ATO

Ultrasonic Wind Speed and Direction Sensor

FST200-204&FST200-204A

Product Manual

(V1.2)

ATO

● Important statement

Thank you very much for choosing our products, we will serve you sincerely forever. The company pursues excellent quality and pays more attention to excellent after-sales service.

Operation errors will shorten the life of the product, reduce its performance, and may cause accidents in severe cases. Please hand over this manual to the end user and read it carefully before using the product. And please keep it in a safe place for reference when needed. The company reserves the right to modify this manual due to product technology and process updates. If there is any change, no further notice will be given, and the final interpretation of this manual is reserved.

● Use safety instructions

1、Brand name

◇IThe ownership of trademarks involving brand names shall belong to the corresponding holders.

2、Safety Instructions

◇Installation and commissioning should only be carried out by designated qualified professionals.

◇It is strictly forbidden to measure or touch live parts.

◇Pay attention to the technical data of the device as well as the storage and operating conditions.

3、Designated purpose

◇The equipment must operate within the specified technical parameters.

◇The operating conditions and purpose of use of the equipment must not violate its original design intent.

◇Modifications or modifications to the equipment cannot ensure its safety and proper operation.

4、Misuse

◇If the device is installed incorrectly, the device may not work.

◇If the device is installed incorrectly, the device may be permanently damaged.

◇Danger or injury can result if the device falls.

5、Warranty

◇The guarantee period is 12 months, effective from the date of delivery. If the user uses the equipment for any purpose other than its intended use, the warranty will no longer be valid.

ATO

● Delivery content

◇Equipment

◇Operation Manual

◇Cables

◇Installation Accessories

● Order model

Note: Some models with special functions can be customized.

Serial number	Model	Illustrate	Remark
1	FST200-204	Wind speed, wind direction	RS485 output 0~5V output 4~20mA output
2	FST200-204A	With heating function Wind speed, wind direction	

● Introduction of ultrasonic wind speed and direction sensor

FST200-204 series ultrasonic wind speed and direction sensors use ultrasonic time difference method to measure wind speed and direction. High measurement accuracy, reliable performance, easy to carry, without any moving parts, and without maintenance and on-site calibration, it is a relatively advanced instrument for measuring wind speed and direction. Because it overcomes the inherent defects of the mechanical anemometer, it can work normally for a long time around the clock, and is more and more widely used. It will be a powerful replacement for mechanical anemometers.

1. Product features

◇Original stainless steel integrated appearance design, beautiful appearance, using advanced sensing technology for real-time measurement, no start-up wind speed limit, no angle limit, and obtain wind speed and wind direction data at the same time.

◇Multiple ultrasonic probes send and receive ultrasonic signals in real time in the measurement space to ensure real-time and efficient parameters.

◇ High measurement accuracy, wide range, good stability, low power consumption, strong anti-interference ability, can work around the clock, not affected by weather changes, no calibration required.

◇ Precise craftsmanship, all-solid design, stronger structure, high strength, weather resistance, corrosion resistance and water resistance, and long service life.

◇Professional integrated installation method, small size, easy to carry and install.

◇ It can be powered by matching solar panels and batteries, remote wireless transmission of measurement information, and long-distance rear detection. It can be widely used in unattended remote areas such as mountains and islands with harsh environments.

2. Application fields

The application of ultrasonic anemometer is convenient and accurate, and can be used flexibly in many fields. It is widely used in urban environmental monitoring, wind power generation, meteorological monitoring, bridges and tunnels, nautical ships, aviation airports, subways, tunnels and mining, and various fans. Manufacturing, and other industries that require ventilation and exhaust systems, etc.

3. Working principle

The working principle of the ultrasonic anemometer is to use the ultrasonic time difference method to measure the wind speed. The velocity of sound in the air is superimposed on the velocity of the airflow in the wind direction. If the ultrasonic wave travels in the same direction as the wind, its speed will increase; conversely, if the ultrasonic wave travels in the opposite direction to the wind, its speed will slow down. Therefore, under fixed detection conditions, the speed of ultrasonic waves propagating in the air can correspond to the wind speed function. Accurate wind speed and wind direction can be obtained through calculation. Since the speed of a sound wave is greatly affected by temperature as it travels through the air; an anemometer detects two opposite directions on two channels, so the effect of temperature on the speed of sound waves is negligible. Users can choose the wind speed unit, output frequency and output format according to their needs. Optional heating (recommended for icy environments) or analog output is also available upon request.

