

General Description

Distance measurement sensor is a low cost full functionality solution for distance measurement applications. The module is based on the measurement of time flight of ultrasonic pulse, which is reflected by an object. The distance to be measured mainly depends on the speed of ultrasonic waves in space or air –which is a constant- and the flight time of the pulse.

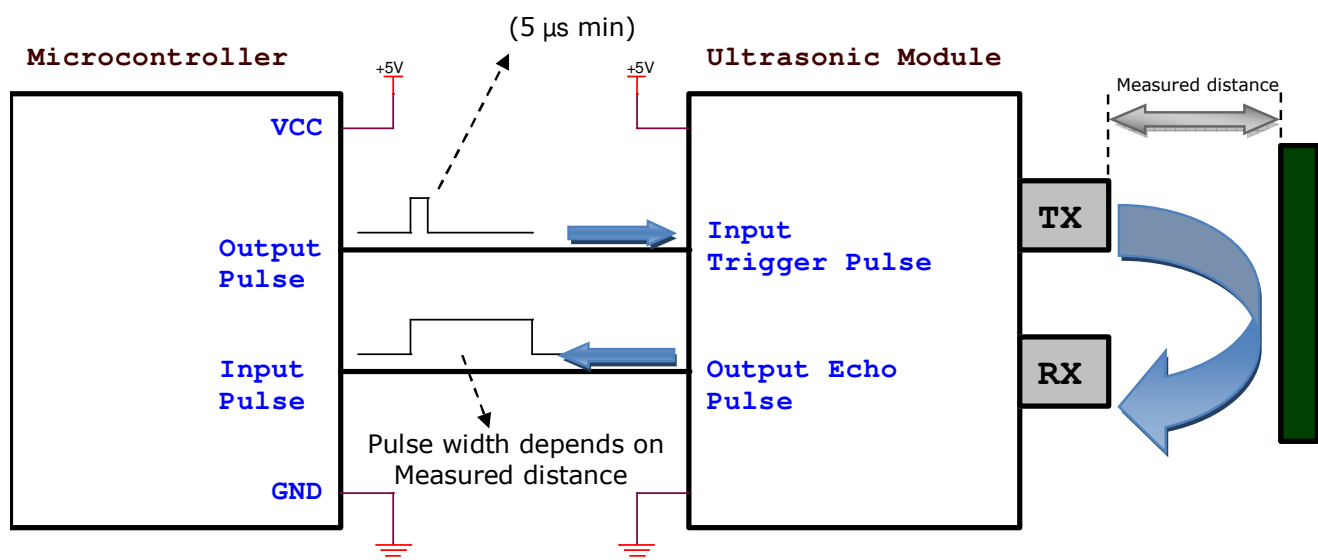
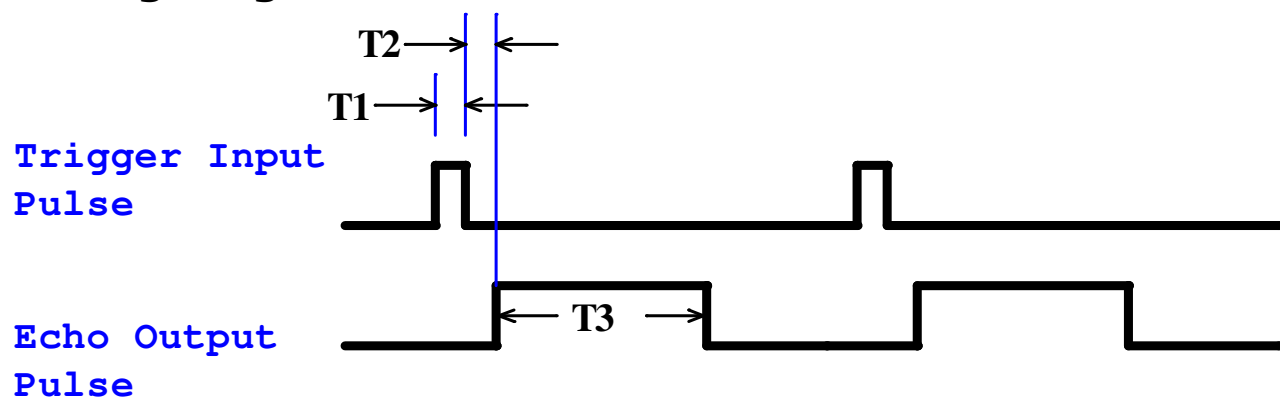
The module performs these calculations and outputs a pulse width depends on the measured distance, this pulse is easily interfaced to any microcontroller.

