ACW1200

AIR SAMPLER

REVISION Y2

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Contents

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Chapter 1

Overview

Figure 1.1: Air Sampler

The Air Sampler shown in Figure 1.1 is an advanced device designed to collect air samples based on user-defined parameters, ensuring accurate and efficient sampling. This versatile sampler allows for customization of key settings, including flow, flow rate, and ON duration, to cater to a wide range of sampling needs. The system operates by continuously collecting air samples until one of the predefined conditions is met Total flow or On duration, offering flexibility and control in various environments.

The device is powered by a High power motor, which controls the speed at which air is drawn into the sampler, thus directly influencing the flow rate and the amount of air sampled. The flow rate can be adjusted according to the user's specific requirements to maintain an optimal sampling rate. Additionally, the sampler features a filter paper that captures particulates

from the air, ensuring that only the relevant particles are collected for analysis. The filter paper can be easily replaced , depending on the nature of the samples and the frequency of use.

A built-in OLED display provides real-time information on the operational status of the air sampler, including flow rate, Status of device and the ON time. This allows for easy monitoring and adjustments during operation, ensuring that the sampler is working within the desired parameters. The combination of these features makes the Air Sampler an indispensable tool for environmental monitoring, air quality testing, and research applications.

- Compact & Portable Design
- Large 1.3”, 128 * 64px OLED Display
- Precision Flow Control
- Real-Time Digital Display:
- Multiple Sampling Modes: Time based & Volume based
- User Defined Sampling Duration & Parameters
- 30 minutes Continious operation
- Versatile Applications

1.1 Technical Specifications

Parameter	**Min**	**Max**	**Unit**	**Remarks**
Operating Voltage	230	250	V	
Current Consumption	5.6	6	A	
Operating Range	0	85	°C	
Flow Rate Range	0.1	1000	LPM	
Dimensions	274*179*222	275*180*223	mm	
Total Weight	2457	2467	g	

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Chapter 2

Hardware

In this section, we'll explore the key hardware components of the air sampler that allow for easy control and monitoring during operation. While the motor and filter are housed inside the unit, their functions are crucial to the air sampling process. The Figure 2.1 showcase the external features, such as the power connector, OLED display, flow rate control knob, and settings knob. Together, these components provide users with the ability to adjust settings, monitor performance, and ensure accurate air sampling results.

Figure 2.1: Air sampler Hardware

where

1 - OLED Display

2 - Settings knob

3 - Power Connector

4 - Flow rate adjust knob

2.1 Motor

Air sampler uses a high power motor. The Motor specifications are listed below,

- Motor Type: Suction Type
- Voltage Rating: 230-250V(AC)
- Power Rating: 1400W
- Airflow Capacity: 1050 LPM
- Current Rating: 6A(Max)

2.2 Connectors

Figure 2.2: Connectors

IEC 60309 connector is used to power the motor as shown in Figure 2.2. It is a a high-performance, industrial-grade cable designed to handle significant electrical loads while ensuring safety, durability, and reliability in demanding environments.

2.3 Flow Rate control knob

The Flow Rate Control Knob, shown in Figure 2.1, is a key feature of the Air Sampler, offering users precise control over the sampling process. This intuitive control mechanism allows for easy adjustment of the flow rate, ensuring the device operates within the desired parameters for accurate and consistent sample collection.

2.4 Settings knob

The Settings Knob, as shown in Figure 2.1, is a multifunctional component used to both power the device on and off and view various sampling settings. This knob enables users to view key parameters, such as total flow, flow rate, on-duration, status, and device details. Additionally, it allows access to the configuration mode, providing an easy way to modify settings for precise control over the sampling process. The dual-functionality of this control enhances the user experience by facilitating quick adjustments and ensuring consistent, accurate sampling every time.

2.5 Filter

The filter is where the sampled air is passed through to capture particulate matter, or other contaminants from the air. The filter material can vary depending on the type of particles or substances being monitored. The filter's pore size is selected based on the specific needs of the air sampling (e.g., fine particles, larger debris, etc.). Filters are typically replaced or checked after a certain number of sampling hours or once they reach a saturation point. The Figure 2.3 illustrates the side where the filter is placed.

