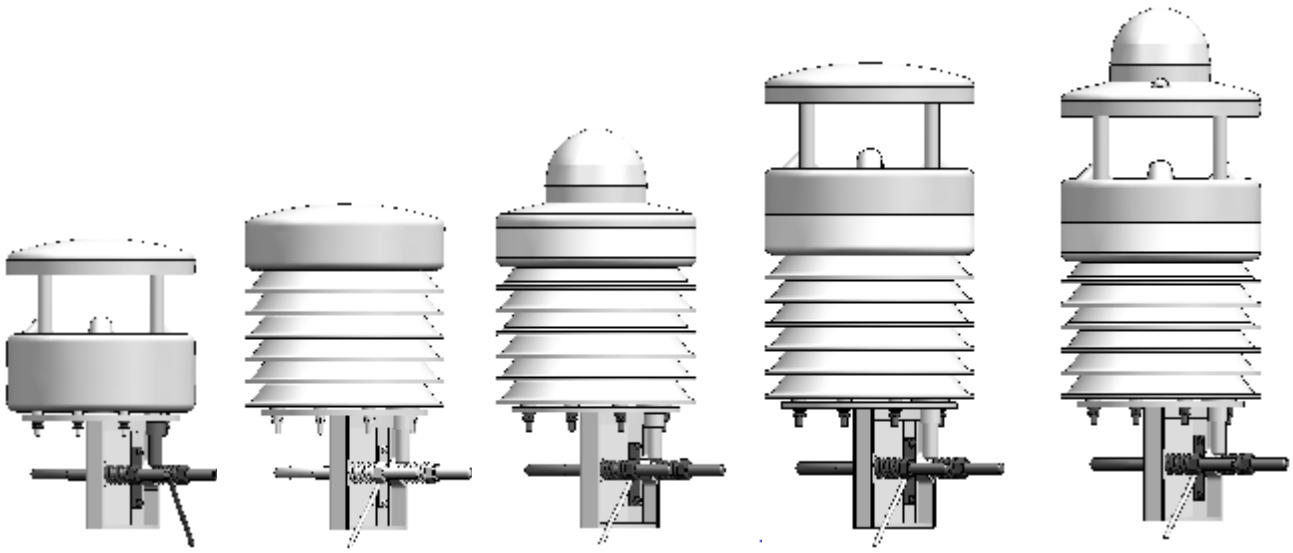
Operating Manual

Compact Weather Station

FRT FWS



Fronttech (Beijing) Limited

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Introduction：

1. This manual introduces how to use compact weather station.
2. This manual describes the installation and setup of FRT meteorological monitoring software.
3. This manual introduces the connection mode and protocol interface.

Title: Manual for FRT FWS series compact weather station

Date：2016（Version:2.5）

Contents

1 Please Read Before Use

1.1Symbols Used

Important information concerning potential hazards to the user

Important information concerning the correct operation of the equipment

1.2 Safety Instructions

- Installation and commissioning must be carried out by suitably qualified specialist personnel only.
- Never take measurements on or touch live electrical parts.
- Pay attention to the technical data and storage and operating conditions.

1.3 Designated Use

- The equipment must only be operated within the range of the specified technical data.
- The equipment must only be used under the conditions and for the purposes for which it was designed.
- The safety and operation of the equipment can no longer be guaranteed if it is modified or adapted.

1.4 Incorrect Use

If the equipment is installed incorrectly,

- It may not function.
- It may be permanently damaged.
- Danger of injury may exist if the equipment is allowed to fall.

If the equipment is not connected correctly,

- It may not function.
- It may be permanently damaged.
- The possibility of an electrical shock may exist.

1.5 Guarantee

The guarantee period is 12 months from the date of delivery. The guarantee is forfeited if the designated use is violated.

1.6 Brand Names

All brand names referred to are subject without limitation to the valid trademark and ownership rights of the respective owner.

2 Scope of Delivery

- Equipment
- Connection cable
- Operating manual

3 Order Numbers

No.	Model	Descriptions	Remark（RS485）
1	FWS 200	Wind direction, Wind speed	
2	FWS 300	Air temperature, Relative humidity, Air pressure	
3	FWS 400	Air temperature, Relative humidity, Air pressure, Precipitation	
4	FWS 500	Wind direction, Wind speed, Air temperature, Relative humidity, Air pressure	
5	FWS 600	Wind direction, Wind speed, Air temperature, Relative humidity, Air pressure, Precipitation	
6	FWS 700	Wind direction, Wind speed, Air temperature, Relative humidity, Air pressure, Global Radiation, Precipitation	
7	FWS 800	Wind direction, Wind speed, Air temperature, Relative humidity, Air pressure, Global Radiation, Precipitation, The UV index	

4 Equipment Description

On the basis of advanced sensor technology, the FWS series micro meteorological station integrates the main meteorological parameter, including Wind direction, Wind speed, Air temperature, Relative humidity, Air pressure and Precipitation. It can be widely used in the areas of Meteorology, Transportation, Electric power industry, Agricultural industry, Environment Field, etc.

- The advanced air temperature and humidity measurement technology in the world (precision < 0.8%RH / 0.1 K), the long-term stable humidity measurement technology.

- The precise of the Ultrasonic wind velocity and direction measurement technology can insure the industrial level stable operation.
- The relatively accurate full range of MEMS Air pressure sensor.
- Ultra-low power consumption (0.2W),especially suitable for higher power consumption requirements battery powered systems.
- The 9 ~ 35V wide supply input power range.
- The measurement data storage function (1~12Month) can ensure the integrity of measurement data.
- The High-precision clock calendar function.
- The industrial level protective casing can ensure the long-term field life for more than 10 years.
- The industrial level electrical interface protection.
- The standard data output protocol.

	FWS200	FWS300	FWS400	FWS500	FWS600	FWS700	FWS800
Air temperature		●	●	●	●	●	●
Relative humidity		●	●	●	●	●	●
Air pressure		●	●	●	●	●	●
Precipitation			●		●	●	●
Wind direction	●			●	●	●	●
Wind speed	●			●	●	●	●
Global Radiation						●	●
The UV index							●

4.1 Air Temperature and Relative Humidity

Temperature is measured by way of a highly accurate Air Chip 3000 while humidity is measured using a capacitive humidity sensor (accuracy < 0.8 % / 0.1 K). In order to keep the effects of external influences (e.g. solar radiation) as low as possible, these sensors are located in a ventilated housing with radiation protection. In contrast to conventional non-ventilated sensors, this allows significantly more accurate measurement during high radiation conditions.

