

User Guide

Vaisala CARBOCAP^(R) Carbon Dioxide Probe

GMP251



VAISALA

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1. About This Document

1.1. Version Information

Table 1 Document versions

Document Code	Date	Description
M211799EN-E	August 2016	This version. Modbus status register values and descriptions updated.
M211799EN-D	July 2016	Previous version. Probe body design and power supply requirements updated. Added Modbus communication examples and information about the recommended use of volatile and non-volatile Modbus configuration registers. Added information about the requirement for environment-appropriate temperature and pressure compensations when applying a relative humidity compensation. Document template updated.
M211799EN-C	March 2016	Updated the instructions for using the cco2 calibration command.

1.2. Related Manuals

Table 2 Related Documents

Document Code	Description
M211798EN	Vaisala CARBOCAP ^(R) Carbon Dioxide Probe GMP251 Quick Guide
M211897EN	Vaisala CARBOCAP ^(R) Carbon Dioxide Probe GMP252 User Guide
M211893EN	Vaisala CARBOCAP ^(R) Carbon Dioxide Probe GMP252 Quick Guide

1.3. Documentation Conventions



DANGER! alerts you to a fatal hazard. If you do not read and follow instructions carefully at this point, death will follow.



WARNING! alerts you to a serious hazard. If you do not read and follow instructions carefully at this point, there is a risk of injury or even death.



CAUTION! warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.



Note highlights important information on using the product.



Tip gives information for using the product more efficiently.

1.4. Trademarks

Vaisala^(R) and CARBOCAP^(R) are registered trademarks of Vaisala Oyj.

Windows^(R) is either a registered trademark or trademark of Microsoft Corporation in the United States and other countries.

All other product or company names that may be mentioned in this publication are trade names, trademarks, or registered trademarks of their respective owners.

1.5. Patent Notice

This product is protected by the following patents and their corresponding national rights:

Table 3 Applicable Patents

Patent Issued By	Patent Number
United States Patent and Trademark Office	US 5,827,438
	US 6,177,673
European Patent Office	EP0776023
	EP0922972
German Patent and Trade Mark Office	69615635

Patent Issued By	Patent Number
Japan Patent Office	4263285
Finnish Patent Office	112005
	105598

2. Product Overview

2.1. Introduction to GMP251

GMP251 is designed for CO₂ measurement in demanding applications that require reliable and accurate performance. The measurement range is 0 ... 20 %CO₂.

The probe is based on Vaisala's patented 2nd generation CARBOCAP^(R) technology and equipped with Vaisala Microglow infrared light source. The probe is easy to install with a plug-in/plug-out M12 connection.

Sensor performance is optimized at 5 %CO₂ measurement. For compensation purposes, the probe also includes an internal temperature sensor that allows measurement compensation according to ambient temperature. As dust and most chemicals do not affect the measurement, and the effect of temperature, pressure and background gas can be compensated for, the probe can provide accurate and stable measurements in a wide range of applications.

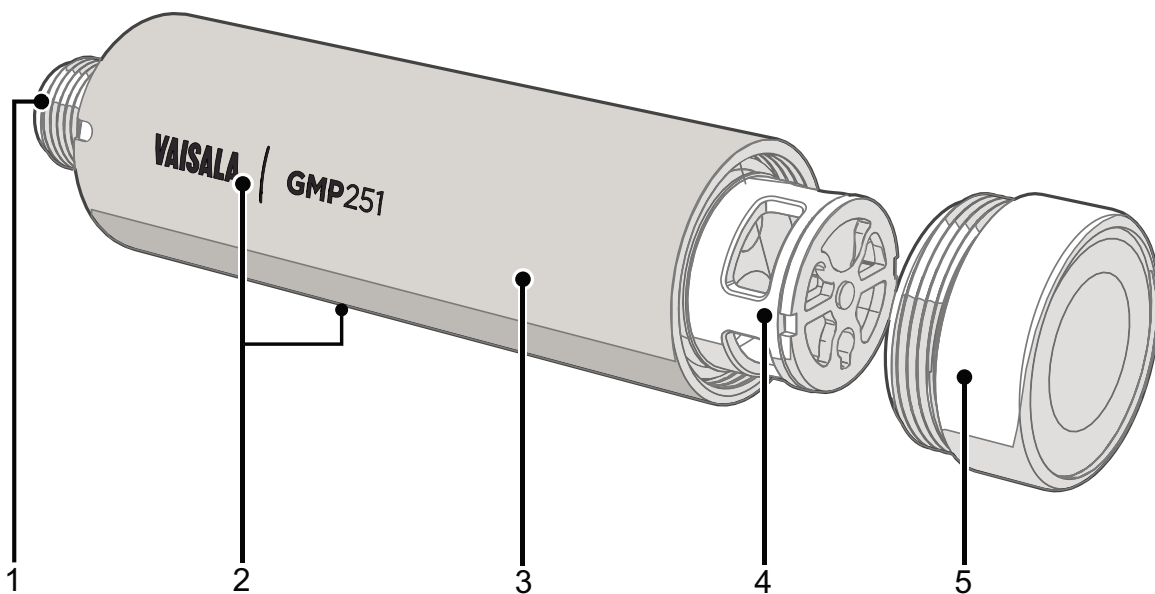


Figure 1 GMP251 Probe Parts

- 1 5-pin M12 connector. For pinout, see [3.5. Wiring \(page 22\)](#).
- 2 Probe name and orientation mark for Vaisala transmitter installations (front) and laser-printed type label (back).
- 3 Probe body. Contains the main component board.
- 4 Measurement cuvette with optics and CARBOCAP^(R) CO₂ sensor.
- 5 Filter (see [2.3. Filter Options \(page 12\)](#)).



CAUTION! Do not attempt to open the probe body. There are no user serviceable parts inside the probe body.

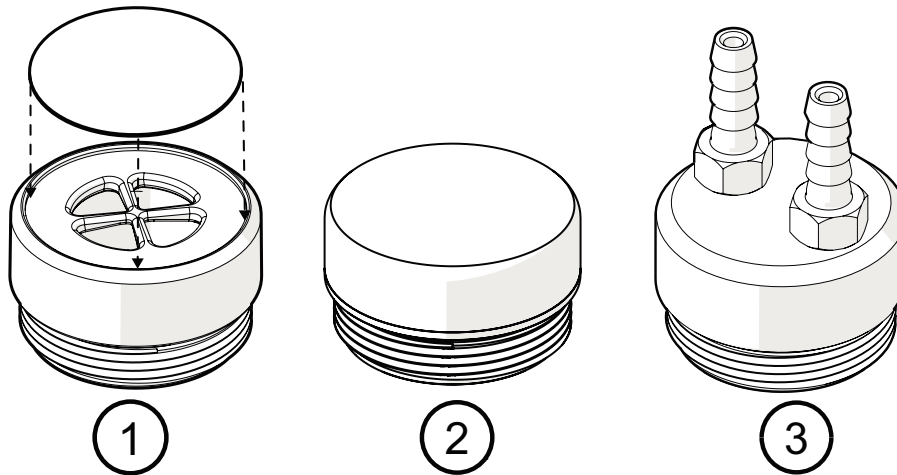
2.2. Basic Features and Options

- CO₂ measurement range 0 ... 20 %.
- Vaisala CARBOCAP^(R) CO₂ sensor with excellent long-term stability.
- Measurement compensated for effects of temperature, pressure, and background gas. The temperature compensation can be based on an integrated temperature sensor or use a set temperature. Pressure and background gas parameters can be set to the probe.
- Heating to avoid condensation on optical elements.
- Digital output with RS-485:
 - Modbus RTU
 - Vaisala Industrial Protocol
- Analog output:
 - Current output (0 ... 20 mA or 4 ... 20 mA)
 - Voltage output (0 ... 5 V or 0 ... 10 V)
- Compatible with MI70 hand-held meter.
- Easy plug-in, plug-out

More Information

- › [Operating Principle of CO₂ Measurement \(page 13\)](#)
- › [Environmental Compensation \(page 14\)](#)
- › [Modbus \(page 58\)](#)
- › [GMP251 Specifications \(page 76\)](#)

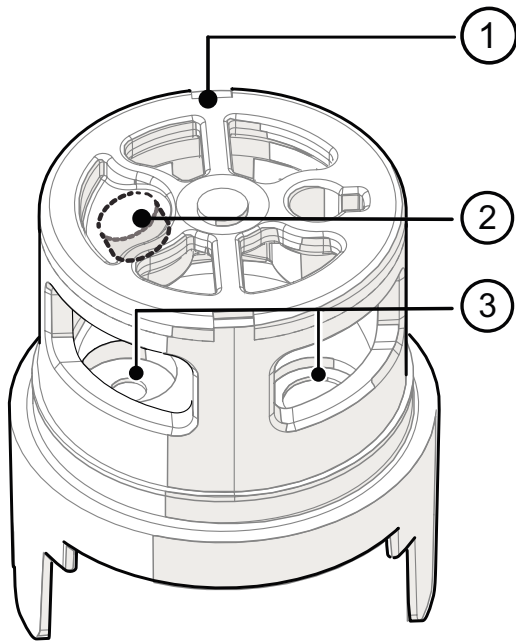
2.3. Filter Options



The following filter options are available for GMP251:

1. Standard membrane filter, order code ASM211650SP. Gas can enter only through the top of the filter (plastic grid covered with membrane), the sides of the filter are solid.
2. Porous sintered PTFE filter for extra protection, order code DRW243649SP. The porous material of the filter allows gas to enter from all sides of the filter.
3. Flow-through adapter, order code ASM211697SP. Two gas ports for controlled gas feed (port outer diameter 4.6 mm, port hole inner diameter 2 mm, suitable for tubing with 4 mm inner diameter).

2.4. Operating Principle of CO₂ Measurement



The Vaisala CARBOCAP^(R) sensor used in the probe is a silicon-based, nondispersive infrared (NDIR) sensor for the measurement of gaseous carbon dioxide in air-like gases.

Figure 2 Probe Cuvette with Mirror and Sensor Chips

- 1 Cuvette
- 2 Mirror
- 3 Sensor chips under TO5 package

The sensitivity to carbon dioxide is based on absorption of infrared light at a characteristic wavelength. During measurement, infrared light is routed through the cuvette that contains the gas to be measured. A mirror reflects the light from the cuvette to a thermopile detector that measures the light intensity at a wavelength determined by a Fabry–Pérot interferometer (FPI) and a band pass filter.

The carbon dioxide measurement consists of two steps: first, the FPI is electrically tuned so that its pass band coincides with the characteristic absorption wavelength of carbon dioxide and the signal is recorded. Second, the pass band is shifted to a wavelength where no absorption occurs in order to get a reference signal. The ratio of these two signals, one at the absorption wavelength and the other at the reference wavelength, gives the fraction of light absorption from which the carbon dioxide concentration is calculated. Measuring the reference signal compensates the possible effects of sensor aging and signal attenuation due to dirt on optical surfaces, making the sensor very stable over time.

TO5 packages with hermetic windows are used to protect the sensor chips from moisture and contamination. A heater chip is utilized to prevent condensation in normal operation.

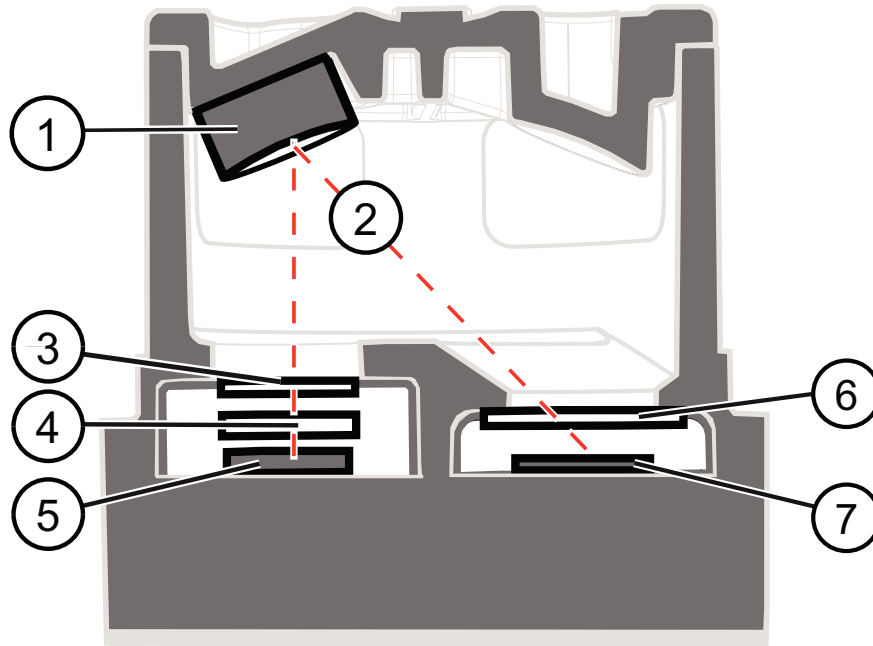


Figure 3 CO₂ Measurement in the Measurement Cuvette

- 1 Gold-plated mirror
- 2 Light absorbed by CO₂ in the measured gas
- 3 Hermetic window
- 4 Fabry-Perot interferometer
- 5 Light source (Microglow)
- 6 Hermetic window
- 7 Thermopile detector

2.5. Environmental Compensation

When necessary, various environmental compensations can be applied to improve the CO₂ measurement accuracy of the probe.

The probe can compensate for the effects of the following parameters:

- Temperature
- Pressure
- Background gas oxygen (O₂) content
- Background gas relative humidity (%RH)



To apply an accurate relative humidity compensation, make sure that also the temperature compensation and pressure compensation configurations match the measurement environment.

The probe has an on-board temperature sensor that can be used to compensate for temperature. Additionally, if the probe is integrated in a system that measures one or more of the compensation parameters (T, P, RH, O₂), they can be updated to the probe continuously.

Compensation parameters are configured on the order form when ordering the probe, and can later be updated using Vaisala Industrial Protocol or Modbus protocol.

You can also turn off any of the compensations. In that case, the probe uses the default compensation value that is mathematically neutral for the probe's internal compensation model.

2.5.1. Temperature Compensation

The probe can measure the approximate temperature of the CARBOCAP^(R) sensor for compensation, or use a fixed setpoint. The temperature measurement is accurate enough to be useful for compensation, and is recommended for use unless a dedicated temperature measurement is available and can be regularly updated to the probe. If the measurement is made in a constant temperature, this fixed temperature setpoint can be set as the compensation value.

