HONGYUV

HY-WDC6E

Mini Weather Station Sensor

Operating Manual

1 Foreword

Thank you for purchasing ultrasonic anemometer manufactured by Hongyuv. This device without moving parts, free of maintenance and calibration on site. We suggest you to read this user manual carefully before operating it.

As our products are developed continuously, Hongyuv reserve the right to make any alterations on performance or appearance without prior notice.

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2 Introduction

HY-WDC6E ultrasonic anemometer has advantage of light weigh, robust,no moving parts, free of maintenance and calibration on site, simultaneously output wind speed and direction.

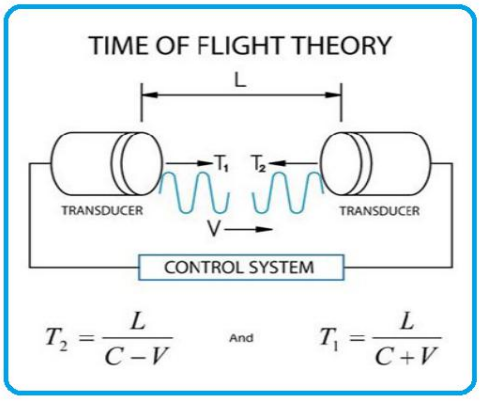
HY-WDC6E can be connected to computer or any other data acquisition module which has compatible communication protocol with it.

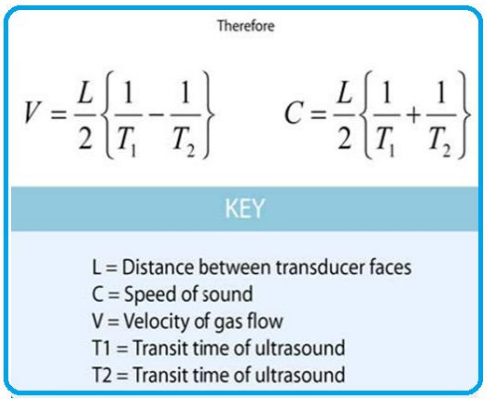
HY-WDC6E has two communication interfaces for option, RS232 or RS485.

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.





Measurement of precipitation adopts advanced small 24GHz Doppler radar，The speed rate of drops is registered with a 24 GHz radar system. By comparison between the speed rate and the size of drops, the quantity of rain or its intensity will be registered. The rain/precipitation type (rain/snow/snow-covered rain/freezing rain/hail) is determined thanks to the speed rate of the rain.

4 Technical Specification

Wind Speed	0 - 40m/s	±5%	0.1m/s
Wind Direction	0 - 359°	±3 °	1°
Temperature	-40℃ – +80℃	±0.5℃	0.1℃
Humidity	0 – 100%	±5%	1
Air Pressure	150 – 1100hPa	±1hPa	0.1hPa
Precipitation	0 – 100mm/hr	±10%	0.01mm
Solar Radiation	0-2000 W/m2	±5%	0.1 W/m2
UV Radiation	0-2000 W/m2	±5%	0.1 W/m2
Luminance	0-200000 lux	±5%	0.1 lux
PM1.0/PM2.5/PM10(dust	0-500 μ g/m3	±10%	1 μ g/m3
Digital Output	RS485 or RS232 or SDI-12		
Baud Rate	4800 - 19200		
Communication Protocol	ModBus-RTU,NMEA0183,SDI-12		
Output Frequency	1Hz		
Protection Grade	IP65		
Operating Temperature	-40℃ - +60℃		
Working Humidity	0 - 100%		
Power Supply	VDC: 7-24V		
Material	ABS engineering plastic		
Dimension/Weight	Φ84×210mm 0.33kg		

Note: Configuration of parameters are decided when place order. Price depends on configuration you need.

5 Packing List

Item	Quantity
HY-WDC6E Weather Station	1 pcs
Four meters communication cable with watertight plug	1 pcs
Operating Manual	1 pcs

