# Serial Triggering and Analysis Application Modules

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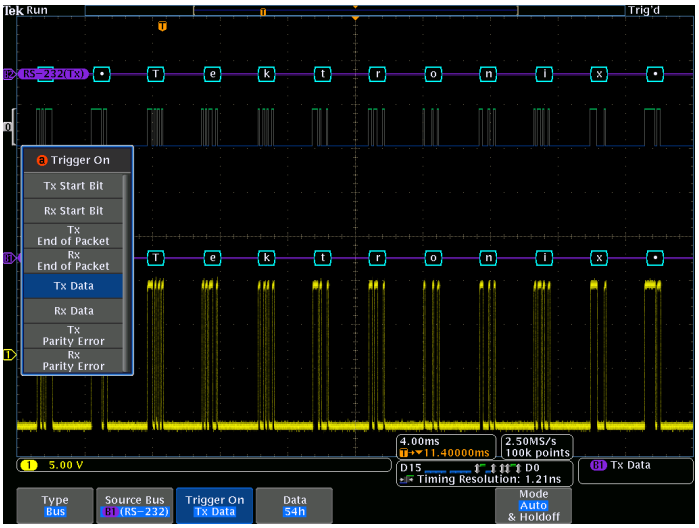
### Key features

- Automated Serial Triggering, Decode, and Search options for $I^2C$, SPI, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, $I^2S$/LJ/RJ/T DM, USB, and Ethernet.
- 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 counting1s and 0s!
- Search through long acquisitions using user-defined criteria to find specific messages. Search mark table provides a tabular view of the events found during an automated search.
- Export Search Mark table data to .csv file.
- Event table shows decoded serialbus activity in a tabular, time-stamped format for quick summaryof system activity.
- Export Event table data to .csv file.

## Serial triggering and analysis application modules

On a serial bus, a single signal often includes address, control, data, and clock information. This can make isolating events of interest difficult. The Serial Application modules for the MDO/MSO/DPO4000B, MDO3 000, and MSO/DPO2000B Series transform the oscilloscopes into a robust tool for debugging serial buses with automatic trigger, decode, and search for $I^2C$, SPI, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, $I^2S$/LJ/RJ/TDM, USB, and Ethernet.




Triggering on a specific transmit data packet going across an RS-232 bus. A complete set of triggers, including triggers for specific serial packet content, ensures you quickly capture your event of interest.

## Serial triggering

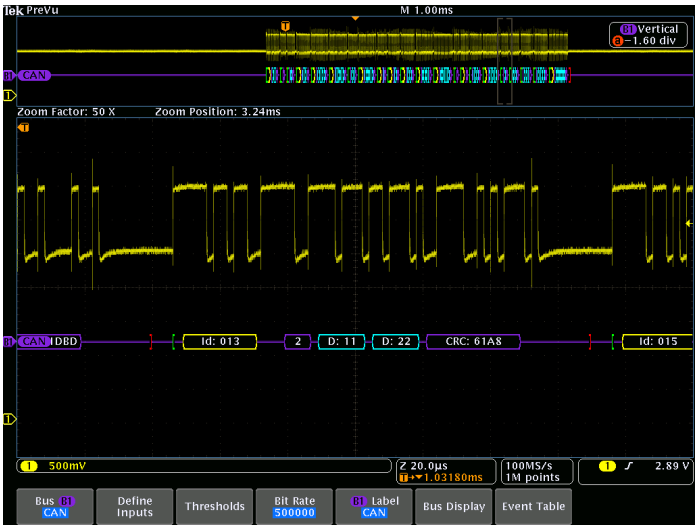
Trigger on packet content such as start of packet, specific addresses, specific data content, unique identifiers, etc. on popular serial interfaces such as $I^2C$, SPI, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and $I^2S$/LJ/RJ/TDM, USB, and Ethernet.

## Bus display

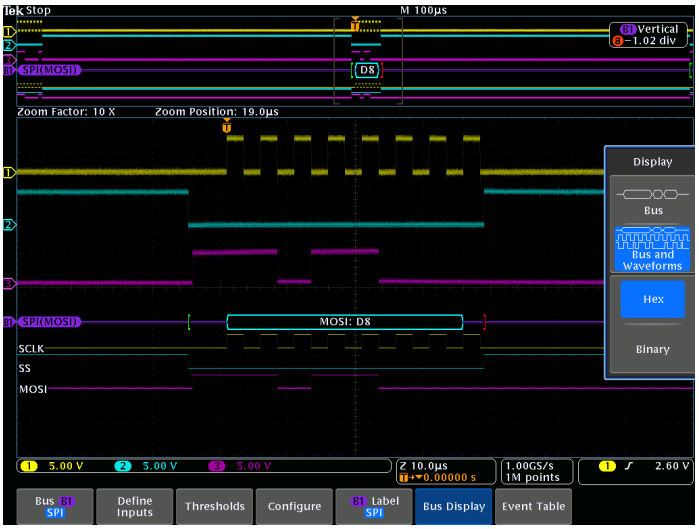
Provides a higher-level, combined view of the individual signals (clock, data, chip enable, etc.) that make up your bus, making it easy to identify where packets begin and end and identifying subpacket components such as address, data, identifier, CRC, etc.

## 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 module do it for you! Once you've set up a bus, the oscilloscope will decode each packet on the bus, and display the value in hex, binary, decimal (LIN, MIL-STD-1553, and FlexRay, USB and Ethernet only), signed decimal ($I^2S$/LJ/RJ/TDM only), or ASCII (RS-232/422/485/UART, USB and Ethernet only) in the bus waveform.



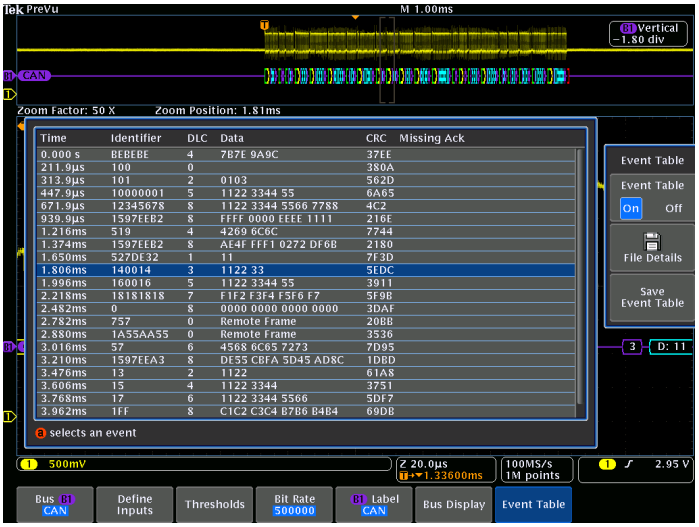

Color-coded display of a CAN bus, showing Start, DLC, Data, CRC, and Stop components of the serial signal.




Simultaneously display the bus and digital waveforms. Digital waveforms show how the bus translates the individual signals based on the threshold settings (useful for making analog channels look like just 1s and 0s).

## Event table

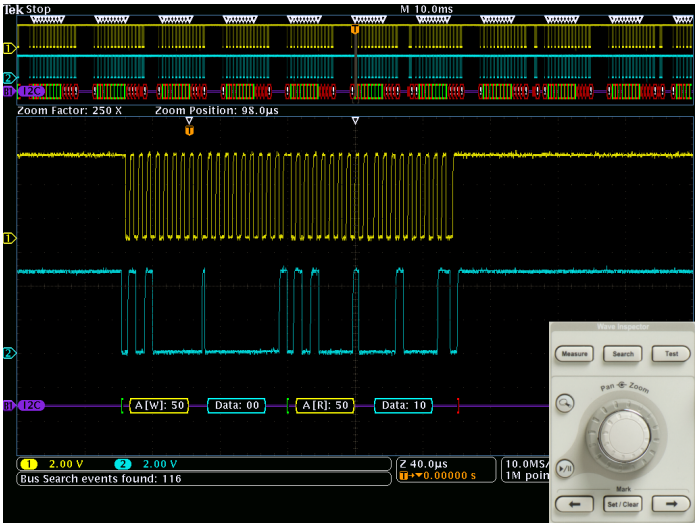
In addition to seeing decoded packet data on the bus waveform itself, you can view all captured packets in a tabular view much like you would see in a software listing. Packets are time stamped and listed consecutively with columns for each component (Address, Data, etc.).




