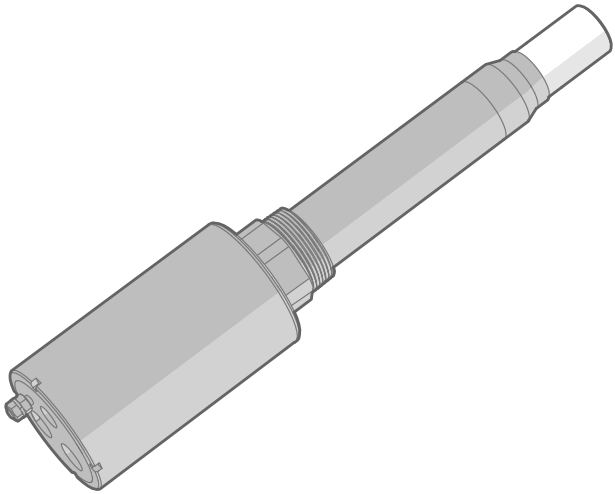
M212273EN-A

# User Guide

MGP261 Multigas Probe for Methane, Carbon Dioxide, and Humidity Measurement

**MGP261**



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# 1. About This Document

## 1.1 Version Information

Table 1 Document versions

| Document Code | Date | Description |
|---|---|---|
| M212273EN-A | August 2019 | This manual. First version of the document. |

## 1.2 Related Manuals

Table 2 Related Manuals

| Document Code | Description |
|---|---|
| M212238EN | MGP261 Multilingual Installation and Safety Guide (languages: English, German, French, Dutch, Spanish, Portuguese, Italian, Hungarian, Czech, Polish, Finnish, Estonian, Swedish, Norwegian, Danish) |
| M212291EN | USB Service Cable 257295 Quick Guide |
| M212283EN | Flow-Through Adapter 258877 Quick Guide |

## 1.3 Documentation Conventions

**WARNING! 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! 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.

## 1.4 Trademarks

Vaisala® and CARBOCAP® are registered trademarks of Vaisala Oyj.

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

# 2. Product Overview

## 2.1 Introduction to MGP261

Vaisala CARBOCAP® MGP261 Multigas Probe for Methane, Carbon Dioxide, and Humidity Measurement is a compact and durable in situ probe for methane ($CH_4$), carbon dioxide ($CO_2$), and moisture ($H_2O$ vapor) measurements in demanding biogas processing conditions. MGP261 probes are Ex certified for use in Ex Zone 0 (parts inserted into process) and Ex Zone 1 (parts outside the process).

MGP261 can be installed directly into raw process gas, removing the need for sample treatment. Application areas include anaerobic digestion of industrial and municipal waste and sludge from waste water treatment, landfill gas monitoring, activated carbon filter monitoring in biogas treatment process, and CHP engine feed gas monitoring.

The proprietary infrared technology of MGP261 provides superior stability and repeatability. Thanks to condensation elimination through probe heating and corrosion-resistant steel and plastic materials, the IP66-rated instrument is highly robust and durable.

MGP261 measurement output options include 3 analog current output channels (4 ... 20 mA) and Modbus RTU over RS-485. The probe also provides a 4 ... 20 mA Ex ia input for connecting an optional external pressure or temperature sensor.

For easy-to-use access to configuration, diagnostics, and calibration and adjustment functionalities, MGP261 can be connected to Vaisala Insight PC software with a USB cable accessory.

## 2.2 Basic Features and Options

- Available measurement parameters: methane ($CH_4$), carbon dioxide ($CO_2$), and moisture ($H_2O$ vapor)
- Ex classification: **Ex II 1/2 (1) G Ex eb mb [ia] IIB T3 Ga/Gb -40 °C ≤ Tamb ≤ +60 °C**
- Operating pressure: -500 ... +500 mbar
- 3 analog outputs (4 ... 20 mA, scalable, isolated)
- Digital output: Modbus RTU over RS-485
- Optional external temperature or pressure sensor input (4 ... 20 mA, Ex ia)
- Power supply input: 18 ... 30 VDC
- Direct installation into process: for pipeline ports with 1.5″ female NPT thread
- Compatible with Vaisala Insight PC software

### 2.2.1 Hazardous Area Safety

**CAUTION!** Do not install or use MGP261 in a hazardous area before reviewing the safety information in Using MGP261 in Hazardous Locations (page 17).

## 2.2.2 Measurement Parameters

Table 3 (page 10) shows the units and ranges of the MGP261 measurement parameters. For further information on the measurement parameters, see Specifications (page 62).

Table 3 MGP261 Measurement Parameters

| Parameter | Unit | Measurement Range |
|---|---|---|
| Methane ($CH_4$) | Volume-% | 0 ... 100 vol-% |
| Carbon Dioxide ($CO_2$) | Volume-% | 0 ... 100 vol-% |
| Water Vapor ($H_2O$) | • Volume-%<br>• Dew point temperature<br>• Dew point and frost point temperature | • 0 ... 100 vol-%<br>• -10 ... +60 °C (14 ... +140 °F) |

## 2.2.3 Wet Basis and Dry Basis Measurement Output

MGP261 methane, carbon dioxide, and water vapor measurements can be shown either as wet basis or dry basis values. The wet basis / dry basis measurement output selection is made when ordering the probe, and can be configured with Vaisala Insight PC software or Modbus.

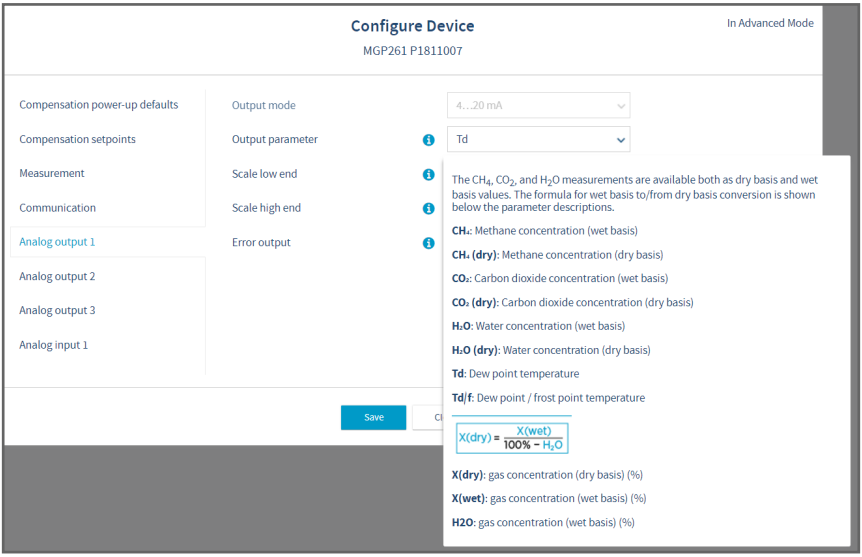



Figure 1 Output Parameter Selections in Vaisala Insight PC Software

**More Information**

- Configuring Analog Outputs with Insight (page 40)

### 2.2.4 Installation Type

MGP261 can be installed either directly into the process (for example, through a flange or ball valve in the actual process pipeline), or using a flow-through adapter (for example, in a sampling line installation or when performing a field calibration).

MGP261 uses different internal calculation models depending on the installation type and gas flow rate. For this reason, the type of the installation must be set correctly in MGP261 settings. You can view and change the installation type configuration with Vaisala Insight PC software: for instructions, see Installation Type Configuration in Insight (page 33).

**CAUTION!** Always ensure that the installation type configuration is set correctly in Insight when changing from one installation type to another, so that the calculation model in use matches the installation environment and measurement accuracy is not affected.

### 2.2.5 Process Flow Range and Installation Type

A process flow range of 2 ... 20 m/s is suitable for the in situ installation calculation model. When operating the probe in a low flow environment (0 ... 2 m/s) or using the flow-through adapter, use the flow-through calculation model. To set the correct calculation model for the flow range, choose the installation type in the Vaisala Insight PC software.

| Process Flow Range | Installation Type Selection in Insight PC Software |
|---|---|
| 2 ... 20 m/s | **Directly in process** |
| 0 ... 2 m/s or with flow-through adapter | **Flow-through adapter** |

**More Information**

- Installation Option: Ball Valve Installation (page 22)
- Installation Option: Flow-Through Adapter Installation (page 23)
- Installation Type Configuration in Insight (page 33)
- Connecting to Insight Software (page 35)
- Specifications (page 62)

### 2.2.6 Connectivity to Vaisala Insight Software

The probe can be connected to Vaisala Insight software using a Vaisala USB cable (order code: 257295). With the Insight software, you can:

- Calibrate and adjust the measurement.
- See device information and status.

- See real-time measurement.
- Configure serial communication settings, analog input and output parameters and scaling, and environmental compensations.

**More Information**

- Connecting to Insight Software (page 35)

## 2.3 Probe Parts

Figure 2 (page 13) shows the MGP261 main components with the connection box of the probe closed and opened.

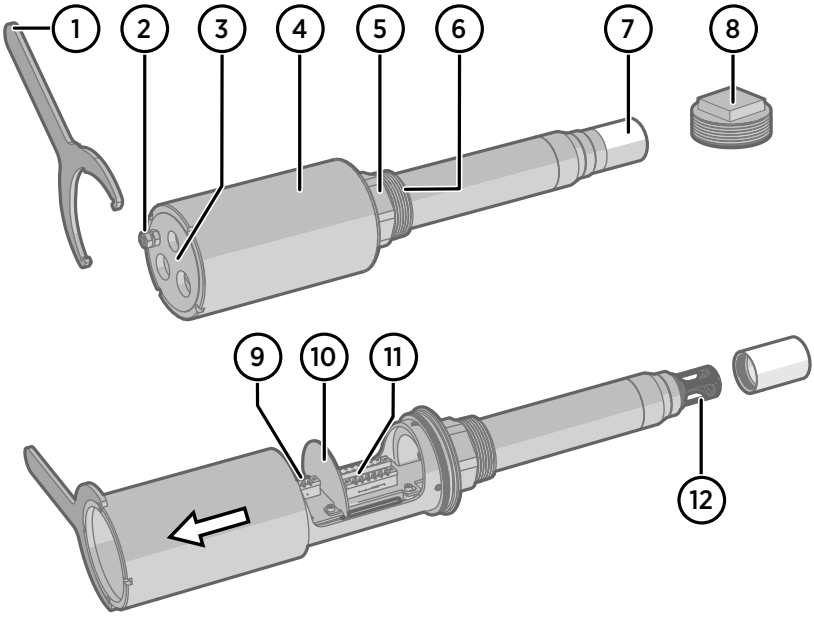



Figure 2 MGP261 Probe Parts (Closed and Opened View)

1 Connection box key
2 Grounding terminal
3 Lead-throughs for wiring: install cable glands as required (see Cable Gland Options and Lead-Throughs (page 14)) and seal unused lead-throughs
4 Connection box cover: open with connection box key to access wiring terminals
5 Tightening nut: only tighten from the tightening nut when installing
6 1.5″ male NPT thread: **never install the probe to any other thread type than 1.5″ female NPT thread**
7 Probe filter
8 1.5″ NPT thread test plug
9 Wiring terminals for optional 4 ... 20 mA input from external pressure or temperature sensor (Ex ia)
10 Barrier separating the intrinsically safe (Ex ia) optional external sensor input terminals from the analog output, power supply input, and RS-485 terminals
11 Wiring terminals for 4 ... 20 mA analog outputs, 18 ... 30 VDC power supply input, and RS-485 communication
12 Measurement cuvette with optics and CARBOCAP® sensor inside the probe filter

### 2.3.1 Cable Gland Options and Lead-Throughs

Figure 3 (page 14) shows the MGP261 cable gland options and lead-through measurements.

Cable glands are not provided by Vaisala. When selecting cable glands for your application, note the requirements in Guidelines for Safe Use in Hazardous Conditions (page 17).

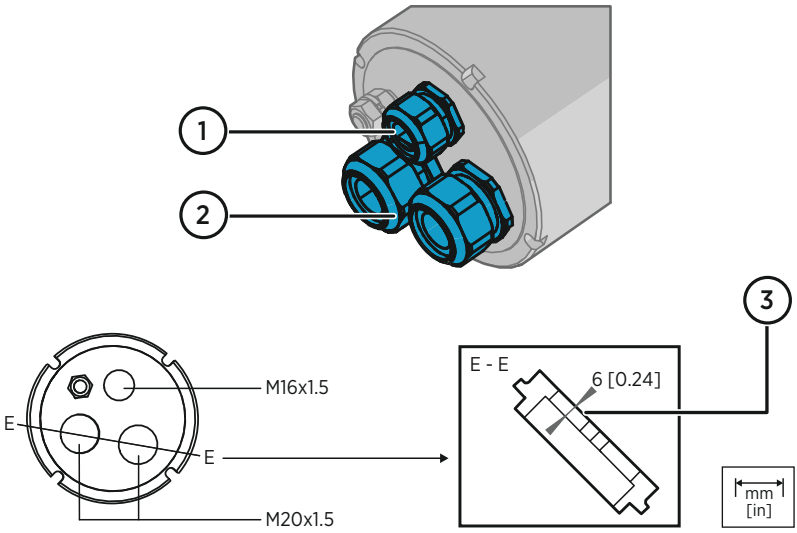


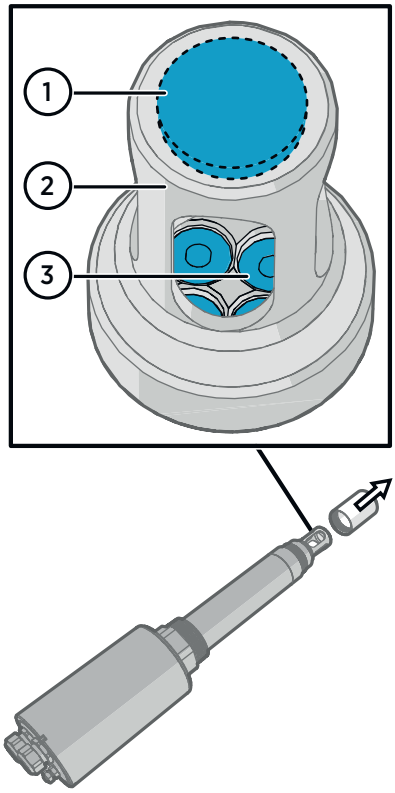

Figure 3 Cable Gland Options and Lead-Throughs

1 M16x1.5 wiring lead-through (1): used when wiring the optional Ex ia external pressure or temperature sensor input terminal
2 M20x1.5 wiring lead-throughs (2): used when wiring the analog output, power supply input, and RS-485 terminals
3 The depth of the lead-throughs is 6 mm (0.24 in): the maximum thread length for the plugs used in the lead-throughs is 8 mm (0.31 in) and the maximum cable gland length is 5 cm (1.97 in)

**More Information**

- Preparing Probe for Installation (page 26)
- Wiring (page 28)

## 2.4 Measurement Principle




The Vaisala CARBOCAP® sensor used in the probe is a silicon-based, nondispersive infrared (NDIR) sensor for the measurement of methane ($CH_4$), carbon dioxide ($CO_2$), and humidity ($H_2O$).

Figure 4 Probe Cuvette with Mirror and Sensor Chips

1 Mirror
2 Cuvette
3 Sensor chips under TO5 packages

The sensitivity to gases 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 thermopile detectors that measure the light intensity at a wavelength determined by a Fabry–Pérot interferometer (FPI) and a band pass filter. One set of optics measures humidity and carbon dioxide, and a second one measures methane.

The measurement consists of two steps: first, the FPI is electrically tuned so that its pass band coincides with the characteristic absorption wavelength of the measured gas 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 gas 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.

