RIKA

Ultrasonic Wind Speed & Direction Sensor

1. Preface

Welcome to use the RK120-07 Ultrasonic Automatic Weather Instrument produced by Rikasensor. The instrument does not have any moving parts, need no maintenance, no on-site calibration. In order to use the instrument better, we recommend that you read this operating manual carefully before installation.

The RK120-07 Ultrasonic Automatic Weather Instrument is continuously under research and development, and we reserve the right to improve some performance and design without prior notice.

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2. Introduction

The RK120-07 Ultrasonic Automatic Weather Instrument produced by Rikasensor has the characteristics of light weight, strong & solid. It has no moving parts, needs no maintenance or on-site calibration. It can output wind speed and direction at the same time.

RK120-07 Ultrasonic Automatic Weather Instrument can be used with computers, data collectors or other acquisition devices that are compatible with the communication format provided by RK120-07 Ultrasonic Automatic Weather Instrument.

RK120-07 Ultrasonic Automatic Weather Instrumenthas two data output formats optional, either RS232 or RS485.
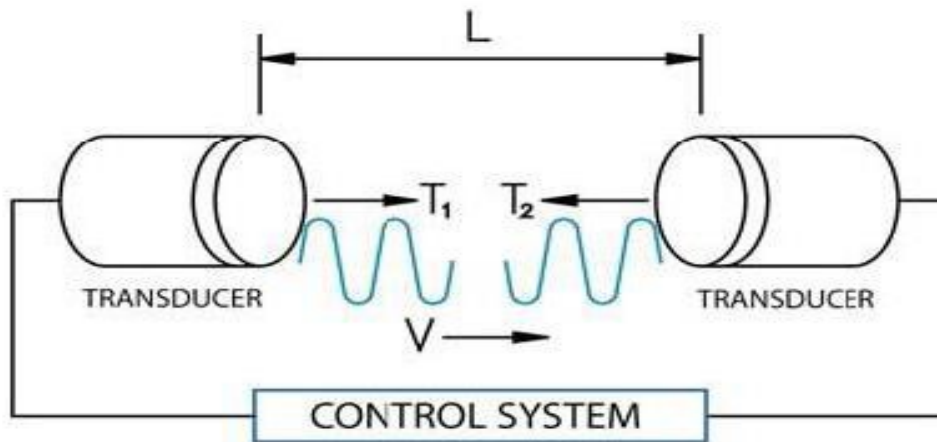
RK120-07 Ultrasonic Automatic Weather Instrument can add some optional modules according to customer needs. Although the shape does not change, additional functions can be added. For example, if the GPS module is installed, the latitude and longitude of the instrument can be tested. If 3D module is added, you can detect the amplitude of the vibration in the horizontal and vertical planes of the instrument.

3. Working principle

RK120-07 Ultrasonic Automatic Weather Instrument measures the time of ultrasonic waves from the N sensor to the S sensor and compares it with the time from the S sensor to the N sensor. Similarly, compare the time of the ultrasonic wave from W to E and the time from E to W. (N= North, S= South, E = East, W= West).

For example, if the wind blows from the north, the time from N to S for ultrasonic waves is shorter than the time from S to N, while the transmission time from W to E and from E to W is the same. By calculating the time difference between the transmission of the ultrasonic waves between the two points, the speed and direction of the wind can be calculated. This calculation method has nothing to do with other factors.

TIME OF FLIGHT THEORY

$$T_2 = \frac{L}{C - V} \qquad \text{And} \qquad T_1 = \frac{L}{C + V}$$

Therefore

$$V = \frac{L}{2}\left\{\frac{1}{T_1} - \frac{1}{T_2}\right\} \qquad C = \frac{L}{2}\left\{\frac{1}{T_1} + \frac{1}{T_2}\right\}$$

KEY

L = Distance between transducer faces
C = Speed of sound
V = Velocity of gas flow
T1 = Transit time of ultrasound
T2 = Transit time of ultrasound

4. Technical Specification

RK120-07 Five-element Ultrasonic Automatic Weather Instrument

|		
Technical Specification	Model	RK120-07
	Signal Output	RS232/RS485
	Power Supply	VDC: 12V-24V
	Data update cycle	1s(default), other optional
	Power consumption	<3W
	Material	Aluminum alloy
	Communication protocol	Modbus protocol
	Dimension	Ø82 * 108mm
Wind Speed	Principle: Ultrasonic Range：0－60m/s Accuracy:±2% Resolution：0.01	
Wind Direction	Principle: Ultrasonic Range：0－359°（without dead end） Accuracy：<3° Resolution：1°	

