

Chapter-2

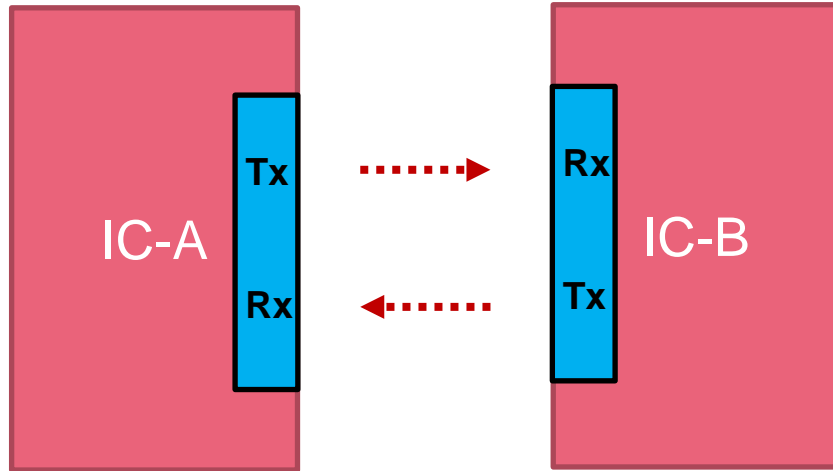
Communication Protocols

UART

UART Protocol



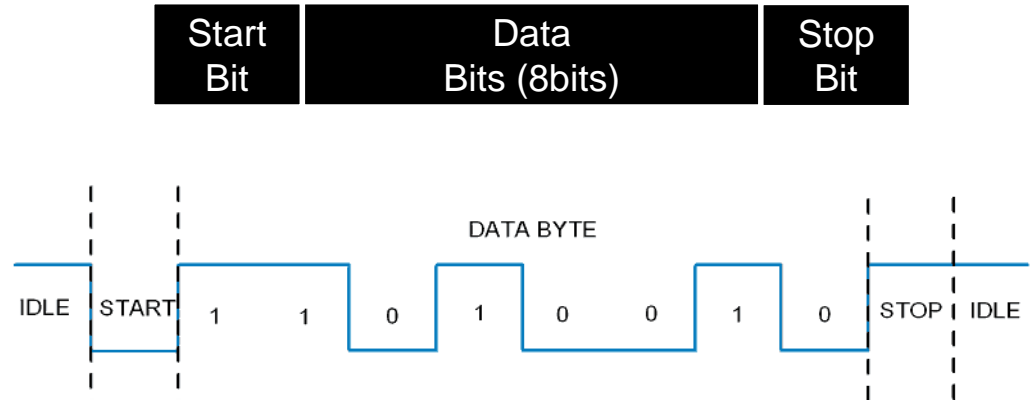
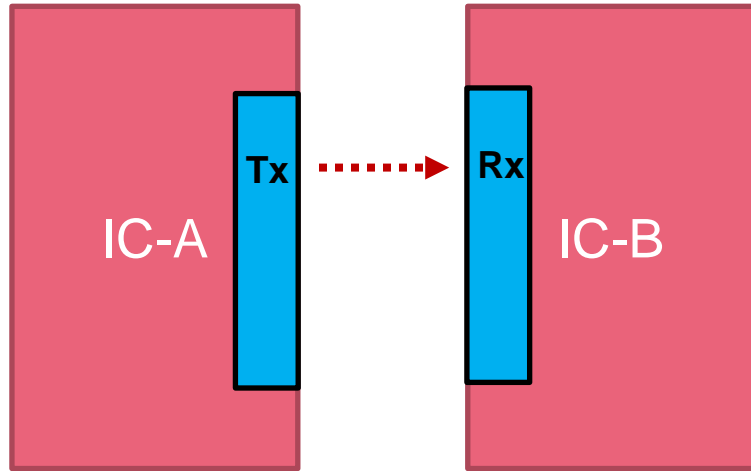
Universal Asynchronous Receiver and Transmitter



Drive Mode of Pins ?

IC-A to IC-B Pin Connections ?

The Protocol

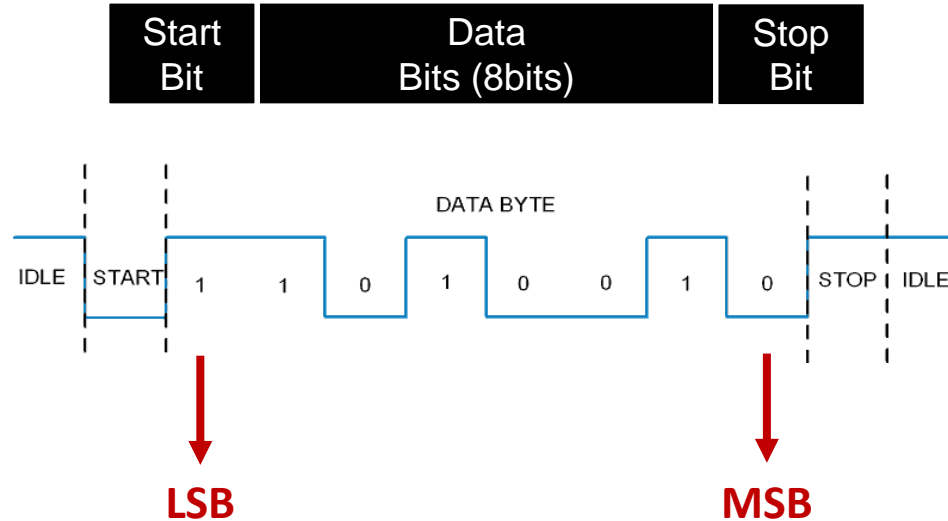


UART baudrate = 1/ 1 bit period

Ref: <https://www.electronicwings.com/arm7/lpc2148-uart0>

***Mode = 8bit Data Transfer, Parity = None, Stop-Bit=1**

The Protocol

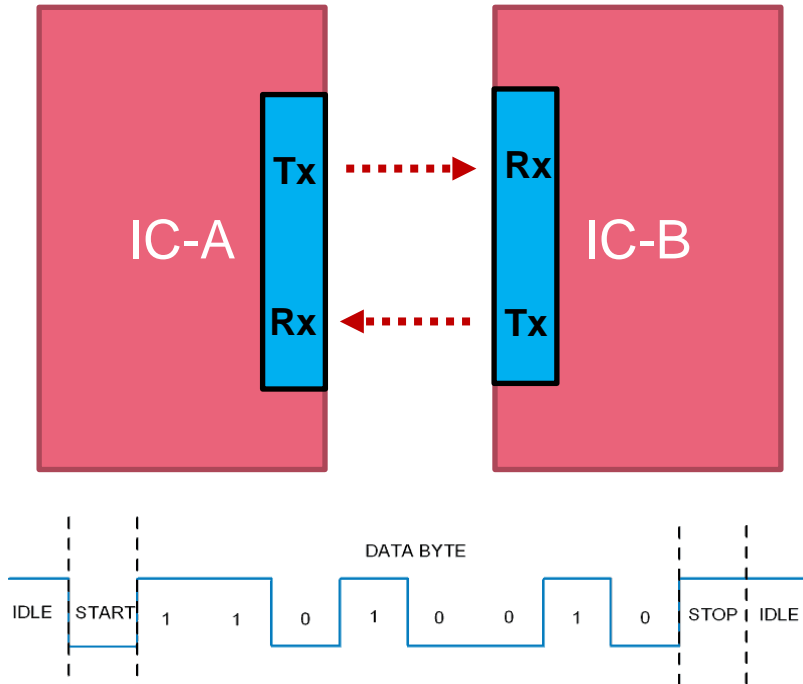


Data byte transferred ?

Why LSB first ?

Ref: <https://www.electronicwings.com/arm7/lpc2148-uart0>

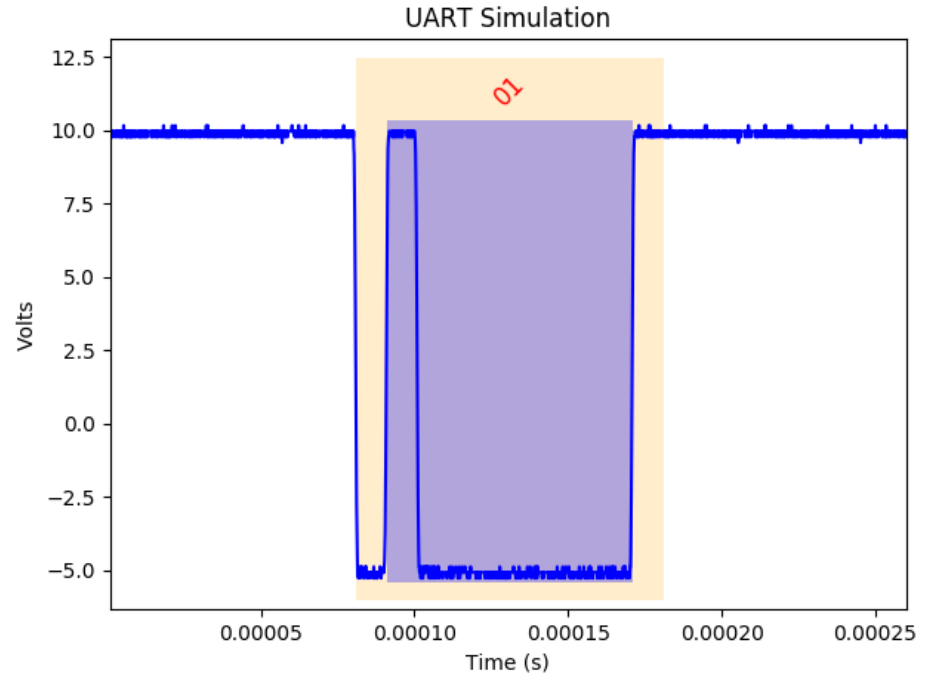
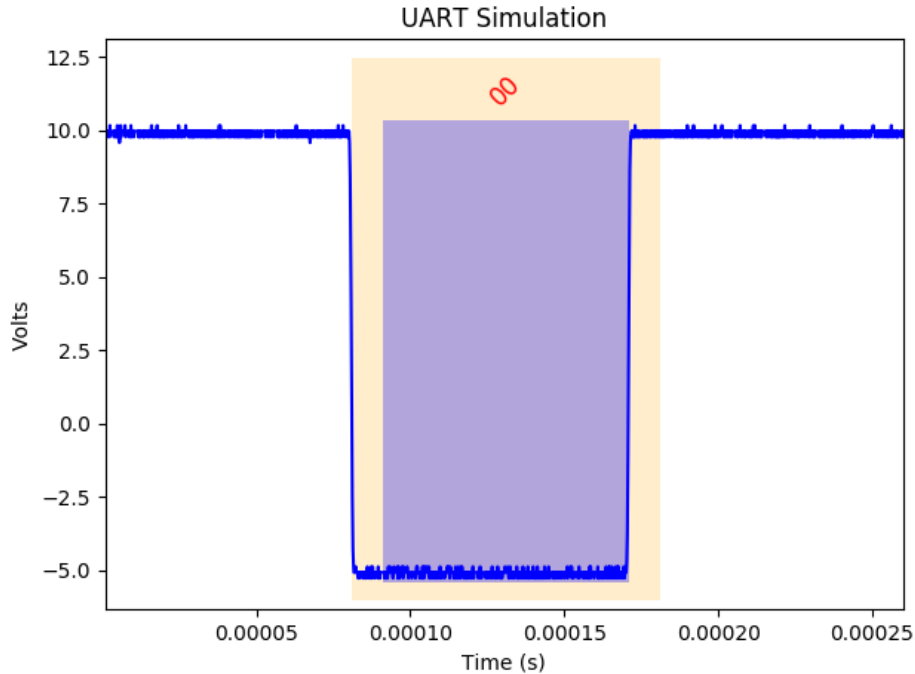
Questions.