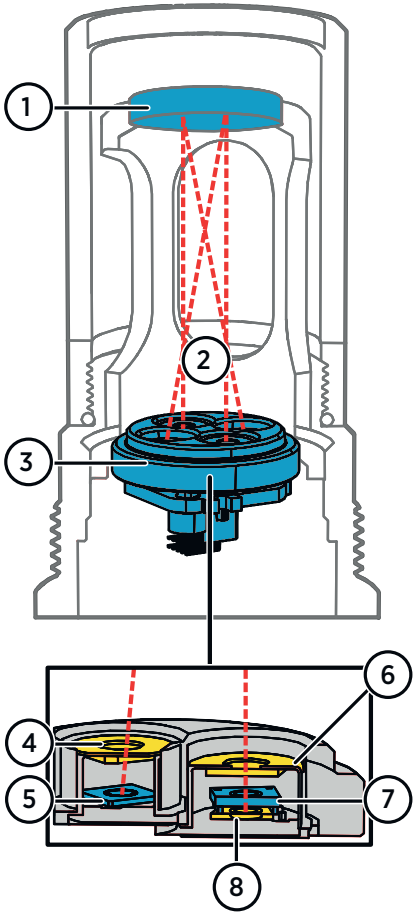



Figure 5 Measurement in the Measurement Cuvette

1 Mirror
2 Light absorbed by the measured gases
3 Sensor chips under TO5 packages (see items 4 ... 8)
4 Hermetic window
5 Thermopile detector
6 Hermetic window
7 Fabry–Pérot interferometer
8 Light source (Microglow)

**More Information**

- Specifications (page 62)

# 2.5 Using MGP261 in Hazardous Locations

**WARNING!** MGP261 has been designed for use in hazardous locations as specified by the product classification. The personnel installing, using, or maintaining the probe are responsible for determining the appropriate protection concept for the specific application the probe is used in, and that the hazardous area classification of the probe meets the requirements of the application.

MGP261 is certified for use in hazardous areas as defined by the following classification:

**Ex II 1/2 (1) G Ex eb mb [ia] IIB T3 Ga/Gb -40 °C ≤ Tamb ≤ +60 °C**

**CAUTION!** The personnel installing, operating, and maintaining MGP261 must have the required competencies for working in the hazardous location, as defined by the applicable standards.

For information on the standards that apply to using MGP261 based on the classification of the device, see MGP261 certification documentation and the declarations of conformity related to MGP261 at www.vaisala.com/declarationofconformity.

## 2.5.1 Guidelines for Safe Use in Hazardous Conditions

### Process Connection and Partition Wall

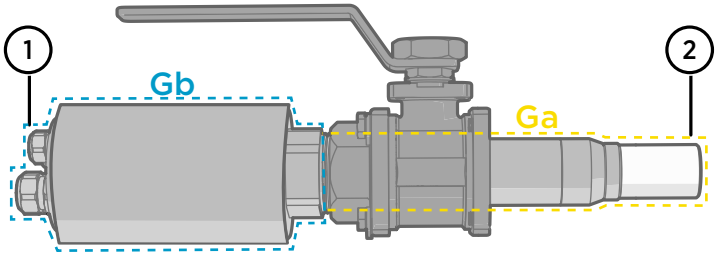



Figure 6 MGP261 Probe Ga/Gb Division

1 The part outside of the process (up until to the NPT 1.5″ connection thread) complies with the **Gb** Equipment Protection Level (EPL).
2 The part inside the process (starting from the NPT 1.5″ thread) complies with the **Ga** EPL. The partition wall is made of stainless steel, sapphire glass, and silicone adhesive. The stress limit temperature range of the silicone adhesive is -40 ... +60 °C (-40 ... +140 °F).

**WARNING!** While installing or uninstalling the device, there is a risk of flammable gas release or flame entrance.

### Wiring Requirements

- The wiring of the optional intrinsically safe (Ex ia) external pressure or temperature sensor input terminal must be kept separate from the analog input, power supply input, and RS-485 wiring.
  - See the overview in the installation instructions.
- The cable glands and wires used for wiring MGP261 must be Ex compliant.
  - Unused lead-throughs must be sealed using Ex compliant plugs.
- Select a strain relief option that suits the application (either use cable glands that include strain relief or install separate clamps: see IEC 60079-14).
- See Table 4 (page 18) for screw terminal requirements.
- Permitted supply short-circuit current ($I_k$): 50 A
- MGP261 analog outputs must be externally powered.

**CAUTION!** Connect only de-energized wires. Never switch on the power supply input before completing the wiring and closing the connection box.

### Screw Terminal Connections

Table 4 Screw Terminal Wiring Requirements

| Property | Specification |
|---|---|
| Connection torque | 0.5 Nm ... 0.6 Nm |
| Connection capacity (solid and flexible) | 0.2 $mm^2$ ... 2.5 $mm^2$ (AWG 24 ... 12) |
| Stripping length | 7 mm (0.27 in) |

### Intrinsic Safety

The overvoltage category of MGP261 is **I** (non-mains equipment), as defined in IEC 60664-1.

MGP261 is in conformance with the IEC 60079-11 dielectric strength requirement. For the intrinsic safe IIB output parameters, see Table 5 (page 18).

Table 5 Intrinsic Safe IIB Output Parameters

| Parameter | Value |
|---|---|
| $U_o$ | 25.2 V |
| $I_o$ | 78 mA |

| Parameter | Value |
|---|---|
| $P_o$ | 0.5 W |
| $U_m$ | 40 V |
| $C_o$ | 820 nF |
| $L_o$ | 20 mH |

The parameters listed in Table 5 (page 18) apply when one of the two conditions below is given:

- the total $L_i$ of the external circuit (excluding the cable) is < 1% of the $L_o$ value; or
- the total $C_i$ of the external circuit (excluding the cable) is < 1% of the $C_o$ value.

The parameters are reduced to 50% when both of the two conditions below are given:

- the total $L_i$ of the external circuit (excluding the cable) is ≥1% of the $L_o$ value; and
- the total $C_i$ of the external circuit (excluding the cable) is ≥1% of the $C_o$ value.

Note: the reduced capacitance of the external circuit (including cable) shall not be greater than 1µF for Groups I, IIA, IIB & IIIC, and 600nF for Group IIC.

The values of $L_o$ and $C_o$ determined by this method shall not be exceeded by the sum of all of the $L_i$ plus cable inductances in the circuit and the sum of all of $C_i$ plus cable capacitances, respectively.

### Connecting Probe to Insight PC Software

The Insight PC software connection cable must only be used outside the explosion hazardous area. Remove the probe from the process for configuration, and use only the Vaisala accessory PC connection cable to connect the probe to Insight.

### Maintenance

The probe filter is the only user-replaceable part in MGP261. For other maintenance requirements, contact Vaisala.

**CAUTION!** Live maintenance is not allowed.

| The content in this chapter is maintained in the following separately tracked document: | |
|---|---|
| Document ID: M212241EN | Revision: B (21 Jan 2019) |

# 3. Installation

## 3.1 Overview

MGP261 can be installed either directly into the process (for example, through a flange or ball valve in the actual process pipeline), or using a flow-through adapter (for example, in a sampling line installation or when performing a field calibration).

For an overview of installing MGP261 directly in the process, see Installation Option: Ball Valve Installation (page 22)

For an overview of the flow-through adapter, see Installation Option: Flow-Through Adapter Installation (page 23)

MGP261 uses different internal calculation models depending on the installation type and gas flow rate. For this reason, the type of the installation must be set correctly in MGP261 settings. You can view and change the installation type configuration with Vaisala Insight PC software: for instructions, see Installation Type Configuration in Insight (page 33).

**CAUTION!** Always ensure that the installation type configuration is set correctly in Insight when changing from one installation type to another, so that the calculation model in use matches the installation environment and measurement accuracy is not affected.

### 3.1.1 Process Flow Range and Installation Type

A process flow range of 2 ... 20 m/s is suitable for the in situ installation calculation model. When operating the probe in a low flow environment (0 ... 2 m/s) or using the flow-through adapter, use the flow-through calculation model. To set the correct calculation model for the flow range, choose the installation type in the Vaisala Insight PC software.

| Process Flow Range | Installation Type Selection in Insight PC Software |
|---|---|
| 2 ... 20 m/s | **Directly in process** |
| 0 ... 2 m/s or with flow-through adapter | **Flow-through adapter** |

**More Information**

- Installation Option: Ball Valve Installation (page 22)
- Installation Option: Flow-Through Adapter Installation (page 23)
- Installation Type Configuration in Insight (page 33)
- Connecting to Insight Software (page 35)
- Specifications (page 62)

### 3.1.2 NPT 1.5″ Thread Test Plug 257525SP

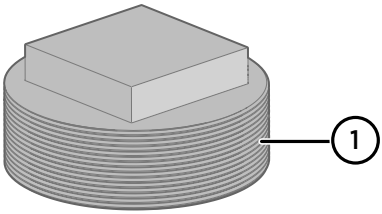



Figure 7 NPT 1.5″ Thread Test Plug

1 NPT 1.5″ male thread (same as on MGP261 connector)

MGP261 comes shipped with an NPT 1.5″ male thread test plug (Vaisala order code: 257525SP). If you are uncertain about the thread type of the process connector you want to install MGP261 into, use the thread test plug to check that it fits into the process connector threads (that is, that the process connector thread type is **NPT 1.5″ female**).

**More Information**

- Inserting Probe into Process and Opening Connection Box (page 27)

### 3.1.3 Installation Preparations

Before starting the installation, check the following:

- Make sure that your installation site suits the Ex classification of MGP261:
  **Ex II 1/2 (1) G Ex eb mb [ia] IIB T3 Ga/Gb -40 °C ≤ Tamb ≤ +60 °C**
- Review the hazardous area information in Using MGP261 in Hazardous Locations (page 17) and make sure that the conditions for safe use are met.
- Review the wiring diagram included in this document for power supply requirements: MGP261 requires a dedicated 24 VDC power supply. Note that in addition to the power supply input for the probe, each analog output must be externally powered.
- Inspect the probe for any possible damage or dirt that could compromise the leak tightness of the device (for example, bent or punctured parts of the probe body, or dirt on the connection box threads preventing it from closing fully).
- When selecting the cable glands and plugs for your application, make sure they are Ex compliant.

**More Information**

- Using MGP261 in Hazardous Locations (page 17)
- Wiring (page 28)

### 3.1.4 Installation Option: Ball Valve Installation

The following figure shows an example MGP261 ball valve installation. The figure highlights the correct wiring routes and shows the recommended installation depth and orientation.

**CAUTION!** Always use a separate cable for the optional (Ex ia) external pressure or temperature sensor input wiring (1), and make sure the wiring remains separated from the terminals and wiring (2) on the other side of the metal barrier (3) on the component board.

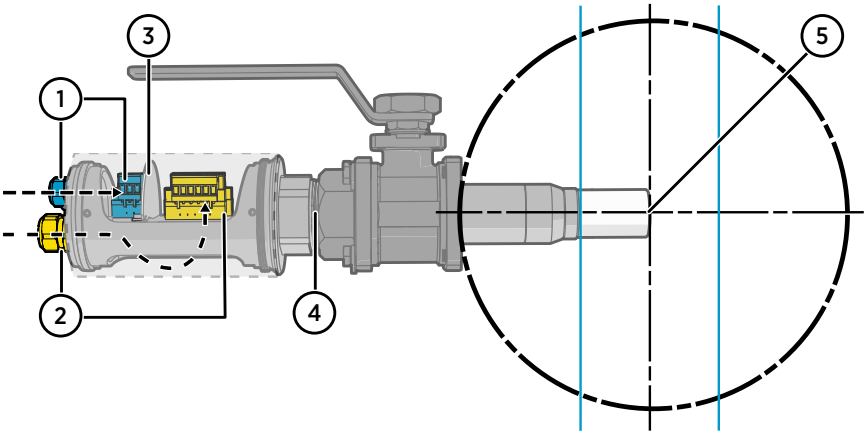



Figure 8 MGP261 Installation Example with Wiring Routes and Recommended Orientation and Depth

1 Optional external pressure or temperature sensor input wiring (Ex ia): use the M16x1.5 lead-through and route the cable directly to the terminal.
2 Standard analog output, power supply input, and RS-485 communication wiring: use the M20x1.5 lead-throughs and route the cables to the terminals through the openings below the component board.
3 Metal barrier separating the intrinsically safe external sensor input terminals (optional, for environmental compensation input) from the analog output, power supply input, and RS-485 terminals on the component board.
4 1.5″ male NPT thread on MGP261: **never install to any other thread type than 1.5″ female NPT**.
5 For best results, install MGP261 horizontally and position the tip of the filter within 1/3 of the pipe's diameter from the pipe centerline. In smaller pipes, the installation depth can be adjusted by using an adapter (for example, a ball valve).

**More Information**

- Recommended Installation Position on Pipeline (page 24)

### 3.1.5 Installation Option: Flow-Through Adapter Installation

Figure 9 (page 23) shows MGP261 attached into the MGP261 flow-through adapter accessory (Vaisala order code: 258877). For instructions on attaching MGP261 to the flow-through adapter, see Attaching Flow-Through Adapter to MGP261 (page 31).

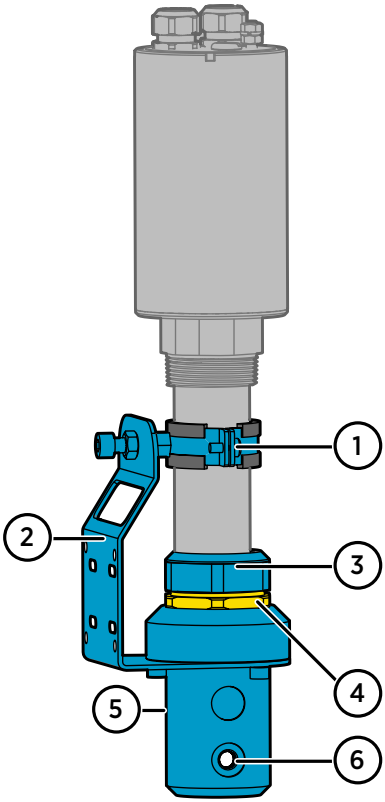



Figure 9 MGP261 in Flow-Through Adapter 258877

1 Clamp with 2 screws
2 Mounting plate (attach to mounting surface with screws or ties)
3 Probe gland tightening nut
4 Probe gland locknut: **do not turn**
5 Gas tube inlet port, G 1/8 (on the other side of the adapter)
6 Gas tube outlet port, G 1/8

**More Information**

- Attaching Flow-Through Adapter to MGP261 (page 31)
- Flow-Through Adapter Dimensions (page 67)

### 3.1.6 MGP261 Dimensions

Figure 10 (page 24) shows the MGP261 dimensions. The figure also shows the cabling lead-through depth: for more information on cable gland options and lead-through dimensions, see Cable Gland Options and Lead-Throughs (page 14).

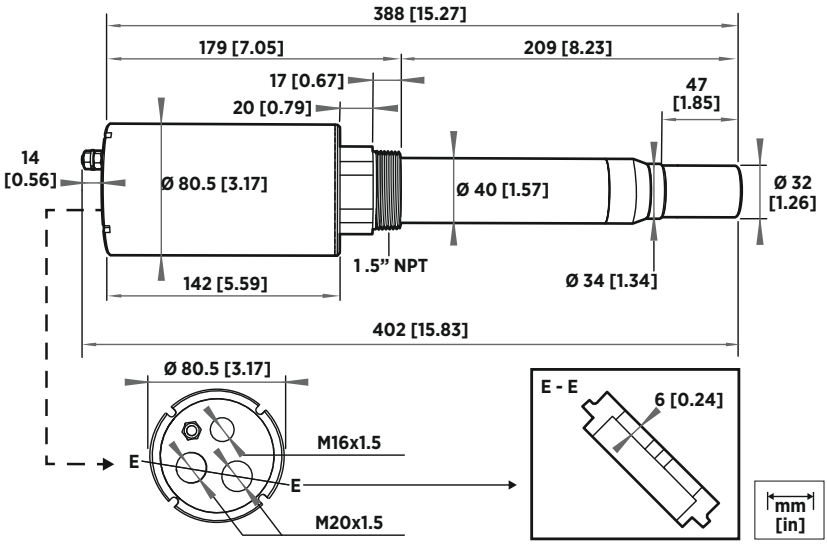



Figure 10 MGP261 Dimensions in Millimeters and Inches

### 3.1.7 Recommended Installation Position on Pipeline

Figure 11 (page 24) shows the recommended installation position for MGP261. Install the probe in a straight run of pipeline, ≥ 5 pipe diameters downstream of the closest bend or other feature affecting gas flow, and ≥ 2 pipe diameters upstream to the next bend or similar feature. For best results, use the orientation and installation depth shown in Figure 8 (page 22).

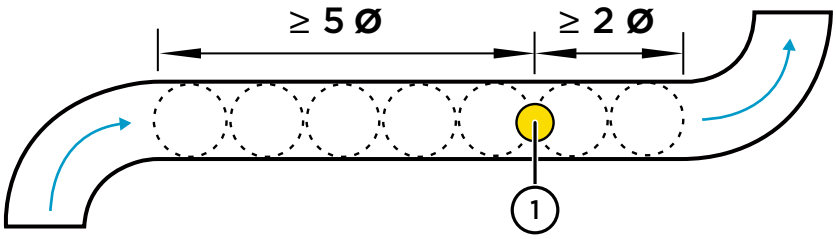



Figure 11 Recommended MGP261 Installation Position on Pipeline

1 Recommended MGP261 installation position on pipeline.

### 3.1.8 Gas Safety During Installation

**WARNING!** While installing or uninstalling the device, there is a risk of flammable gas release or flame entrance.

**WARNING!** Exposure to hazardous gases (for example, hydrogen sulfide ($H_2S$)) is possible when installing or removing MGP261 from the process.