If temperature compensation is turned off, the probe uses the default value of +25 °C (+77 °F).



When the probe is installed through a flange and part of the probe and the cable is left outside the measuring environment, it is possible that temperature conduction from the probe body and cable outside the measurement environment affects the temperature compensation and decreases measurement accuracy.

2.5.2. Pressure Compensation

The probe does not have on-board pressure measurement. However, a pressure reading from an external source can be used as a setpoint value for compensation using Vaisala Industrial Protocol or Modbus.

If pressure compensation is turned off, the probe uses the default compensation value of 1013 hPa.

2.5.3. Background Gas Compensation

The probe does not have on-board oxygen or relative humidity measurement. However, oxygen and relative humidity readings from an external source can be used as setpoint values for compensation via Vaisala Industrial Protocol or Modbus. The default setpoint values are as follows:

- Oxygen concentration: 19.7 %O₂ or 21 %O₂
- Relative humidity: 50 %RH or 93 %RH

If background gas compensations are turned off, the probe uses the value 0 % for both.

More Information

- ▶ [Environmental Compensation \(page 14\)](#)
- ▶ [Configuration Registers \(page 83\)](#)

2.6. Probe Startup

When powered on, the probe starts up within 20 seconds. Measurements from the outputs (digital and analog) become available during this time but note that they will only reach specified accuracy after a 4-minute warm-up period. For this reason, you should design your system so that it does not rely on measurements from the probe during this time.



Specifically note that the CO₂ reading will rise to the correct reading as the sensor's infrared emitter achieves operation temperature.

2.7. Analog Output Overrange Behavior

Analog output of the probe has a defined behavior when the values measured by the probe are outside the scaled analog output range. At first, the output is clipped when the measurement exceeds a set limit (the measurement continues, but the output does not change from the clipped value).

When the measurement exceeds the second limit (error limit), the analog output switches to the error state defined for the output. The table below lists the clipping and error limits and default error state outputs for the analog voltage and current outputs.

Table 4 Analog Output Overrange Clipping and Error Limits

Output voltage / current	Clipping Limit	Error Limit	Default Error State Output
0 ... 5 V	>5 %	>10 %	0 V
0 ... 10 V	>1 %	>10 %	0 V
0 ... 20 mA	>5 %	>10 %	23 mA
4 ... 20 mA	>5 %	>10 %	2 mA

The same clipping and error limits are applied when the measured value drops back to the scaled range: at first the output returns to the clipped value from the error state, and then to normal output.



Clipping and error state limits differ for 0 ... 10 V and 0 ... 5 V outputs. For 0 ... 10 V output the limits are 1 % and 10 %, and for 0 ... 5 V output the limits are 5 % and 10 %.

2.7.1. Analog Output Overrange Example

Consider a probe with 0 ... 5 V output, scaled to 0 ... 200 000 ppm (= 0 ... 20 %) CO₂.

- When the measured CO₂ rises above 20 %, the output rises above 5 V.
- The output keeps rising until the measurement is 21 %CO₂, at which point the probe outputs 5.25 V.
- If the CO₂ level rises above 21 %CO₂, the output still remains at 5.25 V.
- If the CO₂ level rises above 22 %CO₂, the output enters the error state, which is 0 V for the 0 ... 5 V output.

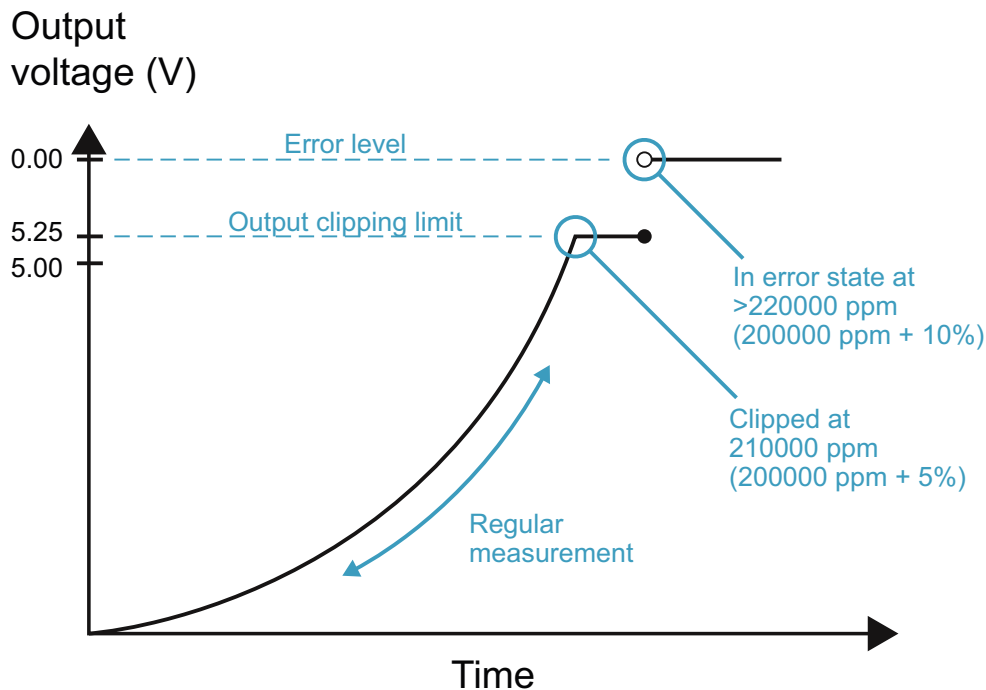


Figure 4 Example of Analog Output Overrange Behavior

This example uses output scaled to 0 ... 5 V and 0 ... 200000 ppm, error level set to 0 V, clipping set to 5 % overrange, and error limit set to 10 % overrange. CO₂ concentrations (ppm) are indicated for the clipping point and error limit point.



This overrange and error behavior is specific to the analog output, and does not affect the readings of the digital outputs.

You can change the analog output overrange behavior using the **aover** command.

2.8. Safety

The probe delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:



WARNING! When returning a product for calibration or repair, make sure it has not been exposed to dangerous contamination, and is safe to handle without special precautions.



CAUTION! Do not modify the unit. Improper modification can damage the product or lead to malfunction.



CAUTION! Do not attempt to open the probe body. There are no user serviceable parts inside the probe body.

2.8.1. ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching an exposed contact on the product.

To make sure you are not delivering high static voltages yourself, avoid touching the pins on the M12 connector.

2.9. Regulatory Compliances

The probe is in conformity with the provisions of the following EU directives:

- RoHS Directive
- EMC Directive

Conformity is shown by compliance with the following standards:

- EN 50581: Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.
- EN 61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – Generic environment.
- EN 55022: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.

3. Installation

3.1. GMP251 Probe Dimensions

The dimensions are given in millimeters (mm).

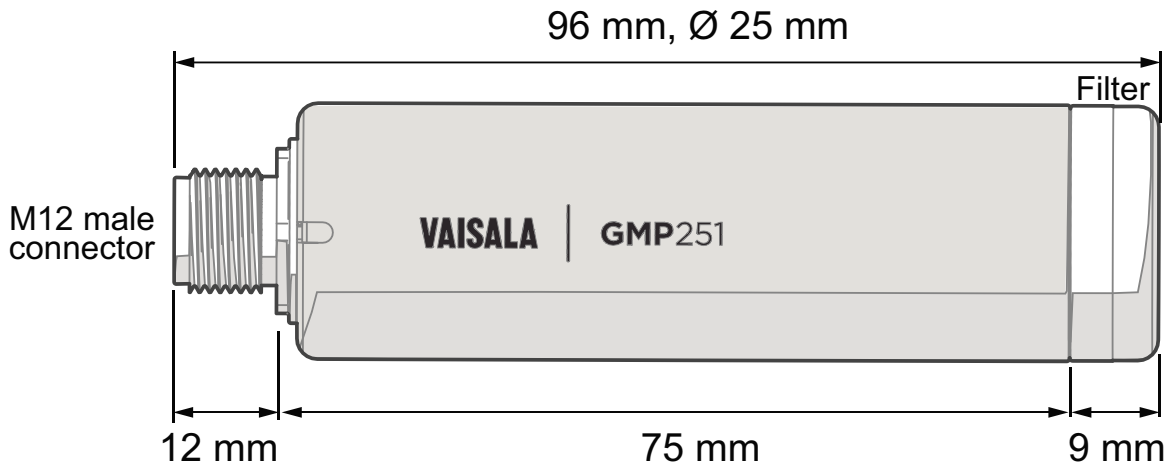


Figure 5 GMP251 Dimensions

3.2. Recommended Installation

The probe can be installed in an environment with an operating temperature range -40 ... +60 °C (-40 ... +140 °F). Make sure the probe is in a location that represents the measurement environment properly.

The 5-pin male M12 connector on the probe provides an easy plug-in/plug-out connection to a compatible cable.

3.3. Installation Accessories

The probe can be installed through a surface using the optional flange accessory (Vaisala product code 243261SP, or attached for example to a wall with the optional clip accessory (two-clip set, Vaisala product code 243257SP).

3.3.1. 243261SP Installation Flange

The optional flange accessory is used to install the probe body through a wall or other surface.

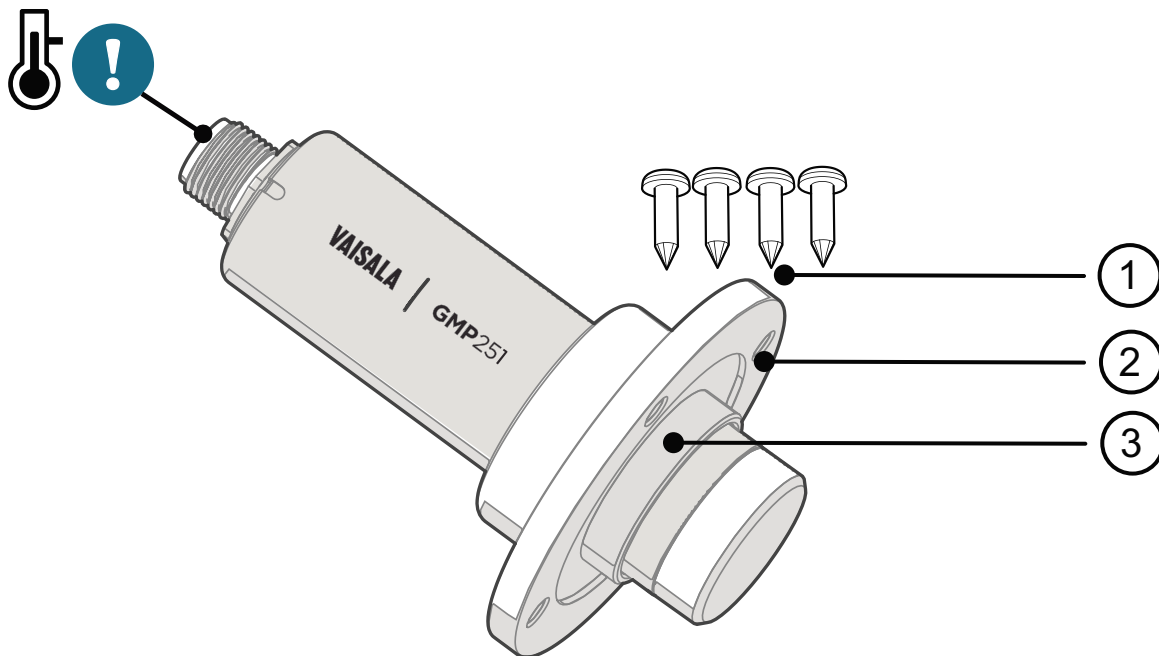


Figure 6 Probe with 243261SP Installation Flange

- 1 4 Phillips head screws (included)
- 2 Installation flange (diameter 60 mm) with four \varnothing 4.2 mm screw holes
- 3 Gasket ring



Leaving part of the probe body and the cable outside the measurement environment can cause heat conduction that affects the temperature compensation and measurement accuracy.

3.3.2. 243257SP Mounting Clips

The optional mounting clips (set of two clips) are used to hold the probe in place for example on a wall or other surface. Each clip base attaches to the installation surface with one screw (screw hole \varnothing 4.2 mm).

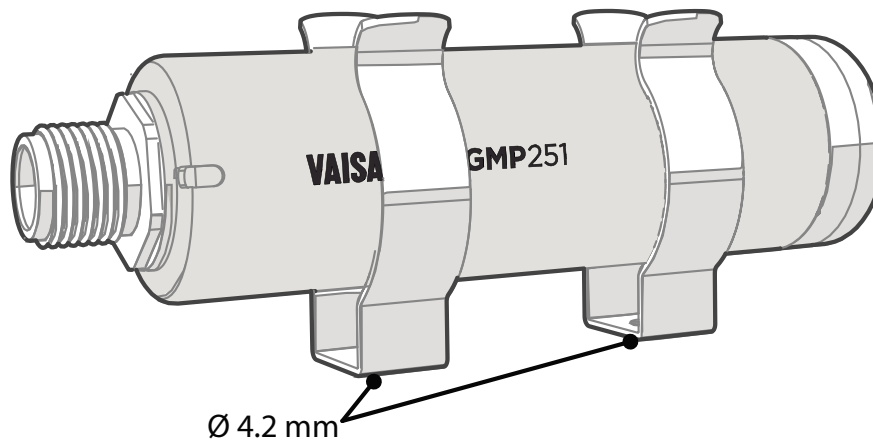


Figure 7 Probe in 243257SP Mounting Clips

3.4. Power Supply

The supply voltage range of the probe is 12 ... 30 VDC with the digital output option. If the analog output is used, the supply voltage range is 12 ... 30 VDC for voltage output and 20 ... 30 VDC for current output.

Typical power consumption is less than 0.4 W in continuous operation, and the maximum is 0.5 W.

3.5. Wiring

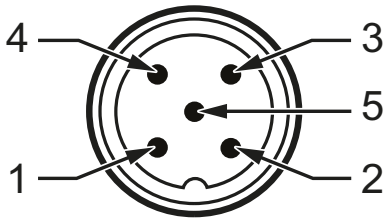


Table 5 M12 Male Connector

Pin#	Function	Note	Cable 223263SP Wire Colors
1	Power in	<ul style="list-style-type: none"> • With digital output: 12 ... 30 VDC • With voltage output: 12 ... 30 VDC • With current output: 20 ... 30 VDC Typical average power consumption <0.4 W, maximum 0.5 W.	Brown
2	RS-485- or voltage output	Voltage: 0 ... 5 VDC or 0 ... 10 VDC (default analog output scaling)	White
3	GND	-	Blue
4	RS-485 + or current output	Current: 0 ... 20 mA or 4 ... 20 mA (default analog output scaling)	Black
5	Output control	Connecting pin #5 to GND (pin #3) forces the probe to analog output mode. If an analog output configuration has not been selected, default 0...10 VDC and 4...20 mA scalings are used. If pin #5 is not connected, the analog or digital output selected when ordering or set later through configuration is used.	Gray



Note that the probe always remains in analog mode when pin #5 is connected to pin #3, and cannot be switched to digital output in this wiring option.

