

# Preface

## About Ivolador

Ivolador is a technology company focused on Raspberry Pi and Arduino open source community development. Committed to the promotion of open source culture, we strive to bring the fun of electronics making to people all around the world and enable everyone to be a maker. Our products include learning kits, development boards, robots, sensor modules and development tools. In addition to high quality products, Ivolador also offers tutorials to help you build your own project.

## About Sensor Kit V1.0

This kit is suitable for Arduino Uno, Mega 2560, and Nano. All the code in this user manual is compatible with these boards.

Our Ivolador board is fully compatible with Arduino board.

You can go to website [https://github.com/Ivolador/Ivolador\\_Sensor\\_Kit\\_for\\_Arduino](https://github.com/Ivolador/Ivolador_Sensor_Kit_for_Arduino) to download related code.

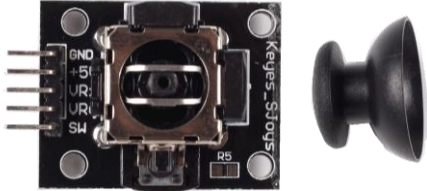




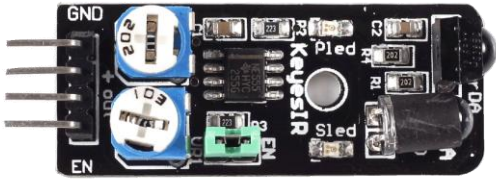

Note: This kit is different from other kits. All the components in this kit are provided in the form of modules which integrate some necessary components, such as comparator, resistor, and capacitor and so on. Therefore it is convenient for circuit connection.

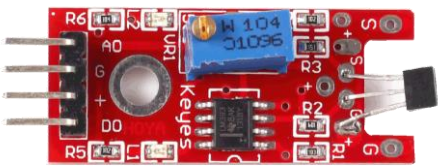
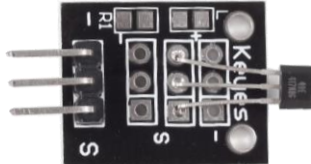
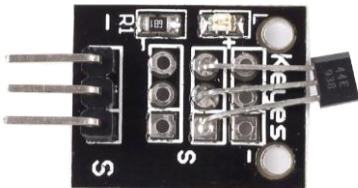


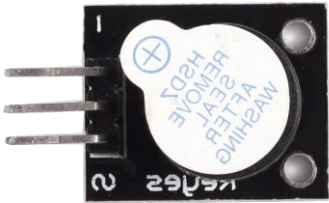
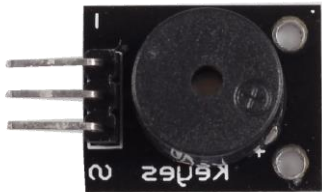
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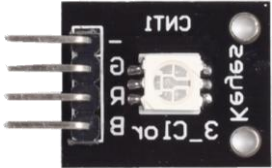
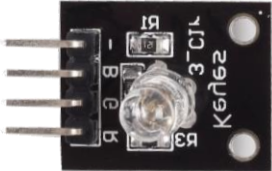
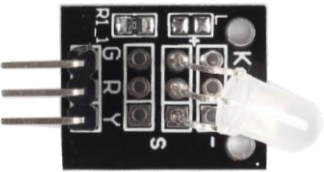
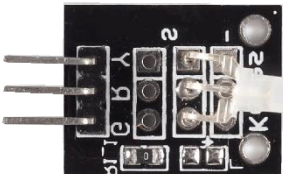
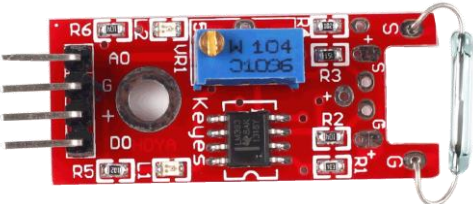
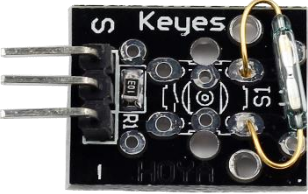

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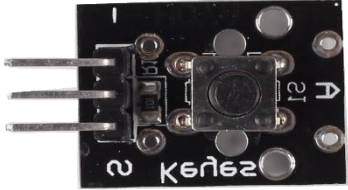
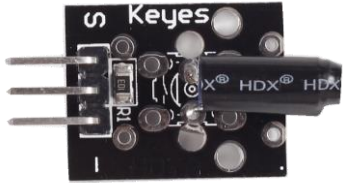

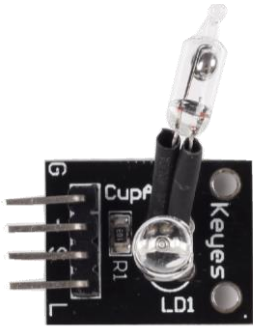
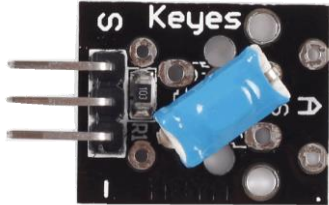


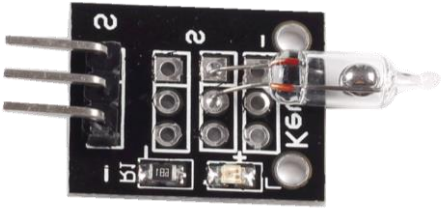
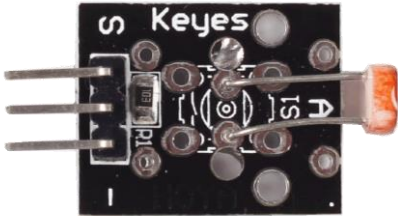
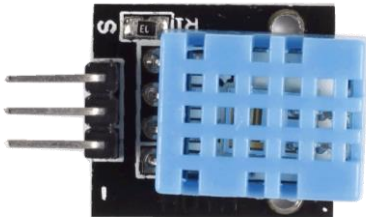
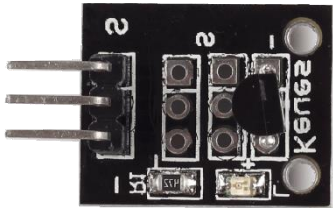
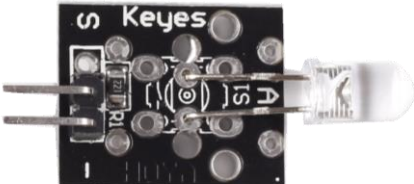
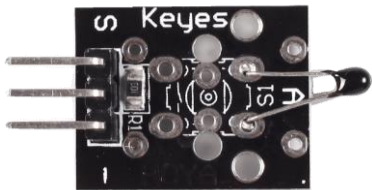
## Components List

No.	Name	Qty.	Component	Lesson
1	Joystick PS2	1		Lesson 1
2	Relay Module	1		Lesson 2
3	High-sensitive Voice Sensor	1		Lesson 3
4	Microphone Sensor	1		Lesson 3
5	Tracking Sensor	1		Lesson 4
6	Obstacle Avoidance Sensor	1		Lesson 5
7	Flame Sensor	1		Lesson 6

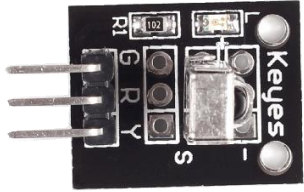
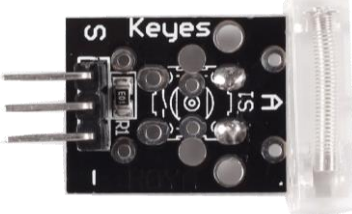
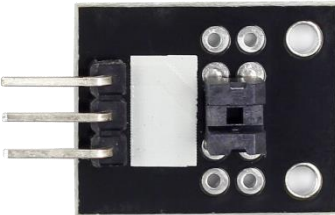
8	Linear Hall Sensor	1		Lesson 7
9	Analog Hall Sensor	1		Lesson 7
10	Hall Magnatic Sensor	1		Lesson 7
11	Metal Touch Sensor	1		Lesson 8
12	Digital Temperature Sensor	1		Lesson 9
13	Active Buzzer	1		Lesson 10
14	Passive Buzzer	1		Lesson 10

15	RGB LED	1		Lesson 11
16	SMG RGB LED	1		Lesson 11
17	Dual-color Common-Cathode LED	1		Lesson 12
18	Mini Dual-color Common-Cathode LED	1		Lesson 12
19	Reed Switch	1		Lesson 13
20	Mini Reed	1		Lesson 14
21	7-color Auto-flash LED	1		Lesson 15

22	Laser Transmitter	1		Lesson 16
23	Button Switch	1		Lesson 17
24	Shock Switch	1		Lesson 18
25	Rotary Encoder	1		Lesson 19
26	Magic Cup	2		Lesson 19
27	Tilt Switch	1		Lesson 20

28	Mercury Switch	1		Lesson 21
29	Photo resistor Sensor	1		Lesson 22
30	Humiture Sensor	1		Lesson 23
31	DS18B20 Temperature Sensor	1		Lesson 24
32	Infrared Transmitter	1		Lesson 25
33	Analog Temperature Sensor	1		Lesson 26

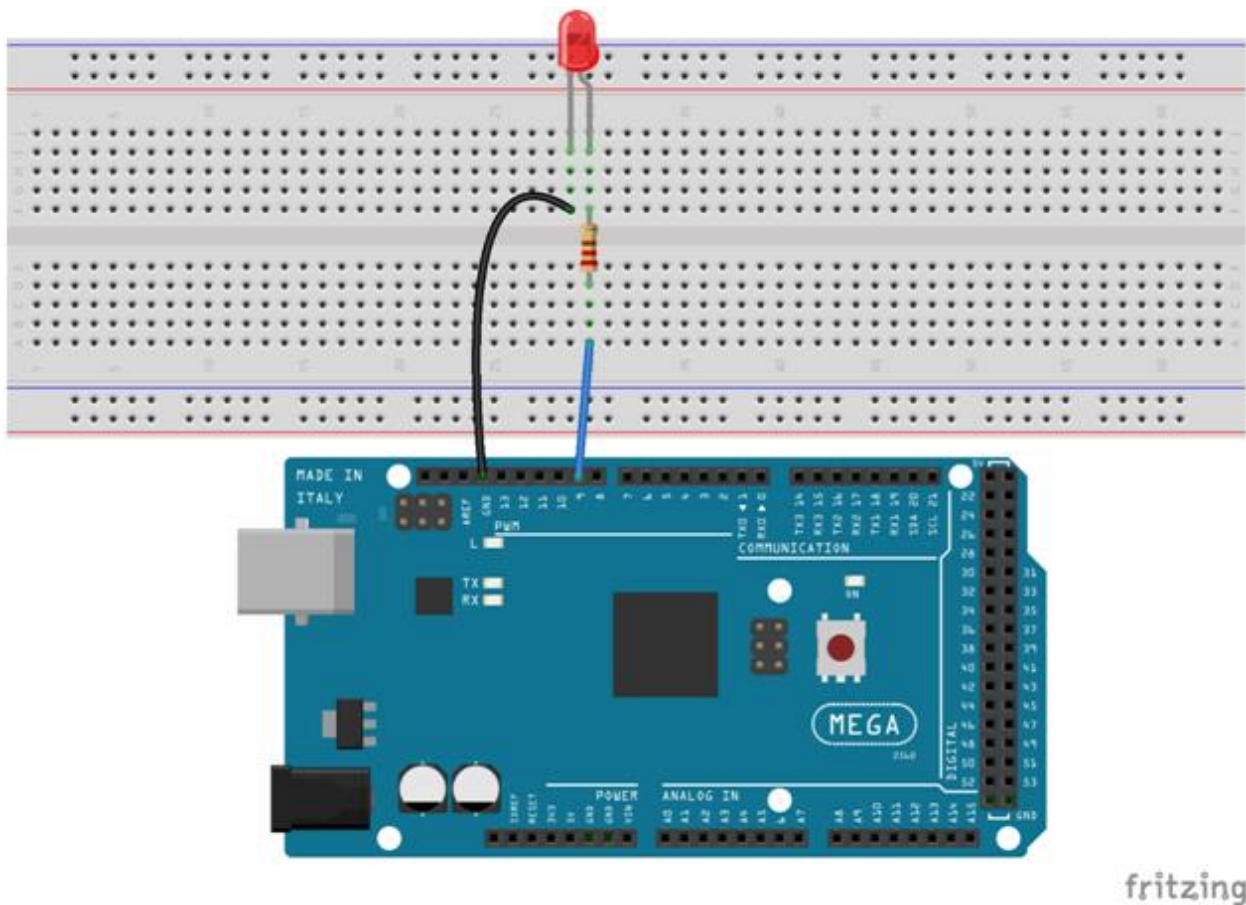


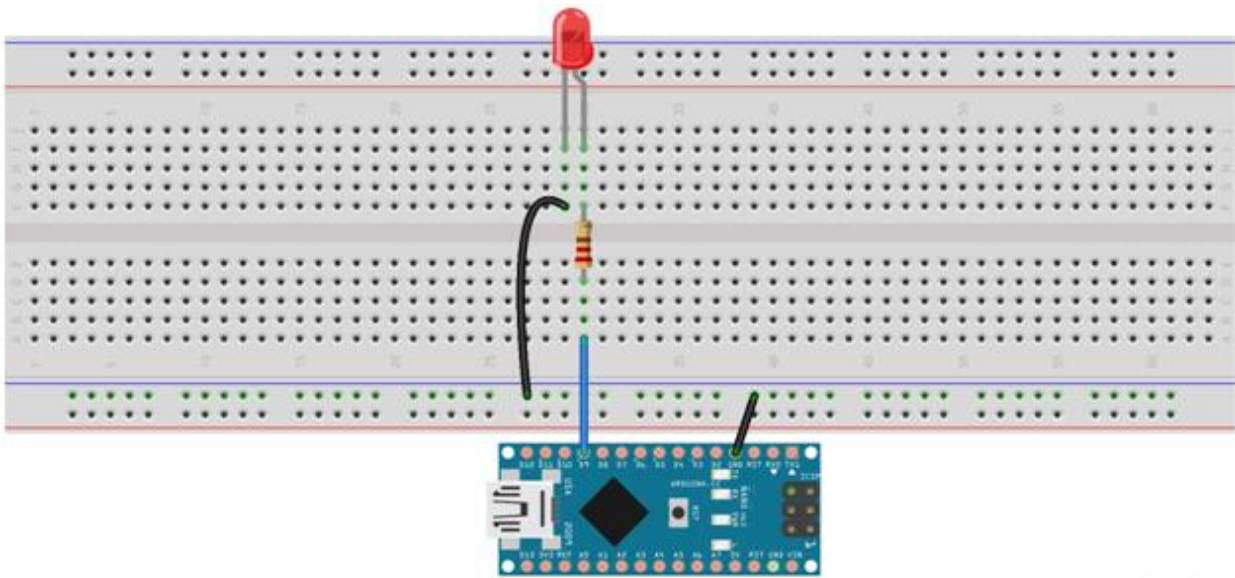
34	Infrared Receiver	1		Lesson 27
35	Knock Sensor	1		Lesson 28
36	Photo-interrupter	1		Lesson 29

## Notice

All the experiments in this kit are done with Ivolor Uno R3 board, but they are also compatible with Ivolor Mega 2560, Ivolor Nano and all official Arduino Boards. All the code included in this kit works with these boards.

So what does COMPATIBLE mean here? It means you can use any of the three boards to do the same experiment with the same wiring. Take turning on an LED as an example. We use Ivolor Uno as the microcontroller, but you can also use Ivolor Nano or Ivolor Mega 2560 to serve the same function. Just select the right Board and COM when compiling.





fritzing



Mega 2560 R3



Uno R3

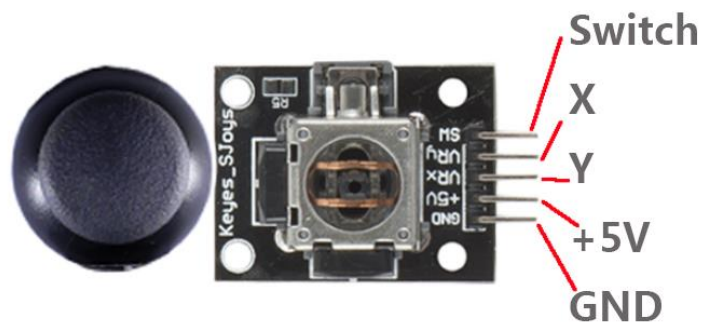


Nano

# Lesson 1 Joystick PS2

## Introduction

A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games and robots. A Joystick PS2 is used here.



## Components

- 1 \* Ivofador Uno board
- 1 \* USB data cable
- 1 \* Joystick PS2 module
- Several jumper wires

## Experimental Principle

This module has two analog outputs (corresponding to X, Y biaxial offsets) and one digital output representing whether it is pressed on Z axis. The module integrates power indicator and can display operation condition.

In this experiment, we use the Ivofador Uno board to detect the moving direction of the Joystick knob and pressing of the button.

## Experimental Procedures

**Step 1:** Build the circuit

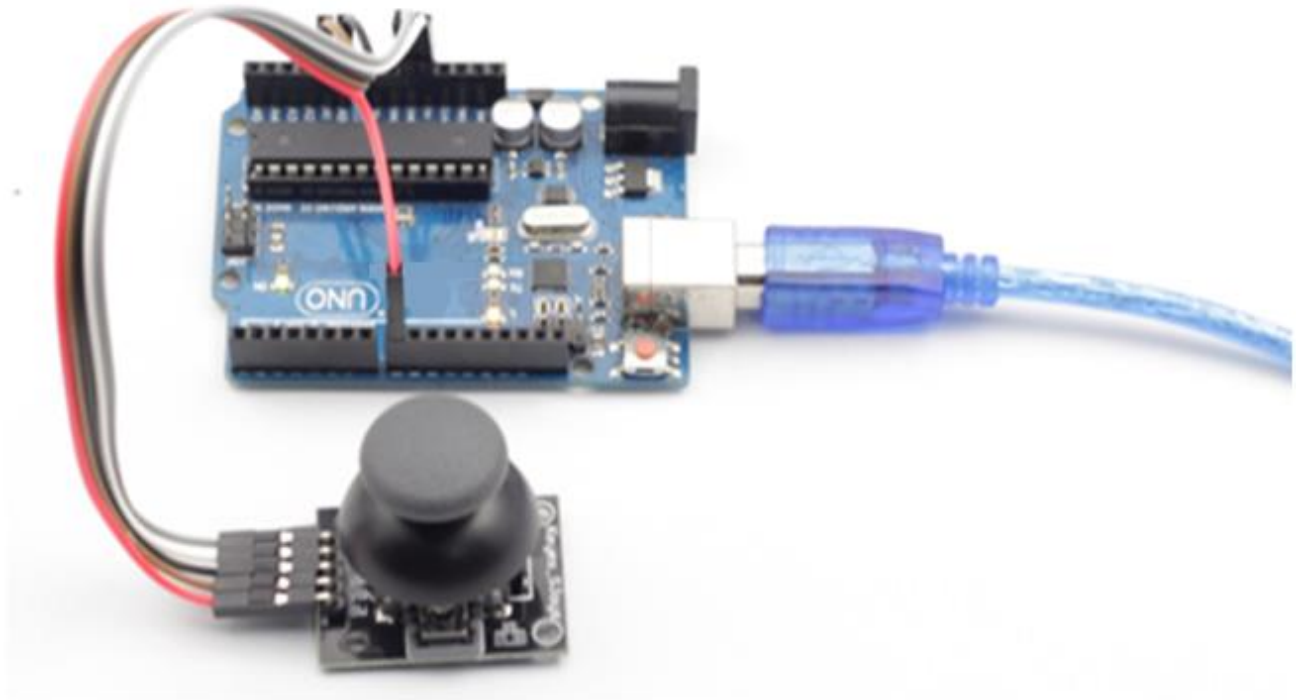
Joystick PS2 Module	Ivofador Uno
SW -----	D8
VRx -----	A0
VRy -----	A1
+5V -----	5V
GND -----	GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

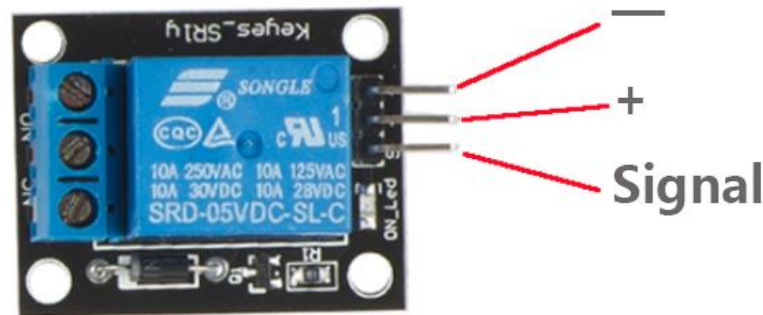
Now, push the rocker and the coordinates of X and Y axes displayed on Serial Monitor will change accordingly; press the button, and the coordinate of Z=0 will also be displayed.



