PRO 918 Ambient Air Quality Monitoring System

USER MANUAL

Content

Introduction

This operating manual (hereinafter referred to as the OM) contains information on ambient air quality monitoring systems, which is necessary to ensure full use of their technical capabilities, proper operation and maintenance.

The operating manual is intended for personnel performing installation, operation, repair and maintenance.

1. Purpose

PRO AQM automatic weather stations are compact professional weather stations that allow you to record various environmental parameters.

The PRO AQM weather station is available in various models. Depending on the model, each device has a different set of sensors and the number of parameters it can record.

The table below shows possible modifications of the weather station.

Table 1. PRO AQM weather station design options

Measured parameters	PRO weather station modificationsAQM*						
	300	308	800	900	918	918A	918B
Air temperature	+	+	+	+	+	+	+
Relative humidity	+	+	+	+	+	+	+
Wind direction		+		+	+	+	
Wind speed		+		+	+	+	
Atmospheric pressure		+		+	+	+	
The amount of precipitation in the form of rain		+				+	+
Direct solar radiation (irradiance), UV index		+				+	+
Carbon monoxide CO concentration			+	+	+	+	
Nitric oxide NO concentration					+	+	
Concentration of nitrogen dioxide NO2			+	+	+	+	
Concentration of sulfur dioxide SO2			+	+	+	+	
Ozone concentration O3			+	+	+	+	
Hydrogen sulfide H2S concentration					+	+	
Carbon dioxide concentration CO2							+
Oxygen concentration O2							+
Ammonia NH3 concentration							+
Concentration of hydrochloric acid HCL							+
Concentration of Volatile Organic Compounds (VOCs)	+				+	+	
Concentration of suspended microparticles PM1							+
Concentration of suspended microparticles PM2.5		+	+	+	+	+	
Concentration of suspended microparticles PM10		+	+	+	+	+	
Noise level		+				+	+

* - Optionally available modifications of the PRO AQM weather station, which can measure the concentration of suspended microparticles TSP.

2. Requirements security

Before using the weather station, please read the operating documentation.

Installation and commissioning must only be carried out by qualified personnel.

Do not perform measurements or touch live equipment. Follow the equipment's technical specifications, storage conditions, and operating conditions.

If the equipment is not connected properly:

— there is a possibility that the equipment will not work;
— the equipment may fail completely;
— Under certain conditions, a risk of electric shock may occur.

3. Technical and metrological characteristics

The main technical and metrological characteristics of PRO AQM weather stations are given in Table 2.

Table 2. Main technical and metrological characteristics, including accuracy indicators

Name of the characteristic	Characteristic values
Air flow velocity measurement range, m/s	from 0.3 to 60
Limits of permissible error in air flow velocity measurements: - absolute in the range from 0.3 to 10 m/s incl., m/s; - relative in the range over 10 to 60 m/s, %	 ± 0.3 ± 3
Air flow direction measurement range, degrees	from 0 to 360
Limits of permissible absolute error in air flow velocity measurements, degrees	± 3
Air temperature measurement range, ºC	from minus 50 to +80
Limits of permissible absolute error in air temperature measurements, ºC	± 0.1
Relative humidity measurement range, %	from 0 to 100
Limits of permissible absolute error in measurements of relative air humidity, %	± 2
Atmospheric pressure measurement range, hPa	from 400 to 1300
Limits of permissible absolute error in atmospheric pressure measurements, hPa	± 1
Range of measurements of the amount of atmospheric precipitation in the form of rain, mm	from 0 to 3276
Limits of permissible relative error in measuring the amount of precipitation in the form of rain, %, no more than	±4
Measurement range of direct solar radiation (irradiance), W/m2	from 0 to 2000
Limits of permissible relative error in measurements of direct solar radiation (irradiance), no more than, %	±5
Ultraviolet index range	from 0 to 15
Measurement range of carbon monoxide (CO) concentration, mg/m3	from 0 to 1150
Limits of permissible absolute error in measuring carbon monoxide (CO) concentration, mg/m3	±0.03
Measurement range of nitrogen oxide (NO) concentration, mg/m3	from 0 to 20
Limits of permissible absolute error in measuring nitrogen oxide (NO) concentration, mg/m3	±0.001
Measurement range of nitrogen dioxide concentration (NO_2), mg/m3	from 0 to 37.6
Limits of permissible absolute error in measuring the concentration of nitrogen dioxide (NO_2), mg/m3	±0.001
Measurement range of sulfur dioxide concentration (SO_2), mg/m3	from 0 to 262
Limits of permissible absolute error in measuring the concentration of sulfur dioxide (SO_2), mg/m3	±0.002
Measurement range of ozone concentration (O_3), mg/m3	from 0 to 39.2

