

SIEMENS



Modbus Air Pressure Sensor with I/O extension QBM3700..

User Guide

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Legal note

Legal note concept

This guide includes notes that must be followed for your own personal safety as well as to prevent damage to property.
Notes dealing only with damage to property do not have the warning triangle and use the signal word NOTICE and an exclamation point.
The notes are depicted as follows:

| | |
|----------|---|
| ! | NOTICE |
| | Type and source of hazard Consequences in the event the hazard occurs <ul style="list-style-type: none"> • Measures/prohibitions to prevent the hazard |

Qualified personnel

Only qualified personnel may commission the device/system. In this regard, qualified personnel have the training and experience necessary to recognize and avoid risks when working with this device/system.

Intended use

The device/system described here may only be used on building technical plants and for the described applications only.
The trouble-free and safe operation of the device/system described here requires proper transportation, correct warehousing, mounting, installation, commissioning, operation, and maintenance.
You must comply with permissible ambient conditions. You must comply with the information provided in the Section "Technical data" and any notes in the associated documentation.
Fuses, switches, wiring and grounding must comply with local safety regulations for electrical installations. Comply with all local and currently applicable laws and regulations.

Exemption from liability

The content of this document was reviewed to ensure it matches the hardware and firmware described herein. Deviations cannot be precluded, however, so that we cannot guarantee that the document matches in full the actual device/system. The information provided in this document is reviewed and updated on a regular basis.

Safety notes in the data sheet

| | |
|----------|--|
| ! | NOTICE |
| | Comply with all safety notes in data sheet "A6V11684000" in the sections "Technical data" and "Notes". |

1 Installation

1.1 Mounting



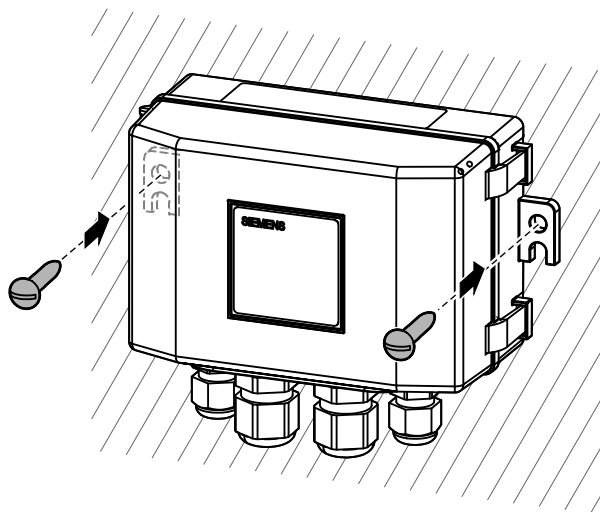
NOTICE

Hint

Mount the sensor in a location that is easy to open the cover and access the terminals, DIP switches and view the LEDs.

Proceed as follows to mount the sensor to a surface:

- Screw the sensor at the 2 brackets (on the device sides) to the mounting surface.



