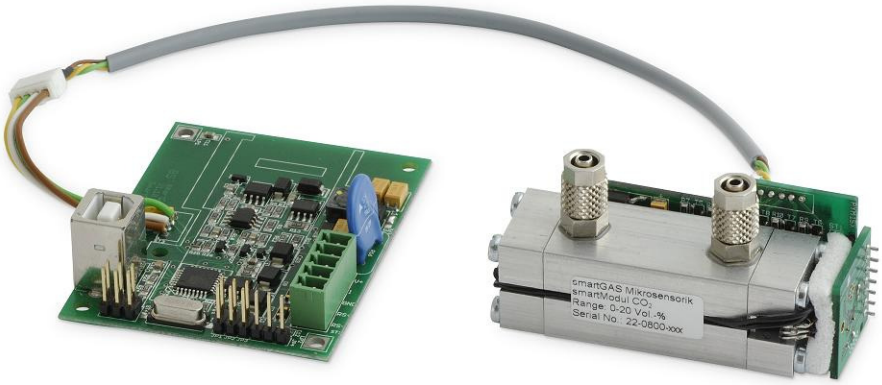
smart*MODUL*PREMIUM

Module- and communication manual



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Contents

1. General

smart*MODUL*^{PREMIUM} combines the advantages of smart*MODUL*^{PREMIUM} with the circuit board of smart*MODUL*^{CONNECT}.

This combination offers not only a variety of interfaces for data exchange, but also the option of controlled perfusion of the sensors via a gas inlet and outlet.

Based on the physical measurement of infrared absorption, the device is not only highly selective but also provides high levels of accuracy and reliability when measuring gas concentration. Its compact construction and low maintenance needs make it ideal for use even under very difficult conditions.

The smart*MODUL*^{PREMIUM} is ideal for creating a sensor system for measuring explosive or poisonous gases, supplying signals that can be read off either via MODBUS ASCII, as linear analogue current or output voltage.
The robust housing guarantees that the test gas remains within the measuring cell and provides the system with mechanical protection.

All smart*MODUL*^{PREMIUM} devices can be used with the following outputs:

- 4-20mA linear (3-wire)
- 0-20mA linear (3-wire)
- 0-1.0V linear combined with a precise 50 Ohm resistor
- 0-2.0 V linear combined with a precise 100 Ohm resistor
- RS 485 communication via MODBUS ASCII

The range of different signal outputs makes integration of the device into existing systems remarkably simple, reducing integration and development costs.

Given the wide range of gasses and their concentrations for which the smart*MODUL* has already been developed, smart*MODUL*^{PREMIUM} from smartGAS Mikrosensorik GmbH offers the optimal basis for universal implementation as top quality IR sensory technology.

2. Connections on the smart*MODUL*^{PREMIUM}

smart*MODUL*^{PREMIUM} is supplied with an operational power supply of 12 to 28V DC (± 5 %). Trouble-free functionality is guaranteed within this range.

Despite internal stabilization, voltage supply fluctuation should be limited.
In some cases, such as in plants where heavy loads are switched, the appropriate precautions need to be taken.

The various connections in power supply and output signals are combined in connector **ST1**.

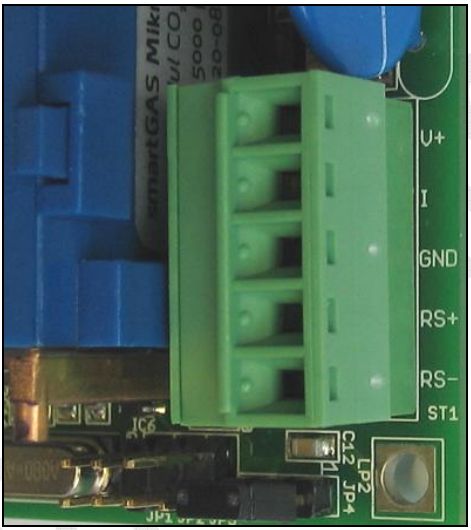


Figure 1. Power supply connections

Connections on **ST1** are designated as follows:

V+	→	power supply connections 12V - 28V DC (± 5 %).
I	→	connection for analog output (selectable as 0-20mA or 4-20mA).
GND	→	ground/GND for **V+**, **I and RS485**.
RS+	→	positive signal level for integrated RS485 interface.
RS-	→	negative signal level for integrated RS485 interface.

The measuring cell and interface PCB are connected by a data cable.
smart*MODUL*^{PREMIUM} can be supplied with cabling up to a metre length on request.

The connection is made with a four-pole push connector.