Additional variables such as dew point, absolute humidity and mixing ratio are calculated from air temperature and relative humidity, taking account of air pressure.

4.2 Air Pressure

Absolute air pressure is measured by way of a built-in sensor (MEMS). The relative air pressure referenced to sea level is calculated using the barometric formula with the aid of the local altitude, which is user-configurable on the equipment.

4.3 Wind

The wind meter uses 4 ultrasound sensors which take cyclical measurements in all directions. The resulting wind speed and direction are calculated from the measured run-time sound differential.

4.4 Heating*

The precipitation sensor and wind meter are heated for operation in winter.

Note: The heating is designed for ambient temperatures down to -10°C, below -10°C the function cannot be ensured under all conditions.

4.5 Precipitation

The optical gauge is built on the basis of principle optics. When there are raindrops hitting the outer surface, the photosensitive member inside obtain the changes of the beam intensity. At the same time, it exports certain pulse value by the changes of beam intensity, and reflects the size of raindrops.

It can detect tiny raindrops depends on complicated circuit and digital signal processing, by filtering out the interference of ambient light. Date compensation was made if the outer surface was defaced.

Besides detecting the outer diameter size of raindrops, the monitoring sensor can also simulate tipping bucket rain gauge (accuracy range is adjustable: 0.2mm / 0.01mm / 0.001mm), but it's more sensitive than tipping bucket rain gauge, which can be monitored to 0.01mm even 0.001mm rainfall.

No moving parts, convex design can complete self-cleaning.

By emitting LED to detect the internal sensor is operating properly.

4.6 Global Radiation

Used for measuring the short-wave radiation (main wavelength: 400 ~ 1100nm), which uses a silicon light detector generates a voltage output signal proportional to the incident light. In order to reduce the cosine error, we placed a cosine corrector in

the instrument, the radiometer can be connected directly to a digital voltmeter or data acquisition, measure the radiation intensity.

4.7 The UV Index

Sense the ultraviolet A and B bands by a built-in light sensor, it can be used in ultraviolet radiation intensity gauge.

5 Measurement Parameters

Measurement parameters are transported by RS485 protocol (factory setting).

5.1 Air Temperature

- Actual temperature values: temperature value at current time.
- Average temperature: the arithmetic mean temperature value within a set period.
- Maximum temperature values: the maximum temperature within a set period.
- Minimum temperature: the minimum temperature within a set period.

Air Temperature	Measurement methods： NTC
	Measurement range： -50°C ... +80°C
	Resolution： 0.1°C
	Sensor accuracy： ± 0.2°C

5.2 Relative humidity

- Actual humidity: humidity value at current time.
- Average humidity: the arithmetic mean humidity value within a set period.
- Maximum humidity values: the maximum humidity within a set period.
- Minimum humidity: the minimum humidity within a set period.

Air Humidity	Measurement methods: Capacitive
	Measurement range: 0 ... 100% RH
	Resolution: 0.1% RH
	Sensor accuracy: 2% RH

5.3 Pressure

- Actual pressure: pressure value at current time.
- Average pressure: the arithmetic mean pressure value within a set period.
- Maximum pressure values: the maximum pressure within a set period.
- Minimum pressure: the minimum pressure within a set period.

Pressure	Measurement methods: MEMS sensor——Capacitive
	Measurement range: 10 ... 1300hPa
	Resolution: 0.1hPa
	Accuracy: ±0.3hPa*
	Unit: hPa

5.4 Wind Speed

- Actual wind speed: wind speed value at current time.
- Average wind speed: the arithmetic mean wind speed value within a set period.
- Maximum wind speed values: the maximum wind speed within a set period.
- Minimum wind speed: the minimum wind speed within a set period.

Wind Speed	Measurement methods: ultrasonic wave
	Measurement range: 0 – 75m/s
	Resolution: 0.1m/s
	Accuracy: ±0.2 m/s or 2%
	Response threshold: 0.2 m/s
	Unit: m/s； km/h

5.5 Wind Direction

- Actual wind direction: wind direction value at current time.
- Average wind direction: the arithmetic mean wind direction value within a set period.
- Maximum wind direction values: the maximum wind direction within a set period.
- Minimum wind direction: the minimum wind direction within a set period.

Wind Direction	Measurement methods: ultrasonic wave
	Measurement range: 0 – 360°
	Resolution: 0.1°
	Accuracy: < 3°, RMSE from 1.0 m / s
	Response threshold: 0.2 m/s

5.6 Precipitation Quantity

- Period Precipitation Quantity: calculate the precipitation quantity within the current transmission period.
- Day Cumulative Precipitation Quantity: Calculate the daily accumulated precipitation quantity.

Precipitation Quantity	Measurement methods: Optical Scattering Method
	Measurement range: Unlimited
	Resolution: 0.001mm /0.01mm/0.2mm
	Accuracy: Better than 3%
	Response threshold: 0.3 m/s

5.7 Global Radiation

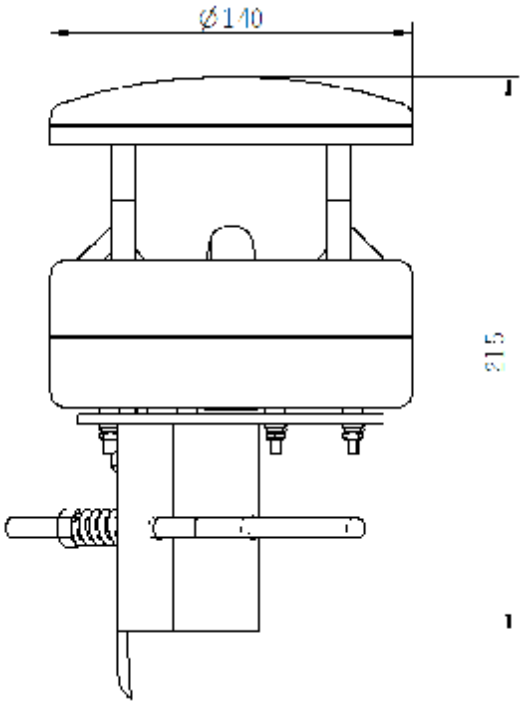
Global Radiation	Measurement methods: Silicon photo detector
	Wavelength range: 400nm～1100nm
	Measurement range: 0～2000w/m2
	Resolution: 1w/m2