- **Significance of baudrate ?**
- **Need for Start/Stop bit**
- **How Rx decodes data ?**
- **Why asynchronous ?**
- **UART pros/cons ?**

Ref: <https://www.electronicwings.com/arm7/lpc2148-uart0>

Examples

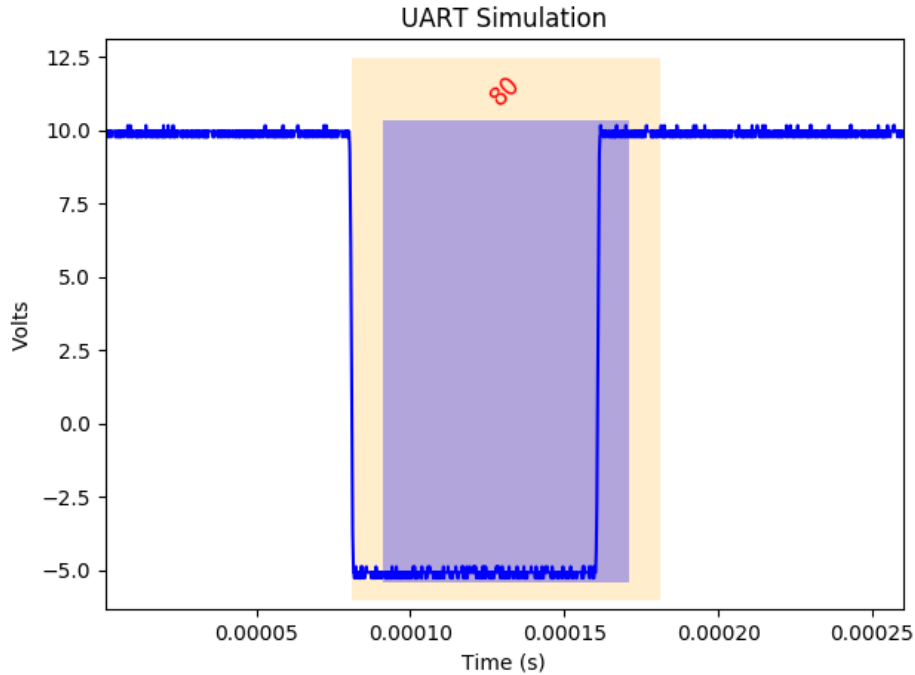


Baudrate ?

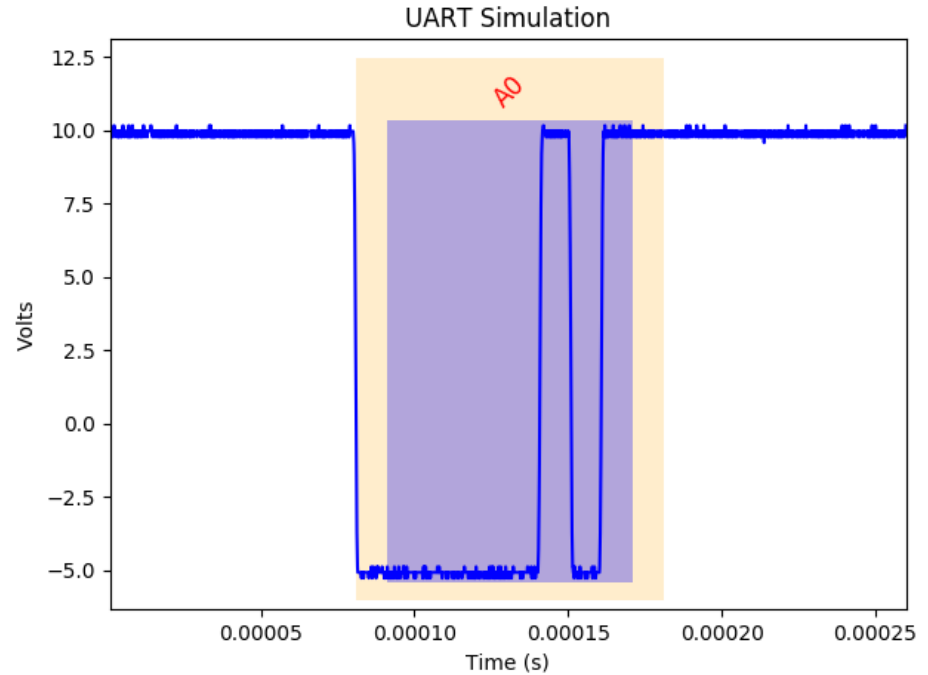
Ref – RIPYL Library (Python)

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Examples

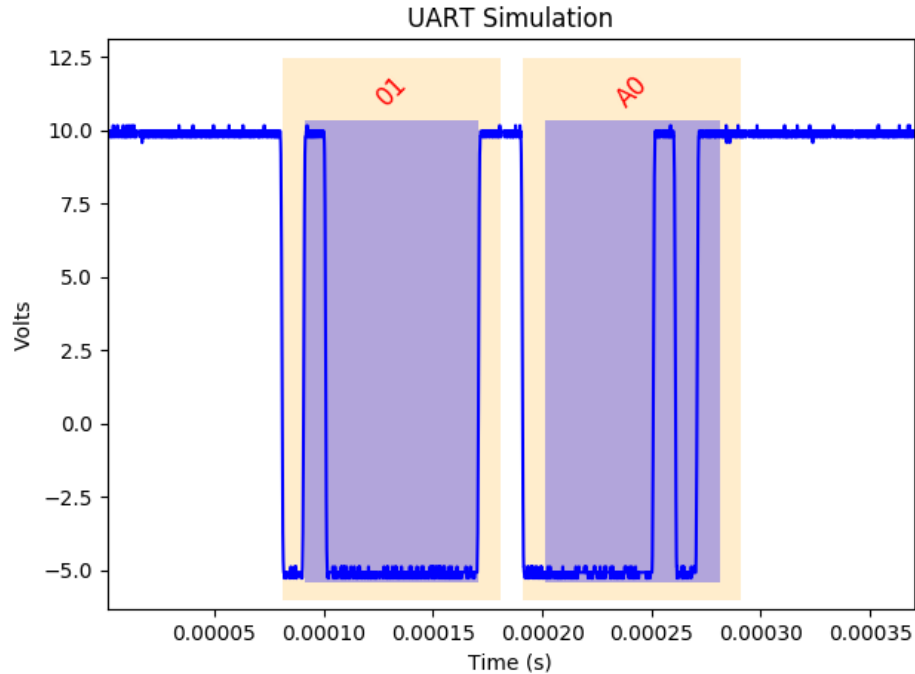


Baudrate ?

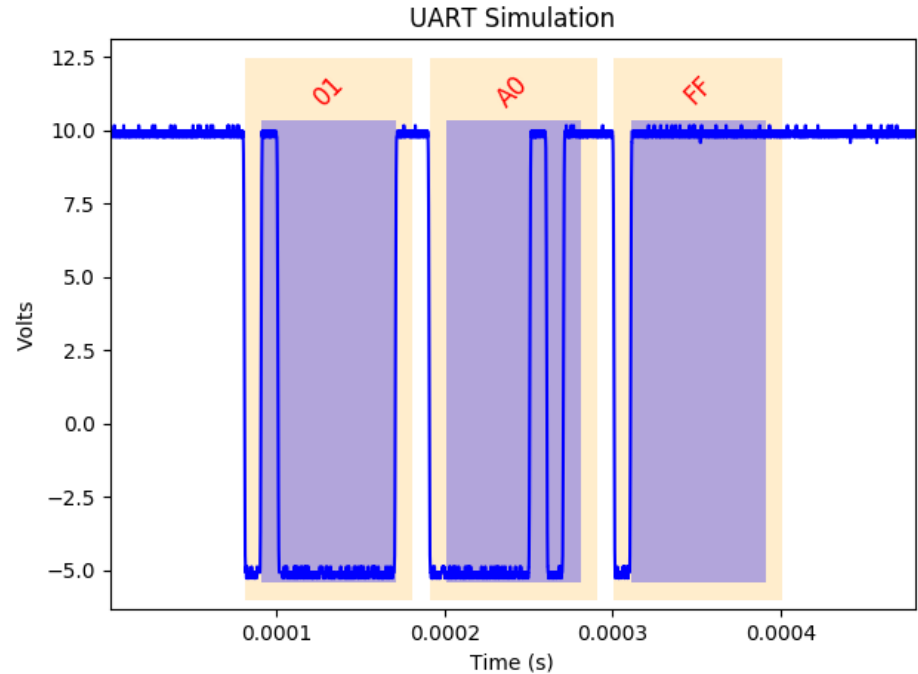


Ref – RPYL Library (Python)

Examples

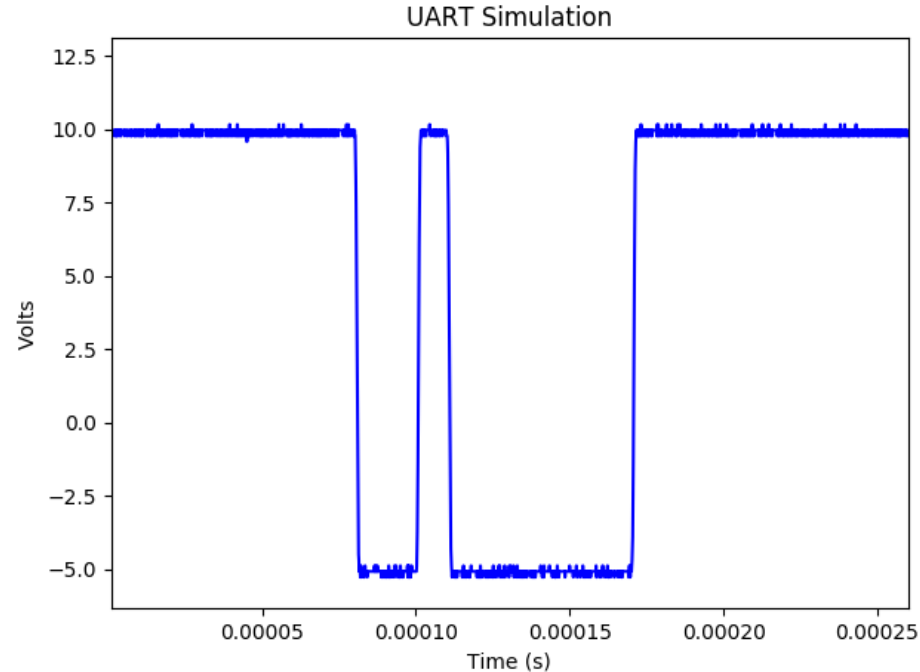


Baudrate ?