● Size structure and installation method

1. Installation method

The sensor bracket is designed to be mounted on the mast. The following tools are required for installation:

◇ Open-end wrench or ring wrench.

◇ Compass, used to adjust the wind measurement to point to the north (or manual observation positioning).

Note: The two installation methods need to be specified at the time of purchase.

◇ Loosen the nut.

◇ Arrange the sensors in the direction facing north.

◇ Push the sensor into the upper end of the mast from top to bottom.

◇ Use even force and tighten the nut, at this time the sensor can be slightly adjusted to keep it level.

◇ Turn the two nuts 3 turns and fix.

2. Wind direction positioning

In order to correctly display the wind direction, the sensor must be aligned to face north, the 'N' arrow indicates the north direction.

Note: The magnetic north pole indicated by the compass does not exactly coincide with the geographic north pole, so the deviation (error) of the location must be considered when arranging the sensors.

3. Select the installation location

In order to prolong the service life of the equipment and ensure the normal operation of the equipment, please pay attention to the following items when choosing the installation location of the equipment

◇ The ground where the mast is installed should be solid and stable.

◇ The installation location of the equipment should be convenient for maintenance.

◇ The installation height is at least 5 meters above the ground.

◇ The area around the sensor should be open.

Note: Buildings, bridges, dikes, and trees can affect wind measurements. Likewise, wind gusts from passing vehicles can affect wind measurements.

◇ The power supply should be stable and reliable to meet the requirements of long-term operation.

◇ When transmitting data through the wireless communication network, ensure that the network coverage is good.

Note: The calculation results of the measured values are only applicable to the installation place of the equipment, and cannot be extended to other areas or the entire road accordingly.

◇ Installing the equipment to the mast, only approved and tested devices are allowed (wires and risers, etc.).

◇ It is necessary to abide by the various specifications related to the operation at this height.

◇ Reasonably choose the size of the mast and fix it correctly.

◇ The mast must be grounded in accordance with regulations.

◇ When working on the side of the road or near the road, you must abide by the relevant safety regulations.

If the device is installed incorrectly

◇ Device may not work.

◇ Equipment may be permanently damaged.

◇ If the device falls, it may cause danger or injury.

4. Signal outgoing line and line color definition

Pin assignment:

1 Red: Positive supply voltage (+24V)

2 Green: RS485_A (485 output mode) or wind speed 0~5V (voltage output) or wind speed 4~20mA (current output)

3 Black: Negative supply voltage

4 White: RS485_B (485 output mode) or wind direction 0~5V (voltage output) or wind direction 4~20mA (current output)

Note: The line color definition is for reference only. Before use, please request the latest user manual or contact customer service to confirm the line color definition.

5. Power supply characteristics

◇ Under 24VDC standard conditions, the current is less than 30mA (without heating).

◇ Under 24VDC standard conditions, the current is less than 2A (during heating).

◇ The power supply unit used must be certified to comply with Class III Equipment Protection

Standard (SELV).

6. Communication interface

There is an industry standard half-duplex two-wire RS485 interface in the device.

Baud rate: 9600

Data bits: 8

stop bits: 1

Parity: none

Adjustable baud rate: 2400~115200

Note: 2400, 4800, 9600 baud rates are recommended.

7. Maintenance

In general, the equipment requires no maintenance. However, an annual functional test is recommended. When performing functional tests, please note the following:

◇ Visual inspection of equipment for sludge.

◇ Send a measurement request signal to check the sensor.