	Accuracy: Better than 5%

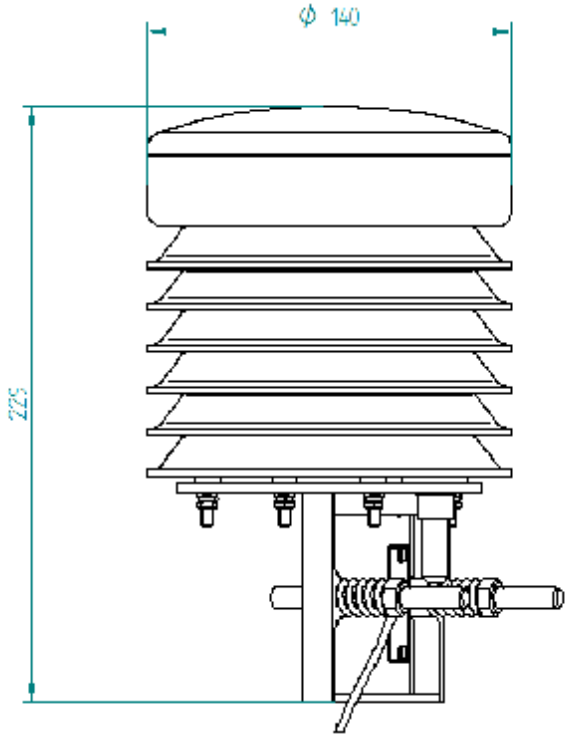
5.8 The UV Index

The UV Index	Measurement methods: Photosensitive element
	Wavelength range: 290nm～400nm
	Measurement range: 0～15 UVI

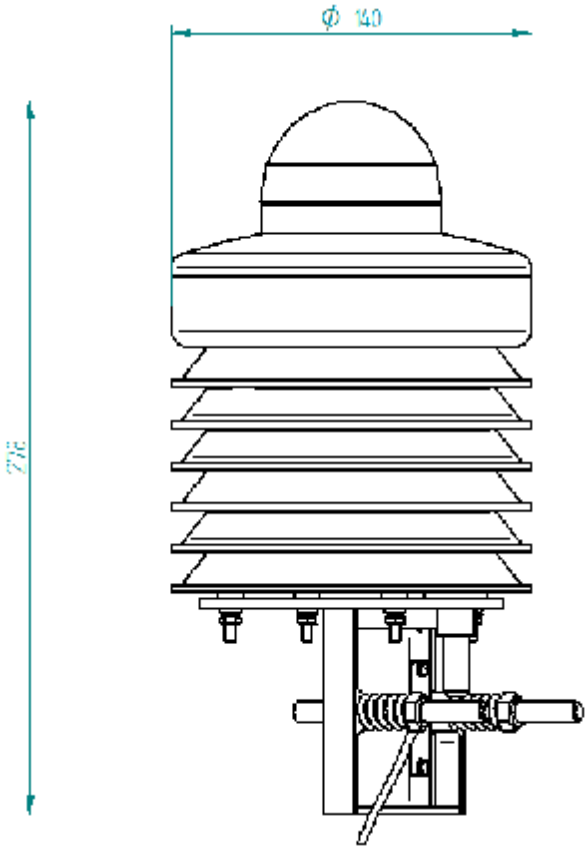
6 Installation



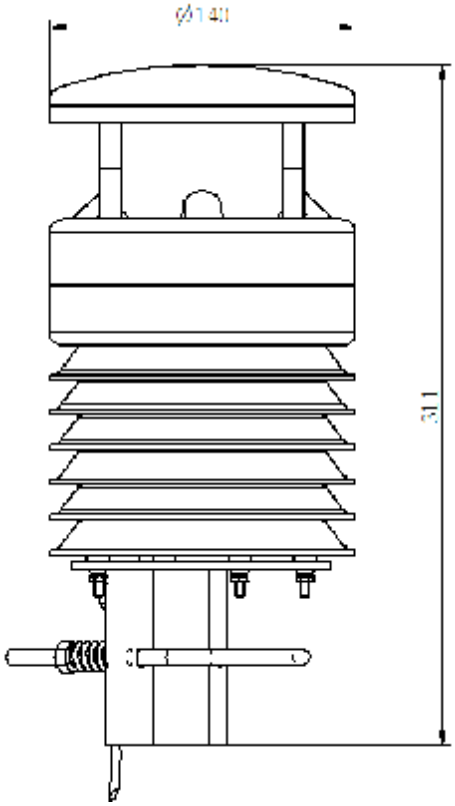
（FWS200 Size）



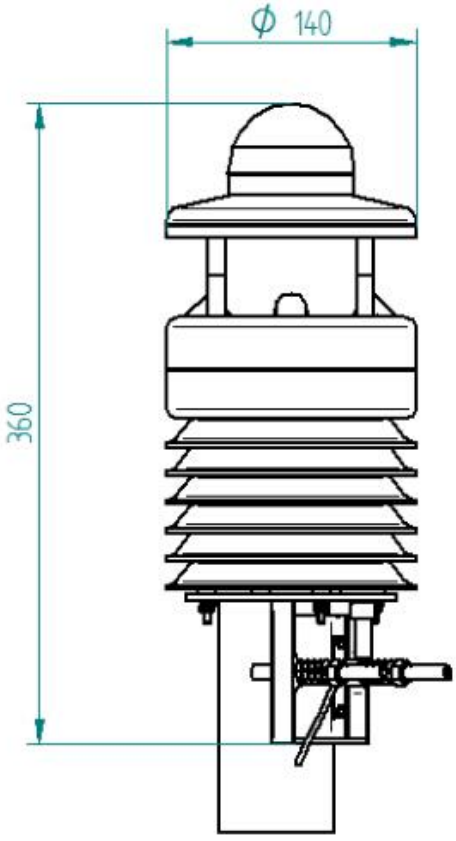
(FWS300 Size)



（FWS400 Size）



(FWS500 Size)



