SKU:SEN0358 (https://www.dfrobot.com/product-2173.html)

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Introduction

This is 200KHz high-frequency ultrasonic ranging sensor with IP65 protection grade. The sensor uses the RS485 interface that follows the standard Modbus-RTU communication protocol, featuring reliable communication. The sensor's slave address and serial port parameter can be revised according to the actual use, so it can be conveniently used with all kinds of industrial controlling machines. In addition, the sensor comes with flexible temperature compensation function that allows users to use the sensor built-in temperature compensation or external temperature compensation according to their needs, which makes it applicable to various complicated application scenarios.

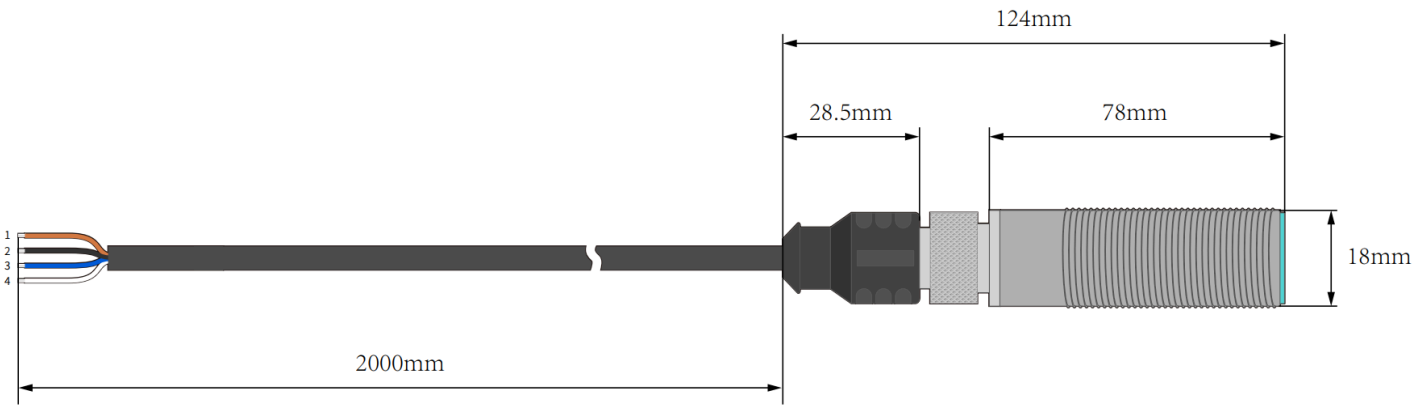
Besides that, the URM14 adopts high-requency and stable ultrasonic transducer that offers 100mm~1500mm effective measuring range for flat reflecting wall, 1mm accuracy, and ±1% error. Compared with the general ultrasonic ranging sensor

working at 40 KHZ acoustic frequency, this ranging sensor has higher measurement accuracy and shorter measurement period, which makes it very suitable for high precision and fast response ranging applications. In addition, the sensor has built-in noise level evaluation function, which can realize adaptive ranging in complex scenes. Users can also obtain noise level to optimize the working conditions of the sensor, so as to obtain the highest precision measurement data.

Specification

- Operating Voltage: DC 7-15V
- Max Instantaneous Current: 350mA
- Effective Measuring Range: 100-1500mm
- Distance Resolution: 0.1mm
- Measuring Accuracy: 1mm
- Distance Error: ±0.1%
- Temperature Resolution: 0.1℃
- Temperature Error: ±1℃
- Measuring Frequency: 30HZ
- Operating Temperature: -20℃ ~ +80℃
- Sensor Acoustic Frequency: 200KHz±4%
- Directional Angle: 12°±2°(-6dB)
- Protection Grade: IP65
- Communication interface: RS485

Board Overview



Module Wire Connecting Order:

- Orange-----VCC
- Black------GND
- Blue------RS485-B
- White-----RS485-A

Register

Register Address	Number	Name	Read/Write	Data Range	Default Value	D
0x00	1	Module PID Register	R	0x0000-0xFFFF	0x0002	P m
0x01	1	Module VID Register	R	0x0000-0xFFFF	0x0010	V re

Register Address	Number	Name	Read/Write	Data Range	Default Value	D
0x02	1	Module Address Register	R/W	0x0001-0x00F7	0x000C	W ac w th ac ti n **Sa o re**
0x03	1	Serial parameter control register 1	R/W	0x0000-0xFFFF	0x0005	M 0x 0x 0x 0x 0x 0x 0x O **Sa o re**

Register Address	Number	Name	Read/Write	Data Range	Default Value	D
0x04	1	Serial parameter control register 2	R/W	0x0000-0xFFFF	0x0001	M H 0x N -(0x -1 0x O -1 o n -2 O **Sa** **o** **re**
0x05	1	Distance register	R	0x0000-0xFFFF	0xFFFF	Th m m 0.
0x06	1	Onboard temperature data register	R	0x0000-0xFFFF	0x0000	Th LS or

		data register				se

Register Address	Number	Name	Read/Write	Data Range	Default Value	D
0x07	1	External temperature compensation data register	R/W	0x0000-0xFFFF	0x0000	W te th te co re ur