Event table showing decoded Identifier, DLC, DATA, and CRC for every CAN packet in a long acquisition

## 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 module, 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 Previous (←) and Next (→) buttons on the oscilloscope front panel. The Search Mark table provides a tabular view of all events found during an automated search. The search mark data can be exported to a .csv file.



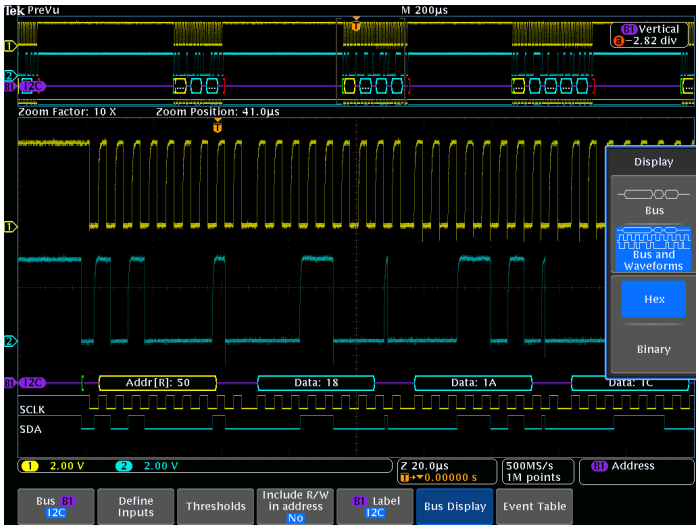

Search – $I^2C$ decode showing results from a Wave Inspector® search for Address value 50. Wave Inspector® controls provide unprecedented efficiency in viewing and navigating waveform data.

# Specifications

## I²C Characteristics

### Bus setup options

| Characteristic | Description |
|---|---|
| Sources (Clock and Data) | Analog channels 1-4<br>Digital channels D0-D15 |
| Thresholds | Per-channel thresholds |
| Recommended probing | Single ended |
| Include R/W in address | Yes or No |
| Decode formats available | Hex, Binary |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

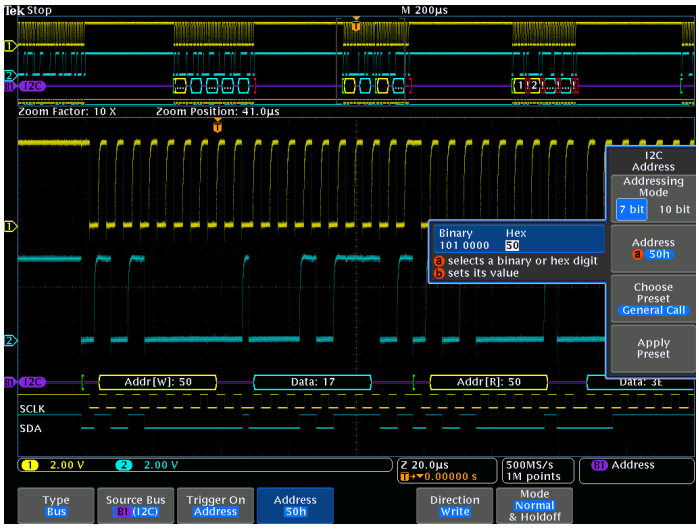



I²C bus setup, showing selection of bus display modes.

## I²C Characteristics

### Bus trigger and search options

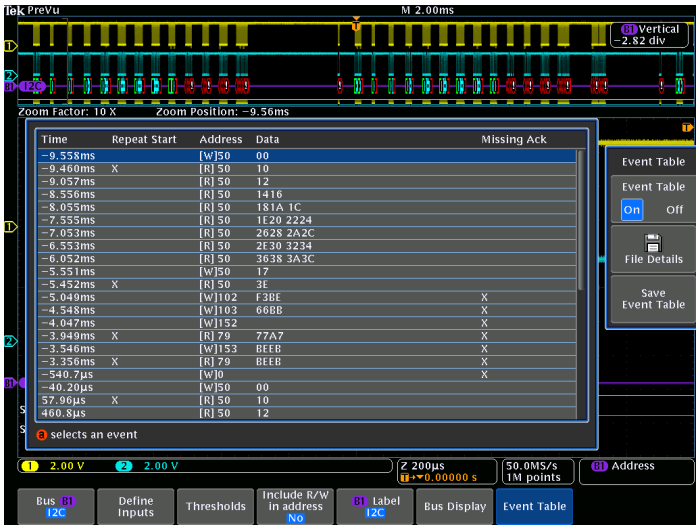
| Characteristic | Description |
|---|---|
| Trigger and/or Search On | Start<br>Stop<br>Repeated Start<br>Missing Ack<br>Address (7 or 10 bit) with R/W Selection<br>Data (number of bytes 1-5)<br>Address and Data |




Triggering on a specific address value on the I²C bus.

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum Clock/Data Rate | Up to 10 Mb/s (for automated decoding of bus) |
| Decode Display | Start (green bracket)<br>Address (yellow box)<br>Missing Ack (red ! symbol)<br>Data (cyan box)<br>Stop (red bracket) |




Event table for I²C bus with all captured packets time stamped and in a tabular view.

## SPI Characteristics

**Bus setup options**

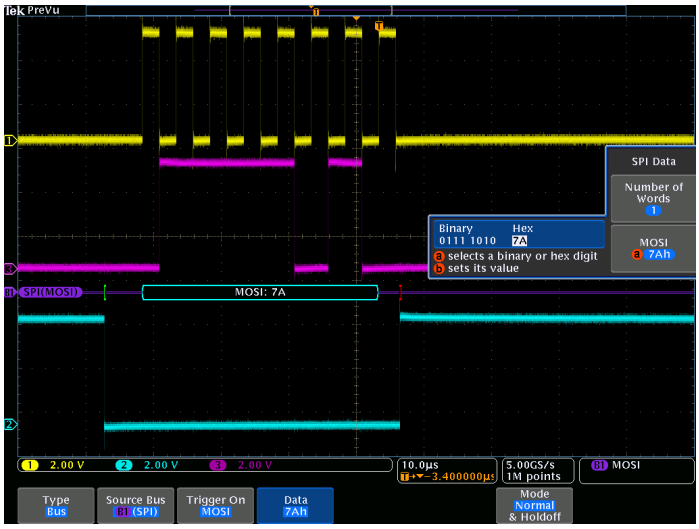
| Characteristic | Description |
|---|---|
| Sources (Clock, Slave Select, MOSI, and MISO) | Analog channels 1-4<br>Digital channels D0-D15 |
| Thresholds | Per-channel thresholds |
| Recommended probing | Single ended |
| Decode configuration | |
| Framing | Idle Time (2-wire SPI)<br>Slave Select (3-wire or 4-wire SPI) |
| Clock | Rising or Falling Edge |
| Slave select | Active High or Active Low |
| MOSI | Active High or Active Low |
| MISO | Active High or Active Low |
| Word size | 4-32 bits |
| Bit order | Most Significant (MS) First<br>Least Significant (LS) First |
| Decode formats available | Hex, Binary |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

SPI bus setup, showing configuration options for bus sources.

## SPI Characteristics

### Bus trigger and search options

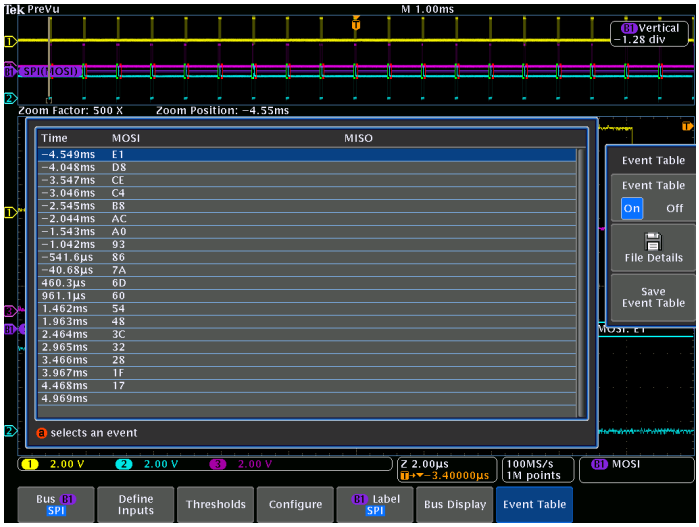
| Characteristic | Description |
|---|---|
| Trigger and/or Search On | SS Active<br>Start of Frame<br>MOSI<br>MISO<br>MOSI and MISO<br>Data: maximum of 128 bits (up to four 32-bit words or 32 four-bit words) |




Triggering on a specific MOSI data value on the SPI bus.

