# EM26AQS - Evaluation Module for TGS26 Series Air Quality Sensors

# Instruction Manual

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## 1. Overview

The **EM26AQS** is a multifunctional evaluation module with built-in signal processing software for the dynamic benchmark renewal algorithm, which is required when incorporating semiconductor-type air quality gas sensors (TGS2600, 2602, 2603) into air purifiers, among other applications.
The module carries out signal processing on the voltage output of the gas sensor to output the Indoor Air Quality Level (VAQL) as a voltage with 5 levels. Furthermore, the degree of indoor air pollution can be monitored visually by 5 LEDs of different colors which correspond to the air quality levels (VAQL).

## 2. Functions and Settings of Each Part

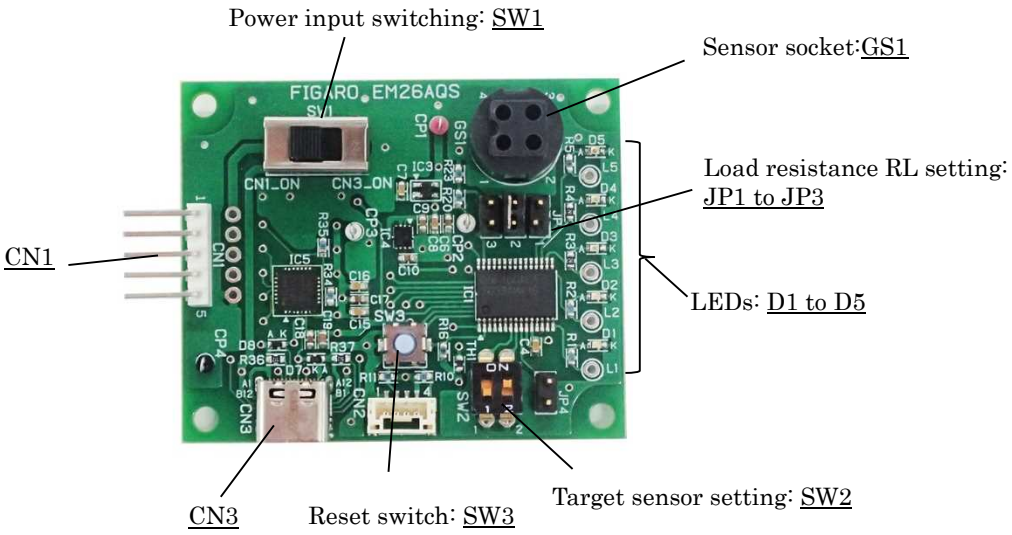



Fig 1. Name of each part

### 2-1) Pin Connections: CN1

| Pin No. (※1) | Name | Description |
|---|---|---|
| 1 | VIN | Circuit voltage |
| 2 | VOUT | Sensor output |
| 3 | VAQL/VIO | Indoor air quality level output/ Ventilation Index Output(※2) |
| 4 | NC | No connection |
| 5 | GND | Ground |

※1 Suggested female connectors for mating with the 5-pin connector (JST:MB5P-90S):
JST: XHP-5P or 05JQ-BT

※2 For the Ventilation Index Output (VIO), please refer to "5. Extension Functions (TGS2660)".

**2-2) Switch setting for Power input: SW1**

There are two connectors available for the power input: a 5-pin connector or a USB-Type C connector. When using the 5-pin connector (CN1), switch SW1 to the "CN1_ON" side. When using the USB-Type C connector (CN3), switch SW1 to the "CN3_ON" side.

By connecting the USB Type-C connector to a PC with a cable, measurement data can be displayed on a computer monitor in real time. For details, please refer to "6. Dedicated PC Application."

**2-3) Switch settings for gas sensor models: SW2**

Before turning on the power, set the DIP switch according to the gas sensor to be evaluated. Both SW2-1 and SW2-2 are set to OFF at the factory.

*** The DIP switch setting is read in the microcontroller only when the power is turned on. It is necessary to turn the module on again after making any changes of SW2 settings.**

| Target sensor | SW2-1 setting | SW2-2 setting |
|---|---|---|
| TGS2600 | OFF | OFF |
| TGS2602 | OFF | ON |
| TGS2603 | ON | OFF |

**2-4) Reset function: SW3**

The reset switch is functional only in the normal mode. For more details, please refer to "3-3) Reset function".