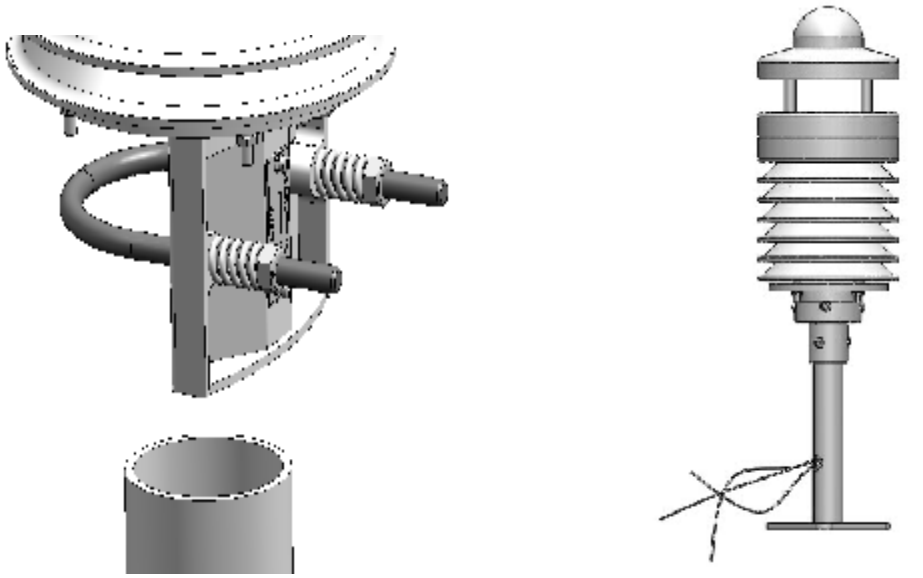
(FWS600/FWS700 Size)

The sensor bracket is designed to be installed on the top of a mast with a diameter of 60 –76mm.

The following tools are required for the installation:

- Open-end or ring spanner (SW13)
- Compass for aligning the wind meter to the

6.1 Fastening



1: Hoop-style　　2：Pinning-style

Figure 2：Fastening to the Mast

- Loosen nuts
- Push the sensor onto the top of the mast from above
- Tighten the nuts evenly until contact is made with the springs but the sensor can still be
- moved easily
- Align the sensor to the North (for wind meters)
- Tighten both nuts with 3 revolutions

6.2 North Alignment

In order for the wind direction to display correctly, the sensor must be aligned to the North. The sensor has a number of directional arrows for this purpose.

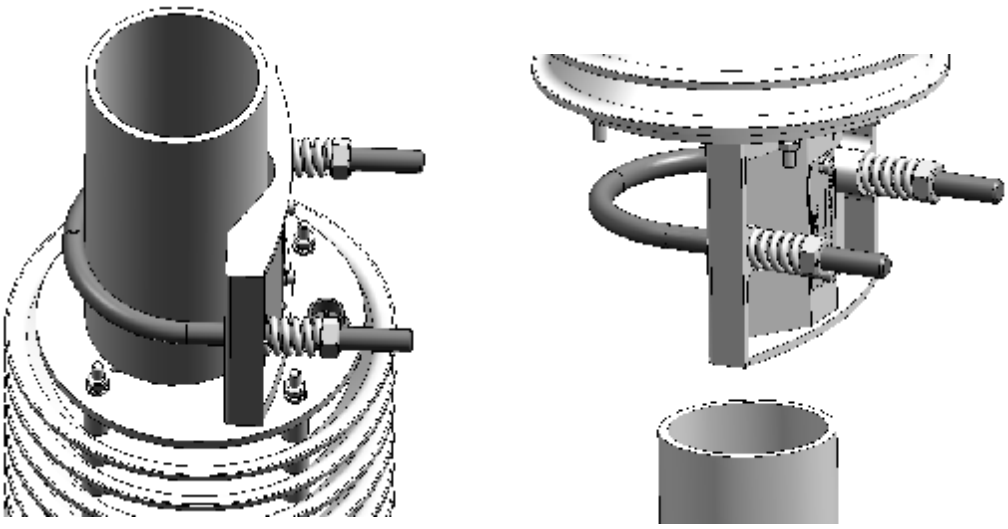


Figure 3：North Markings

Procedure:

- If the sensor is already installed, first loosen both nuts evenly until you can turn the sensor easily
- Using the compass, identify the North and fix a point of reference on the horizon
- Position the sensor in such a way that the South and North sensors are in alignment with the fixed point of reference in the North
- Tighten both nuts with 3 revolutions

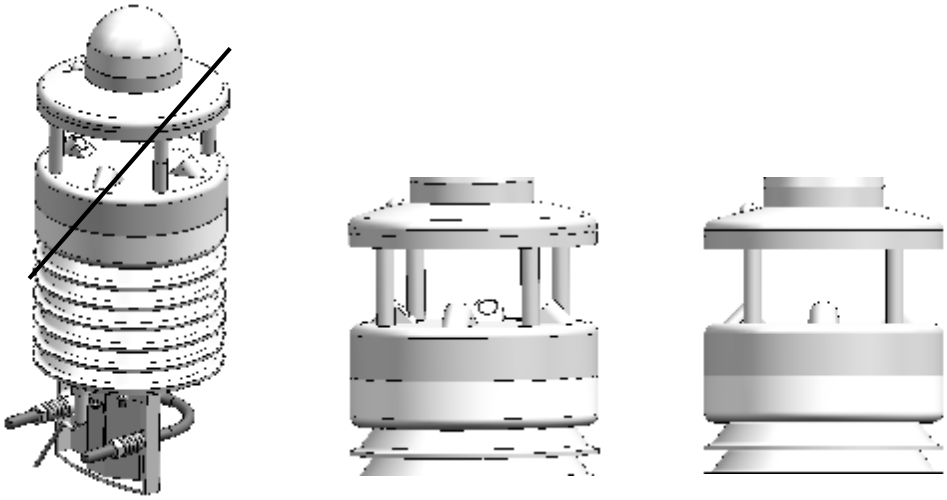


Figure 4：Alignment to North Pole

Note: As the magnetic North Pole indicated by the compass differs from the Geographic North Pole, account must be taken of the declination (variation) at the location when aligning the sensor.

Depending on the location, the variation can be more than 15° (in North America for example). In Central Europe the variation can be largely ignored at present (< 3°). You can find further helpful information on this subject on the Internet.

6.3 Selecting the Installation Location

In order to guarantee long service life and correct equipment operation, please pay attention to the following points when selecting the installation location.

6.3.1 General Instructions

- Stable subsurface for installing the mast
- Free access to the equipment for maintenance works
- Reliable power supply for permanent operation
- Good network coverage when transmitting over a mobile communications network

Note: The computed measurements specifically apply to the equipment location only. No conclusions can be drawn with regard to the wider environment or a complete road section.