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum Clock/Data Rate | Up to 50 Mb/s (for automated decoding of bus) |
| Decode display | Start (green bracket)<br>Data (cyan box)<br>Stop (red bracket) |

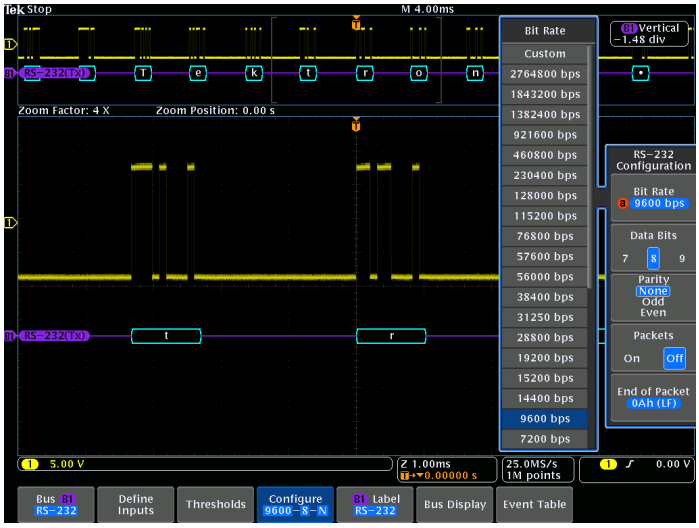



Event table for SPI bus with all captured packets time stamped and in a tabular view.

## RS-232/UART/RS-422/RS-485 Characteristics

**Bus setup options**

| Characteristic | Description |
|---|---|
| RS-232/UART Sources (Transmit and Receive) | Analog channels 1-4<br>Digital channels D0-D15 |
| RS-422/RS-485 Sources (Transmit and Receive) | Analog channels 1-4 |
| Thresholds | Per-channel thresholds |
| Recommended probing | |
| RS-232/UART | Single ended |
| RS-422/RS-485 | Differential |
| Polarity | Normal (RS-232)<br>Inverted (UART, RS-422/RS-485) |
| Decode configuration | |
| Bit rate | |
| Pre-defined list of rates | 50 b/s - 2.8 Mb/s |
| Custom | 50 b/s - 10 Mb/s |
| Data bits | 7, 8, or 9 |
| Parity | None, Odd, or Even |
| Packets | On or Off |
| End of packet | 00h (NUL)<br>0Ah (LF)<br>0Dh (CR)<br>20h (SP)<br>FFh |
| Decode formats available | Hex, Binary, ASCII |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

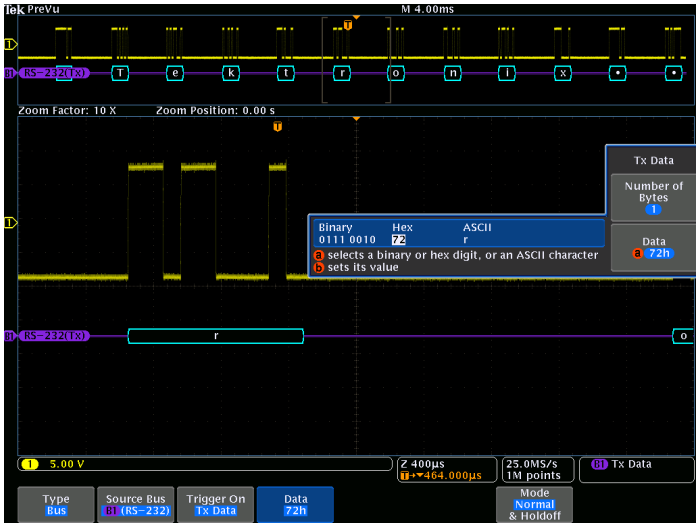



RS-232 bus setup, showing bit rate options for RS-232 bus.

## RS-232/UART/RS-422/RS-485 Characteristics

### Bus trigger and search options

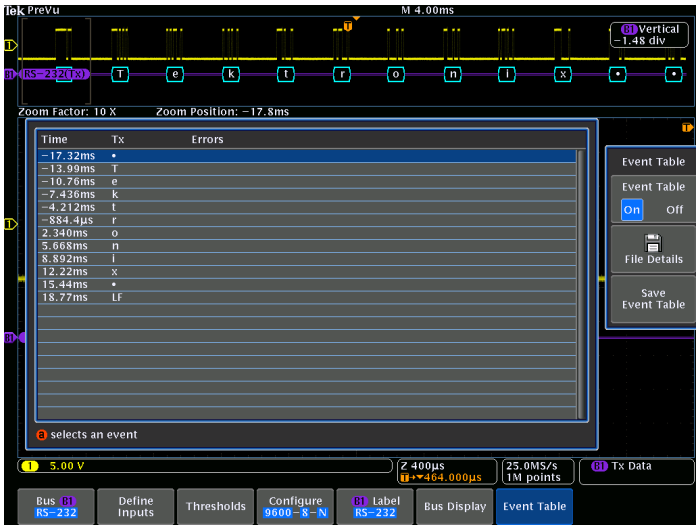
| Characteristic | Description |
|---|---|
| Trigger and/or Search On | Tx Start Bit<br>Rx Start Bit<br>Tx End of Packet<br>Rx End of Packet<br>Tx Data (number of bytes 1-10)<br>Rx Data (number of bytes 1-10)<br>Tx Parity Error<br>Rx Parity Error |




Triggering on a specific Tx data value on the RS-232 bus.

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum Clock/Data Rate | Up to 10 Mb/s (for automated decoding of bus) |
| Decode display | Data (cyan box)<br>Errors (red box)<br>- Parity<br>- Framing |

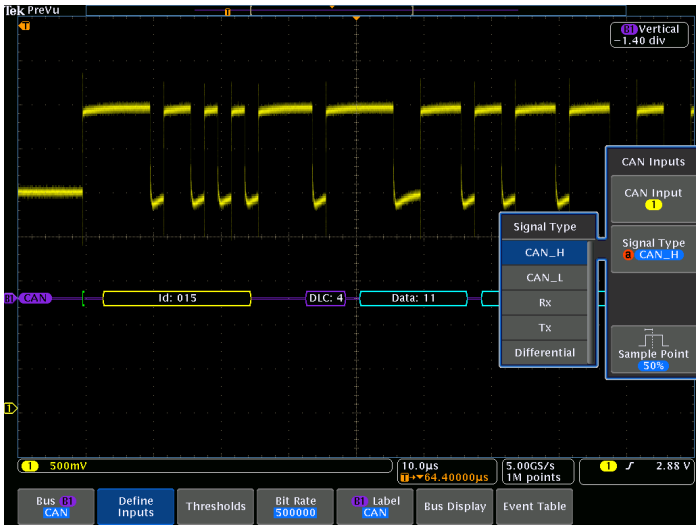



Event table for RS-232 bus with all captured packets time stamped and in a tabular view.

## CAN Characteristics

### Bus setup options

| Characteristic | Description |
|---|---|
| Source for CAN_H, CAN_L, Rx, or Tx probing | Analog channels 1-4<br>Digital channels D0-D15 |
| Source for differential probing | Analog channels 1-4 |
| Thresholds | Per-channel thresholds |
| Recommended probing | |
| CAN_H, CAN_L, Rx, Tx | Single ended |
| Differential | Differential |
| Bit Rate | |
| Pre-defined list of rates | 10 Kb/s - 1 Mb/s |
| Custom | 10 Kb/s - 1 Mb/s |
| Sample Point | Position at 5% to 95% within bit period or unit interval |
| Decode formats available | Hex, Binary |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

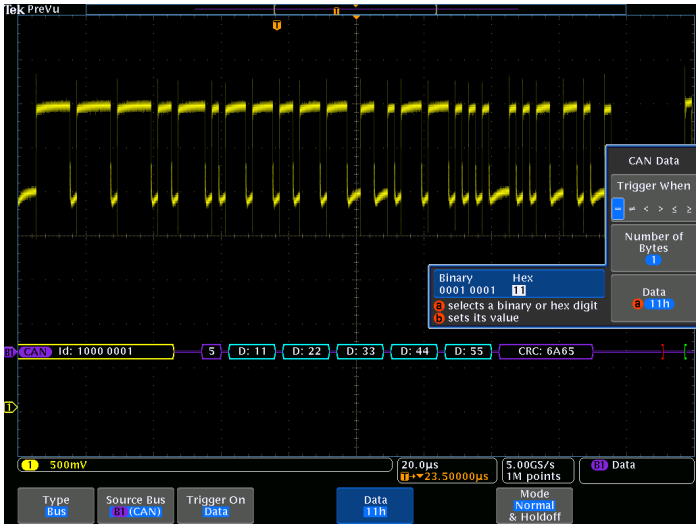



CAN bus setup, showing signal type options for CAN bus.

