METROTEC

Systems for Measuring and Controlling Oxygen

Operating Instructions

U19-SB

Oxygen meter

U19 Series Measuring module

*** Version 1.1 ***

EC Declaration of Conformity

for

Oxygen measuring and control unit Type U19-SB

This device has been designed for industrial purposes in accordance with:

EN 61000-6-4:
EN 61000-6-2:

It is compliant with the directives:
EMC Directive: 2014/30/EU
Low Voltage Directive: 2014/35/EU
RoHs: 2011/65/EU
Radio Equipment Directive 2014/53/EU

This device complies with following standards:
EN 61010-1
EN 61000-6-4:
EN 61000-6-2:
EN 63000
EN 300220-2

Description of measures taken to assure compliance:
Quality management system DIN EN ISO 9001:2015, No. 12 100 27736 TMS

This declaration becomes invalid if changes are made without our consent.

Kirchheim/Teck, 28/09/2023

Place, Date Signature

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1 Safety Instructions

	Please read these operating instructions carefully before installing and using the device. Improper use of the product will invalidate the warranty!
	The ambient conditions described in the Specifications chapter must be complied with in order to ensure the device's proper functioning and operational safety.
	The device may only be started up and operated by qualified and trained personnel. The operator of the device must ensure that all applicable regulations and guidelines are complied with. These are, among others, the EU Directive on work safety, national work safety legislation, accident prevention regulations, etc.
	Please ensure that the supply corresponds with the information given on the type plate. All coverings necessary to provide touch protection must be installed. In case the device is interconnected with other devices and/or installations, the consequences must be considered and appropriate precautions taken before switching the device on.
	In some cases, hot parts or surfaces may be unprotected during or after installing or uninstalling the device. Appropriate precautions must be taken to avoid injuries and/or damage.
	In case the device shows defects which suggest that it will not be possible to operate it safely, it must not be put into operation. We recommend to have the device inspected at least once a year at the factory or by a customer service representative.
	Disposal of the device must be performed according to the applicable regulations.

2 Preface

The measuring device serves for recording oxygen partial pressures in gas atmospheres in connection with an oxygen sensor. Such sensors operate at high temperatures. Therefore, precautions must be taken to keep ignitable gas mixtures from reaching the sensor or the device. In case of the sensor ceramic breaking, sample gases may leak or air may enter the sample gas side. Should this occur, applicable measures must be provided for to protect the environment and device parts from damage.

Wrong entries, leaks, corrosion, condensation, etc. may cause damage of the plant and erroneous measurements. It is vital to have all parts of the system maintained regularly.

The oxygen meters and the attachments have been produced and controlled subject to a consistent quality assurance process in accordance with DIN EN-ISO 9001.
Installation and operation must be performed subject to compliance with all local and special regulations. These particularly include VDE and DVGW requirements.
Depending on the application, a periodic inspection of the measuring device in terms of measuring accuracy and function may be required and must be performed in the course of calibration and inspection procedures after initial commissioning.

3 Introduction

Oxygen Measuring Module U19-SB

The oxygen measuring module in connection with a Type A19-NC oxygen sensor is used for measuring oxygen in gases.

4 Measuring Principle

Oxygen measuring devices are designed to process signals of an oxygen sensor made of stabilised zirconium dioxide. The zirconium dioxide, a ceramic also referred to as solid state electrolyte, is perfectly suited to serve as an oxygen-ion conductor at high temperatures.
Within certain temperature limits, which depend on the doping of the material concerned, such ion conductors are able to fill empty spaces in their crystal lattice with oxygen ions. The oxygen ions form itself on a conductive contact layer, whích usually consists of platinum.
Thus, the oxygen concentration in a sample gas is essential for the extent of oxygen activity and accordingly the number of oxygen ions.
The basic structure of a sensor revolves around a solid state electrolyte which is contacted on both sides. One side of the electrolyte is operated by a reference gas, such as air, the other one with sample gas. The mechanical design of the sensor separates both gas sides from each other, thus preventing the gases to mix.
Depending on the application, either heated or unheated sensors will be used. Unheated sensors are predominantly used in ovens, while heated sensors come into play in applications, where gases below 600 degrees Celsius are to be measured. (The measuring principle requires a minimum temperature of 500 – 650 degrees Celsius.)
Heated sensors are adjusted to a specific target temperature by means of a temperature controller integrated in the processing electronics. The temperature of heated and unheated sensors is measured by the electronic unit and is an essential element in the calculation of the oxygen level (oxygen partial pressure).
The value is calculated by means of the following formula:

$$EMK = \frac{R \cdot T}{4 \cdot F} \cdot \ln\left(\frac{P_1}{P_2}\right)$$

whereby

R = 8.31J/mol K
T = Temperature in Kelvin
F = 96493 As/mol
P1 = Oxygen partial pressure on the reference side with 0.20946 bar
P2 = Oxygen partial pressure on the sample gas side
EMF = Electromotive force in Volt