## Lesson 2 Relay Module

### Introduction

Relays are suitable for driving high power electronic devices such as lights, electric fans and air condition. A relay can be used to control high voltages with a low voltage by connecting it to an MCU.



### Components

- 1 \* Ivোলদর Uno board
- 1 \* USB data cable
- 1 \* Relay module
- Several jumper wires

### Experimental Principle

Connect IO to the Ivোলদর Uno board. When we make the transistor output low level (0V) by programming, the transistor will conduct electricity because of current saturation. The normally open contact of the relay will be closed, while the normally closed contact of the relay will be opened; when it outputs high level (5V), the transistor will be cut off, and the relay will restore to the initial state.

### Experimental Procedures

**Step 1:** Build the circuit

Relay module	Ivোলদর Uno
S	D6
-	GND
+	5V

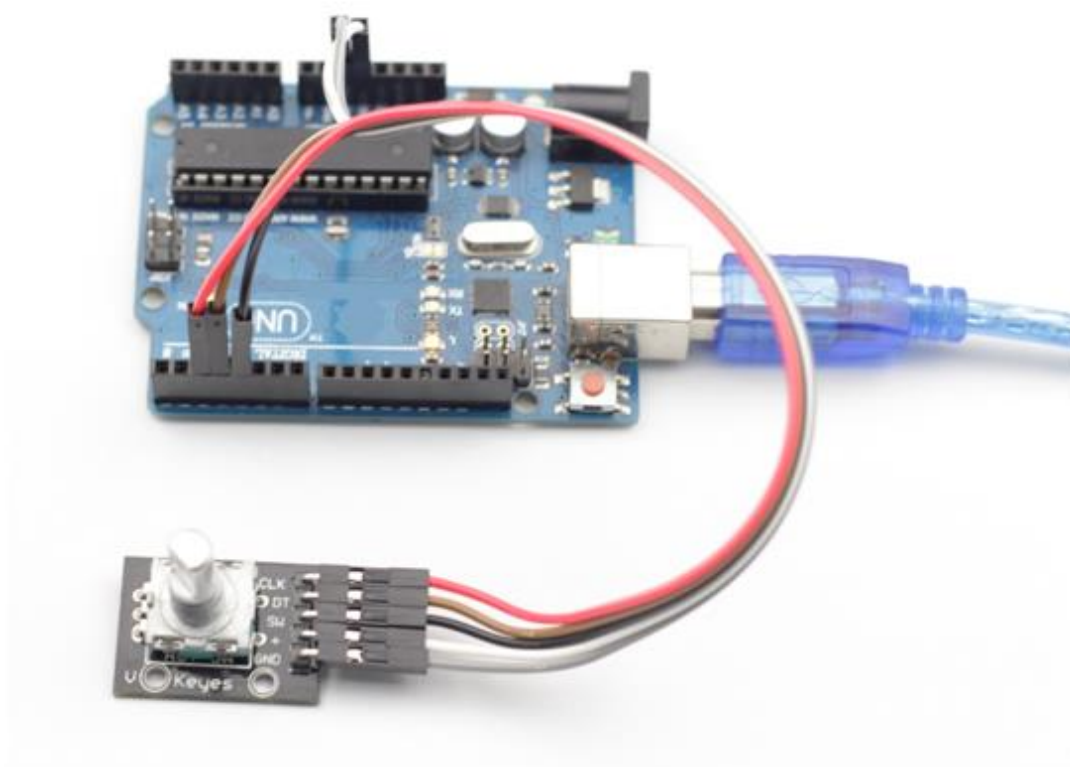
**Step 2:** Program (Please refer to the example code in [Ivোলদর \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivোলদর Uno



Now, you may hear the ticktock. That's the normally closed contact opened and the normally open contact closed. You can attach a high voltage device to the module. For example, connect a bulb of 220V voltage to the output port of the relay module, and then the relay will act as an automatic switch.



## Lesson 3 Microphone Sensor

### Introduction

There are two kinds of microphone sensor in this kit: microphone sensor and high-sensitive voice sensor (as shown below). The only difference between them is sensitivity. In this experiment, we will take the microphone sensor for example. You may try to apply the other sensor based on what you've got during the process.

Both sensors have two outputs:

**AO:** analog output, to output voltage signals from microphone in a real-time manner

**DO:** When sound intensity reaches a certain threshold, the sensor outputs high or low level (you can adjust the threshold by potentiometer)



### Components

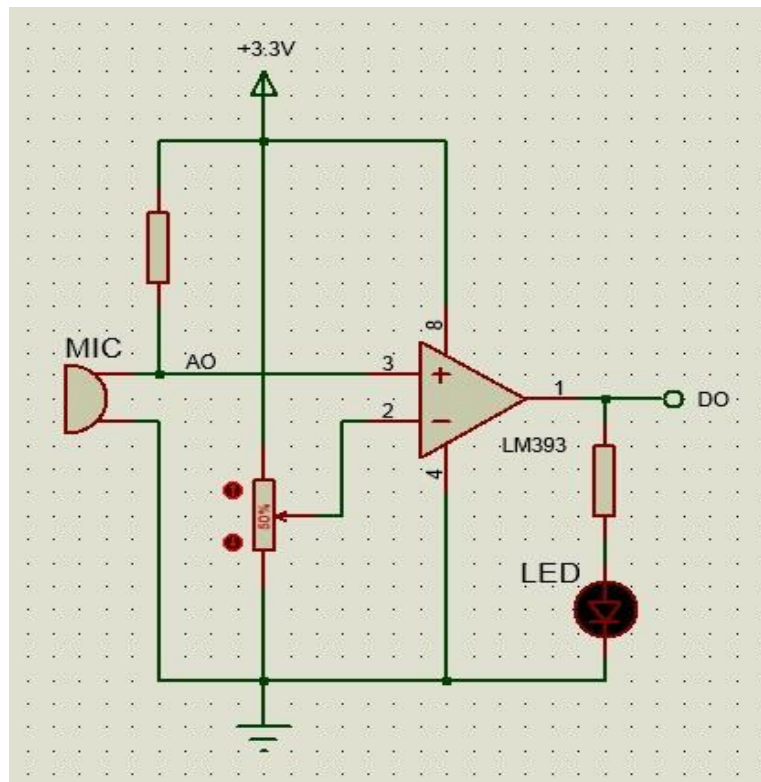
- 1 \* Ivofador Uno board
- 1 \* Breadboard
- 1 \* USB data cable
- 1 \* Microphone sensor module
- Several jumper wires

### Experimental Principle

Microphone can convert audio signal into electrical signal (analog quantity), then convert analog quantity into digital value by ADC and transfer it to MCU to process.



The schematic diagram:



LM393 is a voltage comparator. When the voltage of the in-phase terminal (pin 3) is higher than that of the inverting terminal (pin 2), the output terminal (pin 1) will output high. Otherwise, it outputs low. First, adjust the potentiometer to make the voltage for pin 2 of LM393 less than 5V. When there is no voice input, the resistance of the microphone is very large. The voltage for pin 3 of LM393 is close to power supply voltage (5V), pin 1 outputs high and the LED is on; when there is voice input, the resistance of the microphone decreases, pin 1 outputs low and the LED is off. And connect pin 1 to IO of the Ivolor Uno board to detect sounds by programming.

## Experimental Procedures

**Step 1:** Build the circuit

### Microphone Sensor Module

### Ivolor Uno

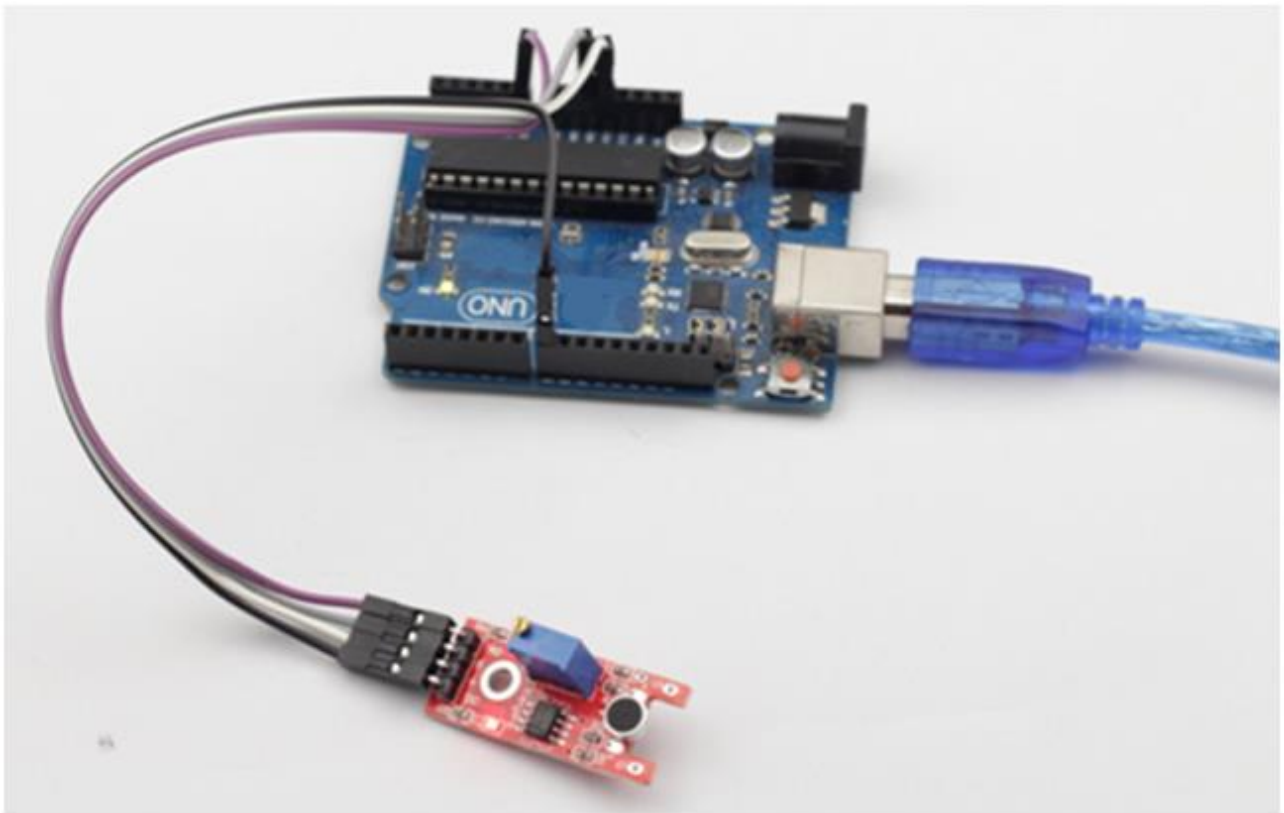
AO	-----	A0
G	-----	GND
+	-----	5V
DO	-----	D8

**Step 2:** Program (Please refer to the example code in [Ivolor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolor Uno

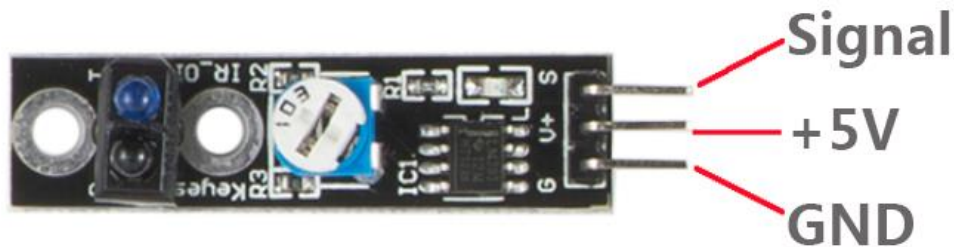
Now, speak near or blow into the microphone, and you can see the LED attached to pin 13 on the Ivolador Uno board brighten.



## Lesson 4 Tracking Sensor

### Introduction

A tracking sensor (as shown below) has the same principle with an obstacle avoidance sensor but has small transmitting power.



### Components

- 1 \* Ivোলদর Uno board
- 1 \* USB data cable
- 1 \* Tracking sensor module
- Several jumper wires

### Experimental Principle

When the infrared transmitter emits rays to a piece of paper, if the rays shine on a white surface, they will be reflected and received by the receiver, and pin S will output low level; If the rays encounter black lines, they will be absorbed, thus the receiver gets nothing, and pin S will output high level.

In this experiment, we will use an obstacle avoidance sensor module and an LED attached to pin 13 of the Ivোলদর Uno board to build a simple circuit to make a tracking light.

Since an LED has been attached to pin 13, connect the pin out to D8 of the Ivোলদর Uno board. When the tracking sensor detects reflection signals (white), the LED will be on. Otherwise, it will be off (black line).

### Experimental Procedures

**Step 1:** Build the circuit

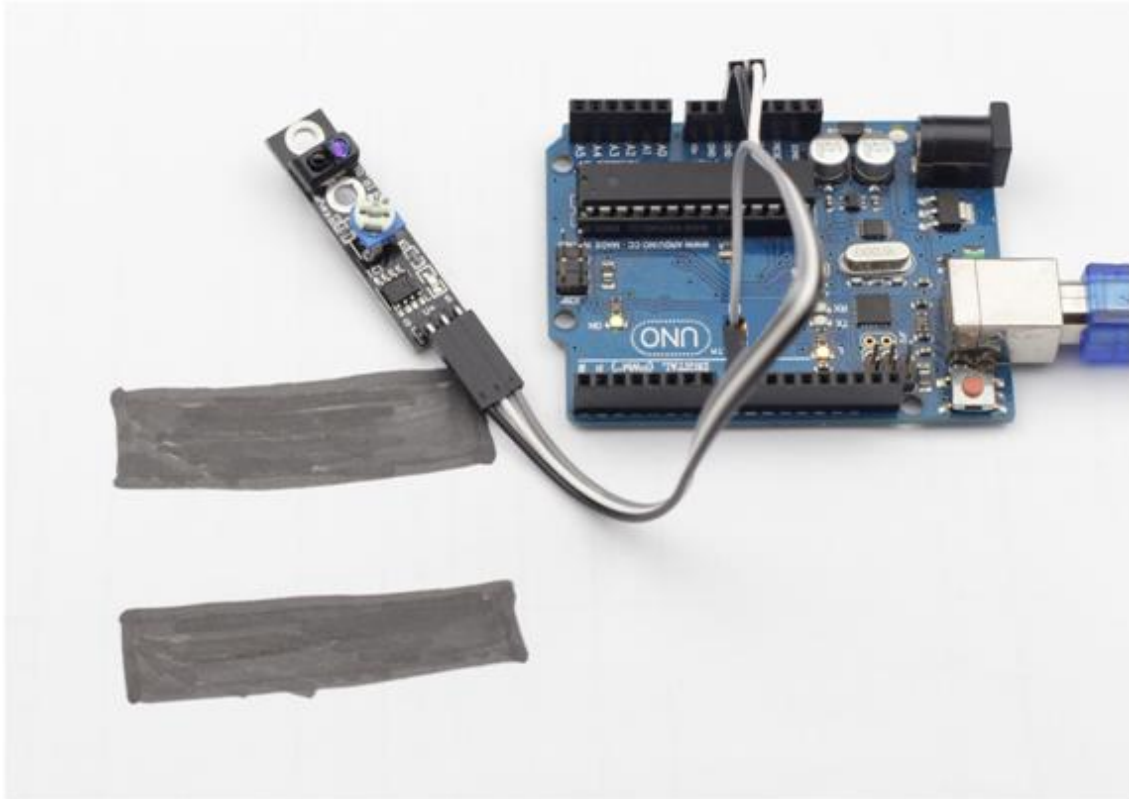
Tracking Sensor Module	Ivোলদর Uno
S -----	D8
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, draw two black thick lines on the paper. If the rays emitted by the sensor encounter the black lines, the LED attached to pin 13 on Ivolador Uno board will light up. Otherwise, it will go out.



# Lesson 5 Obstacle Avoidance Sensor

## Introduction

An Obstacle Avoidance Sensor (as shown below) uses infrared reflection principle to detect obstacles. When there is no object in front, infrared-receiver cannot receive signals; when there is an object in front, it will block and reflect infrared light, then infrared-receiver can receive signals.



## Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Obstacle Avoidance Sensor module
- Several jumper wires

## Experimental Principle

An obstacle avoidance sensor mainly consists of an infrared-transmitter, an infrared-receiver and a potentiometer. According to the reflecting character of an object, if there is no obstacle, emitted infrared ray will weaken with the propagation distance and finally disappear. If there is an obstacle, when infrared ray encounters an obstacle, it will be reflected back to the infrared-receiver. Then the infrared-receiver detects this signal and confirms an obstacle exists in front.

In this experiment, we will use an obstacle avoidance sensor module and an LED attached to pin 13 of the Ivolor board to build a simple circuit. With the LED attached to pin 13, connect pin OUT to D8 of the Ivolor board. When the obstacle avoidance sensor detects an obstacle, the LED will be on. Otherwise, it will be off.

**Note:** The obstacle avoidance distance of infrared sensor is adjustable; you can adjust the obstacle avoidance distance by adjusting the potentiometer.

## Experimental Procedures

**Step 1:** Build the circuit

**Obstacle Avoidance Sensor module**

**Ivolador Uno**

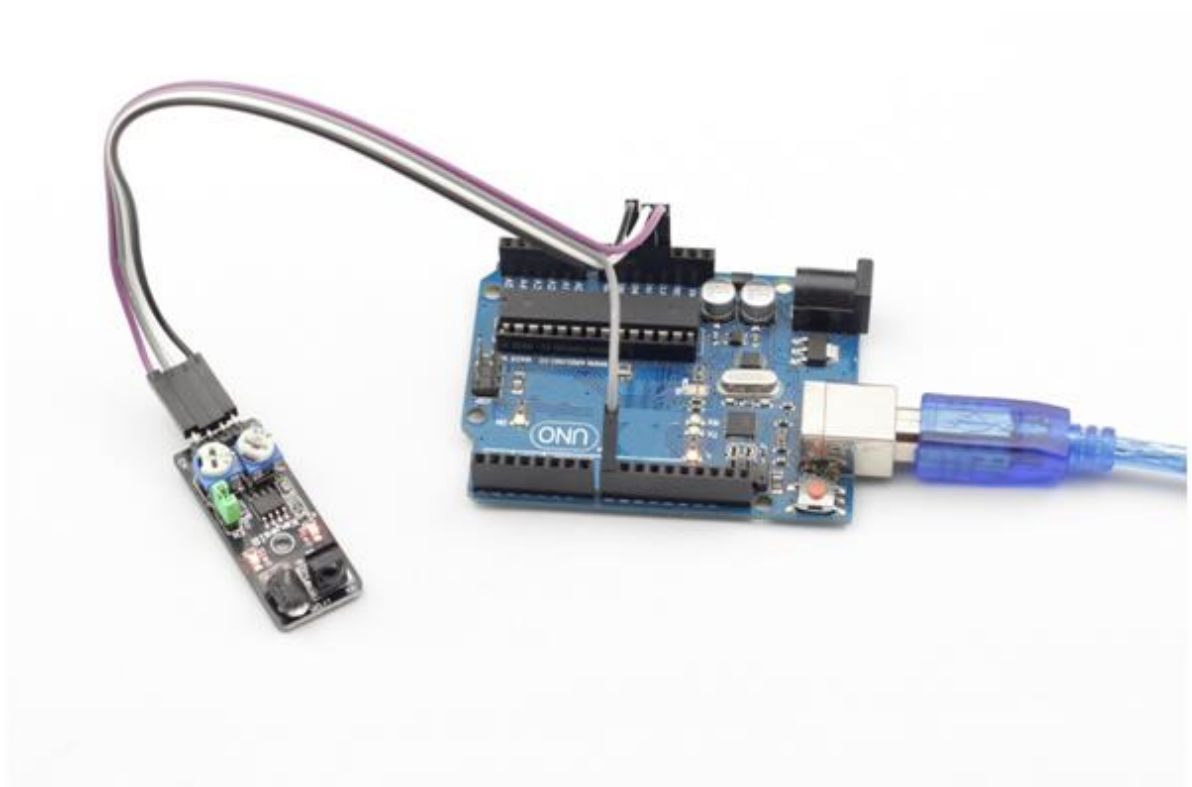
out -----	D8
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

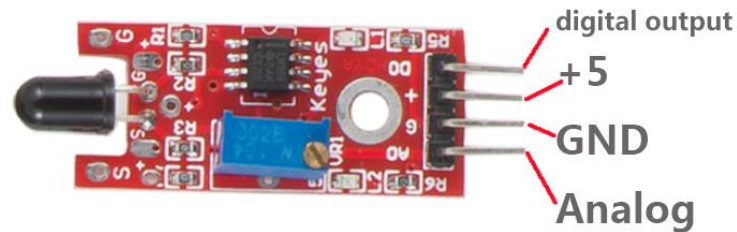
Now, put an obstacle in front of the Obstacle Avoidance Sensor and the LED attached to pin 13 on the Ivolador Uno board will light up.