5. Packing List

RK120-07 Ultrasonic Automatic Weather Instrument	1
Data cable (with waterproof plug) 4 m	1
User Manual	1

6. Packing

When the RK120-07Ultrasonic Automatic Weather Instrument is transported to the installation site, the instrument must be placed in the inner package.Do not throw away any packaging material. The equipment can be used for frequent transportation.

7. Outside Drawing

The outside drawing of RK120-07 Ultrasonic Automatic Weather Instrument

ø82

N

108

3-ø4.5

44

10

ø50
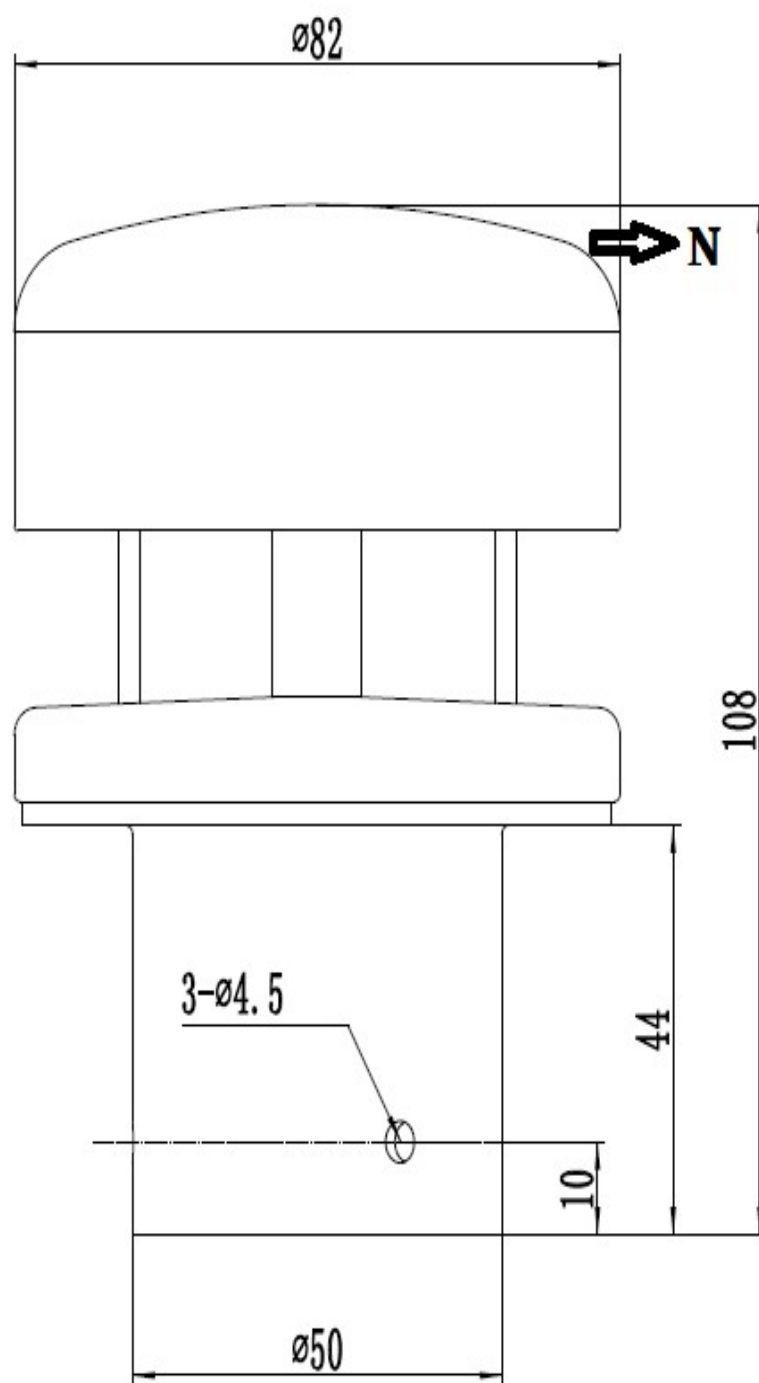
8、Cable connection

The communication cable is 4 cores for RS485 output , and the connection method is as follows:

Red	Black	Yellow	Green
DC12V-24V＋	DC12V-24V -	RS485 DA+	RS485 DB-

The communication cable is 5 cores for RS232 output , and the connection method is as follows:

Red	Black	Green	Yellow
DC12-24V＋	DC12-24V -	RS232TX	RS232 RX

   Note: the final label on the communication cable shall be subject to the label.