4. Vaisala Industrial Protocol

4.1. Overview

RS-485 line of the probe provides an implementation of the Vaisala Industrial Protocol that can be used for service and configuration use, or for interfacing with the system to which the probe is integrated. The protocol is a plaintext protocol suitable for use both by human operators and automated systems.

4.2. Serial Interface Settings

Table 6 Default Serial Interface Settings

Property	Description/Value
Bit rate	19200
Parity	None
Data bits	8
Stop bit	1
Flow control	None

4.3. Physical Interface

The physical interface is a non-isolated 2-wire interface. The data lines are RS-485 D- and RS-485 D+. Ground is shared with power supply. The connector is a 5-pin male M12.

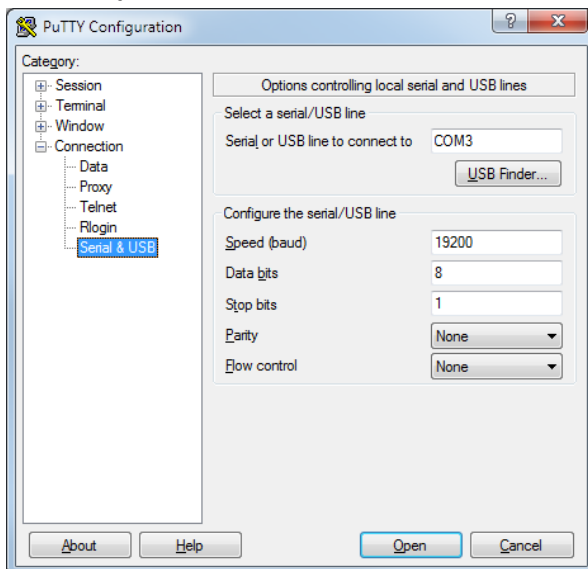
4.4. Connecting with a Computer



- Vaisala USB service cable (order code 242659)
- Computer with:
 - Windows operating system
 - Terminal application
 - Free USB port
 - Driver for Vaisala USB service cable installed

The steps below describe how to connect to the probe using the PuTTY terminal application for Windows and a USB computer connection cable. Connecting with a computer allows you to configure and troubleshoot your probe using serial line commands.

- ▶ 1. If you have not used the Vaisala USB cable before, install the driver before attempting to use the cable.
2. Connect the USB serial interface cable between your computer and the M12 connector of the probe.
3. Start the PuTTY application.
4. Select **Connection > Serial & USB** and check that the correct COM port is selected in the **Serial or USB line to connect to** field. If you are using the PuTTY terminal application supplied by Vaisala, you can press the **USB Finder** button to open the Vaisala USB Instrument Finder program.
5. Check that the other serial settings are correct for your connection, and change if necessary. **Flow control** should be set to **None** unless you have a reason to change it.



6. Select **Terminal**. Use the following settings:
 - **Local Echo**
Select **Force on**. This setting ensures that your typing is shown on the session window.
 - **Send line ends with line feeds (CR+LF)**
Set to **Selected**. This setting ensures that all text lines remain visible on the session window.
7. To open the connection window and start using the serial line, select **Open**.



If PuTTY is unable to open the serial port you selected, it shows you an error message instead. If this happens, restart PuTTY and check the settings.

4.4.1. Installing the Driver for the USB Service Cable

Before taking the USB service cable into use for the first time, you must install the provided USB driver on your computer (requires Windows). When installing the driver, you must accept any security prompts that may appear.

- ▶ 1. Check that the USB service cable is not connected. Disconnect the cable if you have already connected it.
- 2. Insert the media that came with the cable.
- 3. Run the USB driver installation program (setup.exe), and accept the installation defaults. The installation of the driver may take several minutes.
- 4. After the driver has been installed, connect the USB service cable to a USB port on your computer. Windows will detect the new device, and use the driver automatically.
- 5. The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the Vaisala USB Instrument Finder program that has been installed in the Windows Start menu. Windows will recognize each individual service cable as a different device, and reserve a new COM port. Remember to use the correct port in the settings of your terminal program.

4.5. Accessing Serial Commands from Modbus or Analog Mode

- ▶ 1. Connect the USB cable to your PC and start the terminal application as instructed in [4.4. Connecting with a Computer \(page 23\)](#).
- 2. Start a new terminal session using the default serial settings.
- 3. Keep the Enter key pressed down and connect the probe to the USB cable. When the probe is powered on (connected to your PC with the USB cable), you must send five carriage returns (Enter key presses) within 0.7 seconds to force the probe to serial command mode. The probe model information appears in the terminal application when the mode has been successfully changed, and Vaisala Industrial Protocol commands are available for use.
- 4. To test the connection, enter for example the **?** command. If the mode change failed, close the terminal application, disconnect the probe from the USB cable, and repeat [step 2](#) and [step 3](#).
- 5. To keep the serial mode in use (forced serial mode access is temporary and switches off at reset), select a serial output option (stop/run/poll) with the **smode** command.



Note that the probe always remains in analog mode when pin #5 is connected to pin #3, and cannot be switched to digital output in this wiring option.

4.6. Enabling Modbus Mode from Vaisala Industrial Protocol

If you need to switch from Vaisala Industrial Protocol to Modbus mode, you must configure the following settings:

- Serial line operating mode
- Modbus address
- Serial line settings (bit rate, parity, stop and data bits)

- ▶ 1. Connect the USB cable to your PC and start the terminal application as instructed in [4.4. Connecting with a Computer \(page 23\)](#).
2. Set the serial mode to Modbus with the **smode** command:

```
smode modbus
```

3. Set the Modbus address to 240 with the **addr** command:

```
addr 240
```

4. Set the serial line settings to 19200/N/8/2 with the **seri** command:

```
seri 19200 N 8 2
```

5. Power off (disconnect) the probe or reset with the **reset** command. The new configuration is available at the next restart.

4.7. Changing From Digital Output to Analog Output

- ▶ 1. Set up a terminal connection as instructed in [4.4. Connecting with a Computer \(page 23\)](#).
2. Change the mode from digital to analog with the smode serial command: **smode analog**.

3. Reset the probe (disconnect and reconnect the cable or use the reset serial command) to power on in analog output mode.

4.8. Serial Commands

The notation **<cr>** refers to the carriage return control character, which you can send in a terminal application by pressing enter on your keyboard. Before entering commands, send a **<cr>** to clear the command buffer.

You can enter the commands in uppercase or lowercase. In the command examples, the keyboard input by the user is in bold type.

[Table 7 \(page 27\)](#) lists the basic serial commands that are available by default. To access advanced serial commands (listed in [Table 8 \(page 28\)](#)), enter the command **pass 1300**.

Table 7 Basic Serial Commands

Command	Description
Device information and status	
?	Show probe information.
??	Show probe information (will respond in POLL mode).
errs	Show currently active errors.
help	Show list of currently available serial commands.
snum	Show probe serial number.
system	Show probe firmware information.
time	Show probe operation hours and uptime.
vers	Show probe firmware version.
Serial line output and communication	
close	Close connection to probe (POLL mode)
form [modifier string]	Show or set output format.
intv [0 ... 255 s/min/h]	Set continuous output interval for R command.
open [address]	Open connection to probe in POLL mode.
r	Start the continuous outputting.
s	Stop the continuous outputting.
sdelay [0 ... 255]	Show or set serial line transmission delay in milliseconds.

Command	Description
send	Output a single measurement message.
seri [baud data stop parity]	Show or set the serial interface settings.
smode [mode]	Show or set startup serial mode: RUN , STOP , or POLL .
Environmental compensation	
env	Show or set environmental parameters.
Adjustment information	
adate	Show CO ₂ factory adjustment date.
atext	Show CO ₂ factory adjustment information.
Other commands	
reset	Reset the probe.
pass [1300]	Access advanced serial commands.

Table 8 Advanced Serial Commands

Command	Description
Serial line output and communication	
addr [0 ... 254]	Show or set probe address.
Analog output	
amode	Show or set analog output mode (analog output limits and error level).
aover	Show or set analog output overrange and clipping behavior.
asel	Show or set analog output parameter and scaling.
Calibration and adjustment	
cco2	Adjust CO ₂ measurement gain and offset.
cdate	Show or set calibration date.
ct	Adjust temperature measurement offset.
ctext	Show or set calibration information.
Environmental compensation	

Command	Description
o2cmode	Show or set oxygen compensation mode.
pcmode	Show or set pressure compensation mode.
rhcmode	Show or set humidity compensation mode.
tcmode	Show or set temperature compensation mode.
Other commands	
frestore	Restore probe to factory settings.

4.9. Device Information and Status

Table 9 ? Command

Syntax	Description
?<cr>	Show listing of device information.
??<cr>	Show listing of device information even if device is in poll mode and connection has not been opened using the open command.
Example:	
<pre> ? Device : GMP251 Copyright : Copyright (c) Vaisala Oyj 2015. All rights reserved. SW Name : GMP251 SW version : 1.0.0 SNUM : GMP233_5_18 SSNUM : S1234567 CNUM : c1234567 Calibrated : 20150604 @ Vaisala/R&D Address : 0 Smode : STOP </pre>	

Table 10 Errs Command

Syntax	Description
errs<cr>	Show active error(s). For a list of possible errors and their remedies, see 8.2. Error Messages (page 73) .
Example (no active errors):	
<pre> errs NO CRITICAL ERRORS NO ERRORS NO WARNINGS STATUS NORMAL </pre>	

Table 11 Help Command

Syntax	Description
help<cr>	Show list of currently available serial commands.

Syntax	Description
Example (showing a list of the basic commands):	
<pre> help ADATE ADDR ATEXT CLOSE ENV ERRS FORM HELP INTV PASS RR ESET RX SDELAY SEND SENDX SERI SMODE SNUM SYSTEM UNIQID TIME VERS </pre>	

Table 12 Snum Command

Syntax	Description
snum<cr>	Show serial number of the probe.
Example:	
<pre> snum SNUM : M0220028 </pre>	

Table 13 System Command

Syntax	Description
system<cr>	Show probe firmware information.
Example:	
<pre> system Device Name : GMP251 SW Name : GMP251 SW version : 1.0.0 Operating system : TSFOS1.0 </pre>	

Table 14 Time Command

Syntax	Description
time<cr>	Show how long the probe has been in operation since the last startup or reset. The operation counter is in format hh:mm:ss.
Example:	
<pre> time Time : 01:41:24 </pre>	

Table 15 Vers Command

Syntax	Description
vers<cr>	Show firmware version of the probe.
Example:	
<pre> vers SW version : 1.0.0 </pre>	

4.10. Serial Line Output and Communication

Table 16 Addr Command

Syntax	Description
addr <cr>	Show current device address. Addresses are required for POLL mode.
addr [aaa] <cr>	Set new device address. aaa = address, 0 ... 254 (default = 0)
Example (shows 0 as current address, enter 5 as the new address):	
<pre> addr Address : 0 addr 5 Address : 5 </pre>	

Table 17 Close Command

Syntax	Description
close <cr>	Close the connection that was opened with the open command.
Example:	
<pre> close line closed </pre>	

Table 18 Form Command

Syntax	Description
form <cr>	Show the currently used measurement format.
form / <cr>	Reset measurement format to default.

Syntax	Description
form [sss]<cr>	Set a new measurement format. sss = String consisting of modifiers and abbreviations for measured parameters. See Table 19 (page 35) and Table 20 (page 36) . Maximum length is 150 characters. Maximum length may be shorter when text strings are used.
<p>Example (show currently used measurement format (default format shown here)):</p> <pre data-bbox="223 607 1350 745"> form 6.0 "CO2=" CO2 " " U3 #r #n </pre> <p>Output example (continuous output from RUN mode):</p> <pre data-bbox="223 882 1350 987"> CO2= 452 ppm </pre>	
<p>Example (set output format as %CO₂):</p> <pre data-bbox="223 1122 1350 1261"> form 3.1 "CO2=" CO2% " " U4 #r #n OK </pre> <p>Output example (continuous output from RUN mode):</p> <pre data-bbox="223 1397 1350 1599"> CO2= 5.1 %CO2 CO2= 5.1 %CO2 CO2= 5.0 %CO2 ... </pre>	

Syntax	Description
<p>Example (set output format as CO₂ ppm with Modulus-65536 checksum):</p> <pre>form 6.0 "C02=" C02 " " U3 " " CS4 #r #n OK</pre> <p>Output example (continuous output from RUN mode):</p> <pre>C02= 3563 ppm 9F C02= 3562 ppm 9E C02= 3559 ppm A4 ...</pre>	
<p>Example (set output format as CO₂ ppm, with start of text (ASCII character 002) and end of text (003) ASCII codes, and without line feed and carriage return at the end):</p> <pre>form #002 6.0 "C02=" C02 " " U3 #003 OK</pre> <p>Output example (continuous output from RUN mode, ASCII codes not visible here):</p> <pre>C02= 866 ppm C02= 866 ppm C02= 867 ppm C02= 867 ppm C02= 867 ppm C02= 868 ppm C02= 868 ppm C02= 869 ppm ...</pre>	

Table 19 Output Parameters for Form Command

Output Parameter	Abbreviation in Form Command
Carbon dioxide in ppm	co2
Carbon dioxide in percent	co2%
Currently used temperature compensation value	tcomp
Currently used pressure compensation value	pcomp

Output Parameter	Abbreviation in Form Command
Currently used oxygen concentration compensation value	o2comp
Currently used relative humidity compensation value	rhcomp

Table 20 Modifiers for Form Command

Modifier	Description
x.y	Length modifier (number of digits and decimal places).
#t	Tabulator.
#r	Carriage-return.
#n	Line feed.
""	String constant, length 1 ... 15 characters.
#xxx	ASCII code value (decimal) of a special character; for example, #027 for ESC.
addr	Probe address (0 ... 254).
sn	Probe serial number.
time	Cumulative operating hours of the probe.
ux	Name of the measurement unit using x number of characters. For example, u3 shows the name of the measurement unit with three characters.
cs4	Modulus-65536 checksum of message sent so far, ASCII encoded hexadecimal notation.
csx	NMEA xor-checksum of message sent so far, ASCII encoded hexadecimal notation.



