Tektronix[®]

Serial Triggering and Analysis Application Modules AERO • AUDIO • AUTO • AUTOMAX • COMP • EMBD • FLEX • USB • ENET Datasheet

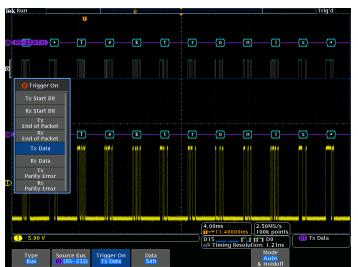


Key features

- Automated Serial Triggering, Decode, and Search options for I²C, SPI, CAN, CAN FD, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, I²S/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 counting 1s 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 serial bus activity in a tabular, timestamped format for quick summary of 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 MDO4000C, MDO3000, and MSO/DPO2000B Series transform the oscilloscope into a robust tool for debugging serial buses with automatic trigger, decode, and search for I²C, SPI, CAN, CAN FD, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, I²S/LJ/RJ/TDM, USB2, 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

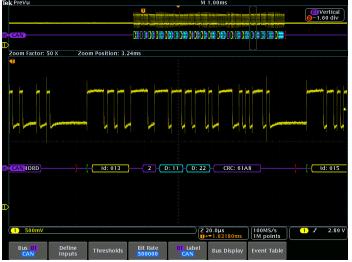
Trigger on packet content such as start of packet, specific addresses, specific data content, unique identifiers, etc. on popular serial interfaces such as I²C, SPI, CAN, CAN FD, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I²S/LJ/RJ/TDM, USB2, and Ethernet.

Bus display

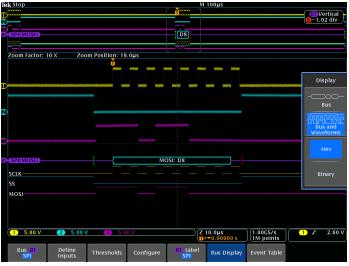
Provides a higher-level, combined view of the individual signals (clock, data, chip enable, etc.) that make up your bus, making it easy to identify where packets begin and end and identifying sub-packet components such as address, data, identifier, CRC, etc.

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 (I²S/LJ/RJ/TDM only), or ASCII (RS-232/422/485/UART, USB and Ethernet only) in the bus waveform.



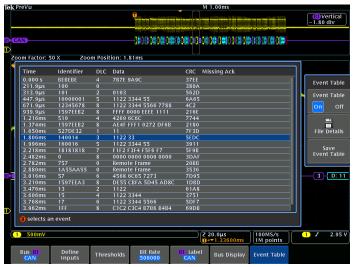
Color-coded display of a CAN bus, showing Start, DLC, Data, CRC, and Stop components of the serial signal.



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

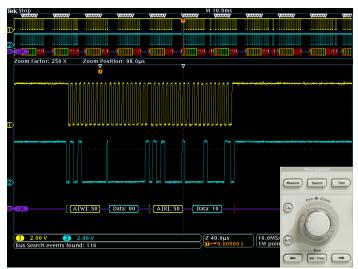
In addition to seeing decoded packet data on the bus waveform itself, you can view all captured packets in a tabular view much like you would see in a software listing. Packets are time stamped and listed consecutively with columns for each component (Address, Data, etc.).



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 (\leftarrow) and Next (\rightarrow) 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

Sources (Clock and Data)	Analog channels 1-4				
	Digital channels D0-D15				
Thresholds	Per-channel thresholds				
Recommended probing	Single ended				
Include R/W in address	Yes or No	Yes or No			
Decode formats available	Hex, Binary				
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			

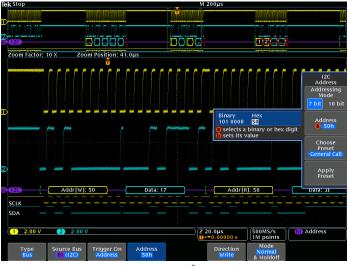
Tek PreVu			M 200µs		
D		Ŭ			BVertical a-2.82 div
			500		<u> </u>
Zoom Factor: 1	0 X Zoom Position: 4	1.0µs			
and an an an other markets of	ů – – – – – – – – – – – – – – – – – – –				
					Display
					Bus
Ľ "					
des anna si di se constituentes	m /m /m /m	(magazina)	1		Bus and Waveforms
					Hex
2		Antiperprint Antiperprint	energy physical productions	andara bilitika kananangar	Binary
					
	Addr[R]: 50	Data: 18			Data: IC
SCLK					
(1) 2.00 V	2 2.00 V) (Z 20.0µs <mark>∏+▼0.0000</mark>	0 s	B Address
Bus B1	Define Inputs Thresholds	mauuress	Label Bus Dis		

I²C bus setup, showing selection of bus display modes.

