Micro Environment Quality Monitoring Station

User Manual

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1. General safety overview

1.1 Precautions for installation and transportation

Identification	Description	Remarks
 **ELECTRIC SHOCK RISK**	The chassis shell should be grounded at installation. Installation is strictly prohibited when it is powered on, otherwise short circuit may occur.	Do not operate when it is power on and ensure safe grounding.
 **ATTENTION**	The equipment should be installed in a clean place which is free of corrosion or violent vibration to reduce equipment contamination, corrosion, and violent vibration.	
	The equipment should be properly installed to make sure that it can support the weight of the host, and should be in strict accordance with the installation instructions.	Make sure the installation is reliable and secure.
	Avoid violent collision and vibration at handling. It should be handled with care to prevent against damage to the parts.	
	It can only be handled after the chassis door is closed to avoid personnel injury.	The chassis cover is prone to squeezing other items or human body.
	Avoid foreign matters falling into the equipment during the installation process since they may cause short circuit in the chassis or malfunction.	The falling matters are prone to causing short circuit or part damage.
	High-precision instrument should ensure reliable grounding.	Ensure normal operation of the equipment.

1.2 Operation Notes

Symbol	Description	Remarks
 **ATTENTION**	Make sure to read the User Manual before operation.	Read the User Manual before operation.
	Do not operate for a long time when the equipment casing cover is open, otherwise it may cause safety hazards. It the equipment is exposed to dust and sundries in long term, its performance may be affected.	Therefore, keep the cover closed at running.

 **DON'TS**	It is forbidden to make any body part or metal object to touch the bare parts, such as wiring terminal.	High possibility of short circuit.
	Liquid is strictly prohibited to enter the chassis and probe, which may cause fires or major failures .	Prevent liquid from entering.
	Snow, ice and frost are prohibited to directly enter the chassis and probe. Prevent fires and major failures.	

1.3 Precautions for maintenance

Symbol	Description	Remarks
 **ELECTRIC SHOCK RISK**	When carry out normal maintenance of the equipment, the power should be turned off to avoid charged operation.	Do not operate when it is power on.
 **ATTENTION**	Read the User Manual before maintenance and check.	
	Avoid operating the device with wet hands.	Waterproof
	Parts can only be replaced by conforming or specified ones, otherwise it will cause failure or malfunction.	Choose conforming parts.
	The scrapped parts should be handled with according to relevant regulations.	Environment protection should be taken into consideration while handling with the scrapped parts.
	Please maintain and calibrate the instrument regularly.	
 **INFO**	If you failed to fix the problem by following the instructions of the Manual, please contact the seller or our technical staff. Unauthorized disassembly may cause an accident or permanent damage to the product.	

2. Product overview

The micro environment quality monitoring station can be used for measuring the concentration of $PM_{2.5}$ and PM_{10} particles, as well as pollutant gas such as SO_2, NO_2, O_3, CO and TVOC under outdoor atmospheric environment. It can monitor environmental parameters, including temperature, humidity, air pressure, etc. Relying on the ARM CortexM3 processor, Internet of things, sensor technology and GPRS wireless communication technology, the instrument can collect the mass concentration of the particles in the air in real time, and transmit the data to the cloud server through GPRS wireless transmission.