- Always follow local safety guidelines. Ensure that the work area is safe and meets local regulations (for example, related to ventilation and personal protective equipment).
- Use a personal gas detector to monitor the safety of the area you are working in.
- After installation, use a gas detector to ensure that process connections are leak-free.

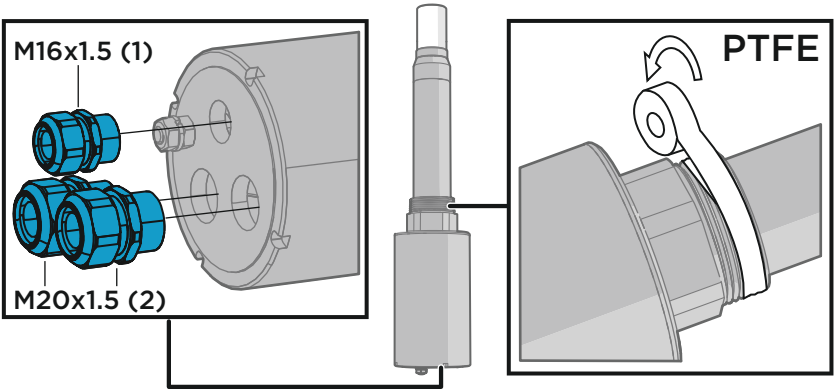
**CAUTION!** To avoid compromising the leak tightness of the installation:

- Ensure that the thread type of the installation port is 1.5″ female NPT. If unsure, verify the thread type with the 1.5″ NPT thread test plug.
- Apply PTFE tape to the 1.5″ male NPT thread of MGP261 as instructed in Preparing Probe for Installation (page 26), and make sure that the PTFE tape seal has not been damaged by rotating the probe open (counter-clockwise) in the installation port.

## 3.2 Preparing Probe for Installation

The following tools are required when installing:

- Adjustable wrench (or a similar suitable tool) for turning the tightening nut
- Connection box key (provided)
- Input and output cables for wiring
- Small slotted screwdriver for screw terminals
- PTFE tape (wide) for the probe threads

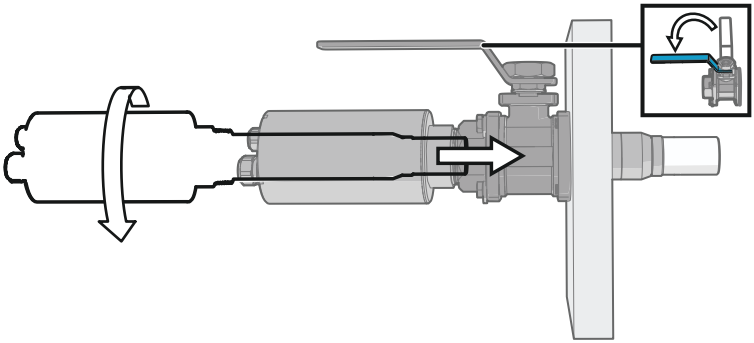



1. Attach cable glands (not provided by Vaisala) to the wiring lead-throughs as required. Note the cable gland requirements listed in Guidelines for Safe Use in Hazardous Conditions (page 17)). For more information on cable gland options and lead-through dimensions, see Cable Gland Options and Lead-Throughs (page 14).
   - Use an M16x1.5 gland for the optional external sensor input wiring (Ex ia).
   - Use 1 or 2 M20x1.5 glands for wiring the 4 ... 20 mA analog output, power supply input and RS-485 terminals (as required in your application).
   - Seal unused lead-throughs.
2. Apply PTFE tape on the probe threads.
   - Inspect the threads and remove any possible dirt.
   - Wrap 2-3 revolutions of tape in the direction of the thread spiral, starting from the first thread. Keep the edge of tape parallel to the face of the thread while wrapping.
   - Do not tape beyond the edge of the threads or leave loose tape hanging.

**CAUTION!** The correct thread type in which to install MGP261 is **1.5″ female NPT**. Installing into any other thread type can damage the equipment and compromise the leak tightness of the connection. If unsure, verify the thread type with the NPT 1.5″ thread test plug.

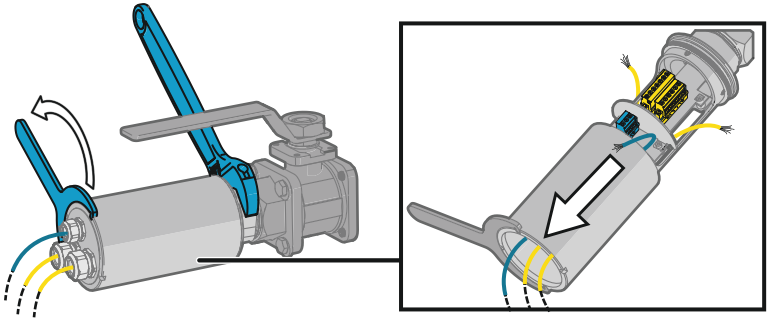
## 3.3 Inserting Probe into Process and Opening Connection Box

1. Insert the probe into the **1.5″ female NPT** installation port and rotate it clockwise until it sits firmly in the port. Do not tighten the probe to full tightness, only enough to keep it securely in place when wiring.



**CAUTION!** Rotating the probe open (counter-clockwise) after it has been installed into the port can tear the PTFE tape. Only adjust the position of the probe in the installation port by tightening (rotating clockwise).

2. Hold the probe by gripping the tightening nut with a wrench. Then open the connection box cover by turning the cover counter-clockwise with the connection box key.



For easier access, loosen the cable glands and insert the wiring cables into the connection box before pulling the connection box cover open.

3. Pull the connection box cover open to access the wiring terminals.

## 3.4 Wiring

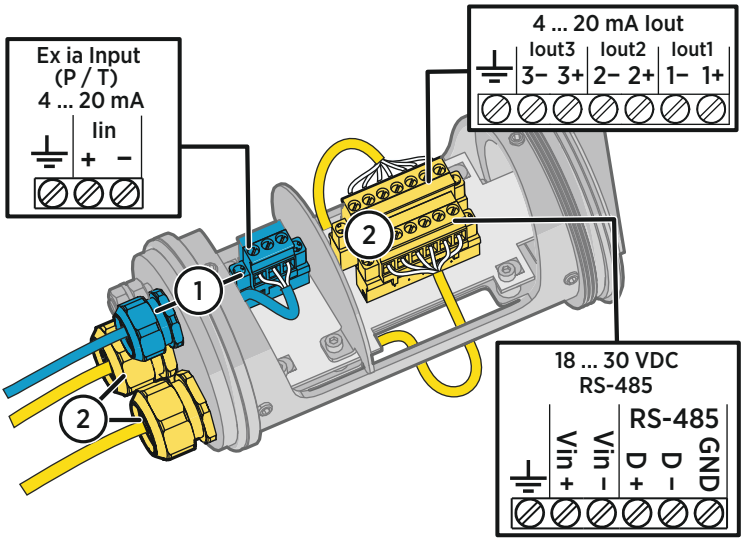



Figure 12 MGP261 Screw Terminal Markings and Cable Routes

**CAUTION!** Connect only de-energized wires. Never switch on the power supply input before completing the wiring and closing the connection box.

1. Connect the input, output, and power supply wiring as required in your application. Figure 13 (page 29) shows an example of wiring the device when all inputs and outputs are used.
   - **1**: Optional external pressure or temperature sensor input wiring (Ex ia): route the cable to the terminal through the M16x1.5 lead-through, above the component board.
   - **2**: Analog output, power supply input, and RS-485 wiring: route the cables to the terminals through the M20x1.5 lead-throughs (1 or 2), below the component board.
   - Adjust cable length and attach strain relief (tighten cable glands or use clamps).

   **CAUTION!** The optional Ex ia external sensor input wiring (**1**) must be kept separate from the analog output, power supply, and RS-485 wiring (**2**). Always use separate cables on each side of the metal barrier.

2. See Finalizing Installation (page 30) for instructions on attaching grounding to the probe grounding terminal.

### 3.4.1 Wiring Diagram

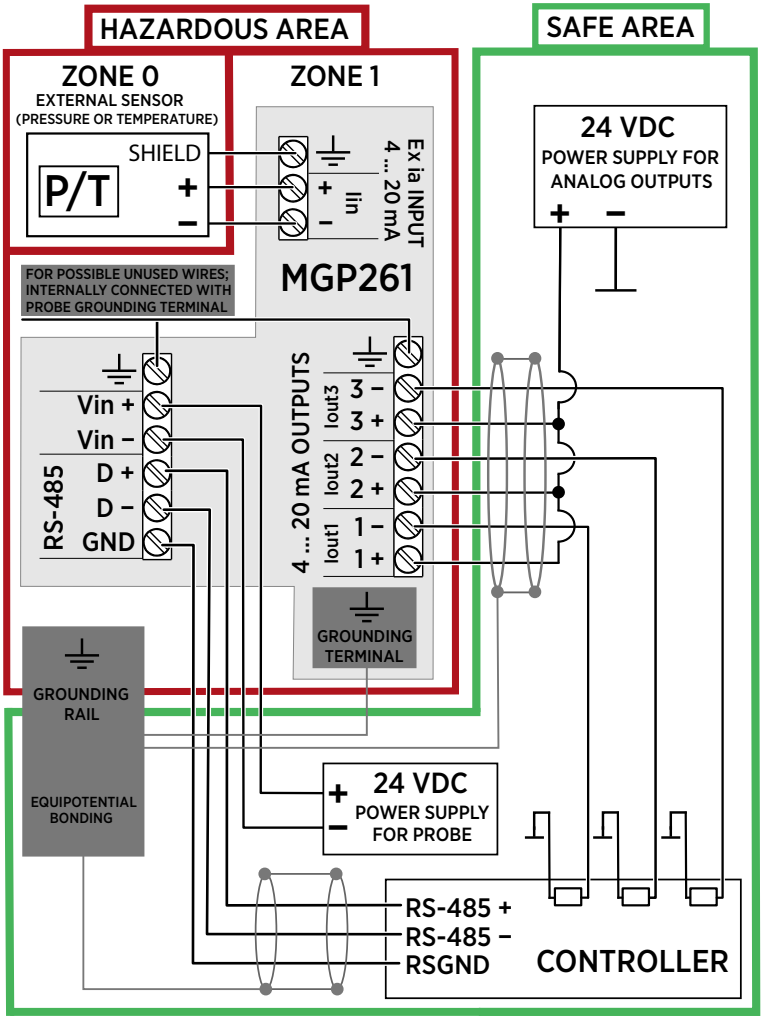
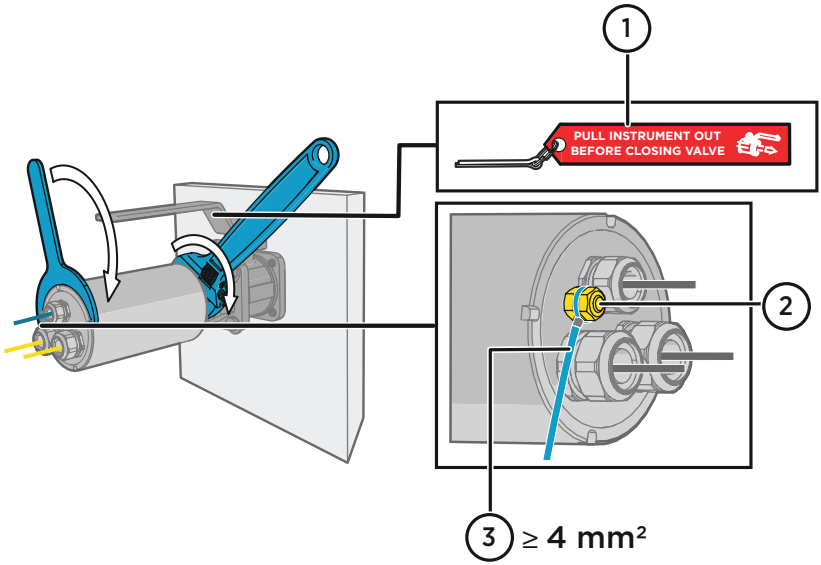



Figure 13 MGP261 Wiring Diagram

# 3.5 Finalizing Installation




1 Safety pin: in ball valve installations, lock the handle of the ball valve in the open position with the safety pin to prevent damage caused by closing the valve with the instrument inside.
2 MGP261 grounding terminal.
3 Use a ≥ 4 $mm^2$ wire to connect the grounding terminal to the grounding rail of the installation site.

1. Close and tighten the connection box (< 0.55 mm cover gap) and cable glands, and tighten the probe to final tightness on the installation port by turning the tightening nut with the wrench.
2. Connect the MGP261 grounding terminal to the grounding rail of the installation site with a ≥ 4 $mm^2$ wire.
3. **Ball valve installations only:** lock the handle of the ball valve in the open position with the safety pin.
4. When done, switch on the power supply input.

**More Information**

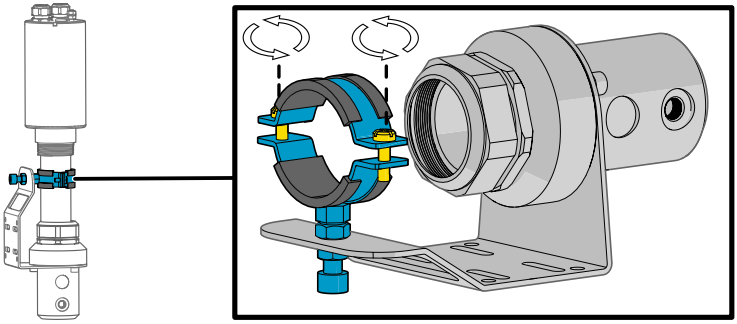
- Installation Type Configuration in Insight (page 33)

## 3.6 Attaching Flow-Through Adapter to MGP261

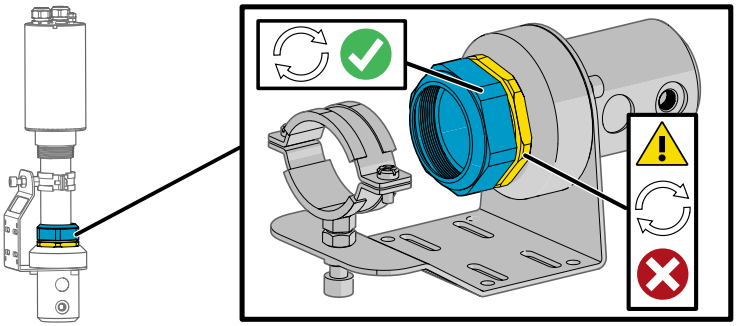
The MGP261 flow-through adapter 258877 is delivered assembled and is intended to be used with the probe installed in an upright position. For an overview of the flow-through adapter, see Installation Option: Flow-Through Adapter Installation (page 23).

To attach the adapter to MGP261:

1. Loosen the 2 screws on the clamp.



2. Loosen the probe gland.



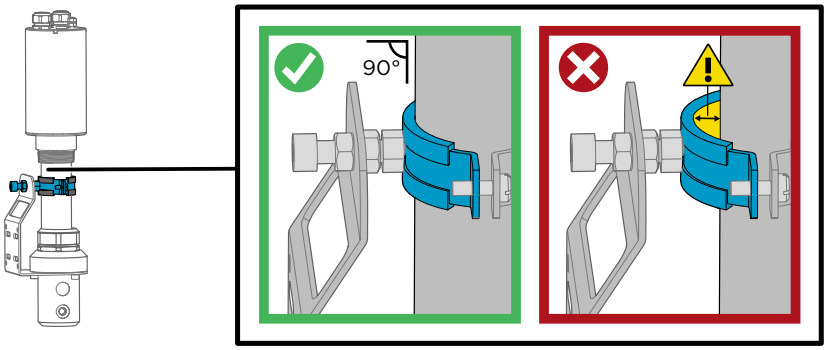
**CAUTION!** Only rotate the tightening nut of the probe gland. Never turn from the locknut of the probe gland (below the tightening nut). The threads of the locknut are glued onto the adapter with a sealant, and rotating the locknut will compromise the leak tightness of the adapter.