I²C Characteristics

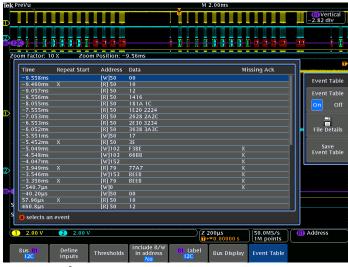
Bus trigger and search options

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



Triggering on a specific address value on the I²C bus.

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



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

Bus decode

SPI Characteristics

Sources (Clock, Slave Select,	Analog channels 1-4	
MOSI, and MISO)	Digital channels D0-D15	
Thresholds	Per-channel thresholds	
Recommended probing	Single ended	
Decode configuration	Paramater	Description
	Framing	Idle Time (2-wire SPI) 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
	Bit order	Most Significant (MS) First Least Significant (LS) First
Decode formats available	Hex, Binary	
Display mode	Mode	Description
	Bus	Bus only
	Bus and waveforms	Simultaneous display of bus and logic waveforms
	Event table	Decoded packet data in a tabular view
		(1) Vertical - 1.28 div configuration SCLK SS
	7 (12) (10) (12) (12) (12) (12) (12) (12) (12) (12	Active High Active High MOSI Active High Active High Active High Active High Active High Active High Active High Active Low -more- I of 2
	(1) 2.00 V (2) 2.00 V (3) 2.00 V (10.0µs (∎++24.7000) (5.0065/5) (D 7 2.60 V)
		10µs 11M points

Define Inputs Thresholds Configure BI Label Bus Display Event Table

Bus B1 SPI

SPI Characteristics

Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	SS Active Start of Frame MOSI MISO MOSI and MISO 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) Data (cyan box) Stop (red bracket)

ек PreVu			M 1.00ms		
		1 1 1		1 1 1	(B) Vertical
					-1.28 div
1 1					
SPI(NOSI)	- <u>0000</u>	······································		-m-m-m-m-m-m-m-m-m-m-m-m-m-m-m-m-m-m-m	
SPI(HOSI)					
Zoom Factor: 5	0 X Zoom Position: -4				
200m ractor. 5	to x Edolit Fosition.				
Time	MOSI	MISO			
-4.549ms	E1				Event Table
-4.048ms	D8				Event Table
-3.547ms	CE				Event Table
-3.046ms	C4				
-2.545ms	88				On Off
-2.044ms	AC				
-1.543ms	A0				- 100 M
-1.042ms	93				
-541.6µs	86				File Details
-40.68μs	7A				
460.3µs	6D				Save
961.1µs	60				Event Table
1.462ms	54				Literite rubie
1.963ms	48 3C				Moai. Ei
2.464ms	32				
2.965ms 3.466ms	28				
3.466ms 3.967ms	28 1F				
4.468ms	17				
4.969ms					
4.909115					
a selects an	event				*****
(1) 2.00 V	2 2.00 V 3 2.0	<u>0 V)</u>	[Z 2.00μs □+▼-3.40000μs [1]	00MS/s	1) MOSI
			[]+▼-3.40000μs	M points	
Bus B1 SPI	Define Inputs Thresholds	Configure B1 Labe	l Bus Display Ev	ent Table	
	for CDI huo with all		1 I		CT 1. 1.

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

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

BusSetupOptions-spectable2

Bus setup options

RS-232/UART Sources	Analog channels 1-4				
(Transmit and Receive)	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: Differentia	RS-232/UART: Single ended RS-422/RS-485: Differential			
Polarity	RS-422/RS-485 Inverted (UART, RS-422/RS-485)				
Decode configuration	Paramater	Description			
	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) 0Ah (LF) 0Dh (CR) 20h (SP) FFh			