**2-5) Air quality level output and LED indication: D1 to D5**

The blue LED blinks during the 2-minute warm-up period after the power is turned on, and the module returns to normal mode once the warm-up is finished. In normal mode, the air quality level is output using the 5 voltage levels shown in the table below, and the LED with the color corresponding to each air quality level will come on.

* Air quality level output (VAQL) can be measured from the pin 3 of CN1.

* The assessment of air pollution levels is a subjective one and may vary from person to person.

| Level | VAQL* | LED color | Degree of air pollution* |
|---|---|---|---|
| 1 | Approx. 1V | D1: Blue | Clean |
| 2 | Approx. 2V | D2: Green | Mildly polluted |
| 3 | Approx. 3V | D3: Yellow-green | Moderately polluted |
| 4 | Approx. 4V | D4: Orange | Heavily polluted |
| 5 | Approx. 5V | D5: Red | Extremely polluted |

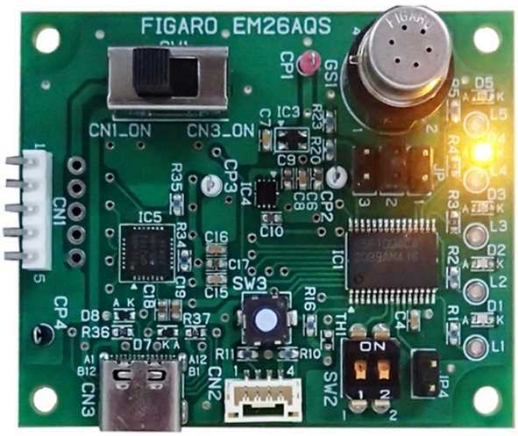



Fig 2. Image of LED lighting (when LED D4 is on.)

**2-6) Load resistance RL setting: JP1-JP3**

The proper load resistance (RL) setting is required to measure the sensor output (VOUT) as follows. The factory setting of the jumper pin JP is 10kΩ as a recommended value. Choose 51kΩ if VOUT value is too small, or 2kΩ if it is too large for easy measurement of sensor output voltage VOUT.

* If RL is not selected, approx. 5V will be output from the pin 2 of CN1.
* When changing the jumper pin JP setting, turn the power off, change the pin setting, and then turn the power back on.

| Load resistance | Setting |
|---|---|
| 2kΩ | JP1 |
| 10kΩ | JP2 |
| 51kΩ | JP3 |

Sensor resistance (Rs) in kΩ is calculated from the sensor output VOUT using the following formula:

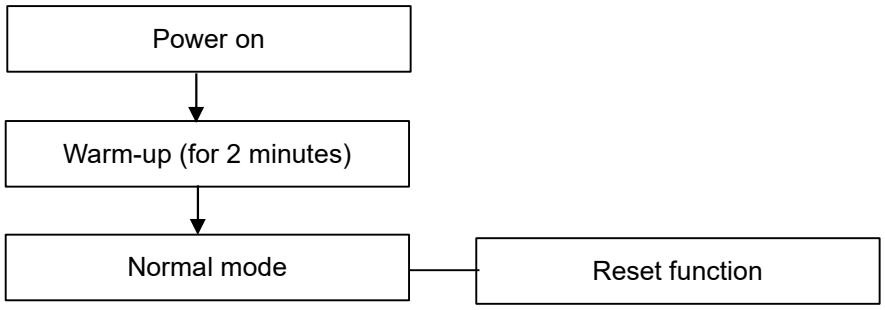
$$Rs = (VIN / VOUT - 1) \times RL$$

**2-7) Notes about sensor output (VOUT)**

The sensor output voltage (VOUT) may vary even among the same sensor models due to individual differences in sensor resistance. Also, VOUT can be varied by changing the load resistance (RL).

## 3. How to use EM26AQS

EM26AQS operates as shown in the follow chart:




**3-1) Warm-up period**

For 2 minutes after turning on the power, the AQ Level 1 (clean) indication will be displayed regardless of the degree of air pollution, and the blue LED will blink at 0.5 second interval. After the warm-up period, the blue LED will stop blinking and go on. At the same time, the resistance value of the sensor (Rs) in the air pollution level at that time will be recorded in the microcontroller as the initial reference value under the clean air.