Features

- Supply voltage +5Vdc
- Supply Current 10mA
- Measurement distance Range from 2cm to 400cm.
- Input trigger pulse is 5V TTL compatible (5 μ s minimum).
- Output echo pulse is 5V TTL compatible.
- Size 44.5mm W x 20mm H x 15mm D.
- Interface connector 4-pin header SIP, 0.1" spacing.
- Operating temperature range 0° - 70° C.

Table1. Connector signals definition

Label	Definition	Direction	Function
VCC	Supply voltage	Power	Supply power to module 5VDC with 10mA max
Trig	Trigger	Input	Input trigger for measurement module. This pin is TTL/CMOS logic (5V and 0V). The trigger pulse should be 5 μ s minimum
Echo	Echo	Output	Output echo pulse from measurement module. This pin is TTL/CMOS logic (5V and 0V). The output pulse width time is function of the distance to be measured
GND	Ground	Ground	System ground connected to the same ground of the host.

Connection Diagram**Timing Diagram**

Timing Characteristics

Time	Description	Value			Unit
		Min	Typ	Max	
T1	Trigger pulse	5	10	-	μs
T2	Echo hold off	400	450	500	μs
T3	Echo pulse	150	-	16000	μs

Calculating equation

$$D = (T \times 0.0343) / 2$$

Where:

D is the measured distance in **cm**.

T is the echo output pulse in **μsec**.

0.0343 is the speed of sound in air in **cm/μsec**.

Alternative calculating equation

$$D = (T / 29.1) / 2$$

Where:

D is the measured distance in **cm**.

T is the echo output pulse in **μsec**.

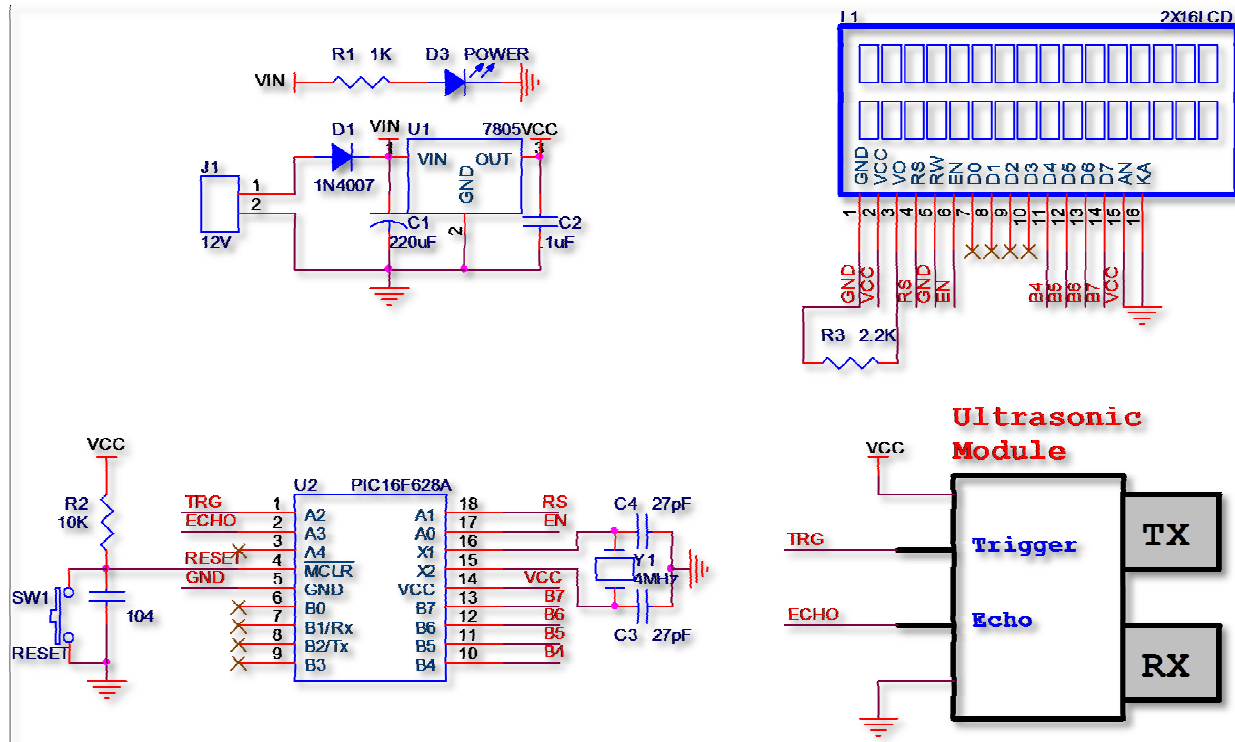
29.1 is the pace of sound in air in **μsec /cm**.

