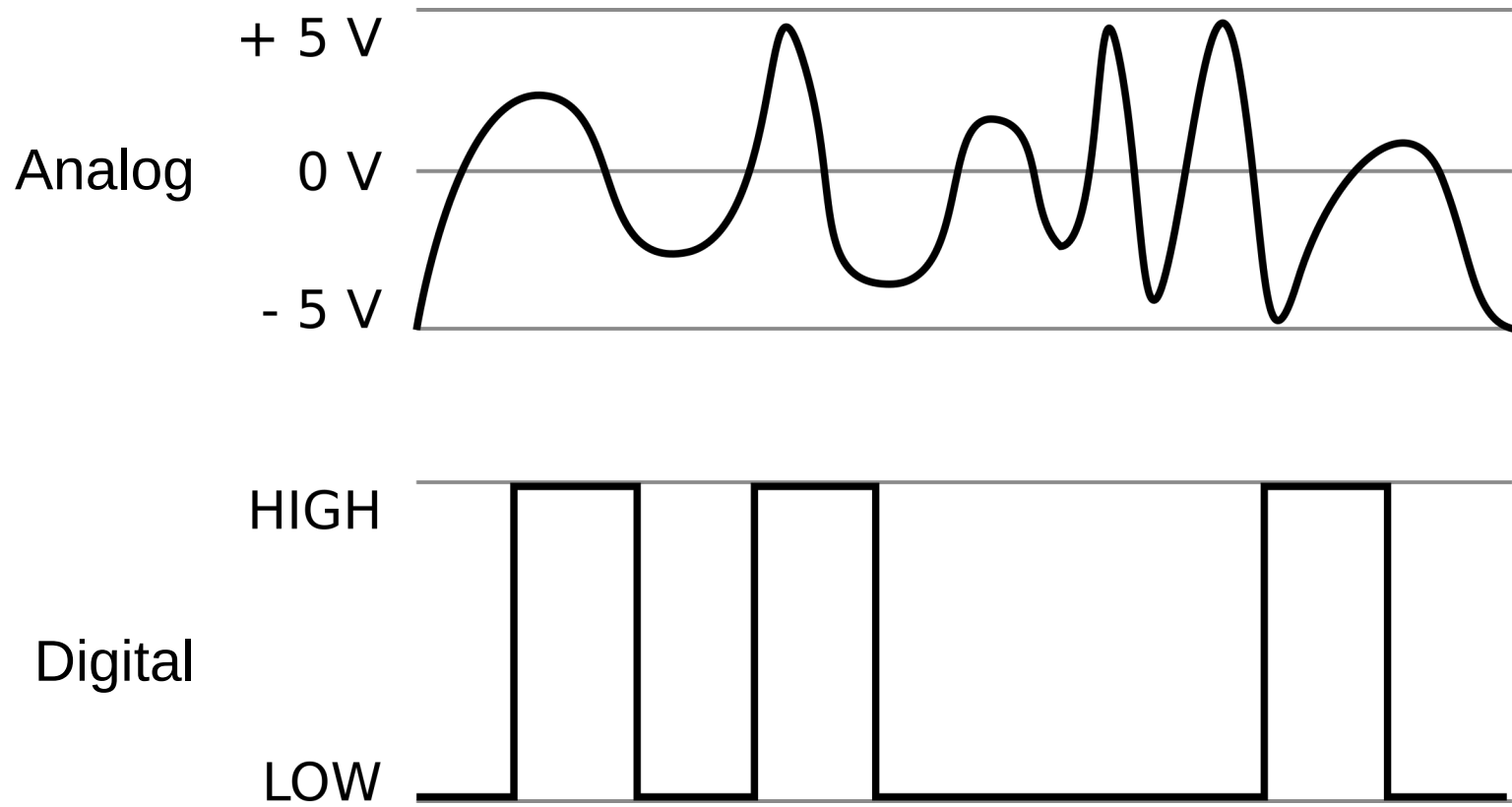


Sketching with Hardware

08: Electronics 03 (Digital Electronics)

Analog vs Digital



Pros and Cons of Digital Signals

- Clearly defined – either there is voltage or not
- Less prone to errors and noise
- Can be saved and reproduced easily

But:

