Temtop®

PMD 351

Aerosol (Mass) Monitor
User Manual

Notices about this User Manual

Technical Support

If you require support, please advise this User Manual to resolve your problem. If you are still experiencing difficulty or have further questions, you may contact a customer service representative during business hours Monday to Friday, 8:30 a.m. to 5:30 p.m. (Pacific Standard Time).

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⚠ CAUTION!

Please read this manual carefully! Use of controls or adjustments or operation other than those specified in this manual, may cause danger or damage to the monitor.

⚠ WARNING!

- The monitor features an internal laser transmitter. Do not open the monitor housing.
- The monitor shall be maintained by the professional from the manufacturer.
- Unauthorized maintenance may cause hazardous radiation exposure of the operator to laser radiation.
- Elitech Technology, Inc. accepts no responsibility for any malfunction that are caused by improper handling of this product, and such malfunction will deem as falling outside the conditions of Warranty and Services outlined in this User Manual.

⚠ IMPORTANT!

- PMD351 has been charged and can be used after unpacking.
- Keep the air inlet in the direction of wind flow and keep the monitor stable during detection.
- Do not use this monitor to detect heavy smoke, high-concentration oil mist, or high-pressure gas to avoid laser tip damage or air pump block.

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1. Introduction

PMD 351 is a small, light, and battery-powered aerosol (mass) monitor with five channels for simultaneous detection of PM1.0, PM2.5, PM4.0, PM10, and TSP (Total Suspended Particles) mass concentrations.

With a large display screen and seven buttons for operation, the monitor is simple and efficient, suitable for fast detection in multiple scenarios. The internal high-performance lithium battery allows the monitor to run continuously for 12 hours. PMD 351 also has a built-in 8GB large-capacity storage and supports two communication modes: USB and RS232. The detected data can be viewed directly on the screen or exported through the USB port for analysis.

2. Product Overview

Fig 1

① Intake Duct	② Display Screen	③ Buttons	④ USB Port
⑤ PU Protective Case	⑥ 8.4V Power Port	⑦ RS-232 Serial Port	

Button Functions

POWER	Hold for 2 seconds to turn on/off the monitor.
MENU	When the monitor is on, press the button to enter MENU interface; In the MENU interface, press the button to switch options.
OK	Press the button to confirm the option.
	Press to back to the previous status.
START/STOP	Press to start/stop sampling.
	Scroll up the options in the Menu interface; Increase parameter value.
	Scroll down the options in the Menu interface; Increase parameter value.

3. Operations

3.1 Power ON

Press and hold POWER for 2 seconds to power on the monitor, and it will display an initialization screen (Fig 2).

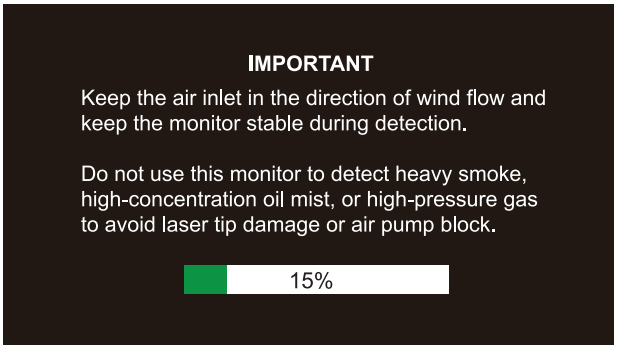

Fig 2

After the initialization, the monitor enters the main interface. It will not start the measurement by default to save the power (Fig 3).

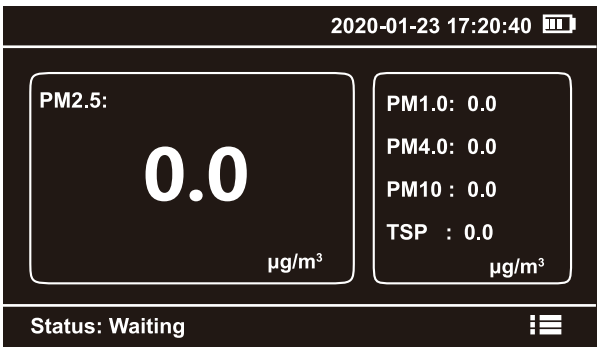

Fig 3

Press START/STOP to start detection, and it will display the real-time concentration of all parameters (Fig 4).