5 General Layout

5.1 Measuring Module

The U19-SB series measuring module includes the following functions:

- Measures the partial pressure of oxygen in connection with a separate Type A19-NC sensor
- Displays the measured value in a 4 to 20 mA range (0 to 20 mA optional)
- Generates alarms
- Data transfer via PowerLink

The module is parametrised after the installation, if necessary, and will operate permanently with these settings.

Note:
In order to implement extensive changes and to display measured values, the METROTEC App for Android or a PowerLink connection is required.

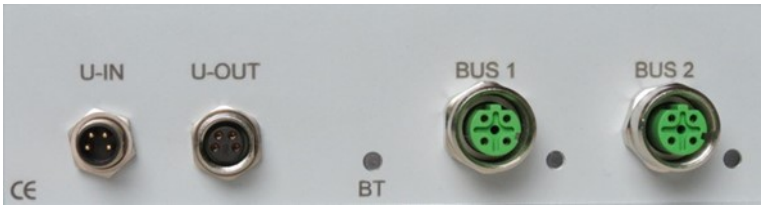
5.2 Sensor

The measuring module requires a separate Type A19-NC extractive oxygen sensor to enable its functioning.

Oxygen Sensor Type A19-NC

5.3 Description of the Measuring Electronics

Both sides are equipped with plug connections and LEDs.
At the left side there is the energy supply with ”U-IN” input and “U-OUT” output in order to form a loop for additional devices. In addition there are the “BUS 1” and “BUS 2” connectors enabling the PowerLink connection as well as LEDs signalling the communication.



On the right are connections for alarms, analog measuring signals and sensor as well as operating information LEDs.

6 Device Start-up

6.1 Switching the Measuring Module on

The measuring module is wired up in accordance with the wiring diagram. The module is ready to start when the supply voltage is applied.

After heating up the sensor, the green "Ready" LED signals readiness, which otherwise shows a red light.
If the currently measured value is below the set limit, the alarm LED lights green, otherwise the colour red signals a limit value alarm.

After heating up, the measuring module delivers the transmitted measured value at the mA output.

6.2 Measurement

After the starting routine the device is ready for use and can determine the oxygen content in gases. This requires supplying the sample gas according to the sensor type. Alternatively the sample gas contains the sensor.

6.3 Switching the Measuring Module off

It is advisable to keep the device continuously in operation. This will avoid the condensation of steam in heated sensors which may cause corrosion.
Should the unit need to be switched off, the energy supply of the measuring module will be interrupted.
See the operating instructions of the respective sensor.

7 Measured Value Output

The measuring module can output the measured value linearly. The default setting is 0-5% O2 “linear” at 4-20 mA and a further measuring range of 0-25% O2.
Note 1:
The measuring ranges are fixed and can only be set to values other than those listed above by Metrotec according to customer specifications.
Note 2:
A change is possible with the METROTEC app for Android and a daily code.

8 Configuration

With the exception of the bus address, changes to the configuration can only be carried out by Metrotec.
Note 1:
To change the bus address, the METROTEC app for Android or a connection to Powerlink is required.
Note 2:
A change is possible with the METROTEC app for Android and a daily code.

The METROTEC app is available for free download at **https://metrotec.eu**.

8.1 Correcting the Measured Value

The measuring system, consisting of the oxygen measuring module U19SB and oxygen sensor A19NC, is calibrated at the factory.
Note:
A change is possible with the METROTEC app for Android and a daily code.

8.2 Adjusting the Limit Value

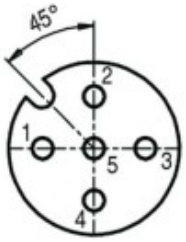
The limit value switches when the current measured value falls below the set limit value. The limit value is within the programmed measuring range 1. An alarm condition is signaled by the alarm LED.
At the same time, the semiconductor relay, whose contact on the alarm plug is available, switches.
The default settings are:
- Switch on high signal at <= 2Vol.-%
- Switch on low signal from >=4 vol.-%

Note:
A change is possible with the METROTEC app for Android and a daily code.