- Keep the following guidelines

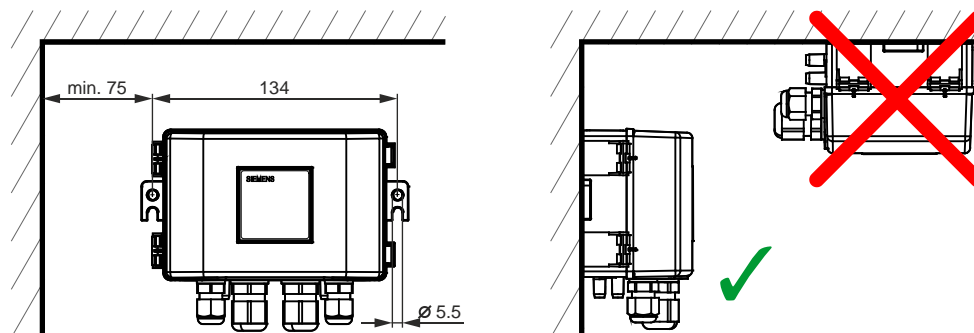
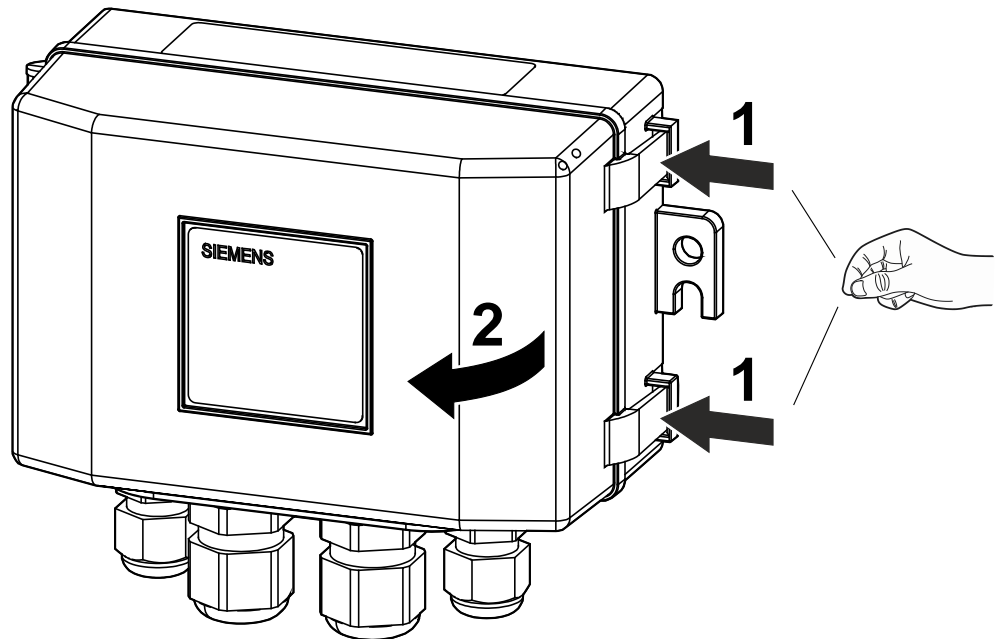