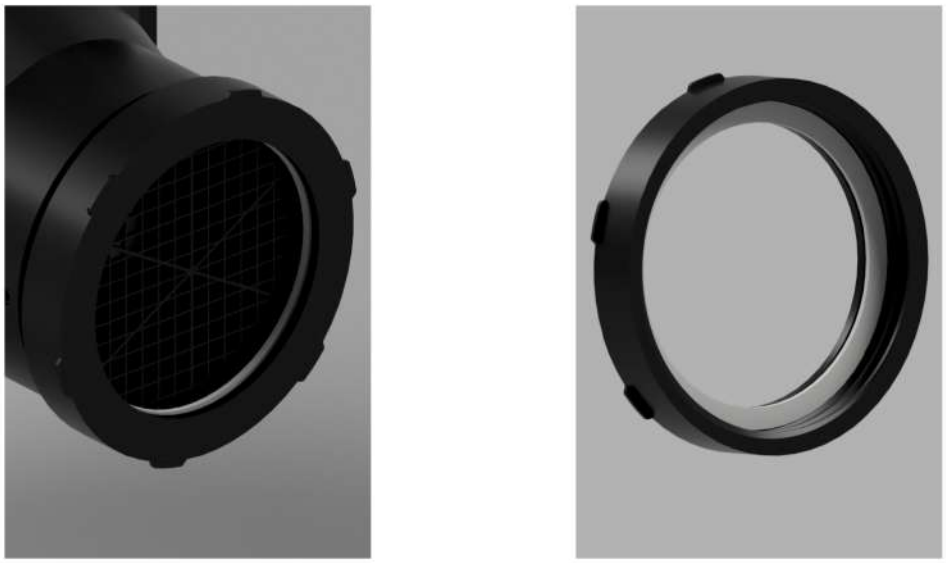

Figure 2.3: Filter

2.6 Display Layout & Navigation

Air Sampler comes with a 1.3” OLED Display with 128*64 Pixel resolution as shown in Figure 2.1. By default, the device consists of 5 pages, cycled through by pressing and releasing the settings knob.

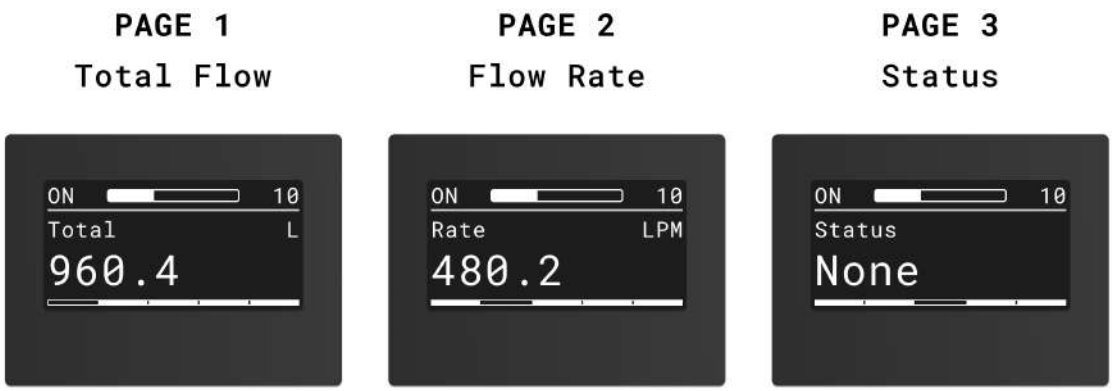

Figure 2.4: Display Pages 1 ,2 & 3

Figure 2.5: Display Page 4

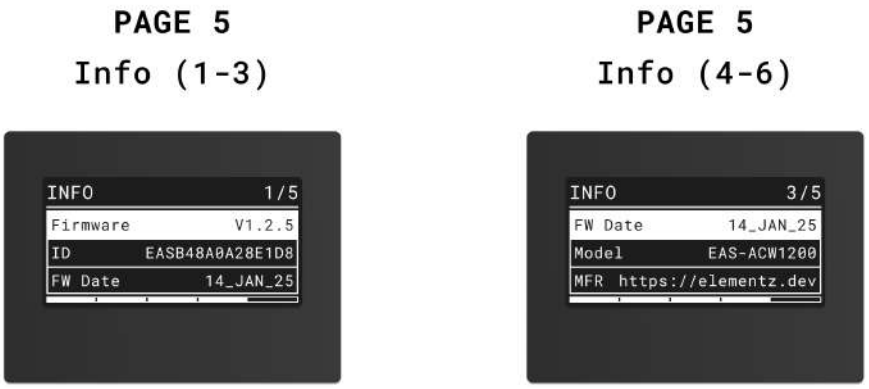

Figure 2.6: Display Page 5

This is a display with a dynamic layout as shown in the Figure 2.4 , Figure 2.5 & Figure 2.6. The pages have a Dynamic Header and Footer Layout. Below are explanations of the various pages that the device can display.