● Technical parameters

1. Wind speed parameters:

Measuring range: 0~60m/s, 0~70m/s

Starting wind speed: 0.1m/s

Response time: 1s

Resolution: 0.1m/s

Accuracy: ±0.3m/s or ±3% (0~30m/s) or ±5% (30~70m/s), whichever is greater

2. Wind direction parameters:

Measuring range: 0~360°

Starting wind speed: 0.1m/s

Accuracy: ±2°

Resolution: 0.1°

3. Basic parameters:

Digital signal: RS485

Analog signal: 0~5V or 4~20mA

Baud rate: 2400~115200

Power supply voltage: 9V~24V DC

Working current: common type: <35mA (12VDC), heating type: 0.6~1A

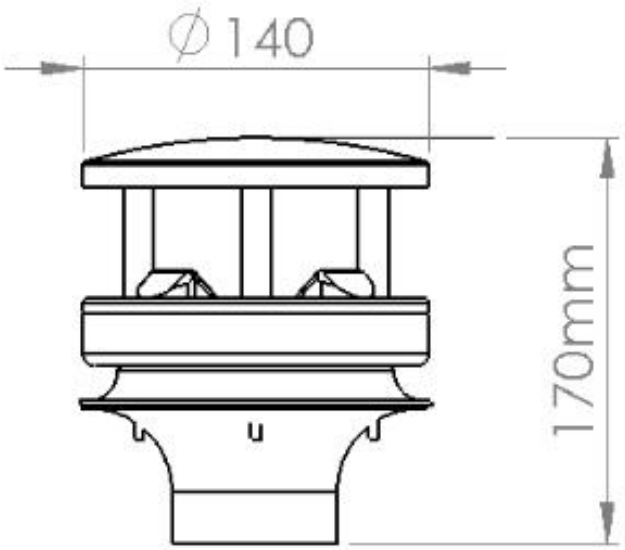
Working temperature: -20℃ ~ 60℃

Working humidity: 0% ~ 95% RH

Protection: IP66

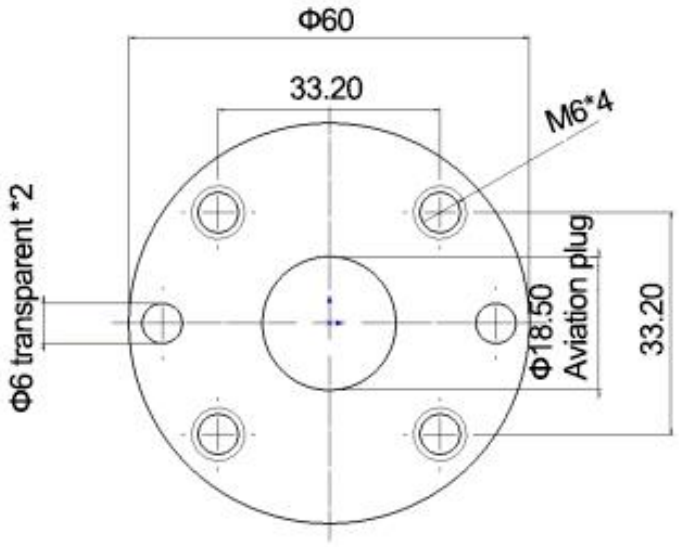
4. Dimensions

The total height of the aviation plug with the bottom is 175mm

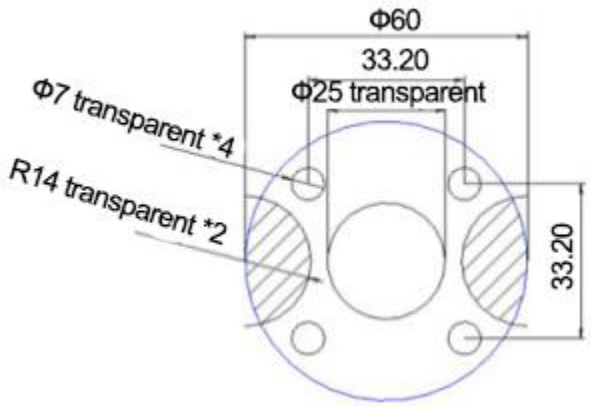


5. Bottom installation dimensions

The diameter of the mounting flange below the sensor is Φ65mm, and the four mounting holes are Φ6mm. The installation is fixed by the flange. The installation dimensions are shown in the figure below:



● Suggestions for making the bottom bracket are as follows



● Depending on the bottom size, it is recommended

Φ6 through * 2" is the drainage port, which cannot be blocked to avoid internal water storage;

M6*4" is the screw hole, it is recommended to open the hole Φ7mm;

The middle hole is a Φ18.5 aviation plug, and the recommended opening diameter is not less than 25mm.

