

SIEMENS



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

User Guide

Contents

Legal note	3
Safety notes in the data sheet.....	3
1 Installation	4
1.1 Mounting	4
1.2 Quick release fasteners and detached cover.....	5
1.3 Connecting tubes.....	6
1.4 Wiring.....	6
1.4.1 Electrical grounding	6
1.4.2 Power supply	7
1.4.3 Connection terminals	7
1.4.4 Signal wiring	8
2 Commissioning	10
2.1 Address.....	10
2.1.1 DIP switches (Climatix and other controllers).....	10
2.1.2 On-event addressing (Climatix controllers).....	10
2.1.3 Baud rate.....	11
2.2 Fault detection, correction or reset.....	11
3 Engineering	13
3.1 Implementing volume flow measurement	13
3.2 Modbus registers.....	13
4 Maintenance	18
4.1 Fused mode analog outputs.....	18
4.2 Zero reset.....	18
5 Supplemental information	19

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
	<p>Type and source of hazard Consequences in the event the hazard occurs</p> <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



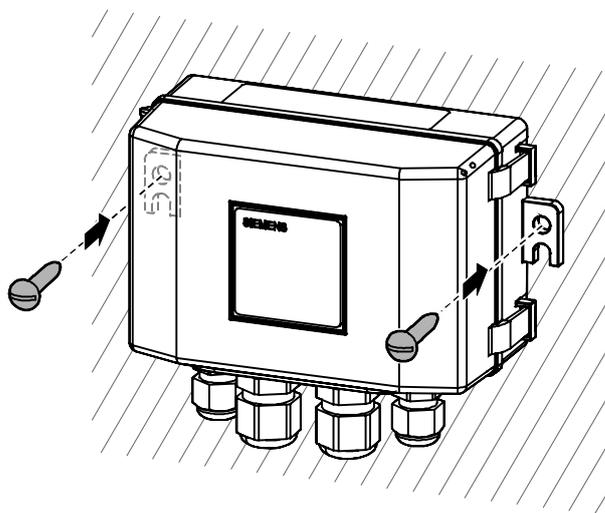
NOTICE

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

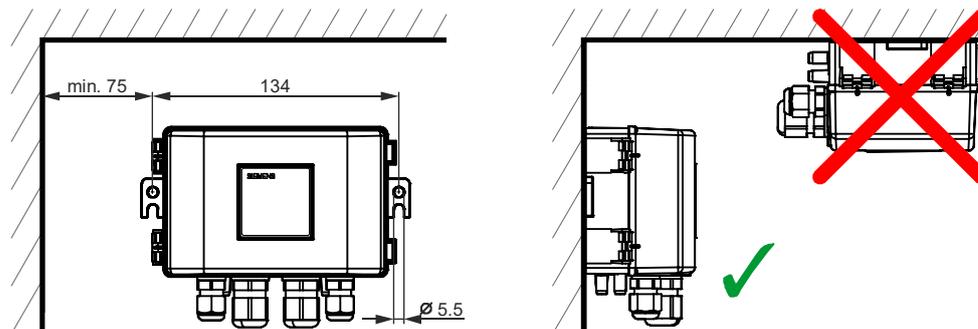
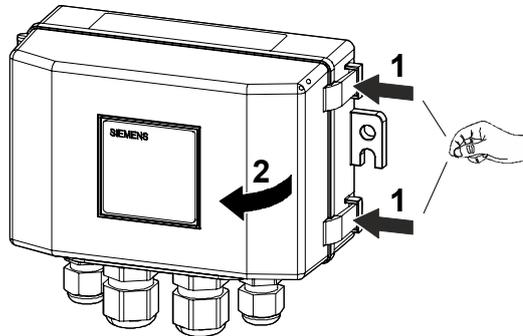