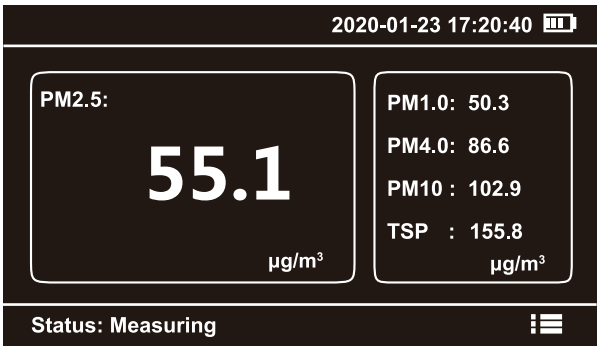

Fig 4

3.2 Settings Menu

Press MENU to enter the MENU interface, then Press ▲ or ▼ to switch between the options. Press OK to enter your preferred option to view or change settings (Fig 5).

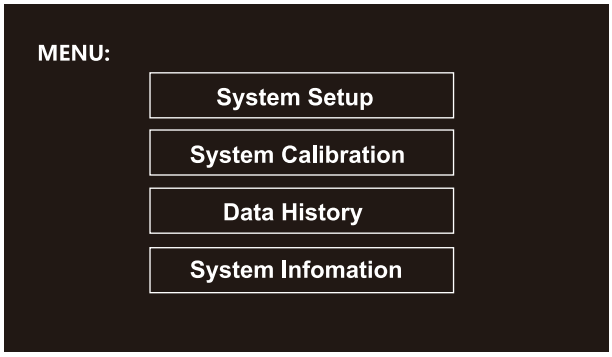

Fig 5

MENU options are as follows:

Menu	Display as...	Description
System Setting	Setting	Set system time, COM and language
System Calibration	Calibration	Calibrate zero, K-Factor and flow
Data History	History	View data history
System Information	Information	Display device information

3.2.1 System Setting

In the system setting interface MENU->Setting, you can set time, COM, and language. Press ▲ or ▼ to switch the options (Fig 6) and press OK to enter.

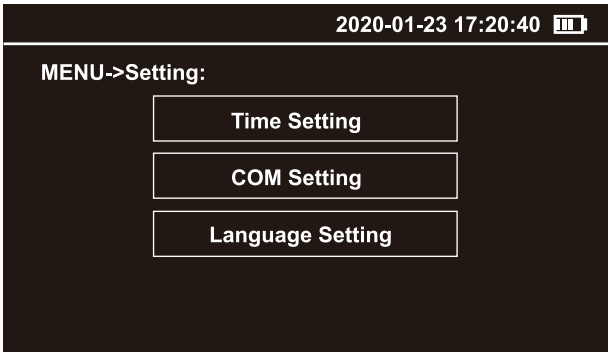

Fig 6

• Time Setting

Press MENU to switch the option, press ▲ or ▼ to increase or decrease the value, finally switch to the option **Set Time** and press OK to save the setting (Fig 7).

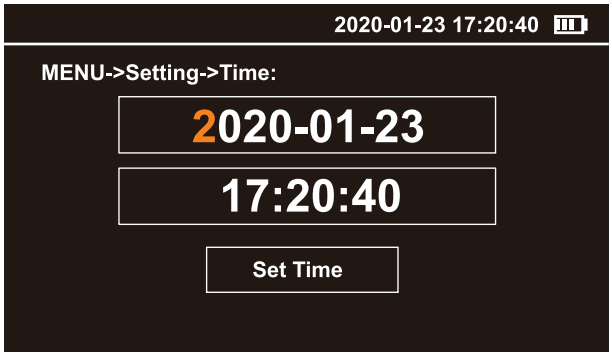

Fig 7

- **COM Setting**

Press ▲ or ▼ to select the baud rates among three options: 9600, 38400, and 115200. Then press MENU to switch to **Set COM** and press OK to save the setting (Fig 8).

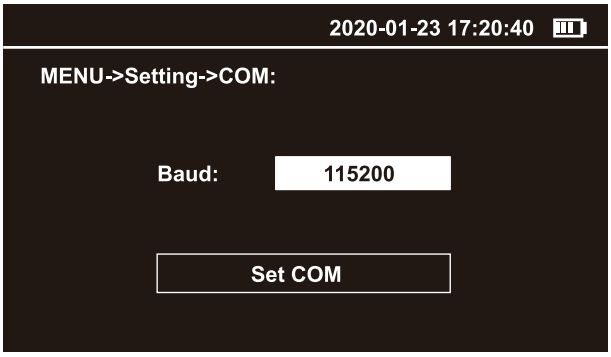

Fig 8

- **Language Setting**

The monitor supports two languages, English and Chinese. Please press ▲ or ▼ to select the desired language, then press MENU to switch to **Set Language** and press OK to save the setting (Fig 9).

