HONGYUV

HY-WDS2E

Ultrasonic Wind Speed & Direction Sensor

Operating Manual

1 FOREWARD

Thank you for purchasing ultrasonic anemometer manufactured by Hongyuv. This device without moving parts, free of maintenance and calibration on site. To achieve optimum performance we recommend that you read the whole of this manual before proceeding with use.

Hongyuv products are in continuous development and therefore specifications may be subject to change.

2 INTRODUCTION

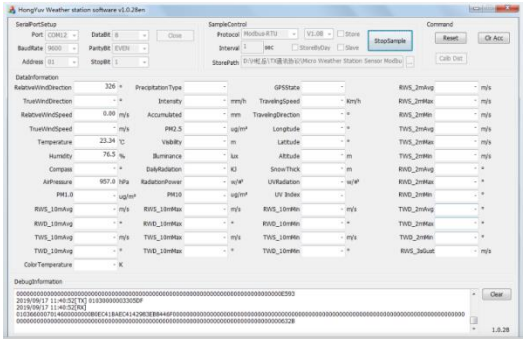
HY-WDS2E ultrasonic anemometer has advantage of light weigh, robust,no moving parts, free of maintenance and calibration on site, simultaneously output wind speed and direction.

HY-WDS2E can be used in conjunction with a PC, data logger or other device, which has compatible communication protocol with it.

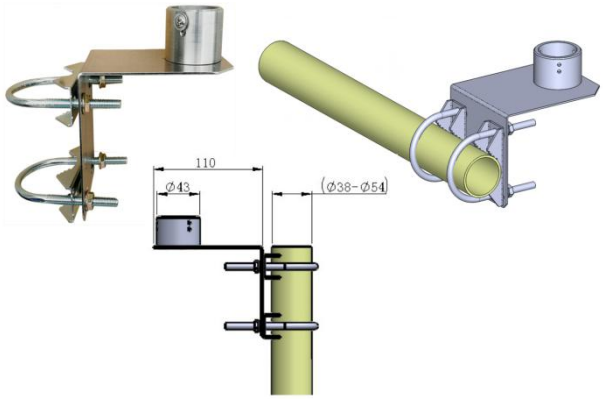
HY-WDS2E can integrate optional modules to meet customers' requirement without changing its appearance. Such as adding barometric pressure sensor to measure air pressure, or adding 3D module to measure vertical or horizontal amplitude of vibration.

The following options are available:

I. Windows XP/WIN7 based testing software which only support MODUBUS protocol($0)



II.Mounting kits($25)

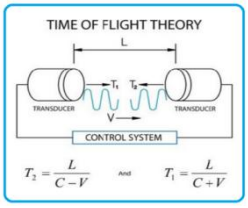


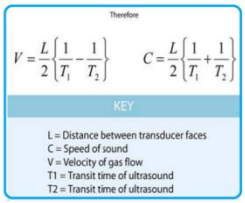
III. One meter USB to RS-232/RS-485 converter Cable ($25)

3 Working Principle

Measure the transmission time of ultrasonic sensors from sensor N to sensor S, and compare with the transmission time of sensor S to sensor N. Similarly, compare the time of W to E and E to W time. (N = north, S = south, E = east, W = west)

For example, if the wind blew from the north, time of ultrasonic from N to S will be shorter than from S to N, and transmission time of it from W to E and E to W is the same. Through calculating the time difference of ultrasonic transmission between two points, the wind speed and direction can be calculated. This calculation method has nothing to do with other factors such as temperature.





4 Technical Specification

Wind speed	Range	0 - 60m/s
	Accuracy	±2%
	Resolution	0.01m/s
	Unit	m/s,km/h,knots,mph,ft/min (selectable)
Wing direction	Measure Range	0-359°
	intersection angle with geographic north	0-359°
	Accuracy	±3°
	Resolution	1°
Digital output	Interface	RS232/RS485/SDI-12
	Baud rate	9600(default) 1200-19200(configurable)
	Frequency	Standard: 1Hz (1 output per second) Customized:4Hz(4 outputs per second)
	protocol	ModBus-RTU/NMEA 0183/SDI-12
Analogue output (current output is optional)		Two ways 4-20mA Max.load 500Ω
Protection grade		IP65
Operating Temperature		-40℃ - +70℃
Operating Humidity		0 - 100%
Power supply		DC 5－30V
Power Consumption		5mA@12V(Heater off) 125mA@12V(Heater on)
Size/Weight		Φ144×165mm / 0.68kg
Body material		ABS

Specifications may be subject to change without prior notice.

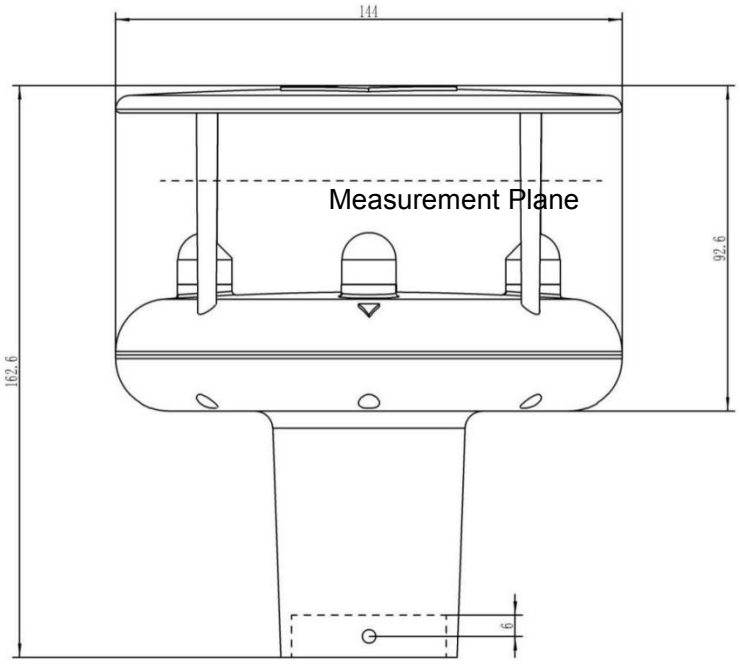
5 Packing List

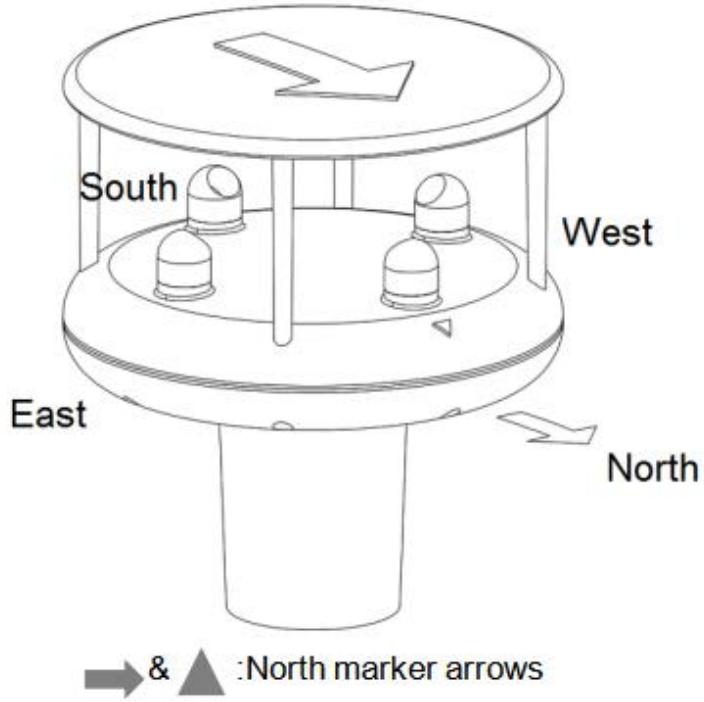
Item	Quantity
HY-WDS2E Anemometer	1 pcs
Four meters communication cable with watertight plug	1 pcs
Operating Manual	1 pcs

6 Package Notice

By keeping HY-WDS2E well positioned in ex-work package when it's being transferred to protect it from any potential damage.

