



# Ultrasonic Module HC-SR04 interfacing with PIC18F4550

## Ultrasonic Sensor HC-SR04



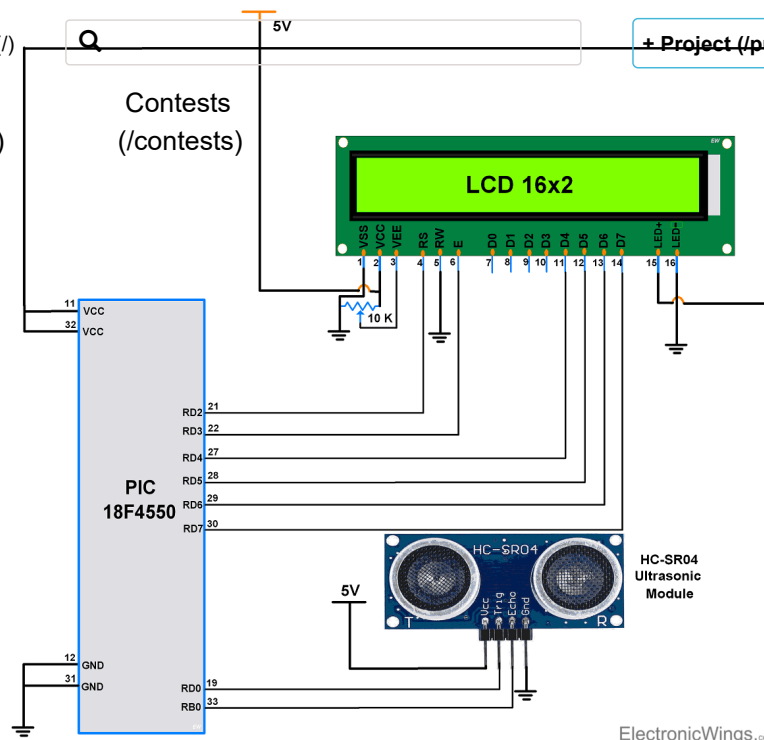
Ultrasonic HC-SR04 Module

Ultrasonic Module HC-SR04 works on the principle of SONAR and RADAR system.

- The HC-SR04 module has an ultrasonic transmitter, receiver, and control circuit on a single board.
- The module has only 4 pins, Vcc, Gnd, Trig, and Echo.
- When a pulse of 10μsec or more is given to the Trig pin, 8 pulses of 40 kHz are generated. After this, the Echo pin is made high by the control circuit in the module.
- The echo pin remains high till it gets an echo signal of the transmitted pulses back.
- The time for which the echo pin remains high, i.e. the width of the Echo pin gives the time taken for generated ultrasonic sound to travel towards the object and return.
- Using this time and the speed of sound in air, we can find the distance of the object using a simple formula for distance using speed and time.

For more information about ultrasonic module HC-SR04 and how to use it, refer to the topic Ultrasonic Module HC-SR04 (<https://www.electronicwings.com/sensors-modules/ultrasonic-module-hc-sr04>) in the sensors and modules section.

## Connection Diagram of Ultrasonic Sensor to PIC18F4550



ElectronicWings.com

Ultrasonic Module HC-SR04 Interfacing with PIC18F4550

## Measure the Distance using HC-SR04 and PIC18F4550

Here let's design an application in which we will find a distance to an object by interfacing ultrasonic module HC-SR04 with PIC18F4550 and display the distance on a 16x2 LCD.

### Steps of Programming

1. PIC18F4550 microcontroller needs to transmit at least 10 us trigger pulse to the HC-SR04 Trig Pin.
2. After getting a trigger pulse, HC-SR04 automatically sends eight 40 kHz sound waves and waits for rising edge output at the Echo pin.
3. When the rising edge capture occurs at the Echo pin which is connected to the input of PIC18F4550, start Timer of PIC18F4550 and again wait for the falling edge on the Echo pin.
4. As soon as the falling edge is captured at the Echo pin, the microcontroller reads the count of the Timer. This time count is used to calculate the distance to an object.

### Calculation (distance in cm)

$$\text{Sound velocity} = 343 \text{ m/s} = 34300 \text{ cm/s}$$


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$$= (34300 * \text{TIMER}) / 2$$

$$= 17150 * (\text{TIMER})$$

Now, if we selected 8 MHz oscillator frequency for PIC18F4550, timer frequency in PIC18F4550 will be 2 MHz. So time to execute 1 instruction is 0.5 us.