Fig 9

3.2.2 System Calibration

In the system setting interface MENU->Calibration, you can operate Zero Point, K-Factor, and Flow Calibration. Press ▲ or ▼ to switch the option and press OK to enter (Fig 10).

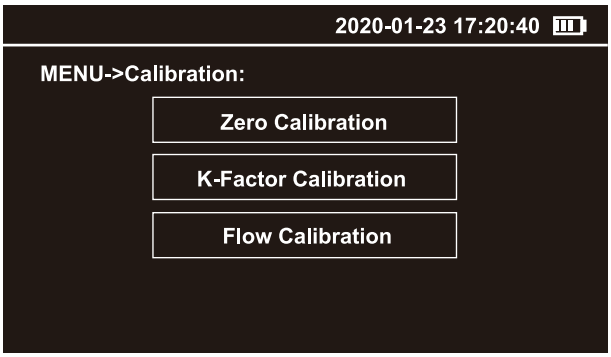

Fig 10

• Zero Calibration

Before start, please install the filter and the air inlet according to the prompt reminder on the display. Please see **5.2 Zero Calibration** for more installation details.

Press OK to start the calibration. It takes about 30 seconds countdown. After the countdown finishes, the display prompts reminder to confirm the calibration finishes successfully and will returns to the MENU interface automatically (Fig 11).

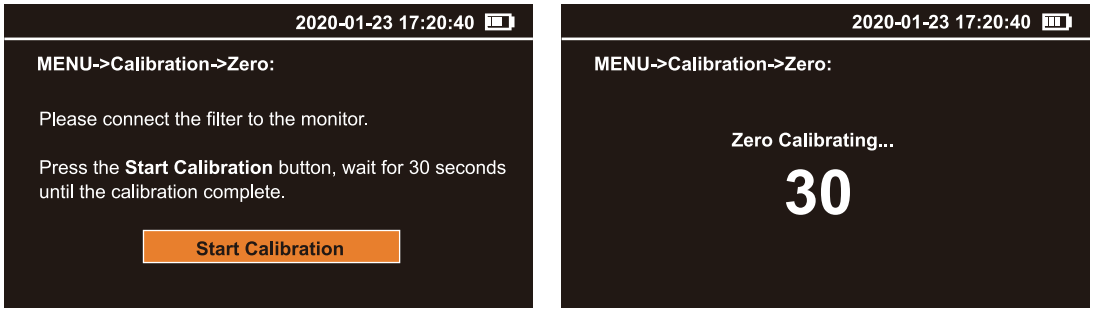

Fig 11

• K-Factor Calibration

Under K-Factor interface, press MENU to switch the option, press ▲ or ▼ to increase or decrease the value, which ranges from 0.1 to 9.9. After the setting is completed, press MENU to switch to **Save** and press OK to save (Fig 12).

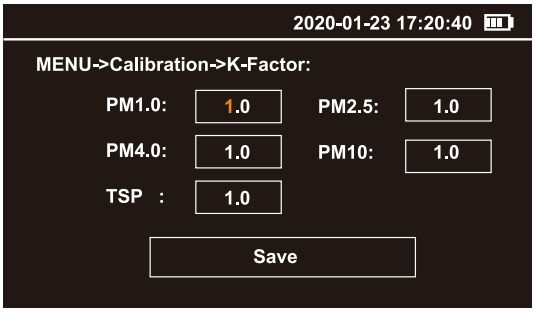

Fig 12

• Flow Calibration

Before start, please install the flow meter to the air inlet as prompt on the display. Please see **5.3 Flow Calibration** for full installation operation.

Under Flow Calibration interface, press OK to start calibrating. Then press ▲ or ▼ to increase or decrease the value until the flow meter reading reaches 2.83 L/min. After the setting finishes, press OK to save the setting and exit (Fig 13).