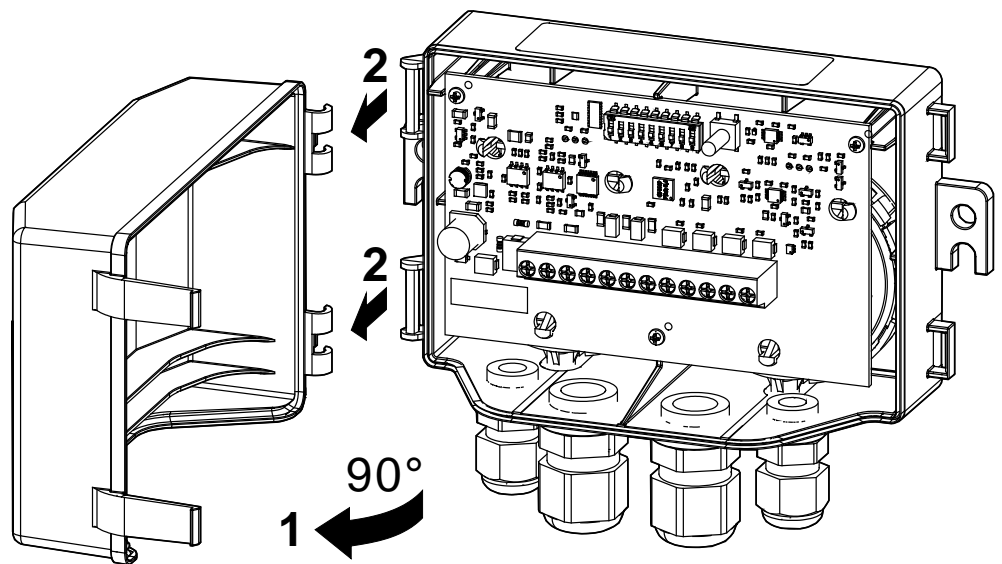
Figure 1: All dimensions in mm

1.2 Quick release fasteners and detached cover

- Open the housing with the quick release fasteners

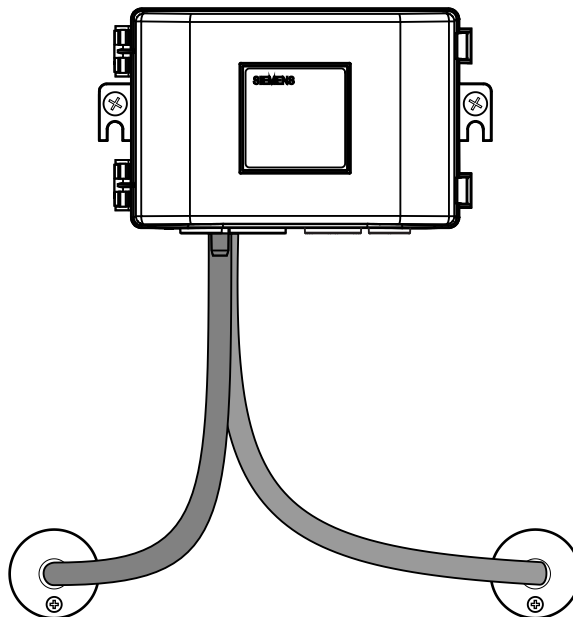


- The cover is easy to remove

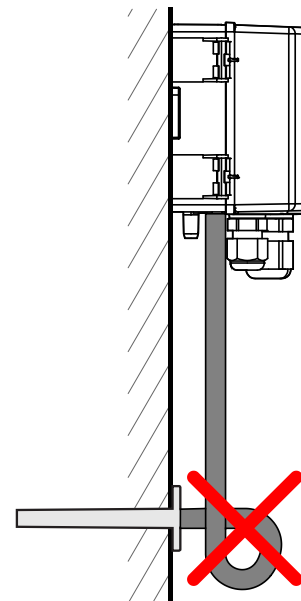


1.3 Connecting tubes

Connect the tubes



Avoid loops

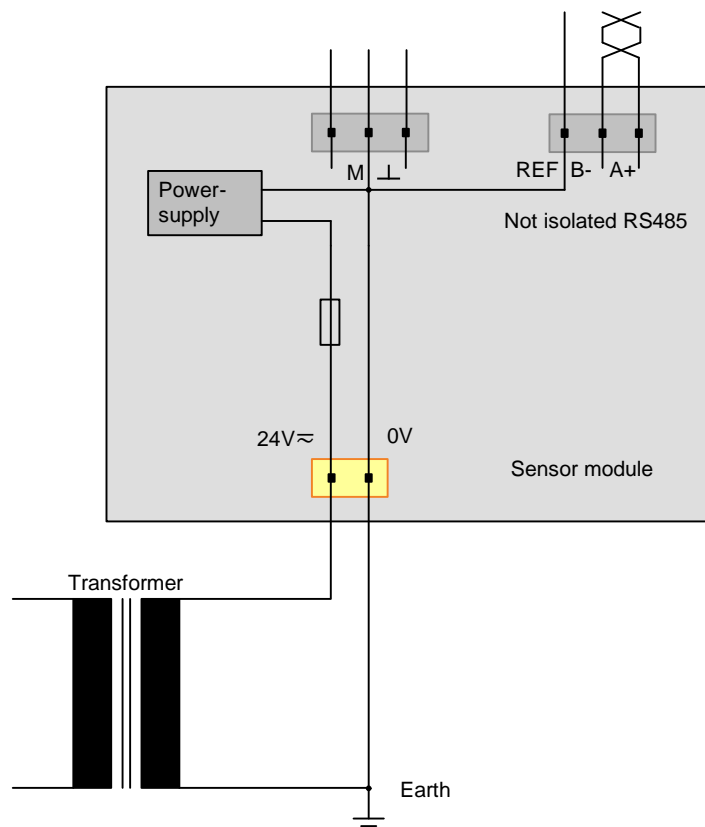


1.4 Wiring

1.4.1 Electrical grounding

Starting point

Note the following grounding situation of the QBM3700...