Register Address	Number	Name	Read/Write	Data Range	Default Value	D
0x08	1	Control register	R/W	0x0000-0xFFFF	0x0004	bi 0· te co 1· te co fu w to co re bi 0· co 1· co bi 0· 1· bi In m bi di di re

						re la re d
Register Address	**Number**	**Name**	**Read/Write**	**Data Range**	**Default Value**	**D**
						Tl cl **Sa o re**
0x09	1	Electrical noise level register	R	0x0000-0x0A	0x0000	0 c le Tl sh p e se n a va se

SEN0358 Register Read/Write Tutorial

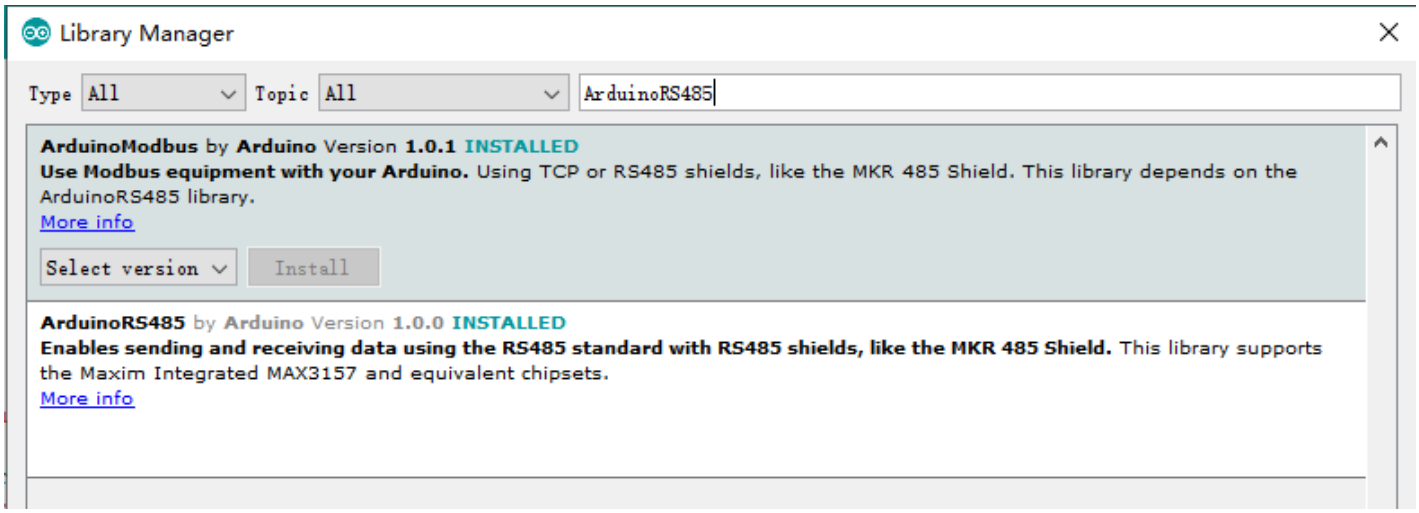
Requirements

- **Hardware**
  - Arduino Leonardo (https://www.dfrobot.com/product-832.html) x 1 (RS485 to TTL needs to occupy one serial port, so we recommend you to use device with more than 2 serial ports. Since Arduino Modbust takes up a lot

