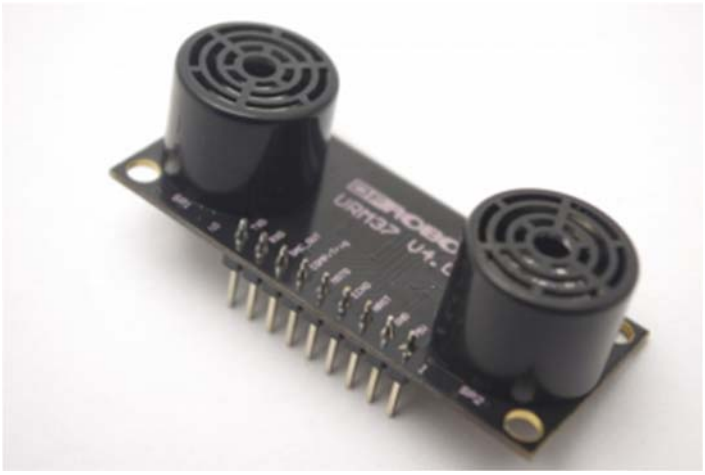
URM37 V4.0 Ultrasonic Sensor (SKU:SEN0001)



URM37 V4.0 Ultrasonic Sensor

Contents

Introduction

URM37 V4.0 Ultrasonic Sensor uses an industrial level AVR processor as the main processing unit. It comes with a temperature correction which is very unique in its class. URM37 V3.2 (last version) has already been a very good realization of ultrasonic switch and serial (TTL and RS232 level optional), pulse output function, the module can also control a servo rotation to realize a spatial ultrasound scanner. On this basis we have to upgrade the function. URM37 V4.0, the current version

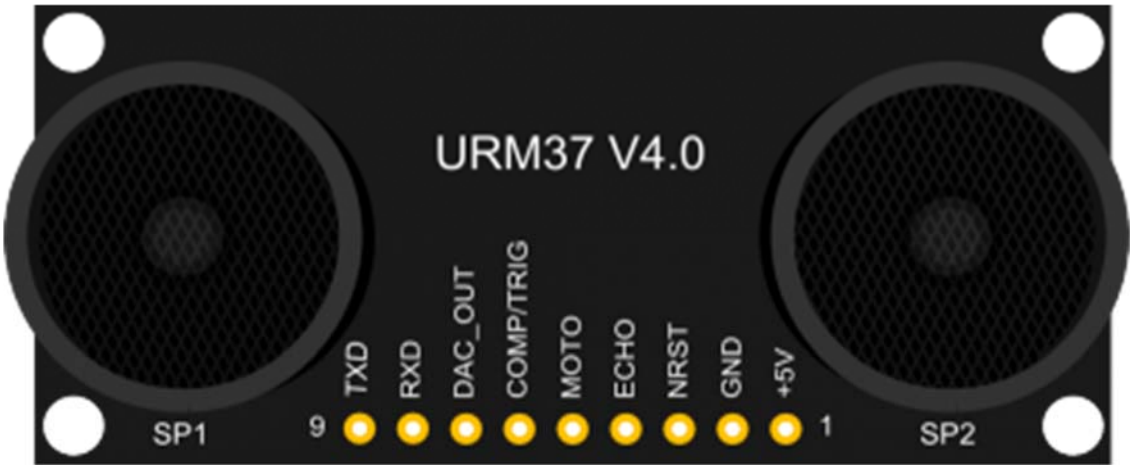
has better intelligence capabilities, meanwhile, mechanical dimensions and pin interface and communication commands are compatible with V3.2, V3.2 has been reversed based on the following changes:

- Serial level selected from the skipped stitches to button, user can easily select RS232 or TTL-level output level output by pressing the settings(after reboot).
- Modified the algorithm, so dead zone was reduced and enhance accuracy.
- Analog voltage output, voltage and the measured distance is proportional.
- Wide voltage support +3.3V-5.0V.
- Power reverse protection.
- Automatic measurement of time interval can be modified.
- Modify a servo controlled angle of 0-180, compatible with the most of the servos on the market.
- Measuring time is 100ms.

Specification

- Power: +3.3V～+5.0V
- Current: <20mA
- Working temperature: -10℃～+70℃
- Detecting range: 5cm-500cm
- Resolution: 1cm
- Interface: RS232 (TTL), PWM
- Size: 22mm × 51 mm
- Weight: 25g

PinOut



Num	Label	Description
1	VCC	Power input (reference +5V)
2	GND	Ground
3	NRST	Reset
4	ECHO	Measured distance presented by the Data Output 0-25000US by PWM pulse width, 1 CM / 50US representative
5	MOTO	Control the servo rotation angle
6	COMP/TRIG	COMP：On/OFF mode, when the detecting distance is smaller than a pre-set value, this pin pulls low./TRIG：PWM mode trigger input
7	DAC	Analog voltage output (each 6.8mV represents 1 cm)
8	RXD	RS232/TTL mode
9	TXD	RS232/TTL mode

Tutorial

Congratulations to you who bought our URM37 V4.0 Ultrasonic Sensor3, you now have the historical most powerful ultrasonic ranging module.

First we have to understand this module basic function, there are three modes:

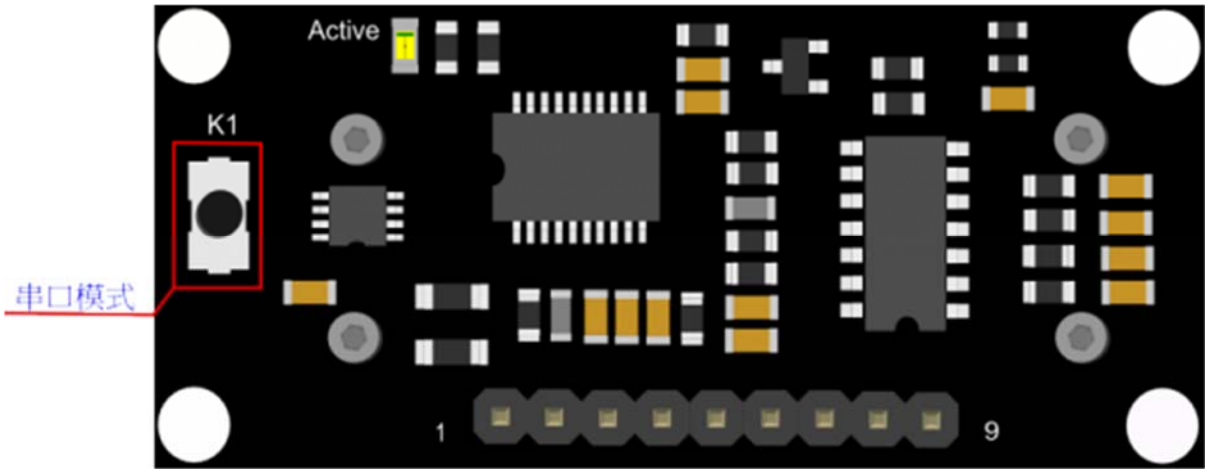
1. PWM triggered measurement mode
2. Automatically measure mode
3. Serial passive measurement