8.3 Practical approach

In many cases, the visualization of the mA signal is not conveniently visible near the measurement module. It is therefore suggested to disconnect the mA connection from the “mA 1” or “mA-2” connector and replace it with a commercially available, portable mA measuring instrument.

or


with pin assignment:


After completing the settings, the previously disconnected connections are restored.
Note:
A change is possible with the METROTEC app for Android and a daily code.

8.4 Definition of Analog Outputs

Connectors “mA 1” and “mA 2” are analog 4-20 mA outputs. The measuring ranges are described in the Specifications section.

9 Interfaces

9.1 Analog Interfaces

Connectors “mA 1” and “mA 2” provide analog 4-20 mA measuring values. The measuring ranges are described in the Specifications section. The outputs provide signals between 4-20 mA as long the “Ready” LED shows a green light. If the “Ready” LED shows a red light, the output is 0 mA.

9.2 Digital Interfaces

The “Alarm” connector provides one semiconductor relay each for “Oxygen Limit Value” and for “Measurement ready”.

10 App for Android

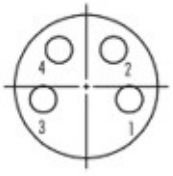
Using the app it is possible to view measured values and change configuration settings.
Reference is made to the special operating instructions “METROTEC APP”.
Note:
A change is possible with the METROTEC app for Android and a daily code.

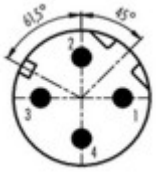
The METROTEC app is available for free download at **https://metrotec.eu**.

11 Connection Diagram

Plug	Pin	Designation	Function
U-IN Connection cable: M8-4P, Code A (m)	1	24 VG (plus)	Power Input, 18-36 VG
	2	24 VG (plus)	Power Input, 18-36 VG
	3	24 VG (minus)	Power Input, GND
	4	24 VG (minus)	Power Input, GND
U-OUT Connection cable: M8-4P, Code A (f)	1	24 VG (plus)	Power Output, 18-36 VG
	2	24 VG (plus)	Power Output, 18-36 VG
	3	24 VG (minus)	Power Output, GND
	4	24 VG (minus)	Power Output, GND
BUS 1 Connection cable: M12-4P, Code D (m)	1	TX +	Transmit Data + (BUS 1)
	2	RX +	Receive Data + (BUS 1)
	3	TX -	Transmit Data - (BUS 1)
	4	RX -	Receive Data - (BUS 1)
	SH	PE	Shield
BUS 2 Connection cable: M12-4P, Code D (m)	1	TX +	Transmit Data + (BUS 2)
	2	RX +	Receive Data + (BUS 2)
	3	TX -	Transmit Data - (BUS 2)
	4	RX -	Receive Data - (BUS 2)
	SH	PE	Shield

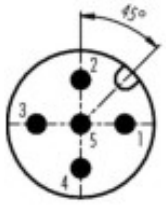
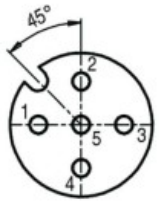
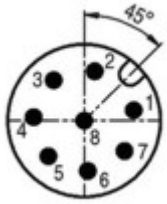
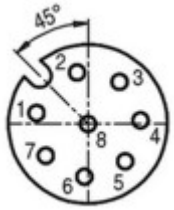
Pin diagram