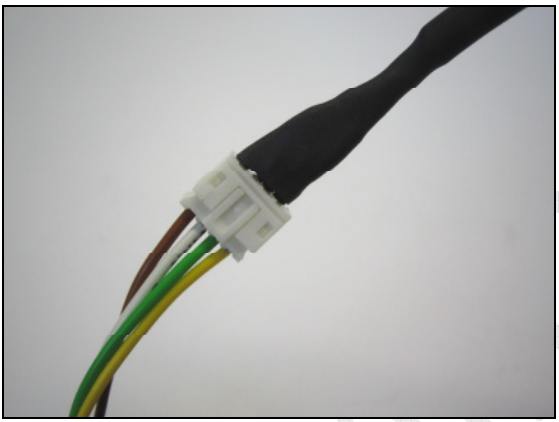


Figure 2. 4-pole connector

WARNING: ***Never disconnect the interface PCB from the measuring cell. You must always see both components as <u>one single</u> unit!***

3. Connections with smart*MODUL*^{PREMIUM}

Connections and signal output for the smart*MODUL*^{PREMIUM} are via the **ST1** connector (Figure 1). For operation and use of the current output, the sensor must first be installed and connected. To avoid faults and possible damage to the device, we recommend adherence to the following sequence of operations:

1. Install smart*MODUL*^{PREMIUM} in the desired application, ensuring sufficient distance from conducting components to avoid short-circuits and possible damage.

2. Remove the green plug from the **ST1** socket. The connections and clamping screws are now easy to reach.

3. Connect the power supply to **V+** and **GND**. Connect the signal cable for current output **I** and **GND** or alternatively **RS+**, **RS-** and **GND** for RS485 communication.
   GND is the common ground for the power supply, the current signal and for RS485.
   Make sure that the sequence of the connections on the plug corresponds to that on the circuit board (make sure the plug is inserted correctly! → see Figure 1).

4. re-connect the **ST1** plug.

If the power supply is switched on, the smart*MODUL*^{PREMIUM} starts automatically with the start-up phase (see Section 4).

4. smart*MODUL*^{PREMIUM} analogue output signals

4.1 Analogue linear signal with 0-20mA / 4-20mA or 0-1V/0-2V (with resistor)

There are two options for indicating measurement values as linear current output. Firstly, it is possible to use a range of 0-20mA, combined with a resistor to produce a linear voltage signal. The second option is a signal output with 4-20mA. In this version, it is easier to detect a wire break, loose connection or sensor failure.

The settings for the output signal are described in the following:

a) 0-20mA → Jumper **JP3** is in place (***delivery status***).

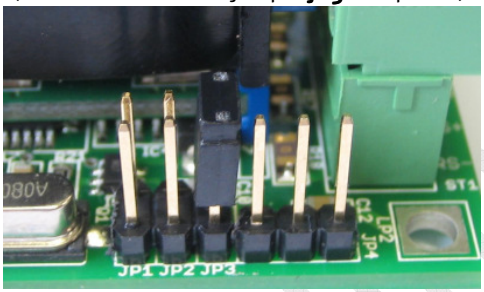


Figure 3. Working range 0-20mA

b) 4-20mA → Jumper **JP3** not in place.

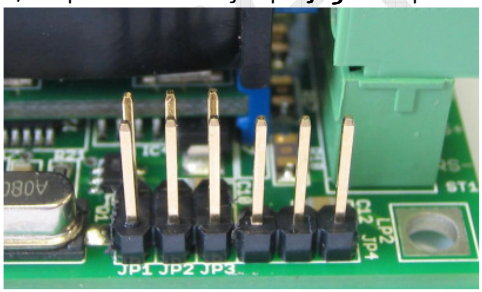


Figure 4. Working range 4-20mA

Select the range of output current for signal transfer you need for your application. Switching between the two ranges is possible once the device is unplugged from the power supply.

4.2 RS485 Interface

The smart*MODUL* *PREMIUM* has a RS485 interface (**half-duplex**). Via this interface the device can communicate via three lines:

- RS- interface's inverted data line
- RS+ interface's non-inverted data line
- GND interface reference potential. This must be used for communication via the interface when the participant does not have the same zero potential (e.g. galvanic separation).

The interface can be accessed via the 5-pole plug connector **ST1**.

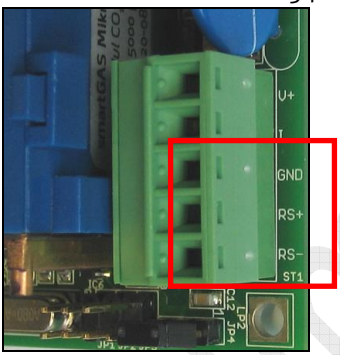
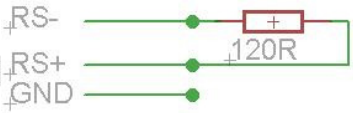


Figure 5. RS485 interface connections

NOTE: *The RS- and RS+ lines should be bridged by at least **30 cm** cable with **120 Ω** resistor inline.*



RS485 settings

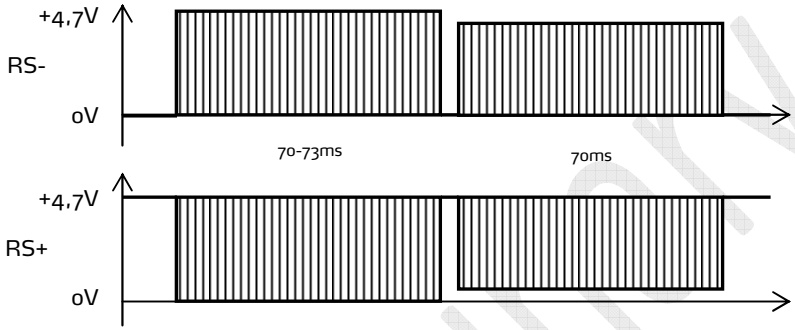
Baud rate:	2400
Data bits:	7
Stop bits:	1
Parity:	Even
Timeout:	1000ms
Retries:	3