Then it also supports:

- Simulation volume output (proportional with measurement distance, 6.8mV/cm)
- Temperature read
- Serial level choose(TTL or RS232 level)
- Internal EEPROM without losing data
- Serial EEPROM data read

The products have been conducted a set of rigorous tests by us, when you get your purchase, you can do some setting according to your demands, firstly, you may have to set the serial port-level (or RS232 TTL level), then we can access to the module through the serial port, then set the range mode (0x02 writes data on the internal EEPROM address), after that, you can access to ultrasound module through MCU or PC.

To begin with this Ultrasonic Sensor, there is a software could help to make it a lot of easier. And there are some paramenters you may want to reverse to meet more situations.



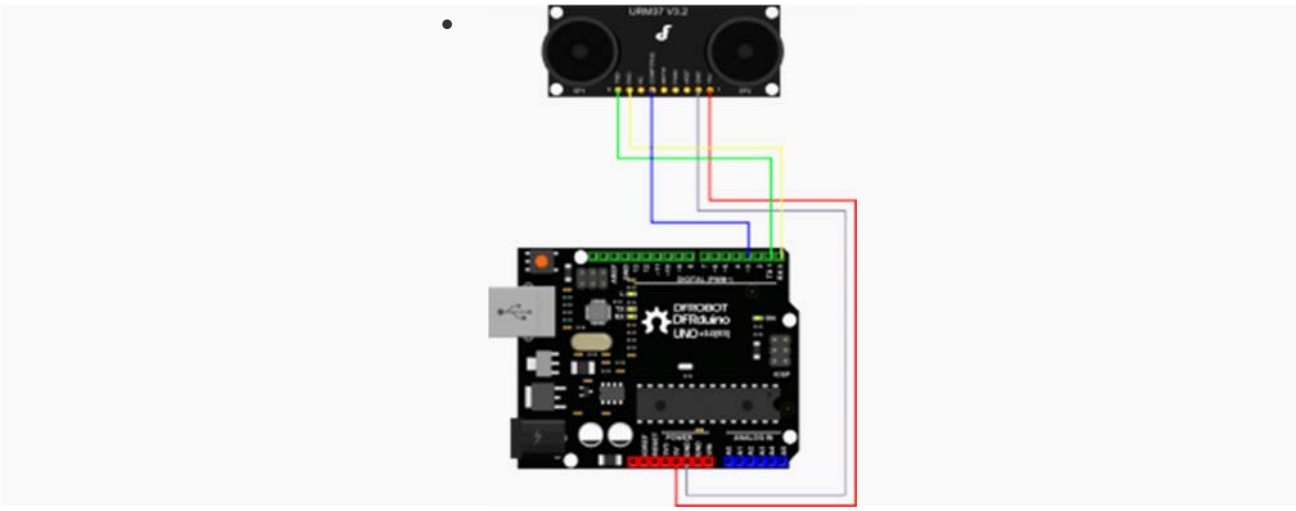
Button for RS232/TTL Choosing

The vesy fisrt basic step to communicate with the model is to choose the serial level_TTL(default) or RS232.We step forward over the last version3.2 which by jumper, now we could do it by **pressing the only one button** on the board for 1 second, after the light turn off from state-on, release the botton.Repower again,he Indicator appears to flash like **once long and once short** -present **TTL** level output, **once long and twice short** flash presenting **RS232** level.

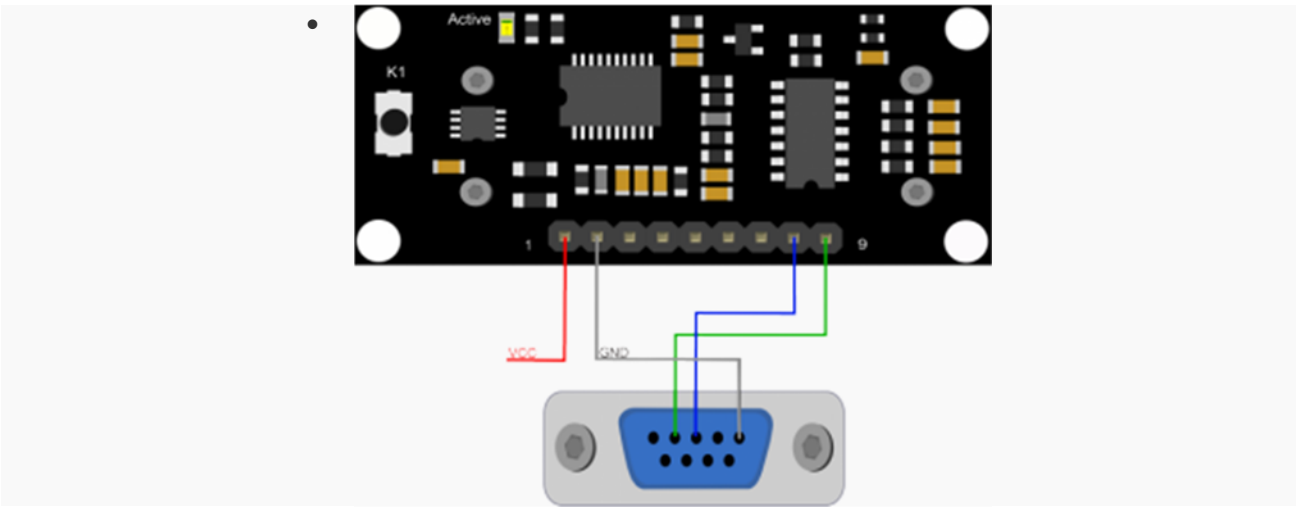
Do not connect to TTL MCU when the output mode is set to RS232, doing so will permanently damage the unit.