Ref – RPYL Library (Python)

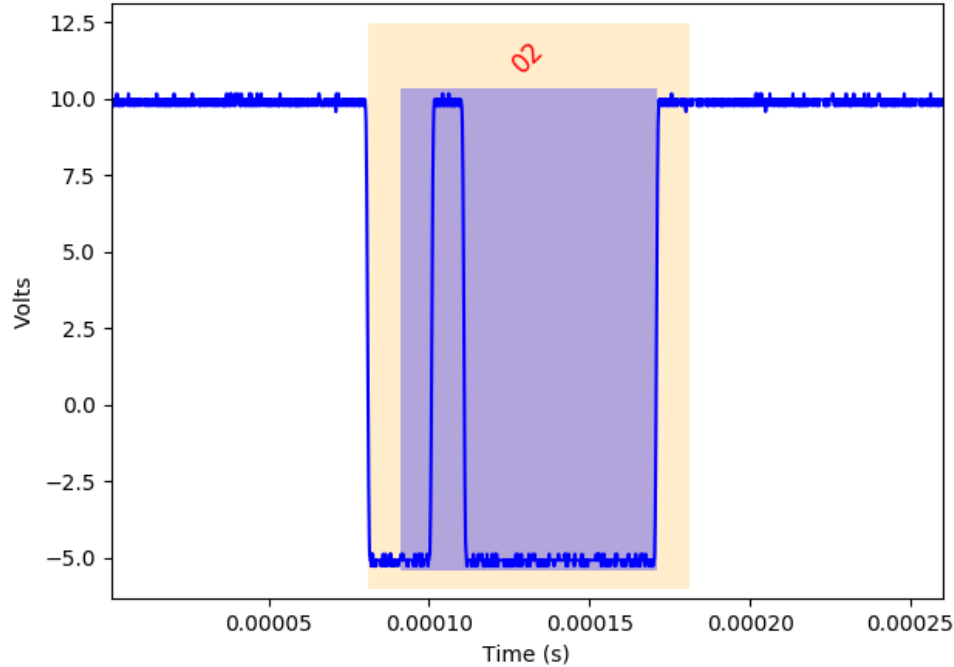
Question.



Ref – RPYL Library (Python)

- **Baudrate ?**
- **Data Byte ?**

Answer

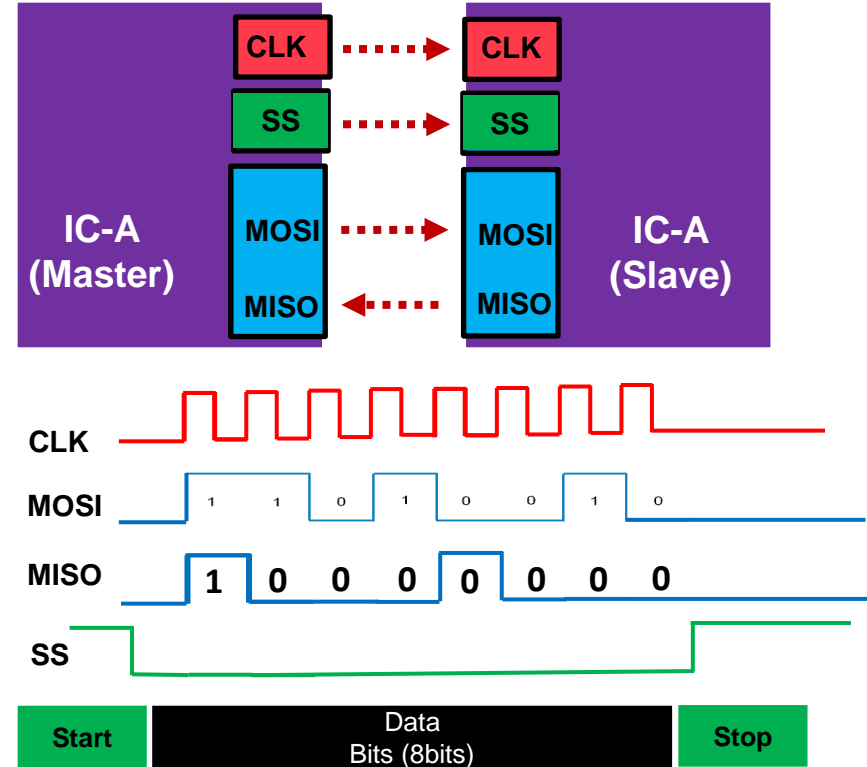
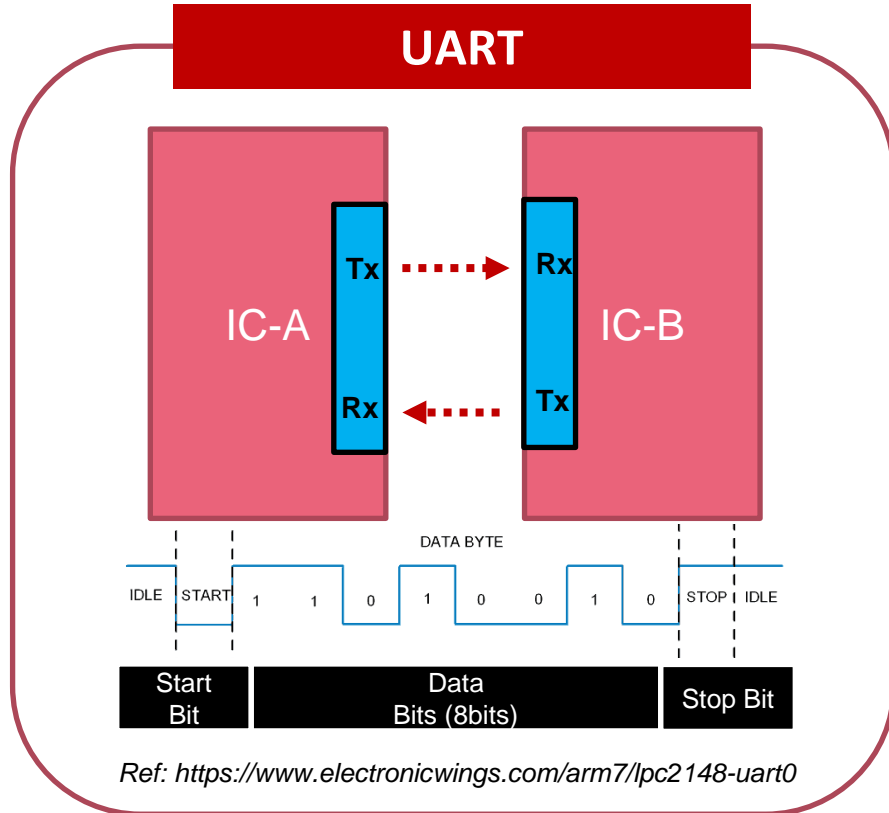


Ref – RPYL Library (Python)



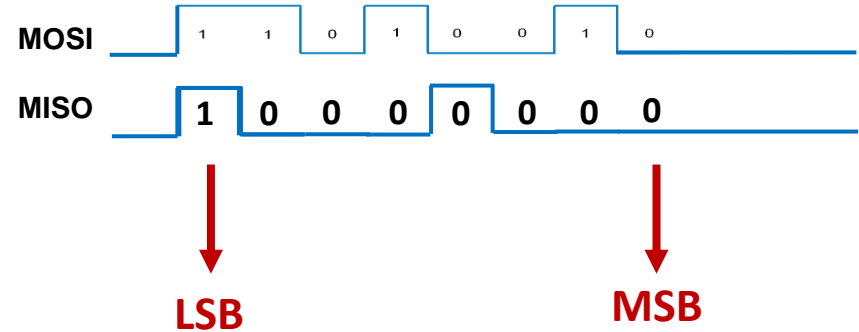
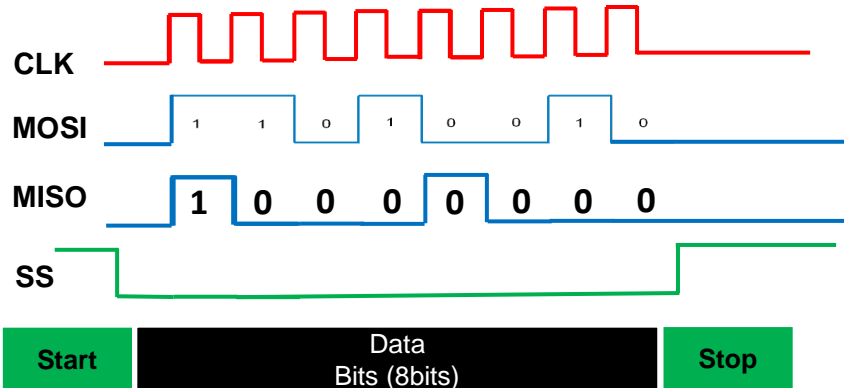
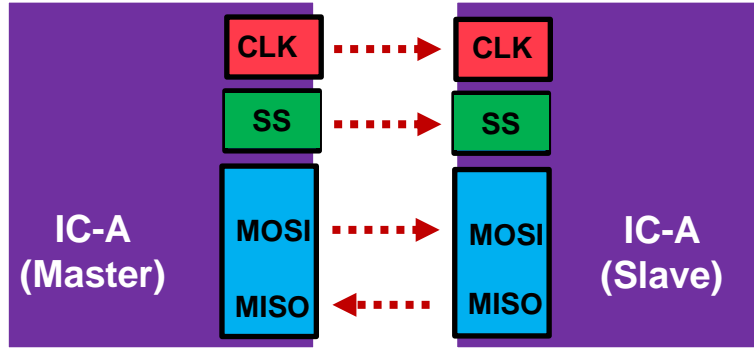
SPI

SPI Protocol



Drive Mode of Pins ?

