# Experiment 1

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## First Question:

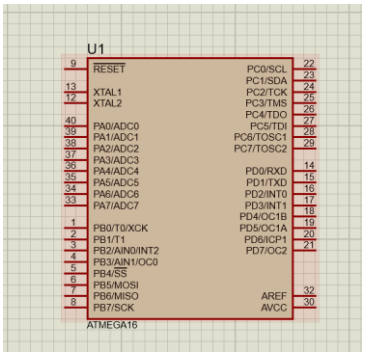
**How to set up a microcontroller in the real world?**

## Answer:

we should use 3 wires:

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

need them to power up the microcontroller.




## Reference:

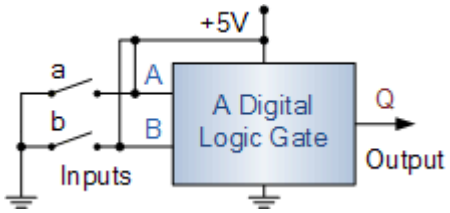
- ✓ [How to prepare an AtMega16 micro controller on a breadboard]

# Second Question:

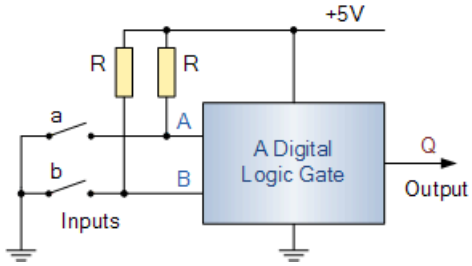
**What is a pull-up?**

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.

We can use bottom circuit to have pull-up:




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



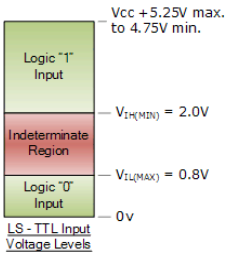

For calculate minimum R for this can use bottom formula:

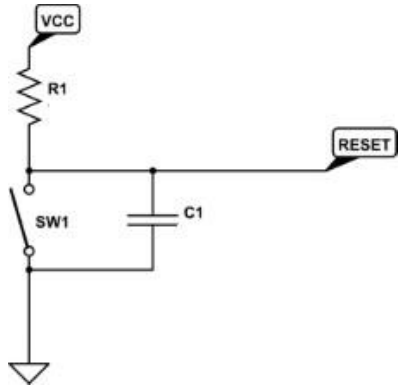
$$R_{min} = (V_{cc} - V_{OL}) / I_{OL}$$

R(min): This means minimum pull up resistor V(cc) :

is supply voltage

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






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:

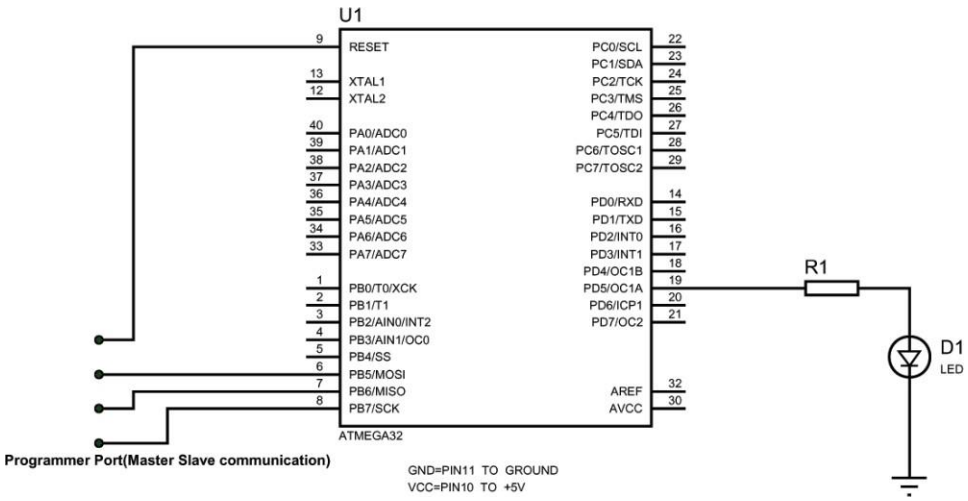
1. 1kΩ to 10kΩ for general purposes. (10k is preferred)
2. 10kΩ to 100kΩ if you have a low-power use case such as a devicethat is battery powered.

## Reference:

- ✓ How do I calculate the required value for a pull-up resistor?

# Third Question:

## Define resistor it for bottom circuit to turn on LED:




Any type of LED have a different Forward Voltage, see examples :

CircuitBread | LED COLORS AND MATERIALS

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

# Question four:

**Store string with 200 character to EEPROM and send it to another microcontroller with 8 wire**

The source code of this project is in gitlab in folderQ4_8_line_communicate with two folder:

- ✓ Sender
- ✓ Receiver
- ✓ Proteus schematic

**Note:** runtime video is uploaded to github. (question_4_run)
**Note:** commands of LCD get from this table:

| Hex Code | Command to LCD Command Register |
|---|---|
| 0E | Display on, Cursor on |
| 0F | Display on, cursor blinking |
| 10 | Shift cursor position to left |
| 14 | Shift cursor position to right |
| 18 | Shift the entire display to the left |
| 1C | Shift the entire display to the right |
| 80 | Force cursor to the beginning of 1st line |
| C0 | Force cursor to the beginning of 2nd line |
| 28 | 2-lines and 5 × 7 matrix D4-D7, 4 bits |
| 33 | Go into 4-bit operating mode |
| 32 | Go into 4-bit operating mode |
| 38 | 2-lines and 5 × 7 matrix D0-D7, 8 bits |

**Reference:**


- ✓ Avr Atmel Atmega16 Eeprom | Avr Atmega

# Question five:

**Implement question four project with only one wire.**

The source code of this project is in gitlab in folderQ5_1_line_communicate with two folder:

- ✓ Sender
- ✓ Receiver
- ✓ Proteus schematic

**Reference:**


- Bit Operation in AVR Microcontroller | by Orvin Demsy | Medium