Decode formats available

Display modes

Hex, Binary, ASCII

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

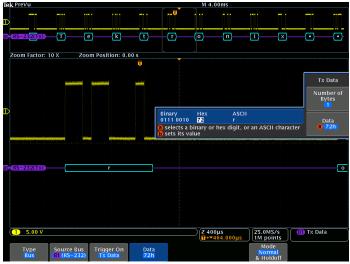
Tek Stop					M 4.00n	ns		
				ů			Bit Rate	BVertical -1.48 div
" – " – " – " – " – " – "							Custom	
BI (RS-232(Tx))	T	e(k t		•	n	2764800 bps	
							1843200 bps	
Zoom Factor: 4	X Zoo	om Position: 0	.00 s				1382400 bps	
				u t			921600 bps	
				1			460800 bps	RS-232 Configuration
							230400 bps	
							128000 bps	Bit Rate
							115200 bps	
							76800 bps	Data Bits
							57600 bps	7 8 9
							56000 bps	Parity
							38400 bps	None Odd
							31250 bps	Even
B) RS-232(Tx)	t			r			28800 bps	Packets
							19200 bps	On Off
							15200 bps	
							14400 bps	End of Packet
							9600 bps	
							7200 bps	
(1) 5.00 V					Z 1.00m	is 0000 s	25.0MS/s 1M points	1 J 0.00 V
Bus B1 RS-232	Define Inputs	Thresholds	Configure 9600-8-N	B1 Labe RS-232	el Bus	Display	Event Table	

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

Tx Start Bit Rx Start Bit Tx End of Packet Rx End of Packet Tx Data (number of bytes 1-10) Rx Data (number of bytes 1-10) Tx Parity Error	
	Rx Start Bit Tx End of Packet Rx End of Packet Tx Data (number of bytes 1-10) Rx Data (number of bytes 1-10)



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

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



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

Bus decode

CAN, CAN FD (ISO and non-ISO) Characteristics

Bus setup options

us setup options Source for CAN_H, CAN_L, Rx, or Tx probing Source for differential probing Thresholds Recommended probing	Id: 015 DLC: 4) Data: 11 Diffe Define Thresholds Bit Rate Bit Rate Bus Display Event CAN bus setup, showing signal type options for CAN bus. Analog channels 1-4 Digital channels D0-D15 Digital channel thresholds TDP1500 differential probe CAN_H, CAN_L, Rx, Tx: Single ended		
Bit Rate	Differential: Differential Parameter	Description	
Dir Nate	Standard: pre-defined list of rates and Custom	10 Kb/s - 1 Mb/s	
	FD: Pre-defined and custom	1 Mb/s - 10 Mb/s (7 M/bs MDO3K)	
Sample Point	Position at 15% to 95% within bit period or unit interval		
Decode formats available	Hex, Binary		
Display modes	Parameter	Description	
	Bus	Bus only	
	Bus and waveforms	Simultaneous display of bus and logic waveforms	
	Event table	Decoded packet data in a tabular view	

CAN, CAN FD (ISO and non-ISO) Characteristics

Bus trigger and search options

Trigger and/or Search On 1 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 End of Frame Missing Ack Bit Stuffing Error FD BRS Bit FD ESI Bit Form Error Any Error Trigger Were From Error Any Error Trigger Were From Error Any Error Trigger Were From Error Trigger Were From Error Start of Frame From Error From Error F	Description	haracteristic
CAN Data Trigger When	Type of Frame (Data, Remote, Error, Overload) Identifier (Standard or Extended) Data (number of bytes 1-8, trigger or search when =, ≠, <, >, ≤ ≥) Identifier and Data End of Frame Missing Ack Bit Stuffing Error FD BRS Bit FD ESI Bit Form Error	igger and/or Search On ¹
(1) 500mV (1) 500mV (1) 22.50000µs (5.00C5/s (1) points (1) points (1) points	Trigger When Image: select sa binary or hex digit Image: select sa binary or hex digit	Binary Hex 0001 0001 Selects a binary Selects a binary Sets its value AN 1d: 1000 0001 (5) (0: 11) (0: 22) (0: 33) (0: 44) (0: 55) (CR

Mode Normal & Holdof

Source Bus Trigger On B1 (CAN) Data

Triggering on a specific data value on the CAN bus.

¹ FD BRS Bit, FD ESI Bit, Form Error and Any Error are available only when CAN FD is selected as BUS

CAN, CAN FD (ISO and non-ISO) Characteristics

Bus decode

Characteristic	Description	
Decode display	Start (green bracket)	
	Address (yellow box)	
	DLC, CRC (purple box)	
	Missing Ack (red ! symbol)	
	Data (cyan box)	
	Stop (red bracket)	
	Bit stuffing errors (red box)	