Consequence

- QBM3700.. uses a non-isolated RS485-Interface.
- The reference of RS485 transceiver is connected to GND.
- All GND pins are on the same potential.
- If the Climatix controller and QBM3700.. are connected to the same power source, take care to avoid incorrect wiring between 24 V input and GND.



The document "Modbus communication" (J3960) provides profound information on Modbus grounding.

1.4.2 Power supply

| | |
|----------|---------------------|
| Terminal | 24V~ →, ⊥, 24V~ ← |
| Diagram | |
| Note | Ground is optional. |

1.4.3 Connection terminals

| | |
|--|--|
| | Power supply AC / DC 24 V |
| | GND |
| | Power supply for external devices AC/DC 24 V |
| | Modbus® communication + |
| | Common |
| | Modbus® communication - |
| | Analog output 1 |
| | GND |
| | Analog output 2 |
| | Analog input 1 |
| | GND |
| | Analog input 2 |

1.4.4 Signal wiring

The following graphics illustrate all signal types of a QBM3700...

1.4.4.1 Analog inputs

Analog inputs for passive sensors

| | | | |
|-------------|--|--|--|
| Application | Connecting passive temperature sensors. Signal types: Pt1000, LG-Ni1000, NTC10k, and Ni1000 | | |
| Terminal | AI1, AI2 | | |
| Diagram | | | |

Analog inputs for voltage signal

| | | | |
|-------------|--|--|--|
| Application | Connecting devices that supply a 0...10 V signal | | |
| Terminal | AI1, AI2 | | |
| Diagram | | | |

1.4.4.2 Analog outputs

Analog outputs with voltage signal

| | | | |
|-------------|---|--|--|
| Application | Connecting devices that are controlled with a 0...10 V signal | | |
| Terminal | AO1, AO2 | | |
| Diagram | | | |

2 Commissioning

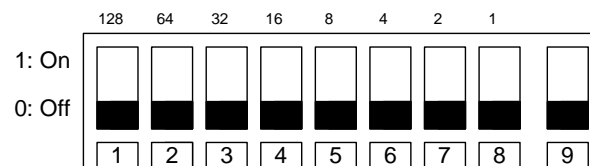
2.1 Address

2.1.1 DIP switches (Climatix and other controllers)

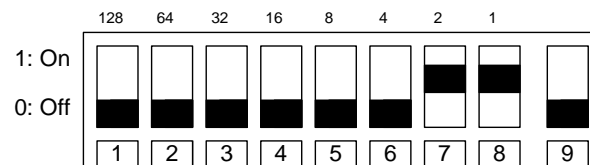
Use DIP switches to adjust the Modbus address and for termination.

- The DIP-switches have priority over register 4x0764 (Modbus address).
- The Modbus address (register 4x0764) is valid as soon as all DIP switches are on '0'.
- Changes to DIP switches are effective after 5 seconds.

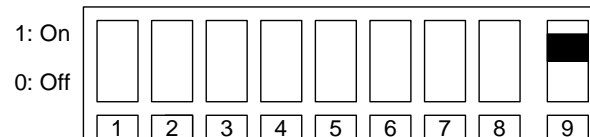
Modbus addressing



The DIP switches allow addresses between 1...247 (Modbus specification).
The following example shows Modbus address '3':



Modbus termination



- The termination is done with 120 Ω + 1nF.
- The termination must be done manually, even if the addressing is done with "On-event addressing (Climatix controllers) [\rightarrow 9]".

2.1.2 On-event addressing (Climatix controllers)

On-event addressing works together with Climatix controllers.

