Serial Bus Options for InfiniiVision 3000 and 4000 X-Series Oscilloscopes

Data Sheet

Supported protocols and features

- I^2C
- SPI
- RS232/UART
- USB 2.0 low- and full-speed
- USB 2.0 hi-speed (4000 X-Series only)
- I^2S
- CAN
- LIN
- FlexRay
- MIL-STD 1553
- ARINC 429
- Hardware-based decoding
- Multi-bus analysis
- Automatic search and navigation
- Compatibility with segmented memory acquisition
- Eye-diagram mask files available for CAN, FlexRay, MIL-STD 1553, and ARINC 429 (requires DSOX3MASK/DSOX4MASK mask test option)
- FlexRay physical layer conformance test software

Introduction

Serial buses are pervasive in today's digital designs and are used for a variety of purposes including on-board chip-to-chip communication, CPU to peripheral control, as well as for remote sensor data transfer and control. Without intelligent oscilloscope serial bus triggering and protocol decode, it can be difficult to debug these buses and correlate data transfers with other mixed signal interactions in your system. Agilent's InfiniiVision 3000 and 4000 X-Series oscilloscopes (DSOs) and mixed-signal oscilloscopes (MSOs) offer optional integrated serial bus triggering and hardware-based protocol decoding solutions that give you the tools you need to accelerate debug of your designs that include serial bus communication.

Hardware-Based Decoding

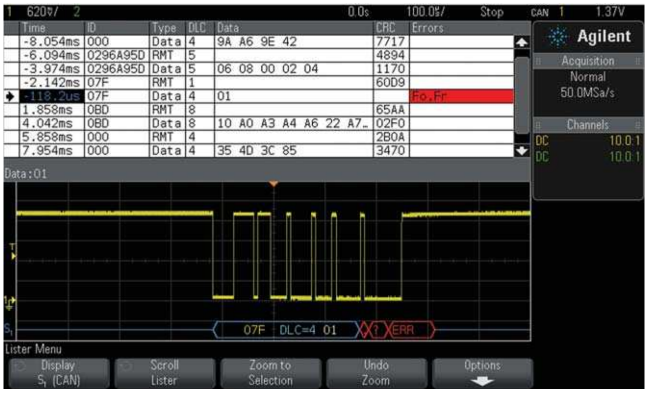


Figure 1: Hardware-based decoding quickly reveals serial communication errors.

Agilent's InfiniiVision Series oscilloscopes are the industry's only scopes to use hardware-based decoding. Most other vendor's scopes with serial bus triggering and protocol decode, use software post-processing techniques to decode serial packets/frames. With these software techniques, waveform- and decode-update rates tend to be slow (sometimes seconds per update.) That's especially true when using deep memory, which is often required to capture multiple packetized serial bus signals. And when analyzing multiple serial buses simultaneously, software techniques can make decode update rates even slower.

Faster decoding with hardware-based technology enhances scope usability, and more importantly, the probability of capturing infrequent serial communication errors. Figure 1 shows an example of an Agilent X-Series scope capturing a random and infrequent CAN error frame. The upper half of the scope's display shows the decoded data in a "Lister" format, along with a time-correlated decode trace shown below the waveform.

Automatic Search and Navigation

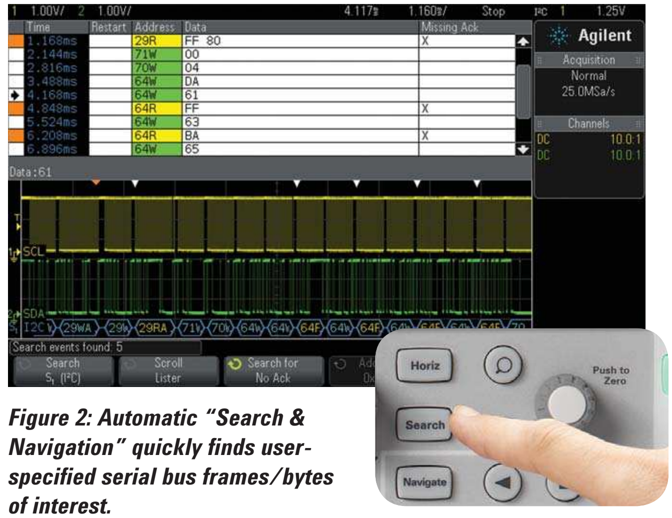


Figure 2: Automatic "Search & Navigation" quickly finds user-specified serial bus frames/bytes of interest.

After capturing a long record of serial bus communication using the InfiniiVision scope's *MegaZoom* deep memory, you can easily perform a search operation based on specific criteria that you enter. Then, you can quickly navigate to bytes/frames of serial data that satisfy the entered search criteria. Figure 2 shows an example of searching on captured I^2C data to find all occurrences of Read or Write operations with "No Ack." In this case, the scope found five occurrences of data transfers with "No Ack," and marked each occurrence with a white triangle to show where in time they happened relative to the captured waveform. Navigating and zooming-in on each marked byte/frame is quick and easy using the scope's front panel navigation keys.

Multi-bus Analysis

Figure 3: An interleaved "Lister" makes it easier to time-correlate activity between two decoded serial buses.

Many of today's designs include multiple serial buses. Sometimes it may be necessary to correlate data from one serial bus to another. Agilent's InfiniiVision X-Series oscilloscopes can decode two serial buses simultaneously using hardware-based decoding. Plus they are the only scopes on the market that can also display the captured data in a time-interleaved "Lister" display, as shown in Figure 3. In this particular example, the scope has simultaneously decoded and interleaved a CAN and LIN bus in an automotive system.

Using Segmented Memory to Capture Multiple Serial Bus Packets

Figure 4: Segmented memory acquisition selectively captures more packets/bytes of serial bus activity.

The segmented memory option for Agilent's InfiniiVision X-Series oscilloscopes can optimize your scope's memory, letting you capture more packets/frames of serial bus activity. Segmented memory acquisition optimizes the number of packetized serial communication frames that can be captured consecutively. Segmented memory does this by capturing just the selective frames/bytes of interest while ignoring (not digitizing) idle time and other unimportant frames/bytes. Figure 4 shows an example of the oscilloscope capturing 500 consecutive hi-speed USB split packets for a total acquisition time of approximately 200 ms. Capturing this much data using conventional oscilloscope acquisition memory would require 1G bytes of memory.

Agilent's InfiniiVision X-Series oscilloscopes are the only scopes on the market today that can acquire segments on up to four analog channels of acquisition, and time-correlated segments on digital channels (using an MSO model), along with automatic hardware-based serial bus decoding for each segment. In addition, you can use the scope's Search & Navigation capability after a segmented memory acquisition has been performed.

Serial Bus Eye-diagram and Pulse Mask Testing

With the addition of the DSOX3MASK or DSOX4MASK mask test option, which can perform over 200,000 pass/fail tests per second, you can perform eye-diagram and pulse mask testing on CAN, FlexRay, MIL-STD 1553, and ARINC 429 signals. Eye-diagram measurements provide a comprehensive signal quality test of the quality of your transmitted and received bits. Agilent provides various mask files that you can download at no charge. The mask files are based on published industry mask standards and/or derived from physical layer/electrical specifications.

