# Arduino 37 Sensor Kit
# First acquaintance

Lecturer Dr. Samuel Kosolapov

# General Appearance: ~ 36+1 modules in one box



In this presentation only simple (even primitive) modules will be explained and demonstrated

# Leaflet inside the box

# Leaflet inside the box: Arrangement of modules

# List of Modules in the box: KY-0XY

- 1 x Small passive buzzer module KY-006
- 1 x 2-color LED module KY-011
- 1 x Hit sensor module KY-031
- 1 x Vibration switch module KY-002
- 1 x Photo resistor module KY-018
- 1 x Key switch module KY-004
- 1 x Tilt switch module KY-020
- 1 x 3-color full-color LED SMD modules KY-009
- 1 x Infrared emission sensor module KY-005
- 1 x 3-color LED module KY-016
- 1 x Mercury open optical module KY-017
- 1 x Yin Yi 2-color LED module 3MM KY-029
- 1 x Active buzzer module KY-012
- 1 x Temperature sensor module KY-013
- 1 x Automatic flashing colorful LED module KY-034
- 1 x Mini magnetic reed modules KY-021
- 1 x Hall magnetic sensor module KY-003
- 1 x Infrared sensor receiver module KY-022

- 1 x Class Bihor magnetic sensor KY-035
- 1 x Magic light cup module KY-027
- 1 x Rotary encoder module KY-040
- 1 x Optical broken module KY-010
- 1 x Detect the heartbeat module KY-039
- 1 x Reed module KY-025
- 1 x Obstacle avoidance sensor module KY-032
- 1 x Hunt sensor module KY-033
- 1 x Microphone sound sensor module KY-038
- 1 x Laser sensor module KY-008
- 1 x 5V relay module KY-019
- 1 x Temperature sensor module KY-001
- 1 x Temperature sensor module KY-028
- 1 x Linear magnetic Hall sensors KY-024
- 1 x Flame sensor module KY-026
- 1 x Sensitive microphone sensor module KY-037
- 1 x Temperature and humidity sensor module KY-015
- 1 x XY-axis joystick module KY-023
- 1 x Metal touch sensor module KY-036

# Problem: Random Arrangement inside the box:

Modules are not arranged as in this picture.
→ First "**exercise**" is to **arrange** modules
    in accordance with this picture

THIS IS NOT A TRIVIAL JOB !!!

Visual difference between some modules is very small.
*(Remember "Find 2 differences games for children" ?*
Small details (like "holes" position)
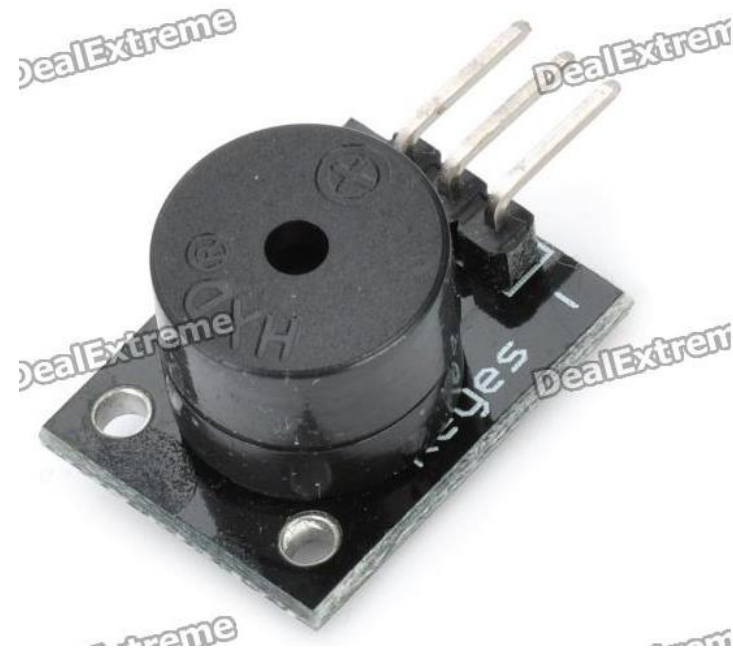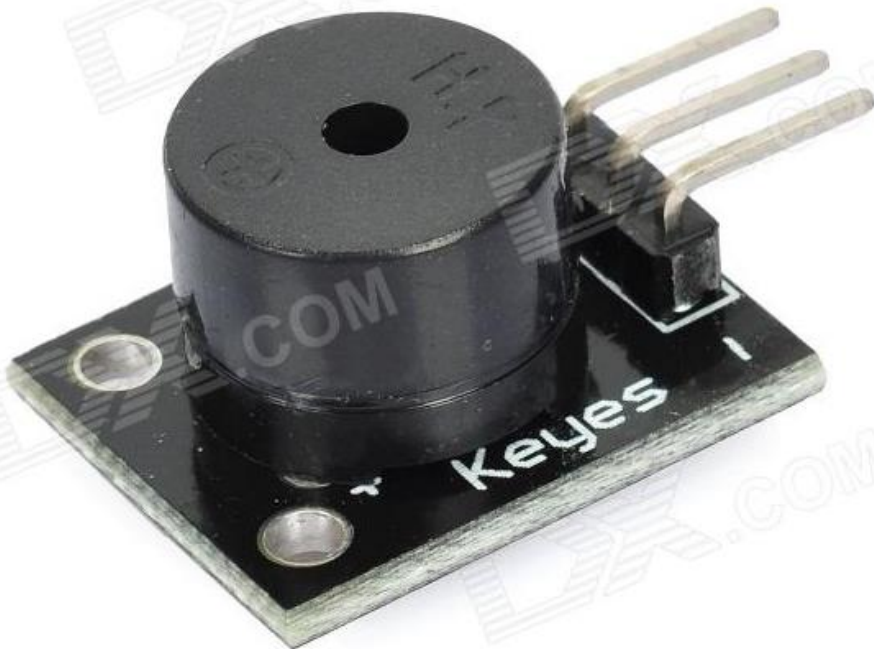    must be taken into account.
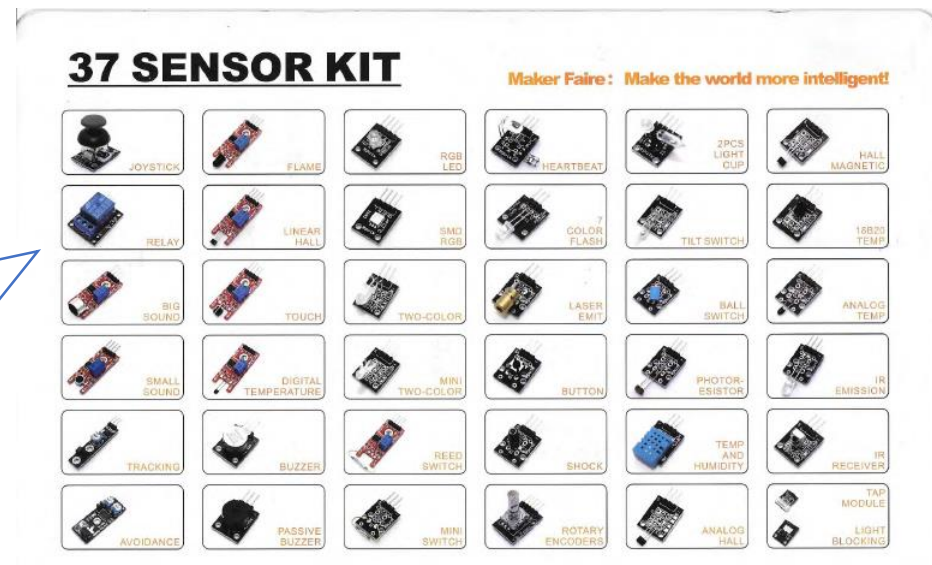
# What is the difference ?
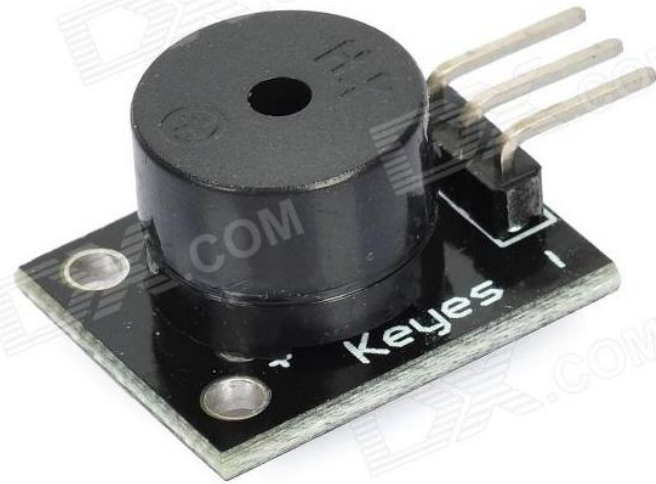## *(KY number is not present on the board ...)*



