Experiment 1

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First Question:

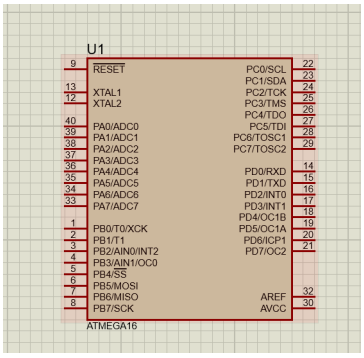
How to set up a microcontroller in the real world?

Answer:

we should use 3 wires:

- VCC
- GND
- AVCC (This should connect to VCC whenever not use)

Note: Top wires are not available in Atmega 16 in the proteus because we don’t need them to power up the microcontroller.



Reference:

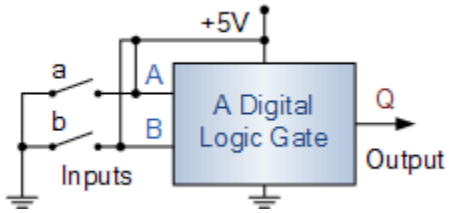
- [How to prepare an AtMega16 micro controller on a breadboard]
- Atmega 16 Datasheet

Second Question:

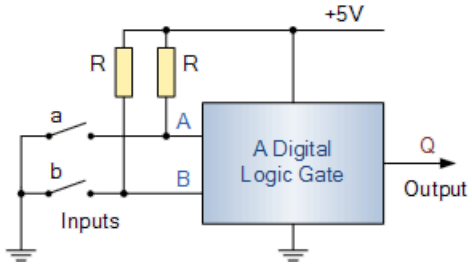
What is a pull-up?

One important issue that pins of microcontrollers have is floating-inputs that means they have random voltage or value (0,1) so to solve this problem we can use pull-ups for having High voltage (1) & low voltage (0) for pins. (like bottom picture)

We can use bottom circuit to have pull-up:



But when a,b connect we get a short circuit between Ground & Vcc that makes a big current and it makes heat. To solve this problem we use resistor to prevent the high current like down picture:



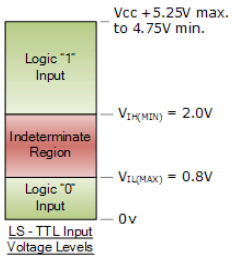
For calculate minimum R for this can use bottom formula:

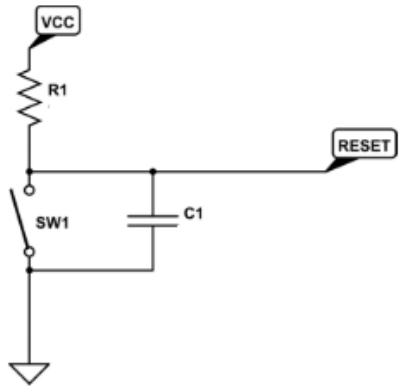
$$R_{min} = (V_{cc} - V_{OL}) / I_{OL}$$

R(min): This means minimum pull up resistor

V(cc) : is supply voltage

IOL & VOL: this comes from a logical - voltage diagram. (like bottom example)





Also we can have a capacitor to have a delay to pull-up .
For the top picture we use it for Reset pin.

$$T = RC$$

We can use the top formula to calculate the time of capacity charge.

How to calculate a pull-up resistor?

From reference i get these bottom tips:

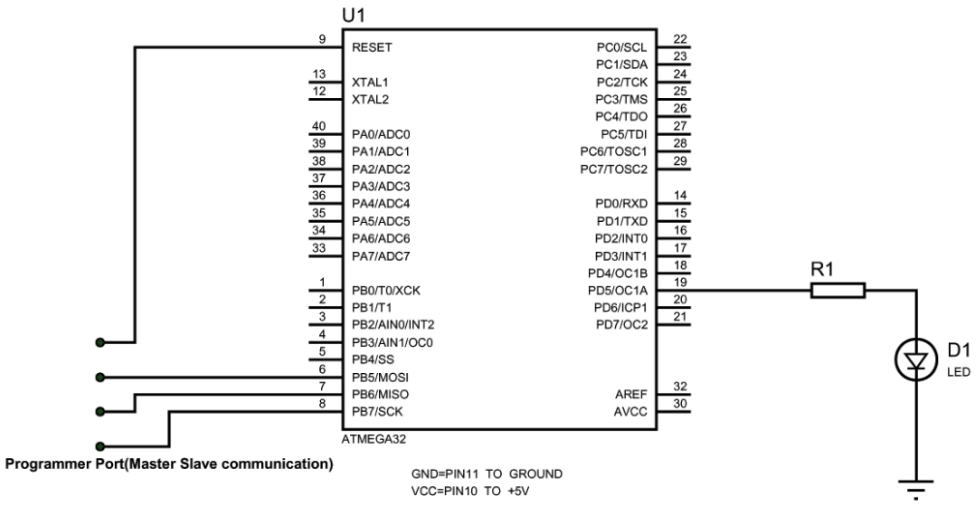
1. 1kΩ to 10kΩ for general purposes. (10k is preferred)
2. 10kΩ to 100kΩ if you have a low-power use case such as a device that is battery powered.

Reference:

- How do I calculate the required value for a pull-up resistor?
- Pull Up Your Pins: How to Size Pull-up Resistors | Bench Talk

Third Question:

Define resistor it for bottom circuit to turn on LED:



Any type of LED have a different Forward Voltage, we can see examples like bottom table :

CircuitBread | LED COLORS AND MATERIALS

Color	Wavelength Range (nm)	Forward Voltage (V)	Material
Ultraviolet	< 400	3.1 - 4.4	Aluminium nitride (AlN) Aluminium gallium nitride (AlGaN) Aluminium gallium indium nitride (AlGaInN)
Violet	400 - 450	2.8 - 4.0	Indium gallium nitride (InGaN)
Blue	450 - 500	2.5 - 3.7	Indium gallium nitride (InGaN) Silicon carbide (SiC)
Green	500 - 570	1.9 - 4.0	Gallium phosphide (GaP) Aluminium gallium indium phosphide (AlGaInP) Aluminium gallium phosphide (AlGaP)
Yellow	570 - 590	2.1 - 2.2	Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium phosphide (GaP)
Orange / Amber	590 - 610	2.0 - 2.1	Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaUInP) Gallium phosphide (GaP)
Red	610 - 760	1.6 - 2.0	Aluminium gallium arsenide (AlGaAs) Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium phosphide (GaP)
Infrared	> 760	> 1.9	Gallium arsenide (GaAs) Aluminium gallium arsenide (AlGaAs)

For calculate Resistor we can use this formula:

$$R = (V_s - V_{LED}) / I_{LED}$$

Reference:

- Interfacing an LED to a microcontroller
- End of Laboratory instructions page.

Question four:

Store string with 200 character to EEPROM and send it to another microcontroller

The source code of this project is in gitlab in folder Q4_8_line_communicate with two folder:

- Sender
- Receiver
- Proteus schematic

Note: runtime video is upload to github. (question_4_run)

Reference:

- Avr Atmega Atmega16 Eeprom | Avr Atmega
- 16x2 LCD Interfacing with Atmega16| Black Box Problem Solved