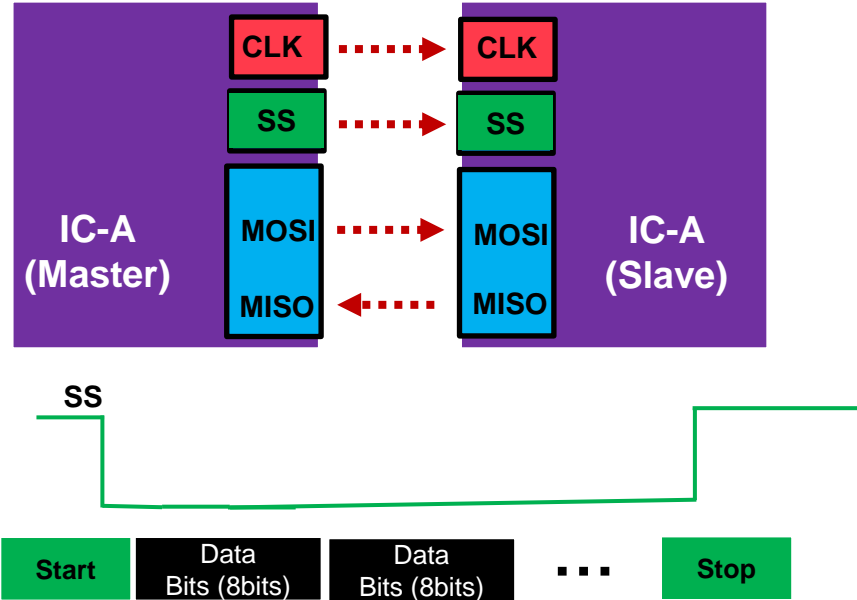
SPI Protocol



- The clock signal is in the low state when idle.
- The **data is changed** on the leading edge of the clock
- The **data is sampled** on the falling edge of the clock

***SPI Mode = 1 (CPOL = 0, CPHA = 1), LSB First Transfer**

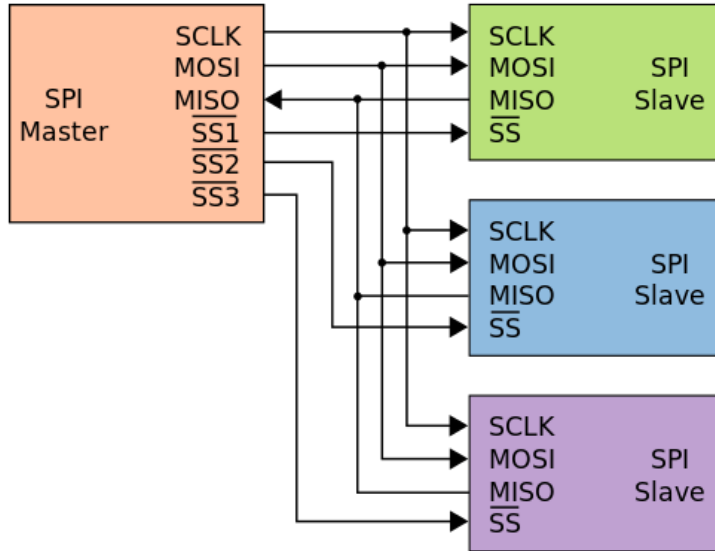
Multi-Byte Transfer



Better than UART

- **No Start/Stop Bit Requirement**
- **Header/Footer Not Required.**
- **Synchronized. Bits Change with Clock. Transfer starts with SS**
- **High Speed**

Multi-Slave Comm.



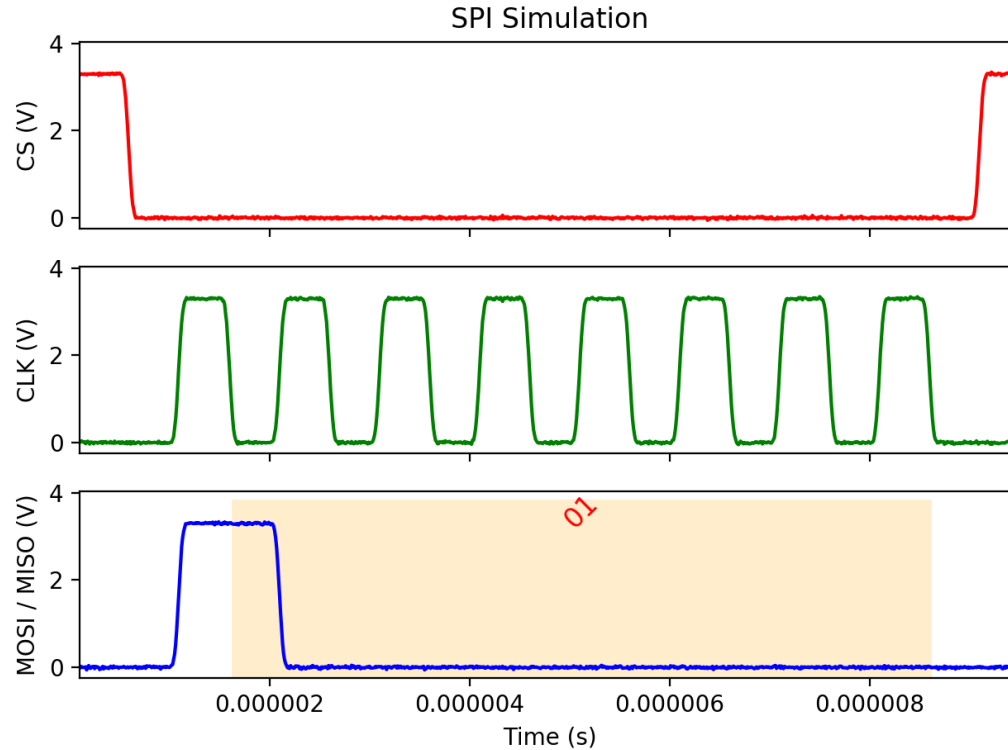
- **How many slave select lines are required for interfacing 8 SPI-Slave devices with SPI-Master**
- **Can UART be used for Multi-Slave Communications ?**

https://en.wikipedia.org/wiki/Chip_select

Questions.

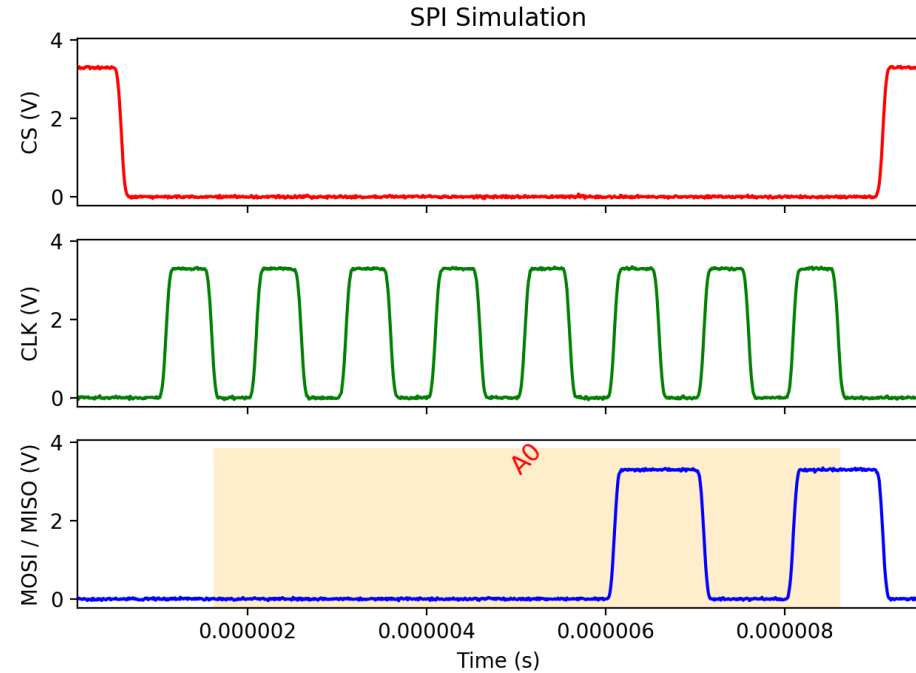
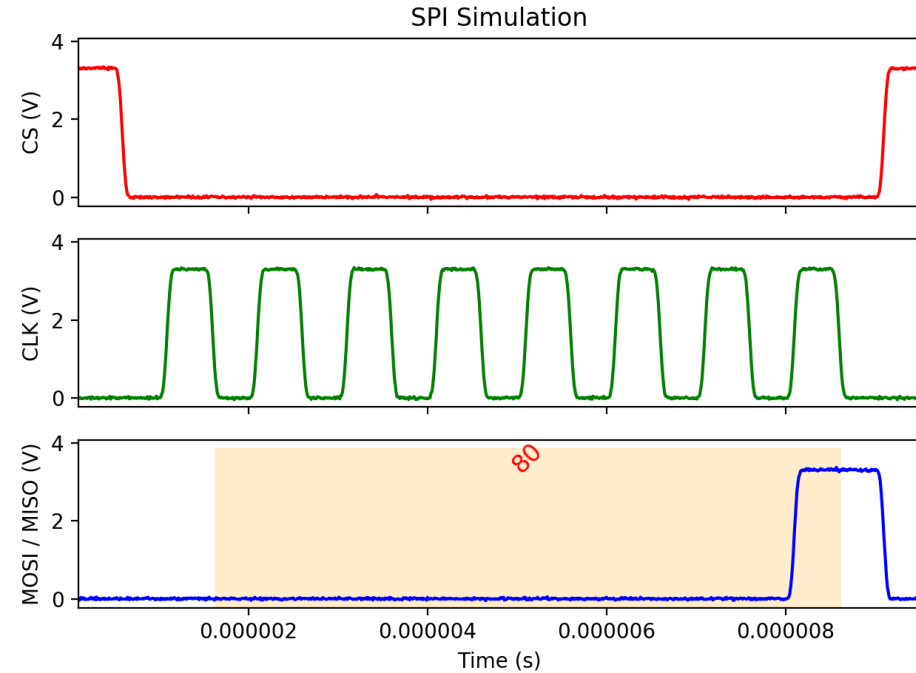
- **Significance of SPI Clock Speed ?**
- **Algorithm for SPI Transmit and SPI Receive ?**
- **Is SPI Synchronous or Asynchronous ?**
- **SPI Pros/ Cons. (SPI require more pins ?)**

Examples



Clock Speed ?

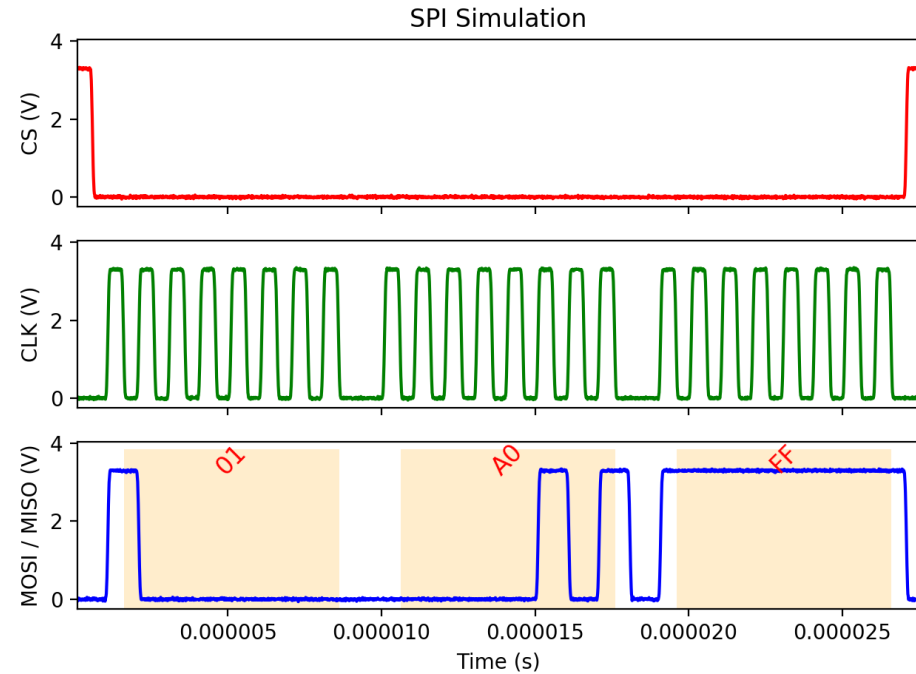
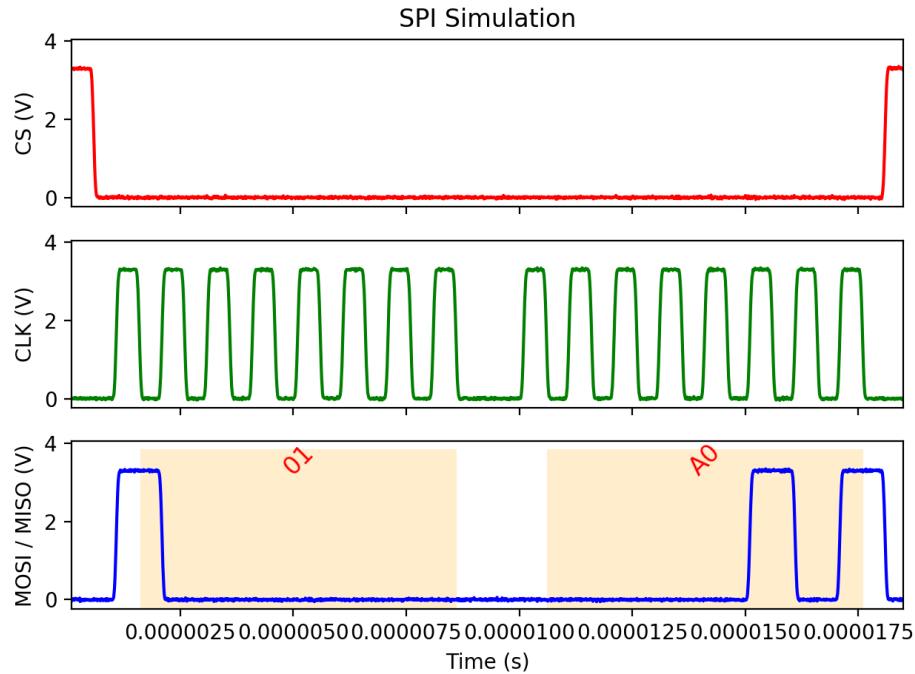
Examples