Type	Plug	Socket
M8-4P, Code A		

M12-4P, Code D		

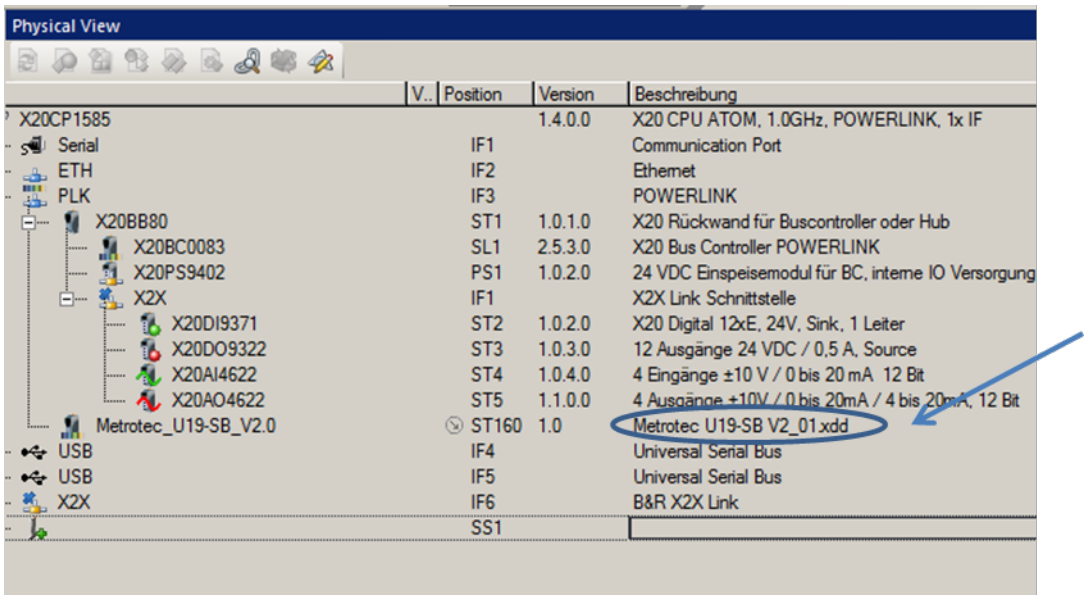
Plug	Pin	Designation	Function
Alarm Connection cable: M12-5P, Code A (m)	1	24 VG (plus)	External 24 VG +
	2	Limit value O_2	Semiconductor relay 24V, 1A
	3	GND	External GND, no functionality
	4	Measurement ready	Semiconductor relay 24V, 1A
	5	PE	Shield
mA 1 Connection cable: M12-5P, Code A (f)	1	24 VG (plus)	External 24 VG, no functionality
	2	0-25% O_2	Analog 4-20 mA (plus)
	3	GND	External GND, no functionality
	4	0-25% O_2	Analog 4-20 mA (minus)
	5	PE	Shield
mA 2 Connection cable: M12-5P, Code A (f)	1	24 VG (plus)	External 24 VG, no functionality
	2	0-1000 ppm O_2	Analog 4-20 mA (plus)
	3	GND	External GND, no functionality
	4	0-1000 ppm O_2	Analog 4-20 mA (minus)
	5	PE	Shield
Sensor Connection cable: M12-8P, Code A (m)	1	Sensor -	Sensor signal
	2	Sensor +	Sensor signal
	3	Heating +	Supply Sensor heating +
	4	Heating +	Supply Sensor heating +
	5	Sense +	Sense line +
	6	Heating -	Supply Sensor heating -
	7	Heating -	Supply Sensor heating -
	8	Sense -	Sense line -

Note:
Digital outputs are potential-free semiconductor contacts (1A, 24V)
mA output is isolated.

Pin diagram		
Type	**Plug**	**Socket**
M12-5P, Code A		
M12-8P, Code A		

12 Powerlink

12.1 Integrating an XDD file



The address (factory setting) = 160

The following IO variables are defined

Kanalname	Physikalischer Wert	Forcen	Wert forcen
ModuleOk	TRUE	☐	FALSE
Parameter_Nr_I2000_S01Out	0	☐	0
Value_I2000_S02Out	0	☐	0
Latch_I2000_S03Out	0	☐	0
Lin_ppm_I2100_S01	0	☐	0
Temperature_I2100_S02	100	☐	0
Output_1_Min_Lin_P4_I2100_S03	0	☐	0
Output_1_Max_Lin_P5_I2100_S04	250000	☐	0
Limit_Value_Lin_P6_I2100_S05	250000	☐	0
Output_2_Min_Lin_P12_I2100_S06	0	☐	0
Output_2_Max_Lin_P13_I2100_S07	1000	☐	0
Hyst_Lim_Relay_Lin_P14_I2100_S08	0	☐	0
Cable_length_P64_I2100_S09	1	☐	0
Knoten_ID_P81_I2100_S0A	160	☐	0
Ready_I2100_S0B	0	☐	0
Alarm_I2100_S0C	0	☐	0
Latch_Acknowledge_I2100_S0D	1	☐	0
SignOfLife_I2100_S0E	55	☐	0
ErrorFlags_P83_I2100_S0F	0	☐	0