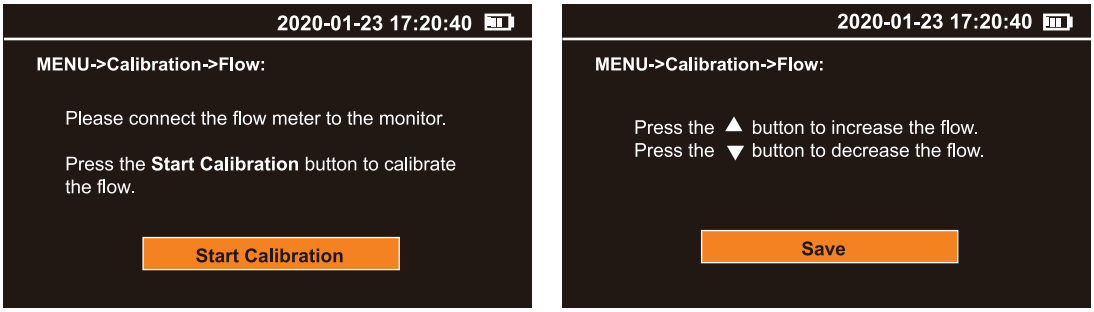

Fig 13

3.2.3 Data History

The History menu interface allows data query and download. Press ▲ or ▼ to switch the option and press OK to enter the corresponding interface (Fig 14).

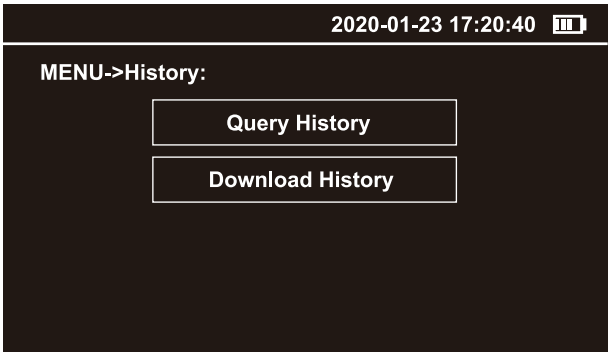

Fig 14

- **Data Query**

Under the Query interface, the data can be queried by month, and the displayed interval is one minute per day for the month.

By default, the system will recommend the current month automatically. If you need data for other months, please press MENU switching to the year and month options, then press ▲ or ▼ to increase or decrease the value. After complete, press MENU to switch to **Query** and press OK to enter.

The displayed data is sorted in descending time where the latest data is at the front. Press ▲ or ▼ to turn the page (Fig 15).

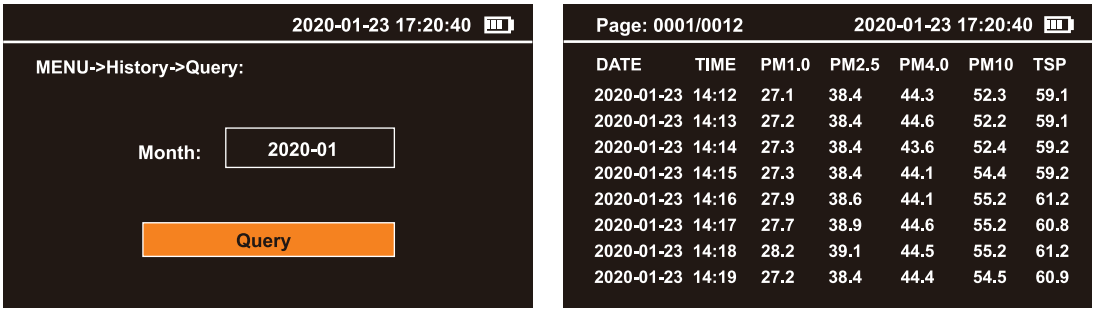

Fig 15

- **Data Download**

In the Download interface, insert a USB device such as a USB flash drive or card reader into the USB port of the monitor and press OK , the monitor will check the connection status of the USB device (Fig 16).

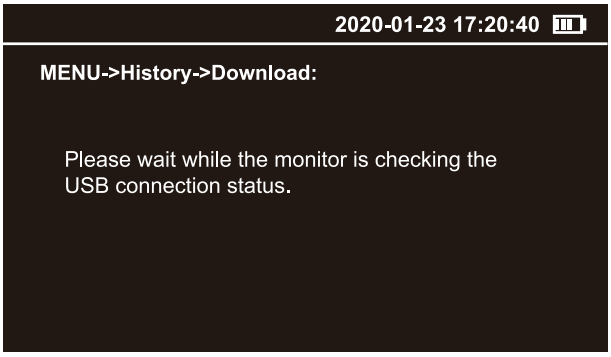

Fig 16

If the USB device fails to connect or there is no USB device connected, the display will prompt a reminder.Please reconnect it or try again later (Fig 17).