Name of the characteristic	Characteristic values
Limits of permissible absolute error in measuring ozone (O3) concentration, mg/m3	±0.5
Measurement range of hydrogen sulfide concentration (H_2S), mg/m3	from 0 to 100
Limits of permissible absolute error in measuring the concentration of hydrogen sulfide (H_2S), mg/m3	±0.004
Measurement range of carbon dioxide (CO2) concentration, ppm	From 0 to 3000
Limit of permissible absolute error in measuring carbon monoxide (CO2) concentration, %	1
Oxygen concentration (O2) measurement range, % vol. d.	30
Limit of permissible absolute error in measuring oxygen concentration (O2), %	1
Ammonia (NH3) concentration measurement range, ppm	From 0 to 100
Limit of permissible absolute error in measuring the concentration of ammonia (NH3), %	2
Measurement range of hydrochloric acid (HCl) concentration, ppm	From 0 to 100
Limit of permissible absolute error in measuring the concentration of hydrochloric acid (HCl), %	6
Measurement range of volatile organic compounds (VOC) concentration, ppm	from 0 to 100
Limits of permissible relative error in measuring the concentration of volatile organic compounds (VOCs), %	±5
Measurement range of suspended particulate matter (PM1) concentration, μg/m3	from 0 to 1000
Limits of permissible error for measuring the concentration of suspended microparticles (PM1) - absolute in the range from 0 to 100 μg/m3 incl., μg/m3 - relative in the range from 100 to 1000 μg/m3, %	 ±10 ±10
Measurement range of suspended microparticles (PM2.5) concentration, μg/m3	from 0 to 1000
Limits of permissible error in measuring the concentration of suspended microparticles (PM2.5) - absolute in the range from 0 to 100 μg/m3 incl., μg/m3 - relative in the range from 100 to 1000 μg/m3, %	 ±10 ±15
Measurement range of suspended microparticles (PM10) concentration, μg/m3	from 0 to 1000
Limits of permissible error in measuring the concentration of suspended microparticles (PM10)	
- absolute in the range from 0 to 100 μg/m3 incl., μg/m3 - relative in the range from 100 to 1000 μg/m3, %	±10 ±15
Measurement range of total suspended particulate matter (TSP) concentration, μg/m3	from 0 to 1000
Limits of permissible error for measuring the concentration of total suspended particles (TSP) absolute in the range from 0 to 100 μg/m3 incl., μg/m3 relative in the range from 100 to 1000 μg/m3, %	 ± 15 ± 15
Noise level measurement range, dB(A)	from 30 to 130
Limits of permissible absolute error in noise level measurements, dB	±1.5
Mean time between failures, h	10000
Service life, years	8

Name of the characteristic	Characteristic values		
Terms of Use: - air temperature, °C - relative air humidity, % - atmospheric pressure, hPa	from minus 50 to +80 from 0 to 100 from 400 to 1300		
Overall dimensions, weight	length, no more, mm	diameter, no more, mm	weight, no more, kg
PWS AQM 300	234	140	0.8
PWS AQM 308	400	140	1.15
PWS AQM 800	300	140	1.05
PWS AQM 900	360	140	1.15
PWS AQM 918	360	140	1.20
PWS AQM 918A	420	140	1.70
PWS AQM 918B	420	140	1.70

4. Completeness

The complete set of the weather station is given in Table 3.