NOTE: *In some cases it is necessary to increase the Timeout time to 1500ms.*

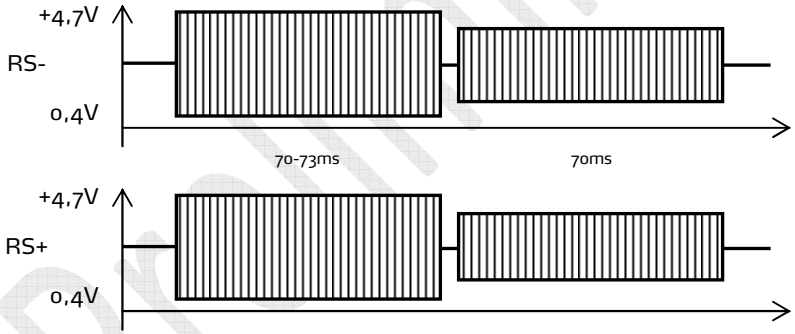
Signal trace

The signal traces at RS485 interfaces can vary greatly. The following are two examples of signals in the data line of the RS485.

Example 1: **RS232/RS485-Converter**



Example 2: **USB/RS485-Converter**



High flexibility of amplitude is available because with RS485 the potential difference of both data lines is evaluated. In the above examples it can be seen that the difference between RS- and RS+ is 0V (inactive) or 2V (active).

The duration of a request data string is 70ms – 73ms. Then a short pause of max 100ms can occur. The module then replies. This depends on how many bytes need to be read off. If only one byte is read then the module reply lasts approx. 70ms. Reading off more bytes correspondingly increases the reply phase.
The amplitude of the data line depends on the RS485 interface used.

4.2.1 smart*MODUL*^{PREMIUM} register assignments

The sequence of registers in the current version is listed below; as they appear in the Host SW. Section 4.2.3 has examples of reading registers.

0x00C0 *(data type: number)*	Modbus_address	Current Modbus status of smart*MODUL*^{PREMIUM}. The addresses can be written and read. After an address has been changed, subsequent communication with the smart*MODUL*^{PREMIUM} is only possible via this address. Normally the Modbus address is equal to the last two digits from the serial number and has to be converted into hexidecimal (See page 13 "Address").
0x0080 – 0x0083 *(data type: string)*	DeviceType	The type of device connected. Read only.
0x0084 – 0x0085 *(data type: string)*	SoftwareVersion	Software version of device connected. Read only.
0x0086 – 0x0089 *(data type: serial number)*	SerialNr	Serial number of device connected. Read only.
0x0005 *(data type: signed number)*	MOD	Assumed value for internal concentration calculation. Read only. **Not equal to the concentration!**
0x000A *(data type: signed number)*	Concentration	Concentration is stored in this register as a numerical value. Depending on the smart*MODUL*^{PREMIUM} type a factor is still required for the calculation, found in the QS certificate supplied with every smart*MODUL*^{PREMIUM}.
0x0003 *(data type: signed number)*	T_module (0.1x°C)	Internal sensor temperature, as reference point for temperature correction. Read only.

0x0045 Alarm_Level
(data type: signed number)
Provides the threshold trigger value for the main gas alarm. Through the pressure admission with gas, this selector shaft can be adjusted. This modulation value is reduced by one, entered in this register and can be freely set by the user.

0x0044 Warn_Level
(data type: signed number)
Provides the threshold trigger value for the gas pre-alarm. Through the pressure admission with gas, this selector shaft can be adjusted. This modulation value is reduced by one, entered in this register and can be freely set by the user.

0x0047 IR_4tagneu
(data type: number)
Register to save the intensity of the measuring during zero point. (See page 22). Can be read and written.

0x0009 Statusflags
(data type: number)
Status flags indicate the states the module can adopt. Read only.

Individual flags, read from right to left, mean:

Flag 0:	Testflag,	value „1" with device test
Flag 1:	Warmup,	value „1" approx. 10s after start
Flag 2:	Syserr,	value „1" device fault
Flag 3:	Alarm,	value „1" with main gas alarm
Flag 4:	Warn,	value „1" with gas pre-alarm
Flag 5:	Startup,	value „1" in the start-up phase (less than 2 minutes)
Flag 6:	Korr,	value „1" when smart*MODUL*^{PREMIUM} is temperature-compensated
Flag 7:	mw_ok,	value „1" when the zero point was set

Flags 6 (Korr) and 7 (mw_ok) are internal flags, set for each process smart*MODUL*^{PREMIUM} during production.
They also have a quality control role and are set to "1" when the smart*MODUL*^{PREMIUM} is temperature–compensated and has been calibrated.

4.2.2. Communication via the Modbus ASCII Protocol

Since smart*MODUL*^{PREMIUM} has a large amount of data potentially available it makes sense to use a BUS protocol.

