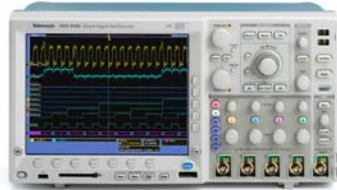


Tektronix 4000 Series Oscilloscopes

USB Bus Demo

1



- Install a DPO4USB application module in an MSO/DPO4000 Series oscilloscope
- Connect two P6139A passive probes (for Low-Speed and Full-Speed USB) to oscilloscope channels 1 and 2, or connect a TDP1000 differential probe (for High-speed USB) to channel 1
- Press **Default Setup** button
- Set Record Length to 1M points

Demo Notes

Demonstrate how the oscilloscope can trigger on LS and FS USB packet level content and decode the entire acquisition. Show how a MSO4104 or DPO4104 can decode an entire HS USB acquisition after triggering on an edge.

Show how to look at each packet with Wave Inspector Pan/Zoom control.

Demonstrate how easy it is to view an entire acquisition as an event table.

2a Low-speed and Full-speed USB Bus Setup

- Connect channel 1 to D+ and channel 2 to D-, and turn on channel 2
- Set Vertical Scales to 2 V/div and position waveforms in upper half of display
- Set Horizontal Scale to 100 μ s/div
- Set Trigger Level to about 1.4 V
- Press **B1** button and set Bus Type to USB
- Press Define Inputs and select appropriate USB speed and single-ended inputs
- Set Threshold values to 1.4V
- Set Trigger Type to Bus
- Set Trigger On to Sync
- Press **Menu Off** button
- Press **Single** button

3 Wave Inspector – Pan/Zoom

- Adjust inner control to zoom in on a single decoded packet of data
- Adjust outer control to position the zoomed area to display the decoded information

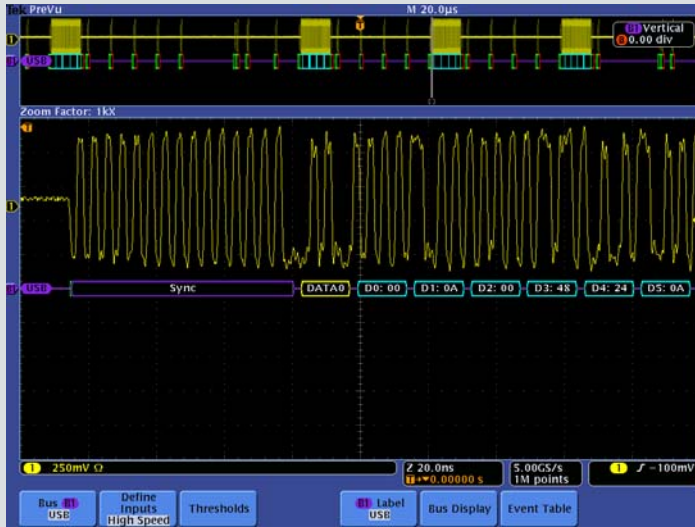
2b High-speed USB Bus Setup (requires 1 GHz model)

- Connect + input to D+ and – input to D-
- Set Vertical Scale to 250 mV/div and position in upper half of display
- Set Horizontal Scale to 10 μ s/div
- Set Trigger Level to about -100 mV
- Press **B1** button and set Bus Type to USB
- Press Define Inputs and select appropriate High-speed USB
- Set High Threshold to +100 mV and set Low Threshold to -100 mV
- Press **Menu Off** button
- Press **Single** button

4 USB Bus Event Table Demo

- Press **B1** button
Set Display As > Event Table to On
- Multipurpose control **a** scrolls through Event Table messages

4000 Series USB Bus Decoding



4000 Series USB Bus Event Table

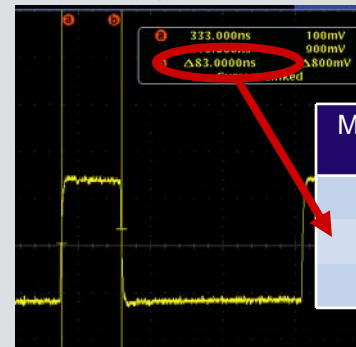


4000 Series USB Bus Search



Determining USB Bus Bit Rate

- Measure width of narrowest pulse(s) in USB message
- Match the pulse width to the bit rate in the table below



Min Pulse Width	USB Bit Rate	USB Speed
667 ns	1.5 Mb/s	Low-speed
83 ns	12 Mb/s	Full-speed
2.08 ns	480 Mb/s	High-speed

For more information, see the *“Debugging Serial Buses in Embedded System Designs”* Application Note.