## CAN Characteristics

### Bus trigger and search options

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

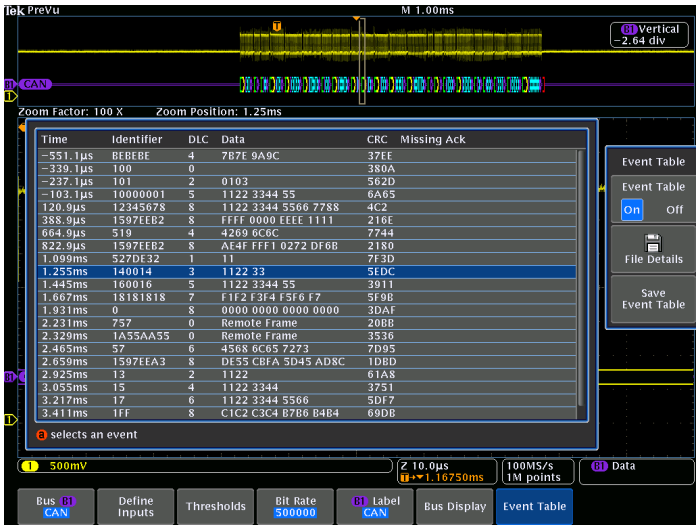



Triggering on a specific data value on the CAN bus.

## CAN Characteristics

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum Clock/Data Rate | Up to 1 Mb/s (for automated decoding of bus) |
| Decode display | Start (green bracket)<br>Address (yellow box)<br>DLC, CRC (purple box)<br>Missing Ack (red ! symbol)<br>Data (cyan box)<br>Stop (red bracket)<br>Bit stuffing errors (red box) |

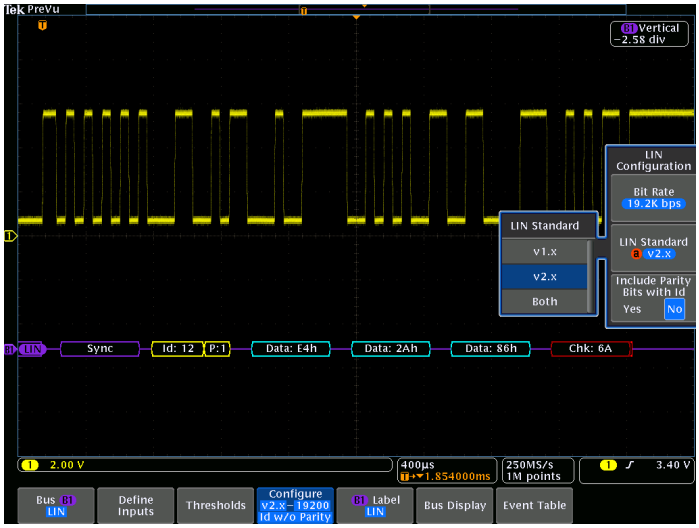



Event table for CAN bus with all captured packets time stamped and in a tabular view.

## LIN Characteristics

### Bus setup options

| Characteristic | Description |
|---|---|
| Source | Analog channels 1-4<br>Digital channels D0-D15 |
| Thresholds | Per-channel thresholds |
| Recommended Probing | Single ended |
| Sample Point | Position at 10% to 90% within bit period or unit interval |
| Decode Configuration | |
| Polarity | Normal or Inverted |
| Bit rate | |
| Pre-defined list of rates | 1.2 kb/s - 19.2 kb/s |
| Custom | 800 b/s - 100 kb/s |
| LIN standard | v1.x, v2.x, or Both |
| Include parity bits with ID | Yes or No |
| Decode formats available | Mixed: ID and Parity are shown in Hex, Data and Checksum are shown in Binary<br>Hex: all fields<br>Binary: all fields |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event Table | Decoded packet data in a tabular view |

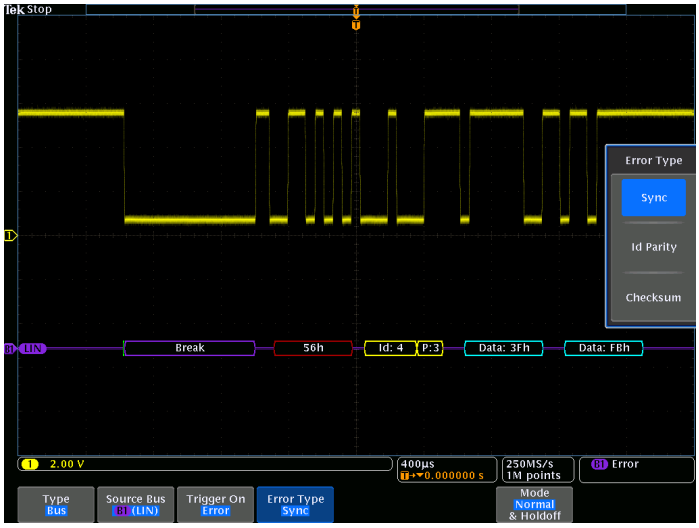



LIN bus setup, showing source configuration options for LIN bus.

## LIN Characteristics

### Bus trigger and search options

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

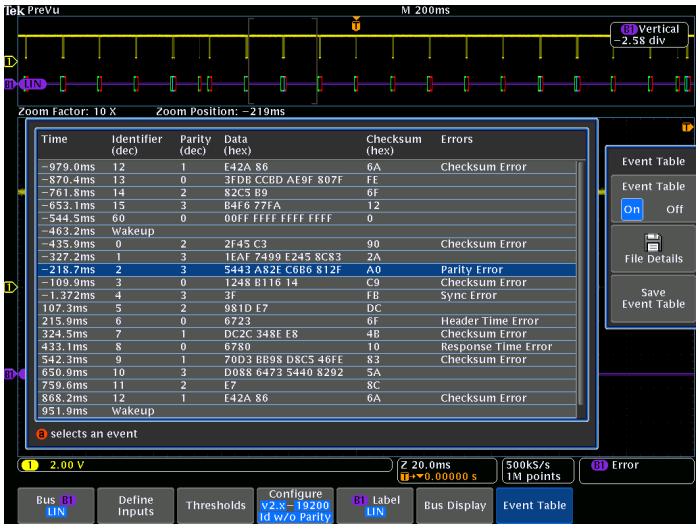



Triggering on a Sync Error on the LIN bus.

## LIN Characteristics

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum bit rate | Up to 1 Mb/s, by LIN definition up to 20 kb/s (for automated decoding of bus) |
| Decode display | Start (green bracket)<br>Sync, Break (purple box)<br>Identifier, Parity (yellow box)<br>Data (cyan box)<br>Checksum, Wakeup (purple box)<br>End of frame (red bracket)<br>Errors (red box)<br>- Sync<br>- Parity<br>- Checksum<br>- Header Time<br>- Response Time<br>- Frame Time<br>- Response and Frame Time |

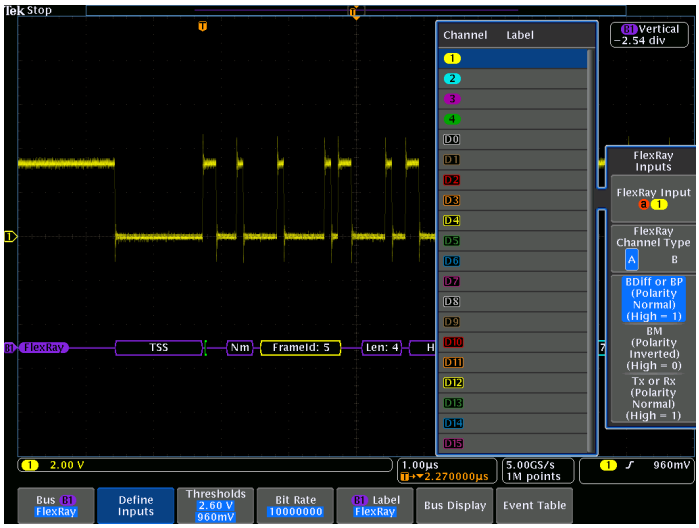



Event table for LIN bus with all captured packets time stamped and in a tabular view.

