

# **HC-SR04 User Guide**

### Part 1 Ultrasonic Introduction

#### **1.1 Ultrasonic Definition**

The human ear can hear sound frequency around  $20HZ \sim 20KHZ$ , and ultrasonic is the sound wave beyond the human ability of 20KHZ.

#### 1.2 Ultrasonic distance measurement principle

Ultrasonic transmitter emitted an ultrasonic wave in one direction, and started timing when it launched. Ultrasonic spread in the air, and would return immediately when it encountered obstacles on the way. At last, the ultrasonic receiver would stop timing when it received the reflected wave. As Ultrasonic spread velocity is 340m / s in the air, based on the timer record **t**, we can calculate the distance (s) between the obstacle and transmitter, namely: s = 340t / 2, which is so- called time difference distance measurement principle

The principle of ultrasonic distance measurement used the already-known air spreading velocity, measuring the time from launch to reflection when it encountered obstacle, and then calculate the distance between the transmitter and the obstacle according to the time and the velocity. Thus, the principle of ultrasonic distance measurement is the same with radar.

Distance Measurement formula is expressed as: L = C X T

In the formula, L is the measured distance, and C is the ultrasonic spreading velocity in air, also, T represents time (T is half the time value from transmitting to receiving ).



### **1.3 Ultrasonic Application**

Ultrasonic Application Technology is the thing which developed in recent decades. With the ultrasonic advance, and the electronic technology development, especially as high-power semiconductor device technology matures, the application of ultrasonic has become increasingly widespread:

- Ultrasonic measurement of distance, depth and thickness;
- Ultrasonic testing;
- Ultrasound imaging;
- Ultrasonic machining, such as polishing, drilling;
- Ultrasonic cleaning;
- Ultrasonic welding;

### Part 2 HC-SR04 Ultrasonic Module Introduction

### **2.1 Product Features**

- Stable performance
- Accurate distance measurement
- High-density
- Small blind

#### **Application Areas:**

- Robotics barrier
- Object distance measurement
- Level detection
- Public security
- Parking detection



# 2.2 Product Image



# 2.3 Module pin definitions

Types	Pin Symbol	Pin Function Description	
	VCC	5V power supply	
	Trig	Trigger pin	
HC-3R04	Echo	Receive pin	
	GND	Power ground	

### 2.4、 Electrical parameters

Electrical Parameters	HC-SR04 Ultrasonic Module	
Operating Voltage	DC-5V	
Operating Current	15mA	
Operating Frequency	40KHZ	
Farthest Range	4m	
Nearest Range	2cm	
Measuring Angle	15 Degree	
Input Trigger Signal	10us TTL pulse	
Output Esha Signal	Output TTL level signal, proportional	
	with range	
Dimensions	45*20 <sup>*</sup> 15mm	



### 2.5 Module operating Principle

Set low the Trig and Echo port when the module initializes , firstly, transmit at least 10us high level pulse to the Trig pin (module automatically sends eight 40K square wave), and then wait to capture the rising edge output by echo port, at the same time, open the timer to start timing. Next, once again capture the falling edge output by echo port, at the same time, read the time of the counter, which is the ultrasonic running time in the air. According to the formular: test distance = (high level time \* ultrasonic spreading velocity in air) / 2, you can calculate the distance to the obstacle.

# Part3 Use Freaduino UNO to test HC-SR04



### 3.1 Freaduino uno and HC-SR04 Connection

Connection Description: D2<----->Trig D3<---->Echo (The users can define the connection pin by themselves)

Note: You need to set the Freaduino UNO switch in 5V Side when use together with HC-SR04 Module.



### 3.2 HCSR04 library function description

#### Long timing()

Function name: timing Parameters: None Return Value: the time of ultrasonic from the transmitter to the receiver

#### float CalcDistance(long microsec,int metric)

Function name: CalcDistance

- microsec: the time of ultrasonic from the transmitter to the receiver
- metric: Set the unit of the return value ( the value of 1 for cm, and the value of 0 for in )

Return Value: the measured distance

### 3.3 Add the HC-SR04 Library

Step1:Download the Demo Code of HCSR04 Ultrasonic from address http://www.elecfreaks.com/store/download/product/Sensor/HC-SR04/HCSR04Ultrasonic\_demo.zip and then unpack it to get the file of HCSR04 Ultrasonic.

Step2: Add the file of HCSR04 Ultrasonic in the file of Arduino-1.0.X / libraries. Step3:If you can see the Example of HCSR04 Ultrasonic in Arduino IDE, the

adding of HC-SR04 library has been successful.

### 3.4 Test the Module with the Examples of Library File

1. Open Arduino IDE 1.0.X, and choose the corresponding board and serial port.

2. Click file/ examples/ HCSR04Ultrasonic until the code pop up.

3. Compiling sketch until Done uploading appears, which represents the uploading has been successful.

- 4. Open serial monitor and set the corresponding BaudRate.
- 5. If you see similar information in serial monitor as below, you succeeded.



COM3						000
						Send
Ultrasoni	c sens	or starting!	ш			9
microsec:	10628	cmdistance:	192.37	indistance:	75.74	2
microsec:	10827	cmdistance:	195.98	indistance:	77.16	
microsec:	10930	cmdistance:	197.84	indistance:	77.89	
microsec:	10911	cmdistance:	197.50	indistance:	77.75	
microsec:	10852	cmdistance:	196.43	indistance:	77.33	
microsec:	10697	cmdistance:	193.62	indistance:	76.23	
microsec:	10888	cmdistance:	197.08	indistance:	77.59	
microsec:	10905	cmdistance:	197.39	indistance:	77.71	
microsec:	10830	cmdistance:	196.03	indistance:	77.18	
microsec:	10810	cmdistance:	195.67	indistance:	77.03	
microsec:	10957	cmdistance:	198.33	indistance:	78.08	
microsec:	10830	cmdistance:	196.03	indistance:	77.18	
microsec:	10812	cmdistance:	195.70	indistance:	77.05	
microsec:	10956	cmdistance:	198.31	indistance:	78.08	
Autoso	roll				No line ending	9600 baud 5.

Chart 3、HC-SR04 testing results