

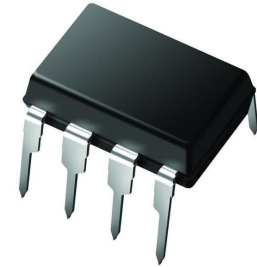
USB-845X SPI & I2C

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Overview

- SPI – Serial Peripheral Interface
 - Simple Master/Slave
 - Four wires needed
 - Clock (SCK)
 - Chip Select/Slave Select (CS/SS)
 - Data In (MOSI)
 - Data Out (MISO)
- I2C – Inter-Integrated Circuit
 - More complicated



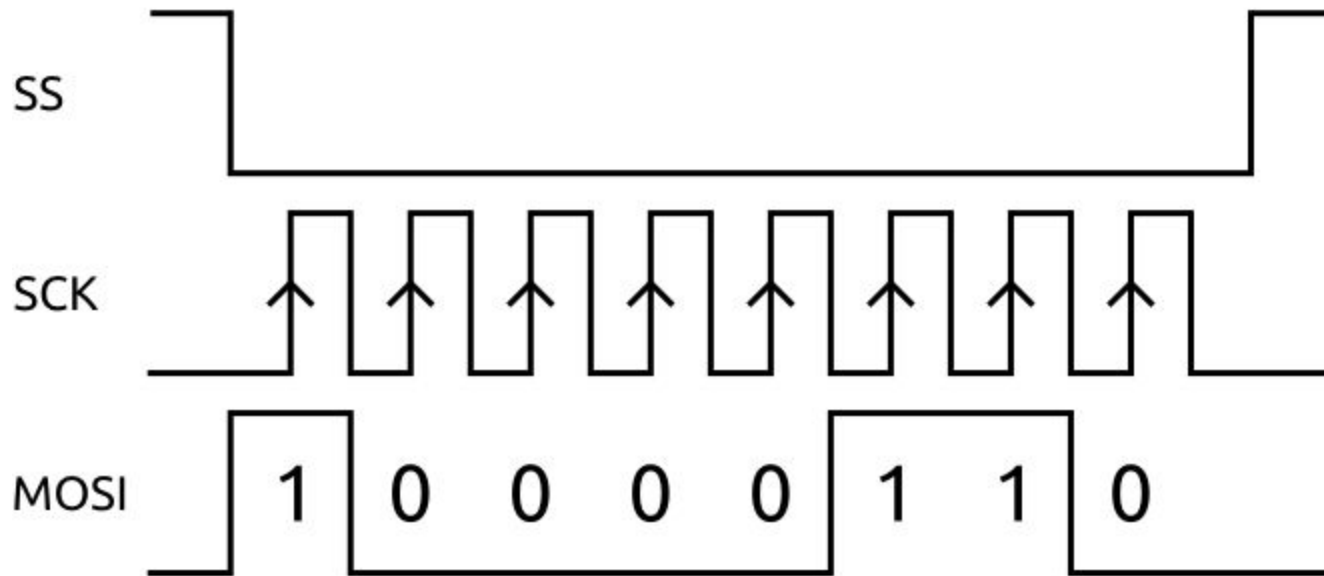
Source: mouser.com



Source:

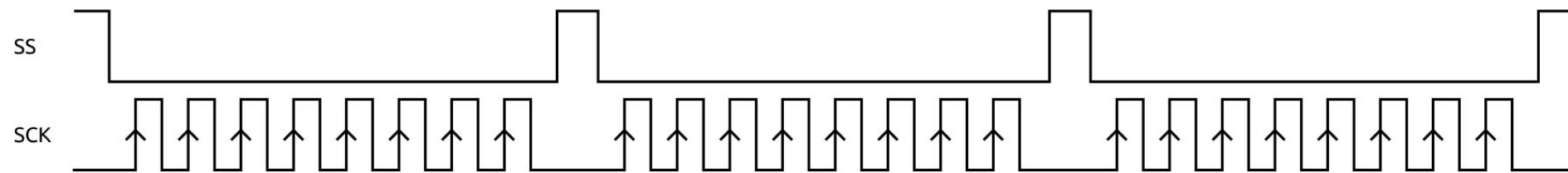
https://startingelectronics.org/beginners/components/LCD/LCD_2x16.jpg

SPI Clock/Data



Source: <https://embeddedmicro.com/media/wysiwyg//SPI/spi.png>

SPI Clock/Data



Source: <https://embeddedmicro.com/media/wysiwyg//SPI/spi.png>

Do you *need* specialized hardware?

