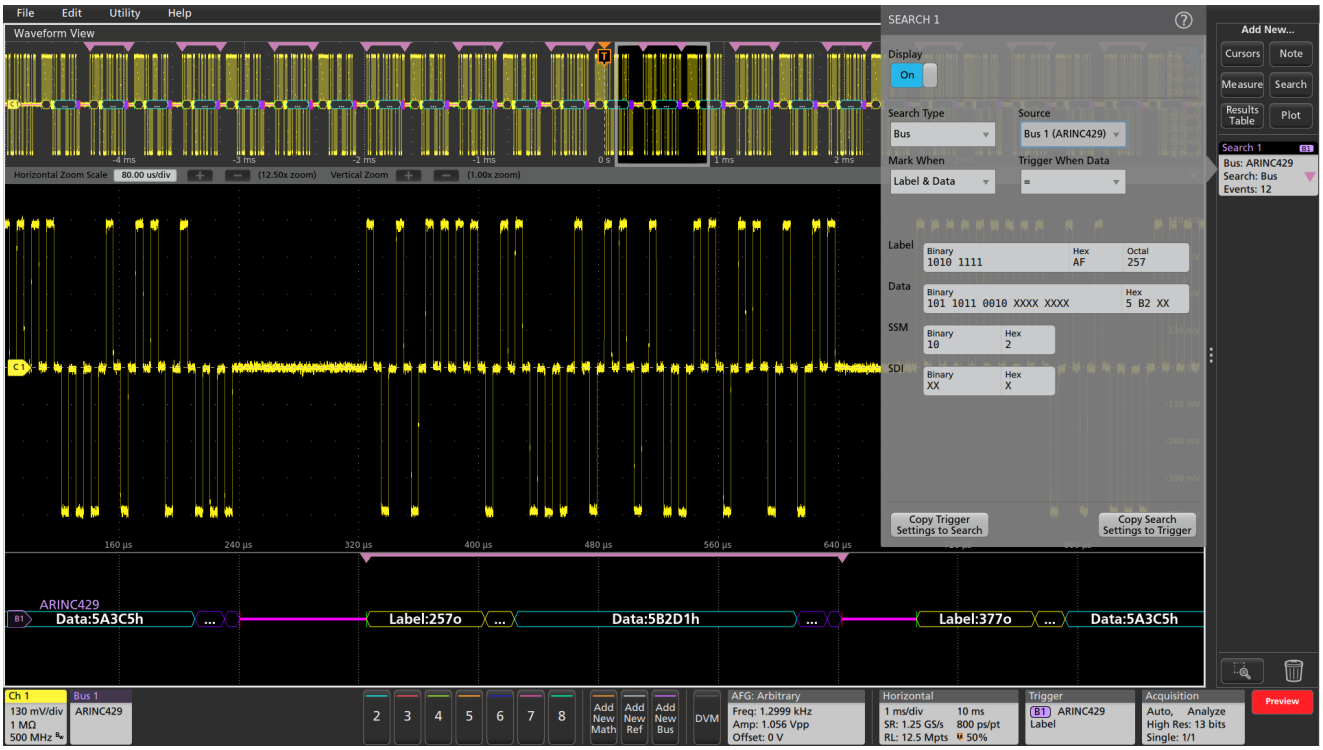
Characteristic	Description
Trigger and/or Search On	Word Start Label (when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Data (when =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Label and Data (Label value and Data =, ≠, <, ≤, >, ≥, Inside Range, Outside Range) Word End Error (Any Error, Parity Error, 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 [11] Active Reference channels [11]
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