Time	Identifier	DLC	Data	CRC Missing Ack	
-551.1µs	BEBEBE	4	787E 9A9C	37EE	
-339.1µs	100			380A	Event
-237.1µs	101	2	0103	562D	Event
-103.1µs	10000001		1122 3344 55	6A65	Event
120.9µs	12345678	8	1122 3344 5566 7788	4C2	On
388.9µs	1597EEB2		FFFF 0000 EEEE 1111	216E	
664.9µs	519		4269 6C6C	7744	
822.9µs	1597EEB2	8	AE4F FFF1 0272 DF6B	2180	E
1.099ms	527DE32			7F3D	File D
1.255ms	140014	3	1122 33	5EDC	
1.445ms	160016		1122 3344 55	3911	
1.667ms	18181818	7	F1F2 F3F4 F5F6 F7	5F9B	Sa Event
1.931ms	0	8	0000 0000 0000 0000	3DAF	Event
2.231ms	757	0	Remote Frame	2088	
2.329ms	1A55AA55	0	Remote Frame	3536	
2.465ms	57		4568 6C65 7273	7D95	
2.659ms	1597EEA3		DE55 CBFA 5D45 AD8C	1DBD	
2.925ms	13	2	1122	61A8	
3.055ms	15	4	1122 3344	3751	
3.217ms	17	6	1122 3344 5566	5DF7	
3.411ms			C1C2 C3C4 B7B6 B4B4	69DB	

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

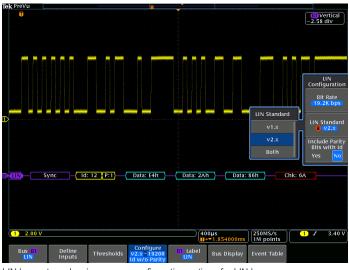
LIN Characteristics

Bus setup options		
Source	Analog channels 1-4	
	Digital channels D0-D15	
Thresholds	Per-channel thresholds	
Recommended probing	Single ended	
Decode Configuration	Parameter	Description
	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

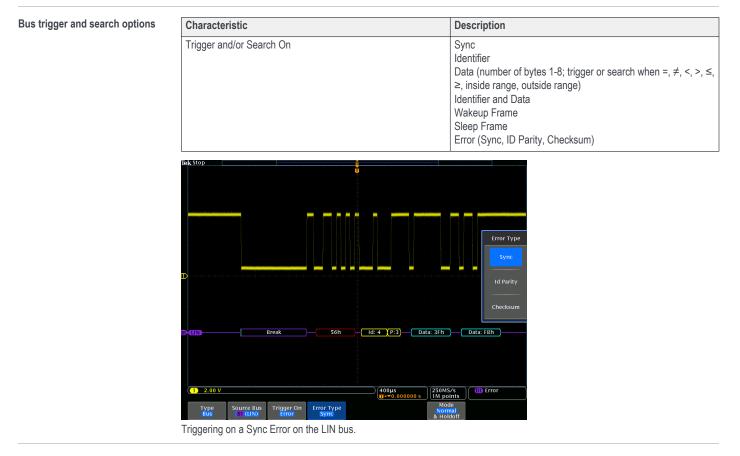
LIN Characteristics

Decode formats available Display modes Mixed: ID and Parity are shown in Hex, Data and Checksum are shown in Binary Hex: all fields Binary: all fields

Mode	Description
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 decode

Characteristic	Description
/laximum bit rate	Up to 1 Mb/s, by LIN definition up to 20 kb/s (for automate decoding of bus)
Decode display	Start (green bracket) Sync, Break (purple box) Identifier, Parity (yellow box) Data (cyan box) Checksum, Wakeup (purple box) End of frame (red bracket) Errors (red box) - Sync - Sync - Parity - Checksum - Header Time - Response Time - Frame Time - Response and Frame Time
2PreVu	M 200ms
Time identifier (dec) Parity Data (dec) -979.0ms 12 1 E42A 86 -870.4ms 13 0 3FD8 CCBD A59 807F -761.8ms 4 2 82C5 80 -653.1ms 15 3 846 77FA -544.5ms 0 00 67F FFFF FFF FFF FFF -435.0ms 0 2 245 C3 -318.7ms 0 2 244 5 C3 -10.9 mms 0 2 5443 882 C606 812F -10.9 mms 3 0 1244 8116 14 -1.372 ms 3 341 821 C606 812F -133.5ms 0 0723 324-5ms 1 0 0723 324-5ms 0 0723 324-5ms 1 DC2C 348F E8 324-5ms 1 7003 8898 D8C5 46FE	ecksum Errors ex) Checksum Error Checksum Error Parity Fror Checksum Error Sync Error Header Time Error Checksum Error
542.3ms 9 1 70D3 BB98 D8C5 46FE 650.9ms 10 3 D088 6473 5440 8292 759.6ms 11 2 E7	