Ref – RIPPYL Library (Python)

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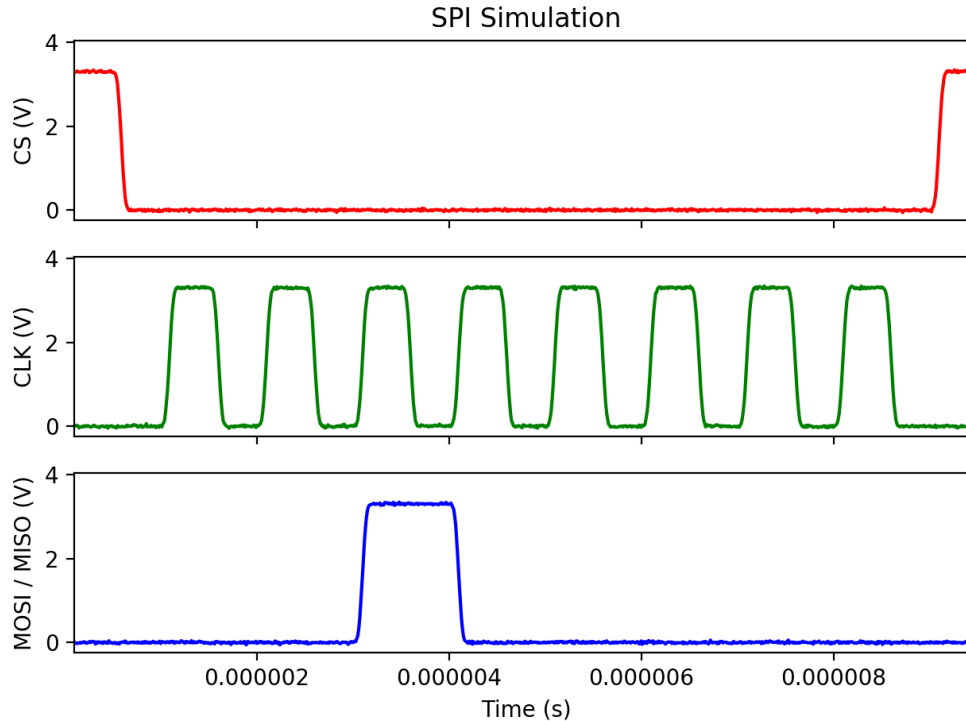
Examples



Ref – RIPYL Library (Python)

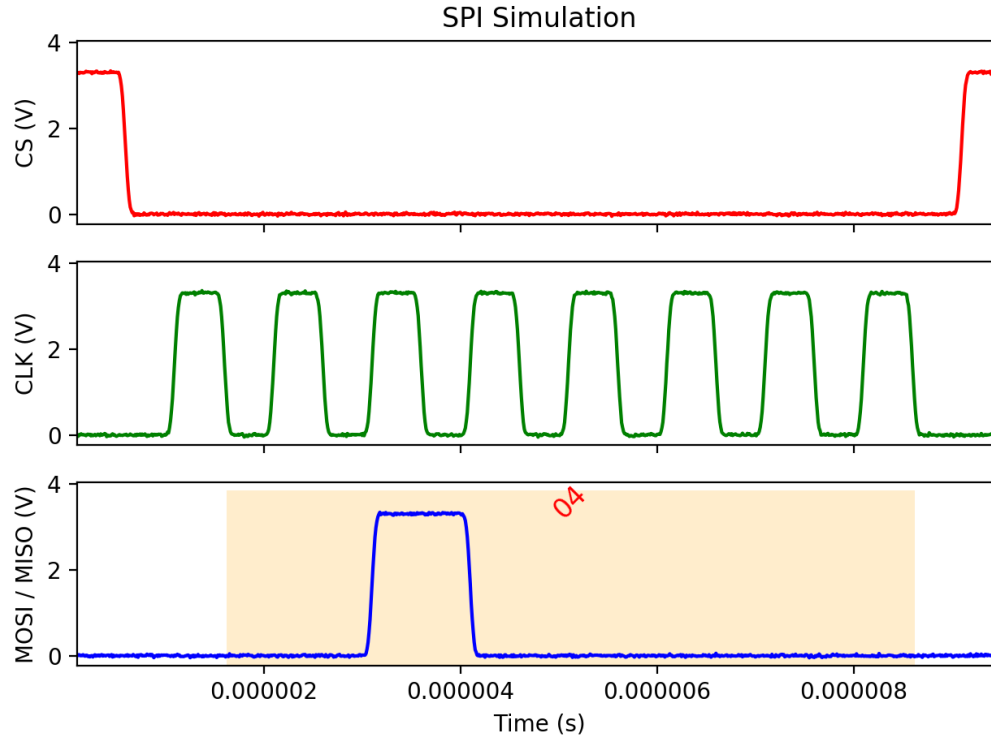
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Question.



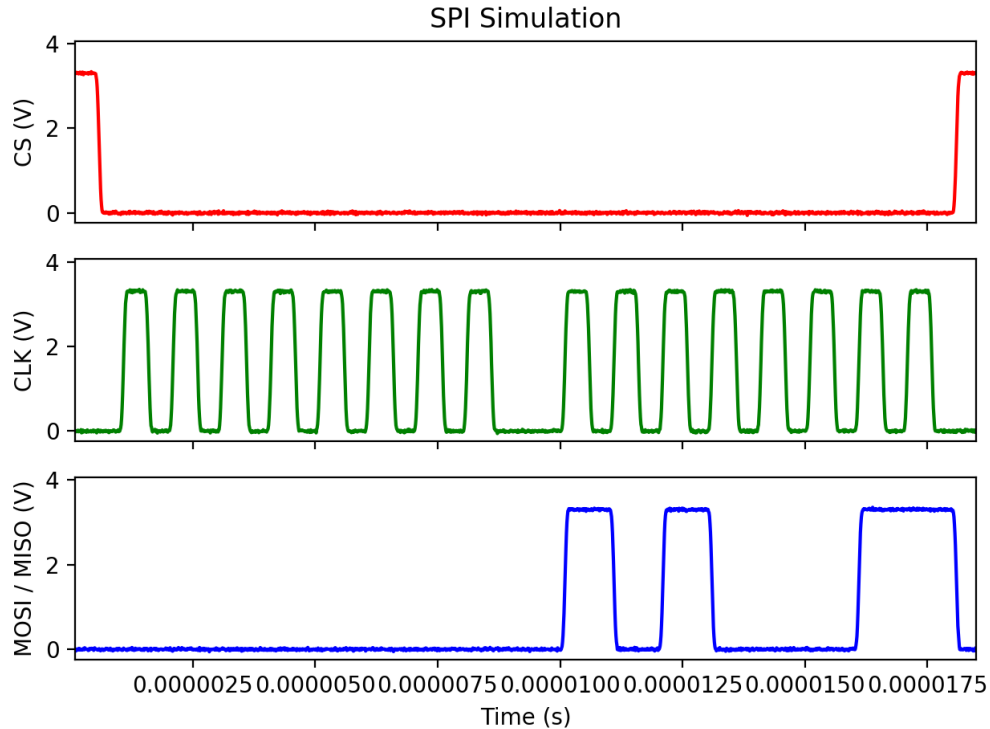
- **Baudrate ?**
- **Data Byte ?**

Answer



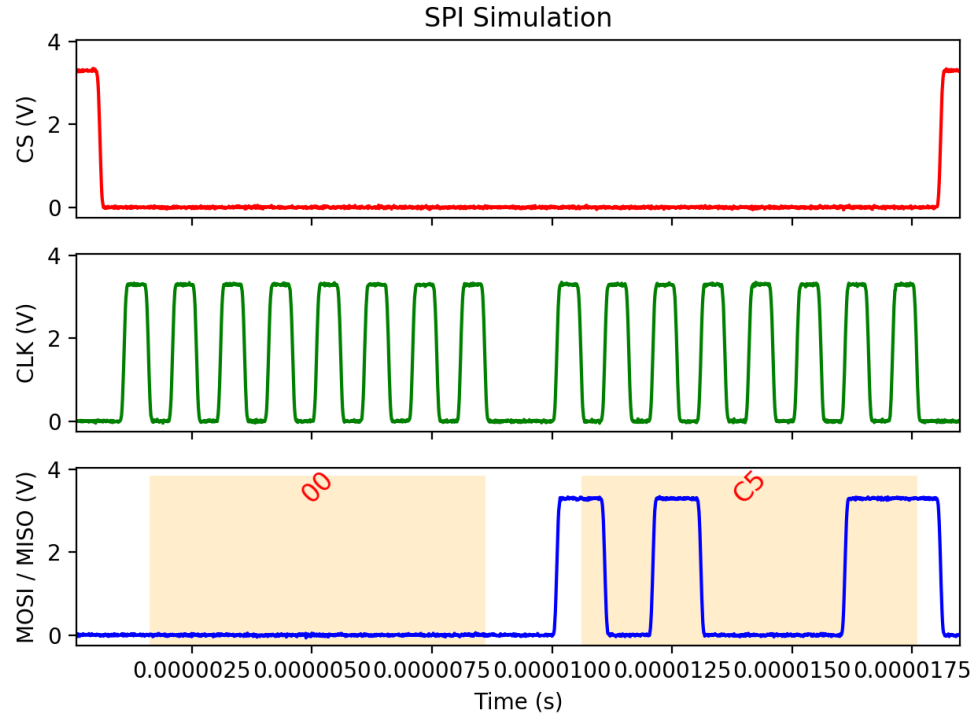
Ref – RPYL Library (Python)

Question.