Arduino KY-006 Small **passive** buzzer module

Arduino KY-012 **Active** buzzer module

# Simple "electronic" test *(demonstrate)*

**passive** buzzer module
will shortly "click"

Connect Pin "-" to GND
Connect Pin "S" to +5V
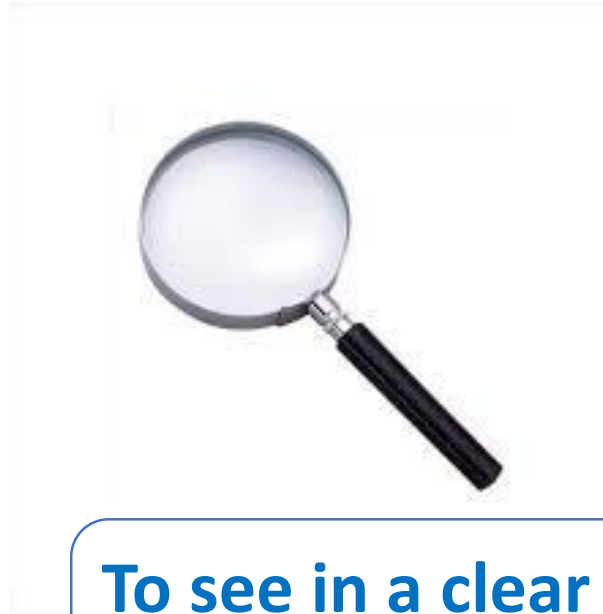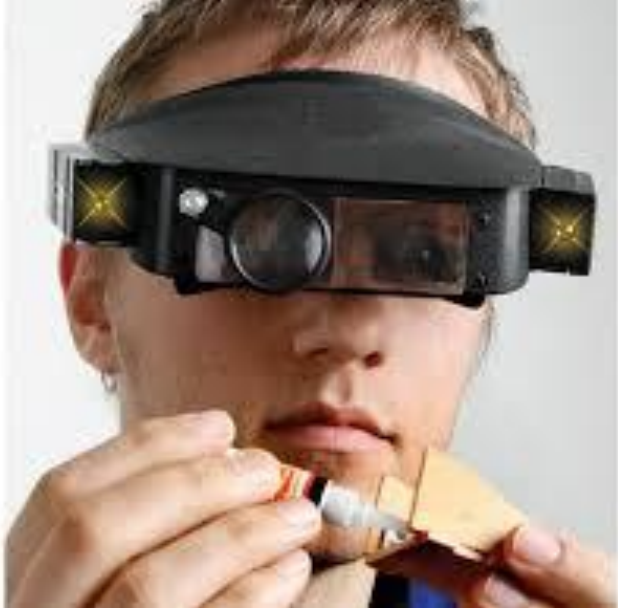Middle Pin: is not important

**Active** buzzer module
will produce constant tone

**Execute "live test" only after you get proper explanations**

**Details and usage later**

# Useful tool for EE: Magnification lens

**To see in a clear way
small letters and pin numbers**

Some elements of the sensors
 can be bend in an **inappropriate way**.
**Gently** unbend   (or ask lecturer in case of doubts)

# Problem: No serious documentation

The problem with finding the data sheet
 is due to the fact that the name
 on the controllers board KEYES
is the name of the board manufacturer
 who does not specify his board anywhere

Their reference for the product is:
318-ENC130175F-12PS
The data sheet **is just one page**
   but it does describe the PIN_OUTS.

However, short module description + examples can be found:
   **https://tkkrlab.nl/wiki/Arduino_37_sensors**
 **(Unfortunately, this site is**
 **Google Translation from Chinese,**
 **so some creativity is needed to understand**
   **what does this means…**

→ **One of the goals of student's presentations:**
      **Create some documents and examples**
**Hint**:  use "KY-xxx" to find youtube videos and exemplary projects

# Primitive Sensor: Switch

+5V (Middle Pin)

Pullup
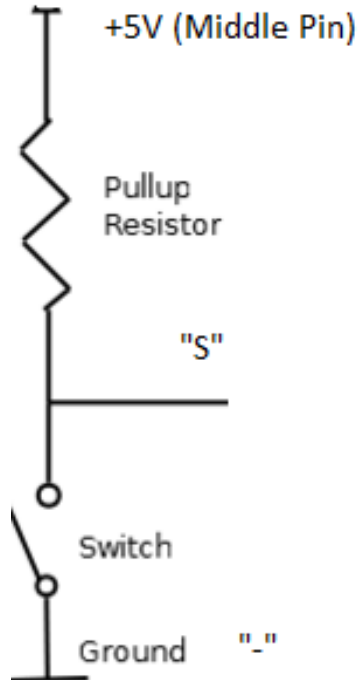Resistor

"S"

Switch

Ground    "-"

37 Sensor Kit contains a number of primitive sensors which are actually operates as a mechanical switch. Despite primitive design , those modules **sense** important events.

In some cases operation of the "switch sensors" can be demonstrated by measuring resistance between "S" and GND pins
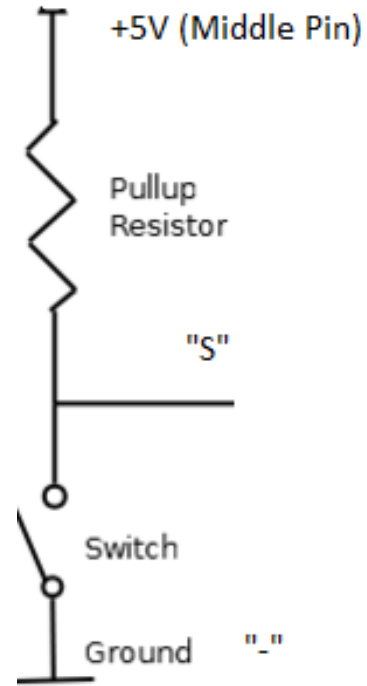
Pin "-"  : Connect to Arduino GND
Middle pin :  Connect to Arduino +5V
Pin "S"  :  Connect to Arduino Digital pin configured to INPUT

Between Pin "S" and Middle Pin ("+5V") there is
    10 k Pull-up resistor

Pull-Up resistor. Reminder:
It is assumed that input impedance
     of the circuit connected to Pin "S" is high
          and has no influence on the Pin "S" voltage.
When switch is OFF, pin "S"  has "5V" (HIGH)
When switch is off, Pin "S" is connected to the Ground
    → Pin "S" is  LOW

# Primitive Sensor: KY-004 Mechanical Key Switch



+5V (Middle Pin)
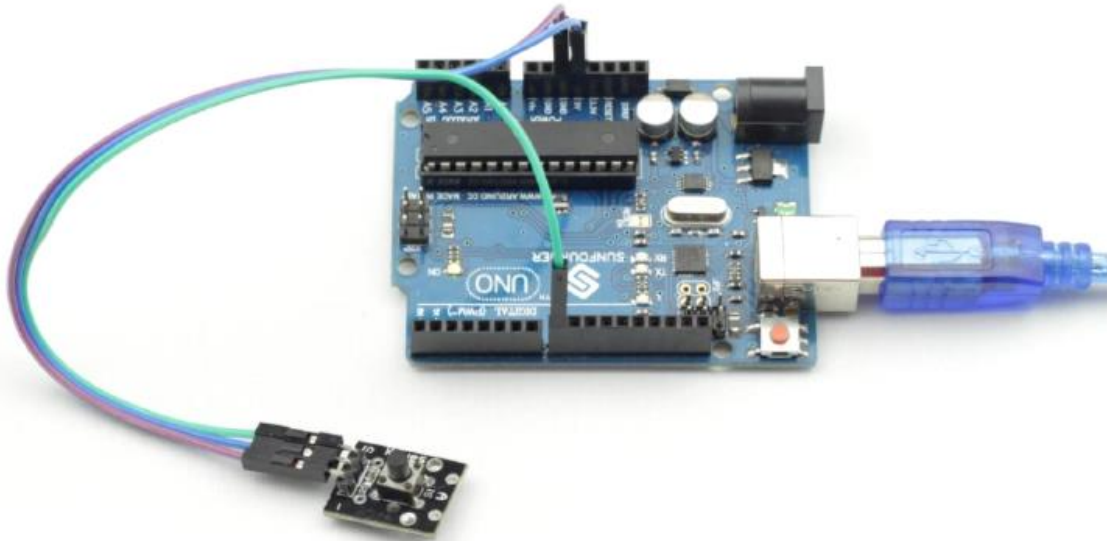
Pullup Resistor

"S"

Switch

Ground    "-"

Pin "-"   : Connect to Arduino GND
Middle pin : Connect to Arduino +5V
Pin "S"  : Connect to Arduino Digital pin configured to INPUT

Between Pin "S" and Middle Pin ("+5V") there is
    10 k Pull-up resistor

**Warning: Image is differ
from real switch (mirror)**

# Example of Mechanical Key Switch Test

Pin "S" of the switch connected to (say) Pin 8 of the Arduino Board

Circuit operation:
   LED13 is normally OFF
   When the button (key) is pressed, LED13 is ON

# Example of Mechanical Key Switch Test

```
int Led = 13 ;// define LED Interface
int buttonpin = 10; // define the key switch sensor interface
int val ;// define numeric variables val
void setup ()
{
  pinMode (Led, OUTPUT); // define LED as output interface
  pinMode (buttonpin, INPUT); // define the key switch sensor output interface
}
void loop ()
{
  val = digitalRead (buttonpin);
    if (val == HIGH)  // When the key switch when the sensor detects a signal, LED flashes
  {
    digitalWrite (Led, HIGH);
  }
  else
  {
    digitalWrite (Led, LOW);
  }
}
```

Pin 10 (and not 8) is used in this example

**No DEBOUNCING in this example !!!
(Human eye will "average" LED intensity changes**

# KY-021 Mini magnetic reed switch
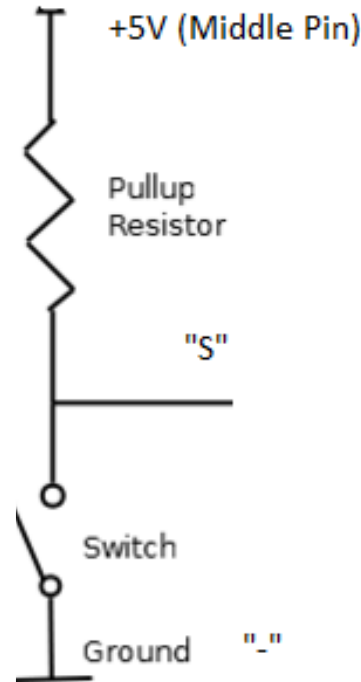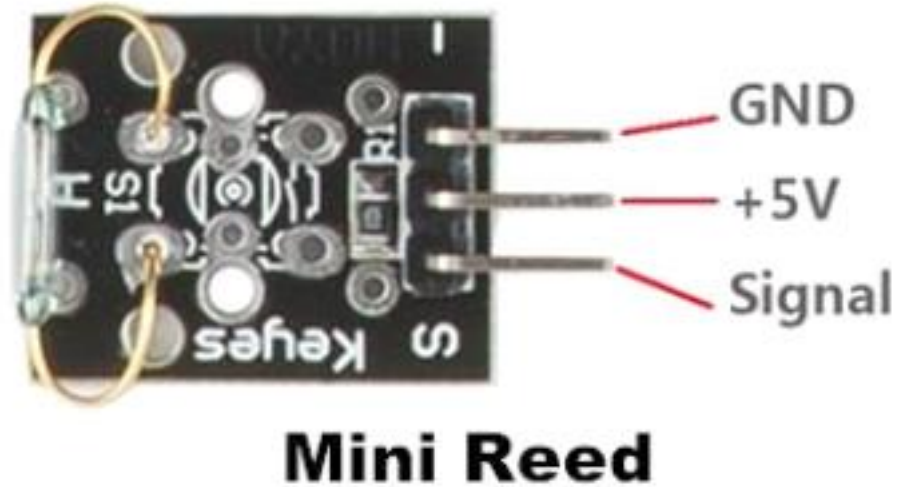
**Mini Reed**

+5V (Middle Pin)

Pullup Resistor

"S"

Switch

Ground    "-"

Pin "-"   : Connect to Arduino GND
Middle pin :  Connect to Arduino +5V
Pin "S"  :  Connect to Arduino Digital pin configured to INPUT

Between Pin "S" and Middle Pin ("+5V")
there is  10 k Pull-up resistor

Switch is Normally OPEN.
When exposed to magnetic field switch get closed

(Demonstrate with tester and small magnet)

The code is as with "simple button/key switch

Discuss usage in the industry and at home.
(Hidden lock (open with magnet.
Door with magnet: is the door open ?