Z 20.0ms ■+▼0.00000 s 500kS/s B Error

B1 Label Bus Display Event Table

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

Thresholds

FlexRay Characteristics

(1) 2.00 V

Bus B

Define Inputs

Bus setup options			
Source for single-ended	Analog channels 1-4		
probing	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	Parameter	Description	
	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	

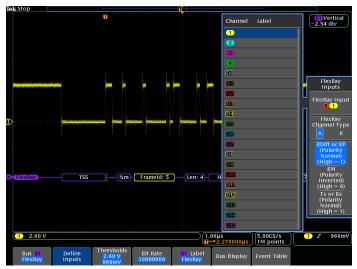
FlexRay Characteristics

Decode formats available

Display modes

Mixed: Identifier, Payload Length and Cycle Count are shown in Decimal, Data and CRCs are shown in Hex. Hex: all fields Binary: all fields

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



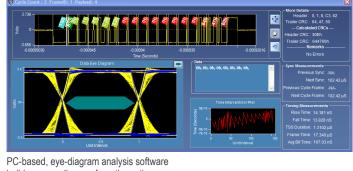
FlexRay bus setup, showing input options for FlexRay bus.

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

FlexRay Characteristics

Bus decode

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



builds an eye-diagram from the entire acquisition and plots it against TP1 mask called out by the FlexRay standard, available with MDO4000C instruments.

I²S/LJ/RJ/TDM Characteristics

Bus setup options			
Sources (Clock, Word, Data)	Analog channels 1-4		
	Digital channels D0-D15		
Thresholds	Per-channel thresholds		
Recommended probing	Single ended		
Decode Configuration	Parameter	Description	
	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 Least Significant (LS) First	
Decode formats available	Signed Decimal, Hex, Binary		
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	
	Tek Run M 4.00µ D D D D	s Trig'd	

lek kun	M 4.00µs	rng u
\mathbb{D}		-3.52 div
		<u>-3.32 uiv</u>
1 (12) L: 10 (R: -10) (Left: 8) (R: -8) (Left: 6) (R:	-6 . Left: 4 . R: -4 . Left: 2 . R: -2	Left: 0
Zoom Factor: 4 X Zoom Position: 0.00 s		
	Audio Bus Type	Audio Inputs Type a 125
	Left Justified (LJ)	a (125)
	Right Justified (LJ) TDM	Bit Clock
		Word Select
		Data 3
1) [25] Left: 6 Right: -6	Left: 4	Right: -4
		· · · · · · · · · · · · · · · · · · ·
(1) 2.00 V (2) 2.00 V (3) 2.00 V	(Z 1.00μs □→▼0.00000 s)(2.50G5/s 100k point	B) Data
Bus B1 Define Inputs Thresholds Configure	B1 Label Bus Display Event Table	
I ² S bus setup, showing input configurati	on options for I ² S bus.	

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I²S/LJ/RJ/TDM Characteristics

Bus trigger and search options

Characteristic	Description
Trigger and/or Search On	Word Select Frame Sync
	Data (select either word, left word, or right word; trigger or search when =, \neq ,<,>, \leq , \geq , inside range, outside range)

Tek Run	M 4.00µs	Trig'd
\mathbb{D}		
2	فتقل ويبيدين المتغذاذ بواجهي الاختلاقا ويبيه	
	كالمسابة والمسابي المسابر المسابر المسابر	
	R: -6 (Left: 4) (R: -4 (Left: 2) (R: -2) (Left: 2)	eft: 0)- <mark>Right: 0</mark>
Zoom Factor: 4 X Zoom Position: 0.00 s	Ť	
		125 Data
		Trigger When
		Either Word
		Left Word Right Word
2	Binary <u>He</u> x Decimal	
	1111 1010 FA -006 e selects a binary, hex or decimal digit, or the sig	Data
	b sets its value	
B 125 Left: 6 Right: −6	Left: 4	Right: -4
1 2.00 V 2 2.00 V 3 2.00 V	Z 1.00µs ii→▼0.00000 s 2.50GS/s 100k points	🚯 Data
Type Source Bus Trigger On	Data Mode	
Bus B1 (12S) Data	E006 & Holdoff	
Triggoring on a chaoifia data value or	the 12C hue	