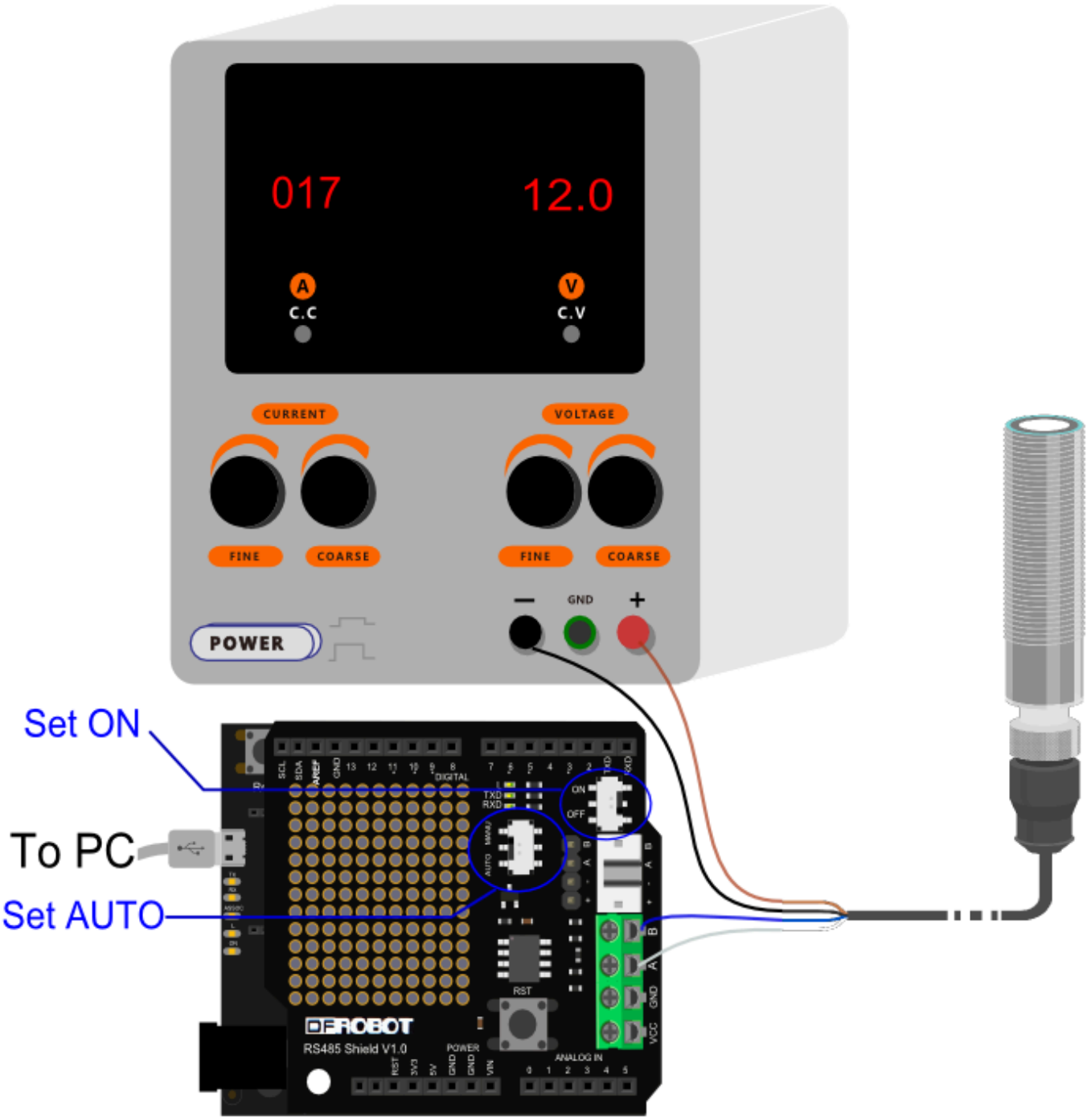
of memory, it is suggested to use Arduino Mega2560 controller.)

- RS485 Shield for Arduino (https://wiki.dfrobot.com/Arduino_RS485_Shield_SKU__DFR0259) x1
- DC Power Supply x1
- USB Data Cable (Connect the Arduino board to a computer via the USB cable)

- **Software**
  - Arduino IDE (https://www.arduino.cc/en/Main/Software)
  - Open Library Manager(Ctrl+Shift+I) in Arduino IDE, find and install ArduinoModbus and ArduinoRS485 Libraries.