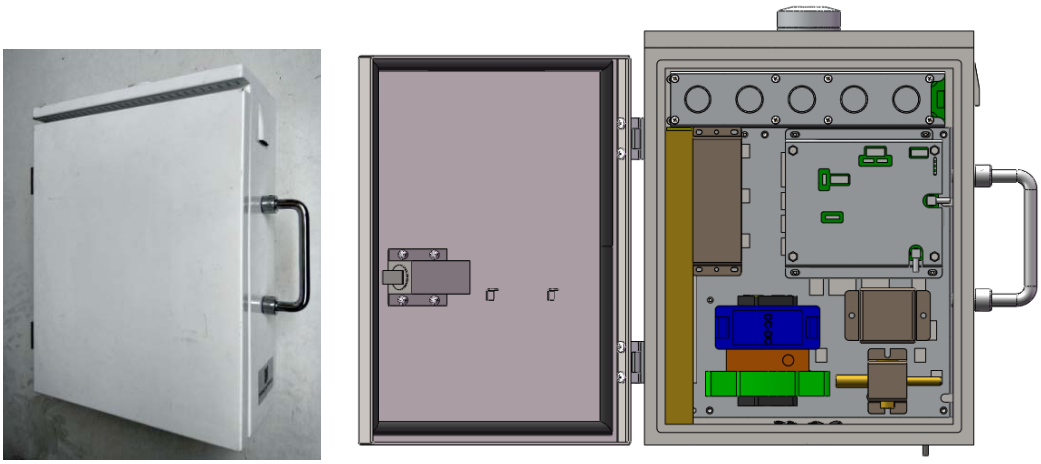

Fig. 3.1 Micro environment quality monitoring station

Thanks to the industrial grade components and the integration of long-service life laser measuring module, GPS positioning module, heating and dehumidification regulating module etc., the equipment can run stably and reliably for long term. The modular design makes on-site maintenance easy.

3. Product features:

- Long-service life light scattering measurement module;
- Industrial grade electronic components enable long-term operation within the temperature range from -30 to 50 °C;
- The heating and dehumidification regulation can significantly reduce the impacts of water vapor;
- GPRS wireless communication function;
- GPS positioning and anti-theft tracking function;
- Support automatic recovery and data reissue function in case of disconnection;
- The built-in backup battery is available. The platform will alarm when the external power supply is disconnected.

4. Working principle

4.1 Light scattering principle

This product adopts modular design which is characterized by simple on-site maintenance. Following the laser scattering measurement principle, when the suspended particles in the air are irradiated by laser, scattering will occur. The curve of scattered light intensity changes over time can be obtained by the photoelectric conversion circuit. According to Mistral's theoretical algorithm, the

equivalent particle size and quantity of the particles in unit volume can be calculated. In addition to technologies such as automatic temperature control, GPS positioning, GPRS wireless communication and intelligent electronic lock, the equipment is characterized by high precision, strong environmental adaptability, safe and reliable operation etc. It can run stably and reliably for long term under outdoor atmospheric environment.

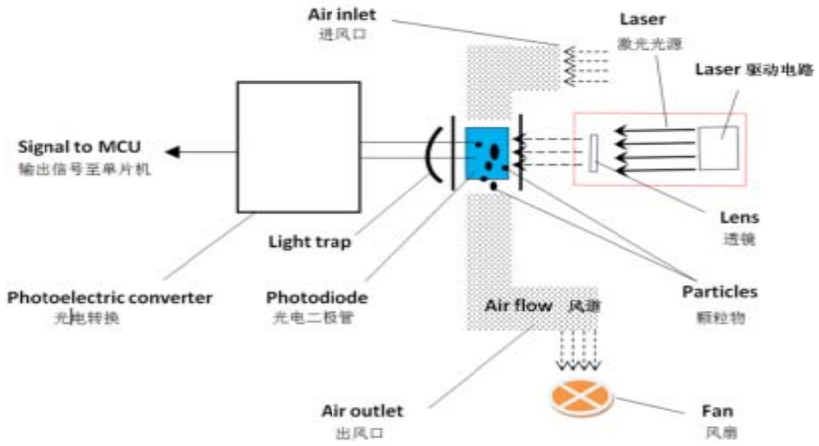

Fig. 5.1 Light scattering principle

4.2 Principle of electrochemistry

Atmospheric environmental gas pollutants, such as SO_2, NO_2, O_3 and CO work according to the principle of electrochemistry. Based on the electrochemical oxidation process of the gas to be measured on the working electrode potential in the electrolytic cell, the current generated by the electrochemical reaction of the gas to be tested is proportional to its concentration, and follows Faraday's law. The concentration of the gas to be measured can be determined by measuring the magnitude of the current.