## FlexRay Characteristics

### Bus setup options

| Characteristic | Description |
|---|---|
| Source for single-ended probing | Analog channels 1-4<br>Digital channels D0-D15 |
| Source for differential probing | Analog channels 1-4 |
| Thresholds | High and low thresholds per-channel |
| Recommended probing | Single ended or differential |
| Decode configuration | |
| Bit rate | 2.5 Mb/s, 5 Mb/s, 10 Mb/s, or Custom (1 Mb/s - 100 Mb/s) |
| Channel type | A or B |
| Polarity | BDiff or BP, BM, Tx or Rx |
| Decode formats available | Mixed: Identifier, Payload Length and Cycle Count are shown in Decimal, Data and CRCs are shown in Hex.<br>Hex: all fields<br>Binary: all fields |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |




FlexRay bus setup, showing input options for FlexRay bus.

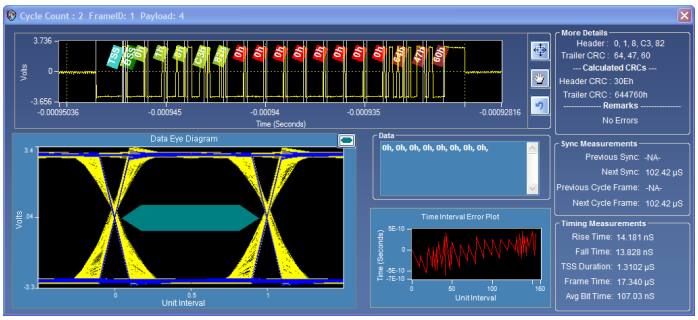
### Bus trigger and search options

| Characteristic | Description |
|---|---|
| Trigger and/or Search On | Start of Frame<br>Indicator Bits (Normal, Null, Payload, Sync, Startup)<br>Identifier (trigger when =, ≠, <, >, ≤, ≥, inside range, outside range)<br>Cycle Count (trigger when =, ≠, <, >, ≤, ≥, inside range, outside range)<br>Header Fields (Indicator Bits, Identifier, Payload Length, Header CRC, and Cycle Count)<br>Data (number of bits 1-16; byte offset 'don't care' – 253; trigger when =, ≠, <, >, ≤, ≥, inside range, outside range)<br>Identifier and Data<br>End of Frame (Static, Dynamic (DTS), All)<br>Error (Header CRC, Trailer CRC, Null Frame (static or dynamic), Sync Frame, Startup Frame) |

## FlexRay Characteristics

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum bit rate | Up to 10 Mb/s (for automated decoding of bus) |
| Decode display | TSS (purple box)<br>Start (green bracket)<br>Frame ID (yellow box)<br>Payload Length (purple box)<br>Headers (purple box)<br>- Null<br>- Normal<br>- Sync<br>- Payload<br>- Startup<br>- Unknown<br>- Null Sync<br>- Payload Sync<br>- Null Startup<br>- Payload Startup<br>- CRC<br>- Cycle Count (yellow box)<br>- Data (cyan box)<br>- CRC, DTS, CID (purple box)<br>- Stop (red bracket)<br>- TSS<br>- Header CRC<br>- Trailer CRC<br>- Null Frame<br>- Sync Frame<br>- Startup Frame<br>- BSS<br>- FSS |

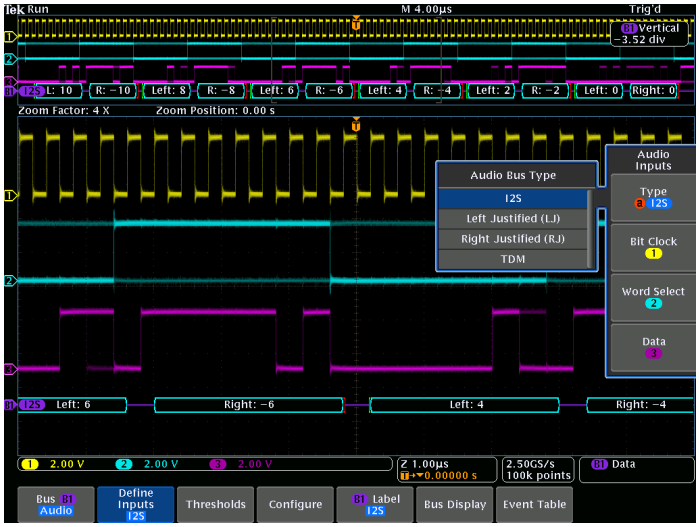



PC-based, eye-diagram analysis software builds an eye-diagram from the entire acquisition and plots it against TP1 mask called out by the FlexRay standard, available with MSO/DPO4000B and MDO4000B instruments.

## I²S/LJ/RJ/TDM Characteristics

**Bus setup options**

| Characteristic | Description |
|---|---|
| Sources (Clock, Word, Data) | Analog channels 1-4<br>Digital channels D0-D15 |
| Thresholds | Per-channel thresholds |
| Recommended probing | Single ended |
| Decode configuration | |
| Word size | 4-32 bits |
| Clock | Rising or falling edge |
| Word Select polarity | Normal or inverted |
| Data High | 1 or 0 |
| Bit order | Most Significant (MS) First<br>Least Significant (LS) First |
| Decode formats available | Signed Decimal, Hex, Binary |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

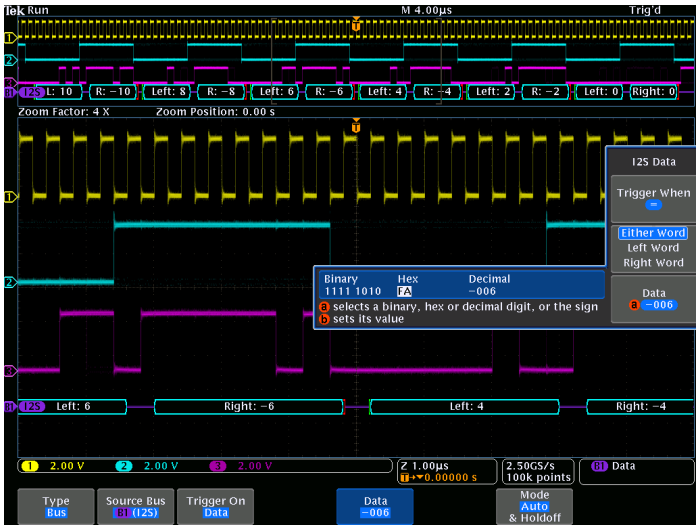



I²S bus setup, showing input configuration options for I²S bus.

## I²S/LJ/RJ/TDM Characteristics

### Bus trigger and search options

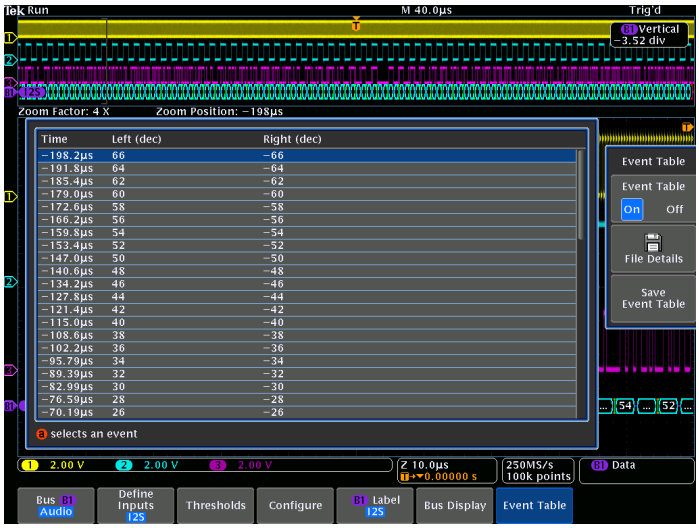
| Characteristic | Description |
|---|---|
| Trigger and/or Search On | Word Select<br>Frame Sync<br>Data (select either word, left word, or right word; trigger or search when =, ≠,<,>, ≤, ≥, inside range, outside range) |




Triggering on a specific data value on the I²S bus.