**3-2) Normal mode**

The module will switch to normal mode once the warm-up is finished.
One of the LEDs with five different colors will illuminate, and a different air quality level output (VAQL) will be produced from the 3 pin of CN1, which corresponds to each level of air pollution. During the normal mode, the reference value of the sensor resistance in the microcontroller is successively updated according to changes in the degree of air pollution, and the microcontroller will continue to evaluate the degree of air pollution in 5 levels by comparing the current sensor resistance value to the updated reference value.

**3-3) Reset function**

When the tactile switch (SW3) is pressed for **4** seconds or more during normal operation mode, the reference value will be forced to update to the sensor resistance value in the ambient air conditions at that moment. The air quality level around the sensor at that time will be regarded as clean, and the air quality level output (VAQL) will be reset (*) to 1V (i.e. Clean).

**3-4) Sensor mounting**

When mounting a gas sensor in its socket, ensure proper sensor orientation.
(Mounting the sensor incorrectly will result in inaccurate output.)

## 4. Specifications

| | |
|---|---|
| Model No.: | EM26AQS |
| Product Name: | Evaluation Module for Air Quality Sensors |
| Compatible gas sensors: | TGS2600, TGS2602, TGS2603 (Extension Function: TGS2660 mode) |
| Input voltage: | 5.0 ± 0.2VDC |
| Sensor output voltage: | Max. 5V (depending on input voltage) |
| Air quality level output: | Approx.1 to 5V |
| Operating temperature and humidity conditions: | -10°C to 50°C, 0% to 95%RH (no condensation) |
| Dimensions: | Approx. 45 x 55 x 17 (mm) excluding gas sensor |
| Weight: | Approx. 15g (excluding gas sensor) |

## 5. Extension Function

As an extension function, the EM26AQS has a dedicated TGS2660 mode that facilitates the evaluation of the ventilation index sensor TGS2660.
The TGS2660 mode enables to provide 5 levels of the Ventilation Index Output (VIO) as an indication of low-concentration indoor air pollution caused by room occupants using TGS2660 sensor.

### 5-1) Switch settings for TGS2660 Mode: SW2

Before turning on the power, set the Dip switch (SW2) as shown in the table below.

| Target Sensor | SW2-1 Setting | SW2-2 Setting |
|---|---|---|
| TGS2660 | ON | ON |

### 5-2) Ventilation Index Output and LED Indication: D1 to D5

As with the evaluation of TGS2600, 2602, and 2603 sensors, when used with TGS2660, the Ventilation Index Output (VIO) is output using the five voltage levels and LED indication with different colors corresponding to each ventilation index level.
The LED color corresponding to the Ventilation Index Output (VIO) and the state of air pollution are shown in the table below. The Ventilation Index Output (VIO) can be measured from pin 3 of CN1.

| Level | VIO | Color of LED | Indoor Air Pollution Levels | Approximately corresponding $CO_2$ concentration ranges* |
|---|---|---|---|---|
| 1 | approx.1V | D1：Blue | Clean indoor air level | 400～800ppm |
| 2 | approx.2V | D2：Green | Stale air | 800～1500ppm |
| 3 | approx.3V | D3：Greenish yellow | Level associated with complaints of drowsiness and poor air. | 1500～2500ppm |
| 4 | approx.4V | D4：Orange | Stagnant, stale, stuffy air, level associated with sleepiness | 2500～5000ppm |
| 5 | approx.5V | D5：Red | Very strong discomfort | 5000ppm or over |

* The corresponding $CO_2$ concentration ranges are for reference purposes only. The information contained in the table shall not be construed as a correlation between ventilation index levels and indoor $CO_2$ concentrations.

**5-3) Operation in TGS2660 mode**

As with the evaluation of the other TGS260x series air quality sensors, the extension function includes warm-up, normal mode, and reset functions. Please refer to "3. How to use EM26AQS " for details. When the tactile switch (SW3) is pressed for **4** seconds or more during normal operation mode, the reference value will be forced to update to the sensor resistance value in the ambient air conditions at that moment. The air quality level around the sensor at that time is regarded as clean, and the Ventilation Index Output (VIO) will be reset (*) to 1V (i.e. clean air).