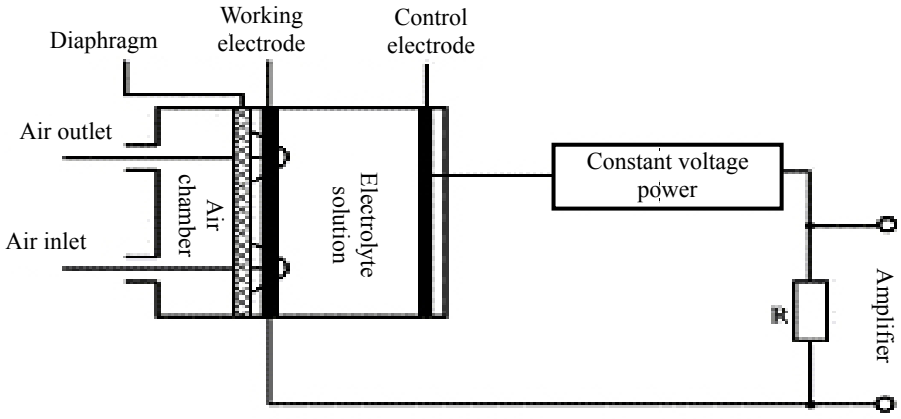

Fig. 5.2 Principle of electrochemistry

4.3 PID principle

TVOC gas detection is based on PID photoion principle. The PID sensor consists of main parts such as ultraviolet light source and ion chamber. The positive and negative electrodes are allocated in the ion chamber to form an electric field. The organic volatile molecules are excited by high-energy ultraviolet light source to generate negative electrons and positive ions. These ionized particles form current between the electrodes. The current signal will be output through detector amplification and processing. And finally, ppm level of concentration can be detected.

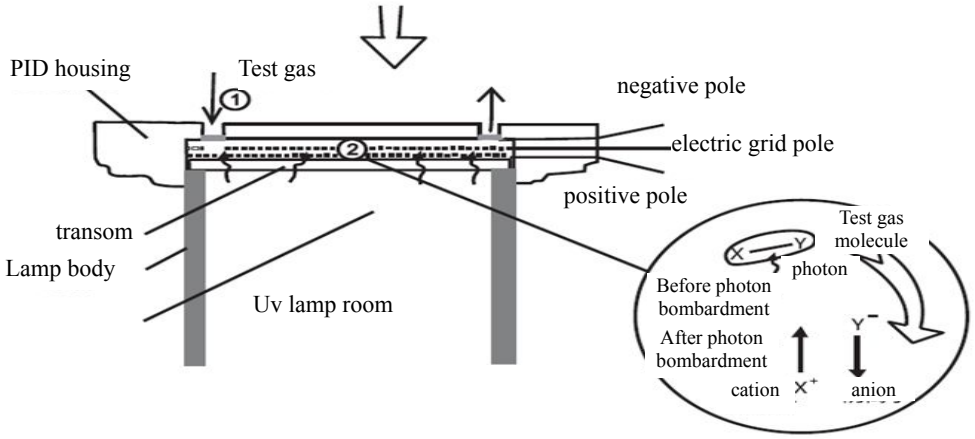

Fig. 5.3 PID photoion principle

5.Performance indices

Items	Technical index
Sampling interval	5min
Particle type	**$PM_{2.5}$**
Measuring range	0 ~ 1000μg/m^3
Measuring accuracy	> 100μg/m^3 , ±15% ; < 100μg/m^3 , ±15μg/m^3 , Correlation coefficient between sensors >0.95.
Particle type	**PM_{10}**
Measuring range	0 ~ 1000μg/m^3
Measuring accuracy	> 100μg/m^3 , ±20% ; < 100μg/m^3 , ±20μg/m^3 , Correlation coefficient between sensors >0.95.
Pollutant type	**SO_2**
Measuring range	0~10 ppm