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No







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Bit Banging

- ❖ With three spare DIO lines on any DAQ you can drive a 2x16 LCD display!
- ❖ See Kevin Darrah on YouTube or kevindarrah.com

NI Products

Model	Price	Maximum I2C Clock Rate 	Maximum SPI Clock Rate 	Enclosed 
> USB-8451	\$ 467.00	Select 	Select 	Select 
> USB-8451	\$ 503.00	250 kHz	12 MHz	No
> USB-8451	\$ 503.00	250 kHz	12 MHz	Yes
> USB-8452	\$ 540.00	3.33 MHz	50 MHz	No
> USB-8452	\$ 667.00	3.33 MHz	50 MHz	Yes

Source: ni.com

Should you buy the USB-8451?

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No

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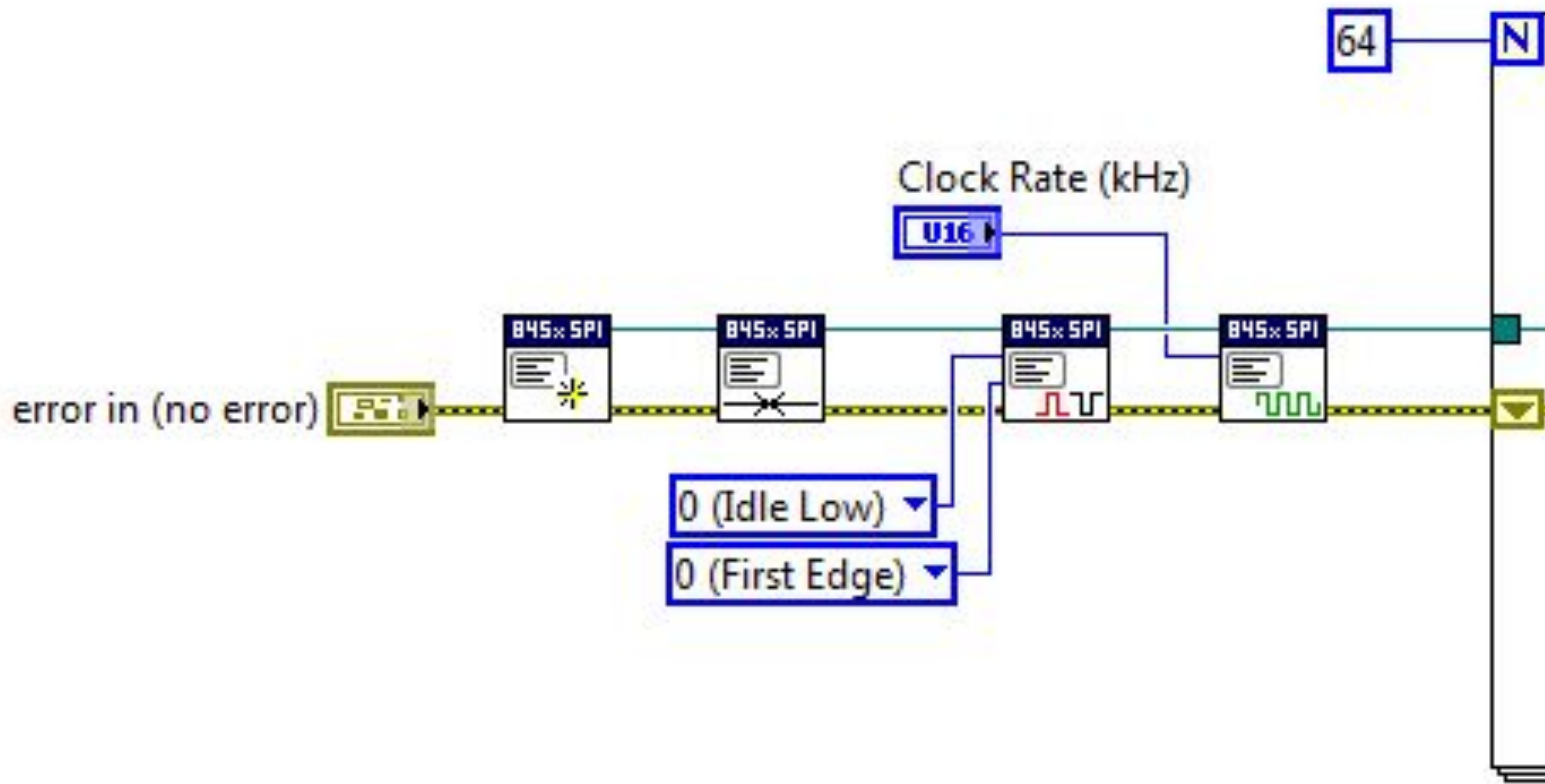
No