# KY-021 Mini magnetic reed switch



Small magnet
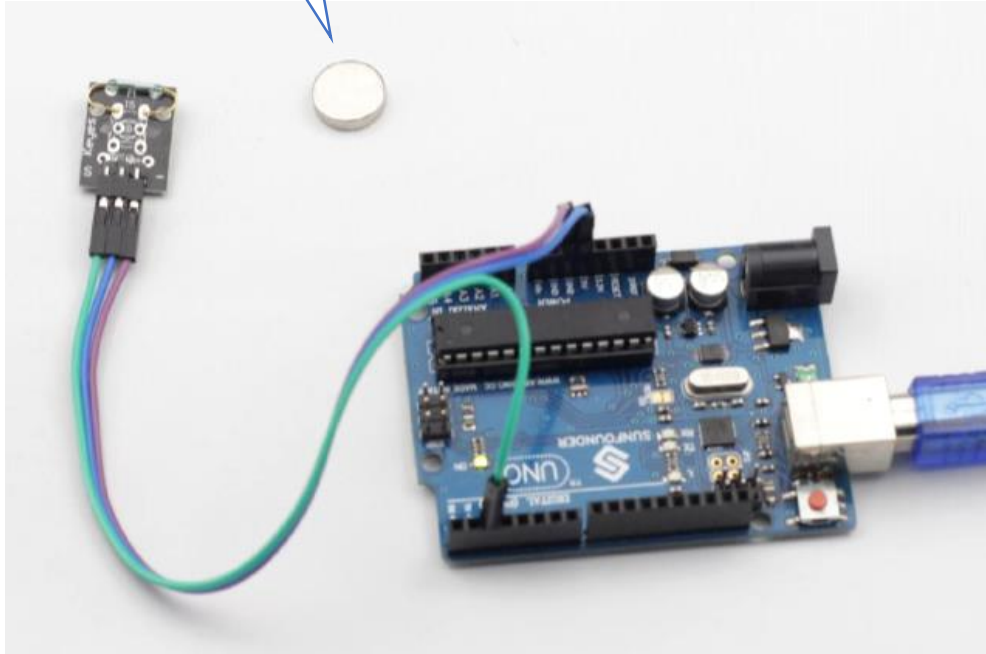
The shell of a reed switch is commonly a
sealed glass pipe
in which
two iron elastic reed electroplates are equipped
and inert gases are filled.
Normally, the two reeds are separated.
However, when a magnetic substance (for example, small magnet)
approaches the glass tube,
the two reeds in the glass tube are magnetized and attract each other
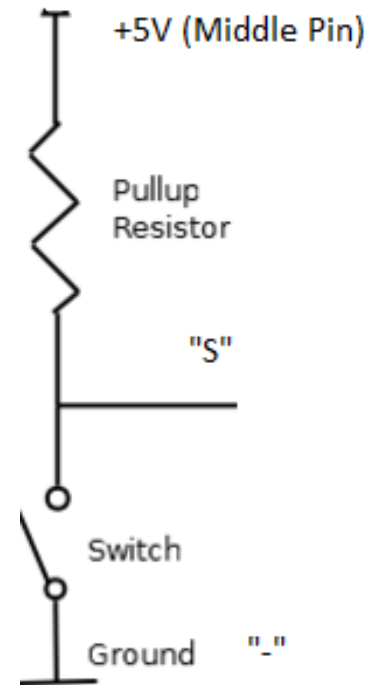As a result, the two reeds will pull together
creating electrical contact
After external magnetic force disappeared,
the two reeds will be separated with each other
because they have the same magnetism,
then the circuit is disconnected.

# KY-020 Tilt switch



+5V (Middle Pin)

Pullup
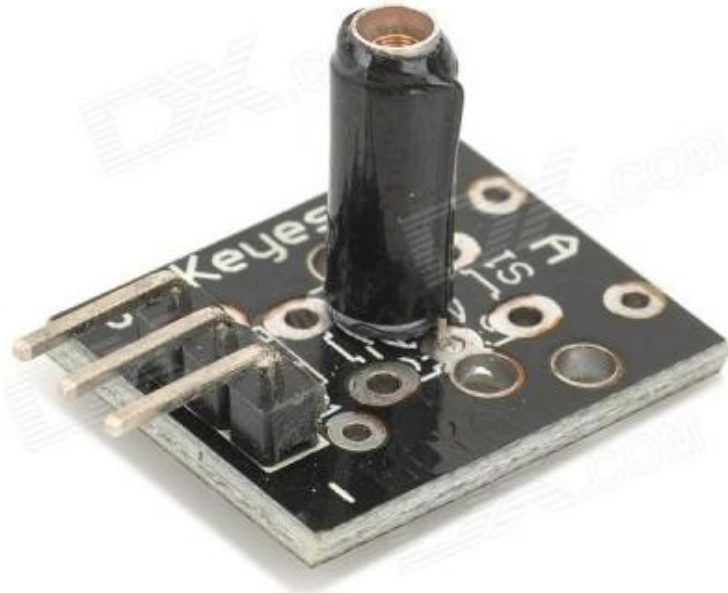Resistor

"S"

Switch

Ground    "-"

Pin "-"   : Connect to Arduino GND
Middle pin :  Connect to Arduino +5V
Pin "S"  :  Connect to Arduino Digital pin
configured to INPUT

Between Pin "S" and Middle Pin ("+5V")
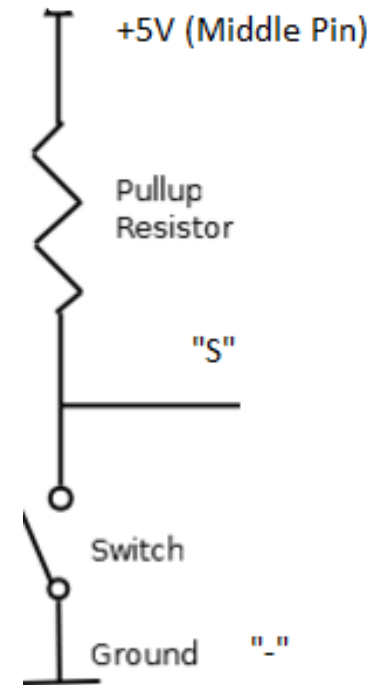there is  10 k Pull-up resistor

Switch is Normally OPEN.
When oriented upwards, the switch is closed.
Inside: a small ball that moves when orientation changes
(Demonstrate with tester)

The code is as with "simple button/key switch

Discuss usage in the industry and at home.
 (Theft protection ?
Alarm when object is moved ?

# KY-002 Vibration switch

+5V (Middle Pin)

Pullup Resistor

"S"

Switch

Ground "-"

Pin "-"  : Connect to Arduino GND
Middle pin :  Connect to Arduino +5V
Pin "S"  : Connect to Arduino Digital pin configured to INPUT

Between Pin "S" and Middle Pin ("+5V") there is  10 k Pull-up resistor

A shock switch also called
   vibration switch, spring switch or shock sensor,
      is an electronic switch.
It contains conductive vibration spring.
Switch is normally open.
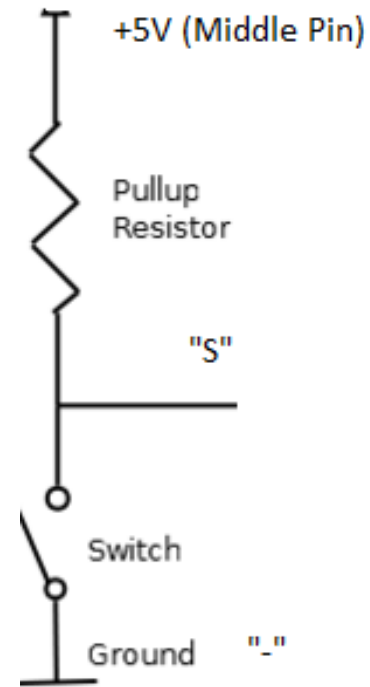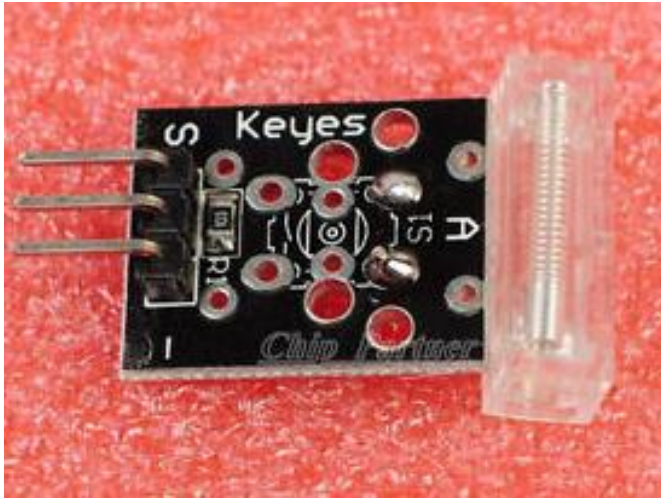When vibrated, switch is closed.