## 6. Dedicated PC Applications

By using the dedicated PC application for EM26AQS, air quality sensors can be easily evaluated, and measurement data can be saved in CSV format.

**6-1) Acquisition of Dedicated Application Software Package**

Please download the EM26AQS dedicated application software package from the following Figaro website: “EM26AQS Product Details” Page

(Japanese site): https://www.figaro.co.jp/product/entry/em26aqs.html

(English site): https://www.figaro.co.jp/en/product/entry/em26aqs.html

(Chinese site): https://www.figaro.co.jp/cn/product/entry/em26aqs.html

Save the downloaded folder in the desired location on the PC (e.g., desktop). Open the folder named "EM26AQSMeasure" saved on your PC and confirm that the executable files, EM26AQSMeasure.exe and EM26AQSMeasure.exe.config, are present.

Icon of the dedicated application executable file:

**6-2) Installation Method for USB Drivers**

Before starting the dedicated application, perform the following three installations:

① USB Driver

Open the [USB Driver] folder in the dedicated application folder that was downloaded in the previous step and double-click either of the following executable file icons to install the USB driver:

- For 32-bit Windows OS: "CP210xVCPInstaller_x86.exe"
- For 64-bit Windows OS: "CP210xVCPInstaller_x64.exe"

② .Net Framework 3.5

Download and install Microsoft .Net Framework 3.5 software from Microsoft website:

(Japanese site): https://www.microsoft.com/ja-jp/download/details.aspx?id=22

(English site): http://www.microsoft.com/en-us/download/details.aspx?id=22

(Chinese site): https://www.microsoft.com/zh-CN/download/details.aspx?id=22

③ MS Chart Controls

Download and install Microsoft Chart Controls from Microsoft website.

When downloading, make sure to check all boxes:

(Japanese site): http://www.microsoft.com/ja-jp/download/details.aspx?id=14422

(English site): http://www.microsoft.com/en-us/download/details.aspx?id=14422

(Chinese site): http://www.microsoft.com/zn-CN/download/details.aspx?id=14422

6-3) Launching and Operation of the Dedicated Application

① Attach the TGS26xx sensor to EM26AQS.

② Connect EM26AQS to the PC using a USB Type-C cable.

Power is supplied to EM26AQS through the USB cable.

③ Set SW1 (Power Input Switch) on EM26AQS to the CN3_ON position.

④ Double-click the icon of the dedicated application "EM26AQSMeasure.exe" installed on your PC to display the startup screen as shown in Figure 3.