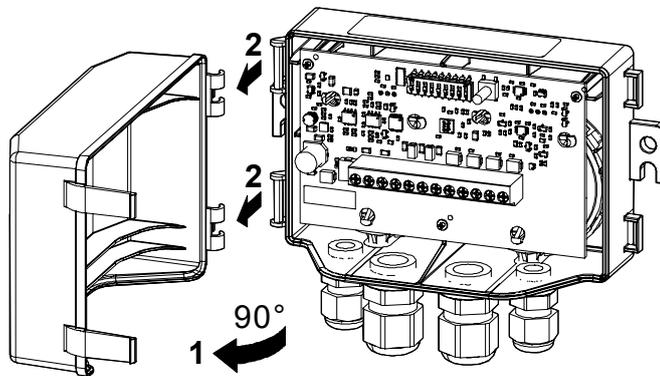
Fig. 1: All dimensions in mm

1.2 Quick release fasteners and detached cover

- Open the housing with the quick release fasteners

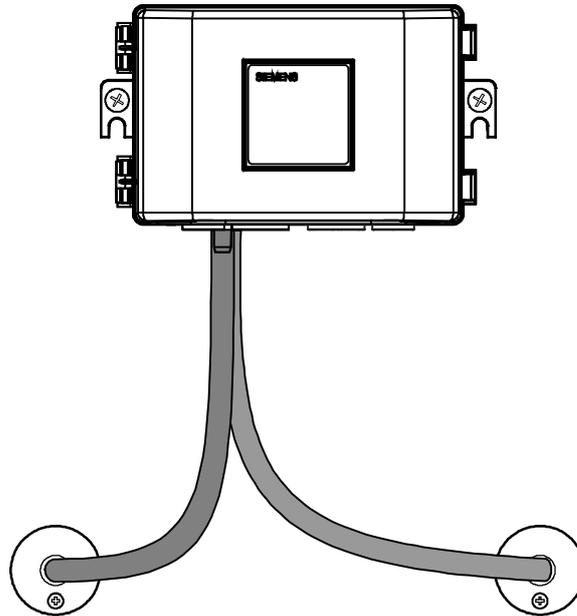


- The cover is easy to remove

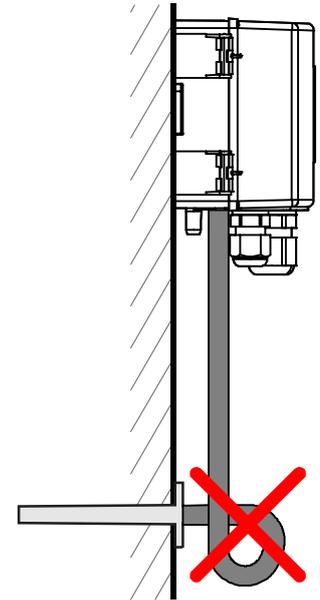


1.3 Connecting tubes

Connect the tubes



Avoid loops

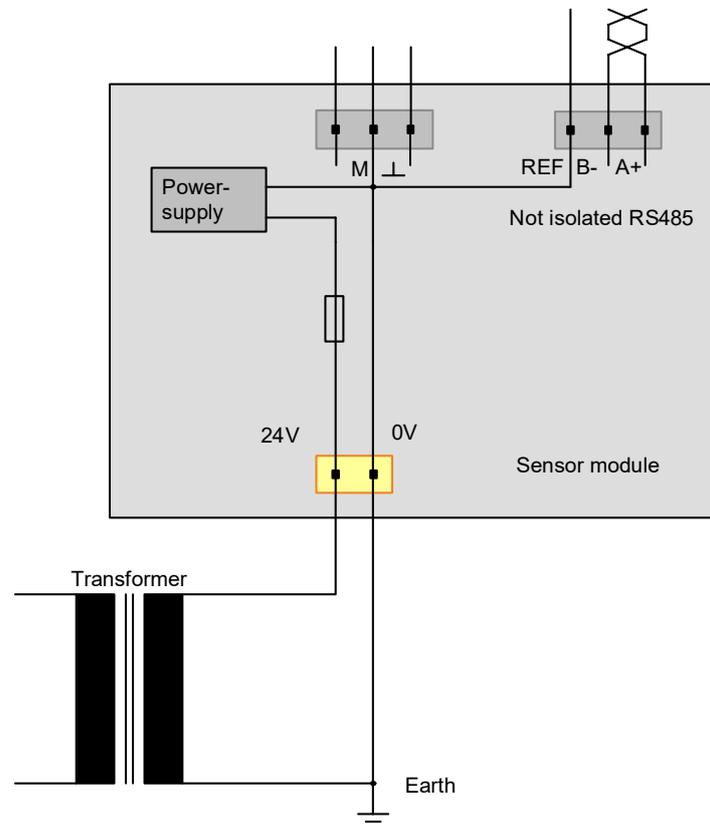


1.4 Wiring

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 \approx \rightarrow , \perp , 24V \approx \leftarrow
Diagram	
Note	Ground is optional.