The code is as with "simple button/key switch

Discuss usage in the industry and at home.

**Operation of this module cannot be demonstrated by using multimeter (too slow)**

# KY-031 knock/tap switch



+5V (Middle Pin)

Pullup Resistor
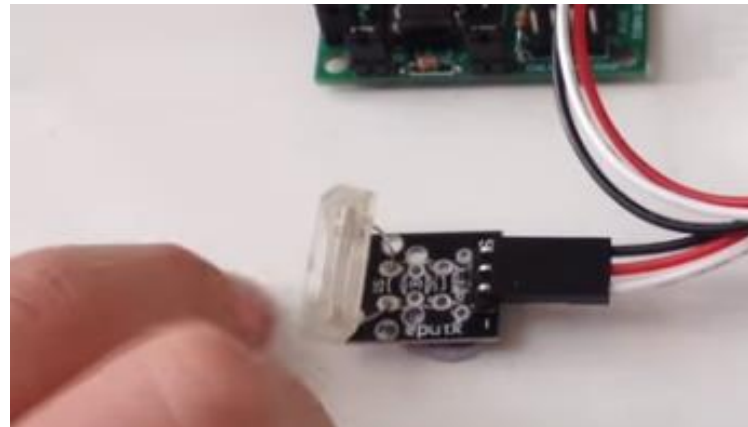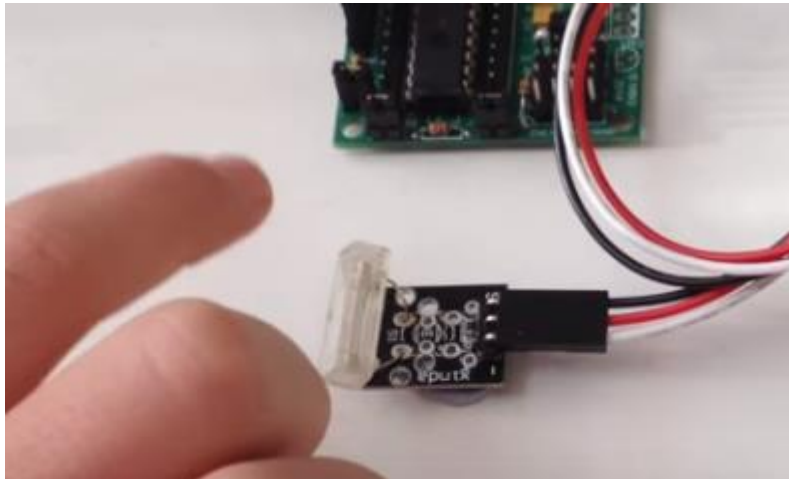
"S"

Switch

Ground    "-"

Pin "-"    : Connect to Arduino GND
Middle pin :  Connect to Arduino +5V
Pin "S"   : Connect to Arduino Digital pin
configured to INPUT

Between Pin "S" and Middle Pin ("+5V")
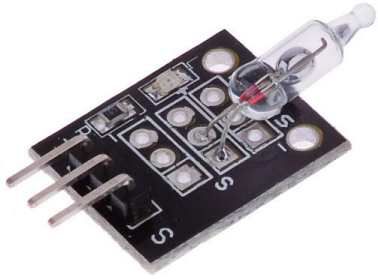there is  10 k Pull-up resistor

The code is as with
"simple button/key switch

Discuss usage in the industry and at home.

**Operation of this module cannot be demonstrated  by using multimeter (too slow)**
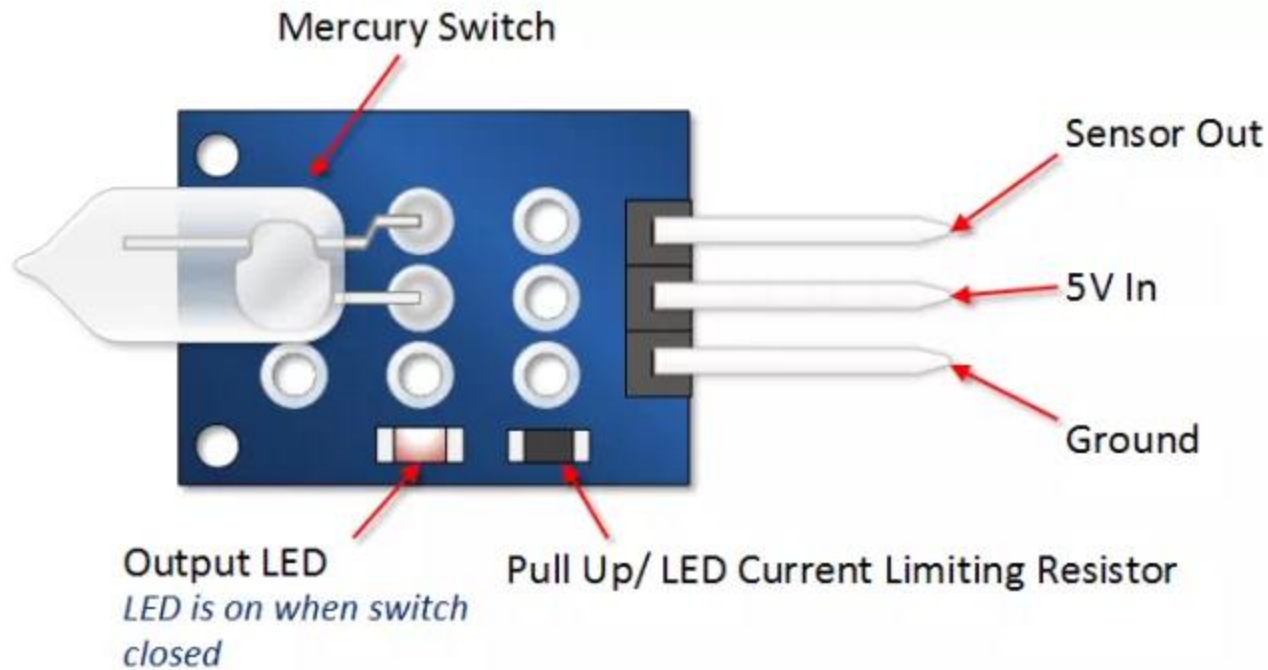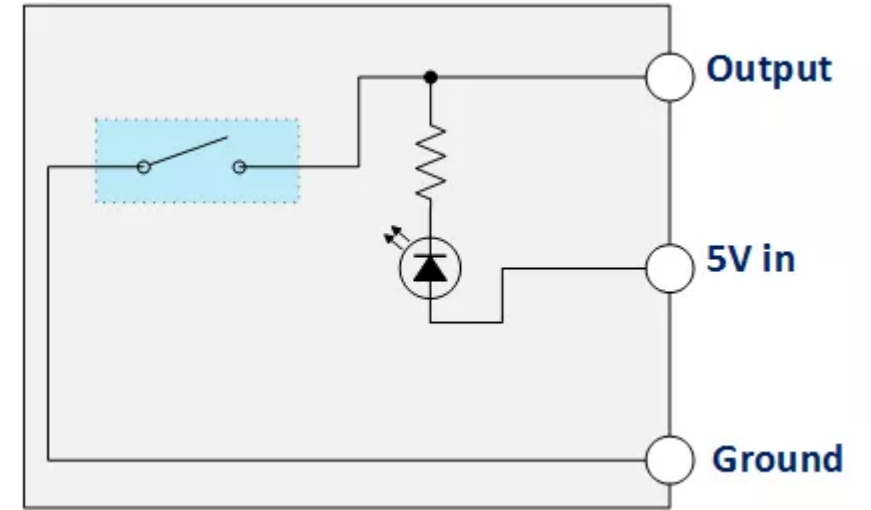
# KY-017 Mercury tilt switch

Pin "-"  : Connect to Arduino GND
Middle pin : Connect to Arduino +5V
Pin "S"  : Sensor Out