You can also use the backslash character \ instead of the hash character #.

Table 21 Intv Command

Syntax	Description
intv<cr>	Show the output interval of the automatically repeating measurement messages (r command and run mode).
intv [iii uuu]<cr>	Set the output interval. <ul style="list-style-type: none"> • iii = interval, range 0 ... 255 • u = unit for interval setting: <ul style="list-style-type: none"> • s = seconds • min = minutes • h = hours <p>If you set the interval to 0, the output messages are output as quickly as they are generated, without additional delay.</p>
Example:	
<pre>intv 5 s Output interval: 5 S</pre>	

Table 22 Open Command

Syntax	Description
open [aaa]<cr>	Open a connection to a device at the specified address. Required when device is in poll mode. aaa = address, range 0 ... 254.
Example (target probe in POLL mode, with address 52):	
<pre>open 52 GMP251: 52 Opened for operator commands</pre>	

Table 23 R Command

Syntax	Description
r<cr>	Start the continuous outputting of measurement values as an ASCII text string to the serial line. The probe keeps outputting measurement messages at the interval that has been set with the intv command until stopped with the s command.
Example:	
<pre> r C02= 5.1 %C02 C02= 5.1 %C02 C02= 5.1 %C02 C02= 5.0 %C02 C02= 5.0 %C02 ... </pre>	

Table 24 S Command

Syntax	Description
s<cr>	Stop the continuous outputting that was started with the r command.
Example:	
<pre> ... C02= 5.1 %C02 C02= 5.0 %C02 C02= 5.0 %C02 s </pre>	

Table 25 Sdelay Command

Syntax	Description
sdelay<cr>	Show serial line transmission delay in milliseconds.
sdelay [delay]<cr>	Set a new serial line transmission delay. delay = Serial line delay, range 0 ... 255 (milliseconds).

Syntax	Description
Example (set delay to 50 milliseconds):	
<pre>sdelay 50 COM transmit delay : 50</pre>	

Table 26 Send Command

Syntax	Description
send<cr>	Output a single measurement message.
send [aaa]<cr>	Output a single measurement message from a device in poll mode. aaa = address of the probe, range range 0 ... 254
Example:	
<pre>send C02= 5.0 %C02</pre>	
Example (target probe in POLL mode, with address 52):	
<pre>send 52 C02= 5.0 %C02</pre>	

Table 27 Seri Command

Syntax	Description
seri<cr>	Show current serial line settings.

Syntax	Description
seri [b p d s]<cr>	<p>Set new serial line settings. The new settings will be taken into use when the probe is reset or powered up.</p> <p>b = baud rate (9600, 19200, or 38400) p = parity</p> <ul style="list-style-type: none"> • n = none • e = even • o = odd <p>d = data bits (7 or 8) s = stop bits (1 or 2)</p> <p>For Modbus, baud rate must be 9600 ... 38400 and parity must be none.</p>
<p>Example (show current settings):</p> <pre> seri Com1 Baud rate : 19200 Com1 Parity : N Com1 Data bits : 8 Com1 Stop bits : 1 </pre>	
<p>Example (set serial line to 9600 baud, even, 7 data bits, and 1 stop bit, and reset the probe to take the new settings in use):</p> <pre> seri 9600 e 7 1 OK seri Com1 Baud rate : 9600 Com1 Parity : E Com1 Data bits : 7 Com1 Stop bits : 1 reset GMP251 1.0.0 </pre>	

Table 28 Smode Command

Syntax	Description
smode<cr>	Show current start-up operating mode of the serial line, and prompt to enter new mode.

Syntax	Description
smod [mode]<cr>	<p>Set serial line start-up operating mode. New mode is taken into use when the device is reset or powered up.</p> <p>Available modes:</p> <p>stop = No automatic output. All commands available. Default mode.</p> <p>run = Automatic output of measurement messages. You can stop the output with the s command, and recontinue with the r command.</p> <p>poll = No automatic output. Will respond to addressed send command and ?? command. You can use other commands after opening a connection using an addressed open command. Use with RS-485 buses where multiple probes can share the same line.</p> <p>modbus = Serial line communication uses the Modbus protocol (see Modbus on page 54). Serial line commands (Vaisala Industrial Protocol) are not accessible in the Modbus mode. For instructions on returning to serial mode, see 4.5. Accessing Serial Commands from Modbus or Analog Mode (page 25).</p> <p>analog = Switches the probe from digital output to analog output (active after probe reset). Serial line commands are not accessible in the analog mode: for instructions on returning to serial mode, see 4.5. Accessing Serial Commands from Modbus or Analog Mode (page 25).</p>
<p>Example (set serial mode to "poll"):</p> <pre> smod poll Serial mode : POLL </pre>	

4.11. Analog Output

Table 29 Amode Command

Syntax	Description
amode [channel]<cr>	<p>Show currently set analog output limits and error level.</p> <p>channel = Analog output channel</p> <ul style="list-style-type: none"> • 1 = voltage output (V) • 2 = current output (mA)

Syntax	Description
amode [channel lo_value hi_value error_value] <cr>	Set new analog output limits and error output value. channel = Analog output channel <ul style="list-style-type: none"> • 1 = voltage output (V) • 2 = current output (mA) lo_value = Low limit of the channel. hi_value = High limit of the channel. error_value = Error value of the channel.
Example (show current configuration):	
<pre> pass 1300 amode 1 Aout 1 range (V) : 0.00 ... 10.00 (error : 0.00) amode 2 Aout 2 range (mA) : 4.00 ... 20.00 (error : 2.00) </pre>	
Example (set channel 1 to 0 ... 5 V, and error output to 0.0 V; set channel 2 to 0 ... 20 mA, and error output to 23 mA):	
<pre> amode 1 0 5 0.0 Aout 1 range (V) : 0.00 ... 5.00 (error : 0.00) amode 2 0 20 23 Aout 2 range (mA) : 0.00 ... 20.00 (error : 23.00) </pre>	

Table 30 Aover Command

Syntax	Description
aover [channel<cr>]	Show the behavior of the analog output when the measured value is outside the scaled output range. channel = Analog output channel <ul style="list-style-type: none"> • 1 = voltage output (V) • 2 = current output (mA)

Syntax	Description
aover [channel clipping error_limit]<cr>	Set the behavior of the analog output when the measured value is outside the scaled output range. channel = Analog output channel <ul style="list-style-type: none"> • 1 = voltage output (V) • 2 = current output (mA) clipping = Output margin (%) at which the output is clipped. error_limit = Measurement value margin (%) at which the output of the channel goes into the error state. The current or voltage output of the error state is defined using the amode command, see Table 29 (page 41) on the previous page.
Example (view currently set analog output overrange behavior on channel 1): <pre data-bbox="245 801 1369 1003"> pass 1300 aover 1 Aout 1 clipping :5.00 % Aout 1 error limit :10.00 % </pre>	

Example (for channel 1):

1. View currently set analog output scaling (**asel** command), limits and error level (**amode** command), and overrange behavior (**aover** command):

```

pass 1300
asel 1
Aout 1 quantity : CO2(0 ... 200000)
amode 1
Aout 1 range (V) : 0.00 ... 5.00 (error : 0.00)
aover 1
Aout 1 clipping :1.00 %
Aout 1 error limit :5.00 %
          
```

2. Set analog output overrange clipping to 5 % and error limit to 10 %:

```

aover 1 5 10
Aout 1 clipping : 5.00 %
Aout 1 error limit : 10.00 %
          
```

The analog output now behaves like this:

- Clipping is now set to 5.00 %, meaning the voltage output is allowed to vary between 0 ... 5.25 V. The analog channel will output the measurement for 0 ... 210 000 ppm, but range 0 ... 5 V remains scaled to 0 ... 200 000 ppm.
- Error limit is 10 %, which means the output will show the error state (0 V) when the measured CO₂ concentration is 10 % outside the scaled output range. With the settings above, this will happen if the measured CO₂ concentration is outside range 0 ... 220 000 ppm.
- The voltage output will never be above 5.25 V because of clipping: the voltage output is clipped when the output reaches 5.25 V, and if the measured CO₂ concentration keeps rising above 220 000 ppm, the output jumps directly to the error state 0 V.

Output voltage (V)

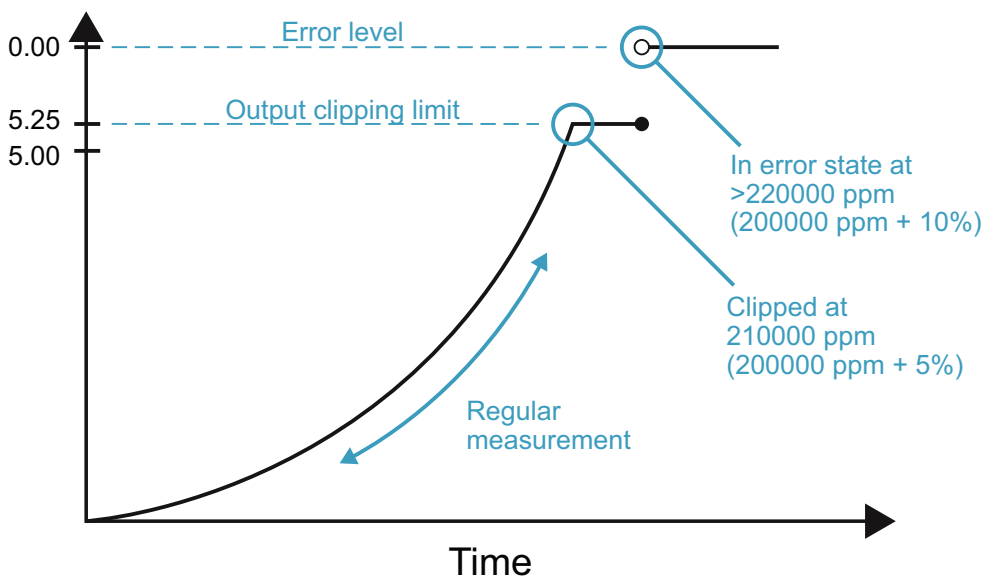


Figure 8 Example of Analog Output Overrange Behavior

The example shown above uses output scaled to 0 ... 5 V and 0 ... 200 000 ppm, has error level set to 0 V, clipping set to 5 % overrange, and error limit set to 10 % overrange. CO₂ concentrations (ppm) are indicated for the clipping point and error limit point.

Table 31 ASEL Command

Syntax	Description
asel [channel]<cr>	Show the parameter and scaling of the analog output in ppm. channel = Analog output channel <ul style="list-style-type: none"> • 1 = voltage output (V) • 2 = current output (mA)
asel [channel] [parameter lowlimit highlimit]<cr>	Set the parameter and scaling of the analog output. channel = Analog output channel parameter = Parameter that is output on analog channel. The only parameter available is CO ₂ (in ppm). lowlimit = Lower limit of channel scaling in ppm. Minimum value is -1000000 ppm (= - 100 %). highlimit = High limit of channel scaling in ppm. Maximum value is 1000000 ppm (= 100 %).
Example (for channel 1, show the currently set analog output parameter and scaling):	
<pre>pass 1300 asel 1 Aout 1 quantity : CO2(0 ... 200000 ppm)</pre>	
Example (for channel 1, set scaling to 0 ... 10 % (= 100 000 ppm)):	
<pre>pass 1300 asel 1 co2 0 100000 Aout 1 quantity : CO2(0 ... 100000 ppm)</pre>	

4.12. Calibration and Adjustment



CAUTION! Before using the calibration and adjustment commands, read through [7.3. Calibration and Adjustment \(page 69\)](#). Make sure that the environmental compensation settings of the probe are properly set for your calibration environment; see [2.5. Environmental Compensation \(page 14\)](#).

Table 32 Adate Command

Syntax	Description
adate<cr>	Show CO ₂ factory adjustment date.
Example:	
<pre> adate Adjustment date : 20150420 </pre>	

Table 33 Atext Command

Syntax	Description
atext<cr>	Show CO ₂ factory adjustment information.
Example:	
<pre> atext Adjusted at Vaisala/Helsinki </pre>	

Table 34 Cdate Command

Syntax	Description
cdate<cr>	Show calibration date.
cdate [yyyymmdd]<cr>	Set a new calibration date. yyyymmdd = Year (yyyy), month (mm) and day (dd) of calibration
Example:	
<pre> pass 1300 cdate Calibration date : 20150220 </pre>	

Syntax	Description
Example (set a new calibration date to June 30, 2015):	
<pre>cdate 20150630 Calibration date : 20150630</pre>	

Table 35 Ctext Command

Syntax	Description
ctext <cr>	Show calibration information text.
ctext [text]<cr>	Set a new calibration information text to be shown after the automatic text "Calibrated at".
Example:	
<pre>pass 1300 ctext Calibrated at 5.0% in lab</pre>	
Example (set a new information text):	
<pre>ctext 0% 5% by NN Calibrated at 0% 5% by NN</pre>	

Table 36 CCO2 Command

Syntax	Description
cco2 <cr>	Show current user adjustment status.
cco2 -lo [co2]<cr> cco2 -hi [co2]<cr>	Perform a 1-point (only either low or high concentration) or 2-point (both low and high concentrations) calibration and adjustment. - lo = Adjustment at low concentration (under 2 %CO2) - hi = Adjustment at high concentration (over 2 %CO2) co2 = CO2 concentration reference in ppm

Syntax	Description
cco2 -save<cr>	Save the currently entered adjustments. Successfully saving the adjustment clears the calibration date (cdate command) and calibration text (ctext command) that have been stored in the probe. Use those commands to enter a new calibration date and text.
cco2 -cancel<cr>	Cancel currently entered adjustments.
cco2 -reset<cr>	Clear user adjustments.
<p>Example (show current user adjustment status; no adjustment done):</p> <pre> pass 1300 cco2 1.Ref. point low 0 1.Meas. point low 0 2.Ref. point high 200000 2.Meas. point high 200000 Gain : 1.0000 Offset : 0.0000 </pre>	
<p>Example (perform a 1-point calibration):</p> <ol style="list-style-type: none"> Let the probe stabilize in the desired CO₂ concentration (here: 5 %CO₂ (=50000 ppm)). Enter the calibration commands: <pre> pass 1300 cco2 -hi 50000 OK cco2 -save OK </pre> Enter a new calibration date and information text: <pre> cdate 20150630 Calibration date : 20150630 ctext 5% in lab Calibrated at 5% in lab </pre> 	

Syntax	Description
<p>Example (perform 2-point calibration):</p> <ol style="list-style-type: none"> 1. Let the probe stabilize in the desired low CO₂ concentration (here: 0 %CO₂). 2. Enter the calibration commands: <pre data-bbox="304 477 1374 712"> pass 1300 cco2 -lo 0 OK cco2 -save OK </pre> <ol style="list-style-type: none"> 3. Let the probe stabilize in the desired high CO₂ concentration (here: 5 %CO₂ (=50000 ppm)). 4. Enter the calibration commands: <pre data-bbox="304 880 1374 1115"> pass 1300 cco2 -hi 50000 OK cco2 -save OK </pre> <ol style="list-style-type: none"> 5. Enter a new calibration date and information text: <pre data-bbox="304 1249 1374 1485"> pass 1300 cdate 20150430 Calibration date : 20150430 ctext 0% 5% by NN Calibrated at 0% 5% by NN </pre>	

4.13. Environmental Compensation Commands




To apply an accurate relative humidity compensation, the temperature and pressure compensation configurations must also match your measurement environment. See the **rhcmode**, **tcmode** and **pcmode** commands for instructions on enabling compensation configuration, and **env** command for instructions on setting a compensation value.