On-event addressing performs several functions that otherwise would have to be done 'manually':

Workflow

- ▷ The QBM3700.. sensor is wired and connected to the controller via Modbus.
- ▷ The DIPs 1...8 (addressing DIPs) are set to '0'.
- ▷ The on-event addressing functionality is configured in the application.
- ▷ The necessary functional block is therefore available in the CAS library. The CAS library online help contains further engineering documentation.

1. Press and hold the push button for 5...10 seconds.
2. As soon the button is released the status LED lights up orange.
 - ⇒ The QBM3700.. temporarily receives address 246 to connect.
 - ⇒ The baud rate is automatically recognized.
 - ⇒ The format changes to 1-8-E-1.
 - ⇒ The master writes the Modbus parameter.
 - ⇒ Master writes '1' into register 4x0768 ("Bus config command").
3. QBM3700.. gets its final Modbus address by the application/HMI. Further settings are made automatically (see engineering background below).
 - ⇒ After a successful pairing the status LED blinks green (normal mode).



NOTICE

- On-event addressing is active for a maximum of 10 minutes.
- The DIP switches set Modbus line termination. See "DIP switches (Climatix and other controllers) [→ 9]".

2.1.3 Baud rate

The default value of the QBM3700.. Modbus baud rate is "Auto". That means the QBM3700.. takes over the baud rate of the calling device.



The first connection to the QBM3700.. can last up to 30 seconds (to process the auto baud function).

2.2 Fault detection, correction or reset

Detect and correct faults

- The status LED blinking red indicates a failure or wrong configuration.
- Read out Error Code (register 4x0002) value 0...11 (see table below)
- Further information contain:
 - Status register of pressure sensor
 - Status register of universal inputs

| Value | Value Error code (register 4x0002) | Reliability pressure sensor (register 4x0004 + 4x0006) | Reliability analog inputs (register 4x0008 + 4x0010) |
|-------|------------------------------------|--|--|
| 0 | No error. | No error. | No error. |
| 1 | No sensor | Disruption in operation | Sensor not connected |
| 2 | Overload | Overload | Temperature >150 °C |
| 3 | Overload | Negative pressure | Temperature <-50 °C |
| 4 | Open-loop control | | |
| 5 | Short overload | | Short overload |
| 6 | No output signal | | |
| 7 | Other error | Zero point reset required | |

| Value | Value Error code (register 4x0002) | Reliability pressure sensor (register 4x0004 + 4x0006) | Reliability analog inputs (register 4x0008 + 4x0010) |
|-------|------------------------------------|--|--|
| 8 | Calculation error | | |
| 9 | Extended error | | |
| 10 | EEPROM protection active | | |
| 11 | Configuration error | Configuration error | Configuration error |

LED status indication

| Color | Status | Function |
|--------|---------------------------------------|--|
| Red | Blinking, 1 second on, 5 seconds off | Internal error |
| Red | Blinking, 0.1 second on, 1 second off | Incorrect configuration |
| Orange | Continuous | Waiting for on-event addressing |
| Orange | Blinking, 1 second on, 5 seconds off | Bus communication error |
| Orange | Blinking, 0.1 second on, 1 second off | Device not configured (factory settings) |
| Green | Continuous | Start-up |
| Green | Blinking | Normal operation |
| Green | Flickering | Bus communication |
| Blue | Continuous | Reset zero point |

Reset to factory setting

Use the push button to reset to factory settings. The Sensor is reset to delivered setting. Factory settings are listed in the register list "Modbus registers" – default values.

- Hold the push button for 20...30 seconds.

3 Engineering

3.1 Implementing volume flow measurement

Implementing volume flow measurement In addition to normal (differential) pressure measurement, the QBM3700.. provides volume flow measurement (i.e. used with 3rd party controllers).