The Modbus Protocol basically works on the master/slave principle. The master (PC or µ controller) sends a request to the slave (smart*MODUL*^{PREMIUM}), which in turn answers. The duration of this phase, until all data is received, depends on how many registers need to be read. As a rule, the smart*MODUL*^{PREMIUM} reacts to the request within **100ms**. The character string is sent directly, without reply pause. The slave does not send any data without a request. The request is always first interpreted after dispatch by CRLF.

***WARNING**: Some programmes automatically send the CRLF; with most conventional programmes this needs to be tagged onto the string manually! The CRLF may only be sent once!*

The smart*MODUL*^{PREMIUM} sends no reply if it receives an incomplete request. This is also the case when one or more registers are absent from a register set (section request).

Datagram structure

The following section describes how a request data string to smart*MODUL*^{PREMIUM} is constructed.
The example below shows the current modulation read off from a smart*MODUL*^{PREMIUM} with address 160.

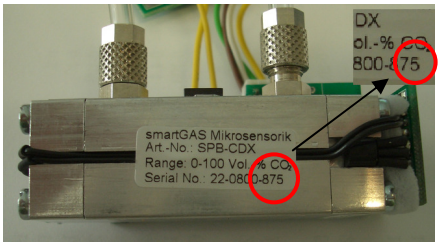
Example string looks as follows:
:A003000500016

Start	Address	Ctrl Com.	Data	checksum LRC
1 character	2 characters	2 characters	0-100 * 2 characters	2 characters
:	A0	03	00 05 00 01	A6

***NOTE:** Addresses, control commands and data are prefixed with "0x" and the actual address / commands as "nn". The "0x" merely indicates that the data is hexadecimal, but since the Modbus Protocol ASCII is defined as hexadecimal, this information is superfluous and only the address or command is transferred. The string contains no "0x" and "0x05" becomes "05".*

Start:
As a rule datagrams start with a colon":", irrespective of whether they are requests or replies.

Address:
This defines to which device address the string is assigned. As standard, the device address is the last two digits of the *MODUL*^{PREMIUM} serial number as delivered. How to use and to convert it is shown in the example.



Device address = 75 decimal → 4B hexadecimal
Device address for Modbus ASCII communication is 4B.
In case that the serial number ends with „00" the address is 64 hexidecimal always.

To search for unknown Modbus addresses the sensors have to be connected at first. Now any register (e.g. concentration) can be requested from all module addresses (1-255) with a timeout of one second. A module with the correct address responds by sending a reply. This reply includes the module address so that at the end of the search cycle it is possible to see by processing the reply which module addresses are currently connected to the bus system.

Control commands:
The control commands indicate what needs to be done with the aforesaid address.
Basically the *MODUL*^{PREMIUM} distinguishes between:

"**Read from register→0x0003**"

"**Write into register→0x0006**"

The command in the example shown here is "Read Register" (0x0003→03)

Data:

The register number is sent in data as a parameter.
In the example here it is:

"**Start Address High (0x0000→00) / Low (0x0005→05)"**

and

"Number Register High (0x0000→00) / Low (0x0001→01)"

The Start Address High" and "Start Address Low" indicate to which register address the control command is directed; in this case, address 0005→0x0005 "MOD".
"Number Register High" and "Number Register Low" state how many registers beginning with the start address should be read. Should 10 Registers be read, then 0010 needs to be entered.
In the example registers 05 to 14 would be read out and transferred.

NOTE: *Data is transferred in its hexadecimal form! The number of bytes doubles after conversion to from ASCII to Hex.*

4.2.3. Calculating the checksum in C

The checksum calculates according to a LRC method (Longitudinal Redundancy Check) from all the bytes sent without CR and LF characters. The bytes are added and the sum subtracted from oxFF. A "1" is added to the result, making the LRC complete.
In the example shown here the value is "A6"

(Command: Read register 5 only→ Modulation MOD):

```
Data[0]:=':'; Data[1]:='A'; Data[2]:='0'; Data[3]:='0'; Data[4]:='3';
Data[5]:='0'; Data[6]:='0'; Data[7]:='0'; Data[8]:='5'; Data[9]:='0';
Data[10]:='0'; Data[11]:='0'; Data[12]:='1'
Laenge=12;
```

Note: *LRC and CRLF do not belong to the data. CRLF is not included in the LRC calculation!*

1. `Lrc=0;` *//(checksum set to 0)*

   `For(i=1;i<Length;i++)`
2. `Lrc=Lrc+daten[i];` *//(All bytes transferred binary summed with overlap (8 Bit). Example: 200+200=400. With 8Bit only 256→ 144 written = Lrc.*

(In the example above the rest sum is 90.