9、Installation Caution

RK120-07 Ultrasonic Automatic Weather Instrument can meet or even exceed the specifications listed in it, and can be used in different environments around the world without maintenance and calibration.
Check regularly to ensure that the RK120-07 Ultrasonic Automatic Weather Instrument is not disturbed by other operating equipment that may not fully comply with common standards, such as radio/radar transmitters, ship engines, generators, etc.
● 　　　Do not install on a flat surface with any radar scanner, at least at a distance of 2m or more
● 　　　Recommends keeping the following distance from some nearby radio receiving antennas
● 　　　Use the cables recommended by RIKA SENSOR.

● If the cable is cut and not properly connected, or if the cable shield is not properly maintained, EMC may decrease.
● Do not need to create a ground loop, please connected according to the installation instructions.
● Ensures the continuous power supply of RK120-07 Ultrasonic Automatic Weather Instrument in operation.
● Avoid turbulence generated by surrounding buildings such as trees, power poles, tall buildings, etc., which can affect the accuracy of ultrasonic wind speed and direction detector.The detector is best mounted on one side of the prevailing wind.

The WMO (World Meteorological Organization) makes the following recommendations
● Installation standard of anemometer: over 10 meters above ground in open area.The definition of open area is that the distance between the anemometer and any obstacle is more than 10 times the height of the obstacle.
● If mounted on a building, the wind meter should theoretically be installed at a height of 1.5 times that of the building.
● The length of the boom or branch must be at least twice the minimum diameter or diagonal of the tower if it is mounted on the boom or mast.The boom needs to be mounted on the prevailing wind side

10 Mechanical installation

10.1 Installation of land meteorological stations

Location: Generally, RK120-07 is installed on a vertical installation pipe to ensure the measurement on the same horizontal . (As the right picture shows)
For indoor use, the sensors can be installed in any desired direction to measure wind speed and direction on different horizontal.
Alignment:the point (red dot) of the detector should point to the north.And then tighten it up. There are two marks to ensure alignment.
Note: when installing, use the compass to determine the appropriate mark and direction, which will make installation easier.

Installation: installation Pipe need 3 isometric holes, M5 screws, and its position away 7.5mmfrom the pipe top. Feed the cable (waterproof aviation plug) through the installation pipe.
Note: You must do proper stress relief for cables. You can connect the plug to the socket of the RK120-07 ,by rotating the plug and gently pushing it in. When the plug is connected, the outer sleeve can be rotated clockwise, and then the plug will be locked.

 RK120-07 can be fixed on the installation pipe by three stainless-steel screws (the maximum installation torque of the screws is 4Nm).

You must ensure that the RK120-07 is installed in an open area to avoid obstruction or turbulence caused by surrounding buildings. Do not install it close to high-power radar or radio transmitters.

10.2 Installation of mobile carriers (ships or vehicles)

Location: RK120-07 are installed on a vertical installation tube to ensure that there are no other high points 2 meters near the same horizontal plane, so as to avoid obstacles to air flow or turbulence caused by surrounding buildings.
Alignment:The points(red dot)of the detector of RK120-07 poits to the moving carrier moving forward (such as the heading and bow direction).And then fasten the installation. There are two red marks pointing to ensure alignment.

11.Clean

If dust is deposited on the instrument, it can be lightly scrubbed with a cloth (with biodegradable) soft lotion. Do not use dissolving reagents and carefully scrub to avoid scratched the surface of the instrument. If there is snow or ice on the surface of the instrument, it should be slowly and naturally dissolved, and must not be forced to remove by tools.

12. Service

The instrument has no moving parts, and does not require routine maintenance. If you open the instrument or damage the safety seal on it, you will no longer be entitled to our quality assurance and calibration.
If there is any problem with the instrument, you can send it to the authorized agent of Rika.