Test on Software

This feature is only available for Rev2 and after. If there are no jumpers, or no button on the back of the sensor, the sensor should be Rev1 and hence not supporting this feature.

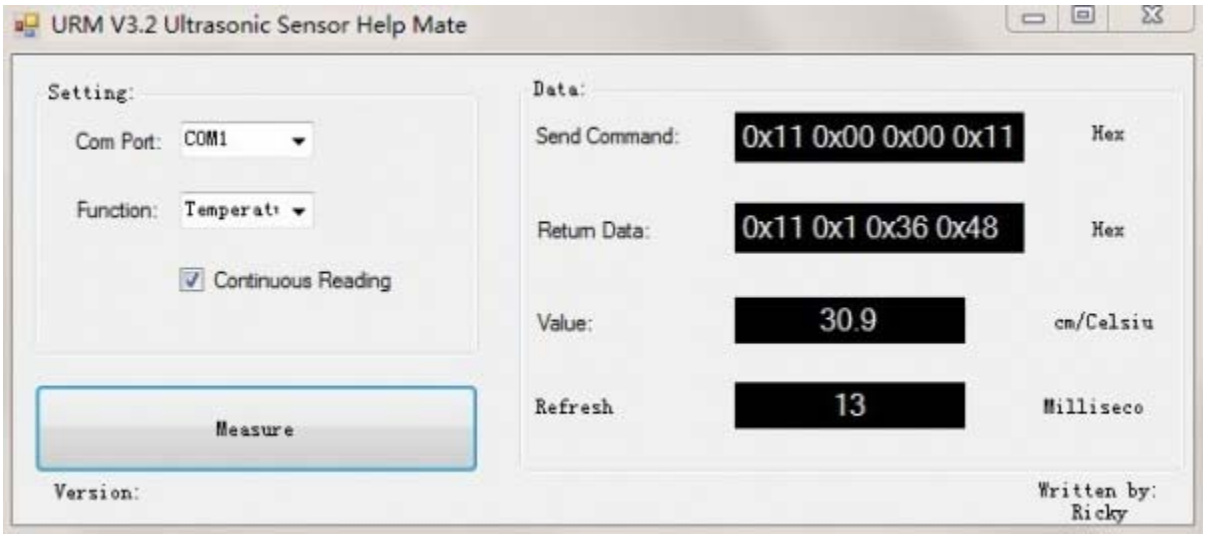
- 

TTL Mode Connection Diagram

- 

RS232 Mode Connection Diagram

Power on the sensor, read the blink of the LED(active) to get the serial level(see above), wire according to the above picture.After this,you can use our "URMV3.2HelpMate" to test the module.



The usage of the software is very simple: ensure that there is no other software on the computer occupied the serial port, and then run Mate.exe, select the COM Port, and choose the parameter what you want to measure, and choose the "Continuous Reading ". Click "Measure" it will measure the temperature and the distance.

Othere Setting address in EEPROM

Here, we are talking about the meaning of the data in EEPROM several addresses.(For more details, can be found in the [Serial control protocol] part)

Address	Meaning
0x00	larger than set distance
0x01	less than set distance
0x02	measure mode(write 0xaa present automatically measure mode, other data except 0xaa present PWM Passive measurement mode)
0x03	Serial level mode(TTL/RS232)(write 0x00 present TTL mode, 0x01 present RS232 mode, other data will be modified to 0x00)
0x04	automatically measure time span(default set is the lowest 25ms, witting format is 8-bit 16 binary, e.g. Write 64 means 100ms)

The factory default settings

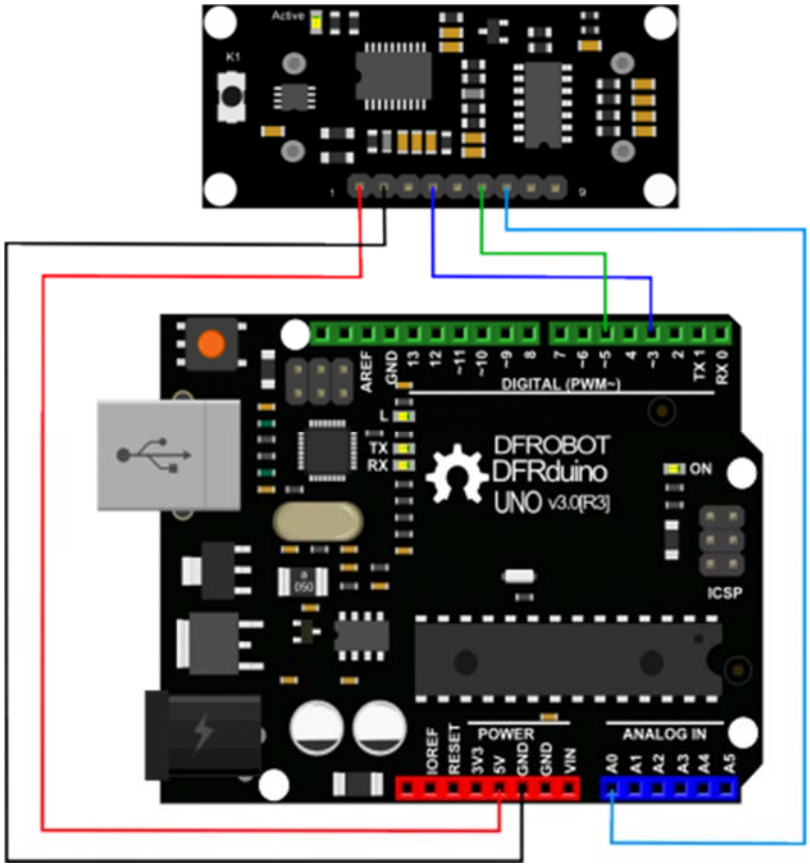
- Serial TTL level
- Measure mode: PWM trigger
- Comparison of distance : 0
- Automatically measure interval time:25ms
- Internal EEPROM Data are all 0x00
- the EEPROM address are unavailable: 0x00~0x04, please do not try to modify the data.