3. `Lrc=oxFF-Lrc;` *//(Total (90) is subtracted from 255.)*

4. `Lrc=Lrc+1;` *//(255-90+1=166=A6 in Hex (checksum reply)*

Example of how to calculate the checksum:

Conversion table for ASCII values:

hex.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
dec.	48	49	50	51	52	53	54	55	56	57	65	66	67	68	69	70

Example: (read out MOD value from device address 160)**:**
Data string → **A00300050001**

Data string conversion:

	address		command		start register				number of register				sum
String Hex.	A	0	0	3	0	0	0	5	0	0	0	1	---
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
ASCII Dec.	65	48	48	51	48	48	48	53	48	48	48	49	**602**

Sum as ASCII (dec): 602-256=346
346-256=**90** (rest)

Checksum: 255-90+1=**166 (ASCII dec.)** → **A6 (String hex.)**

After calculation of the checksum the complete data string would be:
Data string :A00300050001**A6**

The checksum is always transmitted with the data and recalculated by the recipient. Should a value in the data set become corrupt, then the checksum calculated by the recipient would be different from that sent. The data set in this case would be unusable.

4.2.4. Examples of registers read offs

All the following refer to a smart*MODUL* with address 160.

- **Read off "Device Type" register→ 0x0080 – 0x0083**

Send the following string:

Start	Adr.160	read	Start register	Register no.	checksum
:	A0	03	00 80	00 04	A0

Reply:

Start	Adr.160	read	no. of bytes	S	M	-	C	O	2			checksum
:	A0	03	08	53	4D	2D	43	4F	32	20	20	64

Data is transferred as characters and can be converted using an ASCII table.

- **Read off "Serial No." register→ 0x0086 – 0x0089:**

Send the following string:

Start	Adr.160	read	Start register	Register no.	checksum
:	A0	03	00 86	00 04	9A

Reply:

Start	Adr.160	read	no. of bytes	2	0	08	00	410		checksum
:	A0	03	08	32	30	08	00	019A	0000	99

The first two bytes are transferred as characters and can be converted using an ASCII table.
The third and fourth bytes are transferred as hexadecimal values and each yields a two-decimal place number.
The fifth and sixth bytes are summed as a hexadecimal value and produce a three-decimal place number.

- **Read off "Status flags" register→ 0x0009:**

Send the following string:

Start	Adr.160	read	Start register	register no.	checksum
:	A0	03	00 09	00 01	A2

Reply:

Start	Adr.160	read	no. of bytes	11000000	checksum
:	A0	03	02	00C0	F7

The two data bytes are summed and transferred as hexadecimal value. If this value is converted to binary number then the flags raised can be determined.

- **Read off "Software Version" register→ 0x0084 – 0x0086:**

Send the following string:

Start	Adr.16o	read	Start register	register no.	checksum
:	A0	03	00 84	00 02	9E

Reply:

Start	Adr.16o	read	no. of bytes	3	.	3	0	checksum
:	A0	03	04	33	2E	33	30	22

The data is transferred as characters and can be converted using an ASCII table.

- **Read off "Concentration" register→ 0x000A:**

Send the following string:

Start	Adr.16o	read	Start register	register no.	checksum
:	A0	03	00 0A	00 01	9A

Reply:

Start	Adr.16o	read	no.of bytes	456	checksum
:	A0	03	02	01C8	EE

The two data bytes are summed and transferred as a hexadecimal value. If this value is converted to a decimal number, the concentration can be determined (here - 456ppm).
If necessary the correction factor (to be found on the QM-document) has to be used.

5. Start-up phase after switching on the power supply

After power supply and current output have been connected to smart*MODUL*^{PREMIUM} the sensor starts a warm-up phase. This lasts less than 2 minutes and serves as an internal check of all components and routines.

The following states can occur during the warm-up phase, depending on the operation mode chosen:

4-20mA mode: First approx. **2mA**, then a jump to approx. **4mA**. After less than 2 minutes I ≥ 4mA, depending gas concentration present. Sensor signal can accept data below 4mA, because it can depart from the accurate concentration during the warm-up time.

0-20mA mode: First **0mA**. After less than 2 minutes **I ≥ 0mA** depending on gas concentration present. During the warm-up time, the sensor signal can depart from the accurate concentration.

When the warm-up phase has finished and all test routines completed trouble-free, smart*MODUL*^{PREMIUM} automatically switches to normal operation and displays gas concentration measured as linear current signal.

6. Wire break between smart*MODUL*^{PREMIUM} and interface electronics

If the connection between a smart*MODUL*^{PREMIUM} and the interface electronics is interrupted (accidental separation or wire break) the following state is displayed at the current output:

Operating with **4-20mA** → Output current is frozen at **2mA**.
Operating with **0-20mA** → Frozen at the **last delivered** current value.

Depending on operating current and switching values, this state can be used as error recognition.
If the fault is rectified, smart*MODUL*^{PREMIUM} automatically re-enters the normal warm-up phase and then switches over to normal operation when complete, as described in Section 5.

NOTE:
*If operation with **0-20mA** has been chosen the **frozen current value is maintained until end of the new warm-up phase**.*
Trouble-free wire break recognition is general only possible operating with 4-20mA!

7. Using smart*MODUL*^{PREMIUM} with voltage output

In some applications it is necessary to convert the smart*MODUL*^{PREMIUM} output signal into a linear voltage signal so that it can be evaluated.
This is easily achieved by inserting a precision resistor into the voltage output (between **I** and **GND** → see Figure 1).
The result drop-off in voltage across the resistor reflects the concentration of the gas measured.