2.6.1 Total Flow Page

This page shows the Total cumulative flow in liters on the left side of the screen. This value is displayed as an integer. This value is presented as a decimal as shown in Figure 2.4

2.6.2 Flow Rate Page

This page shows the Flow Rate on the left side of the screen in Liters per minute as shown in Figure 2.4 . This value is displayed as an decimal.

2.6.3 Status Page

Status page as shown in Figure 2.4 indicates any errors related to flow rate being outside the configured limits.

2.6.4 Settings Page

This page shows the device's key parameters as shown in shown in Figure 2.5 .
Timer: Displays the duration for which the sampler is configured to run (in minutes).
Auto Stop: This setting will stop the sampler once the configured liters (1000L) of air have been collected.
Error Detect: Enables detection of errors such as under or overflow.

Flow Minimum:Displays the minimum flow rate for the air sampler.
Flow Maximum: Displays the maximum flow rate for the air sampler.
Flow Time: A check time to ensure the sampler's settings are configured correctly.
Configuration Mode: This consists of the currently saved calibration factor.

2.6.5 Info Page

This page shows the basic settings and identifier of the device. The page showcases Firmware version , Device ID, Firmware Date, Model number and Manufacturer Details as shown in Figure 2.6

Chapter 3

Usage

The configuration of Air sampler devices can only be accessed with a webpage.
In order to connect to the device using Wi-Fi, refer to the section 3.2.

3.1 Turning On Air sampler

To activate the air sampler in configuration mode, first press the settings knob, then turn on the power supply. The display will light up and show the configuration mode as shown in Figure 3.1

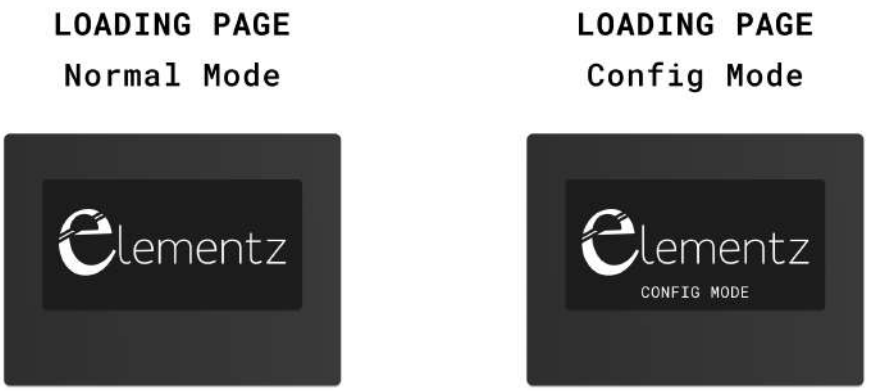

Figure 3.1: Configuration and Normal mode

3.2 Accessing the Configuration (Wi-Fi)

Following is the procedure to connect to Air Sampler devices.

- Make sure to turn on the device in Calibaration mode(Refer 3.1).
- The device will now create a Wi-Fi Access Point (Hotspot). Connect to that Wi-Fi network.
  Note: The Wi-Fi Access Point will have a name in the format **EASXXXXXXXXXXX** . Validate it with the label on the device. The default password will be **123456789**. This is shown in Figure 3.2