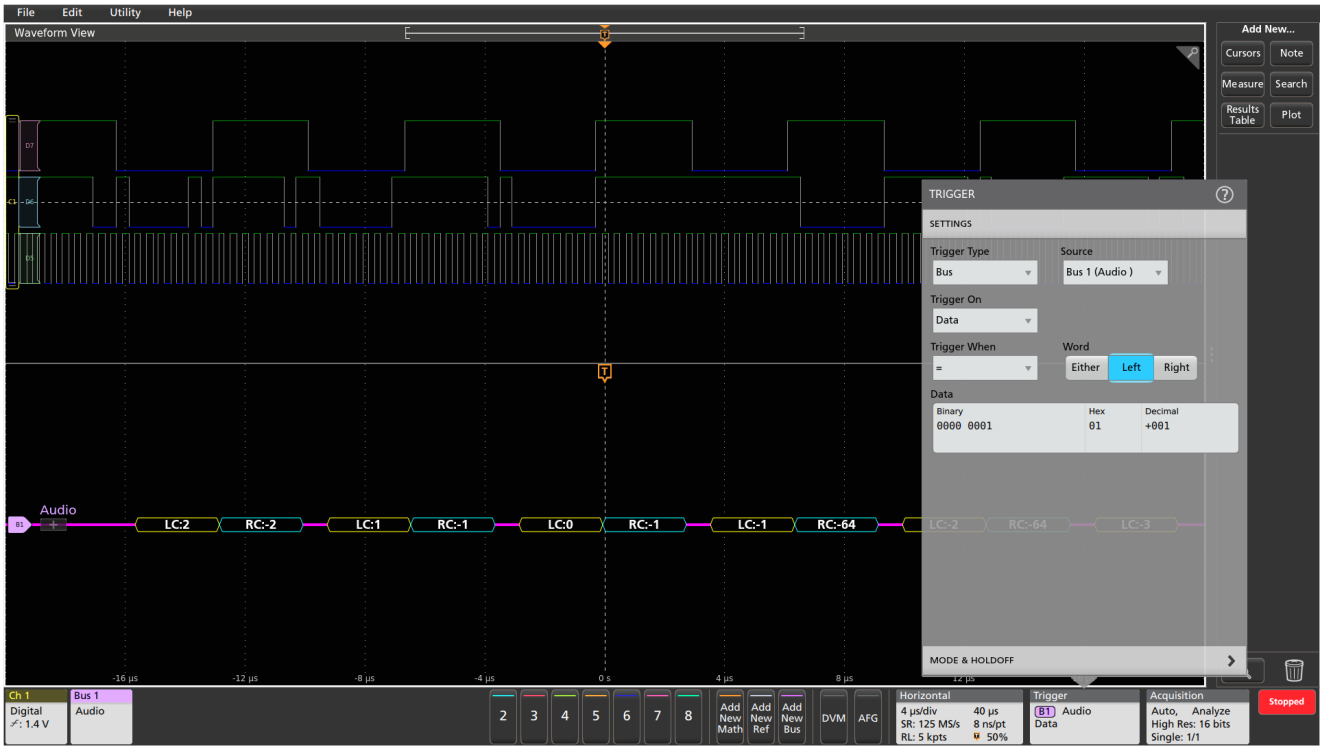
Bus trigger and search options

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

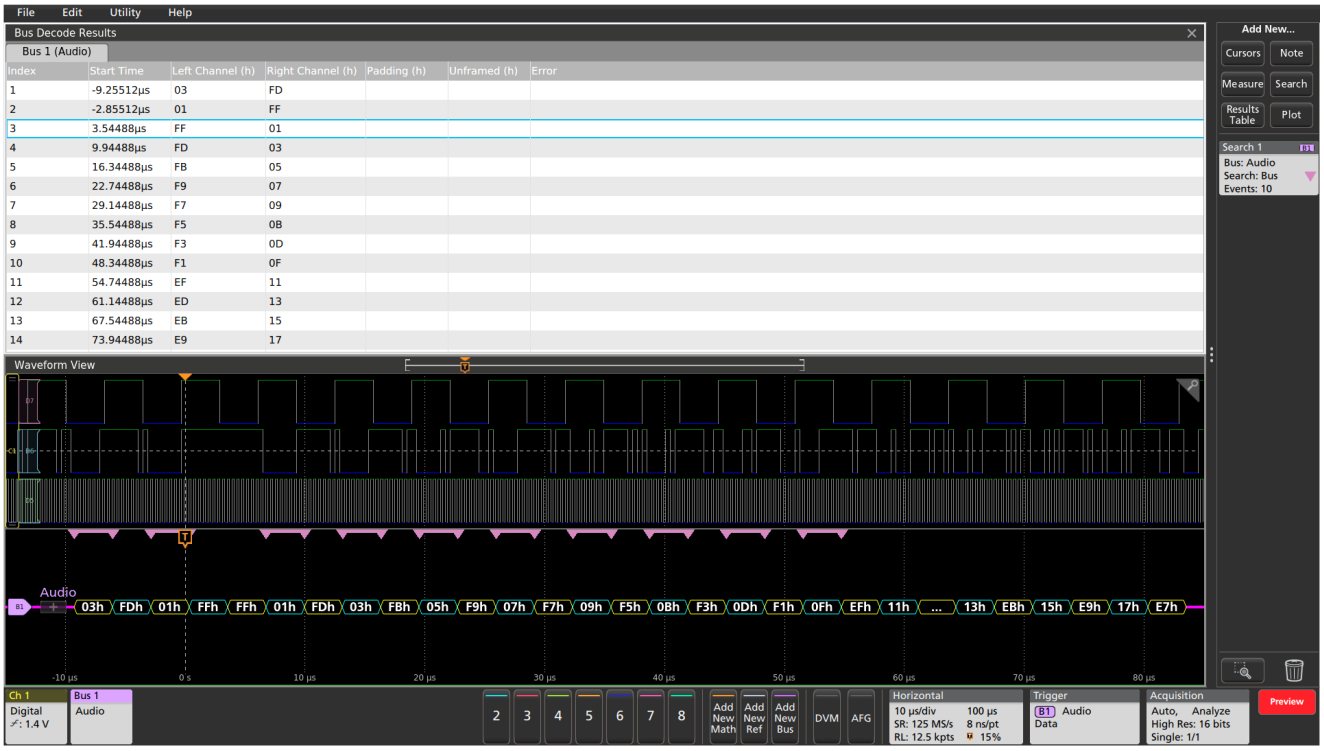
Bus decode

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 I2S/LJ/RJ bus) 3 Series MDO: Up to 25 Mb/s (for automated decoding of TDM bus)
Decode Display	Left Channel Data (I^2S, LJ, RJ) (yellow box) Right Channel Data (I^2S, LJ, RJ) (cyan box) Channel 1 Data (TDM) (yellow box) Channel 2 - N Data (TDM) (cyan box)

11 Not available on 3 Series MDO.