7 Appearance Sketch





8 Wiring

1.Red-----Power + for anemometer 2.White--Power + for heater
3.Brown--RXD(RS232) 4.Green--TXD(RS232);DB(RS485);SDI-12
5.Yellow--DA (RS485) 6.Black---Common GND for heater and anemometer

Communication cable is six cores, connected as below

Power Supply 7-30VDC		RS485		RS232	SDI-12	Heating
Power +	GND	DA	DB/TXD	RXD	SDI-12	DC12-24V
Red	Black	Yellow	Green	Brown	Green	White

Note : Note:Final definition of cable wiring should be referred to sticker on cable.

1.Red-----Power + for anemometer

2.White--Power + for heater

3.Brown--RXD(RS232)

4.Green---TXD(RS232);DB(RS485);SDI-12

5.Yellow--DA(RS485)

6.Black---Common GND for heater and anemometer

Note:

RS232: Max. cable length:6.5 m (20 ft)

RS485: Max. cable length:1 km (3200 ft)

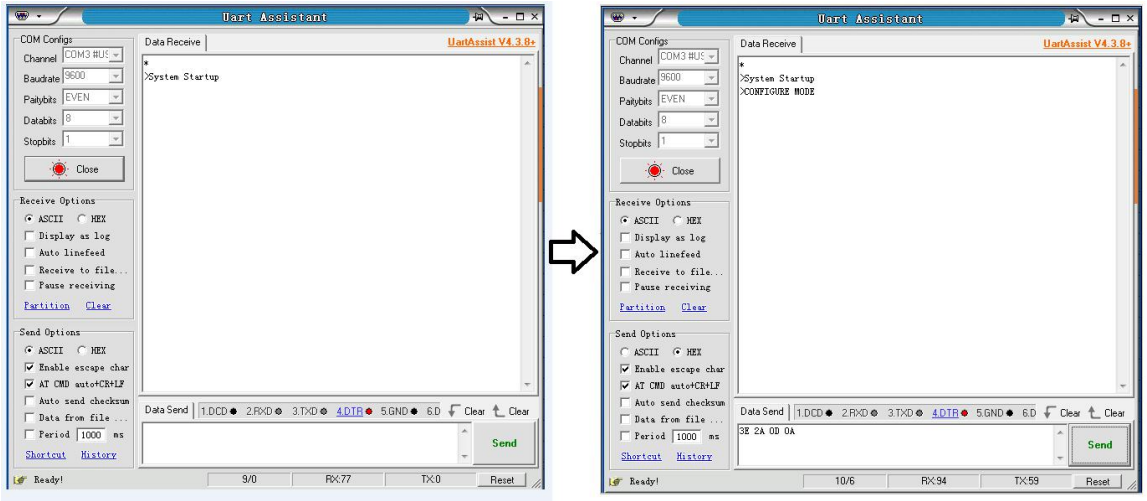
9 Procedure of confirmation of wiring and communication

3 seconds after wiring of our Device and correctly configuring serial communication tool, our instrument will output characters “>System Startup” in ASCII(0A 3E 53 79 73 74 65 6D 20 53 74 61 72 74 75 70 0D 0A in HEX), which indicate that our instrument is powered up.

We can simply test its response by inputting “enter setting mode” command “3E 2A 0D 0A”.

Our instrument will immediately respond “>CONFIGURE MODE” in ASCII(3E 43 4F 4E 46 49 47 55 52 45 20 4D 4F 44 45 0D 0A in HEX).

So far, the communication test is finished, device is proven to be communicated successfully.



Communication troubleshooting

Foreword:The most effective and efficient way to test a sensor is creating a test environment as simple as you can.

We understand that you may integrate our sensors into your systems by connecting them to your data loggers, SCM platforms, data transmission units etc.

However, we don't recommend you to test our sensors on those device at the very beginning.

The way recommended is to use an USB to RS232 or RS485 converter, and test communication and response initially.

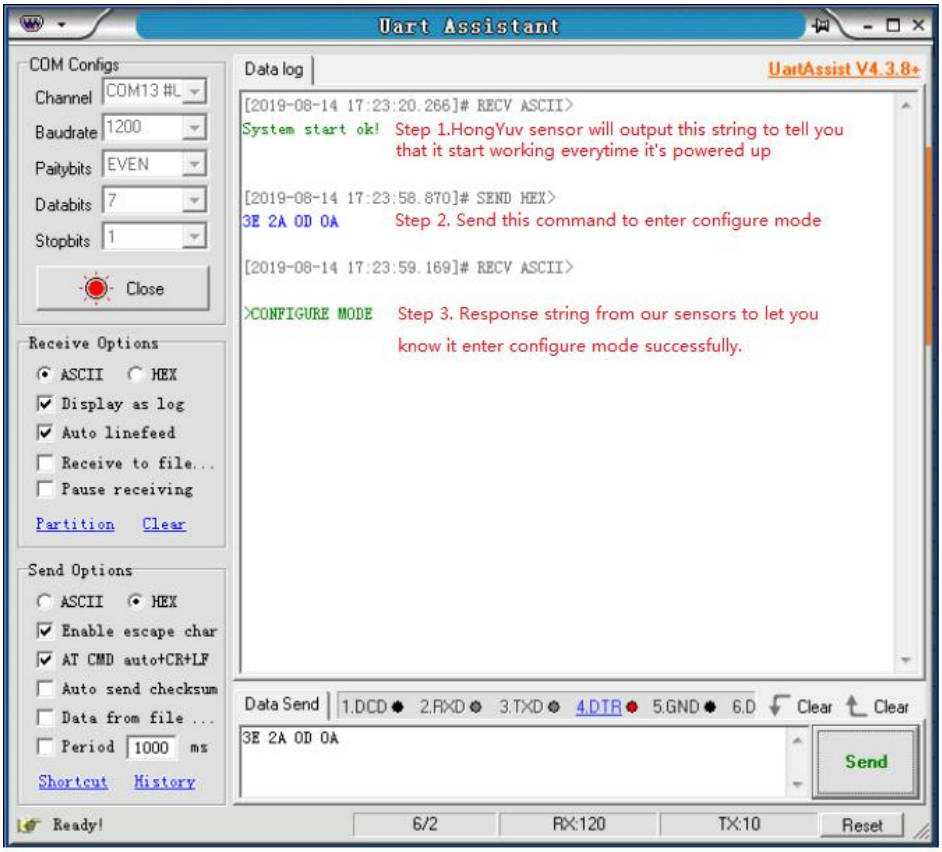
Following steps will help you understand if the sensor working or not.