3. Insert the probe head into the adapter through the clamp and probe gland. Push the probe into the adapter until the shoulder of the probe head meets the slot inside the adapter and stops. The probe filter should cover both the inlet and outlet ports from the inside. Check the installation depth measurement as shown in Figure 29 (page 67).
4. Tighten the probe gland.

5. After tightening the probe gland, tighten the 2 screws on the clamp.

> **WARNING!** A high process pressure can cause the probe to detach from the adapter if the clamp and gland have been left loose. Always fully tighten the clamp and probe gland.

6. Attach the mounting plate to the mounting surface with screws or ties. For mounting plate dimensions, see Figure 30 (page 67).
7. Check that the probe sits closely in the clamps after mounting. The mounting kit and the flow-through adapter have been aligned so that the probe sits in the adapter in a straight angle. A gap between the probe body and clamp indicates that the mounting alignment is incorrect and must be adjusted.




> **CAUTION!** Ensure the adapter mounting does not pull the probe out of a straight angle. If the mounting pulls the probe to the side, the leak tightness of the gland O-ring can be affected.

8. Connect the gas inlet tube to the upper port of the adapter and the gas outlet tube to the lower port. Adapter port size: G 1/8.
9. Connect to Vaisala Insight PC software and ensure that the installation type has been set as **Flow-through adapter**. For instructions, see Installation Type Configuration in Insight (page 33).

**More Information**

- Installation Type (page 11)
- Installation Option: Flow-Through Adapter Installation (page 23)
- Installation Type Configuration in Insight (page 33)
- Flow-Through Adapter Dimensions (page 67)

# 3.7 Installation Type Configuration in Insight

Vaisala Insight PC software allows configuring the installation type of MGP261. The available options are **Directly in process** and **Flow-through adapter**.

When the selected installation type is **Flow-through adapter**, the internal calculation model is adapted to the flow-through environment. Always set the installation type according to the installation to ensure the correct calculation model is used.

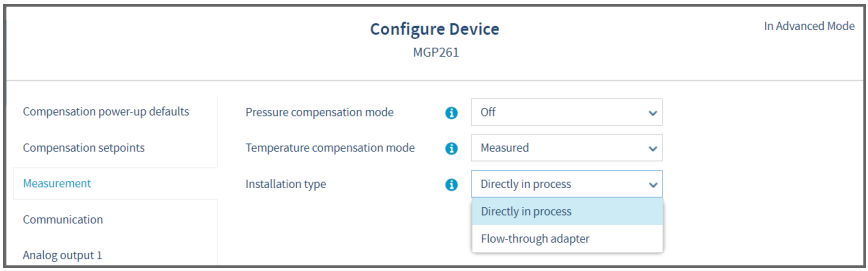



Figure 14 Installation Type Selection in Insight

If you install your probe directly into the process, for example, through a flange or ball valve in the actual pipeline, select **Directly in process**.

If you are using the probe with a flow-through adapter, for example, in a sampling line installation, select **Flow-through adapter**.

To configure the installation type:

1. Connect to Insight (see Connecting to Insight Software (page 35)).
2. Select > **Configure Device > Measurement**.
3. Select the correct **Installation type** from the dropdown menu (either **Directly in process** or **Flow-through adapter**).
4. Store the selection with **Save** and exit with **Close**.

**More Information**

- Installation Type (page 11)
- Connecting to Insight Software (page 35)

# 4. Operating with Insight Software

## 4.1 Vaisala Insight Software

Vaisala Insight software is a configuration software for Indigo-compatible probes. The supported operating systems are Windows 7 (64-bit), Windows 8.1 (64-bit), and Windows 10 (64-bit).

With the Insight software, you can:

- See device information and status.
- See real-time measurement.
- Configure serial communication settings, analog input and output parameters and scaling, and environmental compensations.
- Calibrate and adjust the device.

Download Vaisala Insight software at www.vaisala.com/insight.

The probe can be connected to Vaisala Insight software using a Vaisala USB cable (no. 257295).

**More Information**


- Connecting to Insight Software (page 35)
- Insight Main View (page 37)
- Configuring Modbus Communication Settings with Insight (page 39)
- Configuring Analog Outputs with Insight (page 40)
- Configuring Environmental Compensations with Insight (page 44)
- Calibration and Adjustment with Insight PC Software (page 52)


### 4.1.1 Basic and Advanced User Modes

You can switch between the **Basic Mode** and **Advanced Mode** user modes with the selections in the **Settings** menu.

Certain functionalities are only available in **Advanced Mode**. The options enabled by switching to **Advanced Mode** are often intended for administrative users: set the user mode according to the requirements of the personnel that use the device.

**More Information**


- Insight Main View (page 37)

# 4.2 Connecting to Insight Software

- Computer with Vaisala Insight software installed
- USB connection cable (no. 257295)
- Small flat head screwdriver for opening the screw terminal block screws

**CAUTION!** The Insight PC software connection cable must be used only outside the explosion hazardous area. Remove the probe from the process for configuration, and use only the Vaisala accessory PC connection cable 257295 to connect the probe to Insight.

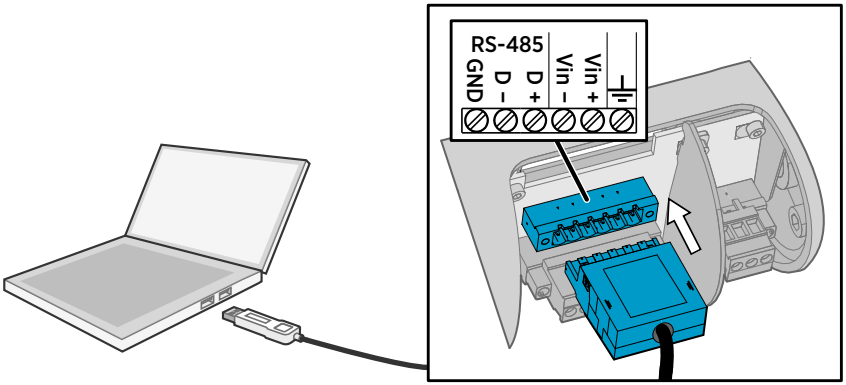



Figure 15 Connecting Probe to Insight

1. Open the Insight software.
2. Connect the USB cable to a free USB port on the PC.
3. Open the MGP261 connection box.
4. Unscrew the 6-pin screw terminal block on the MGP261 component board and lift the block out.
5. Plug the USB cable into the open port as shown in the illustration.
6. Wait for Insight software to detect the probe.

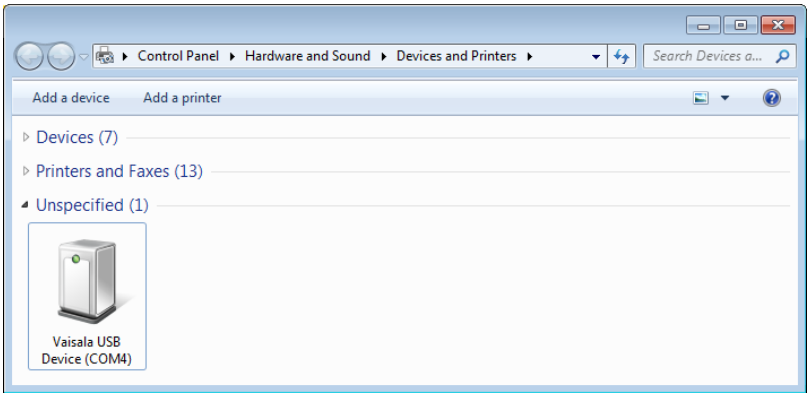
**More Information**

- Installing the Driver for the USB Service Cable (page 36)
- Removing Probe from Process (page 59)

### 4.2.1 Installing the Driver for the USB Service Cable

Only Windows® operating systems are supported by the driver of the USB service cable.

1. Connect the USB service cable to a USB port on your computer. Windows® detects the new device and installs the appropriate driver.
2. Open **Devices and Printers** from the Windows® Start menu. Use search to find it if necessary (search for "devices").
3. Locate the cable in the list of devices:
   - If the device is listed as **Vaisala USB Device** with a COM port number in brackets, the cable is ready for use. Take note of the COM port number for later use.
   - If the device is listed as **Vaisala USB Instrument Cable** without a COM port number listed, you must install the driver manually.




4. To install the driver manually:
   a. Disconnect the USB service cable from the computer.
   b. Download the Vaisala USB driver at www.vaisala.com/software (search and select the appropriate USB Instrument Driver Setup for your cable).
   c. Run the USB driver installation program *`Vaisala USB Device Driver Setup.exe`*. Accept the installation defaults.
   d. Go back to step 1 and verify that the driver installation works as expected.

# 4.3 Insight Main View

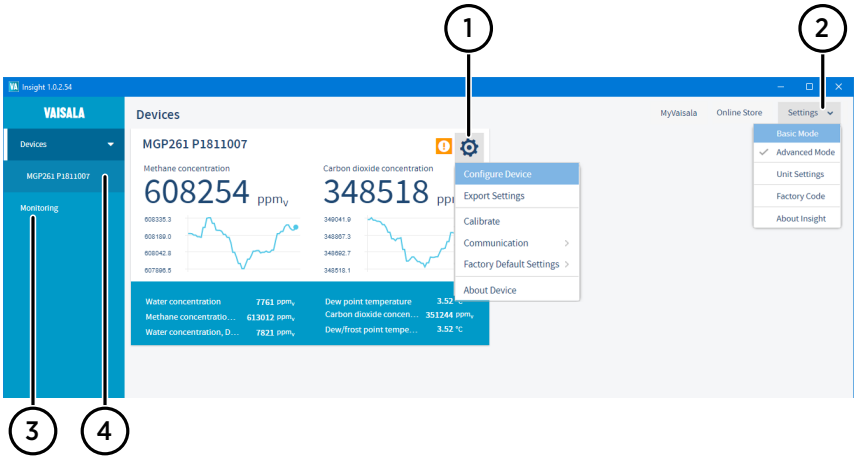



Figure 16 Insight Main Menu and Settings

1 Select ⚙ to access Insight main menu.

- **Configure Device**: environmental compensation settings, analog input and output settings, Modbus configuration, error limits and general settings.
- **Export Settings**: creates a text file export of the device settings.
- **Calibrate**: options for calibrating and adjusting methane, carbon dioxide, and water vapor output, viewing adjustment data, and restoring factory adjustments.
- **Communication**: contains a quick access selection for restarting the device.
- **Factory Default Settings**: restores the transmitter back to default settings, clears any user adjustments and restores the latest factory calibration.
- **About Device**: general device information such as serial number and software version.

2 Select **Settings** to switch between the **Basic Mode** and **Advanced Mode** user modes, change the units of parameters (metric/non-metric), enter a factory code to access restricted functionalities, or view information about the Insight software.

3 **Monitoring** provides options for monitoring and recording selected parameters, and exporting the monitoring data as a CSV (comma-separated values) file.

4 Device information menu with the following tabs:

- **Measurements**: measurement graph view with parameter drop-down selection.
- **Calibration Information**: read-only information about the latest stored calibration.
- **Diagnostics**: troubleshooting and administrative information about the device status. Also includes an option to export the device error log as a text file. When contacting Vaisala support, it is recommended to include an up-to-date export of the error log with the support request.

# 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.

The pre-configured default Modbus serial settings are presented in the following table. Modbus communication settings can also be configured using Vaisala Insight PC software.

For a description of MGP261 Modbus registers, see Modbus Registers (page 68).

Table 6 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**

- Configuring Modbus Communication Settings with Insight (page 39)
- Modbus Registers (page 68)

# 5.1 Configuring Modbus Communication Settings with Insight

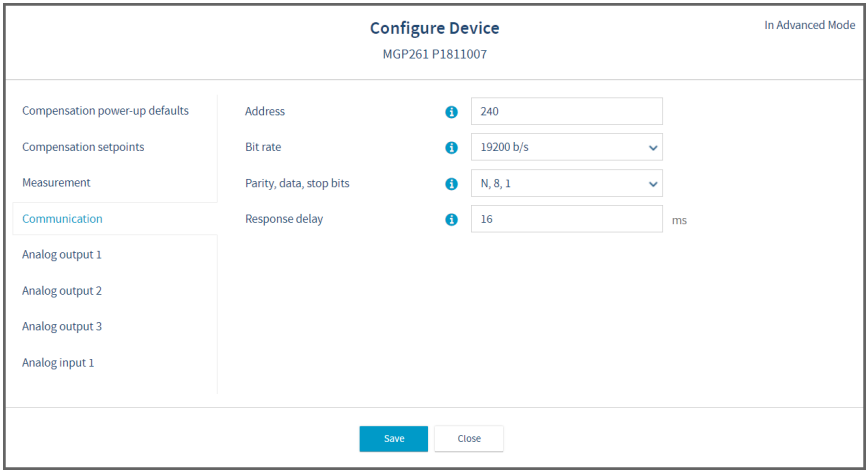



Figure 17 Modbus Communication Settings in Insight PC Software

You can configure the following Modbus communication settings with Insight PC software:

- Device address
- Communication bit rate
- Parity, data bits, and stop bits
- Response delay

To configure the Modbus communication settings with Insight:

1. Connect to Insight and select > **Configure Device > Communication**.
2. Enter the communication values as needed: see the instructions in the Insight interface for allowed ranges and additional information.
3. Select **Save** to store the settings.

**More Information**

- Connecting to Insight Software (page 35)

# 6. Analog Output Configuration

## 6.1 Overview

MGP261 has 3 scalable 4 ... 20 mA analog output channels. Each output has the following configuration options:

- Output parameter selection
- Output scale low end and high end
- Error output level

The configuration of the outputs (output parameter selection and scaling) is selected when ordering the probe, and can be changed with Modbus or Vaisala Insight PC software.

## 6.2 Configuring Analog Outputs with Modbus

The Modbus implementation of MGP261 includes configuration registers for analog output measurement parameter selection, scaling, and error output level.

For a description of MGP261 Modbus registers, see Modbus Registers (page 68).

## 6.3 Configuring Analog Outputs with Insight

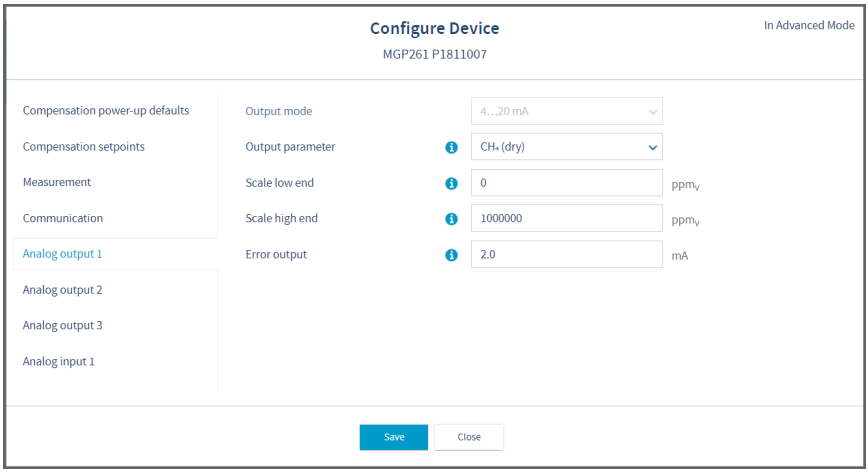



Figure 18 Analog Output Configuration Options in Insight

You can configure the measurement parameter sent on each analog output, the scaling of the parameter, and the error output level. All 3 outputs have the same configuration options.

1. Connect to Insight (see Connecting to Insight Software (page 35)).
2. Select > **Configure Device**, and then one of the 3 analog outputs.
3. Select the measurement parameter that is sent on the output channel you are configuring, set the scaling for the output, and define the output level that indicates an error.
4. Store the selections with **Save** and exit with **Close**.
5. Repeat the configuration for each output (analog outputs 1, 2, and 3) as required.