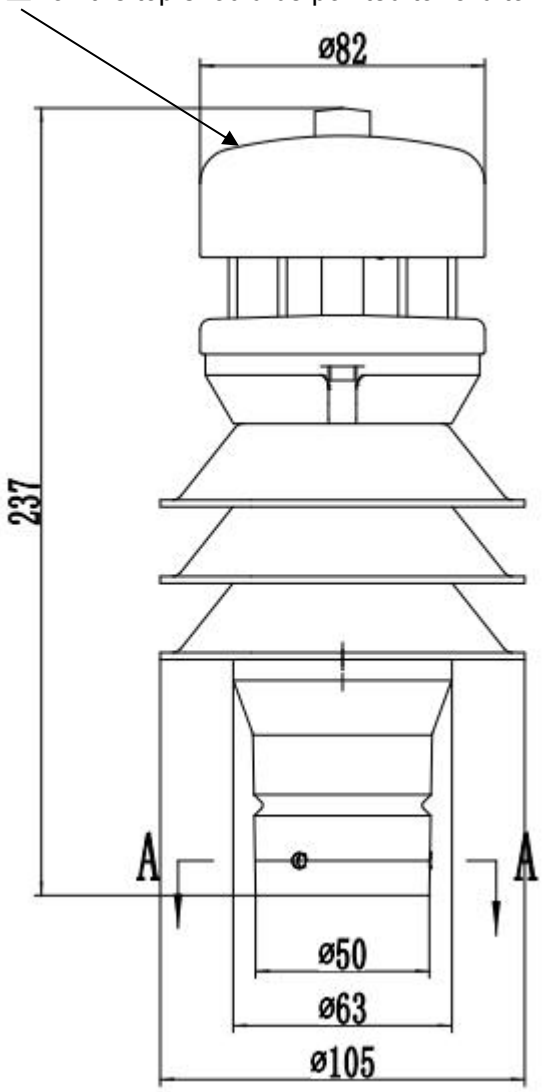
6 Package Notice

By keeping HY-WDC6E well positioned in ex-work package when it's being transferred to protect it from any potential damage.

7 Appearance Sketch

There has three north arrow markers on ABS shell for easy observation from downward, front upward.

”△” on the top should be pointed toward to north, it’s also zero direction for the anemometer.



8 Wiring

For RS485 output, communication cable is four cores, connected as below:

POWER		RS485	
Red	Black	Yellow	Green
V＋	GND	RS485 DA+	RS485 DB-

For RS232 output, communication cable is four cores, connected as below:

POWER		RS232	
Red	Black	Yellow	Green
V＋	GND + RS232 GND	RS232 RX	RS232 TX

For SDI-12 output, communication cable is three cores, connected as below:

POWER		SDI-12	
Red	Black	Yellow	Green
V＋	GND	–	SDI-12

Note:

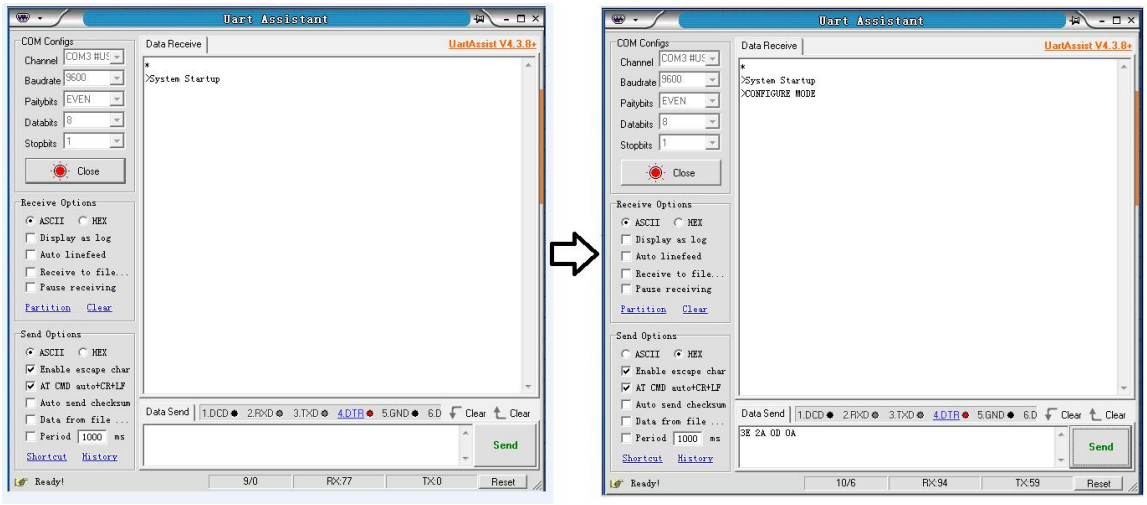
Default output is RS485,final definition of cable wiring should be referred to sticker on cable

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.



10 Installation Guidelines

The HY-WDC6E has been designed to meet and exceed the stringent standards listed in its specification. Operating in diverse environments all over the world, HY-WDC6E 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-WDC6E 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-WDC6E specification at all times.

· Avoid turbulence caused by surrounding structures that will affect the accuracy of the HY-WDC6E 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

10.1 Land meteorological station installation

Location:Normally,HY-WDC6E is installed on a vertical pole horizontally（refer to picture on theright 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-WDC6E outlet. When the plug is connected, turn the outer sleeve clockwise and lock the plug.