Three Measure Modes

PWM trigger mode

In PWM trigger mode, pin COMP/TRIG produces a low level of triggered pulse signal starting distance measurement operation once.

Upload the code below to your arduino board, wire the devices together, then you can realize the distance measurement.



URM37 V4.0 Ultrasonic Sensor

demo code

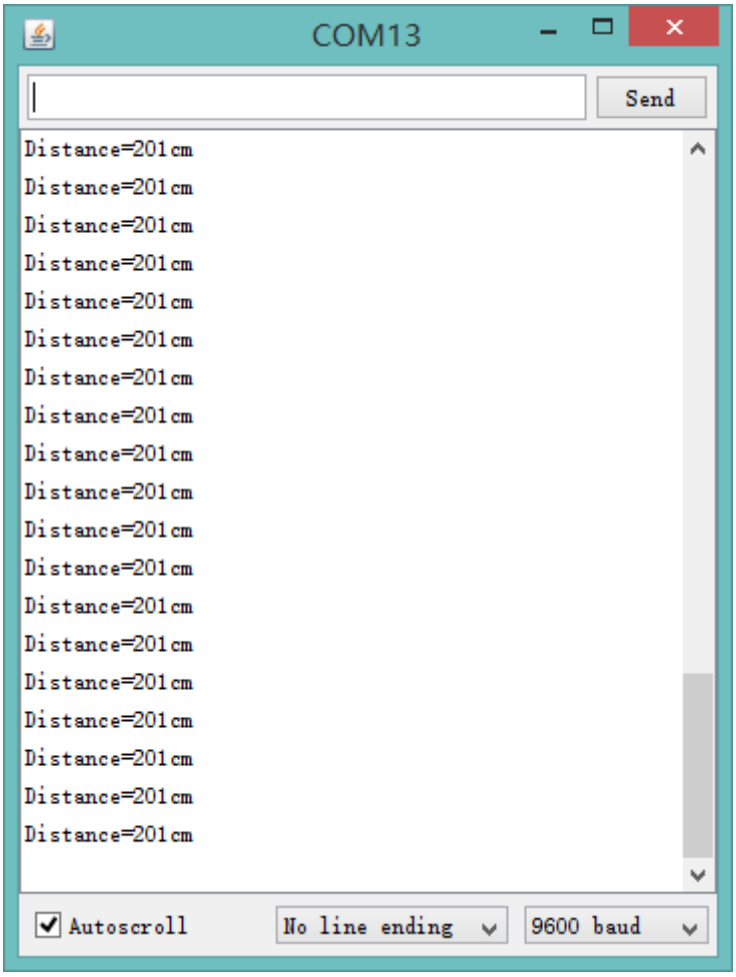
```
 1
 2 // # Editor     : ZRH from DFRobot
 3 // # Date       : 29.08.2014
 4
 5 // # Product name: URM V4.0 ultrasonic sensor
 6 // # Product SKU : SEN0001
 7 // # Version     : 1.0
 8
 9 // # Description:
10 // # The Sketch for scanning 180 degree area 3-500cm detecting range
11 // # The sketch for using the URM37 PWM trigger pin mode from DFRobot
12 // #   and writes the values to the serialport
13 // # Connection:
14 // #       Vcc (Arduino)    -> Pin 1 VCC (URM V4.0)
15 // #       GND (Arduino)    -> Pin 2 GND (URM V4.0)
16 // #       Pin 3 (Arduino)  -> Pin 4 ECHO (URM V4.0)
17 // #       Pin 5 (Arduino)  -> Pin 6 COMP/TRIG (URM V4.0)
18 // #       Pin A0 (Arduino) -> Pin 7 DAC (URM V4.0)
19 // # Working Mode: PWM trigger pin  mode.
20
21 #define  Measure  1     //Mode select
22 int URECHO = 3;         // PWM Output 0-25000US,Every 50US represent 1cm
23 int URTRIG = 5;         // PWM trigger pin
24 int sensorPin = A0;     // select the input pin for the potentiometer
25 int sensorValue = 0;    // variable to store the value coming from the sen
sor
26
27 unsigned int DistanceMeasured= 0;
28
29 void setup()
30 {
31   //Serial initialization
32   Serial.begin(9600);                       // Sets the baud rate to 9600
```

```
33   pinMode(URTRIG,OUTPUT);                      // A low pull on pin COMP/TRI
G
34   digitalWrite(URTRIG,HIGH);                   // Set to HIGH
35   pinMode(URECHO, INPUT);                      // Sending Enable PWM mode co
mmand
36   delay(500);
37   Serial.println("Init the sensor");
38
39  }
40 void loop()
41 {
42   PWM_Mode();
43   delay(100);
44 }
45
46 void PWM_Mode()                               // a low pull on pin COMP/TRI
G  triggering a sensor reading
47 {
48   Serial.print("Distance Measured=");
49   digitalWrite(URTRIG, LOW);
50   digitalWrite(URTRIG, HIGH);                 // reading Pin PWM will output
pulses
51   if( Measure)
52   {
53     unsigned long LowLevelTime = pulseIn(URECHO, LOW) ;
54     if(LowLevelTime>=45000)                   // the reading is invalid.
55     {
56       Serial.print("Invalid");
57     }
58     else{
59     DistanceMeasured = LowLevelTime /50;   // every 50us low level stands
for 1cm
60     Serial.print(DistanceMeasured);
61     Serial.println("cm");
62   }
63
```

```
64   }
65   else {
66     sensorValue = analogRead(sensorPin);
67     if(sensorValue<=10)                  // the reading is invalid.
68     {
69       Serial.print("Invalid");
70     }
71     else {
72     sensorValue = sensorValue*0.718;
73     Serial.print(sensorValue);
74     Serial.println("cm");
75     }
76   }
77 }
```

result

Open the IDE serial port, the distance is display on it.