Table 3 Weather station completeness

Name	**Quantity, pcs.**
Automatic weather station PRO AQM (modification depending on the order)	1
Operation manual for the PRO AQM automatic weather station	1 per batch
Passport	1
Connecting cable	1
Mast mounting kit	1

5. Main functions

The PRO AQM family of weather stations is an integrated design for measuring the following meteorological parameters and air quality:

- air temperature;
- relative air humidity;
- amount of precipitation;
- atmospheric pressure;
- wind direction;
- wind speed;
- direct solar radiation (irradiance),
- ultraviolet radiation index;
- carbon monoxide (CO) concentration;
- nitric oxide (NO) concentration;
- nitrogen dioxide (NO) concentration$_2$);
- sulfur dioxide (SO2) concentration$_2$);
- ozone (O3) concentration;
- concentration of hydrogen sulfide (H_2S);
- carbon dioxide (CO2) concentration;
- oxygen concentration (O2);

- ammonia (NH3) concentration;
- hydrochloric acid (HCl) concentration;
- concentration of volatile organic compounds (VOCs);
- concentration of suspended microparticles PM1;
- concentration of suspended microparticles PM2.5;
- concentration of suspended microparticles PM10;
- total suspended solids (TSP) concentration;
- noise level

The weather station is connected using a 6-pin electrical connector with a threaded joint and a corresponding connecting cable (4 m long).

Configuration and polling of measured values during commissioning are performed using the built-in software – the "PWS" software. Measured data can be transmitted via an RS-485 or RS-232 interface. One of these interfaces is optional; the interface type is determined when ordering the weather station.

6. The structure of a weather station

6.1 Design and appearance

The weather station is housed in a plastic case. The appearance of the various PRO AQM weather station models is shown in Figure 1.