### Bus decode

| Characteristic | Description |
|---|---|
| Maximum Clock/Data Rate | Up to 12.5 Mb/s (for automated decoding of I²S/LJ/RJ bus)<br>Up to 25 Mb/s (for automated decoding of TDM bus) |
| Decode display | Start (green bracket)<br>Data (cyan box)<br>Stop (red bracket |

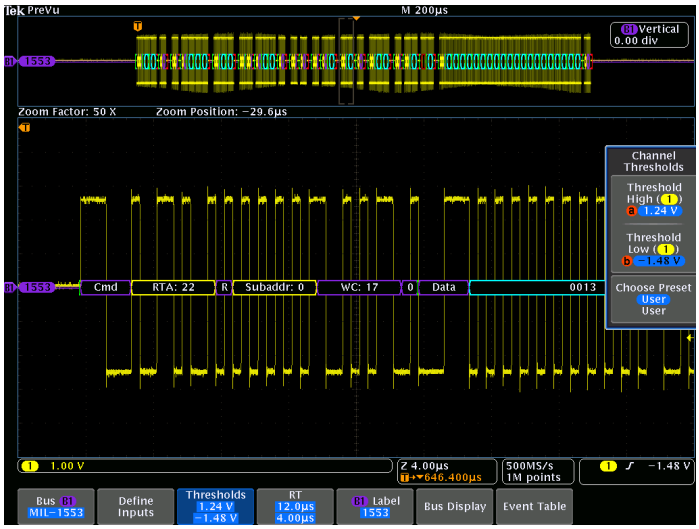



Start (green bracket) Data (cyan box) Stop (red bracket).

## MIL-STD-1553 Characteristics

**Bus setup options**

| Characteristic | Description |
|---|---|
| Source | Analog channels 1-4<br>Reference waveforms 1-4<br>Math waveform |
| Thresholds | High and low threshold per source |
| Recommended probing | Single ended or differential (only one single-ended signal required) |
| Decode configuration | |
| Bit rate | 1 Mb/s per the standard |
| Response Time | 2 µs – 100 µs |
| Polarity | Normal or Inverted |
| Decode formats available | Mixed1: Hex (data), Decimal (addresses and count), Binary (bits)<br>Mixed2: ASCII (data), Decimal (addresses and count), Binary (bits)<br>Block Hex<br>Hex and Binary<br>Binary |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

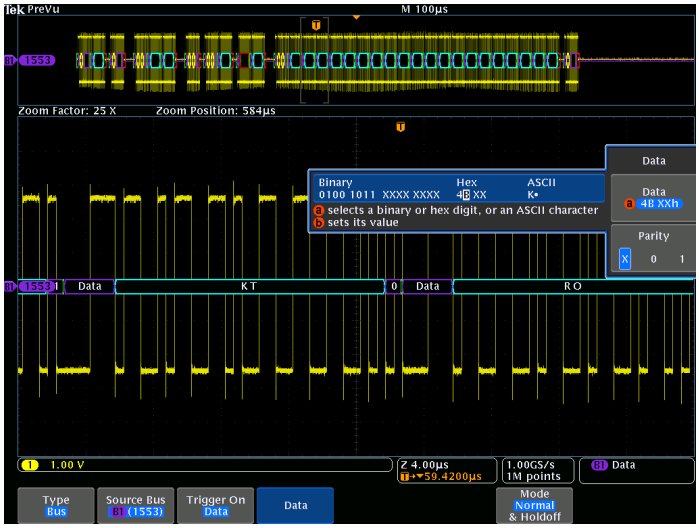



MIL-STD-1553 bus setup, showing threshold entry fields.

## MIL-STD-1553 Characteristics

### Bus trigger and search options

| Characteristic | Description |
|---|---|
| Trigger and/or Search On | Sync<br>Word Type [1] (Command, Status, Data)<br>Command Word [1] (set RT Address (=, ≠, <, >, ≤, ≥, inside range, outside range), T/R, Sub-address/Mode, Data Word Count/Mode Code, and Parity individually)<br>Status Word [1] (set RT Address (=, ≠, <, >, ≤, ≥, inside range, outside range), Message Error, Instrumentation, Service Request Bit, Broadcast Command Received, Busy, Subsystem Flag, Dynamic Bus Control Acceptance (DBCA), Terminal Flag, and Parity individually)<br>Data Word (user-specified 16-bit data value)<br>Error (Sync, Parity, Manchester, Non-contiguous data)<br>Idle Time (minimum time selectable from 4 µs to 100 µs; maximum time selectable from 12 µs to 100 µs; trigger on < minimum, > maximum, inside range, outside range) |

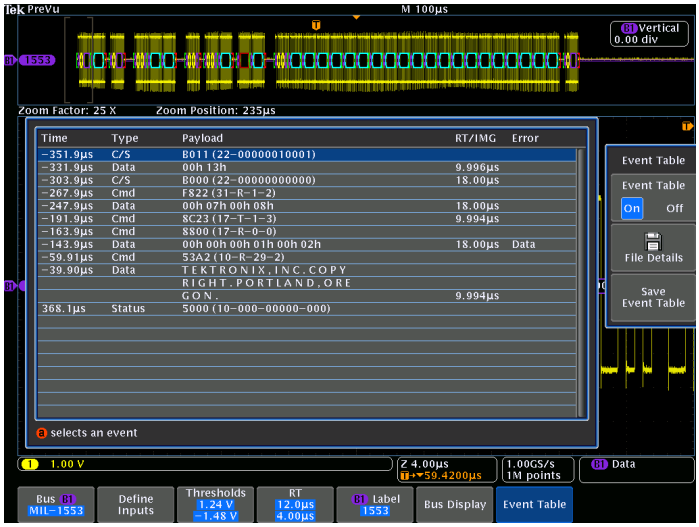



Triggering on a specific data value on the MIL-STD-1553 bus.

[1] Trigger selection of Command Word will trigger on Command and ambiguous Command/Status words. Trigger selection of Status Word will trigger on Status and ambiguous Command/Status words.

## MIL-STD-1553 Characteristics

| Characteristic | Description |
|---|---|
| Maximum Clock/Data Rate | Up to 1 Mb/s (for automated decoding of bus) |
| Decode Display | Start (green bracket)<br>Sync [2] (purple box) with Word Type identified<br>Address (yellow box)<br>R/T (purple box)<br>Word Count (purple box)<br>Status Bits (purple box)<br>Data (cyan box)<br>Parity (purple box)<br>Stop (red bracket)<br>Errors (red box) |



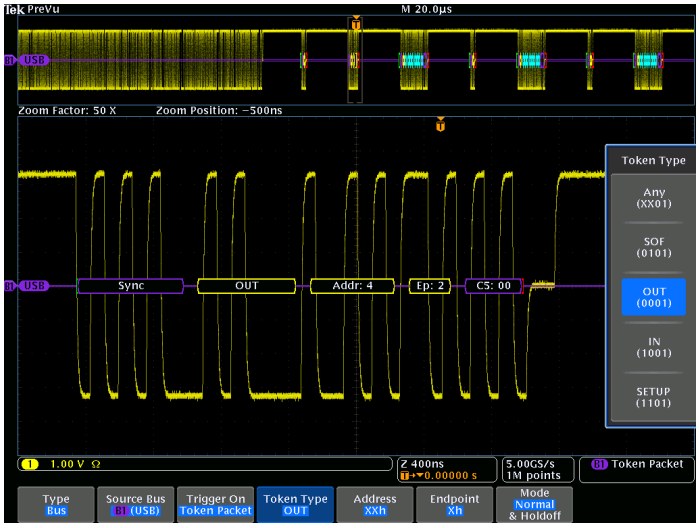

Event table for MIL-STD-1553 bus with all captured packets time stamped and in a tabular view.