For more information on environmental compensation and the default (neutral) compensation values used for disabled compensations, see [2.5. Environmental Compensation \(page 14\)](#)

Table 37 Env Command

Syntax	Description
env <cr>	<p>Show current compensation values. Before using this command, you must enable environmental compensation using the following commands:</p> <ul style="list-style-type: none"> • o2cmode [on] • pcmode [on] • rhcmode [on] • tcmode [on measured]
env [temp pres oxy hum] [value]<cr>	<p>Set new permanent compensation values and store them in EEPROM. EEPROM:</p> <ul style="list-style-type: none"> • Non-volatile memory, values retained during power off. • Number of writes is limited to 30000 cycles by memory implementation. • Must only be used for writing permanent values, to avoid wearing out the EEPROM. <p>temp = Compensation temperature. Range -40 ... +100 °C (-40 ... +212 °F). pres = Compensation pressure. Range 500 ... 1150 hPa. oxy = Oxygen content of background gas. Range 0 ... 100 %. hum = Relative humidity of background gas. Range 0 ... 100 %.</p>

Syntax	Description
<pre>env [xtemp xpres xoxy xhum] [value]<cr></pre>	<p>Set new compensation values and store them in RAM.</p> <p>RAM:</p> <ul style="list-style-type: none"> • Volatile memory that loses the values when probe is reset, and where values are loaded from non-volatile (EEPROM) memory at power-on • Must be used for continuously updated values. <p>xtemp = Compensation temperature stored in RAM. Range -40 ... 100 °C (-40 ... +212 °F).</p> <p>xpres = Compensation pressure stored in RAM. Range 500 ... 1150 hPa.</p> <p>xoxy = Oxygen content of background gas stored in RAM. Range 0 ... 100 %.</p> <p>xhum = Relative humidity of background gas stored in RAM. Range 0 ... 100 %.</p> <div data-bbox="826 824 1372 1160" style="background-color: #f0f0f0; padding: 10px; margin-top: 10px;"> <p> Note: If temperature compensation is configured to use an internally measured value (tcmode is set to measured), it will continuously update the value in RAM, overriding any temperature value that is written to RAM with the ENV command.</p> </div>
<p>Example (Show current compensation values; all compensations are enabled. Note that temperature compensation is in "measured" mode, so the value in use is constantly changing):</p> <div data-bbox="245 1317 1369 1774" style="background-color: #f0f0f0; padding: 10px; margin-top: 10px;"> <pre>env In eeprom: Temperature (C) : 25.00 Pressure (hPa) : 1013.00 Oxygen (%O2) : 21.00 Humidity (%RH) : 50.00 In use: Temperature (C) : 36.40 Pressure (hPa) : 1013.00 Oxygen (%O2) : 19.70 Humidity (%RH) : 93.00</pre> </div>	

Syntax	Description
<p>Example (set temperature compensation to setpoint mode, and change temperature setpoint value to 37.2 in RAM):</p> <pre> pass 1300 tcmode on T COMP MODE : ON env xtemp 37.2 In eeprom: Temperature (C) : 25.00 Pressure (hPa) : 1013.00 Oxygen (%O2) : 21.00 Humidity (%RH) : 50.000 In use: Temperature (C) : 37.2 Pressure (hPa) : 1013.00 Oxygen (%O2) : 19.70 Humidity (%RH) : 93.00 </pre>	

Table 38 O2cmode Command

Syntax	Description
o2cmode<cr>	<p>Check current oxygen compensation mode. Possible modes:</p> <ul style="list-style-type: none"> • on = Compensation enabled using setpoint value. • off = Compensation disabled, default (neutral) value used: see 2.5. Environmental Compensation (page 14)
o2cmode [on off]<cr>	Change oxygen compensation mode (on or off).
<p>Example (check oxygen compensation mode; oxygen compensation is disabled, a neutral value is used):</p> <pre> pass 1300 o2cmode O2 COMP MODE : OFF </pre>	

Syntax	Description
Example (enable oxygen compensation):	
<pre>pass 1300 o2cmode on O2 COMP MODE : ON</pre>	

Table 39 Pcmode Command

Syntax	Description
pcmode<cr>	Check current pressure compensation mode. Possible modes: <ul style="list-style-type: none"> • on = Compensation enabled using setpoint value. • off = Compensation disabled, default (neutral) value used: see 2.5. Environmental Compensation (page 14).
pcmode [on off]<cr>	Change pressure compensation mode (on or off).
Example (check pressure compensation mode; pressure compensation is enabled using a setpoint value):	
<pre>pass 1300 pcmode P COMP MODE : ON</pre>	

Table 40 Rhcmode Command


Syntax	Description
rhcmode<cr>	<p>Check current relative humidity compensation mode. Possible modes:</p> <ul style="list-style-type: none"> • on = Compensation enabled using setpoint value. • off = Compensation disabled, default (neutral) value used: see 2.5. Environmental Compensation (page 14). <div data-bbox="802 618 1350 916" style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;">  To apply an accurate relative humidity compensation, make sure that the temperature compensation and pressure compensation configurations also match the measurement environment. </div>
rhcmode [on off]<cr>	Change relative humidity compensation mode (on or off).
<p>Example (check relative humidity compensation mode; relative humidity compensation is disabled, a neutral value is used):</p> <div data-bbox="225 1167 1350 1339" style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;"> <pre>pass 1300 rhcmode RH COMP MODE : OFF</pre> </div>	
<p>Example (enable temperature, pressure and relative humidity compensation using setpoint values):</p> <div data-bbox="225 1469 1350 1765" style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;"> <pre>pass 1300 tcmode on T COMP MODE : ON pcmode on P COMP MODE : ON rhcmode on RH COMP MODE : ON</pre> </div>	

Table 41 Tcmode Command

Syntax	Description
tcmode<cr>	Check current temperature compensation mode. Possible modes: <ul style="list-style-type: none"> • on = Compensation enabled using setpoint value. • off = Compensation disabled, default (neutral) value used: see 2.5. Environmental Compensation (page 14) • measured = Compensation enabled using internal measurement.
tcmode [on off measured]<cr>	Change temperature compensation mode (on , off or measured).
<p>Example (check temperature compensation mode; temperature compensation is enabled using a setpoint value):</p> <pre> pass 1300 tcmode T COMP MODE : ON </pre>	
<p>Example (change temperature compensation to use internal measurement):</p> <pre> pass 1300 tcmode measured T COMP MODE : MEASURED </pre>	

4.14. Other Commands

Table 42 Frestore Command


Syntax	Description
frestore <cr>	<p>Restore the probe to its factory configuration. All user settings and user calibration parameters will be lost.</p> <div style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;">  <p>After using the frestore command, reset the probe using the reset command.</p> </div>
<p>Example (restore the factory settings and reset the probe):</p> <div style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;"> <pre>pass 1300 frestore Parameters restored to factory defaults reset GMP251 1.0.0</pre> </div>	

Table 43 Pass Command

Syntax	Description
pass [code]<cr>	<p>Access advanced serial commands. Advanced commands can be used until the next reset.</p> <p>code = Code for enabling advanced commands (1300).</p>
<p>Example:</p> <div style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;"> <pre>pass 1300</pre> </div>	

Table 44 Reset Command

Syntax	Description
reset<cr>	Reset the probe. The probe will restart as if it had just been powered on.
Example: <pre data-bbox="244 546 1372 689">reset GMP251 1.0.0</pre>	

5. Modbus

The probe can be accessed using the Modbus serial communication protocol. The supported Modbus variant is Modbus RTU (Serial Modbus) over RS-485 interface.

For instructions on enabling the Modbus mode when you are using the probe with Vaisala Industrial Protocol, see [4.6. Enabling Modbus Mode from Vaisala Industrial Protocol \(page 26\)](#).

For instructions on switching to Vaisala Industrial Protocol when the probe is in Modbus mode, see [4.5. Accessing Serial Commands from Modbus or Analog Mode \(page 25\)](#).

The pre-configured default Modbus serial settings are presented in the following table.

Table 45 Default Modbus Serial Communication Settings

Description	Default Value
Serial bit rate	19200
Parity	N
Number of data bits	8
Number of stop bits	2
Modbus device address	240

More Information

- [Modbus Registers \(page 82\)](#)

6. Operating with MI70 Indicator

6.1. Overview of MI70 Support

The probe is compatible with instruments that utilize the MI70 indicator, for example the GM70 Hand-Held Carbon Dioxide Meter. The MI70 indicator is a convenient service tool for viewing the measurement readings, adjusting the environmental compensation settings, and performing calibration and one-point adjustment.

6.2. Basic Display

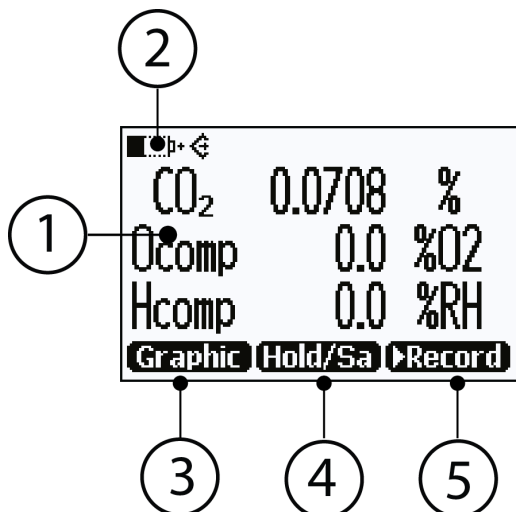


Figure 9 MI70 Basic Display

- 1 Measured parameter and compensations (up to three items on display simultaneously). You can change the shown items in **Main menu > Display > Quantities and units**.
- 2 Battery indicator. Shows current status (charge) of the battery.
- 3 Function key **Graphic** shows the readings as a curve.
- 4 Function key **Hold/Save** freezes the display and you can save the reading in the MI70 memory.
- 5 Function key **Record** is a quick access to the **Recording/Viewing** menu.

You can change the default function key shortcuts (**Graphic**, **Hold/Save**, **Record**) to other menus or functions in **Main menu > Settings > User interface > Program shortcut keys**.

6.3. Graphical Display

The graphical display shows you the measurements as a curve (the curve of the uppermost quantity shown in the basic display). From the curve you can examine the data trend and history of the last minutes.

To open the graphical display, select **Graphic** in the basic display or select **Main menu > Display > Graphic history > Show**.

To get the statistical info on the graph area (minimum, maximum, and average values), press **Info**.

To get the curve of the other selected quantities, press **Next**. To get the curves of all the quantities, press **Next** until the text **All** appears, and then select **All**.

To zoom in and out, press the up/down arrow keys.

To move back and forward in the timeline, use the left/right arrow keys.

6.4. Main Menu

In the main menu, you can configure the MI70 settings and basic display options, view information about the probe, access recordings and clear the memory, set alarms, start adjustments, and use the analog output option of the MI70 indicator.

To open the main menu and navigate in the menus:

- ▶ 1. Go to the basic display.
- 2. Press any arrow key, then select **Open** (must be pressed within 5 seconds or the indicator returns to the basic display).
- 3. Move in the menus using the **▲▼** buttons.
- 4. Select an item with the **▶** button.
- 5. To return to the previous level, press **◀**.
- 6. To return to normal operation, press **Open Exit**.

6.5. Connecting Probe to MI70 Indicator

- ▶ 1. If the probe is installed permanently into a device (for example, an incubator or a chamber), disconnect the probe from the connector.
- 2. If the MI70 indicator is on, turn it off.
- 3. Connect the probe to the MI70 indicator using the MI70 connection cable (Vaisala order code: CBL210472).
- 4. Turn on the MI70 indicator (time and date are requested at first startup). MI70 detects the probe and proceeds to show the measurement screen. The parameters measured by probe will start to show valid measurement results after a few seconds.

6.6. MI70 Indicator Parts

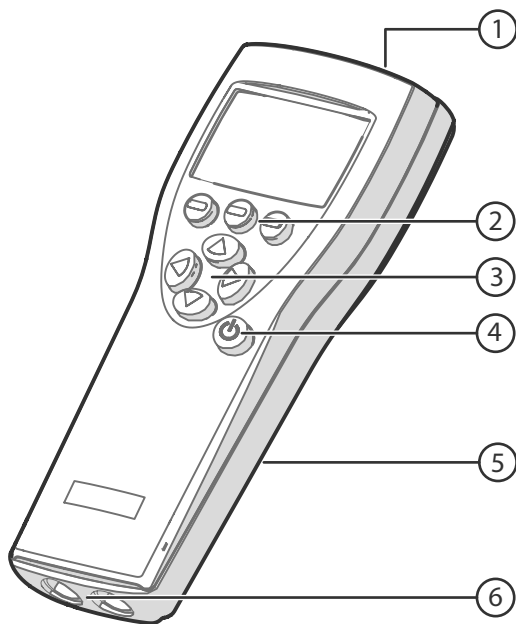







Figure 10 MI70 Indicator Parts

- 1 Charger socket
- 2 Function buttons . The functions change according to what you are doing with the indicator.
- 3 Arrow buttons:
 -  Move up in a menu
 -  Move down in a menu
 -  Enter a sub-menu
 -  Return to previous menu level
- 4 Power On/Off button
- 5 Battery compartment at the back of the indicator
- 6 Two ports (labeled I and II) for connecting probes and instruments.