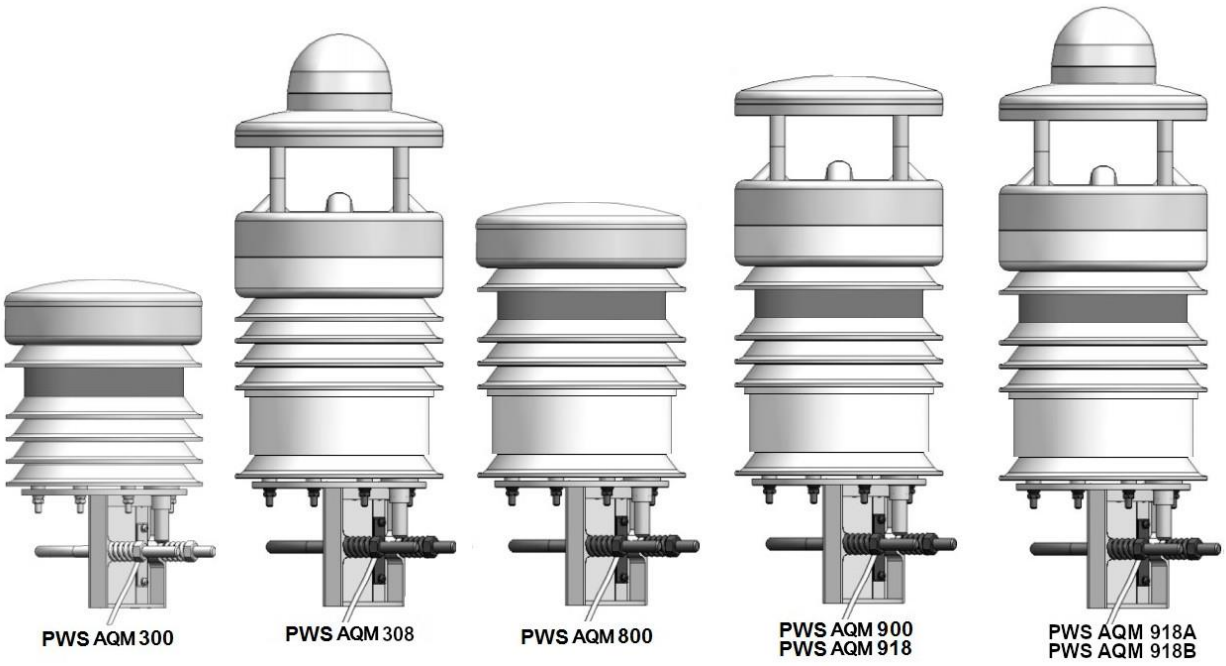
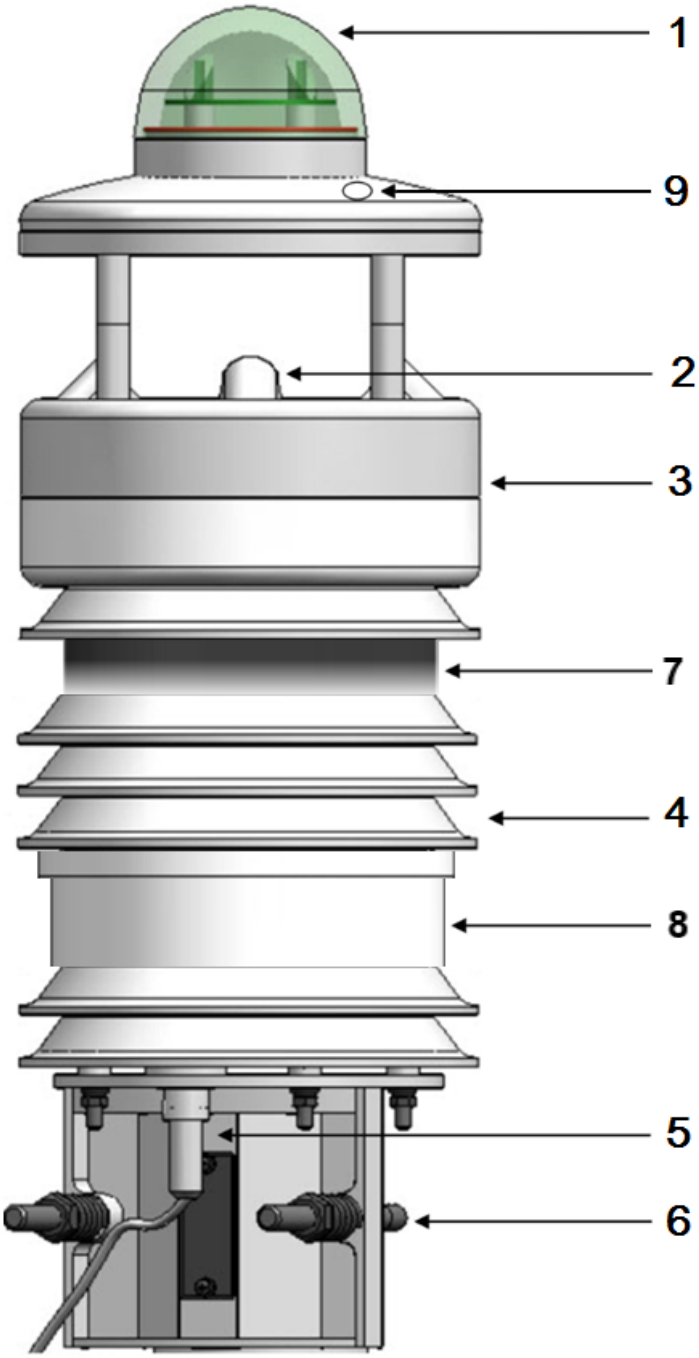


Figure 1 – External appearance of weather stations PRO AQM

The location of the sensors is shown in Figure 2.



1 – precipitation sensor in the form of rain,
2 – ultrasonic sensor of air flow speed and direction,
3 – atmospheric pressure sensor,
4 – temperature and relative humidity sensor,
5 – connector for connecting external converters,
6 – bracket for mounting the weather station,
7 – noise sensor, gas sensors (no more than 6 pcs.), VOC sensor,
8 – laser sensor of microparticles (PM1, PM2.5, PM10),
9 – pyranometer, UV index indicator.

Figure 2 – Location of sensors

6.2 Digital data transmission interfaces

Weather station configuration, data transfer, and firmware updates are possible via RS-485/RS-232 interfaces (specified when ordering). The following protocols are available: MLP-14 and MODBUS. The data transfer rate via these interfaces is approximately 19,200 bps.