Please notice that the essential precondition is correct wiring and suitable power supply.

Any under-voltage power supply will fail to turn on our sensors.

Any over-voltage power supply is harmful and can cause irreversible damage to our products.

Step 1~3 as below.



If Step 1 return gibberish. Please swap data cable DA/DB or TXD/RXD or re-confirm configuration of serial port

If Step 1 has correct response, but Step 3 has none response. Please check if you wrongly wire communication cable, it indicate that you can receive from sensor, but sensor didn't receive your command.

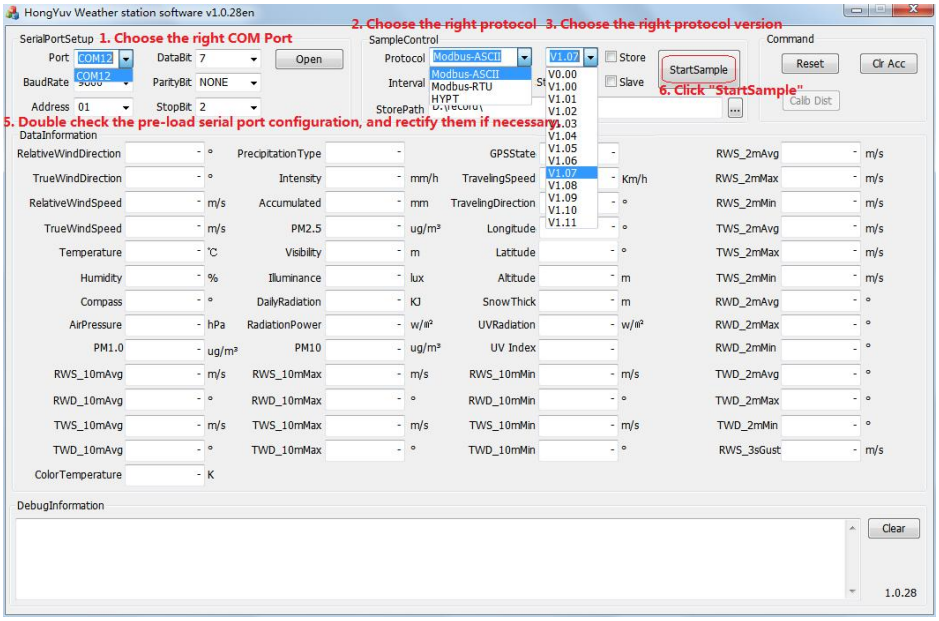
When the number of register you inquiry exceed existing registers within our sensor. Following Error Code will be responded: 01834181 or 0183030131

Passing Step 1~3 means that communication test goes well, now you can move to next step, we have a free software that workable on Window XP, WIN 7 for you on next page.

For continuous monitoring or testing, please download our MODBUS software at: https://drive.google.com/file/d/1rIRxGtBkUb-S92mXKFbkweZ2CiIgzk3M/view

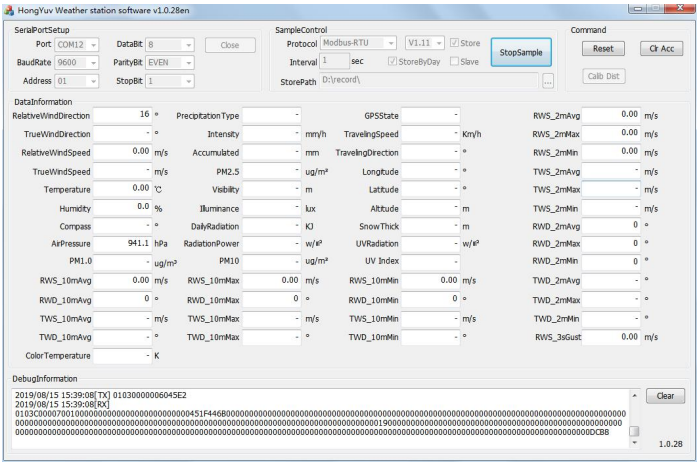
NMEA0183 software at: https://drive.google.com/file/d/1ErXZFDejh-zGukGquy70Fe87GqawdVCE/view

It request computer to install Net Framework version above 4.0.Link below on Microsoft Website: https://dotnet.microsoft.com/download/dotnet-framework/net472

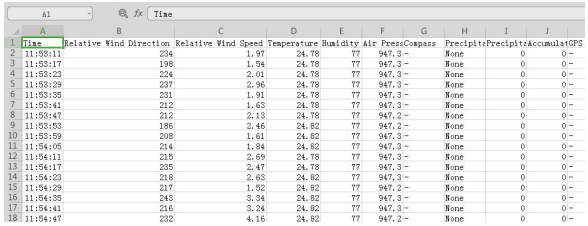


Notice: Select “Store” to activate record function(one *.csv file per hour); Select “StoreByDay” will make it store file per day.Select “Slave” will enable software to start recognize and record comprehensible data come from COM Port.

Sampling interval is configurable.



Stored *.csv file looks as below.



Time	Relative Wind Direction	Relative Wind Speed	Temperature	Humidity	Air Press	Compass	Precipits	Precipits	Accumulat	GPS
11:53:11	234	1.97	24.78	77	947.3	-	None	0	0	-
11:53:17	198	1.54	24.78	77	947.3	-	None	0	0	-
11:53:23	224	2.01	24.78	77	947.3	-	None	0	0	-
11:53:29	237	2.96	24.78	77	947.3	-	None	0	0	-
11:53:35	231	1.91	24.78	77	947.3	-	None	0	0	-
11:53:41	212	1.63	24.78	77	947.3	-	None	0	0	-
11:53:47	212	2.13	24.78	77	947.2	-	None	0	0	-
11:53:53	186	2.46	24.82	77	947.2	-	None	0	0	-
11:53:59	208	1.61	24.82	77	947.3	-	None	0	0	-
11:54:05	214	1.84	24.82	77	947.3	-	None	0	0	-
11:54:11	215	2.69	24.78	77	947.3	-	None	0	0	-
11:54:17	235	2.47	24.78	77	947.3	-	None	0	0	-
11:54:23	218	2.63	24.82	77	947.3	-	None	0	0	-
11:54:29	217	1.52	24.82	77	947.2	-	None	0	0	-
11:54:35	243	3.34	24.82	77	947.3	-	None	0	0	-
11:54:41	216	3.24	24.82	77	947.3	-	None	0	0	-
11:54:47	232	4.16	24.82	77	947.2	-	None	0	0	-

10 Installation Guidelines

The HY-WDS2E has been designed to meet and exceed the stringent standards listed in its specification. Operating in diverse environments all over the world, HY-WDS2E requires no calibration and adjustment whatsoever.

As with any sophisticated electronics, good engineering practice should be followed to ensure correct operation.

Always check the installation to ensure the HY-WDS2E is not affected by other equipment operating locally, which may not conform to current standards, e.g. radio/radar transmitters, boat engines, generators etc.