Connection Diagram

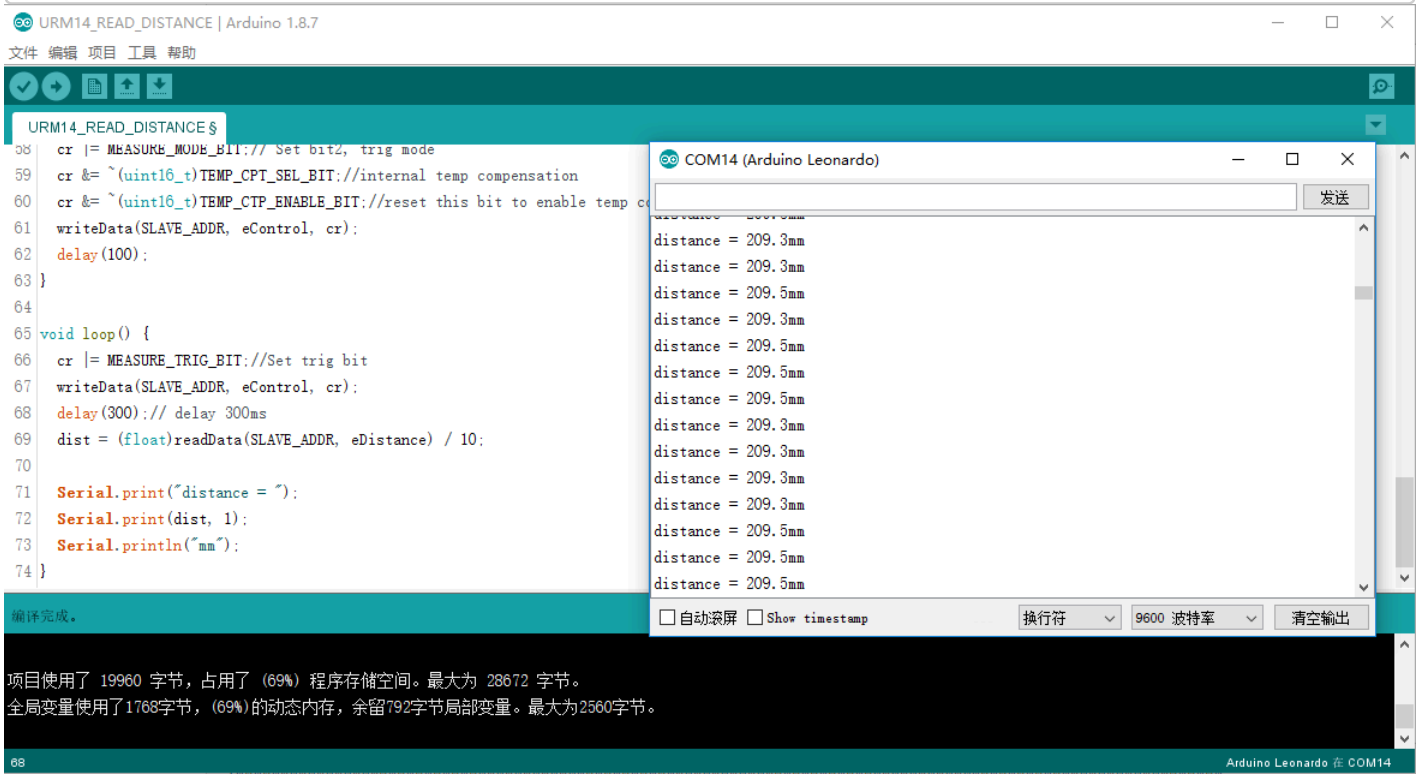


Read the detected distance

```
/**********************************************************************
     This code tests the range finder function of the URM14 ultrasonic sensor
     @ author : roker.wang@dfrobot.com
     @ data   : 11.08.2020
     @ version: 1.0
**********************************************************************
#include <ArduinoModbus.h>
#include <ArduinoRS485.h>

#define   SLAVE_ADDR               ((uint16_t)0x0C)

#define   TEMP_CPT_SEL_BIT         ((uint16_t)0x01)
#define   TEMP_CPT_ENABLE_BIT      ((uint16_t)0x01 << 1)
#define   MEASURE_MODE_BIT         ((uint16_t)0x01 << 2)
#define   MEASURE_TRIG_BIT         ((uint16_t)0x01 << 3)


typedef enum{
  ePid,
  eVid,
  eAddr,
  eComBaudrate,
  eComParityStop,
  eDistance,
  eInternalTempreture,
  eExternTempreture,
  eControl,
  eNoise
}eRegIndex_t;//Sensor register index

/*
 *@brief Read data from holding register of client
 *
 *@param addr :  Address of Client
```

```
 *@param reg: Reg index
 *@return data if execute successfully, false oxffff.
 */
uint16_t readData(uint16_t addr, eRegIndex_t reg)
{
  uint16_t data;
  if (!ModbusRTUClient.requestFrom(addr, HOLDING_REGISTERS, reg, 1)){
    Serial.print("failed to read registers! ");
    Serial.println(ModbusRTUClient.lastError());
    data = 0xffff;
  }else{
    data =  ModbusRTUClient.read();
  }
  return data;
}

/*
 *@brief write data to holding register of client
 *
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@param data: The data to be written
 *@return 1 if execute successfully, false 0.
 */
uint16_t writeData(uint16_t addr, eRegIndex_t reg, uint16_t data)
{
  if (!ModbusRTUClient.holdingRegisterWrite(addr, reg, data)){
    Serial.print("Failed to write coil! ");
    Serial.println(ModbusRTUClient.lastError());
    return 0;
  }else
    return 1;
}

float  dist;
volatile uint16_t cr = 0;
void setup() {
  ModbusRTUClient.begin(19200);
  Serial.begin(9600);
  cr |= MEASURE_MODE_BIT;//Set bit2 , Set to trigger mode
  cr &= ~(uint16_t)TEMP_CPT_SEL_BIT;//Select internal temperature compensation
  cr &= ~(uint16_t)TEMP_CPT_ENABLE_BIT;//enable temperature compensation
```

```
  writeData(SLAVE_ADDR, eControl, cr); //Writes the setting value to the contr
  delay(100);
}

void loop() {
  cr |= MEASURE_TRIG_BIT;//Set trig bit
  writeData(SLAVE_ADDR, eControl, cr); //Write the value to the control regist
  delay(300);//Delay of 300ms(minimum delay should be greater than 30ms) is to
  dist = (float)readData(SLAVE_ADDR, eDistance) / 10;//Read distance register,

  Serial.print("distance = ");
  Serial.print(dist, 1);
  Serial.println("mm");
}
```