# Lesson 6 Flame Sensor

## Introduction

A flame sensor module performs detection by capturing infrared wavelengths from flame. It can be used to detect and warn of flames.



## Components

- 1 \* Ivoldor Uno board
- 1 \* USB data cable
- 1 \* Flame sensor module
- Several jumper wires

## Experimental Principle

There are several types of flame sensors. In this experiment, we will use a far-infrared flame sensor. It can detect infrared light with a wavelength ranging from 700nm to 1000nm. A far-infrared flame probe converts the strength changes of the external infrared light into current changes. And then it converts analog quantities into digital ones.

In this experiment, connect pin D0 to D8 of the Ivoldor Uno board. When the flame sensor detects flame signals, the LED attached to pin 13 of the Uno board will brighten. Otherwise, it will keep off.

## Experimental Procedures

**Step 1:** Build the circuit

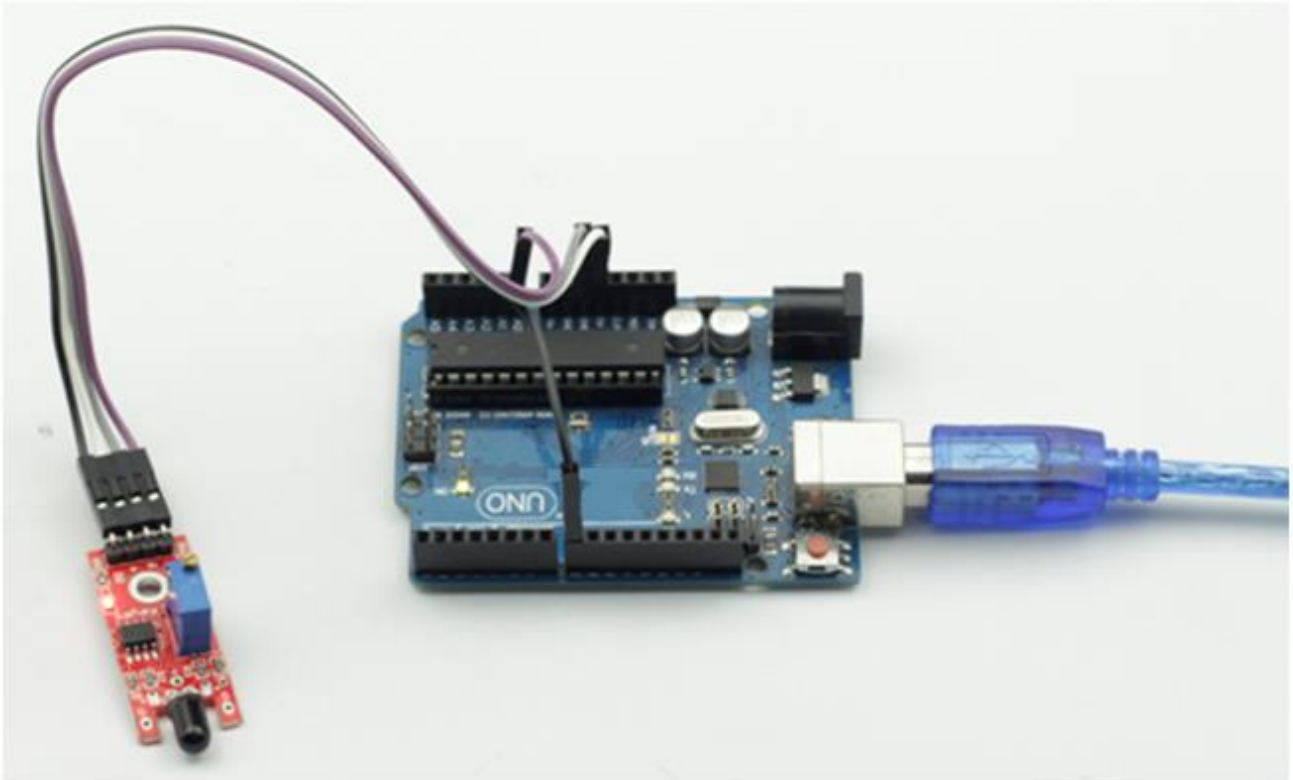
Flame Module	Ivoldor Uno
AO -----	A0
G -----	GND
+ -----	5V
DO -----	D8

**Step 2:** Program (Please refer to the example code in [Ivoldor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivoldor Uno

Now, ignite a lighter near the flame sensor, and the LED on the module and that attached to pin 13 on Uno will light up.





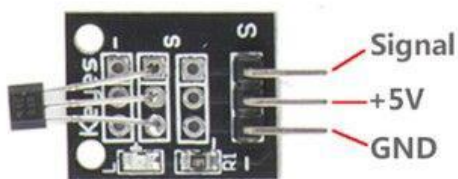
## Lesson 7 Hall Sensor

### Introduction

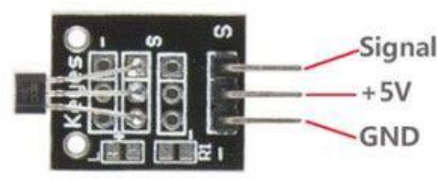
Based on the Hall Effect, a hall sensor is one that varies its output voltage in response to a magnetic field. Hall sensors are used for proximity switching, positioning, speed detection, and current sensing applications.

Hall sensors can be categorized into linear (analog) Hall sensors and switch Hall sensors. A switch Hall sensor consists of voltage regulator, Hall element, differential amplifier, Schmitt trigger, and output terminal and it outputs digital values. A linear Hall sensor consists of a Hall element, linear amplifier, and emitter follower and it outputs analog values.

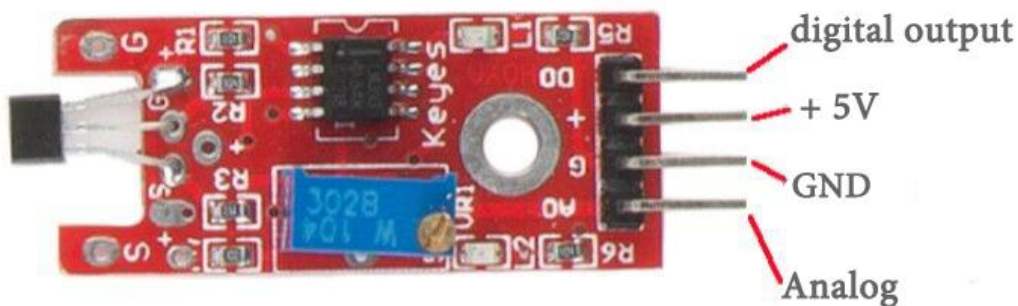
There are three types of hall sensor module in this kit (as shown below): linear Hall sensor (in two forms) which outputs analog signals, and switch Hall sensor which outputs digital signals. If you add a comparator to the linear Hall sensor, it will be able to output both analog and digital signals.



**Linear Hall**



**Switch Hall**



**Linear Hall**

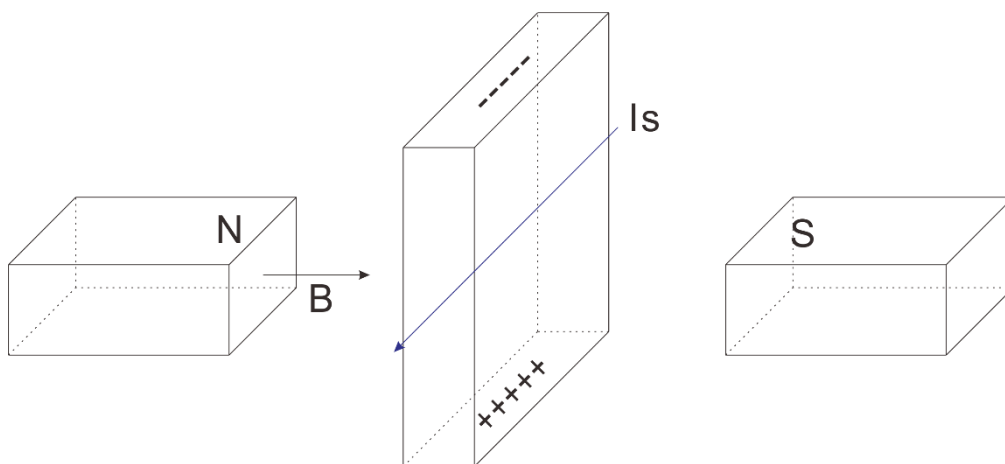
## Components

- 1 \* Ivolador Uno board
- 1 \* USB data cable
- 1 \* Hall sensor module
- 1 \* LCD1602
- 1 \* Potentiometer
- Several jumper wires

## Experimental Principles

### Hall Effect

Hall Effect is a kind of electromagnetic effect. It was discovered by Edwin Hall in 1879 when he was researching conductive mechanism about metals. The effect is seen when a conductor is passed through a uniform magnetic field. The natural electron drift of the charge carriers causes the magnetic field to apply a Lorentz force (the force exerted on a charged particle in an electromagnetic field) to these charge carriers. The result is what is seen as a charge separation, with a buildup of either positive or negative charges on the bottom or on the top of the plate.



### Hall Sensor

A hall sensor is a kind of magnetic field sensor based on the effect.

Electricity carried through a conductor will produce a magnetic field that varies with current, and a Hall sensor can be used to measure the current without interrupting the circuit. Typically, the sensor is integrated with a wound core or permanent magnet that surrounds the conductor to be measured.

## Experimental Procedures

For **linear Hall sensor module**, please take the following steps.

**Step 1:** Build the circuit

Linear Hall Sensor Module	Ivolador Uno
S -----	A5
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can see the LED attached to pin 13 on Ivolador Uno board blinking. If a magnet approaches the linear Hall sensor, the blinking frequency of LED will increase or decrease.



For **Switch Hall Sensor module**

**Step 1:** Build the circuit

**Switch Hall Sensor Module**

**Ivolador Uno**

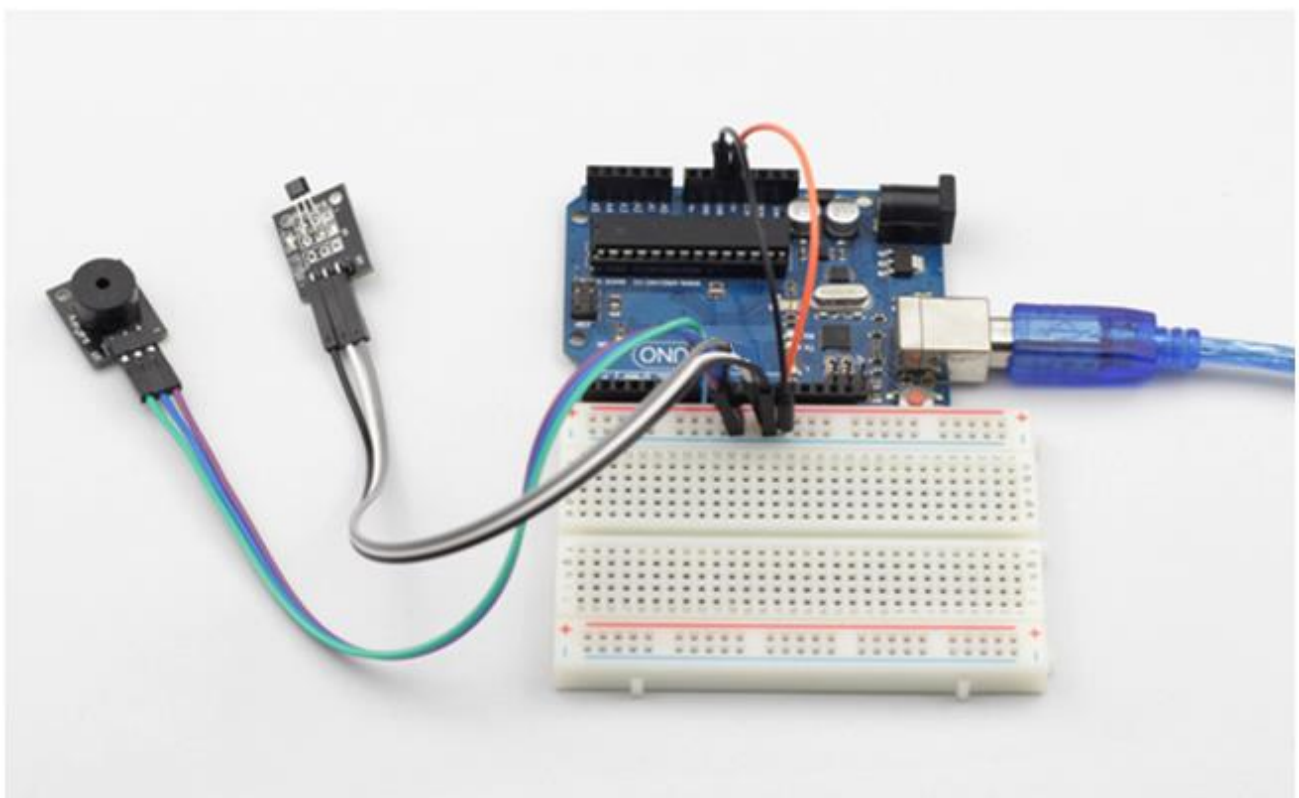
S ----- Digital 8  
- ----- GND  
+ ----- 5V

**Step 2:** Program (Please refer to the example code in **Ivolador \_Sensor Kit for Arduino**)

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, place a magnet close to the switch Hall sensor. Then the indicator LED on the switch Hall sensor will light up and the buzzer will beep. At the same time, the LED attached to pin 13 on the Ivolador Uno board will light up.



For **linear Hall sensor module (with a comparator added)**

**Step 1:** Build the circuit

Linear Hall Sensor Module	Ivolador Uno
AO -----	A0
DO -----	Digital 8
- -----	GND
+ -----	5V

**LCD1602 connection:** connect pin RS to digital pin 3; R/W to GND; E to digital pin 4; D4~D7 to digital pin 9 to 12; VSS to GND; VDD to 5V; A to 3.3V; K to GND

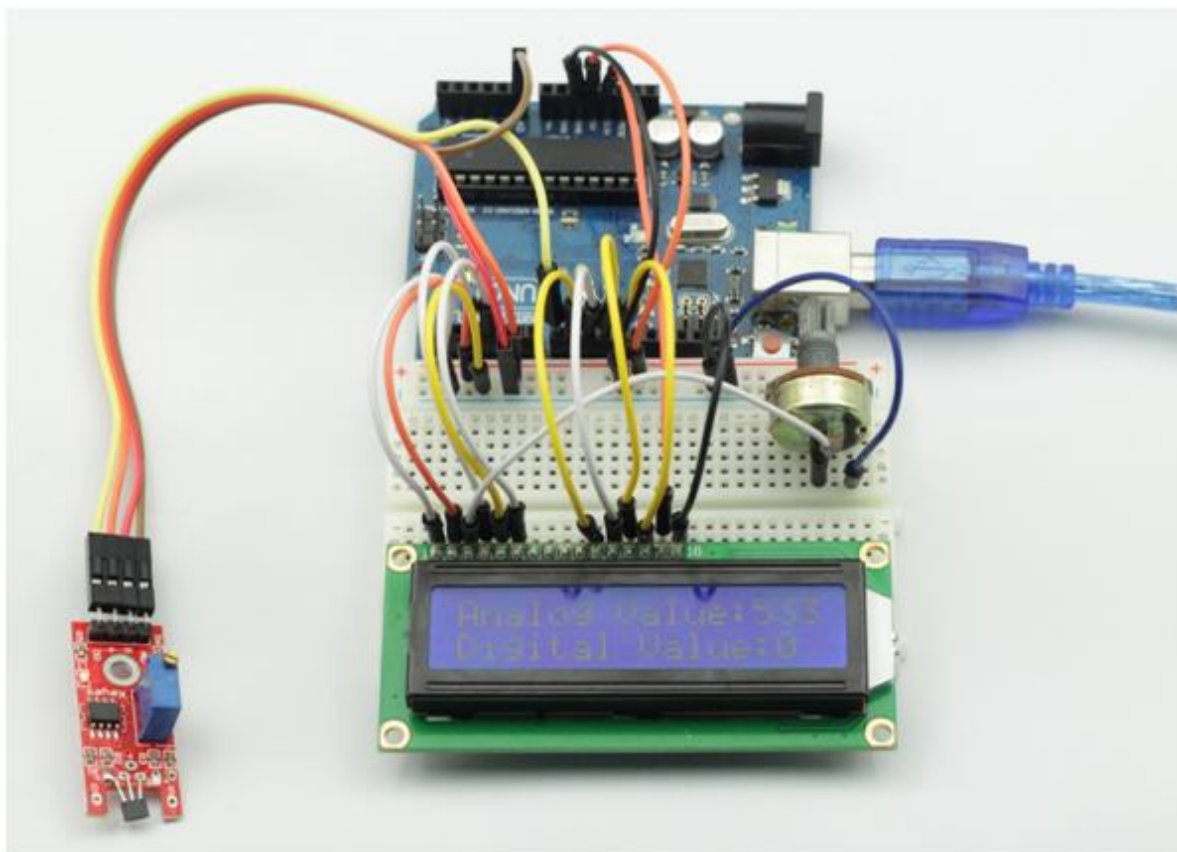
**Potentiometer connection:** Connect its middle pin to VO of LCD1602 and any other pin to GND

**Step 2:** Program (Please refer to the example code in **Ivolador \_Sensor Kit for Arduino**)

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

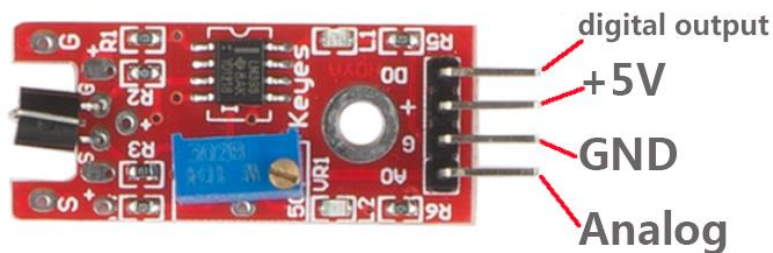
Now, put a magnet close to the linear Hall sensor, and the indicator LED on the linear Hall sensor will light up. At the same time, the analog and digital value displayed on the LCD will change accordingly.



# Lesson 8 Metal Touch Sensor

## Introduction

A metal touch sensor is a type of switch that only operates when it's touched by a charged body. It has a high-frequency transistor which can conduct electricity when receiving electromagnetic signals.



## Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Metal touch sensor module
- Several jumper wires

## Experimental Principle

In this experiment, touch the base electrode of a transistor with fingers to make it conduct electricity, for human body itself is a kind of conductor and an antenna that can receive electromagnetic waves in the air. These electromagnetic wave signals collected by human body are amplified by the transistor and processed by the comparator on the module to output steady signals.

With the LED attached to pin 13 of Uno, connect pin D0 of the sensor to D7 of the Uno board. When the metal touch sensor detects touch signals, the LED will be on. Otherwise, it will be off.

## Experimental Procedures

**Step 1:** Build the circuit

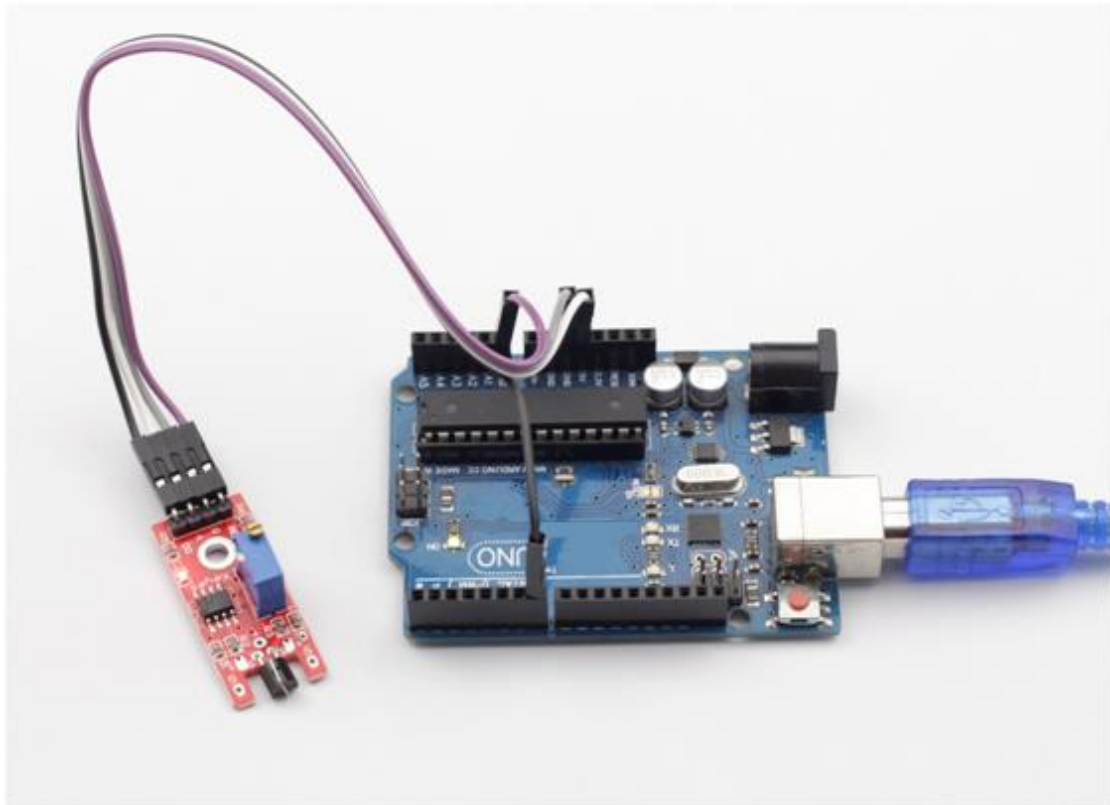
Metal Touch Sensor	Ivolor Uno
AO -----	A0
G -----	GND
+ -----	5V
D0 -----	D7

**Step 2:** Program (Please refer to the example code in [Ivolor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, touch the base electrode of the transistor and the LED attached to pin 13 on the Ivolador Uno board will light up.