Additionally
  there is  10 k Pull-up resistor and LED

Output

5V in

Ground
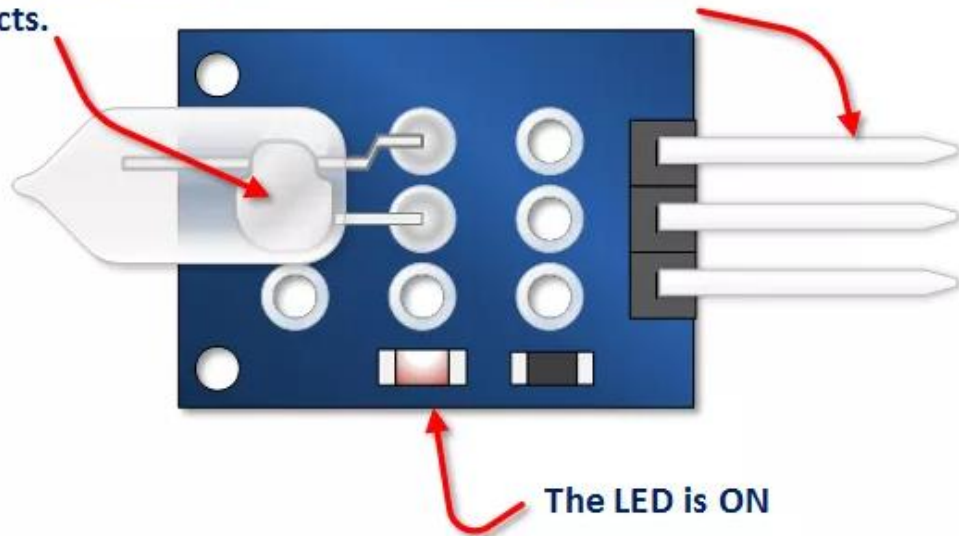
Mercury Switch

Sensor Out

5V In

Ground

Output LED
*LED is on when switch closed*

Pull Up/ LED Current Limiting Resistor

# KY-017 Mercury tilt switch

Not Tilted

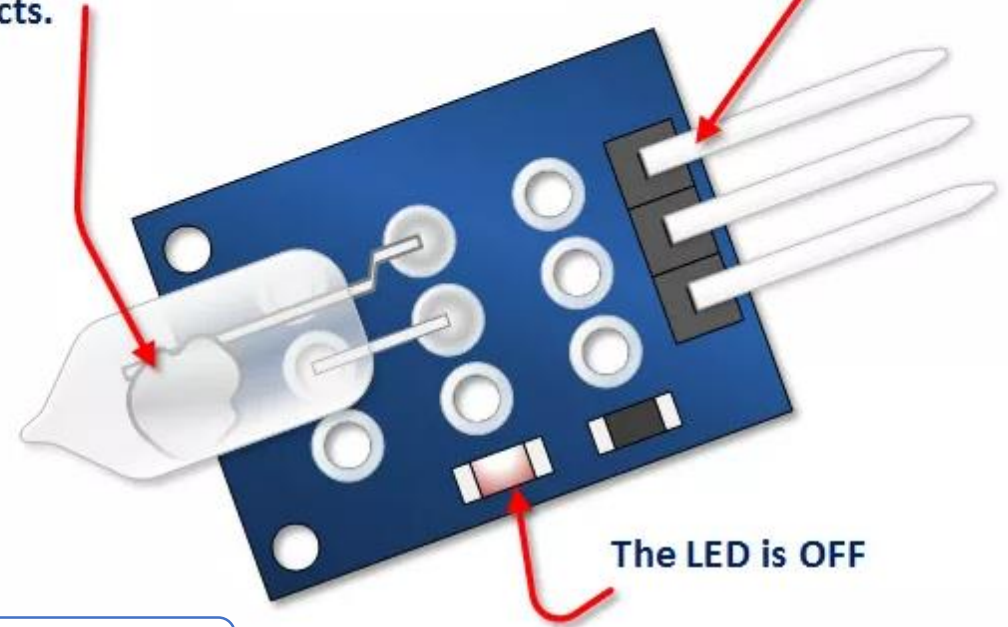The code is as with
"simple button/key switch

Tilted

The output is High

The ball of mercury is
shorting the switch
contacts.

The output is LOW

The ball of mercury is NOT
shorting the switch
contacts.

The LED is ON

The LED is OFF

Discuss usage in the industry and at home.

# Simple Actuators

37 Sensor Kit contains a number of simple ACTUATORS like LED, Buzzer.

In some cases operation of these modules can be demonstrated by applying +5V to relevant pins (do not forget about GND, however)

The simplest usage of these modules is to signal to human operator that something happen

# LED as actuator.

We already know
how to operate Flashing LED
on the Pin13 of the Arduino Board



Flashing LED
(Pin 13)

Power On
LED

Serial Communications
LEDs
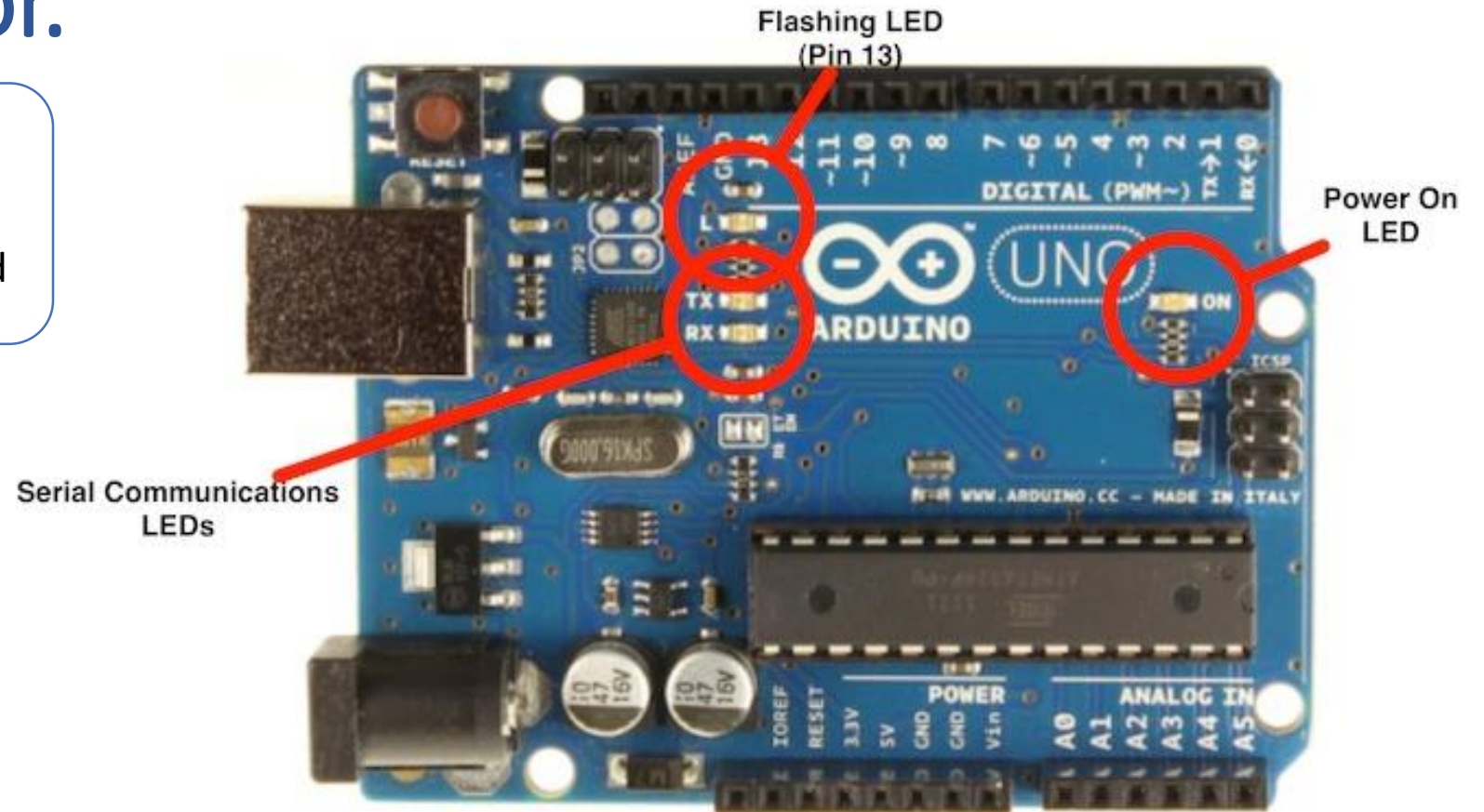
The trivial usage of the LEDs is to send to human operator simple predefined messages.
For example "Power is ON";  Serial communication is going on

# LED as actuator.
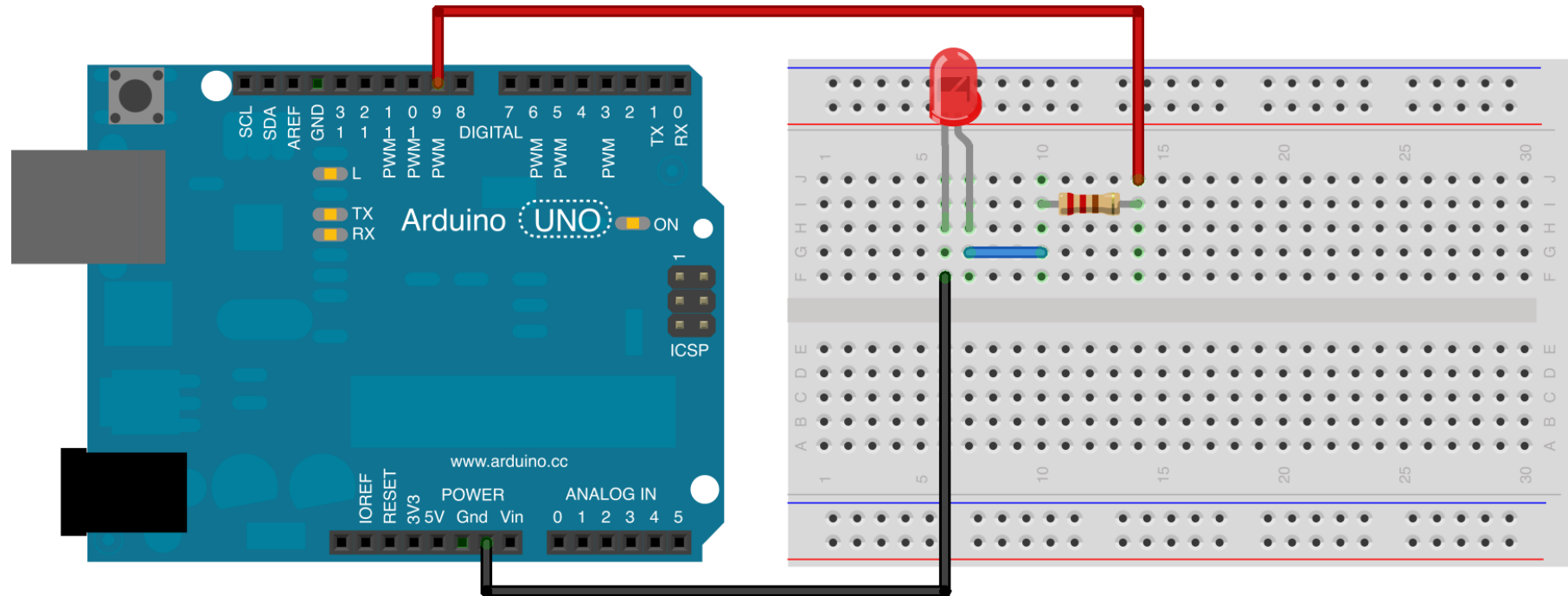


Made with ▯ Fritzing.org

LED can be easily connected to Arduino.

