Instrument Overview

Visibility meters provide measurements related to meteorological visibility, and the sensors are designed based on the aerosol forward scattering principle, which is a new generation of meteorological visibility monitoring equipment developed following the transmission visibility meter. The sensor can be widely used in weather stations, remote automatic weather stations and transport sectors such as airports, motorways, airways and large ships.

The visibility meter is composed of light transmitter, light receiver and microprocessor controller and other main components. The transmitter emits infrared pulse light, the receiver simultaneously detects the intensity of the pulse light scattered by the forward scattering of aerosol particles in the atmosphere, and all the measurement information is collected by the microprocessor controller and converted into Meteorological Optical Range (MOR) by special mathematical modelling algorithm.

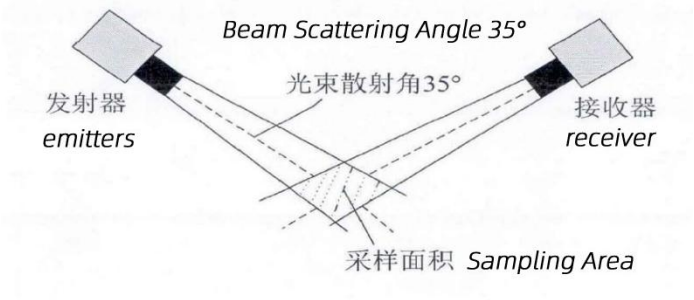
The visibility instrument requires a DC12V power supply and a three-wire RS485 communication cable. The instrument sends the meteorological visibility values and status information to the host computer in the monitoring centre via a communication interface.

The visibility instrument provides several sets of built-in commands for configuring system parameters and controlling many functions of the system. During assembly and maintenance, a display terminal is required to check system parameters and may be used to change parameter values.

Working Principle

The visibility meter has all the performance characteristics of a forward scattering instrument, which is achieved by measuring the forward scattered light emitted by suspended particles in a sampling area of less than 90 degrees; the sampling area of the visibility meter is determined by the intersection of the transmitter's transmitting optical path and the receiver's receiving optical path. Obviously, it differs from the total extinction coefficient measured by a transmissometer in that a forward scatterometer measures only the scattering coefficient at a certain angle, i.e. a narrower scattering angle near the central forward scattering angle. It is generally accepted that the calculation of daytime and nighttime visibility requires the measurement of the total extinction coefficient, not the angular scattering coefficient, and it is therefore necessary to show that the angular scattering coefficient is, under certain conditions, in definite proportion to the total atmospheric extinction coefficient, which consists of the sum of the scattered and absorbed rays over the whole range. At visibility measurements of less than 100 km, suspended particles such as fog, smoke, haze, dust or sand, and various types of precipitation determine the atmospheric extinction of visible and near-visible light, and it is only at distances of more than 100 km that the scattering of molecular matter comes into play; the absorption of

suspended particles and precipitation is negligible compared to their scattering. For these reasons, the total scattering coefficient can be equal to the total extinction coefficient at visibility less than 100 km.

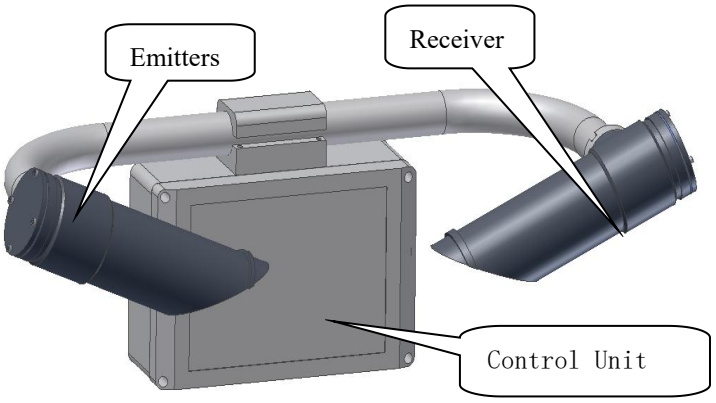


Technical parameters

Supply Voltage	DC12V
Signal output	RS485
Communication protocol	MODBUS protocol
Baud rate	9600
Technical principle	Light Scattering
Average Power Consumption	0.8W
Scattering Angle Coverage	39°-51°Front Scatter
Peak Wavelength	875nm
Bandwidth	100nm
Measurement range	5-10KM
Measurement Accuracy	≤2km, 2%； 2km-10km, ±10%；
Working Temperature	-40-80℃
Operating humidity	0-95%RH
Standard Cable Length	10m