2 Ambiguous Command and Status words will be labeled with C/S and a generic bit decode will be displayed.

## USB Characteristics

**Bus setup options**

| Characteristic | Description |
|---|---|
| USB 2.0 Compatibility | Low-speed and Full-speed: All MDO/MSO/DPO4000 or MDO3000 Series models<br>High-speed: Models with 1 GHz analog channel bandwidth |
| Sources | Single-ended:<br>Analog channels 1-4<br>Digital channels D0-D15<br>Differential:<br>Analog channels 1-4<br>Math channel<br>Reference channels 1-4 |
| Recommended probing | Low-speed and Full-speed: Single-ended or differential<br>High-speed: Differential |
| Threshold presets | Low-speed and Full-speed: Single-ended (D+: 1.4 V; D–: –1.4 V), differential (High: 1.4 V; Low: –1.4 V)<br>High-speed: Differential (High: 100 mV; Low: –100 mV) |
| Decode formats available | Mixed1: Frame and Address are shown in Decimal, Data shown in Hex<br>Mixed2: Frame and Address are shown in Decimal, Data shown in ASCII<br>Hex: all fields<br>Binary: all fields |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

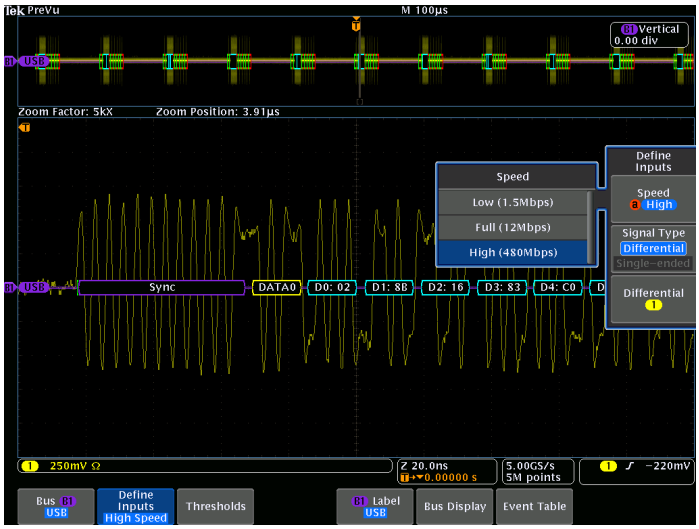



Triggering on a specific PID on a USB FS bus.

## USB Characteristics

### Bus decode

| Characteristic | Description |
|---|---|
| USB 2.0 Data Rates | Low-speed: 1.5 Mb/s<br>Full-speed: 12 Mb/s<br>High-speed: 480 Mb/s |
| Decode Display | Start (green bracket)<br>PID (yellow box)<br>Data (cyan box)<br>CRC (purple box)<br>Stop (red bracket) |




High-speed USB decoded display, automatically displaying bus content.

## USB Characteristics

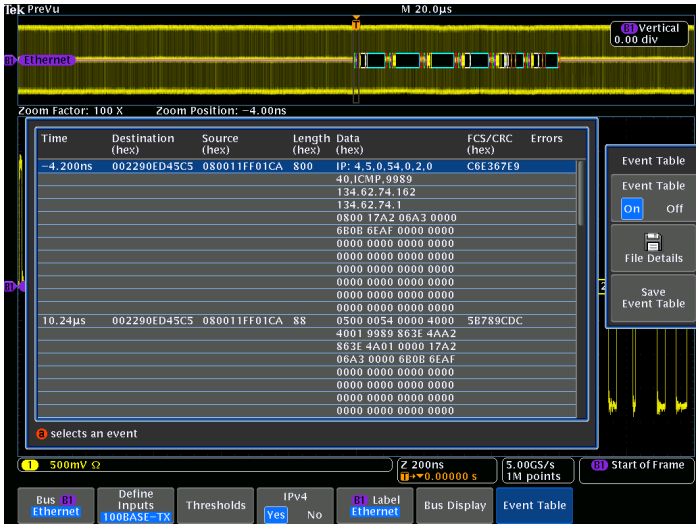
**Bus trigger and search options**

| Characteristic | Description |
|---|---|
| Trigger and/or Search On | Low-speed: Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error.<br>Token Packet – Any token type, SOF, OUT, IN, SETUP; Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using Binary, Hex, Unsigned Decimal, and Don't Care digits.<br>Data Packet – Any data type, DATA0, DATA1; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range.<br>Handshake Packet – Any handshake type, ACK, NAK, STALL.<br>Special Packet – Any special type, Reserved.<br>Error – PID Check, CRC5, CRC16, Bit Stuffing. |
| | Full-speed: Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error.<br>Token Packet – Any token type, SOF, OUT, IN, SETUP; Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using Binary, Hex, Unsigned Decimal, and Don't Care digits.<br>Data Packet – Any data type, DATA0, DATA1; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range.<br>Handshake Packet – Any handshake type, ACK, NAK, STALL.<br>Special Packet – Any special type, PRE, Reserved.<br>Error – PID Check, CRC5, CRC16, Bit Stuffing. |
| | High-speed: Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error.<br>Token Packet – Any token type, SOF, OUT, IN, SETUP; Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using Binary, Hex, Unsigned Decimal, and Don't Care digits.<br>Data Packet – Any data type, DATA0, DATA1, DATA2, MDATA; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range.<br>Handshake Packet – Any handshake type, ACK, NAK, STALL, NYET.<br>Special Packet – Any special type, ERR, SPLIT, PING, Reserved. SPLIT packet components that can be specified include:<br>Hub Address<br>Start/Complete – Don't Care, Start (SSPLIT), Complete (CSPLIT)<br>Port Address<br>Start and End bits – Don't Care, Control/Bulk/Interrupt (Full-speed Device, Low-speed Device),<br>Isochronous (Data is Middle, Data is End, Data is Start, Data is All)<br>Endpoint Type – Don't Care, Control, Isochronous, Bulk, Interrupt<br>Error – PID Check, CRC5, CRC16 |

## Ethernet Characteristics

### Bus setup options

| Option | Description |
|---|---|
| Ethernet compatibility | 10BASE-T, 100BASE-TX<br>On MDO/MSO/DPO4000 Series only |
| Sources | Single-ended: Analog channels 1-4<br>Differential:<br>Analog channels 1-4<br>Math channel<br>Reference channels 1-4 |
| Recommended probing | 10BASE-T: Single-ended or differential<br>100BASE-TX: Differential |
| Thresholds presets | 10BASE-T: Single-ended (D+: 1.25 V; D–: 1.25 V); Differential (High: 1.25 V; Low: –1.25 V)<br>100BASE-TX: Single-ended (D+: 500 mV; D–: 500 mV); Differential (High: 500 mV; Low: –500 mV) |
| Decode formats available | Mixed1: Data is shown in Hex, all other fields are shown in either Decimal or Hex<br>Mixed2: Data is shown in ASCII, all other fields are shown in either Decimal or Hex<br>Hex: all fields<br>Binary: all fields |
| Display modes | |
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |

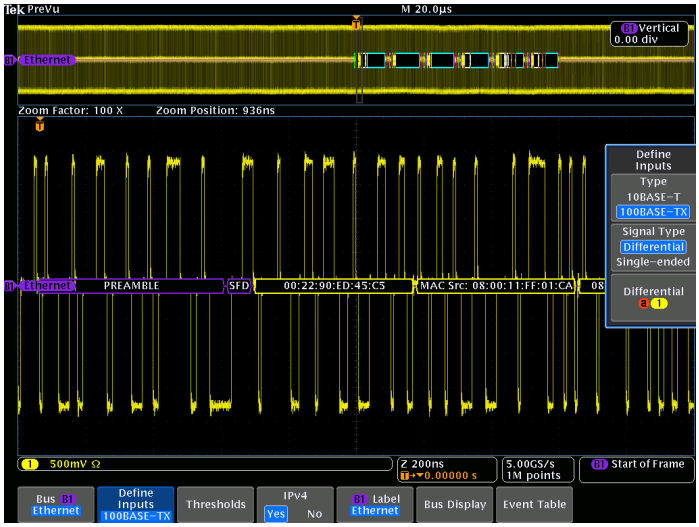



DPO4ENET 100BASE-TX decoded Event Table showing all packet information.