The following CAN mask files are available:

- 125 kbps – 400 meters
- 250 kbps – 200 meters
- 500 kbps – 10 meters
- 500 kbps – 80 meters
- 800 kbps – 40 meters
- 1000 kbps – 25 meters

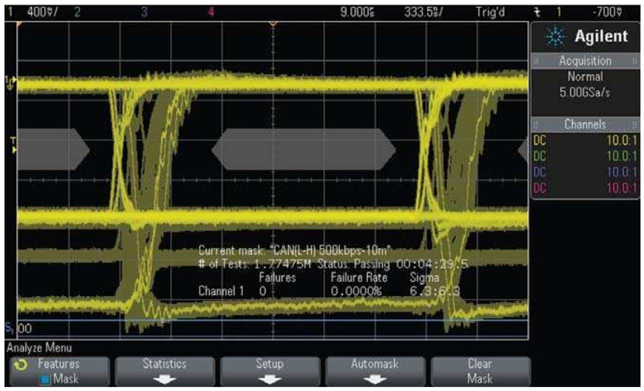


Figure 5: CAN 500 kbps mask test on 10 meter system

The following FlexRay mask test files are available:

- TP1 standard voltage (10 Mbps only)
- TP1 increased voltage (10 Mbps only)
- TP11 standard voltage (10 Mbps only)
- TP11 increased voltage (10 Mbps only)
- TP4 10 Mbps
- TP4 5 Mbps
- TP4 2.5 Mbps

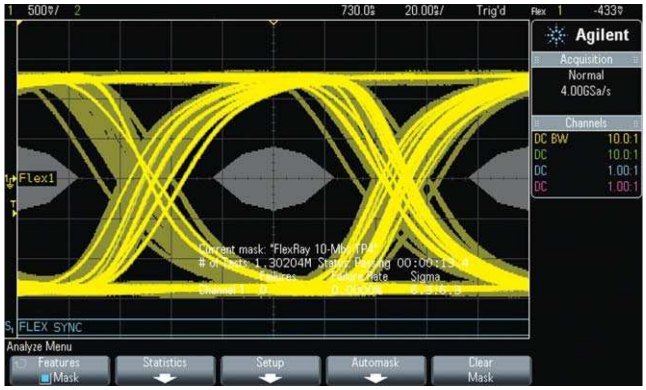


Figure 6: FlexRay TP4 eye-diagram mask test.

The following MIL-STD 1553 mask test files are available:

- System xfmr-coupled Input
- System direct-coupled Input
- BC xfmr-coupled Input
- BC direct-coupled Input
- RT xfmr-coupled Input
- RT direct-coupled Input

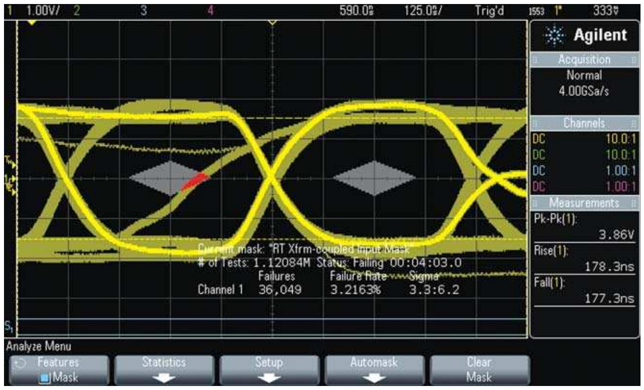


Figure 7: MIL-STD 1553 BC to RT xfrm-coupled input mask test reveals a shifted bit that violates the pass/fail mask.

Serial Bus Eye-diagram and Pulse Mask Testing

The following ARINC 429 mask/pulse test files are available:

- 100 kbps Eye Test
- 100 kbps 1's Pulse Test
- 100 kbps 0's Pulse Test
- 100 kbps Null Level Test
- 12.5 kbps Eye Test
- 12.5 kbps 1's Pulse Test
- 12.5 kbps 0's Pulse Test
- 12.5 kbps Null Level Test

For additional information about eye-diagram mask testing on CAN, FlexRay, MIL-STD 1553, and ARINC 429 signals, refer to the application notes listed at the end of this document.

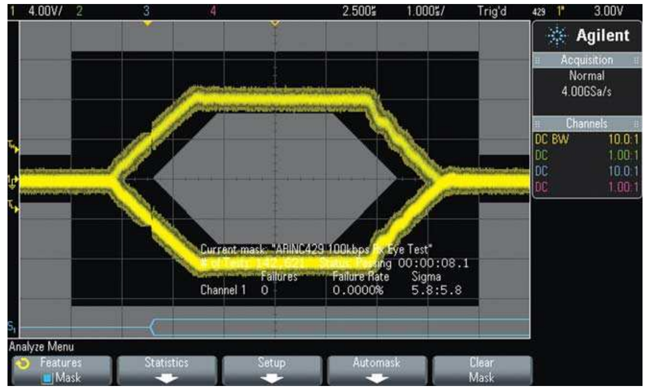
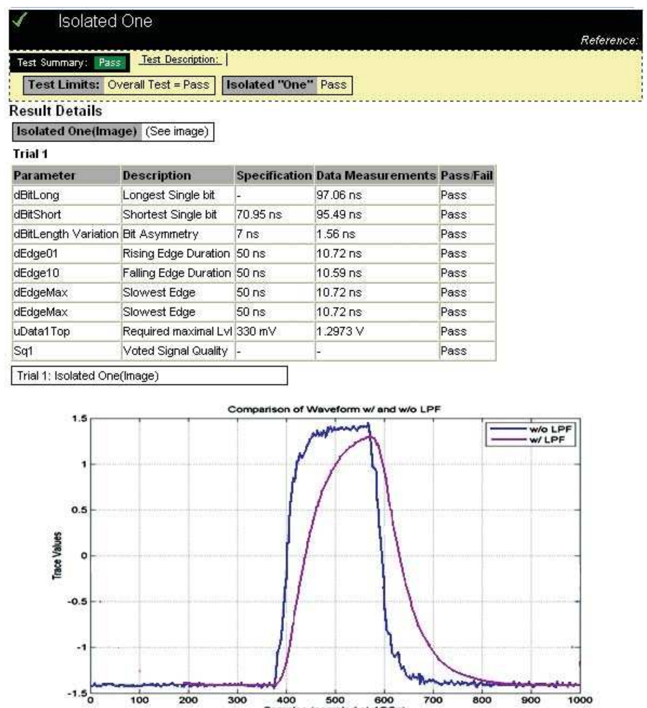


Figure 8: ARINC 429 100 kbps eye-diagram mask test.

Automated FlexRay Physical Layer Conformance Testing

To perform Physical Layer Conformance testing on the differential FlexRay bus, Agilent provides a PC-based software package that you can download from Agilent's website at no additional charge. If the InfiniiVision X-Series scope is licensed with the FlexRay, Mask Test, and Segmented Memory, you can perform automated physical layer tests at either receiver input or transmitter output test points. Figure 9 shows an example of the generated report from a Signal Integrity Voting Test on a 10-Mbs isolated "1" pulse. The test report includes comprehensive pass/fail and margin analysis based on published specifications.