Decoded I²S bus, with data values displayed in signed decimal format, and the MSO triggered on a specific data value.



Decoded I²S 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

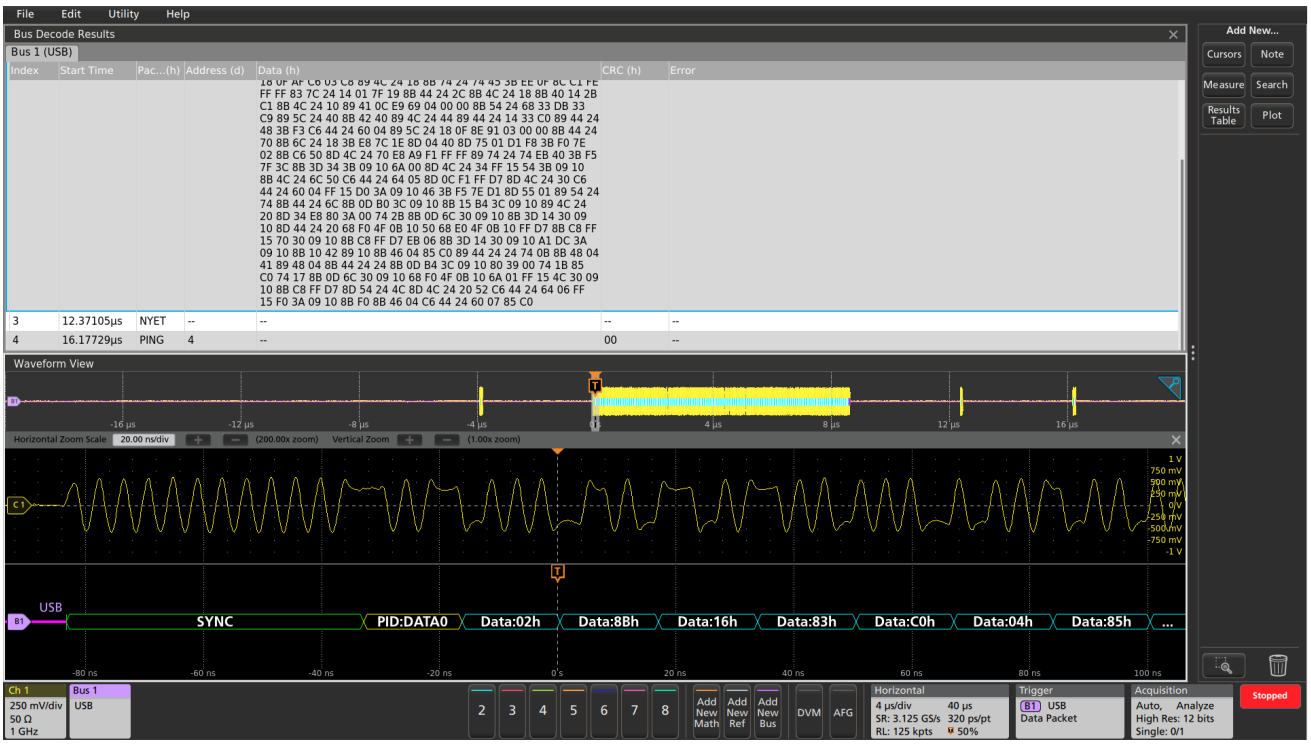
Characteristic	Description
Trigger On	Sync Reset Suspend Resume End of Packet Token (address) Packet Data Packet Handshake Packet: ACK, NAK, STALL, NYET (HS only) Special Packet: PRE (FS only), ERR, SPLIT, PING, Reserved Error: PID check, CRC5 or CRC16, Bit stuffing (LS and FS only)