**More Information**

- Wet Basis and Dry Basis Measurement Parameters (page 42)

## 6.4 Changing Units in Insight

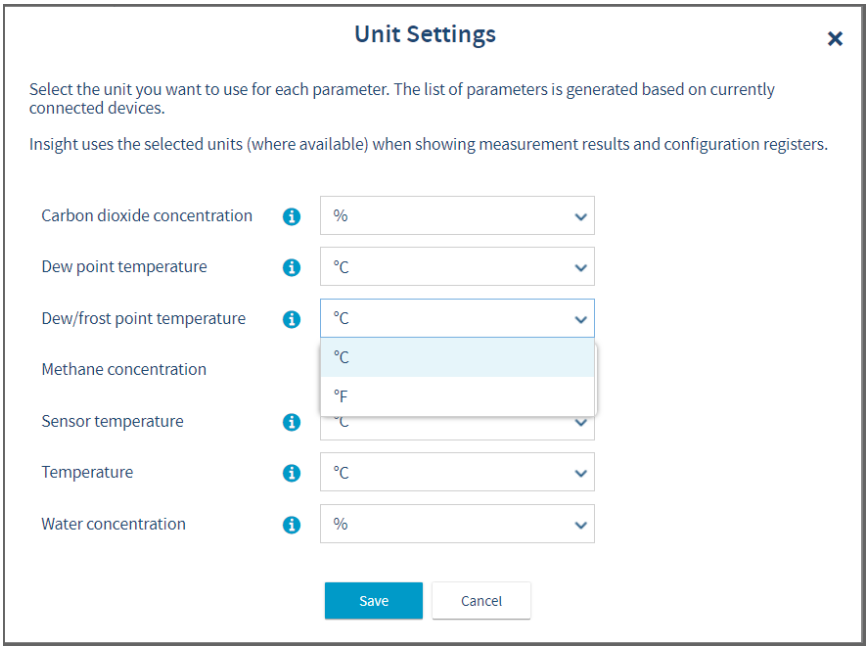



Figure 19 Unit Selection in Insight

You can change the units of parameters (for example, metric or non-metric temperature) in the **Unit Settings** menu in Insight.

1. Connect to Insight (see Connecting to Insight Software (page 35)).

2. In the **Settings** dropdown menu (upper right corner of the main view), select **Unit Settings**.
3. Select the units for the parameters and store the selections with **Save**.

## 6.5 Wet Basis and Dry Basis Measurement Parameters

MGP261 methane, carbon dioxide, and water vapor measurements can be shown either as wet basis or dry basis values. The wet basis / dry basis measurement output selection is made when ordering the probe, and can be configured with Vaisala Insight PC software or Modbus.

The following formula shows the conversion between wet basis and dry basis values.

$$X(dry) = \frac{X(wet)}{100\,\% \; - \; H_2O}$$

where:

X(dry) gas concentration (dry basis) (%)
X(wet) gas concentration (wet basis) (%)
$H_2O$ gas concentration (wet basis) (%)

Figure 20 (page 42) shows the analog output configuration options in Vaisala Insight Software with the available output parameters.

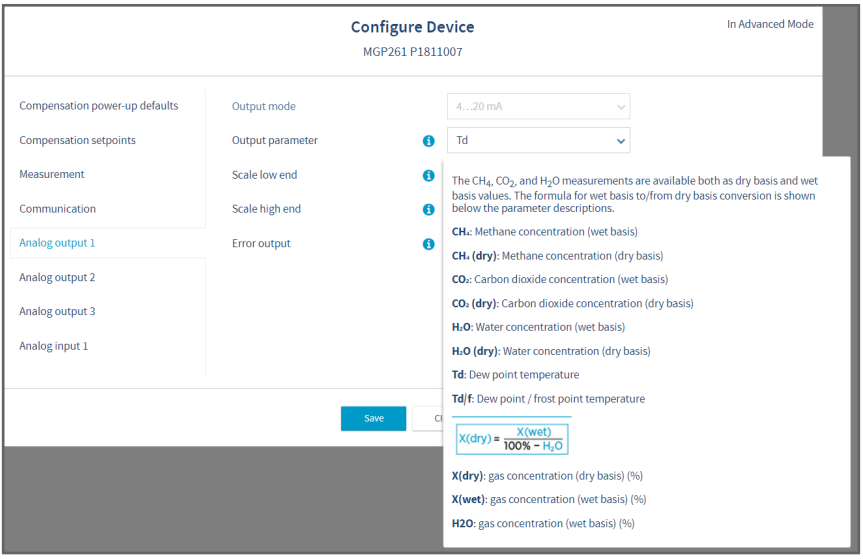



Figure 20 Output Parameter Selections in Vaisala Insight PC Software

# 7. Environmental Compensation

## 7.1 Overview

When necessary, environmental compensations can be applied to improve the measurement accuracy (for example, to provide the probe with a real-time pressure reading from the measurement environment by using input from an external sensor).

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

- Temperature (T)
- Pressure (P)

Environmental compensation parameters can be provided to the probe from the following sources:

- The internal temperature sensor of the probe can be used for temperature compensation.
- An external sensor can be connected to the probe (4 ... 20 mA analog input, Ex ia) to provide temperature or pressure compensation values.
- If the temperature and pressure values are known and remain constant, they can be entered as fixed setpoint values.
- If the probe is integrated in a system that measures either temperature or pressure, they can be updated to the probe continuously.

The method used for environmental compensation is configured on the order form when ordering the probe, and can later be updated using Vaisala Insight PC software or Modbus protocol.

### 7.1.1 Temperature Compensation

MGP261 can measure the approximate temperature of the CARBOCAP® sensor for compensation, use a fixed setpoint value as the temperature compensation, or receive the temperature compensation value from an external temperature sensor.

Unless a dedicated temperature measurement is available and can be regularly updated to the probe, it is strongly recommended to use the probe's internal temperature compensation to ensure real-time accurate measurements. If the measurement is made in a constant temperature, the constant temperature can be set as the compensation value (fixed setpoint option).

### 7.1.2 Pressure Compensation

The probe does not have on-board pressure measurement. You can either configure a fixed setpoint value that is used as the pressure compensation, or set the probe to receive the pressure compensation value from an external pressure sensor.

### 7.1.3 Compensation Mode During Calibration

When you start to calibrate the probe with Insight, the probe enters calibration mode, and the compensation mode is automatically switched to **Setpoint**. In this compensation mode, you must enter the conditions of your calibration environment as temporary setpoint values in the **Compensation setpoints** tab of the calibration menu.

When you exit calibration mode, the values you have entered in the **Compensation setpoints** tab remain in use as the current setpoint values, but the compensation mode switches back to the selection that was in place before starting calibration (either **Off**, **Setpoint**, **Measured**, or **External**).

**More Information**

- Configuring Environmental Compensations with Insight (page 44)

## 7.2 Configuring Environmental Compensations with Modbus

The Modbus implementation of MGP261 includes configuration registers for pressure and temperature compensation setpoints. You can also configure the temperature and pressure compensation mode (**External**, **Setpoint**, **Measured** (temperature only), or **Off**).

For a description of MGP261 Modbus registers, see Modbus Registers (page 68).

**More Information**

- Modbus (page 38)
- Modbus Registers (page 68)

## 7.3 Configuring Environmental Compensations with Insight

Using Insight, you can configure the following temperature and pressure compensation settings:

- Temperature or pressure compensation mode (select the source where the compensation value is received from)
- The setpoint values for temperature or pressure compensation
- The scaling of the analog input channel (**Analog input 1**) that is used to receive temperature or pressure values from an external sensor.

Figure 21 (page 45) describes the different environmental compensation selections in Insight.

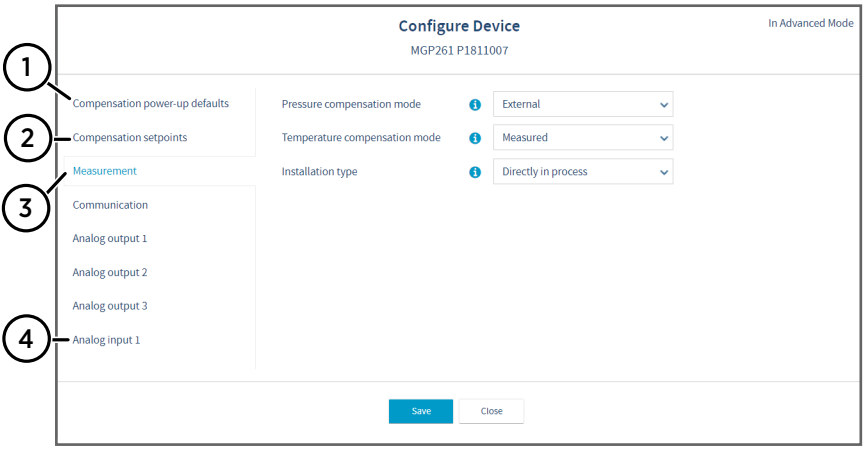



Figure 21 **Measurement** Menu View in Insight PC Software

1 **Compensation power-up defaults**: configure the setpoint compensation values that are taken into use at device reset. Used when the temperature or pressure compensation mode is set as **Setpoint**.
2 **Compensation setpoints**: configure the temporary setpoint compensation values that are in use while the device is powered on, but revert back to power-up defaults when the device is reset. Used when the temperature or pressure compensation mode is set as **Setpoint**.
3 **Measurement** (shown in figure): configure the pressure and temperature compensation modes (available options: **Setpoint**, **External**, **Measured** (temperature only), and **Off**.
4 **Analog input 1**: configure the input from the external pressure or temperature sensor (used when the pressure or temperature compensation mode is set as **External**).

1. Connect to Insight (see Connecting to Insight Software (page 35)),
2. Select > **Configure Device**.
3. Select one of the compensation modes in the **Measurement** menu.
4. See the separate instructions for configuring the compensations in each compensation mode:
   - Configuring Setpoint Values for Compensations with Insight (page 46)
   - Using Probe Measurement as Temperature Compensation (page 46)
   - Using Compensation Received from External Temperature or Pressure Sensor (page 46)
   - Configuring Input from External Analog Pressure or Temperature Sensor (page 47)

**More Information**

- Compensation Mode During Calibration (page 44)

### 7.3.1 Configuring Setpoint Values for Compensations with Insight

To configure a fixed setpoint value for pressure or temperature compensation in Insight:

1. Select > **Configure Device**.
2. Open the **Measurement** menu, set the compensation mode of the compensation parameter (temperature, pressure, or both) as **Setpoint** from the mode selection dropdown list, and select **Save** when done.
3. Open the **Compensation setpoints** menu, enter the setpoint value in the text field, and select **Save** when done.

   Note that the setpoint value you enter in the **Compensation setpoints** is temporary and resets back to the power-up default at device reset.

4. Optional: If you want to keep the setpoint value in use also after device reset, enter the same value in the **Compensation power-up defaults** menu and store the setting by selecting **Save**.

### 7.3.2 Using Probe Measurement as Temperature Compensation

To set the internal temperature measurement of the probe as the temperature compensation source:

1. Select > **Configure Device**.
2. Open the **Measurement** menu.
3. Select **Measured** from the **Temperature compensation mode** dropdown list, and then select **Save**.

### 7.3.3 Using Compensation Received from External Temperature or Pressure Sensor

If you have connected an external pressure or temperature sensor to the 4 ... 20 mA Ex ia analog input channel of MGP261 (see Wiring (page 28)), you can use the measurement received from the sensor as the environmental compensation.

You can receive the compensation value from an external sensor for only one parameter (temperature or pressure) at a time.

To use an external sensor for temperature or pressure compensation:

1. Select > **Configure Device**.
2. Open the **Measurement** menu.

3. Select **External** from either the **Pressure compensation mode** or the **Temperature compensation mode** dropdown list, and then select **Save**.
4. Open the **Analog input 1** menu and configure the scaling of the external sensor input. See Configuring Input from External Analog Pressure or Temperature Sensor (page 47).

### 7.3.4 Configuring Input from External Analog Pressure or Temperature Sensor

When you set either the **Temperature compensation mode** or **Pressure compensation mode** to use measurement from an **External** sensor, you can configure the scale of the external sensor input in the **Analog input 1** menu.

The **Input mode** and **Input parameter** selections are set automatically based on the external compensation parameter selection.

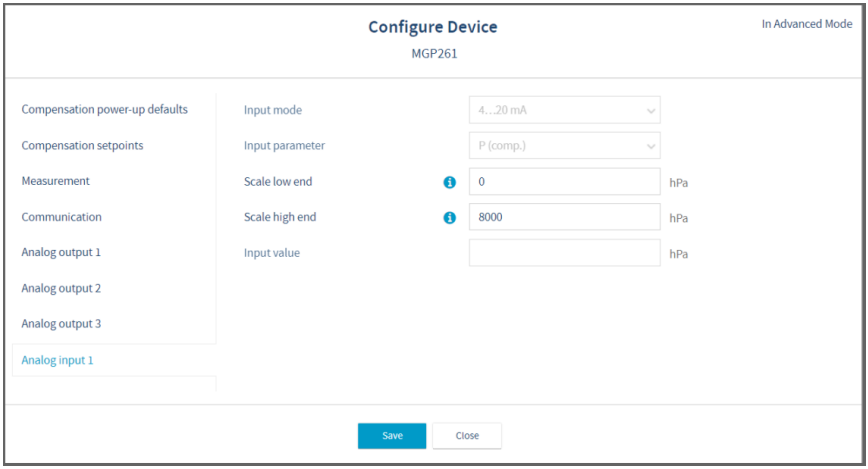



Figure 22 Analog Input 1 Configuration Menu in Insight

1. In the **Measurement** menu, set either the pressure or temperature compensation mode as **External** to use input from a connected sensor. See Using Compensation Received from External Temperature or Pressure Sensor (page 46).

   You can receive the compensation value from an external sensor for only one parameter (temperature or pressure) at a time.

2. Store the setting with **Save**.
3. In the **Analog input 1** menu, enter the scaling for the temperature or pressure input from the external sensor.

4. Store the setting with **Save**.

# 8. Calibration

## 8.1 Calibration Overview

The methane ($CH_4$) and carbon dioxide ($CO_2$) measurements of MGP261 can be calibrated and adjusted using gas references with known values. You can also calibrate and adjust the probe's internal temperature measurement (used for environmental compensation only). The $H_2O$ measurement can only be adjusted at the low end (simultaneously with $CH_4$ and $CO_2$ when a zero point adjustment is made).

Carrying out calibrations and adjustments requires connecting MGP261 to Vaisala Insight PC software (requires Vaisala USB cable 257295). For instructions on connecting the probe to Insight, see Connecting to Insight Software (page 35).

To feed reference gases to MGP261 in a controlled manner when calibrating and adjusting, use a flow-through adapter. An MGP261 flow-through adapter is available as an optional accessory: for more information, see Flow-Through Adapter (page 50).

**WARNING!** Before removing the probe from the process for calibration and adjustment, review the instructions in Removing Probe from Process (page 59).

The following calibration and adjustment options are available when the probe is connected to Vaisala Insight PC software:

- Methane ($CH_4$) and carbon dioxide ($CO_2$) measurement calibration and adjustment (1-point or 2-point adjustments).
- Temperature measurement adjustment (probe's internal sensor measurement used only for environmental compensation).
- Zero point adjustment for all gas measurement parameters ($CH_4$, $CO_2$, and $H_2O$: adjusts all parameters simultaneously). Zero point adjustment replaces the low end adjustment of all gas parameters in 2-point adjustments.
- Reset to factory adjustment (given separately for each parameter).

The accuracy of field calibration and adjustment is dependent on a number of factors such as suffcient stabilization time, calibration setup conditions, and reference quality. To ensure fully accurate calibration and adjustment results, use the traceable calibration and adjustment services provided by Vaisala.

**More Information**

- Connecting to Insight Software (page 35)
- Flow-Through Adapter (page 50)
- Removing Probe from Process (page 59)

### 8.1.1 Compensation Mode During Calibration

When you start to calibrate the probe with Insight, the probe enters calibration mode, and the compensation mode is automatically switched to **Setpoint**. In this compensation mode, you must enter the conditions of your calibration environment as temporary setpoint values in the **Compensation setpoints** tab of the calibration menu.

When you exit calibration mode, the values you have entered in the **Compensation setpoints** tab remain in use as the current setpoint values, but the compensation mode switches back to the selection that was in place before starting calibration (either **Off**, **Setpoint**, **Measured**, or **External**).

**More Information**

- Configuring Environmental Compensations with Insight (page 44)

### 8.1.2 Flow-Through Adapter

The MGP261 flow-through adapter (Vaisala order code: 258877) is used in sampling line installations and field calibration and adjustment to achieve a controlled flow of gas to the probe.

The flow-through adapter is delivered assembled with a mounting clamp, mounting plate, and a gland for attaching the probe to the adapter. Figure 23 (page 50) shows the main parts of the flow-through adapter and mounting kit.