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 I ² S/LJ/RJ bus) Up to 25 Mb/s (for automated decoding of TDM bus)
Decode display	Start (green bracket) Data (cyan box) Stop (red bracket

m Factor: 4				
		tion: –198µs		_
Time	Left (dec)	Right (dec)		annananana an
-198.2µs	66	-66	1	Even
-191.8µs	64	-64		Even
-185.4µs	62	-62		Even
-179.0µs	60	-60		
-172.6µs	58	-58		On
-166.2µs	56	-56		
-159.8µs	54	-54		
–153.4µs	52	-52		
–147.0µs	50	-50		File
–140.6µs	48	-48		
-134.2µs	46	-46		s
-127.8µs	44	-44		Even
–121.4µs	42	-42		L Ven
–115.0µs	40	-40		
-108.6µs	38	-38		
-102.2µs	36	-36		
-95.79µs	34	-34		
-89.39µs	32	-32		
-82.99µs	30	-30		
-76.59μs -70.19μs	28 26	-28 -26		54

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

MIL-STD-1553 Characteristics

setup options			
Sources	Analog channels 1-4		
	Reference waveforms 1-4		
	Math waveform		
Thresholds	High and low threshold per source		
Recommended probing	Single ended or differential (only one single-ended signal required)		
Decode Configuration	Parameter	Description	
	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 co (bits) Block Hex Hex and Binary Binary	ount), Binary (bits) Mixed2: ASCII (data), Decimal (addresses and count), Binar	
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	
	30 413533		
	Zoom Factor: 50 X Zoom Position: -29.6us	Channel Threshold Threshold Threshold to Data (0013 (0) Data (0013	

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 Word Type ² (Command, Status, Data) Command Word ² (set RT Address (=, ≠, <, >, ≤, ≥, inside range, outside range), T/R, Sub-address/Mode, Data Word Count/Mode Code, and Parity individually) Status Word ² (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) Data Word (user-specified 16-bit data value) Error (Sync, Parity, Manchester, Non-contiguous data) 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)
Tek PreVu M 100µ 100-00-00-0000000000000000000000000000	S CCCCCCCC-40 Hex ASCII JEXX K* Data

selects a b sets its val

1 1.00

Trigger On

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

Source Bus

0 Data

Z 4.00µs

1.00GS/s 1M points **B** Data

² 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)Sync 3 (purple box) with Word Type identifiedAddress (yellow box)R/T (purple box)Word Count (purple box)Status Bits (purple box)Data (cyan box)Parity (purple box)Stop (red bracket)Errors (red box)
Bk PreVu M 100µs E5559 410-41-4100-41410-400000000000000000000	CCCCCC 4
Time Type Payload RT -351.9µs C/S B011 (22-00000010001) RT	ZING Error
-351.9µs C/S B011(22-00000010001)	Event Table

File Details Save Event Tabl

🚹 Data

1.00GS/s 1M points

Event Table

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

Z 4.00µs

Data Emd Emd Data Emd Data

selects an event

1.00 V

Bus B1

8800 (17-R-0-0) 00h 00h 01h 00h 02h 53A2 (10-R-29-2) TEKTRONIX, INC.COPY RIGHT.PORTLAND, ORE GON. 5000 (10-000-00000-000)

USB Characteristics

Bus setup options	USB 2.0 Compatibility
	Low-speed and Full-speed: All MDO4000C or MDO3000 Series models
	High-speed: Models with 1 GHz analog channel bandwidth
Sources	Single-ended: Analog channels 1-4
	Digital channels D0-D15
	Differential: Analog channels 1-4, Math channel, Reference channels 1-4
Recommended probing	Low-speed and Full-speed: Single-ended or differential High-speed: Differential
Thresholds presents	Low-speed and Full-speed: Single-ended (D+: 1.4 V; D-: -1.4 V), differential (High: 1.4 V; Low: -1.4 V) High-speed: Differential (High: 100 mV; Low: -100 mV) High-speed: Differential (High: 100 mV; Low: -100 mV)

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

Serial Triggering and Analysis Application Modules

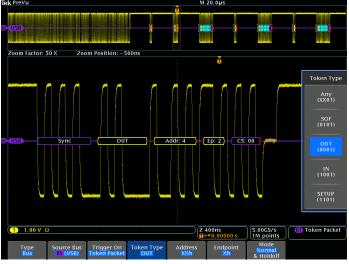
USB Characteristics

Decode formats available

Display modes

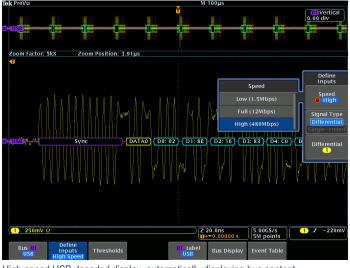
Mixed1: Frame and Address are shown in Decimal, Data shown in Hex Mixed2: Frame and Address are shown in Decimal, Data shown in ASCII Hex: all fields Binary: all fields

Mode	Description
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.