But the USB-8452 is pretty good!

Speed and Communication

- Data Has to be buffered
- NI-845x Drivers
 - Basic
 - Bit banging w/ style (inherently millisecond delay)
 - Scripts
 - Build batch commands in software and execute them in hardware (preferred method for writing data out)
 - 64 'message' limit per script (software enforced limit)
 - Streaming
 - Continuously read data from sensors (USB-8452 only)

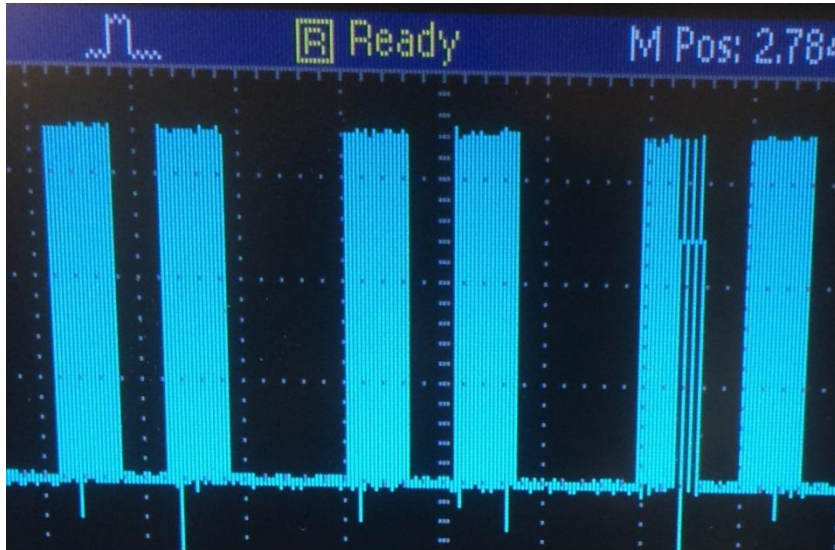
Script Code



Types of Delay

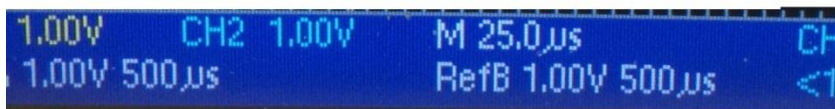
- Intra-Byte
 - Each byte (8bits) is a separate command
- Intra-Message
 - Each message consists of 2 bytes and toggling the Select line, adding delay while Select switches
- Batch Delay
 - Unique to USB-8451, undocumented, annoying
- Script Delay
 - Between scripts you are relying on software timing, so delays are to be expected