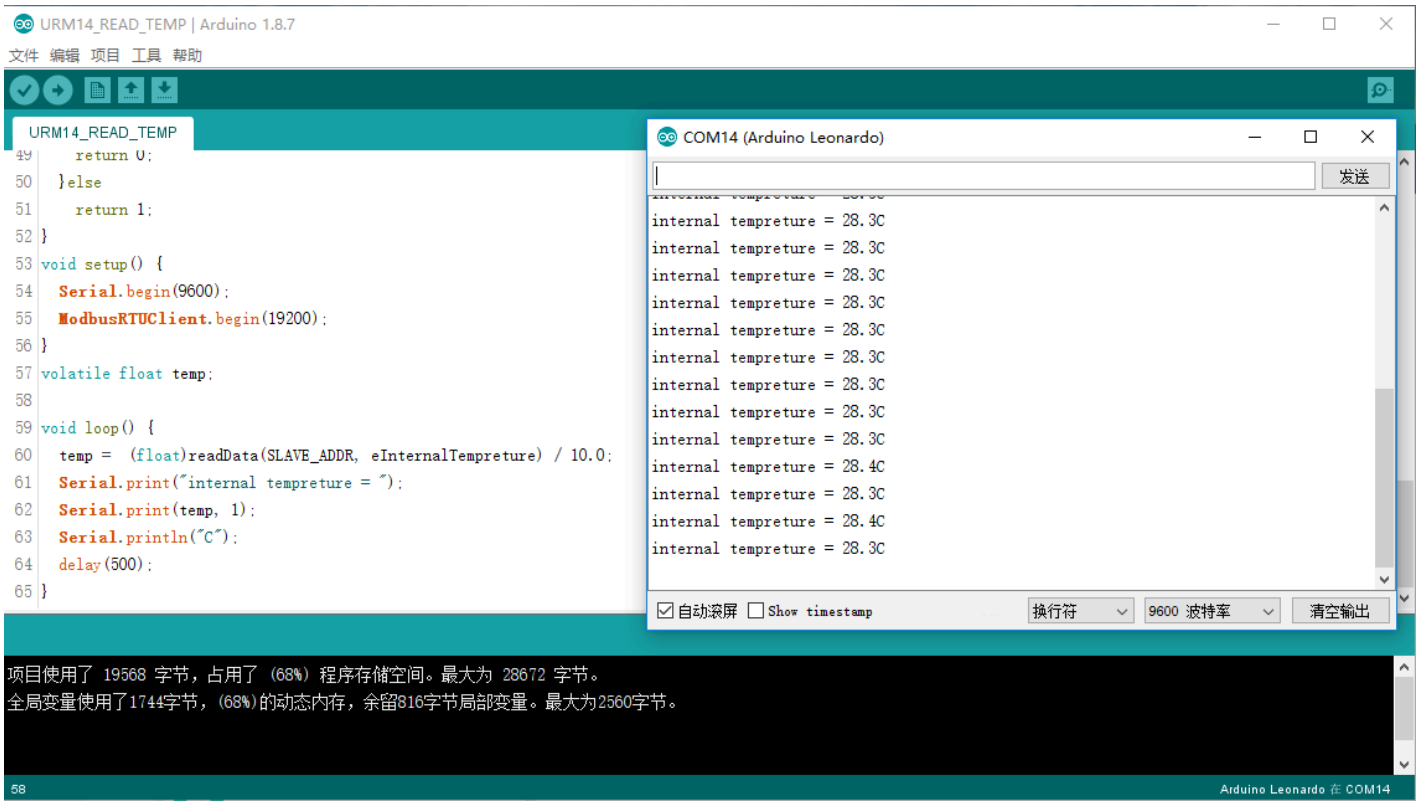


Read Onboard Temperature

```
/**********************************************************************
     This code tests the temperature measurement function of the URM14 ultrasc
     @ author : roker.wang@dfrobot.com
     @ data   : 11.08.2020
     @ version: 1.0
     RX(TTL-RS485转接板) -> TX1/D1 （Arduino Leonardo）  TX（TTL-RS485转接板）-
**********************************************************************
#include <ArduinoModbus.h>
#include <ArduinoRS485.h>

#define   SLAVE_ADDR               ((uint16_t)0x0C)

#define   TEMP_CPT_SEL_BIT         ((uint16_t)0x01)
#define   TEMP_CPT_ENABLE_BIT      ((uint16_t)0x01 << 1)
#define   MEASURE_MODE_BIT         ((uint16_t)0x01 << 2)
#define   MEASURE_TRIG_BIT         ((uint16_t)0x01 << 3)

typedef enum{
  ePid,
  eVid,
  eAddr,
  eComBaudrate,
  eComParityStop,
  eDistance,
  eInternalTempreture,
  eExternTempreture,
  eControl,
  eNoise
}eRegIndex_t;//Sensor register index


/*
 *@brief Read data from holding register of client
 *
```

```
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@return data if execute successfully, false oxffff.
 */
uint16_t readData(uint16_t addr, eRegIndex_t reg)
{
  uint16_t data;
  if (!ModbusRTUClient.requestFrom(addr, HOLDING_REGISTERS, reg, 1)){
    Serial.print("failed to read registers! ");
    Serial.println(ModbusRTUClient.lastError());
    data = 0xffff;
  }else{
    data =  ModbusRTUClient.read();
  }
  return data;
}

/*
 *@brief write data to holding register of client
 *
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@param data: The data to be written
 *@return 1 if execute successfully, false 0.
 */
uint16_t writeData(uint16_t addr, eRegIndex_t reg, uint16_t data)
{
  if (!ModbusRTUClient.holdingRegisterWrite(addr, reg, data)){
    Serial.print("Failed to write coil! ");
    Serial.println(ModbusRTUClient.lastError());
    return 0;
  }else
    return 1;
}

void setup() {
  Serial.begin(9600);
  ModbusRTUClient.begin(19200);
}

volatile float temp;
void loop() {
```

```
    temp =  (float)readData(SLAVE_ADDR, eInternalTempreture) / 10.0;//Read the t
    Serial.print("internal tempreture = ");
    Serial.print(temp, 1);
    Serial.println("C");

    delay(500);
  }
```