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



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

USB Characteristics

Bus trigger and search options

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

Ethernet Characteristics

Bus setup options	Ethernet compatibility 10BASE-T, 100BASE-TX On MDO4000C Series only					
Sources	Single-ended: Analog channels 1-4					
	Differential: Analog channels 1-4, Math channel, Reference chan	nels 1-4				
Recommended probing	10BASE-T: Single-ended or differential 100BASE-TX: Differential					
Thresholds presents	5 ()	10BASE-T: Single-ended (D+: 1.25 V; D-: 1.25 V); Differential (High: 1.25 V; Low: -1.25 V) 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 Mixed2: Data is shown in ASCII, all other fields are shown in either Decimal or Hex Hex: all fields Binary: all fields					
Display modes	Mode	Description				

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

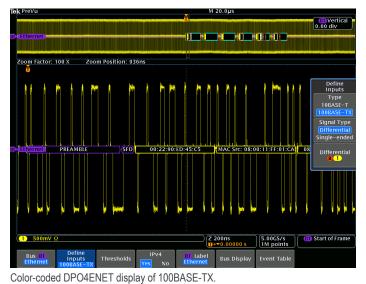
PreV	'u				М 20.0µs				B) Vertica 0.00 div
ther						00100	- 2101		<u>(0.00 uit</u>
oom	Factor: 10	00 X Zoom P	osition: –4.00ns						
Ti	ime	Destination (hex)	Source (hex)	Length (hex)	Data (hex)	FCS/CRC (hex)	Errors		
-4	4.200ns	002290ED45C5	080011FF01CA	800	IP: 4,5,0,54,0,2,0	C6E367E9)		Event Tal
					40,ICMP,9989				Event Tal
					134.62.74.162				Event Ta
					134.62.74.1				On C
					0800 17A2 06A3 0000				
					6B0B 6EAF 0000 0000				100
					0000 0000 0000 0000				H
					0000 0000 0000 0000				File Deta
					0000 0000 0000 0000				
					0000 0000 0000 0000				2 Save
					0000 0000 0000 0000				Event Tal
10	0.24µs	002200504505	080011FF01CA	00	0500 0054 0000 4000	58789CD	c		
F ¹⁰	0.24jas	002290ED45C5	0800THITUTCA	00	4001 9989 863E 4AA2	3678900			
					863E 4A01 0000 17A2				
					06A3 0000 6B0B 6EAF				
					0000 0000 0000 0000				
					0000 0000 0000 0000				
					0000 0000 0000 0000				
					0000 0000 0000 0000				M 1 M
a	selects an	event							
	500mV Ω				Z 200ns	5.	00GS/s	6	🕽 Start of Fra
					.0000		1 points		
	s (B1) ernet	Define Inputs Th	nresholds	Pv4 No	B1 Label Ethernet Bus Dis	splay Ev	ent Table		

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

Ethernet Characteristics

Bus decode

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



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

reVu				M 20.0µs			B Vert 0.00 div
hernet					000 (0))		0.00 div
om Factor: 1	Destination (hex)	osition: –4.00ns Source (hex)	Length (hex)	Data (hex)	FCS/CRC (hex)	Errors	
-4.200ns		080011FF01CA		$\begin{array}{c} 1P: 4, 5, 0, 54, 0, 2, 0\\ 4, 0, CMP, 9869\\ 134, 62, 74, 162\\ 134, 62, 74, 162\\ 134, 62, 74, 162\\ 134, 62, 74, 162\\ 134, 62, 74, 162\\ 16008 64, 7400000000\\ 0000000000000000000\\ 00000000000000000000\\ 00000000000$	C6E367E5 5B789CD		Event 1 Event 1 On File De Event 1
 a selects ar 500mV Ω 				(Z 200ns	(5.	00G5/s	GI Start of F
Bus B1 Ethernet	Define	nresholds	Pv4 No	B1 Label Ethernet Bus Di	00 S [10	ent Table	
04ENET		TX decode	d Eve	ent Table showir	ng all pa	acket in	formation.