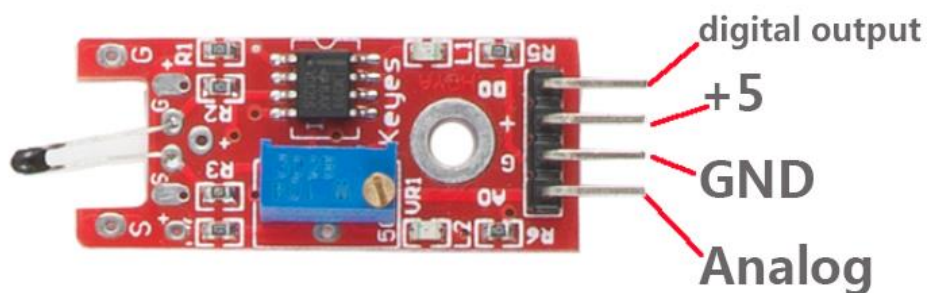




## Lesson 9 Digital Temperature Sensor

### Introduction

Compared with an analog temperature sensor, a digital temperature sensor (as shown below) only adds a digital output. You can adjust the threshold by the potentiometer onside. When the output is higher than the threshold, the sensor will output high level; when it is lower than the threshold, the sensor will output low level.



### Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Digital Temperature Sensor module
- Several jumper wires

### Experimental Principle

In this experiment, we will use a Digital-temperature Sensor module and an LED attached to pin 13 of Ivolor to build a simple circuit to make a temperature light.

With the LED attached to pin 13, connect the pin DO to D7 of Ivolor Uno. When the Digital Temperature Sensor detects that the ambient temperature is higher than a certain value (threshold), the LED will be on. Otherwise, it will be off. You can adjust the threshold by adjusting the potentiometer.

### Experimental Procedures

**Step 1:** Build the circuit

#### Digital Temperature Sensor Module

#### Ivolor Uno

AO ----- A0  
DO ----- D7  
- ----- GND



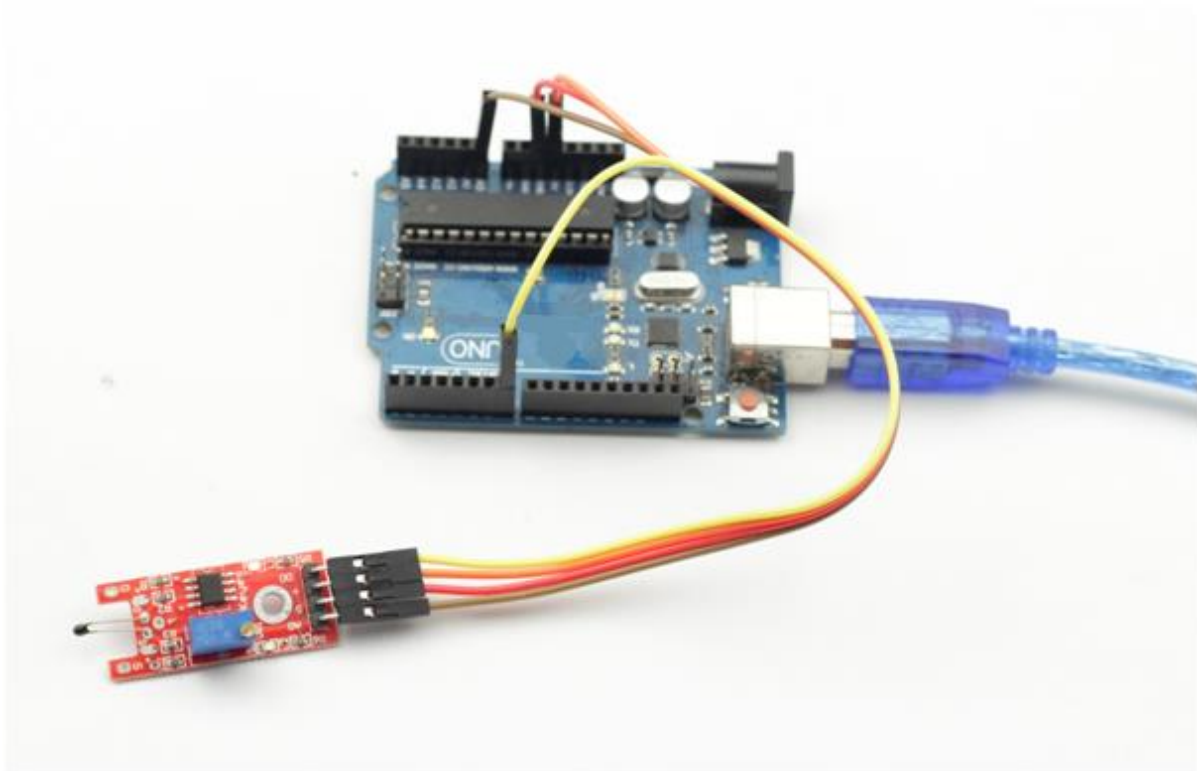
+ ----- 5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

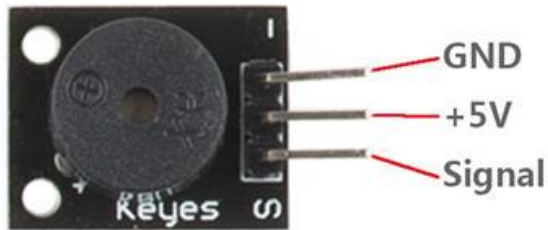
Now, touch the thermistor and you will see the LED attached to pin 13 on Ivolador Uno board light up after a while.



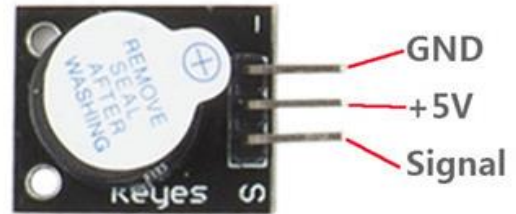
# Lesson 10 Buzzer

## Introduction

Buzzers can be categorized as active buzzers and passive ones (See the following picture).



**Passive**



**Active**

## Components

- 1 \* Ivoldor Uno board
- 1 \* USB data cable
- 1 \* Buzzer module
- Several jumper wires

## Experimental Principle

Place the pins of two buzzers face up and you can see the one with a green circuit board is a passive buzzer, while the other with a black tape, instead of a board, is an active buzzer, as shown below.



An active buzzer has a built-in oscillating source, so it will make sounds when electrified. But a passive buzzer does not have such source, so it will not beep if DC signals are used; instead, you need to use square waves whose frequency is between 2K and 5K to drive it. The active buzzer is often more expensive than the passive one because of multiple built-in oscillating circuits.

## Experimental Procedures

### Passive Buzzer

**Step 1:** Build the circuit

#### Passive Buzzer Module

#### Ivolador Uno

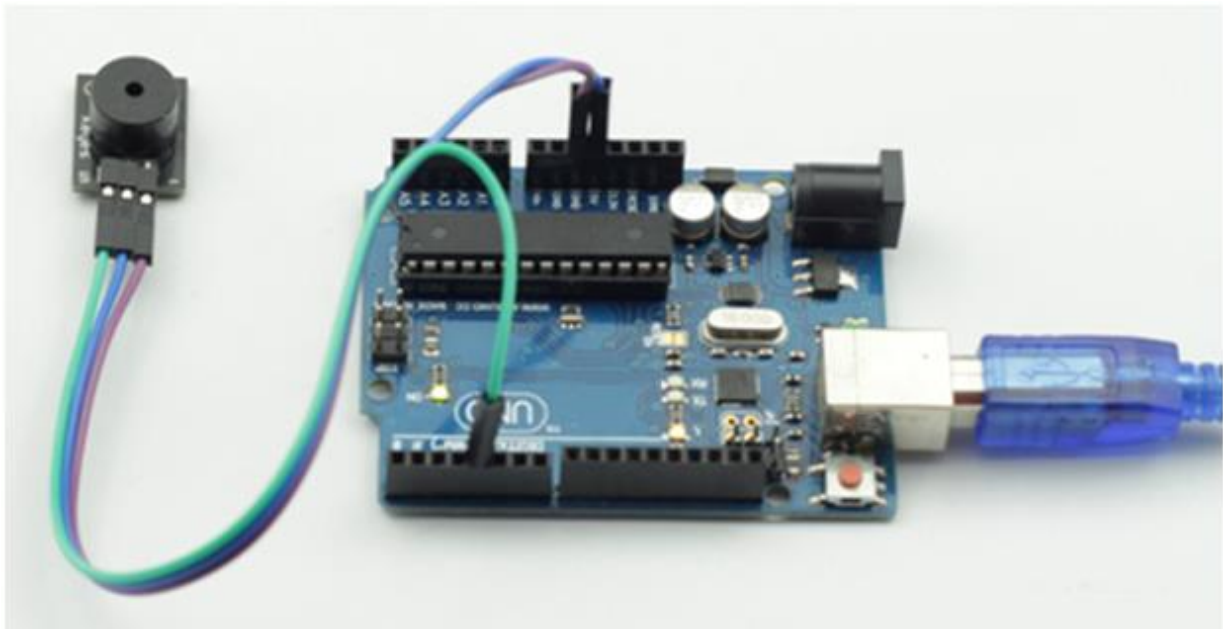
S ----- D11  
- ----- GND  
+ ----- 5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can hear the passive buzzer beep for warning.



## Active Buzzer

*Note:* The active buzzer has built-in oscillating source, so it will beep as long as it is electrified, but it can only beep with a fixed frequency.

**Step 1:** Build the circuit

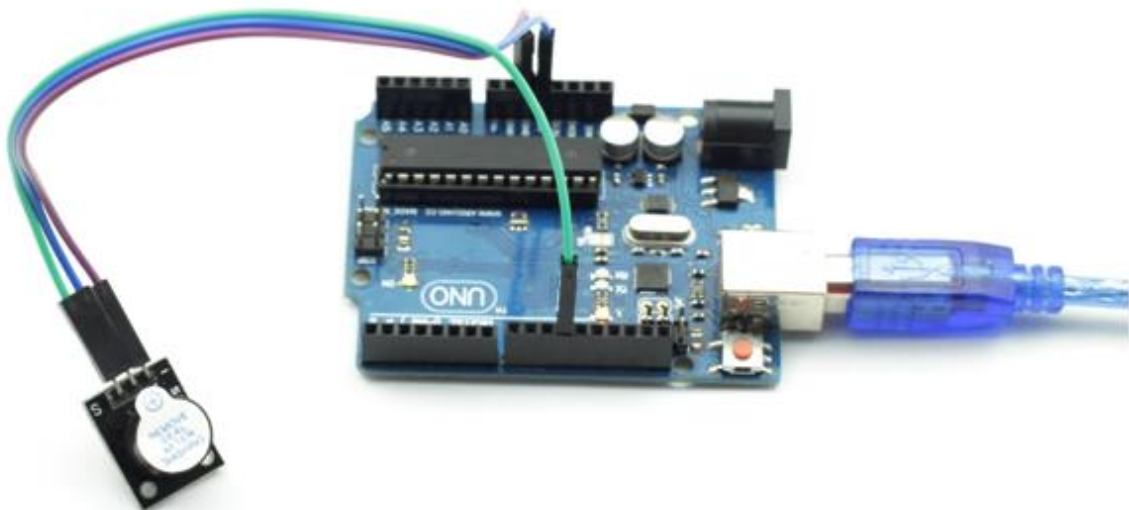
Active Buzzer Module	Ivolador Uno
S -----	D1
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

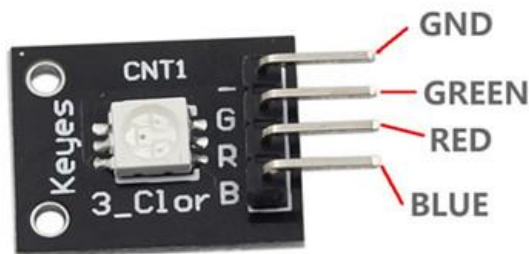
Now, you can hear the active buzzer beep.



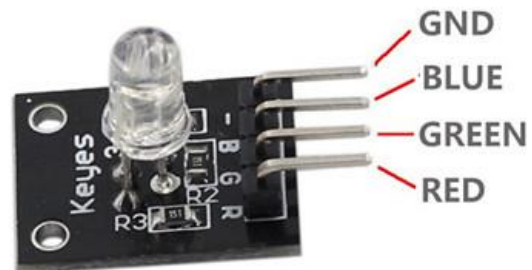
# Lesson 11 RGB LED

## Introduction

There are two kinds of packages for RGB LED (as shown below) in this kit. One is Surface Mount Device (SMD) type, and the other is Dual In-line Package (DIP) type.



**SMD Package**



**DIP Package**

## Components

- 1 \* Ivofador Uno board
- 1 \* USB data cable
- 1 \* RGB LED module
- Several jumper wires

## Experimental Principle

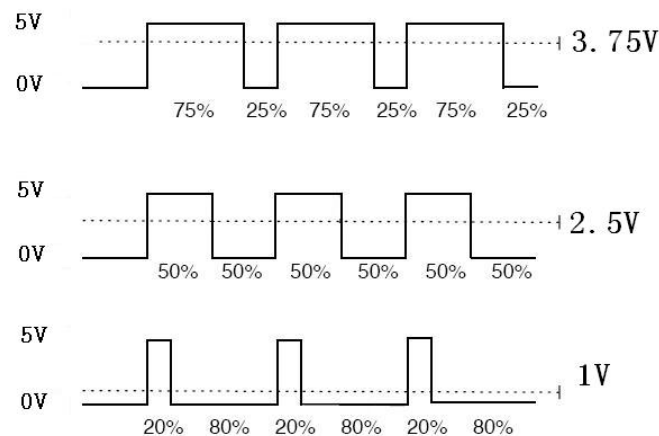
RGB LED modules can emit various colors of light. Three LEDs of red, green, and blue are packaged into a transparent or semitransparent plastic shell with four pins led out. The three primary colors, red, green, and blue, can be mixed into various kinds of color by brightness, so you can make an RGB LED emit colorful light by controlling the circuit.

In this experiment, we will also use PWM technology to control the brightness of RGB.

Before we talk about PWM, let's take a look at the applications of PWM first. PWM has been successfully applied in motor speed regulation, steering angle control, light intensity control and signal output. For example, when PWM is applied to a horn, it will make sounds. After we know about its special functions, let's find out what PWM really is.

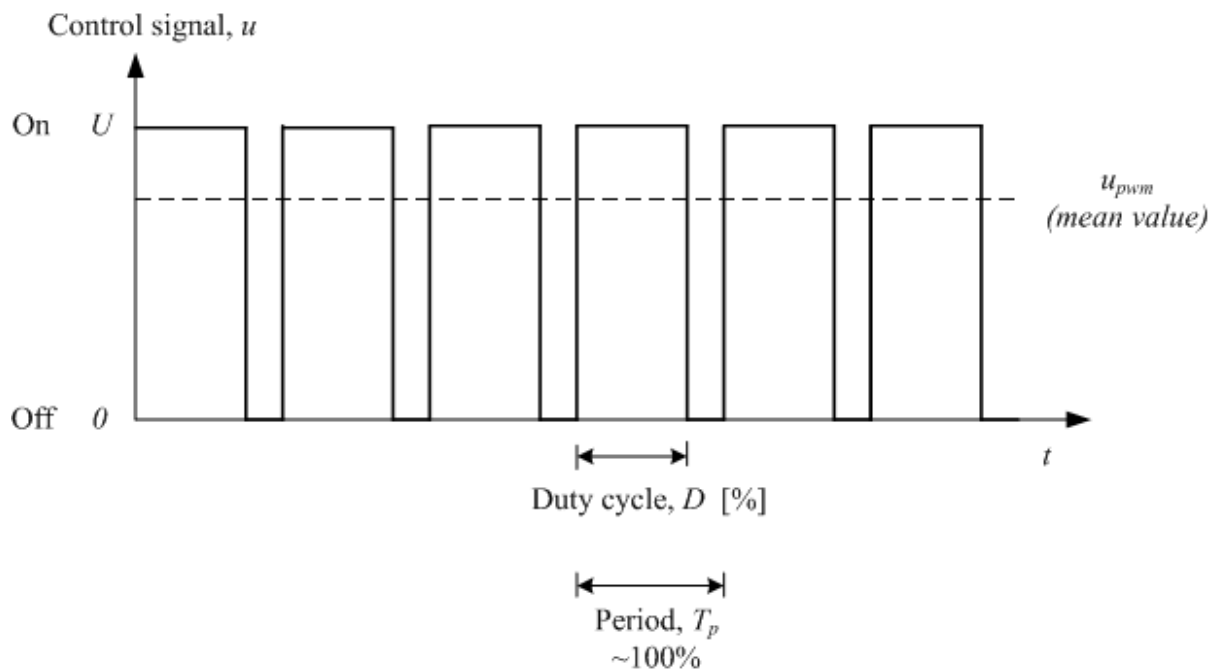
Pulse Width Modulation commonly refers to PWM. Pulse Width Modulation (PWM) is a digital coding method for analog signal levels. Since a computer cannot output an analog voltage but digital voltage value 0V or 5V, we modulate the duty cycle of square waves to encode a specific level of analog signal by using a high-resolution counter. PWM signals are essentially digital signals, for the full amplitude DC power supply is either 5V (ON) or 0V (OFF)

at any given time. Voltage or current source is applied to an analog load in the form of ON or OFF repetitive pulse sequence. When it is on, DC power supply will be applied to the load; when it is off, DC power supply will be disconnected. If only the bandwidth is wide enough, any analog value can be encoded by PWM. The output voltage value is calculated by the on and off time.  $V_{out} = (T_{on}/T) * V_{max}$ .



We can see from the top oscillogram that the amplitude of DC voltage output is 5V. However, the actual voltage output is only 3.75V through PWM, for the high level only takes up 75% of the total voltage within a period.

Here is the introduction to three basic parameters of PWM:



1. The term **duty cycle** describes the proportion of 'on' time to the regular interval or 'period' of time

2. **Period** describes the reciprocal of pulses in one second
3.  **$U_{pwm}$**  describes the mean value of output voltage (e.g. 0V-5V)

Here we input any value between 0 and 255 to the three pins of the RGB LED to make it flash different colors.

RGB LEDs can be categorized into common anode type and common cathode type. In this experiment, we use common cathode RGB LED.

