RS-232/UART Triggering and Hardware-Based Decode (N5457A) for Agilent InfiniiVision Oscilloscopes

Data Sheet

Find and debug intermittent errors and signal integrity problems faster

Features:

- RS-232/UART serial bus triggering
- RS-232/UART hardware-based protocol decoding
- Real-time frame and error totalize counters

Agilent Technologies

Introduction

Debugging systems that use an RS-232 serial bus can be difficult, unless your scope is capable of triggering on and decoding the RS-232 protocol. Traditional methods of debugging serial buses such as RS-232 include manual bit counting. But this visual technique of counting “1s” and “0s” can be tedious and it is prone to errors.

Agilent Technologies’ serial bus options for InfiniiVision oscilloscopes offer powerful triggering and provide unique hardware-accelerated decoding to help you debug embedded designs with RS-232 and UART serial buses faster. With the industry’s fastest serial decode update rates, you can more easily find and debug random and intermittent errors and signal integrity problems that you could easily miss using other serial bus decode tools.

Other oscilloscope solutions with serial bus triggering and protocol decode typically use software post-processing techniques to decode serial packets/frames. Using these software techniques, waveform- and decode-update rates tend to be slow (sometimes seconds per update), especially when you use deep memory, which is often required to capture multiple packetized serial signals.

Bus configuration

The RS-232/UART option for Agilent InfiniiVision Series scopes supports a broad range of protocol structures including many RS-422 and RS-485 applications, as shown in Figure 1. Setting up an InfiniiVision Series scope to trigger on and decode your particular RS-232 or UART bus is easy. You can select the following settings:

- Number of bits = 5 to 8
- Parity selection = None, odd, or even
- Baud rate = 1200 b/s up to 2.7648 Mb/s
- Polarity = Idle low or Idle high
- Bit order = LSB out first, or MSB out first

Figure 1. Defining the RS232/UART protocol structure

RS-232/UART protocol decoding formats

You can serially decode transmit and receive signals in either binary, hex, or ASCII format. Figure 2 shows a transmit and receive message decoded in hex format. Figure 3 shows the same message decoded in a color-coded ASCII format. Note the red "1" character at the end of this important message. Red is an indication that a parity error was detected for that particular byte.

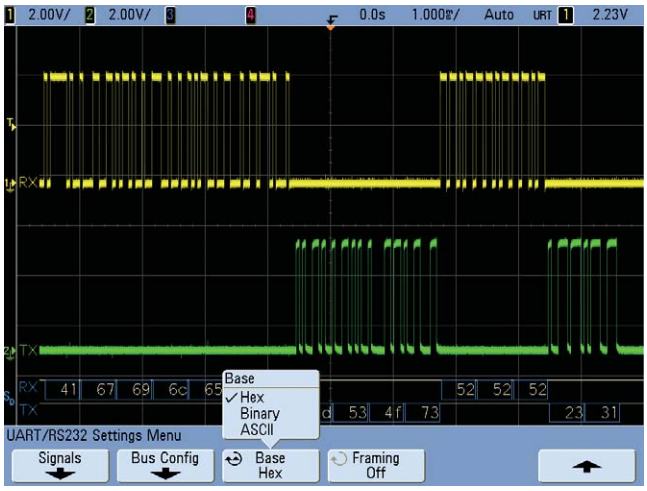

Figure 2. InfiniiVision Series scopes provide flexible RS-232/UART decoding formats including binary, hex, and ASCII.

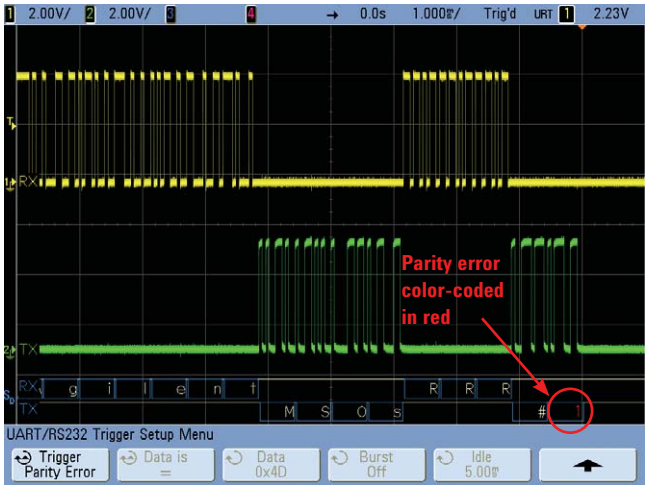

Figure 3. Color-coded ASCII decoding makes reading a transmitted or received message much easier.