Refer to the tables in the Specifications/Characteristics section of this document on page 15 to see the entire list of 33 available FlexRay tests that can be selected and performed using the FlexRay Physical Layer Conformance Test software package.



Isolated One

Reference:

Test Summary: Pass Test Description:

Test Limits: Overall Test = Pass Isolated "One" Pass

Result Details

Isolated One(Image) (See image)

Trial 1

Parameter	Description	Specification	Data Measurements	Pass/Fail
dBitLong	Longest Single bit	-	97.06 ns	Pass
dBitShort	Shortest Single bit	70.95 ns	95.49 ns	Pass
dBitLength Variation	Bit Asymmetry	7 ns	1.56 ns	Pass
dEdge01	Rising Edge Duration	50 ns	10.72 ns	Pass
dEdge10	Falling Edge Duration	50 ns	10.59 ns	Pass
dEdgeMax	Slowest Edge	50 ns	10.72 ns	Pass
dEdgeMax	Slowest Edge	50 ns	10.72 ns	Pass
uData1Top	Required maximal Lvl	330 mV	1.2973 V	Pass
Sq1	Voted Signal Quality	-	-	Pass

Trial 1: Isolated One(Image)

Figure 9: FlexRay Signal Integrity Voting test performed on an isolated "1" bit.

Probing Differential Serial Buses

Some of today's serial buses are based on differential signaling, such as CAN, FlexRay, MIL-STD 1553, and ARINC 429. Probing differential serial buses such as these requires that you use a differential active probe. Agilent offers a range of differential active probes compatible with the InfiniiVision X-Series oscilloscopes for various bandwidth and dynamic range applications.

For the USB 2.0 hi-speed bus applications, Agilent recommends using the bandwidth N2750A 1.5-GHz differential active probe shown in Figure 10. With this probe's unique InfiniiMode feature, all it takes is the press of a button on the probe to quickly switch between viewing the differential signal, high-side signal, low-side signal, or the common mode signal on the USB 2.0 hi-speed bus.

For CAN, MIL-STD 1553, and ARINC 429 differential bus applications, Agilent recommends the 25-MHz bandwidth N2791A differential active probe shown in Figure 11.

For both CAN and FlexRay applications, Agilent recommends the 200-MHz bandwidth N2792A differential active probe shown in Figure 12.

If you need to connect to DB9-SubD connectors on your differential CAN and/or FlexRay bus, Agilent also offers the CAN/FlexRay DB9 probe head (Part number 0960-2926). This differential probe head, which is shown in the insert of Figure 11, is compatible with both the N2791A and N2792A differential active probes and allows you to connect easily to your CAN and/or FlexRay differential bus.

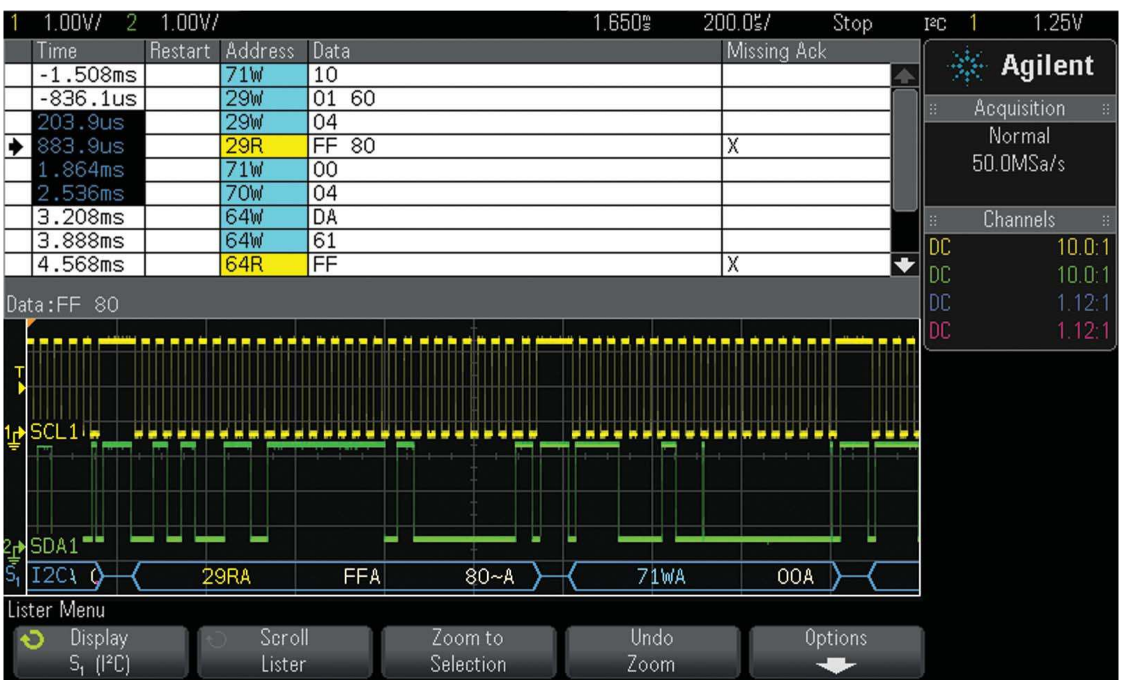
Figure 10: N2750A 1.5-GHz differential active probe.

Figure 11: Agilent N2791A 25-MHz differential active probe.

Figure 12: Agilent N2792A 200-MHz differential active probe.