Resolution (detection limit)	5Ppb, correlation coefficient between sensors >0.8.
Pollutant type	**NO_2**
Measuring range	0~10ppm
Resolution (detection limit)	15ppb, correlation coefficient between sensors >0.8.
Pollutant type	**O_3**
Measuring range	0~5ppm
Resolution	15ppb, correlation coefficient between sensors >0.8.
Pollutant type	**CO**
Measuring range	0~10ppm
Resolution (detection limit)	5ppb, correlation coefficient between sensors >0.8.
Pollutant type	**TVOC**
Measuring range	0~50ppm
Resolution (detection limit)	1ppb, correlation coefficient between sensors >0.9.
Power supply method	Battery powered or DC power supply (power range: 18~72V standard value: 48V)
Battery parameter	Output voltage: 3.7V Battery capacity: 5300mAH
Industrial design	Meet IP53 industrial grade standards; waterproof
Weight	Less than 3kg
Power consumption of the overall machine	≤3W (When the temperature is lower than 0 °C, the heating module will start. The power consumption is 11W.)
Data encryption	Data encryption, data verification and authentication functions available
Self-test	Power failure alarm available Data link timeout and sensor failure alarm function available
Operation temperature range	-30℃ ~ 50℃

Working atmosphere pressure	86-110Kpa
Working humidity	0-95%RH
Precision	< 10%FS
CPU	ARM CortexM3
Wireless communication	GPRS
Positioning	GPS, outdoor positioning accuracy error is within 10m
Data transfer protocol	MQTT
Electromagnetic compatibility	IEC grade 3
Overall dimensions	240x300x100mm
SIM card	Unicom / Mobile 2G IoT Card
GPS positioning accuracy	<10m (outdoor)
Real-time data transmission	Time interval of data reception 5min

6.Installation

6.1 List of equipment and accessories

- Product 1 set;
- An AC (220V) converting to DC (48V) power adapter;
- 1 three-phase power cord;
- 1 air plug female head with 10cm of welded cable;
- 1 fuse (placed inside the chassis).

6.2 Installation and precautions

- The equipment must be powered by the supplied power adapter;
- The equipment should be installed vertically. The antenna must face the zenith. And there should be no obstacles above;
- The equipment supports secondary lightning protection. It must be grounded through a ground terminal with a single-core hard cable of 2.5 square or above.
- When it is fixed on a metal pole, such as the communication base station and the street light pole of the Tower, it needs to be installed vertically, 6 to 10 meters above the ground;
- When it is fixed on the wall, it should be installed vertically, 6 to 10 meters above the ground. And ensure that there is no rain water flowing down the wall to avoid the exit of strong air

ducts (such as air conditioning outlets);

6.3 Installation and construction steps

- Make the power supply cable; calculate the distance between the fixing position of the equipment and the power supply; and cut the red and black two-core power supply cable of sufficient length;
- Use the accessory, the waterproof crimp terminal, to connect one end of the power cable to the DC output cable of the power adapter. And connect the other end to the power supply air plug (female), which is an accessory as well. The red line is connected to the positive pole (the first leg of the air plug), and the black wire is connected to the negative pole (the second leg of the air plug);
- Test the power supply cable, power on the power adapter, and measure the male end of the air plug with a multimeter. The reading should be DC 48V. If it failed to pass the test, for example the line sequence is reversed or the voltage is not 48V, please do not use it;
- Fix the equipment;
- Insert the prepared power supply cable (the female end of the air plug) and the power supply end (the male end of the air plug) at the bottom of the device, and screw tightly;
- The accessory, power adapter, is bundled and fixed in the distribution box, or other rainproof areas. After power-on, the adapter blue light will be on;
- When the mobile communication GSM network signal is normal, the device can be online to the server after 10 to 20 minutes of power-on. At this time, use the mobile APP to scan the code and submit the online information;
- After the online information is submitted, the device is installed.

FCC Warning :

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device,
pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause
harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.