Bus Search options

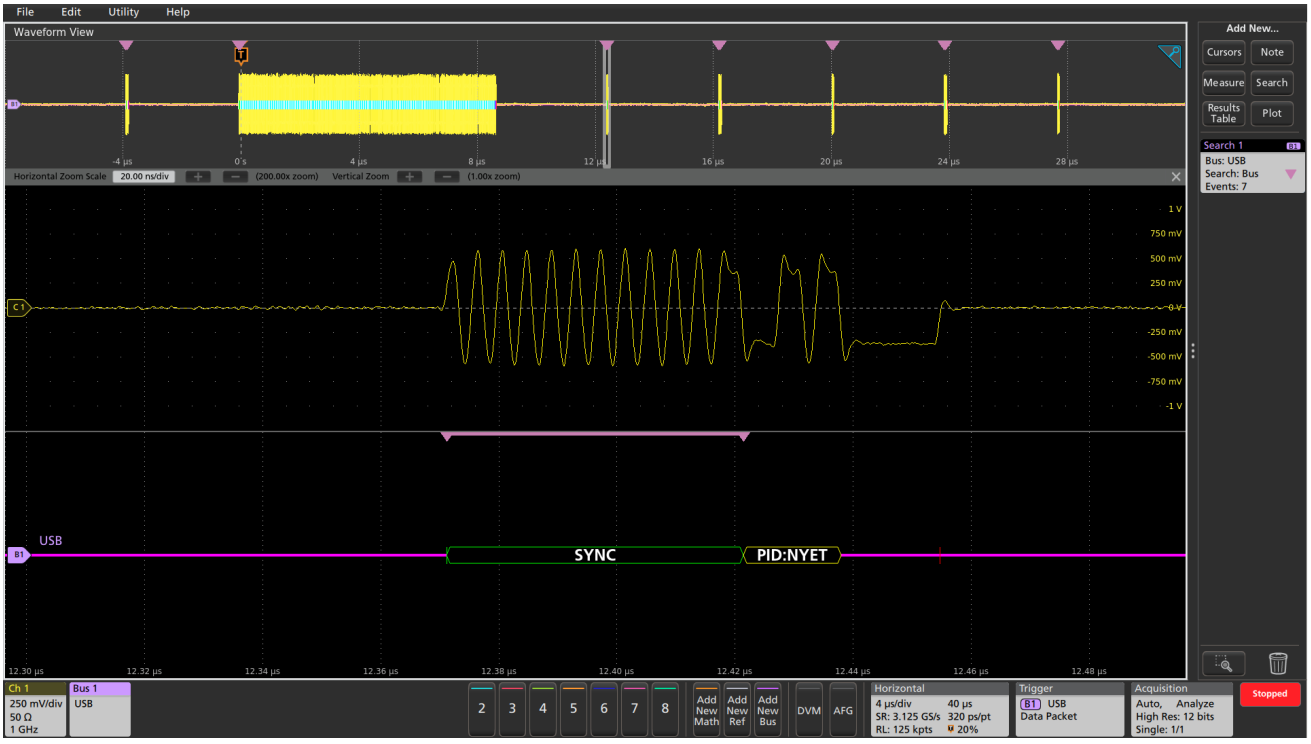
Characteristic	Description
Search On	Sync Reset Suspend Resume End of Packet Token (address) Packet Data Packet Handshake Packet: ACK, NAK, STALL, NYET (HS only) Special Packet: PRE (FS only), ERR, SPLIT, PING, Reserved Error: PID check, CRC5 or CRC16, Bit stuffing (LS and FS only)