ATTENTION:

- Only approved and tested appliances (conductors, risers etc.) should be used to install the device on the mast.
- All relevant regulations for working at this height must be observed.
- The mast must be sized and anchored appropriately.
- The mast must be earthed in accordance with regulations.
- The corresponding safety regulations for working at road side and in the vicinity of the road carriageway must be observed.

If the equipment is installed incorrectly

- It may not function.

- It may be permanently damaged.
- Danger of injury may exist if the equipment is allowed to fall.

6.3.2 Sensors with Wind Measurement

- Installation at the top of the mast
- Installation height at least 2m above the ground
- Free field around the sensor

Note: Buildings, bridges, embankments and trees may corrupt the wind measurement.
Equally, passing traffic may cause gusts which may influence the wind measurement.

6.3.3 Installation Sketch

7 Connections

There is an 8 pole screw connector on the underside of the equipment. This serves to connect the supply voltage and interfaces by way of the supplied connection cable.

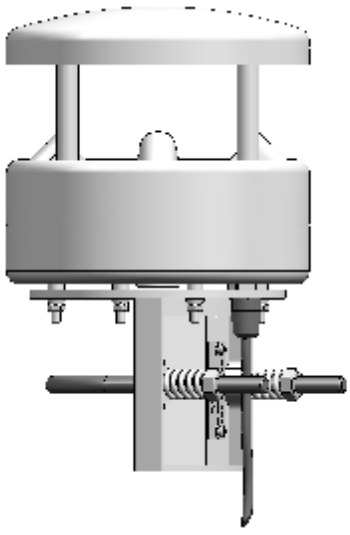
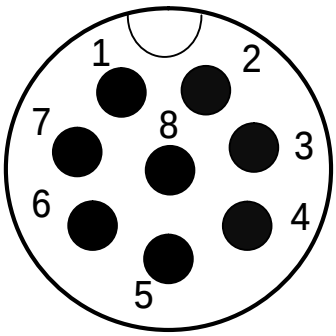
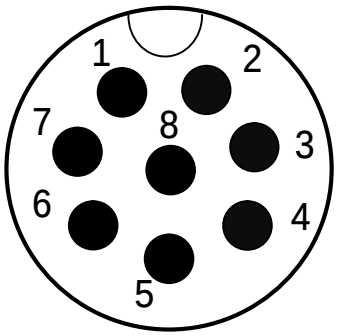


Figure 5: Connection



Pin assignment:
1 Red Positive heating voltage
2 Black Negative heating voltage
3 Yellow RS485_A
4 Blue RS485_B
5 Unassigned
6 Unassigned
The cable marking is in accordance with DIN 47100.

Mode 1 View on sensor connection



Pin assignment:
1 Red Positive heating voltage
2 Black Negative heating voltage
3 Yellow RS485_A
4 Blue RS485_B

Mode 2 View on sensor connection

Note: The protective cap must be removed before plugging in the equipment.（When applicable）
If the equipment is not connected correctly
- It may not function
- It may be permanently damaged
- The possibility of an electrical shock may exist

7.1 Supply Voltage

The supply voltage for the compact weather station is 12 - 24V DC. The power supply unit used must be approved for operation with equipment of protection class III (SELV).

Note: A heating voltage of 24V DC is recommended to guarantee full heating duty. If the heating is operated on 12V DC, account must be taken of the functional restrictions in winter operation.

7.2 RS485 Interface

The equipment has an electrically isolated, half-duplex, 2 wire RS485 interface for configuration, measurement polling and the firmware update.

8 Maintenance

In principle the equipment is maintenance-free.

However, it is recommended to carry out a functional test on an annual basis. When doing so, pay attention to the following points:

- Visual inspection of the equipment for soiling
- Check the sensors by carrying out a measurement request

In addition, an annual calibration check by the manufacturer is recommended for the humidity sensor (not on WS200-UMB). It is not possible to remove or replace the humidity sensor. The complete compact weather station must be sent to the manufacturer for testing.

9 Technical Data

Power supply: 12 - 24VDC +/- 10%
Current consumption and power input - sensor:

FRT	FWS200	When12VDC,ca. 20mA
FRT	FWS300	When12VDC,ca. 15mA
FRT	FWS400	When12VDC,ca. 20mA
FRT	FWS500	When12VDC,ca. 25mA
FRT	FWS600	When12VDC,ca. 30mA
FRT	FWS700	When12VDC,ca. 30mA
FRT	FWS800	When12VDC,ca. 30mA

Dimensions including mounting bracket:

FRT	FWS200	Ø 140mm, height215mm
FRT	FWS300	Ø 140mm, height230mm
FRT	FWS400	Ø 140mm, height230mm
FRT	FWS500	Ø 140mm, height311mm
FRT	FWS600	Ø 140mm, height360mm
FRT	FWS700	Ø 140mm, height360mm

FRT FWS800 Ø 140mm, height360mm

Weight including mounting bracket, excluding connection cable:

FRT	WS200 ca. 0.8 kg
FRT	WS300 ca. 1.0 kg
FRT	WS400 ca. 1.3 kg
FRT	WS500 ca. 1.2 kg
FRT	WS600 ca. 1.5 kg
FRT	WS700 ca. 1.5 kg
FRT	WS800 ca. 1.5 kg

Fastening: Stainless steel mast bracket for Ø 60 - 76mm
Protection class: III (SELV)
Protection type: IP64

Storage Conditions
Permissible storage temperature: -50°C ... +85°C
Permissible relative humidity: 0～100% RH

Operating Conditions
Permissible operating temperature: -50°C ... +85°C
Permissible relative humidity: 0 ... 100% RH
Permissible altitude above sea level: N/A

RS485 interface, 2 wire, half-duplex
Data bits: 8 (SDI-12 mode: 7)
Stop bit: 1
Parity: No (SDI-12 mode: even, Modbus mode none or even)
Tri-state: 2 bits after stop bit edge
Adjustable baud rates: 1200, 2400, 4800, 9600, 14400, 19200, 28800, 57600
(In SDI-12 mode, the interface is changed to meet the requirements of the standard.)
Housing: Plastic (PC)

10 Fault Description

Error description	**Cause - Remedy**
Device does not allow polling / does not respond	- Check power supply - Check interface connection - Incorrect device ID **à** check ID;

11 Repair / Corrective Maintenance

Please arrange for any faulty equipment to be checked and, if necessary, repaired by the manufacturer exclusively. Do not open the equipment and do not under any circumstances attempt to carry out your own repairs.