- **Baudrate ?**
- **Data Byte ?**

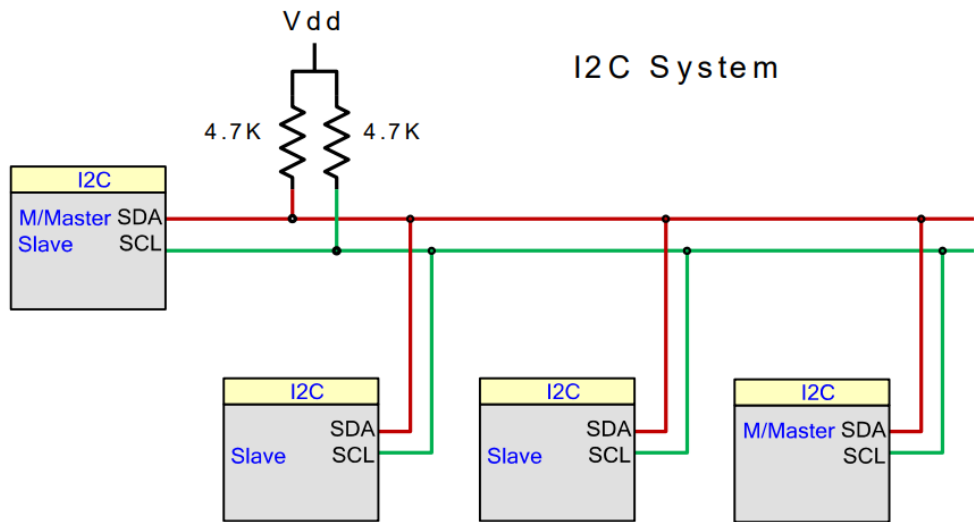
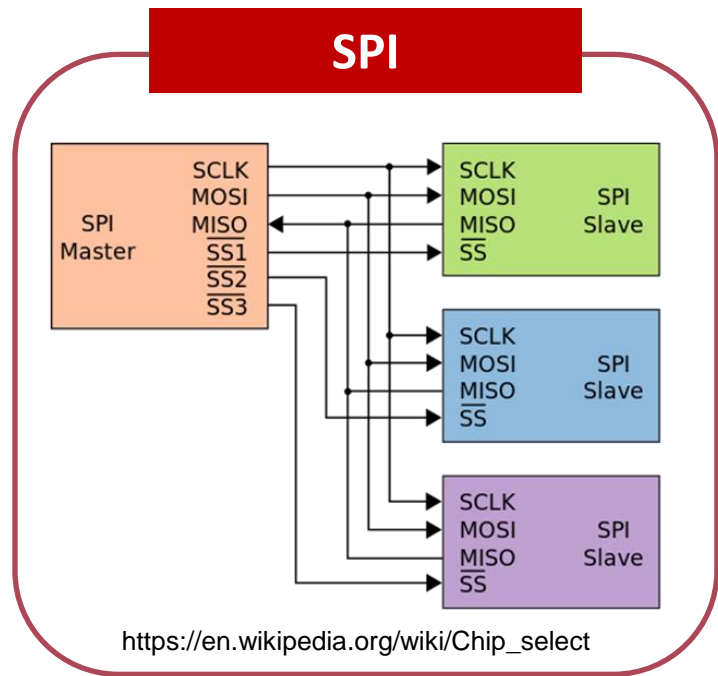
Answer



Ref – RPYL Library (Python)

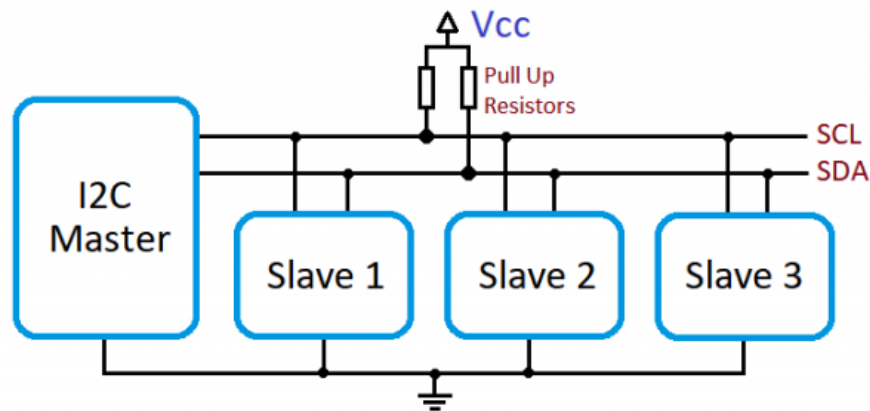
I2C

I2C Protocol



Drive Mode of Pins ?
How to decide Pull-Up Value ?

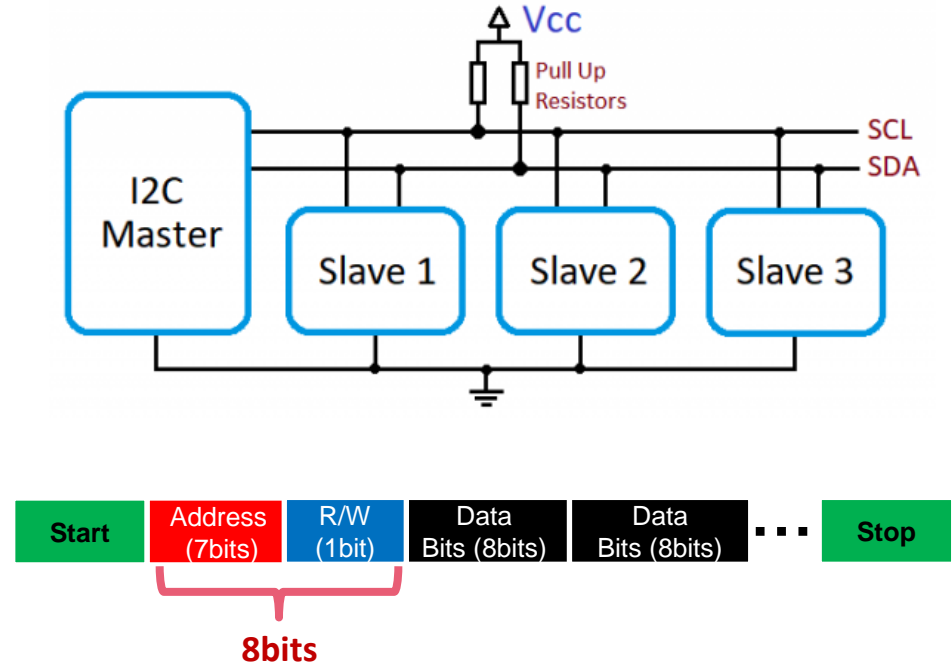
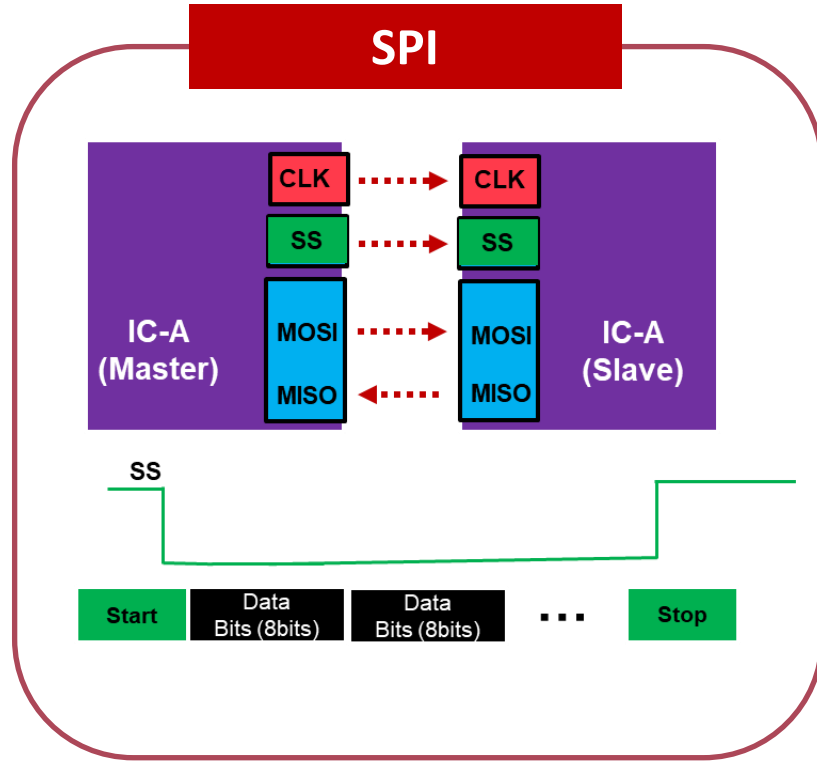
Questions



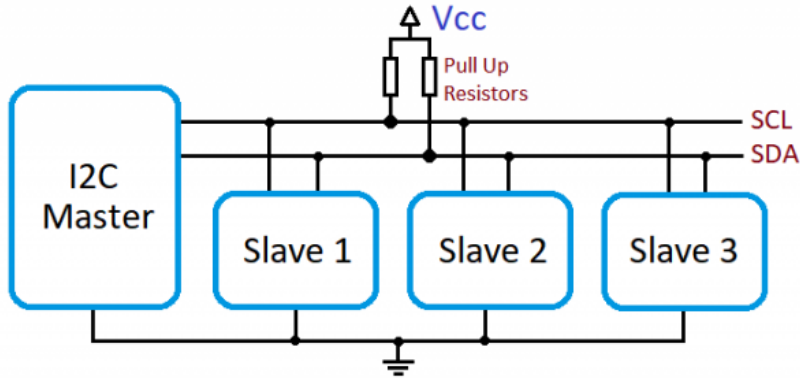
<https://electrosome.com/i2c/>

- **How to Address a Slave ?**
- **How to transfer data ?**
- **Why SCL/SDA has pull-up ?**