● Communication protocol

The command subset of the MODBUS-RTU protocol is adopted, and the read register command (03) (06) is used.

The following does not explain that it is expressed in hexadecimal by default.

1. Data transmission method:

The communication method is RS485 serial communication, and the default configuration is 8 data bits, 1 stop bit, and no parity bit.

2. Data transfer rate:

The default baud rate is 9600bps, and the supported baud rate is 2400~115200.

Note: The baud rate range will affect the communication effect. 9600, 4800, 2400 baud rates are recommended. If the baud rate is too high and the data line is too long, it will cause communication failure.

3. Datagram format

(1) Function code 0x03--query the content of slave device register

Master message	Correct message from the device
Slave device address (0x01-0x7F 1 byte)	Slave device address (0x01-0x7F 1 byte)
Function code (0x03 1 byte)	Function code (0x03 1 byte)
Start register address (2 bytes)	Number of bytes in the data area (2*number of registers 1 byte)

Number of registers (2 bytes)	Data area (register content 2*register number 1 byte)
CRC check code (2 bytes)	CRC check code (2 bytes)

(2) Function code 0x06--set data to slave device register

Master message	Correct message from the device
Slave device address (0x01-0x7F 1 byte)	Slave device address (0x01-0x7F 1 byte)
Function code (0x06 1 byte)	Function code (0x06 1 byte)
Start register address (2 bytes)	Number of bytes in the data area (2*number of registers 1 byte)
Data written to the register (2* number of registers 1 byte)	Data area (register content 2* register number 1 byte)
CRC check code (2 bytes)	CRC check code (2 bytes)

Note:

The low bit of the CRC check code is in front of the high bit, and the address of the register, the number of registers, and the data are high in the front and low in the back;

The register word length is 16bit (two bytes);

4. Register description and command format

Parameter data register definition table

Register address (Hex)	Register content	Register status	Data range	Corresponding range
0x002A	Wind speed	Read only	0~700	0~70.0
0x002B	Wind direction	Read only	0~3600	0~360.0
0x2000	Device address	Read and write	1~127	1~127
0x2001	Baud rate	Read and write	24,48,96,144,192, 384,560,576,1152	24,48,96,144,192, 384,560,576,1152

Address definition description

1) Wind speed (0x002A)

The unit is 0.1m/s. That is, if the reading value is 100 (or 0x64), it means that the wind speed value is 10.0m/s

2) Wind direction (0x002B)

The unit is 0.1 degrees. That is, if the reading value is 100 (or 0x64), it means that the wind direction is 10.0 degrees

3) Device number (0x2000)

Range: 1~127. After modifying the device number, the data is only saved and does not take effect

immediately. It will take effect after restarting.

4) Baud rate (0x2001)

Configurable baud rates: 2400, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200. After modification, the data is only saved and does not take effect immediately. It will take effect after restarting.

5. Command example:

All register address bytes, register number bytes, and data bytes in the command are high-order first and low-order last; CRC check code low-order byte first and high-order byte last;

1) Read the wind speed value:

Slave address 02, baud rate 9600, N,8,1

Slave address	Function code	The high 8 bits of the start register address	The lower 8 bits of the start register address	The high 8 bits of the number of registers	The lower 8 bits of the number of registers	CRC lower 8 bits	CRC high 8 bits
0x02	0x03	0x00	0x2A	0x00	0x01	0xA5	0xF1

Response from the device (assuming the current wind speed value is 0x0064, which means the wind speed value is 10.0m/s)

Slave address	Function code	data area Bytes	Wind speed value high 8 bits	The lower 8 bits of the wind speed value	CRC lower 8 bits	CRC high 8 bits
0x02	0x03	0x02	0x00	0x64	0xFD	0xAF

2) Read the wind direction value:

Slave address 02, baud rate 9600, N,8,1

Slave address	Function code	The high 8 bits of the start register address	The lower 8 bits of the start register address	The high 8 bits of the number of registers	The lower 8 bits of the number of registers	CRC lower 8 bits	CRC high 8 bits
0x02	0x03	0x00	0x2B	0x00	0x01	0xF4	0x31