Intra-Byte & Intra-Message



500kHz Clock, USB-8451

6 Bytes Shown



12MHz Clock, USB-8451

8 Bytes Shown

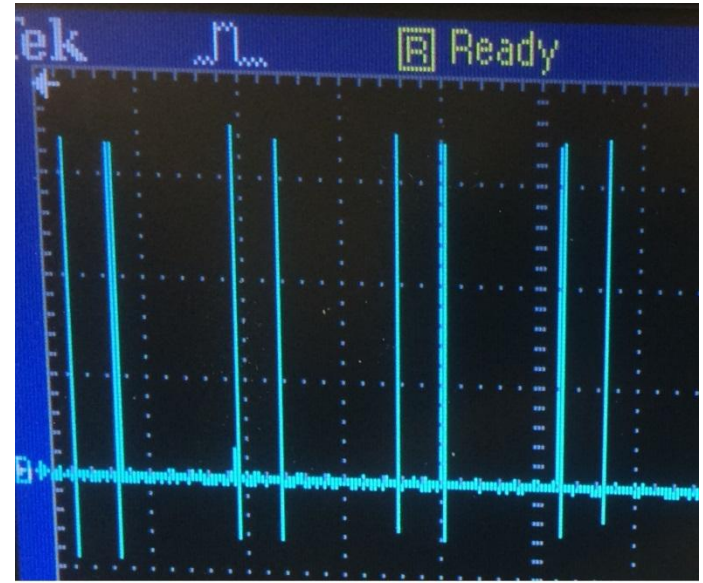


Intra-Byte & Intra-Message



20MHz Clock, USB-8452

8 Bytes Shown

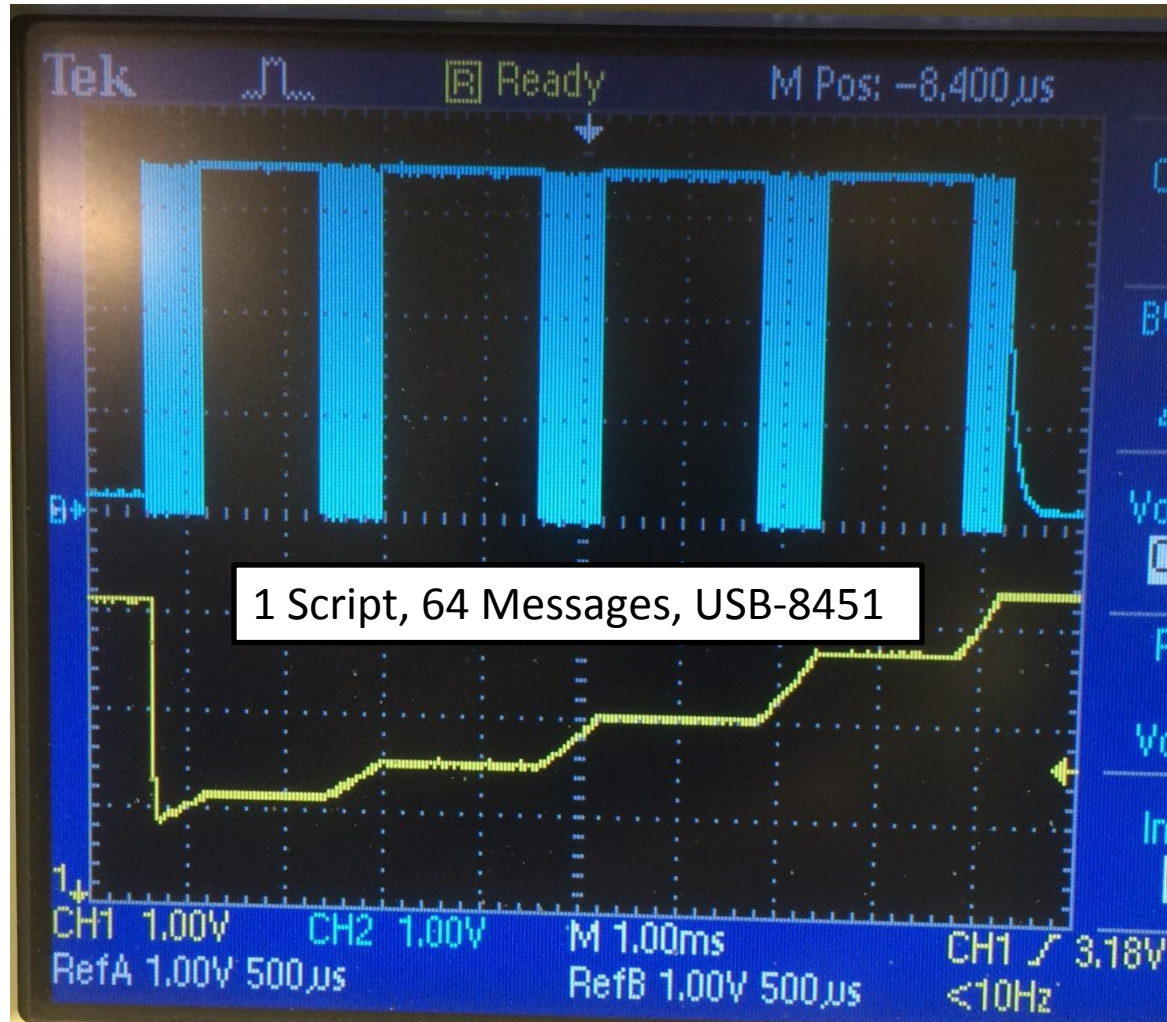


12MHz Clock, USB-8451

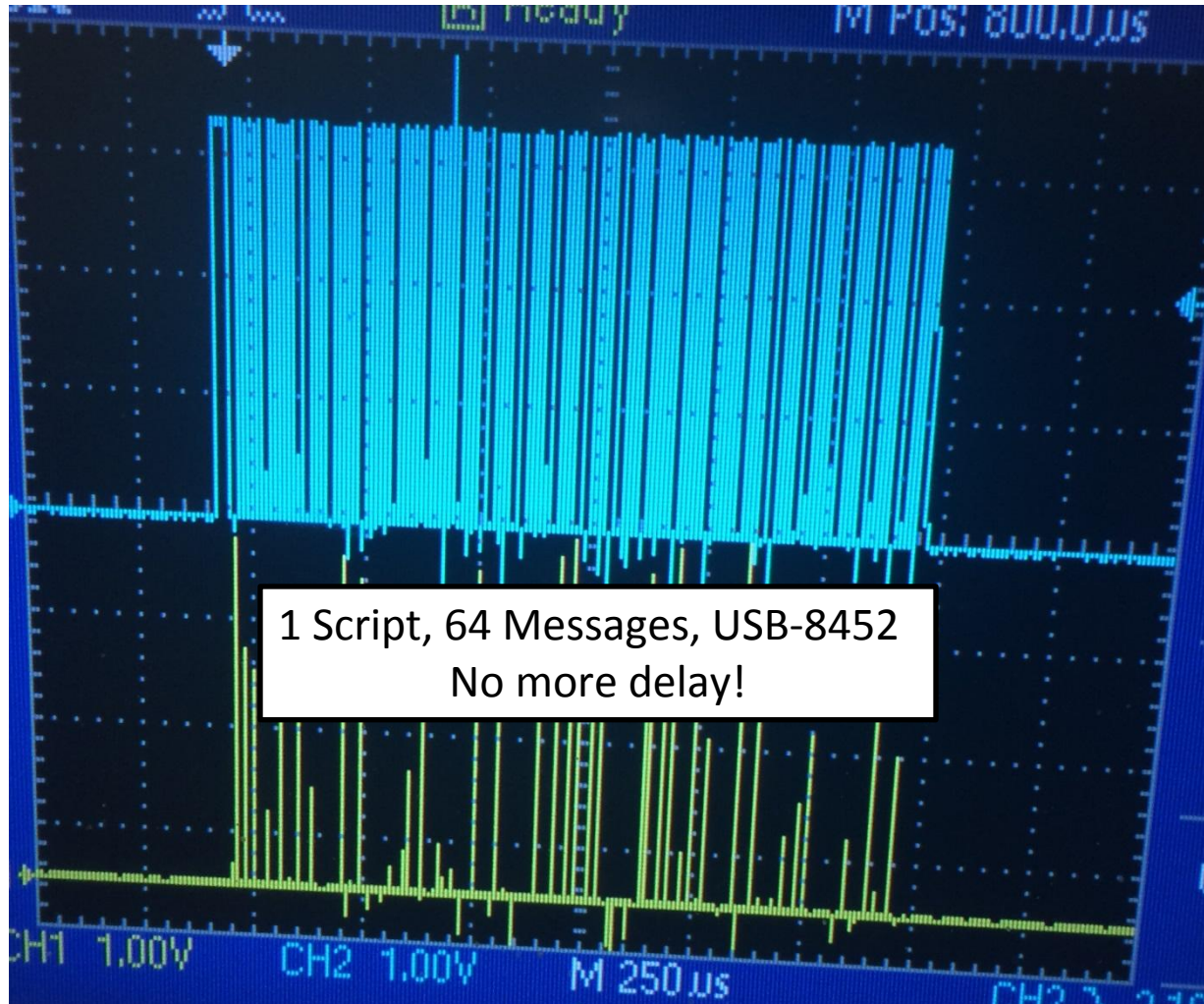