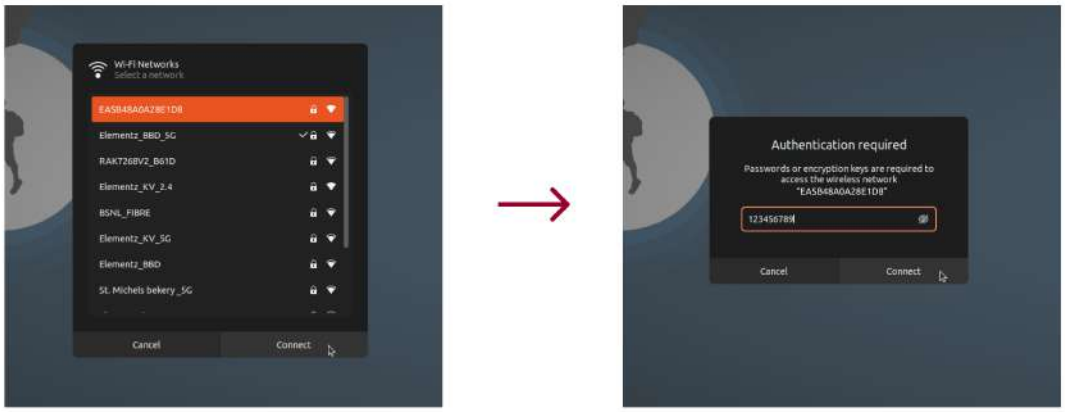

Figure 3.2: Connecting to Wi-Fi Access Point

- Once the computer is connected to the Wi-Fi access point, access 192.168.4.1 on a web browser.
- A configuration page will load with all the modifiable parameters.

3.2.1 Modifying a Configuration Parameter

There are 7 main sections within the configuration page. Timer, Cumulative flow threshold, Flow error detection, Flow test time, Lower flow cut off threshold , Upper flow cut off Threshold and Calibaration settings. Changes in Configuration needs to be saved by using the **Submit** button.

Connect the device with the configurator as mentioned in 3.2. Following is the procedure to get or modify configuration of the Air Sampler.

- Make the Required Changes in Configuration.
  For example, Set the Timer to 5 so that the device will collect samples for 5 minutes.

- On Clicking the **Submit** Button of the configured data, a **Submitted** tag will be shown if the configuration has been successfully modified as shown in Figure 3.3.

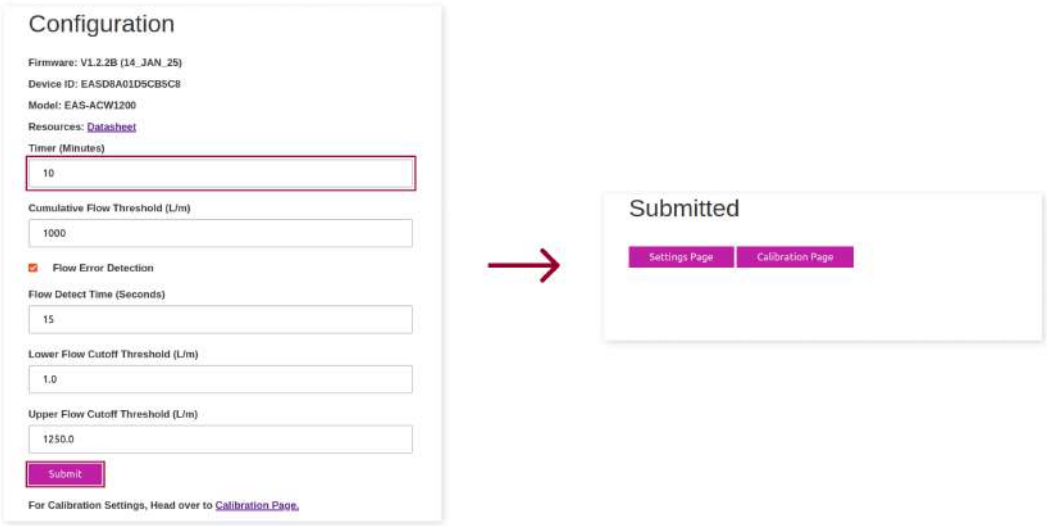

Figure 3.3: Modifying and saving Air Sampler parameter

- Once the Configuration Parameters have been changed, Go to the **Calibaration page** and make necessary changes as instructed by the manufacturer. Save the calibaration changes by clicking the **Submit** Button. A **Submitted** message will be displayed as shown Figure 3.4.

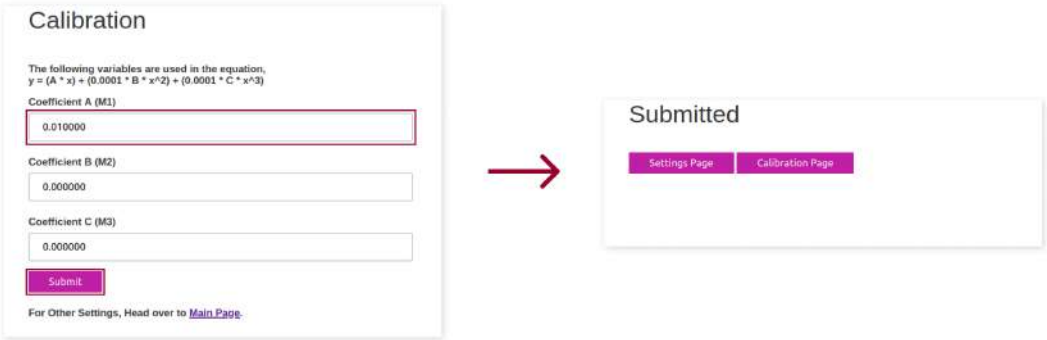

Figure 3.4: Modifying and saving Air Sampler calibaration coefficients

- The device needs to be **Restarted** to enter the Normal Working Mode with the new Configuration.