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 [12]

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

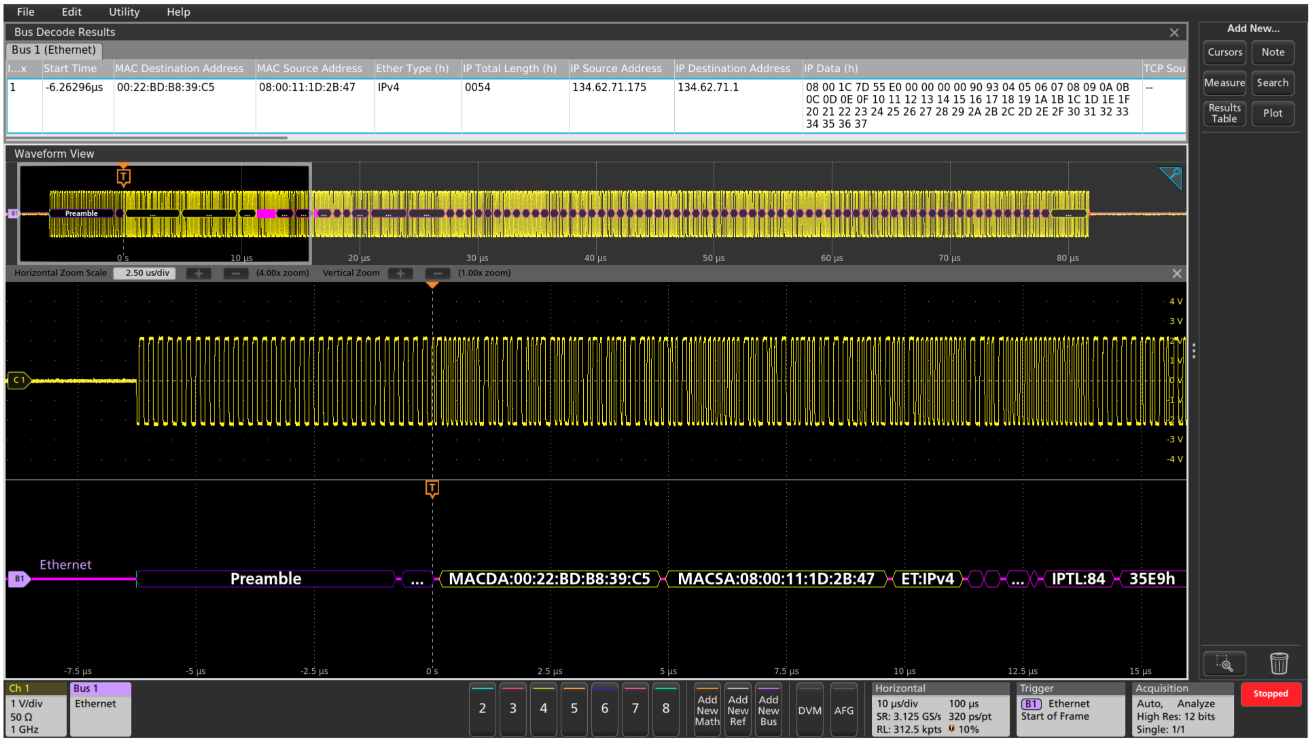
Bus search options

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

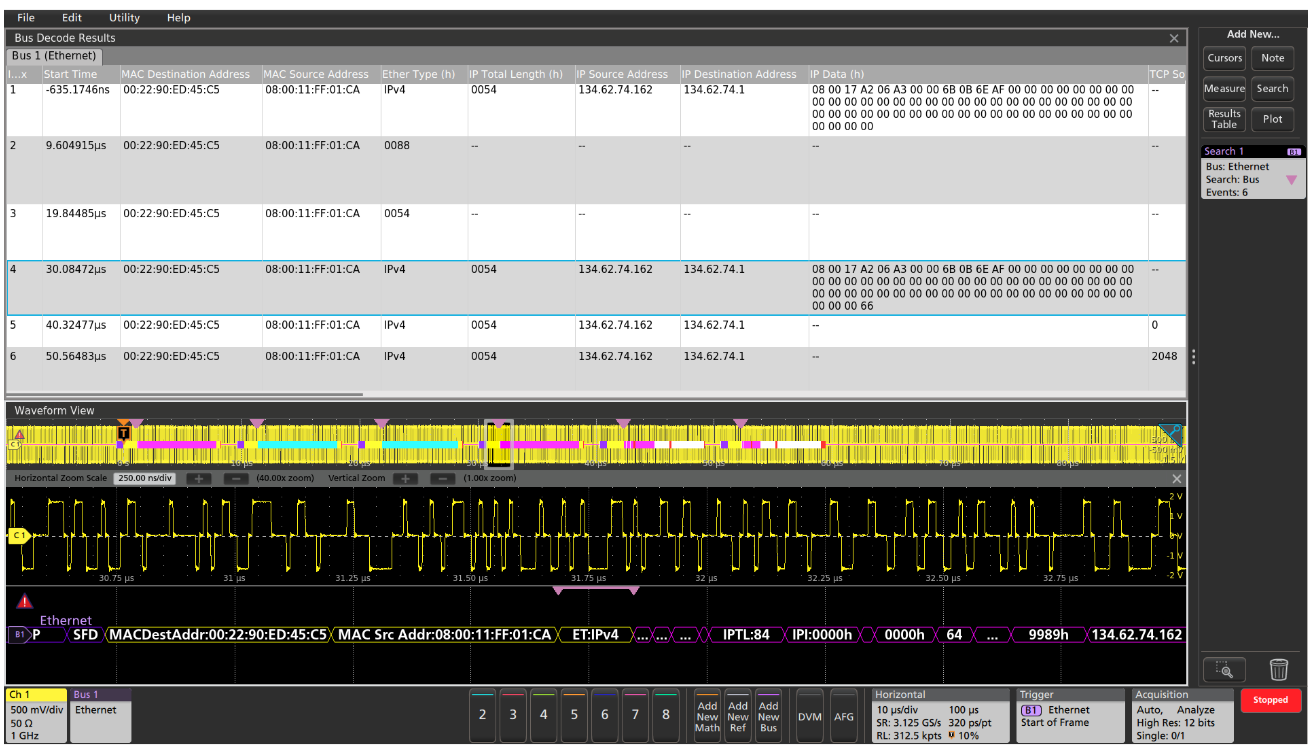
Bus decode

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)

12 Ethernet is not available on 3 Series MDO.



Protocol Decode Results Table provides a time-stamped, tabular view of all captured packets on the 10BASE-T Ethernet bus



Triggering and automatically searching on the 100BASE-TX Ethernet bus.

SPMI characteristics [13]