·Avoid mounting in the plane of any radar scanner – a vertical separation of at least 2m should be achieved.

·Radio transmitting antennas, the following minimum separations (all round) are suggested

VHF IMM – 1m

MF/HF – 5m

Satcom – 5m (avoid likely lines of sight)

·Use cables recommended by Hongyuv. If cables are cut and re-connected incorrectly (perhaps in a junction box) then EMC performance may be compromised if cable screen integrity is not maintained.

·Earth loops should not be created – wire the system in accordance with the installation guidelines.

· Ensure the power supply operates to the HY-WDS2E specification at all times.

· Avoid turbulence caused by surrounding structures that will affect the accuracy of the HY-WDS2E such as trees, masts and buildings. Ideally sensors should be mounted on the prevailing wind side of the site.

The WMO make the following recommendations:

The standard exposure of wind instruments over level open terrain is 10m above the ground. Open terrain is defined as an area where the distance between the sensor and any obstruction is at least 10 times the height of the obstruction.

If mounting on a building then theoretically the sensor should be mounted at a height of 1.5 times the height of the building.

If the sensor is to be mounted on a mast boom, part way up a tower or mast, then the boom should be at least twice as long as the minimum diameter or diagonal of the tower. The boom should be positioned on the prevailing wind side of the tower.

11 Mechanical Installation

11.1 Land meteorological station installation

Location:Normally,HY-WDS2E is installed on a vertical pole horizontally（refer to picture on the right side）

For indoor use, sensor can be installed anywhere to measure wind speed and direction of corresponding plane.

Orientation: orient north maker to north, then fix sensor.

Note:Use a standard compass to find correct geographic north direction then orient north marker to it.

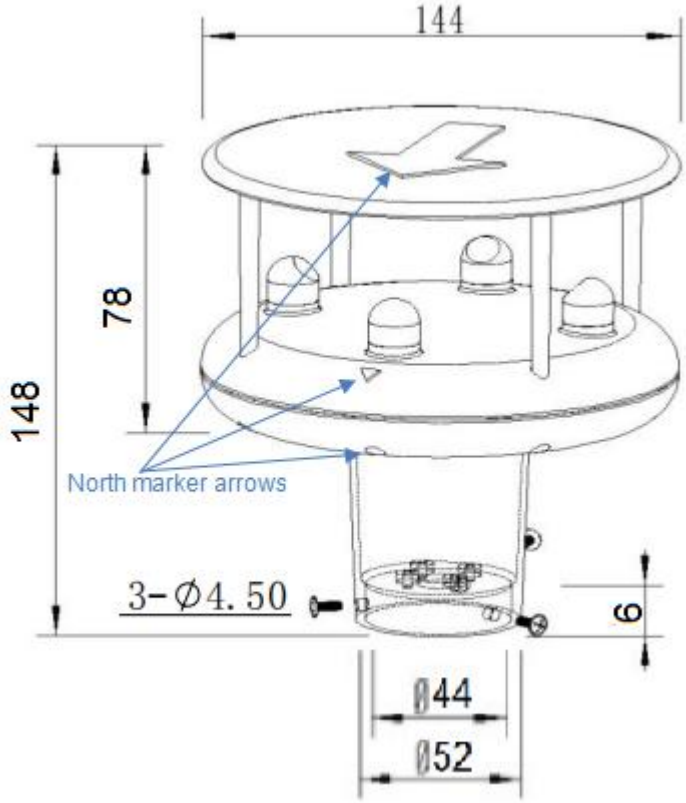
Installation: Pole should have three 3 equally spaced holes for M5 screw 7.5mm lower than top of pole,put cable(waterproof aerial plug) through pole.

Note: the user must have proper stress relief on the cable.

Turn the plug and press it gently into the socket to connect the plug to the HY-WDS2E outlet. When the plug is connected, turn the outer sleeve clockwise and lock the plug.

With 3 stainless steel screws, the HY-WDS2E can be fixed to the mounting pipe (the screw has a maximum installed torque of 4Nm)

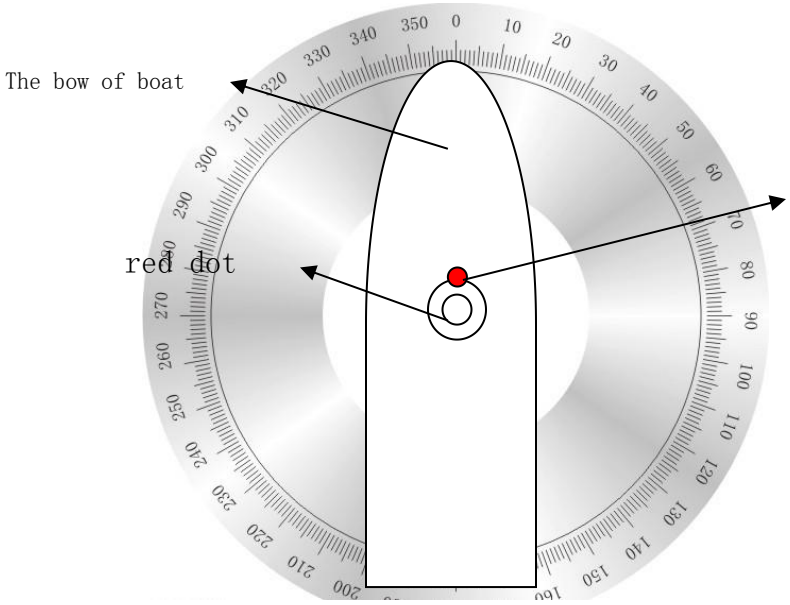
Customers must ensure that the HY-WDS2E is installed in an open area so as to avoid obstacles to airflow or turbulence in the surrounding buildings. Do not install HY-WDS2E on the side of a high power radar or radio transmitter.



11.2 Installation on a vehicle or vessel

Location:Normally,HY-WDS2E is installed on a vertical pole horizontally ensure no other things over 2 meters in the same horizontal plane to avoid obstruct the airflow or turbulence from surrounding buildings.

Alignment: North marker of HY-WDS2E should be aligned to point to any other reference direction –for example, the bow of a boat. There are two red arrows to help alignment as shown below.



Note: Red dot is direction of internal electric compass,it's also direction of boat's bow,marked as red dot on shell.

12 Clean

If dust is deposited on the instrument, you can scrub it gently with cloth coated with (biodegradable) soft lotion. Do not use dissolved reagents, scrub carefully and avoid cutting the surface of the instrument. If snow or ice is accumulated on the surface of the instrument, it should be melted slowly and naturally. Never use tools to force it away.

12 After-sale service

The instrument does not have any moving parts and does not require routine maintenance.

If the user opens the instrument on its own or damages the safety seal on it, it will no longer enjoy our quality assurance and calibration.

If anything goes wrong with the instrument, you may send the instrument to the authorized agent of HongYuv.

13 Instrument Return

If the instrument needs to be returned, please carefully pack the instrument in the original package and deliver it to the authorized agent of the Hongyuv with the detailed explanation of malfunction.

14 Communication Protocol

Refer to appendix.