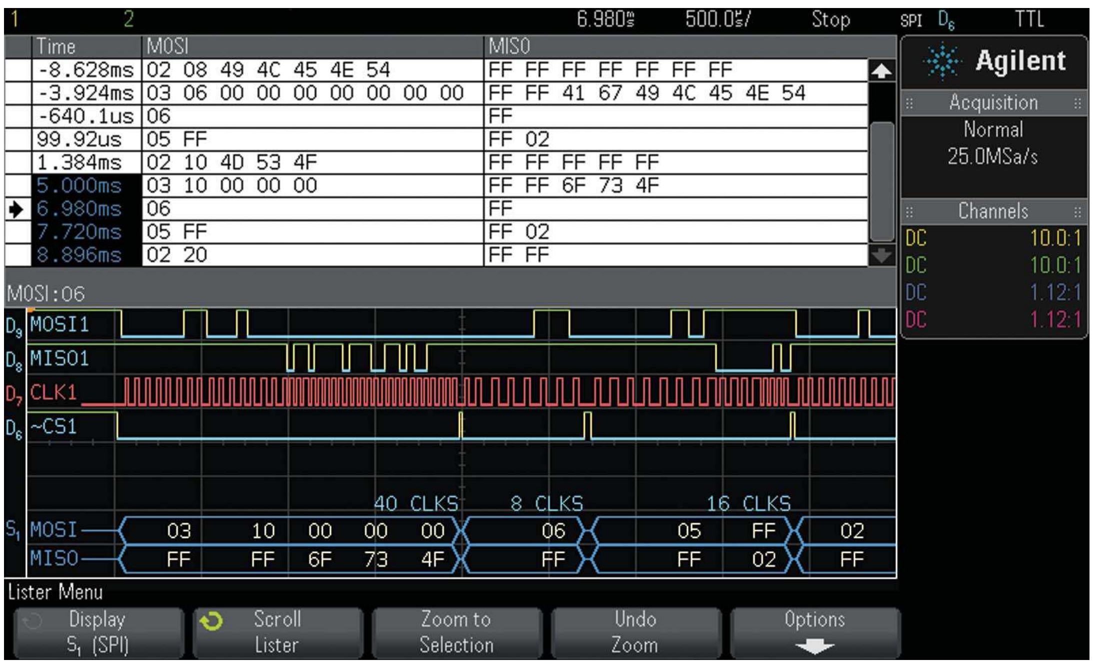
Specifications/Characteristics

I^2C specifications/characteristics (DSOX3EMBD and DSOX4EMBD)	
Clock and data input source	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
Max clock/data rate	Up to 3.4 Mbps
Triggering	Start condition Stop condition Missing acknowledge Address with no acknowledge Restart EEPROM data read Frame (Start:Addr7:Read:Ack:Data) Frame (Start:Addr7:Write:Ack:Data) Frame (Start:Addr7:Read:Ack:Data:Ack:Data2) Frame (Start:Addr7:Write:Ack:Data:Ack:Data2) 10-bit write
Hardware-based decode	Data (HEX digits in white) Address decode size: 7 bits (excludes R/W bit) or 8 bits (includes R/W bit) Read address (HEX digits followed by "R" in yellow) Write address (HEX digits followed by "W" in light-blue) Restart addresses ("S" in green, followed by HEX digits, followed by "R" or "W") Acknowledges (suffixes "A" or "~A" in the same color as the data or address preceding it) Idle bus (mid-level bus trace in dark blue) Active bus (bi-level bus trace in dark blue) Unknown/error bus (bi-level bus trace in red)
Multi-bus analysis	I^2C plus one other serial bus (including another I^2C bus)



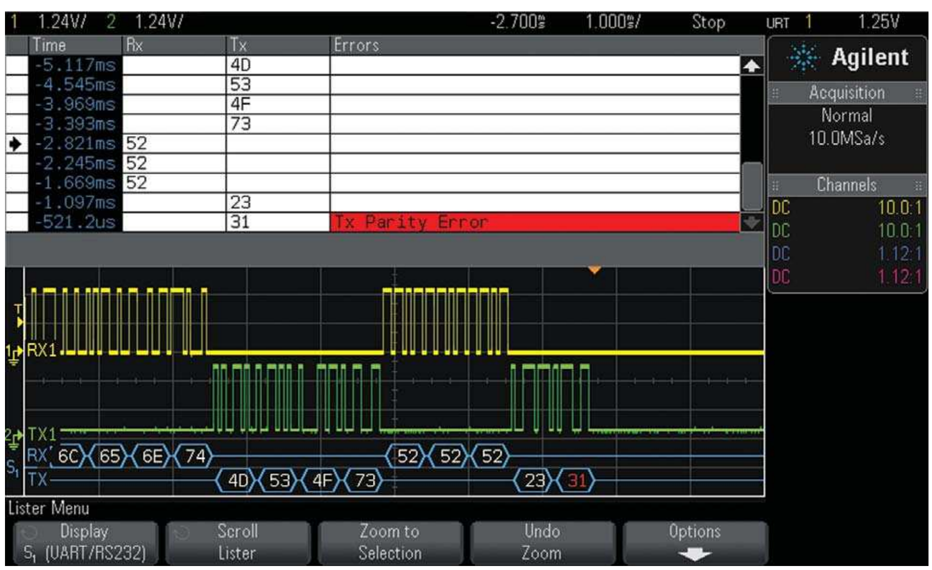
Specifications/Characteristics

SPI specifications/characteristics (DSOX3EMBD and DSOX4EMBD)	
MOSI, MISO, Clock, and CS input source	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
Max clock/data rate	Up to 25 Mb/s
Triggering	4- to 64-bit data pattern during a user-specified framing period Framing period can be a positive or negative chip select (CS or ~CS) or clock idle time (timeout)
Hardware-based decode	Number of decode traces: 2 independent traces (MISO and MOSI) Data (hex digits in white) Unknown/error bus (bi-level bus trace in red) Number of clocks/packet (“XX CLKS” in light-blue above data packet) Idle bus (mid-level bus trace in dark blue) Active bus (bi-level bus trace in dark blue)
Multi-bus analysis	SPI plus one other serial bus (excluding another SPI bus)



Specifications/Characteristics

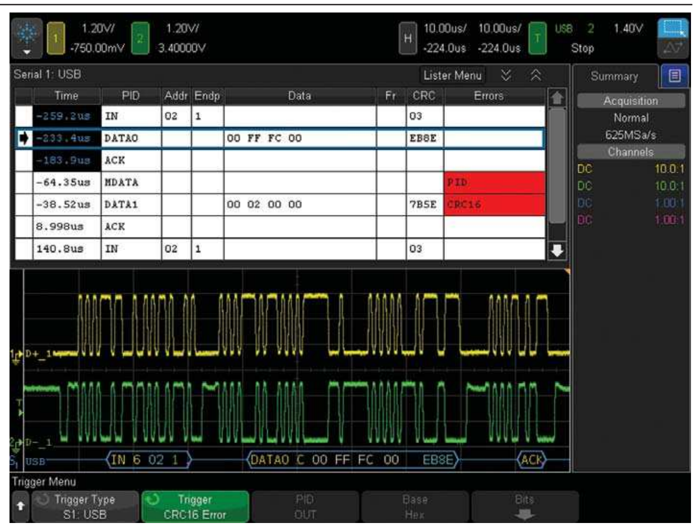
RS232/UART specifications/characteristics (DSOX3COMP and DSOX4COMP)	
Tx and Rx input source	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
Bus configuration Baud rates Number of bits Parity Polarity Bit order	 100 b/s up to 10 Mb/s 5 to 9 None, odd, or even Idle low or idle high LSB out first or MSB out first
Triggering	Rx start bit Rx stop bit Rx data Rx 1:data (9-bit format) Rx 0:data (9-bit format) Rx X:data (9-bit format) Rx or Tx parity error Tx start bit Tx stop bit Tx data Tx 1:data (9-bit format) Tx 0:data (9-bit format) Tx X:data (9-bit format) Burst (nth frame within burst defined by timeout)
Hardware-based decode Number of decode traces Data format Data byte display Idle bus trace Active bus trace	 2 independent traces (Tx and Rx) Binary, hex, or ASCII-code characters White characters if no parity error, red characters if parity or bus error Mid-level bus trace in blue Bi-level trace in blue
Multi-bus analysis	RS232/UART plus one other serial bus (including another RS232/UART bus)
Totalize/counter function	Total received frames Total transmitted frames Total parity error frames (with percentage)



Specifications/Characteristics

USB 2.0 Low- and Full-speed Specifications/Characteristics (DSOX4USBFL)