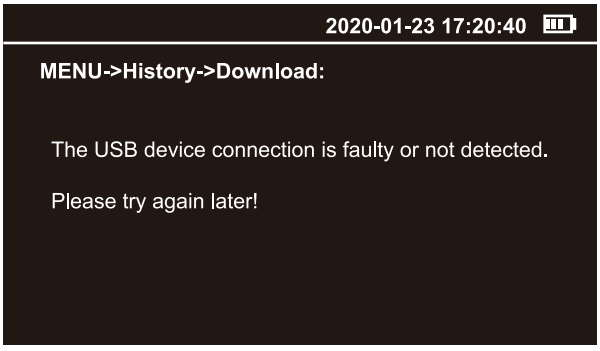

Fig 17

If the USB device is successfully connected, press OK to download the data (Fig 18).

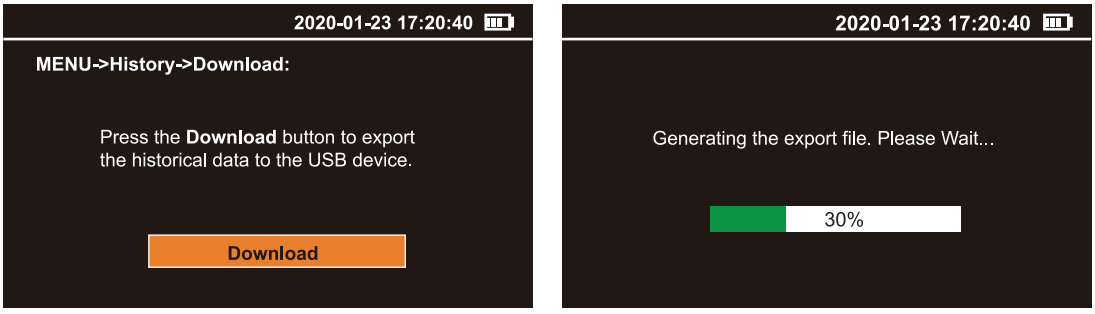

Fig 18

After the data downloaded, unplug the USB device and insert it into the computer to find a folder named **Temtop**. You can view and analyze the data now.

3.2.4 Product Information

The Information interface shows the following information (Fig 19).

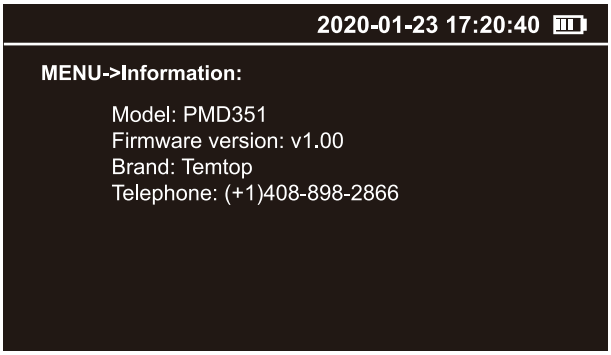

Fig 19

3.3 Power OFF

Press and hold POWER for 2 seconds to turn off the monitor (Fig 20).

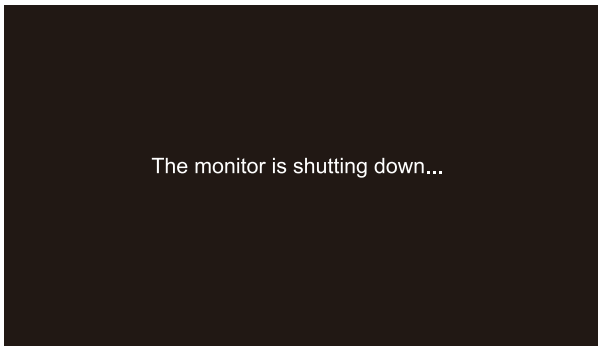

Fig 20

4. Protocols

PMD 351 supports two communication modes: RS-232 and USB.
RS-232 serial communication is used for real-time interaction.
USB communication is used to export data history.

4.1 RS-232 Serial Communication

The PMD 351 is based on the Modbus RTU protocol.

Description

1) Master-Slave:

Only the master can initiate communication, as the PMD 351 is a slave and will not initiate communication.