Compact Weather station communication protocol

ModBus-RTU V1.11

Modbus Specification

Start Bit	1 bit
Data Bits	8 bit
Parity	EVEN
Stop Bits	1 bit
Baud Rate	9600 Baud

Communication interface

Communication interface:RS485 or RS232, default interface:***RS485***。

Communication Protocol

MODBUS Protocol - RTU Mode.

Protocol Description

MODBUS protocol defines a simple protocol data unit(PDU) independent from basic communication layer.

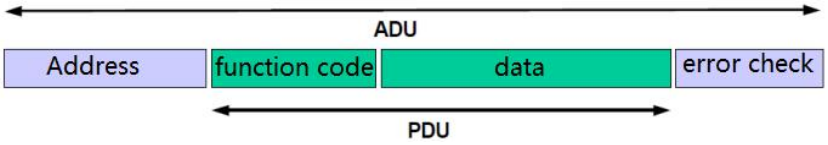


Figure 2. Commonly used MODBUS frame

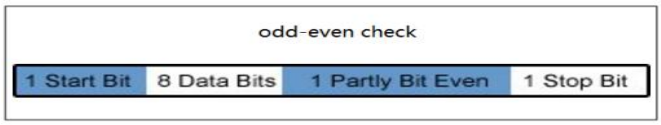
MODBUS has two transmission mode:RTU and ASCII.

Our sensor adopts RTU mode.

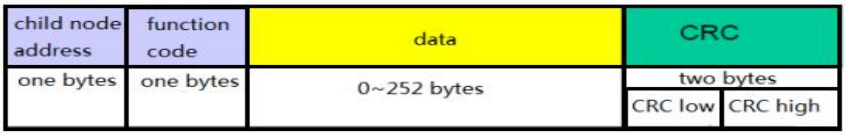
1. RTU transmission mode

When controllers are setup to communicate on a Modbus network using RTU (Remote Terminal Unit) mode, each eight-bit byte in a message contains two four-bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII for the same baud rate. Each message must be transmitted in a continuous stream.

- **RTU Mode serial bits**



- **Modbus RTU message frame**



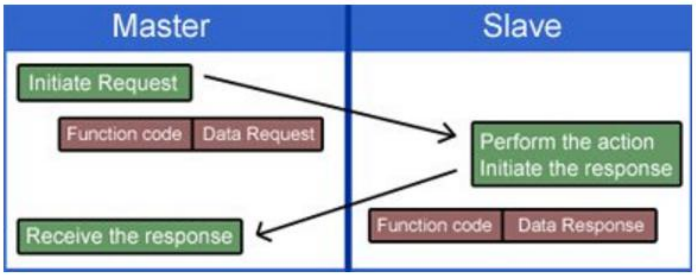
- **CRC Check**

RTU Mode has Cyclical Redundancy Checking(CRC) on all content of message, no matter if there is an odd-even check or not.

CRC check code is a 16 bits value composed by two 8 bits value and added as tail of message. After calculation, lower byte first then high byte. CRC higher byte is the last byte of message.

The CRC check code is calculated by sender. Receiver will recalculate CRC check code and compare it with CRC code received, if they are different, then there is an error happen during transmission.

MODBUS communication Mode



Data Coding

MODBUS use ”big-Endian” to indicate address and data, which means when there is several bytes be sent out, the most significant bit is sent and received first.

Eg.

Register Size	Value
16bit	0x1234

The first byte is 0x12, after it is 0x34

1. Protocol of Device

- **Function Code Supported**

Function code type	Length	Function Code（HEX）	Description
Data access	16 bit	03	Read data from internal register
Data access	16 bit	10	Write data to multiple register

- **Error Code Supported**

Error code	Description
01	Function Code Error
02	Register Address Error
03	Register Value error
06	Device Busy

- **Internal Registers Description：**

Register	Length	Data Type	Definition	Range
Register 1	16 bit	16 bit int	Device State	0x0000 ~0xFFFF Refer to Appendix I
Register 2	16 bit	16 bit int	Wind Direction	0 - 359 °
Register 3	16 bit	32 bit float	Wind Speed	0 - +60 m/s
Register 4	16 bit			
Register 5	16 bit	32 bit float	Temperature	-40 - +80 ℃
Register 6	16 bit			
Register 7	16 bit	32 bit float	Humidity	0 - 100 %
Register 8	16 bit			
Register 9	16 bit	32 bit float	Air Pressure	150 - 1100 hPa
Register 10	16 bit			
Register 11	16 bit	16 bit int	Compass Heading	0 - 359 °
Register 12	16 bit	16 bit int	Precipitation Type	Refer to Appendix III
Register 13	16 bit	32 bit float	Precipitation Intensity	Single-precision
Register 14	16 bit			
Register 15	16 bit	32 bit float	Accumulated Precipitation	Single-precision
Register 16	16 bit			

Register 17	16 bit	16 bit int	N/A	Reserved
Register 18	16 bit	16 bit int	GPS Status	0: Positioned 1: No Positioned
Register 19	16 bit	32 bit float	GPS Speed	Km/h
Register 20	16 bit			
Register 21	16 bit	16 bit int	GPS Heading	0 - 359 °
Register 22	16 bit	32 bit float	Longitude	East: positive West: negative
Register 23	16 bit			
Register 24	16 bit	32 bit float	Latitude	North: positive South: negative
Register 25	16 bit			
Register 26	16 bit	32 bit float	PM2.5 concentration	0-500 ug/m^3
Register 27	16 bit			
Register 28	16 bit	32 bit float	Visibility	m
Register 29	16 bit			
Register 30	16 bit	32 bit float	Radiation Illuminance	Lux
Register 31	16 bit			
Register 32	16 bit	32 bit float	Accumulated solar radiation	Daily Solar Radiation KJ
Register 33	16 bit			
Register 34	16 bit	32 bit float	Solar Radiation Power	W/m^2
Register 35	16 bit			
Register 36	16 bit	32 bit float	Compass Corrected (True) Wind Direction	0 ~ 359.9 °
Register 37	16 bit			
Register 38	16 bit	32 bit float	Altitude	m
Register 39	16 bit			
Register 40	16 bit	32 bit float	GPS Corrected(True) Wind Speed	0-60m/s
Register 41	16 bit			
Register 42	16 bit	32 bit float	Accumulated Snow Thickness	m
Register 43	16 bit			
Register 44	16 bit	32 bit float	UV Radiation	W/m2
Register 45	16 bit			
Register 46	16 bit	32 bit float	PM1.0 concentration	0-500 ug/m^3
Register 47	16 bit			
Register 48	16 bit	32 bit float	PM10 concentration	0-500 ug/m^3
Register 49	16 bit			
Register 50	16 bit	32 bit float	Color Temp	K
Register 51	16 bit			
Register 52	16 bit	16 bit int	Device State 2	0x0000~0xFFFF Refer to Appendix II
Register 53	16 bit	32 bit float	0-10 min Avg. Relative Wind Speed	0-60m/s
Register 54	16 bit			
Register 55	16 bit	32 bit float	0-10 min Max. Relative Wind Speed	0-60m/s
Register 56	16 bit			
Register 57	16 bit	32 bit float	0-10 min Min. Relative Wind Speed	0-60m/s
Register 58	16 bit			
Register 59	16 bit	16 bit int	0-10 min Avg. Relative Wind Direction	0 ~ 359 °
Register 60	16 bit	16 bit int	0-10 min Max. Relative Wind Direction	0 ~ 359 °
Register 61	16 bit	16 bit int	0-10 min Min. Relative Wind Direction	0 ~ 359 °
Register 62	16 bit	32 bit float	0-10 min Avg. True Wind Speed	0-60m/s
Register 63	16 bit			
Register 64	16 bit	32 bit float	0-10 min Max. True Wind Speed	0-60m/s
Register 65	16 bit			
Register 66	16 bit	32 bit float	0-10 min Min. True Wind Speed	0-60m/s
Register 67	16 bit			
Register 68	16 bit	32 bit float	0-10 min Avg. True Wind Direction	0 ~ 359.9 °
Register 69	16 bit			