Response from the device: (Assume the current wind direction value is 0x0384, which is 90.0°)

Slave address	Function code	data area Bytes	Wind speed value high 8 bits	The lower 8 bits of the wind direction value	CRC lower 8 bits	CRC high 8 bits
0x02	0x03	0x02	0x03	0x84	0xFC	0xD7

3) Continuously read wind speed and direction values:

Slave address 02, baud rate 9600, N,8,1

Slave address	Function code	The high 8 bits of the start	The lower 8 bits of the start register	The high 8 bits of the	The lower 8 bits of the number of	CRC lower 8 bits	CRC high 8 bits

		register address	address	number of registers	registers		
0x02	0x03	0x00	0x2A	0x00	0x02	0xE5	0xF0

Response from the device (assuming the current wind speed is 10.0m/s and the wind direction is 90.0°)

Slave address	Function code	data area Bytes	Wind speed value high 8 bits	The lower 8 bits of the wind speed value	High 8 bits of wind direction value	The lower 8 bits of the wind direction value	CRC lower 8 bits	CRC high 8 bits
0x02	0x03	0x04	0x00	0x64	0x03	0x84	0x88	0x7F

4) Modify the device address:

Slave device address No. 02, changed to No. 03

Slave address	Function code	The high 8 bits of the start register address	The lower 8 bits of the start register address	Modified baud rate high 8 bits	Modified baud rate lower 8 bits	CRC lower 8 bits	CRC high 8 bits
0x02	0x06	0x20	0x00	0x00	0x03	0xc2	0x38

Slave address	Function code	The high 8 bits of the start register address	The lower 8 bits of the start register address	Modified baud rate high 8 bits	Modified baud rate lower 8 bits	CRC lower 8 bits	CRC high 8 bits
0x02	0x06	0x20	0x01	0x00	0x60	0xD3	0xD1

5) Modify the baud rate to 9600:

The baud rate is an integer multiple of 100, for example, 9600 baud rate should be set to 96, that is, 0x0060

Note: Modifying the baud rate and device address will take effect only after power off and restarting.

6. CRC check calculation method

// ---------- ----------

// DESCRIPTION: High byte table of CRC-16 check

// ---------- ----------

static const unsigned char HiCRCTable[] = {

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40, 0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41,

0X00, 0XC1, 0X81, 0X40, 0X01, 0XC0, 0X80, 0X41, 0X01, 0XC0, 0X80, 0X41, 0X00, 0XC1, 0X81, 0X40};