Depending on operating current the following voltages can be set:

4-20mA	→	0.2V – 1.0V	with a 50Ω resistor
	→	0.5V – 2.0V	with a 100Ω resistor
0-20mA	→	0V – 1.0V	with a 50Ω resistor
	→	0V – 2.0V	with a 100Ω resistor

NOTE:
The maximum resistor possible for producing output signals is 125Ω.
Anything larger would give rise to measurement error, or even in some cases, damage to smartMODUL^{PREMIUM}*. The maximum permitted output voltage is 2.5V and should not be exceeded.*

8. Calibrating smart*MODUL*^{PREMIUM}

Many applications require sensor calibration after the first operational run up or at regular intervals thereafter.

There are basically two types of calibration to consider.

1. Zero point calibration

This serves to indicate the normal zero gas concentration to the sensor. It is not necessarily 0% gas; measuring atmospheric CO_2 results in a concentration of 350 ppm – 380 ppm. Therefore the selection of the right zero gas is extremely important.

2. Span calibration

The span calibration serves to set the upper measurement value (UMV).
This is the maximum value that can be reliably detected and measured by the sensor.
When selecting sensors it is important not to set the UMV too small as this may result in inaccuracy and erroneous measurement.

IMPORTANT: *smartMODUL^{PREMIUM} must be run for at least 15 minutes before calibration! Unless not else specified by the application, an inspection every 2 years is recommended*

8.1. Zero point calibration

1. Perfuse the sensor with **zero gas**, making sure the measuring cuvette has been fully purged and only zero is present.

2. Place a jumper on positions **1-2** in **JP4** and wait **approx. 20 seconds**. The value of the output current should be either 0mA or 4mA (depending on operation mode), or drop to 0V or 0.5V (e.g. with 100Ω). Removing the jumper ends calibration and the new value is saved in the sensor.

WARNING: Only run calibration with zero gas, otherwise subsequent measurements may be faulty.

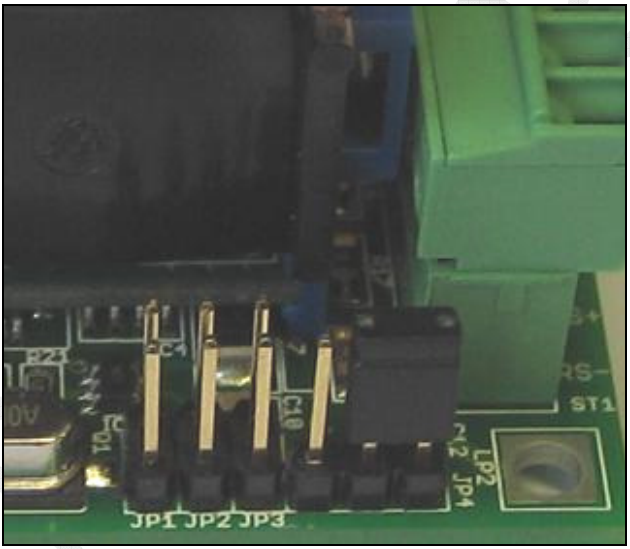


Figure 6. Zero calibration (Jumper on **JP4, PIN 1-2**)

8.2 Zero point calibration via Modbus Open Protocol

To calibrate the **zero point** via RS485, the smart*MODUL*^{PREMIUM} needs to be connected to the voltage supply and the Modbus ASCII Protocol. The sensor needs to be perfused with **zero gas**. The register is then read as 0x0004 by the Modbus Protocol. The value in this register is analogous to the gas concentration. The following example describes reading off this register in a smart*MODUL*^{PREMIUM} with Modbus address 160:

Send the following command to the smart*MODUL*^{PREMIUM}:
:A003000400001A7

Start	Address 160	Read	Start register 0x0004	Register no.: 1	checksum
:	A0	03	00 04	00 01	A7

The following reply is dispatched (data content can vary):
:A003021F1AE1

Start	Address 160	Read	No. bytes: 2	Data: 7962	checksum
:	A0	03	02	1F 1A	E1

Now the register 0x0004 has content 0x**1F1A** (=7962).
If this value remains stable over period of time, then the measure gas concentration is stable. The zero point can now be set and register 0x0047 now needs to be written with the content of the previously read register (0x0004).

Send the following command to the smart*MODUL*^{PREMIUM}:
:A00600471**F1A**75

Start	Address 160	Write	Write to register: 0x0047	Data to write:0x1F1A	checksum
:	A0	06	00 47	1F 1A	75

If the command is correctly transferred then the same command is returned as reply.
Register 0x0047 can be checked to see if the values have been correctly written.

Send the following command to the smart*MODUL*^{PREMIUM}:
:A00300470001A0

Start	Address 160	Read	Start register 0x0047	Register no.	checksum
:	A0	03	00 47	00 01	A0

The following reply is sent:
:A003021F1AE1

Start	Address 160	Read	No. of bytes: 2	Data: 7962	checksum
:	A0	03	02	1F 1A	E1

8.3 Span calibration

1. Flood smart*MODUL*^{PREMIUM} with the gas concentration corresponding to the upper measurement value which the sensor is build for and make sure no residual gas is present in the cuvette.