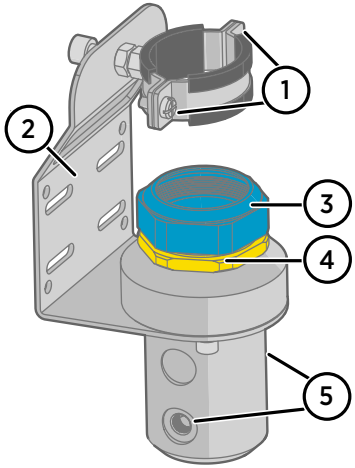



Figure 23 Flow-Through Adapter 258877

1. Probe clamp (industrial M8, 38-44 mm, insulated) and tightening screws
2. Mounting plate for screw or cable mounting
3. Probe gland (M50/9x1.5, 37.0 - 42.0 mm) tightening nut for inserting and removing the probe: **only open and tighten from the tightening nut**
4. Probe gland locknut: locked to the threads with Loctite threadlocker, **do not rotate**
5. Gas tube inlet and outlet ports (G 1/8) on opposite sides of the adapter body

For instructions on attaching the flow-through adapter and setting the correct installation type configuration in Vaisala Insight PC software, see Attaching Flow-Through Adapter to MGP261 (page 31).

**More Information**

- Installation Option: Flow-Through Adapter Installation (page 23)
- Attaching Flow-Through Adapter to MGP261 (page 31)
- Installation Type Configuration in Insight (page 33)
- Flow-Through Adapter Dimensions (page 67)

# 8.2 Calibration and Adjustment with Insight PC Software

Figure 21 (page 45) describes the calibration and adjustment selections in Insight.

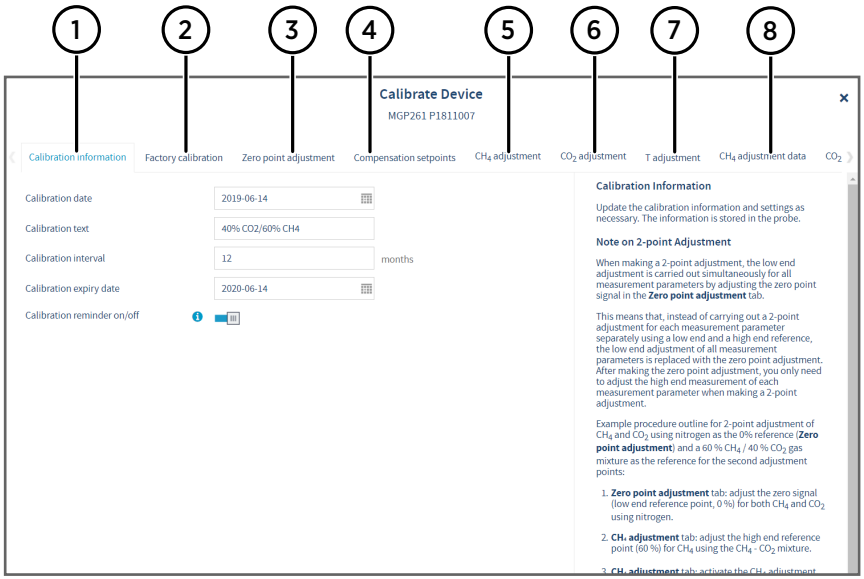



Figure 24 Calibration Menu View in Insight PC Software

1 Calibration information: enter information about the latest calibration (date, text description) in this tab. Also includes the calibration interval and calibration reminder selections.
2 Factory calibration: shows read-only information about the factory calibration.
3 Zero point adjustment: adjusts the zero point signal (simultaneously for all gas measurement parameters). This adjustment replaces the low end adjustment in 2-point adjustments.
4 Compensation setpoint configuration for the calibration and adjustment environment.
5 Methane ($CH_4$) measurement adjustment tab. In 2-point adjustments, use this tab for high end adjustment and the zero point adjustment for low end adjustment.
6 Carbon dioxide ($CO_2$) measurement adjustment tab. In 2-point adjustments, use this tab for high end adjustment and the zero point adjustment for low end adjustment.
7 Temperature measurement adjustment tab.
8 Adjustment data tabs show the latest stored adjustment for each parameter. Use the scroll arrows next to the menu tabs on the left and right edge of the view to view all tabs.

1. Connect to Insight (see Connecting to Insight Software (page 35)),

2. Select ⚙ **> Calibrate > Yes**.
3. Select one of the adjustment options in the **Calibrate** menu and see the separate instructions for each option.

### 8.2.1 Example: 2-Point Adjustment with Zero Point Adjustment

When making a 2-point adjustment, the low end adjustment is carried out simultaneously for all measurement parameters by adjusting the zero point signal in the **Zero point adjustment** tab.

This means that, instead of carrying out a 2-point adjustment for each measurement parameter separately using a low end and a high end reference, the low end adjustment of all measurement parameters is replaced with the zero point adjustment. After making the zero point adjustment, you only need to adjust the high end measurement of each measurement parameter when making a 2-point adjustment.

Example procedure outline for 2-point adjustment of $CH_4$ and $CO_2$ using nitrogen as the 0% reference (**Zero point adjustment**) and a 60 % $CH_4$ / 40 % $CO_2$ gas mixture as the reference for the second adjustment points:

1. **Zero point adjustment** tab: adjust the zero signal (low end reference point, 0 %) for both $CH_4$ and $CO_2$ using nitrogen.
2. **$CH_4$ adjustment** tab: adjust the high end reference point (60 %) for $CH_4$ using the $CH_4$ - $CO_2$ mixture.
3. **$CH_4$ adjustment** tab: activate the $CH_4$ adjustment.
4. **$CO_2$ adjustment** tab: adjust the high end reference point (40 %) for $CO_2$ using the $CH_4$ - $CO_2$ mixture.
5. **$CO_2$ adjustment** tab : activate the $CO_2$ adjustment.

### 8.2.2 Zero Point Adjustment

The zero point adjustment adjusts the zero output signal of the probe and applies simultaneously to all gas measurement parameters ($CH_4$, $CO_2$, and $H_2O$,). This means that, instead of carrying out a 2-point adjustment for each gas measurement parameter separately using a low end and high end reference, the low end adjustment of all gas measurement parameters is replaced with the zero point adjustment.

After carrying out the zero point adjustment, you only need to adjust the high end measurement of each gas measurement parameter when carrying out a 2-point adjustment.

Always use nitrogen as the reference gas for the zero point adjustment.

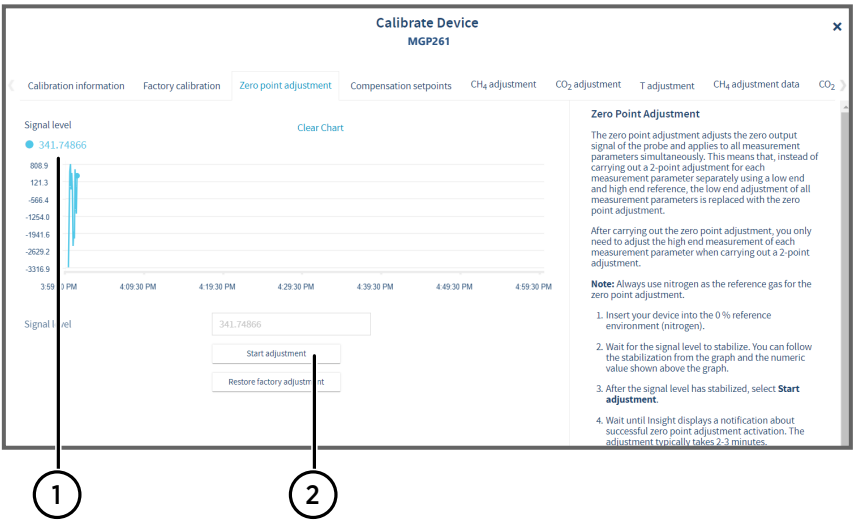



Figure 25 Zero Point Adjustment Tab

1 Follow the signal stabilization from the graph and the numeric value shown above the graph.
2 After the signal has stabilized, select **Start adjustment** and wait for the notification message about successful zero point adjustment activation. The adjustment is saved automatically.

1. Insert your device into the 0 % reference environment (nitrogen).
2. Wait for the signal level to stabilize. You can follow the stabilization from the graph and the numeric value shown above the graph.
3. After the signal level has stabilized, select **Start adjustment**.
4. Wait until Insight displays a notification about successful zero point adjustment activation. The adjustment typically takes 2-3 minutes.
5. The zero point adjustment is saved automatically after it has been successfully activated. To remove an incorrect adjustment, select **Restore factory adjustment**.
6. For a 2-point adjustment, carry out the high end adjustments for each measurement parameter in the separate adjustment tabs using appropriate references (for example, a 60 % $CH_4$ / 40 % $CO_2$ gas mixture).

## 8.2.3 Calibrating and Adjusting Methane ($CH_4$) Measurement

Prepare the calibration gases required to create the reference condition for the adjustment, and the setup for controlled calibration gas feed to the probe.

When making a 2-point adjustment, first carry out the zero signal adjustment in the **Zero point adjustment** tab. The zero signal adjustment replaces the low end adjustment in a 2-point adjustment.

1. Reset any possible existing adjustments with the **Restore factory adjustment** button. This prevents earlier adjustments from having an effect on the current adjustment.
2. Insert your device in the reference environment.
3. Before starting the adjustment, make sure that your environmental compensation settings are correct for your present environment. You can review and change the settings for pressure and temperature compensation setpoints in the **Compensation setpoints** tab.
4. Wait for the measurement (shown in the graph) to stabilize fully.
5. When the measurement has stabilized, click the **Reference value, point 1** text box and enter the known $CH_4$ level of the calibration point. Press **ENTER** or click outside the text box when done.
6. Check that the measured value for point 1 is automatically inserted.
7. Check the difference between the reference and the measured value. Very large differences may be due to insufficient stabilization time or unsuitable calibration setup.
   a. If you want to apply the adjustment you have made, select **Activate adjustment**.
   b. To exit without taking the adjustment in use, select **Close**.
8. After completing the adjustment, update the information in the **Calibration Information** tab.

### 8.2.4 Calibrating and Adjusting Carbon Dioxide ($CO_2$) Measurement

Prepare the calibration gases required to create the reference condition for the adjustment, and the setup for controlled calibration gas feed to the probe.

When making a 2-point adjustment, first carry out the zero signal adjustment in the **Zero point adjustment** tab. The zero signal adjustment replaces the low end adjustment in a 2-point adjustment.

1. Reset any possible existing adjustments with the **Restore factory adjustment** button. This prevents earlier adjustments from having an effect on the current adjustment.
2. Insert your device in the reference environment.
3. Before starting the adjustment, make sure that your environmental compensation settings are correct for your present environment. You can review and change the settings for pressure and temperature compensation setpoints in the **Compensation setpoints** tab.
4. Wait for the measurement (shown in the graph) to stabilize fully.

5. When the measurement has stabilized, click the **Reference value, point 1** text box and enter the known $CO_2$ level of the calibration point. Press **ENTER** or click outside the text box when done.
6. Check that the measured value for point 1 is automatically inserted.
7. Check the difference between the reference and the measured value. Very large differences may be due to insufficient stabilization time or unsuitable calibration setup.
   a. If you want to apply the adjustment you have made, select **Activate adjustment**.
   b. To exit without taking the adjustment in use, select **Close**.
8. After completing the adjustment, update the information in the **Calibration Information** tab.

## 8.2.5 Calibrating and Adjusting Temperature Measurement

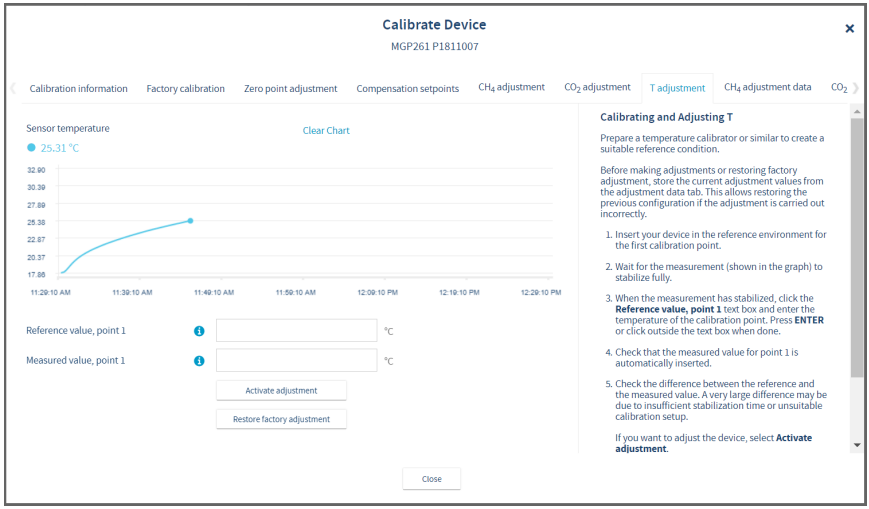



Figure 26 Temperature Adjustment View in Insight

Prepare a temperature calibrator or similar to create a suitable reference condition.

You can adjust temperature either in nitrogen or in air.

1. Insert your device in the reference environment.
2. Wait for the measurement (shown in the graph) to stabilize fully.

3. When the measurement has stabilized, click the **Reference value, point 1** text box and enter the known temperature of the calibration point. Press **ENTER** or click outside the text box when done.
4. Check that the measured value for point 1 is automatically inserted.
5. Check the difference between the reference and the measured value. Very large differences may be due to insufficient stabilization time or unsuitable calibration setup.
    a. If you want to apply the adjustment you have made, select **Activate adjustment**.
    b. To exit without taking the adjustment in use, select **Close**.
6. After completing the adjustment, update the information in the **Calibration Information** tab.

# 9. Maintenance

## 9.1 Filter Change

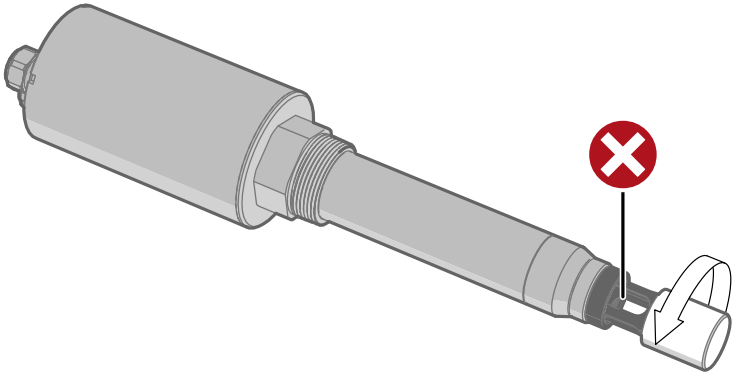


Figure 27 Replacing Filter

Replacement filters are available from Vaisala (order code: DRW249919SP). Remove the filter by rotating counter-clockwise.

**CAUTION!** Do not touch the optical surfaces inside the measurement cuvette when replacing the filter.

The probe filter is the only user-replaceable part in MGP261. For other maintenance requirements, contact Vaisala.

## 9.2 Removing Probe from Process

**WARNING!** When installed in situ, the surface of the probe is in direct contact with the biogas process. Bacteria, viruses, or fungi can be carried from the process on the probe surface.

- Always wear appropriate personal protective equipment when handling items that have been in contact with the biogas process. Follow local regulations and site-specific guidelines.
- Ensure the area where you place the probe after removing it from the process is suitable for working with items that have been in contact with the biogas process.

**WARNING!** While installing or uninstalling the device, there is a risk of flammable gas release or flame entrance.

**WARNING!** Exposure to hazardous gases (for example, hydrogen sulfide ($H_2S$)) is possible when installing or removing MGP261 from the process.

- Always follow local safety guidelines. Ensure that the work area is safe and meets local regulations (for example, related to ventilation and personal protective equipment).
- Use a personal gas detector to monitor the safety of the area you are working in.
- After installing or removing the probe, use a gas detector to ensure that process connections are leak-free.

1. Prepare an area where you can place the probe after removing it from the process.
   a. Clear other items and equipment away from the area.
   b. Cover surfaces around the area with protective material as necessary.
2. Switch off the probe power supply input.
3. If necessary, open the connection box and remove the wiring cables. See Inserting Probe into Process and Opening Connection Box (page 27).
   a. Hold the probe in place by gripping the tightening nut with a wrench. Then open the connection box by turning the cover counter-clockwise with the connection box key.
   b. Loosen the cable glands and pull the connection box open.
   c. Open the screw terminals inside the connection box with a small screwdriver and remove the wiring cables.
   d. Close the connection box.

4. Rotate the tightening nut of the probe counter-clockwise with a wrench to release the probe. See Inserting Probe into Process and Opening Connection Box (page 27).