3.3 Device operation

Power on the device. It will boot up, displaying the Elements logo as shown in Figure 3.1 and showing Page 1. To turn on the air sampler, press and hold the settings knob for 5 seconds. . You can navigate through different pages by pressing and releasing the settings knob to know total flow, flow rate,status, calibration and device information as described in Section 2.6. Adjust the flow rate by turning the flow rate knob to your desired value. The air sampler will continue collecting samples until the specified ON duration or configured Total flow volume is reached. To turn off the device, press and release the settings knob for 5 seconds, then release it. Afterward, you can remove the filter to collect the samples.

Chapter 4

Calibration of Air Sampler

4.1 A 3-Point Approach

The air sampler was calibrated using a 3-point calibration approach with a 3rd-degree polynomial equation to ensure accurate flow rate measurements across different operational settings. The reference device used for calibration was a **Testo 405i**, which has been previously calibrated and verified for accuracy. The equation used for calibration assumes $d = 0$ for zero point offset, simplifying the 4th-degree polynomial to a 3rd-degree polynomial. The following procedure outlines the steps taken during the calibration process and the application of the polynomial calibration equation.

Calibration Procedure

1. Setup

- Securely position both the air sampler and the calibrated reference device.
- Ensure that all tubing and connections are leak-free.
- Activate the calibrated reference device and ensure it is measuring flow accurately.

2. Obtain Calibration Data

- Set the air sampler to three different flow rates: **low**, **medium**, and **high** (e.g., 50 LPM, 500 LPM, and 1000 LPM).
- Measure the actual flow rate at each of these points using the calibrated reference device.
- Record the air sampler's readings at each flow rate.

3. 3rd-Degree Polynomial Calibration Equation with $d = 0$

The 3rd-degree calibration equation, with $d = 0$, is represented as:

$$Y = aX^3 + bX^2 + cX$$

where:

- Y is the measured flow rate by the air sampler (LPH).
- X is the reference flow rate (measured by the reference device in LPH).
- a, b, and c are the calibration coefficients to be determined.

4. Solve for Calibration Coefficients (a, b, c)

Using the three calibration data points, solve for the polynomial coefficients a, b, and c. For three data points:

- (X_1, Y_1)
- (X_2, Y_2)
- (X_3, Y_3)

You will have the following system of equations:

$$Y_1 = aX_1^3 + bX_1^2 + cX_1$$
$$Y_2 = aX_2^3 + bX_2^2 + cX_2$$
$$Y_3 = aX_3^3 + bX_3^2 + cX_3$$

These three equations can be solved simultaneously using methods such as curve fitting ,matrix algebra, or numerical solvers to find the values for a, b, and c.

5. Apply the Calibration Equation

Once the coefficients a, b, and c have been determined, use the polynomial equation to apply the calibration to future readings from the air sampler. For any measured reference flow rate X (in LPH), you can now use the calibration equation to calculate the corrected air sampler flow rate Y (in LPH):

$$Y = aX^3 + bX^2 + cX$$

6. Verification and Adjustment

After applying the calibration, verify that the air sampler's measurements are within acceptable tolerance limits compared to the reference device. If discrepancies persist, recheck the calibration process or adjust the coefficients if needed.

7. Documentation

- Record the calibration coefficients a, b, and c in the calibration log.
- Document the flow rates at each calibration point, as well as any adjustments made during the calibration process.

Notes

- Ensure environmental factors (e.g., temperature, pressure, humidity) are stable during calibration to minimize measurement variability.
- Follow the manufacturer's instructions if the air sampler or reference device includes specific calibration requirements or software features.
- Periodically recheck calibration to ensure ongoing accuracy.

List of Abbreviations

OLED	Organic Light-Emitting Diode
Wi-Fi	Wireless fidelity
V	Voltage
A	Ampere
°C	Degree Celsius
g	gram
mm	millimeter
LPM	Liters per minute
IEC	International Electrotechnical Commission