In matters of guarantee or repair please contact:

Fronttech (Beijing) Limited

Hot line: 4006-900-516

Phone: 010-62698418 010-62698498

Sales@fronttech.com.cn

or your local distributor.

Appendix 1:FWS Protocol

1 Serial Communication Command

1.1Checking the Current Communication Settings(aXU)

With this command you can request the current communication settings, protocol and reporting elements.

Command Format: aXU<cr><lf>

Command Parameter:

where

a = Device address, which may consist of the following characters:0（default）…9,A…Z, a…z;

XU = Serial Communication Command Settings;

<cr><lf> = Command terminator.

NOTE: <cr> is 0x0d, <lf> is 0x0a

Command Frame Structure:

Device address	Command Type（XU）	0xd	0xa
1 byte	2 bytes	1 byte	1 byte

The response to the command:

aXU,A=a,M=[M],T=[T],C=[C],I=[I],B=[B],D=[D],P=[P],S=[S],L=[L],N=[N],V=[V]<cr><lf>

The response message parameter:

a = Device address;

XU = Serial communication command settings;

[A] = Device address: 0（default）…9,A…Z,a…z;

[M] = Communication protocol;

A=Automatic;

A=Automatic with Vaisala WXT520 protocol;

P=Polled;

p=Polled with Vaisala WXT520 protocol;

[T] = Test parameter: 0; Currently used (reserved);

[C] = Serial interface: 1=RS-232(reserved); 2=RS-485;

[I] = Automatic repeat interval for composite data message: 1… 3600s;

[B] = Baud rate:2400，4800，9600，19200(default)，38400;

[D] = Data bits:8（default）or9;

[P] = Parity: O=Odd, E=Even, N=None;

[S] = Stop bits: 1(default) or 2;

[L] = Line delay:0～1000ms; 0(default);

Effective when RS-485 is selected;

[N] = Name of the device: 5 characters;

[V] = Software version: 10 characters;

<cr><lf> = Response terminator(0x0d 0x0a).

NOTE: [I] demonstrates that the update time which is the automatic repeat interval for aR0 composite data message.

Example:

The software layer command: 0XU<cr><lf>

The hardware layer response:

0XU,A=0,M=P,T=0,C=2,I=0010,B=019200,D=8,P=N,S=1,L=00025,

N=ga306, V=v02.00.001<cr><lf>

1.2Changing the Communication Settings(aXU)

Make the desired settings with the following command. Select the correct value/letter for the setting fields, see the Command Parameter.

Command Format: aXU, A=x, M=x, T=x, C=x, I=x, B=x, D=x, P=x, S=x, L=x<cr><lf>

Command Parameter:

A,M,T,C,I,B,D,P,S,L=The communication setting fields;

x=Input value for the setting;

<cr><lf>=Command terminator.

Example:

Changing the device address from 0 to 1; polled communication protocol and baud settings 9600 with automatic protocol.

Checking the actual settings:

0XU, A=1,M=A,B=9600<cr><lf>

Note: You can change several parameters in the same command as long as the command length does not exceed 20 bytes (including ","and "=").

1.3 Checking the Modbus protocol command （aMB）

With this command you can request the current communication settings of Modbus.

Command format: aMB<cr><lf>

Command parameter:

a = Device address: 0（default）…9,A…Z,a…z;

MB = Device settings command in Modbus;

<cr><lf> = Command terminator.

NOTE: <cr> is 0x0d, <lf> is 0x0a

Command Frame Structure:

Device address	Command Type （MB）	0xd	0xa
1 byte	2 bytes	1 byte	1 byte

The response to the command:

Amb, P= [P] <cr><lf>

The response message parameter：

a = Device address;

MB = Communication command settings;

[P] = Protocol type: 0= ASCII (default); 1=Modbus;

<cr><lf> = Command terminator(0x0d 0x0a).

NOTE: Setting the protocol Modbus, the ASCII protocol goes uneffective and the default address is 0x30.

Example:

The software layer command: 0MB<cr><lf>

The hardware layer response:

0MB, P=0<cr><lf>

1.4 Changing the Modbus Communication Settings（aMB）

Make the desired settings with the following command. Select the correct value/letter for the setting fields, see the Modbus Command Parameter.

Command format: aMB, P=x<cr><lf>

Command parameter: P = The communication setting fields;

x= Input value for the setting;

<cr><lf>=Command terminator.

2Getting the Data Messages

The parameter order in messages is as follows:

Wind: Dn、Dm、Dx、Sn、Sm、Sx

PTU: Ta、Tp、Ua、Pa

Rain: Rc、Rd、Ri、Rp

Radiation： Sr

Ultraviolet： Uv

The order of the parameters is fixed, but you can exclude any parameter from the list when configuring the transmitter.

3Abbreviations and Units

Abbreviations and units

Abbreviation	Name	Unit
Sn	Wind speed minimum	m/s, km/h
Sm	Wind speed average	m/s, km/h

Sx	Wind speed maximum	m/s, km/h
Dn	Wind direction minimum	deg
Dm	Wind direction average	deg
Dx	Wind direction maximum	deg
Pa	Air pressure	hPa, Pa, bar
Ta	Air temperature	^{o}C, ^{o}F
Tp	Internal temperature	^{o}C, ^{o}F
Ua	Relative humidity	%RH
Rc	Rain accumulation	mm
Rd	Rain duration	s
Ri	Rain intensity	mm/h
Rp	Rain peak intensity	mm/h
Sr	Global radiation	W/m2
Uv	UV index	I(level)

4General Commands

4.1Reset(aXZ)

This command is used to perform software reset on the device.

Command format: aXZ<cr><lf>

Command parameter:

a = Device address;

XZ = Reset command;

<cr><lf> = Command terminator.

4.2Device Address（?）

This command is used to query the address of the device on the bus.

The response to the command: ?<cr><lf>

The response message parameter：

? = Device address query command;

<cr><lf> = Command terminator.

The software layer command: b<cr><lf>

The hardware layer response:

b = Device address（default=0）;

<cr><lf> = Response terminator.

Example: The software layer command: ?<cr><lf>

The hardware layer response: 0<cr><lf>

If you need to change the device address, see 1.1.

4.3Acknowledge Active Command(a)

This command is used to ensure that a device is responding to a data recorder or another device. It asks a device to acknowledge its presence on the bus.

Command format: a<cr><lf>

Command parameter:

a = Device address;

<cr><lf> = Command terminator.