Typical application circuit using PIC16F628A

Here is a simple project you may build to test your module.

The project uses PIC16F628A microcontroller to trigger the module, measuring the echo pulse, calculating the distance in cm and displaying it on 2X16 LCD.

The project also include the source code written in BASIC language for PROTON compiler. The firmware may be rewritten for any other compiler to perform the required function.



```

'=====
'===== Initialization =====
'=====
Device = 16F628A      'Microcontroller name
XTAL = 4              ;XTAL speed in MHz
Config XT_OSC,WDT_OFF,BODEN_OFF,LVP_OFF,PWRTE_OFF,CP_OFF
'-----
;I/O Ports Programming
TRISA = %11111000
TRISB = %00001111
CMCON = %00000111
'-----
'LCD definition
Symbol DO_RS      = PORTA.1
Symbol DO_EN      = PORTA.0
Symbol DO_LCD_D4   = PORTB.4
Symbol DO_LCD_D5   = PORTB.5
Symbol DO_LCD_D6   = PORTB.6
Symbol DO_LCD_D7   = PORTB.7
'-----
'Other I/O definitions
Symbol DO_Trigger  = PORTA.2
Symbol DI_Echo     = PORTA.3
'-----
'Variables declaration
Dim W_Word As Word
Dim F_Float As Float
'-----
'LCD Initialization
LCD_TYPE 0          '0 FOR ALPHABETIC 1 FOR GRAPHIC
LCD_INTERFACE 4     '4 BIT DATA LENGTH
LCD_LINES 2         'NUMBER OF LINES
LCD_DTPIN DO_LCD_D4 'DATA PORT
LCD_ENPIN DO_EN     'ENABLE PIN
LCD_RSPIN DO_RS     'RS PIN

'=====
'Main
'=====
Cls
Print At 1,1,"Distance =      "
Start:
    DO_Trigger = 0      ' Output low to the trigger input of ultrasonic module.
    DelayUS 10         ' Wait 10 µs for trigger pulse.
    DO_Trigger = 1      ' Output high to the trigger input of ultrasonic module.
    W_Word = PulsIn DI_Echo,1 ' Read the echo pulse time ( refer to Proton help to get
                           ' more information about "PulseIn" instruction)
    F_Float = W_Word * 10 ' convert the unit of time to microseconds .
    F_Float = F_Float * 0.0343 ' multiply the time by the speed of sound in air (cm/µsec).
    F_Float = F_Float / 2     ' Divide the calculated distance by 2
    Print At 1,12,"      "   ' Clear the last value on LCD.
    Print At 1,12,DEC1 F_Float ' Display the new distance on LCD.
    DelayMS 300             ' Wait 300 millisecond before next measurement.
GoTo Start

```

Example Code for ARDUINO

It should be noticed that:

1. The calculation of distance rely on the Pace of sound (29.1 $\mu\text{sec/cm}$) and not the speed of sound
2. The distance limited to 200cm only.
3. The calculated distance is sent over serial interface.

```
/*
ultrasonic module Ping distance sensor]
VCC to arduino 5v GND to arduino GND
Echo to Arduino pin 13 Trig to Arduino pin 12
*/

#define trigPin 12
#define echoPin 13
void setup()
{
    Serial.begin (9600);
    pinMode(trigPin, OUTPUT);
    pinMode(echoPin, INPUT);
}

void loop()
{
    int duration, distance;
    digitalWrite(trigPin, HIGH);
    delayMicroseconds(1000);
    digitalWrite(trigPin, LOW);
    duration = pulseIn(echoPin, HIGH);
    distance = (duration/2) / 29.1;
    if (distance >= 200 || distance <= 0)
    {
        Serial.println("Out of range");
    }
    else
    {
        Serial.print(distance);
        Serial.println(" cm");
    }
    delay(300);
}
```

Notes:

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