2) Packet identification:

Any message(packet) starts with a silent interval of 3.5 characters. Another silent interval of 3.5 characters marks message end.Silence interval between characters in the message needs to be kept less than 1.5 characters.

Both intervals are from the end of Stop-bit of previous byte to the beginning of the Start-bit of the next byte.

3) Packet Length:

PMD351 supports a maximum data packet (serial line PDU, including address byte and 2 bytes CRC) of 21 bytes.

4) Modbus Data Model:

PMD 351 has 4 main data tables (addressable registers) that can be overwritten:

- Discrete input (read-only bit)
- Coil (read / write bit)
- Input register (read-only 16-bit word, interpretation depends on application)
- Holding register (read / write 16-bit word)

Note: The sensor does not support bit-wise access to registers.

4.1.1 Register List

Restrictions:

1. Input registers and holding registers are not allowed to overlap;
2. Bit-addressable items (i.e., coils and discrete inputs) are not supported;
3. The total number of registers is limited: 8 input registers and 14 holding registers.

The register map (all registers are 16-bit words) is summarized in the table below.

Input Register List		
No.	**Meaning**	**Description**
0	N/A	Reserved
1	N/A	Reserved
2	N/A	Reserved
3	PM1.0 concentration	Concentration value
4	PM2.5 concentration	Concentration value
5	PM4.0 concentration	Concentration value
6	PM10 concentration	Concentration value
7	TSP concentration	Concentration value

Holding Register List			
No.	**Meaning**	**Description**	
0	N/A	Reserved	
1	Instruction Register	Instruction	Parameter
		0x00	0x00: Stop detection 0x01: Start detection
2	N/A	Reserved	
3	PM1.0 coefficient	Coefficient value	
4	PM2.5 coefficient	Coefficient value	
5	PM4.0 coefficient	Coefficient value	
6	PM10 coefficient	Coefficient value	
7	TSP coefficient	Coefficient value	
8	Year	Year	
9	Month	Month	
10	Day	Day	
11	Hour	Hour	
12	Minute	Minute	
13	Second	Second	

4.1.2 Function Code Description

PMD351 supports the following function codes:
0x03: Read holding register
0x04: Read input register
0x06: Write a single holding register
0x10: Write multiple holding register
The remaining Modbus function codes are not supported for the time being

4.1.3 Serial Setting

Baud rate: 9600, 38400, 115200 (see **3.2.1 COM Setting**)
Data bits: 8
Stop bit: 1
Check bit: N/A

4.1.4 Application Example

- **Read Detected Data**

The sensor address is 0xFE.
Use 0x04 (read input register) in Modbus to obtain detected data.
The detected data put in a register with a starting address of 0x03, the number of registers is 0x05, and the CRC check is 0x06D4.
The PMD351 responds a value that is 10 times the actual concentration. In the example
PM1.0 is 0x00CF (actual value is 20.7ug / m^3),
PM2.5 is 0x0138 (actual value is 31.2ug / m^3),
PM4.0 is 0x018F (actual value is 39.9ug / m^3),
PM10 is 0x01F5 (actual value is 50.1ug / m^3),
TSP is 0x0241 (actual value is 57.7ug / m^3).

The master sends:

Slave Address	Function Code	Starting address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x04	0x00	0x03	0x00	0x05	0xD4	0x06

The slave responds:

Slave Address	Function Code	Quantity	PM1.0 Hi	PM1.0 Lo	PM2.5 Hi	PM2.5 Lo	PM4.0 Hi	PM4.0 Lo
0xFE	0x04	0x0A	0x00	0xCF	0x01	0x38	0x01	0x8F

PM10 Hi	PM10 Lo	TSP Hi	TSP Lo	CRC16 Lo	CRC16 Hi
0x01	0xF5	0x02	0x41	0x68	0xE9

- **Start Detection**

The sensor address is 0xFE.
Use 0x06 (write a single holding register) in Modbus to start the detection.
Write 0x01 to register 0x01 to start detection. The starting address is 0x0001, and the registered value is 0x0001. CRC calculated as 0xC50D, first sent in low byte.

The master sends:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x06	0x00	0x01	0x00	0x01	0x0D	0xC5

The slave responds:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x06	0x00	0x01	0x00	0x01	0x0D	0xC5

- **Stop Detection**

The sensor address is 0xFE.
Use 0x06 (write a single holding register) in Modbus to stop the detection.
Write 0x000B to register 0x01 to start the detection. The starting address is 0x0001, and the registered value is 0x0000. CRC calculated as 0x05CC, first sent in low byte.