   Place a jumper on positions **2-3** on **JP4** and wait **approx. 20 seconds**. Output should increase to **20mA or 2.0V** (e.g. with 100Ω). Removing the jumper ends calibration and the new value is saved in the sensor.

WARNING: Only run calibration with the appropriate gas concentration for the measurement range given, otherwise subsequent measurements may be faulty.

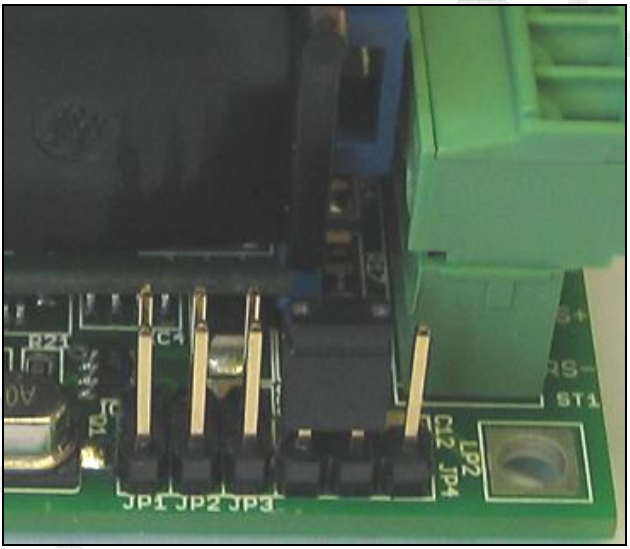


Figure 7. Span calibration (Jumper on **JP4, PIN 2-3**)

9. Measuring cell with gas line

The smart*MODUL*^{PREMIUM} housing is made of aluminium to protect the sensor from mechanical damage and is with fitted with gas line connectors (inlet and outlet) to allow perfusion of the smart*MODUL*^{PREMIUM} (see Figure 8).
Tubing with an internal diameter of 3 mm and external diameter of 5 mm is needed to connect up to the measurement cell. Ensure that tubing is securely attached to the inlet and outlet connectors.

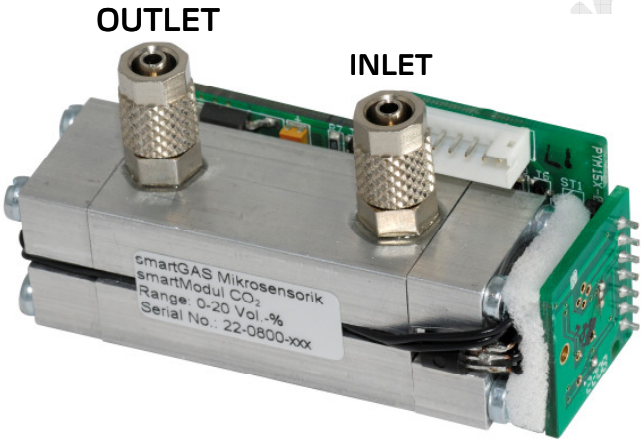


Figure 8: Measurement cell with gas inlet and outlet

Adhere to the directional designation of INLET and OUTLET; switching the direction of gas PREMIUM through the cell could lead to erroneous results.

NOTE:
Ensure the correct type of tubing is used. In some applications, corrosive gases occur and could cause problems with the tubing material.
Do not perfuse the smartMODUL^{PREMIUM} *at a gas PREMIUM rate of greater than 1l per minute!*

10. General information

Connections not discussed in this document include:

- JP1 ***Must be left free!***
- JP2 Production-relevant
- ST2 USB, production-relevant
- ST4 Keep free!

These connectors are production-relevant and may not under any circumstances be used for normal operation. Misuse or attempts to use these connectors will damage the electronics and void the manufacturer's guarantee!

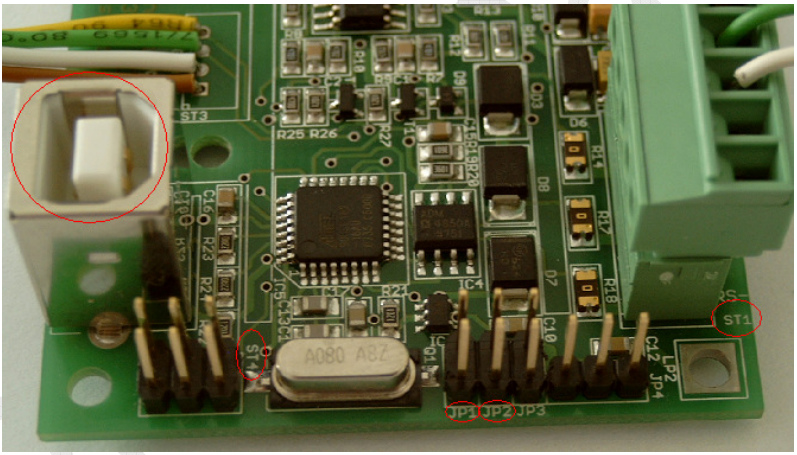


Figure 9. Additional connectors

smart*MODUL*^{PREMIUM} may **only be used with the smart*MODUL* supplied**.
To ensure and maintain the trouble functionality and compliance with the conditions of the manufacturer's guarantee **do not attempt** to exchange, replace or modify in any way the smart*MODUL* or the interface PCB supplied with another smart*MODUL* or interface PCB.
smartGAS does not take over any liability in case of violation.