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

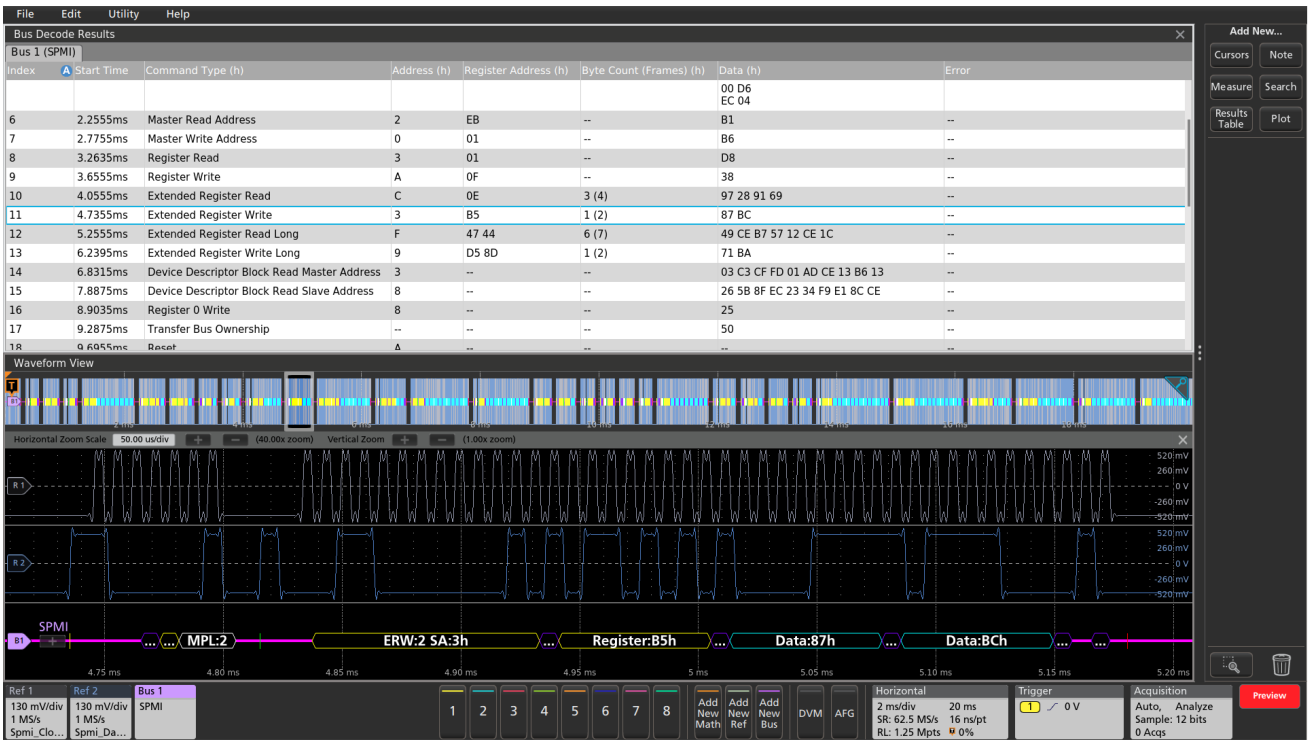
Characteristic	Description
Search On	Sequence Start Condition (SSC) Reset Sleep Shutdown Wakeup Authenticate Master Read Master Write Register Read Register Write Extended Register Read Extended Register Write Extended Register Read Long Extended Register Write Long Device Descriptor Block Master Read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