With 3 stainless steel screws, the HY-WDC6E can be fixed to the mounting pipe (the screw has a maximum installed torque of 4Nm)

Customers must ensure that the HY-WDC6E is installed in an open area so as to avoid obstacles to airflow or turbulence in the surrounding buildings. Do not install HY-WDC6E on the side of a high power radar or radio transmitter.

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.

13 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.

14 Calibration

The anemometer calibration is based on fundamental physical principles and does not change with use. Recalibration should therefore not be necessary.

15 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.

16 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.

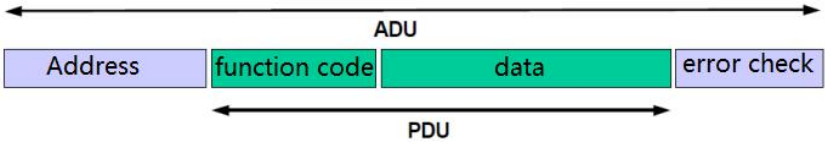


Figure 2. Commonly used MODBUS frame

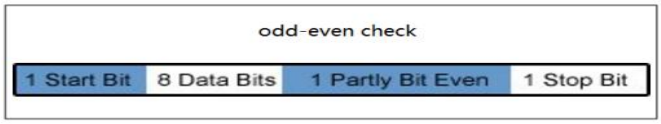
MODBUS has two transmission mode:RTU and ASCII.

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**



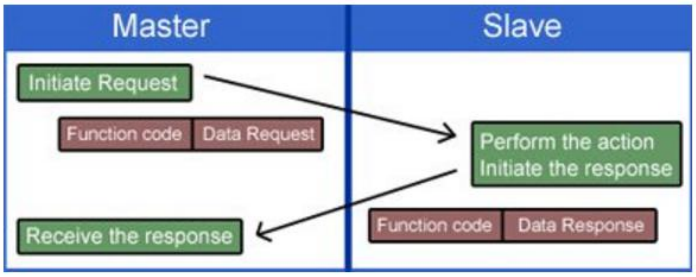
- **Modbus RTU message frame**

child node address	function code	data	CRC	
one bytes	one bytes	0~252 bytes	two bytes	
			CRC low	CRC high

- **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)

0103C05DFF000063AC3CAE876441CC71B24289CFDD446C
002E000133333F3300000000000F000174BC3D130000EC764
2CFE59741F56666418A000000008A0046A9CCCD413C999A
436100004238F854440D63AC3CAE0000000047AE3FE1CCC
D412C0000419800000000007FA5413E9C999A3FD900000000
0133014400A8F2593D8BE1483F3A000000004C51424200004
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 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 Available Baudrate:1200~115200 bps; Available Parity: E:EVEN; N:NONE; O:ODD Available DataBits:7, 8; Available StopBits:1,2;		
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 CRC Verification

The CRC we are using is 16 bits, lower byte comes first.
The cyclic redundancy check (CRC) field is two bytes which contain 16 bits binary value. The value of the CRC appended to the message is calculated by the transmitting device. When receiving the message, the receiving device recalculates the CRC value and compares the calculated result with the actual received CRC value. If the two values are not equal, it is an error.
During the generation of CRC, each 8-bits characters are XOR with the value in the register. The result then shifts 1 bit in the LSB direction, while the MSB position is charged to zero. Then extract and check LSB: if LSB is 1, the value in the register is XOR with a fixed preset value; if LSB is 0, no XOR operation is performed.
This process will be repeated until 8 shifts have been performed. After the last (8th) shift and related operations, the next 8-bit byte is XOR with the current value of the register, and then repeat 8 times as described above. The final value in the register obtained after all sub sections of the message are calculated is CRC.

Procedure of calculating a CRC:
1. Load a 16 bit register with hexadecimal FFFF (all 1). Call it CRC register
2. XOR the first byte of 8 bits in message with the low er byte of the 16 bit CRC register, and place the result in the CRC register
3. Move the CRC register to the right by 1 bit (in the direction of LSB), fill the MSB with zero, extract and detect LSB
4. If LSB is 0: repeat step 3 (do another shift)
(if LSB is 1): conduct XOR operation with CRC register.
5. Repeat steps 3 and 4 until 8 shifts have been completed. When this is done, the full 8-bit byte operation will be completed.
6. Repeat steps 2 to 5 for the next byte in the message, and continue the operation until all messages are processed.
7. The final content in CRC register is CRC value
8. When placing CRC value in message, as described below, higher and lower byte must be exchanged.

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
```