Triggering

Figure 4 shows the available selections for triggering on RS-232/UART transmit and receive signals, including triggering on either receive or transmit parity errors.

In addition to being able to trigger on specific transmit or receive bytes, this scope's "burst trigger" mode allows you to specify to trigger on the "Nth" byte within a burst of data bytes that satisfies the data entry.

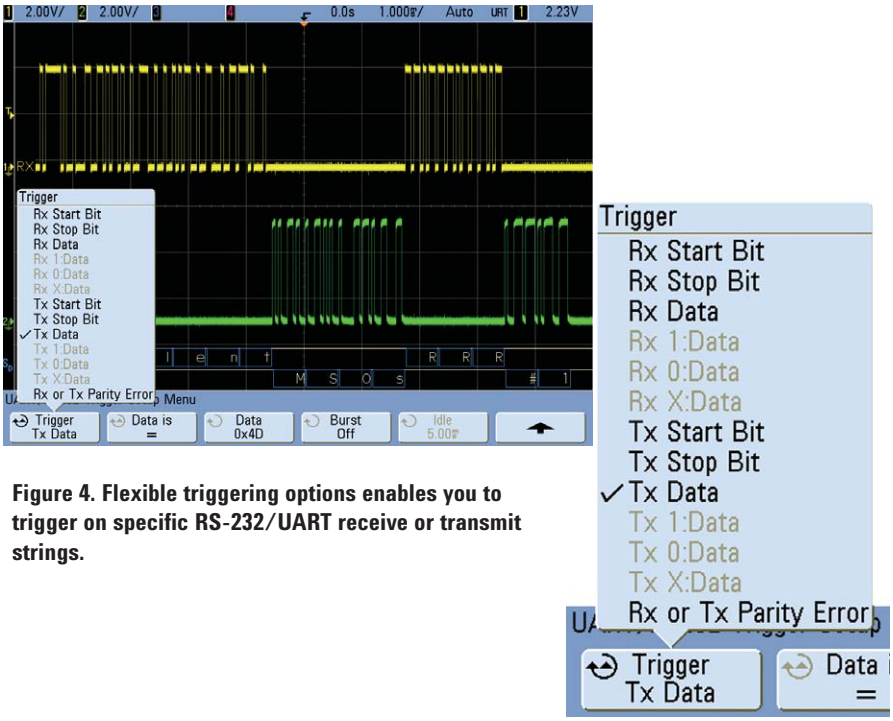

Figure 4. Flexible triggering options enables you to trigger on specific RS-232/UART receive or transmit strings.

Real-time frame/byte totalizer

In addition to flagging parity errors, InfiniiVision's RS-232/UART option also provides a real-time totalizer/counter of transmitted and received frames/bytes, as shown in Figure 5. In addition, the option allows you to count parity error bytes and see a percent readout that gives an indication of the quality of your serial bus. This totalize function, which is not available in other oscilloscopes currently on the market, is independent from the scope's acquisition or triggering. In addition, this RS-232/UART byte counter is not affected by either the oscilloscope's acquisition window or scope dead-time. Totalize counts run continuously, even when the scope's acquisition is stopped.

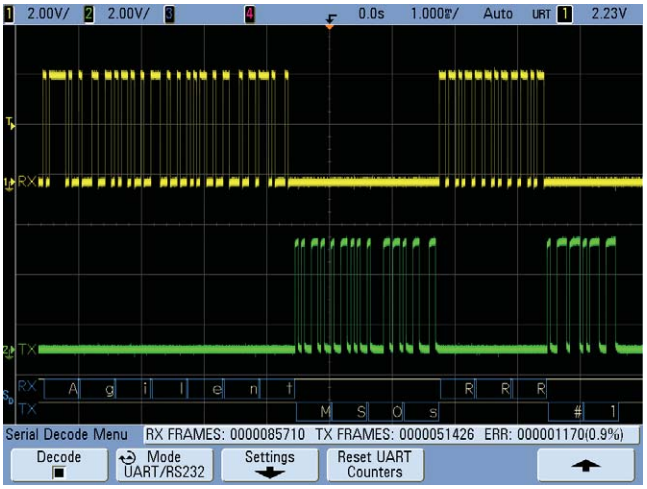

Figure 5. InfiniiVision's real-time totalizer counts all received and transmitted bytes/frames, along with all parity errors.

Segmented memory captures more frames

The segmented memory option for Agilent's InfiniiVision Series oscilloscopes can optimize your scope's acquisition memory, allowing you to capture more RS-232/UART signals using less memory. Segmented memory acquisition optimizes the number of packetized serial communication frames/bytes that can be captured consecutively by selectively ignoring (not digitizing) unimportant idle time between frames. And with a minimum 250 picoseconds time-tagging resolution, you will know the precise time between each frame.