Flow is a volume over time. It is related to differential pressure according to the following formula: $Q = k \times \sqrt{\Delta p}$

Flow measurement with QBM3700.. is set up in an application as follows:

1. Write the vendor specific k-factor for the measured device to register 4x0083 (sensor 1) and/or 4x0093 (sensor 2). Permitted range 0...1500.
2. Select requested unit in register 4x0084 (sensor 1) and/or 4x0094 (sensor 2). Selectable are m³/h, m³/s or l/s.
⇒ QBM3700.. calculates the flow value.
3. Read out the flow value from registers 4x0081/4x0082 (flow low/flow high of sensor 1) resp. registers 4x0091/4x0092 (flow low/flow high of sensor 2).

Value in register

The two registers exist for mathematical reasons: The QBM3700.. works with a high 16 bit and a low 16 bit register.

Example

- Value in register "flow high" = 12
- Value in register "flow low" = 35012

Calculation:

$$12 * 65536 = 786432$$

$$786432 + 35012 = 821444$$

With scaling (0.01) the end value = 8214.44m³/h.

3.2 Modbus registers

| Supported function codes | |
|--------------------------|--------------------------|
| 03 (0x03) | Read holding register |
| 04 (0x04) | Read input registers |
| 06 (0x06) | Write single register |
| 16 (0x10) | Write multiple registers |



Any changes in settings are completed with setting 4x0768 (Bus config command) to "1" (toggle bit).

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|--------------------------------------|---------|-------------|-----|--|-----------|
| 4x0001 | Type | | 1 | R | 9705 = 1x 500 Pa 9710 = 1x 1250 Pa 9720 = 1x 2500 Pa | uint16_t |
| 4x0002 | Error code | | 1 | R | | uint16_t |
| 4x0003 | Analog output coupling | | 1 | R/W | 0 = Analog output coupled with differential pressure sensors = default 1 = Analog output coupled as defined in 4x0028/4x0058 (setpoint) | uint16_t |
| 4x0004 | Differential pressure 1- Reliability | | 1 | R | | uint16_t |
| 4x0005 | Differential pressure 1 - Value | | See config. | R | | uint16_t |
| 4x0006 | Differential pressure 2- Reliability | | 1 | R | | uint16_t |
| 4x0007 | Differential pressure 2 - Value | | See config. | R | | uint16_t |
| 4x0008 | Analog input 1 - Reliability | | 1 | R | | uint16_t |
| 4x0009 | Analog input 1 - Value | °C / mV | 0.1 / 1 | R | | int16_t |
| 4x0010 | Analog input 2 - Reliability | | 1 | R | | uint16_t |
| 4x0011 | Analog input 2 - Value | °C / mV | 0.1 / 1 | R | | int16_t |

Analog input 1

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|-----------------|---------|---------|-----|--|-----------|
| 4x0020 | Reliability. | | 1 | R | | uint16_t |
| 4x0021 | Value | °C / mV | 0.1 / 1 | R | | int16_t |
| 4x0022 | Sensor type AI1 | | 1 | R/W | 0 = No sensor (default) 1 = PT1000 2 = LG-Ni 1000 3 = NTC 10 k 4 = NI 1000 5 = 0...10 V | uint16_t |

Analog output 1

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|---------------------------|------|---------|-----|--|-----------|
| 4x0027 | Value | mV | 1 | R/W | 0 ≤ VAL ≤ 10500 | uint16_t |
| 4x0028 | Dependency ^{SEP} | | 1 | R/W | 0 = Value @ 4x0027 = default if 4x0003=1 1 = With analog output 1 2 = With analog output 2 3 = With pressure sensor 1 = default if 4x0003=0 4 = With pressure sensor 2 | uint16_t |
| 4x0029 | Scaling low - (0.0V) | mV | 1 | R/W | 0 ≤ VAL < Scaling high (0 = Default) | uint16_t |
| 4x0030 | Scaling high - (10.0V) | mV | 1 | R/W | Scaling low < VAL (10000 = Default) | uint16_t |