Dimension	610mm x 230mm x 300mm
Weight	＜10KG
Material	Anodised rigid aluminium, protected by spray paint on the outer surface
Protection class	IP65

Structure composition



(1) Transmitter: Built-in laser tube that emits laser signals outward at a fixed angle;
(2) Receiver: built-in photosensitive receiving device, used to receive the laser tube irradiation to the suspended particles in the air generated by a certain angle of the scattering signal.
(3) Microprocessor control unit: built-in microprocessor controller, which samples and calculates the current visibility value. The real-time visibility value is transmitted to the data acquisition terminal through RS-485 interface.

Reliability and Maintenance Cycles

Mean Time Between Failure (MTBF): greater than 18,000 hours.
Clean optics: 3 months, or depending on the usage environment.

Environmental Adaptability

Geographic adaptability: Can be used continuously in coastal areas

Instrument Features

- structural features: visibility instrument using an integrated structural design, compact and small, sensor size and weight is very small, packaging, storage and transportation, easy to install, but also can be used as a portable instrument; unique double scattering receiver structure design, the sun and other stray light interference is reduced to a minimum.
- transmitter and receiver window lenses have undergone special anti-dust and anti-mould coating treatment, so that the thickness and speed of the lens in the natural environment to accumulate dust is greatly reduced, but also reduces the chance of contamination of salt spray and oil.
- The instrument's structural materials are high-quality rigid aluminium and 316 stainless steel, with anodized passivation treatment on the surface and multi-stage paint protection; all screws are selected from corrosion-resistant stainless steel screws; and the interior of the housing is sealed to achieve IP65 protection level with coastal climate adaptability.
- instrument power consumption is extremely low, less than 1W, so it can be adapted to battery or solar panel power supply power supply mode of operation. DC 12VDC power supply, convenient for system integration.
- Instrument collector design emphasises long-term operational stability, built-in watchdog circuit, after a long period of operational test, the instrument works stably and reliably.
- real-time data display: the sensor can output a series of digital information every 60 seconds, the information can be output through the passive recruited way.
- The DC power supply circuit of instrument has the double design of anti-reverse connection and self-recovery insurance, even if the user misoperation, it will not cause the instrument circuit board to burn, no need to replace the fuse, and it can be restored to normal after re-correct operation.
- The communication interface chip of instrument has 15KV anti-static protection, which can protect the circuit from the harm of human body static electricity to the maximum extent when the user is wired for operation.
- instrument has lightning protection measures, its communication interface and power interface have lightning protection design, which can minimise lightning damage.

Installation Requirements

Before you start installing the visibility meter, create a plan of the installation steps. The following are examples of how to organise a plan for the installation process:

a) Mount the column

b) Mounting the visibility meter on the post

c) Connecting the equipment

-Connect the power and communication cables from the site to the terminal blocks

-Connect the communication cable to the host computer.

d) Perform start-up tests of the system

The main requirements for the location of the visibility meter are:

a) The measurements at the location should be representative of the surrounding weather conditions.

b) This location should be free from obstacles and reflective surfaces that interfere with optical measurements and from obvious sources of pollution.

It is recommended that there are no obstructions in the line of sight of the transmitter and receiver. If the transmitter beam reflects off an obstacle onto the receiver, the sensor will indicate a very low visibility value because it will not be able to distinguish between the reflected signal and the true scattered signal.

Installation location Avoid direct sunlight into the receiver. The receiver wiring may become saturated in bright sunlight and the built-in diagnostics will display a warning. Strong sunlight also increases the noise level inside the receiver.

Installation steps

Installation of the visibility meter requires the user to provide an existing mounting post and the instrument is supplied with mounting clamps, which have a very large mounting allowance.

Mounting the visibility meter

Hold the visibility meter up, with the V-clamp on the back of the control box close to the column, and use another V-clamp and 2 screws to mount the visibility meter in its entirety on the column or cross arm. The mounted visibility meter is in a horizontal position with the open slopes of the transmitter and scatter receiver facing down.

Front Mounting Diagram

Rear Mounting Diagram

Communication protocols

Communication parameters: Baud rate 9600 Data bits 8 bits No parity bit

The interval between two communications is at least 1000ms

[1] Write device address

Send: 00 10 Address CRC (5 bytes)

Return: 00 10 CRC (4 bytes)

Note: 1. The address bit of the read/write address command must be 00. 2.