13. Instrument return

If the instrument needs to be returned, please pack it carefully according to the original packaging, and send it to the authorized agent of Rika., attaching detailed failure instructions of the instrument.

14. Communication protocol:

Communication parameters: Baud rate 9600 Data bits:8,Stop bit:1,Check bit :EVEN

Register	Byte length	Conception	Type	Range
1	16 bit	Device status	Integer type	0xA000~0xA03F
2	16 bit	Wind direction	Integer type	0-359°
3.4	32 bit	Wind speed	Float point type	0-40m/s

14.1 Read real-time data

Client sends:

01 03 00 00 00 04 44 09

Weather Station Return:
01 03 08 0002 0126 80AD4003 77E1

14.2 Description of Return data format

No.	Conception	Byte Number	Description	Remarks
1	Address block	1	Address(0x01)	0x01
2	Function code	1	Only read(0x03)	0x03
3	Number of bytes	1	0X04	08bytes
4	Device status	2	0xBF 0xFF	Device status
5	Data block	2	Wind direction	0x0126 (294°)
		4	Wind speed	0x400380AD (2.05m/s)

15 .Instrument configuration(you can choose ASCII or Hex)

Through the connecting with the instrument, some parameters of the instrument can be configured, such as changing the communication address and changing the Baud rate

● **Command one: Enter the Settings mode**

Sent
（ASCII）   >*\r\n
（Hex）   3E 2A 0D 0A

Response
（ASCII）   \n>CONFIGURE MODE\r\n
（Hex）   0A 3E 43 4F 4E 46 49 47 55 52 45 20 4D 4F 44 45 0D 0A

● **Command two: Set the serial port configuration**

Sent
（ASCII）   >CUS 9600 8-N-1\r\n
（Hex）   3E 43 55 53 20 39 36 30 30 20 38 2D 4E 2D 31 0D 0A

Response
（ASCII）   >CMD IS SET\r\n
（Hex）   3E 43 4D 44 20 49 53 20 53 45 54 0D 0A

Note: The CUS is required followed by the serial port parameters that will need to be set. If it is not followed by the parameters, the command becomes the current query configuration.(Such as sent: '>ID\r\n', Response:' \n>COM USART SET : 9600 N-8-1\r\n')

● **Command three: Set the address**

Sent
（ASCII）   >ID 2\r\n
（Hex）   3E 49 44 20 32 0D 0A

Response
（ASCII）   >CMD IS SET\r\n
（Hex）   3E 43 4D 44 20 49 53 20 53 45 54 0D 0A

Note: This 2 is the address you want to set(set according to the need,1-255)，which must be in decimal format, If 'ID' is not followed by address, the command becomes the current query address(Such as sent: >ID\r\n, Response: ID(HEX) : 02\r\n)

● **Command four: Reset**

Sent:
（ASCII）   >RESET\r\n
（Hex）   3E 52 45 53 45 54 0D 0A
After the instrument receives this command successfully，Soft reset is performed.

● **Command five: Manually exit the Settings mode**

Sent:
（ASCII）	>!\r\n	
（Hex）	3E 21 0D 0A	

Response:
（ASCII）	\n>NORMAL MODE\r\n	
（Hex）	0A 3E 4E 4F 52 4D 41 4C 20 4D 4F 44 45 0D 0A	

16. Steps:

16.1. Set the address

'Command one' => 'Command three' => 'Command five' => 'Command four'

16.2. Set the serial port configuration

'Command one' => 'Command two' =>' Command five' =>' Command four'

Note:
1. There are two spaces in the 'CUS 9600 8-N-1'to note,'8-N-1' separated by'-', no spaces.

Baud rate	Data Bits	Parity	Stop Bits
2400-115200	8	N:NONE, E:EVEN, O:ODD	1 2

2. Any setting instruction (2, 3) must first let the instrument enter the setting mode, and the setting mode will be automatically closed if no operates on setting within 15-second. so the setting instruction must be input within 15 seconds. and the 15-second countdown reset restart after successful input.

3. After setting the instrument, "Command four must be sent to make the instrument soft reset before the new setting can take effect.

4. "\r\n" is the carriage return line feed, corresponding to HEX (0x0D,0x0A)