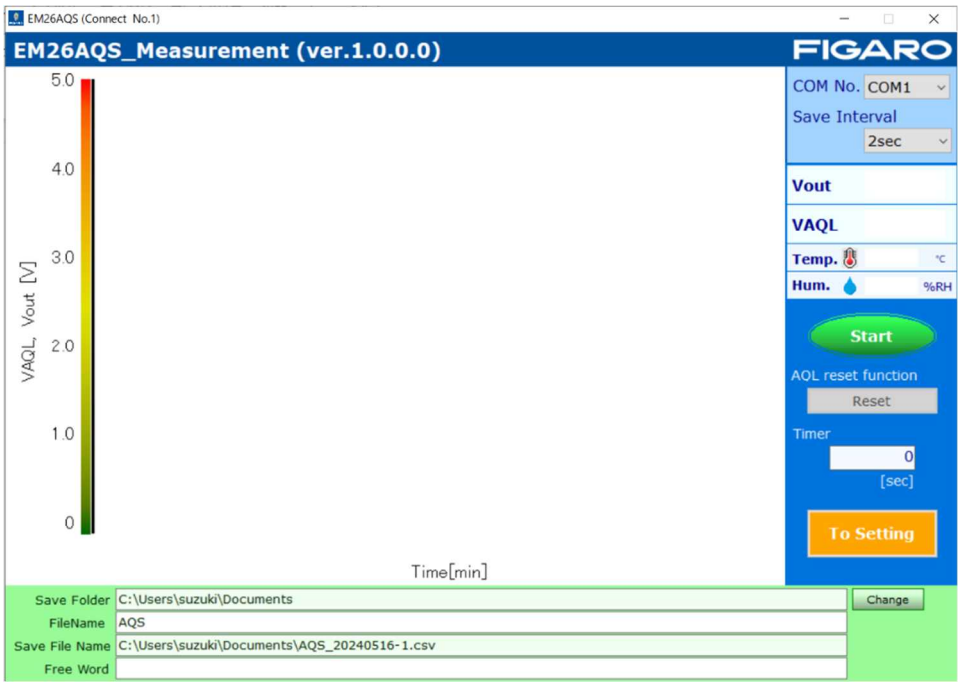



Figure 3: Startup screen

⑤ [COM No.] Setting COM Port Number

Select the COM port number that is automatically recognized by the PC application from the pull-down menu for "COM No." in the upper right corner of the screen.

⑥ [Save Interval] Setting Recording Interval

Select one of 2 seconds, 4 seconds, 10 seconds, 30 seconds, 60 seconds, 2 minutes, 5 minutes, 10 minutes, 30 minutes, or 60 minutes from the "Save Interval" pull-down menu on the right side of the screen for the interval for recording measurement data in CSV format. (Note: The measurement data graph displayed on the screen is updated at a fixed interval of one second.)

⑦ [Save Folder] Setting Save Destination

The directory of the default save folder is displayed.

The destination for saving measurement data (CSV format file) can be changed by pressing the [Change] button when measurement data is not being conducted.

⑧ [Save File Name] Setting Save File Name

The measurement data is automatically saved with a file name following the format like "AQS_20240516-1.csv", where the file name, which is input in [FileName], is followed by the date (20240516) and serial number (-1).

⑨ [Free Word] Inputting Free Words

You can input information or notes about the measurement into the [Free Word] field, which will be recorded in the header section of the CSV file.

⑩ Starting the Measurement

- Press the [Start] button to start the measurement. The graph will display the sensor output (a solid line) and the air pollution level output (a blue dashed line).
- The measurement period is every 2 seconds, and the screen displays measurement data from approximately 10 minutes ago to the latest measurement data. (Figure 4)
- Save the measurement data in CSV format on the PC according to the set recording interval.