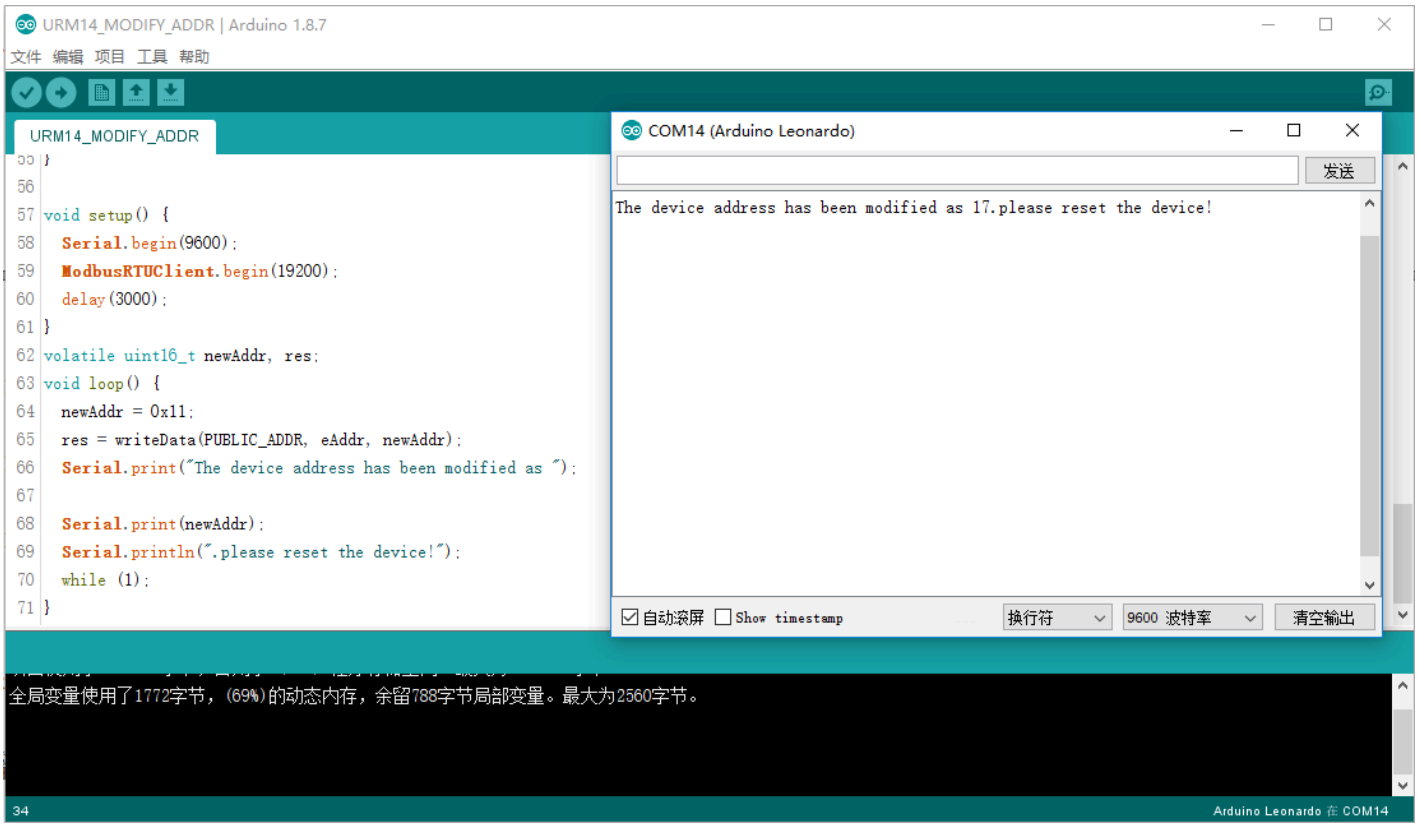


Revise Module Address

```
/**********************************************************************
     This code tests the address modification function of the URM14 ultrasonic
     @ author : roker.wang@dfrobot.com
     @ data   : 11.08.2020
     @ version: 1.0
     RX(TTL-RS485转接板) -> TX1/D1 （Arduino Leonardo）  TX（TTL-RS485转接板）-
**********************************************************************
#include <ArduinoModbus.h>
#include <ArduinoRS485.h>

#define   PUBLIC_ADDR              ((uint16_t)0x00)
#define   SLAVE_ADDR               ((uint16_t)0x0C)

#define   TEMP_CPT_SEL_BIT         ((uint16_t)0x01)
#define   TEMP_CPT_ENABLE_BIT      ((uint16_t)0x01 << 1)
#define   MEASURE_MODE_BIT         ((uint16_t)0x01 << 2)
#define   MEASURE_TRIG_BIT         ((uint16_t)0x01 << 3)

typedef enum{
  ePid,
  eVid,
  eAddr,
  eComBaudrate,
  eComParityStop,
  eDistance,
  eInternalTempreture,
  eExternTempreture,
  eControl,
  eNoise
}eRegIndex_t;//Sensor register index

/*
 *@brief Read data from holding register of client
 *
```

```
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@return data if execute successfully, false oxffff.
 */
uint16_t readData(uint16_t addr, eRegIndex_t reg)
{
  uint16_t data;
  if (!ModbusRTUClient.requestFrom(addr, HOLDING_REGISTERS, reg, 1)){
    Serial.print("failed to read registers! ");
    Serial.println(ModbusRTUClient.lastError());
    data = 0xffff;
  }else{
    data =  ModbusRTUClient.read();
  }
  return data;
}

/*
 *@brief write data to holding register of client
 *
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@param data: The data to be written
 *@return 1 if execute successfully, false 0.
 */
uint16_t writeData(uint16_t addr, eRegIndex_t reg, uint16_t data)
{
  if (!ModbusRTUClient.holdingRegisterWrite(addr, reg, data)){
    Serial.print("Failed to write coil! ");
    Serial.println(ModbusRTUClient.lastError());
    return 0;
  }else
    return 1;
}

void setup() {
  Serial.begin(9600);
  ModbusRTUClient.begin(19200);
  delay(3000);
}
volatile uint16_t newAddr, res;
void loop() {
```

```
    newAddr = 0x11;
    res = writeData(PUBLIC_ADDR, eAddr, newAddr);//Writes the new address value
    Serial.print("The device address has been modified as ");

    Serial.print(newAddr);
    Serial.println(".please reset the device!");
    while (1);
  }
```