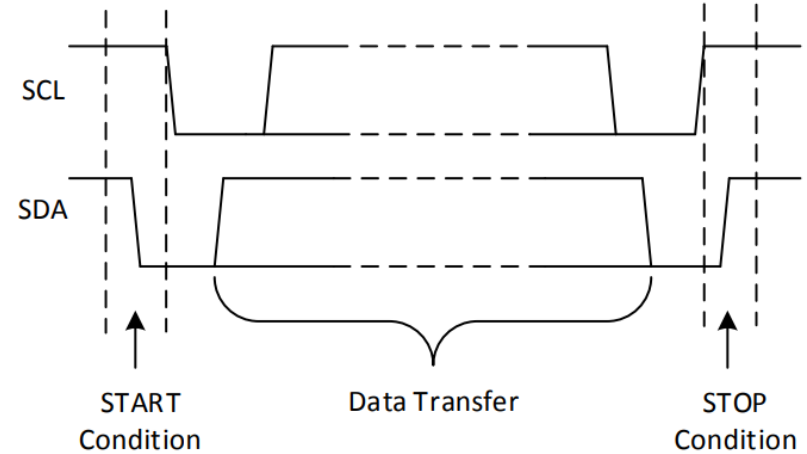
Addressing, Data Tx-Rx



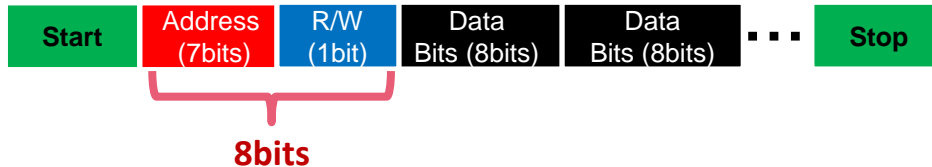
Start/ Stop



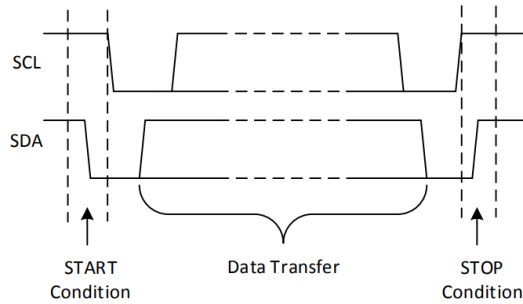
<https://electrosome.com/i2c/>



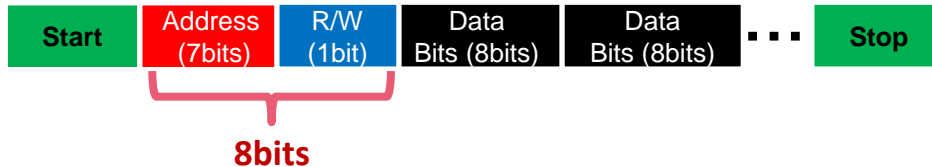
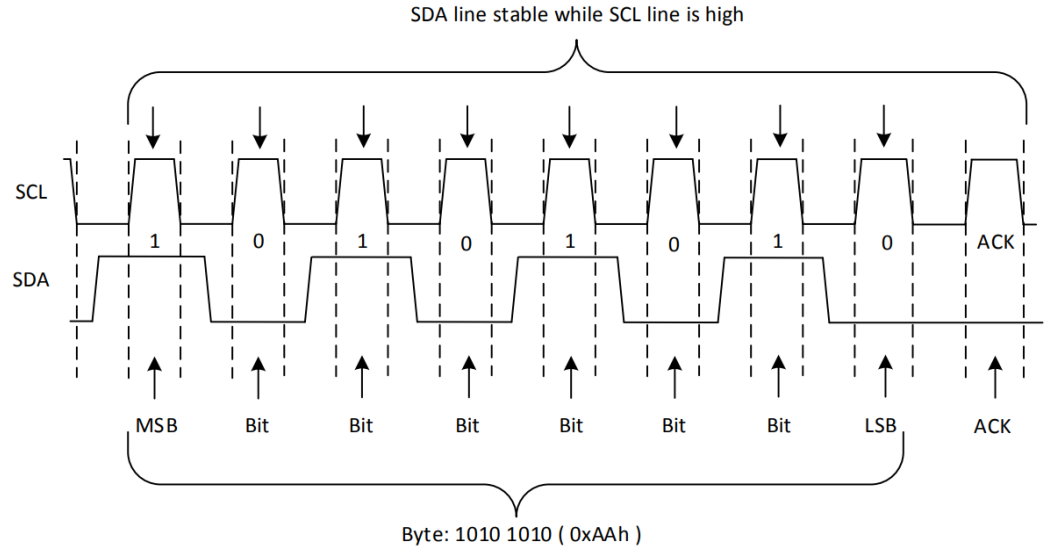
Ref: Understanding the I2C Bus, Texas Instruments



Byte Transfer

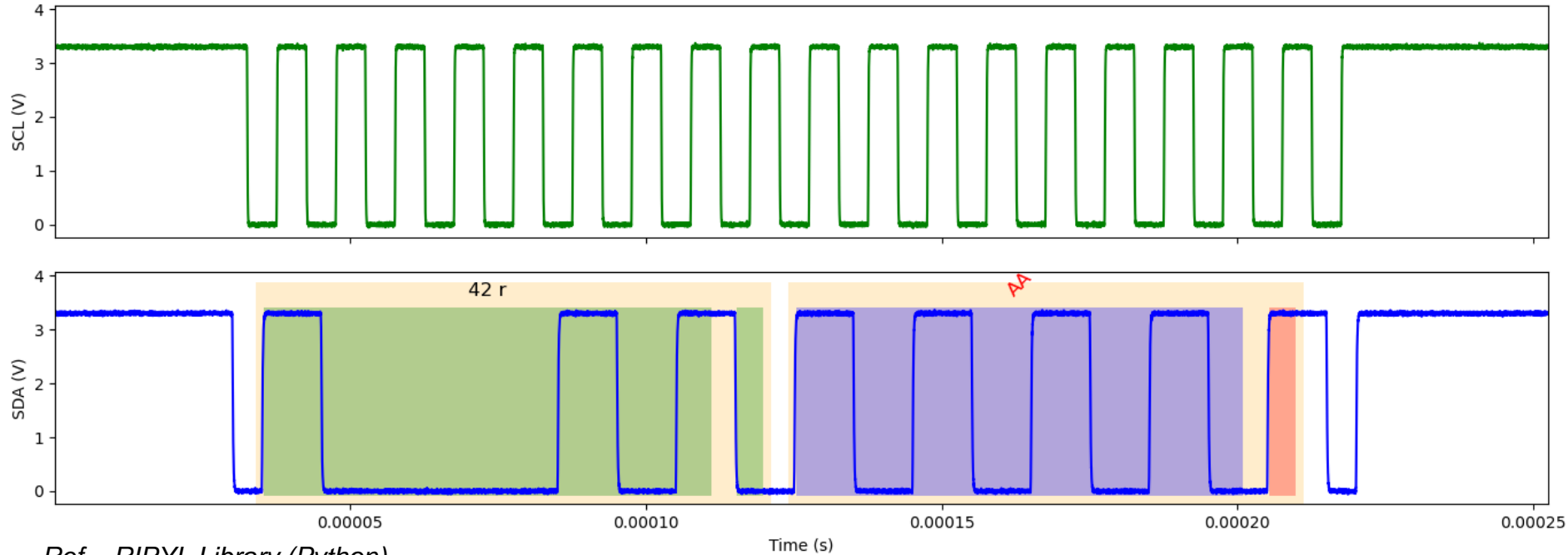


Ref: Understanding the I2C Bus, Texas Instrun

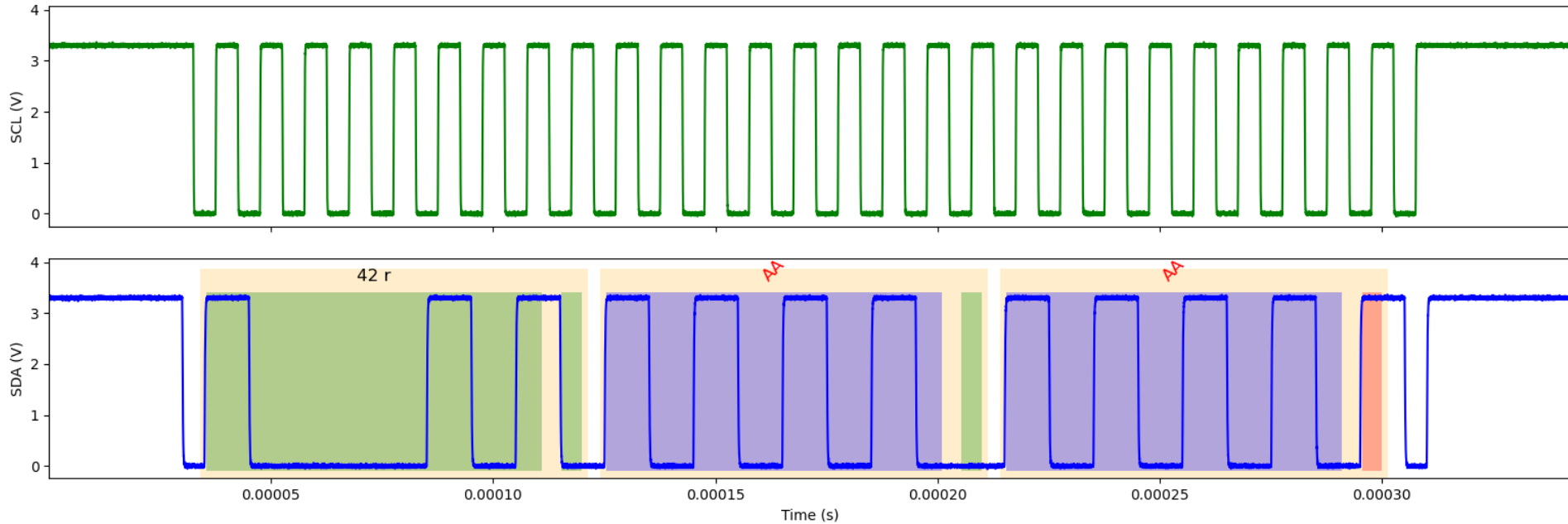


Master expects an acknowledgment from slave after every byte transfer !