USB input source (D+ & D-)	Analog channels 1, 2, 3, 4 Digital channels D0-D15
Speed	Low (1.5 Mb/s) and Full (12 Mb/s)
Triggering	Start of Packet (SOP) End of Packet (EOP) Suspend – when bus is idle for > 3 ms Resume – when exiting an idle state > 10 ms Reset – when SE0 is > 10 ms Token Packet with specified content Data Packet with specified content Handshake Packet with specified content Special Packet with specified content All Errors – any of the below error conditions PID Error – if packet type field does not match check field CRC5 Error – if 5 bit CRC error is detected CRC16 Error – if 16 bit CRC error is detected Glitch Error – if two transitions occur in half a bit time Bit Stuff Error – if >6 consecutive “ones” are detected SE1 Error – if SE1 > 1 bit time
Hardware-based Decode	
Base Format	Hex, Binary, ASCII, or Decimal data decode
Token Packets (excluding SOF, 3 bytes)	PID (yellow, “OUT”, “IN”, “SETUP”, “PING”) PID Check (yellow when valid, red when error detected) – numeric value Address (blue, 7 bits) Endpoint (green, 4 bits) CRC (blue when valid, red when error detected, 5 bits)
Token Packets (SOF, 3 bytes)	PID (yellow, “SOF”) PID Check (yellow when valid, red when error detected, 5 bits) Frame (green, 11-bits) – the frame number CRC (blue when valid, red when error detected, 5 bits)
Data Packets (3 to 1027 bytes)	PID (yellow, “DATA0”, “DATA1”, DATA2”, “MDATA”) PID Check (yellow when valid, red when error detected, 16 bits)
Handshake Packets (1 byte)	PID (yellow, “ACK”, “NAK”, “STALL”, “NYET”, “PRE”, “ERR”) PID Check (yellow when valid, read when error detected) – numeric value Hub Addr (green, 7 bits) SC (blue, 1 bit) Port (green, 7 bits) S & E|U (blue, 2 bits) ET (green, 2 bits) CRC (blue when valid, red when error detected, 5 bits
Multi-bus analysis	USB low-/ full-speed plus one other serial bus (including another USB bus)

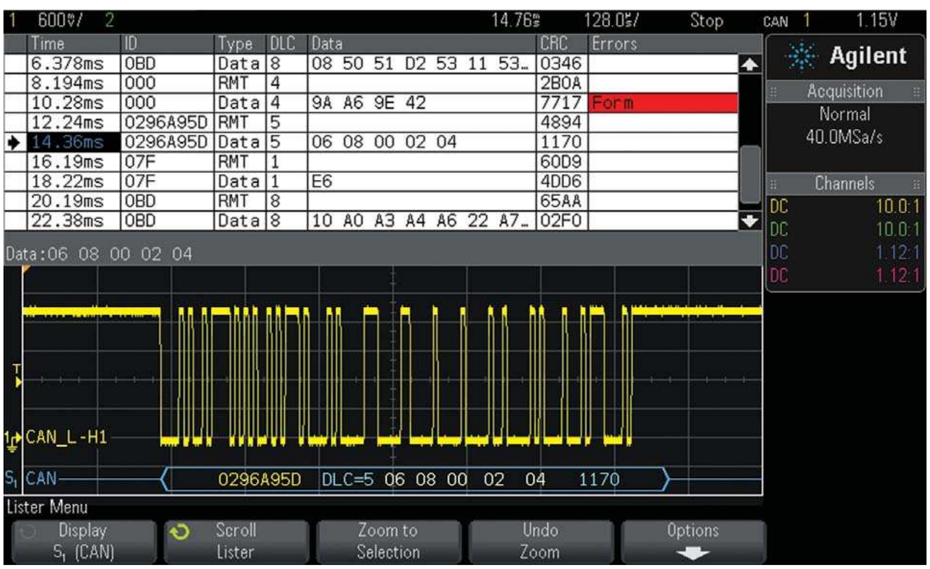


Specifications/Characteristics

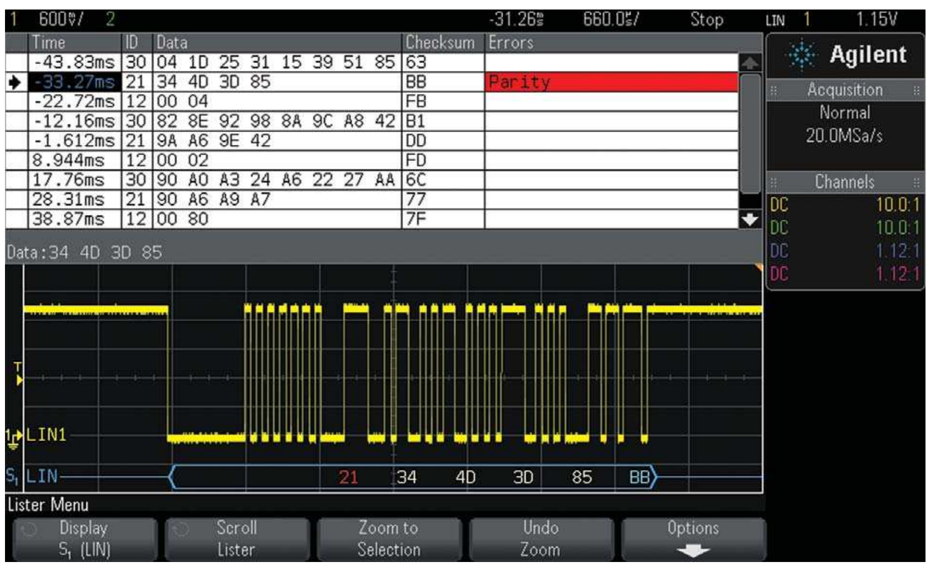
USB 2.0 High-speed Specifications/Characteristics (DSOX4USBH)	
USB differential input source	Analog channels 1, 2, 3, 4 (using a differential active probe)
Speed	High (480 Mb/s)
Triggering	Token Packet with specified content Data Packet with specified content Handshake Packet with specified content Special Packet with specified content All Errors – any of the below error conditions PID Error – if packet type field does not match check field CRC5 Error – if 5 bit CRC error is detected CRC16 Error – if 16 bit CRC error is detected Glitch Error – if two transitions occur in half a bit time
Hardware-based Decode	
Base Format	Hex, Binary, ASCII, or Decimal data decode
Token Packets (excluding SOF, 3 bytes)	PID (yellow, "OUT", "IN", "SETUP", "PING") PID Check (yellow when valid, red when error detected) – numeric value Address (blue, 7 bits) Endpoint (green, 4 bits) CRC (blue when valid, red when error detected, 5 bits)
Token Packets (SOF, 3 bytes)	PID (yellow, "SOF") PID Check (yellow when valid, red when error detected, 5 bits) Frame (green, 11-bits) – the frame number CRC (blue when valid, red when error detected, 5 bits)
Data Packets (3 to 1027 bytes)	PID (yellow, "DATA0", "DATA1", DATA2", "MDATA") PID Check (yellow when valid, red when error detected, 16 bits)
Handshake Packets (1 byte)	PID (yellow, "ACK", "NAK", "STALL", "NYET", "PRE", "ERR") PID Check (yellow when valid, read when error detected) – numeric value Hub Addr (green, 7 bits) SC (blue, 1 bit) Port (green, 7 bits) S & E|U (blue, 2 bits) ET (green, 2 bits) CRC (blue when valid, red when error detected, 5 bits
Multi-bus analysis	N/A