Register 70	16 bit	32 bit float	0-10 min Max. True Wind Direction	0 ~ 359.9 °
Register 71	16 bit			
Register 72	16 bit	32 bit float	0-10 min Min. True Wind Direction	0 ~ 359.9 °
Register 73	16 bit			
Register 74	16 bit	32 bit float	Gust (3 s Max. Wind Speed)	0-60m/s
Register 75	16 bit			
Register 76	16 bit	32 bit float	0-2 min Avg. Relative Wind Speed	0-60m/s
Register 77	16 bit			
Register 78	16 bit	32 bit float	0-2 min Max. Relative Wind Speed	0-60m/s
Register 79	16 bit			
Register 80	16 bit	32 bit float	0-2 min Min. Relative Wind Speed	0-60m/s
Register 81	16 bit			
Register 82	16 bit	16 bit int	0-2 min Avg. Relative Wind Direction	0 ~ 359 °
Register 83	16 bit	16 bit int	0-2 min Max. Relative Wind Direction	0 ~ 359 °
Register 84	16 bit	16 bit int	0-2 min Min. Relative Wind Direction	0 ~ 359 °
Register 85	16 bit	32 bit float	0-2 min Avg. True Wind Speed	0-60m/s
Register 86	16 bit			
Register 87	16 bit	32 bit float	0-2 min Max. True Wind Speed	0-60m/s
Register 88	16 bit			
Register 89	16 bit	32 bit float	0-2 min Min. True Wind Speed	0-60m/s
Register 90	16 bit			
Register 91	16 bit	32 bit float	0-2 min Avg. True Wind Direction	0 ~ 359.9 °
Register 92	16 bit			
Register 93	16 bit	32 bit float	0-2 min Max. True Wind Direction	0 ~ 359.9 °
Register 94	16 bit			
Register 95	16 bit	32 bit float	0-2 min Min. True Wind Direction	0 ~ 359.9 °
Register 96	16 bit			

Note: Starting address of registers start from zero, E.g. address of register 1 is *0x0000*

- **32 bit float type format**

D3	D2	D1	D0
Higher byte	Middle byte 1	Middle byte 2	Lower byte

- **Format of data stored in register**

Definition	Register	Bit	Byte position
Wind speed	Register 2-higher byte	8 bit	D1
	Register 2-lower byte	8 bit	D0
	Register 3-higher byte	8 bit	D3
	Register 3-lower byte	8 bit	D2

◆ **Function code(0x03) description - read holding register**

A remote device can use function code to read data of holding register. The request PDU specifies starting address and quantity of registers. Register address from zero,therefore, the address register 1-3 corresponds to address 0-2.

Response packet from each register is divided into two bytes in binary format. The first byte is higher bits, the second byte is lower bits.

Request

Function Code	1 byte	0x03
Starting Address	2 bytes	0x0000 ~ 0x005F
Register Quantity	2 bytes	1 ~ 96

Response

Function Code	1 byte	0x03
Bytes Quantity	1 bytes	N*2
Register Data	N*2 bytes	

Note： N is quantity of registers

Error response

Error Code	1 byte	0x83
Exception Code	1 byte	01 or 02 or 03 or 06

Communication Example：

Read 96 internal registers

Communication Example：

Request		**Explanation**
Description	(HEX)	
Device address	01	Request instrument of “01” address for data of 96 registers starting from register Number “00”. For instance: Address of our register start coding from 00~95 (Total quantity:96)
Function code	03	
Starting address higher byte	00	
Starting address lower byte	00	
Quantity of register to read higher byte	00	
Quantity of register to read lower byte	60	
Checksum higher byte	45	
Checksum lower byte	E2	

- **Request：**
  (HEX) **01030000006045E2**
- **Response：**
  (HEX)

0103C05DFF000063AC3CAE876441CC71B24289CFDD446C002E000133333F3300000000000F000174BC3D130000EC7642CFE59741F56666418A000000008A0046A9CCCD413C999A436100004238F854440D63AC3CAE0000000047AE3FE1CCCD412C0000419800000000007FA5413E9C999A3FD900000000133014400A8F2593D8BE1483F3A000000004C51424200004 22C000042288F5C3FC2A5413E9C999A3FD90000000001330 14400A8F2593D8BE1483F3A000000004C5142420000422C00 004228A3F9
(Detailed analysis is at next page)

Explanation of above response string in HEX as below:

Instrument address		01	Address is "01"
Function Code		03	"03" means read
Total Bytes		C0	192 bytes
Register	1	5DFF	Device state:1011101111111111 (from left to right) 1:UV radiation 0:Snow thickness 1:True wind speed 1:True wind direction 1:Altitude 0:Visibility 1:Luminance 1:Solar radiation 1:PM1.0/2.5/10 1:GPS 1:Precipitation 1:Compass 1:Pressure 1:Relative wind 1:Temperature and humidity
Register	2	0000	Wind direction: 0°
Register	3-4	63AC3CAE	Wind speed: 0.02 m/s Converted by 3CAE63AC all 32 bit float date in this protocol comply to IEEE754 Standard
Register	5-6	876441CC	Temperature: 25.57℃
Register	7-8	71B24289	Humidity: 68.7%
Register	9-10	CFDD446C	Pressure: 947.2 hPa
Register	11	002E	Compass heading: 46°
Register	12	0001	Precipitation type:001 means rain
Register	13-14	33333F33	Rain intensity: 0.7 mm/h
Register	15-16	00000000	Accumulated rain:0 mm
Register	17	000F	Reserved
Register	18	0001	GPS state: "1" means positioned
Register	19-20	74BC3D13	Traveling speed: 0.036 Km/h
Register	21	0000	Traveling heading: 0°
Register	22-23	EC7642CF	Longitude: 103.961838
Register	24-25	E59741F5	Latitude: 30.737104
Register	26-27	6666418A	PM2.5: 17 μg/m3
Register	28-29	00000000	Visibility(reserved)
Register	30-31	8A0046A9	Luminance: 21701 Lux
Register	32-33	CCCD413C	Accumulated solar radiation:11.8 KJ
Register	34-35	999A4361	Solar radiation power: 225.6W/m2
Register	36-37	00004238	True wind direction: 46°
Register	38-39	F854440D	Altitude: 567.9 m