## Experimental Procedures

**Step 1:** Build the circuit

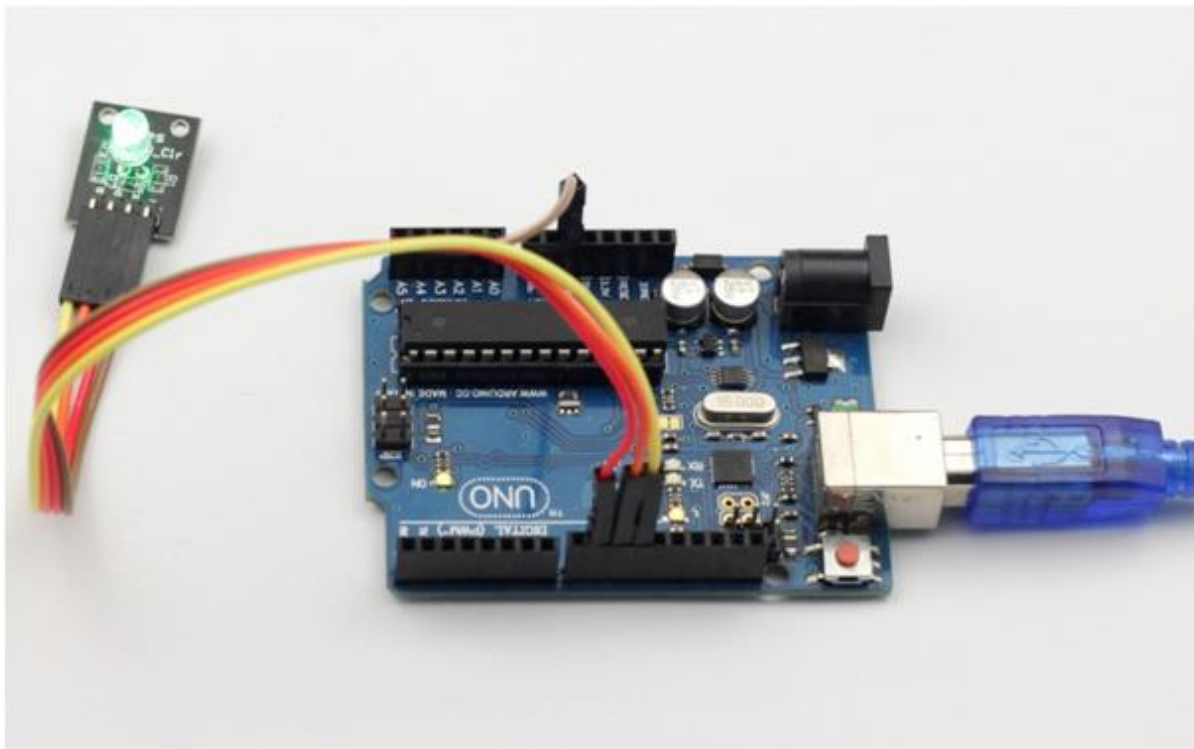
RGB LED Module	Ivolador Uno
R -----	D11
G -----	D10
B -----	D9
- -----	GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can see the RGB LED flash red, green and blue first, and then red, orange, yellow, green, blue, indigo and purple.



# Lesson 12 Dual-color Common-Cathode LED

## Introduction

There are two kinds of dual-color Common-Cathode LED in this kit. The only difference is the package size of the LED, as shown below:



## Components

- 1 \* Ivollador Uno board
- 1 \* USB data cable
- 1 \* Dual-color Common-Cathode LED module
- Several jumper wires

## Experimental Principle

Control the LED brightness by the digital port. The color of the LED changes from yellow to red as well as flashes a mixed color.

## Experimental Procedures

**Step 1:** Build the circuit

Dual-color Common-Cathode LED	Ivollador Uno
Y -----	D10
- -----	GND
R -----	D11

**Step 2:** Program (Please refer to the example code in [Ivollador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivollador Uno



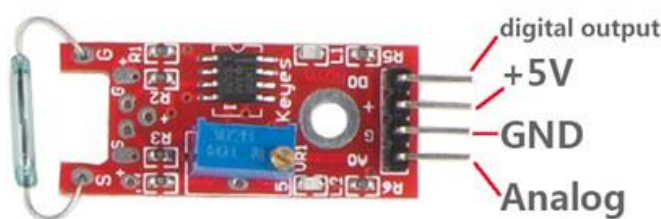


# Lesson 13 Reed Switch

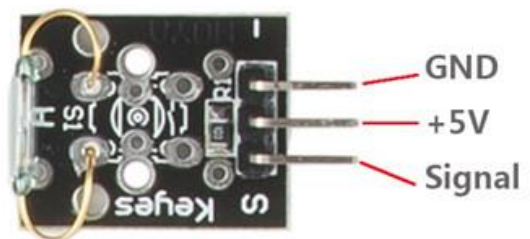
## Introduction

A reed switch (as shown below) is a sensor used to detect the magnetic field. Hall sensors are generally used to measure the speed of smart car and count products on assembly lines. Reed switches are often used to detect the existence of magnetic field.

There are two reed switches in this kit: reed switch and mini reed. They work in the same principle.



**Reed Switch**



**Mini Reed**

## Components

- 1 \* Ivollador Uno board
- 1 \* USB data cable
- 1 \* Reed switch module
- Several jumper wires

## Experimental Principle

A reed switch is a type of line switch component that realizes control by magnetic signals. It induces by a magnet. The "switch" here means dry reed pipe, which is a kind of contact passive electronic switch component with the advantage of simple structure, small size, and convenient control. 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 made of special materials in the glass tube are separated. However, when a magnetic substance approaches the glass tube, the two reeds in the glass tube are magnetized to attract each other and get touched due to the magnetic force. As a result, the two reeds close the circuit connected with the nodes.

After the external magnetic force disappears, the two reeds will be separated with each other again because their like poles are placed near which intend to repel them apart, thus

breaking the circuit. Therefore, as line switch components function by magnetic signals, they can be used to count stuff, restrict positions and so on. At the same time, it is widely used in a variety of communication devices.

In this experiment, since an LED has been attached to pin 13, just connect pin D0 of the reed switch to D8 of the Ivolorador Uno board. When the reed switch inducts magnetic field signals, the LED will be on. Otherwise, it will be off.

## Experimental Procedures

**Step 1:** Build the circuit

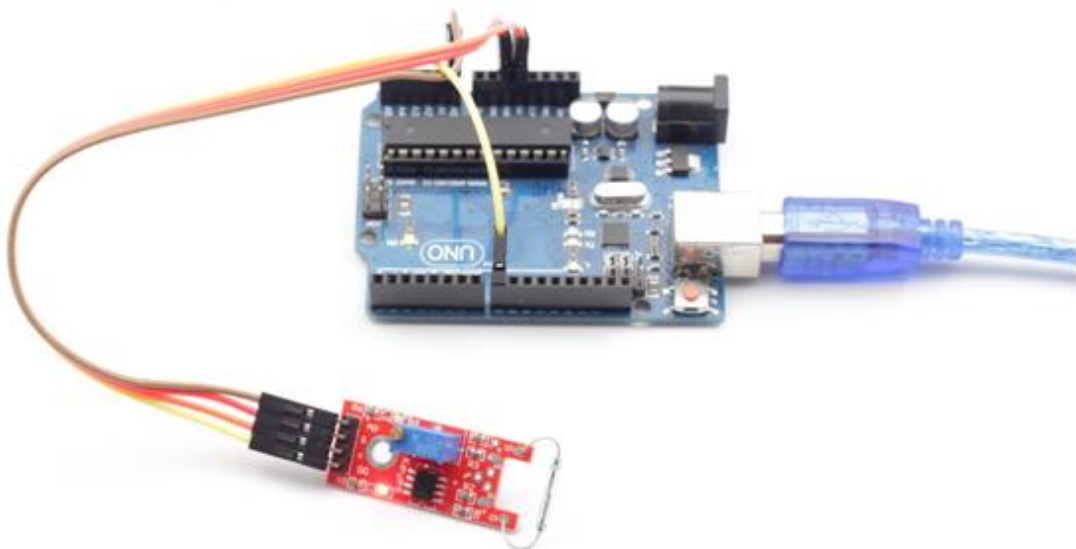
Reed Switch Module	Ivolorador Uno
AO -----	A0
DO -----	D8
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolorador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

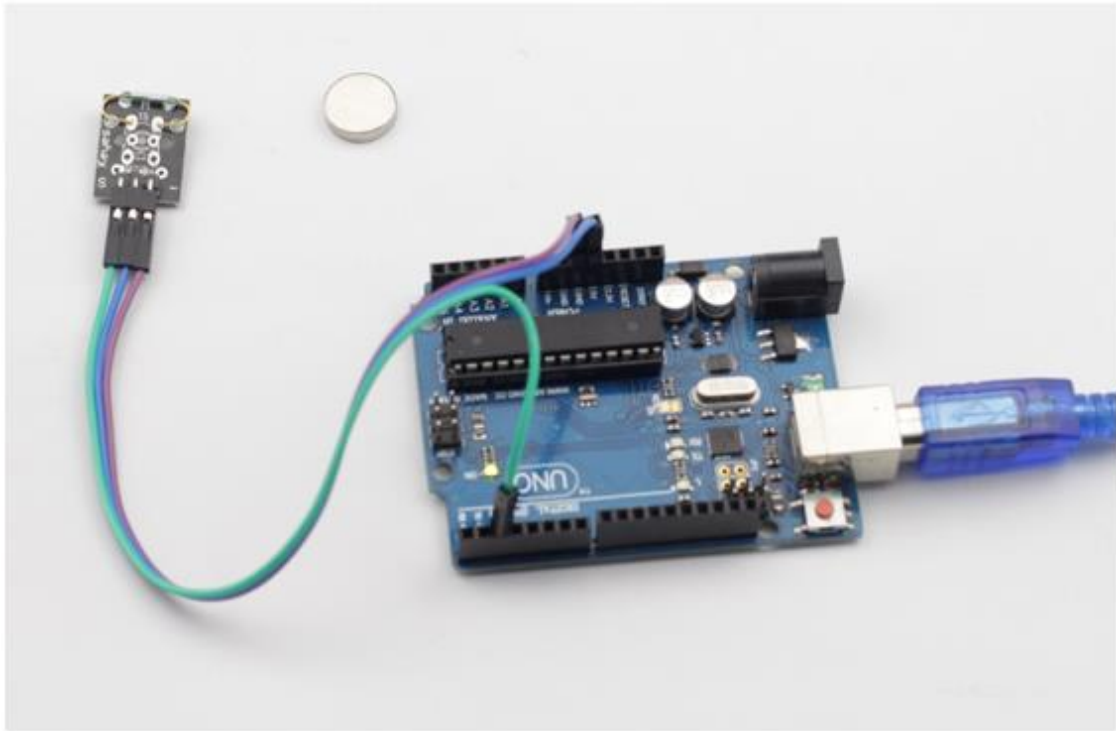
**Step 4:** Upload the sketch to Ivolorador Uno

Now, put a magnet close to the reed switch, and you will see the LED attached to pin 13 on the Ivolorador Uno board light up.



## Mini Reed

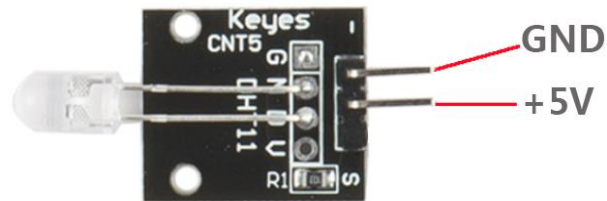
The experimental procedures are the same as those of Reed Switch. Connect pin 5 to D2 of the I/O expander board, and you will see the LED attached to pin 13 light up when a magnet approaches the mini reed.



# Lesson 14 7-Color Auto-flash LED

## Introduction

It can automatically flash built-in colors after power on.



## Components

- 1 \* Ivofador Uno board
- 1 \* USB data cable
- 1 \* 7-color auto-flash LED module
- Several jumper wires

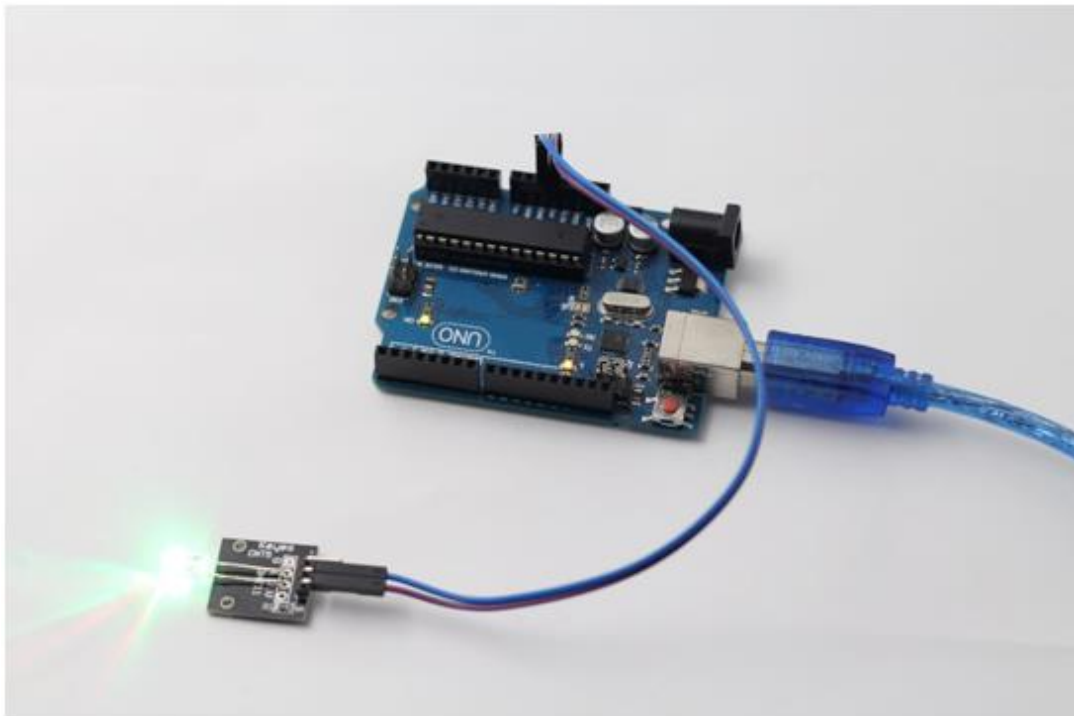
## Experimental Principle

When being power on, the 7-color auto-flash LED will flash built-in colors.

## Experimental Procedures

Just connect pin S to 5V of the Ivofador Uno board and pin - to GND.

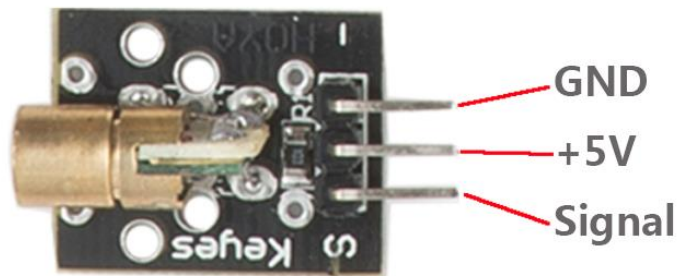
Now, you can see the 7-color auto-flash LED flashing seven colors.



# Lesson 15 Laser Transmitter

## Introduction

Laser is widely used in medical treatment, military, and other fields due to its good directivity and energy concentration. The Laser Transmitter module (as shown below), as the name suggests, is a one that can emit laser.



## Components

- 1 \* Ivoldor Uno board
- 1 \* USB data cable
- 1 \* Laser transmitter module
- Several jumper wires

## Experimental Principle

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. Lasers differ from other sources of light because they emit light coherently.

Spatial coherence allows a laser to be focused to a tight spot, enabling applications like laser cutting and lithography, and a laser beam to stay narrow over long distances (collimation), enabling applications such as laser pointer. Lasers can also have high temporal coherence which allows them to have a very narrow spectrum, i.e., they only emit a single color of light. And its temporal coherence can be used to produce pulses of light—as short as a femtosecond.

## Experimental Procedures

**Step 1:** Build the circuit

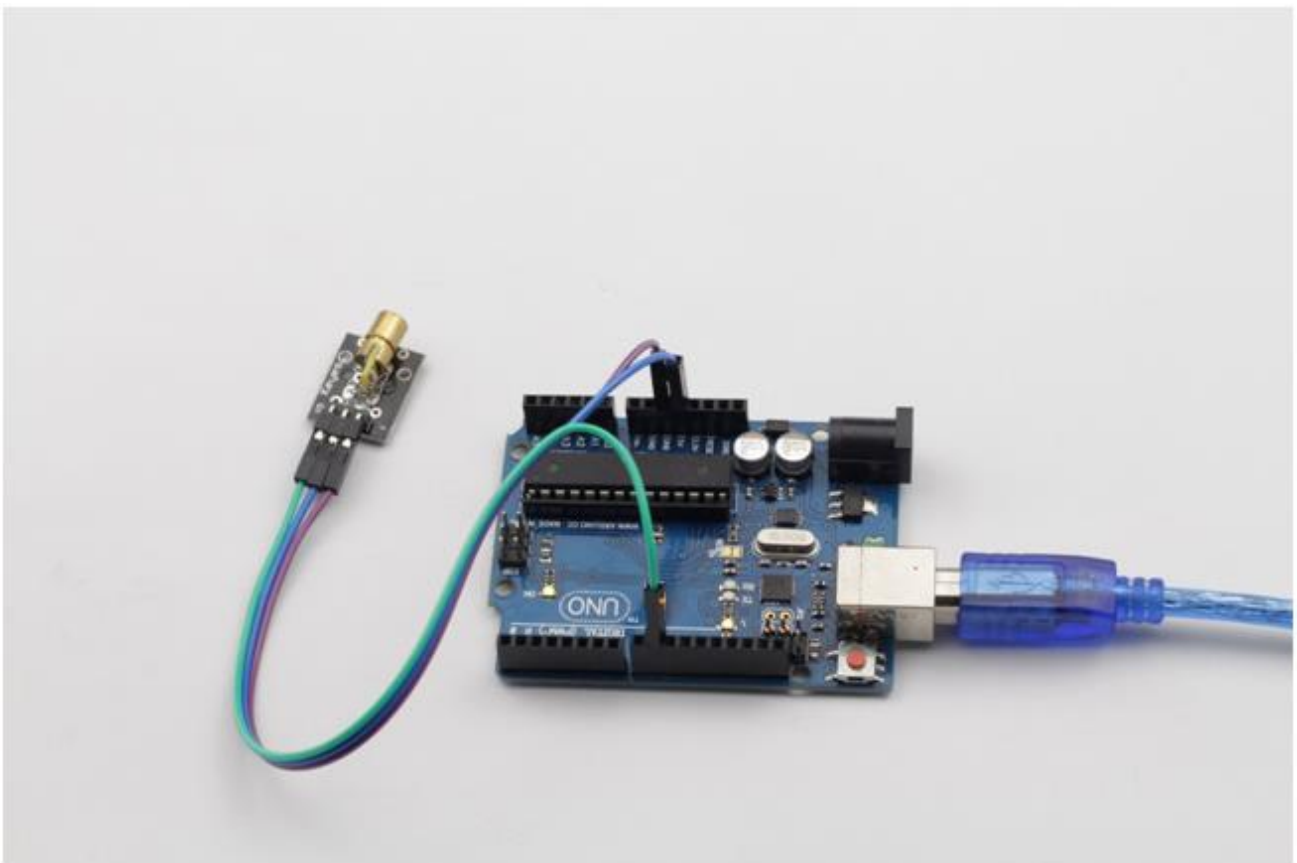
Laser Transmitter Module	Ivolador Uno
S -----	Digital 9
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can see the laser transmitter module send out Morse signals.



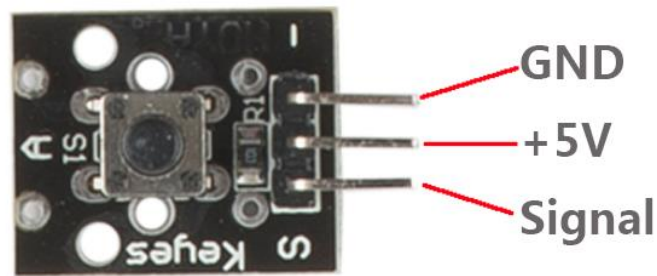
**Note: DO NOT look directly at the laser head. It can cause great harm to your eyes.**



# Lesson 16 Button Switch

## Introduction

Most Ivolor boards already have an LED attached to pin 13 itself. So we will use a button module and this LED to build a simple circuit and make an LED brighten.



## Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Button module
- Several jumper wires

## Experimental Principle

With the LED attached to pin 13, connect the button module to digital pin 8. When the button module inducts button-pressing signals, the LED will be on. Otherwise, it will be off.