Specifications/Characteristics

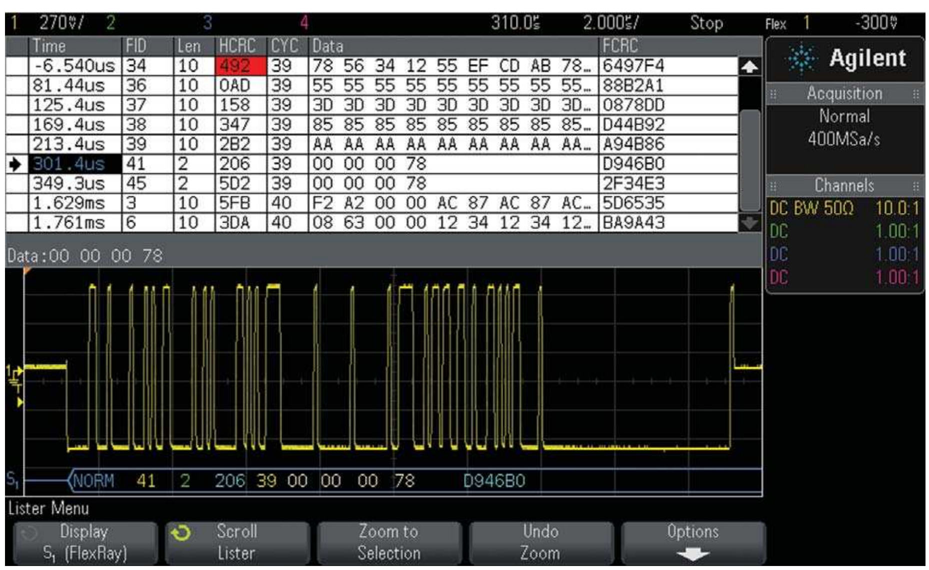
CAN specifications/characteristics (DSOX3AUTO and DSOX4AUTO)	
CAN input source	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15 (non-differential)
Signal types	Rx Tx CAN_L CAN_H Diff (L-H) Diff (H-L)
Baud rates	10 kb/s up to 5 Mb/s
Triggering	Start-of-frame (SOF) Remote frame ID (RMT) Data frame ID (~RMT) Remote or data frame ID Data frame ID and data Error frame All errors (includes protocol “form” errors that may not generate flagged error frames) Acknowledge errors Overload frames ID length: 11 bits or 29 bits (extended)
Hardware-based decode	Frame ID (hex digits in yellow) Remote frame (RMT in green) Data length code (DLC in blue) Data bytes (hex digits in white) CRC (hex digits in blue = valid, hex digits in red = error) Error frame (bi-level bus trace and ERR message in red) Form error (bi-level bus trace and “?” in red) Overload frame (“OVRLD” in blue) Idle bus (mid-level bus trace in dark blue) Active bus (bi-level bus trace in dark blue)
Multi-bus analysis	CAN plus one other serial bus (including another CAN bus)
Totalize function	Total frames, Total overload frames, Total error frames, Bus utilization (bus load)
Eye-diagram Mask Testing (requires DSOX3MASK)	Various downloadable mask files available based on differential probing polarity, baud rate, and network length



LIN specifications/characteristics (DSOX3AUTO and DSOX4AUTO)	
LIN input source	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
LIN standards	LIN 1.3 or LIN 2.0
Baud rates	2400 b/s to 625 kb/s
Triggering	Sync break Frame ID ($0X00_{HEX}$ to $0X3F_{HEX}$) Frame ID and data
Hardware-based decode	Frame ID (6-bit hex digits in yellow) Frame ID and optional parity bits (8-bit hex digits in yellow if valid, red if parity bit error) Data bytes (hex digits in white) Lin 2.0 check sum (hex digits in white) Lin 1.3 check sum (hex digits in blue = valid, hex digits in red = error) Sync error ("SYNC" in red) THeader-max ("THM" in red) TFrame-max ("TFM" in red) Parity error ("PAR" in red) LIN 1.3 wake-up error ("WUP" in red) LIN 1.3 idle bus (mid-level bus trace in dark blue) LIN 2.0 idle bus (bi-level bus trace in dark blue) Active bus (bi-level bus trace in dark blue)
Multi-bus analysis	LIN plus one other serial bus (including another LIN bus)



FlexRay specifications/characteristics (DSOX3FLEX and DSOX4FLEX)	
FlexRay input source	Channel 1, 2, 3, or 4 (using differential probe)
FlexRay Channels	A or B
Baud rates	2.5 Mbps, 5.0 Mbps, and 10 Mbps
Frame triggering	• Frame type: startup (SUP), not startup (~SUP), sync (SYNC), not sync (~SYNC), null (NULL), not null (~NULL), normal (NORM), and All • Frame ID: 1 to 2047 (decimal format), and All • Cycle - - Base: 0 to 63 (decimal format), and All - Repetition: 1, 2, 4, 8, 16, 32, 64 (decimal format), and All
Error triggering	• All errors • Header CRC error • Frame CRC error
Event Triggering	• Wake-up • TSS (transmission start sequence) • BSS (byte start sequence) • FES/DTS (frame end or dynamic trailing sequence)
Frame decoding	• Frame type (NORM, SYNC, SUP, NULL in blue) • Frame ID (decimal digits in yellow) • Payload-length (decimal number of words in green) • Header CRC (hex digits in blue if valid, or red digits if invalid) • Cycle number (decimal digits in yellow) • Data bytes (HEX digits in white) • Frame CRC (hex digits in blue if valid, or red digits
Totalize function	• Total frames • Total synchronization frames • Total null frames
Eye-diagram Mask Testing (requires DSOX3MASK mask test option plus downloadable mask files)	TP1 standard voltage (10 Mbps only) TP1 increased voltage (10 Mbps only) TP11 standard voltage (10 Mbps only) TP11 increased voltage (10 Mbps only) TP4 10 Mbps, TP4 5 Mbps and TP4 2.5 Mbps
Multi-bus Analysis	FlexRay plus one other serial bus (including another FlexRay bus)



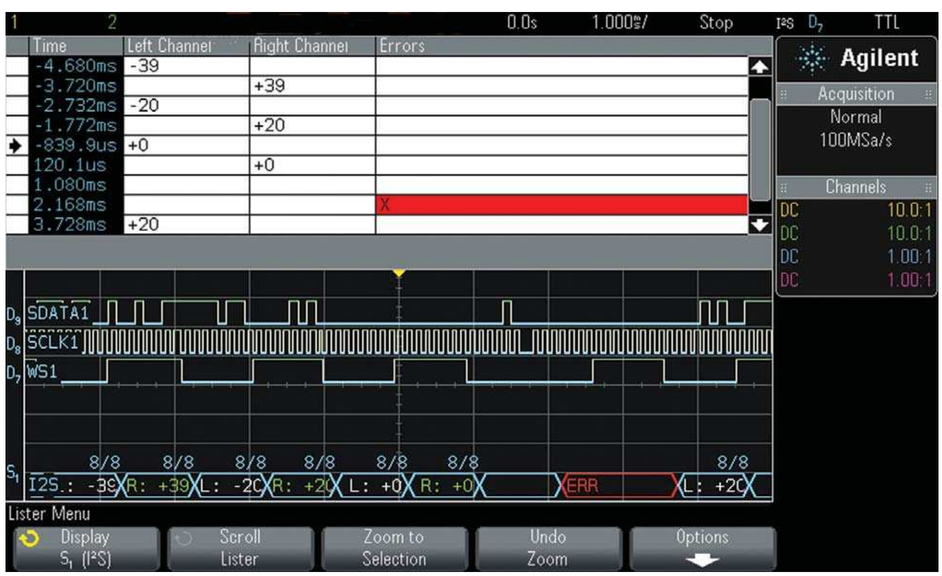
FlexRay Physical Layer Conformance Test software (Requires DSOX3FLEX/DSOX4FLEX, DSOX3MASK/DSOX4MASK, and DSOX3SGM)