System variable

Variable	Type	Description
ModulOK	BOOL	Connection status

Input variables

Variable	Type	Description
Lin_ppm_I2100_S01	UDINT	Oxygen measured value in ppm
Temperature_I2100_S02	UDINT	Sensor temperature in °C
Output_1_Min_Lin_P4_I2100_S03	UDINT	Measuring range mA output 1 (4mA) in ppm
Output_1_Max_Lin_P5_I2100_S04	UDINT	Measuring range mA output 1 (20mA) in ppm
Limit_Value_Lin_P6_I2100_S05	UDINT	Alarm limit oxygen content in ppm
Output_2_Min_Lin_P12_I2100_S06	UDINT	Measuring range mA output 2 (4mA) in ppm
Output_2_Max_Lin_P13_I2100_S07	UDINT	Measuring range mA output 2 (20mA) in ppm
Hyst_Lim_Relay_Lin_P14_I2100_S08	UDINT	Hysteresis limit value relay in ppm
Cable_length_P64_I2100_S09	UDINT	Cable length sensor module (without function)
Knoten_ID_P81_I2100_S0A	UDINT	Node ID, default 160

Ready_I2100_S0B	UDINT	Corresponds to LED READY (0/1)
Alarm_I2100_S0C	UDINT	Corresponds to LED alarm (0/1)
Latch_Acknowledge_I2100_S0D	UDINT	See parameter change 12.2
SignOfLife_I2100_S0E	UDINT	value increases after each update
ErrorFlags_P83_I2100_S0F	UDINT	Error flag = 0 - no error

Output variables

Variable	Type	Description
Parameter_Nr_I2000_S01Out	UDINT	Number of the variable to be changed
Value_I2000_S02Out	UDINT	New value for variable
Latch_I2000_S03Out	UDINT	See parameter change 12.2

12.2 Changing parameter P81 node ID:

The P81 Node ID parameter is the only parameter that can be changed via the bus.
To change this parameter to 100, for example, the following sequence must be observed.

1. Write the parameter number [81] into the variable "Parameter_Nr_I2000_S01Out".
2. Write the value [100] into the "Value_I2000_S02Out" variable.
3. Read the "Latch_Acknowledge_I2100_S0D" variable, increase it by 1 and write it to the "Latch_I2000_S03Out" variable.
   This triggers the takeover process in the measuring device!

After a successful change, the "Latch value" is increased again by 1 by the measuring device and as an acknowledgment in the variable "Latch_Acknowledge_I2100_S0D". The "ErrorFlags_P83_I2100_S0F" remain at 0.
The value is immediately adopted and stored in the EEPROM. In the future, the measuring device will start with the new value.

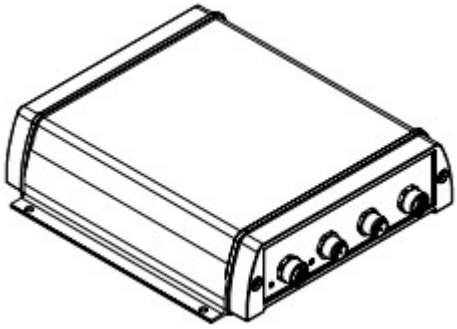
ErrorFlags_P83_I2100_S0F
The error flag is set to 1 if the parameter number is unknown.