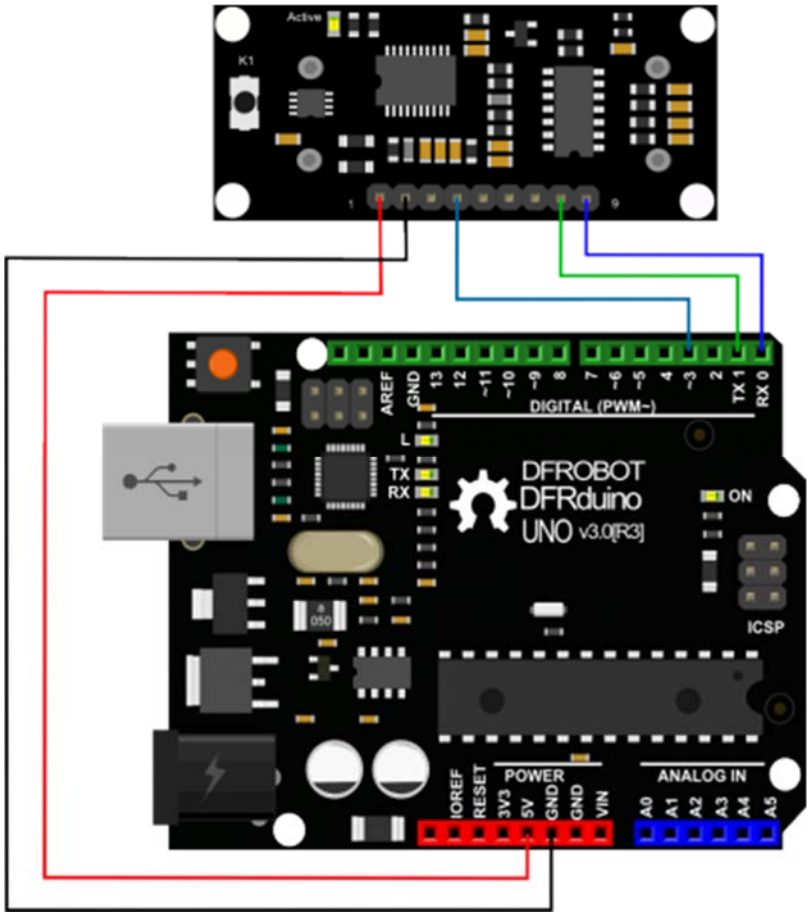
URM37 V4.0 Ultrasonic Sensor

In the above code, you may not get the distance like 500cm, for we just set it like 450cm.This is just a basic demo, after this, we will dive deeper to find more about it. Note: reverse the code"#define Measure 1 " to "#define Measure 0", and it can read the distance by analog value.

NOTE: PWM trigger mode support multiple parallel modules.

Auto Measure Mode

By means of the computer software or MCU Module, write 0xAA to 0x02 address to switch to automatic measurement mode. Writting a 8-bit 16 binary data to 0x04 address to reverse the measure time interval.
This module measures distance automatically every 25 ms (Settable) , then compare the data with the set value, if equal to or less than the set value, COMP/TRIG pin output low. In addition, in every measure,the PWM Terminal will read the distance as a low level pulse, 50uS represents 1 cm.
Tips:if you have set the Compare value, you could use this module as a Ultrasonic Switch.



Download the sample code to the Arduino board, then wire as shown modules and Arduino connected on ultrasonic distance measurement can be achieved.**Note**:download first before connect the Arduino TX/RX, or download will failed.

Demo Code

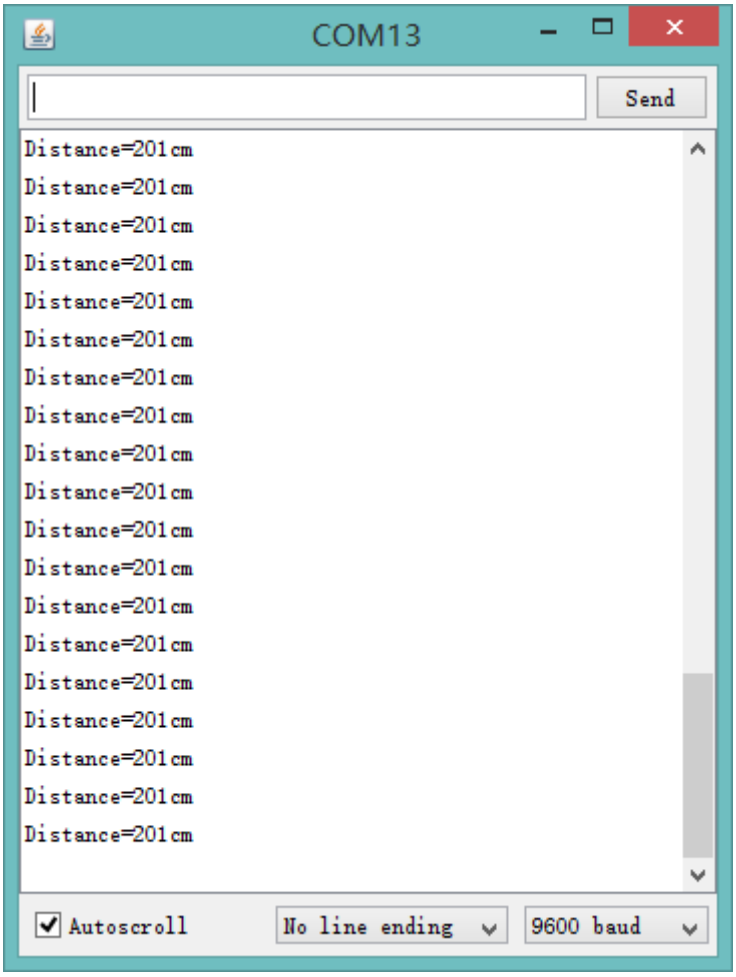
```
1        //Put your code here
2
3 // # Editor    :Zrh from DFRobot
4 // # Data      :29.08.2014
5 // # Product name:ultrasonic scanner
6 // # Product SKU:SEN0001
7 // # Version :  1.0
8
9 // # Description:
10 // # The sketch for using the URM37 autonomous  mode from DFRobot
11 // #   and writes the values to the serialport
```

```
12
13
14 // # Connection:
15 // #       Vcc (Arduino)      -> Pin 1 VCC (URM V4.0)
16 // #       GND (Arduino)      -> Pin 2 GND (URM V4.0)
17 // #       Pin 3 (Arduino)    -> Pin 4 ECHO (URM V4.0)
18 // #       Pin TX1 (Arduino)  -> Pin 8 RXD (URM V4.0)
19 // #       Pin RX0 (Arduino)  -> Pin 9 TXD (URM V4.0)
20 // # Working Mode: autonomous  mode.
21
22 int URECHO = 3; // PWM Output 0—25000US，Every 50US represent 1cm
23
24 unsigned int Distance=0;
25 uint8_t EnPwmCmd[4]={0x44,0x02,0xaa,0xf0};    // distance measure command
26
27 void setup(){                                 // Serial initialization
28   Serial.begin(9600);                         // Sets the baud rate to 960
0
29   AutonomousMode_Setup();
30 }
31
32 void loop()
33 {
34  AutonomousMode();
35  delay(100);
36 }                     //PWM mode setup function
37
38 void AutonomousMode_Setup(){
39   pinMode(URECHO, INPUT);                      // Sending Enable PWM mode
command
40   for(int i=0;i<4;i++){
41       Serial.write(EnPwmCmd[i]);
42    }
43 }
```

```
44 void AutonomousMode(){
45     unsigned long DistanceMeasured=pulseIn(URECHO,LOW);
46     if(DistanceMeasured>=45000){              // the reading is invalid.
47       Serial.print("Invalid");
48    }
49     else{
50       Distance=DistanceMeasured/50;           // every 50us low level stan
ds for 1cm
51       Serial.print("Distance=");
52       Serial.print(Distance);
53       Serial.println("cm");
54    }
55
56 }
```