Table 1: Receiver Input Tests	
Parameter Tested	**Test Description**
Eye-diagram Mask Tests:	
TP4 – All	Receiver mask test on all frames
TP4 – ID	Receiver mask test on specified frame
Signal Integrity Voting Tests on 13 MHz low-pass filtered Isolated "1":	
uData1Top	Required maximal level
dBitShort	Shortest single bit
dBitLengthVariation	Bit Asymmetry
dEdge01	Rising Edge Duration (-300 mV to +300 mV)
dEdge10	Falling Edge Duration (+300 mV to -300 mV)
dEdgeMax	Slowest Edge
Sq1	Isolated "1" voted signal quality
Signal Integrity Voting Tests on 13 MHz low-pass filtered Isolated "0":	
uData0Top	Required minimal level
dBitShort	Shortest single bit
dBitLengthVariation	Bit Asymmetry
dEdge01	Rising Edge Duration (-300 mV to +300 mV)
dEdge10	Falling Edge Duration (+300 mV to -300 mV)
dEdgeMax	Slowest Edge
Sq0	Isolated "0" voted signal quality
Advanced Diagnostic Tests:	
gdTSSTransmitter	Transmitted TSS width @ receiver
MCT	Mean Corrected Cycle Time
uBusRx-Data	Data 1 Amplitude
-uBusRx-Data	Data 0 Amplitude
uRx-Idle	Mean Idle Level
dBusRx01	Rise Time Data0 to Data1 (-300 mV to +300 mV)
dBusRx10	Fall Time Data1 to Data0 (+300 mV to -300 mV)

Table 2: Transmitter Output Tests	
Parameter Tested	**Test Description**
Eye-diagram Mask Tests (10 Mbs only):	
TP1 – Std V	Mask test on standard voltage bus driver output
TP1 – Incr V	Mask test on increased voltage bus driver output
TP11 – Std V	Mask test on standard voltage active star output
P11 – Incr V	Mask test on increased voltage active star output
Advanced Diagnostic Tests:	
gdTSSTransmitter	Transmitted TSS width
uBusTx-Data	Data 1 Amplitude
-uBusTx-Data	Data 0 Amplitude
uRx-Idle	Mean Idle Level
dBusTx01	Rise Time Data0 to Data1 (20% to 80%)
dBusTx10	Fall Time Data1 to Data0 (80% to 20%)

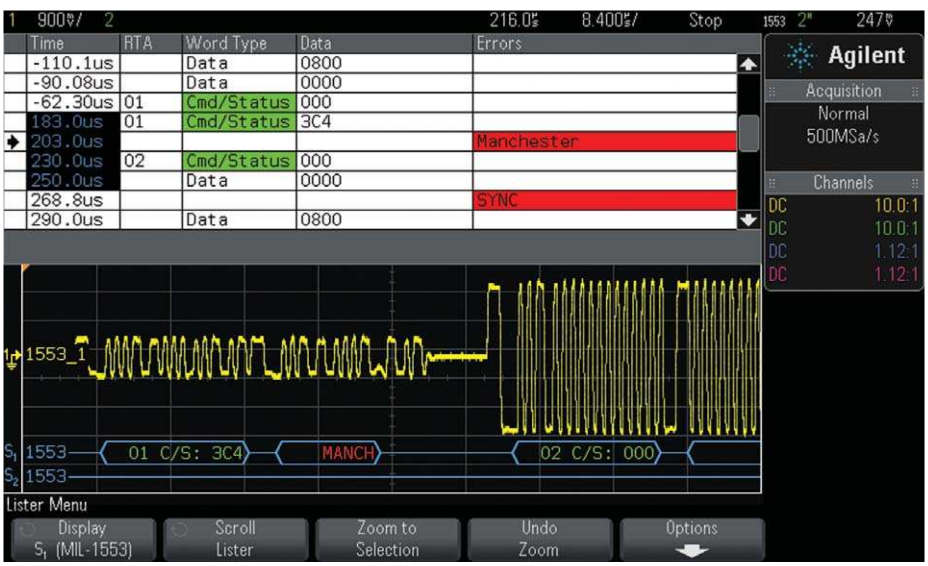
Specifications/Characteristics

I^{2}S specifications/characteristics (DSOX3AUDIO and DSOX4AUDIO)	
SCLK, WS, and SDATA input source	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
Bus configuration:	
Transmitted word size	4 to 32 bits (user selectable)
Decoded/Receiver word size	4 to 32 bits (user selectable)
Alignment	Standard, left-justified, or right-justified
Word select - low	Left-channel or right-channel
SCLK slope	Rising edge or falling edge
Decoded base	Hex (2's complement) or signed decimal
Baud rates	2400 b/s to 625 kb/s
Triggering:	
Audio channel	Audio left, audio right, or either
Trigger modes	= (Equal to entered data value) ≠ (Not equal to entered data value) < (Less than entered data value) > (Greater than entered data value) >< (Within range of entered data values) <> (Out of range of entered data values) Increasing value that crosses armed (<=) and trigger (>=) entered data values Decreasing value that crosses armed (>=) and trigger (<=) entered data values
Hardware-based decode:	
Left channel	L: "decoded value" in white
Right channel	R: "decoded value" in green
Error	ERR in red (mismatch between transmitted and received word size, or invalid input signaling)
Word size indicator	"# of TX / # of RX" CLKS in blue displayed above each decoded work
Multi-bus analysis	I^{2}S plus one other serial bus (<u>excluding</u> another I^{2}S bus)