8 Bytes Shown



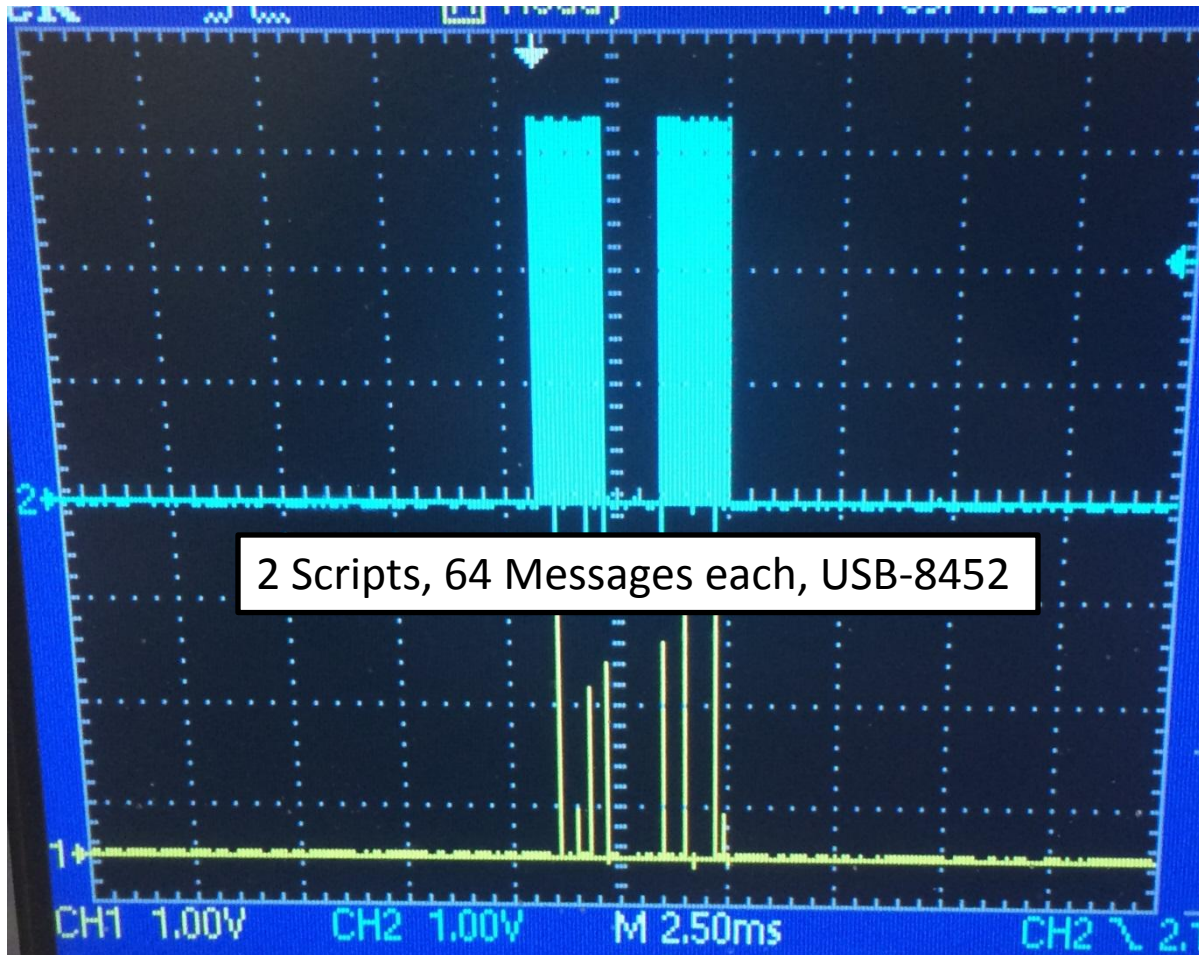
Batch Delay



Batch Delay



Script Delay



Simulation?

- You cannot simulate an 8451 or 8452 in MAX
- NI is too lazy to write one, so keep that in mind if you deploy your only card!

Summary

- You don't need specialized hardware to run SPI devices in your projects
- If you do need/want specialized hardware, always buy the NI USB-8452 over the NI USB-8451
- If speed/performance is a factor, be aware your time averaged data rate will be far slower than your maximum clock speed

Thanks for listening!

Questions?

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