result

Arduino send the distance information to the computer through serial.



Serial Passive Mode

In this mode, actually, as long as you wire the module TX & RX with the MCU, just as we did in the [test on software],you are using this mode.By serial, you have all authority to access to the sensor such as: ultrasonic distance measurement, temperature measurement, the distance changes, automatic measurement intervals set, serial port set(RS232 or TTL, reboot to take effect).
e.g.

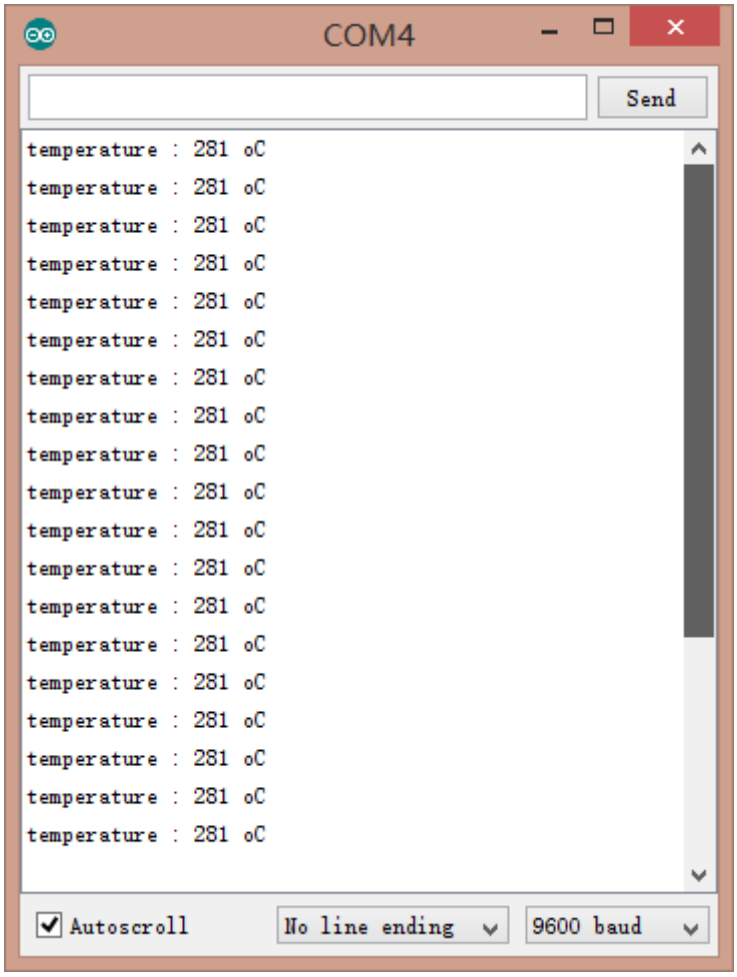
1. Read the temperature data command： 0x11 0x00 0x00 0x11
2. Read the distance data command： 0x22 0x00 0x00 0x22
3. Read EEPROM data command： 0x33 0x00 0x00 0x33
4. Write EEPROM data command： 0x44 0x02 0x00 0x46

Download the code below to your uno board(if you use the leonardo,please modify the code for the serial problem, help on arduino.cc), then wire the TX/RX,5V,GND.Follow [test on software].Here,we use the sensor to read the tempreture.
Demo Code

```
 1
 2 // # Editor     : ZRH from DFRobot
 3 // # Date       : 29.08.2014
 4
 5 // # Product name: URM V4.0 ultrasonic sensor
 6 // # Product SKU : SEN0001
 7 // # Version     : 1.0
 8
 9 // # Description:
10 // # The sketch for using the URM37 Serial  mode from DFRobot
11 // #   and writes the values to the serialport
12
13 // # Connection:
14 // #       Vcc (Arduino)      -> Pin 1 VCC (URM V4.0)
15 // #       GND (Arduino)      -> Pin 2 GND (URM V4.0)
16 // #       Pin TX1 (Arduino)  -> Pin 8 RXD (URM V4.0)
17 // #       Pin RX0 (Arduino)  -> Pin 9 TXD (URM V4.0)
18 // # Working Mode: Serial  Mode.
19
20 uint8_t EnTempCmd[4]={0x11,0x00,0x00,0x11};    // temperature measure comm
and
21 uint8_t TempData[4];
22 unsigned int TempValue=0;
23 void setup()
24 {
25   Serial.begin(9600);
26   delay(100);
27   Serial.println("Init the sensor");
28 }
29 void loop()
30 {
31   SerialCmd();
32   delay(200);
33 }
```

```
34 void SerialCmd()
35 {
36    int i;
37    for(i = 0;i < 4;i++){
38       Serial.write(EnTempCmd[i]);
39    }
40     while (Serial.available() > 0)  //if serial receive any data
41     {
42        for(i = 0;i < 4;i++){
43          TempData[i] = Serial.read();
44        }
45        TempValue = TempData[1]<<8;
46        TempValue =TempValue+TempData[2];
47        Serial.print("temperature : ");
48        Serial.print(TempValue,DEC);
49        Serial.println(" oC");
50     }
51 }
```