## Experimental Procedures

**Step 1:** Build the circuit

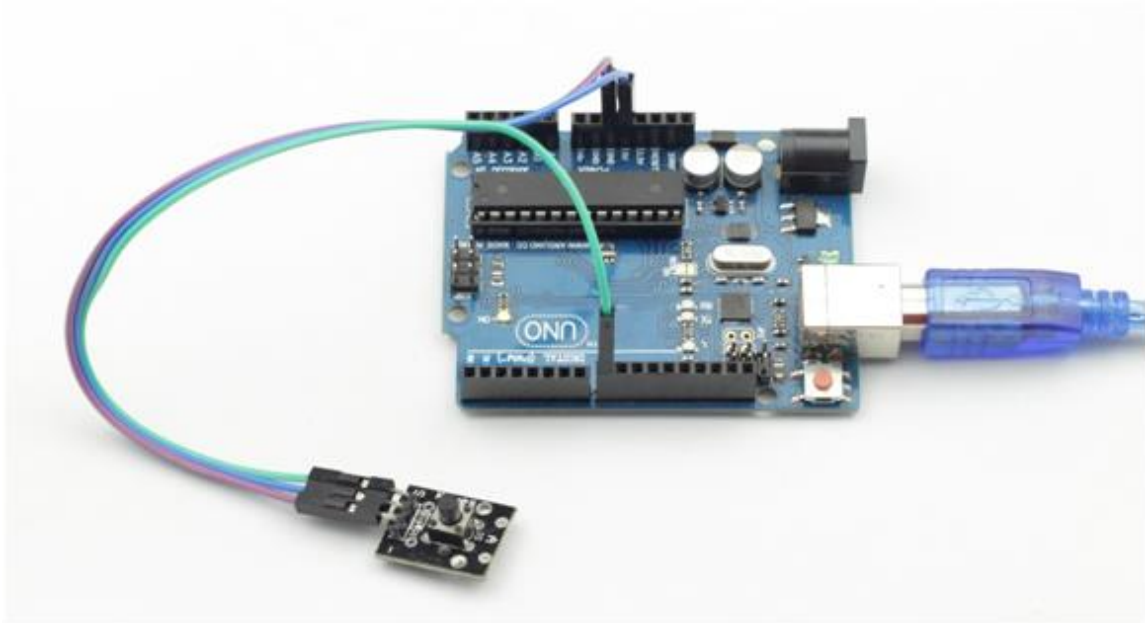
Button Module	Ivolor Uno
S -----	Digital 8
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolor Uno

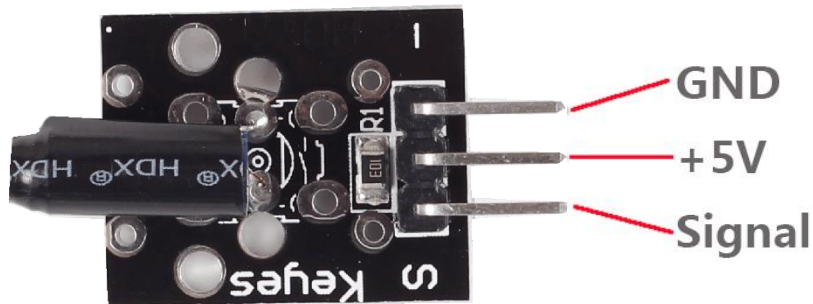
Now, press the button and the LED attached to pin 13 on the Ivoldor Uno board will light up.



# Lesson 17 Shock Switch

## Introduction

A shock switch (as shown below), also vibration switch, spring switch or shock sensor, is an electronic switch which senses vibration amplitude and transfers the signals to circuit device thus switching on the circuit. It composes of conductive vibration spring, switch, trigger pin, packaging agent and so on.



## Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Shock switch module
- Jumper wires

## Experimental Principle

The shock switch works like this: the conductive vibration spring and trigger pin are precisely placed in the switch and fixed by adhesive. Normally, the spring and the trigger pin are separated. Once the sensor detects shock, the spring will vibrate and contact with the trigger pin, thus conducting and generating trigger signals.

With the LED attached to pin 13 already, connect the shock switch to digital pin 8. When the shock switch induces shock signals, the LED will light up.

## Experimental Procedures

**Step 1:** Build the circuit

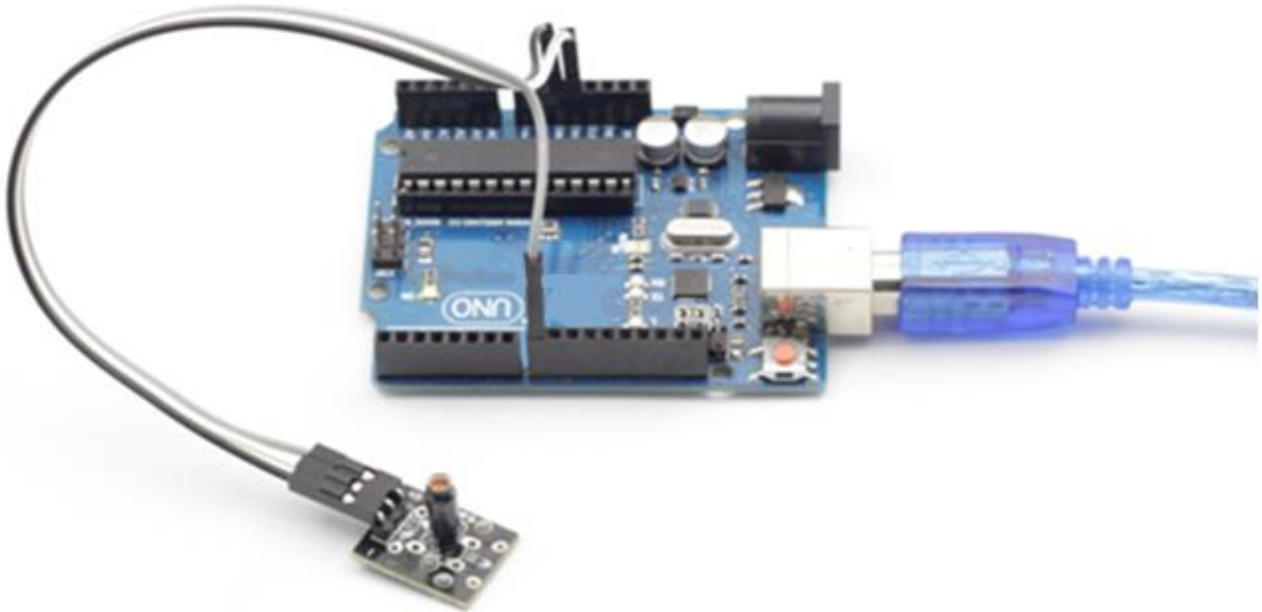
Shock Switch Module	Ivolor Uno
S -----	D8
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

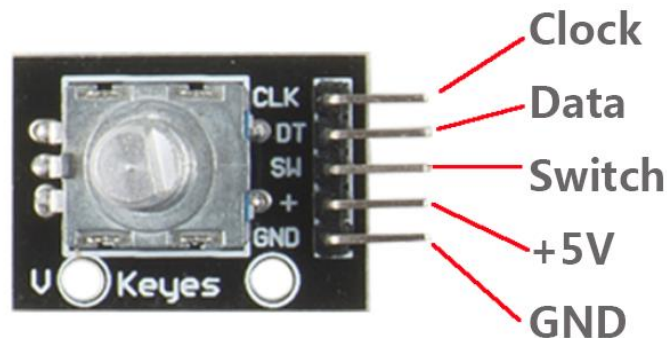
Now, shake the switch module and you will see the LED attached to pin 13 on the Ivolador Uno board light up.



# Lesson 18 Rotary Encoder

## Introduction

A rotary encoder is an electro-mechanical device that converts the angular position or motion of a shaft or axle to an analog or digital code. Rotary encoders are usually placed at the side which is perpendicular to the shaft. Rotary encoders act as sensors for detecting angle, speed, length, position and acceleration in automation field.



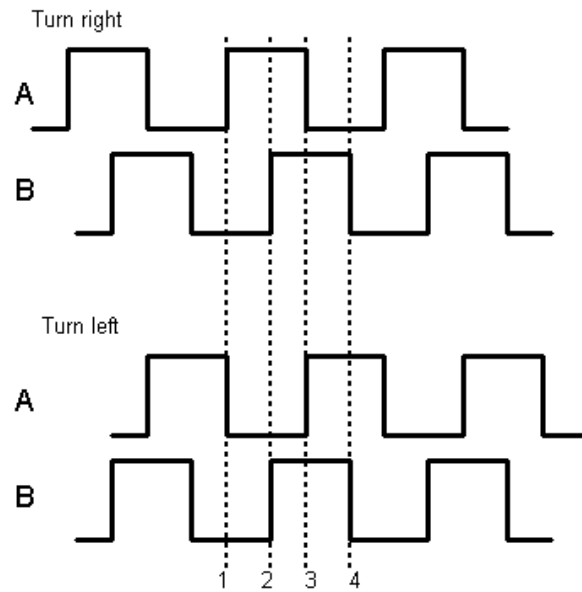
## Components

- 1 \* Ivoldor Uno board
- 1 \* USB data cable
- 1 \* Rotary Encoder module
- Jumper wires

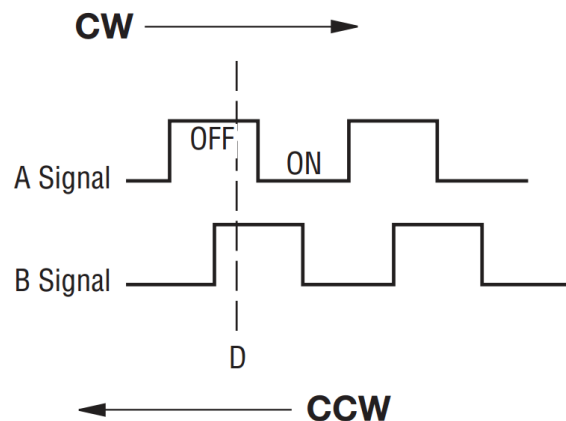
## Experimental Principle

There are mainly two types of rotary encoder: absolute and incremental (relative) ones. The output of absolute encoders indicates the current position of the shaft, making them angle transducers. The output of incremental encoders provides information about the motion of the shaft, which is typically further processed elsewhere into information such as speed, distance, and position.

In this experiment, we will use the latter. An incremental encoder is a rotary sensor to turn rotational displacement into a series of digital pulse signals which are then used to control the angular displacement. It generates two-phase square waves whose phase difference is  $90^\circ$ . Usually the two-phase square waves are called channel A and channel B. See the following figure for details.



It is difficult to distinguish between the left turn and right turn when programming. However, when using an oscilloscope to observe the left turn and right turn of a switch, you will find a phase difference between the signals of the two output pins as shown below.



It shows that if output 1 and output 2 is high, then the switch rotates clockwise; if output 1 is high and output 2 is low, then the switch rotates counterclockwise. As a result, during SCM programming, if output 1 is high, then you can tell whether the rotary encoder turns left or right as long as you know the state of output 2.

## Experimental Procedures

### Step 1: Build the circuit

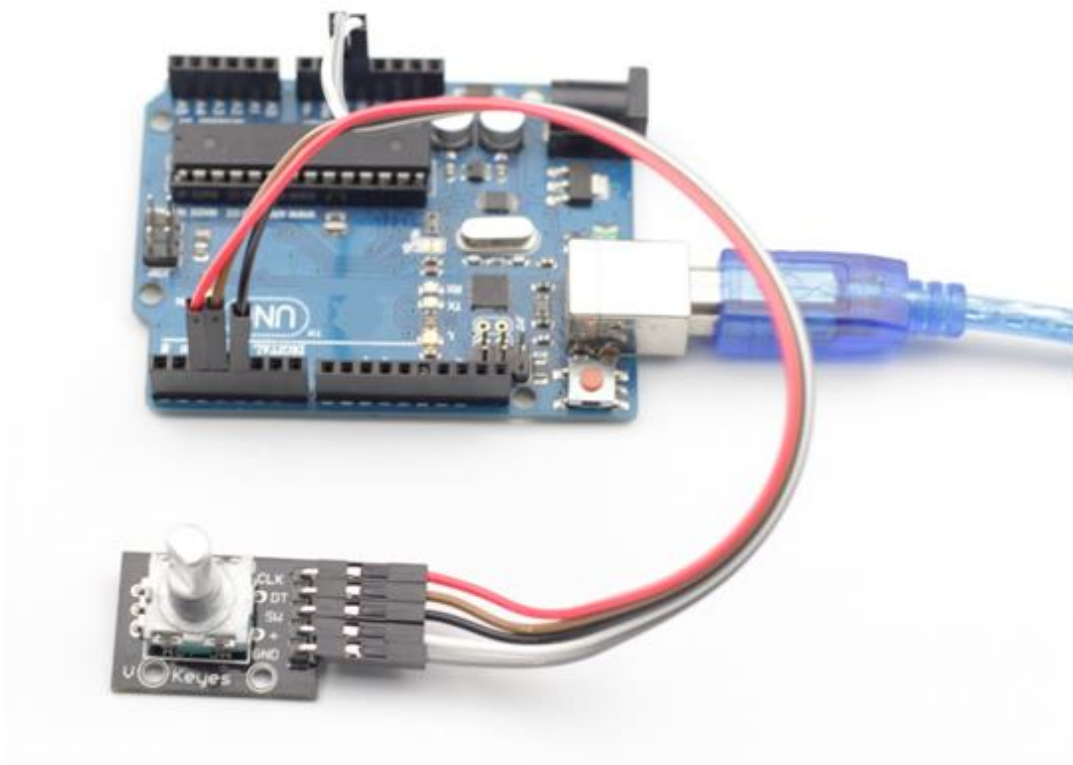
Rotary Encoder Module	Ivolador Uno
CLK -----	D2
DT -----	D3
SW -----	D4
+ -----	5V
- -----	GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can see the angular displacement of the rotary encoder printed on Serial Monitor. When you spin the rotary encoder clockwise, the angular displacement increases; when you spin it counterclockwise, the value decreases. Press the switch on the rotary encoder and the value will return to zero.

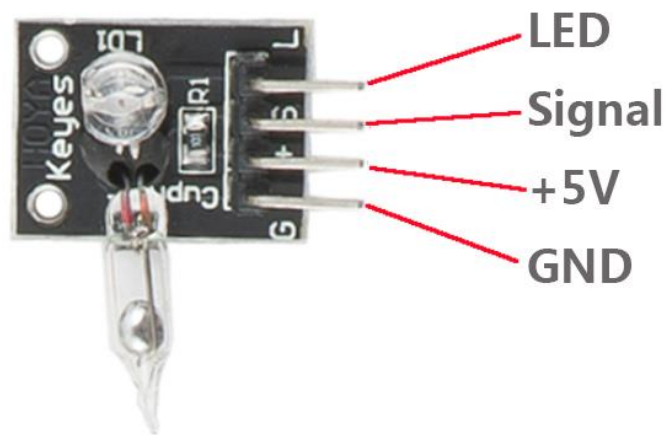




# Lesson 19 Magic Cup

## Introduction

There are two same Magic Cup modules in this kit, and each adds a separate LED based on the mercury switch. You may learn the application of one module and then try to apply two modules together to make one dim when at the same time the other brightens.



## Components

- 1 \* Ivollador Uno board
- 1 \* USB data cable
- 2 \* Magic cup module
- Several jumper wires

## Experimental Principle

Connect pin S and pin L of one module to digital pin 7 and pin 5 of the Ivollador Uno board; pin S and pin L of the other module to D4 and pin 6 of the Uno.

When you tilt one mercury switch, the LED attached will become dimmer gradually, while the other LED will slowly brighten. The effect is just like the telepathy.

## Experimental Procedures

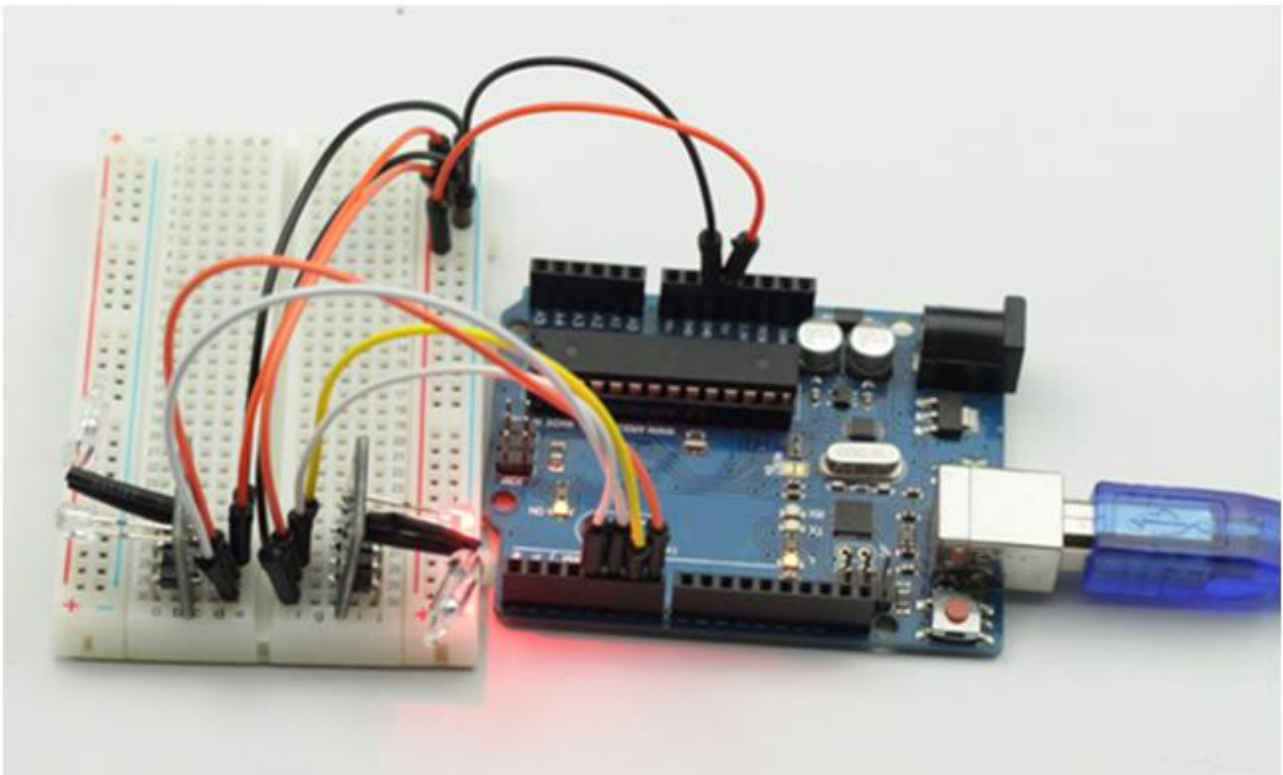
**Step 1:** Connect pin S and pin L of one module to D7 and pin 5 of the Ivollador Uno; pin S and pin L of the other module to D4 and pin 6 of Uno.

**Step 2:** Program (Please refer to the example code in [Ivollador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivollador Uno

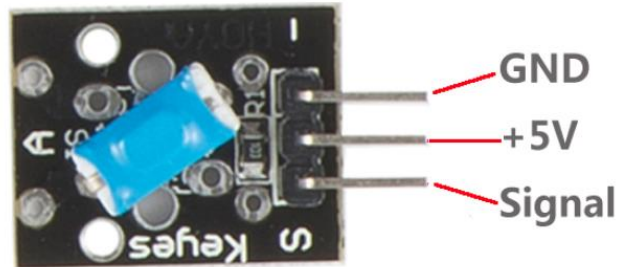
Now, tilt the breadboard and you will see the LED on one module gets dimmer while that on the other LED becomes brighter.



# Lesson 20 Tilt-Switch

## Introduction

The tilt switch sensor module is a ball tilt switch with a metal ball inside. It is used to detect inclinations of a small angle.



## Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Tilt-switch module
- Several jumper wires

## Experimental Principle

Apply the principle that the ball in the switch moves with different angles of inclination to make triggering circuits. The tilt switch module uses a ball tilt switch with bidirectional conduction. When it tilts towards either side, as long as the tilt degree and force meet the condition, the switch will be energized; thus, it will output low level signals.

In this experiment, we use a tilt switch module and an LED that has been attached to pin 13 of the Ivolor board to build a simple circuit.

With the LED attached to pin 13, connect pin S to D2 of Ivolor Uno board. When the Tilt-switch inducts tilt signals, the LED will be on. Otherwise, it will be off.

## Experimental Procedures

**Step 1:** Build the circuit

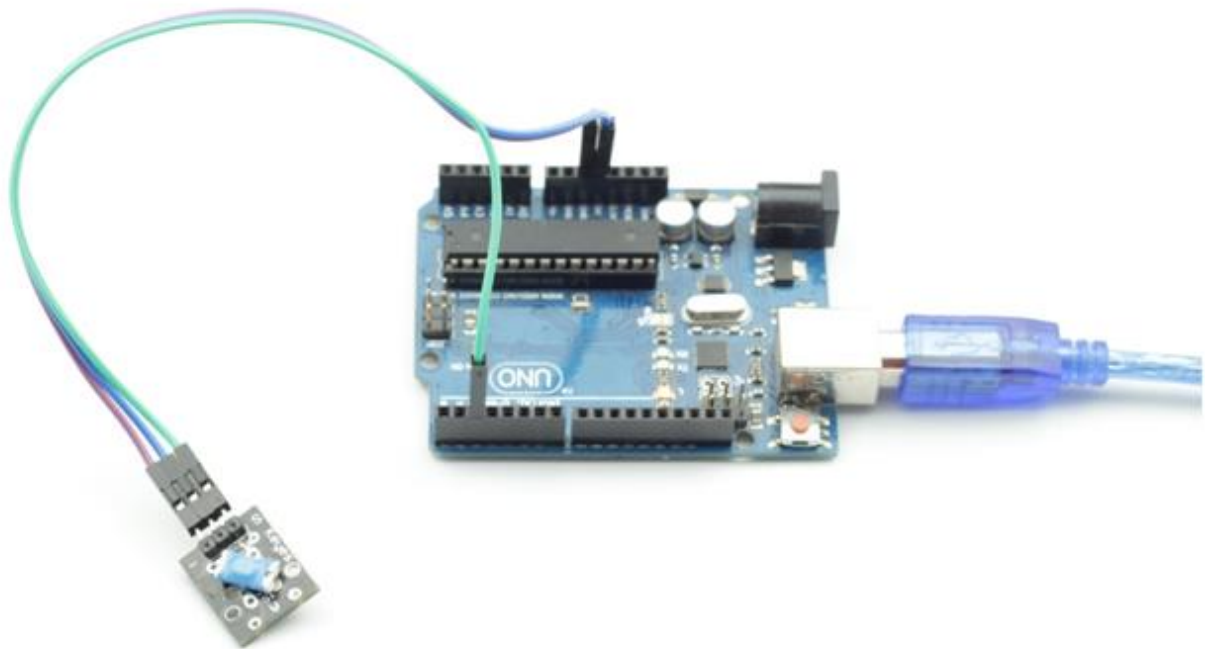
Tilt-switch Module	Ivolor Uno
S -----	D2
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolor Uno

Now, tilt the switch and the LED attached to pin 13 on the Ivolor Uno board will light up.