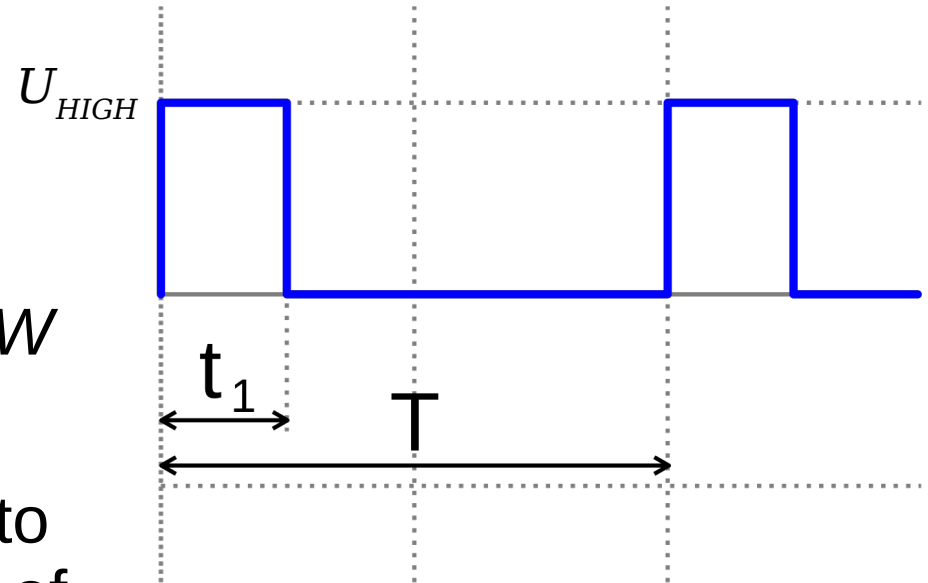
- Less information than analog “original”
- Digital components are more complex

Pulse Width Modulation (PWM)

- Digital “simulation” of analog signal

$$U = U_{HIGH} * \frac{t_1}{T}$$

- Signal is *HIGH* for a certain part (t_1) of the time interval T and *LOW* for the remaining time
- Net voltage over T corresponds to the *HIGH* voltage times the ratio of t_1 to T





Live Demo...

Serial Data Transfer

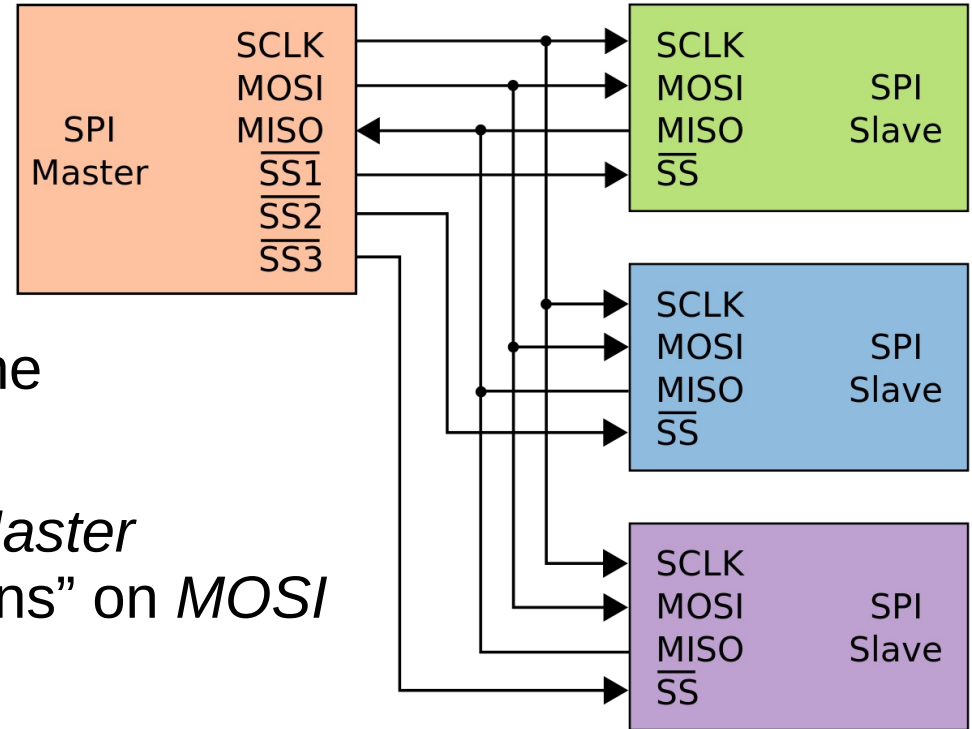
- The Arduino Micro has two serial ports:
 - **Serial** communicates with the computer via USB
 - **Serial1** uses the pins *RX* (receive) and *TX* (transceive) to communicate with connected devices
- Activity over serial ports is indicated by two LEDs (*RX* and *TX*)
- The *baudrate* has to be defined beforehand and has to match between the devices
 - **Arduino:** `Serial.begin(baudrate);`
 - **PC:** Dropdown menu of Serial Monitor