Register	40-41	63AC3CAE	True wind speed: 0.2 m/s
Register	42-43	00000000	Snow thickness(reserved)
Register	44-45	47AE3FE1	UV Radiation: 1.76 W/m2
Register	46-47	CCCD412C	PM1.0: 10.8 μg/m3
Register	48-49	00004198	PM10: 19.0 μg/m3
Register	50-51	00000000	Color Temp(reserved)
Register	52	007F	Device state2: 1111111 (from left to right) 1:2 minutes true wind direction 1:2 minutes true wind speed 1:2 minutes relative wind 1:Gust 1:10 minutes true wind direction 1:10 minutes true wind speed 1:10 minutes relative wind
Register	53-54	A5413E9C	10 min Avg. relative wind speed: 0.31 m/s
Register	55-56	999A3FD9	10 min Max. relative wind speed: 1.70 m/s
Register	57-58	00000000	10 min Min. relative wind speed: 0 m/s
Register	59	0133	10 min Avg. relative wind direction: 307°
Register	60	0144	10 min Max. relative wind direction: 324°
Register	61	00A8	10 min Min. relative wind direction: 168°
Register	62-63	F2593D8B	10 min Avg. true wind speed: 0.07 m/s
Register	64-65	E1483F3A	10 min Max. true wind speed: 0.73 m/s
Register	66-67	00000000	10 min Min. true wind speed: 0 m/s
Register	68-69	4C514242	10 min Avg. true wind direction: 48.6°
Register	70-71	0000422C	10 min Max. true wind speed: 43°
Register	72-73	00004228	10 min Min. true wind speed: 42°
Register	74-75	8F5C3FC2	Gust: 1.52 m/s
Register	76-77	A5413E9C	2 min Avg. relative wind speed: 0.31 m/s
Register	78-79	999A3FD9	2 min Max. relative wind speed: 1.70 m/s
Register	80-81	00000000	2 min Min. relative wind speed: 0 m/s
Register	82	0133	2 min Avg. relative wind direction: 307°
Register	83	0144	2 min Max. relative wind direction: 324°
Register	84	00A8	2 min Min. relative wind direction: 168°
Register	85-86	F2593D8B	2 min Avg. true wind speed: 0.07 m/s
Register	87-88	E1483F3A	2 min Max. true wind speed: 0.73 m/s
Register	89-90	00000000	2 min Min. true wind speed: 0 m/s
Register	91-92	4C514242	2 min Avg. true wind direction: 48.6°
Register	93-94	0000422C	2 min Max. true wind speed: 43°
Register	95-96	00004228	2 min Min. true wind speed: 42°
Ending Characters		A3F9	Checksum

Int type Take wind direction for example

D1	D0
Register 3 higher byte	Register 3 lower byte
00	38
higher byte	lower byte

Transformed as int type, value is **0x0038 => 56°**

- **Float type(IEEE754 Standard)** Take temperature for example

D3	D2	D1	D0
Register 7 higher byte	Register 7 lower byte	Register 6 higher byte	Register 6 lower byte
41	E7	33	33
higher byte	middle byte1	middle byte2	lower byte

Convert to float type, value is **0x41E73333 => 28.9 ℃**

- **Appendix I. Device State 1 (Device State Sheet)**

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8
1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Color Temp	UV Radiation	Accumulated Snow Thickness	True Wind Speed	True Wind Direction	Altitude	Visibility	Luminance
BIT 7	**BIT 6**	**BIT 5**	**BIT 4**	**BIT 3**	**BIT 2**	**BIT 1**	**BIT 0**
1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Solar Radiation	PM1.0 PM2.5 PM10	GPS	Precipitation	Compass Heading	Pressure	Relative Wind	Temperature Humidity

Note:Only when status bit is "1", corresponding data is valid, otherwise it's invalid. Same for below.

- **Appendix II. Device State 2 (Device State Sheet)**

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8
1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
BIT 7	**BIT 6**	**BIT 5**	**BIT 4**	**BIT 3**	**BIT 2**	**BIT 1**	**BIT 0**
1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Reserved	2 Min True Wind Direction	2 Min True Wind Speed	2 Min Relative Wind	Gust	10 Min True Wind Direction	10 Min True Wind Speed	10 Min Relative Wind

- **Appendix III. Precipitation State（HEX）**

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8
0	0	0	0	0	0	0	0
BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
0	0	0	0	0	Hail 0/1	snow 0/1	rain 0/1

For identifying purpose, attention should be paid to last three digits only.

To eliminate phenomenon of '1' at other digits may show up during identification, we recommend you to conduct 'AND' operation between precipitation code and 0000 0000 0000 0111 bit by bit before identifying precipitation type.

For instance:

BIT 2	BIT 1	BIT 0	Type
0	0	1	Rain
0	1	0	Snow
1	0	0	Hail
0	1	1	Rain+Snow
...			

Clear accumulated precipitation Command(fixed string)：

- **Request：**
  (HEX) 01 10 00 0F 00 02 04 00 00 00 00 B3 EF
- **Response：**

(HEX) 01 10 00 0F 00 02 71 CB

Commands and Procedures

Following parameters such as communication address or baud rate, system time, precipitation automatic clear period can be set by users.

Commands			Response
Instruction 1	ASCII	>*\r\n	>CONFIGURE MODE\r\n
	HEX	3E 2A 0D 0A	0A 3E 43 4F 4E 46 49 47 55 52 45 20 4D 4F 44 45 0D 0A
Remark	Enter Setting Mode		
Instruction 2	ASCII	>CUS 9600 8-N-1\r\n	>CMD IS SET
	HEX	3E 43 55 53 20 39 36 30 30 20 38 2D 4E 2D 31 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A
Remark	Configure serial port configuration as Baud Rate 9600 bps; Data bits:8 bits; Parity:NONE; Stop bits:1 bit. Inquiry current setting command ASCII: >CUS\r\n HEX:3E 43 55 53 0D 0A		
Instruction 3	ASCII	>ID 2\r\n	>CMD IS SET
	HEX	3E 49 44 20 32 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A
Remark	Configure address of device as 2. Inquiry address command is ASCII: >ID\r\n HEX: 3E 49 44 0D 0A		
Instruction 4	ASCII	>RESET\r\n	System start ok!\r\n
	HEX	3E 52 45 53 45 54 0D 0A	53 79 73 74 65 6D 20 73 74 61 72 74 20 6F 6B 21 0D 0A
Remark	Reboot device		
Instruction 5	ASCII	>!\r\n	>NORMAL MODE\r\n
	HEX	3E 21 0D 0A	3E 4E 4F 52 4D 41 4C 20 4D 4F 44 45 0D 0A
Remark	Save configuration of WDS series and exit setting mode.		
Instruction 6	ASCII	>DEBUGEN\r\n	Usart In Debug Mode\r\n
	HEX	3E 44 45 42 55 47 45 4E 0D 0A	55 73 61 72 74 20 49 6E 20 44 65 62 75 67 20 4D 6F 64 65 0D 0A
Remark	Enter secondary setting mode(only for WDS series, WDC series don't need to enter this mode.)		
Instruction 7	ASCII	>TimeSet:16,03,00,19,05,07,02\r\n	>TimeSet set ok!\r\n
	HEX	3E 54 69 6D 65 53 65 74 3A 31 36 2C 30 33 2C 30 30 2C 31 39 2C 30 35 2C 30 37 2C 30 32 0D 0A	3E 54 69 6D 65 53 65 74 20 73 65 74 20 6F 6B 21 0D 0A
Remark	Set system time as 2019.05.07 16:03;00 Tuesday. "02" means Tuesday, likewise 07 means Sunday. 16:hour; 03:minute; 00:second; 19:year; 05:month; 07:day; 02:Tuesday		
Instruction 8	ASCII	>RainClrTime:360\r\n	>Time of rain clear set ok!\r\n
	HEX	3E 52 61 69 6E 43 6C 72 54 69 6D 65 3A 33 36 30 0D 0A	3E 54 69 6D 65 20 6F 66 20 72 61 69 6E 20 63 6C 65 61 72 20 73 65 74 20 6F 6B 21 20 0D 0A
Remark	Set Accumulated precipitation automatic reset time as 360 days(only for WDS series ordered before 2019.5.22)		
Instruction 9	ASCII	>RainPeriodSet:360\r\n	>Time of rain clear set ok!\r\n
	HEX	3E 52 61 69 6E 50 65 72 69 6F 64 53 65 74 3A 33 36 30 0D 0A	3E 54 69 6D 65 20 6F 66 20 72 61 69 6E 20 63 6C 65 61 72 20 73 65 74 20 6F 6B 21 20 0D 0A
Remark	Set Accum.precipitation automatic reset time as 360 days(for WDS series ordered after 2019.5.22, and all WDC series)		
Instruction 10	HEX	01 10 00 0F 00 02 04 00 00 00 00 B3 EF	01 10 00 0F 00 02 71 CB
Remark	Manually reset accumulated precipitation.		