1.4.3 Connection terminals

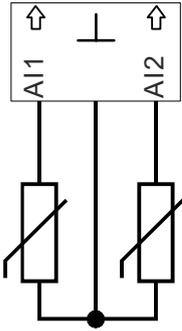
	Power supply AC / DC 24 V
	GND
	Power supply for external devices AC/DC 24 V
	Modbus® communication +
	Common
	Modbus® communication -
	Analog output 1
	GND
	Analog output 2
	Analog input 1
	GND
	Analog input 2

1.4.4 Signal wiring

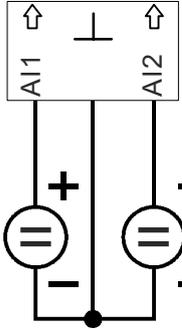
The following graphics illustrate all signal types of a QBM3700...

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	<p>The diagram illustrates the connection of two analog outputs, AO1 and AO2, to two motors. AO1 is connected to the positive terminal of the first motor. AO2 is connected to the positive terminal of the second motor. The negative terminals of both motors are connected to a common ground point.</p>		

2 Commissioning

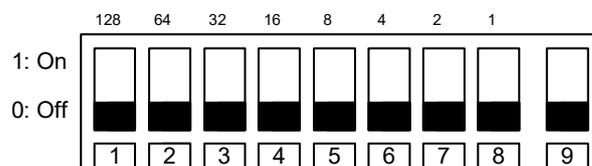
2.1 Address

2.1.1 DIP switches (Climatix and other controllers)

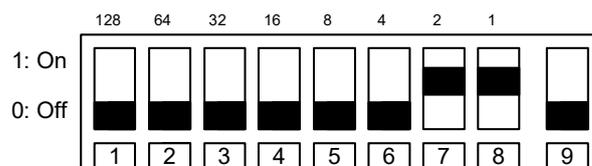
Use DIP switches to adjust the Modbus address and for termination.

- 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.

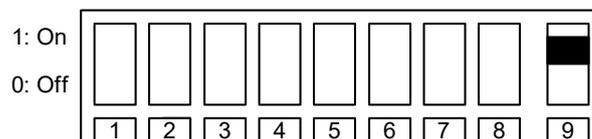
Modbus addressing



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



Modbus termination



- The termination is done with $120 \Omega + 1nF$.
- The termination must be done manually, even if the addressing is done with "On-event addressing (Climatix controllers) [\rightarrow 10]".

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) [→ 10]".

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	$0 \leq \text{VAL} \leq 10500$	uint16_t
4x0028	Dependency		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	$0 \leq \text{VAL} < \text{Scaling high}$ (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 ¹ _{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

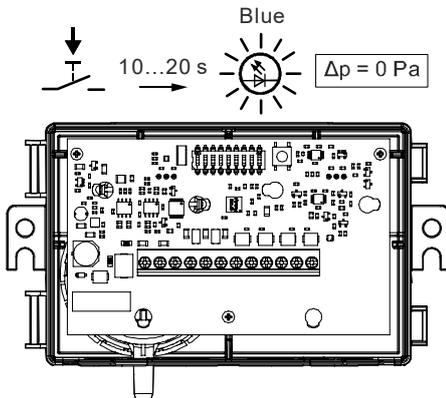
4.1 Fused mode analog outputs

QBM37.. Are supplied with a fused mode. This prevents damage caused by an interruption in Modbus communications.

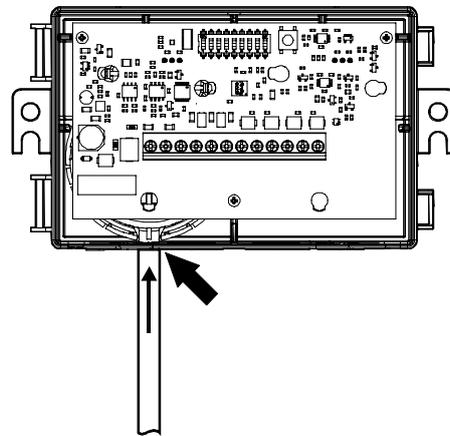
The analog outputs are switched to DC 0 V for interruptions to communications >60 seconds.

4.2 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

Issued by
Siemens Switzerland Ltd
Smart Infrastructure
Global Headquarters
Theilerstrasse 1a
CH-6300 Zug
+41 58 724 2424
www.siemens.com/buildingtechnologies

© Siemens Switzerland Ltd, 2019
Technical specifications and availability subject to change without notice.