> **CAUTION!** The PTFE tape seal on the probe threads will tear when you rotate the probe open, and must be replaced when reinstalling the probe.

5. Pull the probe out of the process connection and place it on the area you prepared for handling the probe. Hold the probe from the connection box when handling it, and avoid touching the parts that have been inserted into the process.

> Use a cloth or similar to prevent dripping when pulling out the probe.

6. **Ball valve installations only**: remove the safety pin that locks the handle of the ball valve in the open position and close the ball valve.
7. Clean the probe as instructed in Cleaning the Probe (page 60) and move the probe to a clean area for further handling.
8. When reinstalling the probe, repeat the installation steps starting from Preparing Probe for Installation (page 26).

## 9.3 Cleaning the Probe

> **WARNING!** Removing the probe from the process can expose you to biological and chemical hazards due to the nature of the biogas process environment. Review the warnings and instructions listed in Removing Probe from Process (page 59).

- Moist cloth for wiping the probe
- Running water
- Standard cleaning agents can be used in cleaning

1. Prepare an area for cleaning the probe.
2. To remove the probe from process, follow the instructions in Removing Probe from Process (page 59).

3. Clean the probe with running water and a cloth. Standard cleaning agents can be used.

**CAUTION!** Do not clean the probe with a pressure washer.

**CAUTION!** Do not immerse the probe in liquid to clean it.

4. To install the probe back into the process after cleaning, follow the installation instructions starting from Preparing Probe for Installation (page 26).
5. If you are sending the probe to Vaisala for maintenance, allow it to dry fully before packing it. See the instructions in Sending Probe to Vaisala (page 61).

## 9.4 Sending Probe to Vaisala

If you need to return the probe for maintenance or replacement, contact Vaisala technical support.

**CAUTION!** Do not ship the probe to Vaisala without contacting technical support. Technical support will provide you with return authorization and up-to-date shipping instructions.

1. Read the warranty information.
2. Contact Vaisala technical support and request a Return Material Authorization (RMA) and shipping instructions.

For information on product warranties, technical support, and repair services, see www.vaisala.com/support.

Always request the RMA before returning any material to Vaisala.

3. Follow the return instructions received from Vaisala technical support. When packing the probe for shipping, ensure that you use sufficient padding, the probe has dried completely after cleaning, and that the probe is tightly sealed in a plastic bag.

# 10. Technical Data

## 10.1 Specifications

Table 7 Measurement Performance

| Property | Methane $CH_4$ | Carbon Dioxide $CO_2$ | Water Vapor $H_2O$ |
|---|---|---|---|
| Sensor | CARBOCAP® | CARBOCAP® | CARBOCAP® |
| Measurement unit | Volume-% | Volume-% | Volume-%, dew point °C |
| Measurement range | 0 ... 100 vol-% | 0 ... 100 vol-% | 0 ... 25 vol-%,<br>-10 ... +60 °C<br>(14 ... +140 °F) |
| **Accuracy specification at 25 °C (+77 °F) and 1013 mbar including non-linearity, calibration uncertainty, and repeatability; temperature and pressure compensated** | | | |
| Accuracy at +25 °C (+77 °F) and 1013 mbar [1] | • 0 ... 40 vol-%: **±2 vol-%**<br>• 40 ... 70 vol-%: **±1 vol-%**<br>• 70 ... 100 vol-%: **±2 vol-%** | • 0 ... 30 vol-%: **±2 vol-%**<br>• 30 ... 50 vol-%: **±1 vol-%**<br>• 50 ... 100 vol-%: **±2 vol-%** | 0 ... 25 vol-%: **±0.5 vol-%** |
| Repeatability | ±0.5 vol-% at 60 vol-% | ±0.3 vol-% at 40 vol-% | ±0.1 vol-% at 10 vol-% |
| Temperature dependence | Compensated, 0 ... 100 vol-%: ±0.1 % of reading/°C | Compensated, 0 ... 100 vol-%: ±0.1 % of reading/°C | Compensated, 0 ... 25 vol-%: ±0.1 % of reading/°C |
| | Uncompensated, 0 ... 100 vol-%: -0.6 % of reading/°C | Uncompensated, 0 ... 100 vol-%: -0.2 % of reading/°C | Uncompensated, 0 ... 25 vol-%: -0.2 % of reading/°C |
| Pressure dependence | Compensated, 0 ... 100 vol-%: ±0.015 % of reading/mbar | Compensated, 0 ... 100 vol-%: ±0.01 % of reading/mbar | Compensated, 0 ... 25 vol-%: ±0.025 % of reading/mbar |
| | Uncompensated, 0 ... 100 vol-%: +0.2 % of reading/mbar | Uncompensated, 0 ... 100 vol-%: +0.2 % of reading/mbar | Uncompensated, 0 ... 25 vol-%: +0.15 % of reading/mbar |
| Long-term stability | ±2 vol-%/year | ±2 vol-%/year | ±2 vol-%/year |
| Start-up time [2] | 30 s | | |
| Warm-up time [3] | 2 min [4] | | |
| Response time ($T_{90}$) | 90 s [5] | | |

| Property | Methane $CH_4$ | Carbon Dioxide $CO_2$ | Water Vapor $H_2O$ |
|---|---|---|---|
| Response time with flow-through adapter | | | 90 s at ≥ 0.5 l/min [5]<br>(recommended: 0.5 ... 1 l/min) |

*1) Excluding cross-interferences to other gases.*
*2) Time to first reading*
*3) Time to specified accuracy*
*4) At +20 °C (+68 °F) ambient temperature*
*5) With standard PTFE filter*

Table 8 Operating Environment

| Property | Specification |
|---|---|
| Operating temperature range | -40 ... +60 °C (-40 ... +140 °F) |
| Operating humidity range | 0 ... 100 %RH |
| Storage temperature range | -40 ... +60 °C (-40 ... +140 °F) |
| Storage humidity range | 0 ... 90 %RH |
| Process pressure range | -500 ... +500 mbar(g) |
| Process temperature range | +0 ... +60 °C (+32 ... +140 °F) |
| Process flow range | 0 ... 20 m/s [1] |

*1) A process flow range of 2 ... 20 m/s is suitable for in situ installations (probe installed directly into process). For process flow ranges between 0 ... 2 m/s, a flow-through installation is recommended.*

Table 9 Compliance

| Property | Specification |
|---|---|
| Electromagnetic compatibility (EMC) | EN61326-1(2014), Industrial environment |
| Ex classification | Ex II 1/2 (1) G Ex eb mb [ia] IIB T3 Ga/Gb -40 °C ≤ Tamb ≤ +60 °C |
| IP rating | IP66 |

Table 10 Inputs and Outputs

| Property | Specification |
|---|---|
| Operating voltage | 18 ... 30 VDC |
| Power consumption | Typical: 3 W<br>Maximum: 6 W |

| Property | Specification |
|---|---|
| Digital output | RS-485 (Modbus RTU) |
| Analog output | 3 × 4 ... 20 mA scalable, isolated |
| Analog output load | Minimum: 20 Ω<br>Maximum: 500 Ω |
| Analog output accuracy | ±0.2 % of full scale at 25 °C (77 °F) |
| Analog output temperature dependence | 0.005 %/°C (0.003 %/°F) full scale |
| Analog input (optional) | 1 × 4 ... 20 mA (Ex ia) for external pressure or temperature sensor [1)] |

*1) The optional analog input is galvanically isolated and provides power for the connected external pressure sensor.*

Table 11 Mechanical Specification

| Property | Specification |
|---|---|
| Weight | 2.5 kg (5.5 lb) |
| Thread type | 1.5″ male NPT |
| Cable lead-throughs | 1 x M16x1.5<br>2 x M20x1.5 |
| **Materials** | |
| Probe body | AISI316L stainless steel, PPS |
| Filter cap | Sintered PTFE |

Table 12 Options and Accessories

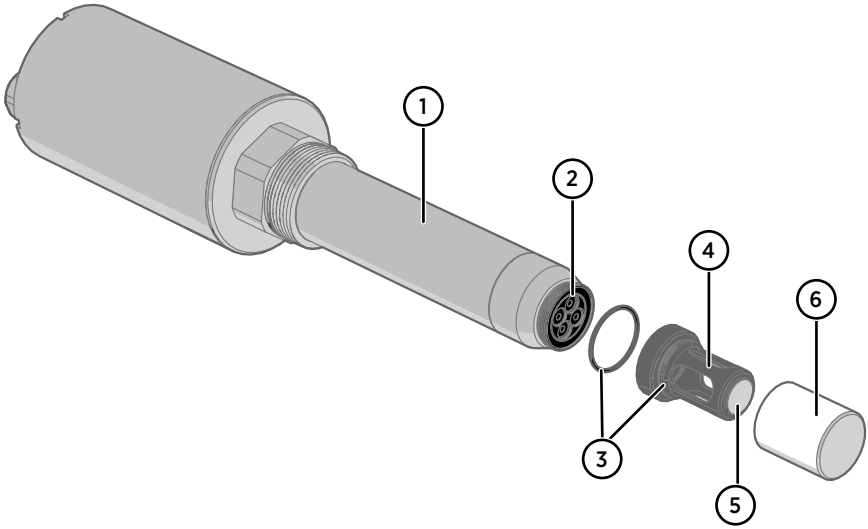
| Item | Order Code |
|---|---|
| Configuration cable (RS485/USB) [1)] | 257295 |
| Flow-through adapter | 258877 |
| Sintered PTFE filter (includes O-ring) | DRW249919SP |
| Connection box key | DRW250233SP |
| Shipping sleeve | ASM213114SP |
| NPT 1.5″ thread test plug | 257525SP |

*1) Vaisala Insight software for Windows® available at www.vaisala.com/insight.*

CE

## 10.2 Wetted Parts Material Information

Vaisala Oyj, as a manufacturer of the Vaisala CARBOCAP Multigas Probe MGP261, certifies that the materials used in the wetted parts of the MGP261 probe are the following:




1 **Probe body**: AISI 316L, EN 1.4404 (X2CrNiMo17-12-2) (AISI 316L)
2 **Sensor package window**: polished sapphire
3 **O-ring**: ethylene-propylene rubber, black
4 **Measurement cuvette**: PPS GF40 (polyphenylene sulfide, 40 % glass fibers, black)
5 **Infrared measurement mirror**: Optical borosilicate glass, class BK7
6 **Filter cap**: PTFE (polytetrafluoroethylene, porous/solid structure)

## 10.3 MGP261 Dimensions

Figure 28 (page 66) shows the MGP261 dimensions. The figure also shows the cabling lead-through depth: for more information on cable gland options and lead-through dimensions, see Cable Gland Options and Lead-Throughs (page 14).

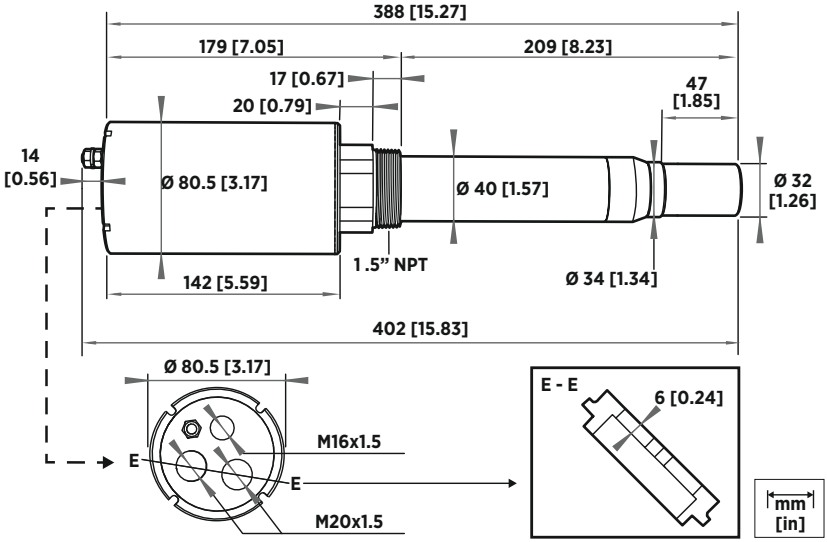



Figure 28 MGP261 Dimensions in Millimeters and Inches

# 10.4 Flow-Through Adapter Dimensions

Figure 29 (page 67) shows the dimensions of the MGP261 flow-through adapter 258877 with MGP261 installed into the adapter. The dimension figure also shows the measurement (from the edge of the adapter mounting plate to the edge of the connection box) that can be used to verify that the probe has been inserted to correct installation depth. The dimensions are given in millimeters and [inches].

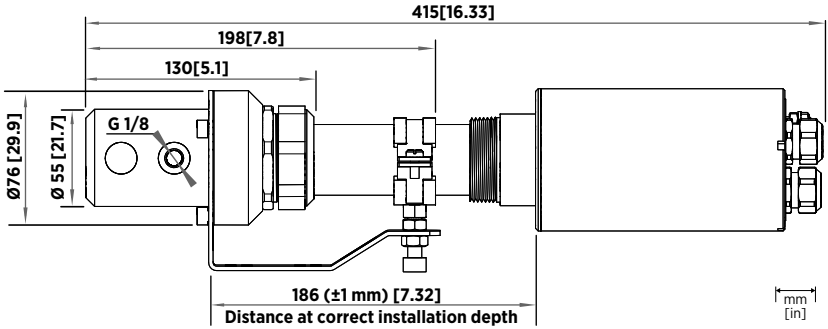



Figure 29 Flow-Through Adapter Dimensions with MGP261 Probe

Figure 30 (page 67) shows the dimensions and screw hole sizes of the flow-through adapter mounting plate.

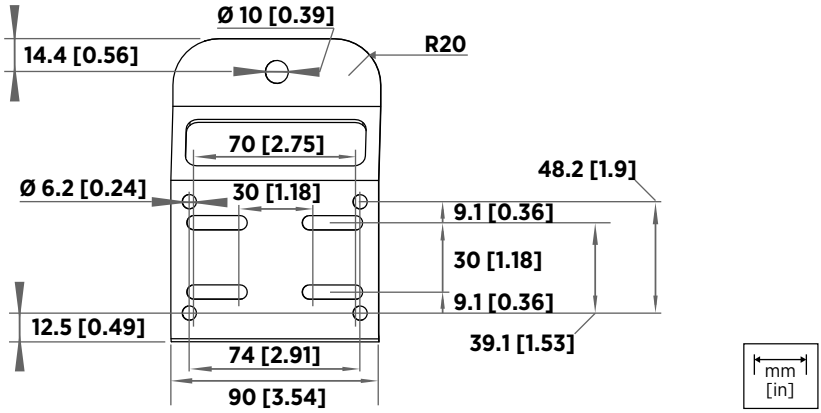



Figure 30 Flow-Through Adapter Mounting Plate Dimensions

# Appendix A. Modbus Registers

## A.1 Modbus Registers

**CAUTION!** Registers are numbered in decimal, starting from one. Register addresses in actual Modbus messages (Modbus Protocol Data Unit (PDU) are in hexadecimal and start from zero. Subtract 1 from the register number presented in this manual to get the address used in the Modbus message. For example, the register number 769 (Modbus address) corresponds to address $0300_{hex}$ in the Modbus message.

Accessing unavailable (temporarily missing) measurement data does not generate an exception. "Unavailable" value (a quiet NaN for floating point data or $0000_{hex}$ for integer data) is returned instead. An exception is generated only for any access outside the applicable register ranges.