To open menus, press an arrow button and then press the shortcut buttons. To activate a function shown above the shortcut button, press the shortcut button. To navigate in the menus, press arrow buttons.

6.7. Holding and Saving the Display

With the **Hold/Save** function, you can freeze a certain display reading. This reading can be saved in the MI70 memory and it will be available even after MI70 is disconnected from the transmitter.

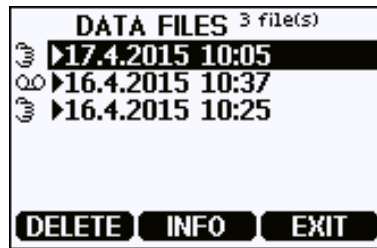
- ▶ 1. In the basic display, select **Hold/Save**. Alternatively, select **Main menu > Display > Hold/Save display > Hold**.
2. Press **Save**.
3. To view the saved display, go to basic display and select **Record > View recorded data**. Alternatively, select **Main menu > Recording/Viewing > View recorded data**.
A list of saved displays and data recordings appears. The icons on the left of the date and time indicate whether the file is a saved display or a longer recording of data:



Saved display

Data recording

4. Select the saved display based on date and time by pressing the right arrow key.



6.8. Recording Data

With MI70, you can record transmitter measurement data over a certain period at chosen intervals. These recordings are saved in MI70 memory and are available even after MI70 is disconnected from the transmitter.


Starting and Stopping the Recording

You can record the measurement of the parameters that are currently shown on the MI70 basic display. You can change the shown parameters in **Main menu > Display > Quantities and units**.

1. In the basic display, select **Record > Record data**. Alternatively, select **Main menu > Recording/Viewing > Record data**.
2. If needed, change the interval and duration of the recording in the **RECORD DATA** view. The measurement intervals and maximum recording times are shown in the following table.



If you set the duration to "Memory full", the recording continues until the MI70 memory is full or until you stop the recording manually. The maximum recording time is shown when you start the recording.

3. Select **Start/Stop recording > Start**.
The recording continues until the duration has passed or until you stop the recording manually.
You can switch the MI70 off during recording to save battery. A progress bar  is shown on the display every 10 seconds (or all the time, if a charger is connected). The progress bar shows the amount of recorded data.



CAUTION! Do not disconnect the probe when the data recording is on, even if the indicator is off. This may cause loss of recorded data.

4. To stop the recording manually, in the basic display select **Record > Record data > Start/stop recording > Stop**. To view the recorded file, select **Show**.

6.9. Changing Environmental Compensation Settings with MI70 Indicator

You can see the compensation values that are currently used by the probe by selecting them as display quantities from **Main menu > Display > Quantities and Units**. The quantities are as follows:

- **Tcomp**: currently active temperature compensation value.
- **Pcomp**: currently active pressure compensation value.
- **Ocomp**: currently active oxygen concentration compensation value.
- **Hcomp**: currently active relative humidity compensation value.

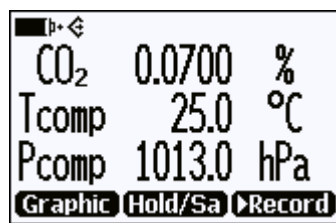


Figure 11 CO₂ Reading with Tcomp and Pcomp on MI70 Screen

You can change the compensation settings from **Main menu > Settings > Measurement settings**.

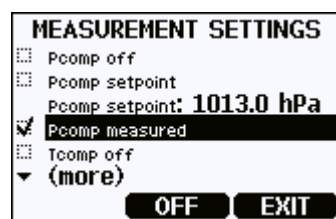


Figure 12 Probe Compensation Settings on MI70 Screen



When you turn a compensation off, the probe still shows a value for the corresponding display quantity (for example, Pcomp shows 1013.2 hPa). This is the default compensation value that is mathematically neutral for the probe's internal compensation model.

6.10. Calibration and Adjustment with MI70 Indicator



Before using the MI70 indicator for calibration and adjustment, read the instructions in [7.3. Calibration and Adjustment \(page 69\)](#). Make sure that the environmental compensation settings of the probe are properly set for your calibration environment; see [6.9. Changing Environmental Compensation Settings with MI70 Indicator \(page 63\)](#).



When two probes are connected to the MI70 indicator, MI70 uses Roman numerals “I” and “II” to indicate which port the parameter or function in question is connected to.

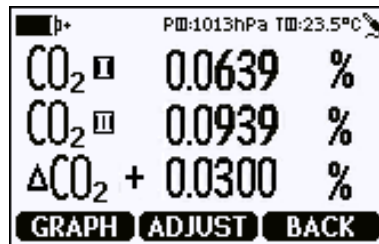
6.10.1. 1-Point Adjustment with an MI70-Compatible Reference Probe

- ▶ 1. Connect the GMP251 probe to Port I of the MI70 indicator.
2. Connect the calibrated reference probe to Port II. Make sure the reference probe is in the same environment as the GMP251's sensor.
3. If you are using the calibration adapter to feed a calibration gas to the GMP251, you must feed the same gas to the reference probe also. Refer to the documentation of your reference probe on how to do this, and what accessories you need.
4. Turn on the MI70 indicator.
5. Start the adjustment sequence from **Main menu > Functions > Adjustments**.

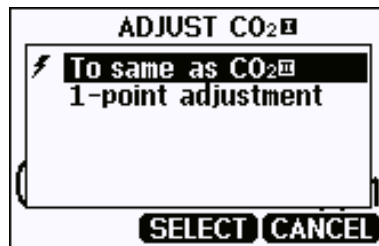


6. MI70 notifies you that automatic power off is disabled during adjustment mode, press **OK** to acknowledge.
7. To proceed with the adjustment, select the **CO2(I)** parameter in the **Select Quantity** screen. In the **Select Quantity** screen you can also view the currently used compensation values, and the **Last adjustment date** information. You can update the date and text using the **CDATE** and **CTEXT** commands on the serial line.

8. You may be prompted to check the environmental settings of the reference probe before proceeding. Press **Yes** to check the settings and **Exit** when you have checked and corrected the settings.
9. The adjustment mode is now active, and you can see the measured CO₂ readings and their difference on the screen. Allow the measurement to stabilize. To proceed with the adjustment, press **Adjust**.



10. Select **To same as CO₂(II)**.



11. You will be prompted to confirm you want to adjust: select **Yes**.
12. If the adjustment is successful, MI70 will show the text **Adjustment Done**, after which you will return to the adjustment mode. At this point you can press **Back** and **Exit** to leave the adjustment mode. The adjustment is now completed. If the adjustment cannot be applied, MI70 will show the text **Cannot adjust**, possibly followed by a text stating the reason. A possible reason for an adjustment failure is attempting to apply a very large correction to the reading.

6.10.2. 1-Point Adjustment with a Reference Gas

- ▶ 1. Connect the GMP251 to Port I of the MI70 indicator.
2. Feed a calibration gas to the GMP251 using the calibration adapter accessory (Vaisala order code: DRW244827SP). If you are using ambient air as the calibration gas, you must have a reference meter in the same environment to verify the CO₂ concentration.
3. Turn on the MI70 indicator.

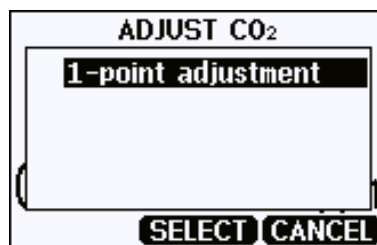
4. Start the adjustment sequence from **Main menu > Functions > Adjustments**.



5. MI70 notifies you that automatic power off is disabled during adjustment mode, press **OK** to acknowledge.
6. Select the CO₂ parameter when prompted.
7. You may be prompted to check the environmental settings of the reference probe before proceeding. Press **Yes** to check the settings and **Exit** when you have checked and corrected the settings.
8. The adjustment mode is now active, and you can see the measured CO₂ reading on the screen. To proceed with the adjustment, press **Adjust**.

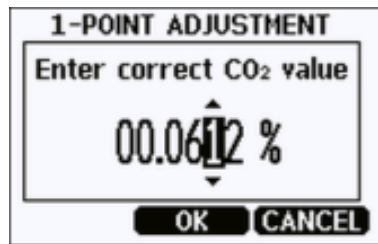


9. Select **1-point adjustment**.



10. You will be prompted if you really want to adjust. Select **Yes**.
11. You are now in the 1-point adjustment screen. Allow the measurement to stabilize and press **Ready**.

12. Enter the CO₂ concentration of the reference gas and press **OK**.



13. You will be prompted if you really want to adjust. Select **Yes**.
14. If the adjustment is successful, MI70 will show the text **Adjustment Done**, after which you will return to the adjustment mode. At this point you can press **Back** and **Exit** to leave the adjustment mode. The adjustment is now completed. If the adjustment cannot be applied, MI70 will show the text **Cannot adjust**, possibly followed by a text stating the reason. A possible reason for an adjustment failure is attempting to apply a very large correction to the reading.

7. Maintenance

7.1. Cleaning

You can clean the probe body by wiping it with a moist cloth. Standard cleaning agents can be used.

When cleaning, follow these precautions:

- Do not immerse the probe in liquid to clean it.
- Be careful not to block the filter when cleaning the probe. The optional sintered PTFE filter is especially sensitive to blockage.
- When changing the filter, you can use clean instrument air to gently blow any loose dirt and filter material from the sensor. Do not attempt to clean the optical surfaces in any other manner.

7.1.1. Chemical Tolerance

The following chemicals can be used to clean the probe:

- H₂O₂ (2000 ppm), non-condensing
- Alcohol-based cleaning agents such as ethanol and IPA (70 % Isopropyl Alcohol, 30 % water)
- Acetone
- Acetic acid



Avoid exposing the probe to chemicals for unnecessarily long periods of time. Do not immerse the probe in a chemical, and wipe chemicals off the probe after cleaning.

7.2. Changing the Filter

Change the filter to a new one if it shows visible signs of contamination or dirt. When changing the filter, use clean gloves to avoid blocking the pores of the new filter.

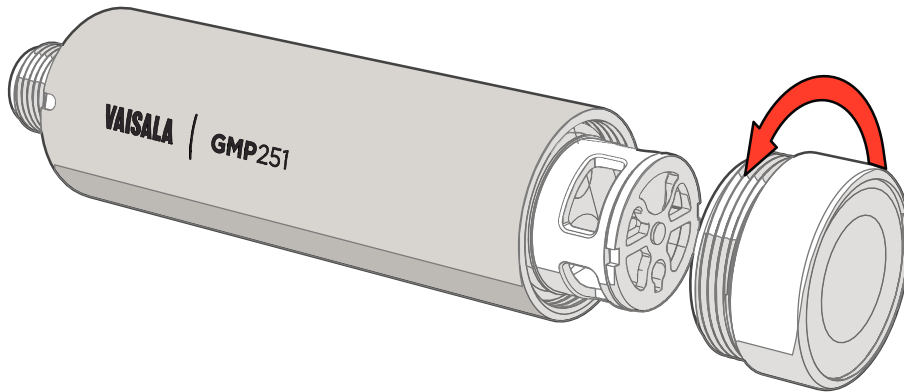


Figure 13 Opening the Filter



CAUTION! When changing the filter, you can use clean instrument air to gently blow any loose dirt and filter material from the sensor. Do not attempt to clean the optical surfaces in any other manner.

7.3. Calibration and Adjustment

Calibrate and adjust the CO₂ measurement of the probe as needed. Before starting, read through this section completely so that you are aware of your options, and the main factors that affect the result.



Performing an accurate calibration and adjustment takes some time and preparation. Instead of doing it yourself, you can also have a Vaisala Service Center calibrate and adjust your probe.



Calibration means comparing the measurement output of the device to a known reference, such as a known environment in a calibration chamber or the output of a reference instrument. Correcting the reading of the device so that it measures accurately is referred to as **adjustment**.

7.3.1. Calibration Setup

Using Hand-Held Meter as Reference

You can perform a 1-point calibration using a hand-held meter as a reference. You will need a calibrated reference instrument to compare against, for example a GM70 hand-held meter with a calibrated GMP221 probe.

With the probe and the reference instrument in the same space, allow the measurement to stabilize before comparing the readings. Try to provide as stable an environment as you can during this time. Avoid working around the probe and reference instrument during this time.

Using Calibration Gas as Reference

There are two easy ways to use a calibration gas as a reference:

- You can supply the gas to the probe using the calibration adapter accessory (Vaisala order code DRW244827SP). Gas flow should be in the range 0.5 ... 1.1 l/min, recommendation is 1 l/min. Allow the measurement to stabilize for three minutes before starting the calibration.
- You can fill the entire incubator with the calibration gas. You can use calibration gas as a reference by putting the probe in a suitable chamber (for example, an incubator) and filling that chamber with the calibration gas.

To perform a two-point adjustment, you need two calibration gases: one gas that is below 2 %CO₂ (low-end reference) and one that is above 2 %CO₂ (high-end reference).

When supplying the gas from a gas bottle, make sure the gas bottle has stabilized to room temperature before starting.

7.3.2. Effect of Environmental Compensations

The probe has various environmental compensations that improve its CO₂ measurement accuracy (see [2.5. Environmental Compensation \(page 14\)](#)). As the calibration and adjustment environment may differ from the actual measurement environment, you must make sure that the compensation settings are properly set. Here are some key points to remember:

- Pressure and temperature compensations have a significant effect on accuracy. If you are using setpoint values instead of the values from the builtin temperature sensor or an integrated system, make sure to correct the setpoints so that they correspond to your calibration situation. Consider switching temperature compensation to use the internal sensor and/or integrated system when calibrating, and then switching back when calibration and adjustment is done.
- The effect of background gas compensations for humidity and oxygen may be significant when using calibration gases, since these gases are often dry and oxygen-free. For example, pure nitrogen gas is typically used as a convenient 0 ppm CO₂ reference. As it does not contain any oxygen or humidity, the compensations for them must be set to zero.

- Remember to restore the normal compensation settings after completing calibration and adjustment. If you are integrating the calibration functionality of the probe as part of a control software, also implement proper handling of the environmental compensations.

7.3.3. Limits of Adjustment

The probe limits the amount of adjustment that is allowed to the CO₂ measurement. The maximum correction that you can apply is 1000 ppm + 25 % of the probe's uncorrected reading. Previous user adjustments do not affect this limit (the correction is not cumulative). This feature limits the possible error introduced by incorrect adjustment.