Inter-Integrated Circuit (I²C)

- Bidirectional, serial data bus using the *Master/Slave* model
- Multiple *slaves* can be connected to one *master*
- Requires two lines:
 - Serial Clock (SCL): Controls transfer rate by alternating between *HIGH* and *LOW*
 - Serial Data (SDA): Transfers data (one bit per clock cycle)
- The first transferred byte defines receiver an direction

Serial Peripheral Interface (SPI)

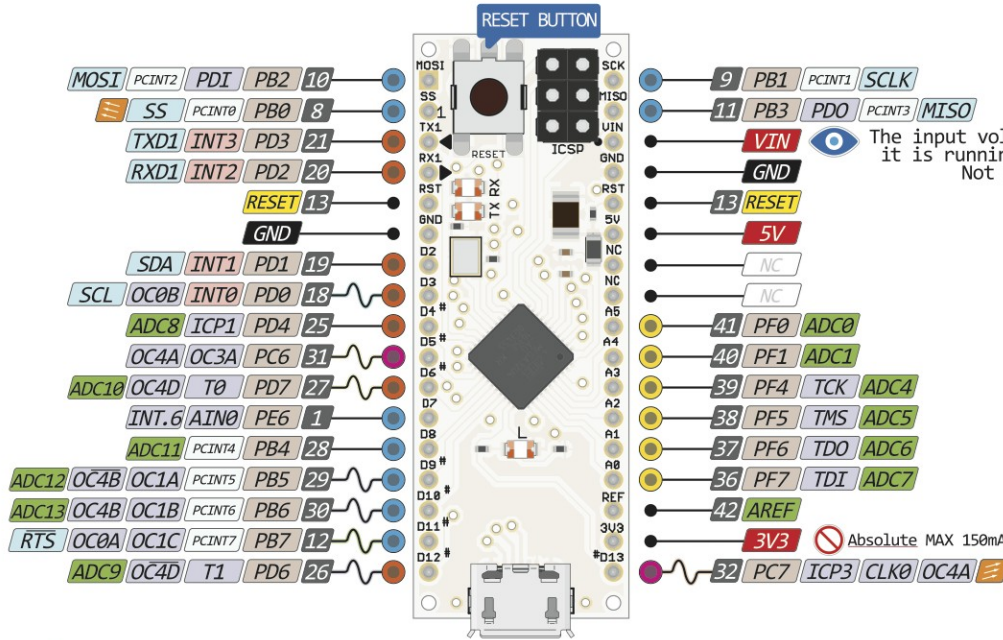
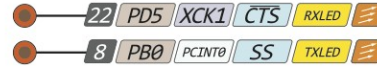
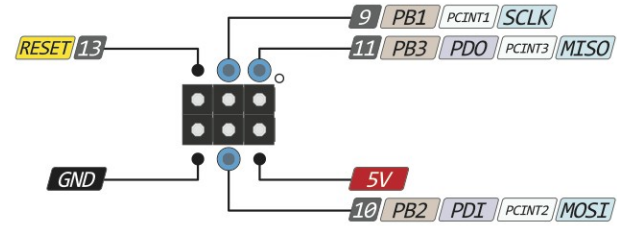
- Synchronous, serial data bus using the *Master/Slave* model
- Three common lines:
 - SCLK (*Serial Clock*)
 - MISO (*Master in, Slave out*)
 - MOSI (*Master out, Slave in*)
- One SS (*Slave Select*) line from the *Master* to each *Slave*
- Once a *Slave* is selected by the *Master* (by setting its SS to *LOW*), it “listens” on *MOSI* and answers over *MISO*



MICRO PINOUT

PWM TYPE

- 10bit
- 8/16bit
- HS
- 16bit
- 8bit



The input voltage to the board when it is running from external power. Not USB bus power.

- Power
- GND
- Serial Pin
- Analog Pin
- Control
- INT
- Physical Pin
- Port Pin
- Pin function
- Interrupt Pin
- PWM Pin
- Port Power

The power sum for each pin's group should not exceed 100mA

Absolute MAX per pin 20mA recommended 10mA

Absolute MAX 200mA for entire package

USB JACK Micro Type B