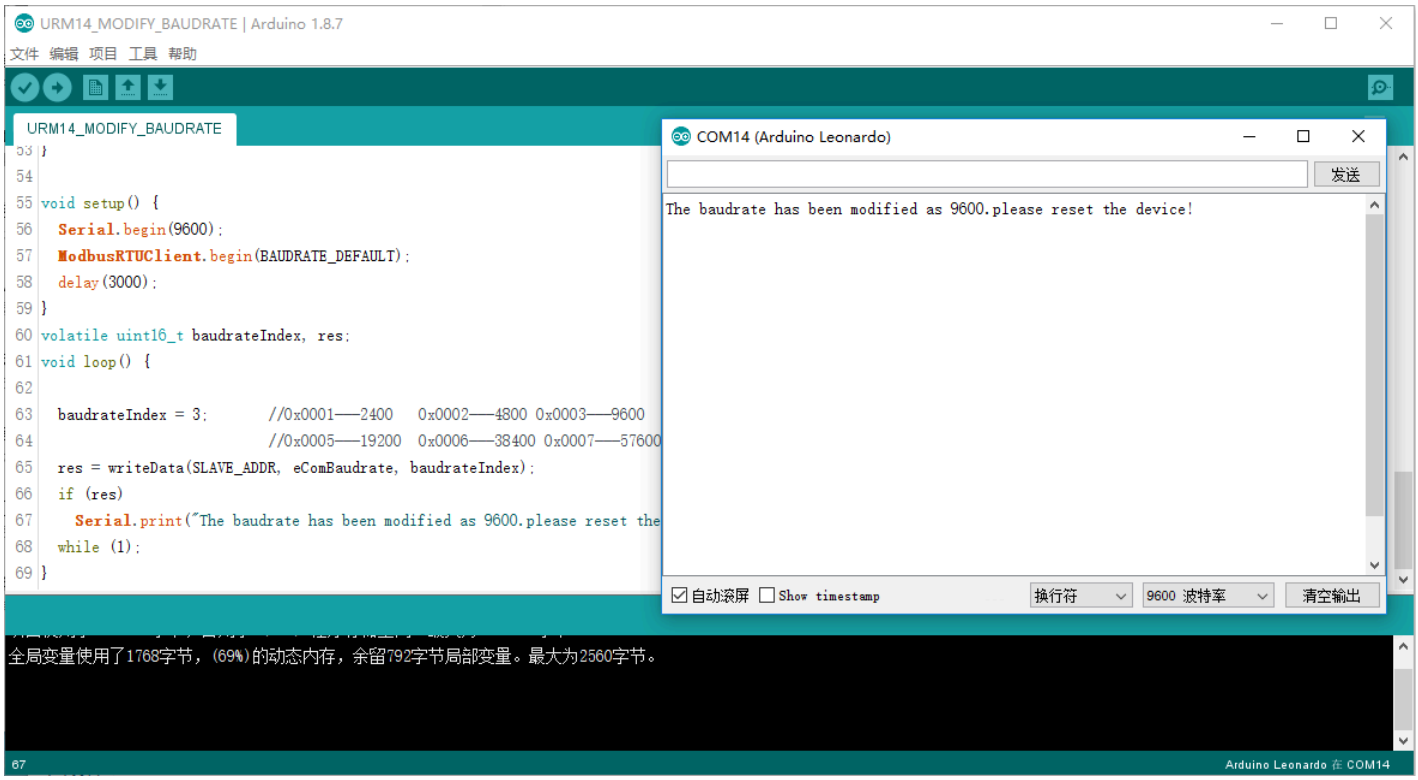


Revise Module Baud Rate

```
/**********************************************************************
     This code tests the baudrate modification function of the URM14 ultrasoni
     @ author : roker.wang@dfrobot.com
     @ data   : 11.08.2020
     @ version: 1.0
     RX(TTL-RS485转接板) -> TX1/D1 （Arduino Leonardo）  TX（TTL-RS485转接板）-
**********************************************************************
#include <ArduinoModbus.h>
#include <ArduinoRS485.h>

#define   BAUDRATE_DEFAULT          ((uint32_t)19200)
#define   SLAVE_ADDR                ((uint16_t)0x0C)

#define   TEMP_CPT_SEL_BIT          ((uint16_t)0x01)
#define   TEMP_CPT_ENABLE_BIT       ((uint16_t)0x01 << 1)
#define   MEASURE_MODE_BIT          ((uint16_t)0x01 << 2)
#define   MEASURE_TRIG_BIT          ((uint16_t)0x01 << 3)

typedef enum{
  ePid,
  eVid,
  eAddr,
  eComBaudrate,
  eComParityStop,
  eDistance,
  eInternalTempreture,
  eExternTempreture,
  eControl,
  eNoise
}eRegIndex_t;//Sensor register index

/*
 *@brief Read data from holding register of client
 *
```

```
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@return data if execute successfully, false oxffff.
 */
uint16_t readData(uint16_t addr, eRegIndex_t reg)
{
  uint16_t data;
  if (!ModbusRTUClient.requestFrom(addr, HOLDING_REGISTERS, reg, 1)){
    Serial.print("failed to read registers! ");
    Serial.println(ModbusRTUClient.lastError());
    data = 0xffff;
  }else{
    data =  ModbusRTUClient.read();
  }
  return data;
}

/*
 *@brief write data to holding register of client
 *
 *@param addr :  Address of Client
 *@param reg: Reg index
 *@param data: The data to be written
 *@return 1 if execute successfully, false 0.