**BUT:  As LED as Arduino board can be damaged in some cases.**

**→ Do not connect LEDs before checking voltages and currents.**

**Details later**

# KY-016 3-Color 5V RGB LED Module.

**For some reason known to producer only :**
**"R" == "B"**
**"G" == "G"**
**"B" ==" R"**

**Demonstrate direct connection of R, G, B pins to 5V. Pin "-" to GND.**
**Safe, because protection resistors are on the module.**
*RGB trichromatic limiting resistor to prevent burnout*

**Advanced usage with PWM and analogWrite will be explained later**
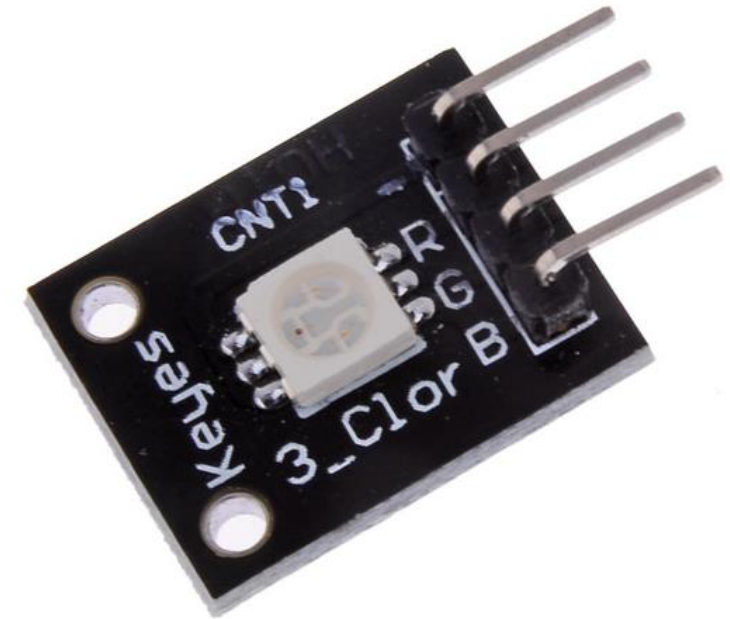
# KY-009  3-Color 5V RGB SMD LED Module.

You can't connect the led's directly to the Arduino
→ You will need resistors!!
Arduino pin 9 > 180 Ohm resistor > Pin 'R' of KY009 module
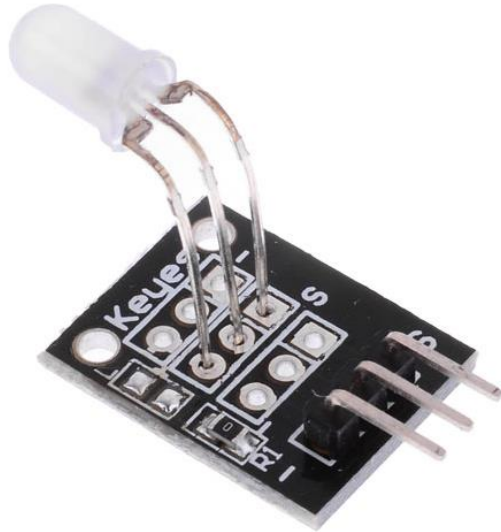Arduino pin 10 > 100 Ohm resistor > Pin 'G' of KY009 module
Arduino pin 11 > 100 Ohm resistor > Pin 'B' of KY009 module

No demonstrations
  Students will not get this module (no reason)
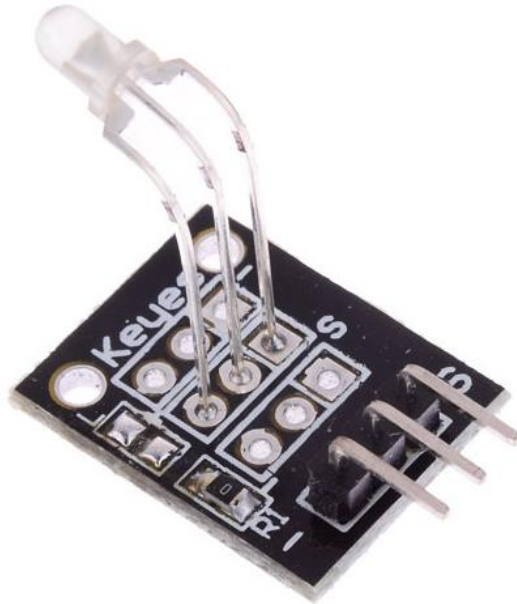
# KY-011 Two color LED 5mm .



Color: Green + Red
Diameter: 5mm
Case Color: None
Package Type: Diffusion
Voltage (V) :2.0-2.5v
Using a current (MA): 10
Viewing angle: 150
Wavelength (NM): 571 +644
Luminous intensity (MCD) :20-40; 40-80
Stent type: long-legged
→ **330 Ohm resistor is needed**
→ **DO NOT USE**

**No demonstrations**
 **Students will not get this module (no reason)**

# KY-029 Two color LED mini 3mm diam.

Color: Green + Red
Diameter: 3mm
Case Color: None
Package Type: Diffusion
Voltage (V) :2.0-2.5v
Using a current (MA): 10
Viewing angle: 150
Wavelength (NM): 571 +644
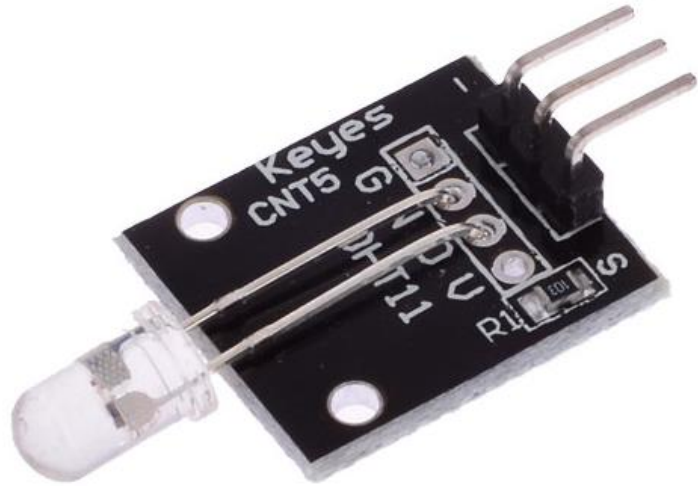Luminous intensity (MCD) :20-40; 40-80
**???  Ohm resistor is needed**
→ **DO NOT USE**

**No demonstrations**
  **Students will not get this module (no reason)**

# KY-034 7-color Automatically Flashing LED

The module contains a 7-color 5mm LED
  with a built-in chip
 that sequentially flashes each color in turn.
Color pattern is repeated in about **15 seconds**.
  LED model: YB-3120B4PNYG-PM
  Forward voltage: 2.5V - 6V
  Forward current: 40mA

## Connection

| Pin | Description |
|---|---|
| "S" | +5V or +3.3V |
| Central | Ground |
| "-" | Not connected |