Notice: 1. Characters “\r\n” is CRLF Carriage-Return Line-Feed, corresponding to HEX (0x0D,0x0A)

Commands		Content	Response
Instruction 11	ASCII	>ASDM 3\r\n	>CMD IS SET\r\n
	HEX	3E 41 53 44 4D 20 33 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A

Remark	Set 2 minutes average period as 3 seconds, “3” can be set as number from 1~120;		
Instruction 12	ASCII	>ASDS 3\r\n	>CMD IS SET
	HEX	3E 41 53 44 53 20 33 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A
Remark	Set 10 minutes average period as 3 seconds, “3” can be set as number from 1~600;		
Instruction 13	ASCII	>WSUS 3\r\n	>CMD IS SET
	HEX	3E 57 53 55 53 20 33 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A
Remark	Set wind speed unit as kph; “3” can be set as 0~4, 0:m/s; 1:knots; 2:mph; 3:kph; 4:ft/min Command >WSUS\r\n is used to inquiry current wind speed unit.		
Instruction 14	ASCII	>ASGS 3\r\n	>CMD IS SET
	HEX	3E 41 53 47 53 20 33 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A
Remark	Set Gust calculation period. “3” can be set as 1~600;		
Instruction 15	ASCII	>TimeReq\r\n	
	HEX	3E 54 69 6D 65 52 65 71 0D 0A	
Remark	Inquiry system time		
Instruction 16	ASCII	>SaveConfig\r\n	>CMD IS SET
	HEX	3E 53 61 76 65 43 6F 6E 66 69 67 0D 0A	3E 43 4D 44 20 49 53 20 53 45 54 0D 0A
Remark	Save setting for WDC series		
Instruction 17	ASCII	>DEBUGDN\r\n	>USART IN NORMAL MODE
	HEX	3E 44 45 42 55 47 44 4E 0D 0A	3E 55 53 41 52 54 20 49 4E 20 4E 4F 52 4D 41 4C 20 4D 4F 44 45
Remark	Exit secondary setting mode(only for WDS series, WDC series don't need to enter this mode.)		
Notice: 1. Characters “\r\n” is CRLF Carriage-Return Line-Feed, corresponding to HEX (0x0D,0x0A)			

Setting Procedures

No.	Function	Instructions
1	Set Communication Address	WDC:1→3→16
		WDS:1→3→5→4
2	Set Serial Port Parameters	WDC:1→2→16
		WDS:1→2→5→4
3	Set System Time	WDC:7→16
		WDS:1→6→7→17→5→4
4	Set accumulated precipitation automatic clear period	WDC:9→16
		WDS:1→6→9→17→5→4
5	Manually reset Accumulated precipitation(to zero)	10
6	Change 2 minutes calculate period	WDC:1→11→16→4
		WDS:1→11→5→4
7	Change 10 minutes calculate period	WDC:1→12→16→4
		WDS:1→12→5→4
8	Change output wind speed unit	WDC:1→13→16→4
		WDS:1→13→5→4
9	Change Gust calculate period	WDC:1→14→16→4
		WDS:1→14→5→4
10	Inquiry System time	WDC:15
		WDS:1→6→15→17→5→4

Notice:

Above commands are applicable on our weather station.

System time is a key parameter, since accumulated daily solar radiation will be reset to zero at 00:00 by internal system of our device.

Accumulated precipitation automatic clear period is counting down from the moment device is powered on, not from the moment you change accumulated precipitation automatic clear period(Function No.4).

Accumulated precipitation automatic clear period is default set as 30 days.

Accumulated solar radiation is automatically reset as zero at 00:00 every day.

Default precipitation automatic reset period is 3600 days.(sold after 3rd,July,2019.)

Once you enter secondary setting mode, you have to exit it by inputting command 17 or power off-on sensor, otherwise it will keep staying in setting mode where you can't access to any data.

I .Appendix LRC Verification
Using a C language function code to generate LRC values

The function code uses 2 independent variables：

unsigned char *auchMsg; // To generate the LRC value, point the pointer to the buffer containing the binary data

unsigned short usDataLen; //Number of bytes in the buffer。

//This function returns LRC as a type“unsigned char” 。

// RC check code generation

static unsigned char LRCCheck(auchMsg, usDataLen)

unsigned char *auchMsg; /* calculating by information byte LRC*/

unsigned short usDataLen; /*calculating by information byteLRC*/

{

unsigned char uchLRC = 0 ; /*Initializing LRC characters */

while (usDataLen--) /*through the data buffer*/

uchLRC += *auchMsg++; /*Add buffer byte Buffer byte no carry*/

return ((unsigned char)(–((char)uchLRC))) ; /*reture to Binary complement*/

}

II .Appendix transform HEX to float data

Use C language’s subfunction to transform 4 bytes(HEX) as float data(C language)

union

{

float TestData_Float;

unsigned char TestArray[4];

}TData;

Analysis example:

D3	D2	D1	D0
Higher byte of register 2	Lower byte of register 2	Higher byte of register 1	Lower byte of register 1
40	AC	19	DF
Higher byte	Middle byte 1	Middle byte 2	Lower byte

After transformed to float data, value: 5.378

Subfunction:

float Tempfloat;

TData.TestArray [3]= 0x40; //input higher byte

TData.TestArray [2]= 0xac; //

TData.TestArray [1]= 0x19; //

TData.TestArray [0]= 0xdf; //input lower byte

Tempfloat = TData.TestData_Float; //return result 5.378