6.3 Operating principle. Description of the main measured parameters

6.3.1 Temperature and relative humidity

Relative humidity is measured using a capacitive sensing element. A precise NTC measuring element is used to measure air temperature. To minimize the impact of external factors (such as solar radiation), the sensing elements are housed in a ventilated, radiation-shielded enclosure.

The sensor is characterized by high measurement accuracy, high performance and high reliability.

Temperature	Measurement method: NTC
	Range: -50 to +80 °C
	Resolution: 0.1 °C
	Error: ±0.1 °C
Relative humidity	Measurement method: Capacitive
	Range: 0 to 100%
	Resolution: 0.1%
	Error: ±2%

6.3.2 Atmospheric pressure

Absolute atmospheric pressure is measured using built-in MEMS sensors.

The relative air pressure, depending on the altitude configured in the sensor, is calculated using the barometric formula.

Pressure	Measurement method: MEMS
	Range: 400 to 1300 hPa
	Resolution: 0.1 hPa
	Error: ±1 hPa

6.3.3 Wind direction and speed

Wind is measured using four ultrasonic sensors, which take cyclical measurements in all directions. Based on this data, the resulting wind speed and direction are calculated.

The built-in electronic compass allows you to control and adjust the sensor's north orientation accordingly to measure wind direction.

Wind speed	Measurement method: ultrasonic
	Range: 0.3 to 60 m/s
	Resolution: 0.1 m/s
	Error: ±0.3 m/s or ±3%

Wind direction	Measurement method: ultrasonic
	Range: 0 to 360°
	Resolution: 0.1°
	Error: ±3 °
	Response threshold 0.3 m/s

6.3.4 Atmospheric precipitation in the form of rain

Using an optical sensor, the amount of precipitation in the form of rain is calculated.

Amount of precipitation	Measurement method: optical
	Range: 0 to 3276 mm

	Resolution: 0.1 mm
	Error: ±4%

6.3.5 Direct solar radiation (irradiance), UV index

Direct solar radiation (irradiance) is measured by a pyranometer, which is installed in the dome of the weather station.

The UV index can be measured. The UV index is an international measure of the level of ultraviolet radiation on the Earth's surface.

Energy illuminance	Measurement method: pyranometer
	Range: 0 to 2000 W/m2
	Wavelength range: 400 to 1100 nm
	Resolution: 1 W/m2
	Error: ±5%
UV index	Measurement method: ultraviolet sensor
	Wavelength range: 290 to 400 nm
	Range: 0 to 15 UVI

6.3.6 Carbon monoxide (CO)

The weather station uses an electrochemical method to determine the concentration of carbon monoxide in the air.

Carbon monoxide (CO)	Measurement method: electrochemical
	Range: 0 to 1150 mg/m3
	Sensitivity: 0.001 mg/m3
	Error: ±0.03 mg/m3
	Overload: 2000 mg/m3

6.3.7 Nitric oxide (NO)

The weather station uses an electrochemical method to determine the concentration of nitrogen oxide in the air.

Nitric oxide (NO)	Measurement method: electrochemical
	Range: 0 to 20 mg/m3
	Sensitivity: 0.001 mg/m3
	Error: ± 0.001 mg/m3
	Overload: 50 mg/m3

6.3.8 Nitrogen dioxide (NO2)

The weather station uses an electrochemical method to determine the concentration of nitrogen dioxide in the air.

Nitrogen dioxide (NO_2)	Measurement method: electrochemical
	Range: 0 to 37.6 mg/m3
	Sensitivity: 0.001 mg/m3
	Error: ± 0.001 mg/m3
	Overload: 50 mg/m3

6.3.9 Sulfur dioxide (SO2)

The weather station uses an electrochemical method to determine the concentration of sulfur dioxide in the air.

Sulfur dioxide (SO_2)	Measurement method: electrochemical
	Range: 0 to 262 mg/m3
	Sensitivity: 0.001 mg/m3
	Error: ± 0.002 mg/m3
	Overload: 200 mg/m3

6.3.10 Ozone (O3)

The weather station uses an electrochemical method to determine the concentration of ozone in the air.