### A.1.1 Measurement Data

Table 13 Modbus Measurement Data Registers (Read-Only)

| Register Number (Decimal) | Address (Hexadecimal) | Register Description | Data Format | Unit |
|---|---|---|---|---|
| **Floating Point Values** | | | | |
| 1 | $0000_{hex}$ | Methane ($CH_4$) concentration | 32-bit float | $ppm_v$ |
| | $0001_{hex}$ | | | |
| 3 | $0002_{hex}$ | Methane ($CH_4$) concentration, dry basis | 32-bit float | $ppm_v$ |
| | $0003_{hex}$ | | | |
| 5 | $0004_{hex}$ | Carbon dioxide ($CO_2$) concentration | 32-bit float | $ppm_v$ |
| | $0005_{hex}$ | | | |
| 7 | $0006_{hex}$ | Carbon dioxide ($CO_2$) concentration, dry basis | 32-bit float | $ppm_v$ |
| | $0007_{hex}$ | | | |
| 9 | $0008_{hex}$ | Water ($H_2O$) concentration | 32-bit float | $ppm_v$ |
| | $0009_{hex}$ | | | |
| 11 | $000A_{hex}$ | Water ($H_2O$) concentration, dry basis | 32-bit float | $ppm_v$ |
| | $000B_{hex}$ | | | |

| Register Number (Decimal) | Address (Hexadecimal) | Register Description | Data Format | Unit |
|---|---|---|---|---|
| **Floating Point Values** | | | | |
| 13 | $000C_{hex}$ | Dew point temperature | 32-bit float | $T_d$ °C |
| | $000D_{hex}$ | | | |
| 15 | $000E_{hex}$ | Dew / frost point temperature | 32-bit float | $T_{df}$ °C |
| | $000F_{hex}$ | | | |
| 17 | $0010_{hex}$ | Sensor temperature | 32-bit float | Ts °C |
| | $0011_{hex}$ | | | |
| **Integer values** | | | | |
| 257 | $0100_{hex}$ | Methane ($CH_4$) concentration | 16-bit integer | $ppm_v$ / 100 (parts per ten thousand) |
| 258 | $0101_{hex}$ | Methane ($CH_4$) concentration, dry basis | 16-bit integer | $ppm_v$ / 100 (parts per ten thousand) |
| 259 | $0102_{hex}$ | Carbon dioxide ($CO_2$) concentration | 16-bit integer | $ppm_v$ / 100 (parts per ten thousand) |
| 260 | $0103_{hex}$ | Carbon dioxide ($CO_2$) concentration, dry basis | 16-bit integer | $ppm_v$ / 100 (parts per ten thousand) |
| 261 | $0104_{hex}$ | Water ($H_2O$) concentration | 16-bit integer | $ppm_v$ / 100 (parts per ten thousand) |
| 262 | $0105_{hex}$ | Water ($H_2O$) concentration, dry basis | 16-bit integer | $ppm_v$ / 100 (parts per ten thousand) |
| 263 | $0106_{hex}$ | Dew point temperature | 16-bit integer (× 10) | $T_{df}$ °C<br>$T_{df}$ °F |
| 264 | $0107_{hex}$ | Dew / frost point temperature | 16-bit integer (× 10) | $T_{df}$ °C<br>$T_{df}$ °F |

## A.1.2 Configuration Registers

Table 14 Modbus Configuration Data Registers (Writable)

| Register Number (Decimal) | Address (Hexadecimal) | Register Description | Data Format | Unit / Valid Range |
|---|---|---|---|---|
| **Environmental Compensation** | | | | |
| 769 | $0300_{hex}$ | Power-up value for pressure compensation | 32-bit float | hPa<br>Range: 450 ... 1550<br>Init/default: 1013.25 |
| 771 | $0302_{hex}$ | Power-up value for temperature compensation | 32-bit float | °C<br>Range: -10 ... 70<br>Init/default: 25 |
| 773 | $0304_{hex}$ | Volatile pressure compensation (value cleared at probe reset) | 32-bit float | hPa<br>Range 450 ... 1550 hPa<br>Init/default: 1013.25 |
| 775 | $0306_{hex}$ | Volatile temperature compensation (value cleared at probe reset) | 32-bit float | °C<br>Range: -10 ... 70<br>Init/default: 25 |
| **Function Control** | | | | |
| 1281 | $0500_{hex}$ | Pressure compensation mode selection | Enum | **0** = Off<br>**1** = Setpoint<br>**2** = External |
| 1282 | $0501_{hex}$ | Temperature compensation mode selection | Enum | **0** = Off<br>**1** = Setpoint<br>**2** = Measured<br>**3** = External |
| 1283 | $0502_{hex}$ | Installation type selection | Enum | **0** = Directly in process<br>**1** = Flow-through adapter |
| **Communication** | | | | |
| 1537 | $0600_{hex}$ | Serial address | 16-bit integer | Valid range 1 ... 255<br>Default: 240 |

| | | | | |
|---|---|---|---|---|
| **Communication** | | | | |
| 1538 | $0601_{hex}$ | Bit rate | Enum | Valid range 4800 ... 115200<br>**4** = 4800<br>**5** = 9600<br>**6** = 19200<br>**7** = 38400<br>**8** = 57600<br>**9** = 115200<br>(default: **6** (19200)) |
| 1539 | $0602_{hex}$ | Parity, data, stop bits | Enum | **0** = N,8,1<br>**1** = N,8,2<br>**2** = E,8,1<br>**3** = E,8,2<br>**4** = O,8,1<br>**5** = O,8,2 |
| 1540 | $0603_{hex}$ | Response delay | 16-bit integer | Valid range 0 ... 1000 |
| 1541 | $0604_{hex}$ | Restart device | Function | |
| **Analog Output 1** | | | | |
| 1794 | $0701_{hex}$ | Analog output 1 measurement parameter selection. When written, scalings are reset. | Reg | $0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis)<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis)<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$)<br>See Table 13 (page 68) |

| **Analog Output 1** | | | | |
|---|---|---|---|---|
| 1795 | $0702_{hex}$ | Scale low end for analog output 1 measurement parameter.<br>Minimum and maximum values vary for different parameters. | Float | Output parameters<br>$0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis):<br>Minimum: 0<br>Maximum: 1000000 |
| | | | | Output parameters<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis):<br>Minimum: 0<br>Maximum: 250000 |
| | | | | Output parameters<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$):<br>Minimum: -10<br>Maximum: 60 |

| **Analog Output 1** | | | | |
|---|---|---|---|---|
| 1797 | $0704_{hex}$ | Scale high end for analog output 1 measurement parameter.<br>Minimum and maximum values vary for different parameters. | Float | Output parameters<br>$0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis):<br>Minimum: 0<br>Maximum: 1000000 |
| | | | | Output parameters<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis):<br>Minimum: 0<br>Maximum: 250000 |
| | | | | Output parameters<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$):<br>Minimum: -10<br>Maximum: 60 |
| 1799 | $0706_{hex}$ | Error output level (mA) | Float | Min. 0.5 mA<br>Max. 24 mA |

| **Analog Output 2** | | | | |
|---|---|---|---|---|
| 2050 | $0801_{hex}$ | Analog output 2 measurement parameter selection. When written, scalings are reset. | Reg | $0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis)<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis)<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$)<br>See Table 13 (page 68) |

| **Analog Output 2** | | | | |
|---|---|---|---|---|
| 2051 | $0802_{hex}$ | Scale low end for analog output 2 measurement parameter.<br>Minimum and maximum values vary for different parameters. | Float | Output parameters<br>$0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis):<br>Minimum: 0<br>Maximum: 1000000 |
| | | | | Output parameters<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis):<br>Minimum: 0<br>Maximum: 250000 |
| | | | | Output parameters<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$):<br>Minimum: -10<br>Maximum: 60 |

| **Analog Output 2** | | | | |
|---|---|---|---|---|
| 2053 | $0804_{hex}$ | Scale high end for analog output 2 measurement parameter.<br>Minimum and maximum values vary for different parameters. | Float | Output parameters<br>$0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis):<br>Minimum: 0<br>Maximum: 1000000 |
| | | | | Output parameters<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis):<br>Minimum: 0<br>Maximum: 250000 |
| | | | | Output parameters<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$):<br>Minimum: -10<br>Maximum: 60 |
| 2055 | $0806_{hex}$ | Error output level (mA) | Float | Min. 0.5 mA<br>Max. 24 mA |

| **Analog Output 3** | | | | |
|---|---|---|---|---|
| 2306 | $0901_{hex}$ | Analog output 3 measurement parameter selection. When written, scalings are reset. | Reg | $0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis)<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis)<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$)<br>See Table 13 (page 68) |

| **Analog Output 3** | | | | |
|---|---|---|---|---|
| 2307 | $0902_{hex}$ | Scale low end for analog output 3 measurement parameter.<br>Minimum and maximum values vary for different parameters. | Float | Output parameters<br>$0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis):<br>Minimum: 0<br>Maximum: 1000000 |
| | | | | Output parameters<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis):<br>Minimum: 0<br>Maximum: 250000 |
| | | | | Output parameters<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$):<br>Minimum: -10<br>Maximum: 60 |

| | | | | |
|---|---|---|---|---|
| **Analog Output 3** | | | | |
| 2309 | $0904_{hex}$ | Scale high end for analog output 3 measurement parameter.<br>Minimum and maximum values vary for different parameters. | Float | Output parameters<br>$0000_{hex}$ ($CH_4$ wet basis)<br>$0002_{hex}$ ($CH_4$ dry basis)<br>$0004_{hex}$ ($CO_2$ wet basis)<br>$0006_{hex}$ ($CO_2$ dry basis):<br>Minimum: 0<br>Maximum: 1000000 |
| | | | | Output parameters<br>$0008_{hex}$ ($H_2O$ wet basis)<br>$000A_{hex}$ ($H_2O$ dry basis):<br>Minimum: 0<br>Maximum: 250000 |
| | | | | Output parameters<br>$000C_{hex}$ ($T_d$)<br>$000E_{hex}$ ($T_{df}$):<br>Minimum: -10<br>Maximum: 60 |
| 2311 | $0906_{hex}$ | Error output level (mA) | Float | Min. 0.5 mA<br>Max. 24 mA |
| **Analog Input 1** | | | | |
| 2562 | $0A01_{hex}$ | Analog input 1 compensation parameter.<br>Read-only: controlled by the pressure and temperature compensation mode registers. | Reg | $0204_{hex}$ (pressure)<br>$0206_{hex}$ (temperature) |

| Analog Input 1 | | | | |
|---|---|---|---|---|
| 2563 | $0A02_{hex}$ | Scale low end for analog input 1 compensation parameter.<br>Minimum and maximum values vary for different parameters. | Float | $0204_{hex}$ (pressure)<br>Minimum: 0<br>Maximum: 20 000 |
| | | | | $0206_{hex}$ (temperature)<br>Minimum: -200<br>Maximum: 400 |
| 2565 | $0A04_{hex}$ | Scale high end for analog input 1 compensation parameter.<br>Minimum and maximum values vary for different parameters. | Float | $0204_{hex}$ (pressure)<br>Minimum: 0<br>Maximum: 20 000 |
| | | | | $0206_{hex}$ (temperature)<br>Minimum: -200<br>Maximum: 400 |
| 2567 | $0A06_{hex}$ | Input value (read-only) | Float | |

## A.1.3 Status Registers

Table 15 Modbus Status Data Registers (Read-Only)

| Register Number (Decimal) | Address (Hexa-decimal) | Register Description | Data Format | Bitmask |
|---|---|---|---|---|
| 513 | $0200_{hex}$ | Error code | 32-bit signed integer | $0201_{hex}$ (status code low): see Table 16 (page 81). |
| | $0202_{hex}$ | | | $0202_{hex}$ (status code high): see Table 17 (page 82). |
| 517 | $0204_{hex}$ | Pressure compensation values in use | Float | |
| 519 | $0206_{hex}$ | Temperature compensation values in use | Float | |

| Register Number (Decimal) | Address (Hexa-decimal) | Register Description | Data Format | Bitmask |
|---|---|---|---|---|
| 521 | $0208_{hex}$ | $CH_4$ measurement status | 16-bit signed integer | **$0000_{hex}$**: Unsupported<br>**$0001_{hex}$**: Reading is not reliable<br>**$0002_{hex}$**: Under range<br>**$0003_{hex}$**: Over range<br>**$0004_{hex}$**: Noisy<br>**$0005_{hex}$**: Value locked<br>**$0006_{hex}$**: Calibration expired<br>**$0007_{hex}$**: Sensor failure<br>**$0008_{hex}$**: Measurement not ready |
| 522 | $0209_{hex}$ | $CH_4$ measurement status (dry basis) | 16-bit signed integer | |
| 523 | $020A_{hex}$ | $CO_2$ measurement status | 16-bit signed integer | |
| 524 | $020B_{hex}$ | $CO_2$ measurement status (dry basis) | 16-bit signed integer | |
| 525 | $020C_{hex}$ | $H_2O$ measurement status | 16-bit signed integer | |
| 526 | $020D_{hex}$ | $T_{df}$ measurement status | 16-bit signed integer | |
| 527 | $020E_{hex}$ | $T_s$ measurement status | 16-bit signed integer | |
| 528 | $020F_{hex}$ | Device status | 16-bit signed integer | **$0000_{hex}$**: Critical failure<br>**$0001_{hex}$**: Error<br>**$0002_{hex}$**: Warning<br>**$0003_{hex}$**: Notification |
| 529 | $0210_{hex}$ | Clear error log: the error log is cleared if 1 is written, other values are ignored. Register always reads as 0. | Function | |

Table 16 Error Codes in Register $0200_{hex}$ (Status Code Low)

| Bitmask | Error Message | Severity |
|---|---|---|
| $0000_{hex}$ | Firmware checksum mismatch. | Critical |
| $0001_{hex}$ | Device settings corrupted. | Critical |
| $0009_{hex}$ | Infrared source temperature too high. | Error |
| $0010_{hex}$ | Infrared source failure. | Error |
| $0011_{hex}$ | Infrared source failure. | Error |
| $0012_{hex}$ | Supply voltage out of range. | Error |
| $0013_{hex}$ | Internal voltage out of range. | Error |

| Bitmask | Error Message | Severity |
|---|---|---|
| $0014_{hex}$ | Sensor signal low. | Error |
| $0015_{hex}$ | Sensor signal low. | Error |
| $0016_{hex}$ | Internal voltage out of range. | Error |
| $0017_{hex}$ | Sensor signal distorted. | Error |
| $0018_{hex}$ | Sensor signal distorted. | Error |
| $0019_{hex}$ | $CH_4$ measurement out of range. | Error |
| $0020_{hex}$ | $CO_2$ measurement out of range. | Error |
| $0021_{hex}$ | $H_2O$ measurement out of range. | Error |
| $0022_{hex}$ | $T_d$ measurement out of range. | Error |
| $0023_{hex}$ | Sensor heater failure. | Error |
| $0024_{hex}$ | Infrared source temperature too high. | Error |
| $0025_{hex}$ | Internal temperature too high. | Error |
| $0026_{hex}$ | Temperature measurement error. | Error |
| $0027_{hex}$ | Supply power insufficient for analog input. | Error |
| $0028_{hex}$ | Analog input 1 out of range. | Error |
| $0030_{hex}$ | Internal temperature error. | Error |
| $0031_{hex}$ | Supply power insufficient for operation. | Error |

Table 17 Error Codes in Register $0202_{hex}$ (Status Code High)

| Bitmask | Error Message | Severity |
|---|---|---|
| $0032_{hex}$ | Sensor signal low. | Warning |
| $0033_{hex}$ | Sensor signal low. | Warning |
| $0034_{hex}$ | Internal temperature high. | Warning |
| $0035_{hex}$ | Sensor signal distorted. | Warning |
| $0036_{hex}$ | Sensor signal distorted. | Warning |
| $0037_{hex}$ | Sensor signal distorted. | Warning |
| $0038_{hex}$ | Unexpected device restart. | Warning |
| $0039_{hex}$ | Calibration has expired. | Warning |
| $0042_{hex}$ | Infrared source temperature out of range. | Warning |

| Bitmask | Error Message | Severity |
|---|---|---|
| $0043_{hex}$ | Supply power insufficient for analog input. | Warning |
| $0044_{hex}$ | Infrared source temperature out of range. | Warning |
| $0048_{hex}$ | Heater off. | Info |
| $0049_{hex}$ | Calibration is about to expire. | Info |

### A.1.4 Device Identification Objects

Table 18 Device Identification Objects

| Object ID (Decimal) | Object ID (Hexadecimal) | Object Name | Example Contents |
|---|---|---|---|
| 0 | $00_{hex}$ | VendorName | "Vaisala" |
| 1 | $01_{hex}$ | ProductCode | "MGP261 " |
| 2 | $02_{hex}$ | MajorMinorVersion | Software version (for example "1.2.3") |
| 3 | $03_{hex}$ | VendorUrl | "http://www.vaisala.com/" |
| 4 | $04_{hex}$ | ProductName | "Vaisala Multigas Probe MGP261 " |
| 128 | $80_{hex}$ | SerialNumber [1)] | Probe serial number (for example, "R0710040") |
| 129 | $81_{hex}$ | Calibration date [1)] | Date of the factory calibration |
| 130 | $82_{hex}$ | Calibration text [1)] | Information text of the factory calibration |

*1) Vaisala-specific device information object*

# Warranty

For standard warranty terms and conditions, see www.vaisala.com/warranty.
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.

# Technical Support

Contact Vaisala technical support at helpdesk@vaisala.com. 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 more information, see www.vaisala.com/support.

# Recycling

Recycle all applicable material.

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

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www.vaisala.com