**Use as fancy ALARM.**
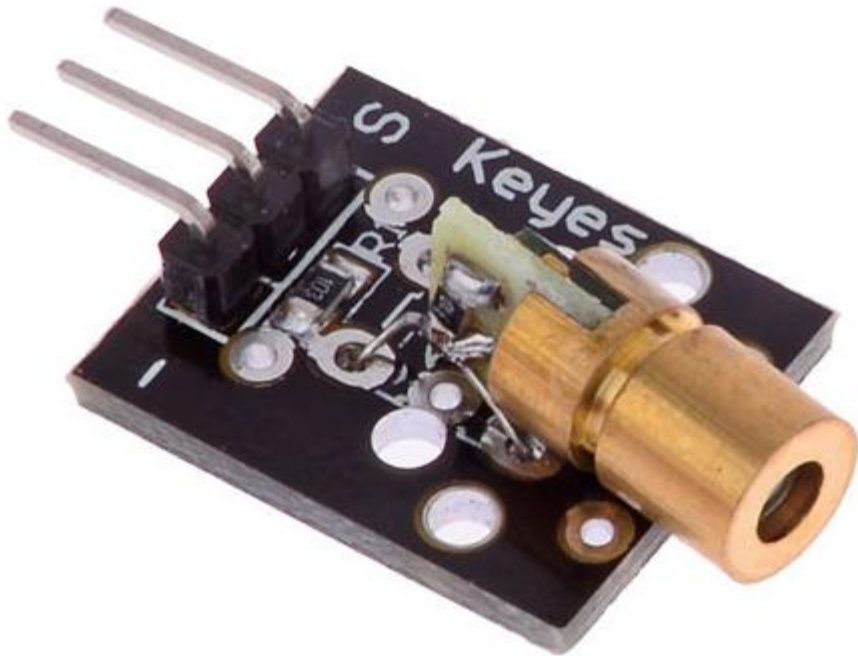**Mind 15 sec time needed to see all the colors**

**Demonstrate by direct connection.**
**Attention: GND is Middle pin !!!**

# KY-008 Laser Diode 650 nm

## Connection

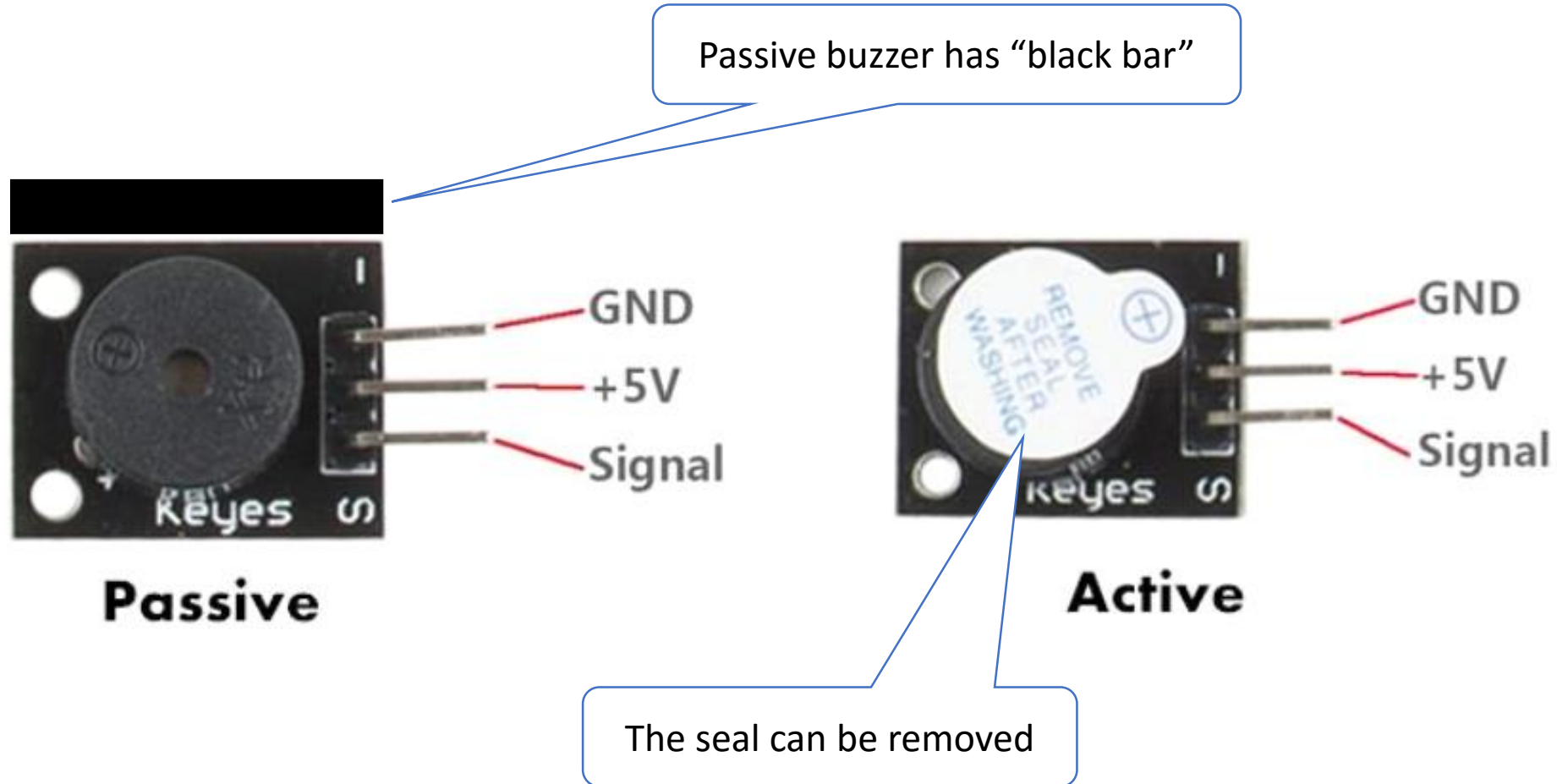| Pin | Description |
|---|---|
| "S" | +5V or +3.3V |
| Central | Not connected |
| "-" | Ground |

Laser Diodes are widely used in electronics

BUT: Students will not get Laser Diode
Because this device is really dangerous.

# KY-006 Passive Buzzer and KY-012 Active Buzzer

Passive buzzer has "black bar"



GND

+5V

Signal

**Passive**

The seal can be removed

GND

+5V

Signal

**Active**

# KY-006 Passive Buzzer and KY-012 Active Buzzer

Passive buzzer has passive piezo element inside

Active buzzer has piezo element and additional "oscillator" inside
→ More expensive, but simpler for usage

# KY-006 Passive Buzzer and KY-012 Active Buzzer

**Passive Buzzer**
 Can be used as Primitive Speaker
   with limited frequency range)

Pin (-)   : GND
Pin (S) : Signal
**Middle pin is NOT USED**

Connect "S" to pin producing "signal" of **different frequencies** → Buzzer will produce "sound"

Generally square wave  (up to ~ 5K) generated by digital pin is used.

When DC (5V) is connected to "S"
Only short "click" is heard.

**Active Buzzer**
  Can be used as very simple **ALARM**

Pin (-)   : GND
Pin (S) : Signal
**Middle pin is NOT USED**

 When DC (or Pin having 5V or 3.3V) is connected to "S" signal of **constant** frequency is heard

# KY-012 Active Buzzer

**Active Buzzer**

  Can be used as very simple **ALARM together with LED13**

Pin (-)   : Connect to GND
Pin (S) :  Connect to (say) Pin 12
**Middle pin is NOT USED**

 When Pin12 is low nothing happened
 When Pin12 is HIGH "ALARM" is heard

**More sophisticated usage of active buzzer
with PWM will be discussed later**

# KY-006 Passive Buzzer

**Passive Buzzer can be used as a cheap alternative to speaker**
    BUT: Useful frequency range is limited

**tone** function
Syntax
    tone(pin, frequency)
    tone(pin, frequency, duration)
Parameters
    pin: the pin on which to generate the tone
    frequency: the frequency of the tone in Hertz - *unsigned int*
    optional parameter: duration: the duration of the tone in milliseconds - *unsigned long*
Returns
    nothing

**For UNO:**
   **min frequency: 31 Hz. Max frequency 65535 Hz**
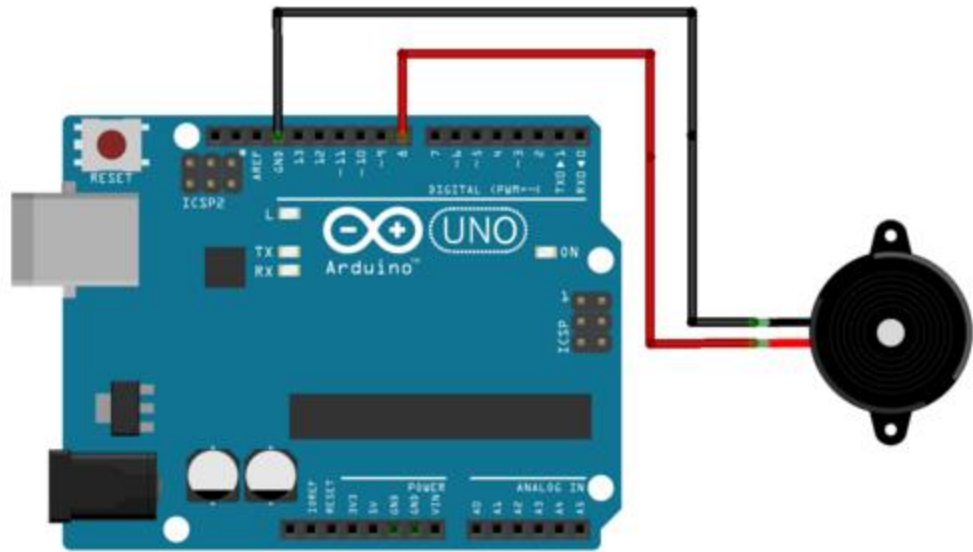**BUT:**
    **primitive buzzer cannot play such**
        **a high frequencies.**

The alternative tone function can be implemented by direct manipulations with relative pin
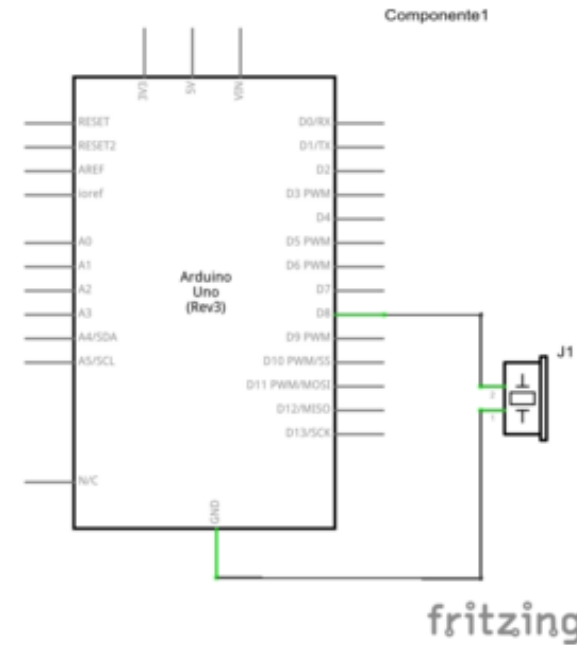
# KY-006 Passive Buzzer play melody

Circuit

Schematic



fritzing

fritzing

Go to above page to see the code. **BUT: Use buzzer, not 8 Om speaker !!!!!!**

# Speaker instead of Passive Buzzer

If you connected the speaker directly to the Arduino digital pin
   you have damaged your Arduino pin by pulling too much current from it.

Do not rely on internal protection resistor.

You need at least a 120 ohm resistor in line with the speaker for direct connection.
 Of course it will not be as loud but then you are not burning your output pin.

For best results you need to use a transistor and capacitor to connect your speaker. Google for lots of schematics.

Translation: Use Power Amplifier with different Power Supply.