The master sends:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x06	0x00	0x01	0x00	0x00	0xCC	0x05

The slave responds:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x06	0x00	0x01	0x00	0x00	0xCC	0x05

- **Set K-Factor**

The sensor address is 0xFE.
Use 0x06 (write a single holding register) in Modbus to set the K-Factor (10 times the actual value, the range is 1-99, corresponding to the actual value 0.1-9.9).
Set the K-Factor of PM1.0 to 1.1 by writing 0x000B to register 0x03 (similar for the remaining PM2.5, PM4.0, PM10, and TSP).
The CRC check is 0x022C.

The master sends:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x06	0x00	0x03	0x00	0x0B	0x2C	0x02

The slave responds:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x06	0x00	0x03	0x00	0x0B	0x2C	0x02

- **Read K-Factor**

The sensor address is 0xFE.
Use 0x03 (read holding register) in Modbus to read K-Factor (10 times the actual value, the range is 1-99, corresponding to the actual value 0.1-9.9).
The K-Factor of PM2.5 put in the holding register at address 0x04, and the number of registers is 0x01.
The CRC check is 0xC4D1.
The slave responds with 0x0C as the value of K-Factor, and the actual value is 1.2.

The master sends:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x03	0x00	0x04	0x00	0x01	0xD1	0xC4

The slave responds:

Slave Address	Function Code	Quantity	K Hi	K Lo	CRC16 Lo	CRC16 Hi
0xFE	0x03	0x02	0x00	0x0C	0xAC	0x55

- **Set Time**

The sensor address is 0xFE.
Use 0x10 (write multiple holding registers) in Modbus to set the time.
In the register with start address 0x08, the number of registers is 0x06, and the number of bytes is 0x0C, which respectively correspond to the year, month, day, hour, minute, and second.
Year is 0x07E4 (actual value is 2020),
Month is 0x0002 (actual value is February),
Day is 0x0002 (actual value is 2th),
Hour is 0x0011 (actual value is 17),
Minute is 0x0023 (actual value is 35 minutes),
Second is 0x0013 (actual value is 19 seconds),
The CRC check is 0x8DE8.

The master sends:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	Byte Count	Year Hi
0xFE	0x10	0x00	0x08	0x00	0x06	0x0C	0x07

Year Lo	Month Hi	Month Lo	Day Hi	Day Lo	Hour Hi	Hour Lo	Minute Hi
0xE4	0x00	0x02	0x00	0x02	0x00	0x11	0x00

Minute Lo	Second Hi	Second Lo	CRC16 Lo	CRC16 Hi
0x23	0x00	0x13	0xE8	0x8D

The slave responds:

Slave Address	Function Code	Starting Address Hi	Starting Address Lo	Quantity Hi	Quantity Lo	CRC16 Lo	CRC16 Hi
0xFE	0x10	0x00	0x08	0x00	0x06	0xD5	0xC6

4.2 USB Communication

Please see **3.2.3 Data History - Data Download** for detail USB operations.

5. Maintenance

5.1 Maintenance Schedule

To make better use of PMD 351, regular maintenance is required in addition to correct operation. Temtop recommends the following maintenance plan:

Service Items	Frequency	By
Zero calibration	Every week/User-defined	User/Manufacturer
Flow calibration	Every month	User/ Manufacturer
Air pump, pipeline, optical detector Inspection and cleaning	Every year	Manufacturer only
Battery pack inspection	Every year	Manufacturer only

5.2 Zero Calibration

Contamination or poor air-tightness inside the monitor will affect the accuracy of the detected results. Regular calibration is required, and the matching filter should be used for calibration by the following steps (Fig.21):

1. Unscrew counterclockwise the filter cover on the intake duct.	2. Insert the filter on the air inlet of the monitor. Please note that the direction of the arrow indicates the air intake direction.