 */
uint16_t writeData(uint16_t addr, eRegIndex_t reg, uint16_t data)
{
  if (!ModbusRTUClient.holdingRegisterWrite(addr, reg, data)){
    Serial.print("Failed to write coil! ");
    Serial.println(ModbusRTUClient.lastError());
    return 0;
  }else
    return 1;
}

void setup() {
  Serial.begin(9600);
  ModbusRTUClient.begin(BAUDRATE_DEFAULT);
  delay(3000);
}
volatile uint16_t baudrateIndex, res;
void loop() {
```

```
  baudrateIndex = 3;       //0x0001---2400   0x0002---4800 0x0003---9600   0x0
                           //0x0005---19200  0x0006---38400 0x0007---57600 0x0
  res = writeData(SLAVE_ADDR, eComBaudrate, baudrateIndex);//Writes the new ba
  if (res)
    Serial.print("The baudrate has been modified as 9600.please reset the devi
  while (1);
}
```



Detection Angle and Sensitivity

Normally, the detection area of an ultrasonic sensor is irregular and hard to define due to its physical characteristics, so the detection angle is indeterminate. In actual use, the detection area and sensitivity of this sensor prove to be smaller than those of other ultrasonic sensors. We used 2 different target obstacles to repeatedly test multiple sample products, and the reference detection area of the corresponding target is as follows:

- Detection area for PVC pipe of 7.5cm diameter (https://dfimg.dfrobot.com/nobody/wiki/719bac2c8caf9f5533ac3bcd6e4466a9.p

df)

- Detection area for 30cmx20cm plane plate (https://dfimg.dfrobot.com/nobody/wiki/41d5020e5b2ca8b2a5b231a8b07a91ad.pdf)

FAQ

For any questions, advice or cool ideas to share, please visit the **DFRobot Forum** (https://www.dfrobot.com/forum/).

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