For example, if you are adjusting using a 5 %CO₂ calibration gas (50000 ppm), the maximum correction you can apply is approximately 13500 ppm. Attempting to apply a greater adjustment will fail. Notification of failure from the probe depends on the interface you are using for adjustment.

7.3.4. Adjustment Types

You can adjust the CO₂ measurement of the probe in one or two points.

- One-point adjustment is recommended if you are interested in maintaining a fixed CO₂ level. For best result, use a calibration gas with a CO₂ concentration that is close to the intended level.
- Two-point adjustment is recommended if you typically measure a variable CO₂ level.

Available adjustment functions depend on the interface you use to operate the probe. If you want to integrate the functionality into a control system, the Modbus interface and the Vaisala industrial protocol are recommended. If you want to compare the reading of the probe to a reference instrument and adjust it accordingly, use an MI70 hand-held indicator and a reference probe.

Vaisala Industrial Protocol

Vaisala industrial protocol supports one and two-point adjustment with the **cco2** command. Configuration of the environmental compensation settings can be done using serial line commands.

Modbus

The environmental compensation settings can be configured using Modbus registers.

MI70 Hand-Held Indicator

MI70 hand-held indicator supports one-point adjustment, either using a calibration gas or using a reference instrument that is connected to the MI70.

7.3.5. DRW244827SP Calibration Adapter

The optional calibration adapter accessory can be used to feed a reference gas to the probe through a gas port when calibrating. Gas flow should be in the range 0.5 ... 1.1 l/min, recommendation is 1 l/min. Allow the measurement to stabilize for three minutes before starting the calibration.

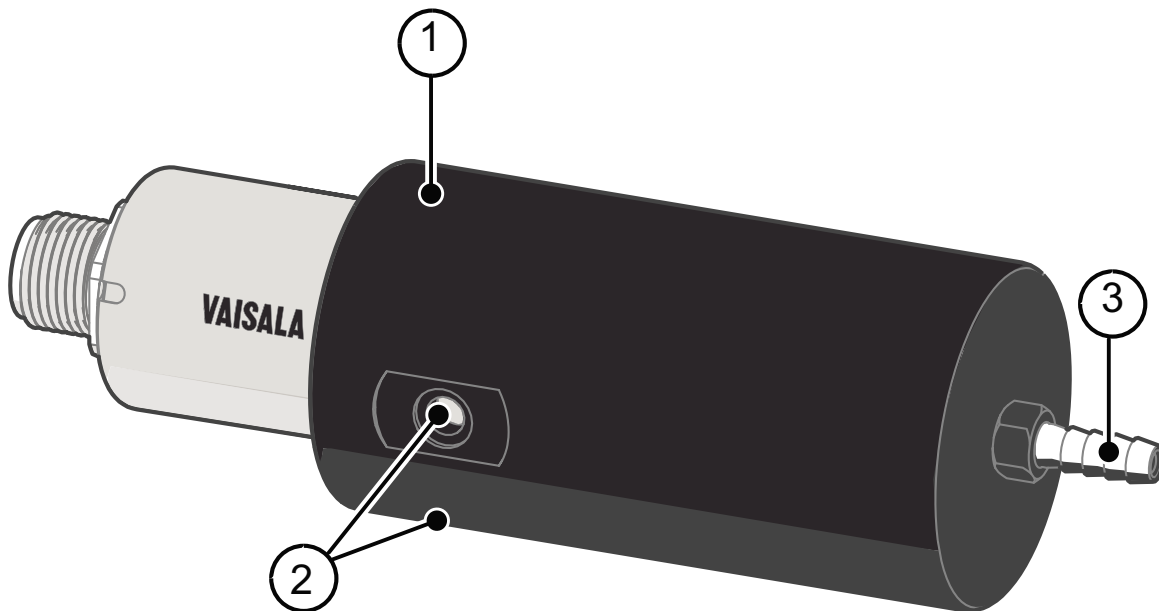


Figure 14 DRW244827SP Calibration Adapter with Probe Inserted

- 1 O-ring inside the adapter
- 2 Gas outlet on each side of the adapter
- 3 Gas port (port outer diameter 4.6 mm, port hole inner diameter 2 mm, suitable for tubing with 4 mm inner diameter)

8. Troubleshooting

8.1. Problem Situations

Problem	Possible Cause	Remedy
Analog output reading is unchanging and appears incorrect.	Analog output is in error state.	Remove the cause of the error state and the analog output will recover its normal function.
Probe outputs stars "*****" on serial line instead of measurement data.	Incorrect supply voltage.	Check the power supply. Check the active errors using the ERRS command on the serial line.
	Unsuitable operating environment.	Verify that the operating environment is within specified operating limits.
Unable to access probe on the RS-485 line.	Incorrect wiring.	Check that the RS-485 connection is wired correctly.
	Probe in POLL mode with unknown address.	Power cycle or reset the probe and try again.
CO ₂ measurement not working.	Condensation on the sensor.	Remove the filter and check if condensation has formed on the sensor. If yes, dry out the condensation with instrument air and insert a new dry filter. Keep the probe powered and operating to prevent re-occurrence.

8.2. Error Messages

The error messages are categorized according to the severity of the status:

- **Critical errors** are fatal to the operation of the unit. It may not be able to respond to communication at all, and will not measure correctly.
- **Errors** prevent CO₂ measurement and cause the analog outputs to be set to the error state. Depending on the problem, errors may resolve themselves. For example, sensor heating will eventually dry out condensation on the optical surfaces.
- **Warnings** do not prevent normal operation but may indicate possible problems.
- **Status** indicates a known state of the unit.

Error Message	Description	Recommended Action
Critical errors		

Error Message	Description	Recommended Action
Program memory crc critical error	Program memory is corrupted.	Fatal error, contact Vaisala.
Parameter memory crc critical error	Parameter memory is corrupted.	Fatal error, contact Vaisala.
Errors		
Low supply voltage error		Check supply voltage.
Internal 30 V error	Low internal 30 V voltage.	
Low RX signal error	Low input signal. Can be caused by dirt or condensation on the optical surfaces.	Wait to see if condensation is removed by heat.
Internal 8 V error	Low internal 8 V voltage.	
RX signal cut error	Signal distortion (EMC interference)	
Out of measurement range error	CO ₂ concentration is too high to measure.	Wait for CO ₂ concentration to fall into the measurable range.
Sensor heater error	Sensor heater resistance is out of range.	
IR temperature error	IR source temperature error.	
FPI slope error	Signal receiver error.	Contact Vaisala.
Internal 2.5 V error	Internal 2.5 V voltage out of range.	
Internal 1.7 V error	Internal 1.7 V voltage out of range.	
Low IR current error	IR source failure.	Contact Vaisala.
Warnings		
Signal too low warning	Low input signal. Can be caused by dirt or condensation on the optical surfaces.	Continue normally.
Cut warning	EMC interference error limit approaching.	Check for EMC interference sources.
Unexpected restart detected	Transmitter is reset by watchdog process.	Continue normally.
Status messages		
CO ₂ adjustment mode active		Complete the CO ₂ adjustment.

8.3. Analog Output Error State

The probe sets the analog output channel into a defined error level instead of the measured result in two situations:

- Probe detects a measurement malfunction. This means an actual measurement problem, such as sensor damage or unsuitable environmental conditions.
- Measured value(s) are significantly outside the scaled output range.

The default error level depends on the output type:

Output	Default Error Level
0 ... 20 mA	23 mA
4 ... 20 mA	2 mA
0 ... 5 V	0 V
0 ... 10 V	0 V

The probe resumes normal operation of the analog output when the cause of the error state is removed.

9. Technical Data

9.1. GMP251 Specifications

Table 46 Performance

Property	Specification
Measurement range	0...20 %CO ₂
Accuracy at 25 °C (77 °F) and 1013 hPa (incl. repeatability and nonlinearity)	
at 5 %CO ₂	±0.1 %CO ₂
0...8 %CO ₂	±0.2 %CO ₂
8...20 %CO ₂	±0.4 %CO ₂
Calibration uncertainty	
at 5 %CO ₂	±0.05 %CO ₂
at 20 %CO ₂	±0.19 %CO ₂
Long-term stability	
0...8 % %CO ₂	±0.3 %CO ₂ /year
8...12 %CO ₂	±0.5 %CO ₂ /year
12...20 %CO ₂	±1.0 %CO ₂ /year
Temperature dependence	
with compensation at 5 %CO ₂ , 0 ... 50 °C (32 ... 122 °F)	<±0.05 %CO ₂
with compensation, 0...20%CO ₂ , -40...60 °C (-40 ... 140 °F)	±0.045 % of reading/°C
without temperature compensation at 5 %CO ₂ (typical)	-0.25 % of reading/°C
Pressure dependence	
with compensation at 5 %CO ₂ 700...1100 hPa	±0.05 %CO ₂
with compensation, 0...20%CO ₂ 500...1200 hPa	±0.015 % of reading/hPa

Property	Specification
without compensation (typical)	+0.15 % of reading/hPa
Humidity dependence	
with compensation, 0...20%CO ₂ , 0...100 %RH	±0.7 % of reading (at 25 °C (77 °F))
without compensation (typical)	+0.05 % of reading/%RH
O₂ dependence	
with compensation, 0...20%CO ₂ , 0 ... 90 %O ₂	±0.6 % of reading (at 25 °C (77 °F))
without compensation (typical)	-0.08 % of reading/%O ₂
Flow rate dependence (for flow-through model option)	
< 1 l/min flow	no effect
1...10 l/min flow	<0.6% of reading/ l/min
Start-up time at 25 °C (77 °F)	< 10 s
Warm-up time for full spec.	< 4 min
Response time (T90)	
with standard filter	< 1 min
flow-through model with >0.1 l/min	< 1 min

Table 47 Operating Environment

Property	Specification
Operating temperature of CO ₂ measurement	-40 ... +60 °C (-40 ... +140 °F)
Storage temperature	-40 ... +70 °C (-40 ... +158 °F)
Pressure	
Compensated	500 ... 1100 hPa
Operating	< 1.5 bar
Humidity	Humidity
Gas flow (for flow-through option)	
Operating range	< 10 l/min
Recommended range	0.1...0.8 l min

Property	Specification
Condensation prevention	Sensor head heating, when power on
Electromagnetic compatibility	EN61326-1, Generic Environment
Chemical tolerance (temporary exposure during cleaning)	<ul style="list-style-type: none"> • H₂O₂ (2000 ppm, non-condensing) • Alcohol-based cleaning agents (for example ethanol and IPA) • Acetone • Acetic acid

Table 48 Inputs and Outputs

Property	Specification
Operating voltage	
With digital output in use	12...30 VDC
With voltage output in use	12...30 VDC
With current output in use	20...30 VDC
Digital output	Over RS-485: <ul style="list-style-type: none"> • Modbus • Vaisala Industrial Protocol
Analog outputs	<ul style="list-style-type: none"> • 0 ... 5/10 V (scalable), min load 10 kΩ • 0/4 ... 20 mA (scalable), max load 500 Ω
Power consumption	
Typical (continuous operation)	0.4 W
Maximum	0.5 W

Table 49 Mechanics

Property	Specification
Materials	
Probe housing material	PET plastic
Filter	PTFE membrane, PET plastic grid
Connector	Nickel plated brass, M12 / 5 pin
Housing classification, probe body	IP65

Property	Specification
Connector	M12 5-pin male
Weight, probe	45 g
Dimensions	
Probe diameter	25 mm
Probe length	96 mm

9.2. Spare Parts and Accessories



Information on spare parts, accessories, and calibration products is available online at www.vaisala.com and store.vaisala.com.

Name	Order Code
Standard membrane filter	ASM211650SP
Porous sintered PTFE filter (extra protection)	DRW243649SP
Probe cable with open wires (1.5 m)	223263SP
Probe cable with open wires and 90° plug (0.6 m)	244669SP
Probe cable with open wires (10 m)	216546SP
Flow-through adapter with gas ports	ASM211697SP
USB cable for PC connection	242659
MI70 connection cable for probe	CBL210472
Flat cable for GMP250 probes, M12 5-pin	CBL210493SP
Probe mounting clips (2 pcs)	243257SP
Probe mounting flange	243261SP
Calibration adapter	DRW244827SP

9.3. GMP251 Probe Dimensions

The dimensions are given in millimeters (mm).