Ozone (O_3)	Measurement method: electrochemical
	Range: 0 to 39.2 mg/m3
	Sensitivity: 0.001 mg/m3
	Error: ± 0.5 mg/m3
	Overload: 50 mg/m3

6.3.11 Hydrogen sulfide (H2S)

The weather station uses an electrochemical method to determine the concentration of hydrogen sulfide in the air.

Hydrogen sulfide (H_2S)	Measurement method: electrochemical
	Range: 0 to 100 mg/m3
	Sensitivity: 0.005 mg/m3
	Error: ± 0.004 mg/m3
	Overload: 200 mg/m3

6.3.12 Carbon dioxide (CO2)

The weather station uses infrared absorption to determine the concentration of carbon dioxide in the air.

Carbon dioxide (CO_2)	Measurement method: infrared absorption
	Range: 0 to 3000 ppm
	Sensitivity: 1 ppm
	Accuracy: ±(50 ppm + 5% of full scale)
	Overload: 5000 ppm

6.3.13 Oxygen (O2)

The weather station uses an electrochemical method to determine the concentration of oxygen in the air.

Oxygen (O_2)	Measurement method: electrochemical
	Range: 0 to 30%
	Sensitivity: 0.1%
	Error: ± 1%

	Operating conditions: from -30 to +55 °C; Within 0 to 95% relative humidity (non-condensing)

6.3.14 Ammonia (NH3)

The weather station uses an electrochemical method to determine the concentration of ammonia in the air.

Ammonia (NH_3)	Measurement method: electrochemical
	Range: 0 to 75.9 mg/m3
	Sensitivity: 0.227 mg/m3
	Error: ± 0.227 mg/m3
	Overload: 151 mg/m3

6.3.15 Hydrochloric acid (HCl)

The weather station uses an electrochemical method to determine the concentration of carbon dioxide in the air.

Hydrochloric acid (HCl)	Measurement method: electrochemical
	Range: 0 to 100 ppm
	Sensitivity: 1 ppb
	Error: ± 6%
	Overload: 200 ppm

6.3.16 Volatile Organic Compounds (VOCs)

The weather station uses a semiconductor method to determine the concentration of volatile organic compounds (VOCs) in the air.

Volatile Organic Compounds (VOCs)	Measurement method: semiconductor
	Range: 0 to 100 ppm
	Sensitivity: 0.2 ppm
	Error: ± 5%
	Overload: 200 ppm

6.3.17 Microparticles (PM1, PM2.5, PM10, TSP)

The weather station uses laser scattering method to determine the concentration of microparticles (PM1, PM2.5, PM10, TSP) in the air.

Microparticles (PM1)	Measurement method: laser scattering
	Range: 0 to 1000 µg/m3
	Sensitivity: 0.3 µg/m3
	Error: ±10 µg/m3 or ±10%
Microparticles (PM2.5)	Measurement method: laser scattering
	Range: 0 to 1000 µg/m3
	Sensitivity: 0.3 µg/m3
	Error: ±10 µg/m3 or ±15%
Microparticles	Measurement method: laser scattering

(PM10)	Range: 0 to 1000 μg/m3
	Sensitivity: 0.3 μg/m3
	Error: ±10 μg/m3 or ±15%
Microparticles (TSP)	Measurement method: laser scattering
	Range: 0 to 1000 μg/m3
	Sensitivity: 0.5 μg/m3
	Error: ±15 μg/m3 or ±15%

6.3.18 Noise

The weather station uses a semiconductor noise measurement method. It records all the noise in the surrounding environment.

Noise	Measurement method: semiconductor microphone
	Range: from 30 to 130dB(A)
	Error: ±1.5dB

6.4 Installation of a weather station

6.4.1 Selecting an installation location

To ensure a long service life and proper operation of the weather station, please pay attention to the following points when choosing an installation location:

- The weather station should be located in an open area with easy access to the equipment. The area around the weather station should be free of significant obstacles (large buildings, groups of trees).
- In no case is it recommended to install a weather station near highly heated surfaces, such as roofing felt.
- The installation site is selected in an area that is characteristic (typical) of the surrounding area and does not differ from the surrounding territory in any features of heat and moisture exchange.
- The weather station should not be located in the shade.
- The weather station is mounted on a mast above ground level. The installation height is at least 4.5 meters above ground level.
- An uninterruptible power supply is required for continuous operation of the device.