Figure 6 shows an RS-232/UART measurement with the scope set up to trigger on a receive start-bit condition. Using this triggering condition with the segmented memory acquisition mode turned on, the scope easily captures 500 consecutive bursts of serial communication for a total acquisition time of 9.6 seconds. After acquiring the 500 segments, we can easily scroll through all frames individually to look for any anomalies or errors.

Agilent' s InfiniiVision Series oscilloscopes are the only scopes on the market today that can acquire segments on up to four analog channels of acquisition, capture time-correlated segments on digital channels of acquisition (using an MSO model), and perform hardware-based serial bus protocol decoding.

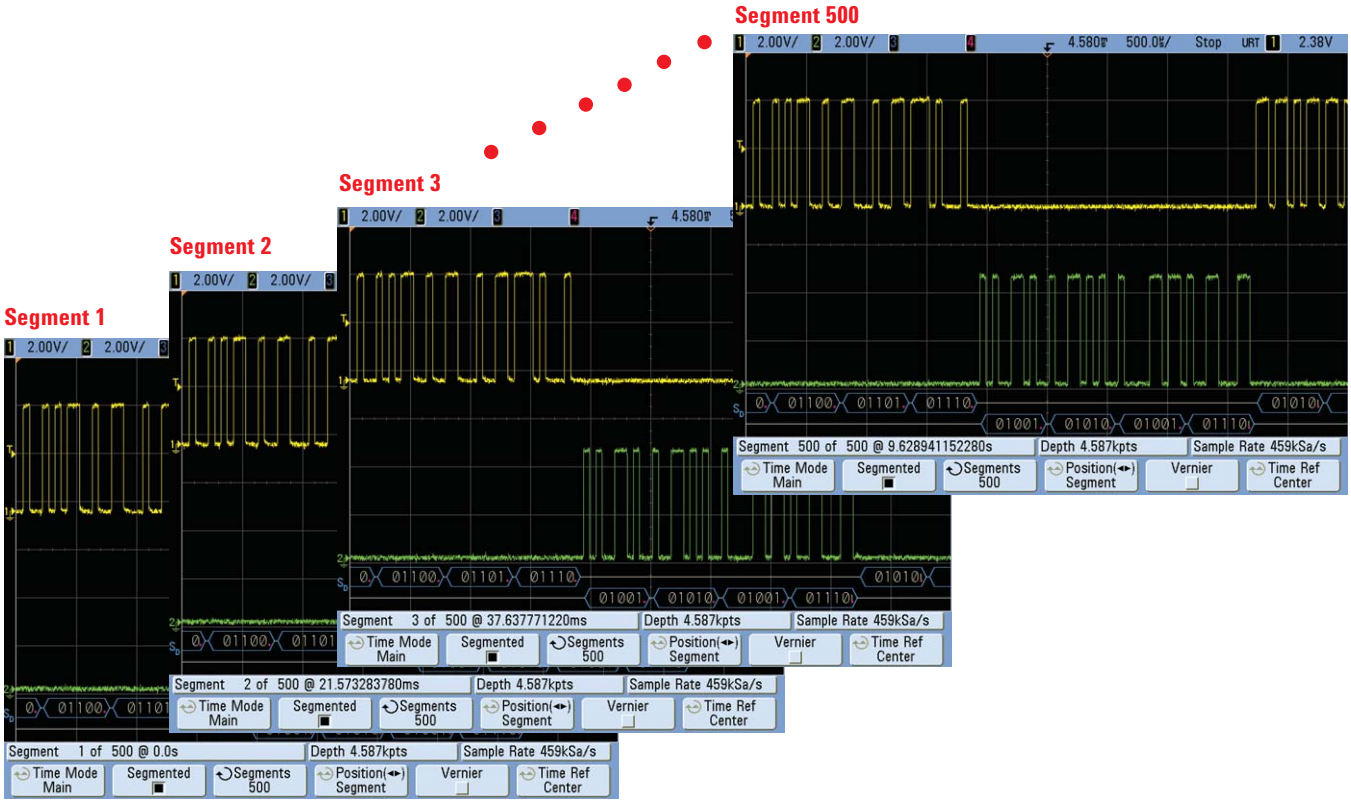

Figure 6. InfiniiVision's segmented memory acquisition mode captures more bytes while using less memory.