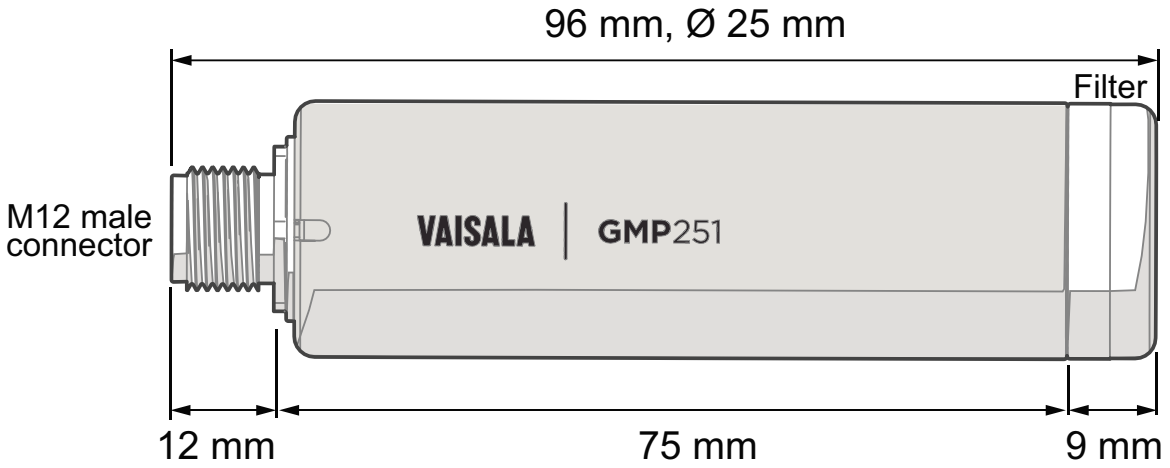


Figure 15 GMP251 Dimensions

9.4. 243261SP Mounting Flange Dimensions

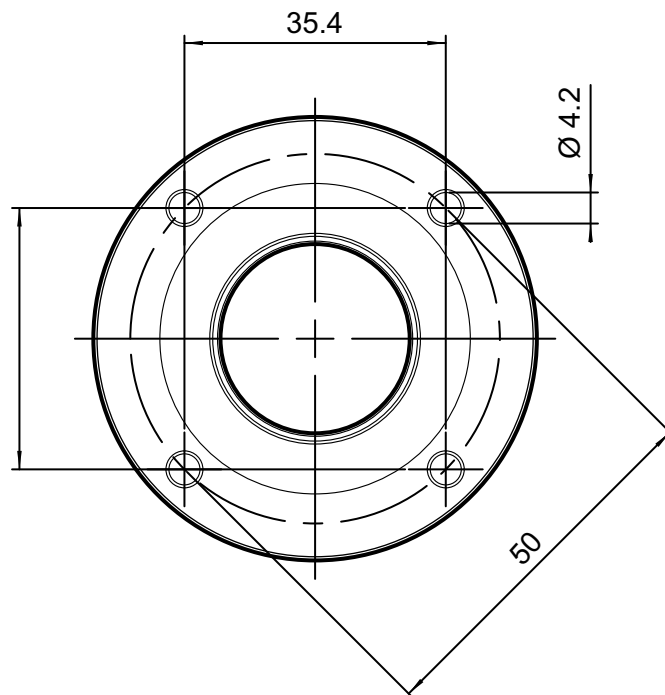


Figure 16 243261SP Mounting Flange Dimensions

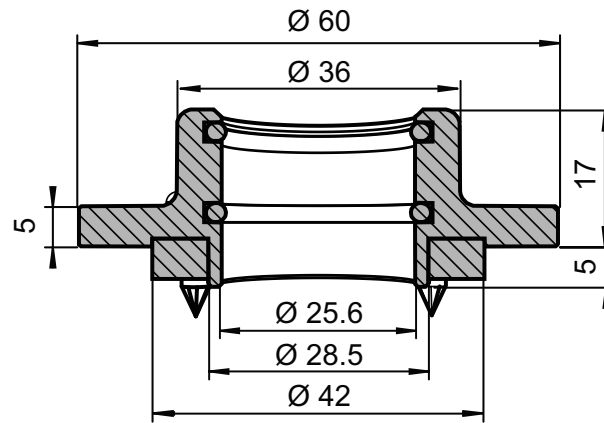


Figure 17 243261SP Mounting Flange Dimensions, Cross Section

9.5. 243261SP Calibration Adapter Dimensions

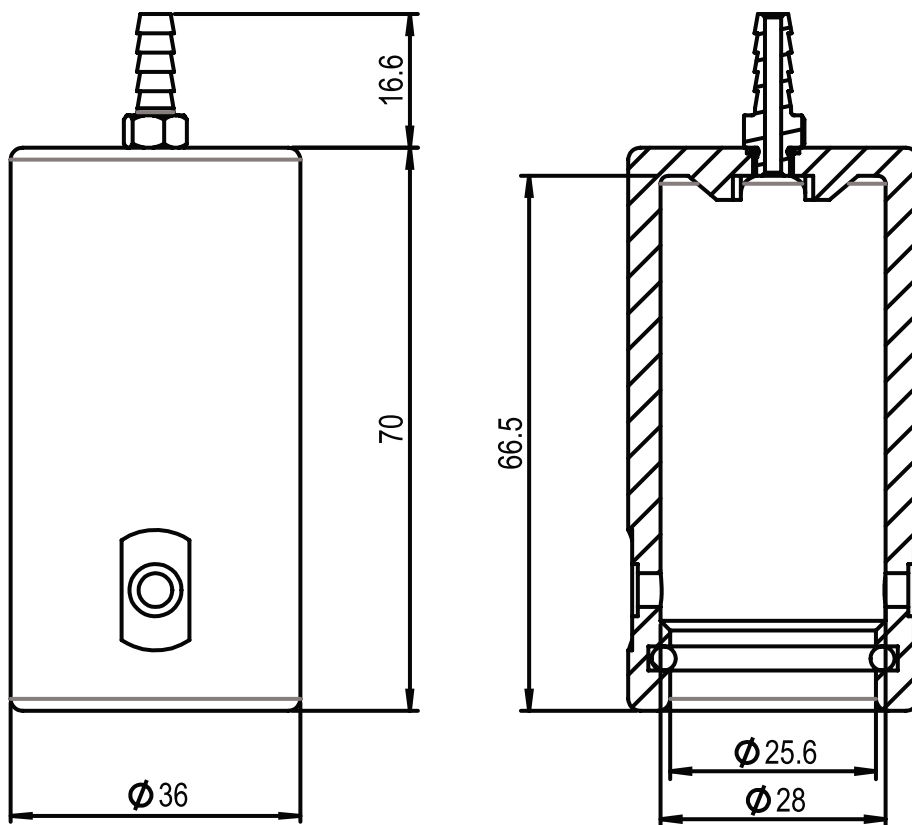


Figure 18 243261SP Calibration Adapter Dimensions

Appendix A. Modbus Reference

A.1. Function Codes

Table 50 Supported Function Codes

Function Code (Decimal)	Function Code (Hexadecimal)	Name
03	03	Read Holding Registers
16	10	Write Multiple Registers
43 14	2B 0E	Read Device Identification

A.2. Modbus Registers



CAUTION! The decimal numbering of register addresses used in this manual is 1-based (the register addresses start from 1). Note that the register addresses in actual Modbus messages (Modbus Protocol Data Unit (PDU)) start from zero. Subtract 1 from the decimal addresses presented in this manual to get the address used in the Modbus message (for example, the decimal register address 1 (Measured CO₂ value) becomes register address 0 in the actual Modbus message).

Accessing unavailable (temporarily missing) measurement data does not generate an exception. “Unavailable” value (a quiet NaN for floating point data or 0x0000 for integer data) is returned instead. An exception is generated only for any access outside the applicable register ranges.

A.2.1. Measurement Data

Table 51 Modbus Measurement Data Registers (Read-Only)

Address (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
1	00 00	Measured CO ₂ value	32-bit float	ppm
3	00 02	Compensation T	32-bit float	°C

Address (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit
5	00 04	Measured T	32-bit float	°C
257	01 00	Measured CO ₂ value	16-bit signed integer	ppm (up to 32 000 ppm)
258	01 01	Measured CO ₂ value	16-bit signed integer	ppm ¹⁾ (scaled, up to approx. 320 000 ppm)

1) The ppm output of the second Measured CO₂ value register (address 258) is scaled and must be multiplied by 10.

A.2.2. Configuration Registers



CAUTION! Default power-up values (registers 513-519) are written into non-volatile EEPROM memory. The EEPROM memory implementation has a limit of 30000 writes, and is intended to be used only when saving long-term or permanent configurations. Use the volatile memory (registers 521-527, values cleared on power-up) for non-permanent configurations (for example, if the probe is used in a system that regularly updates the compensation values).

Table 52 Modbus Configuration Data Registers (Writable)

Address (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
513	02 00	Power-up value for pressure compensation	32-bit float	hPa 700 ... 1500 hPa Operating <1.5 bar (Init/default: 1013.25)
515	02 02	Power-up value for temperature compensation	32-bit float	°C -40 ... +80 (Init/default: 25)
517	02 04	Power-up value for humidity compensation	32-bit float	%RH 0 ... 100 % (Init/default: 0)
519	02 06	Power-up value for oxygen compensation	32-bit float	%O ₂ 0 ... 100 % (Init/default: 0)
521	02 08	Volatile (value cleared at probe reset) pressure compensation	32-bit float	Range 700...1500 hPa (Init copied from power-up value)

Address (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
523	02 0A	Volatile (value cleared at probe reset) temperature compensation	32-bit float	Range -40...+80 °C (Init copied from power-up value)
525	02 0C	Volatile (value cleared at probe reset) humidity compensation	32-bit float	Range 0...100 %RH (Init copied from power-up value)
527	02 0E	Volatile (value cleared at probe reset) oxygen compensation	32-bit float	Range 0...100 %O ₂ (Init copied from power-up value)
769	03 00	Modbus address	16-bit integer	Valid range 1...247 (default: 240)
770	03 01	Serial speed	enum	Valid range 4800...115200 0 = 4800 1 = 9600 2 = 19200 3 = 38400 4 = 57600 5 = 115200 (default: 2 (19200))
771	03 02	Serial parity	enum	0 = None 1 = Even 2 = Odd (default: 0 (None))
772	03 03	Serial stop bits	16-bit integer	Valid range 1...2 (default: 2)
773	03 04	Pressure compensation mode	enum	0 = Off 1 = On (default: 1 (On))
774	03 05	Temperature compensation mode	enum	0 = Off 1 = Given 2 = Measured (default: 2 (Measured))
775	03 06	Humidity compensation mode	enum	0 = Off 1 = On (default: 0 (Off))
776	03 07	Oxygen compensation mode	enum	0 = Off 1 = On (default: 0 (Off))

Address (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Unit / Valid Range
777	03 08	CO ₂ filtering factor	16-bit integer	Valid range 0 ... 100 (default: 100 (no filtering)). For information on setting the filtering factor, see A.4. Filtering Factor (page 89) .



To apply an accurate relative humidity compensation (775), you must also enable temperature compensation (774) and pressure compensation (773).

A.2.3. Status Registers

Table 53 Modbus Status Registers (Read-Only)

Address (Decimal)	Address (Hexadecimal)	Register Description	Data Format	Notes
2049	08 00	Device status	16-bit	0 = Status OK. 2 = Critical error, maintenance needed. 4 = Error, device may recover automatically. 8 = Warning.
2050	08 01	CO ₂ status	16-bit	0 = Status OK. 2 = CO ₂ reading not reliable. This status also appears during transmitter start-up.



Multiple device statuses can be present simultaneously. In those cases, the value of the device status register is the sum of the applicable numbers, for example 12 if a warning (8) and an error (4) are present simultaneously.

A.2.4. Device Identification Objects

Table 54 Device Identification Objects

Object ID (Decimal)	Object ID (Hexadecimal)	Object Name	Example Contents
0	00	VendorName	"Vaisala"

Object ID (Decimal)	Object ID (Hexadecimal)	Object Name	Example Contents
1	01	ProductCode	"GMP25x Carbon Dioxide Probe "
2	02	MajorMinorVersion	Software version (for example "1.2.3")
3	03	VendorUrl	"http://www.vaisala.com/"
4	04	ProductName	"GMP25X "
128	80	SerialNumber ¹⁾	Transmitter serial number (for example, "K0710040")
129	81	Calibration date ¹⁾	Date of the factory calibration
130	82	Calibration text ¹⁾	Information text of the factory calibration

1) Vaisala-specific device information object

A.3. Modbus Communication Examples

Reading CO₂ Value




Device address used in the following examples is 240 (F0h). The values returned by the device differ depending on the ambient conditions and/or device settings. Your device might not return exactly same values.

Request		Response	
Bytes on the Line (Hexadecimal)	Description	Bytes on the Line (Hexadecimal)	Description
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
F0	GMP25x address	F0	GMP25x address
03	Function (Read Holding Registers)	03	Function (Read Holding Registers)
00	Register address	04	Number of data bytes
00		D4	Value of first register (least significant word)
00	Number of 16-bit registers to read (2)	7A	
02		43	Value of second register (most significant word)
D1	Modbus RTU checksum	E8	
2A		33	Modbus RTU checksum
(silence for 3.5 bytes)	End of Modbus RTU frame	AB	
		(silence for 3.5 bytes)	End of Modbus RTU frame

Communication Description	
Register address	1 (1-based Modbus documentation format) = 0000h (0-based format used in actual communication).
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Returned value	43E8D47Ah, which is binary32 representation of 465.65997 (ppm).

Writing Volatile Compensation Pressure Value

Request		Response	
Bytes on the Line (Hexadecimal)	Description	Bytes on the Line (Hexadecimal)	Description
(silence for 3.5 bytes)	Start of Modbus RTU frame	(silence for 3.5 bytes)	Start of Modbus RTU frame
F0	GMP25x address	F0	GMP25x address
10	Function (Write Multiple Registers)	10	Function (Write Multiple Registers)
02	Register address	02	Register address
08		08	
00	Number of registers to write (2)	00	Number of 16-bit registers written (2)
02		02	
04	Number of data bytes	D4	Modbus RTU checksum
50	Value for the first register (least significant word)	93	
00		(silence for 3.5 bytes)	End of Modbus RTU frame
44	Value for the second register (most significant word)	<div style="background-color: #f0f0f0; padding: 10px; border: 1px solid #ccc;">  <p>The response to a write function informs that the function was correctly received by the device. It does not guarantee that the written value was accepted by the device (for example, in case out-of-range values). To verify that the value was really accepted by the device, read the register value after writing.</p> </div>	
7D			
0E	Modbus RTU checksum		
B7			
(silence for 3.5 bytes)	End of Modbus RTU frame		

Communication Description	
Register address	521 (1-based Modbus documentation format) = 0208h (0-based format used in actual communication).

Communication Description	
Data format	Two 16-bit Modbus registers interpreted as IEEE 754 binary32 floating point value, least significant word first.
Value to write	1013.25 (hPa), in binary32 format 447D5000h.

A.4. Filtering Factor

Modbus register 777 sets the CO₂ filtering factor. The filtering factor affects the speed at which the latest CO₂ measurement is integrated into the output of the probe. A new measurement is produced approximately every two seconds.

By default, the filtering factory is set to 1.0, which means the latest measurement is shown directly in the output, without any filtering. If the measuring environment produces occasional exceptionally high or low readings that need to be averaged out in the output, filtering can be applied.

To apply filtering, you need to set a filtering factor that determines how much the previous measurements affect the calculation of measurement output. For example, when using filtering factor of 0.1, the new output is a combination of previous measurements (90%) and the latest measurement (10%).

Examples of the effect of filtering on output:

- Filtering factor 1.0 = No filtering, the latest measurement is output directly without integrating previous measurements.
- Filtering factor 0.5 = The reading output shows ~75% of the measurement change after two two-second measurement cycles and ~93% after four cycles.
- Filtering factor 0.1 = The reading output shows ~90% of the measurement change after 22 measurement cycles.

The configuration range of the filtering factor is 0 ... 100 in the 16-bit register: for example, to set the factor to 0.5, set the value of the register to 50.

The following formula is used when calculating the output:

$$o_{\text{new}} = o_{\text{old}}(m_{\text{new}} - o_{\text{old}}) \times f$$

o_{new}	New output
o_{old}	Previous output
m_{new}	New measurement
f	Filtering factor

Technical Support



Contact Vaisala technical support. . Provide at least the following supporting information:

- Product name, model, and serial number
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

For Vaisala Service Center contact information.

Warranty

For standard warranty terms and conditions

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

Recycling



Recycle all applicable material.



Follow the statutory regulations for disposing of the product and packaging.

VAISALA

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