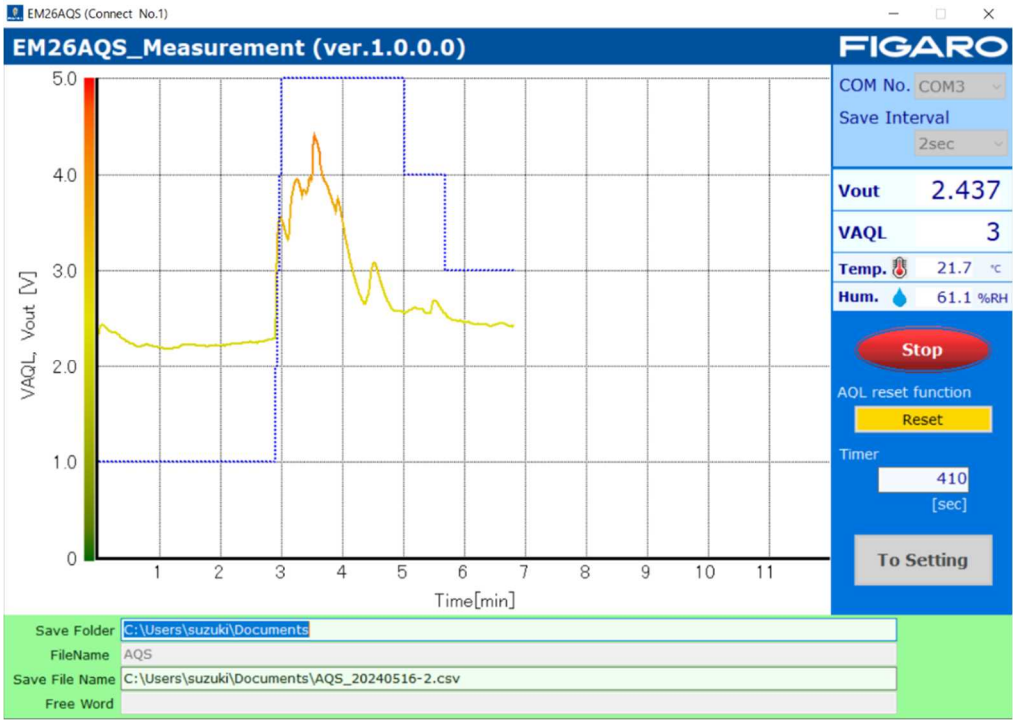



Figure 4: Example of measurement data display

⑪ Ending the Measurement

Press the [Stop] button to end the measurement. After ending, the measurement data is saved in CSV format.

## 6-4) Setting Various Parameters

Various parameters regarding sensor responses to indoor air pollution can be set by pressing [To Setting] (Figure 5). The [To Setting] button is operable only when measurement is not in progress.

- Press the [Read setting] button to read the parameter settings recorded in the MCU (Microcontroller) on the EM26AQS.
- Press the [Write new setting] button to write the information of the settings displayed on the PC screen to the MCU of the EM26AQS that is connected to the PC.
- Press the [Back] button to return to the measurement screen.

Details of parameter settings are as follows:

① AQL threshold

- G1 to G8: Setting values for increasing or decreasing AQL thresholds (Please refer to the factory preset values shown on the left side of the screen for each sensor model.)
- T1_bench mark renewal: Time per segment for updating benchmark values
- T2_delay timer: Time for the delay processing (*1) timer

② Saturation func.threshold

- G9 to G10: Threshold levels to control the saturation operation (*2)
- T3_saturation timer: Time for saturation operation timer

③ TGS2660 setting *Extension Function: Operable only when the TGS2660 mode is set.

- T4_bench mark renewal: Time elapsed until starting benchmark value correction
- Correction factor b: Correction value of ventilation index

*For the factory settings of EM26AQS, G1 to G8 settings are preset suitable for evaluation with TGS2600 and other settings are preset to the values that are calculated based on our evaluation tests. Please modify settings according to the expected operating environment and intended gas sensor application.

(*1) The Delay Processing is to gradually change AQL when the air quality changes rapidly from polluted to clean state.

(*2) The saturation operation is a process of adjusting the AQL towards a cleaner direction if the sensor response is saturated at the same AQL while the air quality is judged to be polluted (AQL ≥ 2).

- The saturation operation is turned on 2 seconds after AQL changes to AQL ≥ 2. The saturation operation timer starts when Rs/R02 ≤ G9. (where: R02 is the sensor resistance value 2 seconds before the current Rs).
- The saturation timer is reset when Rs/R03 ≤ G10 (where: R03 is the sensor resistance value 3 minutes before the current Rs).