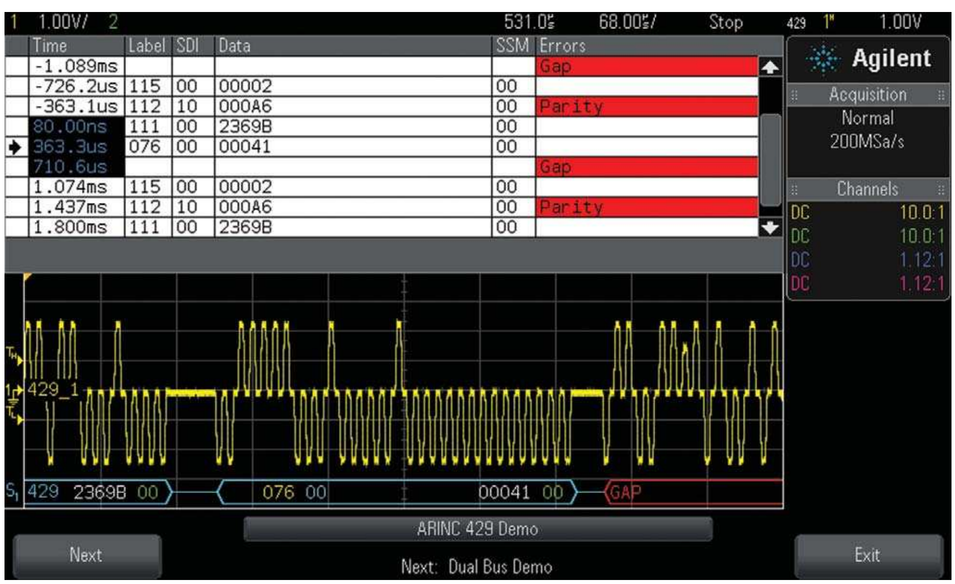
Specifications/Characteristics

MIL-STD 1553 specifications/characteristics (DSOX3AERO and DSOX4AERO)	
MIL-Std 1553 Input Source	Analog channels 1, 2, 3, or 4 (using a differential active probe)
Triggering	• Data Word Start • Data Word Stop • Command/Status Word Start • Command/Status Word Stop • Remote Terminal Address (hex) • Remote Terminal Address (hex) + 11 Bits (binary) • Parity Error • Sync Error • Manchester Error
Color-coded, hardware-accelerated decode	• Base: HEX or Binary • Command or Status Word ("C/S" in green) • Remote Terminal Address (hex or binary digits in green) • 11 Bits following RTA (hex or binary digits in green) • Data Word ("D" in white) • Data Word Bits (hex or binary digits in white) • Parity Error (all decoded text in red) • Synchronization Error ("Sync" in red) • Manchester Error ("Manch" in red)
Eye-diagram Mask Testing (requires DSOX3MASK mask test option plus downloadable mask files)	• System xfmr-coupled Input • System direct-coupled Input • BC xfmr-coupled Input • BC direct-coupled Input • RT xfmr-coupled Input • RT xfmr-coupled Input
Multi-bus Analysis	MIL-STD 1553 plus one other serial bus, (including another MIL-STD 1553 bus)



Specifications/Characteristics

ARINC 429 specifications/characteristics (DSOX3AERO and DSOX4AERO)	
ARINC 429 Input Source	Analog channels 1, 2, 3, or 4 (using a differential active probe)
Baud Rates	High (100 kbps) Low (12.5 kbps)
Triggering	Word Start Word Stop Label (octal) Label (octal) + Bits (binary) Label Range (octal) Parity Error Word Error Gap Error Word or Gap Error All Errors All Bits (useful for eye-diagram testing)) All 0 Bits All 1 Bits
Color-coded, hardware-accelerated decode	Word Format: Label/SDI/Data/SSM or Label/Data/SSM or Label/Data Label (octal digits in yellow) SDI (binary digits in blue) Data (hex or binary digits in white) SSM (binary digits in green) Errors (text in red)
Totalize function	Total Words Total Errors
Eye-diagram and Pulse Mask Testing (requires DSOX3MASK plus downloadable mask files)	100 kbps Eye Test 100 kbps 1's Test 100 kbps 0's Test 100 kbps Null Test 12.5 kbps Eye Test 12.5 kbps 1's Test 12.5 kbps 0's Test 12.5 kbps Null Test
Multi-bus Analysis	ARINC 429 plus one other bus (including another ARINC 429 bus)



Ordering Information

The various serial bus options are compatible on most models of the Agilent InfiniiVision 3000 and 4000 X-Series oscilloscopes. Existing InfiniiVision X-Series oscilloscopes can also be upgraded with these options.

Model number	Description
DSOX3EMBD or DSOX4EMBD	I^2C and SPI trigger and decode
DSOX3COMP or DSOX4COMP	RS232/UART trigger and decode
DSOX3AUTO or DSOX4AUTO	CAN and LIN trigger and decode
DSOX3FLEX or DSOX4FLEX	FlexRay trigger and decode
DSOX3AERO or DSOX4AERO	MIL-STD 1553 and ARINC 429 trigger and decode
DSOX3AUDIO or DSOX4AUDIO	I^2S trigger and decode
DSOX3SGM	Segmented memory (standard on 4000 X-Series models)
DSOX3MASK or DSOX4MASK	Mask test option
DSOX4USBFL	USB 2.0 low- and full-speed trigger and decode
DSOX4USBH	USB 2.0 hi-speed trigger and decode
N2791A	25-MHz differential active probe (recommended for CAN, MIL-STD 1553, and ARINC 429 applications)
N2792A	200-MHz differential active probe (recommended for FlexRay applications)
N2750A	1.5 GHz differential active probe (recommended for USB 2.0 hi-speed applications)
0960-2926	DB9 probe head adapter for N2791A and N2792A

Additional options and accessories are available for Agilent's InfiniiVision oscilloscopes. Refer to the *Agilent InfiniiVision Oscilloscope Probes and Accessories* selection guide, 3000 X-Series data sheet, or 4000 X-Series data sheet for ordering information about these additional options and accessories.

Related Agilent literature

Publication Title	Publication Type	Publication Number
InfiniiVision 3000 X-Series Oscilloscope	Data Sheet	5990-6619EN
InfiniiVision 4000 X-Series Oscilloscope	Data Sheet	5991-1103EN
N2750A/51A/52A InfiniiMode Differential Active Probes	Data Sheet	5991-0560EN
InfiniiVision Oscilloscope Probes and Accessories	Selection Guide	5968-8153EN
Using Oscilloscope Segmented Memory for Serial Bus Applications	Application Note	5990-5817EN
CAN Eye-diagram Mask Testing	Application Note	5991-0484EN
FlexRay Eye-diagram Mask Testing	Application Note	5990-4923EN
MIL-STD 1553 Eye-diagram Mask Testing	Application Note	5990-9324EN
ARINC 429 Eye-diagram Mask Testing	Application Note	5990-9325EN

To download these documents, insert the publication number in the URL:
http://cp.literature.agilent.com/litweb/pdf/xxxx-xxxxEN.pdf

Product Web site

For the most up-to-date and complete application and product information, please visit our product Web sites at:
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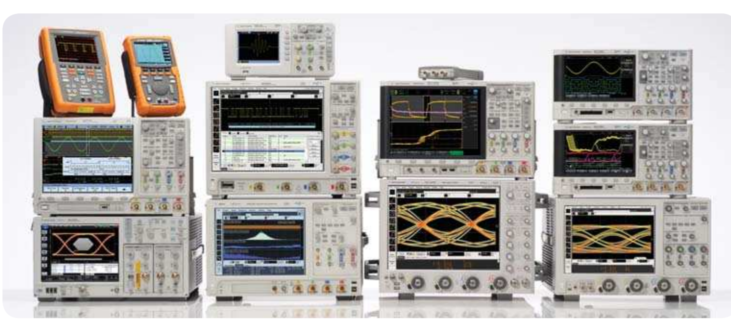

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