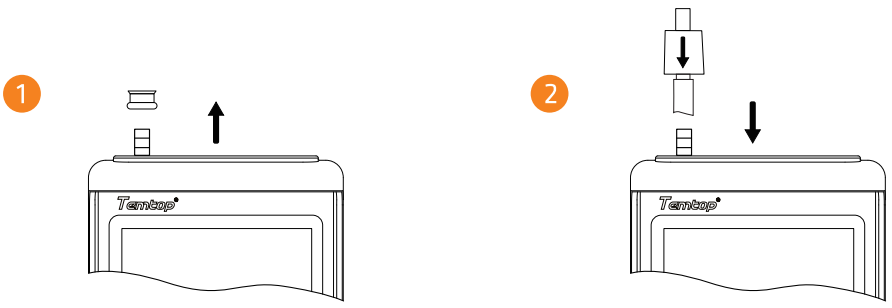

Fig 21

After the filter installed, open the Zero Calibration interface and refer to **3.2.2 System Calibration-Zero Calibration** for operation. After the calibration completed, remove the filter and screw the filter cover back.

5.3 Flow Calibration

PMD 351 sets the default flow rate to 2.83 L/min. The flow rate may change subtly due to continuous use and ambient temperature changes, thus reducing detection accuracy. Temtop offers flow calibration accessories for testing and adjusting flow.

Follow the steps below to calibrate the flow:

- Remove the intake duct.
- Connect the air inlet of the monitor to the inlet adapter of the flow meter.
- Start sampling and observe the flow meter reading after about 30 seconds.
- Follow **3.2.2 System Calibration-Flow Calibration** to adjust the flow to 2.83L/min and save.

Note: 1. When using the flow meter, slowly open the upstream valve first until it is fully open, and then use the downstream valve to adjust the flow. When stop using the flow meter, slowly close the upstream valve first, and then the downstream valve.
2. Only read the flow meter when the floater remains stable. Reading position: The

5.4 Annual Maintenance

It is recommended to return PMD351 to the manufacturer for annual calibration by specialized maintenance personnel in addition to weekly or monthly calibration by users. Annual return-to-factory maintenance also includes the following preventative items to reduce accidental failures:

- Check and clean the optical detector;
- Check air pumps and pipes;
- Cycle and test the battery.

6. Troubleshooting

Failure	Possible Causes	Solution
Low battery information	Low battery level	Charge the battery for 3.5 hours
Sensor noise	The sensor has been polluted	Calibrate the flow.
		Send the monitor to the service center
Cannot be turned on, no display	Battery discharged	Charge the battery for 3.5 hours
	The battery is faulty	Send the monitor to the service center
Display is on, but pump does not run	Low battery level	Charge the battery for 3.5 hours
	The pump is faulty	Send the monitor to the service center
Detected value is not reliable	Flow closed	Check flow rate
	Inlet filter clogged	Check the inlet filter
Unable to charge the battery	The battery is faulty	Send the monitor to the service center
	Charger module failure	Contact the service center

7. Specifications

Item	Parameter	Remark
Particle Diameter	PM1.0, PM2.5, PM4.0, PM10, TSP	Both detection and display
Measurement Range	0~1000 μg / m^3	
Accuracy	±10%	Calibrate aerosol
Resolution	0.1 μg / m^3	
Principle	Light scattering technique	
Light Source	50mW, 780nm	
Sampling Time	1min	
Flow	2.83 L/min	Error ±5%
Display	4.0" TFT LCD screen	
Communication	USB/RS-232	
Memory	2,000,000 readings	
Battery	Rechargeable lithium battery	
Charging Time	3.5h	Under normal conditions
Operating Time	8h	Continuous operation
Operating Temperature	0~50 °C	
Storage Temperature	-20~60 °C	
Monitor Dimensions	170 x 110 x 48 mm	Not include intake duct and protective case
Weight	980g	

8. What's Included

Aerosol Mass Monitor x 1
PU Protective Case x 1
Filter Tube x 1
USB Flash Drive x 1
RS-232 Serial Converter Cable x 1
AC Power Adapter x 1
AC Power Cord x 2
User Manual x 1
Carrying Case x1

Optional Accessories
Flow Meter
Filter Element

9. Warranty & Services

Warranty: Any defective monitors can be replaced or repaired during the warranty period. However, the warranty does not cover the monitors that have been altered or modified as a result of misuse, negligence, accident, natural behavior, or the ones that are not modified by Elitech Technology, Inc.
Calibration: During the warranty period, Elitech Technology, Inc. provides free calibration services with shipping charges at the customer's expense. The monitor to be calibrated must not be contaminated by pollutants such as chemicals, biological substances, or radioactive materials. If the pollutants mentioned above have contaminated the monitor, the customer shall pay the processing fee.
Temtop warrants the included item for 5 years from the date of the original purchase.

Item	Warranty Period
Monitor	5 years included
Accessories	N/A

Temtop®

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