So timer gets incremented after 0.5 us time elapse.

$$= 17150 * (\text{TIMER value}) \times 0.5 \times 10^{-6} \text{ cm}$$

$$= 0.5 * (\text{TIMER value}) / 58.30 \text{ cm}$$

$$= 0.5 * (\text{TIMER value}) / 58.30 \text{ cm}$$

or

$$= (\text{TIMER value}) / 117 \text{ cm}$$

## Ultrasonic Sensor HC-SR04 Code for PIC18F4550



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Interfacing Ultrasonic module HC-SR04 with PIC18F4550

for finding distance to an object

<http://www.electronicwings.com>

\*/

```
#include <xc.h>
```

```
#include <pic18f4550.h>
```

```
#include <stdio.h>
```

```
#include "Configuration_Header_File.h"
```

```
#include "16x2_LCD_4bit_File.h"
```

```
void Trigger_Pulse_10us();
```

```
#define _XTAL_FREQ 8000000 /* Define freq */
```

```
#define Trigger_Pulse LATD0 /* Define Trig pin of HC-SR04 */
```

```
void main()
```

```
{
```

```
    float Distance;
```

## Video of Distance Measurement using Ultrasonic HC-SR04 Sensor









I cant get output for this code.can u give the connections in breadboard?  
Can u give the circuit diagram

Reply Like

lokeshc  
(/users/lokeshc/profile)  
2018-03-06 21:08:45

Did you make connections properly?  
Please check the connections as per given in Interfacing diagram.  
Here, lcd is used in 4-bit mode.  
If still you are getting problem then let me know.

Reply Like

rodch98

(/users/rodch98/profile)  
2018-03-29 10:26:20

i'm really interested on your code, is very simple and it seems to work just fine, i just have one question, on line `INTCON2bits.RBPU=0; /* Enable PORTB Pull-ups */` why do you need to enable this?, i thought the echo pin stays LOW till trigger send 8 pulses then goes HIGH til the pulses return and goes LOW

Reply Like

lokeshc  
(/users/lokeshc/profile)  
2018-03-29 22:13:34

Hi,  
To read proper level on input pin pull ups are enabled using RBPU. PIC microcontroller donot have internal pull up ON by default of PORTB. So, to avoid floating condition and to read proper high/low level it is enabled.

Reply Like

elunico590

(/users/elunico590/profile)  
2018-06-17 00:37:38

How do you jump from  $17150 * (\text{TIMER value}) \times 0.5 \times 10^{-6} \text{ cm}$  to  $0.5 * (\text{TIMER value}) / 58.30 \text{ cm}$ ? Not sure I understand the math

Reply Like

elunico590  
(/users/elunico590/profile)  
2018-06-17 01:41:34

never mind I figured it out you calculated it based on the max distance the sensor can measure which is 400 cm and considering that the speed is constant you deduced the number of timer pulses equivalent to a centimeter.

Reply Like 1

Isteward

(/users/Isteward/profile)  
2018-09-20 17:16:18

I have noticed that this works ok when using a a perpendicular object to bounce the signal off. But it fails if you put this object at 45 degrees to the sensor and reports a 0.034 result on the lcd which it cannot recover from. It continues with this error in the while loop. Any ideas on the correction to this problem? I can understand that the signal is being reflected and no return signal can be seen by echo but when you return the object to perpendicular it should recover - but it doesn't.

Reply Like

jimvincentm  
(/users/jimvincentm/profile)  
2018-11-22 22:47:15

I have encountered the same problem. I still can't figure out, why it can't recover after it breaks. I hope someone can tell a solution.

Reply Like

lemowilliams552





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(/users/lemowilliams552/profile)  
2020-04-11 09:32:49

yea so i think thats a hardware issue rather than a software issue since the echo pin behaves differently when the range is 0 or above max range...i may be wrong since other modules may behave differently from mine  
Reply Like

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Jose

(/users/Jose/profile)  
2018-09-29 10:19:34

no obtengo resultados, estoy usando el pickit 2 y no me aparece el archivo hex, me podrias apoyar en la ruta del archivo hex.  
Reply Like

mikelove73

(/users/mikelove73/profile)  
2018-12-14 04:14:19

Hello I am getting an error where t display 0.120cm and does not continue to read distance, HELP  
Reply Like

duniasattar680

(/users/duniasattar680/profile)  
2019-02-06 16:42:49

Hello,

How can I convert the above code to be compatible with microcontroller tm4c123gh6ph?  
Reply Like

authorized

(/users/authorized/profile)  
2019-02-07 12:11:19

are you using energia or code composer to program ?  
whatever you use you need to go through all steps as mentioned in above code like

\*\*\*\*\*

first you have to define two digital pins on it  
one as input and one as output

connect output pin to trigger pin and input pin to echo pin of hcsr04 .

pass 10us pulse on output pin and wait for rising edge at echo pin.

as rising edge arrive start timer/counter to count time until the falling edge detect at echo pin

on falling edge detect stop timer/counter.

finally convert that measured count to distance with formula.