Examples

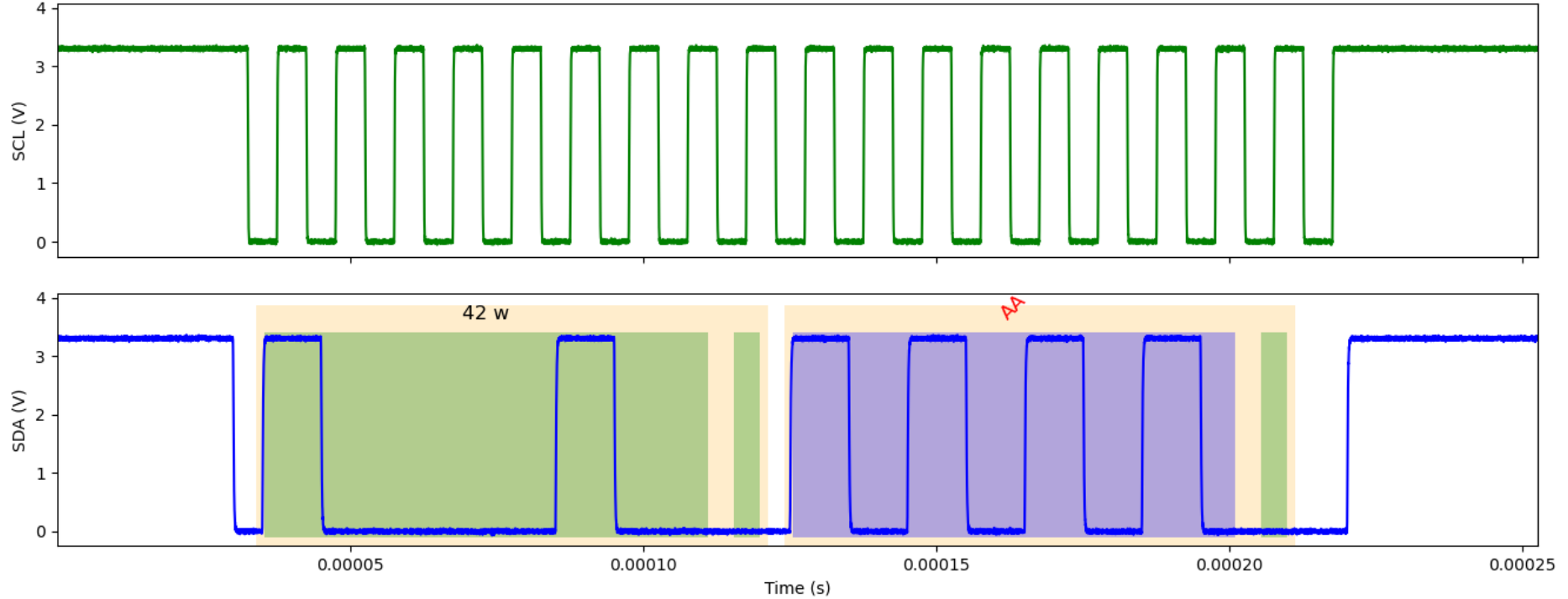


Examples



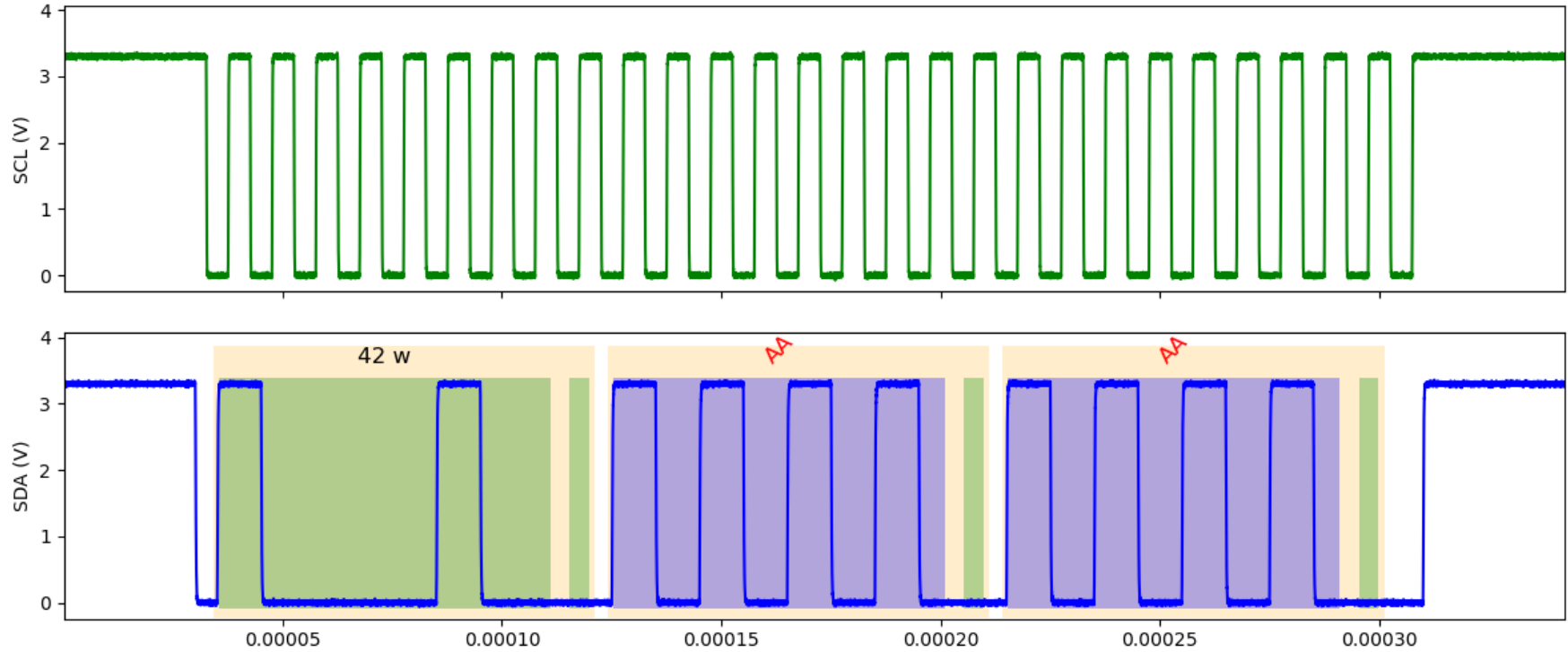
Ref – RPYL Library (Python)

Examples



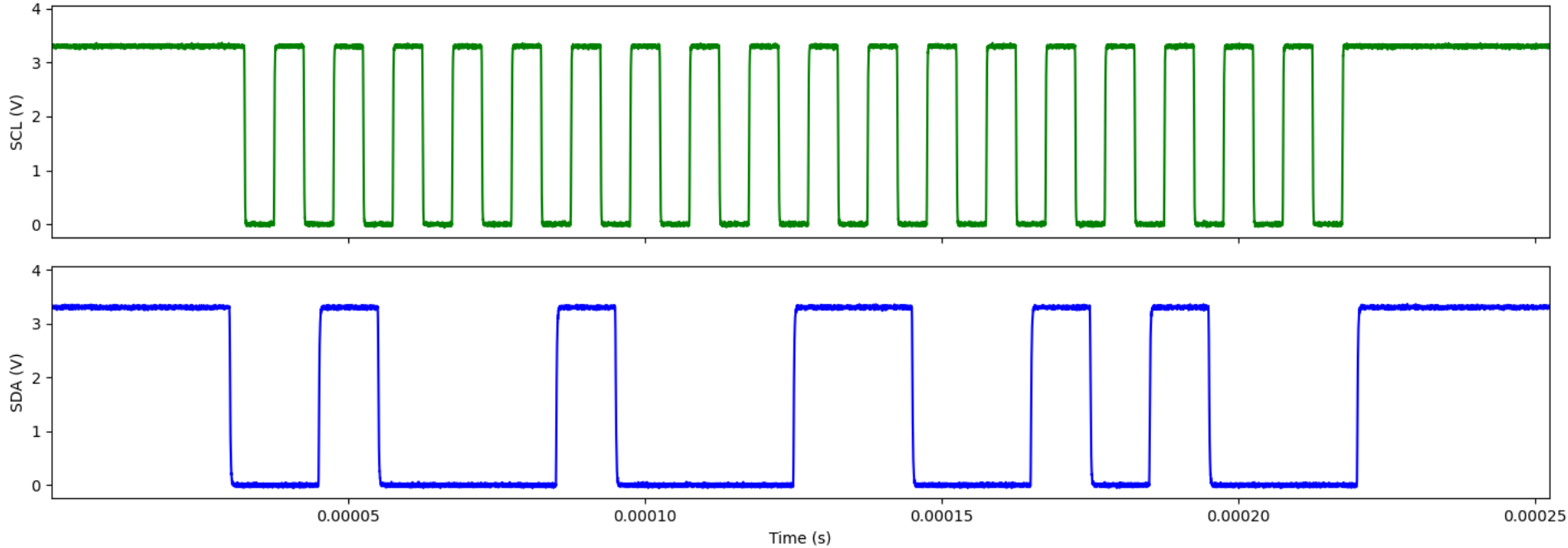
Ref – RPYL Library (Python)

Examples



Ref – RPYL Library (Python)

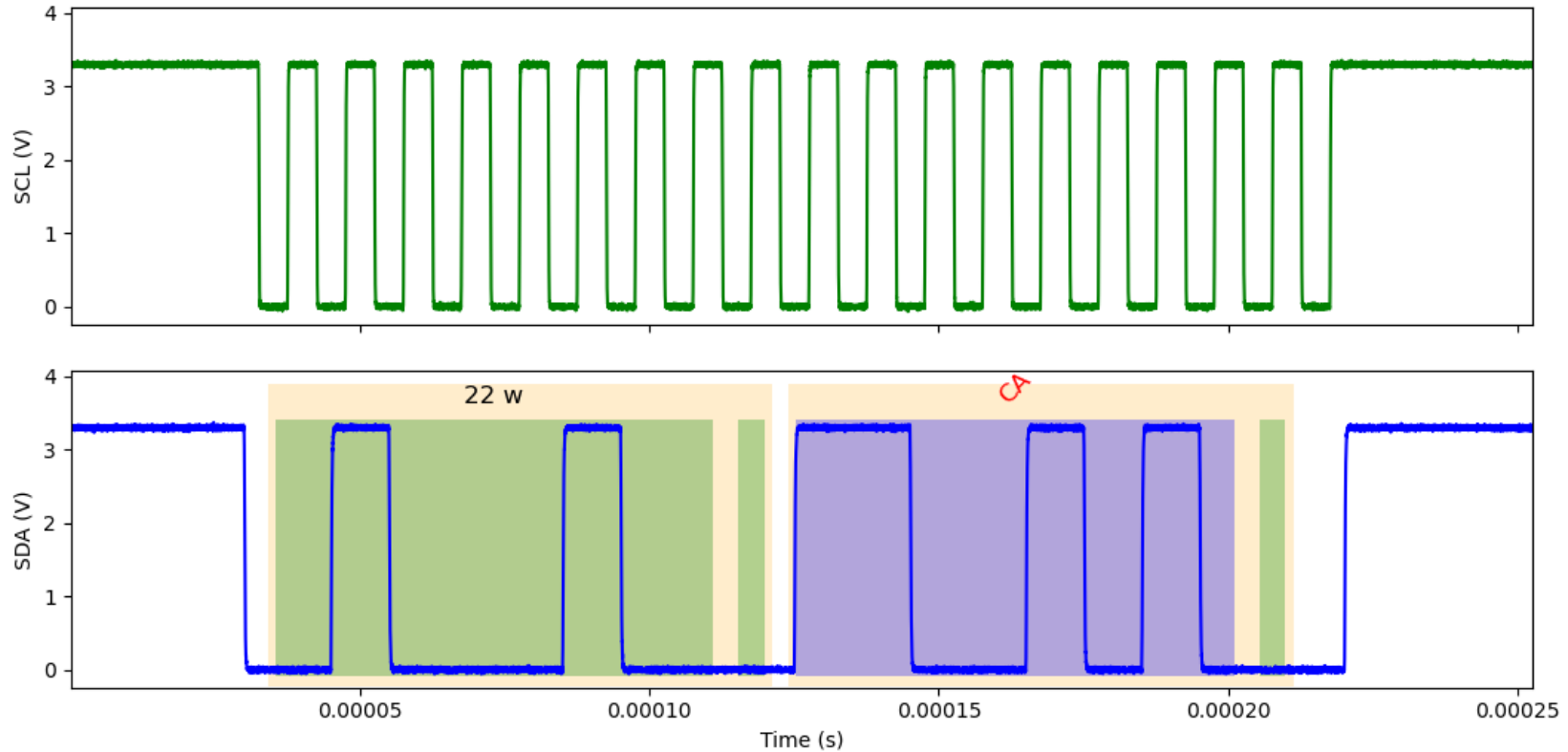
Question



Ref – RPYL Library (Python)

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Answer



SPI, I2C and UART

- **Simplest Protocol ?**
- **Slowest Protocol ?**
- **Multi-Master ?**
- **Multi-Slave ?**
- **Detect Presence of Slave ?**
- **Header/Footer Requirement ?**
- **Full-Duplex ?**
- **Synchronous ?**