Differential pressure 1

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|--------------|------|---------|-----|------|-----------|
| 4x0035 | Reliability. | | 1 | R | | uint16_t |
| 4x0036 | Value | | 1 | R | | uint16_t |

| | | | | | | |
|--------|---------------------------|--------------------|--------|-----|--|----------|
| 4x0037 | Unit | | 1 | R/W | 0 = Pa = (Default) 1 = PSI 2 = mmHG 3 = mmH2O | uint16_t |
| 4x0038 | Value [Pa] | Pa | 1 | R | | uint16_t |
| 4x0039 | Value [PSI] | PSI | 0.0001 | R | | uint16_t |
| 4x0040 | Zero point calibration | | 1 | R/W | 0 = No action (toggle bit) 1 = Zero point calibration P1+P2 2 = Zero point calibration P1 3 = Zero point reset to factory setting P1+P2 4 = Zero point reset to factory setting P1 | uint16_t |
| 4x0041 | Sensor 1 full scale value | Pa | 1 | R | | uint16_t |
| 4x0042 | Average 500 ms | See config #4x0037 | | R | | uint16_t |
| 4x0043 | Average 1000 ms | See config #4x0037 | | R | | uint16_t |
| 4x0044 | Average 4000 ms | See config #4x0037 | | R | | uint16_t |
| 4x0045 | Average 16000 ms | See config #4x0037 | | R | | uint16_t |

Analog input 2

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|-----------------|---------|---------|-----|--|-----------|
| 4x0050 | Reliability. | | 1 | R | | uint16_t |
| 4x0051 | Value | °C / mV | 0.1/1 | R | | int16_t |
| 4x0052 | Sensor type AI2 | | 1 | R/W | 0 = No sensor (default) 1 = PT1000 2 = LG-Ni 1000 3 = NTC 10 k 4 = NI 1000 5 = 0...10 V | uint16_t |

Analog output 2

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|---------------------------|------|---------|-----|--|-----------|
| 4x0057 | Value | mV | 1 | R/W | 0 ≤ VAL ≤ 10000 | uint16_t |
| 4x0058 | Dependency _{SEP} | | 1 | R/W | 0 = Value @ 4x0057 = default if 4x0003=1 1 = With analog output 1 2 = With analog output 2 3 = With pressure sensor 1 4 = With pressure sensor 2 = Default if 4x0003=0 | uint16_t |
| 4x0059 | Scaling low - (0V) | mV | 1 | R/W | 0 ≤ VAL < Scaling high (0 = Default) | uint16_t |
| 4x0060 | Scaling high - (10V) | mV | 1 | R/W | Scaling low < VAL (10000 = Default) | uint16_t |

Differential pressure 2

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|--------------|------|---------|-----|------|-----------|
| 4x0065 | Reliability. | | 1 | R | | uint16_t |
| 4x0066 | Value | | 1 | R | | uint16_t |

| | | | | | | |
|--------|---------------------------|--------------------|--------|-----|--|----------|
| 4x0067 | Unit | | 1 | R/W | 0 = Pa = Default 1 = PSI 2 = mmHG 3 = mmH2O | uint16_t |
| 4x0068 | Value [Pa] | Pa | 1 | R | | uint16_t |
| 4x0069 | Value [PSI] | PSI | 0.0001 | R | | uint16_t |
| 4x0070 | Zero point calibration | | 1 | R/W | 0 = No action (toggle bit) 1 = Zero point calibration P1+P2 2 = Zero point calibration P2 3 = Zero point reset to factory setting P1+P2 4 = Zero point reset to factory setting P2 | uint16_t |
| 4x0071 | Sensor 2 full scale value | Pa | 1 | R | | uint16_t |
| 4x0072 | Average 500 ms | See config #4x0067 | | R | | uint16_t |
| 4x0073 | Average 1000 ms | See config #4x0067 | | R | | uint16_t |
| 4x0074 | Average 4000 ms | See config #4x0067 | | R | | uint16_t |
| 4x0075 | Average 16000 ms | See config #4x0067 | | R | | uint16_t |

Flow (Diff-pressure Sensor 1)