# KY-019 5V Relay Module

http://tinkbox.ph/sites/tinkbox.ph/files/downloads/KEYES%205V%20Relay%20Module%20KY-019.pdf

Relay module with one normally open and one normally closed contacts.
It can be used to control home appliances up to **220V AC 10A or 30 V DC 10A.**

**Do not Connect serious staff here**
REMEMBER: It case of 220 V
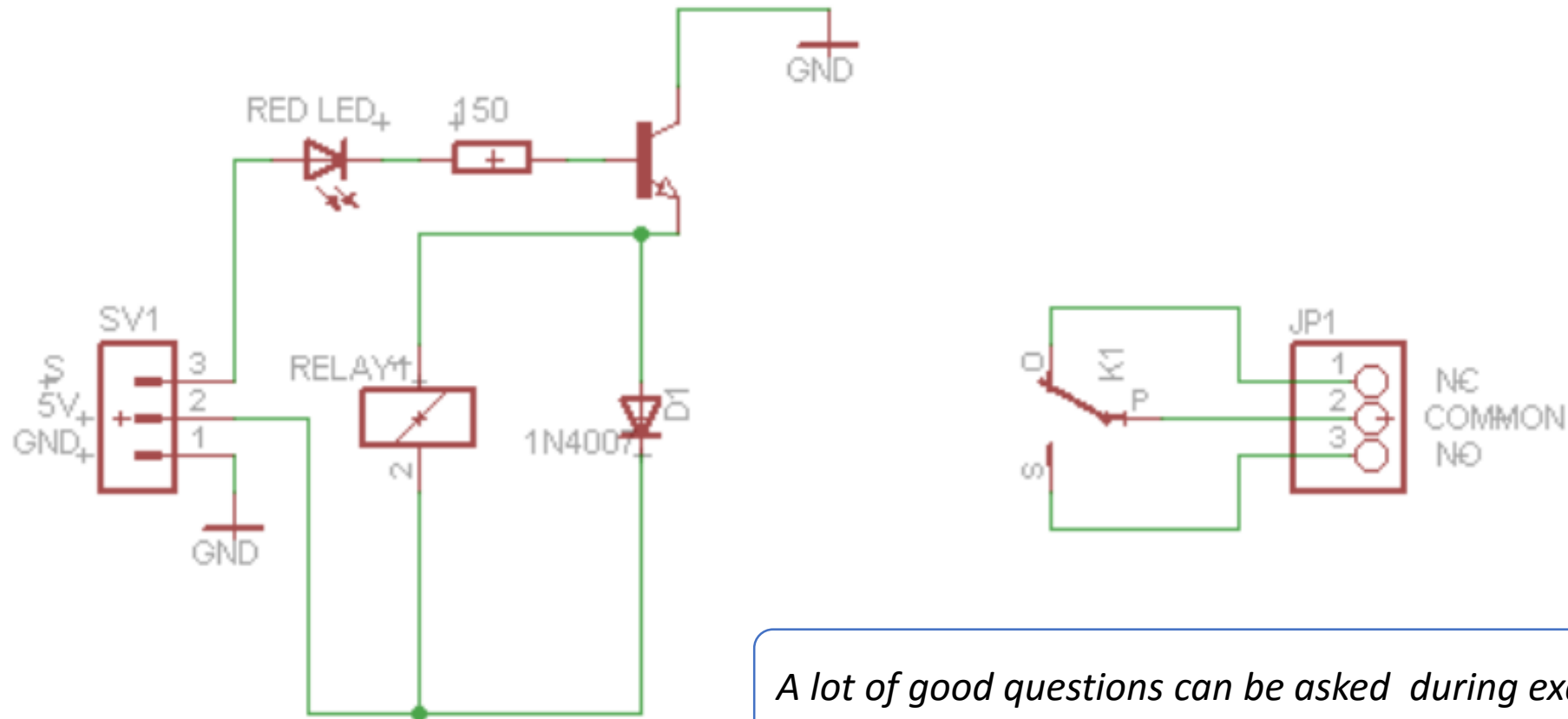EE must think what and how can
be connected
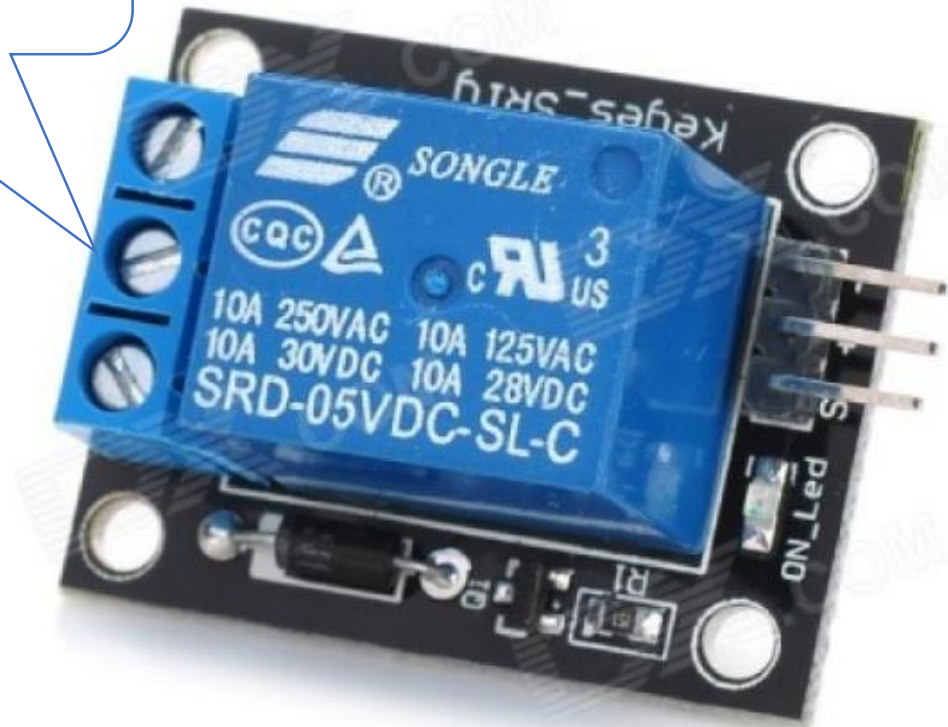
"-"  : GND
Middle Pin :  "+5V"
"S"  : Digital Signal

NC : Normally closed
NO : normally open
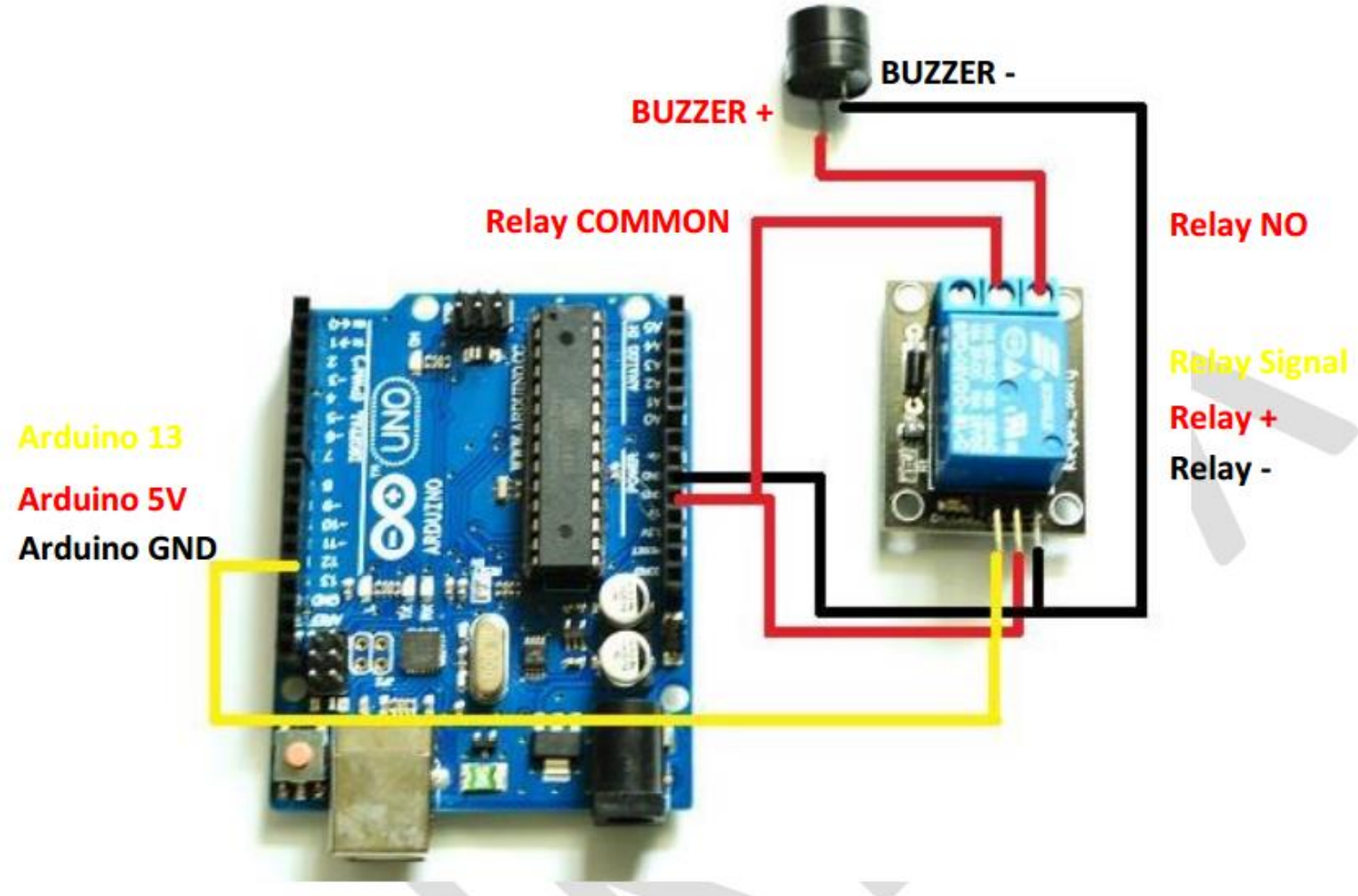Common : common

# KY-019 5V Relay Module

http://tinkbox.ph/sites/tinkbox.ph/files/downloads/KEYES%205V%20Relay%20Module%20KY-019.pdf



*A lot of good questions can be asked during exam…*

# KY-019 5V Relay Module. Low Voltage connection

**Wiring Diagram**



BUZZER +

BUZZER -

Relay COMMON

Relay NO

Relay Signal

Relay +

Relay -

Arduino 13

Arduino 5V

Arduino GND

# KY-019 5V Relay Module. Low Voltage connection

## Sample Program

```
// Keyes 5V Relay Module Sample Program

void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);    // turn the 5V buzzer on
  delay(2000);               // on for two seconds
  digitalWrite(13, LOW);     // turn the 5V buzzer off
  delay(2000);               // off for two seconds
}
```

The **buzzer** will turn on every two seconds. You can also hear the **tick of relay** every two seconds

# Other Modules

Design and usage of other modules will be explained later.

**Please do not use them before explanations**