The response to the command: a<cr><lf>

The response message parameter：

a = Device address;

<cr><lf> = Response terminator.

4.4Wind Data Message（aR1）

With this command you can request the wind data message.

Command format: aR1<cr><lf>

Command parameter:

a = Device address;

R1 = Wind message query command;

<cr><lf> = Command terminator.

Example of the response(the parameter set is configurable. The default parameter: Dn,Dm,Dx,Sn,Sm,Sx)

0R1, Dn=x,Dm=x,Dx=x,Sn=x,Sm=x,Sx=x<cr><lf>

The response message parameters：

a	=	Device address;
R1	=	Wind message query command;
Dn	=	Wind direction minimum;
Dm	=	Wind direction average;
Dx	=	Wind direction maximum;
Sn	=	Wind speed minimum;
Sm	=	Wind speed average;
Sx	=	Wind speed maximum;
<cr><lf>	=	Response terminator.

In the message, letters like Dn occupy 2 bytes. To change the parameters and units in the response message and to make other sensor settings, see 5.1.2.

NOTE: Dn, Dm, Dx: rounding numbers.

Sn, Sm, Sx: 1 decimal places.

4.5Pressure,Temperature and Humidity Data Message（aR2）

With this command you can request a pressure, temperature and humidity data message.

Command format: aR2<cr><lf>

Command parameter:

a	=	Device address;
R2	=	Pressure, temperature and humidity message query command;
<cr><lf>	=	Command terminator.

Example of the response:

0R2, Ta=023.6,Tp=024.5,Ua=014.2,Pa=001026.6<cr><lf>

The response message parameter：

0	=	Device address;
R2	=	Pressure, temperature and humidity query command;

Ta	=	Air temperature（C = ^{o}C）;
Tp	=	Internal temperature（C = ^{o}C）;
Ua	=	Relative humidity（P = %RH）;
Pa	=	Air pressure（H = hPa）;
<cr><lf>	=	Response terminator.

To change the parameters and units in the response message and to make other sensor settings, see 5.2.2.

NOTE:Whether the four measurement exist depends on the factor working alone of the Air pressure,Temperature and Humidity command frame structure.

4.6Precipition Data Message（aR3）

With this command you can request the precipitation data message.

Command format: aR3<cr><lf>

Command parameter:

a	=	Device address;
R3	=	Precipitation message query command;
<cr><lf>	=	Command terminator.

Example of the response:

0R3, Rc=0004.2M,Rd=0021S,Ri=00014.2M,Rp=00014.2M<cr><lf>

The response message parameter：

0	=	Device address;
R3	=	Precipitation message query command;
Rc	=	Rain accumulation（M= mm）;
Rd	=	Rain duration（S = s）;
Ri	=	Rain intensity（M = mm/h）;
Rp	=	Rain peak intensity（M = mm/h）;
<cr><lf>	=	Response terminator.

To change the parameters or the units in the response message and to make other precipitation sensor settings, see 5.3.1.

NOTE:Whether the four measurement exist depends on the factor working alone of the Rain accumulation sensor command frame structure.

4.7Optical Radiation Data Message（aR4）

With this command you can request the optical radiation data message.

Command format: aR4<cr><lf>

Command parameter:

a	=	Device address;
R4	=	Optical radiation query command;
<cr><lf>	=	Response terminator.

Example of the response:

0R4, Sr=0001.5W<cr><lf>

The response message parameter:

0	=	Device address;
R4	=	Optical radiation query command;
Sr	=	Optical radiation intensity（W = W/m2）;
<cr><lf>	=	Response terminator.

4.8UV intensity Data Message（aR5）

With this command you can request the UV intensity message.

Command format: aR5<cr><lf>

Command parameter:

a	=	Device address;
R5	=	UV intensity query command;
<cr><lf>	=	Response terminator.

Example of the response:

0R5, Uv=01I<cr><lf>

The response message parameters:

0	=	Device address;

R5 = UV intensity query command;

Uv = UV intensity level(I);

<cr><lf> = Response terminator.

4.9Combined Data Message(aR)

With this command you can request all the individual messages aR1(Wind), aR2(Air, Temperature and Humidity) with just one command.

Command format: aR<cr><lf>

Command parameter:

a = Device address;

R = Combined Data Message;

<cr><lf> = Command terminator.

Example of the response:

The input command: aR<cr><lf>

The response command:

0R1,Dm=270D,Sm=001.0M<cr><lf>
(This command occupies 23 bytes. D is the currently wind direction unit setting, and M is the currently wind speed unit setting.)

0R2, Ta=023.6C,Ua=014.2P,Pa=001026.6H<cr><lf>

0R3, Rc=0014.2M<cr><lf>

0R4, Sr=0001.5W<cr><lf>

0R5, Uv=03I<cr><lf>

4.10Composite Data Message Query(aR0)

This command is used to request a combined data message with user configurable set of wind, pressure, temperature, humidity, precipitation and supervisor data. The parameter which the message carry may be inconsistent with aR1.Specificly see the wind speed sensor, air pressure, temperature and humidity settings.

Command format: aR0<cr><lf>

Command parameter:

a = Device address;

R0 = Composite data message query command;

<cr><lf> = Command terminator.

Example of the response: (The measurement data carried in the message can configure the parameter carried in the report via from the configuration command of aWU、aTU、aRU、aYU、aUV.)

0R0, Dx=305D, Sx=002.8M, Ta=024.5C, Ua=014.8P, Rc=0014, Sr=0001.5W, Uv=03I<cr><lf>

Appendix2: Compatible with WXT520 protocol

First,we should set ‘M’ as ‘a’ (compatible with WXT520 protocol automatic mode),or ‘p’(compatible with WXT520 protocol polled mode) via from the communication checking setting command(aXU) in the appendix 1.

Data Frame Format:

WXT520 I-frame weather element consists of 3-second wind direction average, 3-second wind speed average,temperature,air pressure,rain accumulation,and rain intensity. Every element takes ‘,’ as a separator.