Technical data

General features	
Measurement principle:	Non Dispersive Infra-Red (NDIR), dual wavelength
Measurement range:	dependent on model – see list
Gas supply:	by perfusion
Dimensions:	Length (model dependent) x 28 mm x 42 mm (L x W x H) [3]
PCB Dimensions:	72 mm x 55 mm x 34 mm (L x W x H)
Gas line connectors:	3 mm internal, 5mm outer diameter
Technical features @ 25°C, 1013 mbar gas pressure, 0.5 l/min constant gas flow	
Response time (t90):	Appr. 15 s (at 0.5 l/min) [3]
Resolution:	1 ppm to 0.01 Vol.% FS [1]
Accuracy:	≤ ±2 % FS [1]
Long term stability (zero):	≤ ±2 % FS [1] over 12 month period
Long term stability (span):	≤ ±2 % FS [1] over 12 month period
Repeatability:	≤ ±2 % FS [1]
Linearity error:	≤ ±1 % FS [1]
Lower detection limit:	≤ 1 % FS [1] (typically)
Operating temperature:	-10 °C to 40 °C
Storage temperature:	-20 °C to 60 °C
Humidity:	0 % to 95 % rel. humidity (not condensing)
Temp. dependence (zero):	≤ ±0.01 % FS [1] via °C
Temp. dependence (span):	≤ ±0.2 % FS [1] via °C
Air pressure:	950 to 1050 mbar
Pressure dependence (zero):	-
Pressure dependence (span):	0.1 % to 0.2 % via mbar [2]
Warm-up time:	< 2 minutes (start up time) < 30 minutes (full specification)
Flow rate:	0.2 - 1.5 l/min
Calibration:	zero by jumper / SW and span by jumper

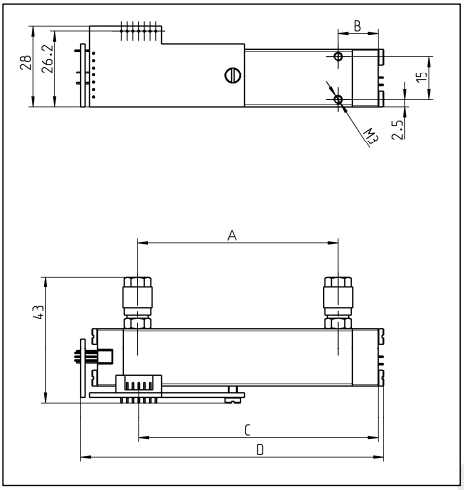
Communication	
Analogue output signal:	0 - 20 mA linear
	4 - 20 mA linear
	0 - 1 V linear (with 50 Ω)
	0 - 2 V linear (with 100 Ω)
Maximum load:	125 Ω
Digital output signal:	Modbus ASCII via RS485
Electrical data	
Supply voltage:	12 - 28 V DC ± 5 %
Supply current:	70 mA average, max. 140 mA
Power consumption:	< 1 Watt

[1]FS=Full scale | [2]Dependent on the gas and the measurement range | [3]Dependent on model type

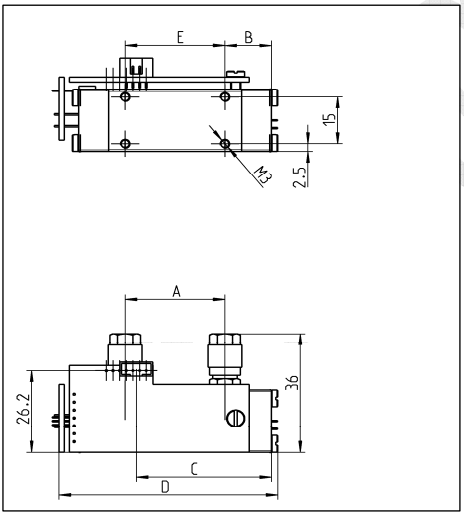
Please consult smartGAS Marketing for parts specified with other temperature and measurement ranges. At first initiation and depending on application and ambient conditions recalibration are recommended. Recurring cycles of recalibration recommended.

For more information, please visit www.smartGAS.eu or contact us at sales@smartgas.eu

Mechanical drawings



Item No.:	A	B	C	D
P1-010236-00000	70	14	84	106
P1-020146-00000				
P1-030246-00000				
P1-212505-00000				
P1-221206-00000				
P1-040446-00000				
P1-050176-00000				
P1-600503-00000				
P1-600105-00000				



Item No.:	A	B	C	D	E
P1-020108-00000	30	14	41	66	10
P1-212207-00000					
P1-212108-00000					
P1-221107-00000					
P1-221108-00000					
P1-040108-00000					
P1-050108-00000					

All dimensions in this manual are expressed in Millimetres (metric system).