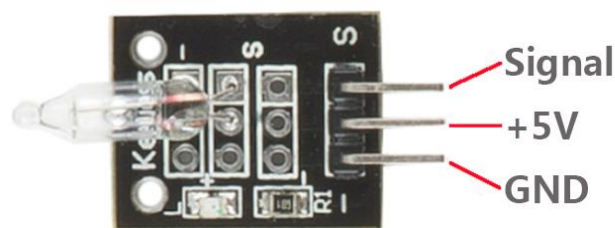


# Lesson 21 Mercury Switch

## Introduction

Similar to a tilt switch, a mercury switch is used to detect slight inclinations of a large angle. A mercury switch (also known as a mercury tilt switch) is a switch which opens and closes an electrical circuit through a small amount of liquid mercury.

Mercury switches have one or more sets of electrical contacts in a sealed glass envelope which contains a bead of mercury. The envelope may also contain air, an inert gas, or a vacuum. Gravity is constantly pulling the drop of mercury to the lowest point in the envelope. When the switch is tilted in the appropriate direction, the mercury touches a set of contacts, thus completing the electrical circuit through those contacts. Tilting the switch the opposite direction causes the mercury to move away from that set of contacts, thus breaking that circuit.



## Components

- 1 \* Ivোলদর Uno board
- 1 \* USB data cable
- 1 \* Mercury switch module
- Several jumper wires

## Experimental Principle

Since the LED has been attached to pin 13, just connect pin S to D2 of the Ivোলদর Uno board. When the mercury switch inducts tilt signals, the LED will be on. Otherwise it will be off.

**Note:** Mercury is harmful to human body and environment. Thus, please BE CAREFUL when using a mercury switch in case of glass breaking. It should also be properly handled if it's no longer used.

## Experimental Procedures

**Step 1:** Build the circuit

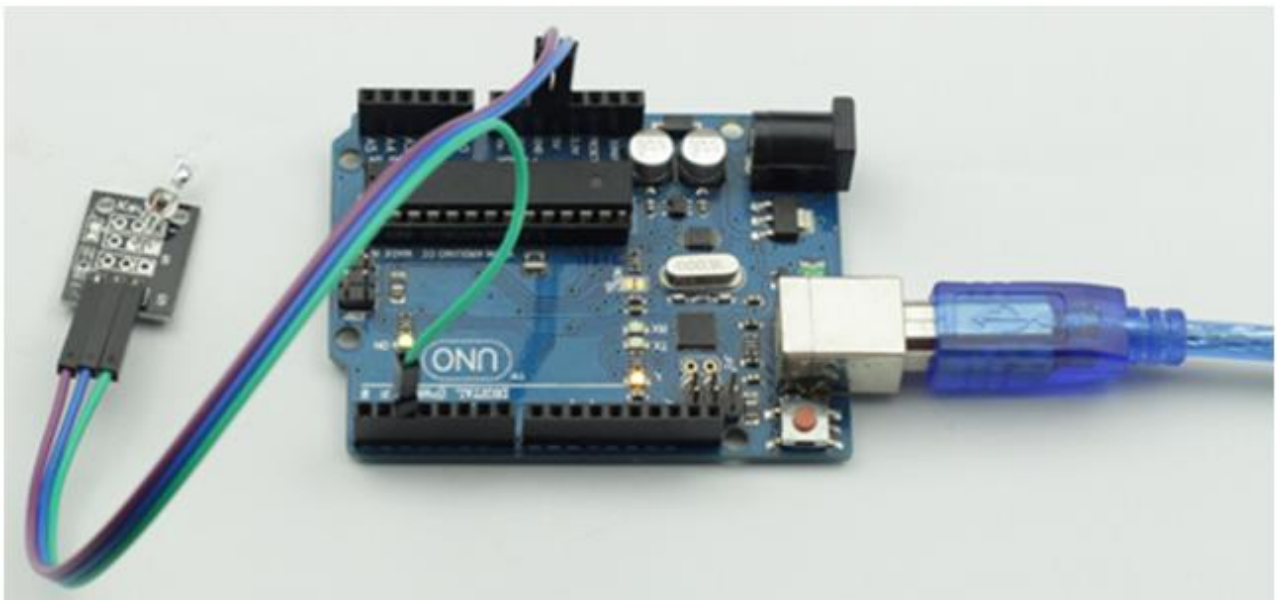
Mercury Switch Module	Ivolador Uno
S-----	D2
- -----	GND
+ -----	5V

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

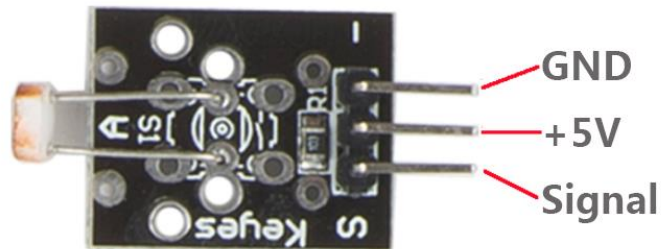
Now, tilt the switch and the LED attached to pin 13 on the Ivolador Uno board will light up.



## Lesson 22 Photoresistor Sensor

### Introduction

The sensor is in fact a photoresistor which changes its resistance with varying light intensity. It can be used to make a photoswitch.



### Components

- 1 \* Ivofador Uno board
- 1 \* USB data cable
- 1 \* Photoresistor sensor module
- Jumper wires

### Experimental Principle

A photoresistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

In this experiment, hook up pin S to an analog port of the Ivofador board. When the light intensity changes, the resistance of photoresistor will change accordingly. Thus it will also change the output voltage of pin S. You can read the output voltage and display it on an LCD to observe this change.

### Experimental Procedures

**Step 1:** Build the circuit

Photoresistor Sensor Module	Ivofador Uno
S -----	A0
- -----	GND
+ -----	5V

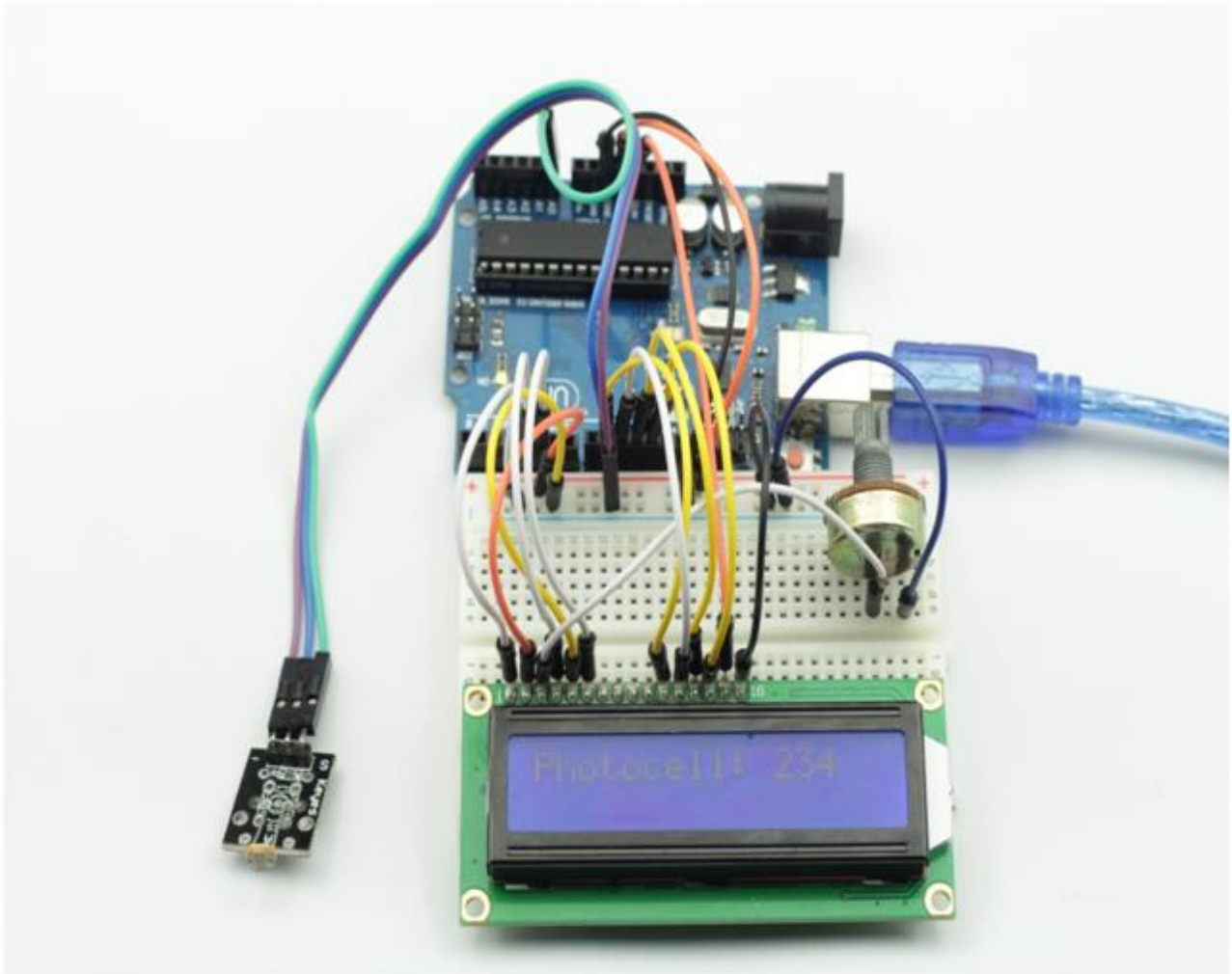


**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, cover the photoresistor with a cloth or your palm to change the light intensity, and you will find the value displayed on the LCD changes accordingly.

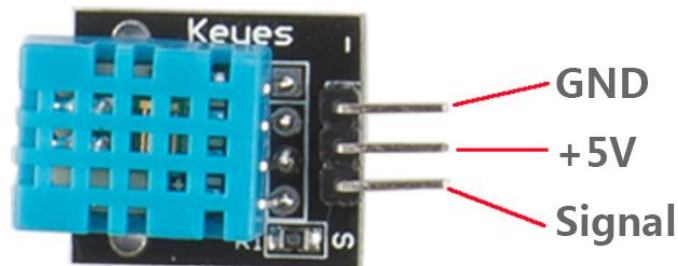


# Lesson 23 Humiture Sensor

## Introduction

The digital temperature and humidity sensor DHT11 is a composite sensor that contains a calibrated digital signal output of temperature and humidity. The technology of a dedicated digital modules collection and the temperature and humidity sensing technology are applied to ensure that the product has high reliability and excellent long-term stability.

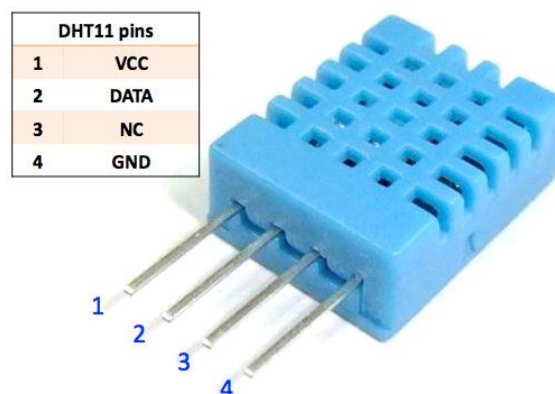
The sensor includes a resistive sense of wet component and an NTC temperature measurement device, and is connected with a high-performance 8-bit microcontroller.



## Components

- 1 \* Ivolador Uno board
- 1 \* USB data cable
- 1 \* Humiture sensor module
- 1 \* LCD1602
- 1 \* Potentiometer
- Jumper wires

## Experimental Principle



Only three pins are available for use: VCC, GND, and DATA. The communication process begins with the DATA line sending start signals to DHT11, and DHT11 receives the signals and

returns an answer signal. Then the host receives the answer signal and begins to receive 40-bit humiture data (8-bit humidity integer + 8-bit humidity decimal + 8-bit temperature integer + 8-bit temperature decimal + 8-bit checksum). For more information, please refer to DHT11 datasheet.

## Experimental Procedures

### Step 1: Build the circuit

Humiture Sensor Module	Ivolador Uno
S -----	D4
- -----	GND
+ -----	5V

**LCD1602 connection:** connect pin RS to digital pin 5; R/W to GND; E to digital pin 6; D4~D7 to digital pin 9 to 12; VSS to GND; VDD to 5V; A to 3.3V; K to GND

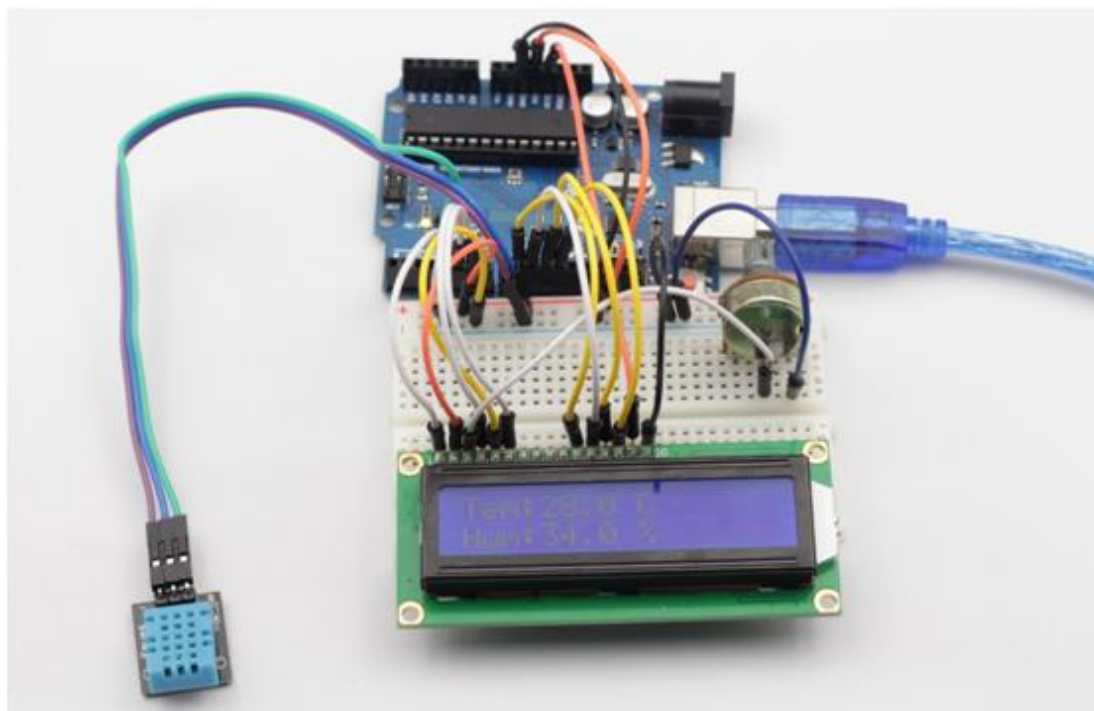
**Potentiometer connection:** Connect the middle pin to VO of LCD1602 and any other pin to GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

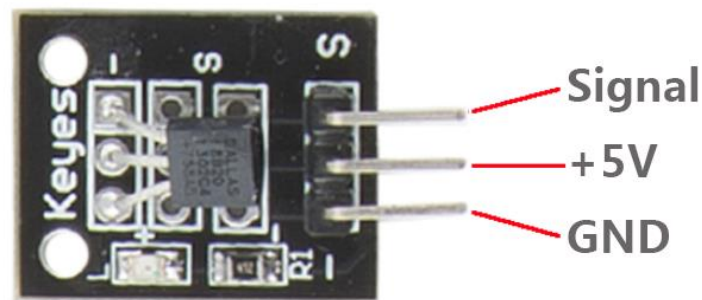
Now, you can see the value of the current humidity and temperature displayed on the LCD.



# Lesson 24 DS18B20 Temperature Sensor

## Introduction

The Temperature Sensor DS18B20 is a commonly used digital temperature sensor featured with small size, low-cost hardware, strong anti-interference capability and high precision. The digital temperature sensor is easy to wire and can be applied a various occasions after packaging. Different from conventional AD collection temperature sensors, it uses a 1-wire bus and can directly outputs temperature data.



## Components

- 1 \* Ivoldor Uno board
- 1 \* USB data cable
- 1 \* DS18B20 Temperature Sensor module
- 1 \* LCD1602
- 1 \* Potentiometer
- Several jumper wires

## Experimental Principle

With a unique single-wire interface, DS18B20 requires only one pin for a two-way communication with a microprocessor. It supports multi-point networking to measure multi-point temperatures. Eight DS18B20s can be connected at most, because too many of them will consume too much of the power supply and cause low voltage thus instability of signal transmission.

## Experimental Procedures

**Step 1:** Build the circuit

DS18B20 Temperature Sensor	Ivoldor Uno
S -----	D2
- -----	GND
+ -----	5V

**LCD1602 connection:** connect pin RS to digital pin 4; R/W to GND; E to digital pin 5; D4~D7 to digital pin 9 to 12; VSS to GND; VDD to 5V; A to 3.3V; K to GND

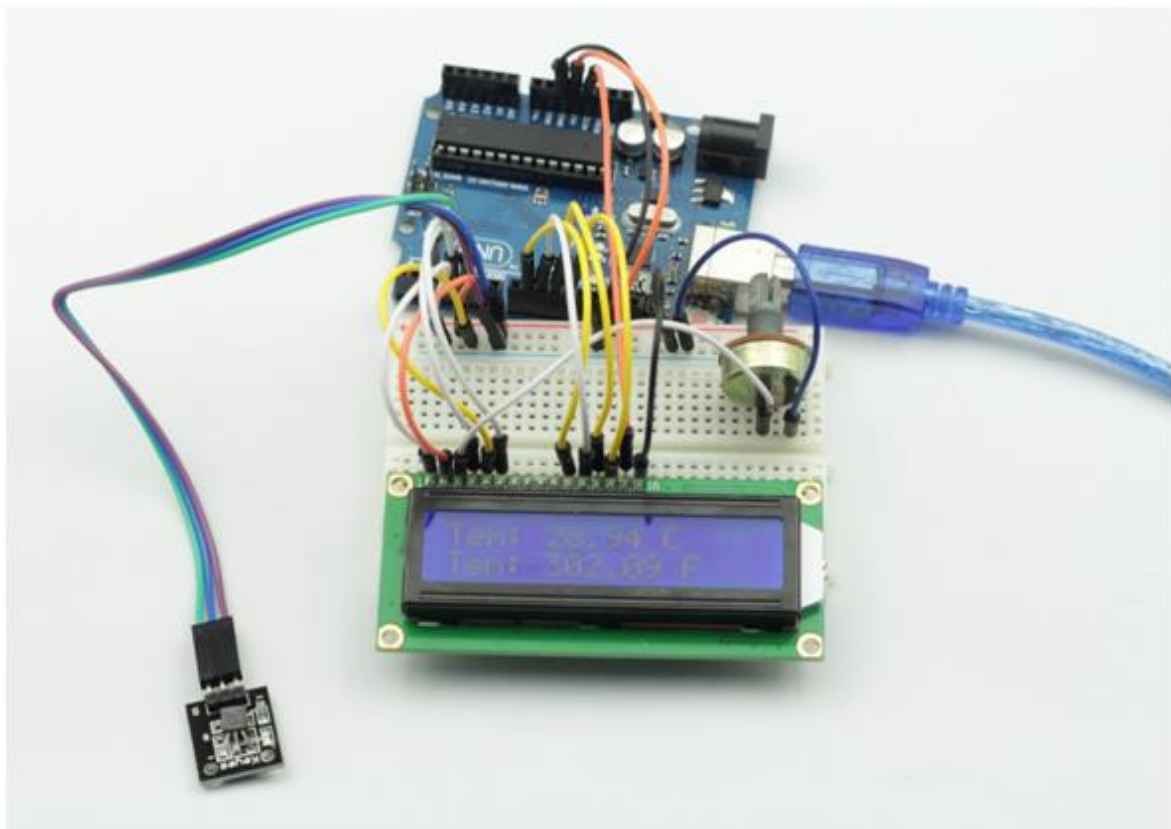
**Potentiometer connection:** Connect the middle pin to VO of LCD1602 and any other pin to GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can see the value of the current temperature displayed on the LCD.