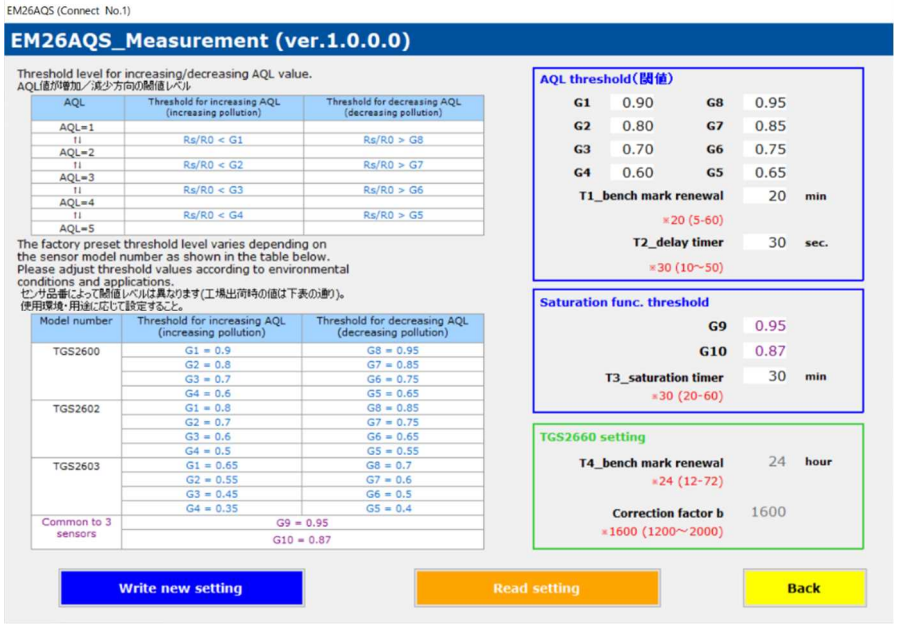



Figure 5: Setting screen of various parameters

## 6-5) Reset Function

The reset function can be also controlled on the dedicated PC application screen.

(Refer to 3-3) for details on the reset function.)

Press the [Reset] button to change the VAQL to 1V, assuming the air at that time is clean.

Figure 6 shows an example of executing the reset function when displaying VAQL = 4V on the graph.

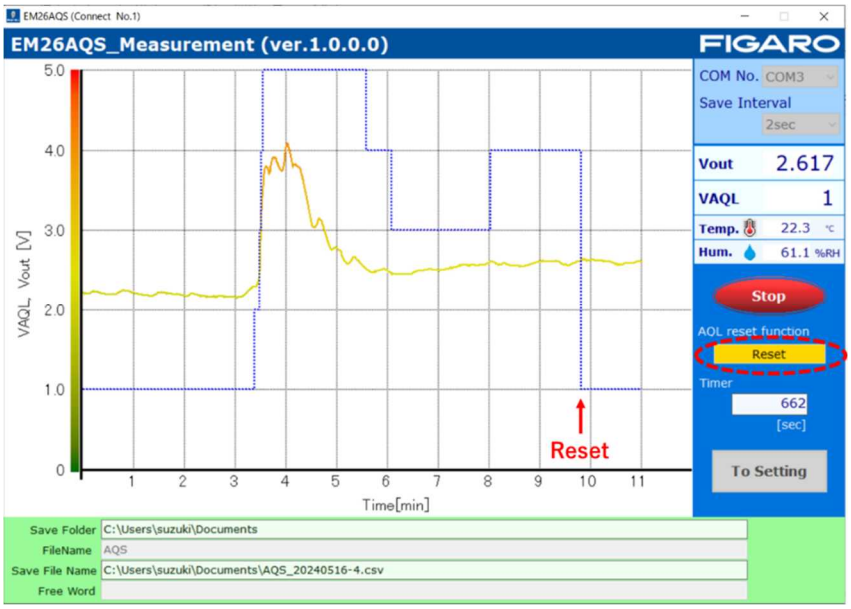



Figure 6: Example of executing the reset function

## 7. Troubleshooting

The following are the possible causes and suggested actions to take when an abnormality occurs:

| Fault conditions | Possible causes | Suggested actions |
|---|---|---|
| None of the LEDs are lit. | - Low power supply voltage<br>- Power supply voltage is not input. | Please check the power supply.<br>Please set SW1 to the correct configuration. |
| | Failure of this module<br>(Due to electrostatic damage to electronic components, etc.) | - |
| The red LED is blinking. | Fault determination by the microcontroller | * To reset the fault condition, please turn the power off and then turn it back on. |
| | Sensor failure | Please replace the sensor. |
| Red LED lights up, then is blinking.<br>Green or yellow-green LED hardly changes. | Sensor is not installed, or incorrectly inserted. | Please install the sensor in the correct orientation. |
| VAQL does not change.<br>VAQL changes minimally or significantly. | Selection error with SW2, or<br>Incorrect parameter settings, or<br>Polluted indoor air | Please set SW2 correctly.<br>Set parameters according to the environment.<br>Ensure sufficient ventilation indoors. |
| PC application does not operate. | Driver software is not installed. | Properly install all the drivers in the PC as described in this document. Then connect EM26AQS to PC to power on. Restart the PC application. |
| Others | Microcontroller runaway due to external noise | Please turn the power off and then turn it back on. |
| | Other faults | Please contact the manufacturer. |

* This module is designed for the evaluation of TGS26-series air quality sensors only and not for other purposes or applications.

For any product-related inquiries, please contact us using the information provided below.

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