Note:The measured parameter values are valid only for the location where the weather station is installed. These data should not be used to draw conclusions for the entire surrounding area.

Figure 3 shows a diagram of the installation of a weather station in an open area.

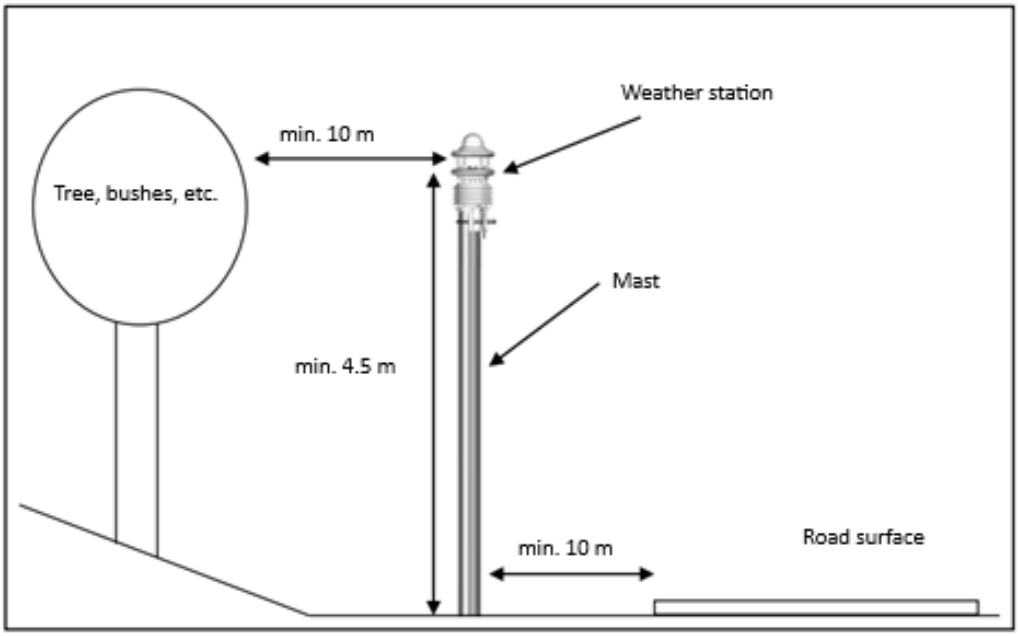


Figure 3 – Location of the weather station in space

6.4.2 Installation procedure

The device bracket is designed for installation on the top of a mast with a diameter of 50-76 mm.

The following tools are required for installation:

– 13 mm spanner (open-end or box-end).
– Compass for setting the anemometer in the north direction.

The procedure for attaching the weather station to the mast is as follows:

– The nuts should be loosened.
– Install the weather station on the top of the mast.
– Tighten the nuts evenly until there is no contact with the base of the mast, but the weather station can still be moved easily.
– Point the weather station north to accurately measure wind direction.
– Tighten both nuts.