2. Address is 1 byte, the range is 0-255.

Example: Send 00 10 01 BD C0

Return: 00 10 00 7C

[2] Read device address

Send: 00 20 CRC (4 bytes)

Return: 00 20 Address CRC (5 bytes)

Note: Address is 1 byte, the range is 0-255.

Example: Send 00 20 00 68

Return: 00 20 01 A9 C0

A. Read real-time data:

Assume the device address is: 0X01, valid range 0~254, 0 is broadcast address.

such as：01 03 00 00 00 05 84 18

NO.	Implications	Offset	Bytes	Description
1	Device address	0	1	Device unique address
2	Opcode (Read)	1	1	Fixed value 0x03
3	Register start number	2	2	First register number read
4	Number of registers to read	5	2	5 registers
5	CRC16 check	6	2	Low before high after

Device Returns：

01 03 0A xx xx xx xx xx xx xx xx xx xx CRC16

NO.	Implications	Offset	Bytes	Description
1	Address field	0	1	Address (0x01)
2	Opcode	1	1	Read only (0x03)
3	Data length field	2	1	
4	Data field	3	2	Visibility value
	Debug Data	5	4	Voltage
	Debug Data	9	2	Current Visibility Value
	Debug Data	5	8	Visibility: Previous values
5	Checksum field	13	2	Low Front High Back

Operation code: fixed at **0x03**, i.e. read operation, no other operation is supported.
Starting number: range 0-15, indicates the first register number to be read.
Number of registers: range 1-16, said to read the last register number +1, the read data does not include the contents of this number of registers, only as the end of the mark, its value must be guaranteed to be greater than or equal to the "starting number".

B. The device returns the data frame:
01 03 0A 27 10 00 00 07 D0 2E E0 12 00 CRC16

Communication example:
Send: 01 03 00 00 00 00 01 84 0A
Return:
01 03 0A 27 10 00 00 00 07 D0 2E E0 12 00 9D DD
27 10 is the visibility data, is a hexadecimal integer, converted to decimal is 10000, visibility resolution is 1, that is, 10000 M.

C. CRC16 check digit calculation
1) Preset 1 16-bit register to hex FFFF (i.e., all 1s); call this register the CRC register;

2) Isolate the first 8-bit binary data (both the first byte of the communication information frame) with the lower 8 bits of the 16-bit CRC register, and put the result in the CRC register;

3)Shift the contents of the CRC register right one bit (towards the lower bit) to fill the highest bit with 0, and check the shifted out bit after the right shift;

4) If the shifted out bit is 0: repeat step 3 (shift right one bit again);
If the shifted out bit is 1: the CRC register is iso-or with the polynomial A001 (1010 0000 0000 0001);

5) Repeat steps 3 and 4 until it is shifted right 8 times so that the entire 8-bit data is all processed;

6) repeating steps 2 to 5 for the next byte of the communication information frame;

7) exchanging the high and low bytes of the 16-bit CRC register obtained after all bytes of this communication information frame have been calculated according to the above steps;

8) The content of the CRC register obtained at last is the CRC16 code. (Note that the CRC code obtained is the order of low before high)

D. Channel data conversion
For example, the visibility of the hexadecimal code for "27 10", converted to decimal for 10000, that is, 2 * 16 ^ 3 + 7 * 16 ^ 2 + 1 * 16 ^ 1 + 0 * 16 ^ 0 = 10,000, this time, the visibility resolution of 1, the final result of 10000M

Fault resolution

- When data is output from , the display indicates that the value is 0 or not within range. The collector

may not be able to acquire information correctly due to wiring problems. Please check whether the wiring is correct and firm, and whether the power supply voltage is normal;

- If it is not the above reason, please contact the manufacturer.

After Sales & Service

- The unit has no moving parts and does not require complex routine maintenance on site.
- If the user opens the equipment by himself or damages the safety seal on it, he will not be able to enjoy our quality assurance and approval.
- In the unlikely event of any problems with the equipment, our staff can be contacted to analyse and answer questions;

If the equipment needs to be returned, please pack the instrument carefully according to the original packaging and mail it to our company with the detailed failure manual of the instrument.

Appendix:

Modbus Point Table:

Register Address	Byte	Meaning
41001	2	Measured Value
41002	4	Voltage Value
41003		
41004	2	Current Value
41005	2	Previous Value

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