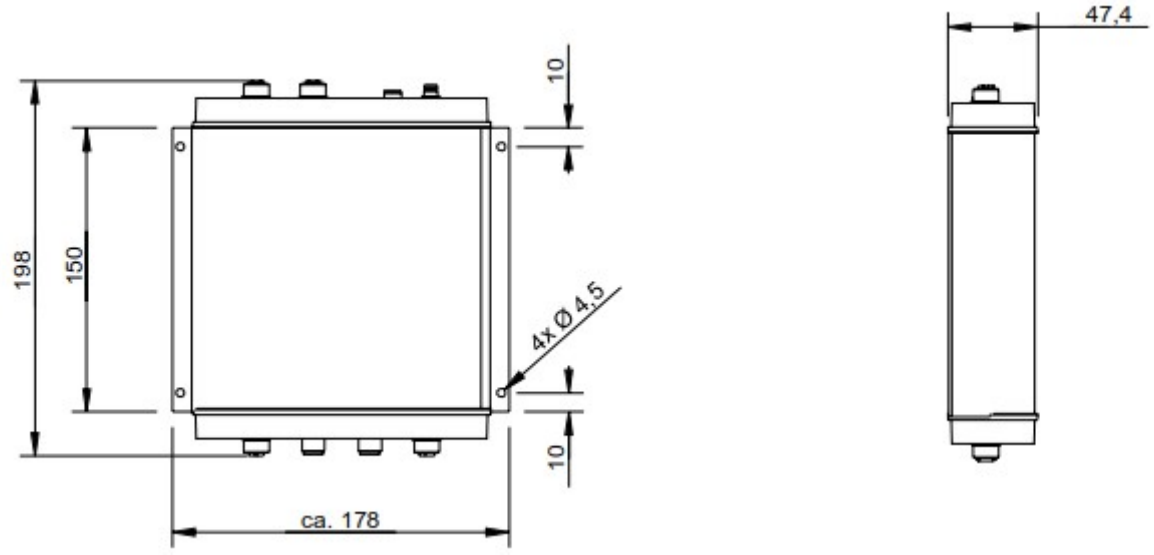
13 Specifications

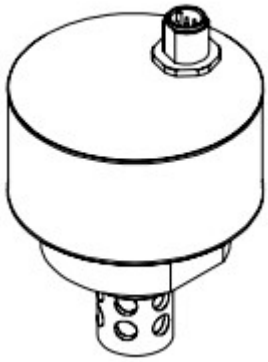
measuring range	Section 1 0-5% O_2 Section 2 0-25% O_2
Ambient temperature	0 to 45 degrees Celsius
Precision*	+/- 1,5 %
Measuring accuracy	+ 0.5 mV EMF sensor at least - 0.5 ppm - 2 mV EMF sensor at least + 1.5 ppm +/- 2 degrees Celsius +/- 2 % of mA output
Dimensions	ca. 48 x 178 x 198 mm (HxWxD)
Weight	0.5 kg
Supply voltage	24 VG (22.6 to 26.4 Volt) Observe Type Plate! Wrong power supply can destroy the module!
Output	Acc. to sensor type, ca. 100 VA max.
Analog output	4 – 20 mA floating 0 mA results in error message
Relay output	for collective alarm, 1A, 24 V (ohmic)

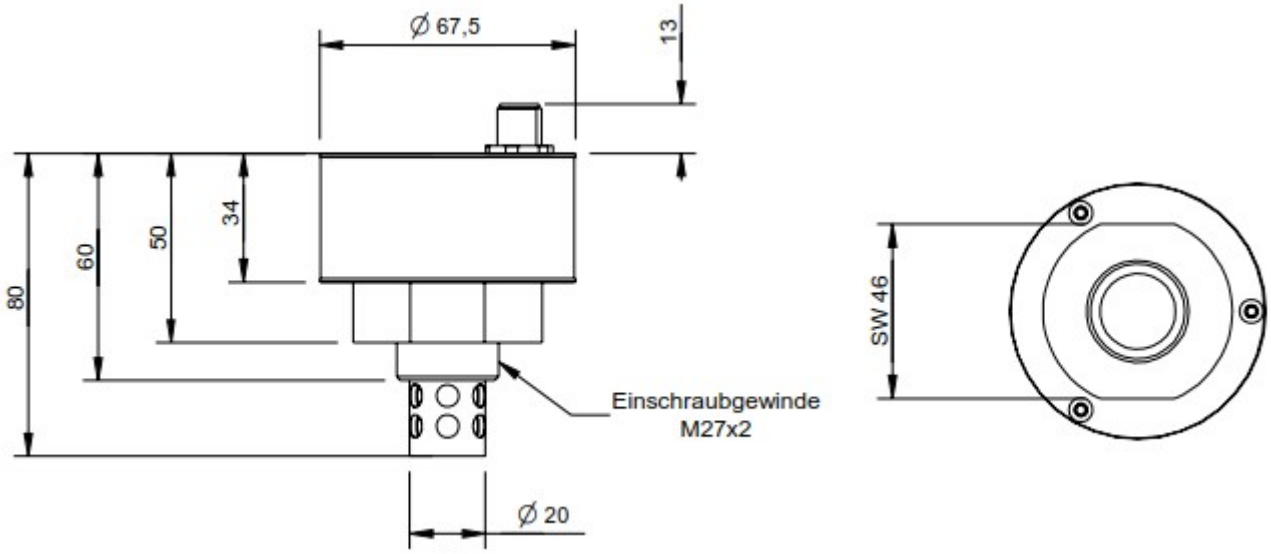
* Precision was established from measuring values with connected sensor A19 according to DIN 55350.

14 Drawings








Ø 67,5
13
80
60
50
34
SW 46
Einschraubgewinde
M27x2
Ø 20