Bus decode

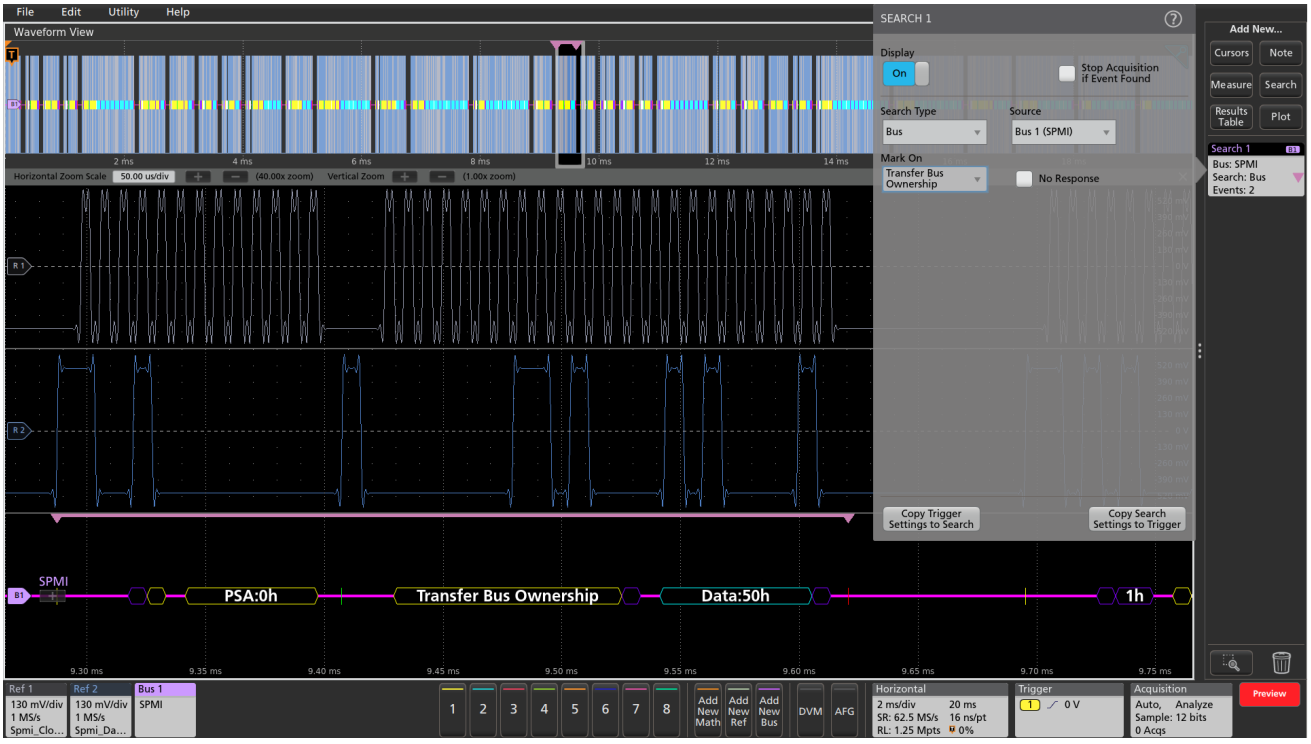
Characteristic	Description
Decode Display	Arbitration Start (yellow bar) Connect Bit (purple packet) Master ID (purple packet) Alert Bit (yellow packet) Slave Request Bit (yellow packet) Master Priority Level (gray packet) SSC (green bar) Command Frame, including Byte Count [14] (yellow packet) Address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