\*\*\*\*\*

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mmeeppo

(/users/mmeeppo/profile)  
2019-02-08 10:44:22

When I pass 279cm the values come out negative and un accurate. Does my timer output negative values? I can never get a distance higher than 279cm.  
Reply Like

authorized

(/users/authorized/profile)  
2019-02-08 11:00:29

there is variable defined in above program

=> int Time; ( which is from -32768 to +32768 i.e. it has 32768 limit in positive value beyond that it will start negative count )  
 which is int so that above program will measure distance correctly upto limit you mentioned.  
 if you want more limit then simply use unsigned int  
 => unsigned int Time; ( which can count from 0 to 65535 )

so i think you should try replacing int with unsigned int type of Time variable.

Reply Like 1

mmeepo

(/users/mmeepo/profile)  
 2019-02-08 12:12:47

Thanks! I finally got it to work!

Also, I'm not quite sure if I fully understand the formula for the distance..

I have a sensor that could reach 600cm but I don't understand how to manipulate the formula

Reply Like

sabal9672

(/users/sabal9672/profile)  
 2019-03-10 20:34:04

I want this code in assembly language can you please help me out I'm in serious trouble

Reply Like

jokerpath7

(/users/jokerpath7/profile)  
 2019-03-16 14:15:03

Can i ask u something..when i try to build this source code it say that cant open "Configuration\_Header\_File.h no such file and directory..can u help me solve this

Reply Like

lokeshc

(/users/lokeshc/profile)  
 2019-03-16 18:33:15

Are you building this project on mplabx ide?

I downloaded it and successfully compile it. Can u check for configuration file in downloaded attachment?

Reply Like

moathabdelkarim

(/users/moathabdelkarim/profile)  
 2019-07-14 08:24:18

Hey, how did you fix this issue?

Reply Like

lokeshc

(/users/lokeshc/profile)  
 2019-07-14 10:34:47

You can check in your folder that this configuration file is there or not?

If not then you can create a new one and include that configuration header file in your main code.

Then you can compile your code to check any error.

Reply Like

jagtappranav4

(/users/jagtappranav4/profile)  
 2020-02-11 15:53:07

How to include configuration header file in main code?

Reply Like

syarifmuhd24

(/users/syarifmuhd24/profile)



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Hello why my coding is wrong?? and its wrong at #include pic18f4550.h and #include

xc.h in my .c file and .h file??

Reply Like

lokeshc

(/users/lokeshc/profile)

2019-04-06 23:55:29

It's better to include xc.h. as it has all definitions regarding pic & compiler related. It also has delay functions which seen in above code.

But what error you are getting?

Reply Like

syarifmuhd24

(/users/syarifmuhd24/profile)

2019-04-07 17:34:28

when im debug the output said its error at include pic18f4550 & include xc.h it cant locate it and configuration header file .h and 16x lcd 4bit file .h cant locate the pic18f4550 & xc.h. So I dont know what to do

Reply Like

lokeshc

(/users/lokeshc/profile)

2019-04-08 08:24:13

On which ide you are compiling?

Reply Like

syarifmuhd24

(/users/syarifmuhd24/profile)

2019-04-08 11:08:08

mplab ide v8.63

Reply Like

blarblublubar

(/users/blarblublubar/profile)

2019-05-13 13:10:40

Distance of Object(cm)= 17150 \* (TIMER value) x 0.5 x 10<sup>-6</sup> cm

Distance of Object(cm)= 0.5 \* (TIMER value)/58.30 cm

How this value get? how do u calculate it?

Reply Like

lokeshc

(/users/lokeshc/profile)

2019-05-14 11:18:08

0.5x10<sup>-6</sup> is cpu time as frequency is 8MHz.

This time is multiplied to timer count to get Time. Rest is given in the above content.

Reply Like 2 🍷

blarblublubar

(/users/blarblublubar/profile)

2019-05-14 09:09:38

LCD\_String\_xy(1,1,"Distance:"); Distance argument mean incompatible pointer types.

Because Distance is float and LCD\_String\_xy(char, char, const char \*)

Reply Like

lokeshc

(/users/lokeshc/profile)

2019-05-14 11:14:10

In

LCD\_String\_xy(1,1,"Distance:");

Distance is string.

Whereas

In

LCD\_STRING\_XY (2, 1, Total\_Distance)

Total distance is also string. As you can see in code, float value Distance is

converted into string and assigned to Total\_Distance.

Reply

Like

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robertosousa95

(/users/robertosousa95/profile)  
2020-01-03 22:42:39

Hi !

I'm doing a Embebids Project with the Pic 18F4580 .. Does this configurations work in the pic ? I'm doing the alterations oh the regists of ports, etc ..