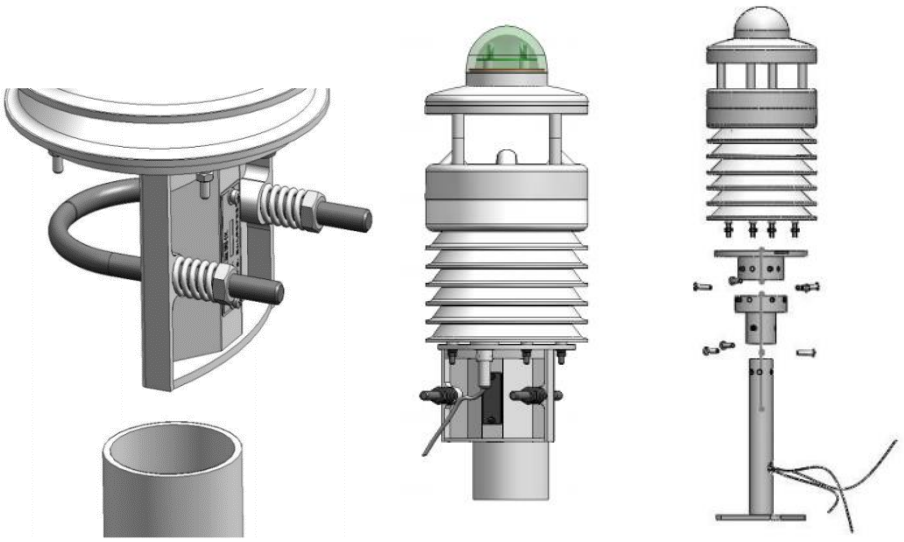


Figure 4 – Installation of the weather station on the mast

In order for a weather station to display accurate data, it must not only be correctly placed, but also accurately configured.

To accurately determine wind direction, the weather station must be oriented north. For this purpose, special arrows are located on the weather station body.

The sequence of actions for aligning the weather station to the north:

- If the sensor is already mounted, first loosen both nuts enough to allow the sensor to rotate easily.
- Using a compass, determine north and fix the starting point on the horizon.
- Orient the sensor so that south and north are aligned with the north point fixed on the horizon.
- Tighten both nuts 3 turns.

Note:Since the magnetic north pole shown by the compass differs from the geographic north pole, the declination at the installation site (magnetic declination of the site) must be taken into account when orienting the sensor.

On the bottom of the weather station is a 6-pin screw connector used for power supply and communication via the interfaces provided with the weather station's connecting cable. Below is a diagram showing the connectors, and Table 4 provides their descriptions.

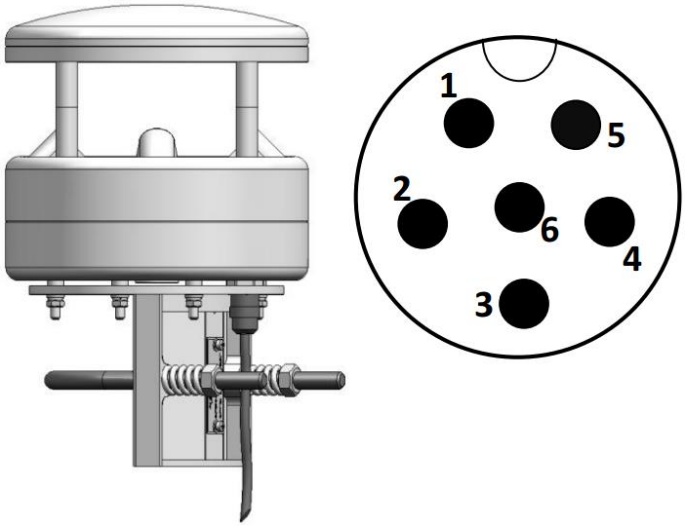


Figure 5 – Power and interface connectors

Table 4. Pinout

Pin number and color	**Purpose**
1 "Red"	Power supply "+12 V"
2 "Black"	GND power supply
3 "Yellow"	RS-485 A / RS-232 RX*
4 "Blue"	RS-485 B / RS-232 TX*
5 "Gray"	Not used
6 "Pink"	Not used
* - RS-485 or RS-232 communication interface is determined when ordering a weather station	

Note: To connect the weather station connector, you need to remove the yellow plug.

When connecting the power supply, it is imperative to observe polarity. Incorrect heating voltage polarity, as well as reversed polarity, will damage the weather station!

7. Maintenance

The equipment does not require maintenance, but it is recommended to perform a functional check once a year. When performing the check, pay attention to the following:

– Visual inspection to detect contamination of the device.
– Checking the operation of sensors by polling measured values.

8. Manufacturer's (supplier's) warranties

The manufacturer guarantees that the product complies with technical specifications, subject to the conditions of transportation, storage, installation and operation.

The warranty period is 12 months from the date of transfer of the product to the buyer.

During the warranty period of the product, the manufacturer has the right to supervise the correct operation in order to improve the quality and efficiency of operation.

During the warranty period, repairs to the product are carried out at the expense of the manufacturer.

Manufacturer's warranties are void if the product is damaged beyond the manufacturer's control.