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|-------------|------|---------|-----|---|-----------|
| 4x0081 | Flow low | | 0.01 | R | | uint16_t |
| 4x0082 | Flow high | | 0.01 | R | | uint16_t |
| 4x0083 | K-factor | | 1 | R/W | 0 ≤ VAL ≤ 1500 | uint16_t |
| 4x0084 | Unit | | 1 | R/W | 0 = m ³ /h (Default) 1 = m ³ /s 2 = l/s | uint16_t |

Flow (Diff-pressure Sensor 2)

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|-------------|------|---------|-----|---|-----------|
| 4x0091 | Flow low | | 0.01 | R | | uint16_t |
| 4x0092 | Flow high | | 0.01 | R | | uint16_t |
| 4x0093 | K-factor | | 1 | R/W | 0 ≤ VAL ≤ 1500 | uint16_t |
| 4x0094 | Unit | | 1 | R/W | 0 = m ³ /h (Default) 1 = m ³ /s 2 = l/s | uint16_t |

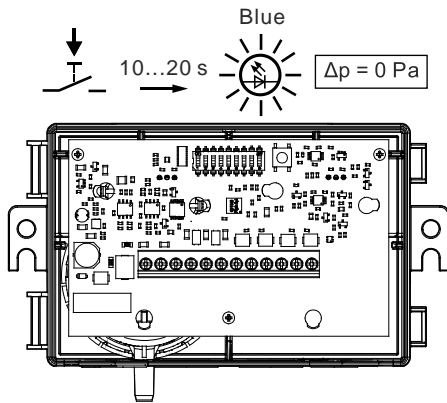
| Modbus Settings (as per Climatix) | | | | | | |
|-----------------------------------|---------------------|------|---------|-----|---|-----------|
| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
| 4x0764 | Modbus addressing | | 1 | R/W | 1 ≤ VAL ≤ 247 255 = Default | uint16_t |
| 4x0765 | Baud rate | | 1 | R/W | 0 = Auto (Default) 1 = 9600 2 = 19200 3 = 38400 4 = 57600 | uint16_t |
| 4x0766 | Format | | 1 | R/W | 0 = 1-8-E-1 (Default) 1 = 1-8-O-1 2 = 1-8-N-1 3 = 1-8-N-2 | uint16_t |
| 4x0768 | Bus config. command | | 1 | R/W | 0 = Ready (Default) 1 = Load 2 = Discard | uint16_t |

| Addr. | Description | Unit | Scaling | R/W | Area | Data type |
|--------|------------------|------|---------|-----|------|-----------|
| 4x9014 | software version | | 1 | R | | uint16_t |

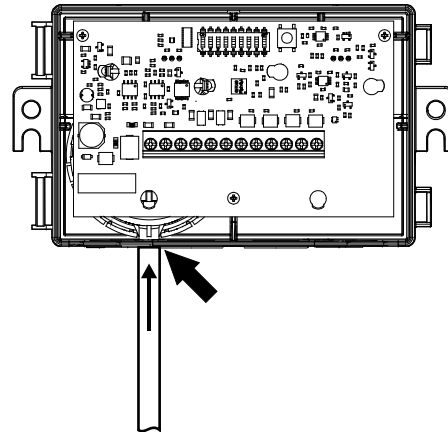
4 Maintenance

4.1 Zero reset

Perform the zero reset without tubes.



Afterwards reconnect the tubes



NOTICE

Use cases for the zero reset

- As the allowed mounting position is vertical only (see "Mounting [→ 4]"), the sensor does not have to be recalibrated during commissioning in the case of normal pressure measurement.
- Only in case of relative pressure measurement (pressure nipple "-" connected to ambient atmosphere) a zero point calibration is recommended during commissioning.

5 Supplemental information

| Document title | Topic | Document no: |
|---|--|--------------|
| Datasheet: Modbus air pressure sensor with I/O extension: QBM3700.. | Functions, use, technical data, terminals, dimensions and Modbus registers | A6V11684000 |
| Mounting instructions: Differential Pressure Sensors QBM3700.. | Mounting / installation | A6V11697501 |

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