// ---------- ----------

// DESCRIPTION: Low byte table of CRC-16 check

// ---------- ----------

static const unsigned char LoCRCTable[] = {

0X00, 0XC0, 0XC1, 0X01, 0XC3, 0X03, 0X02, 0XC2, 0XC6, 0X06, 0X07, 0XC7, 0X05, 0XC5, 0XC4, 0X04,

0XCC, 0X0C, 0X0D, 0XCD, 0X0F, 0XCF, 0XCE, 0X0E, 0X0A, 0XCA, 0XCB, 0X0B, 0XC9, 0X09, 0X08, 0XC8,

0XD8, 0X18, 0X19, 0XD9, 0X1B, 0XDB, 0XDA, 0X1A, 0X1E, 0XDE, 0XDF, 0X1F, 0XDD, 0X1D, 0X1C, 0XDC,

0X14, 0XD4, 0XD5, 0X15, 0XD7, 0X17, 0X16, 0XD6, 0XD2, 0X12, 0X13, 0XD3, 0X11, 0XD1, 0XD0, 0X10,

0XF0, 0X30, 0X31, 0XF1, 0X33, 0XF3, 0XF2, 0X32, 0X36, 0XF6, 0XF7, 0X37, 0XF5, 0X35, 0X34,

```
0XF4,
    0X3C, 0XFC, 0XFD, 0X3D, 0XFF, 0X3F, 0X3E, 0XFE, 0XFA, 0X3A, 0X3B, 0XFB, 0X39, 0XF9,
0XF8, 0X38,
    0X28, 0XE8, 0XE9, 0X29, 0XEB, 0X2B, 0X2A, 0XEA, 0XEE, 0X2E, 0X2F, 0XEF, 0X2D, 0XED,
0XEC, 0X2C,
    0XE4, 0X24, 0X25, 0XE5, 0X27, 0XE7, 0XE6, 0X26, 0X22, 0XE2, 0XE3, 0X23, 0XE1, 0X21, 0X20,
0XE0,
    0XA0, 0X60, 0X61, 0XA1, 0X63, 0XA3, 0XA2, 0X62, 0X66, 0XA6, 0XA7, 0X67, 0XA5, 0X65, 0X64,
0XA4,
    0X6C, 0XAC, 0XAD, 0X6D, 0XAF, 0X6F, 0X6E, 0XAE, 0XAA, 0X6A, 0X6B, 0XAB, 0X69, 0XA9,
0XA8, 0X68,
    0X78, 0XB8, 0XB9, 0X79, 0XBB, 0X7B, 0X7A, 0XBA, 0XBE, 0X7E, 0X7F, 0XBF, 0X7D, 0XBD,
0XBC, 0X7C,
    0XB4, 0X74, 0X75, 0XB5, 0X77, 0XB7, 0XB6, 0X76, 0X72, 0XB2, 0XB3, 0X73, 0XB1, 0X71, 0X70,
0XB0,
    0X50, 0X90, 0X91, 0X51, 0X93, 0X53, 0X52, 0X92, 0X96, 0X56, 0X57, 0X97, 0X55, 0X95, 0X94,
0X54,
    0X9C, 0X5C, 0X5D, 0X9D, 0X5F, 0X9F, 0X9E, 0X5E, 0X5A, 0X9A, 0X9B, 0X5B, 0X99, 0X59,
0X58, 0X98,
    0X88, 0X48, 0X49, 0X89, 0X4B, 0X8B, 0X8A, 0X4A, 0X4E, 0X8E, 0X8F, 0X4F, 0X8D, 0X4D,
0X4C, 0X8C,
    0X44, 0X84, 0X85, 0X45, 0X87, 0X47, 0X46, 0X86, 0X82, 0X42, 0X43, 0X83, 0X41, 0X81, 0X80,
0X40};


    // ********************************************** ******************************
    // Design Notes:
    // pMsg: the first address of the data buffer to be verified
    // iSize: length of data bytes to be verified
    // ---------------------------------------------- ----------------------------
    unsigned short QuickCRC16( unsigned char * pMsg, unsigned short iSize )
    {
        unsigned char iHiVal; // high byte of CRC initialized
        unsigned char iLoVal; // low byte of CRC initialized
        unsigned char index; // will index into CRC lookup table

        // Initial value for the CRC
        iHiVal = 0xff;
        iLoVal = 0xff;
```

```
        while ( iSize-- )
        {
            // Calculate the CRC
            index = iLoVal ^ ( unsigned char )( *pMsg++ );

            iLoVal = iHiVal ^ HiCRCTable[index];
            iHiVal = LoCRCTable[index];
        }
        return ( iHiVal << 8 | iLoVal );
    }
```

● Maintenance and maintenance

This instrument is a precision electronic product, correct maintenance and maintenance will help to protect the performance of the instrument and prolong the service life of the instrument, please pay attention to the following points:

1. Please use the instruction manual correctly according to the requirements of the instruction manual. Wrong wiring may cause damage to the instrument.
2. Do not wipe the instrument with volatile liquids, otherwise it may cause discoloration and deformation of the instrument; wipe with a soft cloth to avoid scratches on the outer protective film of the instrument and prolong the service life of the instrument.
3. The instrument should be handled with care, and should not be dropped or pressed heavily, otherwise it will cause deformation of the instrument and damage to the internal circuit board.
4. Do not touch the sensing part when the instrument is charged, so as to affect the measurement result or cause damage to the internal circuit of the instrument.
5. Please do not disassemble or modify the instrument without authorization, so as not to cause damage to the instrument.
6. When the instrument is in use, it should be firmly fixed with screws, otherwise the instrument may be damaged.
7. Regularly check the power supply voltage of the instrument to ensure the normal operation of the instrument.
8. Please do not modify the internal parameters of the equipment without permission, so as not to cause abnormal operation of the instrument. If you need to modify, please operate under the guidance of the manufacturer's technical personnel.