# Lesson 25 Infrared Transmitter

## Introduction

An infrared transmitter module (as shown below) is a device that uses 38K modulation signal generated by MCU to emit infrared rays.



## Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Infrared transmitter module
- 1 \* LCD1602
- 1 \* Potentiometer
- Several jumper wires

## Experimental Principle

An infrared transmitter is a device applied in remote control. It can emit rays within a certain range through an infrared transmitting tube so as to control signals. Infrared transmitter is widely used in consumer electronics, industry and communication, etc.

In this experiment, connect pin S of the infrared transmitter module to D3 to build a simple circuit. When the coded value for an infrared ray is input by programming and then the infrared transmitter module emits the infrared ray, the LED attached to pin 13 will light up. In addition, the coded value of the infrared ray will be displayed on LCD1602.

## Experimental Procedures

**Step 1:** Build the circuit

Infrared Transmitter Module	Ivolor Uno
S	D3
-	GND

**LCD1602 connection:** connect pin RS to digital pin 5; R/W to GND; E to digital pin 4; D4-D7 to digital pin 9 to 12; VSS to GND; VDD to 5V; A to 3.3V; K to GND

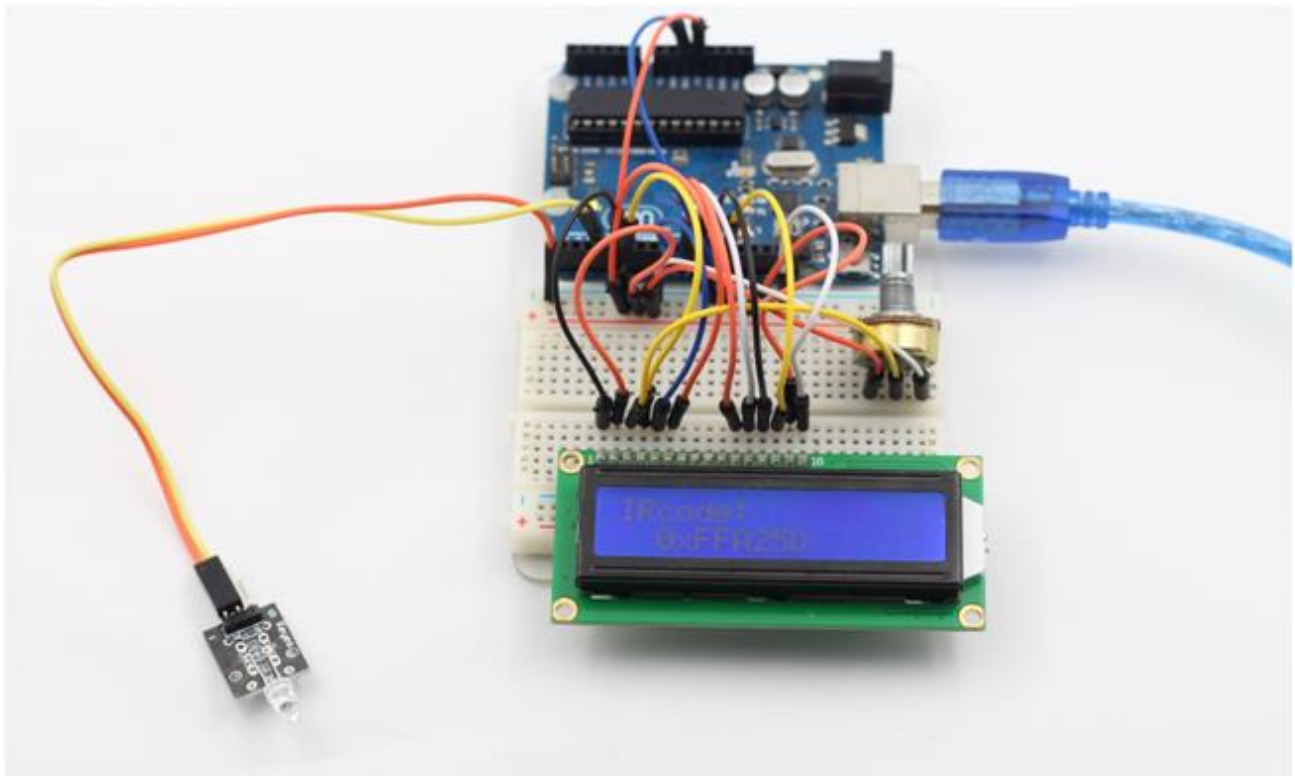
**Potentiometer connection:** Connect the middle pin to VO of LCD1602 and any other pin to GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

Now, you can see the infrared transmitter emit infrared rays through a camera or your phone camera. At the same time, the LED attached to pin 13 on Ivolador Uno board lights up and a coded value is displayed on the LCD.

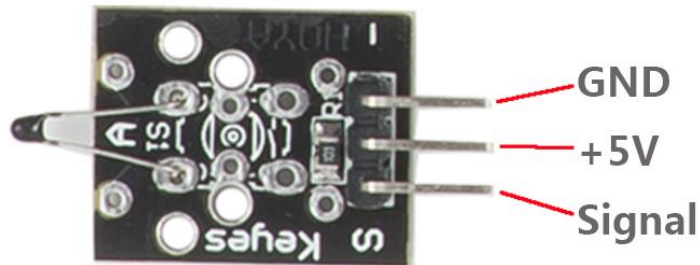




# Lesson 26 Analog Temperature Sensor

## Introduction

A thermistor is the core component of an analog temperature sensor (as shown below).



## Components

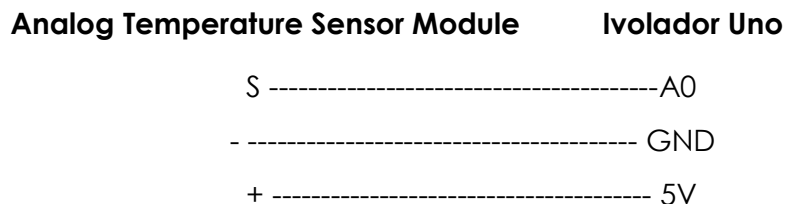
- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Analog Temperature Sensor module (thermistor)
- 1 \* LCD1602
- 1 \* Potentiometer
- Several jumper wires

## Experimental Principle

This module is based on thermistor principle, whose resistance varies significantly with ambient temperature changes. It can detect surrounding temperature changes in real time and send the temperature data to analog I/O port of the Ivolor Uno board. You only need to convert the output to Celsius temperature by simple programming and display it on an LCD.

## Experimental Procedures

**Step 1:** Build the circuit



**LCD1602 connection:** connect pin RS to digital pin 4; R/W to GND; E to digital pin 5; D4~D7 to digital pin 9 to 12; VSS to GND; VDD to 5V; A to 3.3V; K to GND

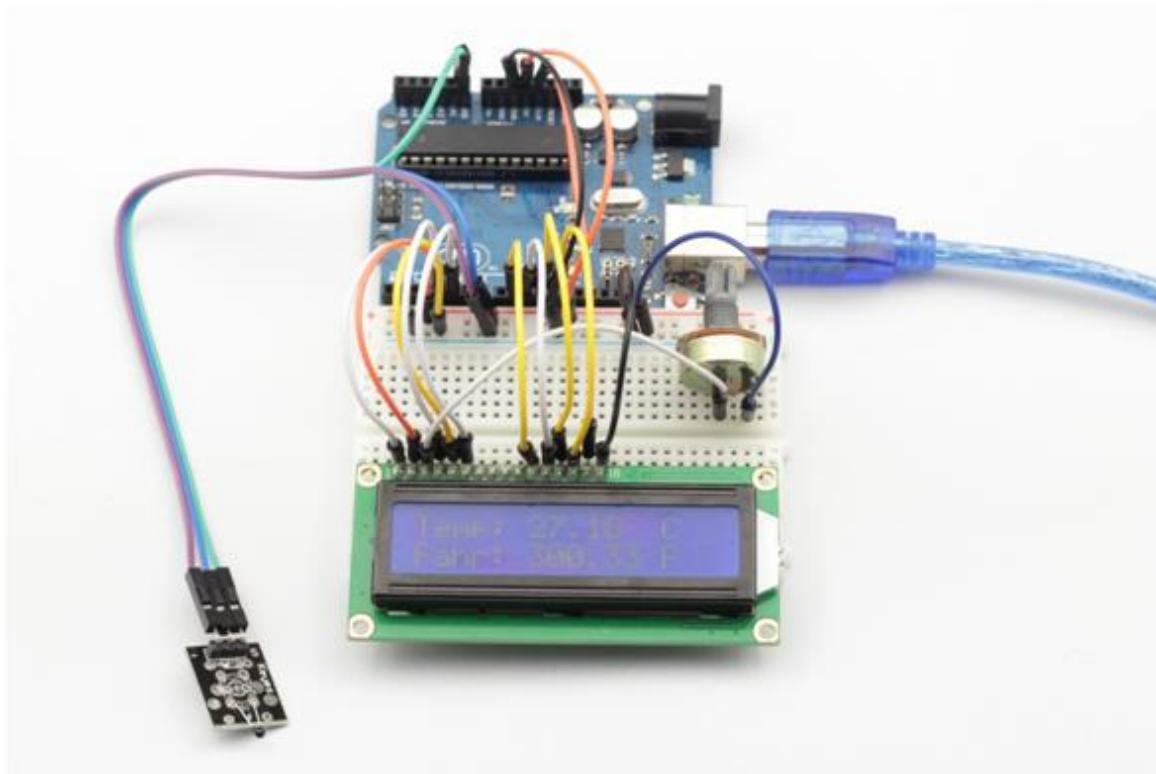
**Potentiometer connection:** Connect the middle pin to VO of LCD1602 and any other pin to GND

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

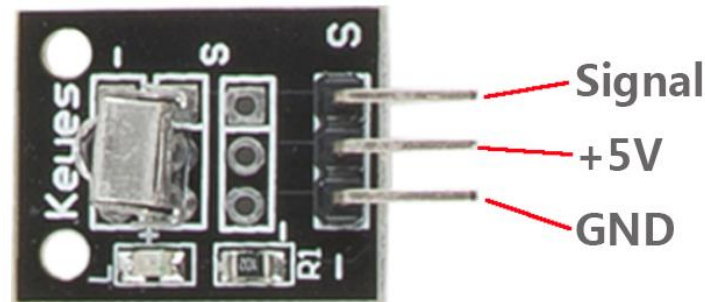
Now, touch the thermistor and you can see the current temperature displayed on the LCD in both Celcius and Fahrenheit degrees.



# Lesson 27 Infrared-Receiver

## Introduction

An infrared-receiver is a component that receives infrared signals and can independently receive infrared ray and output signals compatible with TTL level. It's similar with a normal plastic-packaged transistor in size and it is suitable for all kinds of infrared remote control and infrared transmission.



## Components

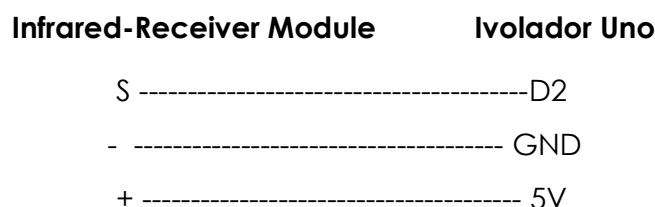
- 1 \* Ivoldor Uno board
- 1 \* USB data cable
- 1 \* Infrared-Receiver module
- 1 \* Remote controller
- Several jumper wires

## Experimental Principle

Control a certain key (for example, Power key) via a remote controller by programming. When you press the key, infrared rays will be emitted from the remote controller and received by the infrared receiver, and the LED on the Ivoldor Uno board will light up.

## Experimental Procedures

**Step 1:** Build the circuit



**Step 2:** Program (Please refer to the example code in [Ivoldor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivoldor Uno

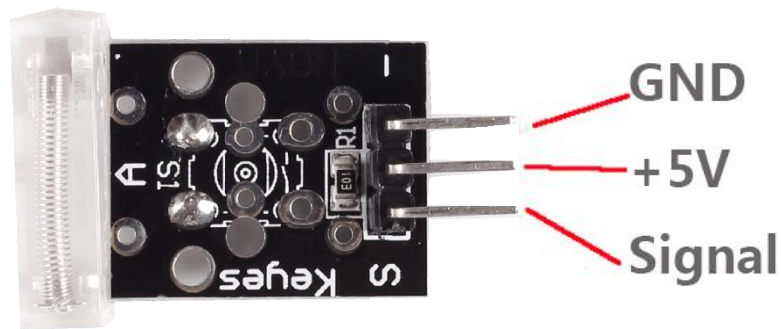
Now, press Power on the remote control and the LED attached to pin 13 on the Ivoldor Uno board will light up. If you press other keys, the LED will go out.



## Lesson 28 Knock Sensor

### Introduction

A knock sensor (as shown below) is similar to the shock switch except that it's more sensitive. It can feel small amplitude vibration.



### Components

- 1 \* Ivolor Uno board
- 1 \* USB data cable
- 1 \* Knock sensor module
- Several jumper wires

### Experimental Principle

The principle is similar to that of the shock switch. Connect the knock switch sensor pin S to D3 to build a simple circuit. When the knock switch sensor inducts knock signals, the LED attached to pin 13 will light up.

### Experimental Procedures

**Step 1:** Build the circuit

Knock Sensor Module	Ivolor Uno
S	D3
-	GND
+	5V

**Step 2:** Program (Please refer to the example code in [Ivolor \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolor Uno

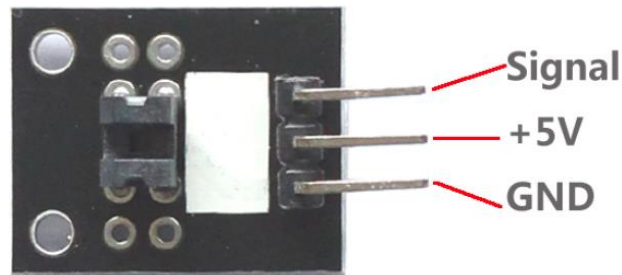
Now, knock the sensor and the LED attached to pin 13 on the Ivolor Uno board will light up.



# Lesson 29 Photo-interrupter

## Introduction

A photo-interrupter is a sensor that arranges light-emitting component and light-receiving component face-to-face and packages them together. It applies the principle that light is interrupted when an object passes through the sensor. Therefore, photo-interrupters are widely used in speed measurement.



## Components

- 1 \* Ivোলদর Uno board
- 1 \* USB data cable
- 1 \* Photo-interrupter module
- Several jumper wires

## Experimental Principle

Basically a photo-interrupter consists of two parts: transmitter and receiver. The transmitter (e.g., an LED or a laser) emits light and then the light goes to the receiver. If that light beam between the transmitter and receiver is interrupted by an obstacle, the receiver will detect no incoming light even for a moment and the output level will change. In this experiment, we will turn an LED on or off by using this change.

## Experimental Procedures

**Step 1:** Build the circuit

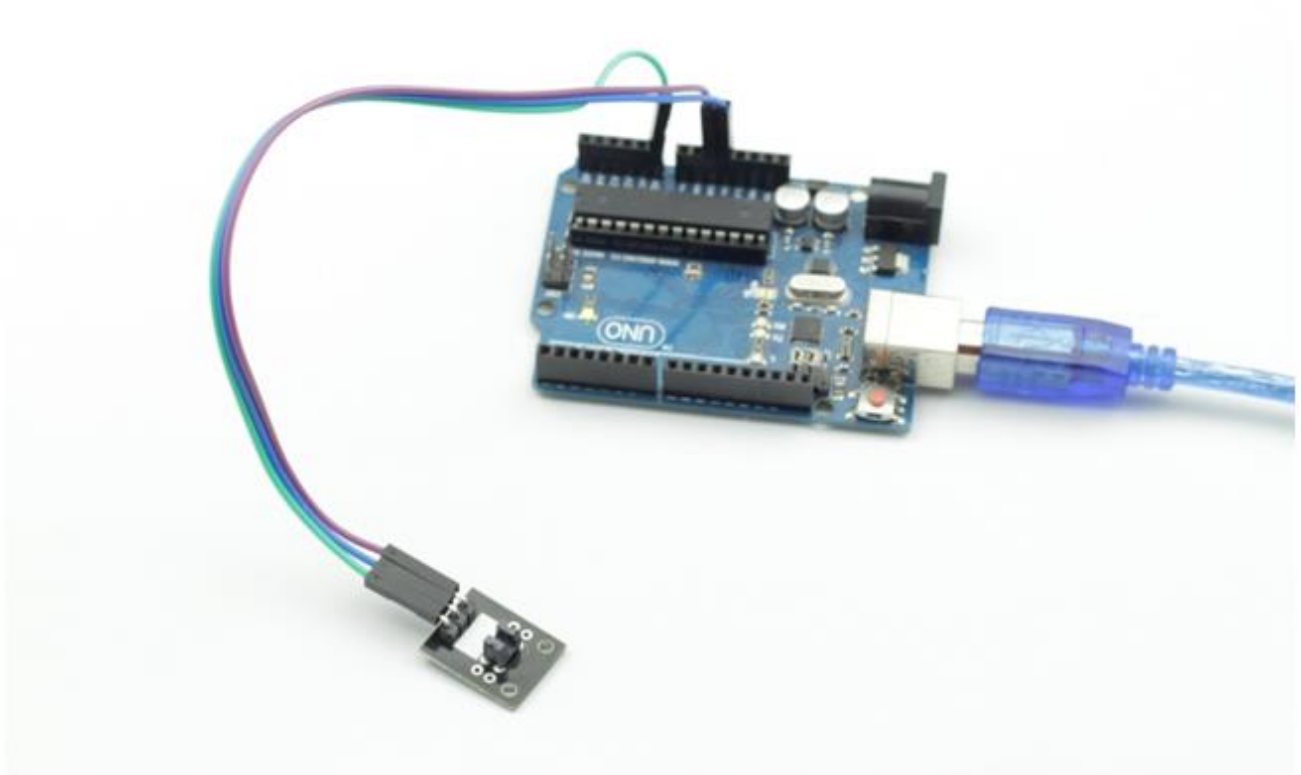
Photo-interrupter Module	Ivোলদর Uno
S	A0
-	GND
+	5V

**Step 2:** Program (Please refer to the example code in [Ivোলদর \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivোলদর Uno

Now, stick a piece of paper in the gap of the sensor, and the LED attached to pin 13 on the Ivofador Uno will go out; remove the paper, and then the LED will light up again.





# Lesson 30 Lie Detector

## Introduction

How can an Evil Genius be sure that their prisoners are telling the truth? By a lie detector, of course. This lie detector uses an effect known as galvanic skin response. As a person becomes nervous – for example, when telling a lie – their skin resistance decreases. We can measure this resistance using an analog input and use an LED and buzzer to indicate an untruth. Use a multicolor LED that can display red to indicate a lie, green to indicate the truth, and blue to show that the lie detector should be adjusted by the variable resistor.

## Components

- 1 \* Ivollador Uno board
- 1 \* USB data cable
- 1 \* RGB module
- 1 \* Buzzer module
- 1 \* Potentiometer (250k)
- 1 \* Resistor (470k)
- Several jumper wires

## Experimental Principle

The subject's skin resistance is measured by using the test subject as a resistor in a potential divider and a fixed resistor as the other. The lower their resistance is, the more analog input 0 will be pulled towards 5V. The higher the resistance gets, the closer to GND it will become.

The buzzer, despite of the noise level these things generate, is actually quite low in current consumption and can be driven directly from the Ivollador Uno digital pin. This experiment uses an RGB LED. In this case, however, we are not going to make it flash mixed colors but just turn one of the LEDs on at a time to display red, green, or blue.

## Experimental Procedures

**Step 1:** Build the circuit

**RGB Connection:** Connect pin R to digital pin 9, G to digital pin 10, B to digital pin 11, and pin - to GND

**Buzzer Connection:** Connect pin S to digital pin 8, + to 5V, and pin - to GND

**Potentiometer Connection:** Connect the middle pin to analog port A1, and the other two pins to GND and 5V

**Resistor Connection:** connect one terminal to analog port A0, and the other to GND

Then, take out two jumper wires, and connect one end of one jumper wire to A0 and one end of the other wire to 5V.

**Step 2:** Program (Please refer to the example code in [Ivolador \\_Sensor Kit for Arduino](#))

**Step 3:** Compile

**Step 4:** Upload the sketch to Ivolador Uno

To test the lie detector, you might need a test subject, as you will need one hand free to adjust the knob of the potentiometer.

Now ask your test subject to side down. First, let him/her touch the other end of the two jumper wires with two adjoining fingers. Then spin the knob of the pot until the LED turns green.

You may now "interrogate" the subject. If he/she lies to your questions, the LED will flash red and the buzzer beeps. If the LED flashes either red or blue, you should adjust the knob until it changes to green again. Then continue the interrogation.