I'm doing a Ultrasonic that turn on some leds and activats a buzzer when it's too close of the ultrasonic, and with the LCD 16x2 i'm showing the distance and the temperature, i did my sorce files and header files, only some warnings, no errors , in my main i called the functions but the project dosen't work. I don't know if you can help me ?

Reply Like

lemowilliams552

(/users/lemowilliams552/profile)  
2020-04-11 07:48:16

bro you got to send the code for us to look at.... no code == no help

Reply Like

jagtapppranav4

(/users/jagtapppranav4/profile)  
2020-02-11 15:51:06

I'm using MPLAB IDE v8. 89 .It is giving an error of unable to locate xc.h Configuration\_Header\_file.h and 16x2\_LCD\_4bit\_File.h

I have also downloaded the project file and it is in zip format. Where should I extract the above files to remove the error

Reply Like

blarblublublar

(/users/blarblublublar/profile)  
2020-03-16 22:36:59

while(PORTBbits.RB0==1 && !TMR1IF);/\* Wait for falling edge \*/  
if we get falling edge, but do we still need to wait Timer overflow?

Reply Like

lemowilliams552

(/users/lemowilliams552/profile)  
2020-04-11 07:45:21

hey blarblublublar, the code isnt waiting for an overflow...the reason why the program checked the TIMER1 interrupt flag was because when the timer overflows and set the flag, TMR1 register overflows to 0000h(in other words it restarts the count from zero) and if you read the value of the TMR1 register it wouldn't give the desired results...so for example, it more or less prevents the sensor from reading that the distance is 500cm and then the code says its 2cm...hope i helped :)

Reply Like

SzymonKus

(/users/SzymonKus/profile)  
2021-01-05 16:43:24

I want to convert the distance measured to percentage. All works well until I'm changing "cm" to "%" inside LCD\_String(" cm"); the LCD shows the only a constant number and the number doesn't change.

Can u please explain :

void LCD\_String(const char \*msg)

```
{
    while((*msg)!=0)
    {
```

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Reply Like 1

STIPpro

(/users/STIPpro/profile)  
2023-06-22 11:32:18

same here

Reply Like

gabymoise

(/users/gabymoise/profile)  
2021-01-09 18:04:02

Hello guys, I have a problem. I'm using dsPIC33FJ64MC802 with pikit3 and C30 compiler and I can't config the ultrasonic sensor, HC-SR04. Also, I am using 4x20 LCD. Can someone help me with this problem? This is my code.

```

void initPLL(void)
{
    // Configure PLL prescaler, PLL postscaler, PLL divisor
    PLLFBD = 41; // M = 43 FRC
    //PLLFBFBD = 30; // M = 32 XT
    CLKDIVbits.PLLPOST=0; // N1 = 2
    CLKDIVbits.PLLPRE=0; // N2 = 2

    // Initiate Clock Switch to Internal FRC with PLL (NOSC = 0b001)
    __builtin_write_OSCCONH(0x01); // FRC
    //__builtin_write_OSCCONH(0x03); // XT
    __builtin_write_OSCCONL(0x01);

    // Wait for Clock switch to occur
    while (OSCCONbits.COSC != 0b001); // FRC
    //while (OSCCONbits.COSC != 0b011); // XT

    // Wait for PLL to lock
    while(OSCCONbits.LOCK!=1) {};
}

void prvSetupHardware( void )
{
    ADPCFG = 0xFFFF;
    initPLL();
    LCD_init();
}

/*-----*/

int main( void )
{
    prvSetupHardware();

    float Distance;
    int Time;
    float Total_distance[10];
    _TRISB6=1;
    _RB6=0;
    _TRISB7=0;
    _RB7=0;

```



T1CON = 0x80;  
TMR1 = 0;

[+ Project \(/publish/project\)](#)


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```

while (1)
{
    _RB7 = 1;
    __delay_us(10);
    _RB7 = 0;

    while(!_RB6);
    TMR1=0;
    T1CONbits.TON = 1;
    while(_RB6);
    Time = TMR1;
    T1CONbits.TON = 0;
    Distance = ((float)Time/118.00);
    sprintf(Total_distance,"%03f",Distance);
    LCD_Goto(2,1);
    LCD_printf(Total_distance);
    __delay_us(10);
}
}

Reply Like

```

EricLin  
[\(/users/EricLin/profile\)](#)  
2021-06-29 13:47:13

I will try it.  
Thank u Sir.  
Reply Like

STIPpro  
[\(/users/STIPpro/profile\)](#)  
2023-06-22 10:42:10

why is not measuring?  
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MohanKondaypudi  
[\(/users/MohanKondaypudi/profile\)](#)  
2 weeks ago

i was unable to convert the code into assembly code??  
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igshid=1cip10jjttko)

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