result



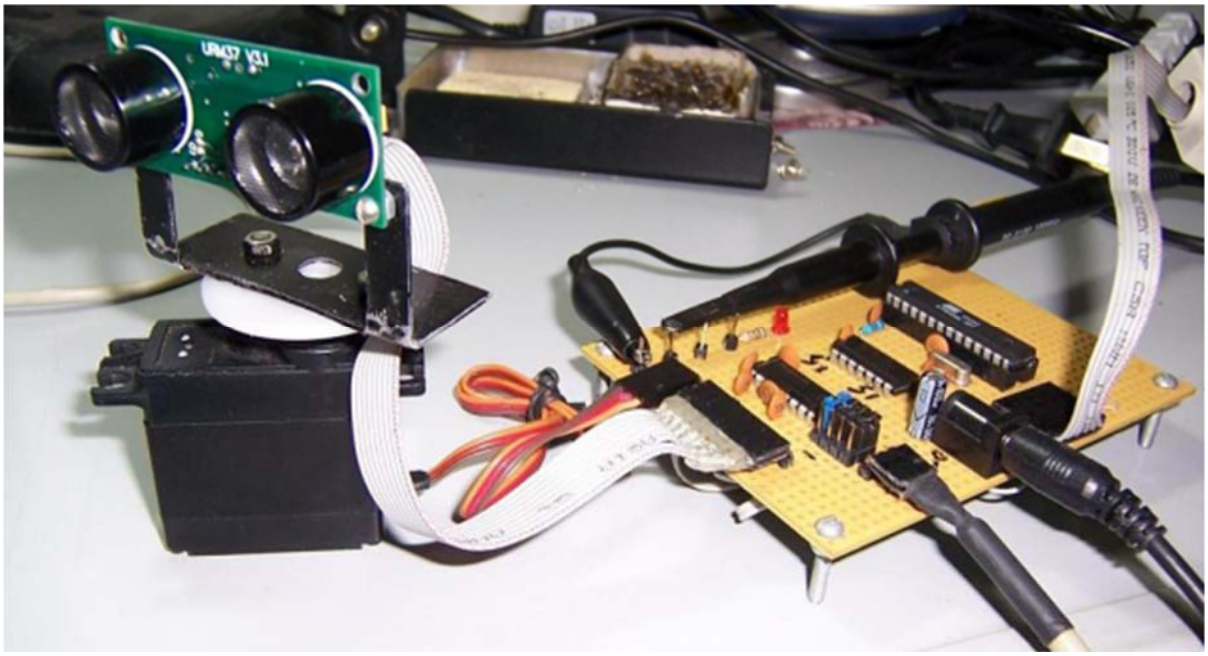
NOTE: This temperature was magnified 10 times, in the test, actual tempreture is 28.1 degrees Celsius.

Servo Rotation Reference Table

Servo control command reference table:

DEC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HEX	0	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
Degree	0	6	12	18	24	29	35	41	47	53	59	65	70	76	82	88
DEC	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

HEX	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
Degree	94	100	106	112	117	123	129	135	141	147	153	159	164	170	176	182
DEC	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	
HEX	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	
Degree	188	194	200	206	211	217	223	229	235	241	247	252	258	264	270	