Ethernet Characteristics

Bus trigger options

Option	Description
Trigger and/or Search On	10BASE-T: Start Frame Delimiter MAC Addresses: Trigger on Source and Destination 48-bit address values MAC Q-tag Control Information: Trigger on Q-tag 32-bit value MAC Q-tag Control Information: Trigger on Q-tag 32-bit value MAC Length/Type: Trigger on $\leq, <, =, >, \geq, \neq$ a particular 16-bit value, or inside or outside of a range MAC Client Data: Trigger on $\leq, <, =, >, \geq, \neq$ 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 IP Header: Trigger on IP header 8-bit value, Source Address, Destination Address TCP Header: Trigger on Destination Port, Source Port, Sequence Number, and Ack Number TCP/IPv4 Client Data: Trigger on $\leq, <, =, >, \geq, \neq$ 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 End of Packet FCS (CRC) Error
	100BASE-TX: Start Frame Delimiter MAC Addresses: Trigger on Source and Destination 48-bit address values MAC Q-tag Control Information: Trigger on Q-tag 32-bit value MAC Length/Type: Trigger on $\leq, <, =, >, \geq, \neq$ a particular 16-bit value, or inside or outside of a range MAC Client Data: Trigger on $\leq, <, =, >, \geq, \neq$ 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 IP Header: Trigger on IP header 8-bit value, Source Address, Destination Address TCP Header: Trigger on Destination Port, Source Port, Sequence Number, and Ack Number TCP/IPv4 Client Data: Trigger on $\leq, <, =, >, \geq, \neq$ 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 End of Packet FCS (CRC) Error Idle

Ethernet Characteristics

Tek Stop		м	20.0µs			
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	territori, aktor a	distant" terestati	ter territer			
B) Ethernet		<mark>N</mark> iko)(Rikol.)(Jaimininininin			
		an the set of the literation		AND COMPANY OF A DESCRIPTION	Track PETRENE	and the second second
Zoom Factor: 20 X Zoom Position: 100ns						
		Ť				
	Binary			Hex		MAC Address
	0000 1000	0000 0000	0001 0001	08:00:11:1D:2	2B:47	Source
		binary or he				08:00:11:
MAN MANANANANA MAN MAN MANYANANAN M	b sets its v		n aigit			
			··· .			
B Chernet MAC Source Addr: 08:00:11:1D:2B:	.47	MAC Type	: 0800h (4) 5 - 00	Total L	ength: 84) (
		1912 (1916)		HA HAHAA	N N N N	
(1) 1.00 V Ω) (Z	1.00µs + ▼ 0.00000 s	5.00GS/s		Addresses
Type Source Bus Q- (VLAN) The Bus Bull (thermal) Tagging	rigger on	Destination	Source 08:00:11	Mode Normal		
Bus B1 (Ethernet) Tagging A	ddresses	xx:xx:xxh	1D:28:47			
		~				

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

Ordering information

Current/discontinued products

Current products

Serial Bus	MDO4000C Series Module	MDO3000 Series Module	MSO/DPO2000B Series Module
I ² C, SPI ⁴	DPO4EMBD	MDO3EMBD	DPO2EMBD
RS-232 / 422 / 485 / UART	DPO4COMP	MDO3COMP	DPO2COMP
CAN/CAN FD, LIN	DPO4AUTO	MDO3AUTO	DPO2AUTO
FlexRay		MDO3FLEX	
CAN/CAN FD, LIN, FlexRay	DPO4AUTOMAX 5		
I ² S/LJ/RJ/TDM ⁶	DPO4AUDIO	MDO3AUDIO	
MIL-STD-1553	DPO4AERO	MDO3AERO	
USB 7	DPO4USB	MDO3USB	
Ethernet 8	DPO4ENET		

Discontinued products

Serial Bus	MSO/DPO4000B and MDO4000/B Series Module	MSO/DPO4000 Series Module	MSO/DPO3000 Series Module	MSO/DPO2000 Series Module
I ² C, SPI ⁴	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 ⁵	DPO4AUTOMAX ⁵		
I ² S/LJ/RJ/TDM ⁶	DPO4AUDIO	DPO4AUDIO	DPO3AUDIO	
MIL-STD-1553	DPO4AERO	DPO4AERO	DPO3AERO	
USB 7	DPO4USB	DPO4USB		
Ethernet ⁸	DPO4ENET			

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.

- 5 DPO4AUTOMAX includes a PC-based software package for FlexRay eye diagram analysis.
- 6 Not available on models that have only 2 analog channels and no digital channels.
- 7 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 MSO/DPO4000B and MDO4000/B/C Series.
- 8 100BASE-TX requires ≥ 350 MHz model.

⁴ SPI support is limited to 2-wire SPI only on models that have only 2 analog channels and no digital channels.

Serial Triggering and Analysis Application Modules

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

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