## Ethernet Characteristics

### Bus decode

| Characteristic | Description |
|---|---|
| Ethernet Data Rates | 10BASE-T: 10 Mb/s<br>100BASE-TX: 100 Mb/s |
| Decode Display | Start (green bracket)<br>MAC Address (yellow box)<br>Data (cyan box)<br>IPv4 Header (white box)<br>TCP Header (brown box)<br>CRC (purple box)<br>Stop (red bracket)<br>Error (red box) |
| Internet Protocol Support | IPv4 |
| Transport Layer Protocol Support | TCP |

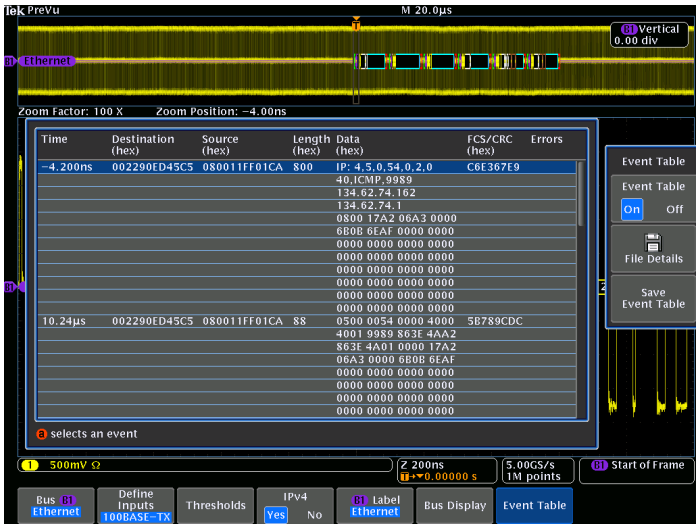



Color-coded DPO4ENET display of 100BASE-TX.

## Ethernet Characteristics

### Display modes

| Mode | Description |
|---|---|
| Bus | Bus only |
| Bus and waveforms | Simultaneous display of bus and logic waveforms |
| Event table | Decoded packet data in a tabular view |



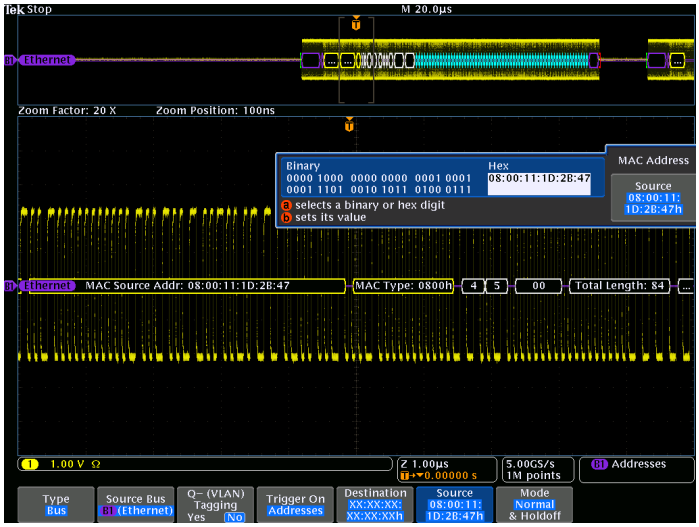

DPO4ENET 100BASE-TX decoded Event Table showing all packet information.

## Ethernet Characteristics

**Bus trigger options**

| Option | Description |
|---|---|
| Trigger and/or Search On | 10BASE-T:<br>Start Frame Delimiter<br>MAC Addresses: Trigger on Source and Destination 48-bit address values<br>MAC Q-tag Control Information: Trigger on Q-tag 32-bit value<br>MAC Length/Type: Trigger on ≤, <, =, >, ≥, ≠ a particular 16-bit value, or inside or outside of a range<br>MAC Client Data: Trigger on ≤, <, =, >, ≥, ≠ a particular 16-bit value, or inside or outside of a range. Selectable number of bytes to trigger on from 1-16. Byte offset options of Don't Care, 0-1499<br>IP Header: Trigger on IP header 8-bit value, Source Address, Destination Address<br>TCP Header: Trigger on Destination Port, Source Port, Sequence Number, and Ack Number<br>TCP/IPv4 Client Data: Trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Selectable number of bytes to trigger on from 1-16. Byte offset options of Don't Care, 0-1499<br>End of Packet<br>FCS (CRC) Error |
| | 100BASE-TX:<br>Start Frame Delimiter<br>MAC Addresses: Trigger on Source and Destination 48-bit address values<br>MAC Q-tag Control Information: Trigger on Q-tag 32-bit value<br>MAC Length/Type: Trigger on ≤, <, =, >, ≥, ≠ a particular 16-bit value, or inside or outside of a range<br>MAC Client Data: Trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Selectable number of bytes to trigger on from 1-16. Byte offset options of Don't Care, 0-1499<br>IP Header: Trigger on IP header 8-bit value, Source Address, Destination Address<br>TCP Header: Trigger on Destination Port, Source Port, Sequence Number, and Ack Number<br>TCP/IPv4 Client Data: Trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Selectable number of bytes to trigger on from 1-16. Byte offset options of Don't Care, 0-1499<br>End of Packet<br>FCS (CRC) Error<br>Idle |

## Ethernet Characteristics




DPO4ENET triggering on a specific 10BASE-T MAC source address.

# Ordering information

## Current/discontinued products

### Current products

| Serial Bus | MDO/MSO/DPO 4000B Series Module | MDO3000 Series Module | MSO/DPO2000B Series Module |
|---|---|---|---|
| $I^2C$, SPI [3] | DPO4EMBD | MDO3EMBD | DPO2EMBD |
| RS-232 / 422 / 485 / UART | DPO4COMP | MDO3COMP | DPO2COMP |
| CAN, LIN | DPO4AUTO | MDO3AUTO | DPO2AUTO |
| FlexRay | -- | MDO3FLEX | -- |
| CAN, LIN, FlexRay | DPO4AUTOMAX [4] | -- | -- |
| $I^2S$/LJ/RJ/TDM [5] | DPO4AUDIO | MDO3AUDIO | -- |
| MIL-STD-1553 | DPO4AERO | MDO3AERO | -- |
| USB [6] | DPO4USB | MDO3USB | -- |
| Ethernet [7] | DPO4ENET | -- | -- |

### Discontinued products

| Serial Bus | MDO4000 Series Module | MSO/DPO4000 Series Module | MSO/DPO3000 Series Module | MSO/DPO2000 Series Module |
|---|---|---|---|---|
| $I^2C$, SPI [3] | DPO4EMBD | DPO4EMBD | DPO3EMBD | DPO2EMBD |
| RS-232 / 422 / 485 / UART | DPO4COMP | DPO4COMP | DPO3COMP | DPO2COMP |
| CAN, LIN | DPO4AUTO | DPO4AUTO | DPO3AUTO | DPO2AUTO |
| FlexRay | -- | -- | DPO3FLEX | -- |
| CAN, LIN, FlexRay | DPO4AUTOMAX [4] | DPO4AUTOMAX [4] | -- | -- |
| $I^2S$/LJ/RJ/TDM [5] | DPO4AUDIO | DPO4AUDIO | DPO3AUDIO | -- |
| MIL-STD-1553 | DPO4AERO | DPO4AERO | DPO3AERO | -- |
| USB [6] | DPO4USB | DPO4USB | -- | -- |
| Ethernet [7] | DPO4ENET | -- | -- | -- |

## Recommended probes

Please refer to www.tek.com/probes for further information on the recommended models of probes and any necessary probe adapters.

CE

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3 SPI support is limited to 2-wire SPI only on models that have only 2 analog channels and no digital channels.

4 DPO4AUTOMAX includes a PC-based software package for FlexRay eye diagram analysis.

5 Not available on models that have only 2 analog channels and no digital channels.

6 USB LS/FS triggering and decode available on all models in all indicated product families. HS decode available only on 1 GHz models. HS triggering only available on 1 GHz models in MDO/MSO/DPO4000B and MDO4000 Series.

7 100BASE-TX requires ≥ 350 MHz model.

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

Updated 10 April 2013

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16 Jul 2014

3GW-26221-7

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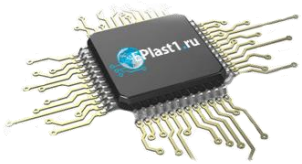
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

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