Arduino Sketch

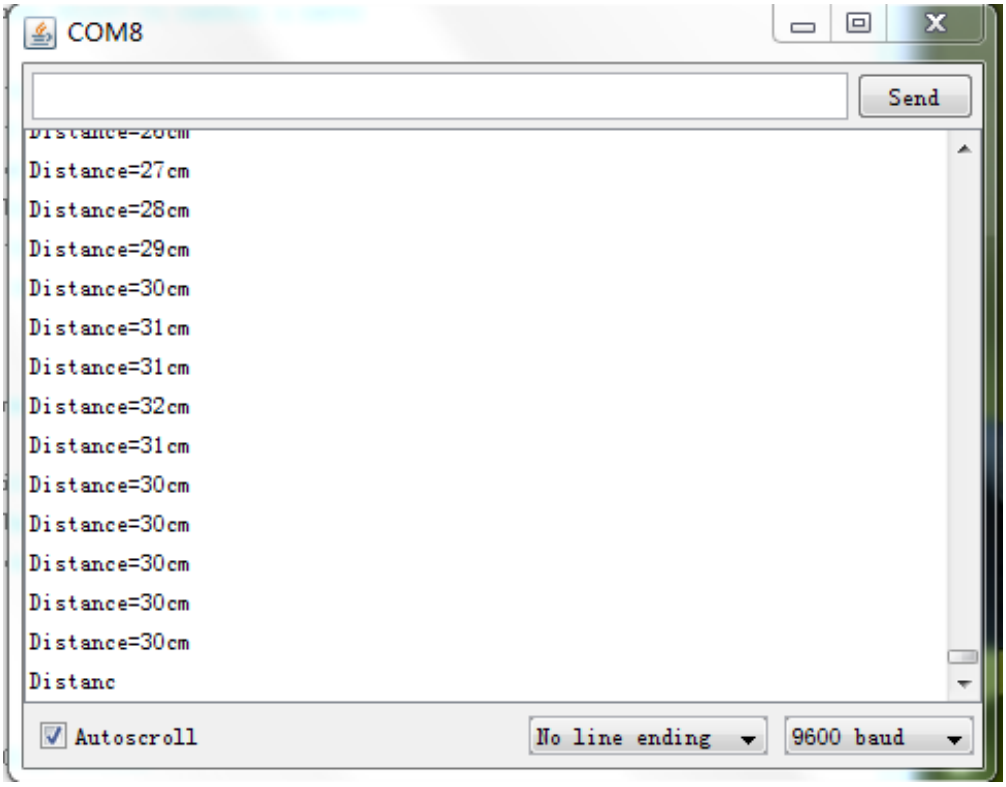
NOTE: Please put the sensor jumpers to TTL mode. See above for a picture indicating TTL mode

```
// # Editor    : Jiang from DFRobot
// # Data      : 24.07.2012

// # Product name:ultrasonic scanner Kit
// # Product SKU:SEN0001
```

```
// # Version :  0.2


// # Description:
// # The Sketch for scanning 180 degree area 4-500cm detecting range


// # Connection:
// #       Pin 1 VCC (URM V3.2) -> VCC (Arduino)
// #       Pin 2 GND (URM V3.2) -> GND (Arduino)
// #       Pin 4 PWM (URM V3.2) -> Pin 3 (Arduino)
// #       Pin 6 COMP/TRIG (URM V3.2) -> Pin 5 (Arduino)
// # Pin mode: PWM
// # Working Mode: PWM passive control mode.
// # If it is your first time to use it,please make sure the two jumpers to t
he right hand
// # side of the device are set to TTL mode. You'll also find a secondary jum
per on
// # the left hand side, you must break this connection or you may damage you
r device.


#include <Servo.h>                                      // Include Servo library
Servo myservo;                                          // create servo object to
control a servo


int pos=0;                                              // variable to store the
servo position
int URPWM=3;                                            // PWM Output 0-25000us,e
very 50us represent 1cm
int URTRIG=5;                                           // PWM trigger pin
boolean up=true;                                        // create a boolean varia
ble
unsigned long time;                                     // create a time variable
unsigned long urmTimer = 0;                              // timer for managing th
e sensor reading flash rate


unsigned int Distance=0;
uint8_t EnPwmCmd[4]={0x44,0x22,0xbb,0x01};          // distance measure comma
nd
```

```
void setup(){                                          // Serial initialization
  Serial.begin(9600);                                  // Sets the baud rate to 9
600
  myservo.attach(9);                                    // Pin 9 to control servo
  PWM_Mode_Setup();
}


void loop(){
   if(millis()-time>=20){                               // interval 0.02 seconds
     time=millis();                                     // get the current time o
f programme
     if(up){                                            // judge the condition
      if(pos>=0 && pos<=179){
        pos=pos+1;                                      // in steps of 1 degree
        myservo.write(pos);                             // tell servo to go to po
sition in variable 'pos'
      }
      if(pos>179)  up= false;                           // assign the variable ag
ain
    }
     else {
      if(pos>=1 && pos<=180){
        pos=pos-1;
        myservo.write(pos);
      }
      if(pos<1)  up=true;
    }
   }


   if(millis()-urmTimer>50){
     urmTimer=millis();
     PWM_Mode();
   }
 }
```

```
 void PWM_Mode_Setup(){
  pinMode(URTRIG,OUTPUT);                           // A low pull on pin COM
P/TRIG
  digitalWrite(URTRIG,HIGH);                        // Set to HIGH


  pinMode(URPWM, INPUT);                            // Sending Enable PWM mo
de command


  for(int i=0;i<4;i++){
      Serial.write(EnPwmCmd[i]);
   }
}


void PWM_Mode(){                                    // a low pull on pin COM
P/TRIG  triggering a sensor reading
    digitalWrite(URTRIG, LOW);
    digitalWrite(URTRIG, HIGH);                     // reading Pin PWM will
output pulses


    unsigned long DistanceMeasured=pulseIn(URPWM,LOW);


    if(DistanceMeasured==50000){                    // the reading is invali
d.
      Serial.print("Invalid");
   }
    else{
      Distance=DistanceMeasured/50;                 // every 50us low level
stands for 1cm
   }
  Serial.print("Distance=");
  Serial.print(Distance);
  Serial.println("cm");
}
```



Protocol

Serial setting：Port rate: 9600; Parity: none; Stop bit: 1

Command: Control command consists of four bits, command+data0+data1+sum. Sum=Low 8 bit of the sum of command+data0+data1.

Command Format	Function	Description
0x11＋NC＋NC＋Sum (Sample: 0x11 0x00 0x00 0x11)	Enable 16 bit temperature reading	Reading the temperature, the return data format will be: 0x11+High(temperature)+Low(temperature)+SUM If the temperature is above 0, the first four bits of High will be all 0. If the temperature is below 0, the first four bits of High will be all 1. The last 4 bits of High together with the Low bits stands for 12bits temperature. The resolution is 0.1. When the reading is invalid, it returns 0x11+0xFF+0xFF+SUM
0x22＋Degree＋NC＋SUM (Sample: 0x22 0x00 0x00 0x22)	Enable 16 bit distance reading	The degree in the command is used to control a servo motor to rotate corresponding degree. Degree: 0-46 stands for 0-270 degrees, for example, 3 stands for 18 degrees. Return data format will be: 0x22＋High(distance)＋Low(distance)+SUM. When the reading is invalid, it returns 0x22+0xFF+0xFF+SUM

0x33＋Add＋NC＋SUM	Enable internal EEPROM reading	Return data will be 0x33＋Add＋Data＋SUM.
0x44＋Add＋Data＋SUM (Sample: 0x44 0x02 0xbb 0x01) Enable PWM mode	Enable internal EEPROM writing	Written data can only from 0-255. Address 0x00-0x02 is used to configure the mode. 0x00 – threshold distance (Low) 0x01 – threshold distance (High) 0x02 – Operation Mode (0xaa for autonomous mode) (0xbb for PWM passive control mode) The return data format will be: 0x44＋Add＋Data＋SUM

NOTE: NC stands for any data, SUM stands for sum, Add stands for address.

1. *PWN_ON must be set to High to enable sensor.*

Examples: Function to calculate the temperature:

```
IF(HightByte>=0xF0)
{
Temperature= ((HightByte-0xF0)*256-LowByte)/10
 }
Else
{
Temperature= ((HightByte)*256-LowByte)/10
}
```

Trouble shooting

1. If you have connected sensor to the Arduino, but unable to use it, please first check the current serial port-level mode, it may be in TTL level, while our module works in RS232 levels.
2. The ultrasonic attenuation violently in the air (inversely proportional to the **d²**(distance)), besides, barrier surface reflection of the sound is affected by many factors (such as barrier shape, orientation and texture) the influence of ultrasonic distance measurement is therefore limited.
3. The far testing distance is a wall, close test can be a pen. Analyte based on the use of the environment and quality of different measurement may result in inconsistent with the data provided.
4. The mentioned servo above is a ordinary model on the market, can be rotated 180 degrees. If you use a special steering servo, it may draw the user's attention to control the timing in a different way.
5. If you are experiencing technical issues, please ask on our **forum** or send us **email**, we will answer your questions as soon as possible.

More question and cool idea,visit DFRobot Forum

More

- Arduino Library from milesburton(IDE 0023 and below)
- Old version_URM37 V3.2