Performance characteristics

Performance characteristics

Tx and Rx source	Analog channels 1, 2, 3, or 4 Digital channels D0 – D15 (on MSO models)
Bus configuration	
Baud rates	1200 bps up to 2.765 Mb/s (default = 19.2 kb/s)
Number of bits	5 to 9 (default = 8-bits)
Parity	None, odd, or even (default = None)
Polarity	Idle low or idle high (default = Idle low)
Bit order	LSB out first or MSB out first (default = LSB)
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)
Color-coded decode	
Number of decode traces	2 independent traces (1 for Tx, and 1 for Rx)
Data format	Binary, hex, or ASCII-code characters (default = Hex)
Data byte display	White characters if no parity error, red characters if parity or bus error
Idle bus trace	High or low trace in white (depends on polarity setting)
Active bus trace	Byte-delimited bi-level trace in blue if no parity error, red if parity error
Totalize/counter function	Total received frames Total transmitted frames Total parity error frames (with percentage)

Agilent InfiniiVision portfolio

Agilent's InfiniiVision lineup includes 5000, 6000 and 7000 Series oscilloscopes. These share a number of advanced hardware and software technology blocks. Use the following selection guide to determine which best matches your specific needs.

	 **Largest display, shallow depth** **7000 Series**	 **Optional battery, 100 MHz MSO** **6000A Series**	 **Ideal for ATE rackmount applications** **6000L Series**	 **Smallest form factor, lowest price** **5000 Series**
100 MHz Bandwidth	●	●	●	●
300/350 MHz Bandwidth	●	●	●	●
500 MHz Bandwidth	●	●	●	●
1 GHz Bandwidth	●	●	●	
MSO Models	●	●	●	
GPIB Connectivity		●	●	●
Rackmount height	7U	5U	1U	5U
Battery option		●		
Display size	12.1″	6.3″	6.3″	
Footprint (WxHxD)	17.9″x 10.9″x 6.8″	15.7″x 7.4″x 11.1″	17.1″x 1.7″x 10.6″	15.2″x 7.4″x 6.9″

Agilent's InfiniiVision oscilloscope portfolio offers:

- A variety of form factors to fit your environment
- Responsive controls and best signal visibility
- Insightful application software
- Responsive deep memory with Mega*Zoom* III

Ordering information

The N5457A RS-232/UART option is compatible with all 4-channel and 4+16-channel Agilent InfiniiVision Series oscilloscopes (5000, 6000, and 7000 Series scopes). This option is available as a factory-installed option if ordered as Option-232 along with a specific oscilloscope model, or existing InfiniiVision Series oscilloscope users can order this option as an after-purchase product upgrade (N5457A).

Model number – user installed	Option number – factory installed	Description
N5457	232	RS-232/UART triggering and decode (for 4- and 4+16-channel scope models only)
N5423A	LSS	I^2C/SPI serial decode option (for 4- and 4+16-channel scope models only)
N5424A	AMS	CAN/LIN automotive triggering and decode (for 4- and 4+16-channel scope models only)
N5454A	SGM	Segmented memory

Note that additional options and accessories are available for Agilent InfiniiVision Series oscilloscopes. Refer to the appropriate 5000, 6000, or 7000 Series oscilloscope data sheet for ordering information about these additional options and accessories, as well as ordering information for specific oscilloscope models.

Related literature

Publication title	Publication type	Publication number
Agilent Technologies Oscilloscope Family Brochure	Brochure	5989-7650EN
Agilent 7000 Series InfiniiVision Oscilloscopes	Data Sheet	5989-7736EN
Agilent 6000 Series InfiniiVision Oscilloscopes	Data Sheet	5989-2000EN
Agilent 5000 Series InfiniiVision Oscilloscopes	Data Sheet	5989-6110EN
Agilent InfiniiVision Series Oscilloscope Probes and Accessories	Data Sheet	5968-8153EN
Segmented Memory Acquisition (N5454A) for Agilent InfiniiVision Series Oscilloscopes	Data Sheet	5989-7833EN
I^2C and SPI Triggering and Hardware-Based Decode (N5423A) for Agilent InfiniiVision Series Oscilloscopes	Data Sheet	5989-5126EN
CAN/LIN Measurements (option AMS) for Agilent's InfiniiVision Series Oscilloscopes	Data Sheet	5989-6220EN
Evaluating Oscilloscopes for Best Signal Visibility	Application Note	5989-7885EN
Debugging Embedded Mixed-Signal Designs Using Mixed Signal Oscilloscopes	Application Note	5989-3702EN
Using an Agilent InfiniiVision MSO to Debug an Automotive CAN Bus	Application Note	5989-5049EN
Choosing an Oscilloscope with the Right Bandwidth for Your Applications	Application Note	5989-5733EN
Evaluating Oscilloscope Sample Rates vs. Sampling Fidelity	Application Note	5989-5732EN
Evaluating Oscilloscope Vertical Noise Characteristics	Application Note	5989-3020EN

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

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