The I-frame ASCII format table is as follows:

Name	Identifier	Unit Identifier	Data Area	Output Resolution	Example
Frame Header	0r0				0r0
Separator	,				,
3-second wind direction average	Dm	D	0-360 Radian	1 Radian	Dm=257D
Separator	,				,
3-second wind speed average	Sm	M	0-60 m/s	0.1 m/s	Sm=0.1M
Separator	,				,
Temperature	Ta	C	-52 - + 60	0.1 centigrade	Ta=20.7C
Separator	,				,
Air Pressure	Pa	H	600 - 1100	0.1hPa	Pa=1018.2H
Separator	,				,
Rain Accumulation	Rc	M	0- 655.35	0.01mm	Rc=0.01M
Separator		,			,
Rain Intensity	Ri	M	0-200mm/h	0.1mm/h	Ri=0.0M
CRC-Computation	The value that participate in the CRC-Computation				JMF

value	operation is from 0R0 to Rain Intensity.				
Frame End	<cr><lf>				/r/n

Example:

0r0,Dm=257D,Sm=0.1M,Ta=20.7C,Pa=1018.2H,Rc=0.00M,Ri=0.0MJMF/r/n

The yellow is the data which participate in the CRC-Computation. The red is the CRC-Computation value, and the grey is the frame end.

NOTE: The I-Frame content is in the form of ASCII, and case sensitive. Every element takes ',' as separator. The CRC-Computation comes after the Rain Intensity.

CRC-Computation

The CRC character consists of three ASCII characters. All operations are assumed to be on 16 bit CRC-Computation value.

The algorithm is:

```
{
                    WORD wCrc;
   Char cCrc1, cCrc2, cCrc3;
                        wCrc = 0;
    for (0 to n) //For each character beginning with the address, up to but not including the carriage return <CR> and 3-byte CRC-Computation value.
   {
        wCrc = wCrc ^Hollerith value;
        for (count = 1; count < 8; count++)
      {
        if (wCrc &0x01)
          {
            wCrc = wCrc >>1;
            wCrc = wCrc ^0Xa001;
          }
       else
          {
            wCrc = wCrc >>1;
          }
      }
   }
   cCrc1 = 0x40|( wCrc>>12);
   cCrc2 = 0x40|(( wCrc>>6)&0x3F);
   cCrc3 = 0x40|( wCrc&0x3f);
}
```

Appendix3:Modbus protocol

First, it should pass through the Modbus protocol check command:
Amb, P=1 <cr><lf>
Then, it should fit the Modbus standard protocol specification, specificly see introduction about Modbus protocol.
The collector has two kinds of function code: 0x03-read register 0x10-write register.
Instruction of the read register is as follows (Hexadecimal):

Address code	Function code	The high byte of the starting address	The low byte of the starting byte	The high byte of the register number	The low byte of the register number	The low byte of the CRC-Computation code	The high byte of the CRC-Computation code
01	03	00	00	00	04		

Among them, Address code shows the address of the collector; the starting code shows the starting address of the read register; the number of the register shows the number of the register which need be read.

Instruction of the write register are as follows（Hexadecimal）: set the sampling interval

Address code	Function code	The high byte of the starting address	The low byte of the starting byte	The high byte of the register number	The low byte of the register number	The number of bytes	The high byte of the register data
01	10	00	09	00	01	02	00

The low byte of the register	The low byte of the CRC-Computation code	The high byte of the CRC-Computation code					

data							
01							

◆Check time and register state（Hexadecimal）：01030000000F05CE

ASK

Address code	1 byte	01
Function code	1 byte	03
The starting address	2 bytes	0000
The number of the register	2 bytes	000F
CRC-Computation code	2 bytes	

ANSWER

Address code	1 byte	01
Function code	1 byte	03
The number of bytes	1 byte	2*N
Register data	N*2 bytes	

N = The number of register.

The command reads the content of 20 registers. And thevalue of the wind speed and direction comes after the 12th register.

◆ Set site number（Hexadecimal）：011000080000102000226D9

ASK

Address code	1 byte	01
Function code	1 byte	10
The starting address	2 bytes	0013
The number of register	2 bytes	0001
The number of bytes	1 bytes	2*N
Register data	N*2 bytes	value

N-The number of the setting register, where N=1.

ANSWER

Address code	1 byte	01

Function code	1 byte	10
The starting address	2 bytes	0013
The number of register	2 bytes	0001

So are the other commands.

Set time: 0110000000060C000B0005000B000D003710

Modbus Register version: V2.1

1 Address: 1~100(algorism)

2 Register description:

Address	Name	Data length	Description
0	Wind direction minimum	2 bytes	Read only; Unsigned integer
1	Wind direction average	2 bytes	Read only; Unsigned integer
2	Wind direction maximum	2 bytes	Read only; Unsigned integer
3	Wind speed minimum	2 bytes	Read only; Unsigned integer; Expand ten times
4	Wind speed average	2 bytes	Read only; Unsigned integer; Expand ten times
5	Wind speed maximum	2 bytes	Read only; Unsigned integer; Expand ten times
6	Air temperature	2 bytes	Read only; Unsigned integer; Expand ten times
7	Air humidity	2 bytes	Read only; Unsigned integer; Expand ten times
8	Air pressure	2 bytes	Read only; Unsigned integer; Expand ten times
9	Rain accumulation	2 bytes	Read only; Unsigned integer; Expand ten times
10	Global radiation	2 bytes	Read only; Unsigned integer; Expand ten times
11	Ultraviolet grade	2 bytes	Read only; Unsigned integer
12	Reserved	2 bytes	
13	Reserved	2 bytes	
14	Reserved	2 bytes	
15	Reserved	2 bytes	
16	Reserved	2 bytes	
17			

18			
19			
20	Device address	2 bytes	Read-write; Default address:0x31
21	Baud rate	2 bytes	Read-write;4800、9600、19200、38400
22	Wind speed average time	2 bytes	Read-write; Unsigned integer; Unit: sec; Value:1-3600
23	Temperature and humidity update time	2 bytes	Read-write; Unsigned integer; Unit: sec; Value:1-3600;Advice:not less than 10
24	Rain accumulation supply control	2 bytes	Read-write; Unsigned integer;0=Close ;1=Open
25	Rain accumulation reset	2 bytes	Write only; 1=Reset
26	Software reset	2 bytes	Write only; 1=Reset
27	Factory reset	2 bytes	Write only; 1= Factory reset
28	Set protocol	2 bytes	Write only; 0=ASCII protocol;1= Modbus protocol
29			
30			
31			
32			
33			

3 Data register: Algorism is the current system data.

4 Supply voltage:

Algorism: Such as 168, which shows that voltage is 16.8 V.

5 Default communication interface:

Serial baud rate: 19200

Start bit: 1

Stop bit: 1

Data bit: 8

Parity bit: NONE