13 SPMI is not available on 3 Series MDO.

14 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 type	3 Series MDO Option	4 Series MSO Option	5 Series MSO Option	6 Series MSO Option	Description
I ^{2}C, SPI	3-SREMBD	4-SREMBD	5-SREMBD	6-SREMBD	Embedded Serial Triggering and Analysis (I^2C, SPI). Enables triggering on packet-level information on I^2C 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.
I3C	---	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.
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.
SENT	---	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.
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.
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^2S, LJ, RJ, TDM	3-SRAUDIO	4-SRAUDIO	5-SRAUDIO	6-SRAUDIO	Audio Serial Triggering and Analysis (I^2S, 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.

Serial bus type	3 Series MDO Option	4 Series MSO Option	5 Series MSO Option	6 Series MSO Option	Description
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.
Ethernet	---	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.
SPMI	---	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.
Serial options bundle	3-BND	---	---	---	Adds all serial analysis options and the power analysis option available for an instrument.

To upgrade an already purchased instrument

Serial bus [15]	3 Series MDO Node-Locked License [16]	4 Series MSO Node-Locked/Floating License	5 Series MSO Node-Locked/Floating License	6 Series MSO Floating/Floating License
I^2C, SPI	SUP3 SREMBD	SUP4-SREMBD SUP4-SREMBD-FL	SUP5-SREMBD SUP5-SREMBD-FL	SUP6-SREMBD SUP6-SREMBD-FL
I3C	---	SUP4-SRI3C SUP4-SRI3C-FL	SUP5-SRI3C SUP5-SRI3C-FL	SUP6-SRI3C SUP6-SRI3C-FL
CAN, CAN FD, LIN, FlexRay	SUP3 SRAUTO	SUP4-SRAUTO SUP4-SRAUTO-FL	SUP5-SRAUTO SUP5-SRAUTO-FL	SUP6-SRAUTO SUP6-SRAUTO-FL
SENT	---	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
MIL-STD-1553, ARINC 429	SUP3 SRAERO	SUP4-SRAERO SUP4-SRAERO-FL	SUP5-SRAERO SUP5-SRAERO-FL	SUP6-SRAERO SUP6-SRAERO-FL
I^2S, LJ, RJ, TDM	SUP3 SRAUDIO	SUP4-SRAUDIO SUP4-SRAUDIO-FL	SUP5-SRAUDIO SUP5-SRAUDIO-FL	SUP6-SRAUDIO SUP6-SRAUDIO-FL
USB 2.0	SUP3 SRUSB2	SUP4-SRUSB2 SUP4-SRUSB2-FL	SUP5-SRUSB2 SUP5-SRUSB2-FL	SUP6-SRUSB2 SUP6-SRUSB2-FL
Ethernet	---	SUP4-SRENET SUP4-SRENET-FL	SUP5-SRENET SUP5-SRENET-FL	SUP6-SRENET SUP6-SRENET-FL
SPMI	---	SUP4-SRPM SUP4-SRPM-FL	SUP5-SRPM SUP5-SRPM-FL	SUP6-SRPM SUP6-SRPM-FL
Serial analysis bundle [17]	SUP3 BND	---	---	---

15 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.

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

Recommended probes Please refer to 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.

17 All serial bus and power analysis options that are available for an instrument.

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

For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tek.com.

14 May 2019 61W-61101-5

www.tek.com

Tektronix®